Effective starting Serial Number 307

SERIES 3900

PRECISION CALIBRATOR

OPERATING & SERVICE MANUAL

4th Printing

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CERTIFICATION

Rotek Instrument Corp. certifies that this instrument has been calibrated to meet or exceed all the specifications contained in this manual prior to being shipped from the factory. The calibration has been performed with instruments the accuracies of which are traceable to the National Bureau of Standards.

WARRANTY

Rotek Instrument Corp. warrants each instrument manufactured by it to be free from defects in material and workmanship for a period of one year from the date of delivery to the original purchaser, provided the instrument is used in accordance with the instructions in this manual. Rotek's obligation under this warranty is limited to servicing or adjusting an instrument returned to the factory, transportation charges prepaid, for that purpose. This is the only warrant offered in connection with the sale of this instrument, no other warranty is implied. Rotek is not liable for consequential damages.

If a fault in operations occurs, the following steps should be taken:

1. Notify Rotek Instrument Corp. giving full details of the faulty operation, the model number and serial number of the instrument. On receipt of this information, service data or shipping instructions will be provided.

2. On receipt of the shipping instructions, forward the instrument prepaid and repairs will be made at the factory.

If it is necessary to return this instrument to the factory, it should be shipped in the original packing carton. If it is not available, use any suitable rigid container with adequate packing to protect the unit during transit.

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SECTION 1

GENERAL INFORMATION

1.1 Description

The Series 3900 Calibrators are precision sources of direct and low distortion alternating voltage and current, providing voltages from 0.001 to 1000 volts and currents from 0.001 milliamperes to 1000 milliamperes, from dc to 5000 Hertz. Some Models of the Series have an optional deviation control which provides a readout of meter error on a decimal display, a selection of eight standard resistance values for determining the accuracy of resistance functions in multimeters and a fractional setting control to simplify testing non decade meter scales.

List of Series 3900 Models

Model	Functions	Number of Setting Decades	Other Features
3910	AC/DC Voltage & Current	3	None
3920	AC/DC Voltage & Current & Resistance	3	Error Measurement
3930	AC/DC Voltage & Current & Resistance	3	Fractional Setting Divider
3940	AC Voltage	3	Error Measurement
3950	AC/DC Voltage & Current & Resistance	4	Error Measurement
3960	AC/DC Voltage & Current & Resistance	5	Error Measurement
3970	AC/DC Voltage & Current & Resistance	4	Error Measurement Fractional Setting Divider
3993	AC/DC Voltage & Current & Resistance	5	Error Measurement IEEE 488 Interface

Table 1-1

Because of the high accuracy and the rapid settling time (even at 50 Hz) the Series 3900 finds application in the calibration of analog volt meters, ammeters, multimeters and three and four digit ac and dc digital multimeters.

1.2 Accessories

Model 350A High Current Adapter.

In the current mode, the range of the 3900 Series may be extended to 10 Amperes dc and 50 Amperes ac from 50 to 2000 Hz with the Model 350A High Current Adapter. The output of the High Current Adapter is controlled by the 3900 Series. Electrical specifications for the Model 350A are included under the ac and dc current headings in Section 1.3.

1.3 Specifications (As applicable to the functions available in the several Models)

All accuracy specifications obtain within 60 minutes after turn on at a temperature of 23 ±5 C, relative humidity of 50% maximum, a line frequency of 50 to 60 Hz, at nominal line voltage +5 -10% including loading or compliance except as otherwise specified and are maintained for a period of not less than six months.

Nominal line voltages are selectable (at installation) as 100, 120, 220 and 240 volts RMS. All specifications describe maximum limits from 10% to 100% of range unless stated otherwise.

1.3.1 Functions and Ranges

Voltage AC & DC:
- 1000, 100, 10 volt, 1000, 100, 10 mvolts.
- 1 uv to 1000 volts DC and 5 kHz AC.

Current AC & DC:
- 1000, 100, 10 ma, 1000, 100, 10 ua Ranges.
- 10 ua Range DC only.
- 10 ua to 50 Amps AC (with Model 350A).
- 1 na to 10 Amps DC (with Model 350A).

Frequency:
- 40 to 5000 Hz (Option 20 - 5000 Hz).
- Hz x 10, Hz x 100, Hz x 1000 Ranges.
- One decade dial.
- Accuracy ±5%.

Amplitude Settability - Resolution

Voltage/Current:
- See Table 1-1

Ohms:

Cardinal Values, 1, 10, 100, 1K, 10K, 100K, 1 Meg, 10 Meg. Kelvin 4 wire connections.

Deviation:

0.1, 1.0, 10% Ranges.
3 Digit plus decimal point display (not active in the ohms mode).

1.3.2. DC Voltage

Accuracy:	Series 3910-3940	Series 3950-3993
1-1100V	±0.01% stg ±0.002% rng	±0.005% stg ±0.001% rng
0-1000mV	±0.01% stg ±0.004% rng ±2uV	±0.005% stg ±0.002% rng ±2uV

Noise: 0.03% RMS +150uV in 100kHz Band

Loading:

15-1000V	10mA	150 milliohms output impedance
10-15V	7mA	
.1-10V	100mA	
0-100mV		10 ohms output impedance

Temperature Coefficient: 15-20C, 30-35C, 10ppm/C or 4uV/C whichever is greater

1.3.3 AC Voltage

Accuracy:

50-1000Hz	0.1% stg +0.01% rng +10uV	0.05% stg +0.005% rng +10uV
2-5kHz	0.25% stg +0.01% rng +10uV	0.1% stg +0.01% rng +10uV

Loading:

400-1000V	220pf & 20mA,	150 milliohms & 3 millihenrys output impedance
150-399V	1500pf & 70mA	150 milliohms & 1 millihenry output impedance
100-150V	1500pf & 50mA linearly increasing to 70mA at 150V	
1.0-100V	10000pf & 100mA	
100-1000mV	10000pf & 100mA	
0-100mV		10 ohms output impedance

Distortion & Noise:	Series 3910-3940	Series 3950-3993
50-1000Hz	0.05% +150uV RMS in 100kHz Band	
2-5kHz	0.1% +150uV RMS in 100kHz Band	

Temperature Coefficient: 15-20C, 30-35C

50-1000Hz	25ppm/C
2-5kHz	100ppm/C

1.3.4 DC Current

Accuracy:

0-100mA	±0.05% stg ±0.005% rng +50nA	±0.02% stg ±0.002% rng +10nA
100mA-1.1 Amp	±0.05% stg ±50uA	±0.02% stg ±50uA
1-10A (Model 350)	±0.15% stg ±3mA	±0.1% stg ±3mA

Noise:

0-1.1 Amp	0.05% +150nA in 100kHz Band
1-10 Amp (Model 350)	0.2%

Compliance:

0-10 Amp	2V (0.3V 1uA to 1000uA)
Temperature Coefficient	10ppm/C or 25nAmp/C whichever is greater

1.3.5 AC Current

Accuracy:

.01-1100mA		
40-400Hz	±0.1% stg ±0.01% rng +100nA	±0.05% stg ±0.005% rng +100nA
500-1000Hz	±0.2% stg ±0.02% rng ±200nA	±0.1% stg ±0.01% rng ±200nA
1-10A (Model 350)		
40-400Hz	±0.2% stg ±3mA	±0.1% stg ±3mA
500-1000Hz	±0.4% stg ±3mA	±0.3% stg ±4mA
10-50A (Model 350)		
40-400Hz	0.6% stg	0.5% stg

Compliance:	Series 3910-3940	Series 3950-3993
0-10 Amp	2V (0.3V 1uA to 1000uA; 1V 500Hz to 2000Hz)	
10-50 Amps	0.25V	

Nose & Distortion:

0-1100mA	0.05% +150nA in 100kHz	0.05% +150nA in 100kHz
1-10A	0.2% Band	0.2% Band
10-50A	0.5%	0.5%

Temperature Coefficient: 25ppm/C max. 25ppm/C max.

1.3.6 Resistance

Value:	Accuracy:
1	0.1%
10	0.05%
100	0.02%
1K	0.01%
10K	0.01%
100K	0.01%
1M	0.01%
10M	0.1%

Accuracy measured in the 4 wire mode for values 1-1000ohms

1.3.7 Physical:

3910-3993	178mm H x 442mm W x 537mm D(7"H x 17 3/8"W x 21 1/8"D) 20.4Kg (45 lbs), 100 watts; 100/120/220/240 volts (+5 -10)%, 50/60 Hz.
350	134mm H x 442mm W x 537mm D(5¼"H x 17 3/8"W x 21 1/8"D) 20.4Kg (45 lbs), 25 watts; 100/120/220/240 volts (+5 -10)%, 50/60 Hz
360	134mm H x 442mm W x 537mm D(5¼"H x 17 3/8"W x 21 1/8"D) 20.5Kg (45 lbs), 60 watts; 115/220 volts (±10%), 50/60 Hz.

Special Option for Operation at 16-2/3 or 25Hz

Specifications:

16-2/3Hz ±2%

AC Voltage:

0-10VAC:	Accuracy: 0.075% stg +0.005% rng +10uV Distortion: 0.15% Loading: 30mA maximum
10-1000VAC:	Accuracy: 0.15% Distortion: 1.0% Loading: 10-100V: 50mA 100-300V: 40mA 300-1000V: 20mA

AC Current:

.01-1100mA:	Accuracy: 0.075% stg +0.005% rng +100mA Distortion: 0.15% Compliance: 2V RMS

25Hz ±2%

AC Voltage:

0-10VAC:	Accuracy: 0.075% stg +0.005% rng +10uV Distortion: 0.1% Loading: 100mA
10-1000VAC:	Accuracy: 0.1% stg Distortion: 0.3% Loading: per spec. 40-5000Hz

AC Current:

.01-1100mA:	Accuracy: 0.075% stg +0.005% rng +100mA Distortion: 0.1% Compliance: 2V RMS

Operation below 15Hz not specified.

The frequency 16-2/3Hz or 25Hz is available by selecting the Series 3900 Calibrator setting of 20Hz and activating a toggle switch on the rear panel of the 3900. For normal operation, with decade settings of frequency, the rear panel toggle switch must be deactivated.

10 - 40Hz Low Frequency Option

Specifications:

10Hz

AC Voltage:

0-10VAC:	RMS	Accuracy: 0.10% stg +0.005% rng +10uV
		Distortion: 0.20% maximum
		Loading: 30mA maximum
10-30VAC:	RMS	Accuracy: 0.20% stg
30-100 VAC:	RMS	Accuracy: 1.00% stg
100-300VAC:	RMS	Accuracy: 0.20% stg
300-1000VAC:	RMS	Accuracy: 1.00% stg
		Loading: 10-100 volts: 20mA
		100-300 volts: 25mA
		300-1000 volts: 2mA

AC Current:

.01-1100mA:	Accuracy: 0.10% stg +0.005% rng +100mA
	Distortion: 0.20% Maximum
	Compliance: 2V RMS

20Hz

AC Voltage:

0-10VAC:	Accuracy: 0.075% stg +0.005% rng +10uV
	Distortion: 0.15%
	Loading: 30mA maximum
10-1000VAC:	Accuracy: 0.15%
	Distortion: 1.0%
	Loading: 10-100V: 50mA
	100-300V: 40mA
	300-1000V: 20mA

AC Current:

01-1100mA:	Accuracy: 0.075% stg +0.005% rng +100mA
	Distortion: 0.15%
	Compliance: 2V RMS

SECTION 2

OPERATING INSTRUCTIONS

2.1 Power Requirements

The 3900 Series can be operated from an ac power source of 100, 120, 220 or 240 volts (+5-10)%, 50-60 Hertz. The selection of line voltage operation is made prior to connecting the instrument to the power source by inserting the printed circuit adapter board in the ac receptacle assembly (located on the rear panel) with the appropriate voltage mark readable. The line fuse is rated at 1.5 Amps Slow Blow, 100 or 120 volts; 1.0 Amps Slow Blow at 220 or 240 volts.

A three conductor power cable is provided; when this conductor is connected to a standard three wire outlet the instrument chassis is connected to power systems ground. This prevents the instrument case from assuming voltages hazardous to personnel. In the event an adapter is used to connect the three wire cable to a two wire outlet the green adapter terminal should be connected to the power system ground.

2.2 Installation

The 3900 Series standard configuration is bench mounted. Combination handles and rack mounting ears are available on special order and are interchangeable with the bench mounting handles.

2.3 Controls and Displays

Figure 2-1 illustrates and describes the function of all front and rear panel controls, connections and indicators. Each element of control, display or connection is numbered and the description of the function appears under the number in the table of the figure. The operation of the Model 3993 is described in Section 7.

2.4 General Operating Information

The 3900 Series has three modes of operation, voltage, current and resistance. In the current mode of operation the Model 350 High Current Adapter may also be employed, its output being controlled by the setting of the 3900. This operation is described separately in the manual for the Model 350. In the voltage mode, voltage settings may be varied from 0.000 millivolt to XXX.X volts (corresponding to 1111.0 volts). Positive or negative direct voltages or alternating voltages at frequencies of 40 through 5,000 Hertz may be selected.

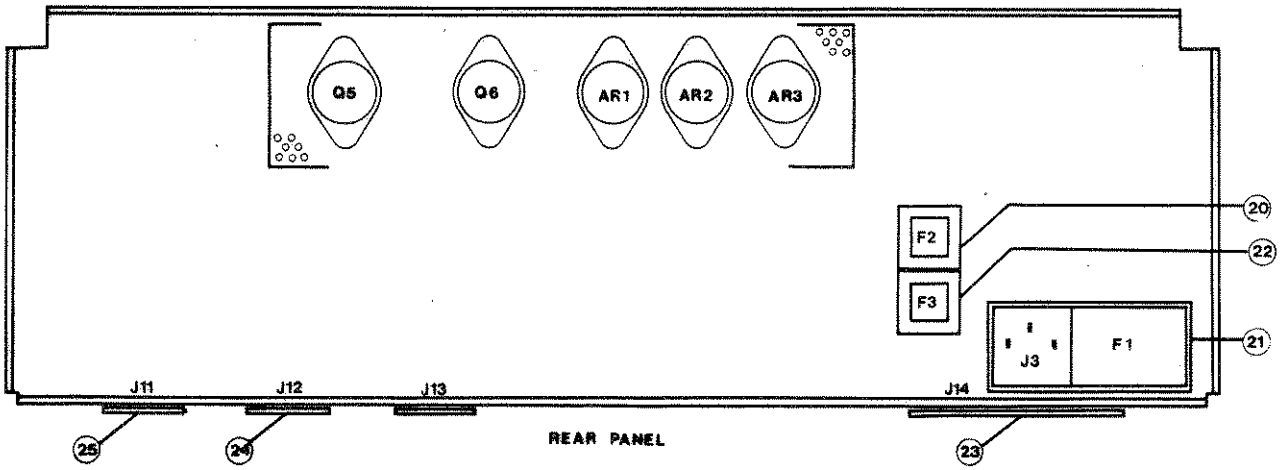


FIGURE 2-1A

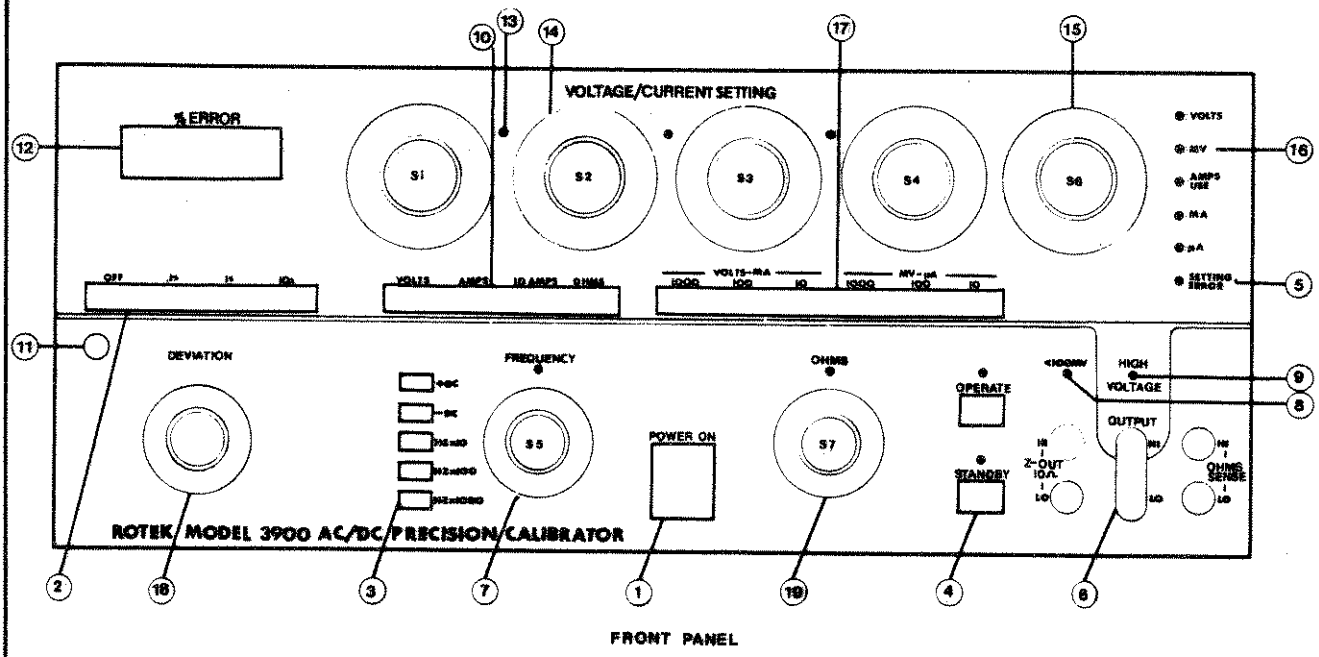


FIGURE 2-1B

SCALE	APPROVED BY	DRAWN BY M W
DATE 11-7-79		
ROTEK INSTRUMENT CORP.		
FRONT & REAR PANEL LOCATION		DRAWING NUMBER 39-101-034

Controls as Applicable to the Several Models

1 Power (Includes ON Indicator)
Switch (Toggle) to energize Calibrator.

2 Deviation Range Selector (Not on 3910)
Four interlocked push switches which select the deviation range, 0.1%, 1.0%, 10% and OFF. Corresponding full deviations are approximately 0.12%, 1.2% and 12%. The off position disables the Deviation Control.

3 Frequency Function Controls
Five interlocked push switches selecting +DC, -DC, Hz x 10, Hz x 100 or Hz x 1000. (+DC, -DC, not on 3940).

4 Output Controls
Two independent momentary push switches, illuminated red for Operate and green for Standby. Pushing Standby causes the output to be disconnected from active circuits and shorts the output HI terminal to the output LOW terminal. Pushing Operate causes the output to assume the selected function and setting.

5 Setting Error Indicator
This indicator is illuminated when a setting amplitude or frequency is not functional. The Calibrator is also in the standby state when this indication occurs.

6 Output Terminal Array
Output terminals High and Low are connection points for the meter under calibration. The high voltage terminals are recessed for the safety of the operator. When the millivolt lamp is illuminated the millivolt terminals should be used. The Ohms sense terminals are provided for four wire ohms measurements. (Ohms not available in 3910). Pomona P/N 1286 adapts the output terminals to binding posts.

7 Frequency Setting Control (AC Indicator)
A Rotary selector switch selects the frequency in Hertz, which is multiplied by the frequency range multiplier. The ac indicator is illuminated whenever a frequency range is selected. The control may be set from 1 to 11.

8 100 MV Indicator Lamp
Indicates that specified accuracy is obtained at the millivolt terminals.

Table 2-1

9 High Voltage Indicator
Lamp which is illuminated intermittently whenever the output voltage becomes high and there is a hazard for shock.

10 Function Controls (Not on 3940)
Four interlocked push switches selecting the operating function as Volts, Amps, 10 Amps (Option) or Ohms. (3910 has three switches, no Ohms).

11 Record Deviation Control
This optional switch is momentarily held to output a record or print command signal.

12 Digital Deviation Readout (Not on 3910)
Displays the deviation in % of setting as a 2+ digit readout. The maximum reading on the highest range is approximately 12.0%; the resolution on the lowest deviation range is .001%. The display is blank for the Deviation Range "OFF" position.

13 Decimal Point Indicators
Shows location of decimal point in one of three positions.

14 Output Setting Controls
Decade selector switches which determine output voltage and current amplitude. The most significant decade is usable from 1 to X except 0 to X for dc current and volts less than 10; the remaining decades may be set from 0 to X (10).

15 Fraction of Setting Control (With On Display)
(3930 and 3970 only)
This control divides the Setting in 1/5's, 1/4's or 1/3's. The indicator is illuminated when the Control is active. (Not off).

16 Function Indicators
Five lamps, one of which displays the units modifier for the Voltage/Current Setting. When Amps lamp is illuminated the output is available at the terminals of the Model 350.

17 Range Controls
Six interlocked push switches selecting the ranges 1000, 100, 10 Volts, 1000, 100, 10 Millivolts, 1000, 100, 10 Milliamperes or 1000, 100, 10 Microamperes.

Table 2-1 Cont.

18 Deviation Control (Not on 3910)
Potentiometer which inserts change in output to measure meter under test error.

19 Ohms Selector (OHMS on Indicator) (Not on 3910)
An eight position rotary selector switch connecting one of the resistors 1, 10, 100, 1K, 10K, 100K, 1M or 10M ohms to the output terminals in the OHMS mode.

20 Fuse +30V, 3 2/10A Slow Blow

21 Combination Line Cord Receptacle, Fuse, Line Voltage Selector
To replace fuse, remove line cord and pull "Fuse" lever. Replace with 1.5A for 100 or 120 volt operation; 1A for 220 or 240 volt operation.

To select line voltage, remove line cord and remove printed circuit board. Locate the marking of the desired line voltage and insert the printed circuit board with the marking on the top surface and facing towards the Calibrator rear.

22 Fuse -30V, 3 2/10A Slow Blow

23 Connector BCD Error Output,J14 (Option)

24 Connector for Model 360,J12

25 Connector for Model 350,J11

Note: Pushing any of the Function, Range, Frequency or Frequency Multiplier Switches for a new selection causes the Standby condition.

Table 2-1 Cont.

In the current mode, current settings from 0.000 microampere to XXX.X milliamperes (corresponding to 1111.0 milliamperes) may be obtained as positive or negative direct currents or alternating currents at 40 through 1,000 Hertz.

In the resistance mode, resistances may be selected having the values 1, 10, 100, 1K, 10K, 100K, 1M and 10M.

WARNING

The selection of inappropriate functions and settings and subsequent applications of voltages or currents corresponding to these settings to an instrument can damage it. The 3900 Series has safety features to minimize this possibility. The selection of a new function (i.e. change from voltage to current or resistance or any combination thereof) or range or certain frequency ranges, including change to positive or negative dc, automatically places the Calibrator in the standby mode as evidenced by the green illuminated standby push button. A change in voltage, current or frequency settings does not cause the standby condition, but once the Calibrator is in standby, current or voltage can be applied at the output terminals only by pressing the Operate button. An additional safety feature is the illuminated high voltage indicator above the output terminals. High voltages that might inflict shock on personnel are indicated by this illuminated indicator. A further safety feature is the automatic standby condition when power is turned on, to avoid the inadvertent application of incorrect voltages or currents.

WARNING

The 3900 Series is overload protected. A dc current at the power amplifier output greater than 5 amperes peak, or voltage greater than 15 volts in current modes, trips the overload circuit placing the Calibrator in the standby condition. The overload must be removed before the Calibrator can be caused to operate.

2.5 The 3900 Series as Precision Voltage Source

Apply power to the Calibrator by pressing the Power switch in the middle of the front panel; then press the voltage function, the voltage range, the polarity or frequency and observe that the Calibrator is in the standby condition.

Attach the instrument to be calibrated to the output terminals, the high lead being connected to the Output High terminal, and the low lead being connected to the Output Low terminal. Set the instrument to be calibrated to the proper scale in the voltage function. Set the voltage setting on the digital dials of the Calibrator and push the Operate button. The set value is applied to the instrument under calibration. If the Deviation Off button is in, the Deviation function is not activated. To determine the instrument error select a deviation range and a Deviation Dial setting which causes the instrument being calibrated to read exactly the voltage setting of the Calibrator. The % Deviation Reading appears on the meter.

The calibration of electronic meters having 100 millivolt or even 10 millivolt full scale readings is possible using the 100 millivolt or 10 millivolt range of the Calibrator. Since electronic voltmeters usually have very high input impedance on these ranges (in excess of 1 Meg ohm), the 10 ohm output impedance of the Calibrator on these ranges introduces no significant error.

Scale linearity may easily be checked by setting the most significant digit from 1 to 10 and observing the deviation at each point. The operation of a digital display may be observed by sequencing through the settings 1111, 2222, etc. Further operation of digital meters at points above full scale is possible by use of the X (meaning 10) positions.

Should a short circuit be inadvertently applied to the Calibrator, it is automatically placed in standby so that no damage will occur. Once the short circuit is removed the Operate button may be pushed to restore normal operation.

2.6 The 3900 Series as a Precision Current Source

To operate the Calibrator as a precision current source push the Amps function button, select the range, polarity or frequency and the current setting as desired. Push the Deviation Off button. The Calibrator is now in the standby mode.

Connect the instrument to be calibrated to the terminals of the Calibrator as described in paragraph 2.5. Make sure the instrument under test is set to the proper range. Push the Operate button and the Calibrator output terminals are activated with the current. The 3900 Series is a current source with a compliance of 2 volts dc or RMS so that variations in lead resistance or poor connections do not affect the current output of the Calibrator. The reading error of the meter under calibration may be determined by using the % Deviation Display.

Should the operator of the Calibrator inadvertently press a voltage function, the Calibrator is immediately placed in the standby mode so as to avoid the application of damaging voltages to the ammeter being calibrated.

If the output leads are opened in operation, or too large an impedance is at the output terminals in operation, the condition standby occurs. The open must be removed before the operate state can be obtained.

2.7 3900 Series Calibrates Resistance Scales of Multimeters

Operate the 3900 Series by pushing the Ohms Selector button. Thereafter the standby mode occurs. In this mode of operation one of eight precision resistors is connected to the output terminals, the value of the resistor being selected by the Ohms Control. To connect the selected resistor to the output terminals the Operate button is pushed. Operation of the Ohms Control does not affect the operate status; so a sequence of resistance values can be applied to the output terminals to verify the resistance function of multimeters.

The precision resistor is available as a two terminal device. In this configuration (Fig. 2-2A) lead resistance within the Calibrator is in series with the precision resistor and the output terminals. This adds to the inaccuracy of the resistance as measured at the output terminals.

The precision resistors are also available with a four wire connection (Fig. 2-2B) for voltage and current pairs. This configuration results in the least inaccuracy, however the meter under test must have a four wire connection.

2.8 Calibration of Low Impedance dc Millivolt Meters

Many moving coil millivolt meters have a low impedance and cannot be calibrated on the 100 or 10 millivolt ranges of

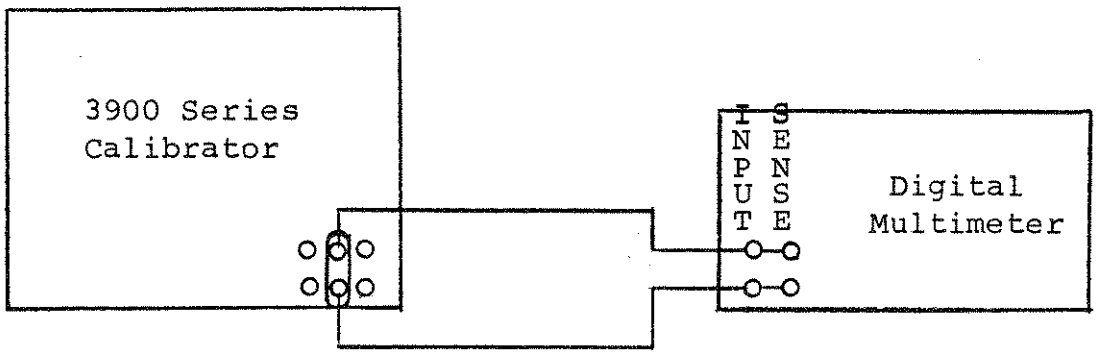


Figure 2-2A

Two Wire Resistance Connection

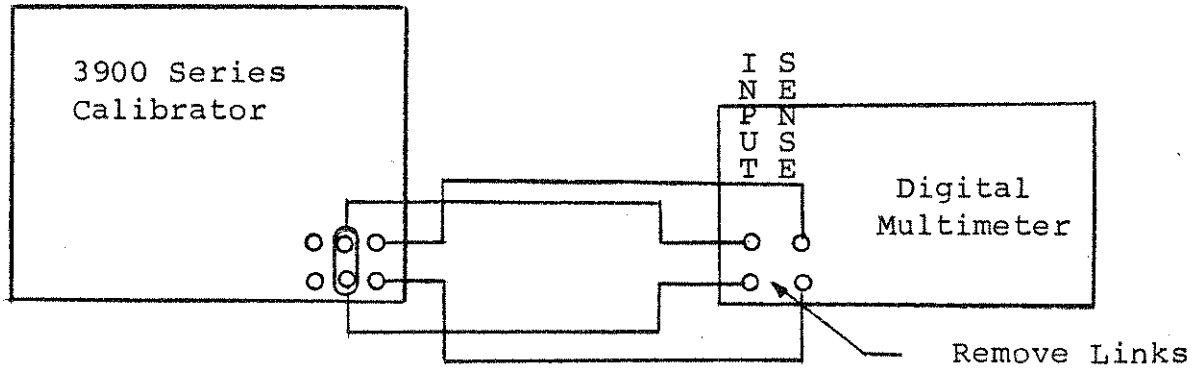


Figure 2-2B

Four Wire Resistance Connection

the Calibrator. The high output impedance would cause too great an error. The recommended procedure is to calibrate these meters on the 1000m Volt range. Although settings will be less than 1/10 of the range, the accuracy of the output should be sufficient for calibrating most meters of this category. Typically 50 millivolts can be set this way with 0.1% accuracy, 10 millivolts with 0.5% accuracy.

SECTION 3

MAINTENANCE

3.1 Purpose

This section describes the performance test and calibration procedures.

3.2 Test Equipment

The equipment required to maintain the Series 3900 is listed in Table 3-1. Equipment may be substituted based upon the equivalence of performance specifications.

3.3 Performance Test

Performance tests may be used to verify instrument adherence to specifications either for periodic maintenance or at incoming inspection. The performance tests are conducted with a nominal line voltage +5, -10%, 50-60 Hertz at a temperature of 23C ±1C, at a relative humidity not greater than 50%. A performance check list is provided as Table 3-2; this check list may be copied and entries made on it to maintain a record of periodic inspection. The performance list designates a limited number of test points which are believed to verify specifications.

3.3.1 Front Panel Controls, Displays, Terminals

Turn power on and observe that the Standby light is on regardless of position of any other control. Make no connection to the output terminals.

Push the button marked VOLTS/MILLIAMPS 10; the standby lamp is on. Connect a multimeter arranged to read +10 volts dc as shown in Figure 3-1 to the output terminals of the 3900.

Table 3-1

List of Equipment to Inspect and Calibrate

Rotek Series 3900 Calibrators

Instrument Nomenclature	Specifications	Use	Manufacturer and Model No.
Standard Cell with Enclosure	DC Standard Voltage ±5 uV traceable to NBS	Reference	Eppley Lab Model 121
DC Voltage Standard	10 Volts, Short Term Stability ± 5uV	Stable Source	PPMLTD Model 410
Voltage Divider	7 Place Decade Divider	Voltage Attenuator	ESI Model RV722
Volt-Ohm Box	5 PPM Resistance from 0.05 ohm to 10M ohm in steps	Attenuator & Current Shunt	ESI Volt Ohm Box Model 1063
DC Meter	Most Sensitive Scale: 1uV max. Full Scale 2% Accuracy F.S. Zero Center	Null Detection	Keithley Instr. Model 155
Distortion Meter	Voltage Range 1-300V Distortion Range .02% - 100% 50-600kHz	Distortion Meas.	Hewlett Packard Model 335A
AC Voltmeter	0.5 - 1000 Volts 0.005% Accuracy	AC Voltage Meas.	Holt Instr. Lab Model 6A
AC Voltmeter	RMS Differential Voltmeter 10mV to 1000V	AC Voltage Meas. Low Volt	John Fluke Co. Model 931B
Precision Resistor	0.1 ohm ±.0005% at 1 amp.	Current Meas.	Leeds & Northrup Model 4221-B
Oscilloscope	AC & DC 5mV Sensitivity	Observe Wave Forms	Tektronix, Inc. Model T935

Table 3-1

(Continued)

Instrument Nomenclature	Specifications	Use	Manufacturer and Model No.
Multimeter	AC & DC Voltage Current & Resistance	Measure Voltage, Currents, Resistance	Simpson Elec. Co. Model 260, John Fluke Co. Model 8000A
Counter	5Hz - 100kHz, 5 Digit 0.01%	Measure Frequency	John Fluke Co. Model 1900A
DVM	± .001% Using Substitution Method	Measure Resistance	Kiethley Model 191
Current Shunt	± 0.02% AC-DC Difference	Measure AC Current	Holt Instr. Lab. Model HCS-1 1 Amp. 10 mAmp.
	100 Ohms ± 0.01% 5pf shunt capacity	Measure AC Current	Vishay Resistance Products Co. S102
Resistors: 100 Ohm 10W 50K Ohm 50W 100K Ohm 50W	± 5%	Loads	
Capacitors: 200pf 1500V 0.01uf 500V	± 5%	Load	

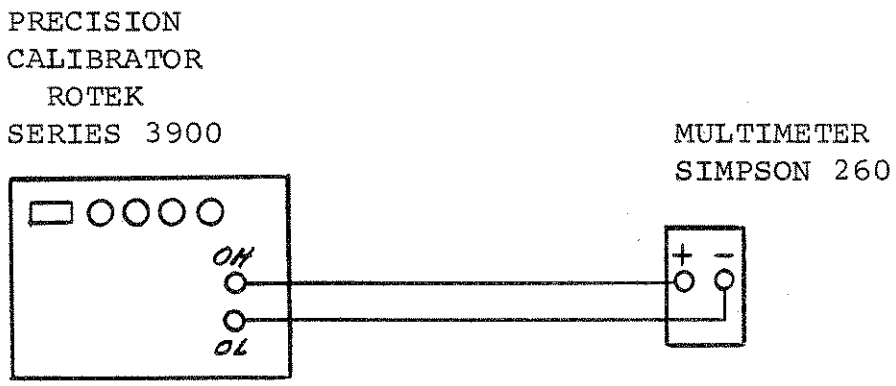


Figure 3-1

Function Check

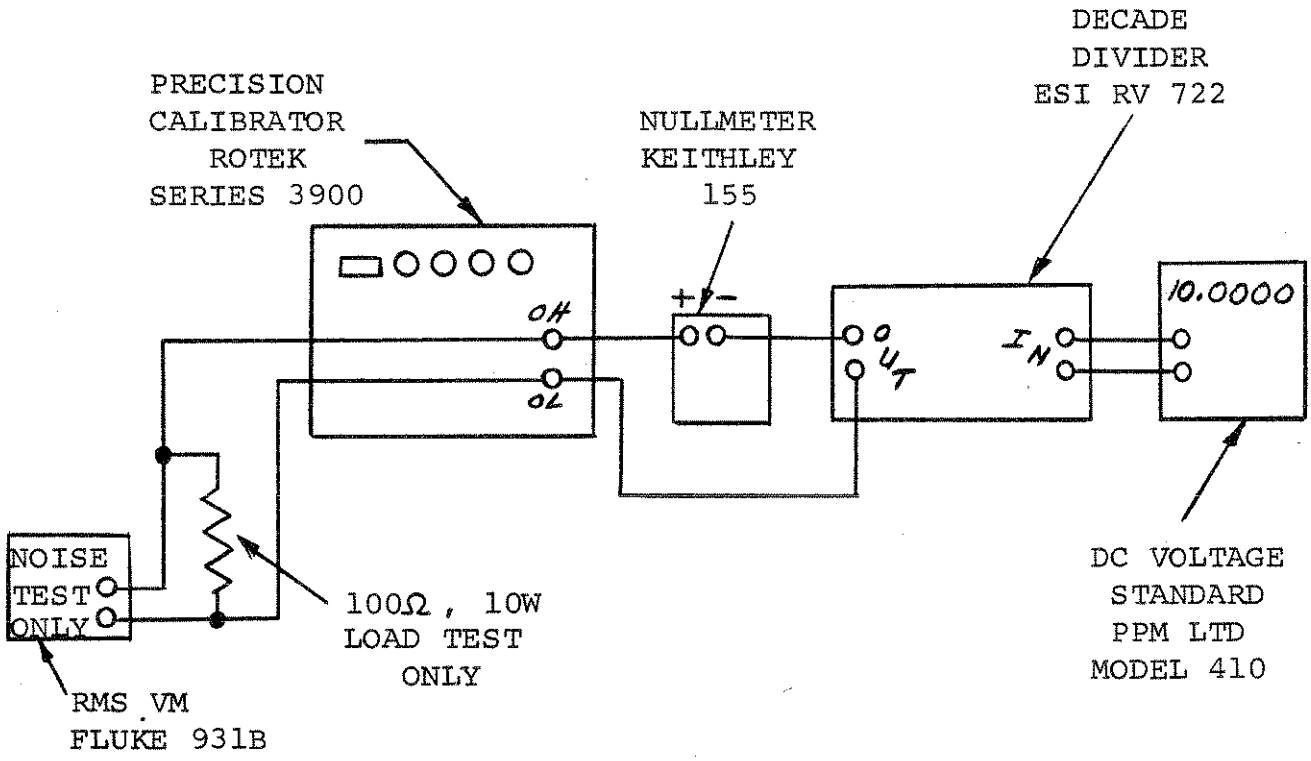


Figure 3-2

DC Voltage Less Than 10 Volts

Accuracy Test

Push the buttons Volts, Deviation Off, +DC, establish a dial setting of X.000. Push the Operate control and observe the reading on the multimeter to be approximately 10 volts.

Push the AMPS button, observe that the Calibrator is in Standby; select the 10 milliampere scale on the multimeter and push the Operate control, observing that the multimeter reads approximately 10 milliamperes. Push the 10 Amps button and observe that the Calibrator is in Standby. Push the Operate control and observe that the meter reads approximately 10 milliamperes (this checks the operation of the unit should the 10 amp accessory Model 350 be attached at a later date).

Push the Ohms select button and observe that the Calibrator is in Standby. Select the 1000 ohm setting of the Ohms control and arrange the multimeter to read ohms on a scale suitable for 1000 ohms. Push the Operate button and observe that the meter reads approximately 1000 ohms.

Push the Volts, Volts/Milliamperes 1000 and -DC buttons and arrange the multimeter to read -1000 volts dc. Press the Operate button and observe that the meter reads approximately -1000 volts dc.

Push the X100 Hz button and set 4 on the Frequency dial, observe that the Calibrator is in Standby. Arrange the multimeter to read 1000 volts AC. Press the Operate control and observe that the multimeter reads approximately 1000 volts.

Check the operation of the Volts/Milliampere 100 and the Millivolt/Microampere 1000 ranges in a manner identical to that which was used to check the 1000 volt range at 400 hertz, in each case observing the meter reading, and that the Calibrator automatically is placed in Standby upon switching function or range.

