

**Models 401A and 401B  
Modular System Bins  
Model 402A  
Power Supply  
Operating and Service Manual**

This manual applies to instruments

401A "Rev 26" on rear panel  
401A "Rev 02" on rear panel  
402A "Rev 25" on rear panel

## STANDARD WARRANTY FOR ORTEC INSTRUMENTS

ORTEC warrants that the items will be delivered free from defects in material or workmanship. ORTEC makes no other warranties, express or implied, and specifically **NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

ORTEC's exclusive liability is limited to repairing or replacing at ORTEC's option, items found by ORTEC to be defective in workmanship or materials within one year from the date of delivery. ORTEC's liability on any claim of any kind, including negligence, loss or damages arising out of, connected with, or from the performance or breach thereof, or from the manufacture, sale, delivery, resale, repair, or use of any item or services covered by this agreement or purchase order, shall in no case exceed the price allocable to the item or service furnished or any part thereof that gives rise to the claim. In the event ORTEC fails to manufacture or deliver items called for in this agreement or purchase order, ORTEC's exclusive liability and buyer's exclusive remedy shall be release of the buyer from the obligation to pay the purchase price. In no event shall ORTEC be liable for special or consequential damages.

### QUALITY CONTROL

Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

### REPAIR SERVICE

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing or by telephone [(615) 482-4411], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped **PREPAID** via Air Parcel Post or United Parcel Service to the nearest ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty will be repaired at the standard charge unless they have been grossly misused or mishandled, in which case the user will be notified prior to the repair being done. A quotation will be sent with the notification.

### DAMAGE IN TRANSIT

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment if necessary.

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## 402A POWER SUPPLY

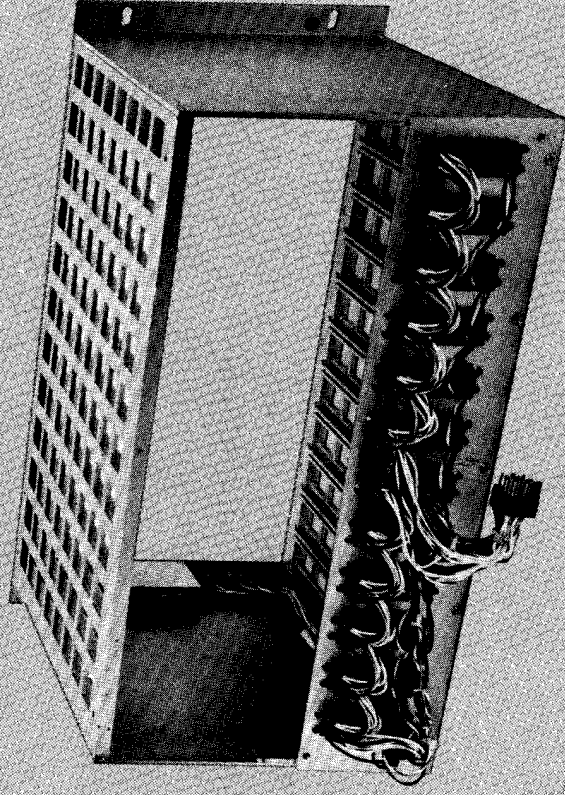
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## ILLUSTRATION

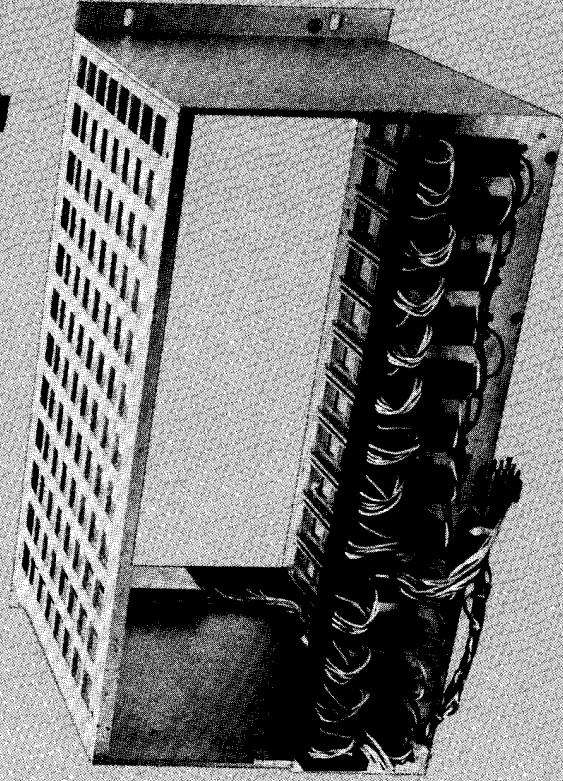
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401A or 401B



401A



401B

## ORTEC 401A AND 401B MODULAR SYSTEM BINS

### 1. DESCRIPTION

#### 1.1. AEC STANDARD MODULE PROGRAM

The ORTEC 401A(B) Modular System Bin conforms to the recommended standards of AEC Report TID-20893 (Rev.), "Standard Nuclear Instrument Modules." This report, the work of a committee of equipment users from AEC-related institutions, provides standards for a modular instrument system that allow electrical and mechanical interchangeability of units made in conformance with the standards. The standards prescribe the necessary mechanical dimensions and connector types to ensure mechanical interchangeability. They also specify standard power supply voltages and pin assignments in the connectors so that electrical interchangeability is assured, at least with respect to the main connector joining module to bin.

The standards currently specify power supply voltages of plus and minus 6, 12, and 24 V dc and of 115 V ac delivered to assigned module connector pins. The available current specified to each pin has undergone some change with successive issues of the standards. Refer to the most recent issue of TID-20893 (Rev.) and addenda for current requirements. Also, since power supplies of earlier manufacture conformed to earlier versions of the standards, the user should familiarize himself with the specifications of the particular supply in use to determine the available current at each voltage.

Twelve basic module widths of 1.35 in. each are provided in a standard bin. Modules may be of single width or any multiple thereof as required by the individual module design. However, all 12 module connectors are provided in the standard bin, allowing any desired combination of module location. Two module and bin heights are provided by the standards, 8 $\frac{3}{4}$  in. and 5 $\frac{1}{4}$  in. These standard heights, as well as the basic external mounting dimensions of the bin, conform to the established ASA standards for relay rack mounting of electrical equipment. Therefore the TID-20893 (Rev.) standard bins will mount in standard relay racks along with other rack-mounted equipment.

