Operating and Maintenance Manual

MODEL 6880A

10Hz to 110kHz
Programmable Distortion Analyzer

KROHN-HITE CORPORATION

10Hz TO 110kHz

PROGRAMMABLE

DISTORTION ANALYZER

MODEL 6880A SERIAL NO._____

OPERATING AND MAINTENANCE MANUAL

011990

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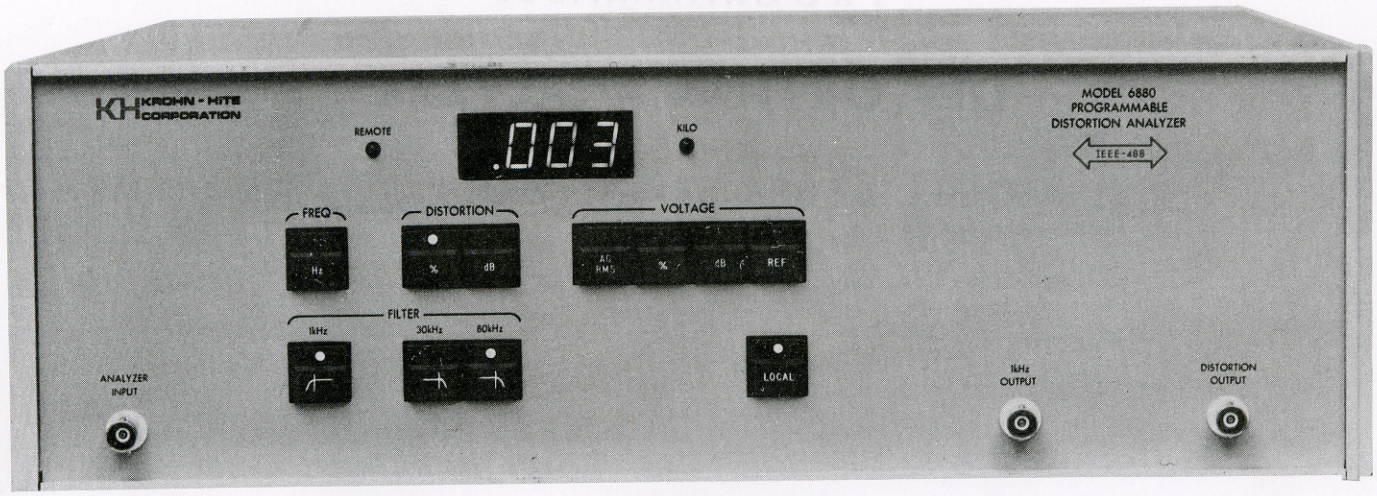

Figure 1. Model 6880 Programmable Distortion Analyzer

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SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

The Krohn-Hite Model 6880, shown in Figure 1, is a totally automatic Programmable Distortion Analyzer designed for benchtop and ATE sustems testing of high performane audio and high fidelity equipment.

The 6880 combines a low distortion analyzer, ac voltmeter and frequency counter into one instrument and covers the frequency range from 10Hz to 110kHz (1Hz optional). All measurement capabilities are simple to use and are controlled by an internal microprocessor. Press a key or send a simple command to obtain maximum resolution and accuracy of desired measurement.

As a distortion analyzer, the 6880 measures total harmonic distortion, in percent or dB, down to .003% (-90dB), with .001% (0.1dB) resolution for any input level from 0.1 volts to 130 volts rms. The 6880 doesn't require any manual tuning of frequency; it automatically tunes itself to the frequency of the external signal over the entire range. The unique Auto Set Level feature completely eliminates any need to preset an amplitude reference for any input level. The fast settling time allows most distortion measurements to be made in less than 2 seconds. Switch-selectable high and low pass filters are provided to reduce the effects of hum and noise during distortion measurements.

As an ac voltmeter, the 6880 provides rms voltage measurments (average responding) between 0.1 volts and 130 volts rms. Accuracy is typically 2% (0.2dB). The 6880 also provides deviation measurements, in percent or dB, with respect to either its internal reference of 0dBm (1mW into 600 ohms) or any selected reference.

As a frequency counter, the 6880 will display the fundamental input frequency from <1.0Hz to >500kHz.

Additional features of the Model 6880 include a distortion output for visual inspection or spectral analysis of the input signal after the fundamental is nulled out, an analog output which provides a dc voltage proportional to the percent distortion reading and an ultra-low distortion (<.003%) 1kHz sinewave output for use as a standard to test circuit or system distortion characteristics.

For remote programming applications, the Model 6880 is totally compatible with the IEEE-488 GPIB.

This instrument has been carefully inspected, tested and aged before shipment and should be ready for operation when unpacked. If it appears to have been damaged in shipment, file a claim with the carrier and notify Krohn-Hite or its nearest sales office immediately.

1.2 SPECIFICATIONS

DISTORTION METER SPECIFICATIONS

Fundamental Frequency Range: 10Hz to 110kHz (1Hz optional).

Input Level: 100mV to 130V rms.

Distortion Range: 0.001% to 50%; -99.9dB to-6dB.

Resolution: 0.001%, <0.2% distortion; 0.01%, <2% distortion; 0.1%, <20% distortion; 1%, 20% to 50% distortion; 0.1dB, -99.9dB to -6dB distortion; auto-ranging.

Accuracy: 10Hz to 110kHz, ±15% (±1.5dB), for harmonics <500kHz at distortion levels >0.1% (-60dB). Below 0.1% specifications apply up to the fifth harmonic.

Residual Noise And Distortion: 0.005% (-86dB) or 10µV, whichever is higher, 10Hz to 9.5kHz, 80kHz BW; 0.02% (-74dB) or 30µV, whichever is higher, 10Hz to 9.5kHz, 500kHz BW; 0.03% (-70dB), 9.5kHz to 110kHz, 500kHz BW.

Filters: 1kHz High Pass: 40dB/decade rolloff.
30kHz Low Pass: 60dB/decade rolloff.
80kHz Low Pass: 60dB/decade rolloff.
10th Harmonic Low Pass: 20dB/decade rolloff automatically switched in at distortion levels below 0.1%.

Distortion Output: 10mV rms/percent distortion, Impedance, <600 ohms.

Analog Output: 10mV dc/percent distortion, Impedance, <600 ohms.

AC VOLTMETER

Frequency Range: 10Hz to 110kHz (1Hz optional).

Voltage Range: 10mV to 130V rms.

Resolution: 0.001V, 0.010 to 1.050V; 0.01V, .95 to 10.50V; 0.1V, 9.5 to 130V; auto-ranging.

Accuracy: ±2% ±1 digit.

DEVIATION METER

Deviation Range: -100% to >+100%, 0 to ±70dB.

FREQUENCY COUNTER

Frequency Range: 10.00Hz to 500kHz (1Hz optional).

Accuracy: ±1 digit.

Resolution: 3 1/2 digits with auto-ranging.

Input Sensitivity: 100mV to 130V rms.

OSCILLATOR OUTPUT

Frequency: 1kHz, ±5%, fixed.

Voltage: 5 volts rms ±5%.

Distortion: <0.003% (-90dB).

Output Impedance: 600 ohms ±10%

Output Current: 3mA rms.

REMOTE PROGRAMMING

Program Interface: GPIB, conforms to IEEE Std. 488-1978, optically isolated from Analyzer.

Implementation Sub Sets: SH1, AH1 T5, L4, SR1, RL1, PP1, DC1, DT0, C0, E1.

Program Status Control Indicators:

REMOTE (LED): Indicates a remote programming status; front panel keyboard is disengaged.
LOCAL (key and LED): Returns programming control to the front panel keyboard.

Unless otherwise noted, specifications apply at 25°C ±5°C.

1.3 GENERAL

Input Impedance: 110k ohms shunted by 75pF.

Maximum dc Component: 100V.

Operating Temperature Range: 0°C to 45°C.

Meter Display: 0.5", 7 segment LED display.

Isolation To Chassis: 500V dc.

Modes Of Operation: Distortion, AC Voltage, Voltage Deviation, Frequency Counter.

DISPLAY MODES

FREQ Hz: Displays fundamental frequency.

DISTORTION %: Displays total harmonic distortion in percent.

DISTORTION dB: Displays total harmonic distortion in dB.

VOLTAGE AC RMS: Displays the input voltage level calibrated in rms.

VOLTAGE %: Displays deviation of input voltage in percent.

VOLTAGE dB: Displays deviation of input voltage in dB.

VOLTAGE REF: Used with VOLTAGE % or dB to select either internal 0dBm (600) or external reference level.

CONTROLS

Front panel: Keyboard for entry of operational modes (Section 2, Operation).

Rear panel: Main ac power, floating GROUND switch and LINE switches for selection of NORM/LO and 115V/230V ac line operation.

BNC CONNECTORS

ANALYZER INPUT: Input 0.1-130 volts rms. Impedance, 110k ohms in parallel with 75pF.

1kHz OUTPUT: 1kHz sinewave, fixed at 5 volts rms, less than .003% distortion. Impedance, 600 ohms ±10%. Output current, 3mA rms.

DISTORTION OUTPUT: The distortion signal after the fundamental is filtered out, scaled to approximately 10mV rms per 1% distortion. Impedance, <600 ohms.

ANALOG OUTPUT: DC voltage proportional to 10mV per 1% distortion displayed. Impedance, <600 ohms.

POWER REQUIREMENTS

The Model 6880 is designed to operate from a single phase, 50-60Hz ac power source of 90-110, 108-132, 180-220 or 216-264 volts. Line switches on the rear panel allow the 6880 to be powered from one of the above 4 voltage ranges. The ac power receptacle, on the rear panel, is a standard 3-pin connector and complies with the European I.E.C. standard. A detachable, 3-wire line cord is provided with the instrument.

Power consumption; 85 watts maximum.

The fuse receptacle contains a properly rated fuse for the instrument's point of destination's power requirements.

DIMENSIONS AND WEIGHTS

Wide	High	Deep	Weight
16.625"	5.25"	15"	20lb
42.4cm	13.3cm	38.1cm	9.1kg.

OPTIONS

Option 001: Extends range to 1Hz.

Rack Mounting Kit: Krohn-Hite part number RK-519 permits installation of the Model 6880 into a standard 19" rack.

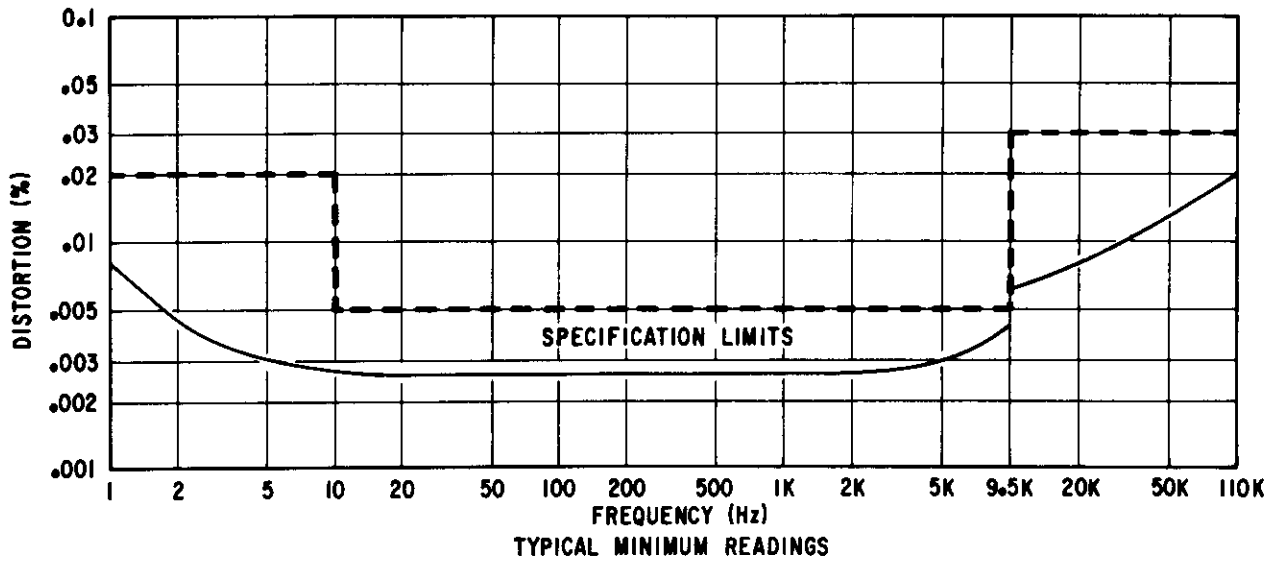


Figure 2. Typical Internal Distortion

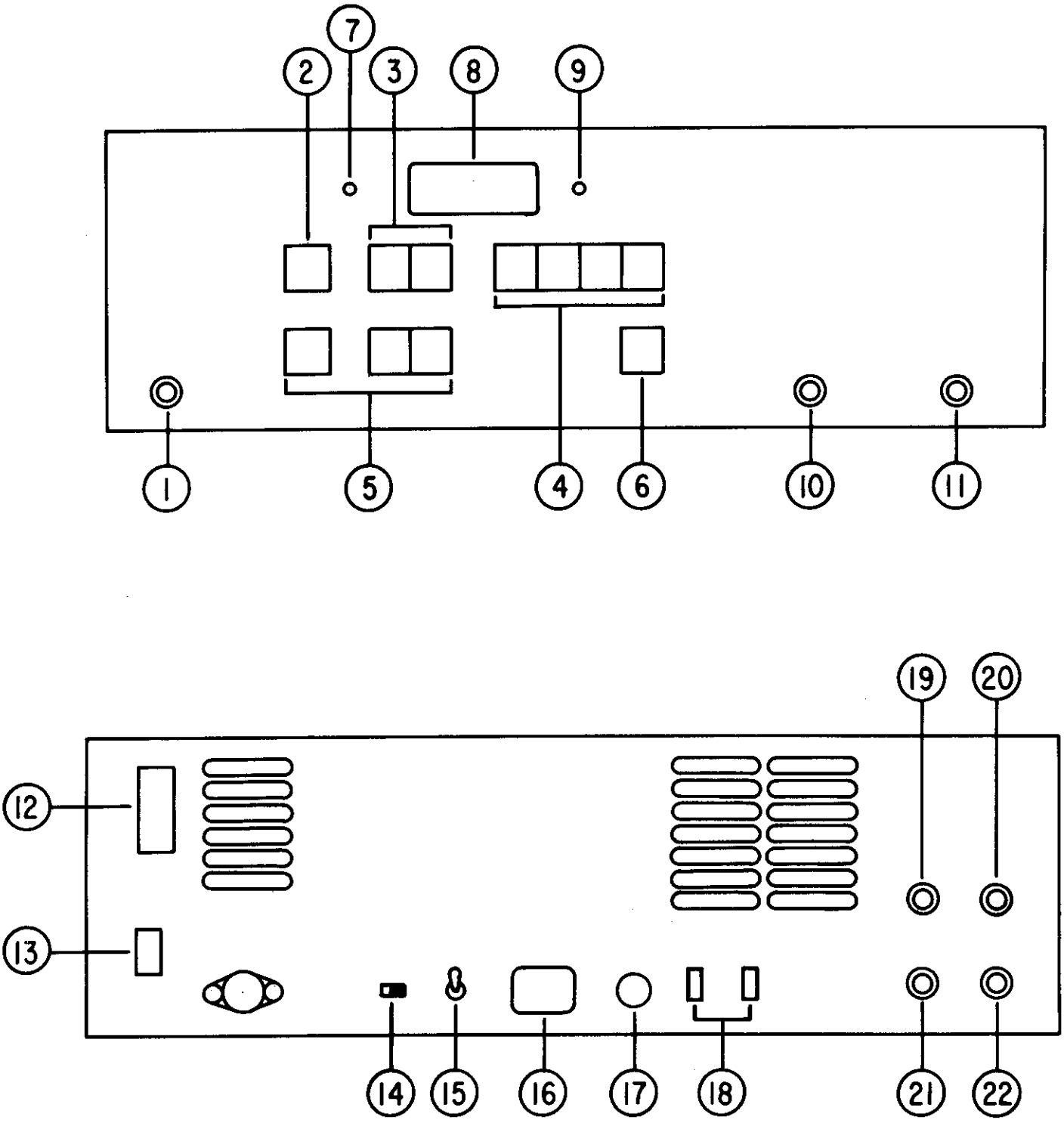


Figure 3. Operating Controls, Connectors and Display.

SECTION 2

OPERATION

2.1 INTRODUCTION

This section describes the basic operation of the Model 6880. It includes the proper ac power requirements, the recommended turn-on procedure and a detailed explanation of all operating controls, modes of operation and special features.

Implementation of the IEEE-488 standard interface for remote programming of the Model 6880 is explained in Section 3 of this manual.

2.2 POWER REQUIREMENTS

The 6880 is designed to operate from a single phase, 50-60Hz ac power source of 90-110, 108-132, 180-220, or 216-264 volts. Line switches on the rear panel allow the 6880 to be powered from one of the above 4 voltage ranges. The ac power receptacle, on the rear panel, is a standard 3-pin connector, and complies with the European I.E.C. standard. A detachable, 3-wire line cord is provided with the instrument.

The fuse receptacle contains a properly rated fuse for the instrument's point of destination's power requirements.

2.3 TURN-ON PROCEDURE

a. Set the line switches for the correct voltage range and check to see that a fuse with the correct rating is in the fuse receptacle.

   For 90-110 volts, set the 120V/240V switch to 120V and the NORM/LO switch to LO. The fuse should be a .5 amp.

   For 108-132 volts, set the 120V/240V switch to 120V and the NORM/LO switch to NORM. The fuse should be a .5 amp.

   For 180-220 volts, set the 120V/240V switch to 240V and the NORM/LO switch to LO. The fuse should be a 0.25 amp.

   For 216-264 volts, set the 120V/240V switch to 240V and the NORM/LO switch to NORM. The fuse should be a 0.25 amp.

b. Make sure that the POWER switch, in the rear of the unit, is in the OFF position.

c. Plug the line cord into the unit and into an ac outlet.

WARNING!

The chassis of this intrument is connected to ground. For safety purposes, connect the line cord to a grounded, 3 terminal ac outlet.

d. If the 6880 is to be remotely programmed via the IEEE-488 GPIB, connect the bus cable to the rear panel outlet at this time. Programming information is provided in Section 3 of this manual.

e. The POWER switch is a locking toggle type on the rear panel. The lever has to be pulled out in order to switch it. Turn the power on.

CAUTION !

Because of the potentially dangerous voltages that exist within the unit, the covers of this instrument should not be removed when the instrument is connected to an ac power source.

2.4 OPERATING CONTROLS, CONNECTORS AND DISPLAY (Figure 3)

1. ANALYZER INPUT: Input voltage; 0.1-130 volts rms. Input impedance; 110k ohms in parallel with 75pF.

2. FREQUENCY [Hz]: Press to display frequency at ANALYZER INPUT, <1.0Hz to >500kHz.

3. DISTORTION keys:

   [%]: Press to display total harmonic distortion in percent, of ANALYZER INPUT, .000%-50.0%.

   [dB]: Press to display total harmonic distortion in dB, of ANALYZER INPUT, -6dB to -90dB.

4. VOLTAGE keys:

   [AC RMS]: Press to display rms voltage (average responding) at ANALYZER INPUT, 0.1-130 volts rms.

   [%]: Press to display deviation of ANALYZER INPUT voltage in percent, with respect to internal or external reference, -100% to >+100%, depending upon input.

   [dB]: Press to display deviation of ANALYZER INPUT voltage, in dB, with respect to internal or external reference, ±70dB.

   [REF]: Used with [%] or [dB] mode. When pressed, voltage at ANALYZER INPUT becomes reference; any deviation at ANALYZER INPUT is then displayed in percent or decibels, as selected by [%] or [dB] keys. When not used, internal reference of 0dBm (775mV) is engaged.

5. FILTER keys:

   Note: The filters are effective in DISTORTION [%] or DISTORTION [dB] modes only.

   [1kHz]: High-pass, 12dB/octave.
   [30kHz]: Low-pass, 18dB/octave.
   [80kHz]: Low-pass, 18dB/octave.

6. [LOCAL]: When the 6880 is in a remote programming state, press to return to keyboard control, unless remote local-with-lockout is in effect (see Section 3).

7. REMOTE (LED): Indicates the unit is in a remote programming status (keyboard disengaged).

8. 3 1/2 digit, Auto-Ranging display.

9. KILO (LED): In frequency mode, indicates when display is in kilohertz.

10. 1kHz OUTPUT: 1kHz sinewave, fixed at 5 volts rms, less than .003% distortion. Impedance, 600 ohms ±10%. Output current, 3mA rms.

11. DISTORTION OUTPUT: The distortion signal after the fundamental is filtered out, scaled to approximately 10mV rms per 1% distortion. Impedance, <600 ohms.

12. IEEE-488 CONNECTOR: Standard IEEE-488 GPIB connector (uses metric hardware). See Section 3.

13. GPIB ADDRESS: Programs (hardwires) the power-on primary address for the 6880. See Section 3.

14. GROUND: Slide switch, disconnects signal ground (⏚) from chassis (⏚) ground.

15. POWER-ON: On-off locking toggle for main ac power. The lever has to be pulled out in order to be switched.

16. AC POWER RECEPTACLE: Standard 3-pin receptacle. Complies with European I.E.C. standard.

17. FUSE RECEPTACLE:0.75 ampere slow blow fuse for 90V-132V ac line and 180V-264V ac line.

18. LINE: Slide switches select 120V or 240V operation and normal or low ac line.

19. 1kHz OUTPUT: Same as front panel 1kHz OUTPUT.

20. ANALOG OUTPUT: DC voltage proportional to 10mV per 1% distortion displayed. Impedance, <600 ohms.

21. DISTORTION OUTPUT: Same as front panel DISTORTION OUTPUT.

22. ANALYZER INPUT: Same as front panel ANALYZER INPUT.

2.5 OPERATION

2.5.1 DISTORTION MEASUREMENTS

Distortion measurements are totally automatic. The 6880 presets its reference level for any input from 0.1-130 volts rms. The panel meter will signal "HI"

or "LO" to indicate an out-of-range voltage input. The 6880 will then tune itself to the fundamental frequency over the entire range of 10Hz to 110kHz (1Hz if option 001 is applicable).

The digital panel meter will then display the total harmonic distortion in [%] or [dB] and will auto-range to provide maximum resolution.

To measure distortion:

a. Connect the test signal to the ANALYZER INPUT.

b. Press DISTORTION [%] or DISTORTION [dB].

The panel meter will display the total harmonic distortion in [%] or [dB] with the following resolution:

RANGE		RESOLUTION	
[%]	[dB]	[%]	[dB]
0.000 - 0.100	0.001		
0.10 - 1.00	-6 to -90	0.01	0.1
1.0 - 50.0			0.1

Note: When the total harmonic distortion being measured is less than 0.1%, an internal auto-tracking low pass filter is switched in which limits the measurement bandwidth to approximately 10 times the fundamental frequency. The filter has a roll-off of 6dB per octave.

When the distortion being measured is greater than 0.1%, the auto-tracking filter is switched out and the measurement bandwidth will be approximately 500kHz.

FILTERS:

The 1kHz, 30kHz and 80kHz selectable filters, are effective only in the DISTORTION mode.

1. The 1kHz high-pass filter has an attenuation rate of 12dB/octave and may be used to suppress low frequency noise <1kHz.

2. The 30kHz and 80kHz low-pass filters may be used to either suppress high frequency noise or to provide a controlled bandwidth during distortion measurements.

DISTORTION OUTPUT:

The distortion output may be used for visual inspection or further spectral analysis of the distortion signal after the fundamental is filtered out. It's approximately 10 millivolts rms per 1% of the distortion displayed.

ANALOG OUTPUT:

The ANALOG OUTPUT is a dc voltage proportional to the percent distortion displayed. It may be used with a recorder or plotter. Output is approximately 10 millivolts dc per 1% distortion displayed.

2.5.2 AC VOLTAGE MEASUREMENTS

The 6880 will measure and display the rms voltage (average responding) of the signal at the ANALYZER INPUT for any voltage from 0.1-130 volts rms at frequencies between 10Hz-110kHz (1Hz if option 001 is applicable). The digital panel meter will automatically auto-range to provide maximum resolution.

To measure ac voltage:

a. Connect the test signal to the ANALYZER INPUT.

b. Press [AC RMS].

VOLTAGE RANGE	RESOLUTION
0.100-1.00	0.001
1.00-10.00	0.01
10.0-130.0	0.1

Voltmeter accuracy is ±2%, ±1 digit.

2.5.3 VOLTAGE DEVIATION MEASUREMENTS

The 6880 may be used to measure voltage deviation, in [%] or [dB] (such as for response testing) with respect to either the internal reference of 0dBm (775mV rms) or by any other reference level selected by the user, by pressing the [REF] key.

To measure voltage deviation:

1. Using the 6880's internal reference (0dBm, 775mV rms);

a. Connect the test signal to the ANALYZER INPUT (10Hz-110kHz, 0.1-130 volts rms).

b. To display deviation in percent, press VOLTAGE [%]; the meter will display the voltage deviation in percent with respect to 775mV rms, from -100% to >+100%.

c. To display deviation in decibels, press VOLTAGE [dB]; the meter will display the voltage in dB with respect to 0dBm, from -70dB to +70dB.

2. Using an external reference:

a. Connect the test signal to the ANALYZER INPUT (10Hz-110kHz, 0.1-130 volts rms).

b. Adjust the voltage at the ANALYZER INPUT to the desired reference level.

c. Press [REF] (LED on); this presets the reference level.

d. Select VOLTAGE [%] or VOLTAGE [dB]; as the level is varied at the ANALYZER INPUT, the meter will display the deviation in percent or decibels, with respect to the preset level.

Accuracy of the deviation reading in any mode is ±2%, ±1 digit.

2.5.4 FREQUENCY MEASUREMENTS

The 6880 will also measure and display frequency in Hertz from <1.000Hz to >500kHz. The meter will auto-range for maximum resolution. Accuracy is ±1 digit. The KILO LED indicates when the display is in kilohertz.

To measure frequency, press FREQUENCY [Hz].

SECTION 3

IEEE-488 STD INTERFACE SOFTWARE FORMAT

3.1 INTRODUCTION

The Krohn-Hite Model 6880 is completely compatible with the IEEE-488 Standard (GPIB) Interface Bus. All data can be read and all front panel controls can be set via the bus.

3.2 IMPLEMENTATION SUB SET

Identification and capabilities:

SH1 Complete source handshake.
AH1 Complete acceptor handshake.
T5 Basic talker, with talk-only mode, talker is un-addressed when unit is addressed to listen.
L4 Basic listener, no listen-only mode, listener is un-listened when unit is addressed to talk.
SR1 Service requested when any out of range condition occurs.
RL1 Complete Remote/Local and Local lockout control.
PP1 Complete parallel poll capabilities.
DC1 Complete device clear capabilities.
DT0 No device trigger.
C0 No controller capability.
E1 Open collector drivers.