Set the Calibrator to +DC Volts on the 10 Volt range and the setting to 5.000. Set the multimeter to read 5 volts dc. Press the Operate control. Press the Deviation 10% full scale button. Rotate the Deviation control from + to - observing that the multimeter reading varies from 4.5 to 5.5 volts.

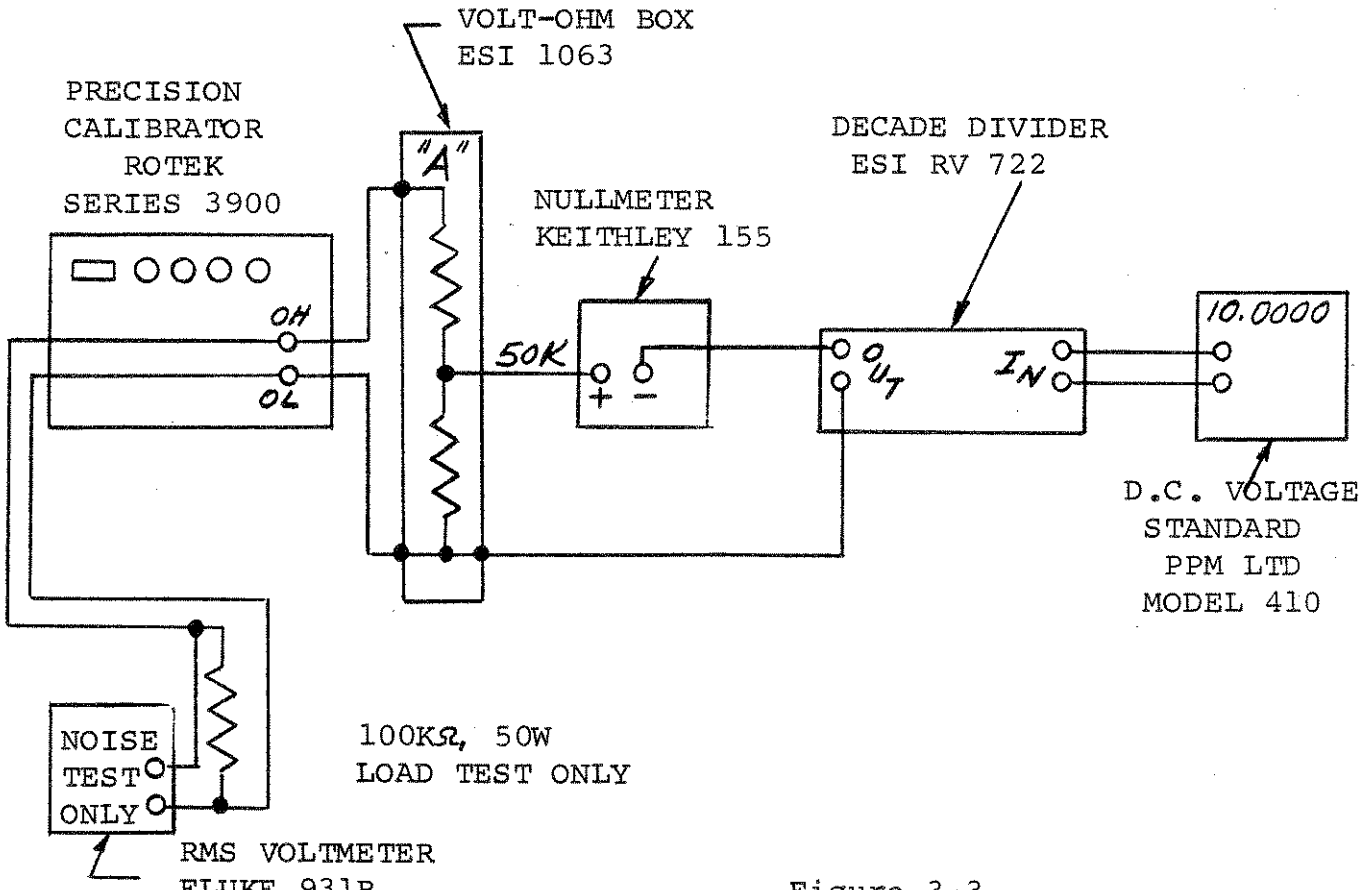


Figure 3-3
DC Voltage Greater Than
10 Volts Accuracy Test

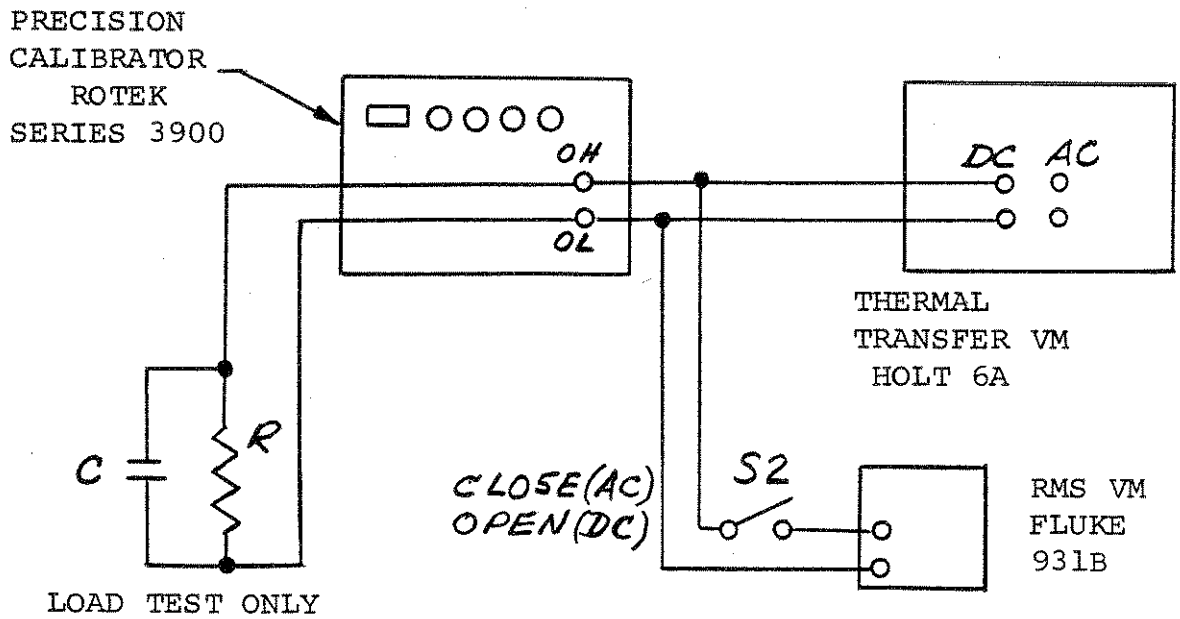


Figure 3-4

AC Voltage Accuracy Test

Observe that the decimal indicators correctly indicate decimal location for each selection of function and range.

Observe that the units indicators show the correct units for the appropriate selection of function and range.

Observe that the ac indicator shows the selection of any ac mode and the ohms indicator shows the selection of the ohms function.

Observe that the "use 350" indicator shows the selection of the function AMPS.

Observe that the Setting Error shows the selection of less than 40 Hz or more than 5 kHz or "0" Setting MSD in any voltage mode.greater than 10 volts.

Observe that the 10 ohm output Z indicator shows the selection of 100 or 10 millivolt ranges.

Observe that the high voltage indicator is illuminated for ac or dc voltages in excess of 10 volts.

3.3.2 DC Voltage Accuracy, Less Than 10 Volts

Arrange the Precision Calibrator and the test equipment as shown in Figure 3-2. Set the 3900 to +DC 10 Volts with a setting of X.000, and the Deviation selector in the Off position. Start with this setting and, using the output of the Decade Divider at each point as a reference, check each setting in sequence on the performance check list of Table 3.2 under DC Voltage Accuracy for all dc voltages less than 10 volts.

3.3.3 DC Voltage Accuracy Tests Greater Than 10 Volts

Arrange the test equipment as shown in Figure 3-3; connect the point "A" to the 500,000 ohm point on the Volt Ohm Box. Select the setting +X0.00 DC Volts on the 3900 and set the Decade Divider to the reference setting of 10 volts.

Prior to setting +X00.0 volts on the 3900 attach point "A" to the 5 Mohm terminal on the Volt Ohm Box, ESI Model 1063.

3.3.4 DC Loading

Using the equipment arranged in the configuration of Figure 3-3 set the 3900 to +X00.0 volts and, prior to pushing the Operate button, connect a 100 Kohm $\pm$ 5%, 50 watt resistor across

the output terminals.

Arrange the equipment in the configuration of 3-2 to determine the effect of loading at the setting X.000 volts, connect a 100 ohm ± 5%, 10 watt resistor across the output terminals. Measure the output voltage.

3.3.5 DC Noise Test

Arrange the equipment in the configuration of Figure 3-3 and set the Calibrator to read 100.0 volts, attach the RMS Volt Meter, Fluke Model 931B, to the output terminals and measure the noise output in the operate condition at that setting.

Arrange the equipment in the configuration of Figure 3-2 attaching the RMS reading voltmeter, Fluke Model 931B, and measure the noise appearing at the output at a setting of X.000 volts.

3.3.6 Deviation Test

Arrange the equipment as shown in Figure 3-2, setting the 3900 to 5.000 volts DC, set the Deviation scale button to 10%, and set the Decade Divider, ESI Model RV722, to .5500000 use the Deviation Dial to achieve a balance on the Keithley Null Meter. The Deviation at null is between the limits 9.88 and 10.12.

Set the Decade Divider to .4500000 and use the Deviation control to achieve a balance on the Null Meter. The Deviation is between the limits -9.88 and -10.12.

Set the Decade Divider to .5050000; push the 1% full scale Deviation button and cause a balance on the Null Meter. Record the Deviation.

Set the Decade Divider to .5005000; push the 0.1% Deviation button and use the Deviation control to achieve a balance on the Null Meter. Record the Deviation.

3.3.7 AC Voltage Accuracy Tests

Arrange the apparatus as shown in Figure 3-4, place the Calibrator and the Thermal Voltmeter in the standby mode. First set the 3900 at the voltage setting to be calibrated in the dc volts mode. For example the first point to be tested is the X00.0

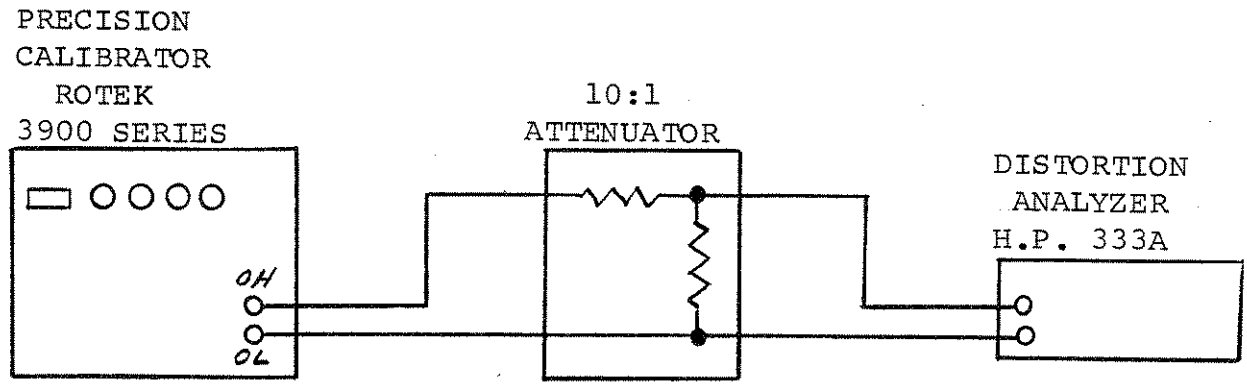
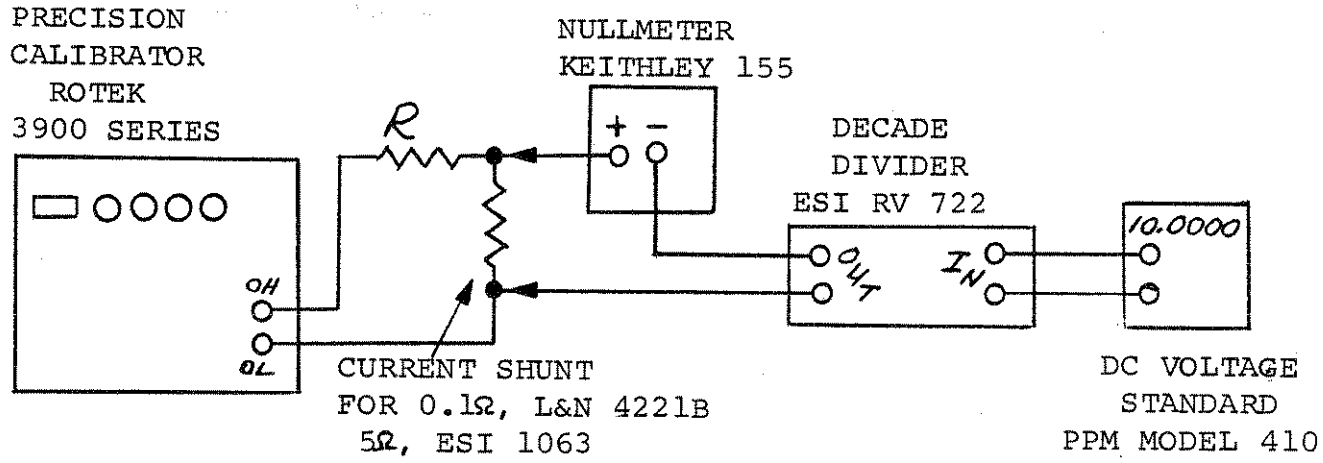


Figure 3-5

AC Noise And Distortion Test



VALUE OF R, 1.9Ω , 10W
USE ONLY AT X00.0 MA

Figure 3-6

DC Current Accuracy Test

setting at 50 Hertz; set the 3900 to +DV Volts, X00.0. In this series of tests the dc reference for the Thermal Transfer Voltmeter will be previously tested settings of the Precision Calibrator. Apply the dc output of the Calibrator to the Thermal Transfer Voltmeter on the proper scale and balance the Voltmeter. Place the Thermal Transfer Voltmeter in standby and transfer the Calibrator from dc to ac operation at the measurement frequency (ie. 50 Hertz for the first test point). Apply the output of the 3900 to the Thermal Transfer Voltmeter, leaving the amplitude setting unchanged, and observe the error in % on the Transfer Voltmeter indicator directly.

The capacitive loading of the Transfer Voltmeter may cause a measureable deviation from the no load 3900 output at higher frequencies. If the no load output voltage needs to be measured, connect the RMS Voltmeter, Fluke 931B, to the output during the preceding measurement. Set the Model 931B in the differential mode and balance the Model 931 at the output setting. Observe the deviation on the Fluke Model 931B Voltmeter when the Thermal Transfer Voltmeter is removed, by placing it in standby. Taking due regard to sign, add the deviation on the Fluke Voltmeter to the previously determined deviation on the Holt Thermal Transfer Voltmeter to compute a new deviation which is the deviation at no load. This measurement is repeated for each setting listed under the AC voltage accuracy tests.

3.3.8 AC Loading

This test involves a two step procedure. The first step calibrates the RMS Voltmeter, Fluke Model 931B, using the Precision Calibrator and the Holt Model 6A; the second step uses the Fluke Model 931B to measure the deviation from the standardized value with load.

Set the 3900 to the equivalent dc voltage of the test point. With no load attached to the output terminals balance the Holt Model 6A Thermal Transfer Voltmeter. Observing precautions in the transfer, change to AC operation of the 3900. Apply the output of the 3900 to the Holt Model 6A, and using the appropriate deviation range of the 3900 balance the Holt Model 6A. The output of the Calibrator is now standardized, and the Fluke RMS Voltmeter is connected to the output of the Calibrator and adjusted to a null in the differential mode condition on the most sensitive scale. The Model 931B is now also standardized. Disconnect the Holt Model 6A and attach the load described on the check list to the

output of the Calibrator (making sure the Calibrator is in the standby mode when the load is connected), press the Deviation OFF button. Operate the Calibrator and observe the deviation on the Fluke Voltmeter recording the deviation in percent.

Repeat these measurements for each load and setting in the check list.

3.3.9 AC Noise and Distortion Tests

Connect the equipment as shown in figure 3-5. To measure the distortion at a setting of 50 Hertz and X00.0 volt an attenuator is required between the Calibrator and the Distortion Analyzer. This attenuator is not necessary at any of the other points. The distortion may be measured directly in percent on the Distortion Analyzer. In some locales where strong radio interference is present the Distortion Analyzer may detect this interference and indicate erroneous readings. Should this be the case, it may be necessary to attach a wave filter tuned to the frequency of the interfering broadcast station at the input terminals of the Distortion Analyzer to eliminate the harmful effect.

3.3.10 DC Current Tests

Arrange the equipment as shown in Figure 3-6 to perform the tests at X00.0 milliamperes. Use the 0.1 ohm Leeds & Northrup Model 4221-B Current Shunt. Set the 3900 to the X00.0 milliampere DC Setting. Adjust the Decade Divider to 0.0100000. Operate the Calibrator and observe the deflection on the Keithley Null Meter.

To conduct the current accuracy test at 2.0 volt compliance and X00.0 milliamperes add the 1.9 ohm resistor as shown in Figure 3-6. Repeat the measurement of the preceding paragraph.

Reduce the setting of the 3900 to 100.0 milliamperes, remove the 0.1 ohm shunt and replace it with a 10 ohm shunt, ESI Model 1063. Remove the 1.9 ohm resistor and replace it by a short in the following tests. Set the Decade Divider, ESI RV722, to .1000000. Operate the Calibrator and observe the deflection on the null meter. Repeat this test for a setting of -X00.0dc milliamperes.

Repeat the measurement of the preceding paragraph setting the 3900 to X0.00 milliamperes and using a 10 ohm shunt.

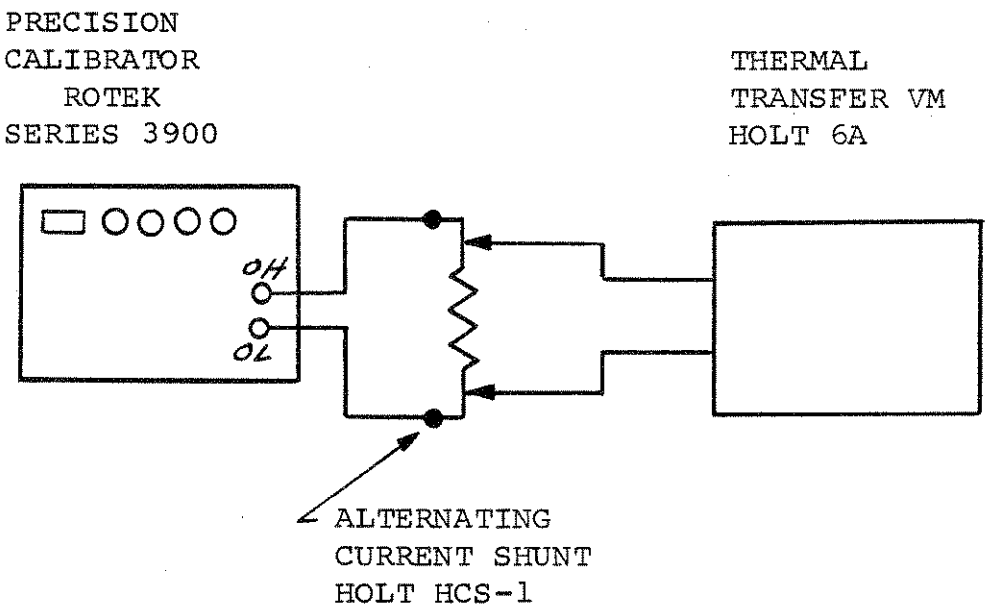


Figure 3-7

AC Current Accuracy Test

Repeat the preceding measurements using a setting of X.000 milliamperes and a 100 ohm shunt.

Repeat the measurements of the preceding paragraph with a setting of X00.0 microamps employing a 1000 ohm shunt.

Repeat the measurement of the preceding paragraph at a setting of X0.00 microamps using a 10000 ohm shunt and setting the voltage divider at .10000000.

Repeat the preceding measurement at a setting of X.000 microamperes using a 100000 ohm shunt.

3.3.11 AC Current Tests

The AC current is tested by calibrating first the drop in a precision shunt caused by a DC current at the standard value, and comparing this drop with the drop caused by the corresponding AC current. Arrange the equipment as shown in Figure 3-7. Use a 1 ampere shunt and set the 3900 to X00.0 milliamperes DC. Balance the Holt Model 6A Thermal Transfer Voltmeter observing the usual precautions. Change the 3900 to 400 Hertz operation at the same current setting and observe the deviation on the Model 6A deviation meter, reading it directly in percent.

Change the current shunt to a 100 milliampere shunt and repeat the measurements above for settings of 100.0 milliamperes at the test frequencies.

To verify the performance at 1000 microamperes the test circuit of Figure 3-8 is used. The shunt is a Vishay Resistance Product Company 100 ohm S102 resistor. Readings of the Fluke Model 931 should be increased by +.01% to account for meter loading.

3.3.12 Resistance Mode Tests

Use a Keithley Instruments Model Digital Volt Ohmmeter and a Volt Ohm Box, ESI Model 1063 to measure the resistance at the terminals of the 3900 in the Ohms mode on a substitution basis.

3.4 Calibration Procedure

Table 3-3 is a list of the steps required to calibrate the 3900. The temperature is 23 C $\pm$1 C. The calibration is performed at the nominal line voltage $\pm$1%, 50-60 Hertz with the top cover of

the instrument in place. The cover is momentarily removed to make adjustments or measurements. Adjustments are identified on the inside of the top cover. Use caution in making connections to test points; accidental shorting between test points and circuit elements could destory components.

3.5 Periodic Maintenance

The following procedure is recommended:

3.5.1 Degreasing

Leakage across the surface of some of the sensitive analog circuits can introduce intermittent varying errors. All such circuits are protected by guard paths. However, leakage can be introduced by the residue from handling.

If a repair involving soldering is required, or if the circuits are handled for any reason, they should be cleaned by washing with a pure grain alcohol applied with a clean brush. Trichlorethelene may also be used in the event alcohol is not available.

Do not submerge the modules in these solvents as some of the electrolytic capacitor seals may be damaged thereby.

DATE: _____

Table 3-2

MODEL: _____

3900 Series

SERIAL NO: _____

Performance Check List - 1

Function	Setting	Observed Reading	Allowable Limits
Front Panel Controls:			3950-3970 (3910-3940)
Power on-Standby Ck		_____	
Operate On Check		_____	
Standby On Check		_____	
Volts, Amps, 10 Amps. Ohms.		_____	
Ranges		_____	
DC Frequency		_____	
Deviation		_____	
Decimal Indicators		_____	
Units Indicators		_____	
Zener Reading (TP-16 TO OL)		_____	
Ref. Reading (TP-17 TO OL)		_____	
DC Voltage Accuracy: (NOT APPLICABLE TO 3940)			
+10 Volt Range	X.000 Volt	_____	±600uVolts (1200)
	9.999 Volt	_____	±600uVolts (1200)
	8.888 Volt	_____	±541uVolts (1088)
	7.777 Volt	_____	±488uVolts (977)
	6.666 Volt	_____	±432uVolts (866)
	5.555 Volt	_____	±377uVolts (755)
	4.444 Volt	_____	±322UVolts (644)
	3.333 Volt	_____	±266uVolts (533)
	2.222 Volt	_____	±211uVolts (422)
	1.111 Volt	_____	±155uVolts (5311)
	1.000 Volt	_____	±150uVolts (300)
-10 Volt Range	-X.000Volt	_____	±600uVolts (1200)
	-1.000Volt	_____	±150uVolts (300)
+1000mVolt Range	+X00.0mVolt	_____	± 72uVolts (142)
	+100.0mVolt	_____	± 27uVolts (54)
-1000mVolt Range	-X00.0mVolt	_____	± 72uVolts (142)
AT MV TERMINALS +100M Volt Range	+X0.00mVolt	_____	± 9uVolts (16)
AT MV TERMINALS +10M Volt Range	+X.000mVolt	_____	±2.7uVolts (3.4)
+100 Volt Range	+X0.00 Volt	_____	±600uVolts (1200)
+1000 Volt Range	+X00.0 Volt	_____	±600uVolts (1200)
-1000Volt Range	-X00.0 Volt	_____	±600uVolts (1200)

DATE: _____

Table 3-2 (Cont.)

MODEL: _____

3900 Series

SERIAL NO: _____

Performance Check List - 2

Function	Setting	Observed Reading	Allowable Limits 3950-3970	3910-3940
DC Loading:				
10mA (100K ohms, 50W)	X00.0 Volt	_____	± 601uVolts	(1201)
DC Noise:				
10mA Load	100.0 Volt	_____	± 30mV/RMS	(30)
Deviation Control:	(NOT APPLICABLE TO 3910)			
10% Full Scale	+1.00	_____	+.98, +1.02	
10% Full Scale	-1.00	_____	-.98, -1.02	
1% Full Scale	+1.00	_____	+.98, +1.02	
0.1% Full Scale	+1.00	_____	+.98, +1.02	
(After this test be sure to press the DEV. OFF Button.)				
AC Voltage Accuracy:				
1000 Volt Range	50Hz X00.0V	_____	±550mV (±.055%)	(0.11%)
	400Hz X00.0V	_____	±550mV (±.055%)	(0.11%)
	5000Hz X00.0V	_____	±1.100V (±.11%)	(0.26%)
	50Hz 100.0V	_____	±100mV (±.10%)	(0.2%)
	400Hz 100.0V	_____	±100mV (±.10%)	(0.2%)
	5000Hz 100.0V	_____	±200mV (±.20%)	(0.35%)
100 Volt Range	50Hz X0.00V	_____	±55mV (±.055%)	(0.11%)
	5000Hz X0.00V	_____	±110mV (±.11%)	(0.26%)
10 Volt Range	400Hz X.000V	_____	±5.5mV (±.055%)	(0.11%)
	5000Hz X.000V	_____	±11.0mV (.110%)	(0.26%)
1000m Volt Range	400Hz X00.0mV	_____	±560mV (±.056%)	(0.11%)
AC Loading:				
20mA (50K, 50W) and 220pf	400Hz X00.0V	_____	±550mV (±.055%)	(0.11%)

DATE:_____

Table 3-2 (Cont.) MODEL:_____

3900 Series SERIAL NO:_____

Performance Check List - 3

Function	Setting	Observed Reading	Allowable Limits 3950-3970	Allowable Limits 3910-3940
AC Noise & Distortion:				
1000 Volt Range	50Hz X00.0V	_____	±0.05%	
	100.0V	_____	±0.05%	
1000mVolt Range	400Hz X00.0V	_____	±0.052%	
	5000Hz X00.0V	_____	±0.102%	
DC Current Accuracy:	(NOT APPLICABLE TO 3940)			
1000mA				
1.0V Compl.	X00.0mA	_____	±0.025%	(.055%)
0.1V Compl.	100.0mA	_____	±0.07%	(.1%)
1.0V Compl.	100.0mA	_____	±0.07%	(.1%)
100mA 1.0V Compl.	X0.00mA	_____	±0.022%	(.055%)
10mA 1.0V Compl.	X.000mA	_____	±0.022%	(.055%)
1000uA 1.0V Compl.	X00.0uA	_____	±0.023%	(.06%)
100uA 1.0V Compl.	X0.00uA	_____	±0.032%)	(.105%)
10uA 1.0V Compl.	X.000uA	_____	±0.22%	(.555%)
AC Current Accuracy:	(NOT APPLICABLE TO 3940)			
1000mA 400Hz				
1.0V Compl.	X00.0mA	_____	±550uA (.055%)	(.11%)
10mA 400Hz				
1.0V Compl.	X.000mA	_____	±5.5uA (.055%)	(.11%)
10mA 1000Hz				
1.0V Compl.	X.000mA	_____	±10.1uA(.11%)	(.22%)

DATE:_____

Table 3-2 (Cont.) MODEL:_____

3900 Series SERIAL NO:_____

Performance Check List - 4

Function	Setting	Observed Reading	Allowable Limits
Resistance Accuracy (4 WIRE) (NOT APPLICABLE TO 3910 OR 3940)			
	1 Ohm	_____	±0.001 ohm
	10 ohms	_____	±0.005 ohms
	100 ohms	_____	±0.02 ohms
	1000 ohms	_____	± 0.1 ohms
	10000 ohms	_____	±1.0 ohms
	100000 ohms	_____	± 10.0 ohms
	1M ohms	_____	±100.0 ohmd
	10M ohms	_____	±10000 ohms

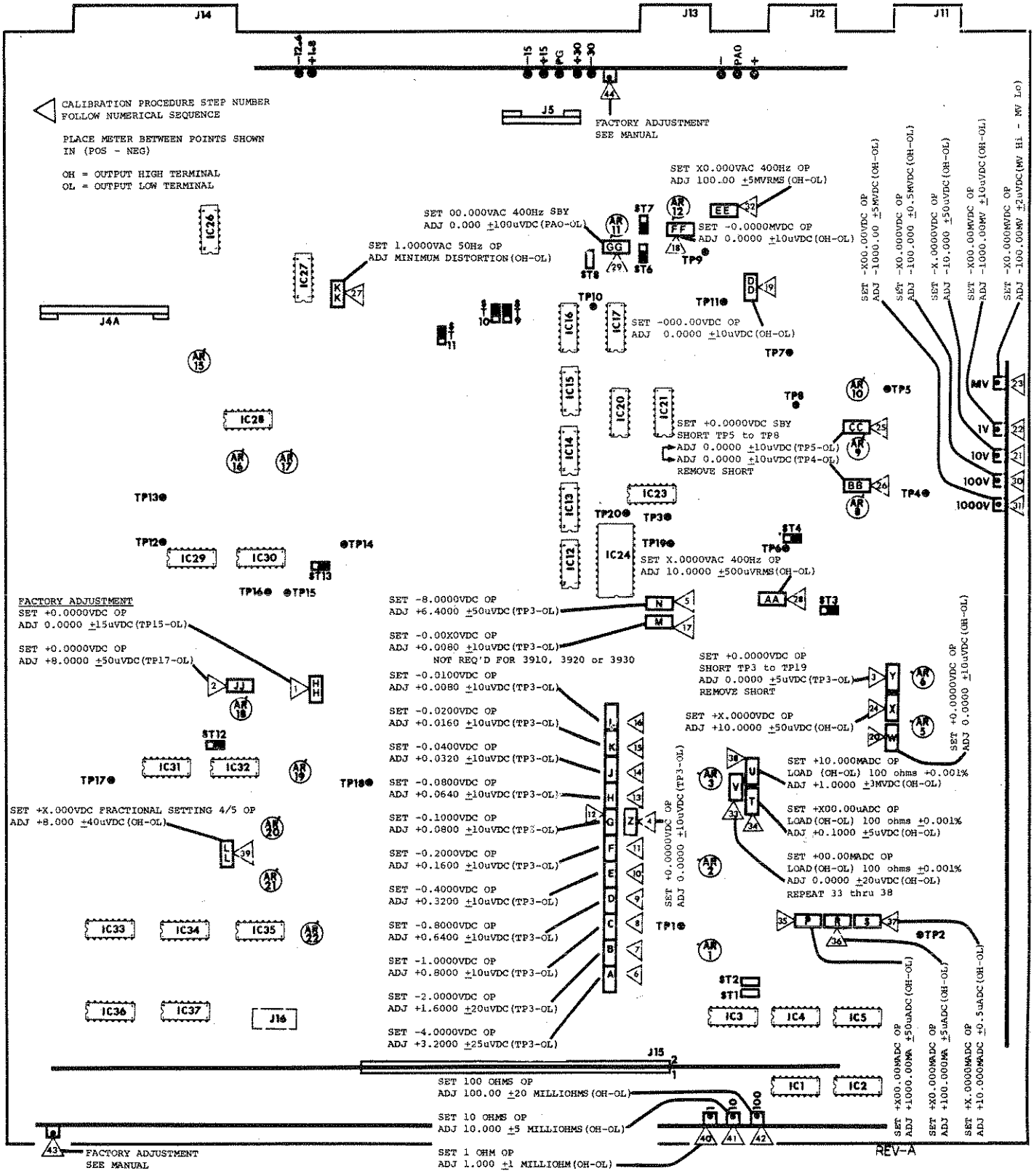


Figure 3-8

Calibration Procedure

CALIBRATION PROCEDURE

	Parameter To Be Adjusted	3900 Status, Settings	Adjustment Procedure	Reference, Schematic & Test Diagram
(1)	(Factory Adjustment - If Required Be Careful Of Thermal Voltages)			
	DC Voltage TP-15 to C71 Low - Measure TP-15	+0.0000VDC, OP (OPERATE)	ADJ HH For 0 ±15uV. DC	39-109-001/1 Figure 3-2 (Connect 155 + Lead to TP-15)
(2)	DC Voltage TP-17 - OL	+0.0000VDC, OP	ADJ JJ For 8.000V ± 50uVDC	39-109-0001/1 Figure 3-2
(3)	Offset AR6; DC Voltage TP3-OL	+0.0000VDC, OP	Place a short from TP3 - TP19 ADJ Y for 0 ±5uVDC Remove short	39-109-001/5 Figure 3-2 (Connect 155 + Lead to TP3)
(4)	Leakage at AR6; DC Voltage TP3-OL	+0.0000VDC, OP	ADJ Z for 0 ±10uVDC. Repeat 3 & 4 until both conditions obtained	39-109-001/5 Figure 3-2 (Connect 155 + Lead to TP3)
(5)	8's Digit DC Voltage TP3-OL	-8.0000VDC, OP	ADJ N for 6.4000V ±50uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)

Table 3-3

CALIBRATION PROCEDURE

	Parameter to Be Adjusted	3900 Status, Settings	Adjustment Procedure	Reference, Schematic & Test Diagram
(6)	4's Digit, DC Voltage TP3-OL	-4.0000VDC, OP	ADJ A for +3.200V ±25uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)
(7)	2's Digit,DC Voltage TP3-OL	-2.0000VDC, OP	ADJ B for +1.6000V ±20uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)
(8)	1's Digit,DC Voltage TP3-OL	-1.00VDC, OP	ADJ C for +0.8000V ±10uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)
(9)	0.8's Digit,DC Voltage TP3-OL	-0.8000 VDC, OP	ADJ D for +0.6400V ±10uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)
(10)	0.4's Digit,DC Voltage TP3-OL	-0.4000 VDC, OP	ADJ E for +0.3200V ±10uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)
(11)	0.2's Digit,DC Voltage TP3-OL	-0.2000 VDC, OP	ADJ F for +0.1600V ±10uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)

Table 3-3 Cont.

CALIBRATION PROCEDURE

	Parameter to Be Adjusted	3900 Status, Settings	Adjustment Procedure	Reference, Schematic & Test Diagram
(12)	0.1's Digit, DC Voltage TP3-OL	-0.1000VDC, OP	ADJ G for +0.0800V ±10uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)
(13)	0.08's Digit, DC Voltage TP3-OL	-0.0800VDC, OP	ADJ H for +0.0640V ±10uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)
(14)	0.04's Digit, DC Voltage TP3-OL	-0.0400VDC, OP	ADJ J for +0.0320V ±10uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)
(15)	0.02's Digit, DC Voltage TP3-OL	-0.0200VDC, OP	ADJ K for +0.0160V ±10uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)
(16)	0.01's Digit, DC Voltage TP3-OL	-0.0100VDC, OP	ADJ L for +0.0080V ±10uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)

Table 3-3 Cont.

CALIBRATION PROCEDURE

	Parameter to Be Adjusted	3900 Status, Settings	Adjustment Procedure	Reference, Schematic & Test Diagram
	NOTE: STEP #17 IS OMITTED FOR MODELS 3910, 3920, 3930			
(17)	0.00X's Digit, DC Voltage TP3-OL	-0.00X0VDC, OP	ADJ M for +0.0080V ±10uVDC	39-109-001/4 Figure 3-2 (Connect 155 + Lead to TP3)
(18)	Voltage Offset AR-12, VDC OH-OL	-000.0mVDC, OP	ADJ FF for 0.0000 ±5uV	39-109-001/6 Figure 3-2
(19)	Current Offset AR-12, VDC OH-OL	-0.000VDC, OP	ADJ DD for 0.0000 ±10uV. Repeat 18 and 19 until both conditions obtained	39-109-001/6 Figure 3-2
(20)	Offset AR-5, VDC OH-OL	+0.0000VDC, OP	ADJ W for 0.0000 ±10uV	39-109-001/5 Figure 3-2
(21)	-10VDC Range VDC OH-OL	-X.0000VDC, OP	ADJ R18 (10V) for -10.000V ±50uVDC (On Output Board)	39-109-001/8 Figure 3-2
(22)	-1000mVDC Range OH-OL	-X00.00mVDC, OP	ADJ R14 (Marked "1") for -1000.00mV ±10uVDC	39-109-001/8 Figure 3-2

Table 3-3 Cont.

CALIBRATION PROCEDURE

	Parameter to Be Adjusted	3900 Status, Settings	Adjustment Procedure	Reference, Schematic & Test Diagram
(23)	-100mVDC Range MV HI-MV LO	-X0.00mVDC, OP	ADJ R10 (100mV) for -100.0mV ±2uVDC	39-109-001/8 Figure 3-2
(24)	+10VDC Range OH-OL	+X.0000VDC, OP	ADJ X for 10.000V ±50uVDC	39-109-001/5 Figure 3-2
(25)	Rectifier AR9,10 Offset VDC TP5-OL	+0.0000VDC, SBY	Short TP5 to TP8 ADJ CC for 0.0000VDC ±10uVDC. Leave Short in place	39-109-001/3 Figure 3-2 (Connect 155 + Lead to TP5)
(26)	Integrator AR8 Offset VDC TP4-OL	+0.0000VDC, SBY	ADJ BB for 0.0000VDC ±10uVDC. Repeat 25 and 26 until both obtained. Remove short TP5-TP8	39-109-001/3 Figure 3-2 (Connect 155 + Lead to TP4)
(27)	Modulator Balance; Distortion VAC, OH-OL	1.0000VAC, 50Hz OP	ADJ KK for Minimum Distortion (0.05%)	39-109-001/2 Figure 3-2
	ALTERNATE IF DISTORTION METER NOT AVAILABLE:			
(27A)	ACV at Jnct. R63, C3 near AR15 (Use oscilloscope)	1.0000VAC, 400Hz OP	ADJ KK for minimum AC voltage	39-109-001/2

Table 3-3 Cont.

CALIBRATION PROCEDURE

	Parameter to Be Adjusted	3900 Status, Settings	Adjustment Procedure	Reference, Schematic & Test Diagram
(28)	10VAC Range OH-OL	X.0000VAC; 400Hz OP	ADJ AA for 10.0000V ±500uVRMS (±0.005%)	39-109-001/3 Figure 3-4
(29)	Power Amp Offset V>10 VDC PAO (TP9 Backpanel)-OL	00.000VAC, 400Hz SBY	ADJ GG for 0.0V ±100uV DC	39-109-001/6
(30)	100VDC Range OH-OL	-X0.00VDC, OP	ADJ R24 (100V) for -100.000VDC ±500uVDC (±50uV in Figure 3-3)	39-109-001/8 Figure 3-3
(31)	1000VDC Range OH-OL	-X00.00VDC, OP	ADJ R30 (1000V) for -1000.00V ±5mV DC (±50uV in Figure 3-3)	39-109-001/8 Figure 3-3
(32)	100V AC Range OH-OL	X0.000VAC, 400Hz OP	ADJ EE for 100.00V ±0.005%	39-109-001/6 Figure 3-4
(33)	DC Current Zero OH-OL	+00.00mADC, OP Load OH-OL 100 ±0.001% Ohms	ADJ V for 0.0000V ±50uVDC OH-OL	39-109-001/7 Figure 3-6
(34)	Current Zero Compliance OH-OL	+X00.00uADC, OP	100 Ohms ±0.001% OH-OL ADJ T for 0.10000V ±5uVDC	39-109-001/7 Figure 3-6

Table 3-3 Cont.

