Errata

Title & Document Type: 2401C Integrating Digital Voltmeter Operating and Service Manual

Manual Part Number: 02401-90681

Revision Date: June 1969

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HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

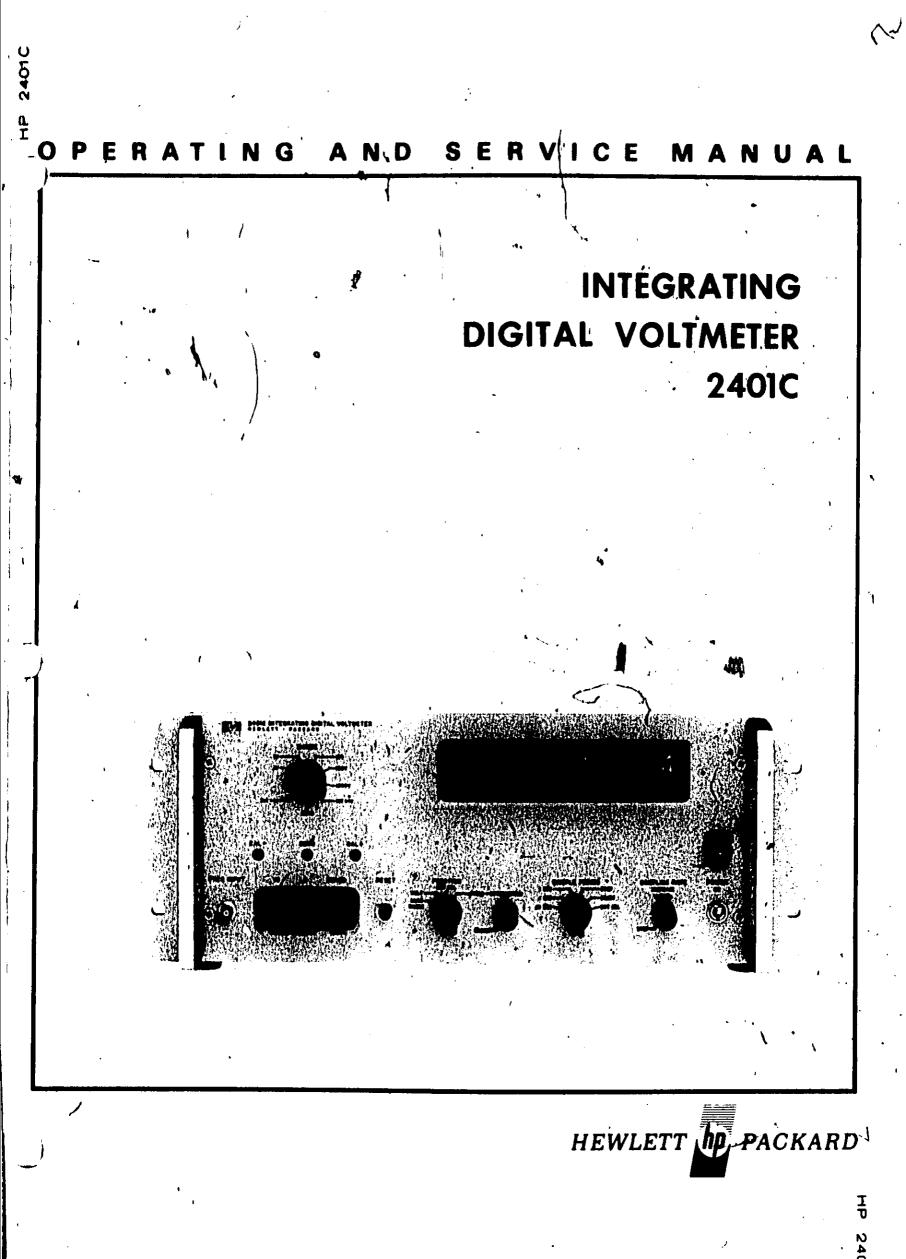
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The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

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OPERATING AND SERVICE MANUAL

(STOCK NO. 02401-9028)

MODEL HP-2401C / INTEGRATING DIGITAL VOLTMETEI

(FSN 6625-999-2066)

SERIAL NUMBERS COVERED

This manual applies directly to Model 2401C Voltmeters having serial numbers prefixed 501-, 521-, 526-, 529-, 533-, 537-, 605-, 610-, 614-, 622-, 637-, 735-, 739-, 749-, 751-, and 811-. Instruments with higher prefix numbers will be covered in an Updating Manual Supplement at the rear of this manual.

OPTIONS COVERED

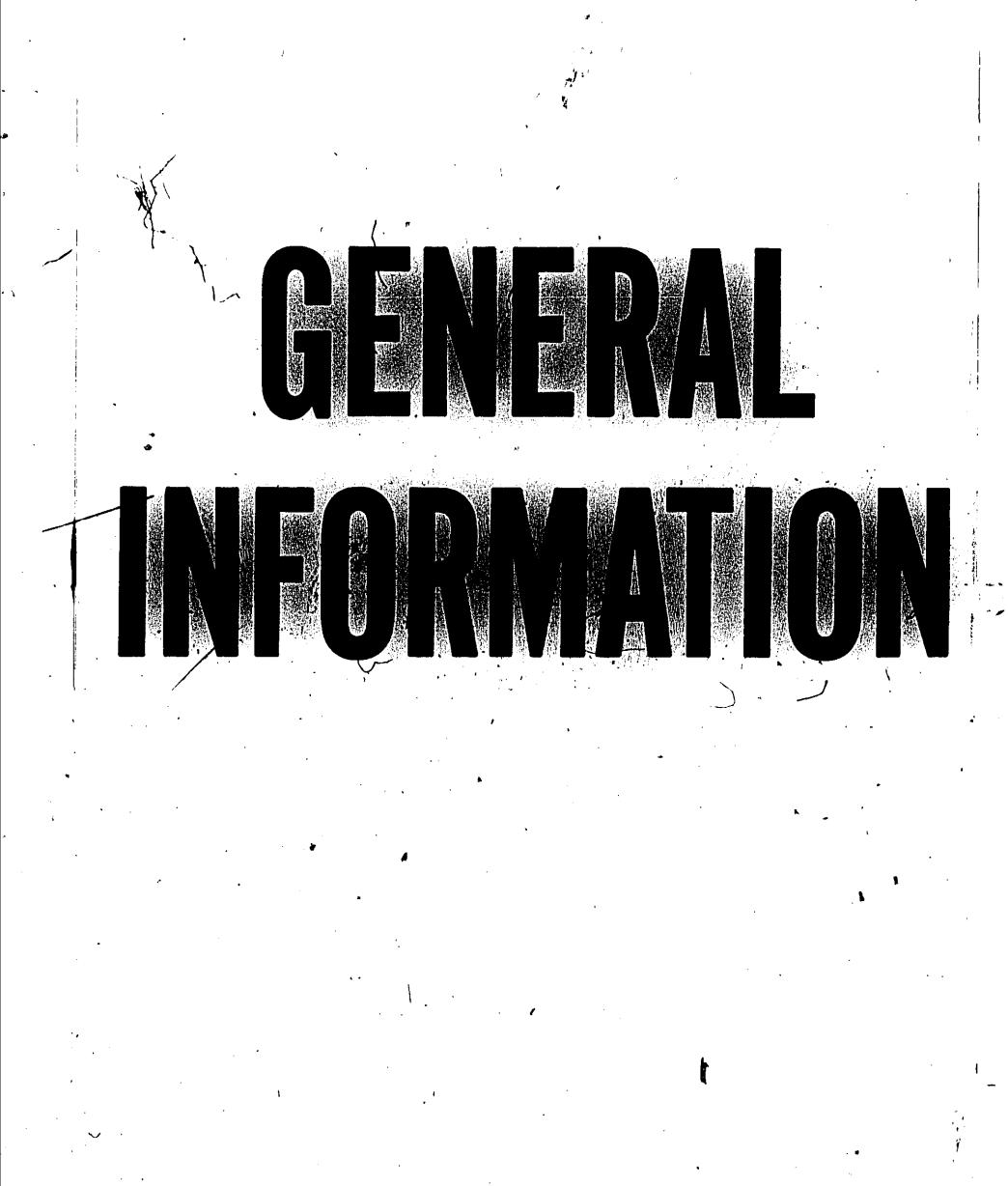
This manual covers instruments equipped with any of options 18, 21, 29, 30, 31, 35, and 146, as well as the standard instrument. These options were identified as M18, M21, M29, M30, M31, M35, and M146 on some older instruments but are the same as the present options. i. e. M18 is the same as option 18, M21 is the same as option 21, etc.

Microfiche No. 02401-90681

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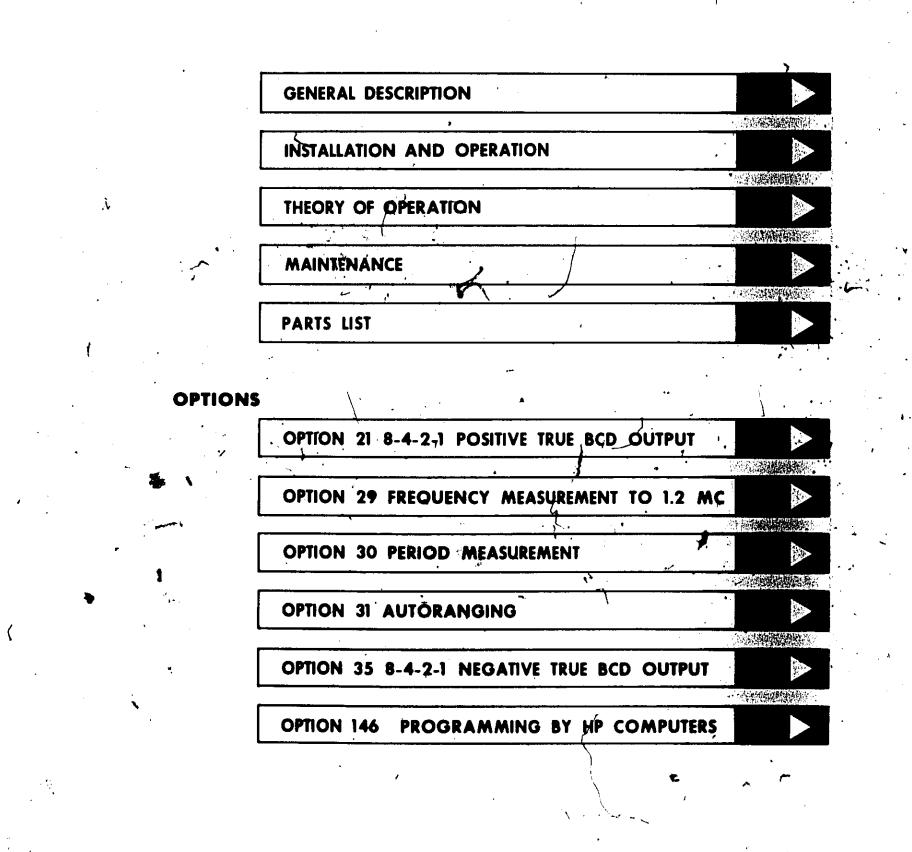
HEWLETT-PACKARD COMPANY 395 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A

Printed: JUNE 1969



QUICK REFERENCE INDEX

To locate desired data quickly, bend the handbook back to expose the index marks on the first pages of all the sections. These marks correspond to data identification marks on this page. The detailed contents of Sections 1 through 4 are listed individually just before the first page of each section.



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2401C

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NOTE: The contents of Sections 2 through 4 are listed just before the first page of each Section.

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GENERAL DESCRIPTION

1.1 BASIC CAPABILITIES

The HP-2401C Integrating Digital Voltmeter is an all solid state electronic instrument which measures dc potentials up to ± 1000 volts. The lowest of the instrument's five decade multiple voltage ranges is a ± 0.1 volt range that permits high-resolution millivolt measurements. In addition to voltage measurements, the HP -2401C is capable of frequency measurements from 5 Hz to 300 kHz. Measurements are indicated on a direct reading 6 digit display that is accompanied by an identification display of the units being measured and input polarity.

The measurements and units are made available in 4-2'-2-1 binary-coded decimal (bcd) for recording by a digital printer or for further digital data processing. Other capabilities may be added to the standard instrument in the form of various accessories and modifications which are discussed briefly in Sections 1.4 and 1.5.

1.2 FUNCTIONAL DESCRIPTION

Basically, the HP -2401C consists of a precise input attenuator, a highlyaccurate, highly-linear voltage-to-frequency converter (vfc) and a frequency counter. The vfc has separate outputs, one produced in response to positive input, the other produced in response to negative input. The frequency counter counts the pulses from the vfc for one of three specific sample periods, producing a count that is directly proportional to the average input voltage to the HP-2401C. The sample periods of the HP-2401C, .01, \1, and 1 second, are produced by decade division of the output from a 100kHz reference oscillator. The counter can be used alone for frequency measurements, as noted previously.

1.3 DESIGN FEATURES

1.3.1 Averaging of Positive and Negative Excursions

During voltage measurements, the decade counters in the HP-2401C can count either up or down under the control of special logic -- averaging the positive and negative excursions of the input algebraically. Regardless of the polarity of the input; the counters count up initially. Reversal of the input polarity switches the counters to a down count. At the down count of zero, the counters are switched to counting up and the polarity logic is switched. The count at the end of the sample period is the algebraic sum of the voltage-time integrals of the positive and negative signals tagged with the signal polarity that has the greatest voltage-time integral. Section 1

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1.3.2 Noise Rejection

The HP-2401C design virtually eliminates voltage measurement errors caused by extraneous noise. This is accomplished without imposing any restrictions on the grounding of the signal source or the grounding of any interface equipment. The greatest noise rejection is achieved by using a floating and guarded vfc that eliminates common mode noise. Further noise rejection is achieved by the input averaging design of the HP-2401C. Combined, these techniques yield an effective noise rejection greater than 140 db (10 million to 1) at all frequencies, including dc.

Induced ac ground currents, usually at power line frequency, can generate a potential of several volts between the signal source ground and the voltmeter chassis ground. If not blocked these currents will cause a voltage larger than the signal to appear at the input, resulting in a completely er-To prevent this effect, known as common-mode pickup, roneous reading. the HP-2401C features a shield or 'guard' that completely isolates the mea-, suring circuit from the instrument chassis. The guard breaks the common With the HP-2401C operated at the ground potential of the sigmode loop. nal source, common mode rejection (defined as the ratio between the common mode signal and the spurious voltage it causes to be superimposed on the signal to be measured) exceeds 120 db at 60 HZ and 160 db at dc with a 'ground leg' impedance of 1000 ohms between the source ground and the low side of the voltmeter input. The combined effect of guarding and ayeraging is such that a common mode potential of 100 volts will not cause a discernible error in the HP-2401C reading.

To reduce superimposed noise, the HP-2401C, by means of active integration, reads the average value of the applied voltage over a fixed sample period. When the average value of superimposed noise is zero over the selected sample period, no error caused by superimposed noise appears in the measurement. (See Figure 3-6, a graph of noise rejection versus noise frequency for the fixed sample periods that are provided in the HP-2401C.)

1.3.3 Overranging

Overranging to 300% of full scale is permissible on every range except the 1000 volt range. This provides additional resolution and accuracy on readings that are within the overranging capability. If the instrument is accidentally overloaded beyond 300% of full scale, the input attenuator is switched automatically to the 1000 volt range. This occurs at approximately 310% of full scale. The overload condition is indicated on the units display and on the recording output. The instrument resets automatically when it starts taking the next sample. If the overload condition persists, the protective cycle and overload indication are repeated.

1.3.4 Manual Control of Display Duration and Sampling Rate

At the end of the sample period, the display and recording outputs can be held for a period that is adjustable from 200 milliseconds to 7 seconds. At the end of this period, the HP-2401C will take a new sample. The sample-hold cycle will repeat indefinitely. The repetition rate of this cycle and the duration of the display period are set by the SAMPLING RATE control on the front panel.

1.3.5 Adaptability to Data Acquisition Systems

To facilitate its use in data acquisition systems, the HP-2401C has been designed to be completely programmable. Programming is accomplished simply by means of external contact closures to ground. The following may be programmed:

- a. Measurement function (volts, frequency, or other functions added by accessories or modification of the standard instrument).
- b. Voltage range.
- c. Sample period.

System cabling is simplified because input, programming, and bcd output connections are made at the rear of the instrument. Data acquisition system programming of the HP-2401C can bypass the SAMPLING RATE control on the front panel. The maximum sampling rates then depend upon selection of the sample period. The .01 second sample period most frequently used for data acquisition systems permits a maximum of 50 readings per second. Nine readings per second are possible when the .1 second sample period is selected. This sample period provides the optimum combination of speed, resolution, and accuracy for most measurements. The 1 second period, providing about 1 reading per second, is useful where maximum resolution is required.

1.3.6 Control of Sample Period

The input signal can be integrated over one of the fixed sample periods, or over an extended period which may be started manually or by programming. In this way analog signals from transducers can be integrated over any desired time interval, 'permitting totalization of flows, pressures, or other quantities.

1.3.7 Self Checking

A precision internal ± 1 volt reference source is provided for checking the calibration of the HP-2401C. The internal standard is obtained from a specially aged, temperature stabilized Zener diode that is selected for less than 0.006% drift in 6 months. The provision of this internal standard permits inplace calibration, avoiding frequent unracking and transportation of the instrument to the standards laboratory.

The HP-2401C design also provides for a self check of forward counting and decimal point logic.

1.4 CAPABILITIES PROVIDED BY ACCESSORIES

1.4.1 HP-2410B AC/Ohms Converter

The HP-2410B AC/Ohms Converter adapts the HP-2401C for resistance and ac voltage measurements. This instrument makes possible resistance measurement on six decade-mulitple ranges from 0.1K ohms to 10 megohms full scale. AC voltage measurement ranges are the same as the dc ranges of the HP-2401C, except that the input cannot be allowed to exceed 750 volts peak. The HP-2401C includes the Ω_y K Ω , M Ω , and AC displays which indicate the units being measured when the HP-2410B is used with the HP-2401C.

1.4.2 HP-2411A Guarded Data Amplifier

The HP-2411A Guarded Data Amplifier adapts the HP 2401C for low-level, high input impedance measurements. The HP-2411A (at + 10 gain) – HP-2401C (at . 1V range) combination affords a \pm 10 millivolt full scale range, with overranging to \pm 30 millivolts. At +10 or +1 gain, the HP-2411A input impedance is 10,000 megohms (effictive at +1 gain and HP-2401C to \pm 10 volts). The HP-2411A bypasses its input directly to the HP-2401C when more than 10 volts is applied. During the time required for switchover to bypass mode, the HP-2411A will tolerate up to 300 volts overload. Correct positioning of the decimal point on the HP-2401C is controlled by decimal logic assembly A30 (supplied with the HP-2411A to be plugged into the HP-2401C.

CAPABILITIES PROVIDED BY OPTIONS

A variety of standard options to the HP-2401C are available. These are summarized briefly as follows.

<u>18:</u> Fits the HP-2401C with Zero-Trak C-300-S-20 slides. This facilitates calibration and servicing of rack mounted instruments.

<u>21:</u> Provides positive-true 8-4-2-1 bcd recording outputs instead of the $4-2^{-}2-1$ bcd recording outputs supplied by the standard instrument.

29: Allows frequency measurements to 1.2 MHz.

<u>30:</u> Adds period measurement capability. Full scale period of 1, 10, and 100 milliseconds may be measured.

<u>31:</u> Adds automatic ranging capability. The HP-2401C automatically selects the appropriate voltage measurement range on receipt of a read command signal. Maximum time from the read command to the start of the meas-

urement, allowing change from lowest to highest range or vice versa, is 34 milliseconds. The autoranger also controls the HP-2410B AC/Ohms Converter or the HP-2411A Guarded Data Amplifier when either is used with the HP-2401C.

<u>35:</u> Provides negative-true 8-4-2-1 bcd recording outputs instead of the 4-2-2-1 positive-true bcd recording outputs supplied by the standard instrument.

146: Adapts HP-2401C for single-connector program input from HP computers.

1.6 PHYSICAL DESCRIPTION

The HP-2401C mounts in a standard 19-inch rack and requires 7 inches of vertical panel space. It extends to a depth of 18-3/8 inches (including the , externally-mounted cooling fan). The instrument chassis is made of , alodined aluminum, and the front panel is finished in light grey baked enamel with black-filled engraved titles.

1.7 SPECIFICATIONS

VOLTAGE MEASUREMENT

NOISE REJECTION

Overall Effective Common Mode Rejection: (ratio of common mode signal to its effect on digital display): 140 db at all frequencies, 160 db at dc (0.1 second sample period).

<u>Common Mode Rejection</u>: (ratio between common mode signal and voltage it superimposes on source): 120 db at 60 Hz, 160 db at dc, with 1000 ohms between low side of source and low side of voltmeter input (resistances up to 10K permissible).

Superimposed Noise Rejection: (ratio of superimposed noise to its effect on digital display): More than 20 db at 55 Hz for 0, 1 second sample period; increases 20 db per decade increase in frequency. Infinite rejection at frequencies evenly divisible by 10. (For 1 second and 0.01 second sample periods see Figure 3-6.) Combined amplitude of signal and superimposed noise can equal ±3 times full scale, for any signal amplitude.

INPUT CIRCUIT

<u>Type</u>: Floated and guarded signal pair. Signal pair and guard may be operated up to 500v above chassis ground.

Ranges: 5 ranges from 0.1 to 1000v full scale (see also 'Resolution' on page 1-6). 10 mv range with accessory HP-2411A Amplifier. Range selection by front panel switch or remote circuit closure to ground. See page 1-6 for specifications of optional Autoranger. Signal polarity sensed automatically.

Overranging: Overranging to 300% of full scale permissible, except on 1000v range. Attenuator switches automatically (in 3 ms) to 1000v range if overload exceeds 310%. Reset automatically by next internal or external read command signal.

Input Impedance: 10M on 10, 100, 1000v ranges. 1M on 1v range. 100K on 0.1v range. Impedance is within ±.02% of nominal value, all ranges. <150 pf all ranges.

<u>Connectors</u>: Front panel binding posts (3/4 inch centers) for HI, LO and GUARD. Alternate input via guarded connector on rear panel.

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INTÉRNAL CAUBRATION STANDAED

A al volt internal standard is provided for self office bration. This standard can be used to maintain specified monumay for 6 months after it has been set at the factory, or at another calibration facility, to better than . 00% absolute accuracy at 25°C.

- ABSOLUTE ACCURACY

Beolification holds for all ranges, \$10% line voltage a variation, and 0 months variation, assuming daily calibration against internal standard after 90-minute initial warmup.

.01% rdg a.005% fn at digit (0 to fn) .03% rdg at digit (nt Ra fn) .02% rdg at digit (nt Sa fn)

Temperature Coefficients:

When 2401C is calibrated against internal standard at operating temperature above or below 20°C, add:

.001% rdg per *C (10* to 40*); .0015% rdg per *C (40* to 50*C)

When \$401C operating temperature differs from estibrate temperature, add:

, 002% rdg 4, 0005% fs per "C (0, iv range) , 002% rdg 4, 0002% fs per "C (other ranges)

MEASUREMENT SPEED

Fixed sample periods of 0,01, 0,1 or 1 second may be selected by front panel switch or remote circuit closure to ground. Bampling rate determined by detay between samples, adjustable at front panel from 0,2 to 7, seconds. (Max. speeds shown in Table.)

RESOLUTION

Depends on sample period selected -- see Table.

Man, resolution is 1 microvoli per digit (0, 1v range, 1 second sample).

		M			R 1	ALL MATRIAL	11 1
• •			0.1 1 10 600 9300	100000W 100000V 100000V 100000V	, 16 5 a 4	B 0 0 0 0 0 0 0 WY B 0 0 0 0 0 0 WY B 0 0 0 0 0 0 V B 0 0 0 0 0 0 V E 0 0 0 0 0 V	
			01 1 10 100 1000	10000WV 10000V 10000V		VM 0 0,00 6 V 0 0 0 0,0 V 0 0 0,0 V 0 0,0 0 6)
	/ 3		0 I I I0 100 1900	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		8000WV 8000V 8000V 8000V	,

MOTEL POLIARES BENER AND MOLATER AUTOMATICALLY

AUTORANGER

VOLTAGE RANGES

Automatically selects appropriate range from 5 inputranges of standard instrument (0.1v to 1000v full scale) on receipt of read command signal. Starts at range selected for previous reading, proceeds directly to higher or lower range as required. Automager also selects appropriate gain setting (at or a10) when HP 2401C is used with HP 2411A Amplifier.

RANGE CHANGE POINTS

Upranges at 310% of full scale, Downranges at 30% of full scale.

RANGE SELECT TIME

6.0 ms (nominal) for each range change. When correct range is reached there is an encode delay of 9.7 ms before sample period commences. Max. time from receipt of read (encode) command to start

input signal is integrated over selected sample period. Using fixed sample period (1, 0, 1 or 0, 01 second) integral corresponds to average of input, readout is in volts. Alternatively, sample period may be started and stopped by front panel switch or remote signal (see External Programming) in which case display reads in millivoit-seconds or volt-seconds as appropriate.

Note: Instrument displays true integral with correct polarity, even if signal crosses through zero during sample period. of sample period, allowing autoranger to travel from lowest to highest range or vios versa, to 34 ms.

VARYING SIGNALS

Upranges if signal increases beyond 310% of full scale during sample period and starts new sample (record command at end of aborted sample period is supressed). Does not downrange if signal decreases below 30% of full scale during sample period. This technique ensures that voltmeter will always arrive at valid reading, even in presence of very severe superimposed noise.

MODE SELECTION

Autoranging mode selected by front panel function switch or external circuit closure to ground, applied at programming input connector.

DC VOITAGE INTEGRATION

Rángen:

0 to: 100,000 millivoit-seconds 1000,00 millivoit-seconds 10,0000 voit-seconds 100,000 voit-seconds 1000,000 voit-seconds

<u>Accuracy</u>: finme as for DC Voltage Measurement, with exception that errors given as percent of full scale must be multiplied by the integration time in seconds.

IREQUENCY MEASUREMENTS Hange: 6 Ha to 300 kHs. To 1.2 MHs with Option 29. Display Time: Continuously variable from 0.2 to 7 seconds, or held continuously until reset either menually or by remote signal (see External programming). Gate Time: 0.01, 0.1, 1.0 second or manual control front panel switch or remote signal, see External programming). 1 second gate provides 1 Hz display resolution, Input Sensitivity: 0.1 to 100v rms (front panel attenuator) or will accept pulses, Iv min. amplitude, 2 µs to 1 ms width. Internal adjust-Accuracy; al count atime base accuracy. rgent is required for positive or negative pulse measurements. Internal Time Base: Stability at constant temperature (45 °C) is $4\pi/10^8$ per week. Temperature effect is $\pm 100/3$ 10⁴ over range 10 to 50°C. (Self-check control on front Impedance: 1 M shunted by 150 pf. panel for counting internal 10 kHz for selected gate time.) Friernal Time Base: Rear BNC and switch provided for external frequency standard. Level required is 2v Connector: SNC on front and rear penals. p-p into 1.1K. PERIOD MIASUREMENTS (Option 30) Accuracy: al count atime base accuracy, strigger error divided by number of periods averaged. Ranges: 1, 10, and 100 periods, 5 Hs to 10 kHs. 1 For time base accuracy see 'Frequency Measurements'. Trigger error for 0, 1v rms sine-wave input is 0, 3% for signals with 40 db signal/noise ratio. Trigger er-Display: Reads directly in milliseconds. (Recorder output in ms \times 10⁻⁵, where \times is range digit recorded.) ror decreases with increased signal amplitude and slope. Sensitivity, Impedance, Connector: Same as for 'Fre-quency Measurements'. Resolution (referred to single period): Mode Relection: By front panel function switch or ex-ternal circuit closure to ground, applied to program-1 period 100 µs 10 periods 10 µs 100 periods 1 µs ming input bonnector.

GENERAL SPECIFICATIONS

DISPLAY

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6 digit Nixie readout (6 full scale digits plus overrange digit). Polarity, decimal point, function and overload condition indicated automatically. (This biso applies when HP 2401C used with HP 2410B AC/ Ohms Converter.) Rear switch provided to select 'Biore' or 'Display' during count period.

RECORDING OUTPUTS

Binnry-coded decimal outputs provided as follows:

Function	1	1	digit
Dalat			digits
Decimal	potet:	1	digti

(Decimal point digit indicates negative exponent, e.g. for reading of 137.56 volts, or 13758 \times 10 $^{-2}$, output is digit "3".)

Outputs will drive HP 562A Digital Recorder directly, or other devices either directly or through a Dymec coupler. Table shows printout of a special printwheel supplied with J66/5 563AR for recording function.

BATA	Punction	•	ų	6 IC - 1	-1		
0	PENDO **	•					
1	4 VBC	•		•	1	1	•
	- VOC	•	•	1	•	1	-
1	RC .			١		1	•
4	×Δ1	0	1	1 ⁵	'e	•	
1	нд [†]	0	I	1	1		
6		•	ł	0	0		>
7		١.	I	Q	1	7	<
	TIME	1	١	1	•	•	l T
1	OVERLOAD	1	1	۱	1		
		1	0	•	0	BLANK,	-
	WIC !	1	0	0	1	1 🖌	

BCD Outputs:

VOLTAGE	*o*	-36 TO -24.5V	
LEVELS	• •••	-2.8 TO OV	
-	DATA	100K	
MPERMOE	PLINCTION, DEC. PT	83K	
MAX.	DATA	AM E.O	
CURRENT	PLUCTION,	1.864	

<u>Record Command</u>: Level '1' for record and '0' during sample period, or vice-verst. (See below.)

REPERCINCE	3 *0*	*1*
LEVEL	-84.8 TO -81.6V	-8 70 -1V
SOUNDAN	A 0008	1000 A
MAX. CURRENT	1 864	15 MA

HP 562A Recorder Reference Voltages:

REPRICEMENT	*e*	* 1*
LEVEL	-24.5 TO -21.8V	-8 TO -4V
IMPERANCE	000 A	140 A
MAN. CURRENT	1 MA	0.5 MA

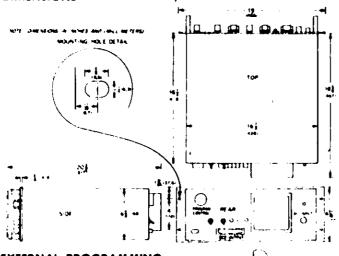
Connector: Amphenol 57-40500 50-pin connector on rear panel.

FREQUENCY OUTPUT

Internal 100 kHz frequency standard is available at rear BNC. (Square wave, 0 to -1.2v, 1K source impedance.)

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DIMENSIONS



EXTERNAL PROGRAMMING

HP 2401C may be completely programmed by external circuit closures to ground (defined as contact closure or equivalent that raises internal circuit to -1v or more positive level and that can supply up to 70 ma). For maximum sampling speed, pulse input may be used for reset/encode command. Unless otherwise stated, all programming commands are received via rear MS3102A28-218 37-pin connector.

<u>Function:</u> HP 2401C measures voltage unless closure is received on 'frequency' command line.

Range: Separate closure required to select any of the live voltage ranges. Range select time < 6 ms.

Sample Period: Separate, closure required to select any of the three fixed sample periods or to activate 'manual' control. When 'manual' control is activated, closure (or -1 to +5v) on 'start/stop' line starts sample period, open circuit (or -5 to -30v) stops sample period. (Input resistance 4K.) Sample period starts/stops within 1 μ s of command.

Reset (Encode): Counter portion of HP 2401C may be reset and new count started by closure on 'Counter Reset' line, or counter may be reset by -15v, 25 μ s pulse (rise time < 2 μ s) applied to separate rear BNC (not available with 146). Fixed delay of 12.7 ms to start of new count with closure reset, 9.7 ms with pulse reset.

Hold: Positive 1 to 12v (4.5 ma, max.) inhibits start of new count. Negative 1 to 35v permits new count. Received via recorder (bcd) output connector.

Accessory Amplifier: When used with HP 2411A Amplifier, decimal point logic card furnished with the 2411A must be installed in the 2401C.

AC/Ohms Measurements: If used with HP 2410B AC/ Ohms Converter, coupling cards supplied with 2410B must be installed in the 2401C. External programming, except pulse encode command, is accomplished through 2410B.

OPERATING CONDITIONS

Ambient temperatures 10 to 50°C, relative humidity to 95° at 40°C.

POWER REQUIRED

115/230v ±10⁷, 50 to 60 Hz, 150 watts approx. WEGHT

Net wt. 48 lb (22 kg); shipping wt. \$7 lb (25, 7 kg). PANEL FINISH

🔨 Light grey baked enamel, black-filled lettering.

OPTIONS

- Rack-Mounting Slides: HP 2401C fitted with Zero-Trak C-300-S-20 slides for easy withdrawal_from rack.
- 21. +8-4-2-1 BCD Output: Supplied instead of standard +4-2-2-1 output (same specifications). Required for compatibility with Hewiett-Packard Computers.
- 29. 1 MHz Frequency Range: Extends frequency measurement range to 1.2 MHz.
- 30. Period Measurements: Adds measurement of multiple period averages of signals to 10 kHz. Specifications on page 1-7.
- 31. Autoranging: Specifications on page 1-6.
- 35. -8-4-2-1.BCD Output: Supplied instead of standard +4-2'-2-1 output (same specifications except '0' and '1' state levels reversed).
- 146. Programming by HP Computers: Adapts 2401C for singleconnector program input from HP Computers. Provided in place of rear 'Counter Reset' BNC. Option 21 the loc required.

ACCESSORIES AVAILABLE

(Order by accessory orestock number.)

- 1. H008 5050A Digital Recorder. Check with local Hewlett-Packard sales office for appropriate options, price, and delivery.
- 2. J66/65 562AR Digital Recorder. Check with local Hewlett-Packard sales office for appropriate options, price, and delivery.
- 3. 2547A Coupler. Offers a choice of several different serial-entry output recorders, including magnetic tape, punched tape, punched cards, and typed log. Check with local Hewlett-Packard sales office for appropriate options
- Prógramming Input Connector. MS3106 B28-21 P, 37-pin (with clamp) stock number 5060-2440
- Recorder Output Connector: Amphenol 57-30500, stock number 1251-0086
- 6. Input Connector. Mates with rear guarded input connector, stock number 1251-0350 (One connector is furnished with instrument.)
- 7. Cover. Plugs onto front input terminals to prevent their use when rear input is in use. Accessory number 12529A

ACCESSORIES FURNISHED

- Power Cable. Length 7-1/2 feet, plugs into rear connector. Stock number 8120-0078.
- 2. Input Connector. Mates with rear guarded input connector. Stock number 1250-0350.
- 3. Extender Boards. For servicing plug-in circuit boards. Set of five. Stock number 5060-5078.

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Section II

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- 2.3 Local Operation
- 2.4 Functions of Controls
- 2.5 Special Operating Capabilities
- 2.6 Programmed Operation
- 2.7 Recording Outputs

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 - 2-3 Program Control Connector J1
 - 2-4 BCD Output Connector J2
 - 2-5 Function Codes

ILLUSTRATIONS

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Input Signal Connections

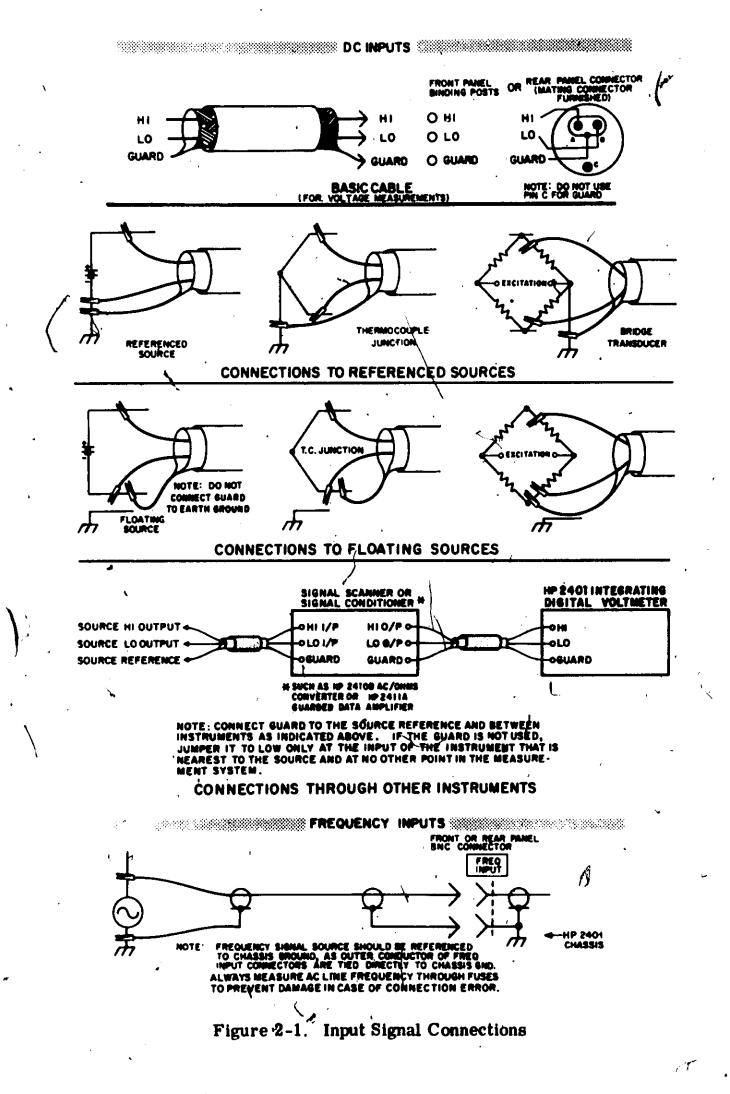
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SECTION II INSTALLATION AND OPERATION

INSTALLATION

The HP-2401C Integrating Digital Voltmeter mounts in a standard 19-inch rack, requiring 7 inches of vertical panel space, and is also suitable for bench-top use. "Depth required behind the front panel, including recommended cable clearances, is 21-3/8 inches. The HP-2401C contains its own cooling fan. No special ventilation is required unless the temperature of the instrument would otherwise be outside the range of $10-50^{\circ}$ C or relative humidity would otherwise exceed 95 percent.

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Line Set Switch and Power Requirements

A slide switch on the rear panel allows the HP-2401C to be set for operation from either 115 or 230-volt power, at 50 to 60 Hz, without rewiring the primary connections of the power transformer. The HP-2401C is normally supplied from the factory with the line set switch in the 115 volt position and a 2 ampere slow-blow fuse installed in the fuseholder on the front panel. Power required is approximately 150 watts.

CAUTION

Before operating the HP-2401C, make certain that the line set switch is positioned correctly. Slide this switch to expose 115 for operation from 115 volts or to expose 230 for operation from 230 volts. For 230-volt operation, replace the 2 ampere slow-blow fuse with a 1 ampere slow-blow fuse.

2.1.2 Input, Output, and Programming Connectors

<u>HI, LO, and GUARD</u>: Binding post terminals on the front panel. The HI and LO terminals receive the two-wire dc input voltage; the GUARD terminal (connected internally to the guard chassis) receives the reference potential of the measurement source. The signal pair and guard may be operated up to 500 volts above chassis ground. See Figure 2.1 for input signal connections.

If guarding is not used, the GUARD terminal must be connected to the LO terminal. For example, when measuring a floating dc voltage -- such as the output of a floated dc amplifier -- do not connect GUARD to the chassis ground of the amplifier; connect the GUARD terminal to the LO terminal.

CAUTION

Do not connect voltage to the HI and LO terminals when plug is connected to J31. Voltage thus applied can damage any instrument whose output is connected to the HP-2401C via J31.

<u>DC INPUT (J31)</u>: A special guarded receptacle on the rear panel. Pins A and B connect to the HI and LO dc input lines. The oval shell connects to guard.

FREQ INPUT: Front and rear panel paralleled BNC receptacles, either of which may receive the input signal whose frequency is to be counted when the HP-2401C is used for frequency measurement.

<u>100 Hz</u> STD OUTPUT/INPUT (J3): Rear panel BNC receptacle that provides an output of the internal 100 kHz time base for external use, or receives a precise external time base input if desired. An associated toggle switch labelled INT-EXT selects the internal or external time base mode.

<u>COUNTER RESET (J4)</u>: Rear panel BNC receptacle which receives an external pulse that is used to reset the counter section of the voltmeter.

<u>PROGRAM CONTROL (J1)</u>: Rear panel MS3102A28-21S receptacle that receives the external program commands when the HP-2401C is programmed by external circuit closures to ground, as in data acquisition systems. (See Section 2.6.) Also receives program commands from a HP-2410B AC/Ohms Converter or HP-2411A Guarded Data Amplifier when either of these instruments is used with the HP-2401C. (See Sections 2.5.3 and 2.5.4.)

<u>BCD OUTPUT (J2):</u> Rear panel Amphenol 57-40500 receptacle that provides bcd outputs for function, data, and range, + and -bcd reference voltages, and + and -print commands. It also accepts holdoff signal and scan signal from recorder or coupler (scan signal is routed to PROGRAM CON-TROL connector).

2.1.3 'HP-2410B AC/Ohms Converter Coupling Cards

When the HP-2401C is used with a HP-2410B AC/Ohms Converter, the two coupling cards (printed circuit boards) supplied with the HP-2410B must be installed in the voltmeter. (If a HP-2410B/HP-2401C combination is purchased, the coupling cards are installed in the voltmeter at the factory.)

The two printed circuit boards are the HP-2410B Units Coupling (A9) and AC/Ohms Delay Gate (A23). Install HP-2410B Units Coupling Card (A9) in connector XA9; AC and Ohms Delay Gate Card (A23) in connector XA23. These locations are shown in Figures 4-3 and 4-4.

2.1.4 HP-2411A Guarded Data Amplifier Decimal Point Logic Card

When the HP-2401C is used with a HP-2411A Guarded Data Amplifier, the HP-2411A Decimal Point Logic Printed Circuit Card (A30) supplied with the HP-2411A must be installed in the voltmeter. This assures correct positioning of the decimal point when the HP-2411A is set for +10 gain. (If a HP-2401C/HP-2411A combination is purchased, A30 is installed in the voltmeter at the factory -- see Figure 4-4.) When the HP-2401C is purchased

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separately, a jumper board is installed in the A30 position. HP-2411A Decimal Point Logic Card A30 replaces this jumper board in receptacle XA30.

2.2 PREOPERATIONAL CHECK AND CALIBRATION

To achieve the specified measurement accuracy, perform the following preliminary checkout and calibration procedures daily, or each time the instrument is turned on. Allow a 1-1/2 hour warmup.

2.2.1 Counter Section Check

a. Set Power switch to ON, other controls as follows:

100 KC STD (rear panel):	INT.
FUNCTION:	FREQ.
ATTENUATION:	CHECK.
SAMPLING RATE:	CW from STOP.

b. Check reading at each of the three fixed sample periods in turn; readings should be as follows (±1 count):

Sample Period:			.01	Sec,	10.0	KC Reading
		•	.1	Sec,	10,00	KC Reading
•	,		1.0	Sec,	10.000	KC Reading

2.2.2 ZERO Adjustment (After 1½ Hour Warmup)

a. Set Power switch to ON, note time, and set other controls as follows:

100 KC STD (rear panel):	INT.
FUNCTION:	VOLT.
RANGE:	ZERO.
SAMPLE PERIOD:	⁽ 1 SEC.
SAMPLING RATE:	CW from STOP.

b. After the HP-2401C has been on for at least 1-1/2 hours, set the front panel ZERO adjustment for zero ± 1 count readout on the digital display.

2.2.3 Full-Scale Adjustment (After ZERO Adjustment)

a. Set the RANGE switch to INT +1V.

b. Set the front panel CAL+ adjustment for +1000.00 MILLIVOLTS indication on the digital readout.

c. Set the RANGE switch to INT -1V.

d. Set the front panel CAL- adjustment for 1000.00 MILLIVOLTS indication on the digital readout.

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Section Π

2.3 LOCAL OPERATION

Operation of the HP-2401C is straightforward and can be controlled locally at the front panel per Table 2-1 or can be programmed as required for data acquisition systems use. (See Section 2.6 for programmed operation.)

2.4 FUNCTIONS OF CONTROLS

2.4.1 Front Panel Controls

FUNCTION switch: Selects the type of measurement to be made, such as VOLT for dc voltage measurements, AUTO RANGE for automatic ranging voltage measurements (with HP-2401C-31), FREQ for frequency measurements, or PERIOD for period measurements (with HP-2401C- 30). An EXT SEL position prepares the HP-2401C to respond to function and range programming via PROGRAM CONTROL connector J1.

RANGE switch: Selects the full-scale range of .1, 1, 10, 100, or 1000 volts. INT +IV, ZERO, and INT -IV positions are also provided for daily calibration of the instrument.

<u>SAMPLE PERIOD</u> switch: Fixed sample periods of .01, .1, or 1 second are selected by this switch. In addition, the sample period may be started manually by switching to START position and ended by switching to STOP. An EXT SEL position allows programmed selection of a fixed sample period or programmed starting and stopping of the sample period.

<u>SAMPLING RATE control</u>: Adjusts the length of time that the display and recording outputs are held after the end of the sample period. The time is adjustable from 200 milliseconds to 7 seconds (approximately). When switched to STOP position, the reading is held until reset either manually or by programming. Programmed control can achieve up to 50 readings per second, as noted in Section 1.3.5.

RESET pushbutton: Resets the instrument, including the digital display, and automatically initiates another sample period if one of the three fixed sample periods is selected and the SAMPLING RATE control is in STOP position. With SAMPLE PERIOD switch at STOP, resets the instrument to zero; sample period begins when SAMPLE PERIOD switch is set to START.

ATTENUATION control: Determines the input signal attenuation when making frequency or period measurements. A switched CHECK position connects a 10 kHz signal derived from the internal time base oscillator to the counters. This is used for a confidence check of the counter section.

<u>Power switch and Line fuse</u>: Controls ac power to the voltmeter; 2 ampere fuse is used for operation from 115 volts, 1 ampere fuse for operation from 230 volts ac.

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2.4.2 Rear Panel Controls

STORE/DISPLAY DURING COUNT switch: In the STORE position, the previous visual display is held until the end of the current sample period, at which time the display changes directly to the new reading. However, external encode commands or RESET switch triggering causes transfer of all zeros to the digital display at the start of the triggered sample. In the DISPLAY position, the actual counting is displayed during the sample period.

100 KC STD switch: Selects the source of the counter time base reference standard. The INT position of this switch selects the internal 100 kHz time base signal and connects it to the adjacent 100 KC STD INPUT/OUTPUT BNC connector J3. The EXT position selects an external signal, received via BNC connector J3, as the time base standard of the instrument.

<u>115/230V switch:</u> Sets the instrument for operation from available line voltage (115 or 230 vac; 2 ampere fuse is used for 115 vac operation, 1 ampere fuse for 230 vac operation).

Table 2-1. Operation Summary (Std. 30, 31 Instruments)

 TURN-ON AND PRELIMINARY CONTROL SETTINGS a. Set Power switch to ON (display digits light). b. Set 100 KC STD switch to INT (EXT if external standard is to be used). c. Set SAMPLING RATE for desired display interval or to STOP for measurement triggering by RESET pushbutton or remote command. d. Select SAMPLE PERIOD that achieves the desired resolution of measurements (see Table 2-2).
VOLTAGE MEASUREMENT a. Set FUNCTION switch to VOLT (VOLT or MILLIVOLT display lights). b. Select lowest RANGE that can be used without lighting the OVERLOAD display.
AUTORANGING VOLTAGE MEASUREMENT (HP-2401C-31) a. Set FUNCTION switch to AUTO RANGE. b. Set RANGE switch to any position except INT +1V, INT -1V, or ZERO.
 FREQUENCY MEASUREMENT a. Set FUNCTION switch to FREQ (KC display lights). b. Adjust ATTENUATION control clockwise about 30° past the point where consistent measurements are obtained.
 PERIOD MEASUREMENT (HP-2401C-30) a. Set FUNCTION switch to PERIOD (MILLISEC display lights). b. Adjust ATTENUATION control clockwise about 30° past the point where consistent measurements are obtained.
CONNECTIONS
a. Connect voltage to be measured and shield to HI, LO, and GUARD terminals per Figure 2-1.
b. Connect signal whose frequency or period is to be measured to FREQ INPUT receptacle per Figure 2-1.

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Sample Period				Frequency Reading	Perioda Averaged*	
1 SICC	. 1V	100.000 MV	300,000 MV	000.000 KC	,100	
	1.0V	1000,00 MV	9000,00° MV		(1 / Bec	
	10,0V	10,0000 V	30.0000 V		Resolution)	
	100.0V	100.000 V	300.000 V			
	1000.0V	1000. 0 0 V				
. i sec	. 1V	100,00 MV	300.00 MV	0000.90 KC	10	
	1, OV	1,0000 V	3.0000 V	-	(10 µ8ac	
	· 10.0V	10,000 V	30.000 V		Ronolution)	
	100.0V	100,00 V	800.00 V			
	1000, <u>Q</u> V	1000.0 JV		,		
			• •			
.01 SEC	. 1V	100 0 MV	300.0 V	00000.0 KC	1	
	1.0V	1.00p V	3.000 V	x	(100 µ8oc	
	10.0V	10.00 V	30.00 V	J	Resolution)	
	100. OV	100 / 0 V	300.0 V	2		
	1000, OV	1000. V			(

Table 2-2. Resolution of Measurements

HP-2401C- 30.

2.5 SPECIAL OPERATING CAPABILITIES

2.5.1 Operation With External Time Base Reference

Accurate external 10 kHz, 1 kHz, or 100 Hz, reférences can be used to achieve multiplication of the fixed sample periods of the instrument by 10, 100, or 1,000. If such sample period multiplication is used, the decimal point must be shifted one, two, or three places to the left. Switcheyer to the external standard signal is accomplished by setting the 100 KC STD switch to EXT and connecting the standard signal to the 100 KC STD INPUT/OUT-PUT receptacle at the rear of the instrument. This external signal must have 2 volt peak-te-peak amplitude across a 1.2K load.

2.5.2 Manual Control of Sample Period

Duration of the sample period (counter gate time) can be controlled manually, as follows:

- a. Set the SAMPLE PERIOD switch to STOP and reset the counter by actuating the RESET pushbutton.
- b. Set the SAMPLE PERIOD switch to START.
- c. End the sample period by setting the SAMPLE PERIOD switch to STOP.

When a manually started and stopped sample period is used, flows, pressures, thrusts, countable events, etc., can be totalized over periods that are longer than the fixed periods selectable on the SAMPLE PERIOD switch. Average voltage or frequency may be determined by dividing the reading by the duration (in seconds) of the extended sample period.

NOTE: The counting process is always displayed while the SAMPLE PERIOD switch is in START or STOP position, regardless of the STORE/DISPLAY switch setting.

2.5.3 AC Voltage Measurements and Resistance Measurements

The HP-2410B AC/Ohms Converter makes possible ac voltage and resistance measurements with the HP-2401C. Assemblies A9 and A23, supplied with the HP-2410B, must be installed in the HP-2401C. Specified accuracy of the HP-2410B is achieved after 1 hour warmup; but it can be used 15 seconds after it is turned on.

Initial Preparation

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- a. Connect the HP-2410B programming cable from receptacle J8 on the rear of the HP-2410B to PROGRAM CONTROL receptacle J1 on the rear of the HP-2401C.
- b. Connect the HP-2410B signal output cable from the HI, LO, and GUARD dc terminals on the terminal strip at the rear of the HP-2410B to corresponding terminals on the HP-2401C.

NOTE: To avoid unnecessary measurement errors, make certain that the guard shield is connected at only one point, the measurement reference point. If a GUARD terminal is tied to a LO`terminal at the front panel of the HP-2410B, make certain that such connection is not duplicated between GUARD and LO terminals at the rear of the HP-2410B or at the front panel of the HP-2401C.

c. Turn on both instruments and set HP-2401C FUNCTION switch to EXT SEL, SAMPLE PERIOD switch to desired position, SAMPLING RATE coutrol to STOP, and RANGE switch to 1V.

AC Voltage Measurement

- a. Set HP-2410B FUNCTION switch to AC NORM for frequencies below 400 Hz or AC FAST for frequencies above 400 Hz; set HP-2410B RANGE switch to lowest range that can be used without lighting OV-ERLOAD indicator on HP-2401C.
- b. Connect ac voltage to HI, LO, and GUARD AC/DC INPUT of HP-2410B, but do not exceed 750 volts peak input.
- c. Initiate measurements by actuating the RESET pushbutton on the HP-2401C or by setting SAMPLING RATE control clockwise from STOP.

Resistance Measurement

- a. Perform the HP-2410B ohms zero calibration as specified in the HP-2410B handbook.
- b. Set HP-2410B FUNCTION switch to OHMS and RANGE switch to the lowest range that can be used without lighting OVERLOAD indicator on HP-2401C.

- c. Connect resistance to be measured to the resistance input of the HP-1 2410B.
- d. Initiate measurements by actuating the RESET pushbutton on the HP-2401C or by setting the SAMPLING RATE control clockwise from STOP.

2.5.4 Measurements Using the HP-2411A Guarded Data Amplifier

The HP-2411A Guarded Data Amplifier makes possible measurement of lowlevel inputs at a full-scale sensitivity of 10 millivolts with the HP-2401C. This instrument may also be used for extremely high input impedance measurements at +1 gain on the .1 and 1 volt ranges of the HP-2401C. Assembly A30, supplied with the HP-2411A, must be installed in the HP-2401C. To achieve specified zero drift, the HP-2411A requires a 2 hour warmup, at constant temperature, but it can be used 15 seconds after it is turned on. Proceed as follows:

- a. Connect the HP-2411A programming output cable from PROGRAM OUT-PUT receptacle J2 on the HP-2411A to the PROGRAM CONTROL receptacle J1 on the rear of the HP-2401C.
- b. Connect the HP-2411A signal output cable from OUTPUT receptacle J5 on the HP-2411A, to the DC INPUT receptacle, J31, on the rear of the HP-2401C.

<u>NOTE:</u> To avoid unnecessary measurement errors, make certain that the guard shield is connected at only one point, the measurement reference point. Make certain that the guard shield is connected at the measurement source reference point and that the GUARD and LO terminals on the front panels of the HP-2411A and HP-2401C are not tied together.

c. Turn on both instruments and set the HP-2411A ZERO adjustment as specified in the HP-2411A handbook.

- d. Set the HP-2401C FUNCTION switch to EXT SEL, SAMPLE PERIOD switch to desired sample period, and SAMPLING RATE control to STOP.
- For maximum resolution of low-level measurements, set the HP-2411A
 MODE switch to +10 gain and the HP-2401C RANGE switch to .1V. This achieves a ±10 millivolt full-scale range (±30 millivolt overrange).
- f. For minimum loading of the voltage being measured, set the HP-2411A MODE switch to +1 gain. The input resistance will then be 10,000 megohms for input voltages to ± 10 volts. Input greater than 10 volts automatically switches the HP-2411A to bypass mode, which reduces input impedance to that of the HP-2401C.
- g. Connect the dc voltage to be measured to the HI, LO, and GUARD IN-PUT terminals of the HP-2411A in accordance with the general principle expressed in Section 2.1.1 and Figure 2-1.
- h. Initiate measurements by actuating the RESET pushbutton on the HP-2401C or by setting the SAMPLING RATE control clockwise from STOP.

2.5.5 Pulse Measurements

To measure pulses at the FREQ INPUT connectors, the input trigger circuit must be adjusted so that the hysteresis limits will be triggered by either a positive pulse or a negative pulse. Refer to Section 4.7.11 for the adjustment procedure. Refer to Section 4.7.12 to readjust for sine wave operation.

2.6 PROGRAMMED OPERATION

The measurements described in Sections 2.3 and 2.5 may be programmed and initiated by external circuit closures to ground. This feature makes the HP-2401C particularly adaptable for use in automatic data acquisition systems. The remote control lines do not interfere with the guarding properties of the measurement circuits. All programming and input connections can be made at the rear of the instrument, which simplifies cabling.

2.6.1 Centrel Settings

Set front panel controls of the HP-2401C as follows for fully programmed operation:

EXT SEL.

FUNCTION: SAMPLE PERIOD: SAMPLING RATE: RANGE:

EXT SEL. STOP (switched position) or desired rate. Any position except INT -1V, INT +1V, or ZERO.

2.6.2 Programming Requirements

Refer to Table 2-3 for the pins of J1 that must be connected to program and initiate the various measurements. (An external contact closure to ground is defined as a contact closure or equivalent which raises the internal circuit to a potential that is no more negative than 1 volt at a maximum load current of 70 milliamperes.) Complete programming information must be present, for each type of measurement, otherwise the input attenuator switches automatically to the 1000 volt range and the decimal point blanks. The programming required for each type of measurement is as follows:

DC Voltage Measurements: Only range and sample period must be programmed. The HP-2401C automatically measures dc voltage if the frequency measurement function is not programmed.

Autoranging Voltage Measurements (HP-2401C-31 Only): Autoranging function and sample period must be programmed; ranges must not be programmed.

Frequency Measurements: Frequency function and sample period must be programmed.

Period Measurements (HP-2401C-30 Only): Period function and Sample period (number of periods averaged) must be programmed.

2.6.3 Application of Program Commands

The external contact closures are applied between the required pin(s) of J1 and pin Z. For example, to program a frequency measurement over a sample period of 1 second, external contact closures must connect pins B and R of J1 to pin Z.

Table 2-3. Program Control Connector (J1)

Connector Type: MS3102A28-218 Mating Connector: MS3106B28-21P J1 Pin Description A Spare Function Volts/Frequency (Measures volts if not programmed.) В C* Ohms D* AC Normal 2* AC Fast F* Spare Range (Volts) G 0.1 H ſ Л 10 K 100< L 1000 10M Ω ¬ M* Sample Period (Sec) Periods Averaged (W/Option M30) Λ N .01 P .1. 10 R 1 100 HP-2411A +10 Gain Input to A30 (+10 Gain to HP-2411A with Option 31) 8 T Spare U Spare Ÿ Autorange (W/Option 31) W Spare х HP-2411A Sense (W/Option 31) Z Chassis Ground (System Common) 8 Manual Gate Selection b Start/Stop Manual' Gate (Closure to Start) С Counter Reset (Closure) Overload Reset (Pulse or Closure) Input/Output** d Overload Signal Output (30 Milliamperes Maximum) e f Period (W/Option 30) g. Spare h Spare j Spare k Spare Jumpered to J2 (49) to Route Signal Scan from Printer m р Spare r Spare Chassis Ground .

* Pins for HP-2410B use only.

**Overload reset not normally used since counter resets overload circuit. When counter section is reset, pin d provides overload reset pulse for HP-2410B and HP-2411A overload reset.

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2.6.4 Initiating Measurements

Measurement may be initiated by either of two encode command inputs. One of these inputs is a contact closure between pin c of J1 and pin Z, which grounds the counter reset program line. This triggers a reset pulse after about 3 milliseconds delay, starting a new measurement cycle. The 3 millisecond delay prevents multiple reset commands caused by contact bounce when relay contact closure is used for resetting. The other input which may be used to initiate measurement is a -15 volt, 25 microsecond pulse with rise time less than 2 microseconds. This pulse, applied to COUNTER RESET receptacle J4 on the rear panel of the HP-2401C resets the digital display to all zeros and starts a new measurement cycle immediately.

2.6.5 Standard Measurement Delays

Measurement (the sample period) actually begins 9.7 milliseconds after the reset pulse has reset the time base and counting/display decades of the HP-2401C. AC Normal, AC Fast, or resistance measurements programmed through a HP-2410B AC/Ohms Converter introduce up to 550, 220, or 110 milliseconds additional delay.

2.6.6 Programmed Control of Extended Sample Periods

Program periods longer than 1 second as follows:

- a. Enable extended sample period programming by connecting pin a of J1 to pin Z.
- b. Start the sample period by connecting pin b of J1 from pin Z.
- c. Stop the sample period by disconnecting pin b of J1 from pin Z.
- d. Reset the HP-2401C as specified in Section 2.6.4 before initiating the next measurement.

Repeat steps a, b, and c of this procedure for each measurement involving an extended sample period. When extended sample period programming is no longer desired, disconnect pin a of J1 from pin Z and program the correct pin for the desired fixed sample period (.01, .1, or 1 second).

NOTEA: Alternatively, sample periods may be started by a relatively positive potential (-1 to +5 volts) and stopped by a negative potential (-5 to -30 volts) applied through J1 pin b across $4K\Omega$.

NOTE B: The counting process can be displayed during programmed extended sample periods only be setting the STORE 'DISPLAY switch to DISPLAY position.

2.6.7 Programming Through HP-2410B or HP-2411A

When using HP-2410B or HP-2411A accessory instrument with the voltmeter, programming must be connected to the accessory instrument. See the applicable handbook for details. This is necessary for correct operation of the HP-2401C logic circuits, particularly the display and decimal point logic. The programming functions applied to the accessory instrument are routed through it to the HP-2401C via the same programming output cable that is used when making manually controlled measurements per Section 2.5.3 or 2.5.4.

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Table 2-4. BCD Output Connector (J2)

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Connector Type: 57-40500 Mating Connector: 57-30500 HP-662A J2 PIN ASSIGNMENTS Column **BCD Weighting** Source (Columna Of 4-Line Outputs " in Run 8,7,6, 2 21 1 4 Signals and Levels HP-2401C 5, 4, 3, 2, 1) 1* 2* 4+ 8* Decimal 10⁻ⁿ Multiplier 1 2 1 26 27 A22 (7, 10, 9, 5)Data 10[°] Digit 4\$ 29 3 28 **A1**1 (7, 5, H, 4) Data 10¹ Digit 3 5 30 31 A12 (7, 5, Ӊ, 4) Data 10² Digit 76 18 32 33 4 A13 (7, 5, H, 4) Ì0 Data 10³ Digit 5 9 34 35 A14 (7, 5, H, 4) Data 10⁴ Digit 12 6 36 37. A15 11 (7, 5, H, 4) Data 10⁵ Digit 13 7 14 38 39 A46 (7, 5, H, 4) Function 16 40 41 A22 8 15 (19, 20, 21, 16) For all of above: "0" = -35 to -24V "1" \simeq -5 to -1V (1-Line Signals) Ground Chassis 50 +Ref. (-5 to -4V) A7 (4) 25 -Ref. (-24.5 to -21.5V) A7 (6) 24 +Record Command A17 (7) 23 During Measurement: -35 to -24V During Display: -5 to -1V -Record Command A17 (11) 21 Levels same as +Record, but inverted. +Hold (+1 to +12V)** A17 (9) 22 Scan Signal from Recorder To J1 (m) 49_ See Printer handbook for levels. 1

* Coding of outputs from HP-2401C-21 or 35; "0" and "1" state levels from HP-2401C-35 are reversed: "0" = -5 to -1v and "1" = -35 to -24v.

**Non-hold state is -1 to -35v.

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Function	J2 Pins Coding	15 1	16 2	40 2'	41 4	HP 562AR Std.	Printwheels 4610
Period W/ Option 30) +VDC -VDC KC KΩ (W/HP-2410B) MΩ (W/HP-2410B) Spare Spare Time Overload	, ,	0 1 0 1 0 1 0 1 0 1	0 0 1 1 1 1 0 0 1 1 1 0 0 1 1 1 0 0 1 1 1 1 1 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 1 1 1 1 1 1	0 0 0 0 0 1 1 1 1 1	0 1 2 3 4 5 6 7 8 9	P + - F K M -> - T Q
VAC (W/HP-2410B)	l .	0 1	0	0 0	- 1 \	B	lank A

Table 2-5. Function Codes

2.6.8 Overload Resetting

Any overload condition occurring on a previous measurement is reset automatically by resetting the counters per Section 2.6.4. It is also possible to reset an overload condition without resetting the counters. This is accomplished by connecting pin d of J1 to pin Z temporarily.

2.7 **RECORDING OUTPUTS**

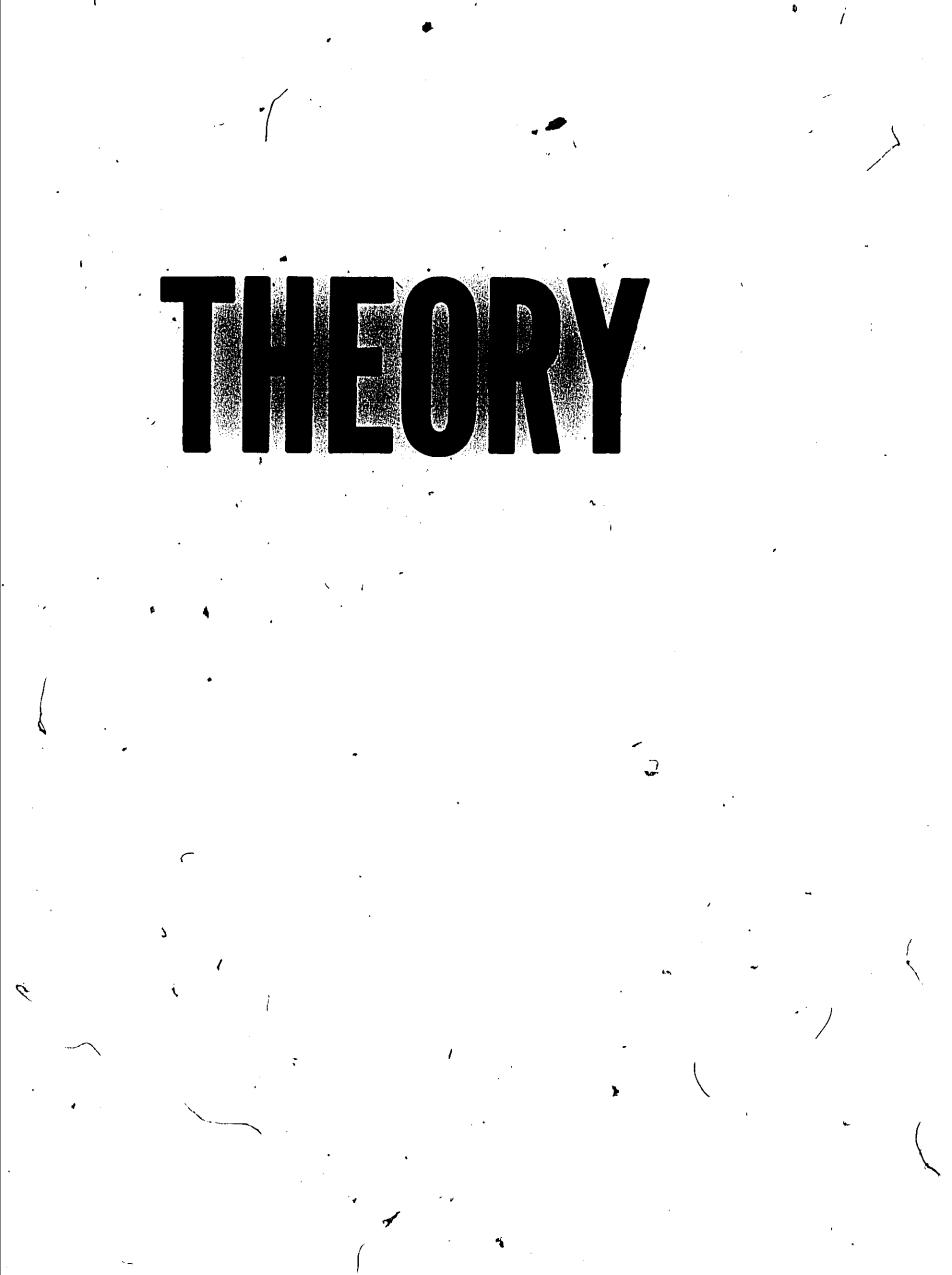
BCD voltages (ground referenced) are produced for each measured digit and for indication of measurement function (+VDC, -VDC,KC, etc.) and decimal point. These bcd outputs are available at the BCD OUTPUT connector, J2. Pin assignments of J2 are outlined in Tables 2-4 and 2-5.

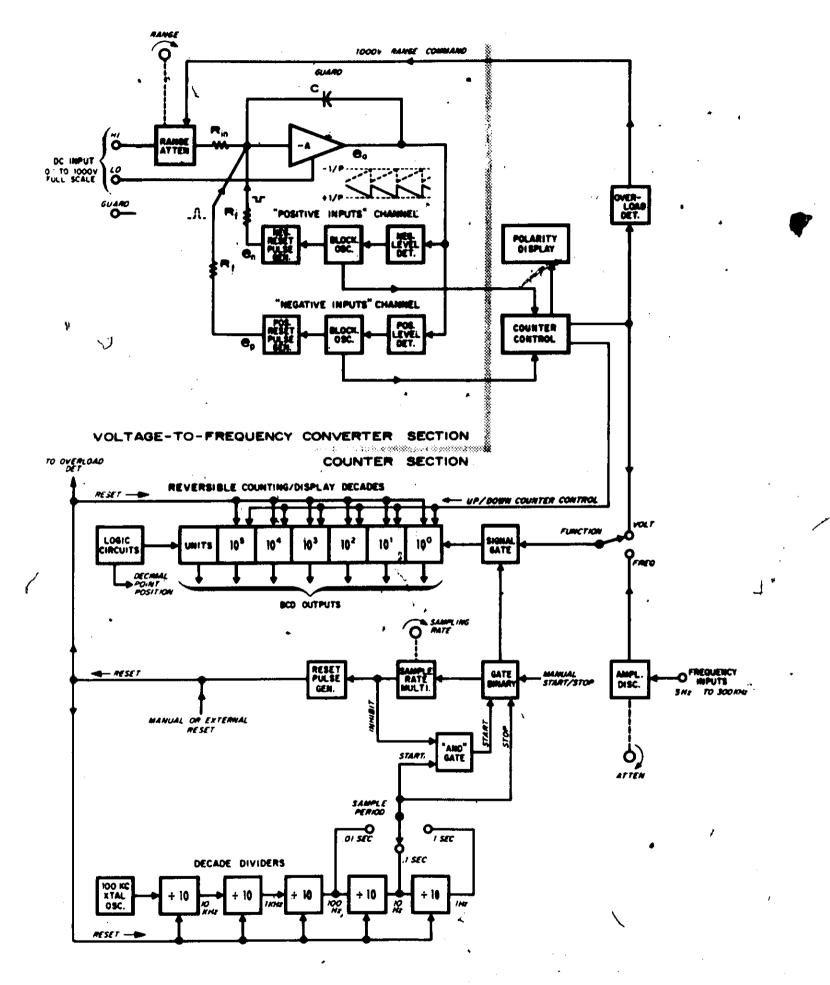
Also given in Table 2-4 are the bcd output weighting and levels, record command output, and bcd reference voltages. A hold command may be applied to J2 pin 22 to inhibit the voltmeter from initiating a new measurement until the recording device has completed its/cycle or has stored the data. The hold should be used only when the SAMPLING RATE control is used to initiate measurements at an unsynchronized rate. A reset command will reset the DCU's but a new measurement is not initiated until any hold-off command is removed. A voltage to J2 pin 22 that is between +1 and +12 volts (maximum load 4.5 milliamperes) inhibits the counter section of the voltmeter. A voltage to J2 pin 22 that is between -1 and -35 volts enables the counter section of the voltmeter.

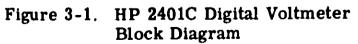
The scan signal and hold command from the recording device are also routed to PROGRAM CONTROL connector J1/for systems use.

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SECTION III CONTENTS

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THEORY OF OPERATION

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SECTION III THEORY OF OPERATION

3.1 GENERAL

The functional elements of the HP-2401C Integrating Digital Voltmeter are illustrated in Figure 3-1. As indicated, the HP-2401C consists principally of a voltage-to-frequency converter (vfc) and a counter. The vfc includes an input attenuator and integrating and pulse forming circuits. The vfc output is applied to the counter section and an overload detector via a counter control circuit. The counter includes a precision time base generator, decade dividers, control logic circuits, and six reversible counting and display decades.

3.1.1 Voltage Measurement

Voltage to be measured is applied via the HI-LO input ferminals to the programmable input attenuator, which provides precisely calibrated attenuations for full-scale ranges of 0.1, 1, 10, 100, and 1000 volts. The GUARD terminal is provided for connecting the vfc chassis to the low side of the voltage source. Thus connected, the guard shields the input to the vfc, attenuating common-mode noise.

The output from the attenuator, is transformed by the vic to a proportional pulse rate. The integrating amplifier (-A in Figure 3-1)generates a charging current for C whose value is directly proportional to the input voltage. This current charges capacitor C to a negative or positive voltage that is inverted with respect to the voltage being measured. At a specified level, the voltage across C triggers the negative or positive inputs channel. The, pulse from the triggered channel opposes the original amplifier input, discharging capacitor C. At the end of this pulse, the amplifier output cur-rent recharges capacitor C to a level that triggers one of the inputs channels. The average pulse rate thus generated is directly proportional to the average input voltage. The vic output pulses are coupled through the couner control circuit and the gignal gate to the counting/display decades when the FUNCTION switch is set to VOLT. The average vfc output rate is 100, kHz for a full-scale input. Although vfc output pulses are generated continually while an input voltage is connected to the HP-2401C, they are counted only during sample periods.

The counter control circuit receives the pulses from the positive or negative inputs channel and provides output pulses for triggering the counting/ display decades in the counter section. These pulses are also applied to an overload detector. In addition, the counter control circuit provides up/ down count commands to the counting/display decades and a polarity signal that lights the + or -polarity indicator of the digital display during dc voltage measurement.

During each sample period, the counting/display decades count the pulse output from the counter control circuit when the signal gate is opened and

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the FUNCTION switch is set to VOLT. The decades count up during the entire sample period if the input polarity does not change. If the input polarity changes, the counter control circuit changes its count up command to a count down command. The decades then count down toward zero. If zero is reached during down counting, the counter control circuit changes its count down command to a count up command. At the same time the polarity display is switched. At the end of the sample period, the digital display reads out the algebraic average of the applied input voltage, tagged with the correct polarity.

The overload detector always receives a pulse train output from the counter control circuit. If the pulse rate exceeds 310kHs (310% of full scale) at any time, the overload detector turns on an OVERLOAD indication on the digital display and switches the programmable attenuator to its highest range (1000V). The overload detector is reset at the start of each new sample period.

3.1.2 Frequency Measurement

A signal whose frequency is to be measured is applied to the counter gate circuits via an amplitude discriminator. The amplitude discriminator consists of an amplifier and a Schmitt Trigger. The amplitude of the amplifier output signal is set by the front panel ATTENUATION control. The Schmitt circuit shapes the amplifier output to provide a fast-rise, constantamplitude signal for driving the 10° counting/display decade. During the sample period this signal is applied to the 10° decade through the signal gate if the FUNCTION switch is set to FREQ. Refer to Section 2.5.5 for special pulse measurement requirements.

3.1.3 Sample/Display Period Control

The sample period of the HP-2401C for voltage or frequency measurements is normally controlled by an output from the time base dividers. However, sample period can also be controlled manually to start and stop counting to provide any desired interval.

The time base dividers divide the 100 kHz signal from the crystal-controlled reference oscillator by factors of 10. This produces accurate sample periods of 0.01, 0.1, and 1 second. The output from the divider that produces the selected sample period is coupled to an AND gate. When this signal is present and no inhibit is applied from the sample rate multivibrator, the gate binary flips. This opens the signal gate and allows voltage or frequency pulses to be counted. The inhibit from the sample rate multivibrator is removed at the end of the display interval. The duration of the inhibit is set by the SAMPLING RATE control on the front panel.

The pulses from the signal gate are counted during the selected sample per-' iod. This period is ended by a trigger (from one of the decade dividers) that flips the gate binary, closing the signal gate and stopping the count.

The transition of the gate binary to count inhibit state triggers the sample rate multivibrator, starting the display interval. During this interval no



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new count can be started. At the end of this interval the reset generator is triggered, which causes the counting/display and divider decades to be reset. Then, after a small delay that is provided to allow circuits to stabilize, a signal from the appropriate divider decade initiates a new sample period.

3.1.4 Display Units and Decimal Control

The units readout to the left of the six-digit decimal display indicates the units being measured (e.g., VOLTS or KC). This readout position is controlled via logic networks in response to control settings or programming. These logic circuits interpret the various measurement control inputs and cause the appropriate units to be indicated on the units display. The logic circuits also interpret the control settings to determine the correct position for the docimal point indication. This assures that the display will be direct reading in the units indicated.

VOLTAGE-TO-FREQUENCY CONVERTER (A28, A31-A33)

NOTE

Unless otherwise stated, incomplete designations (C25, V1, Q8, etc.) which appear in the following discussions (Sections 3.2.1 through 3.18.3) pertain to components of the circuit assembly being described.

3.2.1 Programmable Attenuator A20 (Figure 4-29)

Programmable attenuator assembly A28 standardizes the current (1 microampere full scale) that is applied to summing point P30 of integrating amplifter A31. Thus, the vfc output with 1000 volt input on the 1000 volt range is the same as with 100 millivolt input on the .1 volt range.

Attenuation (voltage range of the HP-2401C) is controlled by relays K1 to K5 as summarized in the RANGE switch table in Figure 4-29. These relays are controlled by the RANGE switch when the FUNCTION switch is set to VOLT, or by programming when the FUNCTION switch is set to EXT SEL position. Range control is routed through attenuator coupling logic assembly A8 (discussed in Section 1.5.1).

3.2.2 Integrating Amplifier A31 (Figures 3-2, 4-29, and 4-30)

System Operation

Integrating amplifier A31 charges capacitor C25 positively or negatively at a rate that is proportional to the input current applied to its summing point, P30. This develops an output potential that is continually applied to negative and positive trigger level detectors A32 and A33. At 0.1 volt, this potential triggers one of the detectors. The polarity and which detector is triggered

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are determined by the polarity of the input voltage being measured. For example, negative input voltage causes a positive-going potential that triggers negative trigger level detector A32 at +0.1 volt.

The triggering of A32 or A33 produces a constant area pulse that causes a pulsed current flow to the summing point which is greater than the input cunrent. Amplified by A31, this current partly discharges C25. At the end of each such pulse, the input current to the amplifier again causes charging of C25 to the trigger potential. The design of the vfc is such that the average of the pulsed discharge currents is equal to the input current and proportional to the voltage being measured. Thus, the pulse rate is proportional to input voltage.

Integrating amplifier A31 consists of an operational amplifier with feedback coupled through C25. The gain of the operational amplifier is so high $(-10^7 \text{ to } -10^8)$ that the feedback (C25) and input (R_{in}) impedances determine operation.

When a dc voltage is connected to the input of the HP-2401C, a small current, proportional to the magnitude of the input, flows through R_{in} to the amplifier. The inverted and greatly amplified output from the amplifier is fed back through C25 as an opposing current. The result is an extremely high integrating amplifier input impedance. Since the currents at the summing point very nearly cancel, the summing point voltage is virtually zero. Thus, the voltage at the amplifier output is that which is developed across C25 as it is charged by the feedback current. This voltage is directly proportional to the integral of the input current. The mathematical expression for the relationship shows that for a step input voltage (e_{in}) the amplifier output (e_0) increases linearly at a rate that is determined by the constant factors R and C, as follows:

 $e_0 = \frac{-1}{C}$ $i_{in} dt = \frac{-1}{RC}$ $e_{in} dt$

This expression is true for both the measurement input and the reset input to the summing point. The result is the balancing of input current by pulsed reset current, as discussed in the second paragraph under Section 3.2.2.

Internal Functions

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The functional elements of integrating amplifier A31 are shown in Figure 3-2. These include a chopper amplifier, a wideband amplifier, the integration feedback circuit, and a non-linear feedback network. The circuit diagram is Figure 4-30.

<u>Chopper Amplifier</u> -- The chopper amplifier amplifies dc and low frequency signals, after their conversion to ac by a photochopper. Because only ac is amplified, the chopper amplifier introduces no dc drift into the amplifying system. DC drift error caused by the wideband amplifier is divided by 10⁴, the effective dc gain of the chopper amplifier. The resulting drift is so small that it has no effect upon the accuracy of the digital readout.

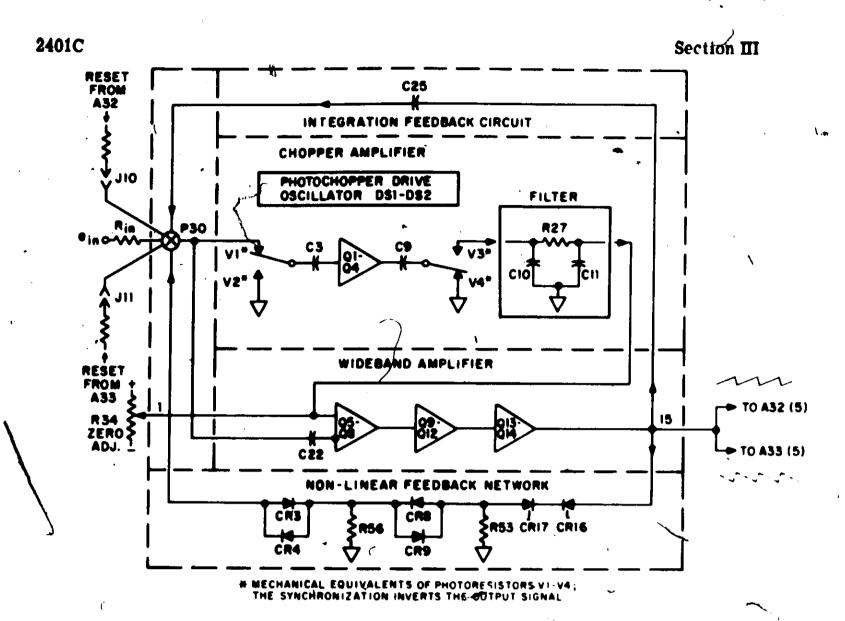


Figure 3-2. Integrating Operational Amplifier A31, Functional Diagram

The chopper amplifier input and output are modulated and de-modulated synchronously by solid-state photoresistors V1-V4 which are driven by flashes of light from the neon bulbs of a relaxation oscillator. The oscillator frequency is set by the DRIVE OSC ADJ resistor to be 240 Hz with power line voltage at 102 or 204 vac. The photochopper mechanical equivalent is shown in Figure 3-2. After filtering, the pulsed signal from demolpulating photoresistors V3 and V4 is a smooth, amplified and inverted replica of the dc and low frequency components of the signal at the summing point. The output is coupled directly to one input of the wideband amplifier. The chopper amplifier output is prevented from exceeding ± 0.5 yolts by CR6 and CR7.

Wideband Amplifier -- The wideband amplifier amplifies do and low frequency signal components from the chopper amplifier and high frequency signal components coupled through C22. The high frequency signal components are connected to the inverting input of differential input stage Q5-Q8. The output from Q8 is amplified without further inversion by Q9-Q12. Complementary push-pull emitter followers Q13 and Q14 form a fow-impedance, singleended output stage that has practically equal output impedance for either output polarity. The output current charges C25 to the trigger level of A32 or A33.

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Gain and response of the wideband amplifier are shaped by negative feedback from Q10 to Q9 and from Q13-Q14 to Q11. A filter network in the Q9 base circuit completes the shaping of response. Overall, the wideband amplifier amplifies input signals from dc to about 1 megacycle, with a 6 db/octave rolloff of signal gain at frequencies above 100 Hz.

Potentiometer R34, the front panel ZERO adjustment, is set to make zero input current produce zero output current from the integrating amplifier. It cancels fixed dc offset voltages existing within the integrating amplifier by applying a stable equivalent voltage of oppositve polarity to the wideband amplifier dc input (the base of Q5).

<u>Non-Linear Feedback Network</u> -- Protection of the amplifier from severe short-term overloading is provided by a non-linear feedback network whose principal elements are voltage breakdown diodes CR16 and CR17. Whenever the amplifier output voltage exceeds the breakdown potential of CR16 or CR-17, these diodes conduct a negative feedback current that prevents saturation of the amplifier, which could cause excessive recovery time.

3.2.3 Trigger Level Detectors A32 and A33 (Figure 4-29)

A32 and A33 are voltage-sensitive pulse generators. These detectors are essentially identical, except that one responds to negative voltage and the other to positive voltage. Either of these pulse generators provides a constant voltage-time area pulse of a polarity opposite to the polarity of the input signal.

Operation of detector A33 is typical. When a positive voltage is being measured, the potential from the output of A31 increases negatively until it reaches the -0.1 volt trigger level of A33. The trigger level is set by potentiometer R27. At the trigger level, blocking oscillator Q3 is triggered through emitter follower Q6, non-inverting amplifier Q5, and emitter follower Q4. The output from Q3 is a sharp pulse that triggers binary Q1-Q2. This pulse is also transformer-coupled through the guard shield to the counter control circuit on A16.

The pulse from the blocking oscillator triggers a change of binary state, causing reversal of current in the primary of a special saturating-core transformer, T1. This produces a pulse in the secondary, which is connected for full-wave rectification. A diode within transformer T1 polarizes the output pulse. Because of the precisely controlled saturation characteristics of the T1 core, the output pulse has constant volt-time area. The output pulse is applied to summing point P30 through a resistor network. Through integrating amplifier A31 this resets the potential across C25 to a level that is below the trigger level.

If the input voltage is still present, the amplifier output continues to move toward the trigger level. Each time the trigger level is reached another reset pulse is generated, tending to keep the amplifier output constant near the trigger level, as shown in Figure 3-3.

Over any given interval the sum of the areas of the reset pulses is equal to the total integral of the input signal. By counting the number of suchン

pulses generated during the sample period a direct measurement of the average input voltage is obtained. For example, if each reset pulse has an area of 10 microvolt-seconds (i.e., 10 volt amplitude and 1 microsecond duration), one volt at the input will produce 100,000 output pulses per second (100,000 \times 10 microvolt-seconds = 1 volt-second).

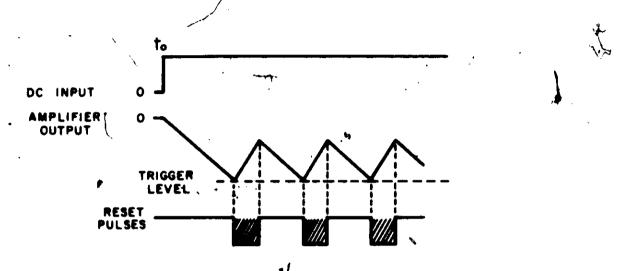


Figure 3-3. VF Converter Waveforms

3.3 COUNTER CONTROL A16 (FIGURES 4-7, 4-8 AND 4-18)

The logic on A16 generates the count direction commands for reversible decade counters A11-15 and 46 and provides the signals that light the correct polarity indicator and produce the correct BCD function output. This logic also generates delayed counter trigger pulses and undelayed rate output pulses for the overload detector, A10.

3.3.1 Derivation of Count Direction Commands

The count direction commands are derived from the positive and negative channel pulse outputs of the voltage-to-frequency converter (vfc), and the state of the zero detect line from the reversible decades. The control state memories for this logic are input polarity flip-flop Q3-4 and count polarity flip-flop Q7-8. Basically, the count up command is produced when both flip-flops are in the same state (i. e., both in positive state or both in negative state). The count down command is produced when the flip-flops are in different states (i. e., Q3-4 in positive state and Q7-8 in negative state, or vice versa).

States of the Polarity Flip-Flops

The positive state of 23-4 is Q3 off, with its collector near -35 volts, and Q4 on, with its collector near ground. The positive state of Q7-8 is Q7 off, with its collector near -35 volts, and Q8 on, with its collector near ground. The negative states of both flip-flops are the reverse of the positive states.

The Count Up Command

The count up command consists of two outputs from A16. One of these out-

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puts is an inhibit from the count down (not down) logic line. The positive state of the count down logic line closes the down count AND gates on the reversible decade counters. The other output is the negative state of the up (not up) logic line that lets the up count AND gates on the reversible decade counters remain open.

Derivation of the Count Up Command

When both flip-flops are in the same state, the negative outputs from Q3 and Q7 or from Q4 and Q8 produce a negative output from AND gate CR9-10 or from AND gate CR7-8. Either negative output is coupled through OR gate CR11-12, and AND gates CR13 and R35-36 to logic inverter Q9. The positive output from Q9 cuts off the count up logic inverter, Q13-14, which leaves the count up line negative. The positive output from Q9 is inverted and re-inverted by Q10 and Q11-12, which makes the count down line positive, inhibiting down counting as mentioned previously.

The Count Down Command

The count down command is the complement of the count up command. The positive inhibit is applied to the reversible decades along the count up logic line, closing the up count AND gates. The negative state of the count down-logic line lets the down count AND gates on the reversible decades remain open.

Derivation of the Count Down Command

When flip-flops Q3-4 and Q7-8 are in different states, the negative output from Q3 is accompanied by a positive output from Q7, or vice versa, and the negative output from Q8 is accompanied by a positive output from Q4, or vice versa. Neither AND gate CR9-10 nor CR7-8 couples a negative output to OR gate CR11-12. The output of OR gate CR11-12) to logic inverter Q9 is positive. The negative output from Q9 is inverted by the count up logic inverter Q13-14, which applies a positive inhibit to the up count AND gates of the reversible decades via the up logic line. The negative output from Q9, inverted and re-inverted by Q10 and Q11-12 produces a negative down output that leaves the down count AND gates on the reversible decades open.

Typical Operating Sequence

When the first pulse during a sample period is from the positive channel, the output from Q1 triggers Q3-4 to positive state. Because the decades are all in the zero state, the negative output from zero detect emitter follower Q22 and the negative output from Q3 sets count polarity binary Q7-8 to the identical (positive) state by turning on Q8. Turn-on of Q8 cuts off Q7, which sets the +signal line positive and lights the +polarity indicator lamp through AND gate Q6. With both flip-flops in positive state, the A16 logic commands up counting as described previously.

If input voltage polarity crosses zero and becomes negative during the sample period, the first pulse from the negative channel triggers Q3-4 to negative state (Q3 on and Q4 off). Because the count is not zero, the count polarity binary remains in the positive state. The A16 logic now commands

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down counting because the flip-flops are in different states. Down counting continues wintil the sample period ends or until a zero count is reached.

If the decades all reach a count of zero, the detection of zero, coupled through Q22, opens the count polarity binary input AND gates to the negative input from Q4. The negative output from AND gate CR3-R10 sets Q7-8 to the same (negative) state as Q3-4, by turning on Q7. This reverses the signals applied to the polarity signal lines and indicator lamps and switches the A16 logic so that up counting is commanded. The decades now accumulate an increasing count that is identified as negative.

3.3.2 Overlead Output

OR gate CR15, 33 couples positive or negative channel pulses from Q1 or Q2 to overload detector A10 through pin 1 of A16.

3.3.3 Counter Output

OR gate CR26-27 couples positive or negative channel pulses from Q1 or Q2 to one-shot Q18-19. Each positive pulse from OR gate CR26-27 cuts off Q18, triggering the one-shot to its unstable state. The negative pulse from the Q18 collector is coupled through emitter follower Q20, logic assembly A19, and a differentiating circuit to the trigger input of reversible counter decade A11. The differentiated, positive-going trailing edge of the Q18 output pulse triggers decade A11 after a 1.5 microseconds delay.

Whenever zero is detected or input polarity changes, the delay of the counter trigger is extended to assure triggering after all circuit logic changes have occurred and settled. Delay is extended by reducing the turn-on bias that is applied to the base of Q18. This increases the time that Q18 remains cut off. When the Q22 and Q18 collectors are both negative Q25 is turned on through a resistance-capacitance (r-c) delay circuit. Conduction through Q25 reduces the bias voltage that is applied to Q18. As determined by the r-c delay, conduction through Q25 decreases exponentially at a rate that permits turn of Q18 after it has been off for about 6 microseconds. Similar r-c circuits turn on Q17 when input polarity flip-flop Q3-4 changes states. The conduction through Q17 that is timed by these circuits extends cutoff time of Q18 to about 9 microseconds.

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During display periods, the zero detect logic is disabled by a ground input from A17Q8 to pin F, which closes the zero detect AND gate. During the sample period this inhibit is removed, opening the gate to the negative zero detect input from counting/display decades A11-A15 and A46. The input from these decades is negative only when all binaries are in the zero state. The negative zero detect input is coupled through Q22 to the count polarity input AND gates and the 6 microsecond delay AND gate. The disabling of the zero detect output from Q22 prevents the count polarity binary from changing states until the next measurement period.

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The state of count polarity flip-flop Q7-8 is coupled through AND gates Q5 and Q6 to the ⁺ and - lamp and signal lines (pins 7, H, and J). The positive state of Q7-8 (Q7 off, Q8 on) opens Q6, setting the + lamp and signal lines positive (near ground). The negative state of Q7-8 (Q7 on, Q8 off) opens Q5, setting the -lamp and signal lines positive. The polarity indication is inhibited by cutoff of polarity blanking amplifier Q24 when FREQ, AC, or Ω (ohms) measurement function is selected, clamping in P of A16 to ground.

3.4 OVERLOAD DETECTOR A10 (FIGURES 4-7, 4-15 AND 4-16)

The pulse train output from the vfc is coupled through counter control assembly A16 to overload detector A10, pin 1. When the pulse rate exceeds approximately 310 kHz (310% of full scale), the overload detector generates an overload signal, causing:

An OVERLOAD indication on units indicator display A24;

Input attenuator switchover to 1000 volt range by energizing (relay K5 and de-energizing previously energized range programming relays;

An overload signal to J1, pin e for switching the HP-2410B to 1000 volt range and to printer coupling card A22 for recording.

3.4.1 Overload Signal Memory

For serial prefix 610- and above flip-flop Q3-Q4 serves as the overload signal memory (see figure 4-15). Each negative reset pulse, inverted by Q1, resets Q3-Q4 to overload not state by cutting off Q4. Because Q3 is conducting, the overload not state cuts off overload signal driver Q5. When the output rate from the vfc exceeds the overload threshold (which can range from 305 to 320 kHz), a positive pulse from the Q2 collector cuts off Q3, setting Q3-Q4 to overload state. With Q3 cut off in overload-state, -35 volts turns on overload signal driver Q5 through R20 and R25. Conduction through Q5 clamps the overload line to ground, dausing all of the actions noted in Section 3.4.

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For serial prefix 501- through 605-, the overload signal memory is 4-layer diode CR6 (see figure 4-16). CR6 is turned on by a positivegoing pulse coupled to its anode from the collector of Q1. Once it is turned on, CR6 continues conducting, clamping the overload logic line to ground (true) until its holding current is interrupted. CR6 is cut off and the overload indication is reset when a positive pulse is applied to the CR6, cathode through C7 and R13. The positive pulse is produced by grounding J1 (d) through an external contact closure. The negative-going reset pulse, which turns on Q2, produces the same effect as grounding J1 (d). The reset pulse is generated by assembly A18 or A7 as described in Sections 3.6.4 and 3.17.1.

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3.4.2 Overload Detection

For serial prefix 610- and above, the overload detector is a blocking oscillator whose feedback is switched from negative to positive by the voltage output from a frequency-to-voltage converter (fvc). The threshold at which feedback switches from negative to positive is set by means of variable resistor R3 at approximately 310 kHz; the permissible range for this threshold is 305 to 320 kHz.

When the input voltage to the Voltmeter is increased, the vfc output frequency increases. As the vfc frequency increases, current through fvc diode CR2 reduces the negative charge across C5. At input frequencies below the threshold, the voltage at the cathode of CR3 is more negative than the voltage at the cathode of CR4. Because of this, the only feedback path from the collector to the base of blocking oscillator Q2 is negative, through windings 3 and 1 of T1. At the threshold frequency, the charge across C5 makes the voltage at the CR3 cathode less negative than the voltage at the CR4 cathode. Now the feedback path from the Q2 collector to base is regenerative, through windings 3 and 2 of T1. Noise initiates the blocking oscillator action of Q2, which generates trigger pulses for the overload detector memory.

So long as the overload condition keeps the cathode of CR3 less negative than the cathode of CR4, the blocking oscillator pulses will continue to trigger the overload signal memory. This action is repeated at a rate that is determined by the time constant of R5 and C4, assuring that the switching of the attenuator to 1000 volt range is not delayed by reset. Usually only a few pulses are generated before the attenuator is switched to the 1000 volt range, removing the overload.

For serial prefix 501- through 605-, the positive overload memory trigger pulse from the collector of Q1 is developed when current flows through the No. 2 winding of transformer T1. If the vfc is not overloaded, current flows only through the No. 1 winding of

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The conditions which determine when the current switches from wind-T1. ing No., 1 to winding No. 2 are the voltage levels existing at the cathodes of CR3 and CR4. The voltage at the onthode of CR4 is so to about -25 volte by potentiometer RS. The voltage at the cathode of CR3, is determined by the frequency of the pulses arriving at pin 1. These pulses, acupted through C1 and CR2, apply a positive charge across C10. Between pulses Cill charges negatively. The voltage auross Cill thus depends upon the pulse froquendy, For pulse frequencies less than 310 ke the voltage morous C10 is such that the cathode of CR3 is more negative than the cathode of CR4 and current flows from ground, through R5, and, winding No. 1. Random thermal noise voltages developed across R5 as a result of the current flow are coupled to amplifier Q1. The output of amplifier Q1 is transformer coupled back to winding No. 1. Because of the phase relation between the primary and secondary winding No. 1, the feedback voltage is out of phase with the input, resulting in cancellation of the noise voltage.

If the input pulse frequendy reaches or exceeds \$10 kHz, the voltage across C10 rises to a level that makes the cathode of CR3 more positive than the cathode of CR4. At this point the current switches from winding No. 1 to winding No. 2. We rangen noise voltage developed across R5 is now amplifted and inverted by QI and coupled back to winding No. 2. The feedback from the primary to secondary winding No. 2 is in phase with the amplifier Regeneration quickly saturates the amplifier, generating a positive input, pulse large enough to trigger conduction of 4-layer diode CRS. The regenerative action also increases current to the point where the transformer core saturates and no longer privides the coupling action. This stops the engenerative detion. Amplifier conduction then decreases, returning to the previous unsaturated condition. After a time-delay that is essentially determined by the time constant of R5 and C2, the comparison circuit is ready This action continues as long as the overload, producing to cyclo again. a train of positive-going pulses from the collector of Q1. Although only one pulse is required to turn on the 4-layer diode, the series of pulses prevents removal of the overload indication by resetting until the overload condition has been corrected. Usually only a few-pulses are generated before the attenuator is switched to the 1000 volt range.

3.5 ATTENUATOR COUPLING LOGIC AS AND IV RELAY TIMING AND

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Attenuator Coupling Logic A8 (Figure 4-13)

The attenuator coupling logic controls range programming relays K1 through K4 of attenuator assembly A28. During normal manual operation, the RANGE switch provides a ground connection through the FUNCTION switch to the in-¹ put logic line for the desired range. During external programming, the ground connection must be provided at the correct pin of PROGRAM CONNECTOR J1, from which it is routed through an EXT SEL contact of the FUNCTION switch to the input logic line. For example, a ground connection to pin 12 of A8 programs the 100 volt range. Coupled through diode GR5, this causes transistor Q8 to conduct, energizing 100 volt range relay K4, provided that no overlead condition exists and that no ac or ohms measurement using a HP-2410B is being made. This example is typical of operation of the other

2401C

The detection of an overload by the circuit on A10 causes pins 2 and 13 of A8 to be grounded. The grounding of pin 15 energizes 1000 volt range relay K4. The grounding of pin 2, amplified by Q3 and Q4 and connected through diedes to the bases of gating transistors Q5, Q5, Q7, and Q8, cuts off current to range programming relays K1 through 166, Causing them to de-energize.

When a HP-2410B is used with the HP-2401C for ac or ohms measurements, a ground is connected to pin 4 of A8 from the HP-2410B units coupling card, A9. This signal is used to turn on Q6, energizing the 1 volt range relay K2. Amplifted by Q1 and Q2, this signal disables the other range gating transistors.

3.5.2 1 Volt Roley Timing A47 (Figures 4-13 and 4-29)"

The 1 volt rolay timing circuit on A47 times the energizing and de-energizing of IV range rolay K2 on A28 so that it and 1000 V range relay K5 are never energlood at the same time. If K2 and K5 were energized at the same time, up to 1000 volts could be applied across attenuator resistor R42. For a brief period R42 would dissipate 100 watts, suggaining gamage proportional to the duration of the overload.

When K2 is not programmed, conduction through Q1 discharges capacitor C1. When K2 is programmed, C2 initially presents a low impedance path while it charges. The long time constant charging of C2 holds K2 de-energized until all other relays, including K5, have had time to de-energize.

When the attenuator is switched from 1v to 1000y range, programming of relay K2 is interrupted? The energy stored in the coil of K2 discharges across capes itor C1 and resistor R1 and relay K2 de-energizes. The energizing of K5 is delayed, by capacitor C102 (across the K5 coil) until K2 has de-energized. At the same time, capacitor C2 of A47 is disconnected from the K2 relay soli by the reversal of voltage polarities across diode CR1. It is dischargeed by Q1 and thus has no effect upon de-energize timing of K2.

3.6

GATE CONTROL A17 AND DISPLAY CONTROL A18 (Figures 4-7 and 4-19)

Gate and display control assemblies A17 and A18 operate together to control the gating of voltage or frequency measurement pulses to input counter decade A11. They also control the display period and the transfer of each new measurement to the digital displays of the decade counters. These functions are performed as directed by the settings of the SAMPLE PERIOD switch and the SAMPLING RATE control.

3.6.1 Measurement Phase

The measurément/display cycle of the HP-2401C is illustrated in Figure 4-28. The measurement phase (sample period) of this cycle begins when

the decade divider output selected by the SAMPLE PERIOD switch is applied to start/stop input pin/4 of gate control assembly A17 via logic assembly A21. The positive-going part of the decade divider signal cuts off A17Q1 of gate flip-flop A17Q1-Q2. This upons a clamp to -1 volt that normally inhibits triggering of the first decade counter, A11. The next positive-going socursion of the time base input signal cuts off A17Q2, turning on A17Q1, blanking counter input triggers applied to A11 pin 10, and terminating the sample period.

3.6.2 Transfer to Digital Display

The positive-going voltage from the A17Q1 collector at the end of the sample period cuts off A18Q2 of transfer one-shot A18Q1-Q2. The one-shot remains in this unstable state (A18Q2 off, A18Q1 on) for about 70 milliseconds. During this period, storage gate amplifier A18Q3 is cut off, allowing the count of the decade binaries to be transferred to the display storage circuits. At the end of this period conduction through A18Q2 turns on storage gate amplifier A18Q3, which holds the new count until the next transfer pulse is triggered.

The previously-described transfer mechanism is effective only when STORE/ DISPLAY switch S7 is in STORE position. When S7 is in DISPLAY position A18Q3 is disconnected and the states of the decade counter binaries are displayed at all times, not just after transfer.

3.6.3 Variation Duration Display Phase

The negative transfer pulse from the A16Q2 collector turns on A18Q4, cutting off A18Q5 of the display timing flip-flop. (Flip-flop A18Q4-Q5 is acfually a one-shot whenever the SAMPLING RATE control is not switched to STOP position.) Duration of this unstable state, determined by the time constant of A18C8 and the setting of SAMPLING RATE potentiometer R204, may range from 0.2/ to 7 seconds. Conduction through A18Q4 inhibits start AND gate A17C1-R3 of gate flip-flop A17Q1-Q2, by cutting off A18CR7 and A17Q4., This prevents the start of a measurement during the display period.

An external clamp to ground from a digital recorder, programmer, or other digital data processing device may be applied to J2 (22) to hold the display and recording outputs longer than the normal period. This clamp, coupled through A17CR9 to pin 10 of A18, holds A18Q5 off until it is removed.

3.6.4 Resetting

The negative-going trailing edge of the signal from the A18Q4 collector triggers a negative reset pulse via amplifiers A18Q6-Q7. This negative pulse resets decade dividers A1-A5, decade counters A11-A15 and A46, gate flip-flop A17Q1-Q2, and the overload signal memory on overload detector A10. After resetting, the measurement phase can be initiated as described in Section 3.6.1.

Current generator A1797 conducts additional bias to A1895 during the period between resetting and the start triggering of gate flip-flop A1791-92. This assures that A1894-95 remains in the stable "measurement enable" state until it is triggered to initiate the display period.

3.6.5 Manual Control of Measurement Phase

During manual operation, the automatic measurement/display control logic is bypassed. The starting and stopping of the measurement is controlled by the START and STOP positions of the SAMPLE PERIOD switch. The START and STOP positions both apply a clamp via the manual logic line and pin 10 that holds A18Q5 cut off, inhibiting triggering by the time base input from A21, pin 24. The positive START level cuts off A17Q1, starting the measurement. A negative level produced by switching to STOP position turns on A17Q1, stopping the measurement.

3.6.6 Reset-Triggered Measurement and Display

Switching the SAMPLING RATE control to STOP position converts A18Q4-Q5 to a flip-flop. The measurement-display cycle is then triggered by a positive-going reset pulse from the -35 volt regulator and reset card, A7. Through A18CR6 this pulse cuts off A18Q4, which turns on A18Q5, enabling the start triggering of gate flip-flop A17Q1-Q2 as described in Section 3.6.1. Transfer one-shot A18Q1-Q2 and display timing flip-flop A18Q4-Q5 are triggered as noted in Sections 3.6.2 and 3.6.3, except that A18Q4-Q5 continues to inhibit measurement until it is reset by a positive-going pulse from A7.

3.6.7 Record Signal Emitter Followers

Record signal emitter followers A17Q5 and A17Q6 couple the state of gate flip-flop A17Q1-Q2 to the digital recorder or other digital data processing device that may be connected to the BCD OUTPUT receptacle of the HP-2401C. During the sample period, A17Q5 clamps the -record command line to ground (positive true)! A17Q6 clamps the +record command line to ground during the display period, when the bcd outputs of the HP-2401C are not changing.

3.7 100KHz OSCILLATOR AND SCHMITT TRIGGER A6 (Figures 4-7 and 4-11)

The internal time base standard for the counter section is generated by a 100kHz crystal controlled oscillator. The output of the oscillator is routed to the 100 KC STD switch, S6. The INT position of S6 connects the 100 kHz escillator output to a Schmitt trigger circuit. The output of the Schmitt trigger is a 100kHz square wave that is used to trigger the first decade divider (A1). A rear-panel BNC connector, 100 KC STD OUTPUT/INPUT, (J3), is connected via the INT position of switch S6 to the output of the Schmitt trig-

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ger so that the internally generated 100kHz signal can be used externally. The EXT position of S6 connects receptacle J3 to the Schmitt trigger input. The Schmitt circuit may then be triggered by an external time base signal connected to J3.

3.8 TIME BASE DIVIDERS A1-A5 (Figures 4-7 and 4-10)

There are five identical time base dividers operating in series to divide the 100kHz time base frequency successively by ten, These dividers provide output frequencies of:

10 kHz ----- Used to check operation of the counter section.

1 kHz 100 Hz

10 Hz \rightarrow Used for the standard 0.01, 0.1, 1 second sample periods. 1 Hz

Each decade divider consists of four cascaded transistorized binaries, such that the output of the first is coupled to the input of the second, and so on. Feedback networks are arranged on the binaries to provide 4-2'-2-1 binary code weighting and input-to-output division ratio of 10:1./

At the end of each counter display period the decade dividers are reset. During normal operation, when the sampling rate is determined by variable setting of the SAMPLING RATE control (i. e. 0.2 to 7 seconds), the reset pulse from the display control circuit (A18) resets the decade dividers (A1-A5) to 97033. This means that 2967 counts (or 29.67 milliseconds) are required before the outputs of the decade dividers can start another sample period. This delay allows A18C8 (the capacitor determining the 0.2 to 7 seconds display time) to discharge before the next display period starts. In the fast sampling mode of operation, when the SAMPLING RATE control is in the STOP position and resetting from A7 is used, the decade dividers are reset to 99033. This means that 967 counts (or 9.67 milliseconds) are required before the next count can start. This small delay provides attenuator switching time and settling time for the HP-2411A Guarded Data Amplifier, if used.

3.9 ATTENUATION CONTROL, INPUT AMPLIFIER, AND TRIGGER CIRCUIT A25-A27 (Figures 4-7 and 4-27 or 4-28)

1.

When the HP-2401C is used for making direct frequency measurements, the input frequency is connected to the front or rear panel FREQ INPUT connector. It is then routed through the attenuation control circuit where the level of the input signal is adjusted by the ATTENUATION control to provide a reliable count. When the ATTENUATION control is in the CHECK position, the 10kHz frequency from the first decade divider, A1, is routed through the attenuation control circuit is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is routed through the attenuation control circuit is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is routed through the attenuation control circuit is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is routed through the attenuation control circuit is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is the trig-frequency from the first decade divider, A1, is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is coupled through the input amplifier to the trig-frequency from the first decade divider, A1, is coupled through the

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3.10 REVERSIBLE 300 KHz DECADE COUNTERS A11-A15, A46 (Figures 4-7 and 4-17)

Six identical reversible decade counting units connected in series count input pulses and display the count as a six-digit number. The positive input triggers are coupled to the first counting decade, A11, through logic on A19 and a differentiating network. Gating of the triggers is controlled by A17 as , described in Section 3.6.1.

3.10.1 Counting (

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The counting decades can count either forward or backward. The count direction is determined by the states of the count \overline{up} and count down control lines from counter control assembly A16. Regardless of count direction, the feedback between the binaries is arranged to produce a count output in $4-2^{1}-2-1$ binary-coded-decimal (bcd) form. The bcd outputs from the decades are connected to the rear panel BCD OUTPUT receptacle J2.

Up Counting

The decades always count up during frequency measurements and during the first phase of voltage measurements. Up counting is enabled when the count down line is clamped to ground and the count up line is placed near negative 35 volts by the counter control logic on A16. This closes the down count AND gates and opens the up count AND gates. Positive triggers are coupled from the collectors of odd-numbered transistors (QI, Q3, Q5, Q7) to succeeding stages. Each trigger advances the count by one. After the count reaches 9 and is then advanced to zero, the first decade generates a trigger which advances the count of the second decade is and so on through all six counting units. The waveforms associated with up counting are shown at the left of the dashed line in the Figure 4-17 waveforms diagram. The count progression is as follows:

, Count	Even-Numbered Transistors On	BCD Output Table
0	NONE	0
1	Q2	1
2	Q4	2
3	Q2, Q4	1 + 2
4	Q4, Q8	2 + 2
5	Q2, Q4, Q8	1 + 2 + 2'
6	Q8, Q6	2' + 4
7	Q2, Q8, Q6	1 + 2' + 4
8	Q4, Q8, Q6	2 + 2 + 4
9	Q2, Q4, Q8, Q6	1 + 2 + 2' + 4
10	NONE	0 + a trigger to the next decade

Down Counting

The decades are commanded by the counter control logic to count down when the polarity of the input voltage reverses. The down count continues until a zero count is detected. Down counting is enabled when the count \overline{up} line is clamped to ground and the count down line is placed near negative 35 volts by the counter control logic on A16. This opens the down count AND gates and closes the up count AND gates. Positive triggers are coupled from the collectors of even-numbered transistors (Q2, Q4, Q6, Q8) to succeeding stages. If the up count accumulated before reversal of the count commands is 10, it consists of zero states in the A11 decade, a 1 state in the A12 decade, and zero states in the remaining decades. The first down count trigger sets the A11 decade to the count of 9, which triggers the A12 decade to zero. The progression of the down count is the exact-reverse of the up count progression.

3.10.2 Zero Detection

Decade counting units A11-A15 and A46 contain an 18-input AND gate (CR9, CR10, and CR13 of each decade) whose output is a positive-true inhibit if any of the decade binaries are in other than a zero state. All binaries in a decade are in zero state when the odd-numbered transistors (Q1, Q3, Q5, Q7) are conducting. When all biparies in the counting decades are in zero state, the zero detect line is no longer clamped to ground by conduction through an even-numbered transistor (Q2, Q4, Q8) in any of the decades. During a measurement period, removal of the clamp activates the zero detect logic of A16. In response to the detection of zero, the counter control logic commands up counting by the decades.

3.10.3 Display Section

The $4-2^{+}-2-1$ bcd output from the decade binaries is connected to neon lamps that are associated with a photoconductive translator matrix. The pattern of lighted neon temps sets up a low-resistance path through the translator matrix that causes the correct humeral to light in the digital display tube. For example, a 5 count lights neon lamps DS1A, DS2A, DS3B, and DS4A. When decoded by the matrix, the lighted states of DS1A, DS3B, and DS4A light the 5 numeral in the display tube.

The position of STORE/DISPLAY switch S7 determines when each count is displayed. The DISPLAY position of S7 disconnects the store signal from the neon transfer line. This is used for continuous display of the binary states before, during, and after each count. The STORE position of S7 connects the store signal (a relatively low-impedance ground return) to the neon transfer line. The store signal is interrupted at the end of each count by a 70 millisecond transfer pulse that is generated on display control assembly A18. This interruption connects the binaries to the neon lamps. Restoration of the store signal at the end of the transfer pulse keeps the neon lamps on and off in the configuration established during the transfer pulse by providing a return path that is independent of the binaries.

3.10.4 Resetting and Presetting

Reversible decade counters A11-A15 and A46 are reset by a negative pulse applied to pin R. This reset pulse turns on all odd-numbered transistors (Q1, Q3, Q5, Q7), establishing the zero state.

Presetting is used for special data system applications. It involves applying a negative pulse to pins L, 6, F, and E of the various decades as required to achieve the desired initial count states. The negative preset pulse turns on the transistor(s) to which it is applied, establishing a preset count in standard 1-2-2'-4 bcd code as follows:

BCD Weighting	1	2	2	4
Preset Pin	L	6	F	E
Transistor Turned On	Q2	Q4	Q 8	Q 6

UNITS/COUNTER INPUT LOGIC A19 (Figures 4-7, 4-9, and 4-20)

The units logic of A19 connects to the front-panel FUNCTION and SAMPLE PERIOD switches and provides signal outputs for lighting the units display, for decimal point logic assembly A20 and for blanking/time base selection assembly A21. (The units logic is illustrated in Figures 4-9 and 4-20.

By means of positive AND gates the counter input logic determines whether the counter gate is controlled manually or by one of the standard sample periods. When voltage is to be measured, the volt signal at pin 15 of A19 is negative. This signal opens AND gate Q10 to the negative pulses that are received from the vfc via counter control assembly A16. These pulses are coupled through AND gate Q10 to units decade counter A11 through a trigger differentiating circuit. The positive triggers produced by this circuit are counted when the counter gate opens.

When the frequency of a signal is to be counted, the freq signal at pin 17 is negative. This signal opens AND gate Q11 to the positive pulses from the Schmitt trigger on A27. The output pulses from Q11 are routed to units decade counter Au in the same manner as voltage pulses. \langle

When opening and closing of the counter gate (flip-flop A17Q1-Q2) is manually controlled (SAMPLE PERIOD switch in START) or STOP position, the man logic line is negative. This opens AND gate Q12 to the logic level on the start-stop logic line. When the SAMPLE PERIOD switch is set to START the ground clamp output from Q12 sets A17Q1-Q2 to measurement enable state. When the SAMPLE PERIOD switch is set to STOP position, the negative-going voltage passed by the base-collector diode of Q12 turns on A17-Q1, setting A17Q1-Q2 to measurement inhibit state.

3.12 DECIMAL POINT LOGIC ASSEMBLIES A20 AND A30

3.12.1 Decimal Point Logic Assembly A20 (Figures 4-9, 4-21, and 4-32)

The decimal point lamps are controlled via a photoconductor assembly. (See Figure 4-33.) When a given decimal lamp is to light, the appropriate neon lamp (NE-1 to NE-5) in the photoconductor assembly is lighted by the decimal point logic circuits on A20. The light from the neon lamp reduces the resistance in the associated photoconductor, allowing the proper decimal lamp

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in the decimal assembly to light. When an incomplete measurement program occurs, a signal from the blanking logic circuit on A21 lights NE-6, which prevents any of the other decimal lamp controlling neons (NE-1 to NE-5) from lighting. This in turn prevents lighting of any of the decimal points on the visual display. (The instrument is also switched to 1000v range resulting in a low reading when programming is incomplete.)

The decimal point logic circuitry, consisting of diode and transistor gates, translates the control settings for the various modes of operation to determine the proper decimal point position. This assures that the digital display is direct reading in volts, millivolts, or kilohertz. This logic also provides the correct decimal point placement for ac voltage measurements and resistance measurements when a HP-2410B is used with the HP-2401C.

The decimal point logic is illustrated in Figure 4-9. Essentially, the diode and transistor gates combine negative- and positive-true inputs to light one of the five neon lamps (NE1-NE5) in the photoconductor assembly. The positive-true input, a voltage range (0.1, 1, 10, 100, or 1000) for voltage measurements, completes an emitter ground for one or more of the transistor gates. A negative true input applied to the base of one of these transistor gates then produces a positive true sellector output that lights the associated neon lamp. The negative true transistor AND gate input is assembled by a diode AND gate; it represents the removal of all positive true inputs, which are clamps to ground.

Decimal point placement is determined by the function measured (VOLT or FREQ), the voltage range (if VOLT function is selected), and the sample period. For example, when FREQ function is selected, transistor AND gates Q5, 97, or Q9 are enabled via OR gate CR14-CR15. Selection of sample period determines which transistor AND gate opens and which neon lamp lights, as follows:

Sample Period	Transistor, Cate. Opened	Neon Lamp Lighted	Decimal Placement On Digital Display	
.01 Sec	Q5 (1)	NE2 \ <i>P</i>	00000.0	
0.1 Sec	Q7	NE3 1	0000.00	
1 Sec	Q9	NE4 '	000.000	
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Only one neon lampline can be positive at any one time; all other lines are negative. If none of the lines is positive, the output of negative AND gate CR24-CR28 is negative, indicating an incomplete program. This negative signal is coupled to logic on A21, causing, the decimal point display to blank and the 1000v attenuator relay to energize.

3.12.2 HP-2411A Decimal Point Logic Card A30 (Figure 4-31)

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Logic card A30 provides for correct positioning of the decimal point when the HP-240 C is used with a HP-2411A Guarded Data Amplifier. The logic shifts the decimal one place to the left, or two places to the right while lighting the MILLI portion of the MILLIVOLTS display, when the HP-2411A is set for ± 10 gain.

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Section III

3-21

As an example of the A30 logic, assume that the HP-2401C is program-med for 1V RANGE and .01 SEC SIMPLE PERIOD. This grounds the emitters of AND gates Q9, Q10, and Q11 via the NE4 logic line and A20. When the HP-2411A is set for +1 gain, the false state (near -35 volts) of the X10 logic line turns on Q1, grounding the X10 logic line and closing AND gates Q9 and Q11. (AND gate Q10 is opened, lighting NE-4 on the When the HP-2411A is set for +10 gain, QI is photoconductor assembly. This closes Q10 and leaves Q9 and Q11 subject cut off and Q2 conducts. to the false state of the millidrive line, which turns on Q3, grounding the millidrive line and closing AND gate Q11. AND gate Q9 is opened, light-ing NE - 2. This decimal shift two places to the right is matched by the lighting of the MILLI portion of the MILLIVOLTS display because the grounding of the X10 line is coupled to the millidrive output line through OR diode CR1. (When . 1V RANGE and 1 SEC SAMPLE PERIOD are selected, the NE4Vand millidrive lines are both true (near ground). When the X10 700 line is also true, gates Q9 and Q10 are closed and Q11 is opened, lighting NE-5. This decimal shift one place to the left converts the 000.000 MILLIVOLTS display to 00.0000 MILLIVOLTS display.

If HP-2411A Decimal Point Logic card A30 is not installed in the HP-2401C, a jumper board is installed in receptacle XA30. The connections completed by this board are shown in the upper right corner of Figure 4-31.

3.13 BLANKING LOGIC/TIME BASE SELECTION A21 (Figures 4-7, 4-9, and 4-22)

The blanking logic/time base selection circuitry combines appropriate operating logic signals to blank the decimal point lamps on the display and energize the 1000v attenuator range relay, when programming is incomplete. It also selects one of the three standard time base frequencies (100 Hz, / 10 Hz, or 1 Hz) to gate the counter section when using one of the standard sample periods.

If programming is incomplete, assembly A20 provides no output for lighting any of decimal neons NE1-NE5; therefore, none should be lighted. Nevertheless, additional logic is required to program the 1000v range. Logic is also provided to blank the decimal neons without programming the 1000v range.

When no decimal neon is programmed from A20, a negative signal from A20 pin 6 to A21 pin 17 and the "false" state of the freq \bullet man logic line produce a positive output from AND transistor Q5. This output lights NE6 on the photoconductor block, inhibiting the lighting of any of NE1-NE5. This output also programs the 1000v relay logic line, setting attenuator A28 to 1000v range.

The "true" state of the freq • man logic line, coupled through diode CR6, lights NE-6. This blanks all decimal neons but does not switch A28 to 1000v range because AND transistor Q5 is cut off through CR8.

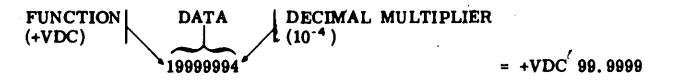
The time base selection circuitry selects one of three standard time bases by opening one of three positive AND gates connected to the time base out-

2401C

puts of the decade dividers. For example, if a .01 SEC sample period is selected, the input at pin 16 of A21 will be negative (indicated by .01 SEC). (See Figure 4-7.) This signal opens AND gate Q7. When the 100 Hz signal from the decade divider goes positive, AND gate Q7 provides a positive output. This output is coupled through a positive OR gate to the gate control circuit on A17.

3.14 **PRINTER COUPLING A22 (Figures 4-9, 4-23, and 4-24)**

The printer coupling circuit translates decimal position, range, and function information to appropriate bcd codes for digital recording. The decimal position is a number from 0 through 7. This number (n) stands for a negative power of ten multiplier (i.e., 10^{-4}) that indicates the position of the decimal point on the recorded measurement for the selected units. A sample digital printout follows:



Function coding is shown in Table 2-5.

The decimal position information is received from the outputs of the standard decimal point logic assembly A20, (and HP-2411A Decimal Post Logic Card A30 if installed) and then interpreted by the logic networks on A22. The decimal point logic network on A22 translates millivolt readings on the HP-2401C display to equivalent readings in volts for the recording output. For example a reading of +0001.23 MILLIVOLTS on the HP-2401C is recorded as 10001235, indicating that the function is +VDC and the decimal point is five places to the left (i.e., 0.00123).

3.15 HP-2410B AC AND OHMS GATE DELAY A23 (Figure 4-25)

The ac and ohms delay gate delays measurements as required when a HP-2410B AC/Ohms Converter is used with the HP-2401C. The delays provided differ with the type of measurement, /as follows:

Type of Measurement		Delay (Milliseconds)
0	AC (Normal)	500-550
	AC (Fast)	200-220
	Ohms	100-110

The programming of a measurement using the HP-2410B cuts off Q2 through OR diode CR5, CR6, or CR7, opening AND gate Q2-CR8. Each negative reset pulse/from the reset bus is then passed through the AND gate, triggering flip-flop Q3-Q4. The negative-going output from the Q4 collector is coupled through emitter follower Q1 to a resistance-capacitance (r-c) delay circuit. The negative output from the Q1 emitter allows capacitor

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C1 of the r-c delay circuit to charge negatively at a rate that is determined by circuit resistance.

When the negative voltage across capacitor C1 reaches a certain level, the flip-flop is driven to its original state. —The delay time required for this action is determined by the measurement function that is programmed. When ohms is programmed, resistors R1, R2, and R3 are effectively connected in parallel through diodes CR2 and CR4, thus providing the minimum delay of 100-110 milliseconds. When AC Fast is programmed R2 and R3 are in parallel, providing a longer delay of 200-220 milliseconds. When AC normal is programmed, R3 determines the longest delay, which is 500-550 milliseconds.

While the flip-flop is in the reset-triggered delay state, a negative-going pulse, coupled via non-inverting amplifier Q5, blanks the trigger input to the second time base divider, A2. The transition of Q3-Q4 to non-delay state triggers the 4-millisecond one-shot, Q6-Q7. The output pulse from the Q6 emitter prolongs the measurement delay an additional 4 milliseconds. After this delay the, time base sample gate is generated as usual

3.16 HP-24108 UNITS COUPLING A9 (Figures 4-9 and 4-14)

The HP-2410B units coupling circuit is required when a HP-2410B AC/Ohms Converter is used. This circuit interprets the programmed range and function inputs and provides output signals to light the appropriate units and decimal on the digital display.

When the 10 megohm range is programmed by a ground connection to pin 15 of A9, the signal is coupled through A9 to light the "M Ω " lamp on the units display, and to the 10 volt logic line to position the decimal point on the digital display. At the same time, this signal is coupled through a positive OR gate to cut off transistor AND gate Q3 so that the "K Ω " lamp cannot be lighted. The blanking of the K Ω lamp is necessary, because whenever the 10 megohm line is programmed, the ohms line is also programmed. This would ordinarily allow Q3 to conduct, lighting the K Ω Tamp. When the ohms line is programmed, the "VOLT", "MILLI" and polarity-lamps are blanked.

The K Ω lamp will light under measurement conditions equivalent to those which light the VOLT lamp when voltage measurements are made. This requires that the 10 megohm and milli-drive lines not be programmed (i.e., negative) and that the ohms line be programmed (i.e., positive). The ohms line is always programmed for resistance measurements.

The " Ω " lamp lights when the milli-drive and ohms lines are positive and when the frequency and manual gate lines are negative. (The Ω lamp is equivalent to the MILLI and VOLTS lamps when voltage measurements are made.)

The programming of AC measurements grounds pin 8, lighting the AC lamp. The programming of either AC or ohms measurements has two additional effects. The polarity blanking amplifier, A16Q24, is cut off, blanking the $p\phi$ larity outputs from the counter control assembly. The positive true (ground) ø.

state of the AC or ohms logic line is connected to the attenuator coupling logic on A8, energizing 1v range relay A28K2 and causing all other attenuator range relays to be de-energized. This is done because all measurements made with the $HP_{-}2410B$ must use the 1v range of the $HP_{-}2401C$.

347 -35 VOLT REGULATOR AND RESET CIRCUIT A7 AND +6V BIAS CIRCUIT

3.17.1 A7 Reset Circuit (Figures 4-7 and 4-12)

The reset circuit on card A7 is designed, to provide counter section reset pulses in response to pulse or contact-closure reset triggering. Pin 12 of A7, the closure input to the react circuit, is connected to the frontpanel RESET pushbutton and to pin "o" of rear-panel PROGRAM CONTROL connector J1. When pin 12 is grounded, a Schmitt trigger, Q4-Q5, is flipped after a delay of approximately 3 milliseconds. This delay is caused by an integrating network, R17-C2 which discharges toward ground when pin 12 is grounded. This network smooths out irregularities in the input signal caused by contact bounce, preventing the triggering of multiple reset signals. When the voltage across C2 reaches the emitter bias level, the Schmitt trigger is flipped as Q4 is cut off. The output of the Schmitt trigger is a fast-rising, positive-going pulse which is coupled out pin 9 to reset the display timing flip-flop on A18 to the non-display state. The Schmitt trigger output, amplified and inverted by Q7, is also coupled out pin 8 as a negative pulse to the reset buss. This pulse resets the decade counting units, the decade dividers, and the overload detector.

Pin 14 of A7 is a second input to the reset circuit that is connected to the rear panel COUNTER RESET receptacle J4. The reset circuit is designed to respond to a negative 15-volt, 25-microsecond reset pulse with a risetime of less than 2 microseconds. The pulse reset signal is assumed to be much cleaner than a contact closure signal applied at pin 12, and therefore the pulse is simply amplified and inverted by Q6 and Q7 and coupled out pins 9 and 8 as previously mentioned.

3.17.2 A7 -35 Volt Regulator (Figure 4-12)

The -35 volt regulator provides regulated -35 vdc power for the transistorized circuits of the HP-2401C and the bcd reference level voltages that are required by an HP562A Digital Recorder. The + reference on pin 4 of A7, approximately -2 vdc, is the reference for a binary "1". The reference on pin 6, approximately -25 vdc, is the reference for a binary "0". These reference levels are connected to rear-panel BCD OUTPUT \checkmark receptacle J2.

The -35 volt regulator circuit consists of a differential amplifier, Q2-Q3, and an emitter follower, Q1. The output from Q1 is coupled externally by a chassis-mounted emitter follower, Q3, to series regulators Q1 and Q2. The series regulators are on a chassis-mounted heat sink. The regulator output is set at -35 volts by means of variable resistor R10. Differential

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amplifier Q2-Q3 compares the potential tapped by R10 with that developed across resistor R6. Output voltage variations, coupled through breakdown diode CR1, amplified and inverted by Q2-Q3, and coupled by Q1 provide the negative feedback that regulates the -35 volt output. The negative feedback from the amplifiers on A7 increases or decreases conduction through the chassis-mounted series regulators enough to correct variations of output voltage almost completely.

3.17.3 A29 +6V Bias Circuit (Figure 4-12)

The +6v bias circuit on card A29 supplies regulated positive 6 vdc bias to counter control card A16 and reversible counting decades A11-A15 and A46. In addition, rectifier-filter circuits mounted on this card (A29) provide unregulated +150 vdc and -150 vdc outputs to the digital and decimal displays.

The +6 volt reference is provided by voltage breakdown diode CR3. The potential dropped across CR3 is coupled to the +6 volt bias line by emitter follower Q1.

3.18 POWER SUPPLY FILTER A36, SERIES REGULATOR A34, AND CALIBRATION STANDARD A35 (Figure 4-32)

3.18.1 Filter Board A36

Filter board A36 supplies rectified and filtered dc voltages to series regulator assembly A34 and to calibration standard assembly A35. It also provides rectified and filtered 300 vdc to the photochopper driver oscillator on A31.

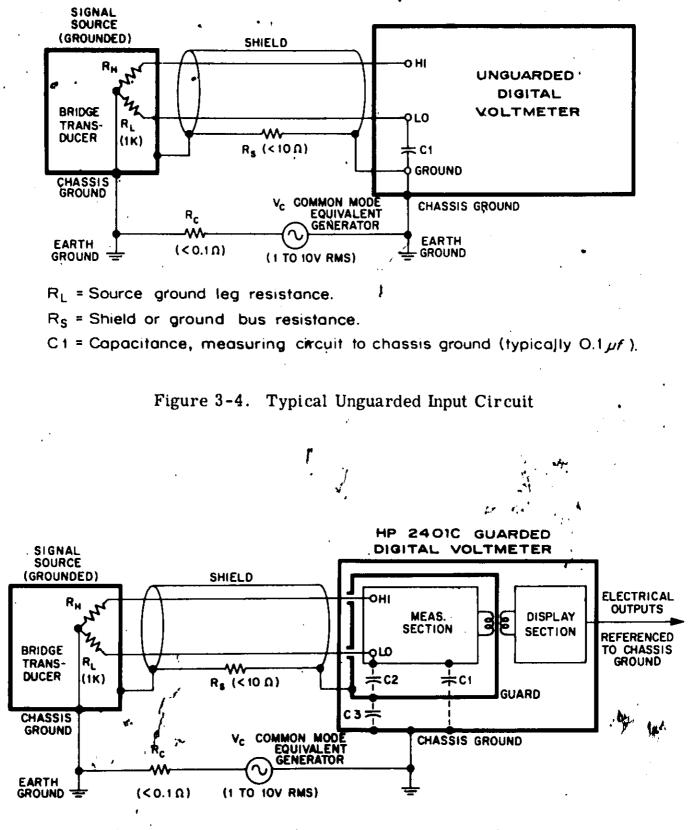
3.18.2 Series Regulator Assembly A34

The series regulator assembly contains the circuits that control the positive and negative 12.3 vdc outputs of the HP-2401C power supply. These outputs power vfc assemblies A31, A32, and A33. The series regulators perform this function in response to inputs received from calibration standard assembly A35.

3.18.3 Calibration Standard Assembly A35

The calibration standard assembly contains the calibration standard supply and amplifiers that control the positive and negative 12.3 vdc series regulators. These circuits are discussed separately in the following paragraphs.

The negative 12.3 vdc output from the power supply is set by potentiometer R9. Output voltage variations are fed back to series regulator A34Q1 through differential amplifiers Q11 and Q1-Q2 and dc amplifier A34Q2. DC amplifier A34Q2, on series regulator card A34, provides the inversion nec-



C1 = Stray capacitance, medsuring circuit to chassis (< 2.5 pf). C2 = Stray capacitance, measuring circuit to guard (.002 μf approx.)

C3 = Stray capacitance, guard to chassis (.002 μf approx.)

Figure 3-5. HP-2401C Guarded Measurement Technique

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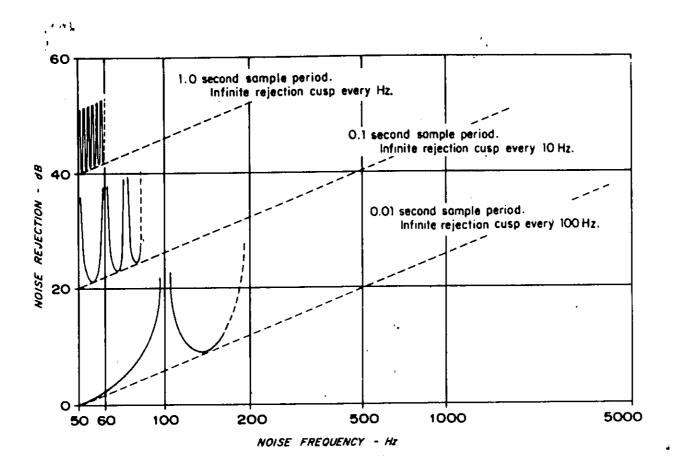


Figure 3-6. Rejection of Superimposed Noise

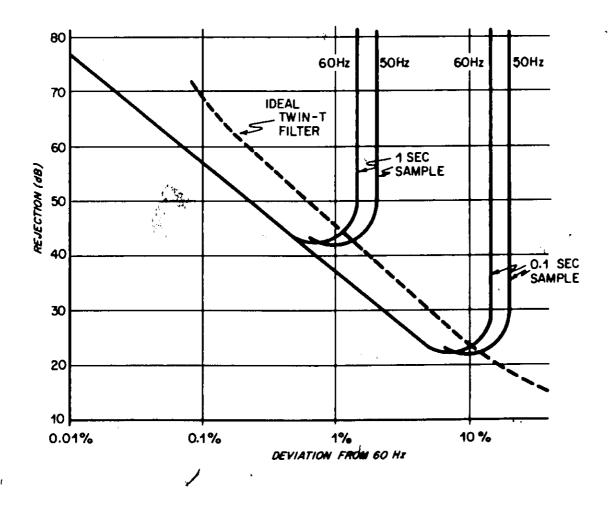


Figure 3-7. Rejection Around 60 or 50 Hz

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essary for negative feedback and regulation of the negative 12.3 volt output potential. The voltage reference of the negative 12.3 volt regulator amplifier is provided by avalanche diode CR1, in the base circuit of Q10.

The positive output voltage from the power supply is set by the negative output voltage, which is used as the reference for the positive regulator amplifier. The output voltage from the positive supply is held approximately equal in magnitude to that from the negative supply by emitter follower Q9, dc amplifier Q8, and series regulator A34Q3. Equal positive and negative voltages applied across divider R25-R26 place the Q9 baseemitter near ground potential. This allows conduction through dc amplifier Q8, which biases series regulator A34Q3 to conduct the load current required from the +12.3 vdc power supply circuit. Variation of the +12.3 vdc supply output potential with respect to the negative output is amplified and inverted by Q8. Negative feedback from the Q8 collector to series regulator A34Q3 largely corrects output voltage variations. Any increase or decrease of the negative output voltage establishes a new reference that causes a corresponding increase or decrease of the +12.3 vdc " output potential. The positive regulator operates to keep the Q9 base emitter near ground potential, which is the operating point of dc amplifier Q8.

The calibration standard circuit consists of voltage reference diode CR3, which is aged and selected for less than $\pm 0.006\%$ drift in six months. The reference potential developed across this diode is compared with the output from series regulator Q4 by differential amplifier Q6. The inverted output from the collector of Q6A is coupled without inversion through a second differential amplifier, Q3-Q5, to series regulator Q4. The negative feedback thus provided holds the series regulator output voltage constant. This output is applied across a drift-compensated voltage divider network, from which is tapped the 1 volt output of the calibration standard.

3.19 REJECTION OF COMMON MODE AND SUPERIMPOSED NOISE

3.19.1 Rejection of Common Mode Noise

Common mode voltages are those dc and ac voltages that are common to both input leads of the Digital Voltmeter. These voltages result when the signal source ground and the Digital Voltmeter ground are not at the same potential. The potential difference between the signal source and the Digital Voltmeter grounds is the common mode voltage source. Unless precautions are taken, the common mode voltage source will cause unwanted currents to flow through the signal source impedance, producing a significant error in the signal voltage measurement. The proper way to eliminate this error is to break the common mode ground loop. In the HP-2401C the ground loop is broken by a technique known as guarding, in which the input to the Digital Voltmeter is completely isolated from the chassis and its associated ground.

Figure 3-4 shows a typical unguarded circuit where the common mode voltage source is represented by V_c . The ground loop currents of concern are

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those through the LO input side of the Digital Voltmeter (i.e., through R_c , R_L , C1); currents through the HI side are insignificant because of the high input impedance. With a typically large value of C1 (0.1 μ f) and $R_L = 1K$, the common mode rejection (defined as the ratio between the common mode signal and the voltage it causes to be superimposed on the signal source) is limited to about 29 db at 60 Hz. The common mode pickup can be minimized by utilizing a shield to shunt the common mode current path, but the additional rejection obtained is negligible because of the low value of R_c with respect to the shield resistance.

Figure 3-5 shows the guarded input circuit used in the HP-2401C. In this instrument the common mode ground loop is broken by using a separate "guard" shield to isolate the analog part of the measuring circuit from the chassis. Except for a slight voltage drop in R_s , the guard operates at the potential of the signal source, resulting in a negligible current through C2 and thus a negligible current through R_L . The circulating ground current forced by V_c is now effectively shunted away from the measuring circuit and flows through R_s and C3. By utilizing the guard shield the leakage capacitance (C1) between the measuring circuit and the chassis has been reduced to less than 2.5 picofarads. Reduction of C1 to this low value yields a common mode rejection of 120 db at 60 Hz (160 db at dc) even when the value of R_L is as much as 1000 ohms.

3.19.2 Rejection of Superimposed Noise

Superimposed noise voltages are primarily those unwanted ac signals that are superimposed on the input signal, usually as a result of electromagnetic pick-up from any ac field. When this occurs, the superimposed noise is added directly to the signal to be measured. Techniques used to combat common mode noise will not eliminate this type of noise since there is no ground loop to break. The problem of superimposed noise is effectively dealt with in the HP-2401C by the process of integration, in which the input signal is integrated over a preselected sample period to obtain an average reading. If the period of the superimposed noise is such that its average value over the selected sample period is zero, no error results in the reading. For example, the fixed sample periods in the HP-2401C are multiples and submultiples of one second, and the average value of 60 Hz ac noise over a one second interval is zero. As a result the instrument provides infinite rejection at 60 Hz.

Figure 3-6 shows a graph of rejection versus noise frequency at three different fixed sample periods. Note the infinite rejection cusps such as occur at 60 Hz At other frequencies, for example at 55 Hz over a 0.1 sample period, 20° db of rejection is obtained. The rejection increases 20 db per decade (6 db per octave) increase in frequency.

