MODEL SR560

LOW-NOISE PREAMPLIFIER

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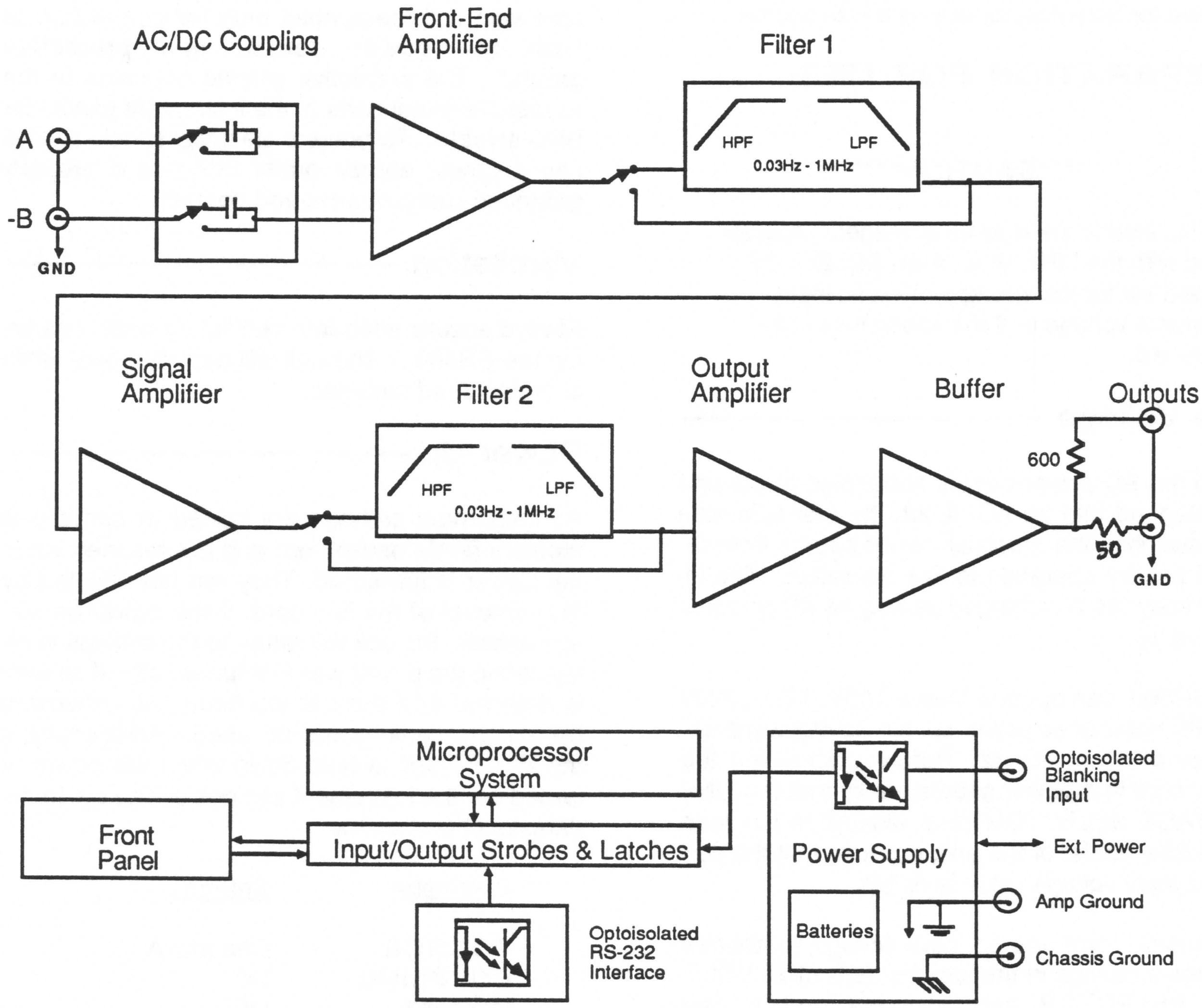


Figure 1: SR560 Block Diagram

INSTRUMENT OVERVIEW

The SR560 architecture is diagrammed above. The instrument provides dc-coupled low-noise amplification of single-ended and true differential input signals at gains of 1 to 50,000. Two configurable R-C filters are provided to selectively condition signals in the frequency range from dc to 1MHz. The user can choose high dynamic reserve or low noise settings, and can invert the output relative to the input. The SR560 normally operates with a fully-floating ground -- that is, it can be viewed as an "in-line-BNC amplifier" with the amplifier ground isolated from the chassis and the AC power supply. Optoisolated input blanking control and listen-only RS-232 interface lines are provided for instrument control. The absence of all digital noise is achieved by shutting down the microprocessor's oscillator except during the short time required to alter the instrument's configuration, either through a front-panel pushbutton or through an RS-232 command. Internal sealed

Repackaging for Shipment

The original packing materials should be saved for reshipment of the SR560. If the original packing materials are not available, wrap the instrument in polyethylene sheeting or equivalent and place in a strong box, cushioning it on all sides by at least three inches of high-density foam or other filler material.

Use in Biomedical Applications

Under certain conditions, the SR560 may prove to be unsafe for applications involving human subjects. Incorrect grounding, component failure, and excessive common-mode input voltages are examples of conditions in which the instrument may expose the subject to large input currents. Therefore, Stanford Research Systems does not recommend the SR560 for such applications.

Warning Regarding Use with Photomultipliers

The front end amplifier of this instrument is easily damaged if a photomultiplier is used improperly with the amplifier. When left completely unterminated, a cable connected to a PMT can charge to several hundred volts in a relatively short time. If this cable is connected to the inputs of the SR560, the stored sharge may damage the front-end FETs. To avoid this problem, provide a leakage path of about 100kΩ to ground inside the base of the PMT to prevent charge accumulation.

SPECIFICATIONS

SR560 LOW-NOISE PREAMPLIFIER

Inputs	Single-ended or True Differential
Impedance	100 MOhm +25 pF, dc-coupled
Maximum Inputs	1V DC before overload; 10V peak max AC coupled: protected to 100V DC
Noise	<4 nV/√ Hz at 1kHz
CMRR	>80dB to 1kHz, decreasing by 6dB/octave (20dB/decade) above 1kHz
Gain Accuracy	1%, DC to 10kHz 3%, 10kHz to 100kHz
Gain Stability	200 ppm/° C
Filters	.03Hz to 1MHz, 10% typical accuracy
Distortion	0.01% typical
Power	100, 120, 220, 240 Vac (50/60 Hz) 60 Watts Max
	Internal Batteries: 3x12V, 1.9Ah sealed lead-acid (rechargeable)
	+/- 12 VDC in/out through rear panel banana jacks
Battery life	20 hours nominal 250-1000 charge/discharge cycles
Charge time	4 hours to 80% of capacity
Mechanical	1/2 Rack-Mount width, 3 1/2" height weight 15 lbs.
Dimensions	14-7/8" x 8-1/8" x 3-1/2"
Warranty	1 year parts and labor on materials and workmanship

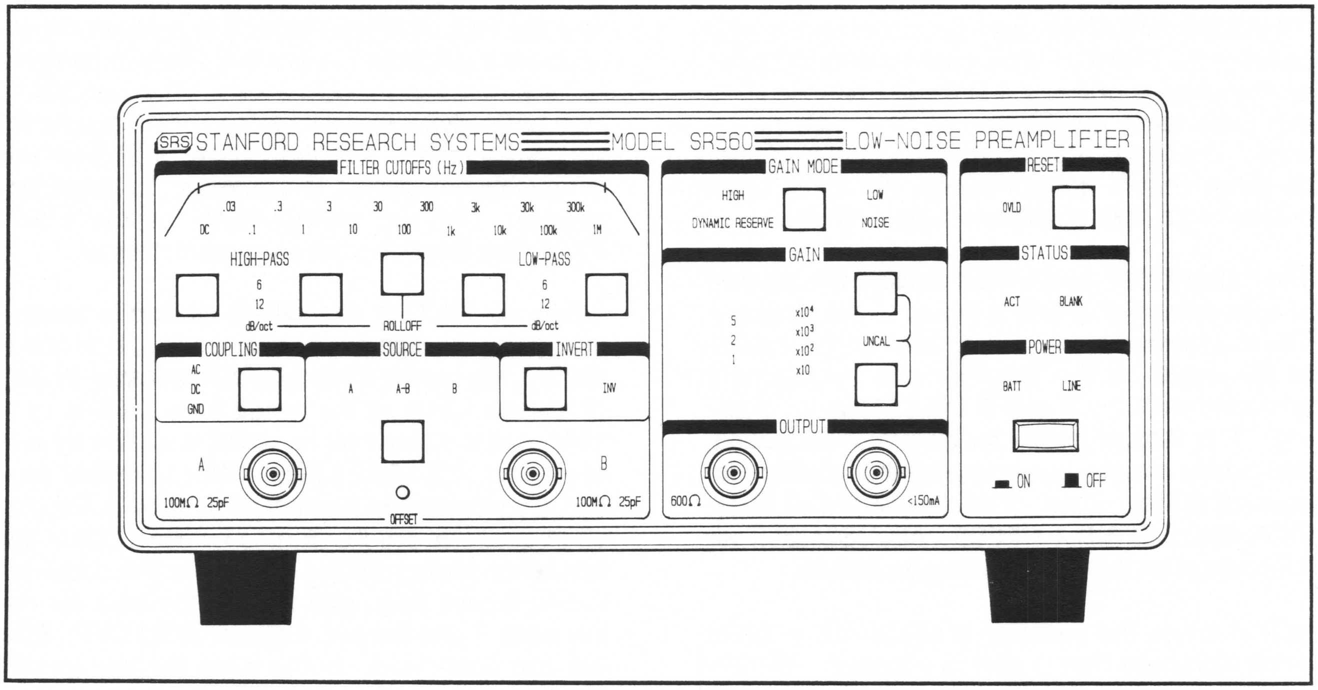


Figure 2: SR560 Front Panel

SR560 OPERATING SUMMARY

The operation of the SR560 Low-Noise Preamplifier has been designed to be as simple as possible. The effect of each keypress on the front panel is reflected in the change of a nearby LED. The front panel LED's will remain lighted at all times unless dip switch SW601 (accessible through the bottom cover of the unit) positions 3 and 4 are placed in the "off" position. All front panel functions can be controlled through the rear-panel RS-232 interface.

Power

The SR560 is turned on by depressing the **POWER** switch. When disconnected from AC power, the unit will operate for approximately 20 hours on internal sealed lead-acid batteries. Up to 200 mA of unregulated battery power is available at the rear panel banana jacks as long as the power switch is in the on position. Battery life will be reduced when the unit is providing external power through the rear panel jacks. When operating on batteries, the front panel "BATT" indicator will be lighted. As the batteries near exhaustion, this indicator will change from green to red, indicating that the unit should be connected to AC power to charge the batteries.

When connected to an AC power source, amplifier power is derived from regulated line power, and the internal batteries are automatically charged. When operating on AC power, the front panel "LINE" indicator is on to indicate the source of amplifier power. Charging status is indicated on the rear panel by the "CHARGE" and "MAINTAIN" LED indicators.

Source

There are two input connectors located in the **SOURCE** section of the front panel. The pushbutton located between them selects among single-ended (**A**), differential (**A-B**), or single-ended (**B**) inputs.

The **A** and **B** inputs are voltage inputs with 100 MOhm, 25 pF input impedance. Their connector using the **GAIN** pushbuttons. Gain settings from 1 to 50,000 are available and are displayed in the form of a factor (1, 2 or 5) and a multiplier (none (i.e. 1), 10, 100, 1,000 or 10,000). In addition to these fifteen fixed gain settings, the user may specify arbitrary gains through the UNCAL feature. To set an uncalibrated or arbitrary gain the user must press both Gain buttons simultaneously, lighting the UNCAL LED . In this mode the user may reduce the calibrated gain in roughly 1/2% increments by pressing the Gain Up or Gain Down pushbuttons. In contrast to other front-panel functions, when in UNCAL the instrument's key-repeat rate will start slowly and increase to a limit as long as either Gain button is depressed. Simultaneously pressing both Gain buttons once again will restore the unit to the previous calibrated gain setting, and turn off the UNCAL LED.

Output

The outputs of the instrument are located within the **OUTPUT** section of the front panel. Two insulated BNCs are provided: a 600 ohm output and a 50 ohm output. The amplifier normally drives high impedance loads and the instrument's gain is calibrated for high impedance loads. When driving a 600 ohm load via the 600 ohm output (or a 50 ohm load via the 50 ohm output) the gain of the amplifier is reduced by two. The shields of all the front-panel BNCs are connected together and form the amplifier's floating ground.

Reset

The OVLD LED indicates a signal overload. This condition can occur when a signal is too large or the dynamic reserve is too low. Reducing the gain, reducing the input signal and/or switching to the HIGH DYNAMIC RESERVE setting should remedy this condition. If an overload occurs with filter settings of long time constants, the **RESET** pushbutton will speed the SR560's recovery from overload.

Status

The ACT LED indicates communications activity over the SR560's optoisolated RS-232 port. Please refer to APPENDIX A -- REMOTE PROGRAMMING for further details on programming the instrument via RS-232.

The BLANK LED indicates the optoisolated **BLANKING** input (on the rear panel of the SR560) is active. The SR560 responds to a blanking input by internally grounding the amplifier signal path after the front end and before the first filter stage.

Blanking Input

The opto-isolated blanking input will blank the amplifier input as long as a TTL level signal is present referenced to the Blanking BNC shield.

RS-232 Interface

The RS-232 interface connector allows listen-only communication with the SR560 at 9600 baud, DCE. All front panel functions and blanking, excluding power, are available over the RS-232 interface. For more information on programming and commands, see Appendix A : Remote Programming.

BATTERY CARE AND USAGE

The SR560 can be powered from either an ac power source or from three 12V, 1.9 Amp-hour maintenance-free sealed lead-acid rechargeable batteries. Integral to the SR560 is an automatic battery charger, along with battery protection and charge indication circuitry.

Recharging

During battery operation, the front panel BATT LED will change from green to red to indicate that the batteries are low and require charging. For the longest battery life, the batteries should be immediately charged by plugging the unit into AC power whenever the BATT indicator lights red. Internal protection circuitry will disconnect the batteries from the amplifier if the unit is operated for too long in the low battery condition. This protects the batteries from permanent damage which could occur if they were to remain connected to a load while dead.

The internal battery charging circuitry of the SR560 will automatically charge dead batteries at a quick rate until they are approximately 80% charged. The charge rate is then lowered to a level that is safe for maintaining the batteries. During AC operation, the batteries will be in this "maintain" charge condition indefinitely, and will suffer no degradation from prolonged charging. The sealed lead-acid batteries used in the SR560 differ in this respect from nickel-cadmium batteries, which behave in exactly the opposite manner. The sealed lead-acid batteries will provide the longest service life if they are not allowed to discharge too deeply and if they are charged immediately after use.

Caring for the Batteries

WARNING: As with all rechargeable batteries, for reasons of safety the chemical recombination processes within the cells require that the batteries be free to vent non-corrosive gasses to the atmosphere. Always use the batteries in an area with adequate ventilation.

As with all instruments powered by rechargeable batteries, the user must take some precautions to ensure long battery life. Understanding and following the precautions outlined below will result in a long operating life for the batteries in the SR560.

The SR560's internal lead-acid batteries will have a variable service life directly affected by THE NUMBER OF DISCHARGE CYCLES, DEPTH OF DISCHARGE AND AMBIENT TEMPERATURE. The user should follow these simple guidelines below to ensure longest battery life.

* AVOID DEEP DISCHARGE.
Recharge the batteries after each use. The two-step fast-charge/trickle-charge operation of the SR560 allows the charger to be left on indefinitely. ALWAYS recharge the batteries immediately after the BATT indicator LED on the SR560 turns red. Built-in protection circuitry in the unit removes the batteries from the load once a dead-battery condition is detected. Avoiding deep discharge will provide the longest battery life - upwards of 1,000 charge / discharge cycles.

