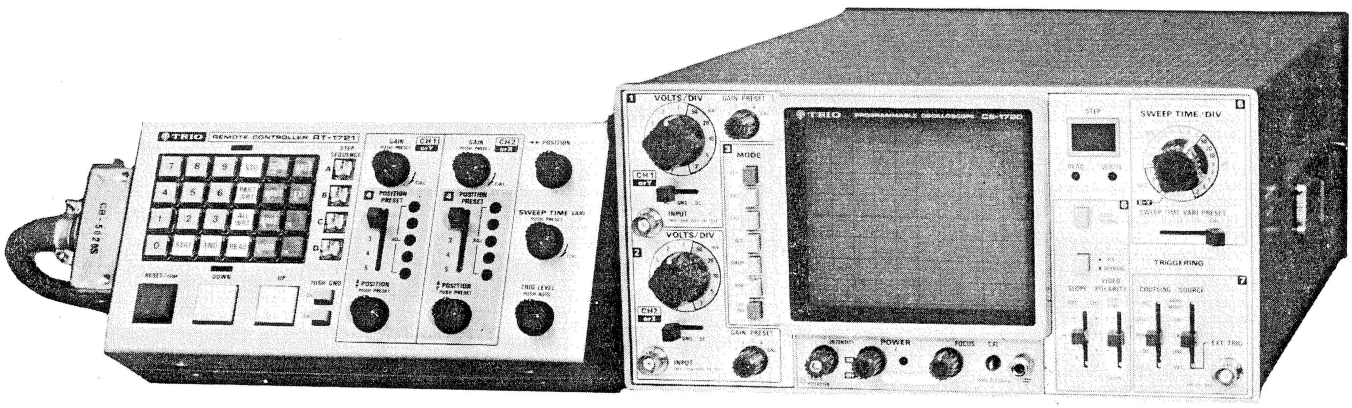
CS-1720

20 MHz DUAL TRACE PROGRAMMABLE OSCILLOSCOPE

OPTION

RT-1721 **MT-1725**



TRIO

CONTENTS

GENERAL INTRODUCTION

The CS-1720 is a dual-trace programmable oscilloscope, with up to 62 main programme functions settings programmable beforehand. With such prior programming, great energy savings are possible in the manufacturing process, as the oscilloscope can be operated with simple key controls. In addition to the programmed operation, it is possible to use the CS-1720 as a normal manually controlled scope by switching it over to the FREE position. The function of the oscilloscope is further increased with optional accessory units: the probe selector, which gives 20 possible signal channels; the memory pack, which can transfer and retain the programme contents; and the printer which can produce a hard copy of the programme data. Remote control test fixture of the production line, and computer control are also possible.

FEATURES

- The microprocessor: programmes with a maximum of 62 steps can be stored in the oscilloscope memory.
- Programming and waveform measuring conditions are easily programmed by panel control with one-touch key operations.
- Parts of the programme can be easily corrected using the clearly laid out function control panel.
- A maximum of 62 steps (00-61) can be directly set with the key board, and sequentially set with the UP/DOWN keys.
- The programme contents have a battery powered back-up system, and are able to be retained in the memory for a long time, even though the POWER switch is off.
- One-touch operation converts the oscilloscope to manual control, when it functions as a normal oscilloscope.
- Presetting of four start (A, B, C, D) and stop steps is possible, so only one-touch operation is necessary to change steps.
- 2 mV/div and 20 MHz gives an oscilloscope of high sensitivity, with a wide bandwidth, and at the same time light and compact.
- The 140 mm rectangular CRT has internal graticule with 8 x 10 divisions, post deflection acceleration, and high trace intensity.
- Vertical and horizontal positioning, variable gain and trig level by remote operation are possible
- As push GND remote operation is possible on CH1 and CH2, the reference level can be easily and accurately calibrated at hand.
- VIDEO FRAME/LINE sync circuit permits to observe both easy and stable VIDEO signal.
- Observation of VIDEO signal in different fields can be carried out simultaneously using the one input signal, dual trace by SEP function.
- CH1/CH2 independent TRIG SLOPE system is provided.
- As CH1 monitor output can be achieved, a frequency counter or similar instrument can be easily connected.
- Memory back-up, down-warning system is provided.

OPTIONAL ACCESSORIES

- By using the probe selector, either 5 types of input signal change-over (RU-1722) per channel, or 10 types (RU-1723) can be programmed.
- By using the thermal printer (TP-1724), a hard copy of the programme contents can be made.
- By using the memory pack (MT-1725), the programme contents for up to 62 steps can be transferred from the oscilloscope to the memory pack or vice versa, and the data can be retained for a long period of time.
- SWEET OUT and SWEEP GATE output terminals are optional.
- The interface unit of the external control unit can be matched.

SPECIFICATIONS

CS-1720 PROGRAMMABLE OSCILLOSCOPE

CATHODE RAY TUBE (CRT)

Model	140CGB31
Type	Rectangular with internal graticule.
Acceleration voltage	6 kV
Display area	8 × 10 divisions (1 div = 9.5 mm)

VERTICAL AXIS (CH1, CH2,)

Sensitivity	2 mV/div – 5 V/div
Accuracy	±5%
Attenuator	2 mV/div – 5 V/div 1-2-5 sequence. Fine adjustment possible between all ranges; remote controller (RT-1721), CAL and 4 range presets with vernier adjustment are possible.
Input resistance	1 MΩ±5%
Input capacity	37 pF±3 pF
Input coupling	AC-GND-DC
Frequency response	
DC	DC – 20 MHz (–3 dB) DC – 30 MHz (–6 dB)
AC	5 Hz – 20 MHz (–3 dB) 5 Hz – 30 MHz (–6 dB)
Risetime	Better than 17.5 ns
Signal delay time	More than 10 ns on the screen.
Crosstalk	–40 dB or better, at 1 kHz
Operating modes	
CH1	CH1 only, single trace
CH2	CH2 only, single trace
ALT	CH1, CH2 dual trace, alternate mode
CHOP	CH1, CH2 dual trace, chop mode
ADD	Single trace algebraic sum of CH1 and CH2
CH2 INV	CH2 inverted polarity, CH1 minus CH2, single trace
SEP	CH1 or CH2, one input signal, dual trace, alternate
Chop frequency	Approx 200 kHz
Maximum input voltages	200 V p-p or 100 V (DC+AC peak)
Maximum undistorted amplitude	8 div. minimum from DC – 20 MHz

HORIZONTAL AXIS (CH2 INPUT)

Operating modes	SWEEP TIME/DIV range can be selected to X – Y mode. CH1 – Y axis: CH2 – X axis
Sensitivity	Same as CH2 vertical axis
Accuracy	Same as CH2 vertical axis
Attenuation	Same as CH2 vertical axis
Input resistance	Same as CH2 vertical axis
Input capacity	Same as CH2 vertical axis
Input coupling	Same as CH2 vertical axis
Frequency response	
DC:	DC – 2 MHz (–3 dB)
AC:	5 Hz – 2 MHz (–3 dB)
X – Y phase difference	Within 3° at 100 kHz

SWEEP CIRCUITS

Sweep system	
NORM	Triggering sweep (remote controller RT-1721)
AUTO	Triggering sweep and auto free run sweep in absence of trigger signal (with RT-1721)
Sweep time	0.2 μs/div – 0.5s/div 1-2-5 sequence, with vernier control fine adjustment between all 20 ranges (with remote controller RT-1721); CAL and 3 range presets with vernier adjustment are possible.
Accuracy	±5%
Sweep magnification	X5 (five times) ±5%
Linearity	3% or better at normal, 5% or better at X5 magnification

TRIGGERING

Source	VERT MODE, CH1, CH2, LINE, EXT.
Coupling mode	AC, LFREJ, HFREJ, DC, VIDEO.
Video polarity	VIDEO (+/–); FRAME (+/–)
Triggering mode	MANUAL, FIX (automatically fixes level at center of trigger source).
Sync polarity	CH1/CH2 (+/+, +/–, –/+, –/–)
External sync	EXT
Input resistance	1 MΩ±5%
Input capacity	40 pF±5 pF
Maximum input voltage	100 Vp-p, or 50 V (DC+AC peak)

SPECIFICATIONS

Trigger sensitivity

Coupling	Frequency range (Hz)	Minimum Sync Voltage	
		INT	EXT
AC	10 ~ 20 MHz 20 ~ 15 MHz	1 div. 0.5 div.	1.0 V 0.5 V
AC (LFREJ)	Below 30 kHz the minimum sync amplitude (voltage) will increase.		
AC (HFREJ)	The range below 20 Hz and above 30 kHz the minimum sync amplitude (voltage) will increase.		
DC	DC – 20 MHz DC – 15 MHz	1 div. 0.5 div.	1.0 V 0.5 V
VIDEO	VIDEO SYNC LEVEL	0.5 div.	0.5 V

AUTO:	Same as above specifications for above 20 Hz
FIX:	20 Hz – 20 MHz, 1 div. (1.0 V)
Calibration voltage	Square wave, positive polarity 0.1 V ±2% 1 kHz ±5%

INTENSITY MODULATION

Input voltage	In TTL level intensity modulation is possible. (More positive levels increase the intensity).
Input impedance	Approx. 10 kΩ
Usable frequency range	DC – 5 MHz
Maximum input voltage	±50 V (DC + AC peak)

VERTICAL AXIS SIGNAL OUTPUT (Signal Output of CH1)

Output voltage	100 mV p-p/div minimum, at 1 kHz
Output impedance	Approx 50 Ω
Frequency response	10 Hz – 20 MHz (–3 dB) (50 Ω load)

SWEEP OUTPUT (Optional)

Output voltage	More than 1 V p-p (50 Ω load)
Output impedance	Approx 50 Ω

GATE OUTPUT (Optional)

Output voltage	TTL output, series resistance 220 Ω negative logic (during sweep operation, low level)

TRACE ROTATION

Trace angle is possible by trace rotation control on the front panel.

PROGRAMME STATES

Programme items	8 blocks, 24 items
1 block (CH1)	
Input coupling	AC/DC
Vertical sensitivity	2 mV/div – 5 V/div (11 ranges) CAL and 4 presets with vernier adjustment are provided.
2 block (CH2)	
Input coupling	AC/DC
Vertical sensitivity	2 mV/div – 5 V/div (11 ranges) CAL and 4 presets with vernier adjustment are provided.
3 block	
Separate	SEP (CH1/CH2)
Operating mode	CH1, CH2, ALT, CHOP, ADD
Polarity inversion	CH2 INV
4 block	
Vertical position	CH1: 5 point presets (more than ±4 div adjustable).
Vertical position	CH2: 5 point presets (more than ±4 div adjustable).
5 block	
Sweep time	0.2 μs/div – 0.5 s/div (20 ranges) CAL and 3 range presets with vernier fine adjustment.
X-Y operation	X-Y, 1 range.
6 block	
Sweep magnification	X5 (five times) MAG
Triggering mode	MANUAL/FIX
Sync polarity	CH1/CH2 (+/+, +/–, –/+, –/–)
VIDEO polarity	VIDEO (+/–); FRAME (+/–)
7 block	
SOURCE	V MODE, CH1, CH2, LINE, EXT
Coupling	AC, LFREJ, HFREJ, DC, VIDEO
EXT trigger input	OFF, 1 2 3 (RU-1722, RU-1723)
8 block	
Input signal changeover (CH1)	1 – 5 (RU-1722) 1 – 10 (RU-1723)
Input signal changeover (CH2)	1 – 5 (RU-1722) 1 – 10 (RU-1723)
Remote	Step sequence: A, B, C, D. Start step, end step, 4 kinds of each.

PROGRAMME CONTROL FUNCTIONS

Control method	Microprocessor control
Memory	CMOS, RAM, with battery
Steps	62 steps (00 – 61)
Operation	Key operation (remote controller RT-1721)
Indication	STEP NO., 2 figures, 7 segments READ: green LED WRITE: red LED PART WRT: green & red LEDs

SPECIFICATIONS

Protective circuitry	Low battery level indication is provided. (7 segments flash on) Memory pack: misconnection avoidance function is provided (no operation). Printer: misconnection avoidance function is provided: warning alarm will sound.

OPTIONAL EXTERNAL ACCESSORIES

Probe selector, RU-1722 (CH1 × 5 & CH2 × 5, EXT × 3)
Probe selector, RU-1723 (CH1 × 10 or CH2 × 10, EXT × 3)
Thermal printer TP-1724
Memory pack MT-1725
It is possible to expand the function of the oscilloscope with external control.

POWER SUPPLY

Voltage	Low: 90 V — 132 V High: 180 V — 264 V
Frequency	50/60 Hz
Power consumption	Approx 43 W

DIMENSIONS

Width	284 (312) mm
Height	138 (150) mm
Length	400 (450) mm

The dimensions in brackets are including fittings.

WEIGHT 7.1 kg

ACCESSORIES Probes; 2 pieces (PC-29)
Instruction manual; 1 copy.
AC power cable: 1 piece

OPERATING ENVIRONMENT

Optimum temperature and humidity:	10°C — 35°C 85% RH or less
Operating temperature and humidity:	0°C — 50°C, 90% RH or less
Storage temperature and humidity:	−20°C — 55°C, 80% RH or less

OPTIONAL ACCESSORIES

Remote controller; RT-1721
Probe selector, (5 inputs × 2 channel); RU-1722
Probe selector, (10 inputs × 1 channel); RU-1723
Thermal printer; TP-1724
Memory pack: MT-1725

RT-1721 REMOTE CONTROLLER (OPTION)

REMOTE OPERATION SECTION

VERTICAL AXIS (CH1, CH2)

Variable attenuation	Vernier fine adjustment between all ranges of VOLTS/DIV control on CS-1720 is possible, in addition to preset change-over.
Position adjustment	5 Presets, more than ± 4 div. adjustable. Vernier fine adjustment: more than ± 2 div adjustable.
Input coupling	Push GND, CH1/CH2
Horizontal position adjustment	More than ± 5 div adjustable.
Sweep time variable	Vernier fine adjustment between all ranges of SWEEP TIME/DIV control on CS-1720 is possible, in addition to preset change-over.
Sweep mode	NORM/AUTO
Trigger level	More than ± 4 div

PROGRAMME OPERATION SECTION

Programme console keys	29 types.

