

SYS*STIM® 220
INTERFERENTIAL NEUROMUSCULAR STIMULATOR
MAINTENANCE MANUAL

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TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
Introduction	3
Precautions	4
Labels	5
Abbreviations	5
Limited Warranty	6
Equipment Description	7
Controls and Displays	9
Operating Instructions	14
Routine Maintenance	17
Fuse Replacement	17
Cleaning	17
Functional Troubleshooting	18
Theory of Operation	19
Sys*Stim 220 Test Procedure	23
Troubleshooting Guide	32
Specifications	33
Sys*Stim 220 Parts List	34
Drawings and Schematics	38

Introduction

This manual is intended to aid biomedical engineers and technicians in the servicing and repair of the Sys*Stim 220 interferential neuromuscular stimulator. It contains sufficient guidance to aid the technician in troubleshooting and repairing malfunctions.

This information is current as of publication. Mettler Electronics Corp. may make changes if and when they are considered necessary. To receive manual updates, send your name and address to:

Mettler Electronics Corp.
Manual Update List
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The ME220 is an interferential neuromuscular stimulator providing amplitude modulated and premodulated operating modes controlled by a membrane control panel.

In the premodulated mode, interferential currents can be premodulated for output to one or two channels for two pad treatments and made to reciprocate between the two channels. In the amplitude modulated mode, the treatment field rotates to effectively increase the area being treated by the interferential currents.

Bright digital displays show treatment time and output intensity. Both channel outputs are displayed simultaneously on the LED display. A dual control knob is used to adjust the intensity of either channel separately or both together.

Operating instructions in this manual are keyed to illustrations. If the operational characteristics of a particular membrane panel section are desired, go to that portion of the instructions where that section is pictured and fully described.

If you need further assistance, call Mettler Electronics Corp. Service Department toll free at (800)854-9305 or (714)533-2221.

PRECAUTIONS

1. DISCONNECT THE LINE SUPPLY CORD PRIOR TO DISASSEMBLY OF THE UNIT.
2. Servicing should be performed by qualified technicians using recommended calibrated test and measurement equipment.
3. The ME220 should be plugged into a grounded wall outlet only to preserve protection against electric shock hazards.
4. Adhere to standard safety practices for troubleshooting and servicing medical electronic equipment.
5. To insure compliance with performance specifications and applicable safety standards, the ME220 should be performance checked and safety tested at least once each year.
6. USE OF CONTROLS OR ADJUSTMENTS, OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN, AND IN THE ME220 INSTRUCTION MANUAL, MAY RESULT IN HAZARDOUS EXPOSURE TO ELECTRICAL ENERGY.
7. Do not operate the ME220 in close proximity with operating shortwave or microwave diathermies.
8. Replace line fuses with the same type and rating as specified in the list of specifications to avoid risk of fire and other component damage.
9. Primary circuit components must be replaced with factory-specified components to insure continued compliance with the UL-544 standard for medical and dental equipment.

LABELS

1. The Food and Drug Administration requires that medical devices be uniquely identifiable. This is accomplished on the Sys*Stim 220 with serial number labels unique to each product.
2. Care should be taken to preserve the integrity of the serialized labels, especially during servicing and repair when such actions as removing access covers could damage the labels.
3. Include applicable serial numbers when requesting service assistance.

ABBREVIATIONS

AC	-	alternating current
BPS	-	beats per second
DB	-	display board
DC	-	direct current
DVM	-	digital voltmeter
Hz	-	hertz (cycles per second)
kohm	-	Kilo-ohm (1000 ohms)
LG1	-	logic one board
LG2	-	logic two board
mA	-	milliamperes (1/1000 ampere)
msec	-	millisecond (1/1000 second)
mW	-	milliwatt (1/1000 watt)
usec	-	microsecond (1/1,000,000 second)
Vdc	-	voltage Direct Current
Vac	-	voltage Alternating Current
W	-	watts

LIMITED WARRANTY

The Sys*Stim 220 is warranted against defects in materials and workmanship for a period of two years from date of purchase. During the applicable warranty period Mettler Electronics Corp. will, at its discretion, either repair or replace the Product without charge for these types of defects.

For service under this warranty, the Product must be returned by the buyer within the applicable warranty period to Mettler Electronics Corp. Shipping charges to and from Mettler Electronics Corp. under this warranty must be paid by the buyer. The buyer must also include a copy of the sales receipt or other proof of the date of purchase. If the Product is returned without proof of the date of purchase, it will be serviced as an out-of-warranty product at Mettler Electronics Corp.'s prevailing service rates.

Alteration, misuse, or neglect of the Product voids this warranty. Except as specifically set forth above, Mettler Electronics Corp. makes no warranties, express or implied, including without limitation any implied warranty of merchantability or fitness for a particular purpose, with respect to the Product. If any implied warranties apply as a matter of law, they are limited in duration to one year.

Mettler Electronics Corp. shall not be liable for any indirect, special, consequential or incidental damages resulting from any defect in or use of the Product.

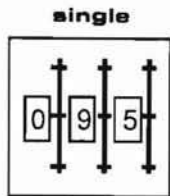
Any legal action brought by the buyer relating to this warranty must be commenced within one year from the date any claim arises and must be brought only in the state or federal courts located in Orange County, California.

Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to the buyer. This warranty gives the buyer specific legal rights, and the buyer may also have other rights which vary from state to state.

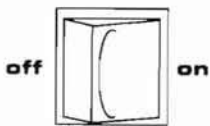
EQUIPMENT DESCRIPTION

1. The Sys*Stim 220 is a portable, solid state, digital, dual channel, interferential neuromuscular stimulator that offers a choice of four frequency modulation modes for each of two operational modes.
2. The injection molded ABS plastic enclosure is divided into two halves, a front half and a back half. Electronics circuitry and indicator subassemblies are assembled into the front half. The back half provides a protective cover and base that is removed by means of four phillips head screws.
3. There are four printed circuit boards in the ME220: RFI, Display, Logic 1 and Logic 2. The RFI board is a small pcb consisting of two line fuses and a line filter. The display and logic boards contain most of the operating and power supply circuits. Each of these subassemblies is described later in the Theory of Operation section.
4. The membrane control panel incorporates graphics, circuitry, switches and connector into one replaceable component.
5. Displays consisting of 7-segment light emitting diodes (LED's), green LED mode indicators, and an audible signal indicate control operation, end of treatment time and certain error conditions are explained later.

time
 05.00
 min sec



beat frequency selector



power

intensity
 1 12 13 2
 milliamps

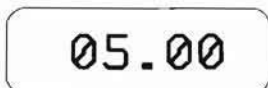
0-15 bps
 80-150 bps
 0-250 bps
 7 sec. fast freq. sweep
 $\frac{am (l)}{r (b)}$ amp. mod. (l) recip. (b)
 bi polar (on) interfer. (off)
 f single freq. select

1 channel 1+2 push 2
 min max

intensity

CONTROL AND DISPLAY PANEL

CONTROLS AND DISPLAYS

A rectangular digital display showing the number 05.00. The digits are in a simple, blocky font. The display is divided into two sections by a vertical line: the left section shows '05' and the right section shows '00'.

min sec

Time Display



Up Down arrows



GO Switch



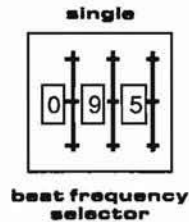
HOLD Switch



RESET switch

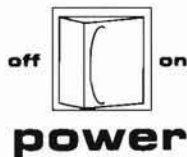
1. The time display shows minutes and seconds. The format for the display is 00.00.
2. Up and down arrows located immediately below the time display allow the operator to select the desired treatment time. Time will increment in one minute steps when the switch is depressed momentarily. Holding the switch down will rapidly increment the time.
3. The "Go" switch allows the operator to begin treatment when intensity controls are fully counterclockwise.
4. The "Hold" switch suspends treatment without altering the desired treatment parameters or time. Intensity must be to zero before "Go" is pressed once again.
5. The "Reset" switch returns the time display to zero and clears all previously set parameters. It will also stop treatment and reset parameters if pressed during "Go".

6. The "Single Frequency Selector" thumbwheel switches control the input of a single beat frequency when the "single freq. select" switch is activated. Beat frequencies from 1-299 bps may be selected.



Single Frequency Selector

7. The Main Power Switch is a rocker switch which, if depressed to the right, applies power to the unit.



Main Power switch

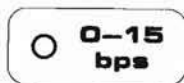
8. The intensity display shows the output of both Channels 1 and 2 simultaneously in milliamps.



Intensity Display

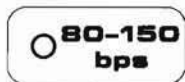
When the following mode selector switches are activated, indicator lights to the left of each switch will be lit.

9. The "0-15" switch activates a beat frequency sweep of 0-15 bps. A normal sweep cycle from 15 to 0 bps and back to 15 bps takes 14 sec. When selected, the switches which control the fast frequency sweep, amplitude modulation/recip. and bipolar modes may also be activated.



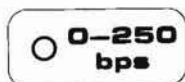
"0-15" switch

10. The "80-150" switch activates a beat frequency sweep of 80-150 bps. A normal sweep cycle from 150 to 80 bps and back to 150 bps takes 14 sec. When selected, the switches which control the fast freq. sweep, amplitude modulation/recip. and bipolar modes may also be activated.



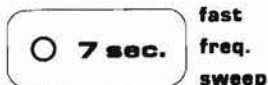
"80-150" switch

11. The "0-250" switch activates a beat frequency sweep of 0-250 bps. A normal sweep cycle from 250 to 0 bps and back to 250 bps takes 14 sec. When selected, the switches which control the fast sweep, amplitude modulation/recip. and bipolar modes may also be activated.



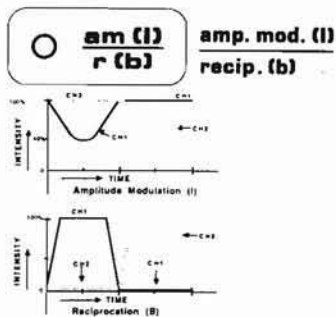
"0-250" switch

12. The switch "7 sec", labeled fast freq. sweep, activates a frequency sweep twice as fast, seven seconds, as the normal frequency sweep of 14 seconds. It cannot be selected when "Single Frequency Select" is being used.



7 sec switch

13. When selected this switch will either modulate the amplitude to 40% of the set intensity and back alternately in each channel in the interferential mode, or a four second reciprocation of each channel occurs in the bipolar mode. In each case the intensity displays will indicate the output intensity of each channel as they change.



Amp. mod. (I)/recip. (b) switch

14. This switch allows the operator to treat a patient using only two electrodes. The stimulation currents are premodulated to create a beat frequency so that only two pads are required for treatment. Example: The carrier frequency of 4000 Hz is mixed with another frequency of 4100 Hz, the output beat frequency is 100 bps. The output is available on both channels. When this switch is not selected the Sys*Stim 220 is in the interferential mode. Channel two always has a frequency of 4000 Hz, while channel one has a frequency that varies from 4001-4299 Hz, depending on the beat frequency settings described above. Four pads must be used for interferential therapy.



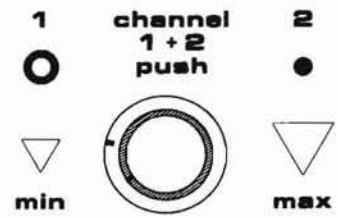
Bipolar (on)/Interfer. (off) switch

15. The single freq. select switch activates the thumbwheel switches which allow selection of a single treatment beat frequency. Only the switches used for amplitude modulation/recip. and bipolar stimulation may be used when this option is selected. (See 13 and 14)



Single freq. select switch

16. The Intensity control knobs allow the operator to adjust the intensity of both channels either simultaneously by pressing down on the top knob to rotate both knobs simultaneously or singly. The lower knob adjusts the intensity for Channel 1 and the upper knob adjusts the intensity for Channel 2. Both channels must be rotated fully counter-clockwise to reset the intensity to zero in order to initiate treatment by pressing

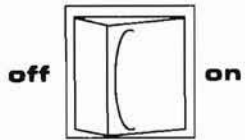


intensity

Intensity control

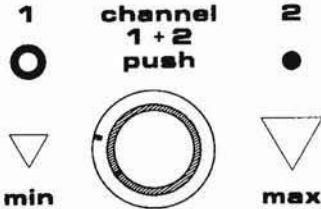
"Go". It should be noted that the intensity controls control the stimulation voltage at the unit terminals. The meter reading in mA will change and the stimulation current changes as the patient/pad/cord loop resistance changes without a change in the intensity control position.