3.3 IEEE-488 BUS DATA TRANSFERS

To receive commands, the 6880 must first receive its primary listen address. This is followed by the desired command. The commands are executed immediately upon receipt. This means no termination character or EOI message is needed, however, these may be sent if desired.

The following chart indicates the ASCII characters that must be received to operate the various controls.

CONTROL	ASCII CODE
Display:	
FREQUENCY	F0
DISTORTION [%]	D0
DISTORTION [dB]	D1
VOLTAGE [AC RMS]	V0
VOLTAGE [%]	V1
VOLTAGE [dB]	V2
REFERENCE & FILTERS	S0
Reference:	
Set to 0.776V (0dBm)	R0
Set to input voltage	R1

Filters:

High-pass off (1kHz)	H0
High-pass on	H1
Low-pass off (both)	L0
Low-pass on (30kHz)	L1
Low-pass on (80kHz)	L2
Low-pass on (both)	L3

To send data, the 6880 must first receive its primary talk address. The 6880 will then send a "space" followed by the data and terminated by carriage return and line-feed codes. The line-feed code is sent with the EOI line true. The data to be sent is in the front panel display.

When STATUS is requested, the data is a three digit number. The following chart indicates each digit's significance.

Digit #1	Reference	off	0
		on	1
Digit #2	HP Filter	off	0
		on	1
Digit #3	LP Filters	off (both)	0
		30kHz	1
		80kHz	2
		on (both)	3

3.4 IEEE-488 STANDARD COMMANDS

These commands are sent with ATN true as described in the Standard.

3.4.1 MULTI-LINE MESSAGES

IEEE-488 COMMAND	MNEMONIC	RESULT
My Listen Address	MLA	Enables unit to receive data.
Unlisten	UNL	Disables all units from receiving data.
My Talk Address	MTA	Designates unit to send data.
Untalk	UNT	Disables all units from sending data.
Local lockout	LLO	Disables return to local key on front panel such that only the controller can activate the front panel keyboard.
Go To Local	GTL	Puts unit into local control mode such that front panel keyboard is activated.
Device Clear	DCL	Returns all units to power on conditions.
Selected Device Clear	SDC	Performs same functions as Device Clear (DCL) except only if unit is addressed.

Discussion: (See Section 2.8 and Figure 10 of the IEEE-488 Interface Standard). Note that there are 4 possible states; local, remote, local-with-lockout and remote-with-lockout. Front panel control is considered to be local, while control from the "bus" is considered to be remote. When the unit is addressed to talk (MTA) or listen (MLA), it goes into remote. When Go To Local (GTL) is sent, it goes into local. Also, if lockout mode is not set by the controller, local lockout (LLO) command is sent; pressing the [LOCAL] key will return the unit to local.

Note: The lockout mode is not related to whether control is local or remote, only whether control can be returned to local by the local key.

Lockout mode (local-with-lockout and remote-with-lockout versus local and remote) is controlled by the controller. Sending the Local Lockout command (LLO) selects the local-with-lockout and remote-with-lockout pair versus remote and local without lockout. Lockout can only be cancelled by the controller placing the remote enable line false.

3.4.2 POLLING COMMANDS

The IEEE standard provides two methods of determining the status of the devices in the system; namely serial poll and parallel poll. The parallel poll produces up to 8 bits of status from up to 8 different units simultaneously. A parallel poll is very fast but provides limited information. The serial poll provides 7 bits of status from one unit at a time.

PARALLEL POLLING

The Model 6880 provides for software configuring of which bit and with which polarity the unit should respond. This bit is "true" when an error condition exists.

Configuring needs to be done only once or anytime the software desires to change the configuration. The commands related to parallel poll are as follows:

For sample sequences, see Section 6.5.4 of the IEEE-488 standard.

IEEE-488 COMMAND	MNEMONIC	RESULT
Configure	PPC	Places unit into a state where it expects parallel poll enable and disable commands to establish which bits should be set or selected in response to a parallel poll.
Unconfigure	PPU	Removes unit from PPC state (UNL does the same thing but also unlistens device).
Enable	PPE	When unit is in PPC state, it indicates which bit and which polarity the device should respond. Hex codes 60-67 selects bits 0-7 respectively to be set to 0 for a true error response. Since logic 0 is HI on open collector lines, this provides a logical "OR" of all units designated to respond with given line. Hex codes 68-6F selects bits 0-7 respectively to be set to 1 for a true (error) response. This can provide logical NAND of all units designated to respond with a given line.
Disable	PPD	Clears any configuration previously entered. This is valid only when unit is in PPC state.

SERVICE REQUEST AND SERIAL POLLING

The Model 6880 has complete serial poll capabilities. When a serial poll is conducted, a "BYTE" of data is sent. The first three (B0-B2) and the seventh (B6) bits of this BYTE indicate the unit's condition. The seventh bit (B6), when set, indicates that an error condition exists and the first three indicates the type of error.

The following chart indicates the error types.

B7 - B0	HEX	ERROR TYPE
0000 0000	00	No error
0100 0001	41	Voltage too high
0100 0010	42	Frequency too high
0100 0011	43	Voltage too low
0100 0100	44	Frequency too low
0100 0101	45	Distortion too high
0000 0110	06	Distortion changing

3.4.3 UNILINE MESSAGES

IEEE-488 COMMAND	MNEMONIC	RESULT
End	END	Sent with last byte of data. A line of data may either be terminated by a line feed character or by this command.
Identify	IDY	This command, issued by the controller, causes a parallel response which was previously configured by the PPC, PPD, PPE and PPU commands.
Remote enable	REN	When true, allows the 6880 to respond to remote messages. When this line goes false, the unit will go to local-with-lockout state, activating the front panel.
Interface clear	IFC	Un-addresses all units and clears all special states.

3.5 REAR PANEL GPIB ADDRESS SWITCH SETUP

When any switch (1, 2, 4, 8 or 16) is "ON", it represents a binary 1; when "OFF", it represents a binary zero. See Figure 4, Table of Switch Combinations For Each Allowed Address.

Switch 32, when "ON", puts the interface into talk-only mode, allowing the unit to send data without being addressed. This mode is useful in systems which have no controller.

When switch 32 is "OFF", the 6880 interface responds normally (listens when addressed only).

Desired Primary Address	"1" = ON; "0" = OFF				
	16	8	4	2	1
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0
21	1	0	1	0	1
22	1	0	1	1	0
23	1	0	1	1	1
24	1	1	0	0	0
25	1	1	0	0	1
26	1	1	0	1	0
27	1	1	0	1	1
28	1	1	1	0	0
29	1	1	1	0	1
30	1	1	1	1	0

Figure 4. Table of Switch Combinations For Each Allowed Address.

SECTION 4

INCOMING ACCEPTANCE AND ROUTINE PERFORMANCE TESTS

4.1 INTRODUCTION

The following procedure may be used to verify that the Distortion Analyzer is operating within specifications, both for incoming inspection, and routine servicing. Tests should be made with the unit at operating temperature, the covers secured in place, and the procedure given below followed in sequence. Familiarize yourself with the inital set-up and operating procedure as outlined in Section 2, Operation.

CAUTION!

Because of the potentially dangerous voltages that exist within the unit, the covers should not be removed when the instrument is connected to an ac power source.

4.2 PROCEDURE

PRELIMINARY SET-UP

For the equipment required, see the Section 6.2 on page 25.

After the Analyzer has been connected to a suitable ac power source (see Section 2.3) connect the Analyzer's 1kHz OUTPUT to both the ANALYZER INPUT and to the scope's external horizontal input. Connect the DISTORTION OUTPUT to the scope's vertical input. Set the input sensitivity to 1mV/cm, ac coupled. Adjust the scope's horizontal control to obtain approximately a 6 cm sweep. Press DISTORTION [%] and make sure [REF] and all filters ([1kHz], [30kHz] and [80kHz]) are off. The display should read <.005%, typically .002%.

LOW DISTORTION CHECK

Connect an Ultra-Low Distortion Oscillator (Krohn-Hite Model 4400A or equivalent) to the ANALYZER INPUT. Press [AC RMS] and adjust the oscillator output voltage to 7 volts rms. Press DISTORTION [%] and check the Analyzer's readings at the following frequency settings:

Oscillator Frequency	Analyzer Reading
100kHz	<.03
11kHz	<.03
9kHz	<.005
1.1kHz	<.005
900Hz	<.005
110Hz	<.005
90Hz	<.005
(Settling time about 30 seconds to achieve .005)	
11Hz 10-100	<.002
9Hz 1-10	<.02
(Settling time about 2 minutes to achieve .01)	

ANALOG OUTPUT

The ANALOG OUTPUT is a dc voltage proportional to the DISTORTION [%] reading and is approximately 100mV/1%. To check this output, connect a dc voltmeter and supply to ANALYZER INPUT. Send various signals of different distortion levels and compare the dc voltmeter readings with the Analyzer's display reading.

DISTORTION OUTPUT

The DISTORTION OUTPUT is an ac signal which represents the input signal with the fundamental frequency signal removed. The level of this signal is approximately 100mV rms/% THD.

AC VOLTMETER CHECK

Press [AC RMS]. Connect an ac standard to the ANALYZER INPUT and verify that the accuracy of the voltmeter is within $\pm$2% $\pm$1 digit.

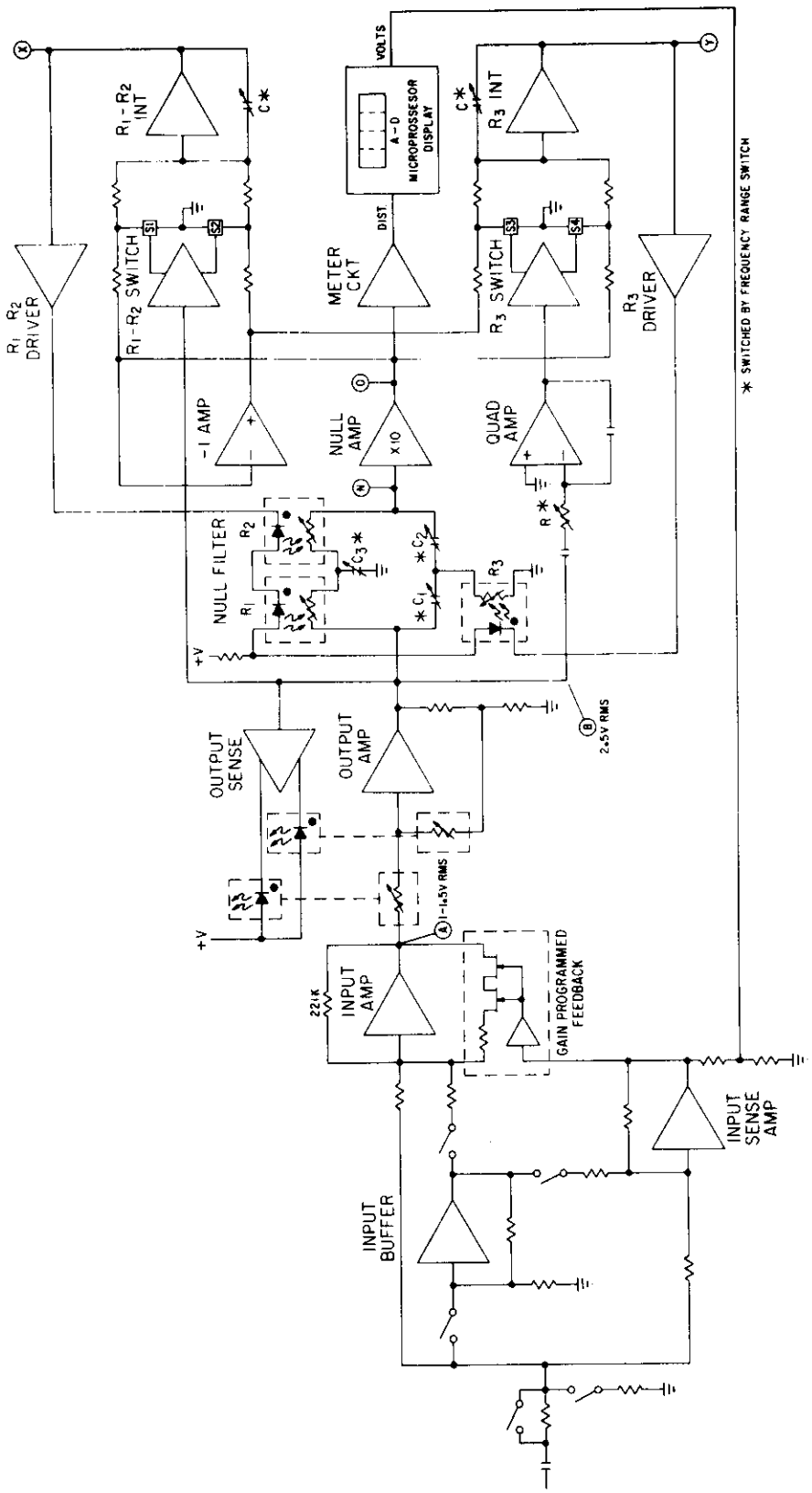


Figure 5. Simplified Block Diagram

SECTION 5

CIRCUIT DESCRIPTION

5.1 INTRODUCTION

As shown in Figure 5, Simplified Block Diagram, the Model 6880 Distortion Analyzer consists of an Auto Level Circuit, a Frequency Tracking Rejection Filter, Meter Circuit, Microprocessor Circuits and Power Supply Circuits.

The Auto Level Circuit converts the 0.1V to 130V input signal to a constant amplitude of 2.5V rms. This permits distortion measurements automatically, independent of input signal amplitude. The output of the Auto Level Circuit is applied to the Frequency Tracking Rejection Filter which automatically nulls out the fundamental of the input signal over the entire frequency range of 10Hz (1Hz optional) to 110kHz. The Meter Circuit converts the distortion signal, the residual ac voltage that remains after the fundamental at the input signal is nulled out, to a dc voltage proportional to the distortion signal. A Digital Display Meter (DDM) indicates distortion directly in percent or dB.

5.2 CIRCUIT DESCRIPTION

5.3 INPUT BUFFER AMPLIFIER

The Input Buffer Amplifier consists of an IC amplifier, U500, providing a gain of five to TP7. In combination with resistor R510 to the summing point of the input amplifier, a maximum gain of ten in the input amplifier is achieved. The microprocessor turns on relays K502, K503 and K504 at input levels between 0.1V and 1.05V, inserting the Input Buffer Amplifier into the circuit.

5.4 INPUT AMPLIFIER

The Input Amplifier consists of a gain programmable operational amplifier, U520, whose gain is varied in discrete steps by FET switches, Q520 to Q529, that change the gain-determining feedback resistor. When the input signal is within 1V-1.5V rms, the Input Amplifier gain is unity and FETs Q520 to Q529 are off. At 1.5V rms input, the dc output voltage of the Input Sense Amplifier, consisting of U560 to U562 and Q570 to Q573, triggers the Level Detector, U525, which turns on Q528 and Q529, reducing the output of the Input Amplifier from 1.5V to 1V rms.

At input voltages of approximately 1.5V, 2.3V, 3.6V, 5.7V, and 8.8V rms, in the 1V-10V input range, five level detectors, U525 to U521, sequentially turn on the corresponding FET switches in the input amplifier, U520. When the input voltage is greater than 10.5V rms, the microprocessor turns of the relay K501 and activates the relay K500 which attenuates the input signal by ten (20dB). All of the FET switches, Q520 to Q529, are turned off. The Auto Level Circuit functions in the same manner up to 130V rms, as it did with 1V-10.5V rms input. At input levels between 0.1V and 1.05V rms, the microprocessor activates K502, K503 and K504 and inserts input buffer amplifier U501, increasing the gain of the input stage to allow for similar operation of the gain programmable amplifier as in the higher voltage ranges.

5.5 OUTPUT CONTROL AMPLIFIER

The Output Control Amplifier consists of the Output Amplifier, U600 and Q600, and the Output Sense Amplifier, U593 and U592. It converts the output of the Input Amplifier, which varies from 1V-1.5V rms, to a constant amplitude of 2.5V rms. The Auto Level Circuit output is maintained constant by the Output Sense Amplifier. The rectified output from Q595 and Q596 is compared with a dc reference voltage, and the error voltage is filtered by the Integrator U593. At frequencies greater than 1kHz, the error voltage is applied directly to the buffer, U592, since Q592 is on. At low frequencies, to minimize ripple, a sample-and-hold circuit, consisting of a switch and gate, Q592 and Q593, and storage capacitor C594, automatically becomes operative. The buffered error voltage drives the balanced amplifier, Q590 and Q591, varying the photo-resistors, U590 and U591, in the gain-determining network of the operational Output Amplifier to maintain constant amplitude. Below 10Hz, the microprocessor turns on Q594 which increases the time constant of the input Sense Amplifier Integrator.

5.6 DISTORTION ATTENUATOR

To prevent overloading of the nulling and measuring circuits at high distortion levels, the 10:1 attenuator, R617, R618, and unity gain buffer amplifier U601, is switched in by the microprocessor at distortion levels above 1.0%.

5.7 NULL NETWORK

The 2.5V rms constant amplitude signal, from the Auto Level Circuit, is attenuated and applied to the Null Network which rejects the fundamental signal but passes the harmonics with minimum attenuation. The residual signal remaining after the fundamental is removed is the Distortion Signal. As shown in Figure A, the Null Circuit consists of a Twin T network, photosensitive resistors, R1, R2 and R3, and capacitors, C1, C2 and C3. Auto Frequency Tracking is accomplished by two control loops which automatically maintain R1, R2 and R3 at the resistance value necessary to null the fundamental signal.

A Null Amplifier buffers the Null Network and amplifies the distortion signal which is then phase-shifted 180 degrees by the Inverting Amplifier to generate a signal that can be full-wave rectified by the two control loops.

One control loop, consisting of diode bridge switches, S1, S2 and associated circuit, R1, R2 Integrator and R1, R2 Driver, maintains the resistance of the photo-sensitive resistors, R1 and R2, at their required value to obtain a null. The other control loop, consisting of diode bridge switches, S3, S4 and associated circuit, R3 Integrator and R3 Driver, performs a similar function for photo-resistor R3.

5.8 METER CIRCUIT

The Meter Circuit converts the distortion signal, the residual ac voltage that remains after the fundamental of the input signal is nulled out, to a dc voltage proportional to the average value of the distortion signal. An analog to digital converter is used by the microprocessor to "read" this voltage. The microprocessor can then display the distortion directly in percent or in dB. Auto Ranging permits distortion measurements from 0.001% to 50% without manual

switching. The Meter Circuit, as shown in Figure 6, consists of a Gain Programmable Amplifier, Filters, Operational Rectifier, Integrator and a Ranging Circuit controlled by the microprocessor.

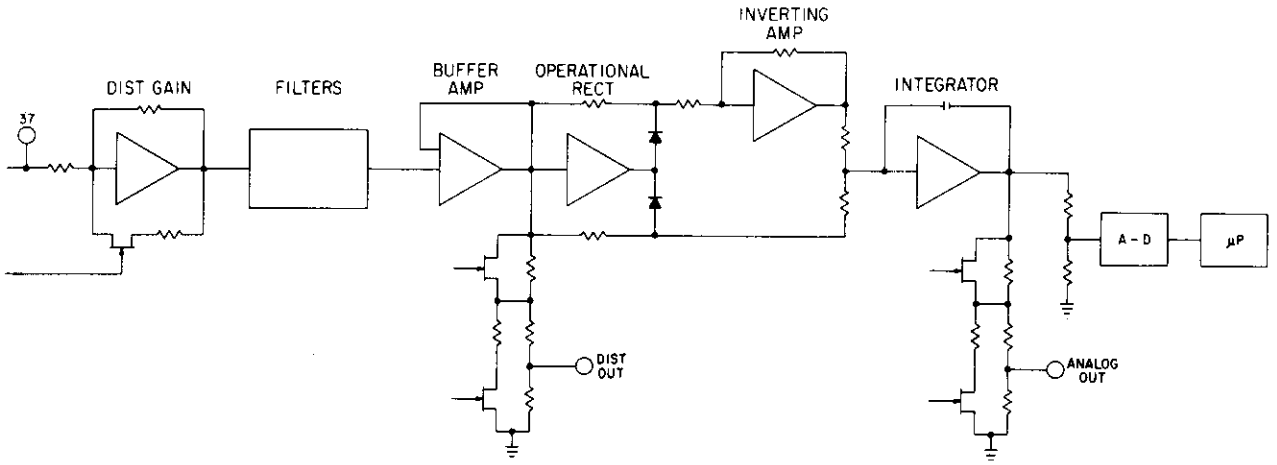


Figure 6. Meter Circuit

The Distortion signal derived from the output of the Null Amplifier, U645 and Q645 to Q649, is buffered by the Boost Amplifier, U670, which provides high frequency compensation, and then is amplified by the Gain Programmable Amplifier U825.

At distortion levels less than 10%, the Gain-Programmable Amplifier, U825, has a gain of ten with Q893 and Q894 off. When the distortion reaches 10%, the gain of the Gain-Programmable Amplifier, U825, is reduced by ten. This permits measurements of up to 50%.

The filters remove noise from the system allowing for the capability of lower distortion readings. Two user selectable low pass filters are provided with cut-off frequencies at 30kHz and 80kHz. A low pass filter that automatically tunes over the frequency range is inserted by the microprocessor at distortion levels below 0.1%. A user selectable high pass filter is available to attenuate hum and noise components below 1kHz. The 30kHz filter is an 18dB per octave filter consisting of R900 to R902 and C900 to C902, buffered by IC U827. The 80kHz is an 18dB per octave filter consisting of R904 to R906 and C904 to C906, buffered by IC U828 and follower Q908. The low pass tracking filter is a 6dB per octave filter and is set as close to the fundamental as possible to maintain the 5th harmonic within specifications. The tracking filter circuit consists of a photo-resistor U829 and a microprocessor selectable capacitor C880, C884 or C888. The resistor value of the photo-resistor is determined by the current required in the auto nulling photo-resistors U620, U621 and U622. The 1kHz high pass filter is a 12dB per octave filter consisting of C913, C916 and R915, R916 and buffered at the input by U830 and on its output by U831.

The buffered output of the distortion signal, after filtering, is full-wave rectified by the Operational Rectifier, U822 and U823, and then amplified and filtered by the Integrator, U824 and transistors Q843 to Q847. At low frequencies, to minimize ripple, a sample-and-hold circuit, Q844, Q845 and storage capacitor C846, automatically becomes operative. The buffered dc output voltage derived from Q847 is applied to the the microprocessor's analyzing circuit.

5.9 1kHz OSCILLATOR

The 1kHz oscillator, Figure 7, provides a fixed frequency, 5V rms, low distortion signal less than 0.003% which may be used as a stimulus for a system under test, or to self-check the Analyzer.

The oscillator consists of an R-C, bridged "T" circuit with AVC, and whose frequency is fixed at 1kHz by the values of R958 to R964 and C958 to C960.

5.10 POWER SUPPLY

The ±15V regulated supplies, see Schematic MPS-1, consists of series regulators Q100, Q105 and sensing and control elements U101, Q102, and U102, Q103. Two +5V supplies, one for the relays, consisting of regulator U100 and the other isolated for the microprocessor consisting of U1101.

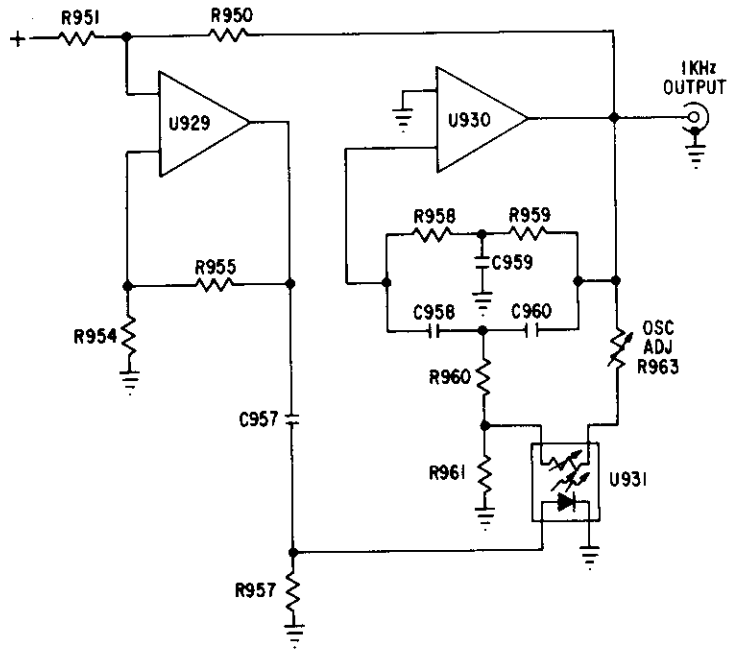


Figure 7. 1kHz Oscillator

SECTION 6

CALIBRATION

WARNING!

This calibration procedure should be performed by qualified personnel only. It is strongly recommended that extra precautions be taken when working with exposed circuitry, and that insulated probes and tools be used.

SHUT THE POWER SWITCH OFF AND DISCONNECT THE LINE CORD FROM THE POWER SOURCE BEFORE REPAIRING OR REPLACING COMPONENTS.

6.1 INTRODUCTION

The following procedure is provided for the calibration and adjustment of the Analyzer in the field. Adherence to this procedure should restore the Analyzer to its original performance specifications. If the Analyzer can't be calibrated by the procedure given, see Section 7, Maintenance, or consult our Factory Service Department. The location of all test points and adjustable components may be found in the component layout drawings at the rear of this manual.

6.2 CALIBRATION PROCEDURE

See Section 2, Operation, for the correct turn-on procedure. Allow the instrument to warm up for at least 30 minutes.

Required Test Equipment:

1. (DMM) Digital Multimeter: 2000 count minimum. Fluke 8000A or equivalent. Note: When measuring with DMM, it's ground must be connected to the ground on the board being measured.
2. AC Voltmeter: 1MHz bandwidth minimum. Ballantine 323-01 or equivalent.
3. Oscillator: 10V rms, 500kHz. Krohn-Hite Model 4200A or equivalent.
4. (LD) Oscillator: Low Distortion, 7V rms, .001% distortion. Krohn-Hite Model 4400A or equivalent.
5. Oscilloscope: 5mv/cm, 50MHz bandwidth. Tektronix 465 or equivalent.
6. Probe: X10 for Oscilloscope.
7. 2 megohm resistor with alligator clips.
8. 8" jumper with alligator clips.
9. Card extender.

6.3 POWER SUPPLY

a. Connect DMM to TP-15V. Check for a reading of -15V $\pm$.1V dc. If off, adjust R129 for a reading of -15V.
b. Connect DMM to TP+15V. Check for a reading of +15V $\pm$.3V dc.
c. Connect DMM to TP-5V. Check for a reading of -5V $\pm$.25V dc.
d. Connect DMM to TP+5V. Bottom terminal of LM323. Check for a reading of +5V $\pm$.25V dc.