*AVOID TEMPERATURE EXTREMES.
When using battery power, operate the SR560 at or near room temperature. Operating at lower temperatures will reduce the capacity of the batteries. At low temperatures it will also require more time to recharge the batteries to their rated capacity. Higher temperatures accelerate the rate of reactions within the cell, reducing cell life.

*KEEP THE BATTERIES COOL.
When not using the SR560, it should be stored in a cool, dry place with the batteries fully charged. This reduces the self-discharge of the batteries and ensures

Differential Low-Noise Front End

Two high-impedance inputs A and B allow the instrument to operate in either single-ended or true differential modes. Relays K103 and K104 allow the inputs A and B to be individually grounded, while K101 selects AC or DC coupling. Inversion of the inputs is provided by relay K105. The input capacitances and R101 and R102 establish the front end's input impedance at 25 pF and 100 Mohms.

U106 is an NPD5564 low-noise matched FET pair which, along with U102 and U103 form the first differential amplifier stage. U102 compares the currents in the drain loads of U106, and U103 maintains the sum of those currents at a fixed level by varying the total current in both FETs. C109 provides open-loop compensation for U102, and front end gain is nominally established by the sum of R118 and R112 over the sum of R114 and R128. K102 is a gain switching relay which selects a front end gain of 2 or 10. In the gain of 2 position, gain to the next stage becomes 1 when R116 divides with the input attenuator to the next stage. For a gain of 10, relay K102 shorts the top of R115 and R128 together, essentially eliminating them from the gain loop. P103 allows adjustment of front-end offset, and P104 allows for offset compensation when in the low gain configuration. P102 allows adjustment of the front-end common-mode rejection ratio, along with P101 which adjusts the CMRR in the low gain configuration.

In the second gain stage, U105 is configured with a fixed gain of 10. By switching the input attenuation of this stage with DG444 U101, the overall gain of this stage can be computer selected as 2, 5, or 10. C111 provides high frequency compensation for U105. The output of this stage passes through all three sections of U104, a CMOS multiplexer that serves as the blanking control. The three parallel switches provide a low "on" resistance to select either the output of the second stage amplifier or ground as the input to the next stage, the first filter section.

Configurable Filters and Gain

The two filter stages in the SR560 each consist of 16 R-C filters which can be configured as either high pass or low pass by a relay. In the following description, part references in parentheses refer to filter two. Relay K201(K301) selects either the high-pass or low-pass configuration for all of the sixteen filters. The output of one R-C section is selected by multiplexer U202 or U203 (U301 or U302) and passed on to non-inverting buffer U202(U303).

The approximately 80 pF input capacitance of the multiplexers was included in the calculation of the R-C time constants of the filters. The four highest frequency stages are not available as high-pass filters because of unacceptable attenuation of the signal that occurs when the filter capacitance forms a divider with the input capacitance of the multiplexers.

DG444 U205D(U401A) is used to bypass the filter sections entirely, and U101D(U304D) is used to "reset" the filter stages by discharging them through R228(R329).

U201(U305) is the third (fourth) gain stage with a fixed gain of 5. The input attenuator U205(U304) allows setting the gain of these stages to 1, 2, or 5 under computer control.

Output Stages

The fifth gain stage consists of op-amp U402 which is configured as a non-inverting amplifier with a gain of 5. U401 is a DG444 that again serves to switch the input attenuation of this stage for overall gains of 1, 2, or 5. Additionally, output offset adjustment is provided by this stage. U405B, half of an AD7528 dual 8-bit DAC is used to provide a +/- 5 volt offset voltage at the non-inverting input of U402. The front panel offset control also sums at this junction, and provides an offset voltage of +/- 5 V that is buffered by U407D.

Following amplifier U402 is the other half of the 8-bit DAC U405A, which along with op-amp U404 forms a digital gain vernier. This vernier is used in interrupted battery power to the system RAM so that stored instrument settings are retained when the power is switched off.

Power Regulators

The +5v and +10v supplies are produced with three-terminal regulators U801 and U802, respectively. The -10v supply is constructed of op-amp U803 and Q801, an N-channel MOSFET as the pass element. The +10v supply serves as the reference for the -10v supply through divider R807 and R806.

The power output banana jacks on the rear panel -- J801 and J803 -- are connected to the pre-regulated voltages after the power switch and before the regulators. This output can provide up to 200 mA of power for use as an external bias source, etc.. Under some conditions, these jacks may be used to supply the unit with external DC power.

U506D and U506B generate the TTL level input to the processor to indicate when the unit is operating on the AC line.

Capacitors C801 through C821 are logic supply bypass capacitors distributed throughout the printed circuit board.

Rear Panel Interfaces

Two optically isolated rear panel interfaces are provided on the SR560. The blanking input accepts a TTL-level signal and grounds the amplifier signal path after the front end for as long as the input is held high. The response time of the blanking input is typically "on" 5 μs after the rising edge and "off" 10 μs after the falling edge.

The RS-232 interface allows calibration and control of the instrument at 9600 baud. Data in and out on the connector are tied together, echoing data back to the sender. Hardware handshaking lines CTS, DSR, and CD are tied to DTR. Refer to appendix A-1 for information on remote programming of the SR560.

Batteries and P.E.M.

The batteries used in the SR560 are of sealed lead-acid construction. There are three 12 volt, 1.9 amp-hour batteries, two of which serve as the positive power supply, and one of which serves as the negative power supply. Powering the SR560 alone, battery life should be greater than 20 hours. The batteries should last for more than 1000 charge/discharge cycles, provided the guidelines under the Usage section are followed. Two 3A, fast blow fuses on the rear panel protect the battery supplies and amplifier against excessive currents.

The power entry module (P.E.M.) contains the AC line fuse, RFI filter, and voltage selection card. To change the operating voltage of the unit, the voltage selector printed circuit card must be pulled out and reinserted into the P.E.M. with the desired operating voltage visible.

Front Panel

The front panel contains the keypad pushbuttons, LED indicators and serial shift registers. The front panel pushbuttons are decoded in a 3 x 4 matrix fashion. The front panel LEDs are controlled by shift registers U1 through U5, which allow the 5 eight-bit control bytes to be serially shifted-in one bit at a time. The red overload LED is controlled directly from the output of the overload comparator.

The battery LED is a dual-color LED that is green when the unit is operating on battery power, and turns red when the low_batt signal is asserted.

The front panel output offset pot P1 is also mounted on the front panel printed circuit board.

Offset Adjustment

The SR560's front-panel offset adjustment provides an easy way for the user to null the amplifier's dc offset. Use the **COUPLING** pushbutton to light the GND LED. Now, regardless of the **SOURCE** setting, the input to the amplifier is grounded internally. Insert a small screwdriver through the front-panel **OFFSET** hole and adjust the offset potentiometer until the dc offset of the amplifier (e.g. as viewed on a DVM) is zero. Finally, return to the desired coupling.

Calibration

There are four pots which are used to calibrate the instrument. The pots adjust the front-end CMRR (Common Mode Rejection Ratio) and offset. These pots are located close to the front of the instrument, and may be accessed by removing the bottom cover.

These pots should be adjusted to optimize the CMRR or null the offset, or when the front-end FET is replaced. Two of the pots adjust the CMRR and offset when the front-end gain is x10, and two adjust the CMRR and offset when the front-end gain is x2. The x10 gain pots must be set first, followed by the x2 gain pots.

First, the front panel offset pot must be set to zero:

-Adjust front panel Offset pot to read 0 VDC on pin 14, U407.

Use a function generator as the source of a common mode signal:

-Apply 1kHz 1Vp-p sine to both the A and B inputs.

Next adjust the offset and CMRR for the case where the front-end gain is x10. View the amplifier output on a scope and perform the following adjustments:

-Couple=GND, Gain=5k, LOW NOISE: adjust P103 to null DC and output.
-Couple=DC, source=A-B: adjust P102 to null sine wave output.

Now adjust the offset and CMRR for the case where the front-end gain is x2. View the amplifier output on a scope and perform the following adjustments:

-Couple=GND, Gain=5k, HIGH DR: adjust P104 to null DC and output.
-Couple=DC, source=A-B: adjust P101 to null sine wave output.

Note that in the above procedures that the gain of the front-end (x10 or x2) is determined by the selection of LOW NOISE or HIGH DYNAMIC RESERVE.

FRONT END REPLACEMENT

The most commonly damaged component is the front-end FET (U106, National Semiconductor Corp P/N NPD5564) It is located in an 8 pin DIP socket behind the relays near the input BNC's. If the instrument exhibits a constant overload, excessive drift or noise, or large input bias currents, it is likely that this component has been damaged.

When replacing the FET, be certain that all eight pins are inserted into the socket, and observe the orientation for pin #1. After replacement adjust the CMRR and offset per the calibration procedure. More severely damaged front-ends may require replacing (in this order) U102 (LT1028 Low Noise Op Amp), U101 (DG444, Quad SPST Analog Switch), U105 (LT1028) and U104 (74HC4053, Triple SPDT Analog Switch).

BATTERY REPLACEMENT

After three to five years or about 1000 charge/discharge cycles, the sealed lead acid batteries degrade. When the battery operation time shortens, or if the unit stays very warm for more than a day after it is plugged into the line, the batteries may require replacement.

The three batteries are a standard size which are available from several different distributors. All are 12VDC with a charge capacity of about 2.0 Amp-hrs, and measure 7.02" X 1.33" X 2.38". Two of

DYNAMIC RESERVE

The dynamic reserve of the amplifier is a measure of how large a signal can be present at the input to the amplifier without causing an overload condition. The definition of dynamic reserve is:

DR (dB) = 20 log (Vin(f) w/o overload / Vin for full scale)

A full scale output voltage is 10 Vpp. Signals at the output (or at any stage) which exceed 10 Vpp cause an overload. The dynamic reserve is greater than 0 dB only when the filters are used to remove unwanted signals.

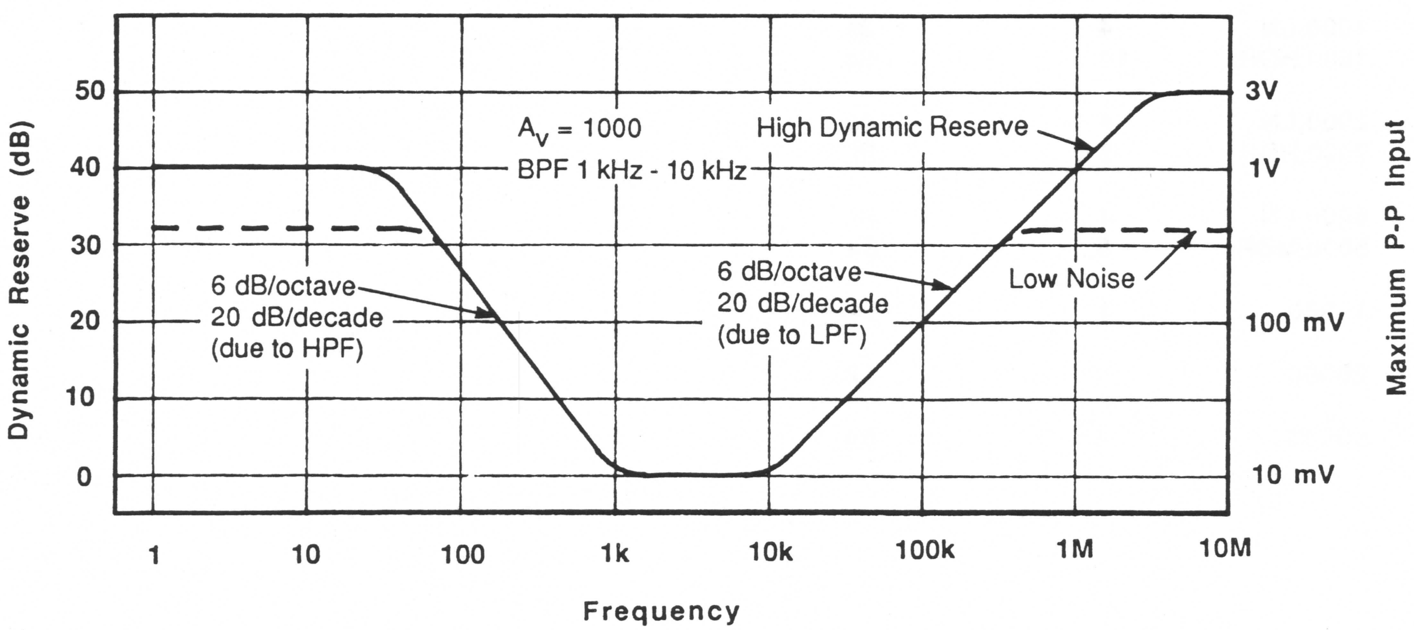
The dynamic reserve is a function of frequency and depends on the amplifier configuration (gain, filters and dynamic reserve setting). The figure below shows the dynamic reserve (and maximum input signal without overload) for an SR560 set to a gain of 1000, the high pass filter set to 1kHz and the low pass filter set to 10kHz (for a bandpass from 1kHz to 10kHz). The dynamic reserve characteristic is shown for both "High Dynamic Reserve" and "Low Noise" gain modes.

There are several features to note. In the bandpass region between 1 and 10kHz the dynamic reserve is 0 dB. The dynamic reserve is 3 dB at the filter frequencies of 1 and 10kHz. The dynamic reserve rises by 6 dB/oct (or 20 dB per decade) as the signal moves away from the pole frequency, since each RC filter attenuates the signal. If a faster roll-off for interfering signals were required, a 12 dB/octave HP or LP filter could be used.

The HIGH DR characteristic offers 16 dB more DR at low frequencies and 26 dB more at high frequencies. The high frequency DR is limited only by the maximum 3 Vpp limit of the input stage.

The maximum DR in the low noise mode is 36 dB. Since there is no gain between the HP and LP filters in the Low Noise gain mode, the DR is the same at very high frequencies and very low frequencies.

Dynamic Reserve vs. Frequency



REMOTE PROGRAMMING

Introduction

The SR560 is equipped with a standard DB-25 RS-232C connector on the rear panel for remote control of all instrument functions. The interface is configured as listen-only, 9600 baud DCE, and is optically isolated to prevent any noise or grounding problems.

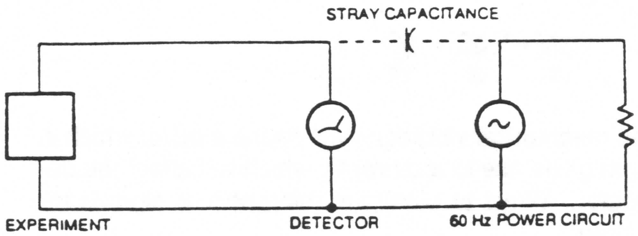
Up to four SR560 amplifiers can be connected in parallel to the same RS-232 interface. Units sharing the same interface must have a unique address as set on dip switch SW601, accessible through the bottom cover of the unit. To set an instrument to one of the four available addresses, adjust positions one and two of dip switch SW601 as follows:

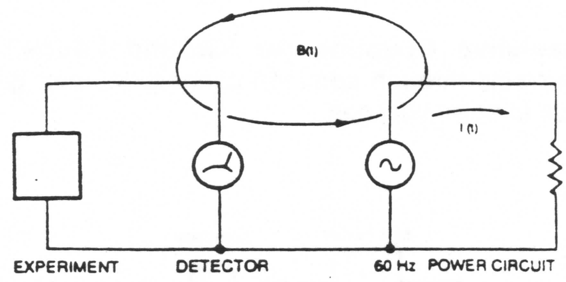
SW601 Pos. 2	SW601 Pos. 1	Address of unit
OFF	OFF	UNIT 0
OFF	ON	UNIT 1
ON	OFF	UNIT 2
ON	ON	UNIT 3

Commands

The following commands are obeyed by all SR560's that are addressed to listen. The LALL, LISN, and UNLS commands are always obeyed and control the address status of the SR560.