OPERATING INSTRUCTIONS



power

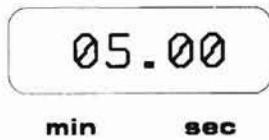
Main Power Switch



intensity

Intensity Controls

time



Up Down Arrows



BEAT FREQ.
100 BPS

1. Turn on the main power switch.

2. Adjust both intensity controls fully counter-clockwise which is minimum intensity.

3. Select the desired treatment time using the up/down arrows located below the "Time Display". Briefly pressing an up or down arrow will increment the time up or down one minute. Holding down the button will rapidly increment the time up or down in one minute intervals. The maximum time which can be entered is 59 minutes. Verify the input time by observing time display. NOTE: It is not necessary to input time in order to operate the Sys*Stim 220. If an indefinite time is desired, initiate operation by pressing "Go" without entering a preset time.

4. Select the treatment type. No choice here will automatically choose the interferential, 2 channel treatment type. (Channel 2 = 4000 Hz, Channel 1 = 4000-4299 Hz, see electrode placement #9). If the bipolar/pre-modulated button is pressed, the currents will be premixed in the unit and



Beat Freq.
100 BPS

0-15
bps

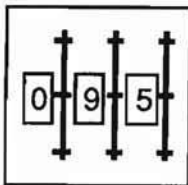
80-150
bps

0-250
bps

f single
freq.
select

7 sec. fast
freq.
sweep

single



beat frequency
selector

each channel will supply a pre-modulated beat frequency of 0-299 bps.

5. Select one of the three preset beat frequency sweep modes by pressing any one of the following: (NOTE: normal sweep cycle time = 14 sec.)

0 - 15 bps

80 - 150 bps

0 - 250 bps

or

select a single treatment frequency by pressing "Single Frequency Select".

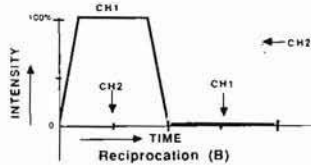
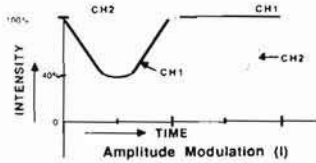
6. If you select a beat frequency sweep range, the normal time to complete an entire sweep cycle is approximately 14 seconds. Press "7 sec" for a more aggressive sweep cycle time of 7 seconds. Example: The sweep cycle for "0-15" is from 15 bps to 0 bps and back to 15 bps.

7. If you select "single frequency select", dial in the desired treatment beat frequency by using the "Single Beat Frequency Selector" thumbwheel switches. The beat frequency range is 0-299 bps.

8. Press this switch to modulate the amplitude to 40% in each channel alternately when in the interferential mode. A sensation of movement of the stimulation is experienced by the patient when in this mode.

Activation of this switch in

$\frac{am (l)}{r (b)}$ amp. mod. (l)
 recip. (b)



bipolar mode will reciprocate the bipolar stimulus between Channels one and two. Each channel will be on for approximately four seconds during each cycle.

In each case the intensity displays will dynamically indicate the output intensity of each channel.

- Install 2 dummy loads. (1K ohm)



- Press GO (both intensity controls must be fully counterclockwise).

intensity
1 **2**
milliamps

- Adjust the output intensity to the desired level using the dual intensity control knob. By pressing down gently on the upper control knob both controls will rotate simultaneously. In order to adjust Channel one, rotate the lower control knob. Channel two is adjusted by rotating the upper control knob. The intensity for both channels will be displayed in milliamps.



- If any program changes are desired, except intensity adjustments, press "Hold" to suspend treatment. Reset the intensity by rotating both intensity controls fully counter-clockwise before pressing "GO" to reinitiate treatment.

- When the treatment time has elapsed, the buzzer will sound, the time and intensity displays will display "0" and the electrical output will stop.

ROUTINE MAINTENANCE

1. The Sys*Stim 220 can be cleaned with a damp cloth. The power cord should be disconnected from the wall before this is done. In the case of stubborn dirt a gentle household cleaner can be sprayed on the cloth and then wiped on the unit. If this method is used, remove any cleaner residue with a damp cloth.
2. The Sys*Stim 220 and electrode cables are not autoclavable.
3. Replace the electrodes and cables upon any sign of wear, tear or corrosion to ensure proper operation of the device.
4. Standard medical electrical safety checks should be performed on an annual basis by qualified biomedical engineers or technicians trained to perform these procedures.

FUSE REPLACEMENT

Two line fuses are used in the Sys*Stim 220. They are located on the RFI filter board. Fuse replacement requires removal of the back enclosure. Use only the same fuse type and rating for replacement to protect against fire hazard.

If it becomes necessary to replace line fuses, the unit should be checked per maintenance manual procedures prior to placing it back in service.

CLEANING

To clean the molded plastic enclosure of the Sys*Stim 220, use a mild detergent with a damp soft cloth. Use of any other cleaning agent or solvent is not recommended.

FUNCTIONAL TROUBLESHOOTING

<u>Symptom</u>	<u>Action Check</u>
1. Nothing lights when the main power switch is turned on.	Is the line cord connected to outlet? Fuse blown?
2. When "Go" is pressed, nothing happens: time does not increment up or down, intensity cannot be adjusted, and the patient does not feel the stimulus.	Preset the intensity by rotating both intensity controls fully counter-clockwise. Press "Go" again to initiate treatment.
3. When "Go" is pressed, time increments up or down, but intensity cannot be adjusted and the patient does not feel the stimulus.	Make sure electrode cables are connected to the Sys*Stim 220 and connected to the patient via electrodes. NOTE: If the electrodes are not adhered to the skin, adjust the intensity to zero before attempting to reapply.
4. During operation, previously selected treatment parameters cannot be changed.	This is a normal operational safety feature of the Sys*Stim 220. Only the amplitude modulation/recip selector may be activated or deactivated during treatment and the intensity controls may be adjusted during treatment. No other controls or modes may be changed during treatment.
5. Unit turns off during treatment with high intensities.	If current values increase to a level in the range of 75 to 90 mA due to a reduced load resistance, stimulation currents are stopped. To reset unit and resume treatment, remove electrodes from patient, turn unit off and then on again, reprogram unit, reapply electrodes and resume. Current shut off is between 75-90 mA.
6. After "Go" with timer counting down and intensity turned up no output is felt on the patient and no meter reading.	Check the cords and pads for open or high resistance.

THEORY OF OPERATION

1. RFI Board

The line power cord attaches directly to the RFI board. This board provides radio frequency interference filtering to meet FCC requirements. A twin inductor and parallel capacitors provide the filtering. Power is then passed to the main power switch after passing through F1 and F2 (1 amp line fuses).

2. Main Power Switch

Primary power is switched through the main power switch with both hot and neutral being switched and passed to the primary of the power transformer.

3. Primary Transformer and Rectifiers

Primary power is passed through the primary side of the heat fused multi-secondary power transformer. The output from this transformer are rectified and provide the unregulated +5 Vdc, +12 Vdc, and +32 Vdc supplies. All but the +32 Vdc supply are sent to four regulators.

4. Regulators

Two regulators provide the +5 Vdc supply to the display board circuits and the +8 Vdc to the CMOS gates and analog section of LG1.

The +32 Vdc supply provides the primary voltage of the output amplifier for patient output potential.

5. Logic One (LG1) Circuits

a. Keyboard Switches

The multi-key membrane control panel is connected via an 18 pin cable to internal circuits. The keys are strobed to sense closure. (See schematic for signal paths.)

b. Display Board (DB) Circuits

The display board, mounted in the front enclosure, provides timer, power, and LED indication of system operations. The LED's are latched by the same circuitry used for the membrane keys. Up/Down strobe features are accomplished through U15-U18 & U30 feeding U1 with initial treatment time.

U1 drives the 4 digit Time Display. Additional features such as GO, HOLD and RESET are signals latched directly from the membrane switches and then fed to U1.

U2-U6 & U31 provide an A to D function displaying the amount of RMS current being supplied to each channel during treatment.

c. Modulation Modes (Refer to sheets 2 & 3 of the LG1 schematic)

There are three selectable sweep frequencies: 0-15 Hz, 80-150 Hz and 0-250 Hz. A Manual Frequency Select provides a nonvarying modulation from 0-299 Hz.

When one of the four modulation options is selected via the membrane control panel, U52 latches it. U53 and U52 insure the four options are mutually exclusive.

The three sweep options have corresponding resistor/capacitor networks which determine the frequency at U41. These networks insure that one complete sweep, high limit to low and back to high, takes 14 seconds (+1 second). Fast sweep, when selected, decreases the capacitance in the networks decreasing the sweep time to 7 seconds (+1 second).

Prior to entering GO, register U13,U16,U18 are loaded with the upper limit of the selected modulation option. Upon entering GO the registers begin counting down unless in the SELECT mode. Once the lower limit is reached, circuitry associated with U35 will cause register U13,16,18 to count up. Each time the upper or lower limit is reached the UP/DOWN input of the registers is toggled. This cycle continues until RESET or HOLD is selected.

When in the MANUAL mode the modulation frequency is loaded into registers U13,16,18 via the front panel Manual Frequency Select thumbwheel switch.

d. Operational Modes

Interferential and bipolar (premodulation) modes are available to user. The unit is automatically in interferential upon power up; and can enter bipolar when selected. Both modes primarily use phase locked loops and function generators to provide a base frequency of 4 kHz on channel 2 and a modulation frequency on channel 1. (4 kHz, plus the contents of register U13,16,18 as discussed in 5.c.)

The difference between the modes is defined by where mixing of these two frequencies (4 kHz and modulation)

occur. In interferential it occurs between channels 1 and 2 electrodes at the treatment area, in bipolar the two frequencies are mixed at U37 (see sheet 5 of the LG1 schematic). The resultant frequency is 4 kHz 100% modulated by the contents of registers U13,16,18.

e. Amplitude Modulate/Reciprocate

Amplitude modulation occurs when selected only in the interferential mode. Each channel is amplitude modulated to 40% alternately each 4 seconds.

Reciprocal operation occurs when selected only in the Bi-Polar mode. Each channel is alternately on for approximately 4 seconds.

In both amplitude and reciprocal operation, the intensity displays indicate the output intensity dynamically for each channel. Both functions use a sawtooth waveform through switching networks to control attenuation of channels 1 and 2 at U50 and U60. U36 controls use the 4 second switching between channels.

f. Intensity Control

The dual intensity control knobs are mounted on a dual 25 kohm concentric potentiometer. The output signals from U50 and U60 discussed in 5.e. above are fed directly to the potentiometer and then back to LG1 via J2.

g. Output Stage

Each channel has a buffer to drive U19 (output amplifier), thereby maintaining signal integrity. U19 is a dual 8-watt audio amplifier. Its output is sent to LG2 via J7.

h. Safety

Both intensity knobs must be set to minimum, completely counterclockwise (ccw), before entering GO. U46 detects and amplifies whenever either intensity knob is not fully ccw (RESET). This signal ("safety"), when high, turns on Q100, inhibiting the GO function. With both intensity knobs at RESET, upon selecting GO relay K1 on LG2 engages, connecting the U19 outputs to channel 1 and 2 output jacks on the front panel.

i. Logic Two (LG2) Circuits

LG2 is primarily a "passive" board consisting of isolation transformers, sense circuits for analog to digital conversion for the milliamp readouts, and output inductors to eliminate RF interference. The

outputs of U19 pass through LG2 to channel 1 and output jacks. LG2 also has overcurrent protection accomplished via U1.

Sys*Stim 220 TEST PROCEDURE

EQUIPMENT REQUIRED

1. 15 MHz oscilloscope
2. DVM
3. Two 1 kohm, 10 W loads
4. Frequency counter
5. One 2 kohm, 4 W load (two 1 kohm resistors in series)

REFERENCE DRAWINGS

1. ME220 Membrane Switch Sys*Stim Interferential (14000)
2. Logic 1 Board Assembly (14003)
3. Logic 2 Board Assembly (14005)
4. Display Board Assembly (14007)
5. ME220 Schematic Logic 1 (14090)
6. ME220 Schematic Logic 2 (14091)
7. ME220 Schematic Display Board (14092)
8. ME220 Block Diagram (14093)

PROCEDURE

- 1.0 Visual Inspection.
 - 1.1 Examine logic pcb 1 (LG1), logic pcb 2 (LG2), and display pcb for discrepancies such as reversed diodes, IC's and capacitors, missing components, bad solder joints, solder splashes, etc.
 - 1.2 Repair as needed before applying primary power.
- 2.0 Power Supply.
 - 2.1 Verify the following are greater than 1 kohm with respect to ground:

U19.11	U59.1	U59.3	U58.3
--------	-------	-------	-------
 - 2.2 Remove all cables and connections from LG1 except J4. Jumper J1.22 to ground.