6.4 INPUT BOARD DC OFFSET ADJUSTMENTS

a. Adjust Oscillator for 1.25V ±.1V rms (at 500Hz).
b. Connect Oscillator to input of 6880. Connect DMM to TP1. Check for a reading of 0mV ±.1mV dc. If off, adjust R564 for correct reading.
c. Connect DMM to TP4. Check for a reading of 0mV ±.1mV dc. If off, adjust R526 for correct reading.
d. Connect DMM to TP6. Check for a reading of 0mV ±.1mV dc. If off, adjust R523 for correct reading.
e. Adjust oscillator for 125mV ±.10mV rms (500Hz). Connect DMM to TP6. Check for a reading of 0mV ±.3mV dc. If off, adjust R504 for correct reading.
f. Disconnect oscillator and short Analyzer Input. Connect DMM to TP3. Check for a reading of 0mV ±.5mV dc. If off, adjust R570 for correct reading.

6.5 VOLTMETER 500Hz CALIBRATION

a. Connect oscillator to Analyzer Input. Set Analyzer to VOLTS MODE. Adjust oscillator for 10V ±.02V rms (500Hz). Connect DMM to TP3. Check for reading of 6V ±.01V dc. If off, adjust R568 for correct reading.
b. Adjust R997 for a display reading of 10.00 ±.01V. R997 is on the Control Board.
c. Press Voltage dB key. Check display for reading of +22.2dB ±.1dB.
d. Press Voltage % key. Check display for reading of +1.191K% ±1%.
e. Press Reference key (LED will come on). Check display for reading of +00.0% ±.1%. Press Reference key again and LED will go out.
f. Adjust oscillator for .5V ±.002V rms (500Hz). Press AC RMS key. Connect DMM to TP3. Check for reading of 3V ±.01V dc. If off, adjust R511 for correct reading.
g. Adjust oscillator for 50mV ±.2mV rms (500Hz). Connect DMM to TP3. Check for reading of .3V ±.001V dc. If off, adjust R570 for correct reading.
h. Adjust oscillator for 10V ±.02V rms (500Hz). Connect DMM to TP3. Set R501 to maximum counter-clockwise to force DMM reading close to .6V dc. Momentarily connect the 2 megohm resistor between C502 and TP1. Remove resistor. Adjust R501 for a reading of .6V ±.001V dc.

6.6 VOLTMETER 100kHz CALIBRATION

a. Adjust oscillator for 5V±.02V rms (500Hz). Adjust R997 for display reading of 5.00 ±.01.
b. Set oscillator to 100kHz. Adjust oscillator for 5V ±.01V rms. Check for a display reading of 5.00V ±.05V. If off, adjust C561 for correct display reading.
c. Adjust oscillator for 10V±.02V rms (100kHz). Connect 2 megohm resistor between C502 and TP1. Adjust C500 for maximum display reading. Remove resistor. Adjust C500 for "DISPLAY" reading of 10.0V (not 10.00V). If 10.00V appears on display, repeat step until a display reading of 10.0V appears.

6.7 INPUT AMPLIFIER FREQUENCY RESPONSE

a. Connect ac voltmeter to TP6. Set oscillator to 100Hz. Adjust oscillator for display reading of 1.10V ±.01V. Readjust oscillator for ac voltmeter reading of 1.10V ±.005V rms. Set oscillator to 100kHz. Check for ac voltmeter reading of 1.10V ±.01V rms. If off, adjust C524 for correct reading.

b. Set the oscillator to 100Hz. Adjust oscillator for display reading of 1.70V ±.01V. Readjust oscillator for ac voltmeter reading of 1.10V±.005V rms. Set oscillator to 100kHz. Check for ac voltmeter reading of 1.10V ±.01V rms. If off, adjust C551 for correct reading.
c. Set the oscillator to 100Hz. Adjust oscillator for display reading of 2.70V ±.01V rms. Readjust oscillator for ac voltmeter reading of 1.10V±.005V rms. Set the oscillator to 100kHz. Check for ac voltmeter reading of 1.10V ±.01V rms. If off, adjust C546 for correct reading.
d. Set the oscillator to 100Hz. Adjust oscillator for display reading of 4.20V ±.01V rms. Readjust oscillator for ac voltmeter reading of 1.10V ±.005V rms. Set the oscillator to 100kHz. Check for ac voltmeter reading of 1.10V ±.01V rms. If off, adjust C541 for correct reading.
e. Set the oscillator to 100Hz. Adjust oscillator for display reading of 6.40V ±.01V. Readjust oscillator for ac voltmeter reading of 1.10V ±.005V rms. Set oscillator to 100kHz. Check for ac voltmeter reading of 1.10V ±.01V rms. If off, adjust C536 for correct reading.
f. Set the oscillator to 100Hz. Adjust oscillator for display reading of 9.90V ±.01V. Display must read 9.90V not 9.9V. Readjust oscillator for ac voltmeter reading of 1.10V ±.005V rms. Set oscillator to 100kHz. Check for ac voltmeter reading of 1.10V ±.01V rms. If off, adjust C532 for correct reading.

6.8 OUTPUT AMPLIFIER ADJUSTMENT AND CHECKOUT

a. Connect ac voltmeter to TP5. Set the oscillator to 100Hz. Adjust oscillator for display reading of 1.30V±.02V. Check for ac voltmeter reading of 2.50V ±.02V rms. If off, adjust R598 for correct reading.
b. Set oscillator to 100kHz. Check for ac voltmeter reading of 2.50V ±.02V rms.
c. Set oscillator to 100Hz. Set oscillator for display reading of 1.10V±.02V. Check for ac voltmeter reading of 2.50V ±.02V rms.
d. Set oscillator to 100kHz. Check for ac voltmeter reading of 2.50V ±.02V rms.
e. Set oscillator to 100Hz. Set oscillator for display reading of 1.40V±.02V. Check for ac voltmeter reading of 2.50V ±.02V rms.
f. Set oscillator to 100kHz. Check for ac voltmeter reading of 2.50V ±.02V rms.

6.9 OUTPUT BOARD DC OFFSET ADJUSTMENT

a. Connect jumper from TP37 to Output board ground. Connect DMM to TP30. Check for DMM reading of 0mV ±.5mV dc. If off, adjust R896 for correct reading. Leave jumper in.
b. Connect DMM to TP31. Check for DMM reading of 0mV ±.5mV dc. If off, adjust R914 for correct reading.
c. Press 1kHz Filter key (LED will come on). Connect DMM to TP32. Check for DMM reading of 0mV ±.1mV dc. If off, adjust R918 for correct reading. Press 1kHz Filter key again (LED will go out).
d. Connect DMM to TP36. Check for DMM reading of 0mV ±.1mV dc. If off, adjust R827 for correct reading.
e. Connect DMM to TP33. Check for DMM reading of 0mV ±.1mV dc. If off, adjust R835 for correct reading.
f. Connect DMM to TP35. Check for DMM reading of 0mV ±.5mV dc. If off, adjust R840 for correct reading. Remove jumper.

6.10 DISTORTION GAIN AND RESPONSE ADJUSTMENT

a. Remove the Twin T and Null boards. Connect jumper from TP37 to C502. Set oscillator to 100Hz. Connect ac voltmeter to TP30 (through 1K ohm resistor). Adjust oscillator for display reading of .275V ±.001V rms. Check for ac voltmeter reading of 2.75V ±.01V. If off, adjust R899 for correct reading.
b. Press Distortion % key. Check for display reading of 1.00% ±.01%. If off, adjust R851 for correct reading.
c. Set oscillator to 100kHz. Check for display reading of 1.00%±.01%. If off, adjust C898 for correct reading.
d. Set oscillator for 100Hz. Check for ac voltmeter reading of .275V ±.001V rms. If off, adjust R899 for correct reading. Check display for reading of 1.00% ±.1%.
e. Set oscillator to 100kHz. Check for display reading of 1.00% ±.1%. If off, adjust C893 for correct reading.

Remove jumper from C502 to TP37 and reinsert the Twin T and Null boards.

6.11 OPTO-COUPLER DRIVER OFFSET ADJUSTMENT

a. Set oscillator (Low Distortion-LD) to 5V rms, 900Hz. Connect DMM Common to Twin T board ground. Connect DMM to TP11 (Twin T board). Check for DMM reading of -20mV ±2mV dc. If off, adjust R641 for correct reading.
b. Connect DMM to TP12 (on Twin T board). Check for DMM reading of -20mV±2mV dc. If off, adjust R634 for correct reading.

6.12 NULL-DETECTOR BOARD ADJUSTMENT

a. Set oscilloscope to the X-Y display mode; .1mV/cm. Connect oscillator (LD) output to the oscilloscope X input (horizontal). Adjust oscilloscope for a full screen deflection. Using X10 probe, connect oscilloscope Y input (vertical) to TP32. Press 30kHz filter (LED will come on). Check to see that Lissajous pattern is closed and flat. If off, adjust R791 and R810 to correct Lissajous pattern.
b. Connect DMM to TP35 (Output board). Adjust R785 and R803 for minimum DMM reading. Check DMM reading of <+160mV dc. Check display reading of <.020%. Press 30kHz filter again (LED will go out).

6.13 NULL AMPLIFIER GAIN AND REGENERATION ADJUSTMENT (TWIN T BOARD)

a. Connect the test equipment as shown in Figure 8. Adjust oscillator (LD) 50 ohm output for exactly 5V rms at 200Hz. Adjust output of 2nd oscillator for exactly 4V rms at 2kHz. Press Distortion % key. Check for a display reading of .80% ±.01%. If off, adjust R654 for correct reading.
b. Set 2nd oscillator to 400Hz. Check for a display reading of .76% ±.02%. If off, adjust R663 for correct reading.
c. Set oscillator (LD) to 11kHz. Set 2nd oscillator to 110kHz. Check for a display reading of .80% ±.01%. If off, adjust R670 for correct reading.
d. Set oscillator (LD) to 100kHz. Set 2nd oscillator to 500kHz. Check for a display reading of .072% ±.002%. If off, adjust R909 for correct reading.

6.14 INTERNAL 1kHz OSCILLATOR

a. Connect 1kHz Analyzer Output to Analyzer Input. Adjust R963 (Control board) for a minimum display reading of ≤.004%.

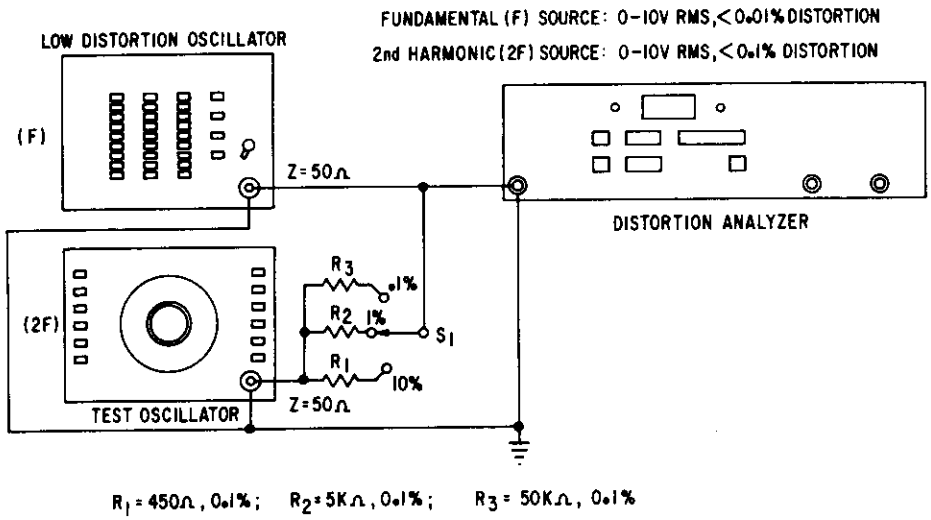


Figure 8. Calibration Set-up

Setup:

Mode; Distortion
Input Voltage; 1V rms
Input Frequency; 1kHz
Distortion; 1% (see Figure 8 on page 29)

PC Card	Test Point	Correct Reading	Trouble Area	Section
MPS-1	-15V	-15V ±0.5V	Power Supply	7.3
MPS-1	+15V	+15V ±0.5V	Power Supply	7.3
MPS-1	+5V	+5V ±0.2V	Power Supply	7.3
MPS-1	+ of C119	+10V ±1V	Power Supply	7.3
6880-6	+ of C1011	+5V	Power Supply	7.3
6880-1	TP1	0V dc ±0.1mV	Input Sense Amplifier	7.6
6880-1	TP2	0.65V peak	Input Sense Amplifier	7.6
6880-1	TP3	0.6V dc	Input Sense Amplifier	7.6
6880-1	TP4	0V dc ±0.1mV	Input Amplifier	7.5
6880-1	TP6	0V dc ±0.1mV	Input Amplifier	7.5
6880-1	TP6	1V rms	Input Amplifier	7.5
6880-1	TP5	2.5V rms	Output Amp/Output Sense Amp	7.7
6880-2	TP10	1.25V rms	Reference Attenuator	7.10
6880-2	TP15	0V dc ±125mV rms	Null Amplifier-Control Loop	7.11
6880-2	TP14	0V dc ±125mV rms	Boost Amplifier	7.12
6880-2	TP13	0V dc ±125mV rms	Inverting Amplifier	7.18
6880-4	TP37	125mV rms	PC 6880-4 Connector (J800)	
6880-4	TP30	125mV rms	Distortion Gain Amplifier	7.15
6880-4	pin 6 of U827	125mV rms	30kHz Filter	7.16
6880-4	pin 2 of U827	125mV rms	80kHz Filter	7.16
6880-4	TP31	125mV rms	Tracking Filter	7.16
6880-4	TP32	125mV rms	1kHz Filter-Buffer Amplifier	7.16
6880-4	DIST OUT		Distortion Output Attenuator	7.17
6880-4	TP35	approx. 0.8V dc	ac-dc Rectifier	7.18

Figure 9. Table 1

SECTION 7

MAINTENANCE

WARNING!

This maintenance procedure should be performed by qualified personnel only. It is strongly recommended that extra precautions be taken when working with exposed circuitry, and that insulated probes and tools be used.

SHUT THE POWER SWITCH OFF AND DISCONNECT THE LINE CORD FROM THE POWER SOURCE BEFORE REPAIRING OR REPLACING COMPONENTS.

7.1 INTRODUCTION

The Model 6880 has been designed in modular construction with sockets for the digital ICs to help facilitate maintenance. To minimize down time, it may be desirable to have a complete set of plug in cards and a complete set of ICs. Before trouble-shooting, it should be determined if the normal adjustments mentioned in Section 6, Calibration, will correct the problem. The trouble-shooting of the Analyzer will be simplified if there is a basic understanding of the Analyzer's operating theory. See Section 5, Circuit Description. An extender card is provided to make it easier to take measurements and make adjustments on any of the plug in cards.

7.2 MAINTENANCE PROCEDURE

To take off the cover, remove the three screws on both sides of the top cover, and lift up.

For the equipment required, see Section 6.2 on page 25.

If the instrument is malfunctioning, it may help to localize the problem in the following manner: Turn OFF the instrument using the rear panel power switch. Turn ON the instrument using the rear panel power switch and observe the light pattern on the front panel. All panel LEDs should be lit simultaneously for about 1 second. If a random number of LEDs light, the most likely source of trouble is the microprocessor card. If only a couple of LEDs are lit and they seem unusually bright, the most likely source of trouble is the front panel card. For the microprocessor card or the front panel card it is recommended that a spare set of ICs be available for replacement purposes. If the micro-proccesor and associated circuitry appear to be working properly, Figure 9, Table 1, should help to localize the trouble area. An extender card is provided to facilitate measurements at various points.

7.3 POWER SUPPLY

The analyzer uses five supply voltages, a plus and minus 15V, a plus 10V unregulated supply, a plus 5V supply for the analog circuitry and a plus 5V for the digital circuit.

Since the negative 15V supply is used as the reference for the positive volts

supply, it must be repaired first. If the ripple on the unregulated -21V supply is appreciably greater than 2 volts ptop, a low -15V regulated supply may be caused by excessive load from other parts of the circuit. If the -21V unregulated is correct, check the voltage of the reference zener, VR101. If the zener voltage is correct and the minus supply is low, pin 2 of U102 should be more positive than pin 3. This should make pin 6 more negative than normal, turning on Q103, in turn, turning on series regulator Q105, increasing the negative supply. If the current being drawn is excessive, the voltage drop across R122 will turn on Q104 shutting down the negative supply to prevent damage. The source of trouble will be where this error correcting sequence is disturbed. In like manner, if the negative supply is more negative than normal, this error correcting sequence should be followed through with correcting voltages being opposite the previous case.

If the negative 15V supply is correct and the positive 15V supply is in error, the error correcting sequence should be followed through in the same manner.

If the positive 5V regulated supply for the analog circuitry is in error and its 9.5V unregulated is 9.5V or greater, the most likely source of trouble is the three terminal regulator U100.

If the positive 10V (+ end of C119) is correct, but the +5V regulated supply for the digital circuitry is in error (+ end of C1011), the most likely source of trouble is the three terminal regulator mounted on the rear panel, U1011.

7.4 INPUT PRE-AMPLIFIER

At signal levels between 0.1V and 1V, the pre-amplifier consisting of U500 and its associated components are switched in by relays K502, K503 and K504. With 0.1V at 1kHz applied to the input terminals approximately 0.5V rms should appear at TP7. If incorrect, the most likely source of trouble is U500.

7.5 INPUT AMPLIFIER

If the dc zero offset adjustments can be made on the input amplifier as outlined in the Calibration procedure, Section 6.4, the input amplifier is probably functioning properly. If any of the dc levels are incorrect, the amplifier associated with the adjustment is the most likely source of trouble.

With 1.25V rms connected to the input of the analyzer, 1.25V rms should appear at TP6. FET switches Q520 to Q529 should be off, the contacts of relays K500, K502, K503 and K504 should be open and the contacts of K501 should be closed. TP3 should read approximately 0.75V dc. An error at TP6 or an excessive dc offset may be caused by a defective U520 or any bad FET switch Q520 to Q529. As the input is increased from 1V rms to 10V rms, the rms voltage at TP6 should vary between 1V and 1.5V. The level at which TP6 is in error will determine the defective level detector U521 to U525 or their associated FET switch. Below 1 volt rms, relays K502, K503 and K504 are activated, and above 10V rms, K500 is activated and K501 is deactivated.

7.6 INPUT SENSE AMPLIFIER

If the voltage at TP3 is incorrect, check the signal at the collector of Q572. If the signal at the collector is correct, localize the problem by checking the signal at TP2.

7.7 OUTPUT AMPLIFIER AND OUTPUT SENSE AMPLIFIER

The voltage at TP5 should remain at 2.5V rms as TP6 varies between 1V and 1.5V rms. If the voltage at TP5 is greater than 2.5V rms, the signal at the collector of Q595 should be greater than normal. This should make pin 6 of U593 more positive than normal. This should also make pin 3 and pin 6 of U592, through switched filter Q592 and C594, more positive. With the output of U592 more positive, Q591 will turn on and Q590 will turn off. This will decrease the ohms of U591 and increase the ohms of U590 reducing the gain of the output amplifier, U600, correcting the voltage at TP5. Where this action is interrupted, the trouble will be localized. In similar manner, if the signal at TP5 is low, the error correcting path may be traced to localize the trouble.

7.8 DISTORTION ATTENUATOR

At distortion levels greater than 1%, relay K505 is deactivated and K506 is activated reducing the signal applied to the null amplifier preventing overloading of the output circuits at high distortion levels. If a distortion reading greater than 1.05% appears on the display, the signal at TP8 should be 1/10th of the signal that is at TP5 or approximately 0.25V rms. If this is not so, the source of trouble is the drive circuits for the relays K505 and/or K506, the relays themselves, U601, or the associated resistors R617, R618.

7.9 SAMPLING PULSE GENERATOR

The constant amplitude sine wave from TP5 is applied to the negative input of U932. U932 should convert this sine wave to a square wave. U932 is prevented from operating in a saturated condition by the circuit consisting of R972, R973, R974, R976, CR973 and CR976. If a square wave is not present at the output of U932, the most likely source of trouble is U932. The output of U932 is rectified by CR969 charging C971. The charge on C971 is used as the bias current for the driver transistor in the sampling circuits and assures the sampling circuit is permanently on if no signal is present at TP5. If no bias current is present at "K" on J900 when there is a signal at TP5, the most likely source of trouble is C971. The pulse is provided through C968, and the frequency at which the sampling filter is on continuously is determined by C969, used to filter the sampling pulse at higher frequencies.

7.10 REFERENCE ATTENUATOR

An attenuator, consisting of U682 is incorporated to reduce the constant 2.5V rms signal to 1.25V rms before it is applied to the null amplifier. If the signal at TP5 is correct at 2.5V rms, but the signal at TP10 is not 1.25V rms, the most likely source of trouble is U682.

7.11 NULL AMPLIFIER - NULL FILTER

Because an apparent error at the output of the Null Amplifier may be a malfunction anywhere in the Control Loop, it is necessary to switch S620 and S621 to the test position. A frequency of approximately 2.5kHz should be applied to the input of the analyzer and TP15 should be observed for a null as the frequency is varied around 2.5kHz. If a partial null is obtained at TP15 and at the output of the analyzer, the most likely source of trouble is in the Control Loop. If a partial null is not obtained, the most likely source of trouble is in the

Null Filter or Null Amplifier. The Null Filter consists of the resistors switched in by S620 and S621 and the capacitors switched in by the relays K620 through K633. If the malfunction occurs over a limited band of frequencies, the problen could be a relay associated with that frequency band.

7.12 CONTROL LOOP

The Control Loop consists of the signal from the outputs of the Boost Amplifier U670, and the Inverting Amplifier, U671. The signals are rectified by the diode switches U720, U740, U750 and U770. The rectified signal is filtered by the R1, R2 and R3 Integrators. The output of the integrators feeds the R1, R2 and R3 drivers which drive the photo-resistors U620, U621 and U622 to provide a null. In order to trace the signal through the Control Loop, it is recommended switches S620 and S621 be put in the test position and a frequency of 2.5kHz be applied to the input. If the tuning network is functioning properly, a partial null should be observed at TP15 as the frequency is varied about 2.5kHz. This same signal should appear at TP14 and inverted at TP13.

A dc voltage should appear at TP24 and TP25, due to the rectification of the R1, R2 switch. In addition, a dc voltage should appear at TP12 that will change polarity (at a rate determined by the time constant of the integrator) as the input frequency is varied above and below the null. Similarly, a dc voltage will appear at TP22 and TP23, due to the rectification of the R3 switch resulting in a dc voltage at TP11 that will change polarity as the input frequency is varied about the null frequency. If the voltages do not occur as indicated, the fault should be found with the associated components. If the voltages are present as indicated, the most likely fault is in the photo-resistors U620, U621 or U622.

7.13 BUFFER AMPLIFIER-R1, R2 SWITCH

The Buffer Amplifier consists of an IC, U691, providing a unity gain sine wave to the R1, R2 switch. The R1, R2 switch converts the sine wave input into square waves to drive the diode bridge rectifiers. If the signals are not as indicated, the most likely fault is the associated components.

7.14 QUADRATURE AMPLIFIER-R3 SWITCH

The Quadrature Amplifier is an integrator that takes the sine wave from the Buffer Amplifier and generates an output that is in quadrature and reduced in amplitude, to the Buffer Amplifier output. This quadrature signal drives the R3 switch to provide the switching signals for the R3 diode bridge rectifier. If the signals are not as indicated, the most likely fault is the associated components.

7.15 DISTORTION GAIN AMPLIFIER

The Distortion Gain Amplifier provides a gain of 10 at distortion levels below 10% and automatically (controlled by the microprocessor) reduces to unity gain for distortion levels above 10%. If the signal at TP37 is normal but the signal and/or dc level at TP30 is off, the most likely source of trouble is the IC, U825, or FET switches Q893 or Q894. If the gain is in error, the most likely source of trouble is the gain determining components.

7.16 FILTERS

The Model 6880 has a series of filters that are by-passed when not engaged and distortion levels are above 0.1%. If the signal at TP32 is not the same as at TP30, the signal should be traced through to ICs, U827, U828, U830 and U831. The tracking filter network capacitors are switched in by FETs, Q880, Q884 and Q888 at distortion levels below 0.1%

7.17 DISTORTION OUTPUT ATTENUATOR

The signal at TP32 should appear at the DISTORTION OUTPUT connector attenuated by the FETs, Q821 and Q820 and their associated components. Q820 should be on for distortion levels above 10%, and Q821 should be on for distortion levels below 1%. For distortion levels between 1% and 10%, both FET switches should be off.

7.18 OPERATIONAL RECTIFIER-INVERTING AMPLIFIER-INTEGRATOR (AC-DC CONVERTER)

The signal at TP32 is rectified by U822, generating a negative half sinusoid at TP34 and a positive half sinusoid at the junction of R830 and R832. If incorrect, check U822 and associated components.

The positive half sinusoid is inverted by unity gain inverting amplifier U823. If incorrect, check U823 and associated components.

The full wave rectified signal is fed to the integrator, U824, and filtered. A dc voltage proportional to the rectified signal should appear at pin 6 of U824. The dc voltage at pin 6 is fed through FET switch Q844 to storage capacitor C846. At frequencies above 1kHz, the switch, Q844, is permanently on. The voltage on the storage capacitor is fed through followers Q846 and Q847 to TP35 and a divider to the microprocessor controlled level detector.

7.19 1kHz OSCILLATOR

If pin 6 of U930 is at zero dc level and there is no 1kHz signal and adjusting R963 will not induce oscillation, the most likely source of trouble is U929, U930 or U931.

SECTION 8

PARTS LISTS, SCHEMATICS AND BOARD LAYOUTS

8.1 ORDERING INFORMATION

When ordering parts from Krohn-Hite, specify the model number (Model 6880), serial number, Schematic Reference Designation (ie; C, CR, R, etc) and the manufacturer's part number (see Figure 10).

Address all inquiries to your local Krohn-Hite Sales Representative or directly to Krohn-Hite.

Any engineering modifications will be found on a Modification Sheet inside the rear cover of this manual.

Part numbers listed are either the actual parts used or direct replacements.

8.2 ORDERING UNLISTED PARTS

When ordering parts from Krohn-Hite that are not listed, include the model number (Model 6880), serial number, a description and location of the part.

