

Model 1040/1060
40/60MHz 3-CHANNEL
6-TRACE OSCILLOSCOPE

SERVICE MANUAL

All information for the Model 1060
are indicated [--] in this manual
unless otherwise noted.

<<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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Outline of difference between the Model 1040 and 1060 is shown below;

	1040	1060
Bandwidth	40MHz	60MHz
Delay line	no	yes
Delayed sweep time	non-calibrated	calibrated

1. SPECIFICATIONS

CRT:

Type:	Aluminized 6-inch rectangular CRT with internal graticule and percentage scale
Acceleration voltage:	12kV/2kV (regulated)
Effective display area:	8 × 10 div. (1 div. = 10mm)
Beam rotator:	Adjustable from front panel
Scale illumination:	Provided
Intensity modulation:	Blanked by TTL level signal (Blanked by H level)

Vertical Axis (CH1 and CH2):

Deflection sensitivity:	5mV/div. to 5V/div. (full bandwidth), 0.5mV/div. to 2mV/div. (5MHz: × 10 MAG) in 10 ranges, 1-2-5 steps, continuously variable between steps
Calibration:	± 3% (± 5%: × 10 MAG ON)
Frequency response:	DC to 40MHz (-3dB, 8 div. ref.) [DC to 60MHz (-3dB, 8 div. ref.)]
DC coupled:	DC to 5MHz (-3dB, 8 div. ref.: × 10 MAG ON)
AC coupled:	Low-band 10Hz, -3dB
Rise time:	8.8ns [5.8ns] (70ns: × 10 MAG ON)
[Delay time for display signals:	Approx. 20ns (front edge observable)]
Input impedance:	1MΩ ± 1.5%, 30pF ± 5pF (Tolerance: ± 2pF)
Input coupling:	AC, GND, DC
Maximum input:	400V (DC + ACp-p)
Display modes:	CH1, CH2, ADD (CH1 + CH2) DUAL (ALT, CHOP) . . . CH1, CH2 TRIPLE (ALT, CHOP) . . . CH1, CH2, CH3 CH2 INVERT
Polarity inversion:	Approx. 50mVp-p/div. (into 50Ω)
CH1 OUT:	DC to 40MHz, -3dB [DC to 60MHz, -3dB]

Vertical Axis (CH3):

Deflection sensitivity:	0.1V/div., 0.5V/div.
Deflection accuracy:	± 3%
Input impedance:	1MΩ ± 1.5%, 30pF ± 5pF
Frequency response:	DC to 40MHz (-3dB, 8 div. ref.) [DC to 60MHz (-3dB, 8 div. ref.)]
Rise time:	8.8ns [5.8ns]
Maximum input:	100V (p-p + DC)

Horizontal Axis:

Sweep method:	Trigger sweep, automatic trigger sweep, continuous delayed sweep, trigger delayed sweep
A sweep time:	0.1μs/div. to 0.2s/div., in 20 ranges in 1-2-5 steps, with continuous adjuster
B sweep time:	0.1μs/div. to 50ms/div. in 18 ranges in 1-2-5 steps
Calibration accuracy:	± 3%
Delayed time-base jitter:	1/10000
Delay time position:	0.5 div. or less to 10 div. or greater than the A sweep [Ten-turn multi-dial setting accuracy: approx. ± 3%]
Magnifier:	10 times ± 5% (± 10% for 0.1μs/div. range)
Maximum sweep time:	10ns/div. (× 10 MAG ON)
Hold-off variable:	One or more sweeps

Sync. signal source: ALT, CH1, CH2, LINE, CH3 (0.1V/div., 0.5V/div.)
 A Sync. coupling: AC, HF-REJ, DC, TV-V, TV-H
 B Sync. coupling: Same as A synchronization. *TV-H (when A Sync. coupling is TV-V)
 Sync. slope: + or -

Sync. sensitivity

	Frequency band	Internal	External
NORM	DC to 10MHz	0.5 div	0.1 Vp-p
	DC to 40MHz, [60MHz]	1.5 div	0.3 Vp-p
AUTO	30Hz to 10MHz	0.5 div	0.1 Vp-p
	30Hz to 40MHz, [60MHz]	1.5 div	0.3 Vp-p

TV synchronization: Extracts Sync. pulses from composite video signals for synchronization. Selects a slope switch according to signal polarity.

X-Y Mode:

X axis: CH1
 Y axis: CH2
 Sensitivity X axis: 5mV/div. to 5V/div. (full band)
 Y axis: 5mV/div. to 5V/div. (full band)
 X axis bandwidth: DC or 10Hz to 1MHz (-3dB, 8 div. ref.)
 X-Y phase difference: 3 degrees or less at 100kHz
 X-Y remote function: Available [optional]

H. IN Mode:

X axis: CH3
 Y axis: CH1, CH2, CHOP (CH1 & CH2)
 Sensitivity X axis: Same as CH3 (calibration accuracy: ±10%)
 Y axis: Same as CH1 and CH2
 X axis bandwidth: DC or 10Hz to 1MHz (-3dB, 8 div. ref.)
 X-Y phase difference: 3 degrees or less at 100kHz

Calibrator:

Output voltage: 0.5Vp-p ± 2%
 Frequency: Approx. 1kHz, square wave

Others:

Power voltage: 100V, 120V, 200V, 220V, or 240V
 Power consumption: 40W [44W]
 Size and weight: 310 (W) × 150 (H) × 375 (D) mm (8 kg)
 Accessories:
 Low-capacitance probe LP-16BX [LP-060X]
 (1:1, 10:1 switch) 2
 Terminal adapter 2
 Fuse 1
 Instruction manual 1

2. TEST EQUIPMENT REQUIRED

The following test equipment is required for calibration and servicing of the Model 1040/1060. The suggested specifications are the minimum necessary for proper calibration of this instrument.

<u>Test Equipment</u>	<u>Minimum Specifications</u>
- Multimeter	Accuracy: $\leq 1\%$ * LEADER Model LDM-853A
- High Voltage Meter	Full scale: 2000Vdc Accuracy: $\leq 1\%$
- Oscilloscope	Sensitivity: 5mV Bandwidth: 100MHz [150MHz] * LEADER Model LBO-516 (100MHz bandwidth) Low capacitance probe * LEADER Model LP-100X (100MHz bandwidth)
- Amplitude Calibrator	Frequency: 1kHz Waveform: square wave Output voltage: 1mV to 20Vp-p Accuracy: $\leq 0.5\%$ * LEADER Model LOC-7005
- Square Wave Generator	Frequency range: 100Hz to 100kHz Rise time: $\leq 1\text{ns}$
- Sine Wave Generator	Frequency range: 10Hz to 40 [60]MHz Flatness: $\leq 0.2\text{dB}$
- Time Mark Generator	Time: 0.2s to 0.01us Accuracy: $\leq 0.5\%$
- Capacitance Meter	Full scale: 30pF
- Terminator	Impedance: 50 ohm, feed-through * LEADER Model LT-2049

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

V POSITION	Center(CH-1 and CH-2)
VOLTS/DIV	0.1V/DIV(CH-1 and CH-2)
VARIABLE	CAL(CH-1 and CH-2)
x10 MAG	OFF(CH-1 and CH-2)
AC-GND-DC	DC(CH-1 and CH-2)
V MODE	CH-1
TRIPLE(CH-3)	OFF
CH-2 INV	OFF

Time base/Horizontal

HORIZ DISPLAY	A
A TIME/DIV	0.5ms
B TIME/DIV	0.1ms
A VARIABLE	CAL
H POSITION	Center
x10MAG	OFF
TRACE SEP	Center
DELAY TIME POS/FINE	Fully counterclockwise(1040 only)
DELAY TIME MULT	0.20(1060 only)

Trigger

COUPLING	AC
SOURCE	CH-1
SLOPE/TV POL	+
CH-3 POS	Center
LEVEL	0
HOLDOFF	NORM

3.3 Power Supply

(1) Low Voltage Power Supply

- Connect the DC voltmeter between test point(T-4481, p/s & V final board) and chassis
- Check the voltage according to Table 3-1.

Test point	Voltage	Tolerance
P13, pin 7	-12V	-11.5V to -12.5V
P13, pin 6	+5V	+4.8V to +5.2V
P13, pin 5	+12V	+11.5V to +12.5V
P13, pin 3	+80V	+76V to +84V
P13, pin 1	+165V(unreg.)	+157V to +173V
IC301, pin 1	+17V(unreg.)	+16V to +18V

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.

- Position the trace to the center horizontal graticule line with the V POSITION control.
- Set: x10 MAG ON
- If the trace moves 1 division or more, adjust VR1, CH-1 DC BAL(T-4480, main board) for minimum trace shift when switching between x1 and x10 MAG.
- Apply the same procedure for CH-2 by adjusting VR101, CH-2 DC BAL(T-4480, main board).

(2) AC Gain Compensation

a. x1

- Set: V MODE CH-1
 VOLTS/DIV 5mV/DIV
 VARIABLE CAL
 AC-GND-DC DC
- Connect the square wave generator to CH-1 INPUT connector using appropriate feed-through terminator and set the frequency to 1kHz, output level for 5 divisions display.
- Adjust VR2, CH-1 x1 AC GAIN(T-4480, main board) for a best flat-top square wave.
- Apply the same procedure for CH-2 by adjusting VR102, CH-2 x1 AC GAIN(T-4480, main board).

b. x10 MAG

- Set: VOLTS/DIV 20mV/DIV
 x10 MAG ON
 AC-GND-DC DC
- Set the generator output level for 5 divisions display.
- Adjust VR3, CH-1 x10 AC GAIN(T-4480, main board) for a best flat-top square wave.
- Apply the same procedure for CH-2 by adjusting VR103, CH-2 x10 AC GAIN(T-4480, main board).

(3) Gain

- | | |
|---------------|----------|
| - Set: V MODE | CH-1 |
| VOLTS/DIV | 10mV/DIV |
| VARIABLE | CAL |
| AC-GND-DC | DC |
- Connect the amplitude calibrator to CH-1 INPUT connector and set the output level to 50mV.
 - Adjust VR52, CH-1 GAIN(T-4480, main board) for a 5 divisions display.
 - Apply the same procedure for CH-2 by adjusting VR152, CH-2 GAIN(T-4480, main board).
 - Check accuracy for all settings of VOLTS/DIV switch.

(4) CH-2 INV Balance

- | | |
|---------------|--------|
| - Set: V MODE | CH-2 |
| V POSITION | Center |
| AC-GND-DC | GND |
- Adjust VR153, INV BAL(T-4480, main board) for a minimum trace shift when CH-2 INV knob is switched between on and off.

(5) Position centering

- | | |
|---------------|--------|
| - Set: V MODE | CH-1 |
| V POSITION | Center |
| AC-GND-DC | GND |
- Adjust VR51, CH-1 POS(T-4480, main board) so that the trace is positioned at the center horizontal graticule line.
 - Apply the same procedure for CH-2 by adjusting VR151, CH-2 POS(T-4480, main board).

(6) Attenuator

a. Phase Compensation

- Set: V MODE
VOLTS/DIV
- CH-1
20mV/DIV
- Connect the square wave generator to CH-1 INPUT connector using appropriate feed-through terminator 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-4480, 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
20mV	VC6	VC106
50mV	VC8	VC108
0.1V	VC2	VC102
1V	VC4	VC104

Table 3-2

b. Input Capacitance

- Set: V MODE
VOLTS/DIV
- CH-1
5mV/DIV
- Connect the capacitance meter to CH-1 INPUT connector. Note the capacitance reading.
- Check the capacitance on all other VOLTS/DIV positions and if value difference is greater than 1pF, adjust Ci(T-4480, main board) for the same reading as noted above.
- Apply the same procedure for all other VOLTS/DIV position and 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 step "a" and "b" as necessary.

(7) CH-1 OUTPUT

a. Output Level Check

- | | |
|---------------|----------|
| - Set: V MODE | CH-1 |
| VOLTS/DIV | 10mV/DIV |
| VARIABLE | CAL |
| AC-GND-DC | DC |
- Connect the audio generator to CH-1 INPUT connector and set the frequency to 1kHz, output level for 5 divisions display.
 - Connect the test oscilloscope to CH-1 OUTPUT connector via 50 ohm terminator.
 - Check that the square wave amplitude on the test oscilloscope should be 5 divisions within 10%.
 - Remove the audio generator and test oscilloscope.

b. High Frequency Compensation

NOTE This step mentions a high frequency compensation of the vertical input and preamplifiers, 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 | 10mV/DIV |
| AC-GND-DC | DC |
- Connect the square wave generator to CH-1 INPUT connector using appropriate feed-through terminator and set the frequency to 100kHz, output level for 4 divisions display.
 - Connect the test oscilloscope to CH-1 OUTPUT connector on the rear panel via 50 ohm terminator and set the sensitivity for 4 divisions display.
 - Adjust following adjustment to obtain a best flat-top square wave on the test oscilloscope.

VC9, HF COMP(T-4480, main board): Mid range

VC51, HF COMP(T-4480, main board): Higher range

- Remove the square wave generator.

- Apply the same procedure for CH-2 by using following adjustment.

VC109, HF COMP(T-4480, main board): Mid range
 VC151, HF COMP(T-4480, main board): Higher range

3.6 CH-3

- Set: V MODE ALT
 TRIPLE(CH-3) ON
 TRIG COUPLING DC
 TRIG SOURCE 0.1V/DIV

(1) Gain

- Set: TRIG SOURCE 0.1V/DIV
- Connect the amplitude calibrator to CH-3 INPUT connector and set the output voltage to 0.5Vp-p.
- Adjust VR154, CH-3 GAIN(T-4480, main board) for 5 divisions display.

(2) Position Centering

- Set: AC-GND-DC GND(CH-1 and CH-2)
 V MODE ALT
 TRIPLE(CH-3) ON
 CH-3 POSITION Center

- Adjust VR155, CH-3 POS(T-4480, main board) so that the trace is positioned at the center horizontal graticule line.

(3) Attenuator

a. Phase Compensation

- Set: TRIG SOURCE 0.5V/DIV
- Connect the square wave generator to CH-3 INPUT connector and set the frequency to 1kHz, output voltage for 5 divisions display.
- Adjust VC301, CH-3 Cc(T-4480, main board) for a best flat-top square wave.

(6) DELAY TIME MULT, Start/End(1060 only)

- Set: HORIZ DISPLAY ALT
A TIME/DIV 0.5ms/DIV
B TIME/DIV 0.5us/DIV
DELAY TIME MULT 0.20

- Position the start point of A trace to the leftmost vertical graticule line with H POSITION control.

- Adjust VR8, DELAY START(T-4641, H control board) so that the B trace starts at the first minor division(0.2 major division).

- Set: DELAY TIME MULT 10.0

- Adjust VR7, DELAY END(T-4641, H control board) so that the B trace starts at the rightmost vertical graticule line.

- Repeat above adjustment if necessary.

3.8 Trigger

(1) Trigger Balance

- Set: V MODE CH-1
AC-GND-DC DC
TRIG COUPLING AC
TRIG SOURCE CH-1
TRIG LEVEL 0

- Connect the sine wave generator to CH-1 INPUT connector and set the frequency to 10kHz, output level for 4 divisions display.

- Position the sine wave to graticule center by using V POSITION control.

- Adjust VR201, CH-1 TRIG BAL(T-4480, main board) for the sine wave starts the same trigger point when TRIG COUPLING knob is switched between DC and AC.

- Apply the same procedure for CH-2 by adjusting VR202, CH-2 TRIG BAL(T-4480, main board).

(2) Slope Balance

- | | |
|---------------|------|
| - Set: V MODE | CH-1 |
| AC-GND-DC | AC |
| TRIG COUPLING | AC |
| TRIG SOURCE | CH-1 |
- Connect the sine wave generator to CH-1 INPUT connector and set the frequency to 10kHz, output level for 4 divisions display.
 - Position the sine wave to the graticule center by using V POSITION control.
 - Switch the SLOPE/TV POL knob between + and -.
 - Adjust VR302, SLOPE(T-4480, main board) for the sine wave to start at the same vertical point, or slightly apart as shown in Figure 3-3.

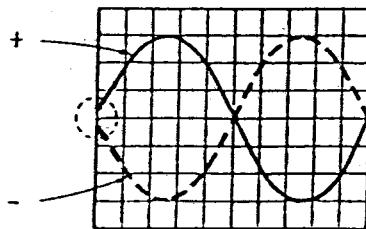


Figure 3-3

(3) Level Center

- Set: same as step "(2)".
- Connect the sine wave generator to CH-3 INPUT connector and set the frequency to 1kHz, output level for 4 division display.
- Position the sine wave to graticule center by using V POSITION control.
- Adjust VR301, TRIG CENTER(T-4480, main board) so that the trigger points as close as possible when SLOPE/TV POL knob is switched between + and -.
- Reduce the generator output for 0.5 division display.
- Adjust VR301, VR302 and LEVEL control again to obtain a stable display when SLOPE/TV POL knob is switched between + and -.

3.9 X-Y Mode

(1) X Gain

- | | |
|----------------------|----------|
| - Set: HORIZ DISPLAY | X-Y |
| CH-1(X) VOLTS/DIV | 10mV/DIV |
| CH-1(X) AC-GND-DC | GND |
- Connect the amplitude calibrator to CH-1(X) INPUT connector and set the output level to 50mVp-p.
 - Adjust VR502, X GAIN(T-4480, main board) for a horizontal deflection of 5 divisions.

(2) X Position Centering

- | | |
|-------------------|--------|
| - Set: X POSITION | Center |
| CH-1(X) AC-GND-DC | GND |
- Adjust VR501, X POS(T-4480, main board) so that the dot is positioned at the center vertical graticule line.

3.10 H IN Mode

(1) Position Centering

- | | |
|----------------------|--------|
| - Set: HORIZ DISPLAY | H IN |
| H POSITION | Center |
- Connect the H IN connector to ground.
 - Adjust VR503, H IN POS(T-4480, main board) so that the dot is positioned at the center vertical graticule line.

3.11 CAL 0.5Vp-p

- Connect the test oscilloscope* to CAL tip on the front panel.
- Adjust VR4, CAL(T-4231, CRT control board) for an amplitude of 0.50Vp-p.

NOTE Vertical sensitivity of the test oscilloscope* must be calibrated within 1% or better.

Do not touch the adjustment VR4 unless the precision peak-voltage measuring device such as well-calibrated oscilloscope is available.

4. TROUBLESHOOTING PROCEDURE

4.1 General

Confirm that the any equipment used with the Model 1040/1060 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.

*** 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 section "7. Block Diagram/Schematic 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 routed through the delay line via a delay line driver(1060 only) 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: Control signal selects the CH-1 input signal for a single trace display.
- CH-2: Control signal selects the CH-2 input signal for a single trace display.
- CHOP: CH-1 and CH-2 signals are displayed. Beam is switched between channels at 250kHz rate during the horizontal sweep to achieve this multi-channel display.
- ALT: CH-1 and CH-2 signals are displayed. Beam is switched between channels at the end of each sweep to achieve this multi-channel display.
- ADD: CH-1 and CH-2 signals are algebraically added or subtracted when CH-2 INV switch is depressed.

- 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 derived 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.
- LINE: AC power line.

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

- AC: Remove any DC components from the trigger signal. AC signal below 10Hz are also attenuated.
- HF REJ: Low pass filter rejects approximately 100kHz or higher component of input waveform.
- DC: Selects direct trigger coupling so all components of the trigger signal are applied to the trigger circuit.
- 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: Selects the positive or negative polarity of incoming signal trigger point.

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.

When the B sweep is selected, the A sweep generator operates continuously to establish the B sweep delay timing. The B sweep generator starts the B sweep ramp when the A sweep ramp reaches the level set by the DELAY TIME control.

Alternate sweep mode displays two waveforms simultaneously, the intensified A sweep and the expanded B sweep which shows up as an intensified portion of the A sweep. Each sweep ramp is switched at the horizontal display control circuitly and applied to the horizontal final amplifier to display the two waveforms alternately.

- Horizontal Amplifier

The sweep ramp from the A and/or B sweep generators 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 A or B TIME/DIV switch setting.

When the X-Y mode is selected, the A and B sweep generators are disabled. 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 A and/or B 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 -1900V/+12kVdc 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 circuitry to maintain a stable high voltage output.

Secondary windings of the high voltage transformer are connected to the high voltage multiplier and rectifier to control display focus and intensity. The output of the high voltage multiplier is connected directly to the CRT anode.

- 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 instrument to mains and turn power on.

- a. Power lamp not on.

Check fuse, F1 on the rear panel for open.

1A time lag fuse for 100V to 120V operation.

0.5A time lag fuse for 200V to 240V operation.

CAUTION Use specified fuse only. Refer to section "9. Parts List".

- b. Check power supply voltages on the pc board(T-4481, p/s & V final board). Refer to Table 4-1.

Yes: Proceed to step "d", high voltage power supply.

No: Proceed to step "c", low voltage power supply.

Test point	Voltage	Tolerance
P13, pin 7	-12V	-11.5V to -12.5V
P13, pin 6	+5V	+4.8V to +5.2V
P13, pin 5	+12V	+11.5V to +12.5V
P13, pin 3	+80V	+76V to +84V
P13, pin 1	+165V(unreg.)	+157V to +173V
IC301, pin 1	+17V(unreg.)	+16V to +18V

Table 4-1

- c. Troubleshoot following power supplies.

-12V: D304, IC303(T-4481, p/s & V final board) and associated circuit.

+5V: D304, IC302(T-4481, p/s & V final board) and associated circuit.

+12V: D304, IC301(T-4481, p/s & V final board) and associated circuit.

+80V: -12V line, D301, Q301-303(T-4481, p/s & V final board) and associated circuit.

+165V: -12V line, +80V line, D303(T-4481, p/s & V final board) and associated circuit.

+17V: D304(T-4481, p/s & V final board) and associated circuit.

d. 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-4484, CRT socket board) for -1900Vdc. Refer to paragraph "3.3 (2)".

Yes: Rotate VR202, INTEN(T-4481, p/s & V final board).

Refer to paragraph "3.4 (1)".

Trace appears.

Yes- Refer to paragraph "3.4 (1)" for proper adjustment.

No- Proceed to step "e", vertical amplifier.

No: Check fuse, F201(T-4481, p/s & V final board), 0.5A normal blow for open.

CAUTION Use specified fuse only. Refer to section "9. Parts List".

Adjust VR201, -1900V ADJ(T-4481, p/s & V final board). Refer to paragraph "3.3 (2)".

Troubleshoot the high voltage generator, feed-back amplifier.

e. Vertical amplifier

Short pin 1(Y+) and pin 4(Y-) of P2(T-4481, p/s & V final board) with clip lead.

Trace appears.

Yes: Short pin 1 and pin 4[3] of P11(T-4480, main board) with clip lead.

Trace appears.

Yes- Proceed to step "f".

No- Troubleshoot vertical driver and final amplifier for unbalance.

