

Model LS1020
20MHz OSCILLOSCOPE
SERVICE MANUAL

<<WARNING>>

This service manual is for use by qualified personnel only. To avoid electrical shock, do not perform any service in this manual unless qualified to do so.

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1. SPECIFICATIONS

CRT Display		150 mm Rectangular, Internal-graticule and Flat Face with illumination lamps and Percentage scale.												
Type		2kV regulated												
Accelerating Potential		8 x 10 div. (1 div. = 10 mm)												
Effective display area		Adjustment on front panel												
Beam Rotator		Selectable in three steps.												
Graticule Illumination		Blanked by TTL Level Signal.												
Intensity Modulation														
Vertical Amplifiers (CH 1 and 2)														
Sensitivity		5 mV/div. to 5V/div. (full bandwidth), 0.5 mV/div. to 2 mV/div. (5 MHz: MAG x 10) in 10 steps, 1-2-5 sequence, continuously variable between steps. ±3% (±5%: MAG x 10)												
Calibration Accuracy		DC to 20 MHz												
Bandwidth (−3 dB, 8 div. ref.)		(DC to 5 MHz: MAG x 10)												
DC coupled		10Hz to 20 MHz												
AC coupled		17.5 ns (70 ns; MAG x 10)												
Rise Time		1 MΩ ± 1.5%, 30 pF within ± 5 pF (Tolerance: within ± 2 pF)												
Input Impedance		AC, GND, DC												
Input Coupling		400V (DC + ACp-p)												
Maximum Input		CH 1, CH 2, CHOP, ALT, ADD												
Display Modes		CH 2 INVERT												
Polarity Invert		Approx. 50 mV/div. in to 50Ω (DC to 20 MHz, −3 dB)												
CH 1 Output														
Horizontal Section														
Sweep Method		Trigger sweep and Automatic trigger sweep.												
Sweep Time		0.1 μs/div. to 0.2 s/div., 1-2-5 sequence in 20 steps with continuous adjuster. ±3%												
Calibration Accuracy		One sweep or more												
Hold-off variable		10 times ±5%, Note the MAG x 10 in 0.1 or 0.2 μs/div. ranges are not calibrated.												
Magnifier		50 ns/div. (MAG x 10 ON)												
Max. Sweep Time														
Synchronization														
Signal Sources		ALT, CH 1, CH 2, LINE, EXT.												
Coupling		AC, HF-REJ, TV-V, TV-H, DC												
Slope		+ or −												
Sensitivity														
		<table><tr><td></td><td>Bandwidth</td><td>INT.</td><td>EXT.</td></tr><tr><td>NORM</td><td>30 Hz to 10 MHz 2 Hz to 20 MHz</td><td>0.5 div. 1.5 div.</td><td>0.2Vp-p 0.6Vp-p</td></tr><tr><td>AUTO</td><td>30 Hz to 10 MHz 30 Hz to 20 MHz</td><td>0.5 div. 1.5 div.</td><td>0.2Vp-p 0.6Vp-p</td></tr></table>		Bandwidth	INT.	EXT.	NORM	30 Hz to 10 MHz 2 Hz to 20 MHz	0.5 div. 1.5 div.	0.2Vp-p 0.6Vp-p	AUTO	30 Hz to 10 MHz 30 Hz to 20 MHz	0.5 div. 1.5 div.	0.2Vp-p 0.6Vp-p
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TV Synchronization		Extracts the synchronizing signal from composite video signal and provides stable synchronization. Slope switch is selected according to polarity of video signals.												
X-Y Mode (X=CH 1, Y=CH 2)														
Sensitivity		X axis: 5 mV/div. to 5V/div. Y axis: 5 mV/div. to 5V/div.												
X axis Bandwidth		DC or 10 Hz to 1 MHz (−3 dB, 8 div. ref.)												
X-Y phase		Less than 3° at 100 kHz												
Calibrator														
Output Voltage		0.5Vp-p ±2%												
Frequency		Approx. 1 kHz, square wave												
Power Requirements														
Line Voltage		AC 100, 120, 200, 220, 240V 50/60 Hz												
Power Consumption		38W												
Size and Weight		310(W) x 150(H) x 375(D) mm, 8.5 kg												

2. TEST EQUIPMENT REQUIRED

The following test equipment is required for calibration and servicing of the Model LS1020. The suggested specifications are the minimum necessary for proper calibration of this instrument.

Test Equipment	Minimum Specifications
- Multimeter	Accuracy <0.1% * LEADER Model LDM-852A
- High Voltage Meter	2000Vdc full scale Accuracy <1%
- Oscilloscope	10mV sensitivity 60MHz bandwidth * LEADER Model LBO-526 Low capacitance probe * LEADER Model LP-061
- Amplitude Calibrator	1kHz square wave 1mV to 20Vp-p Accuracy <0.5% * LEADER Model LOC-7005
- Square Wave Generator	100Hz to 100kHz Rise time <5ns * LEADER Model LOC-7005
- Sine Wave Generator	10Hz to 20MHz Flatness <0.2dB
- Time Mark Generator	0.2s to 0.02us Accuracy <0.5% * LEADER Model LOC-7005
- Capacitance Meter	30pF

3. CALIBRATION PROCEDURE

3.1 General

Calibration should be performed after a 30 minute warm-up period. It should also be confirmed that the unit is connected to the rated power line voltage.

All adjustments should be completed in the given order. Some adjustments may interact with others.

During the adjustment procedure, remove the case only when necessary and replace immediately after making an adjustment. This will maintain all circuits at constant operating temperature.

*** WARNING ***

Electrical shock hazards exist inside this instrument when covers are removed.

To prevent personal injury extreme caution must be used when working in the high voltage section.

3.2 Initial Control Settings

The initial control settings used for each check and adjustment are listed below. Any variations are stated in the applicable paragraphs.

Front panel

Display

INTEN

As desired

FOCUS

Best focused display

ILLUM

As desired

Vertical

POSITION

Center (CH-1 & CH-2)

CH-2 INV

OFF

VOLTS/DIV

0.1V (CH-1 & CH-2)

VARIABLE

CAL'D (CH-1 & CH-2)

x10 MAG

OFF (CH-1 & CH-2)

AC-DC-GND

DC (CH-1 & CH-2)

V MODE

CH-1

Time base
 POSITION
 TIME/DIV
 VARIABLE
 Center
 0.5ms
 CAL'D

Trigger
 LEVEL
 NORM/AUTO
 HOLDOFF
 COUPLING
 SOURCE
 SLOPE/TV POL
 0
 AUTO
 NORM
 AC
 CH-1
 +

3.3 Power Supply

(1) Low Voltage Power Supply

- Connect the DC voltmeter between test point on the T-4228 (power supply/V final amp board) and chassis
- Check the voltage according to Table 3-1.

Test point	Voltage	Tolerance
Pin 7 of P26	-12V	-11.5V to -12.5V
Pin 6 of P26	+5V	+4.8V to +5.2V
Pin 5 of P26	+12V	+11.5V to +12.5V
Pin 3 of P26	+120V	+115.2V to +124.8V
Pin 1 of P26	+220V(unreg.)	+209V to +231V
Pin 1 of P55	+18V(unreg.)	+17V to +19V
Pin 1 of P28	-18V(unreg.)	-17V to -19V

Table 3-1

(2) High Voltage Power Supply

*** WARNING ***

To prevent personal injury extreme caution must be used when working in the high voltage section.

- Connect the DC high voltage meter to TP402(T-4232, CRT socket board).
- Adjust VR401, -1900V ADJ(T-4228, power supply/V final amp board) for a voltage reading of -1900Vdc.

3.4 Display

(1) Intensity

- Set: TIME/DIV 5ms
AC-GND-DC GND
- Set the INTEN control midway between 10 and 11 o'clock position.
- Adjust VR402, INTEN(T-4228, power supply/V final amp board) so the trace is just visible.

(2) Focus

- Set: FOCUS Center
- Apply CAL 0.5Vp-p to CH-1 INPUT connector.
- Adjust VR403, FOCUS(T-4228, power supply/V final amp board) and VR404, ASTIG(T-4228, power supply/V final amp board) alternately for optimum trace sharpness.
- *NOTE* Use insulated screw driver to adjust VR403 through the hole of shield case.

3.5 Vertical Amplifier

(1) DC Balance

- Set: VOLTS/DIV 10mV
VARIABLE Fully counterclockwise
AC-GND-DC GND
- Position the trace to the center horizontal graticule line using the V POSITION control.
- Set: VOLTS/DIV 5mV
VARIABLE CAL'D
x10 MAG ON
- If the trace moves 1 division or more, adjust VR1, CH-1 DC BAL(T-4227, main board) for minimum trace shift when repeat the settings above mentioned.
- Apply the same procedure for CH-2 by adjusting VR101, CH-2 DC BAL(T-4227, main board).

(2) CH-2 INV Balance

- Set: V MODE
AC-GND-DC
- CH-2
GND
- Adjust VR105, INV BAL(T-4227, main board) for a minimum trace shift between CH-2 INV on and off.

(3) Position Centering

- Set: V MODE
V POSITION
AC-GND-DC
- ALT
Center(CH-1, CH-2)
GND(CH-1, CH-2)
- Adjust VR7, CH-1 POS(T-4227, main board) so that the trace is positioned to the center horizontal graticule line.
- Apply the same procedure for CH-2 by adjusting VR107, CH-2 POS(T-4227, main board).

(4) x1 AC Gain

- Set: VOLTS/DIV
VARIABLE
V MODE
AC-GND-DC
- 5mV
CAL'D
CH-1
DC
- Connect the square wave generator to CH-1 INPUT connector and set the frequency to 1kHz, output level for 5 divisions display.
- Adjust VR2, CH-1 AC GAIN(T-4227, main board) for a best flat-top square wave.
- Apply the same procedure for CH-2 by adjusting VR102, CH-2 AC GAIN(T-4227, main board).

(5) x10 AC Gain

- Set: VOLTS/DIV
x10 MAG
- 10mV
ON
- Connect the square wave generator to CH-1 INPUT connector and set the frequency to 1kHz, output level for 5 divisions display.
- Adjust VR3, CH-1 x10 MAG AC GAIN(T-4227, main board) for a best flat-top square wave.

- Apply the same procedure for CH-2 by adjusting VR103, CH-2 x10 AC MAG GAIN(T-4227, main board).

(6) Gain

- Set: VOLTS/DIV 10mV
VARIABLE CAL'D
V MODE CH-1
AC-GND-DC DC
- Connect the amplitude calibrator to CH-1 INPUT connector and set the output level to 50mV.
- Adjust VR6, CH-1 GAIN(T-4227, main board) for a 5 divisions display.
- Apply the same procedure for CH-2 by adjusting VR106, CH-2 GAIN(T-4227, main board).
- Check accuracy for all settings of VOLTS/DIV switch.

(7) Attenuator Phase Compensation

- Set: VOLTS/DIV 20mV
V MODE CH-1
AC-GND-DC DC
- Connect the square wave generator to CH-1 INPUT connector and set the frequency to 1kHz, output level for 5 divisions display.
- Check the waveform for a flat-top square wave with 3% or less overshoot and roll-off on the leading edge.
- If not, adjust VC6, Cc(T-4227, main board) for best flat-top square wave.
- Apply the same procedure for all other VOLTS/DIV position and CH-2 according to Table 3-2.

VOLTS/DIV	CH-1	CH-2
5mV	-	-
20mV	VC6	VC106
50mV	VC8	VC108
0.1V	VC2	VC102
1V	VC4	VC104

Table 3-2

(8) Input Capacitance

- Set: VOLTS/DIV
V MODE

5mV
CH-1

- Connect the capacitance meter to CH-1 INPUT connector. Note the capacitance reading(29pF typical).
- Check the capacitance on all other VOLTS/DIV positions and if value difference is greater than 1pF, adjust Ci(T-4227, main board) for the same reading as noted above. Refer to Table 3-3.
- Apply the same procedure for CH-2 according to Table 3-3.

VOLTS/DIV	CH-1	CH-2
20mV	VC5	VC105
50mV	VC7	VC107
0.1V	VC1	VC101
1V	VC3	VC103

Table 3-3

- Repeat "(7)" and "(8)" as necessary.

(9) High Frequency Compensation

NOTE This step mentions a high frequency compensation of the vertical amplifier, however, the adjustment is very critical. Therefore, if problem is not evident, do not attempt for the following adjustments.

It may be necessary to compromise the band width and the step response adjustments for best frequency response.

- Set: VOLTS/DIV

5mV

- Connect the square wave generator to CH-1 INPUT connector and set the frequency to 100kHz, adjust generator output level for 4 divisions display.
- Check the waveform for a flat-top square wave with 3% or less overshoot and roll-off on the leading edge.
- Adjust following adjustments to obtain a best flat-top square wave.

VC9, HF COMP(T-4227, main board)

VC21, HF COMP(T-4227, main board)

VC101, HF COMP(T-4228, power supply/V final amp board)

- Remove the square wave generator.
- Connect the sine wave generator to CH-1 INPUT connector and set the frequency to 50kHz, output level for 8 divisions display.
- Increase the generator frequency until the amplitude decreased to 5.6 divisions
- The generator frequency should be 20MHz or higher.
- Apply the same procedure for CH-2 by using following adjustments.

VC109, HF COMP(T-4227, main board)
VC121, HF COMP(T-4227, main board)

3.6 Time Base/Horizontal Amplifier

(1) x1 Gain, TIME/DIV

- Set: TIME/DIV 0.5ms
VARIABLE CAL'D
 - Connect the time mark generator to CH-1 INPUT connector and set the time to 0.5ms.
 - Adjust VR5, TIME(T-4230, VR board) to obtain a 13 markers on the trace as shown in Figure 3-1.
- *NOTE* 2 markers out of 13 markers may be positioned off graticule. Use H POSITION control to confirm the markers.

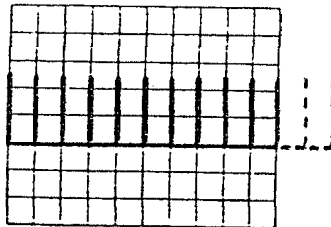


Figure 3-1

3.7 Trigger

(1) Trigger Slope

- | | |
|---------------|------|
| - Set: V MODE | CH-1 |
| TRIG COUPLING | AC |
| TRIG SOURCE | CH-1 |
| TRIG LEVEL | 0 |
- Connect the sine wave generator to the CH-1 INPUT connector and set the frequency to 1kHz, output level for 4 divisions display.
 - Position the sine wave to center of the graticule by using V POSITION control.
 - Switch the SLOPE/TV POL knob between + and -.
 - Adjust VR302, SLOPE/TV POL(T-4227, main board) for the sine wave to start at the same vertical point as shown in Figure 3-2.

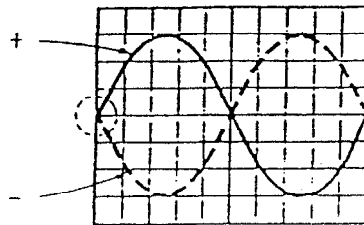


Figure 3-2

(2) Trigger Level

- | | |
|---------------|------|
| - Set: V MODE | CH-1 |
| TRIG COUPLING | AC |
| TRIG LEVEL | 0 |
- Connect the sine wave generator to CH-1 INPUT connector and set the frequency to 1kHz, output level for 0.5 division display.
 - Adjust VR301, LEVEL CENTER(T-4227, main board) to obtain a stable display.

(3) Trigger Balance

- Setup: Same as step "(2)".
- Adjust VR201, CH-1 TRIG BAL(T-4227, main board) to obtain a stable display when COUPLING knob is switched between AC and DC.
- Apply the same procedure for CH-2 by adjusting VR202, CH-2 TRIG BAL(T-4227, main board).

3.8 X-Y Operation

(1) X Gain

- | | |
|-------------|------|
| - V MODE | X-Y |
| X VOLTS/DIV | 10mV |
| AC-GND-DC | DC |
- Connect the amplitude calibrator to X INPUT connector and set the output level to 50mVp-p.
 - Adjust VR501, X-Y GAIN(T-4227, main board) for a horizontal deflection of 5 divisions.

(2) X Position Centering

- | | |
|-------------------|--------|
| - Set: X POSITION | Center |
| X AC-GND-DC | GND |
- Adjust VR502, X-Y POS(T-4227, main board) so that the dot is positioned at the center vertical graticule line.

3.9 CAL 0.5Vp-p

NOTE : Do not touch the adjustment VR4, CAL(T-4231, inten/focus board) except the precision peak-voltage measuring device such as well-calibrated oscilloscope* is available.

- : Vertical sensitivity of the test oscilloscope* must be calibrated within 1% or better.
- Connect the test oscilloscope* to CAL tip on the front panel.
- Adjust VR4, CAL(T-4231, inten/focus board) for an amplitude of 0.50Vp-p.

4. TROUBLESHOOTING PROCEDURE

4.1 General

Confirm that the any equipment used with the Model LS1020 is operating correctly.

Check all control settings. Incorrect setting can make a good unit appear defective. For instance, if the waveform is not stable, TRIG SOURCE switch may be set to external trigger mode instead of internal.

If there is any question about the function, refer to the Instruction Manual for a correct operation.

Check all circuit for visual defects such as broken component, loose connection, open wire, poor soldering etc.

Some troubles can be solved with proper adjustment. For instance, if the trace moves up and down by rotating V VARIABLE control, it can be corrected by adjusting DC BAL on that channel.

Check the voltage and waveform as shown in the Schematic Diagram to locate the defective circuit. Start with the power supply.

Typical voltage and waveform are obtained under the same conditions as "3.2 Initial Control Settings"

*** WARNING ***

Electrical shock hazards exist inside this instrument when covers removed.

4.2 Theory of Operation

The oscilloscope is divided into five major sections; Vertical amplifier, Time base generator, Horizontal amplifier, Unblanking circuit and Power supply. Refer to "7. Block Diagram".

- Vertical Section

The vertical section consists of the input attenuator, preamplifier, channel select gate and final amplifier, all DC coupled balanced circuits.

The signal is applied to CH-1 and/or CH-2 INPUT connector. The input signal is attenuated by the VOLTS/DIV switch and applied to the vertical preamplifier.