2.3 Turn unit on and verify the following with respect to ground:

U19.11	+28.0 Vdc	± 4.0
U59.1	+14.0 Vdc	± 2.0
U10.16	+ 8.0 Vdc	± 0.16
J1.1	+ 5.0 Vdc	± 0.20
J1.2	+ 5.0 Vdc	± 0.20
U46.14	+ 4.0 Vdc	± 0.16

3.0 Preliminary Test/Calibration.

3.1 Manual frequency.

3.1.1 Connect thumbwheel flex cable to J6 LG1.

3.1.2 Connect membrane switch panel to J5 LG1.

3.1.3 Turn unit on.

3.1.4 Press Manual Freq. Select on membrane panel.

3.1.5 Dial 000 on the thumbwheel and observe a squarewave at U10.14. Measure this frequency and record for future reference. The frequency must be 4000 Hz, ± 4 Hz. (Base frequency.)

3.1.6 Check frequency at each position on the following chart.

THUMBWHEEL

VERIFY AT U10.14

177

Base frequency + 177 Hz

288

Base frequency + 288 Hz

3.1.7 Verify that maximum count available on thumbwheel is 299.

3.2 Sinewave Generator.

3.2.1 Dial 100 on thumbwheel.

3.2.2 Adjust R92 fully clockwise. (NOTE: If R92 & 94 are fixed resistors, then simply adjust R93 & 95 for 1.0 Vpp, then verify that step 3.2.7 passes).

3.2.3 Adjust R93 for 2 Vpp sawtooth at U47.2.

3.2.4 Adjust R92 for sinewave with minimum distortion at U47.2. Signal should be 1 Vpp. If needed, readjust R93 for proper amplitude.

3.2.5 Adjust R94 fully clockwise.

3.2.6 Adjust R95 for 2 Vpp sawtooth at U48.2.

- 3.2.7 Adjust R94 for sinewave with minimum distortion at U48.2. Signal should be 1 Vpp. If needed, readjust R95 for proper amplitude. (NOTE: It is crucial that U47.2 and U48.2 are the same amplitude, 1.0 Vpp.)
- 3.2.8 Verify U37.1 is the base frequency modulated by 100 Hz, 100% modulation (maximum amplitude 1.0 Vpp \pm .1V). (See Fig. 415-1A) Sync. on U51.12 if needed.

3.3 Channel timing.

- 3.3.1 Verify squarewave at U36.13 per Figure 415-1D.
- 3.3.2 Turn power off.

3.4 Front panel functions.

- 3.4.1 Connect the following cables:

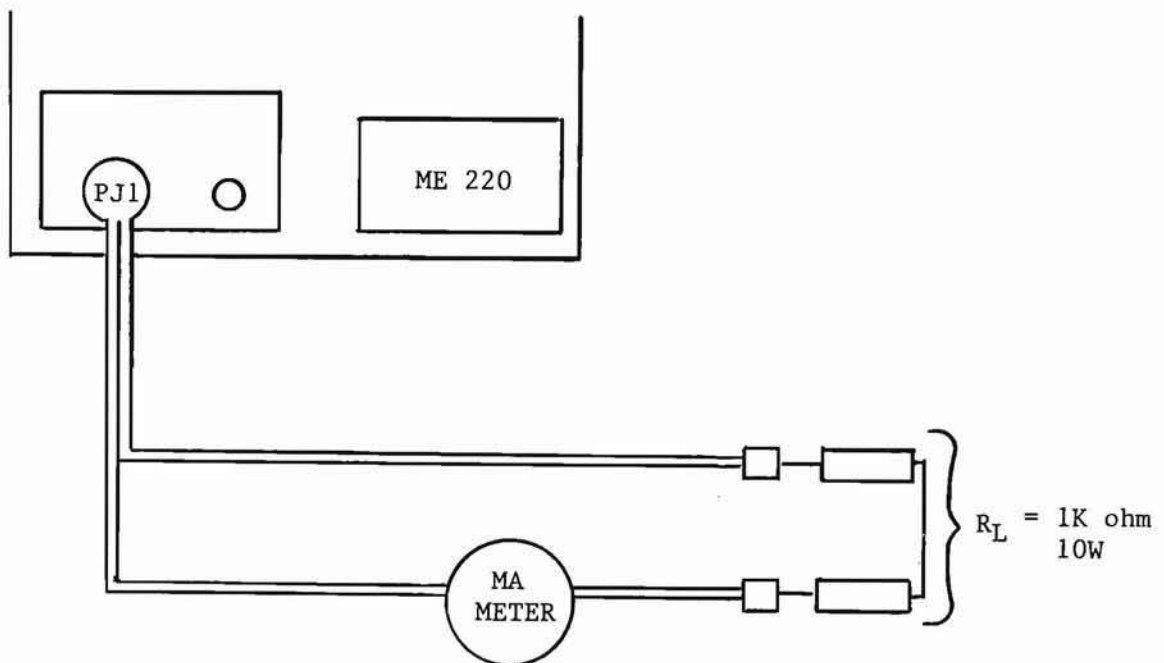
<u>From</u>	<u>To</u>
DB (14007) (J1)	LG1 (14003) (J1)
Pot Cable Assy (14128)	LG1 (J2)
LG2 (14005) (P7)	LG1 (J7)
Blue patient cable	RL1
Green patient cable	RL2
Phone Jack cable assy	LG2 (J3)

- 3.4.2 Remove display board for alignments if necessary.
- 3.4.3 Turn power on.
- 3.4.4 D1 LED should light. All other LED's (D2-D7) should be off. Time should read 00.00.
- 3.4.5 Press UP once. Time should increment to 01.00.
- 3.4.6 Press DN once. Time should increment to 00.00.
- 3.4.7 Using UP and DN selections, insure time is capable of selecting 00.00 through 59.00.
- 3.4.8 Press RESET. Time should go to 00.00.
- 3.4.9 Complete the following chart:

<u>Step</u>	<u>Press</u>	<u>LED's On</u>
1	Fast Sweep	1,4
2	80-150	2,4
3	0-250	3,4
4	Single Freq.	7
5	Amp Mod/Recip.	5,7

6	Bipolar/Interf.	5,6,7
7	Amp Mod/Recip.	6,7
8	Bipolar/Interf.	7

- 3.4.10 Turn power OFF, wait 2 seconds, turn power on. Verify D1 is the only green LED lit.
- 3.4.11 Press Manual Freq. Select and set thumbwheel to 100.
- 3.4.12 Set CH1 and 2 to 1/4-turn from fully counter-clockwise.
- 3.4.13 Press GO. Relay (K1) should not engage (audible) and timer should not count.
- 3.4.14 Turn intensity knobs full clockwise. There should be no voltage at either output.
- 3.4.15 Set CH1 and CH2 fully counter-clockwise.
- 3.4.16 Press GO. Relay (K1) should engage, timer should count up.
- 3.4.17 Verify seconds display counts from 00 to 59 in 59 seconds ± 1 .
- 3.4.18 Adjust R4 for 00 mA on Intensity 1 display.
- 3.4.19 Adjust R1 for 00 mA on Intensity 2 display.
- 3.4.20 Intensity 1 and 2 displays may occasionally flicker from 00 to 0_ or 01. Adjust for 00. Occasional occurrence of $\bar{0}1$ is acceptable, but 0_ is not.
- 3.4.21 Connect test setup as shown below. (Caution: RL could get hot and exposed conductors could have dangerous voltages.)



SET METER TO READ ma.RMS

- 3.4.22 Press GO. (Intensity knobs must be fully ccw to enter GO.) Timer should start counting.
 - 3.4.23 Set intensity to 40 mA on the ammeter with CH1 intensity knob. (Verify CH1 knob controls CH1 intensity display.)
 - 3.4.24 Adjust R6 on display board for 40 mA on intensity 1 display.
 - 3.4.25 Verify Intensity 1 display tracks with mA meter ± 2 digits through 0-60 mA range. (Looking at 20 and 60 mA is sufficient.)
 - 3.4.26 Turn intensity knobs fully counter-clockwise.
 - 3.4.27 Remove PJ1 from CH1 and insert into CH2.
 - 3.4.28 Repeat steps 3.5.23 through 3.5.26 substituting Intensity 2 for Intensity 1 and R2 for R6.
 - 3.4.29 Press RESET. Time should reset to 00.00.
 - 3.4.30 Insert CH1 output jacks leads into an MA meter. Short CH1 output, press GO, turn intensity to max. Verify output is disabled when current reads 75-90 mA.
 - 3.4.31 Repeat 3.4.30 using CH2 instead.
 - 3.4.32 Turn unit off.
- 3.5 Sweep Timing.
- 3.5.1 Reinstall display board into front housing, if necessary.
 - 3.5.2 Turn unit on.
 - 3.5.3 Connect freq. counter to U10.14. Verify base freq. (3.1.5) + 15 Hz. (This is upper limit. Lower limit = base freq. + 1.)
 - 3.5.4 Press GO. Time should start counting.
 - 3.5.5 Verify frequency is sweeping from the upper limit down to the lower limit. This cycle is continuous.
 - 3.5.6 Verify it takes 14 seconds, ± 1 , for CH1 to go from upper to lower and back to upper limit.
 - 3.5.7 Press RESET.
 - 3.5.8 Select 80-150. Repeat steps 3.5.4 through 3.5.7 with the following substitutions:

lower limit = 81 Hz + base frequency
upper limit = 150 Hz + base frequency

3.5.9 Select 0-250. Repeat steps 3.5.4 through 3.5.6 with the following substitutions:

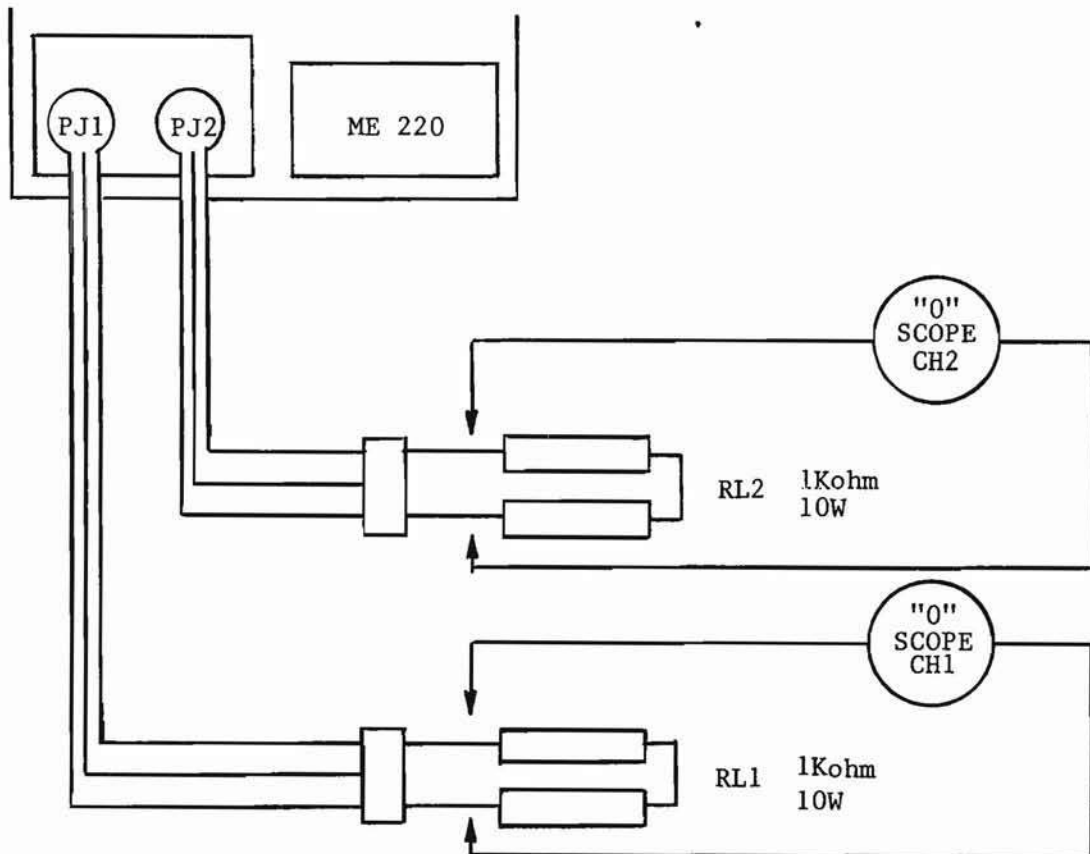
lower limit = 1 Hz + base frequency
upper limit = 250 Hz + base frequency

3.5.10 Press FAST SWEEP. Repeat step 3.5.6 substituting 7 seconds for 14 seconds.

3.5.11 Turn unit off.

4.0 Functional Test

4.1 Connect test set up as shown below: (Caution: During test RL could get hot and exposed conductors could have hazardous voltages.)