BLNK i	Operates amplifier blanking. i = 0 = not blanked, 1 = blanked
CPLG i	Sets input coupling. i=0=ground, 1=DC, 2=AC
DYNR i	Sets dynamic reserve. i = 0 = low noise, 1 = high DR, 2 = calibration gains (defaults)
FLTM i	Sets filter mode. i = 0 = bypass, 1 = 6dB low pass, 2 = 12 dB low pass, 3 = 6 dB high pass, 4 = 12 dB highpass, 5 = band-pass
GAIN i	Sets the gain. i = 0-14 = 1,2,5,... 50k gain
HFRQ i	Sets highpass filter frequency. i = 0-11 sets freq. = .03 Hz to 10 kHz
INVT i	Sets the signal invert sense. i = 0 = non-inverted, 1 = inverted
LALL	Listen All. Makes all attached SR560's listeners.
LISN i	Listen command. Makes SR560 with address i (0,1,2,3) a listener.
LFRQ i	Sets lowpass filter frequency. i = 0-15 sets freq.= .03 Hz to 1 MHz
ROLD	Resets overload for 1/2 second.
SRCE i	Sets the input source. i = 0 = A, 1 = A-B, 2 = B
UCAL i	Sets the vernier gain status. i = 0 = cal'd gain, 1 = vernier gain
UCGN i	Sets the vernier gain to i %. i = 0 to 100
UNLS	Unlisten. Unaddresses all attached SR560's.
*RST	Reset. Recalls default settings.





Capacitive Noise Coupling

To estimate the noise current through C_{stray} into the detector we have

$$i = C_{stray} \frac{dV}{dt} = jwC_{stray}V_{noise}$$

where a reasonable approximation to C_{stray} can be made by treating it as parallel plate capacitor. Here, w is the radian frequency of the noise source (perhaps 2 * π * 60Hz), V_{noise} is the noise voltage source amplitude (perhaps 120 Vac). For an area of $A = (.01\ m)^2$ and a distance of d = 0.1m, the 'capacitor' will have a value of 0.009 pF and the resulting noise current will be 400pA. This meager current is about 4000 times larger than the most sensitive current scale that is available on the SR510 lock-in.

Cures for capacitive coupling of noise signals include:

1) removing or turning off the interfering noise source,

2) measuring voltages with low impedance sources and measuring currents with high impedance sources to reduce the effect of i_{stray},

3) installing capacitive shielding by placing both the experiment and the detector in a metal box.

Inductive Coupling. Here noise couples to the experiment via a magnetic field:

Inductive Noise Coupling

A changing current in a nearby circuit gives rise to a changing magnetic field which induces an emf in the loop connecting the detector to the experiment. (emf = $d\O_B/dt$.) This is like a transformer, with the experiment-detector loop as the secondary winding.)

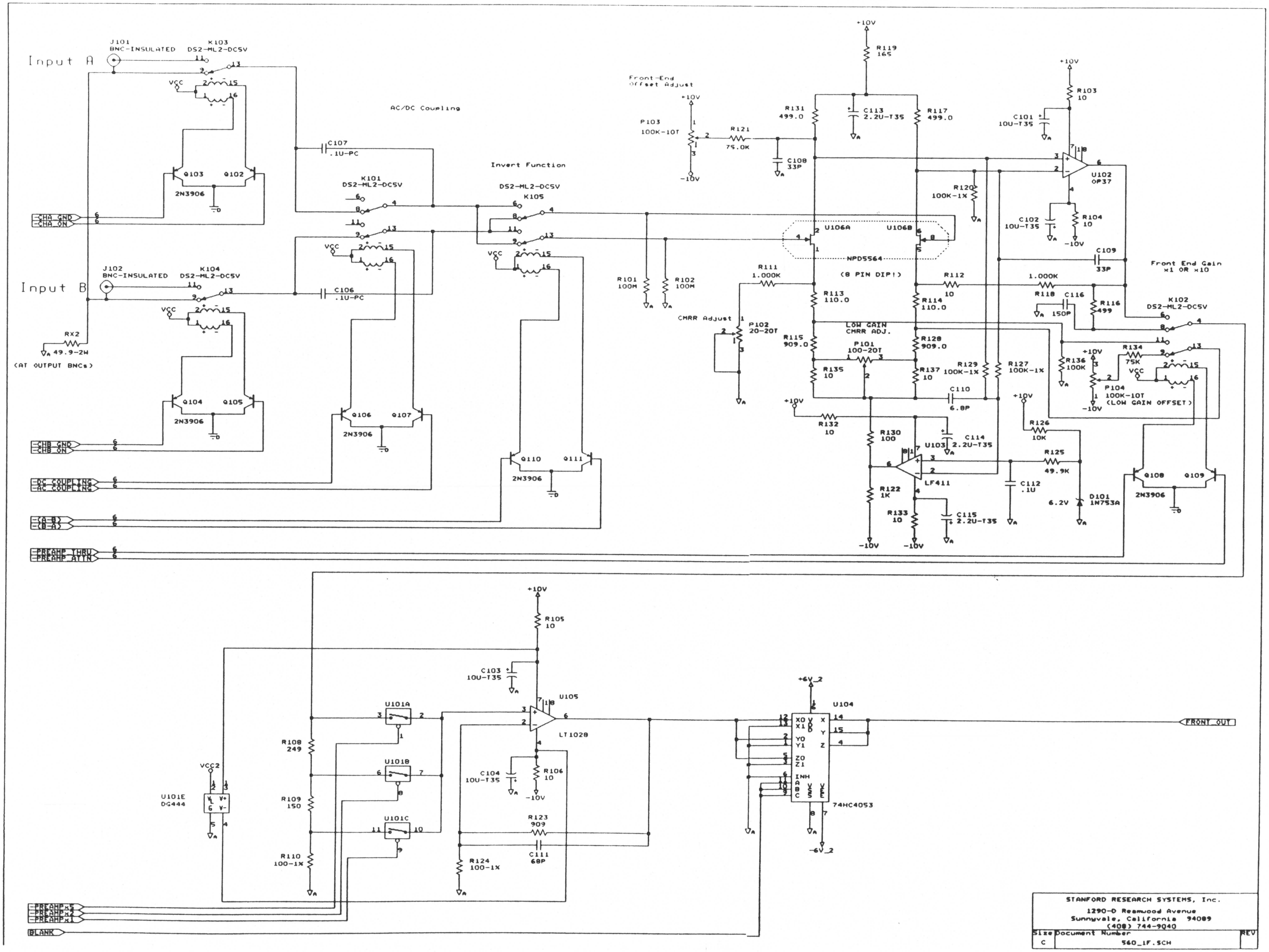
Cures for inductively coupled noise include:

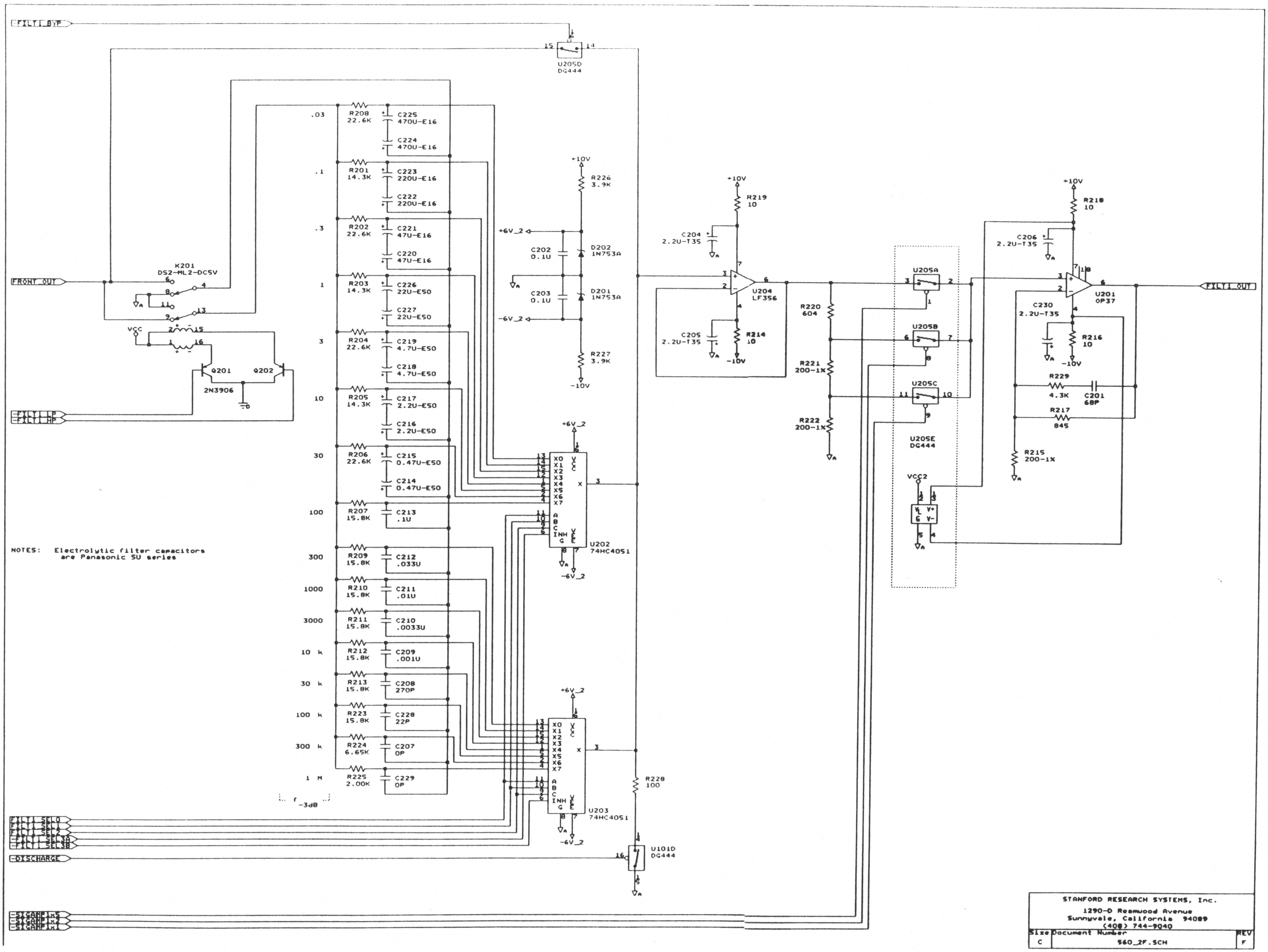
1) removing or turning off the interfering noise source (difficult to do if the noise is a broadcast station),

2) reduce the area of the pick-up loop by using twisted pairs or coaxial cables, or even twisting the 2 coaxial cables used in differential hook-ups,

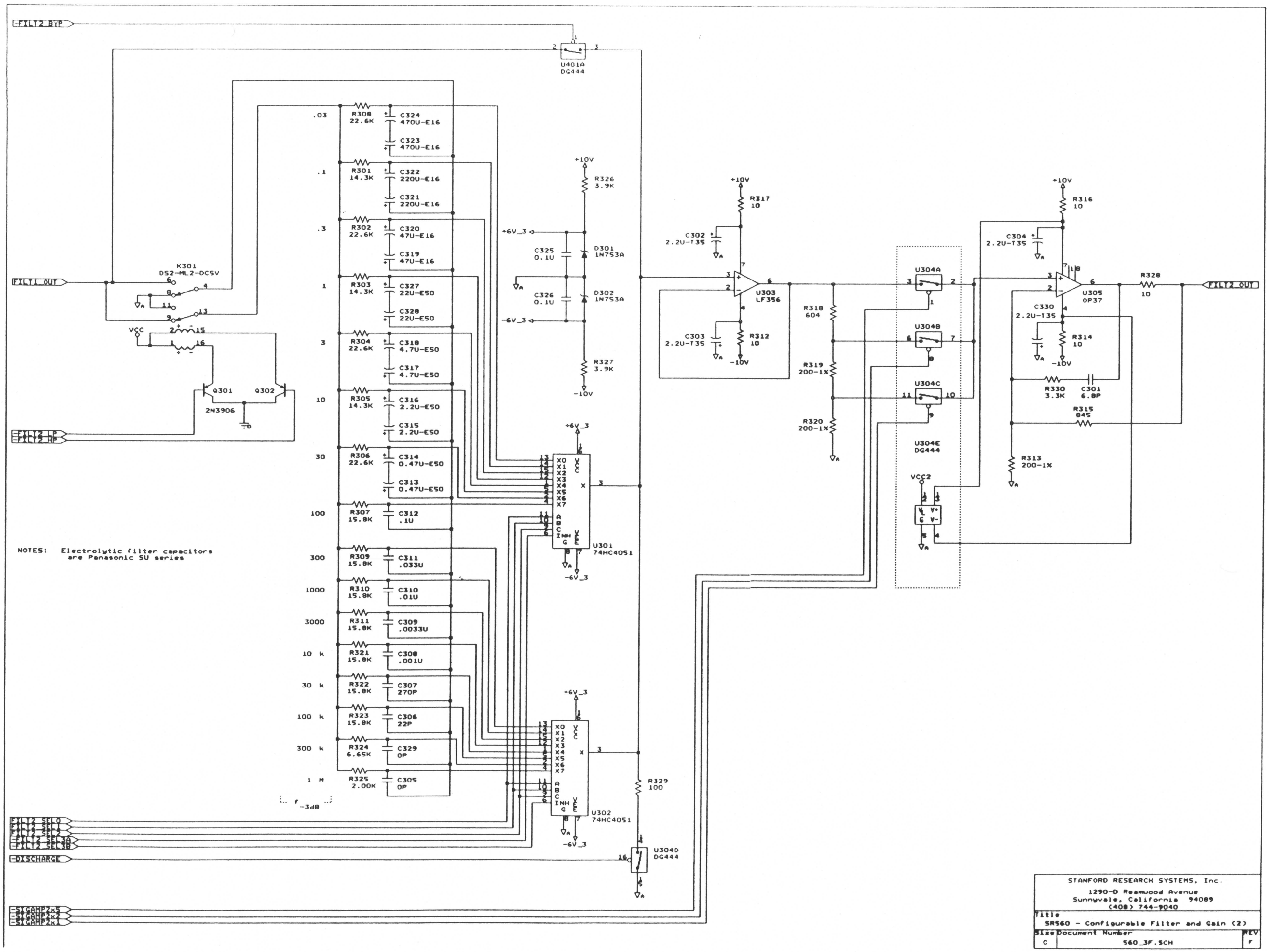
3) using magnetic shielding to prevent the magnetic field from inducing an emf (at high frequencies a simple metal enclosure is adequate),

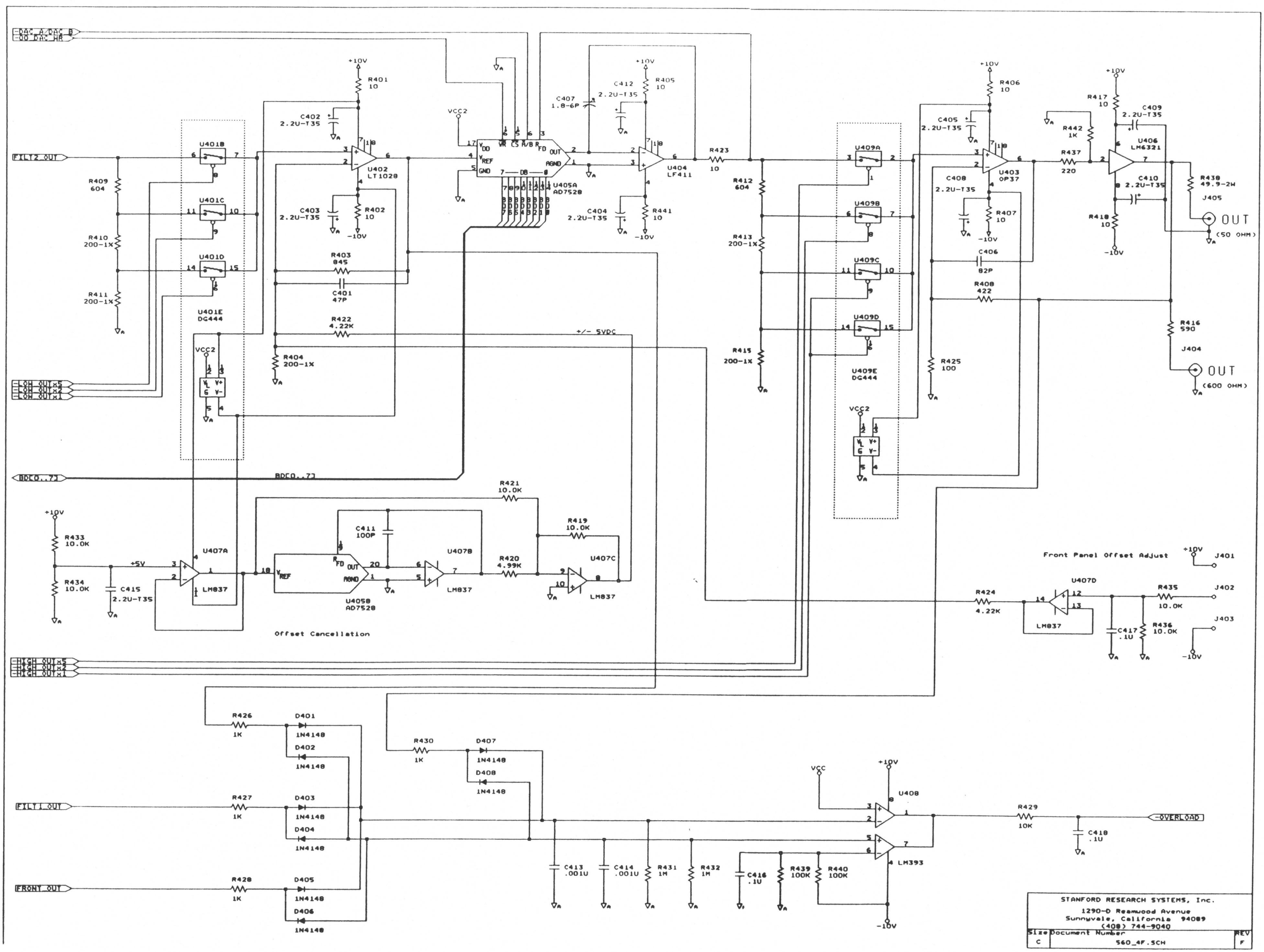
4) measuring currents, not voltages, from high impedance experiments.