The input stage of the vertical preamplifier provides signal amplification, gain control and x10 magnification of the input signal. The output stage provides for positioning of the display and picks-off parts of the input signal for internal triggering. The CH-2 preamplifier circuit is used to provide for the CH-2 INV mode.

The output signals of both vertical preamplifiers are applied to a channel select gate control by the channel select logic.

The selected channel signal(s) are applied to the vertical final amplifier.

The vertical final amplifier converts the current signal to a voltage signal of sufficient amplitude to drive the vertical deflection plates of the CRT.

The vertical display mode is controlled by the channel select logic via the V MODE switches.

CH-1, CH-2: Control signal selects either the CH-1 or CH-2 input signal for a single trace display.

CHOP, ALT: CH-1 and CH-2 signals are displayed either chopped or alternately.

ADD: CH-1 and CH-2 signals are algebraically added or subtracted when CH-2 INV switch is ON.

- Time Base Generator

The trigger pick-off circuit samples the input signal at the vertical preamplifier, and applies it to the trigger generator. The trigger generator produces a trigger pulse to activate the sweep generator.

The triggering signals can be obtained from the following sources:

CH-1: CH-1 signal.

CH-2: CH-2 signal.

ALT: Two asynchronous input signals.

EXT: Signal connected to the EXT TRIG input.

The trigger generator contains Coupling, Slope, Level and Source control switches.

AC: Synchronization to be made with an AC signal.

TV-V: Incorporates a TV Vertical sync separator circuit to strip the vertical sync pulse from the composite video input signal applied to the oscilloscope.

TV-H: Incorporates a TV Horizontal sync separator circuit to strip the horizontal sync pulse from the composite video input signal applied to the oscilloscope.

SLOPE/TV POL: Selects the positive or negative polarity of incoming signal trigger point.

HF REJ: Low pass filter rejects approximately 50kHz or higher component of input waveform.

At AUTO free run mode, the sweep generator produces a sweep ramp automatically with or without input signal. When the signal is applied to vertical input connector, the sweep generator synchronizes to the input signal for a stable display.

When the NORMAl mode is selected, the sweep ramp and unblanking signals are activated by the trigger generator. In this mode, the signal can only be seen when the trigger generator is activated by the incoming signal.

- Horizontal Amplifier

The sweep ramp from the sweep generator is amplified in the horizontal amplifier to drive the beam from left to right on the CRT.

The horizontal amplifier has a x10 magnifier function to increase the sweep rate 10 times at any TIME/DIV switch setting.

When the X-Y mode is selected, the sweep generator is disable. The CH-1 OR X IN input is applied to the horizontal amplifier to be used as the X axis deflection signal instead of sweep ramp. The Y axis deflection signal is applied from CH-2 OR Y IN connector.

- Unblanking

The Z axis amplifier controls the display intensity and the blanking levels. Unblanking signal of the sweep generator is applied to the Z axis amplifier to unblank the display. The chop blanking and the Z AXIS signals are added in the Z axis amplifier to determine display intensity.

- Power Supply

The high voltage power supply produces -1900Vdc to accelerate the electron beam of the CRT.

It consists of a high voltage generator, feed back amplifier and high voltage multiplier. The feed back amplifier controls the high voltage generator circuitly to maintain a stable high voltage output.

Secondary winding of the high voltage transformer is connected to the rectifier to control display focus and intensity.

- Calibrator

The amplitude calibrator provides a 1kHz square wave with accurate voltage output.

4.3 Troubleshooting Aid

*** WARNING ***

Electrical shock hazards exist inside this instrument when covers are removed.

- (1) Overall operation is not satisfactory or no trace visible with the same conditions as Paragraph "3.2 Initial control settings".

Connect the AC power to mains and turn power switch on.

a. Power lamp not on

Check fuse, F1 on the rear panel for open.

1A time lag fuse for 90V-132V operation.

500mA time lag fuse for 180V-264V operation.

CAUTION Use specified Fuse when replace it. Refer to "9. Parts List".

Secondary voltage of the power transformer.

b. Check low voltage power supply.

Connect the DC voltmeter between test point on the T-4228 (power supply/V final amp board) and chassis.

Test point	Voltage	Tolerance
Pin 1 of P55	+18V(unreg.)	+17V to +19V
Pin 1 of P28	-18V(unreg.)	-17V to -19V
Pin 5 of P26	+12V	+11.5V to +12.5V
Pin 7 of P26	-12V	-11.5V to -12.5V
Pin 6 of P26	+5V	+4.8V to +5.2V
Pin 3 of P26	+120V	+115.2V to +124.8V
Pin 1 of P26	+220V(unreg.)	+209V to +231V

Table 3-1

Yes: Proceed to step "c".

No: Troubleshoot the each power supply.

+18V: D504(T-4228, power supply/V final amp board) and associated circuit.

-18V: D504(T-4228, power supply/V final amp board) and associated circuit.

+12V: +18V line, IC501(T-4382 Tr board) and associated circuit.

-12V: -18V line, IC503(T-4382 Tr board) and associated circuit.

+5V: +18V line, IC502(T-4382 Tr board) and associated circuit.

+120V: -12V line, D501, Q501, Q503(T-4228, power supply/V final amp board), Q502(T-4382 Tr board) and associated circuit.

+220V: +120V line, D503(T-4228, power supply/V final amp board) and associated circuit.

c. High voltage power supply

*** WARNING ***

To prevent personal injury extreme caution must be used when working in the high voltage section.

Check voltage at TP402(T-4228, power supply/V final amp board) for -1900Vdc.

Yes: Proceed to step "f".

No: Troubleshoot high voltage generator, feed back amplifier(T-4228, power supply/V final amp board). Adjust VR401(T-4228, power supply/V final amp board) as necessary. Refer to paragraph "3.3 (2)".

Check F401, 500mA normal blow fuse(T-4228, power supply/V final amp board) for open.

CAUTION Use specified Fuse when replace it. Refer to "9. Parts List".

d. Vertical amplifier

Short pins 1 and 4 of P31(T-4228, power supply/V final amp board) with clip lead.

Trace appears.

Yes: Short pins 1 and 4 of P22(T-4228, power supply/V final amp board) with clip lead.

Trace appears.

Yes- Continue the same procedure to input stage to locate the amplifier unbalancing.

No- Troubleshoot the vertical final amplifier for unbalance.

No: Proceed to step "e".

- e. Horizontal amplifier
 - Set TIME/DIV switch to X-Y position.
 - Spot appears.
 - Yes: Proceed to step "(3)".
 - No: Short pins 1 and 4 of P4(T-4227, main board) with short clip lead.
 - Spot appears.
 - Yes- Troubleshoot the horizontal amplifier for unbalance.
 - No- Proceed to step "f".

- f. Unblanking circuit
 - Check that unblanking pulse is present at TP301(T-4228, V final amp/V final amp board).
 - Yes: Troubleshoot CRT control circuit(T-4228, power supply/V final amp board). Adjust VR402 as necessary. Refer to paragraph "3.4 (1)".
 - No: Trace the unblanking signal(sweep gate) to time base generator to locate the defective circuit.

- (2) Vertical Amplifier Section
 - a. No waveform appears on the CRT.
 - Apply the CAL 0.5Vp-p square wave to CH-1 and/or CH-2 INPUT connector and set the VOLTS/DIV switch to 0.1V position.

 - Trace the square wave from the input stage to the output stage to locate the defective circuit.

 - Check that the square wave present at pin 1 and 4 of P22 (T-4228, power supply/V final amp board).
 - Yes: Troubleshoot vertical final amplifier.
 - No : Check that the square wave present at base of Q11 (T-4227, main board) for CH-1, base of Q111(T-4227, main board) for CH-2.
 - Yes- Troubleshoot preamplifier and channel select gate.
 - No- Troubleshoot the input amplifier and attenuator.

 - b. Vertical sensitivity out of tolerance
 - Adjust VR6(T-4227, main board) for CH-1, VR106(T-4227, main board) for CH-2. Refer to paragraph "3.5 (4)".

- c. V MODE switch not working correctly
 Troubleshoot MODE switch(S3, T-4229, SW board), channel select gate and control circuit.
 CH-1: IC203-204(T-4227, main board) and associated circuit.
 CH-2: IC203-204(T-4227, main board) and associated circuit.
 CHOP: Check waveform at pin 6 of IC204(T-4227, main board) for switching signal.
 Yes- Channel select gate.
 No- S3(T-4229, SW board), multivibrator(IC201 T-4227, main board) and control circuit.
 ALT: IC202(T-4227, main board) and associated circuit.

- d. CH-2 INV not working
 Check Q114, Q116(T-4227, main board) and control circuit.

- e. x10 MAG mode not working correctly
 Check S4(T-4227, main board) for CH-1, S104(T-4227, main board) for CH-2 and associated circuit.
 Adjust VR3(T-4227, main board) for CH-1, VR103(T-4227, main board) for CH-2 as necessary. Refer to paragraph "3.5 (5)".

- (3) Time base/Horizontal Amplifier Section
 - a. No trace appears on sweep mode(only spot appears)
 Check that the sawtooth wave present at TP402(T-4227, main board).
 Yes: Troubleshoot horizontal amplifier.
 No: Check that the trigger signal is present at TP302 (T-4227, main board).
 Yes- Troubleshoot sweep gate and sweep generator.
 No- Proceed to step "(4)".

 - b. Sweep time out of tolerance
 Adjust VR5(T-4230, VR board) and VC401(T-4227, main board).
 Refer to paragraph "3.6 (1)"

 - c. x10 MAG mode not working correctly
 Check Q504, 507(T-4227, main board) and control circuit.

(4) Trigger Section

a. Display is unstable

The trigger signal must be applied from vertical amplifier to sweep generator via trigger pickoff circuit

Check waveform at TP301(T-4227, main board).

Yes: Troubleshoot sawtooth generator.

No: Troubleshoot trigger pickoff circuit, trigger amplifier and pulse shaper.

b. TRIG COUPLING not working correctly

Check that the contact of COUPLING switch, S5(T-4229, SW board) and control circuit.

c. TRIG SOURCE not working correctly

Check that the contact of SOURCE switch, S4(T-4229, SW board) and control circuit.

(5) Others

a. No TRACE ROTATION works

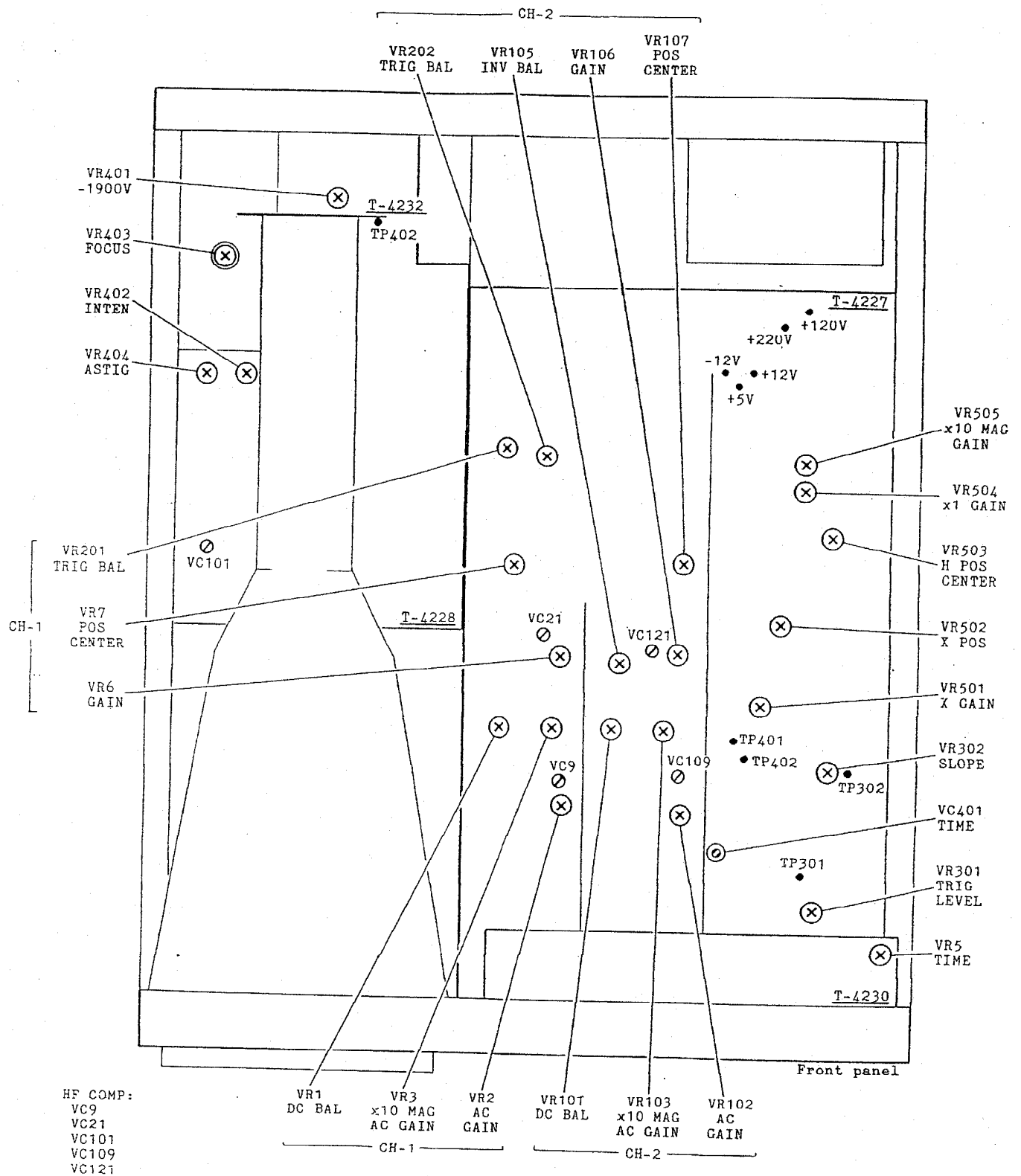
Check rotation coil for open.

b. CAL signal not present

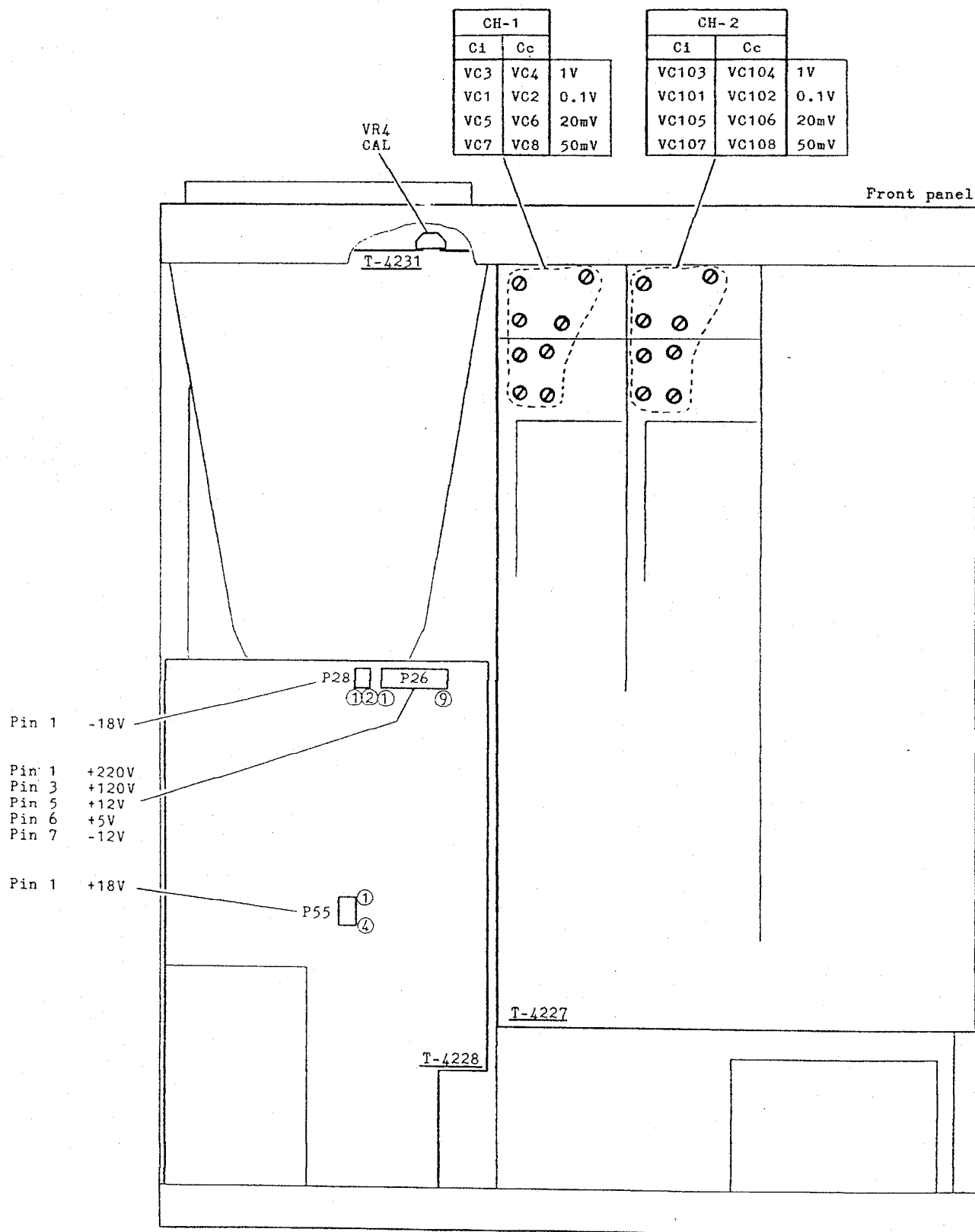
Troubleshoot IC1(T-4231, inten/focus board) and associated circuit.

Adjust VR4(T-4231, inten/focus board) if necessary. Refer to paragraph "3.9".