DIMENSIONS

Width	230 (290) mm
Height	55 (69) mm
Length	115 (120) mm

Dimensions in brackets are with fittings.

WEIGHT 1.2 kg
ACCESSORY Connecting cable CB-5020S
OPERATING ENVIRONMENT
Same as oscilloscope CS-1720

MT-1725 MEMORY PACK (OPTION)

Memory ..... CMOS RAM 1K × 4 BIT with backup with a lithium battery.

Battery low level level indication ..... When the MT-1725 is connected to the CS-1720, the voltage level of the battery is automatically checked. If it is too low the 7 segment LEDs of the STEP indicator will flash on and off.

Detector voltage ..... Approx. 2.5 V

PRECAUTIONS

Battery replacement

Remove 2 screws holding the case at the connector side and slide the case forward. Check the level of disc type lithium battery in the printed circuit board. If the level is below 2.5 V, replace the battery. In this case, observe the polarity.

NOTE

In order to avoid damage of the stored data, make sure the power switch of the CS-1720 is set to OFF when connecting the MT-1725 memory pack, or disconnecting it. As the memory pack contains its own backup battery, avoid any sudden shocks or high temperature and humidity.

Operating environment .....Temp: 5°C – 40°C,
Hum: Less than 80% RH
Storing environment .....Temp: –20°C – 55°C,
Hum: Less than 85% RH
(Avoid excess condensation)
Dimensions .....Width 57 mm
Height 26 mm
Length 92 mm (104 mm*)
*The dimensions in brackets are with fittings.
Weight .....110 g

■ Circuit and rating are subject to change without notice due to developments in technology.

PRECAUTIONS

NOTE

Before using the oscilloscope CS-1720, check the power supply voltage, and make sure that the voltage selector switch is correctly set to the corresponding voltage. If the control is incorrectly set, damage to the electric circuits will occur, so check carefully. After checking that the power supply voltage and the voltage selector switch correspond, connect the CS-1720 oscilloscope to a suitable socket using the AC power cord.

1) **Do not switch the power switch on and off rapidly in succession, as this may cause it to malfunction. Allow at least 3 seconds between switching on and switching off.**
2) **When connecting or disconnecting any of the optional accessories, the power must be OFF.**
3) Avoid using the CS-1720 under the following conditions:
   a) In direct sunlight.
   b) In a room with high temperature and humidity.
   c) In a room affected by vibration from nearby machinery.
   d) Near any high voltage instrument, or one with a strong magnetic field.
4) Ensure that the voltage at each input terminal does not exceed the maximum rating.
   CH1, CH2 input: Refer to specifications
   EXT TRIG input: Refer to specifications
   Z AXIS input: Refer to specifications
   Do not connect any of the output terminals to an external signal source.

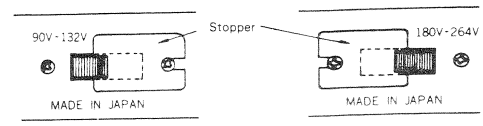


Fig. 3-1

5) Keep the brightness control to the necessary minimum.
6) Do not leave the CS-1720 for any length of time with a stationary spot displayed on the screen.
7) The CS-1720 uses a backup battery system for the programme data. When the battery level is getting low, the STEP LED will flash when the power is switched on. In this event, replace the batteries, referring to the appropriate section in the maintenance instructions.
8) To avoid possible electric shocks, ensure the earth terminal is properly connected. (See front panel ⏚ (16) for explanation and instructions)
9) Be sure that no objects are allowed to rest on the top of the unit or that cooling vents are not blocked, since this will cause an undue temperature rise.
10) Before removing the case, be sure to turn off the power. Since the CS-1720 makes use of high voltage circuitry, if removing the case, refer to the "MAINTENANCE" for removing the case.
11) Setting the AC voltage selector.
    1) Loosen the screw and remove the stopper plate.
    2) Switch the lever to the opposite side.
    3) Lock the lever by attaching the stopper plate to the opposite side and tight the two screws.
12) Cascade connection must not be made. Never make cascade connection with CH1 output to the CH2 input or EXT input.
13) Never connect CH1 or CH2 input in parallel with EXT input.
14) In order to obtain accurate measurements, it is most important to calibrate the probe correctly before using the oscilloscope. First, connect the probe to the channel to be used, and connect the tip of the probe to the CAL terminal on the front panel. Adjust the probe trimmer pot to get the proper square waveform on the CRT screen. When connecting the probe to the CAL terminal, be sure always to connect it together with the GND terminal. When the GND terminal is in an open condition, signal noise will accompany the waveform.

CONTROLS AND INDICATORS

PROGRAMMABLE OSCILLOSCOPE CS-1720

<FRONT PANEL>

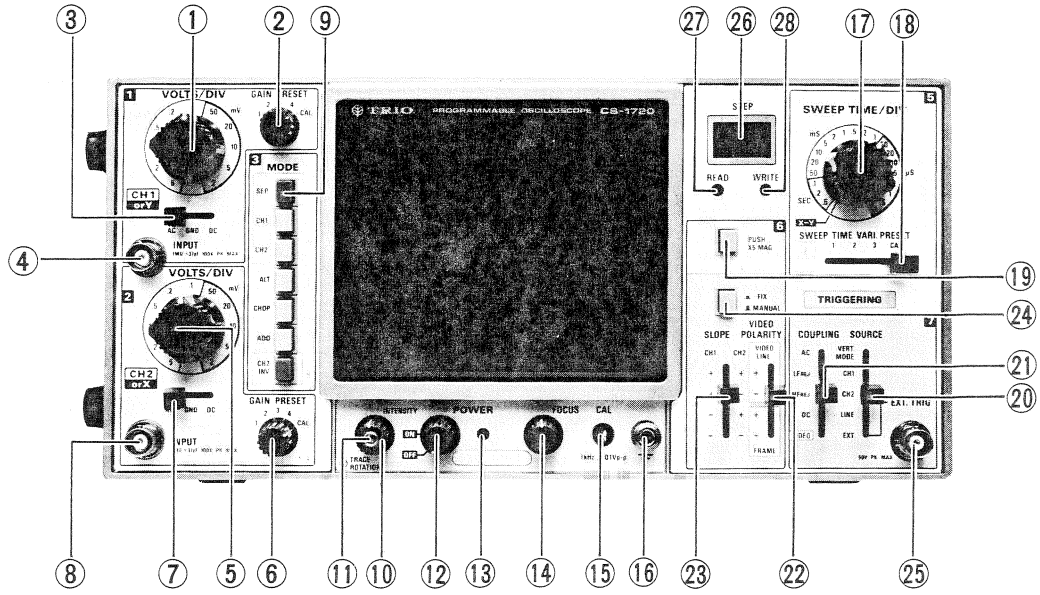


Fig. 4-1

(1) **VOLTS/DIV**
Vertical attenuator calibrated in voltage per division, in 1-2-5 sequence, and adjustment will give the optimum waveform. The vertical sensitivity is calibrated at GAIN CAL position. When the oscilloscope is being used as an X-Y scope, this control serves as the Y-axis control.

(2) **GAIN PRESET**
Vertical attenuation adjuster and preset selector; change-over of 4 preset ranges and CAL, set by the vertical attenuation adjustment control (29). This selector is calibrated in the CAL position. In X-Y scope this control is the Y-axis preset selector.

(3) **AC-GND-DC**
Vertical input selector switch for CH1. In X-Y operation, the Y axis-input selector switch.

AC: The DC component of the input signal is blocked.

GND: Opens signal path and ground input to vetical amplifier. This provides a zero signal base line.

DC: Direct input of both AC and DC components of input signal.

(4) **INPUT**
Vertical input terminal for CH1. During X-Y operation, the Y-axis input.

(5) **VOLTS/DIV**
Vertical attenuator for CH2, having the same function as CH1 VOLTS/DIV (1). During X-Y operation, the X-axis attenuator.

(6) **GAIN PRESET**
CH2 vertical attenuator adjuster and preset selector. Has the same function as CH1 GAIN PRESET (2). In X-Y operation, the X-axis preset attenuation selector.

(7) **AC-GND-DC**
CH2 vertical input selector. In X-Y operation, the X-axis input selector switch. It has the same function as CH1 AC-GND-DC (3).

(8) **INPUT**
CH2 vertical input. In X-Y operation, the X-axis input terminal.

(9) **MODE**
Selects the operating mode of the vertical axis.

CH1: CH1 input signal is displayed on the CRT screen.

CH2: CH2 input signal is displayed on the CRT screen.

ALT: CH1 and CH2 signals are displayed alternately.

CHOP: CH1 and CH2 signals are displayed in chopping mode.

ADD: The algebraic sum of CH1 and CH2 is

displayed, in single trace. When CH2 INV is set, the difference is displayed in single trace.

CH2 INV: The polarity of CH2 signal is reversed.

SEP: CH1 input signal is alternately displayed in both "main" and "sub". Refer to SEPARATE PRESET (30) instructions.
In CH2, CH2 input signal is displayed as same function as CH1 SEP operation.

NOTE

The various vertical mode are related to trigger source. Refer to SOURCE (20) instructions.

(10) INTENSITY

Adjusts the brightness of the trace, with outside axis control. Clockwise rotation increases brightness.

(11) TRACE ROTATION

Adjusts the angle of the horizontal trace.

(12) POWER

Switches on or off the power to the CS-1720. When connecting or disconnecting any of the optional accessories be sure the power switch is in the OFF position.

(13) PILOT LAMP

When lit, indicates power is ON.

(14) FOCUS

Adjusts the focus of the trace. As the CS-1720 uses an auto focus circuit, once this control is adjusted, it need not frequently to be readjusted.

(15) CAL

Provides 0.1 V peak to peak square wave input signal at 1 kHz.

(16) ⏚ GND

The ground terminal used to earth the oscilloscope chassis and body as an aid against electrical shocks.

(17) SWEEP TIME/DIV

Horizontal sweep time control. It selects sweep times from 0.2 μs/div — 0.5 s/div in 20 ranges in 1-2-5 sequence. In addition, full counter-clockwise rotation energises X-Y scope operation.

(18) SWEEP TIME VARI PRESET

This control is a fine adjuster and preset for sweep time. It can select three range presets and CAL set by SWEEP TIME VARI PRESET (36). Sweep time is calibrated in CAL position.

(19) PUSH X5 MAG

When this control is pushed in (■) position, the sweep time is made 5 times faster per division. With the button in (▬) position, mormal sweep time is resumed.

(20) SOURCE

Selects sweep trigger source.

VERT MODE: Trigger signal is selected by setting vertical mode.

CH1	CH1 signal becomes trigger source
CH2	CH2 signal becomes trigger source
ALT	For CH1, CH1 signal becomes trigger source For CH2, CH2 signal becomes trigger source.
CHOP	CHOP change-over signal becomes trigger source
ADD	Algebraic sum of CH1 & CH2 signals becomes trigger source

CH1: CH1 signal becomes trigger source.

CH2: CH2 signal becomes trigger source.

LINE: The power source frequency signal becomes trigger source.

EXT: The signal applied to EXT TRIG (25) becomes trigger source.

NOTE

1) When the vertical axis mode is set in ALT, in VIDEO FRAME (22) CH1 signal will be fixed to trigger source.
2) When the vertical axis mode is set in CHOP, as the CHOP change-over signal becomes the trigger source, stable display cannot be observed. Therefore in this instance, select proper trigger signal, excluding VERT MODE.

(21) COUPLING

Controls the coupled trigger signal

AC: Trigger signal is AC coupled, excluding DC components.

LFREJ: Trigger signal is coupled to sync circuit through high pass filter. All low frequency components are attenuated.

HFREJ: Trigger signal is coupled to sync circuit through low pass filter. All high frequency components are attenuated.

DC: Trigger singal is DC coupled, and is coupled to sync circuit, including DC components.

VIDEO: For video sync signal. In this case if VIDEO POLARITY switch (22) is set to VIDEO LINE or FRAME, horizontal sync (TV. H) or vertical sync (TV. V) can be selected for synchronization.

(22) VIDEO POLARITY

Select polarity of video snyc signal.

VIDEO LINE: Sweep is triggered on horizontal sync signal in video signal. At this time, + or − polarity should be selected.

+: For positive polarity sync signal (sync signal is up side of the VIDEO signal)

−: For negative polarity sync signal (sync signal is down side of the VIDEO signal)

VIDEO FRAME: Sweep is triggered on vertical sync signal in VIDEO signal.

+: For positive polarity sync signal (Sync signal is up side of the VIDEO signal)
−: For negative polarity sync signal (Sync signal is down side of the VIDEO signal)

NOTE
As the 1/2 divider circuit is provided in the VIDEO FRAME synchronizing circuit, odd or even field can be selected by the SLOPE (23) selector switch; refer to VIDEO SYNC in OPERATION instruction.

(23) SLOPE
Sync polarity selector switch. Also odd or even field selector when VIDEO FRAME is set.

CH1: CH1 sync polarity change-over.
+: Sweep is triggered on rising slope of waveform.
−: Sweep is triggered on falling slope of waveform.

CH2: CH2 sync polarity change-over.
+: Sweep is triggered on rising slope of waveform.
−: Sweep is triggered on falling slope of waveform.

NOTE
For SLOPE the polarity of CH1 +/− and CH2 +/− is changed over according to the sync signal selected on SOURCE (20). However, since some connections exist with MODE and VIDEO FRAME, refer to the OPERATION instructions.

