# RA-1713G

## INTRODUCTION

The RA-1713G is an auxiliary electronics system for use with the Westrex RA-1712G. It comprises a current regulated digital readout recorder lamp supply, a direct-photocell monitor amplifier with compensatory frequency equalization, a compressor-limiter, a cross-modulation distortion correction circuit for electroprinting and for normal negative recording, and a cross-modulation signal generator. The RA-1713G is designed to be inserted directly into the Westrex RA-1712G processing chain. The two systems together provide a complete electronic system for use with a galvanometer type recorder to record 35 mm, 16 mm, or 8-mm optical sound tracks.

The current regulated lamp supply provides from 3.5 amps to 8.5 amps of current. The Lamp current is adjusted by a front panel ten-turn potentiometer and is displayed directly in amperes on the front panel digital meter.

The monitor circuit provides internal frequency compensation to cancel film loss equalization introduced in the RA-1712G. It picks off the electronic signal internally for the direct monitor and provides a photocell amplifier for monitoring the Galvanometer response directly via a photocell monitor if one is available on that particular recorder. The levels of the two monitor pickoffs are independently adjustable allowing A-B comparison. The monitor output is capable of driving a 600 Ω load at 20 dB.

The compressor-limiter is specifically designed for recording optical sound tracks. It comes into action only for signals greater than 3 dB below 100 percent modulation. Depending on the selected switch position, it provides from 3 dB to 12 dB of added head room

The cross-modulation correction circuit can be used to cancel distortion in electroprints and provides a broad range correction capability, which can be set to cancel cross-modulation distortion across the entire recorded spectrum. This last feature allows cross-modulation distortion tests to be made at any convenient high frequency with the assurance that cancellation at that frequency guarantees cancellation at all high frequencies.

The cross-modulation signal generator provides all the signals necessary for recording cross-modulation distortion test at 4, 6, 8, and 10 kHz. The cross-modulation test signals can be injected at any time by toggling a single toggle switch.

The RA-1713G is housed in a 5¼inch X 18-inch rack mountable case, which matches the RA-1712G case.

## INSTALLATION

The RA-1713G is designed for use with the Westrex RA-1712G Optical Sound Record Electronics system. For installation it is critical that good grounding practice be followed to avoid ground loops and ground noise. The back panel terminals on the RA-1713G marked A, GND and B should be connected to the corresponding terminals on the back of the RA-1712G. If the RA-1712G is grounded to the system ground pr to a power supply ground that ground is carried to the RA-1713G via the GND terminal and the power supply ground of the RA-1717G must be lifted using an isolation power plug. There must be only ONE ground in the system!

The recorder lamp is connected to the two terminals labeled LAMP on the back panel of the RA-1713G. Do not ground either of these terminals.

The silicon photocell used as the galvanometer monitor, if available, is connected to the two terminals labeled PC+ and PC-. The black, or negative, lead should be connected to the PC- terminal. The monitor output appears on the two terminals labeled MON OUT and MON GND. The MON GND is indeed system ground and should be so treated. The monitor amplifier will drive 600 Ωto 20 dB.

## OPERATION

### LAMP SUPPLY

The RA 1713G lamp supply is current regulated. This is desirable in that the current flow through the recorder lamp is independent of lamp contact resistance and hence more stable than could be achieved with a voltage regulated design. The ten-turn pot on the front panel labeled LAMP controls the lamp current. Before turning on the RA-1713G for the first time, turn the LAMP control as far counterclockwise as possible to assure minimum lamp current. Turning the LAMP control clockwise increases the lamp current. The digital LAMP CURRENT meter reads the lamp current directly in amperes.

### MONITOR

The monitor amplifier circuit operates in either a direct or record mode. In the direct mode the electronic signal being directed to the RA-1712G to be recorded is picked off as the monitored signal. In the record mode a photocell input signal becomes the monitored signal, if one is available. The levels of the two signals are independently adjustable via the front panel level pots. For A - B comparison the levels are set to match and the MODE toggle switch selects between the two modes. The REC.EQ. switch is set to the same position as the EQUALIZATION switch on the RA-1712G. This removes the film loss equalization added by the RA-1712G from the monitored signal.

## COMPRESSOR-LIMITER

The compressor-limiter is designed to enhance the headroom characteristics of recorded optical sound tracks. It operates only on the last 3 dB of recording amplitude. It maps onto those last three dB from 6 to 15 dB of input signal level. Thus in switch position 1, the headroom is increased 3 dB, in position 2 the headroom is also increased 3 dB and so on until in switch position 4, a total of 12 dB of headroom is added