4.2 Turn unit on.

4.3 Press Manual Frequency Select.

- 4.4 Dial 100 on thumbwheel
- 4.5 Press BIPOLAR.
- 4.6 Press GO. Timer should start counting. (Intensity knobs must be fully counter-clockwise.)
- 4.7 Set intensity to read 10 mA on intensity 1 & 2 displays. Verify 'scope is as shown in Fig. 415-1A. (Disregard 1 Vpp limitation.)
- 4.8 Press ROTATE/RECIP. Verify sequence of waveforms (a) and (b) on 'scope is as shown in Fig. 415-2. (Do not expect a good sync.)
- 4.9 Press ROTATE/RECIP. Waveform should not change. ROTATE/RECIP light should stay on.
- 4.10 Press HOLD.
- 4.11 Press 0-250 function.
- 4.12 Press ROTATE/RECIP. Verify ROTATE/RECIP LED is off.
- 4.13 Set intensity knobs fully counter-clockwise.
- 4.14 Press GO. TIME should count up.
- 4.15 Set intensity CH1 & CH2 display to read 10 mA. Verify waveform is as shown in Fig. 415-3. (Do not expect a good sync.)
- 4.16 Press HOLD. TIME should hold count.
- 4.17 Press BIPOLAR. BIPOLAR LED should go off.
- 4.18 Press Manual Freq. Select.
- 4.19 Set Intensity control knobs fully counter-clockwise.
- 4.20 Press GO.
- 4.21 Set CH1 & CH2 intensity to obtain 100 Vpp on 'scope.
- 4.22 Verify base frequency + 100 Hz, at CH1. (Base freq. in 3.1.5.)
- 4.23 Verify base frequency appears at CH2.
- 4.24 Press ROTATE/RECIP. ROTATE/RECIP LED should go on.
- 4.25 Verify frequency of waveform (a) through (d) is as shown in Fig. 415-4. (NOTE: If waveform does not decrease to 40 ± 5 Vpp in (b) & (d), you may need to change R86 & R87 to a factory select resistor. The

values of the resistors you can use are found on drawing 14003, Note 2/Sheet 1.

- 4.26 Press ROTATE/RECIP.
 - 4.27 Press RESET.
 - 4.28 Set intensity control knobs fully counter-clockwise.
 - 4.29 Set time to 1 minute. Record start time. Press GO.
 - 4.30 Set CH1 & CH2 intensity fully clockwise. Milliamp displays should read, 65, ± 5 mA.
 - 4.31 After 1 minute ($\pm 2/0$ seconds), buzzer should sound, the intensity displays should be 00, and there should be no output on the 'scope.
- 5.0 Life Test Procedure
- 5.1 Secure all pcb's in place.
 - 5.2 Install display board screws and tie wraps.
 - 5.3 Torque seal all pots.
 - 5.4 Close unit, install rubber feet.
 - 5.5 Turn unit on. Press Manual Freq. Select. Set 299 in the thumbwheel.
 - 5.6 Turn intensity knobs fully counter-clockwise. Press GO.
 - 5.7 Set intensity fully clockwise both channels.
 - 5.8 Run unit for one hour.
 - 5.9 Turn power off.
- 6.0 Hipot Test
- This test is not recommended for general repair testing. It is a destructive test.
- 6.1 Disconnect power cord from outlet.
 - 6.2 Clip red hipot lead to two AC terminals on power plug.
 - 6.3 Clip black hipot lead to ground terminal on unit power plug.
 - 6.4 Hipot test to 2500 volts for 1 second. j Return tester to 0 volts.

- 6.5 Insert 2 kohm series load into CH1 output jack.
- 6.6 Remove black hipot lead from ground plug and connect to junction of two test load resistors.
- 6.7 Test to 2500 volts for 1 second. Return tester to 0 volts.
- 6.8 Remove load in CH1 and insert into CH2.
- 6.9 Repeat step 6.7.

- 7.0 Leakage Current Test
- 7.1 Plug unit into electrical safety tester.
- 7.2 Set range scale to 200 microamps.
- 7.3 Hold red lead on center contact of load connector.
- 7.4 Test for leakage current: NORMAL and CLOSED, NORMAL and OPEN, REVERSE and CLOSED, and REVERSE and OPEN. Reading should be very low. Limit is 50 microamps. Test CH1 and CH2.

- 8.0 Functional Retest.
- 8.1 Retest steps 3.4.3 through 3.4.14, 3.4.29 through 3.4.32 and 4.0 all.
- 8.2 Turn POWER off.

TROUBLESHOOTING GUIDE

<u>SYMPTOM</u>	<u>POSSIBLE CAUSE/ACTION</u>
1. Will not turn on.	Check line power cord, fuses, and Main Power Switch.
2. Upon turn on, no display.	Check interconnections and +5 V P/S. Replace DB if required.
3. Will not accept timer input.	Check membrane switch and connections, DB, and +5 V P/S.
4. GO will not activate.	Check Intensity Controls fully ccw, board conn's., DB and LG2.
5. HOLD will not activate.	Check membrane switch, interboard conn's. and DB.
6. Timer display does not light.	Check inter-board conn's., DB, +5 V P/S, and LG1 +8 V P/S.
7. Buzzer will not operate at end of treatment time.	Check buzzer, buzzer driver, DB, +5 V P/S and LG1 +8 V P/S.
8. Will not enter Bipolar.	Check membrane switch, interboard conn's., DB and LG1.
9. One or more LED's will not light.	Same as 8.
10. Will not enter amp. mod./recip.	Check membrane switch and LG1.
11. Will not RESET.	Check membrane switch and DB.
12. No output.	Check K1 engages on GO on LG2 and U19 on LG1.
13. No Intensity control.	Check concentric pot. assembly.

SPECIFICATIONS

Line Input: 115 VAC ($\pm 10\%$) / 50/60 Hz
(Export - 220 VAC $\pm 10\%$ 50/60 Hz)

UL Listed: Model ME220 (E55876)

Output: 0-60 mA

Waveform Type: Sinusoidal

Base Medium Frequency: 4000 Hz

Beat Frequency: 1 - 299 BPS

Modes: Interferential, Bipolar

Beat Freq. Sweep Ranges: 0 - 15 bps
80 - 150 bps
0 - 250 bps

Frequency Sweep Time: 14 ± 1 Sec.

Fast Frequency Sweep Time: 7 ± 1 Sec.

Reciprocation Time: 4 ± 1 Sec (Each Channel)

Amplitude Modulation Time: 4 ± 1 Sec (Each Channel)

Amplitude Modulation: To 40% of set intensity
(one channel at a time)

Fuse: 1 Amp

TREATMENT TIMER

Indicator:

The timer digital indicator indicates set time in minutes and seconds prior to the start of treatment, and treatment time remaining during the treatment and while in HOLD. Time is measured only during treatment.

Accuracy:

+0.5 minute (at all settings).

Maximum setting:

59 minutes (preset); 60 minutes (not preset)

Automatic Stop:

When time reaches "0" the output is disabled and counting stops.

Sys*Stim 220 Parts List

<u>PARTS</u> <u>LOCATION</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
MAIN ASSEMBLIES COMPLETE		
	PCB LOGIC 1 BOARD (LARGE)	XC4-15
	PCB LOGIC 2 BOARD (SMALL)	XC4-16
	PCB DISPLAY BOARD	XC4-17
	FUSE & FILTER PCB COMPLETE W/ AC POWER CORD AND SWITCH CABLE	Q05-01
	FRONT HOUSING ASSLY INCLUDES MEMBRANE SWITCH, LABEL AND CABLE TIE HOLDERS	XC4-13
	BACK HOUSING ASSLY INCLUDES MOUNT STUD (ORDER SHIELDS SEPARATE)	XC4-14
	HANDLE CARRY	WKR2-03
MISCELLANEOUS PARTS & ASSEMBLIES		
	PCB FUSE & FILTER (WITHOUT CABLES)	QK5-05
	AC POWER CORD WITH LUGS	QK5-08
	FUSE FILTER PCB TO AC SWITCH CABLE	QK5-02
	11 CONDUCTOR RIBBON CABLE	EC4-08
	26 CONDUCTOR RIBBON CABLE	EC4-23
	THUMB WHEEL FLEX CABLE (13 CONDUCTOR) ORDER INSULATOR PAD BELOW	EC4-21
	INSULATOR PAD	KN1-08
	CABLE TIE MOUNTS	GG2-02
	CABLE TIE'S	GC1-02
	MEMBRANE SWITCH	HG1-10
	AC ROCKER POWER SWITCH	HH2-01
	THUMB WHEEL SWITCH	HH2-03
	INTENSITY CONTROL POTENTIOMETER WITH CABLE & PLUG	Q03-06
	INTENSITY CONTROL POTENTIOMETER	Q03-04
	KNOB SET, INTENSITY CONTROL (ALSO ORDER LABEL BELOW)	KD1-12
	KNOB LABEL "2"	PA7-06
	OUTPUT JACK ASSLY, 2 JACKS, CABLE & PLUG (ALSO ORDER 2 TRIM NUTS BELOW)	Q03-09
	OUTPUT JACK (ONLY) (ALSO ORDER 2 TRIM NUTS BELOW)	EC2-02
	BLACK TRIM NUTS (OUTPUT JACK)	EC2-02A
	FUSE PCB INSULATOR (ORDER FUSE LABEL BELOW)	KN1-09
	FUSE LABEL	PA1-01
	FUSE 1 AMP 3AG	FB1-01
	POWER TRANSFORMER ASSLY COMPLETE W/CABLE, CONNECTOR & PLUGS	Q05-02
	POWER TRANSFORMER	DF2-02
	TRANSFORMER TO SWITCH CABLE	Q03-10

<u>PARTS</u> <u>LOCATION</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
MISCELLANEOUS PARTS & ASSEMBLIES, CONTINUED		
	TRANSFORMER TO 5 PIN CONNECTOR	QO5-03
	SHIELD BACK COVER TOP (HANDLE END)	LJ3-04
	SHIELD CENTER (CSA)	LJ3-01
	SHIELD BOTTOM (POWER INPUT END)	LJ3-05
	NYLON SPACER (BETWEEN PCB'S)	LH1-13
	HEX STAND OFF 2 1/4" LONG	KL1-13
	RUBBER FEET (EACH)	KA1-03

PCB LOGIC 1 BOARD PARTS

C1	CAP 56PF 50V CER	CB2-31
C2,3,19	CAP .01 MFD 50V CER	CB2-21
C5-15,18,21,22, 38-42,50-53,100	CAP .1MFD 50 V CER	CB1-09
C16,54,55	CAP 68PF 50V CER	CB2-30
C17	CAP 5PF 50V CER	CB2-32
C20,45,46	CAP 1MFD 50V AL ELEC.	CC1-01
C23,26	CAP .22 MFD 50V CER	CB1-31
C24,25	CAP 560PF 200V CER	CB1-32
C28,30,31,47	CAP 10 MFD 50V CER	CD2-32
C29,34,57-59	CAP 10 MFD 16V TAN	CD1-05
C32,33,35,56	CAP 2.2 MFD 16V TAN	CD1-04
C43,44	CAP 4700 MFD 35V AL ELEC	CD1-14
C60	CAP 250 PF 50V CER	CB2-17
R1,2,4,5,1000 51	RESISTOR 4.7K,1/4W,5%	BC22-39

PCB LOGIC 1 BOARD PARTS, CONTINUED

R3,R6	RESISTOR 1K,1/8W,1%	BH2-29
R9,12,48,49,79, 80,13,7,15,98, 100,10,17,18,38, 39,104,106	RESISTOR 100K,1/8W,1%	BH2-30
R11,28-34,36,37, 73-76,85,99,101 114,115	RESISTOR 10K,1/4W,1%	BH2-08
R19-27,44,45	RESISTOR 20K,1/4W,1%	BC2-24
R35,42,43,52, 61-68,72,77, 118,110,111, 123,124,212	RESISTOR 100K,1/4W,5%	BC22-10
R40	RESISTOR 47K,1/4W,5%	BC2-19
R41	RESISTOR 10 MEG,1/4W,5%	BC22-54
R46,47	RESISTOR 332 OHM,1/8W,1%	BH2-34
R50	RESISTOR 15K,1/4W,5%	BC22-52
R53-56	RESISTOR 1K,1/4W,5%	BC22-28
R69-71	RESISTOR 220K,1/4W,5%	BC2-16
R78	RESISTOR 220 OHM,1/4W,5%	BC22-53
R81	RESISTOR 340K,1/8W,1%	BH2-39
R82	RESISTOR 18.2K,1/8W,1%	BH2-40
R83	RESISTOR 68.1K,1/4W,1%	BH2-06