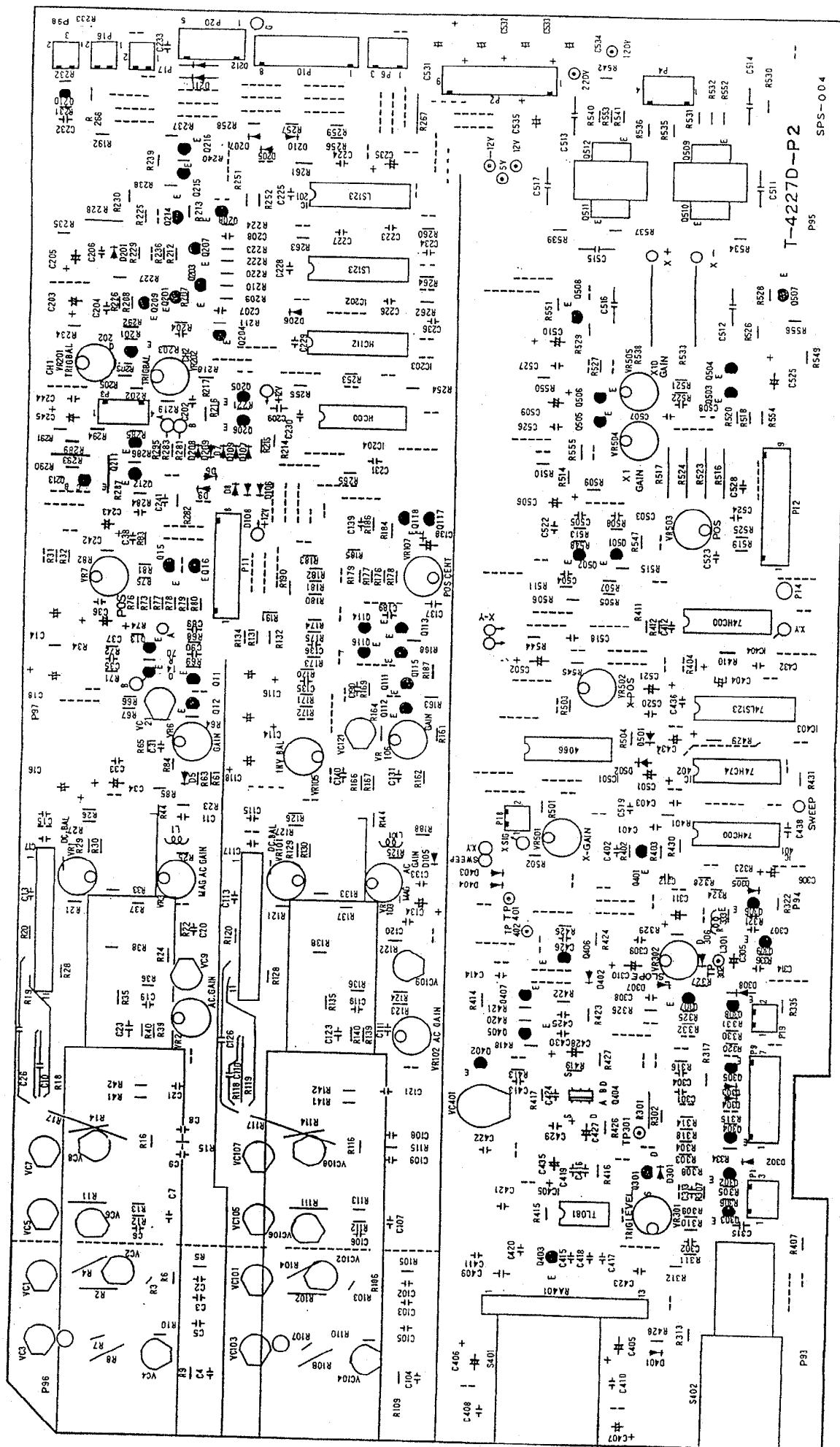
5. ADJUSTMENT LOCATIONS

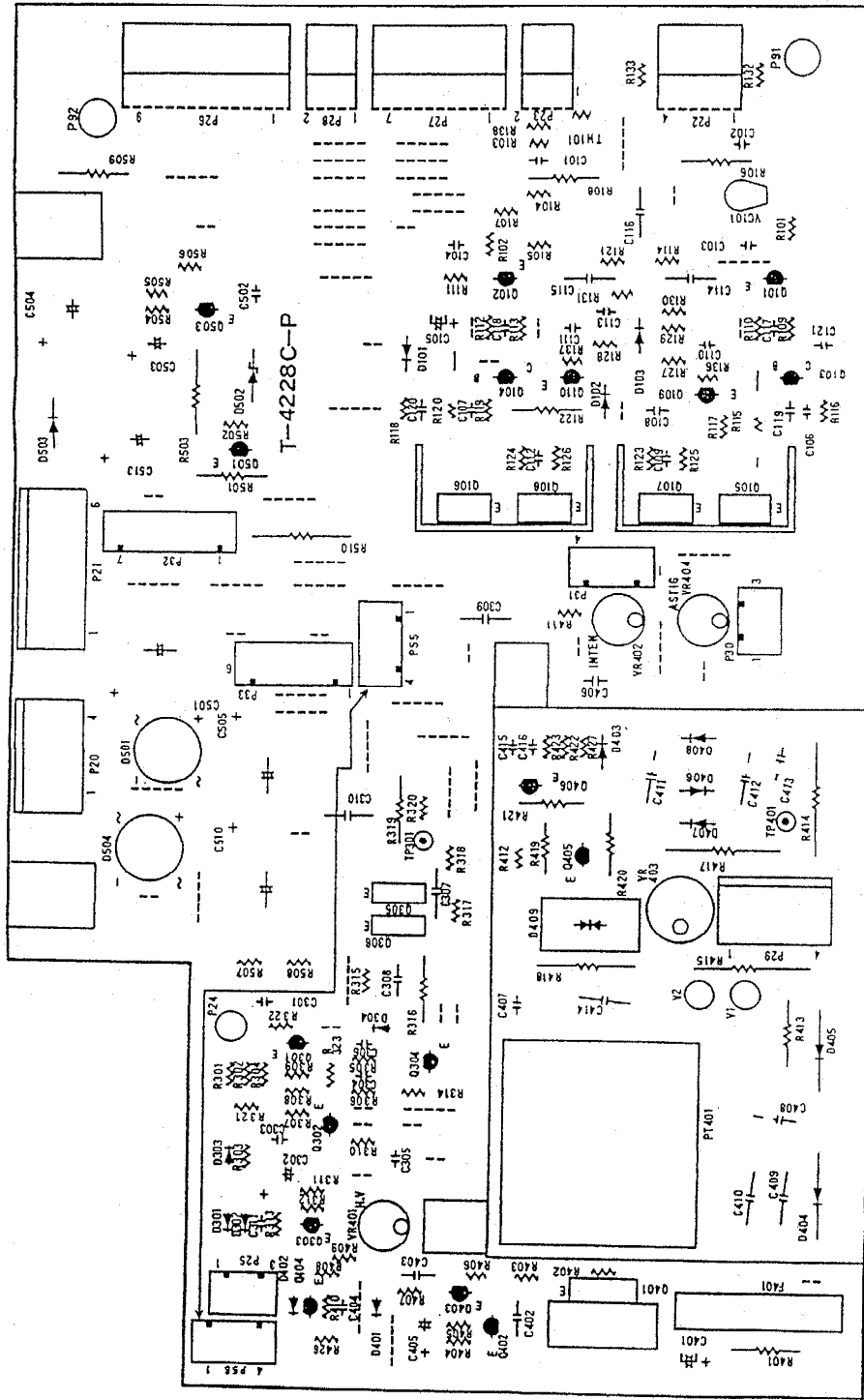


Top View

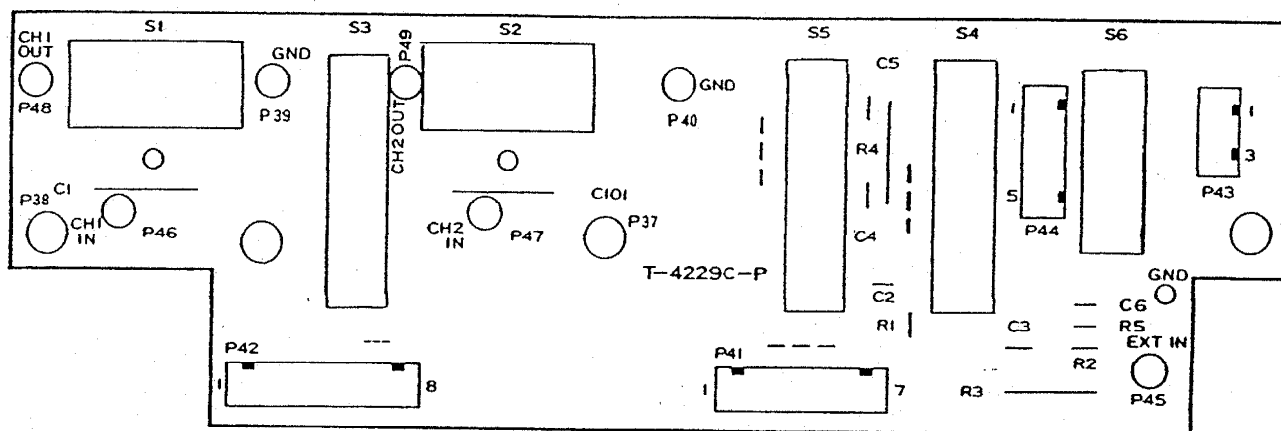


Bottom View

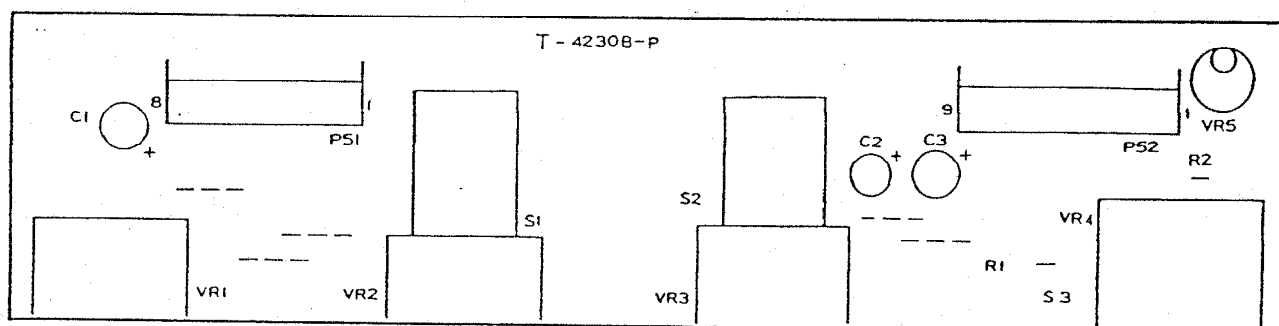




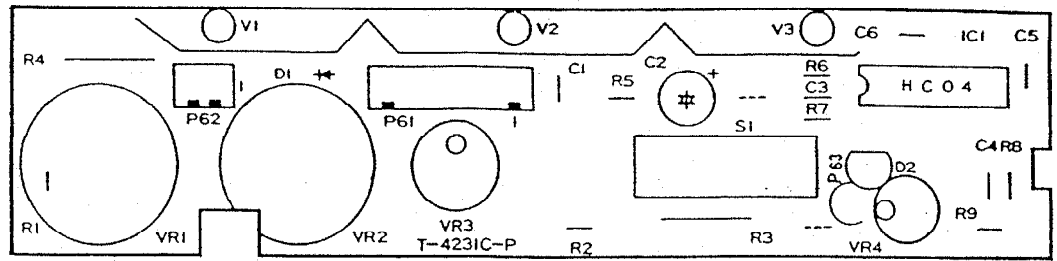
T-4228 V Final Amp/Power Supply Board



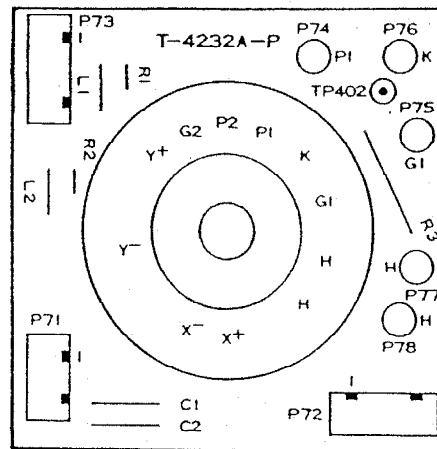
T-4229 SW Board



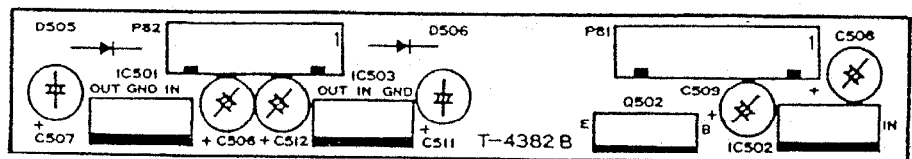
T-4230 VR Board



T-4231 Inten/Focus Board

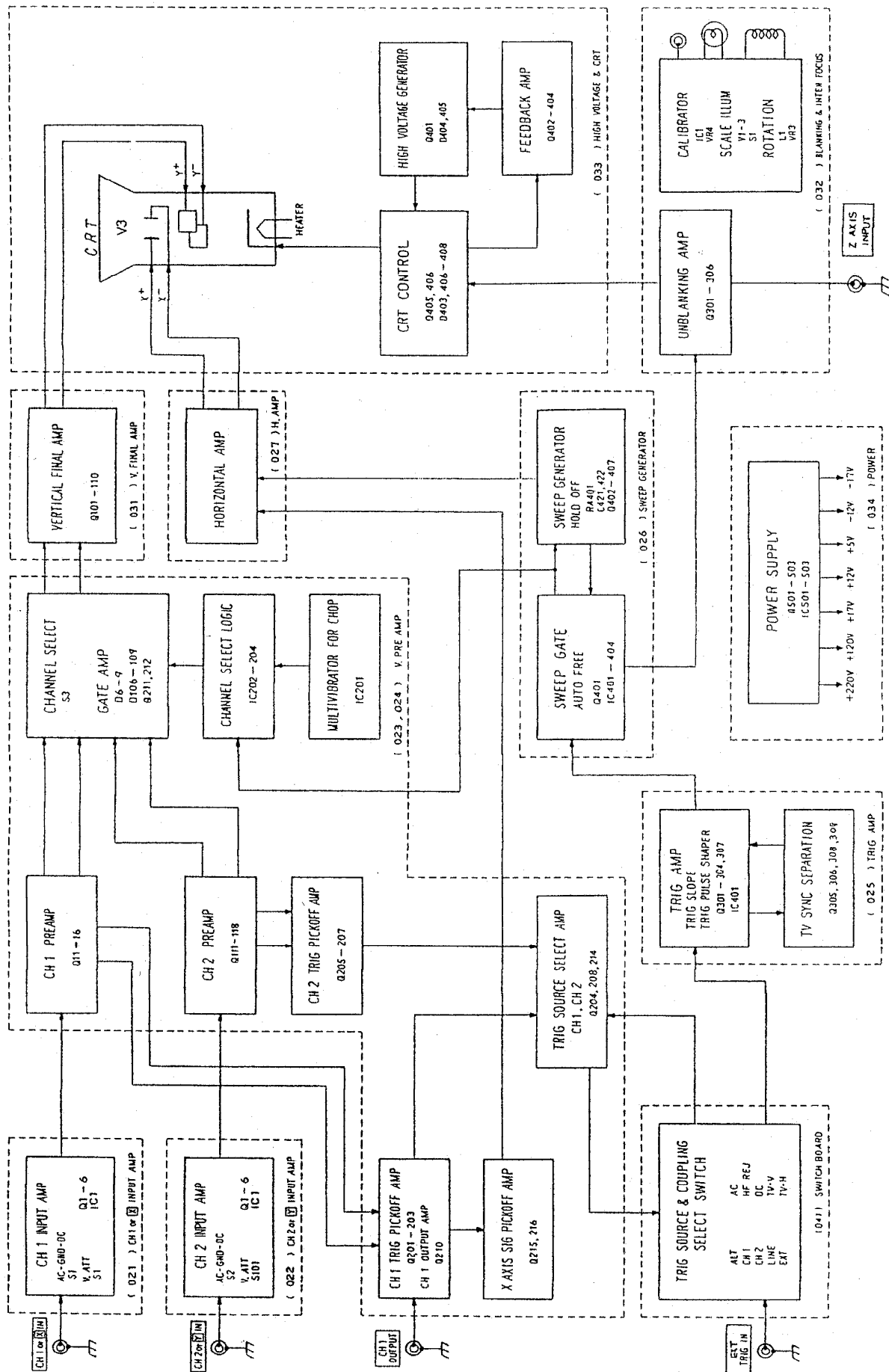


T-4232 CRT Socket Board

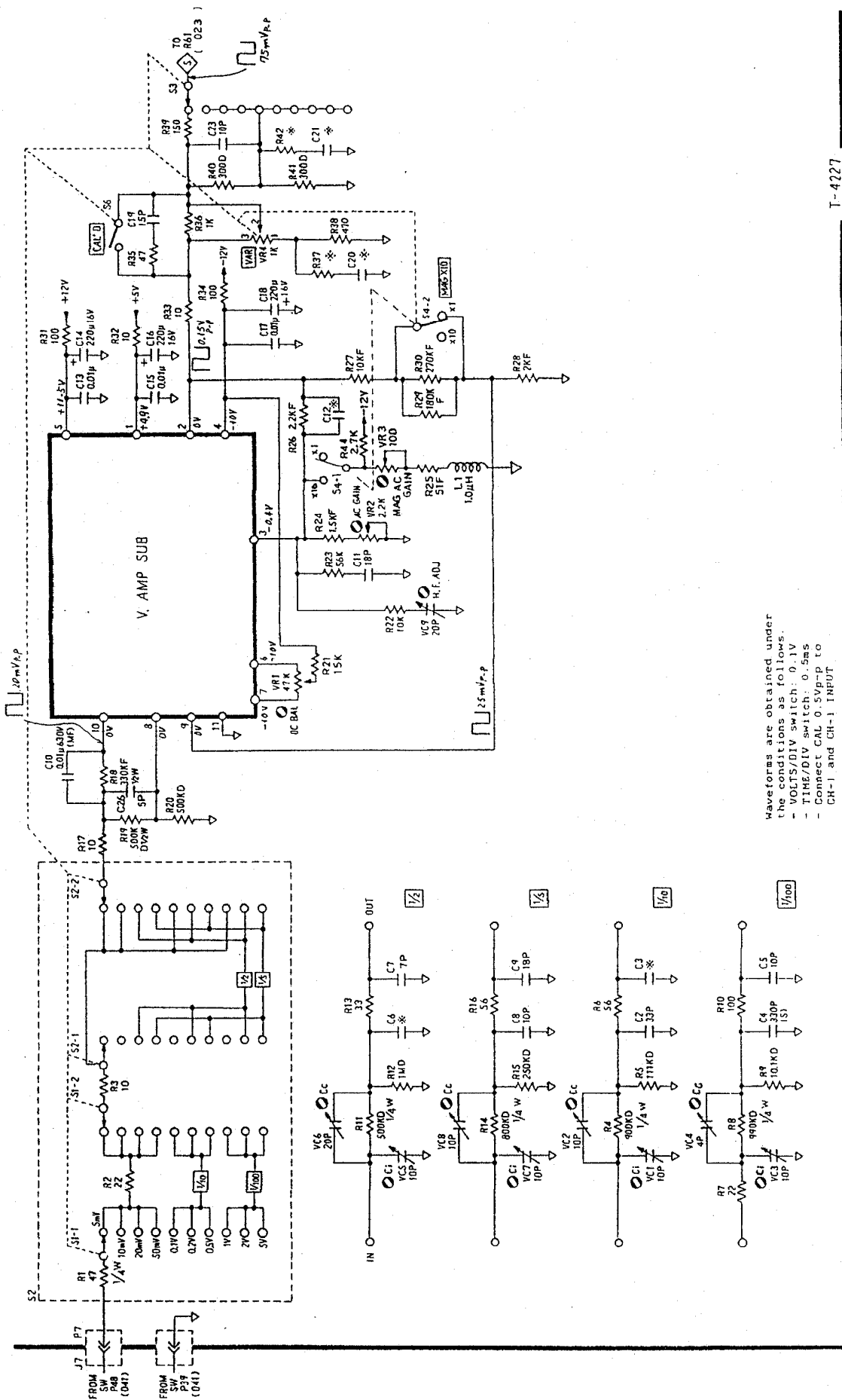


T-4382 Tr Board

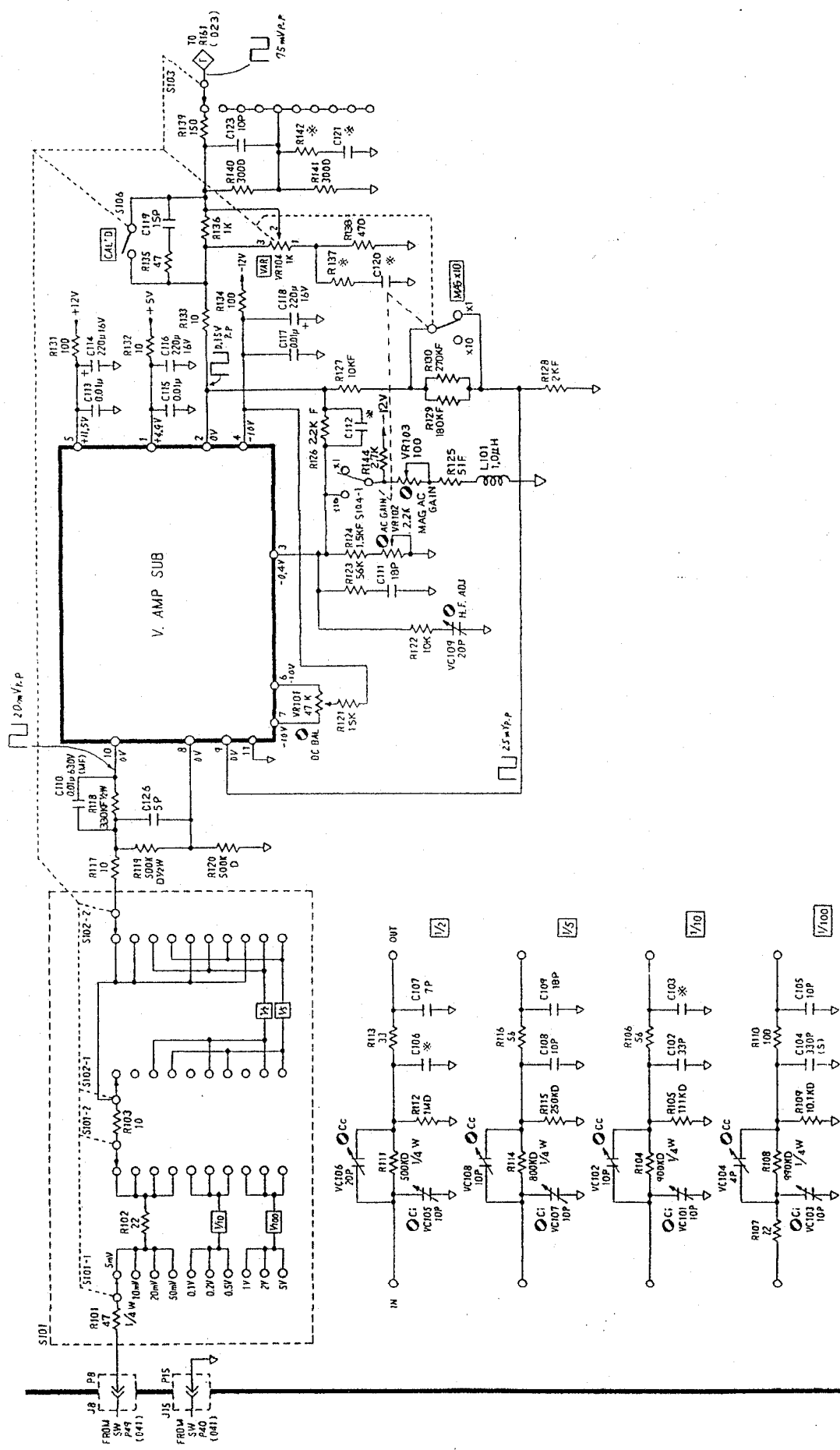
7. BLOCK DIAGRAM/ SCHEMATIC DIAGRAM



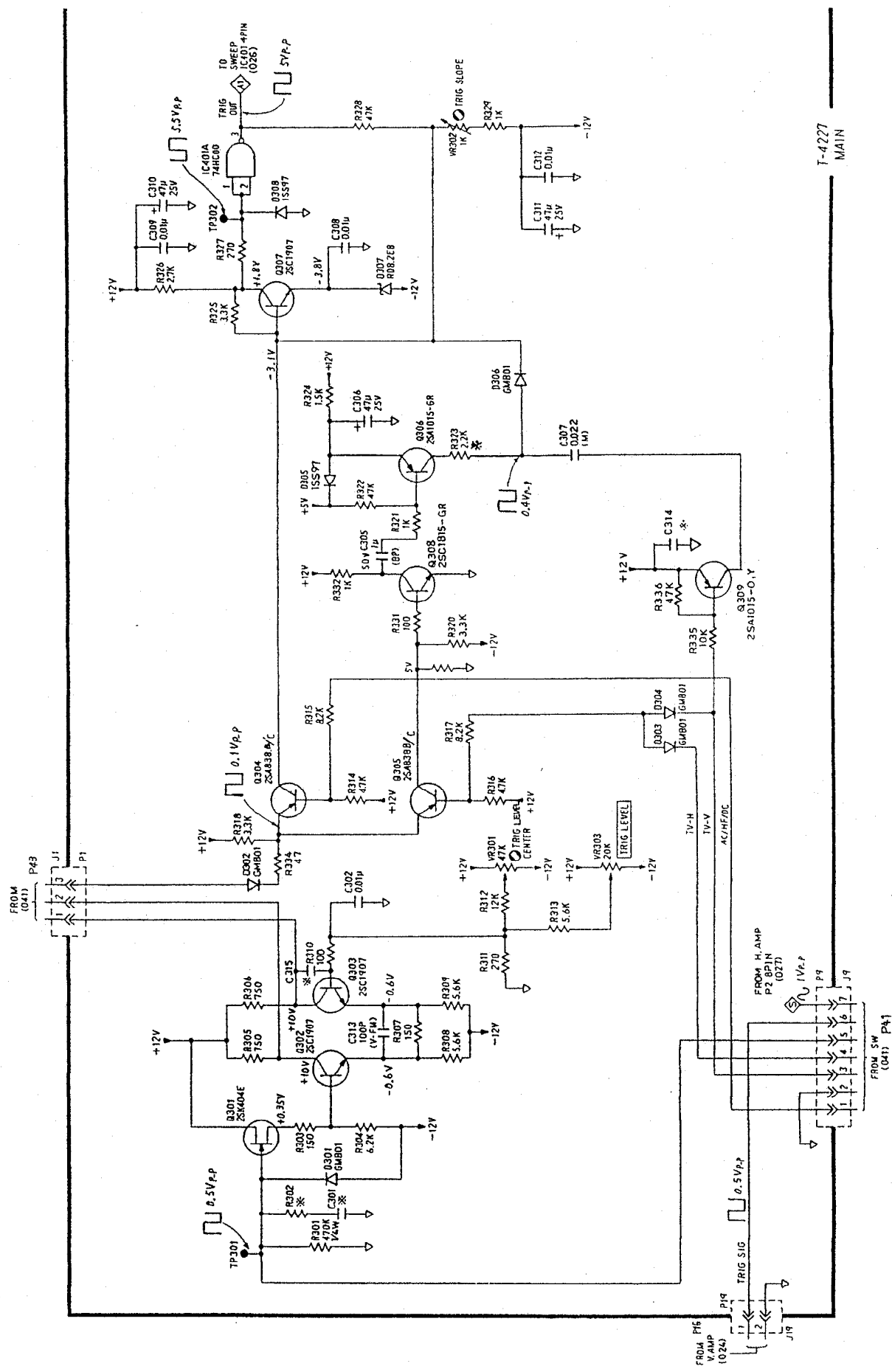
Block Diagram
O-2069-001



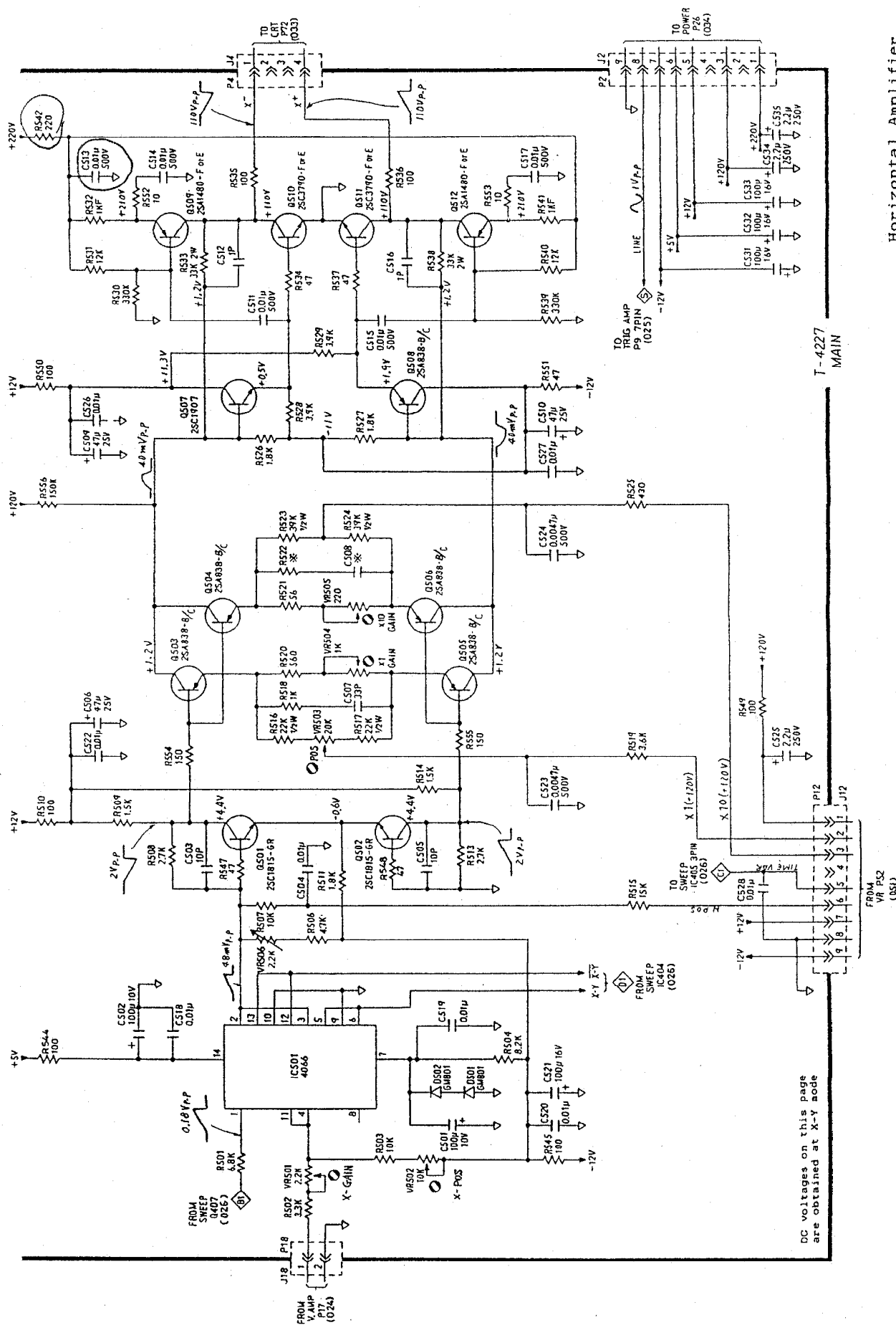
I-4227
MAIN

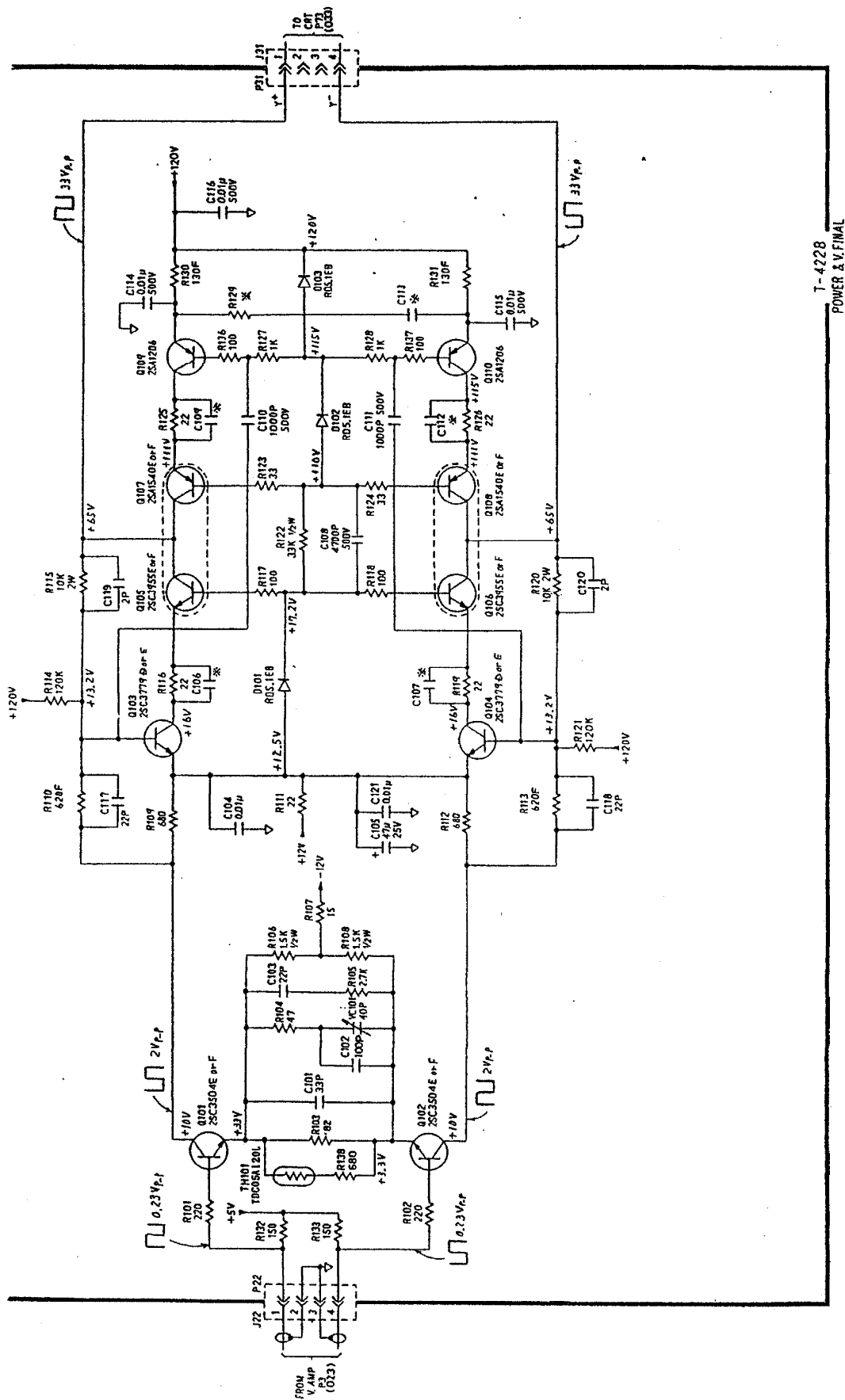


T-4227
MAIN

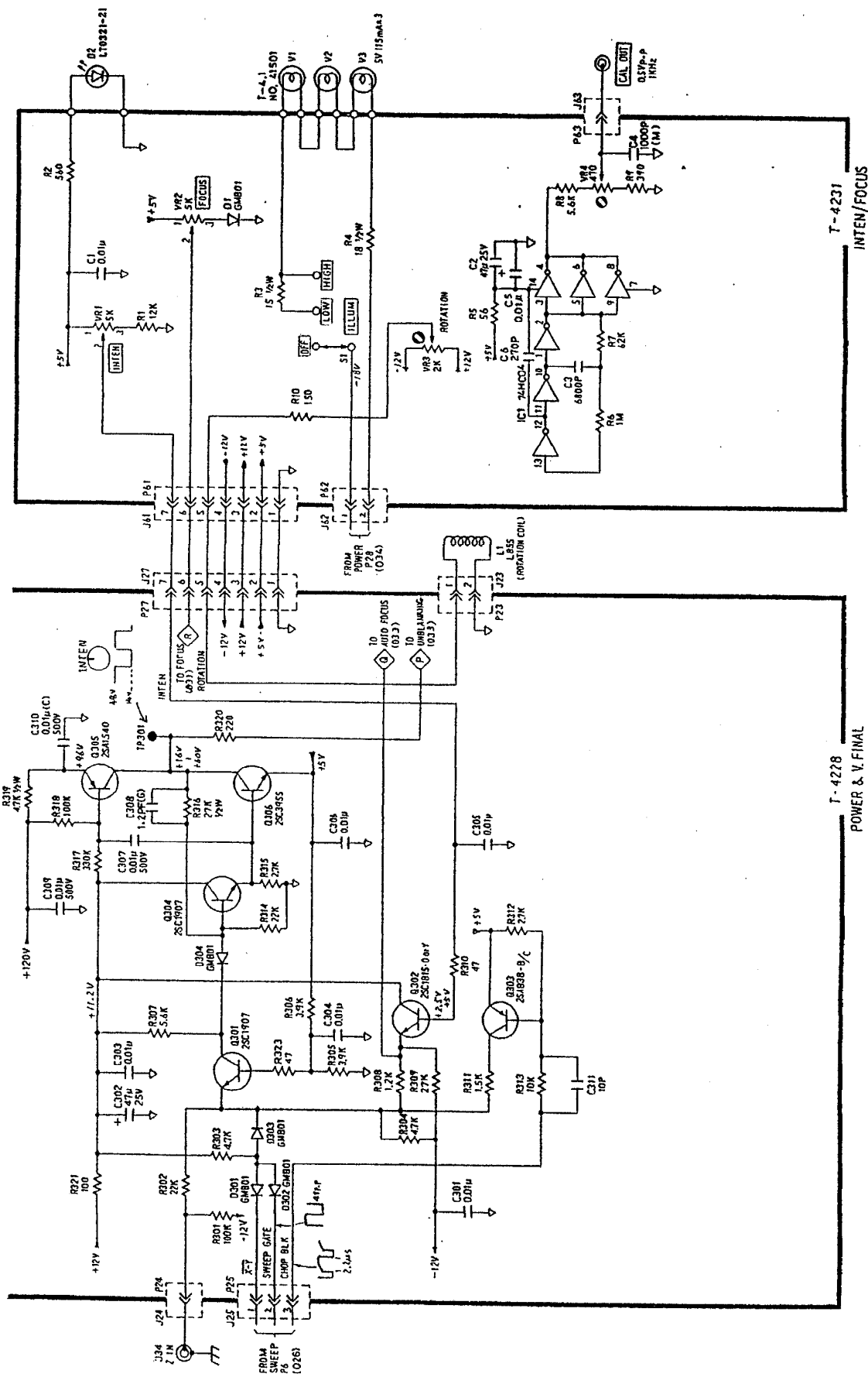


T-4227
MAIN

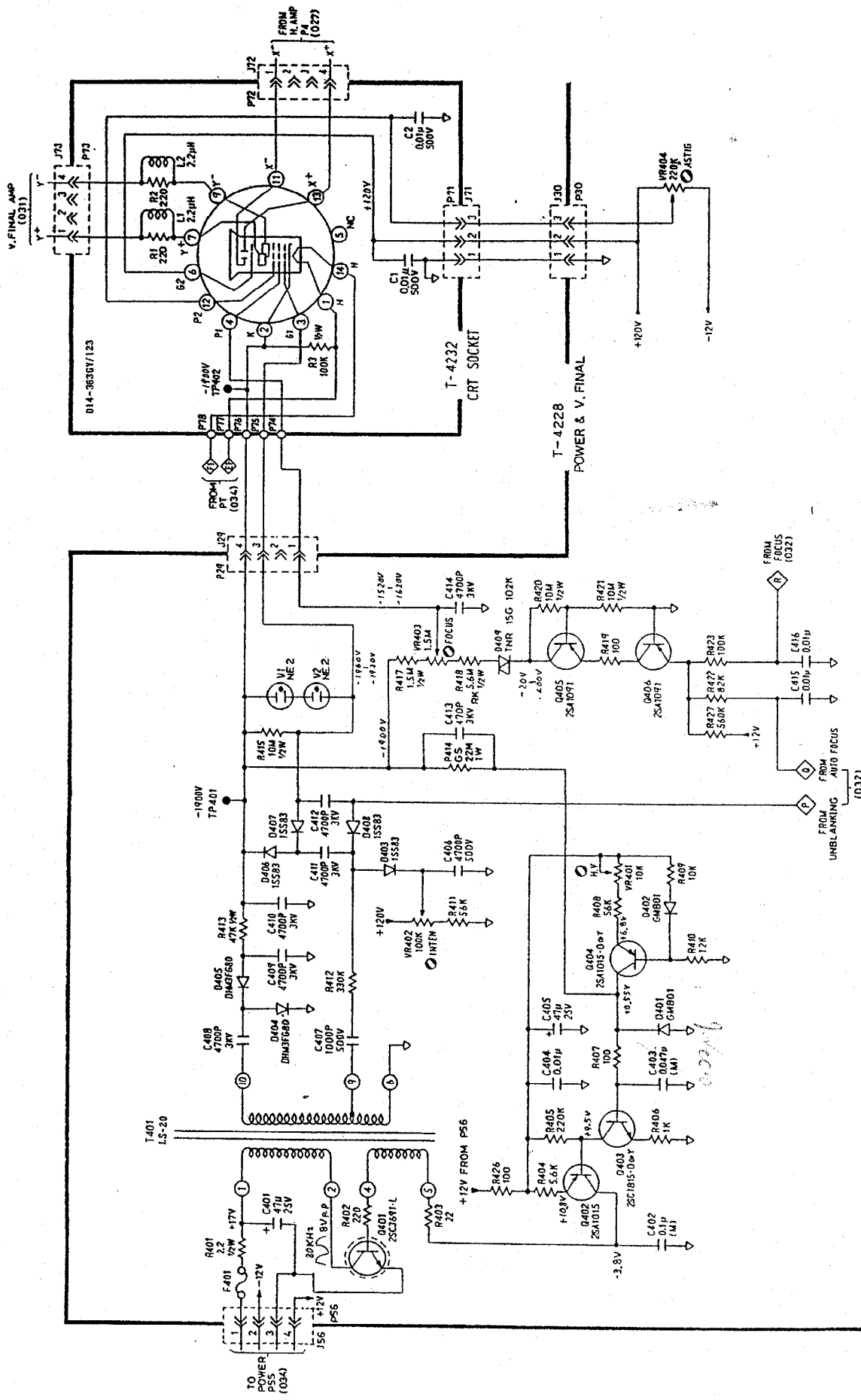


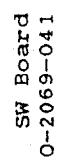


J-4228
POWER AV.FINAL



Blanking/Intensity
O-2069-032



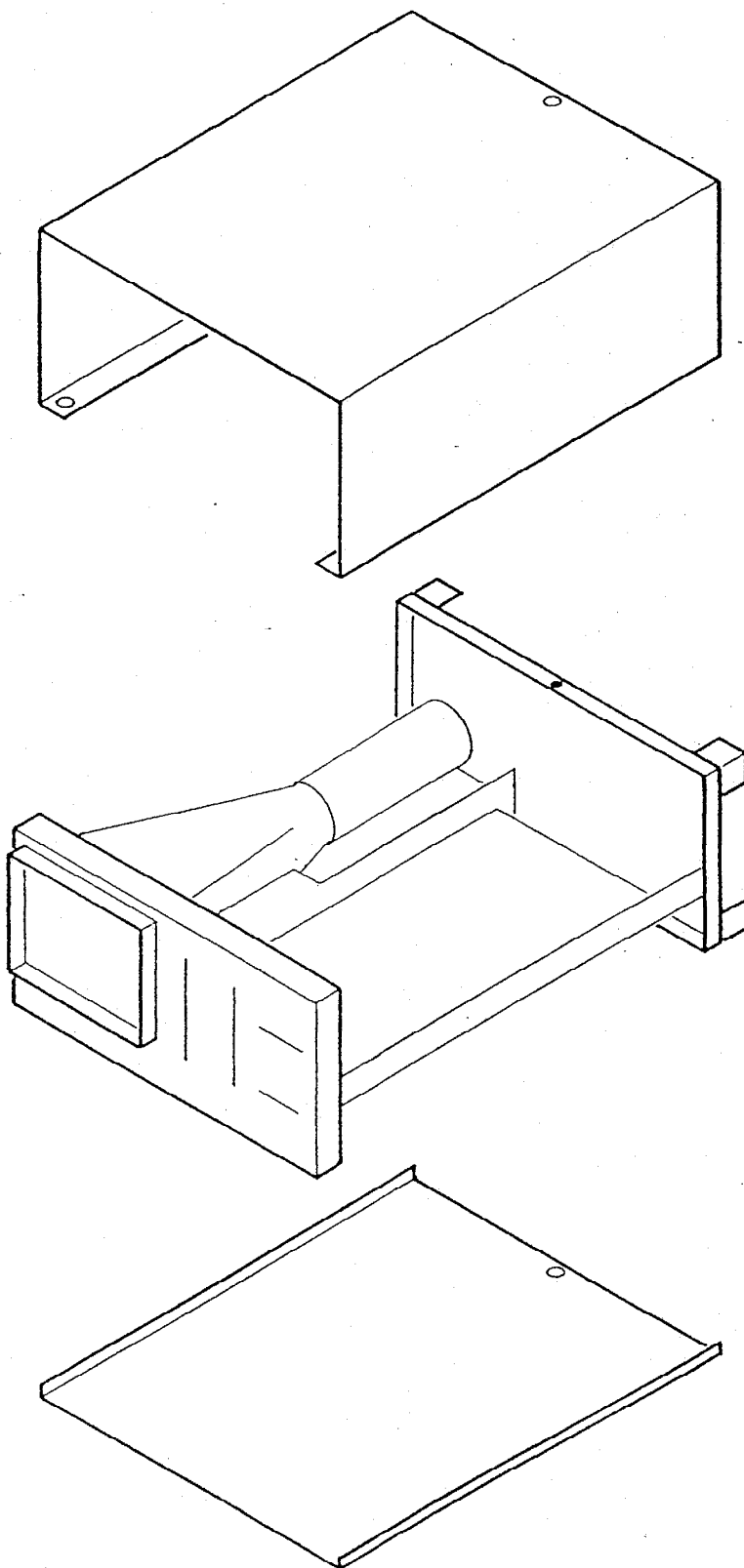




VR Board
0-2069-051

8. CABINET REMOVAL

- Take six screws off. Spread bottom of the Top cover to both side then slide to rear and lift it up.
- Take screw off to remove the Bottom cover.



9. PARTS LIST

No.	LDR PT No.	DESCRIPTION	
*** MAIN FRAME ***			
-TUBE-			
	3710040020	CRT	D14-363GY/123
-TRANSFORMER-			
T1	3800600023	POWER TRANSFORMER	OSL-32
-SWITCH-			
S1	4020138009	PUSH	ESB-70702V "POWER"
-FUSES-			
F1	4369999007	FUSE	[NEED YURE VOLTAGE] ST-4 TYPE
-MISCELLANEOUS-			
	4371009003	FUSE HOLDER	PH MF527
	4513091019	KNOB	B9S(18 SERR.) "INTEN"
	4513091019	KNOB	B9S(18 SERR.) "FOCUS"
	4513091019	KNOB	B9S(18 SERR.) "CH-1 POSITION"