MFR	NAME	FSCM
AV	Aavid Engineering, Laconia NH	30161
AB	Allen Bradley Co., Milwaukee WI	01121
AD	Analog Devices Inc., Norwood MA	24355
ALC	Alco Electronic Products Inc., Div. of Augat Inc., North Andover MA	95146
AMP	Amphenol North America, Div. of Buker-Ramo, Oak Brook IL	29587
AMZ	American Zettler, Irvine CA.	-----
APD	American Power Devices, Andover MA	50273
AS	Atlantic Semiconductor, Northridge CA	17545
ATM	Amatom Electronics Hardware, Windsor Locks CT	06540
AVX	Aerovox Inc., New Bedford MA	00656
BKM	Beckman Helipot Div., Fullerton CA	73138
BUS	Bussman, Div. of McGraw-Edison Co., St. Louis MO	71400
CA	Circuit Assembly, Costa Mesa CA.	-----
CC	Coto-Coil Co., Providence RI	71707
CD	Cornell-Dubilier Electronics, Newark NJ	14655
CDI	Compensated Devices Inc., Melrose MA	-----
CGW	Corning Glass Works, Wilmington NC	27167
CK	C&K Components Inc., Newton MA	09353
CLX	Clairex Corp., Mt. Vernon NY	-----
CPC	Components Corp., Denville NJ	26364
CW	CW Industries, Warminster PA	79727
DE	Dale Electronics Inc., Columbus NE	91637
DLV	Delevan Corp., East Aurora NY	99800
DL	Dialight Corp., Brooklyn NY	72619
ECI	Electronic Concepts Inc., Eatontown NJ	50558
FCD	Fairchild, Semiconductor Group, Mountain View CA	07263
FXC	Ferroxcube Corp., Div. of N.A. Phillips, Saugerties NY	02114
GI	General Instrument Corp., Semiconductor Div., Hicksville NY	11711
HG	Hi-G Co., Windsor Locks CT	02289
HP	Hewlett-Packard component supplied by Schweber, Bedford MA	-----
ITT	ITT Components-Capacitors, Santa Ana CA	-----
KGN	Kahgan Electronics Corp., Hempstead NY	57582
KH	Krohn-Hite Corp., Avon MA	88865
KLN	Kelvin Industries, Fajardo PR	-----
KNG	Kings Electronics, Tuckahoe NY	91836
KRL	KRL Electronics Inc., Manchester NH	18235
LFI	Littlefuse Inc., Des Plaines IL	75915
LNX	Lionex, Burlington MA	-----
MAL	Mallory Capacitor Co., Indianapolis IN	90201
MON	Monsanto, Electronics Div., Palo Alto CA	26483
MOT	Motorola Inc., Semiconductor Group, Phoenix AZ	04713
MT	M-Tron Industries Mfg. Inc., Van Nuys CA	31649
NS	National Semiconductor Corp., Semiconductor Div., Santa Clara CA	27014
PRP	Precision Resistive Products Inc., Mediapolis IA	-----
QC	Quality Components Inc., St. Mary's PA	-----
RCA	RCA Solid State Div., Somerville NJ	02735
RCL	RCL Electronics, Div. of AMF, Electro-Components Group, Pompano Beach FL	-----
RI	Resistors Inc., Chicago IL	83827
SCH	ITT Schadow Inc., Eden Prarie MN	-----
SIG	Signetics, Sunnyvale CA	-----
SLX	Siliconix Inc., Sunnyvale CA	100010
STL	Stackpole Components Co., Raliegh NC	-----
SP	Sprague Electric Co., N. Adams MA	56289
STT	Stettner-Trush Inc., Cazenovia NY	52763
SUP	Superior Electric Company, Bristol CT.	-----
SWC	Switchcraft Inc., Chicago IL	82389
TD	Teledyne Semiconductor, Mountain View CA	15818
TI	Texas Instruments, Dallas TX	01295
TMY	Thermalloy, Dallas TX	13103
TOR	Torin Corp., Torrington CT	60399
TRW	TRW Capacitors, Ogallala NE	84411
YSA	Yuasa Battery, Santa Fe CA	-----

Figure 10. Manufacturer's Abbreviation and FSCM Number.

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
* USED FOR LOW BAND OPTION + SUBSTITUTE 6.8uF FOR LOW BAND OPTION				
B100	FAN	TOR	TA300	018003
C100	10000uF 10% 16V	SP	TVA1175.8	473910
C102	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C103	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C104	0.001uF 20% 500V	SP	5GAD10	412210
C105	1uF 20% 35V	ITT	TAPA1M35	471510
C106	2000uF 50V	SP	TVA1318.2	472821
C107	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C108	3300pF 20% 500V	SP	5GAD33	412233
C109	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C110	0.001uF 20% 500V	SP	5GAD10	412210
C111	2000uF 50V	SP	TVA1318.2	472821
C112	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C113	0.001uF 20% 500V	SP	5GAD10	412210
C114	3300pF 20% 500V	SP	5GAD33	412233
C115	1uF 20% 35V	ITT	TAPA1M35	471510
C116	0.01uF 20% 500V	SP	5GASS10	412310
C117	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C118	0.001uF 20% 500V	SP	5GAD10	412210
C119	10000uF 10% 16V	SP	TVA1175.8	473910
C200	0.01uF 20% 500V	SP	5GASS10	412310
C201	0.01uF 20% 500V	SP	5GASS10	412310
C202	0.01uF 20% 500V	SP	5GASS10	412310
C203	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C204	0.01uF 20% 500V	SP	5GASS10	412310
C205	27pF 10% 500V	KGN	DM15C270K	421027
C206	27pF 10% 500V	KGN	DM15C270K	421027
C207	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C208	0.01uF 20% 500V	SP	5GASS10	412310
C209	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C210	0.01uF 20% 500V	SP	5GASS10	412310
C211	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C212	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C300	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C301	0.001uF 20% 500V	SP	5GAD10	412210
C302	0.001uF 20% 500V	SP	5GAD10	412210
C303	0.001uF 20% 500V	SP	5GAD10	412210
C304	0.001uF 20% 500V	SP	5GAD10	412210
C308	0.001uF 20% 500V	SP	5GAD10	412210
C310	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C400	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C401	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C500	4.5-20pF TRIMMER	KH	482008	482008
C501	15pF 5% 500V	KGN	DM15C150J	423015
C502	1uF 10% 200V	KH	441511	441511
C502*	10uF 10% 100V	KH	441611	441611
C503	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C504	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C505	5.6pF 10% 500V	KH	411956	411956
C507	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C508	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C510	18pF 5% 500V	KGN	DM15C180J	422018
C511	3-9pF TRIMMER	KH	482003	482003
C514	4.7pF 10% 500V	KH	411947	411947
C515	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C516	2.5-6pF TRIMMER	KH	482002	482002
C520	9.1pF 10% 500V	KH	411911	411911
C521	4.7pF 10% 500V	KH	411947	411947
C522	22pF 10% 500V	KH	DM15C220K	423022
C523	22pF 10% 500V	KH	DM15C220K	423022
C524	3.5-13pF TRIMMER	KH	482006	482006
C525	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C529	0.1uF 20% 100V	LNX	SR211E104MAA	413410

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
C530	15pF 5% 500V	KGN	DM15C150J	423015
C531	0.01uF 20% 500V	SP	5GASS10	412310
C532	4.5-20pF TRIMMER	KH	482008	482008
C533	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C534	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C536	4.5-20pF TRIMMER	KH	482008	482008
C537	0.01uF 20% 500V	SP	5GASS10	412310
C538	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C541	3.5-13pF TRIMMER	KH	482006	482006
C542	0.01uF 20% 500V	SP	5GASS10	412310
C543	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C546	3-9pF TRIMMER	KH	482003	482003
C547	0.01uF 20% 500V	SP	5GASS10	412310
C548	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C551	3-9pF TRIMMER	KH	482003	482003
C552	0.01uF 20% 500V	SP	5GASS10	412310
C553	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C557	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C560	4.7pF 10% 500V	KH	411947	411947
C561	2.5-6pF TRIMMER	KH	482002	482002
C562	6.8pF 10% 500V	KH	411968	411968
C563	0.01uF 20% 500V	SP	5GASS10	412310
C566	0.01uF 20% 500V	SP	5GASS10	412310
C569	0.033uF 10% 100V	CD	WMF1S33	431333
C570*	0.33uF 10% 100V	CD	WMF1P33	431433
C576	0.47uF 20% 100V	ITT	SR301E474MAA	413447
C578	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C587	100uF 10% 6V	SP	TE1102	471711
C590	100uF 10% 6V	SP	TE1102	471711
C594	0.47uF 20% 100V	ITT	SR301E474MAA	413447
C596	0.01uF 10% 100V	CD	WMF1S1	431310
C597*	0.1uF 1% 200V	KH	452410	452410
C606	4.7pF 10% 500V	KH	411947	411947
C610	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C611	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C614	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C616	12pF 10% 500V	KH	411012	411012
C620	1000pF 5% 500V	KGN	DM15C102J	421210
C621*	10uF 2% 50V	KH	441610	441610
C622	1uF 2% 200V	KH	451510	451510
C623	0.1uF 2% 200V	KH	452410	452410
C624	0.01uF 1% 200V	KH	452310	452310
C625	100pF 10% 500V	KGN	DM15C101K	422110
C626*	1uF 2% 200V	KH	451510	451510
C627	0.1uF 2% 200V	KH	452410	452410
C628	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C629	0.01uF 2% 200V	KH	452310	452310
C630	1000pF 5% 500V	KGN	DM15C102J	421210
C631	330pF 5% 500V	KGN	DM15C331J	423133
C632*	3.2uF 2% 50V	KH	441532	441532
C633	0.32uF 2% 200V	KH	452432	452432
C634	0.032uF 2% 200V	KH	452332	452332
C635	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C636	3200pF 1% 300V	KGN	DM19C322F	421232
C647	10pF 10% 500V	KH	411011	411011
C649	100pF 10% 500V	KGN	DM15C101K	422110
C654	10pF 10% 500V	KH	411011	411011
C655	0.01uF 20% 500V	SP	5GASS10	412310
C658	0.01uF 20% 500V	SP	5GASS10	412310
C661	390pF 10% 500V	KGN	DM15C391K	422139
C668	0.01uF 20% 500V	SP	5GASS10	412310
C670*	5uF 1% 100V	KH	451550	451550
C671*	5uF 1% 100V	KH	451550	451550
C672	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C673	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C675	0.01uF 20% 500V	SP	5GASS10	412310

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
C680	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C681	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C690	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C691	0.01uF 20% 500V	SP	5GASS10	412310
C692	1uF 20% 100V	ITT	SR401E105MAA	412510
C693	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C694	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C699	0.01uF 20% 500V	SP	5GASS10	412310
C700	220pF 10% 500V	KGN	DM15C221K	423122
C701	0.02uF 20% 500V	SP	5GASS20	412320
C710	0.22uF 10% 100V	CD	WMF1P22	431422
C720	200pF 1% 500V	KGN	DM15C201F	422120
C736	200pF 1% 500V	KGN	DM15C201F	422120
C751	0.01uF 20% 500V	SP	5GASS10	412310
C767	0.01uF 20% 500V	SP	5GASS10	412310
C787	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C788	1uF 10% 200V	KH	441511	441511
C789*	10uF 10% 100V	KH	441611	441611
C790	0.1uF +1% 200V	KH	452410	452410
C791	0.001uF 20% 500V	SP	5GAD10	412210
C805	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C806	1uF 10% 200V	KH	441511	441511
C807*	10uF 10% 100V	KH	441611	441611
C808	0.1uF 1% 200V	KH	452410	452410
C809	0.001uF 20% 500V	SP	5GAD10	412210
C820	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C825	68pF 5% 500V	KGN	DM15C680J	422068
C826	0.01uF 20% 500V	SP	5GASS10	412310
C821	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C828	0.01uF 20% 500V	SP	5GASS10	412310
C822	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C833	10pF 10% 500V	KH	411011	411011
C834	0.01uF 20% 500V	SP	5GASS10	412310
C836	0.01uF 20% 500V	SP	5GASS10	412310
C843	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C844*	0.32uF 1% 200V	KH	452432	452432
C845	0.032uF 1% 200V	KH	452332	452332
C846	0.47uF 20% 100V	ITT	SR301E474MAA	413447
C857	0.01uF 20% 500V	SP	5GASS10	412310
C876	0.01uF 20% 500V	SP	5GASS10	412310
C880	510pF 10% 500V	KGN	DM15C511K	423151
C884	0.047uF 20% 50V	ITT	SR205E473MAA	413347
C888	4700pF 20% 500V	SP	5GAD47	412247
C890	68pF 5% 500V	KGN	DM15C680J	422068
C891	5uF 10% 200V	KH	441550	441550
C892	56pF 10% 500V	KGN	DM15C560K	422056
C893	4.5-20pF TRIMMER	KH	482008	482008
C894	390pF 10% 500V	KGN	DM15C391K	422139
C895	0.01uF 20% 500V	SP	5GASS10	412310
C897	0.01uF 20% 500V	SP	5GASS10	412310
C898	3-9pF TRIMMER	KH	482004	482004
C900	1000pF 1% 500V	KGN	DM19C102F	421209
C901	3300pF 10% 100V	CD	WMF1D33	431233
C902	100pF 10% 500V	KGN	DM15C101K	422110
C904	1000pF 1% 500V	KGN	DM19C102F	421209
C905	3300pF 10% 100V	CD	WMF1D33	431233
C906	100pF 10% 500V	KGN	DM15C101K	422110
C913	0.001uF 10% 100V	CD	WMF1D1	431210
C916	0.001uF 10% 100V	CD	WMF1D1	431210
C917	0.01uF 20% 500V	SP	5GASS10	412310
C919	0.01uF 20% 500V	SP	5GASS10	412310
C925	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C940	0.01uF 20% 500V	SP	5GASS10	412310
C941	0.01uF 20% 500V	SP	5GASS10	412310
C947	0.01uF 20% 500V	SP	5GASS10	412310
C953	0.01uF 20% 500V	SP	5GASS10	412310

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
C956	0.01uF 20% 500V	SP	5GASS10	412310
C957	0.01uF 20% 500V	SP	5GASS10	412310
C958	0.01uF 1% 200V	KH	452310	452310
C959	0.01uF 1% 200V	KH	452310	452310
C960	0.01uF 1% 200V	KH	452310	452310
C961	TRIM			
C968	0.01uF 20% 500V	SP	5GASS10	412310
C969	0.01uF 20% 500V	SP	5GASS10	412310
C971+	1uF 20% 35V	ITT	TAPA1M35	471510
C975+	1uF 20% 35V	ITT	TAPA1M35	471510
C978	3.3pF 10% 500V	KH	411933	411933
C980	0.1uF 20% 100V	LNX	SR211E104MAA	413410
C982	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C990	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C991	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C993	0.01uF 20% 500V	SP	5GASS10	412310
C994	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C995	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C1006	15pF 5% 500V	KGN	DM15C150J	423015
C1010	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
C1011	6.8uF 20% 35V	ITT	TAPA6.8M35	471568
CR100	DIODE, RECTIFIER	MOT	MR500	200500
CR101	DIODE, RECTIFIER	MOT	MR500	200500
CR102	DIODE, RECTIFIER	MOT	MR500	200500
CR103	DIODE, RECTIFIER	MOT	MR500	200500
CR104	DIODE, RECTIFIER	AS	1N4002	244002
CR105	DIODE, RECTIFIER	AS	1N4002	244002
CR106	DIODE, RECTIFIER	AS	1N4002	244002
CR107	DIODE, RECTIFIER	AS	1N4002	244002
CR108	DIODE, SWITCHING	APD	1N4149	234149
CR109	DIODE, SWITCHING	APD	1N4149	234149
CR110	DIODE, SWITCHING	APD	1N4149	234149
CR111	DIODE, SWITCHING	APD	1N4149	234149
CR112	DIODE, RECTIFIER	MOT	MR500	200500
CR113	DIODE, RECTIFIER	MOT	MR500	200500
CR114	DIODE, RECTIFIER	MOT	MR500	200500
CR115	DIODE, RECTIFIER	MOT	MR500	200500
CR300	DIODE, SWITCHING	APD	1N4149	234149
CR301	DIODE, SWITCHING	APD	1N4149	234149
CR302	DIODE, SWITCHING	APD	1N4149	234149
CR303	DIODE, SWITCHING	APD	1N4149	234149
CR304	DIODE, SWITCHING	APD	1N4149	234149
CR305	DIODE, SWITCHING	APD	1N4149	234149
CR306	DIODE, SWITCHING	APD	1N4149	234149
CR500	DIODE, SWITCHING	APD	1N4149	234149
CR501	DIODE, SWITCHING	APD	1N4149	234149
CR505	DIODE, SWITCHING	APD	1N4149	234149
CR506	DIODE, SWITCHING	APD	1N4149	234149
CR507	DIODE, SWITCHING	APD	1N4149	234149
CR508	DIODE, SWITCHING	APD	1N4149	234149
CR517*	DIODE, SWITCHING	APD	1N4149	234149
CR531	DIODE, SWITCHING	APD	1N4149	234149
CR537	DIODE, SWITCHING	APD	1N4149	234149
CR542	DIODE, SWITCHING	APD	1N4149	234149
CR547	DIODE, SWITCHING	APD	1N4149	234149
CR552	DIODE, SWITCHING	APD	1N4149	234149
CR567	DIODE, SWITCHING	APD	1N4149	234149
CR568	DIODE, SWITCHING	APD	1N4149	234149
CR573	DIODE, LOW LEAKAGE	FCD	FD300	280300
CR602	DIODE, SWITCHING	APD	1N4149	234149
CR603	DIODE, LOW LEAKAGE	FCD	FD300	280300
CR604	DIODE, LOW LEAKAGE	FCD	FD300	280300
CR620*	DIODE, SWITCHING	APD	1N4149	234149
CR621	DIODE, SWITCHING	APD	1N4149	234149
CR622	DIODE, SWITCHING	APD	1N4149	234149
CR623	DIODE, SWITCHING	APD	1N4149	234149

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
CR628	DIODE, SWITCHING	APD	1N4149	234149
CR629	DIODE, SWITCHING	APD	1N4149	234149
CR633	DIODE, SWITCHING	APD	1N4149	234149
CR635	DIODE, SWITCHING	APD	1N4149	234149
CR636	DIODE, SWITCHING	APD	1N4149	234149
CR650	DIODE, SWITCHING	APD	1N4149	234149
CR651	DIODE, SWITCHING	APD	1N4149	234149
CR696	DIODE, SWITCHING	APD	1N4149	234149
CR705	DIODE, SWITCHING	APD	1N4149	234149
CR708	DIODE, SWITCHING	APD	1N4149	234149
CR815	DIODE, SWITCHING	APD	1N4149	234149
CR820	DIODE, SWITCHING	APD	1N4149	234149
CR821	DIODE, SWITCHING	APD	1N4149	234149
CR822	DIODE, SWITCHING	APD	1N4149	234149
CR823	DIODE, SWITCHING	APD	1N4149	234149
CR824	DIODE, SWITCHING	APD	1N4149	234149
CR825	DIODE, SWITCHING	APD	1N4149	234149
CR829	DIODE, SWITCHING	APD	1N4149	234149
CR830	DIODE, SWITCHING	APD	1N4149	234149
CR855	DIODE, SWITCHING	APD	1N4149	234149
CR859	DIODE, SWITCHING	APD	1N4149	234149
CR871*	DIODE, SWITCHING	APD	1N4149	234149
CR876	DIODE, SWITCHING	APD	1N4149	234149
CR928	DIODE, SWITCHING	APD	1N4149	234149
CR933	DIODE, SWITCHING	APD	1N4149	234149
CR935	DIODE, SWITCHING	APD	1N4149	234149
CR936	DIODE, SWITCHING	APD	1N4149	234149
CR937	DIODE, SWITCHING	APD	1N4149	234149
CR968	DIODE, SWITCHING	APD	1N4149	234149
CR969	DIODE, SWITCHING	APD	1N4149	234149
CR971	DIODE, SWITCHING	APD	1N4149	234149
CR973	DIODE, SWITCHING	APD	1N4149	234149
CR976	DIODE, SWITCHING	APD	1N4149	234149
CR1001	DIODE, SWITCHING	APD	1N4149	234149
CR1002	DIODE, SWITCHING	APD	1N4149	234149
CR1003	DIODE, SWITCHING	APD	1N4149	234149
CR1004	DIODE, SWITCHING	APD	1N4149	234149
CR1008	DIODE, SWITCHING	APD	1N4149	234149
DS314	INDICATOR, LED	KH	344073	344073
DS318	INDICATOR, LED	KH	344073	344073
DS319	INDICATOR, LED	KH	344073	344073
DS321	INDICATOR, LED	KH	344073	344073
DS338	INDICATOR, LED	KH	344073	344073
DS339	INDICATOR, LED	KH	344073	344073
DS340	INDICATOR, LED	KH	344073	344073
DS342	INDICATOR, LED	KH	344073	344073
DS343	INDICATOR, LED	KH	344073	344073
DS345	INDICATOR, LED	KH	344073	344073
DS347	INDICATOR, LED	KH	344073	344073
DS348	LED	MON	MV5025	295025
DS349	LED	MON	MV5025	295025
DS350	DISPLAY, 7-SEGMENT	MON	MAN6730	296730
DS351	DISPLAY, 7-SEGMENT	MON	MAN6710	296710
F100	FUSE, 120V	BUS	MDL3/4A	021011
F100	FUSE, 240V	BUS	MDL3/8A	021008
J100	AC RECEPTACLE	SWC	EAC301	029030
J101	CONNECTOR, PC EDGE	KH	015015	015015
J200	CONNECTOR, PC EDGE	KH	015007	015007
J201	CONNECTOR, PC EDGE	KH	015014	015014
J400	CONNECTOR, PC EDGE	KH	015014	015014
J500	CONNECTOR, PC EDGE	KH	015014	015014
J501	CONNECTOR, BNC	AMP	31-010	370402
J502	CONNECTOR, BNC	AMP	31-010	370402
J600	CONNECTOR, PC EDGE	KH	015014	015014
J700	CONNECTOR, PC EDGE	KH	015014	015014

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
J800	CONNECTOR, PC EDGE	KH	015014	015014
J801	CONNECTOR, BNC	AMP	31-010	370402
J802	CONNECTOR, BNC	AMP	31-010	370402
J803	CONNECTOR, BNC	AMP	31-010	370402
J900	CONNECTOR, PC EDGE	KH	015014	015014
J901	CONNECTOR, BNC	AMP	31-010	370402
J902	CONNECTOR, BNC	AMP	31-010	370402
K500	RELAY	CC	CR-2203-5-40	029024
K501	RELAY	CC	CR-2203-5-40	029024
K502	RELAY	CC	CR-2203-5-40	029024
K503	RELAY	CC	CR-2203-5-40	029024
K504	RELAY	CC	CR-2203-5-40	029024
K505	RELAY	CC	CR-2203-5-40	029024
K506	RELAY	CC	CR-2203-5-40	029024
K620*	RELAY	CC	CR-2203-5-40	029024
K621	RELAY	CC	CR-2203-5-40	029024
K622	RELAY	CC	CR-2203-5-40	029024
K623	RELAY	CC	CR-2203-5-40	029024
K624*	RELAY	CC	CR-2203-5-40	029024
K625	RELAY	CC	CR-2203-5-40	029024
K626	RELAY	CC	CR-2203-5-40	029024
K627	RELAY	CC	CR-2203-5-40	029024
K628*	RELAY	CC	CR-2203-5-40	029024
K629	RELAY	CC	CR-2203-5-40	029024
K630	RELAY	CC	CR-2203-5-40	029024
K631	RELAY	CC	CR-2203-5-40	029024
K632	RELAY	CC	CR-2203-5-40	029024
K633	RELAY	CC	CR-2203-5-40	029024
K690	RELAY	CC	CR-2203-5-40	029024
K691	RELAY	CC	CR-2203-5-40	029024
K692*	RELAY	CC	CR-2203-5-40	029024
K693	RELAY	CC	CR-2203-5-40	029024
K694*	RELAY	CC	CR-2203-5-40	029024
K695	RELAY	CC	CR-2203-5-40	029024
K820	RELAY	CC	CR-2203-5-40	029024
K821	RELAY	CC	CR-2203-5-40	029024
K822	RELAY	CC	CR-2203-5-40	029024
K823	RELAY	CC	CR-2203-5-40	029024
K824	RELAY	CC	CR-2203-5-40	029024
Q100	TRANSISTOR, PNP	MOT	TIP32A	200032
Q101	TRANSISTOR, PNP	MOT	MPS6518	206518
Q102	TRANSISTOR, NPN	MOT	MPS6515	206515
Q103	TRANSISTOR, PNP	MOT	MPS6518	206518
Q104	TRANSISTOR, NPN	MOT	MPS6515	206515
Q105	TRANSISTOR, NPN	MOT	TIP31A	200031
Q200	TRANSISTOR, NPN	MOT	MPS6515	206515
Q201	TRANSISTOR, NPN	MOT	MPS6515	206515
Q300	TRANSISTOR, NPN	MOT	MPS6515	206515
Q301	TRANSISTOR, PNP	MOT	TIP32A	200032
Q302	TRANSISTOR, PNP	MOT	TIP32A	200032
Q303	TRANSISTOR, PNP	MOT	TIP32A	200032
Q304	TRANSISTOR, PNP	MOT	TIP32A	200032
Q305	TRANSISTOR, PNP	MOT	TIP32A	200032
Q306	TRANSISTOR, PNP	MOT	TIP32A	200032
Q307	TRANSISTOR, PNP	MOT	TIP32A	200032
Q310	TRANSISTOR, PNP	MOT	TIP32A	200032
Q313	TRANSISTOR, NPN	MOT	MPS6515	206515
Q314	TRANSISTOR, NPN	MOT	MPS6515	206515
Q315	TRANSISTOR, NPN	MOT	MPS6515	206515
Q316	TRANSISTOR, NPN	MOT	MPS6515	206515
Q317	TRANSISTOR, NPN	MOT	MPS6515	206515
Q318	TRANSISTOR, NPN	MOT	MPS6515	206515
Q319	TRANSISTOR, NPN	MOT	MPS6515	206515
Q320	TRANSISTOR, NPN	MOT	MPS6515	206515
Q400	TRANSISTOR, PNP	MOT	MPS6518	206518