CALIBRATION PROCEDURE

	Parameter to Be Adjusted	3900 Status, Settings	Adjustment Procedure	Reference, Schematic & Test Diagram
(35)	1000mADC Range OH-OL	+X00.00mADC, OP	ADJ P for 1000.00mA ±50uADC (±50uV in Figure 3-6)	39-109-001/7 Figure 3-6
(35A)	1000mADC Range OH-OL	-X00.00mADC, OP	Readjust Pots V & P to get best balance between + and -	39-109-001/7 Figure 3-6
(36)	100mA DC Range OH-OL	+X0.000mADC, OP	ADJ R for 100.000mA ±5uADC (±50uV in Figure 3-6)	39-109-001/7 Figure 3-6
(37)	10mA DC Range OH-OL	+X.0000mADC, OP	ADJ S for 10.0000mA ±0.5uADC (±50uV in Figure 3-6)	39-109-001/7 Figure 3-6
(38)	Current Full Compliance, OH-OL	+10.00mADC, OP (100mA Range)	100 Ohms ±0.001% OH-OL ADJ U for 1.0000V ±300uVDC	39-109-001/7 Figure 3-6
(38A)	Current Full Compliance, OH-OL	-10.00mADC, OP (100mA Range)	Readjust Pot U to get best balance between + and -	39-109-001/7 Figure 3-6

REPEAT 34-38A TO OBTAIN BEST COMPROMISE

Table 3-3 Cont.

5/15/80

CALIBRATION PROCEDURE

	Parameter to Be Adjusted	3900 Status; Settings	Adjustment Procedure	Reference, Schematic & Test Diagram
(39)	Fractional Setting OH-OL	+X.000VDC Fraction Setting 4/5	ADJ LL for +8.000V OH-OL	Figure 3-2
(40)	1 Ohm Value	1 Ohm, OP	ADJ LL for 1.000 Ohms ±0.001 Ohms at OH	39-101-001/4
(41)	10 Ohm Value	10 Ohms, OP	ADJ MM for 10.000 Ohms ±0.005 Ohms at OH	39-101-001/4
(42)	100 Ohm Value	100 Ohms, OP	ADJ NN for 100.00 Ohms ±0.02 Ohms at OH	39-101-001/4
(43)	Meter FACTORY ONLY	See Manual		39-101-001/4
(44)	PA Idle I FACTORY ONLY	See Manual		

SERIES 3900

CALIBRATION PROCEDURE

FACTORY ADJUSTMENTS

These adjustments are required only if repairs have been made replacing the reference zener RX-1, the components in the power amplifier or in the Meter Circuits of 39-109-001/1.

Parameter to Be Adjusted	3900 Status, Settings	Adjustment Procedure	Reference, Schematic & Test Diagram
Reference Voltage at TP7 VDC TP7-OL	0.0000VDC, OP	Select Values R9-13 such that Pot JJ is approximately centered when +8.0000 obtained.	39-109-001/1 Figure 3-2
Idle Current Power Amplifier Output Stage. VDC TP6 (High)-TP10 (Low) on 250mV Range (Use floating meter)	+0.0000VDC, SBY	Set R-34 full clock-wise (From top view) Gradually turn CCW until reading 15mVDC (150mA)	39-109-001/6
Meter Zero	5.000VDC OP, Deviation Range 10% Set Deviation for 5.000 ±0.0005VDC	ADJ "Meter Zero" for 0.0% Deviation	39-109-001/1

SECTION 4

TROUBLE SHOOTING & MAINTENANCE

4.1 Purpose

The purpose of this section is to describe logical procedures for diagnosing malfunctions.

WARNING

HAZARDOUS VOLTAGES ARE PRESENT ON SOME OF THE CIRCUIT ELEMENTS' TERMINALS.

4.2 Access & Procedures

In the event of a malfunction, access to the circuits is accomplished by removing the two screws at the rear holding the top cover in place. The cover may then be removed. Part location and schematic drawings are included in Section 6. Block diagrams showing the arrangement of the components in each of six different operating modes are included in this section and are referred to later.

As a first step in trouble shooting a failure, refer to Table 4-1 which lists a number of common failures and the possible malfunctions. If the fault cannot be identified from the Table, the circuit tracing procedures should be used.

WARNING

CMOS SWITCHES, 16 PIN DIP IC MARKED "201" ARE USED. EXERCISE CARE IN HANDLING THEM. WHEN REMOVING CMOS, DISCHARGE STATIC ELECTRICITY ON THE BODY BY TOUCHING GROUND FIRST. STORE CMOS IN CONDUCTING FOAM WHEN REMOVED FROM SOCKETS.

4.3 Fault Finding by Circuit Tracing

4.3.1 Suspected Power Amplifier Failure (39-109-001/6)

To check the operation of the Power Amplifier circuits remove K4, move ST9 and 10 to forward (open) positions. Clip a

Table 4-1

Trouble Shooting Chart

Symptom, Schematic Reference	Malfunction
1.0 Line power on - No indicator leds.	1.1 Line fuse failed. Check rear panel line receptacle fixture.
	1.2 Line selector set to 220 or 240V when line is 120V. Check selection in line receptacle fixture.
2.0 No output at OH-OL, all indicator leds operating. Operate & Standby leds function. 39-109-001/9 39-107-001	2.1 Power amplifier fuses failed. Check rear panel F2, F3. (See power amp failure below)
	2.2 Output relay, K14, not energized in OP state.
	2.3 Lead from K14-6 to OUT HI terminal discontinuous.
3.0 Failure to respond to operate control.	
3.1.0 Operate lamp not illuminated.	
3.1.1 Disallowed setting.	Check "Disallowed setting" lamp.
3.1.2 Failure of overlimit circuits. 39-109-001/3	IC26-6 High in Standby. AR13-6 Low in Standby. AR14-6 High in Standby.
3.1.3 Failure of overlimit input.	
3.1.3.1 Power amplifier output. 39-109-001/6	TP9 on backboard > 17 volts in Standby.
3.1.3.2 Integrator output. 39-109-001/3	TP4 > 11 volts in Standby.
3.1.3.3 Current guard output. 39-109-001/7	IC1-6 > 5 volts in Standby.
3.1.3.4 Overburden. 39-109-001/3	IC26-13 Low.
3.1.4 Failure of timing circuits. 39-111-001/1	IC12-3 Low. IC11,12,13,27,33,41,10. Failure to respond to OP at J2-4.

Table 4-1

(Continued)

Symptom, Schematic Reference	Malfunction
3.1.5 Failure in Disallowed Settings circuits. 39-111-001/3	IC43-8 Low in absence of disallowed setting.

In the event of an overlimit input failure proceed to Fault Finding arranged by mode. If the failure occurs in all modes of operation start with "Failure in Mode DC Voltage 0-10 Volts".

3.2.0 Operate indicator illuminated followed by Standby.	
3.2.1 One of more overload limits exceeded.	Burden or compliance limits exceeded. Check external load.
3.2.2 Transient failure Power amplifier output. 39-109-001/6	TP9 on backboard 17 volts after OP asserted.
3.2.3 Integrator output transient failure. 39-109-001/3	TP4 > 11 volts after OP is asserted.
3.2.4 Current guard output transient failure. 39-109-001/7	IC1-6 > 5 volts after OP is asserted
3.2.5 Overburden transient failure. 39-109-001/3	IC26-13 becomes low after OP is asserted.

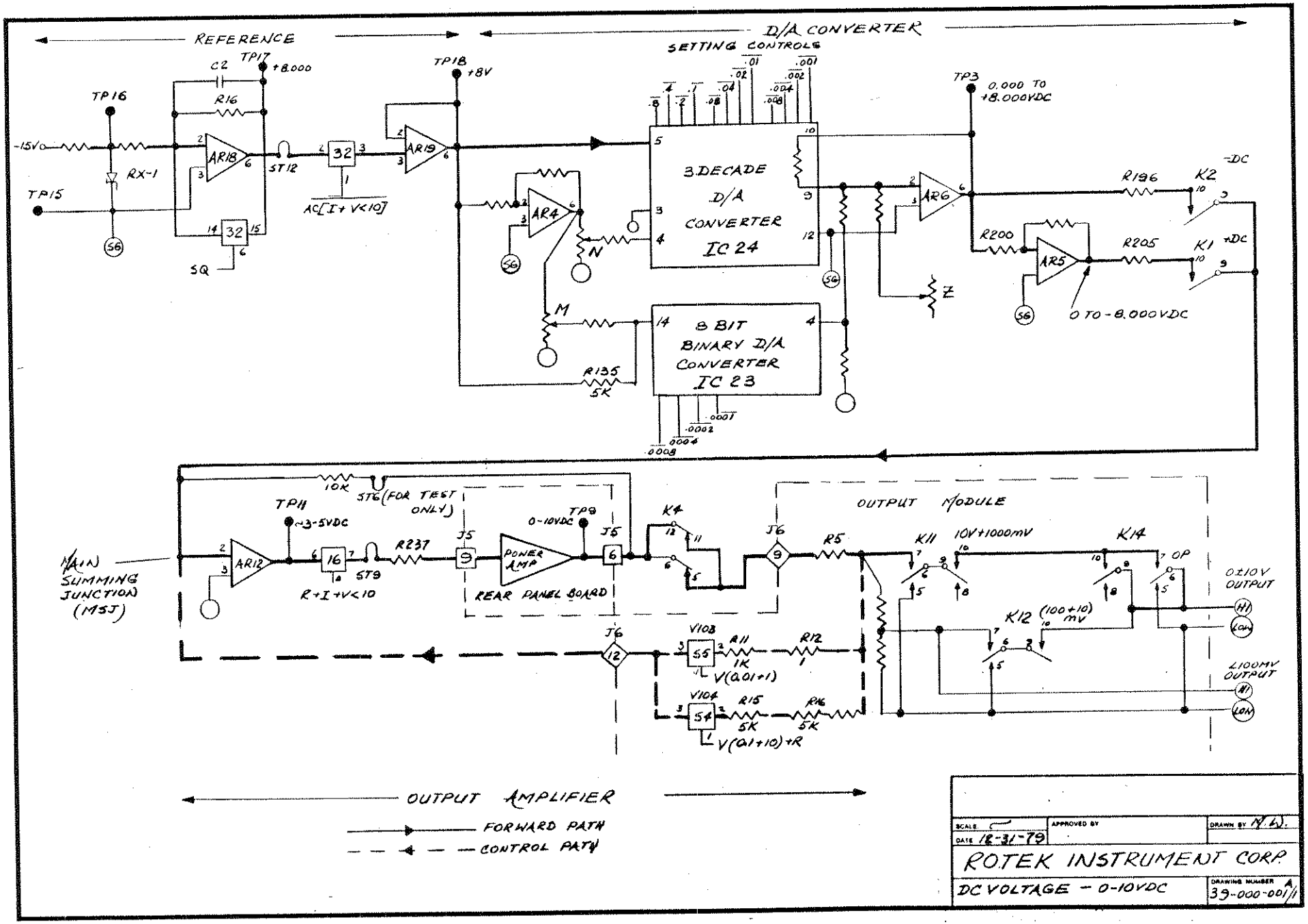
The above signals 3.2.1 - 3.2.5 must be examined with an oscilloscope, triggered by the OP signal; the malfunction condition must be asserted until the timeout at IC29 pin 12. Proceed to Fault Finding by mode to locate the failure mechanism.

4.0 Standby asserted when switching from 300-400 volts or vice versa.	
5.0 Failure to adjust parameter to specified value per Calibration chart.	See Fault Finding.

Table 4-1

(Continued)

Symptom, Schematic Reference	Malfunction
6.0 Power amplifier fuses destroyed repeatedly. 39-109-001/6	6.1 Open CR1,2,3,4,5 on rear panel.
	6.2 R34 setting incorrect. See Factory Adjustment Procedure.


REFERENCE
D/A CONVERTER
SETTING CONTROLS
TP16
TP17
+8.000
C2
R16
TP18
+8V
-15V0
RX-1
TP15
AR18
ST12
32
AR19
AC[I+V<10]
SQ
3 DECADE D/A CONVERTER IC 24
.8 .4 .2 .1 .08 .04 .02 .01 .008 .004 .002 .001
TP3
0.000 TO +8.000VDC
-DC
+DC
AR4
N
M
AR6
R196
K2
R200
AR5
R205
K1
Z
0 TO -8.000VDC
8 BIT BINARY D/A CONVERTER IC 23
R135 5K
.0008 .0004 .0002 .0001
10K
ST6 (FOR TEST ONLY)
TP11
-3-5VDC
AR12
R237
ST9
R+I+V<10
J5
TP9
0-10VDC
POWER AMP
REAR PANEL BOARD
K4
J6
OUTPUT MODULE
R5
K11
10V+1000mV
K14
OP
0 TO 10V OUTPUT
K12
(100+10) mV
0 TO 100MV OUTPUT
MAIN SUMMING JUNCTION (MSJ)
V108
R11 1K
R12 1
V(0.01+1)
V104
R15 5K
R16 5K
V(0.1+10)+R
OUTPUT AMPLIFIER
FORWARD PATH
CONTROL PATH
SCALE
DATE 12-31-79
APPROVED BY
DRAWN BY M.L.
ROTEK INSTRUMENT CORP.
DC VOLTAGE - 0-10VDC
DRAWING NUMBER A 39-000-001/1

jumper across R22 on the rear panel circuit board. Measure TP9 of the Power Amplifier (on rear panel Circuit board) in the condition +VDC, 0.000, 10V range SBY. The voltage is 0 to +6 volts DC. If the jumper across R22 is removed, the voltage becomes approximately -20 volts.

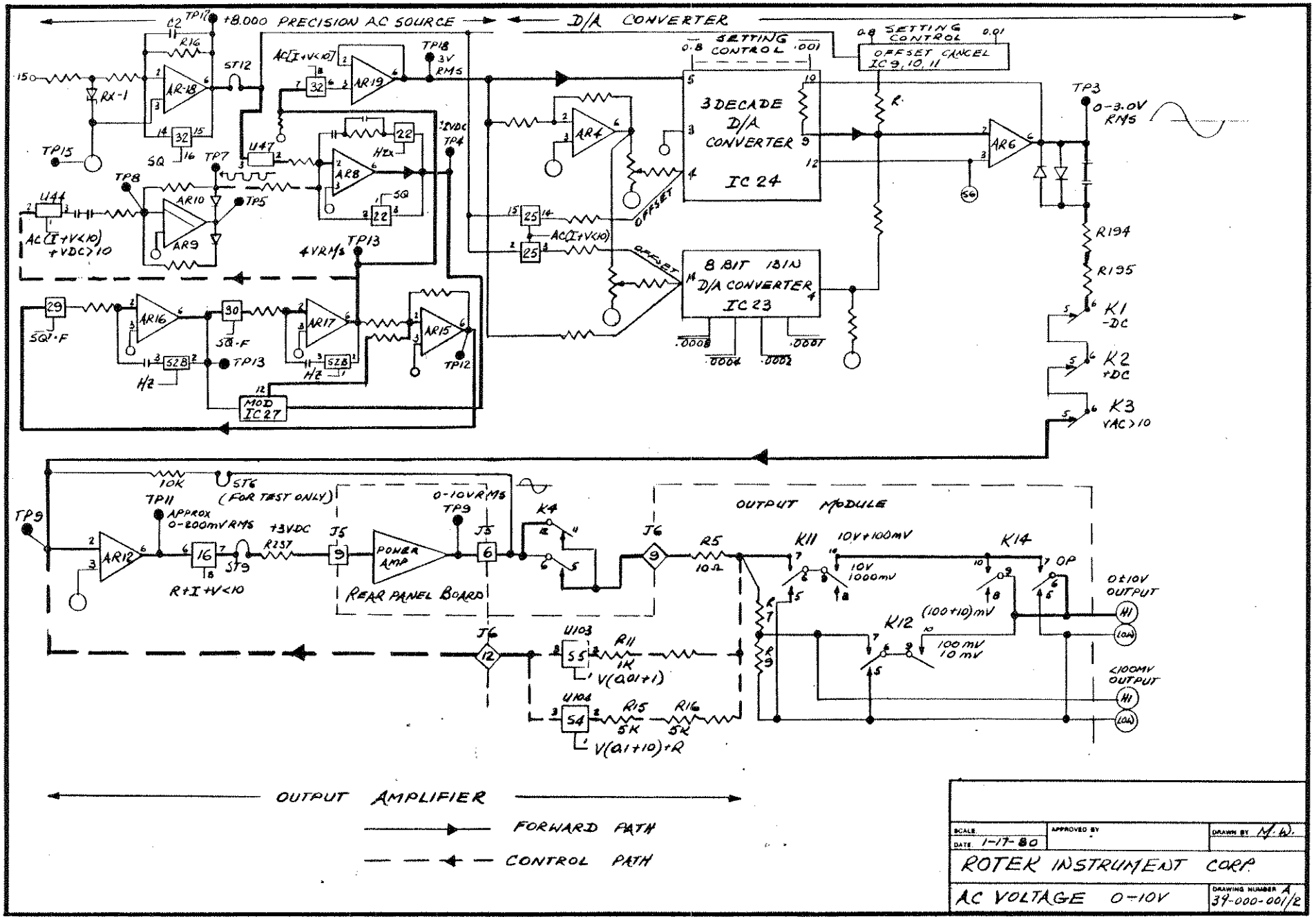
When this test is completed replace K4 and move ST9 and 10 to the rear or shorted positions. Remove the jumper across R22.

4.3.2 Failure in Mode DC Voltage 0-10 Volts (39-000-001/1)

1. Check zener voltage TP16 to OL. Compare with Certificate value to diagnose drift with time.
2. Check reference at TP17 to OL, as +8.0000V ±350uV DC. Reference should not vary by more than ±100uV as top cover is moved.
3. Check TP18 voltage, approximately +8.00V DC with fluctuation less than +100uV.
4. Check operation of D-A Converter at TP3 to OL.
   4.1 Check front panel setting 0.000VDC, OP as 0 ±50uV DC.
   4.2 Test other settings according to the relation
   TP3-OL = +0.8 front panel setting volts
   ±0.003% ±50uV DC.
5. Check operation of D-A Converter at AR5-6 (or R205) as for 4 above except the voltages are negative.
6. Check accuracy of output at K11 side of R5 (on output module).

Assuming the above conditions are met then the fault is located between TP9 on AR12 and OH.

1. Remove K4 and move ST9 & 10 to forward (open) condition. Check Power Amplifier as described previously.
2. With conditions as in 1, move ST7 forward (shorted). Disconnect the Output Sense at J6 and J7. AR12 is now isolated with R210 as a feedback resistor.
3. Turn on and check TP11-OL as the front panel settings are varied from 0.000 to ±X.000 on 10V DC range. TP11 varies approximately to ±4.7 volts.
   3.1 At setting 0.000 it should be possible to adjust FF and DD by measuring the voltage TP11 to OL.
   3.2 FF adjustment: short R210, adjust FF for ±5uV.
   3.3 DD adjustment: remove short, adjust DD for ±10uV; repeat 3.2 and 3.3 for both condition.
   3.4 Check continuity of signal at TP11 through IC16 pins 6,7.


+8.000 PRECISION AC SOURCE
D/A CONVERTER
3 DECADE D/A CONVERTER IC 24
8 BIT BIN D/A CONVERTER IC 23
OFFSET CANCEL IC 9, 10, 11
SETTING CONTROL
OUTPUT MODULE
REAR PANEL BOARD
POWER AMP
0-3.0V RMS
0-10VRMS
K1 -DC
K2 +DC
K3 VAC>10
K11 10V+100mV
K12 (100+10)mV
K14
0±10V OUTPUT
<100MV OUTPUT
OUTPUT AMPLIFIER
FORWARD PATH
CONTROL PATH
SCALE
DATE 1-17-80
APPROVED BY
DRAWN BY M.W.
ROTEK INSTRUMENT CORP.
AC VOLTAGE 0-10V
DRAWING NUMBER A 39-000-001/2

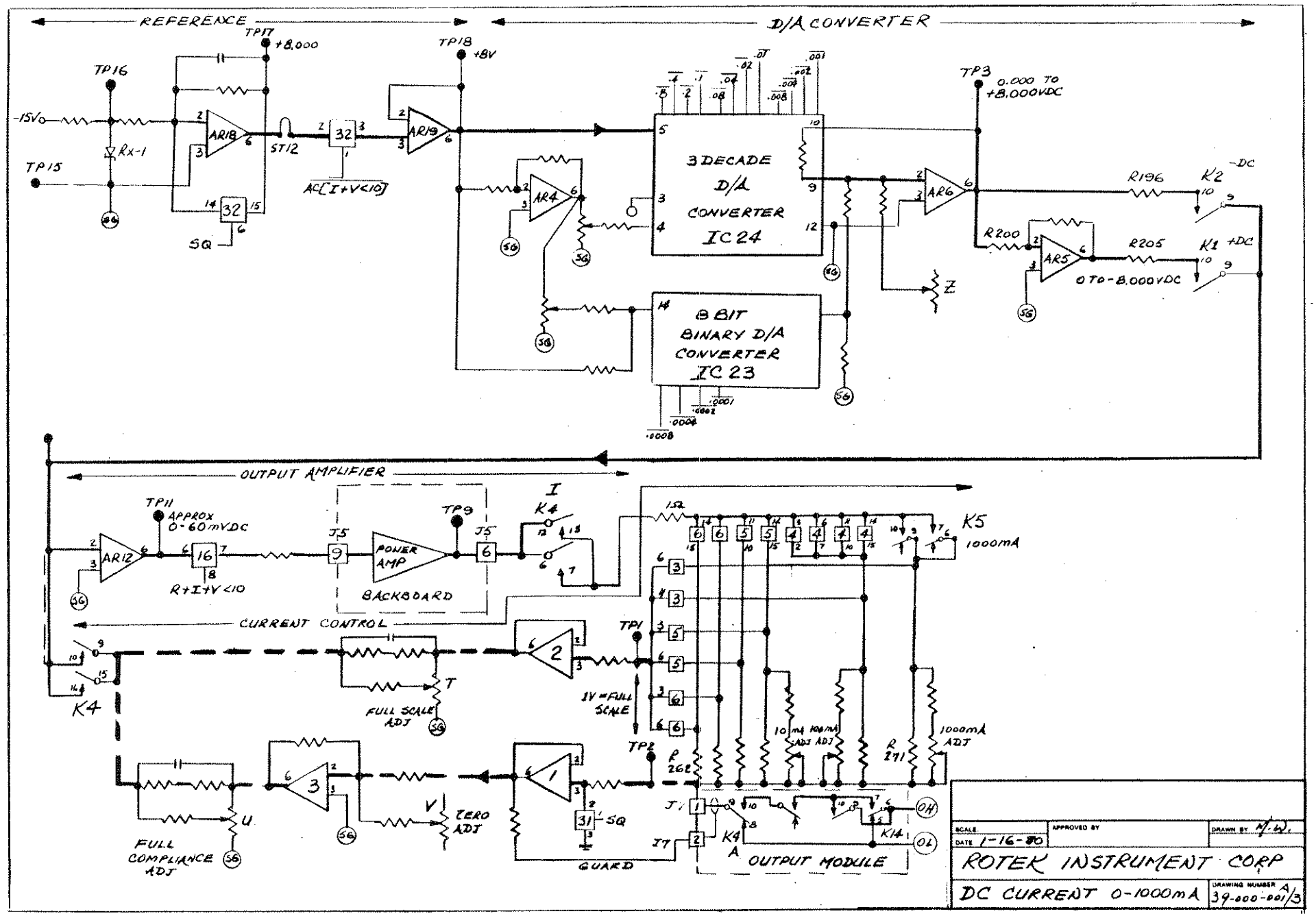
4. Restore ST7 to its back (open) position; ST9 to its back (closed) position and ST6 to the forward (closed) position. Remove the jumper across R22 of the Power Amplifier, if it is still in place. AR12 and the Power Amplifier now form an isolated loop with R211 as the feedback resistor.
   4.1 Turn on and measure the voltage from TP9 (Rear Panel) to OL. Examine the voltage as the front panel settings are varied from 0.000 to ±X.00. (Approximately ±10.0V).
   4.2 Restore ST10 to back (closed) position to see if unwanted leakage occurs through IC16-10,11.
   4.3 With K4 still removed install the Output Sense module to determine if faulty operation of U103-108 is introducing error (particularly at 0.000 setting).
5. Move ST6 to back position; install K4.

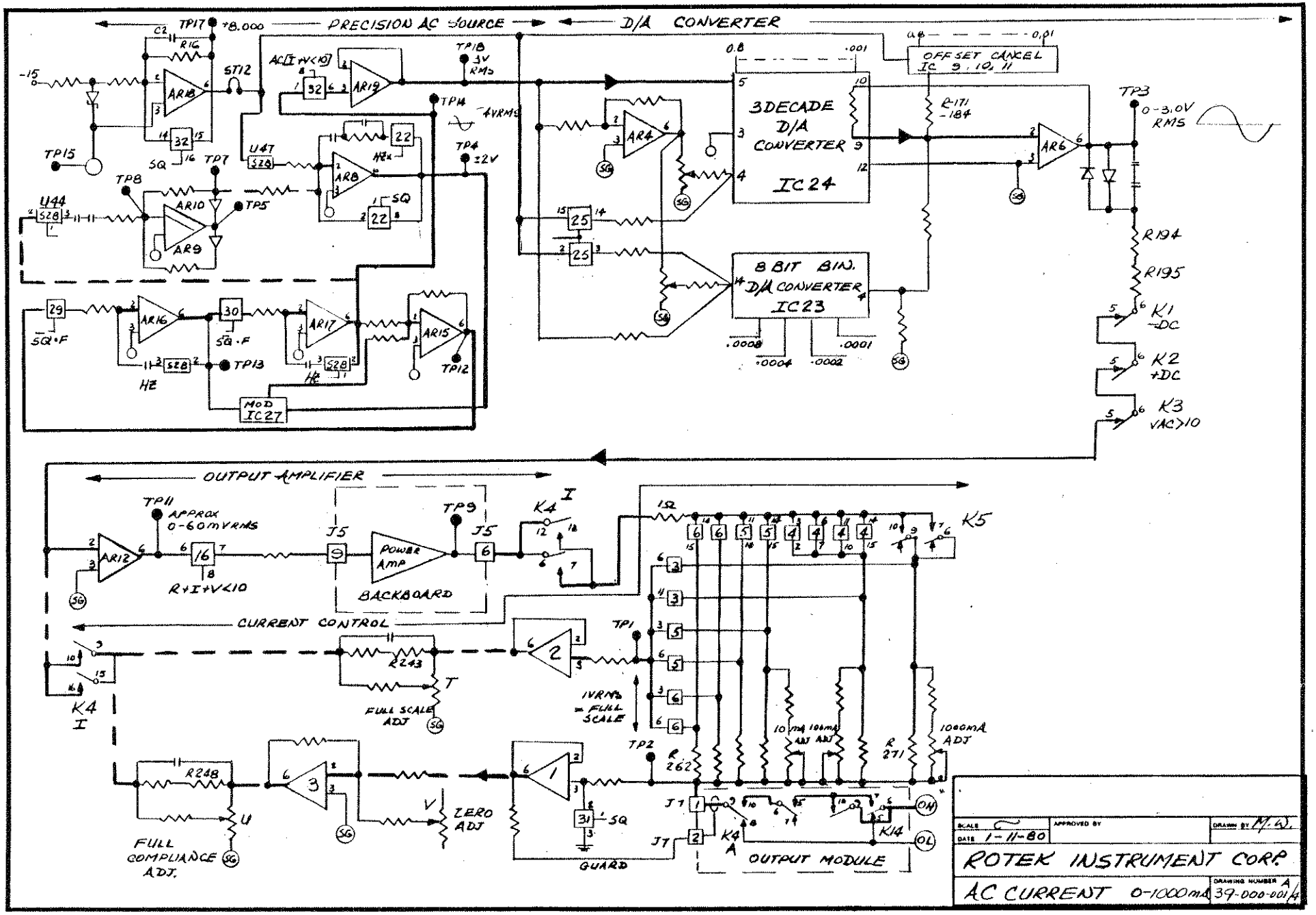
4.3.3 Failure in Mode AC Voltage 0-10 Volts (39-000-001/2)

This section assumes the operation in DC Voltage 0-10 Volts meets all specification limits. Set the frequency to 400Hz.

1. Check TP17 to insure the reference voltage is correct.
2. Check the continuity of switch U47. The voltage across U47 is approximately 3 millivolts.
3. The voltage at TP4 goes negative momentarily after the Operate condition is asserted, and in normal operation returns to a voltage near 0 ±2 volts. If the TP4 voltage remains full negative, the Operate condition is negated through the overlimit detector.
4. The voltage at TP14 is an undistorted sine wave at 400Hz approximately 4V RMS. The signals at TP12 and 13 are similar.
5. Insure continuity of switch U44. The signal at TP7 consists of rectified negative half sine waves with approximately 7 volts peak.
6. Check the TP18 voltage as 3V RMS.
7. Examine TP3 as the front panel settings are varied from 0.000 to X.000. TP3 varies to 3.000V RMS.

Assuming relays K1, K2 and K3 are continuous and that previous conditions are satisfactory the fault is in the circuits between TP9 and OH. Follow the procedure under "Failure in DC Voltage 0-10 Volts".


REFERENCE
D/A CONVERTER
TP17 +8.000
TP16
TP18 +8V
-15V
TP15
Rx-1
AR18
AR19
ST12
32
AC[I+V<10]
SQ
AR4
3 DECADE D/A CONVERTER IC24
8 BIT BINARY D/A CONVERTER IC23
TP3 0.000 TO +8.000VDC
AR6
R196
K2
-DC
R200
AR5
R205
K1
+DC
0 TO -8.000VDC
Z
OUTPUT AMPLIFIER
TP11 APPROX 0-60mVDC
AR12
R+I+V<10
JS
POWER AMP
BACKBOARD
TP9
I
K4
1Ω
K5
1000mA
CURRENT CONTROL
TP1
T
FULL SCALE ADJ
1V = FULL SCALE
TP2
R 268
10mA 100mA ADJ ADJ
R 271
1000mA ADJ
U
FULL COMPLIANCE ADJ
V
ZERO ADJ
GUARD
J7
K4A
OUTPUT MODULE
OH
OL
SCALE
DATE 1-16-80
APPROVED BY
DRAWN BY M.W.
ROTEK INSTRUMENT CORP
DC CURRENT 0-1000mA
DRAWING NUMBER A
39-000-001/3


PRECISION AC SOURCE
D/A CONVERTER
OUTPUT AMPLIFIER
CURRENT CONTROL
TP17 +8.000
TP18 3V RMS
TP14 4VRMS
TP4 ±2V
TP15
TP7
TP8
TP5
TP13
TP12
TP11 APPROX 0-60mVRMS
TP9
TP1
TP2
TP3 0-3.0V RMS
3 DECADE D/A CONVERTER IC 24
8 BIT BIN. D/A CONVERTER IC 23
OFF SET CANCEL IC 9, 10, 11
MOD IC 27
POWER AMP
BACKBOARD
R+I+V<10
FULL SCALE ADJ
1VRMS = FULL SCALE
ZERO ADJ
FULL COMPLIANCE ADJ.
GUARD
OUTPUT MODULE
10mA ADJ
100mA ADJ
1000mA ADJ
R194
R195
K1 -DC
K2 +DC
K3 VAC>10
K4 I
K4 A
K5
K14
SCALE C
DATE 1-11-80
APPROVED BY
DRAWN BY M.W.
ROTEK INSTRUMENT CORP.
AC CURRENT 0-1000mA
DRAWING NUMBER A 39-000-001 4

4.3.4 Failure in Mode DC & AC Current (39-000-001/3 & 4)

This section assumes the operation in DC Voltage and AC Voltage 0-10 Volts meets all specification limits. Set DC Current 1000uA, +X00.0, connect a 1000 ohm resistor OH-OL.

1. In the Operate state check TP1 voltage as 2 volts and the TP2 voltage as 1 volt. The voltage TP1-TP2 (both ungrounded) is 1.000V ±0.005%. Check the continuity of IC5, 6, 7.
2. Check the action of amplifiers AR1,2,3.
   The output of AR1 is approximately TP2. (1 volt).
   The output of AR2 is approximately TP1. (2 volts).
   The output of AR3 is approximately -1 volt.

In the event only one range exhibits defective operation, examine the CMOS switches for that range and neighboring ranges for leakage or discontinuity.

Repeat the above for a setting of 1000uA, X00.0, 400Hz with a 1000 ohm resistor connected from OH to OL.

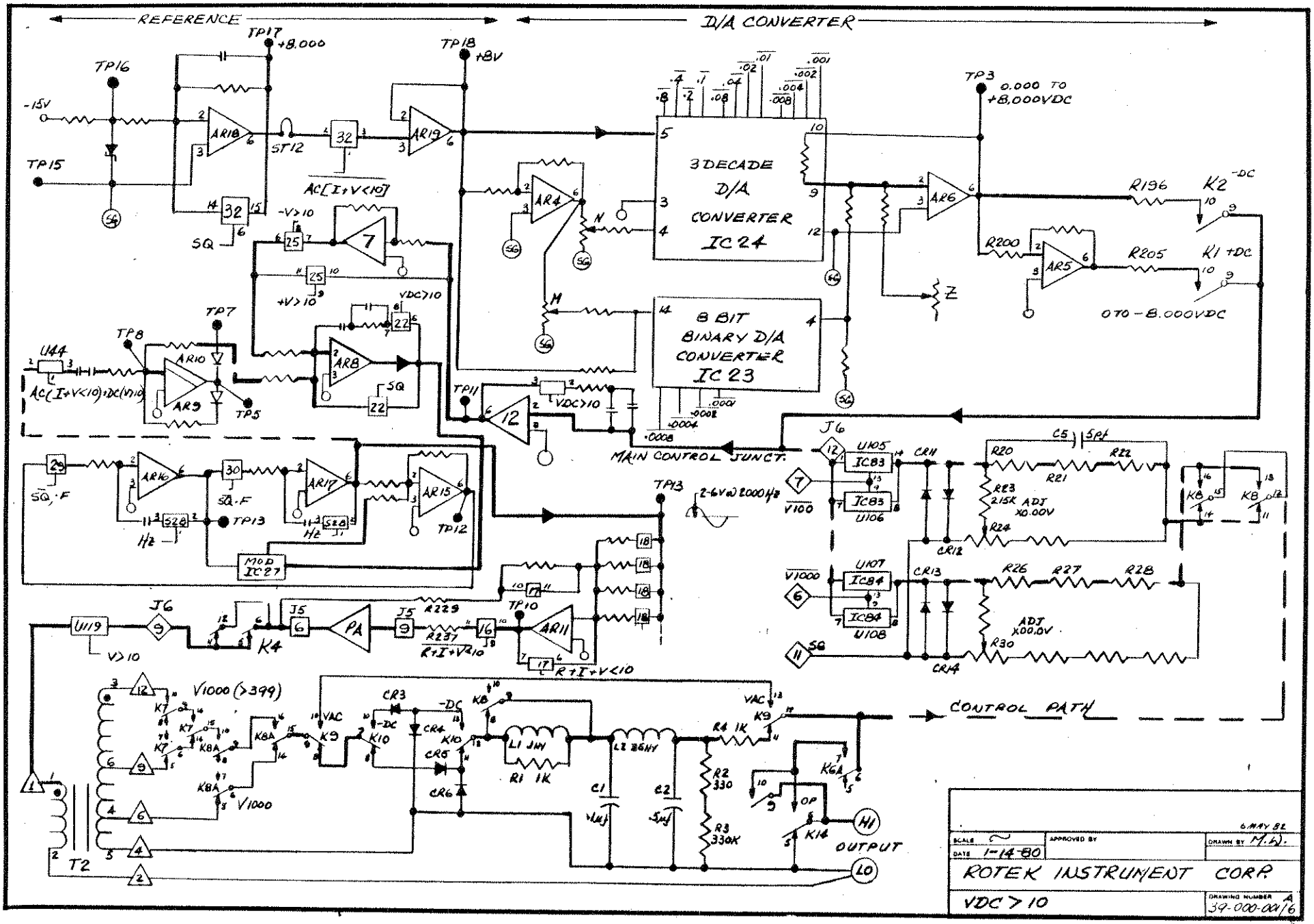
4.3.5 Failure in Mode AC Voltage 10-1000V (39-000-001/5)

This section assumes the operation in DC and AC Voltage 0-10V meets specification limits. Set 400Hz, X0.00 volts.

WARNING

HAZARDOUS VOLTAGES ARE PRESENT DURING THESE TESTS.

1. Follow steps 1-4 under DC Voltage 0-10 Volts, except settings below 10.00 inhibit operate.
2. Observe that the voltage at TP4 goes negative immediately after Operate is asserted and then rises to near 0 volts (or in the case of a malfunction causes the overlimit trip to Standby).
3. The voltage at TP13 is an undistorted 400Hz wave approximately 3.5 RMS in amplitude.
4. The voltage at IC18 pins 2 and 10 is identical to that at TP13 and is then amplified by the combination of AR11 - PA.
5. The voltage at TP9 of the Power Amplifier is approximately 9 volts RMS.
6. Check for continuity through K4 and K6 to terminal 1 of T2.


REFERENCE
D/A CONVERTER
TP17 +8.000
TP18 +8V
TP16
-15V
TP15
AR18
AR19
ST12
AC[I+V<10]
-V>10
SQ
+V>10
VDC>10
TP7
TP8
U144
AC[I+V<10]+DC(V>10)
AR10
AR9
TP5
AR8
AR4
N
M
3 DECADE D/A CONVERTER IC24
8 BIT BINARY D/A CONVERTER IC23
TP3 0.000 TO +8.000VDC
AR6
R196
K2 -DC
R200
AR5
R205
K1 +DC
0 TO -8.000VDC
Z
TP11
VDC>10
MAIN CONTROL JUNCT.
J6
U105 IC83
U106 IC83
CR11
C5 5pf
R20
R22
R21
R23 2.15K ADJ X0.00V
R24
CR12
V100
U107 IC84
U108 IC84
CR13
R26
R27
R28
ADJ X00.0V
R30
CR14
V1000
SG
CONTROL PATH
TP13
2-6Vrms 2000Hz
SQ·F
MOD IC27
TP12
TP10
AR11
R229
R237
R+I+VR10
R+I+V<10
U119
V>10
K4
PA
V1000 (>399)
K7
K8A
K9
K10
CR3
CR4
CR5
CR6
-DC
VAC
L1 1MH
R1 1K
L2 86HY
C1 1μf
C2 .5μf
R2 330
R3 330K
R4 1K
K6A
OP
K14
HI
LO
OUTPUT
T2
6 MAY 82
SCALE
APPROVED BY
DRAWN BY M.L.
DATE 1-14-80
ROTEK INSTRUMENT CORP.
VDC > 10
DRAWING NUMBER A 39-000-00/6

7. Trace the signal from T2 terminal 4 K7,8A,9,6A and 8.
8. Test TP11 at the output of AR12, it should have a value very close to 4.0V RMS.
9. Test U45 for continuity and TP7 for a half wave rectified waveform having a 7 volt peak.

