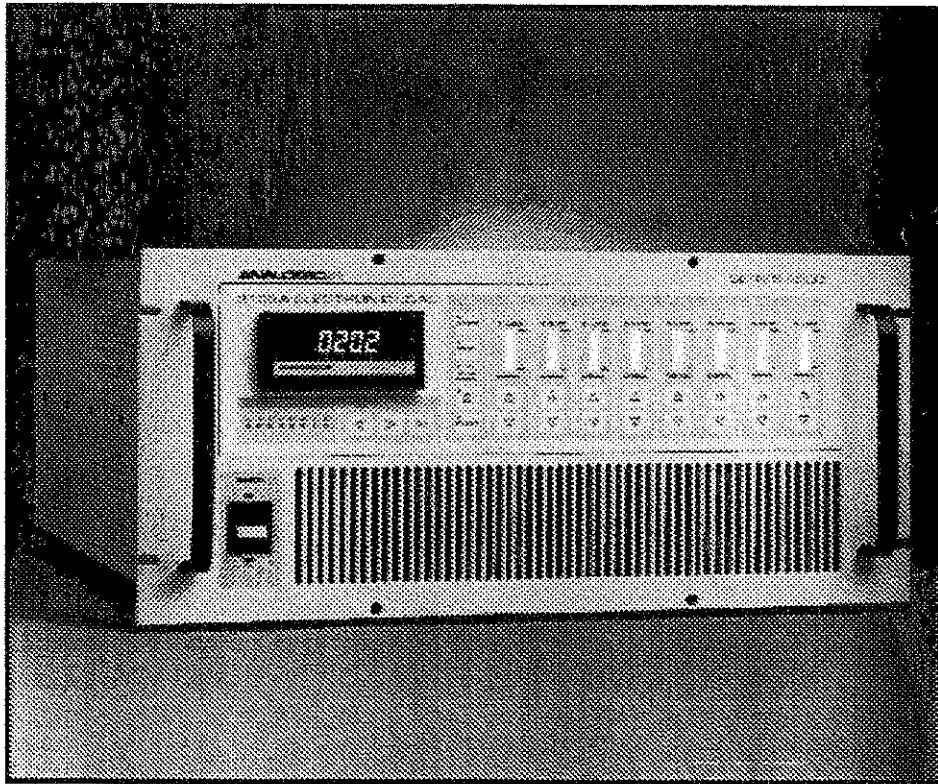


# Series 2000 - Model 2103 Electronic Load



USER'S MANUAL

**ANALOGIC** ■  
The World Resource  
for Precision Signal Technology

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# Chapter 1

## Introduction and Overview

### **Description**

The Model 2103A Electronic Load is a self-contained modular DC load which provides a flexible cost effective solution for many power test applications. Combined with a programmable AC source and some supervisory software/PC computer, it becomes a "mini-tester" for multiple output switching and linear power supplies. The 2103A contains a sophisticated new control and measuring system which may be operated via the front panel or reported over the GPIB bus with an optional IEEE-488 interface. Available with 8 channels, this unit is an ideal solution for high volume burn-in applications. In addition to constant current and constant resistance modes of operation, the 2103A has some dynamic capabilities.

### **Capabilities**

The multi-channel electronic load unit is available with 8 channels. Each channel provides up to 50 amps, 250 watts with voltages ranging between 4 to 150 VDC and is independently configurable. Two basic modes of operation are available on each channel: constant current and constant resistance. Load configuration options allow the user to define exactly what is needed for a particular test problem. For example, constant current and constant resistance modes as well as external modulation are user selectable.

Channels may be paralleled to increase the current handling capability to 400 amps or 2000 watts per electronic load.

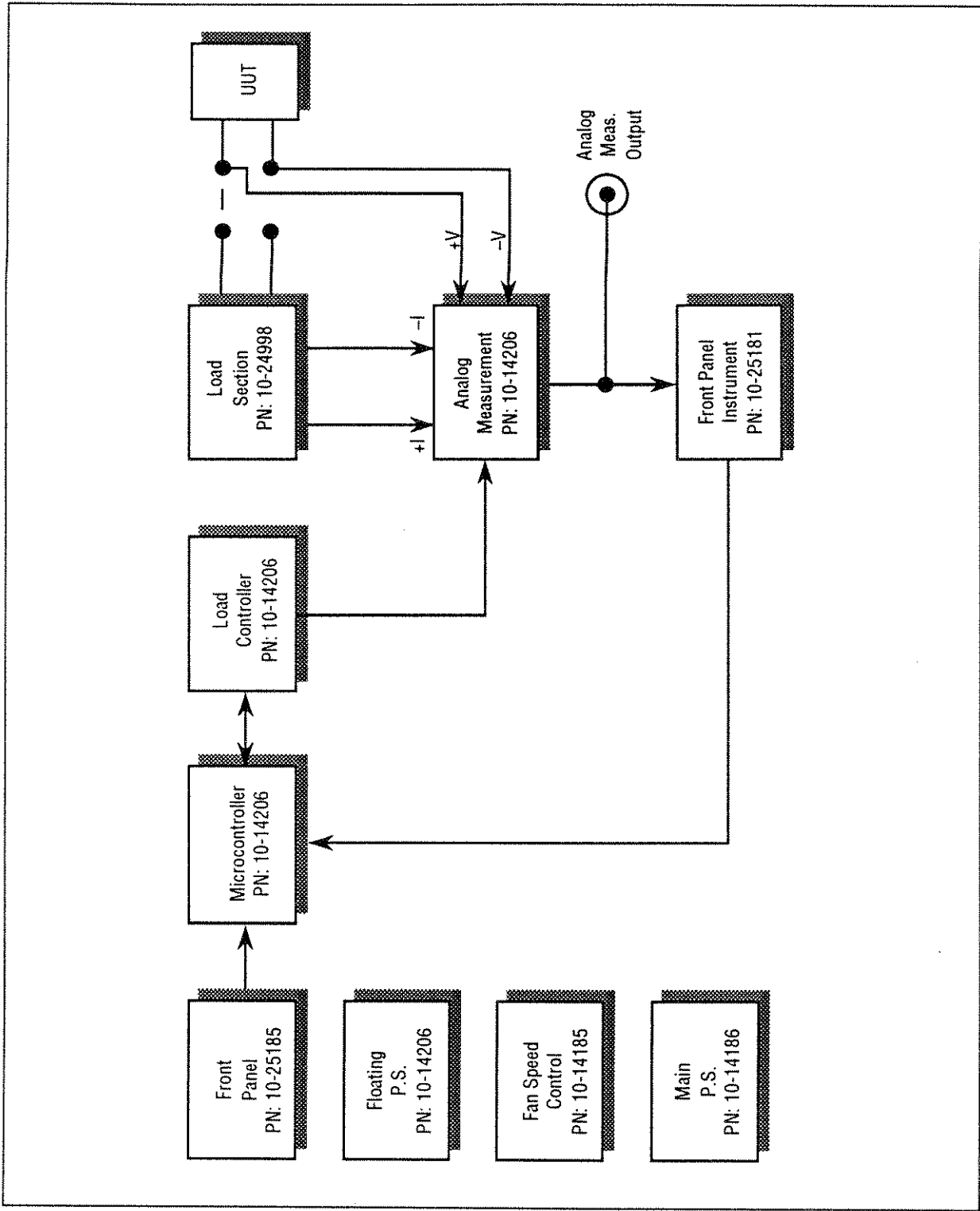


Figure 1-1. Model 2103A System Block Diagram.



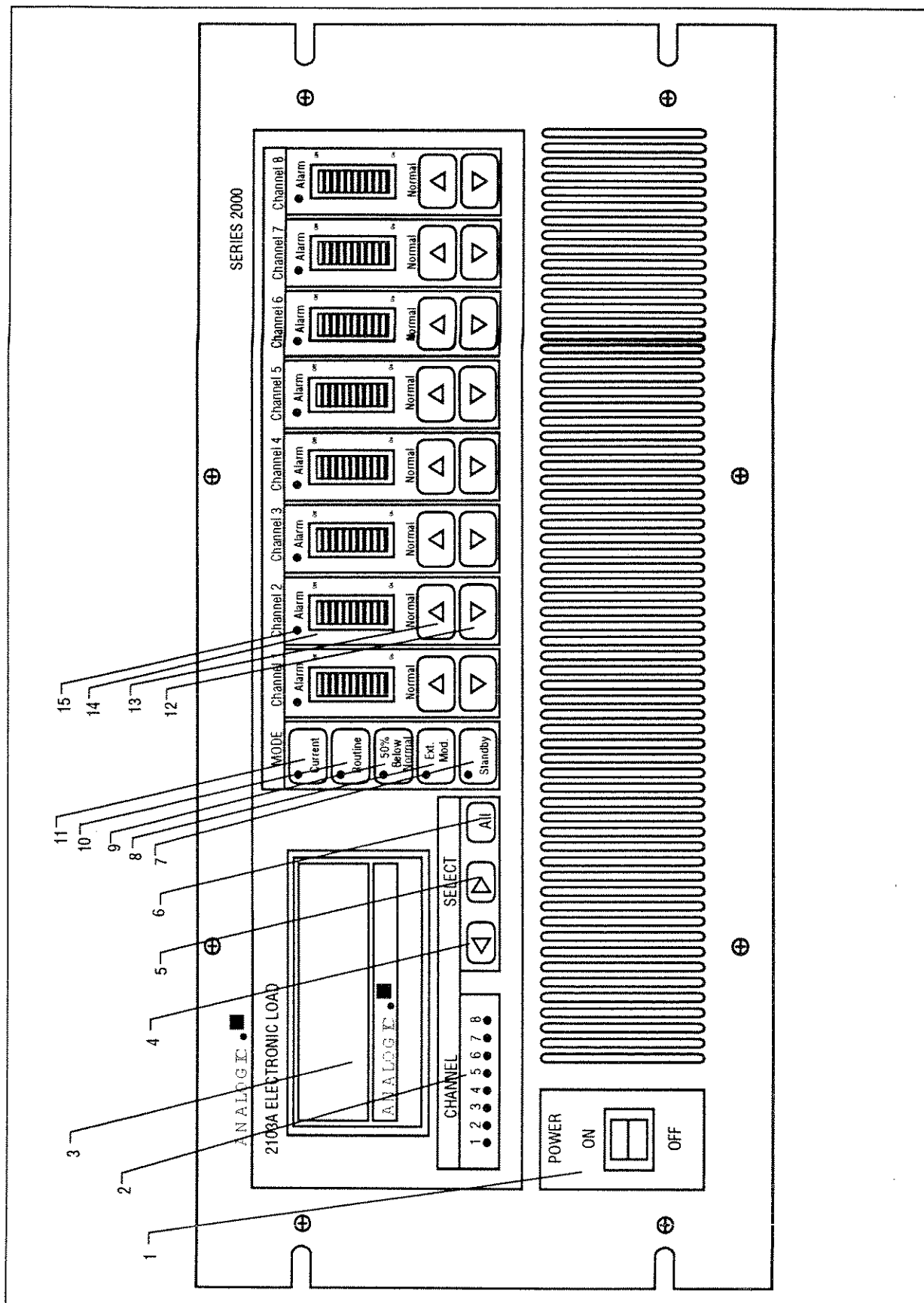


Figure 1-2. Front Panel Keyboard.

## Electronic Load Key Definition Guide

The following is a list of each of the keys and their functions that appear on the front panel of the Model 2103A Electronic Load system. In parentheses please note the key number as it is referenced in Figure 1-2.