(24) FIX/MANUAL
FIX (▬): Automatic triggering level control. Sync is obtained without connection with TRIG LEVEL (60).

MANUAL (▬): Triggering level can be adjusted by TRIG LEVEL (60).

NOTE
When TRIG LEVEL (60) is pulled out (PULL NORM), FIX operation is automatically cancelled, and manual operation is selected.

(25) EXT TRIG
External trigger input terminal. If SOURCE (20) switch has been set to EXT, the signal at this input becomes the trigger source.

(26) STEP
Programme step number indicator. Step number can be indicated from 00 to 61 as 2 figures of seven segments. When PART WRT is selected numbers from 1 to 8 can be indicated in single figures. This is also used as the battery low level warning indicator which will flash when the internal memory back-up battery is below its operational level.

NOTE
Step numbers from 00 to 99 can be indicated. However, if 62 or over is indicated, the indicator will flash once, and the step will have no effect.

(27) READ
Green LED indicates programme data are being read out. At the time of PART WRT it will light up together with the WRITE LED (28).

(28) WRITE
Red LED indicates input signal is being written in the memory. When PART WRT is set, it will light up together with the READ LED (27).

<LEFT SIDE>

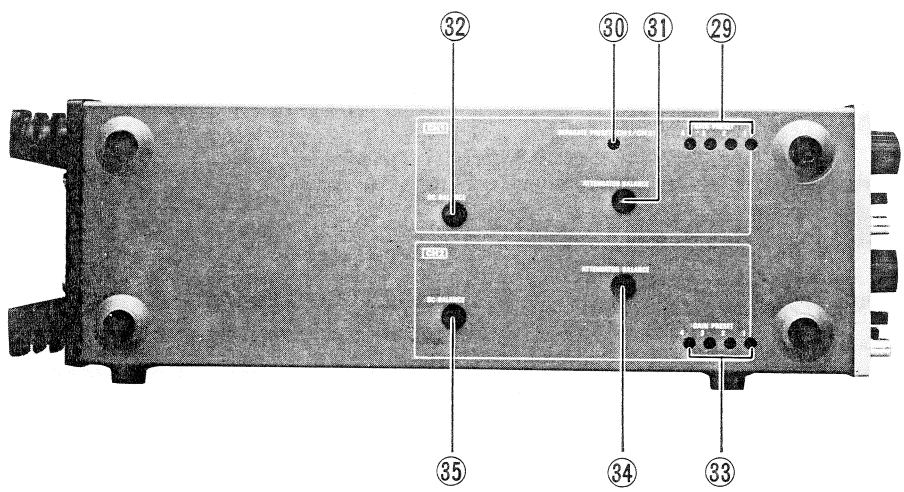


Fig. 4-2

(29) GAIN PRESET
Fine adjustment control CH1 vertical attenuation for preset. 4 preset gains can be set and selected by GAIN PRESET (2).

(30) SEPARATE PRESET (CH1/CH2)
Vertical position adjustment for sub-sweep preset when SEP (9) in vertical axis mode is selected. Preset adjustment is possible within ±4 div from the main

vertical sweep position. The preset distance will not change despite changing ▲▼ POSITION controls (52/53, 55/56).

(31) ATTENUATOR BALANCE
Vertical DC balance control for CH1 or Y. When turning VOLTS/DIV (1) adjust this control so the trace does not shift vertically.

(32) DC BALANCE
Vertical DC balance control for CH1 or Y. When the GAIN (51) control of the vertical amplifier is being turned, DC balance should also be adjusted to fix the trace position. This adjustment should be carried out after having set ATTENUATOR BALANCE (31) correctly.

(33) GAIN PRESET
Fine adjustment control for preset of CH2 vertical attenuation. Four preset gains can be set and selected by GAIN PRESET (6).

(34) ATTENUATOR BALANCE
Vertical DC balance control for CH2 or X. When being turned the VOLTS/DIV (5), adjust so the trace does not shift vertically.

(35) DC BALANCE
Vertical DC balance control for CH2 or X. When the GAIN (54) control of the vertical amplifier is being turned, DC balance should be adjusted to fix the trace position. This adjustment should be carried out after having set ATTENUATOR BALANCE (34) correctly.

<RIGHT SIDE>

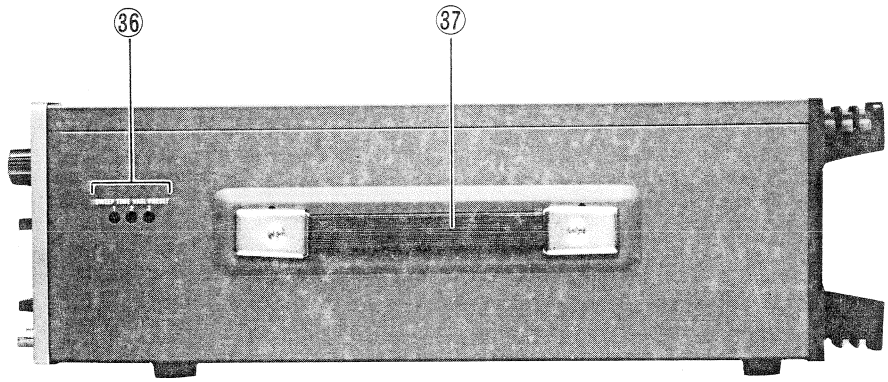


Fig. 4-3

(36) SWEEP TIME VARI PRESET
Control for fine adjustment of preset time base. Changes between ranges of SWEEP TIME/DIV continuously. Ranges can be set and selected by SWEEP TIME VARI PRESET (18).

(37) CARRYING HANDLE
The oscilloscope should be carried using this handle.

<REAR PANEL>

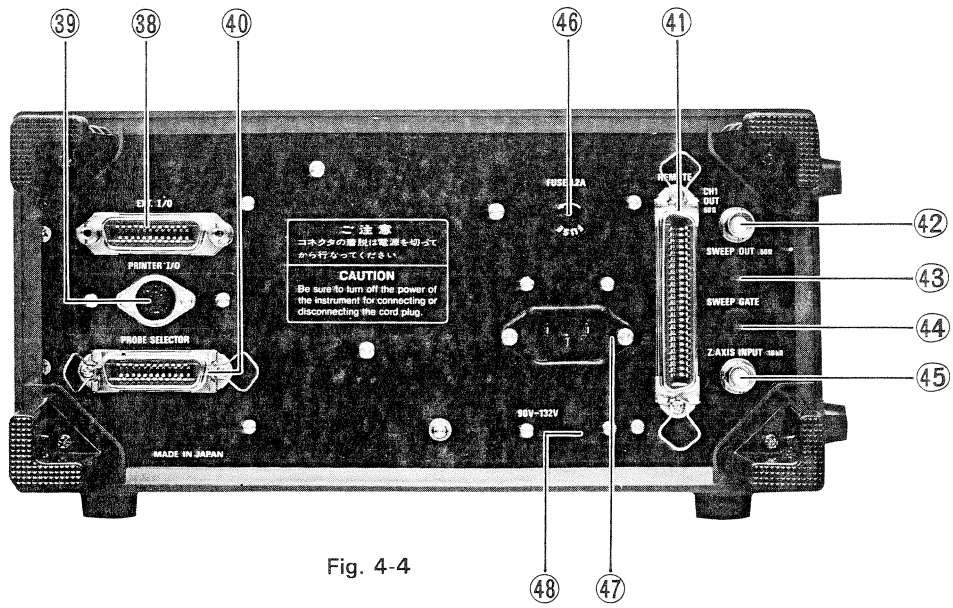


Fig. 4-4

CONTROLS AND INDICATORS

(38) EXT I/O
Connecting socket for optional memory pack (MT-1725) and the other external unit.

(39) PRINTER I/O
Connecting socket for optional printer (TP-1724).

(40) PROBE SELECTOR
Connector for optional probe selector (RU-1722, RU-1723).

(41) REMOTE
Connector for optional remote controller (RT-1721).

NOTE
When connecting or disconnecting any of the above accessories (38), (39), (40), (41), ensure the power switch is in the OFF position.

(42) CH1 OUT
Vertical signal output terminal of CH1.

(43) SWEEP OUT (OPTIONAL)
Mounting point for output terminal of sweep signal.

(44) SWEEP GATE (OPTIONAL)
Mounting point for output terminal of sweep gate signal.

(45) Z-AXIS INPUT
Intensity modulation terminal. Intensity is modulated at TTL level.

(46) FUSE HOLDER
Carries 1.2 A fuse.

(47) POWER SOURCE CONNECTOR
Connector for AC power input cable. Center pin of three-wire cord is ground terminal.

(48) POWER SUPPLY SELECTOR SWITCH
This switch must be adjusted according to the available AC power.
LOW: 90 V — 132 V; **HIGH:** 180 V — 264 V.

<BOTTOM>

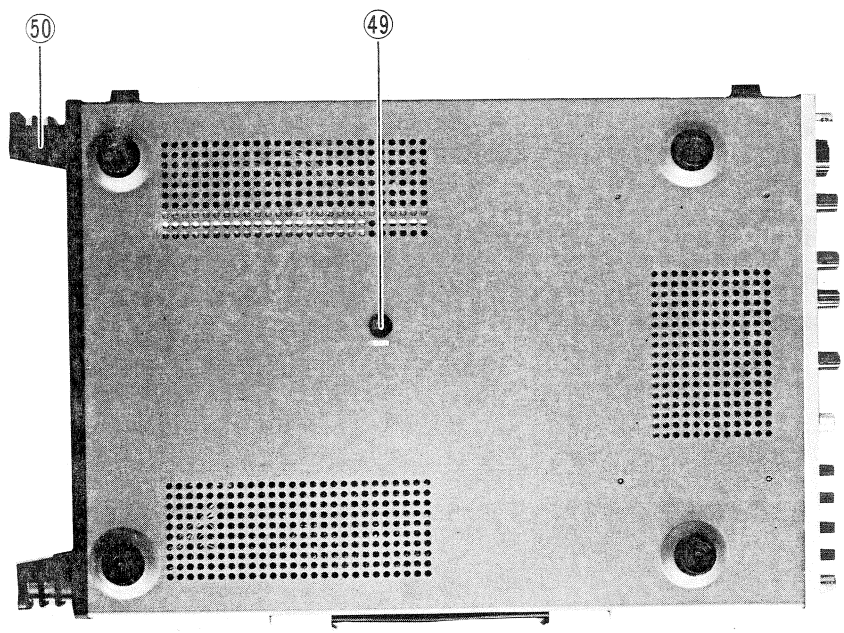


Fig. 4-5

(49) ASTIG
Trace or spot astigmatism compensation control. Once adjusted, this control does not need frequent readjustment.

(50) FEET/CABLE WRAP
When the CS-1720 is used upright (vertically), these mouldings act as feet. The AC power cable can also be wrapped around them when the CS-1720 is not in use.

CONTROLS AND INDICATORS

REMOTE CONTROLLER: RT-1721 (OPTION)

<REMOTE OPERATION SECTION>

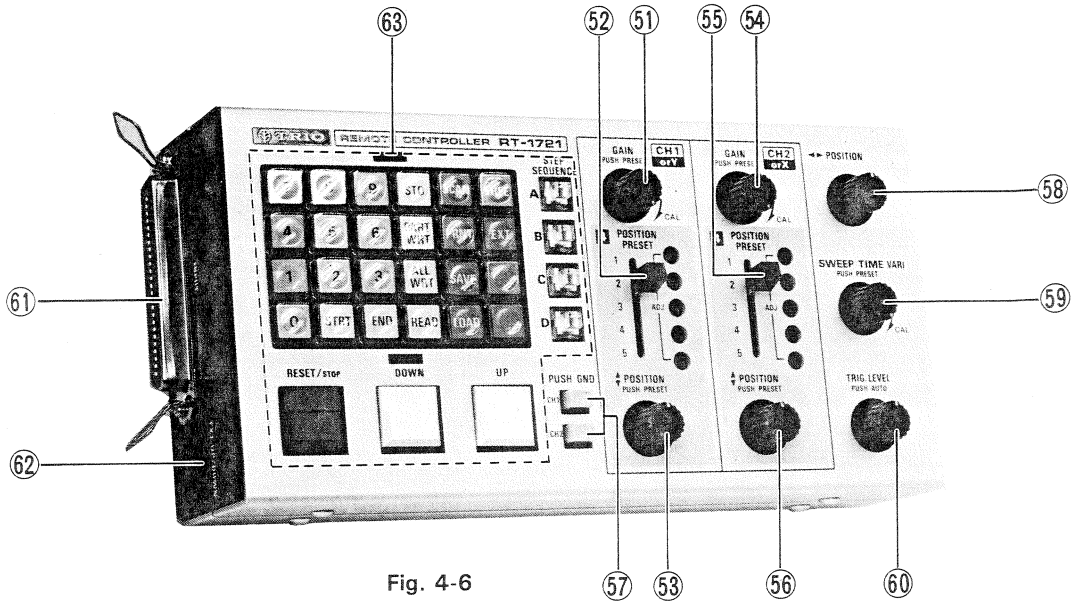


Fig. 4-6

(51) GAIN PUSH PRESET

CH1 vertical attenuation fine adjustment control. Continuously variable between the ranges of VOLTS/DIV (1). At CAL position, (fully clockwise), vertical attenuator can be calibrated. For X-Y operation, it becomes the Y-axis attenuation fine adjustment control. When this control is pushed in (PUSH PRESET), the former function is cancelled, and the gain can be set by GAIN PRESET (2) or (29), and the gain is that value which is programmed or selected.

(52) POSITION PRESET

CH1 vertical position, preset and preset change-over control. Continuously variable within ± 4 div on the screen. 5 point presets are set and selected.