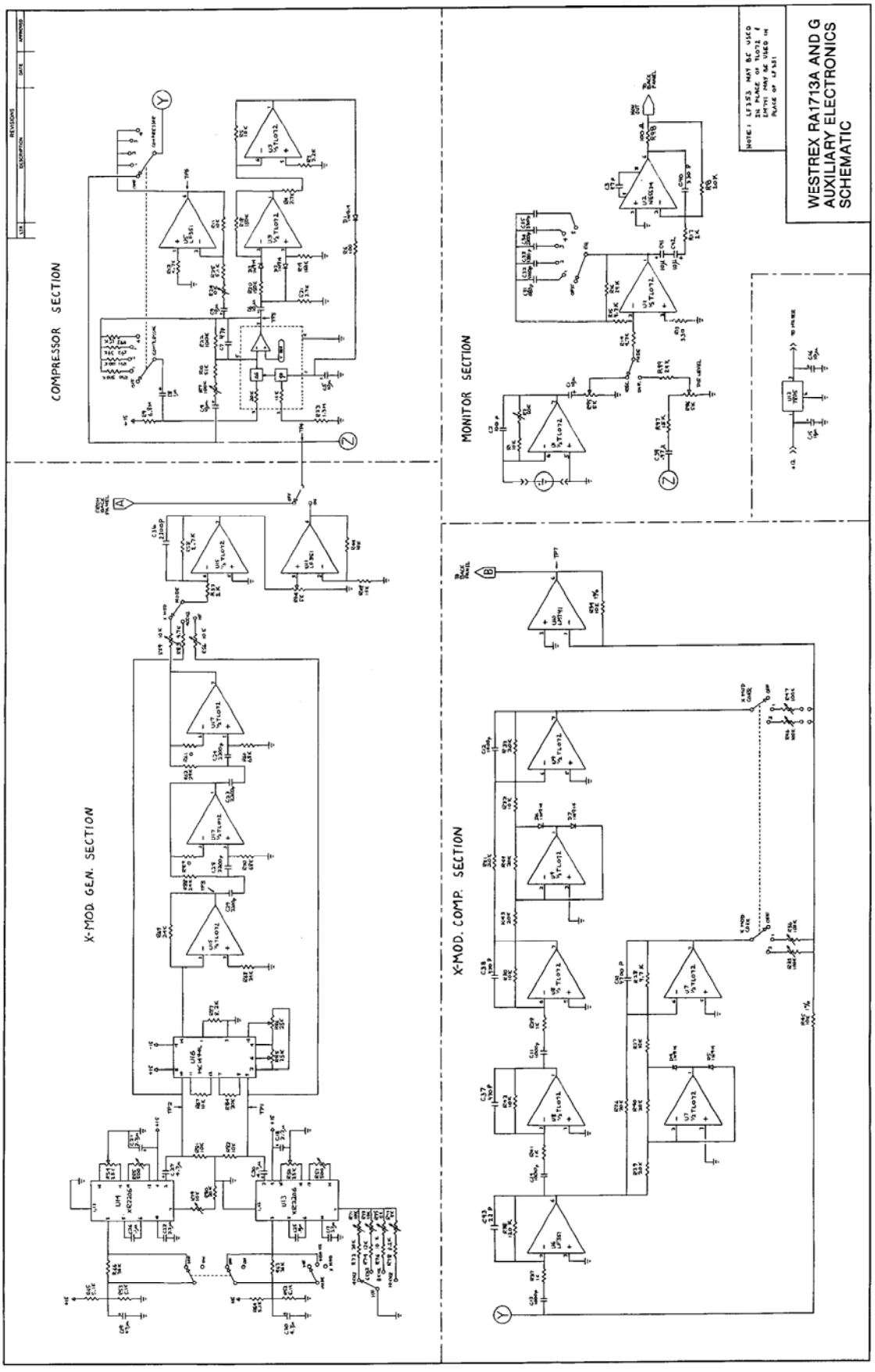
## CROSS-MODULATION CORRECTION

The cross-modulation correction circuit may be adjusted to provide correction of distortion on electroprint positive recordings or to provide correction of distortion over the entire recorded spectrum for standard negative recordings. Two operational modes of the circuit are front panel selectable. The position selected determines the amount and frequency characteristics of the distortion correction provided. The circuit is factory set for distortion correction in negative recording for 16 mm sound tracks using film equivalent to Agfa AT-8 negative stock in switch position 1 and for 16 mm electroprinting in switch position 2. Cross-modulation tests should be made for each individual recorder, stock and laboratory used to optimize the use of this feature. The amount and frequency characteristics of the correction can be internally adjusted for the two switch positions. The setup of the distortion correction for particular applications is discussed in the manual section on calibration.