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
Q402	TRANSISTOR, PNP	MOT	MPS6518	206518
Q403	TRANSISTOR, PNP	MOT	MPS6518	206518
Q405	TRANSISTOR, PNP	MOT	MPS6518	206518
Q411	TRANSISTOR, PNP	MOT	MPS6518	206518
Q414	TRANSISTOR, PNP	MOT	MPS6518	206518
Q502	TRANSISTOR, PNP	MOT	MPS6518	206518
Q503*	TRANSISTOR, PNP	MOT	MPS6518	206518
Q520	FET, N-CHANNEL	MOT	MPF4393	204393
Q521	FET, N-CHANNEL	MOT	MPF4393	204393
Q522	FET, N-CHANNEL	MOT	MPF4393	204393
Q523	FET, N-CHANNEL	MOT	MPF4393	204393
Q524	FET, N-CHANNEL	MOT	MPF4393	204393
Q525	FET, N-CHANNEL	MOT	MPF4393	204393
Q526	FET, N-CHANNEL	MOT	MPF4393	204393
Q527	FET, N-CHANNEL	MOT	MPF4393	204393
Q528	FET, N-CHANNEL	MOT	MPF4393	204393
Q529	FET, N-CHANNEL	MOT	MPF4393	204393
Q570*	FET, N-CHANNEL	MOT	MPF4393	204393
Q571	FET, N-CHANNEL	MOT	MPF4393	204393
Q572	TRANSISTOR, NPN	MOT	MPS6515	206515
Q573	FET, N-CHANNEL	MOT	MPF4393	204393
Q590	TRANSISTOR, NPN	MOT	MPS6515	206515
Q591	TRANSISTOR, NPN	MOT	MPS6515	206515
Q592	FET, N-CHANNEL	MOT	MPF4393	204393
Q593	TRANSISTOR, NPN	MOT	MPS6515	206515
Q594*	FET, N-CHANNEL	MOT	MPF4393	204393
Q595	TRANSISTOR, NPN	MOT	MPS6515	206515
Q596	TRANSISTOR, NPN	MOT	MPS6515	206515
Q600	TRANSISTOR, NPN	MOT	MPS6515	206515
Q629A	TRANSISTOR, PNP	MOT	2N2917A	202917
Q292B	TRANSISTOR, PNP	MOT	2N2917A	202917
Q636A	TRANSISTOR, PNP	MOT	2N2917A	202917
Q636B	TRANSISTOR, PNP	MOT	2N2917A	202917
Q645	TRANSISTOR, PNP	MOT	MPS6518	206518
Q646	TRANSISTOR, PNP	MOT	MPS6518	206518
Q647	TRANSISTOR, NPN	MOT	MPS6515	206515
Q648	TRANSISTOR, NPN	MOT	MPS6515	206515
Q649	TRANSISTOR, PNP	MOT	MPS6518	206518
Q690	TRANSISTOR, PNP	MOT	MPS6518	206518
Q691*	TRANSISTOR, PNP	MOT	MPS6518	206518
Q692	TRANSISTOR, PNP	MOT	MPS6518	206518
Q693	TRANSISTOR, PNP	MOT	MPS6518	206518
Q694	FET, N-CHANNEL	MOT	MPF4393	204393
Q700	TRANSISTOR, PNP	MOT	MPS6518	206518
Q701	FET, N-CHANNEL	MOT	MPF4393	204393
Q702	TRANSISTOR, PNP	MOT	MPS6518	206518
Q703	FET, N-CHANNEL	MOT	MPF4393	204393
Q720	TRANSISTOR, NPN	MOT	MPS6515	206515
Q721	TRANSISTOR, NPN	MOT	MPS6515	206515
Q722	TRANSISTOR, PNP	MOT	MPS6518	206518
Q723	TRANSISTOR, PNP	MOT	MPS6518	206518
Q724	TRANSISTOR, NPN	MOT	MPS3646	203646
Q740	TRANSISTOR, PNP	MOT	MPS6518	206518
Q741	TRANSISTOR, PNP	MOT	MPS6518	206518
Q742	TRANSISTOR, NPN	MOT	MPS6515	206515
Q743	TRANSISTOR, PNP	MOT	MPS6518	206518
Q744	TRANSISTOR, NPN	MOT	MPS3646	203646
Q750	TRANSISTOR, NPN	MOT	MPS6515	206515
Q751	TRANSISTOR, NPN	MOT	MPS6515	206515
Q752	TRANSISTOR, PNP	MOT	MPS6518	206518
Q753	TRANSISTOR, PNP	MOT	MPS6518	206518
Q754	TRANSISTOR, NPN	MOT	MPS3646	203646
Q770	TRANSISTOR, PNP	MOT	MPS6518	206518
Q771	TRANSISTOR, PNP	MOT	MPS6518	206518
Q772	TRANSISTOR, NPN	MOT	MPS6515	206515
Q773	TRANSISTOR, PNP	MOT	MPS6518	206518

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
Q774	TRANSISTOR, NPN	MOT	MPS3646	203646
Q780	TRANSISTOR, NPN	NS	TIS97	220097
Q800	TRANSISTOR, NPN	NS	TIS97	220097
Q820	FET, N-CHANNEL	MOT	MPF4393	204393
Q821	FET, N-CHANNEL	MOT	MPF4391	204391
Q843*	FET, N-CHANNEL	MOT	MPF4393	204393
Q844	FET, N-CHANNEL	MOT	MPF4393	204393
Q845	TRANSISTOR, NPN	MOT	MPS6515	206515
Q846	FET, N-CHANNEL	MOT	MPF4393	204393
Q847	TRANSISTOR, NPN	MOT	MPS6515	206515
Q854	FET, N-CHANNEL	MOT	MPF4393	204393
Q858	FET, N-CHANNEL	MOT	MPF4393	204393
Q866	TRANSISTOR, PNP	MOT	MPS6518	206518
Q870*	TRANSISTOR, PNP	MOT	MPS6518	206518
Q874	TRANSISTOR, PNP	MOT	MPS6518	206518
Q878	TRANSISTOR, PNP	MOT	MPS6518	206518
Q880	FET, N-CHANNEL	MOT	MPF4391	204391
Q882	TRANSISTOR, PNP	MOT	MPS6518	206518
Q884	FET, N-CHANNEL	MOT	MPF4391	204391
Q886	TRANSISTOR, PNP	MOT	MPS6518	206518
Q888	FET, N-CHANNEL	MOT	MPF4391	204391
Q893	FET, N-CHANNEL	MOT	MPF4393	204393
Q894	FET, N-CHANNEL	MOT	MPF4393	204393
Q908	TRANSISTOR, NPN	MOT	MPS6515	206515
Q940	TRANSISTOR, PNP	MOT	MPS6518	206518
Q941	TRANSISTOR, PNP	MOT	MPS6518	206518
Q981	TRANSISTOR, PNP	MOT	MPS6518	206518
Q982	TRANSISTOR, NPN	MOT	MPS3646	203646
Q983	TRANSISTOR, NPN	MOT	MPS3646	203646
R100	18 5% 10W	KH	787018	787018
R101	100 3% 5W	KH	770110	770110
R102	0.82 5% 1W	KH	747908	747908
R103	3.6 5% 1/4W	AB	CB36G5	927936
R104	1K 10% 1/4W	AB	CB1021	928210
R105	470 10% 1/4W	AB	CB4711	928147
R106	100 10% 1/4W	AB	CB1011	928110
R107	1K 10% 1/4W	AB	CB1021	928210
R108	2.7K 10% 1/4W	AB	CB2721	928227
R109	9.31K 1% 1/4W	KH	850293	850293
R110	100 10% 1/4W	AB	CB1001	928110
R111	220 10% 1/4W	AB	CB2211	928122
R112	4.7K 10% 1/4W	AB	CB4721	928247
R113	9.31K 1% 1/4W	KH	850293	850293
R116	100 10% 1/4W	AB	CB1011	928110
R117	100 10% 1/4W	AB	CB1011	928110
R118	220 10% 1/4W	AB	CB2211	928122
R119	470 10% 1/4W	AB	CB4711	928147
R120	100 10% 1/4W	AB	CB1011	928110
R121	100 3% 5W	KH	770110	770110
R122	0.82 5% 1W	KH	747908	747908
R123	3.6 5% 1/4W	AB	CB36G1	927936
R124	1K 10% 1/4W	AB	CB1021	928210
R125	1K 10% 1/4W	AB	CB1021	928210
R126	4.7K 10% 1/4W	AB	CB4721	928247
R127	3.92K 1% 1/4W	KH	850239	850239
R128	150K 10% 1/4W	AB	CB1541	928415
R129	100K POT 1/2W	BKM	72XWR100K	658411
R130	2.4K 5% 1/4W	AB	CB2425	927224
R131	2.7K 10% 1/4W	AB	CB2721	928227
R132	9.31K 1% 1/4W	KH	850293	850293
R133	100 10% 1/4W	AB	CB1011	928110
R200	3.3K 10% 1/4W	AB	CB3321	928233
R201	10K 10% 1/4W	AB	CB1031	928310
R202	10K 10% 1/4W	AB	CB1031	928310
R203	10K 10% 1/4W	AB	CB1031	928310
R204	10K 10% 1/4W	AB	CB1031	928310

SCHEM REF.	DESCRIPTION			MFR	MFR PART NUMBER	KH NUMBER
R205	10K	10%	1/4W	AB	CB1031	928310
R206	10K	10%	1/4W	AB	CB1031	928310
R207	3.3K	10%	1/4W	AB	CB3321	928233
R208	3.3K	10%	1/4W	AB	CB3321	928233
R210	2.7K	10%	1/4W	AB	CB2721	928227
R211	4.7K	10%	1/4W	AB	CB4721	928247
R212	27K	10%	1/4W	AB	CB2731	928327
R213	7.5K	1%	1/4W	KH	822275	822275
R214	681	1%	1/4W	KH	850168	850168
R300	10K	10%	1/4W	AB	CB1031	928310
R301	10K	10%	1/4W	AB	CB1031	928310
R302	10K	10%	1/4W	AB	CB1031	928310
R303	10K	10%	1/4W	AB	CB1031	928310
R304	10K	10%	1/4W	AB	CB1031	928310
R305	4.7K	10%	1/4W	AB	CB4721	928310
R306	1M	10%	1/4W	AB	CB1051	928510
R307	220	10%	1/4W	AB	CB1031	928122
R308	10K	10%	1/4W	AB	CB1031	928310
R309	100K	10%	1/4W	AB	CB1041	928410
R312	120	10%	1/4W	AB	CB1211	928112
R313	120	10%	1/4W	AB	CB1211	928112
R314	120	10%	1/4W	AB	CB1211	928112
R315	120	10%	1/4W	AB	CB1211	928112
R316	120	10%	1/4W	AB	CB1211	928112
R317	120	10%	1/4W	AB	CB1211	928112
R318	120	10%	1/4W	AB	CB1211	928112
R319	120	10%	1/4W	AB	CB1211	928112
R320	680	10%	1/4W	AB	CB6811	928168
R321	680	10%	1/4W	AB	CB6811	928168
R322	680	10%	1/4W	AB	CB6811	928168
R323	680	10%	1/4W	AB	CB6811	928168
R324	680	10%	1/4W	AB	CB6811	928168
R325	680	10%	1/4W	AB	CB6811	928168
R326	680	10%	1/4W	AB	CB6811	928168
R327	680	10%	1/4W	AB	CB6811	928168
R340	1K	10%	1/4W	AB	CB1021	928210
R341	1K	10%	1/4W	AB	CB1021	928210
R342	1K	10%	1/4W	AB	CB1021	928210
R343	1K	10%	1/4W	AB	CB1021	928210
R344	1K	10%	1/4W	AB	CB1021	928210
R345	1K	10%	1/4W	AB	CB1021	928210
R346	1K	10%	1/4W	AB	CB1021	928210
R347	27	10%	1/4W	AB	CB2701	928027
R348	1K	10%	1/4W	AB	CB1021	928210
R349	27	10%	1/4W	AB	CB2701	928027
R350	1K	10%	1/4W	AB	CB1021	928210
R351	27	10%	1/4W	AB	CB2701	928027
R352	1K	10%	1/4W	AB	CB1021	928210
R353	27	10%	1/4W	AB	CB2701	928027
R354	1K	10%	1/4W	AB	CB1021	928210
R355	27	10%	1/4W	AB	CB2701	928027
R356	1K	10%	1/4W	AB	CB1021	928210
R357	27	10%	1/4W	AB	CB2701	928027
R358	1K	10%	1/4W	AB	CB1021	928210
R359	27	10%	1/4W	AB	CB2701	928027
R360	1K	10%	1/4W	AB	CB1021	928210
R361	1K	10%	1/4W	AB	CB1021	928210
R362	1K	10%	1/4W	AB	CB1021	928210
R363	1K	10%	1/4W	AB	CB1021	928210
R400	2.2K	10%	1/4W	AB	CB2221	928222
R401	10K	10%	1/4W	AB	CB1031	928310
R402	130	5%	1/4W	AB	CB1311	937113
R403	130	5%	1/4W	AB	CB1311	937113
R404	130	5%	1/4W	AB	CB1311	937113
R405	130	5%	1/4W	AB	CB1311	937113
R406	130	5%	1/4W	AB	CB1311	937113

SCHEM REF.	DESCRIPTION			MFR	MFR PART NUMBER	KH NUMBER
R407	130	5%	1/4W	AB	CB1311	937113
R420	10K	10%	1/4W	AB	CB1031	928310
R421	10K	10%	1/4W	AB	CB1031	928310
R422	10K	10%	1/4W	AB	CB1031	928310
R423	10K	10%	1/4W	AB	CB1031	928310
R424	10K	10%	1/4W	AB	CB1031	928310
R425	10K	10%	1/4W	AB	CB1031	928310
R446	10K	10%	1/4W	AB	CB1031	928310
R447	10K	10%	1/4W	AB	CB1031	928310
R448	10K	10%	1/4W	AB	CB1031	928310
R449	10K	10%	1/4W	AB	CB1031	928310
R450	10K	10%	1/4W	AB	CB1031	928310
R454	10K	10%	1/4W	AB	CB1031	928310
R456	130	5%	1/4W	AB	CB1311	937113
R460	10K	10%	1/4W	AB	CB1031	928310
R468	1K	10%	1/4W	AB	CB1021	928210
R472	130	5%	1/4W	AB	CB1311	937113
R474	1K	10%	1/4W	AB	CB1021	928210
R478	130	5%	1/4W	AB	CB1311	937113
R500	11.8K	1%	1/4W	KH	850311A	850311A
R501	1K	POT	1/2W	BKM	72XWR1K	658211
R502	100K	1%	1/4W	KH	850410	850410
R503	100	10%	1/4W	AB	CB1011	928110
R504	100K	POT	1/2W	BKM	72XWR100K	658411
R505	10M	10%	1/4W	AB	CB1061	928610
R506	1K	10%	1/4W	AB	CB1021	928210
R507	100	10%	1/4W	AB	CB1011	928110
R508	100	10%	1/4W	AB	CB1011	928110
R509	10K	10%	1/4W	AB	CB1031	928310
R510	121K	1%	1/4W	KH	850412	850412
R511	200	POT	1/2W	BKM	72XWR200	658120
R512	1.21K	1%	1/4W	KH	850212	850212
R513	5.11K	1%	1/4W	KH	850251	850251
R514	121K	1%	1/4W	KH	850412	850412
R515*	10K	10%	1/4W	AB	CB1031	928310
R516*	10K	10%	1/4W	AB	CB1031	928310
R517*	10K	10%	1/4W	AB	CB1031	928310
R518*	100	10%	1/4W	AB	CB1011	928100
R518	100K	10%	1/4W	AB	CB1041	928410
R519	1K	10%	1/4W	AB	CB1021	928210
R520	221K	1%	1/4W	KH	850422	850422
R521	10K	10%	1/4W	AB	CB1031	928310
R522	10M	10%	1/4W	AB	CB1031	928610
R523	100K	POT	1/2W	BKM	72XWR100K	658411
R524	221K	1%	1/4W	KH	850422	850422
R525	100	10%	1/4W	AB	CB1011	928110
R526	100K	POT	1/2W	BKM	72XWR100K	658411
R527	220K	5%	1/4W	AB	CB2245	927422
R528	100	10%	1/4W	AB	CB1011	928110
R529	100	10%	1/4W	AB	CB1011	928110
R530	71.5K	1%	1/4W	KH	850371	850371
R531	100K	10%	1/4W	AB	CB1041	928410
R532	10M	10%	1/4W	AB	CB1031	928610
R533	100	10%	1/4W	AB	CB1011	928110
R534	10K	10%	1/4W	AB	CB1031	928310
R535	9.76K	1%	1/4W	KH	850297	850297
R536	110K	1%	1/4W	KH	850411	850411
R537	100K	10%	1/4W	AB	CB1041	928410
R538	10M	10%	1/4W	AB	CB1061	928610
R539	10K	10%	1/4W	AB	CB1031	928310
R540	1.87K	1%	1/4W	KH	850218A	850218A
R541	169K	1%	1/4W	KH	850416A	850416A
R542	100K	10%	1/4W	AB	CB1041	928410
R543	10M	10%	1/4W	AB	CB1061	928610
R544	10K	10%	1/4W	AB	CB1031	928310
R545	1.21K	1%	1/4W	KH	850212	850212

SCHEM REF.	DESCRIPTION			MFR	MFR PART NUMBER	KH NUMBER
R546	261K	1%	1/4W	KH	850426A	850426A
R547	100K	10%	1/4W	AB	CB1041	928410
R548	10M	10%	1/4W	AB	CB1061	928610
R549	10K	10%	1/4W	AB	CB1031	928310
R550	750	1%	1/4W	KH	850175	850175
R551	402K	1%	1/4W	KH	850440	850440
R552	100K	10%	1/4W	AB	CB1041	928410
R553	10M	10%	1/4W	AB	CB1061	928610
R554	10K	10%	1/4W	AB	CB1031	928310
R555	499	1%	1/4W	KH	850149	850149
R556	909	1%	1/4W	KH	850190	850190
R557	100	10%	1/4W	AB	CB1011	928110
R560	221K	1%	1/4W	KH	850422	850422
R561	100	10%	1/4W	AB	CB1031	928110
R562	100K	1%	1/4W	KH	850410	850410
R563	100	10%	1/4W	AB	CB1031	928110
R564	25K	POT	1/2W	BKM	72XWR25K	658326
R565	9.31K	1%	1/4W	KH	850293	850293
R566	100	10%	1/4W	AB	CB1031	928110
R567	9.31K	1%	1/4W	KH	850293	850293
R568	200K	POT	1/2W	BKM	72XWR200K	658420
R569	1M	1%	1/4W	KH	850510	850510
R570	100K	POT	1/2W	BKM	72XWR100K	658411
R571	470K	10%	1/4W	AB	CB4741	928477
R572	1K	10%	1/4W	AB	CB1021	928210
R573	100	10%	1/4W	AB	CB1031	928110
R574	100	10%	1/4W	AB	CB1031	928110
R575	3.16M	1%	1/4W	KH	850531	850531
R576	100K	10%	1/4W	AB	CB1041	928410
R577	1K	10%	1/4W	AB	CB1021	928210
R578	10K	10%	1/4W	AB	CB1031	928310
R585	3K	5%	1/4W	AB	CB3025	927230
R586	100	10%	1/4W	AB	CB1031	928110
R587	390	10%	1/4W	AB	CB3911	928139
R588	100	10%	1/4W	AB	CB1031	928110
R589	1K	10%	1/4W	AB	CB1021	928210
R590	390	10%	1/4W	AB	CB3911	928139
R591	1K	10%	1/4W	AB	CB1021	928210
R592	10	10%	1/4W	AB	CB1001	928010
R593	10	10%	1/4W	AB	CB1001	928010
R594	100K	10%	1/4W	AB	CB1041	928410
R595	1K	10%	1/4W	AB	CB1021	928210
R596	100	10%	1/4W	AB	CB1031	928110
R597	11.8K	1%	1/4W	KH	850311A	850311A
R598	200	POT	1/2W	BKM	72XWR200	658120
R599	909	1%	1/4W	KH	850190	850190
R600	10M	1%	1/4W	KH	850610	850610
R601	10M	1%	1/4W	KH	850610	850610
R602	10K	10%	1/4W	AB	CB1031	928310
R603	10K	10%	1/4W	AB	CB1031	928310
R604	1K	10%	1/4W	AB	CB1021	928210
R606	10K	5%	1/4W	AB	CB1035	927310
R607	9.1K	5%	1/4W	AB	CB9125	927291
R608	3K	5%	1/4W	AB	CB3025	927230
R609	1.1K	5%	1/4W	AB	CB1125	927211
R610	100	10%	1/4W	AB	CB1031	928110
R611	100	10%	1/4W	AB	CB1031	928110
R612	1.1K	5%	1/4W	AB	CB1125	927211
R613	1K	10%	1/4W	AB	CB1021	928210
R614	100	10%	1/4W	AB	CB1031	928110
R615	2.7	10%	1/4W	AB	CB27G1	937127
R616	1K	10%	1/4W	AB	CB1021	928210
R617	1K	1%	1/4W	KH	850209	850209
R618	9.09K	1%	1/4W	KH	850290	850290
R620	2.05K	1%	1/4W	KH	850221	850221
R621	1.1K	1%	1/4W	KH	850211	850211

SCHEM REF.	DESCRIPTION			MFR	MFR PART NUMBER	KH NUMBER
R622	220K	5%	1/4W	AB	CB2245	927422
R623	24K	5%	1/4W	AB	CB2425	927324
R624	220K	5%	1/4W	AB	CB2245	927422
R625	24K	5%	1/4W	AB	CB2425	927224
R626	4.7K	10%	1/4W	AB	CB4721	928247
R627	910	5%	1/4W	AB	CB9115	927192
R628	160	5%	1/4W	AB	CB1615	927116
R629	100	10%	1/4W	AB	CB1011	928110
R630	300	5%	1/2W	AB	EB3015	937130
R631	510	5%	1/2W	AB	CB5115	937151
R632	10K	10%	1/4W	AB	CB1031	928310
R633	120	10%	1/4W	AB	CB1211	928112
R634	25K	POT	1/2W	BKM	72XWR25K	658326
R635	160	5%	1/4W	AB	CB1615	927116
R636	100	10%	1/4W	AB	CB1011	928110
R637	300	5%	1/2W	AB	CB3155	937130
R638	510	5%	1/2W	AB	CB5115	937151
R639	10K	10%	1/4W	AB	CB1031	928310
R640	120	10%	1/4W	AB	CB1211	928112
R641	25K	POT	1/2W	BKM	72XWR25K	658326
R642	560	10%	1/4W	AB	CB5611	928156
R643	560	10%	1/4W	AB	CB5611	928156
R645	1.5K	10%	1/4W	AB	CB1521	928215
R646	6.2K	5%	1/4W	AB	CB6225	927262
R647	1.5K	10%	1/4W	AB	CB1521	928215
R648	909	1%	1/4W	KH	850190	850190
R649	1K	10%	1/4W	AB	CB1021	928210
R650	100	1%	1/4W	KH	850109	850109
R651	220	10%	1/4W	AB	CB2211	928122
R652	1K	10%	1/4W	AB	CB1021	928210
R653	470	10%	1/4W	AB	CB4711	928147
R654	200	POT	1/2W	BKM	72XWR200	658120
R655	22	10%	1/4W	AB	CB2201	928022
R656	22	10%	1/4W	AB	CB2201	928022
R657	22	10%	1/4W	AB	CB2201	928022
R658	22	10%	1/4W	AB	CB2201	928022
R659	1K	10%	1/4W	AB	CB1021	928210
R660	100	1%	1/4W	KH	850109	850109
R661	68	10%	1/4W	AB	CB6801	928068
R662	100	1%	1/4W	KH	850109	850109
R663	200	POT	1/2W	BKM	72XWR200	658120
R664	10	1%	1/4W	KH	850010	850010
R665	4.7K	10%	1/4W	AB	CB4721	928247
R668	100	10%	1/4W	AB	CB1011	928110
R669	1.5K	5%	1/4W	AB	CB1525	927215
R670	5K	POT	1/2W	BKM	72XWR5K	658251
R672	1.1K	1%	1/4W	KH	850211	850211
R673	1.1K	1%	1/4W	KH	850211	850211
R674	1.1K	1%	1/4W	KH	850211	850211
R675	100	10%	1/4W	AB	CB1011	928110
R676	1.1K	1%	1/4W	KH	850211	850211
R680	4.7K	10%	1/4W	AB	CB4721	928247
R681	1.1K	1%	1/4W	KH	850211	850211
R682	1.1K	1%	1/4W	KH	850211	850211
R690	10K	10%	1/4W	AB	CB1031	928310
R691	100	10%	1/4W	AB	CB1011	928110
R692	51K	5%	1/4W	AB	CB5135	927351
R693	10K	10%	1/4W	AB	CB1031	928310
R694	10K	10%	1/4W	AB	CB1031	928310
R695	10K	10%	1/4W	AB	CB1031	928310
R696	100K	10%	1/4W	AB	CB1041	928410
R697	430K	5%	1/4W	AB	CB4345	927443
R698	100	10%	1/4W	AB	CB1011	928110
R699	100	10%	1/4W	AB	CB1011	928110
R700	10M	10%	1/4W	AB	CB1061	928610
R701	1M	10%	1/4W	AB	CB1051	928510

SCHEM REF.	DESCRIPTION			MFR	MFR PART NUMBER	KH NUMBER
R702	100K	10%	1/4W	AB	CB1041	928410
R703	10K	10%	1/4W	AB	CB1031	928310
R704	10K	10%	1/4W	AB	CB1031	928310
R705	10K	10%	1/4W	AB	CB1031	928310
R706	10K	10%	1/4W	AB	CB1031	928310
R707	10K	10%	1/4W	AB	CB1031	928310
R708	10K	10%	1/4W	AB	CB1031	928310
R709	100K	10%	1/4W	AB	CB1041	928410
R710	1M	10%	1/4W	AB	CB1051	928510
R720	4.7K	10%	1/4W	AB	CB4721	928247
R721	3.01K	1%	1/4W	KH	850229	850229
R722	2K	5%	1/4W	AB	CB2025	927220
R723	11K	1%	1/4W	KH	850308	850308
R724	6.04K	1%	1/4W	KH	850260	850260
R725	430	5%	1/4W	AB	CB4315	927143
R726	430	5%	1/4W	AB	CB4315	927143
R727	910	5%	1/4W	AB	CB9115	927192
R728	100	10%	1/4W	AB	CB1011	928110
R729	6.98K	1%	1/4W	KH	850269	850269
R730	6.98K	1%	1/4W	KH	850269	850269
R731	100	10%	1/4W	AB	CB1011	928110
R732	910	5%	1/4W	AB	CB9115	927192
R733	2.21K	1%	1/4W	KH	850222	850222
R736	4.7K	10%	1/4W	AB	CB4721	928247
R737	7.5K	5%	1/4W	AB	CB7525	927275
R738	3.01K	1%	1/4W	KH	850229	850229
R739	6.04K	1%	1/4W	KH	850260	850260
R740	2K	5%	1/4W	AB	CB2025	927220
R741	430	5%	1/4W	AB	CB4315	927143
R742	430	5%	1/4W	AB	CB4315	927143
R743	100	10%	1/4W	AB	CB1011	928110
R744	2K	5%	1/4W	AB	CB2025	927220
R745	6.98K	1%	1/4W	KH	850269	850269
R746	6.98K	1%	1/4W	KH	850269	850269
R747	100	10%	1/4W	AB	CB1011	928110
R748	910	5%	1/4W	AB	CB9115	927192
R749	2.21K	1%	1/4W	KH	850222	850222
R750	4.7K	10%	1/4W	AB	CB4721	928247
R751	100	10%	1/4W	AB	CB1011	928110
R752	7.5K	5%	1/4W	AB	CB7525	927275
R753	2K	5%	1/4W	AB	CB2025	927220
R754	100	10%	1/4W	AB	CB1011	928110
R755	430	5%	1/4W	AB	CB4315	927143
R756	430	5%	1/4W	AB	CB4315	927143
R757	910	5%	1/4W	AB	CB9115	927192
R758	100	10%	1/4W	AB	CB1011	928110
R759	6.98K	1%	1/4W	KH	850269	850269
R760	6.98K	1%	1/4W	KH	850269	850269
R761	100	10%	1/4W	AB	CB1011	928110
R762	910	5%	1/4W	AB	CB9115	927192
R766	4.7K	10%	1/4W	AB	CB4721	928247
R767	100	10%	1/4W	AB	CB1011	928110
R768	7.5K	5%	1/4W	AB	CB7525	927275
R769	2K	5%	1/4W	AB	CB2025	927220
R770	100	10%	1/4W	AB	CB1011	928110
R771	430	5%	1/4W	AB	CB4315	927143
R772	430	5%	1/4W	AB	CB4315	927143
R773	910	5%	1/4W	AB	CB9115	927192
R774	2K	5%	1/4W	AB	CB2025	927220
R775	6.98K	1%	1/4W	KH	850269	850269
R776	6.98K	1%	1/4W	KH	850269	850269
R777	100	10%	1/4W	AB	CB1011	928110
R778	910	5%	1/4W	AB	CB9115	927192
R780	10K	10%	1/4W	AB	CB1031	928310
R781	2M	5%	1/4W	AB	CB2055	927520
R782	2M	5%	1/4W	AB	CB2055	927520