No: Troubleshoot horizontal amplifier. Proceed to step "g", horizontal amplifier.

f. Short pin 2 and pin 3 of CH-1 V SUB-2(T-4480, main board).

Trace appears.

Yes: Troubleshoot vertical input amplifier and associated circuit.

No: Troubleshoot channel select gate and associated circuit.

Apply the same procedure for CH-2 to locate the amplifier unbalancing.

g. Horizontal amplifier

Set HORIZ DISPLAY switch to X-Y mode.

Spot appears.

Yes: Troubleshoot the sawtooth generator. Proceed to step "(3)".

No: Short pin 1(X-) and pin 4(X+) of P23(T-4480, main board) to check the amplifier balancing.

Spot appears.

Yes- Proceed to step "h", horizontal amplifier.

No- Troubleshoot unblanking circuit. Proceed to step "i", unblanking circuit.

h. Short collector of Q503 and Q504(T-4480, main board).

Spot appears.

Yes: Continue the same procedure to the input stage to check the amplifier unbalancing.

No: Troubleshoot the horizontal final amplifier.

i. Unblanking circuit

Check that the unblanking signal present at the collector of Q106(T-4481, p/s & V final board).

Yes: Check CRT control circuit.

No: Check the waveform at pin 1 of P5(T-4481, p/s & V final board).

Yes- Troubleshoot unblanking amplifier.

No- Trace the unblanking signal for time base generators to locate the defective circuit.

(2) Vertical Amplifier Section

a. No waveform appears on the CRT.

Setup: Connect the square wave generator to CH-1 and/or CH-2 INPUT connector and set the frequency to 1kHz, output voltage to 25mVp-p.

Set the VOLTS/DIV switch to 5mV/DIV for 5 divisions display.

Trace the square wave from the input stage to the output stage to locate the defective circuit. Use oscilloscope with a low capacitance probe.

Check that the square wave present at pin 1 and pin 4[3] of P11(T-4480, main board).

Yes: Troubleshoot [delay line, driver], final amplifier and associated circuit.

No: Check that the square wave present at pin 19 of CH-1 V SUB-2(T-4480, main board) for CH-1

Yes- Troubleshoot CH-1 preamplifier and channel select gate.

No- Troubleshoot CH-1 input amplifier, attenuators and associated circuit.

Check that the square wave present at pin 19 of CH-2 V SUB-2(T-4480, main board) for CH-2.

Yes- Troubleshoot CH-2 preamplifier and channel select gate.

No- Troubleshoot CH-2 input amplifier, attenuators and associated circuit.

b. Sensitivity out of tolerance

Adjust VR52, CH-1 GAIN(T-4480, main board) for CH-1

Adjust VR152, CH-2 GAIN(T-4480, main board) for CH-2.

Refer to paragraph "3.5 (3)".

c. V MODE switch not working correctly

Troubleshoot channel select gate, MODE switch(S3, T-4482, switch board) and following circuit.

CH-1: IC202(T-4480, main board) and associated circuit.

CH-2: IC202(T-4480, main board) and associated circuit.

CHOP: Check waveform at pin 12 of IC205(T-4480, main board) for interval of approximately 2.2us pulse.

Yes- Troubleshoot channel select gate.

No- Troubleshoot multivibrator, IC205(T-4480, main board) and control circuit.

ALT: Check waveform at pin 2 of IC205(T-4480, main board) for alternate switching signal.

Yes- Troubleshoot channel select gate.

No- Troubleshoot the A sweep generator.

ADD: Check Q215, 216(T-4480, main board) and associated circuit.

d. CH-2 INV not working

Check state at pin 11 of CH-2 V SUB-2(T-4480, main board) and control circuit.

- e. x10 MAG mode not working correctly
Check S5(x10 MAG switch) for CH-1, and associated circuit.
Check S105(x10 MAG switch) for CH-2, and associated circuit.

Adjust VR3, CH-1 x10 AC GAIN(T-4480, main board) for CH-1.
Adjust VR103, CH-2 x10 AC GAIN(T-4480, main board) for CH-2.

Refer to paragraph "3.5 (2)".

(3) Time base/Horizontal Amplifier Section

- a. No trace appears on A sweep mode(only spot appears).
Check that the ramp wave present at pin 3 of IC501(T-4480, main board).
Yes: Troubleshoot the horizontal amplifier.
Trace the ramp wave from the input stage to the output stage to locate the defective circuit.
No: Troubleshoot horizontal display selector, IC501 (T-4480, main board).
Check that the A trigger signal present at pin 3 of IC401(T-4480, main board).
Yes- Troubleshoot A sweep generator and A sweep gate.
No- Troubleshoot trigger circuit. Proceed to step "(4)".
- b. No trace appears on B sweep mode(only spot appears)
Check that the ramp present at pin 3 of IC501(T-4480, main board).
Yes: Troubleshoot the horizontal amplifier.
Trace the square wave from the input stage to the output stage to locate the defective circuit.
No: Troubleshoot horizontal display selector, IC501 (T-4480, main board).
Check that the B trigger signal present at pin 8 of IC405(T-4480, main board)
Yes- Troubleshoot B sweep generator, B sweep gate.
No- Troubleshoot trigger circuit. Proceed to step "(4)".
- c. Sweep time out of tolerance
A TIME/DIV: Adjust VR5, A TIME(T-4641, H control board) and/or VC401, A TIME(T-4480, main board).
Refer to paragraph "3.7 (1)".
B TIME/DIV: Adjust VR451 and/or VC451, B TIME(T-4480, main board). Refer to paragraph "3.7 (2)".

- d. Sweep delay function not working correctly
Confirm that the A and B sweeps are working correctly.

Check that the voltage at pin 4 of IC407(T-4480, main board) is varied when rotate the DELAY TIME control.

- e. x10 MAG mode not working correctly
Check Q504, Q506(T-4480, main board) and control circuit.

(4) Trigger Section

- a. Unstable display

The trigger signal must be applied from trigger pickoff circuit of the vertical system to the sweep generator.

Check the waveform at following points to locate the defective circuit.

Collector of Q203(T-4480, main board) for CH-1.

Collector of Q208(T-4480, main board) for CH-2.

Yes: Check waveform at pin 3 of IC401(T-4480, main board).

Yes- Troubleshoot A sweep generator and A sweep gate.

No- Proceed to step "b", trigger coupling.

No: Troubleshoot trigger pickoff amplifier.

- b. TRIG COUPLING not working correctly

Troubleshoot TRIG COUPLING switch, S5(T-4482, switch board) and control circuit.

DC/AC: Confirm that the trigger circuit works correctly.

HF REJ: Check Q301(T-4480, main board) and associated circuit.

TV H: D302(T-4480, main board) and associated circuit.

TV V: Check D302, Q303(T-4480, main board) and associated circuit.

- c. TRIG SOURCE works incorrect

Troubleshoot TRIG SOURCE switch, S4(T-4482, switch board) and control circuit.

CH-1: Check that the trigger signal present at pin 1 of P6(T-4480, main board)
Yes- Troubleshoot trigger generator.
No- Troubleshoot trigger pick-off amplifier and associated circuit.

CH-2: Check that the trigger signal present at pin 1 of P6(T-4480, main board)
Yes- Troubleshoot trigger generator.
No- Troubleshoot trigger pick-off amplifier and associated circuit.

ALT: Check that the CH-1 and CH-2 trigger mode works properly.
Yes- Troubleshoot control circuit.
No- Troubleshoot CH-1 and CH-2 trigger circuit.

LINE: Check waveform at pin 8 of P13(T-4481, p/s & V final board).
Yes- Troubleshoot Trigger generator.
No- Troubleshoot signal source.

EXT: Troubleshoot external trigger amplifier and control circuit.

(5) Others

a. No TRACE ROTATION works

Check continuity of L1(rotator coil) and associated circuit.

b. CAL signal not present

Troubleshoot IC1(T-4231, CRT control board) and associated circuit.

Adjust VR4(T-4231, CRT control board) if necessary. Refer to paragraph "3.11".

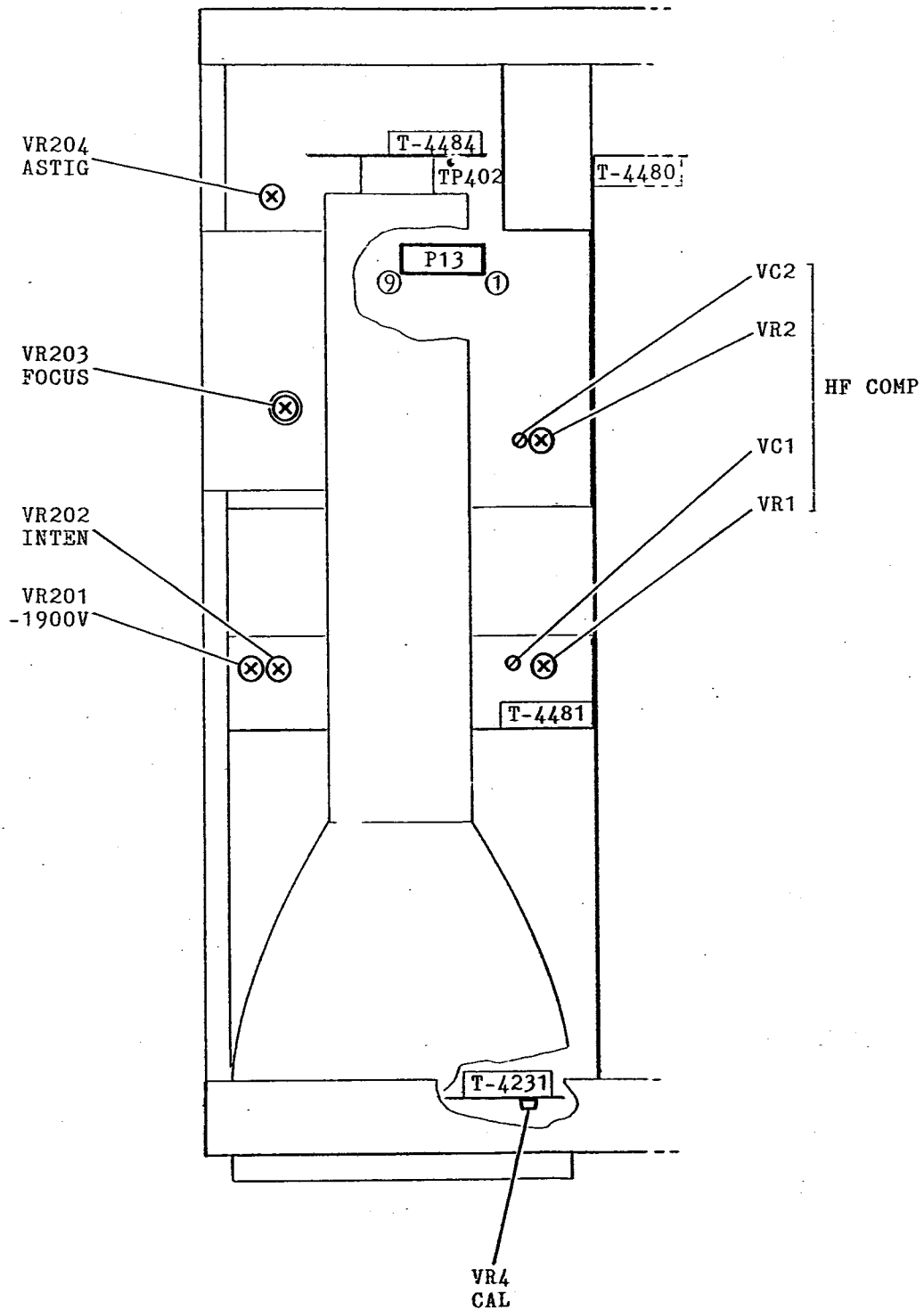
c. No scale illumination lamp lit

Check continuity of V1-V3(T-4231, CRT control board).

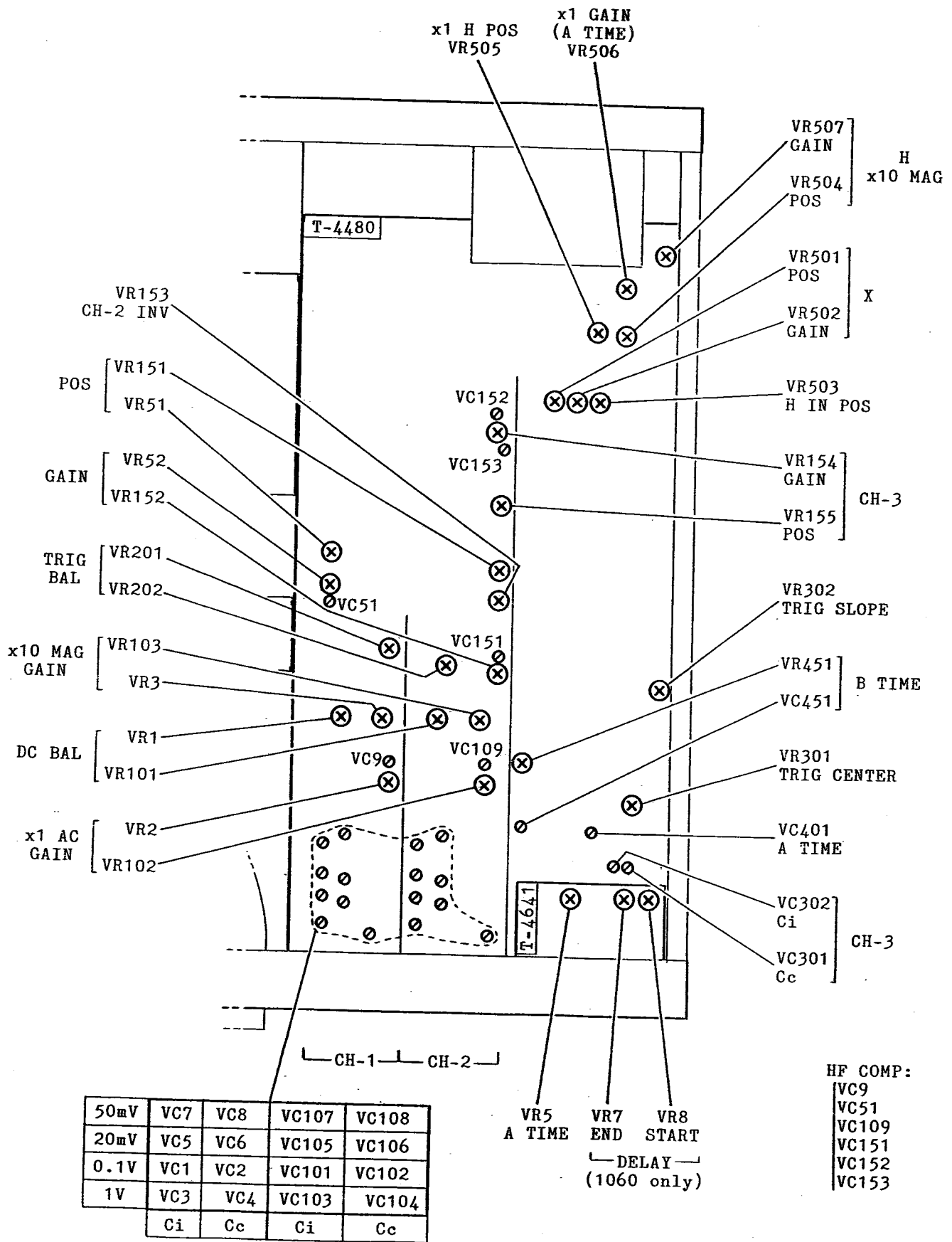
Yes: Troubleshoot S1(T-4231, CRT control board) and associated circuit.

No: Replace the lamps.

5. ADJUSTMENT LOCATIONS

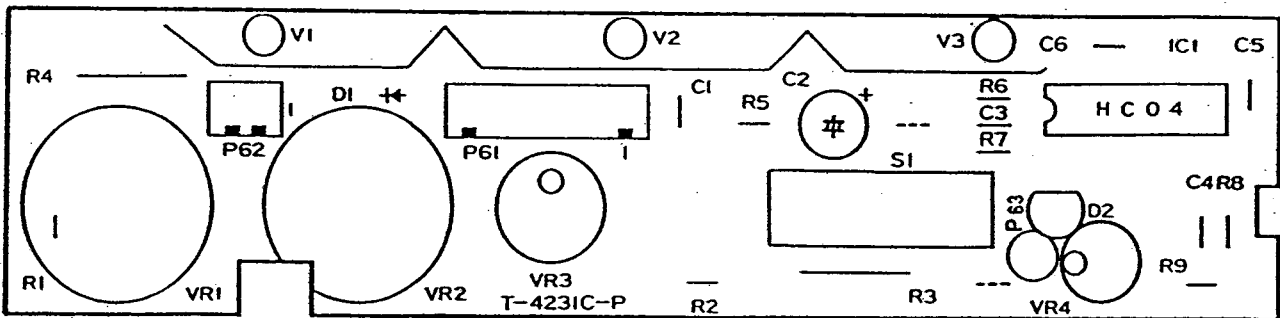


Top View-1
(Left side section)

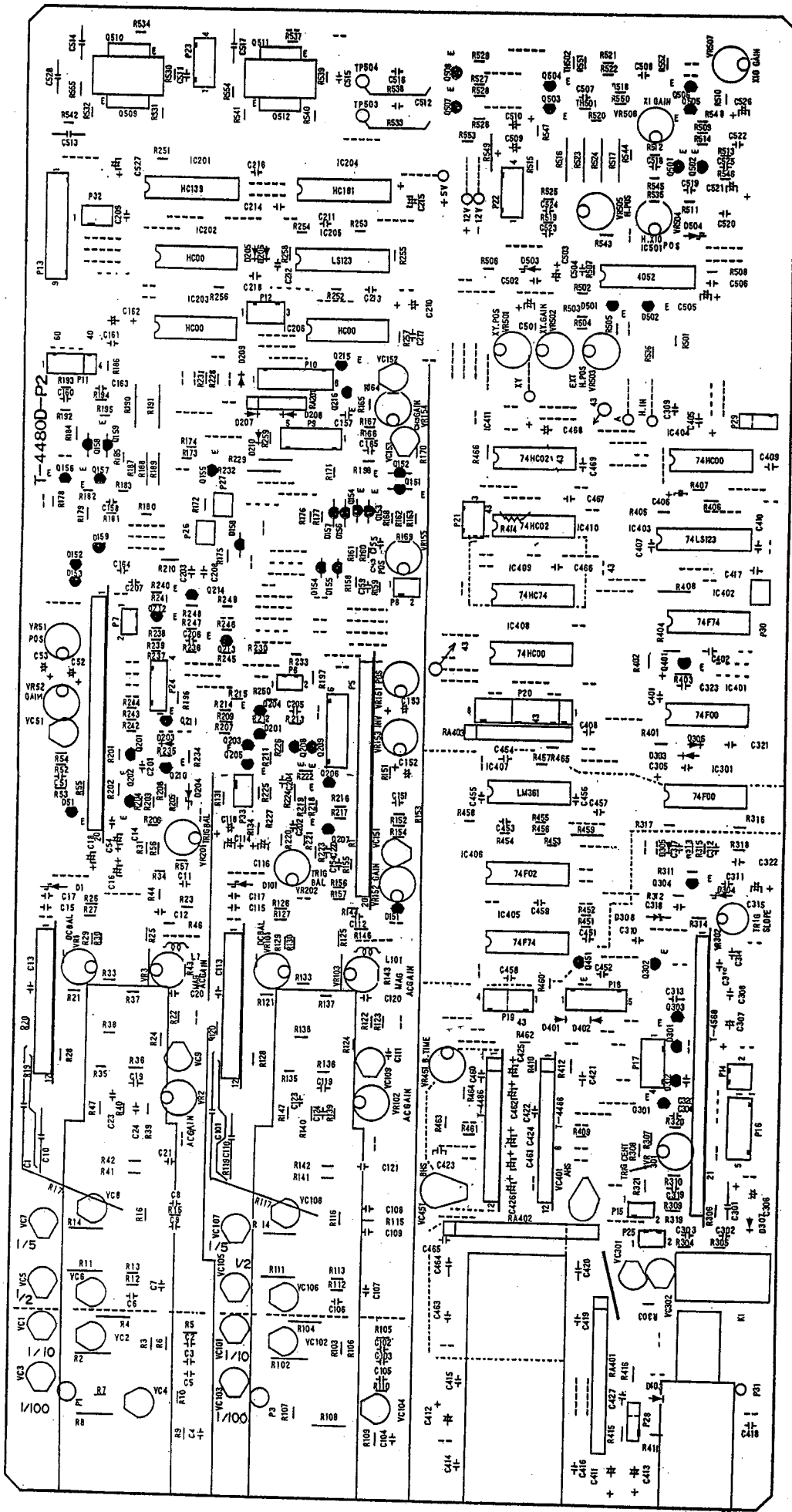


Top View-2
(Right side section)