Noise rejection characteristics around 60 (or 50) Hz for 1 second and .1 second sample periods are shown in Figure 3-7. As indicated, rejection is never more than 25 db poorer than that provided by an <u>ideal</u> Twin-T filter. With respect to the filter characteristic, rejection provided by the HP-2401C improves with increasing deviation from 60 Hz.



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SECTION IV MAINTENANCE

4.1 GENERAL

This section contains instructions for maintenance and servicing of the HP-2401C Integrating Digital Voltmeter. Included are instructions for in-cabinet performance checks, air filter servicing, troubleshooting, instrument cover removal, repair, and calibration. These instructions are supplemented by a list of recommended test equipment (Table 4-1), a maintenance schedule (Table 4-2), test setup, troubleshooting, logic, parts location illustrations, and schematic diagrams (Figures 4-1 through 4-34).

4.2 IN-CABINET PERFORMANCE CHECKS

The In-Cabinet Performance Checks, Table 4-3, may be used to verify specifications of the equipment. The Performance Check Test Card, which follows Table 4-3, may be used as a permanent record of the instrument's performance when filled out. Values or answers in parenthesis below or to the right of test card entry blocks specify correct reading or reading tolerance. The entry numbers on the card correspond to the checks in Table 4-3. The checks in Table 4-3 and in Section 2.2 verify correct operation of all circuits in the HP-2401C and may be used:

a. as part of an incoming inspection check of instrument specifications;

b. periodically, as specified in Table 4-2;

c. as part of a troubleshooting procedure to locate malfunctioning circuits;

d. after repairs or adjustments, before returning the instrument to regular service.

During the Performance Checks the HP-2401C should be connected to the ac line through a variable voltage device so that line voltage may be varied $\pm 10\%$ from nominal (115 or 230 vac) to assure that the instrument operates correctly at various supply voltages.

Instrument	Required	Use	Recommended
Type	, Characteristics		Model
DC Standard	0-1,0-10,0-100,0+1000 vdc outputs accurate to ±0.01% stability ±0.003%.	Performance check and cali- bration.	HP-740A or HP- 740B DC Stand- ard Differential Voltmeter with 11054A and 110- 55B Accessory Cables

Table 4-1., Recommended Test Equipment (Sheet 1 of 3)

Instrument Type	Required Characteristics	Use	Recommended Model
Standard Frequency Source	100kHz, 1 Hz outputs accurate to ± 5 parts in 10^8 .	Performance check and cali- bration of coun- ter time base.	HP100E Frequency Standard
Oscilloscope	10-MHz bandwidth, dual- trace plug-in, calibrated time base and vertical channel, ext sync capa- bility.	Observe wave- forms and mea- sure timing re- lationships dur- ing performance checks, trouble- shooting, and calibration.	HP-175A Oscillo- scope HP-1750A or HP- 1760B Dual-Trace Amplifier HP-10003A Voltage Divider Probe (2)
DC Null Voltmeter	Low range 0-3 μv_1 in- finite impedance at null, operation independent of ac line.	Null sensing and voltage measure- ments during-per- formance checks and calibration.	HP-419A DC Null Voltmeter
Precision Volt Box	1:1, 10:1, 100:1, 200:1, 300:1, 400:1, 500:1,600: 1, 700:1, 800:1, 900:1, 1000:1 resistance ratios accurate to \pm .001% at 1000 Ω/v .	Performance checks and cali- bration.	Julie VDH-1000 or VDN-1000 Pre- cision Voltage Divider
Variable Line Voltage Source with Meter	Variable from 103-127 vac (or 207-253 vac).	Performance checks.	
1 Volt Calibration Standard	1 vdc output calibrated from primary standard to $\pm 0.001\%$ accuracy or better.	Transfer standard for performance checks and cali- bration.	HP-735A Transfer Standard
Isolation Transformer	50-60 cycle, 115v pri- mary, 1:1 ratio.	Common mode noise rejection check.	•
Portable Oscillator	Sine wave output from . 5 Hz to 300 kHz, oper- ation independent of ac power line.	Performance checks and cali- bration.	HP-204B Portable Oscillator
Test Oscillator [°]	Sine wave output from 300 kHz to 1.2 MHz.	Performance check of M29.	HP-650A or HP- 651B Test Oscillator

Table 4-1. Recommended Test Equipment (Sheet 2 of 3)

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Table 4-1.

mended Test Equipment (Sheet 3 of 3)

Instrument Type	R. ed Characteristics	Use	Recommended Model
AC Vacuum Tube Volt- meter	10, 30, 100, 300 mv ranges, measurement of rms voltage.	Performance check of super- imposed noise rejection.	HP-400D VTVM
Pulse Generator	-1v, 2 μs pulse out- put at 1 kHz.	Performance check of fre- quency meas- urement sensi- tivity to pulse input.	HP-212A or HP- 8003A Pulse Generator
Square Wave Generator	Square wave output from 1 Hz to 20 kHz, 27v p-p from 600Ω output.	Performance check of pulsed counter resetting from external source.	HP-211A Square Wave Generator
BNC ''T'' Adapter		• ,	HP-1250-0072
Electronic Counter	Time interval mea- surements at 10 μ s resolution.	Response time and measure- ment speed per- formance checks.	HP-523C or D or 5233L Electronic Counter

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Table 4-2	Maintenance Schedule
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Interval	Maintenance Operation	
Daily or Each Turn-On	For maximum accuracy of measurements perform preopera- tional check and calibration per Section 2.2.	
Weekly	kly Verify accuracy of internal time base per check 3 of Table 4-3 If necessary, calibrate internal time base per Section 4.7.5.	
Monthly*	Clean air filter per Section 4.3.	
Every 6 Months	Calibrate internal 1v reference per Section 4.7.4. Perform checks 1 through 11 in Table 4-3. If necessary, calibrate overload detec- tion per Section 4.7.3; calibrate input attenuator per Section 4.7.8.	

*Shorten this interval if the instrument is operated more than 80 hours per month or if it is operated in a shop environment where no special care is taken to minimize airborne vapors and dust.

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Table 4-3. In-Cabinot Performance Checky Std & Opt. 29 Instruments (Shoet 1 of 15) 1. VOLTAGE MEASUREMENT RANGES Full Scale Ranges: 0.1, 1, 10, -1000V. Overranging: To 300% of full scale except on 1000V range. HP-2401C switches to 1000V range at 310% (308-315%) of full scale. **Overload** Protection: Set HP-2401C Power switch to ON, other controls as follows: a. FUNCTION: VOLT. RANGE: 1000W. · 🍙 SAMPLE PERIOD: ') SÉC. SAMPLING RATE: Clockwing from STOP. 100 KC STD (rear panyf): INT. Refer to Figure 4-1 and connect the + and - OUTPUT terminals of the DC Standard to the HI b. and LO terminals of the HP-2401C. Jumper the GUARD terminal to the LO terminal. Turn on the DC Standard and soft it to provide de outputs as listed below; the HP-2401C C. readouts should be approximately as follows: DC Standard Output HP-2401C Ramge & Approximate HP-2401C Display +1000,00 VOLTS (Volts) (Volts) 1000 1000 100 100 +100,000 VOLTS 10 10 +10,0000 **VOLTS** 1 1 +1000.00MILLIVOLTS 0.1 0.1 +100.000 MILLIVOLTS Check HP-2401C overranging operation as follows: d. HP-2401C Range DC Standard Output Approximate HP-2401C Display +300.000 MILLIVOLTS (Volts) (Volts) 0.3 0.1 3 +3000.00**MILLIVOLTS** 1. 30 10 +30,0000 VOLTS 300 100 VOLTS +300,000 increase DC Standard output voltage slowly until OVERLOAD indicator lights on HPe. 2401C digital display. Set HP-2401C RANGE switch to 1000V and record reading, which should be +312.5 ± 7.5 VOLTS. If incorrect, calibrate overload detection per Section 4.7.3. • **VOLTAGE MEASUREMENT - INTEGRATION** 2. The HP-2401C displays the true integral of the input signal with correct polarity even if the signal crosses through zero during the sample period. With HP-2401C on and operating, set controls as follows: ۵. **SAMPLE PERIOD:** STOP. STORE/DISPLAY (rear panel): DISPLAY. FUNCTION: VOLT. RANGE: INT-1V. Set HP-2401C SAMPLE PERIOD switch to START until 6-digit negative count is accub. mulated; then set switch to STOP. ŧ

2401C

Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 2 of 15) Set HP-2401C RANGE switch to INT+1V and reset SAMPLE PERIOD switch to START. 2. c. Observe counting down to zero (visible on the two most significant digits), reversal of polarity-Indication to +, and count up of +voltage. Set SAMPLE PERIOD switch to STOP and record observations. NOTE If it is desired to view this process in greater detail, apply an input voltage that is about 1/10 or 1/100 of the full scale range selected. After the initial count is accumulated, reverse this input. \dot{f}_{ij} INTERNAL TIME BASE 3. Frequency: 100 kHz. Stability: Aging Rate ≤ 2 parts in 10⁶ per week. Temperature <±100 parts in 10⁶ over range of 10-50°C. Turn on RP-2401C, the Frequency Standard, and the Oscilloscope; note time. **A.** Set 100 KO STD switch on rear of HP-2401C to INT position. b. c. Connect a BNC cable from the 100 KC STD OUTPUT/INPUT receptacle, J3, "on the rear af the HP-2401C to a vertical input of the Oscilloscope. Synchronize the Oscilloscope externally from the 1 cps output of the Frequency Standard. **d**. Set Oscilloscope for display of the 1.2V p-p, 100 kHz square wave time base output from 6. the HP-2401C at 1 μ SEC/CM sweep rate, 1. After the HP-2401C has been operating for at least an hour, observe square wave display on Oscilloscope to determine degree of drift, if any. Left drift is -, right drift is +-The horizontal drift of the square wave in CM/SEC is the difference between the Stanø. dard Frequency and the Counter time base frequency in parts in 10⁶. Determine this difference and record it on the Performance Check Test Card, NOTE A Temperature must be within ±5°C of the temperature at which internal time base oscillator was calibrated. If a record of the temperature and date of last calibration is not available, the frequency offset should not be considered drift or aging rate of the 100 kHz crystal. NOTE B If drift of the internal time base is greater than ± 2 parts in 10⁶, recalibrate per Section 4,7,5. h. Check long term stability by repeating the procedure of steps a through g one week later. 1. If a precisely controlled temperature chamber is available, check temperature stability by repeating the procedure of steps a through g after the HP-2401C has been on and operating at 10 °C for at least 1-1/2 hours, but use 10 μ 8EC/CM sweep rate. Repeat after 1-1/2 hour warmup at 50°C. The horizontal drift of the square wave in CM/SEC is the difference between the standard frequency and the Counter time base in 10 parts in 10^6 . Determine frequency difference, which should be no greater than ± 100 parts in 10⁶.

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	Voltage: Drift:	1V ±.002% (after factory adjustment). <±.006% in six months.	
	Temperature Coefficient:	$(\pm,000\% \text{ in six months.})$ 10-40°C ±.001% per °C. 40-50°C ±.0015% per °C.	
R,	Set DC Standard for 1V output.		
b.	Zero the HP-2401C per the procedure in Section 2.2.2.		
c.	Box, and HP-2401C as sho	DC Null Voltmeter, 1V Calibration Standard, Precision Vol wwn in Figure 4-1(A). Operate the DC Null Voltmeter from ot connect it to the ac line.	
d.	Set the DC Standard output DC Null Voltmeter.	voltage to produce a null on the most sensitive range of t	
		ANGE and set the CAL+ adjustment for +1000.00 MILLIVOI adout.	
f.	Reverse the connections of leads 2 and 4 to the HP-2401C HI and LO terminals and the CAL- adjustment for -1000.00 MILLIVOLTS indication on the digital readout.		
g.	Set the HP-2401C RANGE switch to INT-1V and record the digital readout. This reading should be -1000.00 ± 0.10 MILLIVOLTS (maximum drift of $\pm 0.006\%$, $\pm 0.002\%$ initicalibration, $\pm 0.001\%$ accuracy of external standard, ± 1 digit).		
	NOTE A If reading is not within ±0. per Section 4.7.4 and repe	10 mv of 1000 MIĹLIVOLTS, recalibrate the internal standar at steps a through g.	
	NOTE B Immediately after calibratic be within ±0.03 mv of -100	on, at the calibration temperature, the digital readout shou 0.00 MILLIVOLTS (initial calibration to $\pm 0.002\% \pm 1$ digit.	
h.	Check long term stability b six months.	y repeating the procedure of steps a through g monthly for	
,		mperature chamber is available, the temperature coefficien source may be checked per the procedure of steps i throug	
i.	Hold the HP-2401C on and operating at 40° C (±1 [•]) for at least 1-1/2 hours.		
j.	Repeat steps a through d, above, to obtain a $1V \pm 0.001\%$ external standard.		
k.	Read voltage of external standard on 1V range; then read voltage from internal calibra tion source on corresponding INT 1V range and subtract the difference in readings. Thi difference should be no greater than ±0.17 mv.		
1.	Repeat the procedure of ste at 10°C. The 50°C differe should be no greater than ±	ps i through k, above, after 1-1/2 hour warmup at 50°C and nce should be no greater than ± 0.30 mv; the 10°C different 0.17 mv.	

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Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 4 of 15)

5. **VOLTAGE MEASUREMENT - FULL SCALE ACCURACY** ±.01% rdg ±.005% fs ±1 digit (1). At 25°C: 10-40°C, ±.001% rdg per °C 40-50°C, ±.0015% rdg per °C Temperature Coefficients: (2). 0.1V range, ±.002% rdg ±.0005% fs per °C Other ranges, ±.002% rdg ±.0002% fs per °C (1) Holds for all ranges at 25°C, assuming daily calibration against internal standard, calibration of internal standard every six months, line voltage variation no greater than ±10%. (2) When calibrated against internal standard at operating temperature. (3) Over the range of 10-50°C when calibrated against internal standard at 25°C. After 1-1/2 hour warmup at 25°C with instrument zeroed per Section 2, 2, 2 and controls 2. set as specified below, set the CAL- adjustment for -1000.00 MILLIVOLT reading on the HP-2401C digital display. 100 KC STD (rear panel): INT. ł FUNCTION: VOLT. RANGE: INT-1V. SAMPLE PERIOD: 1 SEC. SAMPLING RATE: Clockwise from STOP. Set the HP-2401C RANGE switch to INT+1V and set the CAL+ adjustment for +1000.00 b. | MILLIVOLT reading on the digital display. Set the HP-34010 to 1V RANGE and set the DC Standard to produce a null on the most C. sensitive range of the DC Null Voltmeter (connections are as shown in Figure 4-1 (A), except for leads 2 and 4 to the HP-2401C, which are reversed, as at the end of check 4). NOTE A All voltage reading tolerances noted in this check include the potential inaccuracy of the external voltage standard (±0.001% for 1V, ±0.002% for other voltages). NOTE B If any range is out of tolerance at 25°C ambient, calibrate per Section 4.7.8. d. Record the next readout. This reading should be within ±0.17 mv of -1000.00 MILLI-VOLTS. Connect leads 2 and 4 exactly as shown in Figure 4-1(A) and record the next readout. **e**. This reading should be within ±0.17 mv of +1000.00 MILLIVOLTS. **f**. Change connections to those shown for . 1V check in Figure 4-1(B) and set the HP-2401C RANGE switch to . 1V. Record the next digital readout. This reading should be within ±0.018 mv of ±099.108 MILLIVOLTS. NOTE The 100K input impedance of the HP-2401C on the . 1V RANGE loads the output of the Precision Volt Box so that the input voltage is +99.108 mv. The accuracy tolerances total ±18 μ v for this reading, scale, and digits, including the ±0.002% tolerance of the voltage source.

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Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 5 of 15)

- δ. g. Change connections to those shown for 10V check in Figure 4-1(B). Set the HP-2401C RANGE switch to 10V and set the DC Standard to exactly 10V, as indicated by a null reading on the most sensitive range of the DC Null Voltmeter. h. Record the next reading. This reading should be within ±0.0018v of +10.000 VOLTS. Change connections to those shown for 100V check in Figure 4-1(B). Set the HP-2401C i. RANGE switch to 100V and set the DC Standard to exactly 100V, as indicated by a null reading on the most sensitive range of the DC Null Voltmeter. Record the next reading. This reading should be within ±0.018v of +100.000 VOLTS. 1. k. Change connections to those shown for 1000V check; set the HP-2401C RANGE switch to 1000V and set the DC Standard to exactly 1000V, as indicated by a null reading on the most sensitive range of the DC Null Voltmeter. 1. Record the next reading. This reading should be within ± 0.18 of ± 1000.00 VOLTS. NOTE If a precisely controlled temperature chamber is available, the voltage measurement temperature coefficient may be checked per the procedure of steps m through o. m. Hold the HP-2401C on and operating at 40°C (\pm 1°) for 1-1/2 hours. Repeat steps c through e, and determine the difference between the readings for 1V inn. put at 25°C and 40°C, which should not be greater than ±0.35 mv. o. Repeat steps c through e after 1-1/2 hour warmup at 50°C and after 1-1/2 hour warmup at 10°C. The 50°C difference should be no greater than ±0.57 mv; the 10°C difference should be no greater than ± 0.35 my. **VÓLTAGE MEASUREMENT - LINEARITY** 6. At Less Than Full Scale: ±.01% rdg ±.005% fs ±1 digit. At 3 Times Full Scale: $\pm .025\%$ rdg ± 1 digit. At 2 Times Full Scale: $\pm .02\%$ rdg ± 1 digit. With ambient temperature at 25°C, line voltage variation no greater than $\pm 10\%$. After 1-1/2 hour warmup at 25°C and with instrument zeroed and calibrated per Sec**a**. tions 2.2.2 and 2.2.3, set controls as specified below. 100 KC STD (rear panel): INT. FUNCTION: VOLT. **RANGE:** 1000V. SAMPLE PERIOD: 1 SEC. SAMPLING RATE: Clockwise from STOP.
 - b. Connect the DC Standard, DC Null Voltmeter, 1V Calibration Standard, Precision Volt Box, and HP-2401C for 10% fs interval linearity checks as shown in Figure 4-1(A) and (B) and set the DC Standard for 900V output.

Tolerance

(Volts)

±0.17

±0,16

±0.14

±0.13

±0.12

±0.11

±0.10

±0.08

±0.07

Reading

<u>(Volts)</u> +0900.00

+0800.00

+0700.00

+0600.00

+0500.00

+0400.00

+0300.00

+0200.00

+0100.00

2401C

Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 6 of 15)

6. c. In turn, connect lead from HI input terminal of the HP-2401C to each of the terminals of the Precision Volt Box that are listed following this step and reset output from the DC Standard for a precise null reading on the most sensitive range of the DC Null Voltmeter. At each point, record the reading.

Precision Volt Box

Terminal	% Full Scale
900:1	
800:1	80
700:1	70
600:1	60
500:1	50
400:1	40
300:1	30
200:1	20
100:1	10

NOTE

All voltage reading tolerances noted in this check include the potential inaccuracy of the external voltage standard $(\pm 0.002\%)$.

- d. Set the DC Standard for output of approximately 3 vdc and change connections to those shown in Figure 4-1(B) for 3X check.
- e. Set the DC Standard output to exactly 3 vdc, as indicated by a null reading on the most sensitive range of the DC Null Voltmeter.
- f. Set the HP-2401C RANGE switch to 1V and record the next reading. This reading should be within ±0.82 mv of +3000.00 MILLIVOLTS.
- g. Reverse the connections to the HI and LO terminals of the HP-2401C and record the next reading, which should be -3000.00 ±0.82 MILLIVOLTS.
- h. Change connections to those shown in Figure 4-1(B) for 2X check.
- i. Set the DC Standard to exactly 2V, as indicated by a null reading on the most sensitive range of the DC Null Voltmeter. Record the next reading. This reading should be within ± 0.45 mv of -2000.00 MILLIVOLTS.
- j. Reverse the connections to the HI and LO terminals of the HP-2401C and record the next reading, which should be +2000.00 ±0.45 MILLIVOLTS.

7. VOLTAGE MEASUREMENT - REJECTION OF COMMON MODE NOISE

140 db.

- a. With the HP-2401C on and operating, connect only the equipment shown in Figure 4-1(C). Set variable voltage transformer for minimum output voltage.
- b. On the HP-2401C, select .1V RANGE and 1 SEC SAMPLE PERIOD. Set SAMPLING RATE control fully clockwise and record the next reading.
- c. Increase output voltage from the variable transformer to maximum, or until the reading on the HP-2401C changes more than ±2 digits. Determine and record rms voltage across secondary of the isolation transformer.

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Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 7 of 15)

8. VC	DLTAGE MEASUREMENT	- REJECTION OF SUPERIMPOSED NOISE
		ample Period: >20 db. ample Period: >40 db.
	(Increases 20 db per d	ecade increase in frequency.)
a.	With HP-2401C on and	operating, connect test equipment as shown in Figure 4-1(D).
b.	Set controls of the HP-	-2401C as follows:
	FUNCTION:	FREQ.
	FUNCTION: SAMPLE PERIOD:	
	SAMPLING RATE: ATTENUATION:	Fully clockwise. Fully clockwise.
c.	Turn on the Portable C the HP-2401C.	Scillator and set it to provide 0.055 kHz output, as counted by
d,	On the HP-2401C reset	controls as follows:
	FUNCTION:	VOLT.
	RANGE:	10V.
	SAMPLE PERIOD:	.1 SEC.
e,	Set the Portable Oscilla by the HP-2401C.	ntor for minimum output amplitude and note the reading display
f.	Slowly increase the Por from right) changes.	table Oscillator output amplitude until the 10 mv digit (second
g.		he rms output from the transformer secondary. More than 10 than the second, 10 mv digit) should be required to produce the HP-2491C reading.
h.	Repeat steps a through output as counted by the	c, above, but set the Portable Oscillator to provide 0.550 kHz HP-2401C.
i.		g, above. More than 1V rms (40 db greater than the 10mv dig roduce the specified change in the HP-2401C reading.
	2401C for other sample	chnique can be used to verify the noise rejection of the HP- periods and other frequencies. See Figure 3-6 for superim- maracteristics with respect to noise frequency and sample per-

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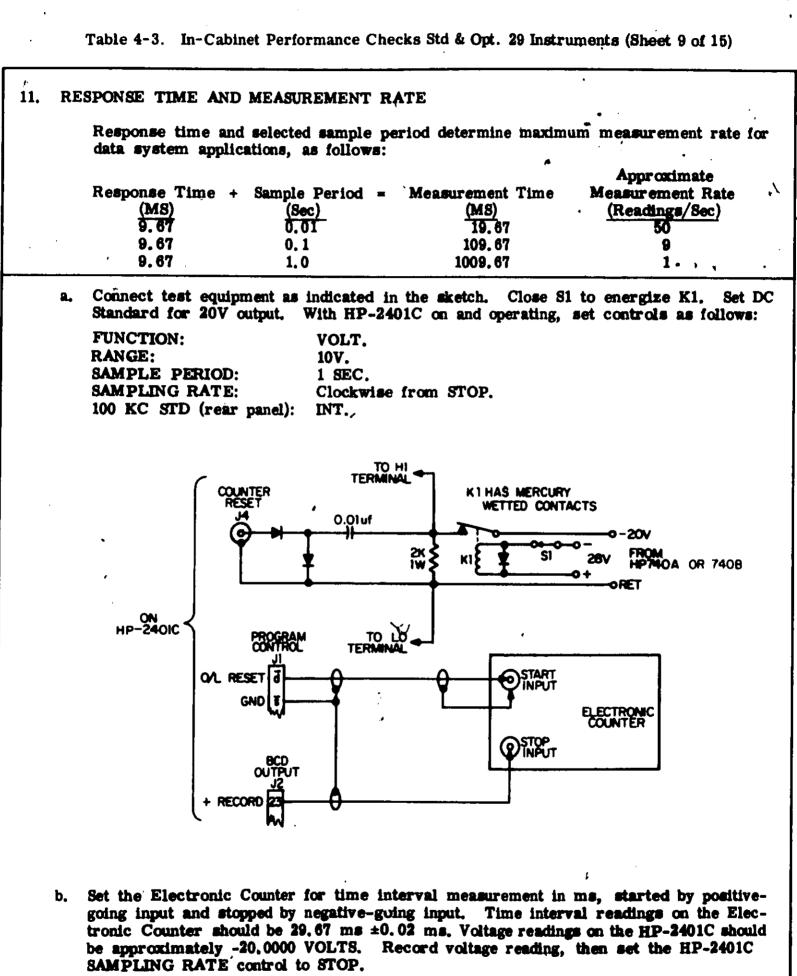
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Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 8 of 15)

9. FI	REQUENCY MEASUREMENT	RANGE - 5 Hz TO 300 KHz (TO 1.2 MHz WITH OPTION 29
۹.	Set HP-2401C Power swit	ch to ON, other controls as follows:
	100 KC STD (rear panel): FUNCTION: SAMPLE PERIOD: SAMPLING RATE: ATTENUATION:	INT. FREQ. .1 SEC. Clockwise from STOP. Fully clockwise.
b.	Connect output of Portable with a BNC "T" connector	e Oscillator to HP-2401C FREQ INPUT and to an Oscilloscope
с.	put frequency downward fr reliably. This frequency cy to determine highest fr	utput amplitude constant at 0.1V rms (0.28V p-p), vary the out- rom 100kHz to determine the lowest frequency that is counted should be 5 Hz or lower. Then increase Oscillator frequen- requency that is counted reliably. This frequency should be d lowest and highest frequencies.
	Portable Oscillator and in	P-2401C-29 instruments, substitute a Test Oscillator for the crease frequency from 300 kHz with amplitude set at 0.5V rms nd record the highest frequency that is counted reliably. This Hz or higher.
10. FR	REQUENCY MEASUREMENT	- SENSITIVITY
	Sine Wave Input:	Std. HP-2401C, 0.1V rms (max.) at 300 kHz. HP-2401C-29 0.5V rms (max.) at 1 MHz.
Pulse In	put (Std. or Option 29):	Polarity, negative or positive. Minimum peak amplitude, 1V (max.). Minimum duration, $2 \mu s$ (max.).
а.	With HP-2401C on and oper 300 kHz Oscillator output fi	rating and its controls set as follows, increase amplitude of rom zero until consistent measurement is obtained.
	100 KC STD (rear panel): FUNCTION: SAMPLE PERIOD: SAMPLING RATE: ATTENUATION:	INT. FREQ. .1 SEC Clockwise from STOP. Fully clockwise.
b.	Determine and record the r voltage should be no greate	ms output voltage from the Oscillator (use AC VTVM); the r than 0.1v rms.
C.	output. Increase Oscillator	Option 29 instrument with the Test Oscillator set for 999.999 kHz output from zero until consistent measurement is obtained. The output voltage, which should be no greater than 0.5v rms.
	NOTE: Perform steps d the operation according to Section	rough f only if trigger circuit has been adjusted for pulse ion 4.7.11.
d.	Connect output of Pulse Gen with a BNC "T" connector. repetition rate.	nerator to HP-2401C FREQ INPUT and to input of Oscilloscope Set Pulse Generator for negative 1v, $2 \mu s$ pulse with 1 kHz
е.	Increase pulse amplitude fr the peak amplitude, which s	om minimum until consistent measurement is obtained. Record hould be no greater than 1v.
		-
f	Set pulse amplitude at 1v an	d increase pulse duration from minimum until consistent lecord the duration, which should be no greater than 2 μ s.

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2401C



- c. Open S1 to de-energize K1, disconnecting the 20V input to the HP-2401C. Then reset the HP-2401C and the Electropic Counter. The HP-2401C should now read $0V \pm 1$ count.
- d. Close 81 to energize K1, connecting the -20V. Then record the reading on the Electronic Counter and the difference between this voltage reading on the HP-2401C and that previously recorded. The Counter reading should be 9.67 ms ± 0.02 ms, and the voltage reading on the HP-2401C should be within ± 0.0002 VOLTS of that recorded in step b.

Set the Electronic Counter for time interval measurement stopped by positive-going in-11. €. put and repeat steps c and d at .01 SEC, .1 SEC, and 1 SEC sample periods. Record the Electronic Counter readings, which should be as follows $(\pm 0.02 \text{ ms})$: **Time Interval Reading** Sample Period (Sec) (MS)19.67 .01 . 1 109.67 1009.67 12. TIME BASE - OUTPUT (Rear Panel) 100kHz square wave. Negative 1.2v p-p. 1K output impedance. With HP-2401C on and operating and 100 KC STD switch set to INT, connect Oscillo-2. scope to rear panel 100 KC STD OUTPUT/INPUT receptacle, J3. Oscilloscope should display a 100kHz square wave, negative-going to 1.2v. Record the Ъ. signal amplitude. The output impedance is determined by a fixed value 1K resistor (R15), which can be c. seen in the assembly A6 circuit diagram, Figure 4-11. 13. TIME BASE - EXTERNAL INPUT (Rear Panel) 2v p-p maximum into 1.2K. With the HP-2401C on and operating, set controls as follows: 8. 100 KC STD (rear panel): EXT. FUNCTION: FREQ. 1 SEC. SAMPLE PERIOD: SAMPLING RATE: Clockwise from STOP. ATTENUATION: Fully clockwise. Connect 100 kHz 2v p-p output, from the Fortable Oscillator to the HP-2401C FREQ b. INPUT and 100 KC STD OUTPUT/INPUT receptacle with a BNC "T" connector. c. Increase Oscillator output amplitude from minimum to the point where consistent measurement is obtained. Determine and record the p-p amplitude of the Oscillator output. Amplitude should be **d.** no greater than 2v p-p. The input impedance is determined by a fixed value 1.2K resistor (R6), which can be seen in the assembly A6 circuit diagram, Figure 4-11. **RECORDING OUTPUTS - BCD DATA** 14. 6 digits. 4-line 4-2'-2-1 code. "O" state level, -35 to -24.5v; "1" state level -2.5 to 0v. Source impedance 100K.

Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 10 of 15)

Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 11 of 15)

With the HP-2401C on and operating, set controls as follows: 14. a. 100 KC STD (rear panel): INT. SAMPLE PERIOD: START. ATTENUATION: CHECK. Connect a 10 pf, 10X attenuation, 10M probe to one channel of the Oscilloscope. b. With the probe, verify "0" and "1" state levels for each data digit at the following pins c. of J2. These levels will be represented by a 22 to 35v p-p square wave. (The square wave frequency differs at each pin of J2.) Record a yes on the test card for each correct 4-line digital output. Digit Decade 10 ⁰ A11 J2 Pins: 3 29 4 28 10¹ A12 5 30 8 31 10² A13 7 33 32 8 10³ A14 9 10 34 35 104 A15 12 11 36 37 10⁵ A46 13 14 38 39 The source impedance is determined by fixed value 100K resistors, which can be seen d. in the assembly A11-15, 46 circuit diagram, Figure 4-17. **RECORDING OUTPUTS - BCD FUNCTION** 15. 1 digit. 4-line 4-2'-2-1 code. "O" state level, -35 to -24.5v; "1" state level -2.5 to 0v. Source impedance 33K. With the HP-2401C on and operating, set as specified below to determine and record 9. dc function levels at the following pins of J2: J2 Pins: 41 40 16 15 Control Settings Function Code: 2' 2 4 1 VOLTS, INT+1V +VDC 0 σ 0 T VOLTS, INT-1 -VDC 0 0 0 1 FREQ KC 0 0 1 1 ł EXT SEL, 1V KΩ (W/HP-2410B) 1 0 0 1 (W/HP-2410B) EXT SEL, 1V MΩ 0 1 1 1 VOLTS, IV* OVERLOAD 1 1 1 1 EXT SEL, 1V VAC (W/HP-2410B) 0 0 1 1 1.4 *With dc input sufficient to produce OVERLOAD indication. The source impedance is determined by fixed value 33K resistors, which can be seen b. in the assembly A22 circuit diagram, Figure 4-23 or 4-24. 16. **RECORDING OUTPUTS - BCD DECIMAL POINT** 1 digit. 4-line 4-2'-2-1 code. "0" state level -35 to -24.5v; "1" state level -2.5 to 0v. Source impedance 33K.

2401C

2401C

Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 12 of 15) With the HP-2401C on and operating, set FUNCTION switch to VOLT, other controls as 16. Я. specified below; determine and record dc decimal levels at the following pins of J2; shortcircuit HI, LO, and GUARD terminals to assure all zeros reading. Sample Period Decimal J2 Pins: 27 26 Range 2 1 (Volts) (Sec) Position Code: 2' 2 4 1 (10^{-0}) 1000 .01 000000.V Ō 0 σ Ō (10⁻¹) 1000 00000.0V 0 .1 0 0 1 (10-2 100 0000.00V 0 0 0 .1 1 (10-3) 000.000V 10 0 . 1 0 1 1 (10^{-4}) 1 00.0000V 0 1 0 . 1 1 (10⁻⁵) 0000,00MV . 1 . 1 0 1 1 1 (10-*) 1.0 000.000MV 1 1 0 .1 0 (10-7) 1.0 00.0000MV* .1 1 1 0 1 *With HP-2411A Guarded Data Amplifier operated at +10 gain(10 MILLIVOLTS full scale); FUNCTION switch set to EXT SEL position; HP-2411A Decimal Point Logic Card A30 installed. Set HP-2401C FUNCTION switch to FREQ, ATTENUATION control just clockwise from b. switched CHECK position, other controls as specified below; use DC Null Voltmeter to check decimal levels at the following pins of J2: Sample Period Decimal J2 Pins: 27 26 2 1 (Sec) Position 2' 2 Code: 4 1 .01 σ (10^{-1}) 00000.0KC 0 Ō 1 (10⁻²) .1 0000,00KC 0 0 0 1 (10-3) 1. 000.000KC 0 0 1 1 STOP 000000 1 0 O 1 The source impedances are determined by fixed value 33K resistors, which can be seen C. in the assembly A22 circuit diagram, Figure 4-23 or 4-24. 17. **RECORDING OUTPUTS - REFERENCE LEVELS** "0" State Level: -24.5 to -21.5v, source impedance 800Ω. "1" State Level: -5 to -4v, source impedance 380Ω . With the HP-2401C on and operating (FUNCTION: VOLT; RANGE: 10V), connect HP-2401C LO terminal to J2, pin 50 and connect HI terminal to J2 pins as specified below and record readings. Reference Measured HI Terminal to J2 Pin **Tolerance of Reading Range** + ('1" Level) 25 - 4.00 to - 5.00V 24 -⁻⁻(''0'' Level) -24.50 to -21.50V b. The source impedances are determined by fixed value 1.2K, 2.0K, and 470Ω resistors (A7R13-R15) which are shown in the A7 and A29 circuit diagram, Figure 4-12. RECORDING OUTPUTS - RECORD COMMANDS 18. "O" State Level: -24.5 to -21.5v, source impedance 5K. "1" State Level: -5 to -lv, source impedance 1K. 1 .- .

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Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 13 of 15)

18.	ę.	With the HP-2401C on and operating, set controls as follows:
		SAMPLE PERIOD: .01 SEC.
n in the second s		SAMPLING RATE: Fully clockwise.
	v	100 KC STD (rear panel): INT.
	b,	Connect Oscilloscope to pins 21 and 22 to verify "0" and "1" state levels. The Oscillo-
		scope will display the switching between these levels as a square wave with 20, 5 to 29, 5
		p-p amplitude. Record p-p signal amplitudes.
	•	The "1" state source impedance is determined by fixed value 1K resistors R6 and R7,
	υ.	which are shown in the A17 and A16 circuit diagram, Figure 4-19, connected to pins
		11 and 17 of A17. The 'O' state source impedance is determined by fixed value 3, 9K
		resistors (A17R18 and A17R21), which are also shown in Figure 4-19.
19.	EX	TERNAL PROGRAMMING - HOLD OFF INPUT
		Hold State: +1 to +12v at 4.5 ma.
	,	Non-Hold State: -1 to -35v.
	R.	With HP-2401C on and operating, set controls as follows:
		100 KC STD (rear panel): INT.
		FUNCTION: λ VOLT.
		RANGE: INT+1V. STORE/DISPLAY (rear panel); DISPLAY.
	*	SAMPLE PERIOD: .01 SEC.
		SAMPLING RATE: Fully clockwise,
-		
	h	Connect a voltage source that can be varied continuously from -2v do to +2v do to J1,
•	U,	pin p (or J1, pin 12), and connect return to J1, pin Z (or J2, pin 50). Set source for -2v de output.
	•	
	C.	Slowly adjust source for more positive (less negative) output until the HP-3401C measurement-display cycle stops. Then measure and record the hold-off voltage while the
		voltage source is still connected to the HP-1401C,
20.	EX	TERNAL PROGRAMMING - FUNCTION INPUT
		ر
		Input Requirement: External contact closure to ground'or clamp that holds input pin
		at -1V do or more positive while supplying 70 ma.Function:With no programming, VOLTS.
		"Programmable functions, FREQ and with HP-2410B Units Cou-
		pling Card A9 installed, R, AC Normal, and AC Fast.
·		
	8.	With HP-2401C on and operating, set controls as follows:
		FUNCTION: EXT SEL.
		SAMPLE PERIOD: 1 SEC.
		RANGE: 1V.
	b.	Record lighted HP-2401C units display which should be VOLTS.
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Section IV

1	Table 4-3. In-Cabinet Perfo				
0 , o,	Connect a jumper from J1 cording HP -3401C units d	, pin Z, to each of splay lighted at each	the following of test.	ther J1 pins in	durn, re-
	Jumper J1 Pin Z to Pin	Units Readout		÷.	£
	, B	KC) (
	C	n		/ • ·	
	D	AC		i i i i i i i i i i i i i i i i i i i	
	E >	· AC	,	·	
, 1. EJ	, CTERNAL PROGRAMMING -	SAMPLE PERIOD	_1	N	
	Input Requirement:	External contact of	osure to group	id or clamp the	it holds in-
	Programmable Periods:	put pin at -1V dc .01, .1, 1 SEC.	or more positi	ve while supply	ing 70 ma.
. ,	With HP-2401C on and ope	rating, set controls	as follows:	***	<u></u>
	FUNCTION:	VOLT.		A	
	SAMPLING RATE:	Cleckwise from ST	Ω D ,	(All -	
ŗ	AMPLE PERIOD:	EXT SEL.			
	RANGE:	INT+1V.			
_. b.	Connect a jumper from J1, cording digital readout at	, pin Z, to each of s each test.	he following o	ther J1 pins in	turn, re-
	Jumper J1 Pin Z to Pin	Digital Readout	Programmed	Sample Period	(Sec)
	N	+001.000V		.01	w veral
	P	+01,0000V	· · ``\	. 1	
	R				
<u> </u>	• `	+1000.00MV		1.	4
2. EX	TERNAL PROGRAMMING -)	1.	.4
2. EX		RANGE INPUT External contact el) Deure to groun	d or clamp that	t holds in-
I. EX	TERNAL PROGRAMMING -	RANGE INPUT	osure to groun r more positiv DOV. Decimal Point I	d or clamp that /e while supply logic Card A30 (ing 70 ma. Installed.
2. EX 8.	TERNAL PROGRAMMING - Input Requirement:	RANGE INPUT External contact el put pin at -1V de . 1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B Un perating and controle	osure to groun r more positiv OOV. Decimal Point I hit Coupling Ca	d or clamp that ye while supply logic Card A30 (rd A9 installed	ing 70 ma. Installed.
	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and co between the HI and LO tern	RANGE INPUT External contact el put pin at -1V dc d .1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B U perating and controls minals.	osure to groun r more positiv OOV. Decimal Point I hit Coupling Ca	d or clamp that ye while supply logic Card A30 (rd A9 installed	ing 70 ma. Installed.
	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and o between the HI and LO tern FUNCTION:	RANGE INPUT External contact el put pin at -1V de d . 1, 1, 10, 100, 10 .01V w/HP-3411A I 10M w/HP-3410B U perating and controls minals. EXT SEL.	osure to groun r more positiv OOV. Decimal Point I hit Coupling Ca	d or clamp that ye while supply logic Card A30 (rd A9 installed	ing 70 ma. Installed.
	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and co between the HI and LO tern	RANGE INPUT External contact el put pin at -1V dc d .1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B U perating and controls minals.	osure to groun r more positiv OOV. Decimal Point I hit Coupling Ca	d or clamp that ye while supply logic Card A30 (rd A9 installed	ing 70 ma. Installed.
R.	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and o between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1,	RANGE INPUT External contact el put pin at -1V de d . 1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B U perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of th	osure to groun r more positiv DoV. Decimal Point I hit Coupling Ca set as specific	d or clamp that ye while supply logic Card A30 i rd A9 installed d below, connec	ing 70 ma, installed, t a jumper
R.	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and of between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1, ing digital readout at each	RANGE INPUT External contact el put pin at -1V de d . 1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B U perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of th test. Then, disconnec	osure to groun r more positiv DOV. Decimal Point I hit Coupling Ca set as specific set as specific following other t jumper from	d or clamp that ye while supply ogic Card A30 f rd A9 installed d below, connec er J1 pins in tu HI and LO ter	ing 70 ma. installed, t a jumper t n, record minals.
R.	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and o between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1,	RANGE INPUT External contact el put pin at -1V de d . 1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B U perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of th test. Then, disconnec	osure to groun r more positiv DOV. Decimal Point I hit Coupling Ca set as specific set as specific following other t jumper from	d or clamp that ye while supply Logic Card A30 ; rd A9 installed d below, connec er J1 pins in tu HI and LO ter Programmed R	ing 70 ma. installed, t a jumper t n, record minals.
. .	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and co between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1, ing digital readout at each Jumper J1 Pin Z to Pin(e)	RANGE INPUT External contact el put pin at -1V de d . 1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B U perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of th test. Then, disconnec Approximate Digital 000.000HV 0000.00MV	osure to groun r more positiv DOV. Decimal Point I hit Coupling Ca set as specific set as specific following other t jumper from	d or clamp that ye while supply ogic Card A30 f rd A9 installed d below, connec er J1 pins in tu HI and LO ter	ing 70 ma. installed, t a jumper t n, record minals.
.	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and of between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1, ing digital readout at each Jumper J1 Pin Z to Pin(s) G H J	RANGE INPUT External contact el put pin at -1V dc d . 1, 1, 10, 100, 10 .01V w/HP-3411A I 10M w/HP-3410B U perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of the test. Then, disconnect Approximite Digital 000,000HV 0000,00MV 00,0000V	osure to groun r more positiv DOV. Decimal Point I hit Coupling Ca set as specific set as specific following other t jumper from	d or clamp that ve while supply Logic Card A30 f rd A9 installed d below, connec er J1 pins in tu HI and LO ter <u>Programmed R</u> 0. IV 1. V 10. V	ing 70 ma. installed, t a jumper t n, record minals.
. .	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and co between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1, ing digital readout at each Jumper J1 Pin Z to Pin(e) C H J K	RANGE INPUT External contact el put pin at -1V de d .1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B Un perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of the test. Then, disconnec Approximite Digital 000.000HV 0000.000V 000.000V	beure to groun ir more positiv 00V. Decimal Point I hit Coupling Ca set as specific set as specific following other t jumper from <u>Readout</u>	d or clamp that ye while supply Logic Card A30 ; rd A9 installed d below, connec d below, conn	ing 70 ma. installed, t a jumper t n, record minals.
.	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-2401C on and of between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1, ing digital readout at each Jumper J1 Pin Z to Pin(e) G H J K L	RANGE INPUT External contact el put pin at -1V dc d .1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B Un perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of th test. Then, disconnec Approximiste Digital 000,000HV 0000,000V 000,000V 0000,00V	beure to groun ir more positiv 00V. Decimal Point I hit Coupling Ca set as specific set as specific following other t jumper from <u>Readout</u>	d or clamp that ye while supply ogic Card A30 (rd A9 installed d below, connec d below, conne	ing 70 ma. Installed. It a jumper It a jumper minals.
R.	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and of between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1, ing digital readout at each Jumper J1 Pin Z to Pin(e) G H J K L G and S-W/A30	RANGE INPUT External contact el put pin at -1V de d . 1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B U perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of the test. Then, disconnee Approximinte Digital 000,000HV 0000,00V 000,000V 000,00V 000,00V 000,00V	beure to groun ir more positiv 00V. Decimal Point I hit Coupling Ca set as specific set as specific following other t jumper from <u>Readout</u>	d or clamp that ye while supply ogic Card A30 f rd A9 installed d below, connec d below, conne	ing 70 ma. installed, it a jumper it a jumper minals. ange
. .	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-2401C on and of between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1, ing digital readout at each Jumper J1 Pin Z to Pin(e) G H J K L	RANGE INPUT External contact el put pin at -1V dc d . 1, 1, 10, 100, 10 .01V w/HP-3411A I 10M w/HP-3410B Un perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of the test. Then, disconnec Approximite Digital 000,000HV 0000,00W 000,000W 000,000W 000,000W 000,000W	beure to groun ir more positiv 00V. Decimal Point I hit Coupling Ca set as specific set as specific following other t jumper from <u>Readout</u>	d or clamp that ye while supply Logic Card A30 f rd A9 installed d below, connect d below,	ing 70 ma. installed, it a jumper it a jumper minals. ange
.	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and of between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1, ing digital readout at each Jumper J1 Pin Z to Pin(s) G H J K L G and 8W/A30 G and C	RANGE INPUT External contact el put pin at -1V de d . 1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B U perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of the test. Then, disconnee Approximinte Digital 000,000HV 0000,00V 000,000V 000,00V 000,00V 000,00V	beure to groun ir more positiv 00V. Decimal Point I hit Coupling Ca set as specific set as specific following other t jumper from <u>Readout</u>	d or clamp that ye while supply Logic Card A30 ; rd A9 installed d below, connect d below,	ing 70 ma. installed, it a jumper it a jumper minals. ange
.	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-3401C on and of between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1, ing digital readout at each Jumper J1 Pin Z to Pin(e) G H J K L G and S - W/A30 G and C H and C J and C K and C	RANGE INPUT External contact el put pin at -1V dc d .1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B U perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of th test. Then, disconnec Approximinte Digital 000.000MV 000.000V 000.000WV 000.000V 000.000W 000.000W	beure to groun ir more positiv 00V. Decimal Point I hit Coupling Ca set as specific set as specific following other t jumper from <u>Readout</u>	d or clamp that ye while supply Logic Card A30 f rd A9 installed d below, connect d below,	ing 70 ma. installed, it a jumper it a jumper minals. ange
. .	TERNAL PROGRAMMING - Input Requirement: Programmable Ranges: With the HP-2401C on and of between the HI and LO tern FUNCTION: SAMPLE PERIOD: RANGE: Connect a jumper from J1, ing digital readout at each Jumper J1 Pin Z to Pin(s) G H J K L G and S - W/A30 G and C H and C J and C W/A9	RANGE INPUT External contact el put pin at -1V dc d .1, 1, 10, 100, 10 .01V w/HP-2411A I 10M w/HP-2410B Un perating and controls minals. EXT SEL. 1 SEC. 1V. pin A, to each of the test. Then, disconnect Approximinte Digital 000,000HV 0000,000W 000,000HV 000,000V 000,000W 00,000MV 00,000MC 00,000MC	osure to groun r more positiv 00V. Decimal Point I hit Coupling Ca set as specific following other i jumper from <u>Readout</u>	d or clamp that ye while supply cogic Card A30 f rd A9 installed d below, connect d below,	ing 70 ma. installed, it a jumper it a jumper minals. ange

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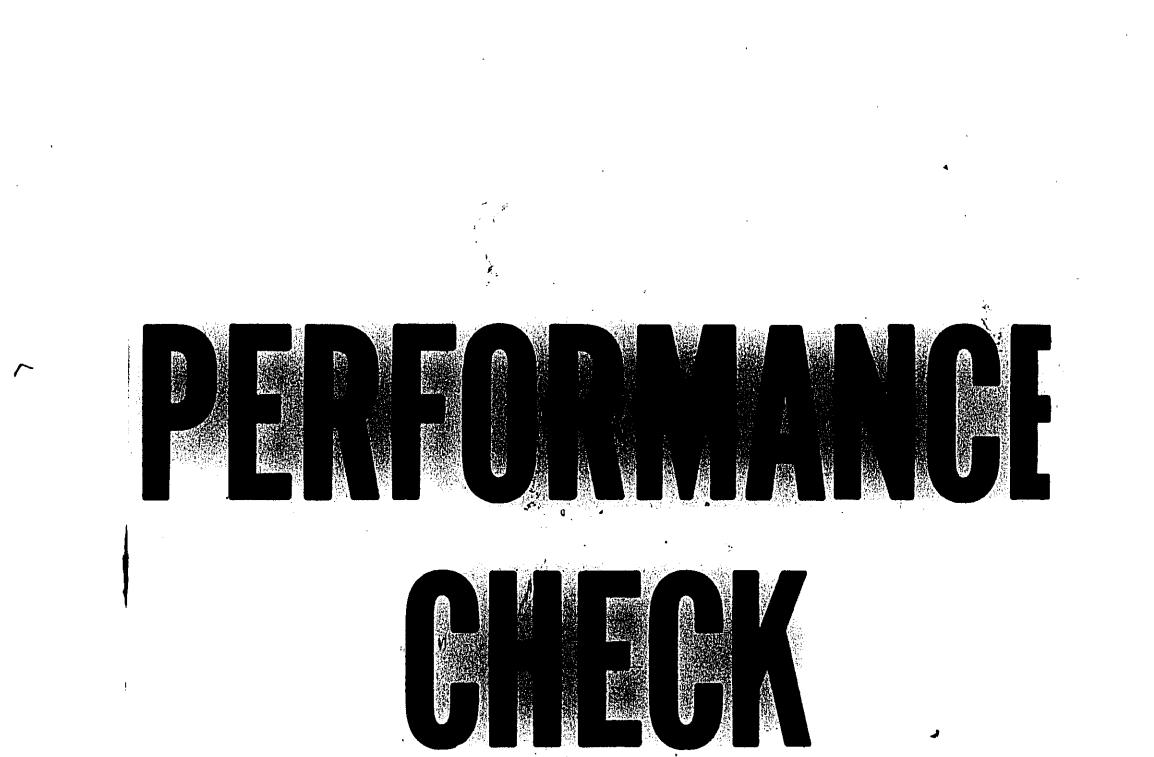
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Table 4-3. In-Cabinet Performance Checks Std & Opt. 29 Instruments (Sheet 15 of 15) EXTERNAL PROGRAMMING - SAMPLE PERIOD START/STOP Start/Stop Enabling: By contact closure to ground or clamp that holds input pin at -ly de or more positive. Sample Period Start: By contact closure to ground or -1 to +5v dc level. Sample Period Stop: By opening contact closure or -5 to -30v dc level. With the HP-2401C on and operating, set controls as follows: STORE/DISPLAY (rear panel); DISPLAY. 100 KC STD (rear panel): NT. VOLT. FUNCTION: SAMPLING RATE: Clockwise from STOP. SAMPLE PERIOD: EXT SEL. RANGE: INT+1V. Connect jumpers from J1, pin Z, to pins a and b of J1; record (start) on the test card if counting starts. c. Disconnect the jumper from pin b of J1 and record (stop) on the test card if counting stops. Then disconnect jumper from pin a. EXTERNAL PROGRAMMING - RESET External contact closure to ground or clamp that holds input pin Counter Reset Line: between 0 and -1v dc. Negative 15v, 25 μ s pulse with rise time <2 μ s to J4 on rear panel. Counter Reset Input: With HP-2401C on and operating, set SAMPLE PERIOD to .01 SEC and SAMPLING RATE to STOP; leave other controls set as specified in step a of check 23. Connect a jumper from pin Z to pin c of J1 and observe HP-2401C digital display. Record yes on test card if counting is triggered for one sample period. c. Disconnect jumper. Record no on test card if counting is not triggered. Connect Square Wave Generator 600Ω output to COUNTER RESET receptacle on rear of HP-2401C through a pulse shaping network as shown below. 0.15 3 K TO COUNTER HP 211A RESET INPUT SQUARE WAVE 39004 600 A GENERATOR N OUTPUT 1

4 15 V 2 #SEC 25 USEC

While monitoring output of pulse shaping network with an Oscilloscope, set Square Wave e. Generator for 15V p-p at 20 kHz output frequency, then for 1 Hz output frequency.

Record a yes on the test card if counting is triggered about once a second. **f**.



	SER	' ⁻	DATE	
	DESCRIPTION		CHECK RESULTS	
1.	VOLTAGE MEASUREMENT RANGES			
	.1, 1, 10, 100, 1000V readings correct .3, 3, 30, 300V readings correct?	?		
	, a, a, ao, aoo reamingo correcti		(yes)	
	Reading of overload voltage		(305-320v)	VOLTS
2.	VOLTAGE MEASUREMENT - INTEGRATION			/
	Polarity reversal reverses count?			
	Polarity symbol changes at zero?			
	Forward counting resumes at zero?		(yes)	
3.	INTERNAL TIME BASE			
	Frequency Offset From 100 kHz:			
	At start of test			p arts i n 10 ⁶
	1 week later			parts in 10 ⁶
	Aging rate difference	A	(± 2 parts in 10 ⁶)	parts in 10 ⁶
	(At 25 ±5°C ambient temperature.)			
	N	OTE	I	
	Because considerable time and a	a precisely-o	controlled temperatur	'e

chamber are required, it is anticipated that few users of the HP-2401C will check the effects of temperature upon the time base, the internal calibration standard, and voltage measurements. For this reason, no spaces are provided for entering temperature test results in any of the checks. However, procedures are presented in Table 4.3 of the handbook for those users who desire to check the effect of temperature upon the performance of the instrument.

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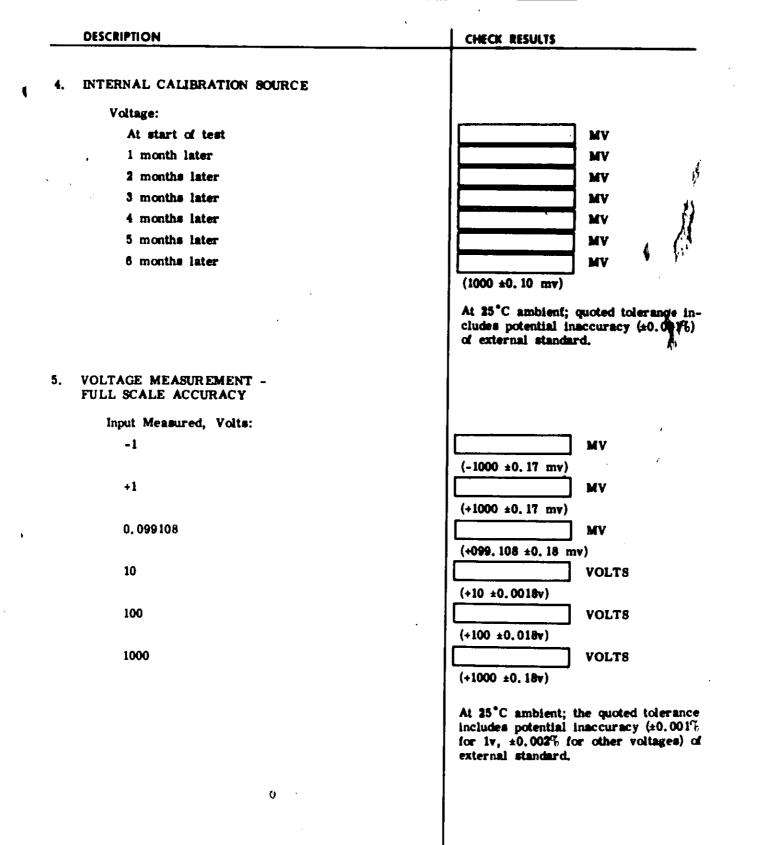
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PERFORMANCE CHECK TEST CARD





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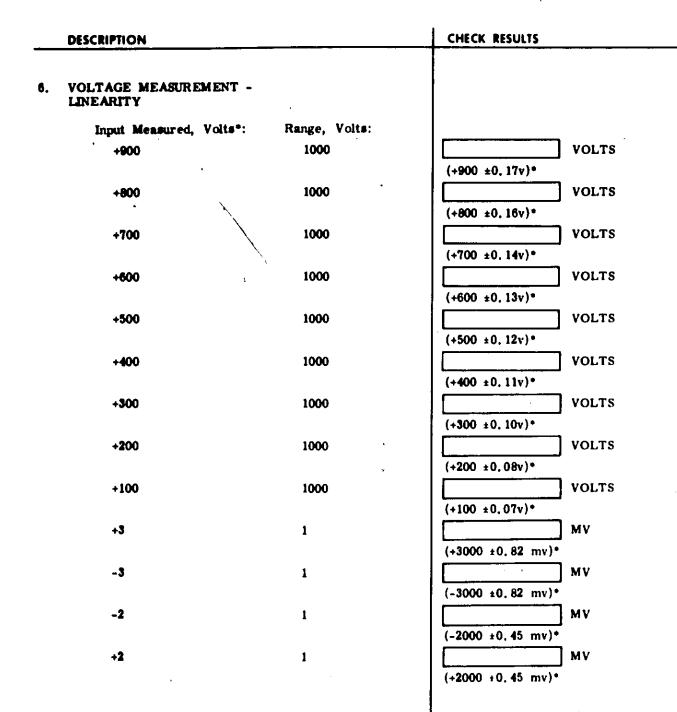
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PERFORMANCE CHECK TEST CARD

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*At 25°C ambient; quoted tolerance includes potential inaccuracy $(\pm 0, 002^{\circ})$ of external standard.

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HP-2401C PERFORMANCE CHECK TEST CARD

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—	DESCRIPTION	CHECK RESULTS
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7.	VOLTAGE MEASUREMENT - REJECTION OF COMMON MODE NOISE	
	Reading of divider input without noise	MV
	AC common mode signal required to change read- ing more than ± 2 digits:	
	1.0 sec sample period	v rms
	0.1 sec sample period	v rms
	.01 sec sample period	v rms
		(>100v rms)
8.	VOLTAGE MEASUREMENT - REJECTION OF SUPERIMPOSED NOISE	
	55 Hz signal required to affect 10 MV digit	mv rms
	550 Hz signal required to affect 10 MV digit	(>100 mv rms) [v rms (>1v rms)
	(10V range, 0.1 sec sample period.)	
9.	FREQUENCY MEASUREMENT RANGE	
	Lowest frequency of the range	KC
	Highest frequency of the range	(<000.005 kHz) [] KC (> 300.000 kHz-8td) (>1200.000 kHz-Option 29)
10.	FREQUENCY MEASUREMENT - SENSITIVITY	
	Minimum signal to trigger at 300 kHz (or 1200 kHz for Option 29)	(0. 1v rms, max., 300 kHs) (0. 5v rms, max., 1200 kHz-Option 29)
	Minimum trigger pulse amplitude (duration constant at 2 μ s)	(-1v, max.)
	Minimum trigger pulse duration (amplitude constant at -lv peak ~	(2 μs, max.) με

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	HP-2401C		PEI	rfQ		е сне ск	TEST CARD
	DESCRIPTION	· · ···					CHECK RESULTS
11.	RESPONSE TIME A	ND MEAS	ЛRЕ	MEN	IT SPEED	بند ا	*
	Reading of stea	dy 20V inp	ut				VOLTS
	Difference betw from step input				ing and r	eading	(±0.0002v, max.)
	Response time	to start of	me	asur	ement		(9.67 ±0.02 ms)
	Total Measurem	ent Times	1.				(e. 07 ±0. 02 ma)
	.01 sec sam		•				ms
							(19, 67 ±0, 02 ms)
	0,1 sec sam	ple period					ms
							(109, 67 ±0, 02 ms)
	1.0 sec sam	ple period					ms
	•,						(1009, 67 ±0, 02 ms)
12.	TIME BASE OUTPU	T (Rear P	anel)			
	Amplitude						
	- mprove					-	(1. 25 ±0. lv p-p)
13.	TIME BASE EXTER	NAL INPU	T (F	lear	Panel)	c .	
	Minimum amplit	ude requir	ed 1	to tr	igger tim	e base	(2v p-p, max.)
14.	RECORDING OUTPU BCD DATA	TS -					
	Decade:	Output	C C	orre	et At J2	Pins:	
	10° (A11)	3	4	28	29 7		
	10' (A12)	5	6	30	31?		
	10 ² (A13)	7	8	32	33?		
	10 ³ (A14)	9	10	34	35?		
	10 ⁴ (A15)	11	12	36	37 ?		
	10 ⁵ (A46)	13	14	38	39?		
							(yes)
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PERFORMANCE CHECK TEST CARD

SER. DATE _ -DESCRIPTION CHECK RESULTS 15. RECORDING OUTPUTS -BCD FUNCTION **Outputs Correct At J2 Pins** Function: <u>41 40 16 15</u> 1? +VDC 9 0 0 0 -VDC 0 ? 0 0 1 KC 0 1 ? ۵ 1 KΩ 0 ? 0 1 1 MΩ 1 ? 0 1 1 OVERLOAD 1 ? 1 1 1 VAC 1 0 0 1 ? (yes) 16. RECORDING OUTPUTS -BCD DECIMAL POINT Outputs Correct at J2 Pins <u>27 26 2 1</u> Display: 000000. V 0 0.- 0 0 ? 00000.0V 1 ? 0 0 0 0000,00V 0 0 ? A 1 000.000V 0 0 1 1 ? 00.0000V 0 0 ? 1 1 0000,00MV 1 ? Û 1 1 000,000MV 0 ? 1 0 1 00.0000MV 1 1 ? 1 Ð (yes) Note: "0" = -35 to -24.5v dc; "1" = -2.5 to 0v dc. 17. RECORDING OUTPUTS -REFERENCE LEVELS "1" state reference at J2, pin 25 v dc .(-5 to -4v dc) "O" state reference at J2, pin 24 X v dc (-24, 5 to -21, 5v dc)

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PERFORMANCE CHECK TEST CARD

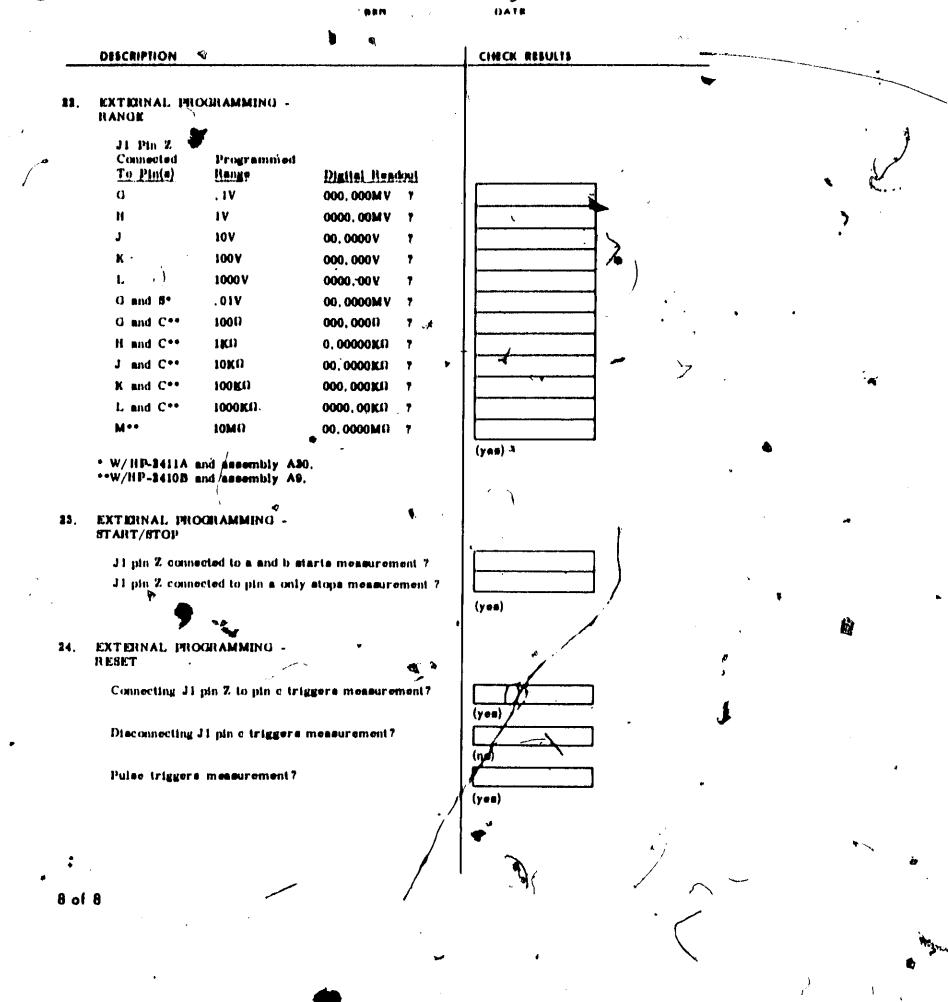
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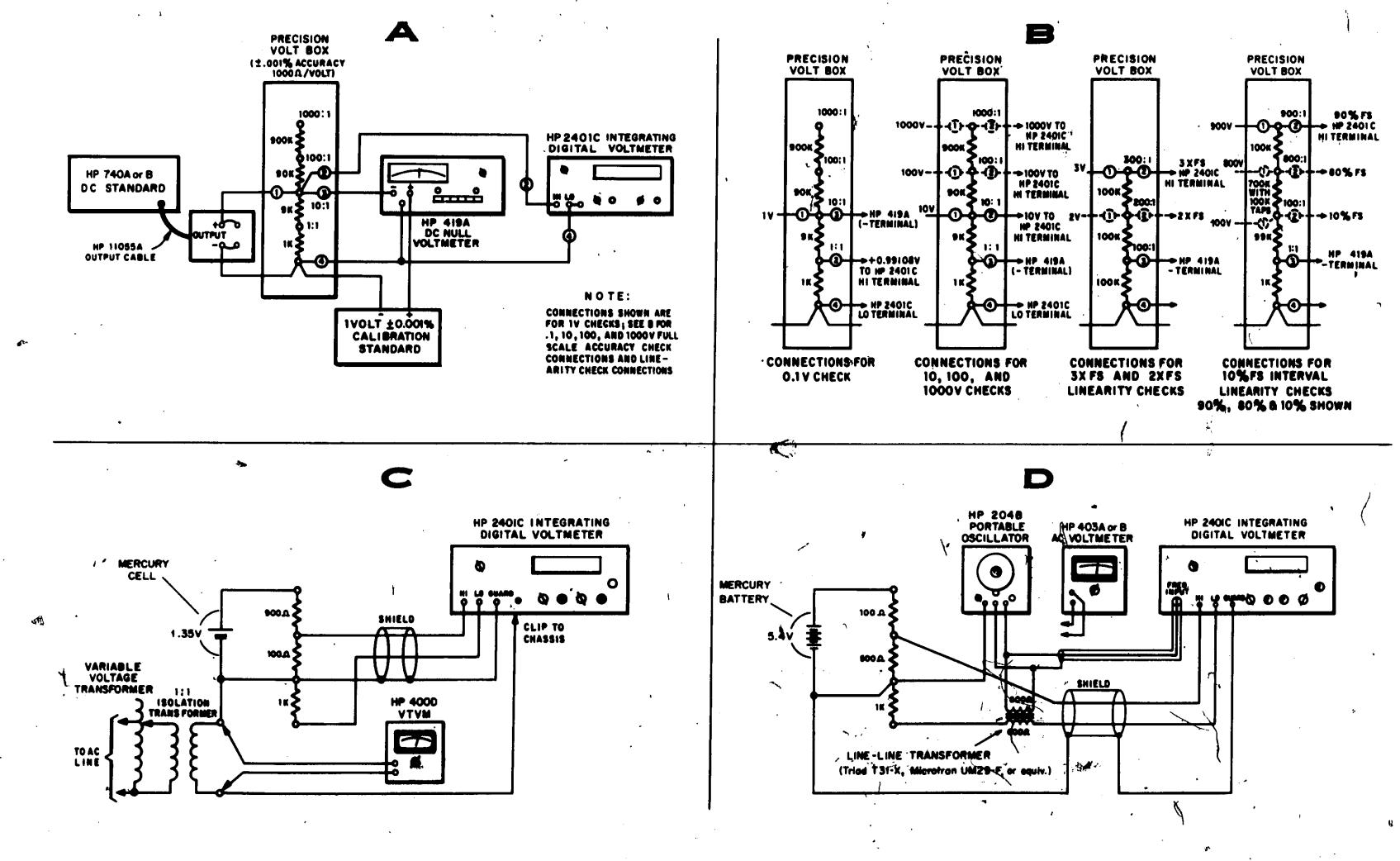
			SER _	<u> </u>	DATE	
	DESCRIPTION	, 			CHECK RESULTS	<u> </u>
18.	RECORDING RECORD CO	OUTPUTS - Mmands			•	. .
	-Record a	mplitude at J2,	, pin 21			v р-р
		mplitude at J2,				v p-p
					(20.5 to 29.5v p-p)	
19.	EXTERNAL 1 HOLDOFF	PROGRAMMINC	J			•
	Hold-off v	oltage			· · ·	v dc
/					(between - & +1v d	-
						G) ∰r.
20.	EXTERNAL I FUNCTION	ROGRAMMING	i -		-	,
	J1 Pin Z					
	Connected	Programmed	l	•		
	<u>To Pin</u> None	VDC			UNITS READOUT	101.00
	B	FREQ				VOLTS
	C	OHMS				κς Ω
	D	VAC				
	E	VAC				AC VOLTS
	E		ŧ			AC VOLTS
21.	EXTERNAL P SAMPLE PER	ROGRAMMING IOD	- :			- `
	J1 Pin Z	Programmed				
	Connected	Sample		4		
	<u>To Pin</u>	Period	Digital Readout	•		
	N	.01 Sec	+001,000V ?			
	Р	0.1 Sec	+01.0000V ?			
	R	1.0 Sec	+1000,00MV ?			
		Se la constante de la constant		•	(yes)	
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PERFORMANCE CHECK TEST CARD



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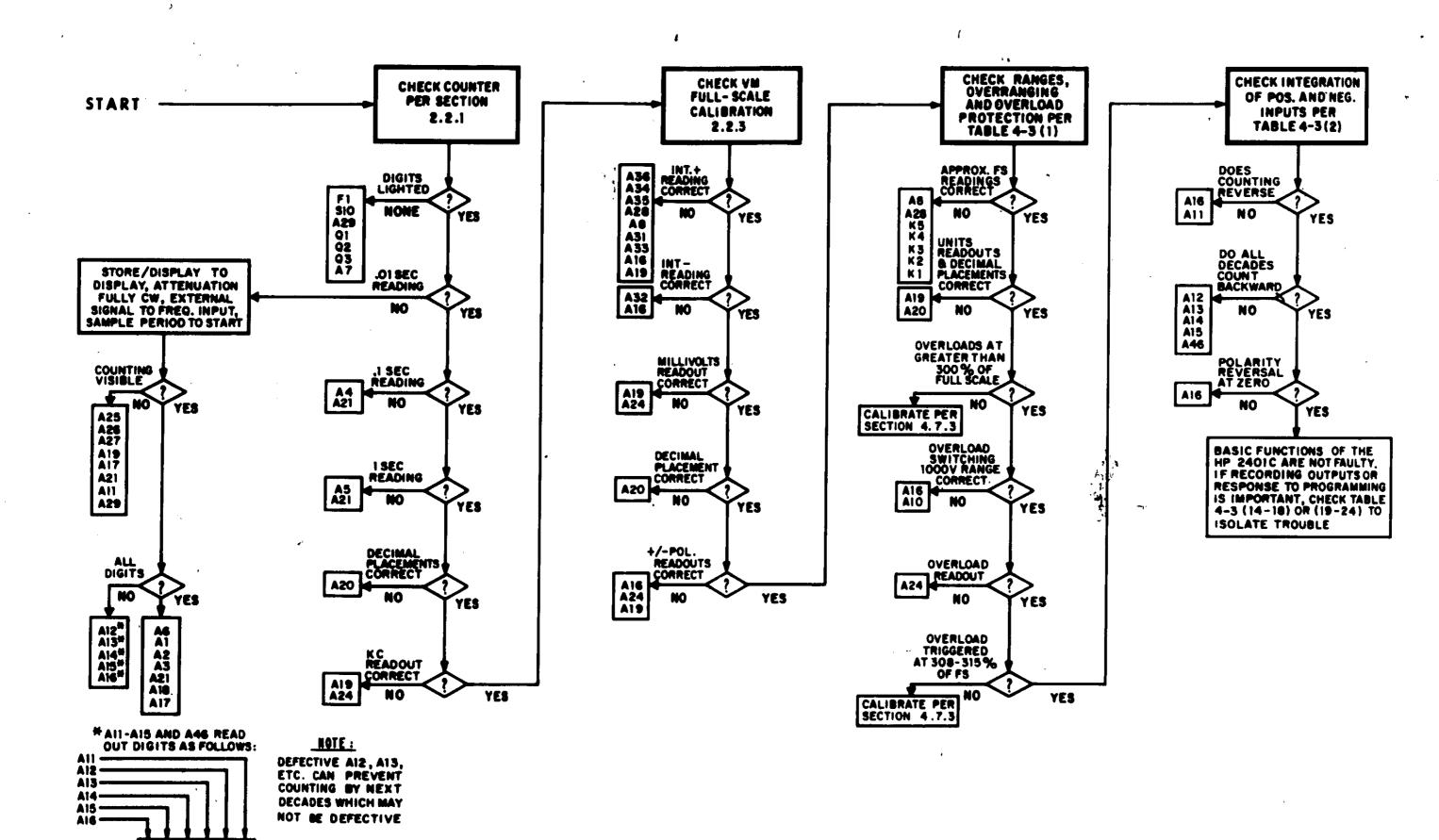


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Section IV



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Figure 4-2. Troubleshooting

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4.3 AIR FILTER

Inspect the air filter (center of rear panel) regularly and clean it before it becomes dirty enough to restrict air flow. Proceed as follows:

- a. Remove filter-housing assembly (unlock the two quarter-turn fasteners and slide housing to rear).
- b. Wash filter in warm water and detergent.
- c. Remove cleaning solution from filter-housing assembly by shaking. Allow the assembly to dry completely before securing it to the rear panel.

CAUTION

DO NOT APPLY ANY COATING COMPOUND TO THE FILTER.

4.4 TROUBLESHOOTING

When trouble is suspected it can often be isolated rapidly to a specific assembly or group of assemblies by performing a series of brief checks, such as those diagrammed in Figure 4-2. From start, and before the instrument's cover is removed, the counter is checked, with various aspects of the check results diagrammed as diamond-shaped decision points. The decision point "yes" outputs form a main sequence that leads to and through the voltmeter (VM) full-scale calibration check, the range-overranging-overload check, and the integration check. "No" outputs point leftward toward checks off the main sequence or toward the component(s) that could cause an incorrect check result at the decision point.

After the initial check has isolated the trouble area, remove the instrument cover per Section 4-5 to permit completion of troubleshooting and repair. This next stage of troubleshooting may be greatly simplified by substituting for each suspected assembly in turn a spare assembly that is known to be operating correctly. Component assembly locations in the HP-2401C are indexed in Table 4-4 and illustrated in Figures 4-3 and 4-4. When the faulty assembly is found, trouble may then be traced to the defective component, or the faulty assembly may be shipped to your Hewlett-Packard field office for repair

If spare assemblies are not available for troubleshooting by substitution, the strouble must be located by signal tracing with oscilloscope and voltmeter. This procedure is also used to locate defective components on a faulty assembly. The HP-2401C overall logic diagram, Figures 4-7 through 4-9 and the wiring diagram, Figure 4-34, are provided to assist the signal tracing process. Equally useful are the detailed parts placement illustrations, circuit diagrams, and circuit descriptions for each assembly that are indexed in Table 4-4, with the assembly locations. For easy access to assembly circuits during operation, use the printed circuit assembly extension card provided with your instrument.

4.5 INSTRUMENT COVER REMOVAL AND ACCESS TO ASSEMBLIES

To remove the top wraparound cover, unscrew the six screws from the lower right and lower left sides of the instrument. The top cover may then be lifted from the instrument.

WARNING

DISCONNECT ANY HIGH POTENTIAL (MORE THAN 50 VOLTS) FROM THE HIGH, LO, AND GUARD TERMINALS TO ELIMINATE SHOCK HAZARD AT THE VFC CHASSIS AND SHIELD PLATES.

Remove the upper shield plate from the vfc by pulling up on the white plastic fasteners. All components shown in Figure 4-3(A) should now be visible. For access to components shown in Figure 4-3(B) pull up on white plastic fasteners at corners of the integrating amplifier card rack.

With the instrument upside down, unscrew the seven attaching screws and remove the bottom cover. The lower vfc shield plate is removed in the same manner as the upper shield. For access to the precision resistors in A28, remove both attaching screws and the cover. These operations expose the components shown in Figure 4-4(A). For access to the components shown in Figure 4-4(B), release the swing chassis fasteners and open the swing chassis.

When replacing plug-in printed circuit assemblies and other components, make certain they are installed in the correct place. Reverse the procedure used to gain access to assemblies when troubleshooting, repair, and calibration of the HP-2401C are completed.

4.6 REPAIR

4.6.1 Assemblies That Should Not Be Repaired in The Field

Satisfactory repair of certain assemblies is difficult to achieve without special training and/or special equipment. Consequently, it is recommended that these assemblies be returned to your Hewlett-Packard field office for repair. The assemblies which should receive this treatment are as follows:

- a. Integrating Operational Amplifier A31.
- b. Trigger Level Detector A32 or A33 -- if R1, R2, R5, R6 or T1 must be replaced.
- c. Reversible Decade Counter A11-A15, or A46 -- if photoconductor plate V1 must be replaced.

4.6.2 Replacement of Components on Printed Circuit Assemblies

Component lead holes in the printed circuit boards have plated walls to assure good electrical contact on the opposite sides of the board. Apply heat sparingly and work carefully to avoid damage to this plating.

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The following replacement procedure is recommended:

- a. Remove defective component.
- b. Melt solder in component lead holes, using clean dry soldering iron to remove excess solder. Clean holes with a toothpick or woooden splinter. Do not use a metal tool for cleaning because it may damage the throughhole plating.
- c. Shape leads of new component to match those of component being replaced and insert leads into the lead holes. Make certain diodes and capacitors are oriented correctly, then solder the component in place, using heat and solder sparingly.
- d. Repair any breaks in through-hole plating (indicated by separation of the round conductor pad on either side of the board) by pressing the conductor pads against the board and soldering component lead to pads on both sides of the board.

CAUTION

Use only rosin-core solder or rosin flux for soldering components of the HP-2401C. Use of other fluxes for soldering can cause erratic and unsatisfactory performance.

4.6.3 Post-Repair Cleanup

Failure to clean a printed circuit board or other assembly after repair can be a prime cause of substandard performance. Performance of attenuator A28, integrating amplifier A31, and trigger level detectors A32 and A33 is particularly susceptible to lowering of leakage resistance and electrolytic effects caused by soldering flux, spattered solder, bits of wire, finger marks, etc. It is partly because of this susceptibility that factory repair of A31, A32, and A33 is strongly recommended.

When cleaning, it is most important to keep in mind that solvents can damage certain parts if not used carefully. The photoconductors in that photochopper assembly on A31, the photodecoder on the counting/display decades, and other plastic encased parts are definitely subject to damage from solvents. For this Teason, any cleaning solvent should be selected carefully and applied sparingly. <u>Particularly to be avoided is the total immersion of any assembly in a solvent bath of any sort</u>. The best way to clean a repaired assembly is with Isopropyl Alcohol or with a rosin solvent, such as Dupont TE-35 Freon (HP stock number 8500-0275). The solvent should be applied with a cottontipped swab, such as a Q-tip, that is used to scrub-clean the repaired area. All solvent should then be wiped off with a dry swab.

4.7 CALIBRATION

For normal day-to-day operation of the HP-2401C only the zero and full-scale calibration adjustments specified in Sections 2.2.2 and 2.2.3 are required. The calibration adjustments given in this section should be accomplished at the intervals specified in Table 4-2, or to correct power supply-output volt-ages or substandard performance.

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The instrument should be calibrated only if correct test equipment, operating within its calibration period, is used. The instrument should be given a 1-1/2 hour warmup at operating temperature before any adjustment is made.

4.7.1 Adjustment of -12.3V Power Supply Output

With the DC Standard Differential Voltmeter measure the potential across filter capacitor C32. If the potential is not within ± 0.002 volts of 12.3 volts adjust A35R9 for exactly 12.3 volts across C32. (See Figure 4-3(B) for locations.) Tap circuit board A35 to verify stability of the setting; if necessary, reset A35R9 for 12.3 volt output.

4.7.2 Adjustment of -35V Power Supply Output

With the DC Standard Differential Voltmeter measure the potential across filter capacitor C10. If the potential is not within ± 0.15 volts of 35 volts, adjust A7R10 for exactly 35 volts across C10. (See Figures 4-3(A) and 4-4(B) for locations.)

4.7.3 Calibration of Overload Detection

Calibrate Overload Detection whenever the OVERLOAD indicator is lighted by an overrange input that is less than 305% of full scale or greater than 320% of full scale. (See performance check 1, Table 4-3.) Proceed as follows:

- a. On any range but the 0.1v range, apply a negative dc input voltage that is 312.5% of full scale on the next lower range. (For example, apply-31.25% vdc to the HP-2401O set for 100v range.)
- b. Select next lower range and check for OVERLOAD indication.
- c. If OVERLOAD indicator does not light, slowly adjust A10R2 counterclockwise to make it light. (See Figure 4-3 for location of adjustments.)
- d. If OVERLOAD indicator lights in step b, set A10R2 clockwise until it no longer lights, then perform step c.
- e. Repeat steps a-d with positive input voltage, but set A16R86 for correct response instead of A10R2.

4.7.4 Calibration of Internal IV Reference Standard

Whenever the internal reference reading obtained from performance check 4 of Table 4-3 is not within ± 0.10 millivolts of 1000.00 MILLIVOLTS, set A35R21 to obtain a reading of 1000 ± 0.02 MILLIVOLTS. Tap circuit board A35 to verify mechanical stability of the setting; if necessary, reset A35-

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R21 for correct output from the internal reference standard. (See Figure 4-3B for location of A35R21.)

4.7.5 Calibration of Internal Time Base

Whenever the horizontal drift of the internal reference square wave, determined in performance check 3 of Table 4-3, exceeds 2 centimeters in 1 second, set capacitor C4 for minimum drift. Improve brightness of oscilloscope display by synchronizing from 100 kHz output of Frequency Standard. (See Figure 4-3(A) for location of C4.)

4.7.6 Coarse Full-Scale Calibration Adjustments (Figure 4-4A)

Perform these adjustments only after replacement of printed circuit assembly A31, A32, or A33 or parts on any of these assemblies. Gain access to adjustments per Section 4.5 (leaving A28 shield in place) and proceed as follows:

- a. Zero the instrument per Section 2.2.2.
- b. Set the RANGE switch to $INT+\overline{1V}$ and mechanically center the front panel CAL+ adjustment.
- c. Set A33R4, the +FULL SCALE CAL ADJustment, for reading of +1000.00 ±0.20 MILLIVOLTS. Tap plug-in assembly A33 to check mechanical stability of the setting; if necessary, reset A33R4 for correct reading.
- d. Repeat steps b and c with the RANGE switch at INT-1V and the CALadjustment centered. Set A32R4 for reading of -1000.00 ± 0.20 MILLI-VOLTS.
- e. Complete normal full-scale calibration of the HP-2401C per Section 2.2.3.

4.7.7 + And - Trigger Level Adjustments

Perform either or both of these adjustments after replacement of printed circuit assembly A32 or A33 or parts on either of these assemblies. With top and bottom of the instrument both accessible as shown in Figures 4-3(A) and 4-4(A), proceed as follows:

- a. Set the RANGE switch to INT+1V.
- b. With oscilloscope, monitor waveform at A31(15); ground oscilloscope probe at A31(P29). See Figure 4-3(A) for locations of A31(15) and (P29).
- c. Set A33R27 for a maximum negative peak amplitude of -0.1v.

NOTE

See Figure 4-4(A) for locations of A33R27 and A32R27.

d. Bet the RANGE switch to INT-IV.

e. Bet A32R27 for a maximum positive peak of +0, 1v.

4.7.8 'Input Attenuator Calibration

Calibration of the input attenuator requires the equipment and setup used for performance check 5 in Table 4-3. Gain screas to adjustment, as specified in Section 4.5, but do not remove the A28 cover shield. Proceed as follows (see Figures 4-1(A) and (B), and 4-4(A):

a. Zero the HP-2401C using the procedure in Section 2.2.2.

b. Connect the DC Standard, DC Null Voltmeter, 1 Volt Calibration Standard, Precision Volt Box, and HP-2401C as shown in Figures 4-1(A) "and (B) for 0, 1V check.

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Operate the DC Null Voltmeter from its internal batteries; do not connect it to the ac line.

- c. Set the DC Standard output voltage to produce a null on the most sensitive range of the DC Null Voltmeter.
- d. On the HP-2401C, set the RANGE switch to . 1V and the CAL+ adjustment for +99, 108 MILLIVOLTS/reading.

NOTE

The 100K input impedance of the HP-2401C on the . 1V RANGE loads the output of the Precision Volt Box so that the input voltage is +00.108 millivolts.

- e. Change HP-2401C connection to that shown in Figure 4-1(A) for 1V check.
- f. Set HP-2401C RANGE switch to 1V and set the 1V calibration objustment (marked on A28 cover) for +1000.00 MILLIVOLTS reading.
- g. Change connections to those shown in Figure 4-1(B) for 10V check and set DC Standard to produce a null on the most sensitive range of the DC Null Voltmeter.
- h. Set RANGE switch to 10V and set the 10V calibration adjustment for +10,0000 VOLTS reading.

1. Change connections to those shown in Figure 4-1(B) for 100V check and set DC Standard to produce a null on the most sensitive range of the DC Null Voltmeter, ١.

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- j. Set RANGE switch to 100V and set the 100V calibration adjustment for +100.000 VOLTS reading.
- k. Change connections to those shown in Figure 4-1(B) for 1000V check and set DC Standard to produce a null on the most sensitive range of the DC Null Voltmeter.
- 1. Set RANGE switch to 1000Y and set the 1000V calibration adjustment for +1000.00 VOLTS reading.

4.7.9 Overrange Linearity Adjustment (See Figure 4.47A)

The negative and positive overrange linearity adjustments of the HP-2401C are A32R32 and A33R32. These adjustments are set at the factory to provide overrange accuracy better than that specified for the instrument and should not be reset unless improved overranging linearity is absolutely necessary. An adjustable dc standard capable of supplying a suftable range of positive or negative voltages that are known accurately to $\pm 0.002\%$ or better is required. If such a standard is available, overranging linearity can be optimized by the following general procedure:

- a. After 1-1/2 hour warmup, zero the HP-2401C per Section 2.2.2. Perform , the full-scale adjustments in Section 2.2.3, but use the 1V RANGE and (and -1.00000 volt inputs from the dc.standgrd.
- b. Before touching A32R32 or A33R32, make a complete plot from full scale to three times full scale, at 0.1 full scale or shorter intervals, of the high or low deviation of HP-2401C readings from the known voltages supplied by the dc standard. Plot both positive and negative inputs.
- c. If the linearity characteristic plotted in step b is unacceptable, adjust A32R32 or A33R32 to correct it. When capacitor C6 (Figure 4-29) is next to R32, clockwise adjustment of R32 compensates for low readings. If an inductor is in the C6 position, clockwise adjustment of R32 compensates for high readings.
- d. Repeat stops b and c, until acceptable linearity is achieved. Then reset coarse full scale calibration adjustments as specified in Section 4.7.6.

4.7.10 Photochopper Drive Oscillator Adjustment

The DRIVE OSC ADJ resistor sets the frequency of the photochopper drive oscillator. On instruments with Bertal Prefix 501-, this adjustment is located on the base of the swing chassis card rack as shown in the inset on Figure 4-3 (B). On instruments with Bertal Prefix 521- and above, this adjustment is located on assembly A31 (see Figure 4-30). The frequency should be 240 \pm 5Hz when line voltage to the HP-2401C is at 102 or 204 vac. The frequency may be counted through a high impedance probe at either terminal of A31C27 when the drive oscillator cover is removed as shown in Figure 4-30.

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Table 4-4. Component Locations and Theory Index (Sheet 1 of 2)

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Table 4-4. Component Location and Theory Index (Sheet 2 of 2)

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7 Trigger Circuit 4-3 4-27 & 4.28 3.9 3-16 8 Attenuator 4-4 4-20 3.2,1 3-3 9 +6V Bias Circuit 4-3 4-12 3.17,3 3-26 9 +6V Bias Circuit 4-3 4-12 3.17,3 3-26 R3 Beries regulator Q3 multicer filter output load 9 +6V Bias Circuit 4-3 4-12 3.17,3 3-26 R4 10 kits check sitemator 10 kits check sitemator </td <td></td> <td>•</td> <td></td> <td></td> <td></td> <td></td> <td>Q1-Q3</td> <td>-35V supply series regulator</td> <td>4 - 3</td> <td>4 - 12</td>		•					Q1-Q3	-35V supply series regulator	4 - 3	4 - 12
A tigger Circuit 4-3 4-27 & 4-20 3, 2, 1 3-10 R1 Current limiting 8 Attenuator 4-4 4-20 3, 2, 1 3-3 R2 -37 V rectifier filter output load 0** Hp-2411A Decimal Point Logic 4-4 4-31 3, 12, 2 3-25 R4 10 kits check attenuator 1 Integrating Operational Amplifier 4-3 4-30 3, 2, 2 3-3 R6, R0 Capacitor C1 discharge 2 Negative Trigger Level Detector 4-4 4-20 3, 2, 3 3-6 R46 Attenuator resider, 1V range 3 Positive Trigger Level Detector 4-4 4-20 3, 2, 3 3-6 R46 Attenuator resized, 1V range 6 Geries Regulator 4-3 4-32 3, 10, 2 3-25 R61, R02 4 -channel output transformer (T5, T4) load 6 Geries Regulator 4-4 4-32 3, 10, 2 3-25 R51 Attenuator relay delay Attenuator K 428R106 A28R101, A28R107 Attenuator relay delay					·		Resistors			
9 +6V Bias Circuit 4-3 4-12 3, 17, 3 3-25 R3 Series regulator Q2 emitter load 0** Hp-2411A Decimal Point Logic 4-4 4-31 3, 12, 2 3-20 R4 10 kits objects attenuator Q2 emitter load 1 Integrating Operational Amplifier 4-3 4-30 3, 2, 2 3-3 R6, R7 + 4 - record command source R8, R7 + 6 - record command source R8, R7 + 6 - record command source R8, R7 + 6 - regulator R6, R7 + 6 - record command source R8, R0 Counter trigger differentiating R8 Attenuator resider, 1V market R8 R8 <td>7</td> <td>Trigger Circuit</td> <td>4-3</td> <td>4-27 & 4-28</td> <td>3,9</td> <td>3-16</td> <td></td> <td>Current limiting</td> <td>4 - 4</td> <td>4 - 12</td>	7	Trigger Circuit	4-3	4-27 & 4-28	3,9	3-16		Current limiting	4 - 4	4 - 12
Wey Haw Circuit 4-3 4-12 5, 17, 3 5-23 Wey Haw Circuit 4-3 4-13 3, 12, 2 3-20 Hyp-2411A Decimal Point Logic 4-4 4-31 3, 12, 2 3-20 I Integrating Operational Amplifier 4-3 4-30 3, 2, 2 3-3 R6, R0 Counter trigger differentiating -record command source R6, R0 Part of cal/zero divider network R6 R6 Calibration Blandard & 4-3 -32 3, 18, 3 3 25 Power Supply Amplifier 4-4 4-3 3, 5, 2 3-13 -record of al/zero divider network I V Relay Timing 4-4 4-4 -32 3, 16, 1 3-25	8	Attenuator	4-4	4 - 29	3, 2, 1	3-3			4 - 4	4 - 12
D** HP-2411A Decimal Point Logic 4-4 4-31 3, 12, 2 3-20 R6 R7 4 secord command source R6, R7 4 4 secord command source R6, R7 4 secord command source R6, R7 4 secord command source R6, R7 4 secord command source R6, R7 secord command source	0	+6V Bias Circuit	4-3	4-12	3, 17, 3	3-25			4-4	4-12 4-27 & 28
Integrating Operational Amplifier 4-3 4-30 3.2.2 3-3 Ré, R7 4 & -record dommand source Counter trigger differentiating Positive Trigger Level Detector 4-4 4-20 3.2.3 3-6 Ré, R0 Counter trigger differentiating Counter trigger differentiating A Series Regulator 4-3 4-32 3.16.2 3-25 Calibration Blandard & 4-3 4-32 3.18.3 3-25 Power Supply Amplifier 4-4 4-13 3.6.2 3-13 Puplied with the HP-2410B. upplied with the HP-2410B. Filter Board is installed in the A30 position if the HP-2401C is or- red by itself). Fransformers Transformers Crystals T1 Power for -35, +6, +150V power supply 6 iV Calibration Blandard 4 -channel output T) * *	RP-2411A Decimal Point Logic	4-4			3-20			4-4	4-27 67 20
2 Negative Trigger Level Detector 4.4 4.29 3.2,3 3.6 3 Positive Trigger Level Detector 4.4 4.29 3.2,3 3.6 4 Series Regulator 4.3 4.32 3.10,2 3.25 5 Calibration Standard 4 4.3 4.32 3.10,3 3.26 6 Calibration Standard 4 4.3 4.32 3.10,1 3.25 7 IV Relay Timing 4.4 4.33 3.6,2 3.13 7 IV Relay Timing 4.4 4.13 3.6,2 3.13 8 Filter Board 4.4 4.13 3.6,2 3.13 8 Filter Board 4.4 4.13 3.6,2 3.13 8 RAMPLE RATE control network 62 FUNCTION 62 8 RAMPLE PEXIOD 65 SAMPLE PEXIOD 65 8 Ramplied with the HP-2410B. Kupplied in the A30 position if the HP-2401Ch is or-leard output 100kHz for time base oscillator A6 4								· · · · · · · · · · · · · · · · · · ·	4 - 4	4-19
S Positive Trigger Level Detector 4-4 4-29 3.2.3 3-6 R49 Part of cal+/Eero divider network A Beries Regulator 4-3 4-32 3.16.2 3-25 R49 Part of cal+/Eero divider network Part of cal+/Eero divider network 5 Calibration Standard & 4-3 4-32 3.16.3 3 25 A28R101, A28R102 Attenuator relay delay 7 Power Supply Amplifier 6 Filter Board 4-4 4-13 3.5.2 3-13 7 IV Relay Timing 4-4 4-13 3.5.2 3-13 55 SAMPLE RATE control network 6 80 Filter Board 4-4 4-13 3.5.2 3-13 55 81 RANGE 7 IV Relay Timing 4-4 4-13 3.5.2 3-13 55 83 SAMPLE PLETION 6 80 FUNCTION 63 SAMPLE PLETION 63 SAMPLE PLETION 63 SAMPLE PLETION 63 SAMPLE PLETION (et al.) 64 74 HP-2410B. Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401Ch is or-lered by itself)									4-4	4-15, 16, 2
3 Positive Trigger Level Detector 4-4 4-20 3. 2.3 30 4 Beries Regulator 4-3 4-32 3. 18. 2 3-25 5 Calibration Standard & 4-3 4-32 3. 18. 3 3 25 6 Calibration Standard & 4-3 4-32 3. 18. 1 3 25 7 Power Supply Amplifier 7 1V Relay Timing 4-4 4-13 3. 5. 2 3-13 7 1V Relay Timing 4-4 4-13 3. 5. 2 3-13 8 8 8 Sapplied with the HP-2410B. Supplied with the HP-2410B. Supplied with the HP-2410B. 4.30 position if the HP-2401C is or-leard Crystals Y1 100kHz for time base oscillator A6			4 - 4	4-29					4 - 3 4 - 4	4 - 2 9 4 - 2 9
4 Beries Regulator 4-3 4-32 3.16.2 3-25 5 Calibration Standard 6 4-3 4-32 3.16.3 3 25 7 Power Supply Amplifier 4-4 4-32 3.18.1 3-25 8 Filter Board 4-4 4-32 3.18.1 3-25 9 Filter Board 4-4 4-13 3.5.2 3.13 1V Relay Timing 4-4 4-13 3.5.2 3.13 6 Filter Board 4-4 4-13 3.5.2 3.13 7 IV Relay Timing 4-4 4-13 3.5.2 3.13 8 SAMPLE RATE control network 51 RANGE 62 FUNCTION 63 SAMPLE PERIOD 65 83 SAMPLE PERIOD 65 SAMPLE VERIOD 65 71 Power for -35, +6, +150V power supplies 4 4 72 Power for -35, +6, +150V power supplies 4 72 74 To mane formers T1 Power for +12, 3V power supplies 4 74 To mane formers Y1	3	Positive Trigger Level Detector	4-4	4-29	3, 2, 3	3-6			4-3	4-20
5 Calibration Blandard 4 4-3 4-32 3.18.3 3 25 Attenuator relay delay Attenuator relay delay 6 Filter Board 4-4 4-32 3.18.1 3-25 SAMPLE RATE control network SAMPLE RATE control network 7 IV Relay Timing 4-4 4-13 3.5.2 3-13 State Sample Control network Sample Control network <t< td=""><td>4</td><td>Series Regulator</td><td>4 - 3</td><td>4-32</td><td>3, 16, 2</td><td>3 - 25</td><td></td><td></td><td>4 - 3</td><td>4 - 2 9</td></t<>	4	Series Regulator	4 - 3	4-32	3 , 16, 2	3 - 25			4 - 3	4 - 2 9
Power Bupply Amplifier 0 Filter Board 4-4 4-32 3.18.1 3-25 7 1V Relay Timing 4-4 4-13 3.5.2 3-13 81 RANGE 81 BANPLE PERIOD 68 82 FUNCTION 83 BAMPLE PERIOD 68 85 BAMPLE PERIOD 68 85 84 81	5	Calibration Standard &	4 - 3	4 - 32	3, 18, 3	3 25			4 - 4	4 - 13
0 Filter Board 4-4 4-32 3.18.1 3-25 7 IV Relay Timing 4-4 4-13 3.5.2 3-13 81 RANGE 82 FUNCTION 83 82 FUNCTION 83 8AM PLLE PERIOD 83 83 BAM PLING RATE 83 8AM PLING RATE 44 7 IV Relay Timing 4-4 4-13 3.5.2 3-13 8 FUNCTION 83 SAM PLING RATE 83 9 Function Standard 44 44 44 9 Function Standard 45 44 4								GAMDIE DATE control natural	4 -4	4-19
7 iV Relay Timing 4-4 4-13 3.5.2 3-13 81 RANGE 82 FUNCTION 83 8AM PLE PERIOD 83 83 BAM PLING RATE 85 8AM PLING RATE Transformers T1 Power for -35, +6, ±150V power supplies T2 Power for ±12.3V power supply & 1V Calibration Standard 4 Supplied with the HP-2410B. 4 Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- Crystals Y1 100kHz for time base oscillator A6	6	Filter Board	4 - 4	4 - 32	3, 10, 1	3 - 25		SAMPLE RATE CONTOL NOWORK	4-4	
Bupplied with the HP-2410B. Supplied with the HP-2410B. Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- lered by itself). Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- Lered by itself). Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- Lered by itself). Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- Lered by itself). Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- Lered by itself). Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- Lered by itself).							81	KANGE	4 - 3	4 713 6 29
Buplied with the HP-2410B. Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- dered by itself). B5 BAMPLING RATE Transformers T1 Power for -35, +6, ±150V power supplies T2 Power for ±12.3V power supplies T4, T5. + 4 -channel output V1 100kHz for time base oscillator A6	•		4 - 4	4 - 1 ()	J. U. K	0-10			4 - 4	4-13 20 4
Bupplied with the HP-2410B. Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401Ch is or- tered by itself).						•			4 - 4 4 - 4	4-19, 20 & 4-19
T1 Power for -35, +6, ±150V power supplies 4 Power for ±12, 5V power supply & 1V Calibration Standard 4 74, 75. + 4 -channel output 4 Bupplied with the HP-2410B. Crystals Y1 100kHz for time base oscillator A6 4		1		•		*6			n j - nj	4-10
Bupplied with the HP-2410B. Bupplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- dered by itself).										
Supplied with the HP-2410B. Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- dered by itself). T4, T5. Y1 100kHz for time base oscillator A6 t									4-3	4 - 12
Supplied with the HP-2410B. Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- dered by itself).	<u> </u>								rd 4-4 4-3	4 - 32 4 - 29
Supplied with the HP-2411A (a jumper board is installed in the A30 position if the HP-2401C is or- dered by itself).	Supplied wit	h the HP-2410B.							1 - U	* ** **
dered by itself).			installed in th	he A30 pomition if	the HP-24	010 1s or-				_
- 28					· · · · · · · · · · · ·		1 Y J	100kHz for time base oscillator A6	4-3	4 - 11
28	-					~		€		ł.
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Section IV

4.7.11 Adjustment Fer Pulse Measurement (Figures 4-27 or 4-28)

Optimum adjustment for pulse measurement will differ from the factory-set optimum sine wave adjustment. Use this adjustment only for pulse measurements. Input Trigger A27 may be adjusted for either positive or negative pulse measurements at frequencies between 5 Hz and 300 kHz (1.2 MHz with Option 29).

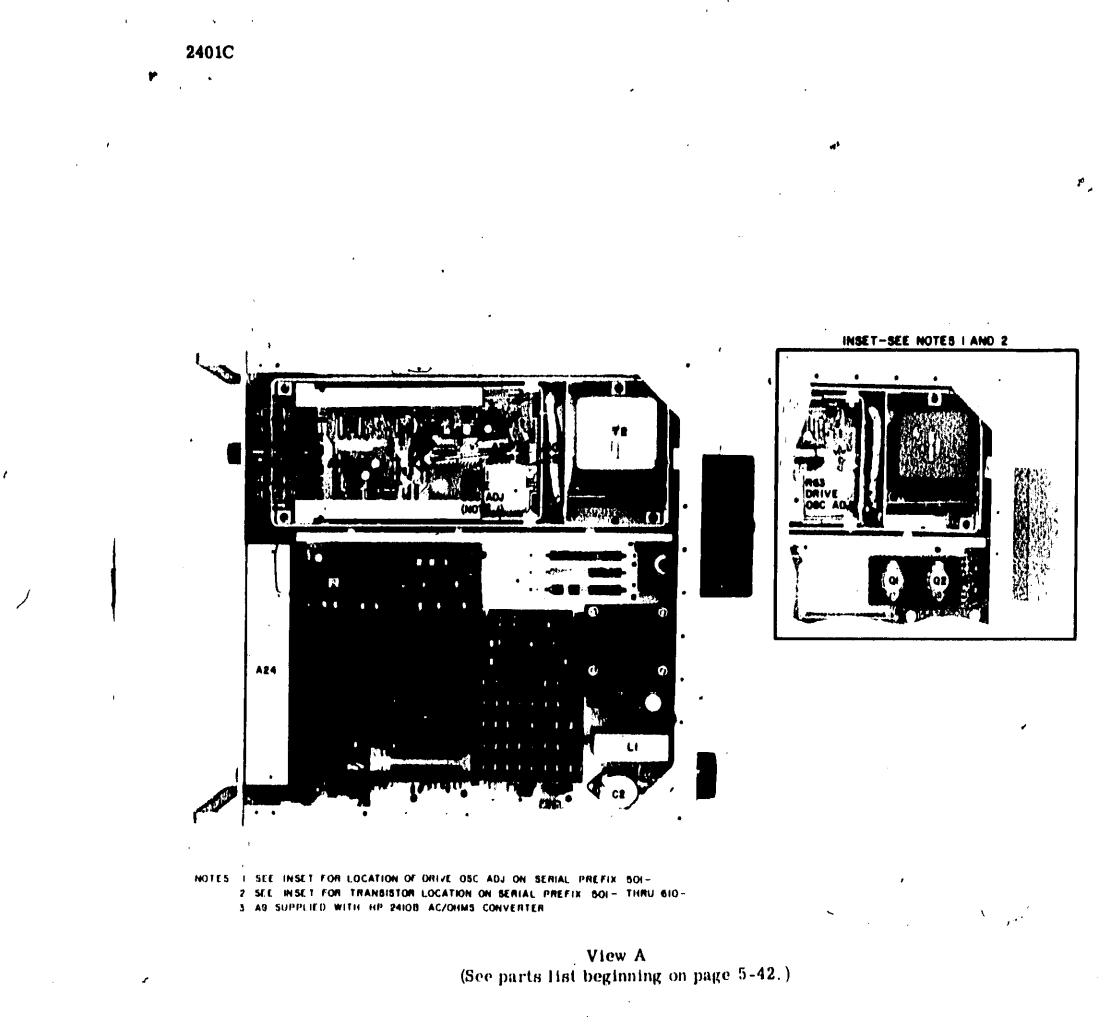
- a. Connect output of Pulse Generator to HP 2401C FREQ INPUT connector.
- b. Set Pulse Generator for positive or negative 1 volt, 2 μ sec pulse, with 300 kHz repetition rate.
- c. Adjust A27R2(A27R3 if applicable) for a steady 300 kHz display.

4.7.12 Readjustment for Sine Wave Measurement (Figures 4-27 or 4-28)

If the instrument was adjusted for pulse measurements, it must be readjusted for sine wave measurement. This adjustment is to factory tolerances and must be made to assure that the instrument will operate within stated specifications. Proceed as follows:

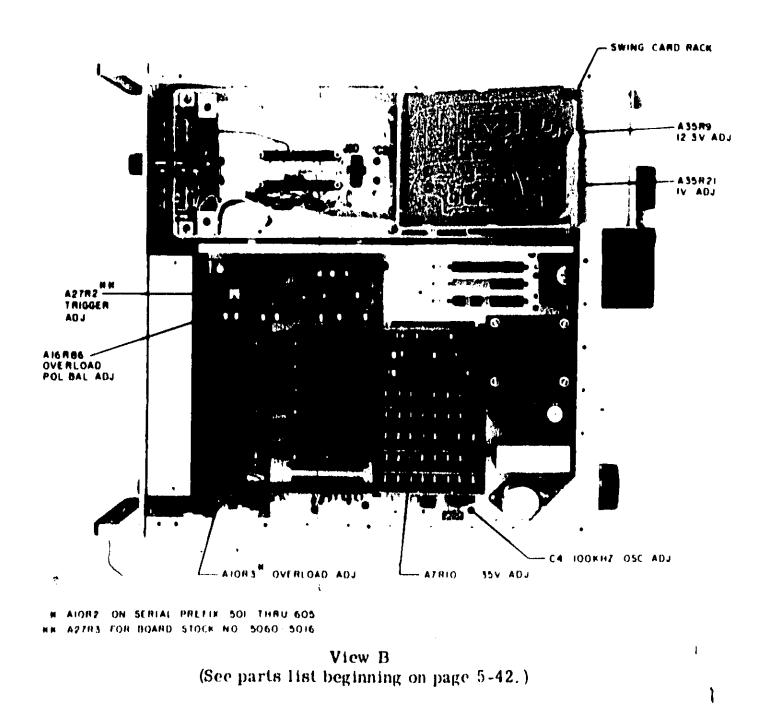
- a. Set Portable Oscillator for 300 kHz and adjust output to zero. Connect the Portable Oscillator output connection to the HP 2401C FREQ INPUT connector and to ac vtvm.
- b. Adjust Portable Oscillator for 50 millivolt output.
- c. Adjust A27R2(A27R3 if applicable) for a steady 300 kHz display.
- d. Slowly reduce the Portable Oscillator output. The display should disappear completely before the output reaches 40 millivolts.
- e. If the requirements of step d are not met, increase the Portable Oscillator output (100 millivolts maximum) and repeat steps c and d until the requirements of 40-millivolt dropout are met.

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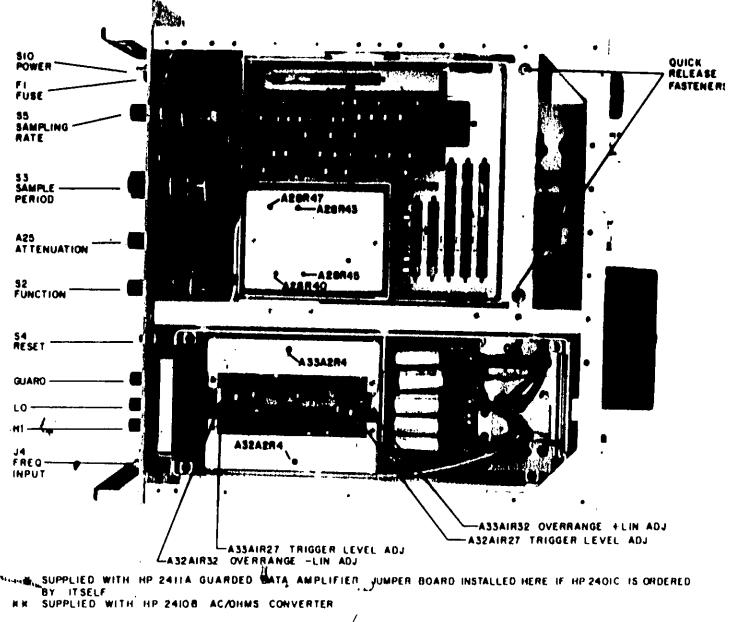
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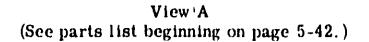
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Figure 4-3. Top Internal View

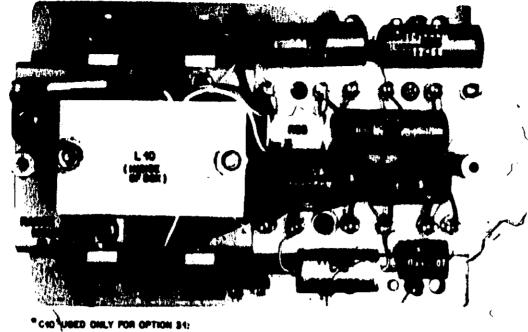


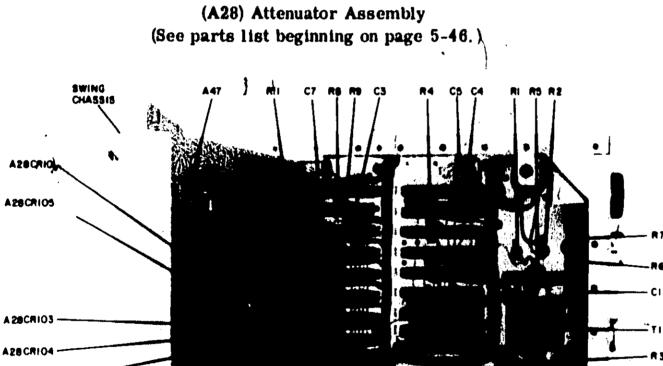


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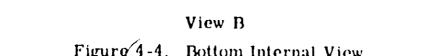


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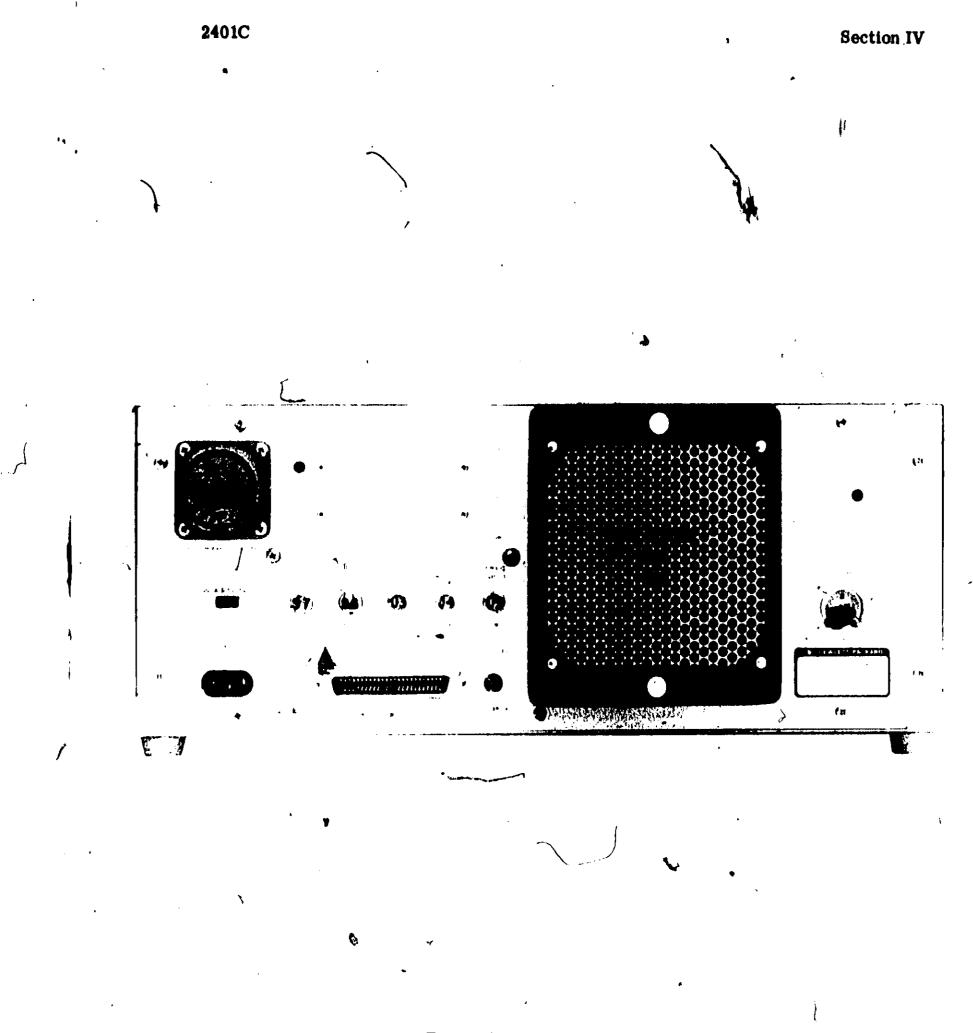
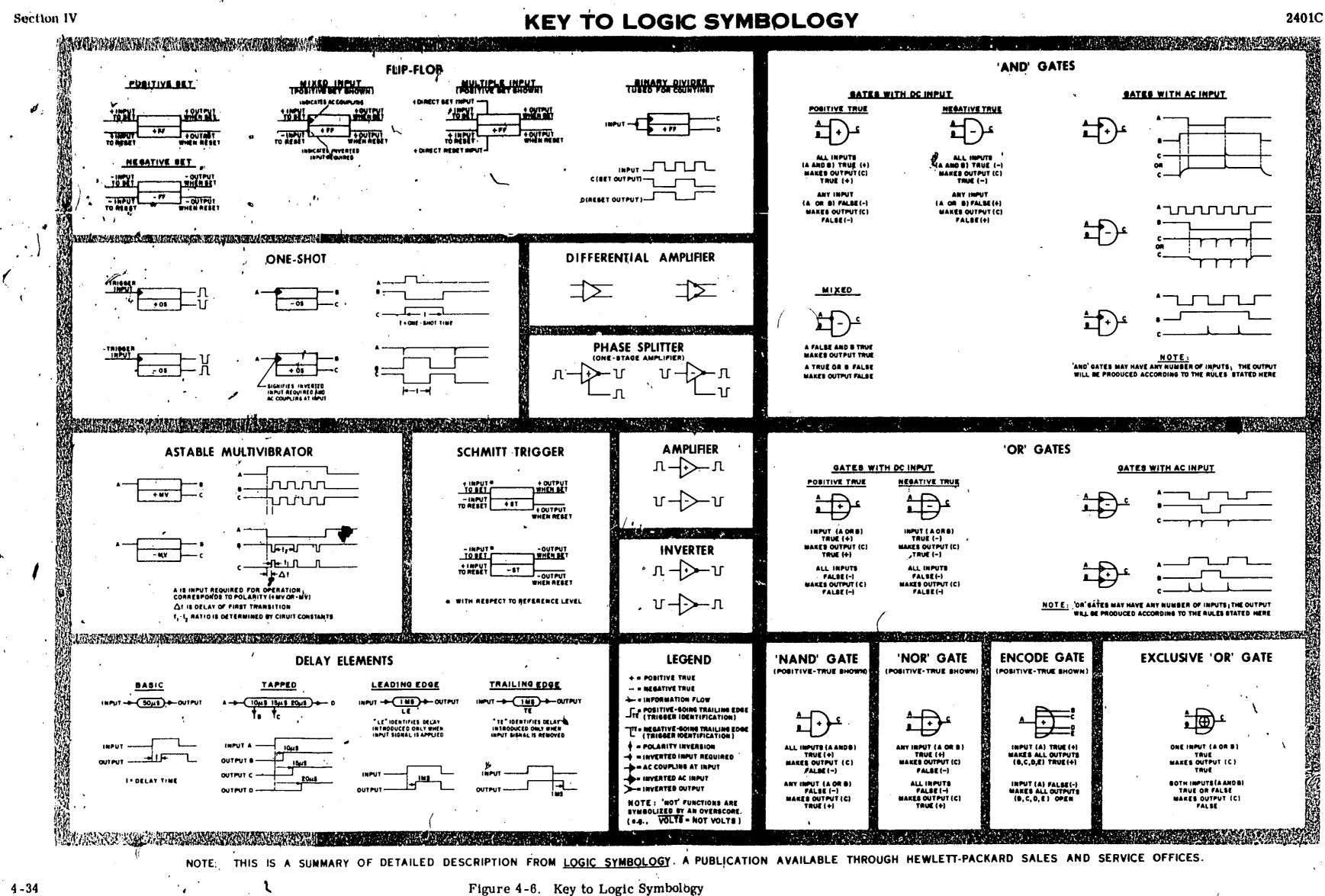


Figure 4-5. Rear Panel View (See parts list beginning on page 5-42.)

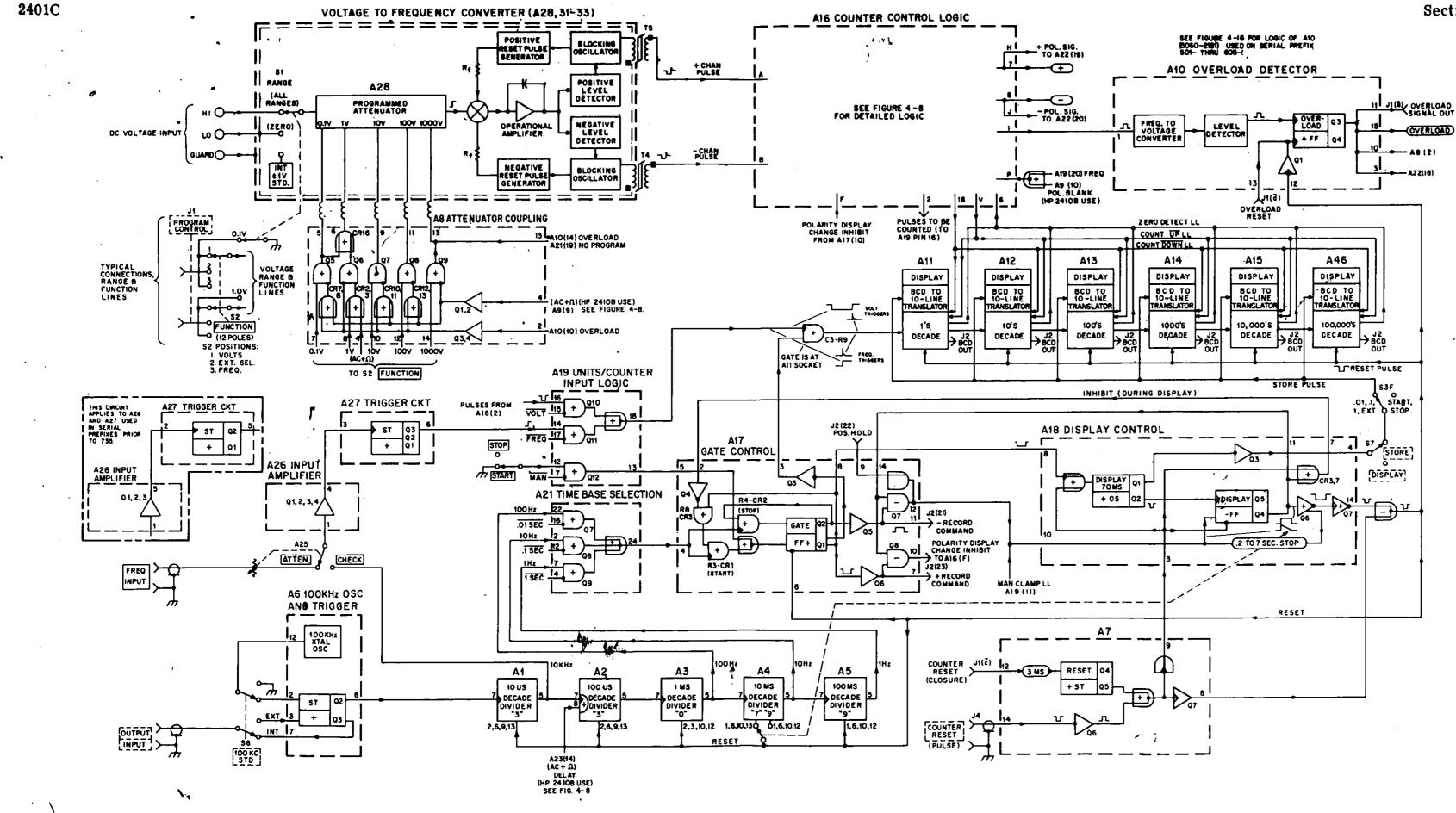
4-33

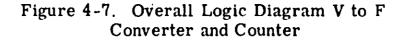


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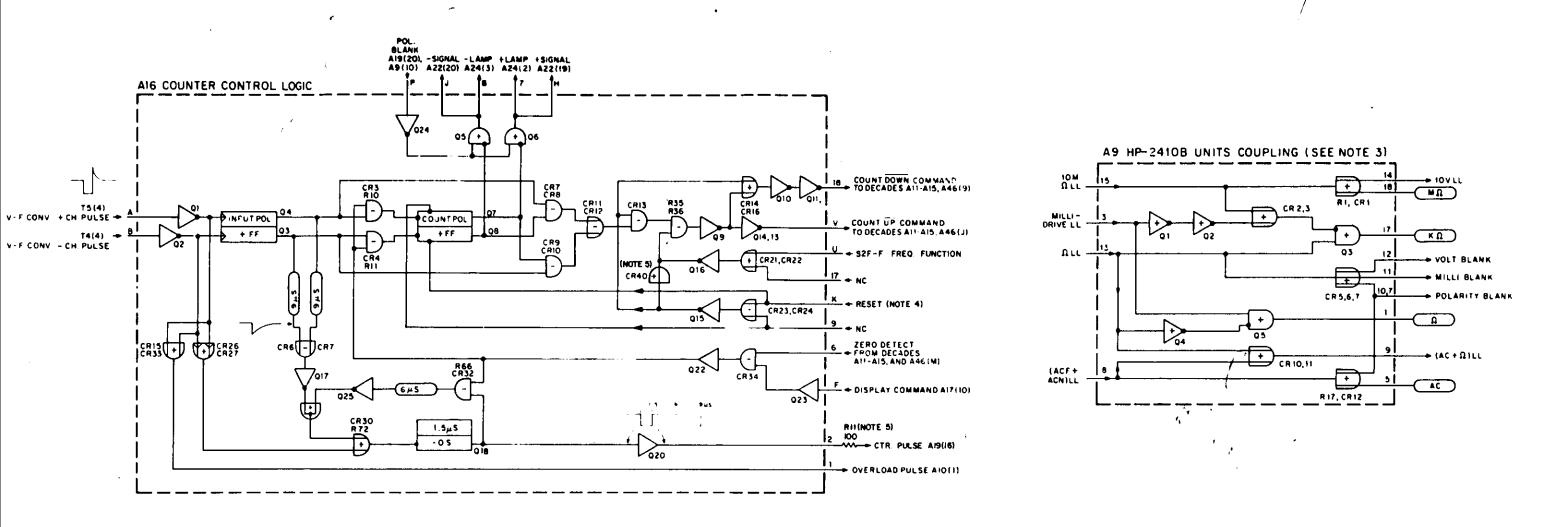
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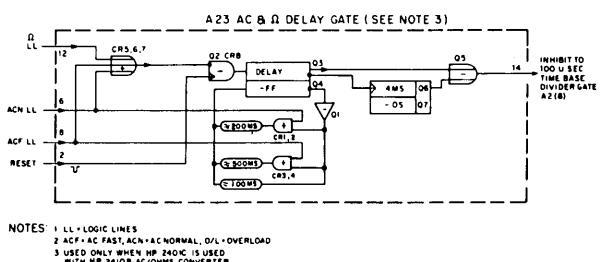
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3 USED ONLY WHEN HP 240C IS USED WITH HP 2410B AC/OHMS CONVERTER 4. NO CONNECTION FOR SERIAL PREFIX 501- THRU 537 5. CR40 AND RIL FIRST USED ON SERIAL PREFIX 606-





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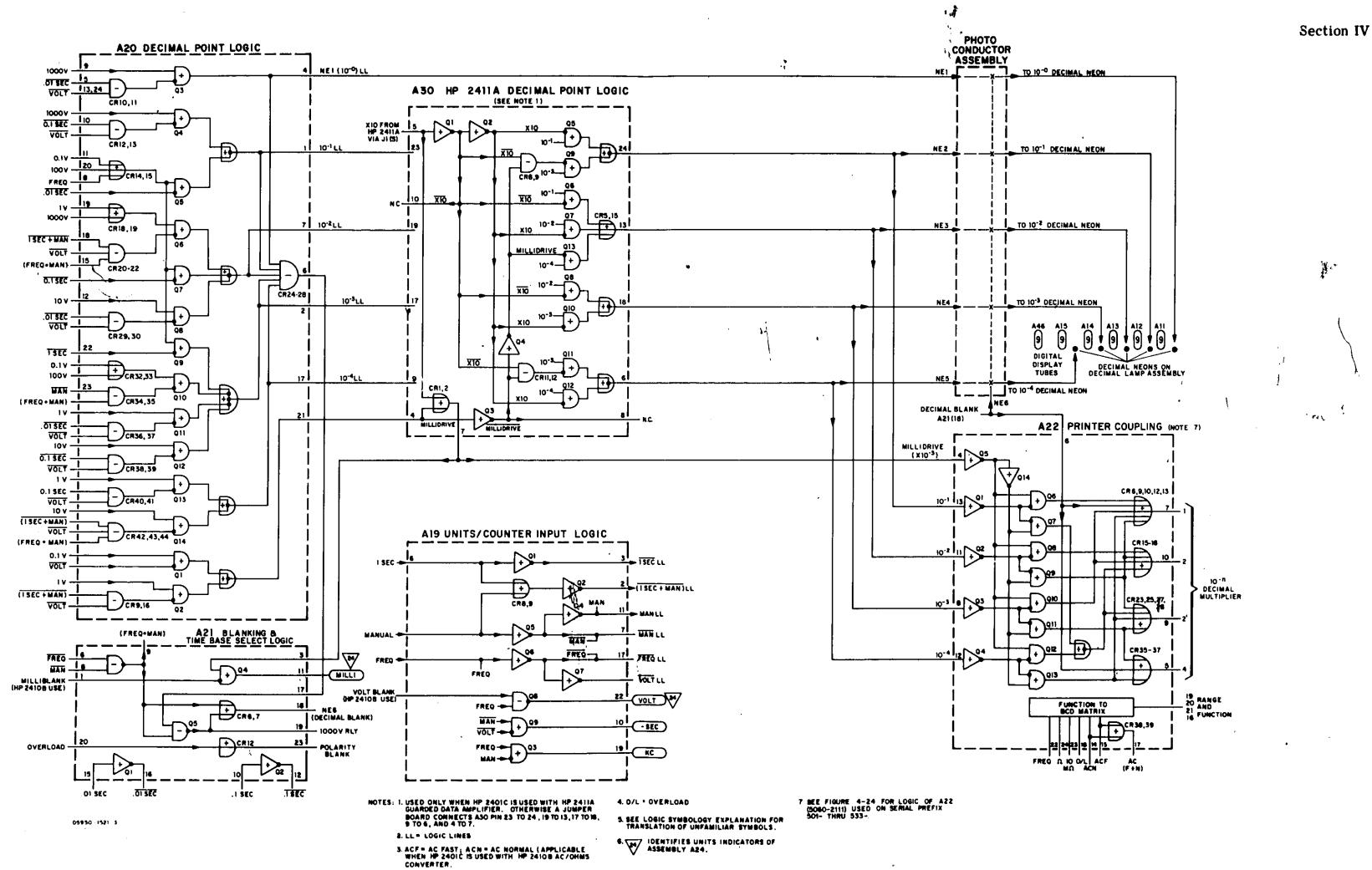
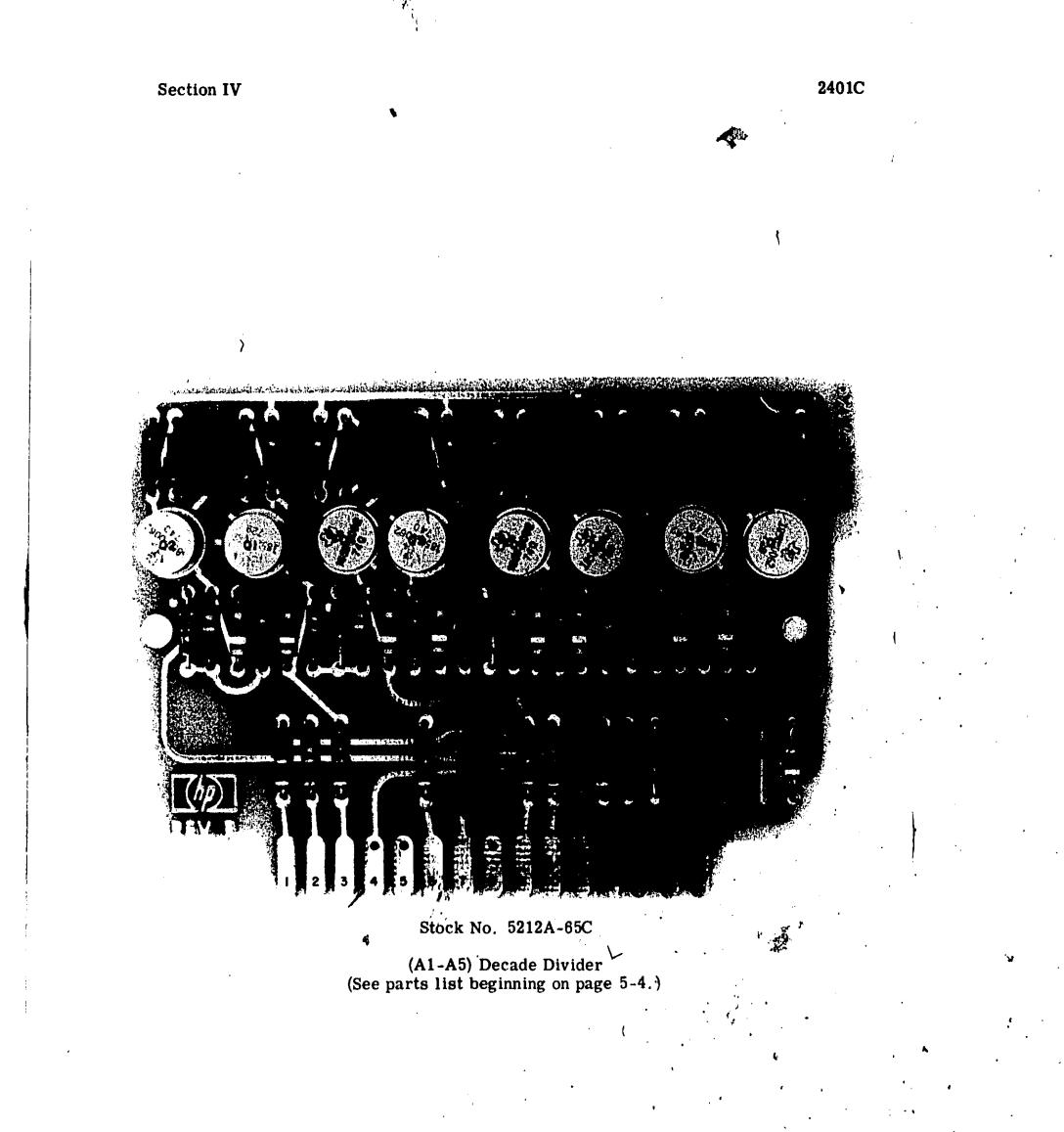
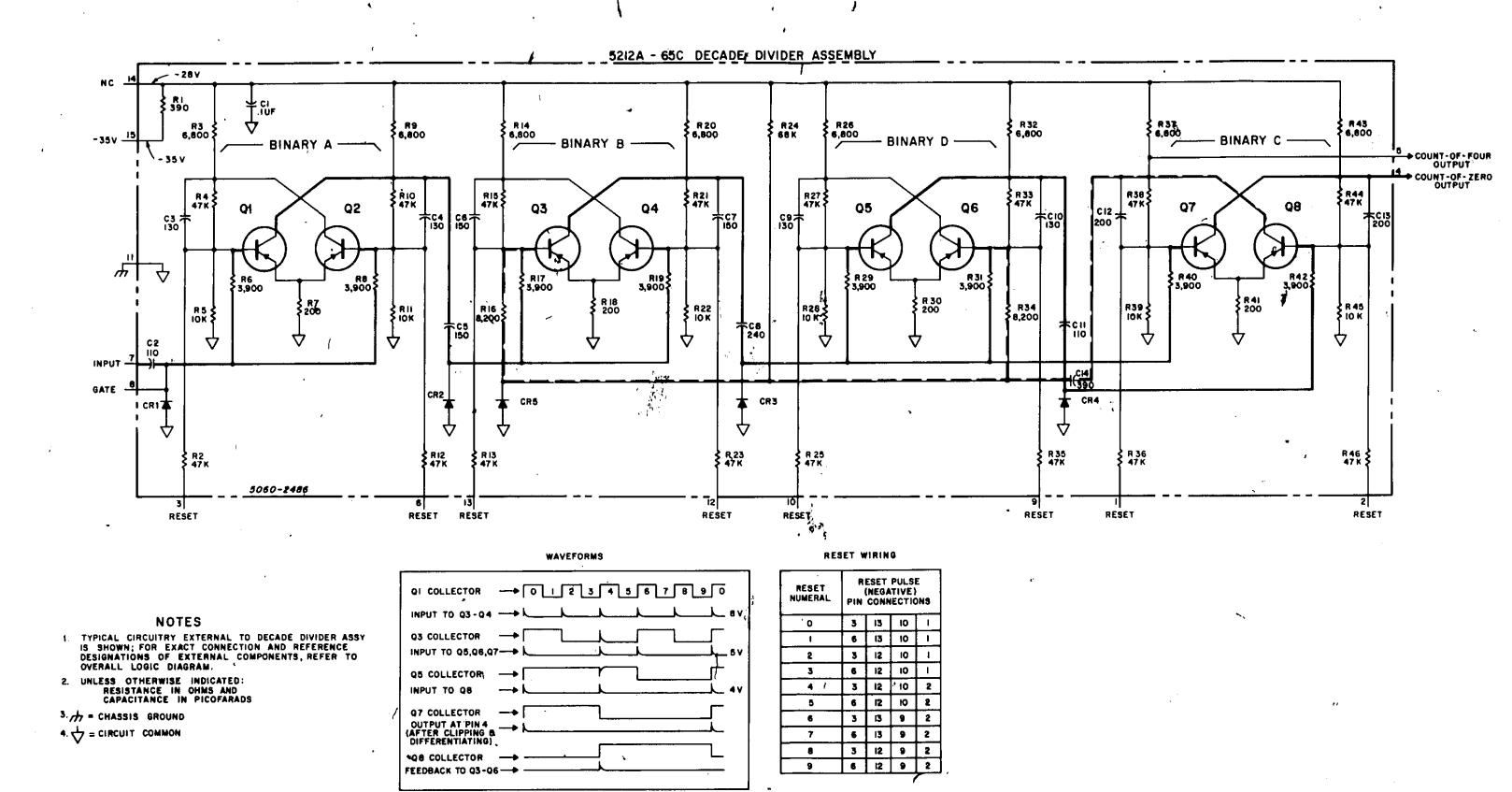


Figure 4-9. Overall Logic Diagram Decimal **Point and Control**

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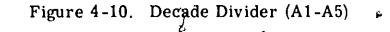




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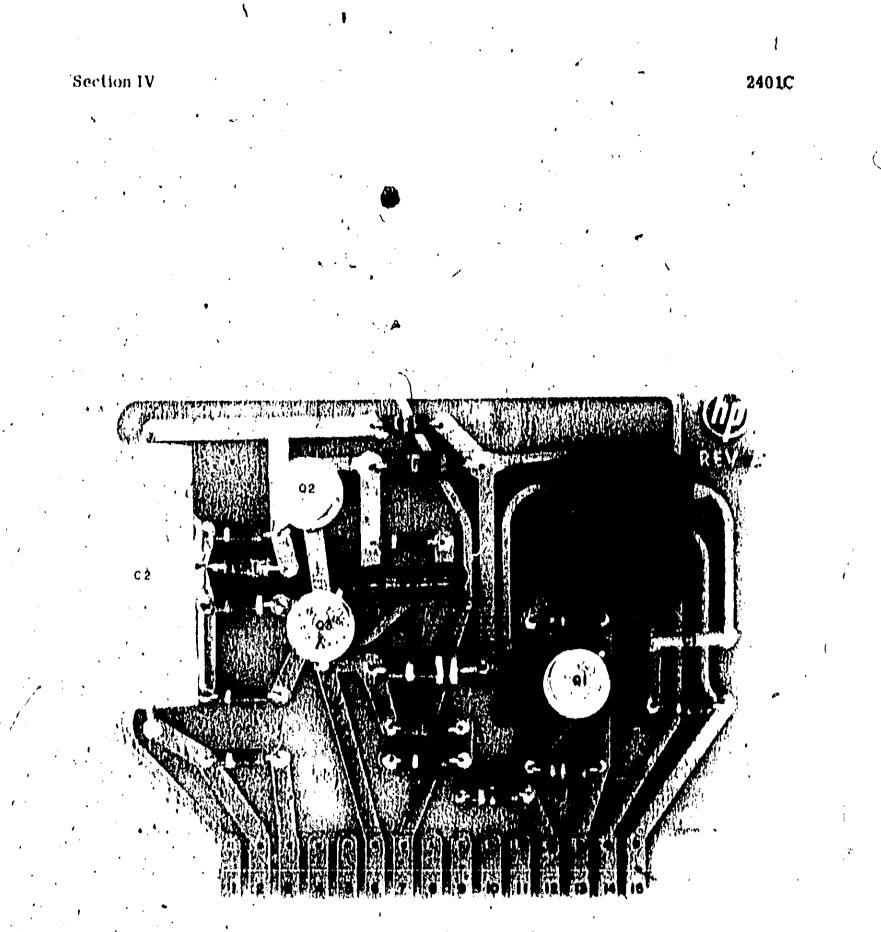
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Section IV



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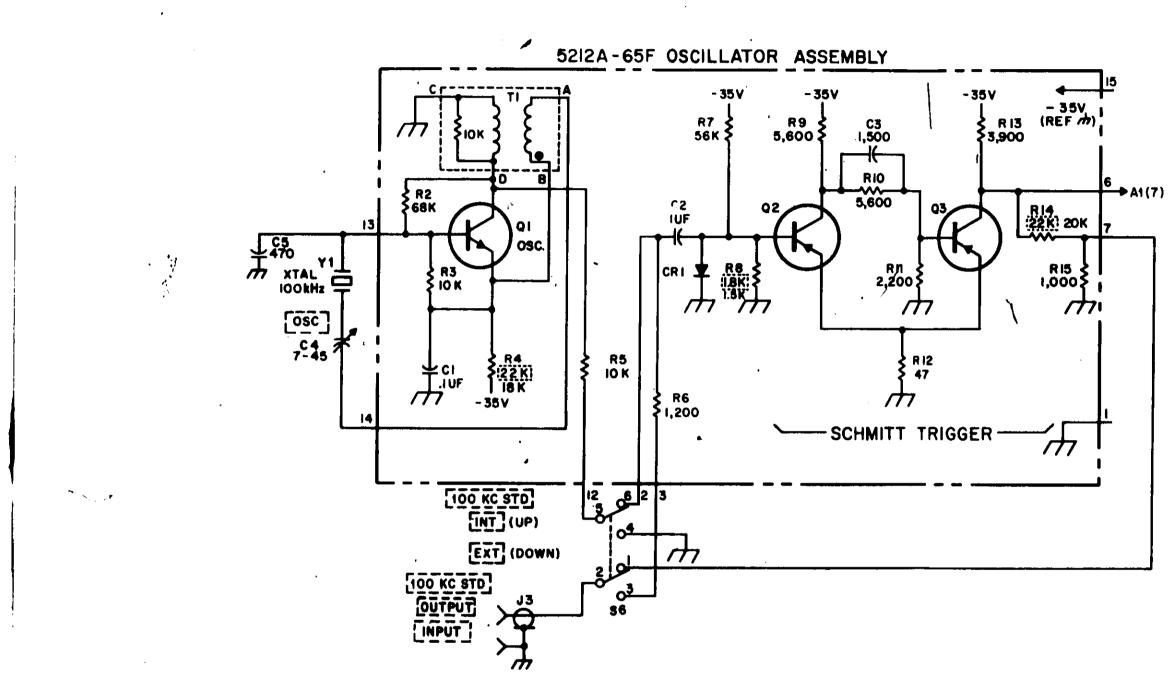


Stock No. 5212A-65F

(A6) 100 KHz Oscillator and Schmitt Trigger (See parts list beginning on page 5-5.)