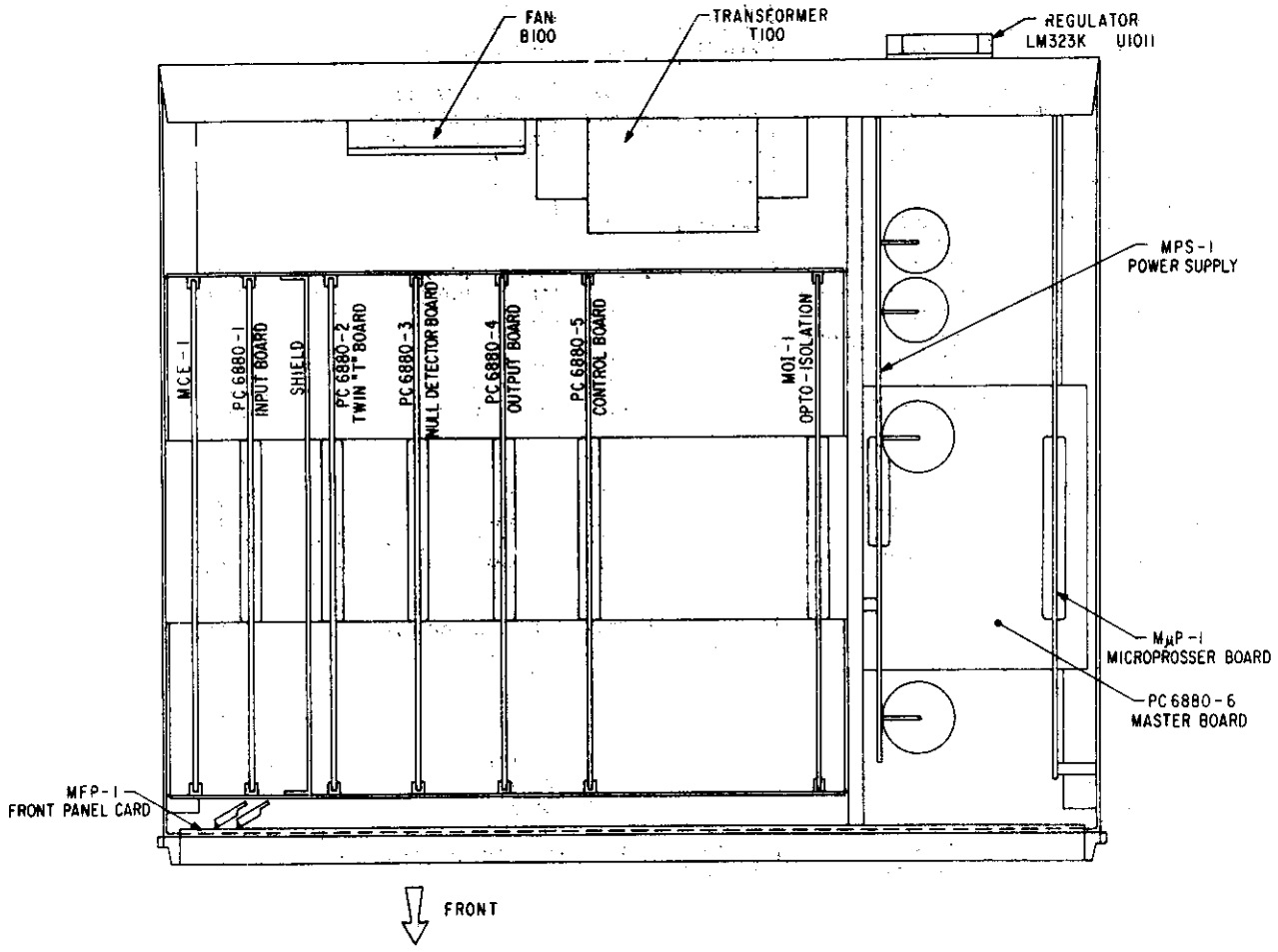
SCHEM REF.	DESCRIPTION			MFR	MFR PART NUMBER	KH NUMBER
R783	10K	10%	1/4W	AB	CB1031	928310
R784	10K	10%	1/4W	AB	CB1031	928310
R785	25K	POT	1/2W	BKM	72XWR25K	658325
R786	470K	10%	1/4W	AB	CB4741	928477
R787	5.1M	5%	1/4W	AB	CB5165	927551
R788	4.3M	5%	1/4W	AB	CB4365	927453
R789	1K	10%	1/4W	AB	CB1021	928210
R790	1K	10%	1/4W	AB	CB1021	928210
R791	25K	POT	1/2W	BKM	72XWR25K	659325
R792	100K	10%	1/4W	AB	CB1041	928410
R793	100	10%	1/4W	AB	CB1011	928110
R794	360	5%	1/4W	AB	CB3615	927136
R795	1M	10%	1/4W	AB	CB1051	928510
R796	100K	10%	1/4W	AB	CB1041	928410
R800	10K	10%	1/4W	AB	CB1031	928310
R801	2M	5%	1/4W	AB	CB2055	927520
R802	2M	5%	1/4W	AB	CB2055	927520
R803	25K	POT	1/2W	BKM	72XWR25K	658325
R804	470K	10%	1/4W	AB	CB4741	928477
R805	5.1M	5%	1/4W	AB	CB5165	927551
R806	4.3M	5%	1/4W	AB	CB4365	927543
R807	1K	10%	1/4W	AB	CB1021	928210
R808	1K	10%	1/4W	AB	CB1021	928210
R809	360	5%	1/4W	AB	CB3615	927136
R810	25K	POT	1/2W	BKM	72XWR25K	658325
R811	100K	10%	1/4W	AB	CB1041	928410
R812	100	10%	1/4W	AB	CB1011	928110
R813	100K	10%	1/4W	AB	CB1041	928410
R814	1M	10%	1/4W	AB	CB1051	928510
R815	10K	10%	1/4W	AB	CB1031	928310
R820	14K	1%	1/4W	KH	850314A	850314A
R821	909	1%	1/4W	KH	850190	850190
R822	619	1%	1/4W	KH	850161	850161
R823	133	1%	1/4W	KH	850113	850113
R824	100K	10%	1/4W	AB	CB1041	928410
R825	1.1K	1%	1/4W	KH	850211	850211
R826	100	10%	1/4W	AB	CB1011	928110
R827	25K	POT	1/2W	BKM	72XWR25K	658326
R828	100	10%	1/4W	AB	CB1011	928110
R829	1.1K	1%	1/4	KH	850211	850211
R830	1.1K	1%	1/4W	KH	850211	850211
R831	10K	10%	1/4W	AB	CB1031	928310
R832	11.3K	1%	1/4W	KH	850311	850311
R833	11.3K	1%	1/4W	KH	850311	850311
R834	100	10%	1/4W	AB	CB1011	928110
R835	25K	POT	1/2W	BKM	72XWR25K	658326
R836	100	10%	1/4W	AB	CB1011	928110
R838	1M	1%	1/4W	KH	850510	850510
R839	1M	1%	1/4W	KH	850510	850510
R840	100K	POT	1/2W	BKM	72XWR100K	658411
R841	510K	5%	1/4W	AB	CB5145	927451
R842	910	5%	1/4W	AB	CB9115	927192
R843	470K	10%	1/4W	AB	CB4751	928477
R844	100K	10%	1/4W	AB	CB1041	928410
R845	1K	10%	1/4W	AB	CB1021	928210
R848	10K	10%	1/4W	AB	CB1031	928310
R849	100	10%	1/4W	AB	CB1011	928110
R850	3.16M	1%	1/4W	KH	850531	850531
R851	1M	POT	1/2W	BKM	72XWR1M	659510
R852	5.11K	1%	1/4W	KH	850251	850251
R853	732	1%	1/4W	KH	850473	850473
R854	51.1K	1%	1/4W	KH	850351	850351
R855	100K	10%	1/4W	AB	CB1041	928410
R856	4.99K	1%	1/4W	KH	850349	850349
R857	681	1%	1/4W	KH	850168	850168
R858	499	1%	1/4W	KH	850149	850149

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
R859	100K 10% 1/4W	AB	CB1041	928410
R865	10K 10% 1/4W	AB	CB1031	928310
R866	10K 10% 1/4W	AB	CB1031	928310
R867	10K 10% 1/4W	AB	CB1031	928310
R868	10K 10% 1/4W	AB	CB1031	928410
R869*	10K 10% 1/4W	AB	CB1031	928410
R870*	10K 10% 1/4W	AB	CB1031	928410
R871*	10K 10% 1/4W	AB	CB1031	928410
R872*	10K 10% 1/4W	AB	CB1031	928410
R837	10K 10% 1/4W	AB	CB1031	928310
R874	10K 10% 1/4W	AB	CB1031	928310
R875	10K 10% 1/4W	AB	CB1031	928310
R876	100K 10% 1/4W	AB	CB1041	928410
R877	10K 10% 1/4W	AB	CB1031	928310
R878	10K 10% 1/4W	AB	CB1031	928310
R879	10K 10% 1/4W	AB	CB1031	928310
R880	10K 10% 1/4W	AB	CB1031	928310
R881	10K 10% 1/4W	AB	CB1031	928310
R882	10K 10% 1/4W	AB	CB1031	928310
R883	10K 10% 1/4W	AB	CB1031	928310
R884	10K 10% 1/4W	AB	CB1031	928310
R885	10K 10% 1/4W	AB	CB1031	928310
R886	10K 10% 1/4W	AB	CB1031	928310
R887	10K 10% 1/4W	AB	CB1031	928310
R888	10K 10% 1/4W	AB	CB1031	928310
R889	1K 10% 1/4W	AB	CB1021	928210
R890	510 5% 1/4W	AB	CB5115	927151
R891	23.2K 1% 1/4W	KH	850323	850323
R892	24.9K 1% 14W	KH	850324	850324
R893	1K POT 1/2W	BKM	71XWR1K	658211
R894	2.7 10% 1/4W	AB	CB27G1	928927
R895	100 10% 1/4W	AB	CB1011	928110
R896	25K POT 1/2W	BKM	72XWR25K	658326
R897	100 10% 1/4W	AB	CB1011	928110
R898	221K 1% 1/4W	KH	850422	850422
R899	25K POT 1/2W	BKM	72XWR25K	659325
R900	360 5% 1/4W	AB	CB3615	927136
R901	7.5K 5% 1/2W	AB	CB7525	927275
R902	9.1K 5% 1/4W	AB	CB9125	927291
R903	1M 10% 1/4W	AB	CB1051	928510
R904	3.3K 5% 1/4W	AB	CB3325	927233
R905	2.7K 5% 1/4W	AB	CB2725	927227
R906	3.3K 5% 1/4W	AB	CB3325	927233
R907	1M 10% 1/4W	AB	CB1051	928510
R908	1K 10% 1/4W	AB	CB1021	928210
R909	1K 10% 1/4W	AB	CB1021	928210
R910	220 10% 1/4W	AB	CB2211	928122
R911	10K 10% 1/4W	AB	CB1031	928310
R912	100K 10% 1/4W	AB	CB1041	928410
R913	220 10% 1/4W	AB	CB2211	928122
R914	25K POT 1/2W	BKM	72XWR25K	658326
R915	10K 5% 1/4W	AB	CB1031	927310
R916	220K 5% 1/4W	AB	CB2245	927422
R917	100 10% 1/4W	AB	CB1011	928110
R918	25K POT 1/2W	BKM	72XWR25K	658326
R919	100 10% 1/4W	AB	CB1011	928110
R920	5K POT 1/2W	BKM	72XWR5K	658251
R921	1.8K 10% 1/4W	AB	CB1821	928218
R925	51K 5% 1/4W	AB	CB5135	927351
R926	2M 5% 1/4W	AB	CB2055	927520
R927	3.3K 10% 1/4W	AB	CB3321	928233
R928	10M 10% 1/4W	AB	CB1061	928610
R929	3.3K 10% 1/4W	AB	CB3321	928233
R930	2M 5% 1/4W	AB	CB2055	927520
R931	20K 5% 1/4W	AB	CB2035	927320
R932	3.3K 10% 1/4W	AB	CB3321	928233

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
R933	10M 10% 1/4W	AB	CB1061	928610
R934	2M 5% 1/4W	AB	CB2055	927520
R935	24K 5% 1/4W	AB	CB2435	927324
R936	3.3K 10% 1/4W	AB	CB3321	928233
R937	10M 10% 1/4W	AB	CB1061	928610
R938	100 10% 1/4W	AB	CB1011	928110
R939	100K 10% 1/4W	AB	CB1041	928410
R940	10K 10% 1/4W	AB	CB1031	928310
R941	10K 10% 1/4W	AB	CB1031	928310
R942	10K 10% 1/4W	AB	CB1031	928310
R943	100K 10% 1/4W	AB	CB1041	928410
R944	100K 10% 1/4W	AB	CB1041	928410
R945	10K 10% 1/4W	AB	CB1031	928310
R946	100 10% 1/4W	AB	CB1011	928110
R947	22M 10% 1/4W	AB	CB2261	928622
R950	8.66K 1% 1/4W	KH	850286	850286
R951	17.8K 1% 1/4W	KH	850317	850317
R953	100 10% 1/4W	AB	CB1011	928110
R954	10K 10% 1/4W	AB	CB1031	928310
R955	10M 10% 1/4W	AB	CB1061	928610
R956	100 10% 1/4W	AB	CB1011	928110
R957	10K 10% 1/4W	AB	CB1031	928310
R958	22.6K 1% 1/4W	KH	850322	850322
R959	22.6K 1% 1/4W	KH	850322	850322
R960	4.99K 1% 1/4W	KH	850249	850249
R961	562 1% 1/4W	KH	850156	850156
R962	620 5% 1/4W	AB	CB6215	927162
R963	100K POT 1/2W	BKM	72XWR1004	658411
R964	100K 10% 1/4W	AB	CB1041	928410
R968	2.2K 10% 1/4W	AB	CB2221	928222
R969	100K 10% 1/4W	AB	CB1041	928410
R970	10K 10% 1/4W	AB	CB1031	928310
R971	10K 10% 1/4W	AB	CB1031	928310
R972	4.7K 10% 1/4W	AB	CB4721	928247
R973	4.7K 10% 1/4W	AB	CB4721	928247
R974	10K 10% 1/4W	AB	CB1031	928310
R975	62K 5% 1/4W	AB	CB6231	928362
R976	10K 10% 1/4W	AB	CB1031	928310
R977	100 10% 1/4W	AB	CB1011	928110
R978	10K 10% 1/4W	AB	CB1031	928310
R979	10K 10% 1/4W	AB	CB1031	928310
R980	100 10% 1/4W	AB	CB1011	928110
R981	3.3K 10% 1/4W	AB	CB3321	928233
R982	1K 10% 1/4W	AB	CB1021	928210
R983	3.3K 10% 1/4W	AB	CB3321	928233
R985	1K 5% 1/4W	AB	CB1021	928210
R986	1K 10% 1/4W	AB	CB1021	928210
R987	3.3K 10% 1/4W	AB	CB3321	928233
R988	1.5K 10% 1/4W	AB	CB1521	928215
R990	510 5% 1/4W	AB	CB5115	927151
R991	510 5% 1/4W	AB	CB5115	927151
R997	5K POT 1/2W	BKM	72XWR5K	658251
R999	9.09K 1% 1/4W	KH	850290	850290
R1001	10K 10% 1/4W	AB	CB1031	928310
R1002	10K 1% 1/4W	KH	850310	850310
R1003	10K 1% 1/4W	KH	850310	850310
R1005	4.7K 10% 1/4W	AB	CB4721	928247
R1006	240K 5% 1/4W	AB	CB2445	927124
R1007	100M 10% 1/4W	AB	CB1071	927510
R1008	910 5% 1/4W	AB	CB9115	927192
R1009	2.21K 1% 1/4W	KH	850222	850222
R1010	9.09K 1% 1/4W	KH	850290	850290
S100	SWITCH, TOGGLE	CK	7101K	346026
S101	SWITCH, SLIDE	KH	346404B	346404B
S102	SWITCH, SLIDE	KH	346404B	346404B
S200	SWITCH, DIP	ALC	DBS-6	346205

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
S314	SWITCH, PUSHBUTTON	KH	344073	344073
S318	SWITCH, PUSHBUTTON	KH	344073	344073
S319	SWITCH, PUSHBUTTON	KH	344073	344073
S321	SWITCH, PUSHBUTTON	KH	344073	344073
S338	SWITCH, PUSHBUTTON	KH	344073	344073
S339	SWITCH, PUSHBUTTON	KH	344073	344073
S340	SWITCH, PUSHBUTTON	KH	344073	344073
S342	SWITCH, PUSHBUTTON	KH	344073	344073
S343	SWITCH, PUSHBUTTON	KH	344073	344073
S345	SWITCH, PUSHBUTTON	KH	344073	344073
S347	SWITCH, PUSHBUTTON	KH	344073	344073
S620	SWITCH, SLIDE	SWC	56206L2	346406
S621	SWITCH, SLIDE	SWC	56206L2	346406
T100	TRANSFORMER	KH	B4016	361029
U100	REGULATOR	MOT	MC7805	207805
U101	OP AMP	MOT	MC1741CP	201741
U102	OP AMP	MOT	MC1741CP	201741
U200	QUAD, 3-STATE BUS TRANCEIVER	MOT	MC3448P	203448
U201	QUAD, 3-STATE BUS TRANCEIVER	MOT	MC3448P	203448
U202	QUAD, 3-STATE BUS TRANCEIVER	MOT	MC3448P	203448
U203	QUAD, 3-STATE BUS TRANCEIVER	MOT	MC3448P	203448
U204	G.P.I.A.	MOT	MC68488P	208488
U207	P.I.A. W/TIMER	MOT	MPS6522	286522
U208	HEX 3 STATE BUFFER	MOT	MC14503BCP	201450
U209	MICROPROCESSOR	MOT	MC6802	206802
U210	2K X 8 EPROM	SI	D2732A	202732
U211	3-8 LINE DECODER	TI	SN74138N	204138
U212	2K X 8 EPROM	SI	D2732A	202732
U214	CMOS NAND GATE	MOT	MC14011B	201401
U300	DECADE COUNTER	MOT	SN74160	204160
U301	HEX INVERTER	TI	SN7404N	207404
U302	QUAD, 2-INPUT NAND GATE	TI	SN7400	207400
U303	TIMER	NS	LM555CN	200555
U304	DECODER/DRIVER	TI	SN74145	204145
U305	3-8 LINE DECODER	TI	SN74138N	204138
U306	READ/WRITE MEMORY	TI	SN7489	207489
U307	READ/WRITE MEMORY	TI	SN7489	207489
U311	TIMER	NS	LM555CN	200555
U400	HEX BUFFER/DRIVER	TI	SN7417	207417
U416	HEX D FLIP/FLOP	TI	SN74175	204175
U417	3-8 LINE DECODER	TI	SN74138N	204138
U500	OP AMP	NS	NE5534A	265534
U510	HEX D FLIP-FLOP	TI	SN74174	204174A
U520	OP AMP	NS	NE5534A	265534
U521	OP AMP	MOT	MC1741CP	201741
U522	OP AMP	MOT	MC1741CP	201741
U523	OP AMP	MOT	MC1741CP	201741
U524	OP AMP	MOT	MC1741CP	201741
U525	OP AMP	MOT	MC1741CP	201741
U560	OP AMP	NS	LF356N	200356
U561	OP AMP	NS	LF356N	200356
U562	OP AMP	NS	LF13741N	213741N
U590	OPTICAL COUPLER	CLX	CLM8000	290002
U591	OPTICAL COUPLER	CLX	CLM8000	290002
U592	OP AMP	NS	LF13741N	213741N
U593	OP AMP	NS	LF13741N	213741N
U600	OP AMP	NS	LM318N	200318
U601	OP AMP	NS	LM318N	200318
U620	OPTICAL COUPLER	CLX	CLM8500	290004
U621	OPTICAL COUPLER	CLX	CLM8500	290004

SCHEM REF.	DESCRIPTION	MFR	MFR PART NUMBER	KH NUMBER
U622	OPTICAL COUPLER	CLX	CLM8000	290002
U645	DUAL FET	NS	J410	200410
U670	OP AMP	NS	LF356N	200356
U671	OP AMP	NS	LF356N	200356
U680	HEX D FLIP-FLOP	TI	SN74174	204174A
U681	DECODER/DRIVER	TI	SN74145	204145
U682	OP AMP, SELECTED	NS	LM318N	200318
U690	HEX D FLIP-FLOP	TI	SN74174	204174A
U691	OP AMP	NS	LF356N	200356
U692	OP AMP	NS	LF356N	200356
U720	BRIDGE DIODE	RCA	CA3019	220319
U740	BRIDGE DIODE	RCA	CA3019	220319
U750	BRIDGE DIODE	RCA	CA3019	220319
U770	BRIDGE DIODE	RCA	CA3019	220319
U780	OP AMP	NS	LF356N	200356
U800	OP AMP	NS	LF356N	200356
U820	3-8 LINE DECODER	TI	SN74138N	204138
U821	HEX D FLIP-FLOP	TI	SN74174	204174A
U822	OP AMP	NS	LF357N	200357
U823	OP AMP	NS	LF356N	200356
U824	OP AMP	NS	LF356N	200356
U825	OP AMP	NS	LF357N	200357
U826	HEX D FLIP-FLOP	TI	SN74174	204174A
U827	OP AMP	NS	LF356N	200356
U828	OP AMP	NS	LF356N	200356
U829	OPTICAL COUPLER	CLX	CLM8000	290002
U830	OP AMP	NS	LF356N	200356
U831	OP AMP	NS	LF356N	200356
U935	OP AMP	MOT	MC1741CP	201741
U926	OP AMP	MOT	MC1741CP	201741
U927	OP AMP	MOT	MC1741CP	201741
U928	OP AMP	NS	LF13741N	213741N
U929	OP AMP	MOT	MC1741CP	201741
U930	OP AMP	NS	LF356N	200356
U931	OPTICAL COUPLER	CLX	CLM8000	290002
U932	OP AMP	NS	LF357N	200357
U933	3-8 LINE DECODER	TI	SN74138N	204138
U934	HEX D FLIP-FLOP	TI	SN74174	204174A
U935	HEX D FLIP-FLOP	TI	SN74174	204174A
U936	HEX D FLIP-FLOP	TI	SN74174	204174A
U937	ANALOG MULTIPLEXER	MOT	MC14051	204051
U938	ANALOG MULTIPLEXER	MOT	MC14051	204051
U939	D-A CONVERTER	AD	DAC80-CBI-V	280080
U940	12 BIT COUNTER	MOT	MC14040	204040
U941	OP AMP, SELECTED	NS	LF356N	200356
U1010	REGULATOR	NS	LM323K	200323
VR100	DIODE, ZENER, 4.3V	APD	1N749A	280749
VR101	DIODE, ZENER, 6.4V	CDI	1N4577A	264577
VR641	DIODE, ZENER, 10V	APD	1N961B	230961
VR642	DIODE, ZENER, 10V	APD	1N961B	230961
VR721	DIODE, ZENER, 4.3V	APD	1N749A	280749
VR751	DIODE, ZENER, 4.3V	APD	1N749A	280749
VR990	DIODE, ZENER, 6.8V	APD	1N957B	230957
VR991	DIODE, ZENER, 6.8V	APD	1N957B	230957
VR1001	DIODE, ZENER, 4.3V	APD	1N749A	280749
Y200	CRYSTAL, 4MHz	MT	VF400	290400



Model 6880 Outline Drawing

MODIFICATION SHEET

Model No: 6880A	Schematic Date:	Date: January 17, 1990

Change and/or Modification

MOTHER BOARD

Connect pin 9, J500 to ground.

PC6880-5

Change R978 to 100K.

MFP-1

Change DS350 to MAN6430.
Change DS351 to MAN6410.
Change DS348 to SLR-34MG3.
Change DS349 to SLR-34YY3.
Change R345 thru R359 to 61.9 ohm.

PC6880-1

C519 Add 22pF between pins 5 and 8 of U520.
Remove CR603 and CR604 and connect between pin 3 of U592 and ground.
Connect CR591 and CR592, 1N4149 back-to-back diodes from base of Q591 to ground.
Relabel R951 to R591.
Change U500 to LF357N.
R558 Add 100 megohm from junction of R505, R506 to -15V.
Change R564 to 100k.
R559 ~~Connect~~ Add 221k in series with center arm of R564.
Change U560 to LM318N.
Change U561 to LM318N.
R574 Add 33k (39.2K) in series with C514.
Add 1N4149 diode from pin 2 to pin 3 of U500 (cathode to pin 3).

MODIFICATION SHEET		
Model No: 6880A	**Schematice Date:**	**Date: January 17, 1990**

Change and/or Modification

MOTHER BOARD

Connect pin 9, J500 to ground.

