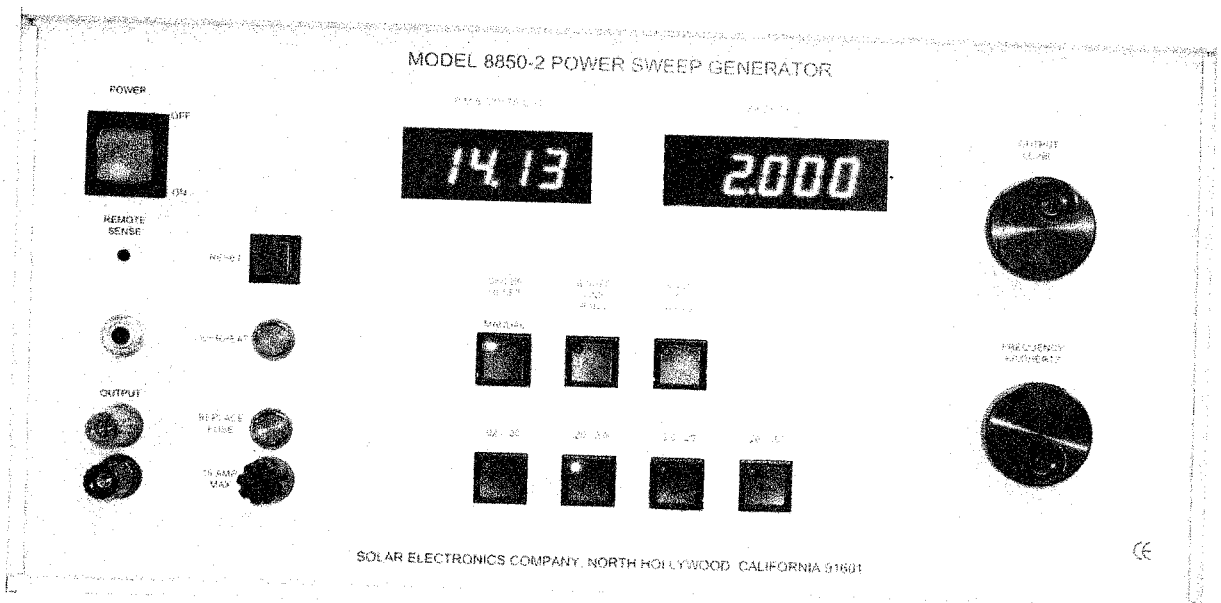
INSTRUCTION MANUAL
FOR
SOLAR MODEL 8850-2
HIGH POWER SWEEP GENERATOR

Revised May 28, 2007



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FEATURES

- Manual or automatic frequency sweeps from 30 Hz to 150 KHz.

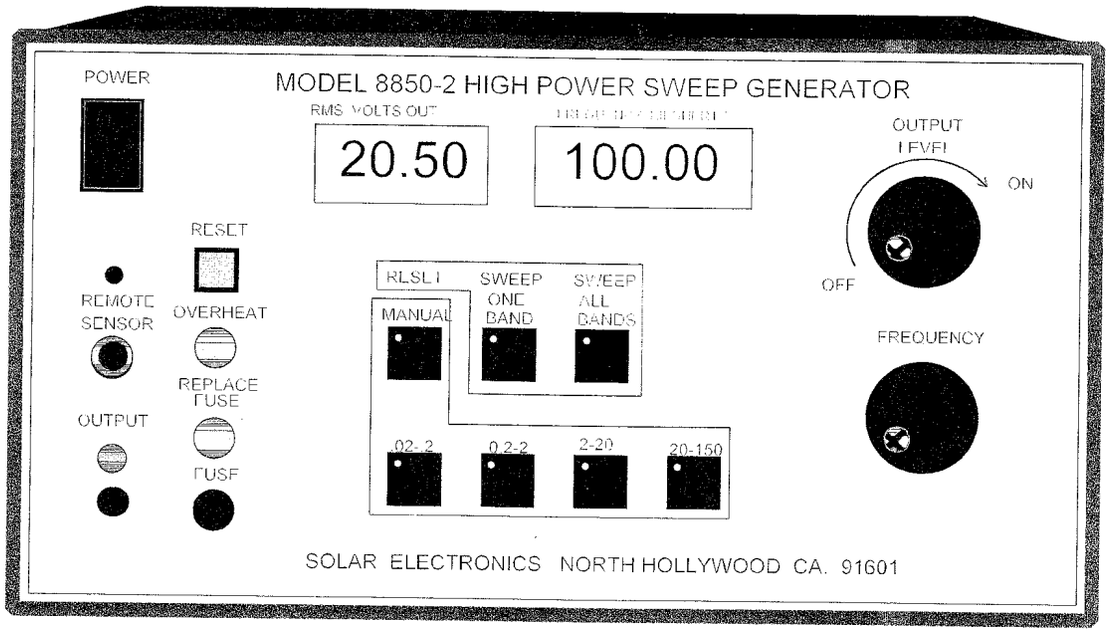
- Digital displays of frequency and RMS voltage output or injection voltage level.

- Remote sensing of voltage being injected into the equipment under Test (EUT).

- Automatic gain control (AGC) of the output voltage as frequency is scanned manually or swept automatically.

- Protective circuits prevent damage to output stage caused by power frequency feedback in typical AC susceptibility test setups.

- Up to 300 watts output into 1.5 ohms resistive load and 200 watts into 2.5 ohms.



USEFUL ACCESSORIES.

- **TYPE 6220-1A AUDIO ISOLATION TRANSFORMER:**
  Used for injecting output of 8850-2 in series with power to test sample as required by test method CS01.

- **TYPE 7021-1 PHASE SHIFT NETWORK:**
  Use for removing the power frequency from the voltmeter in test method CS01 / CS101.

- **TYPE 8810-1 IMPEDANCE MATCHING TRANSFORMER:**
  Plugs into output terminals to step up output to 50 ohms impedance. Used when a 50-ohm signal source is needed.

- **TYPE 8811-1 WIDE RANGE TRANSFORMER:**
  Plugs into output terminals to provide up to 115 volts R.M.S. at 200 watts. Used as a power source for frequencies 30 Hz to over 2 kHz.

- **TYPE 8814-1.5:**
  A high wattage 1.5 ohm load resistor used with 6220-1A to stabilize impedance. Rated at 300 watts.

- **TYPE 8814-2.4:**
  A high wattage 2.4 ohm load resistor used with 6220-1A to stabilize impedance. Rated at 300 watts.

- **TYPE 885066 REMOTE SENSOR CABLE:**
  A high power coiled patch cord which extends 36 inches. Used for sensing up to 7.5 volts from the Type 6220-1A Isolation Transformer or EUT. (Included with Model 8850-2)

1.0.0 DESCRIPTION

Model 8850-2 is a high power sweep generator producing 300 watts of RMS power into a 1.4 Ω load with a frequency range of 30 Hz to 100 KHz. The amplitude falls off from 100 KHz to 150 KHz approximately 50%.
Two digital display meters on the front panel indicate RMS voltage out and frequency in kilohertz.

Controls include two manual control knobs, one for selecting frequency manually, and the second for setting the output voltage.

Seven pushbuttons provide two methods for sweeping frequency, manual mode, sweep one band, and sweep all bands.

A REMOTE SENSE jack on the front panel allows sensing the voltage from the AC voltmeter terminals of an injection device such as the Type 6220-1A isolation transformer. The 8850-2 can use the REMOTE SENSE signal to maintain a constant test signal amplitude verses frequency.

The Model 8850-2 protection devices on the front panel include a 15 A fuse with a blown fuse indicator lamp. An illuminated Reset push-button for protection of over voltage, feedback and over current.

Output terminals are standard 3/4 inch binding posts conveniently located on the front panel for easy access.

2.0.0 APPLICATION

The Model 8850-2 was developed in response to the demand for high audio voltage from a low impedance source for performing CS01 Conducted Audio Susceptibility tests per MIL-STD-461B / 461C and CS101 MIL-STD-461D / 461E. The 8850-2 is especially suited for making tests in a shielded room.

When used with the Type 6220-1A or Type 6220-2 Audio Isolation Transformer, the combination enables the injection of sinewave voltages into active power lines which supply power to the equipment under test (EUT).

SPECIFICATIONS

Output Characteristics

Frequency Range	20 Hz - 150 kHz
Max. Output Voltage (Load > 1.4 Ohms)	20.5 V AC (RMS)
Max. Output Current (Load < 1.4 Ohms)	14.6 A.
Max. Power Output (1.4 Ohms Load)	300 Watts

Shutoff Conditions

Temperature	60° C.
Over voltage (f = 1 kHz)22 V AC Current (f = 1 kHz)	15 A.

Stability

Frequency Stability	< 2250 PPM / °C
Output Level Drift (Stable Load)	< 0.5%
Output Level Drift (Unstable Load)	< 1%
Single Band Sweep Duration	4:45 minutes:seconds
All Band Sweep Duration	19 minutes
Single Band Sweep	per MIL-Std-461E

Remote Level Sensing

Frequency Range	20 Hz - 150 kHz
Remote Sense Input Impedance	100 K ohms
Remote Sense Max. Input	7.5 V AC (RMS)

Power Requirements

Power Source	115/230 V 60/50 Hz
Power Consumption	740 Watts
Power Line Fuses	2 X 10 A.
Output Fuse	15 A.

Physical Dimensions

Net Weight	23.4 Kg (51.6 Lbs.)
Shipping Weight	24.5 Kg (54 Lbs.)
Height	222 mm (8.75 Inches)
Width	432 mm (17.0 Inches)
Depth	330 mm (13.0 Inches)

3.0.0 VERIFICATION & FUNCTIONS OF THE 8850-2 GENERATOR

IF ANY OF THESE STEPS ARE NOT WITHIN THE DESCRIBED PARAMETERS REFER TO THE MAINTENANCE AND CALIBRATION SECTION.

3.0.1 Power Switch

The On / Off 15 A. 115/230 lighted power switch provides primary voltage for the logic circuits, A timing circuit energizes the power amplifier section within 1 second.

3.0.2 Amplitude knob

Adjusting the output level to 20.5 volts maximum, this in effect, sets the Automatic Gain Control (AGC) for the manual and or the Remote Sense feature when plugged in and connected to the output of the generator or the output of a 6220-1A (Maximum 6.0 to 7.2 volts). This maintains a constant amplitude regardless of load.

3.0.3 Sweep Reset/Manual

Pressing the button marked SWEEP RESET MANUAL enables the FREQUENCY KILOHERTZ knob for a manual adjustment to a specific frequency in any of the four frequency bands.

Select one of the four frequency bands and adjust
the FREQUENCY KILOHERTZ knob to the desired frequency. The limits of each frequency band should overlap.

Band 1 20 Hz to 200 Hz
Band 2 200 Hz to 2 kHz
Band 3 2 kHz to 20 kHz
Band 4 20 kHz to 150 kHz

3.0.4 Sweep One Band

Pressing the button marked SWEEP ONE BAND followed by pressing the button for the desired frequency band will enable the Model 8850-2 to continuously sweep the selected band in 4:45 minutes:seconds.

3.0.5 Sweep All Bands

Model 8850-2 will sweep the four bands consecutively in 19 minutes. (4 x 4:45) As the sweep enters each band, an LED lamp will light up indicating which frequency range is being scanned as well as displaying the frequency on the digital display.

3.0.6 Remote Sensing

The Remote Sensing cable provided with the 8850-2 can be used for sensing the output voltage of the 6220-1A Isolation Transformer used as an injection device. When the remote sensing cable is plugged into the 8850-2, internal circuits will prevent the output from exceeding 7.5 volts.

4.0.0 OVERLOAD and RESET CONDITIONS

4.0.1 Stabilizing Impedance.

The current drawn by the EUT through the secondary winding of the 6220-1A or similar Isolation Transformer generates a proportional current on the primary side of the transformer, which goes through the output and ground of the 8850-2. When the power current drawn by the EUT is large, a resistive load may be required across the primary of the 6220-1A to reduce the impedance, minimizing the power frequency voltage fed back to the 8850-2. For best results, this load should be 1 to 3 Ω with a high wattage rating. The Type 8814-1.5 (1.5 Ω, 21 volts max, rated at 300 watts) or the Type 8814-2.4 (2.4 Ω, 20.5 volts max, rated at 200 watts).

4.0.2 Monitoring the output level of the 8850-2 and associated 6220-1A Isolation Transformer with an oscilloscope for waveform is essential. If excessive current or voltage occurs at the output terminals, distortion will cause the protective circuit to trigger and the RESET button will illuminate.

4.1.0 OUTPUT PROTECTION

WARNING! DO NOT REPLACE THE PROTECTIVE FUSE WITH FUSES GREATER THAN 15 AMPERE RATING OR SLOW-BLOW FUSES!

4.1.1 Conditions that cause failure of the fuse, or trigger the protective circuits. To avoid damage to the output transistors, protective circuits have been provided which include a fifteen-ampere fuse and a replace fuse indicator lamp. A reset circuit push-button located on the front panel provides over voltage and over current protection for the Model 8850-2.

4.1.2 REPLACE FUSE indicator

The REPLACE FUSE indicator lights due to fuse failure due to over current at the amplifier output. The current is the current due to the test signal from the Model 8850-2 added to the power frequency current delivered back toward the 8850-2 by the EUT.

4.1.3 RESET Lamp
The reset lamp lights when the amplifier output voltage exceeds 20.5 volts RMS as indicated on the VOLTS OUT digital display on the front panel). RESET can be undone by reducing the output voltage under 20.5 volts and pressing the RESET button.

4.1.4 RESET Lamp Will Not Turn Off
This can be caused by three conditions:

1. The OUTPUT LEVEL knob is set higher than 20.5 volts RMS.

2. Current consumed by the EUT is high enough to send an over voltage at the power line frequency that is sent backwards through the transformer to the 8850-2 output.

3. The 8850-2's internal heatsink temperature exceeds 60° C.
The protective circuit can be reset after the 8850-2 cools down to 50° C.

5.0.0 OPERATION

5.0.1 Operating With Remote Sensing Feature

NOTE: WHEN USING THE REMOTE SENSE FEATURE, THE OUTPUT LEVEL WILL NOT EXCEED 7.5 VOLTS RMS.

With the 8850-2 turned off, plug Remote Sensory Accessory Cable (Solar P/N 885066) into the REMOTE SENSE jack on the front panel. Connect the other end to the AC VOLTMETER terminals of the 6220-1A Isolation Transformer or similar, injection device. Turn on the 8850-2. The RMS VOLTS OUT meter on the 8850-2 will display the voltage seen by the EUT. Automatic gain control will maintain a constant voltage up to 7.5 volts correcting the frequency response of the Type 6220-1A Injection device as frequencies are swept.

5.0.2 Operating Without Remote Sensing Feature
When the Remote Sensory Accessory Cable is not used, the RMS VOLTS OUT meter displays the voltage present at the output terminals of the 8850-2. This voltage can be increased to more than 20 Volts R.M.S., or 15A depending on the load connected to the OUTPUT terminal. The automatic gain control circuits will maintain the selected voltage as frequency is scanned.