	4513091019	KNOB	B9S(18 SERR.) "CH-2 POSITION"
	4513091019	KNOB	B9S(18 SERR.) "H POSITION"
	4513091019	KNOB	B9S(18 SERR.) "TIME VARIABLE"
	4513093013	KNOB	B9T(18 SERR.) "CH-1 VARIABLE"
	4513093013	KNOB	B9T(18 SERR.) "CH-2 VARIABLE"
	4513093013	KNOB	B9T(18 SERR.) "HOLD OFF"
	4513133101	KNOB	B13S-0(90°) "LEVEL"
	4513151011	KNOB	B15S-0 "CH-1 VOLT/DIV"
	4513151011	KNOB	B15S-0 "CH-2 VOLT/DIV"
	4513191013	KNOB	B19S(18 SERR.) "TIME/DIV"
	4515013075	PUSH BUTTON	LIGHT GRAY "POWER"
	4516034015	SLIDE KNOB	E-594 "ILLUM"
	4516034015	SLIDE KNOB	E-594 "V MODE"
	4516034015	SLIDE KNOB	E-594 "COUPLING"
	4516034015	SLIDE KNOB	E-594 "SOURCE"
	4516034015	SLIDE KNOB	E-594 "SLOPE/TV POL"
	6303047002	MATAL TERMINAL	D-3047 8mm
	6303099102	FOOT	D-3099
	6400431030	CORD WINDER-L	E-431B
	6600543019	CRT FILTER	G-543-1 BLUE
	4310782003	BNC CONNECTOR	BNC-355
	4310782003	BNC CONNECTOR	BNC-355
	4310782003	BNC CONNECTOR	BNC-355
	4310782003	BNC CONNECTOR	BNC-355

*** MAIN BOARD

T-4227 ***

-RESISTORS-

R1	1010470003	CARBON FILM	47 OHM	5%	1/4W
R2	1000220003	CARBON FILM	22 OHM	5%	1/4W
R3	1000100003	CARBON FILM	10 OHM	5%	1/4W
R4	1369000027	METAL FILM	900K OHM	0.5%	1/4W
R5	1451113014	METAL FILM	111K OHM	0.5%	1/4W
R6	1000560007	CARBON FILM	56 OHM	5%	1/4W
R7	1000220003	CARBON FILM	22 OHM	5%	1/4W
R8	1369900005	METAL FILM	990K OHM	0.5%	1/4W
R9	1451012009	METAL FILM	10.1K OHM	0.5%	1/4W
R10	1000101005	CARBON FILM	100 OHM	5%	1/4W
R11	1365000032	METAL FILM	500K OHM	0.5%	1/4W
R12	1451004000	MATAL FILM	1M OHM	0.5%	1/4W
R13	1000330000	CARBON FILM	33 OHM	5%	1/4W
R14	1368000012	METAL FILM	800K OHM	0.5%	1/4W
R15	1452503013	METAL FILM	250K OHM	0.5%	1/4W
R16	1000560007	CARBON FILM	56 OHM	5%	1/4W
R17	1000100003	CARBON FILM	10 OHM	5%	1/4W