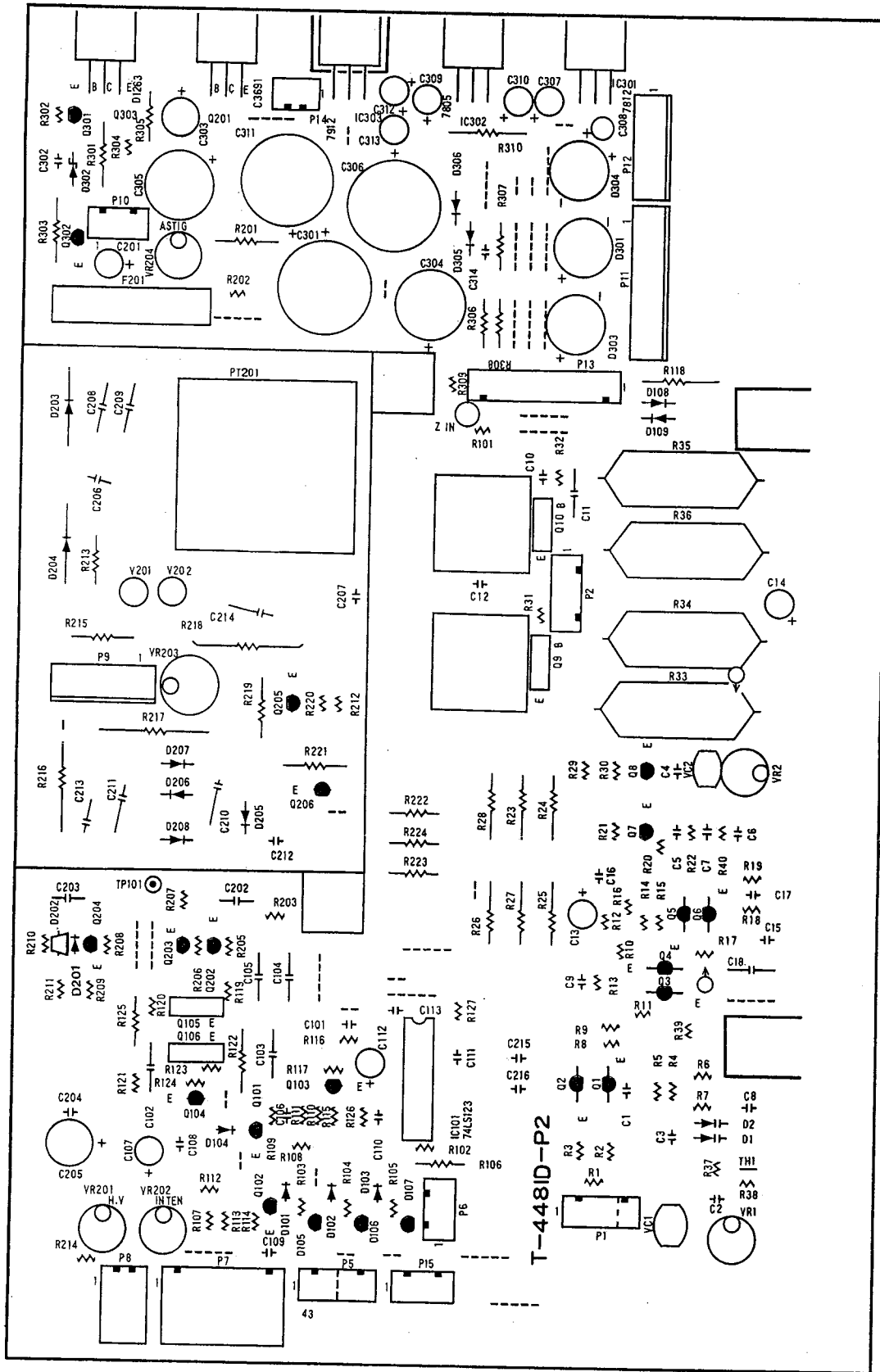
6. PRINTED CIRCUIT BOARD



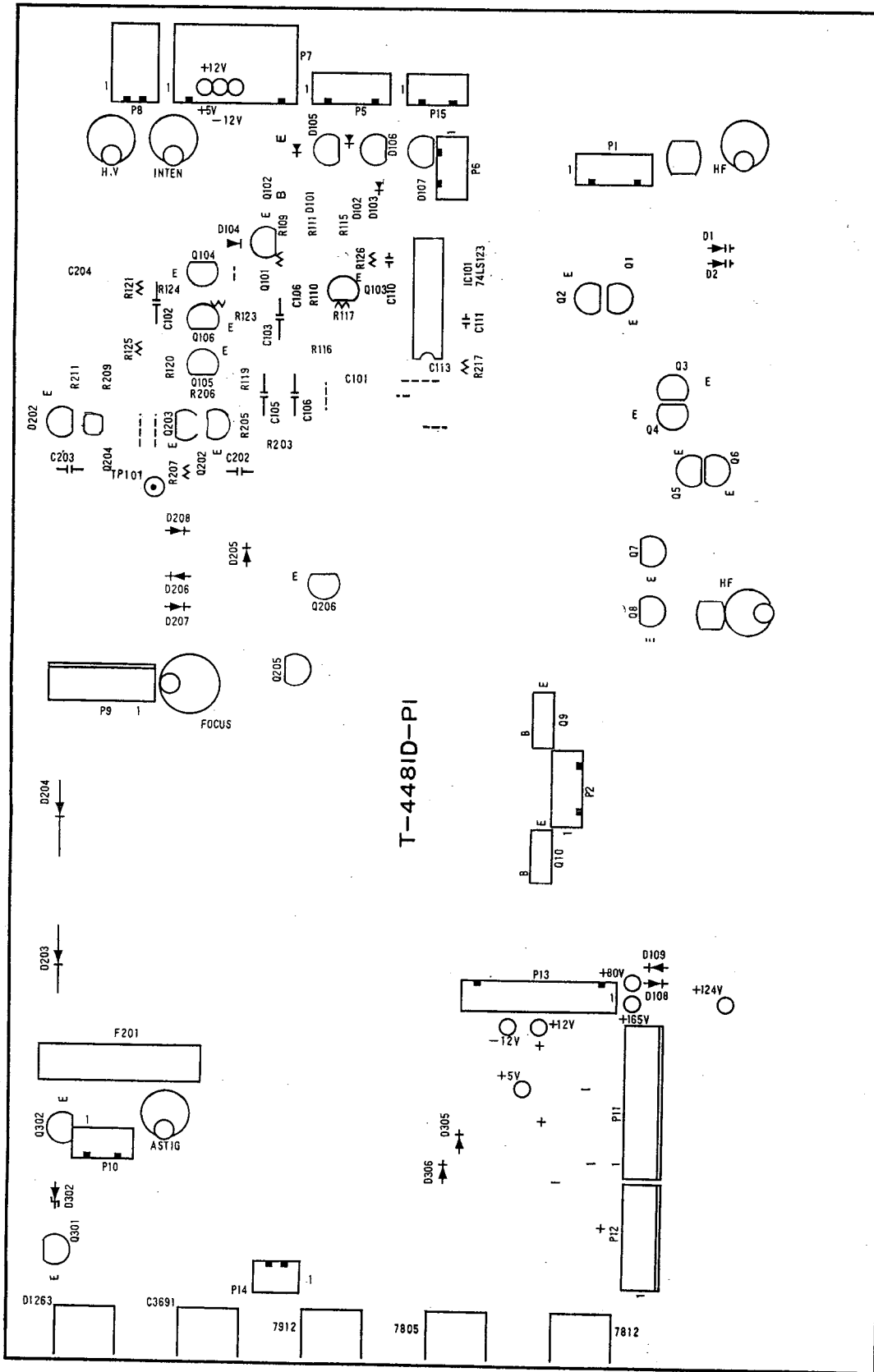
CRT Control Board
T-4231



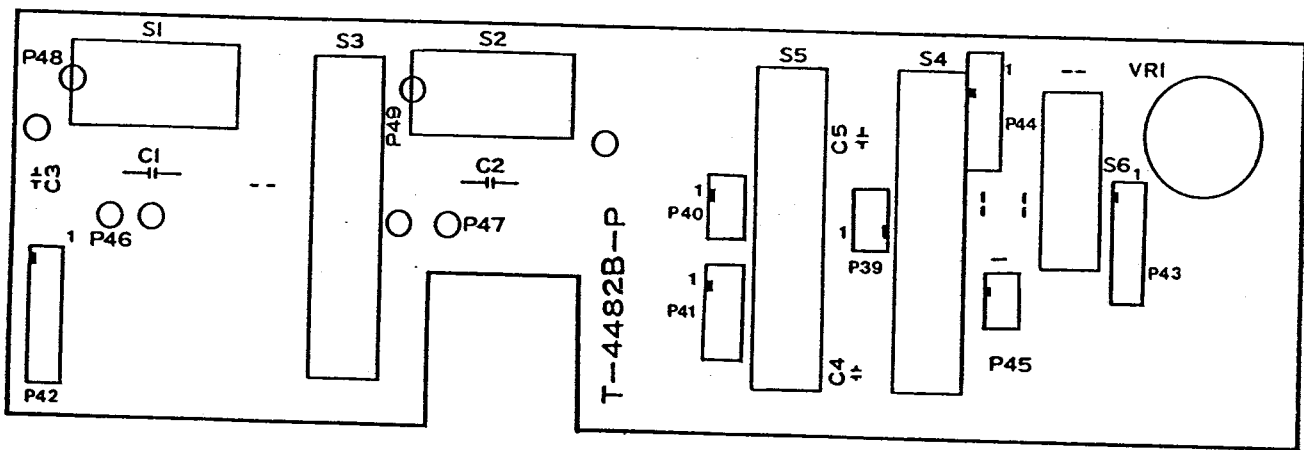
Main Board(Component side)
T-4480



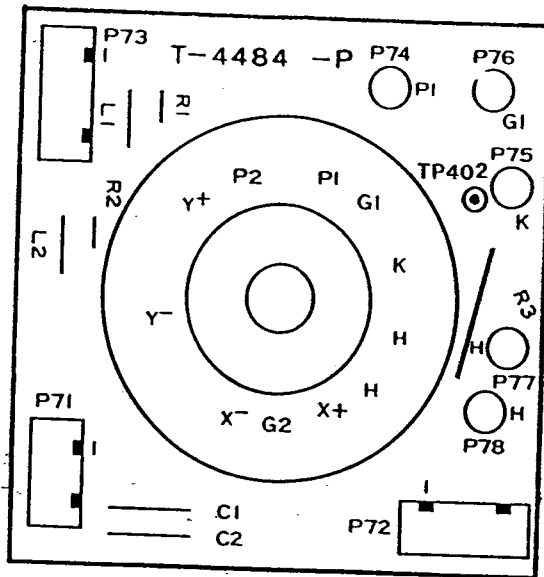
Power Supply, V Final Amp Board
(Component side)
T-4481



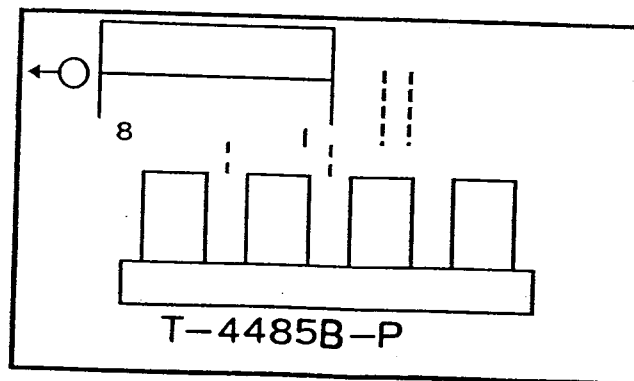
Power Supply, V Final Amp Board
(Soldering side)
T-4481