If the Type 6220-1A Isolation Transformer is connected to the output terminals of the Model 8850-2 High Power Sweep Generator, the audio voltage on its secondary (at one kilohertz) will be approximately one half of the level indicated on the R.M.S. VOLTS OUT meter.

Although the automatic gain control circuit will maintain a constant voltage level at the output terminals as frequency is scanned, the secondary voltage of the Type 6220-1A Isolation Transformer will not remain constant, having high frequency roll off.

5.1.0 Audio Frequency Injection DC Power Lines

When Injecting audio voltages in series with DC power leads to the EUT, it is not necessary to null out interfering voltages from the power line unless the AC ripple on the DC power source is significant. In this situation, a large value capacitance can be connected across the power source in an effort to provide a pure DC voltage to the EUT. See Figure 1.

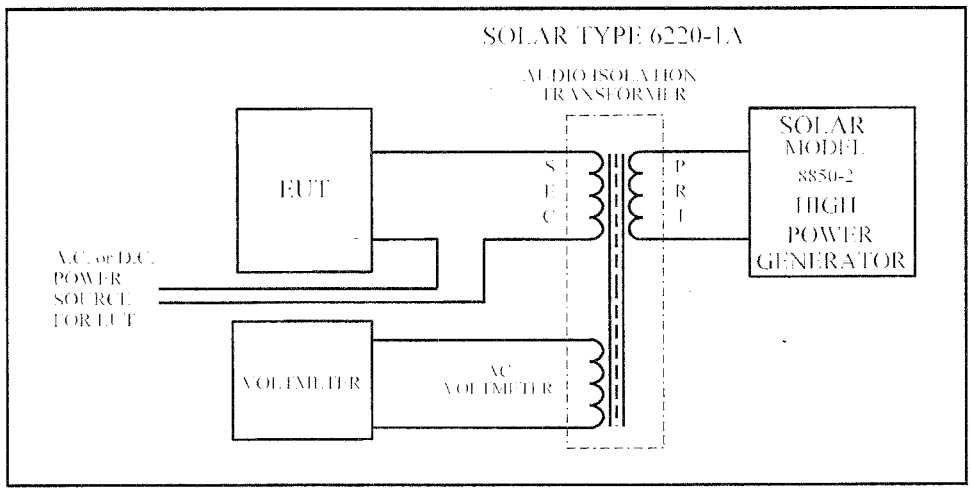


Figure 1 AUDIO SUSCEPTIBILITY TEST SETUP FOR AC or DC LINES

5.3.0 Audio Frequency Injection on AC Power Lines

Section 5.3.0 describes the test procedure for CS01 / CS101 testing without the use of a phase shift network. Section 6.0.0 describes the test using a phase shift network to cancel out the power line frequency from measurements.

5.3.1 Preliminary Procedure.

With the equipment connected as shown in Figure 1, turn on the Model 8850-2. The OUTPUT of the 8850-2 will be disconnected at power up and will remain disconnected until the reset button is pressed. Turn the OUTPUT LEVEL knob to minimum (counterclockwise). Press the RESET button so the red light is off. The 8850-2 output is now connected to the transformer.

5.3.2 Turn on the power to the EUT. Under this condition, the external AC meter and the R.M.S. VOLTS OUT meter on the 8850-2 will read the level of the power line voltage being fed back to the Model 8850-2.

5.3.3 Commence the desired power sweep test by selecting the desired amplitude and sweep mode from the 8850-2 panel.

6.0.0 Audio Frequency Injection on AC Power Lines Using The Solar Model 7021-1 Phase Shift Network

One of the difficulties encountered in performing this test on AC power lines is measuring the injected audio voltage in the presence of the power line voltage. The simplified test setup shown in MIL-STD-462 does not provide a means for measuring the two voltages separately. However, by using the Solar Electronics Model 7021-1 Phase Shift Network, it is possible to measure the injected voltage with little or no interference from the power line voltage. See Figure 2.

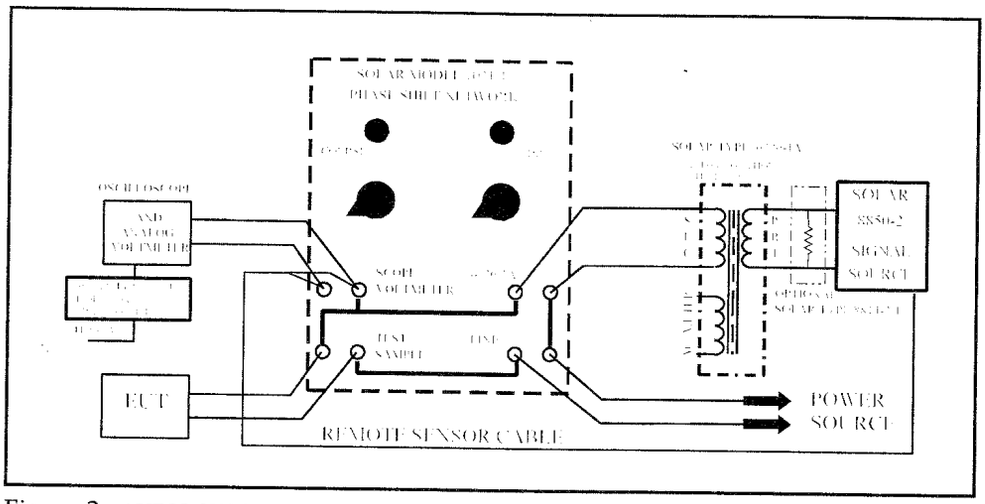


Figure 2 AUDIO SUSCEPTIBILITY TEST SETUP ON AC POWER LINES

The Model 7021-1 Phase Shift Network can be adjusted to cancel out the AC power line frequency to below 300 millivolts without disturbing the injected voltage as indicated on the digital meter labeled R.M.S. VOLTS OUT on the front panel of the Model 8850-2.

6.0.1 Preliminary Procedure
With the equipment connected as shown in Figure 2, turn on the Model 8850-2. After a short delay the equipment will be ready. The OUTPUT of the 8850-2 will be disconnected at power up and will remain disconnected until the reset button is pressed. Turn the OUTPUT LEVEL knob to minimum (counterclockwise). Press the RESET button so the red light is off. The 8850-2 output is now connected to the transformer.

6.0.2 Turn on the power to the EUT. Under this condition, the external AC meter and the R.M.S. VOLTS OUT meter on the 8850-2 will read the level of the power line voltage being fed back to the Model 8850-2.

6.0.3 Adjustment of the 7021-1 Phase Shift Network
Although the operation of Model 7021-1 is relatively simple, there is considerable interaction between the various controls and is necessary to repeat the adjustment for each step several times to achieve the lowest null. With careful attention to this, it should be possible to reduce the power line voltage seen by the R.M.S. VOLTS OUT meter and oscilloscope to below 300 millivolts. The actual level that can be reached is dependent on the harmonic content of the power source current. The network can only reject one frequency at a time the fundamental frequency of the power line such as 50 Hz, 60 Hz, or 400 Hz.

6.0.4 Carefully adjust Model 7021-1, searching for a reduction of the voltage indicated on the external AC voltmeter, oscilloscope and R.M.S. VOLTS OUT meter of Model 8850-2. Begin by setting coarse step switch to '0' and the fine step switch to '1'. For each step of the switches use the coarse and fine controls as verniers, until the lowest null voltage is achieved.

6.0.5 Select the manual mode and one of four frequency bands by pressing the desired frequency range push-button, tune to the desired frequency using the FREQUENCY KILOHERTZ knob. While in the manual mode, increase the OUTPUT LEVEL knob until the desired injection level is indicated on the R.M.S. VOLTS OUT digital meter.

7.0.0 MAINTENANCE & CALIBRATION

7.0.1 Required Equipment
The following equipment is required for the testing and calibration of the 8850-2.

1. Oscilloscope
2. AC voltmeter capable of measuring 0.1 mV to 200 V AC
3. DC voltmeter capable of measuring 0.1 mV to 200 V DC
4. Solar type 6220-1A Audio Isolation Transformer
5. Stopwatch
6. optional: Frequency counter with a range from 20 Hz to 155 kHz,
7. Load resistor, 0.5 ohm, 400 watt

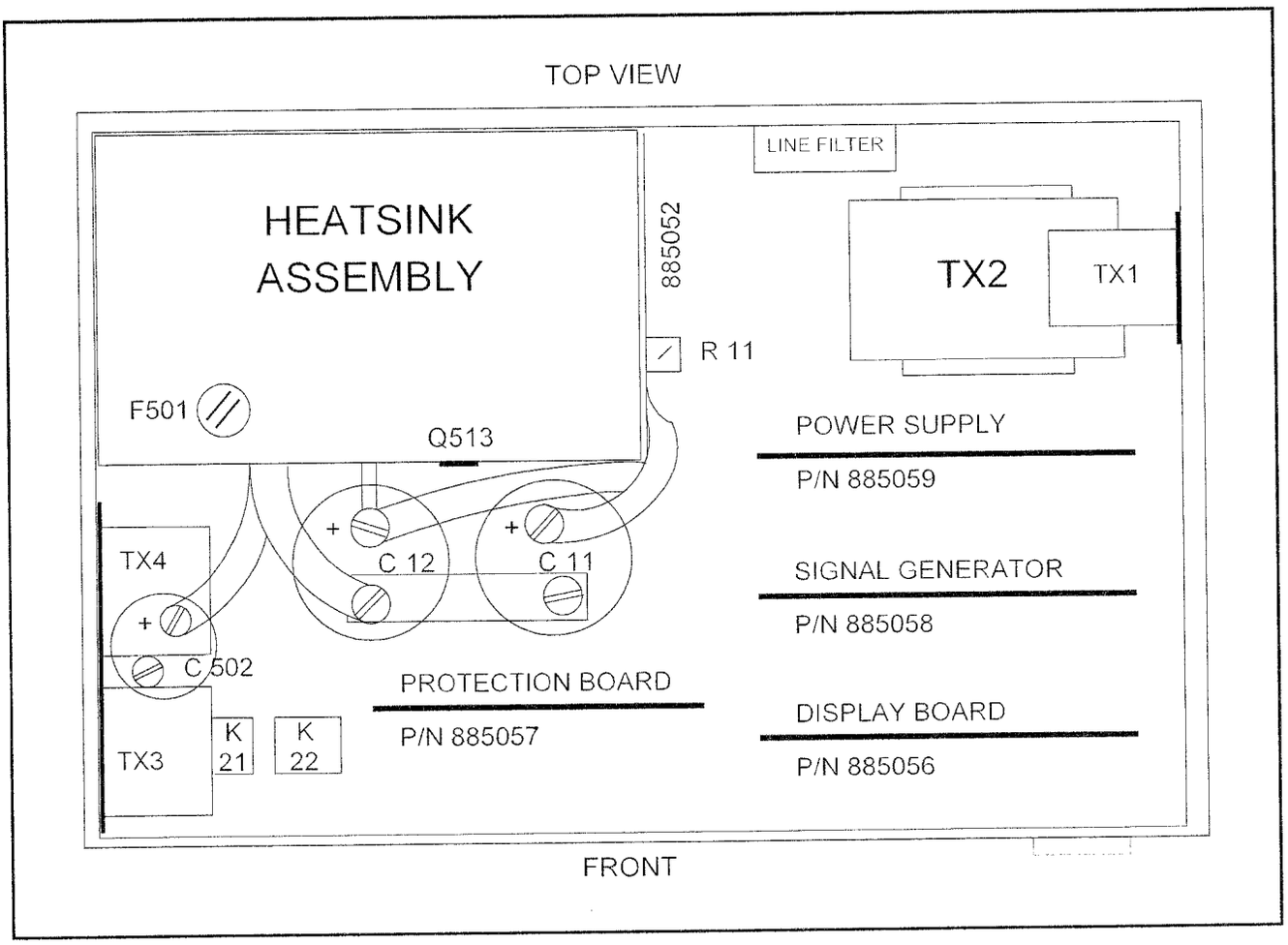
All adjustments will be made with the 8850-2 right side up with the top cover removed and the front panel facing the technician. Turn unit on after test probes are connected. Turn unit off between test procedures.

CAUTION ! Shock hazard exists on the large capacitors C11 & C12 with power disconnected !

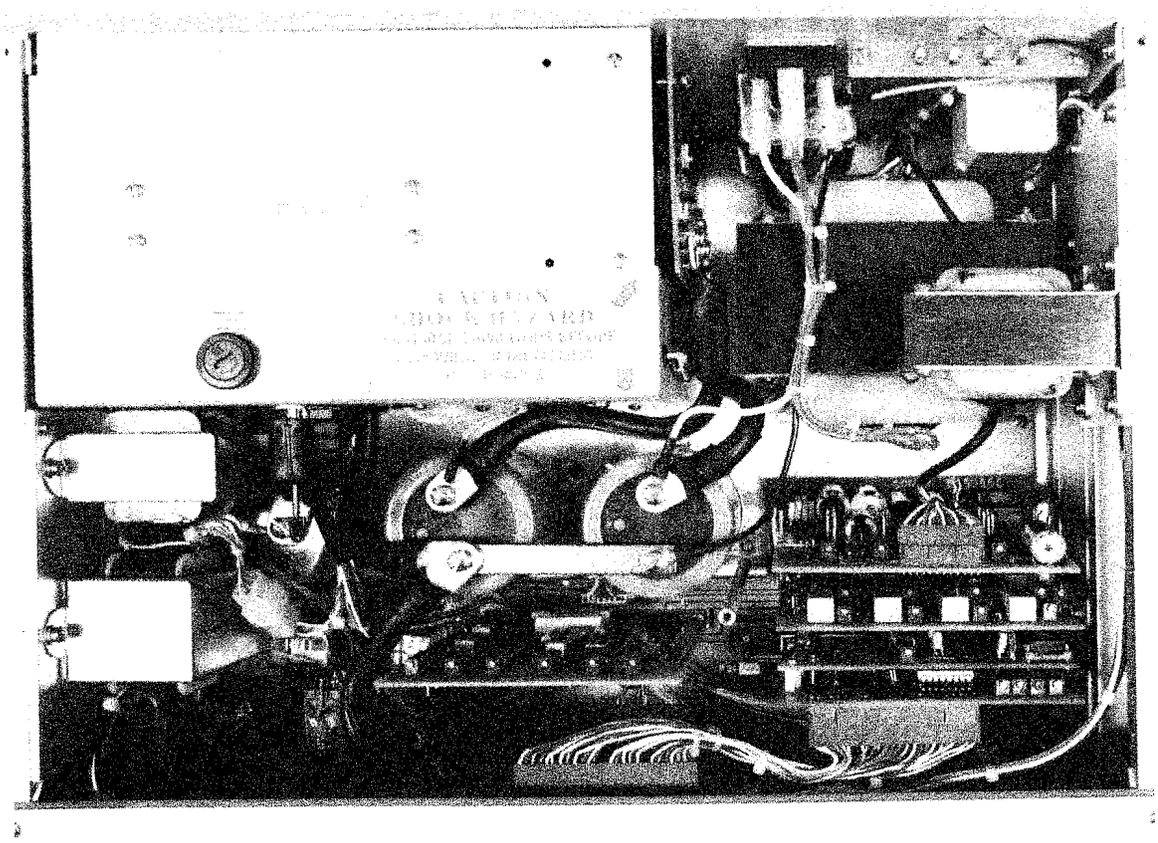
Allow 30 seconds for discharge after turning off the power.