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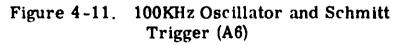
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Section IV

NOTES

1. + = CHASSIS GROUND

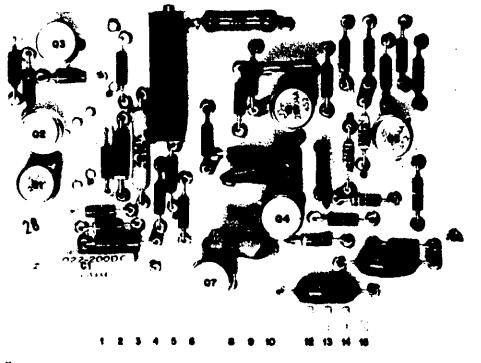
- 2. UNLESS OTHERWISE INDICATED : RESISTANCE IN OHMS AND CAPACITANCE IN PICOFARADS
- 3. RESISTANCE VALUES WITHIN DOTTED LINES APPLY TO SER. PREFIX 501- THRU 614-.



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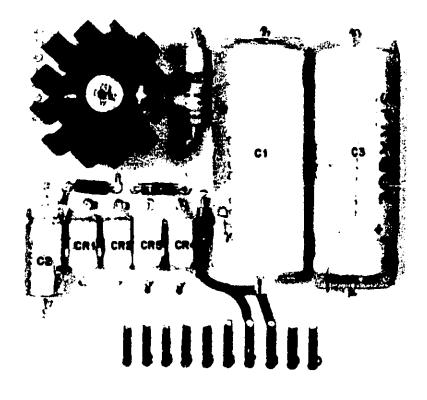




*SEE SCHEMATIC DIAGRAM FOR RI, R2, AND WI USAGE.

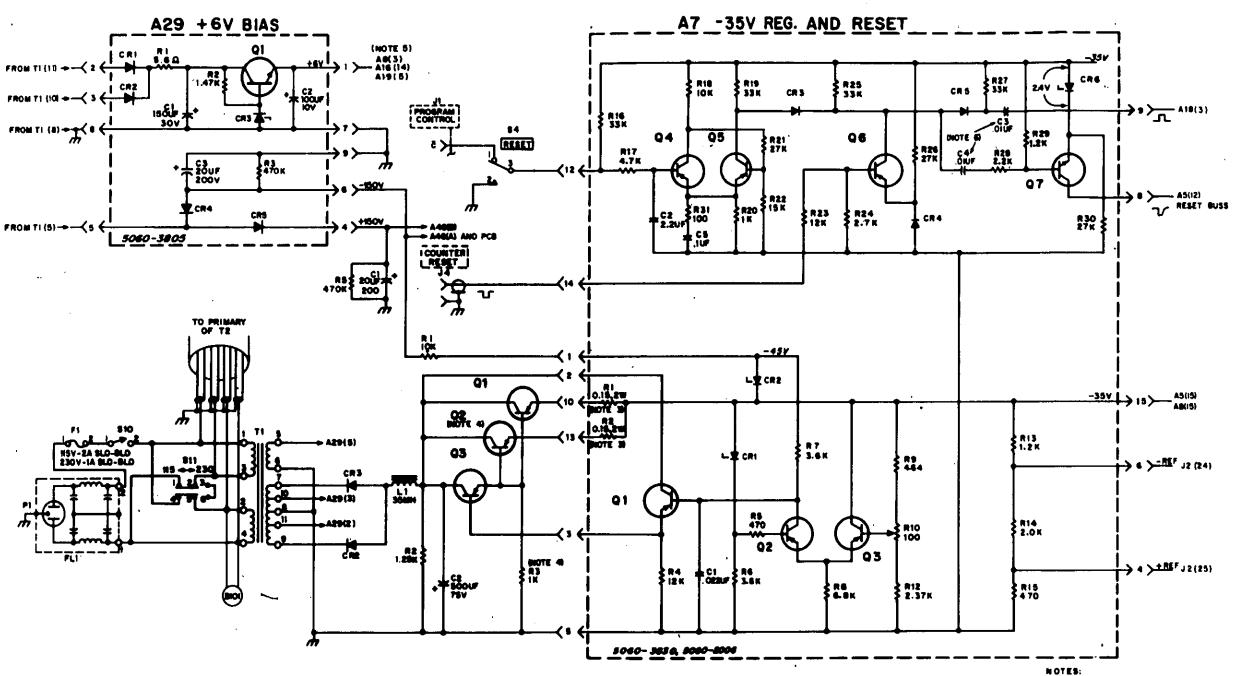
Stock No. 5060-2006 (Serial Prefix 614 and above) Stock No. 5060-3830 (Serial Prefix 501 thru 610)

> (A7) -35V Regulator and Reset (See parts list beginning on page 5-6.)



Stock No. 5060-3805

(A29) +6V Bias (See parts list beginning on page 5-32.)



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NOTES: 1. UNLESS OTHERWISE INDICATED: RESISTANCE IN CHMIS, AND CAMACITANCE IN PICOPARADS 2.,,, = CHASSIS SROUND

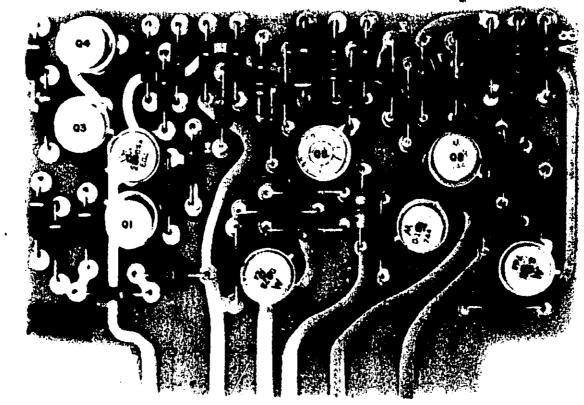
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- ATRI IS REPLACED BY JUMPER IS NOT USED ON SER. PREFIX
- T USED AND R3 IS
- A29(1) CONNECTS TO A16(14) AND A19(1) ON SER. PREFIX 501- THRU 605-
- 6 ATCS AND ATC4 ARE ODSUF ON SER ND 637-04407 AND BELOW

Figure 4-12. -35V Regulator and Reset (A7) and +6V Bias (A29)

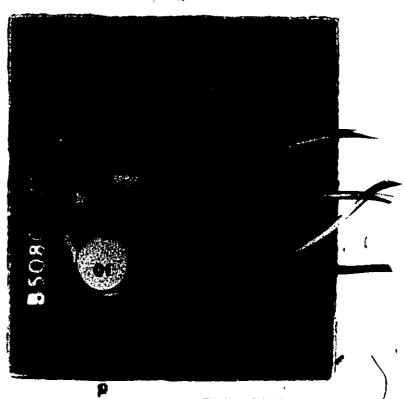
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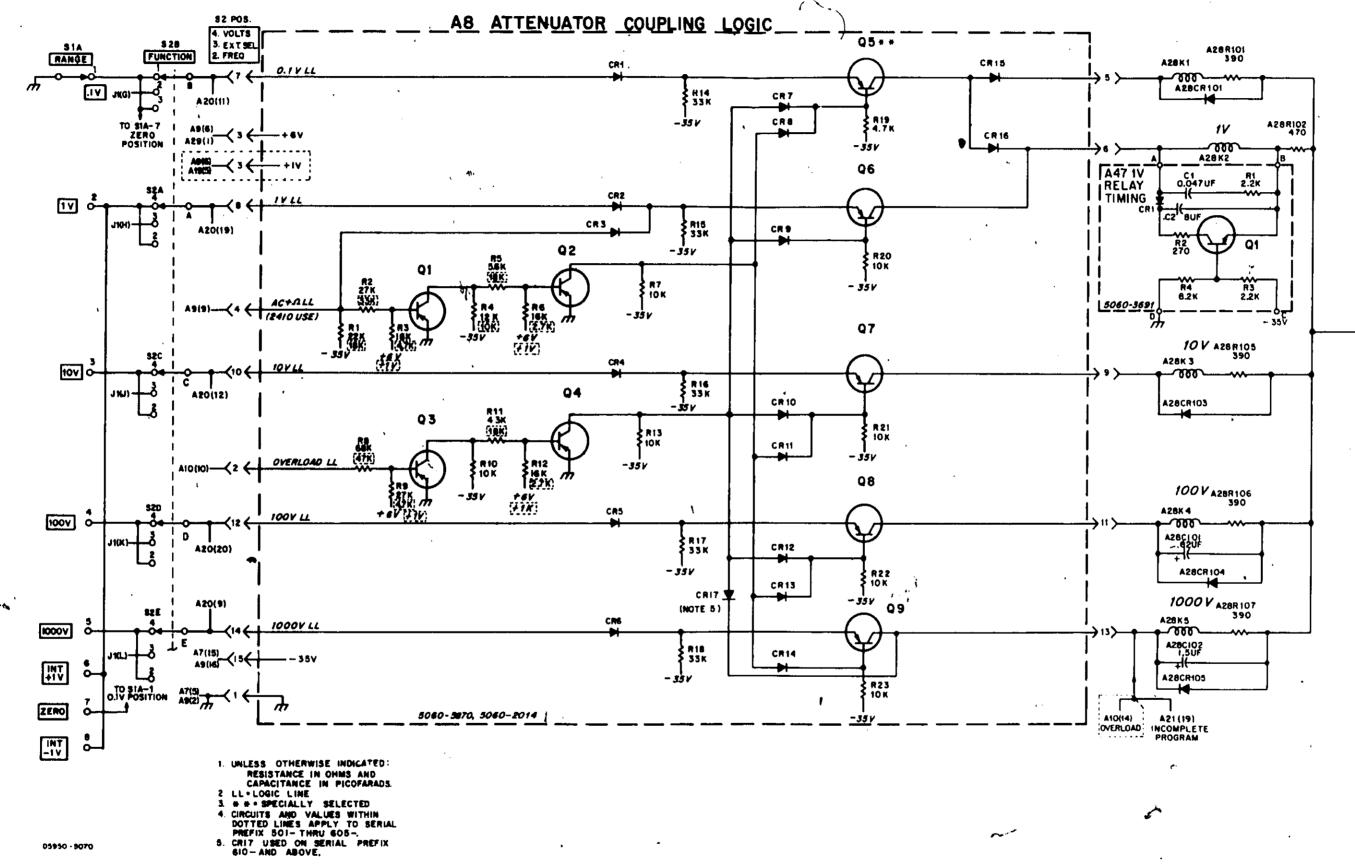


Stock No. 5060-5870 (Serial Prefix 610 and above)

(A8) Attenuator Coupling Logic Assembly (See parts list beginning on page 5-7.)



Stock No. 5060-3691 (A47) IV Relay Timing Assembly (See parts list beginning on page 5-42.)



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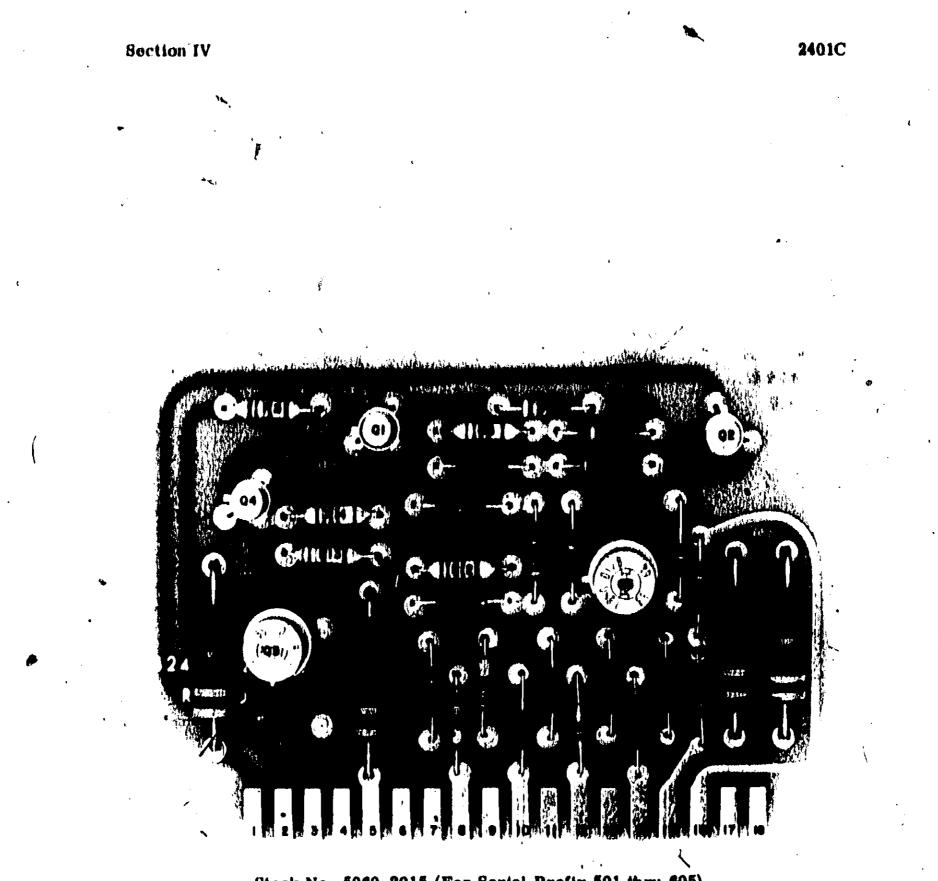
Section IV

Figure 4-13. Attenuator Coupling (A8) and IV Kelay Timing (A47)

- 35 V

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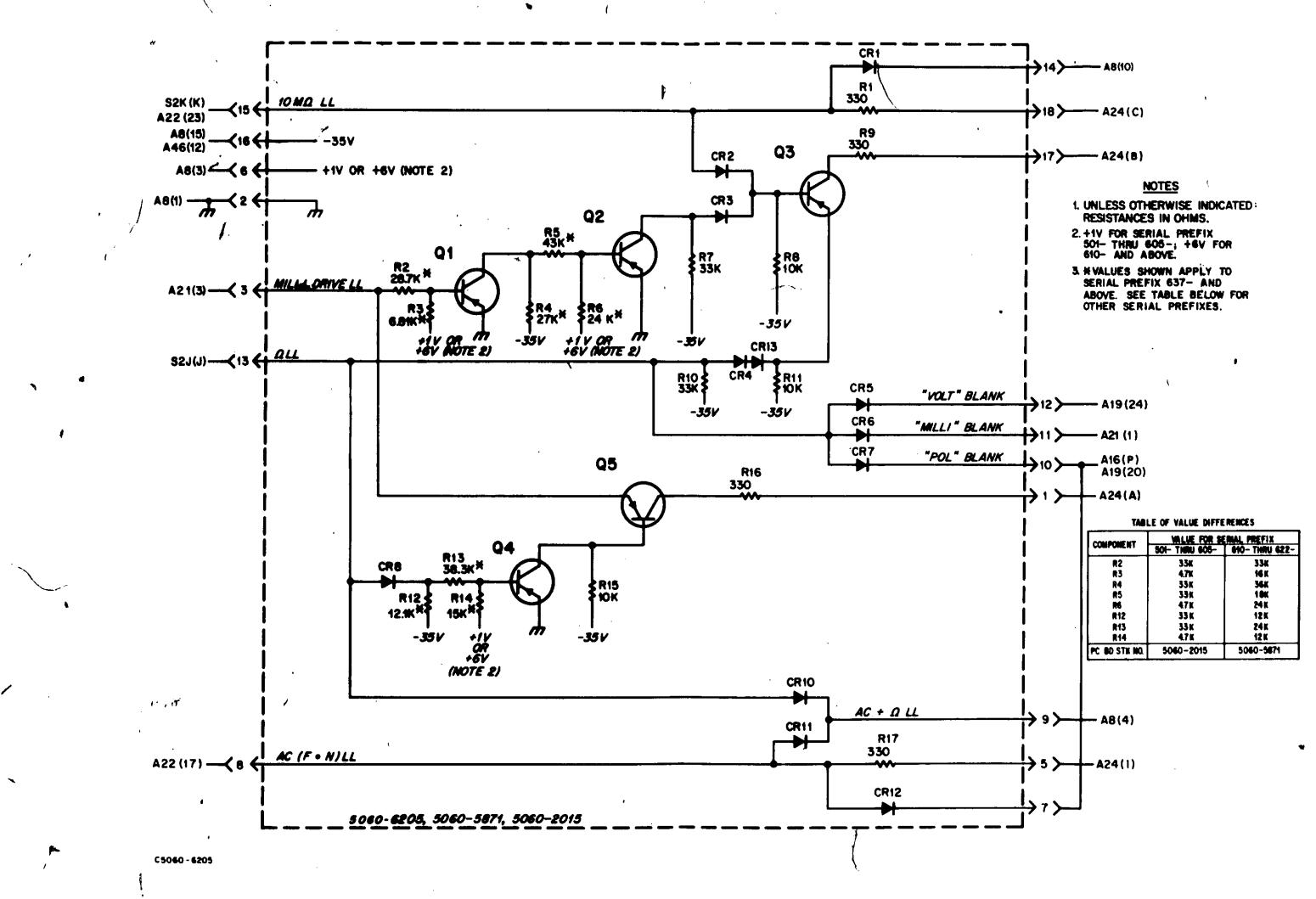
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Stock No. 5060-2015 (For Serial Prefix 501 thru 605) Stock No. 5060-5871 (For Serial Prefix 610 thru 622) Stock No. 5060-6205 (For Serial Prefix 637 and above)

> (A9) HP 2410B Units Coupling (See parts list beginning on page 5-8.)



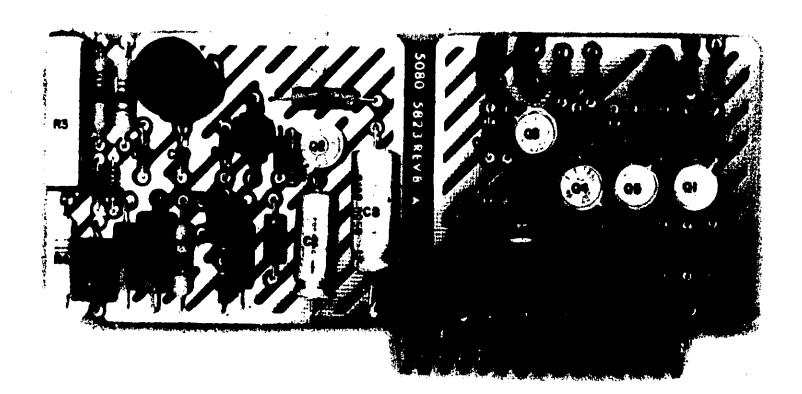


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Figure 4-14. HP 2410B Units Coupling (A9)



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Stock No. 5060-5655 (Serial Prefix 610 and above)

(A10) Overload Detector (See parts list beginning on page 5-11.)

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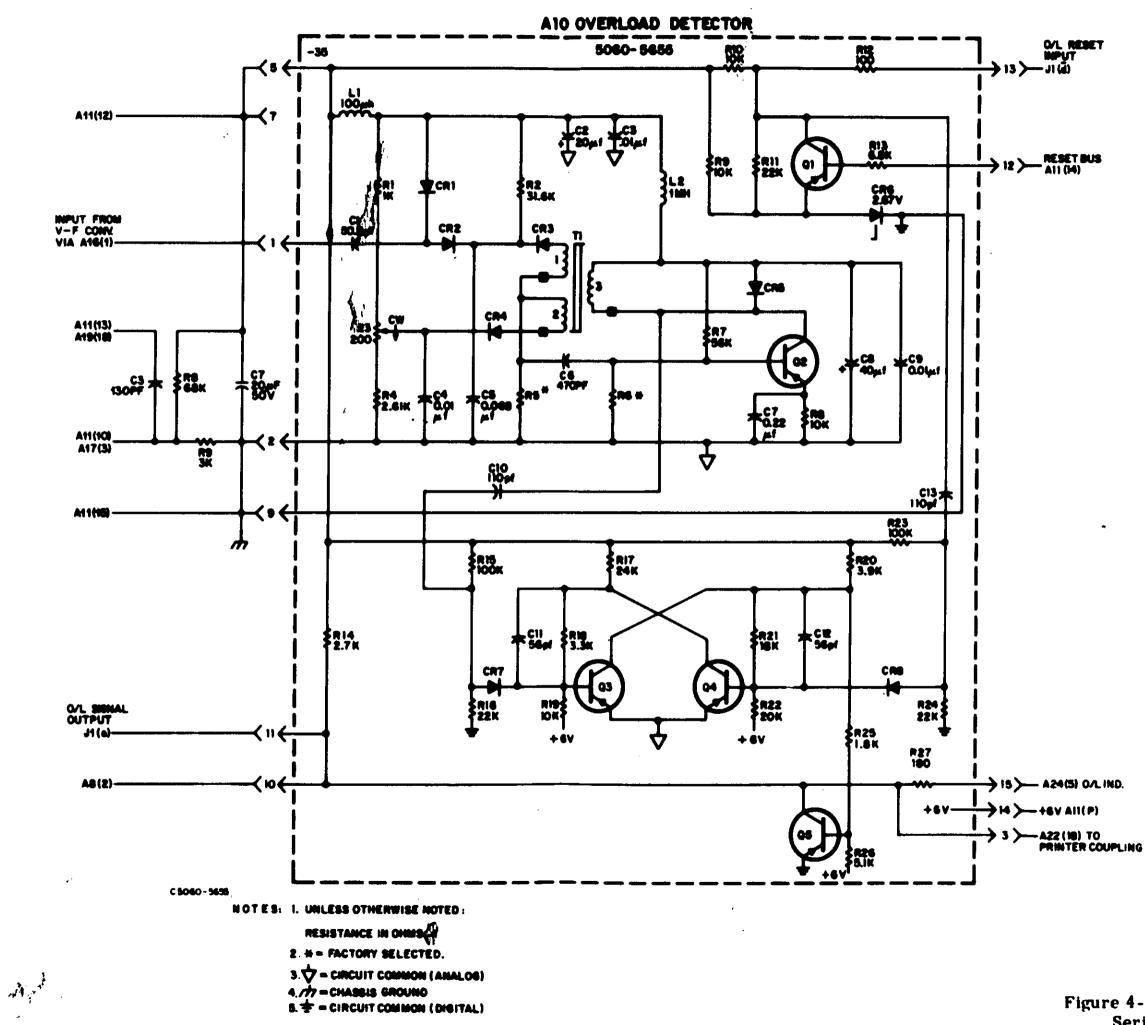
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Figure 4-15. Overload Detector (A10) - For Serial Prefix 610 and above

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AI VOLTAGE COMPARATOR

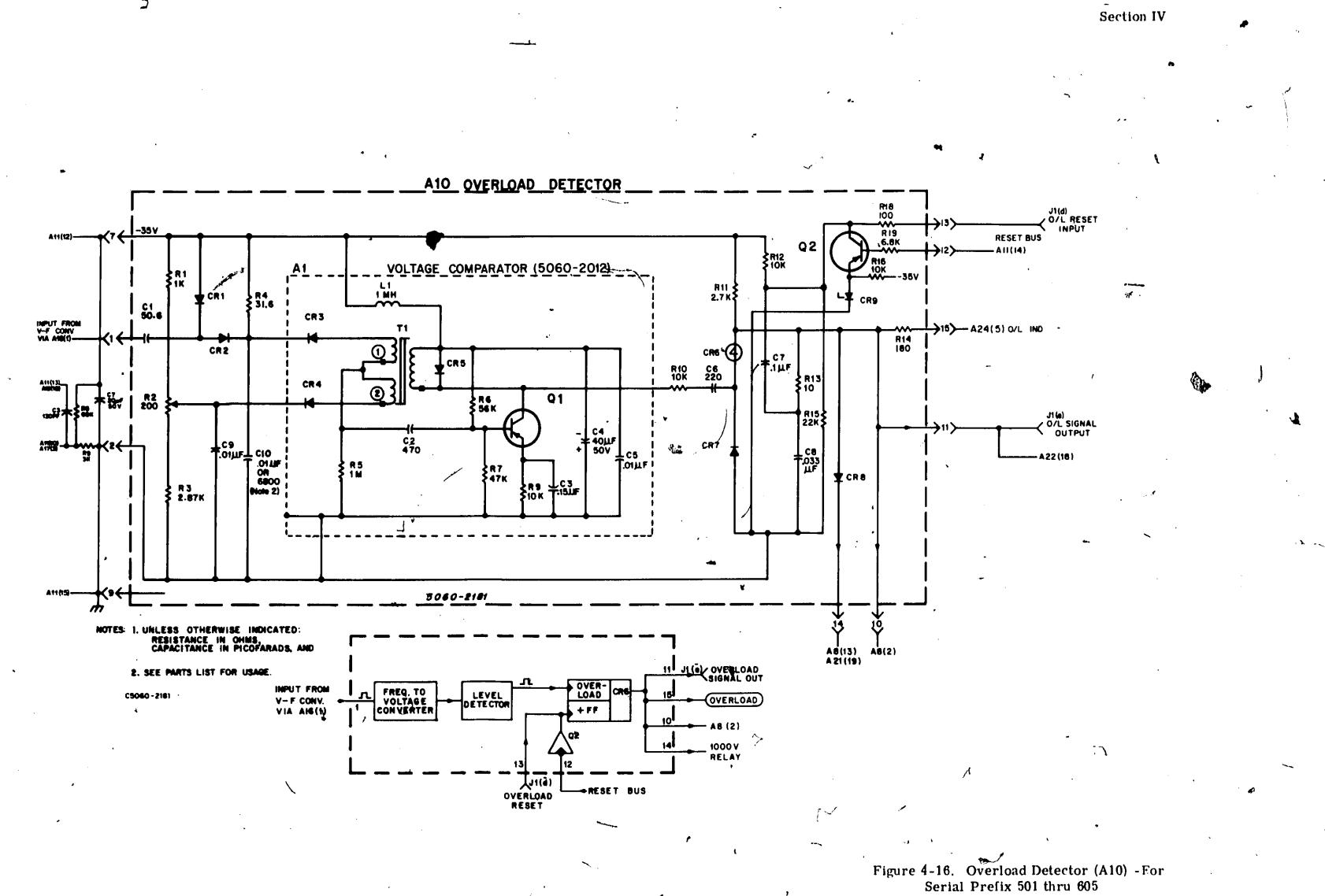
Stock No. 5060-2181 (Serial Prefix 501 thru 605)

(A10) Overload Detector (See parts list beginning on page 5-10.)

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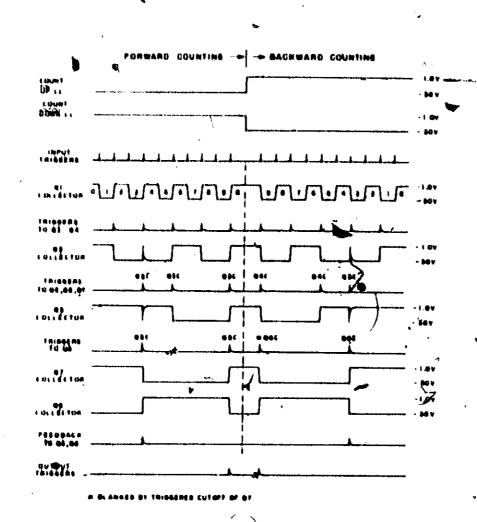
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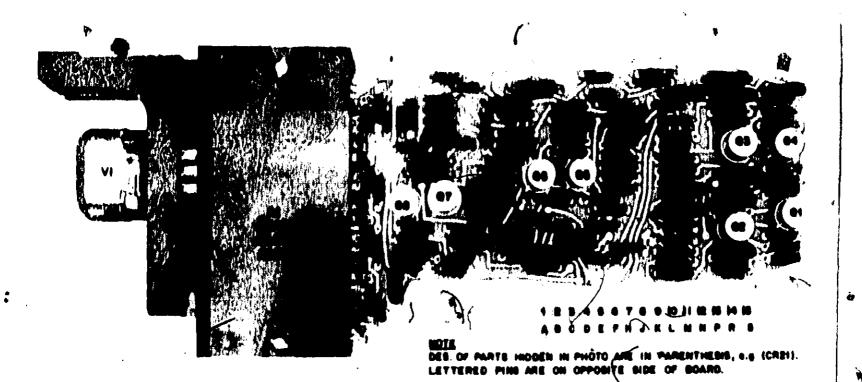
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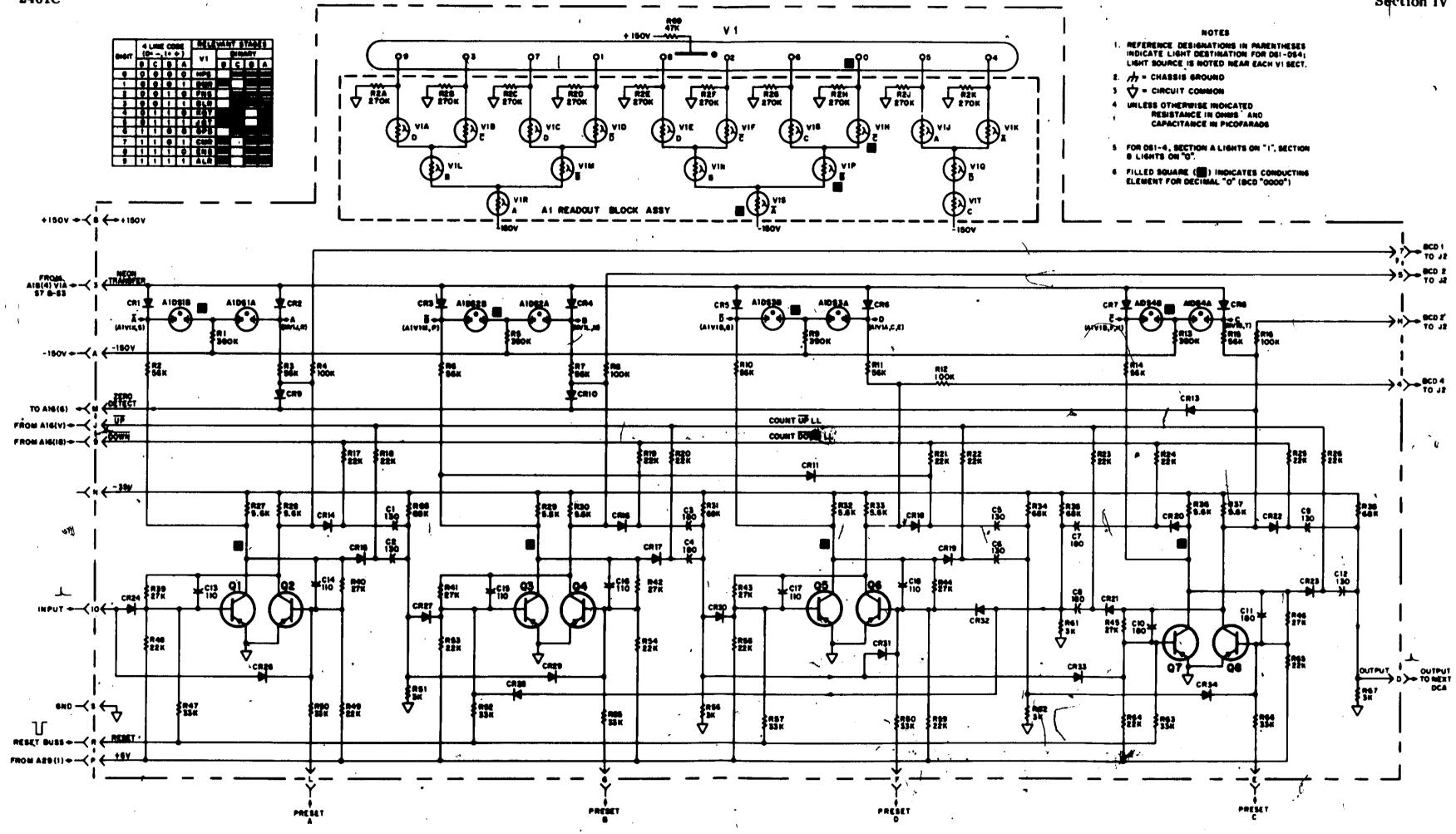
REVERSIBLE DECADE WAVEPORNS



Stock No. 5060-3781 (A11-AT5, A46) Reversible +4-2'-2-1 Decade Counter

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(See parts list beginning on page 5-13.)



Section IV

Figure 4-17. Reversible +4-2'-2-1 Decade Counter (A11-A15, A46)

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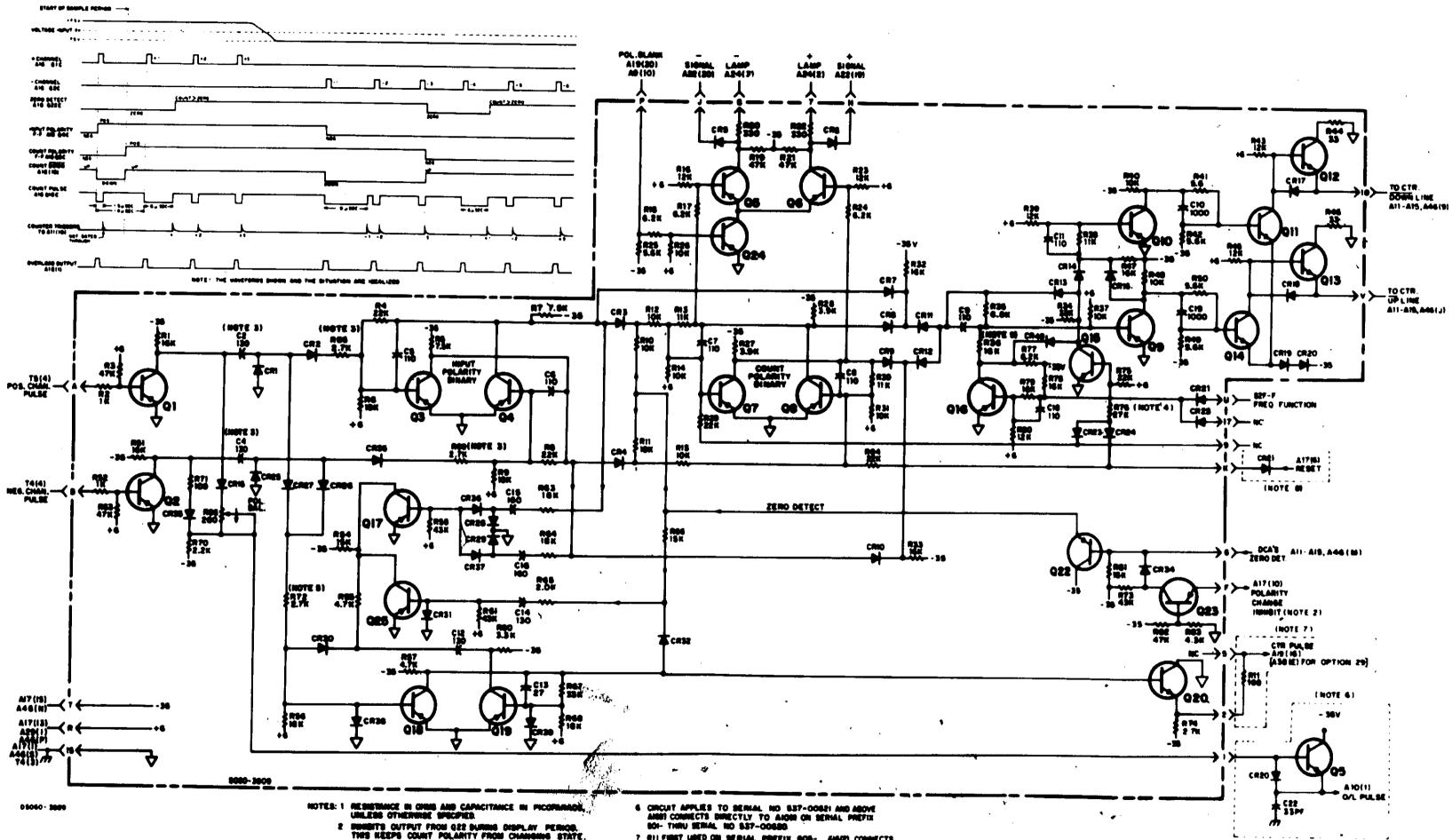
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* CR38 IS UNDER QIS AND CR39 IS UNDER QI9.

Stock No. 5060-3809

(A16) Counter Control (See parts list beginning on page 5-15.)

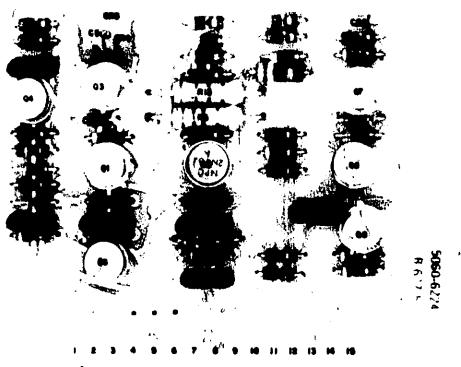
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- C4 ARE 220PF, NOD AND RO
- PREFIX SOI- THRU SEMAL NO 537-00620. 4. R76 IS SSN ON SEMAL PREFIX SOI- THRU 537-
- 5. RTE IS 47K ON SERIAL PREFIX BOI- THRU 614-
- RII FINET USED ON SERIAL PREFIX GOD USED ON SERIAL PREFIX 606- AIGE CONNET TO ANDIAL ON SERIAL PREFIX SOL- THRU ST CTLY
- CREI FIRST USED ON SERIAL PREFIX 605- NC TO PH I ON SERIAL PREFIX 501- THRU \$37-
- & CR40 FIRST USED ON BERIAL PREFIX 605
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Section IV

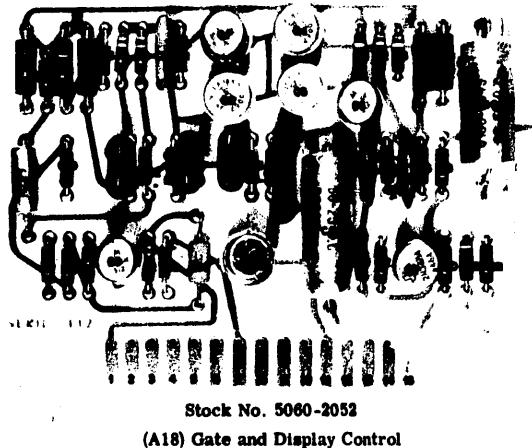
Figure 4-18. Counter Control (A16)



* CRIG AND R30 NOT USED ON 5080-5002.

Stock No. 5060-5002 (Serial Prefix 501 thru 622) Stock No. 5060-6224 (Serial Prefix 637 and above)

> (A17) Gate and Display Control (See parts list beginning on page 5-17.)



(See parts list beginning on page 5-19.)

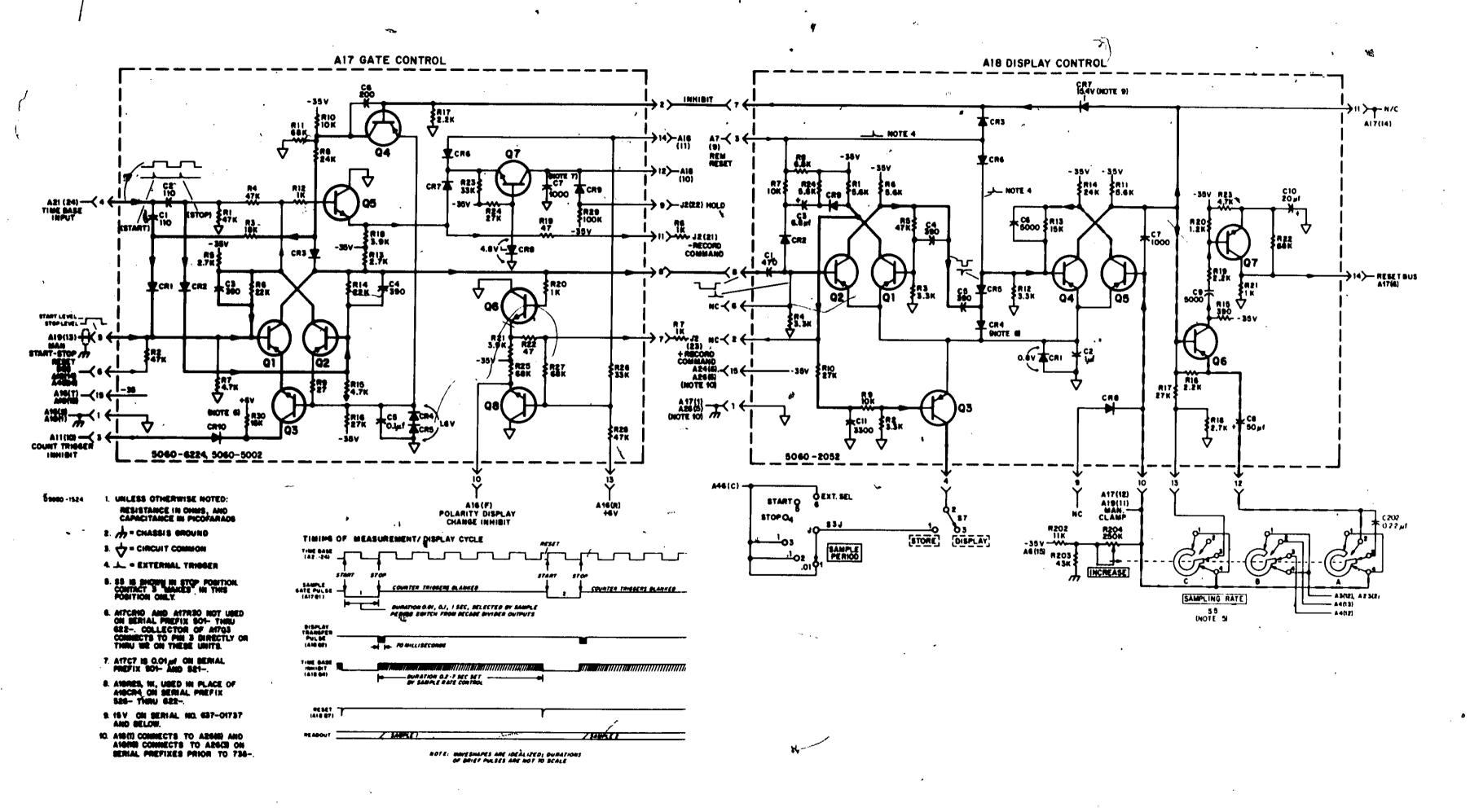


Figure 4-19. Gate and Display Control (A17 and A18)

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Section IV

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" CRI, CRE, AND RI USED ONLY ON BERIAL PREFIX SOI- THRU GOS-

Stock No. 5060-3829 (Serial Prefix 501 thru 605) Stock No. 5060-5872 (Serial Prefix 610 and above)

> (A19) Units/Counter Input Logic (See parts list beginning on page 5-20.)

.

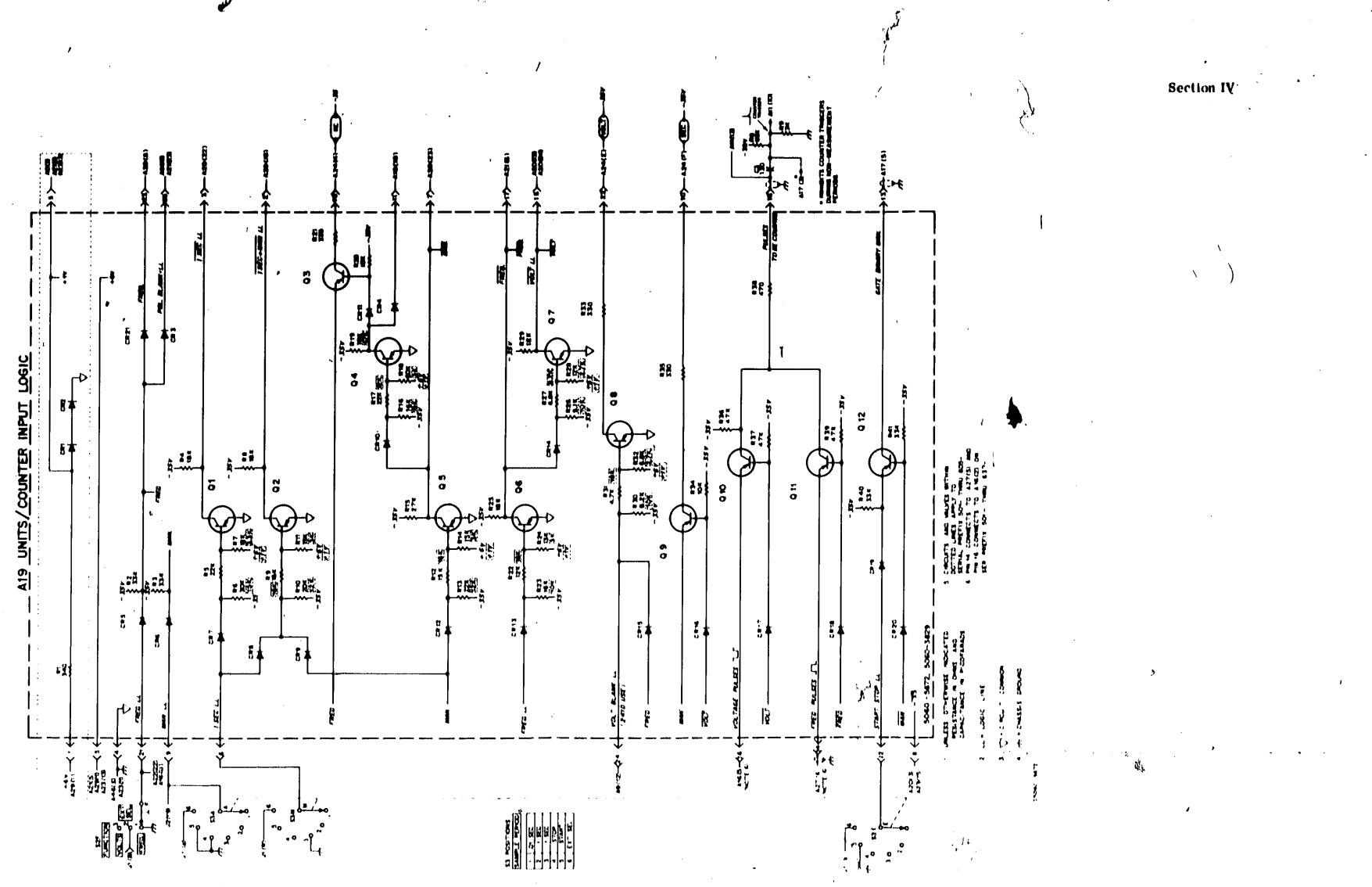


Figure 4-20. Units/Counter Input Logic (A19)

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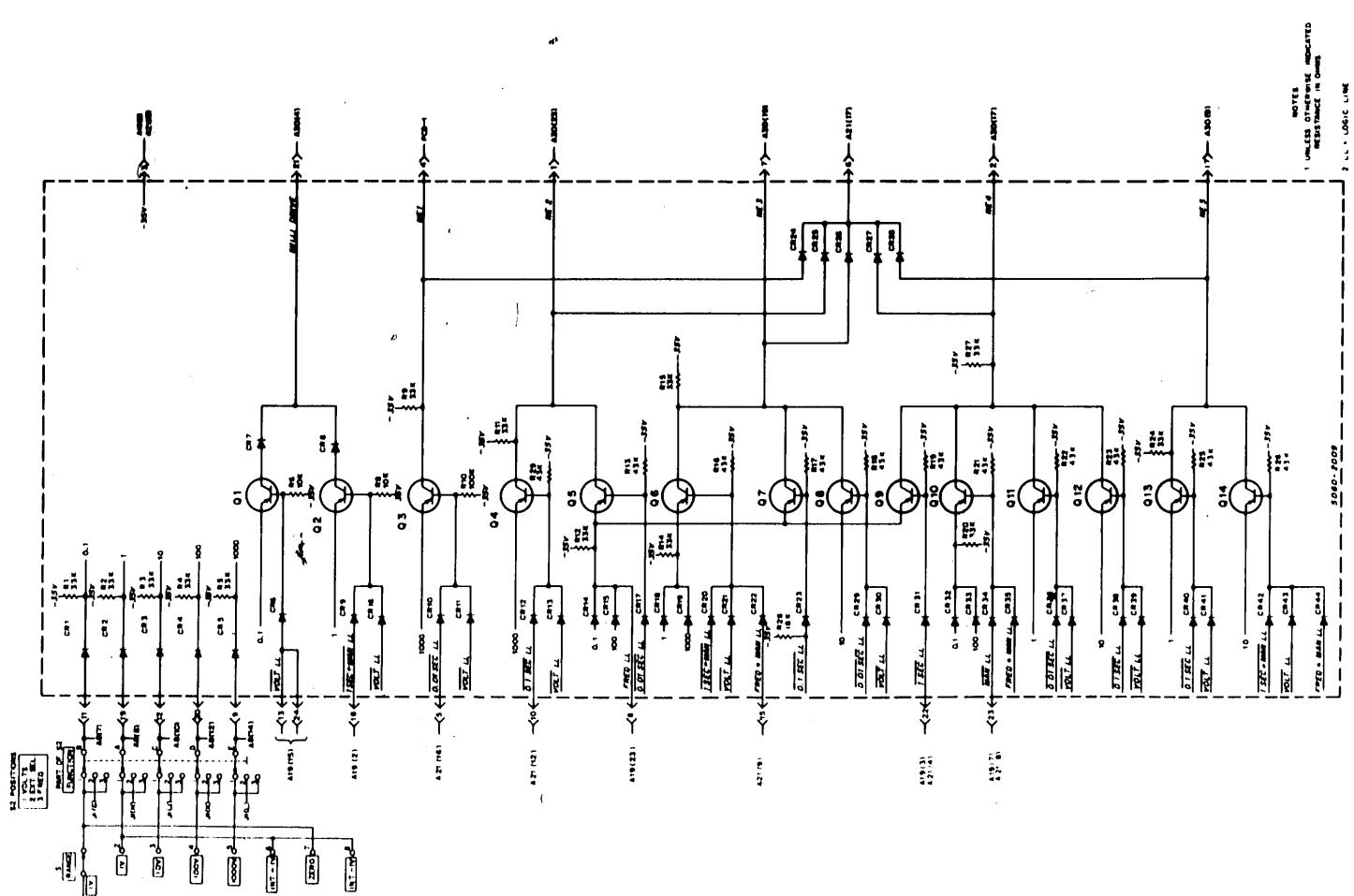
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Stock No. 5060-2009

(A20) Decimal Point Logic (See parts list beginning on page 5-22.) 2401C

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Section IV

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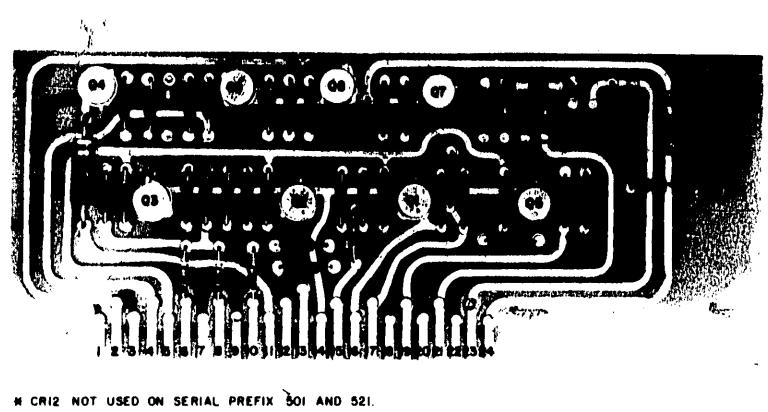
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Figure 4-21. Decimal Point Logic (A20)

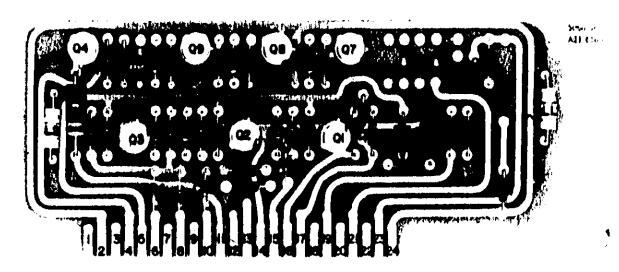




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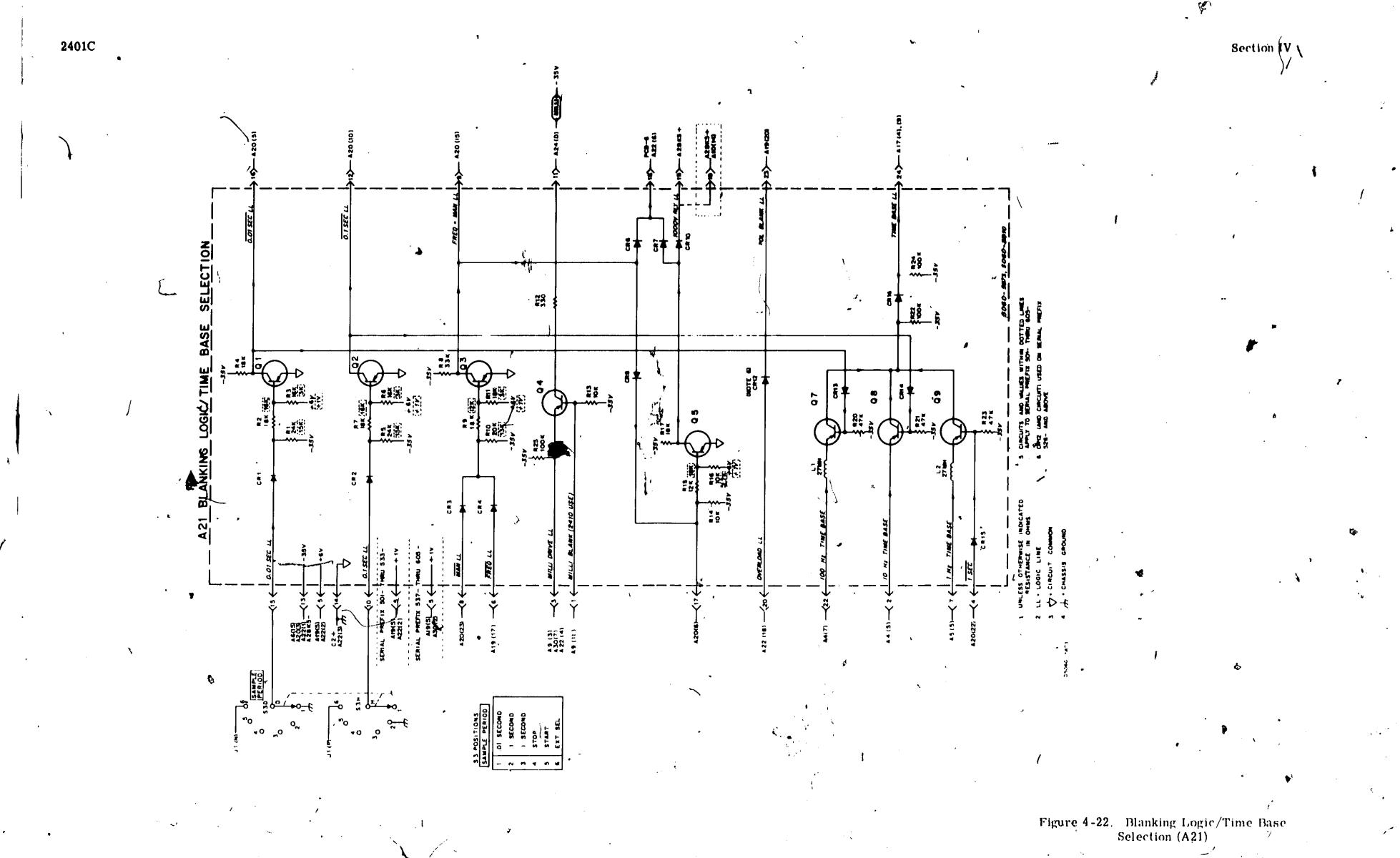


Stock No. 5060-2010 (Serial Prefix 501 thru 605)

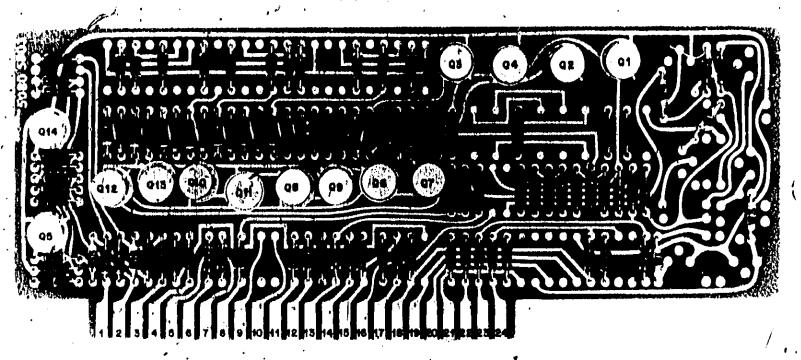


Stock No. 5060-5873 (Serial Prefix 610 and above)

(A21) Blanking Logic/Time Base Selection (See parts list beginning on page 5-23.)

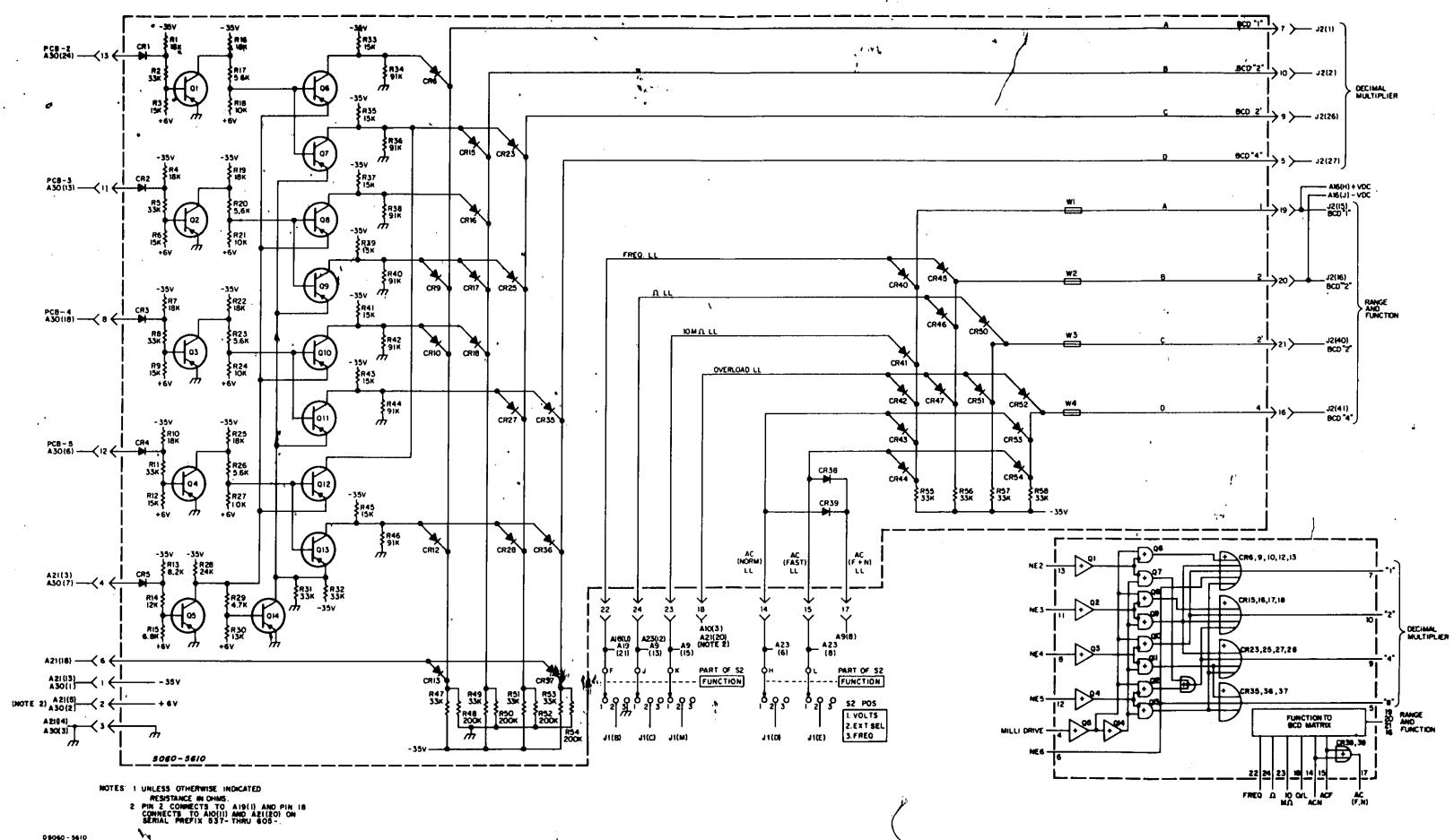


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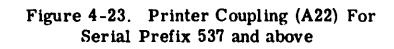
Stock No. 5060-5610 (Serial Prefix 537 and above)

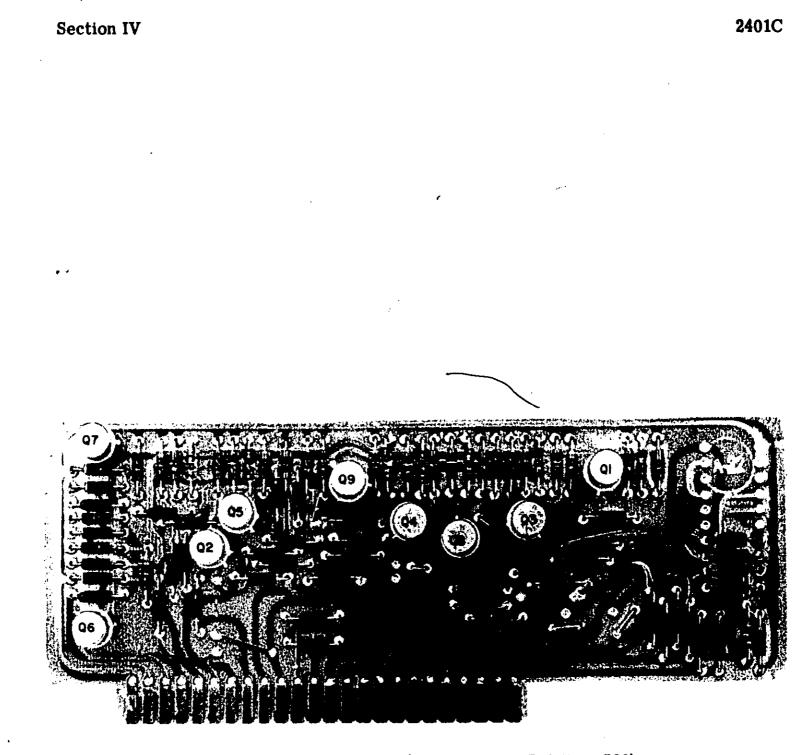
(A22) Printer Coupling (See parts list beginning on page 5-26.)



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Section IV





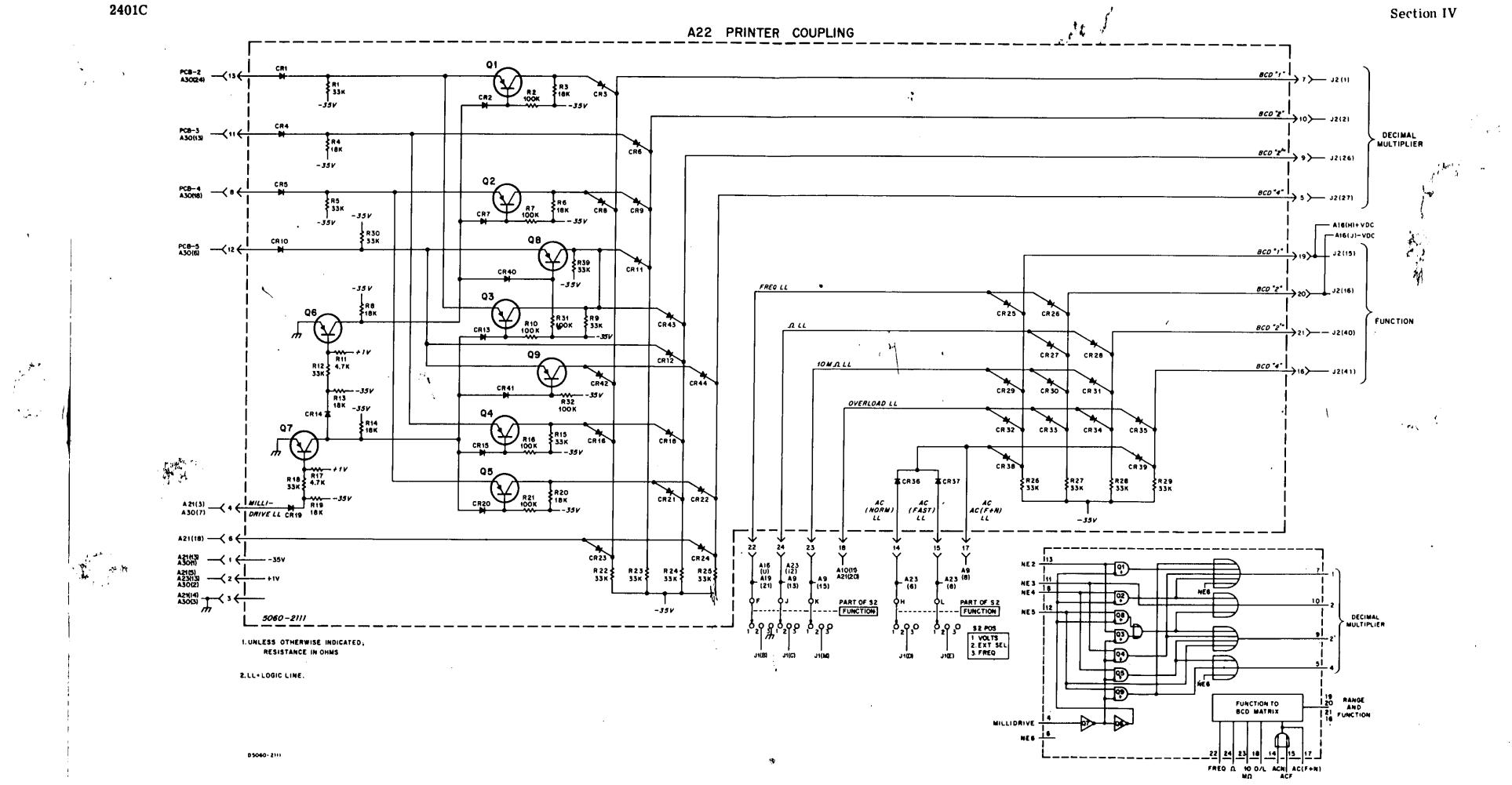
Stock No. 5060-2111 (Serial Prefix 501 thru 533)

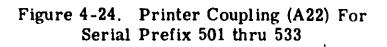
(A22) Printer Coupling (See parts list beginning on page 5-24.)

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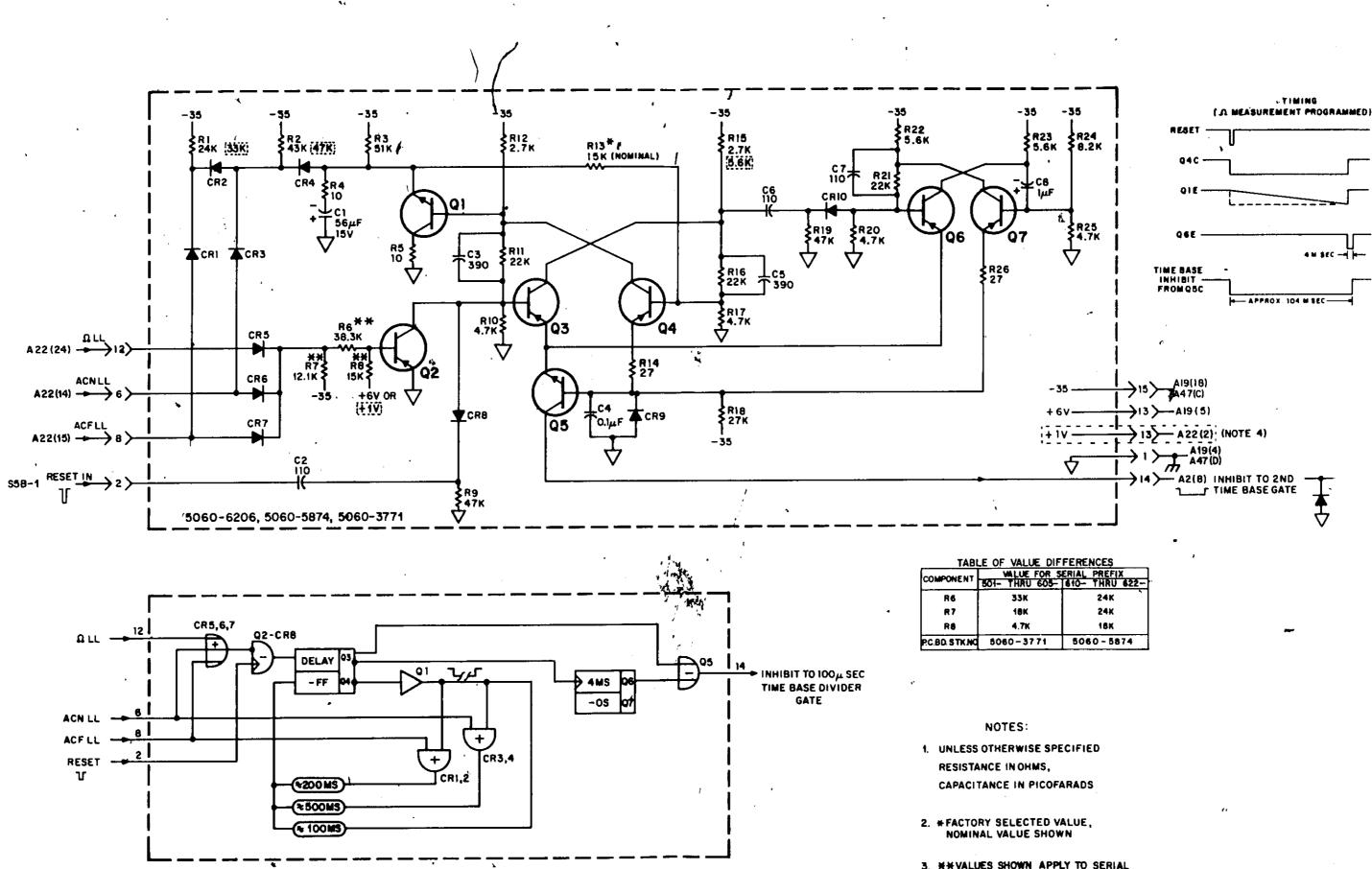
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Stock No. 5060-3771 (Serial Prefix 501 thru 605) Stock No. 5060-5874 (Serial Prefix 610 thru 622) Stock No. 5060-6206 (Serial Prefix 637 and above)

> (A23) HP 2410B AC and Ohms Delay Gate (See parts list beginning on page 5-28.)

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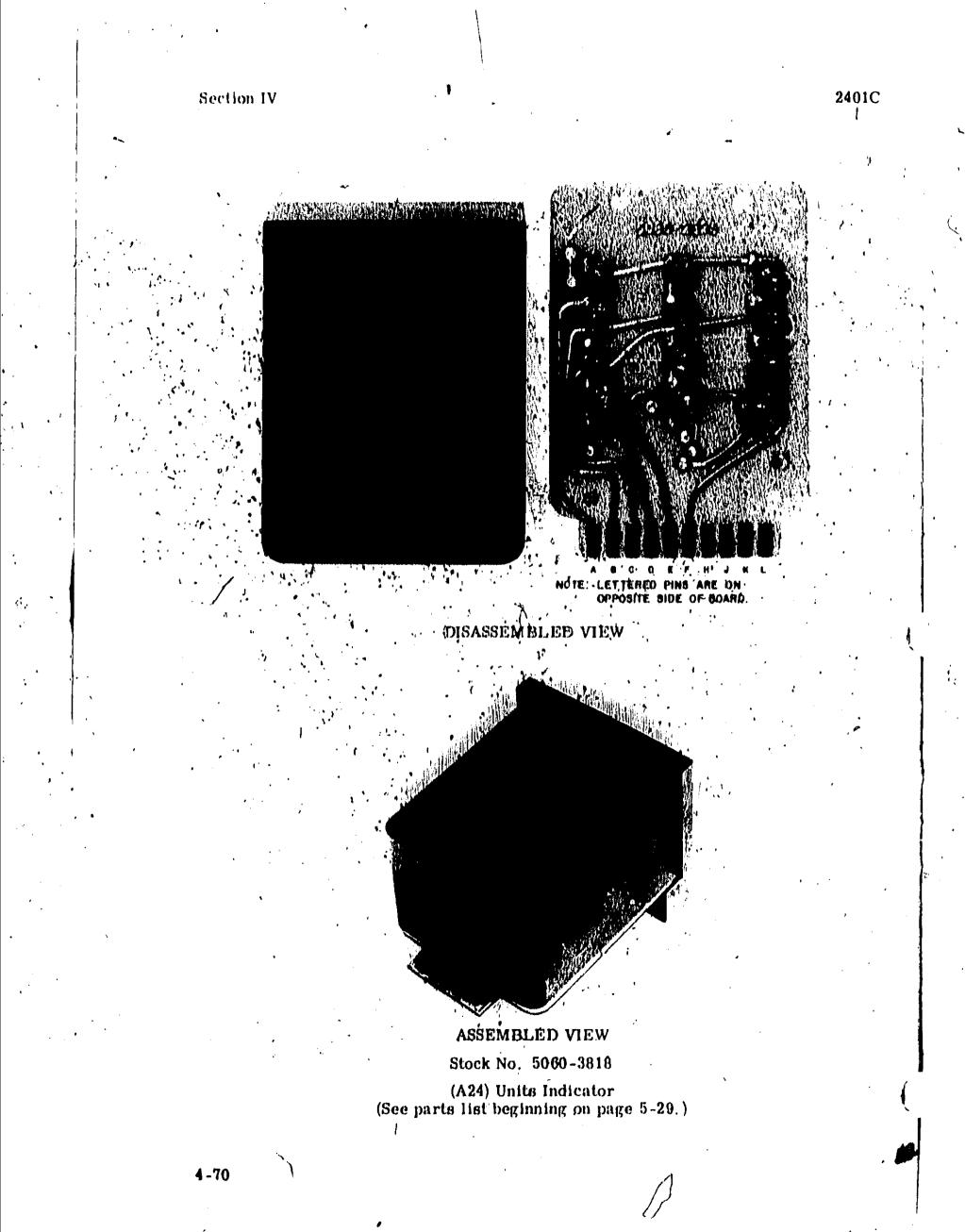
Section IV

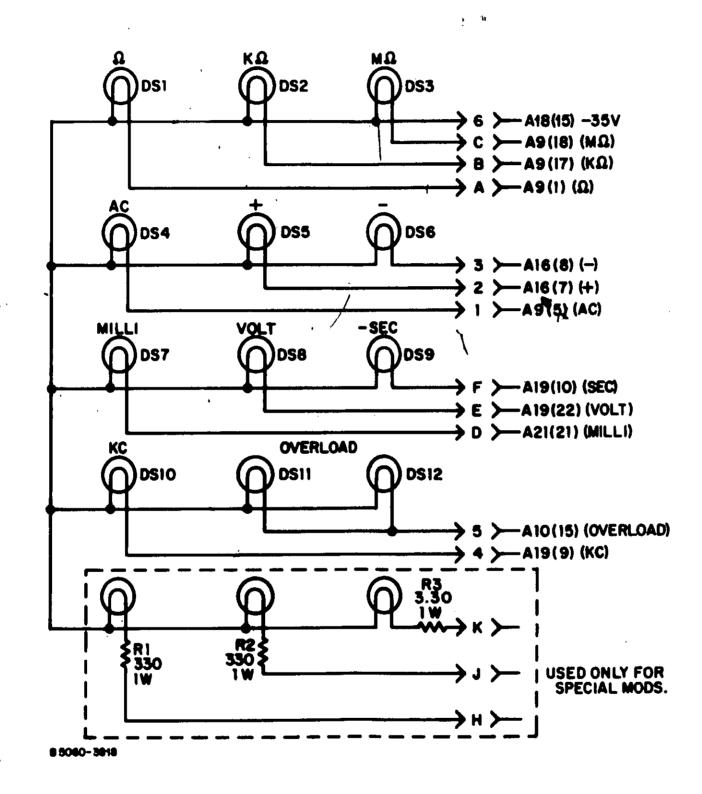
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- 3. ** VALUES SHOWN APPLY TO SERIAL PREFIX 637- AND ABOVE. SEE ABOVE TABLE FOR OTHER SERIAL PREFIXES.
- 4. VALUES AND CIRCUITS WITHIN DOTTED LINES APPLY TO SERIAL PREFIX 501- THRU 605-.

Figure 4-25. HP 2410B AC and Ohms Delay Gate (A23)

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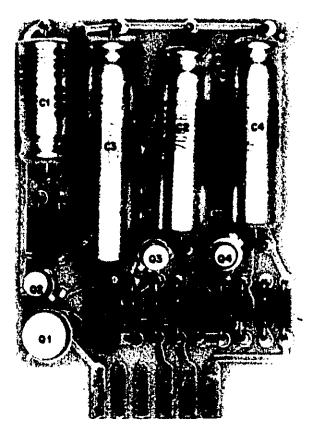
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NOTE: A25 not illustrated.

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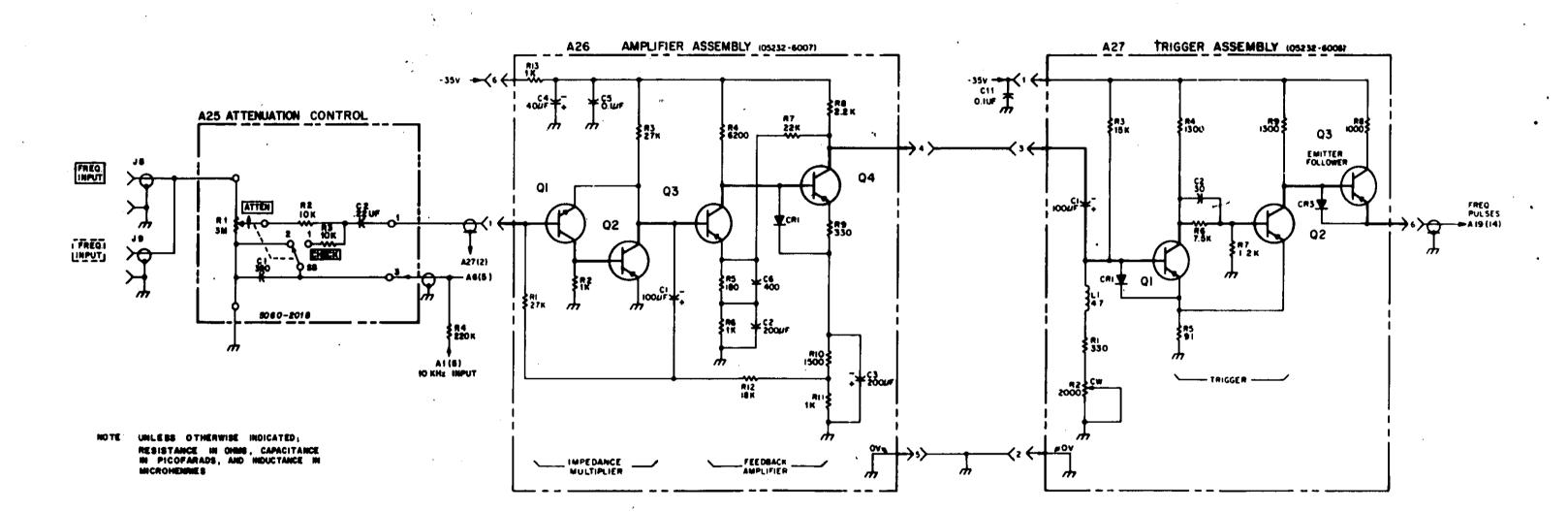
Stock No. 05232-6007 (Serial Prefix 735 and above)

(A26) Input Amplifier (See parts list beginning on page 5-30.)



Stock No. 05232-6006 (Serial Prefix 735 and above) (A27) Trigger (See parts list beginning on page 5-31.)

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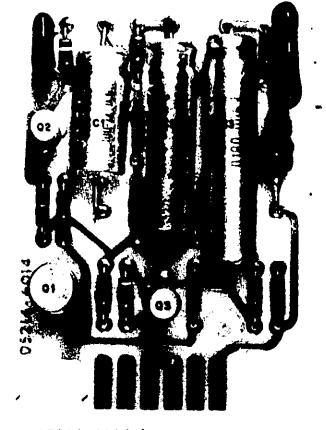


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Figure 4-27. Attenuation Control (A25), Input Amplifier (A26), and Trigger (A27) For Serial Prefix 735 and above



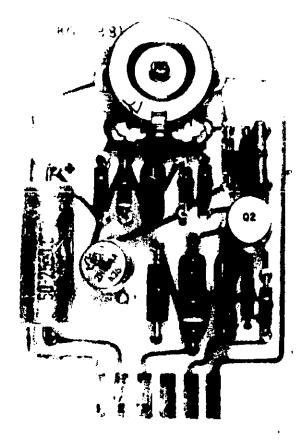
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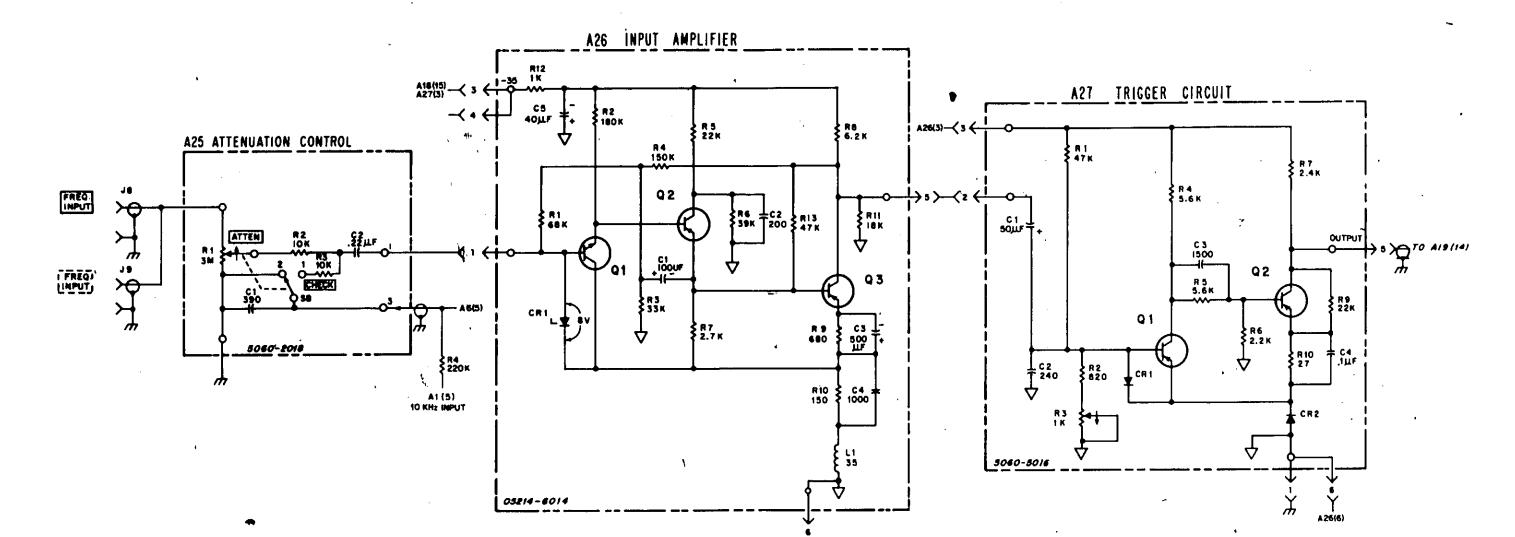
NOTE: A25 not illustrated.

Stock No. 05214-6014 (Serial Prefix 501 thru 637)

(A26) Input Amplifier (See parts list beginning on page 5-30.)



Stock No. 5060-5016 (Serial Prefix 501 thru 637) (A27) Trigger (See papts list beginning on page 5-31.)



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. . NOTES A27(6) 1. UNLESS OTHERWISE INDICATED, RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS, AND INDUCTANCE W MICROHENRIES.

2. . CIRCUIT COMMON

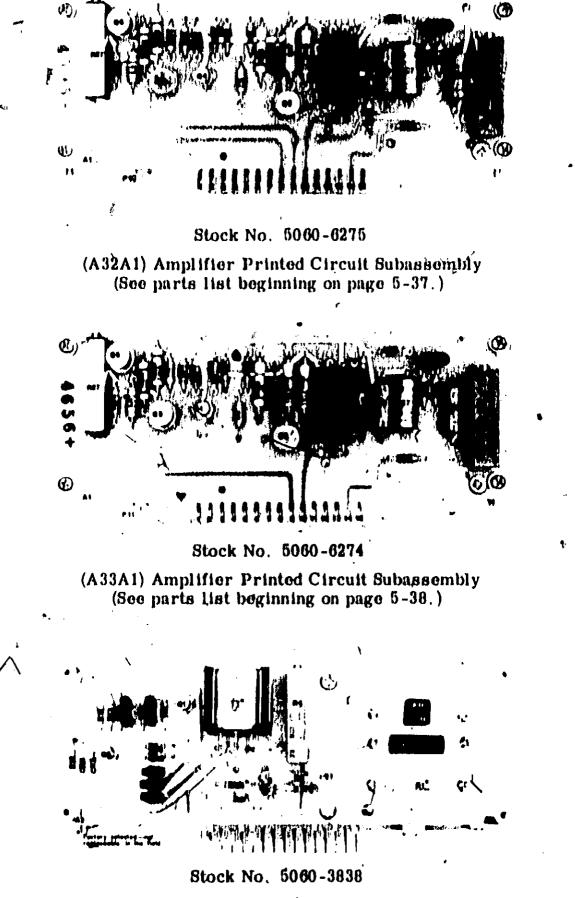
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Figure 4+28. Attenuation Control (A25), Input Amplifier (A26), and Trigger (A27) For Serial Prefix 501 thru 637

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(A32A2 or A33A2) Binary Printed Circuit Subassembly (See parts list beginning on page 5-38.)

(A28) DC Attenuator - See Figure 4-4 (A32) Negative Channel - Stock No. 5060-5001 (A33) Positive Channel - Stock No. 5060-3849



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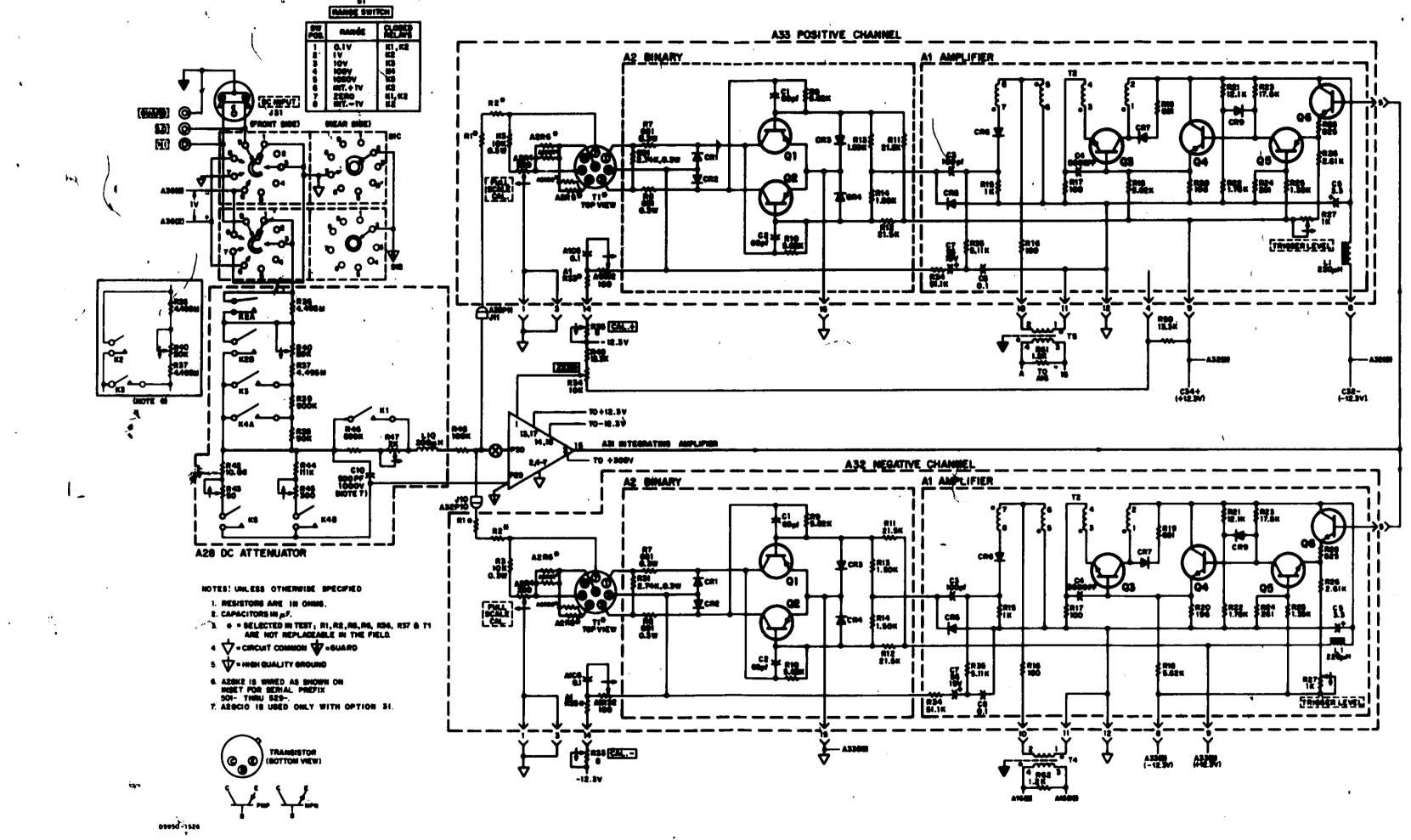
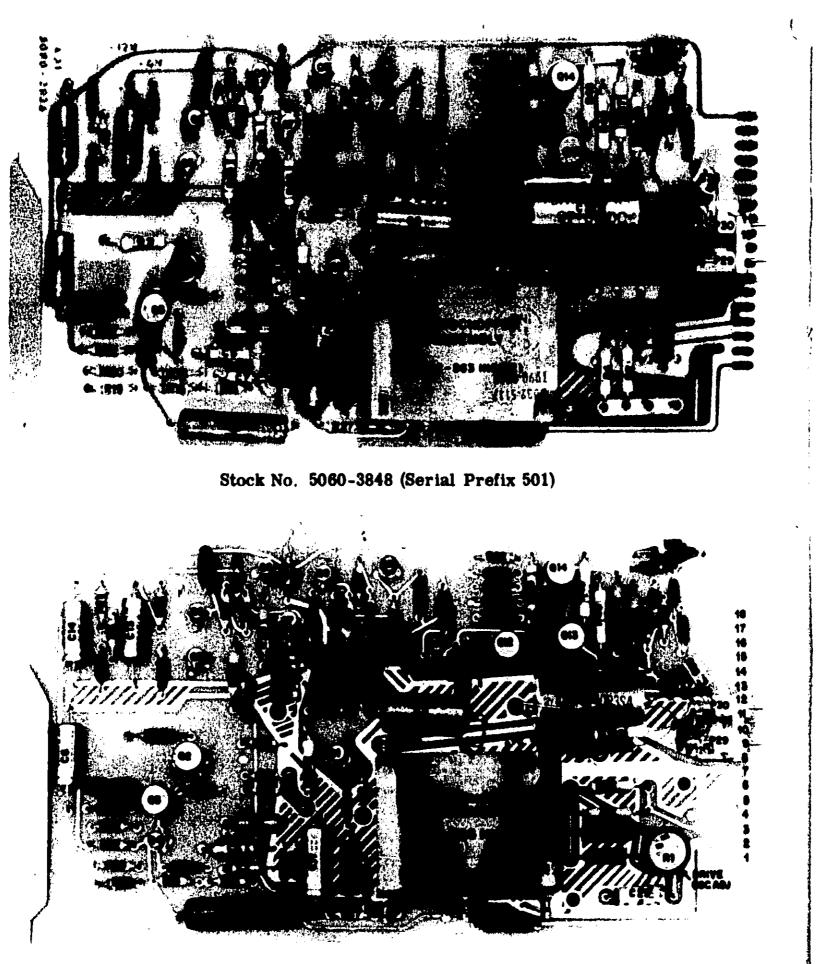


Figure 4-29. DC Attenuator (A28), Negative Channel (A32), and Positive Channel (A33)



Stock No. 5060-5145 (Serial Prefix 521 and above)

(A31) Integrating Operational Amplifier (See parts list beginning on page 5-34.)

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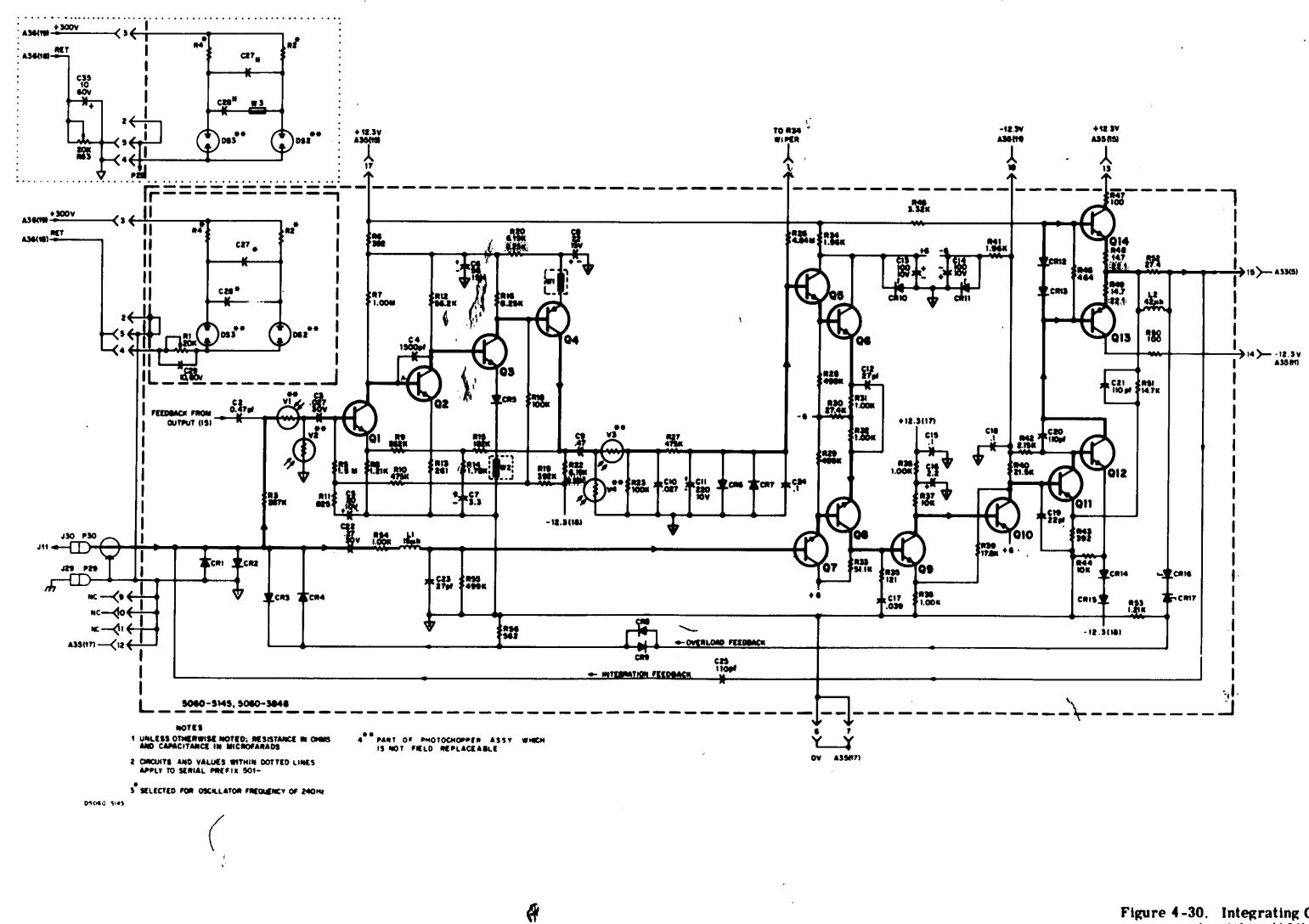
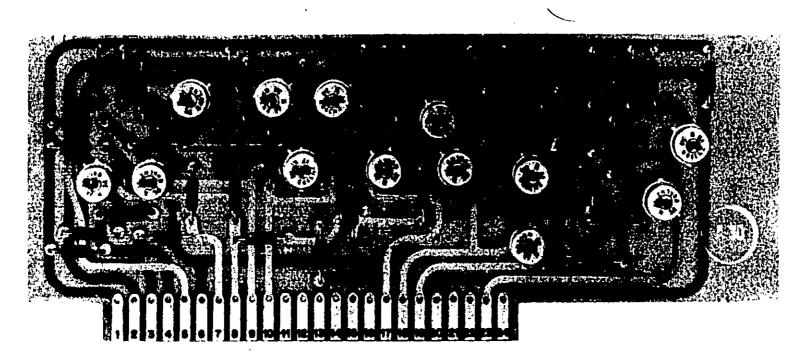


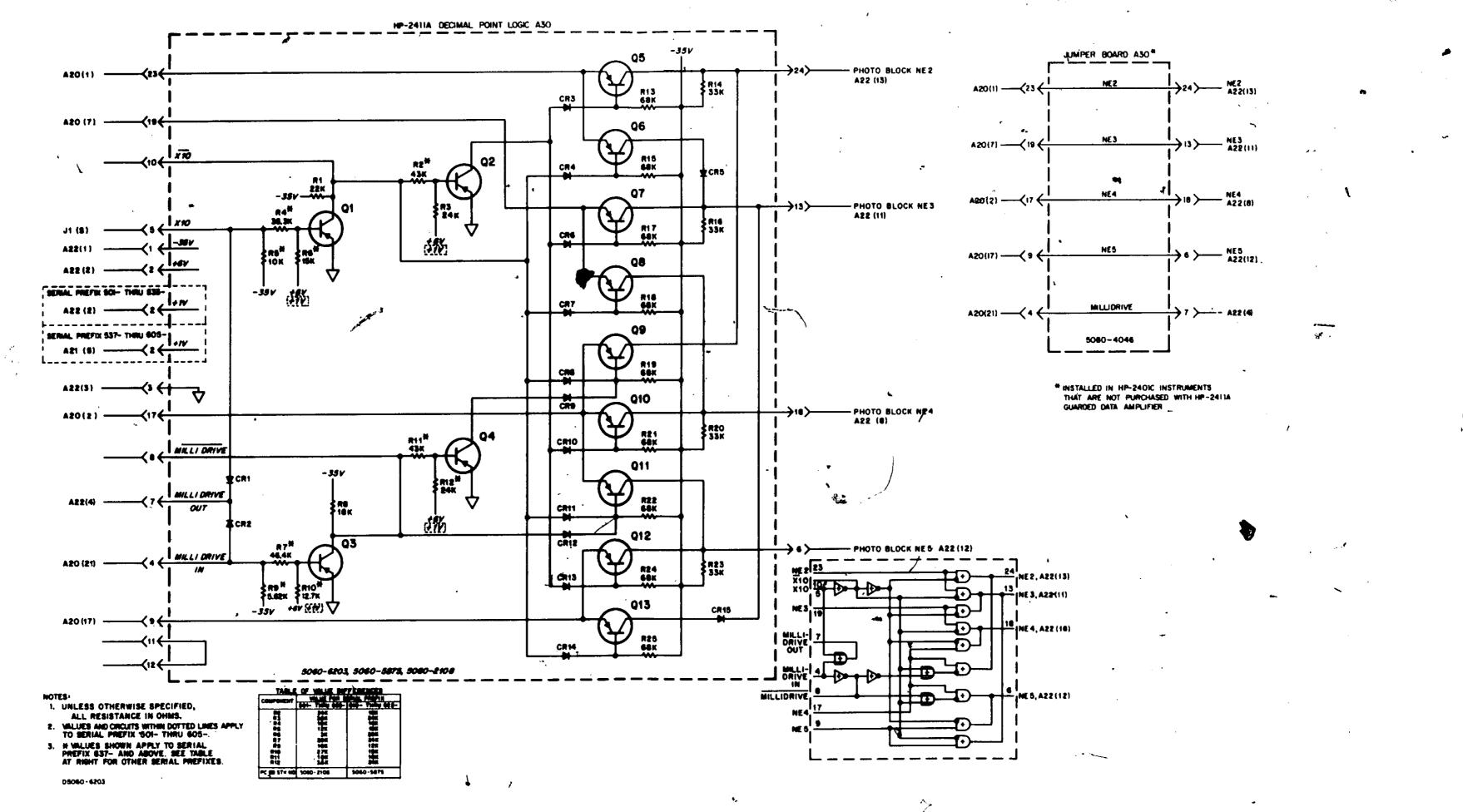
Figure 4-30. Integrating Operational Amplifier (A31)





Stock No. 5060-2108 (Serial Prefix 501 thru 605) Stock No. 5060-5875 (Serial Prefix 610 thru 622) Stock No. 5060-6203 (Serial Prefix 637 and above)

> (A30) HP 2411A Decimal Point Logic (See parts list beginning on page 5-32.)



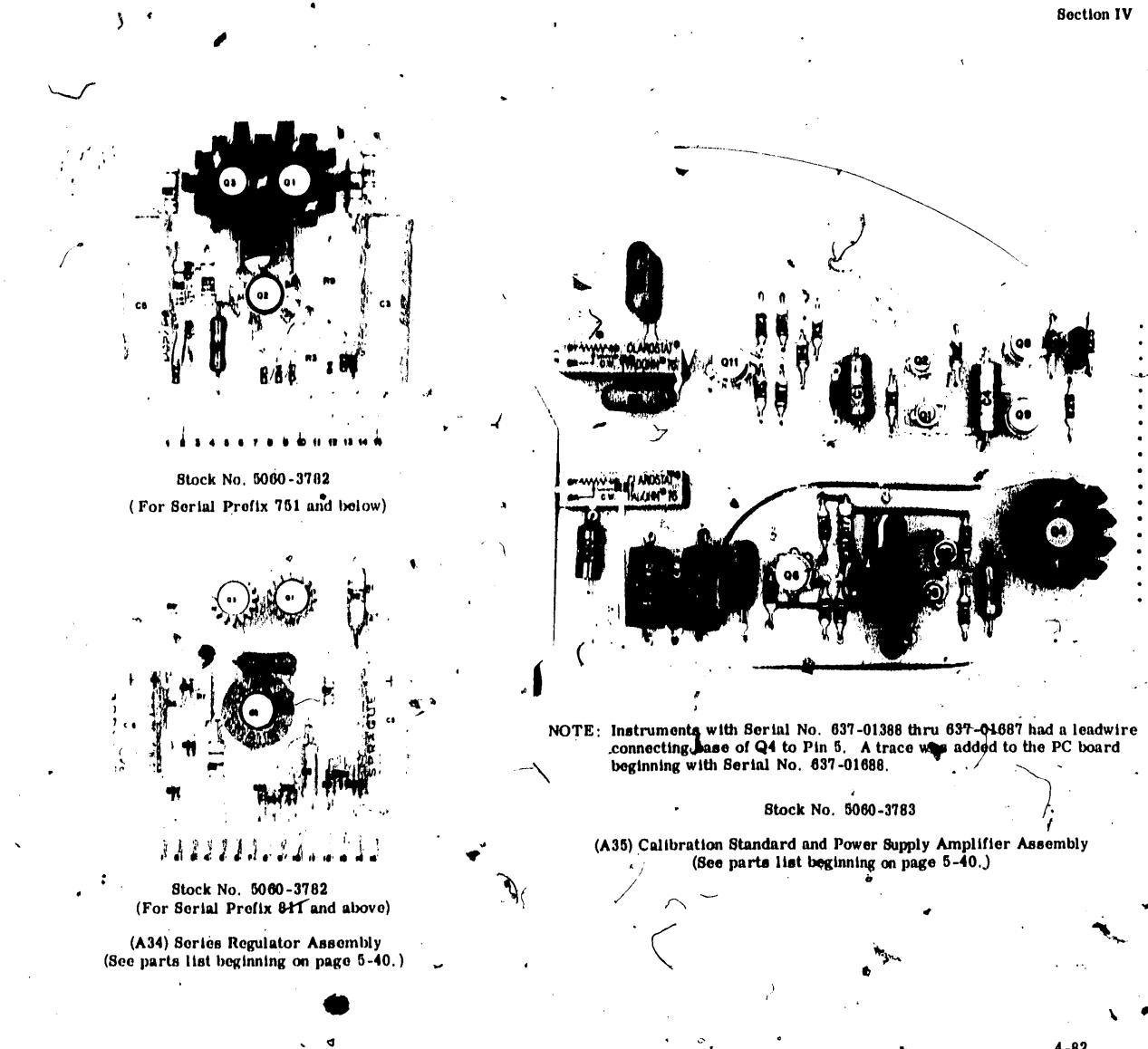
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Figure 4-31. HP 2411A Decimal Point Logic (A30)

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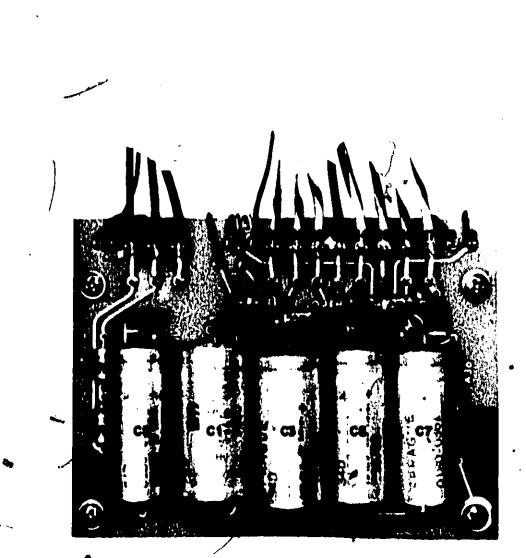
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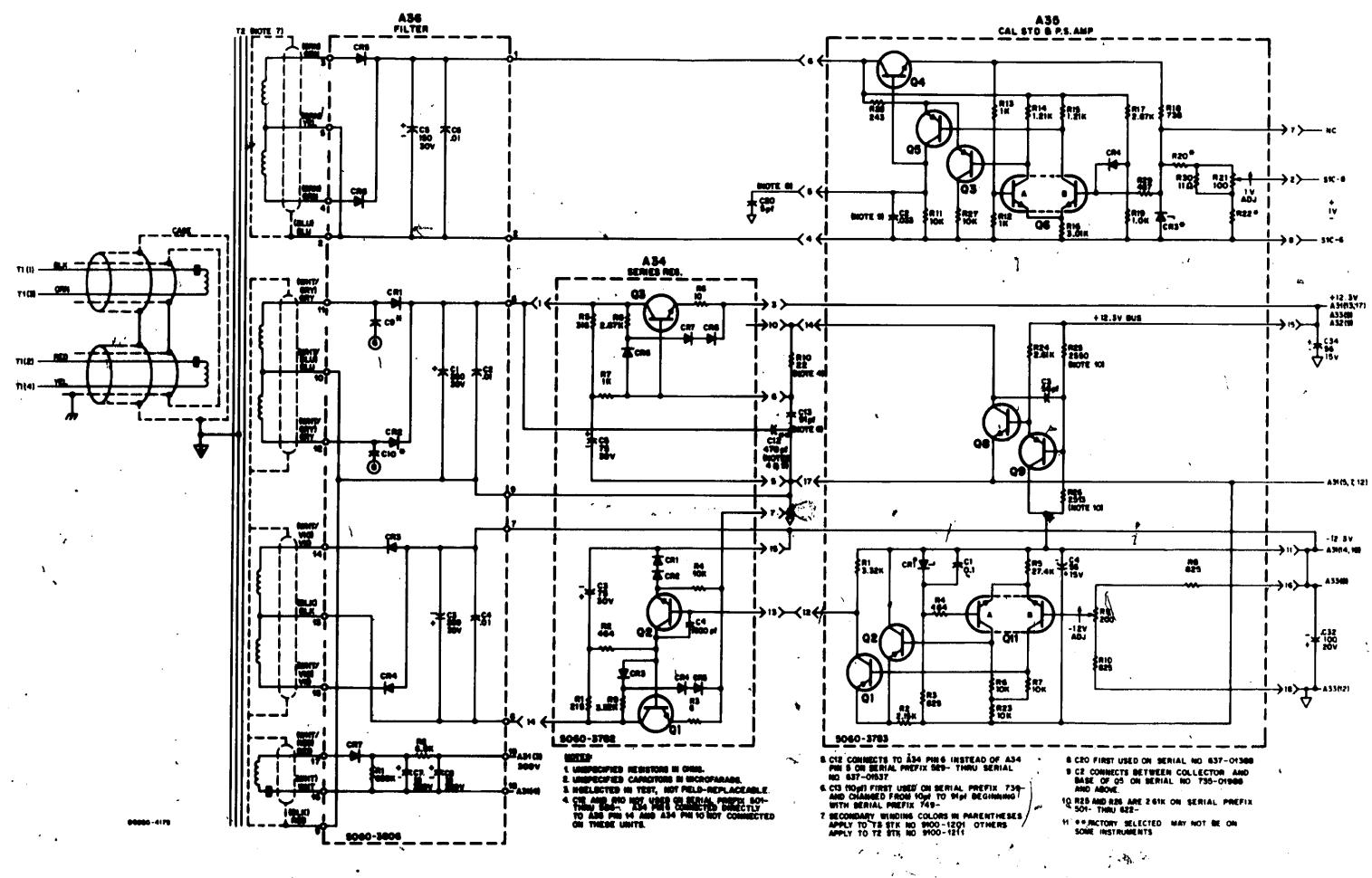
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)stock No. 5060-3806

(A36) Filter Board (Bee parts list beginning on page 5-42.)



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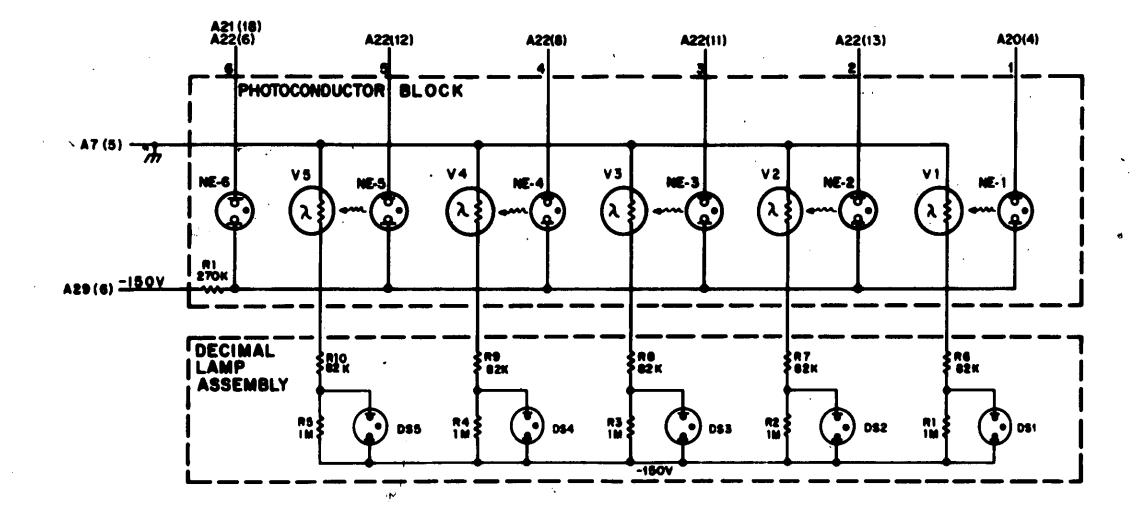
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Section IV

Figure 4-32. Power Supply Circuits (A34, A35, and A36)



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Figure 4-33. Photoconductor and Decimal Lamp

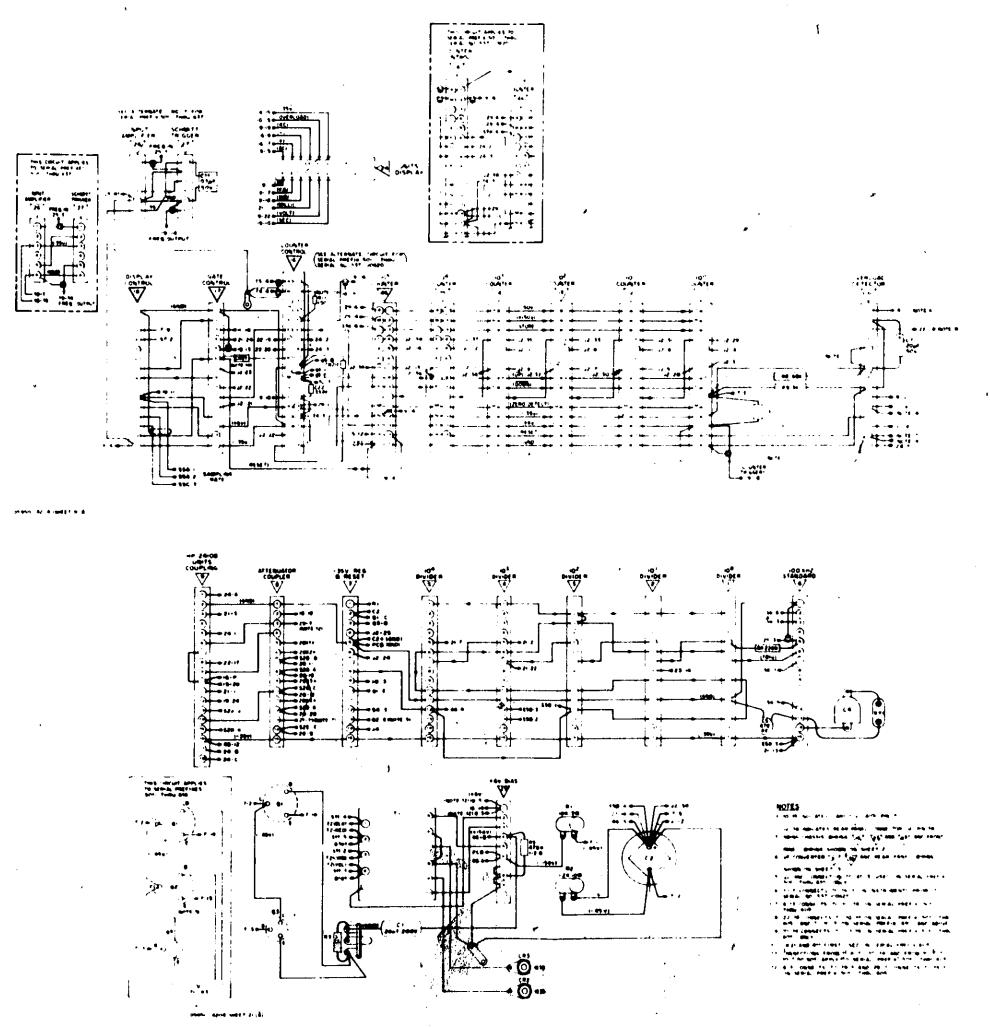


Figure 4-34. Interconnections (Sheet 1 of 3)

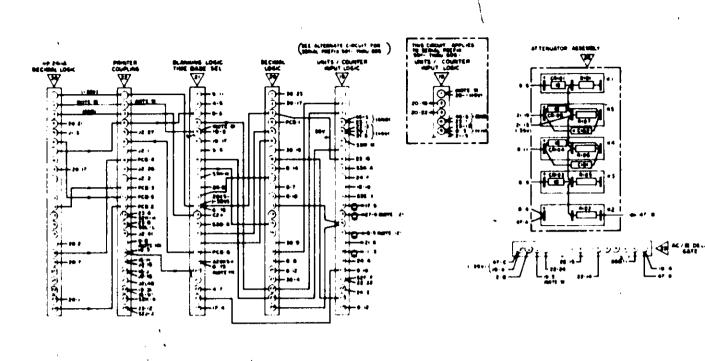
Section IV

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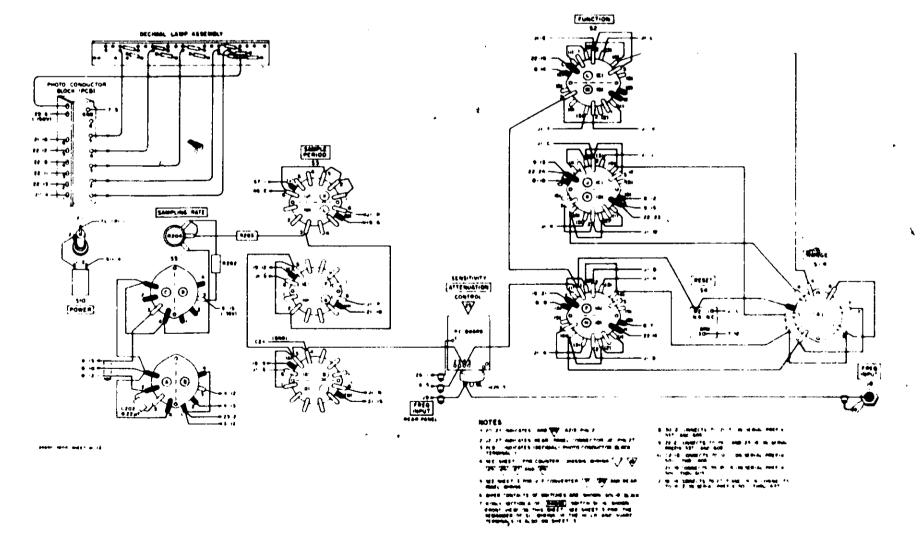
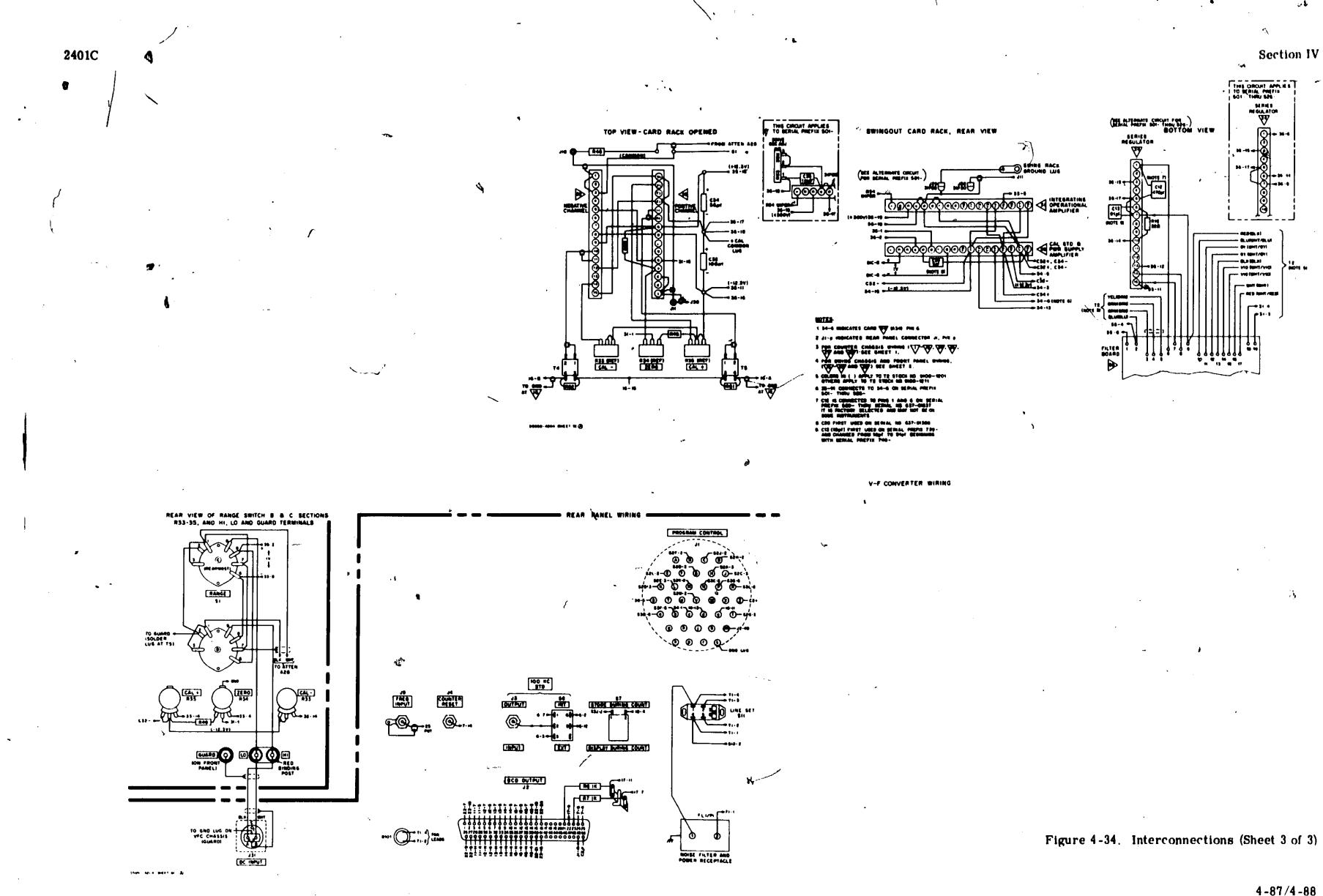


Figure 4-34. Interconnections (Sheet 2 of 3)



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SECTION V CONTENTS

PARTS LIST

Page

5,1	Introduction		5-1
5,2	Ordering		5-2
6/3	Abbreviations Used		5-2
5,4	Recommended Industrial Spares	·	5-3

TABLES

5-1	Reference Designation Index	•	,	5-4
5-2	Replaceable Parts			5-47
5-3	Code List of Manufacturers	•		5-56

LIST OF BOARD ASSEMBLIES

 $\frac{NOTE:}{of letter codes in note column.}$

Reference		Stock		Page
Designation(s)	Description	Number	Note	No
A1	Decade Divider	5212A-65C		5-4
. A2-A5	Decade Divider	5212A-65C		5-5
A6	100KHz Oscillator	5212A-65F	ı.	5-5
A7	.,35V Regulator and Reset Circuit	5060-3830	A-J	5-6
		5060-2006	K-X	5-6
A8	Attenuator Coupling Logic	5060-2014	A-H	5-7
		5060-5870	: J -X	5-7
A9	HP 2410B Unit Coupling Logic	5060-2015	A-H*	5-8
»* · · ·		5060-5871	J-L*∶	5-8
•		5060-6205	M-X	5-8
A10	Overload Detector	5060-2181	A -H	5-10
•		5060-5655	J-X	. 5-11
A11	Reversible Decade Counter	5060-3781	1 - y - y	5-13
A12-A15	Reversible Decade Counter	5060-3781 ·		'5-14 '
A16	Reversible Counter Logic	5060-3809		5-15
,A17	Gate Control	5060-5002	A-L	5-17
•		5060-6224	M-X	5-17
A18 、	Display Control	5060-2052		5-19
A19	Control Logic A	5060-3829	A-H	5-20
۰. ۱		5060-5872	J-X	6-20
A20	Control Logic B	5060-2009	· · · ·	5-22
A21	Control Logic C	5060-2010	A-H	5- 2 3
· .		5060-5873	J-X -	5-23

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5060-6205 May Replace 5060-2015 or 5060-5871.

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LIST. OF S`OARD ASSEMBLIES (Cont'd)

NOTE: Refer to introduction of this section for an explanation of letter codes in note column. 2

Reference Designation(s)	Description	Stock		Page
Designation(s)	Description	Number	Note	No.
A22	Logic Card	5060-2111	A-E	5-24
_		5060-5610	F-X	5-26
A23	AC and Ohms Delay Gate	5060-3771	A-H†	5-28
•	Υ.	5060-5874	J-L†	5-28
	,	5060-6206 [°]	M-X	5-28
A24	Units Display	5060-3818	•	5-29
A25	Attenuator Control	· 5060-2018		5-29
A26	Input Amplifier	05212-6014	A-S	5-30
		05232-6007	T-X	5-30
A27	Schmitt Trigger	5060-5016	A-S	5-31
		05232-6006		5-31
A28	Programmable DC Attenuator	5060-5115	• •	5-46
A29	+6V Bias Supply	5060-3805		5-32
A30	HP 2411A Decimal Point Logic	5060- 210 8	A-H**	5-32
		5060-5875	J-L**	5-32
	· .	5060-6 2 03	M-X	5-32
A31#	Operational Amplifier	5060-3848	Α	5-34
	· · · · · · · · · · · · · · · · · · ·	5060-5145	B-X	5-34
A32#	Negative Channel PC	5060-5001		5-37
A32A1	Amplifier PC	5060-6275		5-37
A32A2	Binary PC	5060-3838		5-38
A33#	Positive Channel PC	5060-3849		5-38
A33A1	Amplifier PC	5060-6274		5-38
A33A2	Binary PC	5060-3838		5-39
A34	Series Regulator	5060-3782		5-40
A35#	Power Supply Amplifier	5060-3783		5-40
436	Rectifier Filter PC	5060-3806	de tal	5-42
446	Reversible Decade Counter	5060-3781	A MARTIN	5-42
447 ,	Relay Time Circuit	5060-3691	、	5-42

[†] 5060-6206 May Replace 5060-3771 or 5060-5874.
^{*} 5060-6203 May Replace 5060-2108 or 5060-5875.

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SECTION V PARTS LIST

5.1 INTRODUCTION

This section contains two lists of information for ordering replacement parts. Table 5-1 lists parts alpha-numerically by reference designation. It provides HP part numbers, a general description of the parts and any applicable notes. The Note column also contains letter codes which identify parts variations between instruments having different serial prefix numbers. Where the Note column has been left blank, the parts apply to all instruments. Following are the codes for the instruments covered by this manual.

Code	<u>Ser Prefix/Ser No.</u>	Code	Ser Prefix/Ser No.
Α	501 -	М	637-01271
В	521 -	Ν	637-01388
С	526-	Р	637 +014 88
D	529-	Q	637-01588
E	533-	R	637-01738
F	537-00371	S	637-01938
G	537-00621	Т	735-
Н	605-	U	739-
J	610-	v	749-
K	614 -	W	751 -
L	622 -	x	811-

Table 5-2 lists parts alpha-numerically by their HP part numbers and provides the following information on each part:

- a. General description of the part.
- b. Typical manufacturer of the part expressed as a five-digit code. (A list of manufacturers and their code numbers appear in Table 5-3.)
- c. Manufacturer's part, stock, or drawing number.
- d. Total quantities used.

5-1

							2401C		2401C				Section V
5.2	ORDERING I	NFORM	ATION						5.4	RECOMMEND	ED INDUSTRIAL SPARES		•
	To order a par to your local H the rear of thi	iewlett-	Packard Sale	kard C es and	o., address y Service Office	our ord . See f	er or inquiry he listing at			or assemblies	here down-time of the equipmed that one of each of the follo be stocked. The instrument	owing plug-in etche can then be kept in	d circuit boar
	Specify the fol	lowing i	nformation o	on each	part:					while the faulty stock number f	v board or assembly is being is listed, check the instrument	repaired. Where in the serial number pr	more than one
-	a. Model	number	and complet	e seria	l number of ir	strume	nt.	i.		graph 5.1 to de	etermine the applicable stock	number.	
	b. Stock n		:										
	c. Circuit	referer	ce designati	on.				1		Circuit			Usable
	d. Descrip		_							Reference	Description	HP Stock No.	On Code
	To order a par	t not lie	tod in Table	51.						A1-A5	Decade Divider	5212A-65C	
	To order a par include functio	n and lo	cation of the	part i	n the instrume	descrip nt and/	tion and or system.			A6	100kHz Oscillator	5212A-65F	
				-		,		1	`	A7	-35V Regulator & Reset	5 060-3 830	A-J
3	ABBREVIATIO	NS USE	D							`	.	50 60-20 06	K-X
									δ. ´	A10	Overload Detector	5060-2181	А-н
											(5 060-56 55	J -X
			REFERENCE DE	ESIGNATION						A11-A15, A46	Reversible Decade	5060-3781	
•	tssembly motor		fuse filter	МК Р	 microphone plug connector 	v	 vacuum tube, neon bulb, photocell, etc. 			A16	Reversible Counter Logic	5060-3809	
	battery capacitor coupler	J	 integrated circuit receptacle connector relay 	Q R RT	 transistor resistor thermistor 	VR W X	 voltage regulator cable, jumper socket 	1 i		A17	Gate Control	5060-5002	A-L
•	diode delay line device signaling (lamp)	L LS	linductor loud speaker meter	S T TB	- switch • transformer • terminal board	Ŷ Z	 crystal tuned cavity, network 	, I		\mathbf{C}		5060-6224	M-X
	misc hardware		microcircuit	TP	 test point 		neveoix			A18	Display Control	5060-2052	
	amperes automatic frequency control		ABBREVIA benries hardware	TIONS N O N PO	 normally open 	RMO	• mick mount only			A19	Control Logic A	5060-3829	A-H
IPL 🔹	amplifier	HEX - HG -	hexagonal mercury		 negative positive zero (zero temperature coefficient) 	RMS RWV	= rool-méan square = reverse working voltage					5060-587 2	J -X
CU s C s	beat frequency oscillator bervilium copper binder head		hour(s) hertz intermediate freg	N PN NRFR	 negative-positive- negative not recommended for 	S-B SCR SE	=slow-blow =screw =selenium			A26	Input Amplifier	5060-6014	A-S
85 ÷	bandpass brass backward wave oscillator	IMPG = INCD -	impregnated incandescent include(s)	NSR	field replacement not separately replaceable		 section(s) 	i.				5060-6007	T-W
R -	rounter clockwise ceramic cabinet mount only	INS -	insulation(ed) internal	OBD OH	 order by description oval head 	SIL SL	- ailver - alide			A27	Schmitt Trigger	5060-5016	A-S
ЕР - М -	coefficient common composition		kilo + 1000 left hand	OX P	 oxide peak 	SPG SPL SST	 spring special stainless steel 					5060-6006	Т-Х
MPL + NN +	complete connector cadmium plate	LIN - LK WASH -	linear taper lock washer	PC PF	 printed circuit picofarads = 10⁻¹² farads 	SR Stl Ta	• split ring • steel • tantalum			A31*	Operational Amplifier	5060-3848	Α
т.	cathode-ray tube clockwise		logarithmic taper low pass filter	PH BRZ Phl Piv	 phosphor bronze Phillips peak inverse voltage 	TD TGL THD	time delay toggie thread					5060-5145	В-Х
٠	deposited carbon drive	M = MEG = MET FLM =		PNP P O	 positive-negative- positive part of 	TI TOL TRIM	titalium lolerance trimmer			A32*	Negative Channel	50 60 -5001	
САР +	electrolytic encapsulated external	MHZ +	metallic oxide manufacturer mega hertz	POLY PORC POS	 polystyrene porcelain position(s) 	TWT U	 traveling wave tube micro < 10⁻⁶ 	*		A33*	Positive Channel	5060-3849	
•	farads Nat head fillister head	MOM • MTG •	niniature momentary mounting	РОТ РР	 pointion(s) potentiometer peak-to-peak point 	VAR VDCW				A34	Series Regulator	5060-3782	
	(ixed giga (10 ⁹) germanium	N - N.C +	''mylar'' nanu (10 ⁻⁹) normally closed	PWV Rect R f	 peak working voltage rectifier radio frequency 	w w wiv	with waits working inverse voltage			A35*	Power Supply Amplifier	5060-3783	
	glass ground(ed)		acon nickel plate	RH	round head or right hand	ww wo	wirewound without						
						l l		1	:	* NOTE: Not fie	ld-repairable.		