PARTS
LOCATION

DESCRIPTION

PART NUMBER

PCB LOGIC 1 BOARD PARTS, CONTINUED

R84	RESISTOR 12.1K,1/4W,1%	BH2-02
R86,87	RESISTOR 2.43K,1/8W,1%	BH2-46
R88,89	RESISTOR 3.32K,1/4W,1%	BH2-04
R90,91	RESISTOR 54.9K,1/8W,1%	BH2-38
R93,95	POTENTIOMETER 50K,1/2W	BD3-09
R102,103	RESISTOR 2.7 OHM,1/2W,5%	BF1-06
R108,109	RESISTOR 1.78K,1/8W,1%	BH2-36
R200,201	RESISTOR 7.5K,1/8W,1%	BH2-31
R202,203	RESISTOR 6.190K,1/4W,1%	BC2-85
R204,205	RESISTOR 2.21K,1/8W,1%	BC2-63
JPR92,JPR94	RESISTOR 200 OHM,1/8W,1%	BH2-41
U45	RESISTOR NETWORK 100K	BF1-05
U10	IC 4518 DUAL BCD UP CTR	RD2-34
U11,28,38	IC 4046 PHASE LOCK LOOP	RD2-27
U12,14,15,17	IC 4522 PROG. U/D CTR	RD2-32
U13,16,18,52	IC 4510 PRESET U/D CTR	RD2-30
U19	IC LM2879P DUAL 8W PWR AMP	RD2-39
U20,32,33,36	IC 4013 DUAL D F-FLOP	RE1-03
U21,31	IC 4050 HEX BUFFER	RD2-29
U22-27	IC 4585 4 BIT MAG. COMP.	RD2-35
U30,42,44,54,55	IC 4066 QUAD ANALOG SWITCH	RD2-22
U34	IC 4081 QUAD 2 INPUT AND	RA1-01
U35	IC 4001 QUAD 2 INPUT NOR	RA1-02
U37,39,46	IC LM324 QUAD OP AMP	RF1-04
U40	IC 4060 14 STAGE CTR	RD2-31
U41	IC 4047 MSMV	RD2-28
U43	IC 4093 QUAD 2 INPUT NAND	RD2-21
U45	SEE RESISTOR NETWORK	
U47,48	IC XR2206CP FUNCTION GEN.	RD2-37
U50,60	IC MC3340P ELECT ATTEN.	RD2-38
U51	IC 4017 DECADE CTR	RD2-20
U53	IC MM74C922N 16 KEY ENCOD	RD2-36
U56,57	IC 4516 BINARY U/D CTR	RD2-33
U58	REGULATOR 7805CT 5V	AD1-01
U59	REGULATOR 7808AC 8V	AD2-03
FOR U58,59	HEATSINK	LI1-02
FOR U19	HEATSINK	LI1-09
D1-17,19-30,33, 36,130,200,20	DIODE IN4148	AA1-07
D34	BRIDGE RECTIFIER	AB6-08
Q1-4,12,100,101	FET N CHAN	AB6-04
DS1	BUZZER HMB-12	SB1-01
X1	CRYSTAL 16KHZ	MC4-01
J1	HEADER CONN. 26 PIN	ED4-30
J2	HEADER 5 PIN, .100	ED4-29
J4	HEADER, 5 PIN, .156	ED4-04
J5	HEADER CONN. 20 PIN	ED4-36
J6	HEADER 14 PIN	ED4-33
J7	HEADER 11 PIN	ED4-12
E1-E2	GROUND TERMINALS	ED3-25

<u>PARTS</u> <u>LOCATION</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
PCB LOGIC 2 BOARD PARTS		
C36,37,48,49	CAPACITOR 220 MFD,35V	CD1-12
D31,32,33,34	DIODE IN 4148	AA1-07
L1,2,3,4	INDUCTOR	DA3-06
U1	IC LM324 QUAD OP AMP	RF1-04
J3	HEADER, 4 PIN FRICTION LOCK	ED4-23
P7	HEADER, 11 PIN	ED4-12
K1	RELAY	HA1-03
R112,R113	RESISTOR 1K,1/8W,1%	BH2-29
R119,120	RESISTOR 10K,1/4W,1%	BH2-08
R121,122	RESISTOR 100K,1/8W,1%	BH2-30
R130	RESISTOR 68.1K,1/4W,1%	BH2-06
R131	RESISTOR 40.2K,1/4W,1%	BC2-40
T1,2,3,4	TRANSFORMER	DA2-03
PCB DISPLAY BOARD PARTS		
C1,2	CAP .22 MFD, 50V CER AXIAL	CD2-47
C3,7	CAP .1 MFD, 50V CER AXIAL	CD2-46
C4	CAP 2.2 MF, 16V, +/-20%, TANT	CD1-04
C5,100,101	CAP .15MF, 50V, CER AXIAL	CD2-45
C102	CAP .033 MFD, CER AXIAL	CD2-43
C103	CAP .01 MFD, 50V, CER AXIAL	CD2-44
D8-12,100,101	DIODE IN4148	AA1-07
U7-14	DISPLAY LED 7 SEG MAN 74A	NB2-01
FOR U7-14	SOCKET, IC 14 PIN	EC7-02
J1	HEADER RA 26 PIN	ED4-10
D1-7	LED	NB1-01
FOR D1-7	LED SPACER	KK1-04
U1	ICM 7217C1P1 UP/DOWN COUNTER	RD2-25
U2,4	CA 3162E A/D CONVERTER	RD2-23
U3,5	4511 IC BCD/7 SEG DRIVER	RD2-24
U6	4049 IC HEX BUFFER	RD2-26
U15,19,21	4013 IC DUAL D F-FLOP	RE1-03
U16,17	4017 IC DECADE COUNTER	RD2-20
U18	4093 IC QUAD SHMITT NAND	RD2-21
U20	4066 IC QUAD ANAL. SWITCH	RD2-22
U30	8 N CHANNEL ARRAY	RA1-06
U31	ULN 2003 A DRIVER ARRAY	RA1-04
R1,4	POTENTIOMETER 50K, 1/2W	BD3-09
R2,6	POTENTIOMETER 10K,1/2W	BD3-08
R3,5	RESISTOR 4.99K,1/4W,1%	BH2-17
R8	RESISTOR 220 OHM,1/4W,5%	BC22-53
R9-21,24,25, 27-30	RESISTOR 100K,1/4W,5%	BC22-10
R23,100,101	RESISTOR 10M,1/4W,5%	BC22-54
R31,32,58,59	RESISTOR 10K,1/4W,5%	BC22-42
R39-52	RESISTOR 100 OHM,1/4W,5%	BC22-22
R53,60	RESISTOR 6.2K,1/4W,5%	BC2-38

DRAWINGS AND SCHEMATICS

1. Block Diagram
2. Logic 1 Board Assembly
3. Logic 2 Board Assembly
4. Display Board Assembly
5. Logic 1 Schematic (1 of 5)
6. Logic 1 Schematic (2 of 5)
7. Logic 1 Schematic (3 of 5)
8. Logic 1 Schematic (4 of 5)
9. Logic 1 Schematic (5 of 5)
10. Logic 2 Schematic (1 of 1)
11. Display Schematic (1 of 3)
12. Display Schematic (2 of 3)
13. Display Schematic (3 of 3)

Figure 1 - Block Diagram - 14093 Rev A

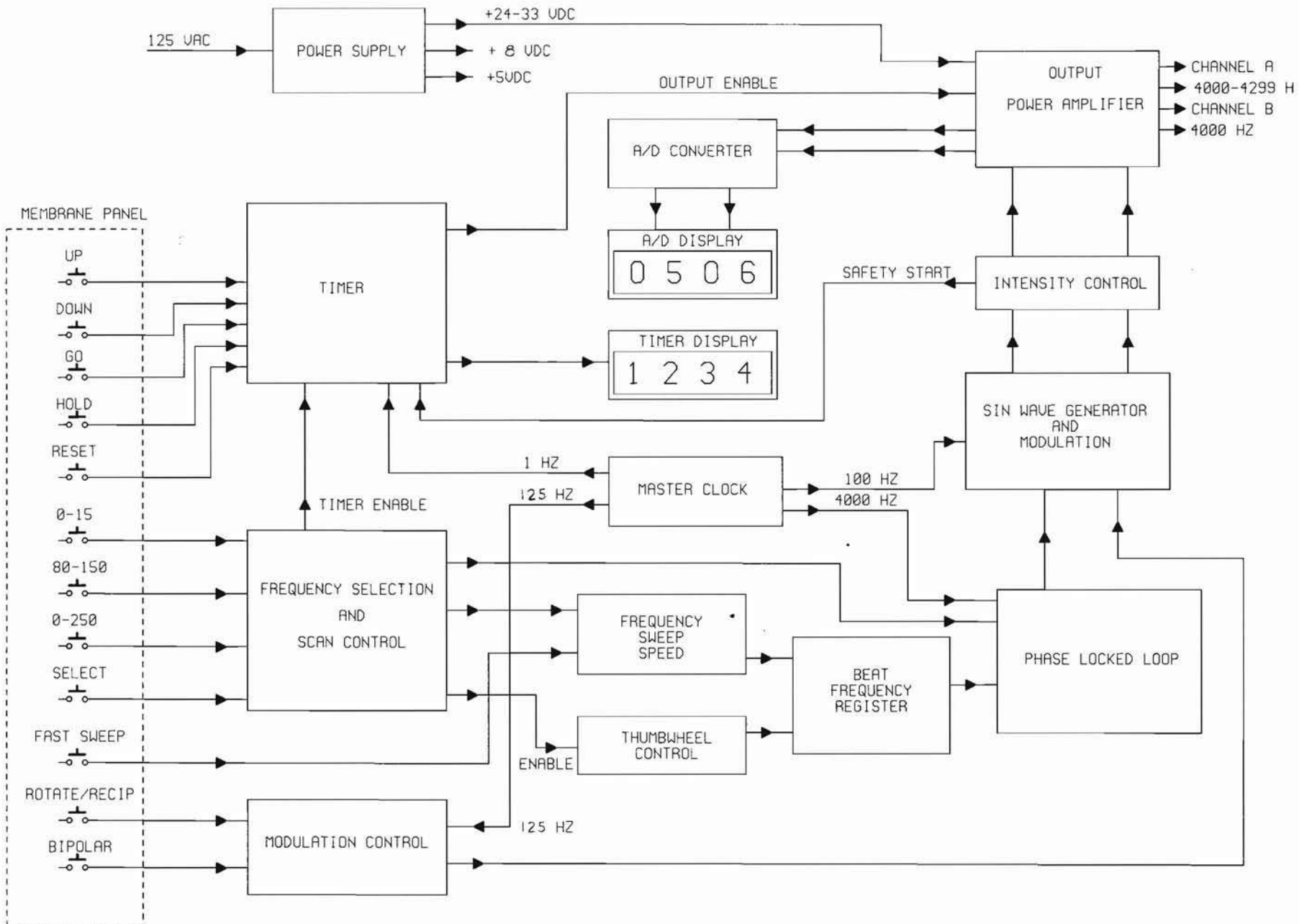
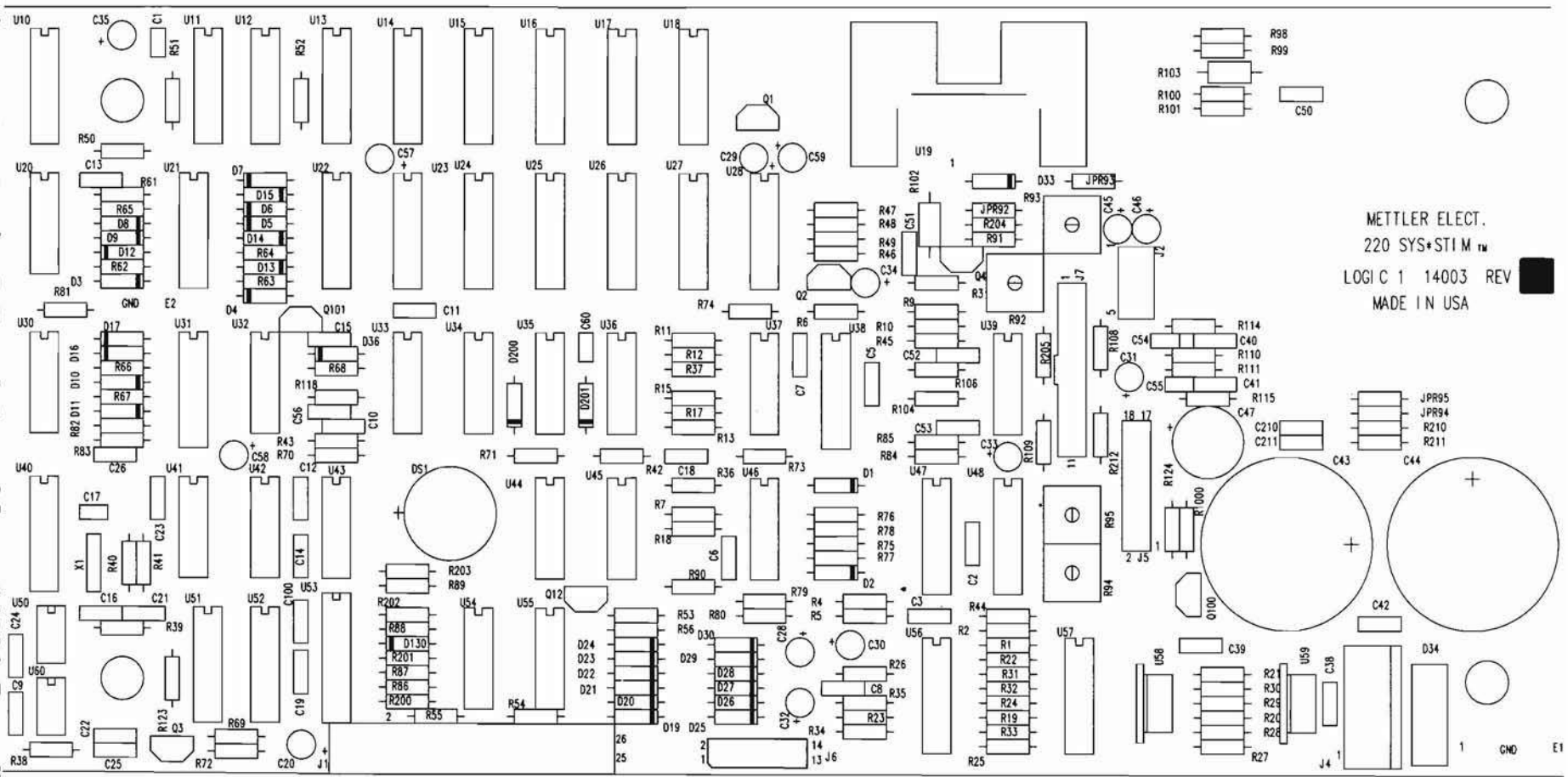