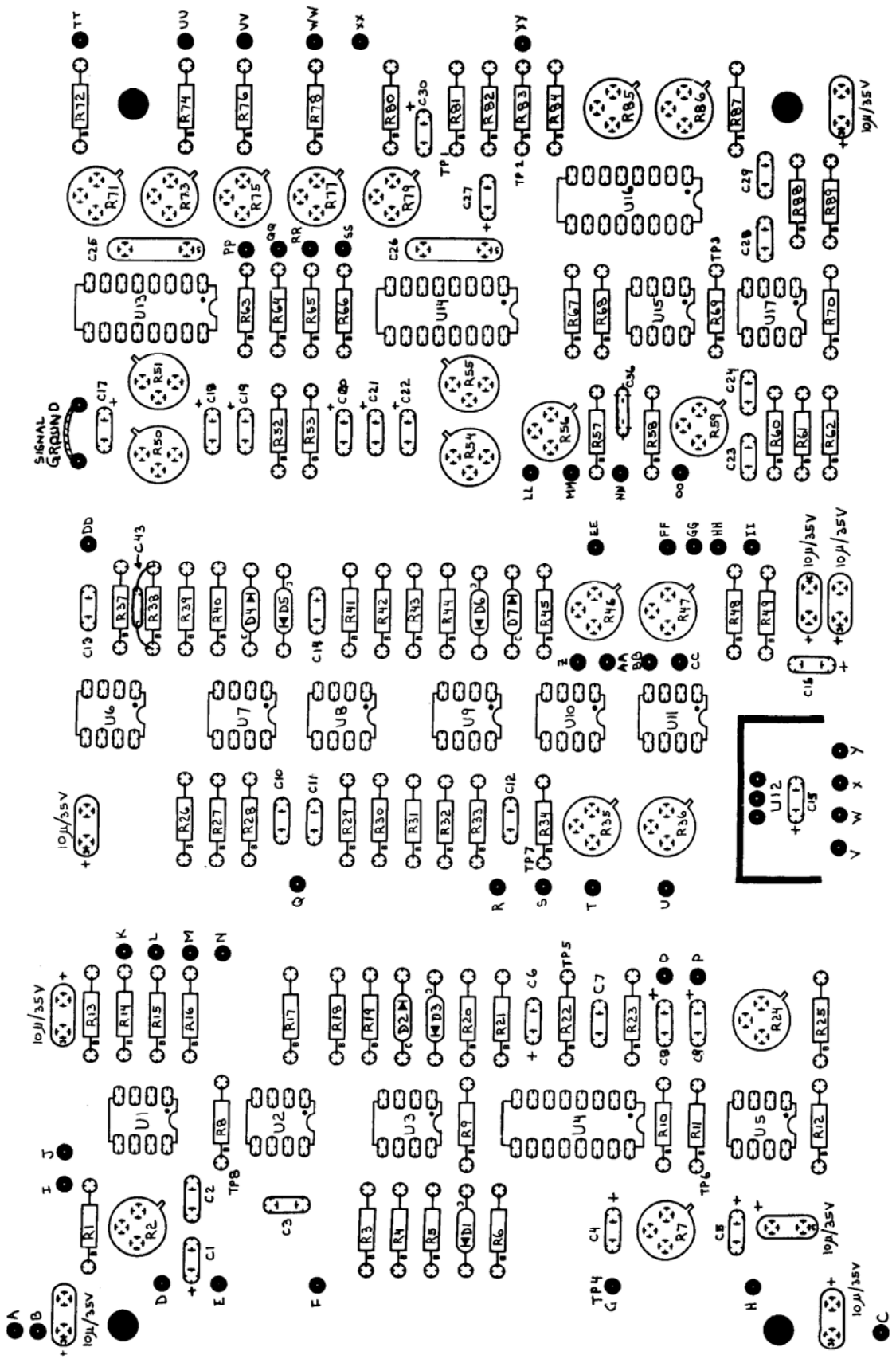
## CROSS-MODULATION SIGNAL GENERATOR

The MODE switch selects the type of signal generated by the generator. In the H.F. MODE, a high frequency signal at the frequency selected by the H.F. switch is generated. In the 400 Hz mode a 400 Hz sine wave is generated and finally in the XM mode a 400 Hz AM modulated signal at the high frequency selected is generated. The level control sets the level of the injected signal. Signals generated by the generator are injected into the signal chain when the cross modulation generator toggle switch is toggled on; otherwise the RA-1712G input signal is selected. The generator is used in the usual fashion to record cross-modulation distortion test series.