7.0.2 Check Power Supply Voltage
See Figure 3. Locate C11, one of the two large capacitors in the center of the 8850-2. Using a DC voltmeter set to the 200 volt scale, measure power supply voltage on C11 on the right-hand side measures approximately 100 V DC with negative connected to the buss bar that connects the two capacitors together. CAUTION These capacitors could hold their charge with the power off. Do not touch or short out these terminals. Use load resistor 25 ohm 25 watt to discharge before removing PC boards, or wait 30 seconds after turning off the power.

7.0.3 Adjust the regulated 80 volts. Locate C12 in the center of the 8850-2. C12 should be 80 volts DC. Adjust the voltage on C12 via trimpot R11, shown in the upper center of Figure 3.



Figures 3 and 3½ Top View 8850-2



7.2.0 POWER SUPPLY BOARD P/N 885059

7.2.1 Locate Power Supply Board P/N 885059 on the right-hand side toward the back back of the 8850-2. See Figures 4 and 5 for test points and trimpot locations. Unless otherwise noted, DC voltage measurements will be made with the negative lead connected to the black binding post (OUTPUT - ground) on the front panel.

7.2.2 Pre-amp Supply
Check that test point TP-10 is +40 VDC ±3V.

7.2.3 +15V Supply
Check that test point TP-11 is +15 VDC ±0.5V.

7.2.4 -15V Supply
Check that test point TP-12 is -15 VDC ±0.5V.

7.2.5 +5V Supply
Check that test point TP-13 is +5 VDC ±0.2V.

7.2.6 Remote Sensor -15V Supply
With the voltmeter negative lead connected to TP-15, check that test point TP-14 is -15 VDC ±0.5V.

7.2.7 Remote Sensor -15V Supply
With the voltmeter negative lead connected to TP-15, check that test point TP-16 is +15 VDC ±0.5V.

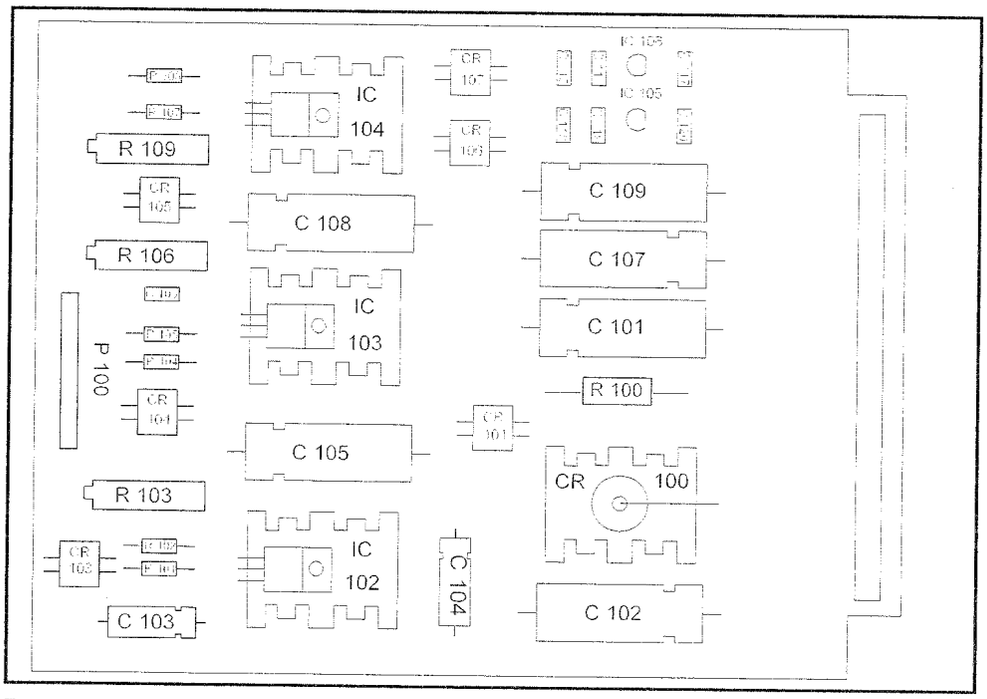


Figure 4 Power Supply Board 885059 component side

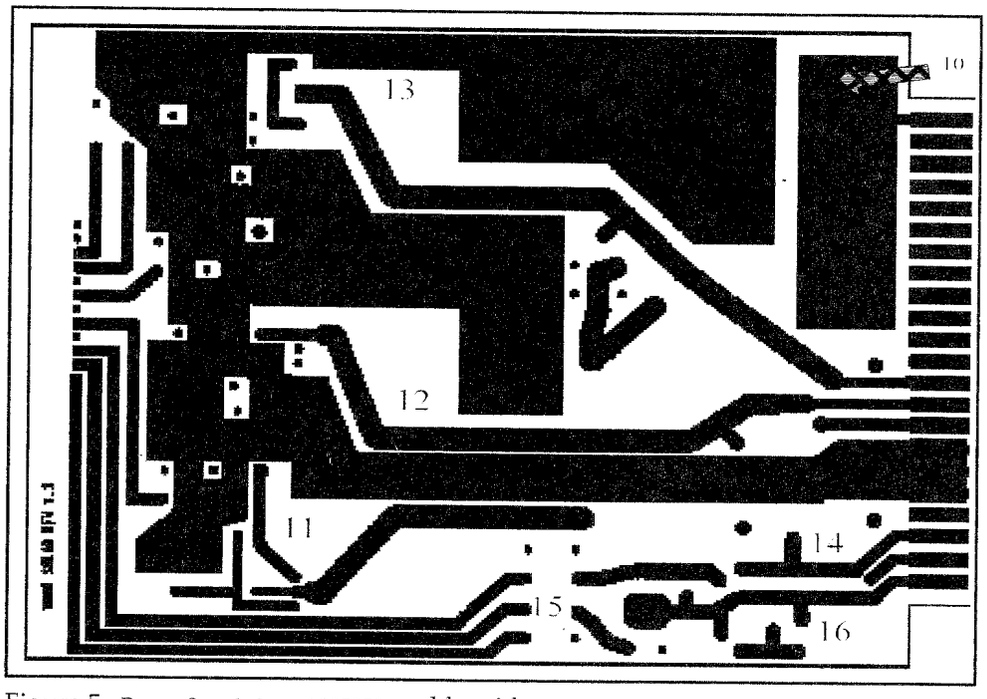


Figure 5 Power Supply board 885059 solder side

7.3.0 SIGNAL GENERATOR BOARD P/N 885058

7.3.1 Locate the Signal Generator Board P/N 885059. See Figure 3.

7.3.2 Adjust Minimum Frequency for each band. Turn the FREQUENCY KILOHERTZ knob to minimum (counterclockwise). There is only one trimpot which adjusts the start frequency for all four bands simultaneously, trimpot R236 shown in Figure 6. The two frequency bands to worry about are the middle two, 0.2-2KHZ and 2-20KHz. Adjust R236 so that one of the start frequencies meets the value in the Start Frequency Adjustment table while the other frequency band's start frequency must be less than the target. For example,
the 0.2-2KHZ start frequency can be adjusted to 191 Hz at 70^{O} F while
the 2-20KHz start frequency must be left at 1.89 KHz.
Choose the start frequency to adjust to based on the estimated temperature of the 8850-2 Signal Generator Board. For a room temperature of 70^{O} F, the 8850-2 will warm up to about 100^{O} F in 37 minutes with the lid on.

Start Frequency Adjustment			
Temperature, F	200Hz-2KHz	2KHz-20KHz	minutes since cold start @70^{O} F
70	191 Hz	1.91 KHz	0
80	193 Hz	1.924 KHz	3:38
90	195 Hz	1.94 KHz	10
100	197 Hz	1.961 KHz	37

Rationale:
The 20 HZ to 200 Hz band is not required to start at 20 Hertz for the CS101 test, only 30 Hertz, so 20 Hz should get priority for the start frequency adjustment. The 20KHz-150KHz band spans less than a decade of frequency, so it may start as low as 15 KHz without the frequency sweep going too fast. Only the middle two frequency bands have to sweep a full decade.

Each band start frequency should be within 10% tolerance. Read the frequencies from the 8850-2 KILOHERTZ digital display. Compare these frequencies with the external frequency counter.

7.3.3 Adjust Maximum Frequency In Each Band

Turn Frequency knob fully clockwise. The following frequency measurements should be read from the 8850-2's KILOHERTZ digital display, with an external frequency counter used as to verify the internal KILOHERTZ display's accuracy. Estimate the 8850-2 temperature. Use the temperature to select the row of the table with the best stop frequencies to adjust to.
Adjust each trimpot R205 through R208 for each of the four stop frequencies

Stop Frequency Adjustments				
trimpot	R205	R206	R207	R208
Temperature, F	.02 - 0.2 KHz	0.2 - 2 KHz	2-20 KHz	20-150 KHz
70	0.201	2.010	20.10	152
80	0.20102	2.014	20.117	151.5
90	0.2015	2.0167	20.128	151.27
100	0.2015	2.0223	20.145	151.32

7.3.4 Adjust Minimum Amplitude
With the OUTPUT LEVEL knob turned to minimum and the FREQUENCY KILOHERTZ knob set to 1 KHz, adjust the amplitude to barely below the R.M.S. VOLTS OUT display's minimum resolution of .01, so that it reads .00. This is adjusted with trimpot R230 shown in Figure 6. An alternative method is to turn the OUTPUT LEVEL knob ½ turn above minimum and adjust the amplitude to 1 volt with trimpot R230.

7.3.5 Adjust SWEEP ONE BAND Sweep Duration
8850-2's manufactured after October 10 2006 do not need sweep rate adjustment. The sweep rate has been set for 4:30 + 5% extra to allow for start and stop frequency tolerances, which works out to 4:43.5 (minutes:seconds). The following table gives a sample measurement of sweep rate verses the temperature of the Signal Generator Board.

temperature, ^{O}F	75	85	91	97	103.2	110
Sweep Time	4:48.56	4:47.16	4:46.35	4:47.22	4:47.53	4:48.37

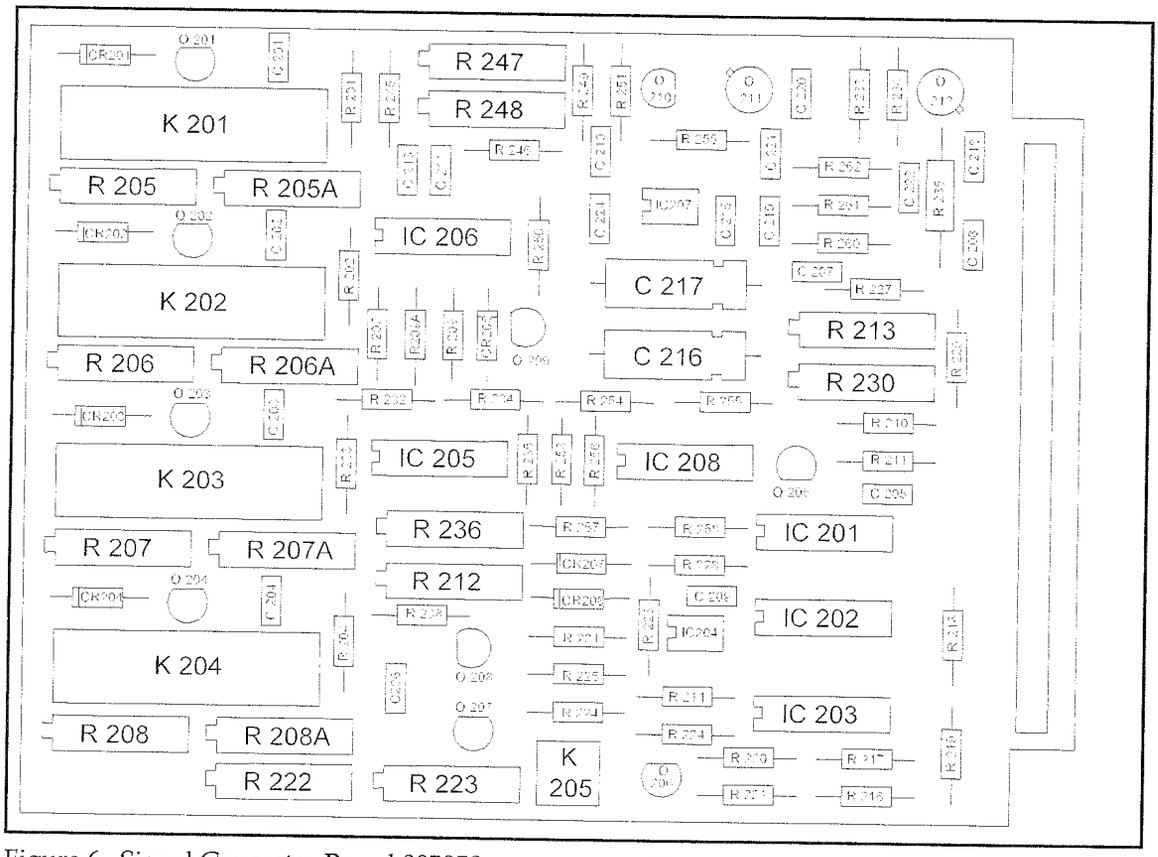


Figure 6 Signal Generator Board 885058 component side

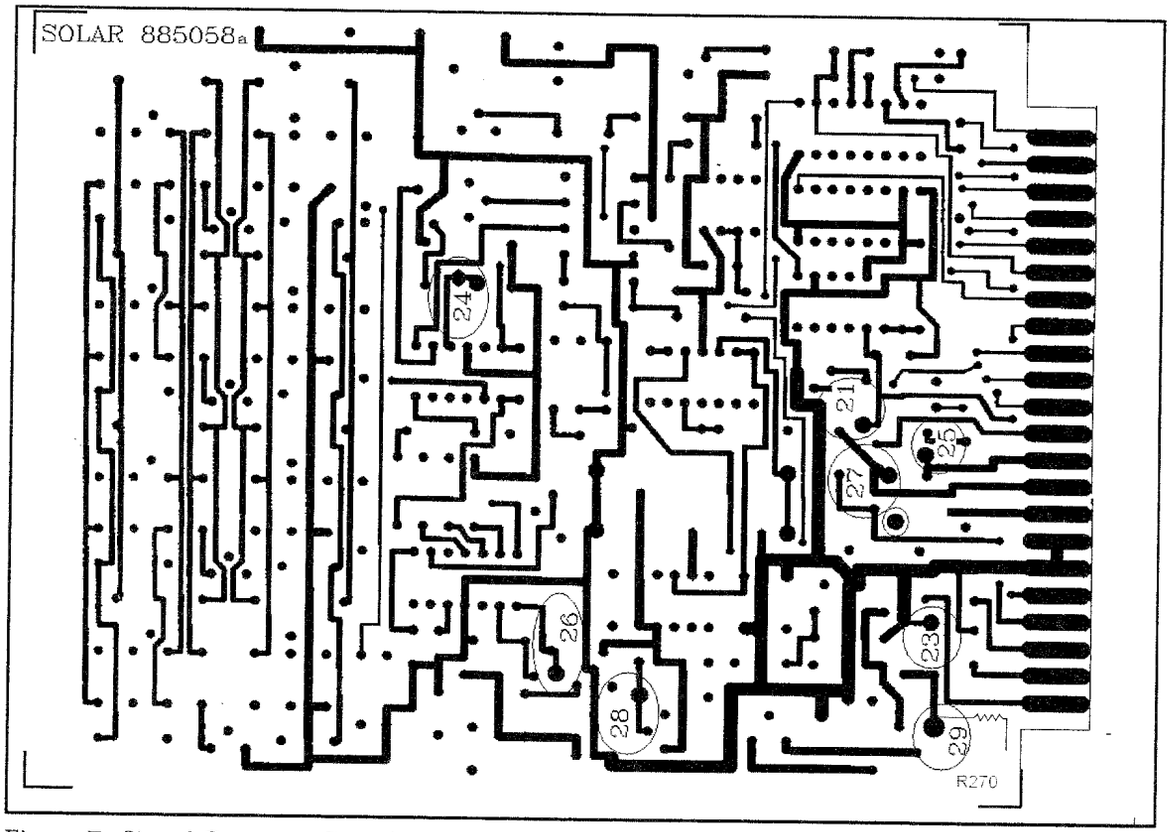


Figure 7 Signal Generator Board 885058 solder side

7.4.0 DISPLAY BOARD P/N 885056

7.4.1 Locate the Display Board P/N 885056. See Figure 3.

7.4.2 Set the 8850-2's OUTPUT LEVEL and FREQUENCY KILOHERTZ knobs to minimum (counterclockwise).

7.4.2 Adjust Meter Reference Voltage
Set test point TP-33 in Figure 9 to 2.499 VDC by adjusting trimpot R310 in Figure 8.