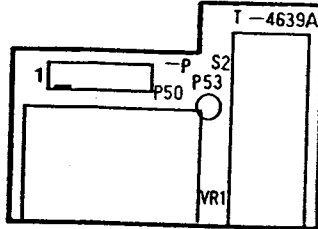
Switch Board
T-4482



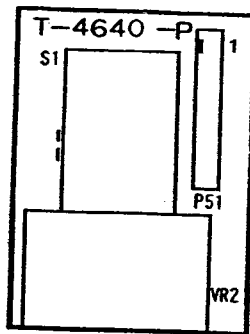
CRT Socket Board
T-4484



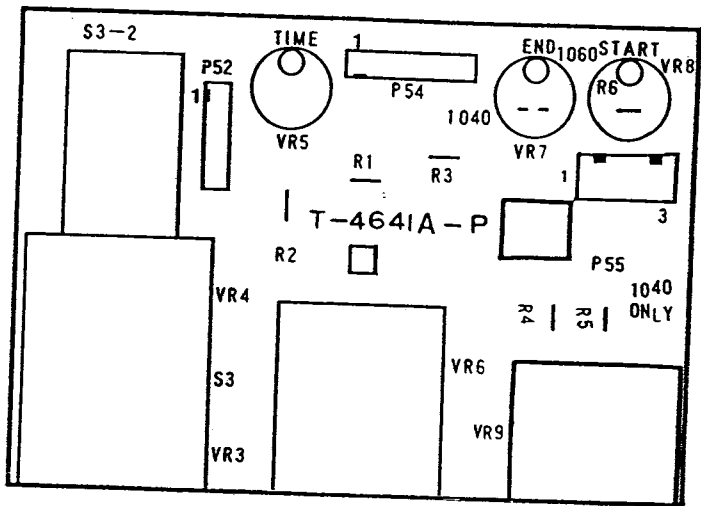
HORIZ DISPLAY Board
T-4485



CH-1 POSITION Board
T-4639

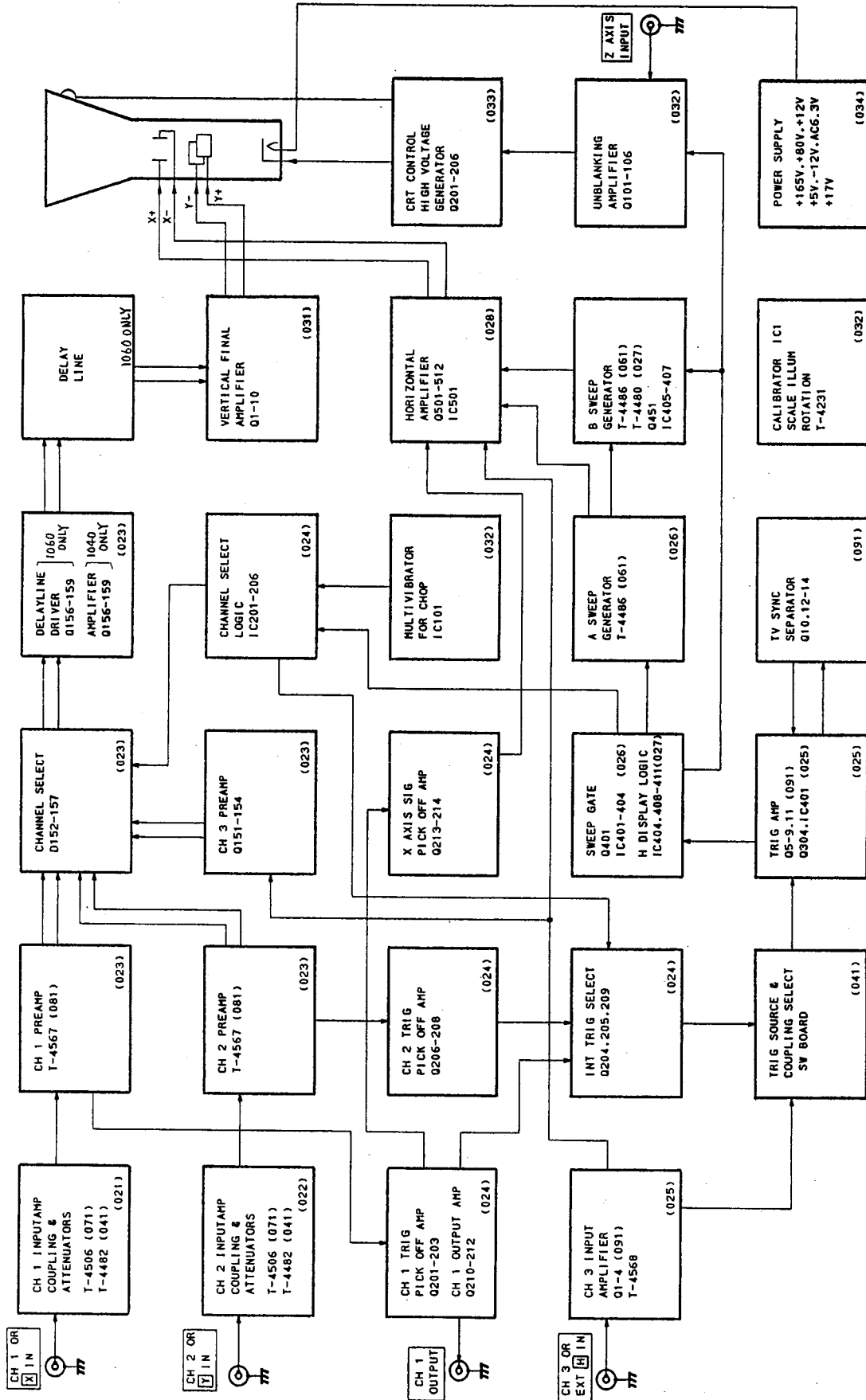


CH-2 POSITION Board
T-4640

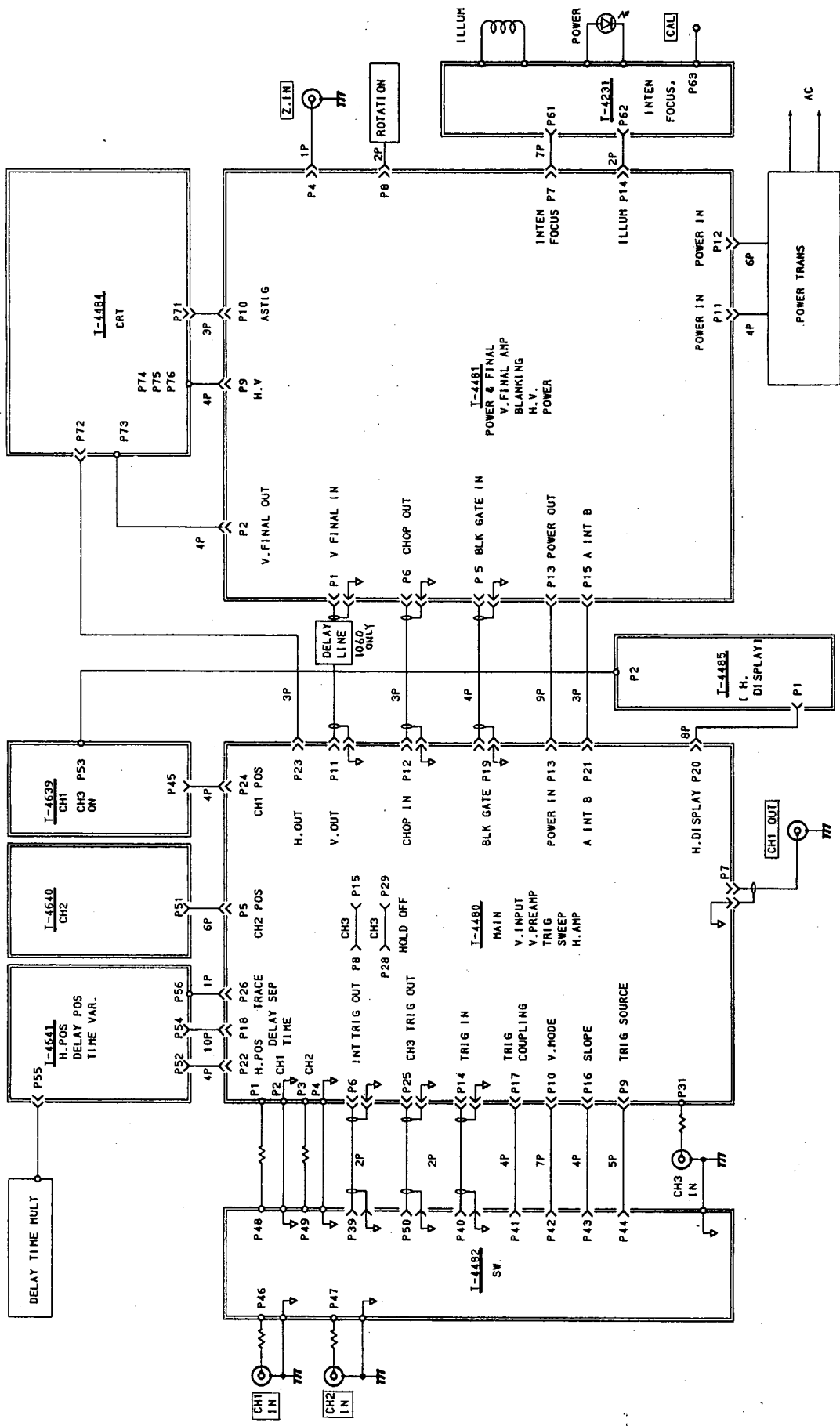


H Control Board
T-4641

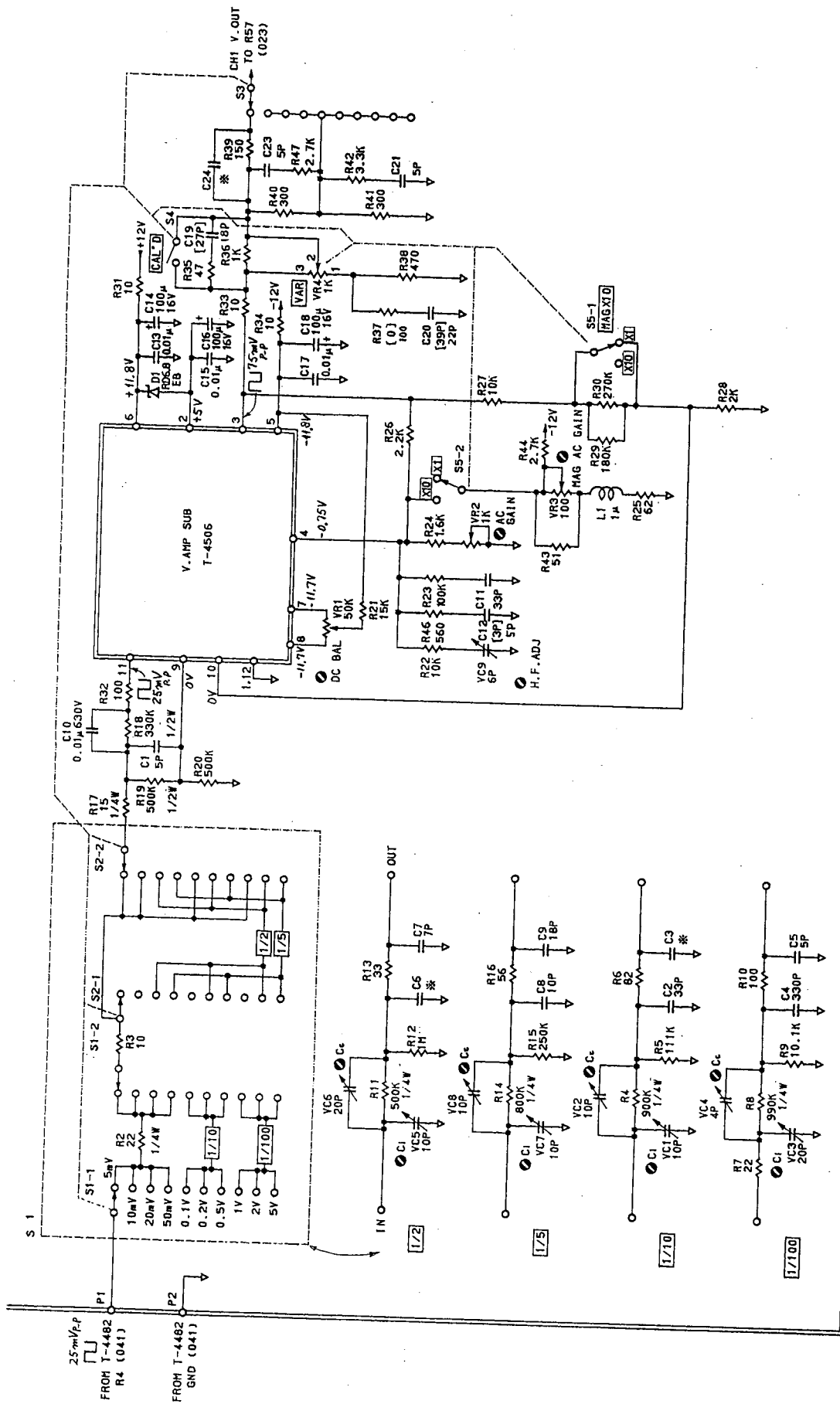
7. BLOCK DIAGRAM/
SCHEMATIC DIAGRAM



Block Diagram
001



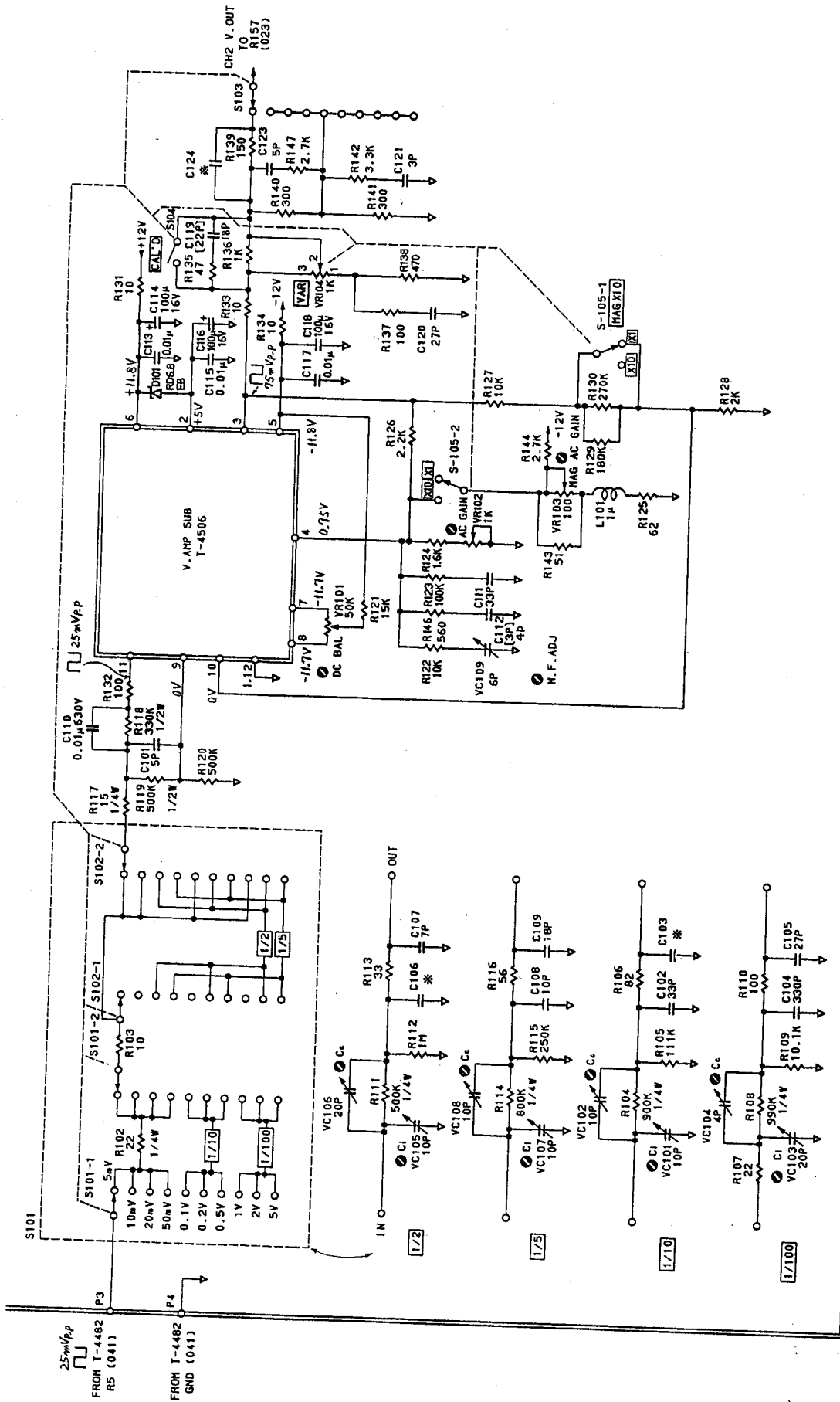
PC Board Interconnections
011



Waveforms are obtained under the conditions as follows:
 - VOLTS/DIV: 5mV/DIV
 - Applied 1MHz, 25mVp-p square wave to INPUT connectors

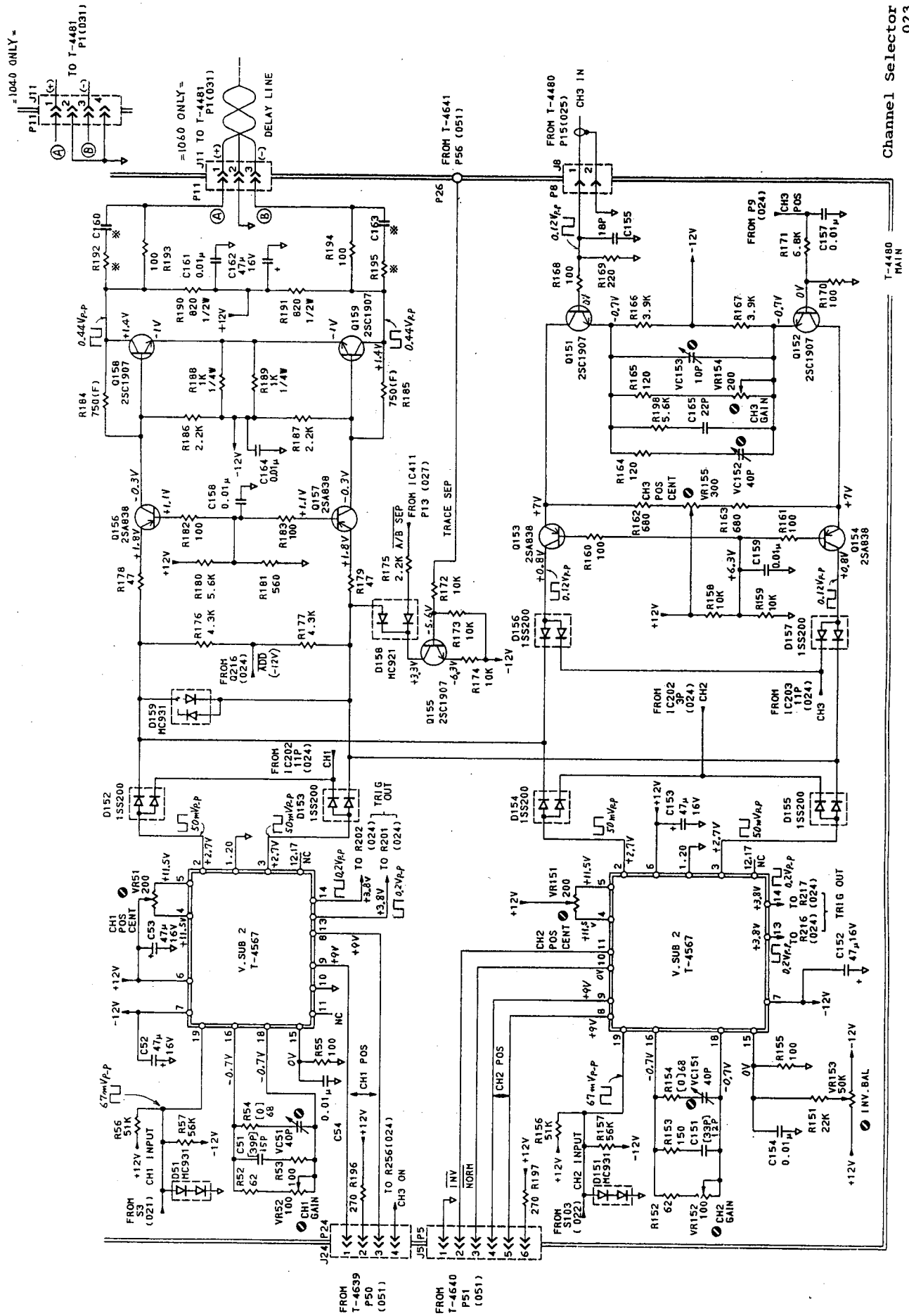
Vertical Input Amplifier(CH-1, X)
 021

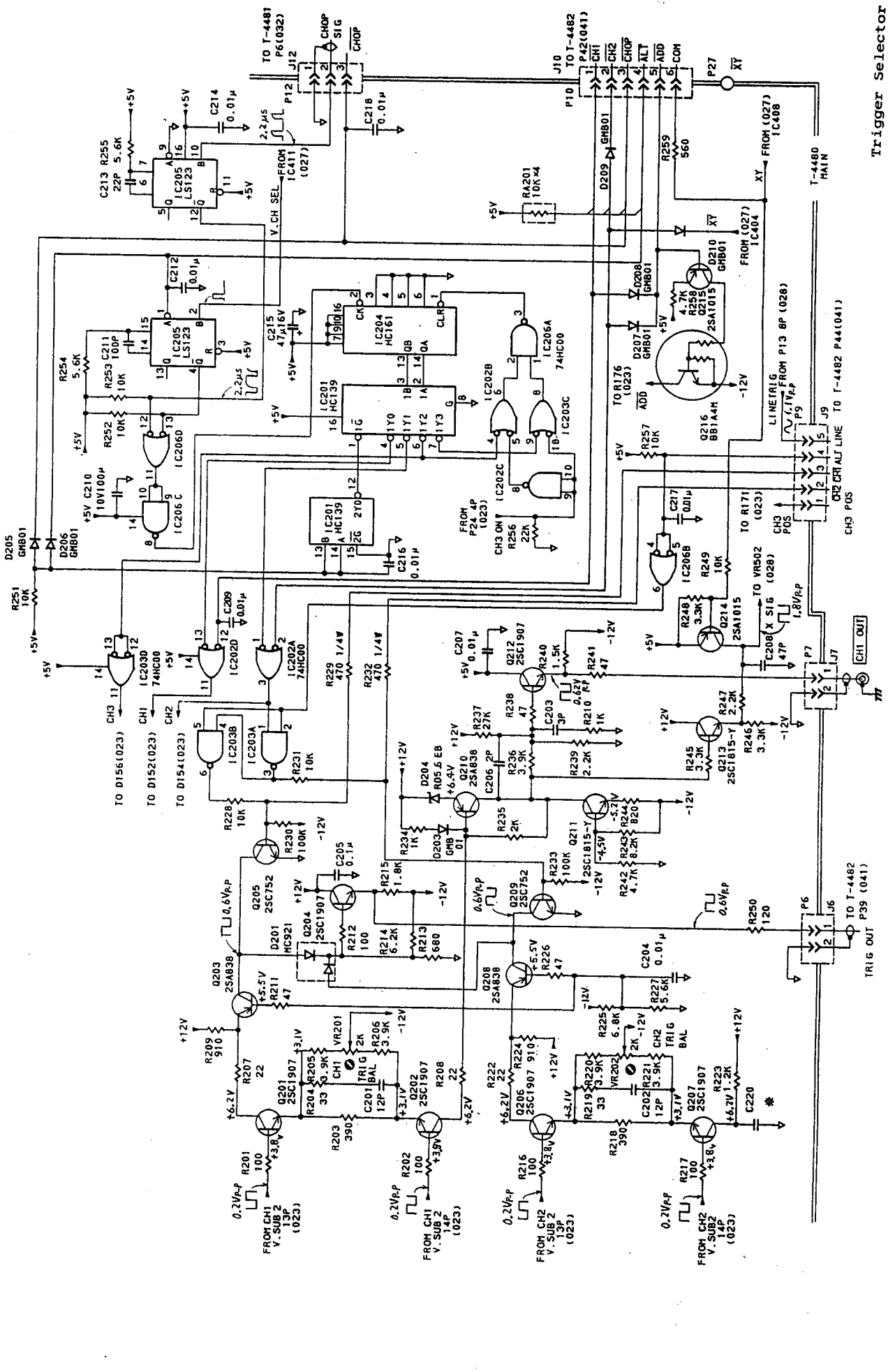
T-4480
 MAIN



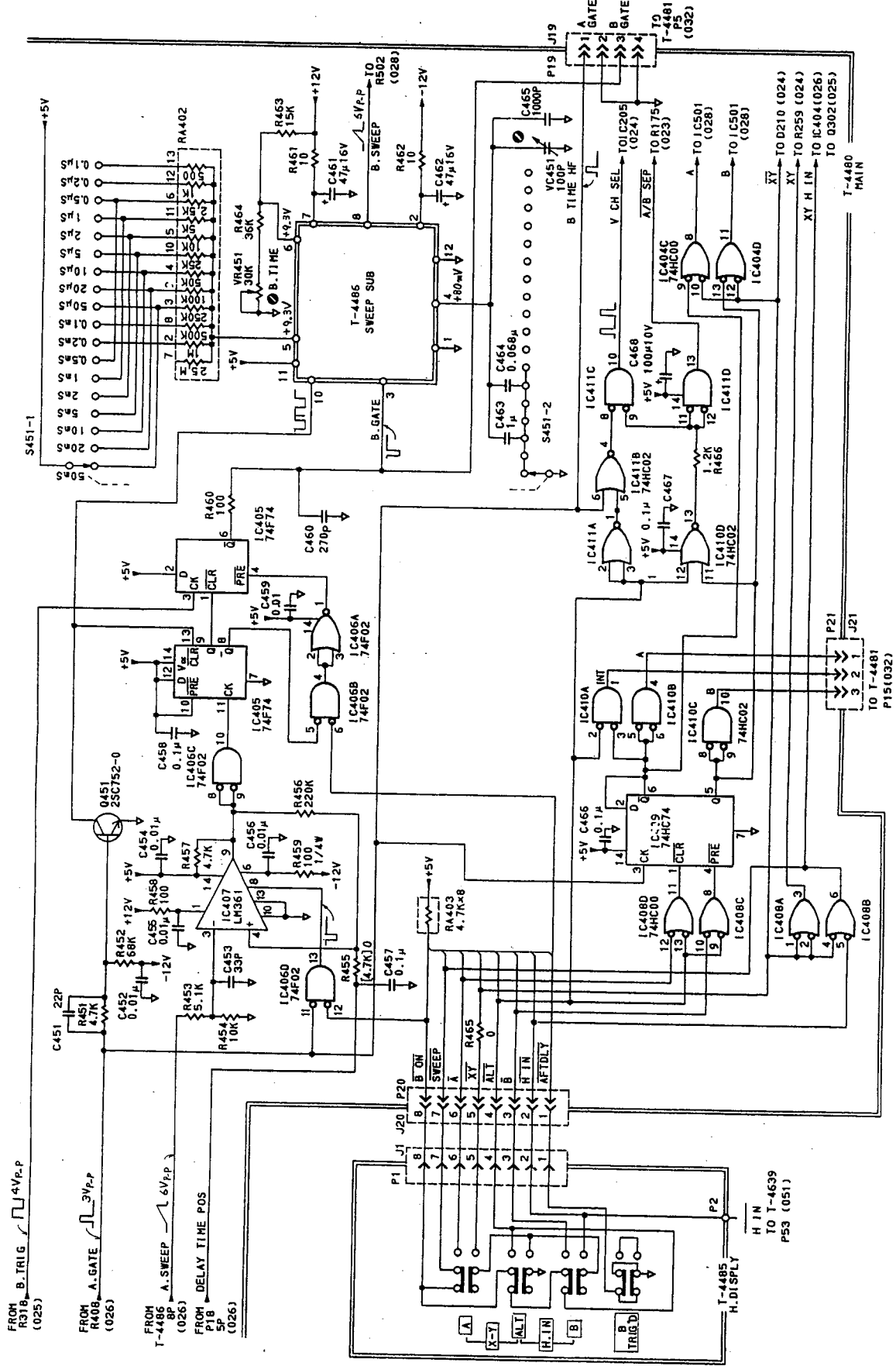
T-4480
MAIN

Vertical Input Amplifier(CH-2, Y) 022

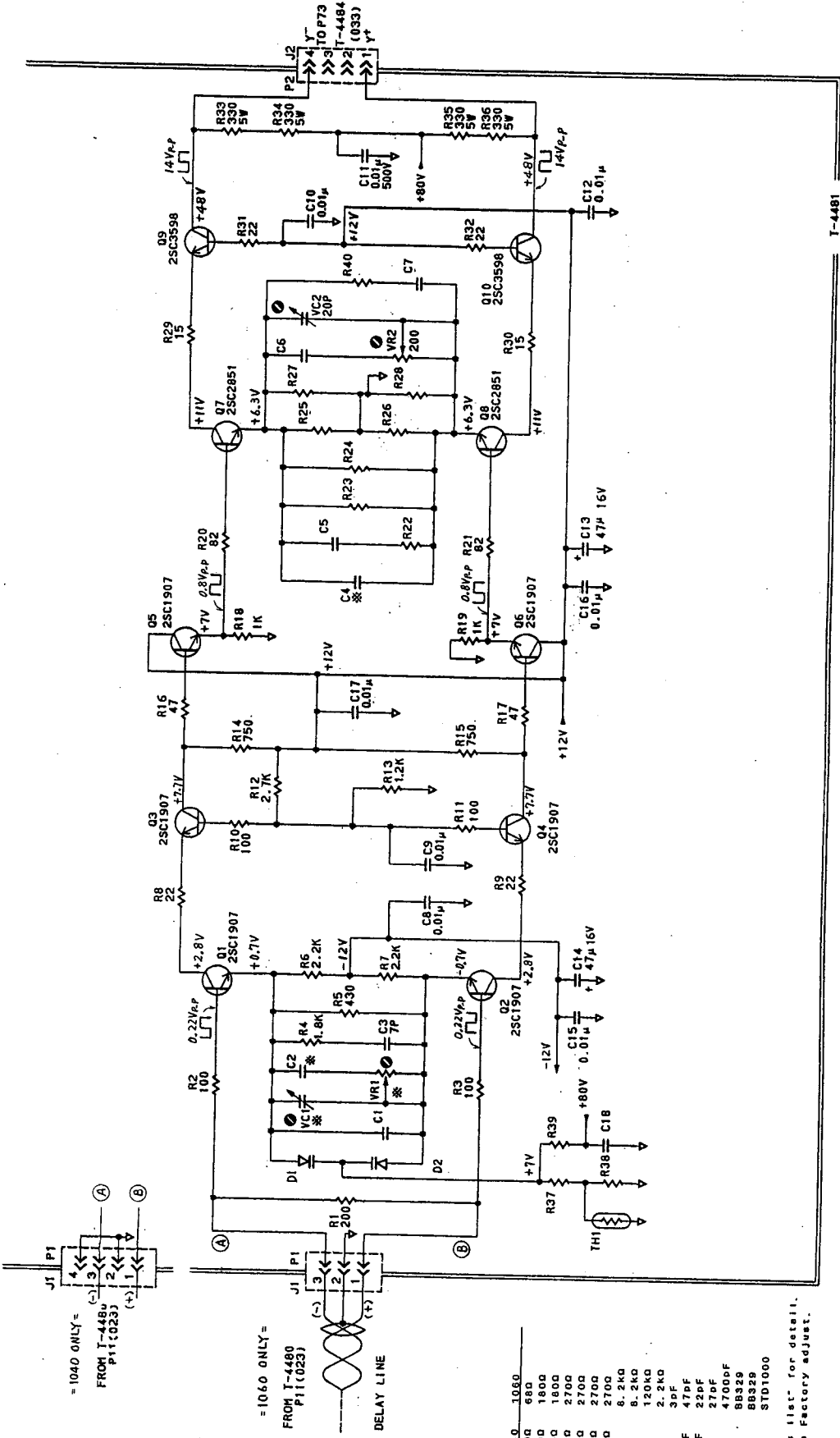




Trigger Selector
024



B Sweep Generator 027



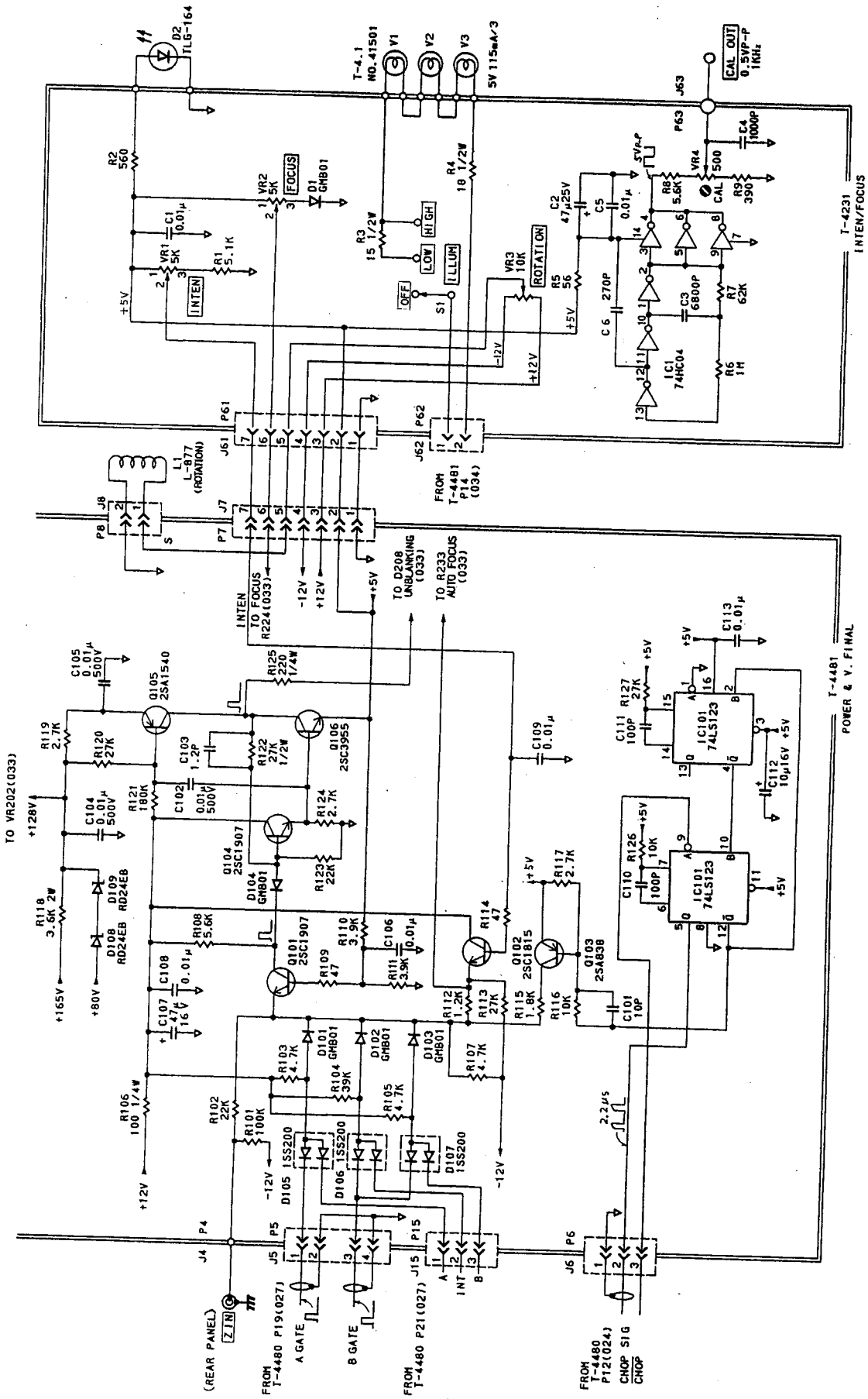
= 1040 ONLY =
FROM T-4481
P11(023)