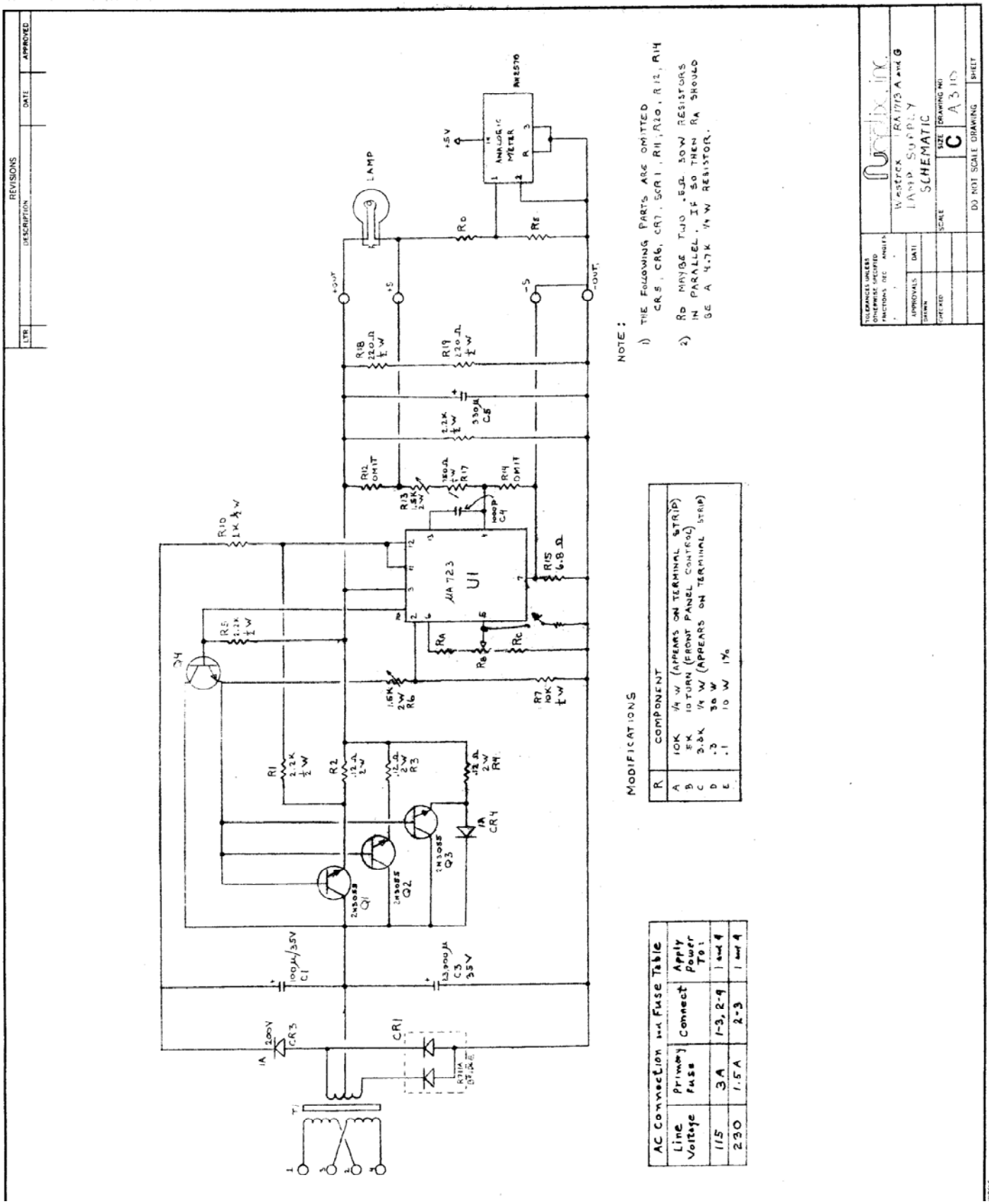
# RA-1713G


WESTREX RA1713A AND G
AUXILIARY ELECTRONICS
SCHEMATIC
COMPRESSOR SECTION
MONITOR SECTION
X-MOD. GEN. SECTION
X-MOD. COMP. SECTION

# RA-1713G




WESTREX RA1713A AND G
AUXILIARY ELECTRONICS
PARTS LOCATION DIAGRAM


REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
NOTE:
1) THE FOLLOWING PARTS ARE OMITTED CR5, CR6, CR7, SCR1, R11, R10, R12, R14
2) R9 MAYBE TWO .5Ω 50W RESISTORS IN PARALLEL. IF SO THEN R4 SHOULD BE A 4.7K ¼ W RESISTOR.
MODIFICATIONS
R | COMPONENT
A | 10K ¼ W (APPEARS ON TERMINAL STRIP)
B | 5K 10 TURN (FRONT PANEL CONTROL)
C | 3.6K ¼ W (APPEARS ON TERMINAL STRIP)
D | .3 3Ω W
E | .1 10 W 1%
AC Connection and Fuse Table
Line Voltage | Primary Fuse | Connect | Apply Power To
115 | 3A | 1-3, 2-4 | 1 and 4
230 | 1.5A | 2-3 | 1 and 4
LAMP
+5V
+OUT
+S
-S
-OUT
ANALOG METER
AM2570
U1
μA723
Q1 2N5088
Q2 2N3055
Q3 2N3055
CR1
CR2
CR3
CR4
T1
C1 100μ/35V
C3 3900μ 35V
C4 100P
C5 330μ
R1 2.2K ½W
R2 .12Ω 2W
R3 .12Ω 2W
R4 .12Ω 2W
R5 2.2K ½W
R6 1.5K 2W
R7 10K ½W
R8 1.5K 2W
R9 220Ω 1W
R10 1K ½W
R11 2.2K 1W
R12 OMIT
R13 1.5K 2W
R14 OMIT
R15 6.8Ω
R16 220Ω 1W
R17 150Ω 1W
R18 220Ω 1W
R19 220Ω 1W
RA
RB
RC
RD
RE
Q4
Westrex RA1713 A and G
LAMP SUPPLY
SCHEMATIC
SIZE C
DRAWING NO A 3115
DO NOT SCALE DRAWING
SHEET

# AN2570

**±1999 count**

**Full Performance, Low Cost**

# DIGITAL PANEL INSTRUMENT

## DESCRIPTION

The Analogic AN2570 is a bipolar 3½-digit (±1999 counts) full performance digital panel instrument. Low cost, without loss of desirable instrumentation features, is made possible through state-of-the-art LSI technology and Analogic's years of leadership in digital panel instrumentation design.