7.4.3 Adjust Reference Voltage
Set test point TP-32 in Figure 9 to 1.99 VDC by adjusting trimpot R306 in Figure 8.

7.5.0 PROTECTION BOARD P/N 885057

7.5.1 Locate the Protection Board P/N 885057 See Figure 3 to.
All adjustments should be made as close as possible and may take several attempts before you are satisfied with the results.

7.5.2 Connect an oscilloscope and an AC voltmeter to the 8850-2 output. Set the 8850-2 output level to minimum and frequency to 1 KHz,

7.5.3 Adjust Zero Voltmeter Reference
Remove 15 amp fuse from front panel. Measure 0.0 mV DC at test point TP-41 in Figure 11. This is accomplished by pressing the RESET bottom. It may be necessary to hold down the RESET button for the output relays to stay energized. Adjust trimpot R405 in Figure 10 or readjust trimpot R230 on signal generator board if necessary to obtain 0.0 mV. Replace 15 amp fuse in front panel.

7.5.4 Set Low Meter Reference Voltage
Set test point TP-41 in Figure 11 to 100 mV DC by turning the OUTPUT LEVEL knob on the front panel up approximately ½ turn.

7.5.5 Adjust Comparator Voltage
Set test point TP-40 in Figure 11 to 100 mV AC by adjusting trimpot R402 in Figure 10, or readjust R230 on the Signal Generator Board.

7.5.6 Set Low RMS Voltmeter Reference

Measure 100 mV AC at test point TP-40 by adjusting the OUTPUT LEVEL knob on front panel.

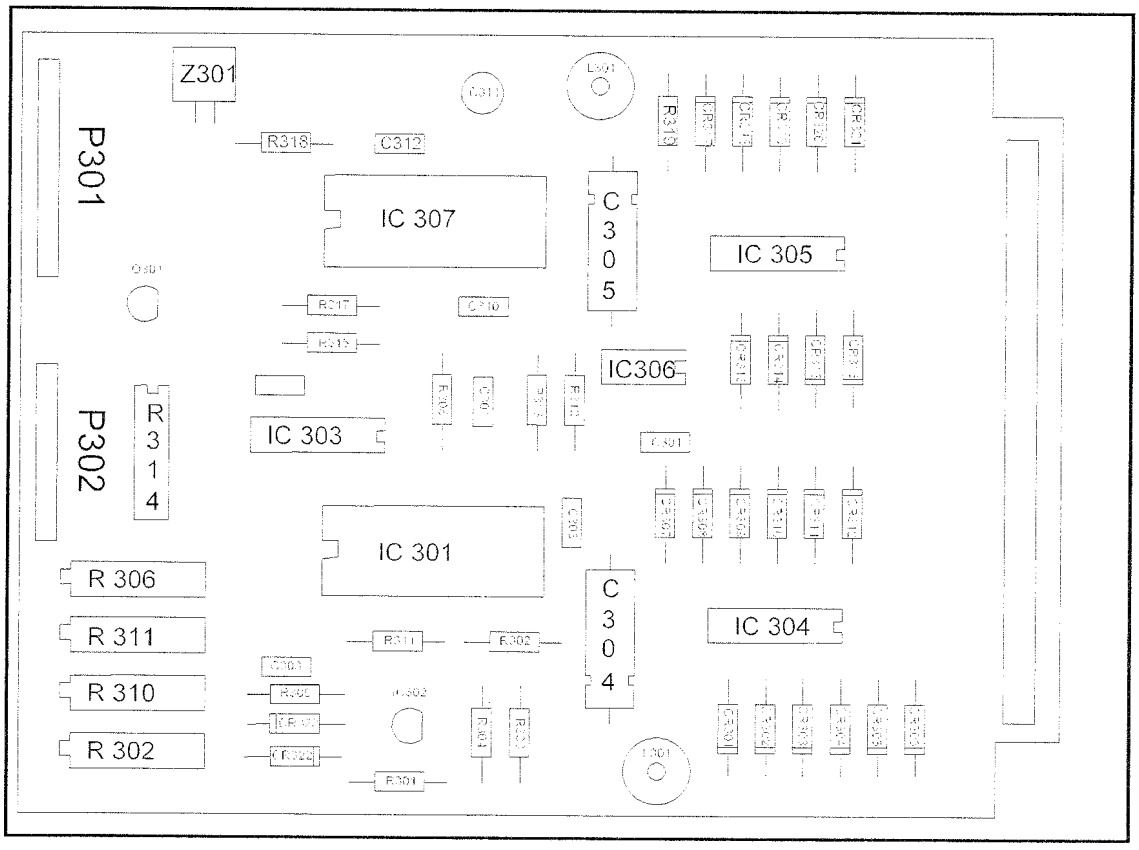


Figure 8 Display Board 885056 component side

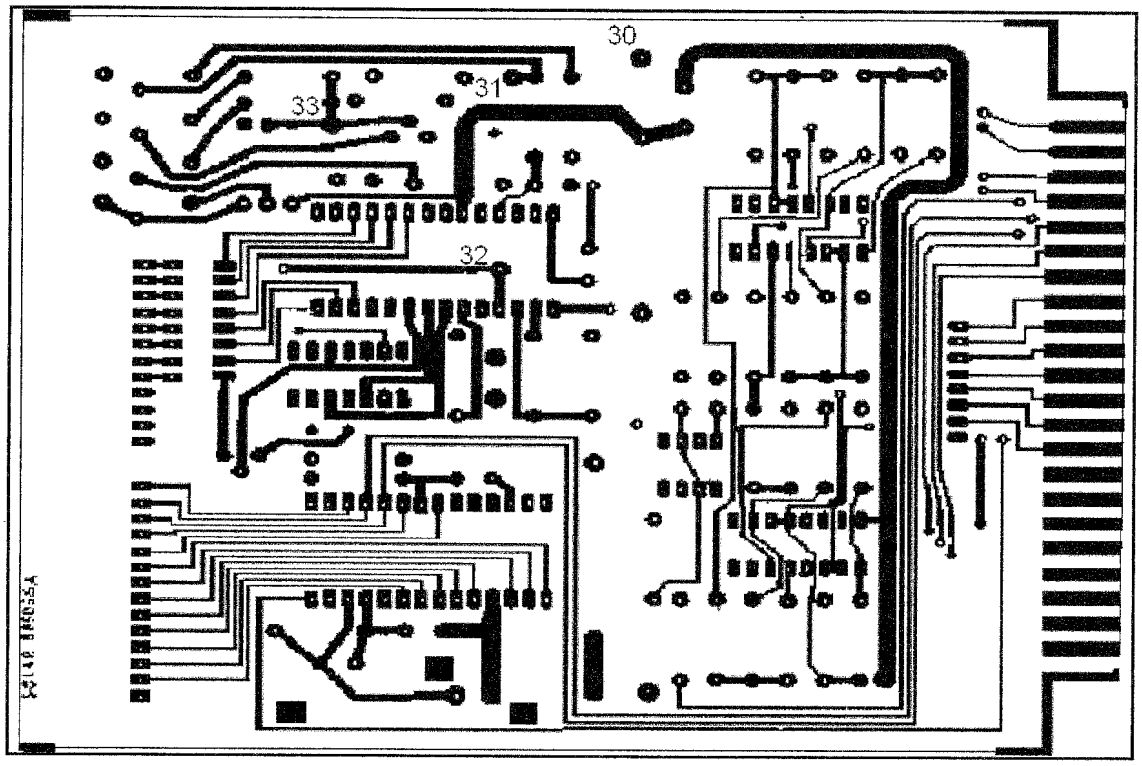


Figure 9 Display Board solder side

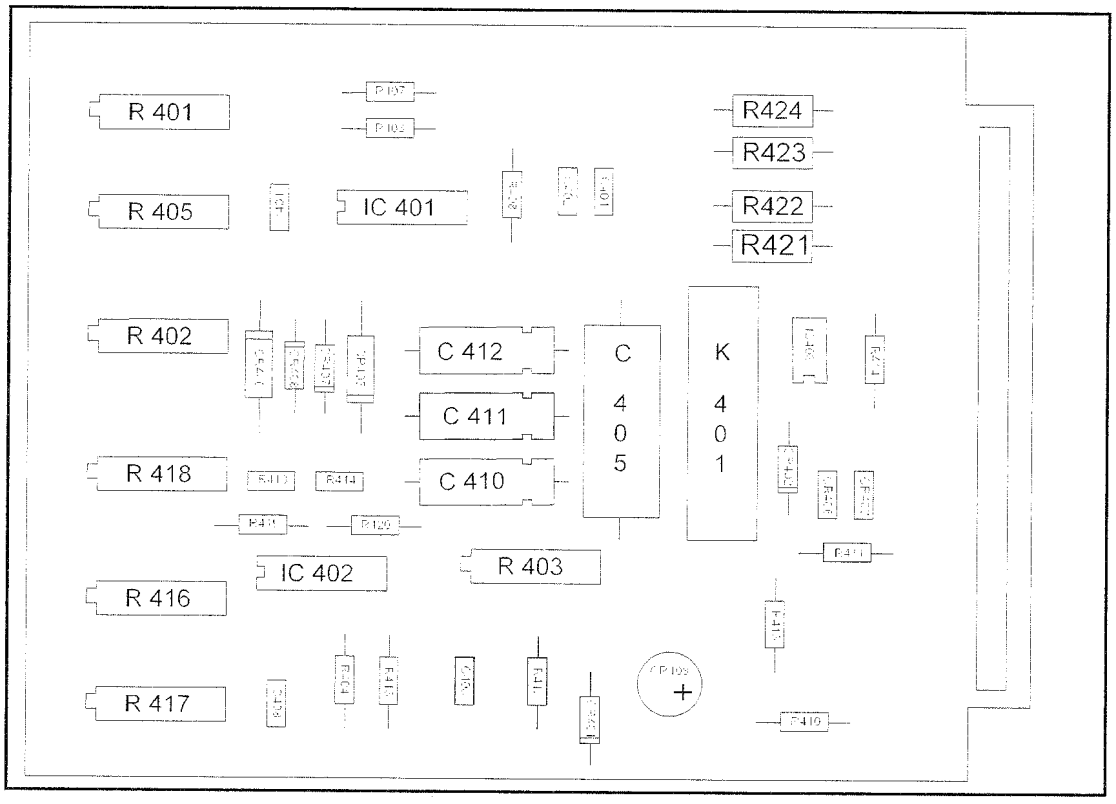


Figure 10 Protection Board 885057 component side

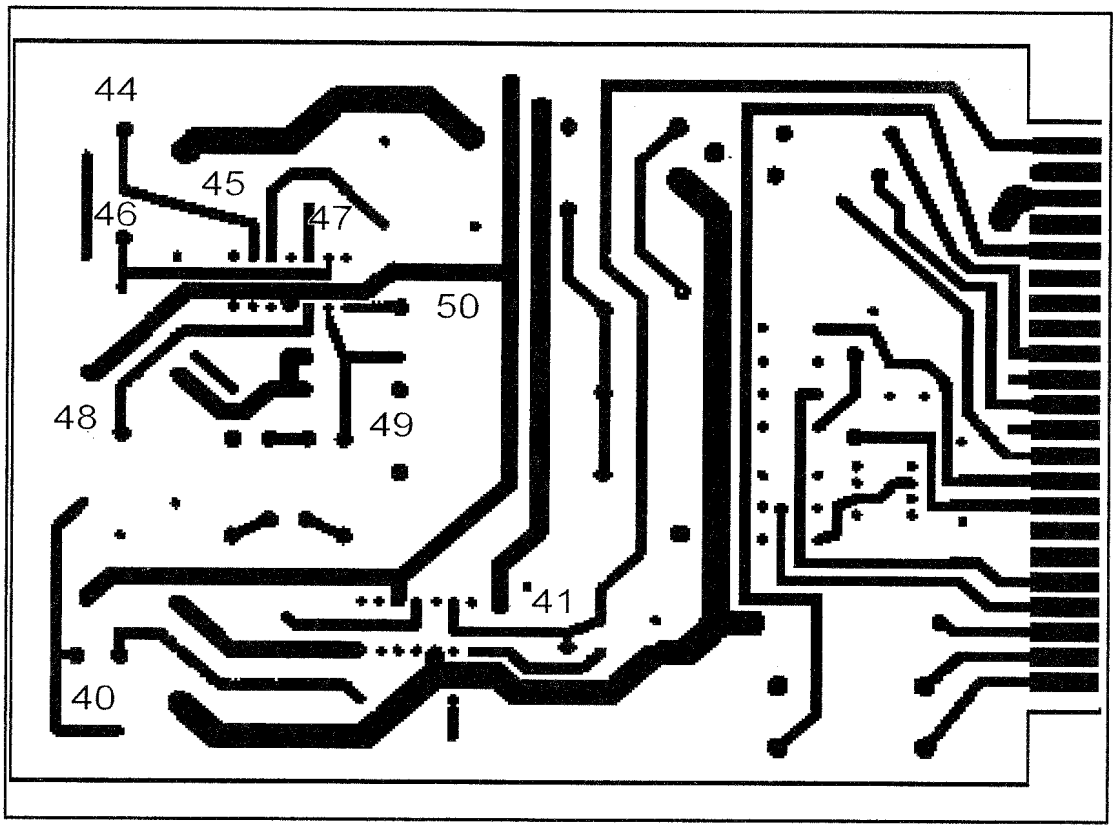


Figure 11 Protection Board 885057 solder side

7.6.0 DISPLAY and PROTECTION BOARD Adjustments

DISPLAY BOARD

7.6.2 Adjust meter to read 1.00 volts RMS by adjusting trimpot R311 in Figure 8. If you are unable to bring the voltmeter to the correct reading, adjust R306 on the display board.