The TID-20893 (Rev.) standards deal only with requirements for electrical and mechanical interchangeability. They do not deal with circuit designs or methods except to the extent of the power supply voltage standards.

In addition to the firm requirements designated as "Standards" in TID-20893 (Rev.), there are "Preferred Practices" which deal with subsidiary matters in the interest

of suggested further compatibility. Included in the Preferred Practices are standard linear and logic signal parameters which, if observed, allow compatible interconnections between instruments.

#### 1.2. ORTEC MODULAR INSTRUMENTS

ORTEC Modular Nuclear Instruments conforming to the standards of TID-20893 (Rev.) are designed for insertion and operation in a 401A(B) Bin with an attached mating power supply. In addition to meeting the basic requirements of TID-20893 (Rev.), each ORTEC module also provides two additional compatibility features:

1. Where applicable, the standard linear and logic signal parameters of the Preferred Practices of TID-20893 (Rev.) are used, providing compatible interconnections between instruments.

2. The power supply demand of any given ORTEC module is limited to no more than its proportional share of the occupancy of Bin space. In this way, the user does not have to compute the power supply total demand and compare this to the capability of the supply. Any system of ORTEC modules will automatically be compatible with the available Bin power.

These ORTEC instrument modules are made only in the 8 $\frac{3}{4}$ -in.-high standard module package. The panel space requirements of this type of research instrumentation have precluded the use of the smaller 5 $\frac{1}{4}$ -in. standard height.

#### 1.3. ORTEC 401A(B) MODULAR SYSTEM BIN

The ORTEC 401A Modular System Bin provides mounting space for 12 standard module widths of the 8 $\frac{3}{4}$ -in.-high type. The 12 corresponding module connectors are provided, with necessary wiring for distribution of all of the standard power supply voltages. The ORTEC 401B Bin is identical except that the standard power supply voltages are distributed to the module connectors through bus bars instead of wires. These power distribution circuits terminate in the standard connector prescribed by TID-20893 (Rev.) for connection to the power supply. A small control panel, not occupying any of the available module space, is located at the right side of the Bin, providing control switch test points, a control switch, and indicator lamps for the power supply. Further description of the 401A(B) Bin is given in the remaining sections of this manual.

## 1.4. POWER SUPPLY CONSIDERATIONS

The power supply provisions of TID-20893 (Rev.) allow either a supply mounted on the rear of the standard bin or an external supply, possibly furnishing power to several standard bins. Specified mounting-screw dimensions and a standard power connector make the bin-mounting power

supplies interchangeable when they are made to the TID-20893 (Rev.) standards.

The ORTEC 402A or 402H Power Supply, which conforms to the requirements of TID-20893 (Rev.) in force at time of manufacture, is usually furnished with the 401A(B) Bin. Please refer to the instruction manual provided with each Power Supply.

## 2. SPECIFICATIONS

**MECHANICAL TOLERANCES** In accordance with TID-20893 (Rev.) provide for interchangeability of all standard modules.

**PANEL DIMENSIONS** Standard Relay Rack, 8 $\frac{3}{4}$  in. high, 19 in. wide.

**DEPTH BEHIND PANEL** Without Power Supply, 10.5 in. (26.6 cm); with 402A Power Supply, 16.0 in. (40.6 cm); with 402H Power Supply, 18.0 in. (45.7 cm).

**MODULE CONNECTORS** 12 each connectors as specified by TID-20893 (Rev.).

**INSTALLED WIRING** All connectors of the 401A are wired in parallel for +6 V, -6 V, +12 V, -12 V, +24 V, -24 V, high-quality power return and 115 V ac, in

accordance with TID-20893 (Rev.) pin assignments, with interface connector furnished for connection to power supply as required by TID-20893 (Rev.). The 401B is equipped with laminated bus bars on the +6 V, -6 V, +12 V, -12 V, +24 V, -24 V (AWG #14 equivalent) and for the power ground return (AWG #10 equivalent).

**CONSTRUCTION** Extruded aluminum side members. Die-cast aluminum top and bottom members containing module guides and cadmium-plated steel rear connector plate. Iridite or cadmium finished, with convenience handles on front panel mounting members.

**WEIGHT** 28 lb net with 402A Power Supply; shipping weight 35 lb; 36 lb net with 402H Power Supply; shipping weight 43 lb.

## 3. INSTALLATION INSTRUCTIONS

### 3.1. POWER SUPPLY INPUT VOLTAGE

The ORTEC 402A or 402H Power Supply that usually accompanies the 401A(B) Bin may be used on either 115 V or 230 V, 50 or 60 Hz, input power. The conversion from one voltage to the other is accomplished by a slide switch located on the rear of the Power Supply, labeled as to voltage choice. The Power Supply will be shipped with the voltage set according to the customer's order instructions. However, it is prudent to check this switch for proper setting before operating the supply on 230 V. The power transformer is tapped for a simple conversion to 100-V or 200-V input levels.

Note that when the Power Supply is operated from 115-V input power, a direct connection provides the 115-V ac

power to the assigned pins in the module connectors and the amount of 115-V power available is limited only by the fuse. However, when input power is 230 V, the 115-V ac power provided for the module connectors is limited by transformer ratings in the Power Supply, as stated in the Power Supply specifications.

The fuse supplied installed in the Power Supply is the proper one for input voltage selection as shipped. If a field change of input voltage is made, the proper fuse change should be made as outlined in the Power Supply instruction manual.

### 3.2. INSTALLATION IN RACK

The mounting provisions of the 401A(B) Bin conform to the well-established ASA standards for rack mounting equipment. The mounting holes at the edge of the panel will

match the standard spacing of tapped 10-32 holes provided in the standard relay rack. The use of the usual oval-head screws and cup washers is recommended. Mechanical support of the Bin may be entirely from the panel members. However, the use of horizontal guide brackets to support the bottom of the Bin will facilitate removal of the Bin from the rack and will remove strain from the Bin and rack.

The basic design of the TID-20893 (Rev.) standard bin and modules provides for cooling by natural convection flow. Several bins can be mounted above each other without heat problems in the usual installation. However, one should not mount heat-producing vacuum tube equipment or other large sources of heat in the same cabinet with the standard bin without accounting for the temperature rise.

The use of cooling fans in equipment cabinets will reduce the operating temperature of the enclosed equipment. How-

ever, it will also invariably couple the circuits involved more tightly to the temperature variations of the environment. In systems installations requiring the ultimate in stability of operating parameters, the best practice is to provide only for natural convection cooling of the equipment. This provides long time constants between the equipment and external temperature variations, with resultant smaller variations, even though the average absolute temperature may be higher.