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C1 0150-01/1 CFR0 CFR 0.1 UF +80-20T S0YDCH AIR22 0683-6835 RFD0 COMP 40R CHR 31 //W C2 0140-0134 CFR0 FIG. 110 FF 5T 50 00 VDCH AIR22 0683-6825 RFR0 COMP 40R CHR 31 //W C3 0140-0134 CFR0 FIG. 130 FF 5T 300 VDCH AIR22 0683-6825 RFR0 COMP 47R CHR 32 1/AH C4 0140-0195 CFR0 FIG. 130 FF 5T 300 VDCH AIR23 0683-7435 RFR0 COMP 47R CHR 35 1/AH C4 0140-0195 CFR0 FIG. 130 FF 5T 300 VDCH AIR24 0683-1035 RFR0 COMP 47R CHR 35 1/AH C5 0140-0196 CFR0 FIG. 130 FF 5T 3 V AIR23 0683-2015 RFRD COMP 400 CHR 5T 1/AH C6 0140-0199 CFR0 FIG. 130 FF 5T 300 VDCH AIR33 0683-2025 RFRD COMP 47R CHR 35 1/AH C1 0140-0195 CFR0 FIG. 100 FF 5T 300 VDCH AIR33 0683-2025 RFRD COMP 47R CHR 35 1/AH C1 0140-0195 CFR0 FIG. 100 FF 5T 300 VDCH AIR33 0683-2025 RFRD COMP 47R CHR 35 1/AH C140-0196 CFR0 MICA 200 FF 5T AIR34 0683-2025 RFRD COMP 47R CHR 35 1/AH AIR35 C110 0140-0196 CFR0 MICA 200 FF 5T <td< th=""><th>Reference Designation</th><th>Part No.</th><th>Description #</th><th>Note</th><th></th><th>Reference Designation</th><th>Part No.</th><th>Description #</th><th></th></td<>	Reference Designation	Part No.	Description #	Note		Reference Designation	Part No.	Description #	
ST24.46C DECADE DUTLET DECADE DUTLET ALEXT DECADE DUTLET Strate Control			A1 5212A-65C					A2-A5 5212A-65C	
C1 0130-0121 C1FND CER 0.1 UP + NC-208 SOVECH AR252 0043-0452 RFPD CER 0.1 UP + NC C2 014-0154 C1FND REA 110 PF NS 0050 RFPD CER 0.1 UP + NC RFPD	1	5212A-65C	DECADE DIVIDER			A1R23 /			
C2 0140-0194 C1700 FTCA 100 FF 51 30 V0CW A1726 6682-6622 R1FXD CORP AGO DIPK 51 1/AW C3 0140-0195 C1700 FTCA 100 FF 51 30 V0CW A1827 6682-6125 41750 CORP AGO DIPK 51 1/AW C4 0140-0195 C1700 FTCA 100 FF 51 30 V0CW A1827 6682-6125 41750 CORP AGO DIPK 51 1/AW C4 0140-0195 C1700 FTCA 100 FF 51	101	0150-0121	C:FXD CER 0.1 UF +80-20¥ 50VDC₩			A1R25			
23 01470-0159 1.1400 M164 132 PF 51 300 VCH AR27 0043-7235 4.4502 ODF 136 ODF 135 1/AW 25 01470-0159 1.1400 M164 132 PF 51 300 VCH AR37 0043-7235 4.4502 ODF 136 ODF 135 1/AW 26 01470-0159 1.1500 M164 130 PF 51 100 VCH AR310 0043-7235 4.4502 ODF 136 ODF 135 1/AW 26 01470 M154 120 PF 51 100 VCH AR310 0043-7235 4.4502 ODF 75 0DF 140 M1 41 100 M1 74 1/AW 26 01470 M154 120 PF 51 300 VCH AR313 0043-7235 4.4502 ODF 75 0DF 75 0DF 74 0DF 75 100 VCH 211 01470 M154 120 PF 51 300 VCH AR313 0043-7235 4.4502 ODF 75 0DF 75 0D	1C2	0140-0194	C:FXD MICA 110 PF 5%			A1R26	0683-6825	R:FXD COMP 6800 OHM 5% 1/4W	
10 10 <td< td=""><td>LC3</td><td></td><td>C:FXD MICA 130 PF 5% 300 VDCW</td><td></td><td></td><td></td><td>0683-4735</td><td>R:FXD COMP 47K OHM 5% 1/4W</td><td></td></td<>	LC3		C:FXD MICA 130 PF 5% 300 VDCW				0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
C4 VQL0-0104 CLFRD HIGL 150 PF 51 ALRDO CRFD COM 200 DMIN SE 1/AW C4 0140-0104 LLFRD HIGL 150 PF 51 000 HIGL 200 PF 51 000								R:FXD COMP 10K OHM 5% 1/4W	
C1 C1 <thc1< th=""> C1 C1 C1<!--</td--><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>R:FXD COMP 3900 OHM 5% 1/4W</td><td> '</td></thc1<>								R:FXD COMP 3900 OHM 5% 1/4W	'
C1 D140-D196 Lifzb TLL 30 DF 31 D122 D140-D196 Lifzb TLL 30 DF 31 D122 0140-D195 Lifzb TLL 30 DF 31 D00 VCLV A1833 D083-A225 Rifzb CDP 400 DHK S1 1/w 11 D140-D194 Lifzb TLL 30 DF 31 D00 VCLV A1833 D083-A225 Rifzb CDP 400 DHK S1 1/w 12 D140-D194 Lifzb TLL 10 DF 31 D00 VCLV A1833 D083-A225 Rifzb CDP 400 DHK S1 1/w 12 D140-D194 Lifzb TLL 10 DF 31 D00 VCLV A1833 D083-A235 Rifzb CDP 400 DHK S1 1/w 13 D140-D144 Lifzb TLL 10 DF 51 A1837 D083-A235 Rifzb CDP 470 DHK 31 1/w D083-A235 14 D100-D144 D100 Lifzbrankuluk 100AA AT 0.35V 60PTV A1840 D083-A235 Rifzb CDP 470 DHK 31 1/w D083-A235 13 D100 CIfzbrankuluk 100AA AT 0.35V 60PTV A1840 D083-A235 Rifzb CDP 470 DHK 31 1/w Rifzb CDP 470 DHK 31 1/w Rifzb CDP 470 DHK 31 1/w 14 D100 CIFZBRANKUN 100AA AT 0.55V 60PTV A1840 D083-A235 Rifzb CDP 470 DHK 31 1/w A1840 D083-A235 Ri		~Q140-0196	C:FXD MICA 150 PF 5%						1.
25 0140-0199 Lifk0 MiCL 240 PF 25 • 0 0140-0199 Lifk0 MiCL 210 PF 25 00 VOCH AIR32 0683-4725 Rifk0 COMP 450 CMH 55 1/AH 0140-0194 Lifk0 MiCL 210 PF 25 00 VOCH AIR32 0683-4725 Rifk0 COMP 450 CMH 55 1/AH 0140-0194 Lifk0 MiCL 210 PF 25 00 VOCH AIR35 0683-4725 Rifk0 COMP 450 CMH 55 1/AH 0140-0194 Lifk0 MiCL 200 PF 51 AIR35 0683-4725 Rifk0 COMP 450 CMH 55 1/AH 0140-0194 Lifk0 MiCL 200 PF 51 AIR37 0683-4725 Rifk0 COMP 450 CMH 55 1/AH Rifk0 COMP 450 CMH 51 1/AH DIODE:GERMANUM 100A AT 0.85Y 60FIV AIR37 0683-4725 Rifk0 COMP 570 CMH 51 1/AH Rifk0 COMP 450 CMH 51 1/AH DIODE:GERMANUM 100A AT 0.85Y 60FIV AIR42 0683-4735 Rifk0 COMP 450 CMH 51 1/AH Rifk0 COMP 450 CMH 51 1/AH DIODE:GERMANUM 100A AT 0.85Y 60FIV AIR42 0683-4735 Rifk0 COMP 450 CMH 51 1/AH Rifk0 COMP 450 CMH 51 1/AH DIODE:GERMANUM 100A AT 0.85Y 60FIV AIR42 0683-4735 Rifk0 COMP 450 CMH 51 1/AH Rifk0 COMP 450 CMH 51 1/AH AIR42 0683-4735 Rifk0 COMP 450 CMH 51 1/AH AIR42 Rifk0 COMP 450 CMH 51 1/AH AIR42	C7	0140-0196	1 : EYD NICA 150 DE 59			AIK31	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
P: 0.440-0135 (LEX) CLFAD MICA 130 PF 35 300 VOCM AL833 (D63-4273) 0.683-4273 (LEX) REFE COMP 35 L/Au 111 0.440-0136 (LEX) CLFAD MICA 10 PF 35 300 VOCM AL833 (D63-4273) 0.683-4273 (LEX) REFE COMP 35 L/Au 112 0.440-0136 (LEX) CLFAD MICA 200 PF 35 L (LEX) AL833 (D63-4733) 0.683-4735 (LEX) REFE COMP 350 L/Au 113 0.663-4735 (LEX) CLFAD MICA 200 PF 35 L (LEX) AL833 (D63-4735) 0.683-4735 (LEX) REFE COMP 350 L/Au 114 0.400-0136 (LEX) CLFAD MICA 200 PF 35 L (LEX) AL833 (D63-4735) REFE COMP 350 L/Au AL833 (D63-4735) 115 0.000 LIX CLFAD MICA 309 PF 32 (LEX) AL833 (D100-016 DL005 CERMANUM IDA AT 0.659 GPV AL833 (D100-016 REFE COMP 350 L/Au AL833 (D63-6252 REFE COMP 350 L/Au AL833 (D63-6252 REFE COMP 350 L/Au AL833 (D63-6252 REFE COMP 350 L/Au AL844 0.683-4735 (REFE COMP 350 L/Au AL844 0.683-	C8					A1R32	0683-6825	REEXD COMP 6800 OHM ST 1/44	
110 0140-0195 LIFXD MICA 150 PF 51 300 UDCM 111 0140-0196 CFRXD MICA 100 PF 51 112 0140-0196 CFRXD MICA 200 PF 91 113 0140-0196 CFRXD MICA 200 PF 92 114 0140-0196 CFRXD MICA 200 PF 92 113 0140-0196 CFRXD MICA 200 PF 92 114 0140-0196 CFRXD MICA 200 PF 92 115 0140-0196 CFRXD MICA 200 PF 92 114 0140-0196 CFRXD MICA 200 PF 92 115 0100EFGERMANUM 100MA AT 0.85V 60PLV AIR83 116 0100EFGERMANUM 100MA AT 0.85V 60PLV AIR84 116 0100EFGERMANUM 100MA AT 0.85V 60PLV AIR84 116 0100EFGERMANUM 100MA AT 0.85V 60PLV AIR84 116 0683-7015 RFRD COMP 951 7/4W 116 0683-7015 RFRD COMP 951 7/4W 116 0683-7015 RFRD COMP 950 00 MH 951 7/4W 116 0683-7025 RFRD COMP 950 00 MH 951 7/4W	C9				l R				
112 0140-0144 C1FKD MICA 110 PF 51 12 0140-0146 C1FKD MICA 200 PF 51 133 0140-0146 C1FKD MICA 200 PF 52 141 0140-0200 C1FKD MICA 200 PF 52 141 0140-0200 C1FKD MICA 200 PF 52 141 0140-0216 DIDDE:CEMANIUM 100MA AT 0.85V 60FLV 141 0140-0116 DIDDE:CEMANIUM 100MA AT 0.85V 60FLV 142 0140-0116 DIDDE:CEMANIUM 100MA AT 0.85V 60FLV 141 0683-1035 RFRD COMP 300 DHN 51 L/AW 142 0100E:CEMANIUM 100MA AT 0.85V 60FLV AIR32 144-1 0683-6255 RFRD COMP 300 DHN 51 L/AW 141 0083-735 RFRD COMP 300 DHN 51 L/AW 142 0100E:CEMANIUM 100MA AT 0.85V 60FLV AIR42 1430-0016 DIDDE:CEMANIUM 100MA AT 0.85V 60FLV AIR42 1431-0016 DIDDE:CEMANIUM 100MA AT 0.85V 60FLV AIR42 1440 0683-4735 RFRD COMP 300 DHN 51 L/AW 1450-0016 DIDDE:CEMANIUM ALLOY JUNCTION AIR42 1450-0016 RFRD COMP 300 DHN 51 L/AW AIR45 1450-0016 RFRD COMP 300 DHN 51 L/AW AIR45 <t< td=""><td>C10</td><td>0140-0195</td><td>L: FXD MICA 130 PF 5% 300 VDCW</td><td></td><td></td><td></td><td></td><td>REFEAD COMP 8200 DHMS 5% 1/4</td><td>. </td></t<>	C10	0140-0195	L: FXD MICA 130 PF 5% 300 VDCW					REFEAD COMP 8200 DHMS 5% 1/4	.
113 0140-0166 0140-0200 C FERD MICA 200 pr 24 C FERD MICA 300 pr 34 C F	C11	0140-0194						RIFXD COMP 47K OHM 5% 1/4	·
114 0140-0169 0140-01200 CLRED MICA 200 PF 35 CLRED M								R: FXD COMP 47K OHM 5% 1/4W	•
14 0140-0200 CLFRD NICA 390 pF 52 ALR38 0683-7355 REPD COMP 527 CMM 52 //W 121 1910-0016 DIODE:GERMANIUM IOMA AT 0.85V ADPLV ALR39 0683-1055 REPD COMP 527 CMM 52 //W 121 1910-0016 DIODE:GERMANIUM IOMA AT 0.85V ADPLV ALR40 0683-1025 REPD COMP 500 CMM 52 //W 121 1910-0016 DIODE:GERMANIUM IOMA AT 0.85V ADPLV ALR40 0683-9225 REPD COMP 500 CMM 52 //W 121 0005-0016 DIODE:GERMANIUM IOMA AT 0.85V ADPLV ALR42 0683-9225 REPD COMP 500 CMM 52 //W 121 0005-0016 DIODE:GERMANIUM IOMA AT 0.85V ADPLV ALR42 0683-9225 REPD COMP 500 CMM 52 //W 121 0005-0016 DIODE:GERMANIUM IOMA AT 0.85V ADPLV ALR42 0683-4735 REPD COMP 600 CMH 52 //W 12 0063-4735 REPD COMP 600 CMH 52 //W ALR44 0683-4735 REPD COMP 600 CMH 52 //W 12 0683-4735 REPD COMP 600 CMH 52 //W A2 SAME AS ALUE PREFIX A4 2 0683-4735 REPD COMP 67X CMH 53 //W A3 SAME AS ALUE PREFIX A4 3 0683-4735 REPD COMP 67X CMH 53 //W A4 SAME AS ALUE PREFIX A4									
AR1 1910-0016 DIDDE-GERMANUU IDMA AT 0.85V 60FIV AR2 1910-0016 DIDDE-GERMANUU IDMA AT 0.85V 60FIV AR83 R23 1910-0016 DIDDE-GERMANUU IDMA AT 0.85V 60FIV AR84 R3 1910-0016 DIDDE-GERMANUU IDMA AT 0.85V 60FIV AR84 R4 1910-0016 DIDDE-GERMANUU IDMA AT 0.85V 60FIV AR84 R4 1910-0016 DIDDE-GERMANUM IDMA AT 0.85V 60FIV AR84 R4 1910-0016 DIDDE-GERMANUM IDMA AT 0.85V 60FIV AR84 R4 1000-016 DIDDE-GERMANUM IDMA AT 0.85V 60FIV AR84 R5 DIDDE-GERMANUM IDMA AT 0.85V 60FIV AR84 0683-425 R:FXD COMP 570 (JM 51 1/4W R5 DIDDE-GERMANUM IDMA AT 0.85V 60FIV AR84 0683-4735 R:FXD COMP 670 (JM 51 1/4W 1 0683-3925 R:FXD COMP 670 (JM 51 1/4W AR45 0683-4735 R:FXD COMP 670 (JM 51 1/4W 2 0683-4735 R:FXD COMP 710 (JM 51 1/4W A2 SAME AS A, USE PREFIX A3 SAME AS A, USE PREFIX A3 3 0683-4735 R:FXD COMP 710 (JM 51 1/4W A4 SAME AS A, USE PREFIX A5 SAME AS A, USE PREFIX A5 3 0683-4735								R:FXD COMP 6800 OHM 5% 1/4W	
R1 1910-0016 0100E:0ERNATUM 100MA AT 0.839 60PlV AIR40 0683-9225 RiFK0 CDMP 3900 DMH 55 1/AM R2 1910-0016 0100E:0ERNATUM 100MA AT 0.839 60PlV AIR40 0683-9225 RiFK0 CDMP 300 DMH 55 1/AM R3 1910-0016 0100E:0ERNATUM 100MA AT 0.839 60PlV AIR40 0683-9225 RiFK0 CDMP 300 DMH 55 1/AM R4 1910-0016 0100E:0ERNATUM 100MA AT 0.839 60PlV AIR42 0683-9625 RiFK0 CDMP 300 DMH 55 1/AM R4 1910-0016 0100E:0ERNATUM 100MA AT 0.839 60PlV AIR43 0683-9625 RiFK0 CDMP 476 DMH 55 1/AM R4 10663-3015 RiFK0 CDMP 300 DMH 55 1/AM AIR44 0663-4735 RiFK0 CDMP 476 UMH 55 1/AM 1 0663-4735 RiFK0 CDMP 476 UMH 55 1/AM AI AI SAME AS AL USE PREFIX AI 2 0633-4735 RiFK0 CDMP 300 DMH 55 1/AM AI AI SAME AS AL USE PREFIX AI 3 0663-1025 RiFK0 CDMP 300 DMH 55 1/AM AI AI SAME AS AL USE PREFIX AI 4 0663-4735 RiFK0 CDMP 476 UMH 55 1/AM AI AI SAME AS AL USE PREFIX AI 5 0663-1025 RiFK0 CDMP 476 UMH 55 1/AM AI <t< td=""><td>.14</td><td>0140-0200</td><td></td><td></td><td></td><td></td><td></td><td>R:FXD COMP 47K OHM 5% 1/4W</td><td></td></t<>	.14	0140-0200						R:FXD COMP 47K OHM 5% 1/4W	
A2 1910-0016 DIDDE:GERMANUM 100MA AT 0.85V GOPIV AIR41 0683-2015 RIFRD COMP 2000 CMM SE 1/4W A1 1910-0016 DIDDE:GERMANUM 100MA AT 0.85V GOPIV AIR42 0683-3225 RIFRD COMP 2000 CMM SE 1/4W A1 1910-0016 DIDDE:GERMANUM 100MA AT 0.85V GOPIV AIR42 0683-3225 RIFRD COMP 2000 CMM SE 1/4W A1 1000-016 DIDDE:GERMANUM 100MA AT 0.85V GOPIV AIR42 0683-6125 RIFRD COMP 2000 CMM SE 1/4W A1 0683-4735 RIFRD COMP 3700 DHM SE 1/4W AIR46 0683-4735 RIFRD COMP 47K CMH SE 1/4W 2 0683-4735 RIFRD COMP 47K CMH SE 1/4W AIR46 0683-4735 RIFRD COMP 47K CMH SE 1/4W 3 0683-4735 RIFRD COMP 47K CMH SE 1/4W AIR46 CoB3-4735 RIFRD COMP 47K CMH SE 1/4W 4 0683-4735 RIFRD COMP 47K CMH SE 1/4W AI AIR46 CoB3-4735 RIFRD COMP 47K CMH SE 1/4W 5 0683-4735 RIFRD COMP 47K CMH SE 1/4W AI AI SAME AS AI, USE PREFIX AI 6 0683-4735 RIFRD COMP 300 CMH SE 1/4W AI AI AI AIR46 6 0683-4735 RIFRD COMP 10K CMH SE 1/	· R 1	1910-0016						R: FXD COMP 10K OHM 5% 1/4W	• •
AR3 1910-0016 DIDDE:GERMANUM 100MA AT 0.85V GOPY AIR42 0683-3925 RIFXD COMP 3500 CMM SE 1/4W AR4 1910-0016 DIDDE:GERMANUM 100MA AT 0.85V GOPY AIR42 0683-6225 RIFXD COMP 3500 CMM SE 1/4W AR4 1910-0016 DIDDE:GERMANUM 100MA AT 0.85V GOPY AIR43 0683-6225 RIFXD COMP 3500 CMM SE 1/4W AIR45 0683-7815 RIFXD COMP 3500 CMM SE 1/4W AIR44 0683-1033 RIFXD COMP 47K CMM SE 1/4W AIR45 0683-7815 RIFXD COMP 3500 CMM SE 1/4W AIR45 0683-7815 RIFXD COMP 47K CMM SE 1/4W AIR45 0683-7815 RIFXD COMP 3500 CMM SE 1/4W AI AI AIR45 0683-7815 AIR45 0683-7815 RIFXD COMP 3500 CMM SE 1/4W AI AI AIR45 SAME AS AI, USE PREFIX AZ C063-7815 RIFXD COMP 3500 CMM SE 1/4W AI AI SAME AS AI, USE PREFIX AZ SAME AS AI, USE PREFIX AZ C063-7815 RIFXD COMP 3500 CMM SE 1/4W AI AI SAME AS AI, USE PREFIX AZ C063-7815 RIFXD COMP 3500 CMM SE 1/4W AI AI SAME AS AI, USE PREFIX AZ C063-7815 RIFXD COMP 3500 CMM SE 1/4W AI AI		1710-0010	DIUDE: GERHANIUM IUUMA AT 0.854 60PTV					REFAD CUMP 3900 0HM 5% 1/4W	
AR3 1910-0016 D10DE:GERMANULY 100NA AT 0.85V 60PTV A1R42 0683-3925 R:FK0 COMP 360 CMH ST 1/4W RR 1910-0016 D10DE:GERMANULY 100NA AT 0.85V 60PTV A1R44 0683-4735 R:FK0 COMP 47K COHH ST 1/4W RF 1910-0016 D10DE:GERMANULY 100NA AT 0.85V 60PTV A1R44 0683-4735 R:FK0 COMP 47K COHH ST 1/4W 1 0683-5915 R:FK0 COMP 47K COHH ST 1/4W A1R43 0683-4735 R:FK0 COMP 47K COHH ST 1/4W 1 0683-6825 R:FK0 COMP 47K COHH ST 1/4W A2 SAME AS A1, USE PREFIX A3 2 0683-6825 R:FK0 COMP 47K COHP 390 DHM ST 1/4W A3 SAME AS A1, USE PREFIX A3 3 0683-6825 R:FK0 COMP 47K COHP 390 DHM ST 1/4W A4 A3 SAME AS A1, USE PREFIX A3 3 0683-6825 R:FK0 COMP 390 DHM ST 1/4W A4 A4 SAME AS A1, USE PREFIX A3 45 0683-6825 R:FK0 COMP 390 DHM ST 1/4W A4 A5 SAME AS A1, USE PREFIX A3 7 0683-7935 R:FK0 COMP 390 DHM ST 1/4W A6 S212A-65F 100KHZ 0SCILLATOR 7 0683-7935 R:FK0 COMP 390 DHM ST 1/4W A6 S212A-65F 100KHZ 0SCILLATOR	R2	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PTV				0005 2015	KITAD CURP 200-UNA 35 1/40	
A4 1910-0016 010DE:GERMANUM 100MA AT 0.85% 60PTY A1843 0683-6825 R:FXD COMP 4500 0H 51 1/4H 11 0683-6715 R:FXD COMP 47K 0HH 51 1/4H A1844 0683-6715 R:FXD COMP 47K 0HH 51 1/4H 12 0683-6715 R:FXD COMP 47K 0HH 51 1/4H A1844 0683-6715 R:FXD COMP 47K 0HH 51 1/4H 14 0683-6715 R:FXD COMP 47K 0HH 51 1/4H A1844 0683-6715 R:FXD COMP 47K 0HH 51 1/4H 14 0683-6715 R:FXD COMP 47K 0HH 51 1/4H A3 SAME AS A1, USE PREFIX A3 3 0683-6725 R:FXD COMP 47K 0HH 51 1/4H A3 SAME AS A1, USE PREFIX A3 4 0683-6725 R:FXD COMP 47K 0HH 51 1/4H A4 SAME AS A1, USE PREFIX A3 5 0683-6725 R:FXD COMP 47K 0HH 51 1/4H A4 A5 6 0683-6725 R:FXD COMP 47K 0HH 51 1/4H A4 A5 7 0683-6725 R:FXD COMP 47K 0HH 51 1/4H A4 A5 8 0683-6725 R:FXD COMP 47K 0HH 51 1/4H A5 SAME AS A1, USE PREFIX A4 9 0683-6725 R:FXD COMP 47K 0HH 51 1/4H A65 SAME AS A1, USE PREFIX A4 10	CR 3		DIODE:GERMANIUM 100MA AT 0.85V 60PIV			A1R42	0683-3925	RIEXD COMP 3000 OHM 54 1744	
146-0016 DIODE:GERMANIUM LOOMA AT 0.85V 60PIV AIR44 0683-4735 RIFKD COMP 47K 00H 5% 1/AM 11 0683-3915 RIFKD COMP 390 DHM 5% 1/AM AIR45 0683-1035 RIFKD COMP 47K 00H 5% 1/AM 1 0683-3915 RIFKD COMP 390 DHM 5% 1/AM AIR45 0683-4735 RIFKD COMP 47K 00H 5% 1/AM 1 0683-6275 RIFKD COMP 37K 00H 5% 1/AM AIR45 0683-4735 RIFKD COMP 47K 00H 5% 1/AM 2 0683-4735 RIFKD COMP 47K 00H 5% 1/AM AIR45 0683-4735 RIFKD COMP 47K 00H 5% 1/AM 3 0683-4735 RIFKD COMP 47K 00H 5% 1/AM AIR45 0683-4735 RIFKD COMP 47K 00H 5% 1/AM 4 0683-4735 RIFKD COMP 47K 00H 5% 1/AM AIR45 0683-4735 RIFKD COMP 47K 00H 5% 1/AM 5 0683-4735 RIFKD COMP 47K 00H 5% 1/AM AIR45 0683-4735 RIFKD COMP 47K 00H 5% 1/AM 6 0683-4735 RIFKD COMP 47K 00H 5% 1/AM AIR45 AIR45 0683-4735 7 0683-4735 RIFKD COMP 47K 00H 5% 1/AM AIR45 AIR45 AIR45 10 0683-4735 RIFKD COMP 47K 00H 5% 1/AM AIR44 AIR45 AIR45 AIR45	.R4	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV			A1R43		R:FXD COMP 6800 OHN 5% 1/4W	
11 0683-1035 RiFKD COMP 10K CHM 52 1/4W 12 0683-76735 RiFKD COMP 47K CHM 52 1/4W 14 0683-76735 RiFKD COMP 47K CHM 52 1/4W 14 0683-76735 RiFKD COMP 47K CHM 52 1/4W 14 0683-76735 RiFKD COMP 47K CHM 52 1/4W 15 0683-76735 RiFKD COMP 47K CHM 52 1/4W 16 0683-76735 RiFKD COMP 47K CHM 52 1/4W 16 0683-76735 RiFKD COMP 47K CHM 52 1/4W 16 0683-76735 RiFKD COMP 47K CHM 52 1/4W 17 0683-2015 RiFKD COMP 47K CHM 52 1/4W 10 0683-76735 RiFKD COMP 47K CHM 52 1/4W 10 0683-76735 RiFKD COMP 47K CHM 52 1/4W 11 0683-76735 RiFKD COMP 47K CHM 52 1/4W 12 0683-76735 RiFKD COMP 47K CHM 52 1/4W 11 0683-76735 RiFKD COMP 47K CHM 52 1/4W 12 0683-76735 RiFKD COMP 47K CHM 52 1/4W 13 0683-76735 RiFKD COMP 47K CHM 52 1/4W 14 0683-76735 RiFKD COMP 47K CHM 52 1/4W 14 0683-76735 RiFKD COMP 47K CHM 52 1/4W 14 0683	R5	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV			A1R44		R: FXD COMP 47K OHM 5% 1/4W	
11- 1850-0022 TRANSISTOR:GERMANIUM ALLOY JUNCTION 1 A1R46 0683-4735 R:FXD COMP 47K CHM 5X 1/4W 1 0683-6735 R:FXD COMP 390 DHM 5X 1/4W A2 SAME AS A1, USE PREFIX A4 2 0683-6735 R:FXD COMP 47K CHM 5X 1/4W A3 SAME AS A1, USE PREFIX A4 3 0683-6735 R:FXD COMP 47K CHM 5X 1/4W A3 SAME AS A1, USE PREFIX A4 4 0683-735 R:FXD COMP 47K CHM 5X 1/4W A4 SAME AS A1, USE PREFIX A4 5 0683-1035 R:FXD COMP 300 DHM 5X 1/4W A5 SAME AS A1, USE PREFIX A5 6 0683-3925 R:FXD COMP 300 DHM 5X 1/4W A5 SAME AS A1, USE PREFIX A5 7 0683-4735 R:FXD COMP 300 DHM 5X 1/4W A5 SAME A5 A1, USE PREFIX A5 8 0683-3925 R:FXD COMP 300 DHM 5X 1/4W A5 SAME A5 A1, USE PREFIX A5 9 0683-4735 R:FXD COMP 300 DHM 5X 1/4W A6 D150-0121 U:FXD COMP 300 DHM 5X 1/4W 9 0683-4735 R:FXD COMP 47K DHM 5X 1/4W A62 0170-0072 C:FXD CMP 47K DHM 5X 1/4W 10 0683-4735 R:FXD COMP 47K DHM 5X 1/4W A6C1 0150-0124 U					•		0683-1035	R: FXD COMP 10K CHM 5% 1/4W	
1 0683-3915 R:FXD COMP 390 DHH 5% 1/4H A2 SAME AS A1, USE PREFIX A2 2 0683-4735 R:FXD COMP 47K DHH 5% 1/4H A3 SAME AS A1, USE PREFIX A3 3 0683-4025 R:FXD COMP 47K DHH 5% 1/4H A4 SAME AS A1, USE PREFIX A3 4 0683-4025 R:FXD COMP 47K DHH 5% 1/4H A4 SAME AS A1, USE PREFIX A4 5 0683-1035 R:FXD COMP 10K DHH 5% 1/4H A5 SAME AS A1, USE PREFIX A5 6 0683-2015 R:FXD COMP 200 DHH 5% 1/4H A6 SAME AS A1, USE PREFIX A5 7 0683-2015 R:FXD COMP 200 DHH 5% 1/4H A6 A6 D100KHZ OSCILLATOR 8 0683-4035 R:FXD COMP 47K DHH 5% 1/4H A6 L:FXD COM2 COLL UF +80-20% S0VDCH 10 0683-4735 R:FXD COMP 47K DHH 5% 1/4H A6C1 D100-0126 L:FXD HT ICA 1500 PF 2% 11 0683-4735 R:FXD COMP 47K DHH 5% 1/4H A6C2 D140-0156 L:FXD HT ICA 1500 VPC X 12 0683-4735 R:FXD COMP 47K DHH 5% 1/4H A6C1 1901-0016 D100E:S1LICDN 14 0683-4735 R:FXD COMP 47K DHH 5% 1/4H A6C2 D140-0156 L:FXD HT ICA 150		1050.00.			4	A1R46	0683-4735	R: FXD COMP 47K OHM 5% 1/4W	
2 0683-4735 K1FXD COMP 47K 0HH 5% 1/4W A3 SAME AS A1, USE PREFIX A3 3 0683-6625 R1FXD COMP 6800 0HH 5% 1/4W A4 SAME AS A1, USE PREFIX A4 5 0683-6125 R1FXD COMP 47K 0HH 5% 1/4W A4 SAME AS A1, USE PREFIX A5 6 0683-9025 R1FXD COMP 3000 0HH 5% 1/4W A5 SAME AS A1, USE PREFIX A5 7 0683-2925 R1FXD COMP 3000 0HH 5% 1/4W A5 SAME AS A1, USE PREFIX A5 9 0683-3925 R1FXD COMP 3000 0HH 5% 1/4W A6C1 0150-0121 L1FXD CER 0.1 UF +80-20% 50V0CW 10 0683-4735 R1FXD COMP 47K 0HH 5% 1/4W A6C2 0170-0072 C1FXD MY 1 UF 10% 200V0CW 12 0683-4735 R1FXD COMP 47K 0HH 5% 1/4W A6C1 1901-0016 D100E1S1LCOM 13 0683-4735 R1FXD COMP 47K 0HH 5% 1/4W A6C1 1901-0016 D100E1S1LCOM 14 0683-4735 R1FXD COMP 47K 0HH 5% 1/4W A6C2 0140-0156 L1FXD R1MP S1LCOM 15 0683-4735 R1FXD COMP 47K 0HH 5% 1/4W A6C2 1851-0002 TRANSISTOR:IGERMANUM ALLOY JUNCTION 14 0683-4735 R1FXD COMP 47K 0HH 5% 1/4W		1850-0062	TRANSISTUR: GERMANIUM ALLOY JUNCTION		۹ ₁			;	l
2 0683-4735 H:FXD COMP 4X OHH 5X 1/4W A3 SAME AS A1, USE PREFIX A3 4 0683-6735 R:FXD COMP 4X OHH 5X 1/4W A4 SAME AS A1, USE PREFIX A4 5 0683-735 R:FXD COMP 4X OHH 5X 1/4W A5 SAME AS A1, USE PREFIX A4 6 0683-2015 R:FXD COMP 300 OHH 5X 1/4W A5 SAME AS A1, USE PREFIX A5 7 0683-2015 R:FXD COMP 300 OHH 5X 1/4W A5 SAME AS A1, USE PREFIX A5 8 0683-2015 R:FXD COMP 300 OHH 5X 1/4W A5 SAME A5 A1, USE PREFIX A5 9 0683-625 R:FXD COMP 300 OHH 5X 1/4W A5 SAME A5 A1, USE PREFIX A5 10 0683-625 R:FXD COMP 300 OHH 5X 1/4W A6C1 0150-0121 L:FXD CER 0.1 UF +80-20X 50V0CW 11 0683-4735 R:FXD COMP 47K OHH 5X 1/4W A6C2 0170-0072 C:FXD MY 1 UF 10X 200V0CH 12 0683-4735 R:FXD COMP 47K OHH 5X 1/4W A6C1 1901-0016 DIODE:SLLICON 12 0683-4735 R:FXD COMP 47K OHH 5X 1/4W A6C2 1851-0006 IRANSISTOR:GRANATUM ALLOY JUNCTION 13 0683-4735 R:FXD COMP 47K OHH 5X 1/4W A6C2 1851-0006	81	0683-3915	R:FXD COMP 390 DHM 5% 1/4W			A2		SAME AS AL USE PREFIX AT	
3 0683-6825 RFKD COMP 6800 OHH 5% 1/4H A 4 0683-1035 RFKD COMP 4500 OHH 5% 1/4H A4 SAME AS A1, USE PREFix A3 5 0683-1035 RFKD COMP 47K UHH 5% 1/4H A5 SAME AS A1, USE PREFix A4 6 0683-1035 RFKD COMP 3900 OHH 5% 1/4H A6 SAME AS A1, USE PREFix A5 7 0683-2015 RFKD COMP 200 OHH 5% 1/4H A6 S212A-65F 100KHZ OSCILLATOR 7 0683-2015 RFKD COMP 4000 OHH 5% 1/4H A6C1 0150-0121 CFKD CMP 400-20% 50VDCH 9 0683-625 RFKD COMP 47K OHH 5% 1/4H A6C1 0150-0124 CFKD CM 10% 200VDCH 10 0683-4735 RFKD COMP 47K OHH 5% 1/4H A6C2 0170-0072 CFKD M 10K 10K 10K 10K 11 0683-4735 RFKD COMP 47K OHH 5% 1/4H A6C3 0140-0156 LFKD KM 10K 110A 1500 PF 2% 12 0683-4735 RFKD COMP 47K OHH 5% 1/4H A6C1 1901-0016 010DE 1% LICAN 13 0683-4735 RFKD COMP 47K OHH 5% 1/4H A6C2 0140-0156 L*FKD MICA 1500 PF 2% 14 0683-4735 RFKD COMP 47K OHH 5% 1/4H A6C2 1851-0006	2	0683-4745					1	. •	
4 0x83-4735 R1FXD COMP 47K UNH 5% 1/4W A4 SAME AS A1, USE PREFIX A4 5 0x83-1035 R1FXD COMP 3900 UNH 5% 1/4W A5 SAME AS A1, USE PREFIX A5 6 0x83-2015 R1FXD COMP 3900 UNH 5% 1/4W A6 S212A-65F 100KHZ OSCILLATOR 7 0x83-2015 R1FXD COMP 3900 UNH 5% 1/4W A6 S212A-65F 100KHZ OSCILLATOR 9 0x83-2025 R1FXD COMP 47K UNH 5% 1/4W A6C1 0150-0121 L1FXD CER 0.1 UF 480-20% 50VDCW 9 0x83-4735 R1FXD COMP 47K UNH 5% 1/4W A6C2 0170-0072 C1FXD NY 1 UF 10% 200VDCW 11 0x683-4735 R1FXD COMP 47K UNH 5% 1/4W A6C3 0140-0156 L1FXD RCAN 12 0x83-4735 R1FXD COMP 47K UNH 5% 1/4W A6C1 1901-0016 D10DE1SILICON 13 0x83-4735 R1FXD COMP 47K UNH 5% 1/4W A6C1 1901-0016 D10DE1SILICON 14 0x83-4735 R1FXD COMP 47K UNH 5% 1/4W A6C1 1901-0016 D10DE1SILICON 15 0x83-4735 R1FXD COMP 47K UNH 5% 1/4W A6C7 1850-0002 TRANSISTOR:GE NPN A 16 0x83-4735	3		R:FXD COMP 47K ONA 5% 174W			M 3		SAME AS AT, USE PREFIX AS	
5 0.683-1035 R1FX0 COMP 10K COMP 5% 1/4W A5 SAME AS A1, USE PREFIX A5 6 0.683-3925 R1FX0 COMP 200 CMH 5% 1/4W A6 5212A-66F 100KH2 OSCILLATOR 7 0.683-2015 R1FX0 COMP 200 CMH 5% 1/4W A6 6212A-66F 100KH2 OSCILLATOR 8 0.683-3925 R1FX0 COMP 200 CMH 5% 1/4W A6C1 0150-0121 L1FXD CER 0.1 UF +80-20% 50VDCM 9 0.683-625 R1FXD COMP 47K CMH 5% 1/4W A6C2 0170-0072 C1FXD MY 1 UF 10% 200VDCW 11 0.683-4735 R1FXD COMP 47K CMH 5% 1/4W A6C2 0170-016 D10DE151LICON 12 0.683-4735 R1FXD COMP 47K CMH 5% 1/4W A6C2 0170-0072 C1FXD MICA 1500 PF 2% 13 0.683-4735 R1FXD COMP 47K CMH 5% 1/4W A6C1 1901-0016 D10DE151LICON 14 0.683-6825 R1FXD COMP 47K OHM 5% 1/4W A6Q1 1851-0006 TRANSISTOR:GE NPN A 15 0.683-6825 R1FXD COMP 47K OHM 5% 1/4W A6Q2 1854-0003 TRANSISTOR:GERMANIUM ALLOY JUNCTION L 16 0.683-3925 R1FXD COMP 8200 OHM 5% 1/4W A6Q3 1855-0062 TRANSISTOR:G	4		RIFXD COMP 47K UHM 51 1/4W			A4		SAME AS A1, USE PREFIX A4	
6 0683-3925 R1FXD CUMP 3000 DHM 5% 1/4W A6 5212A-65F 100KHZ OSCILLATOR 7 0683-2015 R1FXD CUMP 3000 DHM 5% 1/4W A6 0150-0121 L1FXD CER 0.1 UF +80-20% 50 VDC W 9 0683-6825 R1FXD CUMP 4000 DHM 5% 1/4W A6C1 0150-0121 L1FXD CER 0.1 UF +80-20% 50 VDC W 10 0683-6825 R1FXD CUMP 47K DHM 5% 1/4W A6C2 0170-0072 C1FXD MY 1 UF 10% 200VDCW 11 0683-4735 R1FXD CUMP 47K DHM 5% 1/4W A6C2 0170-0016 L1FXD CIMP 47K DHM 5% 1/4W 12 0683-4735 R1FXD CUMP 47K DHM 5% 1/4W A6C1 1901-0016 D10DE1SILICON 13 0683-4735 R1FXD CUMP 47K DHM 5% 1/4W A6C1 1851-0006 TRANSISTOR:GE NPN 14 0683-4735 R1FXD CUMP 47K DHM 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GE NANIUM ALLOY JUNCTION 15 0683-8225 R1FXD CUMP 3000 DHM 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 16 0683-8225 R1FXD CUMP 3900 DHM 5% 1/4W A6Q3 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 17 0683-8225 R1FXD CUMP 3900 DHM 5% 1/4W A6Q3			R:FXD COMP 10K OHM 5% 1/4W	Ŵ	l l	A5			
7 0683-2015 R:FXD CDMP 200 DHM 5% 1/4W A6C1 0150-0121 L:FXD CER 0.1 UF +80-20% 50VDCW 9 0683-6825 R:FXD CDMP 3600 DHM 5% 1/4W A6C1 0150-0121 L:FXD CER 0.1 UF +80-20% 50VDCW 10 0683-4735 R:FXD CDMP 6800 DHM 5% 1/4W A6C2 0170-0072 C:FXD HY 1 UF 10% 200VDCW 11 0683-4735 R:FXD CDMP 47K DHM 5% 1/4W A6C3 0140-0156 L:FXD HX 1 UF 10% 200VDCW 12 0683-4735 R:FXD CDMP 47K DHM 5% 1/4W A6C3 0140-0156 L:FXD HX 1 UF 10% 200VDCW 13 0683-4735 R:FXD CDMP 47K DHM 5% 1/4W A6C1 1901-0016 DIQDE:SILICDN 14 0683-4735 R:FXD CDMP 47K DHM 5% 1/4W A6Q1 1851-0006 TRANSISTOR:GE NPN 15 0683-4735 R:FXD CDMP 47K DHM 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 16 0683-8225 R:FXD CDMP 3900 DHM 5% 1/4W A6Q3 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 17 0683-3925 R:FXD CDMP 3900 DHM 5% 1/4W A6Q3 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 18 0683-2015 R:FXD CDMP 3900 DHM 5% 1/4W A6Q3<	6	0683-3925	R:FXD COMP 3900 DHM 5% 1/4W	NI I			50404	· · · · · · · · · · · · · · · · · · ·	
8 0683-3925 R:FXD COMP 3000 OHH 5% 1/4W A6C1 0150-0121 L:FXD CER 0.1 UF +80-20% 50VDCW 9 0683-6825 R:FXD COMP 3000 OHH 5% 1/4W A6C2 0170-0072 C:FXD MY 1 UF 10% 200VDCW 10 0683-4735 R:FXD COMP 10K OHH 5% 1/4W A6C3 0140-0156 L:FXD MICA 1500 PF 2% 12 0683-4735 R:FXD COMP 47K OHH 5% 1/4W A6C3 0140-0156 L:FXD MICA 1500 PF 2% 13 0683-4735 R:FXD COMP 47K OHH 5% 1/4W A6CR1 1901-0016 DIODE:SILICON 14 0683-6825 R:FXD COMP 47K OHH 5% 1/4W A6G1 1851-0006 TRANSISTOR:GE NPN 15 0683-6825 R:FXD COMP 47K OHH 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GE NANIUH ALLOY JUNCTION 16 0683-8225 R:FXD COMP 3900 OHH 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUH ALLOY JUNCTION 17 0683-3925 R:FXD COMP 3900 OHH 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUH ALLOY JUNCTION 18 0683-2015 R:FXD COMP 3900 OHH 5% 1/4W A6Q3 1850-0062 TRANSISTOR:GERMANIUH ALLOY JUNCTION 19 0683-2015 R:FXD COMP 3900 OHH 5% 1/4W A6Q2 <td>7</td> <td>0683-2015</td> <td>0. FYD CDMD 200 DUM 59 1740</td> <td></td> <td></td> <td>Ab</td> <td>5212A-65F</td> <td>100KHZ OSCILLATOR</td> <td></td>	7	0683-2015	0. FYD CDMD 200 DUM 59 1740			Ab	5212A-65F	100KHZ OSCILLATOR	
9 0683-6825 R:FXD COMP 6800 DHM 5% 1/4W 0683-4735 R:FXD COMP 6800 DHM 5% 1/4W 10 0683-4735 R:FXD COMP 10K DHM 5% 1/4W A6C2 0170-0072 C:FXD MY 1 UF 10% 200VDCH 12 0683-4735 R:FXD COMP 47K DHM 5% 1/4W A6C3 0140-0156 C:FXD MY 1 UF 10% 200VDCH 12 0683-4735 R:FXD COMP 47K DHM 5% 1/4W A6C3 0140-0156 C:FXD MY 1 UF 10% 200VDCH 13 0683-4735 R:FXD COMP 47K DHM 5% 1/4W A6C1 1901-0016 DIODE:SILICON 14 0683-4735 R:FXD COMP 47K DHM 5% 1/4W A6C1 1851-0006 TRANSISTOR:GE NPN 15 0683-4735 R:FXD COMP 47K DHM 5% 1/4W A6Q2 1854-0003 TRANSISTOR:GE NPN A 16 0683-8225 R:FXD COMP 3900 DHM 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION U 17 0683-3925 R:FXD COMP 3900 DHM 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION U 18 0683-3925 R:FXD COMP 3900 DHM 5% 1/4W A6Q3 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION U 19 0683-3925 R:FXD COMP 3900 D	8		R:FXD CDMP 200 OHM 5% 174W			A6C1	0150-0121	(+FYO CER O 1 HE +RO 207 SOUDCH	
10 0683-4735 R:FXD CUMP 47K DHM 5% 1/4W A6C2 0170-0072 C:FXD MY 1 UF 10% 200VDCW 11 0683-1035 R:FXD CUMP 10K DHM 5% 1/4W A6C3 0140-0156 C:FXD MICA 1500 PF 2% 12 0683-4735 R:FXD CUMP 47K DHM 5% 1/4W A6C3 0140-0166 DIDDE:SILICON 13 0683-4735 R:FXD CUMP 47K DHM 5% 1/4W A6C1 1901-0016 DIDDE:SILICON 14 0683-6825 R:FXD CUMP 47K DHM 5% 1/4W A6Q1 1851-0006 TRANSISTOR:GE NPN 15 0683-4735 R:FXD CUMP 47K DHM 5% 1/4W A6Q1 1851-0006 TRANSISTOR:GE NPN 16 0683-8225 R:FXD CUMP 47K DHM 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 17 0683-3925 R:FXD CUMP 3900 DHH 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 18 0683-2015 R:FXD CUMP 3900 DHH 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 19 0683-3925 R:FXD CUMP 3900 DHH 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 19 0683-4735 R:FXD CUMP 3900 DHH 5% 1/4W A6R3 0683-6355<	9		R:FXD COMP 6800 0HM 51 1/4W		i			CIFAD CER 011 OF +80-20% SUVULW	
11 0683-1035 R:FXD COMP 10K DHM 5% 1/4W A6C3 0140-0156 L:FXD MICA 1500 PF 2% 12 0683-4735 R:FXD COMP 47K DHM 5% 1/4W A6C3 0140-0166 DIODE:SILICON 13 0683-4735 R:FXD COMP 47K UHM 5% 1/4W A6C1 1901-0016 DIODE:SILICON 14 0683-4735 R:FXD COMP 47K UHM 5% 1/4W A601 1851-0006 TRANSISTOR:GE NPN 15 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A601 1851-0006 TRANSISTOR:GE NPN 16 0683-8225 R:FXD COMP 8200 DHM 5% 1/4W A602 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 17 0683-3925 R:FXD COMP 3900 OHM 5% 1/4W A602 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 18 0683-3925 R:FXD COMP 3900 OHM 5% 1/4W A6R2 0683-6835 R:FXD COMP 680 OHM 5% 1/4W 20 0683-6825 R:FXD COMP 6800 OHM 5% 1/4W A6R3 0683-1035 R:FXD COMP 68K OHM 5% 1/4W A6R3 21 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A A6R3 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A 21 0683-4735 R:FXD COMP 47K OHM 5% 1/4W	10	0683-4735	RIFXD COMP 47K OHM 5% 1/4W		; l	A6C 2	0170-0072	C:FXD MY 1 UF 10% 200VDCH	
13 0683-4735 R:FXD COMP 47K UHM 5% 1/4W A A6Q1 1851-0006 TRANSISTOR:GE NPN A 14 0683-6825 R:FXD COMP 47K UHM 5% 1/4W A A6Q1 1851-0006 TRANSISTOR:GE NPN A 15 0683-4735 R:FXD COMP 47K UHM 5% 1/4W A A6Q1 1851-0006 TRANSISTOR:GE NPN A 16 0683-8225 R:FXD COMP 8200 OHH 5% 1/4W A A6Q2 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION L 17 0683-3925 R:FXD COMP 3900 OHH 5% 1/4W A6Q3 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION L 18 0683-2015 R:FXD COMP 3900 OHH 5% 1/4W A6Q2 0683-6835 R:FXD COMP 68K OHM 5% 1/4W L 19 0683-2925 R:FXD COMP 3900 OHH 5% 1/4W A6R2 0683-6835 R:FXD COMP 68K OHM 5% 1/4W A 20 0683-6825 R:FXD COMP 6800 OHH 5% 1/4W A A6R3 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A 21 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A A6R4 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A	11	0683-1035	R:FXD COMP 10K DHM 5% 1/4W			A6C3	0140-0156	L:FXD MICA 1500 PF 28	
13 0683-4735 R:FX0 COMP 47K UHM 5% 1/4W A			RIFXD COMP 47K OHM 5% 1/4W	<u> </u>		A6CR1	1901-0016	DIODE:SILICON	
15 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A 16 0683-8225 R:FXD COMP 8200 OHMS 5% 1/4W A 17 0683-3925 R:FXD COMP 3900 OHM 5% 1/4W A 18 0683-2015 R:FXD COMP 200 OHM 5% 1/4W A 19 0683-3925 R:FXD COMP 3900 OHM 5% 1/4W A 19 0683-3925 R:FXD COMP 3900 OHM 5% 1/4W A 20 0683-6825 R:FXD COMP 47K OHM 5% 1/4W A 20 0683-6825 R:FXD COMP 47K OHM 5% 1/4W A 20 0683-6825 R:FXD COMP 47K OHM 5% 1/4W A 20 0683-6825 R:FXD COMP 47K OHM 5% 1/4W A 20 0683-6825 R:FXD COMP 47K OHM 5% 1/4W A 21 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A 21 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A 31 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A 32 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A 33 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A 34 0683-1835 R:FXD COMP 10K OHM 5% 1/4W			R:FXD COMP 47K UHM 5% 1/4W						
16 0683-8225 R:FXD COMP 8200 OHNS 5% 1/4W 1854-0003 TRANSISTOR:NPN SILICON L 17 0683-3925 R:FXD COMP 3900 OHN 5% 1/4W A6Q2 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION L 18 0683-2015 R:FXD COMP 3900 OHN 5% 1/4W A6Q3 1850-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION L 19 0683-6825 R:FXD COMP 3900 OHN 5% 1/4W A6R2 0683-6835 R:FXD COMP 68K OHN 5% 1/4W L 20 0683-6825 R:FXD COMP 6800 OHN 5% 1/4W A6R3 0683-1035 R:FXD COMP 10K OHN 5% 1/4W A6R3 21 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A A6R4 0686-2235 R:FXD COMP 10K OHN 5% 1/4W A			RIFXD COMP 6800 DHM 5% 1/4W			A6Q1	1851-0006	TRANSISTOR: GE NPN	Δ.
17 0683-3925 R:FXD COMP 3900 OHM 5% 1/4W 1450-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 18 0683-2015 R:FXD COMP 200 OHM 5% 1/4W 1450-0062 TRANSISTOR:GERMANIUM ALLOY JUNCTION 19 0683-3925 R:FXD COMP 3900 OHM 5% 1/4W 4 A6R2 0683-6835 R:FXD COMP 68K OHM 5% 1/4W 20 0683-6825 R:FXD COMP 6800 OHM 5% 1/4W 4 A6R2 0683-1035 R:FXD COMP 68K OHM 5% 1/4W 21 0683-4735 R:FXD COMP 47K OHM 5% 1/4W 4 A6R3 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A6R3 0683-4735 R:FXD COMP 47K OHM 5% 1/4W 4 A6R4 0686-2235 R:FXD COMP 22K OHM 5% 1/2W A-			REFAU LUMP 478 UNM 58 174W Rifin Comp 8200 oums 59 1740				1854-0002	TO ANCE CTOB AND A CELECON	
17 0683-3925 R1FXD COMP 3900 OHM 5% 1/4W 18 0683-2015 R1FXD COMP 200 OHM 5% 1/4W 19 0683-3925 R1FXD COMP 3900 OHM 5% 1/4W 19 0683-6825 R1FXD COMP 3900 OHM 5% 1/4W 20 0683-6825 R1FXD COMP 6800 OHM 5% 1/4W 21 0683-4735 R1FXD COMP 47K OHM 5% 1/4W 4 A6R3 0683-1035 0683-4735 R1FXD COMP 47K OHM 5% 1/4W 4 A6R3 0683-4735 R1FXD COMP 47K OHM 5% 1/4W 4 A6R3 0683-1035 R1FXD COMP 10K OHM 5% 1/4W 4 A6R3 0683-1035 R1FXD COMP 10K OHM 5% 1/4W 4 A6R4 0683-1835 R1FXD COMP 10K OHM 5% 1/4W			11110 0010 0200 0003 34 2/78			A692			L·
18 0683-2015 R:FXD COMP 200 OHM 5% 1/4W 19 0683-3925 R:FXD COMP 3900 OHM 5% 1/4W 20 0683-6825 R:FXD COMP 6800 OHM 5% 1/4W 21 0683-4735 R:FXD COMP 47K OHM 5% 1/4W 4 A6R3 0683-1035 R:FXD COMP 10K OHM 5% 1/4W 21 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A 21 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A 21 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A 21 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A 21 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A 21 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A 21 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A 22 0683-1835 R:FXD COMP 10K OHM 5% 1/4W A		0683-3925	R = FXD COMP 3900 OHM 5% 1/4W			-		TRANSISTORIGERMANTIN ALLOY UNCTION	
20 0683-6825 R:FXD COMP 6800 OHM 5% 1/4W 21 0683-4735 R:FXD COMP 47K OHM 5% 1/4W A6R3 0683-1035 R:FXD COMP 10K OHM 5% 1/4W A6R4 0686-2235 R:FXD COMP 22K OHM 5% 1/4W 0683-1835 R:FXD COMP 10K OHM 5% 1/4W A			R:FXD COMP 200 OHM 5% 1/4W						
21 0683-4735 R:FXD COMP 47K 0HM 5% 1/4W A6R3 0683-1035 R:FXD COMP 10K 0HM 5% 1/4W A6R4 0686-2235 R:FXD COMP 22K 0HM 5% 1/2W A 4 A6R4 0686-2235 R:FXD COMP 22K 0HM 5% 1/2W A A			R:FXD COMP 3900 OHM 5% 1/4W			A6R2	0683-6835	R:FXD COMP 68K OHM 5% 1/4W	
4 A6R4 0686-2235 R1FXD COMP 22K 0HM 5% 1/2W A 0683-1835 R1FXD COMP 18K 0HM 5% 1/4W A			RIFXD COMP 6800 OHM 5% 1/4W			44.03	0/07 1075		
0683-1835 R1FXD CUMP 22K UHM 5% 1/2W A-	••	CC1 P ~ C 000	R+FAD CUMP 418 UNM 55 1/48		}			NTEXD COMP 10K OHM 58 1/4W	
	· · ·							REFAU CUMP 22K UMM 5% 1/2W Refau Cump 18k own 6% 1/20	
		/ m .				A6R5		RIFXD COMP LOK OHM 52 1/4M	L-
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Section V

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Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note] ,	Reference Designation	Part No.	Description #	Not
		A6 5212A-65F (CONT'D)		1			, , , , , , , , , , , , , , , , , , , ,	
		A7 5060-3830					A7 5060-3830 (CONT'D)	A-J
		1	A - J				5060-2006 (CONT'D)	К-Х
		5060-2006	, к-х				A8 5060-2014	A-H
A6R6	0683-1225	R: FXD COMP 1200 OHM 5% 1/4W			· ·		5060-5870	J-X
A6R7	0683-5635	R:FXD COMP 56K OHMS 5% 1/4W			A7R8	0683-6825		
A6R8	0683-1825	R: FXD COMP 1800 OHM 5% 1/4W	А-К		A7R9	0727-0739	R:FXD COMP 6800 OHM 5% 1/4W R:FXD CARBON FLM 464 OHM 1% 1/2W	
	0683-1525	R:FXD COMP 1503 DHM 5% 1/4W			A7R10	2100-0490	R:VAR WW 100 OHM 10% 1/2W	
46R9	0686-5625	R:FXD COMP 5600 OHM 5% 1/2W	L-^		A7R10	0727-0764	R:FXD CARBON FLM 2.37K OHM 1% 1/2W	
					A7R12	0683-1225	R:FXD COMP 1200 OHM 5% 1/4W	· ·
A6R10	0683-5625	R:FXD COMP 5600 OHM 5% 1/4W		1		0000-1225	KITAD COMP 1200 OMP 55 174W	
46R11	0683-2225	R:FXD COMP 2.2K OHM 5% 1/4W			A7R14	0686-2025	R:FXD COMP 2000 OHM 5% 1/2W	
46R12	0683-4705	R;FXD COMP 47 OHM 5% 1/4W		· ·	A7R15	0683-4715	R:FXD COMP 470 OHM 5% 1/4W	
6R13	0686-3925	R:FXD COMP 3900 OHM 5% 1/2W		j –	A7R16	0683-3335	R:FXD COMP 33K OHM 5% 1/4W	
46R14	0686-2235	R:FXD COMP 22K BHM 5% 1/2W	А-К		A7R17	0683-4725	R:FXD COMP 4700 OHM 5% 1.4W	
	0683-2035	REFXD COMP 20K OHM 5% 1/4W	L-X		A7R18	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
					1			
6R15	0683-1025	K:FXD COMP 1000 OHM 5% 174W			A7R19	0683-3335	R:FXD COMP 33K OHM 5% 1/4W	
			ſ		A7R20	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
6T1	5212A-9A	TRANSFORMER			A7R21	0683-2735	R:FXD COMP 27K DHM 5% 1/4W	
. . 1					A7R22 .	0683-1535	R:FXD COMP 15K OHM 5% 1/4W	
7	5060-3830	-35V REGULATOR & RESET CIRCUIT	A - J		A7R23	0683-1235	R:FXD COMP 12K DHM 5% 1/4W	
	5000 0000			1				
	5060-2006	-35V REGULATOR & RESET CIRCUIT	A - X	1 · · ·	A7R2,4	0683-2725	R: FXD COMP 2700 DHM 5% 1/4W	
701	0170-0024				A7R25	0683-3335	R:FXD COMP 33K OHM 5% 1/4W	
	0170-0024	C:FXD MY 0.022UF 20% 200VDCW			A7R26	0683-2735	R: FXD COMP 27K OHN 5% 1/4W	1
762	0180-0107				A7R27	0683-3335	R:FXD COMP 33K OHM 5% 1/4W	
7C3	0180-0197 0150-0014	C:FXD ELECT 2.2 UF 10% 20VDCW			A7R28	0683-2225	R:FXD COMP 2.2K OHM 5% 1/4W	
~~··	0150-0012	C: FXD CER 0.005 UF 500VDCW	A-P					
7C4	0150-0012	C=FXD CER 0.01 UF 20% 1000VDCW L=FXD CER 0.005 UF 500VDCW	Q-X	1 ·	A7R29	0683-1225	R:FXD COMP 1200 DHM 5% 1/4W	
	0150-0012	C:FXD CER 0.01 UF 20% 1000VDCW	A-P		A7R30	0683-2735	R:FXD COMP 27K OHM 5% 1/4W	
	0100 0012	CTTAD CER 0.01 OF 204 IJUU4DUW	· Q-X		A7R31	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
765	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW			· A7W1	8159-0005	JUMPER WIRE	к-х
7CR1	1902-0033			1 •		. .		
	1902-0033	DIODE:BREAKDOWN 6.2V			AB	5060-2014	ATTENUATOR COUPLING LOGIC	A-H
7CR2	1902-0025	DIODE:BREAKDOWN 10.0V 5% 400 MW				5060-5870	ATTENUATOR COUPLING LOGIC	
7CR3	1901-0081	DIODE: SILICON 50 VOLTS WORKING	`	· .	·	5500-5570	ATTENDATOR COOPLING LOGIC	J-X
7CR4	1901-0061	DIODESSILICON			ABCR1	1901-0025		
7CR5	1901-0081	DIODE:SILICON 50 VOLTS WORKING			AOCKI	1901-0434	DIDDE:SILICON LOOMA TO MA	A-H
7CR6	1902-0022	DIODE: BREAKDOWN 2.67V				1901-0434	DIODE:STLICON 100MA 50 WIV	
					ABCR2	1901-0025	DIODE:SILICAN 100WV 100MA	J~₩
701	1850-0124	TRANSISTOR: GERMANIUM PNP	l'		ABCR3	1910-0016	DIODE: GERMANIUM 100MA AT 0.85V 60PLV	
					ABCR4	1901-0025	DIODE:SELICON 100WV 100MA	
792	1850-0032	TK ANSISTOR: GER MANIUM PNP			ABCR5	1901-0025	DIODE:SILICON 100WV 100MA	E.
703	1850-0032	TRANSISTOR: GERMANIUM PNP	A-J	•		1701 0025		
704	1850-0111			۰.	A8CR6	1901-0025	DIODE:SILICON 100WV 100MA	
705	1850-0111	TRANSISTUR: GERMANIUM PNP			ASCR7-	1)01 0025	DIODE SILICON LOONA LOONA	
706	1850-0111	TRANSISTOR: GERMANIUM PNP		•	ABCR16	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	
			· · ·		ABCR17	1901-0025	WIDDE:SILICUN LOOWA LOOMA	
107	1851-0024	TRANSISTOR: GERMANIUM NPN					ADIODE STELEON TOOMA TOOMA	X-U
					A8Q1	1850-0128	TRANSISTOR: PNP GERMANIUM	
7R1	0812-0045	RIFXD WW 0.15 UHM 5% 3W				1850-0111	TRANSISTOR: GERMANIUM PNP	А-н
			L-A			(
IR2	0812-0045	R:FXD WW 0.15 DHM 5% 3W	A-J		A8Q2	1850-0113	TRANSISTOR: GERMANIUM PNP	J-X
/R4	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	A-0			1850-0111	TRANSISTOR: GERMANIUM PNP	A-H
R5	0683-4715	K: FXD COMP 470 OHM 5% 1/4W			A8Q3	1850-0128	TRANSISTOR: PNP GERMANIUM	J-X
R6	0686-3625	K* FXD COMP 3600 OHM 5% 1/2W				1850-0111	TRANSISTOR: GERMANIUM PNP	A-H
'R7	0683-3625	R:FXD COMP 3600 DHM 5% 1/4W	•			· [· ·	J-W
		· · · · ·			A8Q4	1850-0113	TRANSISTOR: GERNANIUM PNP	
				κ.	A805	1850-0092	TRANSISTOR: GERMANIUM	
			· ·		A806	1850-0128	TRANSISTOR: PNP GERMANIUM	
1		· · · ·			A8Q7	1850-0128	TRANSISTOR: PNP GERMANIUM	
		•	1 1					
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Table 5-1. Reference Designation Index (Contic	Table 5-1.	Reference	Designation Index	(Cont'd
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Reference Designation	🖗 Part No.	. Description #	Note	1 4	Reference			
Designation					Reference Designation	Part No.	Description #	Not
	. /	A8 5060-2014 (CONT'D)	A-H	1			A9 5060-2015 (CONT'D)	A-H*
							5080-5871 (CONT'D)	
		5060-5870 (CONT'D)	X-L					J-L*
		A9 5060-2015	A-H•				5060-6205 (CONT'D)	M-X
		5060-5871	J-L*		A9CR8	1910-0016	DIODE:GERMANIUM 100MA AT 0:85V 60PLV	
		5060-6205	M-X			1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	А-н
			M-7			1901-0081	DIDDE:SILICON 50 VOLTS WORKING	M-X
808	1850-0128	TRANSISTOR: PNP GERMANIUM 2N3'98B			A9CR 10	1910-0016	DIODE:GERMANIUM LOOMA AT 0.85V 60PIV	J-L A-H
1809	1850-0128	TRANSISTOR: PNP GERMANIUM 2N398B				1901-0434	DIODE:SILICON 100MA 50 WIV	X~L
ABR 1					A9CR11	1910-0016	DIODE:GERMANIUN 100MA AT 0.85V 60PIV	A-H
ION I	0683-1835	K:FXD COMP 18K OHM 5% 1/4W 4	А-Н			1901-0434	DIODE:SILICON 100MA 50 WIV	J-X
	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	J-X		A9CR12	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	
18R2	0683-3335	R: FXD COMP 33K OHM 5% 1/4W	А-н		A9CR13	1901-0025	DIODE:SILICON 100WV 100MA	· ·
0.0.0	0683-2735	KIFXD COMP 27K OHM 5% 1/4W	J-X		4001	1050 0100		
8R3	0683-4725	R:FXD COMP 4700 OHM 5% 1/4W	A-H		A9Q1	1850-0128 1850-0111	TRANSISTOR: PNP GERMANIUM 2N398B	А-н
1	0683-1635	KEFXD COMP 16K OHN 5% 1/4W	X-L			1853-0007	TRANSISTOR: GERMANIUM PNP	J-L
8R4	0683-1235	R:FXD COMP 12K OHM 5% 1/4W		¢. K		1095-0007	TRANSISTOR: SILICON PNP	M-X
	0683-1035	R:FXD COMP 12K OHM 5% 174W . R:FXD COMP 10K OHM 5% 174W	Ј-Х А-Н		A9Q2	1850-0128	TRANSISTOR: PNP GERMANIUM 2N398B	-
8R5	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	A-H A-H			1850-0111	TRANSISTORIFHE BERMANIUM PNP	А-н
	0683-5625	K: FXD COMP 5600 DHM 5% 1/4W	7-11 X-L			1853-0008	TRANSISTOR: SILICON PNP	J-L
8R6	0683-2725	, R: FXD COMP 2700 OHM 5% 1/4W	0-х А-Н	E.	•			M-X
				Į.	A9Q3	1850-0128	TRANSISTOR: PNP GERMANIUM 2N398B	·
	0683-1635	R:FXD COMP 16K DHM 5% 1/4W	J−X		A9Q4	1850-0128	TRANSISTOR: PNP GERMANIUN 2N398B	А-н
8R7	0683-1035	R: FXD COMP LOK OHM 5% 1/4W				1850-0111	TRANSISTOR: GERMANIUM PNP	J-L
BR8	0683-4735	R:FXD COMP 47K DHM 5% 1/4W	А-н		A9Q5	1853-0008	TRANSISTOR: SILICON PNP	M-X
BR9	0757-0968	R: FXD FLM 68K OHM 2% 1/8W	J-X		AYUJ	1850-0128	TRANSISTOR: PNP GERMANIUM 2N398B	
7 10	0683-4725	R:FXD COMP 4700 DHM 5% 174W	А-Н	6. II.	A9R1	0689-3315	R:FXD COMP 330 OHN 5% 1W	
	0757-0958	R:FXD FLM 27K OHM 2% 1/8W	J∸X ^{,4}	. J				
8R 10	0683-1035 ,	R:FXD COMP 10K OHM 5% 1/4W	A-H	ġ,	A9R2	0683-3335	R:FXD COMP 33K OHM 5% 1/4W	A-L
	0757-0948	R:FXD FLM 10K OHM 2% 1/8W	X-L	1.35		0698-3449	R:FXD MET FLM 28.7K OHM 1\$ 1/8W	M-X
8R11	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	A-H	٩,	A9R 3	0683-4725	R: FXD COMP 4700 OHM 5% 1/4W	A-H
	0757-0939	R:FXD FLM 4.3K OHM 2% 1/8W	3-X			0683-1635 0757-0439	R:FXD COMP 16K OHM 5% 1/4W	.J-L
BR 1 2	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W				0131-0439	R:FXD MET FLM 6.81K OHM 1% 1/8W	M-X
	0757-0953	R: FXD FLM 16K OHM 2% 1/8W	Н-А Х-Ц		A9R4	0683-3335	R*FXD COMP 33K OHM 5% 1/4W	1
BR13	0683-1035	REFXD COMP 10K OHM 5% 1/4W	J-X			0683-3635	REFXD COMP 36K OHM 5% 1/4W	А-Н
BR14-						0683-2735	REFXD COMP 27K OHM 5% 1/4W	J-L
BR18	0683-3335	R = FXD COMP 33K OHM 5% 1/4W			A9R5	0683-3335	R: FXD COMP 33K OHM 5% 1/4W	M-X
						0683-1835	R:FXD COMP 18K DHM 5% 1/4W	А-Н
3R19	0686-4725	R#FXD COMP 4700 OHM 5% 1/2W		K		0683-4335	RIFXD COMP 43K OHM 5% 1/4W	J-L M-X
R20	0683-1035	R: FXD COMP LOK OHM 5% 1/4W		1	4054		·	
R21	0683-1035	R:FXD CDMP 10K DHM 5% 1/4W		k.	- A9 R6	0683-4725	R#FXD COMP 4700 OHM 5% 1/4W	/ А-Н
BR22	0683-1035	R: FXD COMP 10K OHM 5% 1/4W		A	A9R7	0683~2435	RIFXD COMP 24K OHM 5% 1/4W	J-X
IR23	0683-1035	R:FXD COMP 10K OHM 5% 1/4W			A9R8	0683-3335 0683-1035	R:FXD COMP 33K OHM 5% 1/4W	Ť
,	5060-2015	HP 24108 UNIT COUPLING LOGIC				VVUJ-1033	R:FXD COMP LOK OHM 5% 1/4W	
I			A-H*	n	A9R9	0689-3315	K:FXD COMP 330 OHN 5% 1W	
1	5060-5871	HP 2410B UNIT COUPLING LOGIC	J-L*		A9R10	0683-3335	R:FXD COMP 33K OHM 5% 1/4W	
	5060-6205	HP 2410B UNIT COUPLING LOGIC	M-X	H	A9R11	0683-1035	R:FXD COMP 10K OHM 58 1/4W	
				B	A9R12	0683-3335	R:FXD COMP 33K OHN 5% 1/4W	A-H
CR1	1910-0010	DIODE:GERMANIUM 100MA AT 0.85V 60PIV				0683-1235	RIFXD CONP 12K OHM 5% 1/4W	J-L
R2	1010-0014					0757-0444	RIFXD MET FLM 12.1K OHN 1% 1/8W	M-X
R3	1910-0016 1910-0016	DIODE:GERMANIUM 100MA AT 0.859 60PIV Diode:Germanium 100Ma at 0.859 60PIV			A9R13	0683-3335		
CR4	1901-0025	DIODE:SECHANICH TOOMA AT 0.850 BOPTV DIODE:SILICON 100WV 100MA		E.		0683-2435	R‡FXD COMP 33K OHM 5% 1/4W R‡FXD Comp 24k ohm 5% 1/4W	А-Н
CR5	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV				0698-3161	R:FXD MET FLM 38.3K DHM 1% 1/8W	J-L
- •	1901-0081	DIODE:SILICON 50 VOLTS WORKING	H–A J–X		A9R14	0683-4725	R: FXD COMP 4700 DHM 5% 1/4W	M-X
		*	U-^			0683-1235	R:FXD COMP 12K OHM 5% 1/4W	A-H
R6	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV				0757-0446	R:FXD NET FLM 15.0K OHM 1% 1/8W	J-L M-X
CR7	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV			40015			^{m-x}
					A9R15	0683-1035	R FXD COMP 10K OHN 5% 1/4W	
	ļ			ji i	A9R16 A9R17	0689-3315	R: FXD COMP 330 OHM 5% 1W	
		+ 5060-6205 MAY PERLACE ENCO TOTE OF				0689-3315	R FXD COMP 330 OHM 5% 1W	
		*5060-6205 MAY REPLACE 5060-2015 OR 5060-5871.		ā.		Í	· · · · · · · · · · · · · · · · · · ·	
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Table 5-1. Reference Designation Index (Cont'd)

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le erence evenetion		Description #	Nole	Reference Designation	😝 Part No.	Description #	N
		· · ·					
· ·		•		<		A10 5060-2181 (CONT'D)	
•	1	A 10 KnallEnter				6080-5655	
		A 10 600 181	A-H				X-L
10	6060~2101	OVERLOAD DETECTOR		ALOALCR4	1901-0058	DIQUEISILICON 150V	
1			AH	ALOA1CR5	1910-0023	DIODÉ:GERMANIUM 83 WIV	
1001	0160-0257	1 LIEXD NICA 50.600 58		A1041L1	9140-0053	CHOKE/COIL:FXD 1 NH 10%	
1006	0160-0134	CIERD NJCA 220PE 58 300VDCH		A104101	1850-0048	TRANSISTORIGERMANIUM 2N650 PNP	
1008	0160-0168 0160-0163	CIFXD NY 0.1 UF 108 200VDCW CIFXD NY 0.033 UF 108 200VDCW					
1009	0160-016)	CIFXD HT 0.01 UF 101 200VDCW		AloA1R5	0727-0274	RIFXD DEPC 1 NEGOHN 1% 1/2W	
	0160-0161 0160-0166	CIFXD MY GIGI UF LOR 200VDCW CIFXD MY .068 UF 108	A-G	ALOAIRO	· 0683-5635	REFXD COMP 56K OHNS 58 1/4W	
			H×	ALCA1R7	0683-4735	RIFXD CONP 47K OHN 5% 1/4W	
10CR1	1901-0071	DI ODE I STLICON BOWY		ALOAIRS	0683-1035	RIFXD CONP. LOK ONN 52 1740	
IOCR2	1901~0071	DIODEISILIGAN JONY		ALOAÌTI 🦾	5080-1454	TRANSFORMER # PULSE	
LOCR6	1903-0003	/ DIQUEISILICON 36V			4	· ·	
IOCRB	1901-0025 1910-0016	DI COE ISTLICON LOONA LOONA		A10	6080-5655		
OCR9	1902-0022	DI ODE I GERMANIUN LOOMA AT 0.85V 60PIV DI ODE BREAKDOWNIZ.67V			-0000	OVERLOAD DETECTOR	-ل
002	1850-0040	TRANSISTORI GERMANIUN PNP		A10C1	0140 0347		-
ORI				AIUCI	0160-0257	C:FRD NICA 50.6PF 58	
UKI	0727-0751 0757-0159	RIFXD DEPC 1000 OHM 11 1/2W	A-F	Alocz	0180-0049	CIFXD AL ELECT 200F SOVDCW	
	0121-0124	RIFXD MET FLN 1000 OHN 18 1/2W	G-H	Aloc3	0160-0161	CIFXD NY 0.01 UF 108 200VDCH	
OR 2	2100-0369	REVAR WE 200 DHA 10% LIN 1/4H		A10C4	0160-0161	CIFXD MY 0.01 UF 108 200VDCW	
OR3	0727-0766	RIFXD CARDON FLN 2.87K CHN 1% 1/2W		A10C5	0160-0166	CI FXD NY .068 UF 10%	
	0698-3101	RIFXD NET FLM 2.87K OHN 18 1/2W	A-F	A10C6	0160-2940	CIFXD NICA 470 PF 5% 300VDCW	
OR4	0727-0792	ALFXD CARBON FLN 31.6K CHN 11 1/2W	G-H (A10C7	0160-0263	CLEVE CER A 33 HE SAR KAUDOU	l l
	0698-3419	AIFAD NET FLM 31.6K OHN 18 1/2W	A-F	Aloca	0180-0050	CIFXD CER 0.22 UF 20% SOVDCW CIFXD ELECT 40 UF +75-10% SOVDCW	
			G-H	A10C9	0160-0161	CIFXD ALECT 40 UF 175-108 SOVDCW	
ORIO	0683-1035	RIFXD COMP LOK DHM 5% 1/4W		ALOCIO	0140-0194	CTFXD NICA 110 PF 5%	
0A11	0758-0004	RIFXD HET OX 2700 OHN 58 1/2W		ALOCII	0140-0191	CIFKD NICH TO PF 5%	
OR12	0683-1035	REFXD CONP LOK ONN 58 1/4H				CITAD NECA DO FF De	
OR 1 3	0683-1005	RIFXD COMP 10 DHM 5% 1/4W	~	A10C12	0140-0191	CIFXD NICA 56 PF 5%	
0R14	0689-1815			A10C13	0140-0194	CIFXD NICA 110 PF 58	
OR15	0683-2235	RIFXD COMP 180 OHM 5% AW				·	
OR 16	0683-1035	RIFXD COMP 22K OHN 5% 1/4W		Alocr1-			
0R18	0603-1015	RIFXD CONP 10K OHM 58 1/4W		Aloca5	1901-0081	OLODEISILICON 50 VOLTS WORKING	
0A 19	0603-6825	REFXD CONP 100 OHN 5% 1/6W					
		RIFXD COMP 6800 OHN 5% 1/4W		Alocr6	1902-0022	OLODE HREAKDOWN12.67V	
DAL	5060-2012	VOLTAGE COMPARATOR		A10CR7	1901-0081	DIODE:SILICON 50 VOLTS WORKING	
				Alocre	1901-0081	DIDDE:SILICON 50 VOLTS WORKING	
DAIC2	0160-2940	LIFXD NICA 470 PF 58 300VDCW		AIOLI	9140-0210	COILIFXD RF 100 UH 5%	
A1C3	0160-0303	CIFXD MYLAR .15 UF 108 200VDCW		A10L2	9140-0053	CHOKE/COIL:FXD 1 NH 10%	
A1C4	0180-0050 0160-0161	CIPXD ELECT 40 UF +75-10% 50VDCW					
		CIFXD NY 0.01 UF 10% 200VDCW		Alogi	1850-0040	TRANSISTORIGERMANIUM PNP	
AICR3	1901-0058	DIODE:SILICON 150V		A10Q2	1850-0048	. IR ANSI STOR : GERMANI UM	J
		i			1850-0184	TRANSI STOR: GERMANI UN PNP	Q-
				A1003	1850-0062	TRANSISTOR: GERNANIUN ALLOY JUNCTION	
				A1004	1850-0062	TRANSISTORIGERMANIUN ALLOY JUNCTION	
		•		A10Q5	1850-0183	TRANSISTURIGERMANIUM PNP	
				Alori	0757-0159 /	R#FXD MET FLM 1000 DHM 13 1/2W	
		• THE FOLLOWING SERIAL NUMBERS USE					
		0160-0161:005-00671, 00672, 00674,			<u>م</u>		1
		00677, 00682, 00683, 00685, 00690,					
		00691, 00692, AND 00699.					

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Table 6-1. Reference Designation Index (Cont
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Table 5-1. Reference Designation Index (Cont'd)

Reference		I		•			le 5-1. Reference Designation Index (Cont'd)	
Reference Designation	Part No.	Description #	Note	Į į	Reference Designation	Part No.	, Description #	Note
		A10 5080-5855 (CONT'D)	X-F				A11 5080-3781	
A10R2 A10R3 A10R4 A10R5 A10R6 A10R7 A10R8 A10R9 A10R10 A10R10 A10R11 A10R12 A10R13 A10R14 A10R15	0698-3419 2100-0369 0598-0024 08D 0683-4735 0683-1035 0683-1035 0683-1035 0683-1035 0683-2235 0683-1015 0683-6825 0689-2725 0683-1045	R: FXD MET FLM 31.6K OHM 1% 1/2W R: VAR WW 200 OHM 10% LIN 1/4W R: FXD MET FLM 2.61K OHM 1% 1/2W FACTORY SELECTED R: FXD COMP 47K OHM 5% 1/4W R: FXD COMP 56K OHMS 5% 1/4W R: FXD COMP 10K OHM 5% 1/4W R: FXD COMP 10K OHM 5% 1/4W R: FXD COMP 10K OHM 5% 1/4W R: FXD COMP 100 OHM 5% 1/4W R: FXD COMP 100 OHM 5% 1/4W R: FXD COMP 100 OHM 5% 1/4W R: FXD COMP 6800 OHM 5% 1/4W R: FXD COMP 2.7K OHM 5% 1W R: FXD COMP 2.7K OHM 5% 1W			A11 A11A1 A11C1 A11C1 A11C2 A11C3 A11C4 A11C5 A11C6 A11C7 A11C8 A11C9	5060-3781 NSR 0140-0195 0140-0195 0140-0219 0140-0219 0140-0195 0140-0219 0140-0219 0140-0219 0140-0219	REVERSIBLE DECADE COUNTER READOUT BLOCK ASSY C: FXD MICA 130 PF 5% 300 VDCH C: FXD MICA 130 PF 5% 300 VDCH C: FXD MICA 130 PF 5% 300 VDCH C: FXD MICA 180 PF 2% C: FXD MICA 180 PF 2% C: FXD MICA 130 PF 5% 300 VDCH C: FXD MICA 180 PF 2% C: FXD MICA 180 PF 5% 300 VDCH C: FXD MICA 180 PF 2% C: FXD MICA 180 PF 5% 300 VDCW	
A10816 A10817 A10818 A10819 A10820	0683-2235 0683-2435 0683-3325 0683-1035 0689-3925	R: FXD COMP 22K OHM 5% 1/4W R: FXD COMP 24K OHM 5% 1/4W R: FXD COMP 3300 OHM 5% 1/4W R: FXD COMP 10K OHM 5% 1/4W R: FXD COMP 3.9K OHM 5% 1W			A11C10 A11C11 A11C12 A11C13- A11C18 A11CR1-	0140-0219 0140-0219 0140-0195 0140-0194	C:FXD MICA 180 PF 2% C:FXD MICA 180 PF 2% C:FXD MICA 130 PF 5% 300 VDCW C:FXD MICA 110 PF 5%	
A10R21 A10R22 A10R23 A10R24 A10R25 A10R26 A10R27	0683-1835 0683-2035 0683-1045 0683-2235 0683-1825 0683-5125 0683-5125 0692-1815	R: FXD COMP 18K OHM 5% 1/4W R: FXD COMP 20K OHM 5% 1/4W R: FXD COMP 100K OHMS 5% 1/4W R: FXD COMP 22K OHM 5% 1/4W R: FXD COMP 1800 OHM 5% 1/4W R: FXD COMP 1800 OHM 5% 1/4W R: FXD COMP 180 OHM 5% 2W		1	Alicr8 Alicr9 Alicr10 Alicr11 Alicr13- Alicr24	1901-0025 1901-0081 1901-0081 1901-0081 1901-0081	DIODE:SILICON 100WV 100MA DIODE:SILICON 50 VOLTS WORKING DIODE:SILICON 50 VOLTS WORKING DIODE:SILICON 50 VOLTS WORKING DIODE:SILICON 50 VOLTS WORKING	
ALOTI	5060-2577 9100-1221	TRANSFORMER # PULSE TRANSFORMER # PULSE	J-L M-W		A11CR26- A11CR34	1901-0081	DIODE:SILICON 50 VOLTS WORKING	
					A1101- A1108 A11R1	1850-0184 068 3- 3945	TRANSISTOR:GERMANIUM PNP R:FXD COMP 390K OHM 5% 1/4W	
					AliR2 AliR3 AliR4 AliR5 AliR6	0683-5635 0683-5635 0683-1045 0683-3945 0683-5635	R:FXD COMP 390K OHM 5% 1/4W R:FXD COMP 56K OHMS 5% 1/4W R:FXD COMP 56K OHMS 5% 1/4W R:FXD COMP 100K OHMS 5% 1/4W R:FXD COMP 390K OHMS 5% 1/4W	
		·			A11R7 A11R8 A11R9 A11R10 A11R11	0683-5635 0683-1045 0683-3945 0683-5635 0683-5635	R:FXD COMP 56K DHMS 5% 1/4W R:FXD COMP 100K DHMS 5% 1/4W R:FXD COMP 390K DHM 5% 1/4W R:FXD COMP 56K DHMS 5% 1/4W R:FXD COMP 56K DHMS 5% 1/4W	
		·			A11R12 A11R13 A11R14 A11R15	0683-1045 0683-3945 0683-5635 0683-5635	R:FXD COMP 100K CHMS 5% 1/4W R:FXD COMP 390K OHM 5% 1/4W R:FXD COMP 56K OHMS 5% 1/4W R:FXD COMP 56K OHMS 5% 1/4W	
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Section V

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Table 5-1. Reference Designation Index (Cont'd)

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Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Beender 4		1			le 5-1. Reference Designation Index (Cont'd)	
Designation	Gran No.	Description #	Note		Reference Designation	Part No.	Description #	No
		A11 5080-3781 (CONT:D)						
		A12-A15, A46 5080-3781					A16 5080-3809	
11R16 11R17- '	0683-1045	. REFXD COMP 100K OHMS 58 1/4W						
1R26	0683-2235	RIFXD COMP 22K OHN 5% 1/4W			A16	5060-3809	COUNTER CONTROL	1
1R27	0686-5625	RIFXD COMP 5600 DHM 58 1/2W				1		
1R28	0686-5625	RIFXD COMP 5600 DHM 58 1/2W			A16C2	0160-0134	C:FXD MICA 220PF 5% 300VDCH C:FXD MICA 130 PF 5% 300 VDCH	A-1
1R29	0686-5625	R:FXD COMP 5600 OHH 5% 1/2H						G - 1
1R30	0686-5625	KIFXD COMP 5600 OHM 55 1/2W			A16C4	0160-0134	CIFXD NICA 220PF 5% 300VDCH	A-1
1R31 1R32	0683-6835 0686-5625	RIFXD COMP 68K OHM 5% 1/4W			A16C5	0140-0194	C:FXD NICA 130 PF 5% 300 VDCW C:FXD NICA 110 PF 5%	G-)
1R33	0686-5625	R:FXD COMP 5600 OHM 5% 1/2W R:FXD COMP 5600 OHM 5% 1/2W			A16C6	0140-0194	CIFXD NICA 110 PF 58	ji I
1R34	0683-6835	R:FXD COMP 68K OHM 5% 1/4W		Í	A16C7	0140-0194	C:FXD MICA 110 PF 58	e de la construcción de la constru
11R35	0683-6835	RIFXD COMP 68K OHM 58 1/4W			A16C8	0140-0194	CIFXD MICA 110 PF 58	1
11836	0686-5625	R:FXD COMP 5600 OHM 5% 1/2W			A16C9	0140-0194	CIFXD NICA 110 PF 5%	
1R37	0686-5625	R:FXD COMP 5600 OHM 5% 1/2W			A16C10	0160-0938	C:FXD MICA 1000PF 5%	
1R38	0683-6835	R:FXD COMP 68K OHM 5% 1/4W			A16C11	0140 194	C:FXD NICA 110 PF 5%	
1R39-					A16C12 A16C13	0140-0195	C:FXD NICA 130 PF 58 300 VDCN	
1R46 1R47	0683-2735 0683-3335	RIFXD COMP 27K OHN 58 1/4W			A16C14	0160-2101 0140-0195	CIFXD HICA 27PF 28 300VDCH CIFXD HICA 130 PF 58 300 VDCH	
1R48	0683-2235	A:FXD COMP 33K OHM 5% 1/4W R:FXD Comp 22k ohm 5% 1/4W			A16C15	0140-0218	CIFXD MICA 160 PF 2%	· .
1849	0683-2235	REFXD COMP 22K OHN 5% 1/4N			A16C16	0140-0218	CIFXD MICA 160 PF 28	· ·
1850	0683-3335	R#FXD COMP 33K OHM 55 1/4W			A16C18	0140-0194	CIFXD MICA 110 PF 58	
LR51	0683-3025	R#FXD COMP 3000 OHM 5% 1/4W			A16C19	8ذ0-0160	C:FXD MICA 1000PF 5%	
R52	0683-3335	RIFXD COMP 33K OHM 58 1/4W	1 1	1				
1853	0683-2235	RIFXD COMP 22K OHN 58 1/4W			A16CR1-	1001 0001		
1R54	0683-2235	R:FXD COMP 22K OHM 5% 1/4W		1	A16CR37	1901-0081	DIODEISILICON 50 VOLTS WORKING	i
1R55	0683-3335	RIFXD COMP 33K OHN 58 1/4W		1	▲16CR38	1901-0143	DIGDETSILICON	
1R56	0683-3025	R: FXD COMP 3000 DHM 58 1/4W			A16CR39	1901-0143	DIODE:SILICON	
R57	0683-3335	R: FXD COMP 33K OHM 5% 1/4W			A16CR40	1901-0081	DIODE:SILICON 50 VOLTS WORKING	н-х
R58	0683-2235	RIFXD COMP 22K OHN 58 1/4W			A16Q1	1853 0000		
R59	0683-2235	RIFXD COMP 22K OHM 5% 1/4W				1653-0008	TRANSISTOR: SILICON PNP	
R60	0683-3335	RIFXD COMP 33K OHM 5% 1/4W			A1692	1853-0008	TRANSISTOR: SILICON PNP	
1R61	0683-3025	R: FXD COMP 3000 OHM 5\$ 1/4W			A16Q3	1850-0111	TRANSISTOR: GERMANIUM PNP	
1R62	0683-3025	RIFXD COMP 3000 OHM 58 1/4W			A1604 A1605	1850-0111 1850-0111	TRANSISTORIGERMANIUM PNP	
LR63 LR64	0683-3335 0683-2235	R‡FXD COMP 33K OHM 58 1/4W R‡FXD Comp 22K ohm 58 1/4W			-1005	1853-0036	TRANSISTOR:GERMANIUM PNP TRANSISTOR:SILICON PNP	A-S
R65	0683-2235	KIFXD COMP 22K CHM 58 1/4W			A1696	1850-0111	TRANSISTOR: GERMANIUM PNP	A-5
IR66	0683-3335	RIFXD COMP 33K OHM 5% 1/4W				1853-0036	TRANSISTORISILICON PNP	T-X
IR67	0683-3025	KI FXD COMP 3000 DHM 5\$ 1/4W			A1607	1850-0111	TRANSISTOR: GERMANIUM PNP	
R68	0683-6835	RIFXD COMP 68K OHM 5% 1/4W			A16Q8	1850-0111	TRANSISTOR: GERMANIUM PNP	
R69	0686-4735	RIFXD COMP 47K OHN 58 1/2W			A1609	1850-0111	TRANSISTOR: GERMANIUM PNP	
VI I	1970-0009	ELECTRON TUBE: INDICATOR 10 DIGIT			A16Q10 A16Q11-	1850-0111	TRANSISTOR:GERMANIUM PNP	
		SAME AS A11, USE PREFIX A12		I	A16Q14	1854-0039	TRANSISTOR: SILICON	
		SAME AS A11, USE PREFIX A13			A16015 A16016	1850-0111 1850-0111	TRANSISTOR:GERMANIUM PNP TRANSISTOR:GERMANIUM PNP	
		SAME AS A11, USE PREFIX A14			A16017	1853-0008		
		SAME AS A11, USE PREFIX A15	1		A16Q18	1853-0008	TRANSISTOR:SILICON PNP TRANSISTOR:SILICON PNP	
		SAME AS A11, USE PREFIX A16		1	A16019 A16020	1853-0008 1854-0039	TRANSISTOR:SILICON PNP TRANSISTOR:SILICON	
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Section V

Table 5-1.	Reference	Designation	Index	(Cont'd)	
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Table 5-1. Reference Designation Index (Cont'd)

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Reference Designation	Part No.	Magaulation 4		1.	Reference			
Jung Ballog		Description #	Note	\$	Designation	Part No.	Description #	Na
							A16 5080-3809 (CONT'D)	
		A16 5060-3909 (CONT'D)					A17 5060-5002	A-L
							5080-6224	M-X
16922	1850-0111	TRANSISTOR: GERMANIUM PNP						
A16023	1850-0111	TRANSISTOR: GERMANIUM PNP	1		A16R46	0683-3305	KEFXD CONP 33 OHM 58 1/4W	
A16024	1850-0111	TRANSISTOR: GERMANIUM PNP			A16R47 A16R48	0683-1635	REFAD COMP 16K DHM 58 1/4W	•
	1853-0036	TRANSISTOR: SILICON PNP	A-5 T-X		A16R49	0683-1035 0683-5625	R:FXD COMP 10K 0HM 5% 1/4W R:FXD COMP 5600 0HM 5% 1/4W	
16925	1853-0008	TRANSISTOR: SILICON PNP	1-7		A16R50	0686-5625	A: FXD COMP 5600 OHM 5% 1/2W	
16R1	0683-1635	RIFXD COMP 16K OHM 58 1/4W		}				
		NUT NO CONF ION UNH 34 1748		}	A16R51	0683-1635	RIFXD COMP 16K OHM 5% 1/4W	
16R2	0683-1025	R: FXD COMP 1000 OHN 5\$ 1/4W	i i		A16R52 A16R53	0683-1025 0683-4735	R:FXD CONP 1000 OHM 5% 1/4W R:FXD COMP 47K OHM 5% 1/4W	
16R3	0683-4735	RIFXD COMP 47K OHM 5% 1/4H			A16854	0683-1535	RIFXD COMP 15K OHN 5% 1/4W	•
16R4	0683-2235	RIFXD COMP 22K OHN 5% 1/4W			A16R55	0683-4725	RIFXD COMP 4700 OHM 5% 1/4W	
16R5	0686-7525	R#FXD COMP 7500 OHN 5\$ 1/2W						
16R6	0683-1835	RIFXD COMP 18K OHM 5% 1/4W			A16R56	0683-1835	R: FXD COMP 18K OHM 5% 1/4W	
					A16R57	0686-4725	RIFXD COMP 4700 OHM 58 1/2W	
16R7	0686-7525	R: FXD' COMP 7500 DHM 58 1/2W			A16R58	0683-4335	REFXD COMP 43K OHM 5% 1/4H	
16R8	0683-2235	R: FXD COMP 22K OHM 5% 1/4W	ļ ļ		A16R60	0686-3325	R = FXD COMP 3300 OHM 5% 1/2W	•
16R9	0683-1835	RIFXD COMP 18K OHN 5% 1/4W	[]		A16R61	0683-4335	RIFXD COMP 43K OHM 58 1/4H	
16R10 16R11	0683-1035	RIFXD COMP 10K OHM 58 1/4W						
19411	0683-1035	R:FXD COMP 10K OHM 58 1/4W			A16R63	0757-0954	R: FXD FLM 18K OHM 28 1/8W	
16R12	0683-1035				A16R64	0757-0954	R:FXD FLM 18K OHM 2% 1/8W	
16R13	0683-1135	RIFXD COMP LOK OHM 5% 1/4N			A16R65	0757-0931	RIFXD FLM 2.0K OHM 2% 1/8W	
16R14	0683-1035	R:FXD COMP 11K OHM 5% 1/4W R:FXD Comp 10k ohm 5% 1/4W			A16R66	0 757-095 2	R:FXD FLM 15K OHM 2% 1/8W	
16R15	0683-1035	RIFXD COMP LOK OHM 5% 1/4W			A16R67	0683-3335	RIFXD COMP 33K OHM 5% 1/4W	
16R16	0683-1235	KIFXD COMP. 12K OHM 5% 1/4W						
		NTTAD CONT. IER UNIT JA 1748			A16R68	0683-1835	RIFXD COMP 18K OHM 5% 1/4W	
16R 17	0757-0943	R:FXD FLM 6.2K OHM 2% 1/8W			A16R69	0683-4725	R:FXD COMP 4.7K 5% 1/4W	A-F
16R18	0757-0943	RIFXD FLM 6.2K CHM 2% 1/8W				0683-2725	R = FXD COMP 2700 OHM 5% 1/4W	G-)
16R19	0683-4735	RIFXD COMP 47K OHM 5% 1/4H			A16R70	0689-2225	RIFXD COMP 2200 OHM 5% 1W	
16R20	0689-3315	RIFXD COMP 330 OHN 5% 1W			A16R71	0683-1015	R=FXD COMP 100 OHM 58 1/4W	
16R21	0683-4735	RIFXD COMP 47K OHM 58 1/4W			A16R72	0683-4725	R:FXD CDMP 4700 OHM 5% 1/4W	A-K
16R22	A400 3315		1 1			0683-2725	RIFXD COMP 2700 DHM 53 1/4W	L-X
16R23	0689-3315	R:FXD COMP 330 OHN 5% 1W			A16R73	0683-4335	RIFXD COMP 43K OHM 58 1/4N	2-2
	0683-1235	R: FXD COMP 12K OHM 5\$ 1/4H			A16R74	0689-2725	R:FXD COMP 2.7K DHM 5% LW	
16R24 16R25 .	0757-0943 0686-5625	RIFXD FLM 6.2K OHM 2% 1/8W			• A16R75	0683-2235	RIFXD COMP 22K OHM 5% 1/4W	
16R26	0683-1035	R#FXD COMP 5600 DHM 5% 1/2W R#FXD COMP 10K DHM 5% 1/4W			A16R76	0683-3335	R:FXD COMP 33K DHM 5% 1/4W	A-G
						0683-2735	R:FXD COMP 27K OHM 58 1/4W	
L6R27	0686-3925	RIFXD COMP 3900 OHM 58 1/2W			A16R77	0757-0943	RIFXD FLM 6.2K OHM 2X 1/8W	H-X
6R28	0686-3925	RIFXD COMP 3900 OHM 5% 1/2W			A16R78	0683-1635	RIFXD COMP 16K OHM 5% 1/4W	
6R29	0683-2235	RIFXD COMP 22K OHM 5% 1/4W			A16R79	0683-1635	RIFXD COMP 16K OHN 5% 1/4W	
L6R30 L6R31	0683-1135 0683-1035	RIFXD COMP 11K OHM 5% 1/4W	1 1		A16R80	0683-1235	RIFXD COMP 12K OHM 5% 1/4W	
	· · · · · · · · · · · · · · · · · · ·	RIFXD COMP 10K OHM 5% 1/4W				A		
16R32	0683-1635	RIFXD COMP 16K OHM 5% 1/4W			A16R81 A16R82	0683-1535	RIFXD COMP 15K OHM 5% 1/4W	
6R33	0683-1635	RIFXD COMP 16K OHM 5% 1/4W			A16R83	0683-4735	RIFXD CONP 47K OHN 5% 1/4W	
6R34	0683-3335	RIFXD COMP 33K OHM 58 1/4W			A16R84	0683-4325 0683-2235	R:FXD COMP 4300 DHM 5% 1/4W R:FXD COMP 22K DHM 5% 1/4W	
6R35	0683-6825	RIFXD COMP 6800 DHH 5% 1/4H			A16R85	C683-4725		
6R36	0683-1635	RIFXD COMP 16K OHM 58 1/4H			ATONO	0683-2725	R:FXD COMP 4.7K 5% 1/4W R:FXD Comp 2700 onm 5% 1/4W	A-F
		AT			A16R86	2100-0369	R:VAR NN 200 OHM 10% LIN 1/4W	G - X
6R37 6R38	0683-1035 0683-1135	REFXD COMP 10K OHM 5% 1/4H						
6R 39	0683-1235	R#FXD COMP 11K OHM 5% 1/4W			A17	5060-5002	GATE CONTROL	A-L
6R40	0683-1035	RIFXD COMP 10K OHM 58 1/4H			1	5060-6224	GATE CONTROL	M-X
6R41	0686-5625	R: FXD COMP 5600 OHN 5% 1/2W						m-X
4943					A17C1	0140-0194	C:FXD MICA 110 PF 5%	1
6R42 6R43	0683-5625 0683-1235	R:FXD COMP 5600 OHM 5% 1/4W R:FXD Comp 12k ohm 5% 1/4W						
6R44	0683-3305	RIFXD COMP 12K OMM 5% 1/4% RIFXD COMP 33 OHM 5% 1/4%			A17C2	0140-0194	CIFXD MICA 110 PF 5%	
6R45	0683-1235	R1FXD COMP 12K OHM 5% 1/4W	I		A17C3	0140-0200	CIFXD NICA 390 PF 58	
· · · · ·		WIN AND TEN ONE 24 FLAM	I I		A17C4	0140-0200	CIFXD MICA 390 PF 5%	
					A17C5	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
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See introduction to this section for ordering information

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Table 5-1.	Reference	Designation Index	(Cont'd)
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Reference Designation

A17826 A17R27 A17R28

A17R29

A17R30

A1761

A18

-A18C1

A18C2

A18C3

A18C4

A18C5

A18C6

A18C7

A18C8

A18C9

A18C10

A18C11

A18CR1

A18CR2

A18CR3

A18CR4

AL8CR5

ALBCR6

A18CR7

A18CR8

A18CR9

A18Q1

A1802

A18Q3

A18Q4

A1805

A1896

A1897

A18R1

A18R2

A18R3

A1884

A18R5

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Reference Designation	Part No.	Description #	Note	L
		A17 5080-5002 (CONT'D)	A-L	6
		5080-6224 (CONT'D)	M-X	
A17C6	0140-0198	CIFXD MICA 200 PF 58		
A17C7	0150-0093	C+FXD CER 0.01 UF +80-20% 100VDCW	А-В	. li
•	0160-0938	CIFXD MICA 1000PF 5%	C-X	
A17CR1 '	1901-0081	DIODE:SILICON 50 VOLTS WORKING -		
A17CR2	1901-0081	DIODE:SILICON 50 VOLTS WORKING	(
A17CR3	1901-0081	DIODE:SILICON 50 VOLTS WORKING		1
ALTCR4	1901-0061	DIODE:SILICON		
ALTCR5	1901-0061	DIODEISILICON		
A17CR6	1901-0081	DIODE:SILICON 50 VOLTS WORKING		
ALTCRT	1901-0081	DIODE:SILICON 50 VOLTS WORKING		
A17CR8	1902-0094	DIODE:BREAKDOWN 4.85V 250HW	•	
AL7CR9	1901-0081	DIODE:SILICON 50 VOLTS WORKING		1
A17CR10	1901-0050	DIODE SILICON 75V	M-X	
A1791	1850-0111	TRANSISTOR: GERMANIUM PNP		
A17Q2	1850-0111	TRANSISTOR: GERMANIUM PNP		
A17Q3	1854-0003	TRANSISTOR: NPN SILICON		
A1704	1850-0111	TRANSISTOR: GERMANIUM PNP		1
A1795	1851-0024	TRANSISTOR: GERMANIUM. NPN	1 1	
A17Q6	1851-0024	TRANSISTOR:GERMANIUM NPN		
A1797	1854-0003	TRANSISTOR:NPN SILICON		E
A1798 ,	1854-0003	TRANSISTOR:NPN SILICON		
A17R1 .	0683-4735	R:FXD COMP 47K OHM 5% 1/4W		•
17R2	0683-4735	R: FXD COMP STK OHM 58 1/4W		1
N17R3	0683-1835	RIFXD COMP 18K OHM 55 1/4W		2
117R4	0683-4735	R:FXD COMP 47K OHM 5% 1/4W		
17R5	0761-0027	R:FXD MET FLM 2.7K OHM 5% 1W		
17R6	0683-2235	RIFXD COMP 22K DHN 58 1/4W		Ť
1787	0683-4725	R#FXD COMP 4700 DHM 5% 1/4W		
17R8	0683-2435	RIFXD COMP 24K OHN 5% 1/4W		1
17R9	0683-2705	RIFXD COMP 27 DHM 5% 1/4W		j
17R10	0683-1035	REFXD COMP 10K OHH 5% 1/4W		G
A17811	0492-4935		i i	- i :

Table 5-1. Reference Designation Index (Cont'd)



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RIFXD COMP 68K OHM 58 1/4H

R=FXD COMP 1000 DHM 58 1/4W

RIFXD COMP 22K OHM 58 1/4W

R:FXD COMP 4700 DHM 58 1/4W R:FXD COMP 27K DHM 58 1/4W

R#FXD COMP 2.2K OHM 58 1/4W R#FXD COMP 3900 OHN 58 1/2W R#FXD COMP 47 OHM 58 1/4W

R: FXD COMP 1000 CHM 53 1/4W

R: FXD COMP 3900 DHM 5% 1/2W

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R: FXD COMP 47 OHM 58 1/4W R: FXD COMP 33K OHM 58 1/4W R: FXD COMP 27K OHM 58 1/4W

RIFXD COMP 68K OHM 58 1/4W

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RIFXD MET FLM 2.7K OHM 5% 1W

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A17812

A17R13

A17R14

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A17R16

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A17R23

A17824

A17825

0683-6835

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0761-0027

0683-2235

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0683-6835

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Section V

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Part No.	Description #	Note
	A17 5080-5002 (CONT'D)	A-L
	5080-6224 (CONT'D)	M-X
· · ·	A18 5060-2052	
• 0683 <u>-</u> 3335		
0683-6835	R:FXD COMP 33K OHM 5% 1/4W R:FXD COMP 68K OHM 5% 1/4W	
0683-4735	REEXD COMP 47K OHM 5% 1/4H	
0683-1045	REFEAD COMP 100K DHMS 5% 1/4W	Í
0683-1835	RIFXD COMP 18K DHM 5% 1/4W	M-X
8159-0005	JUMPER WIRE	A-L
5060-2052	DISPLAY CONTROL	
0160-2940	CIFXD HICA 470 PF 5% 300VDCW	
0160-0127	G:FXD CER 1.0 UF 208 25VDCW	
0180-0116	CIFXD ELECT 6.8 UF 10% 35VDCW	
0140-0200	CIFXD HICA 390 PF 5%	ļ
0140-0200	CIFXD MICA 390 PF 5%	
0150-0014	CIFXD CER 0.005 UF SOOVDCW	
0140-0152	C:FXD NICA 1000 PF 5% 300VDCW	
0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
0150-0014	CIFXD CER 0.005 UF 500VDCH	
0180-0049	C:FXD AL ELECT 20UF 50VDCW	
0160-0155	CIFXD NY 3300 PF 10%	
1901-0025	DIODE:SILICON 100WV 100MA	
1901-0025	DIODE: SILICON 100WV 100MA	
1910-0011	DIDDE:GERMANIUM SMA AT LV	A-L
1901-0081 1910-0011	DIDDE:SILICON 50 VOLTS WORKING	M-X
1910-0016	DIODE:GERMANIUM SMA AT 1V Diode:Germanium 100ma at 0.85v 60piv	A-B
	DIGREGERANNICH LOUMA AT 0.034 SUPIA	M-X
1910-0011	DIODE:GERMANIUM 5MA AT LV	A-L
1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	M-X
1910-0011	DIODE:GERMANIUM 5MA AT 1V	A-L
1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	M-X
1902-0223	DIODE BREAKDOWNISILICON 15.4V DIODEIBREAKDOWN 5% 15.4V	A-Q
		R – X
1901-0025	DIODE:SILICON TOONV 100MA	
1901-0025	DIODE:STLICON LOONA LOONA	
1850-0040	TRANSISTOR: GERMANIUM PNP	
1850-0062	TRANSISTOR: GERMANIUM ALLOY JUNCTION	1
1850-0040	TRANSISTOR: GERMANIUM PNP	
1850-0062	TRANSISTOR: GERMANIUM ALLOY JUNCTION	
1850-0062	TRANSISTOR:GERMANIUM ALLOY JUNCTION TRANSISTOR:GERMANIUM PNP	
1851-0024	TRANSISTORIGERMANIUM NPN	
	RIFXD COMP 5600 DHM 5% 1/2W	,
0683-3325 0683-3325	R‡FXD COMP 3300 DHM 5% 174W R‡FXD Comp 3300 DHM 5% 174W	
0683-3325	RIFKD COMP 3300 OHM 5% 1/4W RIFKD COMP 3300 OHM 5% 1/4W	
0683-4735	RIFXD COMP 47K OHM 5% 1/4W	
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Table 5-1. Reference Designation Index (Cont'd)

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Table 5-1. Reference Designation Index (Cont'd)

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Reference Designation	Part No.	Description #	Note	Reference Designation	Part No.	Description #	No
		A18 5080-2052 (CONT'D)		5 F			
		A19 5060-3829	A-H			A19 5060-3829 (CONT'D)	A-
		5080-5872	x₋t	- 		5060-5872 (CONT'D)	J_;
18R6	0686-5625	R:FXD COMP 5600 OHM 5% 1/2W		A19CR20	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	
18R7	0683-1035	RIFXD COMP 10K OHM 5% 1/4W V 4		A19CR21	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	
18R8	0686-6825	R#FXD COMP 6800 OHMS 5% 1/2W		RIJUNEI		DIDE-DERNATOR LOOKE AT 01034 COTTA	
18R9	0683-1035	R:FXD COMP 10K OHM 5% 1/4W					
18R10	0683-2735	RIFXD COMP 27K OHM 5% 1/4W		A1901-			
18R11	Q686-5625	8. 5VD COND 5400 000 58 1 (20)		A1907	1850-0128	TRANSISTOR: PNP GERMANIUM 2N398B	A-
18812	0683-3325	R:FXD COMP 5600 OHN 5% 1/2W R:FXD COMP 3300 OHM 5% 1/4W			•	TRANSISTOR: GERMANIUM PNP	ل 🗕 📔
18R13	0683-1535	R:FXD COMP 15K OHM 5% 1/4W			1850-0111	' r	
18R14	0683-2435	R*FXD COMP 24K DHH 58 1/4H b		A19Q8	1850-0113	TRANSISTOR: GERMANIUM PNP -	A
18R 15	0683-3915	R*FXD COMP 390 QHM 5% 1/4W			1850-0145	TRANSISTOR: GERMANIUM PNP	J.
TOM 13	0003-3413	KIFAD CUMP 390 UNH 35 1/4W		A1909	1850-0128	TRANSISTOR: PNP GERMANIUM 2N398B	
18R16	0683-2225	R: FXD COMP 2.2K OHM 5% 1/4H		A19Q10	1850-0113	TRANSISTOR: GERMANIUM PNP	
18R17	0683-2735	RIFXD COMP 27K OHN 5% 1/4W					
18818	0683-2725	R: FXD COMP 2700 OHM 5% 1/4W		A19011	1850-0113	TRANSISTOR: GERMANIUM PNP	
18R19	0683-2225	RIFXD COMP 2.2K OHN 5% 1/4W		A19012	1850-0113	TRANSISTOR: GERMANIUM PNP	
18R20	0683-1225	R = FXD COMP 1200 DHM 5% 1/4W	1 1		0757 0334		
				A19R1	0757-0336	R:FXD MET FLM 340 OHM 13 1/4W	^
18R21	0686-1025	R: FXD COMP 1000 OHM 5% 1/2W		A19R2	0683-3335	R:FXD CONP 33K OHM 5% 1/4W	
18R22	0683-6835	R:FXD COMP 68K OHM 5% 1/4W		A19R3	0683-3335	RIFXD COMP 33K OHM 5% 1/4W	
18R23	0683-4725	R#FXD COMP 4700 OHM 5% 1/4W	1 1	A19R4	0683-1835	R: FXD CONP 18K OHM 5% 1/4W	
18R24	0683-5625	R:FXD COMP 5600 DHM 5% 1/4W		A19R5	0683-2235	R: FXD COMP 22K OHN 5% 1/4W	
LOR 25	0683-1025	R#FXD COMP 1000 DHM 5% 1/4W	C-L	A19R6	0683-1535	R: FXD COMP 15K OHM 5% 1/4W	A
					0683-3035	RIFXD COMP 30K DHM 5% 1/4W	J
19	5080-3829	CONTROL LOGIC A	A-H				
	5080-5872	CONTROL LOGIC A	X-L	A19R7	0683~3325	R:FXD COMP 3300 OHN 5% 1/4W	A
					0683-1835	R‡FXD COMP 18K OHM 5% 1/4W	J.
19CR1	1901-0061	DIQUESSILICON		A19R8	0683-1835	REFXD COMP 18K OHM 5% 1/4W	
ITUNI	1901-0081	DIWEISTEICON	А-Н	A19R9	0683-1635	R: FXD COMP 16K OHM 5% 1/4W	A-
19CR2	1901-0061	DIODE:SILICON		1	0683-1535	R:FXD CONP 15K OHM 5% 1/4W	J-
19CR3.	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	A-H				
19084	1910-0037	DI ODE + GERMANI UM		A19R10 ,	0683-1235	R FXD COMP 12K OHN 5% 1/4W	A-
19CR5	1901-0081	DIODE:SILICON 50 VOLTS WORKING			0683-2035	R:FXD COMP 20K OHM 5% 1/4W	J-
19CR6	1901-0081	DIQDE:SILICON 50 VOLTS WORKING		A19R11	0683-3025	R: FXD COMP 3000 OHM 5% 1/4W	A-
					0683-1535	R#FXD CONP 15K OHN 5% 1/4W	J-
19CR7	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	А-Н	A19R12	0683-1635	R:FXD COMP 16K OHN 5% 1/4H	A-
	1901-0081	DIODE:SILICON 50 VOLTS WORKING	J-X)	0683-1535	RIFXD CONP 15K OHM 5% 1/4W	J-
19CR8	1910-0016	DIODE:GERMANIUN 100MA AT 0.85V 60PIV	A-H	A19R13	0683-1235	RIFXD COMP 12K OHM 5% 1/4W	A-
	1901-0081	DIODE:SILICON 50 VOLTS WORKING	J-X	1	0683-2235	RIFXD COMP 22K OHN 5% 1/4W	Ĵ-
L9CR9	1910-0016	DIODE:GERMANIUM LOOMA AT 0.85V 60PIV	A-H	A19R14	0683-3025	REFXD COMP 3000 DHM 5% 1/4W	Ă-
	1901-0081	DIODE:SILICON 50 VOLTS WORKING	J-X		0683-1535	REFXD COMP 15K OHM 5% 1/4W	J.
		01005-058 MANTUM 100MA AT 0 474 (0014					-
19CR10	1910-0016 1901-0081	DIODE:GERMANIUM 100MA AT 0.85V 60PIV DIODE:SILICON 50 VOLTS WORKING	A-H	A19R15	0683-2735		
00011		DIODE: GERMANIUM 100MA AT 0.85V 60PIV	J-X	A19R16	0683-1535	R:FXD COMP 15K OHM 5% 1/4W	A-
L9CR11	1910-0016 1910-0016	DIODE:GERMANIUM 100MA AT 0.85V SUPIV			0683-1635	RIFXD COMP 16K DHM 5% 1/4W	ل ا
176N16	1901-0081	DIODE:SILICON 50 VOLTS WORKING	A-H	A19R17	0683-1235	R:FXD_COMP 12K OHN 5% 1/4W	A-
	1741-0401	ATTACTACT AN ANTIA MARYINA	X-U	· · ·	0683-2235	RIFXD COMP 22K OHM 5% 1/4W	J.
9CR13	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV		A19R18	0683-3025	•	
9CR14	1910-0016	DIODE:GERMANIUM LOONA AT 0.85V 60PIV		AL 7R 10	0683-2035	REFXD COMP 3000 DHM 5% 1/4W	A.
	1901-0081	DIODE:SILICON 50 VOLTS WORKING	A-H	A19R19		R FXD COMP 20K OHM 5% 1/4W	J.
9CR15	1910-0016	DIODE:GERMANIUM LOONA AT 0.85V 60PIV -	J-X-U	447817	0683-4735 0683-1835	R‡FXD COMP 47K OHM 5% 1/4W R‡FXD Comp 18k ohm 5% 1/4W	A J·
					0003-1035	RIFAU CUMP ION UMM DA 1/98	U
9CR16	1910-0016	DIDDE:GERMANIUN 100HA AT 0.85V 60PIV		A19R20	0689-1035	R#FXD COMP 10K OHM 5% 1W	
9CR17	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV		A19R21	0689-3315	RIFXD COMP 330 OHM 5X 1W	
9CR18	1910-0016	DIODE:GERMANIUN 100MA AT 0.85V 60PIV		A19R22	0683-1635	RIFXD COMP 16K OHM 5% 1/4W	Α.
9CR19	1901-0081	DIODE:SILICON 50 VOLTS WORKING	1 P			S RIFXD COMP 12K DHM 5X 1/4W	, , , , , , , , , , , , , , , , , , ,
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Section V

Table 5-1. Reference Designation Index (Cont'd)

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Table 5-1. Reference Designation Index (Con	it 'ɗ)
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		Neg polytica at	1	4		A		
Reference Designation	- () Part No.	Description #	Note	l	, Le crence Designation	• Part No.	Description #	N
	,	A19 6080-3829 (CONT'D)	A-H	. 1		,	A20 8080-2008 (CONT'D)	-+
		6080-6872 (CONT'D)	J-X	· II			A21 8080-3010	A-H
	Į Į	A20 5000-2000		2		•	8080-8673	X-4
9823 .	0609-1015	RIFXD COMP LOK OHN 5% LW	A-H		A20812	0683-3335	RIFED CONP 33K OHN 58 1/4W	
	Cto1-E840	RIFKD COMP 16K DHN 58 1/4W	J-X		A208 13	0683-4335	RIFKD COMP 43K OHN 58 1/4H	
19R24	0683-3025	RIFXD COMP 3000 DHM 58 1/4W Rifxd comp 13k dhn 58 1/4W	A-H J-X		A20814 A20815	0683-3335	REFED CONP 33K ONN SE 1/4W	
19825	0683-18,55	RIFXD COMP 18K OHN SE 1/4W		-	AZORIS	0683-3335 0683-4335	RIFKD CONP 35K OHN SE 1/4W RIFKD CONP 45K OHN SE 1/4W	1
19826	0689-1035		•	1. A. C. M.			· ·	
14450	0757-0947	RIFXD COMP 10K UHM 5% 1W RIFXD FLM 9.1K UHM 2% 1/8W	A-H U+X		A20817 A20818	0463-4335 0463-4335	RIFXD CONP 43K ONN SE 1/4W	
L9A 27	0683-8225	RIFXD CONP 8200 DHNS SE 1/4W	М-н	2	A20# 19	0443-4335	RIFXD CONP 43K ONN SE 1/4N RIFXD CONP 43K ONN SE 1/4N	
	0757-0944	REFXD FLM 6.0K OHN 28 1/0W	X-1	Į.	A20820	0683-3335	RIFXD COMP JDK ONN SE 1/4H	
19828	0757-0950	RIFXD COMP 27K OHM 5% 1/44 RIFXD FLM 12K OHM 2% 1/84	H-A J-X		A20821	0683-4335	RIFKD COMP ASK ONN SE 1/44	
				5	A20822	0483-4335	REFXD COMP 43K OWN ST 1/4W	
19829 19830	0683-1835 0689-1035	RIFXD COMP 18K OHN 55,174W RIFXD COMP 18K OHN 55 1W			A20823	0483-4335 1	RIFXD CONP 43K ONN 52 1/4W	
	0757-0946	RIFXO FLN 6.2K ONN 21 1/6W	H∸A ©X−U		A20R24 A20R25	0483-3335 0483-4335	RIFXD COMP 33K ONN SE 1/4W	
19R31	0683-1835	RIFKO CONP LOK ONN 58 1/4W	A-H .		A208.26	0443-4335	ALFXD CONP 43K ONN SE 1/4H ALFXD CONP 43K ONN SE 1/4H	
	0757-0940	RIFXD FLN 4.7K DHM 28 1/6W	J-X	P .			1	
19832	0663-2725	RIFXD CONP 2700 DHM 58 1/4W	A-H		A20827 A20828	0683-3335 0683-1835	RIFXD COMP 33K ONN 58 1/4W	1 I
	0757-0944	RIFXD FLM 6.8K OHM 28 1/8W	J-X		A208 29	0403-4335	AFFXD COMP 18K ONN 58 1/4M AFFXD COMP 43K ONN 58 1/4M	
19833 19834	0669-3315 0669-1035	RAFXD COMP 330 ONN 58 1W					<i>y</i>	
PE 14	0004-1033	REFER COMP TOK UNN ST TW J			A21	6080-3010	CONTROL LOGIC C	A-1
9835	0689-3315	HIFXD COMP 330 UNIN 58 1W				6080-5673	CONTROL LOGIC C	رغ 📔
9836 9837	0683-4730	RIFXD CONP 47K ONN 58 1/4W					•	
9838	068 3-4735 068 3-4715	-N.IFXD CONP 47K DHN 5% 1/4W Refyxd conp 470 dhn 5% 1/4W			AZICRI-	1"		в
19839	0683-4735	RIFXD COMP 47K OHN 58 1/4W		•	AZICRA	1910-0016	DI ODE : GERMANIUM LOOMA AT 0.850 60PIV	
				у • • •			OIODE SILICON 50 VOLTS WORKING	A-+
19840 · · · · · · · · · · · · · · · · · · ·	0683-3335 0663-3335	-441 FXD COMP 33K ORM 5% 1/4W * Alfxd Comp 33k orm 5% 1/4W			AZICA6	1901-0081		"
	000 3 3 3 3 3		•		AZICR7	1901-0025	DIODE:SILICON LODWY LOONA / DIODE:SILICON LODWY LOONA /	
20	6060-2009	CONTROL LOGIC B		· ·	AZICRE	1901-0025	DIGDEISILICON 100WV_100MA	
OCR1-					AZICAIO	1901-0025	DI ODE I SILICON LOONA LOONA	
ZOCRS	1901-0025	DIQUEISILICON 100WV 100MA			AZICAIZ	1901-0025		
	•	· ·			AZICA13	1910-0016	DIODEISILICON 100WA 100NA Diodeigermanium 100NA at 0.854 60Ptv	C-3
20CR6- 20CR23	41910-0016	•			AZICR14	1910-0016	DIGDE:GERMANIUN 100NA AT 0.85V 60PIV	1 .
OCR24-	V . 1410-0010	DEDDE:GERMANIUM LOOMA AT 0.85V 60PTV			AZICR15 AZICR16	1910-0014 1901-0081	DIODEIGERMANIUN 100MA/AT 0.85V 60PIV	
OCAZE X	1901-0075	DIDDE+SILICUN 100WV 100NA				1101-0001	DI DDE ISILICON SO VOLTS WORKING	1
OCR29	1910-0016	DIDDEIGERMANIUN 100MA AT 0.85V 60PIV			A21L1	9140-0107	COILSFXD RF 27 NH 108 *	
		DIODELOCKWARTON TOONK AT 0.834 POPTA			AZILZ	9140-0197	COILIFED RF 27 NH 108	
001-				1		· · · · · · · · · · · · · · · · · · ·		
20014	1850-0728	TRANSISTURIPHP GERMANIUM 2N3988			A2101	1850-0128	TRANSISTORIPHP GERMANIUN 2N3988	A-H
OR 1-		1				1450-0111	TA ANSISTOR : GERMANIUM PNP	J->
OR 5	0683-3335	RIFXD CONP 33K OHM 58 1/44 ·		.	A2102	1850-0128	TAANSISTOR: PNP GERMANIUN 2N3988	A-H
086	0683-1035	RIFXD COMP LOK OHN 58 1/4W			A2103	1850-0111	TRANSISTORI GERMANI UN PHP	J->
ORA	0683-1035	REFXD CONP LOK DHM ST 1/4W		4	~	1050-0128 1050-0111	TRANSESTOR: PNP GERMANIUN 2N3988 TRANSESTOR: GERMANIUM PNP	A-1
9	0683-333>	RIFXD CONP 33K OHN 58 1/4W		1				J-1
D#10 D#11	0683-1045 0683-3335	RIFXD COMP 100K DHMS 58 1/4W / / / / / / / / / / / / / / / / / /			A2104	1050-0120	TRANSISTOR: PNP GERMANIUN 2N3988	
	0003-3333	NTTAL GUAR JAN UNN JA 1/98			A2105	1850-0113 1850-0145	TRANSISTOR: GERMANIUM PNP TRANSISTOR: GERMANIUM PNP	A-1
			1 1	ļ	A2107	1050-0113	TRANSESTORIGERMANIUM PNP	J-)
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Section V

Table 5-1. Reference Designation Index (Cont'd)

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Table 5.1	Defenses	Thesianation	Tend and	AC and the
Table 5-1 .	Trates and a	TAGE TETRICTOR		(Cont.d)

(erence	A Beat Ma			, 		le 5-1. Reference Designation Index (Cont'd)	
arcance gnotion	Part No.	N Description #	Note	Reference Designation	Part No.	Description #	
		A21 5000-3010 (CONT'D)	A-H		1		
		5000-6575 (CONT'D)	X-L		(
		A22 9090-2111	A-E			A22 5060-2111 (CONT'D)	
	1460-0113	TRANSISTOR: GERMANIUM PNP					
9 }	1850-0113 1850-0113	TRANSISTORIGERMANIUM PNP		A22CR13	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	
/ (<u> </u>	A22CR14	1901-0025	DIDDE:SILICON 100WV 100MA	
1 ((0683-1535	REFXD COMP 15K OHN 5% 1/4W	А-н [A22CR15	1910-0016	DIODE:GERNANIUN 100MA AT 0.85V 60PIV	
	0683-2435	RIFXD COMP 24K OHM 58 1/4W	J-X	A22CR16 A22CR18	1901-0025 1901-0025	DIODE:SILICON 100WV 100MA DIODE:SILICON 100WV 100MA	
	0407-1476					DIGELISTEICON LOURS LOURA	
2	0683-1635 0683-1835	KIFXD COMP 16K OHM 5% 1/4W RIFXD COMP 16K OHM 5% 1/4W	A-H J-X	A22CR19	1901-0025	DIODE:SILICON 100WV 100MA	
3	0483-3025	R: FXD COMP 3000 OHM 58 1/4W	A-H	A22CR20	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	
	0683-1635	RIFXD COMP LOK ONN 58 1/4W	X-t	A22CR21- A22CR35	1001-0035		
	./			A22CR35	1901-0025 1910-0016	DIODE:SILICON 100WV 100MA DIODE:Germanium 100ma at 0.85v 60piv	
	9683-1835	RIFXD COMP 18K OHM 5% 1/4W Rifxd Comp 15k ohm 5% 1/4W					
5	(°0683-1535 0683-2435	RIFKD COMP 15K LINN 5% 174W	A-H J-X	A22CR37	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	
5	068 3-30 25	R:FXD COMP 3000 OHM 58 1/4W	A-H	A22CR38	1901-0025	DIODE:SILICON 100WV 100MA	
	0403-1435	RIFXD COMP 16K ONN 58 1/4W	J-X	A22CR39~, A22CR40	1901-0025 1910-0016	DIODEISILICON LOOMA	
				A22CR40	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV Diode:Germanium 100Ma at 0.85V 60PIV	
ן ז	0683-1635	RIFXD COMP 16K ONN 58 1/4W	A-H		VVLV	ATTACASCUMUTOU TOALW MI 01034 DALTA	
. 1	0683-1835 0683-3335	RIFXD COMP 18K DHM 5% 1/4W RIFXD COMP 33K DHM 5% 1/4W	X-L	A22CR42	1901-0025	DIODE:SILICON LOONV LOOMA	
	0483-1235	RIFXD COMP 12K OHN 5% 1/4W	А-Н	A22CR43	1901-0025	DIODE:SILICON 100WV 100MA	
_	0483-1835	RIFXD COMP 18K OHM 58 1/4W	\ J-X	A22CR44	1901-0025	DIODE:SILICON 100WV 100MA	
				A2201-		L.	
10 🦿 🛔	0683-1335 0683-2035	R:FXD COMP 13K OHM 58 1/4H R:FXD COMP 20K OHM 58 1/4H	H-A J-X	A2209	1850-0128	TRANSISTOR: PNP GERMANIUM	
	0683-3025	RIFKD COMP 200 OHM 58 1/4W	0-X A-H				
	068331835	REFXD COMP 18K OHM 58 1/4W	J-X	A22R1	0683-3335	R#FXD COMP 33K OHM 5% 1/4W	
12	0689 3515	RIFXD COMP 330 OHN 58 LW		A2282	0683-1045	R#FXD COMP 100K OHMS 5% 1/4W	
				A22R3	0683-1835	RIFXD COMP 100K OHM 5% 1/4W RIFXD COMP 18K OHM 5% 1/4W	
13	0683-1035 0683-1035	R:FXD COMP 10K OHM 52 1/4W R:FXD COMP 10K OHM 52 1/4W		A22R4	0683-1835	RIFXD COMP 18K OHM 58 1/4W	
• •	0757-0948	RIFAD COMP TOK ONN 2% 1/4W	H–A X–L	A22R5	0683-3335	RIFXD COMP 33K OHM 58 1/4W	
15	0483-1835	RIFXD COMP 18K OHN 58 1/4W	A-H	A22R6	0683-1835	RIFXD COMP 18K OHM 58 1/4W	
	0757-0950	R:FXD FLM 12K OHN 28 1/6W	J-X	A22R7	0683-1045	RIFXD COMP 100K OHMS 5% 1/4W	
	AAA2-3734	R: FXD COMP 2700 DHM 5% 1/4W		A22R8	0683-1835	RIFXD COMP 18K OHN 5% 1/4W	
16	0683-2725 0757-0948	RIFXD CUMP 2700 UNA 3V 174W RIFXD FLM 10K ONN 28 1/8W	H-A X-L	AZZR9	0683-3335	R:FXD COMP 33K OHM 5% 1/4W	
וז'	0683-1835	RIFXD COMP 18K CHM 5% 1/4W		A22R10	0683-1045	RIFXD CONP 100K CHMS 5% 1/4W	
20	0683-4735	RIFXD COMP 47K OHN 58 1/4W		A22R11	0683-4725	R: FXD COMP 4700 OHM 58 1/4W	
21	0683-4735	RIFXD COMP 47K OHM 58 1/4W		A22R12	0683-3335	R#FXD COMP 33K OHM 5% 1/4W	
22	0683-1045	RIFXD COMP 100K OHMS 53 1/4W		A22R13	0683-1835	RIFXD COMP 18K OHM 5% 1/4W	
22	0683-1045	RIFXD COMP LOOK UNNS 54 174W RIFXD COMP 47K OHM 52 1/4W		A22R 14	0683-1835	RIFXD CONP 18K OHM 5% 1/4W	
24	0683-1045	RIFXD CONP LOOK DHAS 58 1/4W		A22R15	0683-3335	RIFXD COMP 33K OHM 5% 1/4W	
5	0683-1045	RIFXD COMP LOOK OHMS 5% 1/4W		A2 2R 16	0683-1045	RIFXD COMP 100K OHMS 58 1/4W	
				A22817	0683-4725	R=FXD COMP 4700 OHN 53 1/4W	
	5080-2111	LOGIC CARD	A-E	A22R18	0683-3335	RIFXD COMP 33K OHM 5% 1/4W	
	1901-0025	DIDDE:SILICON LOONV LOOMA	1	A22R19	0683-1835	R:FXD COMP 18K OHN 5% 1/4W	
·• P			1 1	A22R20	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
2	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV		A22R21	0683-1045	RIFXD COMP LOOK OHMS 58 174W	
3-				A22822-			
6	1901-0025 1910-0016	DIODE:SILICON 100NV 100NA Diode:Germanium 100NA at 0.85V 60PIV		A22R30	0683-3335	REFXD COMP 33K OHM 5% 1/4W	
	141040010	APPRESENTATION TAANA VI APOJA DALTA	1 1	A22R31	0683-1045	REFXD COMP LOOK OHMS 58 1/4W	
12	1901-0025	DIDDE:SILICON 100WV 100MA		A22R32 A22R39	0683-1045	REFXD COMP LOOK OHMS 58 1/4W	
1	. pro m			ACCR37	0683-3335	RIFXD COMP 33K OHN 58 174W	
	<i>e</i>						
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Section V

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Reference Designation	Part No.	Description #	Nets	Design
		A22 5080-5810	F-X	
A22	5080-5610	LOGIC CARD		A22821 A22822
A22CR1-			F-X	A22823
AZZCR6	1901-0081	DIODE:SILICON 50 VOLTS WORKING		A22R24 A22R25
A22CR9	1901-0081	UIODE+SILICON 50 VOLTS WORKING		A22826
A22CR10	1901-0081	DIGDE:SILICON 50 VOLTS WORKING		A228.27
A22CR12	1901-0081	DIODE:SILICON 50 VOLTS WORKING	1 1	A22828
A22CR13 A22CR15	1901-0081 1901-0081	DIODE:SILICON 50 VOLTS WORKING DIODE:SILICON 50 VOLTS WORKING		A22829 A22830
A22CR16	1901-0081	DIDDE:SILICON 50 VOLTS NORKING		A22R31
A22CR17	1901-0081	DIODE:SILICON 50 VOLTS WORKING	1	A22832
A22CR18	1901-0081	DIDDE:SILICON 50 VOLTS WORKING		A22R33
A22CR23	1901-00#1	DIQUE:SILICON 50 VOLTS WORKING		A22834
A22CR25	1901-0081	DIÓDÉ:SILICON 50 VOLTS WORKING		A22835
A22CR27	1901-0081	DIODEISILICON SU VOLTS NORKING		A22836
A22CR28 A22CR35	1901-0081 1901-0001	DIODE:SILICON 50 VOLTS NORKING		A22R37
A22CR36	1901-0081	DIODE:SILICON 50 VOLTS WORKING DIODE:SILICON 50 VOLTS WORKING		A22R38 A22R39
A22CR37	1901-0081	DIODE:SILICON SO WOLTS WORKING		A22840
A22CR38	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV		A22841
A22CR39	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV		A22842
22CR40-				A22843
A22CR47 A22CR50-	1901-0081	DIODE:SILICON 50 VOLTS WORKING		A22R44
22CR54	1901-0081	DIODE:SILICON 50 VOLTS WORKING		AZZR45
2201-	,			A22846
N2201- N22014	1850-0111	TRANSISTOR: GERMANIUM PNP		A22R47 A22R48
			1 1	A22R49
A22R1	0683-1835	RIFXD COMP 18K OHM 58 1/4W		AZZR50
22R2	0683-3335	KIFXD COMP 33K OHM 58 1/4H		A22851
2283	0683-1535	RIFXD COMP 15K OHM 58 1/4W		A22852
2284	0683-1835	RIFXD COMP 18K OHN 5% 1/4W		A22R53
22R6	0683-3335 0683-1535	RIFXD COMP 33K OHM 5% 1/4W RIFXD COMP 15K OHM 5% 1/4W		A22R54 A22R55
22R7	0683-1835	R:FXD COMP 18K ONN 58 1/4H		A22856
22R8	0683-3335	RIFXD COMP 33K OHN 58 1/4H		A22857
2289	0683-1535	RIFXD COMP 15K OHN 5% 1/4H		A22850
22R10	0683-1835	RIFXD COMP 18K OHM 5% 1/4H	1 1	· ·
22R11	0683-3335	R: FXD COMP 33K OHM 58 1/4W		A2 2W 1- A2 2W4
22R12	0683-1535	RIFXD COMP 15K OHM 58 1/4W		
22R13	0757-0946	RIFXD FLM B.2K OHM 2% 1/8W		
22#14 22#15	0757-0950 0757-0944	R:FXD FLM 12K OHM 2% 1/8W R:FXD FLM 6.8K OHM 2% 1/8W		
22R16	0683-1835	RIFXD COMP 18K OHM 58 1/4W		
22817	0683-5625	R: FXD COMP 5600 DHM 58 1/4W		
22R18	0683-1035	RIFXD COMP 10K CHM 58 1/4W		
22R19	0683-1835	RIFXD COMP 18K OHM 52 1/4W		
22R20	0683-5625	R:FXD COMP 5600 CHM 58 1/4W		
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Table 5-1. Reference Designation Index (Cont'd)

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State 5-1. Reference Designation Index (Cont.d)				
Part No.	Description #	Note		
	A22 5000-0610 (CONT'D)	F-X		
0683-1035	RIFXD COMP 10K CHM 58 1/4W			
0683-1835	RIFXD COMP 18K OHM 58 1/4W			
0683-5625 0683-1035	R:FXD COMP 5600 CHM 52 1/4W R:FXD COMP 10K CHM 52 1/4W			
0683-1835	RIFID COMP 18K CHM 58 1/4W			
0483-5625	RIFXD COMP 5600 CHM 58 1/4W			
0683-1035	RIFXD COMP LOK OWN SE 1/4W			
0683-2435 6683-4725	R: FXD COMP 24K ONN 53 1/4W R: FXD COMP 4700 ONN 53 1/4W			
0683-1335	RIFXD COMP 13K CHM 5% 1/4W	1		
0683-3335	AT FXD CONP 33K CHM 58 1/4W	1		
0683-3335 0683-1535	R: FXD COMP 33K OHM 58 1/4W R: FXD COMP 15K OHM 58 1/4W			
0483-9135	A:FXD COMP 91K ONN 58 1/4W			
0683-1535	RIFXD COMP 15K CHM 5% 1/4W			
0683-9135	REFED CONP 91K OWN 58 1/4W	,		
0683-1535 0683-9135	R:FXD COMP 15K ONM 5% 1/4W R:FXD COMP 91K ONM 5% 1/4W			
0683-1535	AFFXD COMP 15K DNM 58 1/4W			
0683-9135	RIFXD COMP 91K OHN 58 1/4W			
0483-1535	A: FXD COMP 15K OHM 58 1/4W			
0683-9135 0683-1535	R:FXD COMP 91K (MM 53 1/4W R:FXD COMP 15K (MM 58 1/4W			
0483-9135	RIFXD COMP 91K OWN 58 1/4W			
0483-1535	R: FXD CONP 15K ONN 5E 1/4W			
0683-9135	RIFXD COMP 91K OHM 52 1/4W			
0483-3335 0683-2045	R:FXD COMP 33K OHM 58 1/44 R:FXD COMP 200K OHM 58 1/44			
0683-3335	R:FXD COMP 33K ONN 58 1/4W			
068 3-2045	REFXD COMP 200K CHH 58 1/4W			
0683-3335 0683-2045	RIFXD COMP 33K CHM 58 1/4W			
0683-3335	R:FXD COMP 200K CHM 58 1/44 R:FXD COMP 33K CHM 58 1/44			
068 3-2045	RIFXD COMP 200K CHM 58 1/4W			
0483-3335	R: FXD CONP 33K OHM 52 1/4M			
0683-3335	RIFXD CONP 33K OHH 58 1/4W			
0683-3335 0683-3335	R=FXD COMP 33K OHM 5% 1/4W R=FXD COMP 33K OHM 5% 1/4W			
8159-0005	JUNPER WIRE			
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Table 5-1. Reference Designation Index (Cont'd)