(53) POSITION PUSH PRESET

CH1 vertical position control. POSITION PRESET (52) can be adjusted approximately of ± 2 div. In X-Y operation, Y-axis position control, in addition to POSITION PRESET (52). When this control is pushed in (PUSH PRESET) the former function is cancelled, and the position can be set by POSITION PRESET (52) and the trace is positioned at the programmed or selected position.

(54) GAIN PUSH PRESET

CH2 vertical attenuation fine adjustment control. Continuously variable between the range of VOLTS/DIV (5). At CAL position (fully clockwise), vertical attenuation can be calibrated. In X-Y operation it becomes the X-axis attenuation fine adjustment control. When the control is pushed in (PUSH PRESET), the former function is cancelled, and the GAIN PRESET (6) and (33) sets or selects the gain. The gain is then that value selected or programmed.

(55) POSITION PRESET

CH2 vertical position preset and preset change-over control. Continuously variable within ± 4 div on the screen. 5 point presets are programmed and selected.

(56) POSITION PUSH PRESET

CH2 vertical position control. POSITION PRESET (55) can be adjusted approx ± 2 div. During X-Y operation it serves the dual function of X-axis position control as well as POSITION PRESET (55). When this control is pushed in (PUSH PRESET), the former function is cancelled, and the position can be preset by POSITION PRESET (55), and the trace is positioned at where it was selected or programmed.

(57) PUSH GND

CH1: When the knob is depressed, input of the vertical amplifier is disconnected from the CH1 input and connected to ground. Therefore the reference level can be easily ascertained.

CH2: When the knob is depressed, input of the vertical amplifier is disconnected from the CH2 input and connected to ground. Therefore the reference level can be easily ascertained.

CONTROLS AND INDICATORS

(58) ◄► POSITION
Horizontal position control. Cannot be used during X-Y operation.

(59) SWEEP TIME VARI PUSH PRESET
Sweep time fine adjustment control. Continuously variable between SWEEP TIME/DIV ranges. At fully clockwise CAL setting, sweep time is calibrated. When this control is pushed in (PUSH PRESET) the former function is cancelled, and the sweep rate can be set by SWEEP TIME VARI PRESET (18) and (36) and the sweep rate is that value set or programmed.

(60) TRIG LEVEL PUSH AUTO
Adjust starting point for displayed waveform.

PUSH AUTO: Sweep will be initiated by trigger signal. Even when there is no trigger signal, free run sweep is possible, and the trace will appear.

PULL NORM: Sweep is initiated with trigger signal. Where there is no trigger signal, the sweep will not appear.

NOTE
When this control is pulled out (PULL NORM) FIX operation is cancelled, and manual operation is selected.

(61) INPUT
Connector for oscilloscope CS-1720 and remote controller. Connecting cable provided must be used.

(62) EXT UP/DOWN (OPTIONAL)
Mounting point for external UP/DOWN control signal connector.

<PROGRAMME OPERATION SECTION>

(63) PROGRAMME CONSOLE KEYS

0 – 9: Number key. Step numbers and/or block numbers can be set up directly.

STO: The memory key. The programme which has been set up can be written into the RAM.

PART WRT: The part writing key. Part writing state is actuated by 0-8 block units. READ and WRITE LEDs will light up.

ALL WRT: The writing key. All blocks are written into the memory. WRITE LED will light up.

READ: The read out key. Programmed data are read from the memory. The READ LED will light up, and the CS-1720 will operate according to the programme contents.

STRT: Start step setup key. Used for setting up and reading out start step numbers in STEP SEQUENCE.

END: End step point key. Used for setting up and reading out end steps from STEP SEQUENCE.

SCAN: Automatic step transfer key; It automatically advances the steps one by one with about a one second interval between steps.

PRNT: The printer key. Programme contents are printed out.

SAVE: Key for data transfer to memory pack, transferring contents of internal RAM. RAM contents are not altered in any way.

LOAD: Data transfer key from memory pack to RAM. Contents of memory pack remain unaltered.

NOTE
When memory pack is not connected, in order to protect the data, LOAD does not operate.

FREE: Programmed function removal key; all programmed function is cancelled, and ordinary oscilloscope operation is resumed with manual operation. All LEDs will be out except POWER warning lamp. The console keys cannot be operated except RESET/STOP (cancelling key).

EXT: External signal control key. Step control of signal read out unit can be carried out with external signal. At this time, only STEP will be indicated, and only RESET/STOP key on the console can be operated.

STEP SEQUENCE: Programme step (start step to end step) selection key; in steps 00 – 61,4 cases where start or end step has been set can be selected at random.

RESET/STOP: Key for resetting and temporary stopping operation;
a) It can be used to read out the preset start step number.
b) When SCAN and PRNT are selected, it becomes a temporary stopping and resetting key.
c) It can cancel FREE and EXT keys.

DOWN: Step down key. Brings steps down one by one, stopping at the preset start step, or after reading 00 step.

UP: Step up key; goes up through the steps one by one. It returns to the start step after reaching the preset end step, or after reading 61 step.

OPERATIONS

INITIAL STARTING PROCEDURE

This procedure is used to standardise the initial setting of controls as a reference point and to obtain a trace on the CRT in preparation for waveform observation. Set the controls as in the diagramme, referring to the section on panel controls and indicators for necessary explanations.

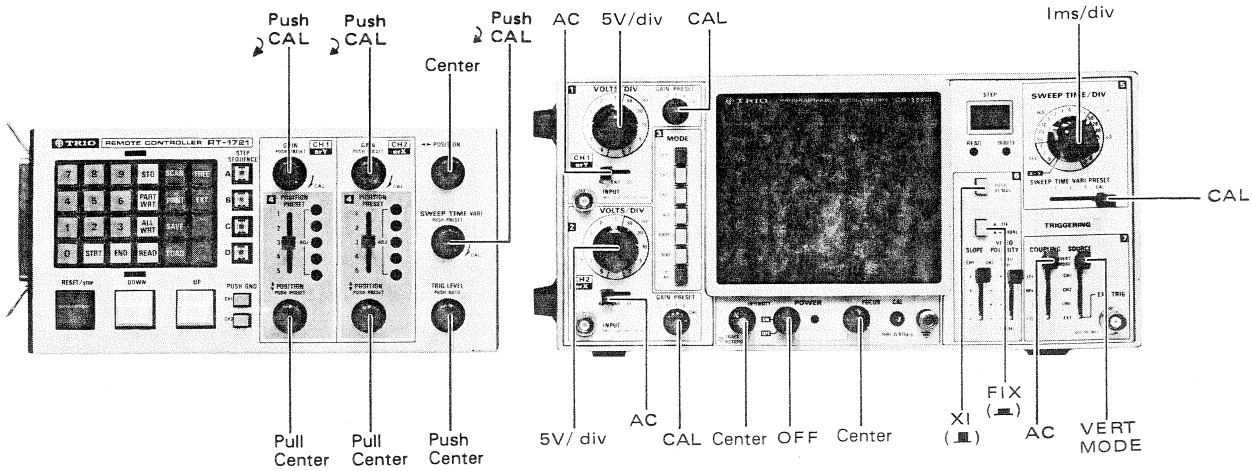


Fig. 5-1

ORDINARY OSCILLOSCOPE MANUAL OPERATION

1) Turn the POWER switch (12) clockwise, and the power will come on, indicated by the power pilot light. Check if any of the following LED indicators light up: STEP (26), READ (27) and STEP SEQUENCE (63). If all of them are lit, push console key FREE (63) and the LEDs will go out, indicating that the oscilloscope is now ready for ordinary manual operation.
   Set up each mode as follows:
   MODE (9): CH1
   SOURCE (20): VERT MODE
   TRIG LEVEL (60): AUTO
2) After a short time the CRT will warm up, and the trace will appear. Position the trace in the center of the screen using POSITION PRESET (52), ▲▼ POSITION (53) (pulled out), and ◄► POSITION (58). Next adjust the INTENSITY (10) and FOCUS (14) controls as necessary to obtain a clear, sharp trace.
3) Set the vertical axis MODE (9) to CH1, and apply a signal to CH1 INPUT (4) in order for the waveform to reach normal operational size by rotating VOLTS/DIV (1). Vertical attenuation fine adjustment can be carried out with GAIN (51) switch, pulled into PULL position. By setting vertical MODE to CH2, and applying a signal to CH2 INPUT (8), by following the same procedures as above, CH2 waveform can be observed. By setting vertical mode to ALT, the input signal waveforms of both CH1 and CH2 will be displayed alternately every other sweep, the trigger signal also alternating between CH1 and CH2. Therefore, there will be a momentary pause between the two waveforms.
   When CHOP is selected on vertical MODE, CH1 and CH2 will be indicated by chopping, each sweep. As the trigger signal becomes the CHOP change-over signal in this mode, select an appropriate setting for SOURCE (20), except VERT MODE. These two waveforms have the same time base. When ADD is selected on the vertical MODE, the waveform on the screen becomes a composite algebraic sum of CH1 and CH2 in single trace. If CH2 INV is then selected in this condition, the waveform is the algebraic difference between CH1 and CH2 (CH1 — CH2). When VOLTS/DIV is set the same for both channels, the sensitivity has that value.

<SEP OPERATION>

Select SEP of the vertical MODE, and set CH1 or CH2. In this setting, the input signals will be indicated by alternate sweeping in main and sub mode with dual trace function. In the case of CH1 being selected, the CH1 signal is the main sweep, the position being adjusted with CH1 ▲▼ POSITION. The sub trace can be adjusted to within ±4 div of the CH1 trace by means of SEPARATE PRESET (30) on the left hand side of the CS-1720. It is then controlled by CH1 ▲▼ POSITION. The sync polarity of both main and sub traces correspond to CH1 +/− and CH2 +/− of SLOPE (23). (Refer to table 3.) If CH2 is selected, then CH2 becomes the main trace, and CH1 the sub. The same operating instructions apply as for CH1 operation.

NOTE

Do not set the sub trace exceed the ±4 div setting, distortion may appear on the waveform.

OPERATIONS

<TRIGGERING OPERATION>

In order to observe the input signal waveform, a correct trigger signal is necessary. There are two possible types of trigger; one is the internal trigger, where the signal is internal, and the other is an external trigger, where the trigger signal is applied to the external trigger input terminal; This signal must have a time or frequency relationship to the signal being observed to synchronize the display.

1) A combination of SOURCE and vertical MODE settings decides which signal is the trigger signal, as shown in Table 5-1.

SOURCE / VERT. MODE	VERT MODE: EXCLUDING VERT MODE	VERT MODE: VIDEO	CH1	CH2	LINE	EXT
CH1	CH1	CH1	CH1	CH2	LINE	EXT
CH2	CH2	CH2				
ALT	CH1: CH1 CH2: CH2	CH1 see note (1)				
CHOP	see note (2)					
ADD	(CH1 + CH2)	(CH1 + CH2)				

Table 5-1 Relation between Vertical MODE and SOURCE

Note 1) In the case of VIDEO FRAME, the alternate traces of CH1 and CH2 appear on the screen, but both CH1 and CH2 displays are triggered with CH1 signal only.

Note 2) As the CHOP change-over signal becomes the trigger signal, triggering is not properly carried out. In this case, set SOURCE excluding VERT MODE.

2) After setting SOURCE, select MANUAL (▬) of FIX/MANUAL (24) and turn TRIG LEVEL (60) to selecte the trigger point. Alternately, by selecting FIX (▬), triggering is automatically fixed in the center of the waveform.

3) By pulling the TRIG LEVEL control to outward, NORMAL operation is selected, under which triggering is not automatic, so that in the case of no trigger signal or the trigger level is too low, no trace will appear. Table 5-2 shows the relation between FIX/MANUAL and AUTO/NORMAL.

TRIG LEVEL / FIX/MANUAL	AUTO (PUSH)	NORMAL (PULL)
FIX	Auto sweep Level fix	Triggered sweep Level adjustable
MANUAL	Auto sweep Level adjustable	Triggered sweep Level adjustable

Table 5-2 The Relation between FIX/MANUAL and AUTO/NORMAL

<SYNC POLARITY>

SLOPE (23) sets the sync polarity of CH1 +/−, CH2 +/−. In the case of VIDEO FRAME, odd and even fields can be selected.

SEPA-RATE	SOURCE / VERTI-CAL MODE	VERT MODE	CH1	CH2	LINE, EXT
ON	CH1	Main: CH1 +/− Sub: CH2 +/−	CH1 +/−	CH2 +/−	Main: CH1 +/− Sub: CH2 +/−
	CH2	Main: CH2 +/− Sub: CH1 +/−			Main: CH2 +/− Sub: CH1 +/−
OFF	CH1	CH1 +/−	CH1 +/−	CH2 +/−	CH1 +/−
	CH2	CH2 +/−			CH2 +/−
	ALT	CH1: CH1 +/− CH2: CH2 +/−			CH1: CH1 +/− CH2: CH2 +/−
	CHOP				CH1 +/−
	ADD	CH1 +/−			

Table 5-3 Sync Polarity

<VIDEO SYNC>

When COUPLING (21) switch is in the VIDEO, the sync is on the VIDEO signal.

1) When VIDEO POLARITY (22) switch is in the VIDEO LINE, the trigger signal is the horizontal sync signal (TV. H) on the VIDEO signal.
When VIDEO POLARITY switch is in the FRAME, triggering is carried out by vertical sync signal (TV. V) on the VIDEO signal.

2) According to the waveform of the VIDEO input signal select VIDEO POLARITY LINE (+/−) or FRAME (+/−) depending on the polarity of the sync signal. When VIDEO FRAME is selected, odd and even fields can be set by SLOPE (23) CH1 +/− or CH2 +/−. The polarity of the observed waveform may be reversed when moving from one monitoring point to another; Therefore, it may be necessary to switch from VIDEO POLARITY + to − (or − to +) or vice versa.

3) Field selection in single trace observation.
Set SOURCE in CH1 or VERT MODE, and synchronize the input VIDEO signal for CH1. Now odd and even fields can be selected using SLOPE CH1 +/−. For CH2, SLOPE CH2 +/− changes the field.