ORTEC modules are designed with all major signal connections on the front panel to the greatest extent possible. In some cases secondary connections are located on the rear of the module when necessary due to panel space limitations. If systems are contemplated that require use of rear panel connections to any great extent, the user may find it convenient to leave open gaps between installed bins for convenience in making front-to-rear connections.

## 4. OPERATING INSTRUCTIONS

### 4.1. CONTROL PANEL FUNCTIONS

**ON-OFF** Switch interrupts both sides of the input power line.

**POWER** Pilot lamp indicates that ac input power is being supplied to the power transformer primary. Either a blown fuse or a temperature cutout will extinguish this lamp.

**TEMP** Warning pilot lamp is illuminated if the Power Supply temperature rises to within  $\sim 20^{\circ}\text{C}$  of the maximum safe operating temperature. When the maximum safe temperature is reached, an internal cutout in the Power Supply removes power and neither lamp will be illuminated.

**TEST JACKS** Located on the panel allow convenient checking of the Power Supply voltages from the front panel without disassembly of the supply.

### 4.2. POWER SUPPLY LIMITATIONS

The available current at each voltage is dependent on the Power Supply. Since the requirements of TID-20893 (Rev.)

have been changed from time to time, the actual capability of any given power supply will depend on its date of manufacture. The instruction manual for the particular power supply in use should be consulted.

The power requirements of individual modules are stated on their front panels. The user should verify that the Power Supply capability is not exceeded in any given system in one bin. Note that a system composed entirely of ORTEC modules will not require this verification, since each ORTEC module uses no more power than its proportional share based on panel space occupancy in the Bin.

### 4.3. INSERTION AND REMOVAL OF MODULES

No damage will result to the Power Supply from insertion or removal of modules while power is on. However, since the sequence of power application to a module is indeterminate when inserted with Bin power on, it is prudent to turn off the Bin power when modules are being changed or inserted.

## 5. CIRCUIT DESCRIPTION

The Bin circuit consists only of passive power distribution wiring. The accompanying wiring diagram provides full information on the wiring.

Power Supply circuit information is contained in the 402A or 402H Power Supply instruction manual immediately following the Bin wiring diagram.

Note the provisions of two "ground" connections in the module connector. Pin 42 is a "high quality ground," and Pin 34 is the "power return ground." The intent is that the high quality ground normally carry negligible current and serve as the reference ground in sensing circuits.

The pins in the module are assigned according to a schedule. Refer to TID-20893 (Rev.) for details on pin assignments.

## 6. MAINTENANCE INSTRUCTIONS

Because of the passive nature of the Bin wiring, maintenance will probably be limited to the addition or removal of wiring. To retain the interchangeability features of the TID-20893 (Rev.) standards, all wiring changes or additions should be done with careful reference to the standard pin assignment schedule, a synopsis of which is given in the figure and table on page 13.

The connector pins specified for use with the standard bins attach to wires by means of a crimped joint. A hand crimping tool is required for this purpose, and is used after the contacts have been pushed into place in the connector block. Removal of a contact also requires the use of a special tool, called a pin-socket extractor.

Assembly details for the connectors and blocks are shown in ORTEC drawing 401-0002, included in this manual. Note that there are two alternate manufacturing sources for the component parts: AMP, Inc., of Harrisburg, Pennsylvania, and Winchester Electronics of Oakville, Connecticut. Each source also provides a hand-crimping tool and a pin-socket extractor. The proper tool for each application must be selected from the same manufacturing source as the connector block and connectors in order to ensure compatibility.

As listed in the details in drawing 401-0002, the AMP connector block for bin mounting is their #202516-3 and is

blue. The equivalent Winchester block is WIN 111-20854 and is orange. The connector block that is mounted on a module that is designed for insertion into the bin can have either an AMP 204186-5 (green) or a WIN 111-20853 (gray) identification.

The hand-crimping tool for use with AMP products is an AMP 90067, which is ORTEC part number 9097-65313. The hand-crimping tool for use with Winchester products is their part 107-0903-2A.

The AMP pin-socket extractor is their part number 305183, ORTEC part number 42947. The Winchester pin-socket extractor is their 107-1015, ORTEC part number 44694.

Either of these tools can be obtained from an authorized distributor of AMP or Winchester parts, respectively, or directly from the manufacturer. They may also be ordered from ORTEC.

The connector pins that are used in the bin and modules are available in several types. Consult TID-20893 and its referenced drawings for suitable types. Additional related information is included in Tables 1, 2, and 3 on ORTEC drawing 401-0002.



## APPENDIX

## REPLACEABLE PARTS

## ORDERING INFORMATION

The Replaceable Parts List shown below contains information needed for ordering spare and/or replacement parts. Each listing indicates the reference designator number, the part number, a description of the component, and the part manufacturer and manufacturer's part number.

All inquiries concerning spare and/or replacement parts and all orders for same should include the model serial, and revision ("Rev" on rear panel) numbers of the instruments involved and should be addressed to the Customer Service Department at 100 Midland Road, Oak Ridge, Tennessee 37830. The Manager of Customer Services can be reached

by telephone at (615) 482-4411. The minimum order for spare and/or replacement parts is \$25.00.

ORDERING INFORMATION  
FOR PARTS NOT LISTED

In order to facilitate the ordering of a part not listed below, the following information should be submitted to the Customer Service Department:

1. the instrument model number,
2. the instrument serial number,
3. revision ("Rev" on rear panel) number,
4. a description of the part,
5. information as to the function and location of the part.