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esignation	Part No.	Description #	Note		Reference Designation	Part No.	Description #	No
1				i n			A23 5060-3771 (CONT'D)	
		A23 5080-3771	А-н•				5060-5874 (CONT'D)	A-H
						1	5060-6206 (CONT'D)	J-L'
		5060-5874	J-L*	ţ				M-X
		5060-6206	M-X				A24 5060-3818 A25 5060-2018	1
3	5060-3771	AC & OHMS DELAY GATE	A-H•	Ľ.	A23R4	0683-1005	R:FXD COMP 10 0HM 5% 1/4W	
	5060-5874				A23R5	0683-1005	REFXD COMP 10 OHN 5% 1/4W	1
	-	AC & OHMS DELAY GATE	J-L*	Ľ	A23R6	0683-3335	RIFXD COMP 33K UHH 5% 1/4W	
	5060-6206	AC & OHMS DELAY GATE	M-X	li li		0683-2435	R:FXD COMP 24K OHN 5% 1/4N	A-
						0698-3161	RIFXD MET FLM 38.3K OHM 15 1/8W	J- M-
3C 1	0180-0196	CIFXD ELECT 56 UF 15VDCW		l.	A23R7	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
3C2	0140-0194	CIFXD MICA 110 PF 5%				0683-2435	RIFXD COMP 24K OHN 5% 1/4H	A-
3C 3	0140-0200	CIFXD MICA 390 PF 58		1		0757-0444	R:FXD MET FLN 12.1K OHN 1% 1/8W	- U -
SC4	0150-0121	C: FXD CER 0.1 UF +80-20% 50VDCW			A23R8	0683-4725	R: FXD COMP 4700 OHM 5% 1/4N	M-
305	0140-0200	C:FXD MICA 390 PF 5%		L.		0683-1835	RIFXD COMP 18K OHM 5% 1/4W	A-
366	0140-0194	C:FXD MICA 110 PF 5%						J-
BC7	0140-0194	CIFXD MICA 110 PF 5%		t i	A23R9	0757-0446 0683-4735	R:FXD MET FLM 15.0K DHM 1% 1/8W R:FXD CDMP 47K DHM 5% 1/4W	M-
C8	0180-0291	C = FXD ELECT 1UF 10% 35VDCW			A23R10	0683-4725	R:FXD COMP 4700 DHM 5% 1/4W	
					A23R11	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
CR1-				l.	A23R12	0761-0027	RIFXD MET FLM 2.7K DHM 5% 1W	1
BCR4	1910-0016	DIODE:GERMANIUM LOOMA AT 0.85V 60PIV			A23R13	NSN	FACTORY SELECTED PART	
CR5	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	А-Н		A23814	0683-2705	R#FXD COMP 27 UHM 58 1/4W	
	1901-0081	DIQUE:SILICON 50 VOLTS NORKING	J-L		A23R15	0683-5625	P:FXD COMP 5.6K OHM 5% 1/4W	Α-
1	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	M-X			0761-0027	RIFXD MET FLM 2.7K UHM 5% IN	-A -L
CR6	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	A-H		A23R16	0683-2235	RIFXD COMP 22K DHM 5% 1/4W	J-
	1901-0081	DIODE:SILICON 50 VOLTS WORKING			A23R17	0683-4725	RIFXD COMP 4700 DHM 5% 1/4W	
	1910-0016	DIODE:GERMANIUM 100MA AT 0.859 60PIV	M-X		A23R18	0683-2735	RIFXD COMP 27K OHN 5% 1/4N	
R7	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	А-Н	3	A23R19	0683-4735	RIFXD COMP 47K OHM 5% 1/4W	
	1901-0081	DIODE:SILICON 50 VOLTS WORKING	J-L	¥	A23R20	0683-4725	R: FXD COMP 4700 DHM 5% 1/4W	1
	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	M-X	1	A23R21	0683-2235	R: FXD COMP 22K OHM 5% 1/4W	i i
CR8	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV			A23R22	0683-5625	K: FXD COMP 5600 OHM 58 1/4W	
R9	1901-0061	DIODE:SILICON			A23R23	0683-5625	R: FXD COMP 5600 OHM 5% 1/4W	
CRIO	1901-0081	DIODEISILICON 50 VOLTS WORKING			A23R24	0683-8225	KIFXD COMP 8200 OHMS 5% 1/4W	
	1701 0001	DEGDE STETCON JO VOETS WORKING		-	A23R25	0683-4725	RIFXD COMP 4700 OHM 5% 1/4W	
Q1	1851-0024	TRANSISTOR:GERMANIUM NPN			A23R26	0683-2705	R: FXD CONP 27 OHN 5% 1/4W	
92	1850-0111	TRANSISTOR: GERMANIUM PNP	A-L					
	1853-0008	TRANSISTOR: SILICON PNP						
93	1850-0111	TRANSISTOR: GERMANIUM PNP	M-X					ļ
G4	1850-0113	TRANSISTOR: GERMANIUM PNP		ł				
95	1851-0006	TRANSISTOR: 2N169A NPN			A24	5060-3818	UNITS DISPLAY ASSY	
Q6	1850-0111	TRANSISTOR: GERMANIUM PNP			A24051-		· • • • • • • • • • • • • • • • • • • •	
57	1850-0113	TRANSISTOR: GERMANIUM PNP			A24D512	2140-0037	LAMP: INCANDESCENT 0.04A 28V	
81	0683-3335	R#FXD COMP 33K OHM 5% 1/4W	А-Н		A25	5060-2018	ATTENUATION CONTROL	ļ
	0683-2435	RIFXD COMP 24K OHM 5% 1/4W	J-X		A25C1	0140-0200	C:FXD MICA 390 PF 58	
R2	0683-4735	R#FXD COMP 47K OHM 5% 1/4W	А-Н					
R3	0683-4335 0686-5135	R±FXD COMP 43K OHM 5% 1/4W R±FXD Comp 51k ohm 5% 1/2W	J-X		A25C2	0170-0038	C:FXD MY 0.22 UF 10% 200VDCW	
	0000-7137	KITAD CUHF JIK UHH J4 1728			A25R1	2100-0273	R:VAR COMP 3 MEGOHM 208 5 CCWLOG 1/4W	
) (A25R2	0683-1035	RIFXD COMP 10K UNN 5% 1/4W	1
					A25R3	0683-1035	RIFXD COMP LOK OHM 58 1/4W	
					A2558		SWITCH:DPST (PART OF RL)	
		/~ (f			•			
		•5060-6206 MAY REPLACE 5060-3771		ł				
		UR 5060-5874.		t.				
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Table 5-1.	Reference	Designation	Index	(Cont'd)
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Reference Designation	Part No.	Description #	Note	I.	Reference Designation	Part No.	Description #	N
							A26 05232-6007 (CONT'D)	Т
		A26 05214-6014	A-5				A27 5060-5016	
		05232-6007	T-X			·	02532-6006	7
28	05214-6014	INPUT AMPLIFIER	A-8	-				
					A26R7	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
26C1	0180-0039	C:FXD ELECT 100UF 12VDCW			A2688 A2689	0683-2225 0683-3315	R=FXD COMP 2.2K OHM 5% 1/4W R:FXD COMP 330 OHM 5% 1/4W	
2462					A26R10	0683-1525	REFAD COMP 1500 DHM 5% 1/4W	
26C2 26C3	0140-0198	CIFXD NICA 200 PF 58			A26R11	0683-1025	R: FXD COMP 1000 DHM 5% 1/4W	
26C4	0180-0063 0140-0152	C:FXD ELECT 500UF -108+1008 3VDCH						
2465	0180-0050	C:FXD MICA 1000 PF 5% 300VDCW C:FXD ELECT 40 UF +75-10% 50VDCW			A26R12	0683-1835	RIFXD COMP 18K OHM 5% 1/4W	
					A26P13	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
26CR1	1902-0199	DIQDE:BREAKDOWN 8.8/10.8V 100MW			A27	5080-5016	SCHWITT TRICCED	
26L1	9140-0027	COIL:FXD RF 35 UH					SCHMITT TRIGGER	A
2691	1854-0003	TRANSISTOR: NPN SILICON			A27C1	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
2692	1850-0037	TRANSISTOR # GERMANIUM			A27C2	0140-0199	CIFXD MICA 240 PF 58	1
2693	1850-0037	TRANSISION: GERHANIUM			A27C3	0140-0156	CIFXD MICA 1500 PF 2%	
					A27C4	0150-0121	C*FXD CER 0-1 UF +80-20% 50VDCW	
26R 1	0683-6835	RIFXD COMP 68K CHM 5% 1/4W			A27CR1	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	
26R2 26R3	0683-1845 0683-3335	R:FXD COMP 180K OHM 5% 1/4W R:FXD Comp 33k ohm 5% 1/4W			A27CR2	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	
26R4	0683-1545	R: FXD COMP 150K OHM 58 1/4W			A2701	1850-0111	TRANSISTOR: GERMANIUM PNP	
26R5 26R6	0683-2235 0683-3935	R:FXD COMP 22K OHM 58 1/4W R:FXD Comp 39k ohm 58 1/4W			A27Q2	1850-0111	TRANSISTOR: GERMANIUM PNP	
2687	0683-2725	R: FXD COMP 2700 CHM 53 1/4W						
26R8	0683-6225	R: FXD COMP 6200 OHM 5% 1/4W			A27R1	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
26R9	0683-6815	R:FXD COMP 680 OHN 5% 1/4W			A2782	0683-8215	R:FXD COMP 820 DHM 5% 1/4W	
26R10	0683-1515	R: FXD COMP 150 OHM 52 1/4W			A27R3	2100-0154	REVAR COMP 1K OHM 30% LIN 0.15W	
26R11	0683-1835	RIFXD COMP 18K OHM 5% 1/4W			A27R4	0686-5625	R:FXD COMP 5600 OHM 5% 1/2W	
26R12	0683-1025	R=FXD COMP 1000 DHM 5% 1/4W	1 1		A2785	0683-5625	R: FXD COMP 5600 OHM 5% 1/4W	
268 13	0683-4735	RIFXD COMP 47K OHN 5% 1/4W			A27R6	0683-2225	R:FXD COMP 2.2K OHM 5% 1/4W	
26	05232-0007	INPUT AMPLIFIER			A27R7	0761-0024	R:FXD MET DX 2.4 OHM 5% LW	
-			T-X		A2789	0683-2235	RIFXD COMP 22K OHM 58 1/4W	
14C1	0180-0039	C:FXD ELECT 100UF 12VDCW			A27R10	0683-2705	KIFXD COMP 27 OHM 5% 1/4W	
6C2	0180-0124	C:FXD ELECT 200UF 6VDCW			A27	05232-6006	INPUT TRIGGER	Т-,
6C3	0180-0104	CIFXD ELECT 2000F 15VDCN	1 1		A27C1	0180-0094	CIFXD ELECT 100UF 25VDCW	
6C4	0180-0050	C:FXD ELECT 40 UF +75-108 50VDCW				0100 0074		
6C5 6C6	0150-0121 0140-0177	C:FXD CER 0.1 UF +80-203 50VDCW C:FXD MICA 400 PF 13			A27C2	0140-0203	CIFXD MICA 30 PF 5%	
6CR1	1910-0011				A27CR1	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	
	_	DIODE:GERMANIUN SMA AT 1V			A27CR3	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	
691	1854-0003	TRANSISTOR:NPN SILICON			A27L1	9140-0112	COIL:FXD RF 4.7 UH	
6Q2 6Q3	1853-0009	TRANSISTOR: SILICON PNP					4	
694	1853-0009	TRANSISTOR:SILICON PNP TRANSISTOR:SILICON PNP			A27Q1	1853-0009	TRANSISTOR: SILICON PNP	
6R1	0683-2735	R#FXD COMP 27K OHN 5% 1/48			A27Q2 A27Q3	1853-0009 1853-0009	TRANSISTOR:SILICON PNP TRANSISTOR:SILICON PNP	
JR 2	0683-1025	R: FXD COMP 1000 DHM 53 1/4M						\$1. % _
6R3	068 3-2735	RIFXD COMP 27K OHM 58 1/4W			A27R1	0683-3315	KIFXD COMP 330 OHM 5% 1/4W	
684	0683-6225	R:FXD COMP 6200 DHN 5% 1/4W						
6R5	0683-1815	R:FXD COMP 180 OHM 58 1/4W						
6R6	0683-1025	RIFXD COMP 1000 DHH 5% 1/4H			1	·		
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Table 5-1.	Reference	Designation	Index	(Cont'd)
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le erence esignation	Part No.	Description #	Note	1	Reference Designation	Part No.	- Description #	
	1	A27 05232-0008 (CONT'D) A29 5060-3805 A30 5060-2108 5060-5875 5060-6203	T-X A-H* J-L* M-X				-A30 5060-2108 (CONT'D) 5060-5875 (CONT'D) 5060-6203 (CONT'D)	L L M
7R2 7R3 7R4	2100-0355 0683-1535 0 <b>758-</b> 0042	R:VAR COMP 2000 DHM 20% LIN 1/8W R:FXD COMP 15K OHM 5% 1/4W R:FXD MET 0X 1300 OHM 5% 1/2W		!	A3065- A30913	1850-0125	TRANSISTOR: PNP GERMANIUM	4
7R5 7R6	0683-9105 0683-7525	R: FXD COMP 91 OHM 5% 1/4W R: FXD COMP 7500 OHM 5% 1/4W			A30R 1	0683-2235	RIFXD COMP 22K OHM 5% 1/4W	~
7R7 7R8 7R9	0683-1225 0758-0003 0758-0042	R:FXD COMP 1200 OHM 5% 1/4W R:FXD MET DX 1000 OHM 5% 1/2W K:FXD MET DX 1300 OHM 5% 1/2W	•	,	A3OR2	0683-2435 0683-1835 0683-4335 ~\0683-3625	R:FXD COMP 24K OHM 5% 1/4W R:FXD COMP 18K OHM 5% 1/4W R:FXD COMP 43K OHM 5% 1/4W R:FXD COMP 3600 OHM 5% 1/4W	א נ א
9		And an an and a second s		1		0683-2435	REFXD COMP 24K OHN 5% 1/4W	
901	<b>5080-3805</b> 0180-0363	+6V BIAS SUPPLY			A30R4	0683-1835 0698-3161	R:FXD COMP 18K OHM 5% 1/4W R:FXD MET FLM 38.3K OHM 1% 1/8W	A
962	0180-0137	L:FXD ELECT 150UF -10+100% 30VDCH C:FXD ELECT 100 UF 20% 10VDCW			A30R5	0683-1235 0757-0442	R:FXD COMP 12K OHN 5% 1/4W R:FXD Met Flm 10.0K ohn 1% 1/8W	A
903	0140-0367	C: FXD ELECT 20UF -10+758 200VDCW			* A30R6	0683-3025	R#FXD COMP 3000 OHN 5% 1/4W	<u>م</u>
PCR1	1901-0026	DIODE:SILICON 0.75A 200 PIV				0683-2035 0757-0446	RIFXD COMP ZOK OHM 5% 1/4W RIFXD MET FLM 15.0K OHM 1% 1/8W	/ J M
PCR2 PCR3	1901-0026 1902-3117 1902-3119	DIODE:SILICON 0.75A 200 PIV DIODE:BREAKDOWN 28 6.34V DIODE:BREAKDOWN:6.49V 28	A-R		A30R7 .	0683-2015 0683-2435 0698-3162	RIFXD COMP 20K OHM 5% 1/4W RIFXD COMP 24K OHM 5% 1/4W RIFXD MET FLM 46.4K OHM 1% 1/8W	A J M
DCR4 DCR5	1901-0029 1901-0029	DIODE:SILICON 600 PIV DIODE:SILICON 600 PIV	S-X		A30R8 A30R9	0683-1835 0683- <b>18</b> 35	R:FXD COMP 18K OHM 5% 1/4W R:FXD COMP 10K OHM 5% 1/4W	
01	1854-0039	TRANSISTOR: SILICON				0683-1235 0757-0748	RIFXD COMP 12K OHM 5% 1/4W RIFXD MET FLM 5.62K OHM 1% 1/4W	J
RL	068 3-0565	RIFXD CONP 5.6 OHN 52 1/4W			A30R10	0683-2725 0683-1535	R = FXD CONP 2700 OHM 5% 1/4W R = FXD CONP 15K OHM 5% 1/4W	A
R2 R3	0757-1078 0683-4745	R:FXD MET FLM 1.47K DHM 18 1/2W R:FXD COMP 470K DHM 58 1/4W	1		ABOR11	0693-3359 0683-1835 0683-4335	R:FXD MET FLM 12.7K 18 1/8W R:FXD COMP 18K OHM 5% 1/4W R:FXD COMP 43K OHM 5% 1/4W	U M U
	5080-2108	HP 2411A DECIMAL POINT LOGIC	A-H*		A30R12	0683-3625	RIFXD COMP 3600 OHM 5% 1/4W	~ M
	5080-5875 5080-6203	HP 2411Á DECIMAL POINT LOGIC HP 2411A DECIMAL POINT LOGIC	J-L* M-X		A30R13 A30R14	0683-2435 0683-6835 0683-3335	RIFXD COMP 24K OHN 5% 1/4W RIFXD COMP 68K OHN 5% 1/4W RIFXD COMP 33K OHN 5% 1/4W	A J
CR1- CR15	1910-0016	DIQUE:GERMANIUN 100MA AT 0.85V 60PIV			A30R 15	0683-6835	RIFXD COMP 68K OHM 58 1/4W	
01	1850-0128 1850-0111	TRANSISTOR: PNP GERMANIUM TRANSISTOR: GERMANIUM PNP	A-H J-L		A30R16 A30R17 A30R18	0683-3335 0683-6835 0683-6835	R#FXD COMP 33K DHM 5% 1/4W R#FXD Comp 68k ohm 5% 1/4W R#FXD Comp 68k ohm 5% 1/4W	
2	1853-0008 1850-0128 . 1850-0111	TRANSISTOR:SILICON PNP TRANSISTOR:PNP GERMANIUM TRANSISTOR:GERMANIUM PNP	M-X A-H		A30R19 A30R20		RIFAD COMP 68K OHM 5% 174W Sy RIFXD COMP 33K OHM 5% 174W 4 19	
	1853-0008	TRANSISTOR: SILICON, PNP	J-L M-X		A30R21 A30R22	0683-6835 0683-6835	RIFXD COMP 68K OHM 5% 1/4W RIFXD COMP 68K OHM 5% 1/4W	
3	1850-0128 1850-0111	TRANSISTOR: PNP GERMANIUM TRANSISTOR: GERMANIUM PNP	A-H J-L		A30R23 A30R24	0683-3335 0683-6835	R‡FXD COMP 33K OHM 5% 1/4W R‡FXD Comp 68k ohm 5% 1/4W	
4	1853-0007 1850-0128 1850-0111 1853-0008	TRANSISTOR:SILICON PNP TRANSISTOR:PNP GERNANIUM TRANSISTOR:GERMANIUM PNP	M-X A-H J-L		A308 29.	0683-6835	RIEXD COMP 68K OHN 5% 1/4W	<b>ר</b> :
	7923-AAA4	TRANSISTOR: SILICON PNP	′ M-X				A	
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		#5060-6203 MAY REPLACE 5060-2108 DK 5060-5875.					1	

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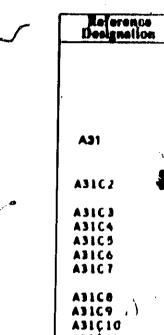
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A31	5060-3848	OPERATIONAL AMPLIFIER				A31L2
1	6060-6146	OPERATIONAL AMPLIFIER		B-X 1 -		ASIP29
A31C2	0150-0021	CAMP TE NERK O ATRE AN ADDING				
	0150-0021	CIFED IT DIOK 0.47PF 58 500VDCW				A31P30
AJICJ	0160-0961	CIFXD POLY 0.0270F 208 SOVDCW				
A31C4	0140-0136	CIFKD NICA 1500 PF 28			· .	A3101
AJICS	0100-0193	CIFAD HICK 1900 FF 24 CIFAD ELECT 20 UF LOVDCH		í - '	<b>~•</b> • •	
AJICO	0160-0194	CIFXD ELECT 56 UF LISVICH	5			A3192
A31C7	0180-0210	CIFKO ELECT 3.3 UF 201 15VOCK		7		A31Q3
						A31Q4
A31C0	0180-0365	CIFXO TA 22UF 108 15VDCW				A31Q5-
A31C9 ()	0160-0970	CIFXD NY 0.4TUF LOE BOVDCH				A31Q9
A31Ç10	0170-0064	CIFXD NY 0.027UF 108 200VDCW	1			
A31C11	0180-0159	CIFXD ELECT 220 UF 108 10VDCW				A31010
A31C12	0160-0378	CIFXD NICA 27PF 5%	/ . • •			A3 [Q11
		.At	•			A31012
A31C13	0160-0137	CIFXD ELECT 100 UF 20% LOVDCW				A31013
A31C14	0160-0137	CIFKD BLECT TOO LA 201 LOVDCH				A31Q14
A31C15	0150-0121	CIFXD CER 0.1 UF +80-208 SOVDEN	フ・			
A31C16	0180-0197	CIFXD BLECT 2.2 UF 1DT 20VDCW	.*	-		A31R1
A31C17	0160-0164	CIFXD NY 0.039 UF 108 200VDCW				A3182
	•	· ·				A3183 #
AJICIO	0150-0121	CIFXD CER 0.1 UF +80-201 50V0CW				A31R4
A31C19	0140-0145 +	CIFXD NICA 22 PF 58	▲			A3185
A31C20	, 0140-0194	CIFXD HICA 110 PF 38	•	I		A3186
A31C21	0140-0194	CIFXD MICA LLO PF 5%	٣			43140
A31C22	0160-0960	CIFXD POLY 0.27 UF 208 30VOCW				A3187
A3LC23	0160-0378	CIFXD MICA 27PF 51		1		A3168
A31C24	0150-0121	CIFRD CER 0.1. UF +80-201 SOVOCH		-		AJIR9
A31C25	0160-0268	CIFXD PORC 110 PF. 5% SOOVDCW				A31810
A31C27	080	FACTORY SELECTED PART		ļ		A31811
A31C28	060	SELECTED IN CONJUNCTION WITH C27				3
		,				Å31812
A31C29	0180-0079	LIFXD ELECT JOUR -15+20% 60V0CW		8-X		A31813
			Ŧ		-	A31814
A31CA1- 7	<b>A</b>					A31815
AJICA4	<b>19</b> 01-0156	DIQUEISTLICON	•			A31R16
431085					1	
A31CR5	1901-0025	DIODELSILICON LOOWY LOONA		1	1	A31818
A31CR6 A31CR7	1901-0025	DIODE SILICON LOOWY LOONA	,			A31819
ASICAN	1901-0025 1901-0156	DIODEISILICON LOOWV 100MA				AJIR20
AJICR9		DI ODE I SILICON				<b>A</b> 1833
	1901-0156	DIODE#SILICON .	· · · · · · · · · · · · · · · · · · ·			
AJICRIO	1902-0096	DI ODE I AVALANCHE 6.2V		· [	ļ	• • /
AJICALI	1902-0096	DI ODETAVALANCHE 6.2V			1	A31823
A31CA12	1901-0025	DI ODEI SILICON 100WV 100MA		Í	4	A31826
ABICRIS	1901-0025	DIODEISILICON LOONV LOONA	•			A31827
AJICA14	1901-0025	DI ODE I SILICON LOONV LOONA	1	1	1	A31R28
-						
A31CR15	1901-0025	DIODE SILICON LOONA		ĺ		A31829
A31CR16	1902-0770	DI ODE+BREAKDOWN SILICON	• · · · · · · · · · · · · · · · · · · ·	· ·	, I	A31830
A31CR17	1902-0770	DI ODE I BREAKDOWN SILLCON		1	` <b>6</b>	AJIRJI
					-	A31832
A31L1	9140-0002	CUILIFXD RF 15 UH - "	$\sim \sim 1$	1		A31833
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Table 5-1. Reference Designation Index (Cont'd)

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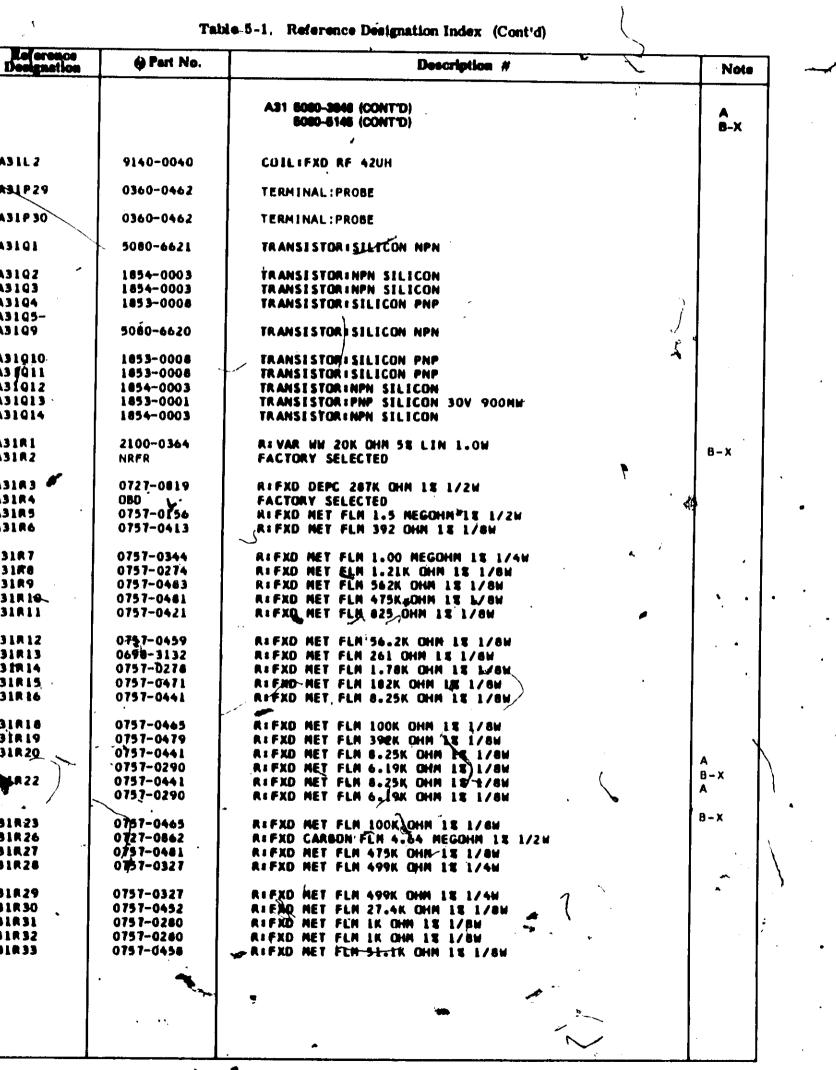
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Reference Designation	Part No.	Description #	Note	Le erence Designation	🕒 Part No.	Description #		N
		A31 5010-3848 (CONT'D) 5080-5145 (CONT'D)	A			A32 5080-5001	۵ 🍐	1
31R34 31R35	0698-0043	₩ R:FXD MET FLM 1.96K DHM 18 1/8W						
31R36	0757-0403 0757-0280	RIFXD NET FLM 121 OHM 18 1/8W RIFXD NET FLM 1K OHM 18 1/8W		A32	5080-5001	NEGATIVE CHANNEL		ŀ
51R37 51R38	0757-0442 0757-0280	RIFXD HET FLM 10.0K OHM 1% 1/8W RIFXD HET FLM 1K OHM 1% 1/8W	• • •	A32P10	1251-0381	PLUGITERNINAL FEEDTHRU TEFLON	,	
1839	0698-3136	RIFXD HET FLN 17.8K DHM 18 17AM		A32R1 A32R2	NRFR NRFR	FACTORY SELECTED FACTORY SELECTED		
1R40 1R41	0757-0199 0698-0083	A:FXD MET FLM 21.5K CHM 13 1/8W R:FXD MET FLM 1.96K CHM 13 1/8W		A32R3	0698-3171	RIFXD NET FLN 10K OHN 18 0.3W		
1R42 1R43	0698-0084 0757-0413	A:FXD MET FLM 2.15K OHM 18 1/8W A:FXD MET FLM 392 OHM 18 1/8W		A32T1	NRFR	TRANSFORMER: PULSE FACTORY SELECTED		
1844	0757-0442	RIFXD MET FLM 10.0K ONM 15 1/8W		A32A1	5060-6275	AMPLIFIER PC	1	
1R45 1R46 1R47	0757-0743	RIFXD NET FLM 3.32K OHM 18 1/4W RIFXD NET FLM 464 OHM 18 1/8W		A32A1C3	0140-0176	CEFXD NICA LOO PF 28		
1848	0757-0194 0757-0992	RIFXD MET FLM 100 CHM 1,8 1/2W RIFXD MET FLM 22.1 CHM 18 1/2W		A32A1C4	0160-0158	CIFXD MYLAR 5600PF 10%		
	0698-3368	RIFXD MET FLM 14.7 DHM 18 1/2W	B-X	A32A1C5 A32A1C6	0180-0210 0160-0168	C#FXD ELECT 3.3 UF 208 15VDCW C#FXD MY 0.1 UF 108 200VDCW		
1849	0757-0992 0698-3368	A:FXD NET FLN 22.1 OHN 18 1/2W R:FXD NET FLN 14.7 OHN 18 1/2W	A B-X	A32A1C7 A32A1Ç8	0180-0388 0160-0168	CIFXD ELECT 56 UF 10% 20VDCW CIFXD MY 0.1 UF 10% 200VDCW		
1R50 1R51	0757-0198 0698-3156	RIFXD NET FLM 100 CHM 18 1/2W RIFXD NET FLM 14.7K CHM 18 1/8W		A32A1CR5	1910-0025	DIÓDE: GE 15WIV 6NS		
1R52 1R53	0757-0367	RIFXD HET FLM 27.4 DHM 18 1/6W		A32A1CR6	1901-0081	DIQUE: SILICON 50 VOLTS WORKING		
1R54 1R55	0757-0274 0757-0280	KIFXD NET FLN 1.21K OHM 18 1/6H RIFXD NET FLN 1K OHM 18 1/6H		A32A1CR7 A32A1CR9	1901-0081 1901-0081	DIODE:SILICON 50 VOLTS WORKING DIODE:STLICON 50 VOLTS WORKING		
1856	0757-0327 0757-0417	RIFXD NET FLM 499K OHM 18 1/4W AIFXD NET FLM 562 OHM 18 1/8W		AJZAIL	9140-0174	COIL +FXD RF -220 NH 58		
LW1	8159-0005	JUMPER WIRE		A32A1L2 A32A1Q3	9140-0075 - 1851-0034	COIL:FXD RF 270 UH TRANSISTOR:GERMANIUM NPN		31
W2 1	8159-0005 8159-0005	JUNPER WIRE		A3 2A 1Q4 A3 2A 1Q5	5080-6620	TRANSISTOR: SILICON NPN		•
		JUNNER WIRE		A32A106	1851-0031 1851-0034	TRANSISTOR:GERMANIUN NPN TRANSISTOR:GERMANIUM NPN	7	
				A32A1815 /	0757-0280	RIFXD MET FLM 1K OHM 18 1/8W		
	ŕ			A32A1R16 A32A1R17	0757-1102	R:FXD MET FLN 180 DHN 18 1/80 R:FXD MET FLN 100 DHN 18 1/20		
Í				A32A1R10 A32A1R19	0757-0200	RIFXD HET FLH 5.62K DHN 18 1/8W RIFXD HET FLH 681 DHN 18 1/8W		
•		-		A32A1820	0757-1060	R: FXD NET FLN 196 DHN 18 1/2W		
				A32A1R21 A32A1R22	0757-0444 0757-0276	R:FXD MET FLM 12.1K OHM 1% 1/8W R# <b>FXD MET FLM 1.70K OHM 1% 1</b> /8W		
				A32A1R23 A32A1R84	0698-3136 0698-3132	AIFXD MET FLM 17.8K CHM 12 1/8W RIFXD MET FLM 261 CHM 12 1/8W		
		· · · · · · · · · · · · · · · · · · ·		A32A1825	0698-3134	A: FXD MET FLN 1.33K CHM 18 1/4W		
	-			A32A1R26 A32A1R27	0498-0085 2100-0371	REFRE MET FEN 2.61K DNN 18 1/6W REVAR WW 1K DNN 108 LEN 1/6W		
				A32A1R20 A32A1R32	0757-0731 2100-1433	. RIFXD NET FLN 025 DHN 18 1/4W RIVAR WW 100 DHN 58 3/4W		
		``		A32A1R33	NRFR	AIFXD CARBON FLN 5-40 ONN SELECTED		нн
	•	• ,			·			
						•		
		·	.   i			TNOT FIELD REPAIRABLE " REPLACES C6 IN CERTAIN APPLICATIONS	¢ ⁰	
· [		•				HH SUBSTITUTED FOR WI WHEN LZ IS USED	ľ	

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Section V

Table	5-1.	Reference	Designation	Index	(Contid)
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Table 5-1. Reference Designation Index (Cont'd)

Keierence	Part No.	Decent etc. 4					
Reference Designation	Gran AU.	Description #	Note	Reference Designation	Part No.	Description #	Note
		A32 5080-5001 (CONT'D) A33 5080-3848				A33 5060-3848 (CONT'D)	
A32A 1R34 A32A 1R35	0757-0458 0757-0438	RIFXD MET FLM 51.1K OHM 1% 1/8W RIFXD MET FLM 5.11K OHM 1% 1/8W		A33A1C8	0160-0165	C: FXD MY 0.1 UF 10% 200VDCW	
A3 2A LT 2	9130-0028	TRANSFORMER		A33A1CR5	1910-0025	DIODE: GE 15WIV 6NS	
A32A1W1 A32A2	8159-0005 <b>5060-3838</b>	JUMPER WIRE BINARY PC		A33A1CR6 A33A1CR7 A33A1CR9	1901-0081 1901-0081 1901-0081	DIODE:SILICON 50 VOLTS WORKING DIODE:SILICON 50 VOLTS WORKING DIODE:SILICON 50 VOLTS WORKING	
A32A2C1	0140-0192	CIFXD NICA 68 PF 5%		A33A1L1			
A32A2C2	0140-0192	GIFXD HICA 68 PF 58		A33A1L2	9140-0174 9140-0075	CUIL:FXD RF 220 NH 58 COIL:FXD RF 270 UF	21
A32A2CR1	1901-0081	DIODE:SILICON 50 VOLTS WORKING		A33A1Q3	1850-0111	TRANSISTOR: GERMANIUM PNP	
A32A2CR2 A32A2CR3 A32A2CR4	1901-0081 1910-0025 1910-0025	DIODE:SILICON 50 VOLTS WORKING DIODE:GE 15WIV 6NS DIODE:GE 15WIV 6NS		A33A1Q4 A33A1Q5 A33A1Q6	1853-0708 1850-0032 1850-0032	TRANSISTOR:SILICON PNP TRANSISTOR:GERMANIUM PNP 2N404 TRANSISTOR:GERMANIUM PNP 2N404	
A32A2Q1	1850-0075	TRANSISTOR: GERMANIUM PNP		A33A1R15	0757-0280	A:FXD NET FLM 1K OHM 1% 1/6W	ļ
A32A2Q2	1850-0075	TRANSISTOR: GERMANIUM PNP		A33A1R16 A33A1R17 A33A1R18	0757-1102 0757-0198 0757-0200	RIFXD MET FLM 180 DHM 18 1/8W RIFXD MET FLM 100 DHM 18 1/2W RIFXD MET FLM 5.62K DHM 18 1/8W	
A32A2R4 A32A2R5 A32A2R6	<b>2100-0738</b> NRFR NRFR	R:VAR COMP 200 OHM 10% 1W Factory Selected Factory Selected		A33A1R19 A33A1R20	0757-0816 0757-1060	KIFXD MET FLM 681 OHM 18 1/2W RIFXD MET FLM 196 OHM 18 1/2W	
A32A2R7 A32A2R8 A32A2R8 A32A2R9 A32A2R10 A32A2R11	0698-3133 0698-3133 0757-0200 0757-0200 0757-0199	R:FXD MET FLM 601 OHM 13 3/10W R:FXD MET FLM 601 OHM 13 3/10W R:FXD MET FLM 5.62K OHM 13 1/8W R:FXD MET FLM 5.62K OHM 13 1/8W R:FXD MET FLM 21.5K OHM 13 1/8W		A33A1R21 A33A4R22 A33A1R23 A33A1R23 A33A1R24 A33A1R25	0757-0444 0757-0276 0698-3136 0698-3132 0698-3134	R:FXD MET FLM 12.1K OHM 1% 1/8W R:FXD MET FLM 1.76K OHM 1% 1/8W R:FXD MET FLM 17.6K OHM 1% 1/8W R:FXD MET FLM 261 OHM 1% 1/8W R:FXD MET FLM 1.33K OHM 1% 1/4W	
A32A2R12 A32A2R13 A32A2R14 A32A2R31 A32A2R31 A32A2R36 A32A2R37	0757-0199 0757-0427 0757-0427 0698-3135 NRFR NRFR	R:FXD MET FLM 21.5K OHM 1% 1/8W R:FXD MET FLM 1500 OHM 1% 1/8W R:FXD MET FLM 1500 OHM 1% 1/8W R:FXD MET FLM 2740 OHM 1% 3/10W FACTORY SELECTED FACTORY SELECTED		A33A1R26 A33A1R27 A33A1R28 A33A1R32 A33A1R32 A33A1R33	0698-0085 2100-0371 0757-0731 2100-1433 NRFR	R:FXD MET FLM 2.61K OHM 18 1/8W R:VAR WW 1K OHM 108 LIN 1/4W R:FXD MET FLN 825 OHM 18 1/4W R:VAR WW 100 OHM 58 3/4W R:FXD CARBON FLM 5-40 OHM SELECTED IN TEST,	76 11
A33	5080-3840	POBITIVE CHANNEL	+	A33A1R34	0757-0458	R:FXD MET FLM 51.1K OHM 18 1/8W	
A33P11	1251-0301	PLUGITERMINAL FEEDTHRU TEFLON		A33A1R35	- 0757-0438	RIFXD MET FLM 5-11K OHM 18 1/8W	
A33R1 A33R2	NRFR NRFR	FACTORY SELECTED FACTORY SELECTED		<b>A33A1T2</b> A33A1W1	<b>9130-0028</b> 5950-0001	TRANSFORMER Jumper Wire	
A3383	0698-3171	RIFXD HET FLM LOK OHM 1% 0.3W		A33A2	5060-3830	BINARY PC	
A33T1	NRFR	TRANSFORMER PULSE FACTORY SELECTED		A33A2C1	0140-0192	CIFXD MICA 68 PF 5%	
A33A1	5060-6274	AMPLIFIER PC		A33A2C2	0140-0192	CIFXD MICA 68 PF 5%	
A33A1C3	0140-0176	CIFXD MICA 100 PF 28		A33A2CR1	1901-0081	DIODE:SILICON 50 VOLTS NORKING	
A33A1C4 A33A1C5 A33A1C6	0160-0158 0180-0210 0160-0168	C:FXD MYLAR 5600PF 10% C:FXD ELECT 3.3 UF 20% 15VDCH C:FXD MY 0.1 UF 10% 200VDCH		A33A2CR2 A33A2CR3 A33A2CR4	1901-0081 1910-0025 1910-9025	DIODE:SILICON 50 VOLTS WORKING DIODE:GE 15WIV 6NS DIODE:GE 15WIV 6NS	
A33A1C7	0180-0388	CIFXD ELECT 56 UF 108 20VDCW		A33A2Q1	1850-0075	TRANSISTOR: GERMANIUM PNP	
		t NOT FIELD REPAIRABLE				" REPLACES C6 IN CERTAIN APPLICATIONS "" SUBSTITUTED FOR WI WHEN L2 IS USED	

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Section V

# Table 5-1. Reference Designation Index (Cont'd)

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Table 5-1.	Reference	<b>Designation Index</b>	(Cont'd)
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Reference Designation	Part No.	Description #	Note		Reference Designation	Part No.	Description #	
		A33 5080-3949 (CONT'D) A34 5080-3782						
		A35 5080-3783				Ì	A36 5080-3783 (CONT'D)	[
33A2Q2	1850-0075	TRANSISTOR: GERMANIUM PNP			A35CR4	1901-0156	DIQUEISILICON	
33A2R4	2100-0738	REVAR COMP 200 OHN 105 1W			A35Q1	1853-0000	TRANSISTOR: SILICON PNP	
33A2R5	NRFR	FACTORY SELECTED			A35G2	1653-0008	TRANSISTORI SILICON PNP	
33A2R6	NRFR	FACTORY SELECTED			A35Q3	1853-0009	TRANSISTORISILICON PNP	
33A2R7	0698-3133	R:FXD MET FLM 681 DHM 18 3/10W			A35Q4	1854-0003	TRANSISTOR: NPN SILICON	
33A2R6	0698-3133	RIFXD NET FLM 681 OHM 13 3/10W			A35Q5	1853-0009	TRANSISTUR: SILICON PNP	
33A2R9	0757-0200	RIFXD NET FLM 5.62K OHN 18 1/8H			A35Q6	1854-0014	TRANSISTORIDUAL NPN SILICON	Ĩ
33A2R10	0757-0200	ALFXD NET FLM 5.62K OHM 18 1/8W			A35Q7	1854-0014		, ,
33A2R11	0757-0199	RIFXD NET FLM 21.5K CHM 13 1/8W		•	A3598	1854-0003	TRANSISTORIDUAL NPN SILICON	
	_	• •			A3509	1853-0001	TRANSISTOR: NPN SILICON TRANSISTOR: PNP SILICON 30V 900MW	
33A2R12	0757-0199	RIFXD NET FLM 21.5K OHN 18 1/8W			A35010	1854-0014	TRANSISTORIDUAL NPN SILICON	
33A2R13	0757-0427	A:FXD NET FLM 1500 OHM 18 1/8W			A35011	1854-0014	TRANSISTOR: DUAL NPN SILICON	
3A2R14 3A2R31	0757-0427 0698-3135	A:FXD NET FLM 1500 DHM 1% 1/6W A:FXD NET FLM 2740 DHM 1% 3/10W	1	1				
33A2R34	NRFR	FACTORY SELECTED			A35R1	0757-0433	R:FXD MET FLM 3.32K OHM 1% 1/8W	
3342437	NRFR	FACTORY SELECTED			1 A260.2	0/00 000		
					A35R2 A35R3	0698-0084	RIFXD HET FLM 2.15K OHM 18 1/8W	
	5080-3782	SERIES REGULATOR			AJJKJ	0698-0091 0811-0961	RIFXD HET FLM 825 DHM 18 1/8W	A
					A35R4	0698-0082	RIFXD WW 825 DHM 0.18 1/4W RIFXD MET FLM 464 DHM 18 1/8W	K->
463	0180-1804	C#FXD ELECT 75 UF +75-10% 40VDCW		1	A35R5	0757-0452	RIFXD HET FLM 27.4K DHM 1% 1/8W	
	0140-0164	C. END MICH 1800 DE 30					HET HET TEN LIGAN ENN 14 170W	
14C4   14C5	0140-0156 0180-1804	C:FXD MICA 1500 PF 28 C:FXD ELECT 75 UF +75-108 40VDCW		4	A35R6	0757-0442	RIFXD MET FLM 10.0K OHM 15 1/8W	1
463	0100-1004	CIFAD ELECT IS OF VISTING VOIDUN		1	A35R7	0757-0442	RIFXD HET FLN 10.0K CHN 18 1/8W	
4CR1-		· · · · · · · · · · · · · · · · · · ·		l	A35R8	0811-0961	R:FXD WW 825 OHM 0.1% 1/4W	
ACRE	1901-0081	DIODE:SILICON 50 VOLTS WORKING		4	A35R9 A35R10	2100-1420	RI VAR WW 200 OHM 58 3/4W	
						0811-0961	RIFXD WW 825 OHM 0.1% 1/4W	
491	1854-0362	TRANSISTOR = SILICON		}	A35R11	0757-0442	RIFXD MET FLM 10.0K DHM 18 1/8W	ł
					A35R12	0811-0963	R#FXD WW 1K 0.25% 1/4W	
34Q2 34Q3	1854-0003 1854-0362	TRANSISTOR:NPN SILICON TRANSISTOR:SILICON		:	A35R13	0811-0963	RIFXD WW 1K 0.25% 1/4W	
	1034-0302	( /		1 1.	A35R14	0757-0274	RIFXD MET FLM 1.21K OHM 18 1/8W	
54R1	0698-0088	- R:FXD NET FLM 215 OHM 18 1/4W		1 1 1	A35R15	0757-0274	RIFXD MET FLM 1.21K CHM 18 1/8W	
34R2	0698-0090	R:FXD MET FLM 464 OHM 18 1/28	· .		A35R16	0757-0273	RIFXD NET FLM 3.01K DHM 18 1/8W	
34R3	0727-0704	RIFXD DEPC 6 OHM 18 1/2W			A35R17	0698-0086	RIFXD HET FLM 2.87K CHM 1X 1/4W	
14R4	0757-0442	RIFXD NET FLM 10.0K OHN 18 1/8W			A35R18 A35R19	0811-0962	RIFXD WW 738 DHM 18 1/2W	
ARS	0698-0087	RIFXD MET FLM 316 OHM 18 1/4W			A35R20	0757-0280 NRFR	REFXD MET FLM 1K OHM 18 1/8W	
14R6	0698-0093	RIFXD MET OX 10 CHM 5% 1W					FACTORY SELECTED: PART OF CR3	1
					A35R21	2100-1433	R: VAR WW 100 DHM 5% 3/4W	
14R7	0757-0338	RIFXD NET FLN 1.00K ONN 18 1/4W		1	A35R22	NRFR	FACTORY SELECTED: PART OF CR3	
488	0698-0086 0757-0743	R:FXD MET FLM 2.87K OHM 15 1/4W R:FXD MET FLM 3.32K OHM 15 1/4W		1	A35R23	0757-0442	RIFXD MET FLM 10.0K OHM 1% 1/8W	
	V121-V143		and the		A35824	0698-0045	RIFXD HET FLN 2.61K OHM 18 1/8W	ļ
6	8060-3783	POWER SUPPLY AMPLIFIER	~ i +	ļ'	A35R25	0698-0092	RIFXD NET FLN 2.61K OHN 18 1/8H	A-L
<b>55C</b> 1	0140-0168	C: FXD NY 0.1 MF 101 200VDCW	pet 1	., • 1	A35R26	0J11-1394 0698-0092	R:FXD NW 2550 DHÁ 0.18 1/8W R:FXD NET FLN 2.61K DNM 18 1/8W	M- X
I			-		8	0811-2388	A: FXD WW 2513 DHM 0.1% 1/8W	A-L
SC2	0160-0163	C:FXD MY 0.033 UF 108 200VDCW 4 C:FXD MICA 56 PF 58			A358.27	0757-0442	A:FXD MET PLM 10.0K OHM 18 1/8W	M-X [*]
5C3 5C4	0140-0191	CIFAD HILA 30 PF 38 CIFAD ELECT 56 UF 15VDCW		;	A35#28	075'7-0408	RIFRD NET FLM 243 DHM 18 1/8W	l
			体图		A35R29	A408-3130	· · · · · · · · · · · · · · · · · · ·	
SCR1	5080-1471	DIODE:BREAKDOWN 6.15-6.5V 400 WW			A35R30	0698-3178 0811-0995	R:FXD MET FLM 487 OHM 1% 1/8W R:FXD WW 11 OHM 5% 3/16W	
JCR3	NRFR	DIODE/RESISTOR SET					N. TAU WW II UNW 34 3710W	
		TNOT FIELD REPAIRABLE						
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Table 5-1. Reference Designation Index (Cont'd)

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Table 5-1,	Reference	<b>Designation Inde</b>	x (Cont'd)
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Reference Designation	Part No.	Description #	Note		erence	urt No.	Description #	
		A36 5080-3806 A46 5080-3781 A47 5080-3881 MAIN CHASSIS			gastion (***		MAIN CHASSIS (CONT'D)	No
A36	5080-3806	RECTIFIER/FILTER		CR2	1901-	0060	UI ODE: SILICON	
A36C1 A36C2	0180-0364	LIFXD ELECT 250UF -10+100% 30VDCW LIFXD CER 0.01 UF 20% 1000VDCW		CR3 CR20 CR21		0081	DIODE:SILICON Diode:Silicon 50 Volts Working Diode:Silicon 50 Volts Working	G-X H-X
A36C3 A36C4 A36C5 A36C6	0180-0364 0150-0012 0180-0363 0150-0012	C:FXD ELECT 250UF -10+100% 30VDCW C:FXD CER 0.01 UF 20% 1000VDCW C:FXD ELECT 150UF -10+100% 30VDCW C:FXD CER 0.01 UF 20% 1000VDCW		F1 F2	2110- 2110-	0007	FUSE:CARTRIDGE 2AMP 125V SLOW BLOW FUSE:CARTRIDGE 1 AMP 250V SLOW BLOW . REPLATES F1 FOR 230V OPERATION.	i
A36C7 A36C8 A36C9	0180-0361 0180-0361 080	C:FXD ELECT 10 UF +50-10% 350VDCW L:FXD ELECT 10 UF +50-10% 350VDCW C:FXD, SELECTED IN TEST		FL1	9110- 9100-		FILTERILINE 3 WIRE I.5A FILTERILINE 3 WIRE 1.5A	/ A-T U-X
A36C10	080	CIFXD, SELECTED IN TEST		IL I	1251-	0119	CONNIFEMALE 37 CUNTACTS	
A36CR1- A36CR6	1901-0026	DIODEISILICON 0.754 200 PIV		J2 J3 J4	1251 1250 1250	0118 0118	CONNECTOR:FEMALE 50-PIN MINAT CUNNECTOR:BNC CUNNECTOR:BNC	
A36CR7	1901-0036	DIODEISILICON 1000 PIV		8L 9L	1250-0 1250-0		CONNECTOR: BNC	
A36R 1	0686-6845	RIFXD COMP 680K OHM 58 1/2W		J31	1251-0	0349	CUNNEGUARDED CHASSIS 3 PIN MALE	
N36F2	0686-6825	RIFXD COMP 6800 DHMS 5% 1/2W		L1	9110-0	0067	CHOKE:35 MH 1.5A	
M6 M7	5080-3881	SAME AS A11, USE PREFIX A46 RELAY TIME CIRCUIT		91	1850-0 1853-0		TRANSISTOR: GERMANIUM PNP	Α-J . κ-x
47C1	0170-0040	CIFXD NY .047 UF 10% 200VDCW		Q2 Q3	1850-0 1850-0		TRANSISTOR: GERMANIUM PNP TRANSISTOR: GERMANIUM PNP 2N1183	A-J
4762	0180-0010	C#FXD ELECT 8 UF -15+20% 30VDCW		95	1853-0		TRANSISTOR: SILICON PNP	G-X
47CR1	1901-0025	DIODE: SILICON LOOWY 100MA		R1	0813-0	0007	REFXD WW 10K CHM 10% 5W	
4791	1851-0024	TRANSISTOR : GERMANIUM NPN		R2 R3	0816-0		R:FXD WW 1250 OHM 10% 10W R:FXD COMP 1K OHM 5% 2W	A-J
47R1	0683-2225	RIFXD COMP 2.2K OHM 58 1/4W		R4	0686-6	825	R: FXD COMP 6800 OHMS 5% 1/2W R: FXD COMP 220K OHM 5% 1/4W	K-X
47R2 47R3 47R4	0683-2715 0683-2225 0686-8225	K:FXD COMP 270 OHM 5% 1/4W R:FXD COMP 2.2K OHM 5% 1/4W R:FXD COMP 8200 OHM 5% 1/2W	5	R5 R6	0686-4	745	RIFXD COMP 470K OHM 5% 1/2W	
	0000-0225	MAIN CHASSIS		R7 R8 R9 R11	0683-1 0683-6 0683-3 0683-1	.025 9835 9025	KIFXD COMP 1000 OHM 5% 1/4W RIFXD COMP 1000 OHM 5% 1/4W RIFXD COMP 68K OHM 5% 1/4W RIFXD COMP 3000 OHM 5% 1/4W RIFXD COMP 100 OHM 5% 1/4W	
101 .	3160-0026 3160-0097	FANITUBEAXIAL 50-60CPS Fanitube Axial	A-V W-X	R12	0683-4	715	R#FXD COMP 470 OHN 5% 1/4W	H-X H-X
1	0180-0367	C:FXD ELECT 20UF -10+758 200VDCW		R202 R203 R204	0686-1 0686-4 NSR	335   (	KIFXD COMP 11K OHM 5% L/2W // RIFXD COMP 43K OHM 5% 1/2W {Part of 55}	٦
2 3 4	0180-0047 0140-0195 0130-0001	CIFXD ELECT 500 UF 75VDCW CIFXD NICA 130 PF 5% 300 VDCW CIVAR CER 7-45PF 500VDCW		51	3100-1		SWITCH:ROTARY 8 POS '3 SECT	
5	0160-2940 0180-0049	CIFXD MICA 470 PF 58 300VDCW CIFXD AL ELECT 20UF 50VDCW		\$2 \$3 \$4	3100-0 3100-0 3101-0	464 004	SWITCH:ROTARY 12 POLE 3 DR 4 POS SWITCH:ROTARY 6 POLE 6 POS SWITCH:PUSHBUTTON SPDT	
11	0150-0121	LIFXD CER 0.1 UF +80-20% 50VDCW	T-X	55 56	3100-0 3101-0		SWITCH:ROTARY W/250K DHM RESISTOR SWITCH:TOG DPDT JAN #ST22N	
22 202	0160-2232 0170-0038	C:FXD MICA 33 PF 2% 300VDCH C:FXD MY 0.22 UF 10% 200VDCH	G-X	57 510 511	3101-0 3101-0 3101-0	001 9	SWITCH:TOGGLE SPST SWITCH:TOGGLE SPST SWITCH:SLIDE DPDT	(

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Table 5-1.	Reference	Designation	Index	(Cont'd)
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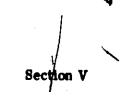
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			•				Designation	<u> </u>
•		MAIN CHASSIS (CONT'D)		,			·	
1	9100-0211	TR ANSFORMER : POWER				•		* <u>,</u>
(A1-					₹,			•
A8 🖅	1251-0135	CUNNECTOR: BODY 15 PIN		•			C12	0160-2
A9	1251-0141	LUNNIPC 18 CONTACTS					C13	-
A10 A11	1251-0135 1251-1024	CONNECTOR: BODY 15 PIN				*		0160-2
A12	1251-1024	CONN:PC 30(2X15) CONTACTS CONN:PC 30(2X15) CONTACTS			1		C20	0150-0
A13	1251-1024	CONNEPC 30(2X15) CONTACTS	1				C32	0180-0
A14	1251-1024	CONNEPC 30(2X15)CONTACTS	<b>`</b> ¥				-C34	0180-0
A15	1251-1024	CONNEPC 30(2X15)CONTACTS			·		C35	0190-0
A16 A17	1251-1035 1251-0135	CONN:PC 36(2X18) CONTACTS Connector:Body 15 Pin					J10	1251-0
A18	1261-0126	CONNECTOR					111	1251-0
A19	1251-0135 1251-0332	CONNECTOR:BODY 15 PIN Conn:PC 24 Contacts					J29	1251-0
A20	1251-0332	CONN: PC 24 CONTACTS					J30	1251-0
A21 A22	1251-0332 1251-0332	CONN:PC 24 CONTACTS CONN:PC 24 CONTACTS				, <b>.</b> .	R10	0683-2
A24	1251-1034	LONN:PC 20(2X10) CONTACTS		[			R33	2100-0
A26	1251-0475	CUNNECTOR: PC 6 CONTACT				•	R34	2100-01
A27	1251-0475	CUNNECTOR: PC 6 CONTACT					R35	2100-0
A29	-1251-0166	CUNNIPC 10 CONTACTS					R48 R49	0811-0
A31	1251-0141	CONNEPC 18 CONTACTS			(	1	R50	0757-0. 0757-0.
A32 A33	1251-0135	CONNECTOR BODY 15 PIN					R61 R62	0757-09
A34	1251-0135 1251-0135	<u>Connector:60dy 15 pin</u> Connector:60dy 15 pin				1	R63 -	2100-03
A35	1251-0141	CONNEPC LO CONTACTS			Pre-		T2	9100-12
N46	1251-1024	CUNN:PC 30(2X15)CONTACTS					T4	9100-12
F1	1400-0084	FUSEHOLDER EXTRACTOR POST TYPE		1			T5	5080-14 5080-14
L	0410-0021	CRYSTAL:QUARTZ 100 KHZ					XA23	1251-01
	5060-3639	DECIMAL LAMP ASSY						
	5060-5019	NEON PHOTOCONDUCTOR BLOCK ASSY					· · · ·	
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Section V

Table 5-1. Reference Designation Index (Cont'd) 18 1 **Description** # -Note . V/F CONVERTER VOLTAGE TO FREQUENCY CONVERTER CHASSIS CIFXU NICA 470 PF 5% 300VOCH 0-X CIFXD MICA 10 PF 5% U LIFXD NICA 91 PF 5% V-X C:FXD CER 5 PF 500VDCW LIFXD ELECT 100 UF 208 20VDCW N - X CIFXD ELECT 56 UF 15VDCW CIFXD ELECT LOUF -15+208 GOVDCH ۸ CONNITEFLON WHITE FEMALE CONNITEFLON WHITE FEMALE CONNETEFLON WHITE FEMALE CONNETEFLON WHITE FEMALE RIFXD COMP 22 OHM 5% 1/4W D - X REVAR WW & DHM 108 2W RIVAR WW LOK OHN LOS 2W REVAR WW & OHM LOS 2W RIFXD WW LOOK OHN 1/100% 1W RIFXD NET FLM 13.3K OHN 1% 1/8W RIFXD MET FLM 13.3K OHM 1% 1/8W RIFXD FLN 1.2K OHN 28 1/8W RIFXD FLM 1.2K OHM 2% 1/8W REVARIAN 20K OHN 5% LIN LOW Α TRANSFORMER: POWER TRANSFORMER: POWER . 0 - X TRANSFORMER: PULSE (SHIELDED) TRANSFORMER : PULSE (SHIELDED) LUNNECTOR: BODY 15 PIN +USABLE ON CODE & THRU C EXCEPT STOCK NUMBER 9100-1211 USED ON SOME INSTRUMENTS. CHECK STOCK NUMBER ON TRANSFORMER CASE BEFORE ORDERING. L

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Le erence Designation	· Part No.	Description #	Note	Part No.	Description #	· Mfr.	Mfr. Part No.	<u> </u>
•	,	A28 6060-6115	A			2	1	-
29	6080-6115	PROGRAMMABLE DC ATTENUATOR ASSEMBLY						
28C101 28C102	0180-(0349 05D 0180-0347 05D	C:FXD TANT ELECT 0,89 UF 108 35VDCW FACTORY BELECTED PART C:FXD TANT ELECT 1.5 UF 108 35VDCW FACTORY SELECTED PART	A-W X - W	0130-0001 0140-0145 0140-0152 0140-0156	CIVAR CER 7-45PF 500VDCH CIFXD MICA 22 PF 58 CIFXD MICA 1000 PF 58 300VDCH CIFXD MICA 1500 PF 28	28480 04062	0130-0001 0140-0145 DM16#102J 0140-0156	
acuròt	1901-0020	DIODEISILICON LOOWV LOOMA		0140-0176 0140-0177 0140-0191 0140-0192 0140-0192	CIFXD NIGA LOU PF 28 CIFXD NIGA 400 PF 18 CIFXD NIGA 56 PF 58 CIFXD NIGA 68 PF 58 CIFXD NIGA 110 PF 58	28480 28480 28480	0140-0176 0140-0177 0140-0191 * 0140-0192 0140-0192	
8CR103 8CR104 8CR105 8K1- 8K5	1901-0025 1901-0025 1901-0025	DI DDEISILICON LOOWV 100MA DI DDEISILICON LOOWV 100MA DI DDEISILICON 100WV 100MA RELAVICOIL		 - 0140-0195 0140-0196 0140-0198 0140-0198	CIFXD MICA 130 PF 58 300 VDCH CIFXD MFCA 150 PF 58 CIFXD MICA 200 PF 58 CIFXD MICA 240 PF 58	04062 28480 28480 28480	DN15F131J BOOV 0140-0196 0140-0198 0140-0199	
	0490-0137 0490-0137 0490-0094	SWITCHINAGNETIC REED CONTACTS FOR KI,K2,K4B,AND K5. Switchinagnetic Reed Contacts for K1,K2A,K2B,K4B,AND K5. Switchinagnetic Reed Contacts for K3 AND K4A.	A-t. F-X	0140-0200 0140-0203 0140-0218 0140-0219 0150-0008 0150-0012	CIFXD NICA 390 PF 58 CIFXD NICA 30 PF 58 CIFXD NICA 160 PF 28 CIFXD NICA 160 PF 28 CIFXD MICA 160 PF 28 CIFXD CER 5 PF 50QVDCW CIFXD CER 0.01 UF 208 1000VDCW	28480 28480 28480 28480	0140-0200 0140-0203 0140-0218 0140-0219 0150-0008 290214A3	
8L 10 8R 36	9140-0237 0811-1516	CUTETEND 200 UH 58 REFERD WW 4.495 MEGUHM .058 2 PPM DEG C		0150x0014 0150-0021 0150-0093 0150-0121	CIFXD CER 0.005 UF 300VDCW CIFXD T1 D10X 0.47PF 58 500VDCW CIFXD CER 0.01 UF +80-208 100VDCW CIFXD CER 0.1 UF +80-208 50VDCW	960 784 91418 56289	TYPE GA TA SCSUBIS-CML S	
88 37 68 38 68 39 68 40 88 42	0811-1516 0811-0152 0811-0201 2100-0708 0841-0154	RIFXD ¹ WH 4.495 NEGDHN .058 2 PPN DEG C Rifxd WH 90K DHN 0.018 1/84 Rifxd WH 900K DHN 0.018 1/44- Rifxd WH 20K DHN 108 24 Rifxd WH 106080K DHM 0.18 3/84		0160-0127 0160-0134 0160-0155 0160-0158 0160-0161	CIFXD CEN 1.0 UF 208 25VDCW CIFXD MILA 220PF 58 300VDCW CIFXD MY 3300 PF 108 CIFXD MYLAN 3600PF 108 CIFXD MY 0.01 UF 108 200VDCW	14655 28480 28480 28480	5C13C5-CNL RDM15F221J3C 0160-0155 0160-0158 0160-0158	
8843 8844 8845 8846 8847	2100-1454 0811-0150 2100-1455 0811-0355 2100-1456	RIVAR WW 50 DHN 5% 324W RIFXD WW 111K DHN 0.05% 178W RIVAR WW 300 DHN 5% 374W RIFXD WW 899K DHN 0.05% 174W RIVAR WW 2K DHN 5% 374W	•	0160-0163 0160-0164 0160-0166 0160-0168 0160-0257	CIFXD MY 0.033 UF 108 200VDCW CIFXD MY 0.039 UF 108 200VDCW CIFXD MY .068 UF 108 CIFXD MY 0.1 UF 108 200VDCW CIFXD MICA 50.6PF 58	28480 28480 28480	0160-0163 0160-0164 0160-0166 0160-0168 RCM156(50.63)	
88 101 88 102 88 105 88 106 88 106 88 107	0689-3915 0689-4715 0689-3915 0689-3915 0689-3915	RIFXD COMP 390 OHN 58 1W NIFXD COMP 470 OHN 58 1W RIFXD COMP 390 OHN 58 1W RIFXD COMP 390 OHN 58 1W RIFXD COMP 390 OHN 58 1W I		0160-0263 0160-0268 0160-0303 0160-0378 0160-0938 0160-0938	CIFXD CER 0222 UF 208 SOVDCW CIFXD PURC 110 PF 58 SOOVDCW CIFXD MYLAR 115 UF 108 200VDCW CIFXD MICA 27PF 58 CIFXD MICA 1000PF 58 CIFXD PDLY 0.27 UF 208 BOVDCW	95275 28480 72136 28480	5C5285-CML VV15C111J 0160-0303 RDM15L270J55 0160-0938 114P2740R354	
				0160-0961 0160-0970 0160-2101 0160-2197 0160-2203	CIFRO POLY 0.0270F 20% 30VDCM CIFRO MY 0.470F 10% BOVDCM CIFRO MICA 27PF 2% 300VDCM CIFRO MICA 10 PF 5% CIFRO MICA 91 PF 5%	56289 72136 28480	114P2730R354 192P4749R0-P15 RDMg51270G3C J 0160-7197 0160-2203 J	
		-		0160-2232 0160-2940 0170-0024 0170-0038 0170-0040	CIFXD NICA 33 PF 28 300V0CW CIFXD NICA 470 PF 58 300V0CW CIFXD NV 0.022UF 208 280V0CW CIFXD NV 0.22 UF 108 200V0CW CIFXD NY .047 UF 108 200V0CW	72136 56209 56289	RDM151.330G3L RDM151.471J3L 197P22302 148P22492 PUM 0170-0040	
	X	*. • / _~	`   *	01/10-0066 0170-0072 0180-0010 0180-0039	CIFXD NY 0.027UF 10% 200VDCM CIFXD NY 1 UF 10% 200VDCM CIFXD ELLCT 8 UF -15+20% 30VDCM CIFXD ELECT 100UF 12VDCM	84411 26209	01 70-0066 HFW 54 1 3 2 0 8 0 5 C 2 0 3 0 U 0 1 7 M 3 0 0 1 0 7 6 0 1 2 0 C 4 M 1	

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Table 5-1.	<b>Replaceable Parts</b>	(Cont'd)
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	TRUE 0-2. Replacentae Parts	(Cont'd)				Table 5-2. Replaceable Parts	(Cont'd	)	-
Part No.	Description #	Mfr.	Mfr. Part No.	TQ	Part No.	Description #	Mfr.	Mir. Part No.	TQ
0180-0047 0180-0049 0180-0050 0180-0058 0180-0058	CIFXD ELECT SOOTUF 75VDCW CIFXD AL ELECT 20UF SOVDCW CIFXD ELECT 40 UF +75-10% SOVDCW CIFXD ELECT SOUF -10%+100% 25VDCW CIFXD ELECT SOOUF -10%+100% 3VDCW	56289 56289 28460 56289 56289	D32443 DFP 30020660500Comi 0180-0450 3005066025004M1 30050760030H6M1	1 3 4 2	0683-2225 0683-2235 0683-2245 0683-2435 0683-2435 0683-2705	RIFXD CUMP 2.2K UHN 58 1/4W RIFXD CUMP 22K UHN 58 1/4W RIFXD CUMP 220K UHN 58 1/4W RIFXD CUMP 24K UHN 58 1/4W RIFXD CUMP 27 UHM 58 1/4W	01121 01121 01121 01121 01121 01121	GU 2225 CH 2235 CH 2245 CH 2245 CH 2455 CH 2455 CH 2705	y 124 1 15
0180-0079 0180-0094 ⁴ 0180-0098 0180-0104 0180-0116	CIFXD ELECT LOUF -15+20% 60VDCW CIFXD ELECT LOOUF 25VDCW CIFXD ELECT LOO UF, 204 20VDCW CIFXD ELECT 200UF 15VDCW CIFXD ELECT 6.4 UF LOX 35VDCW	10411 56289 28480 56289 56289	3001076025044	2 1 1 1	0683-2715 0683-2725 0683-2735 0683-3025 0683-3035	RIFXD LUNP 270 UHM 58 1/4W RIFXD CUNP 2700 UHM 58 1/4W RIFXD CUMP 27K UHM 58 1/4W RIFXD CUMP 3000 UHM 58 1/4W RIFXD CUMP 3000 UHM 58 1/4W		Cii 2715 Cii 2725 Cii 2735 Cii 3025 Cii 3035	1 11 57 34
0180-0124 0180-0137 0180-0159 0180-0193 0180-0195	CIFXD ELECT 2000F 6VDCW CIFXD ELECT 100 UF 20% 10VDCW CIFXD ELECT 220 UF 10% 10VDCW CIFXD ELECT 20 UF 10VDCW CIFXD ELECT 56 UF 15VDCW	56289 28480 28480 56289 82647	0100-0137 0100-0159 1090206C2010C2		0683-3305 0683-3315 0683-3325 0683-3335 0683-3625	RIFXD LUMP 33 UHM 58 1/4W RIFXD LUMP 330 UHM 58 1/4W RIFXD LUMP 3300 UHM 58 1/4W RIFXD LUMP 33K UHM 58 1/4W RIFXD LUMP 3600 UHM 58 1/4W	01121 01121 01121 01121 01121 01121		2 6 179 3
0100-0197 0100-0210 0100-0291 0100-0361 0100-0363	CIFXD ELECT 2.2 UF 104 20VDCW CIFXD ELECT 3.3 UF 208 15VDCW CIFXD ELECT 1UF 108 35VDCW CIFXD ELECT 1U UF +50-108 350VDCW CIFXD ELECT 150UF -10+1008 30VDCW	56289 62376 56289 28460 56289	TES 3.3N-15 1500105X9035A2 0180-0361	2 3 1 2 2	0683-3635 0663-3915 0663-3925 0683-3925 0683-3935 0683-3945 0683-3945	RIFXD LUMP 36K UNM 58 1/4H RIFXD LUMP 390 UNM 58 1/4H RIFXD LUMP 3900 UNM 58 1/4H RIFXD LUMP 3900 UNM 58 1/4H RIFXD LUMP 39K UNM 58 1/4H RIFXD LUMP 390K UNM 58 1/4H	01121 01121 01121 01121 01121 01121	CB 3635 CB 3915 CB 3925 CB 3935 CB 3935	1 60 40 1 1
0180-0364 0180-0365 0180-0367 0180-0388 0180-1804	CIFXD ELECT 2500F -10+100% 30V0CH CIFXD TA 22UF 10% 15V0CH CIFXD ELECT 20UF -10+75% 200VDCH CIFXD ELECT 56 UF 10% 20VDCH CIFXD ELECT 75 UF +75-10% 40VDCH	56289 56289 56289 56289 56289 56289	1500226X901582 340206F200FJ4-058 1300275	2 1 2 2	0683-4325 0683-4335 0683-4705 0683-4715 0683-4725	R:FXD COMP 4.7K OHM 51 1/4W RIFXD CUMP 4300 JHM 51 1/4W RIFXD CUMP 43K LHM 51 1/4W RIFXD CUMP 47 UHM 51 1/4W RIFXD CUMP 470 UHM 51 1/4W RIFXD CUMP 4700 JHM 51 1/4W	01121 01121 01121 01121 01121 01121 01121	CB 4775 CH 4325 CB 4335 CB 4705 CB 4715 CB 4715	7 10 1 1 1 1 1 1 1 1
0360-0462 0410-0021 0490-0094 0490-0099	TERMINAL: PROBE CAYSTALIQUART2 100 KHZ SWITCHISPST 250V IA 15W RELAYICUIL	28480 95348	0360-0467 0410-0021 MR-600-1 0490-0099	2	0683-4735 0683-4745 0683-5125 0683-5625 0683-5635	RIFXD CUNP 47K UHN 58 1/4W RIFXD LUNP 470K UHN 58 1/4W RIFXD LUNP 510G DHN 58 1/4W RIFXD LUNP 5600 UHN 58 1/4W RIFXD LUNP 56K UHNS 58 1/4W	01121	68 4735 68 4745 68 5175 68 5675 68 5675	105 4 1 12 51
0490-0137 0683-0565 0683-1005 0683-1015 0683-1025	SWETCHINAGNETIC REED RIFXD CUMP 5.6 UNM 5% 1/4W RIFXD CUMP 10 UNM 5% 1/4W RIFXD CUMP 100 UNM 5% 1/4W RIFXD CUMP 1000 UNM 5% 1/4W	01121 01121 01121	0490-0137 CH 0565 CH 1005 CH 1015 CH 1025	y 1 3 2 14	0683-6225 0683-6815 0683-6825 0683-6825 0683-6835 0683-7525	RIFXD CUMP 6200 UHN 5% 1/4W RIFXD CUMP 680 UHM 5% 1/4W RIFXD CUMP 6800 UHM 5% 1/4W RIFXD CUMP 68K UHN 5% 1/4W RIFXD CUMP 7500 UHM 5% 1/4W	01121 01121 01121	68 6225 68 6815 68 6825 68 6835 68 7525	, 1 4, 4, 7, 1 1
0663-1035 0663-1045 0663-1135 0663-1225 0663-1235	RIFXD COMP LOK OHN 5% 1/4W RIFXD COMP LOOK UHNS 5% 1/4W RIFXD COMP ILK UHN 5% 1/4W RIFXD COMP 1200 OHN 5% 1/4W RIFXD COMP 12K OHN 5% 1/4W	01121 01121 011 <b>21</b>	CB 1035 CB 1045 CB 1135 CB 1225 CB 1235	76 58 3 5 18	0683-8215 0683-8225 0683-9105 0683-9135 0686-1025	RIFXD CUMP 020 CHM 58 174W RIFXD CUMP 0200 JHMS 58 174W RIFXD CUMP 91 CHM 58 174W RIFXD CUMP 91K CHM 58 174W RIFXD CUMP 1000 CHM 58 172W	01121 01121 01121	68 8215 68 8225 68 9105 5 68 9115 78 1025	
0683-1335 0683-1515 0683-1525 0683-1535 0683-1545	RIFRD COMP 13K CHM 5% 1/4W RIFRD COMP 150 (NHM 5% 1/4W RIFRD COMP 1500 DHM 5% 1/4W RIFRD COMP 150K CHM 5% 1/4W RIFRD COMP 150K CHM 5% 1/4W	01121 01121 01121	CB 1335 CB 1515 CB 1525 CB 1535 CB 1545	5 1 2 4 1	0686-1135 0686-2025 0686-2235 0686-3325 0686-3625	7 RIFXD LUNP IIK UHN 5% 1/26 RIFXD LUNP 2000 UHN 5% 1/26 RIFXD LUNP 22K UHN 5% 1/26 RIFXD LUNP 3500 UHN 5% 1/26 RIFXD LUNP 3600 UHN 5% 1/26	01121 01121 QL121	1 B 4 4 3 5 1 B 202 5 4 B 22 3 5 1 B 3 3 2 5 1 B 3 6 2 5 N	
0683-1635 0683-1815 0683-1825 0683-1835 0683-1845	RIFXD CUMP 16K UHM 5X 174W RIFXD CUMP 180 UHM 5X 174W RIFXD COMP 1800 DHM 5X 174W RIFXD COMP 18K UHM 5X 174W RIFXD CUMP 180K UHM 5X 174W	01121 01121 01121	CO 1635 CB 1015 CB 1025 CD 1835 CB 1045	20 1 2 51 1	0686-3925 0686-4335 0686-4725 0686-4725 0686-4735 0686-4745	R1FXD CUMP 3900 UHN 5% 1/2W R1FXD CUMP 43K UHM 5% 1/2W R1FXD CUMP 4700 UHN 5% 1/2W R1FXD CUMP 47K UHN 5% 1/2W R1FXD CUMP 470K UHM 5% 1/2W	01121 01121 01121	** 1 (3 3 9 7 5 1 (3 4 3 3 5 1 (3 4 7 2 5 1 (3 4 7 4 5 1 (3 4 7 4 5	
0683-2015 0683-2035 0683-2045 0683-2205	RIFXD COMP 200 CHIN 5% 174W RIFXD COMP 20K CHIN 5% 174W RIFXD COMP 200K CHIN 5% 174W RIFXD COMP 22 CHIN 5% 174W	01121 01121	CB 2015 CB 2035 CB 2045 CB 2205	20 7 4 1	0686-5135 0686-5625 0686-6875 0686-6875 0686-6845	RTEXD CUMP 51K UHN 58 1728 RTEXD CUMP 5600 UHN 58 1728 RTEXD-CUMP 6800 UHN 58 1728 RTEXD CUMP 680K UHN 58 1728	01121 01121	48-5135 48-5625 48-6825 48-6825 48-6845	1 56 1 1
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#### Table 5-2. **Replaceable** Parts

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Part No.	Description #	Mfr.	Mír. Part No.	TQ	Part No.	1
					3	1
0686-7525	RIFXD CUMP 7500 UHM 58 1/2W	01121	EB 7525	2		
0686-8225	RIFXD LUNP 8200 JHH 58 1/2W	01121	EB 8225	1 ī	0757-0274	A :FXD
0689-1035	RIFKO LUMP LOK OHM 58 LW	01121	G8 1035	5	0757-0276	RIFXD
0689-1815	RIFXD CUMP 180 UNN 58 1W	01121	G8 1615		0757-0260	RIFXD
0689-2225	RIFED LUNP 2200 DHM 58 1W	01121	GB 2225	i	0757-0289	R IFXD R IFXD
0689-2725	RIFXD CUNP 2.7K UNN SK 1W	01121	G6 2725	2	0757-0327	RIFXD
0689-3315	RIFXD LUMP 330 CHN 58 IW	01121		10	0757-0336	RIFXD
0689-3915	RIFXD CUMP 390 UHN 58 1W	01121		4	0757-0336	RIFXD
0689-3925	RIFXD LUNP 3.9K UHN 58 1W	01121	G6 3925		0757-0344	RIFXD
0689-4715	RIFXD LUMP 470 UHM 52 IN	01121	GB 4715	1	0757-0387	RIFXO
0692-1025	RIFXD CUMP IN UNM SE 2W	01121			0757-0403	RIFXD
)692-1815 )693-3359	RIFXD LUNP 180 UHN 55 24	01121	HB 1815		0757-0408	RIFXD
	R:FXD MET FLM 12.7K 11 1/8W	28480	0693-3359		0757-0413	AIFXD
698-0024	RIFXD NET FLN 2.61K DHM 13 1/2W	28480	0698-0024		0757-0417	RIFXD
696-0082	RIFXD NET FEN 464 OHM 18 L78W	28480	0698-0082	2	0757-0421	RIFXD
698-0083	RIFXD MET FLM 1.VOK DHM 18 1/8W	28480	699-0093	2	0757-0427	RIFXD
0698-0084	RIFXD ALT FLM 2.15K DHM 18 1/8W	284 80	0698-0084		0757-0433	RIFXD
0698-0085	RIFKD MLT FLM 2.61K OHM 18 1/8W	28480	0698-0085	1 3	0757-0430	RIFXD
0086	RIFKD MET FLM 2.87K OHN 13 1/4W	28460			0757-0439	RIFXD
698-0087	RIFXD MET FLM 316 UHM 18 174W	26480	0698-0087		0757-0441	RIFXD
648-0088	RIFXD ALT FLM 215 DHM 18 1/4W	28480	0698-0088		0757-0442	RIFXD
690-0090	RIFXD NET FEN 465 OHN 18 1/2W	28480	0698-0090		0757-0444	RIFXD
698-0091	RIFKD ALT FLA 825 DHA 18 1/AW	28480	0698-0091		0757-0446	RIFXO
698-0092	RIFXD NET FLM 2.61K OHN 18 1/6W	28480	0698-0092		0757-0452	RIFXD I
698-0093	RIFXD NLT UX LO UHM 535 1W	28480	0698-0093		0757-0458	RIFXD
698-3101	RIFXD MLT FLM 2.87K OHM 18 1/2W	28480	0698-3101	1 1	0757-0459	RIFXD I
698-3132	RIFKD MLT FLM 261 DHM 18 176W	28480	0698-3132	1 1	0757-0465	RIFXD
698-3133	REFXD NET FLN 601 OHM 18 3/10W	28480	0698-3133	4	0757-0471	RIFXD I
698-3134	RIFXD MET FLW L.3 3K OHM 18 1/4H	28480		2	0757-0479	RIFXD
698-3135	RIFXD MLT FLM 2740 DHM LT 3/10W	20400	0698-1135		0757-0401	RIFXO I
698-3136	RIFXD NET FLM 17.8K DHM LX 1/0W		0698-3136	) ا	0757-0483	RIFXD
698-3156	RIFXD MLT FLM 14.7K OHM LE 1/8W		0698-3156		0757-0731	RIFXO
698-3161	RIFXD MLT FLM 30.3K OHM 18 1/8W			و ا	0757-0743	RIFXD
698-3162	RIFRD MET FLM 46.4K OHM LE 1/8W		0698-3162	1 1	0757-0748	RIFXD P
698-3171	RIFXD MET FEM LOK DHM LE 0.3W	18612	C 302		0757-0016	RIFXD
698-3178	RIFXD MET FLM 487 OHM 18 1/8W		0698-3178	1	0757-0926	RIFXD F
690-3300	RIFXD MLT FLN 14.7 DHM 18 1/2W		0698-3388		0757-0931	RIFXD I
698-3419	RIFXD MET FLM 31.6K CHM 1% 1/2W		0698-3419	2	0757-0939	RIFXD I
698-3449	RIFXD MLT FLM 28.7K OHM 18 1/8W		0698-3449		0757-0940	RIFXD F
727-0274	RIFXD DEPC 1 MEGUHM 18 1/2W	20400	0721-0214	10	0757-0943	RIFXD F
727-0704	RIFXD DEPC 6 UNN 18 1/2W	28480	0727-0704	1	0767-0944	
727-0739	RIFXD CARBON FEM 464 OHN 18 1/2W	26480	0727-0739		0757-0944	RIFXD F
727-0751	RTFXD DEPC 1000 UHN 1X 1/2W	28480	0727-0751	1  \$	0757-0946	RIFXD #
727-0264	RIFKD GARBON FLM 2.37K DHM 18 1/2W	28480	0121-0164		0757-0947 0757-0948	RIFXD F RIFXD F
727-0766	RIFXO CARBUN FLM 2.87K DHM 1% 1/2W	19701	MF 7G		0757-0950	RIFXDF
121-0192	RIFXD LARBON FLM 31.6K OHN 11 1/2W	28480	0727-0192			
727-0019	RIFXD DEPC 287K UHM 11 1/2W		0727-0019		0757-0952	RIFXD +
727-0862	RIFXD CARBON FLM 4.64 MEGOHM 18 1/2W		0727-0862		0757-0953	RIFXD
157-0156	RIFXD NET FLM 1.5 NEGOHN 18 1/2W		0757-0156		0757-0954	RIFXD F
757-0159	RIFXD MET FLM 1000 DHN 1% 1/2W		0757-0159		0757-0958 0757-0968	RIFXD F RIFXD F
757-0198	RIFXD MET FEM 100 OHN 1X 1/2W	28480	0757-0198			
757-0199	RIFXD MET FEM 21.5K DHM IT 1/8W		0757-0199		0757-0992	RIFXD M
75 - 0200	RIFXD MLT FLM 5.62K DHM 13 1/8W		0757-0200		0757-1060	RIFXD N
151-0213	RIFXD MLT FLM J.OIK (MM 18 1/8W		0757-0213		0757-1078	RIFXD M
		1	······································	t I t	0757-1102	RIFXD M

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# See introduction to this section for ordering information

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## Section V

#### Table 5-2. **Replaceable Parts**

(Cont'd)

Description #	Mfr.	Mfr. Part No.	TQ
······································	· · · · · · · · · · · · · · · · · · ·		
TFXD MET FLM 1.21K DHM 18 1/6W	28480	0757-0214	•
TFXD NET FLN 1.76K OHM 1% 1/6W	28480	0757-0278	1
LIFXD MET FLM IK OHM IN 1/8W	28480		8
LIFXD NET FLN 13.3K OHN 18 1/8W	26480		
LIFXO NET FLN 6.19K DHN 18 1/8W	28480	0757-0240	2
LIFXD NET FLN 499K OHN 18 1/4W	28480	0757-0327	3
LIFXD MET FLM 340 OHM 18 1/4W	28480		1
ITEXD MET FLM 1.00K OHM 18 1/4W	28480		1
LIFXD NET FLM 1.00 NEGOHN 18 1/4W	28480		1
LEFXD NET FLN 27.4 DHN 18 1/8W	19701	NFSC T-U	1 1
IFXD NET FLM 121 DHM 18 1/8W	28460	0757-0403	1 1
IFXD MET FLM 243 OHM 18 1/8W	28480		
IFXD MET FLM 392 OHN 18 1/8W	28480		1 2
IFXD NET FLM 562 DHM 18 1/8W	28480		1
IFXD NET FLN 825 OHN IT 1/8W	28480	0757-0421	1 1
IFXD MET FLM 1500 OHN 1% 1/8W	26480	0757-0427	
IFXD NET FLM 3.32K OHN 18 1/8W	28480		i
1FXD MET FLM 5.11K OHM 18 1/8W	26480		2
SFRD MET FLM 6.81K OHM 18 1/6W	26460		1
IFXD MET FLM 8.25K OHN 18 1/8W	28480	0757-0441	1 3
IFXD MET FLM 10.0K OHM 18 1/8W	28480	0757-0442	4
IFXD NET FLN 12.1K OHN 18 1/6W	28480		1 2
IFXD NET FEM 15.0K OHM 18 1/6W	28480	0757-0446	3
IFXD NET FLN 27.4K DHM 18 1/8W	28480		1
IFXD MLT FLM 51.1K OHN LT 178W	28480	0757-0458	, ,
IFXD MET FEN 56.2K DHM 18 1/8W	28480	0757-0459	
IFXD NET FLN 100K OHN 18 1/8W	28460		
FXD MLT FLM 182K OHN 1% 178W		0757-0471	1
IFXD MET FLM 392K DHM 18 1/8W		0757-0479	1
IFXO NET FLM 475K OHM IS 178W	28460	0757-0481	
IFXD MET FEN 562K OHN 18 1/8W	28480	0757-0483	1 1
IFXD MLT FLM 825 OHM 18 1/4W	28480	0757-0731	1
IFXD MET FLM 3.32K DHM 18 1/4W		0757-0743	1
IFXD MET FLM 5.62K OHN 18 1/4W	28480		
FXD MET FLN 681 OHN 18 1/2W	28480	0757-0816	
FXD FLN 1.2K UNN 2K 1/0W	28460	0151-0926	1 2
FXD FLM 2.OK UHN 28 1/0W	28480	0757-0931	1
FXD FLM 4.3K (HIN 28 1/6W		0757-0919	1
FFXD FLM 4.7K OHM 28 178W FFXD FLM 6.2K OHM 28 178W	28460	0151-0940 0151-0943	
1700 TER UKEN SRIP 24 1/08 'N	70,00	0101-0443	1
FXD FLM 6.6K UNM 28 1/6W	28480	0757-0944	,
1FXD FLM 8.2K WIN 28 1/8W	28480	0157-0946	1
FRD FLN 9-1K OHN 28 1/8W	28460		1
1FXD FLM 10K 0HM 28 178W 1FXD FLM 12K 0HM 28 178W		0757-0948	
TTAN TEN SEN UNN 75 LYON	26480	0757-0950	,
FXD FLN 15K OHN 28 178N	28480	0151-0452	1
IFXD FLM LOK UHN 28 178W	28480	0757-0453	I
FXD FLM 18K UHM 28 1/8W		0151-0954	,
FFXD FLM 27K LHM 2% 1/8W FFXD FLM 68K DHM 2% 1/8W		0757-0958	
TAU FLM OOK UND 25 1708	28460	0757-0868	•
FXD MLT FLM 22.1 OHM 18 172W	28460	0757-0942	1
FXD MLT FLM 196 OHM 18 1/2W		0757-1060	
FXD MET FLM 1.47K OHM 18 1/2W		0757-1078	1
FXD MLT FLM 180 DHM 13 178W	26460	0757-1102	1 1
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# See introduction to this section for ordering information

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🕒 Part No. 🔰	Description #	Mfr.	Mfr. Part No.					<b>.</b>	
		MIF.	MIT. FER NO.	TQ	Part No.	Description #	Mfr.	Mfr. Part No.	TQ
0758-0003	RIFXD MET UX 1000 DHM 58 1/2W		0758-0003	1	1051-0031	TRANSISTOR IGERMANIUN NPN			
0758-0004	RIFXD NET UX 2700 OHN 5% 1/2W		0758-0004	1	1051-0034	TRANSISTORIGERMANIUM NPN		2N1605	•
0758-0042	RIFXD NET UX 1300 OHN 5% 1/2W	28480	0758-0042	2	1051-0001	TRANSISTORIOR PAPER SILICON 30V 900MW		2N1605A	
0761-0024	RIFXD NET UX 2.4 OHN 58 LW	28480	0761-0024		1853-0007	TRANSISTORIPAP SILICON SUV 900AU		1853-0001	i
0761-0027	RIFXD NET FLN 2.7K DHN 54 1W	28480	0761-0027	4	1853-0008	TRANSISTOR:SILICON PNP	07263		19
0811-0150	RIFXD WW LLLK UHM 0.05% 1/8W		0811-0150	1	1853-0009	TRANSISTOR: SILICON PHP	28480	1853-0009	<b>.</b> .
0811-0152 0811-0154	RIFXD WW 90K UNN 0.01% 1/8W	28480	0811-0152		1853-0031	TRANSISTOR: SILICON PNP	04713	2N3789	1
0011-0201	RIFXD WW 10.0dOK CHM 0.1% 3/8W RIFXD WW 900K UNM 0.01% 1/4W		0811-0154 0811-0201		1853-0036	TRANSISTOR: SILICON PNP	28480	1853-0036	'
0611-0354	RIFXD WW LOOK CHW 1/100% 1W		0811-0354		1854-0003 1854-0014	TRANSISTORINPN SILICON TRANSISTORIDUAL NPN SILICON		1854-0003	1
0811-0355	RIFXD WH 899K LHM 0.058 1/4H	28480	0811-0355				•	1854-0014	
0011-0961	RIFKD WW 825 UHN 0.13 1/4W		0811-0961	3	1654-0039	TRANSISTOR: SILICON	02735	2N3053	
0811-0962	RIFXD HW 738 OHM 18 1/2W	28480	0811-0962	i i	1854-0362	TRANSISTOR: SILICON NPN	04713	MM3006	
0811-0963	RIFXD WH 1K 0.25% 1/4M	26460	0811-0963	Ž	1901-0016	DIODEISILICON	04713		-   i
0811-0995	RIFXD WW 11 UNN 58 3/16W	28480	0811-0995	1	1901-0025	DIODEISILICON 100W 100HA	28480		122
	•				1901-0029	DIODEISILICON 0.75A 200 PIV Diodeisilicon 600 Piv	28480		e
0811-1394	A FXD MM 2550 UNN 0.18 1/8M		0811-1394		1001-0027	DIODEISTFICOM DOU PIA	28480	1901-0029	2
0811-1516	RIFXD WW 4.495 NEGOHN .05% 2 PPN DEG C		0811-1516	2	1901-0036	DIODE:SILICON 1000 PIV	28480	1901-0036	
0811-2368	RIFED WW 2513 UHN 0.1% 1/8W		0811-2348		1901-0050	DIODEISILICON 75V	28480	1901-0050	
0612-0045	RIFXD NW 0.15 UNN 53 3W		0812-0045	2	1901-0058	DIODEISILICON 150V	03877	1901-0030 1N628	
0813-0007	RIFXD WW LOK UHM LOX 5W	28480	0813-0007		1901-0060	DIODEISILICON	28480	1901-0060	
0616-0014	RIFKD WW 1250 UNM LOX 10W	28480	0816-0014		1901-0061	DIODE: SILICON	03677	IN816	
250-0118	CONNECTURIENC		1250-0118 V		/				l v
251-0087	CONNECTURIFEMALE 50-PIN MINAT		1251-0047		1901-0071	DIODE+SILICON 30WV	28480	1901-0071	<b>1</b> 2
251-0119	CONNIFEMALE 37 CONTACTS		MS3102A28-215		1901-0081	DIODE:SILICON 50 VOLTS WORKING	28460	1901-0081	212
251-0135	CONNECTURIBUDY 15 PIN		1251-0135	15	1901-0143	DIODEISILICON	28480	1901-0143	2
					1901-0156	DIODEISILICON	28480	1901~0156	7
1251-0141	CONNIPC 18 CONTACTS	13511	143-018	3	1901-0434	DIODEISILICON 100 NA 50 WIV	28460	1901-0434	3
1251-0166	CONNIPC 10 CONTACTS ,	13511	143-010-08	1	1902-0022				
1251-0332	CONNIPC 24 CUNTACTS	28480	1251-0332	5	1902-0025	DIODE BREAKDOWN 2.67V		1902-0022	3
1251-0349	CONNIGUARDED CHASSIS 3 PAN MALE	28480	1251-0349	1	1902-0033	DIODE:BREAKDOWN 10.0V 5% 400 MW DIODE:BREAKDOWN 6.2V		1902-0025	- [ •
1251-0373	CONNITEFLON WHITE FEMALE	98291	SKT-23	4	1902-0094	DIODE:BREAKDOWN 4.85V 250NW	04713		
					1902-0096	DIODEIAVALANCHE 6.2V		1902-0094 1902-0096	
1251-0381	PLUGITERMINAL FELDTHRU TEFLON	98291		2			20400	1402-0046	1 4
1251-0475	CONNECTURIPC 6 CUNTACT		1251-0475	2	1902-0199	DIODE:BREAKDOWN 8.6/10.8V 100MW	28480	1902-0199	· · ·
1251-1024	CONNEPC BOLZKESICONTACTS		1251-1024	6	1902-0223	DIODE : BREAKDOWN SILICON 15.4V		1902-0223	
1251-1034	CONNIPC 2012X107 CONTACTS		1251-1034		1902-0675 🍙	DIODE+BREAKDOWN 5% 15.4V		1902-0675	
1251-1035	CONNIPC 36(2X18) CONTACTS	42630	600-111-18X	1 1	1902-0770	DIODEIBREAKDOWN SILICON		1902-0770	
1400-0084	FUSEHOLDERIEXTRACTOR POST TYPE	79515	342014		1902-3117	DIODEIBREAKDOWN 28 6.34V		1902-3117	1
850-0032	TRANSISTORIGERMANTUM PNP	02735							
1850-0037	TRANSISTORIGERMANIUM 2N274 PNP	86684			1902-3119	DIODE:BREAKDOWN:6.49V 2%	28480	1902-3119	1 1
850-0040	TRANSISTURIGERMANIUM PNP		1850-0040	5	1903-0003	DIODE: SILICON 38V		1903-0003	1
650-0046	TRANSISTURIGERMANIUM PNP	04713		2	1910-0011	DIODE+GERMANIUM 5MA AT 1V		1910-0011	5
1					1910-0016	DIDDEIGERMANIUN 100MA AT 0.85V 60PIV		1910-0016	145
650-0062	TRANSISTORIGERMANIUM ALLOY JUNCTION	28480	1850-0062	41	1910-0023	DIODEIGERMANIUM 83 WIV	28480	1910-0023	1
1850-0064	TRANSISTUK:GERMANIUN PNP	86684	2N1183		1910-0025				
1850-0075	TRANSISTUR: GERMANIUN PNP	87216	2N779Å	4	1910-0025	DIODE:GE 15WIV 6NS		1N995/5555G	6
1850-0111	TRANSISTORIGERMANIUM PNP		2N404A	68	1970-0009	DIODE:GERMANIUM Electron tube:Indicator 10 digit		1910-0037	
850-0113	TRANSISTORIGERMANIUM PNP	01295	2N1997	12	2100-0154	RIVAR COMP IN CHM 30% LIN C.15W	63594		6
					2100-0273	RIVAR COMP IN ORM SOL LIN 0.150 RIVAR COMP 3 MEGORM 201 5 COWLOG 1/4W		2100-0154	
850-0124	TRANSISTORIGERMANIUM PNP	04713				The second a second ave a CUMEDU 1/4W	2040U	2100-0273	1
850-0128	TRANSISTORIPHP GERMANIUM	01295		59	2100-0355	RIVAR COMP 2000 OHM 20% LIN 1/8W	284.00	2100-0355	1.
850-0132	TRANSISTURIGERMANTUM PNP		2N1540		2100-0364	RIVAR WW 20K DHM 5% LIN 1.0W		2100-0364	
850-0145 850-0092	TRANSESTURIGERMANTUM PNP		2N1926	{	2100-0369	RIVAR WH 200 DHH 10% LIN 1/4W		2100-0369	
ugy-vvy/	TRARSISTURIGERMANIUM	28480	1850-0147		2100-0371	RIVAR WW IK DHM 10% LIN 1/4W		2100-0371	
850-0183	TRANSISTUR: GERMANTUM PNP	28460	1050-0103		2100-0490	REVAR WE 100 UHN 108 1/2W		2100-0490	
850-0184	TRANSISTORIGERNANTON PNP		30339	49				<b></b>	· ·
851-0006	TRANSISTURIGERMANTUM NPN		20169A	]]	2100-0704	RIVAR WE LOK UHM LOE 2W	28480	2100-0704	1 1
	FRANSISTURIGERMANIUM NPN		2N388A		2100-0708	REVAR WW 20K UHM 10% 2W		2100-0708	
951-0024			******		1 1100 0330				•
351-0024					2100-0738 2100-0963	RIVAR COMP 200 OHM 103 1W RIVAR WW 8 OHM 103 2W	28480	2100-0738	1 2

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## Table 5-2. Replaceable Parts (Cont'd)

# See introduction to this section for ordering information

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## Section V

## Table 5-2. Replaceable Parts

(Cont'd)

# See introduction to this section for ordering information

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## 2401C

		Mfr.	Mfr. Part No.			• •	Description #	Mfr.		
				TQ					Mfr. Part No.	T
100-1420	R I VAR W 200 UHM 51 3/4W	28480	2100-1420	1		5060-5871	HP 2410B UNIT COUPLING LOGIC	04404	5060-5871	
100-1433	RIVAR NH 100 DHM 58 3/4H		2100-1433	3		5060-5872	CONTROL LOGIC A	04404	5060-5872	-
100-1454	RIVAR W 50 DHN 58 3/4W		2100-1454	1		5060-5673	CONTROL LOGIO C	04404	5060-5873	· ·
100-1455 100-1456	RIVAR WU 300 UHN 5% 3/4W RIVAR WU 2K OHN 5% 3/4W		2100-1455 2100-1456			5060-5874 5060-5875	AC & OHNS DELAY GATE HP 2411A DECINAL POINT LOGIC	04404	5060-5874	1.
		20400	2100-1430	•		5000-5015	THE 24LIA DECIMAL PUINT LUGIC	04404	5060-5875	
110-0006	FUSE: CARTRIDGE 2AMP 125V SLOW BLOW	71400		1		5060-6203	HP 2411A DECIMAL POINT LOGIC	04404		1
110-0007 140-0037	FUSE:CARTRIDGE 1 AMP 250V SLOW BLOW LAMP:INCANDESCENT 0.04A 28V		313001			5060-6205	HP 24106 UNIT COUPLING LOGIC	04404	5060-6205	
100-0464	SWITCHIRUTARY 6 POLE 6 POS	28480	2107D 3100-0464	12		5060-6206	AC & OHNS DELAY GATE	04404	5060-6206	
100-0466	SWITCHAROTARY W/250K OHM RESISTOR		3100-0466	1 1		5060-6274	GATE CONTROL Amplifier PC	04404	5060-6224 5060-6274	
				1 +1						
100-0711	SWITCH#ROTARY 12 POLE 3 OR 4 POS Switch#Rotary 8 Pos 3 Sect		3100-0711 3100-1402			5060-6275 5080-1439	AMPLIFIER PC TRANSFURMERIPULSE (SHIELDED)	04404		1
101-0001	SWITCHITOGGLE SPST		80994-H8			5080-1454	TRANSFURMERIPULSE	04404	5080-1439 5080-1454	
101-0004	SWITCH PUSHBUTTON SPDT		3101-0004	1 1		5080-1471	DIODE: BALAKOUNN 6.15-6.5V 400 MM	03877	SV9417	
101-0005	SWITCHITUG DPUT JAN #ST22N		95691	i		5080-6620	TRANSISTORISILICUN NPN		5080-6620	
101-0033	SWITCH4SLIDE DPDT	79727	6510 C		7	5080-6621	TRANSISTUR: SILICON NPN			
60-0026	FANITUBEAXIAL 50-60CPS			l i		6159-0005	JUNPER WIRE		5080-6621 8159-0005	
160-0097	FAN:TUBE AXIAL	28480	3160-0097	i		9100-0211	TRANSFORMER I PUWER		9100-0211	
060-2006	-35V REGULATOR & RESET CIRCUIT	04404	5060-2006	1		9100-1201	TRANSFORMERIPUWER		9100-1201	
060-2009	CONTROL LOGIC B	04404	5060-2009	1	3	9100-1211	TRANSFORMER # POWER	28480	9100-1211	
060-2010	CONTRUL LOGIC C	04404	5060-2010	1		9100-1221	TRANSFURMERIPULSE	28480	9100-1221	
60-2012	VOLTAGE COMPARATOR	04404	5060-2012	1		9100-2477	FILTERILINE 115-0-115V 1.5A		9100-2477	
60-2014	ATTENUATUR COUPLING LOGIC	04404	5060-2014	1		9110-0067	CHOKE135 HH 1.5A		9110-0067	
060-2015 060-2018	HP 24106 UNIT COUPLING LOGIC	04404	5060-2015		7	9110-0103	FILTERILINE 3 WIRE 1.5A	56289	JN10-11528	
00-2010	ATTENUATION CONTROL	04404	5060-2018		3	9130-0028	TRANSFORMER	56289	662808	
60-2052	DISPLAY CONTRUL			1	1	9140-0027	COLLIFXD RF 35 UH	28480	9140-0027	
060-2108 060-2111	HP 2411A DECIMAL POINT LOGIC		5060-2108		31	9140-0040	COILIFXD RF 420H	99848	1042-15-420	
60-2181	LOGIC CARD Overload detectur		5060-2111 5060-2181			9140-0053 9149-0 <u>8</u> 75	CHDKE/COLLIFXD 1 HH 10% Coll:FXD RF 270 UF	99848	31000-15-102	
60-2577	TRANSFORMER I PULSE		5060-2577			9140-0082	COILIFXO RF 15 UH	284.80	9140-0075 9140-0082	
·				'		9140-0107	COIL FAD AF 27 NH 101		1840-38	1
60-3639	DECINAL LANP ASSY		5060-3639	1				1 1	**	
60-3691	RELAY TINE CIRCUIT		5060-3691		Ň	9140-0112	COIL IFXD RF 4.7 UH		9140-0112	
60-3771	AC & UHMS DELAY GATE Reversible decade counter		5060-3771 5060-3781	1	<u>7</u>	9140-0174 9140-0210	COLLIFXD RF 220 NH 5%		9210-92	
60-3782	SERIES REGULATOR		5060-3782			9140-0237	COIL:FXD RF 100 UH 5% Coil:FXD 200 UH 5%		9140-0210 9140-0237	
				'		05214-6014	INPUT AMPLIFIER		05214-6014	1
60-3783	POWER SUPPLY AMPLIFIER		5060-3783	1						
60-3805	+6V BIAS SUPPLY RECTIFIER/FILTER		5060-3805 5060-3806			05232-6006 05232-6007	INPUT TRIGGER		05232-6006	
60-3809	COUNTER CONTROL		5060-3809	!	N	5212A-65C	INPUT AMPLIFIER Decade Divider		05232-6007	
60-3818	UNITS DISPLAY ASSY		5060-3818			5212A-65F	LOOKHZ USCILLATUR		05212A-65C 5212A-65F	
60-3829	CONTROL LOGIC A	04404	5060-3829	1.		5212A-9A	TRANSFORMER		5212A-9A	
60-3830	-35V REGULATOR & RESET CIRCUIT		5060-3830				·			
60-3838	BINARY PC		5060-3838		4					
60-3848	OPERATIONAL AMPLIFIER	I I	3848 4	ī					ι	1
60-3849	POSITIVE CHANNEL	04404	5060-3849	1	1		· <b>A</b>			
60-5001	NEGATIVE CHANNEL	04404	5060-5001		3				•	1
60-5002	GATE CONTROL		5060-5002							
60-5016	SCHMITT TRIGGER		5060-5016						ł	
60-5019 60-5115	NEON PHILTOCUNDUCTOR BLOCK ASSY Attenuator assy		5060-5019 5060-5115						·	ĺ
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60-5145 60-5610	OPERATIONAL AMPLIFIER Logic Card		5060-5145		}			- I -		
60-5655	OVERLOAD DETECTUR		5060-5610 5060-5655		1	1 1				
60-5870	ATTENUATUR CUUPLING LOGIC		5060-5870		-		•			1
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#### Table 5-2 Renisceshie Parte (Contid)

# See introduction to this section for ordering information

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## TABLE 5-3. CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Bandbooks.

Cade No	Manufacturer	Address	Code No	Manufacturer	Address	Code	Manufacturer	Address	Code No.	Manufacturer	Address
								AND THE			
00000	USA Common	Any supplier of U.S.	05245	Campanents Carp	C- 40 111	09145	Tech Ind Inc. Atohn Liect	Bulbank Calif	17670	Mi Gian Edison Ec	Manchesley # H
		aunt Halty Springs Pa	052//	Restinghouse Liectic Corp.			Electio Assembiles Inc	Chicago, Ill		Power Design Bacil : Inc	Pala Alto Calif
	Sage Electronics Corp. Cemco Inc.	Rochesler N Y Danielson Coan	65347	Sen» Conductor Dept Ultronia Inc	Youngwood Pa		C & K Components Inc	Benton Mass	18083	Clevite Curp See Londuels	
	Homidiat T	Colton, Calif		Union Carbide Colp - Elect	San Wateo Calif Div	09569	Wallory Ballery Co. ol Canada Lid Toro		18324	Signetics Corp	Pala Alte Calif Sunnývale Calif
	Nicialian Ca , Inc 🦛	Valley Stream N.Y.			New York N Y	09922	Buindy Corp	alo Galatio, Canada Norwalk, Conn		Ty Car Mig. Co. Inc.	Heilisten Mans
	Gallock inc Aelovok Colp	Cherry Hill N 2		Viking Ind Inc	Canoga Park - Calif		General Transistor Bestein Co		18446	TRU LIELL COMM Div	Des Plaines fil
	Ang Inc	New Bedford Mass Harrisburg Pa		love Electro Plastics Inc	Sunnyvale Calif			Los Angeles, Calif		Curlis Instiument Inc	WI Riste T Y
	Airrialt Radio Corp	Beanton A J		in a Dentinal Spen Co.	) Cleveland Ohfo		Te Tall lac Calborundum Co	Betheley, Calil		Vishay Instiuments Inc. E. E. DuPont and Co	Walvein Pa Vilmington Del
00815	Nothern Engineering Labora		05674	Barber Colman Co	Recklord (II		CIS of Beine Inc	Niagara Falis N Y Beine, Ind		Durant Mig Co	Bilmaukse Bis
00411	Shanna Alasta C. B. S.	Builington Wis	05724	Talten Optical Lu			Chicago Telephone of Californ		19315	The Bendis Corp	
00833	Sangano Electivo Col Prob	ens Div Pickens S.C	05778	Huslyn Heigh Metro Tei Curp	is Long Island N Y			o Pasadena, Calif	14144	<b>N</b>	Telerboio N j
00866	Gae Engineering La	Cily of Industry Cal		Stewart Engineering Co	Westbury, N.Y. Santa Cruz, Calif		Bay State Liectionics Corp	Tallham, Mass	13500	Thomas A. Edison Industries NeGraw Edison Co	Div of West Orange - N. 3
	Carl L. Holmes Corp.	Las Angeles Calif	05620	Babelield Engineering inc	Wabelietd Mass		Teledyne Inc. Microwave Div National Seal	Donaey Calif	19549	Concoa	Baldwin Park Calif
	Necrolab Inc	fixingsion # 1	06004	Bassick Co. Div. of Stewar			Precision Connector Corp	Janaica, N.Y.		LAC Liectionics	Horseheads N Y
1007	General Liectric Co., Capac	Hudson Falls, J. Y	54090	Happhen Laip	Bridgepoit Conn Reduced City Cold		Duncan Electionics Inc	Losia Mesa, Calif			ndependence Kansas
01009	Alden Products Co	Biochion Mass		ausch and Lomb Optical Co	Redwood Cily, Calif Rochester N Y	11741	General Instrument Corp Sem			General Alionics Coip Executone inc. Li	Philadelphia Pa ing taland City, A.Y
	Allen Urapley Co	Rilmaubee Bis		ETA Finduels Co. of Ami		11717	Div Products Group Imperial Liectronic Inc	Newark N J Buena Park Calif		Falmir Bearing Co. The	New Billain Conn
	Lollon Industries Inc.	Beverly Hills, Calif	06510	Anatan Efectionic Haidware			Weight Inc	Palo Allo Calif -		fansteet Betatturg-cat Corp	A Chicago (H
	TRW Senvionductors inc. Texas instruments inc.	Lawndale Calil		Nada tin to share and	Ren Hachelle k Y		National Semiconductor	Danbury Conn		Texscan Colp	Indianapris Ind
•	Transistor Products Dra	Dallas Texas	00333	Beede Electrical Instrument (	Lu Ini Penacool A H		Philadelphia Handle Co	Canden N J		Brilish Radio Electronics Eld G.L. Eamp Drivision	Bashington D.C.
	The Alliance Mfg. Co.	Alliance Ohio	06611	General Devices Co. Inc.	indianapolis Ind		Giove Mig. Co. In Gullon Ind. Inc. D. Co. In	Shady Grove Pa			aib Cleveland Offic
	Pacific Belays Inc	Van huys Calif		Conjunents Inc. Any Dis-	Phoenix Ariz			Albuquerque N N	24655		Best Concord Mass
	Gudebrud Brus Silk Ce America Coip	New York N.Y	06817	Jonington Mig. Co. Ness D		17697	Clarostat Mtg. Co	Dover N H		Mencellec Comp Dis	Humbington Ind
	Pulse Engineering Co	Rockford Ht	06966	Vacan Associational Div	- Van Nuys - Calet San Carres - Calet		Elmar Filler Corp	W. Haven, Conn		Parelic (ni San Ju Gries Repicducei Cuip	an Capistrano Calif
07114	Feriuscube Corp. of America	Saugetlies N.Y.		Refaile Dire to	Van huys Calif		Nippon Liectric Co., Lld. Netex Electronics Curp	Tokyo Japan Class M. S		Gichet File Co. of America - (	hre Hoinefte N.Y. 👞 .
07116	Wheelock Signals (no	Lon-Ucanch, M. J		Digitizan Constantia	Pasadena Catif			Claib R J wport Beach - Calif			( Instant )
	Cule Rubbei and Plastics inc	•- • •		Transister Declarations Course	Nonearais Non	12954	Dickson Blectionics Coip	Sculladate Arizona		Compan III - ster Cr	Bellenter Calif
	Amphenol Borg Flextronges C Radio July of Americal Sen		0/135	Protopouse Decitor Corp Distances Table Dec	1. mar		Theinalby	Oallas Texas		Hamilton Walch Le	L'ancaster Pa
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021/1	Vocatione Cu. of America. Inc				its of Industry Calif			Ansas Cily Ransas		Heyman Mig. Ei	Bendmoth, N.J.
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	Apex Nachine & Tout Co	Daylon Ohio		Minners (a Hebber Co	Winneapolis Winn			ini lesephone. I Palm Beach: Fla		Stanwyrk fill froduolf y Id	CHICARE (III )
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	Falbel Seat Co. Transolico Electric Curp	Bos Angeles Calif Babefield Nass	0/34/		W1 View Opprations		Cornell Dublier Flectric Corp	Newalk H j	36747	Cynniegtan 🕱 B. £ Biit Eb '	
	Printite Resistor to Inc.	Cedai Knolls N J	07706	Tricknoral Borr Products inc.	Vountfon View Catol Coanfuid N J		Corning Glass Boiss Llectre Culin Inc	Corning N Y	37542	ten Elle Matsing & Colline	inte ()ntaixo: (, anada
03954	Singer Co. Dieht Die			Bed we treat to A	Chicago Mi		Billians Mig. Co	San Gabriel Calif San Jose Calif		Rechanical andustries Pice Co	
04004	Finderne Plant	Summerville M J		Continental Device Colp	Hauthoine Care		Pebsler Electronics Co	New York N Y		Bin alure Pres sion Bearings	
0.003	Arrow Harl and Hegeman Ele	(† 1,0 Hailloid Conn	0/5(4	Raythevic Mity Co. Senioricadus Dive — — — — — — — — — — — — — — — — — — —	to at a block for t	1524	Science's Corp	Barthindge Calif	42196		Chicage pie 2
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	Acco Electronic Lec	Great Necs N Y			Rockaway N J	13336 1		Long Island & Y		Penn Eng. & Wig. Colog	- Digrestiwn "Pa - 2
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	P. N. Notus Company	Wesfchesler III	)		Eleveland Ohio			anoga Paik - Calif		honas & Betts C.c.	Elizabeth h j – 73
04919 1	Component MIg Service Co		08964 4		Indianapolis Ind		umpenents inc	Biddeford Wa	60741 1	og fett ( Sectorical Testorica	Blutten Ghio /
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#### TABLE 5-3.

## CODE LIST OF MANUFACTURERS (Continued)

Manufacture: Address 62819 Universal Electric Co. -0≠essc Nich 12243 Barris est and Electric Ce. WE VEINER A T 64969 Bantere Diestein Cu. ini hep tors A 3 63092 Besten lest int Beston hoffart Newark R 1 66795 Billes MIL Co. Collage 10 66346 Minnesola Mining & Mfg. Co. Hevere Mincom Bis-St. Past Minn 10716 Allen Wig Co Hailford Conn 70305 Allied Cuelics hen ters h t 70118 Alteretal Scien Preduct Co. Inc. Garden Cily A Y - 20412 Angles Dis of Cigssier City Detroit Mich - 20485 Alfantic India Rubber Stors Inc. - Chicage III 70362 Amperite Cullins Union City N J TOLTE ADE Preducts Inc. Winnespelle Winn 10903 Beiden Mtg. Co. Chicage HI 10998 Bird & feitennie ficie Creveland Ohie 11002 Bontach Had o tr fratics hat 21034 Bloby Checkie Co. Inc Lie Pa 71041 Besten Gear Burks Divisit Nurray Cr. Elevas Quiry Wass 11218 Bud Had o line 11218 Canto des Theoremonics Coop 11286 Canto Castener Coop 1 Desphis Obse Canti der Wass Paraning h a 21313 Caldme it indensel Cop a independent L.E. A.A. 71400 Bussmann Mig. C.v. of Michian Edisant 11 Co. 1 No HOL Children Condenses City - (* «**19**4) F1447 Calif Spring C. and Fill Barra Cart ENTER INC and Argensi card 21671 COMMAN DIA ARIANGA LENG Rentana Canid 11462 (L. P., C. avera, C. M. 21556 - Cristiana B. B. V. C. Griefer von Gri Chicage are Here Conner Easter ( СР сар. — 119 Прем Усла, Н. У HIRE COMMENTER THE Annalesia 6 ( 0.046-0 TITES Concerning the second se 1984 Deals many tage Waland Was 77136 Treste Wilser Wig, L., Jos, Biste Jota, Crea HUS EXPLOYED Bearing to B. P. THESE Indiana General Comp. Conclusion of Co. HEASTER NO. 1 12699 Breach Barbarrand Co. Car Eschemans, h.y. 2011 Dept. Mrg. P. Hala chi phi c 1212 Bart R. Its Ger . It she had far a A.S. S. Garden and O GE When the the North Sec. 6 h i 1.514 Hillert W. Hartes C A CALENCE AND Trans to test a provide to the Transfer development of the to ta That is the second Et sea de la 7813F HELL TELL THERE A LINE IN اليناي ال 24,63 Hopesting (eq., a) 18,1165 A state tera chia chia a HERE & price for the Press e i c. h. r. 1354 bornes ta destructo harandaza e su 2355 Sula de Electro Igalo Hasteria com 1554 de celo Magneto Tranto Ang 1 40 C A 1 2004 Geogram av otter i Davidete 1970 - David the stepped to 73734 Federal Science Friday por 11.136 7334 - Koste Starla skip d. 73395 - Geletar Stort kyld i Stee Concernation (Concernation) 1 real tests

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#### TABLE 5-3.

### CODE LIST OF MANUFACTURERS (Continued)

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	.~	1		1960	Manufacturer *	A60/855	No.	Manufacturer	Address
		All Sing of the m	"Peftance Obia"	86684	Badie Ceip Sit-Angelté, Flochonic		95566	Arnold Laginsering Co	Matenge, III.
		Avery Caber Co	Discould Calif			Ratessón, H. J	15747	Dage Llector Co . Inc	ftanklin, ind
		- Halleman weid Die Einigen (* 1775) 1986 - Anne Anne Anne Anne Anne Anne Anne An	MARE HIR, N.C.			ilendale, Colst.		Siepon Mig. Co	<b>∀oy</b> ×o, (()
•		- SMD-RH1 - Arneld Ex Jos - Usoki Gray Ex 1	fiustan, Mang 🕚			Angheim, Calif:		Wechenger Co	-Chicago, III,
		international influments inc.	- Osylan, Ohia Disega Conn		Philes Corporation 11 dasdata Divis	· ·		Nicrowave Assoc., West Inc.	• • •
		Graybolt Cu	LaGrange III	1443	Anstere ji ibraus Gfass Products Co.	Lansdøle Pa		Ri Q Div. of Aelovoj Calp. Thaideisan-Neissgei Inj	Olean, H.Y. Mi Garmet, Hi
		Triad Transformer Curp	Vanice Calif			anciaco, Calif		Solar Manufar Inrea Co	Los Angéles, Calif
	E1312	Rinthester ties Div A ton	int in .	67664		entitte, Calif.		Microswillen, Div. of Minna	
		et al a second s	1 Dakville Conk			evidence fi i	•		Fiteport, 111,
	- 117	Militaty Spearfis aliun				, Lincolu, III, +		Chilles Series Co	Chicago, III.
		international firstifier Corp. Aupan Litertichers Inc	t segundu, Calif	66770	-Guudat National Baltesies, Inc	I. Pavl, Minn		Nicronove Associates, Inc	Buclington, Mass
		Barry Controls Div Darry W		-		Butlelo, N.Y. Daktand, Cylif 🕗		lacel Lidnalormer Co' San Eduando Edual Min. Co	Gabland, Calif.
	,		Waterlown Mass			eneclady, N.Y.	30134	San Feinando Eterl. Nig, Co	
	83042	Carter Precision Liegher Co.	Shable, Ill		United Transformer Co	Chicago, III	96681	Thomson Ind Inc.	San Feinando, Calif Long Is., N.Y.
	11011	-Speit: Faladay tex 🖉 Coppey I	len it	9001	United Shop Machiners Corp	Beudely, Nasa.		Industrial Rotaining Ribg Co.	livington, N.J.
	1	tercha Der .	Hoboken N.J	90179	-115 Abblef Ca' , Çansumer Ind. 8 (*)	fastica	etste –	Automatic & Precision Mfg	Englewood, N. J.
		Elmetere Regulator Corp	Normalk Cosa		Prod Viv f	Passaic, N.J.		Rean Resistor Corp	Yankeis, N.Y.
•	1/14/	Jallers Ligelronics Division e , Carbon Co	· · · · · · · · · · · · · · · · · · ·			encișcu, Calif		Litton System Inc. , Adies We	1
	17170	Tairshild Canera & Impi Corr	Ou Boit, Pt. Soare & Defense			Salam, Mass		- Cammun Div	New Rochelle, N. r
٠.		Systen Div.	Paramusy N. J			nncisco, Calif I Nonie, Calif		R-Tioncis; Inc.	Jamaica, N.Y. Tardena, Cavil
•	\$7709	Nagure Industries Inc	üleenwigh Cabn		Radic Maleriats Co	Chicago, Ill.		Hewlett-Pathaid Ba , Mosele	
	87719	Sylvania Electric Prode Inc.			• • • •	llebora Mass			Pasadens, Calif.
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•			mark Harlison, N.J.			ow Gynve, Pa		Seater Lio Corp	Namðioneak, N.Y
		Smils Defall (n)	- Ehielago, ill.			selialo, Hass		Zera-Mig. Co	Burbank, Catil
	41641	Wetate & Contrate Inc. Spence	Affieberu Mass-		NI Devalogment Co - Redwo White Hig. Cr., inc.	od Coly Calif.		"All Sur Concernent Mañas ha a - Chaobhan a	Cleyvland, Okio
•	E2768	Phillips Advance Control Ca.			Huneywell (m. 1990) South Dry	Chichge, Ill e.	24131	General Willis inc. Lteetjoni	Ninneapolis Nian
		Artrach Pluduits Corp.	Wadison, Wis		stand and for the sector the	Freepayl, III	98/34	Paeco Div. al newiett Packa	d Co
,	878/7	Holion Nig" fe Inc	Wandstals N Y	91961	Nahn Bros, Spring'Cu	abland, Catif			Pain Alto, Calif.
		Verty Liernanie Ce	Glendale Calif		The Constitut Comp P	eatody: Nass	98821	North Holds Eductronics, Hac-	Glen-Cove, N.Y .
4 1		fiaitaett Luig	Lus Angeles Calif &			ichesler, N.Y	585/8	International Electronic Resea	iich Corp
		Cart Lastener Co	Ganbridge, Mass .	\$2602	Tensulete insulated Bere Cu., inc.				Burbanh, Calif
•	01061	hen Bally shire Ball Bearing	Peleibsrough, M.H.	6 7 Ta 7		illythwn, N.Y		Columbia Verhnocal Coip.	New Yolk, N.Y.
	61175	General Instrument Colp. Ca	pacifor Div			Lisiana, M. Y. Rediady, N. J.		Valian Associates *	Palo Atto Calel,
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	e fix en	Unnin Cathide Corp. Consume	New York, N.Y.		Wagner Flett: Corp.: Tung Lot Dre. Cujfran Wright Corp.: Fleetronica Dre.	newalk N J		) LEONING HEVENDORS HAV	
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	83942	Aeronautical Inst. & Hadio Cy.				Beliwoud, 111			•
	64171	Area Electronica Inc.	Great Neck, N.Y.		Aslomatic Netal Products Co	roaklyn, N. Y			
•			an Feancisco, Calif	94142	Nofcester Pressed Aluminum Corp.	د	10000	Notes Tool and Die	Los Angeles, Calif
		THM Câpaciter Div	Ogalikia, Neb			cester, Mass	09007	Willow Leather Products Cor	p. Newark, H.J.
		Saikes Tatzian, Inc. Boonton:Wolding Concany,	Blookington, Ind. Boontan, W. J		Magnecraft (Jectic Co George & Philbijth Researchers (ni	Chicago, III	00044		Ø
			an trancisco, Calif	24043 8		estor dess	000A8 00086	- ETA Precision Instrument Compo	England
		- · · · · · · ·	an Francisco Calif	- 9573E -	Atties Products Corp.			Creersive Instignant Compo	Van Nuys, Calif
		Reifed Hurds Inc	Hamden Coan		<b>A</b>	odside, N.Y.	000CS	Hewlett-Packaul Ço., Colorad	
		Sean tess Rubber Co	Chicago, (UZ	932L3	Leecraft Neg Co. Inc	Island, N.Y		-	de Splings, Cululada
		Falser Beasing Ca.	Los Augeles Calif			heridan, Wya	DOOMM	Rubbergeng & Development	
•	45157	Clifton Precisiog Products Co				report. Conn	000N N	A "N"D Mig. Co	San Jone, Calif
		Pillision Hulter Products Con			a a faar a fa	omfield, N j Nantawa ili	00000	Coolings Colings Contain Lab	Oakland, Calif.
			e veline. Ante	4 1	· , ·	Neadows, Ill	000WW 000YY	California Lastein Leb S.K. Smith Co	Builingion, Calif Les Angeles, Calif
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## MANUAL SUPPLEMENT

## Model HP-2401C Integrating Digital Voltmeter

**Option 21** 

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## 21.1 GENERAL DESCRIPTION

The HP-2401C-21 Integrating Digital Voltmeter provides positive true recorder outputs in 8-4-2-1 binary code instead of the 4-2'-2-1 code provided by the standard HP-2401C recorder outputs. (See Tables 2-4 and 21-1.) Except for this difference in coding, the specifications in Section 1.7 apply without change to the HP-2401C-21.

## 21.2 INSTALLATION AND OPERATION

Install, operate, and program the HP-2401C-21 as specified in Section II of this manual.

## 21.3 THEORY OF OPERATION

The theory of operation of the HP-2401C-21 is the same as that of the standard HP-2401C except as noted in the following paragraphs.

## 21.3.1 Printer Coupling Logic A22 (Figure 21-1)

The logic and circuitry shown in Figure 21-1 converts decimal and function inputs to 8-4-2-1 BCD outputs for recording. The decimal  $10^{-n}$  and function numbers from this assembly are identical to those from a standard printer coupling logic assembly, but they are in 8-4-2-1 code instead of 4-2'-2-1 code.

## 21.3.2 Reversible Decade Counters All-Al5 and A46 (Figure 21-2)

The decade counter shown in Figure 21-2 differs from that shown in Figure 4-17 only in the arrangement of pedback. The waveforms associated with forward and backward counting of HP-2401C-21 decades are shown in the circuit diagram, Figure 21-2.

The decades always count up during frequency measurements and during the first phase of voltage measurements. Up counting is enabled when the count down line is clamped to ground (positive true) and the count up line is near -35v. Both of these signals are provided by Counter Control Logic on A16. These states close the down count AND gates and open the up count AND gates. Positive triggers are coupled from the collectors of odd-numbered transistors (Q1, Q3, Q5, Q7) to succeding stages. Each trigger advances the count by one. When the count is advanced from nine to zero, the turn on of Q7 generates a trigger that increases by one the count in the next decade, and so on through all six counting units. The up count progression is as follows:

Up Even-Nu	
Count Transis	ors On BCD Output Table
0 None	. 0
1 Q2	1
2 Q4	2
3 Q2, Q	
4 Q6	/ 4
5 Q2, Q	6 1+4 •
6 Q4, Q	
7 Q2, Q	
8 Q8	8
9 Q2, Q	8 1 + 8
10 None	

At the forward count of eight, conduction through Q8 and CR20 inhibits triggering of Q3-Q4 by Q1, assuring that Q3-Q4 and Q5-Q6 remain in zero state (Q3 and Q5 on), when the count of ten resets Q1-Q2 to zero state. The resetting of Q1-Q2 to zero state also resets Q7-Q8 to zero state through forward count AND diode CR13 and OR diode CR21.

Down counting is commanded by the Counter Control Logic on A16 when the polarity of the input voltage reverses. This is enabled by the positive-true state of the count  $\overline{up}$  line, which closes the up count AND gates, and the negative-true state (near -35v) of the count down line, which opens the down count AND gates. Positive triggers are then coupled from the collectors of even-numbered transistors to succeeding stages. The count progress-ion is exactly the reverse of the up count progression, which is summarized above.

Starting from the zero state:

- a. The first reverse count trigger sets binary Q1-Q2, triggering binaries Q3-Q4, Q5-Q6, and Q7-Q8 to set state through reverse count AND diodes CR14, CR16, and CR18. Turn-on of Q8 triggers binaries Q3-Q4 and Q5-Q6 back to zero state, leaving Q2 and Q8 on, representing a nine count.
- b. The next trigger sets Q1-Q2 to zero state, reducing the count to eight.
- c.

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The third trigger sets Q2, Q4, and Q6 on, which resets Q7-Q8 to zero state, establishing the count of seven.

The remaining triggers continue subtraction as indicated so long as the reverse count is enabled. Each time a trigger sets the decade from zero to nine during reverse counting, the turn on of Q8 triggers the next decade through reverse count AND diode CR22, reducing the count of the next decade by one.

# 21.4 MAINTENANCE

Figures 4-17, 4-23, and 4-24 are superseded by Figures 21-1 and 21-2 in this section; performance checks 15 and 16 of Table 4-3 are replaced by checks 21.1 and 21.2 in Table 21-2. Otherwise, the maintenance instructions in Section IV of this manual are directly applicable without change to the HP-2401C-21.

Data	Function	Logic	8	4	2	1
0	Period (W/30)		0	0	0	0
1	+VDC		0	Ō	Ŏ	1
2	-VDC		Ó	Ō	1	0
3	KC -		Ŏ	õ	1	1
4	KΩ (W/HP-2410B)	]	Õ	ĩ	· Ô	Ô
5	MΩ $(W/HP-2410B)$		ŏ	1	ň	1
6	Spare		ŏ	î	1	ō
7	Spare	ľ	ŏ	1	1	1
8	Time		1	Â	- 0	ō
9	Overload -		1	Ő	0	1
	VAC (W/HP-2410B)		1	õ	1	1

Table 21-1 Function Coding

## 21.5 PARTS LIST

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The Parts List in Section V of this manual applies to the HP 2401C-21 except as indicated in Tables 21-3 and 21-4.

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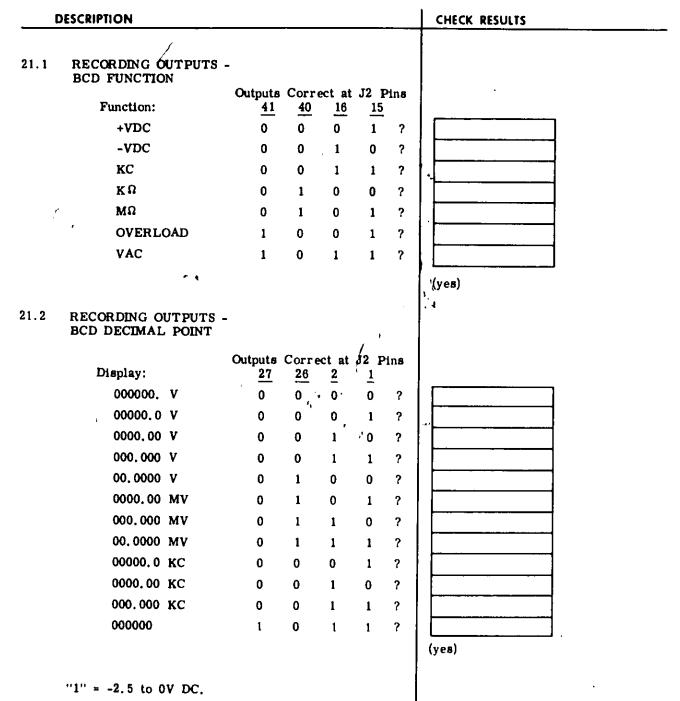
Table 21-2. In-Cabinet Performance Checks Perform checks 1 through 14 and 17 through 24 as specified in Table 4-3 and Section 4.2. 21.1 RECORDING OUTPUTS - BCD FUNCTION , 1 digit. 4-line 8-4-2-1 code. "O" state level, -35 to -24.5V; "1" state level, -2.5 to 0V. Source impedance, 33K. Determine and record dc function levels at the following pins of J2: a. 1 J2 Pin: 41 40 16 15 Function Control Settings 8 4 2 Code: 1 +VDC VOLTS, INT+1V VOLTS, INT-1V Ō δ Ō T -VDC 0 0 1 0 KC FREQ 0 0 1 1 KΩ EXT SEL, 1V EXT SEL, 1V (W/DY-2410B)0 0 1 0 MΩ (W/DY-2410B)0 1 0 1 **OVERLOAD** VOLTS, 1V* 0 0 1 1 VAC (W/DY-2410B) EXT SEL, 1V 0 1 1 1 Ļ *W/dc input sufficient to produce OVERLOAD indication. The source impedance is determined by fixed value 33K resistors, which can be b. seen in the assembly A22 circuit diagram in Figure 21-1. 21.2 **RECORDING OUTPUTS - BCD DECIMAL POINT** Specifications same as for 21-1. а. Set HP-2401C FUNCTION switch to VOLT, other controls as specified below; determine and record dc decimal levels at the following pins of J2; short-circuit HI, LO, and GUARD terminals to assure all zeros reading. J2 Pin: 27 2 26 1 Range Sample Period **Decimal Position** Code: 8 4 2 1 1000V .01 Sec 000000. V δ δ δ δ (10-9) 1000V 0.1 Sec 00000.0V (10-יוֹ 0 0 0 1 100 V 0.1 Sec 0000.00V 0 0 1 0  $(10^{-2})$ 10 V 0.1 Sec 000.000 V 0 0  $(10^{-3})$ 1 1 1 V 0.1 Sec 00.0000 V 0 1 0 0  $(10^{-4})$ 0.1 V 0.1 Sec 0000.00 MV (10^{-5³} 0 1 0 1 0.1 V 1.0 Sec 000.000 MV 0 1 (10-6) 1 0 0.1 V 1.0 Sec 00.0000 MV 0 1 1  $1^{**}(10^{-7})$ **W/HP-2411A at +10 gain (10 MV full scale), FUNCTION at EXT SEL, Card A30 installed. Disconnect short from HI, LO, and GUARD terminals. Set HP-2401C FUNCTION b. switch to FREQ, ATTENUATION control just clockwise from switched CHECK position, other controls as specified below. Use DC Null Voltmeter to check decimal levels at the following pins of J2. J2 Pin: 27 26 2 1 Sample Period **Decimal Position** Code: 2 8 4 1 .01 Sec 00000, 0 KC Ō σ Ū T (10-1) 0.1 Sec 0000,00 KC 0 0 1 0  $(10^{-2})$ 1.0 Sec 000.000 KC 0 0 1 1  $(10^{-3})$ STOP 000000 0 (10-0) 1 1 1 The source impedances are determined by fixed value 33K resistors, which can be C. seen in the assembly A22 circuit diagram in Figure 21-1.

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## PERFORMANCE CHECK TEST CARD

SER _____ - ____ DATE _____



"0" = -35. to -24. 5V DC.