Input A
J101
BNC-INSULATED
K103
DS2-ML2-DC5V
Input B
J102
BNC-INSULATED
K104
DS2-ML2-DC5V
RX2
49.9-2W
(AT OUTPUT BNCs)
Q103
Q102
2N3906
Q104
Q105
2N3906
-CHA_GND
-CHA_ON
-CHB_GND
-CHB_ON
-DC_COUPLING
-AC_COUPLING
-(A-B)
-(B-A)
-PREAMP_THRU
-PREAMP_ATTN
AC/DC Coupling
C107
.1U-PC
C106
.1U-PC
K101
DS2-ML2-DC5V
Q106
Q107
2N3906
Invert Function
DS2-ML2-DC5V
K105
Q110
Q111
2N3906
R101
100M
R102
100M
Front-End
Offset Adjust
P103
100K-10T
R121
75.0K
C108
33P
R119
165
R131
499.0
C113
2.2U-T35
R117
499.0
U106A
U106B
NPD5564
(8 PIN DIP!)
R111
1.000K
CMRR Adjust
P102
20-20T
R113
110.0
R114
110.0
R115
909.0
R128
909.0
LOW GAIN
CMRR ADJ.
P101
100-20T
R135
10
R137
10
R132
10
R130
100
U103
LF411
R122
1K
R133
10
C114
2.2U-T35
C115
2.2U-T35
C112
.1U
R126
10K
R125
49.9K
D101
1N753A
6.2V
C110
6.8P
R129
100K-1%
R127
100K-1%
R120
100K-1%
R103
10
C101
10U-T35
U102
OP37
C102
10U-T35
R104
10
C109
33P
R112
10
1.000K
R118
C116
150P
R116
499
Front End Gain
x1 OR x10
K102
DS2-ML2-DC5V
R136
100K
R134
75K
P104
100K-10T
(LOW GAIN OFFSET)
Q108
Q109
2N3906
R105
10
C103
10U-T35
U105
LT1028
C104
10U-T35
R106
10
U101A
U101B
U101C
U101E
DG444
VCC2
R108
249
R109
150
R110
100-1%
R123
909
C111
68P
R124
100-1%
U104
74HC4053
+6V_2
-6V_2
FRONT_OUT
-PREAMPx5
-PREAMPx2
-PREAMPx1
BLANK
STANFORD RESEARCH SYSTEMS, Inc.
1290-D Reamwood Avenue
Sunnyvale, California 94089
(408) 744-9040
Size
Document Number
REV
C
560_1F.SCH



FILT1_BYP
U205D
DG444
FRONT_OUT
K201
DS2-ML2-DC5V
VCC
Q201
Q202
2N3906
FILT1_LP
FILT1_HP
.03
.1
.3
1
3
10
30
100
300
1000
3000
10 k
30 k
100 k
300 k
1 M
f -3dB
R208 22.6K
C225 470U-E16
C224 470U-E16
R201 14.3K
C223 220U-E16
C222 220U-E16
R202 22.6K
C221 47U-E16
C220 47U-E16
R203 14.3K
C226 22U-E50
C227 22U-E50
R204 22.6K
C219 4.7U-E50
C218 4.7U-E50
R205 14.3K
C217 2.2U-E50
C216 2.2U-E50
R206 22.6K
C215 0.47U-E50
C214 0.47U-E50
R207 15.8K
C213 .1U
R209 15.8K
C212 .033U
R210 15.8K
C211 .01U
R211 15.8K
C210 .0033U
R212 15.8K
C209 .001U
R213 15.8K
C208 270P
R223 15.8K
C228 22P
R224 6.65K
C207 0P
R225 2.00K
C229 0P
NOTES: Electrolytic filter capacitors are Panasonic SU series
+10V
R226 3.9K
+6V_2
-6V_2
C202 0.1U
C203 0.1U
D202 1N753A
D201 1N753A
R227 3.9K
-10V
U202 74HC4051
U203 74HC4051
R228 100
U101D DG444
FILT1_SEL0
FILT1_SEL1
FILT1_SEL2
FILT1_SEL3A
FILT1_SEL3B
DISCHARGE
SIGAMP1x5
SIGAMP1x2
SIGAMP1x1
R219 10
C204 2.2U-T35
C205 2.2U-T35
U204 LF356
R214 10
R220 604
R221 200-1%
R222 200-1%
U205A
U205B
U205C
U205E DG444
VCC2
R218 10
C206 2.2U-T35
U201 OP37
C230 2.2U-T35
R216 10
R229 4.3K
C201 68P
R217 845
R215 200-1%
FILT1_OUT
STANFORD RESEARCH SYSTEMS, Inc.
1290-D Reamwood Avenue
Sunnyvale, California 94089
(408) 744-9040
Size C
Document Number 560_2F.SCH
REV F


FILT2 BYP
U401A
DG444
FILT1 OUT
K301
DS2-ML2-DC5V
VCC
Q301
Q302
2N3906
FILT2 LP
FILT2 HP
NOTES: Electrolytic filter capacitors are Panasonic SU series
.03
.1
.3
1
3
10
30
100
300
1000
3000
10 k
30 k
100 k
300 k
1 M
f -3dB
R308 22.6K
C324 470U-E16
C323 470U-E16
R301 14.3K
C322 220U-E16
C321 220U-E16
R302 22.6K
C320 47U-E16
C319 47U-E16
R303 14.3K
C327 22U-E50
C328 22U-E50
R304 22.6K
C318 4.7U-E50
C317 4.7U-E50
R305 14.3K
C316 2.2U-E50
C315 2.2U-E50
R306 22.6K
C314 0.47U-E50
C313 0.47U-E50
R307 15.8K
C312 .1U
R309 15.8K
C311 .033U
R310 15.8K
C310 .01U
R311 15.8K
C309 .0033U
R321 15.8K
C308 .001U
R322 15.8K
C307 270P
R323 15.8K
C306 22P
R324 6.65K
C329 0P
R325 2.00K
C305 0P
+10V
R326 3.9K
+6V_3
C325 0.1U
D301 1N753A
C326 0.1U
D302 1N753A
-6V_3
R327 3.9K
-10V
U301 74HC4051
U302 74HC4051
R329 100
U304D DG444
FILT2 SEL0
FILT2 SEL1
FILT2 SEL2
FILT2 SEL3A
FILT2 SEL3B
DISCHARGE
SIGAMP2x5
SIGAMP2x4
SIGAMP2x2
SIGAMP2x1
R317 10
C302 2.2U-T35
U303 LF356
C303 2.2U-T35
R312 10
R318 604
R319 200-1%
R320 200-1%
U304A
U304B
U304C
U304E DG444
VCC2
R316 10
C304 2.2U-T35
U305 OP37
C330 2.2U-T35
R314 10
R330 3.3K
C301 6.8P
R315 845
R313 200-1%
R328 10
FILT2 OUT
STANFORD RESEARCH SYSTEMS, Inc.
1290-D Reamwood Avenue
Sunnyvale, California 94089
(408) 744-9040
Title
SR560 - Configurable Filter and Gain (2)
Size Document Number REV
C 560_3F.SCH F



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(408) 744-9040

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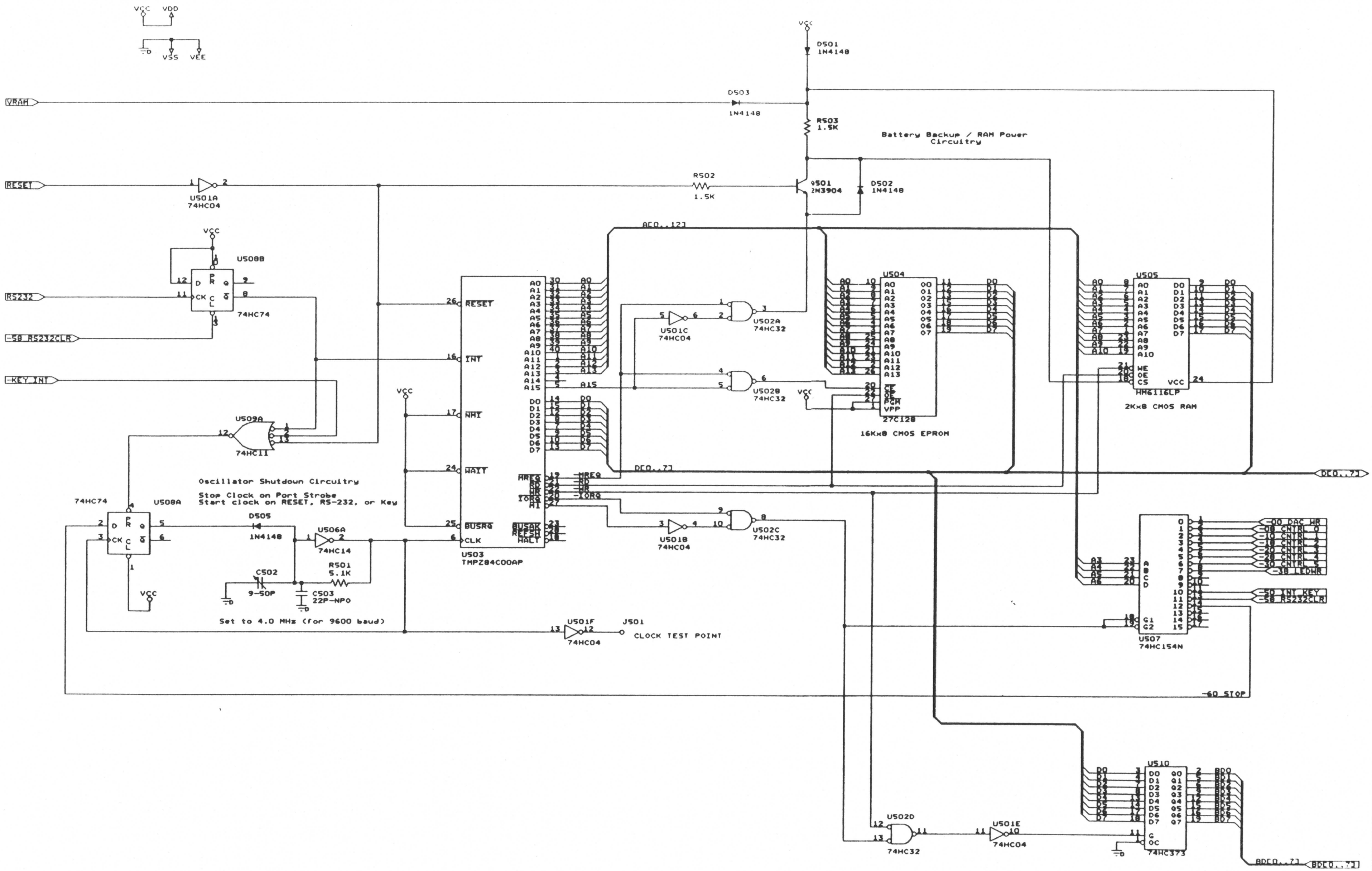

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Sunnyvale, California 94089
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Title		
SR560 - Microprocessor Section		
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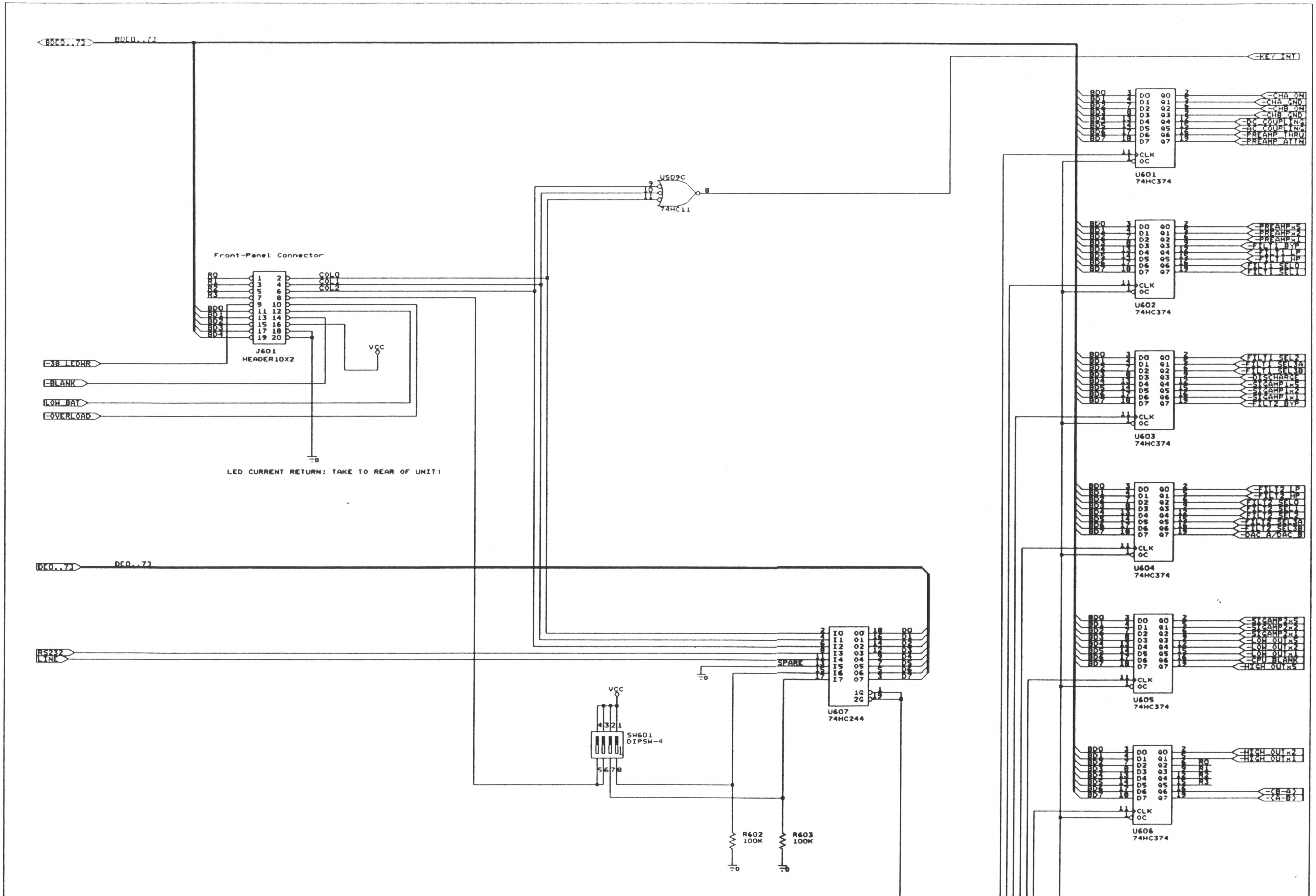