The path from TP3 through the various amplifiers and back to TP7 constitutes a closed loop. A defect in the loop makes it entirely inoperative. In the event of an overlimit fault, the simplest approach is to use the circuit tracing technique, observing the performance immediately after the assertion of operate.

Isolating the Output and Feedback Elements.

1. Remove relay K4 and the Output module from its connections at J6 and 7. Move ST6 to its forward, closed position. This effectively connects a 10000 ohm resistor from J5-6 to J6-12, and eliminates all components on the Output module from the circuit.
2. Repeat the circuit tracing procedures above except for step 7. If the performance is not satisfactory the malfunction is located in the active circuits.
3. If the performance is satisfactory, the malfunction is located on the Output module, possibly a failed switch U105-6-7-8.
4. After these test replace K4 and return ST6 to its back or open position. Replace the Output module.

If the failure occurs only on the 1000 volt range, examine the continuity of K7, the resistors R26,27 and 28 and switches U107-108 of the Output module.

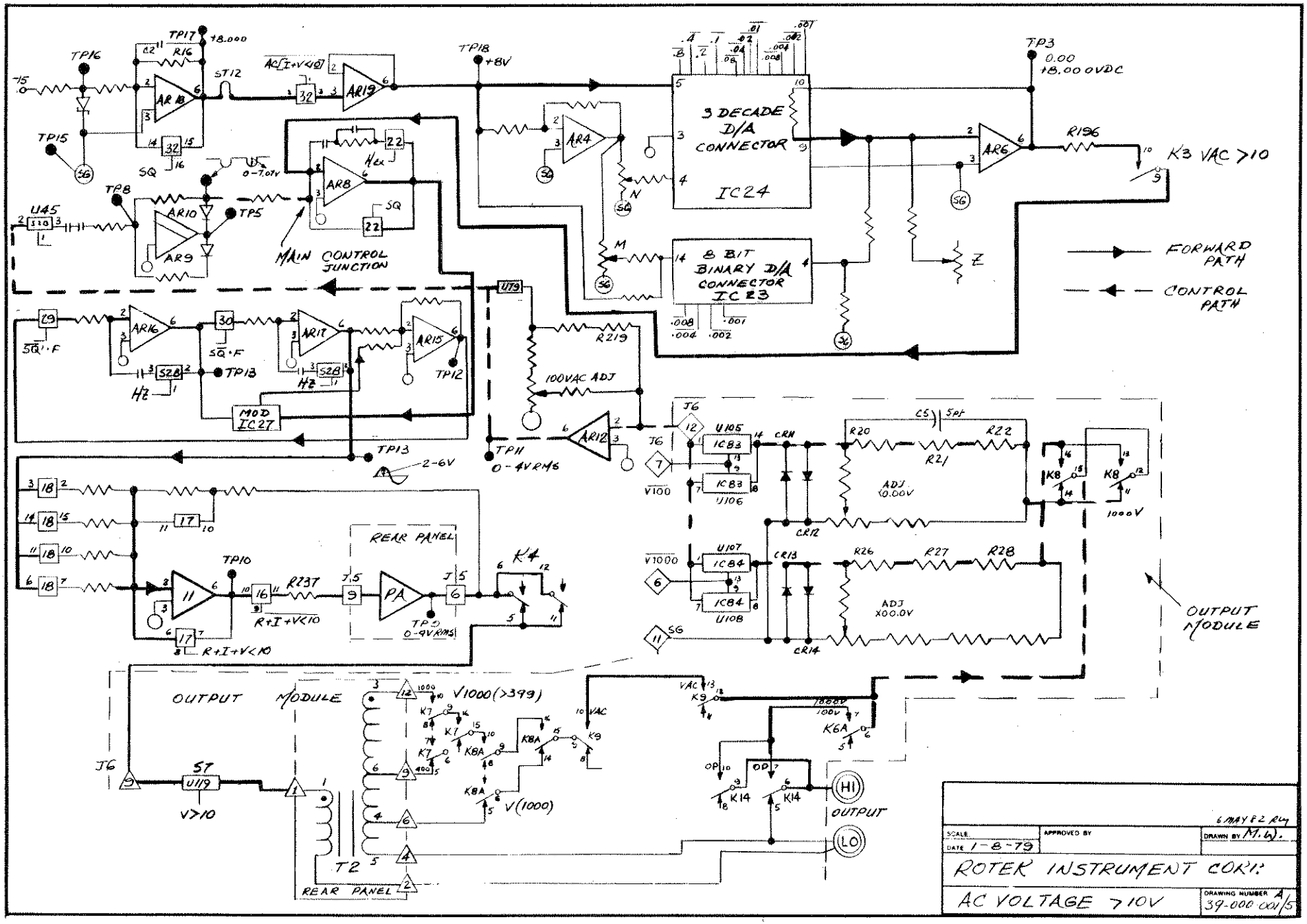
4.3.6 Failure in Mode DC Voltage 10-1000V (39-000-001/6)

WARNING

HAZARDOUS VOLTAGES ARE PRESENT DURING THESE TESTS.

This section assumes all other modes of operation are satisfactory. Set VDC, 100V, +X0.00, OP.

1. Follow steps 1-5 under DC Voltage 0-10 Volts, except settings below 10.00 inhibit operation.
2. Observe TP11 voltage, initially after asserting operate, it rises, then falls to approximately +4.5 volts. Check continuity through IC25-10 and 11.



SCALE	APPROVED BY	DRAWN BY M. W.
DATE 1-8-79		6 MAY 82 RW

ROTEK INSTRUMENT CORP.

AC VOLTAGE >10V

DRAWING NUMBER A 39-000 001/5

3. Check TP13 through TP9 of the Power Amplifier, as for Failure in Mode AC Voltage 10-1000V. The voltage at TP9 is a 2000Hz sine wave, 9V RMS in amplitude.

4. Check continuity through K9, K10, L_1, L_2 and R4 of the Output module. Other parts function properly if the operation in AC is satisfactory. Diodes CR3,4,5 and 6 should be checked.

SECTION 5

REPLACEABLE PARTS LIST

SECTION 5.1

LIST OF RECOMMENDED SPARE PARTS

5.1 List of Recommended Spare Parts

Description	Manufacturer	Quantity
Amplifiers & Other Linear I.C.'s		
AD741JN Op Amp	Analog Devices	1
AD518JH Op Amp	Analog Devices	1
AD741LN Op Amp	Analog Devices	1
OP-07CP OP Amp	PMI	1
HA7-5135-5 Op Amp	Harris	1
LM309K-5 Regulator	National	1
LM320K-15 Regulator	National	1
LM340K-15 Regulator	National	1
Diodes		
1N914	Fairchild	2
1N4002	ITT	1
1N5231B	Fairchild	1
1N5240B	Fairchild	1
Fuses		
3-2/10 Amp MDL-3-2/10	Bussman	10
1-1/2 Amp MDA-1.5	Bussman	5
1 Amp MDA-1	Bussman	5
Integrated Circuits Digital		
74SL00 Gate	T.I.	1
74LS000 Gate	T.I.	2
74S04 Hex Inverter	T.I.	1
74LS04 Hex Inverter	T.I.	1
74LS75 Latch	T.I.	1
74LS123 Multivibrator	T.I.	1
74LS147 Decoder	T.I.	1
SW201GP Switch	PMI	4
DG141BP Switch	Siliconix	1
Relays		
AZ 420-70-219 2PDT	American Zettler	2
AZ 421-70-221 4DPT	American Zettler	2
Transistor		
2N2946A	Raytheon	1
2N3019	Fairchild	1
2N4033	Fairchild	1
GES6014	General Electric	1
GES6015	General Electric	1
2N6052	Motorola	1
2N6059	Motorola	1

5.2

TABLE OF REPLACEABLE PARTS

Table of Replaceable Parts

Notes -

Note 1: All resistor values are in ohms

Note 2: All "Res. C.C." will be 1/4W ±5% unless otherwise specified

Note 3: All "Res. W.W." will have a tolerance of ±0.05% and a temperature coefficient of 5PPM unless otherwise specified

Symbol	Description	Mfg. Part No.	Mfg.
	Capacitors		
C1	0.01uf @100V Cer. Disc	TG-S10	Sprague
C2	0.01uf @100V Cer. Disc	TG-S10	Sprague
C3	0.22uf @50V Polycarbonate	DP2B224K	IMB
C4	0.47uf @50V Polycarbonate	DP2B474K	IMB
C5	0.1uf @50V Polycarbonate	DP2B104K	IMB
C6	100pf Dipped Mica	CM05FD101J03	CDE
C7	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C8	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C9	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C10	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C11	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C12	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C13	0.01uf @100V Cer. Disc	TG-S10	Sprague
C14	0.01uf @100V Cer. Disc	TG-S10	Sprague
C15	0.01uf @100V Cer. Disc	TG-S10	Sprague
C16	0.01uf @100V Cer. Disc	TG-S10	Sprague
C17	0.01uf @100V Cer. Disc	TG-S10	Sprague
C18	0.01uf @100V Cer. Disc	TG-S10	Sprague
C19	0.01uf @100V Cer. Disc	TG-S10	Sprague
C20	0.01uf @100V Cer. Disc	TG-S10	Sprague
C21	0.01uf @100V Cer. Disc	TG-S10	Sprague
C22	0.01uf @100V Cer. Disc	TG-S10	Sprague
C23	0.01uf @100V Cer. Disc	TG-S10	Sprague
C24	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C25	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C26	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C27	0.01uf @100V Cer. Disc	TG-S10	Sprague
C28	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C29	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C30	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C31	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
	Diodes		
CR1	Not Used		
CR2	Signal	1N914	FSC
CR3	Signal	1N914	FSC
CR4	Signal	1N914	FSC
CR5	Signal	1N914	FSC
CR6	Signal	1N914	FSC
CR7	Signal	1N914	FSC
CR8	Signal	1N914	FSC
CR9	Signal	1N914	FSC
CR10	Signal	1N914	FSC
CR11	Signal	1N914	FSC
CR12	Signal	1N914	FSC
CR13	Signal	1N914	FSC
CR14	Signal	1N914	FSC
CR15	Not Used		
CR16	Not Used		
CR17	Zener 5.1V	1N5231B	FSC
CR18	Signal	1N914	FSC

Symbol	Description	Mfg. Part No.	Mfg.
	Indicators		
DS1	Led Red	MV5774C	G.I.
DS2	Led Red	MV5774C	G.I.
DS3	Led Red	MV5774C	G.I.
DS4	Led Red	MV5774C	G.I.
DS5	Led Red	MV5774C	G.I.
DS6	Led Red	MV5774C	G.I.
DS7	Led Red	MV5774C	G.I.
DS8	Led Red	MV5774C	G.I.
DS9	Led Red	MV5774C	G.I.
DS10	Led Red	MV5774C	G.I.
DS11	Led Red	MV5774C	G.I.
DS12	Led Green	MV5274C	G.I.
DS13	Led Red	MV5774C	G.I.
DS14	Led Red	MV5774C	G.I.
DS15	7-Segment numeric	MAN72A	G.I,
DS16	7-Segment numeric	MAN72A	G.I,
DS17	7-Segment numeric	MAN72A	G.I,
DS18	Overflow +/-1	MAN73A	G.I.
DS19	Led Red	MV5774C	G.I.
DS20	Led Amber	MV5374C	G.I.
	Integrated Circuits Digital		
IC1	Decoder DEC-BCD	74LS147N	T.I.
IC2	Decoder DEC-BCD	74LS147N	T.I.
IC3	Decoder DEC-BCD	74LS147N	T.I.
IC4	Decoder DEC-BCD	74LS147N	T.I.
IC5	Decoder DEC-BCD	74LS147N	T.I.
IC6	Decoder DEC-BCD	74LS147N	T.I.
IC7	Latch	74LS75N	T.I.
IC8	Latch	74LS75N	T.I.
IC9	Latch	74LS75N	T.I.
IC10	Latch	74LS75N	T.I.
IC11	Quad Nand Gate	74LS00N	T.I.
IC12	Quad Nand Gate	74LS00N	T.I.
IC13	Hex Inverter	74S04N	T.I.
IC14	Quad Nand Gate	74S00N	T.I.
IC15	Quad Nand Gate	74S00N	T.I.
IC16	Quad Nand Gate	74S00N	T.I.
IC17	Meter Chip	IC7107CPL	Intersil
IC18	Quad Nand Gate	74S00N	T.I.
IC19	Quad Nand Gate	74LS00N	T.I.
	Relay		
K13	2PDT 24VDC	AZ420-70-219	Am. Zettler
	Resistors		
R1	51.1K	M.F. RN55D	TRW/IRC
R2	10K	Variable 70D1N128P103W	A.B.
R3	215	M.F. RN55D	TRW/IRC
R4	215	M.F. RN55D	TRW/IRC

Symbol		Description		Mfg. Part No.	Mfg.
R5		215	M.F.	RN55D	TRW/IRC
R6		215	M.F.	RN55D	TRW/IRC
R7		215	M.F.	RN55D	TRW/IRC
R8		215	M.F.	RN55D	TRW/IRC
R9		215	M.F.	RN55D	TRW/IRC
R10		215	M.F.	RN55D	TRW/IRC
R11		5.11K	M.F.	RN55D	TRW/IRC
R12		5.11K	M.F.	RN55D	TRW/IRC
R13	*	100	M.F.	RN55D	TRW/IRC
R14	**	5.11K	M.F.	RN55D	TRW/IRC
R15	**	1.47K	M.F.	RN55D	TRW/IRC
R16	**	21.5K	M.F.	RN55D	TRW/IRC
R17		348	M.F.	RN55D	TRW/IRC
R18		348	M.F.	RN55D	TRW/IRC
R19		348	M.F.	RN55D	TRW/IRC
R20		1K	Variable	89PR1K	Beckman
R21		68.1K	M.F.	RN55D	TRW/IRC
R22		100	W.W.	1250	Daven
R23		3.48K	M.F.	RN55D	TRW/IRC
R24		1 Meg	M.F.	RN55D	TRW/IRC
R25		50K	W.W.	1250	Daven
R26		3.48K	M.F.	RN55D	TRW/IRC
R27		2.15K	M.F.	RN55D	TRW/IRC
R28		51.1K	M.F.	RN55D	TRW/IRC
R29		100K	M.F.	RN55D	TRW/IRC
R30		5K	Variable	70B1N128P502W	A.B.
R31		1.01 .5%	W.W. 20 PPM	1251	Daven
R32		10.1 .5%	W.W. 15 PPM	1251	Daven
R33		101	W.W. 10 PPM	1251	Daven
R34		1K .005%	W.W. 3 PPM	1251	Daven
R35		10K .005%	W.W. 3 PPM	1251	Daven
R36		100K .005%	W.W. 3 PPM	1251	Daven
R37		1 Meg .005%	W.W. 3 PPM	1252	Daven
R38		10 Meg .1%	W.W. 25 PPM	ML226	Caddock
R39		100	Variable	89PR1K	Beckman
R40		68.1	M.F.	RN55D	TRW/IRC
R41		1K	Variable	89PR10K	Beckman
R42		681	M.F.	RN55D	TRW/IRC
R43		10K	Variable	89PR10K	Beckman
R44		6.81K	M.F.	RN55D	TRW/IRC
R45	*	100	M.F.	RN55D	TRW/IRC

Resistor Network

RU1	47K	SIP 6 Pin	750-61-R47K	CTS
RU2	47K	SIP 6 Pin	750-61-R47K	CTS
RU3	47K	SIP 6 Pin	750-61-R47K	CTS
RU4	47K	SIP 6 Pin	750-61-R47K	CTS
RU5	47K	SIP 6 Pin	750-61-R47K	CTS
RU6	47K	SIP 6 Pin	750-61-R47K	CTS
RU7	47K	SIP 6 Pin	750-61-R47K	CTS
RU8	47K	SIP 6 Pin	750-61-R47K	CTS
RU9	47K	SIP 6 Pin	750-61-R47K	CTS
RU10	47K	SIP 6 Pin	750-61-R47K	CTS
RU11	47K	SIP 6 Pin	750-61-R47K	CTS

Symbol	Description	Mfg. Part No.	Mfg.
RU12	47K SIP 6 Pin	750-61-R47K	CTS
RU13	47K SIP 6 Pin	750-61-R47K	CTS
RU14	47K SIP 6 Pin	750-61-R47K	CTS
RU15	47K SIP 6 Pin	750-61-R47K	CTS

Transistors

Q1	** Signal Amplifier PNP	GES6015	G.E.

* Run Up Option
** BCD Option

Symbol	Description	Mfg. Part No.	Mfg.
	Integrated Circuits Linear		
AR1	Regulator +15V	LM340K-15	National
AR2	Regulator -15V	LK320K-15	National
AR3	Regulator +5V	LK309K-5	National
AR4	Regulator Variable	LM317T	National
	Capacitors		
C1	16000uf @50V Elect.	36DX163G050BC2A	Sprague
C2	16000uf @50V Elect.	36DX163G050BC2A	Sprague
C3	18000uf @15V Elect.	CG183U015R4C	Mallory
C4	0.22uf Film	225P22491XD3	Sprague
C5	0.22uf Film	225P22491XD3	Sprague
C6	22uf @35V Tantalum	TAG20-22/35	ITT
C7	22uf @35V Tantalum	TAG20-22/35	ITT
C8	4.7uf @35V Tantalum	TDC475M035FL	Mallory
C9	4.7uf @35V Tantalum	TDC475M035FL	Mallory
C10	4.7uf @35V Tantalum	TDC475M035F1	Mallory
C11	800uf @50V Elect.	39D807G050HL4	Sprague
C12	0.22uf Film	225P22491XD3	Sprague
C13	0.22uf Film	225P22491XD3	Sprague
C14	0.22uf Film	225P22491XD3	Sprague
C15	0.22uf Film	225P22491XD3	Sprague
C16	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C17	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C18	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C19	0.1uf @50V Cer. Disc	3429-050E-104M	AVX
C20	0.22uf Film	225P22491XD3	Sprague
C21	Not Used		
C22	0.022uf Film	225P22391WD3	Sprague
C23	0.022uf Film	225P22391WD3	Sprague
C24	0.047uf Film	225P47391WD3	Sprague
C25	2200pf Dipped Mica	CM06FD222J03	CDE
C26	1uf @50V Alum. Elect.	TE1300	Sprague
C27	0.01uf @100V Cer. Disc	TG-S10	Sprague
C28	50uf @50V Alum. Elect.	TE1307	Sprague
C29	50uf @50V Alum. Elect.	TE1307	Sprague
C30	0.01uf @100V Cer.Disc	TG-S10	Sprague
C31	330pf Dipped Mica	CM05FD331J03	CDE
C32	330pf Dipped Mica	CM05FD331J03	CDE
	Diodes		
CR1	Signal	1N914	Fairchild
CR2	Signal	1N914	Fairchild
CR3	Signal	1N914	Fairchild
CR4	Signal	1N914	Fairchild
CR5	Signal	1N914	Fairchild
CR6	Zener 20V	1N5357B	Motorola
CR7	Zener 20V	1N5357B	Motorola
CR8	Zener 10V	1N5347B	Motorola
CR9	Zener 10V	1N5347B	Motorola
CR10	Signal	1N270	Motorola
CR11	Not Used		

Symbol	Description	Mfg. Part No.	Mfg.
CR12	Zener 5.1V	1N5231B	Fairchild
CR13	Signal	1N914	Fairchild
CR14	Rectifier	1N4002	Fairchild
CR15	Rectifier	1N4002	Fairchild
CR16	Zener 5.1V	1N5338B	Motorola
CR17	Zener 5.1V	1N5338B	Motorola
CR18	Signal	1N914	Fairchild
CR19	Signal	1N914	Fairchild
CR20	Signal	1N914	Fairchild
CR21	Signal	1N914	Fairchild
CR22	Signal	1N914	Fairchild
CR23	Signal	1N914	Fairchild
CR24	Signal	1N914	Fairchild
CR25	Signal	1N914	Fairchild
CR26	Not Used		
CR27	Rectifier	1N4002	Fairchild
CR28	Not Used		
CR29	Rectifier	1N4002	Fairchild
CR30	Signal	1N914	Fairchild
CR31	Signal	1N914	Fairchild
CR32	Signal	1N914	Fairchild
CR33	Signal	1N914	Fairchild
	Fuses		
F1	1.5A Slow Blow 250V	MDA1-1/1	Bussman
F2	3.2A Slow Blow 250V	MDA3-2/10	Bussman
F3	3.2A Slow Blow 250V	MDA3-2/10	Bussman
	Connectors		
J3	V S & F Fused - Unfiltered	6J1	Corcum
	Transistors		
Q1	RF Small Signal NPN	2N3019	Fairchild
Q2	RF Small Signal NPN	2N3019	Fairchild
Q3	RF Small Signal PNP	2N4033	Fairchild
Q4	RF Small Signal PNP	2N4033	Fairchild
Q5	Silicon Power	2N6059	Motorola
Q6	Silicon Power	2N6052	Motorola
Q7	Signal Amplifier PNP	GES6015	G.E.
Q8	Signal Amplifier NPN	GES6014	G.E.
Q9	Not Used		
Q10	RF Small Signal PNP	2N4033	Fairchild
Q11	RF Small Signal NPN	2N3019	Fairchild
Q12	RF Small Signal NPN	2N3019	Fairchild
	Resistors		
R1	10K M.F	RN55D	TRW/IRC
R2	1K M.F	RN55D	TRW/IRC
R3	10K M.F	RN55D	TRW/IRC
R4	511 M.F	RN55D	TRW/IRC
R5	10K M.F	RN55D	TRW/IRC

Symbol	Description		Mfg. Part No.	Mfg.
R6	1K	M.F.	RN55D	TRW/IRC
R7	348	M.F.	RN55D	TRW/IRC
R8	511	M.F.	RN55D	TRW/IRC
R9	10	M.F.	RN55D	TRW/IRC
R10	Not Used			
R11	348	M.F.	RN55D	TRW/IRC
R12	6.81K	M.F.	RN55D	TRW/IRC
R13	5.11K	M.F.	RN55D	TRW/IRC
R14	10K	M.F.	RN55D	TRW/IRC
R15	10K	M.F.	RN55D	TRW/IRC
R16	100K	M.F.	RN55D	TRW/IRC
R17	1K	M.F.	RN55D	TRW/IRC
R18	2.15K	M.F.	RN55D	TRW/IRC
R19	681	M.F.	RN55D	TRW/IRC
R20	Not Used			
R21	2.15K	M.F.	RN55D	TRW/IRC
R22	147K	M.F.	RN55D	TRW/IRC
R23	14.7	M.F.	RN55D	TRW/IRC
R24	470	C.C. 2W	RC42	
R25	470	C.C. 2W	RC42	
R26	1k	M.F.	RN55D	TRW/IRC
R27	2.2K	C.C. 2W	RC42	
R28	2.2K	C.C. 2W	RC42	
R29	3.3K	C.C. 2W	RC42	
R30	330	C.C. 2W	RC42	
R31	330	C.C. 2W	RC42	
R32	511	M.F.	RN55D	TRW/IRC
R33	2.15K	M.F.	RN55D	TRW/IRC
R34	200	Variable	89PR200	Beckman
R35	1.5K	C.C. 2W	RC42	
R36	1.5K	C.C. 2W	RC42	
R37	6.8K	C.C. 2W	RC42	
R38	215	M.F.	RN55D	TRW/IRC
R39	47	C.C. 2W	RC42	
R40	47	C.C. 2W	RC42	
R41	1.5K	C.C. 2W	RC42	
R42	1.5K	C.C. 2W	RC42	
R43	0.1	Power 10W	MZ10-.1	Memcor
R44	0.5	Power 10W	Mz10-.5	Memcor
R45	0.5	Power 10W	MZ10-.5	Memcor
R46	0.1	Power 10W	MZ10-.1	Memcor
R47	51.1	M.F.	RN55D	TRW/IRC
		Rectifiers		
RU1	Full Wave Bridge		FWLC-300	Mallory
RU2	Full Wave Bridge		FWLC-300	Mallory
		Switiches		
S29	Power On/Off		2600R21E	Arrow Hart
		Transformers		
T1	Power		39-000-050	Rotek

Symbol	Description	Mfg. Part No.	Mfg.
T2	Output	39-000-051	Rotek
	Special Circuits		
U88	Analog Switch	S7	Rotek

Symbol	Description		Mfg. Part No.	Mfg.
		Capacitors		
C1	0.1uf @2KV	Hi Voltage	LQ20-104Y	Plastic Cap.
C2	0.5uf @2KV	Hi Voltage	LQ20-504Y	Plasric Cap.
C3	220pf (Nom.)	Dipped Mica	CM06FD222J03	CDE
C4	680pf	Dipped Mica	CM06FD681J03	CDE
C5	10pf	Dipped Mica	CM05CD010J03	CDE
C6	0.01uf @100V	Cer. Disc	TG-S10	Sprague
C7	0.01uf @100V	Cer. Disc	TG-S10	Sprague
C8	150pf	Dipped Mica	CM05FD151J03	CDE
		Diodes		
CR1	Not Used			
CR2	Not Used			
CR3	Hi Voltage Rectifier		EH-400	EDI
CR4	Hi Voltage Rectifier		EH-400	EDI
CR5	Hi Voltage Rectifier		EH-400	EDI
CR6	Hi Voltage Rectifier		EH-400	EDI
CR7	Signal		1N914	FSC
CR8	Signal		1N914	FSC
CR9	Signal		1N914	FSC
CR10	Signal		1N914	FSC
CR11	Signal		1N914	FSC
CR12	Signal		1N914	FSC
CR13	Signal		1N914	FSC
CR14	Signal		1N914	FSC
		Varistor		
MOV1	Metal Oxide		V420LA20A	G.E.
MOV2	Metal Oxide		V420LA20A	G.E.
MOV3	Metal Oxide		V420LA20A	G.E.
		Integrated Circuits Digital		
IC83	Switch Analog		DG141BP	Siliconix
IC84	Switch Analog		DG141BP	Siliconix
		Relays		
K4A	2PDT 24VDC		AZ420-70-219	Am. Zet.
K6A	2PDT 24VDC		AZ420-70-219	Am. Zet.
K7	4PDT 24VDC		AZ421-70-220	Am. Zet.
K8	4PDT 24VDC		AZ421-70-220	Am. Zet.
K8A	4PDT 24VDC		AZ421-70-220	Am. Zet.
K9	4PDT 24VDC		AZ421-70-220	Am. Zet.
K10	4PDT 24VDC		AZ421-70-220	Am. Zet.
K11	2PDT 24VDC		AZ420-70-219	Am. Zet.
K12	2PDT 24VDC		AZ420-70-219	Am. Zet.
K14	2PDT 24VDC		AZ420-70-219	Am. Zet.
		Inductor		
L1	RF Choke 0.1Hy		70F101AF	JW Miller

Output Sense Assy 39-107-000

Symbol		Description		Mfg. Part No.	Mfg.
L2		Filter Choke 35Hy		C2346	Stancor
			Resistors		
R1		1K	M.F.	RN55D	TRW/IRC
R2		330K	C.C. 2W	RC42	
R3		330K	C.C. 2W	RC42	
R4		1K	Power 50W	RH50-3%	Dale
R5		10	Power 50W	RH50-3%	Dale
R6		68.1K	M.F.	RN55D	TRW/IRC
R7		1K	W.W.	1250	Daven
R8		348	M.F.	RN55D	TRW/IRC
R9		10.1 .5%	W.W. 15 PPM	1251	Daven
R10		200	Variable	89PR200	Beckman
R11		1K	W.W.	1250	Daven
R12		1 .5%	W.W. 20 PPM	1250	Daven
R13		215K	M.F.	RN55D	TRW/IRC
R14		10K	Variable	89PR10K	Beckman
R15		5K	W.W.	1250	Daven
R16		5K	W.W.	1250	Daven
R17		348K	M.F.	RN55D	TRW/IRC
R18		10K	Variable	89PR10K	Beckman
R19		100K	M.F.	RN55D	TRW/IRC
R20		50K	W.W.	1250	Daven
R21		50K	W.W.	1250	Daven
R22		215	M.F.	RN55D	TRW/IRC
R23		215K	M.F.	RN55D	TRW/IRC
R24		10K	Variable	89PR10K	Beckman
R25		1 Meg	M.F.	RN55D	TRW/IRC
R26		500K	W.W.	1250	Daven
R27		500K	W.W.	1250	Daven
R28		2.15K	M.F.	RN55D	TRW/IRC
R29		1 Meg	M.F.	RN55D	TRW/IRC
R30		10K	Variable	89PR10K	Beckman
R31		1 Meg	M.F.	RN55D	TRW/IRC
R32		1 Meg	M.F.	RN55D	TRW/IRC
R33		1 Meg	M.F.	RN55D	TRW/IRC
R34		100	M.F.	RN55D	TRW/IRC
R35		100	M.F.	RN55D	TRW/IRC
R36		14.7	M.F.	RN55D	TRW/IRC
R37		10	M.F.	RN55D	TRW/IRC
R38	*	100K	M.F.	RN55D	TRW/IRC
			Special Circuits		
U103		Switch Circuit		S5	Rotek
U104		Switch Circuit		S4	Rotek
U119		Switch Circuit		S7	Rotek

* LZ Option only

Symbol	Description		Mfg. Part No.	Mfg.	Location
		Integrated Circuits Linear			
AR1	Operational Amplifier		OP-07CP	PMI	I/S 7
AR2	Operational Amplifier		HA7-5135-5	Harris	I/S 7
AR3	Operational Amplifier		OP-07CP	PMI	I/S 7
AR4	Operational Amplifier		AD741JN	A.D.	D/A 4
AR5	Operational Amplifier		OP-07CP	PMI	D/A 5
AR6	Operational Amplifier		OP-07CP	PMI	D/A 5
AR7	Operational Amplifier		AD741JN	A.D.	ACC 3
AR8	Operational Amplifier		OP-07CP	PMI	ACC 3
AR9	Operational Amplifier		OP-07CP	PMI	ACC 3
AR10	Operational Amplifier		AD518JH	A.D.	ACC 3
AR11	Operational Amplifier		AD741LN	A.D.	PA 6
AR12	Operational Amplifier		HA7-5135-5	Harris	PA 6
AR13	Operational Amplifier		AD741JN	A.D.	ACC 3
AR14	Operational Amplifier		AD741JN	A.D.	ACC 3
AR15	Operational Amplifier		AD741JN	A.D.	OSC 2
AR16	Operational Amplifier		AD741JN	A.D.	OSC 2
AR17	Operational Amplifier		AD741JN	A.D.	OSC 2
AR18	Operational Amplifier		OP-07CP	PMI	REF 1
AR19	Operational Amplifier		OP-16FJ	PMI	REF 1
AR20	Operational Amplifier		OP-07CP	PMI	REF 1
AR21	Operational Amplifier		OP-07CP	PMI	REF 1
AR22	Operational Amplifier		OP-07CP	PMI	OSC 2
		Capacitors			
C1	0.01uf @100V	Cer. Disc	TG-S10	Sprague	REF 1
C2	100pf	Dipped Mica	CM06FD102J03	CDE	REF 1
C3	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	REF 1
C4	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	REF 1
C5	10uf	Polycarbonate	RA1A106K	IMB	REF 1
C6	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	REF 1
C7	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	REF 1
C8	0.01uf	Film	225P10391WD3	Sprague	REF 1
C9	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	REF 1
C10	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	REF 1
C11	Not Used				
C12	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	REF 1
C13	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	REF 1
C14	Not Used				
C15	Not Used				
C16	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	OSC 2
C17	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	OSC 2
C18	0.1962uf @50V	Polystyrene	DL1A19622F	IMB	OSC 2
C19	0.01793uf @50V	Polystyrene	PA1A17931F	IMB	OSC 2
C20	1500pf	Dipped Mica	CM06FD152J03	CDE	OSC 2
C21	330pf	Dipped Mica	CM05FD331J03	CDE	OSC 2
C22	Trim Value				
C23	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	OSC 2
C24	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	OSC 2
C25	0.1962uf @50V	Polystyrene	DL1A19622F	IMB	OSC 2
C26	0.01793uf @50V	Polystyrene	PA1A17931F	IMB	OSC 2
C27	1500pf	Dipped Mica	CM06FD152J03	CDE	OSC 2
C28	330pf	Dipped Mica	CM05FD331J03	CDE	OSC 2

Symbol	Description		Mfg. Part No.	Mfg.	Location
C29	Trim Value				
C30	5pf	Dipped Mica	CM05CD050D03	CDE	OSC 2
C31	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	OSC 2
C32	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	OSC 2
C33	4uf @50V	Mylar 20%	MMW05W4	CDE	OSC 2
C34	Not Used				
C35	100uf @25V	Alum. Elect.	TE1211	Sprague	OSC 2
C36	100uf @25V	Alum. Elect.	TE1211	Sprague	OSC 2
C37	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	OSC 2
C38	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	OSC 2
C39	Not Used				
C40	Trim Value				ACC 3
C41	Trim Value				ACC 3
C42	1000uf @6V	Alum. Elect.	500D108H006DH5	Sprague	ACC 3
C43	1000uf @6V	Alum. Elect.	500D108H006DH5	Sprague	ACC 3
C44	0.01uf	Film	225P10391WD3	Sprague	ACC 3
C45	22pf	Dipped Mica	CM05ED220J03	CDE	ACC 3
C46	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C47	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C48	Trim Value				ACC 3
C49	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C50	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C51	4.7uf @35V	Tantalum	TDC475M035FL	Mallory	ACC 3
C52	10pf	Dipped Mica	CM05CD010J03	CDE	ACC 3
C53	33pf	Dipped Mica	CM05ED330J03	CDE	ACC 3
C54	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C55	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C56	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C57	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C58	10uf @50V	Polycarbonate	RA1A106K	IMB	ACC 3
C59	2uf @50V	Mylar 20%	MMW05W2	CDE	ACC 3
C60	2uf @50V	Mylar 20%	MMW05W2	CDE	ACC 3
C61	0.47uf @50V	Mylar 10%	MMW05P47	CDE	ACC 3
C62	0.047uf	Film	225P47391WD3	Sprague	ACC 3
C63	22pf	Dipped Mica	CM05ED220J03	CDE	ACC 3
C64	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 5
C65	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 5
C66	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 4
C67	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 4
C68	10pf	Dipped Mica	CM05CD010J03	CDE	D/A 4
C69	0.1uf	Film	225P10491WD3	Sprague	D/A 4
C70	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 4
C71	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 4
C72	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 4
C73	Not Used				
C74	1000pf	Dipped Mica	CM06FD102J03	CDE	PA 6
C75	22pf	Dipped Mica	CM05ED220J03	CDE	D/A 5
C76	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 5
C77	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 5
C78	1000uf @6V	Alum. Elect.	500D108H006DH5	Sprague	D/A 5
C79	1000uf @6V	Alum. Elect.	500D108H006DH5	Sprague	D/A 5
C80	1000pf	Dipped Mica	CM06FD102J03	CDE	D/A 5
C81	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 5
C82	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	D/A 5
C83	1000pf	Dipped Mica	CM06FD102J03	CDE	PA 6

Symbol	Description		Mfg. Part No.	Mfg.	Location
C84	470pf	Dipped Mica	CM05FD471J03	CDE	PA 6
C85	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	PA 6
C86	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	PA 6
C87	10uf @50V	Polycarbonate	RA1A106K	IMB	PA 6
C88	10uf @50V	Polycarbonate	RA1A106K	IMB	PA 6
C89	Trim Value				PA 6
C90	330pf	Dipped Mica	CM05FD331J03	CDE	PA 6
C91	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	PA 6
C92	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	PA 6
C93	1000uf @6V	Alum. Elect.	500D108H006DH5	Sprague	PA 6
C94	1000uf @6V	Alum. Elect.	500D108H006DH5	Sprague	PA 6
C95	100pf	Dipped Mica	CM05FD101J03	CDE	PA 6
C96	0.1uf	Film	225P10391WD3	Sprague	PA 6
C97	0.01uf @1.4kV	Cer. Disc	DI-104	CRL	PS 9
C98	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	I/S 7
C99	470pf	Dipped Mica	CM05FD471J03	CDE	I/S 7
C100	330pf	Dipped Mica	CM0FD331J03	CDE	I/S 7
C101	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	I/S 7
C102	150pf	Dipped Mica	CM05FD151J03	CDE	I/S 7
C103	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	I/S 7
C104	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	I/S 7
C105	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	I/S 7
C106	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	I/S 7
C107	22uf @35V	Tantalum	TAPS20-22/35	ITT	I/S 7
C108	22uf @35V	Tantalum	TAPS20-22/35	ITT	I/S 7
C109	Not Used				
C110	Not Used				
C111	Not Used				
C112	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C113	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C114	Not Used				
C115	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3
C116	0.1uf @50V	Cer. Disc	3429-050E-104M	AVX	ACC 3

Diodes

CR1	Signal	1N914	FSC	OSC 2
CR2	Signal	1N914	FSC	OSC 2
CR3	Signal	1N914	FSC	OSC 2
CR4	Signal	1N914	FSC	OSC 2
CR5	Signal	1N914	FSC	OSC 2
CR6	Signal	1N914	FSC	OSC 2
CR7	Not Used			
CR8	Signal	1N914	FSC	ACC 3
CR9	Signal	1N914	FSC	ACC 3
CR10	Signal	1N914	FSC	ACC 3
CR11	Signal	1N914	FSC	ACC 3
CR12	Signal	1N914	FSC	ACC 3
CR13	Signal	1N914	FSC	ACC 3
CR14	Not Used			
CR15	Signal	1N914	FSC	ACC 3
CR16	Signal	1N914	FSC	ACC 3
CR17	Signal	1N914	FSC	ACC 3
CR18	Signal	1N914	FSC	ACC 3
CR19	Not Used			