= 1060 ONLY =
FROM T-4480
P11(023)

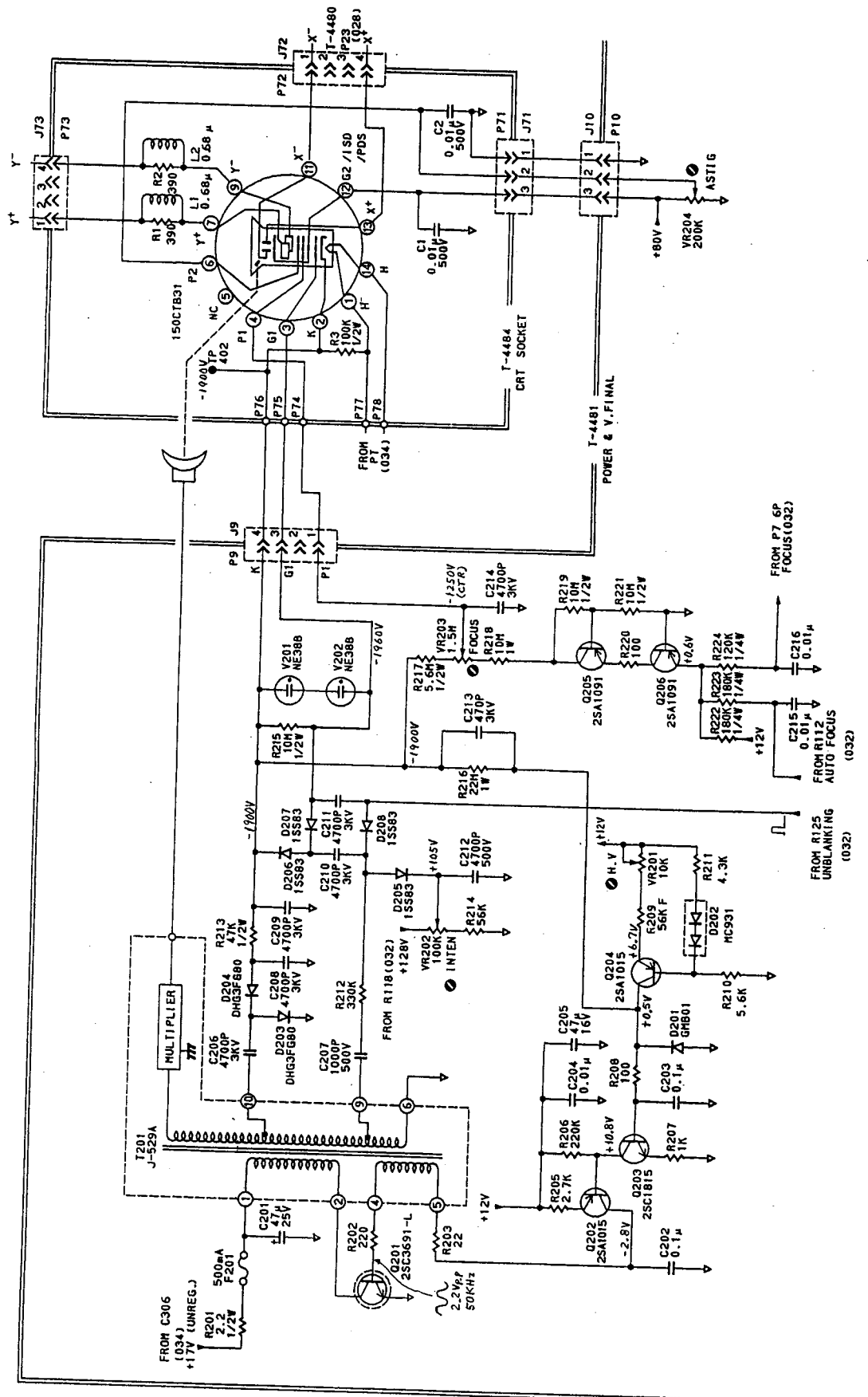
NOTE:

R22	1040	1060
R23	2400	680
R24	2400	1800
R25	2400	1800
R26	5000	2700
R27	5000	2700
R28	5000	2700
R29	5000	2700
R30	*	8.2KΩ
R31	*	8.2KΩ
R32	*	120KΩ
R33	*	2.2KΩ
R34	*	2.2KΩ
R35	20F	30F
R36	39F	47F
R37	50F	22F
R38	50F	27F
R39	*	47000F
D1	*	58329
D2	*	58329
TH1	*	STD1000

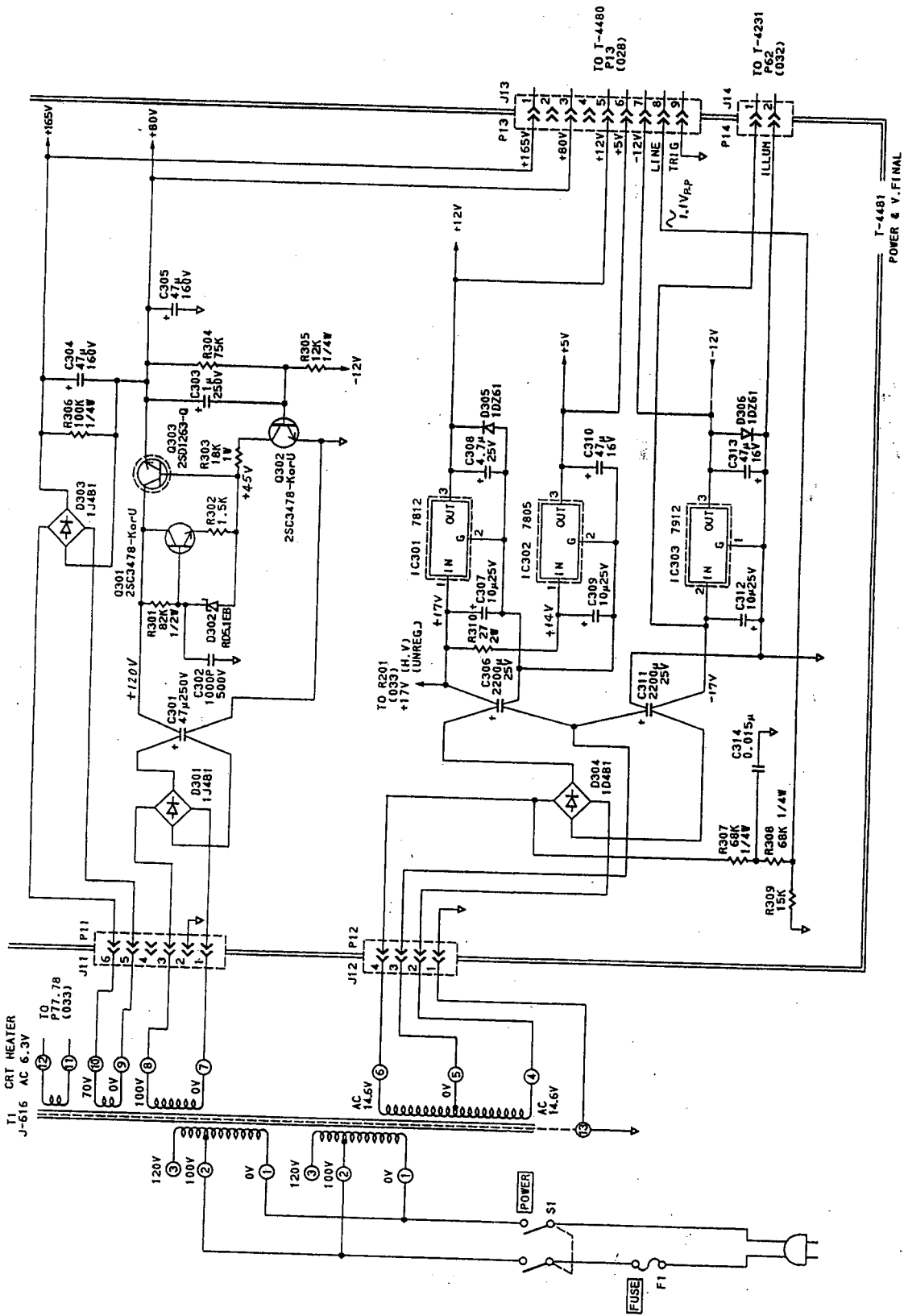
See "Parts list" for detail.
* denote factory adjust.



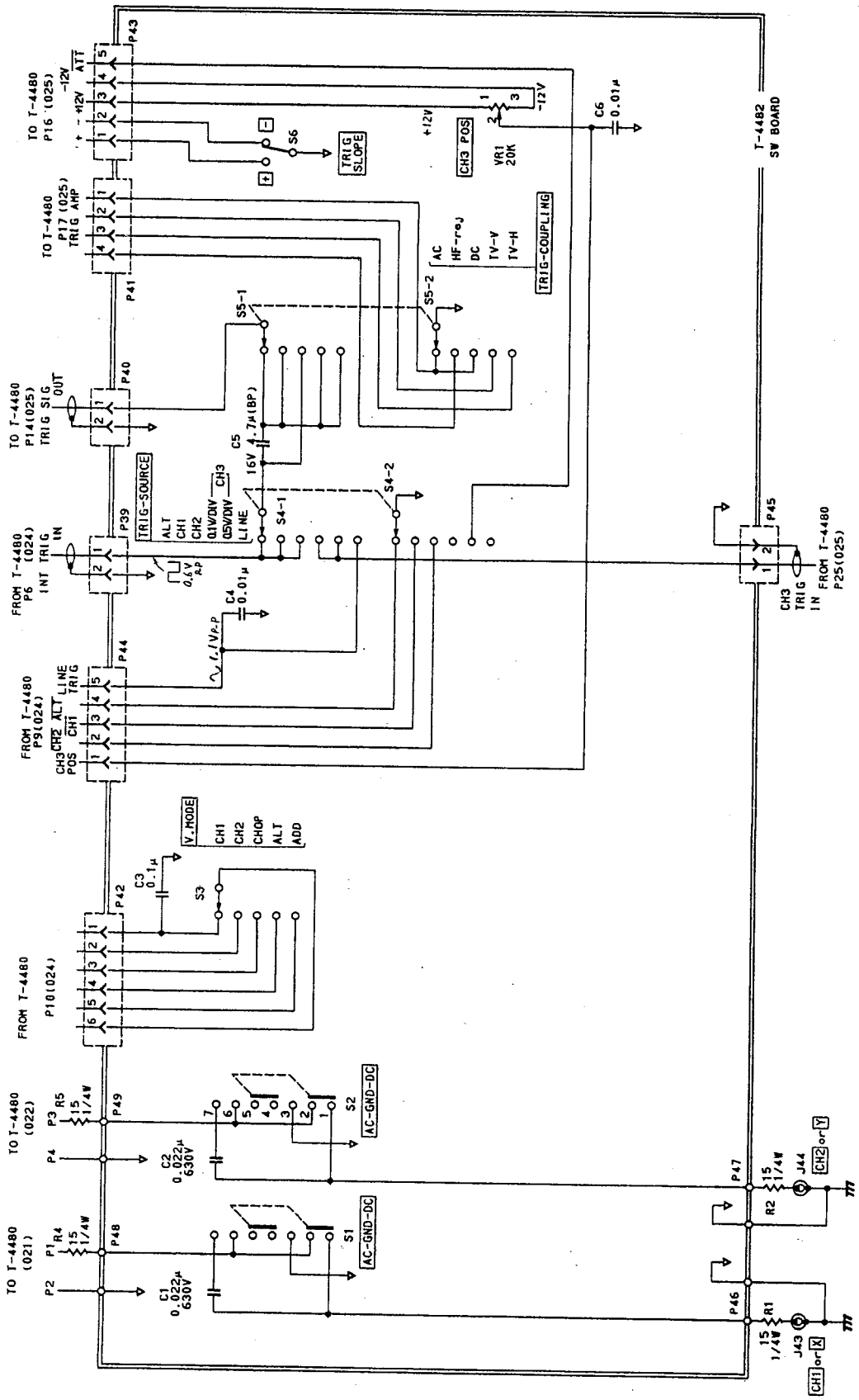
FROM T-4481
P2 (031)



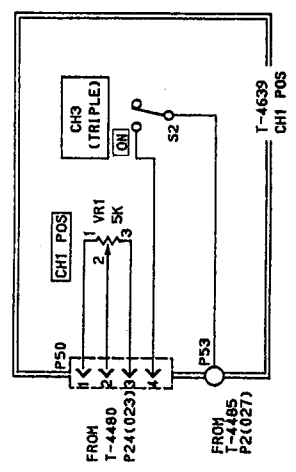
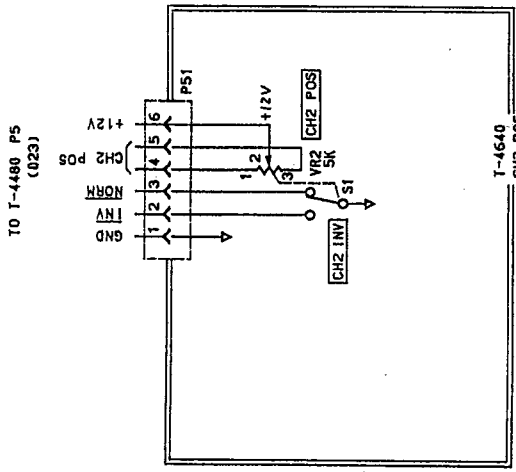
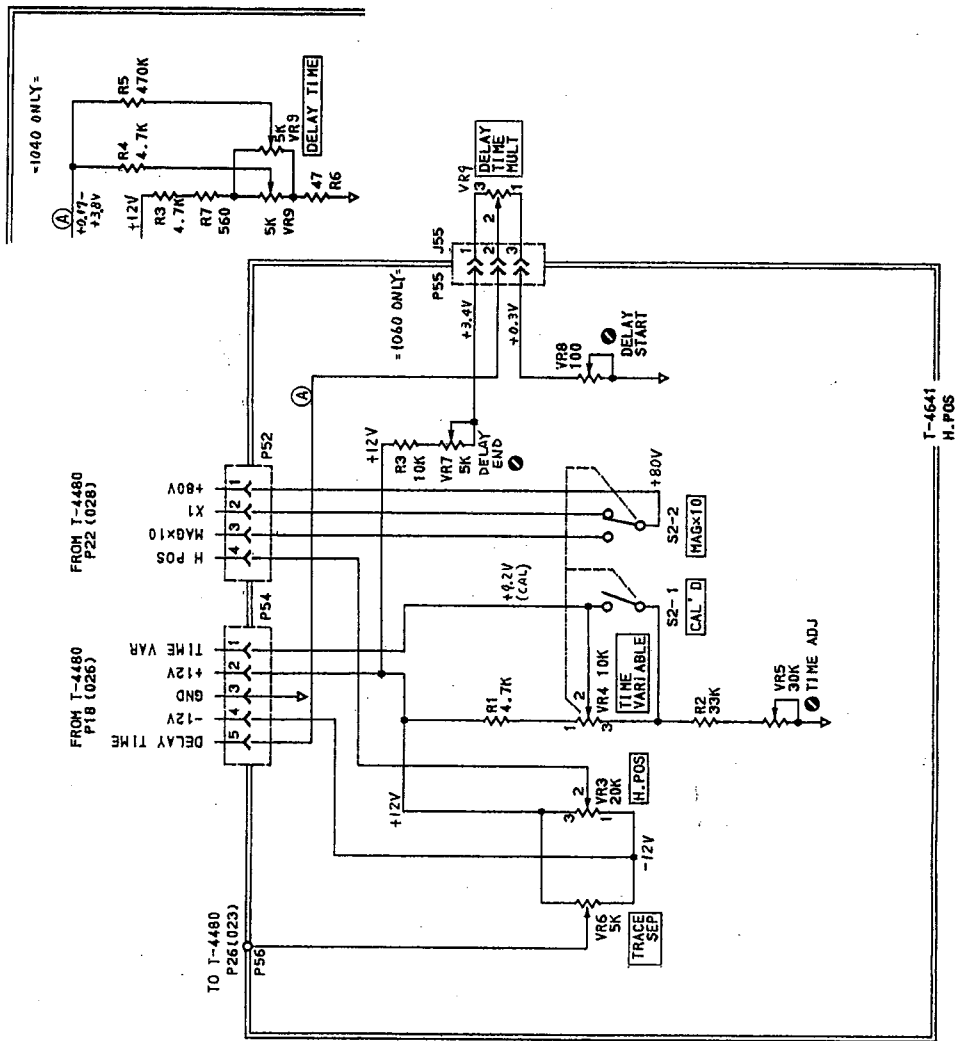
High Voltage Power Supply, CRT
033



Power Supply 034

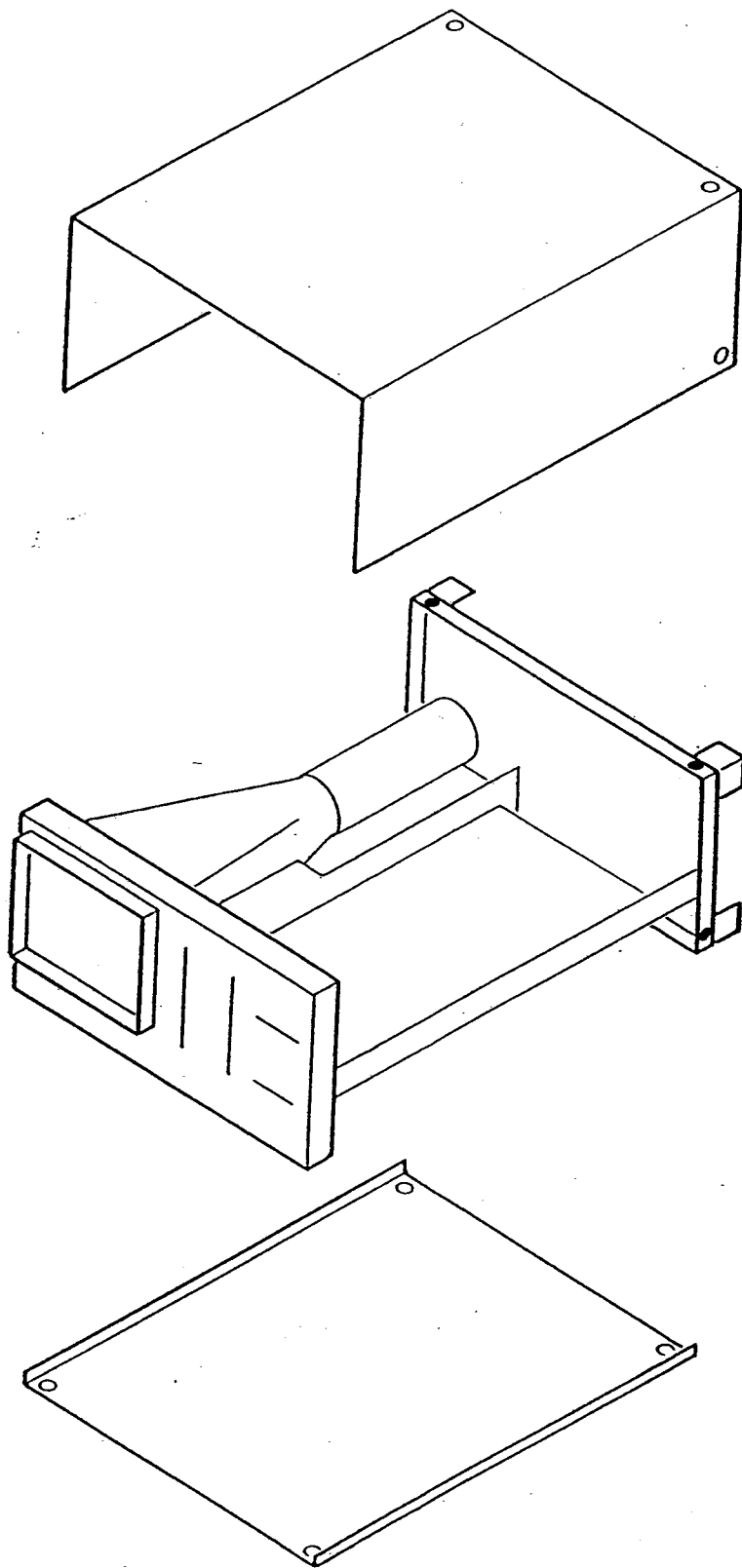


Controls-1
041



8. CABINET REMOVAL

- Take five screws off to remove the Top cover.
- Take four screws off to remove the Bottom cover.