Replaceable Parts List

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
401A-0500	3001 04011			
14	9097 42941	Female Bin Block	81312	#111-20854
15	9097 42942	Harness Block (PG-13)	81312	#111-20859
16	9097 42936	Guide Pin (Bin)	81312	#111-20855
17	9097 42932	Guide Socket (Bin)	81312	#111-20858
18	9097 44696	Contact Socket (Bin)	81312	#100-0820S
19	9097 42943	Contact Socket (Bin)	81312	#100-0817S
20	9097 44695	Contact Pin (PG-13)	81312	#100-0815P
21	9103 41374	Pilot Lamp Assembly	91802	#2150A1
22	9094 41278	Switch, Toggle, DPDT	95146	#MST205-N
30	9097 42937	Guide Socket (Bin)	81312	#111-20856
39	9097 42939	Contact Pin (PG-13)	81312	WIN #100-0812P
40	7180 64835	Terminal Board	ORTEC	401A-0122
C1	9065 40948	6.8 uf 20% 35V Tan.	80183	SPR #150D685X0035B2
C2	9065 40948	6.8 uf 20% 35V Tan.	80183	SPR #150D685X0035B2
C3	9065 40948	6.8 uf 20% 35V Tan.	80183	SPR #150D685X0035B2
C4	9065 40948	6.8 uf 20% 35V Tan.	80183	SPR #150D685X0035B2
C5	9065 40948	6.8 uf 20% 35V Tan.	80183	SPR #150D685X0035B2
C6	9065 40948	6.8 uf 20% 35V Tan.	80183	SPR #150D685X0035B2

[illegible]



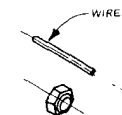
**BIN/MODULE CONNECTOR PIN ASSIGNMENTS  
FOR AEC STANDARD NUCLEAR INSTRUMENT MODULES  
PER TID-20893**

Pin	Function	Pin	Function
1	+3 volts	23	Reserved
2	-3 volts	24	Reserved
3	Spare Bus	25	Reserved
4	Reserved Bus	26	Spare
5	Coaxial	27	Spare
6	Coaxial	*28	+24 volts
7	Coaxial	*29	-24 volts
8	200 volts dc	30	Spare Bus
9	Spare	31	Spare
*10	+6 volts	32	Spare
*11	-6 volts	*33	115 volts ac (Hot)
12	Reserved Bus	*34	Power Return Ground
13	Spare	**35	Reset (Scaler)
14	Spare	**36	Gate
15	Reserved	**37	Reset (Auxiliary)
*16	+12 volts	38	Coaxial
*17	-12 volts	39	Coaxial
18	Spare Bus	40	Coaxial
19	Reserved Bus	*41	115 volts ac (Neut.)
20	Spare	*42	High Quality Ground
21	Spare	G	Ground Guide Pin
22	Reserved		

Pins marked (\*) are installed and wired in ORTEC 401A and 401B Modular System Bins.

Pins marked (\*) and (\*\*) are installed and wired in EG&G/ORTEC—HEP M250/N and M350/N NIMBINS.

HAND CRIMPING TOOL  
SEE NOTE 3  
WIN 107-1015  
ORTEC # 44713



EXTERNAL TYPE  
PIN HOOD (OPTIONAL)  
AMP 201390-5  
ORTEC # 41739  
SEE NOTE 1  
WIN-111-20852-1  
ORTEC 42944

ORTEC #46244 IS A STANDARD PUT-UP OF TEN EACH 8 INCH #20 AWG WITH #41357 (AMP PIN CONTACT 66104-1) WIRE COLORS: BLACK, BROWN, RED, ORANGE, GREEN, BLUE, GRAY, VIOLET, WHITE, WHITE. SPECIAL ORDERS PER TABLE 1 OR TABLE 2

TABLE 1— AMP SOCKET AND PIN CONTACTS (TYPE III +)				
SOCKET CONTACT		PIN CONTACT		FOR WIRE SIZE (AWG) *
AMP NO.	ORTEC NO.	AMP NO.	ORTEC NO.	
66358-1	42433	66359-1	42434	1 #14 OR 2 #18
66100-1	41360	66098-1	41349	1 #16, 1 #18 OR 2 #20
66104-1	41357	66102-1	41355	1 #20 OR 2 #22
66108-1	SPECIAL	66106-1	SPECIAL	1 #24 OR 2 #26

\*ALL WIRE TEFLON INSULATED TYPE EE EXCEPT #18 GA TYPE E.

XXXXX-X-XXXX-XXX-XX/XX  
ORTEC NO. NO. WIRE GAGE LENGTH (INCHES) COLOR(S)  
(PIN OR SOCKET)  
1-BROWN  
2-RED  
3-ORANGE  
4-YELLOW  
5-GREEN  
6-BLUE  
7-VIOLET  
8-GRAY  
9-WHITE  
10-BLACK

EXAMPLE: SOCKET CONTACT FOR 2 #22 WIRES,  
10 INCHES LONG, COLORS, ONE RED,  
ONE BLACK, 41357-2#22-10-2/10

ORTEC  
500007

SOCKET CONTACT  
SEE TABLE 1  
AND TABLE 2

MOUNT IN BIN  
(42) POSITION  
FEMALE BLOCK  
AMP 202516-3  
(BLUE)  
ORTEC # 41358  
WIN-111-20854  
ORTEC 42941  
(ORANGE)

MOUNT ON MODULE  
(42) POSITION  
MALE BLOCK  
AMP 204186-5  
(GREEN)  
ORTEC # 41344  
WIN-111-20853  
ORTEC 42934  
(GRAY)

GUIDE SOCKET  
AMP 20396A-6  
(3) REQ'D  
ORTEC # 41347  
WIN-111-856-1  
ORTEC 42937

GUIDE PIN (GOLD PLATED)  
AMP 200833-4  
(3) REQ'D  
ORTEC # 41346  
WIN-111-20855  
ORTEC 42936

GUIDE SOCKET  
AMP 202512-1  
(GROUND)  
ORTEC # 41325  
WIN-111-20858  
ORTEC 42932

GUIDE PIN (GOLD PLATED)  
AMP 202514-1  
(GROUND)  
ORTEC # 41348  
WIN-111-20855  
ORTEC 42936

PIN-SOCKET EXTRACTOR  
AMP 305183  
ORTEC # 42947  
SEE NOTE 2  
WIN-107-1005  
ORTEC # 44694

- NOTES: 1. PIN HOODS ARE OPTIONAL PARTS IF  
PIN HOOD IS NOT USED 1/32 (.032)  
THICK SPACERS MUST BE SUBSTITUTED  
(4 PLACES.)  
2. PIN-SOCKET EXTRACTOR NECESSARY TO  
REMOVE CONTACTS FROM ALL BLOCKS.  
3. HAND CRIMPING TOOL NECESSARY  
WHEN INSTALLING WIRE IN CONTACTS

TABLE 2 WINCHESTER SOCKET AND PIN CONTACTS				
SOCKET CONTACT		PIN CONTACT		FOR WIRE SIZE (AWG)
WIN. NO.	ORTEC NO.	WIN. NO.	ORTEC NO.	
100-0816S	42940	100-0811P	42938	1 #14, 2 #20
100-0817S	42943	100-0812P	42939	1 #16, 1 #18 OR 1 #20 OR 2 #22
100-0820S	44696	100-0815P	44695	2 #18