Figure 2 - Logic 1 Board Assembly - 14094 Rev. New



METTLER ELECT.
220 SYS+STIM™
LOGIC 1 14003 REV
MADE IN USA

JPR95
JPR94
R210
R211

GND E1

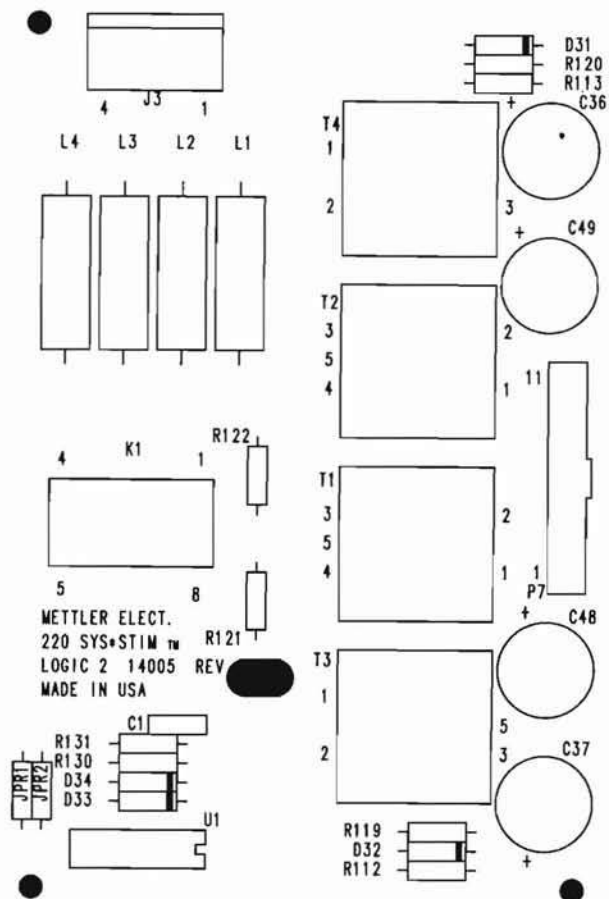


Figure 3 - Logic 2 Board Assembly - 14095 Rev A

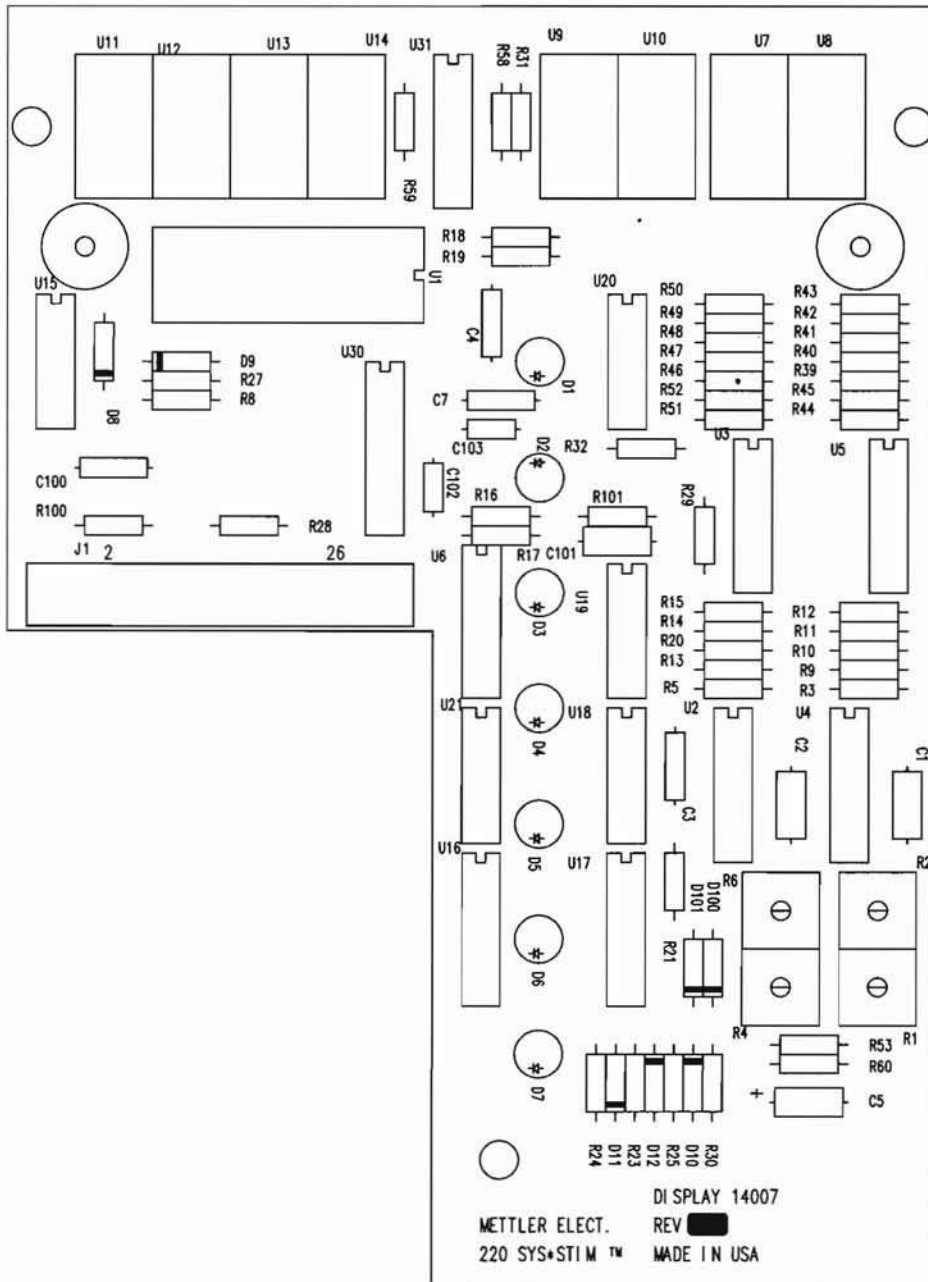
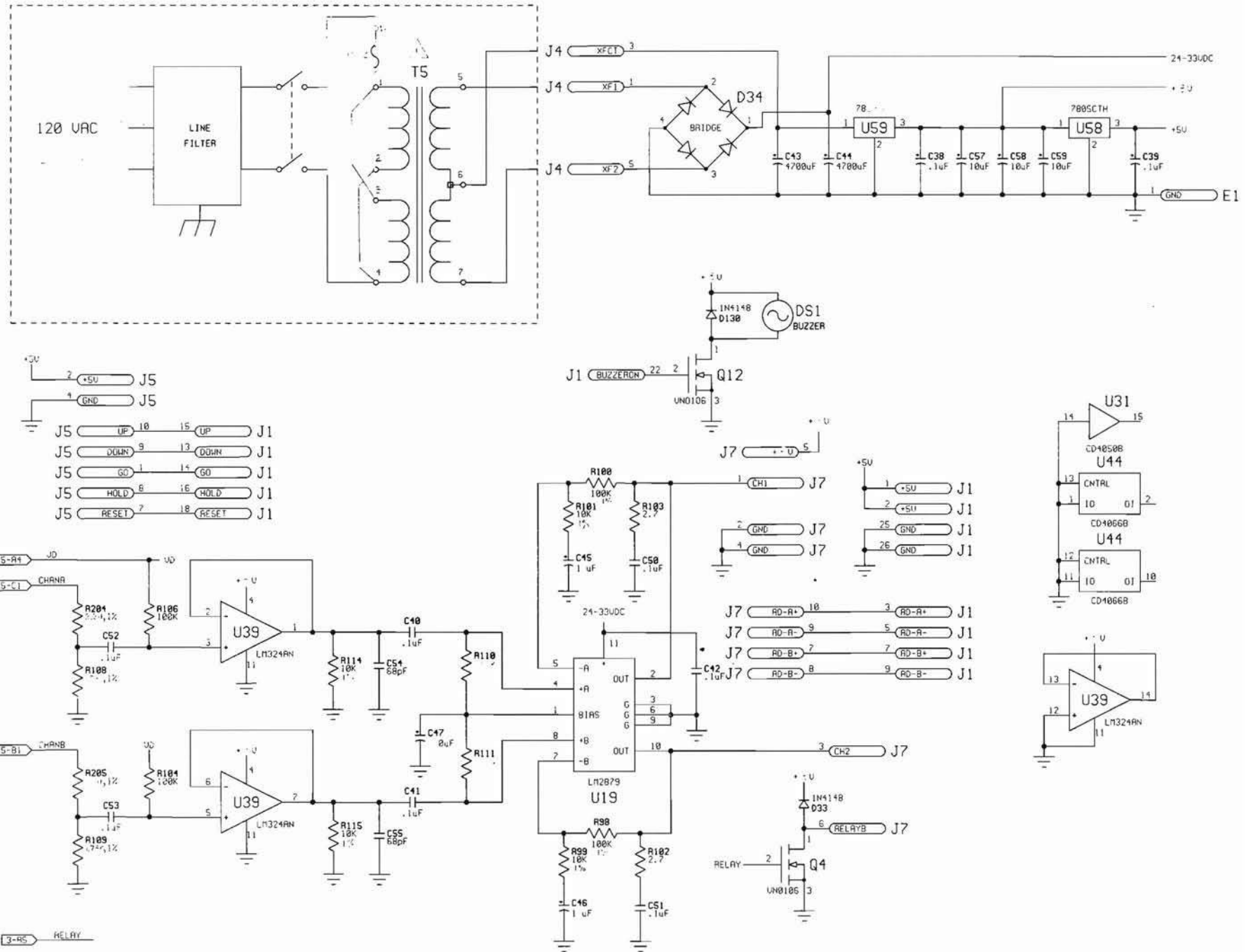