A full scale input range of ±1.999 volts or ±199.9mV, coupled with four available power configurations, (two DC and two AC) make the AN2570 universally applicable. Instrumentation features such as a bipolar differential input, 50 picoAmps of bias current, automatic zero correction and a virtually "blow-up-proof" signal input front end make it easy to use. A host of interface and control signals, including parallel BCD data output, provides maximum versatility for today's instrumentation design.

The displays are designed for maximum readability. Up close, several feet away, or off at an angle, the four large, red LED digits are bright, clear, crisp and free from glare and interpretation problems even under high ambient light conditions. If an input overload condition occurs, all four digits are automatically blanked to prevent an erroneous reading; however, the polarity sign and decimal point remain on to show that the instrument is working properly.

Among the outstanding features that assure high reliability and accuracy are: Comprehensive Quality Control and reliability procedures (e.g., minimum 100 hour temperature-cycled burn-in with power on/off cycle), instantaneous warmup and display (no waiting for readings to settle), isolation that "floats" the measuring circuits up to 1400 volts from the power-line ground (maintains electrical separation between signal and power lines), maximum rejection of ripple and noise due to input signal filtering, and true dual-slope integration.

Packaged in a standard DIN/NEMA high impact plastic case, with front panel accessible span control, every AN2570 is conformance tested before shipment. Rated performance is guaranteed by a Quality control certificate and calibration report enclosed with every instrument.

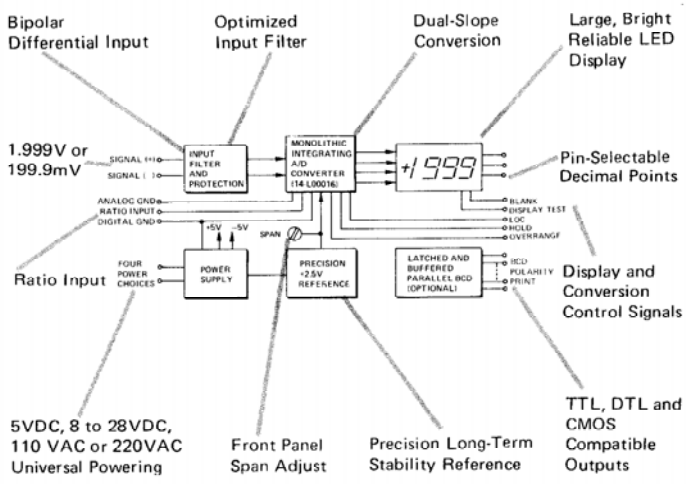



**Figure 1. AN2570 Functional Block Diagram**

## FEATURES

- **Full Performance at Low Cost.**
- **Accuracy: ±0.05% of Reading ±1 Count.**
- **Bipolar Differential Input.**
- **Optimized Signal Input Filter.**
- **50 Picoamps Bias Current.**
- **Input Protected to 300 Volts.**
- **Automatic Zero.**
- **Automatic Overrange Indication.**
- **Automatic Polarity.**
- **Fourth Generation LSI Design.**
- **Large 0.43" LED Display.**
- **Supercool Design for more than 100,000 hours MTBF.**
- **Wide Operating Temp. Range: −10°C to +65°C.**
- **1400 Volts Power Transformer Isolation.**
- **Universal Powering:**
  **+5VDC ±5% @ 170mA**
  **+8VDC to +28VDC @ 90mA**
  **110 VAC ±20% @ 1.6 Watts**
  **220VAC ±20% @ 1.6 Watts.**
- **Ratiometric Operation.**
- **DISPLAY TEST, HOLD, BLANK, EOC, and OVERRANGE Control Signals.**
- **Externally Programmable Decimal Points.**
- **100msec Integration for Highest NMRR and CMRR.**
- **Standard DIN/NEMA High Impact Plastic Case (UL 94V-0 Rated).**
- **Metal Case Available.**
- **Latched and Buffered Parallel BCD Output Available.**
- **Rear Screw Terminal Connector Available.**

## APPLICATIONS

- **Portable Battery Powered Instruments.**
- **Process Control Equipment.**
- **Automotive, Marine, Railroad, and Aircraft Instrumentation.**
- **Ratiometric Indicators.**
- **Computer Controlled Systems.**
- **Biomedical Instrumentation.**