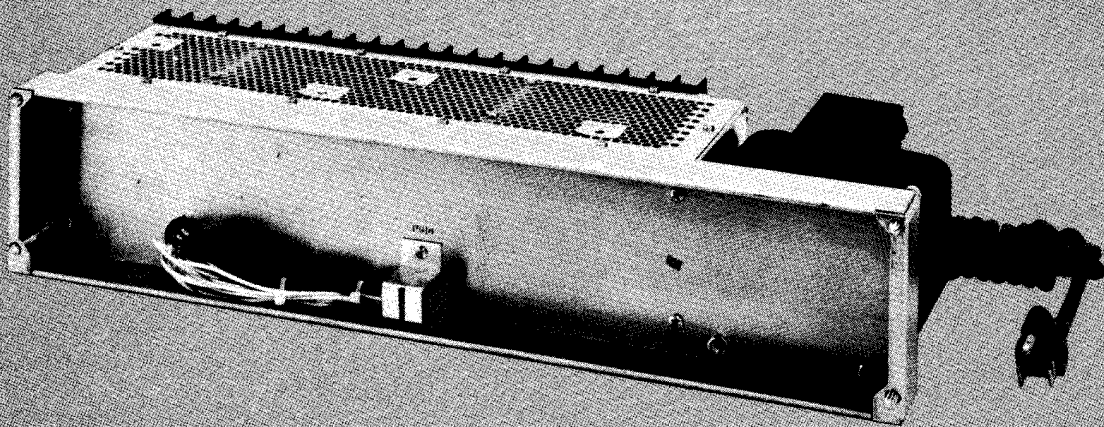
PIN CONTACT  
SEE TABLE 1  
AND TABLE 2

INTERNAL TYPE  
PIN HOOD  
AMP 202394-2  
ORTEC # 41345  
WIN-111-20851-1  
ORTEC 42935

TYPICAL HARDWARE  
FOR GUIDE PINS &  
GUIDE SOCKETS.

TABLE 3 AMP SOCKET AND PIN CONTACTS (TYPE II)				
SOCKET CONTACT		PIN CONTACT		FOR WIRE SIZE (AWG)
AMP NO.	ORTEC NO.	AMP NO.	ORTEC NO.	
202508-2	48214	202507-2	48215	1 #18, 1 #16
202726-2	48216	202725-2	48217	2 #18

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES		TOLERANCES	
FINISH	10/16-67	FINISH	10/16-67
DATE	10/16-67	DATE	10/16-67
BY	10/16-67	BY	10/16-67
CHECKED	10/16-67	CHECKED	10/16-67
APPROVED	10/16-67	APPROVED	10/16-67
42 POSITION CONNECTOR & HARDWARE		401-0002	



## ORTEC 402A POWER SUPPLY

### 1. DESCRIPTION

The ORTEC 402A Power Supply is designed to be mounted in the space provided on the rear of the 401A(B) Modular System Bin. The Supply was designed to exceed the recommended power supply specifications, Appendix A of TID-20893 (Rev.), Type 1, Class A, adopted by the AEC Committee on Nuclear Instrument Modules.

The 402A was designed for both foreign and domestic usage. Input voltage mains of 115 V ac or 230 V ac, 50-65 Hz, may be used. A simple circuit modification permits operation on 100-V or 200-V input mains; see Section 6. A convenience indicating switch located on the rear of the Supply clearly identifies the intended main to use. The primary circuits are fused, and a three-conductor NEMA-standard power cord is included.

The Supply furnishes four standard dc voltages: +12 V at 2 A, -12 V at 2 A, +24 V at 1 A, and -24 V at 1 A, with a maximum power capability of 72 W at 50°C. A high-efficiency heat sink allows additional power dissipation (see "Specifications"). The dc outputs are regulated, short-circuit protected, current limited, and thermal protected.

The 115 V ac is supplied to the Bin connector independent of input mains. The 115-V ac power available is limited only by the Power Supply fuse when operating from 115-V ac mains. When operating from 230-V ac mains, the 115-V ac is derived by autotransformer action and is limited to 50 VA output with a dc load on the power supply of 72 W.

A control panel is provided on the 401A(B) Bin for operating and monitoring the 402A Power Supply. An On-Off switch, power indicating lamp, thermal warning lamp, and convenience dc monitor jacks are provided. The thermal warning lamp is lighted when the internal temperature rises to within 20°C of the maximum safe operating temperature. The Power Supply is automatically cut off by an internal switch should the temperature exceed the maximum safe operating temperature.

The Power Supply regulator amplifiers are located on the two identical plug-in printed circuit boards, which may be interchanged for maintenance purposes. Spare regulator boards are available. The regulating transistors and current monitoring resistors for the current limiting are mounted on a specially designed high-efficiency heat sink.

The power transistors are virtually indestructible due to their power handling capability, current limiting, and short-circuit protection. All-silicon semiconductors, 85°C capacitors with conservative working voltage ratings, and high-quality carbon and metal film resistors are combined to produce this Power Supply which exceeds the TID-20893 (Rev.) requirements.

The dc output voltages are adjustable over a  $\pm 1$ -V range from their nominal ratings through holes in the top of the Power Supply cover plate. The 15-turn adjustment potentiometers are precision wire wound for superior adjustment resolution and resettability of the output voltages.

### 2. SPECIFICATIONS

The specifications for the 402A Power Supply meet or exceed those set forth by the AEC Committee on Nuclear Instrument Modules, TID-20893 (Rev.), Appendix A, Type 1, Class A.

**INPUT** 103-129 V ac, 50-65 Hz, or 210-258 V ac, 50-65 Hz. Input current at 115 V is 1.8 A for a 72-W dc output.

**DC OUTPUT** Output at the following ratings +12 V at 2 A, -12 V at 2 A, +24 V at 1 A, -24 V at 1 A, maximum output power to 50°C ambient, 72 VA; operation to 60°C ambient with current derated not more than 3%/°C. Under certain conditions the 72-VA power limitation may be exceeded to a maximum of 96 VA (see Fig. 2.1).

**115 VOLT AC OUTPUT** 115-V ac output limited only by the supply fuse when operating from 115-V ac mains. Output is limited to 50 VA at 72-VA dc load while operating from 230-V ac mains.