R18	1333303000	METAL FILM	330K OHM	1%	1/2W
R19	1375000002	METAL FILM	500K OHM	0.5%	1/4W
R20	1455003002	MATAL FILM	500K OHM	0.5%	1/4W
R21	1000153004	CARBON FILM	15K OHM	5%	1/4W
R22	1000103009	CARBON FILM	10K OHM	5%	1/4W
R23	1000563003	CARBON FILM	56K OHM	5%	1/4W
R24	1461501001	METAL FILM	1.5K OHM	1%	1/4W
R25	1465109005	METAL FILM	51 OHM	1%	1/4W
R26	1462201005	METAL FILM	2.2K OHM	1%	1/4W
R27	1461002003	METAL FILM	10K OHM	1%	1/4W
R28	1462001007	METAL FILM	2K OHM	1%	1/4W
R29	1461803007	METAL FILM	180K OHM	1%	1/4W
R30	1462703009	METAL FILM	270K OHM	1%	1/4W
R31	1000101005	CARBON FILM	100 OHM	5%	1/4W
R32	1000100003	CARBON FILM	10 OHM	5%	1/4W
R33	1000100003	CARBON FILM	10 OHM	5%	1/4W
R34	1000101005	CARBON FILM	100 OHM	5%	1/4W
R35	1000470006	CARBON FILM	47 OHM	5%	1/4W
R36	1000102007	CARBON FILM	1K OHM	5%	1/4W
R38	1000471008	CARBON FILM	470 OHM	5%	1/4W
R39	1000151000	CARBON FILM	150 OHM	5%	1/4W
R40	1453000004	METAL FILM	300 OHM	0.5%	1/4W
R41	1453000004	METAL FILM	300 OHM	0.5%	1/4W
R44	1000272002	CARBON FILM	2.7K OHM	5%	1/4W
R61	1000470006	CARBON FILM	47 OHM	5%	1/4W
R63	1000151000	CARBON FILM	150 OHM	5%	1/4W
R64	1463309001	METAL FILM	33 OHM	1%	1/4W
R65	1000000009	CARBON FILM	0 OHM		
R66	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R67	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R68	1000331002	CARBON FILM	330 OHM	5%	1/4W
R69	1000331002	CARBON FILM	330 OHM	5%	1/4W
R70	1000221005	CARBON FILM	220 OHM	5%	1/4W
R71	1000123005	CARBON FILM	12K OHM	5%	1/4W
R72	1000682001	CARBON FILM	6.8K OHM	5%	1/4W
R73	1000151000	CARBON FILM	150 OHM	5%	1/4W
R74	1000151000	CARBON FILM	150 OHM	5%	1/4W
R75	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R76	1000152002	CARBON FILM	1.5K OHM	5%	1/4W