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. . . The Digitizers

## AN2570 SPECIFICATIONS

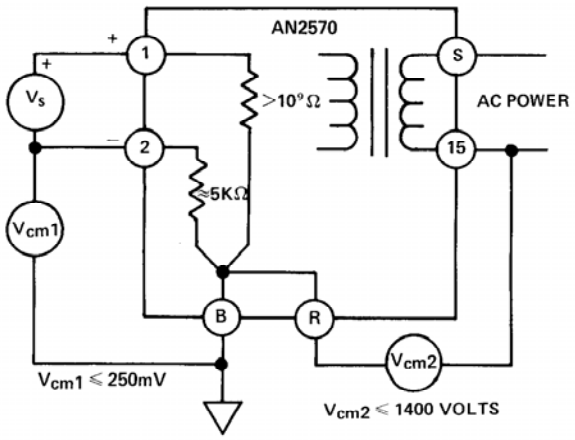
| | |
|---|---|
| **ANALOG INPUT** | |
| Configuration | Bipolar, differential input |
| Full Scale Range | ±1.999VDC or ±199.9mVDC (See Ordering Code) |
| Input Resistance | >1000 megohms |
| Bias Current | 50pA typical, 100pA maximum |
| Input Protection | ±300 volts DC or AC RMS continuous without damage |
| Input Filter | Single pole, optimized signal enhancement filter |
| Normal Mode Rejection Ratio | 65dB typical, @ 50 or 60Hz. |
| Ratiometric Operation | Ratio input for use with external reference. (Consult factory) |
| **COMMON MODE** | |
| Signal Return to Analog Ground Voltage (CMV) | ±0.25VDC or AC peak |
| DC Rejection Ratio (CMRR) DC | 110dB typical, 90dB minimum |
| AC Rejection Ratio (CMRR) AC | 90dB typical, 70dB minimum @ 50 to 60Hz |
| Analog Ground to AC Power Line Voltage (CMV) | 1400 Volts DC or AC peak |
| AC Rejection Ratio (CMRR) AC | 140dB typical, 120dB minimum at 50 to 60Hz |
| **PERFORMANCE** | |
| Accuracy | ±0.05% of reading ±1 count |
| Resolution | ±0.05% for ±1999 counts |
| Range Tempco | ±35ppm of reading/°C typical, ±50ppm of reading/°C maximum |
| Zero Stability | Auto zero, ±1μV/°C maximum zero drift |
| Code Centers | Less than 20μV RMS uncertainty, resulting in very stable readings. |
| Step Response | Less than 400msec for ±0.05% of reading accuracy for a "+" or "−" full scale step input |
| **DISPLAY** | |
| Type | Seven segment planar LED, red, 0.43" (11mm) high |
| Polarity Indication | Automatic, plus "+" or minus "−" sign displayed |
| OVERRANGE Indication | All digits blanked to prevent erroneous readout, "+" or "−" sign and decimal point remain on. |
| Decimal Points | 3 positions, externally programmable with jumper, TTL/DTL, open collector or relay logic. (See Figure 9.) |
| HOLD | Logic "0" (open collector or equivalent) holds last reading in display. |
| BLANK | Logic "0" (open collector or Equivalent) blanks display. |
| DISPLAY TEST | Logic "0" (sink 0.2mA to digital ground) tests all 23 segments of display by displaying "1888". |
| **ANALOG TO DIGITAL CONVERSION** | |
| Technique | Dual slope, six phase conversion with automatic zero correction, complete conversion each cycle. |
| Rate | 2.5 conversions per second nominal, internally triggered. See "HOLD" command for display control. |
| Input Integration Period | 100 milliseconds nominal for optimum 50 and 60Hz noise rejection. |
| **DIGITAL OUTPUTS** | |
| Parallel BCD (Optional) | 15 parallel lines provide latched and buffered BCD output, POLARITY, and PRINT command. All are TTL/DTL and CMOS compatible, 2TTL loads each. (See Figure 3.) |
| OVERRANGE | Logic "0" indicates that input exceeds ±1999 counts, CMOS compatible, 0 to +5VDC. |
| EOC | Falling edge of "End of Conversion" signal indicates conversion complete, CMOS compatible, 0 to +5VDC. |
| **POWER** | |
| Choice of 4 power inputs | +5VDC ±5% @ 170mA nominal<br>+8 to +28VDC @ 90mA nominal (Specifically designed for Automotive, Marine, Railroad, and Aircraft applications; protected against supply reversals.)<br>110VAC RMS ±20%, 47 to 500Hz @ 1.6 Watts nominal (88 to 132VAC input range)<br>220VAC RMS ±20%, 47 to 500Hz @ 1.6 Watts nominal (176 to 264VAC input range) |
| **ENVIRONMENTAL & PHYSICAL** | |
| Operating Temperature Range | −10°C to +65°C |
| Storage Temperature Range | −40°C to +85°C |
| Relative Humidity | 0 to 90%, noncondensing |
| Case | DIN/NEMA standard, high impact molded plastic case UL94V-0 Rated. Metal case available. (See Ordering Code) |
| Dimensions | DIN/NEMA (See Figure 6.) |
| Weight | 5oz (150 grams) nominal, DC Powered; 8oz (230 grams) nominal, AC powered. |
| EMI/RFI | Shielding on 5 sides with metal case option. |
| Special Line Noise Suppression | Provision made for surge suppressors, varistors and line input passive Pi filtering for industrial applications. Consult factory. |
| **RELIABILITY** | |
| MTBF | >100,000 hours, calculated |
| Burn-In | ≥100 hours with 0°C to +55°C temperature cycles and power on/off cycles. |
| Vibration | Each unit vibrated at 5gs for 30 seconds |
| Calibration | NBS traceable. Detailed certificate of calibration shipped with each unit. |
| Recalibration | Recommended 15-month intervals |
| Warranty | 24 months |

## APPLICATION DATA

### PRINCIPLES OF OPERATION

The AN2570 utilizes a true dual-slope form of analog-to-digital conversion, instrumented in a fourth-generation monolithic integrated circuit. In each conversion cycle, the internal offset voltages are sensed and compensated for automatically. The displayed data is the digitized ratio of the input signal to the precision reference within the instrument. Optionally, the user may introduce his own reference (scaled for +2 volts DC), where the output maximum count of 1999 would then represent an input equal to the full value of the external reference. A front panel-accessible span control permits the user to calibrate the precision internal reference to system standards; Analogic's precision reference is calibrated traceable to NBS standards.