9. PARTS LIST

No.	LDR PT No.	DESCRIPTION
*** FRAME ***		
-RESISTORS-		
R1	1010150005	CARBON FILM 15 OHM 5% 1/4W
R2	1010150005	CARBON FILM 15 OHM 5% 1/4W
R3	1010150005	CARBON FILM 15 OHM 5% 1/4W
-VARIABLE RESISTOR-		
VR9	1940032002	WIRE WOUND 5K OHM 5% 2W "DELAY TIME MULT"
-TUBE-		
	3710047015	CRT 150CTB31(IG)-LD
-TRANSFORMER-		
T1	3800616019	POWER TRANSFORMER J-616A
-COIL-		
L1	3900877006	ROTATOR COIL L-877
-SWITCH-		
S1	4020138009	PUSH ESB-70702V "POWER"
-FUSES-		
F1	4363750003	TIME LAG ST4 500mA "200V-240V"
F1	4363765006	TIME LAG ST4 1A "100V-120V"
-PC BOARDS-		
	5904483052	T-4483E-R,P
	5904484100	T-4484RP(4231C4382B)
-MISCELLANEOUS-		
J1	4310769001	CONNECTOR BNC-BR-216
J2	4310769001	CONNECTOR BNC-BR-216
J3	4310769001	CONNECTOR BNC-BR-216
J4	4310769001	CONNECTOR BNC-BR-216
J5	4310769001	CONNECTOR BNC-BR-216
	4513091000	KNOB B9S(18 SERR.) "INTEN"
	4513141009	KNOB E-628 "B TIME/DIV"
	4513233004	KNOB E-627 "A TIME/DIV"
	4513091000	KNOB B9S(18 SERR.) "FOCUS"
	4513091000	KNOB B9S(18 SERR.) "CH-1 POSITION"
	4513091000	KNOB B9S(18 SERR.) "CH-2 POSITION"
	4513091000	KNOB B9S(18 SERR.) "CH-3 POSITION"
	4513093004	KNOB B9T(18 SERR.) "CH-1 VARIABLE"
	4513093004	KNOB B9T(18 SERR.) "CH-2 VARIABLE"
	4513093004	KNOB B9T(18 SERR.) "TIME VARIABLE"
	4513093004	KNOB B9T(18 SERR.) "TRACE SEP"
	4513093004	KNOB B9T(18 SERR.) "HOLDOFF"
	4513133082	KNOB B13S-0 (90°) "H POSITION"
	4513133082	KNOB B13S-0 (90°) "LEVEL"
	4513151002	KNOB B15S-0 "CH-1 VOLTS/DIV"
	4513151002	KNOB B15S-0 "CH-2 VOLTS/DIV"
	4515013075	PUSH BUTTON LIGHT GRAY "POWER"
	4516005054	PUSH BUTTON SUJ DARK GRAY "B TRIG'D"
	4516005063	PUSH BUTTON SUJ LIGHT GRAY "TRIPLE(CH-3)"
	4516005063	PUSH BUTTON SUJ LIGHT GRAY "A"
	4516005063	PUSH BUTTON SUJ LIGHT GRAY "ALT"
	4516005063	PUSH BUTTON SUJ LIGHT GRAY "B"

No.	LDR PT No.	DESCRIPTION
(FRAME	CONT'D)	
	4516034006	SLIDE KNOB E-594 "ILLUM"
	4516034006	SLIDE KNOB E-594 "V MODE"
	4516034006	SLIDE KNOB E-594 "TRIG COUPLING"
	4516034006	SLIDE KNOB E-594 "TRIG SOURCE"
	4516034006	SLIDE KNOB E-594 "TRIG SLOPE/TV POL"
	4371009003	FUSE HOLDER FH-032(6.35X31.8)
	4519004005	10-TURN DIAL SMG20-22B6 (GRAY)
	6303047002	MATAL TERMINAL D-3047 8mm
	6400431012	CORD WINDER-L E-431B-1
	6400482000	FOOT E-482
	6600543000	CRT FILTER G-543 GRAY SMOKE

*** MAIN BOARD
-RESISTORS-

T-4480 ***

R2	1010220000	CARBON FILM	22 OHM	5%	1/4W
R3	1000100003	CARBON FILM	10 OHM	5%	1/6W
R4	1369000027	METAL FILM	900K OHM	0.5%	1/6W
R5	1451113014	METAL FILM	111K OHM	0.5%	1/6W
R6	1000820007	CARBON FILM	82 OHM	5%	1/6W
R7	1000220003	CARBON FILM	22 OHM	5%	1/6W
R8	1369900005	METAL FILM	990K OHM	0.5%	1/6W
R9	1451012009	METAL FILM	10.1K OHM	0.5%	1/6W
R10	1000101005	CARBON FILM	100 OHM	5%	1/6W
R11	1365000032	METAL FILM	500K OHM	0.5%	1/6W
R12	1451004000	MATAL FILM	1M OHM	0.5%	1/6W
R13	1000330000	CARBON FILM	33 OHM	5%	1/6W
R14	1368000012	METAL FILM	800K OHM	0.5%	1/6W
R15	1452503013	METAL FILM	250K OHM	0.5%	1/6W
R16	1000560007	CARBON FILM	56 OHM	5%	1/6W
R17	1010150005	CARBON FILM	15 OHM	5%	1/4W
R18	1333303000	METAL FILM	330K OHM	1%	1/2W
R19	1375000002	METAL FILM	500K OHM	0.5%	1/6W
R20	1455003002	MATAL FILM	500K OHM	0.5%	1/6W
R21	1000153004	CARBON FILM	15K OHM	5%	1/6W
R22	1000103009	CARBON FILM	10K OHM	5%	1/6W
R23	1000104001	CARBON FILM	100K OHM	5%	1/6W
R24	1461601005	METAL FILM	1.6K OHM	1%	1/6W
R25	1466209005	METAL FILM	62 OHM	1%	1/6W
R26	1462201005	METAL FILM	2.2K OHM	1%	1/6W
R27	1461002003	METAL FILM	10K OHM	1%	1/6W
R28	1462001007	METAL FILM	2K OHM	1%	1/6W
R29	1461803007	METAL FILM	180K OHM	1%	1/6W
R30	1462703009	METAL FILM	270K OHM	1%	1/6W
R31	1000100003	CARBON FILM	10 OHM	5%	1/6W
R32	1000101005	CARBON FILM	100 OHM	5%	1/6W
R33	1000100003	CARBON FILM	10 OHM	5%	1/6W
R34	1000100003	CARBON FILM	10 OHM	5%	1/6W
R35	1000470006	CARBON FILM	47 OHM	5%	1/6W
R36	1000102007	CARBON FILM	1K OHM	5%	1/6W
R38	1000471008	CARBON FILM	470 OHM	5%	1/6W
R39	1000151000	CARBON FILM	150 OHM	5%	1/6W
R40	1453000004	METAL FILM	300 OHM	0.5%	1/6W
R41	1453000004	METAL FILM	300 OHM	0.5%	1/6W
R42	1000332004	CARBON FILM	3.3K OHM	5%	1/6W

No.	LDR PT No.	DESCRIPTION			
(T-4480	CONT'D)				
R43	1465109005	METAL FILM	51 OHM	1%	1/6W
R44	1000272002	CARBON FILM	2.7K OHM	5%	1/6W
R46	1000561009	CARBON FILM	560 OHM	5%	1/6W
R47	1000272002	CARBON FILM	2.7K OHM	5%	1/6W
R52	1466209005	METAL FILM	62 OHM	1%	1/6W
R53	1000101005	CARBON FILM	100 OHM	5%	1/6W
R55	1000101005	CARBON FILM	100 OHM	5%	1/6W
R56	1000510008	CARBON FILM	51K OHM	5%	1/6W
R57	1000563003	CARBON FILM	56K OHM	5%	1/6W
R102	1010220000	CARBON FILM	22 OHM	5%	1/4W
R103	1000100003	CARBON FILM	10 OHM	5%	1/6W
R104	1369000027	METAL FILM	900K OHM	0.5%	1/6W
R105	1451113014	METAL FILM	111K OHM	0.5%	1/6W
R106	1000820007	CARBON FILM	82 OHM	5%	1/6W
R107	1000220003	CARBON FILM	22 OHM	5%	1/6W
R108	1369900005	METAL FILM	990K OHM	0.5%	1/6W
R109	1451012009	METAL FILM	10.1K OHM	0.5%	1/6W
R110	1000101005	CARBON FILM	100 OHM	5%	1/6W
R111	1365000032	METAL FILM	500K OHM	0.5%	1/6W
R112	1451004000	MATAL FILM	1M OHM	0.5%	1/6W
R113	1000330000	CARBON FILM	33 OHM	5%	1/6W
R114	1368000012	METAL FILM	800K OHM	0.5%	1/6W
R115	1452503013	METAL FILM	250K OHM	0.5%	1/6W
R116	1000560007	CARBON FILM	56 OHM	5%	1/6W
R117	1010150005	CARBON FILM	15 OHM	5%	1/4W
R118	1333303000	METAL FILM	330K OHM	1%	1/2W
R119	1375000002	METAL FILM	500K OHM	0.5%	1/6W
R120	1455003002	MATAL FILM	500K OHM	0.5%	1/6W
R121	1000153004	CARBON FILM	15K OHM	5%	1/6W
R122	1000103009	CARBON FILM	10K OHM	5%	1/6W
R123	1000104001	CARBON FILM	100K OHM	5%	1/6W
R124	1461601005	METAL FILM	1.6K OHM	1%	1/6W
R125	1466209005	METAL FILM	62 OHM	1%	1/6W
R126	1462201005	METAL FILM	2.2K OHM	1%	1/6W
R127	1461002003	METAL FILM	10K OHM	1%	1/6W
R128	1462001007	METAL FILM	2K OHM	1%	1/6W
R129	1461803007	METAL FILM	180K OHM	1%	1/6W
R130	1462703009	METAL FILM	270K OHM	1%	1/6W
R131	1000100003	CARBON FILM	10 OHM	5%	1/6W
R132	1000101005	CARBON FILM	100 OHM	5%	1/6W
R133	1000100003	CARBON FILM	10 OHM	5%	1/6W
R134	1000100003	CARBON FILM	10 OHM	5%	1/6W
R135	1000470006	CARBON FILM	47 OHM	5%	1/6W
R136	1000102007	CARBON FILM	1K OHM	5%	1/6W
R137	1000101005	CARBON FILM	100 OHM	5%	1/6W
R138	1000471008	CARBON FILM	470 OHM	5%	1/6W
R139	1000151000	CARBON FILM	150 OHM	5%	1/6W
R140	1453000004	METAL FILM	300 OHM	0.5%	1/6W
R141	1453000004	METAL FILM	300 OHM	0.5%	1/6W
R142	1000332004	CARBON FILM	3.3K OHM	5%	1/6W
R143	1465109005	METAL FILM	51 OHM	1%	1/6W
R144	1000272002	CARBON FILM	2.7K OHM	5%	1/6W
R146	1000561009	CARBON FILM	560 OHM	5%	1/6W
R147	1000272002	CARBON FILM	2.7K OHM	5%	1/6W
R151	1000223009	CARBON FILM	22K OHM	5%	1/6W
R152	1466209005	METAL FILM	62 OHM	1%	1/6W
R153	1000151000	CARBON FILM	150 OHM	5%	1/6W

No.	LDR PT No.	DESCRIPTION			
(T-4480	CONT'D)				
R155	1000101005	CARBON FILM	100 OHM	5%	1/6W
R156	1000513008	CARBON FILM	51K OHM	5%	1/6W
R157	1000563003	CARBON FILM	56K OHM	5%	1/6W
R158	1000103009	CARBON FILM	10K OHM	5%	1/6W
R159	1000103009	CARBON FILM	10K OHM	5%	1/6W
R160	1000101005	CARBON FILM	100 OHM	5%	1/6W
R161	1000101005	CARBON FILM	100 OHM	5%	1/6W
R162	1466800001	METAL FILM	680 OHM	1%	1/6W
R163	1466800001	METAL FILM	680 OHM	1%	1/6W
R164	1000121001	CARBON FILM	120 OHM	5%	1/6W
R165	1000121001	CARBON FILM	120 OHM	5%	1/6W
R166	1000392002	CARBON FILM	3.9K OHM	5%	1/6W
R167	1000392002	CARBON FILM	3.9K OHM	5%	1/6W
R168	1000101005	CARBON FILM	100 OHM	5%	1/6W
R169	1000221005	CARBON FILM	220 OHM	5%	1/6W
R170	1000101005	CARBON FILM	100 OHM	5%	1/6W
R171	1000682001	CARBON FILM	6.8K OHM	5%	1/6W
R172	1000103009	CARBON FILM	10K OHM	5%	1/6W
R173	1000103009	CARBON FILM	10K OHM	5%	1/6W
R174	1000103009	CARBON FILM	10K OHM	5%	1/6W
R175	1000222007	CARBON FILM	2.2K OHM	5%	1/6W
R176	1464301001	METAL FILM	4.3K OHM	1%	1/6W
R177	1464301001	METAL FILM	4.3K OHM	1%	1/6W
R178	1000470006	CARBON FILM	47 OHM	5%	1/6W
R179	1000470006	CARBON FILM	47 OHM	5%	1/6W
R180	1000562001	CARBON FILM	5.6K OHM	5%	1/6W
R181	1000561009	CARBON FILM	560 OHM	5%	1/6W
R182	1000101005	CARBON FILM	100 OHM	5%	1/6W
R183	1000101005	CARBON FILM	100 OHM	5%	1/6W
R184	1467500005	METAL FILM	750 OHM	1%	1/6W
R185	1467500005	METAL FILM	750 OHM	1%	1/6W
R186	1000222007	CARBON FILM	2.2K OHM	5%	1/6W
R187	1000222007	CARBON FILM	2.2K OHM	5%	1/6W
R188	1010102004	CARBON FILM	1K OHM	5%	1/4W
R189	1010102004	CARBON FILM	1K OHM	5%	1/4W
R190	1020821003	CARBON FILM	820 OHM	5%	1/2W
R191	1020821003	CARBON FILM	820 OHM	5%	1/2W
R193	1461000009	METAL FILM	100 OHM	1%	1/6W
R194	1461000009	METAL FILM	100 OHM	1%	1/6W
R196	1000271000	CARBON FILM	270 OHM	5%	1/6W
R197	1000271000	CARBON FILM	270 OHM	5%	1/6W
R198	1000562001	CARBON FILM	5.6K OHM	5%	1/6W
R201	1000101005	CARBON FILM	100 OHM	5%	1/6W
R202	1000101005	CARBON FILM	100 OHM	5%	1/6W
R203	1463900007	METAL FILM	390 OHM	1%	1/6W
R204	1000330000	CARBON FILM	33 OHM	5%	1/6W
R205	1000392002	CARBON FILM	3.9K OHM	5%	1/6W
R206	1000392002	CARBON FILM	3.9K OHM	5%	1/6W
R207	1000220003	CARBON FILM	22 OHM	5%	1/6W
R208	1000220003	CARBON FILM	22 OHM	5%	1/6W
R209	1469100001	METAL FILM	910 OHM	1%	1/6W
R210	1000102007	CARBON FILM	1K OHM	5%	1/6W
R211	1000470006	CARBON FILM	47 OHM	5%	1/6W
R212	1000101005	CARBON FILM	100 OHM	5%	1/6W
R213	1466800001	METAL FILM	680 OHM	1%	1/6W
R214	1466201009	METAL FILM	6.2K OHM	1%	1/6W
R215	1000182001	CARBON FILM	1.8K OHM	5%	1/6W

No.	LDR PT No.	DESCRIPTION			
(T-4480	CONT'D)				
R216	1000101005	CARBON FILM	100 OHM	5%	1/6W
R217	1000101005	CARBON FILM	100 OHM	5%	1/6W
R218	1463900007	METAL FILM	390 OHM	1%	1/6W
R219	1000330000	CARBON FILM	33 OHM	5%	1/6W
R220	1000392002	CARBON FILM	3.9K OHM	5%	1/6W
R221	1000392002	CARBON FILM	3.9K OHM	5%	1/6W
R222	1000220003	CARBON FILM	22 OHM	5%	1/6W
R223	1000122003	CARBON FILM	1.2K OHM	5%	1/6W
R224	1469100001	METAL FILM	910 OHM	1%	1/6W
R225	1000682001	CARBON FILM	6.8K OHM	5%	1/6W
R226	1000470006	CARBON FILM	47 OHM	5%	1/6W
R227	1000562001	CARBON FILM	5.6K OHM	5%	1/6W
R228	1000103009	CARBON FILM	10K OHM	5%	1/6W
R229	1010471005	CARBON FILM	470 OHM	5%	1/4W
R230	1000104001	CARBON FILM	100K OHM	5%	1/6W
R231	1000103009	CARBON FILM	10K OHM	5%	1/6W
R232	1010471005	CARBON FILM	470 OHM	5%	1/4W
R233	1000104001	CARBON FILM	100K OHM	5%	1/6W
R234	1461001001	METAL FILM	1K OHM	1%	1/6W
R235	1462001007	METAL FILM	2K OHM	1%	1/6W
R236	1000392002	CARBON FILM	3.9K OHM	5%	1/6W
R237	1000273004	CARBON FILM	27K OHM	5%	1/6W
R238	1000470006	CARBON FILM	47 OHM	5%	1/6W
R239	1000222007	CARBON FILM	2.2K OHM	5%	1/6W
R240	1000152002	CARBON FILM	1.5K OHM	5%	1/6W
R241	1000470006	CARBON FILM	47 OHM	5%	1/6W
R242	1000472000	CARBON FILM	4.7K OHM	5%	1/6W
R243	1000822001	CARBON FILM	8.2K OHM	5%	1/6W
R244	1000821009	CARBON FILM	820 OHM	5%	1/6W
R245	1000332004	CARBON FILM	3.3K OHM	5%	1/6W
R246	1000332004	CARBON FILM	3.3K OHM	5%	1/6W
R247	1000222007	CARBON FILM	2.2K OHM	5%	1/6W
R248	1000332004	CARBON FILM	3.3K OHM	5%	1/6W
R249	1000103009	CARBON FILM	10K OHM	5%	1/6W
R250	1000121001	CARBON FILM	120 OHM	5%	1/6W
R251	1000103009	CARBON FILM	10K OHM	5%	1/6W
R252	1000103009	CARBON FILM	10K OHM	5%	1/6W
R253	1000103009	CARBON FILM	10K OHM	5%	1/6W
R254	1000562001	CARBON FILM	5.6K OHM	5%	1/6W
R255	1000562001	CARBON FILM	5.6K OHM	5%	1/6W
R256	1000223009	CARBON FILM	22K OHM	5%	1/6W
R257	1000103009	CARBON FILM	10K OHM	5%	1/6W
R258	1000472000	CARBON FILM	4.7K OHM	5%	1/6W
R259	1000561009	CARBON FILM	560 OHM	5%	1/6W
R303	1458003000	METAL FILM	800K OHM	0.5%	1/6W
R304	1452503013	METAL FILM	250K OHM	0.5%	1/6W
R305	1461004007	METAL FILM	1M OHM	1%	1/6W
R306	1464703001	METAL FILM	470K OHM	1%	1/6W
R307	1000392002	CARBON FILM	3.9K OHM	5%	1/6W
R308	1000272002	CARBON FILM	2.7K OHM	5%	1/6W
R309	1000681009	CARBON FILM	680 OHM	5%	1/6W
R310	1461101005	METAL FILM	1.1K OHM	1%	1/6W
R311	1000272002	CARBON FILM	2.7K OHM	5%	1/6W
R312	1000222007	CARBON FILM	2.2K OHM	5%	1/6W
R313	1000271000	CARBON FILM	270 OHM	5%	1/6W
R314	1000122003	CARBON FILM	1.2K OHM	5%	1/6W
R315	1000223009	CARBON FILM	22K OHM	5%	1/6W

No.	LDR PT No.	DESCRIPTION			
(T-4480	CONT'D)				
R316	1000102007	CARBON FILM	1K OHM	5%	1/6W
R317	1000103009	CARBON FILM	10K OHM	5%	1/6W
R318	1000221005	CARBON FILM	220 OHM	5%	1/6W
R319	1462400001	METAL FILM	240 OHM	1%	1/6W
R320	1000272002	CARBON FILM	2.7K OHM	5%	1/6W
R321	1000473002	CARBON FILM	47K OHM	5%	1/6W
R401	1000102007	CARBON FILM	1K OHM	5%	1/6W
R402	1000155008	CARBON FILM	1.5M OHM	5%	1/6W
R403	1000104001	CARBON FILM	100K OHM	5%	1/6W
R404	1000333006	CARBON FILM	33K OHM	5%	1/6W
R405	1000104001	CARBON FILM	100K OHM	5%	1/6W
R406	1000472000	CARBON FILM	4.7K OHM	5%	1/6W
R407	1000103009	CARBON FILM	10K OHM	5%	1/6W
R408	1010101002	CARBON FILM	100 OHM	5%	1/4W
R409	1000100003	CARBON FILM	10 OHM	5%	1/6W
R410	1000100003	CARBON FILM	10 OHM	5%	1/6W
R411	1000333006	CARBON FILM	33K OHM	5%	1/6W
R412	1000221005	CARBON FILM	220 OHM	5%	1/6W
R451	1000472000	CARBON FILM	4.7K OHM	5%	1/6W
R452	1000683003	CARBON FILM	68K OHM	5%	1/6W
R453	1465101009	METAL FILM	5.1K OHM	1%	1/6W
R454	1461002003	METAL FILM	10K OHM	1%	1/6W
R455	1000472000	CARBON FILM	4.7K OHM	5%	1/6W
R456	1000224001	CARBON FILM	220K OHM	5%	1/6W
R457	1000472000	CARBON FILM	4.7K OHM	5%	1/6W
R458	1000101005	CARBON FILM	100 OHM	5%	1/6W
R459	1010101002	CARBON FILM	100 OHM	5%	1/4W
R460	1000101005	CARBON FILM	100 OHM	5%	1/6W
R461	1000100003	CARBON FILM	10 OHM	5%	1/6W
R462	1000100003	CARBON FILM	10 OHM	5%	1/6W
R463	1461502003	METAL FILM	15K OHM	1%	1/6W
R464	1463602009	METAL FILM	36K OHM	1%	1/6W
R466	1010122000	CARBON FILM	1.2K OHM	5%	1/4W
R501	1466801003	METAL FILM	6.8K OHM	1%	1/6W
R502	1466801003	METAL FILM	6.8K OHM	1%	1/6W
R503	1000153004	CARBON FILM	15K OHM	5%	1/6W
R504	1461001001	METAL FILM	1K OHM	1%	1/6W
R505	1000153004	CARBON FILM	15K OHM	5%	1/6W
R506	1000101005	CARBON FILM	100 OHM	5%	1/6W
R507	1000272002	CARBON FILM	2.7K OHM	5%	1/6W
R508	1000392002	CARBON FILM	3.9K OHM	5%	1/6W
R509	1000152002	CARBON FILM	1.5K OHM	5%	1/6W
R510	1000101005	CARBON FILM	100 OHM	5%	1/6W
R511	1000182001	CARBON FILM	1.8K OHM	5%	1/6W
R512	1000272002	CARBON FILM	2.7K OHM	5%	1/6W
R513	1000272002	CARBON FILM	2.7K OHM	5%	1/6W
R514	1000152002	CARBON FILM	1.5K OHM	5%	1/6W
R515	1000153004	CARBON FILM	15K OHM	5%	1/6W
R516	1020223003	CARBON FILM	22K OHM	5%	1/2W
R517	1020223003	CARBON FILM	22K OHM	5%	1/2W
R518	1000821009	CARBON FILM	820 OHM	5%	1/6W
R519	1000152002	CARBON FILM	1.5K OHM	5%	1/6W
R520	1462001007	METAL FILM	2K OHM	1%	1/6W
R521	1461000009	METAL FILM	100 OHM	1%	1/6W
R522	1000221005	CARBON FILM	220 OHM	5%	1/6W
R523	1020273008	CARBON FILM	27K OHM	5%	1/2W
R524	1020273008	CARBON FILM	27K OHM	5%	1/2W