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1290-D Reamwood Avenue
Sunnyvale, California 94089
(408) 744-9040

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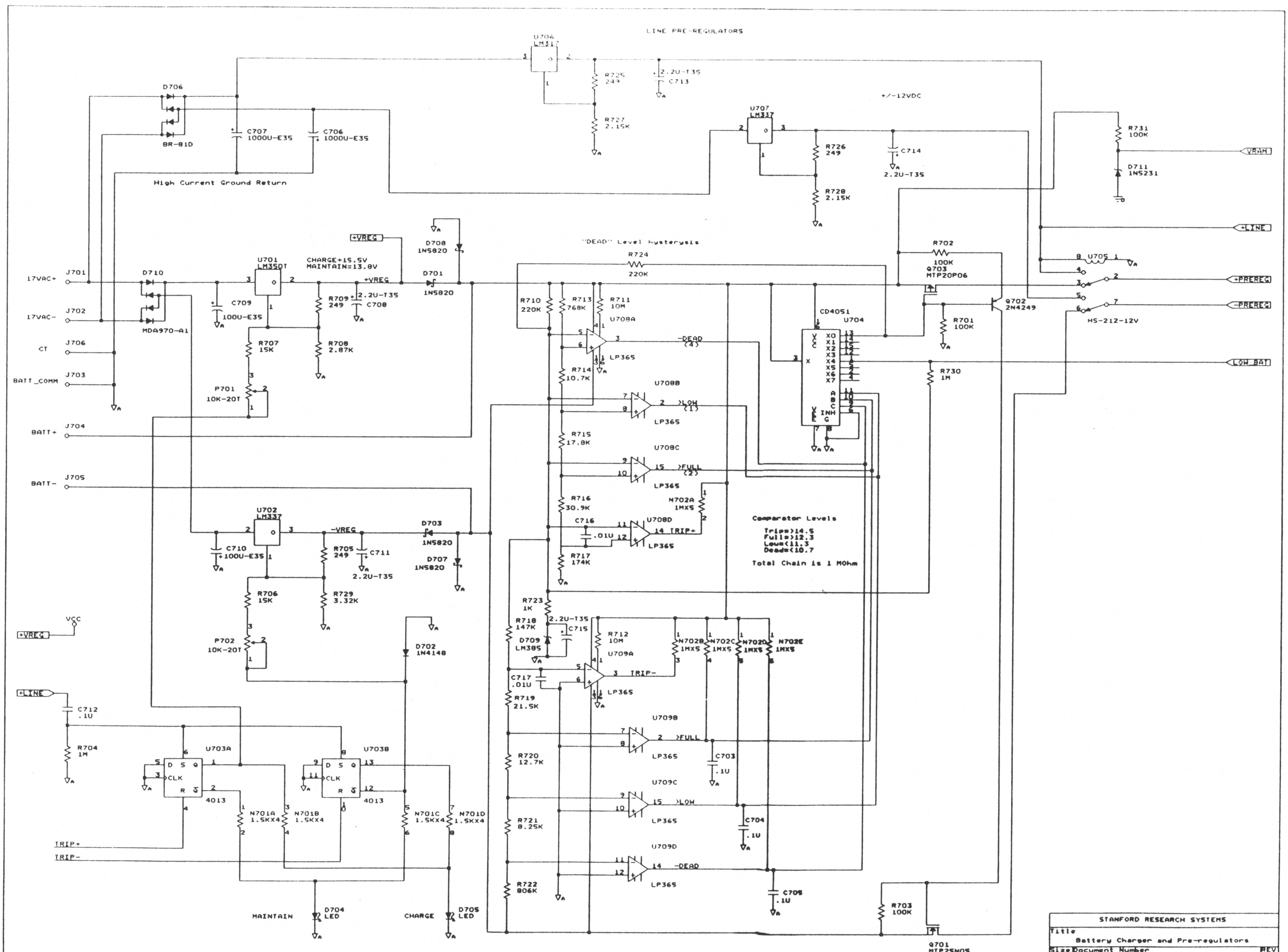

STANFORD RESEARCH SYSTEMS

Title	Battery Charger and Pre-regulators	
Size	Document Number	REV
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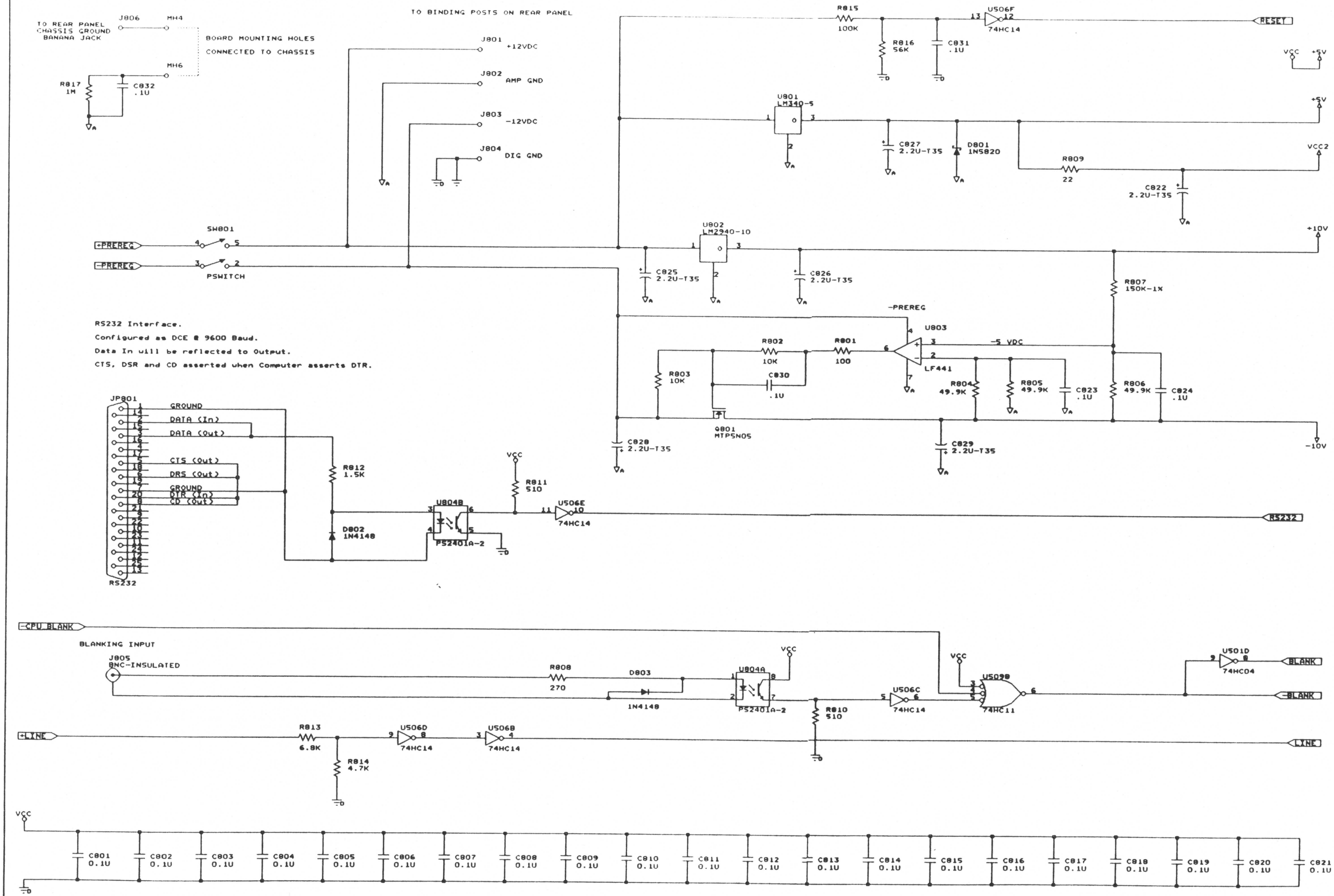

STANFORD RESEARCH SYSTEMS, Inc.
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Title		
Power Regs and Rear Panel Connectors		
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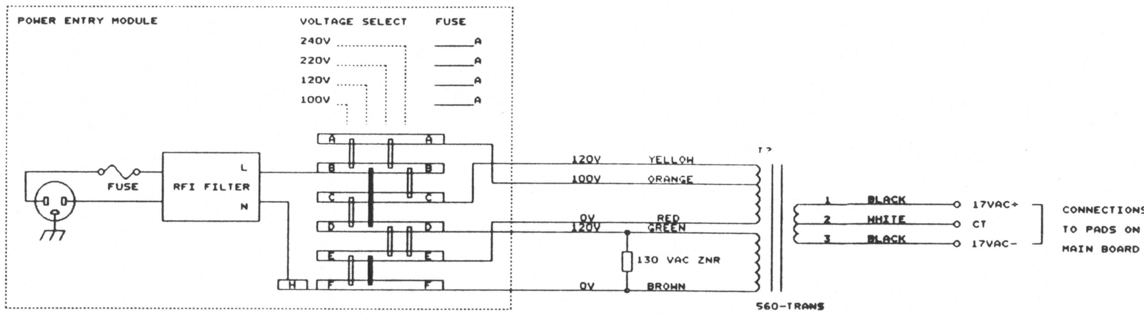

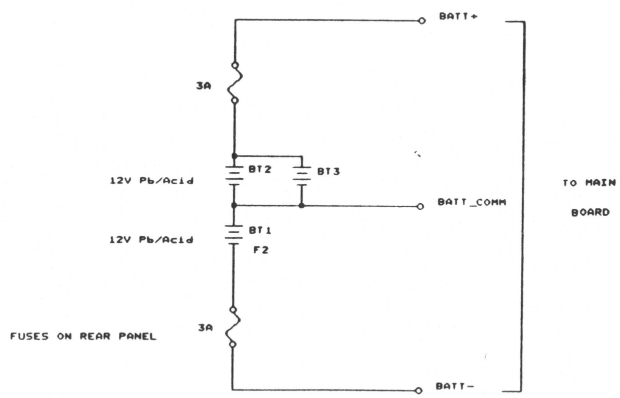

NOTE: FUSES REMOVED FOR EXTERNAL POWER VIA BINDING POSTS

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Sunnyvale, California 94089
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Title		
SR560 BACK PANEL		
Size	Document Number	REV
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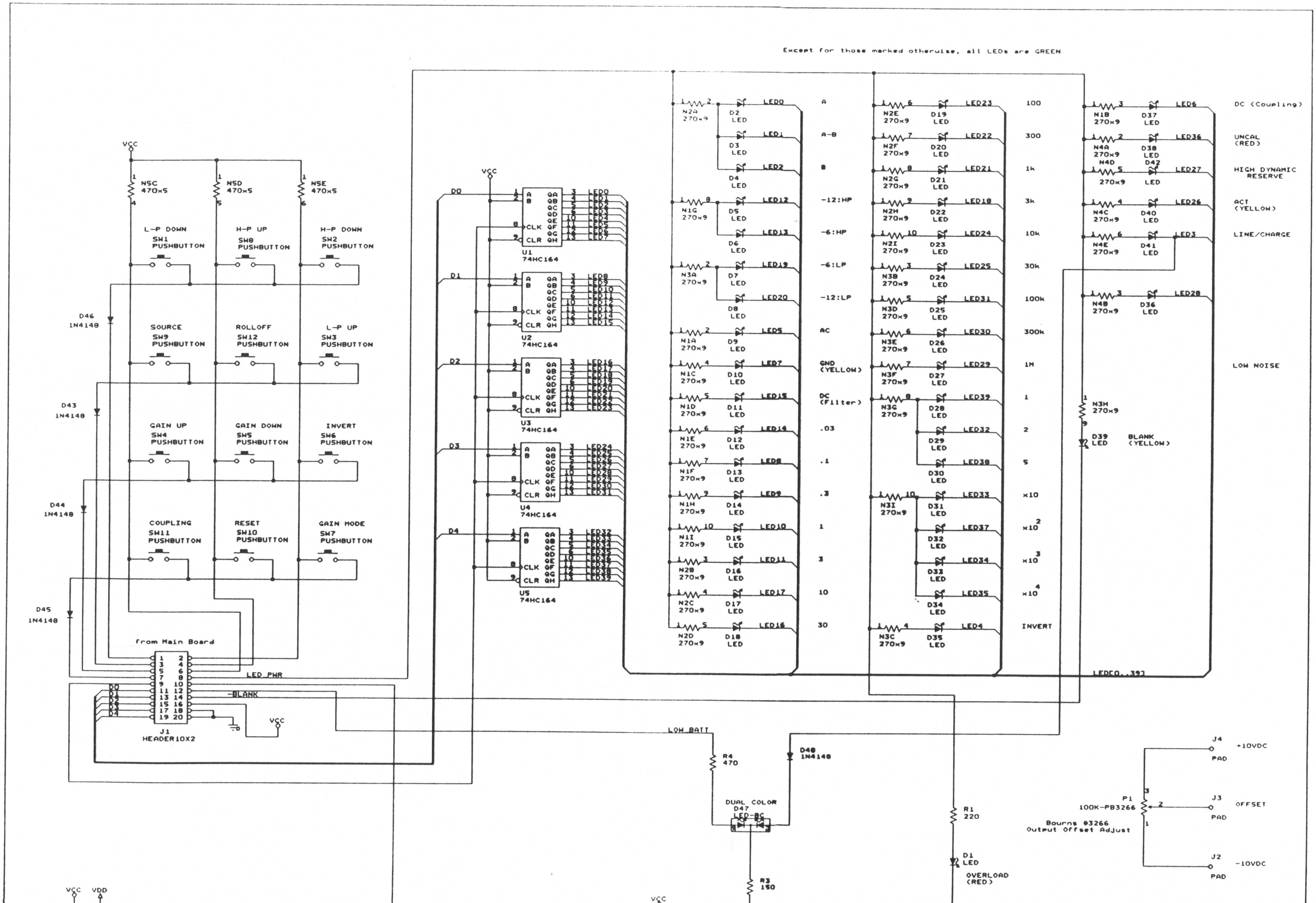

STANFORD RESEARCH SYSTEMS, Inc.
1290-D Reamwood Avenue
Sunnyvale, California 94089
(408) 744-9040

Title		
SR560 - Front-Panel LEDs		
Size	Document Number	REV
C	560FPF.SCH	F

MODEL SR560

LOW-NOISE PREAMPLIFIER

SRS Stanford Research Systems

1290-D Reamwood Avenue
Sunnyvale, CA 94089 U.S.A.
(408) 744-9040

Revision 2.4
(09/2000)