21-1 of 1

Table 21-3. Reference Designation Index	Table	21-3.	Reference	<b>Designation Index</b>
-----------------------------------------	-------	-------	-----------	--------------------------

Reference Designation	Part No.	Description # _	Note
		OPTION 21	
		A11 5060-5066	
		MAKE THE FOLLOWING CHANGES TO TABLE	
		5-1 TO MAKE THE TABLE APPLICABLE TO THE HP 2401C-21:	
A11-		DELETE THE FOLLOWING:	
A15	5060-3781	REVERSIBLE DECADE COUNTER	
A22	5060-2111	LUGIC CARD Logic Card	AE FX
A46	5060-5610 5060-5066	REVERSIBLE DECADE COUNTER ADD THE FOLLOWING:	F - X
A11- A15	5060-5066	KEVERSIBLE DECADE COUNTER	
A22 A46	,5060-5611 5060-5066	PRINTER COUPLING LOGIC REVERSIBLE DECADE COUNTER	
•		REVERSIBLE DECADE COUNTER	
A11	5060-5066		
A11A1	NSR	READOUT BLOCK ASSY	er i
A11C1-	0140-0105	C:FXD MICA 130 RF 5% 300 VDCW	
A11C6	0140-0195	C:FXD MICA 180 PF 25 100 VUCH	
A11C7 A11C8	0140-0219 0140-0195	C:FXD MICA 180 PF 43 444 C:FXD MICA 130 PF 5% 300 VDCW	
A11C9	0140-0195	CIFXD MICA 130 PF 5% 300 VDCW	
A11C10	0140-0194	C:FXD MICA 110 PF \$%	
A11C11	0140-0194	L:FXD MICA 110 PF 募構	
A11C12	0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	
A11C13- A11C18	0140-0194	CIFXD MICA 110 PF 5%	
AllCRI- AllCR8	1901-0025	JIDDE:SILICON 100WV 100MA	
ALLCR9-			
A11CR24 A11CR26-	1901-0081	DIODE:SILICON 50 VULTS WURKING	
A11CR34	1901-0091	DIUDE:SILICON 50 VOLTS WURKING	
A1101- A1108	1850-0184	TKANSISTOR:GERMANIUM PNP	
A1181	0683-3945	R:FXD CDMP 390K OHM 5% 1/4W	
A11R2	0683-5635	R:FXD COMP 56K UHMS 5% 1/4W	
A11R3	0683-5635	RIFXD COMP 56K OHMS 5% 1/4W	
A11R4	0683-1045	REFXD COMP 100K DHMS 5% 1/4W	
A11R5 A11R6	0683-3945 0683-5635	R:FXD COMP 390K OHM 54 1/4W R:FXD COMP 56K OHMS 58 1/4W	
A11R7	0683-5635	R: FXD COMP 56K OHMS 5% 1/4W	
ALIRB	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W R:FXD Comp 390k ohm 5% 1/4W	
A11R9 A11R10	0683-3945 0683-5635	RIFXD COMP 590K OHM 54 174W RIFXD COMP 56K OHMS 58 1/4W	
1			,
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# Table 21-3. Reference Designation Index (Cont'd)

OPTION 21 AT1 B000 5001 CONTENT         OPTION 21 AT1 B000 5001 CONTENT           111 0003-1003 112 0003-1003 113 0003-1005 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 113 0003-2003 114 000-2001 114 114 0003-2003 114 0003-2003 114 0003-2003 114 0003-2003 114 0003-2003 114 115 0003-2003 114 115 0003-2003 114 115 0003-2003 114 115 0003-2003 114 115 0003-2003 114 115 115 0003-2003 114 115 115 115 115 115 115 115 115 115	Reference Designation	Part No.	Description #	Note		Reference	Part No.	Description #	
AT 18 Sec. Sold (CONTR)         AT 18 Sec. Sold (CONTR)           111         0.83 - 10.52         at 20 Controls (CONTR)           112         0.83 - 10.52         at 20 Controls (CONTR)           113         0.83 - 10.52         at 20 Controls (CONTR)           113         0.83 - 10.52         at 20 Controls (CONTR)           113         0.83 - 10.52         at 20 Controls (CONTR)           114         0.84 - 10.55         at 20 Controls (CONTR)           115         0.83 - 10.52         at 20 Controls (CONTR)           116         0.84 - 10.55         at 20 Controls (CONTR)           117         0.84 - 10.55         at 20 Controls (CONTR)           117         0.84 - 10.55         at 20 Controls (CONTR)           117         0.84 - 10.55         at 20 Controls (CONTR)           118         0.84 - 10.55         at 20 Controls (CONTR)           119         0.84 - 10.55         at 20 Controls (CONTR)           110         0.84 - 10.55         at 20 Controls (CONTR)           111         0.84 - 10.55         a					11	Designation			No
ATT Book-See         ATT Book-See         ATT Book-See         ATT Book-See           111         0021-563         kifs 0 Comp Set, Ums St 1/44         ATT         ATT Book-See			OPTION 21					OPTION 21	
111       062-7632       #FED DOP Sex PMIS 51 1/44         112       062-7632       #FED DOP SEX PM			A11 5060-5066 (CONT'D)		1				
113       0003-1000       NEFG COP 1000       NEFG COP 1000       NEFG COP 1000       NEFG COP 1100       NEFG COP 11000       NEFG COP 1100 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>A22 5060-5611</td><td></td></t<>								A22 5060-5611	
113       00001-304-5       ALTRO COMP 300, DUP 31 (JAN)         114       00001-304-5       ALTRO COMP 300, DUP 31 (JAN)       ATZ       SAME AS ATL USE PREFIX ATZ         115       00001-205       REFAD COMP 320, DUP 31 (JAN)       ATZ       SAME AS ATL USE PREFIX ATZ         116       00001-205       REFAD COMP 320, DUP 31 (JAN)       ATZ       SAME AS ATL USE PREFIX ATZ         117       00001-205       REFAD COMP 320, DUP 31 (JAN)       ATZ       SAME AS ATL USE PREFIX ATZ         118       00001-205       REFAD COMP 320, DUP 31 (JAN)       ATZ       SAME AS ATL USE PREFIX ATZ         119       00001-205       REFAD COMP 320, DUP 31 (JAN)       ATZ       SAME AS ATL USE PREFIX ATZ         119       00001-101       REFAD COMP 320, DUP 350, DUP 350, DUP 31 (JAN)       ATZ       SAME AS ATL USE PREFIX ATZ         110       00001-101       REFAD COMP 320, DUP 350, DUP 31 (JAN)       ATZ       SAME AS ATL USE PREFIX ATZ         120       CORE-5620       REFAD COMP 320, DUP 31 (JAN)       ATZ       SAME AS ATL USE PREFIX ATZ         121       CORE-5620       REFAD COMP 320, DUP 31 (JAN)       ATZ       SAME AS ATL USE PREFIX ATZ         121       CORE-5620       REFAD COMP 300, DUP 31 (JAN)       REFAD COMP 300, DUP 31 (JAN)       REFAD COMP 300, DUP 31 (JAN)         12	1811								
111       0003-5633       REFAD COMP Set UNY       ATZ       SAME AS ATL USE PREFIX ATZ         101       0003-5633       REFAD COMP Set UNY       ATZ       SAME AS ATL USE PREFIX ATZ         101       0003-5635       REFAD COMP Set UNY       ATZ       SAME AS ATL USE PREFIX ATZ         102       0003-5635       REFAD COMP Set UNY       ATZ       SAME AS ATL USE PREFIX ATA         2003-5635       REFAD COMP Set UNY       REFAD COMP Set UNY       ATZ       SAME AS ATL USE PREFIX ATA         2003-5635       REFAD COMP Set UNY       REFAD COMP Set UNY       REFAD COMP Set UNY       ATZ         2003-5635       REFAD COMP Set UNY       REFAD COMP Set UNY       ATZ       SAME AS ATL USE PREFIX ATA         2003-5635       REFAD COMP Set UNY       REFAD COMP Set UNY       ATZ       SAME AS ATL USE PREFIX ATA         2003-5635       REFAD COMP Set UNY       REFAD COMP Set UNY       ATZ       SAME AS ATL USE PREFIX ATA         2003-5635       REFAD COMP Set UNY       REFAD COMP Set UNY       ATZ       SAME AS ATL USE PREFIX ATA         2003-5635       REFAD COMP Set UNY       REFAD COMP Set UNY       REFAD COMP Set UNY       ATZ         2003-5635       REFAD COMP Set UNY       REFAD COMP Set UNY       REFAD COMP Set UNY       REFAD COMP Set UNY         2003-563	L1R12 L1R13			1					
113       0083-5635       ALEXE COMP SECURE SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         114       0083-1045       NEXED COMP SECURE SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         125       0083-2235       NEXED COMP SECURE SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         125       0083-2235       NEXED COMP 22X UP SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         23       0083-2235       NEXED COMP 22X UP SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         24       0083-2235       NEXED COMP 22X UP SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         25       0083-2235       NEXED COMP 22X UP SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         26       0083-2235       NEXED COMP 22X UP SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         27       0084-5425       NEXED COMP 25X UP SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         28       0085-5425       NEXED COMP 25X UP SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         29       0085-5425       NEXED COMP 25X UP SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         20       0085-5125       NEXED COMP 25X UP SE L/AU       ATZ       SAME AS ALL USE PRETX ALZ         20       0085-525       NEXED COMP 25	L1R14					5			
17-0       008-223-5       At A       SAME AS AT, USE PREFIX AND SAME A	11R15					A12		SAME AS A11, USE PREFIX A12	
17-2     10-2     17-2     10-2     17-2     10-2     17-2       23     00-3-22-3     14-4     5.04 F A S ATL USE PREFX AT       24     00-3-22-3     14-5     5.04 F A S ATL USE PREFX AT       25     00-3-22-3     14-5     5.04 F A S ATL USE PREFX AT       26     00-3-22-3     14-5     5.04 F A S ATL USE PREFX AT       27     00-3-22-3     14-5     5.04 F A S ATL USE PREFX AT       27     00-3-22-3     14-5     5.04 F A S ATL USE PREFX AT       27     00-3-22-3     14-5     5.04 F A S ATL USE PREFX AT       27     00-3-22-3     14-5     5.04 F A S ATL USE PREFX AT       27     00-0-0-1     10-0-0-1     10-0-0-1       17     00-0-0-1     10-0-0-1     10-0-0-1       17     00-0-0-1     10-0-0-1     10-0-0-1       17     00-0-0-1     10-0-0-1     10-0-0-1       17     00-0-0-1     10-0-0-1     10-0-0-1       17     00-2-0-2     14-2-0-0-0-1     10-0-0-1       17     00-2-0-2     14-2-0-0-0-1     10-0-0-1       17     00-2-0-2     14-2-0-0-0-1     10-0-0-1     10-0-0-1       17     00-2-0-2     14-2-0-0-0-1     10-0-0-1     10-0-0-1       17     00-2-0-2     10-0-0-1	L1R16	0683-1045				A13		SAME AS A11. USE PREFIX A13	
23       068-2625       R1PAD CDMP 224, DHH 55 1/44       A15       EAME AS ATLUSE PRETX AIS         24       068-2625       R1PAD CDMP 224, DHH 55 1/44       A22       ERB-6611       PRINTER COUPLING LOGIC         25       068-2625       R1PAD CDMP 326, DHH 54 1/24       A22       ERB-6611       DIDDE15111CON 50 VDLTS WORKING         26       068-2625       R1PAD CDMP 326, DHH 54 1/24       A22       B264-0031       DIDE15111CON 50 VDLTS WORKING         27       068-2625       R1PAD CDMP 326, DHH 54 1/24       A22       B264-0031       DIDE15111CON 50 VDLTS WORKING         28       068-2625       R1PAD CDMP 326, DHH 54 1/24       A22       B100-0031       DIDE15111CON 50 VDLTS WORKING         29       068-2625       R1PAD CDMP 366, DHH 51 1/24       A2260-001       B100-0031       DIDE15111CON 50 VDLTS WORKING         20       088-2635       R1PAD CDMP 366, DHH 51 1/24       A2260-001       DIDE15111CON 50 VDLTS WORKING         20       088-2635       R1PAD CDMP 366, DHH 51 1/24       A2260-001       DIDE15111CON 50 VDLTS WORKING         21       088-2635       R1PAD CDMP 366, DHH 51 1/24       A2260-1001       DIDE15111CON 50 VDLTS WORKING         23       088-2635       R1PAD CDMP 360, DHH 51 1/24       A22602       DIDE15111CON 50 VDLTS WORKING         23	L1R17-	0003-2043	KIFAD COMP 100K UMMS 54 174W			A14			
25       0.643-2235       RFAD COMP 226 CMIX 55 (1/W)         26       0.645-2235       RFAD COMP 560 CMIX 51 (1/W)       A22       560-6611         27       0.665-522       RFAD COMP 560 CMIX 51 (1/W)       A22 (1/W)       A22 (1/W)         27       0.665-523       RFAD COMP 560 CMIX 51 (1/W)       A22 (1/W)       A22 (1/W)         28       0.665-523       RFAD COMP 560 CMIX 51 (1/W)       A22 (1/W)       A22 (1/W)         28       0.665-523       RFAD COMP 560 CMIX 51 (1/W)       A22 (1/W)       A22 (1/W)       DIODE 51 (1/CMIX 50 VOLTS WORKING         29       0.665-623       RFAD COMP 560 CMIX 51 (1/W)       A22 (1/W)       A22 (1/W)       DIODE 51 (1/CMIX 50 VOLTS WORKING         20       0.665-623       RFAD COMP 560 CMIX 51 (1/W)       A22 (1/W)       A22 (1/W)       DIODE 51 (1/CMIX 50 VOLTS WORKING         20       0.665-623       RFAD COMP 560 CMIX 51 (1/W)       A22 (1/W)       A22 (1/W)       DIODE 51 (1/CMIX 50 VOLTS WORKING         20       0.665-623       RFAD COMP 560 CMIX 51 (1/W)       A22 (1/W)       A22 (1/W)       DIODE 51 (1/CMIX 50 VOLTS WORKING         20       0.665-623       RFAD COMP 560 CMIX 51 (1/W)       A22 (1/W)       A22 (1/W)       DIODE 51 (1/CMIX 50 VOLTS WORKING         20       0.665-723       RFAD COMP 570 CMIX 51 (1/W)<	1R23								
20         0.53-153-2         PRIVE COUPLING LODIC           27         056-562-2         HERD COUPLING LODIC         22500           28         056-562-2         HERD COUPLING LODIC         22500           29         056-562-2         HERD COUPLING LODIC         22500           31         058-562-3         HERD COUPLING LODIC         22500           31         058-562-3         HERD COUPLING LODIC         22500           33         058-562-3         HERD COUPLING LODIC         22500           34         058-562-3         HERD COUPLING LODIC         22500           35         058-562-3         HERD COUPLING LODIC         22500           36         058-562-3         HERD COUPLING LODIC         22500           36         058-562-3         HERD COUPLING LODIC         22500           37         058-562-3         HERD COUPLING LODIC         22500           38         058-562-3         HERD COUPLING LODIC         22500           39         058-562-3         HERD COUPLING LODIC         22500           39         058-562-3         HERD COUPLING LODIC         22500           30         058-52715         HERD COUPLING LODIC         22500           30         058-5271	11R24 11R25		R:FXD COMP 68K 0HM 5% 1/4W R:FXD COMP 22K 0HM 5% 1/4W			Alb		SAME AS ATT, USE PREFIX ATS	
97       0.082-1632       14740       0.000-1632       1/24         98       0.062-6623       14750       0.000-1632       1/24         90       0.000-5623       14750       0.000-1632       1/24         91       0.000-5623       14750       0.000-5623       1/24         92       0.000-5623       14750       0.000-5623       1/24       1/24         93       0.000-5623       14750       0.000-5521       1/001-0501       1/001-0501         93       0.000-6623       14750       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5521       0.000-5531       0.000-5521       0.000-5511       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551       0.000-551		,				A22	5060-5611	PRINTER COUPLING LOGIC	
28         0.66-562- 0         NETRO COMP 500 OHM 55 1/2H CASCEL         1901-00-L 1000FSILICON 50 VUITS WORKING         0100FSILICON 50 VUITS WORKING           30         0.66-562- 0.660-562- 0.660-562- 32         NETRO COMP 500 OHM 55 1/2H NETRO COMP 500 OHM 55 1/2H SICON 500 OHM 55 1/2H SI	1R26 1R27								
29       066-5625       N:FAC COMP Solo DHH ST 1/2H       DUDETSILLOW 30 WILLS WORKING         31       0667-5625       A:FAC COMP Solo DHH ST 1/2H       DUDETSILLOW 30 WILLS WORKING         32       0667-5625       A:FAC COMP Solo DHH ST 1/2H       DUDETSILLOW 30 WILLS WORKING         33       0667-5625       A:FAC COMP Solo DHH ST 1/2H       DUDETSILLOW 30 WILLS WORKING         34       0667-5625       A:FAC COMP Solo DHH ST 1/2H       DUDETSILLOW 30 WILLS WORKING         35       0667-5625       A:FAC COMP Solo DHH ST 1/2H       DUDETSILLOW 30 WILLS WORKING         36       0687-5625       A:FAC COMP Solo DHH ST 1/2H       AZZCRIB       DUDETSILLOW 30 WILLS WORKING         36       0687-5625       A:FAC COMP Solo DHH ST 1/2H       AZZCRIB       DUDETSILLOW 30 WILLS WORKING         37       0688-5625       A:FAC COMP Solo DHH ST 1/2H       AZZCRIB       DUDETSILLOW 30 WILLS WORKING         37       0688-5625       A:FAC COMP Solo DHH ST 1/2H       AZZCRIB       DUDETSILLOW 30 WILLS WORKING         38       0682-6625       A:FAC COMP Solo DHH ST 1/2H       AZZCRIB       DUDETSILLOW 30 WILLS WORKING         39       0682-625       A:FAC COMP SOLO DHH ST 1/2H       AZZCRIB       DUDETSILLOW 30 WILLS WORKING         39       0682-725       A:FAC COMP SOLO DHH ST 1/2H       AZZCRI	1R28								
30         0660-562         RIFED COMP 500 DMH 51 (22)           31         0680-562         RIFED COMP 500 DMH 51 (24)         A22CR0         1001-001         DIDDE:SILICON 50 VDLTS WORKING           32         0680-562         RIFED COMP 500 DMH 51 (24)         A22CR0         1001-001         DIDDE:SILICON 50 VDLTS WORKING           34         0680-562         RIFED COMP 500 DMH 51 (24)         A22CR12         1001-001         DIDDE:SILICON 50 VDLTS WORKING           36         0680-562         RIFED COMP 500 DMH 51 (24)         A22CR18         1001-001         DIDDE:SILICON 50 VDLTS WORKING           36         0680-562         RIFED COMP 500 DMH 51 (24)         A22CR18         1001-001         DIDDE:SILICON 50 VDLTS WORKING           37         0660-5622         RIFED COMP 500 DMH 51 (24)         A22CR23         1001-001         DIDDE:SILICON 50 VDLTS WORKING           38         0683-633         RIFED COMP 500 DMH 51 (24)         A22CR23         1001-001         DIDDE:SILICON 50 VDLTS WORKING           39         0683-632         RIFED COMP 500 DMH 51 (24)         A22CR23         1001-001         DIDDE:SILICON 50 VDLTS WORKING           30         0683-335         RIFED COMP 30X LHH 51 (24)         A22CR37         1001-001         DIDDE:SILICON 50 VDLTS WORKING           30         0683-335         <	1R29			(		A22CR6	1901-0081	DIDDE:SILICON 50 VOLTS WORKING	
31         D683-6835         RiFAD Cure 66K DHH 35 1/24         Add String         D083-6835         RiFAD Cure 66K DHH 35 1/24           33         D683-6835         RiFAD Cure 66K DHH 35 1/24         Add String         D0085-6835         D0085-6835         D0085-6835         D0085-6835         D0085-6835         D0085-6835         D0085-6835         D0085-6835         RiFAD Cure 66K DHH 35 1/24         Add String         D0085-6835         D0085-6835         RiFAD Cure 66K DHH 35 1/24         Add String         D0085-6811 CUR 9 500 CHH 58 1/24         Add String         D0085-6815         D0085-6815         D0085-6815         D0085-6815         D0085-6815         D0085-6815         D0085-6815         D0085-6815         D0085-6816         D0085-6816         D0085-6816         D0085-6816         D0085-6816         D0085-6816         D0085-6816         D0085-6816         D0085-811 CUR 9 500 CHH 58 1/24         Add String         D0085-811 CUR 9 500 CHH 58 1/24         Add String         D0085-811 CUR 9 500 CHH 58 1/24         Add String         D0085-811 CUR 9 500 CHH 58 1/24         Add String         D0085-811 CUR 9 500 CHH 58 1/24         Add String         D0085-811 CUR 9 500 CHH 58 1/24         Add String         D0085-811 CUR 9 500 CHH 58 1/24         Add String         D0085-811 CUR 9 500 CHH 58 1/24         Add String         D0085-811 CUR 9 500 CHH 58 1/24         Add String         D0085-811 CUR 9 500 CHH 58 1/24         Add	1R30				4	40000			
33       068-7623       AFFED CUMP 28A, DBm, 32 1/4w       222(812       1901-0061       DIDDESSILICON 50 VOLTS WORKING         34       068-7623       KFEX COMP 26K DHM 32 1/2W       222(812       1901-0061       DIDDESSILICON 50 VOLTS WORKING         34       068-7623       KFEX COMP 26K DHM 32 1/2W       222(812       1901-0061       DIDDESSILICON 50 VOLTS WORKING         36       068-7623       KFEX COMP 26K DHM 32 1/2W       222(812)       1901-0061       DIDDESSILICON 50 VOLTS WORKING         36       068-7623       KFEX COMP 26K DHM 32 1/2W       222(812)       1901-0061       DIDDESSILICON 50 VOLTS WORKING         37       066-7622       KFEX COMP 26K DHM 32 1/2W       222(812)       1901-0061       DIDDESSILICON 50 VOLTS WORKING         38       068-7623       KFEX COMP 27K DHM 52 1/2W       222(812)       1901-0061       DIDDESSILICON 50 VOLTS WORKING         390-003       0683-7235       KFEX COMP 27K DHM 52 1/2W       222(812)       1901-0061       DIDDESSILICON 50 VOLTS WORKING         300       0683-7235       KFEX COMP 27K DHM 52 1/2W       222(812)       1901-0061       DIDDESSILICON 50 VOLTS WORKING         310       0683-7235       KFEX COMP 27K DHM 52 1/2W       222(845       1901-0061       DIDDESSILICON 50 VOLTS WORKING         320       0683-7235									
34       0080-36.35 0083-68.35 0083-68.35 35       ATERU CUMP SEX UMP 35 1/44 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-22.35 0083-33.35       ATERU CUMP SEX UMP 35 1/44 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-22.35 0083-33.35       ATERU CUMP 27K 0HH 55 1/44 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-68.35 0083-22.35 0083-33.35       ATERU CUMP 27K 0HH 55 1/44 0083-22.35 0083-68.35 0083-22.35       ATERU CUMP 27K 0HH 55 1/44 0083-22.35       ATERU CUMP 27K 0HH 55 1/44 00055111C0N 50 VOITS WORKING 000575111C0N 50 VOITS WORKING 0100575111C0N 50 VOIT	LR 31		R:FXD CUMP 68K OHM 5% 1/4W		3				
33       0060-262.3 0683-6835       61200 DBE SHULLING SEULUM SEU	R32 ·		R:FXD COMP 5600 OHM 5% 1/2W		្មី				
44       0083-8035       At FAD LUMP Bak UMP 35 1/44         35       0085-8035       At FAD CUMP 560 0HH 35 1/24         36       0086-5625       At FAD CUMP 560 0HH 35 1/24         37       0086-5625       At FAD CUMP 560 0HH 35 1/24         38       0083-2335       At FAD CUMP 560 0HH 35 1/24         39-       0083-2335       At FAD CUMP 27K UHH 33 1/44         44       0083-2335       At FAD CUMP 27K UHH 33 1/44         45       0083-2335       At FAD CUMP 27K UHH 33 1/44         46       0083-2335       At FAD CUMP 27K UHH 33 1/44         47       0083-2335       At FAD CUMP 27K UHH 33 1/44         48       0083-2335       At FAD CUMP 27K UH 33 1/44         49       0683-2235       At FAD CUMP 27K UH 33 1/44         48       0083-2335       At FAD CUMP 27K UH 33 1/44         49       0683-2335       At FAD CUMP 27K UH 33 1/44         40       0683-2335       At FAD CUMP 27K UH 33 1/44         41       0033-3335       At FAD CUMP 27K UH 33 1/44         422CR37       1901-0061       DI 000E 1511 CUM 30 VUITS WORKING         422CR47       1901-0061       DI 00E 1511 CUM 30 VUITS WORKING         422CR47       1901-0061       DI 000E 1511 CUM 30 VUITS WORKING	.R33								
36         0686-56/5         RiFXD CDMP 5600 DHH 35 1/2W         Azzers         1001-0051         Dibber 511 [CDM 95 00 UL1 8 WIRKING           37         0686-56/5         RiFXD CDMP 5600 DHH 35 1/2W         Azzers         1001-0051         Dibber 511 [CDM 95 00 UL1 8 WIRKING           39-         0685-635         RiFXD CDMP 5600 DHH 35 1/2W         Azzers         1001-0051         Dibber 511 [CDM 95 00 UL1 8 WIRKING           46         0685-7335         RiFXD CDMP 27K DHH 55 1/4W         Azzers         1901-0051         Dibber 511 [CDM 95 00 UL1 8 WIRKING           46         0685-7335         RiFXD CDMP 27K DHH 55 1/4W         Azzers         1901-0051         Dibber 511 [CDM 95 00 UL1 8 WIRKING           47         0683-7335         RiFXD CDMP 27K DHH 55 1/4W         Azzers         1901-0051         Dibber 511 [CDM 95 00 UL1 8 WIRKING           48         0683-7335         RiFXD CDMP 33K DHH 55 1/4W         Azzers         1901-0051         Dibber 511 [CDM 95 00 UL1 8 WIRKING           50         0683-7335         RiFXD CDMP 33K DHH 55 1/4W         Azzers         1901-0016         Dibber 511 [CDM 55 00 UL1 8 WIRKING           52         0683-7335         RiFXD CDMP 33K DHH 55 1/4W         Azzers         1901-0016         Dibber 511 [CDM 55 00 UL1 8 WIRKING           53         0683-7335         RiFXD CDMP 33K DHH 55 1/4W         Azz	R34	0683-6835				ACCUNIO .	, 1901-0081	DIODEISILICUN DU VULIS WUKKING	
36         0.88-5625         RFRD CDMP 5600 DMH 51 1/2µ         422CR19         1901-0081         0100E1511 LCDN 50 VDITS WORKING           38         0.68-5625         RFRD CDMP 6800 DMH 51 1/2µ         422CR21         1901-0081         0100E151 LCDN 50 VDITS WORKING           39-         0.68-6425         RFRD CDMP 680 DMH 51 1/2µ         422CR21         1901-0081         0100E151 LCDN 50 VDITS WORKING           47         0.68-2125         RFRD CDMP 23K UNH 51 1/4µ         422CR23         1901-0081         0100E151 LCDN 50 VDITS WORKING           48         0.68-2125         RFRD CDMP 23K UNH 51 1/4µ         422CR23         1901-0081         0100E151 LCDN 50 VDITS WORKING           49         0.68-2125         RFRD CDMP 23K UNH 51 1/4µ         422CR26         1901-0081         0100E151 LCDN 50 VDITS WORKING           40         0.68-2125         RFRD CDMP 33K UNH 51 1/4µ         422CR26         1901-0081         010DE150 CDMP 30K UNH 51 1/4µ           50         0.68-3135         RFRD CDMP 33K UNH 51 1/4µ         422CR37         1910-0016         UIDDE150 CDMP 30K UNH 51 1/4µ           51         0.68-3155         RFRD CDMP 33K UNH 51 1/4µ         422CR36         1910-0016         UIDDE150 CDMP 30K UNH 51 1/4µ           52         0.68-3135         RFRD CDMP 33K UNH 51 1/4µ         422CR45         1910-0081 <td< td=""><td>R 35</td><td>0683-6835</td><td>KIFXD COMP 68K OHM 5% 1/4W</td><td></td><td>ty.</td><td>A22CR18</td><td>1901-0081</td><td>DIDDE+STITCON SO VOLTS HOPKING</td><td></td></td<>	R 35	0683-6835	KIFXD COMP 68K OHM 5% 1/4W		ty.	A22CR18	1901-0081	DIDDE+STITCON SO VOLTS HOPKING	
337       0080-3025       K.FAD LUM 2000 UN 34 1/24       A22CR20       1901-0031       DIDDESSILICON 50 VOLTS MORKING         338       0083-6835       AIFAD COMP 56K UM 32 1/44       A22CR21       1901-0081       DIDDESSILICON 50 VOLTS MORKING         339-       0083-6835       AIFAD COMP 55K UM 52 1/44       A22CR21       1901-0081       DIDDESSILICON 50 VOLTS MORKING         477       0683-2235       RIFAD COMP 33K UM 52 1/44       A22CR26       1901-0081       DIDDESSILICON 50 VOLTS MORKING         480       0683-2235       RIFAD COMP 33K UM 52 1/44       A22CR27       1901-0081       DIDDESSILICON 50 VOLTS MORKING         480       0683-2235       RIFAD COMP 33K UM 52 1/44       A22CR28       1910-0016       DIDDESSILICON 50 VOLTS MORKING         480       0683-2335       RIFAD COMP 33K UM 52 1/44       A22CR37       1910-0016       DIDDESSILICON 50 VOLTS MORKING         50       0683-2335       RIFAD COMP 33K UM 52 1/44       A22CR37       1910-0016       DIDDESSILICON 50 VOLTS MORKING         51       0683-2335       RIFAD COMP 33K UM 52 1/44       A22CR37       1910-0016       DIDDESSILICON 50 VOLTS MORKING         52       0683-2335       RIFAD COMP 33K UM 52 1/44       A22CR37       1910-0016       DIDDESSILICON 50 VOLTS MORKING         53       0683-2335	-							DIODESSILICON SO VOLTS WORKING	
All         Ubbs/bs/2         ALR ALL LUM > 560 UMR 56. L/AH         All LUM > 560 UMR 56. L/AH           33 33 33 33 33 33 33 46         DIBB-2635 0683-2735         ALF AL LUM > 560 UMR 56. L/AH         All LUM > 561 L/AH           46         DBB-2735         RLF AL CUMP 27K UMH 55. L/AH         All CLM > 500 ULTS MORKING           47         DBB-3335         RLF AD CUMP 27K UMH 55. L/AH         All CLM > 500 ULTS MORKING           48         DBB-2235         RLF AD CUMP 27K UMH 55. L/AH         All CLM > 500 ULTS MORKING           49         DBB-2235         RLF AD CUMP 27K UMH 55. L/AH         All CLM > 500 ULTS MORKING           49         DBB-2235         RLF AD CUMP 22K UMH 55. L/AH         All CLM > 500 ULTS MORKING           40         DBB-30425         RLF AD CUMP 22K UMH 55. L/AH         All CLM > 500 ULTS MORKING           50         DBB-30425         RLF AD CUMP 23K UMH 55. L/AH         All CLM > 500 ULTS MORKING           51         DBB-30425         RLF AD CUMP 23K UMH 55. L/AH         All CLM > 500 ULTS MORKING           52         DBB-30425         RLF AD CUMP 23K UMH 55. L/AH         All CLM > 500 ULTS MORKING           53         DBB-30425         RLF AD CUMP 23K UMH 55. L/AH         All CLM > 500 ULTS MORKING           54         DBB-30425         RLF AD CUMP 3000 UMH 55. L/AH         All CLM > 500 ULTS MO	R36		R:FXD COMP 5600 OHM 5% 1/2W		1				
and bit         DOBJ-0033         REFAD LUMP BR DMR 5% 1/4W         AZZCR23         1901-0081         DIODE:SILICON 50 VOLTS MORKING           46         0683-2715         REFAD LUMP BR DMR 5% 1/4W         AZZCR25         1901-0081         DIODE:SILICON 50 VOLTS MORKING           47         0683-3315         REFAD LUMP 22K DMH 5% 1/4W         AZZCR25         1901-0081         DIODE:SILICON 50 VOLTS MORKING           48         0683-2235         REFAD LUMP 22K DMH 5% 1/4W         AZZCR27         1901-0081         DIODE:SILICON 50 VOLTS MORKING           50         0683-3335         REFAD LUMP 22K DMH 5% 1/4W         AZZCR27         1901-0081         DIODE:SILICON 50 VOLTS MORKING           50         0683-3025         REFAD LUMP 33K DMH 5% 1/4W         AZZCR37         1901-0081         DIODE:SILICON 50 VOLTS MORKING           52         0683-3335         REFAD LUMP 22K DMH 5% 1/4W         AZZCR47         1901-0081         DIODE:SILICON 50 VOLTS MORKING           53         0683-2235         REFAD LUMP 22K DMH 5% 1/4W         AZZCR47         1901-0081         DIODE:SILICON 50 VOLTS MORKING           54         0683-3335         REFAD LUMP 22K DMH 5% 1/4W         AZZCR47         1901-0081         DIODE:SILICON 50 VOLTS MORKING           55         0683-3335         REFAD LUMP 22K DMH 5% 1/4W         AZZCR48         1901-0081	R37		K: FXD COMP 5600 0HM 5% 1/2W						
0x83         0x83=2735         R1FXD COMP 27K OHH 5% 1/4H         422CR25         1901-0081         010DETSLICON 50 VOLTS WORKING           47         0x83=2235         R1FXD COMP 2XK OHH 5% 1/4H         422CR25         1901-0081         010DETSLICON 50 VOLTS WORKING           49         0x83=2235         R1FXD COMP 2XK OHH 5% 1/4H         422CR26         1901-0081         010DETSLICON 50 VOLTS WORKING           50         0x83=3335         R1FXD COMP 3XK OHH 5% 1/4H         422CR26         1901-0081         010DETSLICON 50 VOLTS WORKING           51         0x68=2235         R1FXD COMP 3XK OHH 5% 1/4H         422CR36         1910-0016         010DETSLICON 50 VOLTS WORKING           52         0x68=3-335         R1FXD COMP 3XK OHH 5% 1/4H         422CR46         1910-0016         010DETSLICON 50 VOLTS WORKING         1           54         0x68=2235         R1FXD COMP 3XK OHH 5% 1/4H         422CR46         1910-0016         010DETSLICON 50 VOLTS WORKING         1           55         0x68=3-335         R1FXD COMP 3XK OHH 5% 1/4H         422CR46         1901-0081         010DETSLICON 50 VOLTS WORKING         1           56         0x68=3-335         R1FXD COMP 33K OHH 5% 1/4H         422CR46         1901-0081         010DETSLICON 50 VOLTS WORKING         1           57         0x683-2255         R1FXD COMP 33	R38	0683-6835	R:FXD COMP 68K OHM 5% 1/4W						
47       0683-3335       RFX0 COMP 33K UHH 5% 1/4H       A25CR37       1001-0081       DIDDETSLITCON 50 VOLTS MORKING         48       0683-2235       RFX0 COMP 22K UHH 5% 1/4H       A25CR37       1901-0081       DIDDETSLITCON 50 VOLTS MORKING         49       0683-2235       RFX0 COMP 22K UHH 5% 1/4H       A22CR37       1901-0081       DIDDETSCONE       DIDDETSCONE         50       0683-3035       RFX0 COMP 33K UHH 5% 1/4H       A22CR37       1901-0081       DIDDETSCONE       DIDDETSCONE         52       0683-3025       RFX0 COMP 33K UHH 5% 1/4H       A22CR37       1901-0081       DIDDETSCONE       DIDDETSCONE <td< td=""><td>.R39-  </td><td></td><td>a</td><td></td><td>3</td><td></td><td>, 1701 0001</td><td>DIODE STETCON JU VOLIS NURKING</td><td></td></td<>	.R39-		a		3		, 1701 0001	DIODE STETCON JU VOLIS NURKING	
4.7       0683-3335       RIFKD COMP 33K UHH 5% 1/4H       A22CR27       -1901-0081       DIDDE:SLICON 50 VOLTS WORKING         60       0683-2335       RIFKD COMP 22K UHH 5% 1/4H       A22CR37       1901-0081       DIDDE:SLICON 50 VOLTS WORKING         60       0683-2335       RIFKD COMP 28K UHH 5% 1/4H       A22CR37       1901-0016       DIDDE:SLICON 50 VOLTS WORKING         51       0683-3335       RIFKD COMP 33K UHH 5% 1/4H       A22CR37       1910-0016       DIDDE:SCRMANIUM 100MA AT 0.85% 60P1V         22       0683-2235       RIFKD COMP 33K UHH 5% 1/4H       A22CR40       DIDDE:SLICON 50 VOLTS WORKING         52       0683-2235       RIFKD COMP 28K UHH 5% 1/4H       A22CR40       DIDDE:SLICON 50 VOLTS WORKING         54       0683-2235       RIFKD COMP 33K UHH 5% 1/4H       A22CR40       DIDDE:SLICON 50 VOLTS WORKING         55       0683-2235       RIFKD COMP 33K UHH 5% 1/4H       A22CR45       1901-0081       DIDDE:SLICON 50 VOLTS WORKING         56       0683-3335       RIFKD COMP 33K UHH 5% 1/4H       A22CR50       1901-0081       DIDDE:SLICON 50 VOLTS WORKING         57       0683-3335       RIFKD COMP 33K UHH 5% 1/4H       A22CR51       1901-0081       DIDDE:SLICON 50 VOLTS WORKING         56       0683-2235       RIFKD COMP 33K0 UHH 5% 1/4H       A22CR52       19	.R46	068 3-27 35	R:FXD COMP 27K OHM 5% 1/4W		à	A22CR25	1901-0081	DIDDE:STITCON 50 VOLTS WORKING	
0633-2335       R:FRD CUMP 33K UPH 32 1/4W         66       0633-2225       R:FRD CUMP 22K UPH 32 1/4W         67       0633-3325       R:FRD CUMP 32K UPH 51 1/4W         68       0633-3325       R:FRD CUMP 32K UPH 32 1/4W         69       0633-3325       R:FRD CUMP 33K UPH 32 1/4W         69       0633-3325       R:FRD CUMP 33K UPH 32 1/4W         60       0633-3325       R:FRD CUMP 33K UPH 52 1/4W         61       0633-3325       R:FRD CUMP 33K UPH 52 1/4W         62       0633-3325       R:FRD CUMP 33K UPH 52 1/4W         63       0633-3325       R:FRD CUMP 33K UPH 52 1/4W         64       022K UPH 52 (UPH 52 (UP	[				×.				
0683-2235       R1FAD CUMP 22K 0MH 5% 1/4W       A22CR37       1961-0081       DIDDE:SILICON 50 VOLTS WORKING         0603-2235       R1FAD COMP 23K 0MH 5% 1/4W       A22CR39       1910-0016       DIDDE:SILICON 50 VOLTS WORKING         0683-2235       R1FAD COMP 33K 0MH 5% 1/4W       A22CR39       1910-0016       DIDDE:SILICON 50 VOLTS WORKING         20       0683-2235       R1FAD COMP 33K 0MH 5% 1/4W       A22CR39       1910-0016       DIDDE:SILICON 50 VOLTS WORKING         22       0683-2235       R1FAD COMP 33K 0MH 5% 1/4W       A22CR39       1910-0016       DIDDE:SILICON 50 VOLTS WORKING         54       0683-2235       R1FAD COMP 33K 0MH 5% 1/4W       A22CR39       1901-0081       DIDDE:SILICON 50 VOLTS WORKING         55       0683-2335       R1FAD COMP 33K 0MH 5% 1/4W       A22CR39       1901-0081       DIDDE:SILICON 50 VOLTS WORKING         56       0683-2335       R1FAD COMP 33K 0MH 5% 1/4W       A22CR39       1901-0081       DIDDE:SILICON 50 VOLTS WORKING         57       0683-2235       R1FAD COMP 33K 0MH 5% 1/4W       A22CR37       1901-0081       DIDDE:SILICON 50 VOLTS WORKING         60       0683-2235       R1FAD COMP 33K 0MH 5% 1/4W       A22CR37       1901-0081       DIDDE:SILICON 50 VOLTS WORKING         57       0683-3335       R1FAD COMP 33K 0MH 5% 1/4W       A22C	.R47				<b>`</b>				
0683-2235       RiFKD CDMP 32K DHM 53 1/4W       A22CR38       1910-0016       DIDDE:GERMANIUM 100MA AT 0.85V 60P1V         0683-335       RiFKD CDMP 33K DHM 55 1/4W       A22CR39       A22CR39       UDDE:GERMANIUM 100MA AT 0.85V 60P1V         52       0683-335       RiFKD CDMP 33K DHM 55 1/4W       A22CR39       UDDE:GERMANIUM 100MA AT 0.85V 60P1V         53       0683-335       RiFKD CDMP 33K DHM 55 1/4W       A22CR45       1910-0016       UDDE:SILICON 50 VDLTS WORKING       T         54       0683-2355       RiFKD CDMP 32K DHM 55 1/4W       A22CR49       1901-0081       UDDE:SILICON 50 VDLTS WORKING       T         55       0683-3025       RiFKD CDMP 33K DHM 55 1/4W       A22CR49       1901-0081       UDDE:SILICON 50 VDLTS WORKING       T         56       0683-3355       RiFKD CDMP 33K DHM 55 1/4W       A22CR49       1901-0081       UDDE:SILICON 50 VDLTS WORKING       T         57       0683-3355       RiFKD CDMP 32K DHM 55 1/4W       A22CR49       1901-0081       UDDE:SILICON 50 VDLTS WORKING       DIDDE:SILICON 50 VDLTS WORKING       DIDDE:SILICON 50 VDLTS WORKING         58       0683-2355       RiFKD CDMP 32K DHM 55 1/4W       A22CR49       1901-0081       DIDDE:SILICON 50 VDLTS WORKING         59       0683-2355       RiFKD CDMP 33K DHM 55 1/4W       A22CR16       B50-0111	R48			•					
DB         DBB-3335         RIFKD CUMP 33K DHM 5% 1/4W           06B-3022         RIFKD CUMP 33K DHM 5% 1/4W         A22CR39         1910-001b         UIDDE:SLICON 50 VOLTS WORKING           52         06B-32235         RIFKD CUMP 33K DHM 5% 1/4W         A22CR49         1910-001b         UIDDE:SLICON 50 VOLTS WORKING           53         06B-2235         RIFKD CUMP 33K DHM 5% 1/4W         A22CR49         1901-0081         UIDDE:SLICON 50 VOLTS WORKING         1           54         06B-32335         RIFKD CUMP 33K DHM 5% 1/4W         A22CR49         1901-0081         UIDDE:SLICON 50 VOLTS WORKING         1           55         06B-3335         RIFKD CUMP 33K DHM 5% 1/4W         A22CR52         1901-0081         UIDDE:SLICON 50 VOLTS WORKING         1           57         06B-3335         RIFKD CUMP 33K DHM 5% 1/4W         A22CR52         1901-0081         UIDDE:SLICON 50 VOLTS WORKING         1           58         06B-2235         RIFKD CUMP 22K DHM 5% 1/4W         A22CR53         1901-0081         UIDDE:SLICON 50 VOLTS WORKING         1           59         06B-2235         RIFKD CUMP 33K DHM 5% 1/4W         A22CR54         1901-0081         UIDDE:SLICON 50 VOLTS WORKING           50         06B-2335         RIFKD CUMP 33K DHM 5% 1/4W         A22CR54         1901-0081         UIDDE:SLICON 50 VOLTS WORKING </td <td>R49</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	R49								
52       0683-3335       KIFXD COMP 33K DHM 5X 1/4H       A22CR45       1601-0681       DIODE ISILICON 50 VOLTS WORKING         53       0683-2235       RIFXD COMP 22K DHM 5X 1/4H       A22CR45       1601-0081       DIODE ISILICON 50 VOLTS WORKING         55       0683-3335       RIFXD COMP 33K DHH 5X 1/4H       A22CR45       1601-0081       DIODE ISILICON 50 VOLTS WORKING         55       0683-3355       RIFXD COMP 33K DHH 5X 1/4H       A22CR45       1901-0081       DIODE ISILICON 50 VOLTS WORKING         56       0683-3355       RIFXD COMP 33K DHH 5X 1/4H       A22CR50       1901-0081       DIODE ISILICON 50 VOLTS WORKING         57       0683-3355       RIFXD COMP 33K DHH 5X 1/4H       A22CR52       1901-0081       DIODE ISILICON 50 VOLTS WORKING         58       0683-2235       RIFXD COMP 33K OHH 5X 1/4H       A22CR54       1901-0081       DIODE ISILICON 50 VOLTS WORKING         59       0683-2355       RIFXD COMP 33K OHH 5X 1/4H       A22CR54       1901-0081       DIODE ISILICON 50 VOLTS WORKING         50       0683-2355       RIFXD COMP 3000 OHH 5X 1/4H       A22CR54       1901-0081       DIODE ISILICON 50 VOLTS WORKING         50       0683-3355       RIFXD COMP 3000 OHH 5X 1/4H       A22CR14       A22CR55       1901-0081       DIODE ISILICON 50 VOLTS WORKING	R50								
922       0683-3335       RIFXD CUMP 33K DHM 5% 1/4W       A22CR45       1901-0081       DIODEISTLICON 50 VOLTS WORKING       1         933       0683-2235       RIFKD CUMP 22K DHM 5% 1/4W       A22CR45       1901-0081       DIODEISTLICON 50 VOLTS WORKING       1         945       0683-3025       RIFKD CUMP 33K DHM 5% 1/4W       A22CR45       1901-0081       DIODEISTLICON 50 VOLTS WORKING       1         955       0683-3335       RIFKD CUMP 33K DHM 5% 1/4W       A22CR45       1901-0081       DIODEISTLICON 50 VOLTS WORKING       1         956       0683-325       RIFKD CUMP 33K DHM 5% 1/4W       A22CR52       1901-0081       DIODEISTLICON 50 VOLTS WORKING       1         957       0683-335       RIFKD CUMP 33K DHM 5% 1/4W       A22CR52       1901-0081       DIODEISTLICON 50 VOLTS WORKING         958       0683-2255       RIFKD CUMP 33K DHM 5% 1/4W       A22CR54       1901-0081       DIODEISTLICON 50 VOLTS WORKING         9683-2025       RIFKD CUMP 33K DHM 5% 1/4W       A22CR54       1901-0081       DIODEISTLICON 50 VOLTS WORKING         9683-2025       RIFKD CUMP 33K DHM 5% 1/4W       A22CR5       1901-0081       DIODEISTLICON 50 VOLTS WORKING         9683-3025       RIFKD CUMP 33K DHM 5% 1/4W       A22R1       0683-1835       RIFKD CUMP 33K DHM 5% 1/4W         9683-3	<u>R51</u>	0683-3025	R:FXD COMP 3000 OHM 54 1/4W	· · ·		A22CR39	1910-0016	ULODE: GERMANTUM LOOMA AT 0.85V KOPLV	
22       0683-2335       R1FXD COMP 33K DHH 5% 1/4H       A22CR45       1501-0081       D10DE1SLICON 50 VOLTS WORKING         33       0683-2235       R1FXD COMP 22K DHH 5% 1/4H       A22CR46       1501-0081       D1DDE1SLICON 50 VOLTS WORKING       1         54       0683-3255       R1FXD COMP 22K DHH 5% 1/4H       A22CR46       1501-0081       D1DDE1SLICON 50 VOLTS WORKING       1         55       0683-3355       R1FXD COMP 33K DHH 5% 1/4H       A22CR46       1501-0081       D1DDE1SLICON 50 VOLTS WORKING       1         56       0683-2355       R1FXD COMP 33K DHH 5% 1/4H       A22CR57       1901-0081       D1DDE1SLICON 50 VOLTS WORKING       1         57       0683-2355       R1FXD COMP 33K DHH 5% 1/4H       A22CR57       1901-0081       D1DDE1SLICON 50 VOLTS WORKING         58       0663-2235       R1FXD COMP 22K DHH 5% 1/4H       A22CR57       1901-0081       D1DDE1SLICON 50 VOLTS WORKING         59       0663-3335       R1FXD COMP 3000 DHH 5% 1/4H       A22CR57       1901-0081       D1DDE1SLICON 50 VOLTS WORKING       1         50       0683-3335       R1FXD COMP 3000 DHH 5% 1/4H       A22CR1       A22CR57       1901-0081       D1DDE1SLICON 50 VOLTS WORKING         50       0683-2335       R1FXD COMP 3000 DHH 5% 1/4H       A22CR1       A22CR57       10					. 3				
33       0683-2235       R1FXD CUMP 22K DHH 5% 1/4H       1         54       0683-2235       R1FXD CUMP 22K DHH 5% 1/4H       1         55       0683-3335       R1FXD CUMP 33K DHH 5% 1/4H       A22CR49       1901-0081       D10DE:SLICON 50 VOLTS WORKING       1         56       0683-3335       R1FXD CUMP 33K DHH 5% 1/4H       A22CR49       1901-0081       D10DE:SLICON 50 VOLTS WORKING       1         57       0683-3335       R1FXD COMP 33K OHH 5% 1/4H       A22CR450       1901-0081       D10DE:SLICON 50 VOLTS WORKING         58       0683-2235       R1FXD COMP 22K OHH 5% 1/4H       A22CR52       1901-0081       D10DE:SLICON 50 VOLTS WORKING         59       0683-2335       R1FXD COMP 33K OHH 5% 1/4H       A22CR53       1901-0081       D10DE:SLICON 50 VOLTS WORKING         50       0683-3335       R1FXD COMP 33K OHH 5% 1/4H       A22CR1       D683-1835       R1FXD COMP 15K OHH 5% 1/4H         52       0683-3335       R1FXD COMP 33K OHH 5% 1/4H       A22CR1       D663-1835       R1FXD COMP 15K OHH 5% 1/4H         54       0683-3335       R1FXD COMP 33K OHH 5% 1/4H       A22R1       D663-1835       R1FXD COMP 15K OHH 5% 1/4H         52       0683-3335       R1FXD COMP 33K OHH 5% 1/4H       A22R1       D663-1835       R1FXD COMP 15K OHH 5% 1/4H	R52						1901-0081	DIDDE:STITCAN SO VOLTS WORKING	
24       0683-2235       R1FXD COMP 22K 0HH 5% 1/4W       A22CR50       1901-0001       DIDDE:SILICON 50 VOLTS WORKING         55       0683-3335       R1FXD COMP 3000 0HH 5% 1/4W       A22CR50       1901-0001       DIDDE:SILICON 50 VOLTS WORKING         57       0683-3335       R1FXD COMP 33K 0HH 5% 1/4W       A22CR50       1901-0001       DIDDE:SILICON 50 VOLTS WORKING         57       0683-2335       R1FXD COMP 33K 0HH 5% 1/4W       A22CR53       1901-0001       DIDDE:SILICON 50 VOLTS WORKING         59       0683-2235       R1FXD COMP 22K 0HH 5% 1/4W       A22CR54       1901-0001       DIDDE:SILICON 50 VOLTS WORKING         50       0683-2235       R1FXD COMP 33K 0HH 5% 1/4W       A22CR54       1901-0001       DIDDE:SILICON 50 VOLTS WORKING         50       0683-2335       R1FXD COMP 33K 0HH 5% 1/4W       A22CR54       1901-0001       DIDDE:SILICON 50 VOLTS WORKING         51       0683-3325       R1FXD COMP 3000 0HH 5% 1/4W       A22CR1       0683-1835       R1FXD COMP 18K UHH 5% 1/4W         52       0683-3325       R1FXD COMP 3000 0HH 5% 1/4W       A22R1       0683-1835       R1FXD COMP 18K UHH 5% 1/4W         54       0683-2235       R1FXD COMP 33K 0HH 5% 1/4W       A22R2       0683-1835       R1FXD COMP 33K 0HH 5% 1/4W         55       0683-2235       R1FXD	R53								
35       0683-3335       R1FXD COMP 33K OHH 5% 1/4W         36       0683-3335       R1FXD COMP 33K OHH 5% 1/4W         37       0683-3335       R1FXD COMP 33K OHH 5% 1/4W         36       0663-2335       R1FXD COMP 33K OHH 5% 1/4W         36       0663-2335       R1FXD COMP 33K OHH 5% 1/4W         36       0663-2335       R1FXD COMP 33K OHH 5% 1/4W         37       0663-3325       R1FXD COMP 33K OHH 5% 1/4W         30       0683-3025       R1FXD COMP 33K OHH 5% 1/4W         30       0683-3025       R1FXD COMP 33K OHH 5% 1/4W         30       0683-3335       R1FXD COMP 33K OHH 5% 1/4W         31       0683-2235       R1FXD COMP 33K OHH 5% 1/4W         32       0683-3325       R1FXD COMP 33K OHH 5% 1/4W         32       0683-2235       R1FXD COMP 33K OHH 5% 1/4W         32       0683-3325       R1FXD COMP 33K OHH 5% 1/4W         34       0683-2235       R1FXD COMP 33K OHH 5% 1/4W         35       0683-2235       R1FXD COMP 33K OHH 5% 1/4W         34       0683-2335       R1FXD COMP 33K OHH 5% 1/4W         35       0683-2335       R1FXD COMP 33K OHH 5% 1/4W         36       0683-3335       R1FXD COMP 33K OHH 5% 1/4W         36       0683-1335	R54			1				DIDDESSILICON 50 VOLTS WORKING	
57       0683-3335 0683-2235       R:FXD COMP 33K OHM 5X 1/4H R:FXD COMP 22K OHM 5X 1/4H N:FXD COMP 22K OHM 5X 1/4H N:FXD COMP 22K OHM 5X 1/4H N:FXD COMP 33K OHM 5X 1/4H N:FXD COMP 3000 OHM 5X 1/4H N:FXD COMP 3000 OHM 5X 1/4H N:FXD COMP 22K OHM 5X 1/4H N:FXD COMP 3000 OHM 5X 1/4H N:FXD COMP 3000 OHM 5X 1/4H N:FXD COMP 3000 OHM 5X 1/4H N:FXD COMP 22K OHM 5X 1/4H N:FXD COMP 22K OHM 5X 1/4H N:FXD COMP 3000 OHM 5X 1/4H N:FXD COMP 22K OHM 5X 1/4H N:FXD COMP 33K OHM 5X 1/4H N:FXD COMP 3	855			· · ·	2				
57       0683-3335       R:FXD COMP 33K OHM 5X 1/4W       A22CR52       1901-0081       DIODE:SILICON 50 VOLTS WORKING         58       0663-2235       R:FXD COMP 22K OHM 5X 1/4W       A22CR53       1901-0081       DIODE:SILICON 50 VOLTS WORKING         59       0663-2235       N:FXD COMP 22K OHM 5X 1/4W       A22CR54       1901-0081       DIODE:SILICON 50 VOLTS WORKING         59       0663-2235       N:FXD COMP 33K OHM 5X 1/4W       A22CR54       1901-0081       DIODE:SILICON 50 VOLTS WORKING         50       0663-2235       N:FXD COMP 33K OHM 5X 1/4W       A22CR54       1901-0081       DIODE:SILICON 50 VOLTS WORKING         50       0683-3025       N:FXD COMP 33K OHM 5X 1/4W       A22CR54       1901-0081       DIODE:SILICON 50 VOLTS WORKING         52       0683-3025       R:FXD COMP 33K OHM 5X 1/4W       A22CR1       0683-1835       R:FXD COMP 18K UHM 5X 1/4W         54       0683-2235       R:FXD COMP 22K OHM 5X 1/4W       A22R2       0683-3335       R:FXD COMP 33K OHM 5X 1/4W         55       0683-3335       R:FXD COMP 33K OHM 5X 1/4W       A22R2       0683-1535       R:FXD COMP 18K UHM 5X 1/4W         56       0683-3335       R:FXD COMP 33K OHM 5X 1/4W       A22R3       0683-1535       R:FXD COMP 18K UHM 5X 1/4W         57       0683-3025       R:FXD COMP 33K	156	0683-3025	R:FXD COMP 3000 OHM 5% 1/4W		4	A22CR50	1901-0081	DIDDE:STLICON 50 VOLTS WORKING	
0       0683-3335       R1FXD CUMP 33K UHM 5% 1/4W         588       0683-2235       R1FXD CUMP 22K UHM 5% 1/4W         599       0663-2235       R1FXD CUMP 22K UHM 5% 1/4W         500       0683-3325       R1FXD CUMP 22K UHM 5% 1/4W         501       0683-3025       R1FXD CUMP 38K UHM 5% 1/4W         52       0683-3025       R1FXD CUMP 38K UHM 5% 1/4W         52       0683-3025       R1FXD CUMP 38K UHM 5% 1/4W         53       0683-2235       R1FXD CUMP 38K UHM 5% 1/4W         54       0683-3335       R1FXD CUMP 38K UHM 5% 1/4W         55       0683-2235       R1FXD CUMP 38K UHM 5% 1/4W         55       0683-2235       R1FXD CUMP 38K UHM 5% 1/4W         55       0683-2235       R1FXD CUMP 38K UHM 5% 1/4W         66       0683-3335       R1FXD CUMP 38K UHM 5% 1/4W         66       0683-3235       R1FXD CUMP 38K UHM 5% 1/4W         77       0683-3025       R1FXD CUMP 3000 UHM 5% 1/4W         88       0683-6835       R1FXD CUMP 38K UHM 5% 1/4W         99       0688-6835       R1FXD CUMP 38K UHM 5% 1/4W         70       0683-3025       R1FXD CUMP 68K UHM 5% 1/4W         71       0683-3025       R1FXD CUMP 68K UHM 5% 1/4W          72       0683-30				· · ]					
0683-2235       R:FXD COMP 22K OHM 5% 1/4W         0663-2335       R:FXD COMP 33K OHM 5% 1/4W         000       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         02       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         03       0683-2355       R:FXD COMP 22K OHM 5% 1/4W         048       0683-2235       R:FXD COMP 3000 OHM 5% 1/4W         059       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         048       0683-2235       R:FXD COMP 22K OHM 5% 1/4W         050       0683-2235       R:FXD COMP 3000 OHM 5% 1/4W         048       0683-2235       R:FXD COMP 22K OHM 5% 1/4W         048       0683-2235       R:FXD COMP 3% OHM 5% 1/4W         051       0683-3355       R:FXD COMP 3% OHM 5% 1/4W         048       0683-3355       R:FXD COMP 3% OHM 5% 1/4W         051       0683-3355       R:FXD COMP 3% OHM 5% 1/4W         051       0683-3355       R:FXD COMP 3% OHM 5% 1/4W         051       0683-3355       R:FXD COMP 3% OHM 5% 1/4W         0683-3355       R:FXD COMP 3% OHM 5% 1/4W       A22R5       0683-1335       R:FXD COMP 15% OHM 5% 1/4W         051       0683-6835       R:FXD COMP 4% OHM 5% 1/4W       A22R6       0683-1535       R:FXD COMP 15% OHM 5% 1/4W         051	157				ŀ				
00       0683-2235       R:FX0 COMP 22K DHM 5% 1/4W         00       0683-3025       R:FX0 COMP 3000 OHM 5% 1/4W         02       0683-3025       R:FX0 COMP 3000 OHM 5% 1/4W         03       0683-3025       R:FX0 COMP 3000 OHM 5% 1/4W         04       0683-3335       R:FX0 COMP 38K OHM 5% 1/4W         05       0683-2235       R:FX0 COMP 38K OHM 5% 1/4W         0683-3335       R:FX0 COMP 38K OHM 5% 1/4W         0683-3025       R:FX0 COMP 3000 OHM 5% 1/4W         0683-3025       R:FX0 COMP 3000 OHM 5% 1/4W         0683-3025       R:FX0 COMP 3000 OHM 5% 1/4W         0683-3025       R:FX0 COMP 47K OHM 5% 1/4W         0683-3025	58				•			DIODE: SILICON 50 VOLTS WORKING	
b1     0683-3025     R:FXD COMP 3000 OHM 5% 1/4W       b2     0683-3025     R:FXD COMP 3000 OHM 5% 1/4W       b3     0683-3025     R:FXD COMP 3000 OHM 5% 1/4W       b3     0683-3025     R:FXD COMP 3000 OHM 5% 1/4W       b4     0683-2235     R:FXD COMP 22K OHM 5% 1/4W       b5     0683-3335     R:FXD COMP 22K OHM 5% 1/4W       b6     0683-3335     R:FXD COMP 3% OHM 5% 1/4W       b7     0683-3025     R:FXD COMP 3000 OHM 5% 1/4W       b7     0683-3025     R:FXD COMP 3000 OHM 5% 1/4W       b8     0683-6835     R:FXD COMP 3000 OHM 5% 1/4W       b9     0686-4735     R:FXD COMP 47K OHM 5% 1/4W       b9     0686-4735     R:FXD COMP 3000 OHM 5% 1/4W       b10     0683-3025     R:FXD COMP 3000 OHM 5% 1/4W       b10     0683-6835     R:FXD COMP 47K OHM 5% 1/4W       b10     0686-4735     R:FXD COMP 3000 OHM 5% 1/4W       b10     0683-6835     R:FXD COMP 3000 OHM 5% 1/4W       b10     0683-6835     R:FXD COMP 47K OHM 5% 1/4W       b10     0683-6835     R:FX	159			4 1	1				
22     0683-3025     R: FXD CQMP 3000 DHM 5% 1/4W     R: FXD CQMP 33K DHM 5% 1/4W       33     0683-3335     R: FXD CQMP 33K DHM 5% 1/4W       44     0683-2235     R: FXD CQMP 22K DHM 5% 1/4W       55     0683-2235     R: FXD CQMP 33K DHM 5% 1/4W       56     0683-3335     R: FXD CQMP 33K DHM 5% 1/4W       56     0683-3335     R: FXD CQMP 33K DHM 5% 1/4W       56     0683-3335     R: FXD CQMP 33K DHM 5% 1/4W       57     0683-3025     R: FXD CQMP 3000 DHM 5% 1/4W       58     0683-3025     R: FXD CQMP 3000 DHM 5% 1/4W       59     0683-4735     R: FXD CQMP 47K DHM 5% 1/4W       59     0686-4735     R: FXD CQMP 47K DHM 5% 1/4W       59     0686-4735     R: FXD CQMP 47K DHM 5% 1/4W       59     0686-4735     R: FXD CQMP 47K DHM 5% 1/4W       50     0683-3025     R: FXD CQMP 3000 DHM 5% 1/4W       50     0683-3035     R: FXD CQMP 3000 DHM 5% 1/4W       50     0683-3035     R: FXD CQMP 18K DHM 5% 1/4W       51     0683-3035     R: FXD CQMP 18K DHM 5% 1/4W       52     0683-3035     R: FXD CQMP 18K DHM 5% 1/4W       54     0683-3035     R: FXD CQMP 18K DHM 5% 1/4W       55     0683-3035     R: FXD CQMP 18K DHM 5% 1/4W       56     0683-3035     R: FXD CQMP 18K DHM 5% 1/4W    <						A22Q1-			
0683-3335       R:FXD COMP 33K OHM 5% 1/4W         0683-2235       R:FXD COMP 22K OHM 5% 1/4W         0683-2235       R:FXD COMP 22K OHM 5% 1/4W         0683-3335       R:FXD COMP 22K OHM 5% 1/4W         0683-3335       R:FXD COMP 33K OHM 5% 1/4W         0683-3355       R:FXD COMP 33K OHM 5% 1/4W         0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         0683-3025       R:FXD COMP 40K OHM 5% 1/4W         0683-3025       R:FXD COMP 40K OHM 5% 1/4W         0683-3025       R:FXD COMP 40K OHM 5% 1/4W         1030       0683-3025         0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         1030       0683-3025         0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         1030       0683-3025         0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         1030       0683-3025         0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         1040       A22R7	61	Voa 3- 3U25	KTFXD LUMP 3000 UHM 5% 1/4W			A22C16	1850-0111	TRANSISTOR: GERMANIUM PNP	
0683-3335       R1FXD COMP 33K OHM 5% 1/4W         04       0683-2235       R1FXD COMP 22K OHM 5% 1/4W         05       0683-2235       R1FXD COMP 22K OHM 5% 1/4W         05       0683-3335       R1FXD COMP 22K OHM 5% 1/4W         0683-3335       R1FXD COMP 22K OHM 5% 1/4W         0683-2235       R1FXD COMP 22K OHM 5% 1/4W         0683-3335       R1FXD COMP 33K OHM 5% 1/4W         0683-3335       R1FXD COMP 33K OHM 5% 1/4W         0683-3355       R1FXD COMP 18K OHM 5% 1/4W         0683-3025       R1FXD COMP 3000 OHM 5% 1/4W         0683-6835       R1FXD COMP 3000 OHM 5% 1/4W         0683-3025       R1FXD COMP 3000 OHM 5% 1/4W         100       0683-3025         R1FXD COMP 3000 OHM 5% 1/4W         100       0683-3025         R1FXD COMP 3000 OHM 5% 1/4W         100       0683-3025         R1FXD COMP 3000 OHM 5% 1/4W         100       0683-3025         R1FXD COMP 3000 OHM 5% 1/4W         100       0683-3355         R1FXD COMP 3000	62		R: FXD COMP 3000 OHM 5% 1/4W			A22R1	0683-1835	RIFXD COMP 18K DHM 58 1744	
05     0683-2235     R:FXD COMP 22K OHM 5% 1/4W     R:FXD COMP 33K OHM 5% 1/4W       0683-3335     R:FXD COMP 33K OHM 5% 1/4W     A22R3     0683-1535       0683-3025     R:FXD COMP 3000 OHM 5% 1/4W     A22R5     0683-1535       0683-6835     R:FXD COMP 3000 OHM 5% 1/4W     A22R5     0683-1535       0683-6835     R:FXD COMP 68K OHM 5% 1/4W     R:FXD COMP 15K OHM 5% 1/4W       0683-3025     R:FXD COMP 68K OHM 5% 1/4W     R:FXD COMP 15K OHM 5% 1/4W       0683-6835     R:FXD COMP 47K OHM 5% 1/4W     A22R6       0683-3025     R:FXD COMP 47K OHM 5% 1/4W     A22R7       0683-1835     R:FXD COMP 15K OHM 5% 1/4W       0683-3025     R:FXD COMP 3000 OHM 5% 1/4W       0683-3025     R:FXD COMP 47K OHM 5% 1/4W       0683-3025     R:FXD COMP 3000 OHM 5% 1/4W       1070     0683-1535     R:FXD COMP 33K OHM 5% 1/4W       1070     0683-1535     R:FXD COMP 33K OHM 5% 1/4W       1070     0683-1535     R:FXD COMP 33K OHM 5% 1/4W	863				1				
0683-2235       R:FXD COMP 22K OHM 5% 1/4N         0683-3335       R:FXD COMP 33K OHM 5% 1/4N         0683-3335       R:FXD COMP 33K OHM 5% 1/4N         07       0683-3025         0683-6835       R:FXD COMP 3000 OHM 5% 1/4N         08       0683-6835         0686-4735       R:FXD COMP 68K OHM 5% 1/4N         09       0686-4735         0683-3025       R:FXD COMP 47K OHM 5% 1/4N         08       0683-6835         0683-6835       R:FXD COMP 68K OHM 5% 1/4N         09       0686-4735         0683-3025       R:FXD COMP 47K OHM 5% 1/4N         09       0683-3335         0683-3025       R:FXD COMP 47K OHM 5% 1/4N         09       0683-3335         00       0683-3325         00       0683-3025         010       0683-3025         02       0683-3025         03       04000         04000       05% 1/4N         04000       0683-3025         04000       0683-3025         0583-3025       R:FXD COMP 3000 OHM 5% 1/4N         04000       0683-3335         04000       R:FXD COMP 3000 OHM 5% 1/4N         04000       0683-3335         04000	64					A22R2	0683-3335	R#FXD COMP 33K OHM 58 1768	
06       0683-3335       R:FXD COMP 33K OHM 5% 1/4W         07       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         08       0683-6835       R:FXD COMP 68K OHM 5% 1/4W         09       0686-4735       R:FXD COMP 47K OHM 5% 1/4W         00       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         00       0683-6835       R:FXD COMP 68K OHM 5% 1/4W         00       0683-3025       R:FXD COMP 47K OHM 5% 1/2W         00       0683-3025       R:FXD COMP 3000 OHM 5% 1/2W         00       0683-3025       R:FXD COMP 3000 OHM 5% 1/2W         00       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         1010       0600       HIM 5% 1/4W         1010       0000       FX COMP 3000 OHM 5% 1/4W	65				4			REFEAD COMP 15K OHM 5% 1/4W	
7       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         8       0683-6835       R:FXD COMP 68K OHM 5% 1/4W         9       0686-4735       R:FXD COMP 68K OHM 5% 1/4W         9       0686-4735       R:FXD COMP 47K OHM 5% 1/2W         0       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         9       0683-3025       R:FXD COMP 47K OHM 5% 1/2W         0       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         10       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         1070       0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         1070       0000       FXD COMP 3000 OHM 5% 1/4W	66	0683-3335	R:FXD COMP 33K OHM 5% 1/4W		1			REFEAD COMP TAK OHM 5% 1/4W	
0683-3025       R:FXD COMP 3000 OHM 5% 1/4W         08       0683-6835         09       0686-4735         00       0683-3025         R:FXD COMP 68K OHM 5% 1/4W         00       0683-3025         R:FXD COMP 47K OHM 5% 1/4W         00       0683-3025         R:FXD COMP 3000 OHM 5% 1/4W         01       0683-3025         R:FXD COMP 3000 OHM 5% 1/4W         02       0683-3025         R:FXD COMP 3000 OHM 5% 1/4W         03       0683-3025         R:FXD COMP 3000 OHM 5% 1/4W         04         04			•		1				
08         0683-6835         R: FXD COMP 68K OHM 5% 1/4W           9         0686-4735         R: FXD COMP 47K OHM 5% 1/2W           00         0683-3025         R: FXD COMP 3000 OHM 5% 1/4W           1070         0683-3025           1070         0600           1070         0000	67				1				.
In 20         0683-3025         R: FXD COMP 3000 OHM 5% 1/4W         A           A22R8         0683-3335         R: FXD COMP 3000 OHM 5% 1/4W           A         A22R9         0683-1535         R: FXD COMP 33K OHM 5% 1/4W	68		KIFXU LUMP GUK UMM 5% L/4W		1		, 1		
0         0683-3025         R: FXD COMP 3000 OHM 5% 1/4W           4         A         A22R8         0683-3335         R: FXD COMP 33K OHM 5% 1/4W           1070         0000         FXD COMP 3000 OHM 5% 1/4W         4         A22R9         0683-1535         R: FXD COMP 15K OHM 5% 1/4W	69		RIFXD COMP 47K OHM 5% 1/2W		1	A22R7	0683-1835	R:FXD COMP 18K OHM 5X 1/4W	
4 A22R9 0683-1535 R1 FXD COMP 15K DHM 5% 1/4W	170	0683-3025	R:FXD COMP 3000 OHM 5% 1/4W	·	1.				
	, 1			4	<b>-</b>				
	1	1970-0009	ELECTRON TUBE: INDICATOR 10 DIGIT		1			RIFXD COMP 18K OHM 5% 1/4W	
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Reference Designation	Part No.	Description #	Note	Reference Designation	Part No.		Description #		No
		OPTION 21 A22 5060-5611 (CONT'D)	•			OPTION 21 A22 5060-561\$ (CONT'D) A46 5060-5066			
22R11	0403-3315			4220 ( 0					
2R12	0683-3335 0683-1535	K:FXD COMP 33K OHM 5% 1/4W K:FXD COMP 15K OHM 5% 1/4W		A22R60 A22R61	0683-3335 0683-2045	REFXD COMP 33K OHM			
22R13	0757-0946	K:FXD FLM 8.2K DHM 2% 1/8W		A22R62	0683-1335	R:FXD COMP 200K OHM			
2R14	0757-0950	REFXD FLM 12K OHM 2% 1/8W		A22R63	0683-3335	R:FXD COMP 13K OHM R:FXD COMP 33K OHM	54 1/4W		
22R15	0757-0944	REFXD FLM 6.8K UHM 2% 1/8W		A22R64	0683-2035	RIFXD COMP 20K-OHM			
22R16	0683-1835	R:FXD COMP 18K OHM 5% 1/4W		A22R65	0683-2035	REFXD COMP 20K OHM	<b>59 1</b> 741		
22R17	0683-5625	R: FXD COMP 5600 OHM 5% 1/4W		A22R66	0683-3335	RIFXD COMP 33K OHM	24 1748 57 1764		
22R18	0683-1035	R:FXD COMP 10K OHM 5% 1/4W		A22R67	0683-2045	REFEAD COMP 200K. OHM	24 1/4W 57 1/24		
22R19	0683-1835	R:FXD COMP 18K OHM 5% 1/4W		A22R68	0683-1335	R:FXD COMP 13K OHM			
22R20	0683-5625	R:FXD COMP 5600 OHM 5% 1/4W					#		
22R21	0683-1035	R:FXD COMP 10K OHM 5% 1/4W		A46		SAME AS A11, USE PREF	IX A46	<u>4</u>	
22R22	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	i					N	1
2R23	0683-5625	R: FXD COMP 5600 0HM '5% 1/4W					· · · · · · · · · · · · · · · · · · ·		<u> </u>
2R24	0683-1035	R:FXD COMP 10K OHM 5% 1/4W			Table	e 21-4. Replaceable Par	rts		
2R25	0683-1835	R:FXD COMP 18K OHM 5% 1/4W		Part No.					
2R26	0683-5625	R:FXD COMP 5600 OHM 5% 1/4W				Description #	Mfr.	Mfr. Part No.	
127	0683-1035	R:FXD COMP 10K OHM 5% 1/%W		· ·		· •			1.
R 28	0683-2435	R:FXD COMP 24K OHM 5% 1/4W							
R29	0683-4725	R:FXD COMP 4700 OHM 5% 1/4W			OPTION 21		-		
30	0683-1335	R:FXD COMP 13K OHM 5% 1/4W							
31	0683-3335	R:FXD COMP 33K OHM 5% 1/4W		0140-0194	C:FXD MICA 1	10 PF 5%	28480	0 0140-0194	
32	0683-3335	R: FXD COMP 33K OHM 5% 1/4W		0140-0195	C:FXD MICA 1	30 PF 5% 300 VDCW	04062	2 DM15F131J 300V	
R33	0683-1535	R:FXD COMP 15K OHM 5% 1/4W		0140-0219	C:FXD MICA 1	80 PF 2%	28480		
R34	0683-9135	R:FXD COMP 91K OHM 5% 1/4W		0683-1035	R * FXD COMP 1	OK UHN 5% 1/4W		CB 1035	1
R35	0683-1535	/R:FXD COMP 15K OHM 5% 1/4W							
				0683-1045	R:FXD COMP 1	00K OHMS 5% 1/4W	01121	CB 1045	
2R36	0683-9135	R:FXD COMP 91K OHM 5% 1/4W		0683-1335		3K OHM 5% 1/4W	01121	CB 1335	
2R37	0683-1535	R:FXD COMP 15K OHM 5% 1/4W	· · · · · ·	0683-1535	R:FXD COMP 1	5K UHM 5% 174W		CB 1535	
2R38	0683-9135	R:FXD COMP 91K OHM 5% 1/4W		0683-1835	R:FXD COMP 1	8K UHM 58 174W	01121	CB 1835	
2R39	0683-1535	R:FXD COMP 15K OHM 5% 1/4W		0683-2035	R FXD CUMP 2	OK UHM 5% 1/4W	01121	CB 2035	
2R40	0683-9135	R:FXD COMP 91K OHM 5% 1/4W		0683-2045					
	0/00 150F	N. FYD COMP 154 ONN 58 1771	42.57	0683-2235	PIERD COMP 2	00K 0HM 5X 1/4W 2K 0HM 5X 1/4W		CB 2045	
2R41	0683-1535	R FXD COMP 15K OHM 5% 1/4W		0683-2435	R + FXD (UMP 2	4K UHM 5% 1/4W		CB 2235	
2R42	0683-9135	R: FXD COMP 91K OHM 5% 1/4W	2.2. W	0683-2735	R:EXD COMP 2	4K UNH 5% 1/4W 7K UHM 5% 1/4W		CB 2435	
2R43	0683-1535	R:FXD COMP 15K OHM 5% 1/4W		0683-3025	REEXD COMP 3	DOO DHM 5% 1/4W		CB 2735	
2R44	0683-9135	R:FXD COMP 91K OHM 5% 1/4W R:FXD Comp 15K ohm 5% 1/4W					01121	CB 3025	
2R45	0683-1535	KERAD GUNE 12K UNM 24 1/4W	1 1	0683-3335	R : FXD CUMP 3	3K DHM 5% 174W	01124	CB 3335	
2R46	0683-9135	R:FXD COMP 91K OHM 5% 1/4W		0683-3945	R FXD COMP 3	90K UHM 5% 1/4W		CB 3945	
2R47	0683-3335	R:FXD COMP 33K OHM 5% 1/4W		0683-4725	R:FXD CUMP 4	700 0HM 5% 1/4W		CB 4725	1
R48	0683-2045	RIFXD COMP 200K OHM 5% 1/4W		0683-5625	R #FXD CUMP 54	500 UHM 5% 174W		CB 5625	
R49	0683-3335	R: FXD COMP 33K WHM 5% 1/4W		0683-5635	REFXD CUMP 50	5K OHMS 5% 1/4W		CB 5635	
R50	0683-2045	RIFXD COMP 200K OHM 5% 1/4W							1 '
				0683-6835	R FXD CUMP 6	3K OHM 5% 174W	01121	CB 6835	
2R51	0683-3335	R:FXD COMP 33K.OHM 5% 1/4W		0683-9135	R = FXD CUMP 9	LK OHM 5% 1/4W		CB 9135	
2R52	0683-2045	K:FXD COMP 200K OHM 5% 1/4W	I I	0686-4735	R:FXD CUMP 47	K UHM 5% 1/2W		EB 4735	
2R53	0683-3335	R:FXD COMP 33K OHN 5% 1/4W		0688-5625	RIFXD COMP 56	00 OHM 5% 1/2W		EB 5625	
R 54	0683-2045	R: FXD COMP 200K OHM 5% 1/4W		0757-0944	KIFXD FLM 6.8	BK UHM 2% 178W		0757-0944	
R55	0683-3335	K:FXD COMP 33K OHN 5% 1/4W		0757-0946		K OHN 2% 1/8W			
0054	0692-2215	R: FXD COMP 33K OHM 5% 1/4W		0757-0950	R:FXD FLM 12K			0757-0946	
2R56 2R57	0683-3335 0683-3335	RIFXD COMP 33K OHM 5% 1/4W		1850-0111	TRANSISTOR:GE	RMANTIM DND		0757-0950	
2R58	0683-3355	RIFXD COMP 33K OHM 5% 1/4W		1850-0184	TRANSISTOR: GE	RMANIUM PNP		2N404A	
2R59	0683-3335	KIFXD COMP 33K OHM 5% 1/4W		1901-0025	DIODE: SILICON	100 WV 100MA		38339 1901-0025	. 4
				1901-0081			20400	1701-0023	4
~				1901-0081		50 VOLTS WORKING		1901-0081	16
				1970-0009	ELECTRON TUNE	UM LOOMA AT 0.85V GOPIV		1910-0016	
		$\mathbf{X}$	1 1	5060-5066	REVERSIBLE DE	INDICATOR 10 DIGIT	83594		1
				5060-5611	PRINTER COUPL	ING LOCIC		5060-5066	
				1	I THAT LE COUPL	AND LUGIC	04404	5060-5611 Y	1

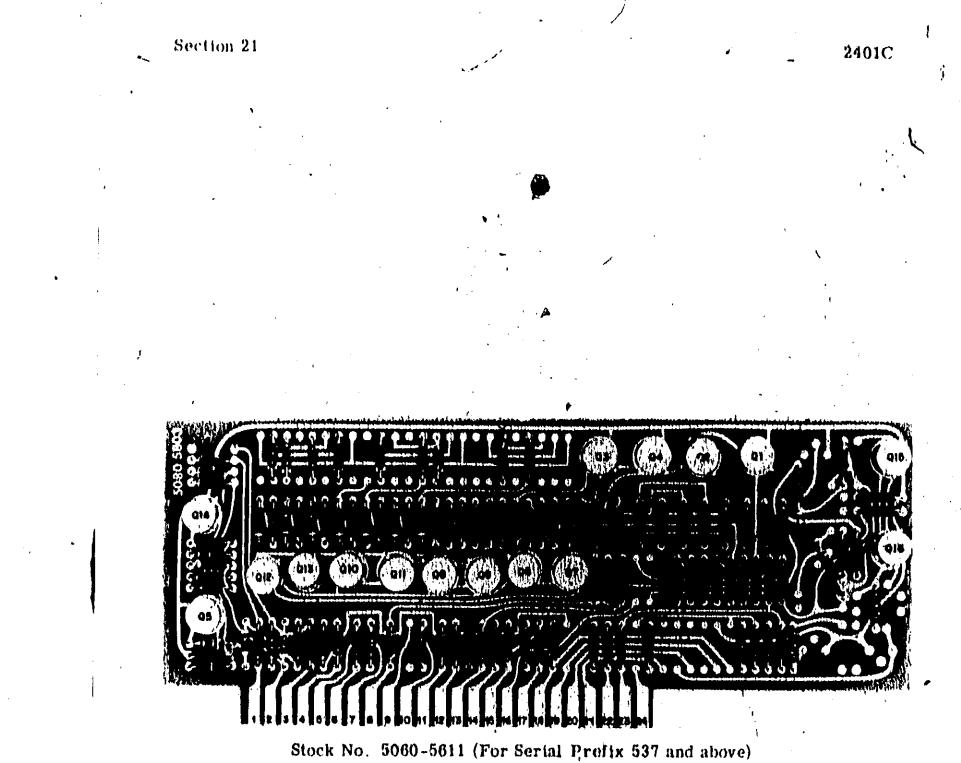
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# Section 21

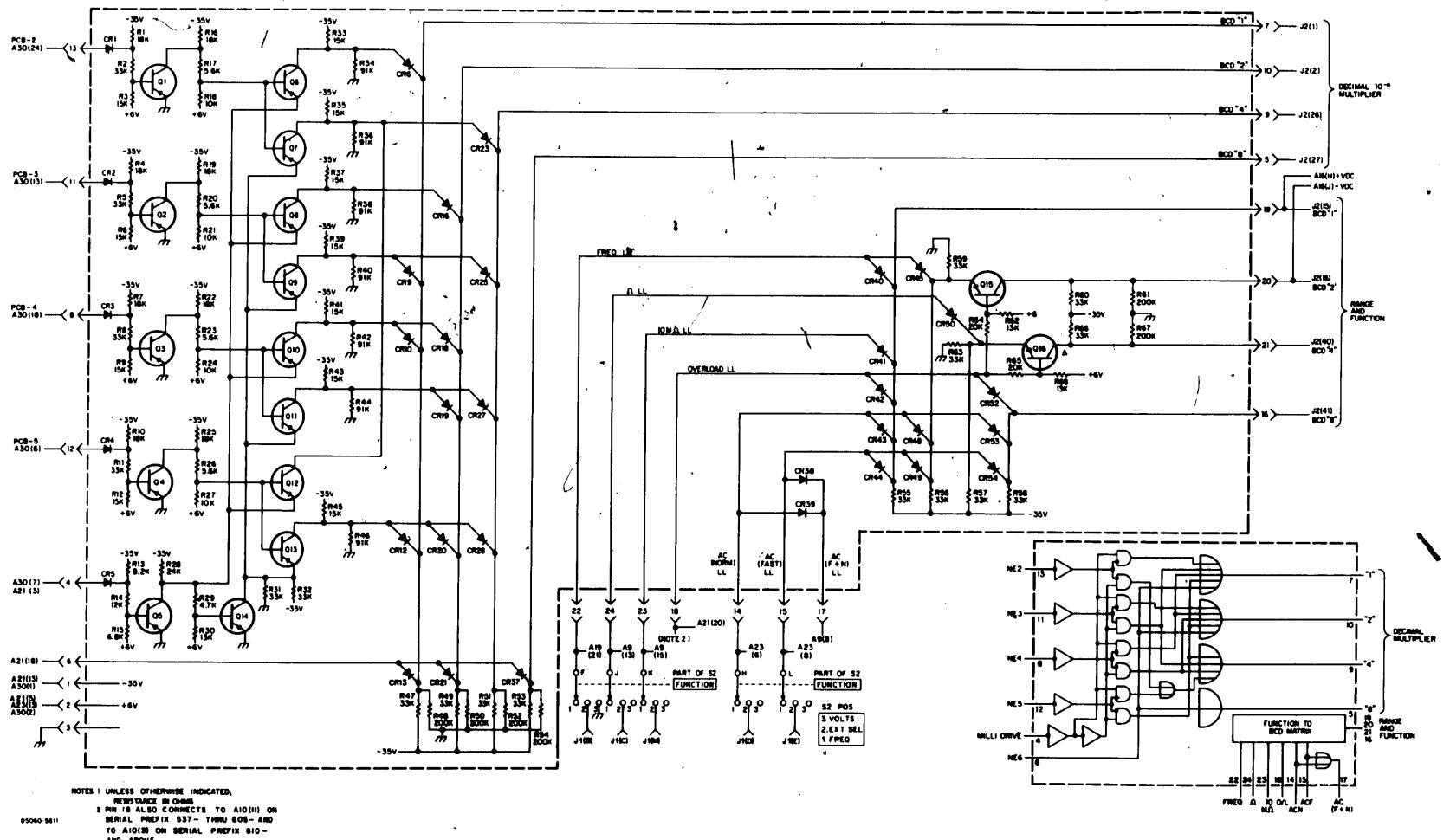
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A22 Printer Coupling

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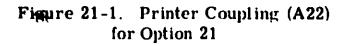


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AND ABOVE

- Section 21



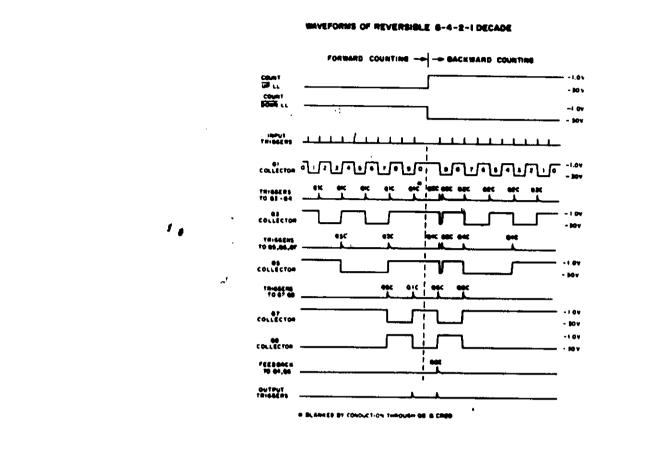
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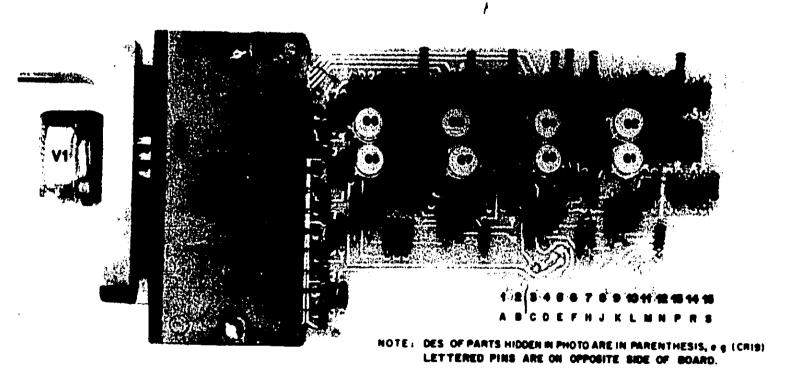
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Stock No. 5060-5066

(A11-A15, A46) Reversible +8-4-2-1 Decade Counter for Option 21

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21-12

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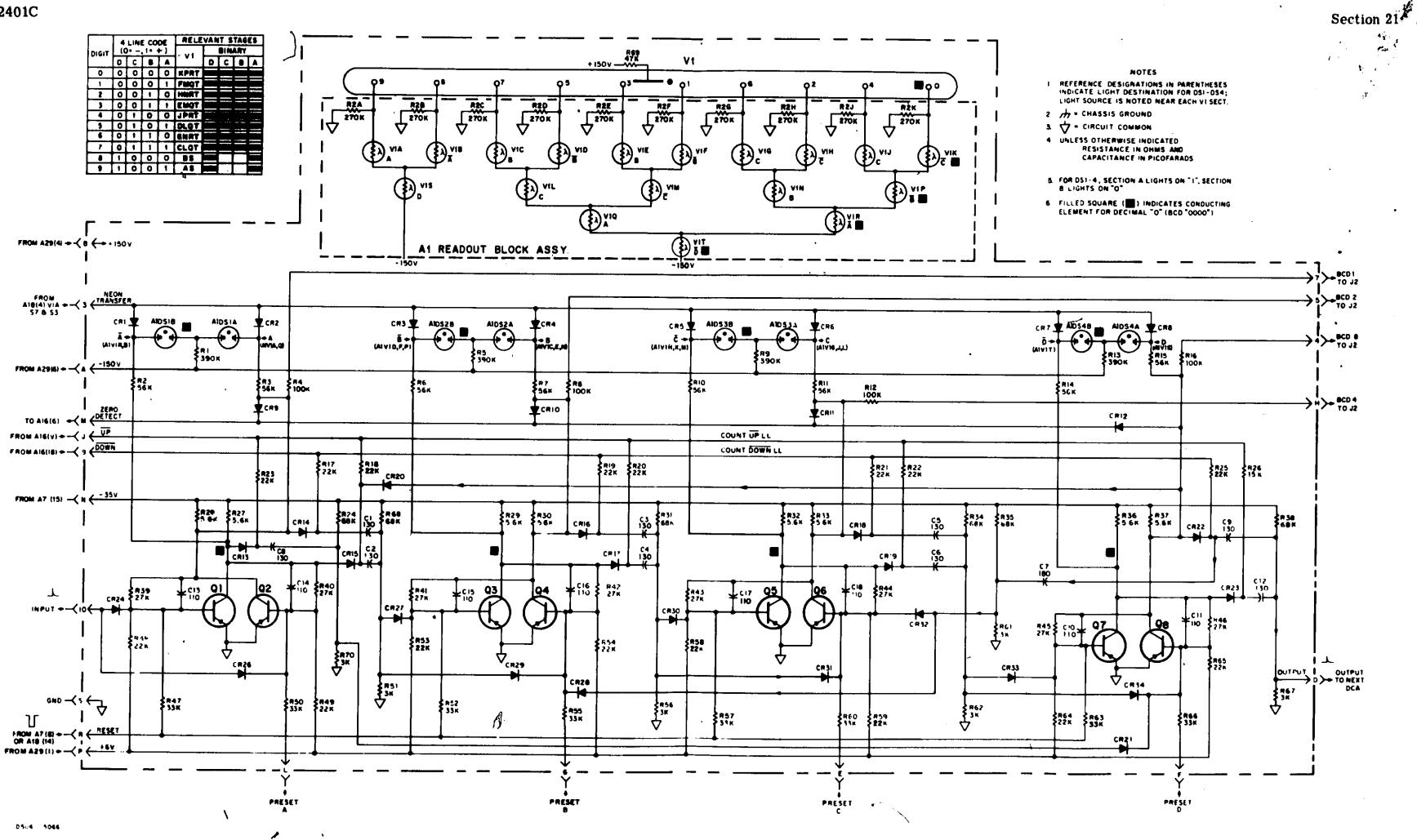


Figure 21-2. Reversible +8-4-2-1 Decade Counter (A11-A15, A46) for Option 21

C.

## 21-13/21-14

## MANUAL SUPPLEMENT MODEL HP-2401C Integrating Digital Voltmeter Option 29

## 29.1 GENERAL DESCRIPTION

2401C

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The HP-2401C-29 Integrating Digital Voltmeter is capable of frequency measurement to 1.2 megahertz. This option is available with 8-4-2-1 positivetrue or negative-true BCD output. The specifications in Section 1.7 of this manual apply without change to the HP-2401C-29.

## 29.2 INSTALLATION AND OPERATION

Install, operate, and program the HP-2401C-29 as specified in Section II of this manual.

## 29.3 THEORY OF OPERATION

The theory of operation of the HP-2401C-29 is the same as that of the standard HP-2401C, except as noted in the following paragraphs.

## 29.3.1 1 MHz Input Amplifier and Trigger Assemblies A26 and A27 (Figure 29-1, Standard on Serial Prefix 735 and Above)

The Input Amplifier (A26) and Schmitt Trigger (A27) assemblies used in the HP-2401C-29 incorporate circuit constants and transistors which are selected to achieve amplification and switching of signals with frequencies up to 1.2 megahertz. Otherwise these circuits, shown in Figure 29-1, are identical to those used in the standard HP-2401C.

# 29.3.2 1 Megahertz Gate Assembly A38 (Figure 29-2)

In the HP-2401C-29, a special Y megahertz gate assembly, A38 performs the counter input gating functions which are performed by circuitry on A19 in the standard instrument. To minimize degradation of the input signal and reduce noise susceptibility of the instrument, the gate assembly is located close to the 1 megahertz counting/display decade, A11.

As indicated in Figure 29-2, frequency pulses are received from Schmitt Trigger A27(6). Whenever the FREQ function is selected, the negative-true state (near -35v) of the freq line opens AND gate CR1-CR2 to the frequency input pulses. At the same time, the positive-true state (near ground) of the volt line closes AND gate CR4-CR5 to volt pulses which are received from Counter Control Assembly A16.

Selection of the VOLT function reverses the states that are applied to A38. The negative-true state of the volt line opens AND gate CR4-CR5 and the positive-true state of the freq line closes AND gate CR1-CR2.

Inverted frequency pulses from Q1 or volt pulses from Q2 are coupled through counter driver Q3 to counter decade A11. The output from Q3 is differentiated

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by C4-R11-R12 to produce the positive spike that is required for triggering the counting decade.

## 29.3.3 Reversible 1 MHz +4-2'-2-1 Decade Counter A11 (Figure 29-3)

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The transistors and circuit constants of decade counter A11 are selected to achieve the fast switching that is required for counting signal frequencies to 1.2 megahertz. The base-emitter junctions of the transistors are protected from reverse bias punch-through by diodes CR25 and CR35-CR41. Otherwise decade A11 is identical to decades A12-A15 and A46.

## 29.3.4 Reversible 8-4-2-1 Decade Counter (Figure 29-4)

Except for the circuit constants and transistors (which are selected for fast switching) and diodes CR25 and CR35-CR41 (which protect the transistors from reverse bias punch-through), the decade counter A11 used in HP-2401C-29/21 and 29/35 instruments is the same as the decade counter described in Sections 21 and 35 of this manual:

The BCD output logic (negative-true or positive-true) supplied from the basic 8-4-2-1 decade is determined by the connection of shorting links. The circuit in Figure 29-4 shows the connections used for negative-true BCD output, wherein the "1" state is near -35v and the "0" state is near ground. As shown, the shorting links are connected between -1, -2, -4, and -8 terminals and the BCD outputs of the decade. Positive-true BCD output is provided from this basic decade by connecting the shorting links from the +1, +2, +4, and +8 terminals to the BCD outputs. Positive-true output reverses the states previously mentioned: "1" state is near ground and "0" state is near -35v.

## 29.4 MAINTENANCE

Figures 29-1 through 29-4 show parts placement and circuit configurations of A11. A26. A27, and A38 for HP-2401C-29, 29/21, and 29/35 instruments. See Figure 29-5 for location of A38, R12, and R13 added for Option 29. Figure 29-6 shows interconnections of the HP-2401C-29 where they differ from those of the standard HP-2401C. Except for the foregoing, the maintenance information in Section IV (and Section 21 or 35 if applicable) of this manual applies without change to all versions of the HP-2401C-29. Assemblies A26 and A27 described in this section are standard on instruments with serial prefix 735 and above.

## 29.5 PARTS LIST

The Parts List in Section V of this manual applies to the various versions of the HP 2401C-29 except as indicated in Tables 29-1 and 29-2.

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## Section 29

Table 29-	1. I	Reference	Designation	Index
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Reference Designation	Part No.	Description #	Note
		OPTION 29 A11 5060-5647	
		MAKE THE FOLLOWING CHANGES TO TABLE 5-1 TO PROVIDE A REPLACEABLE PARTS LIST FOR THE HP2401C-29.	
		DELETE THE FOLLOWING FROM TABLE 5-1:	
A11 A26 A27	5060-3781 05214-6014 5060-5016	REVERSIBLE DECADE COUNTER INPUT AMPLIFIER SCHMITT TRIGGER	A- S A- S
C 3	0140-0195	C:FXD MICA 130 PF 5% 300VDCW	
R8 R9	0683-6835 0683-3025	R:FXD COMP 68K OHM 5% 1/4W R:FXD COMP 3000 DHM 5% 1/4W	
		ADD THE FOLLOWING TO TABLE 5-1:	
A11 A26 A27 A38	5060-5647 05232-6007 • 05232-6006 5060-5700	1 MHZ REVERSIBLE DECADE COUNTER 1 MHZ INPUT AMPLIFIER 1 MHZ INPUT TRIGGER 1 MHZ GATE ASSEMBLY	A-S A-S
C11	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
R12 R13	0683-4715 0683-4715	R:FXD COMP 470 OHM 5% 1/4W R:FXD COMP 470 OHM 5% 1/4W	A-S M-X
XA38	1251-0135	CONNECTOR: BODY 15 PIN	
A11	[^] 5060-5647	1 MHZ REVERSIBLE DECADE COUNTER	
A11A1	, NSR	READOUT BLOCK ASSY	
A11C1	0160-2101	L:FXD MICA 27PF 2% 300VDCW	
A11C2	0160-2101	C:FXD MICA 27PF 2% 300VDCW	
A11C3	0140-0191	C:FXD MICA 56 PF 5%	
A11C4	0140-0191	CIFXD MICA 56 PF 5%	
A11C5 A11C6	0160-2101 0160-2101	C:FXD NICA 27PF 2% 300VDCW C:FXD NICA 27PF 2% 300VDCW	
A11C7	0140-0191	CIFXD MICA 56 PF 52	
A11C8	0140-0191	CIFXD NICA 56 PF 51	
N11C9	0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	
A11C10 A11C11	0140-0191 0140-0191	C:FXD MICA 56 PF 5%	
11012	0140-0195	C:FXD MICA #8 PF 5% C:FXD MICA 130 PF 5% 300 VDCW	
11C13- 11C18	0160-2232	C: FXD MICA 33 PF 2% 300VDCW	
11CR1- 11CR6	1901-0025	DIODE:SILICON 100WV 100MA	
11CR9	1901-0081	UIODE:SILICON 50 VOLTS WORKING	
11CR10	1901-0081	DIODE:SILICON 50 VOLTS WORKING	1
LICRII	1901-0081	DIODE:SILICON 50 VOLTS WORKING	
11CR13- 11CR24	1901-0081	·	
	1901-0081	DIODE:SILICON 50 VOLTS WORKING	
,	/		+

# See introduction to this section for ordering information

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Table 29-1. Reference Designation Index (Cont'd)

		lo 29-1. Reference Designation Index (Cont'd)			Table 29-1. Reference Designation Index (Cont'd)				
Designation	S Part No.	IPeruription //	Note			Designation	🚯 Part No.	Description #	Note
		OPTION 29 A11 5060-5647 (CONT'D)		,					A-6
A11C#25	1901-0143	UTODETSTLICON						A27 05232-8006	A-5
ALICA26- Alica34 Alica35 Alica35	1901-0081 1901-0143 1901-0143	PTODEISTLICON 30 VOLTS WORKING DIODEISTLICON DIODEISTLICON	•			ALIN37 ALIN33 ALIN34	0686-5625 0686-5625 0683-6835 0683-4735		A-G H-X
A11CR37 A11CR38 A11CR38 A11CR39 A11CR40	1901-0143 1901-0143 1901-0143 1901-0143	DIODE + SILICON DIODE + SILICON , DIODE + SILICON DIODE + SILICON				A11835 A11836	0683-6835 0683-3935 0686-5625	AIFRO COMP 66K OHN 58 1/4H RIFKO COMP 39K OHN 58 1/4H RIFRO COMP 5600 OHN 58 1/2H	A-G H-X
A11C841 A11Q1-	1901-0143	DIODEISTLICON				ALL/837 ALL838	0686-5625 0683-6635	REFXD CONP 5600 DHM SE L/ZW REFXD CONP 66K DHM 58 1/4W	A-G
A1100	5080-0615 0683-3945	TRANSISTORIMATCHEO DAIR Rifxd Conp. 390K unn. 58.174M		<b>,</b>	ŀ	A11839- A11850 -	0683-5635	RIFXD CONP 56K OHNS 58 1/4W	H-X .
A1181 A1182	0683-5635	RIFKD CONF SOK OHNS ST 1/4W			1	ALIASI	0683-3025	RIFXD CONP 3000 OHN SE 1/4H	ſ
AliR3 AliR4 AliR5 AliR6	0683-5635 0683-1045 0683-3945 0683-5635	KIFXD CONP 56K DHMS 58 1/4H KIFXD CONP 100K DHMS 58 1/4H KIFXD CONP 390K DHM 58 1/4H RIFXD COMP 56K DHMS 58 1/4H				Alims2 Alims3 Alims4 Alims6 Alims6	0603-5635 0603-5635 0603-5635 0603-5635 0603-5635 0603-3025	RIFXD CONP`S6K OHMS 5% 1/4W RIFXD COMP 56K OHMS 5% 1/4W	
A1187 A1186 A1186 A1189 A11810 A11811	0683-5635 0683-1045 0683-3945 0683-5635 0683-5635	RIFXD COMP 56K UHNS 58 1/4W HIFXD COMP 100K UHNS 58 1/4W RIFXD COMP 390K UHN 58 1/4W RIFXD COMP 56K UHNS 58 1/4W HIFXD COMP 56K UHNS 58 1/4W			•	A11857 A11858 A11858 A11859 A11860 A11861	0483-5435 0483-5435 0483-5435 0483-5435 0483-3025	ALFXD CONP SAK DHAS SE 1/4W	¢)
A11812 A11813 A11814 A11815 A11815 A11816	0683-1045 0683-3945 0683-5635 0683-5635 0683-1045	RIFXD CONP 100K OHNS 5% 1/4W RifXD Conp 390K OHN 5% 1/4W RiFXD Conp 56K Ohns 5% 1/4W RiFXD Conp 56K Ohns 5% 1/4W AifXD Conp 100K Ohns 5% 1/4W	e: /			3 A11862 A11863 A11864 A11865	0683-3025 0683-5635 0683-5635 0683-5635	AIFXD COMP 3000 OHN 58 1/4M AIFXD COMP 56K OHNS 58 1/4M AIFXD COMP 56K OHNS 58 1/4M RIFXD COMP 56K OHNS 58 1/4M	
ALIAL7 ALIAL0 ALIAL9	0683-1535 0683-2235 0683-1535 9683-1535 9683-1835 0683-2235	R#FXD COMP 15K OHM 5% 1/4W R#FXD COMP 22K OHM 5% 1/4W A#FXD COMP 15K OHM 5% 1/4W R#FXD COMP 15K OHM 5% 1/4W R#FXD COMP 18K OHM 5% 1/4W	A-G H-X A-G H-X A-G			A11866 A11867 A11868 A11869	0483-5635 0683-3025 0683-6835 0683-3935 0686-4735		A-G . H-X :
. '	0683-2735	RIEKD COMP 27K OHN 58 1/44	H-X	, ,		A11V1	1970-0009	ELECTRON TUBE: INDICATOR 10 DIGIT	
A11820 A11821 A11822 A11823	0683-2235 0683-3035 0683-3035 0683-2735	RIFXD COMP 22K UNM 58 1/4W RIFXD COMP 30K UNM 58 1/4W RIFXD COMP 30K UNM 58 1/4W RIFXD COMP 27K UNM 58 1/4W				A26 A27	06233-6007 06232-6006		A-8" A-8"
11824 11825 11826	0683-2735 0683-1235 0683-2235 0683-1235 0683-1235	RIFXD COMP 27K OHN 58 1/4W RIFXD COMP 12K OHN 58 1/4W RIFXD COMP 22R OHN 58 1/4W RIFXD COMP 12K OHN 58 1/4W RIFXD COMP 12K OHN 58 1/4W	A-G H_X A-G H-X						ſ
11A27 11A20 11A20 11A29 11A30 11A31	0686-5625 0686-5625 0686-5625 0686-5625 0683-6835 0683-3935	RIFXD CONP 5600 (HM 58 1/2W RIFXD CONP 5600 (HM /58 1/2W RIFXD CONP 5600 (HM 58 1/2W RIFXD CONP 5600 (HM 58 1/2W RIFXD CONP 66K (HM 58 1/4W RIFXD CONP 66K (HM 58 1/4W	A-G H-X	\$		, ,	,		
		* *		, ,				→ SEE PAGE NO. 5-30 #* SEE PAGE NO. 5-31	

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Section 29

-Table 29-1. Reference Designation Index (Cont'd)

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## Table 29-1. Reference Designation Index (Cont'd)

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Table 29-1. Reference Designation Index (Cont'd)								
Designation	Part No.	Description #	· Note	۰ ۲	Le grance Designation	🕒 Parl No.	Description #	No
		OPTION 29 A38 9000-6760		₽ I			OPTION 28/21, 28/35	
A30C1 .	* 0160-0356	CIFED MICA LO PF SE					MAKE THE FOLLOWING CHANGES TO TABLE 5-1 TO PROVIDE A REPLACEABLE PARTS LIST FOR	
A30C2 A30C3 A30C4	0140-0201 0160-0356 0140-0014	CIFXD MICA 12 PF 58 CIFXD MICA 10 PF 58 CIFXD MICA 56 PF 108					THE HP2401C-29/21. DELETE THE FOLLOWING:	
A38CR1- A38CR8	1901-2061	OF ODE ISILICON SO VOLTS WORKING			A11- A15 A22	5060-3701 5060-2111 5060-5610	REVERSIBLE DECADE COUNTER Printer Logic	A-E
A30Q1 ,	1053-0008 1053-0008	TRANSISTOR: SILICON PNP			A26 A27 A46	05214-6014 5060-5016 5060-3781	PRINTER LOGIC INPUT AMPLIFIER Schmitt Trigger Reversible decade counter	F-X A-S A-S
ABOD ABORIN	1853-0008 0757-0947	TRANSISTOR:SILICON PHP R:FXD FLM 9.1K OHM 28 1/6W			C3 R8 R9	0140-0195 0683-6835	C:FXD MICA 130 PF 5% 300VDCW R:FXD Comp 68k ohm 5% 1/4w	
A388 2 A388 3 A3884	0757-0956 0757-0969 0686-5625	A: FXD FLM 27K ONM 28 1/0W A: FXD FLM 11K ONM 28 1/0W R: FXD CONF 5600 ONM 58 1/2W			<b>N J</b>	0683-3025	R:FXD COMP 3K OHN 5% 1/4W ADD THE FOLLOWING TO TABLE 5-1 FOR THE HP2401C-29/21:	
NJOR5 NJOR6 NJOR7	0663-1035 0683-1035 0683-6825	AIFXD COMP LOK ONN 52 1/44 AIFXD COMP 10K ONN 52 1/44 AIFXD COMP 6600 ONN 52 1/44			A11 A12-	5060-6545	IMHE REVERSIBLE DECADE COUNTER	
3889 3889	0683-1535 0683-1835 0689-2725	RIFXD COMP 15K ONN 52 1/4W RIFXD COMP 16K ONN 52 1/4W RIFXD COMP 2.7K ONN 52 1W			A15 A22 A26 A27	5060-5066 5060-5611 05232-6007 05232-6006	REVERSIBLE DECADE COUNTER PRINTER LOGIC INPUT AMPLIFIER SCHMITT TRIGGER	A-5
A30811 A30812	0683-6835 0683-3025	A: FXD COMP 66K OHM 52 1/4W A: FXD COMP 3000 OHM 52 1/4W		ł	A38 A46	5060-5700 5060-5066	IMHE GATE ASSEMBLY REVERSIBLE DECADE COUNTER	A-5
					C11 R12 R13 XA38	0150-0121 0683-4715 0683-4715 1251-0135	C:FXD CER 0.1 UF +80-20% 50 VDCW R:FXD COMP 470 OHM 5% 1/4W R:FXD COMP 470 OHM 5% 1/4W Connector:Body 15 Pin	A-S H-X
							MAKE THE FOLLOWING CHANGES TO TABLE 5-1 TO Provide a replaceable parts list for the HP2401C-29/35.	
					A11-		DELETE THE FOLLOWING:	
		•			A15 A22 A26 A27 A46	5060-3781 5060-2111 5060-5610 05214-6014 5060-5016 5060-3781	REVERSIBLE DECADE COUNTER PRINTER LOGIC PRINTER LOGIC INPUT AMPLIFIER SCHMITT TRIGGER REVERSIBLE DECADE COUNTER	A-E F-X A-S A-S
	/			T	C 3 R 8 R 9	0140-0195 0683-6835 0683-3025	C:FXD MICA 130 PF 5% 300VDCW R:Comp 68k ohm 5% 1/4w R:FXD 3k ohm 5% 1/4w	
							ADD THE FOLLOWING TO TABLE 5-1 FOR THE HP2401C-29/35:	
		1			A11 A12-	5060-5646	IMZ REVERSIBLE DECADE COUNTER	, X , - (
		•		ł	A15	5060-5644 5060-5612	REVERSIBLE DECADE COUNTER PRINTER COUPLING LOGIC	

Table 29-1.	Reference	<b>Designation Index</b>	(Cont'd)
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2401C

### 2401C

Reference Designation				
		OPTION 28/21, 28/35 A11 5080-5645 5080-5645		
426	05232-6007	INPUT AMPLIFIER	A-S	
27	05232-6006	SCHMITT TRIGGER	A-S	
38	5060-5700	IMHE GATE ASSEMBLY		A1187
46	5060-5644	IMHE REVERSIBLE DECADE COUNTER		Alire Alir9
:11	0150-0121	C:FXD CER 0.1 UP +80-20% 50VDCW	A-S	A11R10
R1	1901-0025	DIODE:SILICON 100MV 100MA		A11R11
R4-	1001 0000			A11R12
12	1901-0025	DIODE:SILICON 100MV 100MA		AL1R13
13	0683-4715	R: FXD COMP 470 OHM 5% 1/4W	M-X	A11814
A38	0683-4715 1251-0135	R:FXD COMP 470 OHM 5% 1/4W Connector:Body 15 pin		AliR15
		•		A11816
A11	5080-5645	1 MHZ REVERSIBLE DECADE COUNTER		A11R17
	5080-5646	1 MHZ REVERSIBLE DECADE COUNTER		A11818
	NSR	HEADDUT BLOCK ASSY		A11R19
				A11820
MIICI-				A11821
11C6	0160-2101	CIFXD NICA 27PF 28 300VDCW		A11822
		<b>-</b>		A11823
1107	0140-0191	CIFXD NICA 56 PF 58		A11824
11C8	0160-2101	CIFXD NICA 27PF 28 300VDCW		
1109	0140-0195	C:FXD NICA 130 PF 58 300 VDCW		
11010	0160-2232	CIFXD MICA 33 PF 28 300VDCH		A11R25
11011	0160-2232	CIFXD MICA 33 PF 28 300VDCW		A11014
11C12	0140-0195	C:FXD MICA 130 PF 58 300 VDCW		A11R26 A11R27
11013	0160-2232	CIFXD NICA 33 PF 28 300VDCW		
11014	0160-2232	CIFXD NICA 33 PF 28 300VDCW		A11828
11015	0160-2232	C:FXD NICA 33 PF 28 300VDCW		ALIR29
11016	0160-2232	CIFXD NICA 33 PF 28 300VDCW		A11830
				A11R31
11C17	0160-2232 0160-2232	C‡FXD MICA 33 PF 28 300VDCW C‡FXD MICA 33 PF 28 300VDCW		
	0100-2232	CITAD MICH 33 FF 24 30070CW		A11832
11CR1-				A11R33
11CR8	1901-0025	DIODE:SILICON 100WV 100MA		A11834
11CR9-				A11835
11CR24	1901-0081	DIODE:SILICON 50 VOLTS WORKING		ALINJ
11CR25	1901-0143	DI ODE I SILICON		A11836
11CR26-				A11837
11CR34	1901-0081	DIODE:SILICON 50 VOLTS WORKING		A11R38
11CR35-				A11839-
11CR41	1901-0143	DIODEISILICON		A11850
1191-				A11851
1108	1853-0008	TRANSISTOR: SILICON PNP		A11R52
				A11853
1181	0683-3945	R # FXD COMP 390K OHM 5% 1/4W		A11R54
1182	0683-5635	RIFXD CONP 56K OHMS 58 1/4W		ALLR55
1183	0683-5635	RIFXD COMP 56K OHMS 58 1/4W	1 1	A11856
1184	0683-1045	RIFXD COMP 100K OHMS 5% 1/4W	1 1	A11857
11R5	0683-3945	RIFXD COMP 390K OHM 5% 1/4W	1 1	A11R58
11R6	0683-5635	RIFXD COMP 56K CHMS 58 1/4W		A11R59
				A11R60

## Table 29-1. Reference Designation Index (Cont'd)

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#### Section 29

Part No.	Description #	Note
	OPTION 29/21, 29/35 A11 5050-5645 (CONT'D)	
	5080-5646 (CONT'D)	
0483-5635	A:FXD CONP 56K DHHS 58 1/4W	
0683-1045 0683-3945	R#FXD COMP 100K OHMS 5% 1/4W R#FXD COMP 390K OHM 5% 1/4W	
0683-5635	RIFXD COMP 56K OHNS 52 1/4W	}
0683-5635	RIFXD COMP SOK OHMS SE 1/4W	
0683-1045 0683-3945	K:FXD COMP 100K CHMS 5% 1/4W R:FXD COMP 390K CHM 5% 1/4W	
0683-5635	RIFXD COMP 56K CHMS 5% 1/4W	
0683-5635	RIFXD COMP 56K DHMS 58 1/4W	
0483 1046		
0683-1045 0683-1835	R:FXD COMP 100K OHMS 5% 1/4W R:FXD COMP 18K OHM 5% 1/4W	A-G A-G
0683-2235	RIFXD COMP 22K OHM 5% 1/4W	H-X
0683-1835	RIFXD COMP 18K OHM 5% 1/4W	
0683-2235	RIFXD COMP 22K OHM 58 1/4W	
0683-2235	R:FXD COMP 22K OHM 58 1/4W	
0683-2235	RIFXD COMP 22K OHN 54 1/4W	
0683-2235	RIFXD COMP 22K OHN 5% 1/4W	
0683-1835	RIFXD COMP 18K OHN 58 1/4W	
0683-6835	R:FXD COMP 68K OHM 5% 1/4W	A - G
0683-3935	RIFXD COMP 39K OHM 5% 1/4W	
0683-1835	RIFKD COMP 18K OHM 5% 1/4W	H-X A-G
0643-2235	RIFXD COMP 22K OHM 5% 1/4W	H-X
0683-8225	R: FXD COMP 8200 CHNS 5% 1/4W	A - (.
0686-5625	RIFXD COMP 5600 DHM 58 1/2W	
0686-5625	R: FXD COMP 5600 DHM 58 1/2W	
0686-5625	R:FXD CONP 5600 OHM 5% 1/2W	
0686-5625	R:FXD COMP 5600 UHM 58 1/2W	
0683-6835	RIFXD COMP 68K OHM 51 1/4W	A - (,
0683-4735	RIFXD CONP 47K OHN 5% 1/4W	H- X
0686-5625	RIFXD COMP 5600 OHN 58 1/2W	
0686-5625	AIFXD COMP 5600 DHM 58 1/2W	
0683~6835	RIFXD COMP 68K OHM 58 1/4W	A-G
0683-4735	KIFXD COMP 47K OHM 58 1/4W	H= X
0683-6835	RIFXD COMP 68K OHM 5% 1/4W	
0686-5625	R#FXD COMP 5600 DHM 5% 1/2W	
0686-5625	RIFXD COMP 5600 OHM 5% 1/2W	
0683-6835	RIFXD CONP 68K OHM 58 1/4W	A - G
0683-5635	RIFXD COMP 56K OHMS 5% 1/4W	tt-X
0683-5635	RIFXD COMP 56K DHMS 58 1/4W	
0683-3025	R: FXD COMP 3000 OHM 38 1/4W	
0683-5635 0683-5635	RIFXD COMP 56K OHMS 5% 1/4W	
0683-5635	R:FXD COMP 56K OHMS 58 1/4W R:FXD COMP 56K OHMS 58 1/4W	
0683-5635	RIFXD CONP 56K OHMS 5% L/4W	
0683-3025	RIFXD COMP 3000 OHN 58 1/4W	
0683-5635 0683-5635	RIFXD COMP 56K OHMS 58 1/4W RifXD Comp 56K ohms 58 1/4W	
0683-5635	RIFXD COMP SOK OMMS SX 1/4W RIFXD COMP S6K OMMS SX 1/4W	
0683-5635	RIFXD COMP 56K OHMS 58 1/4W	
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## Table 29-1. Reference Designation Index (Cont'd)

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# Table 29-1. Reference Designation Index (Cont'd)

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Designation	S Part No. Description #			Table 29-2. Replaceable Parts				
Designation		Description #	Nete	Part Ne.	Description #	Mtr.	Mfr. Part No.	TQ
		OPTION 28/21, 28/35 A11 9000-8045 (CONT'D) 9000-8045 (CONT'D) A12- A15 9000-8045 9000-8044 A22 9000-8011 9000-8012 A35 9002-8017		0140-00140140-01910140-01950140-02010160-03560160-2101	OPTION 29 C:FXD MICA 56 PF 10% C:FXD MICA 56 PF 5% C:FXD MICA 130 PF 5% 300VDCW C:FXD MICA 12 PF 5% C:FXD MICA 18 PF 5% C:FXD MICA 27 PF 2% 300VDCW	00\$53 28480 04062 28380 28480 72136	RCM15E560K 0140-0191 DM15F131J 300V 0140-0195 0160-0356 RDM15E270G3C	1 6 3 1 2
A11R61 A11R62	0683-3025 0683-3025	A27 00023-00061 A38 0000-0700 A48 0000-0005 0000-0046 A:FXD CONP 3000 CHM 52 1/4H R:FXD CONP 3000 CHM 52 1/4H		0160-2232 0683-1035 0683-1045 0683-1235	C:FXD MICA 33 PF 28 300VDCW R:FXD COMP 10K OHM 58 1/4W R:FXD COMP 100K OHM 58 1/4W	72136 01121 01121 01121	RDM15E330G3C CB 1035 CB 1045 CB 1235	6 2 4 2
A11R63 A11R64 A11R65 A11R66	0683-5635 0683-5635 0683-5635 0683-5635	RIFXD COMP SAK OHNS SE 1/4W V RIFXD COMP SAK OHNS SE 1/4W RIFXD COMP SAK OHNS SE 1/4W RIFXD COMP SAK OHNS SE 1/4W		0683-1535 0683-1835 0683-2235 0683-2735 0683-3025	R:FXD COMP 15K OHM 5% 1/4W R:FXD COMP 18K OHM 5% 1/4W R:FXD COMP 22K OHM 5% 1/4W R:FXD COMP 27K OHM 5% 1/4W R:FXD COMP 3K OHM 5% 1/4W	01121 01121 01121 01121 01121	CB 1535 CB 1835 CB 2235 CB 2735 CB 3025	3 5 3 7
A11R67 A11R68 A11R69 A11R70	0483-3025 0483-4855 0483-3935 0486-4735 0483-3025	R:FXD COMP 3000 CHM 58 1/4W	A-G H-X	0683-3035 0683-3935 0683-3945 0683-4735 0683-4735 0683-5635	R:FXD COMP 30K OHM 5% 1/4W R:FXD COMP 39K OHM 5% 1/4W R:FXD COMP 390K OHM 5% 1/4W R:FXD COMP 47K OHM 5% 1/4W R:FXD COMP 56K OHM 5% 1/4W	01121 01121 01121 01121 01121 01121	CB 3035 CB 3935 CB 3945 CB 4735 CB 5635	2 3 4 1 33
A11V1 A11Z1 A12	1970-0009 508C-6555	TUBE:ELECTRON NIXIE 0-9 NETWORK:DIODE/RESISTOR	H-X	0683-6825 0683-6835 0686-4735 0686-5625 0689-2725	R:FXD COMP 6.8K OHM 5% 1/4W R:FXD COMP 68K OHM 5% 1/4W R:FXD COMP 68K OHM 5% 1/4W R:FXD COMP 47K OHM 5% 1/2W R:FXD COMP 5.6K OHM 5% 1/2W R:FXD COMP 2.7K OHM 5% 1W	01121 01121 01121 01121 01121 01121	CB 6825 CB 6835 EB 4735 EB 5625 GB 2725	1 7 1 9
A13 A14 A15	1000-0005 9005-0044 9005-0045 9005-0045 9005-0045 9005-0045	REVERBIBLE DECADE COUNTER REVERBIBLE DECADE COUNTER SAME AS A12 USE PREFIX A13 SAME AS A12 USE PREFIX A13 SAME AS A12 USE PREFIX A14 SAME AS A12 USE PREFIX A14 SAME AS A12 USE PREFIX A15	•• ••• •• •• ••	0757-0947 0757-0949 0757-0958 1853-0008 1901-0025	R:FXD FLM 9.1K OHM 2% 1/8W R:FXD FLM 11K OHM 2% 1/8W R:FXD FLM 27K OHM 2% 1/8W TRANSISTOR:SILICON PNP DIODE:SILICON 100MA 100V	28480 28480 28480 01295 284801	0757-0947 0757-0949 0757-0947 2N3250	1 1 3 8
A22 A36 A27	5000-0011 5000-0012 5022-0007 50222-0007	SAME AS A12 USE PREFIX A15 PRINTER LOGIC PRINTER LOGIC INPUT AMPLIFIER SCHWITT TRIGGER	··· ·· A-8* A-5*	1901-0081 1901-0143 1970-0009 5060-5647 5060-5700	DIODE:SILICON SOVDCW DIODE:SILICON ELECTRON TUBE:INDICATOR 10 DIGIT 1MH2 REVERSIBLE DECADE COUNTER 1MH2 GATE ASSEMBLY	28480 28480 83594 04404 04404	1901-0081 1901-0143 05991 5060-5647 5060-5700	13 8 1 1 1
ASU AND	8666-5760 8666-5665 8660-6644	1 MHZ GATE ABBEMBLY SAME AS A12, USE PREFIX ANS	•••	5080-0615	TRANSISTOR:MATCHED PAIR	04404	5080-0615	8
		SAME AS A12, USE PREFIX A46	•••		OPTION 28/21			
				0140-0014 0140-0191 0140-0194 0140-0195 0140-0201	C:FXD MICA 56 PF 10% C:FXD MICA 56 PF 5% C:FXD MICA 110 PF 5% C:FXD MICA 130 PF 5% 300VDCW C:FXD MICA 12 PF 5%	00853 28480 28480 04062 28480	RCM15E560K 0140-0191 0140-0194 DM15F131J 300V 0140-0195	4 1 40 47 1
				0140-0219 0150-0121 0160-0356 0160-2101 0160-2232	C:FXD MICA 180 PF 2% C:FXD CER 0.1 UF +80-20% 50VDCW C:FXD MICA 18 PF 5% C:FXD MICA 27 PF 2% 300VDCW C:FXD MICA 33 PF 2% 300VDCW	28480 56283 28480 72136 72136	0140-0219 5C50B15-CML 0160-0356 RDM15E270G3C RDM15E330G3C	5 1 2 7 8
		и șee table 5-1 ин șee parts list în section 21. инн see parts list în section 35. инн see parts list on page 29-6.	<b>(1</b>	0683-1035 0683-1045 0683-1335 068341535 068341535	R:FXD COMP 10K OHM 5% 1/4W R:FXD COMP 100K OHM 5% 1/4W R:FXD COMP 13K OHM 5% 1/4W R:FXD COMP 13K OHM 5% 1/4W R:FXD COMP 18K OHM 5% 1/4W	01121 01121 01121 01121 01121 01121	CB 1035 CB 1045 CB 1335 CB 1535 CB 1835	3 24 5 17 1 t

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## Table 29-2. Replaceable Parts

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#### Table 29-2. **Replaceable** Parts (Cont'd)

<b>9 Part No.</b>	Description #	Mfr.	Mfr. Part No.	TQ	Part No.	Description #	Mfr.	Mfr. Part No.	
1683-2035						• ···			TQ
683-2035	OPTION 28/21 (CONT'D)								
1683-2035						OPTION 29/35 (CONT'D)			
	R:FXD COMP 20K OHM 58 1/4W	01121	CB 2035	2					
0683-2045 0683-2235	R:FXD COMP 200K OHM 5% 1/4W	01121	CB 2045	6	0150-0121	C:FXD CER 0.1UF +80-20% 50VDCW	56289	5C50B15-CML	1
0683-2435	R:FXD COMP 22K OHM 5% 1/4W R:FXD COMP 24K OHM 5% 1/4W	01121 01121	CB 2235 CB 2435	79	0160-0356	C:FXD MICA 18PF 58	28480	0160-0356	2
0683-2735	R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735	40	0160-2101 0160-2232	C:FXD MICA 27PF 28 300VDCW C:FXD MICA 33PF 28 300VDCW	72136	RDM15E270G3C	7
		01121		70	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	72136	RDM15E330G3C CB 1035	8
0683-3025	R:FXD COMP 3K OHM 5% 1/4W	01121	CB 3025	37					Ů
0683-3335	R:FXD COMP 33K OHM 5% 1/4W	01121	CB 3335	58	9683-1045	R:FXD COMP 100K OHM 5% 1/4W	01121	CB 1045	24
683-3935	R: FXD COMP 39K OHM 5\$ 1/4W	01121	CB 3935	2	0683-1335	R:FXD COMP 13K OHM 5% 1/4W	01121	° CB 1335	3
683-3945	R:FXD COMP 390K OHM 5% 1/4W	01121	CB 3945	24	0683-1535	R:FXD COMP 15K OHM 5% 1/4W	01121	CB 1535	17
683-4715	R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715	2	0683-1835 0683-2035	R:FXD COMP 18K OHM 5% 1/4W	01121	CB 1835	13
683-4725	R:FXD COMP 4.7K OHM 5% 1/4W	01121	CB 4725	1	1013-2135	R:FXD COMP 20K OHM 5% 1/4W	01121	CB 2035	2
683-4735	R:FXD COMP 47K OHM 5% 1/4W	01121	CB 4735	2	0683-2045	R:FXD COMP 200K OHM 5% 1/4W	01121	CB 2045	
683-5625	R:FXD COMP 5.6K OHM 58 1/4W	01121	CB 5625	44	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235	86
683-5635	R:FXD COMP 56K OHM 5% 1/4W	01121	CB 5635	73	0683-2435	R:FXD COMP 24K OHM 58 1/4W	01121	CB 2435	1
83-6825	R:FXD COMP 6.8K OHM 5% 1/4W	01121	CB 6825		9683-2735	R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735	47
			~~ ( ~ ~ ~		0683-3025	R:FXD COMP BK OHM 5% 1/4W	01121	CB 3025	37
83-6835	R:FXD COMP 68K OHM 5% 1/4W R:FXD COMP 8.2K OHM 5% 1/4W	01121 01121	CB 6835 CB 8225	37	0683-3335			on 1114	
83-9135	R:FXD COMP 8.2K OHM 5% 1/4W R:FXD COMP 91K OHM 5% 1/4W	01121	CB 9135		0683-3935	R:FXD COMP 33K OHM 5% 1/4W R:FXD COMP 39K OHM 5% 1/4W	01121	CB 3335	62
83-4735	R:FXD COMP 47K OHM 5% 1/2W	01121	EB 4735		0683-3945	R:FXD COMP 390K OHM 5% 1/4W	01/121	CB 3935 CB 3945	24
86-5625	R:FXD COMP 5.6K OHM 5% 1/2W	01121	EB 5625	l a l	0683-4725	R:FXD COMP 4.7K OHM 5% 1/4W	01121	CB 4725	1
					0683-4735	R:FXD COMP 47K, OHM 5% 1/4W	01121	CB 4735	i
89-2725	R:FXD COMP 2.7K OHM 5% 1W	01121	GB 2725	1					
7-0944	R:FXD FLM 6.8K OHM 23 1/8W	28480	0757-0944		0683-5625	R:FXD COMP 5,6K OHM 5% 1/4W	01121	CB 5625	4
7-0946	R:FXD FLM 8.2K OHM 2% 1/8W	28480	0757-0946		0683-5635	R:FXD COMP 56K OHM 5% 1/4W	01121	CB 5635	73
57-0947	R:FXD FLM 9.1K OHM 2% 1/8W	28480	0757-9747		0683-6825	R:FXD COMP 6.8K OHM 5% 1/4W	01121	CB 6825	1
57-0949	R:FXD FLM 11K OHM 2% 1/8W	28480	0757-0949		0683-6835 0683-8225	R'FXD COMP 68K OHM 5% 1/4W	01121	CB 6835	1 ?
57-0950	R:FXD FLM 8.2K OHM 2% 1/8W	28480	0757-0950		0083-8225	R:FXD COMP 8.2K OHM 5% 1/4W	01121	CB 8225	1
57-0958	R:FXD FLM 27K OHM 2% 1/8W	28480	0757-0958	i	0683-9135	R:FXD COMP 91K OHM 5% 1/4W	01121	CB 9135	,
51-0135	CONNECTOR : BODY 15 PIN	28480	1251-0135	1 1	0686-4735	R:FXD COMP 47K OHM 5% 1/2W	01121	EB 4735	1
50-0111	TRANSISTOR: GERMANIUM PNP	01295	2N404A	16	0686-5625	R:FXD COMP 5.6K OHM 58 1/2W	01121		49
50-0184	TRANSISTOR:GERMANIUM PNP	02735	38339	40	0689-2715	R:FXD COMP 270 OHM 5% 1W	01121	GB 2715	1
					0757-0944	R:FXD FLM 6.8K OHM 2% 1/8W	28480	0757-0944	1
53-0008 01-0025	TRANSISTOR: SILICON PNP	01295 28480	2N3250 1901-0025	11 48	0757-0946				
01-0081	DIODE:SILICON 100MA 100V Diode:Silicon 50VDCW	28480	1901-0081	179	0757-0947	R:FXD FLM 8.2K OHM 2% 1/8W R:FXD FLM 9.1K OHM 2% 1/8W	28480	0757-0946 0757-0947	
01-0143	DIODESTLICON	28480	1901-0143	8	0757-0949	R:FXD FLM 11K OHM 2% 1/8W	28480 28480	0757-0949	
10-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	28480	1910-0016	2	0757-0950	R:FXD FLM 12K OHM 2% 1/8W	28480	0757-0950	
					0757-0955	R:FXD FLM 20K OHM 28 1/8W	28480	0757-0955	4
70-0009	ELECTRON TUBE: INDICATOR 10 DIGIT	83594	B5991	6					
60-5066	REVERSIBLE DECADE COUNTER	04404	5060-5066	5	0757-0957	R:FXD FLM 24K OHM 2% 1/8W	28480	0757-0957	4
60-5611	PRINTER LOGIC	04404	5060-5611		0757-0958	R:FXD FLM 27K OHM 2% 1/8W	28480	0757-0958	1
0-5645	IMHE REVERSIBLE DECADE COUNTER	04404 04404	5060-5645 5060-5700	1 1	1251-0135 1850-0111	CONNECTOR: BOCY 15 PIN	28480	1251-0135	
0-5700	1MHZ GATE ASSEMBLY		5000-5700		1850-0111	TRANSISTOR:GERMANIUM PNP TRANSISTOR:GERMANIUM PNP	01295	2N404A 38339	20 40
0-6555	NETWORK: DIODE RESISTOR	04404	5080-6555	1	1030-0104		02755		
					1853-0008	TRANSISTOR: SILICON PNP	01295	2N3250	11
		ľ	•		1901-0025	DIODE:SILICON 100MA 100V	28480	1901-0025	57
	OPTION 29/35		~		1901-0051	DIODE:SILICON 1.5A 400V	28480	1901-0025	1 2
			۲		1901-0081	DIODE: SILICON SOV	28480	1901-0051	193
n-0n14 n-0191	C:FXD MICA 56PF 10%	00853	RCM15E560K	1	1901-0143	DIODE:SILICON (	28480	1901-0143	8
0-0194	C:FXD MICA 56PF 5% C:FXD MICA 110PF 5%	28480	0140-0191	1	1970-0009	ELECTRON TUBE: INDICATOR 10 DIGIT	075.04	85001	
0-0195	CIFXD MICA IIUPP 5% CIFXD MICA 130PF 5% 300VDCW	28480	0140-0194	40	5060-5612	PRINTER COUPLING LOGIC	83594	B5991 5060-5612	
+0-0219	C:FXD MICA 180PF 2%	04062	DM15F131J 0140-0219	46	5060-5644	REVERSIBLE DECADE COUNTER	04404	5060-5644	і <u>к</u>
		20700	0140-0113	2	5060-5646	IMHZ REVERSIBLE DECADE COUNTER	04404	5060-5646	1 ĭ
					5060-5700	1MHZ GATE ASSEMBLY	04404	5060-5700	
			,			·		2000-2700	
					5080-6555	NETWORK:DIODE/RESISTOR	/ 04404	5080-6555	1
									1
								<b>L</b>	[

### Section 29

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#### Table 29-2. **Replaceable Parts**

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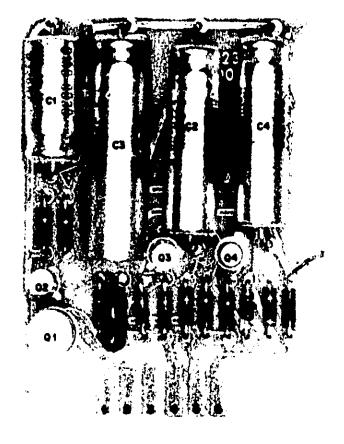
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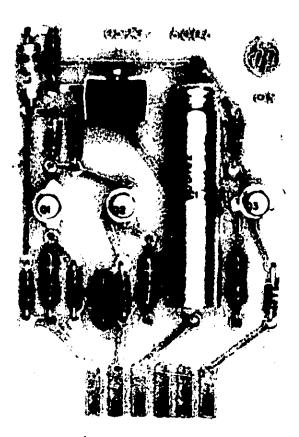
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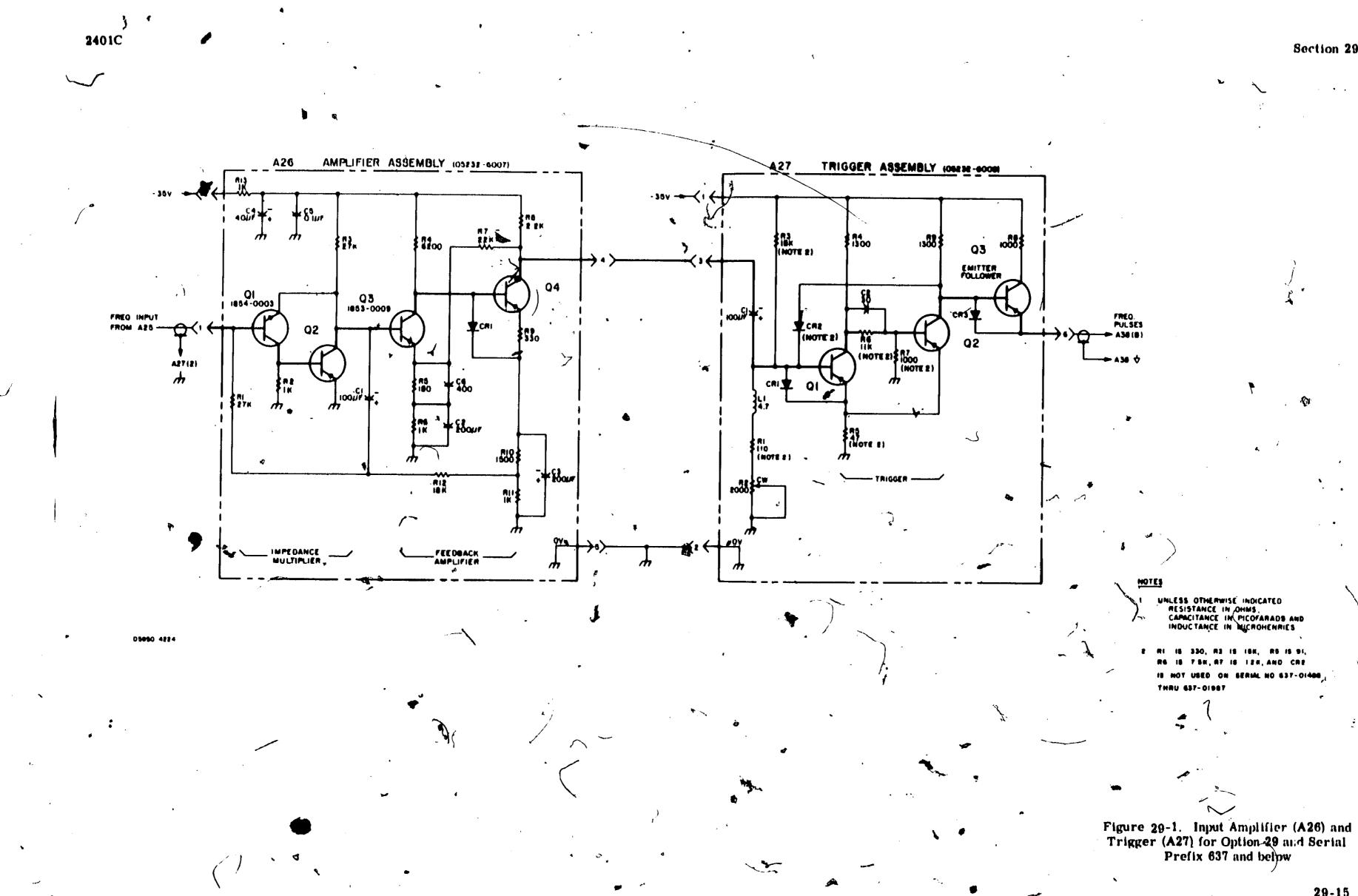
Stock No. 05232-6007 (Serial Prefix 637 and below)

(A26) Input Amplifier for Option 29



Stock No. 05232-6006 (Serial Prefix 637 and below)

(A27) Trigger for Option 29



29-15

A11(12)-

(FREQ. PULSES)

A27 (6)

FRED. LL A19 (17)

.A11 (P)

(VOLT PULSES) A16 (8) -

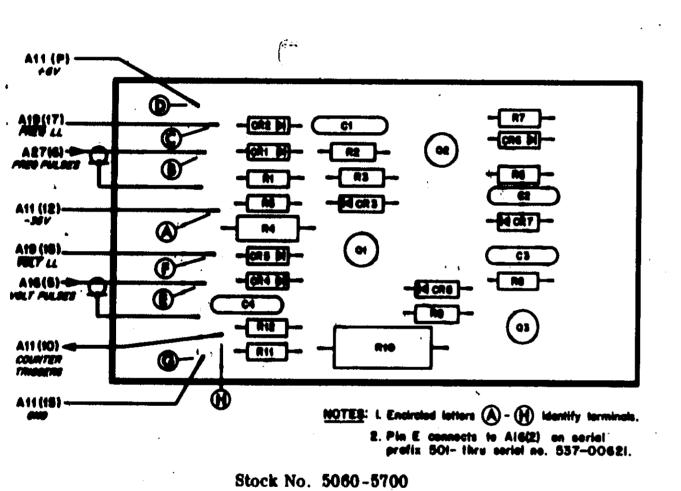
A11 (15)

C 5060 - 5700

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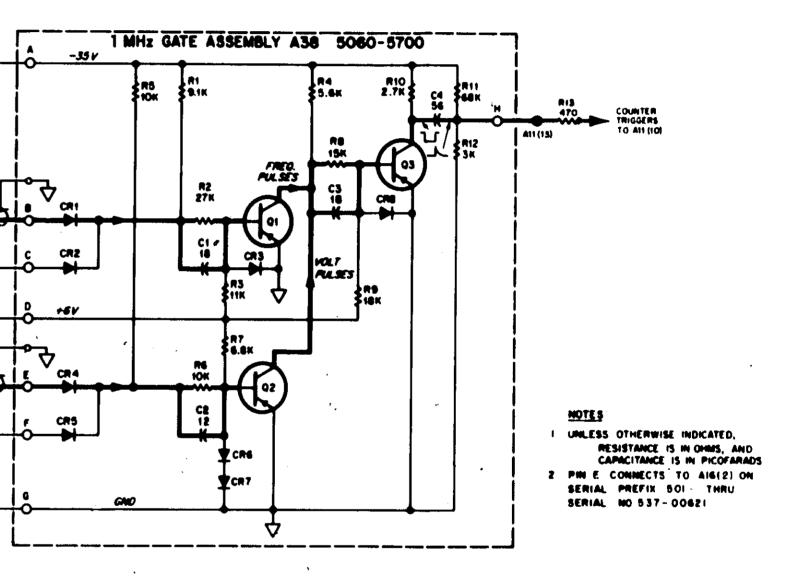
 $\mathbf{C}$ 





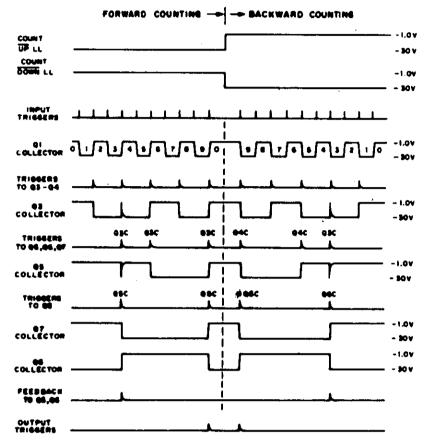
(A38) 1 Megahertz Gate for Option 29

Section 29



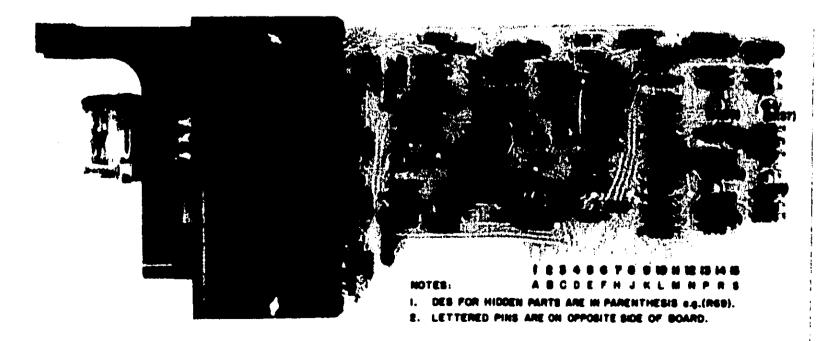
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# Figure 29-2. 1 Megahertz Gate (A38) for Option 29



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#### REVERSIBLE DECADE WAVEFORMS

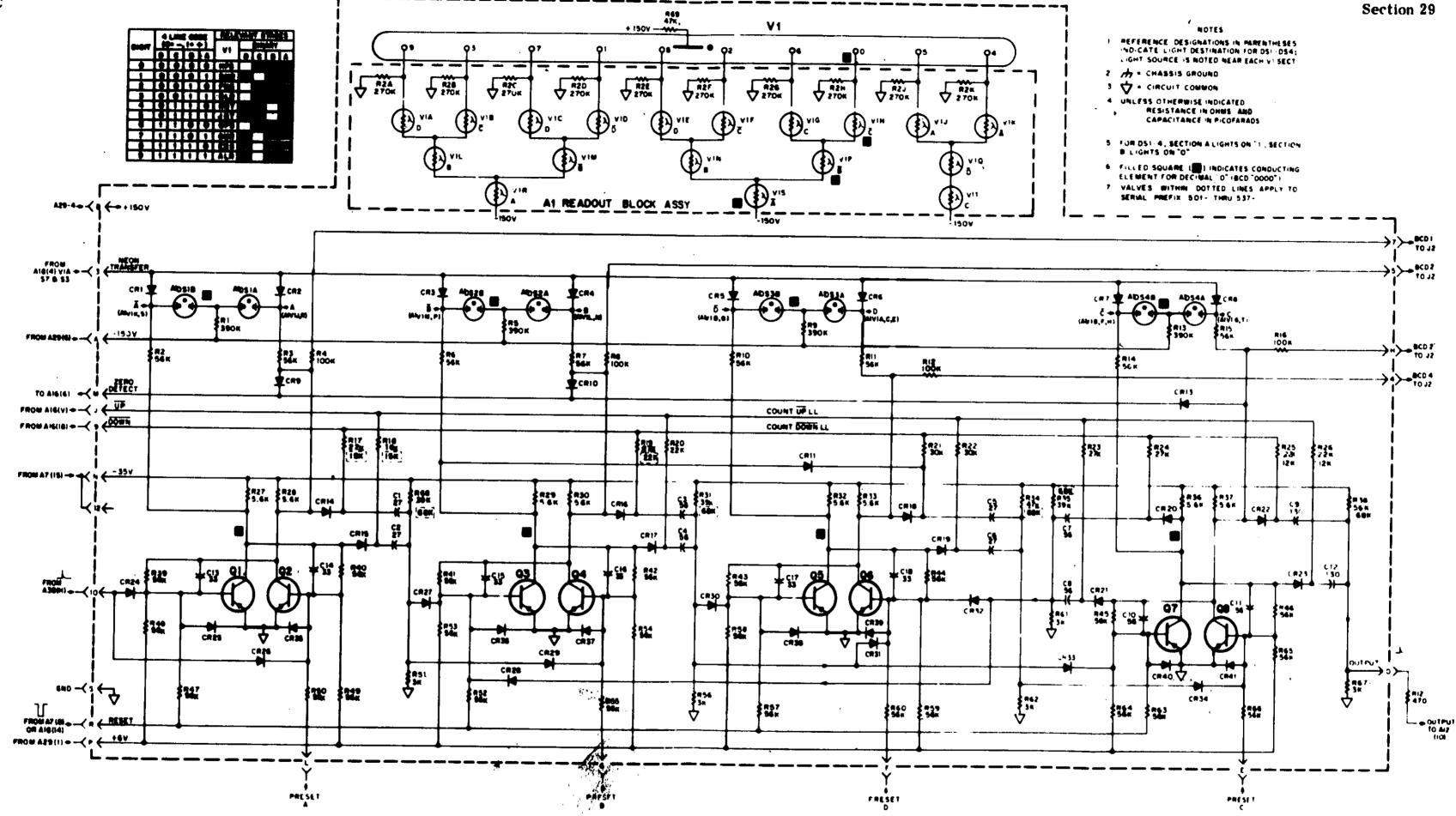


Stock No. 5060-5647

(A11) Reversible 1 MHz +4-2'-2-1 Decade Counter for Option 29

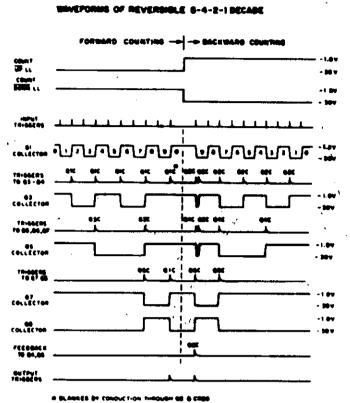
2401C

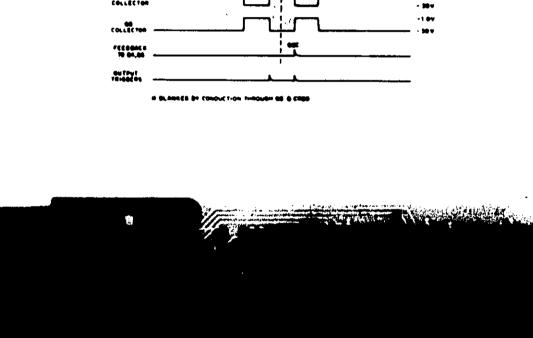
2401C

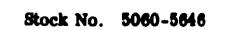


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Figure 29-3. Reversible 1MHz +4-2'-2-1 Decade Counter (A11) for Option 29







1. A.

NOTES

3.