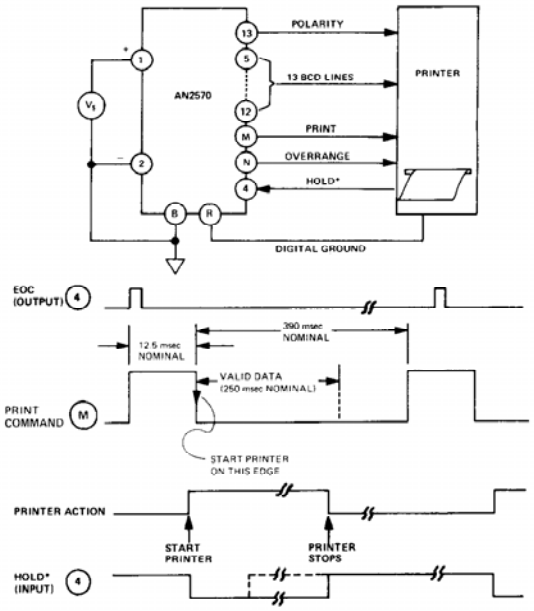
The AN2570 provides a number of status and control signals: an OVERRANGE output line goes to a low level when the conversion exceeds 1999 counts; an EOC output pulse is negative going when the conversion cycle is completed; grounding the input of the DISPLAY TEST line checks the operation of the segments of each display digit; maintaining the HOLD input line at a low level retains and displays the results of the last conversion and also keeps that value latched in the buffered output registers of the BCD option, if installed; and grounding the BLANK line blanks the display. Relationships among these signals are shown in the Timing Diagram of Figure 3. Note that the status/control functions are shared on common lines: HOLD/EOC, and BLANK/OVERRANGE.




**Definitions:**

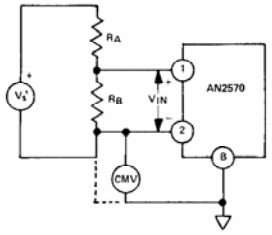
| | |
|---|---|
| $V_s$ | Voltage source to be measured. |
| $V_{cm1}$ | Common mode voltage between pins ② and Ⓑ. Typically this would be due to ground loops or other system noise. Note that only a **differential** input such as on the AN2570 can reject this type of noise and interference. |
| $V_{cm2}$ | Common mode voltage (isolation potential) between power line and digital ground. |
| Pin ① | Positive input for voltage to be measured. |
| Pin ② | Negative input (return) for voltage to be measured. |
| Pin Ⓑ | Analog ground. For single-ended inputs, jumper pins ② and Ⓑ together; for differential inputs, connect as shown. |
| Pin Ⓡ | Digital ground. Internally connected to analog ground via Kelvin connection. All digital signals, such as Decimal Points, HOLD, BLANK, EOC, DISPLAY TEST, OVERRANGE, BCD etc. should be returned to this point. |

**Figure 2. Input Configurations and Common Mode Voltages**




*If Printer is unable to operate at a rate of 2.5 readings/second. HOLD control signal from Printer may be used to synchronize AN2570 measurements to speed of printer.

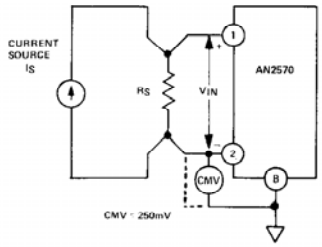
**Figure 3. Using AN2570 with a printer.**




For signal voltages $V_s$ greater than 2 Volts, select $R_A$ and $R_B$ for proper scaling such that $V_{IN}$ is ≤2 Volts for a "1.999" Display*. Program Decimal Point accordingly (See Fig. 9).

*according to $V_{IN} = \left(\frac{R_B}{R_A + R_B}\right) \times V_s$.

**Figure 4. Input Voltage Scaling.**




Select shunt resistance $R_s$ according to following:

$$R_s = \frac{\text{Desired Full Scale Count}}{\text{Full Scale Range of Input Current}} \times K$$