PC6880-5

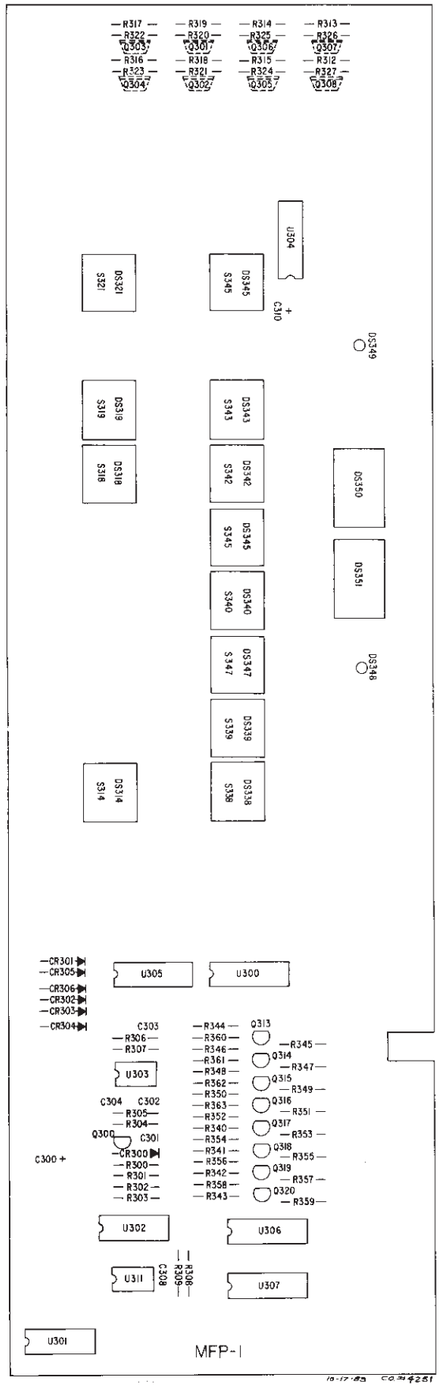
Change R978 to 100K.

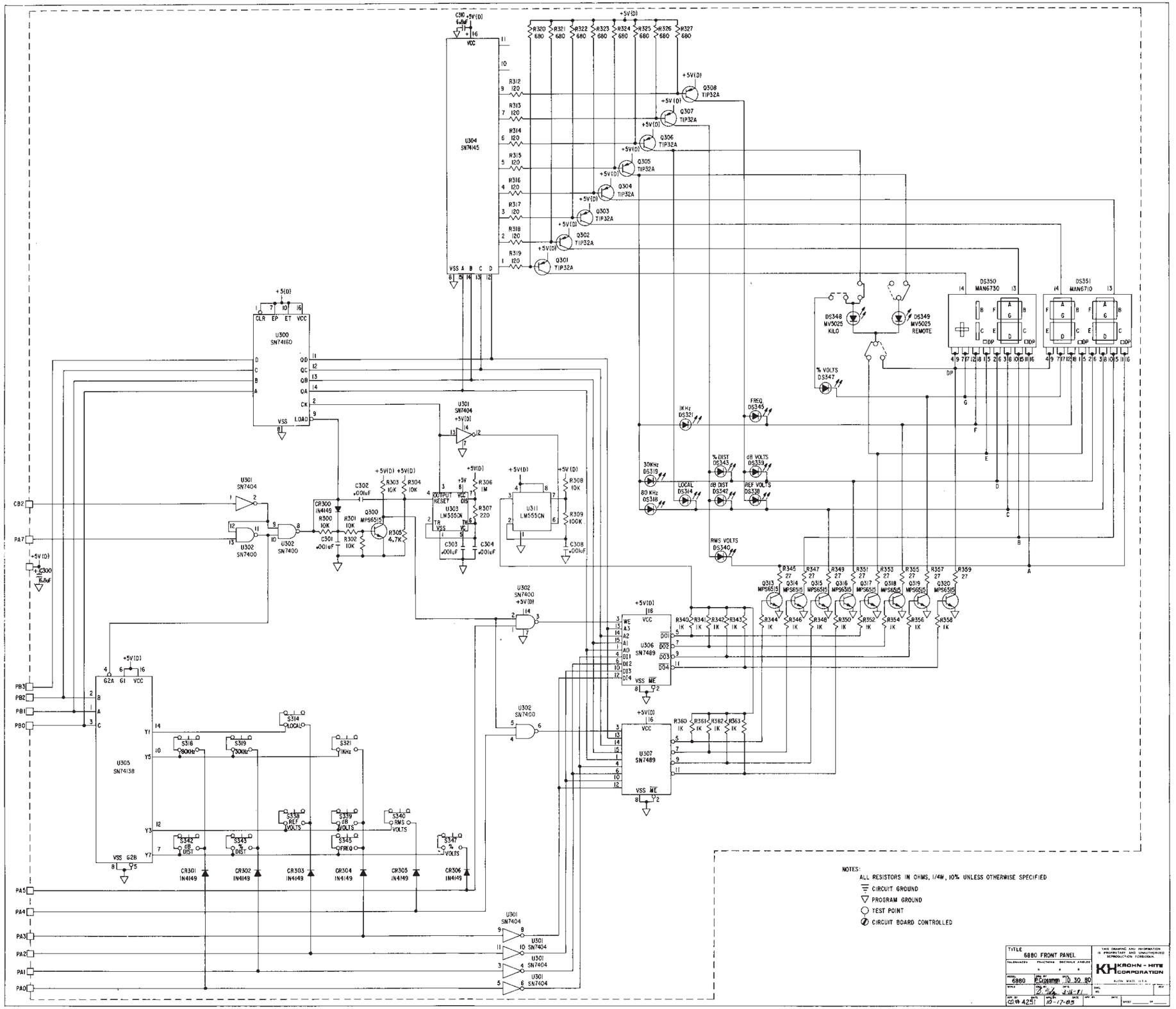
MFP-1

Change DS350 to MAN6430.
Change DS351 to MAN6410
Change DS348 to SOR-34MG3.
Change DS349 to SLR-34YY3.
Change R345 thru R359 to 61.9 ohm.

PC6880-1

C519 add 22pF between pins 5 and 8 of U520.
Remove CR603 and CR604 and connect between pin 3 of U592 and ground.
Connect CR591 and CR592, 1N4149 back-to-back diodes from base of Q591 to ground.
Relabel R951 to R591.
Change U500 to LF357N.
R558 add 100 megohm from junction of R505, R506 to –15V.
Change R564 to 100K.
R559 add 221k in series with center arm of R564.
Change U560 to LM318N.
Change U561 to LM318N.
R579 add 33.2k in series with C514.
Add 1N4149 diode from pin 2 to pin 3 of U500 (cathode to pin 3).

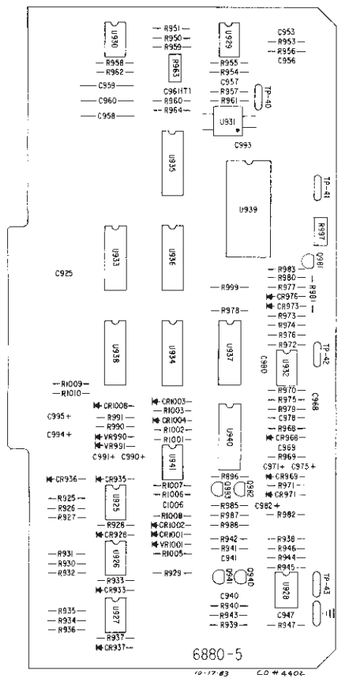




NOTES:
ALL RESISTORS IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED
CIRCUIT GROUND
PROGRAM GROUND
TEST POINT
CIRCUIT BOARD CONTROLLED

TITLE	6880 FRONT PANEL
TOLERANCES	FRACTIONS ± DECIMALS ± ANGLES ±
MODEL	6880
DRAWN	P.Crossman 10 30 80
CHK'D	
APP'D	CO.# 4251 10-17-85

KH KROHN-HITE CORPORATION MASS. U.S.A.



1 KHz OSC

NOTES:
- ALL RESISTORS IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED
- ⏚ CIRCUIT GROUND
- ▽ PROGRAM GROUND
- ○ TEST POINT
- ⊘ CIRCUIT BOARD CONTROLLED

ALL VOLTAGES MEASURED UNDER THE FOLLOWING CONDITIONS:
- AC LINE: 120V 60Hz
- INPUT: INTERNAL 1KHz 5V RMS
- MODE: % DIST
- FILTERS OFF
- REF: OFF

ALL VOLTAGES ±20% UNLESS OTHERWISE SPECIFIED

‡ 6.8uF FOR LOW BAND OPTION

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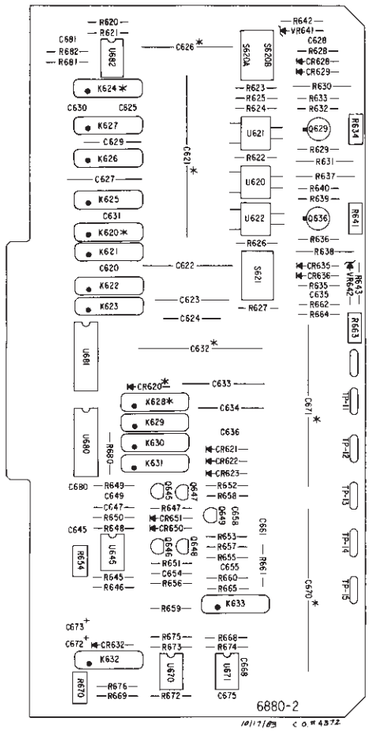
TITLE PC6880-5 CONTROL BOARD

KROHN-HITE CORPORATION

MODEL 6880 | DRN BY Crossman | DATE 3-10-81 | SCALE | CHK'D 6-25-81 | REV | APP'D | DATE | CAT'D CO#4402 10-17-83 | SHEET ___ OF ___



NOTES:

ALL RESISTORS IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED.

⏚ CIRCUIT GROUND

▽ PROGRAM GROUND

○ TEST POINT

⊘ CIRCUIT BOARD CONTROLLED

† 10uF FOR LOW BAND OPTION

* ADD FOR LOW BAND OPTION

ALL VOLTAGES MEASURED UNDER THE FOLLOWING CONDITIONS:

AC LINE: 120V 60Hz

INPUT: INTERNAL 1KHz 5V RMS

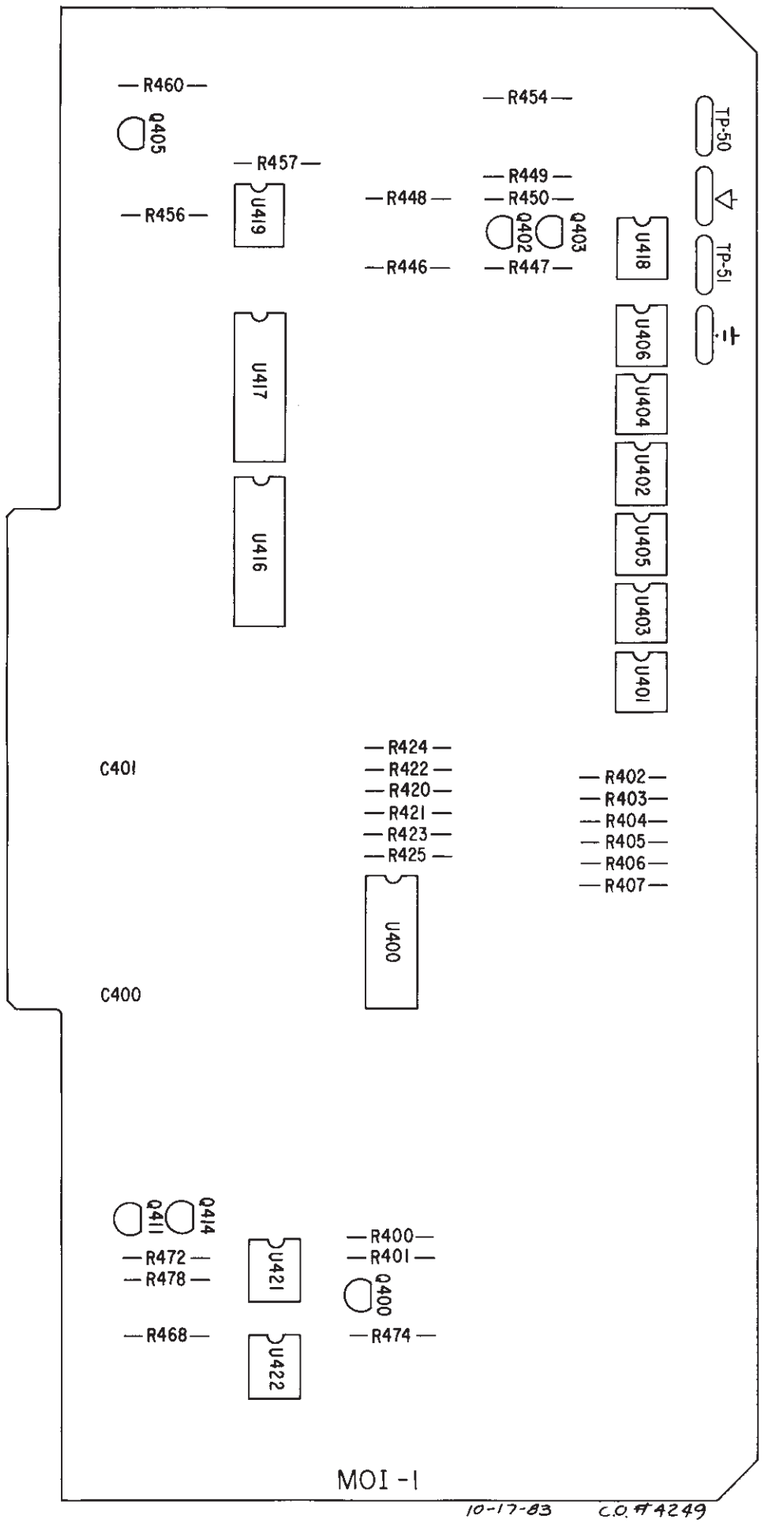
MODE: % DIST.

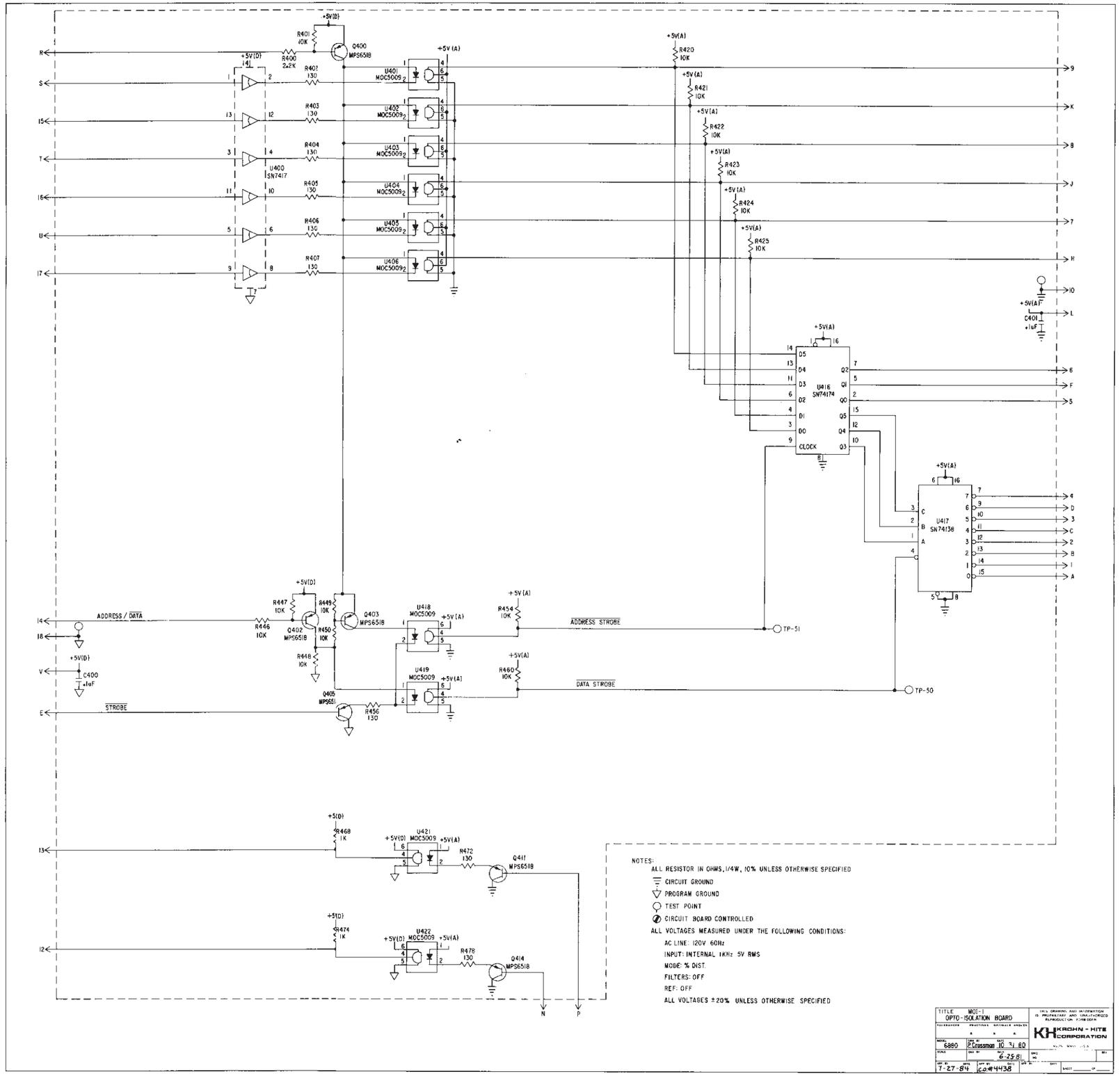
FILTERS: OFF

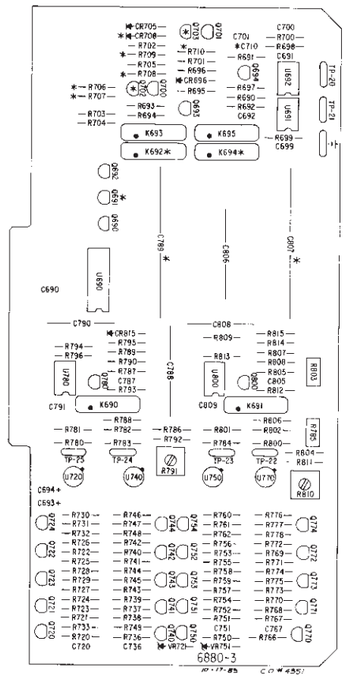
REF: OFF

ALL VOLTAGES ±20% UNLESS OTHERWISE SPECIFIED

TITLE	PC 6880-2 TWIN T BOARD
TOLERANCES	THIS DRAWING AND INFORMATION IS PROPRIETARY AND UNAUTHORIZED REPRODUCTION FORBIDDEN.
MODEL 6880	KROHN-HITE CORPORATION
DRN. BY E.Grossman	DATE 2-25-81
CHK. BY	DATE 6-18-81
APP. BY COM 4372	DATE 10/17/83


R460
Q405
R457
R456
U419
R454
R449
R448
R450
Q402
Q403
R446
R447
U418
TP-50
TP-51
U406
U404
U417
U402
U416
U405
U403
U401
C401
R424
R422
R420
R421
R423
R425
R402
R403
R404
R405
R406
R407
U400
C400
Q413
Q414
R400
R401
R472
R478
U421
Q400
R468
R474
U422
MOI-1
10-17-83
C.O. #4249


+5V(D)
R401 10K
Q400 MPS6518
R400 2.2K
+5V(A)
R420 10K
R421 10K
R422 10K
R423 10K
R424 10K
R425 10K
R407 130
R403 130
R404 130
R405 130
R406 130
U400 SN7417
U401 MOC5009
U402 MOC5009
U403 MOC5009
U404 MOC5009
U405 MOC5009
U406 MOC5009
U416 SN74174
U417 SN74138
C401 .1uF
R447 10K
R449 10K
R450 10K
R448 10K
Q402 MPS6518
Q403 MPS6518
U418 MOC5009
U419 MOC5009
R454 10K
R460 10K
R446 10K
C400 .1uF
Q405 MPS651
R456 130
ADDRESS / DATA
STROBE
ADDRESS STROBE
DATA STROBE
TP-51
TP-50
R468 1K
R474 1K
U421 MOC5009
U422 MOC5009
R472 130
R478 130
Q411 MPS6518
Q414 MPS6518
NOTES:
ALL RESISTOR IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED
CIRCUIT GROUND
PROGRAM GROUND
TEST POINT
CIRCUIT BOARD CONTROLLED
ALL VOLTAGES MEASURED UNDER THE FOLLOWING CONDITIONS:
AC LINE: 120V 60Hz
INPUT: INTERNAL 1KHz 5V RMS
MODE: % DIST.
FILTERS: OFF
REF: OFF
ALL VOLTAGES ±20% UNLESS OTHERWISE SPECIFIED
TITLE MOI-1 OPTO-ISOLATION BOARD
KROHN-HITE CORPORATION
6880
6-25-81
7-27-84
CO#4438



BUFFER AMP

QUAD AMP

R_1R_2 SWITCH

R_3 SWITCH

R_1R_2 INTEGRATOR

R_3 INTEGRATOR

NOTES:

ALL RESISTORS IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED.

⏚ CIRCUIT GROUND

▽ PROGRAM GROUND

○ TEST POINT

⌀ CIRCUIT BOARD CONTROLLED

ALL VOLTAGES MEASURED UNDER THE FOLLOWING CONDITIONS:

AC LINE: 120V 60Hz

INPUT: INTERNAL 1KHz 5V RMS

MODE: % DIST

FILTERS: OFF

REF: OFF

ALL VOLTAGES ±20% UNLESS OTHERWISE SPECIFIED

TITLE: PC6880-3 NULL DETECTOR BOARD

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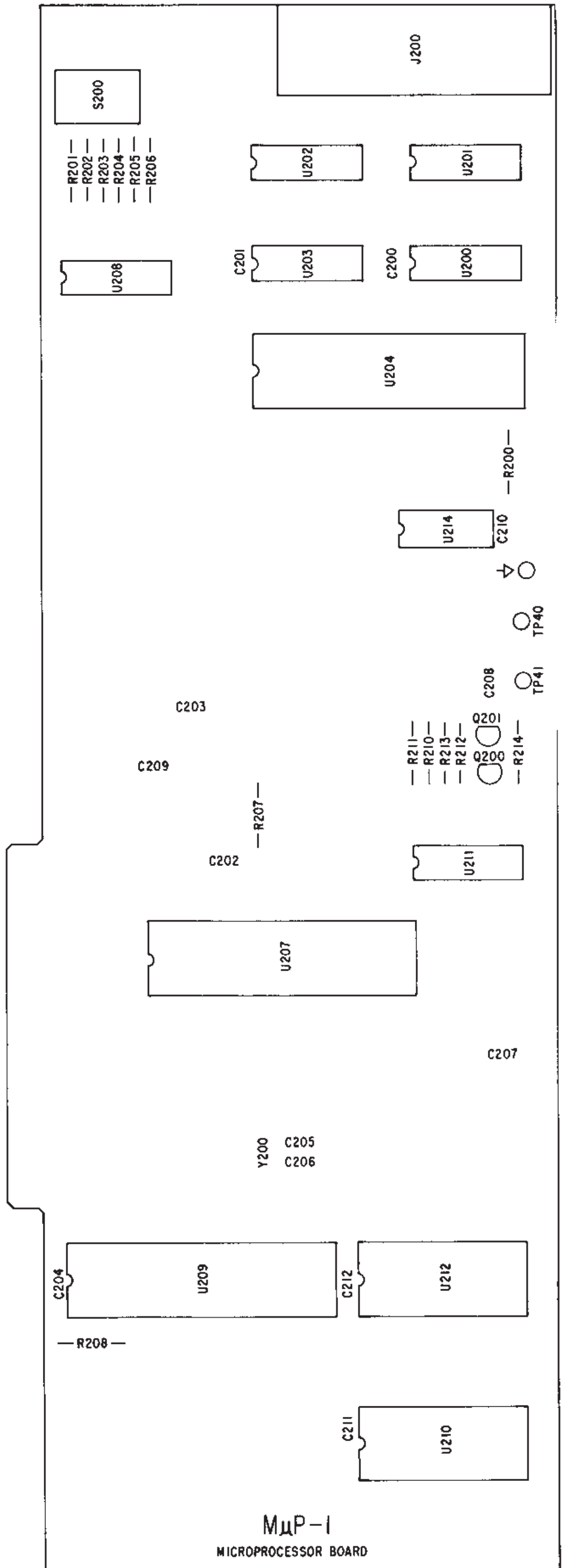
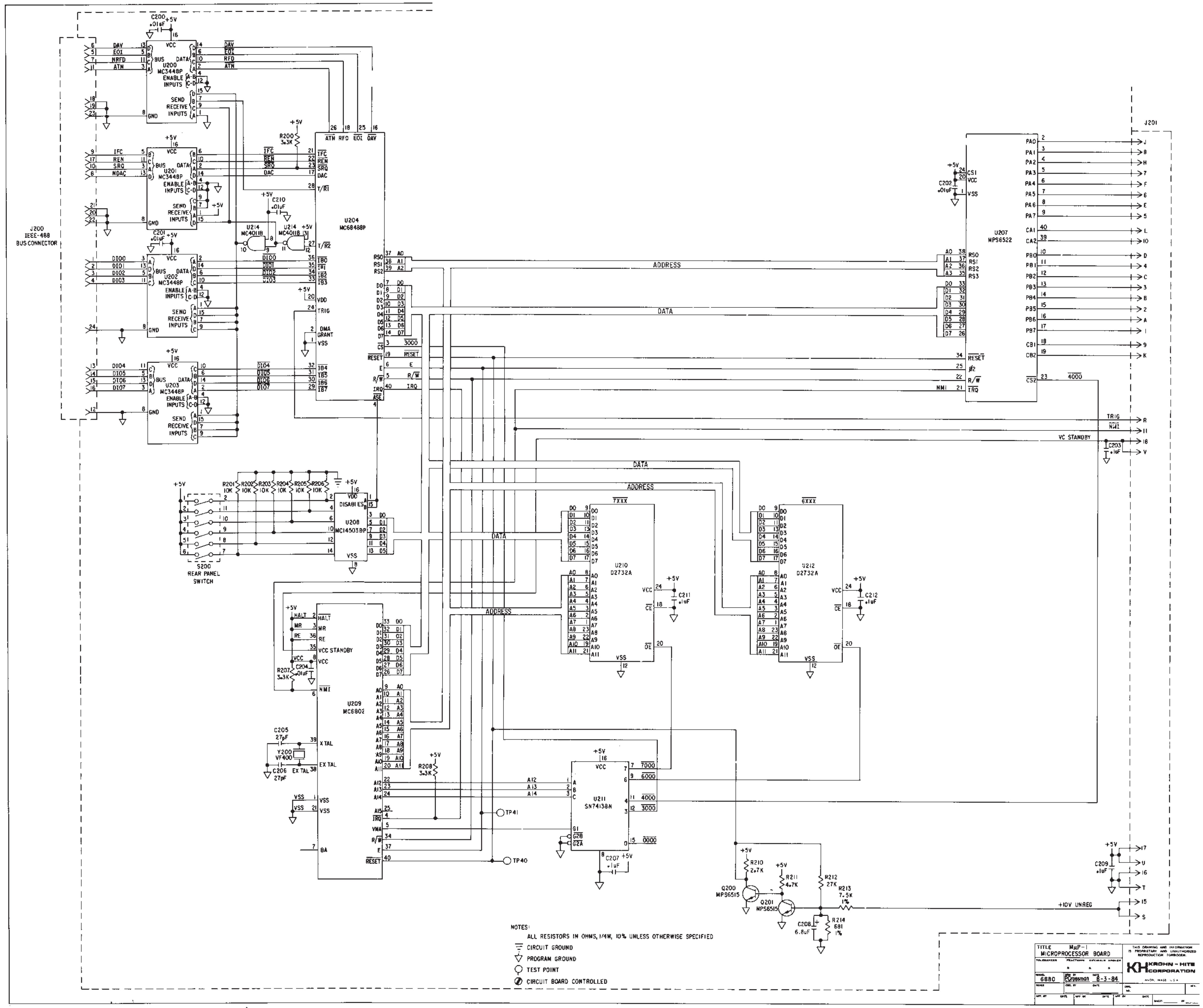
KH KROHN-HITE CORPORATION