R77	1000182001	CARBON FILM	1.8K OHM	5%	1/4W
R78	1000392002	CARBON FILM	3.9K OHM	5%	1/4W
R79	1000392002	CARBON FILM	3.9K OHM	5%	1/4W
R80	1000182001	CARBON FILM	1.8K OHM	5%	1/4W
R81	1000470006	CARBON FILM	47 OHM	5%	1/4W
R82	1000103009	CARBON FILM	10K OHM	5%	1/4W
R83	1000103009	CARBON FILM	10K OHM	5%	1/4W
R84	1000513008	CARBON FILM	51K OHM	5%	1/4W
R85	1000563003	CARBON FILM	56K OHM	5%	1/4W
R101	1010470003	CARBON FILM	47 OHM	5%	1/4W
R102	1000220003	CARBON FILM	22 OHM	5%	1/4W
R103	1000100003	CARBON FILM	10 OHM	5%	1/4W
R104	1369000027	METAL FILM	900K OHM	0.5%	1/4W
R105	1451113014	METAL FILM	111K OHM	0.5%	1/4W
R106	1000560007	CARBON FILM	56 OHM	5%	1/4W
R107	1000220003	CARBON FILM	22 OHM	5%	1/4W
R108	1369900005	METAL FILM	990K OHM	0.5%	1/4W
R109	1451012009	METAL FILM	10.1K OHM	0.5%	1/4W
R110	1000101005	CARBON FILM	100 OHM	5%	1/4W
R111	1365000032	METAL FILM	500K OHM	0.5%	1/4W
R112	1451004000	METAL FILM	1M OHM	0.5%	1/4W
R113	1000330000	CARBON FILM	33 OHM	5%	1/4W
R114	1368000012	METAL FILM	800K OHM	0.5%	1/4W
R115	1452503013	METAL FILM	250K OHM	0.5%	1/4W
R116	1000560007	CARBON FILM	56 OHM	5%	1/4W
R117	1000100003	CARBON FILM	10 OHM	5%	1/4W
R118	1333303000	METAL FILM	330K OHM	1%	1/2W
R119	1375000002	METAL FILM	500K OHM	0.5%	1/4W
R120	1455003002	METAL FILM	500K OHM	0.5%	1/4W
R121	1000153004	CARBON FILM	15K OHM	5%	1/4W
R122	1000103009	CARBON FILM	10K OHM	5%	1/4W
R123	1000563003	CARBON FILM	56K OHM	5%	1/4W
R124	1461501001	METAL FILM	1.5K OHM	1%	1/4W
R125	1465109005	METAL FILM	51 OHM	1%	1/4W
R126	1462201005	METAL FILM	2.2K OHM	1%	1/4W
R127	1461002003	METAL FILM	10K OHM	1%	1/4W
R128	1462001007	METAL FILM	2K OHM	1%	1/4W
R129	1461803007	METAL FILM	180K OHM	1%	1/4W
R130	1462703009	METAL FILM	270K OHM	1%	1/4W
R131	1000101005	CARBON FILM	100 OHM	5%	1/4W
R132	1000100003	CARBON FILM	10 OHM	5%	1/4W
R133	1000100003	CARBON FILM	10 OHM	5%	1/4W
R134	1000101005	CARBON FILM	100 OHM	5%	1/4W
R135	1000470006	CARBON FILM	47 OHM	5%	1/4W
R136	1000102007	CARBON FILM	1K OHM	5%	1/4W
R138	1000471008	CARBON FILM	470 OHM	5%	1/4W
R139	1000151000	CARBON FILM	150 OHM	5%	1/4W
R140	1453000004	METAL FILM	300 OHM	0.5%	1/4W
R141	1453000004	METAL FILM	300 OHM	0.5%	1/4W
R144	1000272002	CARBON FILM	2.7K OHM	5%	1/4W
R161	1000470006	CARBON FILM	47 OHM	5%	1/4W
R162	1000333006	CARBON FILM	33K OHM	5%	1/4W
R163	1000151000	CARBON FILM	150 OHM	5%	1/4W
R164	1463309001	METAL FILM	33 OHM	1%	1/4W
R166	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R167	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R168	1000331002	CARBON FILM	330 OHM	5%	1/4W
R169	1000331002	CARBON FILM	330 OHM	5%	1/4W

R170	1000221005	CARBON FILM	220 OHM	5%	1/4W
R171	1000682001	CARBON FILM	6.8K OHM	5%	1/4W
R172	1000123005	CARBON FILM	12K OHM	5%	1/4W
R173	1000221005	CARBON FILM	220 OHM	5%	1/4W
R174	1000123005	CARBON FILM	12K OHM	5%	1/4W
R175	1000682001	CARBON FILM	6.8K OHM	5%	1/4W
R176	1000151000	CARBON FILM	150 OHM	5%	1/4W
R177	1000151000	CARBON FILM	150 OHM	5%	1/4W
R178	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R179	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R180	1000182001	CARBON FILM	1.8K OHM	5%	1/4W
R181	1000392002	CARBON FILM	3.9K OHM	5%	1/4W
R182	1000392002	CARBON FILM	3.9K OHM	5%	1/4W
R183	1000182001	CARBON FILM	1.8K OHM	5%	1/4W
R184	1000470006	CARBON FILM	47 OHM	5%	1/4W
R185	1000103009	CARBON FILM	10K OHM	5%	1/4W
R186	1000103009	CARBON FILM	10K OHM	5%	1/4W
R187	1000513008	CARBON FILM	51K OHM	5%	1/4W
R188	1000563003	CARBON FILM	56K OHM	5%	1/4W
R190	1000682001	CARBON FILM	6.8K OHM	5%	1/4W
R191	1000682001	CARBON FILM	6.8K OHM	5%	1/4W
R192	1000101005	CARBON FILM	100 OHM	5%	1/4W
R201	1000221005	CARBON FILM	220 OHM	5%	1/4W
R202	1000221005	CARBON FILM	220 OHM	5%	1/4W
R203	1000331002	CARBON FILM	330 OHM	5%	1/4W
R204	1000101005	CARBON FILM	100 OHM	5%	1/4W
R205	1000222007	CARBON FILM	2.2K OHM	5%	1/4W
R206	1000222007	CARBON FILM	2.2K OHM	5%	1/4W
R207	1000220003	CARBON FILM	22 OHM	5%	1/4W
R208	1000220003	CARBON FILM	22 OHM	5%	1/4W
R209	1000331002	CARBON FILM	330 OHM	5%	1/4W
R210	1000222007	CARBON FILM	2.2K OHM	5%	1/4W
R211	1000103009	CARBON FILM	10K OHM	5%	1/4W
R212	1000912002	CARBON FILM	9.1K OHM	5%	1/4W
R213	1000122003	CARBON FILM	1.2K OHM	5%	1/4W
R214	1000221005	CARBON FILM	220 OHM	5%	1/4W
R215	1000221005	CARBON FILM	220 OHM	5%	1/4W
R216	1000331002	CARBON FILM	330 OHM	5%	1/4W
R217	1000470006	CARBON FILM	47 OHM	5%	1/4W
R218	1000222007	CARBON FILM	2.2K OHM	5%	1/4W
R219	1000222007	CARBON FILM	2.2K OHM	5%	1/4W
R220	1000220003	CARBON FILM	22 OHM	5%	1/4W
R221	1000681009	CARBON FILM	680 OHM	5%	1/4W
R222	1000331002	CARBON FILM	330 OHM	5%	1/4W
R223	1000222007	CARBON FILM	2.2K OHM	5%	1/4W
R224	1000103009	CARBON FILM	10K OHM	5%	1/4W
R225	1000470006	CARBON FILM	47 OHM	5%	1/4W
R226	1000180007	CARBON FILM	180 OHM	5%	1/4W
R227	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R228	1000182001	CARBON FILM	1.8K OHM	5%	1/4W
R229	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R230	1000392002	CARBON FILM	3.9K OHM	5%	1/4W
R231	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R232	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R233	1000470006	CARBON FILM	47 OHM	5%	1/4W
R234	1000000009	CARBON FILM	0 OHM		
R235	1000100003	CARBON FILM	10 OHM	5%	1/4W
R236	1000392002	CARBON FILM	3.9K OHM	5%	1/4W

R237	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R238	1000470006	CARBON FILM	47 OHM	5%	1/4W
R239	1000103009	CARBON FILM	10K OHM	5%	1/4W
R240	1000222007	CARBON FILM	2.2K OHM	5%	1/4W
R251	1000471008	CARBON FILM	470 OHM	5%	1/4W
R252	1000471008	CARBON FILM	470 OHM	5%	1/4W
R253	1000103009	CARBON FILM	10K OHM	5%	1/4W
R254	1000103009	CARBON FILM	10K OHM	5%	1/4W
R255	1000103009	CARBON FILM	10K OHM	5%	1/4W
R256	1000103009	CARBON FILM	10K OHM	5%	1/4W
R257	1000103009	CARBON FILM	10K OHM	5%	1/4W
R258	1000103009	CARBON FILM	10K OHM	5%	1/4W
R259	1000103009	CARBON FILM	10K OHM	5%	1/4W
R260	1000103009	CARBON FILM	10K OHM	5%	1/4W
R261	1000273004	CARBON FILM	27K OHM	5%	1/4W
R262	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R263	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R264	1000103009	CARBON FILM	10K OHM	5%	1/4W
R265	1000103009	CARBON FILM	10K OHM	5%	1/4W
R266	1000273004	CARBON FILM	27K OHM	5%	1/4W
R267	1000561009	CARBON FILM	560 OHM	5%	1/4W
R281	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R282	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R283	1000622003	CARBON FILM	6.2K OHM	5%	1/4W
R284	1000622003	CARBON FILM	6.2K OHM	5%	1/4W
R285	1000751004	CARBON FILM	750 OHM	5%	1/4W
R286	1000751004	CARBON FILM	750 OHM	5%	1/4W
R287	1000122003	CARBON FILM	1.2K OHM	5%	1/4W
R289	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R290	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R291	1000473002	CARBON FILM	47K OHM	5%	1/4W
R292	1000473002	CARBON FILM	47K OHM	5%	1/4W
R293	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R294	1000680007	CARBON FILM	68 OHM	5%	1/4W
R295	1000680007	CARBON FILM	68 OHM	5%	1/4W
R301	1000474004	CARBON FILM	470K OHM	5%	1/4W
R303	1000151000	CARBON FILM	150 OHM	5%	1/4W
R304	1000622003	CARBON FILM	6.2K OHM	5%	1/4W
R305	1000751004	CARBON FILM	750 OHM	5%	1/4W
R306	1000751004	CARBON FILM	750 OHM	5%	1/4W
R307	1000151000	CARBON FILM	150 OHM	5%	1/4W
R308	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R309	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R310	1000101005	CARBON FILM	100 OHM	5%	1/4W
R311	1000271000	CARBON FILM	270 OHM	5%	1/4W
R312	1000123005	CARBON FILM	12K OHM	5%	1/4W
R313	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R314	1000472000	CARBON FILM	4.7K OHM	5%	1/4W
R315	1000822001	CARBON FILM	8.2K OHM	5%	1/4W
R316	1000472000	CARBON FILM	4.7K OHM	5%	1/4W
R317	1000822001	CARBON FILM	8.2K OHM	5%	1/4W
R318	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R320	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R321	1000102007	CARBON FILM	1K OHM	5%	1/4W
R322	1000473002	CARBON FILM	47K OHM	5%	1/4W
R323	1000222007	CARBON FILM	2.2K OHM	5%	1/4W
R324	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R325	1000332004	CARBON FILM	3.3K OHM	5%	1/4W

R326	1000272002	CARBON FILM	2.7K OHM	5%	1/4W
R327	1000271000	CARBON FILM	270 OHM	5%	1/4W
R328	1000473002	CARBON FILM	47K OHM	5%	1/4W
R329	1000102007	CARBON FILM	1K OHM	5%	1/4W
R330	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R331	1000101005	CARBON FILM	100 OHM	5%	1/4W
R332	1000102007	CARBON FILM	1K OHM	5%	1/4W
R333	1000000009	CARBON FILM	0 OHM		
R334	1000470006	CARBON FILM	47 OHM	5%	1/4W
R335	1000103009	CARBON FILM	10K OHM	5%	1/4W
R336	1000473002	CARBON FILM	47K OHM	5%	1/4W
R401	1000155008	CARBON FILM	1.5M OHM	5%	1/4W
R402	1000104001	CARBON FILM	100K OHM	5%	1/4W
R403	1000333006	CARBON FILM	33K OHM	5%	1/4W
R404	1000104001	CARBON FILM	100K OHM	5%	1/4W
R407	1000103009	CARBON FILM	10K OHM	5%	1/4W
R410	1000331002	CARBON FILM	330 OHM	5%	1/4W
R411	1000103009	CARBON FILM	10K OHM	5%	1/4W
R412	1000682001	CARBON FILM	6.8K OHM	5%	1/4W
R413	1000182001	CARBON FILM	1.8K OHM	5%	1/4W
R414	1000333006	CARBON FILM	33K OHM	5%	1/4W
R415	1000471008	CARBON FILM	470 OHM	5%	1/4W
R416	1000472000	CARBON FILM	4.7K OHM	5%	1/4W
R417	1000101005	CARBON FILM	100 OHM	5%	1/4W
R418	1000470006	CARBON FILM	47 OHM	5%	1/4W
R419	1000101005	CARBON FILM	100 OHM	5%	1/4W
R420	1000470006	CARBON FILM	47 OHM	5%	1/4W
R421	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R422	1000102007	CARBON FILM	1K OHM	5%	1/4W
R423	1000222007	CARBON FILM	2.2K OHM	5%	1/4W
R424	1000223009	CARBON FILM	22K OHM	5%	1/4W
R425	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R426	1000101005	CARBON FILM	100 OHM	5%	1/4W
R427	1000101005	CARBON FILM	100 OHM	5%	1/4W
R428	1000333006	CARBON FILM	33K OHM	5%	1/4W
R429	1000103009	CARBON FILM	10K OHM	5%	1/4W
R430	1000102007	CARBON FILM	1K OHM	5%	1/4W
R431	1000151000	CARBON FILM	150 OHM	5%	1/4W
R501	1000682001	CARBON FILM	6.8K OHM	5%	1/4W
R502	1000332004	CARBON FILM	3.3K OHM	5%	1/4W
R503	1000682001	CARBON FILM	10K OHM	5%	1/4W
R504	1000822001	CARBON FILM	8.2K OHM	5%	1/4W
R506	1000472000	CARBON FILM	4.7K OHM	5%	1/4W
R507	1000103009	CARBON FILM	10K OHM	5%	1/4W
R508	1000272002	CARBON FILM	2.7K OHM	5%	1/4W
R509	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R510	1000101005	CARBON FILM	100 OHM	5%	1/4W
R511	1000182001	CARBON FILM	1.8K OHM	5%	1/4W
R513	1000272002	CARBON FILM	2.7K OHM	5%	1/4W
R514	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R515	1000153004	CARBON FILM	15K OHM	5%	1/4W
R516	1020223003	CARBON FILM	22K OHM	5%	1/2W
R517	1020223003	CARBON FILM	22K OHM	5%	1/2W
R518	1000102007	CARBON FILM	1K OHM	5%	1/4W
R519	1000362003	CARBON FILM	3.6K OHM	5%	1/4W
R520	1000561009	CARBON FILM	560 OHM	5%	1/4W
R521	1000560007	CARBON FILM	56 OHM	5%	1/4W
R523	1020393008	CARBON FILM	39K OHM	5%	1/2W

R524	1020393008	CARBON FILM	39K OHM	5%	1/2W
R525	1000431006	CARBON FILM	430 OHM	5%	1/4W
R526	1000182001	CARBON FILM	1.8K OHM	5%	1/4W
R527	1000182001	CARBON FILM	1.8K OHM	5%	1/4W
R528	1000392002	CARBON FILM	3.9K OHM	5%	1/4W
R529	1000392002	CARBON FILM	3.9K OHM	5%	1/4W
R530	1000334008	CARBON FILM	330K OHM	5%	1/4W
R531	1000123005	CARBON FILM	12K OHM	5%	1/4W
R532	1461001001	METAL FILM	1K OHM	1%	1/4W
R533	1590333009	METAL FILM	33K OHM	5%	2W
R534	1000470006	CARBON FILM	47 OHM	5%	1/4W
R535	1000101005	CARBON FILM	100 OHM	5%	1/4W
R536	1000101005	CARBON FILM	100 OHM	5%	1/4W
R537	1000470006	CARBON FILM	47 OHM	5%	1/4W
R538	1590333009	METAL FILM	33K OHM	5%	2W
R539	1000334008	CARBON FILM	330K OHM	5%	1/4W
R540	1000123005	CARBON FILM	12K OHM	5%	1/4W
R541	1461001001	METAL FILM	1K OHM	1%	1/4W
R542	1000221005	CARBON FILM	220 OHM	5%	1/4W
R544	1000101005	CARBON FILM	100 OHM	5%	1/4W
R545	1000101005	CARBON FILM	100 OHM	5%	1/4W
R547	1000470006	CARBON FILM	47 OHM	5%	1/4W
R548	1000470006	CARBON FILM	47 OHM	5%	1/4W
R549	1000101005	CARBON FILM	100 OHM	5%	1/4W
R550	1000101005	CARBON FILM	100 OHM	5%	1/4W
R551	1000470006	CARBON FILM	47 OHM	5%	1/4W
R552	1000100003	CARBON FILM	10 OHM	5%	1/4W
R553	1000100003	CARBON FILM	10 OHM	5%	1/4W
R554	1000151000	CARBON FILM	150 OHM	5%	1/4W
R555	1000151000	CARBON FILM	150 OHM	5%	1/4W
R556	1000154006	CARBON FILM	150K OHM	5%	1/4W
RA401	1412013009	RESISTOR ARRAY	42904 USI	1%	

-VARIABLE RESISTORS-

VR1		METAL GLAZE	47K OHM	20%	1/3W
VR2		METAL GLAZE	2.2K OHM	20%	1/3W
VR3	1711004006	METAL GLAZE	100 OHM	20%	1/3W
VR6		METAL GLAZE	220 OHM	20%	1/3W
VR7		METAL GLAZE	470 OHM	20%	1/3W
VR101		METAL GLAZE	47K OHM	20%	1/3W
VR102		METAL GLAZE	2.2K OHM	20%	1/3W
VR103	1711004006	METAL GLAZE	100 OHM	20%	1/3W
VR105		METAL GLAZE	47K OHM	20%	1/3W
VR106		METAL GLAZE	220 OHM	20%	1/3W
VR107		METAL GLAZE	470 OHM	20%	1/3W
VR201	1711004042	METAL GLAZE	1K OHM	20%	1/3W
VR202	1711004042	METAL GLAZE	1K OHM	20%	1/3W
VR301		METAL GLAZE	47K OHM	20%	1/3W
VR302	1711004042	METAL GLAZE	1K OHM	20%	1/3W
VR401	1910077003	VR-482 20K/100K OHM(w/SW)	"LEVEL/HOLDOFF"		
VR501		METAL GLAZE	2.2K OHM	20%	1/3W
VR502	1711004079	METAL GLAZE	10K OHM	20%	1/3W
VR503	1711004088	METAL GLAZE	20K OHM	20%	1/3W
VR504	1711004042	METAL GLAZE	1K OHM	20%	1/3W
VR505	1711004015	METAL GLAZE	200 OHM	20%	1/3W
VR506		METAL GLAZE	2.2K OHM	20%	1/3W