PROTECTION BOARD

7.6.3 Adjust Low voltage at output terminals to match RMS volt meter. Adjust trimpot R401, Figure 10.

7.6.4 Set High Voltmeter Reference

Measure 2.0 V AC at test point TP-40, Figure 11. This is adjusted with OUTPUT LEVEL control on the front panel.

DISPLAY BOARD

7.6.5 Adjust high R.M.S. VOLTS OUT meter to read 20.00 by adjusting trimpot R302, Figure 8. If you are unable to bring the voltmeter to the correct reading adjust R306, Figure, 8 on the display board until the correct reading is achieved.

PROTECTION BOARD

7.6.6 Adjust High Output Voltage to match RMS voltmeter. Adjust Trimpot R401, Figure 10.

Repeat minimum Amplitude adjustment

With Amplitude knob turned up ½ turn and Frequency set to 1 KHz, set the signal at the output terminals to 1 V AC by adjusting trimpot R230, Figure 10.

REPEAT STEPS 7.5.3 through 7.6.6

7.7.0 PROTECTION CIRCUIT TEST

Current Limit Reference Voltage (CLRV).
Positive Limit Reference Voltage (PLRV)
Negative Limit Reference Voltage (NLRV)

TEST THESE CIRCUITS THOROUGHLY BEFORE READJUSTING.

7.7.1 CLRV Test. Connect 6220-1A With .5 ohm load to output terminals. Set Frequency to 30 Hz, increase amplitude until reset occurs, between 16.5 and 17.0 volts.

7.7.2 PLRV & NLRV Test. Remove 6220-1A. Increase amplitude until reset condition occurs, 24 to 25 volts.

7.8.0 PROTECTION CIRCUIT ADJUSTMENT

Adjust CLRV, PLRV and NLRV shutoff protection circuits. Connect Solar Model 6220-1A transformer with 0.5 ohm load to the output terminals.

7.8.1 Adjust CLRV Shutoff Protection Circuit
Record +DC voltage at (TP-44)_____. Increase amplitude to 17 volts, Adjust trimpot R417, Figure 10. Decreasing the DC volt at test point TP-44 will trigger CLRV at a lower current.

7.8.2 Adjust PLRV
Disconnect 6220-1A. Measure DC voltage at test point TP-46. Record voltage _____. Readjust to +5 V DC with trimpot R416, Figure 10 to prevent interference with NLRV circuit adjustment.

7.8.3 Adjust NLRV at test point TP-48. Record voltage _____. Adjust trimpot R418, Figure 10, to trigger at 24 to 25 VAC by increasing amplitude and increasing or decreasing DC voltage at test point TP-48, Figure 11, to trigger at the desired voltage. Record new NLRV voltage _____. Readjust to a higher voltage so not to interfere with PLRV circuit adjustment.

7.8.4 Adjust PLRV at testpoint TP-46. Adjust trimpot R416, Figure 10, to trigger at 24 to 25 volts AC. Increase amplitude to 24 to 25 volts and increasing or decreasing DC voltage at TP-46 will trigger the reset circuit. Readjust new NLRV voltage at TP-48, Figure 11, with trimpot R416, Figure 10.

7.9.0 DETAILED CALIBRATION

To view the interaction between the reference voltage and the trigger voltage, use an Oscilloscope with two inputs. The LM 348 compares the two voltages and when they become equal a pulse will set the 2N4185 dropping out the output relays and illuminating the reset light.

7.9.1 CLRV reference voltage is measured at test point TP-44 and trigger voltage is measured at TP-45.

7.9.2 PLRV reference voltage is measured at test point TP-46 and trigger voltage is measured at TP-47.

7.9.3 NLRV reference voltage is measured at test point TP-48 and trigger voltage is measured at TP-49.

8850-2 PARTS LIST

REFERENCE	CHASSIS & BACKPANEL-885035	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
DRM1	Delay Relay Module (115V)	Solar 885070
P1	A.C. Power Module	Bussman TRON-PDN-C1
PAM1	Power Amp Module	Solar 885074
F1, F2	Fuse, 10amp (115V) Fuse, 5amp (230V)	Bussman AGC-10 Littelfuse 312005
FL1	Line Filter	Solar 739936
M1	Fan (115V)	NMB Tech. 5915PC-12T-B30
TX1	Transformer multi volt	Solar 885061
TX2	Transformer 70 volt	Solar 885062
TX3	Transformer audio	Solar 885063
TX4	Transformer audio driver	Solar 655014

REFERENCE	FRONT PANEL-885002C	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
LEDM1	LED Display Module	Solar 885073
PBM1	Push-button Module	Solar 885072
F403	Fuse, 15amp (115V)	Littelfuse 311015
	Fuse, 12.5amp (230V)	Littelfuse 001.1015
LED401	LED, Red-Low Profile	Dialite 521-9180
LT400,LT402	Indicator Light, 12V	Arcolectric FL589C7R
LT401	Lamp, 14V	Sylvania 382
PB401	Pushbutton Switch	Dialite 554-1121-111
PJ401	Phone Jack	Switchcraft 113
R200,R299	Potentiometer, 10K	Bourns 3540-1-103K
S1	Power Switch	Carling LRGSCK-221

REFERENCE	POWER AMP BOARD - 885050	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
C502	Capacitor, 9800 uF 100V Electrolytic	Sprague 36DX932G100C2A
Q513,Q514,Q515,Q516 Q517,Q518,Q519 Q520,Q521	Transistor, Matched Freescale Semiconductor 2N5629	
R501,R502,R503,R504 R505,R510,R511 R512,R513,R514	Resistor, 2 ohm Wirewound Ohmite 93J2R0	
R506,R507,R508,R509 R515-R518	Resistor, .562 ohm ± 1% Wirewound	Ohmite 80FR562
R519,R520	Resistor, 150 ohm ± 20W Wirewound	Ohmite B20J150

MISCELLANEOUS

QTY		
1	Printed Board	Solar 885050

REFERENCE	80V-MAIN POWER SUPPLY BOARD-885052 & CHASSIS	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
C11,C12	Capacitor, 21000 uF 100V Electrolytic	Mallory CGS213U100X5L
IC11	Voltage Regulator	Texas Instrument TL783C
Q11	Transistor (115V) Transistor (230V)	Freescale Semiconductor MJ802 National BUX22
Q12	Transistor	Freescale Semiconductor 2N6437
R11	Trimpot, 10K ohm	Bourns 3006P-1-103
R12	Resistor, 10K ohm ± 5% 1/2W Carbon	Allen Bradley RCR20GF103J
R13	Resistor, 82 ohm ± 5% 1/2W Carbon	Allen Bradley RCR20GF820J
R14	Resistor, 10 ohm ± 5% 1/2W Carbon	Allen Bradley RCR20GF100J
R15	Resistor, 3.3K ohm ± 5% 1/2W Carbon	Allen Bradley RCR20GF332J
S11	Thermoswitch	Elmwood 3150-023-105

MISCELLANEOUS

QTY

1	Printed Board	Solar 885052

8850-2 PARTS LIST

REFERENCE	LED DISPLAY BOARD-885053	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
LED300 thru LED308	7 Segment Ultra Bright LED Display	AND 362VR
P300A	Lock Header, 12-pin Fraction	Molex 22-23-2121
P301A	Lock Header, 14-pin Fraction	Molex 22-23-2141

MISCELLANEOUS

QTY		
1	Printed Board	Solar 885053

REFERENCE	PUSH BUTTON BOARD-885054	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
C30,C31,C32,C33 C34,C35,C36	Capacitor, .01 uF ± 10% 200V, Ceramic	Kemet CKR06BX103KR
P20A	Lock Header, 16-pin Friction	Molex 22-23-2161
PB30,PB31,PB32,PB33 PB34,PB35,PB36	Pushbutton Switch (w/LED Lum.)	ECG 13001XX1
R30,R31,R32,R33 R34,R35,R36	Resistor, 100 ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF101J

MISCELLANEOUS

QTY		
1	Printed Board	Solar 885054

8850-2 PARTS LIST

REFERENCE	CONNECTOR BOARD-885055	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
C20,C21	Capacitor, 820 uF _+ 20% 15V Tantalum	Sprague 109D827X9015T
C22,C24	Capacitor, 100 uF 0-10VDC	Sprague 511DUSA8833H
C23	Capacitor, 470 uF 63VDC	Sprauge 511DUSA8922H2
P20	Lock Header, 16-pin Right Angle	Molex 22-05-3161
P21,P25	Lock Header, 4-pin Friction	Molex 22-23-2041
P22,P23	Lock Header, 20-pin Friction	Molex 22-23-2201
P24	Lock Header, 8-pin Friction	Molex 22-23-2081
K20	Relay, 24V, 4 Pole	Allied Control T154-2C-2C-24V
K21	Relay, 24V, DPDT	Omron LY2-US-24D
L20	Coil	Solar 8850-947UH
L21,L22	Coil	Solar 8850-890UH
L23	Coil	Solar 8850-143UH
L24	Coil	Solar 8850-721UH
R20	Resistor, 2K ohm ± 5% 5W Wirewound	Ohmite 95J2K0
VR20	Varistor	G.E. V47ZA7

MISCELLANEOUS

QTY		
1	Printed Board	Solar 885055

8850-2 PARTS LIST

REFERENCE	DISPLAY DRIVER BOARD-885056	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
C301	Capacitor, 250 pF ± 5% 500V Dipped Mica	Cornell Dubilier CM04FD251J03
C302	Capacitor, .47 uF ± 10% 50V Ceramic	Kemet CKR06BX474KR
C303	Capacitor, 33 uF 16V Dipped Tantalum	Sprague 199D336X9016D
C304,C305	Capacitor, 1000 uF 10VDC Electrolytic	Sprague 501D108M010NP
C310	Capacitor, .1 uF ± 10% 100V Ceramic	Kemet CKR06BX104KR
C311	Capacitor, 22 pF Dipped Mica	Cornell-Dubilier CM04ED220J03
C312	Capacitor, 62 pF ± 5% 500V Dipped Mica	Cornell-Dubilier CM04ED620J03
C313	Capacitor, 1.0 uF ± 10% 50V Ceramic	Kemet CKR06BX105KR
CR301 thru CR323	Diode	Freescale Semiconductor 1N4007
P300	Lock Header, 12-pin Right Angle Friction	Molex 22-05-3121
P301	Lock Header, 14-pin Right Angle Friction	Molex 22-05-3141
IC301	Analog- to-Digital 4-Digit Display Driver	National ADD3701CCN
IC302	Reference Diode, 2.5V	National LM336H-2.5
IC303	LED Display Digit Driver	National DS75492N
IC304,IC305	Quadruple S-R Latch	Signetics 74279
IC306	Timer	Texas Instruments NE555P
IC307	Frequency Counter/Timer	Intersil ICM7216DIPI
L301	Coil, 150 uH	Solar 8850-150uH
L302	Coil, 7.5 mH	Solar 8850-7.5mH
Q301	Transistor, NPN	Freescale Semiconductor 2N3904
R300,R318	Resistor, 6.8M ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF685J
R301,R303	Resistor, 27.4K ohm ± 1% 1/8W Film	Dale RN55C2742F
R302	Trimpot, 5K ohm	Bourns 3006P-1-502

REFERENCE	DISPLAY DRIVER BOARD-885056 continued	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
R304	Resistor, 1.02K ohm ± 1% 1/8W Film	Dale RN55C1021F
R305	Resistor, 2.4K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF242J
R306	Trimpot, 100K ohm	Bourns 3006P-1-104
R307	Resistor, 261 ohm ± 1% 1/8W Film	Dale RN55C2610F
R308	Resistor, 681 ohm ± 1% 1/8W Film	Dale RN55C6810F
R309,R312	Resistor, 100K ohm ± 1% 1/8W Film	Dale RN55C1003F
R310	Trimpot, 10K ohm	Bourns 3006P-1-103
R311	Trimpot, 50K ohm	Bourns 3006P-1-503
R313	Resistor, 200 ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF201J
R314	Resistor, 7 x 82K ohm ± 5% 1/4W Array	Bourns 4608X-101-82K
R315	Resistor, 16 ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF160J
R316	Resistor, 8 x 33 ohm ± 5% 1/4W Array	Dale MCP1603-330G
R317	Resistor, 82K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF823J
R319	Resistor, 10K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF103J
R320	Resistor, 220K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF224J
Z301	Crystal, 10 MHz	Micronium 44N6398

MISCELLANEOUS

QTY		
1	Printed Board	Solar 885056

8850-2 PARTS LIST

REFERENCE	PROTECTION BOARD-885057	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
C401,C402,C404,C406	Capacitor, 1.0 uF ± 10% 50V Ceramic	Kemet CKR06BX105KR
CR07,C408	Capacitor, .1 uF ± 10% 100V Ceramic	Kemet CKR06BX104KR
C403,C405	Capacitor, 10.0 uF ± 20% 100V Met. Mylar	Electrocube 230B1B106M
C409,C410,C411,C402	Capacitor, 33 uF, 20V Tantalum	Sprague 150D336X9020R
C413,C414	Capacitor, .47 uF ± 10% 50V Ceramic	Kemet CKR06BX474KR
CR401,RC402	Diode	Freescale Semiconductor 1N4007
CR403,CR404	Diode	Diodes Inc. J2
CR405,CR406	Zener Diode, 33V	Freescale Semiconductor 1N5937B
CR408	Transistor, SCR	Freescale Semiconductor 2N4190
IC401	RMS to DC Converter	Analog Devices AD536AJ
IC402	Operational Amplifier	Freescale Semiconductor LM348J
IC403	Operational Amplifier	Freescale Semiconductor MC1741CP1
K401	Relay	Aromat DS4E-S-DC12V
R401,R416,R417,R418	Trimpot, 20K ohm	Bourns 3006P-1-203
R402	Trimpot, 1K ohm	Bourns 3006P-1-102
R403	Trimpot, 1M ohm	Bourns 3006P-1-105
R404	Resistor, 110 ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF111J
R405	Trimpot, 50K ohm	Bourns 3006P-1-503
R406	Resistor, 470K ohm ± 5% 1/2W Carbon	Allen Bradley RCR20GF474J
R407,R408	Resistor, 261 ohm ± 1% 1/8W Film	Dale RN55C2610F
R409	Resistor, 12K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF125J