Select Keys	Function
<b>Key</b>	<b>Function</b>
Left arrow (4)	This key is used to select different channels. Note that by pressing this key the channel number as indicated by the LEDs changes in descending order.
Right arrow (5)	By pressing this key, the selected channel (indicated by one of the eight LEDs in the channel group) will be moved to the right.
All (6)	<p>This key has a number of different functions.</p> <p>Pressing this key followed by any key from the MODE key group results in executing the respective command for all channels as follows:</p> <p>[ALL] [CURRENT] – all the channels will go into current mode.</p> <p>[ALL] [RESISTIVE] – all the channels will go into resistive mode.</p> <p>[ALL] [50% BELOW NOMINAL] – all the channels which are in current mode will go 50% below nominal; the channels in resistive or external modulation mode will not be affected.</p> <p>[ALL] [EXT. MODULATION] – all the channels will go into external modulation mode.</p> <p>[ALL] [STAND BY] – all the channels will go into stand-by except the channels in external modulation mode.</p> <p>If the electronic load is in remote mode (GPIB mode) pressing this key will put the system into local mode.</p> <p>Pressing this key followed by the “left arrow” key will indicate the voltage for the selected channel on the 4 1/2 digit display. When the display is in voltage mode the mode LED is blinking.</p> <p>Pressing this key followed by the “right arrow” key will indicate the current for the selected channel on the 4 1/2 digit display.</p>

<b>Mode Keys</b>	
<b>Key</b>	<b>Function</b>
	Note: All MODE keys have a corresponding MODE LED that indicates the status of the mode. With the LED on, that mode is activated.
Stand By (7)	By pressing this key, the selected channel will go into stand-by mode. Continuously pressing this key switches the load between the nominal current setting and zero dynamically at a frequency of approximately 200 Hz.
Ext. Mod. (8)	Pressing this key enables the external modulation input.
50% Below (9)	If in CURRENT mode, pressing this key results in the value of current setting to change to 50% of its nominal value. Continuously pressing this key switches the load between the nominal current setting and 50% of this value dynamically at a frequency of approximately 200 Hz.
Resistive (10)	Pressing this key activates the RESISTIVE mode of operation.
Current (11)	Pressing this key activates the CURRENT mode of operation.

<b>Channel Keys</b>	
<b>Key</b>	<b>Function</b>
Down arrow (12)	Pressing this key, the value for current or resistance for the respective channel may be decremented.
Up arrow (13)	Pressing this key, the value of current or resistance for the respective channel may be incremented.

### ***Channel LEDs (2)***

There are eight LEDs numbered from 1 to 8 indicating which channel is selected. Selecting a particular channel activates the voltage or current measurement for that channel (using the 4 1/2 digit display); it also enables the user to change the mode of operation using the MODE keys.

### ***Alarm LEDs (15)***

Every channel has an alarm LED which will blink if an alarm condition occurs (over-power, over-voltage, over-current, over-temperature).

### ***Bar Graphs LEDs (14)***

There is a 10 LED bar graph indicator for every channel indicating the setting point for a respective channel.

## Chapter 2

# Product Specifications

The following are the specifications for the multi-channel electronic load:

### ***Dimensions and Weight:***

<b>Height:</b>	8.72 in.
<b>Width:</b>	19.00 in.
<b>Depth:</b>	20.60 in.
<b>Weight:</b>	38 lbs.

### ***Operating Conditions for any Single Channel***

<b>Operating Voltage:</b>	4.0V (at 50A*) to 150 VDC *derated current can be obtained at lower operating voltages. (See Figure 2-1)
---------------------------	---

**Maximum Operating Current:** 50A

**Maximum Operating Power:** 250 watts (See Figure 2-2)

### ***Current Mode***

<b>Range:</b>	0.5 – 50.0 amps*
<b>Resolution:</b>	10.0 mA
<b>Accuracy:</b>	0.2% F.S., $\pm 75$ mA *usable range – range minimum is 0.0 amps $\pm 100$ mA

### ***Resistive Mode***

Resistive mode has four ranges depending on the output voltage of the unit under test.

Note: For good accuracy in Resistive Mode, the value of resistance in ohms should be smaller than the value of voltage in volts.

### ***Range 1***

<b>UUT Output Voltage:</b>	4.0 – 14.0V
<b>Resistance (ohms):</b>	0.096 – 4.8
<b>Resolution (ohms):</b>	0.096
<b>Accuracy:</b>	$\pm 1.5\%$ of setting, $\pm 0.096$ ohms

**Range 2**

UUT Output Voltage:	4.0 – 50.0V
Resistance (ohms):	0.33 – 15
Resolution (ohms):	0.33
Accuracy:	±1.5% of setting, ±0.33 ohms

**Range 3**

UUT Output Voltage:	10.0 – 125V
Resistance (ohms):	0.75 – 30
Resolution (ohms):	0.75
Accuracy:	±5% of setting, ±0.75 ohms

**Range 4**

UUT Output Voltage:	10.0 – 150V
Resistance (ohms):	1 – 40
Resolution (ohms):	1
Accuracy:	±5% of setting, ±1.0 ohms

**Current Measurement**

Resolution:	4 1/2 digits
Accuracy:	±1% of setting, ±10 mA
Linearity:	±1 display count
Temperature drift:	80 ppm/°C
Self Calibration:	Offset and gain calibration once per second
Update rate:	50 ms

**Voltage Measurement\***

Resolution:	4 1/2 digits
Accuracy:	±1% of setting, ±10 mV
Linearity:	±1 display count
Temperature drift:	80 ppm/°C
Self Calibration:	Offset and gain calibration once per second
Update rate:	50 ms

\* with remote sense lines connected (see Figure 1-2, rear panel)

## External Modulation Interface

### Description

The external modulation feature of the Model 2103A Electronic Load enables the user to input waveforms or DC control voltages to control the load current. When the external modulation is used, the load acts as a transconductance (voltage to current) amplifier. The load inputs remain floating and isolated even if more than one load section is connected to the same external input.

### Specifications

Number of External Inputs:	8
Current Ranges:	0 to 50 amps
Input Voltage for Full Scale Output:	5.0 volts
Bandwidth:	-3 dB at 45 kHz

## Operation

### Connecting the Signal Source

The external signal source is interfaced to the Model 2103A Load on the rear panel. There are 8 BNC connectors, labeled 1 to 8, one for each channel of the load. Use a standard BNC cable to connect the load channel to the external signal source.

### Programming the Model 2103A Load

To use the external modulation of a given load channel, select the channel using the left arrow key, the right arrow key, or the ALL key and press "EXTERNAL MODULATION" in the "MODE" field. The "EXTERNAL MODULATION" LED will turn on indicating that the channel is in external modulation mode. The voltage input is linearly proportional to the loaded current.

## Analog Meas. Out

### Description

The BNC connector on the rear panel of the unit is provided so that it supplies the user with means of observing the waveforms for voltage and current in real time. The interface is a standard BNC connector.

### Specification

Current:	
Range:	0 – 50.0 amps 50.0 amps = 1.875 volts $\pm 1\%$ , $\pm 0.5$ mV
Voltage:	
Range:	0 – 150 volts 150 volts = 5.18 volts $\pm 1\%$ , $\pm 1$ mV
Bandwidth:	-3 dB at 50 kHz
Probe:	A high impedance probe should be used

**Operation**

The current or voltage waveforms for a particular channel may be displayed using the ANALOG MEAS OUT connector on the rear panel. This may be activated by selecting the measurement function from the front panel or via the GPIB interface.

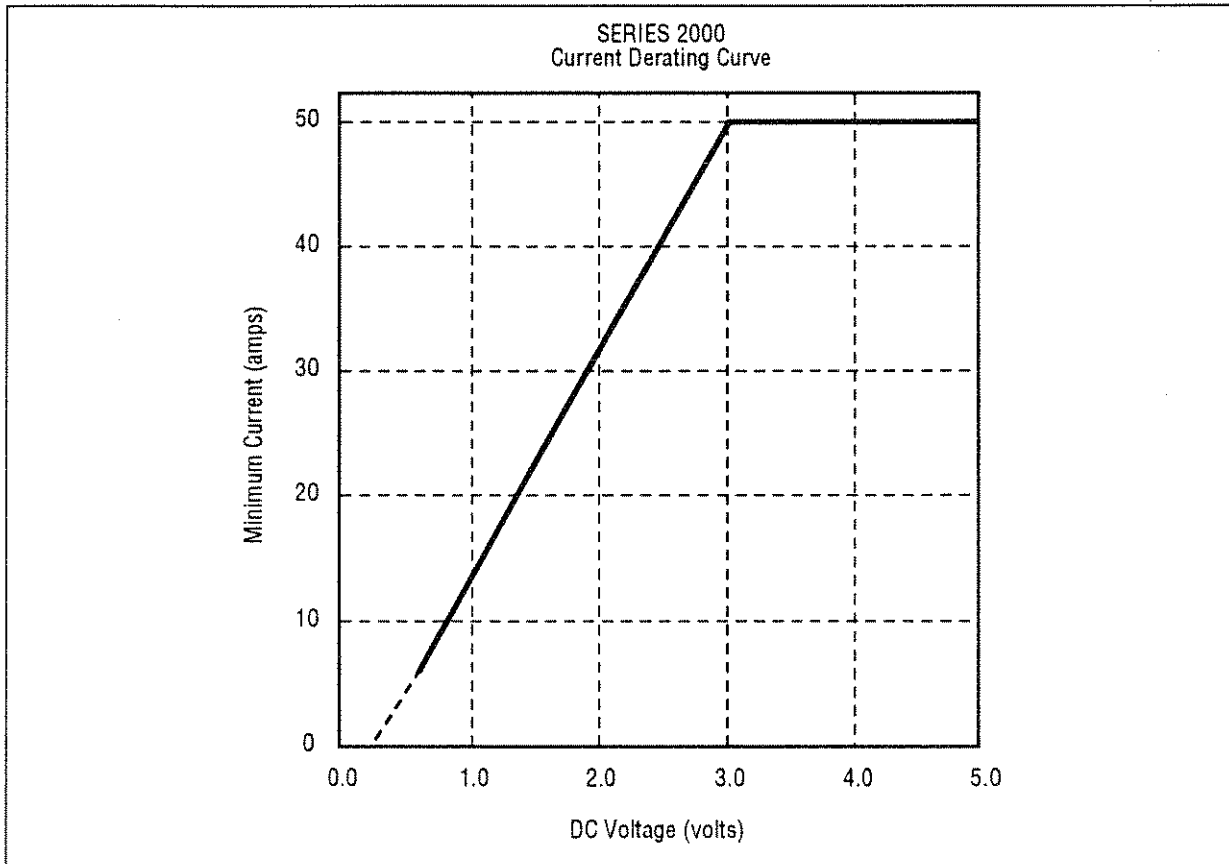


Figure 2-1. Current Derating Curve.

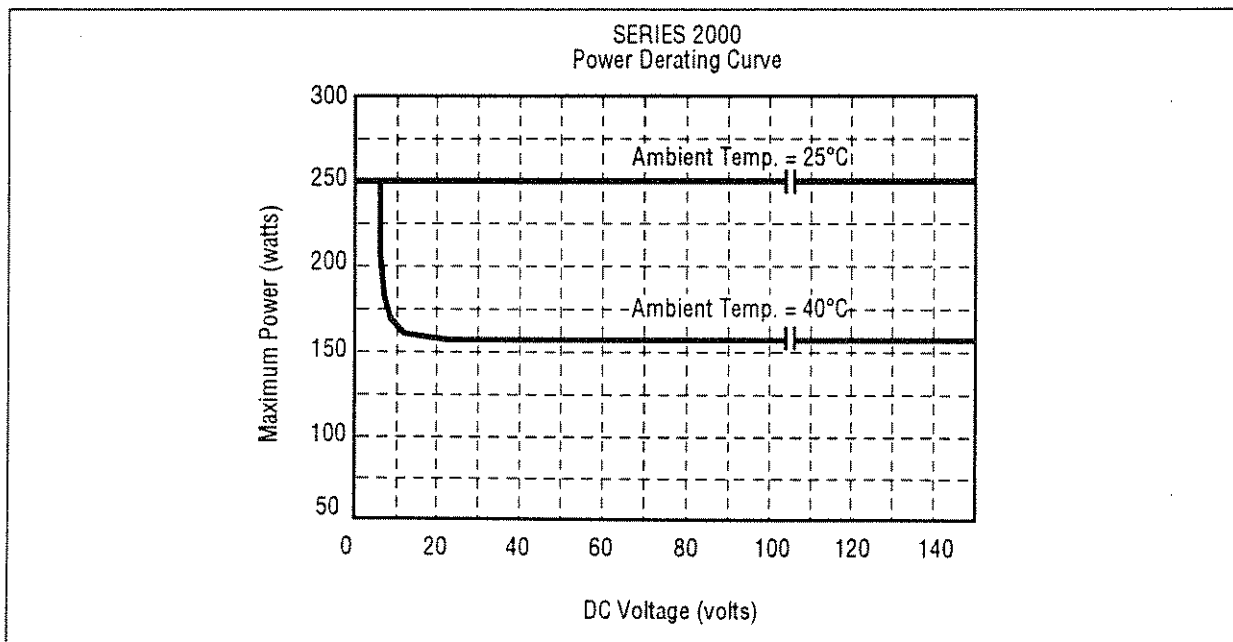


Figure 2-2. Power Derating Curve.