No.	LDR PT No.	DESCRIPTION				
(T-4480	CONT'D)					
R525	1000152002	CARBON FILM	1.5K OHM	5%		1/6W
R526	1462201005	METAL FILM	2.2K OHM	1%		1/6W
R527	1462201005	METAL FILM	2.2K OHM	1%		1/6W
R528	1000392002	CARBON FILM	3.9K OHM	5%		1/6W
R529	1000392002	CARBON FILM	3.9K OHM	5%		1/6W
R530	1000274006	CARBON FILM	270K OHM	5%		1/6W
R531	1000123005	CARBON FILM	12K OHM	5%		1/6W
R532	1469100001	METAL FILM	910 OHM	1%		1/6W
R533	1590273007	METAL FILM	27K OHM	5%		2W
R534	1000470006	CARBON FILM	47 OHM	5%		1/6W
R535	1000472000	CARBON FILM	4.7K OHM	5%		1/6W
R536	1000121001	CARBON FILM	120 OHM	5%		1/6W
R537	1000470006	CARBON FILM	47 OHM	5%		1/6W
R538	1590273007	METAL FILM	27K OHM	5%		2W
R539	1000274006	CARBON FILM	270K OHM	5%		1/6W
R540	1000123005	CARBON FILM	12K OHM	5%		1/6W
R541	1469100001	METAL FILM	910 OHM	1%		1/6W
R542	1000101005	CARBON FILM	100 OHM	5%		1/6W
R543	1000101005	CARBON FILM	100 OHM	5%		1/6W
R544	1000822001	CARBON FILM	8.2K OHM	5%		1/6W
R545	1000470006	CARBON FILM	47 OHM	5%		1/6W
R546	1000470006	CARBON FILM	47 OHM	5%		1/6W
R547	1000151000	CARBON FILM	150 OHM	5%		1/6W
R548	1000151000	CARBON FILM	150 OHM	5%		1/6W
R549	1010101002	CARBON FILM	100 OHM	5%		1/4W
R550	1463001003	METAL FILM	3K OHM	1%		1/6W
R551	1468209007	METAL FILM	82 OHM	1%		1/6W
R552	1000221005	CARBON FILM	220 OHM	5%		1/6W
R553	1000470006	CARBON FILM	47 OHM	5%		1/6W
R554	1000100003	CARBON FILM	10 OHM	5%		1/6W
R555	1000100003	CARBON FILM	10 OHM	5%		1/6W
RA201	1511103112	RESISTOR ARRAY	10K OHM X5	5%		1/8W
RA401	1412013009	RESISTOR ARRAY	RN3QDT			
RA402	1412013009	RESISTOR ARRAY	RN3QDT			
RA403	1515472117	RESISTOR ARRAY	4.7K OHM X9	5%		1/8W

-VARIABLE RESISTORS-

VR1	1711004097	METAL GLAZE	50K OHM	20%		1/3W
VR2	1711004042	METAL GLAZE	1K OHM	20%		1/3W
VR3	1711004006	METAL GLAZE	100 OHM	20%		1/3W
VR51	1711004015	METAL GLAZE	200 OHM	20%		1/3W
VR52	1711004006	METAL GLAZE	100 OHM	20%		1/3W
VR101	1711004097	METAL GLAZE	50K OHM	20%		1/3W
VR102	1711004042	METAL GLAZE	1K OHM	20%		1/3W
VR103	1711004006	METAL GLAZE	100 OHM	20%		1/3W
VR151	1711004015	METAL GLAZE	200 OHM	20%		1/3W
VR152	1711004006	METAL GLAZE	100 OHM	20%		1/3W
VR153	1711004097	METAL GLAZE	50K OHM	20%		1/3W
VR154	1711004015	METAL GLAZE	200 OHM	20%		1/3W
VR155	1711004024	METAL GLAZE	300 OHM	20%		1/3W
VR201	1711004051	METAL GLAZE	2K OHM	20%		1/3W
VR202	1711004051	METAL GLAZE	2K OHM	20%		1/3W
VR301	1711004079	METAL GLAZE	10K OHM	20%		1/3W
VR302	1711004042	METAL GLAZE	1K OHM	20%		1/3W
VR401	1910077003	VR-482	20K/100K OHM (w/SW)			"HOLD OFF"
VR451	1711004152	METAL GLAZE	30K OHM	20%		1/3W
VR501	1711004088	METAL GLAZE	20K OHM	20%		1/3W

No.	LDR PT No.	DESCRIPTION				
(T-4480	CONT'D)					
VR502	1711004051	METAL GLAZE	2K OHM	20%		1/3W
VR503	1711004088	METAL GLAZE	20K OHM	20%		1/3W
VR504	1711004042	METAL GLAZE	1K OHM	20%		1/3W
VR505	1711004079	METAL GLAZE	10K OHM	20%		1/3W
VR506	1711004060	METAL GLAZE	3K OHM	20%		1/3W
VR507	1711004015	METAL GLAZE	200 OHM	20%		1/3W

-CAPACITORS-

C1	2120050005	MICA		5pF		500V
C2	2120330001	MICA		33pF	10%	500V
C4	2200331007	PLASTIC FILM		330pF	5%	100V
C5	2120050005	MICA		5pF		500V
C7	2120070001	MICA		7pF		500V
C8	2120100004	MICA		10pF	10%	500V
C9	2120180008	MICA		18pF	10%	500V
C10	2180103020	PLASTIC FILM		0.01uF	10%	630V
C11	2120330001	MICA		33pF	10%	500V
C12	2120030009	MICA		3pF		500V
C13	2010103014	CERAMIC		0.01uF		50V
C14	2230101047	ELECTROLYTIC		100uF	20%	16V
C15	2010103014	CERAMIC		0.01uF		50V
C16	2230101047	ELECTROLYTIC		100uF	20%	16V
C17	2010103014	CERAMIC		0.01uF		50V
C18	2230101047	ELECTROLYTIC		100uF	20%	16V
C19	2120270009	MICA		27pF	10%	500V
C20	2120390009	MICA		39pF	10%	500V
C21	2120050005	MICA		5pF		500V
C23	2120050005	MICA		5pF		500V
C51	2120390009	MICA		39pF	10%	500V
C52	2230470048	ELECTROLYTIC		47uF	20%	16V
C53	2230470048	ELECTROLYTIC		47uF	20%	16V
C54	2010103014	CERAMIC		0.01uF		50V
C101	2120050005	MICA		5pF		500V
C102	2120330001	MICA		33pF	10%	500V
C104	2200331007	PLASTIC FILM		330pF	5%	100V
C105	2120270009	MICA		27pF	10%	500V
C107	2120070001	MICA		7pF		500V
C108	2120100004	MICA		10pF	10%	500V
C109	2120180008	MICA		18pF	10%	500V
C110	2180103020	PLASTIC FILM		0.01uF	10%	630V
C111	2120330001	MICA		33pF	10%	500V
C112	2120030009	MICA		3pF		500V
C113	2010103014	CERAMIC		0.01uF		50V
C114	2230101047	ELECTROLYTIC		100uF	20%	16V
C115	2010103014	CERAMIC		0.01uF		50V
C116	2230101047	ELECTROLYTIC		100uF	20%	16V
C117	2010103014	CERAMIC		0.01uF		50V
C118	2230101047	ELECTROLYTIC		100uF	20%	16V
C119	2120220004	MICA		22pF	10%	500V
C120	2120270009	MICA		27pF	10%	500V
C121	2120030009	MICA		3pF		500V
C123	2120050005	MICA		5pF		500V
C151	2120330001	MICA		33pF	10%	500V
C152	2230470048	ELECTROLYTIC		47uF	20%	16V
C153	2230470048	ELECTROLYTIC		47uF	20%	16V
C154	2010103014	CERAMIC		0.01uF		50V
C155	2120180008	MICA		18pF	10%	500V

No.	LDR PT No.	DESCRIPTION			
(T-4480	CONT'D)				
C157	2010103014	CERAMIC	0.01uF		50V
C158	2010103014	CERAMIC	0.01uF		50V
C159	2010103014	CERAMIC	0.01uF		50V
C161	2010103014	CERAMIC	0.01uF		50V
C162	2230470048	ELECTROLYTIC	47uF	20%	16V
C164	2010103014	CERAMIC	0.01uF		50V
C165	2120220004	MICA	22pF	10%	500V
C201	2120120000	MICA	12pF	10%	500V
C202	2120120000	MICA	12pF	10%	500V
C203	2120030009	MICA	3pF		500V
C204	2010103014	CERAMIC	0.01uF		50V
C205	2090016006	CERAMIC	0.1uF		50V
C206	2120020006	MICA	2pF		500V
C207	2010103014	CERAMIC	0.01uF		50V
C208	2120470007	MICA	47pF	5%	500V
C209	2010103014	CERAMIC	0.01uF		50V
C210	2220101040	ELECTROLYTIC	100uF	20%	10V
C211	2110101009	MICA	100pF	10%	50V
C212	2010103014	CERAMIC	0.01uF		50V
C213	2120220004	MICA	22pF	10%	500V
C214	2010103014	CERAMIC	0.01uF		50V
C215	2230470048	ELECTROLYTIC	47uF	20%	16V
C216	2010103014	CERAMIC	0.01uF		50V
C217	2010103014	CERAMIC	0.01uF		50V
C218	2010103014	CERAMIC	0.01uF		50V
C301	2180103020	PLASTIC FILM	0.01uF	10%	630V
C302	2120070001	MICA	7pF		500V
C303	2120270009	MICA	27pF	10%	500V
C304	2140103013	PLASTIC FILM	0.01uF	10%	50V
C305	2220101040	ELECTROLYTIC	100uF	20%	10V
C306	2230470048	ELECTROLYTIC	47uF	20%	16V
C307	2240220042	ELECTROLYTIC	22uF	20%	25V
C308	2320022042	ELECTROLYTIC BP	1uF	20%	50V
C309	2010471004	CERAMIC	470pF	10%	50V
C310	2140222002	PLASTIC FILM	2200pF	10%	50V
C311	2010103014	CERAMIC	0.01uF		50V
C312	2120010003	MICA	1pF		500V
C313	2140273018	PLASTIC FILM	0.027uF	10%	50V
C314	2010103014	CERAMIC	0.01uF		50V
C315	2230470048	ELECTROLYTIC	47uF	20%	16V
C316	2010103014	CERAMIC	0.01uF		50V
C317	2120220004	MICA	22pF	10%	500V
C318	2010103014	CERAMIC	0.01uF		50V
C319	2120680008	MICA	68pF	10%	500V
C320	2010103014	CERAMIC	0.01uF		50V
C321	2120470007	MICA	47pF	5%	500V
C322	2120470007	MICA	47pF	5%	500V
C323	2220101040	ELECTROLYTIC	100uF	20%	10V
C401	2110101009	MICA	100pF	10%	50V
C402	2010471004	CERAMIC	470pF	10%	50V
C405	2220101040	ELECTROLYTIC	100uF	20%	10V
C406	2250229047	ELECTROLYTIC	2.2uF	20%	50V
C407	2090016006	CERAMIC	0.1uF		50V
C408	2120470007	MICA	47pF	5%	500V
C409	2010103014	CERAMIC	0.01uF		50V
C410	2010103014	CERAMIC	0.01uF		50V
C411	2220330045	ELECTROLYTIC	33uF	20%	10V

No.	LDR PT No.	DESCRIPTION			
(T-4480	CONT'D)				
C412	2250339044	ELECTROLYTIC	3.3uF	20%	50V
C413	2470338006	ELECTROLYTIC	0.33uF	20%	35V
C414	2140333010	PLASTIC FILM	0.033uF	10%	50V
C415	2140332018	PLASTIC FILM	3300pF	10%	50V
C416	2110121005	MICA	120pF	10%	50V
C417	2110820001	MICA	82pF	10%	50V
C418	2010103014	CERAMIC	0.01uF		50V
C419	2610105025	METAL FILM	1uF	5%	50V
C420	2140683017	PLASTIC FILM	0.068uF	10%	50V
C421	2192022001	PLASTIC FILM	1000pF	1%	100V
C422	2090016006	CERAMIC	0.1uF		50V
C423	2010103014	CERAMIC	0.01uF		50V
C424	2230470048	ELECTROLYTIC	47uF	20%	16V
C425	2230470048	ELECTROLYTIC	47uF	20%	16V
C426	2230470048	ELECTROLYTIC	47uF	20%	16V
C451	2120220004	MICA	22pF	10%	500V
C452	2010103014	CERAMIC	0.01uF		50V
C453	2120330001	MICA	33pF	10%	500V
C454	2010103014	CERAMIC	0.01uF		50V
C455	2010103014	CERAMIC	0.01uF		50V
C456	2010103014	CERAMIC	0.01uF		50V
C457	2090016006	CERAMIC	0.1uF		50V
C458	2090016006	CERAMIC	0.1uF		50V
C459	2010103014	CERAMIC	0.01uF		50V
C460	2010271006	CERAMIC	270pF	10%	50V
C461	2230470048	ELECTROLYTIC	47uF	20%	16V
C462	2230470048	ELECTROLYTIC	47uF	20%	16V
C463	2610105025	METAL FILM	1uF	5%	50V
C464	2140683017	PLASTIC FILM	0.068uF	10%	50V
C465	2192022001	PLASTIC FILM	1000pF	1%	100V
C466	2090016006	CERAMIC	0.1uF		50V
C467	2090016006	CERAMIC	0.1uF		50V
C468	2220101040	ELECTROLYTIC	100uF	20%	10V
C501	2230470048	ELECTROLYTIC	47uF	20%	16V
C502	2010103014	CERAMIC	0.01uF		50V
C503	2220101040	ELECTROLYTIC	100uF	20%	10V
C504	2010103014	CERAMIC	0.01uF		50V
C505	2220101040	ELECTROLYTIC	100uF	20%	10V
C506	2010103014	CERAMIC	0.01uF		50V
C507	2120270009	MICA	27pF	10%	500V
C508	2200271005	PLASTIC FILM	270pF	5%	100V
C509	2230470048	ELECTROLYTIC	47uF	20%	16V
C510	2230470048	ELECTROLYTIC	47uF	20%	16V
C511	2020472003	CERAMIC	4700pF		500V
C512	2120010003	MICA	1pF		500V
C513	2020103002	CERAMIC	0.01uF		500V
C514	2020103002	CERAMIC	0.01uF		500V
C515	2020472003	CERAMIC	4700pF		500V
C516	2120010003	MICA	1pF		500V
C517	2020103002	CERAMIC	0.01uF		500V
C518	2120100004	MICA	10pF	10%	500V
C519	2010103014	CERAMIC	0.01uF		50V
C520	2010103014	CERAMIC	0.01uF		50V
C521	2230101047	ELECTROLYTIC	100uF	20%	16V
C522	2010103014	CERAMIC	0.01uF		50V
C523	2020472003	CERAMIC	4700pF		500V
C524	2020472003	CERAMIC	4700pF		500V

No.	LDR PT No.	DESCRIPTION			
(T-4480	CONT'D)				
C525	2120100004	MICA	10pF	10%	500V
C526	2230470048	ELECTROLYTIC	47uF	20%	16V
C527	2230101047	ELECTROLYTIC	100uF	20%	16V
C528	2020103002	CERAMIC	0.01uF		500V
-VARIABLE CAPACITORS-					
VC1	2910018006	CERAMIC	2.8-10pF		250V
VC2	2910018006	CERAMIC	2.8-10pF		250V
VC3	2910020003	CERAMIC	2.5-22pF		250V
VC4	2910027007	CERAMIC	1.5-5.5pF		250V
VC5	2910018006	CERAMIC	2.8-10pF		250V
VC6	2910020003	CERAMIC	2.5-22pF		250V
VC7	2910018006	CERAMIC	2.8-10pF		250V
VC8	2910018006	CERAMIC	2.8-10pF		250V
VC9	2910029001	CERAMIC	2-8pF		250V
VC51	2910022007	CERAMIC	4-40pF		250V
VC101	2910018006	CERAMIC	2.8-10pF		250V
VC102	2910018006	CERAMIC	2.8-10pF		250V
VC103	2910020003	CERAMIC	2.5-22pF		250V
VC104	2910027007	CERAMIC	1.5-5.5pF		250V
VC105	2910018006	CERAMIC	2.8-10pF		250V
VC106	2910020003	CERAMIC	2.5-22pF		250V
VC107	2910018006	CERAMIC	2.8-10pF		250V
VC108	2910018006	CERAMIC	2.8-10pF		250V
VC109	2910029001	CERAMIC	2-8pF		250V
VC151	2910022007	CERAMIC	4-40pF		250V
VC152	2910022007	CERAMIC	4-40pF		250V
VC153	2910018006	CERAMIC	2.8-10pF		250V
VC301	2910018006	CERAMIC	2.8-10pF		250V
VC302	2910018006	CERAMIC	2.8-10pF		250V
VC401	2910054000	CERAMIC	10-100pF		
VC451	2910054000	CERAMIC	10-100pF		
-TRANSISTORS-					
Q151	3031907004	NPN	2SC1907		
Q152	3031907004	NPN	2SC1907		
Q153	3010838010	PNP	2SA838B		
Q154	3010838010	PNP	2SA838B		
Q155	3031907004	NPN	2SC1907		
Q156	3010838010	PNP	2SA838B		
Q157	3010838010	PNP	2SA838B		
Q158	3031907004	NPN	2SC1907		
Q159	3031907004	NPN	2SC1907		
Q201	3031907004	NPN	2SC1907		
Q202	3031907004	NPN	2SC1907		
Q203	3010838010	PNP	2SA838B		
Q204	3031907004	NPN	2SC1907		
Q205	3030752005	NPN	2SC752(G)TM-0		
Q206	3031907004	NPN	2SC1907		
Q207	3031907004	NPN	2SC1907		
Q208	3010838010	PNP	2SA838B		
Q209	3030752005	NPN	2SC752(G)TM-0		
Q210	3010838010	PNP	2SA838B		
Q211	3031815009	NPN	2SC1815-0 or Y		
Q212	3031907004	NPN	2SC1907		
Q213	3031815009	NPN	2SC1815-0 or Y		
Q214	3011015003	PNP	2SA1015-0 or Y		

No.	LDR PT No.	DESCRIPTION		
(T-4480 CONT'D)				
Q215	3011015003	PNP		2SA1015-0 or Y
Q216	3090042006	NPN		BB1A4M
Q301	3090043008	PNP		BP1A4M
Q302	3090043008	PNP		BP1A4M
Q303	3090043008	PNP		BP1A4M
Q304	3031907004	NPN		2SC1907
Q401	3031907004	NPN		2SC1907
Q451	3030752005	NPN		2SC752(G)TM-0
Q501	3031815027	NPN		2SC1815-GR
Q502	3031815027	NPN		2SC1815-GR
Q503	3010838010	PNP		2SA838B
Q504	3010838010	PNP		2SA838B
Q505	3010838010	PNP		2SA838B
Q506	3010838010	PNP		2SA838B
Q507	3010838010	PNP		2SA838B
Q508	3010838010	PNP		2SA838B
Q509	3011540002	PNP		2SA1540-E or F
Q510	3033955007	NPN		2SC3955-E or F
Q511	3033955007	NPN		2SC3955-E or F
Q512	3011540002	PNP		2SA1540-E or F
-DIODES-				
D1	3120026007	ZENER		RD6.8EB 6.8V
D51	3110072007	DETECTOR	DUAL	MC931
D101	3120026007	ZENER		RD6.8EB 6.8V
D151	3110072007	DETECTOR	DUAL	MC931
D152	3110121004	DETECTOR	DUAL	1SS200
D153	3110121004	DETECTOR	DUAL	1SS200
D154	3110121004	DETECTOR	DUAL	1SS200
D155	3110121004	DETECTOR	DUAL	1SS200
D156	3110121004	DETECTOR	DUAL	1SS200
D157	3110121004	DETECTOR	DUAL	1SS200
D158	3110074001	DETECTOR	DUAL	MC921
D159	3110072007	DETECTOR	DUAL	MC931
D201	3110074001	DETECTOR	DUAL	MC921
D203	3110110009	DETECTOR		GMB01
D204	3120057008	ZENER		RD5.6EB 5.6V
D205	3110110009	DETECTOR		GMB01
D206	3110110009	DETECTOR		GMB01
D207	3110110009	DETECTOR		GMB01
D208	3110110009	DETECTOR		GMB01
D209	3110110009	DETECTOR		GMB01
D210	3110110009	DETECTOR		GMB01
D301	3110121004	DETECTOR	DUAL	1SS200
D302	3110121004	DETECTOR	DUAL	1SS200
D303	3110071005	SCHOTTKY		1SS97
D304	3120028001	ZENER		RD8.2EB 8.2V
D305	3110110009	DETECTOR		GMB01
D306	3110110009	DETECTOR		GMB01
D307	3110110009	DETECTOR		GMB01
D308	3120027009	ZENER		RD7.5EB 7.5V
D401	3110110009	DETECTOR		GMB01
D402	3110110009	DETECTOR		GMB01
D403	3110110009	DETECTOR		GMB01
D501	3110074001	DETECTOR	DUAL	MC921
D502	3110074001	DETECTOR	DUAL	MC921
D503	3120025005	ZENER		RD6.2EB 6.2V

No.	LDR PT No.	DESCRIPTION		
(T-4480 D504	CONT'D 3120024003	ZENER	RD5.1EB	5.1V
-INTEGRATED CIRCUITS-				
IC201	3420139994	HS CMOS	74HC139	
IC202	3420000003	CMOS	TC74HC00P	
IC203	3420000003	CMOS	TC74HC00P	
IC204	3420161016	HS CMOS	HD74HC161P	
IC205	3260123001	TTL	HD74LS123P	
IC206	3420000003	CMOS	TC74HC00P	
IC301	3290000006	TTL	74F00 PC	
IC401	3290000006	TTL	74F00 PC	
IC402	3290074005	TTL	74F74 PC	
IC403	3260123001	TTL	HD74LS123P	
IC404	3420000003	CMOS	TC74HC00P	
IC405	3290074005	TTL	74F74 PC	
IC406	3290002000	TTL	74F02 PC	
IC407	3210361002	COMPARATOR	LM361 N	
IC408	3420000003	CMOS	TC74HC00P	
IC409	3420074002	CMOS	TC74HC74P	
IC410	3420002997	HS CMOS	74HC02	
IC411	3420002997	HS CMOS	74HC02	
IC501	3310052007	CMOS	TC4052BP	
-COILS-				
L1	3930109039	COIL	1uH	20%
L101	3930109039	COIL	1uH	20%
-SWITCHES-				
S1	4000583015	ATTENUATOR	Q-583A	"CH-1 VOLTS/DIV"
S101	4000583015	ATTENUATOR	Q-583A	"CH-2 VOLTS/DIV"
S401	4000598009	ROTARY	SRR6M	"TIME/DIV"
-PC BOARD-				
	5904480047		T-4480D-R.P.P	
-MISCELLANEOUS-				
K1	4080065000	RELAY	DS2-ES-D12V	AG232344
TH501	3550002006	THERMISTOR	D-22A	
TH502	3550002006	THERMISTOR	D-22A	

*** POWER & V. FINAL BOARD

T-4481 ***

-RESISTORS-

R1	1462000005	METAL FILM	200 OHM	1%	1/6W
R2	1000101005	CARBON FILM	100 OHM	5%	1/6W
R3	1000101005	CARBON FILM	100 OHM	5%	1/6W
R4	1000182001	CARBON FILM	1.8K OHM	5%	1/6W
R5	1464300009	METAL FILM	430 OHM	1%	1/6W
R6	1000222007	CARBON FILM	2.2K OHM	5%	1/6W
R7	1000222007	CARBON FILM	2.2K OHM	5%	1/6W
R8	1000220003	CARBON FILM	22 OHM	5%	1/6W
R9	1000220003	CARBON FILM	22 OHM	5%	1/6W
R10	1000101005	CARBON FILM	100 OHM	5%	1/6W
R11	1000101005	CARBON FILM	100 OHM	5%	1/6W
R12	1000272002	CARBON FILM	2.7K OHM	5%	1/6W