REFERENCE	PROTECTION BOARD-885057 continued	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
R410	Resistor, 150 ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF151J
R411	Resistor, 390 ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF391J
R412	Resistor, 10K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF103J
R413	Resistor, 180 ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF181J
R414	Resistor, 1K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF102J
R415	Resistor, 220K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF224J
R419,R420	Resistor, 1M ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF105J
R421,R422 R423,R424	Resistor, 2K ohm ± 5% 5W Wirewound	Ohmite 95J2K0

MISCELLANEOUS

QTY		
1	Printed Board	Solar 885057

REFERENCE	SIGNAL GENERATOR BOARD-885058	REVISED: 3-29-2006
DESIGNATION	DESCRIPTION	MANUFACTURER
C201	Capacitor, 0.47 uF 1% 50V polyproylene	Panasonic ECQ-P1H474FZW
C202	Capacitor, .047 uF 1% 50V polyproylene	Panasonic ECQ-P1H473FZW
C203	Capacitor, .0043 uF 1% 50V polyproylene	Panasonic ECQ-P1H432FZW
C204	Capacitor, 390 pF 5% 50V polyproylene	Panasonic ECQ-P1H391JZW
C205, C207, C208 , C218 C209	Capacitor, 1.0 uF ± 10% 50V Ceramic	Sprague CKR06BX105KR
C214 C215, C220	Capacitor, 33 uF 16V Dipped Tantalum	Sprague 199D336X9016D1
C206	Capacitor, 10.5 uF 50V 1%	Electrocube 650B1A1055F
C216, C217	Capacitor, 820 uF 15V Tantalum	Sprague 109D827X9015T2
C219	Capacitor, 110 pF ± 5% 500V Mica	Cornell Dubilier CM04FD111J03
C221, C222	Capacitor, 130 pF ± 5% 500V Mica	Cornell Dubilier CM04FD131J03
CR201, CR202, CR203 CR204, CR207	Diode	Freescale Semiconductor 1N4007
CR208	Zener Diode, 5.6V	Freescale Semiconductor 1N752A

IC201	Analog Multiplexer/Demultiplexer	Texas Instruments MC14053B
IC202	Synchronous Counter	Texas Instruments SN74161N
IC203	Decoder/Demultiplexer	Texas Instruments SN74LS155AN
IC204	Timer	Texas Instruments NE555P
IC205	Operational Amplifier, rail-to-rail output	Linear Techmology LT1639
IC208	Operational Amplifier	Freescale Semiconductor LM348J
IC206	Precision Waveform Generator /Voltage Control Oscillator Intersil ICL8038CCJD	
IC207	Attenuator	Freescale Semiconductor MC3340P
K201,K202,K203,K204	Relay	Aromat DS4E-S-DC12V
Q201,Q202,Q203,Q204 Q205, Q209,Q210	Transistor, NPN	Freescale Semiconductor 2N3904
Q207	Transistor	Freescale Semiconductor 2N3905
Q208	Transistor, N-channel MOSFET, TO-92	On Semiconductor BS170G
Q211,Q212	Transistor	Freescale Semiconductor 2N697
R201,R202,R203,R204	Resistor, 5.1K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF512J
R205,R206,R207,R208	Trimpot, 20K ohm	Bourns 3006P-1-203
R209,R209A,R253,R255	Resistor, 1.5K ohm ± 1% 1/4W Film	Dale RN60C1501F
R226, CR205	0 ohm	
R228	220K ohm 5% ¼W	Allen Bradley RCR07GF224J
R210, R214, R215, R220 R231, R252, R258, R263	Resistor, 2.2K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF222J
R211, R246, R262	Resistor, 10K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF103J
R236	Trimpot, 10K ohm	Bourns 3006P-1-103
R230	Trimpot, 5K ohm	Bourns 3006P-1-502
R216,R217,R218,R219 R225,R250,R259	Resistor, 510 ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF511J
R224	Resistor, 6.81M ohm ± 1% 1/4W metal film	
R227,R237	Resistor, 52.3K ohm ± 1% 1/8W Film	Dale RN55C5232F
R232, R234	Resistor, 100K ohm ± 1% 1/8W Film	Dale RN55C1003F
R233, R235,R254,R256	Resistor, 150K ohm ± 1% 1/8W Film	Dale RN55C1503F
R239	Resistor, 60.4K ohm ± 1% 1/8W Film	Dale RN55L6042F
R270	Resistor, 180 ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF181J
R251	Resistor, 1K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF102J

R257	Resistor, 15K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF153J
R260	Resistor, 150K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF154J
R224,R261	Resistor, 22K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF223J
R264	Resistor, 62K ohm ± 5% 1/4W Carbon	Allen Bradley RCR07GF623J
R265	Resistor, 1K ohm ± 5% 1/2W Carbon	Allen Bradley RCR20GF102J
THRM1	Thermistor, 22K-ohm 5%, 0805 surface mount	BC Components 2381 615 53223

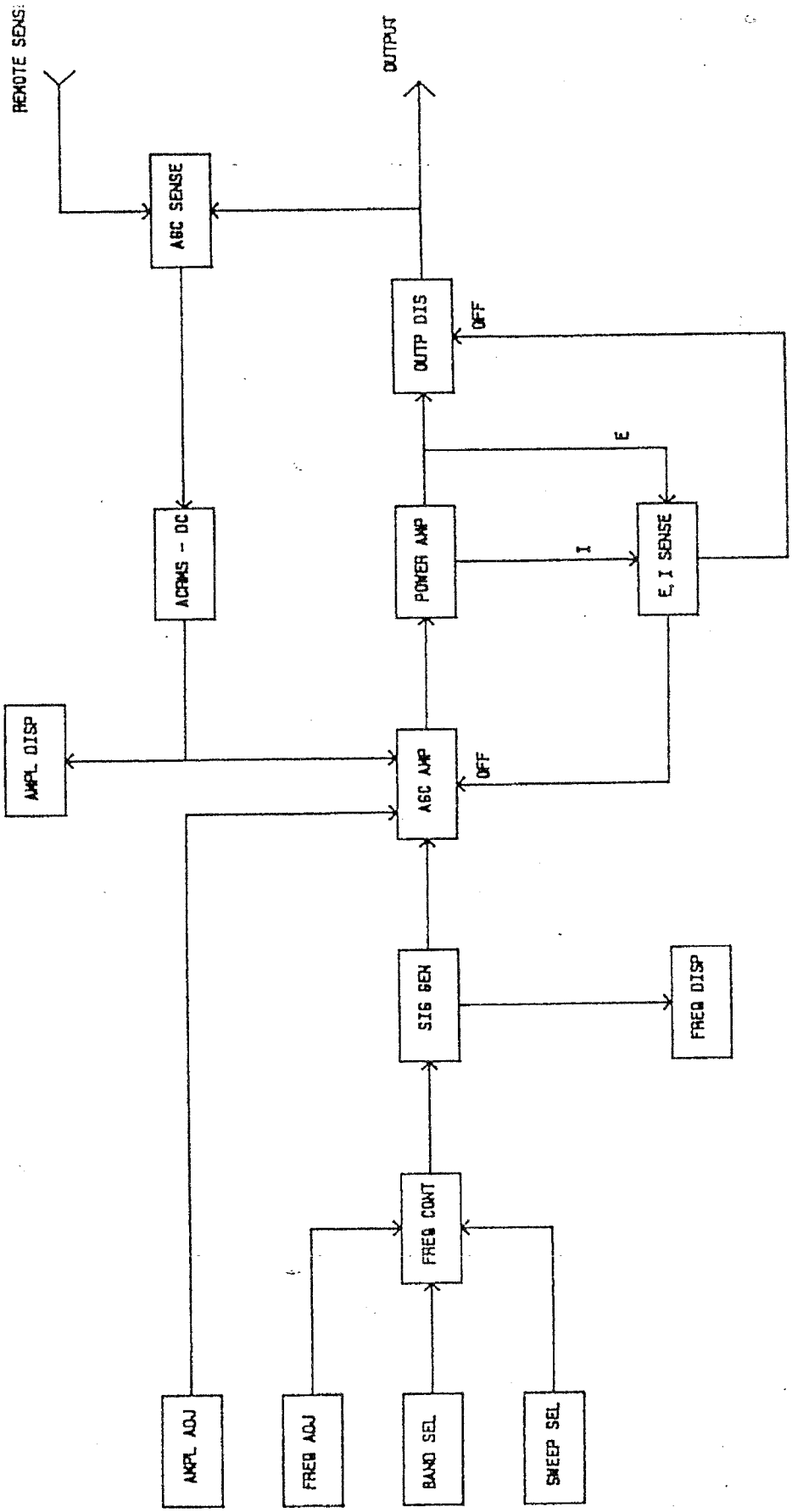
MISCELLANEOUS

QTY		
1	Printed Board	Solar 885058
1	Heat Sink	Wakefield 205CB

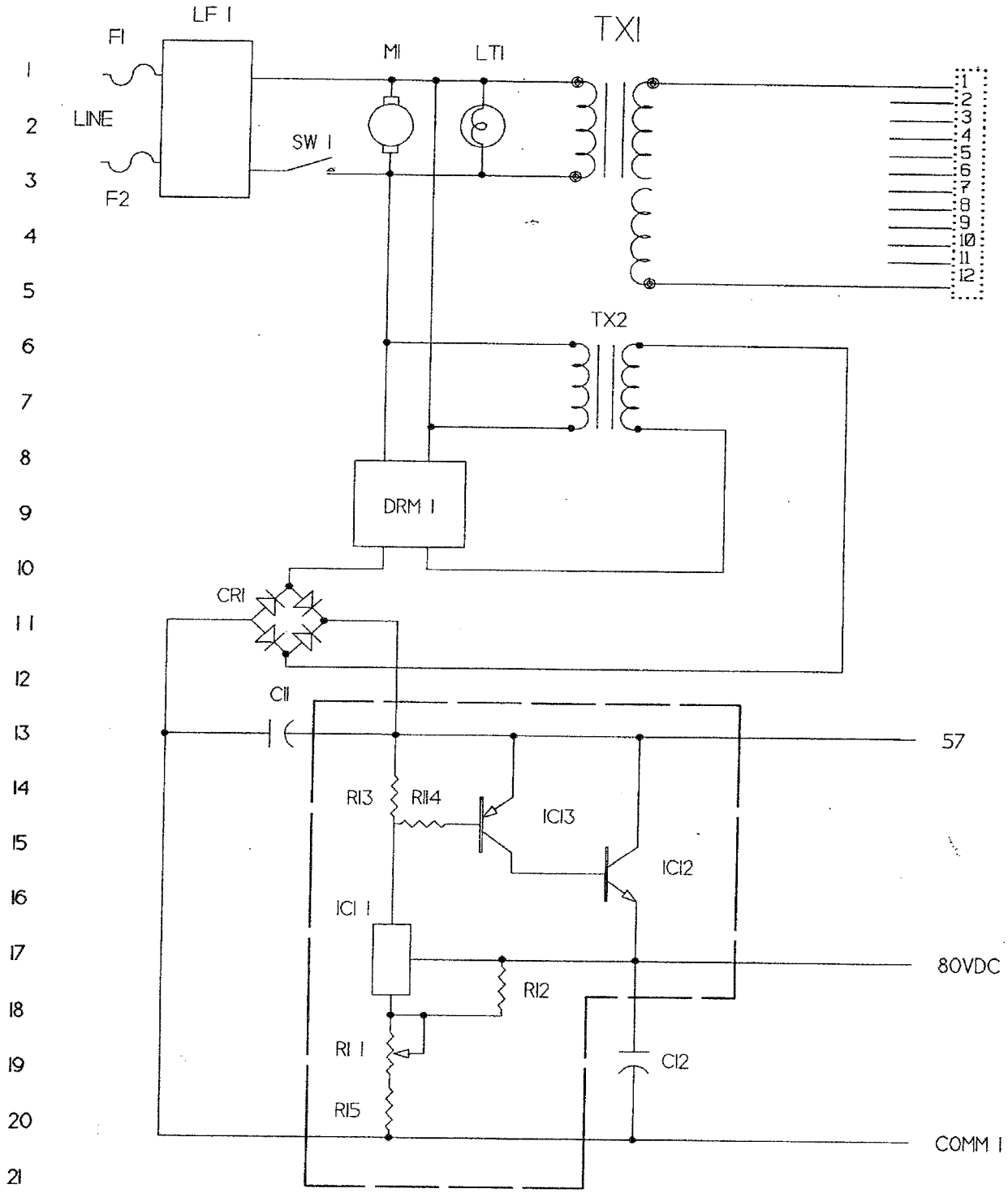
REFERENCE	MULTI-LOW VOLTAGE POWER SUPPLY BOARD-885059	REVISED: 10-10-90
DESIGNATION	DESCRIPTION	MANUFACTURER
C101,C102	Capacitor, 500 uF ± 10% 50V Electrolytic	Sprague TVA-1315
C103,C104 C105,C108	Capacitor, 1000 uF 25VDC Electrolytic	Sprague 501D108M025PR
C115,C116,C117 C118,C119,C120	Capacitor, 1.0 uF ± 10% 50V Ceramic	Kemet CKR06BX105KR
C107,C109	Capacitor, 2000 uF 16VDC Electrolytic	Mallory TC1520A
CR100	Zener Diode, 39V	Freescale Semiconductor 1N2992B
CR101,CR102,CR103 CR104,CR105,CR106	Bridge Rectifier	Diodes Inc. DB102
P100	Lock Header, 12-pin Fraction	Molex 22-01-2141
IC102	Voltage Regulator, 5V	National LM340AT5
IC103	Voltage Regulator, -15V	National LM320T-15
IC104	Voltage Regulator, 15V	National LM340AT15
IC105	Voltage Regulator, 15V	Freescale Semiconductor MC79L15ACP
IC106	Voltage Regulator, -15V	Freescale Semiconductor MC78L15ACP
R100	Resistor, 470 ohm ± 5% 5W Wirewound	Ohmite 95J470
R101,R104,R107	bare jumper wire	