Symbol	Description	Mfg. Part No.	Mfg.	Location
CR20	Signal	1N914	FSC	D/A 5
CR21	Signal	1N914	FSC	D/A 5
CR22	Not Used			
CR23	Not Used			
CR24	Signal	1N914	FSC	PA 6
CR25	Signal	1N914	FSC	PA 6
CR26	Signal	1N914	FSC	PA 6
CR27	Signal	1N914	FSC	PA 6
CR28	Signal	1N914	FSC	PA 6
CR29	Signal	1N914	FSC	PA 6
CR30	Signal	1N914	FSC	ACC 3
CR31	Signal	1N914	FSC	ACC 3
CR32	Signal	1N914	FSC	I/S 7
CR33	Signal	1N914	FSC	I/S 7
CR34	Signal	1N914	FSC	I/S 7
CR35	Signal	1N914	FSC	I/S 7
CR36	Signal	1N914	FSC	I/S 7
CR37	Signal	1N914	FSC	I/S 7
CR38	Not Used			
CR39	Signal	1N914	FSC	ACC 3
CR40	Signal	1N914	FSC	ACC 3
CR41	Rectifier	1N4002	ITT	P/S 9
CR42	Rectifier	1N4002	ITT	P/S 9
CR43	Rectifier	1N4002	ITT	P/S 9
CR44	Rectifier	1N4002	ITT	P/S 9
CR45	Rectifier	1N4002	ITT	P/S 9
CR46	Rectifier	1N4002	ITT	P/S 9
CR47	Rectifier	1N4002	ITT	P/S 9
CR48	Rectifier	1N4002	ITT	P/S 9
CR49	Rectifier	1N4002	ITT	P/S 9
CR50	Rectifier	1N4002	ITT	P/S 9
	Integrated Circuits Digital			
IC1	High Current/Voltage	74568	T.I.	D/A 5
IC2	High Current/Voltage	74568	T.I.	D/A 5
IC3	Quad SPST Analog Switch	SW201GP	PMI	I/S 7 ACC 3
IC4	Quad SPST Analog Switch	ADG201CJ	A.D.	I/S 7
IC5	Quad SPST Analog Switch	ADG201CJ	A.D.	I/S 7
IC6	Quad SPST Analog Switch	SW201GP	PMI	I/S 7
IC7	Quad SPST Analog Switch	SW201GP	PMI	D/A 4
IC8	Quad SPST Analog Switch	SW201GP	PMI	D/A 4
IC9	Quad SPST Analog Switch	SW201GP	PMI	D/A 4
IC10	Quad SPST Analog Switch	SW201GP	PMI	D/A 4
IC11	Quad SPST Analog Switch	SW201GP	PMI	D/A 4
IC12	Hex Inverter	74LS04N	T.I.	D/A 4
IC13	Hex Inverter	74LS04N	T.I.	D/A 4
IC14	Hex Inverter	74LS04N	T.I.	D/A 4,5
IC15	Hex Inverter	74LS04N	T.I.	D/A 5
IC16	Quad SPST Analog Switch	SW201GP	PMI	PA 6
IC17	Quad SPST Analog Switch	SW201GP	PMI	PA 6 ACC 3
IC18	Quad SPST Analog Switch	SW201GP	PMI	PA 6
IC19	Quad SPST Analog Switch	SW201GP	PMI	PA 6

Symbol	Description	Mfg. Part No.	Mfg.	Location
IC20	BCD Binary Converter (3960)	74184	T.I.	D/A 5
IC21	BCD Binary Converter (3960)	74184	T.I.	D/A 5
IC22	Quad SPST Analog Switch	SW201GP	PMI	ACC 3
IC23	Monolithic D/A Converter	AD559KD	A.D.	D/A 4
IC24	12 Bit D/A Converter w/BCD	AD562KD/BCD	A.D.	D/A 4
IC25	Quad SPST Analog Switch	SW201GP	PMI	ACC 3
				D/A 4
IC26	Nand Gate	74L00N	NAT	ACC 3
IC27	Modulator	LM1496	NAT	OSC 2
IC28	Quad SPST Analog Switch	SW201GP	PMI	OSC 2
IC29	Quad SPST Analog Switch	SW201GP	PMI	OSC 2
IC30	Quad SPST Analog Switch	SW201GP	PMI	OSC 2
IC31	Quad SPST Analog Switch	SW201GP	PMI	REF 1
				I/S 7
IC32	Quad SPST Analog Switch	SW201GP	PMI	REF 1
IC33	Quad SPST Analog Switch	SW201GP	PMI	REF 1
IC34	Quad SPST Analog Switch	SW201GP	PMI	REF 1
IC35	Quad SPST Analog Switch	SW201GP	PMI	REF 1
IC36	Quad SPST Analog Switch	SW201GP	PMI	OSC 2
IC37	Quad SPST Analog Switch	SW201GP	PMI	OSC 2
IC38	Quad SPST Analog Switch	SW201GP	PMI	OSC 2

Relays

K1	2PDT 24VDC	AZ 420-70-219	AM ZET	
K2	2PDT 24VDC	AZ 420-70-219	AM ZET	
K3	2PDT 24VDC	AZ 420-70-219	AM ZET	
K4	4DPT 24VDC	AZ 421-70-220	AM ZET	
K5	2PDT 24VDC	AZ 420-70-219	AM ZET	

Inductor

L1	8uHy Choke	5220	Miller	I/S 7

Resistors

R1	500	W.W.	1250	Daven	REF 1
R2	1K	W.W.	1250	Daven	REF 1
R3	1K	W.W.	1250	Daven	REF 1
R4	500	W.W.	1250	Daven	REF 1
R5	200	Variable	68WR200	Beckman	REF 1
R6	100K	M.F.	RN55D	TRW/IRC	REF 1
R7	10K	Variable	68WR10K	Beckman	REF 1
R8	215K	M.F.	RN55D	TRW/IRC	REF 1
R9	Trim	W.W.		Daven	REF 1
R10	Trim	W.W.		Daven	REF 1
R11	Trim	W.W.		Daven	REF 1
R12	Trim	W.W.		Daven	REF 1
R13	Trim	W.W.		Daven	REF 1
R14	2K	W.W.	1250	Daven	REF 1
R15	4K	W.W.	1250	Daven	REF 1
R16	8K	W.W.	1250	Daven	REF 1
R17	50K	W.W.	1250	Daven	REF 1
R18	500K	W.W.	1251	Daven	REF 1
R19	10K	M.F.	RN55D	TRW/IRC	REF 1

Symbol		Description		Mfg. Part No.	Mfg.	Location
R20		400K	W.W.	1250	Daven	REF 1
R21		50K	W.W.	1250	Daven	REF 1
R22		2K	W.W.	1250	Daven	REF 1
R23		1K	W.W.	1250	Daven	REF 1
R24		1K	W.W.	1250	Daven	REF 1
R25		2K	W.W.	1250	Daven	REF 1
R26		5K	W.W.	1250	Daven	REF 1
R27		51.1K	M.F.	RN55D	TRW/IRC	REF 1
R28		1K	Variable	68WR1K	Beckman	REF 1
R29		100	M.F.	RN55D	TRW/IRC	REF 1
R30		1K	W.W.	1250	Daven	REF 1
R31		500	W.W.	1250	Daven	REF 1
R32		500	W.W.	1250	Daven	REF 1
R33		1K	W.W.	1250	Daven	REF 1
R34		500	W.W.	1250	Daven	REF 1
R35		1K	W.W.	1250	Daven	REF 1
R36		2K	W.W.	1250	Daven	REF 1
R37		1K	W.W.	1250	Daven	REF 1
R38		1K	W.W.	1250	Daven	REF 1
R39		1K	W.W.	1250	Daven	REF 1
R40		2K	W.W.	1250	Daven	REF 1
R41		1K	W.W.	1250	Daven	REF 1
R42		500	W.W.	1250	Daven	REF 1
R43		500	W.W.	1250	Daven	REF 1
R44		500	W.W.	1250	Daven	REF 1
R45		2K	W.W.	1250	Daven	REF 1
R46		51.1K	M.F.	RN55D	TRW/IRC	REF 1
R47		51.1K	M.F.	RN55D	TRW/IRC	REF 1
R48		51.1K	M.F.	RN55D	TRW/IRC	REF 1
R49		1K	M.F.	RN55D	TRW/IRC	REF 1
R50		3.48K	M.F.	RN55D	TRW/IRC	OSC 2
R51		10K	* M.F.(10K WW)	RN55D	TRW/IRC	OSC 2
R52		20K	* M.F.(20K WW)	RN55D	TRW/IRC	OSC 2
R53		40.2K	* M.F.(40K WW)	RN55D	TRW/IRC	OSC 2
R54		80.6K	* M.F.(80K WW)	RN55D	TRW/IRC	OSC 2
R55		1K	M.F.	RN55D	TRW/IRC	OSC 2
R56		3.48K	M.F.	RN55D	TRW/IRC	OSC 2
R57		511	M.F.	RN55D	TRW/IRC	OSC 2
R58		10K	* M.F.(10K WW)	RN55D	TRW/IRC	OSC 2
R59		20K	* M.F.(20K WW)	RN55D	TRW/IRC	OSC 2
R60		40.2K	* M.F.(40K WW)	RN55D	TRW/IRC	OSC 2
R61		80.6K	* M.F.(80K WW)	RN55D	TRW/IRC	OSC 2
R62		5.11K	M.F.	RN55D	TRW/IRC	OSC 2
R63		5.11K	M.F.	RN55D	TRW/IRC	OSC 2
R64		5.11K	M.F.	RN55D	TRW/IRC	OSC 2
R65		21.5K	M.F.	RN55D	TRW/IRC	OSC 2
R66		1K	M.F.	RN55D	TRW/IRC	OSC 2
R67		1K	M.F.	RN55D	TRW/IRC	OSC 2
R68		1K	M.F.	RN55D	TRW/IRC	OSC 2
R69		511	M.F.	RN55D	TRW/IRC	OSC 2
R70	KK	1K	Variable	68WR1K	Beckman	OSC 2
R71		511	M.F.	RN55D	TRW/IRC	OSC 2
R72		6.81K	M.F.	RN55D	TRW/IRC	OSC 2
R73		51.1	M.F.	RN55D	TRW/IRC	OSC 2
R74		51.1	M.F.	RN55D	TRW/IRC	OSC 2

Symbol		Description		Mfg. Part No.	Mfg.	Location
R75		6.81K	M.F.	RN55D	TRW/IRC	OSC 2
R76		1.47K	M.F.	RN55D	TRW/IRC	OSC 2
R77		681	M.F.	RN55D	TRW/IRC	OSC 2
R78		3.48K	M.F.	RN55D	TRW/IRC	OSC 2
R79		3.48K	M.F.	RN55D	TRW/IRC	OSC 2
R80		511	M.F.	RN55D	TRW/IRC	OSC 2
R81		1K	M.F.	RN55D	TRW/IRC	OSC 2
R82		1K	M.F.	RN55D	TRW/IRC	OSC 2
R83		1K	M.F.	RN55D	TRW/IRC	OSC 2
R84		1K	M.F.	RN55D	TRW/IRC	OSC 2
R85		1K	M.F.	RN55D	TRW/IRC	OSC 2
R86		1K	M.F.	RN55D	TRW/IRC	OSC 2
R87		1K	M.F.	RN55D	TRW/IRC	OSC 2
R88		1K	M.F.	RN55D	TRW/IRC	OSC 2
R89		1K	M.F.	RN55D	TRW/IRC	OSC 2
R90		1K	M.F.	RN55D	TRW/IRC	OSC 2
R91		6.81K	M.F.	RN55D	TRW/IRC	OSC 2
R92		215	M.F.	RN55D	TRW/IRC	OSC 2
R93		215	M.F.	RN55D	TRW/IRC	REF 1
R94		215	M.F.	RN55D	TRW/IRC	REF 1
R95		511	M.F.	RN55D	TRW/IRC	ACC 3
R96		4K	W.W.	1250	Daven	ACC 3
R97		5.11K	M.F.	RN55D	TRW/IRC	ACC 3
R98		34.8K	M.F.	RN55D	TRW/IRC	ACC 3
R99		5K	W.W.	1250	Daven	ACC 3
R100		Not Used				
R101		10K	M.F.	RN55D	TRW/IRC	ACC 3
R102		10K	M.F.	RN55D	TRW/IRC	ACC 3
R103		100K	M.F.	RN55D	TRW/IRC	ACC 3
R104	AA	10K	Variable	68WR10K	Beckman	ACC 3
R105		34.8	M.F.	RN55D	TRW/IRC	ACC 3
R106		8K	W.W.	1250	Daven	ACC 3
R107		147K	M.F.	RN55D	TRW/IRC	ACC 3
R108		14.7	M.F.	RN55D	TRW/IRC	ACC 3
R109		34.8	M.F.	RN55D	TRW/IRC	ACC 3
R110		200	W.W.	1250	Daven	ACC 3
R111		2K	W>W.	1250	Daven	ACC 3
R112		511	M.F.	RN55D	TRW/IRC	ACC 3
R113		1K	W.W.	1250	Daven	ACC 3
R114		2K	W.W.	1250	Daven	ACC 3
R115		2.15K	M.F.	RN55D	TRW/IRC	ACC 3
R116		1K	M.F.	RN55D	TRW/IRC	ACC 3
R117	CC	10K	Variable	68WR10K	Beckman	ACC 3
R118		100	M.F.	RN55D	TRW/IRC	ACC 3
R119		511	M.F.	RN55D	TRW/IRC	ACC 3
R120		10K	M.F.	RN55D	TRW/IRC	ACC 3
R121		10K	M.F.	RN55D	TRW/IRC	ACC 3
R122	BB	10K	M.F.	RN55D	TRW/IRC	ACC 3
R123		21.5K	M.F.	RN55D	TRW/IRC	ACC 3
R124		21.5K	M.F.	RN55D	TRW/IRC	ACC 3
R125		21.5K	M.F.	RN55D	TRW/IRC	ACC 3
R126		215K	M.F.	RN55D	TRW/IRC	D/A 4
R127		Not Used				
R128		10K	W.W.	1250	Daven	D/A 4
R129		10K	W.W.	1250	Daven	D/A 4

Symbol		Description		Mfg. Part No.	Mfg. Location
R130		34.8K	M.F.	RN55D	TRW/IRC D/A 4
R131		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R132	N	100K	Variable	68WR100K	Beckman D/A 4
R133		51.1K	M.F.	RN55D	TRW/IRC D/A 4
R134		10K	M.F.	RN55D	TRW/IRC D/A 4
R135		5K	** W.W. (4K)	1250	Daven D/A 4
R136		21.5K	M.F.	RN55D	TRW/IRC D/A 4
R137	M	100K	Variable	68WR100K	Beckman D/A 4
R138		1K	M.F.	RN55D	TRW/IRC D/A 4
R139		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R140		348K	M.F.	RN55D	TRW/IRC D/A 4
R141		1.47K	M.F.	RN55D	TRW/IRC D/A 4
R142		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R143		1K	M.F.	RN55D	TRW/IRC D/A 4
R144		100	** M.F. (511)	RN55D	TRW/IRC D/A 4
R145		6.81K	M.F.	RN55D	TRW/IRC D/A 4
R146		6.81K	M.F.	RN55D	TRW/IRC D/A 4
R147	A	100K	Variable	68WR100K	Beckman D/A 4
R148		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R149	B	100K	Variable	68WR100K	Beckman D/A 4
R150		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R151	C	100K	Variable	68WR100K	TRW/IRC D/A 4
R152		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R153	D	100K	Variable	68WR100K	Beckman D/A 4
R154		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R155	E	100K	Variable	68WR100K	Beckman D/A 4
R156		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R157	F	100K	Variable	68WR100K	Beckman D/A 4
R158		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R159	G	100K	Variable	68WR100K	Beckman D/A 4
R160		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R161	H	100K	Variable	68WR100K	Beckman D/A 4
R162		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R163	J	100K	Variable	68WR100K	Beckman D/A 4
R164		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R165	K	100K	Variable	68WR100K	Beckman D/A 4
R166		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R167	L	100K	Variable	68WR100K	Beckman D/A 4
R168		1 Meg	M.F.	RN55D	TRW/IRC D/A 4
R169		215	M.F.	RN55D	TRW/IRC D/A 4
R170		215	M.F.	RN55D	TRW/IRC D/A 4
R171		34.8K	M.F.	RN55D	TRW/IRC D/A 4
R172		34.8K	M.F.	RN55D	TRW/IRC D/A 4
R173		34.8K	M.F.	RN55D	TRW/IRC D/A 4
R174		34.8K	M.F.	RN55D	TRW/IRC D/A 4
R175		34.8K	M.F.	RN55D	TRW/IRC D/A 4
R176		34.8K	M.F.	RN55D	TRW/IRC D/A 4
R177		100K	M.F.	RN55D	TRW/IRC D/A 4
R178		348K	M.F.	RN55D	TRW/IRC D/A 4
R179		348K	M.F.	RN55D	TRW/IRC D/A 4
R180		348K	M.F.	RN55D	TRW/IRC D/A 4
R181		348K	M.F.	RN55D	TRW/IRC D/A 4
R182		348K	M.F.	RN55D	TRW/IRC D/A 4
R183		348K	M.F.	RN55D	TRW/IRC D/A 4
R184		1 Meg	M.F.	RN55D	TRW/IRC D/A 4

Symbol		Description		Mfg. Part No.	Mfg.	Location
R185		100K	M.F.	RN55D	TRW/IRC	D/A 4
R186		Not Used				
R187		Not Used				
R188		Not Used				
R189		Not Used				
R190		Not Used				
R191	Z	100K	Variable	68WR100K	Beckman	D/A 5
R192		1 Meg	M.F.	RN55D	TRW/IRC	D/A 5
R193	Y	10K	Variable	68WR100K	Beckman	D/A 5
R194		1K	W.W.	1250	Daven	D/A 5
R195		2K	W.W.	1250	Daven	D/A 5
R196		8K	W.W.	1250	Daven	D/A 5
R197		8K	W.W.	1250	Daven	D/A 5
R198		14.7	M.F.	RN55D	TRW/IRC	D/A 5
R199	W	10K	Variable	68WR10K	Beckman	D/A 5
R200		8K	W.W.	1250	Daven	D/A 5
R201		100K	M.F.	RN55D	TRW/IRC	D/A 5
R202		215K	M.F.	RN55D	TRW/IRC	D/A 5
R203	X	10K	Variable	68WR10K	Beckman	D/A 5
R204		100K	M.F.	RN55D	TRW/IRC	D/A 5
R205		8K	W.W.	1250	Daven	D/A 5
R206		Not Used				
R207		Not Used				
R208		Not Used				
R209		3.48K	M.F.	RN55D	TRW/IRC	PA 6
R210		5.11K	M.F.	RN55D	TRW/IRC	PA 6
R211		10K	M.F.	RN55D	TRW/IRC	PA 6
R212	FF	10K	Variable	68WR10K	Beckman	PA 6
R213		147K	M.F.	RN55D	TRW/IRC	PA 6
R214		215	M.F.	RN55D	TRW/IRC	PA 6
R215		215	M.F.	RN55D	TRW/IRC	PA 6
R216		147K	M.F.	RN55D	TRW/IRC	PA 6
R217	DD	10K	Variable	68WR10K	Beckman	PA 6
R218		348	M.F.	RN55D	TRW/IRC	PA 6
R219		4K	W.W.	1250	Daven	PA 6
R220		14.7	M.F.	RN55D	TRW/IRC	PA 6
R221		68.1K	M.F.	RN55D	TRW/IRC	PA 6
R222		100K	M.F.	RN55D	TRW/IRC	PA 6
R223	EE	10K	Variable	68WR10K	Beckman	PA 6
R224		5.11K	M.F.	RN55D	TRW/IRC	PA 6
R225		10K	M.F.	RN55D	TRW/IRC	PA 6
R226		20K	M.F.	RN55D	TRW/IRC	PA 6
R227		40.2K	M.F.	RN55D	TRW/IRC	PA 6
R228		21.5K	M.F.	RN55D	TRW/IRC	PA 6
R229		14.7K	M.F.	RN55D	TRW/IRC	PA 6
R230		51.1K	M.F.	RN55D	TRW/IRC	PA 6
R231		100K	M.F.	RN55D	TRW/IRC	PA 6
R232		215K	M.F.	RN55D	TRW/IRC	PA 6
R233		511K	M.F.	RN55D	TRW/IRC	PA 6
R234		21.5K	M.F.	RN55D	TRW/IRC	PA 6
R235	GG	10K	Variable	68WR10K	Beckman	PA 6
R236		10K	M.F.	RN55D	TRW/IRC	PA 6
R237		10K	M.F.	RN55D	TRW/IRC	PA 6
R238		1 Meg	M.F.	RN55D	TRW/IRC	PA 6
R239		Not Used				

Symbol		Description		Mfg. Part No.	Mfg.	Location
R240		215	M.F.	RN55D	TRW/IRC	PA 6
R241		10K	M.F.	RN55D	TRW/IRC	PA 6
R242		1	W.W. 0.5%	1250	Daven	I/S 7
R243		1K	W.W.	1250	Daven	I/S 7
R244		511K	M.F.	RN55D	TRW/IRC	I/S 7
R245	T	100K	Variable	68WR100K	Beckman	I/S 7
R246		1K	M.F.	RN55D	TRW/IRC	I/S 7
R247		1	W.W. 0.5%	1250	Daven	I/S 7
R248		1K	W.W.	1250	Daven	I/S 7
R249		511K	M.F.RN55D	TRW/IRC	I/S 7	I/S 7
R250	U	100K	Variable	68WR100K	Beckman	I/S 7
R251		100K	M.F.	RN55D	TRW/IRC	I/S 7
R252		10K	W.W.	1250	Daven	I/S 7
R253		10K	W.W.	1250	Daven	I/S 7
R254	V	10K	Variable	68WR10K	Beckman	I/S 7
R255		1K	M.F.	RN55D	TRW/IRC	I/S 7
R256		51.1K	M.F.	RN55D	TRW/IRC	I/S 7
R257		1K	M.F.	RN55D	TRW/IRC	I/S 7
R258		51.1K	M.F.	RN55D	TRW/IRC	I/S 7
R259		1K	M.F.	RN55D	TRW/IRC	I/S 7
R260		511K	M.F.	RN55D	TRW/IRC	I/S 7
R261		1K	M.F.	RN55D	TRW/IRC	I/S 7
R262		100K	W.W.	1250	Daven	I/S 7
R263		1K 3 PPM	W.W. 0.005%	1251	Daven	I/S 7
R264		101 10 PPM	W.W. 0.5%	1251	Daven	I/S 7
R265		5.11K	M.F.	RN55D	TRW/IRC	I/S 7
R266	S	10K	Variable	68WR10K	Beckman	I/S 7
R267		681	M.F.	RN55D	TRW/IRC	I/S 7
R268	R	1K	Variable	68WR1K	Beckman	I/S 7
R269		10.1 15 PPM	W.W. 0.5%	1251	Daven	I/S 7
R270		68.1	M.F.	RN55D	TRW/IRC	I/S 7
R271		1.01 25W	Power 0.5%	RH-25	Dale	I/S 7
R272	P	200	Variable	68WR200	Beckman	I/S 7
R273		1 10W	Power	M10-1	Memcor	I/S 7
R274		10K	W.W.	1250	Daven	I/S 7
R275		2 10W	Power	MZ10-2	Memcor	I/S 7
R276		51.1K	M.F.	RN55D	TRW/IRC	I/S 7
R277		1K	M.F.	RN55D	TRW/IRC	I/S 7
R278		6.81K	M.F.	RN55D	TRW/IRC	ACC 3
R279		Not Used				
R280		Not Used				
R281		Not Used				
R282		Not Used				
R283		1K	M.F.	RN55D	TRW/IRC	ACC 3
R284		Not Used				
R285		51.1K	M.F.	RN55D	TRW/IRC	ACC 3
R286		5.11K	M.F.	RN55D	TRW/IRC	ACC 3
R287		5.11K	M.F.	RN55D	TRW/IRC	ACC 3
R288		2.15K	M.F.	RN55D	TRW/IRC	ACC 3
R289		100K	M.F.	RN55D	TRW/IRC	D/A 4
R290		100K	M.F.	RN55D	TRW/IRC	D/A 4
R291		100K	M.F.	RN55D	TRW/IRC	D/A 4
R292		100K	M.F.	RN55D	TRW/IRC	D/A 4
R293		100K	M.F.	TRW/IRC	TRW/IRC	D/A 4
R294		100K	M.F.	RN55D	TRW/IRC	D/A 4

Symbol	Description		Mfg. Part No.	Mfg.	Location
R295	100K	M.F.	RN55D	TRW/IRC	D/A 4
R296	100K	M.F.	RN55D	TRW/IRC	D/A 4
R297	100K	M.F.	RN55D	TRW/IRC	D/A 4
R298	100K	M.F.	RN55D	TRW/IRC	D/A 4
R299	100K	M.F.	RN55D	TRW/IRC	D/A 4
		Resistor Networks			
RU1	47K	SIP 8 Pin	750-81-R47K	CTS	D/A 5
RU2	47K	SIP 8 Pin	750-81-R47K	CTS	D/A 5
		Reference Assy			
RX1	Reference Assembly		LM399AH	NAT	REF 1
		Diode Voltage Regulator			
VR1	Zener 5.1V		1N5231B	FCD	REF 1
VR2	Zener 5.1V		1N5231B	FCD	REF 1
VR3	Not Used				
VR4	Not Used				
VR5	Zener 10V		1N5347B	MOT	I/S 7
VR6	Zener 10V		1N5347B	MOT	I/S 7
VR7	Zener 5,1V		1N5231B	FCD	ACC 3
VR8	Zener 5.1V		1N5231B	FCD	ACC 3
VR9	Zener 5.1V		1N5231B	FCD	ACC 3
VR10	Zener 5.1V		1N5231B	FCD	ACC 3
VR11	Zener 10V		1N5240B	FCD	ACC 3
VR12	Zener 10V		1N5240B	FCD	ACC 3

* With Model 360
** On Model 3960

Symbol	Description		Mfg. Part No.	Mfg.
		Capacitors		
C1	0.01.uf @100V	Cer.Disc	TG-S10	Sprague
C2	0.05uf @100V	Cer. Disc	UK25-503	Centralab
C3	4.7uf @35V	Tantalum	TDC475M035FL	Mallory
C4	400uf @6V	Alum. Elect.	TE1107	Sprague
C5	4.7uf @35V	Tantalum	TDC475M035FL	Mallory
C6	47uf @6V	Tantalum	TAG20-22/35	ITT
C7	10uf @50V	Alum. Elect.	TE1304	Sprague
C8	4.7uf @35V	Tantalum	TDC475M035FL	Mallory
C9	1000pf	Dipped Mica	CM06FD102J03	CDE
C10	0.01uf @100V	Cer. Disc	TG-S10	Sprague
C11	0.01uf@100V	Cer. Disc	TG-S10	Sprague
C12	1500pf	Dipped Mica	CM06FD152J03	CDE
C13	4.7uf @35V	Tantalum	TDC475M035FL	Mallory
C14	1500pf	Dipped Mica	CM06FD152J03	CDE
C15	2200pf	Dipped Mica	CM06FD222J03	CDE
C16	47uf @6V	Tantalum	196D476X9006JA1	Sprague
C17	100uf @25V	Alum. Elect.	TE1211	Sprague
C18	1500pf	Dipped Mica	CM06FD152J03	CDE
C19	220pf	Dipped Mica	CM05FD221J03	CDE
C20	220pf	Dipped Mica	CM05FD221J03	CDE
C21	1500pf	Dipped Mica	CM06FD152J03	CDE
C22	0.01uf @100V	Cer. Disc	TG-S10	Sprague
C23	0.01uf @100V	Cer. Disc	TG-S10	Sprague
C24	0.01uf @100V	Cer. Disc	TG-S10	Sprague
C25	47uf @6V	Tantalum	196D476X9006JA1	Sprague
C26	220pf	Dipped Mica	CM05FD221J03	CDE
		Diodes		
CR1	Signal		1N914	FSC
CR2	Signal		1N914	FSC
CR3	Signal		1N914	FSC
		Integrated Circuits Digital		
IC1	Quad Nand Gate		74LS00N	T.I.
IC2	Quad Nand Gate		74LS00N	T.I.
IC3	Quad Nand Gate		74LS00N	T.I.
IC4	Quad Nand Gate		74LS00N	T.I.
IC5	Quad Nand Gate		74LS00N	T.I.
IC6	Quad Nand Gate		74LS00N	T.I.
IC7	Quad Nand Gate		74LS00N	T.I.
IC8	Quad Nand Gate		74LS00N	T.I.
IC9	Quad Nand Gate		74LS00N	T.I.
IC10	Quad Nand Gate		74S00N	T.I.
IC11	Quad Nand Gate		74LS00N	T.I.
IC12	Quad Nand Gate		74LS00N	T.I.
IC13	Quad Nand Gate		74LS00N	T.I.
IC14	Quad Nand Gate		74LS00N	T.I.
IC15	Quad Nand Gate		74LS00N	T.I.
IC16	Quad Nand Gate		74LS00N	T.I.
IC17	Quad Nand Gate		74LS00N	T.I.
IC18	Quad Nand Gate		74LS00N	T.I.

Symbol	Description	Mfg. Part No.	Mfg.
IC19	Quad Nand Gate	74LS00N	T.I.
IC20	Quad Nand Gate	74LS00N	T.I.
IC21	Timer	NE555V	Signetics
IC22	Quad Nand Gate	74LS00N	T.I.
IC23	Quad Nand Gate	74LS00N	T.I.
IC24	Quad Nand Gate	74LS00N	T.I.
IC25	Quad Nand Gate	74LS00N	T.I.
IC26	Multivibrator	74LS123N	T.I.
IC27	Multivibrator	74LS123N	T.I.
IC28	Multivibrator	74LS123N	T.I.
IC29	Multivibrator	74LS123N	T.I.
IC30	Multivibrator	74LS123N	T.I.
IC31	Quad Nand Gate	74LS00N	T.I.
IC32	Quad Nand Gate	74LS00N	T.I.
IC33	Quad Nand Gate	74LS00N	T.I.
IC34	Quad Nand Gate	74LS00N	T.I.
IC35	Quad Nand Gate	74LS00N	T.I.
IC36	Quad Nand Gate	74LS00N	T.I.
IC37	Quad Nand Gate	74LS00N	T.I.
IC38	Quad Nand Gate	74LS00N	T.I.
IC39	Quad Nand Gate	74LS00N	T.I.
IC40	Quad Nand Gate	74S00N	T.I.
IC41	Quad Nand Gate	74L00N	NAT
IC42	Quad Nand Gate	74LS00N	T.I.
IC43	Quad Nand Gate	74LS00N	T.I.

Resistors

R1	21.5K	M.F.	RN55D	TRW/IRC
R2	10K	M.F.	RN55D	TRW/IRC
R3	511	M.F.	RN55D	TRW/IRC
R4	51.1K	M.F.	RN55D	TRW/IRC
R5	21.5K	M.F.	RN55D	TRW/IRC
R6	21.5K	M.F.	RN55D	TRW/IRC
R7	51.1K	M.F.	RN55D	TRW/IRC
R8	348	M.F.	RN55D	TRW/IRC
R9	51.1K	M.F.	RN55D	TRW/IRC
R10	2.15K	M.F.	RN55D	TRW/IRC
R11	5.11K	M.F.	RN55D	TRW/IRC
R12	3.48K	M.F.	RN55D	TRW/IRC
R13	21.5K	M.F.	RN55D	TRW/IRC
R14	5.11K	M.F.	RN55D	TRW/IRC
R15	21.5K	M.F.	RN55D	TRW/IRC
R16	51.1K	M.F.	RN55D	TRW/IRC
R17	5.11K	M.F.	RN55D	TRW/IRC
R18	21.5K	M.F.	RN55D	TRW/IRC
R19	21.5K	M.F.	RN55D	TRW/IRC
R20	5.11K	M.F.	RN55D	TRW/IRC
R21	5.11K	M.F.	RN55D	TRW/IRC
R22	21.5K	M.F.	RN55D	TRW/IRC
R23	21.5K	M.F.	RN55D	TRW/IRC
R24	5.11K	M.F.	RN55D	TRW/IRC
R25	21.5K	M.F.	RN55D	TRW/IRC
R26	51.1K	M.F.	RN55D	TRW/IRC
R27	1K	M.F.	RN55D	TRW/IRC

Symbol	Description		Mfg. Part No.	Mfg.
R28	1K	M.F.	RN55D	TRW/IRC

Symbol	Description	Mfg. Part No.	Mfg.

"S2B" Parts List

U-Q1	Transistor Signal Amplif. PNP	GES6015	G.E.
U-Q2	Transistor Signal Amplif. NPN	GES6014	G.E.
U-Q3	Transistor Switch PNP	2N2946A	Raytheon
U-R1	Resistor 10K M.F.	RN55D	Corning
U-R2	Resistor 2.15K M.F.	RN55D	Corning
U-R3	Resistor 1 Meg M.F.	RN55D	Corning
U-R4	Resistor 511 M.F.	RN55D	Corning
U-R5	Resistor 511 M.F.	RN55D	Corning
U-CR1	Diode Signal	1N914	FSC

"S4" Parts List

U-Q1	Transistor FET	U290	Siliconix
U-Q2	Transistor Signal Amplif. NPN	GES6014	G.E.
U-Q3	Transistor Signal Amplif. PNP	GES6015	G.E.
U-R1	Resistor 100K M.F.	RN55D	Corning
U-R2	Resistor 3.48K M.F.	RN55D	Corning
U-R3	Resistor 3.48K M.F.	RN55D	Corning
U-R4	Resistor 511 M.F.	RN55D	Corning
U-R5	Resistor 14.7K M.F.	RN55D	Corning
U-CR1	Diode Signal M.F.	1N914	FSC

"S5" Parts List

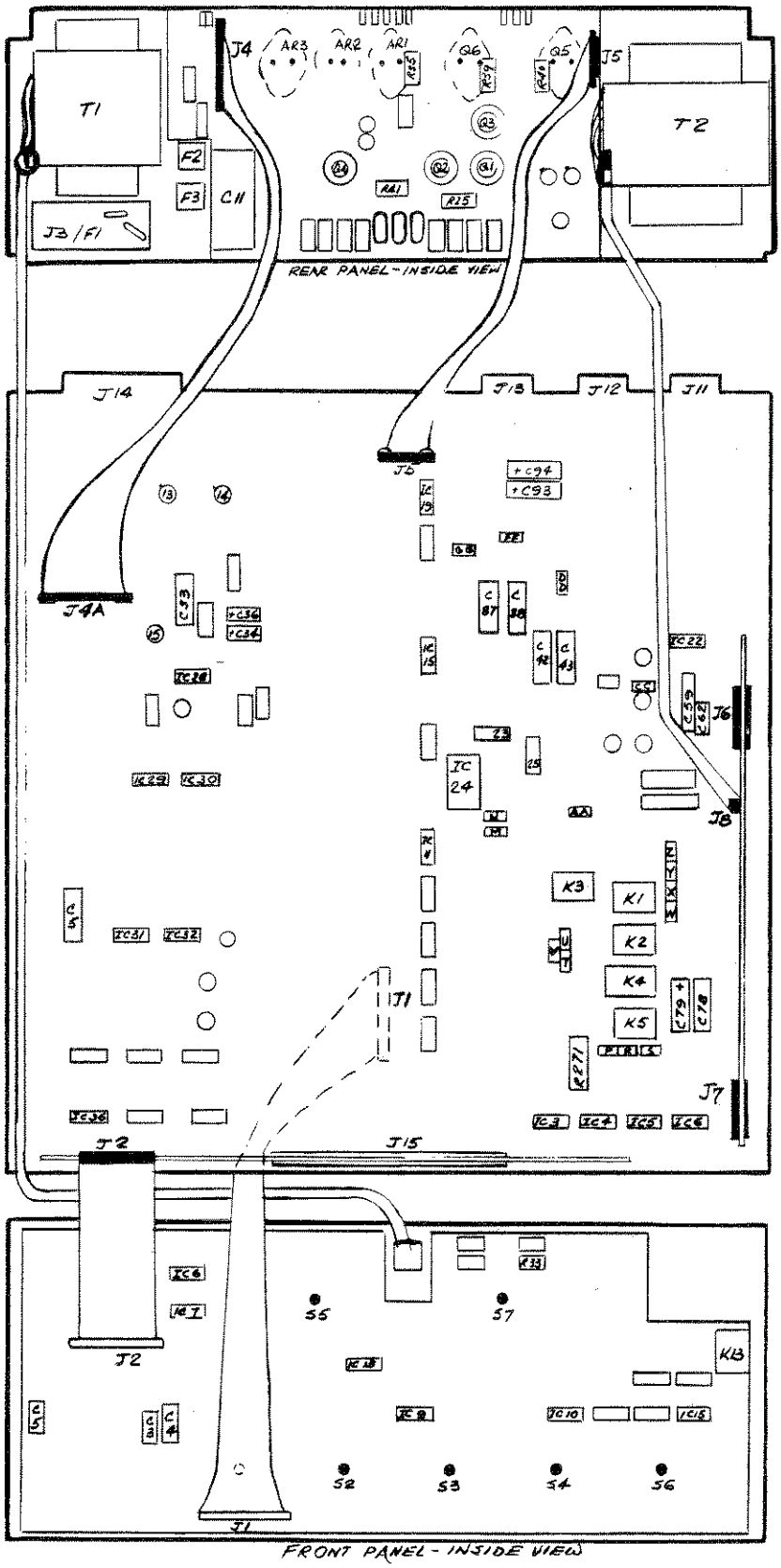
U-Q1	Transistor FET	IRF531	Int. Rect.
U-Q2	Transistor Signal Amplif. NPN	GES6014	G.E.
U-Q3	Transistor Signal Amplif. PNP	GES6015	G.E.
U-Q4	Transistor Switch	2N2946A	Raytheon
U-R1	Resistor 100K M.F.	RN55D	Corning
U-R2	Resistor 1.47K M.F.	RN55D	Corning
U-R3	Resistor 3.48K M.F.	RN55D	Corning
U-R4	Resistor 511 M.F.	RN55D	Corning
U-R5	Resistor 14.7K M.F.	RN55D	Corning
U-R6	Resistor 14.7K M.F.	RN55D	Corning
U-CR1	Diode Signal	1N914	FSC

"S7" Parts List

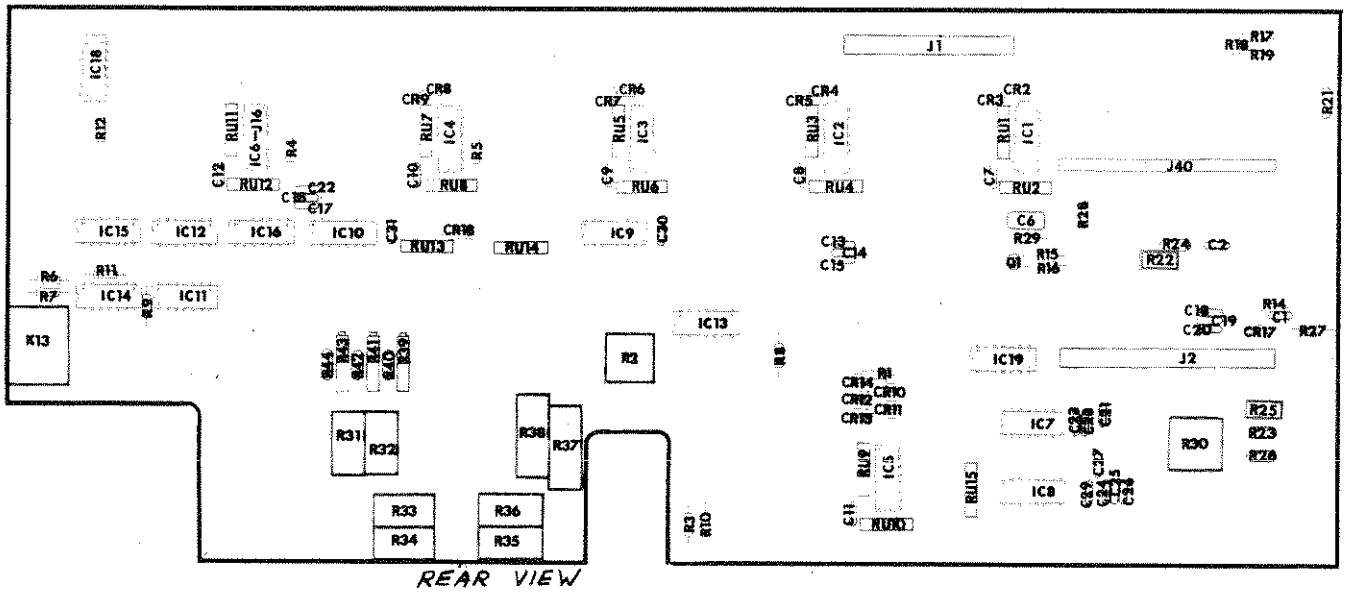
U-Q1	Transistor NPN	2N3019	FSC
U-Q2	Transistor PNP	2N4033	FSC
U-Q3	Transistor FET	IRF531	Int. Rect.
U-Q4	Transistor FET	IRF531	Int. Rect.
U-R1	Resistor 34.8K M.F.	RN55D	Corning
U-R2	Resistor 10K M.F.	RN55D	Corning
U-R3	Resistor 6.81K M.F.	RN55D	Corning
U-R4	Resistor 2.15K M.F.	RN55D	Corning
U-R5	Resistor 6.81K M.F.	RN55D	Corning
U-R6	Resistor 348 M.F.	RN55D	Corning
U-R7	Resistor 100K M.F.	RN55D	Corning
U-CR1	Diode Signal	1N914	FSC
U-CR2	Diode Zener	1N5231B	Motorola
U-CR3	Diode Zener	1N5250B	Motorola
U-CR4	Diode Zener	1N5250B	Motorola