No.	LDR PT No.	DESCRIPTION				
(T-4481	CONT'D)					
R13	1000122003	CARBON FILM	1.2K OHM	5%	1/6W	
R14	1467500005	METAL FILM	750 OHM	1%	1/6W	
R15	1467500005	METAL FILM	750 OHM	1%	1/6W	
R16	1000470006	CARBON FILM	47 OHM	5%	1/6W	
R17	1000470006	CARBON FILM	47 OHM	5%	1/6W	
R18	1000102007	CARBON FILM	1K OHM	5%	1/6W	
R19	1000102007	CARBON FILM	1K OHM	5%	1/6W	
R20	1000820007	CARBON FILM	82 OHM	5%	1/6W	
R21	1000820007	CARBON FILM	82 OHM	5%	1/6W	
R22	1000680007	CARBON FILM	68 OHM	5%	1/6W	
R23	1331800002	METAL FILM	180 OHM	1%	1/2W	
R24	1331800002	METAL FILM	180 OHM	1%	1/2W	
R25	1332700004	METAL FILM	270 OHM	1%	1/2W	
R26	1332700004	METAL FILM	270 OHM	1%	1/2W	
R27	1332400002	METAL FILM	240 OHM	1%	1/2W	
R28	1332400002	METAL FILM	240 OHM	1%	1/2W	
R29	1000150008	CARBON FILM	15 OHM	5%	1/6W	
R30	1000150008	CARBON FILM	15 OHM	5%	1/6W	
R31	1000220003	CARBON FILM	22 OHM	5%	1/6W	
R32	1000220003	CARBON FILM	22 OHM	5%	1/6W	
R33	1610331007	METAL OXIDE	330 OHM	5%	5W	
R34	1610331007	METAL OXIDE	330 OHM	5%	5W	
R35	1610331007	METAL OXIDE	330 OHM	5%	5W	
R36	1610331007	METAL OXIDE	330 OHM	5%	5W	
R37	1000822001	CARBON FILM	8.2K OHM	5%	1/6W	
R38	1000822001	CARBON FILM	8.2K OHM	5%	1/6W	
R39	1000124007	CARBON FILM	120K OHM	5%	1/6W	
R40	1000222007	CARBON FILM	2.2K OHM	5%	1/6W	
R101	1000104001	CARBON FILM	100K OHM	5%	1/6W	
R102	1000223009	CARBON FILM	22K OHM	5%	1/6W	
R103	1000472000	CARBON FILM	4.7K OHM	5%	1/6W	
R104	1000393004	CARBON FILM	39K OHM	5%	1/6W	
R105	1000472000	CARBON FILM	4.7K OHM	5%	1/6W	
R106	1010101002	CARBON FILM	100 OHM	5%	1/4W	
R107	1000472000	CARBON FILM	4.7K OHM	5%	1/6W	
R108	1000562001	CARBON FILM	5.6K OHM	5%	1/6W	
R109	1000470006	CARBON FILM	47 OHM	5%	1/6W	
R110	1000392002	CARBON FILM	3.9K OHM	5%	1/6W	
R111	1000392002	CARBON FILM	3.9K OHM	5%	1/6W	
R112	1000152002	CARBON FILM	1.5K OHM	5%	1/6W	
R113	1000273004	CARBON FILM	27K OHM	5%	1/6W	
R114	1000470006	CARBON FILM	47 OHM	5%	1/6W	
R115	1000182001	CARBON FILM	1.8K OHM	5%	1/6W	
R116	1000103009	CARBON FILM	10K OHM	5%	1/6W	
R117	1000272002	CARBON FILM	2.7K OHM	5%	1/6W	
R118	1590362006	METAL FILM	3.6K OHM	1%	2W	
R119	1000272002	CARBON FILM	2.7K OHM	5%	1/6W	
R120	1000273004	CARBON FILM	27K OHM	5%	1/6W	
R121	1000184005	CARBON FILM	180K OHM	5%	1/6W	
R122	1020273008	CARBON FILM	27K OHM	5%	1/2W	
R123	1000223009	CARBON FILM	22K OHM	5%	1/6W	
R124	1000272002	CARBON FILM	2.7K OHM	5%	1/6W	
R125	1010221002	CARBON FILM	220 OHM	5%	1/4W	
R126	1000103009	CARBON FILM	10K OHM	5%	1/6W	
R127	1000273004	CARBON FILM	27K OHM	5%	1/6W	
R201	1020229005	CARBON FILM	2.2 OHM	5%	1/2W	
R202	1000221005	CARBON FILM	220 OHM	5%	1/6W	

No.	LDR PT No.	DESCRIPTION				
(T-4481	CONT'D)					
R203	1000220003	CARBON FILM	22 OHM	5%		1/6W
R205	1000272002	CARBON FILM	2.7K OHM	5%		1/6W
R206	1000224001	CARBON FILM	220K OHM	5%		1/6W
R207	1000102007	CARBON FILM	1K OHM	5%		1/6W
R208	1000101005	CARBON FILM	100 OHM	5%		1/6W
R209	1465602001	METAL FILM	56K OHM	1%		1/6W
R210	1465901009	METAL FILM	5.6K OHM	1%		1/6W
R211	1464301001	METAL FILM	4.3K OHM	1%		1/6W
R212	1000334008	CARBON FILM	330K OHM	5%		1/6W
R213	1020473006	CARBON FILM	47K OHM	5%		1/2W
R214	1000563003	CARBON FILM	56K OHM	5%		1/6W
R215	1020106009	CARBON FILM	10M OHM	5%		1/6W
R216	1190007004	METAL GLAZE	22M OHM	5%		1W
R217	1130565006	METAL FILM	5.6M OHM	10%		1/2W
R218	1190008006	METAL GLAZE	10M OHM	5%		1W
R219	1020106009	CARBON FILM	10M OHM	5%		1/6W
R220	1000101005	CARBON FILM	100 OHM	5%		1/6W
R221	1020106009	CARBON FILM	10M OHM	5%		1/6W
R222	1010184002	CARBON FILM	180K OHM	5%		1/4W
R223	1010184002	CARBON FILM	180K OHM	5%		1/4W
R224	1010124105	CARBON FILM	120K OHM	5%		1/6W
R301	1020823007	CARBON FILM	82K OHM	5%		1/2W
R302	1000152002	CARBON FILM	1.5K OHM	5%		1/6W
R303	1580183009	METAL FILM	18K OHM	5%		1W
R304	1467502009	METAL FILM	75K OHM	1%		1/6W
R305	1311202008	METAL FILM	12K OHM	1%		1/4W
R306	1010104008	CARBON FILM	100K OHM	5%		1/4W
R307	1010683000	CARBON FILM	68K OHM	5%		1/4W
R308	1010683000	CARBON FILM	68K OHM	5%		1/4W
R309	1000153004	CARBON FILM	15K OHM	5%		1/6W
R310	1590270001	METAL FILM	27 OHM	5%		2W

-VARIABLE RESISTORS-

VR2	1711004015	METAL GLAZE	200 OHM	20%		1/3W
VR201	1711004079	METAL GLAZE	10K OHM	20%		1/3W
VR202	1711004107	METAL GLAZE	100K OHM	20%		1/3W
VR203	1712020000	METAL GLAZE	1.5M OHM	20%		1/3W
VR204	1711004134	METAL GLAZE	200K OHM	20%		1/3W

-CAPACITORS-

C1	2120030009	MICA	3pF			500V
C3	2120070001	MICA	7pF			500V
C5	2110470000	MICA	47pF	10%		50V
C6	2120220004	MICA	22pF	10%		500V
C7	2120270009	MICA	27pF	10%		500V
C8	2010103014	CERAMIC	0.01uF			50V
C9	2010103014	CERAMIC	0.01uF			50V
C10	2010103014	CERAMIC	0.01uF			50V
C11	2020103002	CERAMIC	0.01uF			500V
C12	2010103014	CERAMIC	0.01uF			50V
C13	2230470048	ELECTROLYTIC	47uF	20%		16V
C14	2230470048	ELECTROLYTIC	47uF	20%		16V
C15	2010103014	CERAMIC	0.01uF			50V
C16	2010103014	CERAMIC	0.01uF			50V
C17	2010103014	CERAMIC	0.01uF			50V
C18	2020472003	CERAMIC	4700pF			500V
C101	2120100004	MICA	10pF	10%		500V

No.	LDR PT No.	DESCRIPTION			
(T-4481	CONT'D)				
C102	2020103002	CERAMIC	0.01uF		500V
C103	2195008005	COMPOSITION	12pF	10%	500V
C104	2020103002	CERAMIC	0.01uF		500V
C105	2020103002	CERAMIC	0.01uF		500V
C106	2010103014	CERAMIC	0.01uF		50V
C107	2230470048	ELECTROLYTIC	47uF	20%	16V
C108	2010103014	CERAMIC	0.01uF		50V
C109	2010103014	CERAMIC	0.01uF		50V
C110	2110101009	MICA	100pF	10%	50V
C111	2110101009	MICA	100pF	10%	50V
C112	2230100045	ELECTROLYTIC	10uF	20%	16V
C113	2010103014	CERAMIC	0.01uF		50V
C201	2240470045	ELECTROLYTIC	47uF	20%	25V
C202	2140104015	PLASTIC FILM	0.1uF	10%	50V
C203	2140104015	PLASTIC FILM	0.1uF	10%	50V
C204	2010103014	CERAMIC	0.01uF		50V
C205	2230470048	ELECTROLYTIC	47uF	20%	16V
C206	2090013000	CERAMIC	4700pF		3KV
C207	2020102000	CERAMIC	1000pF		500V
C208	2090013000	CERAMIC	4700pF		3KV
C209	2090013000	CERAMIC	4700pF		3KV
C210	2090013000	CERAMIC	4700pF		3KV
C211	2090013000	CERAMIC	4700pF		3KV
C212	2020472003	CERAMIC	4700pF		500V
C213	2090005010	CERAMIC	470pF	10%	3KV
C214	2090013000	CERAMIC	4700pF		3KV
C215	2010103014	CERAMIC	0.01uF		50V
C216	2010103014	CERAMIC	0.01uF		50V
C301	2280470043	ELECTROLYTIC	47uF	20%	250V
C302	2020102000	CERAMIC	1000pF		500V
C303	2280109002	ELECTROLYTIC	1uF	20%	250V
C304	2270470046	ELECTROLYTIC	47uF	20%	160V
C305	2270470046	ELECTROLYTIC	47uF	20%	160V
C306	2240222046	ELECTROLYTIC	2200uF	20%	25V
C307	2240100042	ELECTROLYTIC	10uF	20%	25V
C308	2344479009	ELECTROLYTIC	4.7uF	20%	25V
C309	2240100042	ELECTROLYTIC	10uF	20%	25V
C310	2230470048	ELECTROLYTIC	47uF	20%	16V
C311	2240222046	ELECTROLYTIC	2200uF	20%	25V
C312	2240100042	ELECTROLYTIC	10uF	20%	25V
C313	2230470048	ELECTROLYTIC	47uF	20%	16V
C314	2140153018	PLASTIC FILM	0.015uF	10%	50V
-VARIABLE CAPACITOR-					
VC2	2910020003	CERAMIC	2.5-22pF		250V
-TRANSISTORS-					
Q1	3031907004	NPN	2SC1907		
Q2	3031907004	NPN	2SC1907		
Q3	3031907004	NPN	2SC1907		
Q4	3031907004	NPN	2SC1907		
Q5	3031907004	NPN	2SC1907		
Q6	3031907004	NPN	2SC1907		
Q7	3032851009	NPN	2SC2851		
Q8	3032851009	NPN	2SC2851		
Q9	3033598009	NPN CHIP	2SC3598-D	or E	
Q10	3033598009	NPN CHIP	2SC3598-D	or E	

No.	LDR PT No.	DESCRIPTION		
(T-4481 CONT'D)				
Q101	3031907004	NPN	2SC1907	
Q102	3031815009	NPN	2SC1815-0	or Y
Q103	3010838010	PNP	2SA838B	
Q104	3031907004	NPN	2SC1907	
Q105	3011540002	PNP	2SA1540-E	or F
Q106	3033955007	NPN	2SC3955-E	or F
Q201	3033691009	NPN	2SC3691-L	or K
Q202	3011015003	PNP	2SA1015-U	or Y
Q203	3031815009	NPN	2SC1815-0	or Y
Q204	3011015003	PNP	2SA1015-0	or Y
Q205	3011091009	PNP	2SA1091-R	
Q206	3011091009	PNP	2SA1091-R	
Q301	3033478009	NPN	2SC3478K	or U
Q302	3033478009	NPN	2SC3478K	or U
Q303	3041263003	NPN	2SD1263-Q	
-DIODES-				
D1	3140025009	VARICAP	BB329A	
D2	3140025009	VARICAP	BB329A	
D101	3110110009	DETECTOR	GMB01	
D102	3110110009	DETECTOR	GMB01	
D103	3110110009	DETECTOR	GMB01	
D104	3110110009	DETECTOR	GMB01	
D105	3110121004	DETECTOR DUAL	1SS200	
D106	3110121004	DETECTOR DUAL	1SS200	
D107	3110121004	DETECTOR DUAL	1SS200	
D108	3120060007	ZENER	RD24EB	24V
D109	3120060007	ZENER	RD24EB	24V
D201	3110110009	DETECTOR	GMB01	
D202	3110072007	DETECTOR DUAL	MC931	
D203	3110106008	RECTIFIER	DHG3FG80	8KV
D204	3110106008	RECTIFIER	DHG3FG80	8KV
D205	3110059005	DETECTOR	1SS83	
D206	3110059005	DETECTOR	1SS83	
D207	3110059005	DETECTOR	1SS83	
D208	3110059005	DETECTOR	1SS83	
D301	3110113005	BRIDGE RECTIFIER	1J4B1	
D302	3120024003	ZENER	RD5.1EB	5.1V
D303	3110113005	BRIDGE RECTIFIER	1J4B1	
D304	3110111001	BRIDGE RECTIFIER	1D4B1	
D305	3110019003	RECTIFIER	1DZ61	
D306	3110019003	RECTIFIER	1DZ61	
-INTEGRATED CIRCUITS-				
IC101	3260123001	TTL	HD74LS123P	
IC301	3217812056	REGULATOR	NJM7812A	+12V
IC302	3217805059	REGULATOR	NJM7805A	+5V
IC303	3217912041	REGULATOR	AN7912	-12V
-TUBES-				
V201	4360027002	NEON BULB	NE-38B	
V202	4360027002	NEON BULB	NE-38B	

No.	LDR PT No.	DESCRIPTION
(T-4481 CONT'D)		
-TRANSFORMER-		
T201	3800529014	HV TRANSFORMER J-529A
-FUSE-		
F201	4363150009	NORMAL BLOW BEQ 500mA
-PC BOARD-		
	5904481049	T-4481D-R.P.P
-MISCELLANEOUS-		
TH1	3550027002	THERMISTOR SDT1000
	4371008001	FUSE CLIP S-N5053

*** SWITCH BOARD

T-4482 ***

-RESISTORS-

R4	1010150005	CARBON FILM	15 OHM	5%	1/4W
R5	1010150005	CARBON FILM	15 OHM	5%	1/4W

-VARIABLE RESISTOR-

VR1	1811924006	VR-493	20K/20K OHM	"CH-3 POSITION"
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-CAPACITORS-

C1	2180223066	PLASTIC FILM	0.022uF	10%	630V
C2	2180223066	PLASTIC FILM	0.022uF	10%	630V
C3	2090016006	CERAMIC	0.1uF		50V
C4	2010103014	CERAMIC	0.01uF		50V
C5	2320062044	ELECTROLYTIC	4.7uF	20%	16V BP
C6	2010103014	CERAMIC	0.01uF		50V

-SWITCHES-

S1	4040028006	LEVER	SLLE62	"CH-1 AC-GND-DC"
S2	4040028006	LEVER	SLLE62	"CH-2 AC-GND-DC"
S3	4030089009	SLIDE	FS-2600-201	"V MODE"
S4	4030089009	SLIDE	FS-2600-201	"TRIG SOURCE"
S5	4030089009	SLIDE	FS-2600-201	"TRIG COUPLING"
S6	4030086003	SLIDE	BS-2300-23	"TRIG SLOPE/TV POL"

-PC BOARD-

5904482032	T-4482C-R.P
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*** H.DISPLAY BOARD

T-4485 ***

-SWITCH-

S1	4000536016	PUSH	Q-536A	"HORIZ DISPLAY"
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-PC BOARD-

5904485029	T-4485B-R.P(4483)
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No.	LDR PT No.	DESCRIPTION				
*** CRT SOCKET BOARD			T-4484 ***			
-RESISTORS-						
R1	1000391000	CARBON FILM	390 OHM	5%	1/6W	
R2	1000391000	CARBON FILM	390 OHM	5%	1/6W	
R3	1020104005	CARBON FILM	100K OHM	5%	1/2W	
-CAPACITORS-						
C1	2020103002	CERAMIC	0.01uF		500V	
C2	2020103002	CERAMIC	0.01uF		500V	
-COILS-						
L1	3930688031	CHOKER COIL	0.68uH			
L2	3930688031	CHOKER COIL	0.68uH			
-PC BOARD-						
	5904484009				T-4484-R.P	
-MISCELLANEOUS-						
	4320018003	CRT SOCKET			NO.1339	
*** INTEN & FOCUS BOARD			T-4231 ***			
-RESISTORS-						
R1	1000512006	CARBON FILM	5.1K OHM	5%	1/6W	
R2	1000561009	CARBON FILM	560 OHM	5%	1/6W	
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%	1/6W	
R6	1000105003	CARBON FILM	1M OHM	5%	1/6W	
R7	1466202001	METAL FILM	62K OHM	1%	1/6W	
R8	1000562001	CARBON FILM	5.6K OHM	5%	1/6W	
R9	1000391000	CARBON FILM	390 OHM	5%	1/6W	
-VARIABLE RESISTORS-						
VR1	1811921000	VR-483	5K OHM		"INTEN"	
VR2	1811921000	VR-483	5K OHM		"FOCUS"	
VR3	1719014007	CARBON FILM	10K OHM	25%	1/2W	"ROTATION"
VR4	1711004033	METAL GLAZE	500 OHM	20%	1/3W	
-CAPACITORS-						
C1	2010103014	CERAMIC	0.01uF		50V	
C2	2240470045	ELECTROLYTIC	47uF	20%	25V	
C3	2140682006	PLASTIC FILM	6800pF	5%	50V	
C4	2140102011	PLASTIC FILM	1000pF	10%	50V	
C5	2010103014	CERAMIC	0.01uF		50V	
C6	2010271006	CERAMIC	270pF	10%	50V	
-DIODES-						
D1	3110110009	DETECTOR	GMB01			
D2	3130063000	LED	TLG164			

No. LDR PT No. DESCRIPTION

(T-4231 CONT'D)

-INTEGRATED CIRCUIT-
 ICI 3420004001 CMOS TC74HC04P

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

-FC BOARD-
 5904231037 T-4231C-R.P

-MISCELLANEOUS-
 4360039009 LAMP 5V 115mA
 4360039009 LAMP 5V 115mA
 4360039009 LAMP 5V 115mA

*** CH1 POSITION BOARD

T-4639 ***

-VARIABLE RESISTOR-
 VR1 1815026008 VR-479 5K OHM(GANG) "CH-1 POSITION"

-SWITCH-
 S2 4000596005 PUSH Q-596 SPUJ-10 "TRIPLE(CH-3)"

-PC BOARD-
 5904639011 T-4639A-R.P (4483)

*** CH2 POSITION BOARD

T-4639 ***

-VARIABLE RESISTOR-
 VR2 1910076001 VR-480 5K OHM(w/SW) "CH-2 POSITION"

-PC BOARD-
 5904640007 T-4640-R.P(4483)

*** H CONTROL BOARD

T-4641 ***

-RESISTORS-
 R1 1000472000 CARBON FILM 4.7K OHM 5% 1/6W
 R2 1463302007 METAL FILM 33K OHM 1% 1/6W
 R3 1000103009 CARBON FILM 10K OHM 5% 1/6W

-VARIABLE RESISTORS-
 VR5 1711004152 METAL GLAZE 30K OHM 20% 1/3W
 VR6 1815026008 VR-479 5K OHM(GANG) "TRACE SEP"
 VR7 1711004125 METAL GLAZE 5K OHM 20% 1/3W
 VR8 1711004006 METAL GLAZE 100 OHM 20% 1/3W
 VR3/4 1910083008 VR-481 20K/10K OHM "H POS/TIME VAR"

-PC BOARD-

5904641018

T-4641A-R.P (4483)

** Model 1040 only **
 (Difference from the Model 1060)

No.	LDR PT No.	DESCRIPTION			
*** MAIN BOARD			T-4480 ***		
-RESISTORS-					
R37	1000101005	CARBON FILM	100 OHM	5%	1/6W
R54	1000680007	CARBON FILM	68 OHM	5%	1/6W
R154	1000680007	CARBON FILM	68 OHM	5%	1/6W
-CAPACITORS-					
C12	2120050005	MICA	5pF		500V
C19	2120180008	MICA	18pF	10%	500V
C20	2120220004	MICA	22pF	10%	500V
C51	2120150009	MICA	15pF	10%	500V
C112	2510040007	CERAMIC	4pF	0.5pF	50V
C119	2120180008	MICA	18pF	10%	500V
C151	2120120000	MICA	12pF	10%	500V
*** POWER & V. FINAL BOARD			T-4481 ***		
-RESISTORS-					
R22	1462400001	METAL FILM	240 OHM	1%	1/6W
R23	1332400002	METAL FILM	240 OHM	1%	1/2W
R24	1332400002	METAL FILM	240 OHM	1%	1/2W
R25	1333600006	METAL FILM	360 OHM	1%	1/2W
R26	1333600006	METAL FILM	360 OHM	1%	1/2W
R27	1333600006	METAL FILM	360 OHM	1%	1/2W
R28	1333600006	METAL FILM	360 OHM	1%	1/2W
-CAPACITORS-					
C1	2120020006	MICA	2pF		500V
C5	2120390009	MICA	39pF	10%	500V
C6	2120560008	MICA	56pF	10%	500V
*** H CONTROL BOARD			T-4641 ***		
-RESISTORS-					
R3	1000472000	CARBON FILM	4.7K OHM	5%	1/6W
R4	1000472000	CARBON FILM	4.7K OHM	5%	1/6W
R5	1000474004	CARBON FILM	470K OHM	5%	1/6W
R6	1000470006	CARBON FILM	47 OHM	5%	1/6W
R7	1000561009	CARBON FILM	560 OHM	5%	1/6W
-VARIABLE RESISTOR-					
VR9	1910088008	VR-508	5K/5K OHM	"DELAY TIME POS"	
*** FRAME ***					
-MISCELLANEOUS-					
	4513093004	KNOB	B9T(18 SERR.) "DELAY TIME POS"		
	4513133082	KNOB	B13S-0 (90°) "DELAY TIME POS"		