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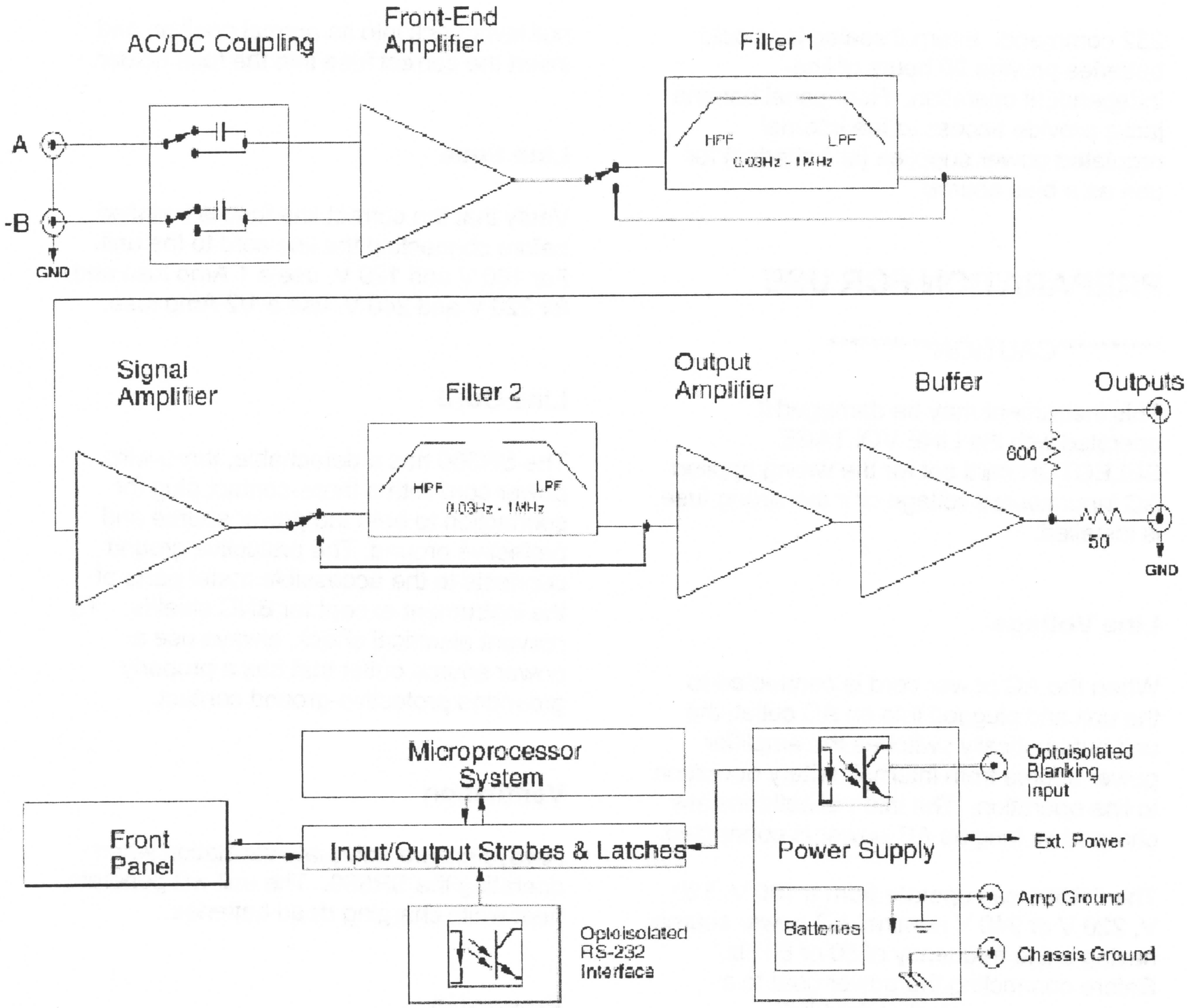


Figure 1: SR560 Block Diagram

INSTRUMENT OVERVIEW

The SR560 architecture is diagrammed above. The instrument provides DC-coupled low-noise amplification of single-ended and true differential input signals at gains of 1 to 50,000. Two configurable R-C filters are provided to selectively condition signals in the frequency range from DC to 1 MHz. The user can choose high dynamic reserve or low noise settings, and can invert the output relative to the input. The SR560 normally operates with a fully floating ground and can be viewed as an "in-line-BNC amplifier" with the amplifier ground isolated from the chassis and the AC power supply. Opto-isolated input blanking control and listen-only RS-232 interface lines are provided for instrument control. Digital noise is eliminated by shutting down the microprocessor's oscillator except during the short time required to alter the instrument's configuration, either through a front-panel pushbutton or through an RSground inside the base of the PMT to prevent charge accumulation.

Accessories Furnished

- Power cable
- Operating Manual

Environmental Conditions

OPERATING
Temperature: 10°C to 40°C
Relative Humidity: <90% Non-condensing

NON-OPERATING
Temperature: -25°C to +65°C
Relative Humidity: <95% Non-condensing

Warning regarding battery maintenance

Batteries used in this instrument are seal lead acid batteries. With usage and time these batteries can leak. Always use and store this instrument in the feet-down position. To prevent possible damage to the circuitboard, it is recommended that the batteries be periodically inspected for any signs of leakage.

SPECIFICATIONS

SR560 LOW-NOISE PREAMPLIFIER SPECIFICATIONS CHART

Inputs	Single-ended or true differential
Impedance	100 MΩ + 25 pF, DC-coupled
Maximum Inputs	1 VDC before overload; 3 V peak to peak max AC coupled; protected to 100 VDC
Maximum Output	10 Vpp
Noise	<4 nV/√Hz at 1 kHz
CMRR	>90 dB to 1 kHz, decreasing by 6 dB / octave (20 dB / decade) above 1 kHz
Gain Accuracy	1%, DC to 10 kHz 3%, 10 kHz to 100 kHz
Gain Stability	200 ppm /°C
Filters	0.03 Hz to 1 MHz, 10% typical accuracy
Distortion	0.01% typical
Power	100, 120, 220, 240 VAC (50/60 Hz 60 Watts Max
	Internal Batteries: 3 x 12 V, 1.9 Ah sealed lead-acid (rechargeable)
	±12 VDC in / out through rear panel banana jacks.
Battery Life	20 hours nominal 250-1000 charge / discharge cycles
Charge Time	4 hours to 80% of capacity
Mechanical	1/2 Rack-Mount width, 3 1/2" height, weight 15 lbs.
Dimensions	14-7/8" x 8-1/8" x 3-1/2"
Warranty	1 year parts and labor on materials and workmanship

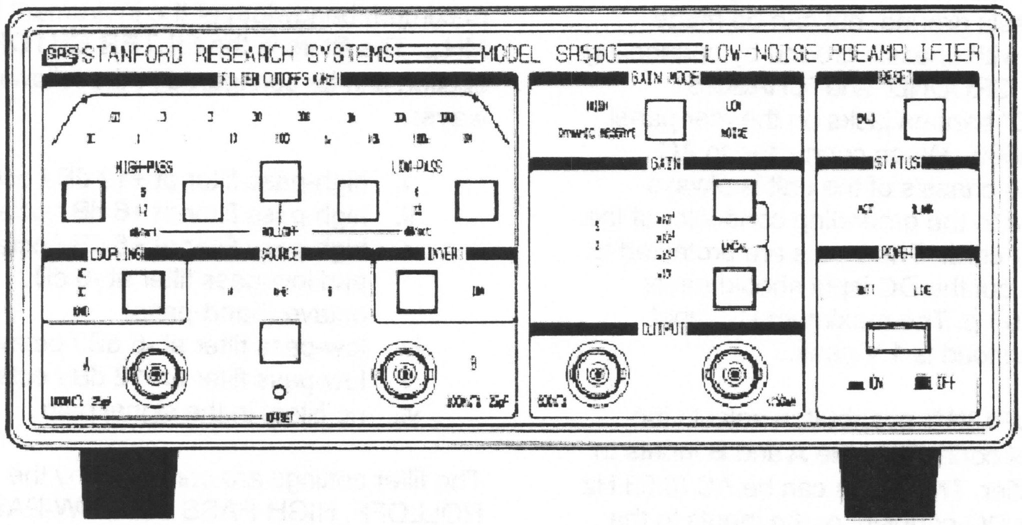


Figure 2: SR560 Front Panel

FRONT PANEL OPERATING SUMMARY

The operation of the SR560 Low-Noise Preamplifier has been designed to be as simple as possible. The effect of each keypress on the front panel is reflected in the change of a nearby LED. The front panel LED's will remain lighted at all times unless dip switch SW601 (accessible through the bottom cover of the unit) positions 3 and 4 are placed in the "off" position. All front panel functions can be controlled through the rear-panel RS-232 interface.

Power

The SR560 is turned on by depressing the POWER switch. When disconnected from AC power, the unit will operate for approximately 20 hours on internal sealed lead-acid batteries. Up to 200 mA of unregulated battery power is available at the rear panel banana jacks as long as the power switch is in the ON position. Battery life will be reduced when the unit is providing external power through the rear panel jacks. When operating on batteries, the front panel "BATT" indicator will be lighted. As the batteries near exhaustion, this indicator will change from green to red, indicating that the unit should be connected to AC power to charge the batteries.

When connected to an AC power source, amplifier power is derived from regulated line power, and the internal batteries are automatically charged. When operating on AC power, the front panel "LINE" indicator is on to indicate the source of amplifier power. Charging status is indicated on the rear panel by the "CHARGE" and "MAINTAIN" LED indicators.

Source

There are two input connectors located in the **SOURCE** section of the front panel. The pushbutton located between them selects either single-ended (**A** or **B**) or differential (**A-B**) inputs.

The **A** and **B** inputs are voltage inputs with 100 MΩ, 25 pF input impedance. Their note under Source: Coupling for information on using filters with the amplifier in AC coupled mode.

Gain Mode

The allocation of gain throughout the instrument is set using the **GAIN MODE** pushbutton The Gain Mode is displayed by two indicator LED's: HIGH DYNAMIC RESERVE and LOW NOISE. For a given gain setting, a HIGH DYNAMIC RESERVE allocates the SR560's gain toward the output stages after the filters. This prevents signals, which are attenuated by the filters from overloading the amplifier. The LOW NOISE setting allocates gain toward the front-end in order to quickly "lift" low-level (nV range) signals above the instrument's noise floor.

Gain

The instrument's gain is increased or decreased using the GAIN pushbuttons. Gain settings from 1 to 50,000 are available and are displayed as the product of a factor 1, 2 or 5 and a multiplier (none (i.e. 1), 10, 100, 1,000 or 10,000). In addition to these fifteen fixed gain settings, the user may specify arbitrary gains through the UNCAL feature. To set an uncalibrated or arbitrary gain the user must press both Gain buttons simultaneously, lighting the UNCAL LED. In this mode by pressing the Gain Up or Gain Down pushbuttons, the user may reduce the calibrated gain in roughly 1% increments from 100% down to 0% of the selected gain. In contrast to other front-panel functions, when in UNCAL the instrument's key-repeat rate will start slowly and increase to a limit as long as either Gain button is depressed. Simultaneously pressing both Gain buttons once again will restore the unit to the previously calibrated gain setting, and turn off the UNCAL LED.

Output

The outputs of the instrument are located within the **OUTPUT** section of the front panel. Two insulated BNCs are provided: a 600Ω output and a 50Ω output. The amplifier normally drives high impedance loads and the instrument's gain is calibrated for high impedance loads. When driving a 600Ω load via the 600Ω output (or a 50Ω load via the 50Ω output) the gain of the amplifier is reduced by two. The shields of all the front-panel BNC's are connected together and form the amplifier's floating ground.

Reset

The OVLD LED indicates a signal overload. This condition can occur when a signal is too large or the dynamic reserve is too low. Reducing the gain, reducing the input signal and/or switching to the HIGH DYNAMIC RESERVE setting should remedy this condition. If an overload occurs with filter settings of long time constants, the RESET pushbutton will speed the SR560's recovery from overload.

Status

The ACT LED indicates communications activity over the SR560's optoisolated RS-232 port. Please refer to **Appendix A: Remote Programming** for further details on programming the instrument via RS-232.

The BLANK LED indicates the optoisolated **BLANKING** input (on the rear panel of the SR560) is active. The SR560 responds to a blanking input by internally grounding the amplifier signal path after the front end and before the first filter stage.

"MAINTAIN" LED will turn on at half brightness. When both batteries switch to "MAINTAIN", the red "CHARGE" LED will turn off and the yellow "MAINTAIN" LED will be on full brightness.

Blanking Input

The blanking input accepts a TTL-level signal and grounds the amplifier signal path after the front end for as long as the input is held high. The response time of the blanking input is typically "on" 5 μs after the rising edge and "off" 10 μs after the falling edge.

RS-232 Interface

The RS-232 interface connector allows listen-only communication with the SR560 at 9600 baud, DCE. Communication parameters should be set to 8 bits, no parity, 2 stop bits. Data sent must be delimited by <CR> <LF>. All front panel functions excluding power and blanking, are available over the RS-232 interface. For more information on programming and commands, see Appendix A: Remote Programming.

BATTERY CARE AND USAGE

The SR560 can be powered from either an AC power source or from three 12 V, 1.9 Amp-hour maintenance-free sealed lead-acid rechargeable batteries. Integral to the SR560 is an automatic battery charger, along with battery protection and charge indication circuitry.

Recharging

During battery operation, the front panel BATT LED will change from green to red to indicate that the batteries are low and require charging. For the longest battery life, the batteries should be immediately charged by plugging the unit into AC power whenever the BATT indicator lights red. Internal protection circuitry will disconnect the batteries from the amplifier if the unit is operated for too long in the low battery condition. This protects the batteries from permanent damage, which could occur if they were to remain connected to a load while dead.

The internal battery charging circuitry of the SR560 will automatically charge dead batteries at a quick rate until they are approximately 80% charged. The charge rate is then lowered to a level that is safe for maintaining the batteries. During AC operation, the batteries will be in this "maintain" charge condition indefinitely, and will suffer no degradation from prolonged charging. The sealed lead-acid batteries used in the SR560 differ in this respect from nickel-cadmium batteries, which do suffer shortened lifetimes due to overcharging. The sealed lead-acid batteries will provide the longest service life if they are not allowed to discharge too deeply and if they are charged immediately after use.

Battery Care

<u>WARNING</u>: As with all rechargeable batteries, for safety reasons the chemical recombination processes within the cells require that the batteries be allowed to vent non-corrosive gases to the atmosphere. Always use the batteries in an area with adequate ventilation.

As with all instruments powered by rechargeable batteries, the user must take some precautions to ensure long battery life. Understanding and following the precautions outlined below will result in a long operating life for the batteries in the SR560.

The SR560's internal lead-acid batteries will have a variable service life directly affected by THE NUMBER OF DISCHARGE CYCLES, DEPTH OF DISCHARGE AND

CIRCUIT DESCRIPTION

DIFFERENTIAL LOW-NOISE FRONT END

Two high-impedance inputs A and B allow the instrument to operate in either single-ended or true differential modes. Relays K103 and K104 allow the inputs A and B to be individually grounded, while K101 selects AC or DC coupling. Inversion of the inputs is provided by relay K105. The input capacitances and R101 and R102 establish the front end's input impedance at 25 pF and 100 MΩ.

U106 is an NPD5564 low-noise matched FET pair, which, along with U102 and U103 form the first differential amplifier stage. U102 compares the currents in the drain loads of U106, and U103 maintains the sum of those currents at a fixed level by varying the total current in both FETs. C109 provides open-loop compensation for U102, and front-end gain is nominally established by the sum of R118 and R112 over the sum of R114 and R128. K102 is a gain switching relay which selects a front end gain of 2 or 10. In the gain of 2 position, gain to the next stage becomes 1 when R116 divides with the input attenuator to the next stage. For a gain of 10, relay K102 shorts the top of R115 and R128 together, essentially eliminating them from the gain loop. P103 allows adjustment of front-end offset, and P104 allows for offset compensation when in the low gain configuration. P102 allows adjustment of the front-end common-mode rejection ratio, along with P101, which adjusts the CMRR in the low gain configuration.

In the second gain stage, U105 is configured with a fixed gain of 10. By switching the input attenuation of this stage with DG444 U101, the overall gain of this stage can be computer selected as 2, 5, or 10. C111 provides high frequency compensation for U105. The output of this stage passes through all three sections of U104, a CMOS multiplexer that serves as the blanking control. The three parallel switches provide a low "on" resistance to select either the output of the second stage amplifier or ground as the input to the next stage, the first filter section.

CONFIGURABLE FILTERS AND GAIN

The two filter stages in the SR560 each consist of 16 R-C filters which can be configured as either high pass or low pass by a relay. In the following description, part references in parentheses refer to filter two. Relay K201, (K301) selects either the high-pass or low-pass configuration for all of the sixteen filters. The output of one R-C section is selected by multiplexer U202 or U203, (U301 or U302) and passed on to non-inverting buffer U202, (U303).