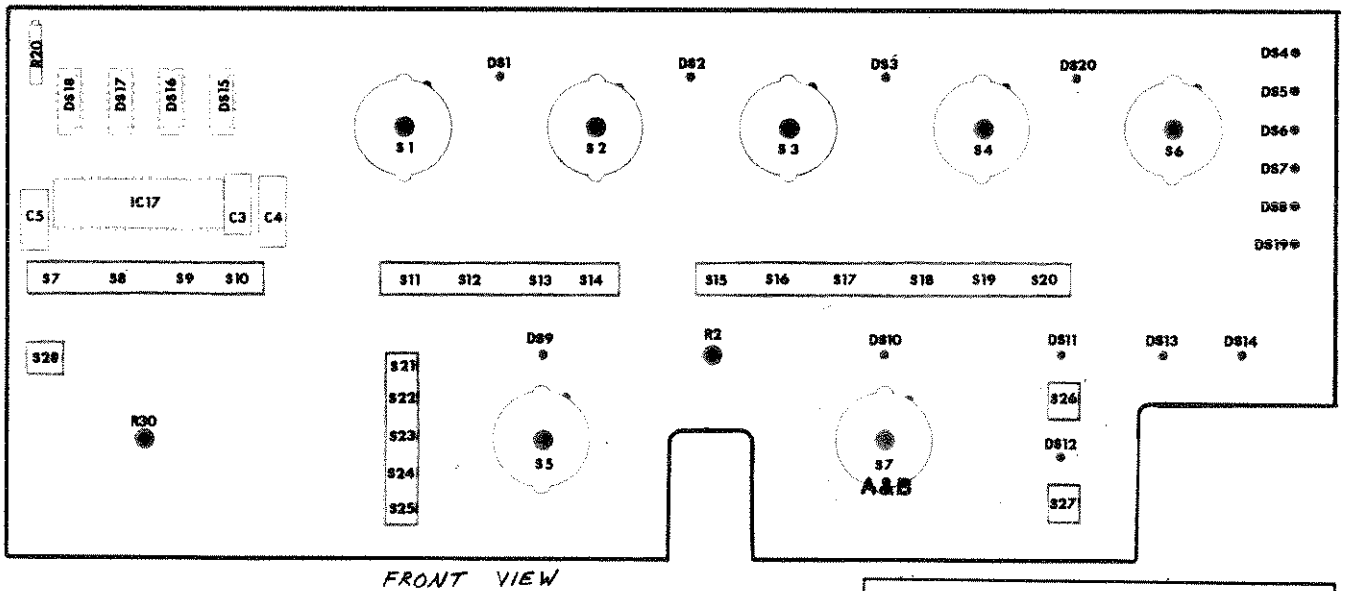
SECTION 6

SCHEMATICS AND LOCATION DRAWINGS



SCALE	APPROVED BY	DRAWN BY M.W.	DRAWING NUMBER
DATE 1-22-80		ROTEK INSTRUMENT CORP.	39-100-000
		MAIN LOCATION - 3900	

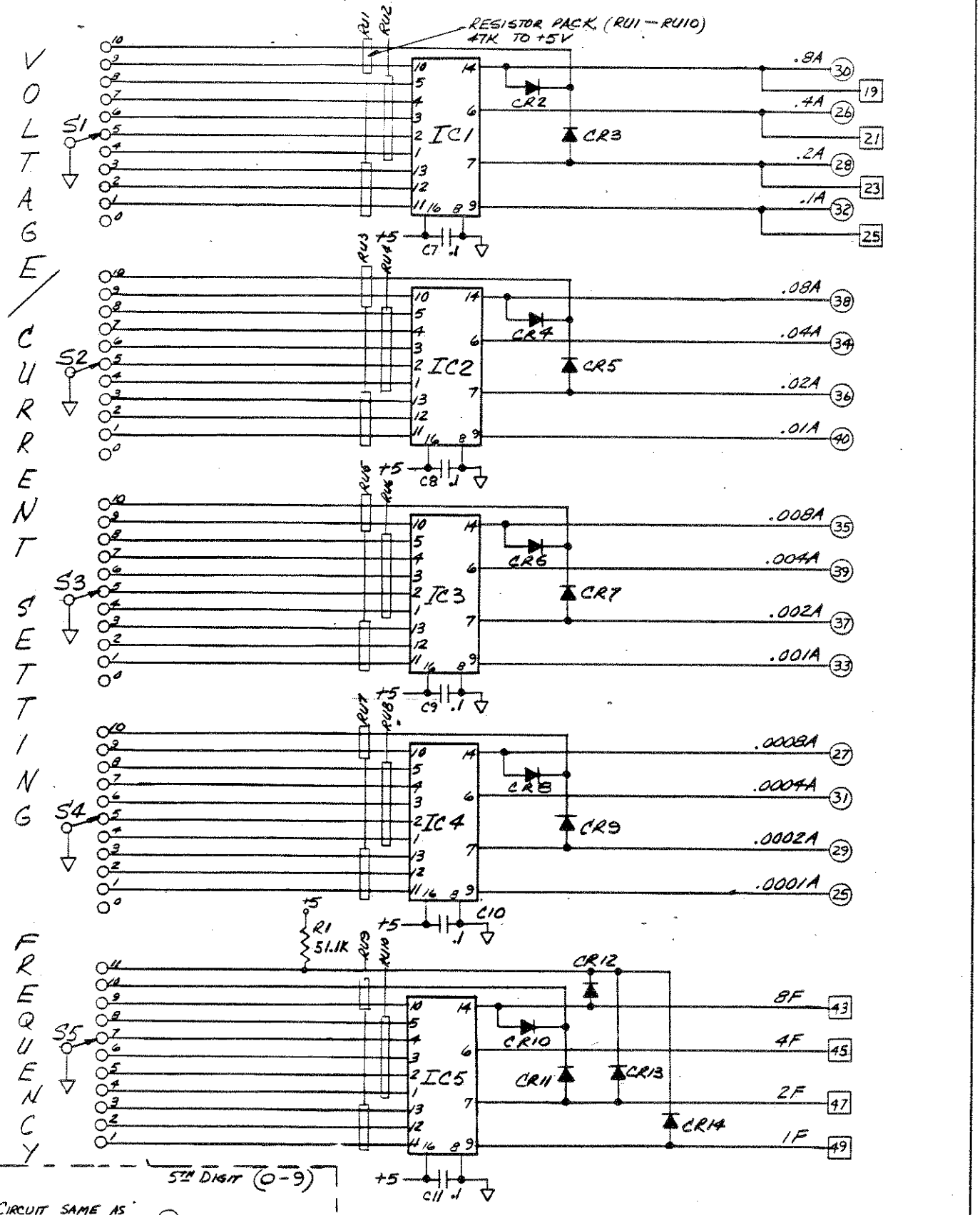


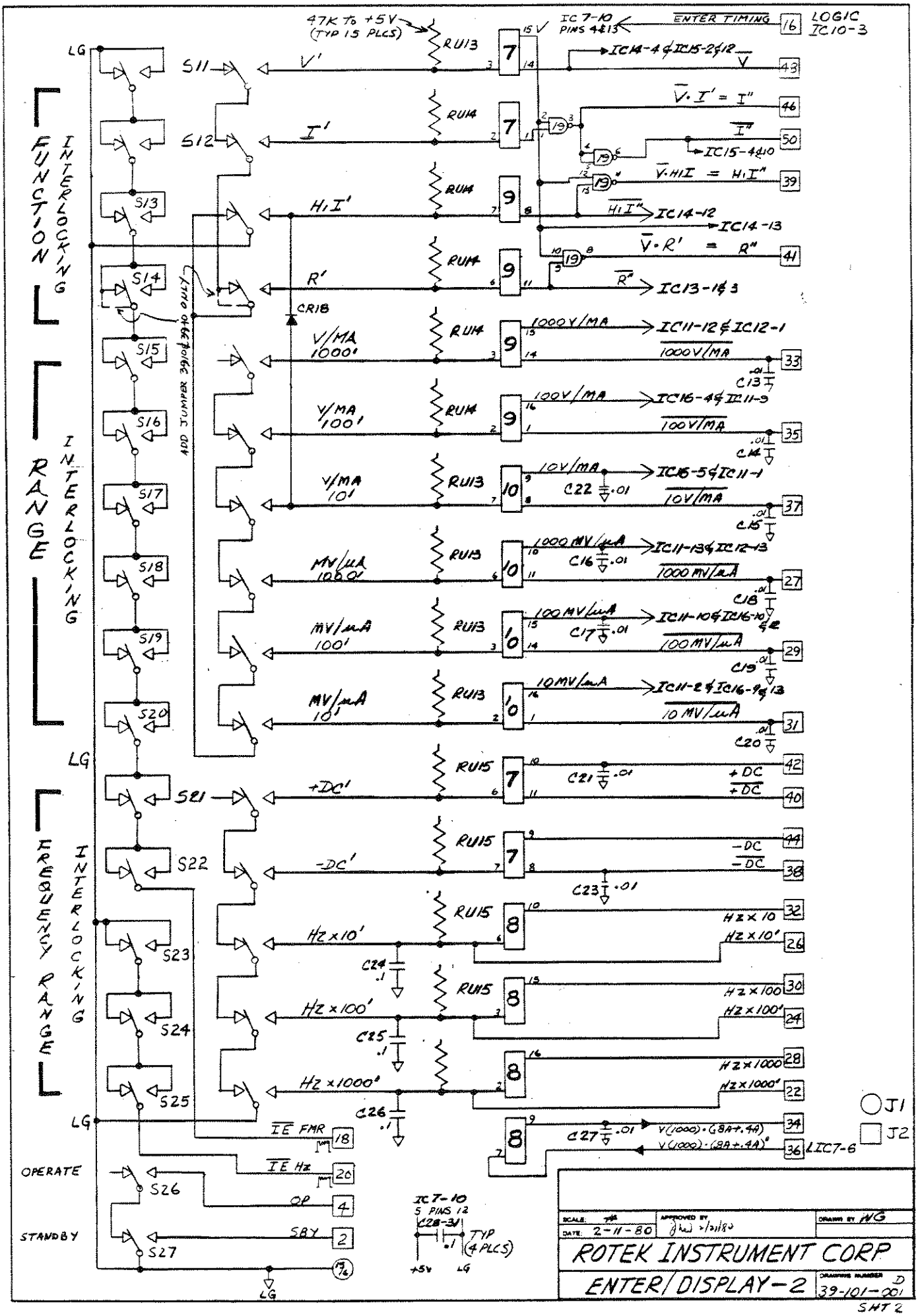


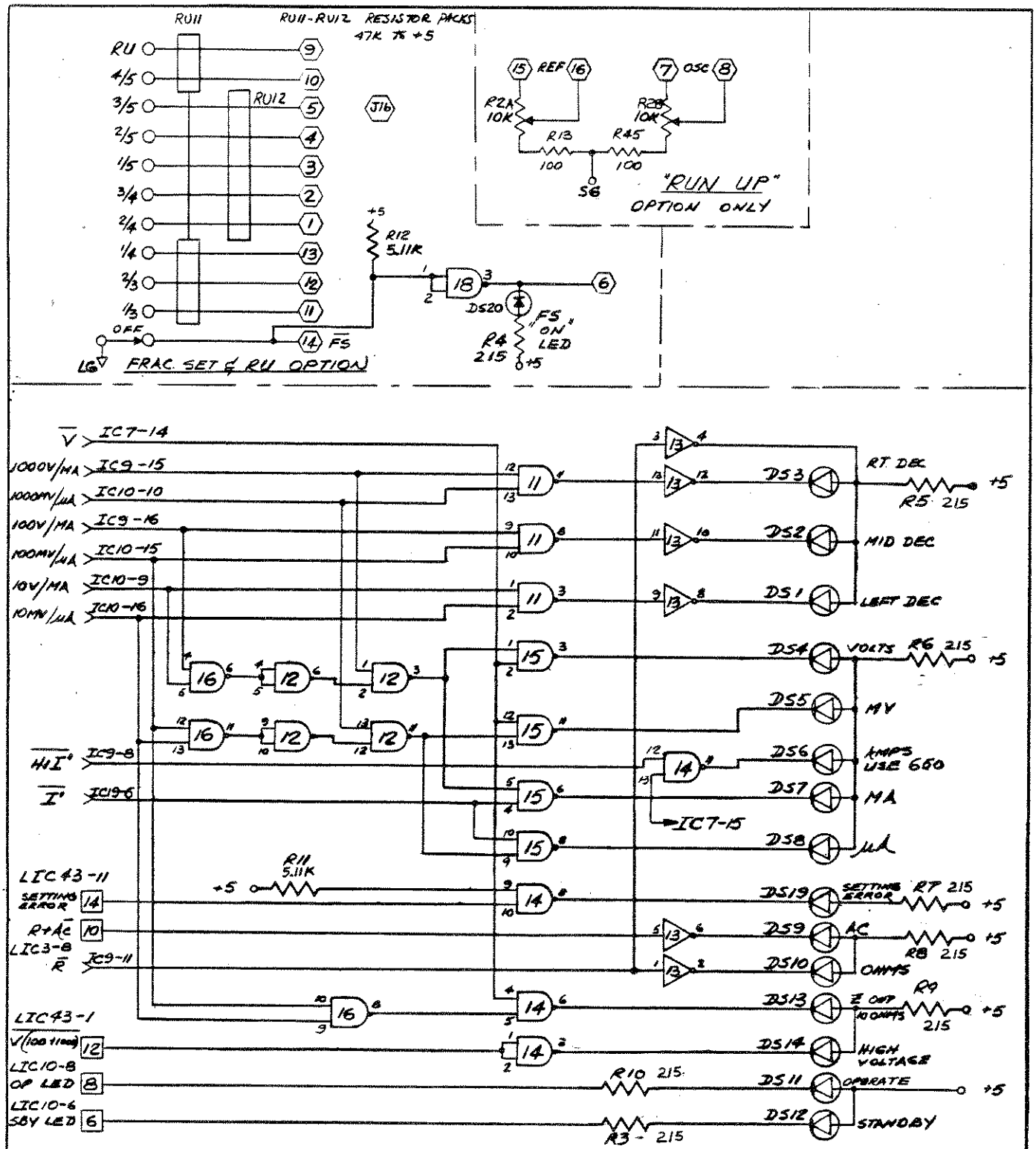
SCALE: ~	APPROVED BY	DRAWN BY: RCH
DATE: 3-7-80		

ROTEK INSTRUMENT CORP

FRONT PANEL P.C. — DRAWING NUMBER 39-101-000


VOLTAGE/CURRENT SETTING FREQUENCY
RESISTOR PACK (RU1 — RU10)
47K TO +5V
RU1
RU2
RU3
RU4
RU6
RU7
RU8
RU9
RU10
S1
S2
S3
S4
S5
IC1
IC2
IC3
IC4
IC5
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
CR11
CR12
CR13
CR14
C7 .1
C8 .1
C9 .1
C10 .1
C11 .1
R1 51.1K
+5
.8A 30
.4A 26
.2A 28
.1A 32
19
21
23
25
.08A 38
.04A 34
.02A 36
.01A 40
.008A 35
.004A 39
.002A 37
.001A 33
.0008A 27
.0004A 31
.0002A 29
.0001A 25
8F 43
4F 45
2F 47
1F 49
5TH DIGIT (0-9)
CIRCUIT SAME AS 4TH DIGIT EXCEPT S4 → S6 IC4 → IC6 RU7 → RU11 RU8 → RU12 CR8 — NOT USED CR9 — NOT USED C10 → C12
STOP AT 9
19 .00008A
23 .00004A
21 .00002A
17 .00001A
+5 13/14 J1
LG 15/16 J2
R1 WAS 47K
SCALE NA
DATE 2-11-80
APPROVED BY
DRAWN BY WG
ROTEK INSTRUMENT CORP.
ENTER/DISPLAY-1
DRAWING NUMBER E
39-101-001
SHT 1


FUNCTION INTERLOCKING
RANGE INTERLOCKING
FREQUENCY RANGE INTERLOCKING
47K TO +5V (TYP 15 PLCS)
LOGIC IC10-3
ENTER TIMING
IC 7-10 PINS 4&13
S11
S12
S13
S14
S15
S16
S17
S18
S19
S20
S21
S22
S23
S24
S25
S26
S27
OPERATE
STANDBY
ADD JUMPER 39104 & 3940 ONLY
CR18
V'
I'
HiI'
R'
V/MA 1000'
V/MA 100'
V/MA 10'
MV/uA 1000'
MV/uA 100'
MV/uA 10'
+DC'
-DC'
Hz x 10'
Hz x 100'
Hz x 1000'
RU13
RU14
RU15
IE FMR
IE Hz
OP
SBY
LG
+5V
IC14-4 & IC15-2 & 12 V
V·I' = I"
I"
IC15-4 & 10
V·HiI = HiI"
HiI"
IC14-12
IC14-13
V·R' = R"
R"
IC13-1 & 3
1000V/MA
100V/MA
10V/MA
1000 MV/uA
100 MV/uA
10 MV/uA
C13 .01
C14 .01
C15 .01
C16 .01
C17 .01
C18 .01
C19 .01
C20 .01
C21 .01
C22 .01
C23 .01
C24 .1
C25 .1
C26 .1
C27 .01
+DC
-DC
Hz x 10
Hz x 100
Hz x 1000
V(1000)·(8A+.4A)
V(1000)·(8A+.4A)*
IC7-6
IC 7-10 5 PINS 12 C28-31 .1 TYP (4 PLCS)
J1
J2
SCALE
DATE 2-11-80
APPROVED BY
DRAWN BY NG
ROTEK INSTRUMENT CORP
ENTER/DISPLAY-2
DRAWING NUMBER D 39-101-001
SHT 2



⬡-J16

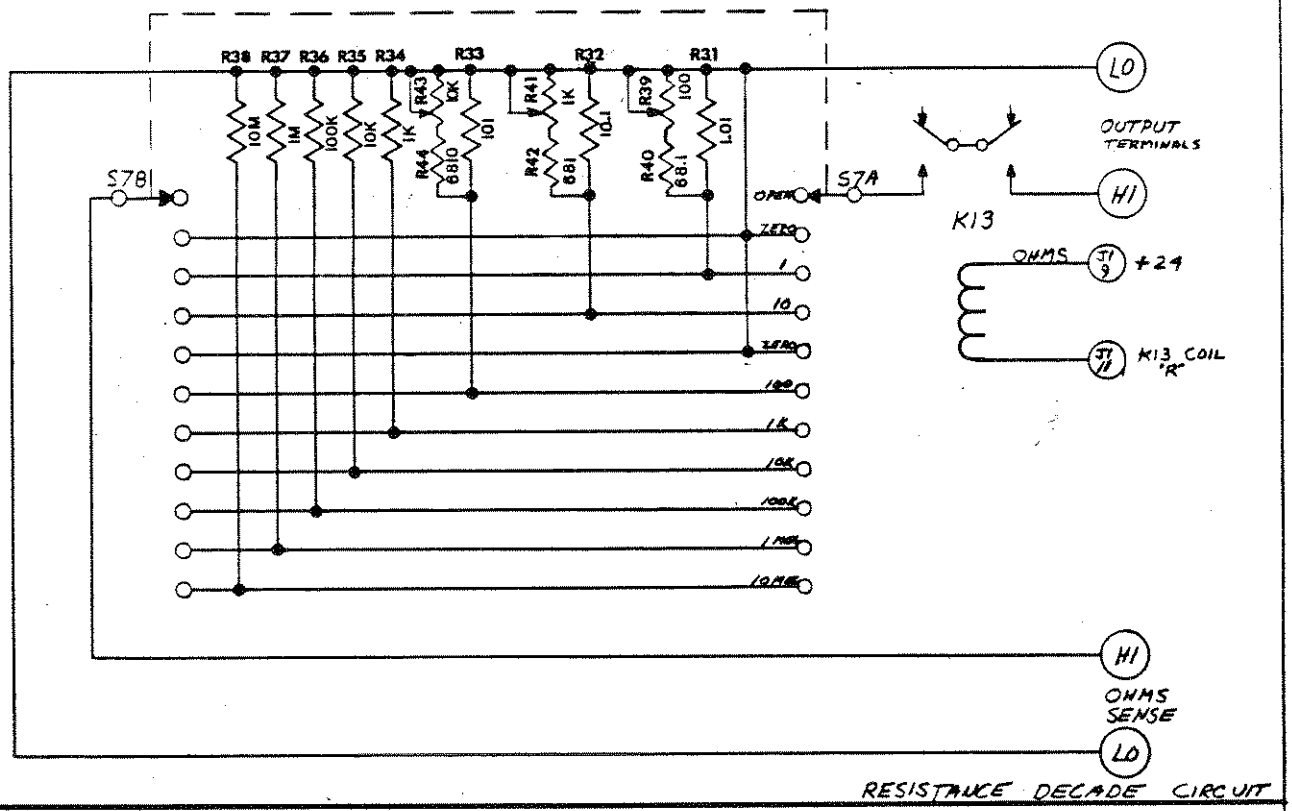
□—J2

SCALE ~	APPROVED BY	DRAWN BY M.N.
DATE 2-11-80		

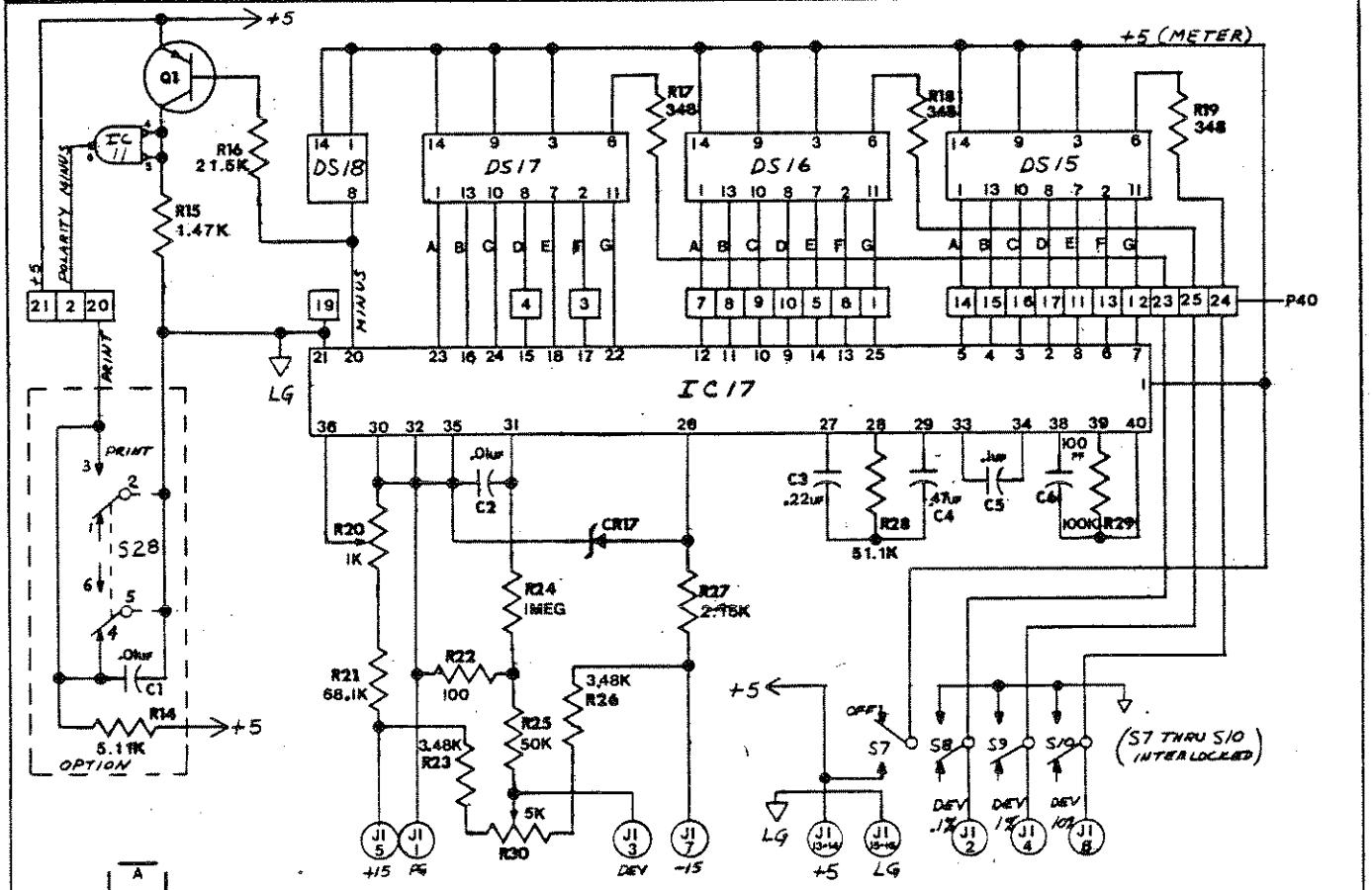
ROTEK INSTRUMENT CORP.

SCHEMATIC - DISPLAY 3 — DRAWING NUMBER 59-101-001 E

SHT 3



RESISTANCE DECADE CIRCUIT



TYPICAL SEGMENT CODE

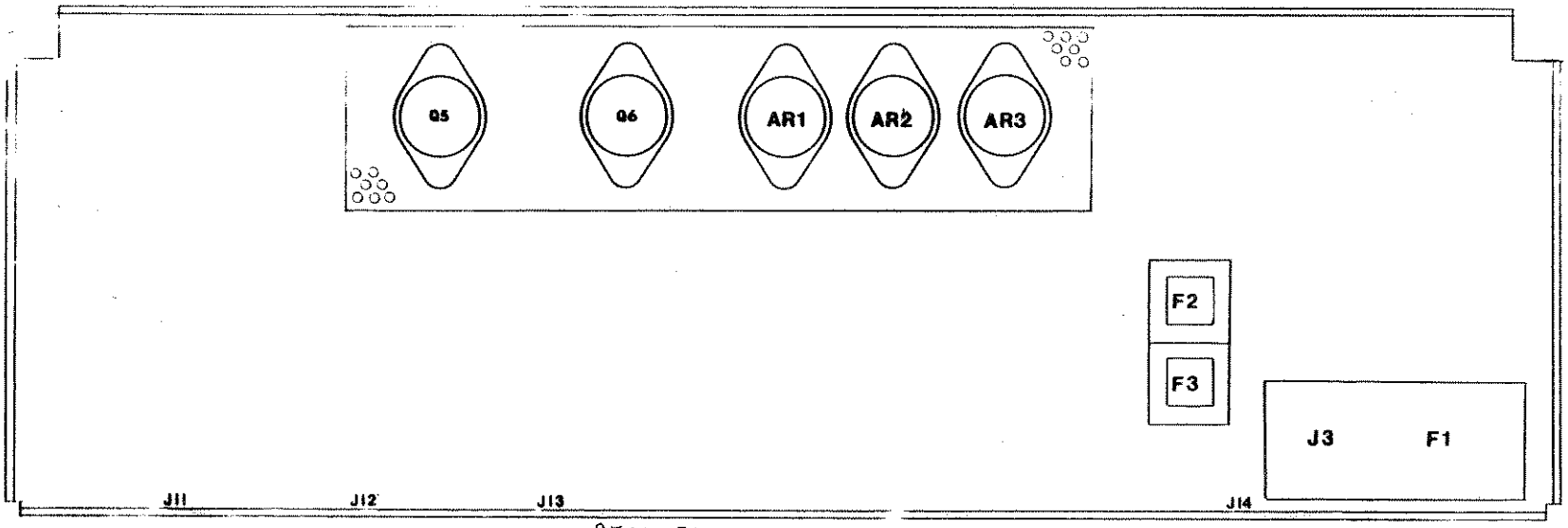
DEVIATION METER CIRCUIT

SCALE:	APPROVED BY:	DRAWN BY:
DATE: 2-11-80		

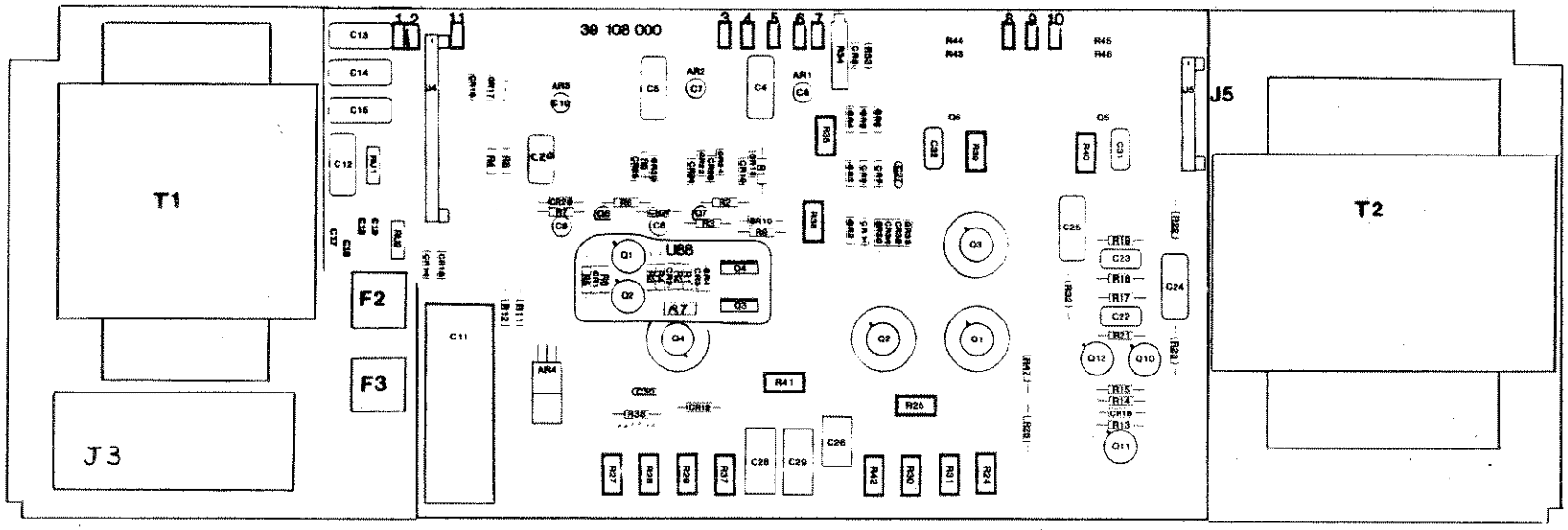
ROTEK INSTRUMENT CORP.

DEVIATION & RESISTANCE — DRAWING NUMBER: 39-101-00/F

SHT 4



REAR PANEL - OUTSIDE VIEW



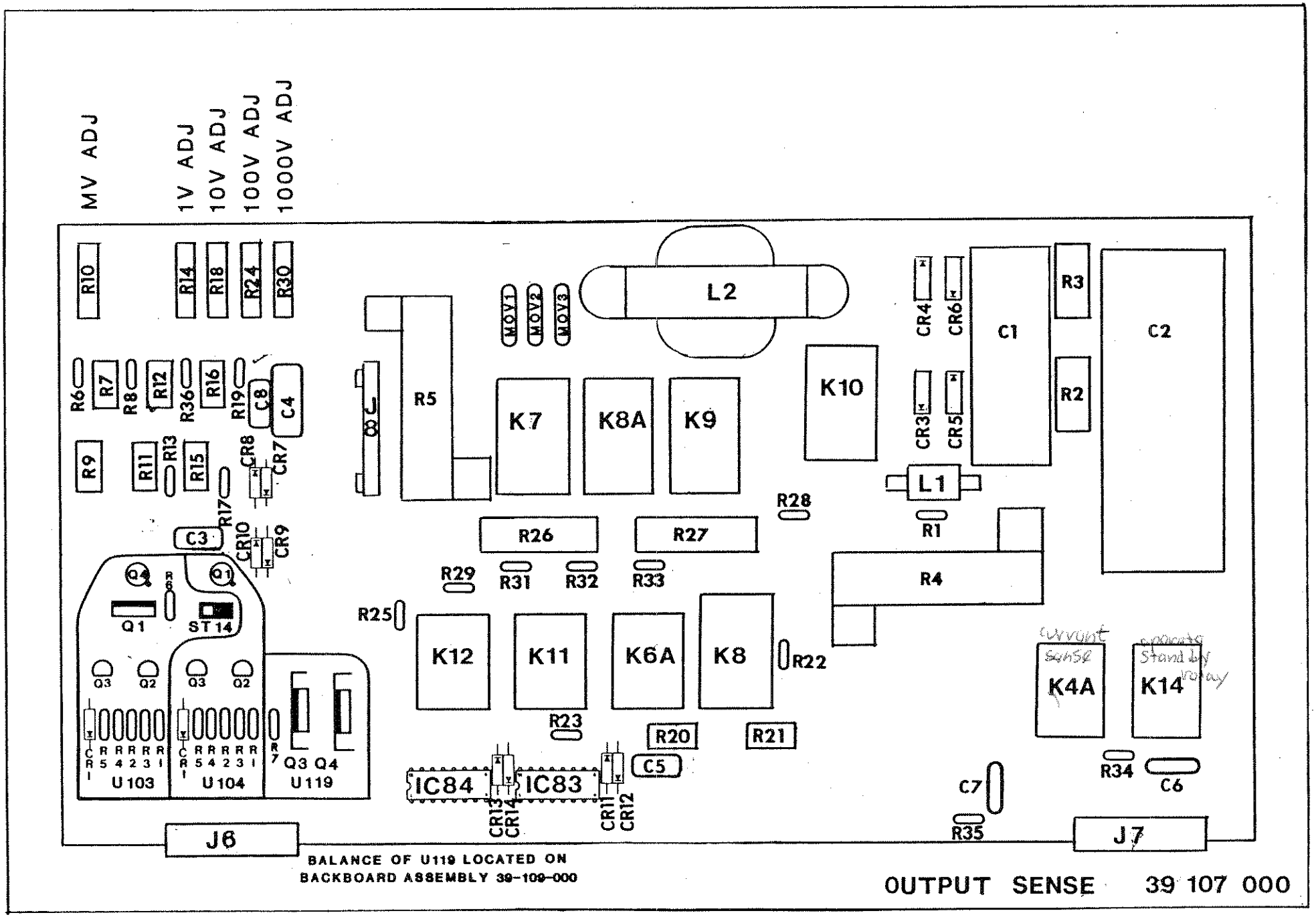
REAR PANEL - INSIDE VIEW

A-2-2-81

ROTEK INSTRUMENT CORP.