Figure 4 - Display Board Assembly - 14096

Figure 5 - Logic 1 Schematic (1 of 5) - 14090 Rev G

43



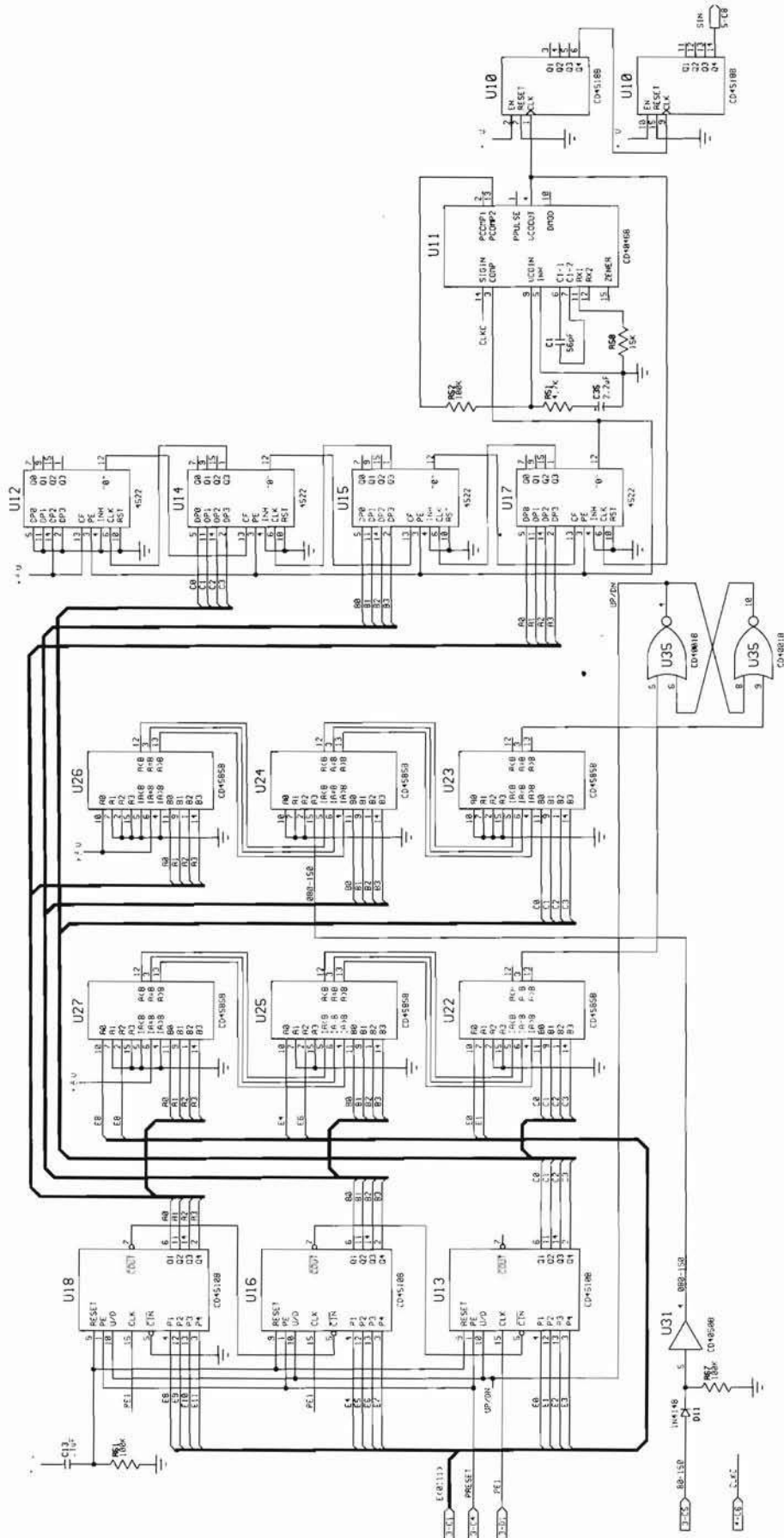
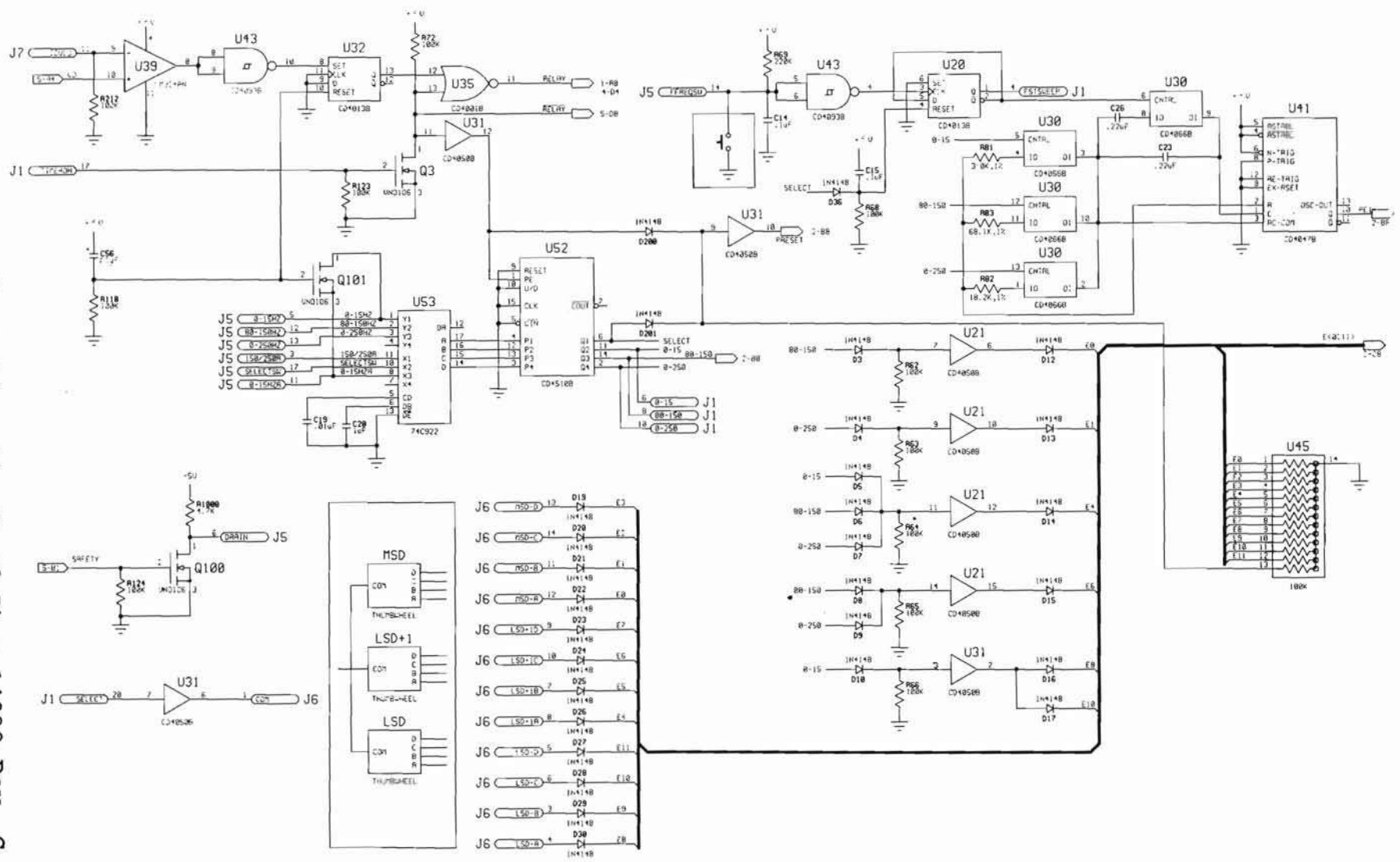