6880 | P. Cressman 3-3-81 | 6-25-81

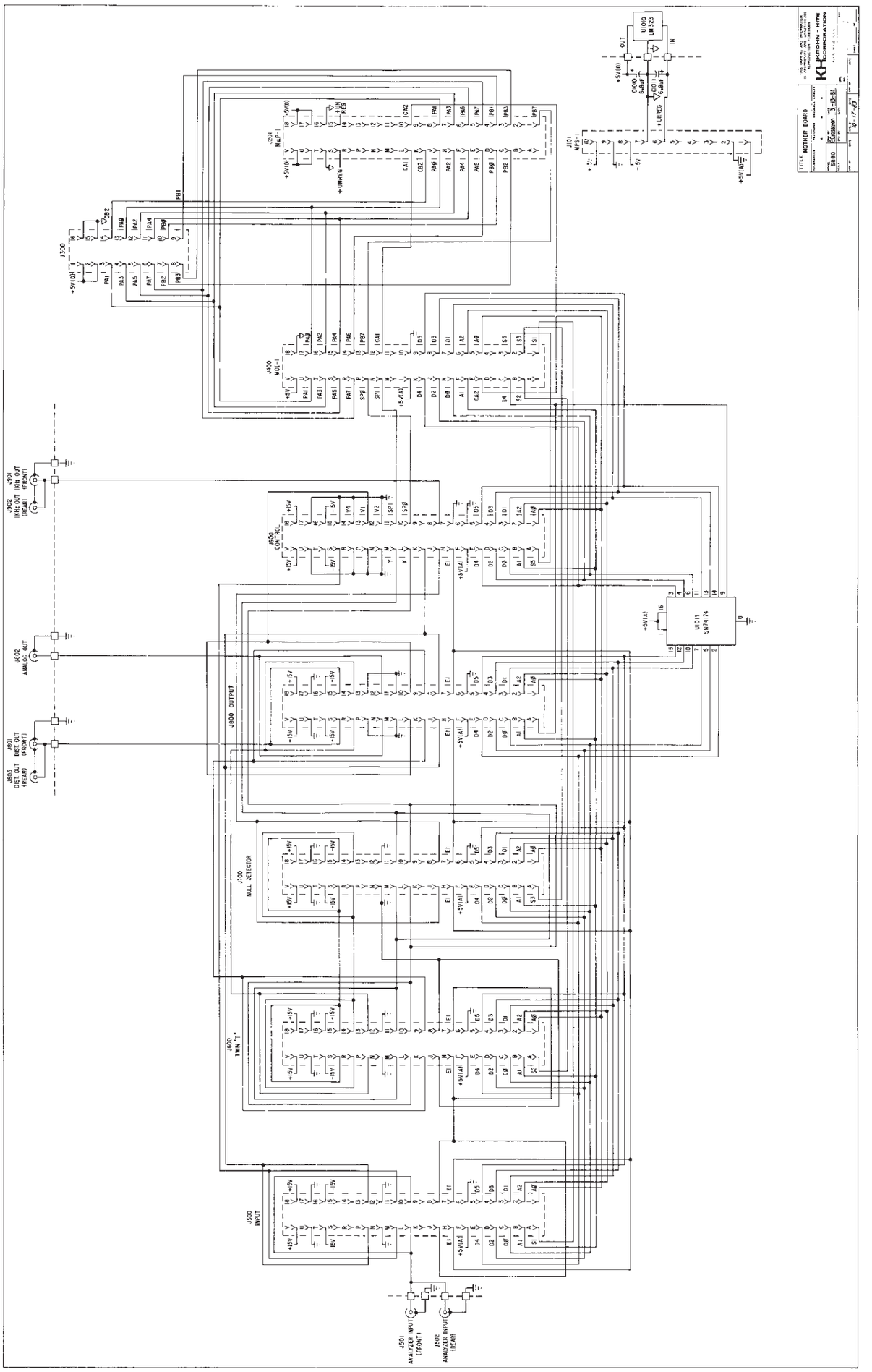
C.O.#4551 10-17-83

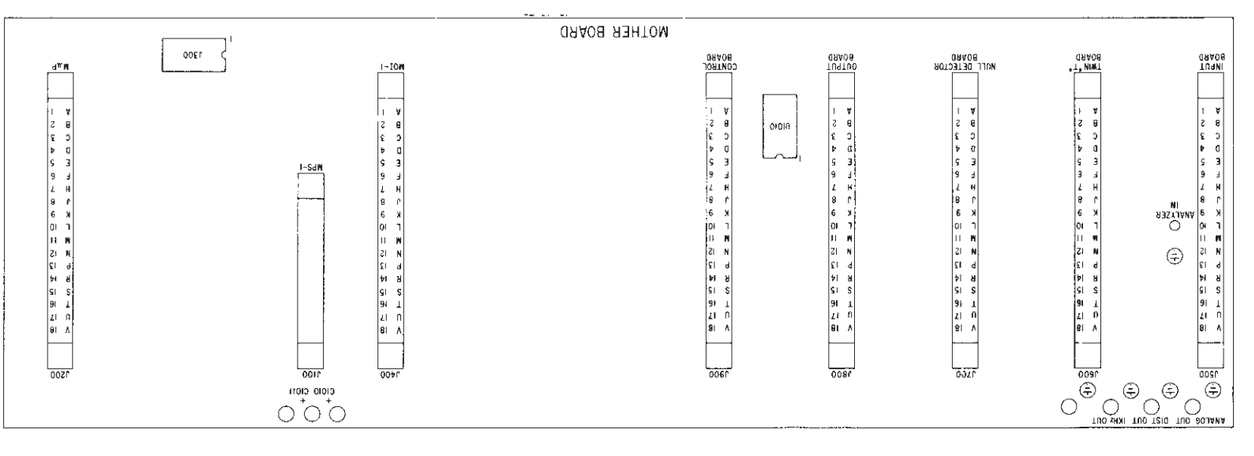


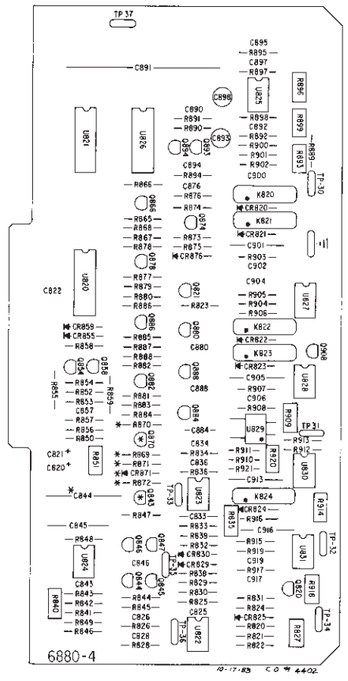
J200
S200
R201 R202 R203 R204 R205 R206
U202
U201
U208
C201
U203
C200
U200
U204
R200
U214
C210
TP40
TP41
C208
Q201
Q200
R211 R210 R213 R212
R214
C203
C209
R207
C202
U211
U207
C207
Y200
C205
C206
C204
U209
C212
U212
R208
C211
U210
MμP-I
MICROPROCESSOR BOARD
7-27-84

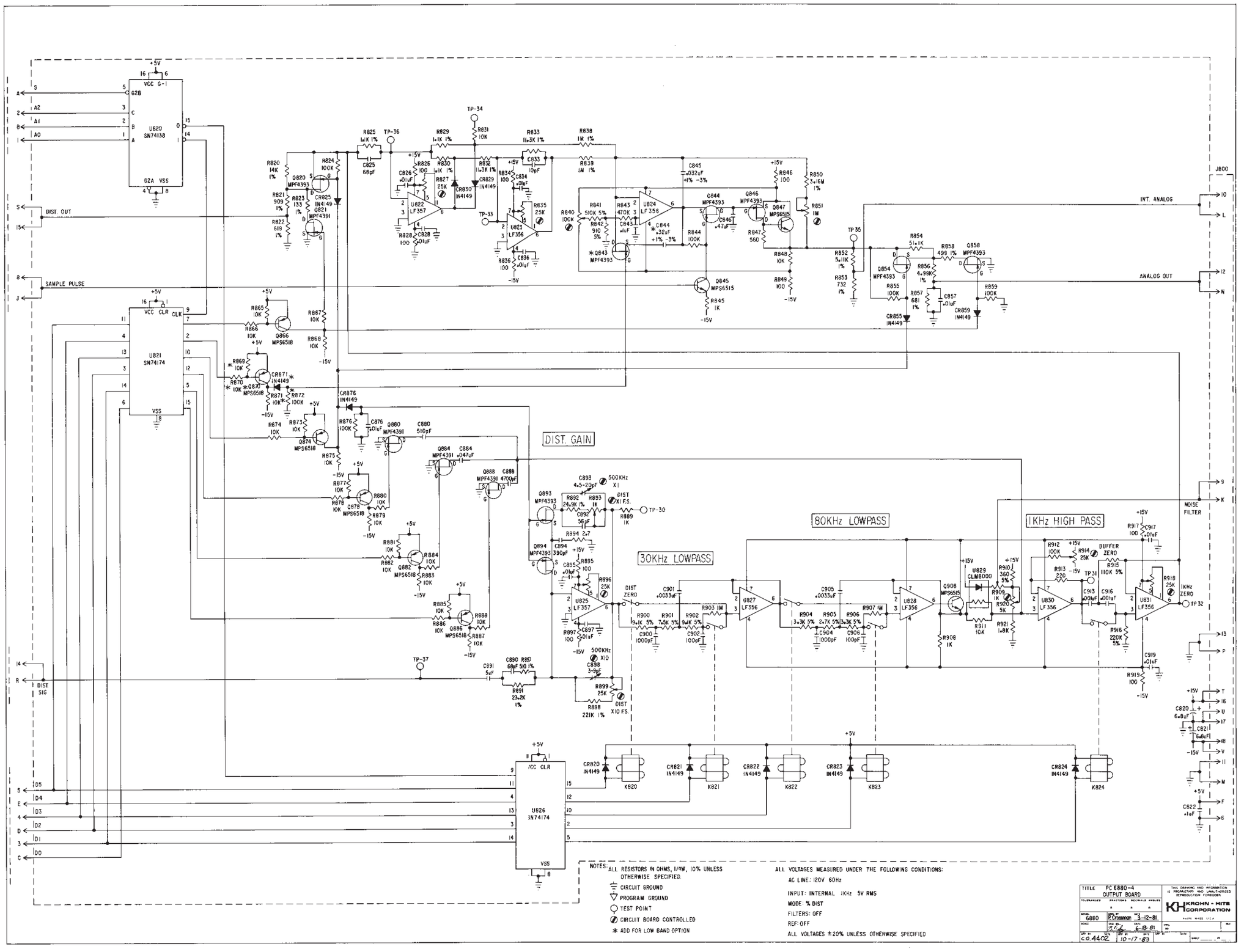


J200
IEEE-488
BUS CONNECTOR
U200 MC3448P
U201 MC3448P
U202 MC3448P
U203 MC3448P
U204 MC68488P
U214 MC4011B
U207 MPS6522
J201
ADDRESS
DATA
U208 MC14503BP
S200
REAR PANEL
SWITCH
U209 MC6802
U210 D2732A
U212 D2732A
U211 SN74138N
Y200 VF400
TP41
TP40
Q200 MPS6515
Q201 MPS6515
TRIG
NMI
VC STANDBY
+10V UNREG
NOTES:
ALL RESISTORS IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED
CIRCUIT GROUND
PROGRAM GROUND
TEST POINT
CIRCUIT BOARD CONTROLLED
TITLE MμP-I
MICROPROCESSOR BOARD
KROHN-HITE CORPORATION
6880
8-3-84




MOTHER BOARD
INPUT BOARD
TWIN T BOARD
NULL DETECTOR BOARD
OUTPUT BOARD
CONTROL BOARD
ANALYZER IN
ANALOG OUT DIST OUT INV OUT





NOTES: ALL RESISTORS IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED.

- CIRCUIT GROUND
- PROGRAM GROUND
- TEST POINT
- CIRCUIT BOARD CONTROLLED
- * ADD FOR LOW BAND OPTION

ALL VOLTAGES MEASURED UNDER THE FOLLOWING CONDITIONS:

AC LINE: 120V 60Hz

INPUT: INTERNAL 1KHz 5V RMS

MODE: % DIST

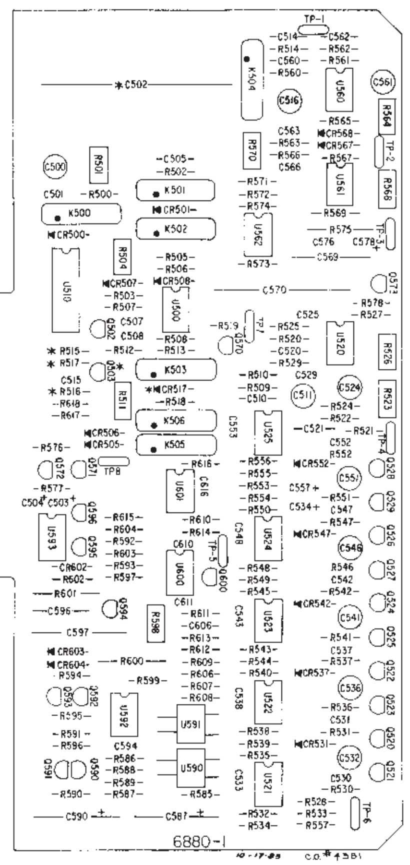
FILTERS: OFF

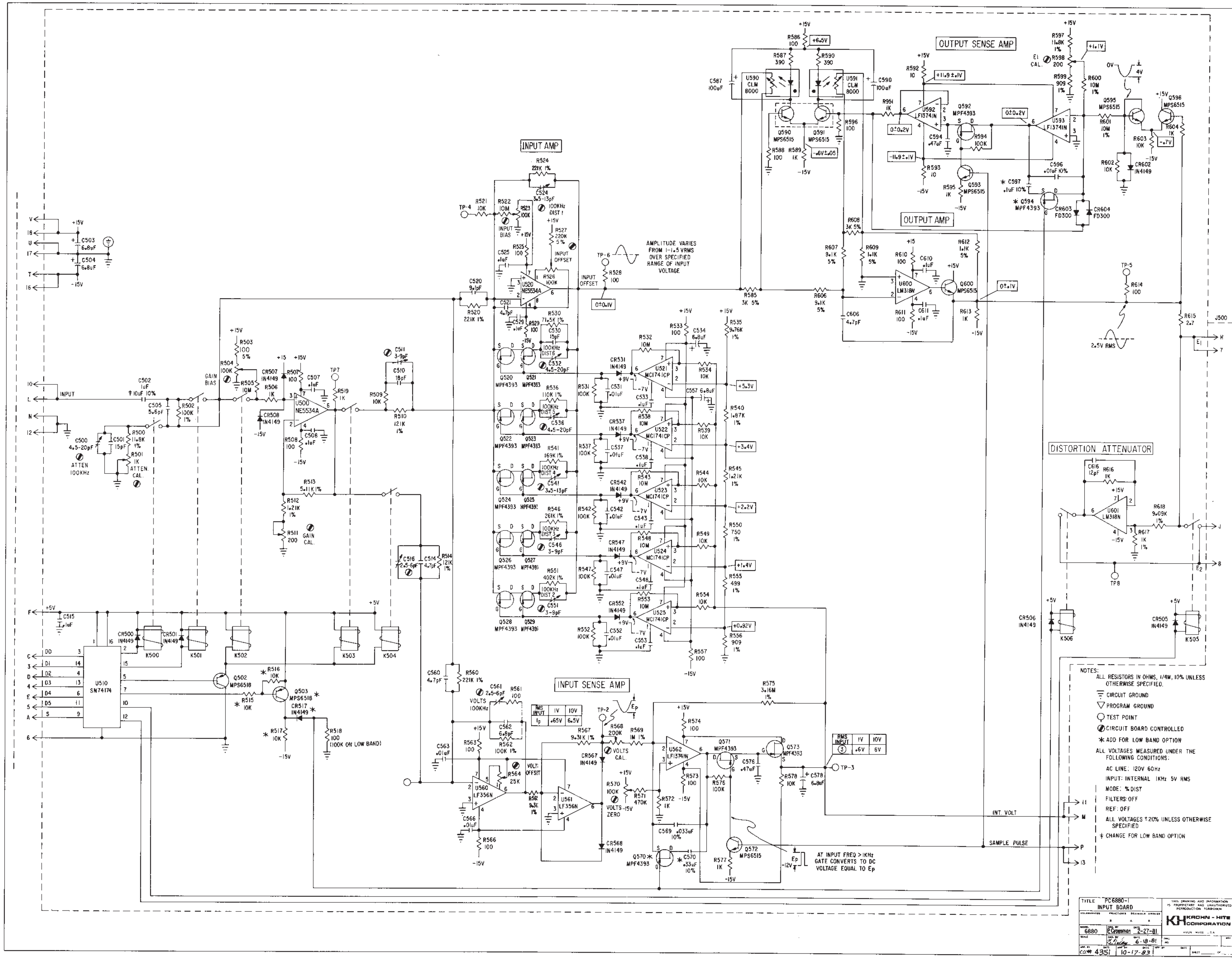
REF: OFF

ALL VOLTAGES ±20% UNLESS OTHERWISE SPECIFIED

TITLE	PC 6880-4 OUTPUT BOARD
MODEL	6880
DRN BY	R.Crossman 3-12-81
CHK BY	6-18-81
APP BY	C0.4402 10-17-83

KH KROHN-HITE CORPORATION


6880-1
10-17-83
C.O.# 4351


INPUT AMP
INPUT SENSE AMP
OUTPUT SENSE AMP
OUTPUT AMP
DISTORTION ATTENUATOR
AMPLITUDE VARIES FROM 1-1.5 VRMS OVER SPECIFIED RANGE OF INPUT VOLTAGE
AT INPUT FREQ >1KHz GATE CONVERTS TO DC VOLTAGE EQUAL TO Ep
NOTES:
ALL RESISTORS IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED.
CIRCUIT GROUND
PROGRAM GROUND
TEST POINT
CIRCUIT BOARD CONTROLLED
✱ ADD FOR LOW BAND OPTION
ALL VOLTAGES MEASURED UNDER THE FOLLOWING CONDITIONS:
AC LINE: 120V 60Hz
INPUT: INTERNAL 1KHz 5V RMS
MODE: % DIST
FILTERS: OFF
REF: OFF
ALL VOLTAGES ±20% UNLESS OTHERWISE SPECIFIED
‡ CHANGE FOR LOW BAND OPTION
TITLE PC6880-1 INPUT BOARD
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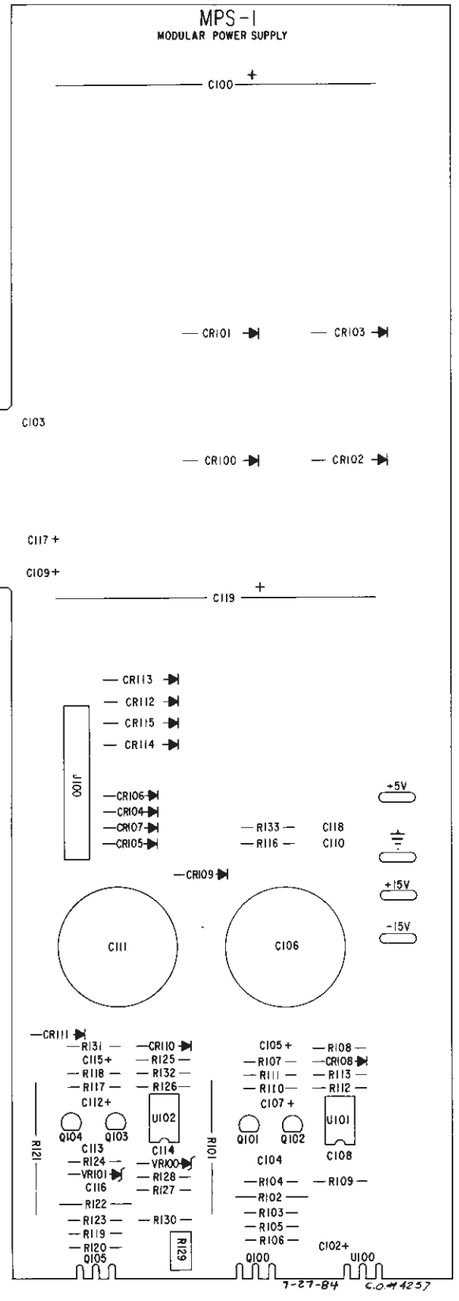
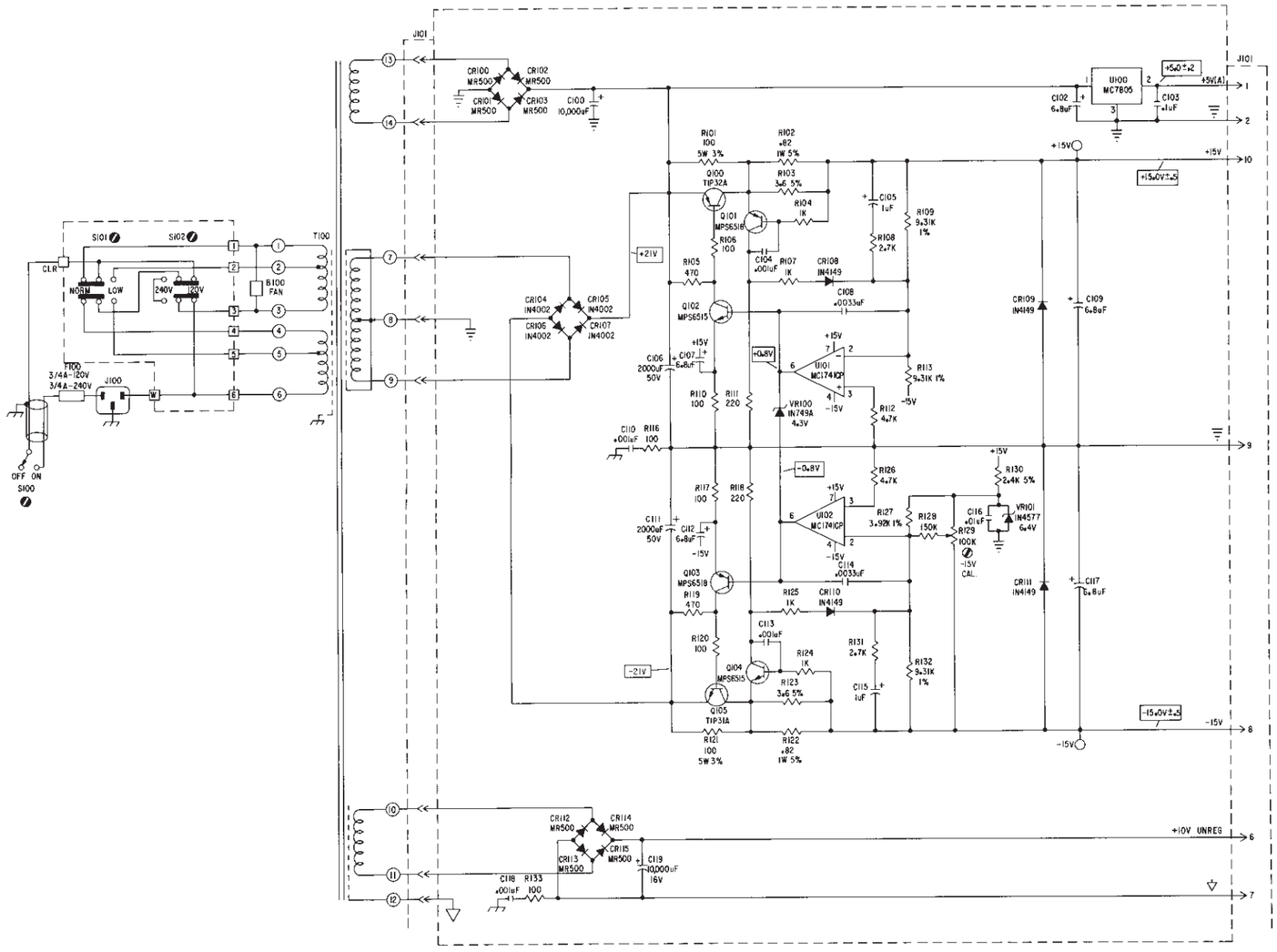
KROHN-HITE CORPORATION
AVON MASS U.S.A.
MODEL 6880
DRN. BY P. Crossman DATE 2-27-81
DATE 6-18-81
C.O.# 4351
DATE 10-17-83





NOTES:

ALL RESISTORS IN OHMS, 1/4W, 10% UNLESS OTHERWISE SPECIFIED

⏚ CIRCUIT GROUND

▽ PROGRAM GROUND

○ TEST POINT

⏚ CHASSIS GROUND

◐ CIRCUIT BOARD CONTROLLED

◐ REAR PANEL CONTROLLED

ALL VOLTAGES MEASURED UNDER THE FOLLOWING CONDITIONS:

AC LINE: 120V 60Hz

INPUT: INTERNAL 1KHz 5V RMS

MODE: % DIST.

FILTERS: OFF

REF: OFF

ALL VOLTAGES ±20% UNLESS OTHERWISE SPECIFIED

TITLE	MPS-1 POWER SUPPLY
MODEL	6880
DRN BY	P.Crossman 10 28 80
CHK BY	6-18-81
DATE	7-27-84
C.O.#	C.O.#4257

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