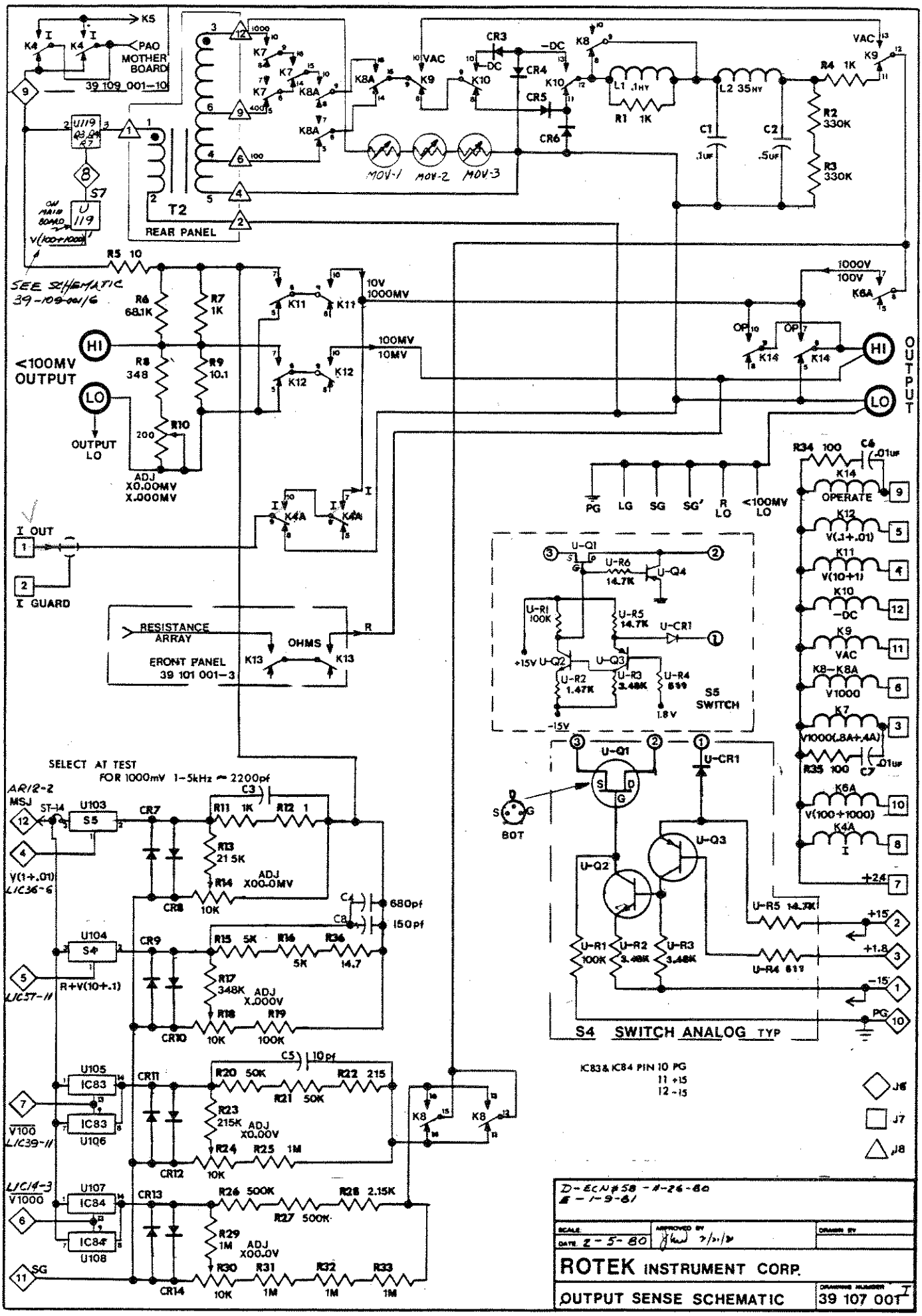
REAR PANEL 39-105-000 B

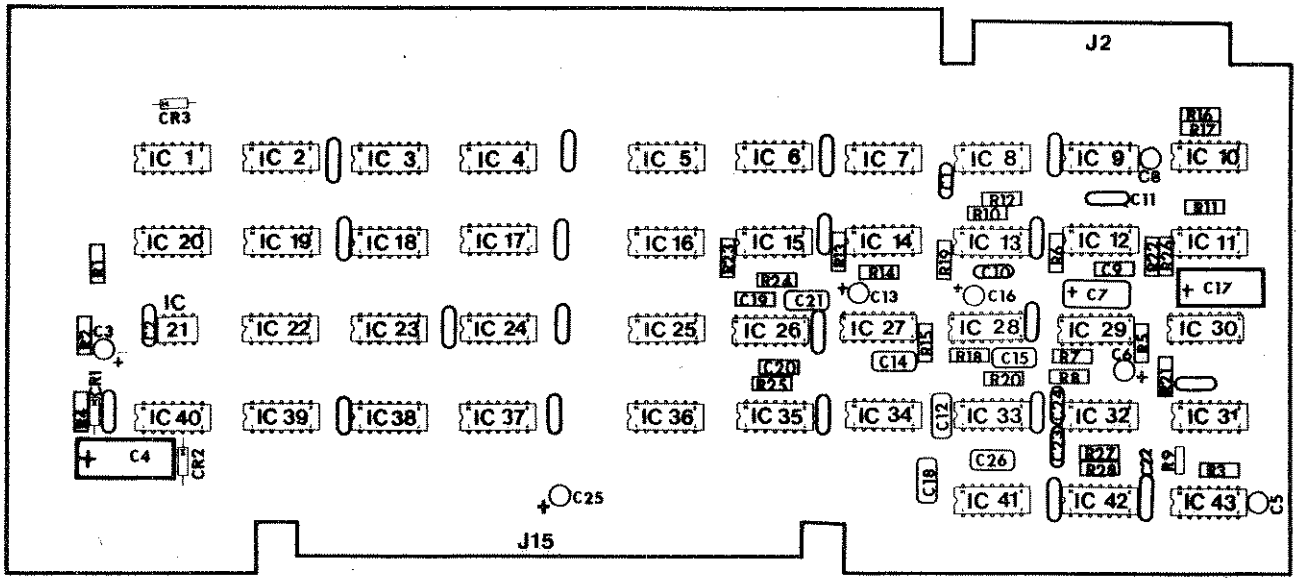
REF SCHEMATIC 39-109-001 SHT 8&9



BALANCE OF U119 LOCATED ON BACKBOARD ASSEMBLY 39-109-000

OUTPUT SENSE 39 107 000


K5
K4
PAO MOTHER BOARD
39 109 001-10
T2
REAR PANEL
MOV-1
MOV-2
MOV-3
CR3
CR4
CR5
CR6
-DC
VAC
L1 .1HY
L2 35HY
R1 1K
R2 330K
R3 330K
R4 1K
C1 .1uF
C2 .5uF
R5 10
SEE SCHEMATIC 39-109-001/6
R6 68.1K
R7 1K
R8 348
R9 10.1
R10 200
ADJ X0.00MV X.000MV
<100MV OUTPUT
OUTPUT LO
10V 1000MV
100MV 10MV
1000V 100V
OUTPUT
I OUT
I GUARD
RESISTANCE ARRAY
OHMS
FRONT PANEL 39 101 001-3
PG
LG
SG
SG'
R LO
<100MV LO
R34 100
C6 .01uF
OPERATE
V(.1+.01)
V(10+1)
-DC
VAC
V1000
V1000(.8A+.4A)
R35 100
C7 .01uF
V(100+1000)
+24
U-Q1
U-Q2
U-Q3
U-Q4
U-R1 100K
U-R2 1.47K
U-R3 3.48K
U-R4 619
U-R5 14.7K
U-R6 14.7K
U-CR1
+15V
-15V
1.8V
S5 SWITCH
BOT
S4 SWITCH ANALOG TYP
SELECT AT TEST FOR 1000mV 1-5kHz ≈ 2200pf
AR12-2
MSJ
U103
S5
U104
S4
U105
IC83
U106
U107
IC84
U108
C3
C4 680pf
C5 10pf
C8 150pf
R11 1K
R12 1
R13 21.5K
R14 ADJ X00.0MV
R15 5K
R16
R36 14.7
R17 348K ADJ X.000V
R18
R19 100K
R20 50K
R21 50K
R22 215
R23 215K ADJ X0.00V
R24
R25 1M
R26 500K
R27 500K
R28 2.15K
R29 1M ADJ X00.0V
R30
R31 1M
R32 1M
R33 1M
CR7
CR8 10K
CR9
CR10 10K
CR11
CR12 10K
CR13
CR14 10K
R+V(10+.1)
V100
V1000
SG
IC836 & IC84 PIN 10 PG
11 +15
12 -15
J6
J7
J8
D-ECN#58 - 4-26-80
E - 1-9-81
SCALE
DATE 2-5-80
APPROVED BY
DRAWN BY
ROTEK INSTRUMENT CORP.
OUTPUT SENSE SCHEMATIC
DRAWING NUMBER 39 107 001 I



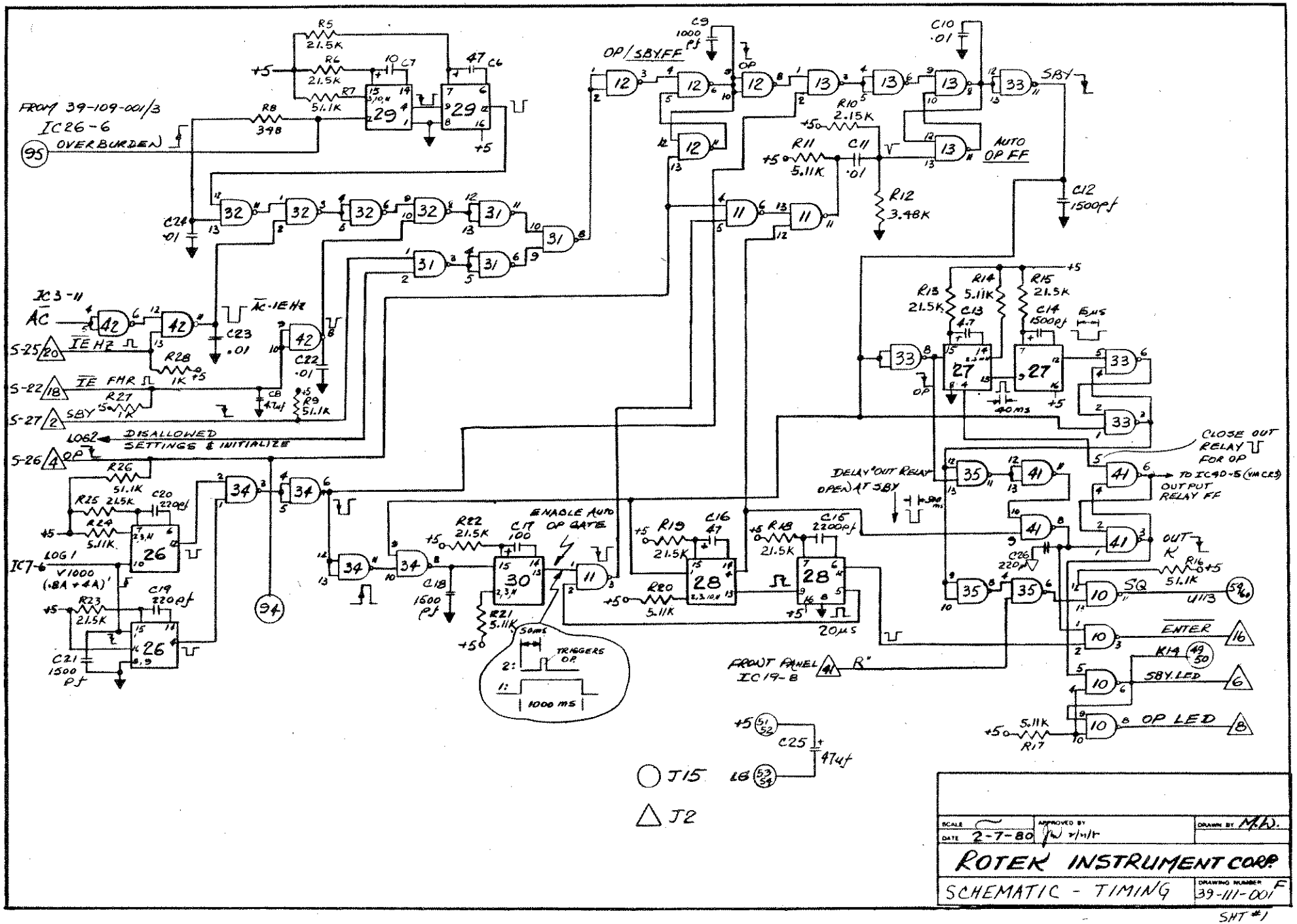
ALL UNMARKED CAPACITORS ARE .01

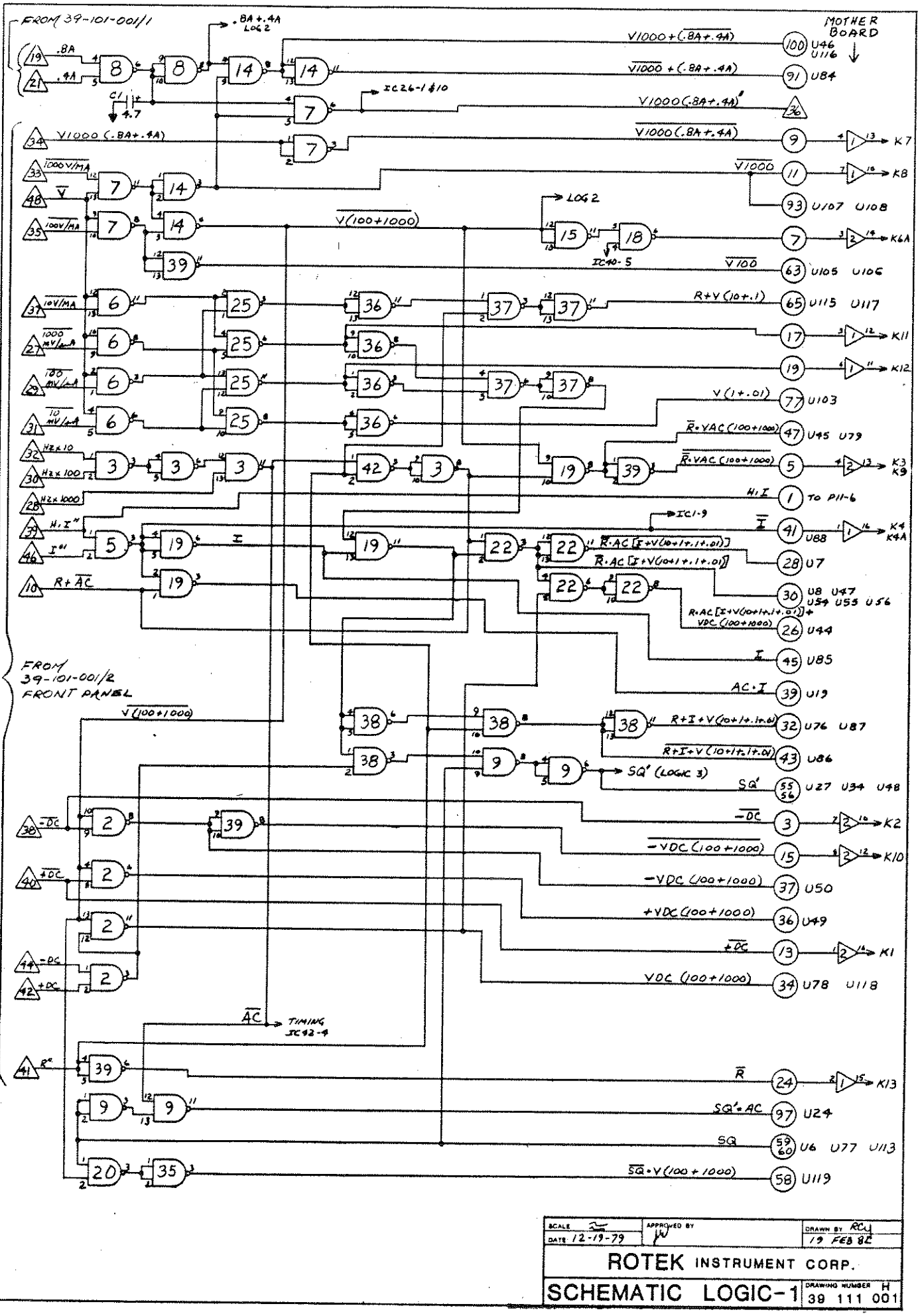
SCALE	APPROVED BY	DRAWN BY M W
DATE 10-24-79		26 JUNE 80

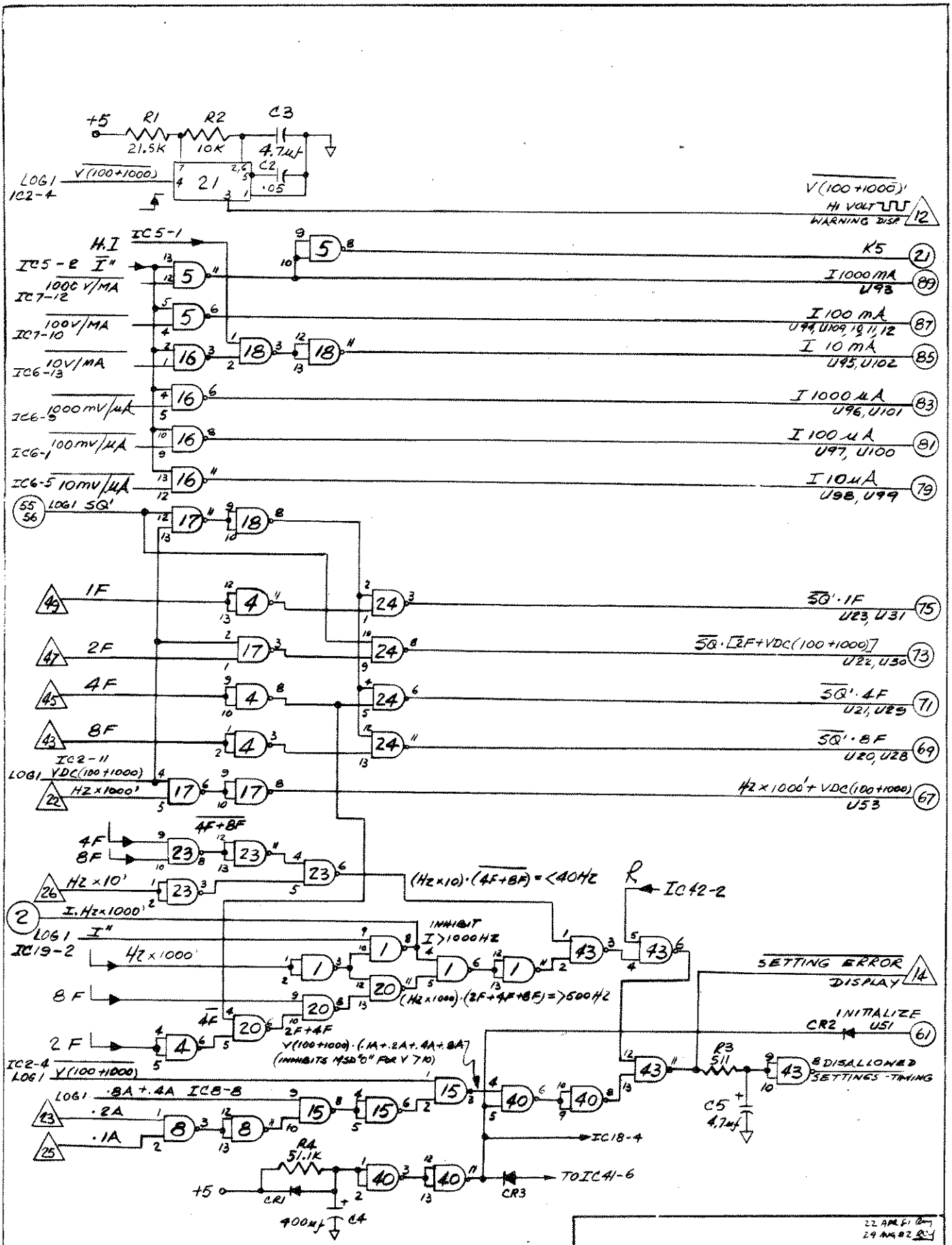
ROTEK INSTRUMENT CORP

LOGIC & TIMING – LOCATION

DRAWING NUMBER C
39-111-000


FROM 39-109-001/3
IC26-6
OVERBURDEN
OP/SBY FF
AUTO OP FF
SBY
AC
1E HZ
DISALLOWED SETTINGS & INITIALIZE
ENABLE AUTO OP GATE
TRIGGERS O.P.
50ms
1000 ms
20µs
40ms
CLOSE OUT RELAY FOR OP
DELAY OUT RELAY OPENS AT SBY
TO IC40-5 (VM CRT) OUTPUT RELAY FF
FRONT PANEL IC19-8
ENTER
SBY. LED
OP LED
SQ
OUT
J15
J2
SCHEMATIC - TIMING
ROTEK INSTRUMENT CORP.
DRAWING NUMBER 39-111-001 F
SHT #1


FROM 39-101-001/1
.8A
.4A
.8A+.4A LOG 2
C1 4.7
IC26-1 #10
V1000 (.8A+.4A)
1000 V/MA
V
100 V/MA
10 V/MA
1000 MV/MA
100 MV/MA
10 MV/MA
HZ x 10
HZ x 100
HZ x 1000
H.I"
I"
R+AC
I
FROM 39-101-001/2 FRONT PANEL
-DC
+DC
AC
TIMING IC42-4
R"
LOG 2
IC40-5
IC1-9
SQ' (LOGIC 3)
TO P11-6
MOTHER BOARD
V1000+(.8A+.4A)
V1000 + (.8A+.4A)
V1000(.8A+.4A)'
V(100+1000)
R+V(10+.1)
V(1+.01)
R·VAC(100+1000)
H.I
R·AC[I+V(10+1+.1+.01)]
R·AC[I+V(10+1+.1+.01)]+ VDC(100+1000)
AC·I
R+I+V(10+1+.1+.01)
SQ'
-VDC(100+1000)
+VDC(100+1000)
VDC(100+1000)
SQ'·AC
SQ
SQ·V(100+1000)
K7
K8
K6A
K11
K12
K3
K9
K4
K4A
K2
K10
K1
K13
U46 U116
U84
U107 U108
U105 U106
U115 U117
U103
U45 U79
U88
U7
U8 U47 U54 U55 U56
U44
U85
U19
U76 U87
U86
U27 U34 U48
U50
U49
U78 U118
U6 U77 U113
U24
U119
SCALE
DATE 12-19-79
APPROVED BY
DRAWN BY RCL 19 FEB 82
ROTEK INSTRUMENT CORP.
SCHEMATIC LOGIC-1
DRAWING NUMBER H 39 111 001
SHT 2



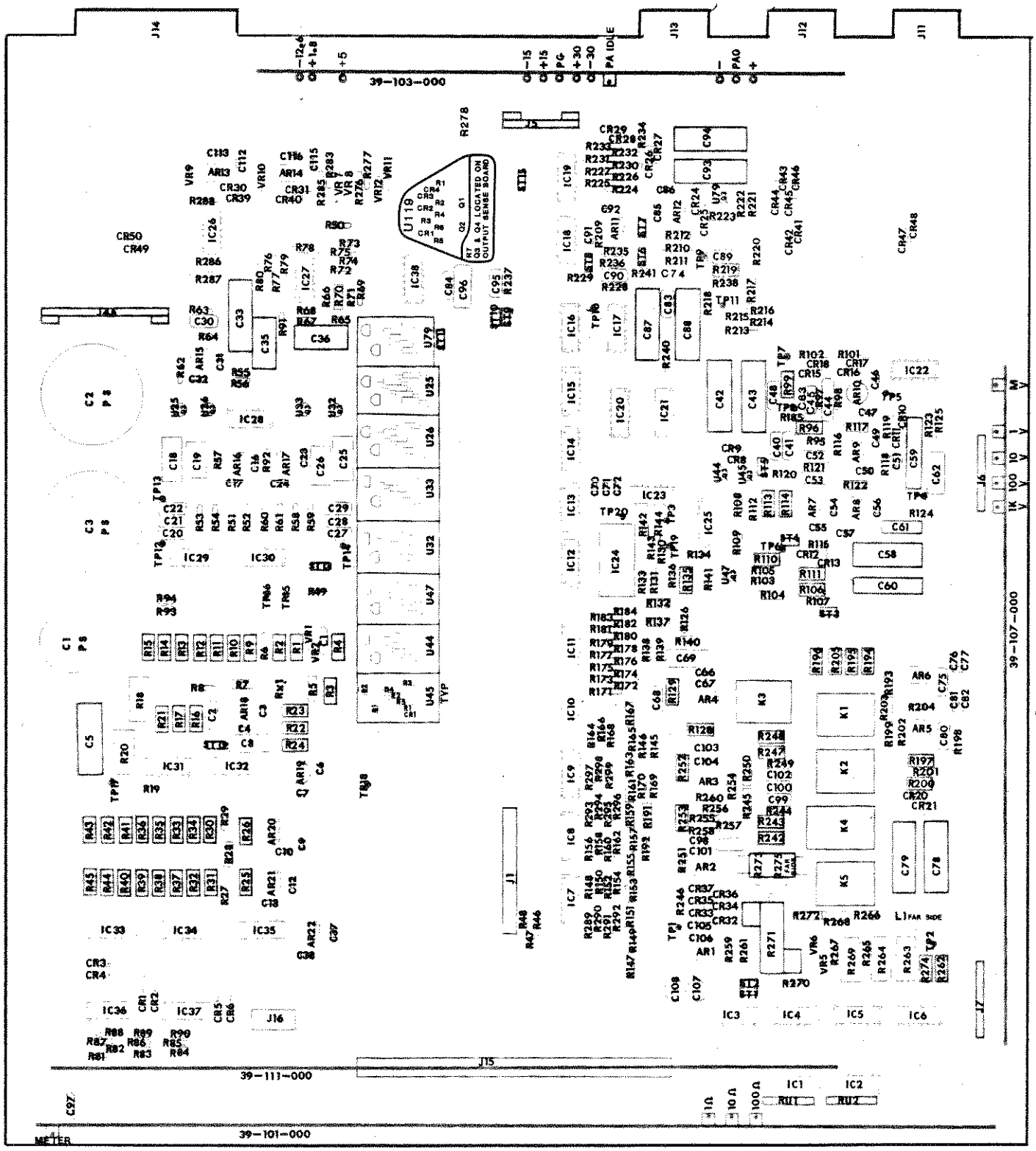
SIZE	APPROVED BY	DRAWN BY M.W.
DATE 12-19-79		

ROTEK INSTRUMENT CORP.