4) Field selection in dual trace operation.

- When SOURCE is set to VERT MODE, vertical MODE to ALT, and the same signal is applied to CH1 and CH2, the input signal of CH1 will be the trigger signal. Now odd or even field can be selected using SLOPE CH1 +/− or CH2 +/− respectively. When CH1 +/CH2 − or CH1 −/CH2 + is set, it is possible to view odd and even fields simultaneously.
- When SOURCE is set to VERT MODE and CH1 SEP mode is selected, SLOPE is CH1 +/− on the main and CH2 +/− on sub. Odd or even field can be selected respectivily. In the case of CH2 SEP mode, SLOPE is CH2 +/− on main and CH1 +/− on sub. When CH1 +/CH2 − or CH1 −/CH2 + is set, it is possible to view odd and even fields simultaneously.

OPERATIONS

<SWEEP MAGNIFICATION>

If a part of the trace were enlarged on the screen, that part which is selected for close observation might be off the screen, when the sweep rate is shorted. In such a case, the following procedure should be carried out. First, using the ◄► POSITION adjust the desired portion of waveform to center of the CRT. Secondly, depress X5 MAG (19) knob (▬) and the trace will be enlarged five times. The sweep rate in this case becomes one-fifth of the set value of SWEEP TIME/DIV.

<X-Y OPERATION>

By using the oscilloscope CS-1720 for X-Y operation, frequency response, frequency measurements, phase shift measurement and other similar measuring functions can be carried out. Turn the SWEEP TIME/DIV control fully counterclockwise to the X-Y position. The CH1 (or Y) signal indicates the vertical axis Y, and the CH2 (or X) signal indicates the horizontal axis X. Adjustment of the X-Y position is carried out using CH1 ▲▼ POSITION for the Y-axis and the CH2 ▲▼ POSITION for the X-axis. The sensitivity of both X and Y components during X-Y operation is controlled by VOLTS/DIV, VARIABLE in CH1 and CH2 respectively.

PROGRAMMING

Programming for the CS-1720 oscilloscope is carried out completely by console key operation. The keys are classified under three types according to the function.

1) Number keys

0 – 9

2) One-key operation

RESET, UP, DOWN, SCAN, PRNT, FREE,
EXT, SAVE, LOAD, A, B, C, D:

3) Multi-key operation

ALL WRT, PART WRT, STO, READ, STRT, END.
The operating contents of these keys will be changed at any time by pre-keying or further keying.

1. EXPLANATION OF CONSOLE FUNCTIONS

1) 0 – 9

These keys set up the step numbers and/or the block number for part writing. The keyed step number will be indicated on the seven-segment STEP LEDs. Two numbers will be indicated for steps 00 – 61, but only one figure will be indicated for block numbers 1 – 8.

2) RESET/STOP

Basically this key returns the programme to the START STEP of the sequence regardless of the set condition. The CS-1720 will then remain in the READ condition. In the case of SCAN or PRINT operation, this key serves as a pause or reset key. If the key is pressed once, in SCAN or PRINT operation, the CS-1720 will pause in the middle of the operation. If the SCAN or PRNT key is then pressed, operation will resume. If the RESET key is pressed twice in succession, the programme will return to the START position, PRINT or SCAN will stop, and the CS-1720 will remain in a READ condition.

3) UP

This control advances the step numbers one by one from the STEP number indicated. When END STEP is reached, it returns to START STEP of the step sequence. If no END STEP is set, or if the UP key is pushed beyond the END STEP key setting, steps will proceed to the last step 61, and will then return to the START STEP of the step sequence, and stop.

4) DOWN

Reduces STEP numbers one by one from indicated STEP number until START STEP of step sequence is reached, and it will stop. If there is no set START STEP, or if the DOWN key is pressed before the START STEP setting it will return to step 00, and then go on to the START STEP, and stop.

5) STEP SEQUENCE (A, B, C, D)

The combination between programme start and step can be set in up to 4 settings (A, B, C, D). Following the programmed STEP number, steps can then be set up at random continuously between 00 – 61. This combination is set from the A to D keys, and once selected, the oscilloscope will be in the READ condition at the start-step. The A, B, C, D programme is preset, and remains set when the power is OFF, being indicated by the appropriate LEDs when power is once again switched on.

6) SCAN

In READ condition, SCAN operation advances the steps one by one with a one-second interval between steps until the END STEP is reached, when it will return to the START STEP and stop in READ. However if no END STEP is set or if the SCAN key is pushed beyond the END STEP setting, the steps will be advanced until 61, after which it will return to the START STEP and stop.

Pause action: Pause in SCAN action is achieved by pressing the RESET key. If the SCAN key is again pressed, scanning will resume.

Cancellation: If the RESET key is pressed twice in succession, the SCAN action will be cancelled, and the CS-1720 will return to the START STEP, in read condition.

7) PRNT

Operates the printer, TP-1724, and the programme data are printed out. Printing is done from the step indicated and continues until step 61, when printing will stop and the CS-1720 will return to the START STEP in the step sequence.

Pause action: Pause of printing action is achieved by pressing the RESET key once. The printer will print up to the 8 block of that step, and stop. Pressing again the PRNT key will resume printing from the following step.

Cancellation: Cancelling printing is done by pressing RESET key twice in succession, when the CS-1720 will return to the START STEP of the step sequence, and printing will stop.

8) FREE

All programmed functions are cancelled, and the CS-1720 becomes a normal oscilloscope with manual control. At this time, FREE can be cancelled by pressing RESET.

9) EXT

The STEP number can be controlled by the external BCD signal, connected to EXT I/O. EXT action is only possible under READ condition, when the STEP SEQUENCE LED is off. When the external signal is disconnected, step sequence 00 is indicated. To cancel EXT action press RESET.

NOTE

During SCAN, PRNT, FREE, and EXT action, all keys except RESET are cancelled and inoperable.

10) SAVE

Transfers the RAM programme data in the memory of the CS-1720 to the memory pack MT-1725. This transfer is effected without changing the RAM contents of the CS-1720 internal memory. When data transfer is finished, a buzzer will sound and the READ or WRITE LED will flash once.

11) LOAD

Transfers the contents of the memory pack MT-1725 to the internal RAM of the CS-1720, without altering the memory pack contents. When the transfer is finished, the buzzer sounds and the READ or WRITE LED will flash as in SAVE above.

When the memory pack is not connected, LOAD will not operate to protect the data in the memory.

NOTE

If SAVE is pushed by mistake instead of LOAD, or vice versa, all important data will be changed. Accordingly be sure to press the correct key.

12) STRT

Start step sequence key. Used for setting up START STEP numbers and/or read out the start step number of the sequence.

13) END

End step sequence key. Used for setting up END STEP numbers and/or read out the end step number of the sequence.

14) READ

The read out key. When pressed, the green READ LED will light and programme will be read out at the indicated step. It operates according to the programme contents.

15) ALL WRT

All blocks are set in WRITE state completely and total panel control operation is possible; and red WRITE LED will light. All panel controls can be set up for programming.

NOTE

The data of the panel set up is stored into RAM only when STO key is pressed.

16) PART WRT

Selects part writing function both READ and WRITE LEDs light up and STEP LED is off.

Set up one of the block number keys from 1 to 8, which necessary to change the mode. In this case, only block number which has been set in PART WRITE state, is indicated in one figure. Panel control operation is possible in the only block which has been set up and can be set up for programming. All other blocks are set in READ state, therefore panel control operation is impossible.

NOTE

When STO key is pressed, part writing of only the block preset will be done, without altering the rest of the blocks.

If it is necessary to change the block number to be part written, press the desired key before pressing the STO key. After part writing is completed, the step number is advanced by one, and is so indicated. The oscilloscope will be in ALL WRT state.

17) STO

The memory activation key. It is used for all writing actions, ALL WRT, PART WRT, START STEP, END STEP.

ALL WRT: The programme setting of each panel switch in all blocks is stored as data, advancing the step number by one.

PART-WRT: Each panel switch programme setting in designated block only, is stored as data, advancing step number by one.

STRT/END: Sets up start steps and end steps of the programme and writes them.

OPERATIONS

2. PROGRAMME OPERATION

Referring to the section on manual oscilloscope operation, switch on the power switch. Check if any of the STEP (26), READ (27) LEDs and one of the STEP SEQUENCE LEDs are lit or not. With the green READ LED lit, the oscilloscope is ready for operation.

NOTE

If at the beginning of operation the first stage programme setting has not been done, all A, B, C, D LEDs may be lit and the buzzer may be sounding. In this case, reset A, B, C, D or push the RESET key. If the buzzer continues to sound, turn power OFF and check each external cable connection before switching on again.

When the oscilloscope is ready for operation, press the RESET key.

I) UP/DOWN Operation for STEP

Continuous STEP UP

With each operation of the UP key, STEP is advanced one by one. When END STEP is reached, it returns to the START STEP. If the UP key is pushed after the END STEP setting, the steps will be advanced until step 61, after which it will return to START STEP. If the UP key is pressed from a number below START STEP, the steps will be advanced till END STEP, and will then return to START STEP.

Continuous STEP DOWN

Each operation of the DOWN key will reverse the step numbers indicated by one, until the START STEP is reached, and operation will stop. If the DOWN key is pressed at a number below the preset START STEP, the steps will go down to 00, then to START STEP and operation will stop. If DOWN is keyed beyond END STEP preset number, normal decrease of steps occurs till START STEP, then operation will stop.

II) START STEP, END STEP Setting

a) STEP SEQUENCE setting

Select one of the keys from A to D and push. The corresponding LED will light up.

b) START STEP setting

Using the number keys, indicate in the window the number of the required step. Push START and STO key in that order, then the START STEP is set up.

c) END STEP setting

Using the number keys, indicate in the window the required number. Push END and STO keys in that order, and the END STEP is set up. Now the programme extent has been set up and recorded in the memory. Using the same procedure as above, three other sequence can be set up.

III) START – END STEP Reading out

a) STEP SEQUENCE selection

From A to D keys select the key to be read, and push it. At this time the START STEP number is indicated in the STEP (26) window, and the oscilloscope will be in the READ state.

b) START STEP, END STEP reading

By pushing START and READ keys in that order, start step reading is possible; similarly, if END and READ keys are pushed in that order, end step reading can be carried out.

IV) PROGRAMME Writing Operation

(1) ALL WRITE

a) STEP Number setting

Set up STEP number for STEP (26) using number keys or UP/DOWN key.

b) ALL WRITE setting

When ALL-WRT key is pushed, the green READ LED will go out, and the red WRITE LED will light. In this setting, panel operation of the oscilloscope is possible.

c) Writing in

By pushing STO key, the setting of every control is stored into the memory. The STEP number is advanced by one to the next step, and the oscilloscope is still in the WRITE condition.

d) Continuous writing in

Under setting (c) above, if each switch is set up and the STO key operated in that order, the programme can be continuously written in.

(2) PART WRITING in

a) STEP number setting

Set up as for ALL WRT above.

b) PART WRITING in setting

By pushing PART WRT key, the STEP LED (26) will go out, and the green and red LEDs of READ and WRITE will light up; the oscilloscope is now in PART WRT condition. Set up the desired block number from 1 to 8, using the number keys. The number will be indicated in the STEP window of the front panel. Panel operation is only possible for the preset block, and the setting for each control will be written in. All other blocks are in READ condition, and panel operation with them is not possible.

c) Writing in

By pushing STO key only the memory of the contents of the set up block can be changed. The STEP number is advanced by one to the next step, and the CS-1 720 is in ALL WRITE condition.

V) Programme Reading Operation

(1) Setting up for READ condition

a) Reading of START STEP

By keying RESET or STEP SEQUENCE, START STEP reading condition is achieved. In this case reading from programme in the STEP SEQUENCE can be continuously carried out, using the UP key.

b) Reading of direct STEP

Set up the desired step numbers using the numbers key or UP/DOWN key. The numbers will be indicated in the STEP window (26) on the CS-1720 front panel. By pressing READ key any step can then be directly read.

VI) Manual Operation of CS-1720 Oscilloscope

When FREE key is pressed, all programmed functions are cancelled and manual operation of the CS-1720 is possible as for any normal oscilloscope. The LEDs for STEP, READ, WRITE, and STEP SEQUENCE are all off. All keys except RESET cannot be used. By pushing the RESET key, FREE action is cancelled.

VII) Automatic Step Transfer Operation

In READ condition, pushing the SCAN key automatically advances the STEP setting from the indicated step through to the end, with a period of about one second between steps. When the end step is reached, the CS-1720 automatically returns to the START STEP and stops.

During SCAN operation, all keys except RESET are inoperable.

Pause action: During SCAN operation, pushing the RESET key will temporarily stop the action. To continue, press the RESET key once again.

Cancellation: The SCAN operation can be stopped if the RESET key is pressed twice in succession. In such a case, the CS-1720 will return to the START STEP and stops.

OPERATION OF OPTION

I) Probe Selector Control and Operating Instructions

The Probe Selector (RU-1722, RU-1723) control can be used in combination with CH1 input, CH2 input, and EXT input of the CS-1720. Also, manual operation of the oscilloscope with the probe selector is possible after pushing FREE key. In Programmed action, the selector becomes the programme section for one part of blocks 7 and 8.

a) Connections with RU-1722

In combination with RU-1722, inputs can be selected as follows:

CH1; 5 inputs
CH2; 5 inputs
EXT; 3 inputs

b) Connections with RU-1723

The following inputs can be selected in combination;

CH1; 10 inputs
CH2; 10 inputs
EXT; 3 inputs

NOTE

(1) The probe selector (RU-1722, RU-1723) power is interconnected with the CS-1720 oscilloscope. For detailed connection and operation instructions, refer to the probe selector instruction manual.
(2) When connecting and disconnecting the probe selectors, make sure power switch of the CS-1720 is in the OFF position.
(3) Use CH1 and CH2 input coupling of oscilloscope in the AC position.