## Chapter 3 Installation

Figure 3-1 shows the rear panel of the Model 2103A Electronic Load. The following is a detailed explanation of the different items on the rear panel and what their functions are, as related to installation:

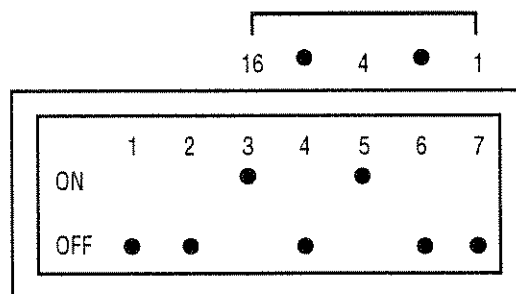
### **IEEE-488 (1) (optional)**

Through this connector (also referred to as GPIB) the Model 2103A Electronic Load may be controlled via a computer if this option is installed. See Chapter 4, *Remote Operation* for more detail.

### **IEEE-488 Address Switch Setting (2) (optional)**

The Model 2103A Electronic Load system can be programmable via the IEEE-488 bus. In order to set the IEEE-488 address, a dip switch located on the rear panel is used. IEEE-488 addresses range from 1 to 30. They are set using binary format where UP or (1) is TRUE and DOWN or (0) is FALSE. The factory default setting is 20. See Figure below. In order to change the IEEE-488 address, turn off the Model 2103A Electronic Load system, set the switch settings for the new address, and then turn the power on. This will reinitialize the load to the new IEEE-488 address.

Factory Default Setting ( $16 + 4 = 20$ )



### **External Modulation (4)**

(See the description under the "Specification" section.)

### **Analog Meas. Out (5)**

(See the description under the "Specification" section.)

### **Load Interface (6) and Remote Sense (7)**

The following is a list of the pin-out connectors for the load interface connector. See Figure 3-2 for physical locations. For load pins (i.e., pins A1 through H2) 10 gauge cable is recommended.



2 Pin Load Connector		17 Pin Sense Connector	
Pin	Function	Pin	Function
A1	Load #1 (+)	1	Load #1 (+) Voltage Sense
A2	Load #1 (-)	2	Load #1 (-) Voltage Sense
B1	Load #2 (+)	3	Load #2 (+) Voltage Sense
B2	Load #2 (-)	4	Load #2 (-) Voltage Sense
C1	Load #3 (+)	5	Load #3 (+) Voltage Sense
C2	Load #3 (-)	6	Load #3 (-) Voltage Sense
D1	Load #4 (+)	7	Load #4 (+) Voltage Sense
D2	Load #4 (-)	8	Load #4 (-) Voltage Sense
E1	Load #5 (+)	9	Load #5 (+) Voltage Sense
E2	Load #5 (-)	10	Load #5 (-) Voltage Sense
F1	Load #6 (+)	12	Load #6 (+) Voltage Sense
F2	Load #6 (-)	13	Load #6 (-) Voltage Sense
G1	Load #7 (+)	14	Load #7 (+) Voltage Sense
G2	Load #7 (-)	15	Load #7 (-) Voltage Sense
H1	Load #8 (+)	16	Load #8 (+) Voltage Sense
H2	Load #8 (-)	17	Load #8 (-) Voltage Sense

Note: Pin 11 is not used.

**Input Power Connector (8)**

At least 300 VA of power is required. The Model 2103A Electronic Load may be configured for 120 or 240 volt operation by simply switching the module referred to by (9) in Figure 3-1.

**Input Voltage Select Module (9)**

As specified above, this module is used to switch from 120 volt input power mode to 240 volt.

**Input Power Fuse (10)**

A 5.0 amp fuse is recommended.

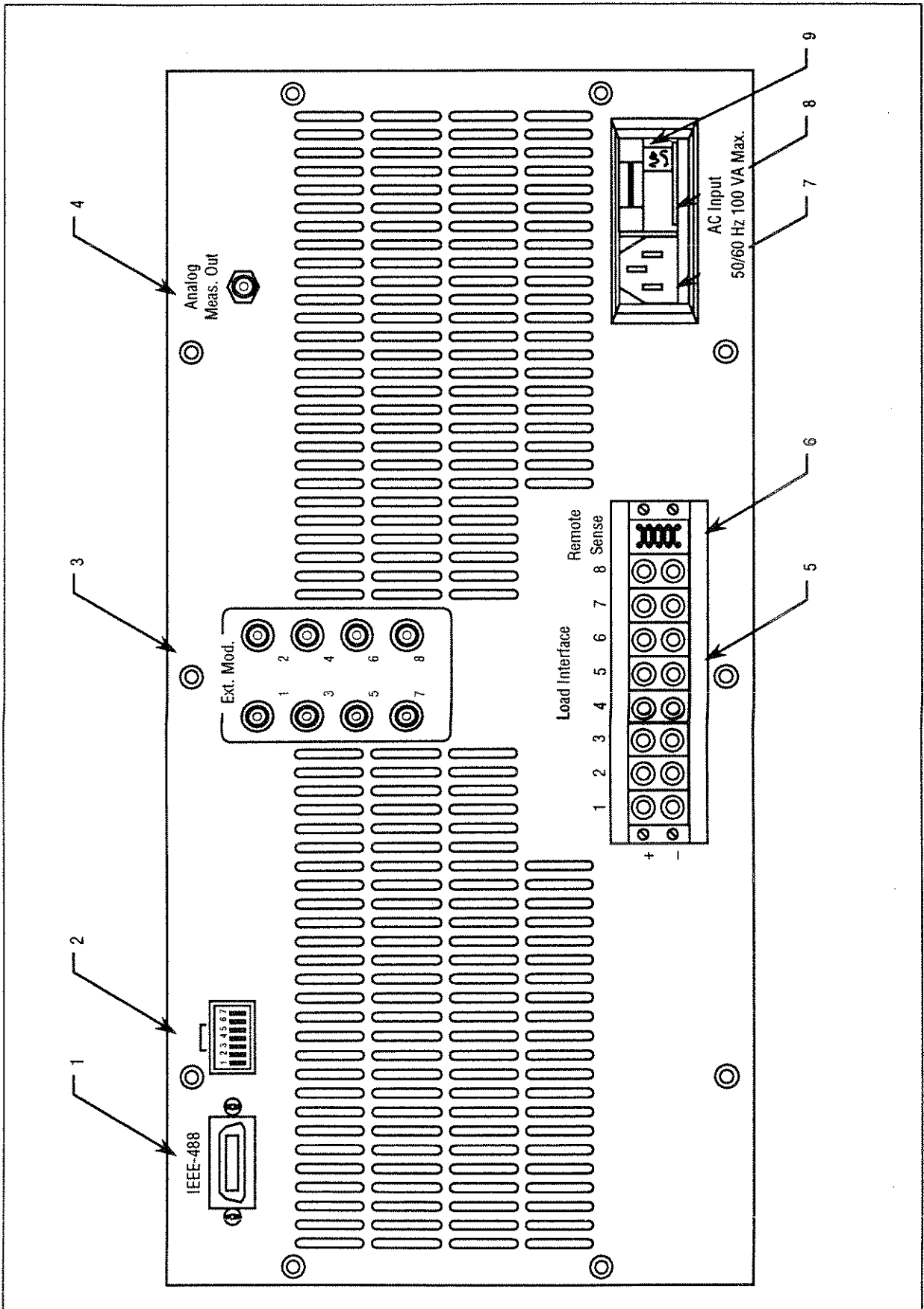


Figure 3-1. Rear Panel

# Chapter 4

## Operating Instructions

The Model 2103A Electronic Load accepts instructions locally, from the front panel, or remotely, over the optional IEEE-488 bus, to control and take measurements for each of the 8 load sections in the unit.

### **Powering the Unit On and Off**

**IMPORTANT:** Insure that no external voltages are applied to the Model 2103A load terminals when powering the unit on or off. Turning the Model 2103A on or off with external voltages applied to the load channels can cause permanent damage to the instrument.

### **Local (Front Panel) vs. Remote (GPIB) Operation**

Note: Square brackets [ ] indicate a command key on the front panel.

After power up the Electronic Load is in local mode with the front panel enabled. At power up the default mode of operation is the "Current Mode." All channels come up in the "Standby" condition. Notice the LEDs for the "Current Mode" and "Standby" are on. With the GPIB option installed, sending a command over the GPIB bus results in the unit to be operating in the REMOTE mode. All CHANNEL LEDs will be turned on indicating that the unit is in REMOTE mode. The Electronic Load can be switched back into 'LOCAL' mode by pressing the [ALL] key.

### **Selecting the Mode of Operation**

Any load channel may operate in Constant Current or Constant Resistance mode. It may also be in the 'standby' mode in which case it will be inactive. In addition the programmed current value may be set to 50% of its nominal value by pressing the '50% below nominal' key. Operating mode for a load channel can be selected in the following manner:

Select the desired load channel using the [left arrow], or [right arrow] keys in the 'SELECT' field. The corresponding LED in the 'CHANNEL' field will be lit. The LEDs in the 'MODE' field indicate the channel status (i.e., if the channel is in 'resistive' mode, then the 'resistive' LED will be lit or if the channel is in 'current' and '50% below nominal' mode then the corresponding LEDs will be lit.) Note that the 4 1/2 digit display indicates the measured current or voltage value for the selected channel.

Change the operating mode for the channel by pressing the desired key in 'mode' field. The LEDs will indicate the new operating mode.

If it is desired to put all channels in a specific operating mode (for example all channels in 'standby' mode), the [ALL] key may be used in the following manner:

Press the [ALL] key. All 'channel' LEDs will be lit.

Press the desired mode key (for example 'CURRENT'). All channels will be in selected mode.

## Setting Current or Resistance Value

The value for current or resistance may be set for every channel using the [up arrow] or [down arrow] keys.

### **Setting the Value of Current in CURRENT Mode:**

Pressing [UP] ([DOWN]) key will increment (decrement) the current value for the respective channel with 10 mA of resolution. Setpoint for every channel is indicated by a bar-graph indicator with a resolution of 5 amps. During incrementing (decrementing) the current value, the LED for corresponding channel blinks.

### **Programming in Constant Resistance Mode:**

To program the 2103 load in the resistance mode, the sense lines for each load channel used have to be connected to the output of the UUT (Unit Under Test) being tested. This also applies for when two or more channels are paralleled together.

To program a channel, press the down arrow key for that channel to increase the current drawn by the output of the UUT being tested and press the up arrow key to decrease the current draw by that output.

The panel display and the bar graph will always show the actual current being drawn by the output of the UUT being tested but not the resistance.

As specified in Chapter Two (Specifications), there are four operating ranges in the Resistive Mode depending on the UUT voltage. When in the Local Mode, the ranges are automatically selected as a function of UUT voltage. For example, if UUT voltage is set at 5 volts, Range 1 will be selected and the value of the resistor may be incremented/decremented with the Up/Down keys in 0.096Ω increments. This resistor value will be maintained over the specified voltage range (i.e., 4–14 volts). If the voltage were to go beyond 14 volts, the range will automatically switch to Range 2 and the resistance value will be set for the new range according to the following formula:

$$\text{New resistance} = \text{New range step} * \frac{\text{old resistance}}{\text{old range step}}$$

For example, if in Range 1 the resistance was at 0.288Ω, and the voltage was increased from 6 volts to 20 volts, the new resistor value will be:

$$0.33 * \frac{0.288}{0.096} = 0.99 \text{ ohm}$$

In the GPIB remote operation, the resistive ranges are established with the RRRANGE Command (See GPIB Commands) and are not changed as a result of voltage change. The user, therefore, should change the range if the UUT voltage is expected to fall out of range.

### **Current Measurement**

Current measurement may be activated by pressing the [ALL] key followed by the [right arrow] key. The instrument will display the current for the selected channel.