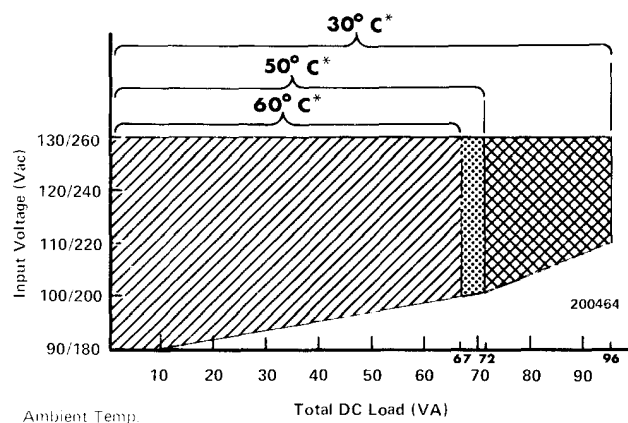


Fig. 2.1. Maximum Safe Operating Range.

**REGULATIONS**  $\pm 0.05\%$  over the combined range of zero to full load and input voltage of 103-129 V ac over any 24-hr period at a constant ambient temperature and rated line and load after a 60-min warmup.

**STABILITY**  $\pm 0.3\%$  after a 24-hr warmup of constant line, load, and ambient temperature over a six-month period.

**TEMPERATURE COEFFICIENT** Less than  $0.01\%/^{\circ}\text{C}$  over a range of  $0^{\circ}\text{C}$  to  $60^{\circ}\text{C}$ .

**THERMAL PROTECTION** A thermal warning switch will be activated when the ambient temperature approaches within  $20^{\circ}\text{C}$  of the safe operating temperature. A thermal cutout switch disables the Power Supply when the temperature exceeds the safe operating temperature.

**NOISE AND RIPPLE** The output noise and ripple are less than 3 mV peak to peak, as observed on a 50-MHz bandwidth oscilloscope.

**VOLTAGE ADJUSTMENT**  $\pm 0.5\%$  minimum range, re-settability  $\pm 0.05\%$  minimum of supply voltage; typical  $\pm 1\%$  V of specified voltage.

**RECOVERY TIME** Less than 50  $\mu\text{sec}$  to return to within  $\pm 0.1\%$  of rated voltage for any change in input voltage and load current from 10 to 100% full load.

**CIRCUIT PROTECTION** The input line to the power supply is fused. In addition, electronic circuitry provides output current limiting, to prevent damage to the supply, and provides automatic recovery when the demand is removed.

**OUTPUT IMPEDANCE** Less than  $0.3\Omega$  at any frequency to 100 kHz.

**OUTPUT CONNECTOR** All power and control circuits terminate in a connector, specified by TID-20893 (Rev.), which mates with the Bin interface connector, completing the necessary control and Power Supply wiring.

**DIMENSIONS** 16.825 in. wide, 3.438 in. high, 5.500 in. deep; conforms to AEC Drawing ND515.

**WEIGHT** 13 lb net; with 401A(B) Bin 27 lb net. Shipping weight for 401A(B)/402A 35 lb gross.

### 3. INSTALLATION

The 402A Power Supply is normally supplied factory-connected to an ORTEC 401A(B) Modular System Bin. However, the supply is designed to TID-20893 (Rev.) specifications and may be attached, in the space provided, to any bin manufactured to TID-20893 (Rev.) specifications.

For attachment to other than ORTEC 401A(B) Bin, please refer to the appropriate instruction manual. The On-Off switch and other controls necessary to operate the Supply are part of the Bin and not furnished with the Power Supply.

For attachment to 401A(B) Bin the following steps are advised:

1. Place the Bin on a table with the back part facing you. Place the Power Supply in the proper mounting position, leaving enough space between the two pieces to attach the interface connector.

2. Mate the interface connector, being careful to align the polarizing pins. Fold and form all wiring close to the connector edges to prevent any wires from being pinched and producing a short circuit in succeeding steps.

3. Mount the Power Supply to the Bin by securely tightening the four 10-32 screws, being careful not to pinch any wires or to use undue force on any parts.

When attaching the 402A Power Supply to older 401 Bins, it is necessary to first remove the left and right side covers and stand the Bin on its front face (handles down). From this point on, assembly is the same; upon completion the side plates should be replaced.

### 4. OPERATING INSTRUCTIONS

The available current from the Power Supply is specified by TID-20893 (Rev.), Appendix A, Type 1, Class A, supply. Under certain conditions these specifications may be exceeded (see Fig. 2.1.) Care must be used to ensure natural convection of heat dissipated by the heat sinks and power transformer. For best results, when using at maximum power loadings the Bin and Power Supply should be

in an open space, placed upon blocks at least 1 in. off the table mounting surface to allow maximum ventilation. When used in a rack, maximum attention should be paid to placement of other heat-generating equipment. Adequate unobstructed space on all sides is necessary for convection ventilation and cooling. If the Bin contains other heat-generating equipment, a blower may be advisable to remove the dissipated heat.



When it is necessary to rack mount several Bins and Power Supplies, especially when other heat-generating equipment is located within the rack, the term "ambient temperature" becomes less clearly defined. A better guide to maximum power loading capability is to monitor the heat sink temperature. In no case allow the heat sink temperature to

continuously run above 85°C. Although this is not the maximum operation temperature, any additional temperature rise due to other conditions of the system may force the Supply out of tolerance and may cause it to automatically shut down operation. Should your operation produce a temperature of 85°C, a blower to remove the dissipated heat is indicated.

## 5. CIRCUIT DESCRIPTION

The 402A Power Supply produces four dc output voltages. A power transformer transforms the input ac line voltage into four separate low-voltage sources. The sources or windings are full-wave-rectified, capacitor-filtered, and regulated by electronic series regulator circuits. The regulator circuits provide short circuit, current limiting, and reverse current protection.

Each of the four series regulator circuits is identical in operation; they are physically different only in component values for each Supply. The regulator essentially operates in two modes: First and normal is the voltage regulation mode; second is the constant-current or current-limiting protection mode.

The regulation will operate in the voltage regulation mode at any current output up to and including the full rated output of a particular supply. When current output beyond the rated output is required, which includes a direct short across the output terminals, the regulator automatically shifts into a constant-current mode. This provides current limiting and protection of the regulator's circuitry and components. When excessive current demands are removed, the regulator resumes the voltage regulation mode.

For operation of the regulator, please refer to circuit Drawing 402A-1100-S1. For convenience, only the +24-V regulator will be discussed, and the following is an explanation

of the regulation in the normal voltage regulation mode.