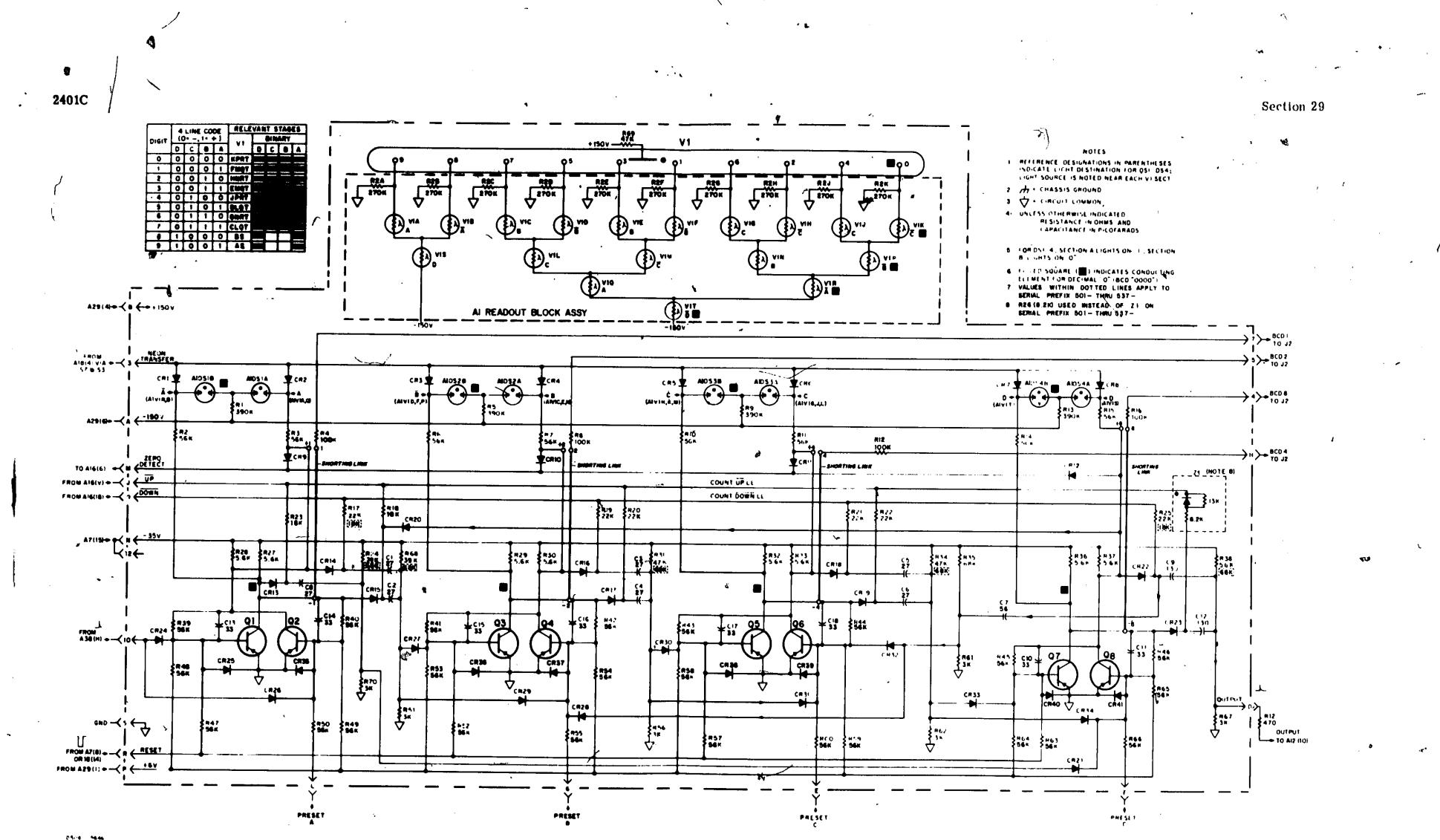
DES POR 4-4-(R68) REF IX

ZI ON SERIAL

XEN PARTS ARE IN PARENTHESIS

4. LETTERED PINS ARE ON OPPOSITE SIDE OF BOARD.

(A11) Reversible 1MHz 8-4-2-1 Decade Counter for Option 29/21 or 29/35



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Figure 29-4. Reversible 1MHz 8-4-2-1 Decade Counter (A11)' for Options 29/21 or 29/35

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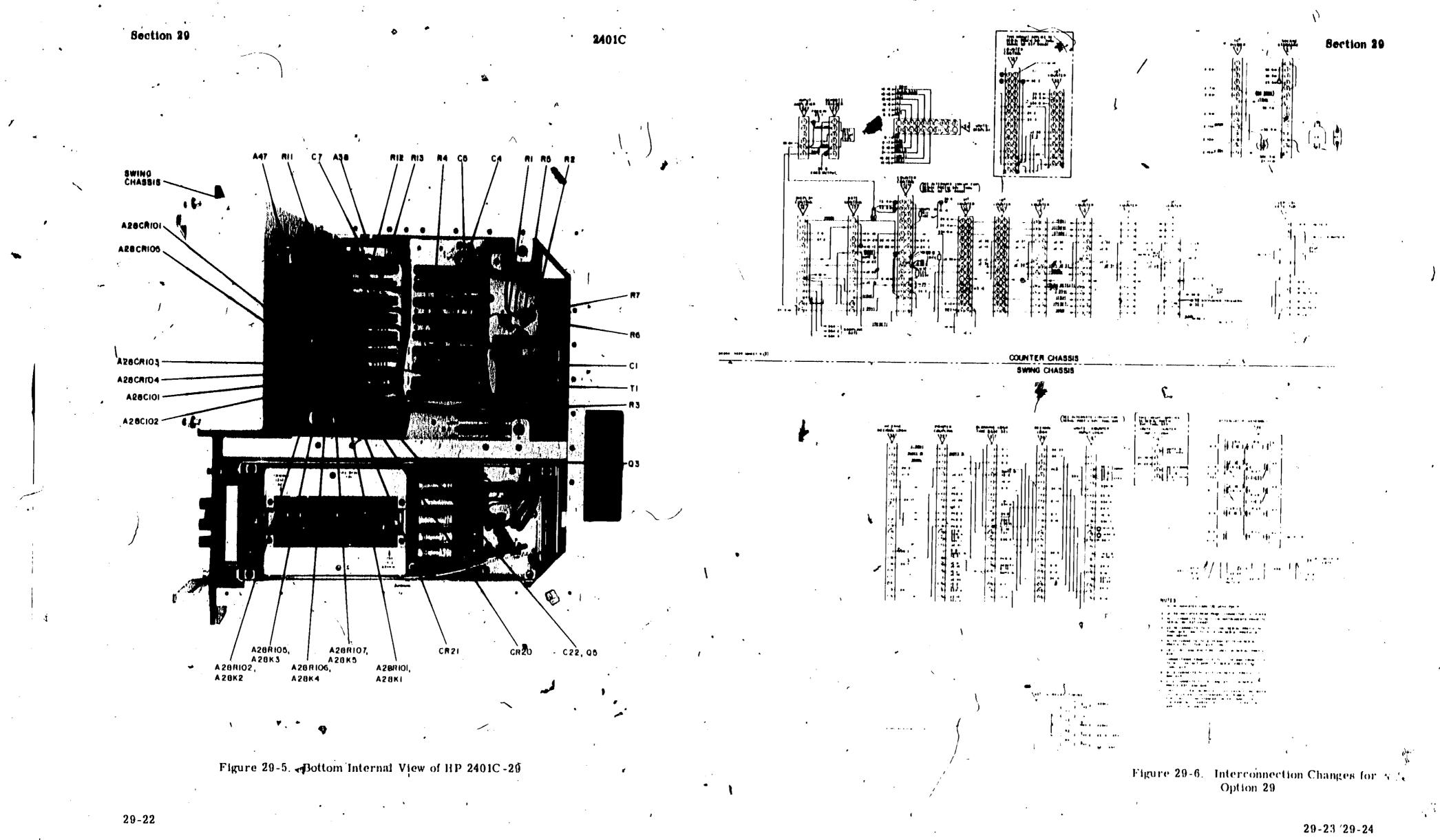
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# MANUAL SUPPLEMENT

# MODIL HP-2401C Integrating Digital Voltmeter

# Option 30

# 30.1 GENERAL DESCRIPTION

The HP-2401C-30 Integrating Digital Voltmeter incorporates logic for period measurement in addition to all capabilities of the standard instrument. The six-digit display of the HP-2401C-30 provides direct readout of period, in milliseconds, with the decimal point properly placed. Period measurement specifications of Option 30 are presented in Section 1.7 of this manual.

# 30.2 INSTALLATION AND OPERATION

Install, operate, and program the HP-2401C-30 as specified in Section II of this manual.

# 30.3 THEORY OF OPERATION

Period is measured by reversing the signal routing used when measuring frequency. In the HP-2401C-30 this reversal is accomplished by period logic assembly A40 when the FUNCTION switch, S2, is set to PERIOD position, or when period measurement is programmed with the FUNCTION switch set to EXT SEL position. (See Figures 30-1 and 30-2.)

#### **30.3.1 Frequency Measurement**

When the FUNCTION switch is set to FREQ position, the false state (near -15 volts) of the period input logic line to pin 5 of A40 enables AND transistors Q5 and Q8. Through logic amplifiers Q1 and Q2 this establishes the frequency measurement connections whereby cycles of an unknown signal are counted by decade counters A11-A15 and A46 for a known sample period, which is derived by decade dividers A1-A5 from the 100 kHz time base output of A6.

# 30.3.2 Period Measurement

When the FUNCTION switch is set to PERIOD position, the true state (near ground) of the period input logic line enables A40 AND transistors Q6 and Q7 through logic amplifier Q1. This switches the known 10 kHz output from decade divider A1 to the decade counters and switches the unknown signal to the circuits that start and stop the gate period. The number of 100 kHz pulses (100 microsecond intervals) counted during the gate period yields a measurement of the period's duration. The decimal point is placed so that the measurement is direct reading in milliseconds.

The selection of SAMPLE PERIOD determines whether the unknown signal is divided by 1, 10, or 100. Division of the unknown signal improves the resolution of measurement because the number of counts of the known signal is multiplied by 10 or 100. The averaging of 10 periods in this manner yields 10 microsecond resolution. Averaging of 100 periods gives 1 microsecond resolution.

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# 30.3.3 Other Functions

The remainder of the period logic on A40 controls display lamps of units indicator assembly A24 and the frequency logic line input to printer coupling logic assembly A22. The selection of either PERIOD or FREQ measurement FUNCTION applies a true state to the FREQ logic lines, assuring that frequency count AND transistor A19Q11 of counter input logic assembly A19 is opened.

# 30.3.4 Volt Measurement

Selection of VOLT measurement FUNCTION has the same effect upon the A40 circuits as the selection of FREQ except that the FREQ logic line is left false. The time base is derived for voltage measurements, but frequency count AND transistor A19Q11 is inhibited and voltage count AND transistor A19Q10 is enabled.

# 30.4 MAINTENANCE

Except as specified in the following paragraphs, service the HP-2401C-30 per the instructions in Section IV of this manual.

### 30.4.1 In-Cabinet Performance Checks

The In-Cabinet Performance Checks for the HP-2401C-30 are specified in Table 30-1. Apy notations to check 30.1, etc. refer to that table only.

# 30.4.2 Location of A40 and Components

Figure 30-2 shows the parts location on A40 and Figure 30-3 shows the location of A40 in the HP-2401C-30.

# 30.4.3 Troubleshooting

Trouble in period logic assembly A40 can prevent counting by the decades when any FUNCTION is selected. (See Figures 30-1 and 30-2.) Figure 30-4 shows connections of the HP-2401C-30 where these differ from those of the standard HP-2401C. The other components involved in period measurement are checked adequately by following the troubleshooting instructions in Section 4.4 of this manual.

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30.1	PI	ERIOD MEASUREMENT RANGES
		1, 10, and 100 periods, 5 Hz (200 ms) to 10 kHz (1 ms) - sine wave input*.
	а,	
		FUNCTION: PERIOD. SAMPLE PERIOD: .01 SEC.
		SAMPLING RATE: Fully clockwise.
		ATTENUATION: Fully clockwise.
		100 KC STD (rear panel): INT.
<b>₽</b> 0,7	b.	Connect output of portable oscillator to HP-2401C-30 FREQ INPUT and to input of oscilloscope with a BNC "T" connector. Set oscillator to provide 5 Hz 0.28v p-p output.
14	c.	Check and record reading on the HP-2401C-30, which should be approximately 200.0 MILLISEC.
	<b>d.</b> .	Set oscillator for reading of exactly 200.0 MILLISEC on the HP-2401C-30. Set SAMPLE PERIOD switch to 1 SEC position and check and record reading, which should be 200.00 ±the setting error in the last (10 $\mu$ s) digit.
	e.	Set oscillator for reading of exactly 200.00 MILLISEC on the HP-2401C. Set SAM- PLING PERIOD switch to 1 SEC position and check and record reading, which should be 200.000 MILLISEC ±the setting error in the last $(1 \ \mu s)$ digit.
0.2	PE.	RIOD MEASUREMENT ACCURACY
		±1 count ±time base accuracy ±trigger error number of periods averaged
<del></del>		
	a.	Turn on frequency standard and connect its SELECTED FREQ OUTPUT to the HP- 2401C-30 FREQ INPUT and oscilloscope as indicated below. Select 10 Hz output.
		4.7K
		SELECTED
		OUTPUT HP 2401C
		500 Ω S FREQ.
		TO
		OSCILLOSCOPE
1	b.	Set HP-2401C-30 Power switch to ON, other controls as follows:
		FUNCTION: PERIOD. SAMPLE PERIOD: .01 SEC.
		SAMPLE PERIOD: .01 SEC. SAMPLING RATE: Fully clockwise.
		ATTENUATION: Fully clockwise.
		100 KC STD (rear panel): INT.
	:.	After required warmup of frequency standard, set 500Ω potentiometer for maximum p-p amplitude of signal to HP-2401C-30 FREQ INPUT. Then record period mea-

Table 30-1. In-Cabinet Performance Check (Sheet 2 of 2)

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30. <b>2</b>	<b>d.</b>	Slowly reduce signal amplitude tapped from the 500 $\Omega$ potentiometer to the point where individual period measurement readouts on the HP-2401C-30 are as low as 00099.6 or as high as 00100.4 MILLISEC. Determine and record p-p amplitude of signal to FREQ INPUT of the HP-2401C-30. Amplitude should be no greater than 0.28v p-p (0.1v rms).
	e.	Set SAMPLE PERIOD switch to .1 SEC and record the most erroneous period mea- surement of the next ten. No readout should be lower than 0099.96 MILLISEC or higher than 0100.04 MILLISEC.
	f.	Repeat step e, above, at 1 SEC SAMPLE PERIOD. No readout should be lower than 099.996 MILLISEC or higher than 100.004 MULLISEC.
30.3	EX	TERNAL PROGRAMMING - PERIOD FUNCTION
		Period measurement is a programmable function of the HP-2401C-30; the require- ments of check 20, Table 4-3, apply.
	a.	Prepare for period measurement as specified in check 30.1, except set the FUNC- TION switch to EXT SEL.
	b.	Record lighted HP-2401C-30 units display, which should be VOLTS.
	c.	Connect a jumper between pins Z and f of J1 and record lighted HP-2401C-30 units display, which should be MILLISEC.

# 30.5 PARTS LIST

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The Parts List in Section V of this manual applies to the HP 2401C-30 except as indicated in Tables 30-2 and 30-3.

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	HP- 2401C		TEST CARD	
	DESCRIPTION	· · ·	CHECK RESULTS	
30.1	PERIOD MEASUREMEN	T RANGES		
	Period			
	1			] m <b>s</b>
			(Approx. 200.0 ms)	-
	10		· · · · · · · · · · · · · · · · · · ·	ms
			(200.0? ms)	]
	100			ms
			(200,00? ms)	<b>-</b> .
30.2	PERIOD MEASUREMEN	T ACCURACY		
	1 period reading, maxim	num amplitude input		ms
			(100.0 ±0.1 ms)	
	Input voltage producing	specified trigger error		v p-p
	(* * * 4		(0.28v p-p, max.)	
	10 period reading with	pecified trigger error		ms
		ſ	(100.00 ±0.04 ms)	
	100 period reading with	specified trigger error		ms
			(100.000 ±0.004 ms)	
30, 3	EXTERNAL PROGRAMM	ING - PERIOD FUNCTION		
	Program Connections	Duration		
	J1-Z to none	Function Volts		
	-		(VOLTS)	
	J1-Z to f	Period		
			(MILLISEC)	
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Table 30-2. Reference Designation Index	AT	ndex	
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Reference Designation	Part No.	Description #	Note
•		OPTION 30	
		A40 5060-2506	A-H
	1	5060-5876	J-X
		ADD THE FOLLOWING TO TABLE 5-1 TO MAKE The table applicable to the HP24010-30.	,
A40	5060-2506	PERIOD MEASUREMENT LOGIC	ľ
A40	5060-5876	PERIOD MEASUREMENT LOGIC	A-H
,			J−X
XA40	1251-0332	CONN:PC 24 CONTACTS	
A40	5060-2506	PERIOD MEASUREMENT LOGIC	А-Н
	5060-5876	PERIOD MEASUREMENT LOGIC	X-L
A40CR1	- 1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	А-Н
·	1901-0025	DIODE#SILICON 100WV 100MA	J-X
A40CR2	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	А-Н
	1901-0025	DIODE:SILICON 100WV 100MA	J-X
A40CR3	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PLV	А-н
	1901-0025	DIODE:SILICON 100WV 100MA	J-X
A40CR4	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PLV	A-H
	1901-0025	DIODE:SILICON 100WV 100MA	J-X
A40CR5	1910-0016	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	A-H
A40CR6	1901-0025	DIODESSILICON 100WV 100MA	J−X
MTVUNU	1910-0016 1901-0025	DIDDE:GERMANIUM 100MA.AT 0.85V 60PIV / Didde:Silicon 100WV 100MA	A-H
			J-X
A40CR7 A40cr8	1901-0025	DIODE:SILICON 100WV 100MA	J-X
A40CR9	1901-0025	DIODE:SILICON 100WV 100MA Diode:Silicon 100WV 100MA	J-X
A40CR10	1901-0025	DIODESSILICON LOONV LOONA DIODESSILICON LOONV LOONA	X-U J-X
A40CR11	1901-0025	DIODE:SILICON 100WV 100MA	
A40CR12	1901-0025	DIODE:SILICON 100WV 100MA	Х-U А-Н
	1910-0016	DIODE:GERMANIUM LOOMA AT 0.85V 60PIV	
40CR13	1901-0025	DIODE:SILICON 100HV 100MA	A-H
,	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	J-X
40CR14	1901-0025	DIODE:SILICON 100WV 100MA	А-н
	1910-0016	DIDDE:GERMANIUM 100MA AT 0.85V 60PIV	J-X
40CR15	1901-0025	DI ODE: SILICON 100WV 100MA	A-H
40CR16	1910-0016 1901-0025	DIODE:GERMANIUM 100MA AT 0.85V 60PIV	J-X
	1910-0016	DIODE:SILICON IOOWA 100MA Diode:Germanium 100ma at 0.85v 60piv	A-H
400017	1001 0005		J-X
40CR17	1901-0025 1910-0016	DIODE:SILICON 100WV 100MA DIODE:GERMANIUM 100MA AT 0.85V 60PIV	H–A J~X
4091	1850-0113	TRANSISTOR: GERHANIUM PNP	
4002	1850-0113	TRANSISTOR: CERMANIUM PNP	А-Н
	1850-0145	TRANSISTOR: GERMANIUM PNP	J-X
4003	1850-0128	TRANSISTOR: PNP GERMANIUM	
4004	1850-0128 1850-0113	TRANSISTORIPHP GERMANIUM TRANSISTORIGERMANIUM PNP	
4096 4097	1850-0113	TRANSISTOR: GERMANIUM PNP	•
4008	1850-0113 1850-0113	TRANSISTOR: GERMANIUM PNP	
4009	1851-0034	TRANSISTOR:GERMANIUM PNP TRANSISTOR:GERMANIUM NPN	
		IN ANGLESIUM GENERALUM NEM	J-X

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Table 30-2.	Reference	<b>Designation Index</b>	(Cont'd)
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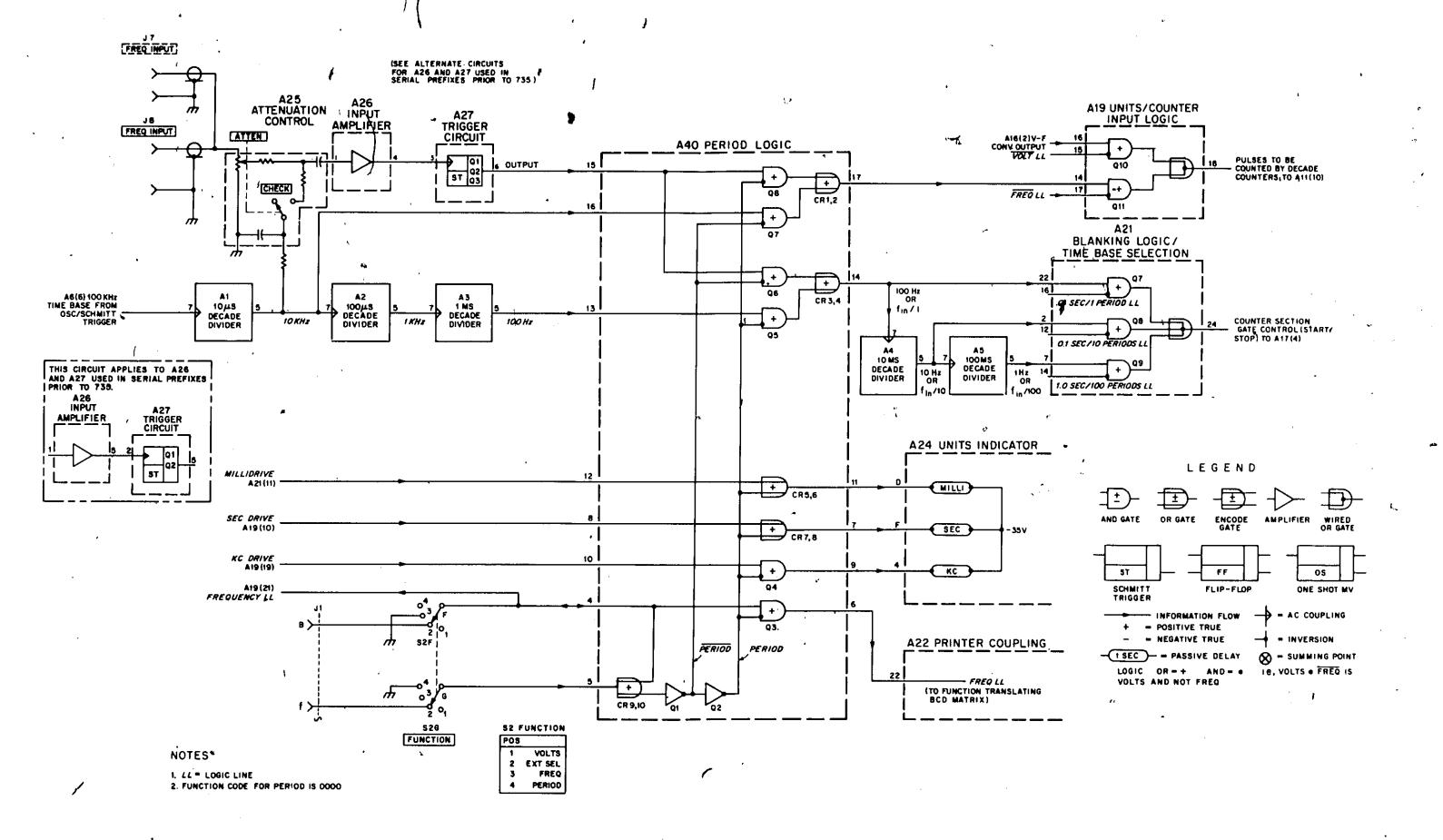
Reference Designation	Part No.	Description #	Note		Part No.	Description #	Mfr.	Mfr. Part No.	ТС
		OPTION 30 A40 5060-2508 (CONT'D) 5060-5876 (CONT'D)	A-H J-X		3	OPTION 30			
40R1 40R2	0683-4735 OBD	R:FXD COMP 47K OHM 5% 1/4W R:FXD COMP 22-47K 5% 1/4W SELECTED			0683-1035 0683-1045	R:FXD COMP 10K UHM 5% 1/4W R:FXD CUMP 100K DHMS 5% 1/4W	01121	CB 1045	
1R3 1R4 1R5 1R6	0683-3335 0683-4735 0683-3335 0683-4735	R:FXD COMP 33K OHM 5% 1/4W R:FXD COMP 47K OHM 5% 1/4W R:FXD COMP 33K OHM 5% 1/4W R:FXD COMP 33K OHM 5% 1/4W			0683-1535 0683-1635 0683-1835	R:FXD LUMP 15K 0HM 5% 1/4W R:FXD CUMP 16K 0HM 5% 1/4W R:FXD LUMP 18K 0HM 5% 1/4W	01121 01121 01121		
R7 R8 R9	08D 0683-3335	R:FXD COMP 47-100K 5% 1/4W SELECTED R:FXD COMP 33K OHM 5% 1/4W			0683-3335 0683-4725 0683-4735 0683-8225	R:FXD CUMP 33K OHM 5% 1/4W R:FXD COMP 4700 DHM 5% 1/4W R:FXD COMP 47K OHM 5% 1/4W R:FXD CUMP 8200 DHMS 5% 1/4W	01121 01121 01121 01121 01121	CB 3335 CB 4725 CB 4735 CB 8225	
R10 R11 R12	0683-1045 0683-1045 0689-3315 0689-3315	R:FXD COMP 100K OHMS 5% 1/4W R:FXD COMP 100K OHMS 5% 1/4W R:FXD COMP 330 OHM 5% 1W R:FXD COMP 330 OHM 5% 1W			0689-3315 0758-0004	R:FXD CUMP 330 UHM 5% 1W R:FXD MET GX 2700 DHM 5% 1/2W	01121 28480	GB 3315 0758-0004	
R13 R14 R15	0683-1035 0683-4735 0683-8225	R:FXD COMP 10K OHM 5% 1/4W R:FXD Comp 47K ohm 5% 1/4W R:FXD comp 8200 ohms 5% 1/4W			1251-0332 1850-0113 1850-0128 1850-0145	CONN:PC 24 CUNTACTS TRANSISTUR:GERMANIUM PNP TRANSISTUR:PNP GERMANIUM TRANSISTUR:GERMANIUM PNP	28480 01295 01295 03508	1251-0332 2N1997 2N3988 2N1926	
R16	0683-4725 0683-1535	R:FXD COMP 4700 OHM 5% 1/4W R:FXD COMP 15K OHM 5% 1/4W	A-H J-X		1851-0034 1901-0025 1910-0016	TRANSISTOR:GERMANIUM NPN DIODE:SILICUN 100WV 100MA DIODE:GERMANIUM 100MA AT 0.85V 60PIV	01295 28480 28480	2N1605A 1901-0025 1910-0016	
R17 R18 R19 R20	0758-0004 0683-1535 0683-4725 0683-1535 0683-1835 0683-1835	R:FXD MET OX 2700 OHM 5% 1/2W R:FXD COMP 15K OHM 5% 1/4W R:FXD COMP 4700 OHM 5% 1/4W R:FXD COMP 15K OHM 5% 1/4W R:FXD COMP 18K OHM 5% 1/4W R:FXD COMP 16K OHM 5% 1/4W	Н–А Н–А Ј–Х А–Н Ј–Х		5060-2506 5060-5876	PERIOD MEASUREMENT LOGIC PERIOD MEASUREMENT LOGIC	04404 04404	5060-2506	ų
R21 R22 R23 R24	0683-4735 0683-4735 0683-1045 0683-4735	R:FXD COMP 47K OHM 5% 1/4W R:FXD COMP 47K OHM 5% 1/4W R:FXD COMP 100K OHMS 5% 1/4W R:FXD COMP 47K OHM 5% 1/4W	, x-r	1					
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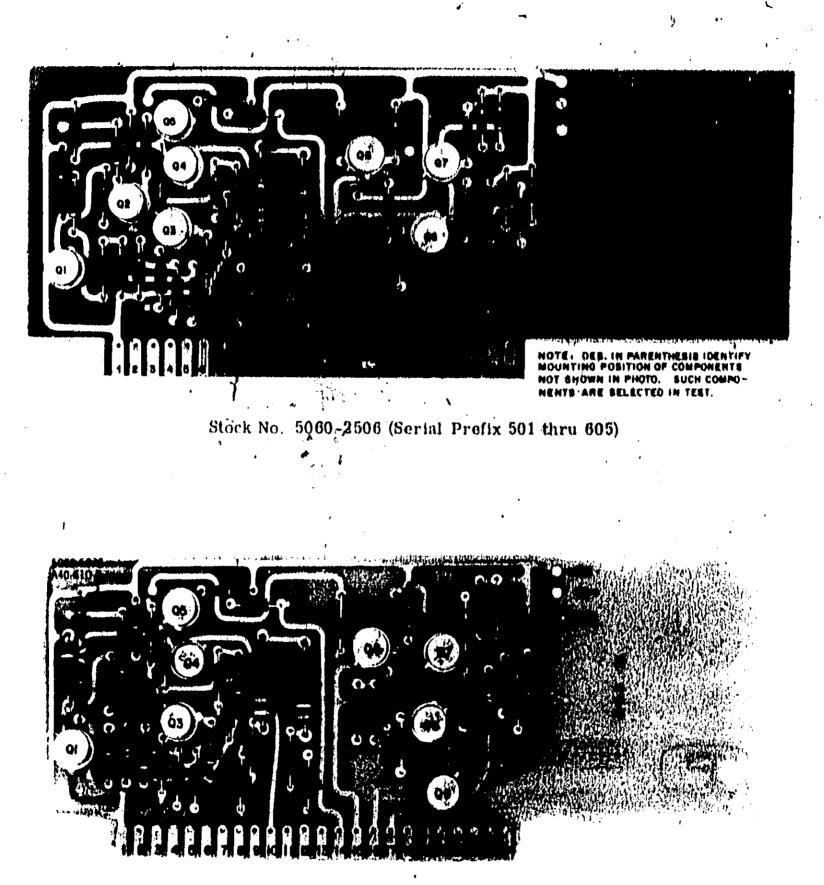
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Section 30

Figure 30-1. Period Measurement Logic for Option 30

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Stock No. 5060-5876 (Serial Prefix 610 and above)

(A40) Period Logic for Option 30

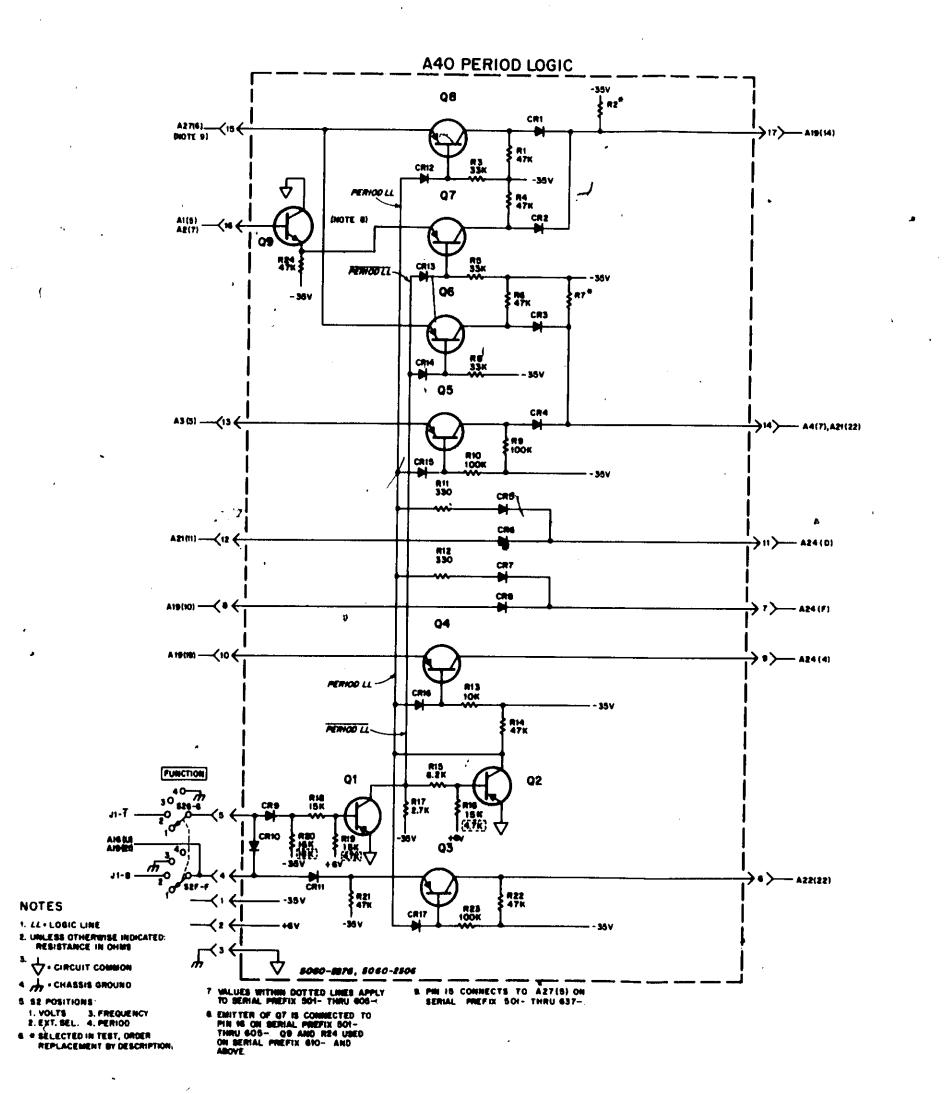


Figure 30-2. Period Logic (A40) for Option 30

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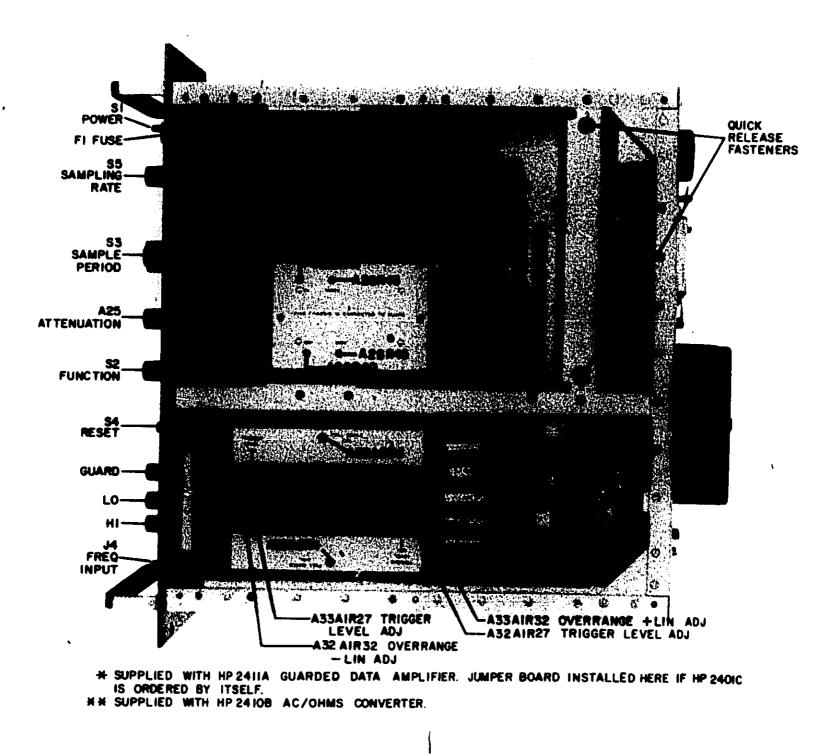
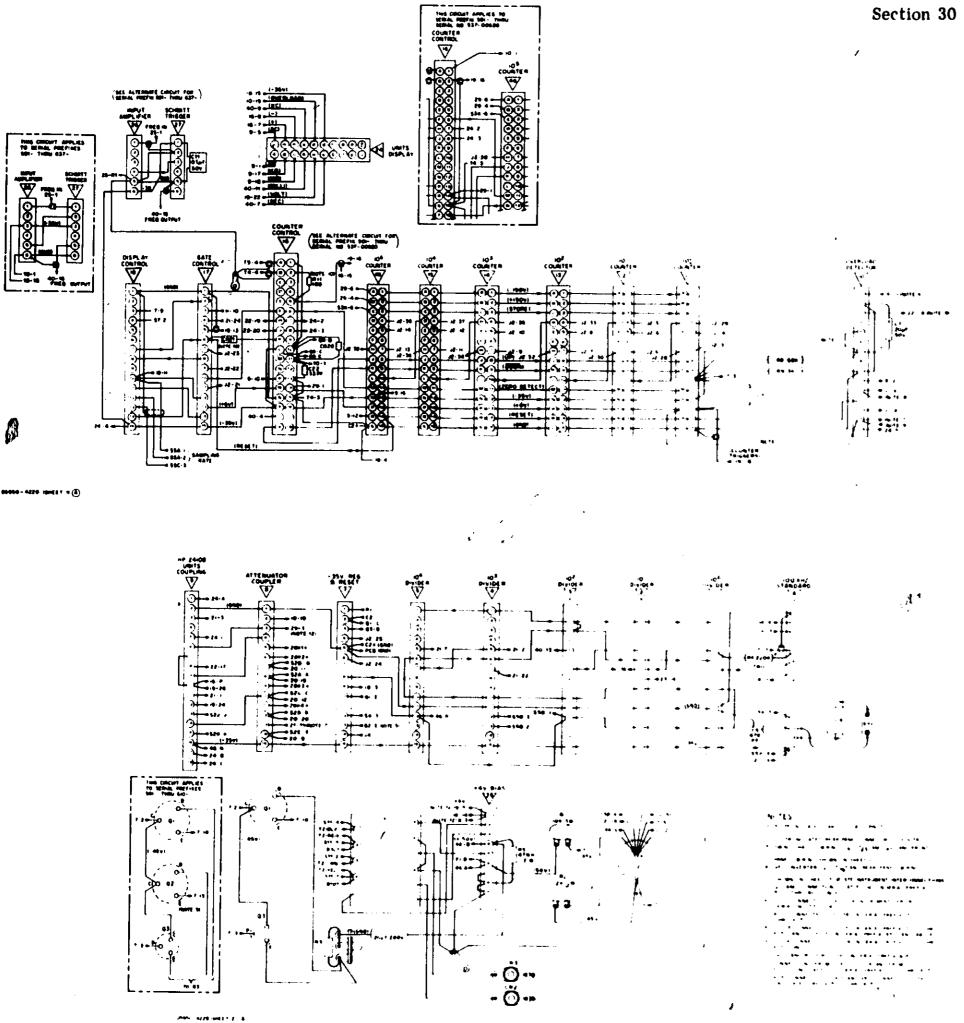


Figure 30-3. Bottom Internal View of HP 2401C-30

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# Figure 30-4. Interconnections for Option 30 (Sheet 1 of 2)

# Section 30

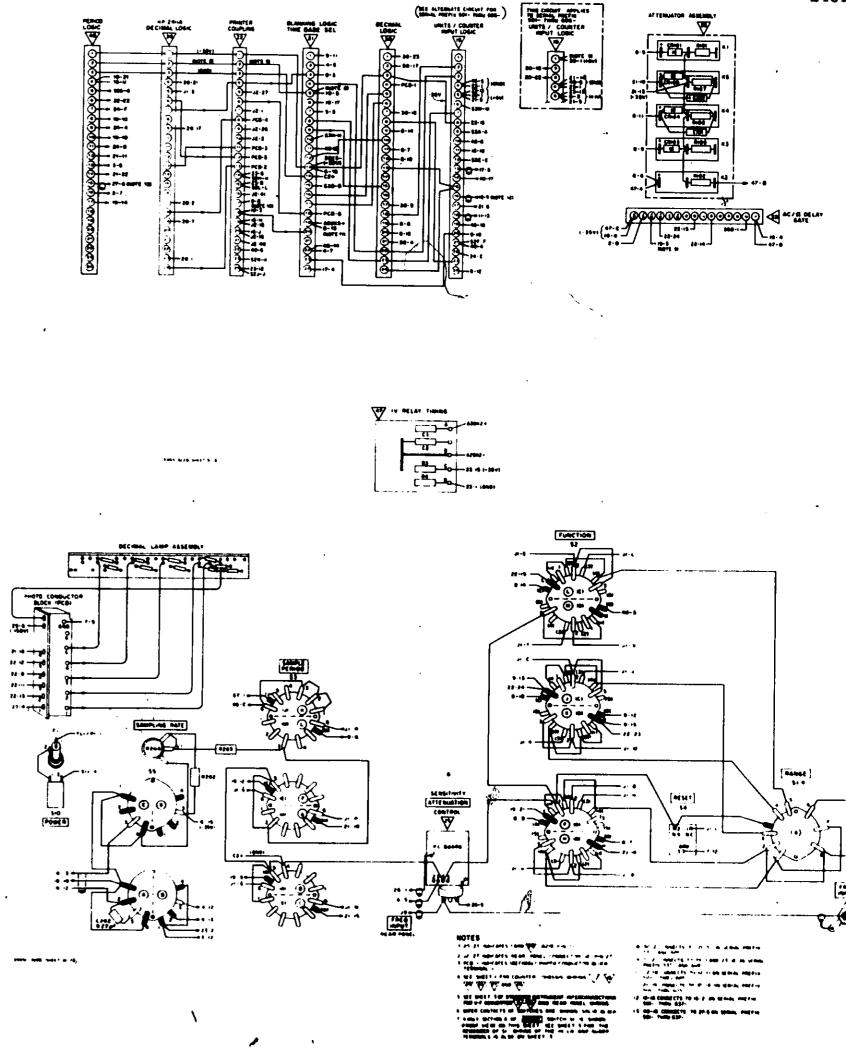


Figure 30-4. Interconnections for Option 30 (Sheet 2 of 2)

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# MANUAL SUPPLEMENT MODEL HP-2401C Integrating Digital Voltmeter

# **Option 31**

# 31.1 GENERAL DESCRIPTION

The HP-2401C-31 Integrating Digital Voltmeter incorporates automatic selection of the appropriate input voltage range in addition to all capabilities of the standard instrument. The autoranging circuitry utilizes the full overrange capability of the standard HP-2401C, upranging at 310% of full scale. It downranges at 30% of full scale.

Operation of the autoranger is rapid - only 6 ms per range change. The autoranger proceeds automatically in the correct direction. Thus even if the appropriate range for a new input signal is at the opposite extreme from that required for the previous reading, the measurement usually commences in 34 ms. (This includes the normal encode delay of 9.7 ms when the correct ' range is reached.) However, if the autoranger has downranged from 1000V to .1V range, noise may force one or two uprangings, resulting in as much as 50 ms delay before the sample period begins. The HP-2401C-31 can therefore be used at high sampling rates with varying input signals, and permits rapid scanning rates when employed in multi-channel systems with widely varying signal levels. However, the maximum sampling rate is limited by the sample period and the time required to reach the correct range.

When used with a HP-2411A Guarded Data Amplifier, the HP-2401C-31 automatically selects the appropriate amplifier gain. It thereby provides six automatically selected ranges from 10 mV to 1000v full scale.

The HP-2401C-31 also provides range selection commands for a HP-2410B AC/Ohms Converter. (HP-2410B-17 for AC/Ohms Converters with serial prefixes earlier than 514-.) However, autoranging ac voltage measurement extends only to the 1v range; ac voltage measurements on the 0.1v range must be selected manually or by specific programming. The autorange logic is such that the record command outputs from the instrument are not necesarily identical to the counter gate time.

# 31.2 INSTALLATION AND OPERATION

For dc voltage measurement, install, operate, and program the HP-2401C-31 as specified in Section II of this manual. The following paragraphs briefly describe how to set controls for autoraning ac and resistance measurements using the HP-2410B AC/Ohms Converter and measurements down to 10 millivolts full scale using the HP-2411A Guarded Data Amplifier. Also briefly discussed is the autoranger's response to various situations during the operating cycle of the HP-2401C-31.

# 31.2.1 Autoranging with HP-24108

For autoranging resistance or ac voltage measurements using a HP-2410B AC/Ohms Converter with a HP-2401C-31, set controls exactly as specified in Section 2.5.3, except for the HP-2410B RANGE switch. Instead of setting the HP-2410B RANGE switch to a specific range, set it to AUTO position. This programs autoranging operation of the HP-2401C-31 regardless of the HP-2410B FUNCTION selected and autoranging resistance or voltage measurements will be automatically completed on the range that yields the best resolution and accuracy.

# NOTE

The logic in the HP-2401C-31 cannot select the 0, 1y ac measurement range of the HP-2410B. Ac voltage measurements on the 0.1v ac range must be selected manually by means of the HP-2410B RANGE switch or by specific programming.

# 31.2.2 Autoranging with HP-2411A

For autoranging dc voltage measurement down to 10 millivolts (0.01y) full scale (30 millivolts overrange), using the HP-2411A Guarded Data Amplifier with the HP-2401C-31, set controls exactly as specified in Section 2.5.4 except for the HP-2401C-31 FUNCTION switch and the HP-2411A MODE selector. Instead of setting the HP-2401C-31 FUNCTION switch/ to EXT SEL, set it to AUTO RANGE position; use EXT SEL position only if autoranging measurements with the HP-2411A are to be programmed externally. Instead of setting the HP-2411A MODE selector to the desired mode, set it to EXT SEL.

# 31.2.3 Response Characteristics of the HP-2401C-31

# Upranging

The HP-2401C-31 always responds to an input that exceeds 310% of full scale by upranging. During the display period, the autoranger switches directly to 1000V range; this is essentially the same as the response of the standard HP-2401C to an overload input, but the OVERLOAD indicator does not light when AUTO RANGE function is selected. Following the encode command, the HP-2401C-31 upranges one range at a time instead of skipping to the 1000 v range.

#### Downranging

The HP-2401C-31 responds to an input that is less than 30% of full scale, only during the encode delay interval that follows the encode pulse and precedes the sample period.

### **Design Objectives**

These response characteristics are designed to achieve the following:

- a. Maximum protection of the instrument from overloading.
- b. Minimum delay between the encode command and the start of a valid measurement.

#### THEORY OF OPERATION 31.3

#### 31.3.1 General

During autorange operation of the HP-2401C-31 the autorange logic selects the appropriate voltage range in response to over and under range input signals from Auto Range Rate Detector A10./ The selection of range and

+1 or +10 gain are routed through PROGRAM CONTROL receptacle J1 to the HP-2410B or the HP-2411A, controlling their operation as well when either is used with the HP-2401C-31.

As shown in Figure 31-5, Auto Range Rate Detector A10 consists of two frequency-to-voltage converters (fvc's) and high and low rate level detec-. tors. The high and low rate outputs from A10 are applied to the Range Gates on Assembly A44, as indicated in Figure 31-6. During the encode delay period, low or high rate pulses are passed to the count one-shot on Range Control Assembly A45. This one-shot produces a delayed trigger for the Range Counter on Assembly A43. The range counter counts up or down, depending upon the logic line input that it receives from the up/down flipflop on A45. The range counters count down in response to low rate pulses because the down state of the up/down flip-flop is not changed. High rate pulses trigger the up/down flip-flop to up state, so that the range counters count up in response to high rate pulses. The states of the range counter binaries are decoded and amplified to program range selection. Down counts program progressively lower ranges and up counts program progressively higher ranges. The details of the autorange logic are discussed in the descriptions that start with Section 31.3.3.

# 31.3.2 Autorange Rate Detector A10 (Figure 31-7)

Unless otherwise stated, incomplete designations (C7, A1, T1, CR4, etc.) which appear in the following discussions (Sections 31.3.2 through 31.3.5) identify components of the circuit assembly (A10, A43, A44, or A45) being described.

The auto range rate detector examines the combined channel pulse train output of the voltmeter vfc to determine if the pulse rate (input voltage) is low or high. If the vfc output is less than 30 kHz (i.e., the input signal is less than 30% of full scale), the low rate detector produces an output. When the vfc output is 310 kHz or greater (i.e., the input signal is at least 310% of full scale), the high rate detector produces an output. Between these extremes, no output is produced by either detector.

The output from either detector is essentially the same, a train of positivegoing 2  $\mu$ s pulses at 5.5 ms intervals. (The quoted duration and spacing are approximate.) The auto range rate detector also provides an overload reset pulse for the HP-2411A Guarded Data Amplifier.

### High Rate Detector

As shown in Figure 31-7, the vfc pulses are received at pin 1 of A10 and coupled to the high rate detector via C7. The high rate detector output from the collector of Q1 is produced only when current can flow through the number 2 winding of T1. The switching of current flow between the number 1 and 2 windings of T1 is determined by the voltage levels at the cathodes of CR3 and CR4.

The voltage at the cathode of CR4, set by potentiometer R3, determines the high rate detector switchover point. The voltage at the cathode of CR3 is 1

#### NOTE

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determined by the frequency of the pulse input to pin 1 and the forward voltage drop across CR18. The pulses that are coupled through C7 and CR2 charge C2 positively. Between pulses C2 charges negatively. The average negative voltage across C2 increases for low input frequencies and decreases for high input frequencies.

With input pulse frequencies below 310 kHz, the voltage across C2 is such that the cathode of CR3 is slightly more negative than the cathode of CR4. (Under these conditions the voltage difference is essentially determined by a forward drop across CR18.) CR4 is cut off, closing the path for regenerative feedback between collector and base of Q1, which is a blocking oscillator.

When the input pulse frequency reaches 310 kHz, the voltage across C2 reaches a level where the cathode of CR3 becomes more positive than the cathode of CR4. This cuts off CR3 and enables conduction through CR4, opening the regenerative path required for cycling of blocking oscillator Q1-T1.

At this point, when current is switched from T1 winding no. 1 to no. 2, thermal noise voltage developed across R5 is amplified and inverted by Q1 and coupled back to winding no. 2. The feedback, now in phase, quickly saturates the blocking oscillator, generating a positive-going pulse at the collector of Q1. Current through Q1 increases to the point where the transformer core saturates and no longer provides the coupling action, disconnecting the regenerative path. Conduction through Q1 then decreases, returning to the unsaturated condition in approximately 2  $\mu$ s. After a time delay that is essentially determined by the time constant of R5 and C3, the comparison circuit is ready to cycle again. This action continues as long as the overload remains, producing a train of positive-going pulses from the collector of Q1.

#### Low Rate Detector

The operation of the low rate detector is similar to that of the high rate detector, except that the action is reversed. At input pulse frequencies above 30 kHz the voltage developed across CR19 keeps the CR10 cathode more positive than the CR9 cathode. Below 30 kHz the C10 voltage falls to the point at which the CR10 cathode is more negative than the CR9 cathode, connecting regeneration that drives Q2 to saturation. The interval between positive pulses from the low rate output is determined by the time constant of R13 and C11.

# Delay Between Rate Detector Pulses

R5 and R13 are factory selected to provide approximately 5.5 ms between rate detector output pulses. This delay allows time for a range change before the next high/low rate detector output pulse is generated. However, this does not delay the first high or low rate pulse, which is generated within a few hundred microseconds after the input frequency reaches 310 or 30 Khz. This is possible because C2 and C10 are partially charged by CR18 and CR19.

#### HP-2411A Reset Output

The reset pulse for the HP-2411A is generated by inverting amplifier Q3, which amplifies the internal reset pulse from the reset bus.

2401C

#### Range Gate A44 (Figures 31-6 and 31-9) 31.3.3

The non-selection of AUTO RANGE function has the same effect upon operation of the range gates as the true state of the holdoff input from A18. In this instance, however, the positive true inhibit is derived by logic inverter A43-Q? from the false state of the autorange logic line. Also, if the FUNCTION switch is not set to AUTO RANGE position. the OVERLOAD indicator is lighted by the overload state of flip-flop A45Q9-Q10. The overload state of A45Q9-Q10 cuts off A10Q4 through OR diode A10CR15 so that the OVERLOAD indicator is not lighted when there is no overload,

After the reset (encode) pulse, AND transistors Q1 and Q2 are no longer inhibited by the holdoff input from A18, which is false. But Q1 and Q2 are inhibited through logic inverter A45Q12 by the ac/ohms delay gate from A23 during resistance or ac voltage measurements with the HP-2410B.

The encode delay starts at the end of the ac/ohms delay gate, or immediately if resistance or ac voltage measurements are not being made. During this period, low rate pulses from A10 are gated through AND transistor Q1 while count flip-flop A45Q13-Q14 is in count down state. This continues until a high rate pulse is generated, the correct range is reached, or the next sample period starts.

A45Q13-Q14 is initially set to count down state by the reset pulse that starts the encode delay period. Any high rate pulse from AND transistor Q2 triggers A45Q13-Q14 to count up state, which inhibits low rate pulses from AND transistor Q1. This prevents upranging in response to low rate pulses. Thereafter, high rate pulses from A10 are gated through Q2 until the correct range is reached.

Low or high rate pulses are coupled to count one-shot A45Q5-Q7 through OR gate CR1-CR2. The remaining logic on assembly A44 derives the lowest and highest range signals that inhibit AND transistor Q1 or Q2 when the autoranger is at either end of its response range.

Section 31

The logic on Range Gate Assembly A44 determines the response of the autoranger to pulses from A10. The low and high rate range gates are AND transistors Q1 and Q2, These gates are inhibited by any of several positive true inputs that may be applied through OR gates CR3-CR8 and CR9-CR12.

### Display Period Logic

During the display period, Q1 and Q2 are inhibited (cut off) by the positive true state of the display holdoff signal from A18. This same state opens overload AND gate C5-R13 through logic amplifier Q3 and OR diode CR15. High rate pulses from A10 can then trigger flip-flop A45Q9-Q10 to overload state through overload OR diode A43CR45. This action, the only autoranger response permitted by the range gates during the display period, switches the attenuator directly to 1000v range, protecting the instrument from overload. Lighting of the OV-ERLOAD indicator is inhibited through OR diode A10CR16 by the positive true state of the autorange logic line when AUTO RANGE FUNCTION is selected.

### Logič When AUTO RANGE Is Not Selected

# Encode Delay Period Logic

# Sample Period Logic

During the sample period, the positive-true state of the record command line from A17 inhibits low rate AND transistor Q1 through OR diode CR4. This logic arrangement allows only upranging during the sample period.

# 31.3.4 Range Control A45 (Figures 31-6 and 31-10)

The logic on Range Control Assembly A45 stores the control states of the autoranging system, except for the range control states. The principal control memories are up/down flip-flop Q13-Q14 and overload flip-flop Q9-Q10. Also on this board are the count one-shot and the record flip-flop.

# Up/Down Control Flip-Flop

Flip-flop Q13-Q14 is preset to count down state by each encode pulse from A7 or A18. This state places the count down and count up lines near ground and negative 35v, respectively. Thereafter, a high rate pulse from A44Q2 may trigger Q13-Q14 to count up state, reversing the potentials on the count down and count up lines. The control states from this flip-flop determine whether the autoranger switches to lower or higher ranges in response to the pulses that are passed by the range gates on A44.

### Overload Flip-Flop

Flip-flop Q9-Q10 is preset to overload state by each encode pulse. It remains in this state (Q9 on, Q10 cut off) until a high rate pulse from AND gate A44C5-R13 triggers it to overload state. This can occur only during the display interval or when the FUNCTION switch is not set to AUTO RANGE position. Cutoff of Q9 during overload state turns on logic inverter Q11, switching the input attenuator to 1000v range. When the autorange logic line is false, the false state from Q9 also lights the OVERLOAD indicator on A24, through logic inverter A10Q4. If Q9-Q10 is in overload state, the encode pulse is gated through AND transistor Q15 to the range counters, setting them to the states that keep the attenuator switched to 1000v range: Thereafter the autoranger is switched to lower ranges if the 1000v range is too high.

#### Count One-Shot

Count one-shot Q5-Q7 delays range triggers that are applied to the range counter. Each range pulse from A44 triggers the one-shot to its unstable state. The positive-going trailing edge of the one-shot output from the Q7 collector triggers the range counter as the one-shot returns to its stable state. The delay allows time for a reversal of up/down logic state to settle before the range counter is triggered. Each positive pulse from the collector of Q5 is applied to the reset buss through inverter Q8.

### Record Flip-Flop

Record flip-flop Q3-Q4 provides + and -record commands that signal an external recorder or data processing device that data is ready to be recorded or used. This flip-flop is triggered to record state (Q3 cut off and Q4 on) at the end of the sample period by the positive-going trailing edge of the +record command signal from A17. Each count pulse from the count one-shot triggers the flip-flop to record state. This logic prevents issuance of a record command when a sample period is not completed because of upranging. A record command is issued only if the resetting of A17Q1-Q2 is not blanked by a negative pulse from Q7 of the count oneshot. The outputs from the record flip-flop are coupled to the record command outputs via emitter followers Q1 and Q4.

# 31.3.5 Range Counter A43 (Figures 31-6 and 31-8)

Flip-flops 1 through 3 and related diode AND gates make up a three-stage reversible counter with a digital range from 0 through 7, of which only 0 through 6 is used. Flip-flops 1 through 3 are identified A, B, and C in Figure 31-8. In the negative true matrix logic used to decode the flipflop outputs, conduction through an even-numbered transistor (Q2, Q4, Q6) represents 0. Through an odd-numbered transistor (Q1, Q3, Q5) conduction represents a count value (A = 1, B = 2, C = 4). The operation of the counter is summarized in Table 31-1.

Count	Off Transistors	С	+ B	+ A	AND Gate		Selected Range
0	Q2, Q4, Q6	0	0	· 0	CR2-5 CR6-8	- Q8	+10 Gain* &
1	`Q2, Q4, Q5	0	0	1	CR6-8	<b>Q9</b> <b>Q9</b>	. 1V . 1V <b>&amp;</b>
2	Q2, Q3, Q6	0	2	· 0,	CR9-12	Q10	+10 Gain 1V
3	Q2, Q3, Q5	0	2	1)	CR13-16	Q11	10V
4	Q2, Q3, Q6 Q1, Q4, Q6	4	0	0	CR17-20	Q12	100V
5	Q1, Q4, Q5	4	0	1	CR21-24	Q13	1000V
6	Q1, Q3	4	2	_	CR25-27	Q14	10M++

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# Up/Down Counting

During up counting, triggers are coupled from the collectors of odd-numbered transistors to succeeding stages. Down counting is inhibited by the positive true state of the count up line, which is applied to the cathodes of AND diodes CR29 and CR33 through R29 and R36. Down counting occurs when up counting is inhibited by the positive true state of the count down line from A45.

### Coupling of Counter Outputs

Coupling of the range selected by the range counter to external circuits is enabled by the true state of the autorange logic line through logic inverter Q7. The inverted output from this line also serves as one of the inputs to HP-2410B control AND transistor Q15.

Table 31-1. Range "Counter A43 gummary

To HP-2411A Guarded Data Amplifier.

To HP-2410B AC/Ohms Converter.

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#### Control of the HP-2410B

#### AND transistor Q15 is enabled if:

The SAMPLING RATE control is in STOP position (used when the HP**a**. 2401C-31 is operated as part of a data acquisition system).

Autorange is programmed. b.

ACF or ACN is programmed.

A sample period is not in progress. d.

When each fample period ends, Q15 is enabled and the overload flip-flop is set via OR gate CR44-CR45. The HP-2401C-31 is switched to the 1000v range, and the HP-2410B is set to the 1000v range via J1, pin e, the overload signal output.

The encode pulse for the next measurement sets the Range Counter Assembly, A43, to 1000v and resets the overload flip-flop via A45CR11. This allows the HP-2401C-31 to switch to the 1v range (ac is programmed), and because the range counter is at 1000v, the HP-2410B remains on the 1000v range. If this is not the proper range, downranging occurs as described previously.

If the HP-2401C-31 is operated in the automatic re-cycle mode (SAMPLING RATE control not at the STOP position) or when ohms function is programmed, Q15 is inhibited and operation is the same as for dc voltages.

#### 31.4 MAINTENANCE

Except as specified in the following paragraphs, service the HP-2401C-31 per the instructions in Section IV of this manual.

#### 31.4.1 In-Cabinet Performance Checks

The in-cabinet performance checks for the HP-2401C-31 are specified in Table 31.2. The test setup is shown in Figure 31-1. Except where otherwise specified, any notations to check 31.1, etc., refer to that table only.

#### 31.4.2 Troubleshooting

Trouble in A10, A43, A44, or A45 can prevent autoranging. Trouble in A10, A44, or A45 can prevent normal overload protection of the HP-2401C-31. (See Figures 31-4 through 31-6.) The other components involved in the operation of the HP-2401C-31 are checked adequately by following the troubleshooting instructions in Section 4.4 of this manual.

The locations of assemblies A10 and A43 through A45 are indicated in Figures 31-2 and 31-3. Figure 31-3 also shows the approximate locations of CR201 through CR205. Figures 31-7 through 31-10 show the location of components on these assemblies and the assembly circuits. Figure 31-11 shows connections to A17 and A18 for HP-2401C-31. Figure 31-12 shows interconnections of the HP-2401C-31.

31-8

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#### 31.4.3 Calibration of Rate Detection

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Calibrate rate detection whenever the HP-2401C-31 uprange or downrange change point is incorrect. (See performance check 31.1, Table 31-2.) proceed as follows:

- With FUNCTION switch set to VOLT, perform steps 1 through 5 of a. Section 4.7.3, but adjust A10R3 where adjustment of A10R2 is specified. (See Figure 31-2 for location of rate detection adjustments.)
- Set HP-2401C-31 controls as follows: b.

FUNCTION:	AUTORANGE.
SAMPLING RATE:	FULLY CLOCKWISE.
SAMPLE PERIOD:	. 01 SEC.

- Set input voltage to 28.5% of any full scale range but the 0.1V range. C. For example, set input voltage to 28.5V, which is 28.5% of the 100V range.
- Adjust A10R11 clockwise until the decimal jumps one place to the d. right on the digital display of the HP-2401C-31.
- Verify correct calibration per performance check 31.1, Table 31-2.

# PARTS LIST

The Parts List in Section V of this manual applies to the HP 2401C-31 except as indicated in Tables 31-3 and 31-4.

Section	31	•		2401C	2401C	
Perfor		Table 31-2. In-Cabine ecks 1 through 24 as specified in 3 JTORANGING - RANGE CHANGE	t Performance Checks (Sheet 1 of 2) Table 4-3 of this manual per instructions in PODMTS	<u>Section 4. 2.</u>	<b></b>	Table 31-2.
			Downranges at 30% of full scale.		d d	Set switch S1 at OV po
	8.	Set HP-2401C-31 Power swith FUNCTION: RANGE: SAMPLE PERIOD: SAMPLE RATE: 100 KC STD (Rear Panel): STORE/DISPLAY (Rear Panel):	th to ON, other controls as follows: AUTORANGE. 1V. 1 SEC. Fully clockwise. INT. DISPLAY.			HP-2401C-31 front pa
	b.	Connect the - and +OUTPUT te of the 31. Jumper the GUAR	rminals of the dc standard to the HI and D terminal to the LO terminal.	LO terminals	e. f.	Set switch S1 at . 4V p Close switch S2. Rece waveform). This time
		out should approximate -300.00			g.	Open switch S2 and prodisplayed on the oscill than 15 ms.
		standard until the decimal point the next measurement, which si	nting is visible, slowly increase output fr on the 31 jumps one position to the rig hould be $-312.5 \pm 7.50$ MILLIVOLTS.	pt. Record	h.	Repeat steps f and g and downranging times
	e.	Slowly decrease output from the one position to the left. Recor MILLIVOLTS.	dc standard until the decimal point on the d the next measurement, which should be	- 31 jumps - 285 ± 10.00		Switch S1 Setting
31.2	EX	TERNAL PROGRAMMING - AUTO	RANGE FUNCTION			0V . 4V
		Autoranging is a programmable check 20, Table 4-3 apply.	function of the HP2401C-31; the requir	ements of		4V 40V 400V
	<b>a.</b>	GRAM CONTROL receptacle J1	UNCTION set to EXT SEL and pins Z and connected. The results of this check sho a yes on the test card if results are the	uld be identi-		
31.3	AU'	TORANGING - RANGE SELECT 1	'IME			<u>незеріс</u> пон ніс
		6 milliseconds, maximum, for 34 milliseconds, maximum, from	each range change; n encode command to start of measureme	nt.		     
	<b>a.</b>	Make connections illustrated in	Figure 31-1; set DC Standard for 800 output			
	b.	With the HP-2401C-31 on and	operating, set controls as follows:			دە <del>م</del>
		FUNCTION: RANGE: SAMPLE PERIOD: SAMPLING RATE: 100 KC STD (rear panel): STORE/DISPLAY (rear panel):	AUTORANGE. 1000V. .1 SEC. STOP. INT. STORE.			
	c.	Set Oscilloscope as follows:				
		Trigger Level: Trigger Slope: Vertical Sensitivity: Sweep Time:	greater than 0 greater than 0 2V/cm (use probe 10X) 1ms/cm			Figure 31-1

In-Cabinet Performance Checks (Sheet 2 of 2)

position, making sure S2 is open. Press RESET pushbutton on panel. The oscilloscope should display the following waveform :



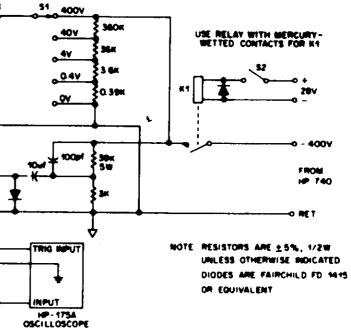
position. Set oscilloscope sweep time at 5 ms /cm.

cord the time interval displayed on the oscilloscope (see above ne interval (upranging time) shall be no greater than 10 ms.

ress the front panel RESET pushbutton. Record the time interval lloscope. This time interval (downranging time) shall be no greater

g for each of the other positions of switch S1. Record the upranging es for each position. These times shall be as follows:

Upranging Time (Max.)	Downranging Time (Max.)
10 ms	10 ms
10 ms	15 ms
16 ms	21 ms
22 ms	27 ms
27 ms	33 ms



1. Setup for Check of Range Select Time

HP-2401C

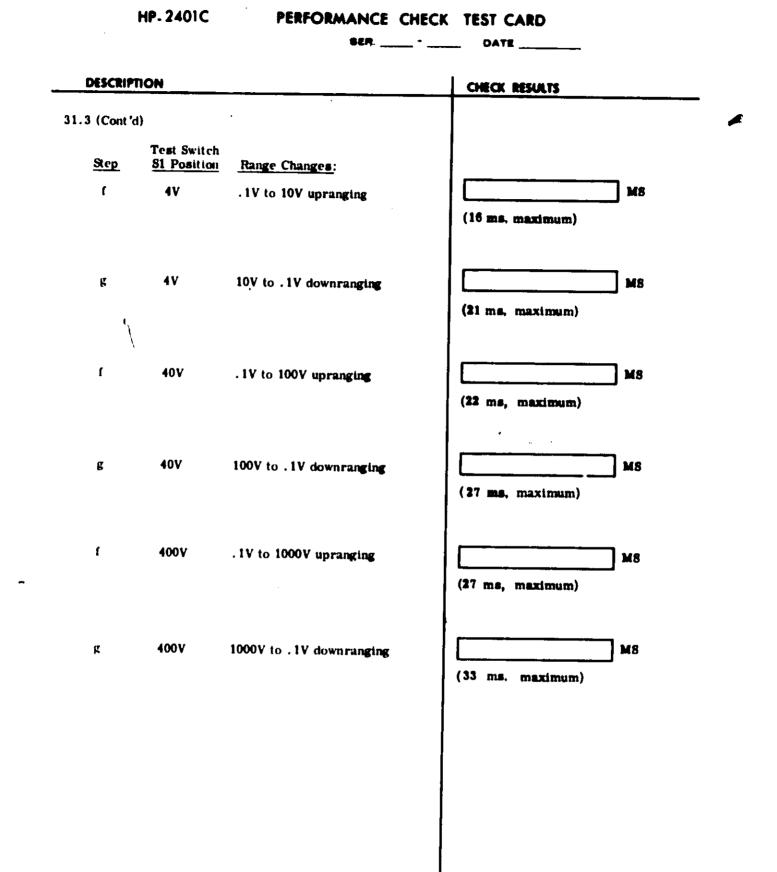
,

PERFORMANCE CHECK TEST CARD

SER ____ DATE ____

DES	CRIPTION			CHECK RESULTS
\$1, 1	AUTORANG RANGE CH	ING - Ange points		٢.
	Upranges at	:	,	(312.5 ± 7.5)
	Downranges	at		(285 ± 10)
31.2	external Autorange	PROCERAMMING	-	
	Autorange pr to pin V pro is repeated?	XXXCes same resu	mnecting pin Z of J1 lts when check 31.1	(yes)
31. 3	Autorange Range seli	NG - Ect time		
	<u>Step</u>	Test Switch S1 Position	Range Changes:	
	d	ov	None	(10 ms. maximum) .
	ſ	.4V	. 1V to 1V up- ranging	(10 ms. maximum)
	R -	.4V	1V to .1V down- ranging	(15 ms, maximum)
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31.1 of 2



# 31-2 of 2

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17010	31-3.	Keierence	Designation	DOCK

Reference Designation	e Part No.	Description #	Note
		OPTION 31 A10 5080-5021 5080-5675	H-A X-L
,		NAKE THE FOLLOWING CHANGES TO TABLE 5-1 TU MAKE THE TABLE APPLICABLE TO THE HP 2401C-31.	
	/ /	DELETE THE FOLLOWING:	
A10	5060-2181 5060-5655	UVERLOAD DETECTOR UVERLOAD DETECTOR	А-Н Ј-Х
		ADD THE FOLLOWING:	
A10 A43 A44 A45	5060-5021 5060-5878 5060-3785 5060-3684 5060-3831	AUTORANGE RATE DETECTOR AUTORANGE RATE DETECTOR KANGE COUNTER RANGE GATES KANGE CONTROL	A-H J-X
	1		
C10	0160-0806	C:FXD POLY 500 PF 10% 1000VDCW	
CR201- CR205	1901-0025	DIODE:SILICON LOOWY LOOMA	
XA43	1251-0332	CUNN:PC 24 CONTACTS	
XA44 XA45	1251-0332 1251-0332	CUNN:PC 24 CONTACTS LUNN:PC 24 CONTACTS	
A10	5080-5021	AUTORANGE RATE DETECTOR	A-H
	5080-5878	AUTORANGE RATE DETECTOR	×⊣t
ALOC1	0160-0161	CIFXD MY 0.01 UF 108 200VDCW	
A10C2	0160-0161 0160-0166	C:FXD MY 0.01 UF 108 200VDCW C:FXD MY .068 UF 108	A-G
A10C3	0160-0161	LIFXD MY 0.01 UF 10% 200VDCW	н-х "
A10C4	0160-0263	CIFXD CER 0.22 UF 20% 50VDCW	
A10C5	0180-0050	C:FXD ELECT 40 UF +75-10% 50VDCW	
A10C6	0160-0161	CIFXD NV 0.01 UF- 108 200VDCW	
A10C7	0160-0257	CIFXD MICA 50.6PF 58	
A10C8 A10C9	0160-0252 0160-0161	CIFXD MICA 257.5 PF 0.5% 500VDCW CIFXD My 0.01 UF 10% 200VDCW	1 1
A10C10	0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	
A10C11	0160-0161	C*FXD MY 0.01, UF 108 200VDCW	
A10C12	0160-0263	CIFXD CER 0.22 UF 208 SOVDCW	
A10C13 A10C14	0180-0049	CIFXD AL ELECT 20UF 50VDCW	
A10C15	0160-0161 0160-2940	CIFXD MY 0.01 UF 10% 200VDCW CIFXD MICA 470 PF 5% 300VDCW /	C-X
A10CR1- A10CR12	/ 1901-0081	DIODE:SILICON 50 VOLTS WORKING	
		THE FOLLOWING SERIAL NUMBERS USE 0160-0161: 605-00671,-00672,-00674, 00677,-00682,-00683,-00685,-00690, -00691,-00692, AND -00699.	

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Table 31-3. Reference Designation Index (Cont'd)

Reference			I	<b></b>		ole 31-3. Reference Designation Index (Cont'd)	
Designation	Part No.	Description #	Note	Reference Designation	Part No.	Description #	n No
		OPTION 31 A10 5080-5021 (CONT'D) 5080-5878 (CONT'D)	A-H J-X			OPTION 31 A10 5080-5021 (CONT'D) 5080-5878 (CONT'D) A43 5060-3785	-+A J-X
LOCR13 LOCR14 LOCR15 LOCR16	1901-0081 1902-0022 1901-0081 1910-0016	<pre>     CDIDDE:SILICON 50 VOLTS WORKING     DIODE BREAKDOWN:2.67V     DIODE:SILICON 50 VOLTS WORKING     DIODE:GERMANIUM 100MA AT 0.85V 60PIV </pre>	А-н	A10R24 A10R25 A10R26	0683-1035 0683-1825 0686-4325	RIFXD CONP 10K OHN 5% 1/4W RIFXD CONP 1800 OHN 5% 1/4W RIFXD CONP 4300 OHN 5% 1/2W	
LOCR17 .	1901-0061	DIODEISILICON		A10T1	5060-2577	TRANSFORMER # PUL SE	A-1
LOCR18 LOCR19 LOCR20 LOCR21	1901–0081 1901–0081 1901–0061 1910–0016	UIODE:SILICON 50 VOLTS WORKING DIODE:SILICON 50 VOLTS WORKING DIODE:SILICON DIODE:GERMANIUM 100MA AT 0.85V 60PIV	C-X .	A10T2	9100-1221 5060-2577 9100-1221	TRANSFORMER : PULSE TRANSFORMER : PULSE TRANSFORMER : PULSE	M=) A=I M=)
OLI	9140-0053	CHOKE/COIL:FXD 1 MH 10%		A43	5080-3785	RANGE COUNTER	1
.0L2	9140-0210	COIL FXD RF JOO UH 5%		A43C1	0160-0153	C:FXD NY 1000 PF 10% 200VDCW	
001	1850-0184	TRANSISTOREGERMANIUM PNP		A43C2	0160-0157	C:FXD MY 0.0047 UF 108 200VDCW	
0Q2 0Q3 0Q4	1850-0184 1850-0040 1850-0145	TRANSISTOR:GERMANIUM PNP TRANSISTOR:GERMANIUM PNP TRANSISTOR:GERMANIUM PNP		A43C3 A43C4 A43C5 A43C6	0160-0153 0160-0157 0160-0153 0160-0157	C:FXD NY 1000 PF 10% 200VDCW C:FXD NY 0,0047 UF 10% 200VDCW C:FXD NY 1000 PF 10% 200VDCW C:FXD NY 0.0047 UF 10% 200VDCW	
0R1 -	0727-0751 0757-0159	R:FXD DEPC 1000 DHM 1% 1/2W R:FXD MET FLM 1000 DHM 1% 1/2W	A-F G-X	A43C7 A43C8 A43C8	0160-0153 0160-01\$7	C:FXD NY 1000 PF 10% 200VDCW C:FXD NY 0.0047 UF 10% 200VDCW	
OR2 OR3	0727-0792 069 <b>8-3419</b> 2100-0369	R:FXD CARBON FLM 31,6K OHM 1% 1/2W R:FXD MET FLM 31.6K OHM 1% 1/2W R:VAR WW 200 OHM 10% LIN 1/4W	A-F G-X	A43C9 A43C10 A43C11	0160-0153 0160-0157 0160-0157	C:FXD MY 1000 PF 10% 200VDCW C:FXD MY 0.0047 UF 10% 200VDCW C:FXD MY 0.0047 UF 10% 200VDCW	
OR4	0727-0765 0698-0024	R:FXD CARBON FLM 2.61K 1% 1/2W R:FXD MET FLM 2.61K OHM 1% 1/2W	A-F G-X	A43C12	0160-0153	C:FXD NY 1000 PF 10% 200VDCW	
OR5	0727-0838 NSN	R:FXD CARBON FLM 1.1 MEGOHM 1% 1/2W Factory selected R:FXD comp 47k ohm 5% 1/4W	A-T U-X	A43CR45	1901-0081	DIODE:SILICON 50 VOLIS WORKING	
0R6 0R7	0683-4735 0683-5635	RIFKD COMP W/K OHM SE 1/4W RIFKD COMP 56K OHMS 58 1/4W		A43Q1- A43Q6	1850-0032	TR ANSISTOR # GERMANJUM PNP	
OR8 OR9	0683-1035 0727-0751 0757-0159	R:FXD COMP 10K OHN 5% 1/4H R:FXD DEPC 1000 OHM 1% 1/2H R:FXD NET FLM 1000 OHN 1% 1/2H	A-F G-X	A43Q7 A43Q8 A43C9-	1850-0811 1850-0111	TRANSISTOR: GERMANIUM PNP TRANSISTOR: GERMANIUM PNP	
OR10 OR11	0698-3278 2100-0369	RIFAD HET FLH 1000 DHH 14 1/20 RIFAD HET FLH 66K DHM 18 1/20 KIVAR WW 200 DHM 108 LIN 1/4W	G-X	A43Q14 A43Q15	1850-0145 1850-0032	TRANSISTOR: GERMANIUM PNP TRANSISTOR: GERMANIUM PNP	
OR 12 OR 13	0727-0765 0698-0024 0727-0840	R:FXD CARBON FLM 2.61K 1% 1/2W R:FXD MET FLM 2.61K DHM 1% 1/2W R:FXD CARBON FLM 1.21 MEGOHM 1% 1/2W	A-F G-X	A43R1 A43R2	0683-3635 0686-1035	REFEAD COMP 36K OHN 58 1/4W	ł
OR 14	NSN 0683-4735	FACTORY SELECTED REFXD COMP 47K OHM 5% 1/4W		A43R3 A43R4 A43R5	0683-4325 0683-7525 0683-8225	R#FXD COMP 10K OHN 5% 1/2W R#FXD COMP 4300 OHN 5% 1/4W R#FXD COMP 7500 OHN 5% 1/4W R#FXD COMP 7500 OHN 5% 1/4W	
OR 15 OR 16 OR 17	0683-5635 0683-1035 0689-1815	R:FXD COMP 56K OHMS 58 1/4W R:FXD Comp 10K ohm 58 1/4W R:FXD comp 180 ohm 58 1W		A43R6 A43R7	0683-8225	R#FXD COMP 8200 OHMS 5% 1/4W R#FXD Comp 8200 OHMS 5% 1/4W R#FXD Comp 12k ohm 5% 1/2W	
OR 18 OR 19	0683-1035 0683-1035	RIFXD COMP 10K OHM 52 1/4W RIFXD COMP 10K OHM 52 1/4W		A43R8 A43R9 A43R 10	0683-3625 0683-1225 0758-0004	R:FXD COMP 3600 OHN 5% 1/4W R:FXD COMP 1200 OHN 5% 1/4W	
DR20 DR21 DR22	0683-2235 0683-1025 0683-6825	* R:FXD COMP 22K OHM 5% 1/4W \ , R:FXD COMP 1000 OHM 5% 1/4W R:FXD COMP 6800 OHM 5% 1/4W		,		RIFXD MET OX 2700 OHN 5% 1/2W	
OR23	0683-1025	RIFXD COMP 1000 OHM 5% L/4W			· ~		
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<b>Table 31-3</b> .	Reference	Designation	Index	(Cont'd)
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Table 51-5. Reference Designation Index (Cont'd)

Reference Designation	6 Part No.	no and an		<b>`</b>	r		ie 31-3. Reference Designation Index (Cont'd)		
Designation	() FBH 140.	Description #	Note	- * `	Designation	<b>() Pari</b> No.	Description #	Note	]
4 3 R L 1 4 3 R L 2 4 3 R 1 3 4 3 R 1 4	0603-3925 0603-1025 0606-5125 0608-3925	OPTION 31 A43 5000-3786 (CONT'D) AIFXD COMP 3900 OHM 5% 1/4W AIFXD COMP 1800 OHM 5% 1/4W CIFXD COMP 5.1K OHM 5% 1/2W AIFXD COMP 3900 OHM 5% 1/4W			A44	5080-3664	OPTION 31 A44 5050-3064 RANGE GATE		
43H15	0683-1825	RIFKD COMP 1000 OHN 58 1/4W			A44C1	0160-0165	CIFXD NY 5600 PF 10%	-	,
4 3R 16 4 3R 17 4 3R 18 4 3R 19 4 3R 20	0686-5125 0683-3925 0683-1825 0686-5125 0683-3925	CIFKD COMP 5.1K DHM 58 1/2W RIFKD COMP 3900 DHM 58 1/4W RIFKD COMP 1800 DHM 58 1/4W CIFKD COMP 5.1K DHM 58 1/4W RIFKD COMP 3900 DHM 58 1/4W			A44C2 A44C4 A44C5 A44C5 A44C5 A44C7	0140-0037 0140-0037 0160-0153 0160-0153 0160-0153	CIFXU NICA 390 PF 58 CIFXU NICA 390 PF 58 CIFXU NY 1000 PF 108 200VUCW CFFXU NY 1000 PF 108 200VUCW CIFXU NY 1000 PF 108 200VUCW		- -
3R21 3R22	0683-1825 0686-5125	RIFXD COMP 1000 DHN 58 1/4W			A44CR1	1901-0061	DIODEISILICON 50 VOLTS WORKING		
3R23 3R24	0683-3925 0683-1825	RIFXD CONP 3900 OHM 58 1/4W RIFXD CONP 1800 OHM 58 1/4W			A44CR2 - A44CR3-	1901-00#1	DIODEISILICON 30 VOLTS WORKING		
N3R25 N3R26 N3R27 N3R20	0686-5125 0686-7525 0683-8225 0683-2035	LIFXD CONP 5-1K DHN BE 1/2W RIFXD CONP 7500 DHN BE 1/2W RIFXD CONP 8200 DHNS 5E 1/4W		ſ	A44CR12 A44CR13 A44CR14	1901-0025 1901-0061 1901-0061	DIODEISILICON LOOWV 100MA		
3A 29 3A 30 3A 31	0683-3335 0686-7525	HIFXD CONP 20K OHN 58 1/4H - HIFXD CONP 33K OHN 58 1/4H HIFXD CONP 7500 OHN 58 1/2H RIFXD COMP 8200 OHNS 58 1/4H			A44CR15- A44CR19 A44CR20 A44CR21	1901-0025 1910-0016 1910-0016	DIODEISILICON LOOWY 100NA Diodeigermanium 100NA at 0.85V 60PIV Diodeigermanium 100NA at 0.85V 60PIV		•
3 A 3 2 3 A 3 3	068 3-2035 068 3-1045	RIFXD CONP 20K DHM SE 1/4W RIFXD COMP LOOK DHMS SE 1/4W			A44CR22 A44CR23 .	1901-0025	DIODEISILICON LOOWV LOOMA	,	
IR 34 IR 35	0683-1235 Q683-3335	RIFXD CONP 12K OHN 58 1/4W RIFXD CONP 33K OHN 58 1/4W 💩			A44CR24 4 A44CR25	1910-0016 1910-0016	JIODEISILICON LOOWV LOOMA TO Diodeigermanium looma at 0.85v 60piv Diodeigermanium looma at 0.85v 60piv	•	
IR 36 IR 37 IR 38	0683-3335 0686-7525 0683-8225	RIFXD CONP 33K DHN 58 1/4W RIFXD CONP 7500 DHN 58 1/2W RIFXD CONP 8200 DHNS 58 1/4W			A44CR26 A44CR27	1901-0025 1901-0025	DIODEISILICÓN LOOWV LOOMA DIODEISILICÓN LOOWV LOOMA		•
1839 ⁴ 1840 1841	0683-20354 0683-1235 0683-1045	RIFXD COMP 20K OHN 51 1/4W RIFXD COMP 12K OHN 51 1/4W KIFXD COMP 100K OHNS 51 1/4W			A44CR28 A44CR29 A44CR30 A44CR31	1910-0016 1901-0025 1901-0025 1901-0025 5	NDIODEIGERMANIUM 100MA AT 0.85V 60PIV DIODEISILICON 100WV 100MA DIODEISFLICON 100WV 100MA QFODELSILICON 100WV 100MA	.   .	· ·
R42 R43	0686-7525 0683-8225	RIFXD COMP 7500 000 58 1/20 RIFXD COMP 8200 0005 58 1/40			A4401	1850-0128	TRANSISTOR: PNP GERMANIUN		
1844 1845 1846	068 3- 20 35 068 3- 33 35 068 <b>6</b> - 75 25	RIFXD COMP 20K OHN 58 1/4W * , RIFXD COMP 33K OHN 58 1/4W @ RIFXD COMP 7500 OHM 58 1/2W			A4402 A4403 A4404	1850-0128 1850-0111 1850-0128	TRANSISTOR: PNP GERMANIUN TRANSISTOR: GERMANIUM PNP TRANSISTOR: PNP GERMANIUM		L
1847 1848 1849	0683-8225 0683-20354 * 0686-7525 ~	RIFXD COMP 8200 DHNS 58 1/4H J Rifxd Comp 20k dhn 58 1/4H J Rifxd Comp 7500 dhn 58 1/2H			A4405 A4406	1651-0654 1650-0128	TRANSISTORIGERMANIUN NPN TRANSISTORIPNP GERMANIUN		
IA 50	0683-8225	RIFXD COMP. 6200 DHNS 58 1/4W			A4407 A4408 A4409	1850-0111 1850-0128 1850-0128	TRANSISTOR: GERMANIUM PNP TRANSISTOR: PNP GERMANIUM TRANSISTOR: PNP GERMANIUM		
R53	0685-2035 0686-1045 0683-1235	RIFRD COMP 20K UNN 58 1/4W RIFRD COMP 100K ONN 58 1/2W RIFRD COMP 12K ONN 58 1/4W			A44010	1850-0128 1850-0128	TRANSISTORIPHP GERMANIUN	•	
154	0683-1535 0683-3335	AIFXD COMP 15K OHN 58 1/44 AIFXD COMP 33K OHN 58 1/44 -			A4481/.	.0683-3935	REFXD CONP 39K OHN 58 1/44		
R36 R57	0683-8235	RIFXD COMP 62K OHN 58 1/4W			A44R2 1 A44R3	0683-3935 0683-1035	RIFKD CONP 39K OHM 58 1/4H RIFKD COMP 10K OHM 58 1/4H		
#50 #50 #59	0683-1035 0683-1035 0683-3335	AIPXD CONP 18K OHN 32 1/4W MFXD CONP 10K OHN 52 1/4W RIFXD CONP 33K OHN 52 1/4W			A44R4 A44R5	0683-1035	RIFXD COMP ION OHN 5% 1/4% RIFXD COMP ION OHN 5% 1/4% RIFXD COMP ZZON OHN 5% 4/4%		
860	0683-3335	R: PXD DOMP 33K OHM SS 1/4W	<b>b</b>			n i			
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#### Table 31-3. Reference Designation Index (Cont d)

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Table 31-3.	Reference	Designation	Index	(Cont'd)
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elerence signation	Part No.	Description #	Note	Reference Designation	Part No.	Description #	
· [		OPTION 31			·····		
ľ		A44 5060-3684 (CONT'D)				OPTION 31	
		A45 5080-3831				A45 5080-3831 (CONT'D)	
R7	0683-3935	HIFXD COMP 39K OHN 5% 1/4W				· · · · · · · · · · · · · · · · · · ·	
RO	0683-6825	RIFXD COMP 6800 OHM 5% 1/4W		A45CR1	1901-0081	DIODE:SILICON 50 VOLTS WORKING	
R9	0683-3935	REFXD CONP 39K OHN 58 1/4H		AADCHI	1401-0081	DIQUETSILICUM SO VOLIS WORKING	
RIO	0683-3935	RIFXD COMP 39K OHN 5% 1/4W		A45CR2	1901-0061	DIODE:STLICON	
R I 1	0683-2245	RIFXD CONP 220K OHM 5% 1/4W		A45CR3	1901-0081	DIODE:SILICON 50 VOLTS WORKING	
R12	0683-1035	RIFXD COMP 10K OHM 5# 1/4H	1 1	A45CR4	1902-0022	PLODE BREAKDOWN+2.67V	
R13	0683-3935	RIFAD COMP TOR ONN SE 1/4W RIFAD COMP 39K ONN 58 1/4W	·	A45CR5	1901-0081	DIODEISILICON 50 VOLTS WORKING	
R14	0683-1535	RIFXD COMP 15K OHN 5% 1/4W		A45CR6	1901-0061	DIODEISILICON 50 VOLTS WORKING	
R15	0683-3335	RIFXD CONP 33K OHN 58 1/4H		A45CR7	1901-0081	DIDDEISILICON 50 VOLTS WORKING	
R16	0683-3335	RIFXD COMP 33K OHM 5% 1/4W		A45CR9	1901-0081	DIODE: SILICON 50 VOLTS WORKING	
R17	0403-1045			A45CR11	1901-0025	DIGDEISILICON 100WV 100MA	
A10	0683-1045 0683-5625	R#FXD COMP 100K OHMS 5% 1/4W R#FXD COMP 5600 OHM 5% 1/4W		A45CR12	1901-0025	DIDDE:SILICON LOOWY 100MA	
R19	0683-1825	RIFXD COMP 5600 OHN 5% 1/4W RIFXD COMP 1800 OHN 5% 1/4W		44501	1851-0014		
N20	0683-2035	AFFXD COMP 20K OHN 5% 1/4H		A45Q1	1851-0034	TKANSISTOR: GERNANI UN NPN	
R21	0683-3925	RIFXD COMP 3900 DHN 58 1/4W		A4592	1850-0184	TRANSISTOR: GERMANIUM PNP	
			1 1	A45Q3	1850-0184	TRANSISTOR: GERMANIUM PNP	
22	0683-1235	RIFXD CONP 12K DHM 58,1/4H	1	A4504	1851-0034	TRANSISTOR: GERMANIUN NPN	
124	0683-1535 0683-3335	RIFXD CONP 15K OHN 5% 1/4H RIFXD CONP 33K OHN 5% 1/4H	1 1	A45Q5	1850-0111	TRANSISTOR: GERMANIUM PNP	
25	0683-3335	RIFXD COMP 33K OHM 58 1/40 RIFXD COMP 33K OHM 58 1/40	+	A45Q6	1851-0031	TRANSISTOR:GERMANIUM NPN	
26	0683-3335	KIFXD CONP 33K OHN 55 1/4W		A4507	1850-0032	TRANSISTOR: GERMANEUN PNP	
				A45Q8	1851-0024	TRANSISTORIGERMANIUM NPN	
27	0683-5625	KIFXD COMP 5600 DHM 58 1/4W		A4509	1850-0032	TRANSISTOR: GERMANIUM PNP	
28	0683-3325	RIFXD COMP 3300 OHM 51 1/4H		A45Q10	1850-0032	TRANSISTOR : GERMANIUM PNP	
29 30 ·	0686-1035 0683-3335	RIFKD COMP LOK DHM 58 1/2W		A45Q11	1850-0145	TRANSISTOR: GERMANIUM PNP	1
31	0683-3335	RIFXD COMP 33K OHM 5% 1/4H RIFXD COMP 33K OHM 5% 1/4H	1 1				
		NTING GUTW JJK UTH 34 1/98		A45012 A45013	1850-0111	TRANSISTOR: GERMANIUM PNP	
32	06'83-1035	RIFXD COMP LOK OHN 58 1/4H		A45014	1850-0032 1850-0032	TRANSISTOR: GERMANIUM PNP TRANSISTOR: GERMANIUM PNP	
33	0683-1525	KIFXD COMP 1500 OHM 58 1/4W		A45015	1850-0128	TRANSISTOR: PNP GERMANIUM	
34	0683-3325	RIFXD COMP 3300 DHN 5% 1/4W				······································	
35	0683-3335	REFXD COMP 33K OHM 58 1/4H		A45R1	0683-4705	RIFXD COMP 47 OHN 58 1/4W	
	0683-3335	RIFXD COMP 33K OHN 5% 1/4W	[ ]				
37	0683-2225	RIFXD COMP 2.2K OHN 58 1/4W		A45R2 A45R3	0689-3925 0683-1025	RIFXD CONP 3.9K OHM 58 LW	
38	0683-1035	RIFXD COMP 10K OHN 58 1/4H		A45R4	0689-3925	RIFXD COMP 1000 CHM 5% 1/4W RIFXD COMP 3.9K CHM 5% 1W	
39	0683-2035	RIFXD COMP ZOK OHN 58 1/4W	1	A4585	0683-3335	RIFXD COMP 33K OHN 5% 1/4W	
	5000 1001	, ,		A45R6	0683-2235	RIFXD CONP 22K OHN 58 1/4W	
	<b>5000-383</b> 1	RANGE CONTROL			`	· · · ·	Į
1	0140-0200	CIFXD NICA 390 PF 52	4	. A4587	0689-3925	RIFXD CONP 3.9K OHM 58 1W	1
			ļ [	A4588 A4589	0683-3335 0683-2235	R:FXD COMP 33K OHM 58 1/4W R:FXD COMP 22K OHM 58 1/4W	
2	0140-0200	LIFXD MICA 390 PF 58	i i	A45R10	0689-3925	RIFXD COMP 22K OHM 54 1740 RIFXD COMP 3.9K OHM 55 10	
3	0160-0153	CIFXD NY 1000 PF 108 200VDCW	] ]	+ A45R11	0683-1025	RIFXD CONP 1000 OHN 58 1/4W	
5	0160-0168	CIFXD NY O.1 UF LOX 200VDCH					
6	0160-0161 0170-0040	CIFXD NY 0.01 UF 108 200VDCW CIFXD NY .047 UF 108 200VDCW	1 1	A45812	0483-1235	RIFXD CONP 12K OHH 58 1/4H	
		CALINO ME SUAL OF TAP COANTER		A45R13	0683-1235	KIFXD COMP 12K OHM 58 1/4H	
7	0160-0157	CIFXD NY 0.0047 UF 108 200VDCH		A45814	0663-4705 0683-1035	RIFXD COMP 47 OHM 58 1/4W RIFXD COMP 10K OHM 58 1/4W	
	0160-0156	CIFXD MY 0.0039 UF 10% 200VDCW	1 1	A45R16	. 0683-4725	RIFXD CONP 4700 CHM 58 1/4W	
	0140-0200	CIFXD NICA 390 PF 5%			· · · · · · · · · · · · · · · · · · ·		1
	0140-0200	CIFXD NICA 390 PF 58		A45R17	0683-2035	REFXD COMP 20K OHM 58 1/4W	
••	0160-0153	CIFXD NY 1000 PF 108 200VDCW		A45R18	0683-1135	RIFXD COMP 11K DHM 58 1/4W	r
12	0170-0040	CIFXD MY .047 UF LOS 200VDCH	[ ]	A45R19	0683-1135	REFXD COMP 11K OHM 5% 1/4W	
3	0160-0161	CIFXD NY 0.01 UF 10% 2000DCW		A45R20	068 3- 20 35	RIFXD CONP 20K OHN 5% 1/4W	
14	0160-0161	LIFXD MY D.OI UF LOX 200VDCW			• • •	· · · · · · · · · · · · · · · · · · ·	
15	0160-0162	CIFXD MY 0.022 UF 108 200VDCW				•	
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Table 31-3. Reference Designation Index (Cont'd)



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Table 31-3. Reference Designation Index (Cont'd)

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Reference Designation	Part No.	Description #	Note	9 Part N
		OPTION 31 A45 5080-3831 (CONT'D)		
A45821	0683-3935	RIFXD COMP 39K OHM 5% 1/4W		0140-0037
A45822	0683-2225	RIFXD COMP 2.2K CHH SE L/4W		0140-0200
45R23	0683-1225	REFXD COMP 1200 DHM SE 1/4H	1 I I I I I I I I I I I I I I I I I I I	0160-0153
45R24 45R25	068 3-2735 068 3-3935	R#FXD COMP 27K OHN 58 1/4W R#FXD COMP 39K OHN 58 1/4W		0160-0156
				0160-0157
45R26 45R27	0683-1335	RIFXD COMP 13K OHN SE 1/4W		0160-0161
45R28	0683-1035 0683-2035	RIFXD COMP LOK OHN 5% 1/4W		0160-0162
45R29	0686-5125	R:FXD COMP 20K 0HM 58 1/4W C:FXD COMP 5.1K 0HM 58 1/2W		0160-0165
45R 30	0683-2035	RIFXD COMP SOL OHN SE 1/4W		0160-0166
45R31	0683-2035	RIFXD COMP 20K OHN SE 1/4W		0160-0168
45R32	0683-1535	RIFAD COMP ZOR ONN SE 1740 RIFAD COMP 15K ONN 5E 1740		0160-0252
45R33	0683-6825	KIFXD COMP 6800 DHM 58 1/4W		0160-0257
45R 34	0683-3625	RIFXD COMP 3600 OHN 58 1/40		0160-0263
45R35	0683-1525	KIFXD COMP 1500 CHM 5% 1/4W		0160-0806
45836	0683-2725	R: FXD COMP 2700 OHN 58 1/4W		0160-2940
45R37	0683-1055	RIFXD COMP 1 NEGONN 5% 1/4W		0170-0040
45R38	0683-1045	RIFXD COMP 100K CHHS 55 1/4W		0180-0049
45R39	0683-8225	RIFXD COMP 8200 DHMS 58 1/4W		0180-0050
45R40	0683-1235	RIFXD COMP 12K OHM 58 1/4W		0683-1015
45R41	0686-5625	RIFXD COMP 5600 OHN 58 1/24		0683-1025
45R42	0683-4725	A: FXD CONP 4700 CHM 58 1/4W		0683-1035
45R43	0683-9145	RIFXD CONP 9100 DHN 58 1/4W		0683-1045
45R44	0686-5625	R: FXD COMP 5600 CHM 58 1/2W		
45845	0683-4725	R:FXD COMP 4700 OHH 5% 1/4W		0683-1135
45846	0683-9125	R: FXD COMP 9100 OHN 58 1/4H		0683-1225
45R47	068 3-20 35	RIFXD COMP 20K OHN 58 1/4H		0683-1235
45848	0683-8225	R#FXD COMP 8200 OHNS 58 1/4W		0683-1335
45R49	0683-3625	R:FXD COMP 3600 OHM 5% 1/4W	4	0683-1525 0683-1535
45R50	0683-9125	R: FXD COMP 9100 CHM 58 1/4W		
45R51	0683-4725	R: FXD COMP 4700 DHM 58 1/4W		0683-1825
5852	0683-1025	RIFXD COMP 1000 OHM 58 1/4W		0683-2035
5853	0686-5125	CIFXD COMP 5.1K OHH 58 1/2W		0683-2225
5854	0683-1015	R=FXD COMP 100 OHM 5% 1/4W		0683-2235
				0683-2245
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Table 31-4. Replaceable Parts

Description #	Mfr.	Mfr. Part No.	TQ
OPTION 31			
CIFXD MICA 390 PF 58		RCM15E391J	
CIFXD MICA 390 PF 58 CIFXD MY 1000 PF 108 200VDCN	28480	0140-0200 0160-0153	
CIFXD MY 0.0039 UF 108 200VDCW	28480		
			· .
CIFXD NY 0.0047 UF 108 200VDCH CIFXD NY 0.01 UF 108 200VDCH	28480	0160-0157 0160-0161	1
CIFXD MY 0.022 UF 108 200VDCW	28480	0160-0162	
CIFXD NY 5600 PF 108	28480	0160-0165	1
C:FXD NY .068 UF 108	28480	0160-0166	1
C:FX0 MY 0.1 UF 108 200VDCW		0160-0108	
CIFXD NICA 257.5 PF 0.5% 500VDCW	72136	RCM15±1275+5)± RCM15£150+6)± 5C5285-CML	1
CIFXD AICA SO. OFF 58	72136	RCM15E(50.6)L	1
CIFXD CER 0.22 UF 208 50VDCW CIFXD POLY 500 PF 108 1000VDCW	56289	565285-6ML 114P50191054	
	•		· ·
CIFXD NICA 470 PF 58 300VDCH	72136	RDM15F471J3C	1
CIFXD NV .047 UF 108 200VDCW	20460	0170-0040	
CIFXD AL ELECT 20UF SOVDCM CIFXD ELECT 40 UF +75-108 SOVDCM	28480	30D206G050DC6M1 0180-0050	
RIFXD CONP 100 UHN 58 1/4W	01121	CB 1015	
			1 .
R:FXD COMP 1000 DHM 58 1/4W R:FXD COMP 10K DHM 58 1/4W		CB 1025 CB 1035	1 11
A IFAD CONP LOOK OHNS 58 1/4W		CB 1045	
RIFXD CONF L NEGOHN 58 1/4W		CB 1055	1
RIFXD LUNP LIK (HM 58 1/4W	01121	CB 1135	
R = FXD LONP 1200 DHN 58 1/4W	01121	CB 1225	1
RIFXD CUMP LZK UNH 58 1/4W		CB 1235	1
R:FXD CUMP 13K UNM 58 1/4W R:FXD CUMP 1500 UNM 58 1/4W		CB 1335 CB 1525	
RIFXD CUMP 1300 UMH 58 1740 RIFXD CUMP 15K UMM 58 1740	01121		
		6 . L	.
R:FXD CUMP 1800 DHM 58 1/4W R:FXD Lump 18k uhm 58 1/4W		CB 1825 CB 1835	
RIFXD COMP 20K UNN 58 1/4H		CB 2035	14
RIFXD CUMP 2.2K UNN 58 1/4W RIFXD CUMP 22K UNN 58 1/4W		GR 2225	
RIFXD CUMP 22K UHH 58 1/4W	01121	CB 2235	,
RIFXD CUMP 220K UMP 58 1/4W	01121	CB 2245	1
RIFXD CUMP 2700 UHM 58 1/4W	01121	LA 2725	1 1
RIFXD CUMP 27K UHM 58 1/4W		CR 2735	
RIFXD CUMP 3300 DHM 58 1/4W RIFXD CUMP 33K (HM 58 1/4W		CB 3325 CB 3335	1 1 5
RIFXD CUNP 3400 OHN 58 1/4W		CB 3625	5
RIFXD CUMP JOK UNN 58 1/4W RIFXD CUMP 3900 UNN 58 1/4W		CB 3635 CB 3925	
RIFXD CUMP 39K UHN 58 1/4W		CB 3935	8
RIFXD LUNP 4JOU OHN 58 1/4W		CB 4325	1
RIFID CUMP 47 UM 58 1/4M	01121	LB 4705	<i>i</i>
RIFXD CUMP 4700 DHM 58 1/4W		CB 4725	
RIFXD CUMP 47K DHR 58 1/4W	01121	CB 4735	1
RIFXD CUMP 5600 DHM 58 1/4M RIFXD COMP 56K UHNS 58 1/4W		CB 5625	
NITAU (UNIT 78% UNITS 78 1/98	01121	CB 5635	· ·
RIFED CONP 6800 UHN 58 1/4W		CB 6825	
RIFED CUMP 7500 UHH 58 1/4H		CB /525	1
RIFXD COMP 6200 UMMS 58 1/4W	1 01121	CB 8225	1 10
RIFXD CUMP BZK OHM SE L/4W		E8 8235	1 1

0683-9125

0686-1035

0686-1045

0686-1235

0686-4325

0686-5125

0686-5625

0686-7525

0689-1815

0689-3925

0698-0024

0698-3278

0698-3419

0727-0751

0727-0765

0727-0792

0727-0838

0727-0840

0757-0159

0758-0004

1251-0332

1850-0032

1850-0040

1850-0111

1850-0128

1850-0145

1850-0184

1851-0024

1851-0031

1851-0034

1901-0025

1901-0061

1901-0081

1902-0022

1910-0016

2100-0369

5060-2577

5060-3684

5060-3785

5060-3831

5040-5021

5060-5878

9100-1221

9140-0053

9140-0210

9 Part No.

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Description #

RIFXD CONP 9100 OHM 58 1/4H

RIFXD CUMP LOK OHM 58 1/2W

RIFXD COMP LOOK DHM 58 1/2W

RIFXD COMP 4300 OHM 58 1/2W

CIFXD COMP 5.1K OHN 58 1/2W

RIFXD CUMP 5000 DHM 58 1/24

RIFXD CUNP 7500 UHM 5% 1/2W

RIFXD NET FLM 2.61K OHM 1% 1/2W

RIFXD NET FLM 31.6K CHM 13 1/2W

RIFXD NET FLM 1000 CHM 18 1/2W

R:FXD HET OX 2700 DHM 58 1/2W

CONNIPC 24 CONTACTS

TRANSI STOR: GERMAN JUN PNP

TRANSISTOR: GERMANIUM PNP

TRANSISTOR: GERMAN JUH PNP

TRANSISTOR: PNP GERMANIUM

TRANSISTOR: GERMANIUM PNP

TRANSISTOR: GERMAN IUM PNP

TRANSISTOR: GERMAN LUM NPN

TRANSISTOR: GERMAN LUM NPN

TRANSISTORIGERMAN JUM NPN

DIODE:SILICON LOOWY LOOMA

DIQUE BREAKDUWN:2.67V

AUTORANGE RATE DETECTOR

AUTORANGE RATE DETECTOR

CHOKE/CUILIFXD 1 MH 108

COLLIFXD RF 100 UH 5%

TRANSFURMERIPULSE

TRANSFURMERIPULSE

RANGE GATE

RANGE LUUNTER RANGE CONTRUL

DIODE:SILICON 50 VOLTS WORKING

RIVAR MU 200 UHM 105 LIN 1/4W

DIODE:GERMANIUM LOOMA AT 0.85V 60PIV

DIODE:SILICUN

R:FXD CARBON FLM 2.6K OHM 18 1/2W

RIFXD CARBUN FLM 31.6K OHM 11 1/2W

RIFXD CARBON FLM 1.1 MEGOHM 15 1/2W

RIFXD CARBON FLM 1.21 MEGOHM 18 1/2W

RIFXD NET FLM 66K OHM 18 1/2W

R:FXD DEPC 1000 DHM 18 1/2W

RIFXD CONP 180 UHM 5% 1W

RIFXD COMP 3.9K UHM 5% 1W

RIFXD COMP 12K UHN 5% 1/2W

OPTION 31

Parts

Mfr. Part No.

(Cont'd)

Mfr.

01121

01121

28480

19701

28480

28480

28480

28480

19701

28480

28480

28480

02735

28480

01295

01295

03508

02735

01295

01295

01295

28480

03877

28480

28480

28480

28480

26480

04404

04404

04404

04404

04404

28480

99848

28480

4

19701 NF7C

01121 CB 9125

01121 EB 1035

01121 E8 1045

01121 E8 1235

01121 EB 4325

01121 EB 7525

01121 G8 1815

01121 68 3925

E8 5125

EB 5425

0698-0024

MF7C T-0

0698-3419

0727-0751

0727-0765

0727-0792

0757-0159

0754-0004

1251-0332

1850-0040

28404

2N404A

2N3988

2N1926

2N388A

2N1605

2N1605A

10016

1901-0025

1901-0081

1902-0022

1910-0016

2100-0369

5060-2577

5060-3684

5060-37.85

5060-3831

5060-5021

5040-5878 VIGo-1221 31000-15-102

9140-0210

18

38339

NF 7C

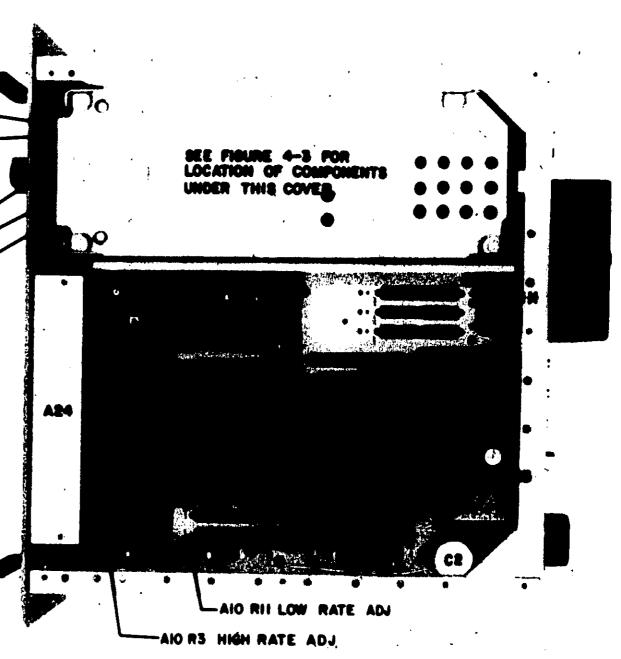
R62-

SI RANGE	
R6I*	•
T5*	•

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31-22

Section 31



SUPPLIED WITH HP 24108 AC/OHMS CONVERTER. ** SEE INSET ON FIGURE 4-3 FOR LOCATION OF QI ON SERIAL PREFIX 610- AND EARLIER

# Figure 31-2. Top Internal View of HP 2401C-31

Section 31

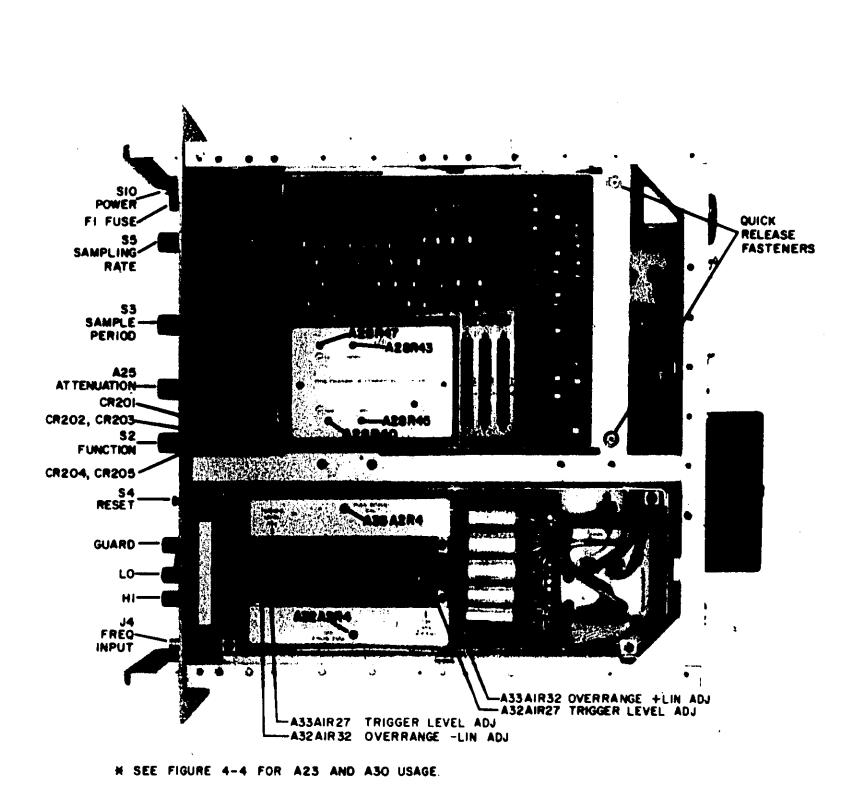
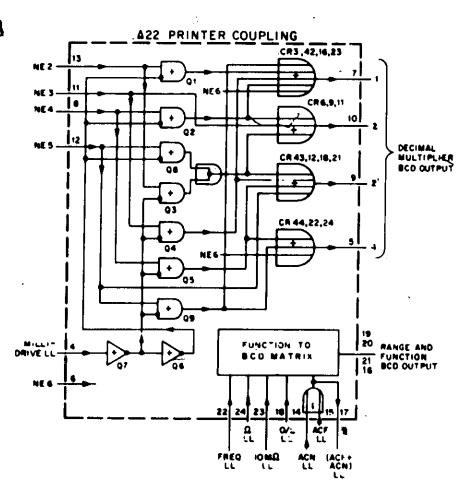


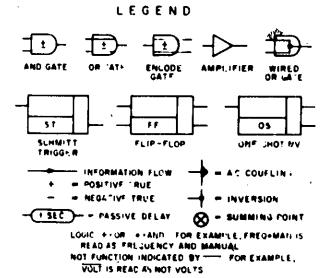
Figure 31-3. Bottom Internal View of HP 2401C-31

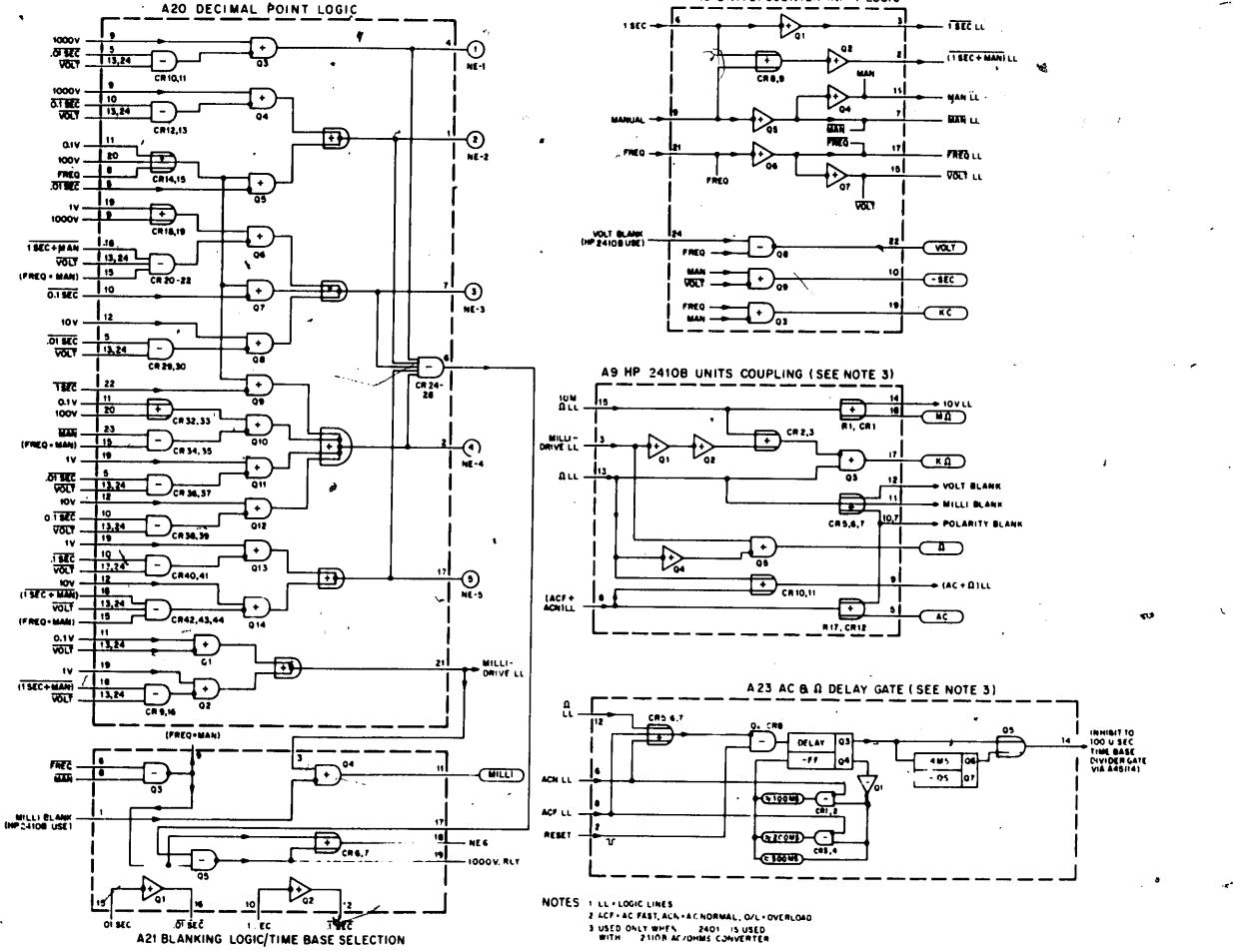




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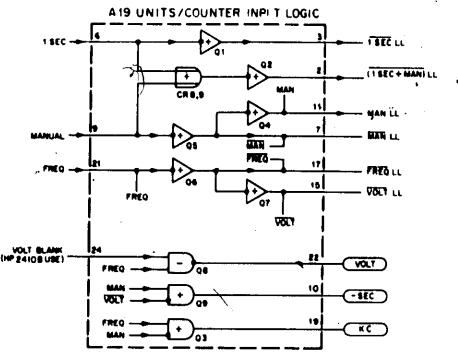




09950-1563(SHEET Z)

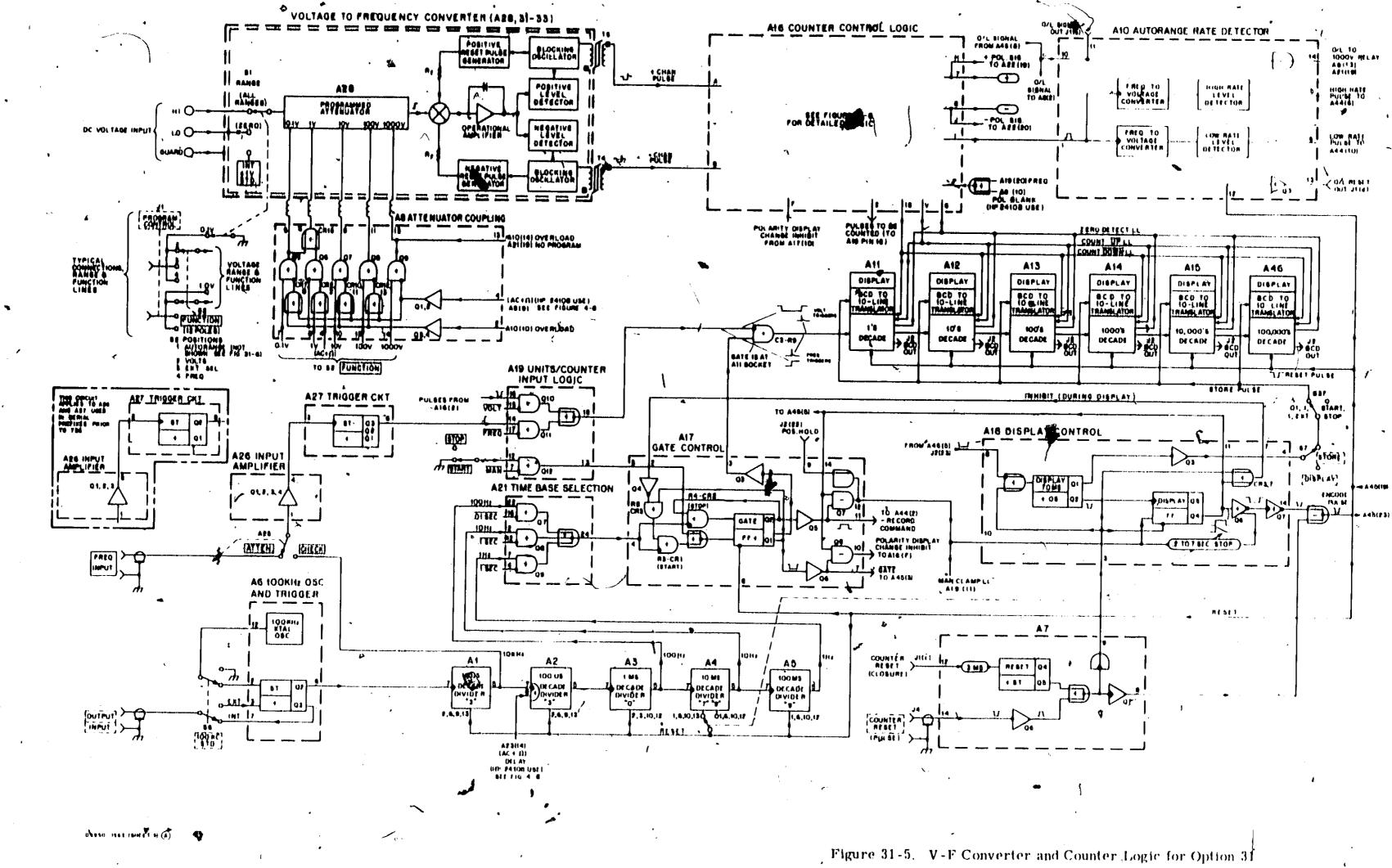
5. YBS 2





# Figure 31-4. Decimal Point and Control Logic for Option 31

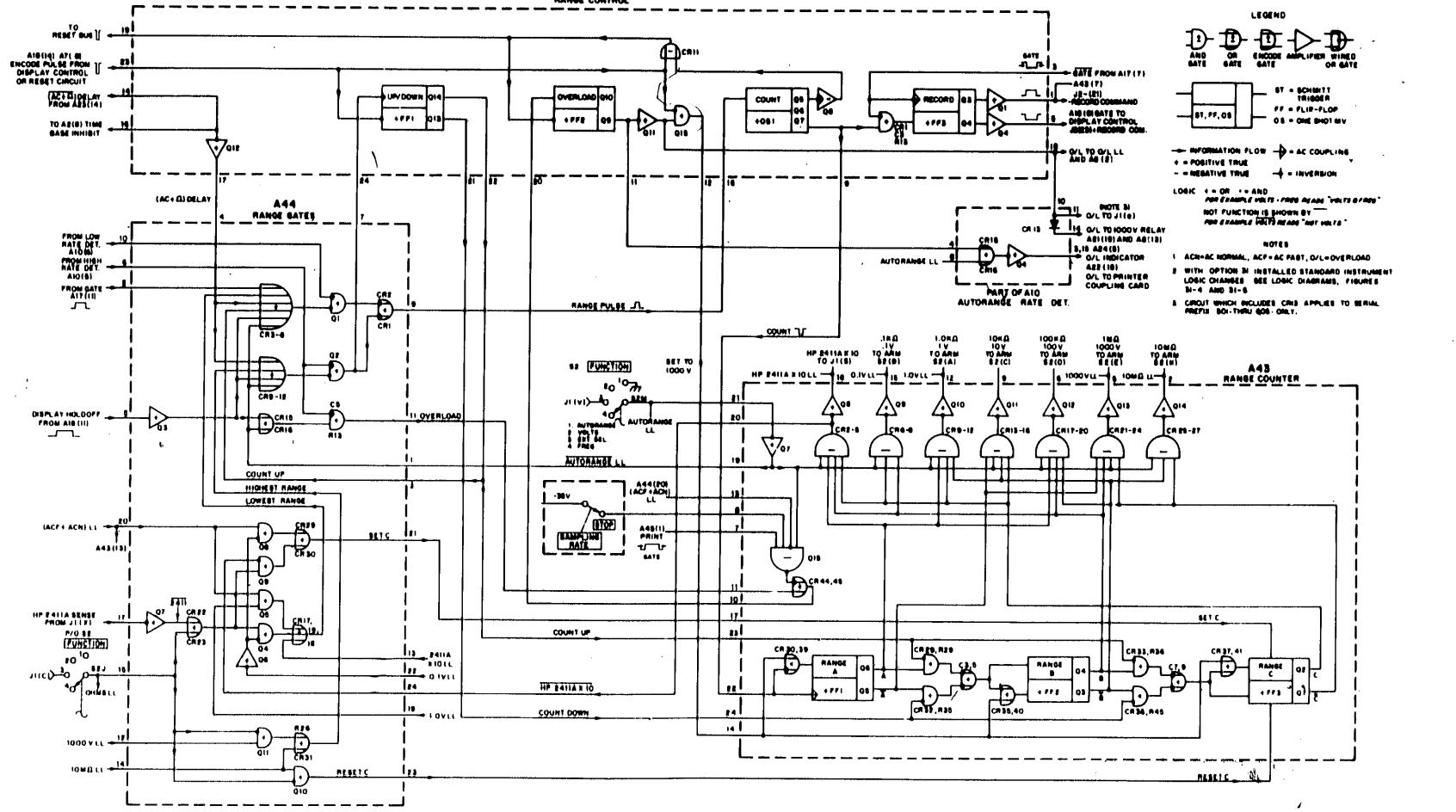
Section 31



2401C



A45 RANGE CONTROL



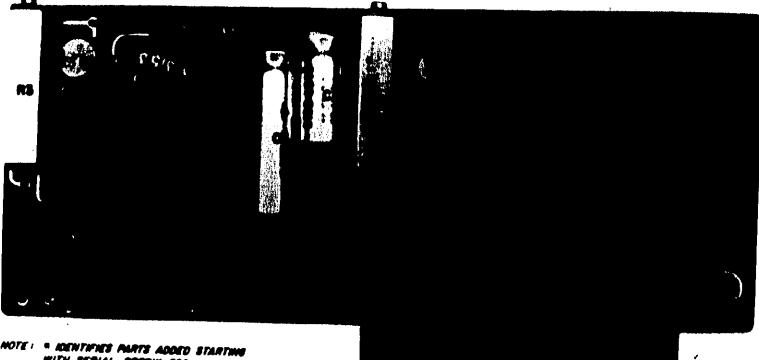
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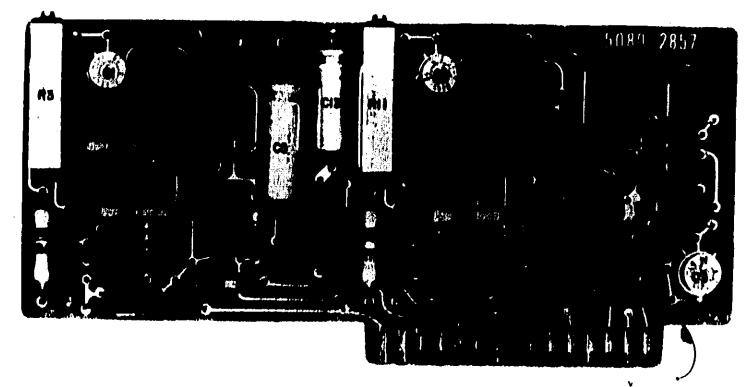
Figure 31-6. Autorange Logic for Option 31





NOTE: " DENTWHES PARTS ADDED STARTING WITH BERIAL PREFIX ERG-"" IDENTIFIES PART DELETED STARTING WITH BERIAL PREFIX OVO-.

Stock No. 5060-5021 (Serial Prefix 501 thru 605)



Stock No. 5060-5878 (Serial Prefix 610 and above)

(A10) Autorange Rate Detector for Option 31

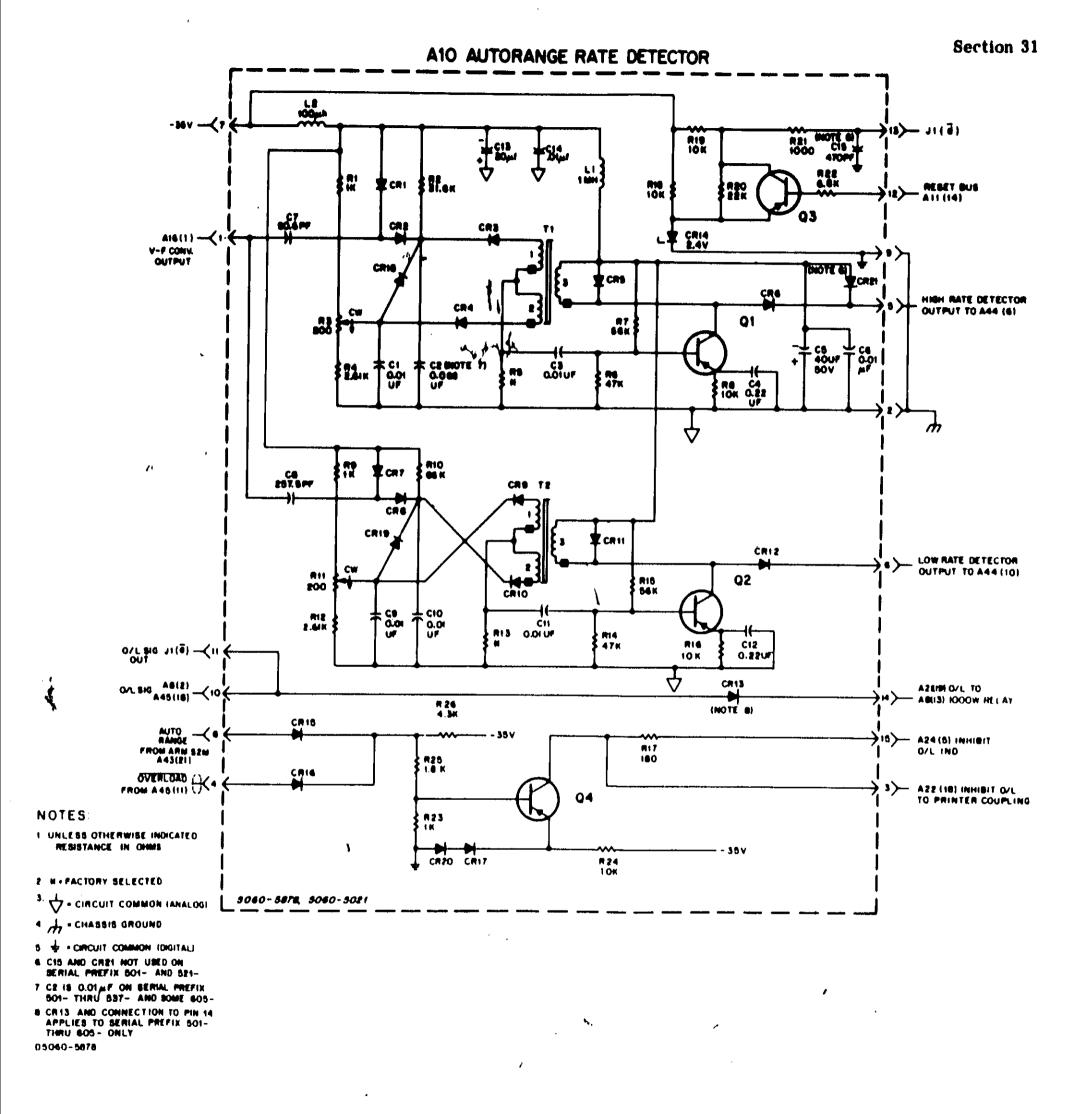


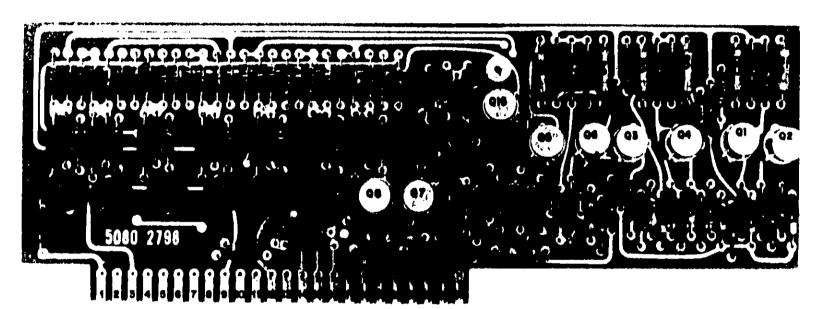
Figure 31-7. Autorange Rate Detector (A10) for Option 31

i.