### **Voltage Measurement**

Voltage measurement may be activated by pressing the [ALL] key followed by the [left arrow] key. The instrument will display the voltage for the selected channel. The LEDs on the 'current' or 'resistive' mode keys (depending on which one is selected) will blink indicating that the voltage measurement (and not current measurement) is displayed.

When changing from voltage to current measurement or vice versa, allow a few seconds for the new measurement value to stabilize.

Measurements of the same type are now faster than measurements of opposite type. For example, if you need to measure voltage and current for all 8 channels, it's faster to read all the voltages first and then read all the currents, rather than alternating voltage and current. It takes longer to alternate because there is a delay involved when switching from voltage to current mode within the panel meter on the front of the 2103.

### **Alarm Conditions**

Over-voltage, over-current, over-power, or over-temperature conditions result in the ALARM LED being on. The LED will remain on even if the alarm condition is removed; the particular alarmed channel will go into the "Standby" mode. Pressing any command key or sending an alarm command via GPIB will turn the LED off.

When an alarm occurs RNOMINAL and RRANGE now go to their default values, RNOMINAL = 50 ohms and RRANGE = 4.

### **External Modulation**

The external modulation inputs may be activated by pressing the [EXT.MOD.] key. The corresponding LED will turn on indicating that the channel is in external modulation. The user shall provide external modulation signal (from a signal generator — see chapter 2 for electrical specifications) via corresponding BNC connector on rear panel. Note that the same signal generator may be used for more than one channel; channel-to-channel isolation is provided internally. The [STANDBY] key will not turn the external modulation mode off. The [EXTERNAL MODULATION] key has to be pressed again to turn the external modulation mode OFF. Note: the external modulation mode will not work in the Remote (GPIB) Program Mode.

### **Dynamic Mode — Front Panel Access**

Manual operation of the front panel keyboard allows the user to dynamically switch 50% of nominal current or 100% of nominal current at a fixed frequency of 200 Hz (factory selectable from 10 to 200 Hz by continually pressing the "50% below nominal" or "Standby" keys). Slew rate is 5.0 amps/ $\mu$ s typical.

### **Dynamic Mode — GPIB Interface**

Each channel can be programmed with two current values from .5 to 50 amps. The channel can be programmed with a switching frequency ranging between 10 Hz to 200 Hz. Slew rate is 5.0 amps/ $\mu$ s typical.

### **Remote (GPIB) Operation**

Remote operation of the Model 2103A Electronic Load system requires a computer keyboard to input instructions or commands to the IEEE-488 bus. The bus will then transfer this information to be carried out by the electronic load unit.

By sending any of the following GPIB commands, the Electronic Load will automatically go into the REMOTE mode. All CHANNEL LEDs will be turned on indicating that the unit is in REMOTE mode.

The GPIB address setting switch is located on the rear panel (see *Installation*, Chapter Three).

The following are the IEEE commands for the Model 2103A Electronic Load unit:

<b>Parameter Commands</b>											
<b>Command</b>	<b>Function</b>										
RRANGE n	This command changes the resistive range of the selected load or group and is dependent on the voltage at the output of the power supply. N is a range number between 1 and 4.										
	<table border="0"> <thead> <tr> <th style="text-align: left;">Range</th> <th style="text-align: left;">Volts</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>4 – 14V</td> </tr> <tr> <td>2</td> <td>4 – 50V</td> </tr> <tr> <td>3</td> <td>10 – 125V</td> </tr> <tr> <td>4</td> <td>10 – 150V</td> </tr> </tbody> </table>	Range	Volts	1	4 – 14V	2	4 – 50V	3	10 – 125V	4	10 – 150V
Range	Volts										
1	4 – 14V										
2	4 – 50V										
3	10 – 125V										
4	10 – 150V										
IOFFSET n	Multiply the nominal current of the selected load(s) by n% (where 0 <= n <= 99).										
RNOMINAL n	Set the nominal resistance to n ohms. Data format: x.xxxxE+xx										
INOMINAL n	Set the nominal current to n amps. Data format: x.xxxxE+xx										
HIGH	This command enables the static high level mode of the selected load or group.										
LOW	This command enables the static low level mode of the selected load or group.										
<b>Measurement Commands</b>											
<b>Command</b>	<b>Functions</b>										
MV nnn	Measure voltage of nnn load(s). nnn = single load, e.x. 1 multiple loads separated by commas, e.x. 1,3,7 range of loads with endpoints separated by .., e.x. 3 .. 7 combinations of the above Data is returned in the format: x.xxxxE+xx,x.xxxxE+xx, etc.										
MI nnn	Measure the current of nnn load(s) nnn = single load, e.x. 1 multiple loads separated by commas, e.x. 1,3,7 range of loads with endpoints separated by .., e.x. 3 .. 7 combinations of the above Data is returned in the format: x.xxxxE+xx,x.xxxxE+xx, etc.\										
FASTV nnn	Provides a very quick rough approximation to the actual voltage. The measurement uses an 8-bit A/D converter, and its accuracy is not specified. nnn is the same as for "MV" and "MI."										
	Note: 1. If the "MV", "MI" or "FASTV" command is entered without a load list, the measurements are performed on the currently selected loads.										

### Mode Commands

Command	Function
IMODE	Set selected load(s) to current mode
RMODE	Set selected load(s) to resistive mode
LOAD nnn	This command selects an individual load or group for programming or measuring. NNN is the load or group.  Note: For a range of loads enter two dots ( . ) between two numbers to indicate a continuous group and/or a comma ( , ) to separate two arbitrary loads or continuous group.  Example: LOAD 3 . . 7 (continuous group) LOAD 1,3,7 (arbitrary group) LOAD 1,3 . . 5,7 (combination group)
DYNAMIC	Set selected load(s) to dynamic current mode, oscillating between INOMINAL and IOFFSET amps at FREQ Hz.
COPY n,nnn	This command copies the parameters of one load to another. N is the source load and NNN is the destination load.
LOCAL	This command switches from remote mode to local mode.
STATIC	Set selected load(s) to static current mode at INOMINAL amps.
FREQ n	Set oscillation frequency to n Hz for load(s) in dynamic current mode (where $10 \leq n \leq 200$ ).

### Status Commands

Command	Function
EXEC	Run the selected load(s) with programmed params. All other commands require an EXEC to take effect.
CLEAR nnn	Sets the selected channels to their default (power-on) settings.
CLEARALL	Sets all channels to their default (power-on) settings.
STOP	Set the selected load(s) to standby mode.
STOPALL	Set all load(s) to standby mode.

<b>Miscellaneous Commands</b>	
<b>Command</b>	<b>Function</b>
STATUS n	<p>Send parameters from selected load(s) to controller.                      Format of return string:                      &lt;LOAD=x: INOMINAL=x, IOFFSET=x, RRANGE=x,                      RNOMINAL=x, IMODE/RMODE,RUN/STOP/EXTMOD/ALARM;&gt;</p>
ALARM	<p>This command lists the alarmed loads. Format for return list of loads which have alarms: ALARM = x,x,x,... where x is the actual load.                      Format for return list of loads which have no alarms: ALARM = none</p>
VERSION	<p>Send version number to controller                      Format of return string:                      ML Vx.xx mm-dd-yy</p> <p>Note: Due to the fact that the GPIB commands are executed with different speed (e.g., the "EXEC" command is executed very fast, and the current or voltage measurement commands are slow), it is recommended that the user checks the serial poll byte for the "BUSY" bit and the "DATA AVAILABLE" bit. The contents of the serial poll byte is the following:</p> <ul style="list-style-type: none"> <li>bit 0 – not used</li> <li>bit 1 – busy (command in progress)</li> <li>bit 2 – rda (requested data available)</li> <li>bit 3 – run/stop (0 – stop, 1 – run)</li> <li>bit 4 – device alarm (alarm condition present)</li> <li>bit 5 – measurement error *</li> <li>bit 6 – service request</li> <li>bit 7 – command error (error in command string)</li> </ul> <p>* Serial poll bit 5 is set to 1 if there is an error in serial communications between the 2103 and the panel meter. This bit should be checked after sending either the "MV" or "MI" commands.</p>



# Chapter 5

## Calibration

### Scope

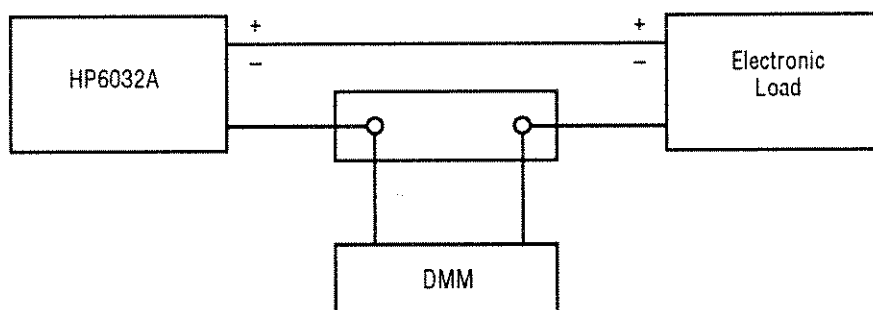
The Model 2103A Electronic Load was designed to minimize the calibration effort. The following consists of a brief procedure that should be performed on the controller board (PN 10-14206). The unit should be calibrated once every six months.

### Equipment

1. Digital Multimeter (HP 3478A or equivalent)
2. DC Power Supply (HP 6032A or equivalent)
3. Current Shunt 100 mV = 50 amps, +0.05% accuracy

### Procedure

1. Turn on the Model 2103A Electronic Load.
2. Connect the power supply (HP 6032A) to channel 1 of the ELECTRONIC LOAD (pins A1 and A2 of the power connector on the rear panel) through the shunt and the DMM as shown in the diagram below:



3. Set the voltage on the HP 6032A to 5 volts.
4. Set the current limit on the HP 6032A to 5 amps.
5. On the DMM press [DCV].
6. Program channel 1 in current mode to the maximum value of 50 amps by pressing [up arrow] key until maximum value is reached (i.e., the current measured with the external digital multimeter doesn't increase anymore).
7. Adjust the resistor pot R14 for a reading of  $100 \pm 0.1$  mV on the HP 3478 voltmeter.
8. Program channel 1 to the minimum value 0 amps by pressing the [DOWN] key until minimum value is reached (i.e., the current measured with the external digital multimeter doesn't decrease anymore).
9. Adjust the resistor pot R134 for a reading of  $0.000 \pm 0.1$  mV on the HP 3478 voltmeter.

10. Connect the output of the power supply to channels 2 through 8 and repeat steps 6 through 9 by adjusting the following resistor pots for full-scale calibration:

	CHANNEL 2 — R16
CHANNEL 3 — R46	CHANNEL 4 — R48
CHANNEL 5 — R78	CHANNEL 6 — R80
CHANNEL 7 — R110	CHANNEL 8 — R112

and the following for zero calibration:

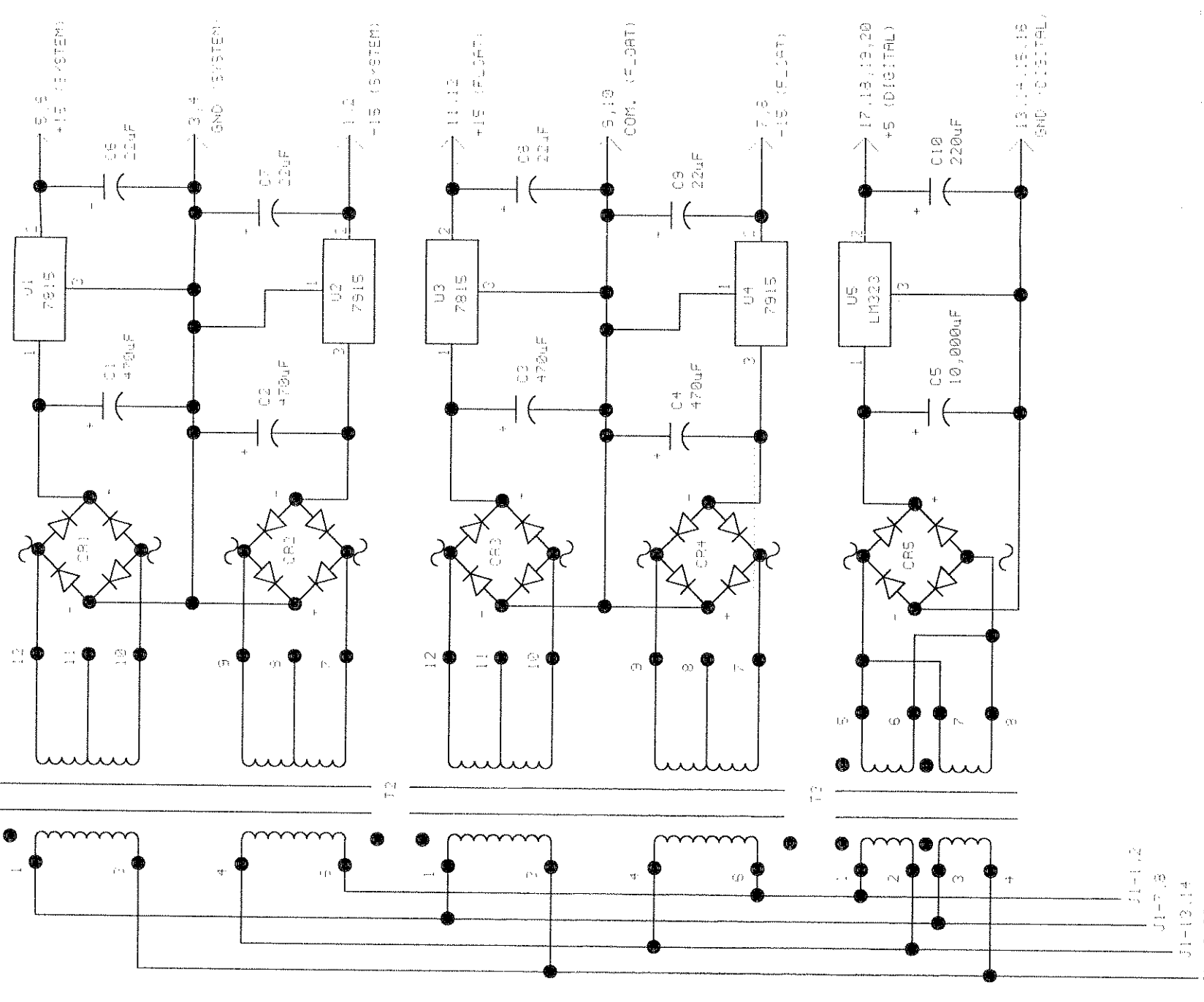
	CHANNEL 2 — R140
CHANNEL 3 — R146	CHANNEL 4 — R152
CHANNEL 5 — R158	CHANNEL 6 — R164
CHANNEL 7 — R170	CHANNEL 8 — R176

*Appendix A*  
**Unit Schematics**



NOTE: COMPONENTS ARE TO BE SPECIFIED BY PART NUMBER AND MANUFACTURER'S NAME. THE PART NUMBER SHOULD BE SPECIFIED IN THE PART LIST. THE PART NUMBER SHOULD BE SPECIFIED IN THE PART LIST. THE PART NUMBER SHOULD BE SPECIFIED IN THE PART LIST.

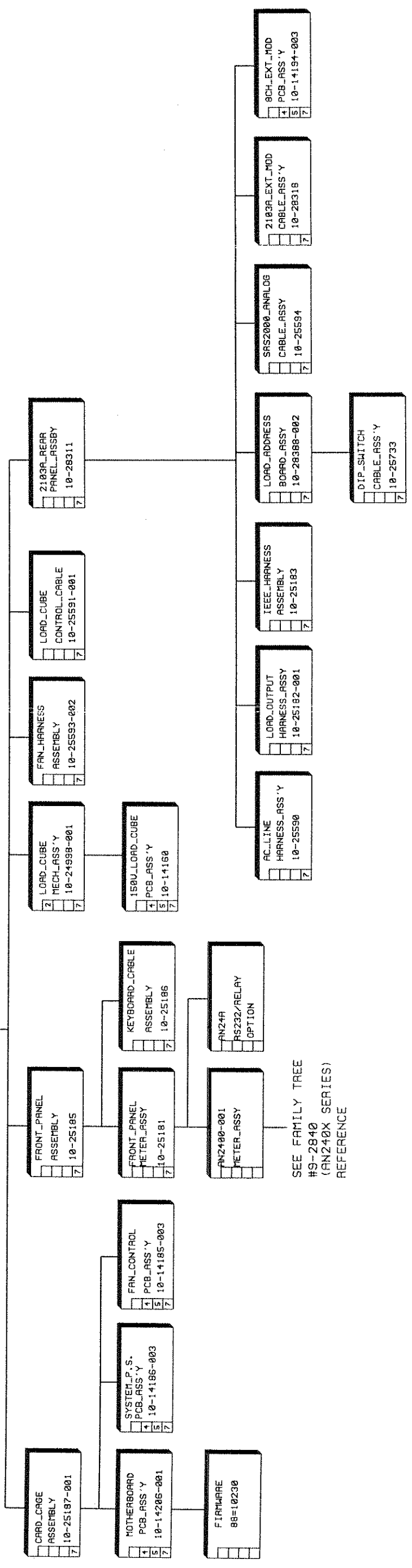
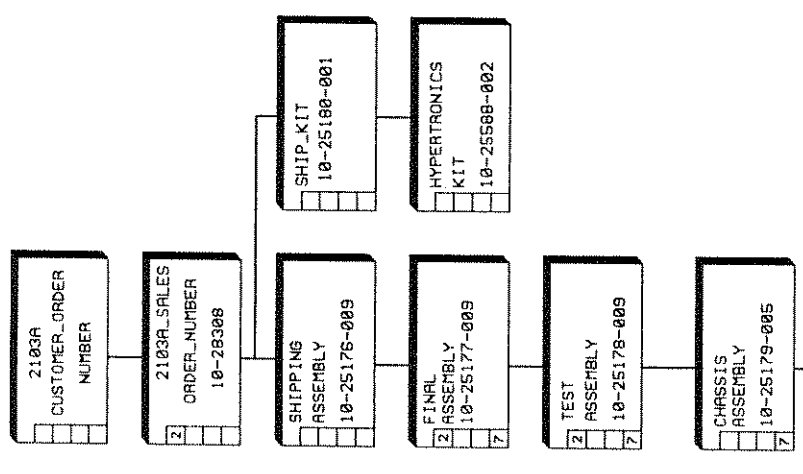
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02	01/10/70	J. J. ...	J. J. ...
03	01/10/70	J. J. ...	J. J. ...
04	01/10/70	J. J. ...	J. J. ...
05	01/10/70	J. J. ...	J. J. ...
06	01/10/70	J. J. ...	J. J. ...
07	01/10/70	J. J. ...	J. J. ...
08	01/10/70	J. J. ...	J. J. ...
09	01/10/70	J. J. ...	J. J. ...
10	01/10/70	J. J. ...	J. J. ...
11	01/10/70	J. J. ...	J. J. ...
12	01/10/70	J. J. ...	J. J. ...
13	01/10/70	J. J. ...	J. J. ...
14	01/10/70	J. J. ...	J. J. ...
15	01/10/70	J. J. ...	J. J. ...
16	01/10/70	J. J. ...	J. J. ...
17	01/10/70	J. J. ...	J. J. ...
18	01/10/70	J. J. ...	J. J. ...
19	01/10/70	J. J. ...	J. J. ...
20	01/10/70	J. J. ...	J. J. ...



DESIGN	5/15/70	5/15/70
CHECKED		
ENGINEER		
ENGINEERING NO.		
QUALITY CONTROL		
PRODUCTION		
WEIGHT		
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES		
APPLICABLE SPECIFICATIONS		
MATERIAL		
FINISH		
10-LSIP	2103	
10-LSIP	2101	
NEAT ASSEMBLY	USED ON	
APPLICATION		
LAST REF. DES. USED	REF. DES. NOT USED	
510, 085, 12, 13, 14, 15		

ANALOGIC	PERBODY, MR. 01390
SCHEMATIC	
POWER SUPPLY	
CODE IDENT. NO.	18M00
SIZE	D
SCALE	1 OF 1
SHEET	2

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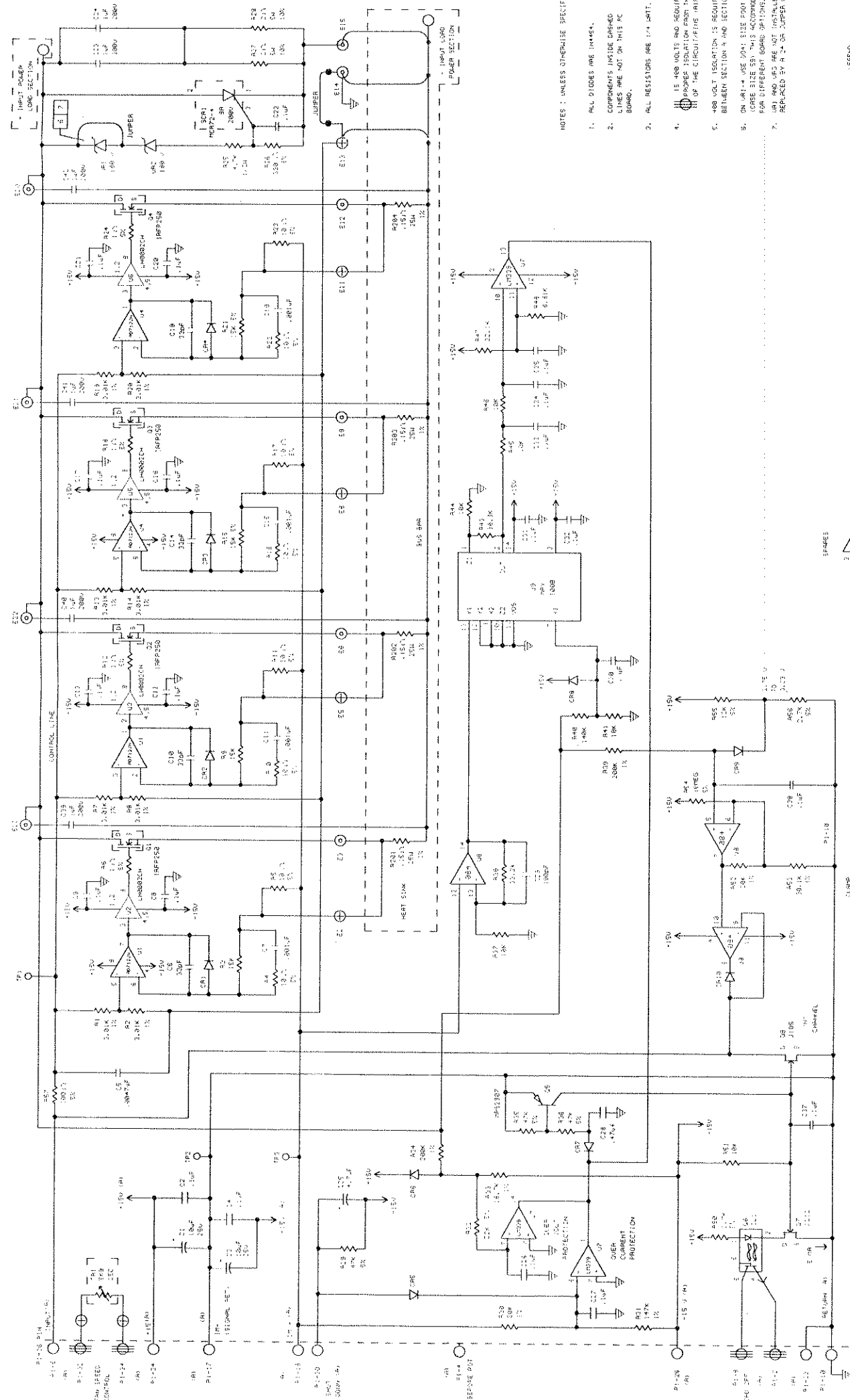
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0	11-8846	RELEASE	DRK	RS	04-23-92
1	33-8286	SEE ECO	WF	HE	11-22-95
2	33-8595	SEE ECO	D.P.	W.F.	9-29-97
3	33-8729	SEE ECO	D.P.	W.F.	2-17-98

<b>ANALOGIC</b>		PEABODY, MA. 01960	
2103A		ELECTRONIC LOAD FAMILY TREE	
DATE	04-03-92	DATE	04-10-92
CHECKED	DAN KEEFE	ENGINEER	P. SHIPPEN
DESIGNED	R. ROSS	ENGINEERING MGR.	S. MARCOVIC
DATE	04-23-92	DATE	04-28-92
QUALITY CONTROL	G. RICHMOND	DATE	04-29-92
PRODUCTION	S. STREETER	DATE	04-24-92
WEIGHT		SCALE	NONE
FILE NAME	928303.SCH	SIZE	18100
REV	3	REV	3
SHEET	1 OF 1	SHEET	1 OF 1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ARE .0005	FINISH	APPLICABLE SPECIFICATIONS
PL10-25177	2103A	USED ON
NEXT ASSY		APPLICATION

LAST REF. DES. USED	REF. DES. NOT USED

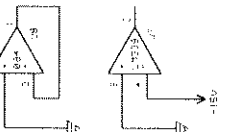
REV.	DATE	BY	CHKD.	APP.
1	10/15/74	J. J. ...		
2	11/15/74	J. J. ...		



- NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL DIODES ARE 1N4148.
  2. COMPONENTS INSIDE DASHED LINES ARE NOT ON THIS PCB BOARD.
  3. ALL RESISTORS ARE 1/4 WATT.
  4. IS 488 VOLTS AND REQUIRE POWER ISOLATION FROM THE REST OF THE CIRCUITRY WITH SW1.
  5. 488 VOLT ISOLATION IS REQUIRED BETWEEN SECTION A AND SECTION B.
  6. ON LANT-1 USE 20-1 SIZE FOOT PRINT FOR ALL COMPONENTS. DIFFERENCES FROM DIFFERENT BOARD REVISIONS WILL NOT BE NOTICED UNLESS REPAIRED BY A 20-1 JUMPER WIRE.

LEGEND

	NOT USED
	A+B
	C+B

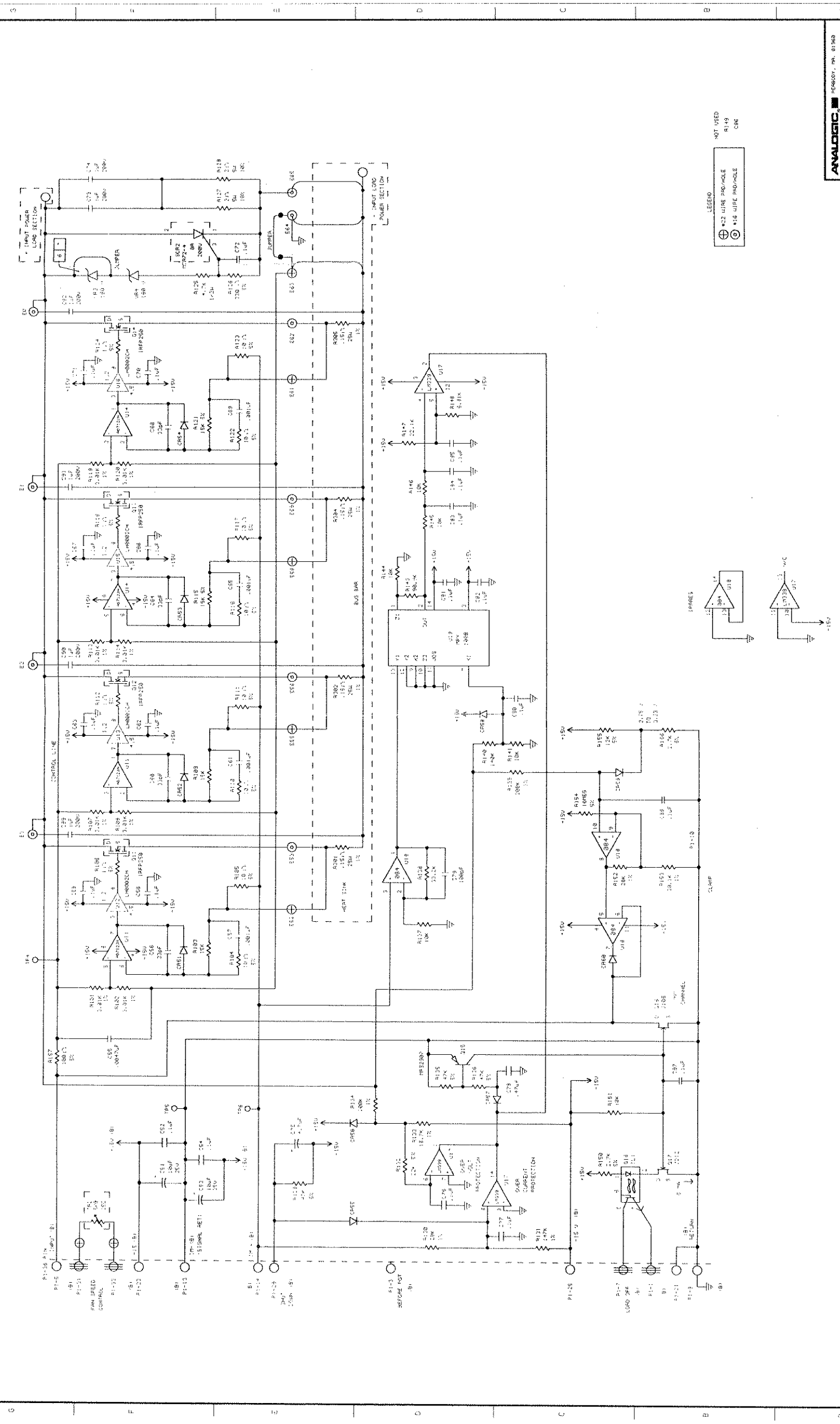


DESIGNER	J. J. ...
DATE	10/15/74
INTEGRATOR	
PROJECT	
REVISION	
USED ON	
APPLICATOR	

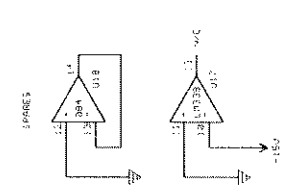
**ANALOGIC** PERSONAL, INC. 91589  
**SCHMATIC**  
**POWER LOAD CUBE**  
 (SECTION A)  
 (SECTION B)

REV. 1.0  
 DATE: 10/15/74  
 SHEET 1 OF 2

REVISIONS  
 1. ORIGINAL DESIGN  
 2. REVISED TO ADD OVER CURRENT PROTECTION  
 3. REVISED TO ADD CLAMP



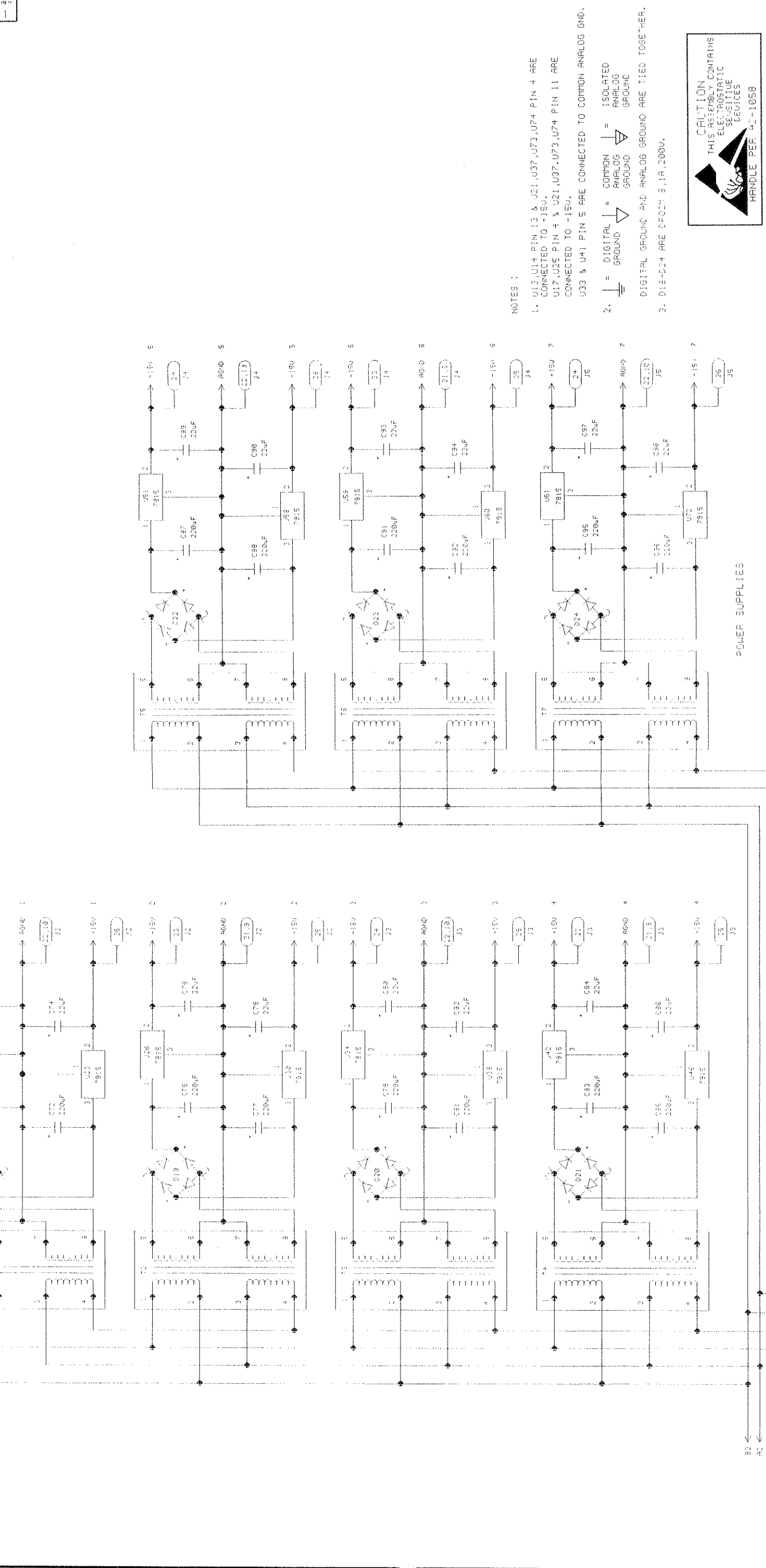
LEGEND  
 ⊕ NOT USED  
 ⊖ R119  
 ⊙ C8E





REV	DATE	DESCRIPTION	BY	CHKD
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2		REVISIONS		
3				
4				
5				
6				
7				
8				
9				
10				

ALL DIMENSIONS UNLESS SPECIFIED OTHERWISE SHALL BE IN INCHES.  
 DIMENSIONS SHOWN IN PARENTHESES ARE IN MILLIMETERS.  
 DIMENSIONS IN MILLIMETERS ARE GIVEN IN PARENTHESES.  
 DIMENSIONS IN MILLIMETERS ARE GIVEN IN PARENTHESES.  
 DIMENSIONS IN MILLIMETERS ARE GIVEN IN PARENTHESES.



- NOTES:
- U13, U14 PIN 13 & U21, U37, U73, U74 PIN 4 ARE CONNECTED TO +15V.  
 U17, U25 PIN 4 & U21, U37, U73, U74 PIN 11 ARE CONNECTED TO -15V.  
 U33 & U41 PIN 5 ARE CONNECTED TO COMMON ANALOG GND.
  - ↓ = DIGITAL GROUND  
 ▽ = COMMON ANALOG GROUND  
 ▽ = ISOLATED ANALOG GROUND  
 ▽ = ANALOG GROUND  
 ▽ = TIED TOGETHER.
  - D18-D24 ARE DF02N 5, 1A, 200V.