II) Operation of The Printer

Connect the Thermal printer TP-1724 to the PRINTER I/O connector on the rear panel of the CS-1720, referring to the printer TP-1724 instruction manual for detailed instructions. Pressing PRNT key activates the printer, and a hard copy of the programme data is printed out, from the step indicated at the time of pressing the PRNT key to step 61, whereafter it will return to START STEP and stop. During printing, the step number indicated on the CS-1720 STEP window will not alter, and all keys except RESET are inoperable.

Pause action: During PRINT action, press RESET key. Print-out will continue till the end of that step, and stop. When PRNT key is pushed again, print-out will continue from the next step.

Cancellation: Print operation can be fully stopped if the RESET key is pressed twice in succession. Print-out will stop, and the CS-1720 will return to START STEP.

NOTE

If PRNT key is pressed when the printer is not or improperly corrected, a warning buzzer will sound. The buzzer can be cancelled by pressing RESET key.

III) Programme Transfer

By connecting Memory Pack MT-1725 to the EXT I/O connector on the rear panel of the CS-1720, data of internal RAM can be transferred in or out.

a) From CS-1720 to Memory Pack MT-1725

By operating SAVE key, programme data contents of the RAM are transferred to the Memory Pack MT-1725.

b) From Memory Pack MT-1720 to CS-1720

By pressing LOAD key, contents of memory pack will be transferred to CS-1720 internal RAM.

both transfer modes, the programme contents of the nsferring unit remain unaltered. When transfer is nplete, a buzzer will sound, and the READ or WRITE LED flash once.

NOTE

When the memory pack is not connected, LOAD key is not effect to protect the data. When connecting or disconnecting the memory pack, be sure power is OFF in order to protect the data. In addition, do not subject the equipment to electrical shocks, due to the fact that the body contains the back-up battery for the memory. High temperature and humidity should also be avoided. When the Memory pack back-up battery is low, the STEP LEDs will flash on and off indicating a change of battery is necessary. If a mistake is made, and SAVE is pressed instead of LOAD, or vice versa, the data will be lost, therefore great care should be taken to push the correct button.

VI) Step Control Operation from External BCD Signal

Step numbers can be controlled from an external BCD unit connected to the EXT I/O socket on the rear of the CS-1720 body. EXT operation is only possible in READ operating condition, with STEP SEQUENCE LED off. If no external signal is connected, when this key is pushed, step 00 will be indicated. To cancel EXT operation, push RESET key.

CIRCUIT DESCRIPTION

GENERAL

Refer to the block diagramme

The programmable part of oscilloscope CS-1720 is an all-logic control circuit. Logic control means that the oscilloscope is controlled by the logic signal only, without selector switches. Thus in the programmable computer CS-1720, there are many relay switches, analogue switches and transistor switches. This logic signal controls several circuits from CPU unit memory through the output port of I/O unit. The logic signals coming from the various switches on the front panel of the CS-1720, remote control unit , probe selector, etc. are connected to the input port of the I/O unit, and can be stored into the CPU unit memory using the STO key on the keyboard. The memory, switches, and circuits are related to each other as indicated in Fig. 6-1 (Input/Output Port is abbreviated).

SWITCH, ENCODE, DECODE CIRCUIT

The I/O unit is in the center of the connection diagrammes 7-1 and 7-2. In Fig. 6-1, the SWITCH is shown on the left side and the CIRCUIT is shown on the right side of the connection diagram 7-1, 7-2. FI17 and FO17 circuits as seen in the diagramme have the following meanings:

F.....Function
I.....Input port (switch side) signal
O .....Output port signal (circuit side)
1.....1 is a sample number from number 1-8. These numbers correspond to the block numbers located on the control panels of the CS-1720 oscilloscope, the remote control unit and the probe selector unit. 1 is the channel 1 VOLTS/DIV, AC/DC switch position.
7.....Each block is composed of 0-7 8 bits. The bit number is this number. No. 7 corresponds to the AC/DC switch of CH1.

For example, if the signal level of FI17 is high, the CH1 AC/DC switch is set to AC. When the level is low, DC is selected. When the signal level of FO17 is high, then CH1 AC/DC switch is set to AC coupling; when the level is low, DC coupling is selected. To know the switch position and the port bit pattern refer to troubleshooting section, Table 9-1 and 9-2. Since there are many contact points in the SWEEP TIME/DIV switch, use the encoder and convert to 6 bit (FI50-FI55).

R8-R36 and C8-C36 of the vertical logic unit act as a noise rejection filter.

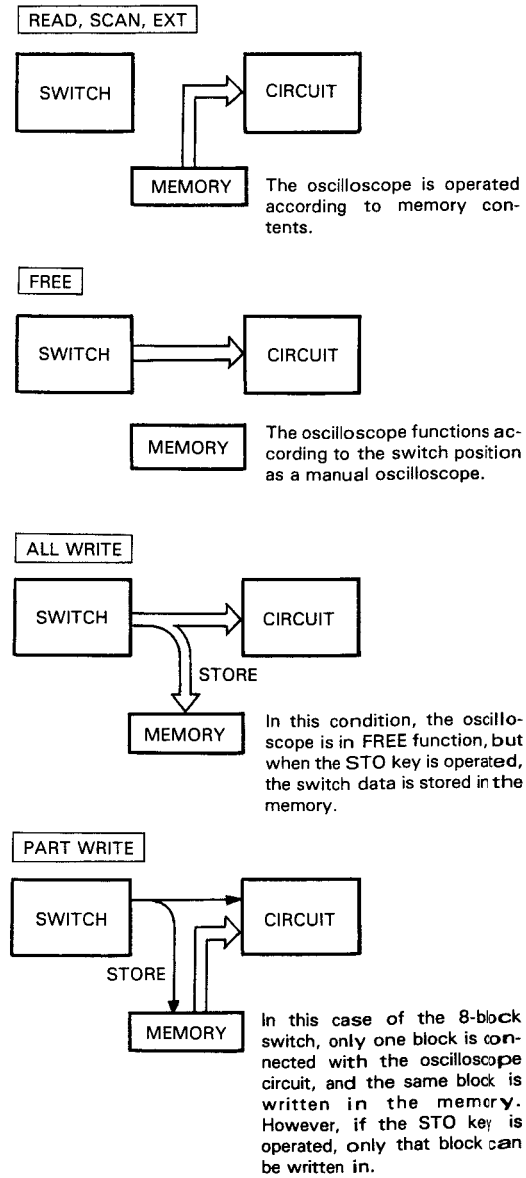


Fig. 6-1

ATTENUATION CIRCUIT

Refer to connection diagramme 7-3

Attenuation circuit selection is achieved using relays. By using the attenuation circuit, attenuation of 1/1, 1/10, 1/100 and 1/1000 can be achieved. The 1/1000 attenuation is achieved by using the 1/10 and 1/100 attenuation in series connection. An attenuation sequence of 1-2-5 selector is composed of the vertical amp unit RL1 -RL4. These relays switch the amplifier load resistance and change the gain. The relationship between VOLTS/DIV and each control signal is shown in toubleshooting section, Table 9-4. When the AC-GND-DC switch is in the GND position, RL1 and RL5 are activated. RL2 is the relay for AC/DC selection. Q1-Q4 is a buffer amplifier which is an impedance converter.

CIRCUIT DESCRIPTION

VERTICAL AMPLIFIER

The converted impedance signal in the attenuator unit is amplified in the vertical amplifier unit. This amplifier is composed of 5 steps involving CH1 and CH2 selector circuit and trace separation circuit, obtaining a gain of approximately 50 dB. These amp units are all composed of differential amplifiers with cascode series stages, except for the trace separation circuit. The first and second stage amps use a constant current source in order to obtain a high CMRR (COMMON MODE REJECTION RATIO). (CH1, Q3, Q6 and Channel 2, Q37, Q40). The second stage amplifier operate GAIN VERIABLE PRESET. Refer to connection diagram 7-4.

FET's Q9 and Q10 in the vertical amplifier unit control CH1 GAIN VARIABLE resistor. When GAIN PRESET is set to CAL, the gate voltage of the FET circuits becomes lower than the pinch off voltage; the value of the resistance R_{DS} between drain and source becomes very high. When gate voltage is high, R_{DS} value is small, and when gate and drain voltages are same level, R_{DS} value is several tens ohm. In this case the second amp gain is at minimum. VR1-VR4 and VR6-VR9 of the attenuator unit act as preset for this gate voltage. IC1 and IC2 in the vertical logic unit act as the analogue switch, and select one of the preset voltage levels. CH1 and CH2 GAIN volume controls of the remote control unit are pull/push switches. When these switches are pulled, INH (INHIBIT) of IC1 and IC2 is at a high level, and the FET gate is separated from the preset volume, and connected to the GAIN volume control of the remote control unit.

The third amplifier effects preset of the vertical position. Vertical position is also controlled by DC, the same as GAIN PRESET. This DC voltage is supplied to the base of Q15 and Q16 of CH1 and Q51 and Q52 of channel 2. Fig. 7-5 is the circuit diagramme of the POSITION PRESET function. The position control signal (CH1/CH2, POS1, POS2) is obtained by IC and transistor switch of the remote control unit. In the third amp on channel 2 side, INVERT operation is carried out in addition to vertical position . In the usual case Q47 and Q48 are operated as differential amplifiers, and Q49 is in cut off state. In the case of INV operation Q49 and Q50 are on; Q47 and Q48 are cut off, and as a result of this, phase is inverted. Q53-Q56 operate as the selector switches for the above operation.

The CH1 OUT amplifier consists of Q21, Q22 and Q31-Q34. Q31-Q34 act as the darlington connected complementary symmetry emitter follower with an output impedance of approximately 50 Ω.

Q63 and Q64 act as the amplifier in CH2 X-axis, during X-Y operation. Q23 and Q24 act as the trigger amplifier for channel 1, and for CH2, Q61 and Q62.

Q25-Q30, Q65-Q70, Q75, and Q76 also act as amplifiers by means of selector circuits CH1 and CH2. When Q of P13 is at a high level, and $\overline{Q}$ is at a low level, Q68 and Q69 are OFF. In this case, CH1 is selected. If on the other hand Q is low and $\overline{Q}$ is high and Q28, Q29 are OFF, CH2 is selected. In the ADD state, Q and $\overline{Q}$ levels are both high. When ADD is selected, Q71 and Q72 are the transistor switches, whose function is to keep the operational level of the circuit constant.

Q73 and Q74 are the amplifiers to pick up the trigger source when VERTICAL MODE is selected. The output of CH1 and CH2 selector circuit goes into the trace separation circuit Q77-Q89 through the delay line. When SEP switch is OFF position, in P12 the TS is low, $\overline{TS}$ is high, Q81 and Q82 are OFF, and Q79 is ON. When SEP switch is ON position, during sub sweep operation, TS is high, $\overline{TH}$ is low, Q79 is OFF, and Q80 is ON. According to the voltage of SEP position of P14 the current from Q80 is supplied to Q77 and Q78 and position is moved. Q84 and Q85 make up the amplitude limiter system so as not to saturate the vertical output amplifier. Q86-Q89 are buffer amplifiers and have a low output impedance.

Q90-Q95 are the transistor switches in order to select the trigger signal for CH1, CH2, V. MODE. According to the $\overline{CH1}$, $\overline{CH2}$ and $\overline{V.\ MODE}$ signal, of P10, the output is realised as the trigger source at P11.

SWEEP UNIT

The internal sync signal from the vertical amplifier unit goes in to the trigger source selector circuit through Q1 and Q2 amplifier circuit. The relays RL1 and RL2 select the sync signals INT, EXT and LINE. RL3, RL4 and Q7 make up the trigger source coupling change-over circuit. When $\overline{DC}$, $\overline{LF_{REJ}}$ and $\overline{HF_{REJ}}$ are in high level, AC coupling comes into effect. Q5 and Q6 comprise the FIX SYNC circuit, and detect positive/negative peak-levels of the trigger source; the center value between positive and negative levels acts as the trigger level. Q8 ~ Q20 are trig amplifier. A Schmidt circuit restores the trigger amplifier output, and after various operations, the trigger amplifier output becomes the clock for flip-flop IC7a as a trigger pulse.

Fig. 6-2 is a detailed block diagram of the above circuit. When the trigger coupling is not set to VIDEO, the trigger amplifier output signal is fed to the Schmidt circuit. This output becomes the clock after selected by SLOPE of P39. When the trigger coupling is set to VIDEO, from the trigger amplifier output signal, the emitter of Q19, only the SYNC signal is picked up by the SYNC separation circuit (Q20). When VIDEO FRAME operation is selected, Q21 is the integral circuit switch to remove the LINE SYNC signal. The SYNC signal through the integral circuit appears in each field. This signal is divided by IC7b and is synchronized

with FRAME. The gate circuit of IC3 selects LINE and FRAME. The VIDEO SYNC signal polarity is selected by IC4c and IC4d.

The AUTO circuit is composed of IC4a and IC4b, and Q23, Q24 of the sweep unit. If there is no trigger signal when the AUTO/NOR switch is set to AUTO, the input signal of NAND GATE, IC6d, goes into high level, and sweep is started when the HOLDOFF circuit is in the positive timing. When there is a trigger signal, or when the NOR position of the AUTO/NOR switch is selected, the AUTO circuit output falls to the low level and sweep is synchronised with the negative timing of IC7a clock.