Stock No. 5060-3785

(A43) Range Counter for Option 31

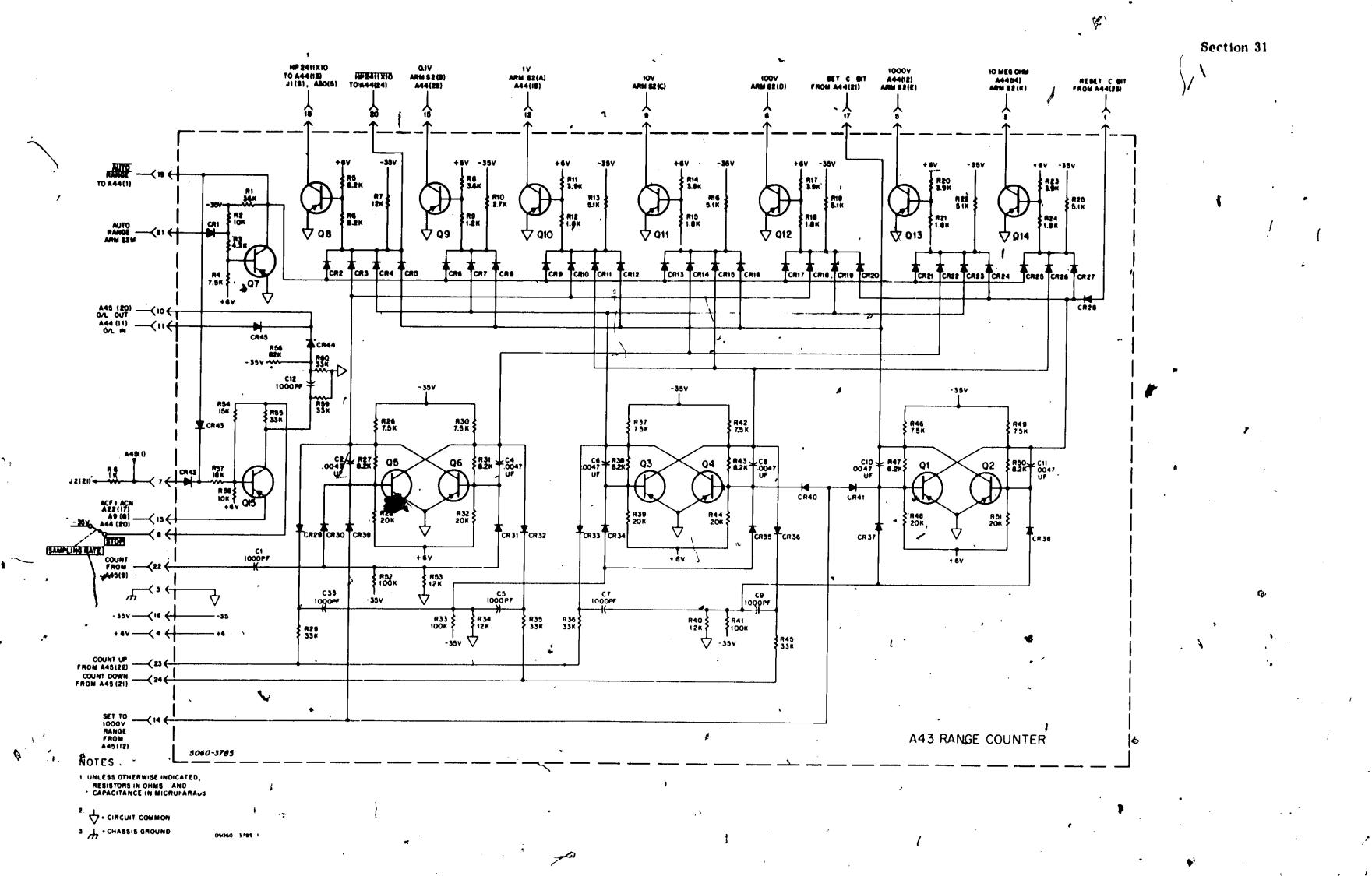
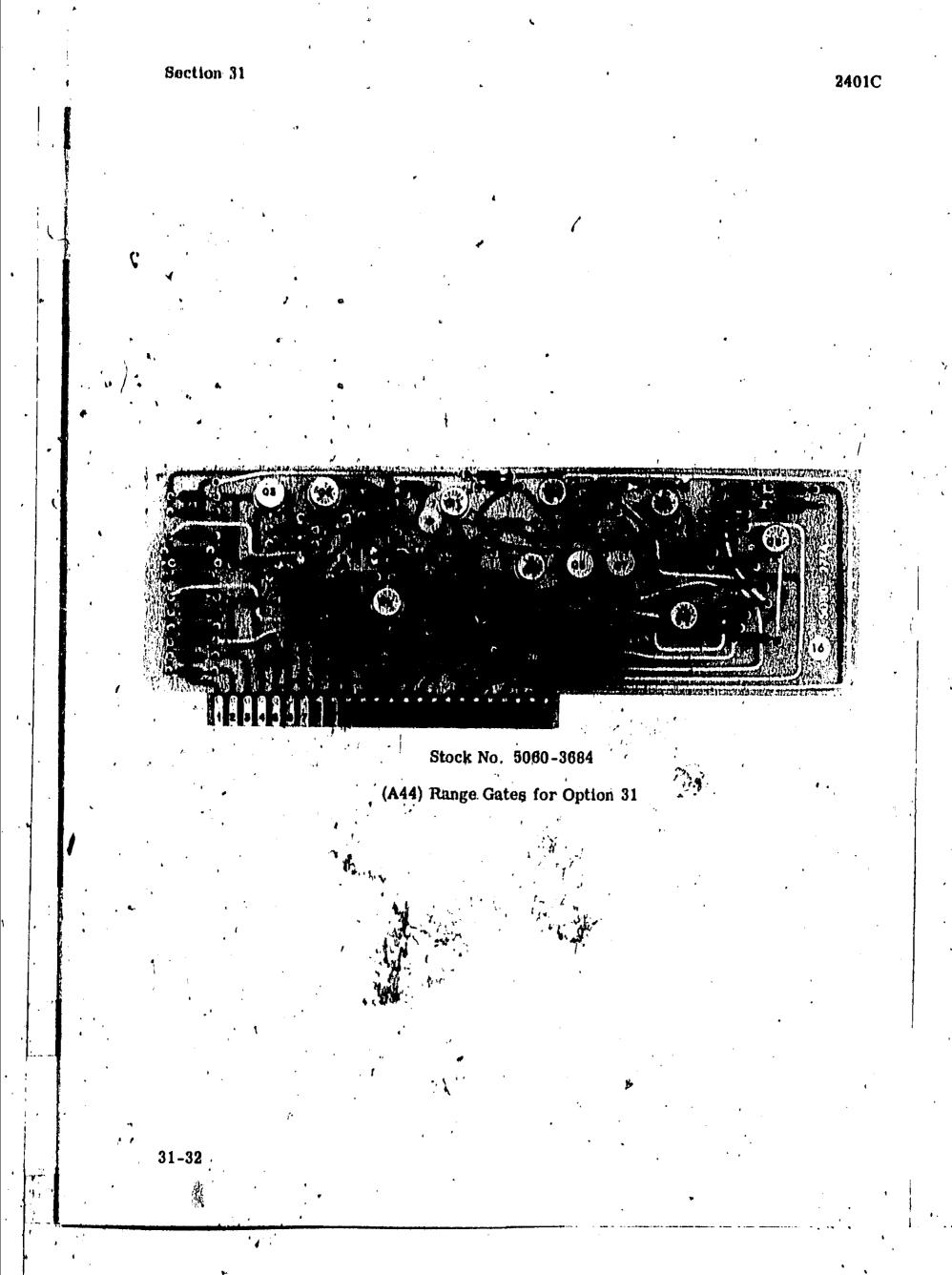


Figure 31-8. Range Counter (A43) for Option 31

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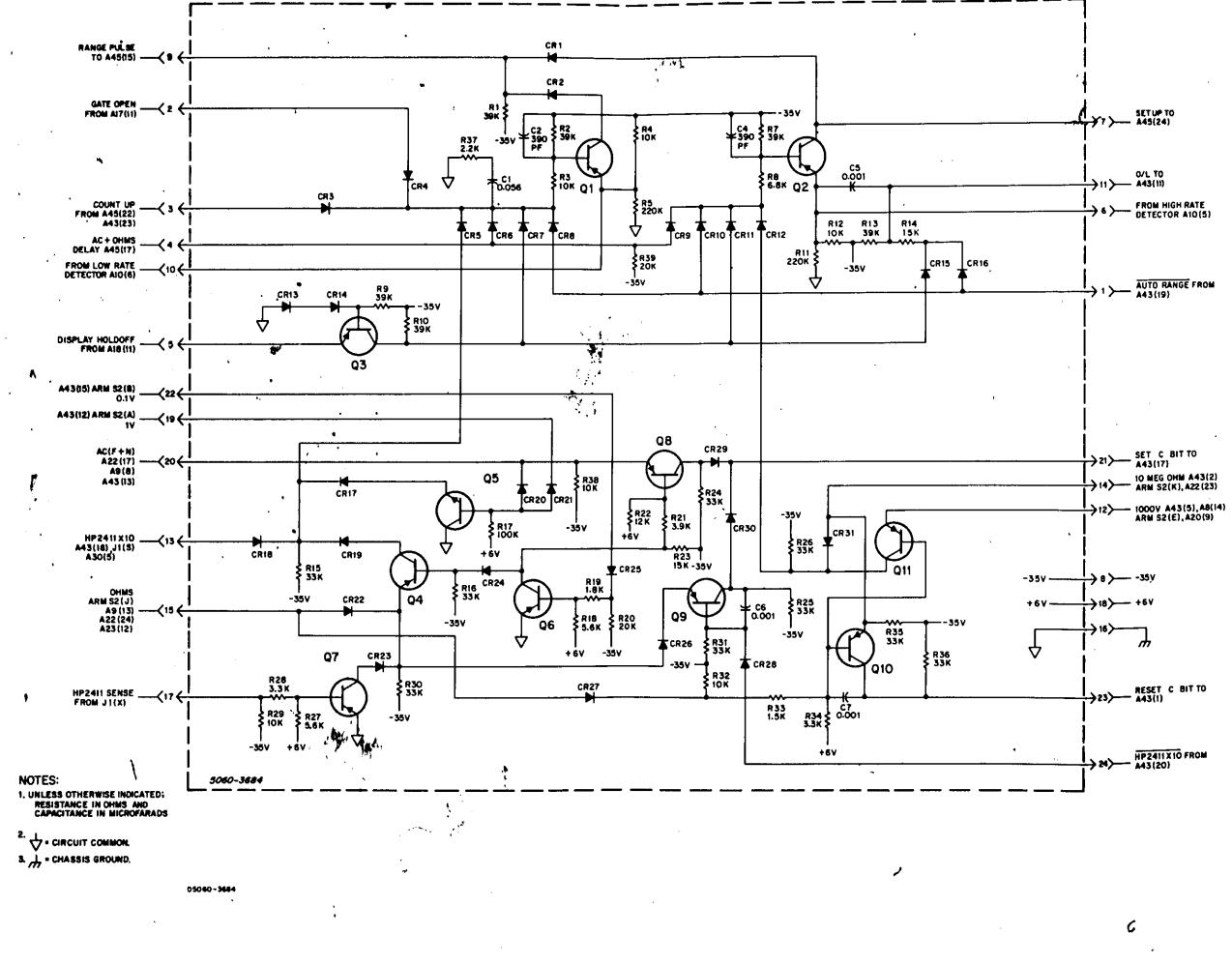


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A44 RANGE GATES



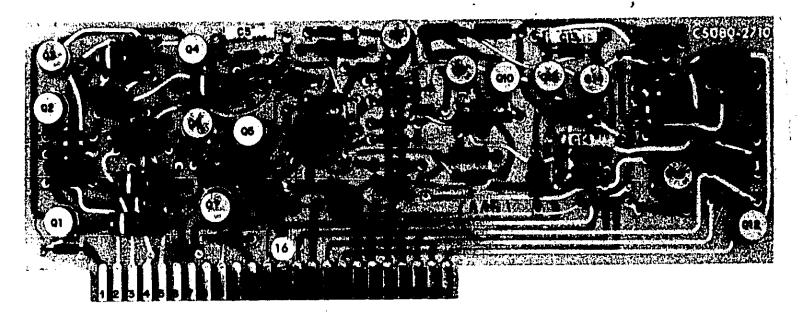
### Section 31

Figure 31-9. Range Gates (A44) for Option 31

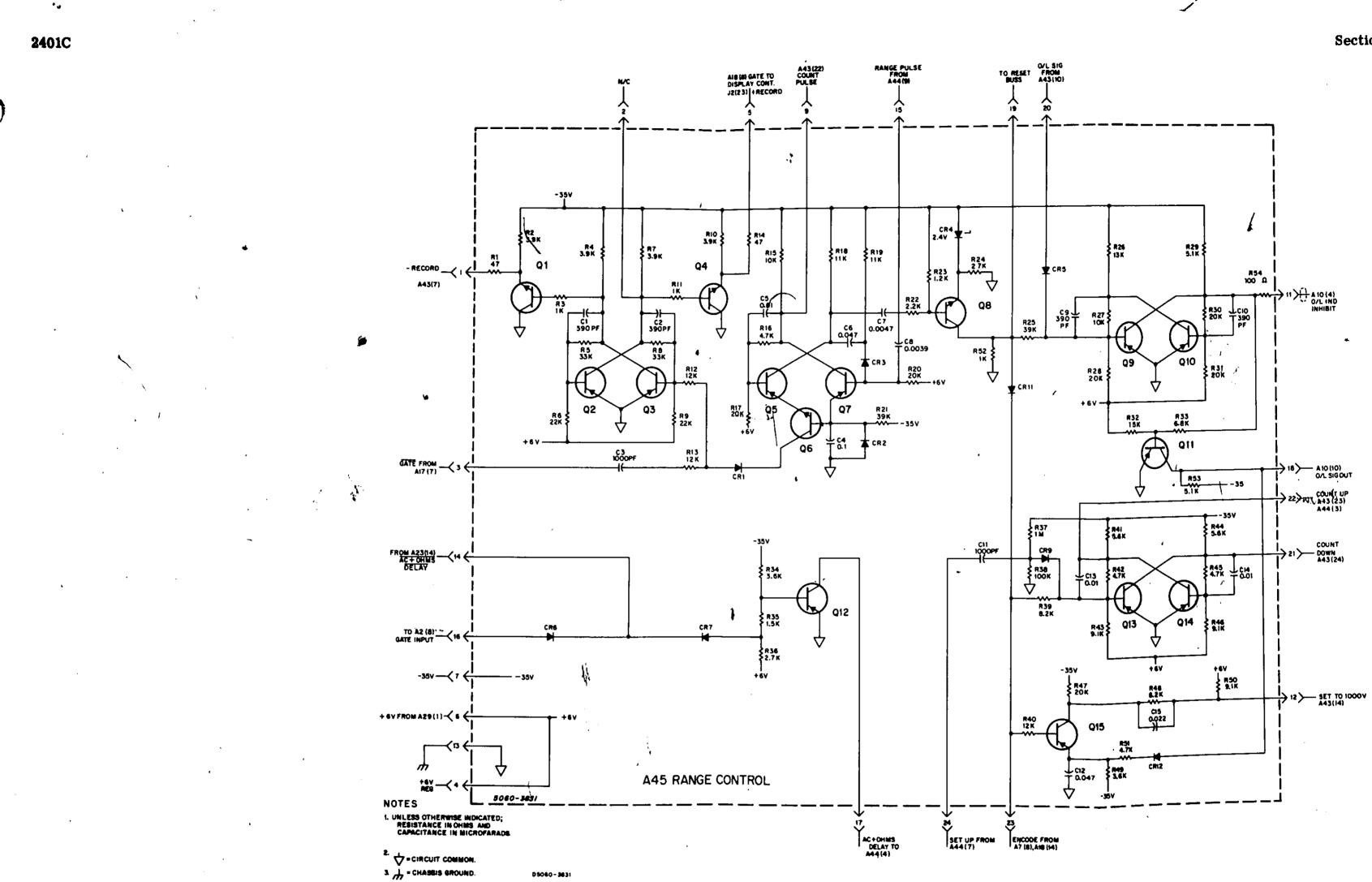
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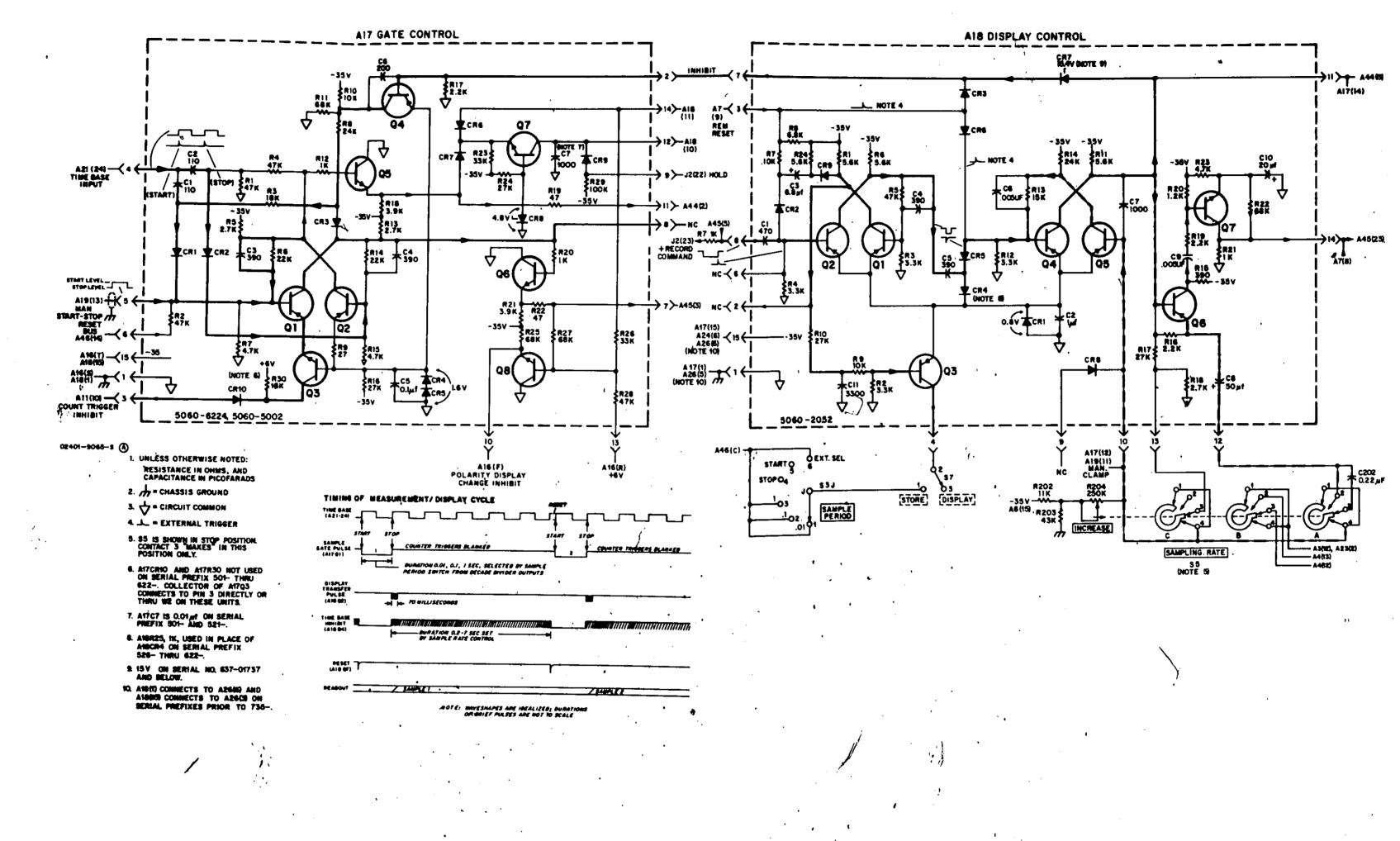
Stock No. 5060-3831 (A45) Range Control for Option 31



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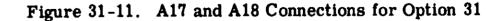
Section 31

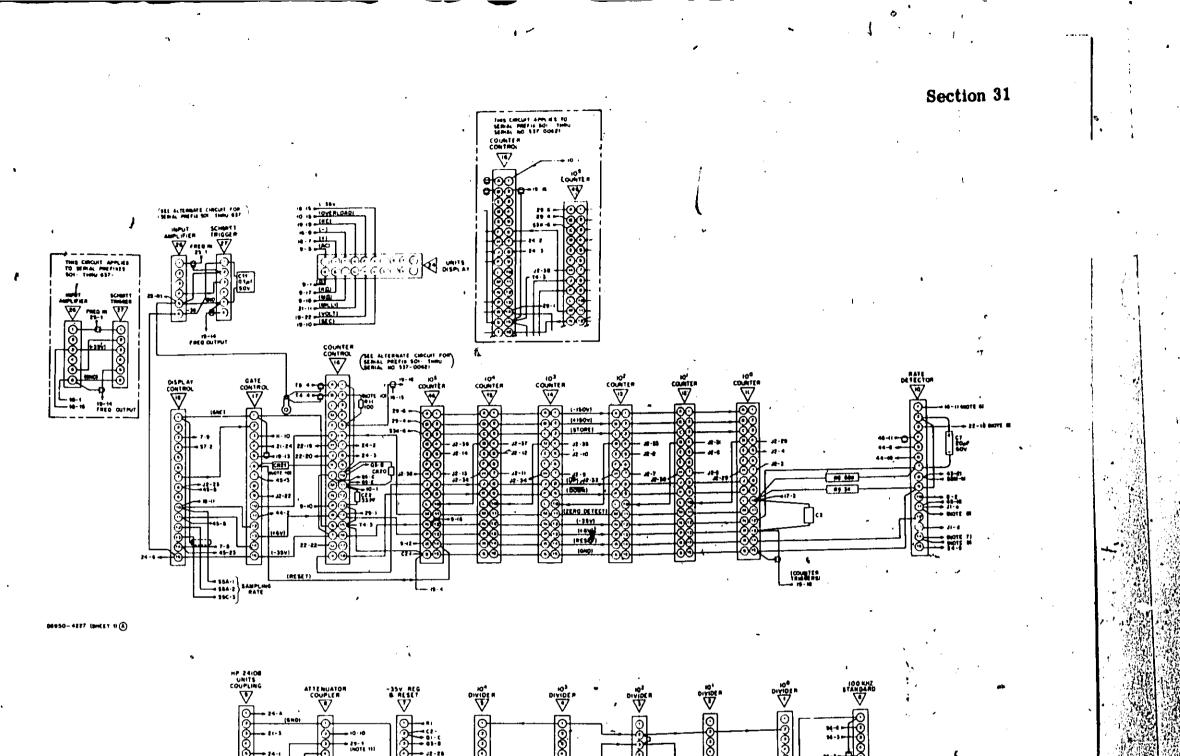
Figure 31-10. Range Control (A45) for Option 31

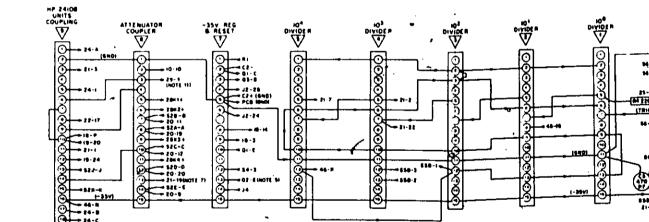


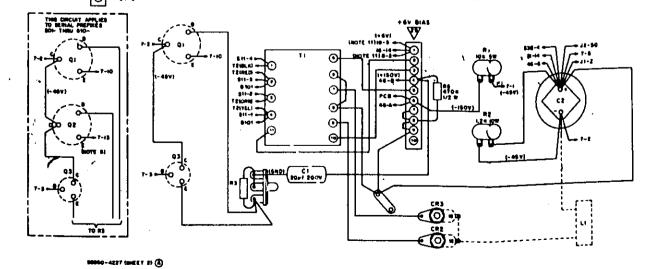
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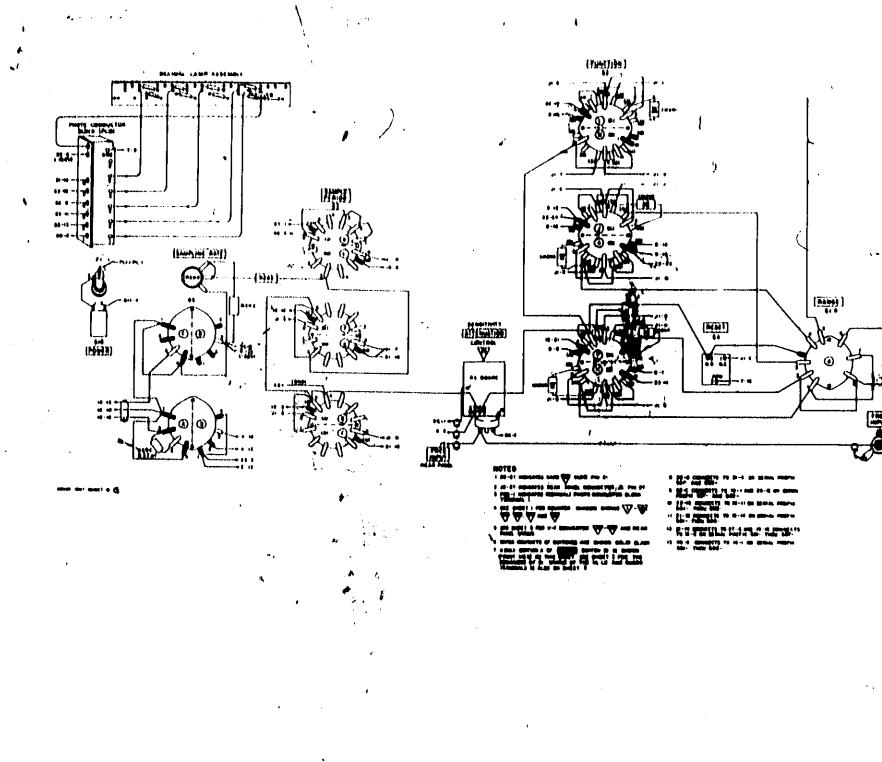


NOTES:

8-3 CONNECTS TO 10-8 AND 28-1 C ON BERAL PREFIL BOS- THRU 605-

Figure 31-12. Interconnections for Option 31 (Sheet 1 of 3)

31-37



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Section 31

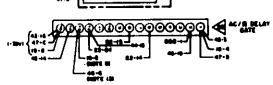
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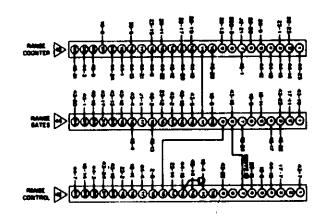
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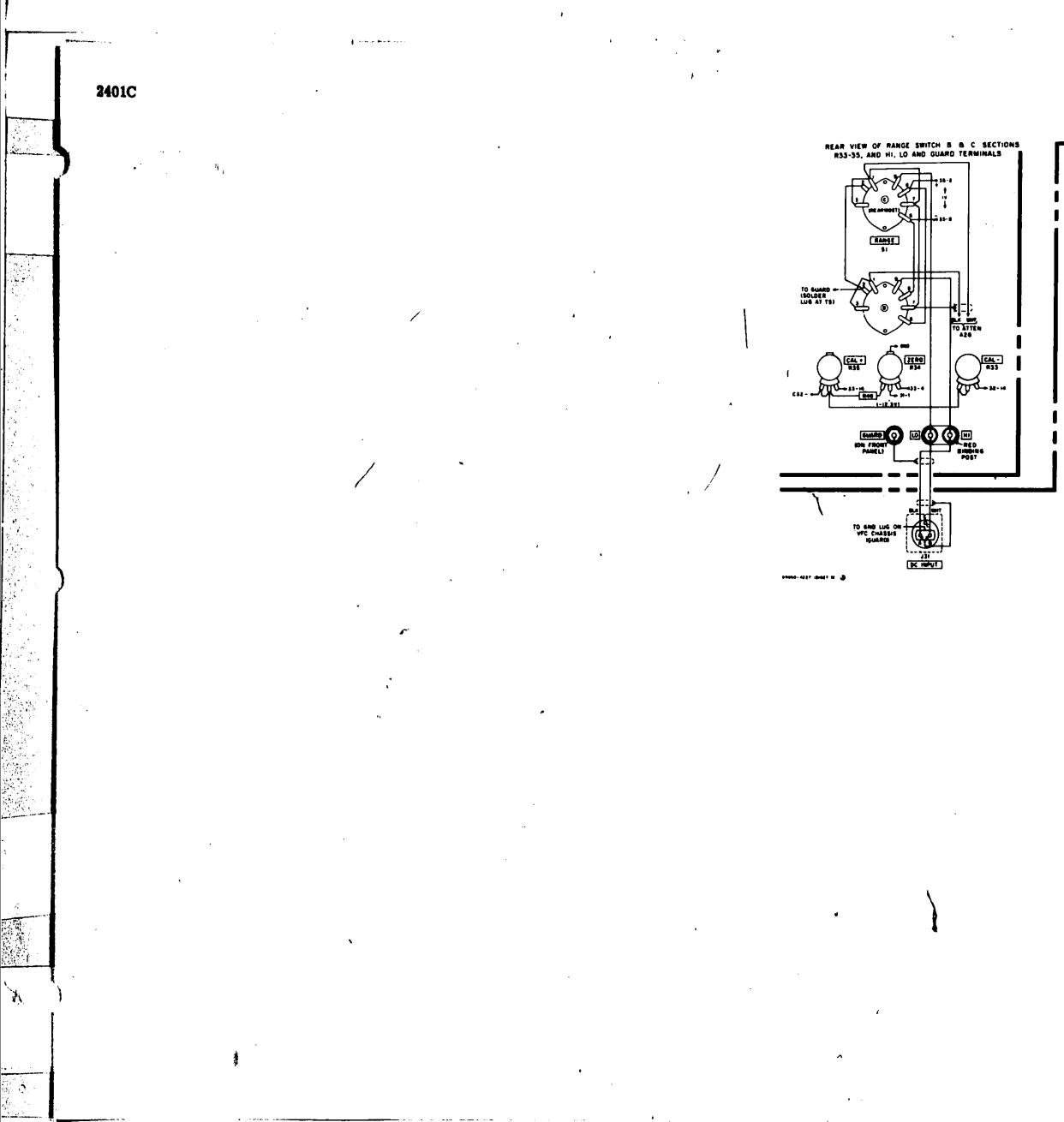
Figure 31-12. Interconnections for Option 31 (Sheet 2 of 3)

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Section 31

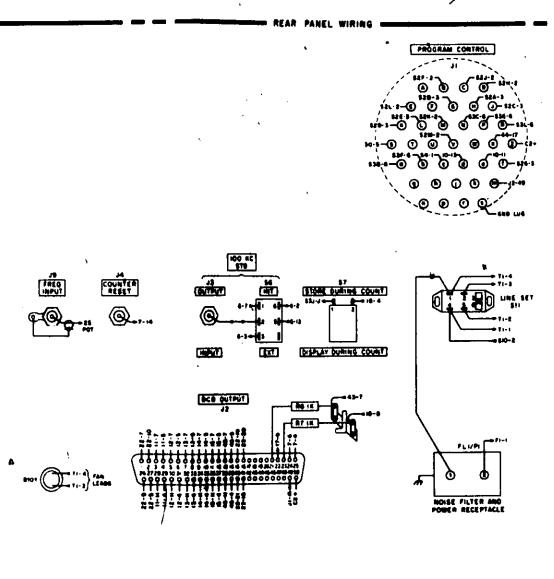


Figure 31-12. Interconnections for Option 31 (Sheet 3 of 3)

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#### MANUAL SUPPLEMENT

### MODEL HP-2401C Integrating Digital Voltmeter Option 35

#### 35.1 GENERAL DESCRIPTION

The HP-2401C-35 Integrating Digital Voltmeter provides negative true recorder outputs in 8-4-2-1 binary code instead of the positive true 4-2'-2-1code provided by the standard HP-2401C recorder outputs. (See Tables 2-4 and 35-1.) Except for this difference in coding, the Specifications in Section 1.7 of this manual apply without change to the HP-2401C-35.

#### 35.2 INSTALLATION AND OPERATION

Install, operate, and program the HP-2401C-35 as specified in Section II of this manual.

#### 35.2 THEORY OF OPERATION

The theory of operation of the HP-2401C-35 is the same as that of the standard HP-2401C except as noted in the following paragraphs:

#### 35.3.1 Printer Coupling Logic A22 (Figure 35-1)

The logic and circuitry shown in Figure 35-1 converts decimal and function inputs to negative true 8-4-2-1 BCD outputs for recording. The decimal  $10^{-n}$  and function numbers from this assembly are identical to those from a standard printer coupling logic assembly, but they are in -8-4-2-1 code instead of 4-2'-2-1 code. Logic inverters Q17 through Q20 produce the negative true function outputs in response to positive true inputs from the function-to-BCD matrix.

#### 35.3.2 Change to Counter Control A16 (Figures 4-18 and 35-1)

Diodes CR8 and CR9, which connect A16 (H) and (J) to J2 (15) and (16), replace diodes A16CR6 and A16CR5. A16CR5 and A16CR6 are replaced by A16W1 and A16W2 as shown on Figure 35-1.

#### 35.3.3 Reversible Decade Counters All-Al5 and A46 (Figure 35-2)

The decade counter shown in Figure 35-2 differs from that shown in Figure 4-17 only in the arrangement of feedback and the transistors from which the BCD outputs are taken. The negative true outputs are taken from the collectors of the odd numbered transistors (Q1, Q3, Q5, Q7). The waveforms associated with forward and backward counting of the HP-2401C-35 decades are shown in the circuit diagram, Figure 35-2.

The decades always count up during frequency measurements and during the first phase of voltage measurements. Up counting is enabled when the count down line is clamped to ground (positive true) and the count up line is near  $^{\prime\prime}$  -35v. Both of these signals are provided by Counter Control Logic on A16.

These states close the down count AND gates and open the up count AND gates. Positive triggers are coupled from the collectors of odd-numbered transistors (Q1, 3, 5, 7) to succeeding stages. Each trigger advances the count by one. When the count is advanced from nine to zero, the turn-on of Q7 generates a trigger that increases by one the count in the next decade, and so on through all six counting units. The up count progression is:

Up Count	Odd-Numbered Transistors Off	BCD Output Table
0	None	0
1	Q1	1
2	Q3	2
3	Q1, Q3	1 + 2
4	Q5	4
5	Q1, Q5	1 + 4
6	Q3, Q5	2 + 4
7	Q1, Q3, Q5	1 + 2 + 4
8	<b>Q</b> 1	8
9	Q1, Q7	1 + 8
10	None	0 + Trigger to Next Decade

At the forward count of 8, conduction through Q8 and CR20 inhibits triggering of Q3-Q4 by Q1, assuring that Q3-Q4 and Q5-Q6 remain in zero state (Q3 and Q5 on) when the count of 10 resets Q1-Q2 to zero state. The resetting of Q1-Q2 to zero state also resets Q7-Q8 to zero state through forward count AND diode CR13 and OR diode CR21.

Down counting is commanded by the Counter Control Logic on A16 when the polarity of the input voltage reverses. This is enabled by the positive-true state of the count up line, which closes the up count AND gates and the negative-true state (near -35v) of the count down line, which opens the down count AND gates. Positive triggers are then coupled from the collectors of even-numbered transistors to succeeding stages. The count progression is exactly the reverse of the up count progression, which is summarized above. Starting from the zero state, the first reverse count trigger sets binary Q1-Q2, triggering binaries Q3-Q4, Q5-Q6, and Q7-Q8 to set state through reverse count AND diodes, CR14, CR16, CR18. Turn on of Q8 triggers binaries Q3-Q4 and Q5-Q6 back to zero state, leaving Q1 and Q7 off, representing a 9 count. The next trigger sets Q1-Q2 to zero state, reducing the count to 8. The third trigger sets Q1, Q3, and Q5 off, which resets Q7-Q8 to zero state, establishing the count of 7. The remaining triggers continue subtraction is indicated so long as the reverse count is enabled. Each time a trigger sets the decade from 0 to 9 during reverse counting, the turn on of Q8 triggers the next decade through reverse count AND diode CR22, reducing the count of the next decade by 1.

#### 35.4 MAINTENANCE

Figures 4-17, 4-23, 4-24 and 4-34, sheet 2,⁷⁷ are replaced by Figures 35-1 through 35-3. Performance checks 35.1 and 35.2 in Table 35-2 replace checks 15 and 16 in Table 4-3. Shorting links W1 and W2 replace CR5 and CR6 on Counter Control assembly A16. Otherwise, Section IV instructions of this manual apply without change to the HP-2401C-35.

				Lo	ģic	
Data	Function		8	4	2	1
0	Period (W	//30)	0	0	0	0
1	+VDC		0	0	0	1
2	-VDC		0	0	1	0
3	KC		0	0	1	1
4	KΩ (W/1		0	1	0	0
5	MΩ (W/1	HP-2410B)	0	1	0	1
6	Spare		0	1	1	0
7	Spare		0	1	1	1 0
8	Time	_	1	0	0	0
9	OVERLOA		1	0	0	1
	VAC (W/H	IP-2410B)	• 1	.0	1	۲ 
BCD Out	put Levels:	''1'' State -35 to -24V	-	ta nctic cima		• oint
•		''0'' State -5 to -1V		ta nctic cima		oint

Table 35-1. Function Codes

#### 35.5 PARTS LIST

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The Parts List in Section V of this manual applies to the HP 2401C-35 except as indicated in Tables 35-3 and 35-4.

35-3

Section 35

Perform checks 1 through 14 and 17 through 24 as specified in Table 4-3 and Section 4.2.

**35.1 RECORDING OUTPUTS - BCD FUNCTION** 1 digit. 4-line 8-4-2-1 code. "1" state level, -35 to -24.5V; "0" state level, -2.5 to 0V. Source impedance, 33K. Determine and record dc function levels at the following pins of J2: 2. 16 J2 Pin 41 40 - 15 Control Settings Function Code 8 <u>4</u> 3 1 VOLTS, INT+1V +VDC 0 0 0 1 VOLTS, INT-1V -VDC 0 0 0 1 FREQ KC 0 0 1 1 EXT SEL, 1V (W/HP-2410B)KΩ 0° 1 0 Û EXT SEL, 1V MΩ (W/HP-2410B) 0 1 0 1 VOLTS, 1V* OVERLOAD 1 0 0 1 EXT SEL, IV VAC (W/HP-2410B) 1 0 1 1 *W/dc input sufficient to produce OVERLOAD indication. The source impedance is determined by fixed value 33K resistors, which can be seen b. in the assembly A22 circuit diagram, Figure 35-1. 1 1 **RECORDING OUTPUTS - BCD DECIMAL POINT** 35.2 Specifications same as for 35.1. Set HP-2401C FUNCTION switch to VOLT, other controls as specified below; deter-8. mine and record dc decimal levels at the following pins of J2; short-circuit HI, LO, and GUARD terminals to assure all zeros reading. J2 Pin 27 26 2 1 Code Range Sample Period **Decimal Position** 8 4 2 1 1000V .01 Sec 000000. V 0 0 0 0 (10-0) 1000V 1 (10-1) 0,1 Sec 00000.0V 0 0 0 100V 0 (10-2) 0.1 Sec 0000,00V 0 0 1 10V 0.1 Sec 000,000V 0 0 1  $1(10^{-3})$ 17 0 (10-4) 0.1 Sec 00.0000V 0 1 0 . 17  $1(10^{-5})$ 0.1.Sec 0000.00MV 0 1 0 .17 1.0 Sec 000,000MV  $0(10^{-6})$ Ö 1 1 1 (10-7) . 17 1.0 Sec 00.0000MV** 0 1 1 **W/HP-2411A at +10 gain (10 MV full scale), FUNCTION at EXT SEL, Card A30 installed. Disconnect short from HI, LO, and GUARD terminals. Set HP-2401C FUNCTION switch b. to FREQ, ATTENUATION control just clockwise from switched CHECK position, other controls as specified below. Use DC Null Voltmeter to check decimal levels at the following pins of J2: J2 Pin 27 26 2 1 Sample Period **Decimal Position** Code 2 8 1 4 00000.0KC .01 Sec 0 0 0 1 (10-1) 0.1 Sec 0000.00KC · 0 0 1 0 (10-2) 1.0 Sec 000.000KC 0 0 1  $1(10^{-3})$ STOP 000000 1 0 1 1 C. The source impedance is determined by fixed value 38K resistors, which can be seen in the assembly A22 circuit diagram, Figure 35-1,

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HP-2401C PERFORMANCE CHECK TEST CARD SER. DATE CHECK RESULTS DESCRIPTION 35.1 RECORDING OUTPUTS -BCD FUNCTION **Outputs Correct At J2 Pins** <u>41 40 16 15</u> Function: +VDC 0 0 1 24 Q ? -VDC 0 0 Ø 1 KC 0 0 1 1 ? * KO 0 0 ? 0 1 ? MΩ 0 1 0 1 ? OVERLOAD 0 0 1 1 . ? VAC 1 0 1 1 (yes) 35.2 RECORDING OUTPUTS -BCD DECIMAL POINT **Outputs Correct At J2 Pins** <u>26</u> <u>2</u> Display: 27 1 000000, V 0 0 ? 0 0 00000, 0V ? 0 0 0 1 0000.00V 1 0 ? 0 0 ? 000,000V 0 0 1 1 ? 00,0000V 0 1 0 0 0000,00MV ? 0 1 0 1 000,000MV 0 1 0 ? 1 00.0000MV 0 ? 1 1 1 ?¹ 00000, 0KC 0 0 0 1 0000,00KC 1 0 ? 0 0 000,000KC ? 1 1 0 0 ? 000000 1 1 1 0 (yes)

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"0" = -2.5 to 0V DC. "1" = -35 to -24.5V DC.

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Section 35

Table 35-3. Reference Designation Index (Cont'd)

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Reference Designation	\varTheta Part No.	Description #	Note
	•	OPTION 36	r
•		A11 5060-5644	-
		MAKE THE FOLLOWING CHANGES TO TABLE 5-1 TO MAKE THE TABLE APPLICABLE TO THE HP2401C-35.	•
		DELETE THE FOLLOWING:	
A11- A15 A22 A46	5060-3781 5060-2111 5060-5610 5060-3781	REVERSIBLE DECADE COUNTER Logic Card Logic Card Reversible decade counter	A-E F-X
		ADD THE FOLLOWING:	
A11- A15 A22 A46	5060-5644 5060-5612 5060-5644	REVERSIBLE DECADE COUNTER PRINTER COUPLING LOGIÇ REVERSIBLE DECADE COUNTER	
CR1	1901-0025	DIODE: SILICON 100WV 100MA	
CR4- CR11	1901-0025	DICRESSILICON LOOWA LOOMA	
,		CR5 IS NOT USED FOR HP2401C-30/35.	
A11 1	5080-5644	REVERSIBLE DECADE DIVIDER	
A11A1	NSR	READOUT BLOCK ASSY	
A11C1- A11C4	0140-0195'	CEFXD NICA 130 PF 58, 300 VDCN	
A11C7 A11C8 A11C9 A11C10 A11C11	0140-0219 0140-0195 0140-0195 0140-0195 0140-0194 0140-0194		
A11C12 · A11C13 A11C14 A11C15	0140-0195 0140-0194 0140-0194 0140-0194	. C:FXD NICA 130 PF 5% 300 VDCW C:FXD NICA 110 PF 5% C:FXD NICA 110 PF 5% C:FXD NICA 110 PF 5% C:FXD NICA 110 PF 5%	
A11C16 A11C17	0140-0194	G:FXD NICA 110 PF 58 G:FXD NICA 110 PF 58	
A11C18	0140-0194	CIFXD MICA 110 PF 58	
AllCR1- AllCR8	1901-0025	DIQUEISILICON 100WV 100NA	
A11CR9- A11CR24	1901-0081	DIODE:SILICON 50 VOLTS WORKING	
A11CR26- A11CR34	1901-0081	DIODE:SILICON 50 VOLTS WORKING	
A1101- A1108	یر 1850-0184	TRANSISTOR: GERMANIUM PNP	
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**Begtion 35** 

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Table 35-3. Reference Designition Index (Cont'd)

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Reference Designation	👍 Part No.	Description #	N
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		OPTION 36 A11 6060-6644 (CONT'D)	
		HIFKD CONP 390K 0HM 58 174M	
ALIRI	0683-3949	KIEKD COME BACK MAN DE LAAM	
A1182	0683-5635	REFXD COMP 56K DHMS 58 174W	
ALIRS	0683-5635	REFXD COMP 36K OHMS 5% 1/4W	
ALIRA	0683-1045	HIFXD COMP LOOK OHMS 5% 1/4W	
ALLR5	0683-3945	RIFXD CONP 390K DHM 58 1/4W	
A11R6	Q683-5635	RIFXD COMP 56K OHNS 5% 1/4W	
	0683-5635	RIFXD COMP 56K DHMS 58 1/4W	
A1187 A1186	0683-1045	RIFXD CONP LOOK OHNS 5% 1/4W	
GALLR9	0683-3945	RIFXD CONP 390K OHM 58 1/4W	
ALIR10	0683-5635	RIFXD COMP 56K OHNS 5% 1/4W	
ALIRII	0683-5635	NIFXD CONP 56K OHNS ST 144W	
		REFEAD CONP LOOK OHNS 5% 1/4W	
A11812	0683-1045 0683-3945	RIFXD COMP 390K CHN 58 1/4W	
A11R13 A11R14	0683-5635	RIFED CUNP S6K OHMS SE 1/4W	
ALIRIS	0683-5635	RIFXD CONP 56K OHNS 58 1/4W	
ALLR16	0603-1045	REFXD COMP LOOK OHMS 54 1/4W	
	<b>-</b>	REFXD CONP 22K OHN 5% 1/4W	
A11817	0683-2235	RIFRD CONP 22K OHN 58 1/4W	
A11R18 A11R19	0683-2235 0683-2235	RIFXD COMP 22K CHM 58 1/4W	
A11R20	0683-2235	RIFXD CONP 22K OHN:58 1/4M	
A11821	0603-2235	RIFXD CONP 22K ONN 5% 1/4W	
HER22	0683-2235	REFXD CONP 22K OHN 5% 1/4M REFXD CONP 22K OHN 5% 1/4M	•
A11R23	0683-2235	RIFRD COMP 22K OHN 54 1/4W	
A11R24 A11R25	0683-6835 0683-2235	RIFXD CONP 22K OHN 58 1/4W	
A11R26	0683-1535	RIFXD COMP 15K OHN 54_1/4W	
A11R27	0686-5625	REFXD CONP 5600 OHN 58 1/2W	
A11R28	0686-5625	RIFXD COMP 5600 OHM 58 1/2W RIFXD COMP 5600 OHM 58 1/2W	
A11R29	0686-5625 0686-5625	RIFXD CONP 5600 CHN 58 1/2W	
A11R30 A11R31	0683-6835	KIFXD CONP 68K OHN 58 1/4W	
A CLASS	0009 0009		
A11832	0686-5625	RIFXD CONP 5600 DHH 58 1/2W	
A11833	0686-5625	RIFXD COMP 5600 OHN 58 1/2W	
A11834	0683-6835	AIÈXD CONP\66K OHN 58 1/4W AIFXD CONP 66K OHN 58 1/4W	
A11R35 A11R36	0683-6835 0686-5625	RIFKD CONP 5600 OHN 58 1/2W	
ATTER			
A11837	0686-5625	RIFXD COMP 5600 OHN 58 1/2W	
A11R36	0683-6835	RIFXD COMP 68K OHN 58 1/4W	
A11R39-+		REFXD COMP 27K DHM 58 1/4W	
AliR46	0683-2735 0683-3335	RIFXD COMP 33K OHM 58 1/4W	
ALIR47	0005-5555		
ALLR48	0683-2235	RIFKO CONP. 228 OHM 58 1/44	ł
A11R49	0683-2235	RIFXD CONP 22K OHM 5% L/4W	1
A11R50	0683-3335	RIFXD CONP 33K OHN 5% 1/4M Rifxd Conp 3000 ohn 5% 1/4W	
A11851	0683-3025	RIFKO COMP 3000 OHN 54 174W RIFKO COMP 33K OHN 54 174W	
A11R52 -	0683-3335		
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Table 35-3. Reference Designation Index (Cont'd)

Note		Le erence Designation	\varTheta Parl No.	, Description #	Ne
				OPTION 35 A11 6080-8644 (CONT'D) A12- A15 8080-8644 A22 8080-8612	
		A11853	0483-2235	RIFXD CONP 22K OHM 58 1/44	
		A11854	044 3-2235	RIFXD CONP 22K OHM 58 1/4H	
		A11855 A11856 '	0683-3335 0683-3025	R:FXD COMP 33K CHM 5% 1/4W R:FXD COMP 3000 CHM 5% 1/4W	
		A11857	0683-3335	RIFAD COMP 33K OHN 58 1/44	
	4	A11858	0483-2235	RIFXD CONF 22K OHM 58 1/4W RIFXD CONF 22K OHM 58 1/4W	
		A11859 A11860	0683-2235 0683-3335	RIFRD CONP 33K ONN SE 1/4	
		A11841	0683-3025	RIFED CONF 3000 ONN SE 1/4W	
		A11862	068.3-3025	RIFXD CONP 3000 CHM 58 1/44	14
		A11863	0483-3335	- RIFKD CONP 33K OHM 58 1/4H	
		AL1864 A11865	0683-2235 0683-2235	ALFXD COMP 22K CHM SE 1/4M RIFXD COMP 22K CHM SE 1/4M	
		A11846	0643-3335	RIFXD CONP 33K OHN SE 1/4M	
		A11867	0483-3025	R: FXD CONF 3000 OHN 53 1/4H	
i	• • •	A11848	0483-4835	RIFKD CONP 60K ONN SE 1/4W	
		ALIR69	0686-4735	R: FXD COMP 47K CMN 58 1/2W R: FXD COMP 3000 CMM 58 1/4M	
		ALLR70	0683-3025		
	•	A11V1	1970-0009	ELECTRON TUBE: INDICATOR 10 DIGIT	
•		` A12		SAME AS A11, USE PREFIX A12	
		× A13		SAME AS A11, USE PREFIX A13 0	
		A14		SAME AS A11, USE PREFIX A14	
1		A16		BAME AS A11, USE PREFIX A15	
		· <b>A22</b>	6060-8612	PRINTER COUPLINE LOUIC	
		AZZCR1	1901-0081	DIODEISILICON SO VOLTS HORKING	
		AZZCRZ	1901-0081	DIODEISILICON SO VOLTS WORKING	
		AZZCR3	1901-0081	DIODESSILICON SO VOLTS WORKING	
		A22CR4 A22CR5	1901-0081 1901-0081	DICORISILICON SO VOLTS WORKING	
		AZZCR7	1901-0041	DIODE:SILICON SO VOLTS WORKING	
		AZZCRO	1901-0081	DI DESSILICON 50 VOLTS WORKING	
1	1	AZZCALI	( 1901-0081	DI COE: SILICON SO VOLTS WORKING	
		AZZCR14	1901-0081 1901-0081	DIODE:SILICON SO VOLTS WORKING DIODE:SILICON SO VOLTS WORKING	
	1	A22CR15 A22CR17	1401-0081	DIODE: SILICON SO VOLTS WORKING	
		A22CR22	1901-0081	DIQUESSILICON SO VOLTS WORKING	
		AZZCRZ4	1901-0081	DIGDE:SILICON SO VOLTS WORKING ( DIGDE:SILICON SO VOLTS WORKING	
		AZZCR26	1901-0081 1901-0081	DIODEISILICON SO VOLTS WORKING	
		A22CR29	1901-0081	DIQUEISILICON SO VOLTS WORKING	
		AZZCRBO	1901-0081	DIDDE:SILICON SO VOLTS WORKING	
		A22CR31	1901-0081	DIODE:SILICON SO VOLTS WORKING	
ļ		A22CR32 A22CR33	1901-0081 1901-0081	DIODE:SILICON SO VOLTS WORKING DIODE:SILICON SO VOLTS WORKING	
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Table 35-3. Reference Designation Index (Cont'd)

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A22R13       0757-0946       R1FXD FLN 8.2K CHN 2% 1/6H         A22R14       0757-0950       R1FXD FLN 12K CHN 2% 1/6H         A22R15       0757-0944       R1FXD FLN 4.0K CHN 2% 1/6H         A22R16       0463-1835       R1FXD COMP 16K CHN 5% 1/4H         A22R17       0463-5425       R1FXD COMP 16K CHN 5% 1/4H         A22R18       0463-1035       R1FXD COMP 16K CHN 5% 1/4H         A22R19       0463-1635       R1FXD COMP 16K CHN 5% 1/4H         A22R20       0463-5425       R1FXD COMP 16K CHN 5% 1/4H         A22R21       0463-1035       R1FXD COMP 16K CHN 5% 1/4H         A22R20       0463-5425       R1FXD COMP 16K CHN 5% 1/4H         A22R21       0463-1035       R1FXD COMP 16K CHN 5% 1/4H         A22R22       0463-1035       R1FXD COMP 16K CHN 5% 1/4H         A22R21       0463-1035       R1FXD COMP 16K CHN 5% 1/4H         A22R22       0463-1035       R1FXD COMP 16K CHN 5% 1/4H         A22R23       0463-5425       R1FXD COMP 16K CHN 5% 1/4H         A22R25       0463-1035       R1FXD COMP 16K CHN 5% 1/4H         A22R25       0463-1035       R1FXD COMP 16K CHN 5% 1/4H         A22R25       0463-1035       R1FXD COMP 16K CHN 5% 1/4H         A22R26       0463-5425       R1FXD COMP 16K CHN 5% 1/4	Le orenes Designation	Pert No.	Description #	Nete
A22CR35       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR36       1001-0081       D10DE:SILICON 1.5A 400MV         A22CR36       1001-0081       D10DE:SILICON 1.5A 400MV         A22CR36       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR37       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR37       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR37       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR38       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR44       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR44       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR45       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR44       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR55       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR44       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR51       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR52       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR53       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR54       1001-0081       D10DE:SILICON 50 VOLTS MORNING				
A22CR35       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR36       1001-0081       D10DE:SILICON 1.5A 400MV         A22CR36       1001-0081       D10DE:SILICON 1.5A 400MV         A22CR36       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR37       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR37       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR37       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR38       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR44       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR44       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR45       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR44       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR55       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR44       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR51       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR52       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR53       1001-0081       D10DE:SILICON 50 VOLTS MORNING         A22CR54       1001-0081       D10DE:SILICON 50 VOLTS MORNING	A336834	1001-0001		
A22CR36       1901-0001       01000:5111CCM 150 YOLES MORKING         A22CR39       1901-0001       01000:5111CCM 1.54 400MV         A22CR39       1901-0001       01000:5111CCM 1.54 400MV         A22CR40       1901-0001       01000:5111CCM 1.54 400MV         A22CR41       1901-0001       01000:5111CCM 10 YOLES WORKING         A22CR42       1901-0001       01000:5111CCM 10 YOLES WORKING         A22CR44       1901-0001       01000:5111CCM 10 YOLES WORKING         A22CR45       1901-0001       01000:5111CCM 10 YOLES WORKING         A22CR55       1901-0001       01000:5111CCM 10 YOLES WORKING         A22CR55       1901-0001       01000:5111CCM 10 YOLES WORKING         A22CR54       1901-0001       01000:5111CCM 10 YOLES WORKING         A22CR55       1901-0001       01000:5111CCM 10 YOLES WORKING         A22CR54       1901-0001       01000:5111CCM 10 YOLES WORKING         A22CR55       1901-0001       01000:5111CCM 10 YOLES WORKING         A22CR54       1901-0001       01000:5111CCM 10 YOLES WORKING <t< td=""><td></td><td></td><td></td><td></td></t<>				
A22CR38       1001-0051       DLOWETSILLEUM 1.5% CONV         A22CR38       1001-0051       DLOWETSILLEUM 1.5% CONV         A22CR39       1001-0051       DLOWETSILLEUM 1.5% CONV         A22CR39       1001-0051       DLOWETSILLEUM 1.5% CONV         A22CR41       1001-0051       DLOWETSILLEUM 1.5% CONV         A22CR42       1001-0051       DLOWETSILLEUM 1.5% CONV         A22CR43       1001-0051       DLOWETSILLEUM 1.5% CONV         A22CR44       1001-0061       DLOWETSILLEUM 1.5% CONV         A22CR44       1001-0061       DLOWETSILLEUM 5.5% VOLTS WORKIME         A22CR44       1001-0061       DLOWETSILLEUM 5.5% VOLTS WORKIME         A22CR55       1001-0061       DLOWETSILLEUM 5.5% VOLTS WORKIME         A22CR52       1001-0061       DLOWETSILLEUM 5.5% VOLTS WORKIME         A22CR53       1901-0061       DLOWETSILLEUM 5.5% VOLTS WORKIME         A22CR54	A22CR36	1901-0081	DIODE:SILICON SO VOLTS WORKING	
A22CR40         1901-0001         BÍ DDE:SILICON 50 VOLTS NORKING           A22CR41         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR42         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR43         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR44         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR44         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR44         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR45         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR45         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR45         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR55         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR54         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22CR5         1901-0001         DIDDE:SILICON 50 VOLTS NORKING           A22C			UIUDEISILICUN I.SA 400WV	
A22CR31         DIDOESSILICON 50 VOLTS MORKING           A22CR43         1601-0041         DIDOESSILICON 50 VOLTS MORKING           A22CR44         1901-0041         DIDOESSILICON 50 VOLTS MORKING           A22CR45         1901-0041         DIDOESSILICON 50 VOLTS MORKING           A22CR44         1901-0041         DIDOESSILICON 50 VOLTS MORKING           A22CR45         1901-0041         DIDOESSILICON 50 VOLTS MORKING           A22CR45         1901-0041         DIDOESSILICON 50 VOLTS MORKING           A22CR45         1901-0041         DIDOESSILICON 50 VOLTS MORKING           A22CR53         1901-0041         DIDOESSILICON 50 VOLTS MORKING           A22CR54         1901-0041         DIDOESSILICON 50 VOLTS MORKING           A22R1         0683-1535         RIFKD COMP 15K CMF 55 1/4M           A22R1         0683-1535         RIFKD COMP 15K CMF 55 1/4M           A22R1         0683-1535	AZZCR39	1901-0051	DIGDEISTLICON L.SA 400NA	
A22CR42       ingl-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR44       1901-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR44       1901-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR44       1901-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR45       1901-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR46       1901-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR57       1901-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR58       1901-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR57       1901-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR58       1901-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR59       1901-0041       DICOE:SILICON 50 VOLTS WORKING         A22CR50       1850-0111       TRAMSISTOR:GERMANIUM PMP         A22R1       0683-1835       RIFKD COMP 18K COM 55 1/AM         A22R2       0683-1835       RIFKD COMP 18K COM 55 1/AM         A22R1       06	A22CR40	1901-0081	dÍODE:SILICON 50 VOLTS NORKING	
A22CR43       1451-0041       DICDESSILICON 50 VOLTS MORKING         A22CR44       1901-0041       DICDESSILICON 50 VOLTS MORKING         A22CR44       1901-0041       DICDESSILICON 50 VOLTS MORKING         A22CR44       1901-0041       DICDESSILICON 50 VOLTS MORKING         A22CR45       1901-0041       DICDESSILICON 50 VOLTS MORKING         A22CR50       1901-0041       DICDESSILICON 50 VOLTS MORKING         A22CR51       1901-0041       DICDESSILICON 50 VOLTS MORKING         A22CR52       1901-0041       DICDESSILICON 50 VOLTS MORKING         A22CR54       1901-0041       DICDESSILICON 50 VOLTS MORKING         A22R1       0483-1835       RIFKD COMP 15K CMF 55 1/4M         A22R1				
A22CR44         1001-0061         DIODEISTLICON 50 VOLTS MORKING           A22CR45         1001-0061         DIODEISTLICON 50 VOLTS MORKING           A22CR45         1007-0061         DIODEISTLICON 50 VOLTS MORKING           A22CR45         1007-0061         DIODEISTLICON 50 VOLTS MORKING           A22CR52         1001-0061         DIODEISTLICON 50 VOLTS MORKING           A22CR53         1001-0061         DIODEISTLICON 50 VOLTS MORKING           A22CR54         1001-0061         DIODEISTLICON 50 VOLTS MORKING           A22CR54         1001-0061         DIODEISTLICON 50 VOLTS MORKING           A22CR54         1001-0061         DIODEISTLICON 50 VOLTS MORKING           A22CR5         0663-1035         RIFXD COMP 18K DMH 55 1/4W           A22R1         0663-1035         RIFXD COMP 18K DMH 55 1/4W           A22R2         0663-1035         RIFXD COMP 18K DMH 55 1/4W           A22R3         0663-1035         RIFXD COMP 18K DMH 55 1/4W           A22R4         0663-1035         RIFXD COMP 18K DMH 55 1/4W           A22R5         0663-1035         RIFXD COMP 18K DMH 55 1/4W           A22R6         0663-1035         RIFXD COMP 18K DMH 55 1/4W           A22R6         0663-1035         RIFXD COMP 18K DMH 55 1/4W           A22R1         0663-1035         <				
A22CR47       1901-0041       DIODE:SILICON 50 VOLTS WORKING         A22CR44       1901-0061       DIODE:SILICON 50 VOLTS WORKING         A22CR50       1901-0061       DIODE:SILICON 50 VOLTS WORKING         A22CR51       1901-0061       DIODE:SILICON 50 VOLTS WORKING         A22CR52       1901-0061       DIODE:SILICON 50 VOLTS WORKING         A22CR53       1901-0061       DIODE:SILICON 50 VOLTS WORKING         A22CR54       1901-0061       DIODE:SILICON 50 VOLTS WORKING         A22R1       0463-1635       RIFXD COMP 18K DMM 55 1/4W         A22R1       0463-1535       RIFXD COMP 18K DMM 55 1/4W         A22R4       0463-1535       RIFXD COMP 18K DMM 55 1/4W         A22R6       0463-1535       RIFXD COMP 18K DMM 55 1/4W         A22R6       0463-1335       RIFXD COMP 18K DMM 55 1/4W         A22R1       0463-1335       RIFXD COMP 18K DMM 55 1/4W         A22R1       0463-1335       RIFXD COMP 18K DMM 55 1/4W         A22R11       0				
A22ch4d         1901-0081         DIIDE: SILICON 50 VOLTS WORKING           A22ch26         1901-0081         DIIDE: SILICON 50 VOLTS WORKING           A22ch27         1901-0081         DIIDE: SILICON 50 VOLTS WORKING           A22ch28         1901-0081         DIIDE: SILICON 50 VOLTS WORKING           A22ch21         DIIDE: SILICON 50 VOLTS WORKING           A22ch2         1800-0081         DIIDE: SILICON 50 VOLTS WORKING           A22ch2         1800-0111         TRAMSISTOR GERMANIUM PMP           A22ch2         0683-1035         RIFXD COMP 18K CMM 52 1/4W           A22ch2         0683-1035         RIFXD COMP 18K CMM 52 1/4W           A22ch2         0683-1335         RIFXD COMP 13K CMM 52 1/4W           A22ch2         0643-1355         RIFXD COMP 13K CMM 52 1/4W           A22ch2         0643-1355         RIFXD COMP 13K CMM 52 1/4W </td <td></td> <td><b>-</b></td> <td></td> <td></td>		<b>-</b>		
A22685       1907-0001       DIODE:SILICON 50 VOLTS WORKING         A22685       1901-0001       DIODE:SILICON 50 VOLTS WORKING         A22685       1901-0001       DIODE:SILICON 50 VOLTS WORKING         A22685       1901-0001       DIODE:SILICON 50 VOLTS WORKING         A22675       1901-0001       DIODE:SILICON 50 VOLTS WORKING         A22675       1901-0001       DIODE:SILICON 50 VOLTS WORKING         A22702       1850-0111       TRAMSISTOR:GERMANIUM PMP         A2281       0663-1835       RIFXD COMP 18K DMN 5% 1/4W         A2282       0663-1835       RIFXD COMP 18K DMN 5% 1/4W         A2283       0663-1835       RIFXD COMP 18K DMN 5% 1/4W         A2284       0663-1835       RIFXD COMP 18K DMN 5% 1/4W         A2285       0643-1835       RIFXD COMP 18K DMN 5% 1/4W         A2286       0643-1835       RIFXD COMP 18K DMN 5% 1/4W         A2287       0643-1835       RIFXD COMP 18K DMN 5% 1/4W         A2288       0643-1835       RIFXD COMP 18K DMN 5% 1/4W         A22810       0643-1835       RIFXD COMP 18K DMN 5% 1/4W         A22811       0643-1835       RIFXD COMP 18K DMN 5% 1/4W         A22812       0643-1835       RIFXD COMP 18K DMN 5% 1/4W         A22811       0643-1835       RIFXD COMP				
A222850       1901-0081       DIODE:SILICON 50 VOLTS MORKING         A220832       1901-0081       DIODE:SILICON 50 VOLTS MORKING         A220833       1901-0081       DIODE:SILICON 50 VOLTS MORKING         A220830       1850-0111       TRAMSISTOR:GERMANIUM PMP         A2201- A22030       1850-0111       TRAMSISTOR:GERMANIUM PMP         A2281       0643-1835       R:FXD COMP 18K CMM 5% 1/4M         A2282       0643-1335       R:FXD COMP 18K CMM 5% 1/4M         A2284       0643-1335       R:FXD COMP 18K CMM 5% 1/4M         A2284       0643-1335       R:FXD COMP 18K CMM 5% 1/4M         A2285       0643-1335       R:FXD COMP 18K CMM 5% 1/4M         A2287       0643-1335       R:FXD COMP 18K CMM 5% 1/4M         A2287       0663-1335       R:FXD COMP 18K CMM 5% 1/4M         A2287       0663-1335       R:FXD COMP 18K CMM 5% 1/4M         A2287       0663-1335       R:FXD COMP 18K CMM 5% 1/4M         A22810       0663-1335       R:FXD COMP 18K CMM 5% 1/4M         A22811       0737-0744       R:FXD COMP 18K CMM 5% 1/4M         A22812       0663-1335       R:FXD COMP 18K CMM 5% 1/4M         A22813       0737-0744       R:FXD COMP 18K CMM 5% 1/4M         A22814       0663-1635       R:FXD COMP 16K				
A22CR32       1401-0081       DIODE:SILICON 50 YOLTS WORKING         A22CR33       1401-0081       DIODE:SILICON 50 YOLTS WORKING         A22CR33       1401-0081       DIODE:SILICON 50 YOLTS WORKING         A22CR32       1400-0081       DIODE:SILICON 50 YOLTS WORKING         A22CR32       1850-0111       TRANSISTOR:GERMANIUM PMP         A22R1       0683-1835       R:FXD COMP 18K OWN 51 1/4W         A22R2       0683-1835       R:FXD COMP 18K OWN 51 1/4W         A22R3       0683-1835       R:FXD COMP 18K OWN 51 1/4W         A22R4       0683-1835       R:FXD COMP 18K OWN 51 1/4W         A22R5       0683-1835       R:FXD COMP 18K OWN 51 1/4W         A22R1       0683-1335       R:FXD COMP 18K OWN				
AZZCR94         1901-0001         DIODE:SILICON 50 VOLTS WORKTING           AZZ020         1850-0111         TRANSISTOR:GERRANIUM PNP           AZZ020         1850-0111         TRANSISTOR:GERRANIUM PNP           AZZ020         1850-0111         TRANSISTOR:GERRANIUM PNP           AZZ01         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ02         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ02         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ02         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ03         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ04         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ04         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ04         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ010         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ011         0403-1835         R:FRD COMP 18K CHM 5% 1/4W		1901-0081	DIGDE:SILICON SO VOLTS WORKING	
AZZCR94         1901-0001         DIODE:SILICON 50 VOLTS WORKTING           AZZ020         1850-0111         TRANSISTOR:GERRANIUM PNP           AZZ020         1850-0111         TRANSISTOR:GERRANIUM PNP           AZZ020         1850-0111         TRANSISTOR:GERRANIUM PNP           AZZ01         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ02         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ02         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ02         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ03         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ04         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ04         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ04         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ010         0403-1835         R:FRD COMP 18K CHM 5% 1/4W           AZZ011         0403-1835         R:FRD COMP 18K CHM 5% 1/4W	4335853	1001-0001		
A2201- A22020       1850-0111       TRANSISTOR:GERMANIUM PMP         A22R1       0463-1835       R:FXD COWP 18K OWN 5% 1/4W         A22R2       0463-1835       R:FXD COWP 18K OWN 5% 1/4W         A22R3       0463-1535       R:FXD COWP 18K OWN 5% 1/4W         A22R4       0463-1535       R:FXD COWP 18K OWN 5% 1/4W         A22R5       0463-1635       R:FXD COWP 18K OWN 5% 1/4W         A22R6       0463-1535       R:FXD COWP 18K OWN 5% 1/4W         A22R7       0463-1535       R:FXD COWP 18K OWN 5% 1/4W         A22R8       0463-1535       R:FXD COWP 18K OWN 5% 1/4W         A22R10       0463-1535       R:FXD COWP 18K OWN 5% 1/4W         A22R11       0463-1535       R:FXD COWP 18K OWN 5% 1/4W         A22R12       0463-1535       R:FXD COWP 18K OWN 5% 1/4W         A22R11       0463-1535       R:FXD COWP 18K OWN 5% 1/4W         A22R12       0463-1535       R:FXD COWP 18K OWN 5% 1/4W         A22R13       0737-0744       R:FXD COWP 18K OWN 5% 1/4W         A22R14       0463-1635       R:FXD COWP 18K OWN 5% 1/4W         A22R15       0463-1635       R:FXD COWP 18K OWN 5% 1/4W         A22R14       0463-1635       R:FXD COWP 18K OWN 5% 1/4W         A22R15       0463-1635       R:FXD COWP 18K OWN 5% 1/4W<				
A22020       1050-0111       TRANSISTOR: GERMANIUM PMP         A22R1       0603-1035       R:FXD COMP 10K OHM 5% 1/4W         A22R2       0603-1335       R:FXD COMP 10K OHM 5% 1/4W         A22R3       0603-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R4       0603-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R5       0603-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R6       0603-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R6       0603-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R6       0603-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R7       0603-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R10       0603-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R11       0603-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R12       0603-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R13       0757-0946       R:FXD FLH 8.2K OHM 2% 1/4W         A22R14       0757-0946       R:FXD FLH 8.2K OHM 2% 1/4W         A22R15       0643-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R16       0643-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R17       0643-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R18       0643-1035       R:FXD COMP 16K OHM 5% 1/4W				
A2281       0+03-1035       R1FND COMP 10K CMM 5% 1/4W         A22813       0+03-1035       R1FND COMP 10K CMM 5% 1/4W         A22813       0+03-1535       R1FND COMP 10K CMM 5% 1/4W         A22814       0+03-1535       R1FND COMP 10K CMM 5% 1/4W         A22815       0+03-1535       R1FND COMP 10K CMM 5% 1/4W         A22816       0+03-1335       R1FND COMP 10K CMM 5% 1/4W         A22817       0+03-1335       R1FND COMP 10K CMM 5% 1/4W         A22810       0+03-1335       R1FND COMP 10K CMM 5% 1/4W         A22810       0+03-1335       R1FND COMP 10K CMM 5% 1/4W         A22811       0+03-1335       R1FND COMP 10K CMM 5% 1/4W         A22811       0+03-1335       R1FND COMP 10K CMM 5% 1/4W         A22812       0+03-1335       R1FND COMP 15% CMM 5% 1/4W         A22813       0737-094-6       R1FND FLM 0.2X CMM 2% 1/4W         A22814       0737-094-6       R1FND FLM 0.2X CMM 5% 1/4W         A22815       0737-094-6       R1FND COMP 10K CMM 5% 1/4W         A22810       0403-1035       R1FND COMP 10K CMM 5% 1/4W         A228110       0403-1035       R1FND COMP 10K CMM 5% 1/4W         A228120       0403-1035       R1FND COMP 10K CMM 5% 1/4W         A228120       0403-1035       R1FND COMP 10K CMM				
A22R2       0483-3335       R.FKD COMP 33K CMM 55 1/4W         A22R3       0483-1535       R.FKD COMP 15K CMM 55 1/4W         A22R4       0483-1535       R.FKD COMP 15K CMM 55 1/4W         A22R5       0483-1535       R.FKD COMP 15K CMM 55 1/4W         A22R6       0483-1535       R.FKD COMP 15K CMM 55 1/4W         A22R6       0483-1535       R.FKD COMP 15K CMM 55 1/4W         A22R7       0683-1535       R.FKD COMP 15K CMM 55 1/4W         A22R8       0483-1535       R.FKD COMP 15K CMM 55 1/4W         A22R10       0483-1535       R.FKD COMP 15K CMM 55 1/4W         A22R11       0483-1535       R.FKD COMP 15K CMM 55 1/4W         A22R12       0483-1535       R.FKD COMP 15K CMM 55 1/4W         A22R13       0757-0946       R.FKD FLM 8.2X CMM 55 1/4W         A22R15       0757-0946       R.FKD FLM 8.2X CMM 55 1/4W         A22R16       0483-1635       R.FKD FLM 8.2X CMM 55 1/4W         A22R16       0483-1635       R.FKD FLM 8.2X CMM 55 1/4W         A22R17       0483-1635       R.FKD FLM 8.2X CMM 55 1/4W         A22R18       0757-0946       R.FKD FLM 8.2X CMM 55 1/4W         A22R17       0483-1635       R.FKD FLM 8.2X CMM 55 1/4W         A22R18       0483-1635       R.FKD COMP 16K CMM 55 1/4W	AZ 2020	1450-0111	TRANSISTURIGERMANIUM PMP	
A22R2       0403-1335       R:FXD COMP 38K CHM 5% 1/4W         A22R3       0403-1335       R:FXD COMP 15K CHM 5% 1/4W         A22R4       0403-1335       R:FXD COMP 15K CHM 5% 1/4W         A22R5       0403-1335       R:FXD COMP 15K CHM 5% 1/4W         A22R6       0403-1335       R:FXD COMP 16K CHM 5% 1/4W         A22R7       0403-1335       R:FXD COMP 16K CHM 5% 1/4W         A22R10       0403-1335       R:FXD COMP 16K CHM 5% 1/4W         A22R11       0403-1335       R:FXD COMP 15K CHM 5% 1/4W         A22R12       0403-1335       R:FXD COMP 15K CHM 5% 1/4W         A22R13       0737-0944       R:FXD FLN 82X CHM 2% 1/6W         A22R14       0737-0944       R:FXD FLN 82X CHM 5% 1/4W         A22R15       0403-1035       R:FXD COMP 16K CHM 5% 1/4W         A22R14       0757-0944       R:FXD COMP 16K CHM 5% 1/4W         A22R15       0403-1035       R:FXD COMP 16K CHM 5% 1/4W         A22R16       0403-1035       R:FXD COMP 16K CHM 5% 1/4W         A22R17       0403-1035       R:FXD COMP 16K CHM 5% 1/4W	A2281	0683-1835	RIFXD COMP 16K OHN 58 1/4W	
A2283       0483-1535       R1FXD COMP 15K CHH 5% 1/4H         A2284       0483-1335       R1FXD COMP 16K CHH 5% 1/4H         A2284       0483-3335       R1FXD COMP 16K CHH 5% 1/4H         A2284       0483-3335       R1FXD COMP 16K CHH 5% 1/4H         A2284       0483-3335       R1FXD COMP 16K CHH 5% 1/4H         A2284       0483-1535       R1FXD COMP 16K CHH 5% 1/4H         A2287       0483-1535       R1FXD COMP 16K CHH 5% 1/4H         A2284       0463-1535       R1FXD COMP 16K CHH 5% 1/4H         A22810       0463-1535       R1FXD COMP 16K CHH 5% 1/4H         A22811       0463-1535       R1FXD COMP 16K CHH 5% 1/4H         A22811       0463-1535       R1FXD COMP 16K CHH 5% 1/4H         A22811       0463-1535       R1FXD COMP 16K CHH 5% 1/4H         A22812       0463-1535       R1FXD COMP 16K CHH 5% 1/4H         A22813       0757-0946       R1FXD FLH 12K CHH 2% 1/6H         A22814       0757-0946       R1FXD FLH 12K CHH 2% 1/6H         A22815       0757-0946       R1FXD COMP 16K CHH 2% 1/4H         A22816       0663-1635       R1FXD COMP 16K CHH 5% 1/4H         A22817       0663-1635       R1FXD COMP 16K CHH 5% 1/4H         A228120       0663-1635       R1FXD COMP 16K CHH 5% 1/4H				
A22R4       0403-1035       R:FED COMP 16K CHM 5% 1/4W         A22R5       0403-1535       R:FED COMP 16K CHM 5% 1/4W         A22R4       0403-1535       R:FED COMP 16K CHM 5% 1/4W         A22R7       0603-1035       R:FED COMP 16K CHM 5% 1/4W         A22R8       0403-1535       R:FED COMP 16K CHM 5% 1/4W         A22R1       0603-1535       R:FED COMP 16K CHM 5% 1/4W         A22R10       0603-1535       R:FED COMP 16K CHM 5% 1/4W         A22R11       0603-1535       R:FED COMP 16K CHM 5% 1/4W         A22R12       0603-1535       R:FED COMP 16K CHM 5% 1/4W         A22R13       0757-0744       R:FED FLM 6.2K CHM 5% 1/4W         A22R14       0603-1535       R:FED FLM 6.2K CHM 5% 1/4W         A22R15       0757-0744       R:FED FLM 6.2K CHM 5% 1/4W         A22R14       0603-1635       R:FED COMP 16K CHM 5% 1/4W         A22R15       0757-0744       R:FED COMP 16K CHM 5% 1/4W         A22R14       0643-1635       R:FED COMP 16K CHM 5% 1/4W         A22R14       0643-1635       R:FED COMP 16K CHM 5% 1/4W         A22R19       0643-1635       R:FED COMP 16K CHM 5% 1/4W         A22R19       0643-1635       R:FED COMP 16K CHM 5% 1/4W         A22R21       0643-1635       R:FED COMP 16K CHM 5% 1/4W <td></td> <td>+</td> <td></td> <td>$\sum_{i=1}^{n}$</td>		+		$\sum_{i=1}^{n}$
A22R5       0483-3335       R: FRD COMP 33K CHM 5% 1/44         A22R6       0483-1535       R: FRD COMP 15K CHM 5% 1/44         A22R7       0683-1835       R: FRD COMP 15K CHM 5% 1/44         A22R8       0643-1535       R: FRD COMP 15K CHM 5% 1/44         A22R1       0643-1535       R: FRD COMP 15K CHM 5% 1/44         A22R10       0643-1535       R: FRD COMP 15K CHM 5% 1/44         A22R11       0643-1535       R: FRD COMP 15K CHM 5% 1/44         A22R12       0643-1535       R: FRD COMP 15K CHM 5% 1/44         A22R13       0757-0744       R: FRD FLN 8.2K CHM 2% 1/64         A22R14       0757-0744       R: FRD FLN 8.2K CHM 2% 1/64         A22R15       0757-0744       R: FRD FLN 8.2K CHM 2% 1/64         A22R16       0643-1835       R: FRD COMP 16K CHM 5% 1/44         A22R17       0643-1835       R: FRD COMP 16K CHM 5% 1/44         A22R18       0643-1035       R: FRD COMP 16K CHM 5% 1/44         A22R19       0643-1035       R: FRD COMP 16K CHM 5% 1/44         A22R10       0643-1035       R: FRD COMP 16K CHM 5% 1/44         A22R11       0643-1035       R: FRD COMP 16K CHM 5% 1/44         A22R11       0643-1035       R: FRD COMP 16K CHM 5% 1/44         A22R20       0643-1035       R: FRD COMP				$\langle \rangle$
A22R17       O463-1835       R:FXD COMP 10K CHM 5% 1/4H         A22R0       O463-1835       R:FXD COMP 10K CHM 5% 1/4H         A22R10       O463-1835       R:FXD COMP 15K CHM 5% 1/4H         A22R10       O463-1835       R:FXD COMP 10K CHM 5% 1/4H         A22R11       O463-1335       R:FXD COMP 10K CHM 5% 1/4H         A22R12       O463-1335       R:FXD COMP 10K CHM 5% 1/4H         A22R13       O757-0746       R:FXD FLM 6.2K CHM 2% 1/6H         A22R14       O757-0746       R:FXD FLM 6.2K CHM 2% 1/6H         A22R15       O757-0746       R:FXD FLM 6.2K CHM 2% 1/6H         A22R16       O463-1835       R:FXD COMP 10K CHM 5% 1/4H         A22R17       O463-5625       R:FXD COMP 10K CHM 5% 1/4H         A22R18       O463-1835       R:FXD COMP 10K CHM 5% 1/4H         A22R19       O463-1835       R:FXD COMP 10K CHM 5% 1/4H         A22R10       O463-1035       R:FXD COMP 10K CHM 5% 1/4H         A22R21       O463-1035       R:FXD COMP 10K CHM 5% 1/4H         A22R22       O463-1035       R:FXD COMP 10K CHM 5% 1/4	A22R5		RIFID COMP 33K ONN 52 1/4W	
A22R8       0683-3335       R:FXD COMP 33K OHM 5% 1/4W         A22R9       0683-1535       R:FXD COMP 15K OHM 5% 1/4W         A22R10       0683-1835       R:FXD COMP 15K OHM 5% 1/4W         A22R11       0683-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R12       0683-1535       R:FXD COMP 15K OHM 5% 1/4W         A22R13       0757-0946       R:FXD FLM 8.2K OHM 2% 1/4W         A22R14       0757-0946       R:FXD FLM 8.2K OHM 2% 1/4W         A22R15       0757-0946       R:FXD FLM 8.2K OHM 2% 1/4W         A22R14       0757-0946       R:FXD FLM 8.2K OHM 2% 1/4W         A22R15       0757-0946       R:FXD FLM 8.2K OHM 2% 1/4W         A22R16       0643-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R17       0643-1035       R:FXD COMP 5600 OHM 5% 1/4W         A22R19       0643-1035       R:FXD COMP 5600 OHM 5% 1/4W         A22R20       0663-1035       R:FXD COMP 5600 OHM 5% 1/4W         A22R21       0663-1035       R:FXD COMP 10K OHM 5% 1/4W         A22R21       0663-1035       R:FXD COMP 10K OHM 5% 1/4W         A22R22       0663-1035       R:FXD COMP 10K OHM 5% 1/4W         A22R23       0663-1035       R:FXD COMP 10K OHM 5% 1/4W         A22R24       0663-1035       R:FXD COMP 10K OHM 5% 1	AZZR6	0683-1535	R:FXD COMP 15K OWN 5% 1/4W	e
A22R8       0683-3335       R:FXD COMP 33K OHM 5% 1/4W         A22R9       0683-1535       R:FXD COMP 15K OHM 5% 1/4W         A22R10       0683-1835       R:FXD COMP 15K OHM 5% 1/4W         A22R11       0683-1335       R:FXD COMP 15K OHM 5% 1/4W         A22R12       0683-1535       R:FXD COMP 15K OHM 5% 1/4W         A22R13       0757-0946       R:FXD FLM 8.2K OHM 2% 1/4W         A22R14       0757-0946       R:FXD FLM 8.2K OHM 2% 1/4W         A22R15       0757-0946       R:FXD FLM 8.2K OHM 2% 1/4W         A22R14       0757-0946       R:FXD FLM 8.2K OHM 2% 1/4W         A22R15       0757-0946       R:FXD FLM 8.2K OHM 2% 1/4W         A22R16       0643-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R17       0643-1035       R:FXD COMP 5600 OHM 5% 1/4W         A22R19       0643-1035       R:FXD COMP 5600 OHM 5% 1/4W         A22R20       0663-1035       R:FXD COMP 5600 OHM 5% 1/4W         A22R21       0663-1035       R:FXD COMP 10K OHM 5% 1/4W         A22R21       0663-1035       R:FXD COMP 10K OHM 5% 1/4W         A22R22       0663-1035       R:FXD COMP 10K OHM 5% 1/4W         A22R23       0663-1035       R:FXD COMP 10K OHM 5% 1/4W         A22R24       0663-1035       R:FXD COMP 10K OHM 5% 1	A2287	0683-1835	REFED COMP LOK ONN SE 1/4H	
A22R10       0463-1835       R:FXD COMP 10K CMM 5% 1/4W         A22R11       0463-1535       R:FXD COMP 15K CMM 5% 1/4W         A22R12       0463-1535       R:FXD COMP 15K CMM 5% 1/4W         A22R13       0757-0744       R:FXD FLM 6.2K CMM 2% 1/6W         A22R14       0757-0744       R:FXD FLM 12K CMM 2% 1/6W         A22R15       0757-0744       R:FXD FLM 12K CMM 2% 1/6W         A22R16       0663-1835       R:FXD COMP 16K CMM 3% 1/4W         A22R17       0663-1635       R:FXD COMP 16K CMM 5% 1/4W         A22R18       0663-1035       R:FXD COMP 16K CMM 5% 1/4W         A22R19       0663-1035       R:FXD COMP 16K CMM 5% 1/4W         A22R20       0663-1035       R:FXD COMP 16K CMM 5% 1/4W         A22R21       0663-1035       R:FXD COMP 16K CMM 5% 1/4W         A22R21       0663-1035       R:FXD COMP 16K CMM 5% 1/4W         A22R22       0663-1035       R:FXD COMP 10K CMM 5% 1/4W         A22R23       0663-1035       R:FXD COMP 10K CMM 5% 1/4W         A22R24       0663-1035       R:FXD COMP 10K CMM 5% 1/4W			RIFXD COMP 33K ONN 58 1/4W	
A22R11       0403-3335       R:FXD COMP 33K OHM 5% 1/4W         A22R12       0403-1535       R:FXD COMP 15K OHM 5% 1/4W         A22R13       0757-0944       R:FXD FLM 8.2K OHM 2% 1/6W         A22R14       0757-0944       R:FXD FLM 8.2K OHM 2% 1/6W         A22R15       0757-0944       R:FXD FLM 8.2K OHM 2% 1/6W         A22R16       0403-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R16       0403-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R17       0403-5425       R:FXD COMP 16K OHM 5% 1/4W         A22R18       0403-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R19       0403-5425       R:FXD COMP 16K OHM 5% 1/4W         A22R20       0403-5425       R:FXD COMP 16K OHM 5% 1/4W         A22R21       0403-5425       R:FXD COMP 16K OHM 5% 1/4W         A22R22       0403-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R21       0403-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R22       0403-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R23       0403-5425       R:FXD COMP 16K OHM 5% 1/4W         A22R24       0403-1035       R:FXD COMP 16K OHM 5% 1/4W         A22R25       0403-1635       R:FXD COMP 16K OHM 5% 1/4W         A22R25       0403-1635       R:FXD COMP 16K OHM 5% 1/				
A22R12       0663-1535       R:FXD COMP 15K OWN 5E 1/4W         A22R13       0757-0946       R:FXD FLW 8.2K OWN 2E 1/8W         A22R14       0757-0946       R:FXD FLW 12K OWN 2E 1/8W         A22R15       0757-0946       R:FXD FLW 12K OWN 2E 1/8W         A22R16       0663-1835       R:FXD FLW 12K OWN 2E 1/8W         A22R17       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R17       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R19       0663-1035       R:FXD COMP 16K OWN 5E 1/4W         A22R20       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R21       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R21       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R21       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R22       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R22       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R25       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R26       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R26       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R26       0663-1635       R:FXD COMP 16K OWN 5E 1/4W         A22R27       0663-1635       R:FXD COMP 16K OWN 5E 1/4W<				
A22R13       0757-0944       R:FXD FLN 5.2K OWN 28 1/6W         A22R14       0757-0944       R:FXD FLN 12K OWN 28 1/6W         A22R15       0757-0944       R:FXD FLN 6.0K OWN 28 1/6W         A22R16       0403-1035       R:FXD COMP 16K OWN 58 1/4W         A22R17       0403-1035       R:FXD COMP 16K OWN 58 1/4W         A22R18       0403-1035       R:FXD COMP 16K OWN 58 1/4W         A22R19       0403-1035       R:FXD COMP 16K OWN 58 1/4W         A22R20       0403-1635       R:FXD COMP 16K OWN 58 1/4W         A22R21       0403-1635       R:FXD COMP 16K OWN 58 1/4W         A22R21       0403-1635       R:FXD COMP 16K OWN 58 1/4W         A22R22       0403-1635       R:FXD COMP 16K OWN 58 1/4W         A22R23       0403-1635       R:FXD COMP 16K OWN 58 1/4W         A22R24       0403-1635       R:FXD COMP 16K OWN 58 1/4W         A22R25       0403-1635       R:FXD COMP 16K OWN 58 1/4W         A22R26       0403-1635       R:FXD COMP 16K OWN 58 1/4W         A22R25       0403-1635       R:FXD COMP 16K OWN 58 1/4W         A22R26       0403-1635       R:FXD COMP 16K OWN 58 1/4W         A22R27       0403-5425       R:FXD COMP 16K OWN 58 1/4W         A22R28       0403-5425       R:FXD COMP 24K OWN 58 1/4				
A22R14       0757-0950       R:FXD FLN 12K ONN 2% 1/8W         A22R15       0757-0944       R:FXD FLN 4.4K ONN 2% 1/8W         A22R16       0683-1835       R:FXD COWP 10K ONN 5% 1/4W         A22R17       0683-5625       R:FXD COWP 10K ONN 5% 1/4W         A22R18       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R19       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R20       0663-5625       R:FXD COWP 10K ONN 5% 1/4W         A22R21       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R22       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R21       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R22       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R22       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R22       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R23       0663-5625       R:FXD COWP 10K ONN 5% 1/4W         A22R25       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R25       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R26       0663-1035       R:FXD COWP 10K ONN 5% 1/4W         A22R27       0663-1035       R:FXD COWP 5600 ONN 5% 1/4W         A22R27       0663-1035       R:FXD COWP 5600 ONN 5% 1	A22812			
A22R15       0757-0944       R:FXD FLM 6.8K CHM 28 1/8H         A22R16       0683-1835       R:FXD COMP 18K CHM 58 1/4H         A22R17       0683-5625       R:FXD COMP 18K CHM 58 1/4H         A22R18       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R19       0663-1835       R:FXD COMP 10K CHM 58 1/4H         A22R10       0663-5625       R:FXD COMP 10K CHM 58 1/4H         A22R20       0663-5625       R:FXD COMP 10K CHM 58 1/4H         A22R21       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R22       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R22       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R22       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R23       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R24       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R25       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R26       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R27       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R27       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R27       0663-1035       R:FXD COMP 10K CHM 58 1/4H         A22R28       0663-2435       R:FXD COMP 24K CHM 58 1/				
A22R16       0603-1835       R:FXD COMP 10K OWN 5% 1/4W         A22R17       0603-5625       R:FXD COMP 5600 OWN 5% 1/4W         A22R18       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R19       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R20       0603-5625       R:FXD COMP 10K OWN 5% 1/4W         A22R21       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R22       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R23       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R24       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R25       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R26       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R25       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R26       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R27       0603-5625       R:FXD COMP 10K OWN 5% 1/4W         A22R26       0603-5625       R:FXD COMP 10K OWN 5% 1/4W         A22R27       0603-1035       R:FXD COMP 10K OWN 5% 1/4W         A22R27       0603-5625       R:FXD COMP 24K OWN 5% 1/4W         A22R27       0603-1035       R:FXD COMP 24K OWN 5% 1/4W         A22R27       0603-2435       R:FXD COMP 24K OWN 5% 1				
A22R18       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R19       0463-1035       R:FXD COMP 16K 0MM 58 1/4M         A22R20       0463-5625       R:FXD COMP 5600 0MM 58 1/4M         A22R21       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R22       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R23       0463-5625       R:FXD COMP 10K 0MM 58 1/4M         A22R24       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R25       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R26       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R25       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R26       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R27       0463-5625       R:FXD COMP 10K 0MM 58 1/4M         A22R26       0463-5625       R:FXD COMP 10K 0MM 58 1/4M         A22R27       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R28       0463-2435       R:FXD COMP 10K 0MM 58 1/4M         A22R28       0463-2435       R:FXD COMP 24K 0MM 58 1/4M         A22R29       0463-4725       R:FXD COMP 4700 0MM 58 1/4M	A22816			
A22R18       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R19       0463-1035       R:FXD COMP 16K 0MM 58 1/4M         A22R20       0463-5625       R:FXD COMP 5600 0MM 58 1/4M         A22R21       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R22       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R23       0463-5625       R:FXD COMP 10K 0MM 58 1/4M         A22R24       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R25       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R26       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R25       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R26       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R27       0463-5625       R:FXD COMP 10K 0MM 58 1/4M         A22R26       0463-5625       R:FXD COMP 10K 0MM 58 1/4M         A22R27       0463-1035       R:FXD COMP 10K 0MM 58 1/4M         A22R28       0463-2435       R:FXD COMP 10K 0MM 58 1/4M         A22R28       0463-2435       R:FXD COMP 24K 0MM 58 1/4M         A22R29       0463-4725       R:FXD COMP 4700 0MM 58 1/4M				
A22R19       G6831835       A:FXD COMP 16K CMM 5% 1/4H         A22R20       G6835625       R:FXD COMP 5600 CMM 5% 1/4H         A22R21       G6831035       R:FXD COMP 10K CMM 5% 1/4H         A22R22       G6631035       R:FXD COMP 10K CMM 5% 1/4H         A22R23       G6635625       R:FXD COMP 10K CMM 5% 1/4H         A22R24       G6631035       R:FXD COMP 10K CMM 5% 1/4H         A22R25       G6631035       R:FXD COMP 10K CMM 5% 1/4H         A22R26       G6631035       R:FXD COMP 10K CMM 5% 1/4H         A22R25       G6631035       R:FXD COMP 10K CMM 5% 1/4H         A22R26       G6635625       R:FXD COMP 10K CMM 5% 1/4H         A22R27       G6631035       R:FXD COMP 10K CMM 5% 1/4H         A22R27       G6632435       R:FXD COMP 10K CMM 5% 1/4H         A22R28       G6632435       R:FXD COMP 24K CMM 5% 1/4H         A22R29       G6834725       R:FXD COMP 4700 CMM 5% 1/4H				
A22R20       0663-5625       R:FXD COMP 5600 CHM 5% 1/4W         A22R21       0663-1035       R:FXD COMP 10K CHM 5% 1/4W         A22R22       0663-1635       R:FXD COMP 10K CHM 5% 1/4W         A22R23       0663-5625       R:FXD COMP 5660 CHM 5% 1/4W         A22R24       0663-1035       R:FXD COMP 10K CHM 5% 1/4W         A22R25       0663-1035       R:FXD COMP 10K CHM 5% 1/4W         A22R26       0663-1635       R:FXD COMP 10K CHM 5% 1/4W         A22R26       0663-5625       R:FXD COMP 10K CHM 5% 1/4W         A22R27       0663-5625       R:FXD COMP 10K CHM 5% 1/4W         A22R27       0663-1035       R:FXD COMP 10K CHM 5% 1/4W         A22R27       0663-1035       R:FXD COMP 10K CHM 5% 1/4W         A22R28       0663-2435       R:FXD COMP 10K CHM 5% 1/4W         A22R28       0663-2435       R:FXD COMP 24K CHM 5% 1/4W         A22R29       0663-4725       R:FXD COMP 4700 CHM 5% 1/4W				
A22822       0683-1835       R:FXD COMP 18K 0MM 5% 1/4M         A22823       0683-5625       R:FXD COMP 5660 0MM 5% 1/4M         A22824       0683-1035       R:FXD COMP 10K 0MM 5% 1/4M         A22825       0683-1835       R:FXD COMP 18K 0MM 5% 1/4M         A22826       0683-5625       R:FXD COMP 18K 0MM 5% 1/4M         A22827       0683-5625       R:FXD COMP 18K 0MM 5% 1/4M         A22827       0683-1035       R:FXD COMP 18K 0MM 5% 1/4M         A22827       0683-1035       R:FXD COMP 10K 0MM 5% 1/4M         A22827       0683-2435       R:FXD COMP 10K 0MM 5% 1/4M         A22828       0683-2435       R:FXD COMP 24K 0MM 5% 1/4M         A22829       0683-4725       R:FXD COMP 4700 0MM 5% 1/4M	A22820	0683-5625	R:FXD COMP 5600 CHM 5% 1/4W	
A22R23       0683-5625       R:FXD COWP 5660 GWI 58 1/4W         A22R24       0683-1035       R:FXD COWP 10K GWI 58 1/4W         A22R25       0683-1635       R:FXD COWP 10K GWI 58 1/4W         A22R26       0683-5625       R:FXD COWP 10K GWI 58 1/4W         A22R27       0683-1035       R:FXD COWP 10K GWI 58 1/4W         A22R28       0683-2435       R:FXD COWP 10K GWI 58 1/4W         A22R29       0683-4725       R:FXD COWP 24K GWI 58 1/4W	A22821	0683-1035	R:FXD COMP 10K CHM 58 1/4W	
A22R23       0683-5625       R:FXD COWP 5660 GWI 58 1/4W         A22R24       0683-1035       R:FXD COWP 10K GWI 58 1/4W         A22R25       0683-1635       R:FXD COWP 10K GWI 58 1/4W         A22R26       0683-5625       R:FXD COWP 10K GWI 58 1/4W         A22R27       0683-1035       R:FXD COWP 10K GWI 58 1/4W         A22R28       0683-2435       R:FXD COWP 10K GWI 58 1/4W         A22R29       0683-4725       R:FXD COWP 24K GWI 58 1/4W	A22822	0483-1835	RIFED COMP LOK ONN SE 1/AM	
A22R24       G603-1035       R:FXD COMP 10K GMH 5% 1/4W         A22R25       G603-1035       R:FXD COMP 10K GMH 5% 1/4W         A22R26       G603-5625       R:FXD COMP 10K GMH 5% 1/4W         A22R27       G603-1035       R:FXD COMP 10K GMH 5% 1/4W         A22R28       G603-2435       R:FXD COMP 10K GMH 5% 1/4W         A22R29       G603-4725       R:FXD COMP 4700 GMM 5% 1/4W	A22823	· · · · · · · · · · · · · · · · · · ·		
A22826         0683-5625         R:FXD CONP 5600 CNN 58 1/4H           A22827         0683-1035         R:FXD CONP 10K CNN 58 1/4H           A22828         0683-2435         R:FXD CONP 24K CNN 58 1/4H           A22829         0683-4725         R:FXD CONP 24K CNN 58 1/4H	A22824	0603-1035	RIFXD COMP LOK CHM 58 1/4W	
A22R27 0683-1035 R:FXD CONP 10K 0HH 58 1/4W A22R28 0683-2435 R:FXD CONP 24K 0HH 58 1/4W A22R29 0683-4725 R:FXD CONP 4700 0HH 58 1/4W	A22825			
A22R28 0683-2435 R1FXD COMP 24K DHA 58 1/4W A22R29 0683-4725 R1FXD COMP 4700 DHA 58 1/4W	AC ( 4 ( 4	V00.5*3023	N+TAB 6000 3000 000 35 1/90	
A22R28 0683-2435 R1FXD COMP 24K CHM 58 1/4W A22R29 0683-4725 R1FXD COMP 4700 CHM 58 1/4W	A22827	0663-1035		
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Table	35-3.	Reference	Designation	Index	(Cont'd)
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Designation	· Part No.	Description #	Note
		OPTION 35	
		A22 8668-8612 (CONT'D)	
A22831	0683-3335	RIFXD COMP 33K OHM 58 1/4W	
A22832	0483-3335	ALFXD COMP 33K ONU 58 1/4W	
A22833	0683-1535	RIFXD COMP 15K CHM 58 1/4W	
A22R34 A22R35	0683-9135	AIFXD COMP 91K CHM 52 1/4W RIFXD COMP 15K CHM 53 1/4W	
M26833			
A22R36	0683-9135	RIFXD COMP 91K OWN 53 1/4W RIFXD COMP 15K OWN 53 1/4W	
A22R37 A22R30	0683-1535 0683-9135	RIFXD COMP 91K CHM 58 1/4W	·
A22839	0683-1535	RIFXD COMP 15K OWN 58 1/4W	
A22840	0483-9135	REFXD COMP 91K OWN 58 1/4W	
A22841	0683-1535	RIFXD COMP 15K ONN 58 1/4M	
A22842	0483-9135	RIFXD COMP 91K CHM 58 1/4W	
A22R43	0683-1535 0683-9135	RIFXD COMP 15K UNH 58 1/4M RIFXD COMP 91K UNH 58 1/4M	
A22R44 A22R45	0683-1535	RIFXD CONP 15K ONN 58 1/4W	
A22846	0683-9135	R:FXD COMP 91K CHM 52 1/64 R:FXD COMP 33K CHM 52 1/64	
A22847	0663-2045	REFXD COMP 200K CHH SE 1/4W	
A22849	0683-3335	RIFXD COMP 33K ONN 58 1/4W	
A22850	0683-2045	R: FXD COMP 200K CHM 52 1/44	
A22851	0683-3335	RIFXD CONP 33K OWN SE 1/4M	
A22852	0683-2045	RIFXD COMP 200K CHM 'SS 1/4W RIFXD COMP 33K CHM SS 1/4W	
A22853 A22854	0683-3335 0683-2045	A: FXD COMP 200K CHM\SE 1/4W	
A22855	0443-3335	REFED COMP 33K CHM SE 1/4W	
A22856	0683-3335	RIFXD COMP 33K ONN SE 1/4W	
A22857	0603-3335	REFND COMP 33K OWN SE 1/4W	
A22856	0683-3335	RIFXD COMP 33K CHM 58 1/4H	
A22859 A22860	0683-3335 0683-3335	RIFID COMP 33K OWN 58 1/4M RIFID COMP 33K OWN 58 1/4M	
A22R42	0603-1335 0603-3335	R: FXD COMP 13K OWN 58 1/4W R: FXD COMP 33K OWN 58 1/4W	
A22863 A22864	0663-2035	RIFID COMP 20K CHH SE 1/4W	7
A22865	0483-2035	RIFXD CONP 20K CHIN SE 1/4W	
A22846	0483-3335 .	RIFND COMP 33K CHH 52 1/44	
A22866	0683-1335	RIFED COMP LOK OWN SE 1/4M	
A22849	0757-0957	R: FXD FLM 24K CMM 22 1/6W R: FXD FLM 20K CMM 23 1/6W	
A22870 A22871	0757-0955 0663-3335	RIFXD COMP 33K CHM SE 1/4W	
A22872	0483-2045	RIFID COMP 200K CHM SE 1/4W	
A 7 5 8 7 1	0757-0957	R: FXD FLM 24K CMM 23 1/8W	
A22873 A22874	0757-0955	R: FXD FLN 20K (DNN 23. 1/04	,
A22875	0663-3335	RIFID COMP 33K OWN SE 1/4W	
A22876	0683-2045 0757-0957	R: FXD COMP 200K CHM 55 1/44 R: FXD FLM 24K CHM 25 1/64	
A22877	V/2/~V/3/		
A22878	0757-0955	RIFXD FLN 20K CHN 28 1/6W RIFXD COMP 33K CHN 58 1/4W	
A22879 A22800	0683-3335 0683-2045	AIFE CONF 200K OW SE 1/4W	
A22801	0757-0957	REFXD FLN ZAR CHIN 28 1/00	
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<b>Table 35-3</b> ,	Reference	<b>Designation Index</b>	(Cont'd)
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Designation	Part No.	Description #	Nete
	<i></i>	OPTION 35 A22 0000-0012 (CONT'D)	
A22R82 A22R83	0757-0955 0483-3335	R: FXD FLM 20K 0HM 25 1/8W R: FXD COMP 33K 0HM 55 1/4W	
A22864	0683-2045	RIFXD COMP 200K CHM 5% 1/4W	
<b>^**</b>		SAME AS A11, USE PREFIX ANS	

### Table 35-4. Replaceable Parts

• Part No.	Description #	Mfr.	Mfr. Part No.	TQ
	OPTION 35			
0140-0194 0140-0195 0140-0219 0603-1035	C:FXD MICA 110 PF 58 C:FXD MICA 130 PF 58 300 VDCW C:FXD MICA 160 PF 28 R:FXD COMP 10K CHM 58 1/4W	28480 04062 28480 01121	0140-0194 DM15F131J 300V 0140-0219 CB 1035	48 54 6 4
0403-1045 0403-1335 0403-1535 0403-1035 0403-2035	R:FXD COMP 100K 0H0K 5% 1/4H R:FXD COMP 13K 0H0 5% 1/4H R:FXD COMP 14K 0H0 5% 1/4H R:FXD COMP 14K 0H0 5% 1/4H R:FXD COMP 15K 0H0 5% 1/4H R:FXD COMP 20K 0H0 5% 1/4H	01121 01121 01121 01121 01121	CB 1535	24 3 17 8 2
0463-2045 J 0463-2235 0463-2435 0463-2735 0463-2725 0463-2025	R=FXD COMP 200K OHM 52 1/4H R=FXD COMP 22K OHM 52 1/4H R=FXD COMP 24K OHM 52 1/4H R=FXD COMP 24K OHM 52 1/4H R=FXD COMP 27K OHM 52 1/4H R=FXD COMP 3000 OHM 52 1/4H	01121 01121 01121 01121 01121	C8 2235 C8 2435	8 96 1 48 36
0103-3335 0103-3745 0103-4725 0103-5635 0103-5635	* RIFXD COMP 33K ONN 58 1/4W RIFXD COMP 396K ONN 58 1/4W RIFXD COMP 4760 DNN 58 1/4W RIFXD COMP 5600 DNN 58 1/4W RIFXD COMP 5660 DNN 58 1/4W	01121 01121 01121 01121 01121		70 24 1 4
0403-6035 0403-7135 0406-4735 0406-5635 0757-0944	RIFXD COMP GON GNN 58 1/4W RIFXD COMP 91K GNN 58 1/4W RIFXD COMP-47K GNN 58 1/4W RIFXD COMP-47K GNN 58 1/2W RIFXD FLM 6-0K GNM 28 1/8W	01121 01121 01121 01121 28460	EB 4735	6 7 6 48 1
0737-0946 0737-0930 0737-0955 0737-0955 0737-0957 1080-0111	RIFTO PLN 0.2K CNN 22 1/0W RIFTO PLN 12K CNN 22 1/0W RIFTO PLN 20K CNN 22 1/0W RIFTO PLN 20K CNN 22 1/0W RIFTO PLN 24K CNN 22 1/0W TRANSISTOR: CORMANIUM PNP	28480 28480 28480 28480 01295	0757-0946 0757-0950 0757-0955 0757-0957 20404A	1 1 4 20
1800-8184 1901-8025 1901-8051 1901-8051	TRANSISTOR: CERNAN IUN PNP DIEDE: SILICEN LOOVY LOOMA DIEDE: SILICEN L.SA 400/Y DIEDE: SILICEN SO VOLTS NORKING	02735 28480 28480 28480	1901-0025 1901-0051 1901-0081	48 48 2 185
1970-0009 9040-3612 9040-3644	ELOCTRON TUDE: INDICATOR 10 DIGIT PRINTER COUPLING LOGIC REVERSIBLE DOCADE DIVIDER	83594 04404 04404	85991 5069-5612 5060-5644	• 1 6

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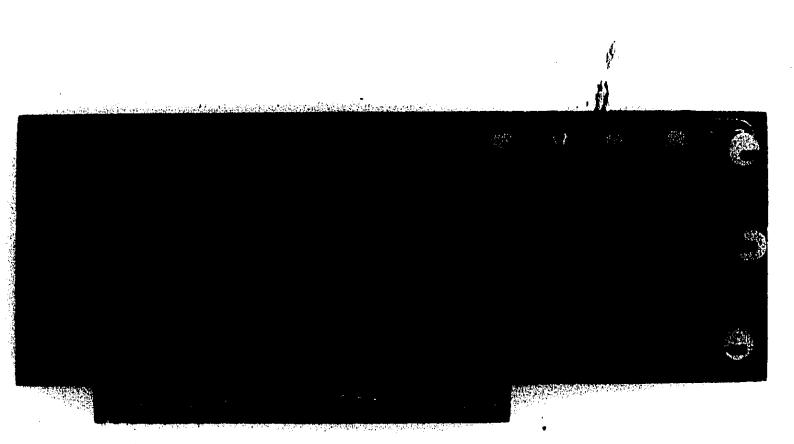
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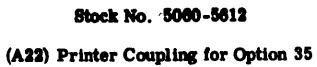
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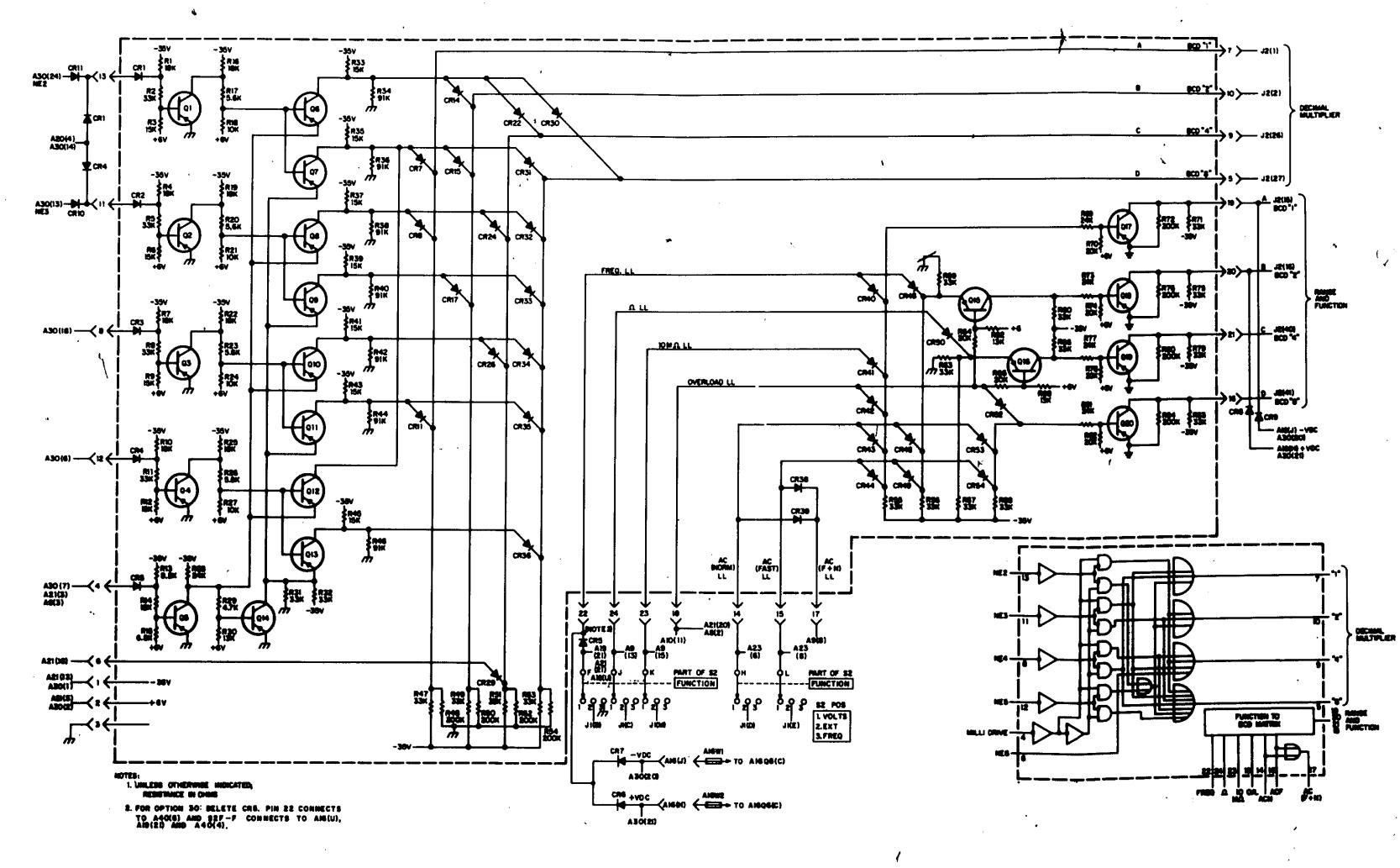




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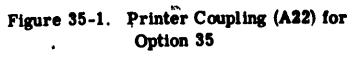
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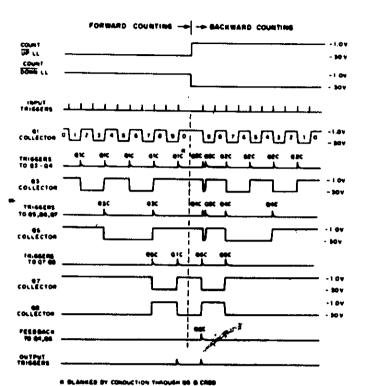


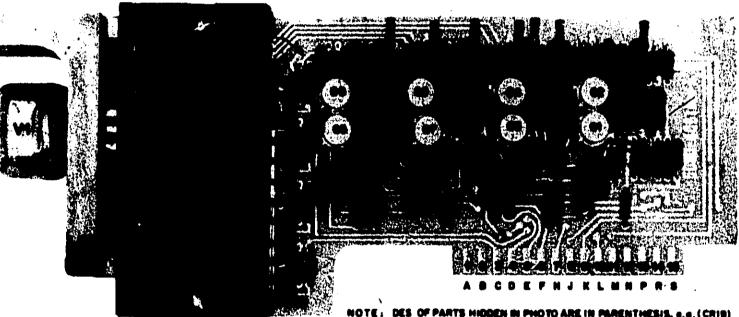
35-13

Section 35

2401C

#### WAVEFORMS OF REVERSIBLE 8-4-2-I DECADE





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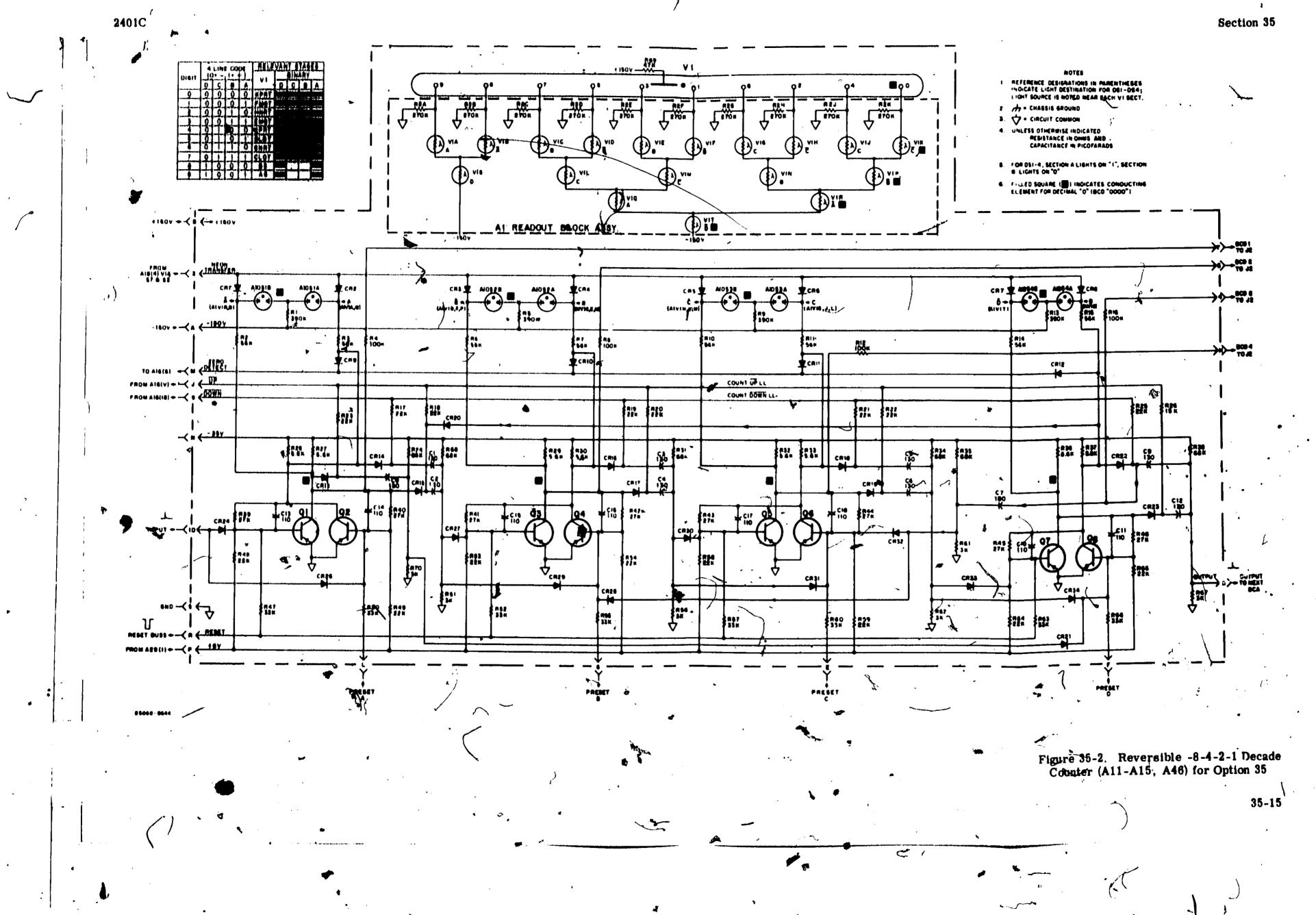
Stock No. 5060-5644

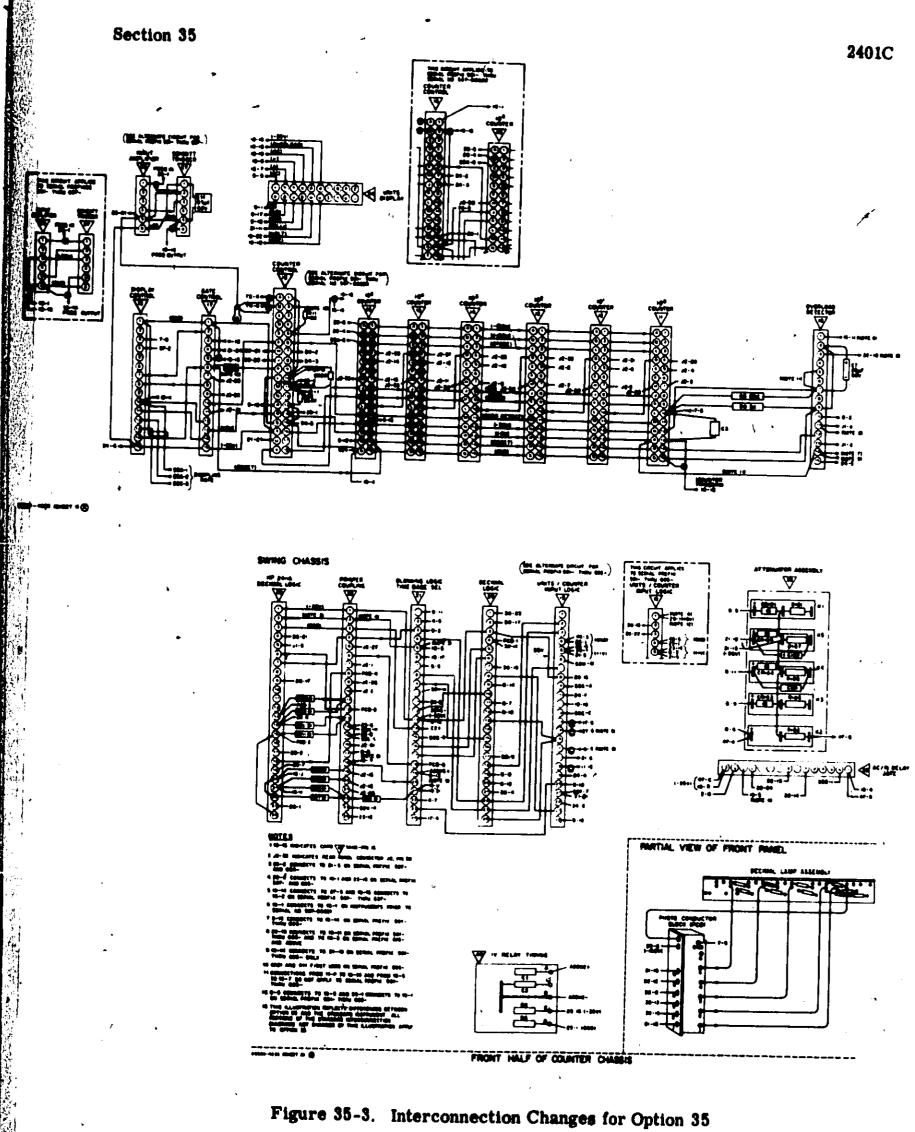
(A11-A15) Reversible -8-4-2-1 Decade Counter for Option 35

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### MANUAL SUPPLEMENT

#### MODEL HP-2401C

Integrating Digital Veltmeter

**Option 146** 

#### 146.1 GENERAL DESCRIPTION

The HP-2401C-146 Integrating Digital Voltmeter permits connecting command signals to a computer (such as the HP Model 2116 Computer) by a single connector. This is accomplished by internal wiring changes.

#### 146.2 INSTALLATION AND OPERATION

Installation and operation of the HP-2401C-146 is the same as for the standard HP-2401C except a signal at COUNTER RESET connector J4 on the rear panel will be routed to the computer via pin n of PROGRAM CONTROL connector J1. The computer in turn will control counter reset via J1(c). Also, the +Record Command is routed to the Computer via J(r) as well as to pin 23 of BCD OUTPUT connector J2.

#### 146.3 THEORY OF OPERATION

Theory of operation of the HP-2401C-146 is the same as for the standard HP-2401C except external programming signals are routed as explained in Section 146.2.

#### 146.4 MAINTENANCE

Figure 146-1 shows the connections to A17, which differ from the standard HP-2401C. Figure 146-2 shows changes in interconnections for the HP-2401C-146. Otherwise, the maintenance instructions in Section IV of this manual are directly applicable without change to the HP-2401C-146.

#### 146.5 PARTS LIST

The Parts List in Section V of this manual applies to the HP-2401C-146 except as indicated in Tables 146-1 and 146-2.

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# Table 146-1. Reference Designation Index

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	· Part No.	Description #	Note
•		OPTION 146	
	)	ADD THE FOLLOWING TO TABLE 5-1 TO MAKE THE TABLE APPLICABLE TO THE HP2401C-146	
C14	0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	
R20	0683-1025	R: FXD COMP 1000 OHM 58 1/4W	
		·	

# Table 146-3. Replaceable Parts

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
	OPTION 146			
0160-0161 0683-1025	C #FXD MY 0.01 UF 108 200VDCW R #FXD COMP 1000 DHM 58 1/4W	28480 01121	0160-0161 CB 1025	1

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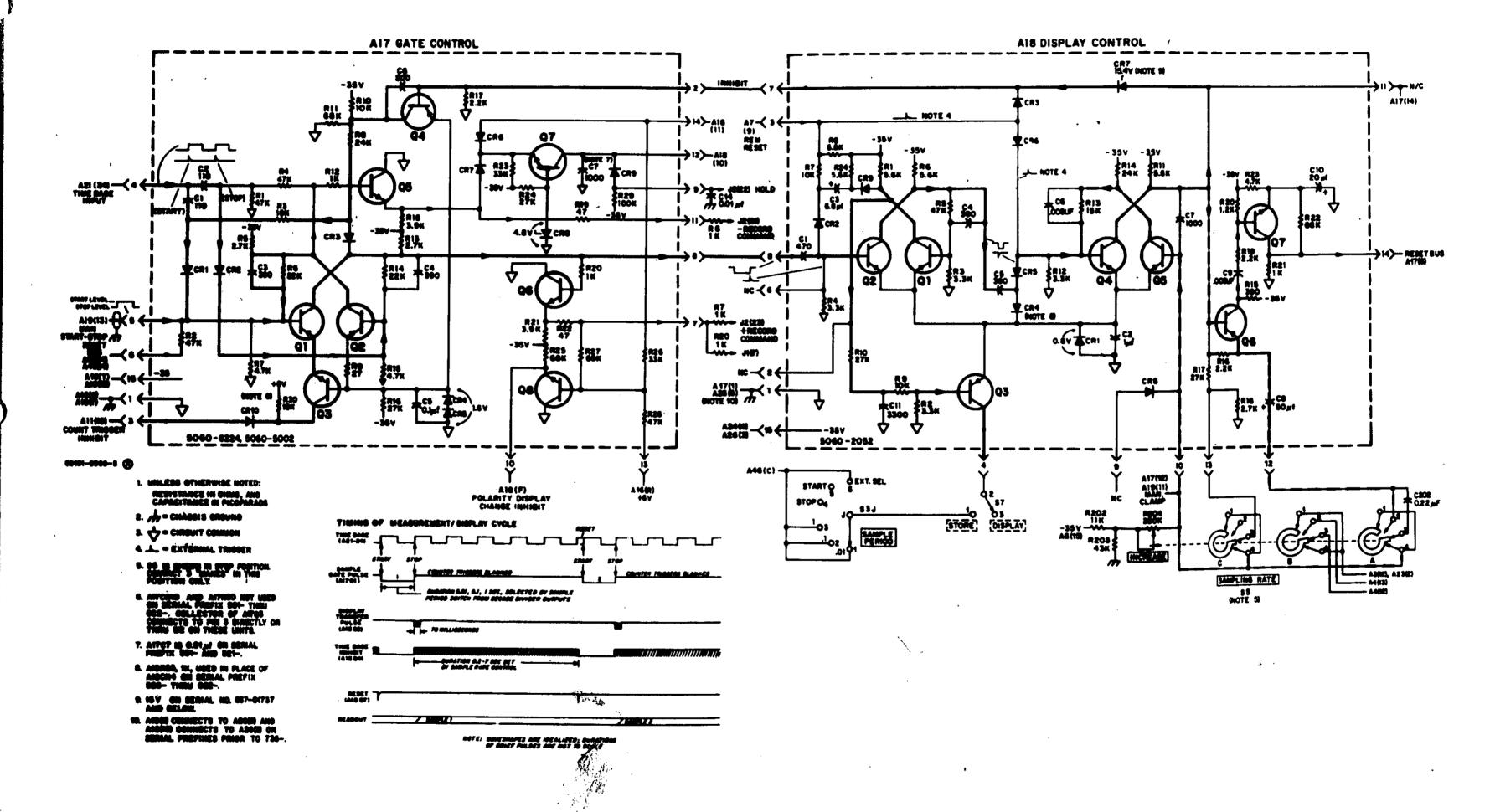
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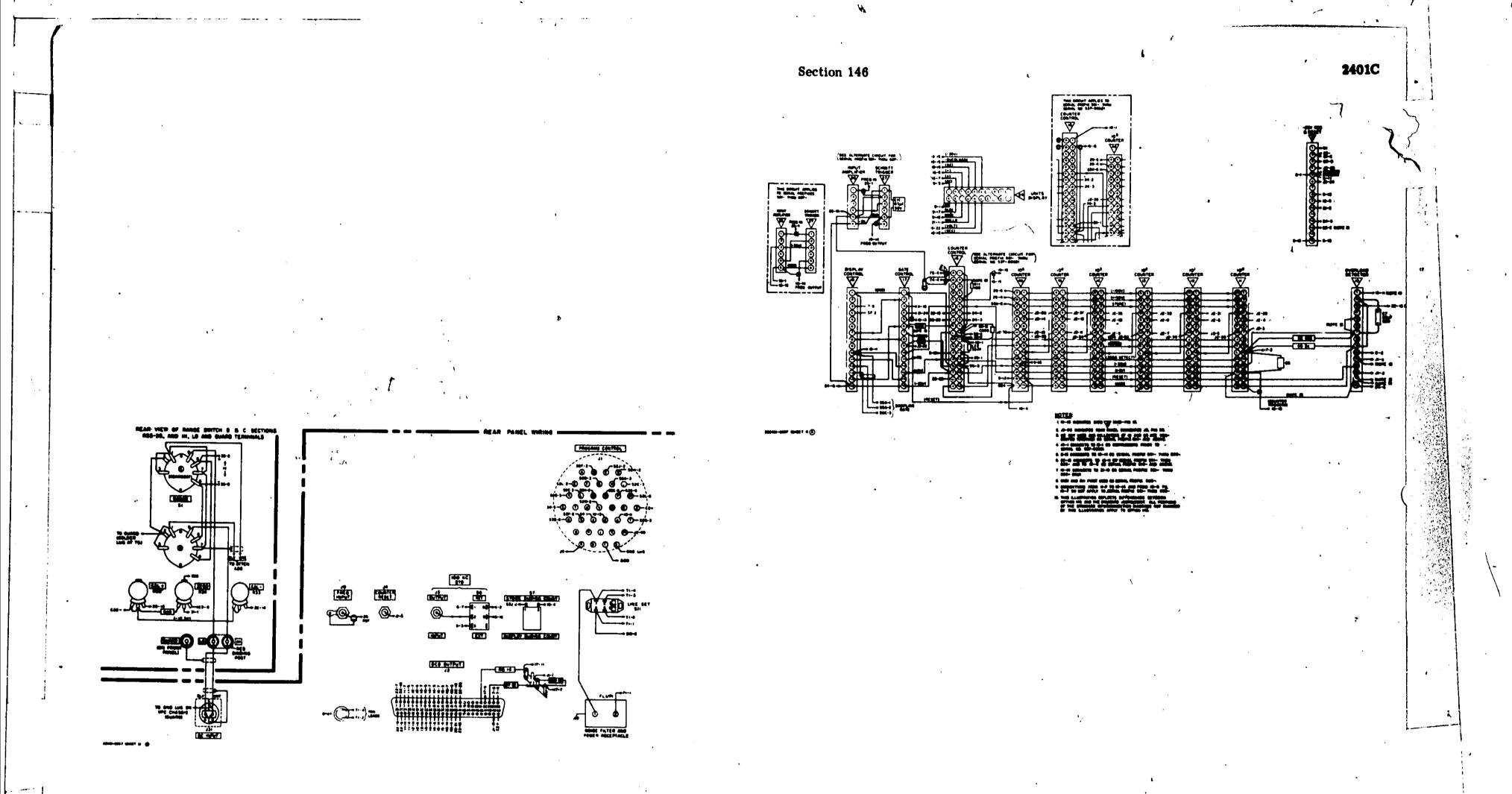
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# Figure 146-1. A17 and A18 Connections for Option 146

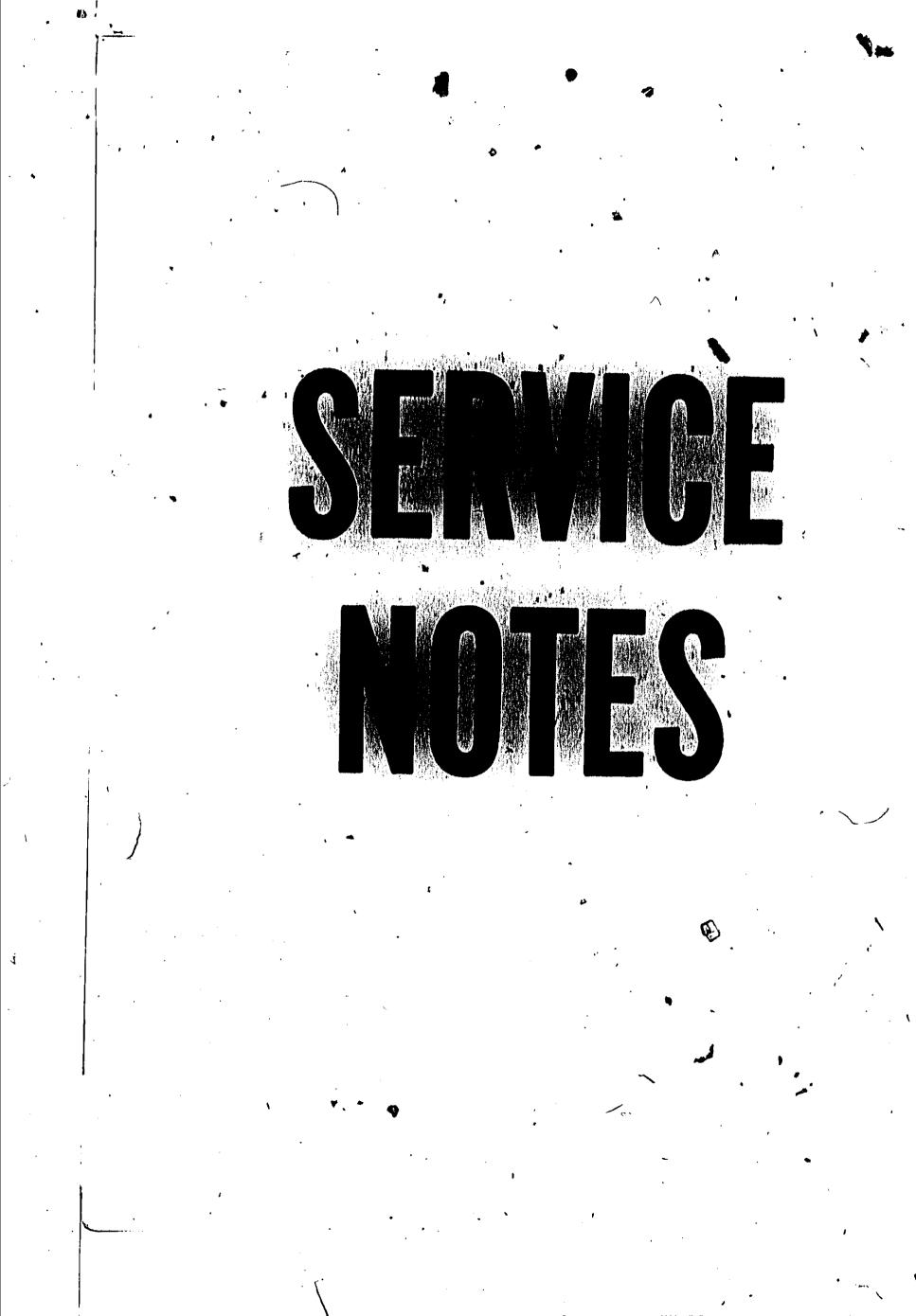




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# Figure 146-2. Interconnection Changes for Option 146

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# HP-2401B/C-2 I C E ΝΟΤΕ R V OUPERSEDES: MODEL HP-2401B/C INTEGRATING DIGITAL VOLTMETERS HP-2401B Serial Number Above 444-01536 HP-2401C Serial Number Below 526-00221 Some 2401B Voltmeters above serial number 444-01536 and 2401C Voltmeters below serial number 526-00221, have caused 2010 Systems to hang up, particularly when operated on .01 second gate with an -hp-562 Digital Recorder. If voltmotor readings are initiated by "External Reset" pulses at certain repetition rates, transistor Q4 on Display Control Board A18 (Disply Flip-Flop) may, not be turned off if the Display One-Shot (Q1,Q2) is triggered simultaneously. This is due to the reset pulse being excessively loaded by diode **CR4**. The remedy is to replace CR4 with a 1Km, 0.25 watt, Allen -Bradley resistor, stock number 0683-1025. This change will be made on all 2401C Voltmeters, serial number 526-00221, and above. ς...

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#### MODEL 2401C INTEGRATING DIGITAL VOLTMETER

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#### Display Decades showing counts during Reset Serials Prefixed Below 605

Some DY-2401C Voltmeters will show erratic counts during reset.

While re-setting the display decades, a binary, which is reset to its Zero state, will occasionally pass a pulse to the following binary. The following binaries will accept this pulse as a counter pulse at the time the reset pulse is removed.

The result is an occasional count appearing when the display decades should be reset to Zero.

A simple cure for this is to gate off the up/down gates so that no pulse can be transferred during the reset period.

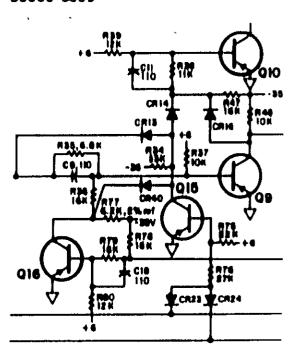
Please note that the following modification is broken down into 3 sections. Sections 1 and 2 should be done with all 2401C's except M70 or combinations with the M70. Sections 1 and 3 should be done with 2401C's having the M70.

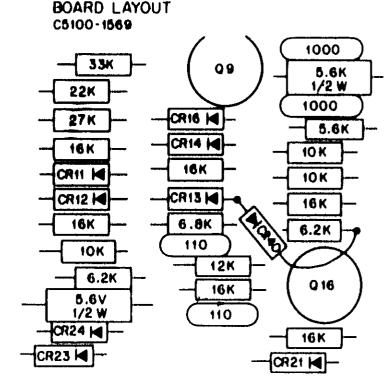
#### 1. A 16 5060-3809

Add	CR40	Diode		-hp-	stock	number	1901-0081
<b>Do 1</b>	R76	Resistor	33K	-hp-	stock	number	0683-3335
Add	R76	Resistor	27K	-hp-	stock	number	0683-2735

SCHEMATIC 05060-3609

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#### HP-2401C M146 INTERGRATING DIGITAL VOLTMETER

#### FAILURE TO GIVE THE HP-2116A COMPUTER THE PROPER PRINT COMMAND

作.

Serial Prefixes Below 739-

When using the 2401C M146 with the HP-2116A Computer, the voltmeter may not issue a print command to the DSI card in the computer. When this problem occurs, the 2116A Computer will appear to be at fault. The true source of the problem has been traced to the 2401C M146, Voltmeter.

The print command from the standard 2401C is normally 25 volts, however, when N146 is installed, a parallel print command is taken out on J1 pin  $\bar{r}$ . The print command on J1  $\bar{r}$  is an input to the DVM program board in the 2116A. The DVM board has an 8 volt Zener Diode in series with the print command which clamps the print command at a maximum of 8 volts. The parallel print command on J2 pin 23 is not large enough to trigger the DSI board in the 2116A Computer.

All 2401C M148 Voltmeters in the field should have the following modification installed:

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Add: R20 Remistor, fixed, 1000 ohms HP stock number 0683-1025

Add: Terminal, stand off HP stock number 0360-0018

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# HP-2401C INTEGRATING DIGITAL VOLTMETER REPLACEMENT OF THE AC LINE FILTER Serial Prefixes 735 and Below

A new AC line filter has been developed for use in the HP-2401C. The new line filter will withstand a higher voltage in the line to ground insulation test.

The HP stock number for the preferred line filter is:

#### 9100-2477

Be sure to update the Table of Replaceable Parts Section in your Operating and Service Manual.

LV/tj/wo

11/67-6 Customer Service • 333 Logue Avenue, Mountain View, California 94040. Tel. (415) 968-9200 Europe: 64 Route Des Acacias, Geneva, Switzerland, Cable: "HEWPACKSA" Tel. (022) 49.81.60 HP-2401C INTEGRATING DIGITAL VOLTMETER OSCILLATION OF THE +12 VOLT POWER SUPPLY Serial Prefixes 739 and Below

Some 2401C voltmeters have shown noise counts in excess of the specifications ( $\pm$  2 counts). This noise is caused by oscillation of the +12 volt power supply.

To correct this problem make the following modification:

- Delete C13 10pf, hp stock number 0160-2197
   NOTE: On units below serial number 735-02037, C13 does not exist.
- Add C13 91pf, hp stock number 0160-2203.
   The capacitor should be installed on connector XA34, pins 5 and 6.

In addition to the above change, if a field replacement of A34, A35, or A36 is made it may be necessary to make the following change:

1. Add or remove Cl2, hp stock number 0140-0149 on connector XA34, pins 1 and 5.

> NOTE: On units having the Paco power transformer, the capacitor C12 will be on connector XA34 pins 1 and 6.

This change is necessary because Cl2 is selected in production test to compensate for parameter changes due to lead lengths and dressing of the cable harness.

Be sure and update the Table of Replaceable parts in the Operating and Service Manual.

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HP 2401C-8

#### HP MODEL 2401C-M31

### LOCK-UP ON ONE RANGE

### Serial Number 751-02187 and below

When operated at ambient temperatures above 50°C, the HP 2401C-M31 autorange circuit tends to lock-up on one range. This problem has been traced to transistors A10Q1 and A10Q2 on the Auto-range Rate Detector Assembly A10 (HP Stk. No. 5060-5878). Typically, these transistors have a lower beta and frequency response than this circuit requires.

To correct this problem, make the following changes on A10: remove Q1 and Q2 (HP Stock No. 1850-0048) and replace them with two HP Stk. No. 1850-0184 transistors. Change the Table of Replaceable Parts to reflect this modification.

Calibration of the Auto-range Rate Detector circuit is required after this change. To calibrate this circuit, use the procedures given in the HP2401C Operating and Service Manual (page M31-10, table 31.2, performance check M31.1),

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# SERVICE NOTE

### HP 2401C

### INTEGRATING DIGITAL VOLTMETER

# NEGATIVE CHANNEL BOARD FAILURE

### Serial Number 811-2568 and below

### PROBLEM DESCRIPTION

When operating the 2401C IDVM in a data acquisition system with a scanner such as the 2901A Input Scanner or 2911 Crossbar Switch, switching transients may destroy transistor Q6 on the Negative Channel Board (A32). This problem has occurred when switching +750V through the scanner to the voltmeter.

#### PROBLEM SOLUTION

Replace transistor Q6 with a direct replacement having a higher breakdown voltage.

#### PROCEDURE

- 1. Remove A32 Negative Channel Board (Stock No. 5060-5001).
- 2. Remove transistor Q6 from Channel Board (Stock No. 1851-0031).
- 3. Install transistor Q6 (Stock No. 1851-0034).
- 4. Install A32 in 2401C IDVM.
- 5. Correct the Table of Replaceable Parts to reflect this change.
- 6. No adjustment or calibration of the instrument is necessary.

This change is incorporated in voltmeters with serial numbers 811-2569 and above.

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### SERVICE NOTE

#### SUPERSEDES:

#### HP 2401C

# INTEGRATING DIGITAL VOLTMETER

### NEGATIVE CHANNEL BOARD FAILURE

### Serial Number 811-2568 and below

#### PROBLEM DESCRIPTION

When operating the 2401C IDVM in a data acquisition system with a scanner such as the 2901A Input Scanner or 2911 Crossbar Switch, switching transients may destroy transistor Q6 on the Negative Channel Board (A32). This problem has occurred when switching +750V through the scanner to the voltmeter.

### PROBLEM SOLUTION

Replace transistor Q6 with a direct replacement having a higher breakdown voltage.

#### PROCEDURE

1.2

1. Remove A32 Negative Channel Board (Stock No. 5060-5001).

2. Remove transistor Q6 from Channel Board (Stock No. 1851-0031).

3. Install transistor Q6 (Stock No. 1851-0034).

4. Install A32 in 2401C IDVM.

5. Correct the Table of Replaceable Parts to reflect this change.

6. No adjustment or calibration of the instrument is necessary.

This change is incorporated in voltmeters with serial numbers 811-2569 and above.

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2401C-10

# SERVICE NOTE

None

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### HP MODEL 2401C-M31 DIGITAL VOLTMETER Serial Numbers 1020A-02897 and Below

# RECOMMENDED TRANSISTOR REPLACEMENT A44Q5

Hewlett-Packard Part Number 1854-0071 is the recommended replacement for transistor A44Q5 (HP Part Number 1851-0034). The new transistor has greater reliability but is recommended for replacement only if failure occurs.

Instruments with serial numbers 1020A-02898 and above, have the 1854-0071 installed during manufacture.

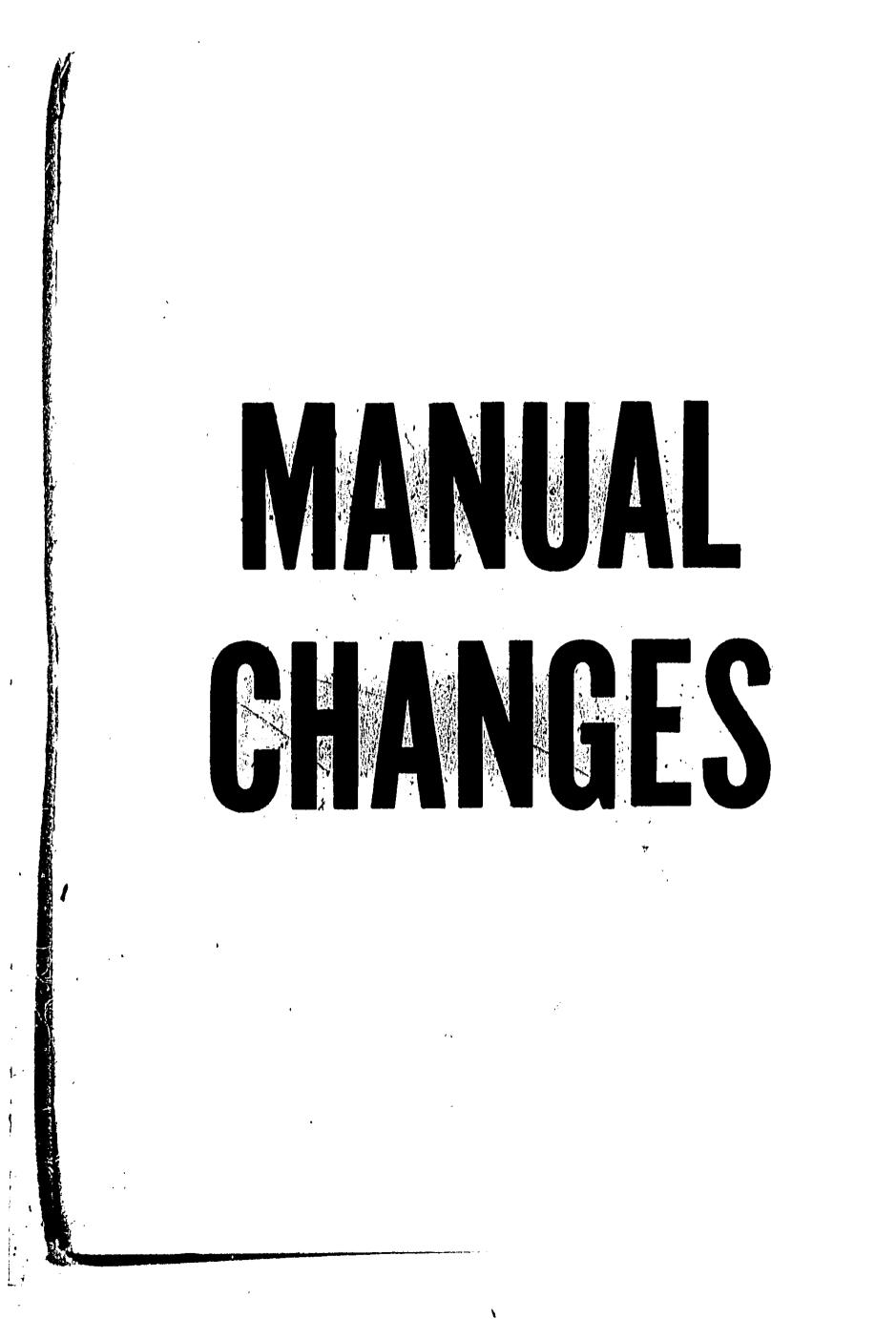
Correct the Replaceable Parts List in your Operating and Ser-

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For more information, call your local HP Sales Office or East (201) 245-5000 + Midwest (312) 477-0400 + South (404) 434-4181 West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 44304. In Europe, 1217 Meyrin-Geneva



PACKARD HEWLETT **, hp**)

### INTEGRATING DIGITAL VOLTMETER

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#### MANUAL UPDATING SUPPLEMENT 24 MARCH 1971

MANUAL PRINTED: June 1969

MANUAL PART NUMBER: 02401-9028

SERIAL NUMBERS COVERED: Serial numbers prefixed 501- through 811-

SUPPLEMENT DESCRIPTION: The purpose of this supplement is to correct manual errors, to describe differences between the instrument described in the manual and the instrument furnished, and to provide additional operating and service information, as required.

#### ΓΓΕΜ

#### DESCRIPTION

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Serial numbers prefixed 1020A (Product Safety Improvements).

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Starting with instruments having serial numbers prefixed 1020A, electrical parts changes were made to ac power input circuits as follows:

Page 1-8, ACCESSORIES FURNISHED, item 1. Change to read:

"1. Power Cord, Length 7-1/2 feet, plugs into rear connector. Stock No. 8120-1348."

Page 2-1, Paragraph 2.1.1. The line set switch now bears the nomenclature SELECTOR switch.

Page 2-4, Paragraph 2.4.1, last item. Change to read:

"<u>POWER switch and LINE (ac line) fuse</u>: Controls ac power to the voltmeter. Legend 115V 2 AT prescribes 2-ampere fuse with normal time lag (slow-blow) for 115-volt operation and legend 230V 1 AT prescribes 1-ampere fuse with normal time lag for 230-volt operation."

Page 2-5, Paragraph 2.4.2, last item. Change to read:

"SELECTOR switch and LINE receptacle. Switch sets the instrument for operation from 115 or 230 line voltage. Legend for LINE receptacle includes operating line voltage and tolerance  $(115/230V \pm 10\%)$ , line frequency range (48-66~), and maximum power consumption (150 VA MAX.)."

Page 4-87, Figure 4-34, sheet 3 of 3. In lower center of figure change LINE SET S11 switch to SELECTOR S11 switch.

Page 5-43, Table 5-1. Change part numbers and descriptions as follows:

Ref. Des.	Part No.	Description
F1 F2 FL1 S7 S10 S11	2110-0303 2110-0312 9100-3115 3101-0030 3101-0030 3101-1234	Fuse: Cartridge 2A, 250V, Slow-Blow Fuse: Cartridge 1A, 250V, Slow-Blow Filter, Line, 6A Switch: Toggle SPST, 15A, 125VAC Switch: Toggle, SPST, 15A, 125VAC Switch: Slide, DPDT

Pages 5-54 and 5-55. Delete entire listing for 2110-0006, 2110-0007, 3101-0001, 3101-0033, and 9100-2477. Add new listings as follows:

Part No.	Description	Mfr	Mr Part	
2110-0303	Fuse: Cartridge 2A	71400	MDX-2A	
2110-0312	Fuse: Cartridge 1A	71400	MDL-1A	
3101-0030	Switch: Toggle, SPST	88140	8906K368	
3101-1234	Switch: Slide, DPDT	82389	11A-1242	
9100-3115	Filter: Line			

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