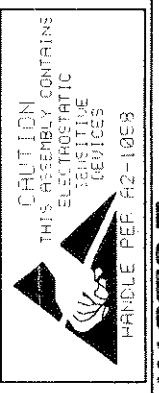
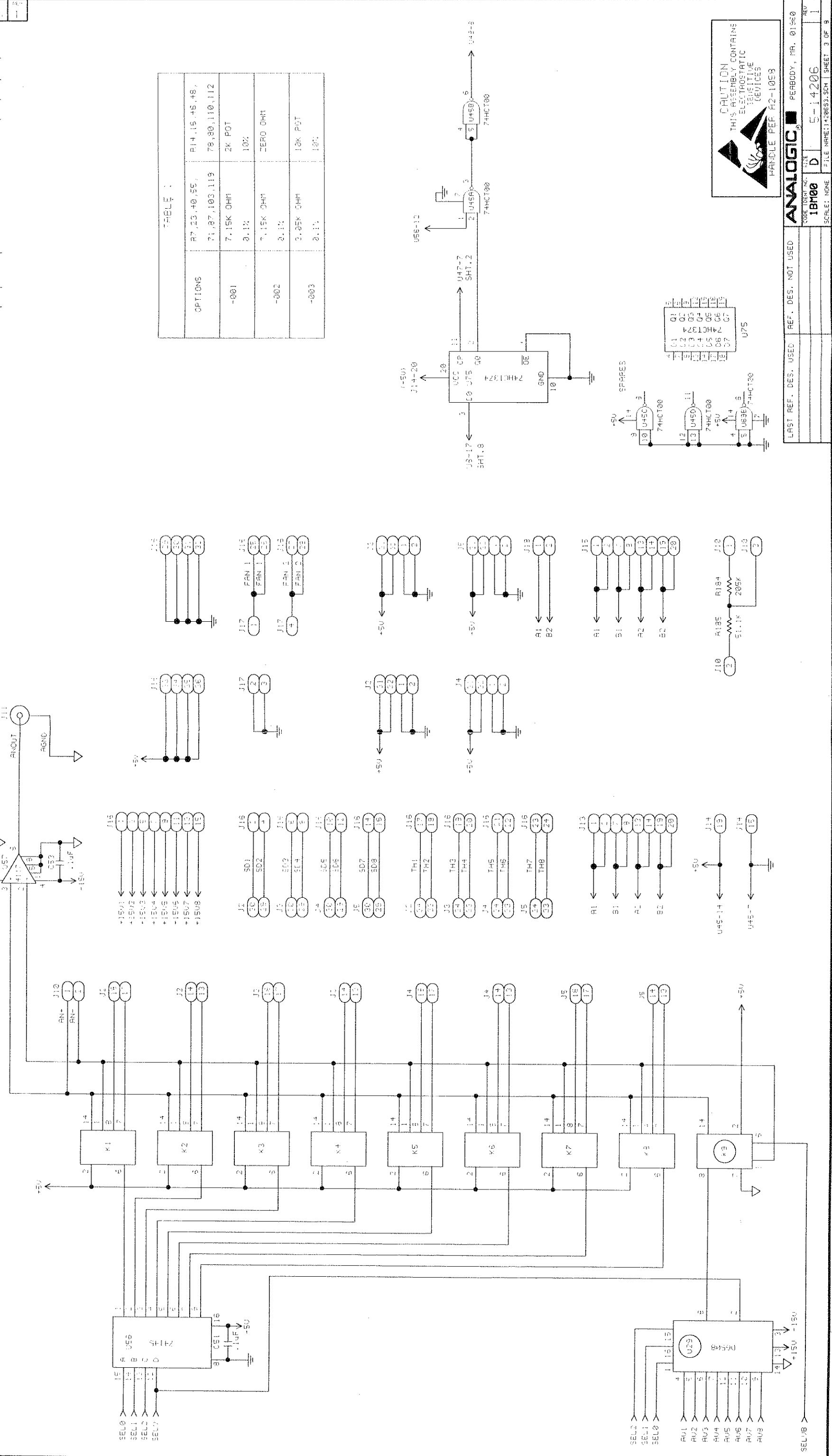
**CAUTION**  
 THIS ASSEMBLY CONTAINS  
 ELECTROSTATIC SENSITIVE  
 DEVICES  
 HANDLE PER AC-1058

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMALS ARE TO 0.005 FRACTIONS ARE TO 1/32		DATE: 7/21/97 DESIGNED BY: J. BELL DRAWN BY: J. BELL CHECKED BY: J. BELL IN CHARGE: J. BELL PROJECT: 2103A	ANALOGIC PERBODY, PA. 21360 SCHEMATIC 2103A MOTHERBOARD
LAST REV. DES. USED: REF. DES. NOT USED D18, D24, J19, J21 R105, R107, U75, R2 R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100, R101, R102, R103, R104, R105, R106, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R135, R136, R137, R138, R139, R140, R141, R142, R143, R144, R145, R146, R147, R148, R149, R150, R151, R152, R153, R154, R155, R156, R157, R158, R159, R160, R161, R162, R163, R164, R165, R166, R167, R168, R169, R170, R171, R172, R173, R174, R175, R176, R177, R178, R179, R180, R181, R182, R183, R184, R185, R186, R187, R188, R189, R190, R191, R192, 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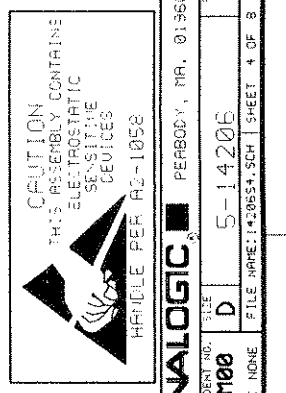
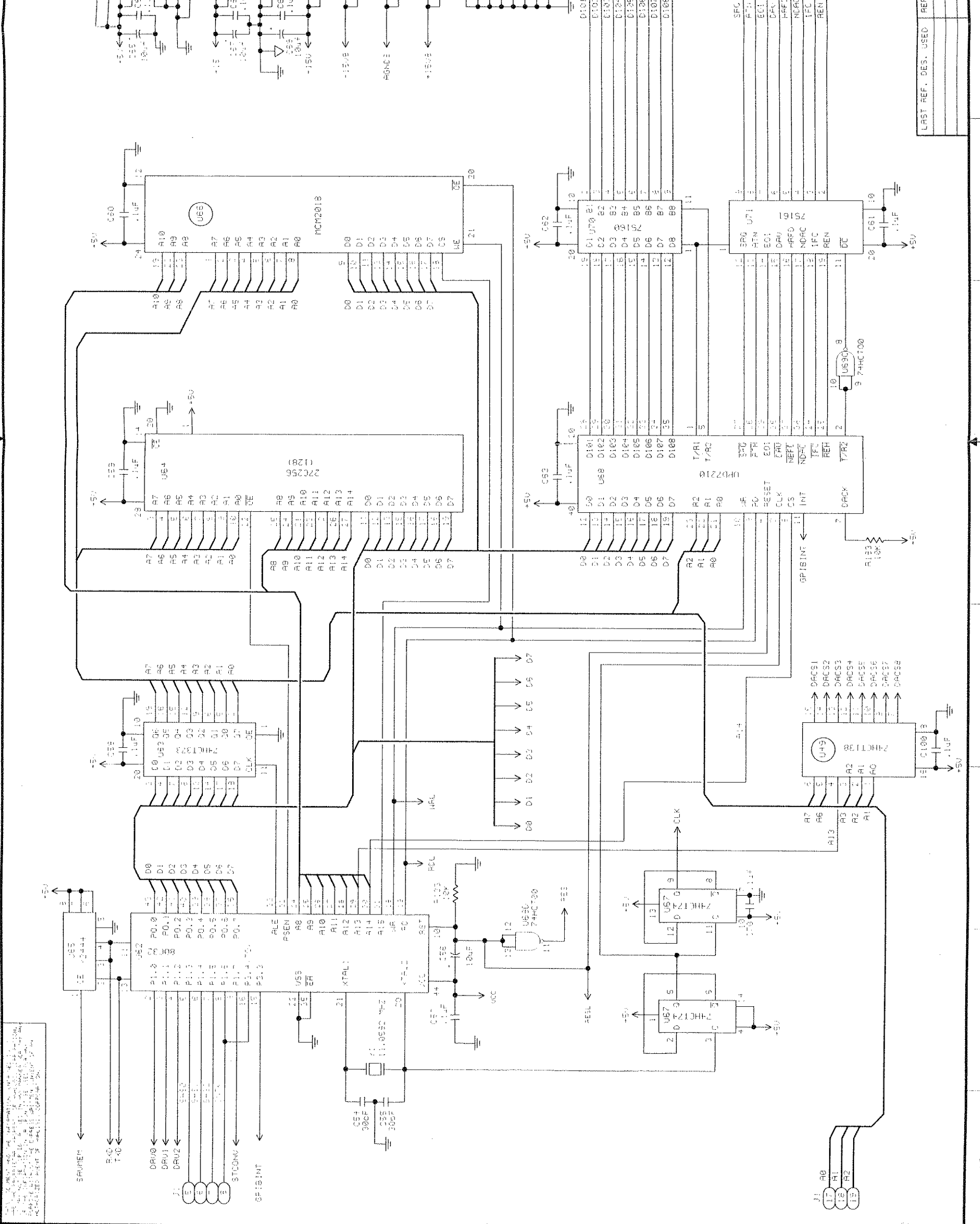
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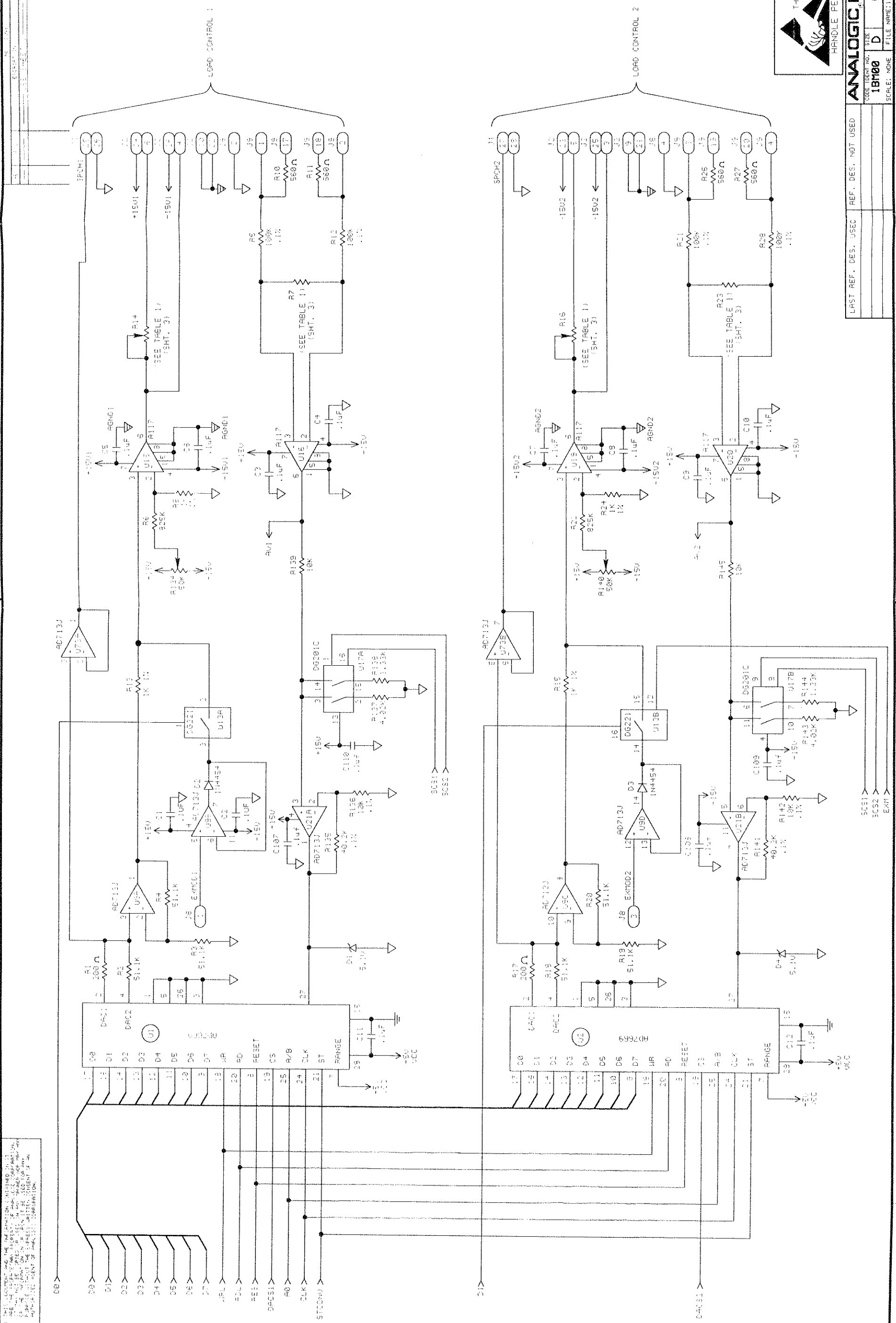
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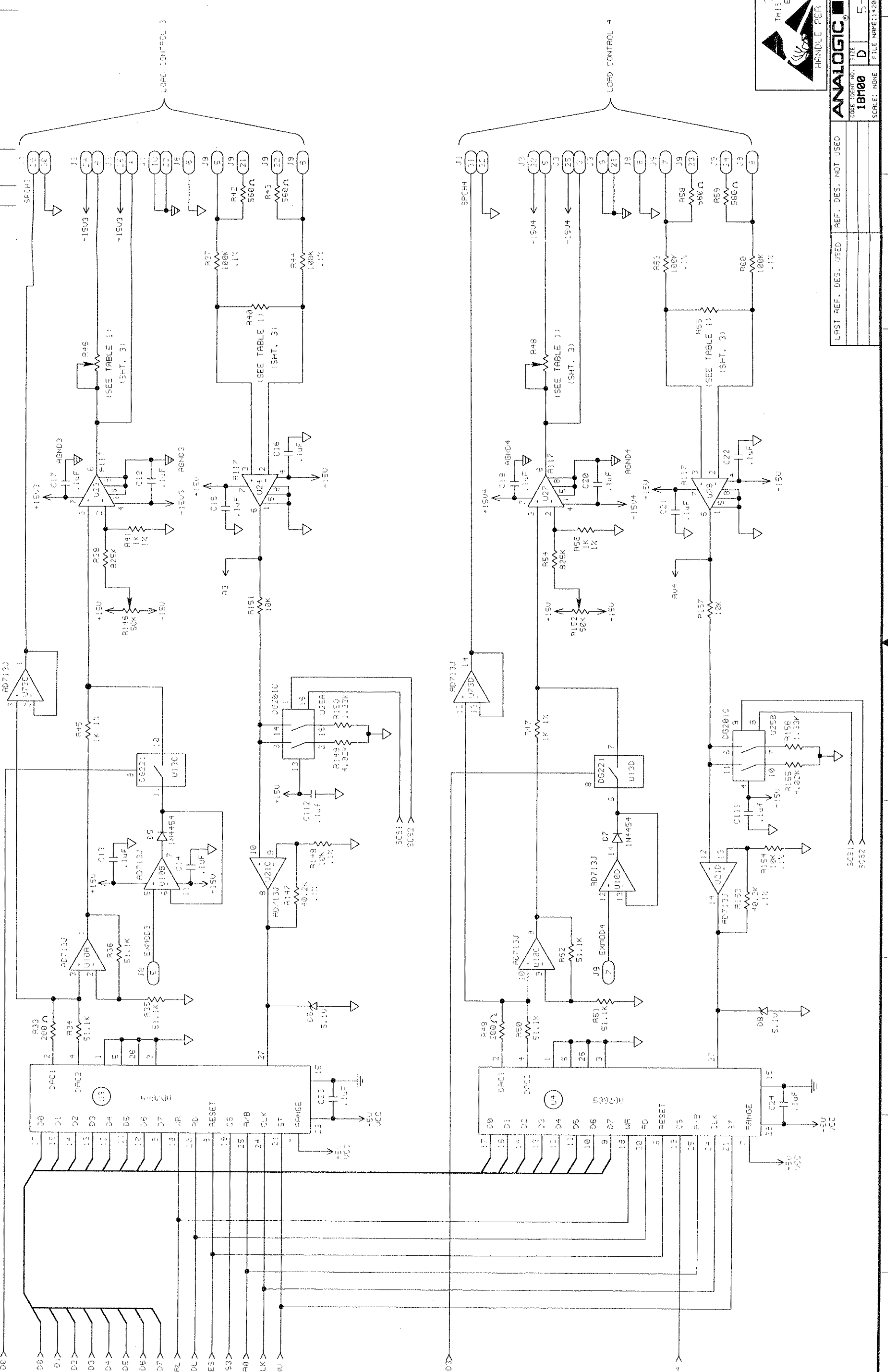
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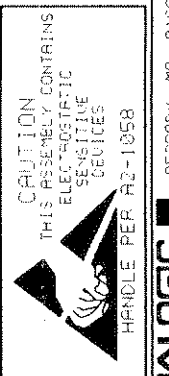
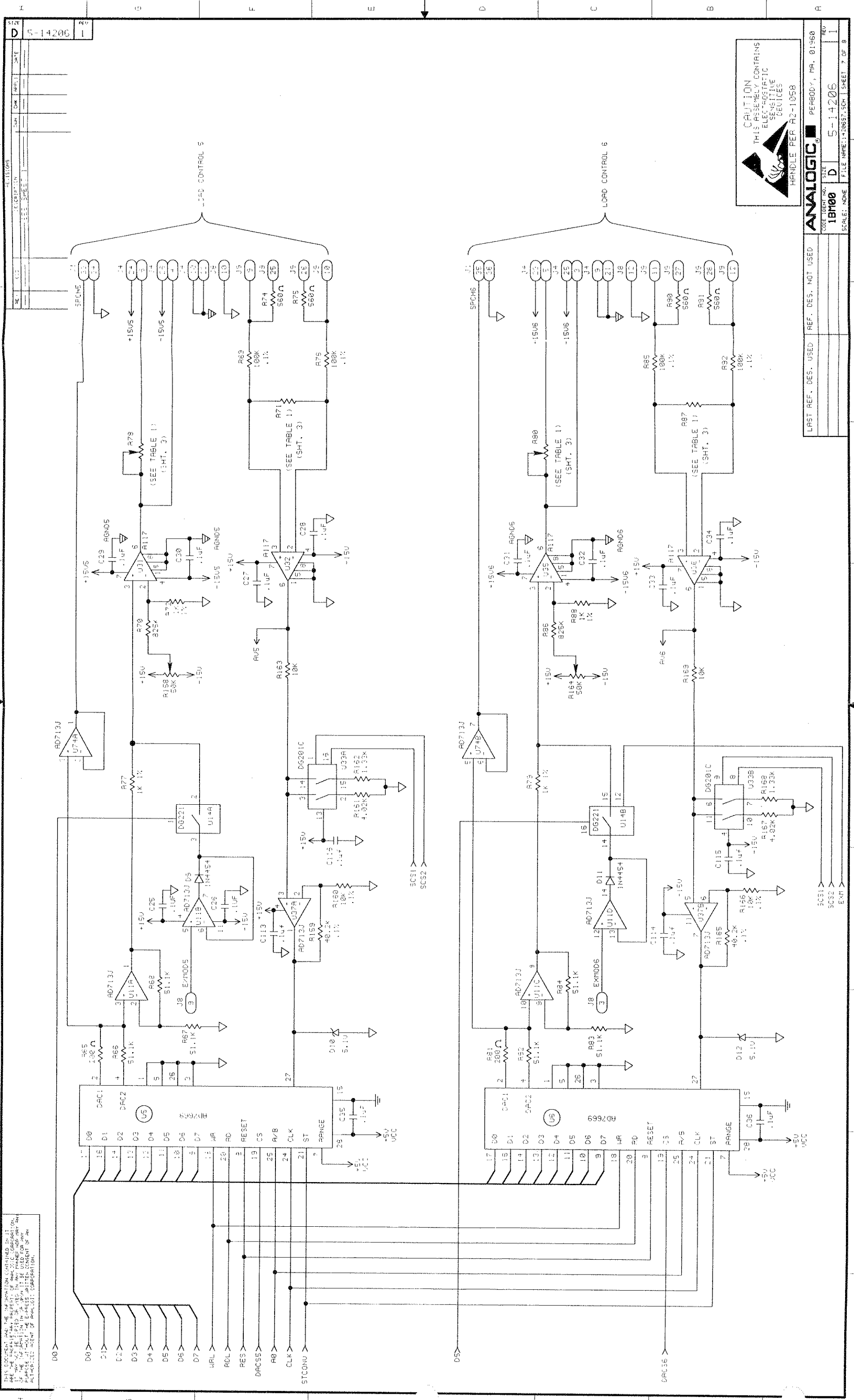