when K = 0.001 for 1.999 $V_{IN}$
K = 0.0001 for 199.9m $V_{IN}$

**Figure 5. Current Measurement with AN2570.**

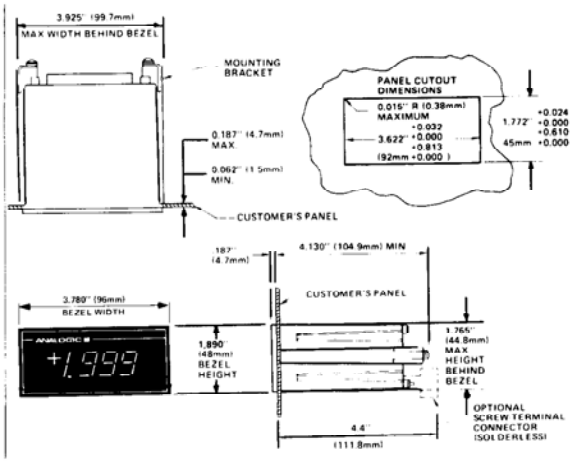



Figure 6. Panel Mounting and Outline Dimensions

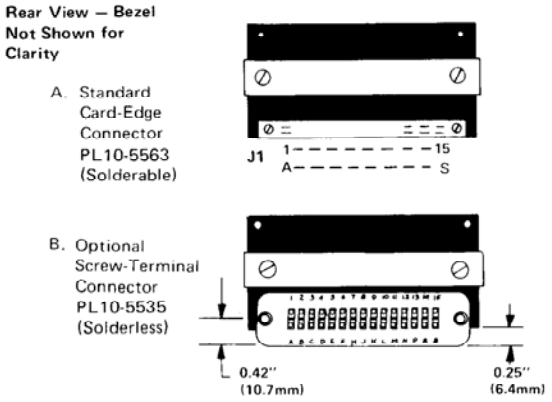



Figure 7. Rear Panel Connectors (Metal Case Option Shown)

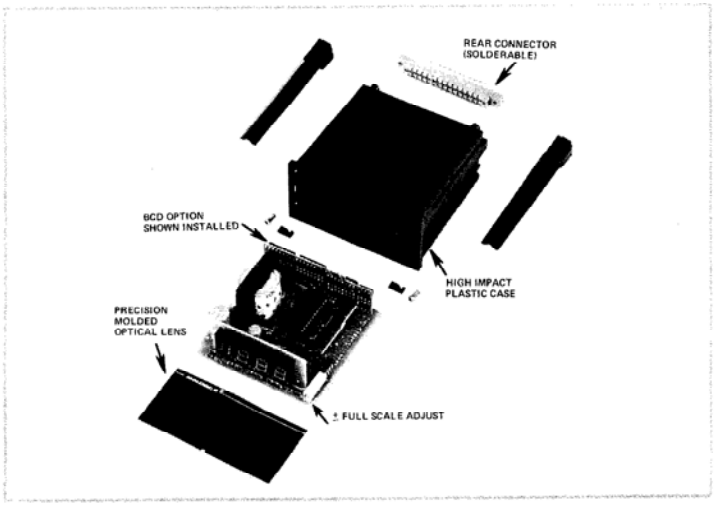



Figure 8. Disassembled View of the AC Powered AN2570.

## ORDERING CODE

AN2570 □ / □ / □ / □

| For | Enter |
|---|---|
| ±1.999 Volts Input Range | 1 |
| ±199.9 mVolts Input Range | 01 |
| **For** | **Enter** |
| No BCD Output | X |
| Parallel Buffered BCD Output | 1 |
| **For** | **Enter** |
| +5VDC Power Input | X |
| 110VAC ±20% | 1 |
| 220VAC ±20% | 2 |
| +8 to +28VDC | 3 |
| **For** | **Enter** |
| Plastic Case (UL 94V-0 Rated) | P |
| Metal Case | M |

(Connectors optional)

## J1 PIN DESIGNATIONS

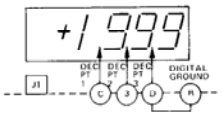
| | | | |
|---|---|---|---|
| Ratio Input | A | 1 | Signal IN (+)# |
| Analog Ground# | B | 2 | Signal Return (–)# |
| Decimal Point 1 | C | 3 | Decimal Point 2 |
| Decimal Point 3 | D | 4 | EOC/HOLD |
| BCD (2)* | E | 5 | BCD (1)* |
| BCD (8)* | F | 6 | BCD (4)* |
| BCD (20)* | H | 7 | BCD (10)* |
| BCD (80)* | J | 8 | BCD (40)* |
| BCD (200)* | K | 9 | BCD (100)* |
| BCD (800)* | L | 10 | BCD (400)* |
| PRINT* | M | 11 | DISPLAY TEST |
| BLANK/OVERRANGE | N | 12 | BCD (1000)* |
| –5.1VDC Output | P | 13 | POLARITY* |
| Digital Ground† | R | 14 | +5V† |
| AC Power IN† | S | 15 | AC Power or +8 to +28VDC IN† |

#See Figure 2.
*These signals are active with BCD option only.

### †POWER CONNECTIONS

| | |
|---|---|
| +5VDC | Pin 14 for +5VDC, Pin R for Power Return |
| +8 to +28VDC | Pin 15 for +8 to +28VDC, Pin R for Power Return |
| 110VAC | Pins S and 15 |
| 220VAC | Pins S and 15 |

### DECIMAL POINT SELECTION




To display the desired decimal point, simply connect the appropriate pin as shown to Digital Ground (Pin R, J1) using a jumper lead.

Figure 9. Decimal Point Position Terminals

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