-CAPACITORS-

C2	2520330021	CERAMIC	33PF	10%	500V
C4	2200331007	PLASTIC FILM	330pF	10%	50V
C5	2520100024	CERAMIC	10PF	10%	500V
C7	2520070021	CERAMIC	7PF	10%	500V
C8	2520100024	CERAMIC	10PF	10%	500V
C9	2520180028	CERAMIC	18PF	10%	500V
C10	2180103020	PLASTIC FILM	0.01uF	10%	630V
C11	2520180028	CERAMIC	18PF	10%	500V
C13	2010103041	CERAMIC	0.01uF		50V
C14	2230221047	ELECTROLYTIC	220uF	20%	16V
C15	2010103041	CERAMIC	0.01uF		50V
C16	2230221047	ELECTROLYTIC	220uF	20%	16V
C17	2010103041	CERAMIC	0.01uF		50V
C18	2230221047	ELECTROLYTIC	220uF	20%	16V
C19	2520150029	CERAMIC	15PF	10%	500V
C23	2520100024	CERAMIC	10PF	10%	500V
C26	2520050025	CERAMIC	5PF	10%	500V
C31	2520330021	CERAMIC	33PF	10%	500V
C33	2010103041	CERAMIC	0.01uF		50V
C34	2240470045	ELECTROLYTIC	47uF	20%	25V
C35	2010103041	CERAMIC	0.01uF		50V
C36	2010103041	CERAMIC	0.01uF		50V
C37	2240470045	ELECTROLYTIC	47uF	20%	25V
C38	2010103041	CERAMIC	0.01uF		50V
C89	2010102012	CERAMIC	1000pF	10%	50V
C90	2010102012	CERAMIC	1000pF	10%	50V
C102	2520330021	CERAMIC	33PF	10%	500V
C104	2200331007	PLASTIC FILM	330pF	5%	50V
C105	2520100024	CERAMIC	10PF	10%	500V
C107	2520070021	CERAMIC	7PF	10%	500V
C108	2520100024	CERAMIC	10PF	10%	500V
C109	2520180028	CERAMIC	18PF	10%	500V
C110	2180103020	PLASTIC FILM	0.01uF	10%	630V
C111	2520180028	CERAMIC	18PF	10%	500V
C113	2010103041	CERAMIC	0.01uF		50V
C114	2230221047	ELECTROLYTIC	220uF	20%	16V
C115	2010103041	CERAMIC	0.01uF		50V
C116	2230221047	ELECTROLYTIC	220uF	20%	16V
C117	2010103041	CERAMIC	0.01uF		50V
C118	2230221047	ELECTROLYTIC	220uF	20%	16V
C119	2520150029	CERAMIC	15PF	10%	500V
C123	2520100024	CERAMIC	10PF	10%	500V
C126	2520050025	CERAMIC	5PF	10%	500V
C131	2520330021	CERAMIC	33PF	10%	500V
C133	2010103041	CERAMIC	0.01uF		50V
C134	2240470045	ELECTROLYTIC	47uF	20%	25V
C135	2010103041	CERAMIC	0.01uF		50V
C136	2010103041	CERAMIC	0.01uF		50V
C137	2010103041	CERAMIC	0.01uF		50V
C138	2240470045	ELECTROLYTIC	47uF	20%	25V
C139	2010103041	CERAMIC	0.01uF		50V
C140	2010103041	CERAMIC	0.01uF		50V
C189	2010102012	CERAMIC	1000pF	10%	50V
C190	2010102012	CERAMIC	1000pF	10%	50V
C201	2520270029	CERAMIC	27PF	10%	500V
C202	2520270029	CERAMIC	27PF	10%	500V
C203	2240470045	ELECTROLYTIC	47uF	20%	25V

C204	2010103041	CERAMIC	0.01uF		50V	
C205	2240470045	ELECTROLYTIC	47uF	20%	25V	
C206	2010103041	CERAMIC	0.01uF		50V	
C209	2010103041	CERAMIC	0.01uF		50V	
C223	2510101001	CERAMIC	100pF	10%	50V	
C224	2510101001	CERAMIC	100pF	10%	50V	
C225	2010103041	CERAMIC	0.01uF		50V	
C226	2510101001	CERAMIC	100pF	10%	50V	
C227	2520220024	CERAMIC	22PF	10%	500V	
C228	2010103041	CERAMIC	0.01uF		50V	
C229	2010103041	CERAMIC	0.01uF		50V	
C230	2010103041	CERAMIC	0.01uF		50V	
C231	2010103041	CERAMIC	0.01uF		50V	
C232	2010103041	CERAMIC	0.01uF		50V	
C233	2010103041	CERAMIC	0.01uF		50V	
C234	2010103041	CERAMIC	0.01uF		50V	
C235	2230470149	ELECTROLYTIC	47uF	20%	16V	
C241	2010103041	CERAMIC	0.01uF		50V	
C242	2240470045	ELECTROLYTIC	47uF	20%	25V	
C243	2010103041	CERAMIC	0.01uF		50V	
C244	2010103041	CERAMIC	0.01uF		50V	
C245	2240470045	ELECTROLYTIC	47uF	20%	25V	
C302	2010103041	CERAMIC	0.01uF		50V	
C305	2325010045	ELECTROLYTIC	1uF	20%	50V	BP
C306	2240470045	ELECTROLYTIC	47uF	20%	25V	
C307	2140223004	PLASTIC FILM	0.022uF	10%	50V	
C308	2010103041	CERAMIC	0.01uF		50V	
C309	2010103041	CERAMIC	0.01uF		50V	
C310	2240470045	ELECTROLYTIC	47uF	20%	25V	
C311	2240470045	ELECTROLYTIC	47uF	20%	25V	
C312	2010103041	CERAMIC	0.01uF		50V	
C313	2510101001	CERAMIC	100pF	10%	50V	
C401	2510101001	CERAMIC	100pF	10%	50V	
C402	2010471004	CERAMIC	470pF	10%	50V	
C403	2010103041	CERAMIC	0.01uF		50V	
C404	2250109047	ELECTROLYTIC	1uF	20%	50V	
C405	2240330049	ELECTROLYTIC	33uF	20%	25V	
C406	2250339044	ELECTROLYTIC	3.3uF	20%	50V	
C407	2470338006	ELECTROLYTIC	0.33uF	20%	35V	
C408	2140333001	PLASTIC FILM	0.033uF	10%	50V	
C409	2140332009	PLASTIC FILM	3300pF	10%	50V	
C410	2510121007	CERAMIC	120PF	10%	50V	
C411	2510820003	CERAMIC	82pF	10%	50V	
C412	2140102002	PLASTIC FILM	1000pF	10%	50V	
C413	2520220024	CERAMIC	22PF	10%	500V	
C414	2010103041	CERAMIC	0.01uF		50V	
C415	2140102002	PLASTIC FILM	1000pF	10%	50V	
C416	2140102002	PLASTIC FILM	1000pF	10%	50V	
C417	2010103041	CERAMIC	0.01uF		50V	
C418	2010103041	CERAMIC	0.01uF		50V	
C419	2010103041	CERAMIC	0.01uF		50V	
C420	2140683008	PLASTIC FILM	0.068uF	10%	50V	
C421	2610105025	METAL FILM	1uF	5%	50V	
C422	2192022001	PLASTIC FILM	1000pF	1%	100V	
C423	2010103041	CERAMIC	0.01uF		50V	
C425	2510181005	CERAMIC	180PF	10%	50V	
C426	2010103041	CERAMIC	0.01uF		50V	
C427	2240470045	ELECTROLYTIC	47uF	20%	25V	

C428	2240470045	ELECTROLYTIC	47uF	20%	25V
C429	2010103041	CERAMIC	0.01uF		50V
C430	2010103041	CERAMIC	0.01uF		50V
C431	2010103041	CERAMIC	0.01uF		50V
C432	2090104058	CERAMIC	0.1uF		50V
C434	2220101040	ELECTROLYTIC	100uF	20%	10V
C435	2230101047	ELECTROLYTIC	100uF	20%	16V
C436	2010103041	CERAMIC	0.01uF		50V
C438	2090104058	CERAMIC	0.1uF		50V
C501	2220101040	ELECTROLYTIC	100uF	20%	10V
C502	2220101040	ELECTROLYTIC	100uF	20%	10V
C503	2520100024	CERAMIC	10PF	10%	500V
C504	2010103041	CERAMIC	0.01uF		50V
C505	2520100024	CERAMIC	10PF	10%	500V
C506	2240470045	ELECTROLYTIC	47uF	20%	25V
C507	2520330021	CERAMIC	33PF	10%	500V
C509	2240470045	ELECTROLYTIC	47uF	20%	25V
C510	2240470045	ELECTROLYTIC	47uF	20%	25V
C511	2020103011	CERAMIC	0.01uF		500V
C512	2520010005	CERAMIC	1PF	10%	500V
C513	2020103011	CERAMIC	0.01uF		500V
C514	2020103011	CERAMIC	0.01uF		500V
C515	2020103011	CERAMIC	0.01uF		500V
C516	2520010005	CERAMIC	1PF	10%	500V
C517	2020103011	CERAMIC	0.01uF		500V
C518	2010103041	CERAMIC	0.01uF		50V
C520	2010103041	CERAMIC	0.01uF		50V
C521	2230101047	ELECTROLYTIC	100uF	20%	16V
C522	2010103041	CERAMIC	0.01uF		50V
C523	2020472012	CERAMIC	4700PF	10%	500V
C524	2020472012	CERAMIC	4700PF	10%	500V
C525	2280229048	ELECTROLYTIC	2.2uF	20%	250V
C526	2010103041	CERAMIC	0.01uF		50V
C527	2010103041	CERAMIC	0.01uF		50V
C528	2010103041	CERAMIC	0.01uF		50V
C531	2230101047	ELECTROLYTIC	100uF	20%	16V
C532	2230101047	ELECTROLYTIC	100uF	20%	16V
C533	2230101047	ELECTROLYTIC	100uF	20%	16V
C534	2280229048	ELECTROLYTIC	2.2uF	20%	250V
C535	2280229048	ELECTROLYTIC	2.2uF	20%	250V

-VARIABLE CAPACITORS-

VC1	2910032000	CERAMIC	2-10pF		250V
VC2	2910032000	CERAMIC	2-10pF		250V
VC3	2910032000	CERAMIC	2-10pF		250V
VC4	2910047003	CERAMIC	1.5-5.5pF		250V
VC5	2910032000	CERAMIC	2-10pF		250V
VC6	2910033002	CERAMIC	2.5-20pF		250V
VC7	2910032000	CERAMIC	2-10pF		250V
VC8	2910032000	CERAMIC	2-10pF		250V
VC9		CERAMIC	3.3-18pF		250V
VC21	2910022007	CERAMIC	4-40pF		250V
VC101	2910032000	CERAMIC	2-10pF		250V
VC102	2910032000	CERAMIC	2-10pF		250V
VC103	2910032000	CERAMIC	2-10pF		250V
VC104	2910047003	CERAMIC	1.5-5.5pF		250V
VC105	2910032000	CERAMIC	2-10pF		250V
VC106	2910033002	CERAMIC	2.5-20pF		250V

VC107	2910032000	CERAMIC	2-10pF	250V
VC108	2910032000	CERAMIC	2-10pF	250V
VC109		CERAMIC	3.3-18pF	250V
VC121	2910022007	CERAMIC	4-40pF	250V
VC401		CERAMIC	10-100pF	250V

-TRANSISTORS-

Q11	3031907004	NPN	2SC1907
Q12	3031907004	NPN	2SC1907
Q13	3031907004	NPN	2SC1907
Q14	3031907004	NPN	2SC1907
Q15	3010838001	PNP	2SA838BorC
Q16	3010838001	PNP	2SA838BorC
Q111	3031907004	NPN	2SC1907
Q112	3031907004	NPN	2SC1907
Q113	3031907004	NPN	2SC1907
Q114	3031907004	NPN	2SC1907
Q115	3031907004	NPN	2SC1907
Q116	3031907004	NPN	2SC1907
Q117	3010838001	PNP	2SA838BorC
Q118	3010838001	PNP	2SA838BorC
Q201	3031907004	NPN	2SC1907
Q202	3031907004	NPN	2SC1907
Q203	3010838001	PNP	2SA838BorC
Q204	3030752014	NPN	2SC752(G)TM-Y
Q205	3031907004	NPN	2SC1907
Q206	3031907004	NPN	2SC1907
Q207	3010838001	PNP	2SA838BorC
Q208	3030752014	NPN	2SC752(G)TM-Y
Q209	3010838001	PNP	2SA838BorC
Q210	3031907004	NPN	2SC1907
Q211	3031907004	NPN	2SC1907
Q212	3031907004	NPN	2SC1907
Q213	3031815009	NPN	2SC1815-0 or Y
Q214	3031907004	NPN	2SC1907
Q215	3011015003	PNP	2SA1015-0 or Y
Q216	3031815009	NPN	2SC1815-0 or Y
Q301	3050404015	FET	2SK404-E
Q302	3031907004	NPN	2SC1907
Q303	3031907004	NPN	2SC1907
Q304	3010838001	PNP	2SA838BorC
Q305	3010838001	PNP	2SA838BorC
Q306	3011015021	PNP	2SA1015-GR
Q307	3031907004	NPN	2SC1907
Q308	3031815027	NPN	2SC1815-GR
Q309	3011015003	PNP	2SA1015-0 or Y
Q401	3031907004	NPN	2SC1907
Q402	3030752014	NPN	2SC752(G)TM-Y
Q403	3010872001	PNP	2SA872E
Q404	3050404015	FET	2SK404-E DUAL
Q405	3031907004	NPN	2SC1907
Q406	3030752014	NPN	2SC752(G)TM-Y
Q407	3010838001	PNP	2SA838BorC
Q501	3031815027	NPN	2SC1815-GR
Q502	3031815027	NPN	2SC1815-GR
Q503	3010838001	PNP	2SA838BorC
Q504	3010838001	PNP	2SA838BorC
Q505	3010838001	PNP	2SA838BorC

Q506	3010838001	PNP	2SA838BorC
Q507	3031907004	NPN	2SC1907
Q508	3010838001	PNP	2SA838BorC
Q509	3011480000	PNP	2SA1480-E or F
Q510	3033790001	NPN	2SC3790-E or F
Q511	3033790001	NPN	2SC3790-E or F
Q512	3011480000	PNP	2SA1480-E or F

-DIODES-

D5	3110110010	DETECTOR	GNB01-BT
D6	3110110010	DETECTOR	GNB01-BT
D7	3110110010	DETECTOR	GNB01-BT
D8	3110110010	DETECTOR	GNB01-BT
D9	3110110010	DETECTOR	GNB01-BT
D105	3110110010	DETECTOR	GNB01-BT
D106	3110110010	DETECTOR	GNB01-BT
D107	3110110010	DETECTOR	GNB01-BT
D108	3110110010	DETECTOR	GNB01-BT
D109	3110110010	DETECTOR	GNB01-BT
D201	3110110010	DETECTOR	GNB01-BT
D205	3110110010	DETECTOR	GNB01-BT
D206	3110110010	DETECTOR	GNB01-BT
D207	3110110010	DETECTOR	GNB01-BT
D208	3110110010	DETECTOR	GNB01-BT
D209	3110110010	DETECTOR	GNB01-BT
D210	3110110010	DETECTOR	GNB01-BT
D211		DETECTOR	SB0015-03A
D212		DETECTOR	SB0015-03A
D301	3110110010	DETECTOR	GNB01-BT
D302	3110110010	DETECTOR	GNB01-BT
D303	3110110010	DETECTOR	GNB01-BT
D304	3110110010	DETECTOR	GNB01-BT
D305	3110071005	DETECTOR	1SS97
D306	3110110010	DETECTOR	GNB01-BT
D307	3120028001	ZENER	RD8.2EB 8.2V
D308	3110071005	DETECTOR	1SS97
D401	3110110010	DETECTOR	GNB01-BT
D402	3110110010	DETECTOR	GNB01-BT
D403	3110110010	DETECTOR	GNB01-BT
D404	3110110010	DETECTOR	GNB01-BT
D501	3110110010	DETECTOR	GNB01-BT
D502	3110110010	DETECTOR	GNB01-BT

-INTEGRATED CIRCUITS-

IC201	3260123001	TTL	HD74LS123P
IC202	3260123001	TTL	HD74LS123P
IC203	3420112994	HS CMOS	74HC112
IC204	3420000012	HS CMOS	HD74HC00P
IC401	3420000012	HS CMOS	HD74HC00P
IC402	3420074011	HS CMOS	HD74HC74P
IC403	3260123001	TTL	HD74LS123P
IC404	3420000012	HS CMOS	HD74HC00P
IC405	3201018008	SINGLE OP AMP	TL081CP
IC501	3310066998	CMOS	4066B

-COILS-

L1	3930109039	COIL	1uH	20%
L101	3930109039	COIL	1uH	20%

-SWITCHES-

S1-6 4000583015 ATTENUATOR
S101-106 4000583015 ATTENUATOR
S401 4000584017 ROTARY

Q-583A "CH-1 VOLT/DIV"
Q-583A "CH-2 VOLT/DIV"
SRRS3M001B "TIME/DIV"