Transistors Q6 and Q7 operate as a differential amplifier pair, comparing the reference voltage of D4 at the base of Q6, with a portion of the output voltage divided down through R16, R17, and R18. Trim potentiometer R17 is used to adjust the output voltage to the specified level. A difference voltage at the collector of Q7 is dc amplified by Q4 and Q2. The collector of Q2 drives emitter-follower Q1, which supplies the necessary current to drive the remotely located series power transistor. This transistor is heat-sink-mounted to dissipate the power consumed in the regulation process.

In the constant-current or limiting mode, remotely located resistor R1, in series with the output, senses the output current level and produces a proportional voltage rise. The sense voltage is compared to the output voltage at the base of Q5. For output current levels less than or equal to the rated output, Q5 remains back-biased and will have no effect on the regulator performance. However, when the output current exceeds the rated output, Q5 becomes forward-biased and conducts, causing Q2 to conduct harder, thereby reducing the available base drive current to emitter-follower Q1 and the series pass regulator transistor. As a result, the output voltage is reduced until the output current is within the required limits. Upon removal of the short circuit or excessive current demand, the regulator resumes the normal voltage regulation mode.

## 6. MODIFICATION

The transformer in this ORTEC 402A Power Supply has a tap in each of the primary windings to permit operation with a nominal 100/200 V ac input. The tap for one primary is a yellow wire and for the other primary is a white wire. These leads are covered with shrinkable tubing over the ends and are included in the bundle of leads from the transformer.

To operate the 402A Power Supply from either a 100 or 200 V ac power source, use the following steps to change the primary winding connections:

1. Remove the top cover from the 402A Power Supply.
2. Remove the two plug-in regulator boards.
3. Locate the unused yellow and white wires and remove the shrinkable tubing from the wire ends.
4. Disconnect the black wire from the 115/230 VAC switch and connect the yellow wire to the switch terminal in place of the black wire.
5. Disconnect the black/white and red wires from the 115/230 VAC switch and connect the white wire to this switch terminal.
6. Use shrinkable tubing or electrical insulation tape to cover the bare end of the black wire.
7. Connect the black/white and red wires together and wrap the ends with electrical insulating tape.
8. Return the two plug-in regulator boards and the top cover to the 402A Power Supply.

The 402A is now wired for 100/200 V ac line operation instead of 115/230 V ac. Ensure that the switch selects the proper range before applying power to the unit.

## APPENDIX

## REPLACEABLE PARTS

## ORDERING INFORMATION

The Replaceable Parts List shown below contains information needed for ordering spare and/or replacement parts. Each listing indicates the reference designator number, the part number, a description of the component, and the part manufacturer and manufacturer's part number.

All inquiries concerning spare and/or replacement parts and all orders for same should include the model serial, and revision ("Rev" on rear panel) numbers of the instruments involved and should be addressed to the Customer Service Department at 100 Midland Road, Oak Ridge, Tennessee 37830. The Manager of Customer Services can be reached

by telephone at (615) 482-4411. The minimum order for spare and/or replacement parts is \$25.00.

ORDERING INFORMATION  
FOR PARTS NOT LISTED

In order to facilitate the ordering of a part not listed below, the following information should be submitted to the Customer Service Department:

1. the instrument model number,
2. the instrument serial number,
3. revision ("Rev" on rear panel) number,
4. a description of the part,
5. information as to the function and location of the part.

The solid-state-device (diodes, transistors, and integrated circuits) types installed in your instrument may differ from those shown in the schematic diagram and parts list. In such cases, necessary replacements can be made with either the type shown or the type actually installed in the instrument.

## Replaceable Parts List

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
402A-1000	5010 40158			
6	9090 42373	Transformer, Power	07119	#T-3526A KMC
7	9094 41299	Sw, Thermo, N.C. 203° F	14604	#2450 ESS
8	9094 41300	Sw, Thermo, N.C. 180° F	14604	#2450 ESS
9	9097 41304	Connector, 22-Pin	CHJ	#250-22-30-170 CHJ
10	9097 42945	Block, P/S Harness (PG14)	81312	#111-20860 WIN
11	9097 42943	Contact, Socket, (PG14)	81312	#100-0817S WIN
12	9097 42428	Connector Clamp	ORTEC	402A-1204
13	9101 41365	Fuse Holder	75915	#342004 LIT
14	9101 41746	Fuse, 3-Amp, 3AG	75915	#312003 LIT
15	9094 41298	Sw, Slide, DPDT	82389	#46256-LF SWC
26	9148 41903	Power, Cord, 3-Cond. 6'	70903	#17237-SVT BMC
27	9125 41801	Strain Relief - Bushing	28520	#SR-5P-1 HMC
28	9097 44696	Contact, Socket, (PG14)	81312	#100-0820S WIN
37	9101 41747	Fuse, 1.5 Amp. Std.	75915	#312001-5 LIT
D1	9080 44206	F.W. Bridge	27777	#VH247 VRO
D6	9080 44206	F.W. Bridge	27777	#VH247 VRO
D11	9080 44206	F.W. Bridge	27777	#VH247 VRO
D12	9080 44206	F.W. Bridge	27777	#VH247 VRO