MISCELLANEOUS

QTY

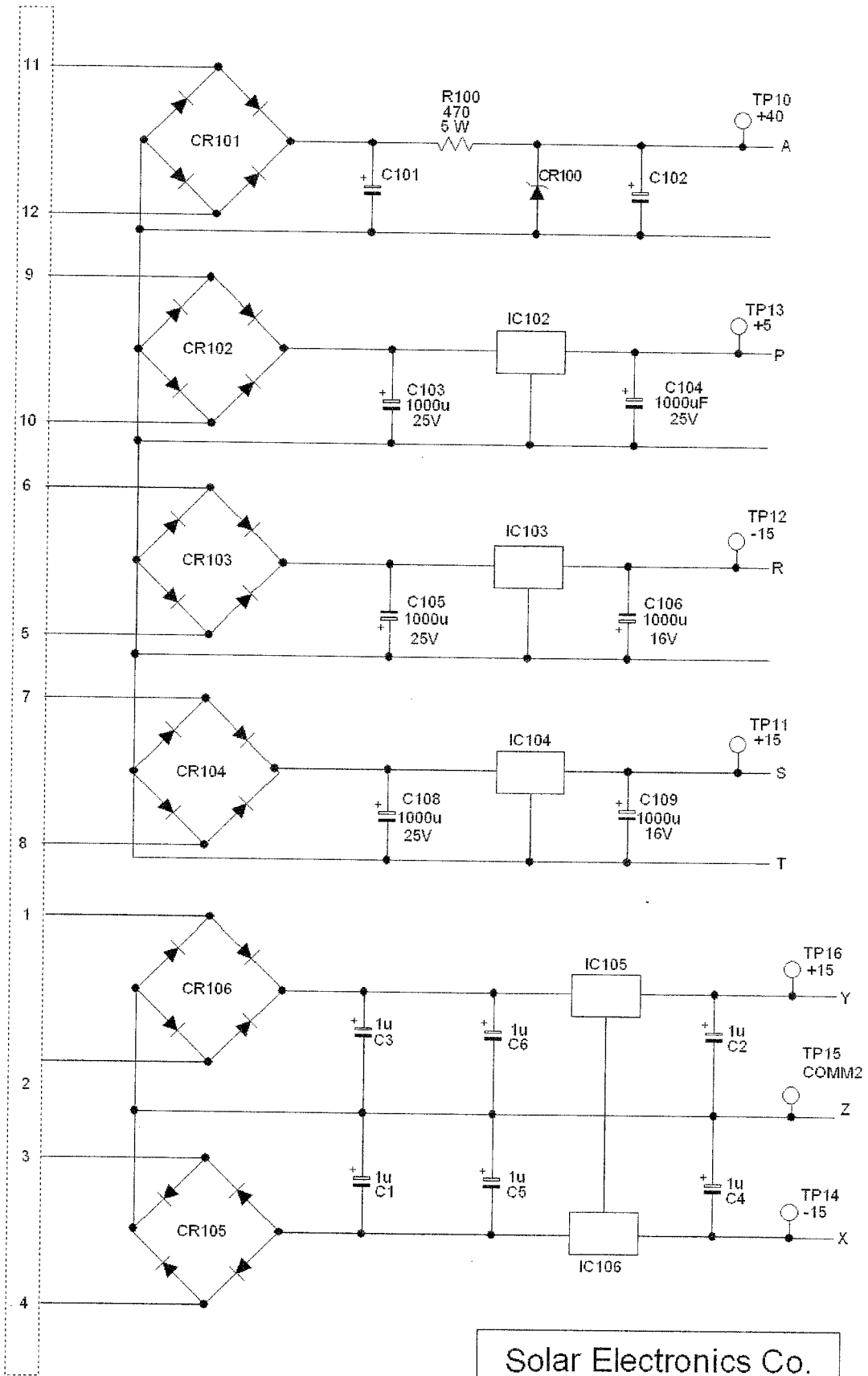


MODEL 8850-1 GENERATOR BLOCK DIAGRAM

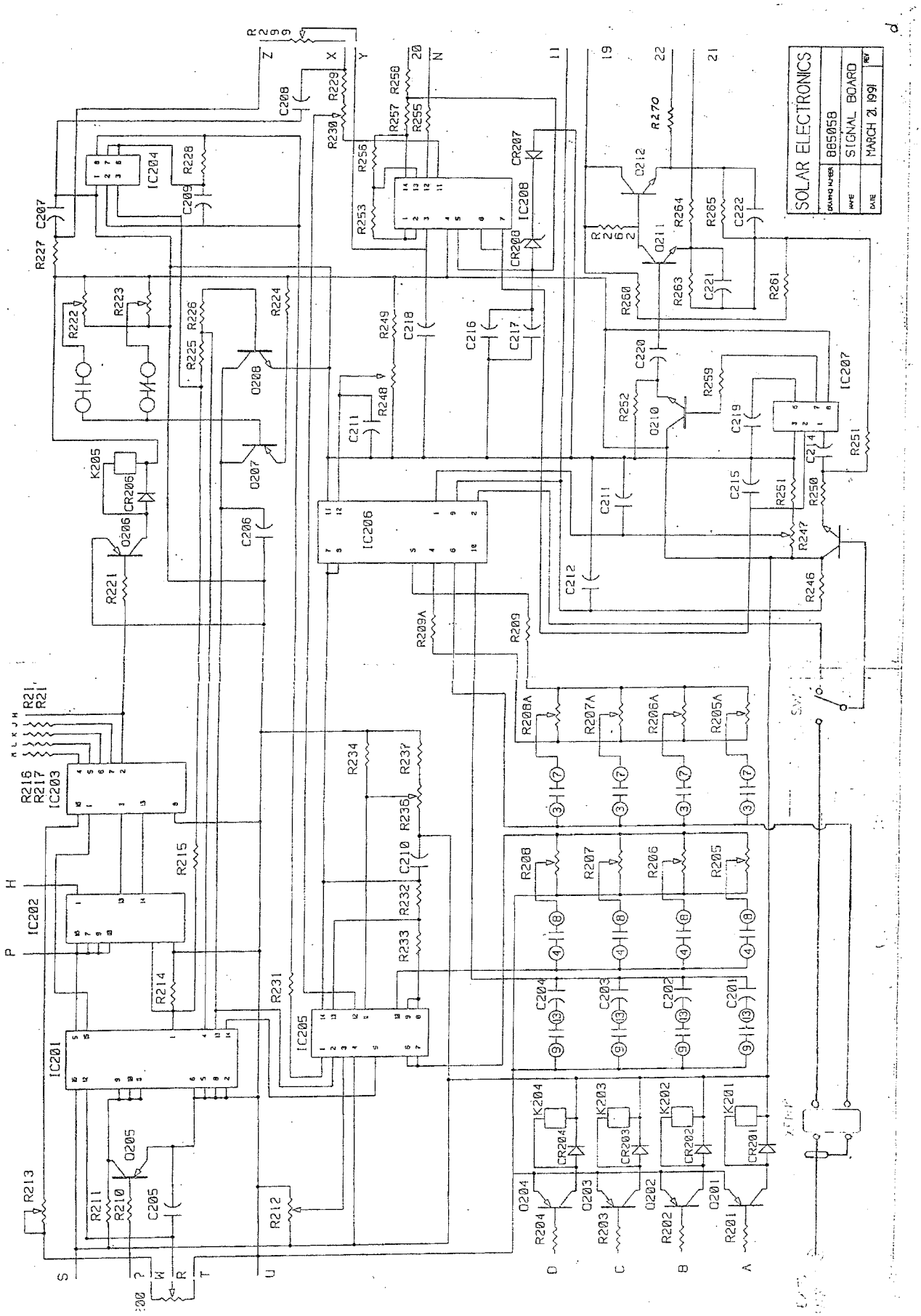


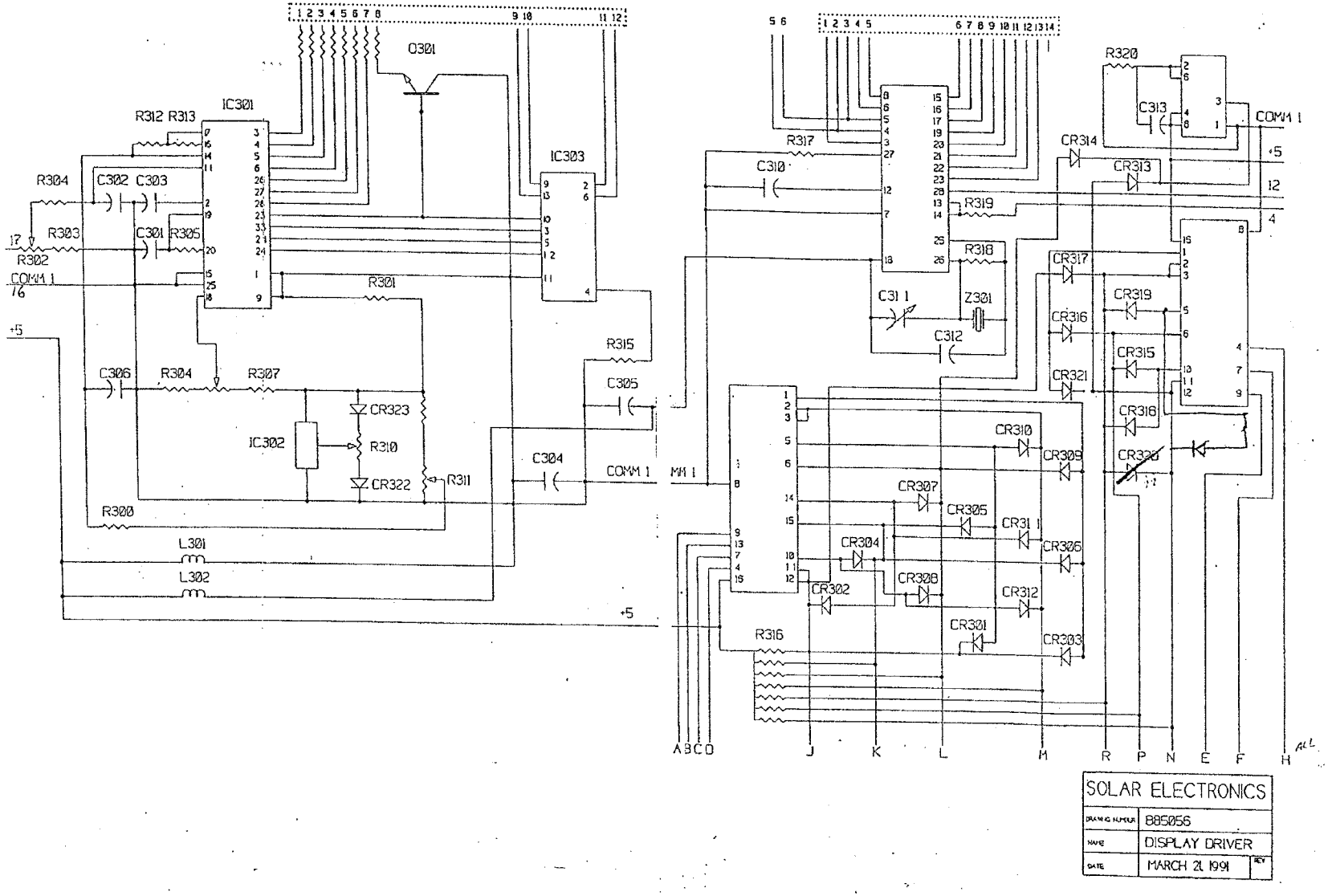
SOLAR ELECTRONICS		
DRAWING NUMBER	885052	
NAME	HV POWER BOARD	
DATE	MARCH 21. 1991	REV