*** POWER & V FINAL BOARD

T-4228 ***

-RESISTORS-

R101	1000221005	CARBON FILM	220 OHM	5%	1/4W
R102	1000221005	CARBON FILM	220 OHM	5%	1/4W
R103	1000820007	CARBON FILM	82 OHM	5%	1/4W
R104	1000470006	CARBON FILM	47 OHM	5%	1/4W
R105	1000272002	CARBON FILM	2.7K OHM	5%	1/4W
R106	1020152006	CARBON FILM	1.5K OHM	5%	1/2W
R107	1000150008	CARBON FILM	15 OHM	5%	1/4W
R108	1020152006	CARBON FILM	1.5K OHM	5%	1/2W
R109	1000681009	CARBON FILM	680 OHM	5%	1/4W
R110	1466200007	METAL FILM	620 OHM	1%	1/4W
R111	1000220003	CARBON FILM	22 OHM	5%	1/4W
R112	1000681009	CARBON FILM	680 OHM	5%	1/4W
R113	1466200007	METAL FILM	620 OHM	1%	1/4W
R114	1000124007	CARBON FILM	120K OHM	5%	1/4W
R115	1590103002	METAL OXIDE	10K OHM	5%	2W
R116	1000220003	CARBON FILM	22 OHM	5%	1/4W
R117	1000101005	CARBON FILM	100 OHM	5%	1/4W
R118	1000101005	CARBON FILM	100 OHM	5%	1/4W
R119	1000220003	CARBON FILM	22 OHM	5%	1/4W
R120	1590103002	METAL OXIDE	10K OHM	5%	2W
R121	1000124007	CARBON FILM	120K OHM	5%	1/4W
R122	1020333000	CARBON FILM	33K OHM	5%	1/2W
R123	1000330000	CARBON FILM	33 OHM	5%	1/4W
R124	1000330000	CARBON FILM	33 OHM	5%	1/4W
R125	1000220003	CARBON FILM	22 OHM	5%	1/4W
R126	1000220003	CARBON FILM	22 OHM	5%	1/4W
R127	1000102007	CARBON FILM	1K OHM	5%	1/4W
R128	1000102007	CARBON FILM	1K OHM	5%	1/4W
R130	1461300001	METAL FILM	130 OHM	1%	1/4W
R131	1461300001	METAL FILM	130 OHM	1%	1/4W
R132	1000151000	CARBON FILM	150 OHM	5%	1/4W
R133	1000151000	CARBON FILM	150 OHM	5%	1/4W
R136	1000101005	CARBON FILM	100 OHM	5%	1/4W
R137	1000101005	CARBON FILM	100 OHM	5%	1/4W
R138	1000681009	CARBON FILM	680 OHM	5%	1/4W
R301	1000104001	CARBON FILM	100K OHM	5%	1/4W
R302	1000223009	CARBON FILM	22K OHM	5%	1/4W
R303	1000472000	CARBON FILM	4.7K OHM	5%	1/4W
R304	1000472000	CARBON FILM	4.7K OHM	5%	1/4W
R305	1000392002	CARBON FILM	3.9K OHM	5%	1/4W
R306	1000392002	CARBON FILM	3.9K OHM	5%	1/4W
R307	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R308	1000122003	CARBON FILM	1.2K OHM	5%	1/4W
R309	1000273004	CARBON FILM	27K OHM	5%	1/4W
R310	1000470006	CARBON FILM	47 OHM	5%	1/4W
R311	1000152002	CARBON FILM	1.5K OHM	5%	1/4W
R312	1000272002	CARBON FILM	2.7K OHM	5%	1/4W
R313	1000103009	CARBON FILM	10K OHM	5%	1/4W

R314	1000223009	CARBON FILM	22K OHM	5%	1/4W
R315	1000272002	CARBON FILM	2.7K OHM	5%	1/4W
R316	1020273008	CARBON FILM	27K OHM	5%	1/2W
R317	1000334008	CARBON FILM	330 OHM	5%	1/4W
R318	1000104001	CARBON FILM	100K OHM	5%	1/4W
R319	1020472004	CARBON FILM	4.7K OHM	5%	1/2W
R320	1000221005	CARBON FILM	220 OHM	5%	1/4W
R321	1000101005	CARBON FILM	100 OHM	5%	1/4W
R323	1000470006	CARBON FILM	47 OHM	5%	1/4W
R401	1020229005	CARBON FILM	2.2 OHM	5%	1/2W
R402	1000221005	CARBON FILM	220 OHM	5%	1/4W
R403	1000220003	CARBON FILM	22 OHM	5%	1/4W
R404	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R405	1000224001	CARBON FILM	220K OHM	5%	1/4W
R406	1000102007	CARBON FILM	1K OHM	5%	1/4W
R407	1000101005	CARBON FILM	100 OHM	5%	1/4W
R408	1000563003	CARBON FILM	56K OHM	5%	1/4W
R409	1000103009	CARBON FILM	10K OHM	5%	1/4W
R410	1000123005	CARBON FILM	12K OHM	5%	1/4W
R411	1000563003	CARBON FILM	56K OHM	5%	1/4W
R412	1000334008	CARBON FILM	330 OHM	5%	1/4W
R413	1020473006	CARBON FILM	47K OHM	5%	1/2W
R414	1190007004	METAL GLAZE	22M OHM	5%	1W
R415	1130106013	METAL FILM	10M OHM	10%	1/2W
R417	1130155007	METAL FILM	1.5M OHM	10%	1/2W
R418	1130565006	METAL FILM	5.6M OHM	10%	1/2W
R419	1000101005	CARBON FILM	100 OHM	5%	1/4W
R420	1020106009	CARBON FILM	10M OHM	5%	1/4W
R421	1020106009	CARBON FILM	10M OHM	5%	1/4W
R422	1000823003	CARBON FILM	82K OHM	5%	1/4W
R423	1000104001	CARBON FILM	100K OHM	5%	1/4W
R426	1000101005	CARBON FILM	100 OHM	5%	1/4W
R427	1000564005	CARBON FILM	560K OHM	5%	1/4W
R501	1020124001	CARBON FILM	120K OHM	5%	1/2W
R502	1000182001	CARBON FILM	1.8K OHM	5%	1/4W
R503	1580333002	METAL OXIDE	33K OHM	5%	1W
R504	1000474004	CARBON FILM	470K OHM	5%	1/4W
R505	1461503005	METAL FILM	150K OHM	1%	1/4W
R506	1461202001	METAL FILM	12K OHM	1%	1/4W
R507	1000564005	CARBON FILM	560K OHM	5%	1/4W
R508	1000153004	CARBON FILM	15K OHM	5%	1/4W
R509	1020104005	CARBON FILM	100K OHM	5%	1/2W
R510	1590560000	METAL FILM	56 OHM	5%	2W

-VARIABLE RESISTORS-

VR401	1711004079	METAL GLAZE	10K OHM	20%	1/3W
VR402	1711004107	METAL GLAZE	100K OHM	20%	1/3W
VR403	1712020000	METAL GLAZE	1.5M OHM	20%	1/3W
VR404		METAL GLAZE	220K OHM	20%	1/3W

-CAPACITORS-

C101	2520330021	CERAMIC	33pF	10%	500V
C102	2510101001	CERAMIC	100pF	10%	50V
C103	2520220024	CERAMIC	22pF	10%	500V
C104	2010103041	CERAMIC	0.01uF		50V
C105	2240470045	ELECTROLYTIC	47uF	20%	25V
C108	2020472012	CERAMIC	4700pF		500V
C110	2020102019	CERAMIC	1000pF		500V

C111	2020102019	CERAMIC	1000pF		500V
C114	2020103011	CERAMIC	0.01uF		500V
C115	2020103011	CERAMIC	0.01uF		500V
C116	2020103011	CERAMIC	0.01uF		500V
C117	2520220024	CERAMIC	22pF	10%	500V
C118	2520220024	CERAMIC	22pF	10%	500V
C119	2520020026	CERAMIC	2pF		500V
C120	2520020026	CERAMIC	2pF		500V
C121	2010103041	CERAMIC	0.01uF		50V
C301	2010103041	CERAMIC	0.01uF		50V
C302	2240470045	ELECTROLYTIC	47uF	20%	25V
C303	2010103041	CERAMIC	0.01uF		50V
C304	2010103041	CERAMIC	0.01uF		50V
C305	2010103041	CERAMIC	0.01uF		50V
C306	2010103041	CERAMIC	0.01uF		50V
C307	2020103011	CERAMIC	0.01uF		500V
C308	2195015002	CERAMIC	12pF	10%	500V
C309	2020103011	CERAMIC	0.01uF		500V
C310	2020103011	CERAMIC	0.01uF		500V
C311	2520100024	CERAMIC	10pF	10%	500V
C401	2240470045	ELECTROLYTIC	47uF	20%	25V
C402	2140104006	PLASTIC FILM	0.1uF	10%	50V
C403	2140104006	PLASTIC FILM	0.047uF	10%	50V
C404	2010103041	CERAMIC	0.01uF		50V
C405	2240470045	ELECTROLYTIC	47uF	20%	25V
C406	2020472012	CERAMIC	4700pF		500V
C407	2020102019	CERAMIC	1000pF		500V
C408	2090013000	CERAMIC	4700pF		3KV
C409	2090013000	CERAMIC	4700pF		3KV
C410	2090013000	CERAMIC	4700pF		3KV
C411	2090013000	CERAMIC	4700pF		3KV
C412	2090013000	CERAMIC	4700pF		3KV
C413	2090005010	CERAMIC	470pF	10%	3KV
C414	2090013000	CERAMIC	4700pF		3KV
C415	2010103041	CERAMIC	0.01uF		50V
C416	2010103041	CERAMIC	0.01uF		50V
C501	2280470209	ELECTROLYTIC	47uF	20%	250V
C502	2020102019	CERAMIC	1000pF		500V
C503	2280109204	ELECTROLYTIC	1uF	20%	250V
C504	2270470046	ELECTROLYTIC	47uF	20%	160V
C505	2240222046	ELECTROLYTIC	2200uF	20%	25V
C510	2240222046	ELECTROLYTIC	2200uF	20%	25V
C513	2270470046	ELECTROLYTIC	47uF	20%	160V

-VARIABLE CAPACITOR-

VC101	2910022007	CERAMIC	4-40pF		250V
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-TRANSISTORS-

Q101	3033504004	NPN	2SC3504-E or F
Q102	3033504004	NPN	2SC3504-E or F
Q103	3033779003	NPN	2SC3779-E
Q104	3033779003	NPN	2SC3779-E
Q105	3033955007	NPN	2SC3955-E or F
Q106	3033955007	NPN	2SC3955-E or F
Q107	3011540002	PNP	2SA1540-E or F
Q108	3011540002	PNP	2SA1540-E or F
Q109	3011206004	PNP	2SA1206
Q110	3011206004	PNP	2SA1206

Q301	3031907004	NPN	2SC1907
Q302	3031815009	NPN	2SC1815-0 or Y
Q303	3010838001	PNP	2SA838BorC
Q304	3031907004	NPN	2SC1907
Q305	3011540002	PNP	2SA1540-E or F
Q306	3033955007	NPN	2SC3955-E or F
Q401	3033691009	NPN	2SC3691-L or K
Q402	3011015003	PNP	2SA1015-0 or Y
Q403	3031815009	NPN	2SC1815-0 or Y
Q404	3011015003	PNP	2SA1015-0 or Y
Q405	3011091009	PNP	2SA1091-R
Q406	3011091009	PNP	2SA1091-R
Q501	3033478009	NPN	2SC3478K or U
Q503	3033478009	NPN	2SC3478K or U

-DIODES-

D101	3120024003	ZENER	RD5.1EB	5,1V
D102	3120024003	ZENER	RD5.1EB	5,1V
D103	3120024003	ZENER	RD5.1EB	5,1V
D301	3110110010	DETECTOR	GNB01-BT	
D302	3110110010	DETECTOR	GNB01-BT	
D303	3110110010	DETECTOR	GNB01-BT	
D304	3110110010	DETECTOR	GNB01-BT	
D401	3110110010	DETECTOR	GNB01-BT	
D402	3110110010	DETECTOR	GNB01-BT	
D403	3110059005	DETECTOR	1SS83	
D404	3110149006	RECTIFIER	DHM3FG80	8KV
D405	3110149006	RECTIFIER	DHM3FG80	8KV
D406	3110059005	DETECTOR	1SS83	
D407	3110059005	DETECTOR	1SS83	
D408	3110059005	DETECTOR	1SS83	
D409	3550031003	VARISTOR	TNR15G 102K	
D501		BRIDGE RECTIFIER	2W06G 2A 600V	
D502	3120024003	ZENER	RD5.1EB	5,1V
D503	3110008008	RECTIFIER	1S1830	
D504		BRIDGE RECTIFIER	2W06G 2A 600V	

-TRANSFORMER-

T401	TRANSFORMER	LS-20 HV UNIT
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-TUBES-

V1	NEON BULB	NE-2
V2	NEON BULB	NE-2

-FUSE-

F401	4363150009	NORMAL BLOW	BEQ 500mA
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-MISCELLANEOUS-

TH101	THEMISTOR	TDC05A120L
F401	FUSE HOLDER	FB-521D(CQ-200S)

*** SWITCH BOARD

T-4229 ***

-RESISTORS-

R1	1000391000	CARBON FILM	390 OHM	5%	1/4W
R1	1000470006	CARBON FILM	47 OHM	5%	1/4W
R2	1000273004	CARBON FILM	27K OHM	5%	1/4W

R3	1020474008	CARBON FILM	470K OHM	5%	1/2W
R4	1000104001	CARBON FILM	100K OHM	5%	1/4W
R5	1000181009	CARBON FILM	180 OHM	5%	1/4W
R101	1000470006	CARBON FILM	47 OHM	5%	1/4W

-CAPACITORS-

C1	2180223002	PLASTIC FILM	0.022uF	10%	630V
C2	2140102002	PLASTIC FILM	1000pF	10%	50V
C3	2520680028	CERAMIC	68pF	10%	500V
C4	2520330021	CERAMIC	33pF	10%	500V
C5	2180223002	PLASTIC FILM	0.022uF	10%	630V
C6	2520680028	CERAMIC	68pF	10%	500V
C7	2090104058	CERAMIC	0.01uF		50V
C101	2180223002	PLASTIC FILM	0.022uF	10%	630V

-SWITCHES-

S1	4040028006	LEVER	SLLE62	"CH-1 AC-GND-DC"
S2	4040028006	LEVER	SLLE62	"CH-2 AC-GND-DC"
S3	4030085001	SLIDE	BS-2500-08	"V MODE"
S4	4030085001	SLIDE	BS-2500-08	"SOURCE"
S5	4030085001	SLIDE	BS-2500-08	"COUPLING"
S6	4030086003	SLIDE	BS-2500-08	"SLOPE"

*** VR BOARD

T-4230 ***

-RESISTORS-

R1	1000472000	CARBON FILM	4.7K OHM	5%	1/4W
R2	1000273004	CARBON FILM	27K OHM	5%	1/4W

-VARIABLE RESISTORS-

VR1	1815026008	VR-479	5K OHM(GANG)	"CH-1 POSITION"
VR2/S1	1910076001	VR-480	5K OHM(W/SW)	"H POSITION"
VR3/S2	1910080002	CARBON FILM	20K OHM	"TIME VARIABLE"
VR4/S3	1910079007	VR-486	10K OHM	
VR5	1711004097	METAL GLAZE	50K OHM 1/3W	"CH-2 POSITION"

-CAPACITORS-

C1	2240470045	ELECTROLYTIC	47uF	20%	25V
C2	2240470045	ELECTROLYTIC	47uF	20%	25V
C3	2240470045	ELECTROLYTIC	47uF	20%	25V

*** INTEN & FOCUS BOARD

T-4231 ***

-REDISTORS-

R1	1000123005	CARBON FILM	12K OHM	5%	1/4W
R2	1000561009	CARBON FILM	560 OHM	5%	1/4W
R3	1020150002	CARBON FILM	15 OHM	5%	1/2W
R4	1020180001	CARBON FILM	18 OHM	5%	1/2W
R5	1000560007	CARBON FILM	56 OHM	5%	1/4W
R6	1000105003	CARBON FILM	1M OHM	5%	1/4W
R7		METAL FILM	62K OHM	5%	1/4W
R8	1000562001	CARBON FILM	5.6K OHM	5%	1/4W
R9	1000391000	CARBON FILM	390 OHM	5%	1/4W

-VARIABLE RESISTORS-

VR1	1811921000	VR-483	5K OHM	"INTEN"
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VR2	1811921000	VR-483	5K OHM	"FOCUS"	
VR3		CARBON FILM	2K OHM	25%	1/2W
VR4		METAL GLAZE	470 OHM	20%	1/3W

-CAPACITORS-

C1	2010103041	CERAMIC	0.01uF		50V
C2	2240470045	ELECTROLYTIC	47uF	20%	25V
C3	2140682006	PLASTIC FILM	6800pF	10%	50V
C4	2140102002	PLASTIC FILM	1000pF	10%	50V
C5	2010103041	CERAMIC	0.01uF		50V
C6	2010271006	CERAMIC	270pF	10%	50V

-DIODES-

D1	3110165004	DETECTOR	GMB01	
D2		LED	LT0321-21	

-INTEGRATED CIRCUIT-

IC1	3420004001	CMOS	TC74HC04P	
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-SWITCH-

S1	4030086003	SLIDE	BS-2300-23	"ILLUM"
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-MISCELLANEOUS-

V1	4360039009	LAMP	5V	115mA
V2	4360039009	LAMP	5V	115mA
V3	4360039009	LAMP	5V	115mA

*** SOCKET BOARD

T-4232 ***

-RESISTERS-

R1	1000221005				
R2	1000221005	CARBON FILM	220 OHM	5%	1/4W
R416	1020104005	CARBON FILM	100K OHM	5%	1/2W

-CAPACITORS-

C1	2020103002	CERAMIC	0.01uF		500V
C2	2020103002	CERAMIC	0.01uF		500V

-COILS-

L1	2020103002	CHOKE COIL	2.2uH	
L2	2020103002	CHOKE COIL	2.2uH	

-MISCELLANEOUS-

4320018003	CRT SOCKET	No. 1339
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***Tr BOARD

T-4382 ***

-CAPACITORS-

C506	2240100042	ELECTROLYTIC	10uF	20%	25V
C507	2240470045	ELECTROLYTIC	47uF	20%	25V
C508	2240100042	ELECTROLYTIC	10uF	20%	25V
C509	2240470045	ELECTROLYTIC	47uF	20%	25V
C511	2240100042	ELECTROLYTIC	10uF	20%	25V
C512	2240470045	ELECTROLYTIC	47uF	20%	25V

-TRANSISTORS -

Q501	3041263003	NPN	2SD1263-Q
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-DIODES-

D505	3110151003	RECTIFIER	1S1887
D506	3110151003	RECTIFIER	1S1887

-INTEGRATED CIRCUITS-

IC501	3217812056	REGULATOR	NJM7812A	+12V
IC502	3217805059	REGULATOR	NJM7805A	+5V
IC503	3217912041	REGULATOR	AN7912	-12V