Fig. 6-3 shows the basic circuit of the sweep generator. When Q25 is OFF, according to the SWEEP GATE signal, the timing condensers C30 and C31 are charged by the constant current circuit (Q35), decided by the timing resistors, (R91-R101), and sawtooth wave is obtained. When this sawtooth wave reaches a prescribed level, the Schmidt output of the HOLDOFF circuit is inverted, the sweep gate signal rises to high level, and Q25 is switched on. As a result of these processes, the timing condenser is discharged. The timing resistor R_T is selected by the selector switch composed of Q36 to Q51. In addition the timing condenser can be altered by the switch composed of Q28-Q33. The selector signal is controlled by $\overline{RT1}$-$\overline{RT8}$ and $\overline{CT1}$-$\overline{CT7}$ of P41. Refer to Table 9-3 indicated troubleshooting.

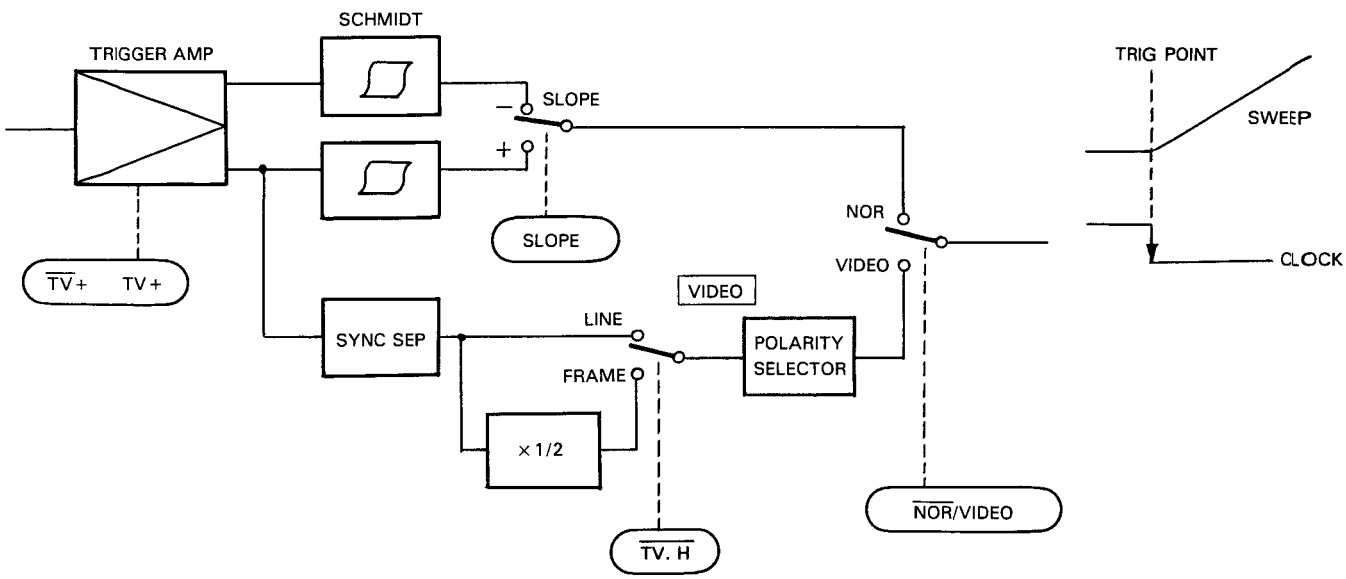


Fig. 6-2 Detail Block Diagram of Trigger Logic

CIRCUIT DESCRIPTION

DC voltage is added to the base of Q35 in order to carry out SWEEP VARI PRESET. This voltage controls the constant current source output. The SWEEP TIME VARI PRESET circuit can be seen in connection diragram 7-6. The preset voltage is set by VR1-VR4 of the horizontal switch unit, and is selected by the switch (Q1-Q4). If the SWEEP TIME VARI volume switch is pulled (on the remote controller), switch Q1-Q4 is OFF and depending on the position of VR15, the preset voltage is changed.

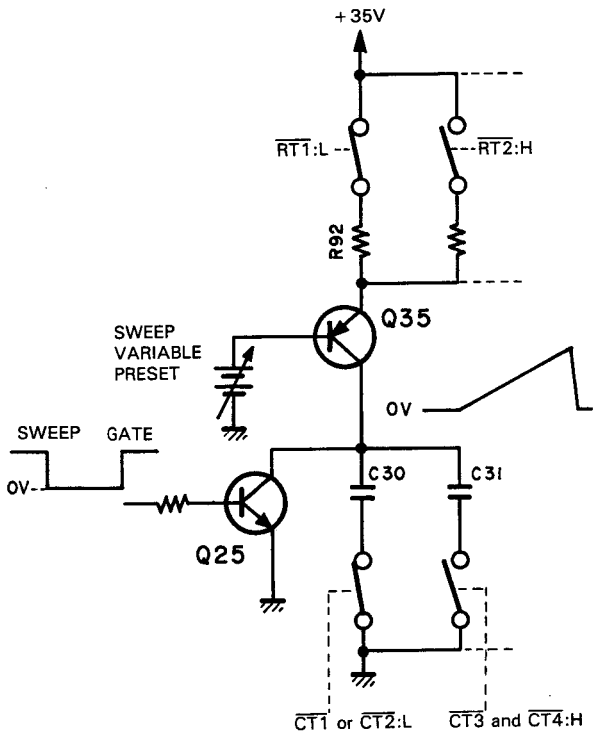


Fig. 6-3 Basic Circuit of Sweep Generator

IC8b, IC8c, IC10, Q27 and Q28 of the sweep unit comprise the HOLDOFF circuit. The sawtooth waveform signal, impedance is converted by Q54, is added to the Schmidt circuit composed of Q27, Q28, IC8b and IC8c. When the sawtooth waveform signal is above the prescribed level, the Schmidt circuit output is inverted, the sweep gate level is high and the timing condenser is discharged. At this time, D25 is OFF, so the input to the Schmidt circuit falls by a time constant, determined by hold-off condensers C24-C29 and R77. When the voltage drops below the hysterisis level of the Schmidt circuit, the Schmidt output level is high, and goes into trigger wait condition. IC10 is the HOLDOFF condenser selector switch. In the 0.5μs and 0.2μs ranges, all switches are OFF, and the HOLDOFF condenser becomes a stray capacitor for the switch. The waveform of each part is illustrated in Fig. 6-4

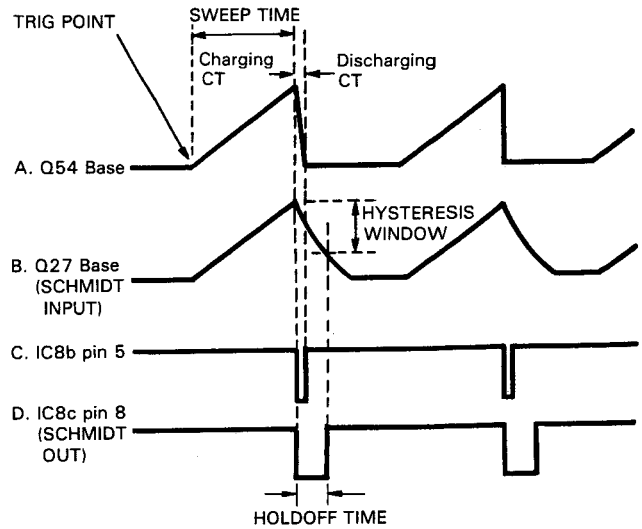


Fig. 6-4 Waveform of HOLDOFF Circuit

IC9a and IC9d form the CHOP selector oscillator circuit, with a frequency of approximately 400 kHz. IC9b and IC9c act as chop oscillator and as blanking signal from SWEEP GATE signal and have signal Qo which select vertical axis CH1 and CH2. Q56 and Q57 form the selector switch in order to send the X-axis signal to the horizontal amplifier, in X-Y operation. Q60 and Q61 control the base bias of the transistor switches. The calibaration voltage generator circuit is composed of Q63-Q65.

VERTICAL OUTPUT AMPLIFIER UNIT

The signal from the vertical amplifier is amplified by the vertical output amplifier unit with a gain of 20 dB. Q5 is the active load of the cascode amplifier Q1 and Q3; peaking is carried out by C11.

VERTICAL AND HORIZONTAL LOGIC UNIT

Refer to the connection diagramme, 7-2. In the vertical and horizontal logic unit, encode/decode, vertical mode, trigger source, and coupling slope signals are converted to achieve perfect control of the vertical amplifier and sweep unit. IC9b acts as a flip-flop for CH1 and CH2 selection in the vertical amplifier. RS flip-flop operation is carried out by $\overline{\text{CH1 SET}}$ and $\overline{\text{CH2 SET}}$ in single trace operation. In dual trace operation, CH1 and CH2 selection are carried out by the negative edge of the clock input. In ALT mode the timing is effected by the end of the sweep, and in CHOP, the CHOP signal carries out the timing.

IC9a selects trace separation using the negative edge of the sweep gate signal. IC5-IC7, and IC8b, IC8c and IC8d produce the signal for selection of the trigger source; these

signals are $\overline{\text{V.MODE}}$, $\overline{\text{CH1}}$ and $\overline{\text{CH2}}$, from the vertical mode signal, trigger source and the vertical selector signal (Q). IC4 and IC8b are the switches for slope selection. Refer to Fig, 6-5 for the time chart.

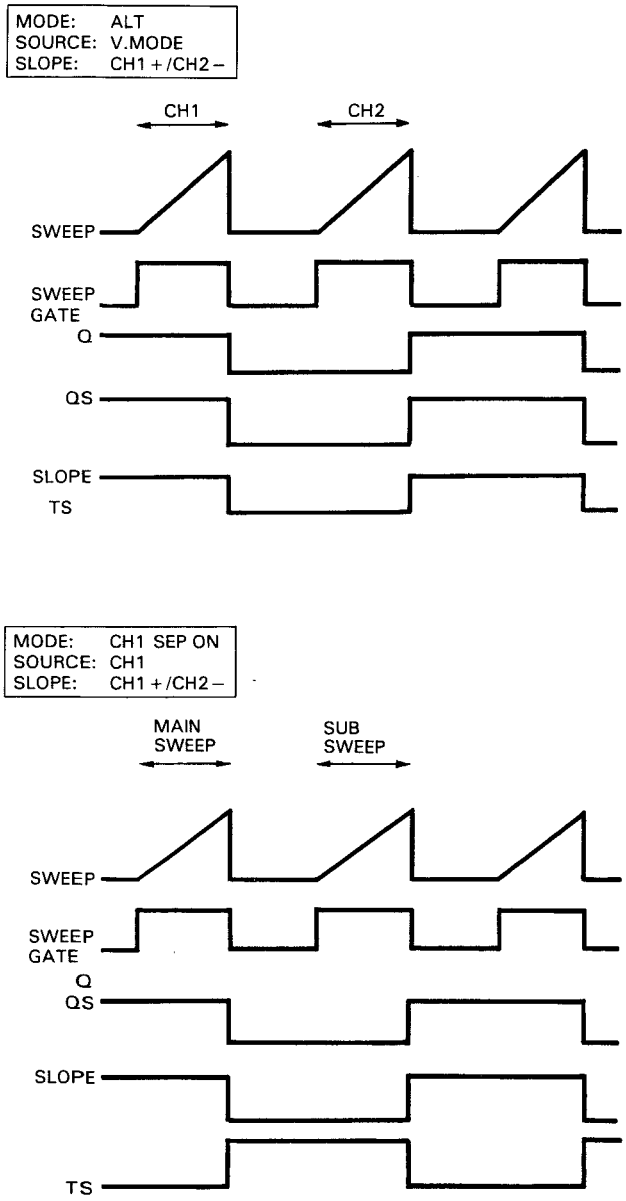


Fig. 6-5 Time Chart

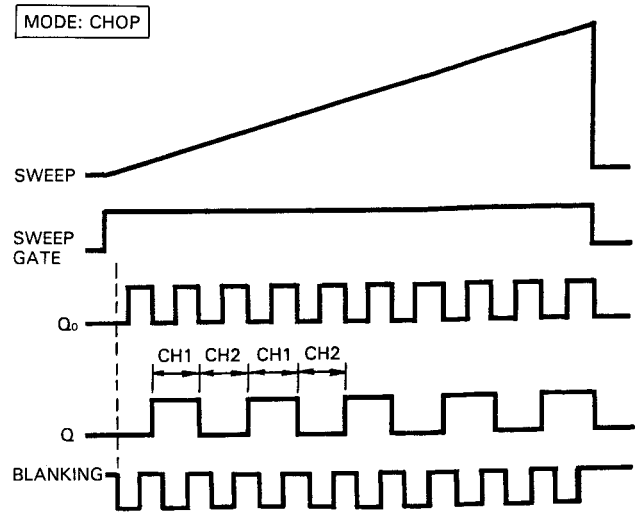


Fig. 6-6

HORIZONTAL AMPLIFIER UNIT

The horizontal amplifier unit is composed of two stages. The front stage of the amplifier, Q5 and Q6 operates the X5 MAG function by selecting the gain. Q1 and Q3 are the switches for the above function. Q2 and Q4 act as the constant current regulator. D6 and D7 act as the clip diodes in order to avoid saturation of the following amplifier stage. The second stage amplifier is composed of Q9-Q12. C11 is the peaking condenser, to improve the high frequency response.

POWER BLANKING UNIT

Of the six voltage systems output from the switching power circuit, all but the +55 V are doubly stabilized by a series regulator. Q1-Q7 are its control transistors. IC1 and IC2 are the error amplifiers. The CRT high tension voltage is obtained from a DC-DC converter. Q21 is the blocking oscillator and is connected to the converter transformer in P61. 6.3 V, the negative line of −1500 V and the positive line of 4.5 kV are delivered already stabilised. Q17-Q19 act as the error amplifier. The blanking circuit is composed of Q12-Q14, Q23 and Q24. Q15 carries out the switching for these outputs. DC reproduction takes place on the first grid of the CRT. The autofocus circuit is controlled by Q10 and Q11. The blanking waveform and reverse phase signal are added to the focus electrode of the CRT. Q16 is the DC reproduction circuit. Q22 is the external brightness modulator circuit. When the TTL level is high, the brightness of the trace is increased. Q8 and Q9 are the transistors for trace rotation circuit.