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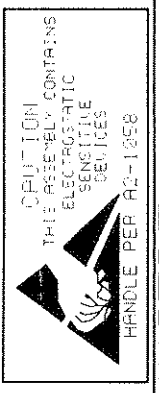
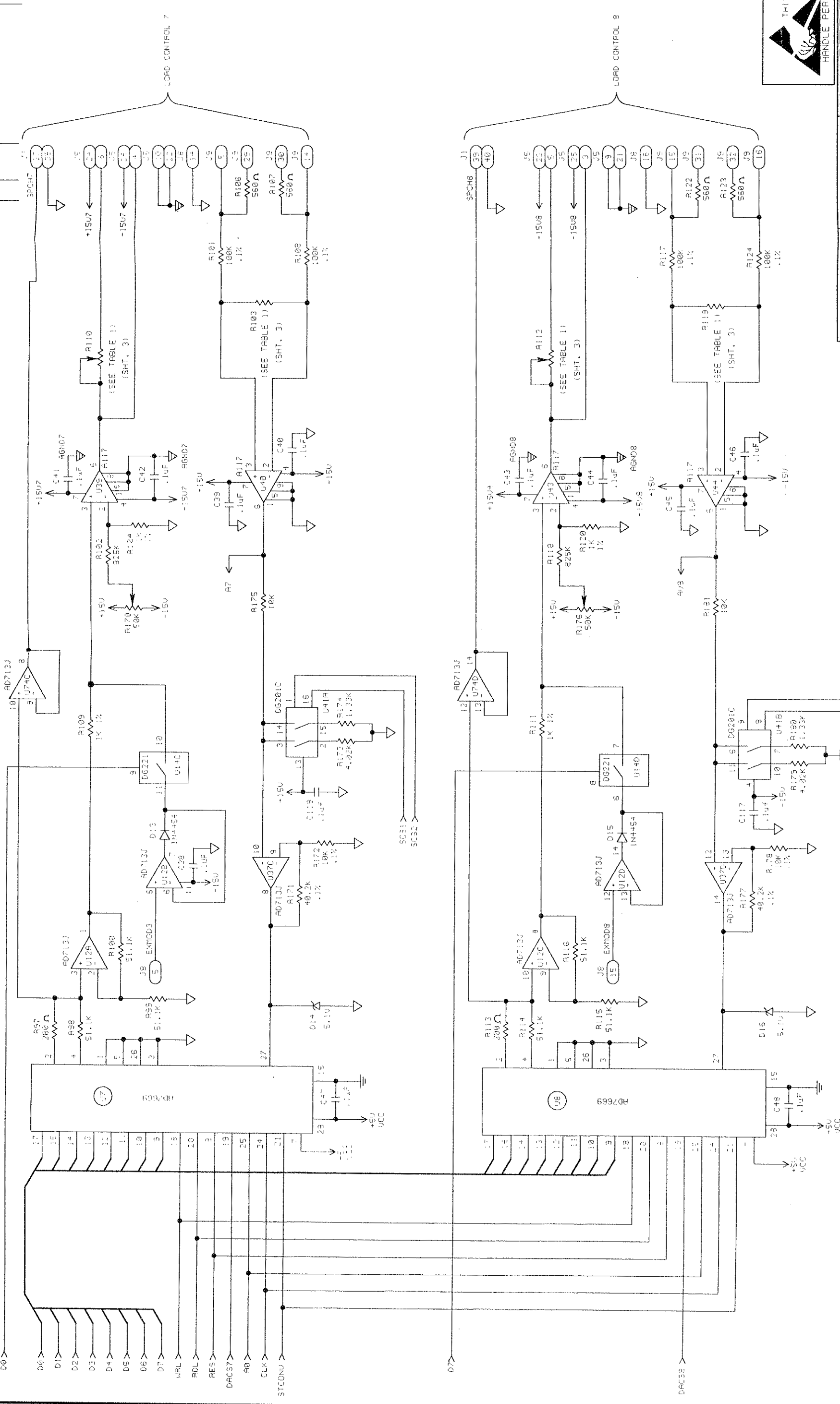
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