b

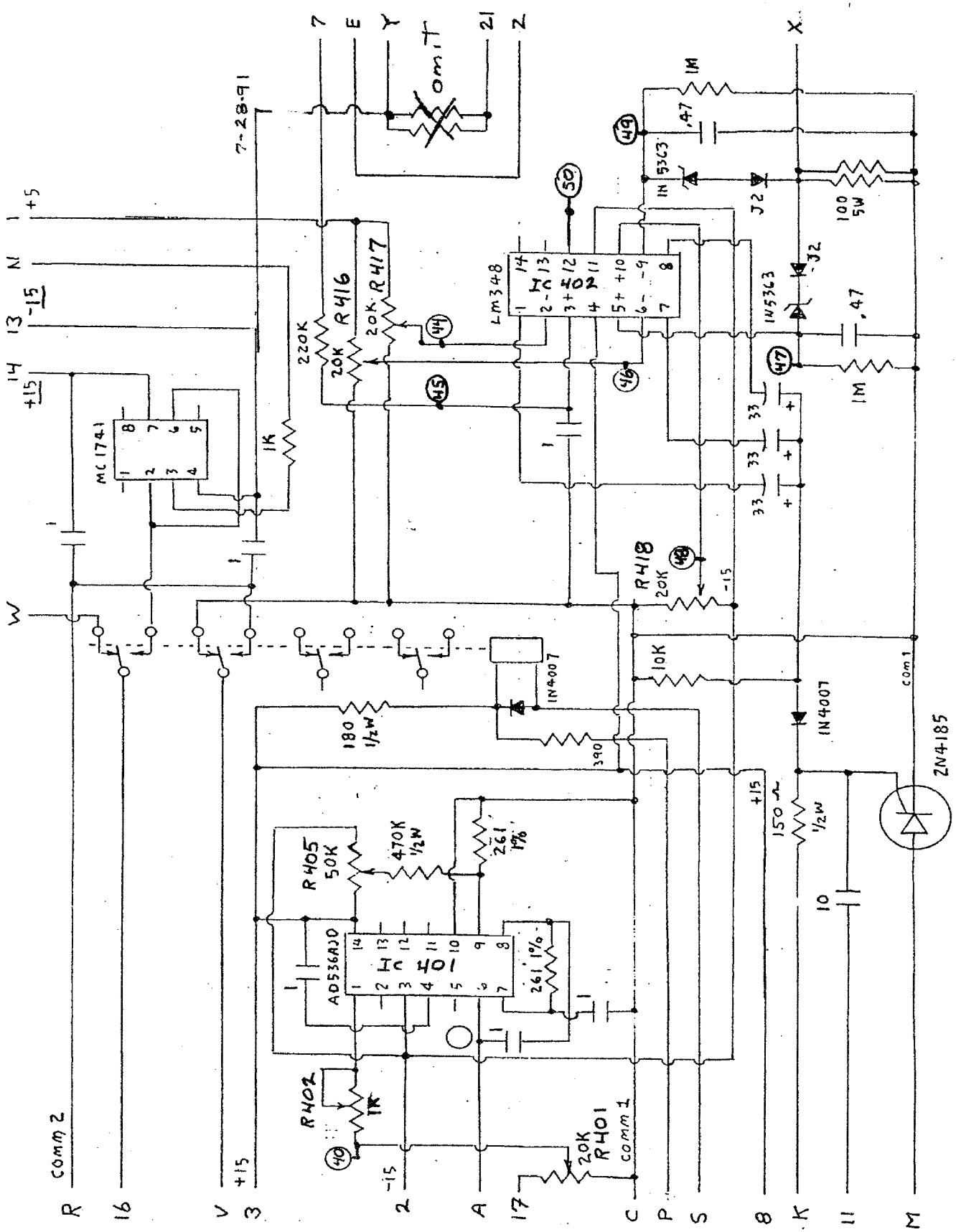


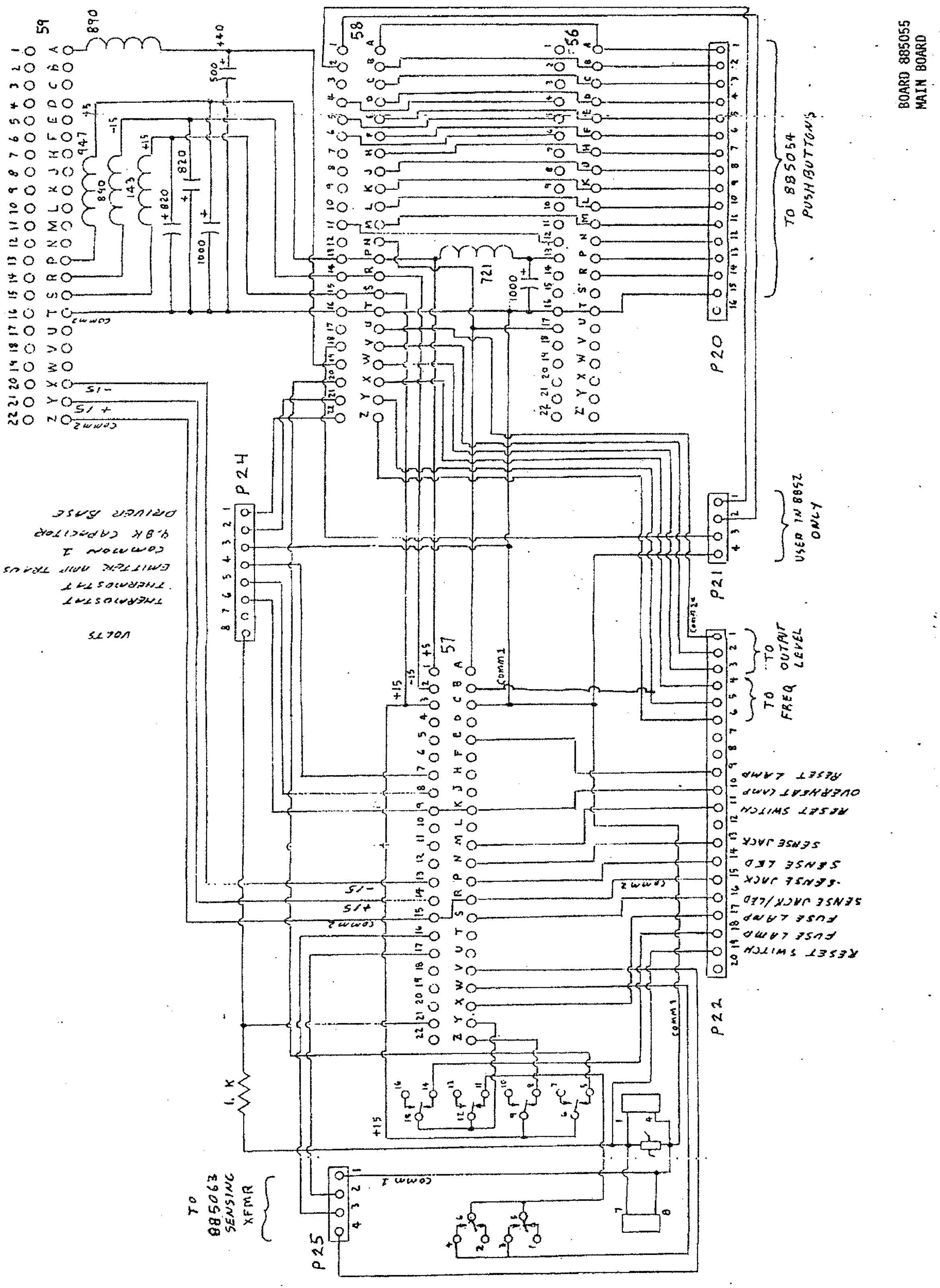
Solar Electronics Co.	
Drawing Number	885059A
Title	MV POWER BOARD
Date	10/02/06

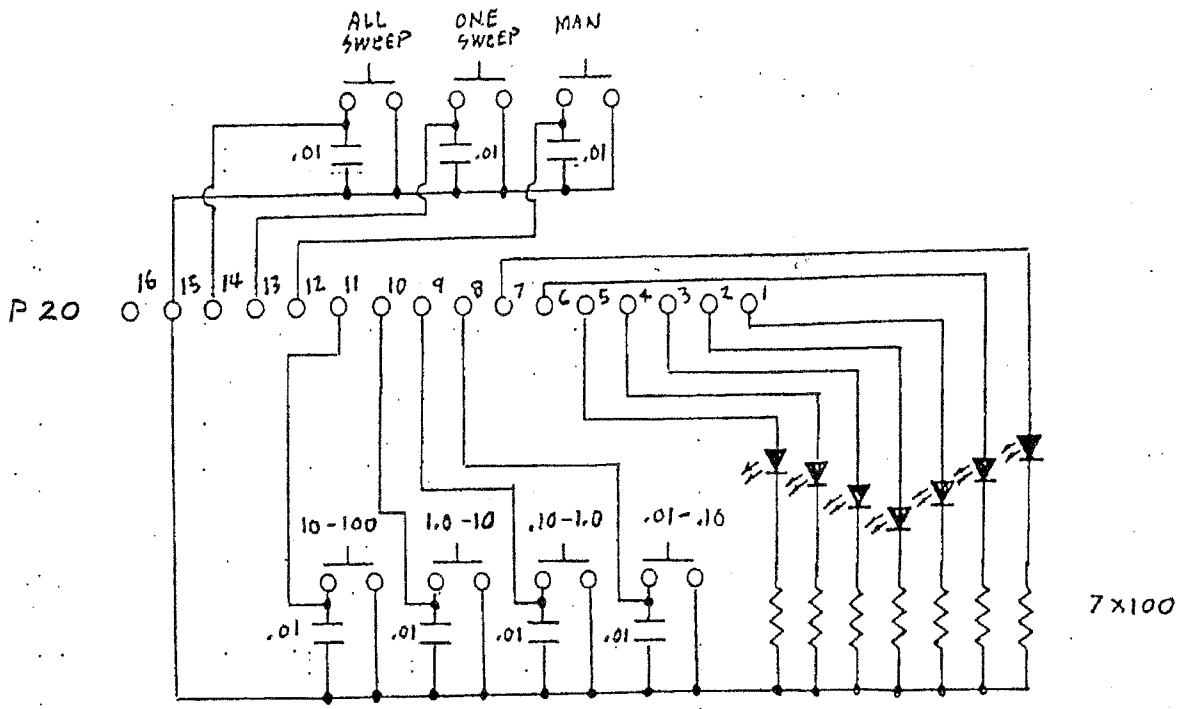

SOLAR ELECTRONICS
DRAWING NUMBER 885058
NAME SIGNAL BOARD
DATE MARCH 21, 1991
REV



SOLAR ELECTRONICS	
DRAWING NUMBER	B85056
NAME	DISPLAY DRIVER
DATE	MARCH 21 1991

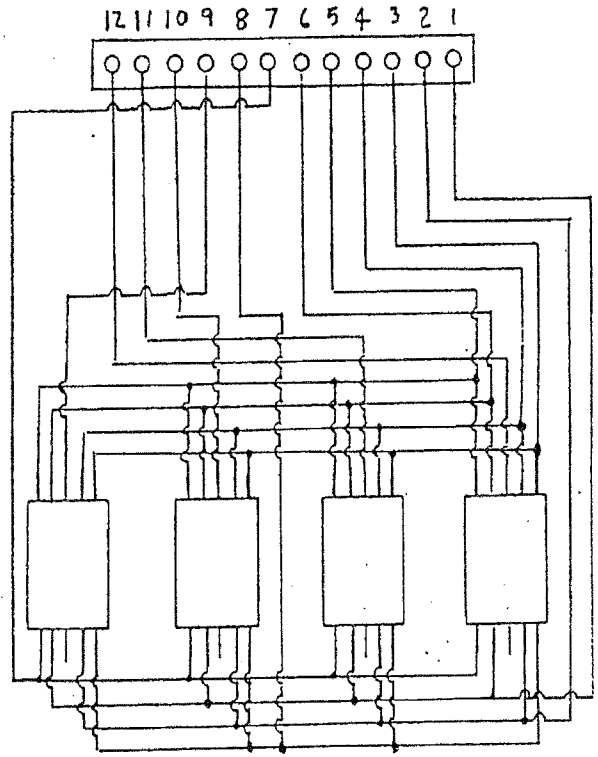

BOARD 885057
PROTECTION BOARD
7-28-91
omit
R416
220K
20K
R417
20K
R418
20K
R405
50K
R402
1K
20K
R401
470K
1/2W
261
1%
180
1/2W
390
10K
150Ω
1/2W
1K
1M
.47
100
5W
33
10
IC 402
LM348
IC 401
AD536AJD
MC1741
IN5363
IN4007
2N4185
+5
+15
-15
comm 2
comm 1
R
16
V
3
2
A
17
C
P
S
8
K
11
M
W
N
X
Y
Z
E
7
21


BOARD 885055
MAIN BOARD
TO 885054
PUSH BUTTONS
USED IN 8852 ONLY
TO OUTPUT LEVEL
TO FREQ
RESET LAMP
OVERHEAT LAMP
RESET SWITCH
SENSE JACK
SENSE LED
SENSE JACK/LED
FUSE LAMP
FUSE LAMP
RESET SWITCH
THERMOSTAT
THERMOSTAT
EMITTER AMP TRANSISTOR
COMMON 1
DRIVER BASE
VOLTS
TO 885063 SENSING XFMR
P20
P21
P22
P24
P25

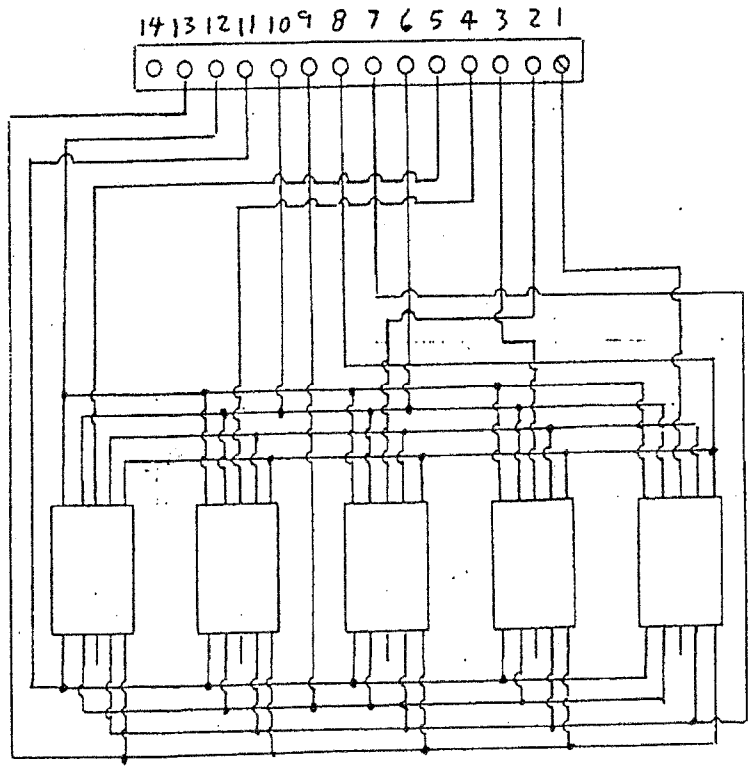


BOARD 885054
PUSH BUTTONS

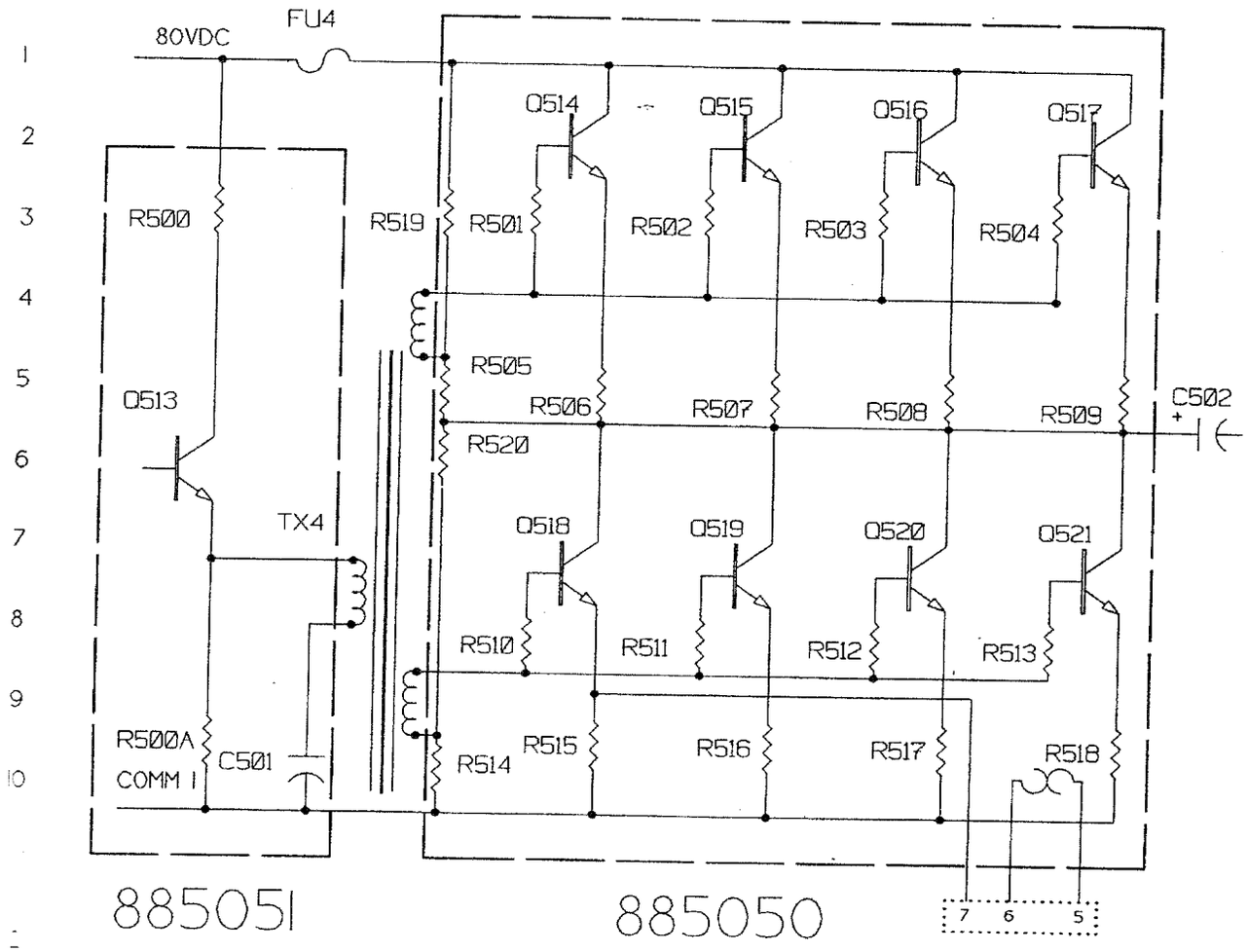
P 300A



P 301A



885053
LED DISPLAY



SOLAR ELECTRONICS		
DRAWING NUMBER	885050 & 51	
NAME	OUTPUT AMPLIFIER	
DATE	MARCH 21. 1991	REV

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