Figure 6 - Logic 1 Schematic (2 of 5) - 14090 Rev. G

Figure 7 - Logic 1 Schematic (3 of 5) - 14090 Rev. G



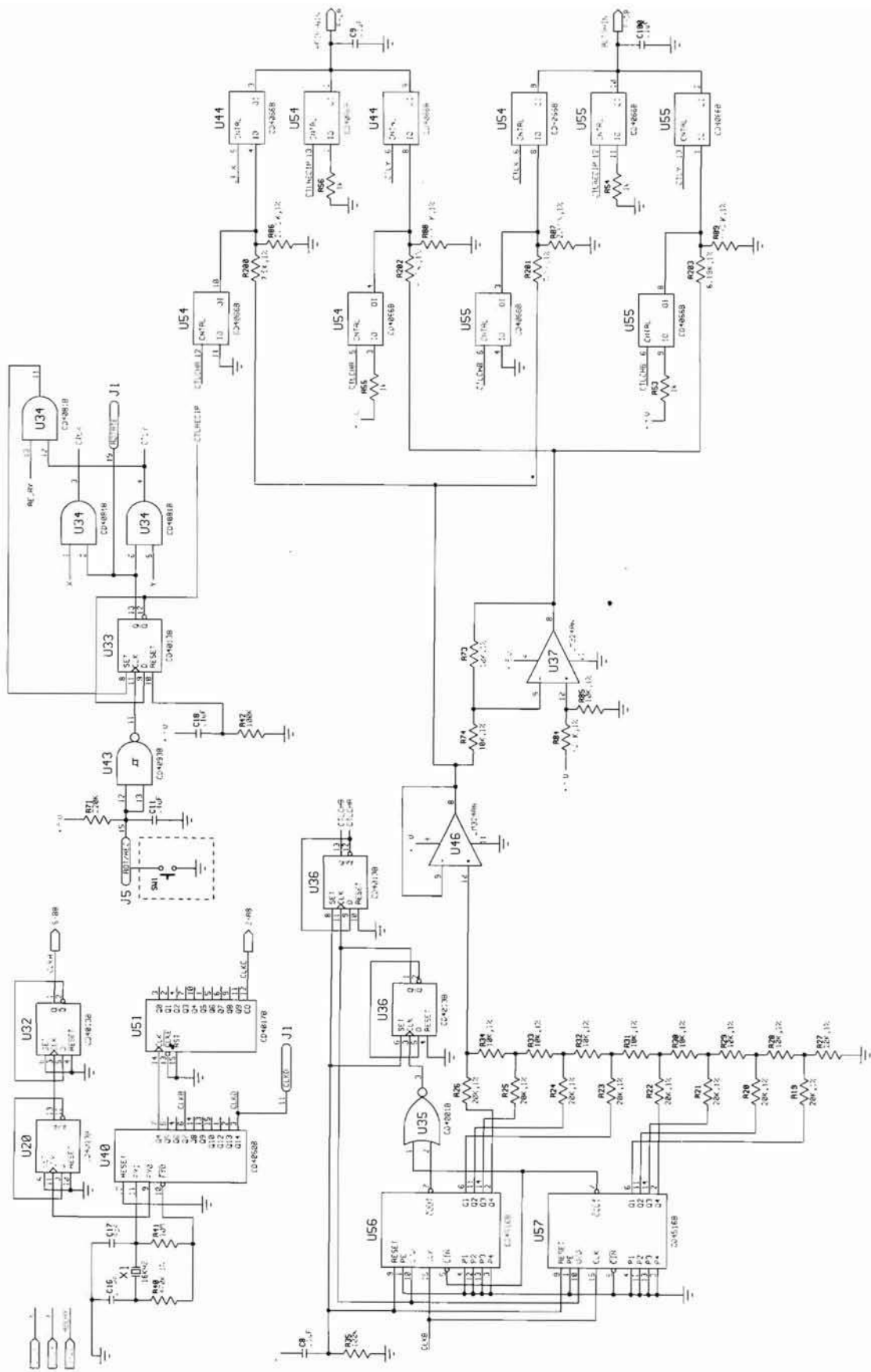


Figure 8 - Logic 1 Schematic (4 of 5) - 14090 Rev G

Figure 9 - Logic 1 Schematic (5 of 5) - 14090 Rev G

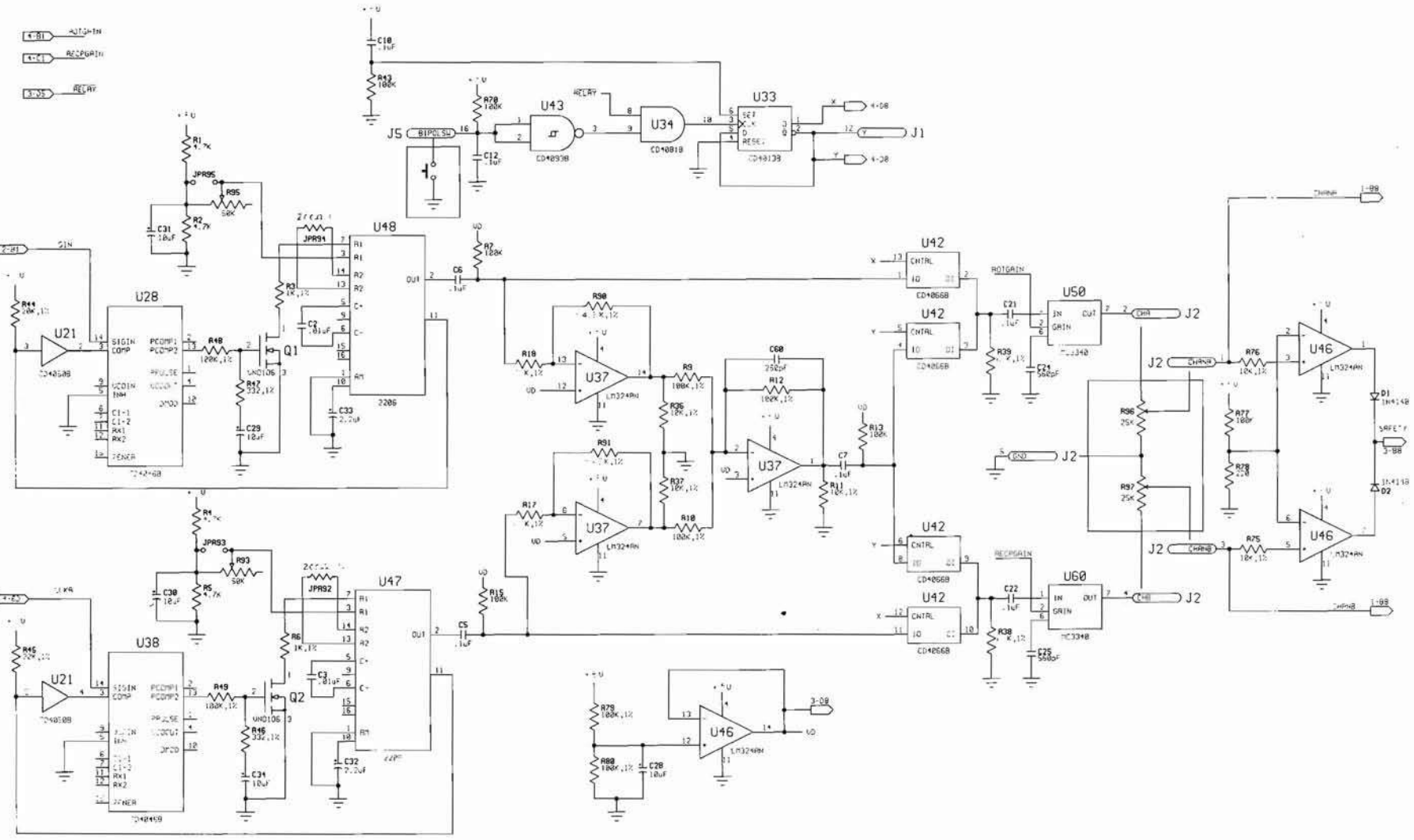


Figure 10 - Logic 2 Schematic (1 of 1) - 14091 Rev. B

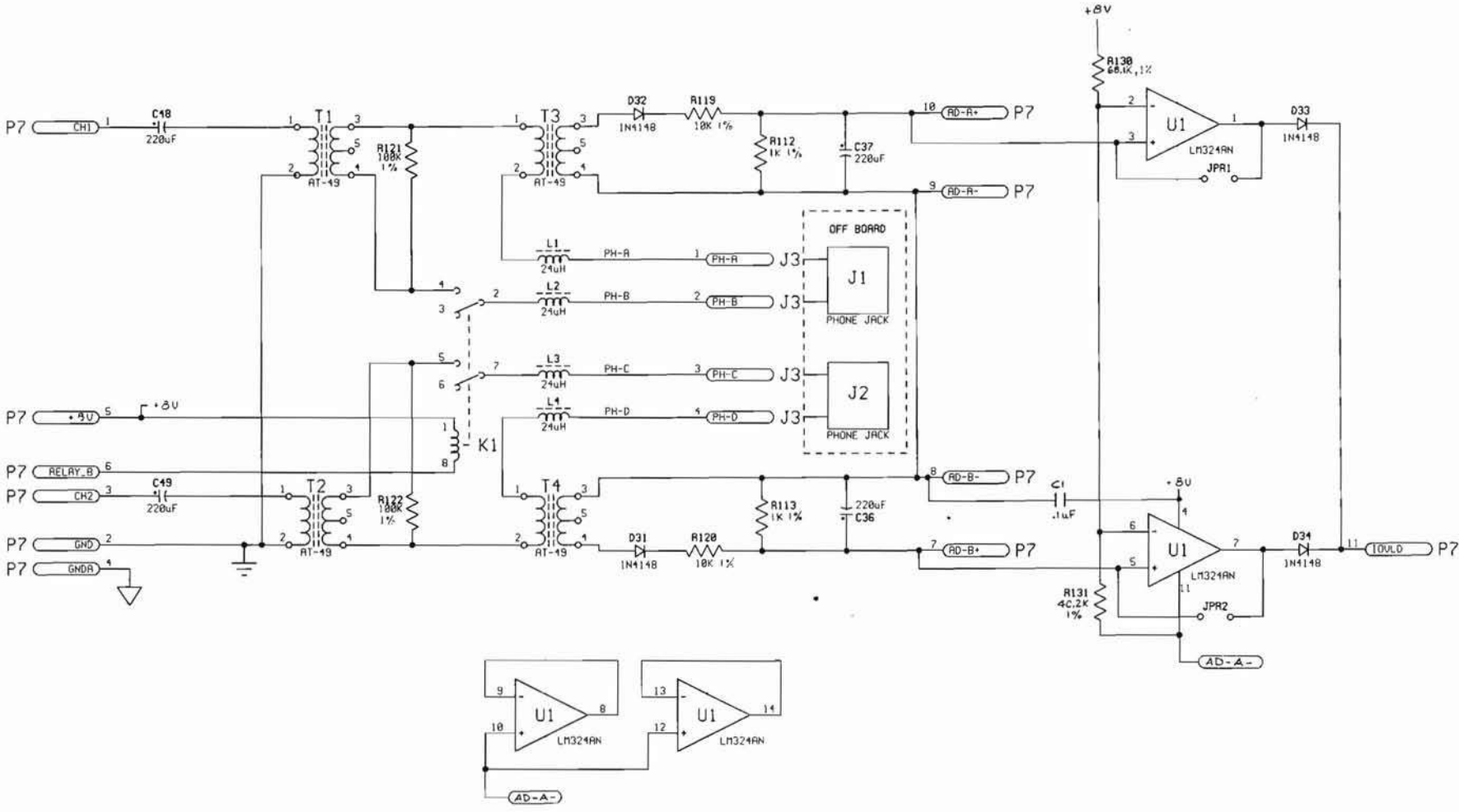
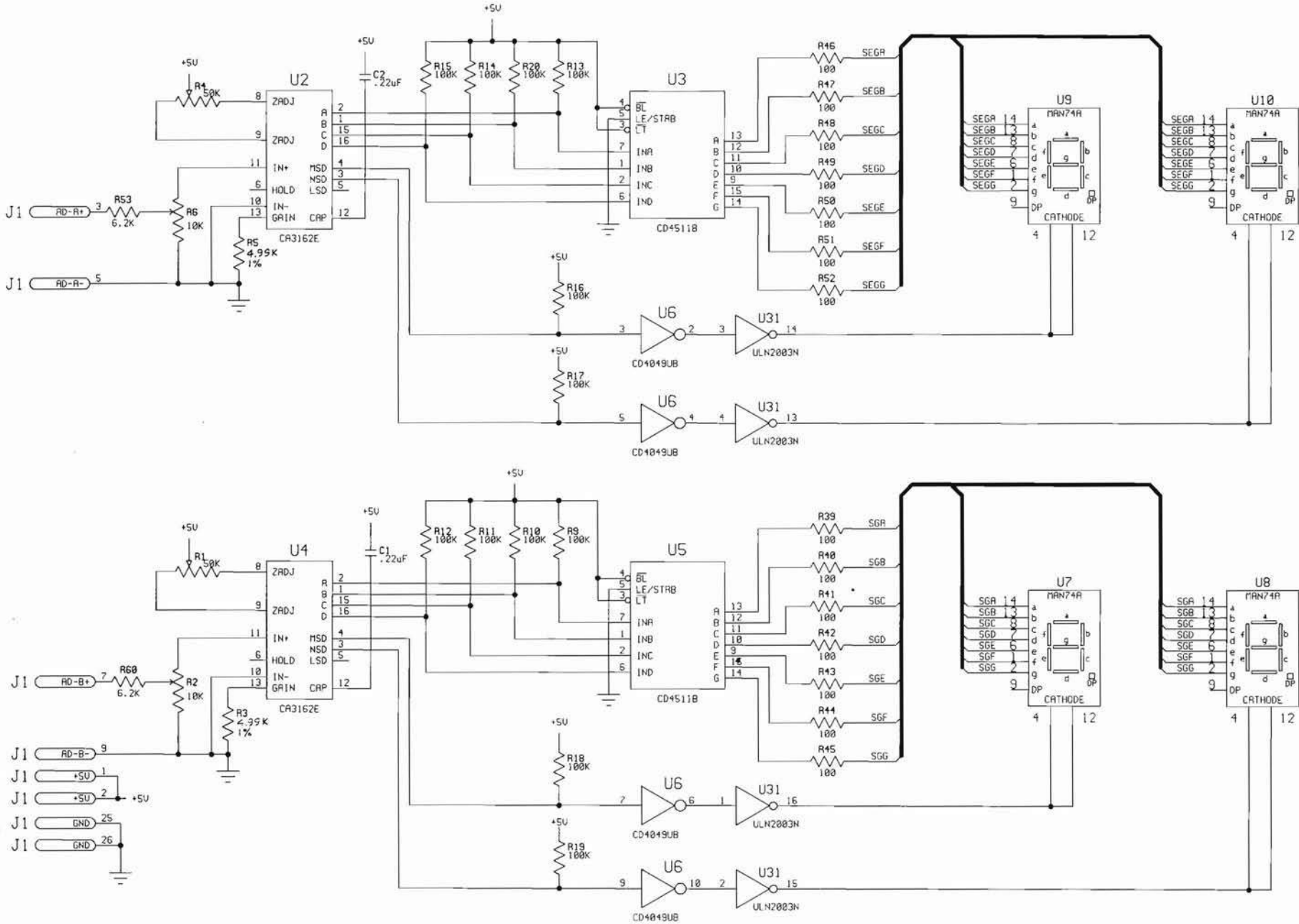


Figure 11 - Display Board (1 of 3) - 14092 Rev B



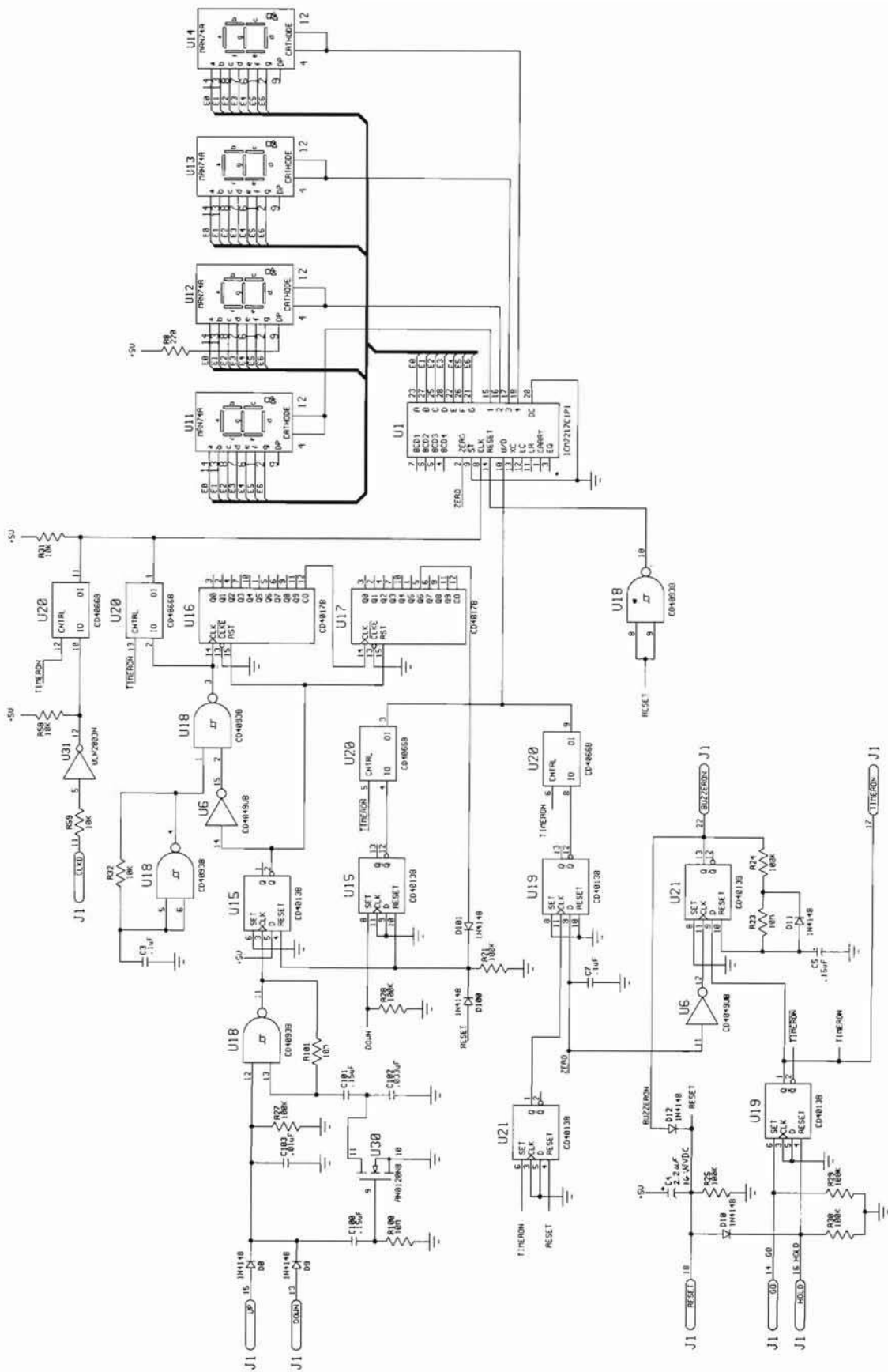


Figure 12 - Display Board (2 of 3) - 14092 Rev B

Figure 13 - Display Board (3 of 3) - 14092 Rev B