Approximately 80 pF input capacitance of the multiplexers is included in the calculation of the R-C time constants of the filters. The four highest frequency stages are not available as high-pass filters because of unacceptable attenuation of the signal that occurs when the filter capacitance forms a divider with the input capacitance of the multiplexers.

DG444 U205D, (U401A) is used to bypass the filter sections entirely and U101D, (U304D) is used to "reset" the filter stages by discharging them through R228, (R329).

U201, (U305) is the third, (fourth) gain stage with a fixed gain of 5. The input attenuator U205, (U304) allows setting the gain of these stages to 1, 2, or 5 under computer control.

OUTPUT STAGES

The fifth gain stage consists of op-amp U402 which is configured as a non-inverting amplifier with a gain of 5. U401 is a DG444 that again serves to switch the input attenuation of this stage for overall gains of regulators, limiting peak battery charging voltage. As there are two positive batteries and one negative battery, U701 is a LM350 regulator that provides twice the current of the LM317 negative battery regulator.

Charging is controlled by changing the set voltage of the regulators based on battery charge status. Flip-flop U703 determines whether the charge regulators will be set to 15.5 volts for a quick charge or 13.8 volts for a trickle or "maintain" charge by grounding the bottom of P701 and P702. C712 and R704 insure that the charger always powers up in the "quick" charge mode. P701 and P702 are provided to adjust the open circuit trickle charge voltage to 13.8 volts. D701 and D703 are blocking diodes for the charging circuits while not charging, and D707 and D708 are clamps to guard against battery polarity reversal.

Comparators U708 and U709 are LP365 micropower comparators that monitor the battery voltage. A resistive divider chain sets the four trip points for each comparator. D709 provides a stable 2.5 volt reference against which levels are compared. For each battery, three level indications are provided, and are decoded by multiplexer U704. The "trip" level is 14.5 volts. The trip outputs control the state of U703 and switch the battery charge voltage settings. The "low" level is 11.3 volts and activates the front panel low battery indicator. R730 provides some level hysteresis for the low battery indication to prevent oscillation around the trip point. The "dead" level is 10.7 volts and is used to disconnect the load from the batteries before they are damaged by an excessively deep discharge. Q701 and Q703 are power MOSFET switches used to disconnect battery power from the amplifier. Dead level hysteresis is provided by R724. R731 and D711 provide un-interrupted battery power to the system RAM so that stored instrument settings are retained when the power is switched off.

POWER REGULATORS

The +5 V and +10 V supplies are produced with three-terminal regulators U801 and U802, respectively. The -10 V supply is constructed of op-amp U803 and Q801, a N-channel MOSFET as the pass element. The +10 V supply serves as the reference for the -10 V supply through divider R807 and R806.

The power output banana jacks on the rear panel (J801 and J803) are connected to the pre-regulated voltages after the power switch and before the regulators. This output can provide up to 200 mA of power for use as an external bias source, etc. Under some conditions, these jacks may be used to supply the unit with external DC power.

U506D and U506B generate the TTL level input to the processor to indicate when the unit is operating on the AC line.

Capacitors C801 through C821 are logic supply bypass capacitors distributed throughout the printed circuit board.

REAR PANEL INTERFACES

Two optically isolated rear panel interfaces are provided on the SR560. The blanking input accepts a TTL-level signal and grounds the amplifier signal path after the front end for as long as the input is held high. The response time of the blanking input is typically "on" 5 μs after the rising edge and "off" 10 μs after the falling edge. The RS-232 interface allows calibration and control of the instrument at 9600 baud. Data in and out on the connector are tied together, echoing data back to the sender. Hardware handshaking lines CTS, DSR, and CD are tied to DTR. Refer to Appendix A-1 for information on remote programming of the SR560.

CALIBRATION AND REPAIR

OFFSET ADJUSTMENT

The SR560's front-panel offset adjustment provides an easy way for the user to null the amplifier's DC offset. Use the COUPLING pushbutton to light the GND LED. Now, regardless of the SOURCE setting, the input to the amplifier is grounded internally. Insert a small screwdriver through the front-panel OFFSET hole and adjust the offset potentiometer until the DC offset of the amplifier (e.g. as viewed on a DVM) is zero. Finally, return to the desired coupling.

CALIBRATION

There are four pots, which are used to calibrate the instrument. The pots adjust the front-end CMRR (Common Mode Rejection Ratio) and offset. These pots are located close to the front of the instrument, and may be accessed by removing the bottom cover.

These pots should be adjusted to optimize the CMRR or null the offset when the front-end FET is replaced. Two of the pots adjust the CMRR and offset when the front-end gain is x10, and two adjust the CMRR and offset when the front-end gain is x2. The x10 gain pots must be set first, followed by the x2 gain pots.

First, the front panel offset pot must be set to zero:

- Adjust front panel Offset pot to read 0 VDC on pin 14, U407.

Next adjust the offset and CMRR for the case where the front-end gain is x10. View the amplifier output on a scope and perform the following adjustments:

- Couple = GND, Gain = 5 k, LOW NOISE: adjust P103 to null DC and output.

Now use a function generator as the source of a common mode signal:

- Apply 1 kHz 1 Vpp sine to both the A and B inputs.

- Couple = DC, source = A - B: adjust P102 to null sine wave output.

Now adjust the offset and CMRR for the case where the front-end gain is x2. View the amplifier output on a scope and perform the following adjustments:

- Couple = GND (remove signal from A and B inputs), Gain = 5 k, HIGH DR: adjust P104 to null DC and output.

- Apply 1 kHz 1 Vpp sine to both the A and B inputs.

- Couple = DC, source = A - B: adjust P101 to null sine wave output.

NOTE: In the above procedures, the gain of the front-end (x10 or x2) is determined by the selection of LOW NOISE or HIGH DYNAMIC RESERVE.

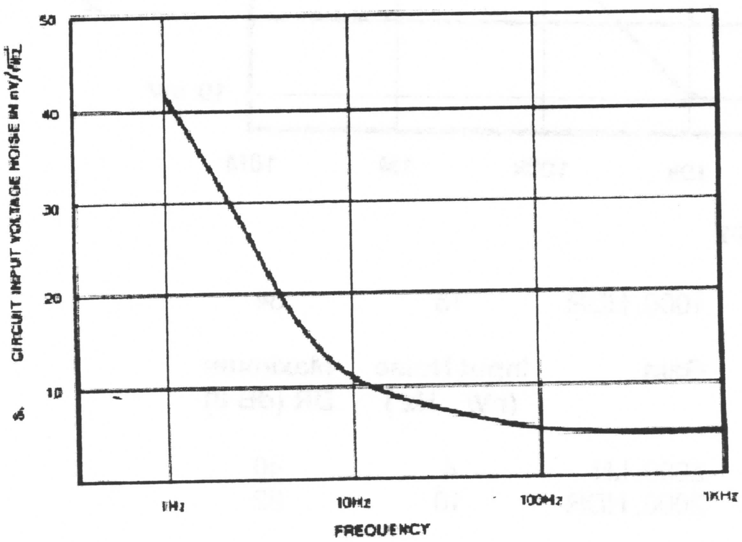
FRONT END REPLACEMENT

The most commonly damaged component is the front-end FET (U106, National Semiconductor Corp. P/N NPD5564). It is located in an 8-pin DIP socket behind the relays near the input BNCs. If the instrument exhibits a constant overload, excessive drift or noise, or large input bias currents, it is likely that this component has been damaged.

When replacing the FET, be certain that all eight pins are inserted into the socket, and observe the orientation of pin #1. After replacement adjust the CMRR and offset per the calibration procedure. More severely damaged front-ends may require replacement of op-amp, U102.

INPUT VOLTAGE NOISE

The amplifier's input voltage noise approximates that of a 1000Ω resistor (about 4 nV/√Hz). For source impedances below 1000Ω, the output noise will be dominated by the amplifier's input voltage noise. A typical amplifier has an input voltage noise vs. frequency as shown in the figure below. Notice that the voltage noise rises at lower frequencies ("1/f" noise).



DYNAMIC RESERVE

The dynamic reserve of the amplifier is a measure of how large a signal can be present at the input to the amplifier without causing an overload condition.

The definition of dynamic reserve is:

- DR (dB) = 20 log (Vin(f) w/o overload / Vin for full scale)

A full-scale output voltage is 10 Vpp. Signals at the output (or at any stage) which exceed 10 Vpp cause an overload. The dynamic reserve is greater than 0 dB only when the filters are used to remove unwanted signals.

The dynamic reserve is a function of frequency and depends on the amplifier configuration (gain, filters and dynamic reserve setting). The figure below shows the dynamic reserve (and maximum input signal without overload) for a SR560 set to a gain of 1000, the high pass filter set to 1 kHz and the low pass filter set to 10 kHz (for a bandpass from 1 kHz to 10 kHz). The dynamic reserve characteristic is shown for both "High Dynamic Reserve" and "Low Noise" gain modes.

There are several features to note. In the bandpass region between 1 and 10 kHz the dynamic reserve is 0 dB. The dynamic reserve is 3 dB at the filter frequencies of 1 and 10 kHz. The dynamic reserve rises by 6 dB/oct (or 20 dB per decade) as the signal moves away from the pole frequency, since each RC filter attenuates the signal. If a faster roll-off for interfering signals were required, a 12 dB/octave HP or LP filter could be used.

The HIGH DR characteristic offers 16 dB more DR at low frequencies and 26 dB more at high frequencies. The high frequency DR is limited only by the maximum 3 Vpp limit of the input stage.

The maximum DR in the low noise mode is 36 dB. Since there is no gain between the HP and LP filters in the Low Noise gain mode, the DR is the same at very high frequencies and very low frequencies.

The input reference voltage noise for the High DR gain mode is about 10 nV/√Hz, compared to 4 nV/√Hz in the Low Noise gain mode. The table (middle of next page) summarizes the input referenced noise and maximum dynamic reserve for all gains.

SR560 COMPONENT PARTS LIST

Front Panel Parts List

REF.	SRS part#	VALUE	DESCRIPTION
D 1	3-00013-306	RED	LED, Rectangular
D 2	3-00012-306	GREEN	LED, Rectangular
D 3	3-00012-306	GREEN	LED, Rectangular
D 4	3-00012-306	GREEN	LED, Rectangular
D 5	3-00012-306	GREEN	LED, Rectangular
D 6	3-00012-306	GREEN	LED, Rectangular
D 7	3-00012-306	GREEN	LED, Rectangular
D 8	3-00012-306	GREEN	LED, Rectangular
D 9	3-00012-306	GREEN	LED, Rectangular
D 10	3-00175-306	YELLOW	LED, Rectangular
D 11	3-00012-306	GREEN	LED, Rectangular
D 12	3-00012-306	GREEN	LED, Rectangular
D 13	3-00012-306	GREEN	LED, Rectangular
D 14	3-00012-306	GREEN	LED, Rectangular
D 15	3-00012-306	GREEN	LED, Rectangular
D 16	3-00012-306	GREEN	LED, Rectangular
D 17	3-00012-306	GREEN	LED, Rectangular
D 18	3-00012-306	GREEN	LED, Rectangular
D 19	3-00012-306	GREEN	LED, Rectangular
D 20	3-00012-306	GREEN	LED, Rectangular
D 21	3-00012-306	GREEN	LED, Rectangular
D 22	3-00012-306	GREEN	LED, Rectangular
D 23	3-00012-306	GREEN	LED, Rectangular
D 24	3-00012-306	GREEN	LED, Rectangular
D 25	3-00012-306	GREEN	LED, Rectangular
D 26	3-00012-306	GREEN	LED, Rectangular
D 27	3-00012-306	GREEN	LED, Rectangular
D 28	3-00012-306	GREEN	LED, Rectangular
D 29	3-00012-306	GREEN	LED, Rectangular
D 30	3-00012-306	GREEN	LED, Rectangular
D 31	3-00012-306	GREEN	LED, Rectangular
D 32	3-00012-306	GREEN	LED, Rectangular
D 33	3-00012-306	GREEN	LED, Rectangular
D 34	3-00012-306	GREEN	LED, Rectangular
D 35	3-00012-306	GREEN	LED, Rectangular
D 36	3-00012-306	GREEN	LED, Rectangular
D 37	3-00012-306	GREEN	LED, Rectangular
D 38	3-00175-306	YELLOW	LED, Rectangular
D 39	3-00175-306	YELLOW	LED, Rectangular
D 40	3-00012-306	GREEN	LED, Rectangular
D 41	3-00012-306	GREEN	LED, Rectangular
D 42	3-00012-306	GREEN	LED, Rectangular
D 43	3-00004-301	1N4148	Diode
D 44	3-00004-301	1N4148	Diode
D 45	3-00004-301	1N4148	Diode
D 46	3-00004-301	1N4148	Diode
D 47	3-00377-305	GLPED2	LED, Rectangular, Bicolor
D 48	3-00004-301	1N4148	Diode

SR560 COMPONENT PARTS LIST

Main Board Parts List

REF.	SRS part#	VALUE	DESCRIPTION
BT1	6-00050-612	GB1219-36	Battery
BT2	6-00050-612	GB1219-36	Battery
BT3	6-00050-612	GB1219-36	Battery
C 101	5-00098-517	10U	Capacitor, Tantalum, 35V, 20%, Rad
C 102	5-00098-517	10U	Capacitor, Tantalum, 35V, 20%, Rad
C 103	5-00098-517	10U	Capacitor, Tantalum, 35V, 20%, Rad
C 104	5-00098-517	10U	Capacitor, Tantalum, 35V, 20%, Rad
C 106	5-00069-513	.1U	Capacitor, Mylar/Poly, 50V, 5%, Rad
C 107	5-00069-513	.1U	Capacitor, Mylar/Poly, 50V, 5%, Rad
C 108	5-00013-501	33P	Capacitor, Ceramic Disc, 50V, 10%, SL
C 109	5-00013-501	33P	Capacitor, Ceramic Disc, 50V, 10%, SL
C 110	5-00159-501	6.8P	Capacitor, Ceramic Disc, 50V, 10%, SL
C 111	5-00019-501	68P	Capacitor, Ceramic Disc, 50V, 10%, SL
C 112	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 113	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 114	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 115	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 116	5-00005-501	150P	Capacitor, Ceramic Disc, 50V, 10%, SL
C 201	5-00019-501	68P	Capacitor, Ceramic Disc, 50V, 10%, SL
C 202	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 203	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 204	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 205	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 206	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 208	5-00010-501	270P	Capacitor, Ceramic Disc, 50V, 10%, SL
C 209	5-00061-513	.001U	Capacitor, Mylar/Poly, 50V, 5%, Rad
C 210	5-00063-513	.0033U	Capacitor, Mylar/Poly, 50V, 5%, Rad
C 211	5-00065-513	.01U	Capacitor, Mylar/Poly, 50V, 5%, Rad
C 212	5-00067-513	.033U	Capacitor, Mylar/Poly, 50V, 5%, Rad
C 213	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 214	5-00194-542	.47U MIN	Cap, Mini Electrolytic, 50V, 20% Radial
C 215	5-00194-542	.47U MIN	Cap, Mini Electrolytic, 50V, 20% Radial
C 216	5-00193-542	2.2U MIN	Cap, Mini Electrolytic, 50V, 20% Radial
C 217	5-00193-542	2.2U MIN	Cap, Mini Electrolytic, 50V, 20% Radial
C 218	5-00213-546	4.7U	Cap, Mini Electro, 100V, 20%, Rad
C 219	5-00213-546	4.7U	Cap, Mini Electro, 100V, 20%, Rad
C 220	5-00033-520	47U	Capacitor, Electrolytic, 16V, 20%, Rad
C 221	5-00033-520	47U	Capacitor, Electrolytic, 16V, 20%, Rad
C 222	5-00031-520	220U	Capacitor, Electrolytic, 16V, 20%, Rad
C 223	5-00031-520	220U	Capacitor, Electrolytic, 16V, 20%, Rad
C 224	5-00232-520	470U	Capacitor, Electrolytic, 16V, 20%, Rad
C 225	5-00232-520	470U	Capacitor, Electrolytic, 16V, 20%, Rad
C 226	5-00192-542	22U MIN	Cap, Mini Electrolytic, 50V, 20% Radial
C 227	5-00192-542	22U MIN	Cap, Mini Electrolytic, 50V, 20% Radial
C 228	5-00008-501	22P	Capacitor, Ceramic Disc, 50V, 10%, SL
C 230	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 301	5-00017-501	47P	Capacitor, Ceramic Disc, 50V, 10%, SL
C 302	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad

SR560 COMPONENT PARTS LIST

C 710	5-00227-526	100U	Capacitor, Electrolytic, 35V, 20%, Rad
C 711	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 712	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 713	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 714	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 715	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 716	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 717	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 801	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 802	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 803	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 804	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 805	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 806	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 807	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 808	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 809	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 810	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 811	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 812	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 813	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 814	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 815	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 816	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 817	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 818	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 819	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 820	5-00225-548	.1U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
C 821	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 822	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 823	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 824	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 825	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 826	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 827	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 828	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 829	5-00100-517	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 830	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 831	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
C 832	5-00023-529	.1U	Cap, Monolythic Ceramic, 50V, 20%, Z5U
CR724	5-00262-548	.01U AXIAL	Capacitor, Ceramic, 50V,+80/-20% Z5U AX
CX506	5-00233-532	22P	Capacitor, Ceramic Disc, 50V, 10% NPO
D 101	3-00368-301	1N753A	Diode
D 201	3-00368-301	1N753A	Diode
D 202	3-00368-301	1N753A	Diode
D 301	3-00368-301	1N753A	Diode
D 302	3-00368-301	1N753A	Diode
D 401	3-00004-301	1N4148	Diode
D 402	3-00004-301	1N4148	Diode
D 403	3-00004-301	1N4148	Diode
D 404	3-00004-301	1N4148	Diode
D 405	3-00004-301	1N4148	Diode

SR560 COMPONENT PARTS LIST

Q 110	3-00022-325	2N3906	Transistor, TO-92 Package
Q 111	3-00022-325	2N3906	Transistor, TO-92 Package
Q 201	3-00022-325	2N3906	Transistor, TO-92 Package
Q 202	3-00022-325	2N3906	Transistor, TO-92 Package
Q 301	3-00022-325	2N3906	Transistor, TO-92 Package
Q 302	3-00022-325	2N3906	Transistor, TO-92 Package
Q 501	3-00021-325	2N3904	Transistor, TO-92 Package
Q 701	3-00310-329	MTP25N05	Voltage Reg., TO-220 (TAB) Package
Q 702	3-00887-325	MPS2907A	Transistor, TO-92 Package
Q 703	3-00374-329	MTP20P06	Voltage Reg., TO-220 (TAB) Package
Q 801	3-00376-329	MTP5N05	Voltage Reg., TO-220 (TAB) Package
R 2	4-00616-453	49.9	Resistor, 2W, 1%
R 101	4-00306-407	100M	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 102	4-00306-407	100M	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 103	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 104	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 105	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 106	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 108	4-00169-407	249	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 109	4-00041-401	150	Resistor, Carbon Film, 1/4W, 5%
R 110	4-00141-407	100	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 111	4-00217-408	1.000K	Resistor, Metal Film, 1/8W, 0.1%, 25ppm
R 112	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 113	4-00301-408	110	Resistor, Metal Film, 1/8W, 0.1%, 25ppm
R 114	4-00301-408	110	Resistor, Metal Film, 1/8W, 0.1%, 25ppm
R 115	4-00619-408	909	Resistor, Metal Film, 1/8W, 0.1%, 25ppm
R 116	4-00193-407	499	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 117	4-00528-408	499	Resistor, Metal Film, 1/8W, 0.1%, 25ppm
R 118	4-00217-408	1.000K	Resistor, Metal Film, 1/8W, 0.1%, 25ppm
R 119	4-00544-407	165	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 120	4-00142-407	100K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 121	4-00203-407	75.0K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 122	4-00021-401	1.0K	Resistor, Carbon Film, 1/4W, 5%
R 123	4-00215-407	909	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 124	4-00141-407	100	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 125	4-00192-407	49.9K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 126	4-00034-401	10K	Resistor, Carbon Film, 1/4W, 5%
R 127	4-00142-407	100K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 128	4-00619-408	909	Resistor, Metal Film, 1/8W, 0.1%, 25ppm
R 129	4-00142-407	100K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 130	4-00031-401	100	Resistor, Carbon Film, 1/4W, 5%
R 131	4-00528-408	499	Resistor, Metal Film, 1/8W, 0.1%, 25ppm
R 132	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 133	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 134	4-00102-401	75K	Resistor, Carbon Film, 1/4W, 5%
R 135	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 136	4-00142-407	100K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 137	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 201	4-00516-407	14.3K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 202	4-00164-407	20.0K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 203	4-00516-407	14.3K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 204	4-00168-407	22.6K	Resistor, Metal Film, 1/8W, 1%, 50PPM

SR560 COMPONENT PARTS LIST

R 328	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 329	4-00031-401	100	Resistor, Carbon Film, 1/4W, 5%
R 330	4-00065-401	3.3K	Resistor, Carbon Film, 1/4W, 5%
R 401	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 402	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 403	4-00325-407	845	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 404	4-00165-407	200	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 405	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 406	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 407	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 408	4-00317-407	422	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 409	4-00296-407	604	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 410	4-00165-407	200	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 411	4-00165-407	200	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 412	4-00296-407	604	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 413	4-00165-407	200	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 415	4-00165-407	200	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 416	4-00555-407	590	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 417	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 418	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 419	4-00138-407	10.0K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 420	4-00188-407	4.99K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 421	4-00138-407	10.0K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 422	4-00186-407	4.22K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 423	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 424	4-00186-407	4.22K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 425	4-00141-407	100	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 426	4-00021-401	1.0K	Resistor, Carbon Film, 1/4W, 5%
R 427	4-00021-401	1.0K	Resistor, Carbon Film, 1/4W, 5%
R 428	4-00021-401	1.0K	Resistor, Carbon Film, 1/4W, 5%
R 429	4-00034-401	10K	Resistor, Carbon Film, 1/4W, 5%
R 430	4-00021-401	1.0K	Resistor, Carbon Film, 1/4W, 5%
R 431	4-00022-401	1.0M	Resistor, Carbon Film, 1/4W, 5%
R 432	4-00022-401	1.0M	Resistor, Carbon Film, 1/4W, 5%
R 433	4-00138-407	10.0K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 434	4-00138-407	10.0K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 435	4-00138-407	10.0K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 436	4-00138-407	10.0K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 437	4-00057-401	220	Resistor, Carbon Film, 1/4W, 5%
R 438	4-00616-453	49.9	Resistor, 2W, 1%
R 439	4-00142-407	100K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 440	4-00142-407	100K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 441	4-00030-401	10	Resistor, Carbon Film, 1/4W, 5%
R 442	4-00021-401	1.0K	Resistor, Carbon Film, 1/4W, 5%
R 501	4-00084-401	5.1K	Resistor, Carbon Film, 1/4W, 5%
R 502	4-00027-401	1.5K	Resistor, Carbon Film, 1/4W, 5%
R 503	4-00027-401	1.5K	Resistor, Carbon Film, 1/4W, 5%
R 602	4-00142-407	100K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 603	4-00142-407	100K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 701	4-00142-407	100K	Resistor, Metal Film, 1/8W, 1%, 50PPM
R 702	4-00088-401	51K	Resistor, Carbon Film, 1/4W, 5%
R 703	4-00142-407	100K	Resistor, Metal Film, 1/8W, 1%, 50PPM

SR560 COMPONENT PARTS LIST

U 102	3-00382-340	OP37	Integrated Circuit (Thru-hole Pkg)
U 103	3-00090-340	LF411	Integrated Circuit (Thru-hole Pkg)
U 104	3-00385-340	74HC4053	Integrated Circuit (Thru-hole Pkg)
U 105	3-00297-340	LT1028	Integrated Circuit (Thru-hole Pkg)
U 106	3-00246-340	NPD5564	Integrated Circuit (Thru-hole Pkg)
U 201	3-00382-340	OP37	Integrated Circuit (Thru-hole Pkg)
U 202	3-00270-340	74HC4051	Integrated Circuit (Thru-hole Pkg)
U 203	3-00270-340	74HC4051	Integrated Circuit (Thru-hole Pkg)
U 204	3-00189-340	LF356	Integrated Circuit (Thru-hole Pkg)
U 205	3-00371-340	DG444	Integrated Circuit (Thru-hole Pkg)
U 301	3-00270-340	74HC4051	Integrated Circuit (Thru-hole Pkg)
U 302	3-00270-340	74HC4051	Integrated Circuit (Thru-hole Pkg)
U 303	3-00189-340	LF356	Integrated Circuit (Thru-hole Pkg)
U 304	3-00371-340	DG444	Integrated Circuit (Thru-hole Pkg)
U 305	3-00382-340	OP37	Integrated Circuit (Thru-hole Pkg)
U 401	3-00371-340	DG444	Integrated Circuit (Thru-hole Pkg)
U 402	3-00297-340	LT1028	Integrated Circuit (Thru-hole Pkg)
U 403	3-00382-340	OP37	Integrated Circuit (Thru-hole Pkg)
U 404	3-00090-340	LF411	Integrated Circuit (Thru-hole Pkg)
U 405	3-00241-340	AD7528JN	Integrated Circuit (Thru-hole Pkg)
U 406	3-00383-340	LM6321	Integrated Circuit (Thru-hole Pkg)
U 407	3-00243-340	LM837	Integrated Circuit (Thru-hole Pkg)
U 408	3-00143-340	LM393	Integrated Circuit (Thru-hole Pkg)
U 409	3-00371-340	DG444	Integrated Circuit (Thru-hole Pkg)
U 501	3-00155-340	74HC04	Integrated Circuit (Thru-hole Pkg)
U 502	3-00045-340	74HC32	Integrated Circuit (Thru-hole Pkg)
U 503	3-00298-340	Z80H	Integrated Circuit (Thru-hole Pkg)
U 505	3-00081-341	2KX8-100	STATIC RAM, I.C.
U 506	3-00039-340	74HC14	Integrated Circuit (Thru-hole Pkg)
U 507	3-00158-340	74HC154N	Integrated Circuit (Thru-hole Pkg)
U 508	3-00049-340	74HC74	Integrated Circuit (Thru-hole Pkg)
U 509	3-00277-340	74HC11	Integrated Circuit (Thru-hole Pkg)
U 510	3-00259-340	74HCT373	Integrated Circuit (Thru-hole Pkg)
U 601	3-00046-340	74HC374	Integrated Circuit (Thru-hole Pkg)
U 602	3-00046-340	74HC374	Integrated Circuit (Thru-hole Pkg)
U 603	3-00046-340	74HC374	Integrated Circuit (Thru-hole Pkg)
U 604	3-00046-340	74HC374	Integrated Circuit (Thru-hole Pkg)
U 605	3-00046-340	74HC374	Integrated Circuit (Thru-hole Pkg)
U 606	3-00046-340	74HC374	Integrated Circuit (Thru-hole Pkg)
U 607	3-00044-340	74HC244	Integrated Circuit (Thru-hole Pkg)
U 701	3-00384-329	LM350T	Voltage Reg., TO-220 (TAB) Package
U 702	3-00141-329	LM337T	Voltage Reg., TO-220 (TAB) Package
U 703	3-00067-340	CD4013	Integrated Circuit (Thru-hole Pkg)
U 704	3-00152-340	CD4051	Integrated Circuit (Thru-hole Pkg)
U 705	3-00239-335	HS-212-12	Relay
U 706	3-00149-329	LM317T	Voltage Reg., TO-220 (TAB) Package
U 707	3-00141-329	LM337T	Voltage Reg., TO-220 (TAB) Package
U 708	8-00072-860	SR566 ASSY	SRS sub assemblies
U 709	8-00072-860	SR566 ASSY	SRS sub assemblies
U 801	3-00112-329	7805	Voltage Reg., TO-220 (TAB) Package
U 802	3-00307-340	LM2940T-10	Integrated Circuit (Thru-hole Pkg)
U 803	3-00090-340	LF411	Integrated Circuit (Thru-hole Pkg)

SR560 COMPONENT PARTS LIST

Z 0	1-00127-177	.062" DIAM	Terminal, Female
Z 0	1-00128-171	20 COND	Cable Assembly, Ribbon
Z 0	4-00541-435	130V/1200A	Varistor, Zinc Oxide Nonlinear Resistor
Z 0	5-00027-503	.01U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
Z 0	6-00004-611	1A 3AG	Fuse
Z 0	6-00074-611	3A 3AG	Fuse
Z 0	7-00194-715	PS300-38	Bracket
Z 0	7-00201-720	SR500-32	Fabricated Part
Z 0	7-00222-701	SR560-XX	Printed Circuit Board
Z 0	7-00232-709	SR560-4	Lexan Overlay
Z 0	7-00251-720	SR560-21	Fabricated Part
Z 0	7-00252-720	SR560-23-25	Fabricated Part
Z 0	7-00257-720	SR560-20	Fabricated Part
Z 0	7-00258-720	SR560-26	Fabricated Part
Z 0	7-00680-720	PS300-52	Fabricated Part
Z 0	7-00795-720	BATTERY PAN	Fabricated Part
Z 0	7-00796-720	BATTERY RETAINR	Fabricated Part
Z 0	9-00127-907	1/2" CLEAR	Shrink Tubing
Z 0	9-00267-917	GENERIC	Product Labels
Z 0	9-00792-917	EC WARNING	Product Labels

APPENIDX A

REMOTE PROGRAMMING

Introduction

The SR560 is equipped with a standard DB-25 RS-232C connector on the rear panel for remote control of all instrument functions. The interface is configured as listen-only, 9600 baud DCE, 8-bit, no parity, 2 stop bits, and is optically isolated to prevent any noise or grounding problems.

Up to four SR560 amplifiers can be connected in parallel to the same RS-232 interface. Units sharing the same interface must have a unique address as set on dip switch SW601, accessible through the bottom cover of the unit. To set an instrument to one of the four available addresses, adjust positions one and two of dip switch SW601 as follows:

SW601 Pos. 2	Pos.1	Address of unit
OFF	OFF	UNIT 0
OFF	ON	UNIT 1
ON	OFF	UNIT 2
ON	ON	UNIT 3

Commands

The following commands are obeyed by all SR560's that are addressed to listen. The LALL, LISN, and UNLS commands are always obeyed and control the address status of the SR560. Commands must end with a carriage return and line feed <CR> <LF>.

BLINK i — Operates amplifier blanking.
i = 0 = not blanked, 1 = blanked

CPLG i — Sets input coupling.
i = 0 = ground, 1 = DC, 2 = AC

DYNR i — Sets dynamic reserve.
i = 0 = low noise, 1 = high DR, 2 = calibration gains (defaults)

FLTM i — Sets filter mode.
i = 0 = bypass, 1 = 6 dB low pass, 2 = 12 dB low pass, 3 = 6 dB high pass, 4 = 12 dB highpass, 5 = bandpass

GAIN i — Sets the gain.
i = 0 – 11 sets frequency = 0.03 Hz to 10 kHz

INVT i — Sets the signal invert sense.
i = 0 = non-inverted, 1 = inverted

LALL — Listen all. Makes all attached SR560's listeners.

LISN i — Listen command. Makes SR560 with address i (0,1,2,3) a listener.

LFRQ i — Sets lowpass filter frequency.
i = 0 – 15 sets frequency = 0.03 Hz to 1 MHz

ROLD — Resets overload for ½ second.

SRCE i — Sets the input source.
i = 0 = A, 1 = A-B, 2 = B

UCAL i — Sets the vernier gain status.
i = 0 = cal'd gain, 1 = vernier gain

UCGN i — Sets the vernier gain to i %.
i = 0 to 100

UNLS — Unlisten. Unaddresses all attached SR560's.

*RST — Reset. Recalls default settings.