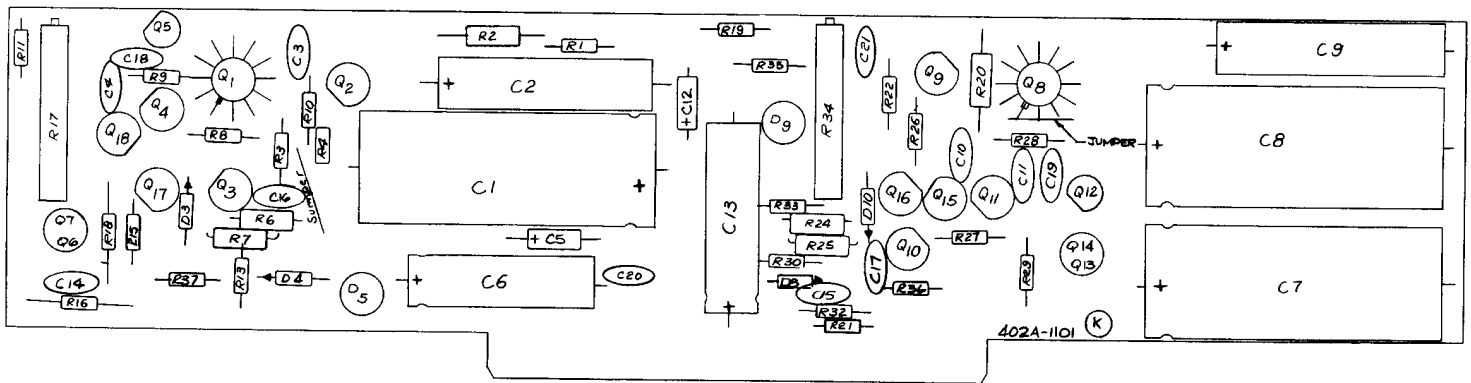
### Replaceable Parts (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
402A-1000	5010 40158			
cont'd.				
Q1	9078 43682	Transistor - MJE3055	80211	MOT
Q2	9078 43682	Transistor - MJE3055	80211	MOT
Q3	9078 43682	Transistor - MJE3055	80211	MOT
Q4	9078 43682	Transistor - MJE3055	80211	MOT
R1	9039 40750	3 $\Omega$ 10W 5% WW	00213	SAG
R2	9039 40749	1.5 $\Omega$ 10W 5% WW	00213	SAG
R3	9039 40750	3 $\Omega$ 10W 5% WW	00213	SAG
R4	9039 40749	1.5 $\Omega$ 10W 5% WW	00213	SAG
402A-1100	5007 40159			
C1	9067 40987	1000 uf -10+100% 50V El.	29505	#301-011-01 TPE
C2	9067 42687	75 uf 50V El.	80183	#TE1308 (30D) SPR
C3	9055 40838	0.001 uf 20% 1KV Disc.	80183	#C023K102E102M SPR
C4	9055 40855	0.01 uf 20% 50V Disc.	80183	#C023K101F103M SPR
C5	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C6	9067 42688	150 uf 25V EL.	80183	#TE1212 (30D) SPR
C7	9067 40986	2000 uf -10+100% 35V El.	29505	#301-082-01 TPE
C8	9067 40986	2000 uf -10+100% 35V El.	29505	#301-082-01 TPE
C9	9067 42687	75 uf 50V El.	80183	#TE1308 (30D) SPR
C10	9055 40838	0.001 uf 20% 1KV Disc.	80183	#C034 K102E102M SPR
C11	9055 40855	0.01 uf 20% 50V Disc.	80183	#C023K101F103M SPR
C12	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C13	9067 42688	150 uf 25V El.	80183	#TE1212 (30D) SPR
C14	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C15	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C16	9057 40832	100 Pf NPO 1KV Disc.	80183	#C028K102E101M SPR
C17	9057 40832	100 pf NPO 1KV Disc.	80183	#C028K102E101M SPR
C18	9055 40855	0.01 uf 20% 50V Disc.	80183	#C023K101F103M SPR
C19	9055 40855	0.01 uf 20% 50V Disc.	80183	#C023K101F103M SPR
C20	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C21	9055 40855	0.01 uf 20% 50V Disc.	80183	#C023K101F103M SPR
D3	9080 41125	Diode - 1N4009	14433	ITT
D4	9080 44208	Diode - 1N938 (Zener)	81483	IRI
D5	9080 42479	Diode - MR1030B	80211	MOT
D8	9080 44197	Diode - 1N823 (Zener)	80211	MOT
D9	9080 42479	Diode - MR1030B	80211	MOT
D10	9080 41125	Diode - 1N4009	14433	ITT

## Replaceable Parts (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
402A-1100	5007 40159			
cont'd.				
Q1	9078 41070	Transistor - 2N3053	86684	RCA
Q2	9078 41083	Transistor - 2N3643	13715	FSC
Q3	9078 41088	Transistor - 2N3568	13715	FSC
Q4	9078 41080	Transistor - 2N3638A	13715	FSC
Q5	9078 41080	Transistor - 2N3638A	13715	FSC
Q6	* 9078 43667	Transistor - MD-2219A	80211	(1st Choice) MOT
Q7	* 9078 43667	Transistor - MD-2219A	80211	(1st Choice) MOT
Q8	9078 41070	Transistor - 2N3053	86684	RCA
Q9	9078 41083	Transistor - 2N3643	13715	FSC
Q10	9078 41088	Transistor - 2N3568	13715	FSC
Q11	9078 41080	Transistor - 2N3638A	13715	FSC
Q12	9078 41080	Transistor - 2N3638A	13715	FSC
Q13	* 9078 43667	Transistor - MD-2219A	80211	(1st Choice) MOT
Q14	* 9078 43667	Transistor - MD-2219A	80211	(1st Choice) MOT
Q15	9078 41080	Transistor - 2N3638A	13715	FSC
Q16	9078 41083	Transistor - 2N3643	13715	FSC
Q17	9078 41083	Transistor - 2N3643	13715	FSC
Q18	9078 41080	Transistor - 2N3638A	13715	FSC
R1	9015 40209	100 $\Omega$ 1/4W 5% C	01121	CB ABC
R2	9017 40329	2.2 K 1/2W 5% C	01121	EB ABC
R3	9015 40210	120 $\Omega$ 1/4W 5% C	01121	CB ABC
R4	9027 40517	1.47 K 1/8W 1% MF	IRC	CEA IRC
R6	9027 40517	1.47 K 1/8W 1% MF	IRC	CEA IRC
R7	9027 40517	1.47 K 1/8W 1% MF	IRC	CEA IRC
R8	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R9	9015 40271	51 $\Omega$ 1/4W 5% C	01121	CB ABC
R10	9015 40231	2 K 1/4W 5% C	01121	CB ABC
R11	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R13	9027 40522	2 K 1/8W 1% MF	IRC	CEA IRC
R15	9027 40523	2.15 K 1/8W 1% MF	IRC	CEA IRC
R16	9026 46771	2 K 1/8W 1% MF	IRC	CEA (50PPM T-2) IRC
R17	9051 40793	200 $\Omega$ 20T Cer. Pot.	73138	#78P-R200 BEK
R18	9026 46806	1.15 K 1/8W 1% MF	IRC	CEA (50 PPM T-2) IRC
R19	9015 40220	510 $\Omega$ 1/4W 5% C	01121	CB ABC
R20	9017 40351	2 K 1/2W 5% C	01121	EB ABC
R21	9015 40210	120 $\Omega$ 1/4W 5% C	01121	CB ABC
R22	9027 40517	1.47 K 1/8W 1% MF	IRC	CEA IRC
R24	9027 40578	1.21 K 1/8W 1% MF	IRC	CEA IRC
R25	9027 40578	1.21 K 1/8W 1% MF	IRC	CEA IRC
R26	9015 40226	1 K 1/4W 5% C	01121	CB ABC
*	OPTION:	Transistor - SGC-2539	01295	(2nd Choice) TII

[illegible]



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