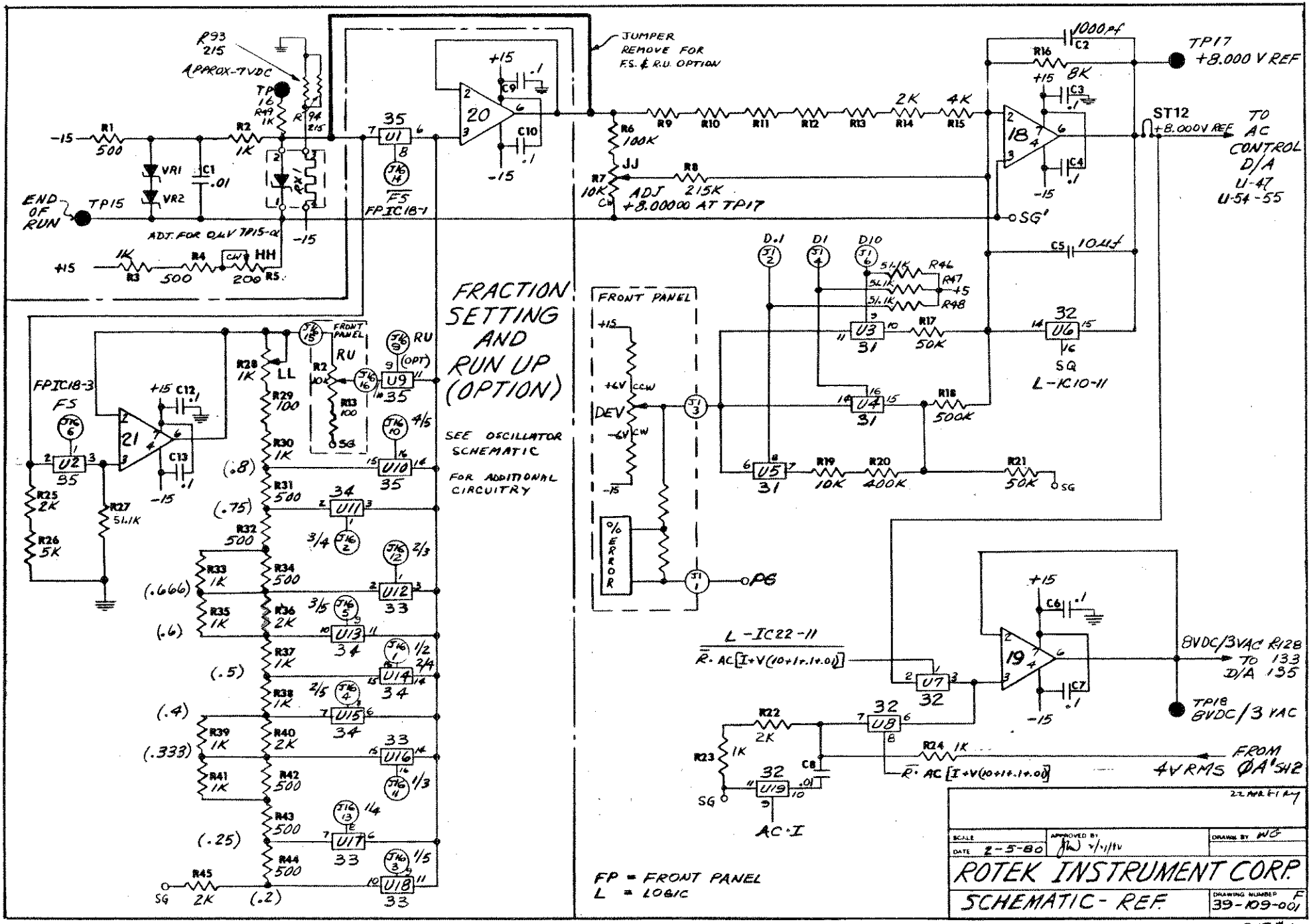
SCHEMATIC - LOGIC 2

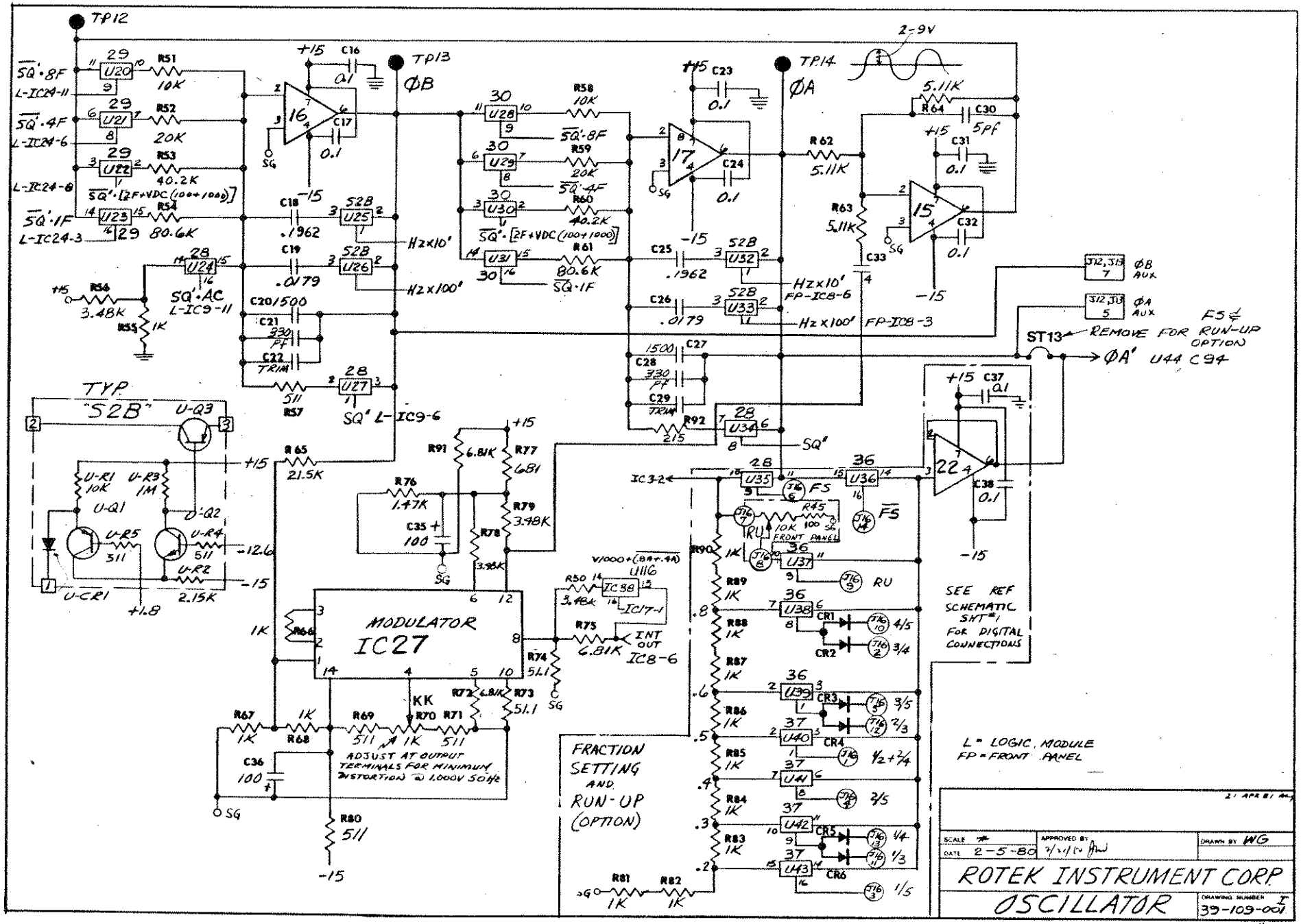
DRAWING NUMBER 39-111-001 G

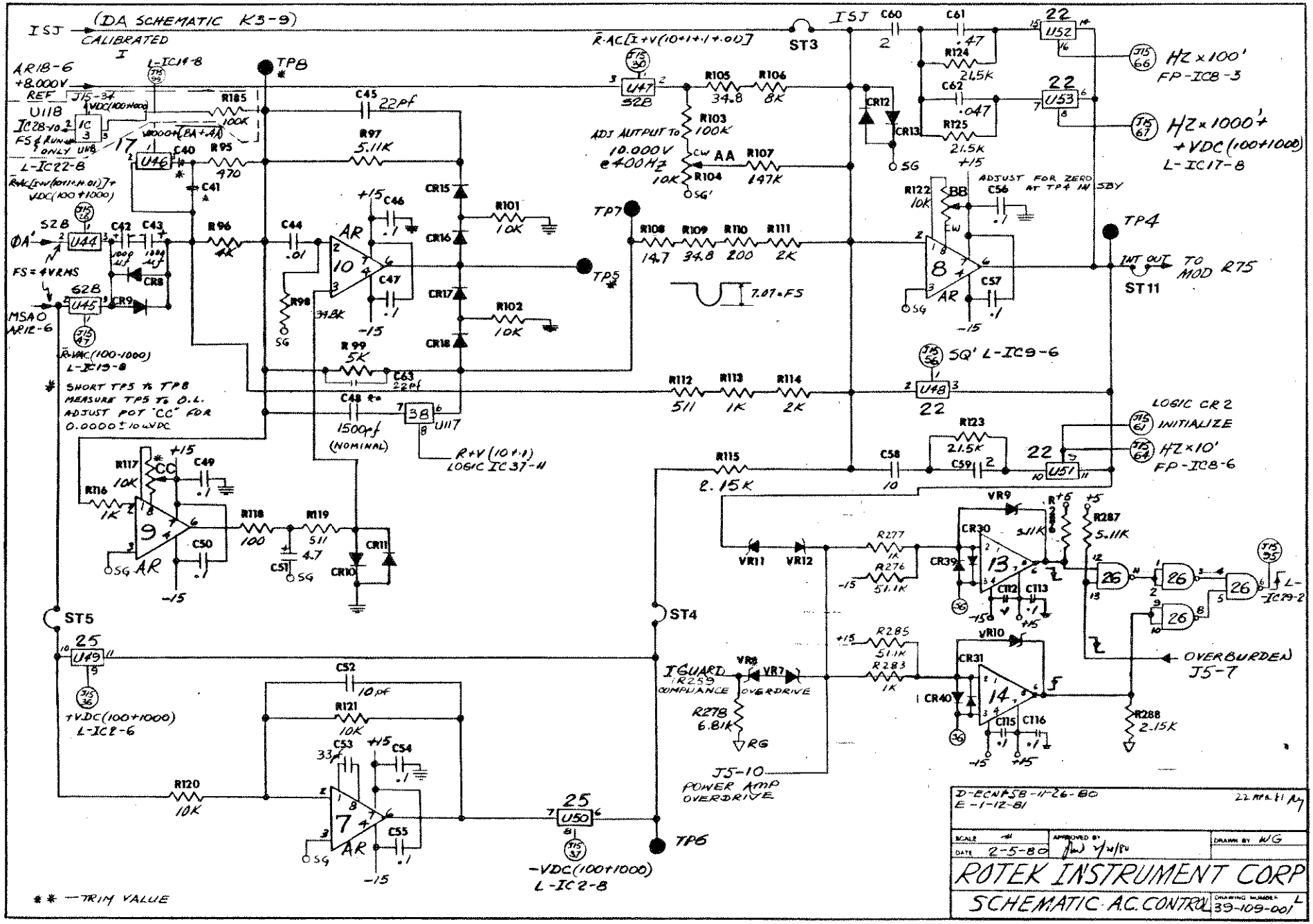
SHT #3

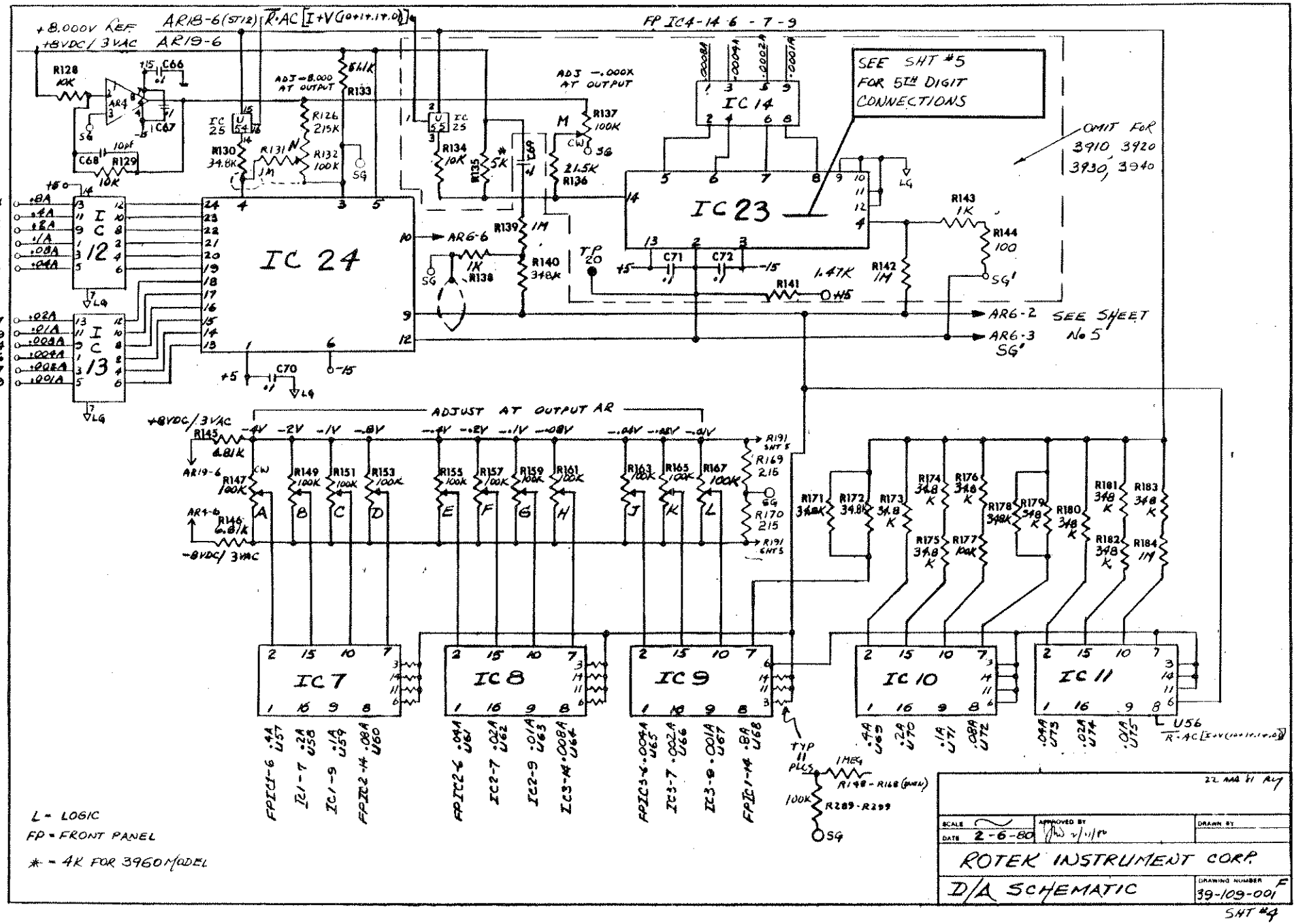


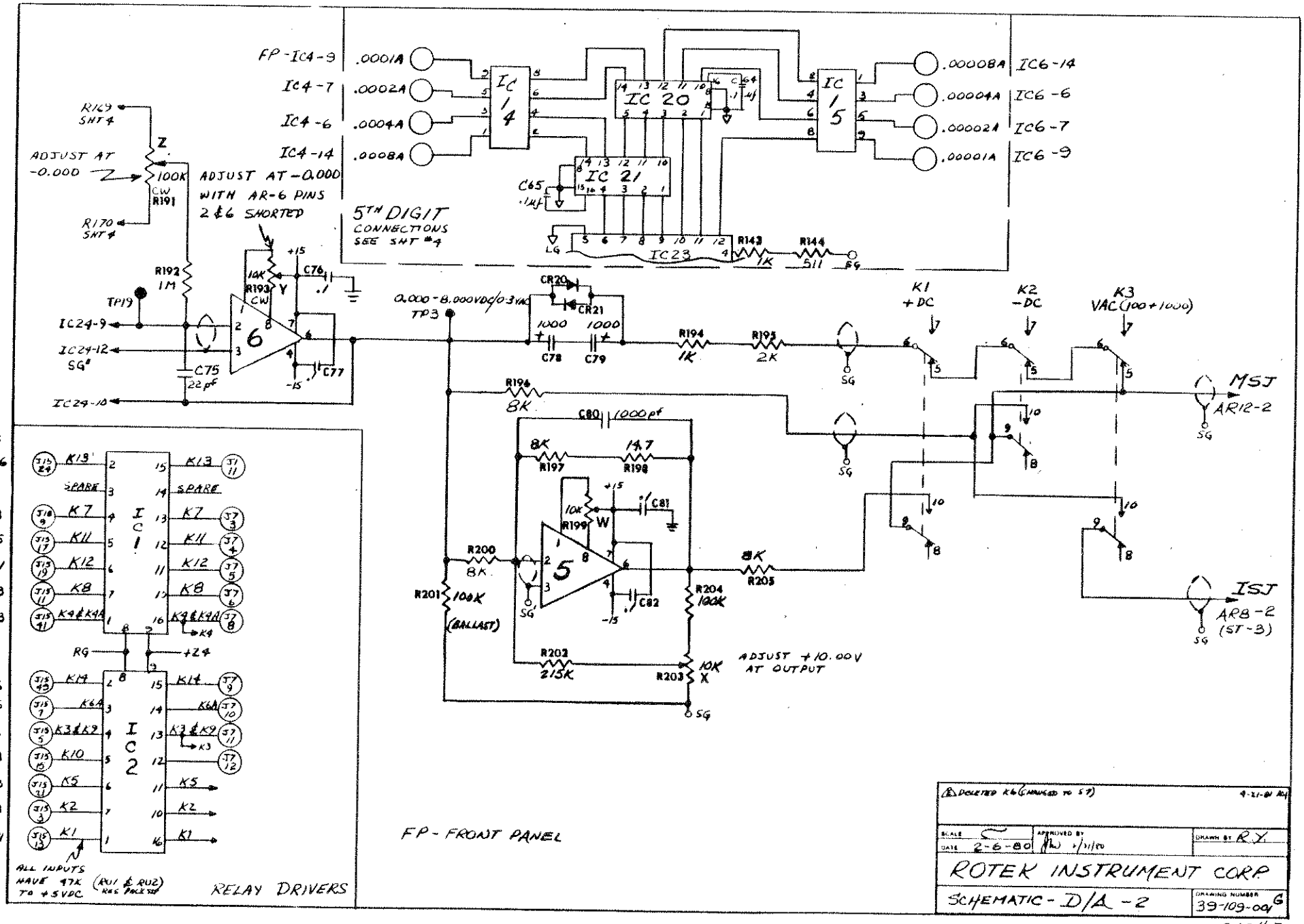
BACKBOARD ASS'Y 39-109-000

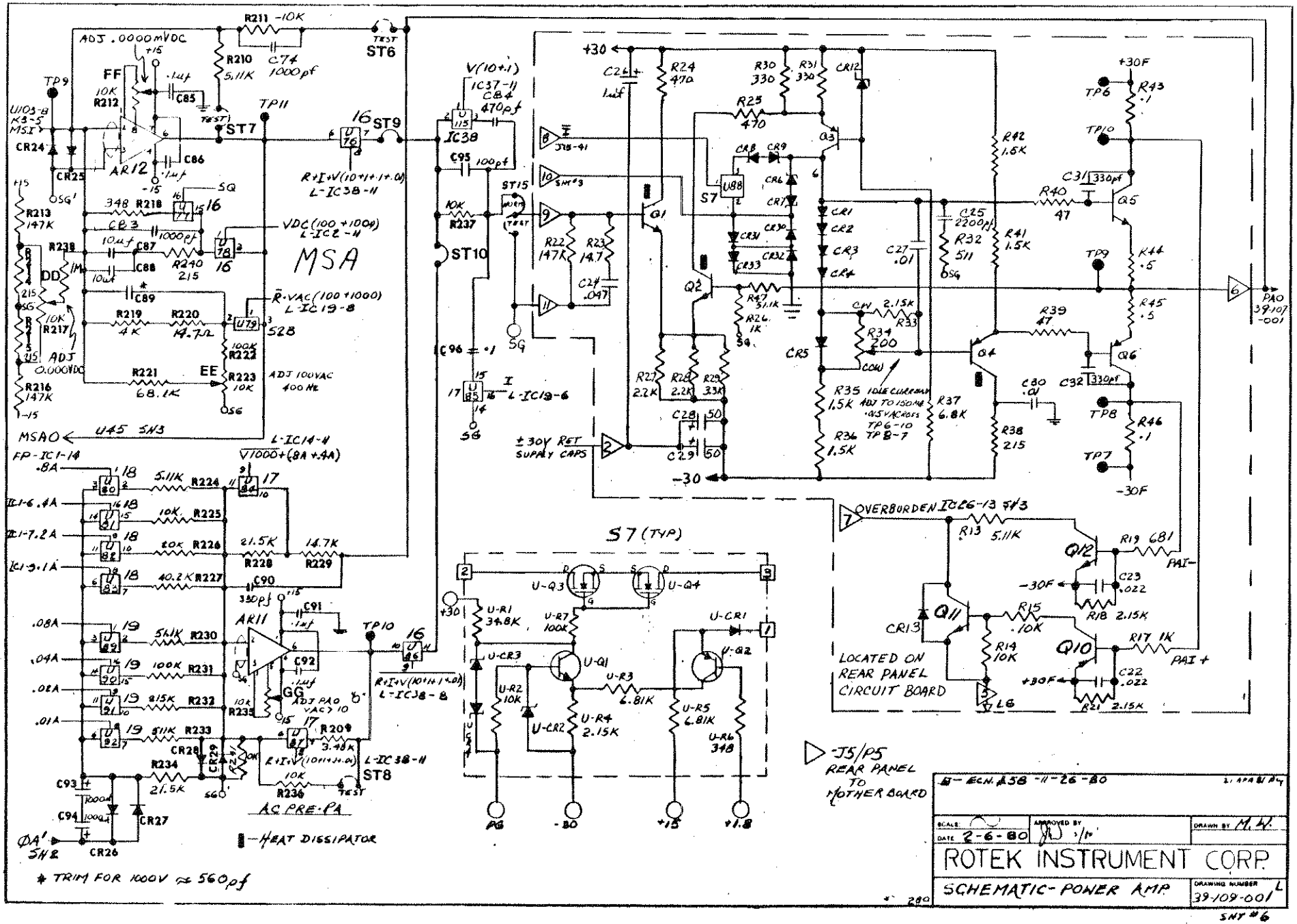

FRACTION SETTING AND RUN UP (OPTION)
SEE OSCILLATOR SCHEMATIC FOR ADDITIONAL CIRCUITRY
FRONT PANEL
JUMPER REMOVE FOR F.S. & R.U. OPTION
R93 215
APPROX -7VDC
TP16
R99 1K
R94 215
-15
R1 500
R2 1K
VR1
VR2
C1 .01
END OF RUN
TP15
ADJ. FOR 0.4V TP15-Q
+15
R3 1K
R4 500
R5 200
U1 35
FS FP IC18-1
+15 C9 .1
C10 .1
-15
R6 100K
R7 10K CW
JJ
R8 215K
ADJ +8.00000 AT TP17
R9 R10 R11 R12 R13 2K R14 4K R15
R16 8K
C2 1000pf
C3 .1
C4 .1
TP17 +8.000 V REF
ST12 +8.000V REF
TO AC CONTROL D/A U-47 U-54-55
SG'
C5 10µf
D.1 D1 D10
R46 51.1K
R47 51.1K
R48 51.1K
+5
U3 31
R17 50K
U6 32 Vc SQ
L-IC10-11
U4 31
R18 500K
U5 31
R19 10K
R20 400K
R21 50K
SG
FRONT PANEL
+15
+6V CCW
DEV
-6V CW
-15
% ERROR
PS
FPIC18-3 FS
U2 35
C12 .1
C13 .1
R25 2K
R26 5K
R27 51.1K
R28 1K
LL
R29 100
R30 1K
R31 500
R32 500
R33 1K
R34 500
R35 1K
R36 2K
R37 1K
R38 1K
R39 1K
R40 2K
R41 1K
R42 500
R43 500
R44 500
R45 2K
SG
(.8)
(.75)
(.666)
(.6)
(.5)
(.4)
(.333)
(.25)
(.2)
RU
R12 10K
R13 100
U9 35
U10 35
U11 34
U12 33
U13 34
U14 34
U15 34
U16 33
U17 33
U18 33
3/4
2/3
3/5
1/2
2/5
1/3
1/4
1/5
4/5
L-IC22-11
R. AC [I+V(10+1+.1+.01)]
+15
C6 .1
C7 .1
-15
U7 32
U8 32
U19 32
R22 2K
R23 1K
R24 1K
C8 .01
R. AC [I+V(10+1+.1+.01)]
AC·I
8VDC/3VAC R128 TO 133 D/A 135
TP18 8VDC/3 VAC
FROM 4V RMS ØA'SH2
FP = FRONT PANEL
L = LOGIC
SCALE
DATE 2-5-80
APPROVED BY
DRAWN BY WG
ROTEK INSTRUMENT CORP.
SCHEMATIC - REF.
DRAWING NUMBER F 39-109-001
SNT 1

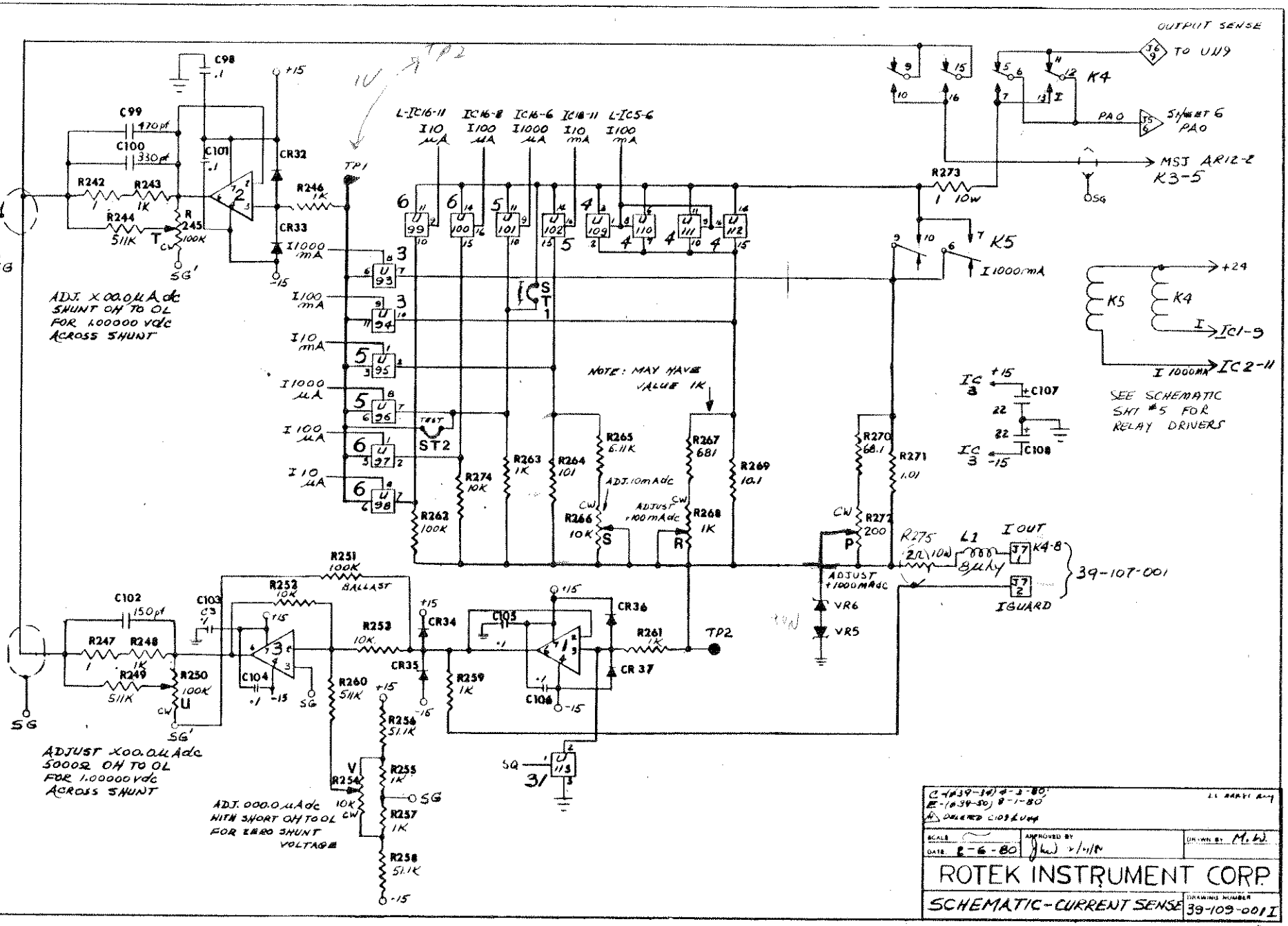

TP12
TP13
ΦB
TP14
ΦA
2-9V
SQ'·8F
L-IC24-11
SQ'·4F
L-IC24-6
L-IC24-8
SQ'·[2F+VDC(100+1000)]
SQ'·1F
L-IC24-3
SQ'·AC
L-IC9-11
Hz×10'
Hz×100'
SQ' L-IC9-6
FP-IC8-6
FP-IC8-3
ΦB AUX
ΦA AUX
FS
ST13
REMOVE FOR RUN-UP OPTION
ΦA' U44 C94
TYP "S2B"
U-Q3
U-Q1
U-Q2
U-CR1
+1.8
-12.6
-15
+15
MODULATOR IC27
IC27-1
IC8-6
INT OUT
KK
ADJUST AT OUTPUT TERMINALS FOR MINIMUM DISTORTION @ 1000V 50Hz
FRACTION SETTING AND RUN-UP (OPTION)
SQ'
FS
RU
FRONT PANEL
SEE REF SCHEMATIC SHT #1 FOR DIGITAL CONNECTIONS
L = LOGIC MODULE
FP = FRONT PANEL
SG
ROTEK INSTRUMENT CORP.
OSCILLATOR
39-109-001
SHT #2

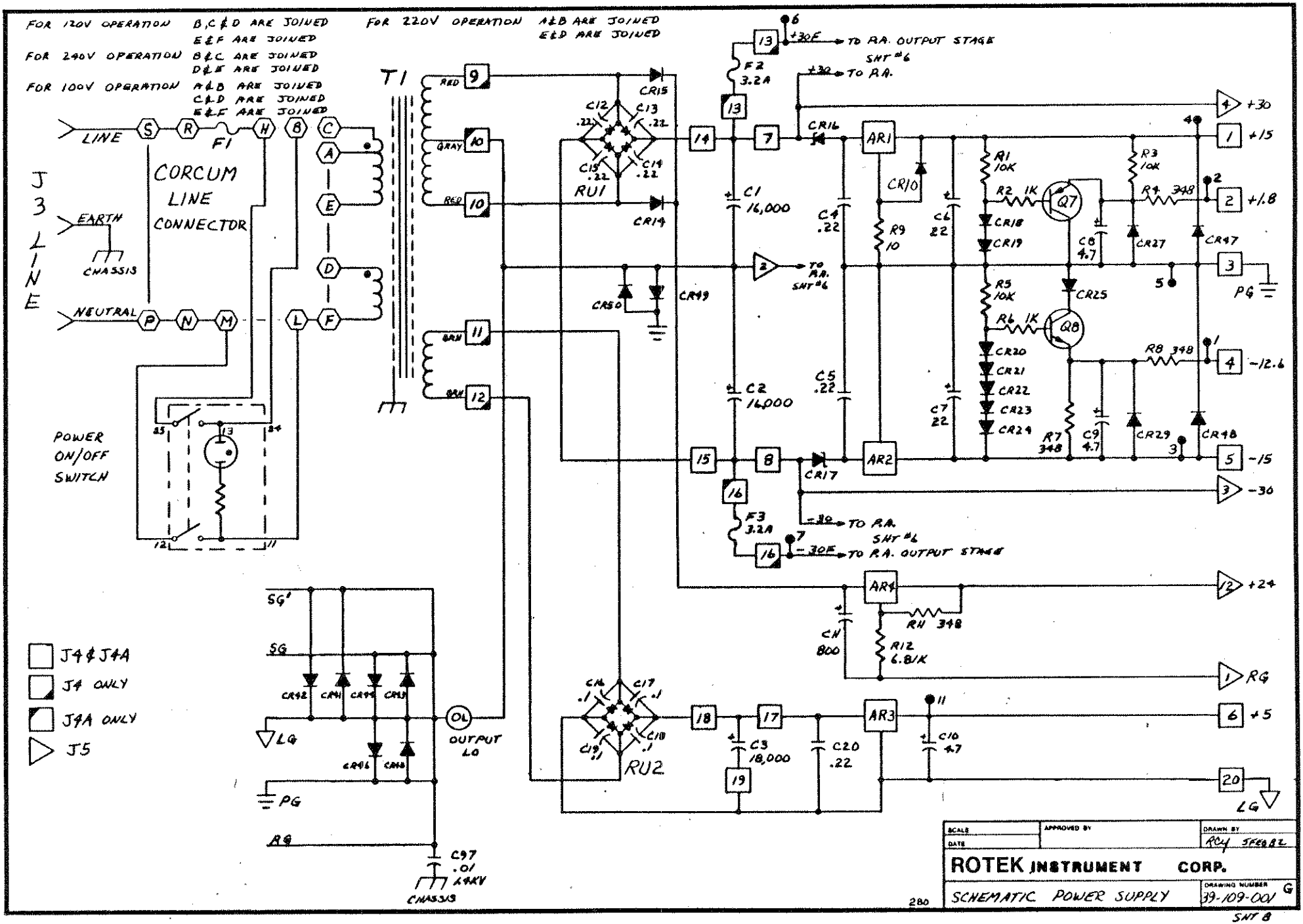

(DA SCHEMATIC K3-9)
ISJ
CALIBRATED
I
AR18-6
+8.000V
REF
U118
L-IC19-8
TPB
ST3
ISJ
C60
C61
R124
21.5K
C62
.047
R125
21.5K
HZ x 100'
FP-IC8-3
HZ x 1000'
+VDC (100+1000)
L-IC17-8
R105
34.8
R106
8K
R103
100K
ADJ AUTPUT TO
10.000V
@400Hz
R104
10K
R107
147K
CR12
CR13
+15
ADJUST FOR ZERO
AT TP4 IN SBY
R122
10K
C56
TP7
TP4
TP5
R108
14.7
R109
34.8
R110
200
R111
2K
7.07=FS
INT OUT TO MOD R75
ST11
R185
100K
C45
22pf
R97
5.11K
C40
R95
470
C41
R96
4K
C44
.01
R98
34.8K
C46
.1
C47
.1
CR15
CR16
CR17
CR18
R101
10K
R102
10K
R99
5K
C43
22pf
C48 Ra
1500pf
(NOMINAL)
R+V (10:1)
LOGIC IC37-11
FS = 4VRMS
MSAO
AR12-6
SHORT TP5 & TPB
MEASURE TP5 TO O.L.
ADJUST POT "CC" FOR
0.0000 ± 10uVDC
R112
511
R113
1K
R114
2K
5Q' L-IC9-6
LOGIC CR2
INITIALIZE
HZ x 10'
FP-IC8-6
R123
21.5K
C59
R115
2.15K
C58
10
R117
CC
10K
C49
.1
R116
1K
R118
100
R119
511
C51
4.7
CR10
CR11
C50
.1
ST5
ST4
VR9
VR11
VR12
R277
1K
R276
51.1K
CR30
CR39
R287
5.11K
C112
C113
.1
OVERBURDEN
J5-7
L-IC29-2
IGUARD
(R259
COMPLIANCE
VR8
VR7
OVERDRIVE
R278
6.81K
RG
J5-10
POWER AMP
OVERDRIVE
R285
51.1K
R283
1K
VR10
CR31
CR40
C115
C116
R288
2.15K
C52
10pf
R121
10K
C53
33pf
C54
.1
C55
.1
R120
10K
TP6
-VDC(100+1000)
L-IC2-8
+VDC(100+1000)
L-IC2-6
D-ECN#SB-11-26-80
E-1-12-81
SCALE
DATE 2-5-80
APPROVED BY
DRAWN BY WG
ROTEK INSTRUMENT CORP
SCHEMATIC A.C. CONTROL
DRAWING NUMBER 39-109-001 L
SHT #3
** — TRIM VALUE

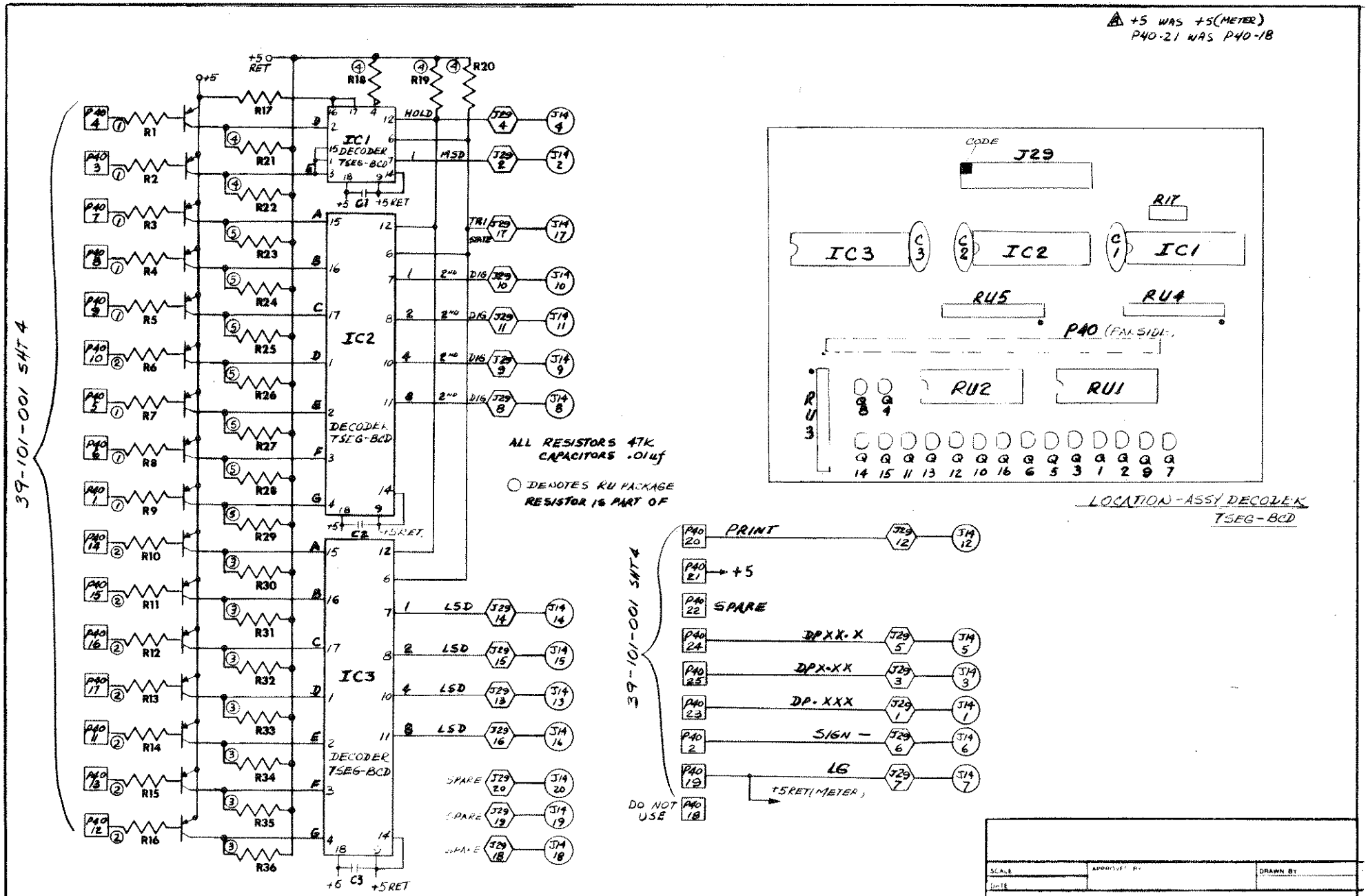

+8.000V REF
+8VDC/3VAC
AR18-6(ST12)
AR19-6
FP IC4-14 6 - 7 - 9
SEE SHT #5 FOR 5TH DIGIT CONNECTIONS
OMIT FOR 3910 3920 3930, 3940
IC 14
IC 23
IC 24
IC 12
IC 13
IC 7
IC 8
IC 9
IC 10
IC 11
ADJUST AT OUTPUT AR
AR6-2
AR6-3
SEE SHEET No 5
L = LOGIC
FP = FRONT PANEL
* = 4K FOR 3960 MODEL
ROTEK INSTRUMENT CORP.
D/A SCHEMATIC
39-109-001 F
SHT #4
6-19

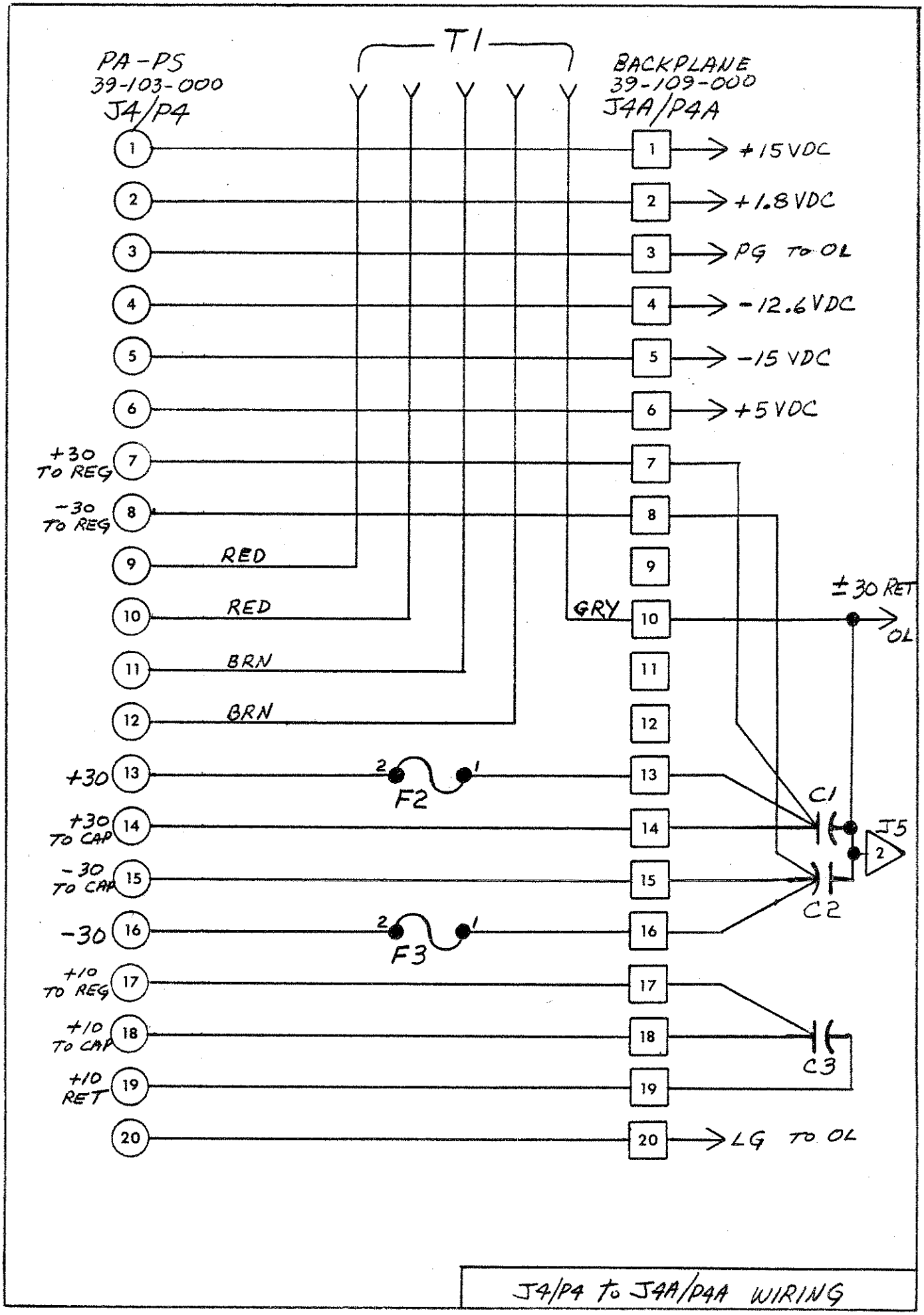

FP-IC4-9
.0001A
IC4-7
.0002A
IC4-6
.0004A
IC4-14
.0008A
IC 1/4
IC 20
IC 21
IC23
IC 1/5
.00008A
IC6-14
.00004A
IC6-6
.00002A
IC6-7
.00001A
IC6-9
5TH DIGIT
CONNECTIONS
SEE SHT #4
R169
SHT 4
ADJUST AT
-0.000
Z
100K
CW
R191
R170
SHT 4
ADJUST AT -0.000
WITH AR-6 PINS
2 & 6 SHORTED
R192
1M
TP19
IC24-9
IC24-12
SG
IC24-10
C75
22pF
C76
.1
C77
R193
10K
CW
Y
+15
-15
0.000 - 8.000VDC/0.3VAC
TP3
CR20
CR21
C78
1000
C79
1000
R194
1K
R195
2K
R196
8K
C80
1000pF
R197
8K
R198
14.7
R199
10K
W
C81
R200
8K
R201
100K
(BALLAST)
C82
R202
215K
R203
10K
X
R204
100K
R205
8K
ADJUST +10.00V
AT OUTPUT
K1
+DC
K2
-DC
K3
VAC (100+1000)
MSJ
AR12-2
ISJ
AR8-2
(ST-3)
SG
IC 1
IC 2
K13
SPARE
K7
K11
K12
K8
K9 & K9A
K14
K6A
K3 & K9
K10
K5
K2
K1
RG
+24
ALL INPUTS
HAVE 47K
TO +5VDC
(RU1 & RU2)
RELAY DRIVERS
FP - FRONT PANEL
DELETED K6 (CHANGED TO ST)
4-21-80 RH
SCALE
DATE 2-6-80
APPROVED BY
DRAWN BY RX
ROTEK INSTRUMENT CORP.
SCHEMATIC - D/A - 2
DRAWING NUMBER
39-109-004 G
SHT #5


ADJ .0000mVDC
R211 -10K
R210 5.11K
C74 1000pf
ST6
TP9
FF
R212 10K
C85 .1uf
TP11
ST7
AR12
C86 .1uf
CR24
CR25
SG'
R213 147K
348 R218
CR3
10uf
1000pf
C87
C88 10uf
R240 215
R238 1M
DD
215
SG
R217 10K
ADJ 0.000VDC
R216 147K
C89
R219 4K
R220 14.7K
R221 68.1K
EE
R223 10K
R222 100K
ADJ 100VAC 400 Hz
SG
MSA
VDC(100 +100) L-IC2-11
R·VAC(100 +1000) L-IC19-8
S28
MSA0 U45 SH3
L-IC14-4
FP-IC1-14 .8A
IC1-6.4A
IC1-7.2A
IC1-9.1A
R224 5.11K
R225 10K
R226 10K
R227 40.2K
R228 21.5K
R229 14.7K
C90 330pf
C91 .1uf
AR11
C92 .1uf
GG
ADJ PAO VAC) 10
R235 10K
R209 3.48K
R236 10K
R+I+V(10++1.0) L-IC38-8
L-IC38-11
ST8
AC PRE-PA
HEAT DISSIPATOR
.08A
.04A
.02A
.01A
R230 5.11K
R231 100K
R232 215K
R233 5.11K
CR28
CR29
R234 21.5K
C93 1000uf
C94 100uf
CR27
CR26
ΦA' SH2
* TRIM FOR 1000V ≈ 560pf
R+I+V(10++1.0) L-IC38-11
ST9
V(10+1) IC37-11
C84 470pf
IC38
C95 100pf
R237 10K
ST15
ST10
C96 .1
SG
I L-IC19-6
+30
C24 1uf
R24 470
R30 330
R31 330
CR12
R25 470
318-91
SHT#3
Q3
CR8
CR9
S7
U88
CR6
CR7
CR1
CR2
CR3
CR4
CR30
CR31
CR32
CR33
Q1
R22 147K
R23 14.7
C24 .047
Q2
R47 5.11K
R26 1K
SG
CR5
R27 2.2K
R28 2.2K
R29 33K
C28 50
C29 50
±30V REG SUPPLY CAPS
-30
C25 2200pf
R32 511
SG
R42 1.6K
R41 1.5K
C27 .01
CW 2.15K
R33
R34 200
CCW
R35 IDLE CURRENT 1.5K ADJ TO 150MA 0.45VAC across TP6-10 TP8-7
R36 1.5K
R37 6.8K
R38 215
Q4
R39 47
C80 .01
C31 330pf
R40 47
Q5
TP6
TP10
+30F
R43 .1
TP9
R44 .5
R45 .5
C32 330pf
Q6
TP8
R46 .1
TP7
-30F
PAO 39-107 -001
OVERBURDEN IC26-13 SH3
R13 5.11K
Q12
R19 681
PAI-
C23 .022
R18 2.15K
-30F
Q11
CR13
R15 10K
R14 10K
Q10
R17 1K
PAI+
+30F
C22 .022
R21 2.15K
L6
LOCATED ON REAR PANEL CIRCUIT BOARD
S7 (TYP)
U-Q3
U-Q4
U-R1 34.8K
U-R7 100K
U-CR1
U-CR3
U-Q1
U-Q2
U-R3 6.81K
U-R2 10K
U-CR2
U-R4 2.15K
U-R5 6.81K
U-R6 348
+30
PG
-30
+15
+1.8
-J5/P5 REAR PANEL TO MOTHER BOARD
B- ECN #38 -11-26-80
SCALE
DATE 2-6-80
APPROVED BY
DRAWN BY M.M.
ROTEK INSTRUMENT CORP.
SCHEMATIC-POWER AMP
DRAWING NUMBER 39-109-001 L
SHT #6


OUTPUT SENSE
TO U19
K4
PAO
SHEET 6 PAO
MSJ AR12-2 K3-5
K5
I 1000mA
+24
K5
K4
I
IC1-9
I 1000mA IC2-11
SEE SCHEMATIC SHT #5 FOR RELAY DRIVERS
C98 .1
C99 470pf
C100 330pf
C101 .1
R242 1
R243 1K
R244 511K
R245 100K
CR32
CR33
R246 1K
TP1
L-IC16-11 I10 µA
IC16-8 I100 µA
IC16-6 I1000 µA
IC18-11 I10 mA
L-IC5-6 I100 mA
R273 1 10w
I1000mA
I100 mA
I10 mA
I1000 µA
I100 µA
I10 µA
ST1
ST2
TEST
NOTE: MAY HAVE VALUE 1K
R262 100K
R263 1K
R264 101
R265 6.11K
R266 10K
R267 681
R268 1K
R269 10.1
R270 68.1
R271 1.01
R272 200
ADJ. 10mA dc
ADJUST +100mA dc
ADJUST +1000mA dc
R274 10K
R275 2Ω 10W
L1 880 µHy
I OUT
K4-8
IGUARD
39-107-001
VR6
VR5
IC 3 +15
IC 3 -15
C107 22
C108 22
ADJ. X00.0 µA dc SHUNT ON TO OL FOR 1.00000 vdc ACROSS SHUNT
C102 150pf
C103 .1
C104 .1
R247 1
R248 1K
R249 511K
R250 100K
R251 100K BALLAST
R252 10K
R253 10K
C105 .1
C106 .1
CR34
CR35
CR36
CR37
R259 1K
R260 511K
R261 1K
TD2
ADJUST X00.0 µA dc 5000Ω ON TO OL FOR 1.00000 vdc ACROSS SHUNT
R254 10K
R255 1K
R256 51.1K
R257 1K
R258 51.1K
ADJ. 000.0 µA dc WITH SHORT ON TO OL FOR ZERO SHUNT VOLTAGE
SG
SG'
+15
-15
C = (#39-34) 8-3-80
E = (#39-30) 8-1-80
DELETED C103 & U14
ROTEK INSTRUMENT CORP.
SCHEMATIC-CURRENT SENSE
DRAWING NUMBER 39-109-001 I
SCALE
DATE 8-6-80
APPROVED BY
DRAWN BY M. W.


FOR 120V OPERATION B,C & D ARE JOINED
E & F ARE JOINED
FOR 240V OPERATION B & C ARE JOINED
D & E ARE JOINED
FOR 100V OPERATION A & B ARE JOINED
C & D ARE JOINED
E & F ARE JOINED
FOR 220V OPERATION A & B ARE JOINED
E & D ARE JOINED
J3 LINE
LINE
EARTH
CHASSIS
NEUTRAL
CORCUM LINE CONNECTOR
F1
T1
POWER ON/OFF SWITCH
RU1
RU2
C1 16,000
C2 16,000
C3 18,000
C4 .22
C5 .22
C6 22
C7 22
C8 4.7
C9 4.7
C10 4.7
C11 .1
C12 .22
C13 .22
C14 .22
C15 .22
C16 .1
C17 .1
C18 .1
C19 .1
C20 .22
CN 800
C97 .01 1.4KV
CR1 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR20 CR21 CR22 CR23 CR24 CR25 CR27 CR29 CR47 CR48 CR49 CR50
AR1 AR2 AR3 AR4
Q7 Q8
R1 10K
R2 1K
R3 10K
R4 348
R5 10K
R6 1K
R7 348
R8 348
R9 10
R11 348
R12 6.8K
F2 3.2A
F3 3.2A
+30 TO R.A. OUTPUT STAGE SHT #6
+30 TO R.A.
-30 TO R.A. SHT #6
-30E TO R.A. OUTPUT STAGE
TO R.A. SHT #6
+30
+15
+1.8
PG
-12.6
-15
-30
+24
RG
+5
LG
OUTPUT LO
J4 & J4A
J4 ONLY
J4A ONLY
J5
ROTEK INSTRUMENT CORP.
SCHEMATIC POWER SUPPLY
39-109-001 G
SHT 8


39-101-001 SHT 4
+5 RET
+5
R18
R19
R20
R17
IC1 DECODER 7SEG-BCD
HOLD
MSD
C1
+5 RET
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R21
R22
R23
R24
R25
R26
R27
R28
R29
R30
R31
R32
R33
R34
R35
R36
IC2
DECODER 7SEG-BCD
TRI STATE
2ND DIG
IC3
DECODER 7SEG-BCD
LSD
SPARE
C2
C3
+6
+5 RET
ALL RESISTORS 47K
CAPACITORS .01uf
DENOTES RU PACKAGE
RESISTOR IS PART OF
CODE
J29
R17
IC3
IC2
IC1
RU5
RU4
P40 (PARTSIDE)
RU2
RU1
RU3
LOCATION - ASSY DECODER 7SEG-BCD
39-101-001 SHT 4
PRINT
+5
SPARE
DPXX.X
DPX.XX
DP.XXX
SIGN —
LG
+5RET(METER)
DO NOT USE
+5 WAS +5(METER)
P40-21 WAS P40-18
ROTEK INSTRUMENT CORP.
SCHEMATIC-DECODER
DRAWING NUMBER 06-200-001
3900 BCD OPTION



J4/P4 to J4A/P4A WIRING

J11 350 Connections

1		2		
3	Chassis	4	Hz x 1000'	(J15-2)
5	PG	6	Hi I"	(J15-1)
7		8		
9		10	LG	
11		12	I Guard	
13	I Guard	14	I in	
15	I Guard	16	I Guard	
17		18	PG	
19		20		

J12 360 Connections

1		2		
3		4		
5	ØA	6	SG	
7	ØB	8	I	
9	Hz x 10' (J15-64)	10	SG	
11		12		
13		14		
15		16		
17		18		
19		20		