CIRCUIT DESCRIPTION

CPU CIRCUIT COMPONENTS

CPU: μPD8085AC (IC11)
Central processing chip of the CPU Board.

ROM: MB8516ZC or MB2732A (IC6)
Programed Rom. This Rom is FAMOS Type, and 2 kilobytes or 4 kilobytes size.

RAM: MB8414 (IC2, 5)
For data storage and subroutine stack. The ram is synchronous type CMOS RAM and 1 k×4 bits size.

ADDRESS LATCH: MB74LS373 (IC8)
The lower 8 bits of the CPU ADDRESS bus is multiplexed with DATA bus, ADDRESS bus is separated by ALE signal from CPU chip. The lower 8 bits of ADDRESS bus is latched by the IC with ALE signal.

LOW BATTERY LEVEL DETECT CIRCUIT (IC4)
The circuit detects Battery Level down to protect RAM's data. If Battery is down, the circuit send a signal to CPU's RST5.5 terminal, and external signal from Memory pack is same.

POWER SUPPLY LEVEL DETECTER AND EXTERNAL BATTERY LEVEL DETECT CIRCUIT. (Q3 AND, PIN 11 AND 12 OF IC10)
To protect RAM's DATA, when power switch is operated the circuit disable to access the RAM from CPU. And when power level reach about 4.7 V, the circuit enable to access the RAM.

ADDRESS DECODER: M74LS138 (IC3), M74LS32 (IC1)
The circuit makes chip enable signals for many circuits, for example on CPU board's RAM ROM, memory pack etc. The circuit also makes signals ANDed $\overline{WR}$ signal for I/O board using IC1.

PRINTER DRIVER: 2SC536 (Q4)
The circuit transfer signal from CPU's SOD terminal to printer's ports.

MEMORY DISABLE CIRCUIT: 2SC945 (Q1)
The circuit disable to access to the RAM, when power line level reaches about 4.7 V.

OTHER CIRCUITS
(1) IC10 f:
Buffer for HOLD signal from CPU chip.

(2) IC10 d:
When HOLD signal comes high level, IO/$\overline{M}$ signal goes three state.

(3) IC10 b:
When HOLD signal comes high level, output $\overline{WR}$ signal from the IC goes three state.

(4) IC10 a:
When HOLD signal comes high level, output $\overline{RD}$ signal from the IC goes three state.

(5) IC 7 b:
Bus transceiver controll to access from CPU chip to external or internal circuit.

CIRCUIT DESCRIPTION

CPU CHIP μPD8085 PIN CONNECTION

Number	Sign	Function
1	X_1	X Tal connection terminal
2	X_2	X Tal connection terminal
3	RESET OUT	For RESET output signal
4	SOD	Serial data output port
5	SID	Serial data input port
6	TRAP	This input is not subject to any mask or interrupt enable/disable instruction. The receipt of a positive-going edge on the TRAP input triggers the processor's hardware interrupt sequence.
7	RST 7, 5	Negative edge of input interrupter
8	RST 6, 5	High level input interrupter
9	RST 5, 5	High level input interrupter
10	INTR	High level input interrupter
11	$\overline{INTR}$	INTR interrupter
12	AD_0	Address data of least significant bit LSB
13-19	$AD_1 \sim AD_7$	Address data of numbered bits, 1 ~ 7
20	Vss	GND terminal
21-27	$A_8 \sim A_{14}$	Bit address data, 8 ~ 14
28	A_{15}	Address data of most significant bit MSB
29	S_0	Status signal (refer to Table 6-2)
30	ALE	Address latch negative edge signal
31	$\overline{WR}$	Address latch positive edge signal
32	$\overline{RD}$	CPU-BUS read signal
33	S_1	Status signal (refer to another fig)
34	IO/$\overline{M}$	Memory I/O select signal memory (memory select in low level)
35	READY	Signal for temporary stop of CPU (stop in low level)
36	$\overline{RESET\ IN}$	RESET input signal (RESET in low level)
37	CLK	CPU CLK output terminal
38	HLDA	CPU HOLD acknowledge signal
39	HOLD	HOLD require signal from CPU
40	Vcc	+5V

Table 6-1

CPU STATUS

Terminal	IO/$\overline{M}$	S_1	S_0	Status
	0	0	1	WRITE to MEMORY
	0	1	0	READ from MEMORY
	1	0	1	Write to I/O
	1	1	0	READ from I/O
	0	1	1	FETCH of OPE code
	1	1	1	Acknowledgement of INTERRUPT
		0	0	HALT

Table 6-2

Mμ8516 ZC PIN CONNECTION

Pin Number	Sign	Function
1-8	A_7-A_0	Address bits, 7-0
9-11	D_0-D_2	DATA bits 0-bits, 2
12	GND	GND terminal
13-17	D_3-D_7	DATA bits, 3-7
18	$\overline{CE}$	Chip Select signal (in low level)
19	A_{10}	Address bit, 10
20	$\overline{OE}$	Signal to open output buffer of PROM
21	Vpp	Programme voltage terminal
22	A_9	Address bit, 9
23	A_8	Address bit, 8
24	Vcc	Power supply terminal

Table 6-3

Voltage value of each component

Power supply.....5 V ±5%
Battery voltage .....2.7 V-3.4 V
Zenner diode .....D3, approx 2.8 V

CPU μPD8085 Output frequency from P37

1.793 MHz ±5%

CPU Terminal Levels in Normal Operation

TRAP terminal .....LOW
RST 6.5 .....LOW (High level when battery power is low)
HLDA.....LOW
RST 5.5 .....LOW (HIGH with operation of key)

Other terminals are dynamic operation.

CIRCUIT DESCRIPTION

I/O CIRCUIT COMPONENT

Oscilloscope control port: M74LS374
Input port from panel switch: M74LS373
7 segments LED indication port: TC4511
Output port decoder: M74LS138
Input port decoder: M74LS138
Key board driver port: M74LS196
Key board input port: M74LS126
Buzzer step sequence LED port: M74LS374
Auxiliary logic circuit: M74LS02

MEMORY MAP

	READ	WRITE
0 ~ 0FFF	PROM	
1000 ~ 13FF	RAM	RAM
3000		KEY DRIVE PORT
4000		7 SEGMENTS LED INDICATION PORT
5000		STEP SEQUENCE BUZER LED PORT
6000	KEY BOARD RETURN	MEMORY PACK RESET
7000	MEMORY PACK DATA	MEMORY PACK DATA
8000 ~ 800F	OSCILLOSCOPE CONTROL PORT	OSCILLOSCOPE CONTROL PORT

Note: Involves FF 16 expansion version

Table 6-4

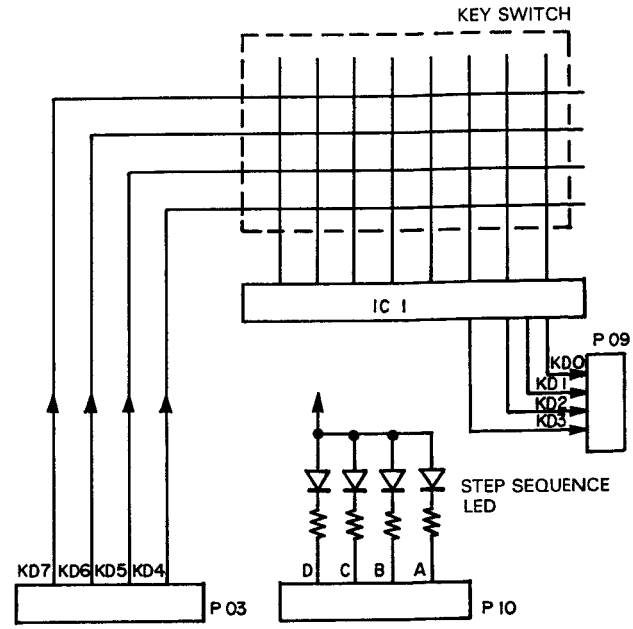
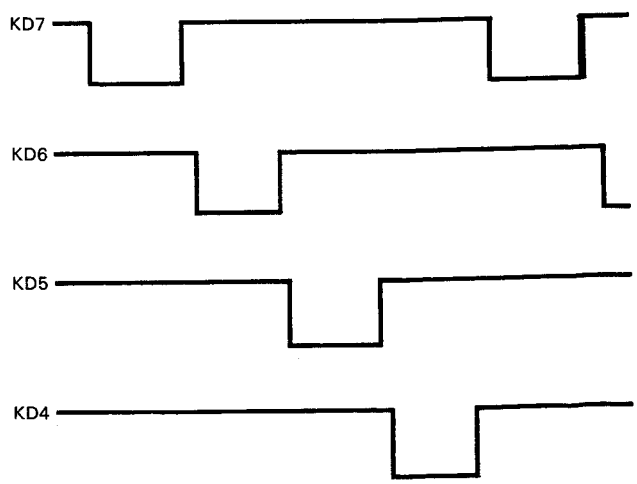


Fig. 6-7



Note: The software preset the timing, therefore timing is not constant as shown. When the key is depressed, the level of the key drive line is raised to high level.

Fig. 6-8

KEYBOARD UNIT

Located in RT-1721 control unit
Using IC units, SN74LS148
To encode the signal from the keyboard.

OPERATION

The drive signal originates from the I/O board of the main body (refer to Fig. 6-7). This signal is the input from P03, and if the key is not pushed, then the output signal from P09 is in high level at KD0-KD2, and at KD3 it is in low level. When the key is operated, the level of KD3 is raised to high, and the code corresponding to the key is output at KD0-KD2. This P03 key drive signal is cancelled. (refer to Table 6-5)

CIRCUIT DESCRIPTION

MEMORY PACK OPERATION

BUS TRANSCEIVER

Buffer between main body of CS-1720/and memory

MEMORY

COUNTER

Counter deciding memory address

OTHER CONTROL CIRCUITS

TC4001

Pins 9, 10, 11

Clock for address counter

Pins 1, 2, 3

Counter RESET signal

TL061

Backup battery monitor

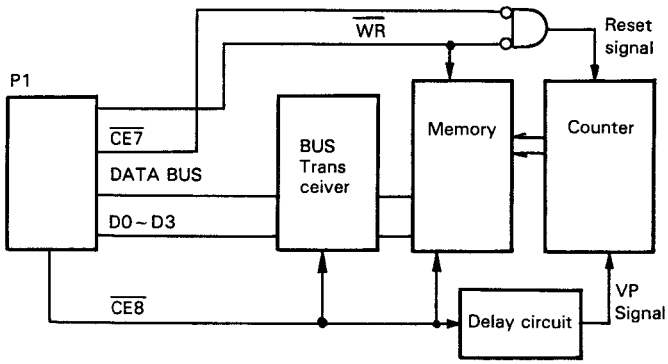


Fig. 6-9

KD0	KD1	KD2	Corresponding key
0	0	0	A, STO, 7
1	0	0	S24, DOWN, READ, 6
0	1	0	S23, D, ALL WRT, 5
1	1	0	PRNT, SCAN, PART WRT, 4
0	0	1	SAVE, UP, END, 3
1	0	1	LOAD, RST, START, 2
0	1	1	EXT, C, 9, 1
1	1	1	FREE, B, 8, 0

Table 6-5

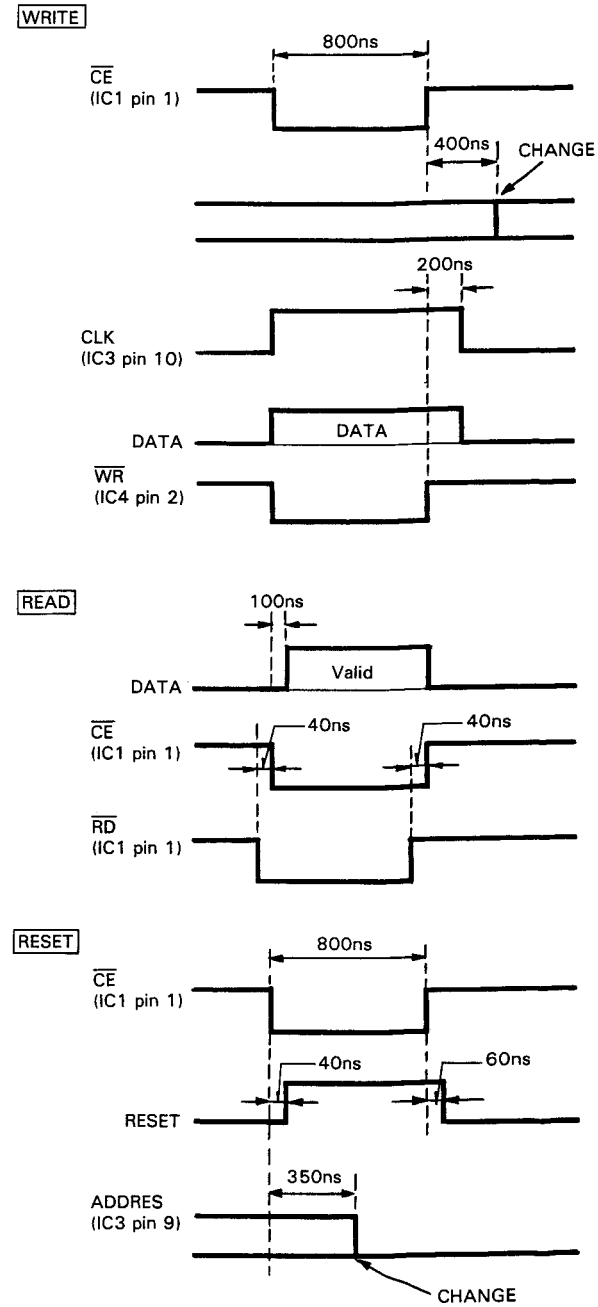
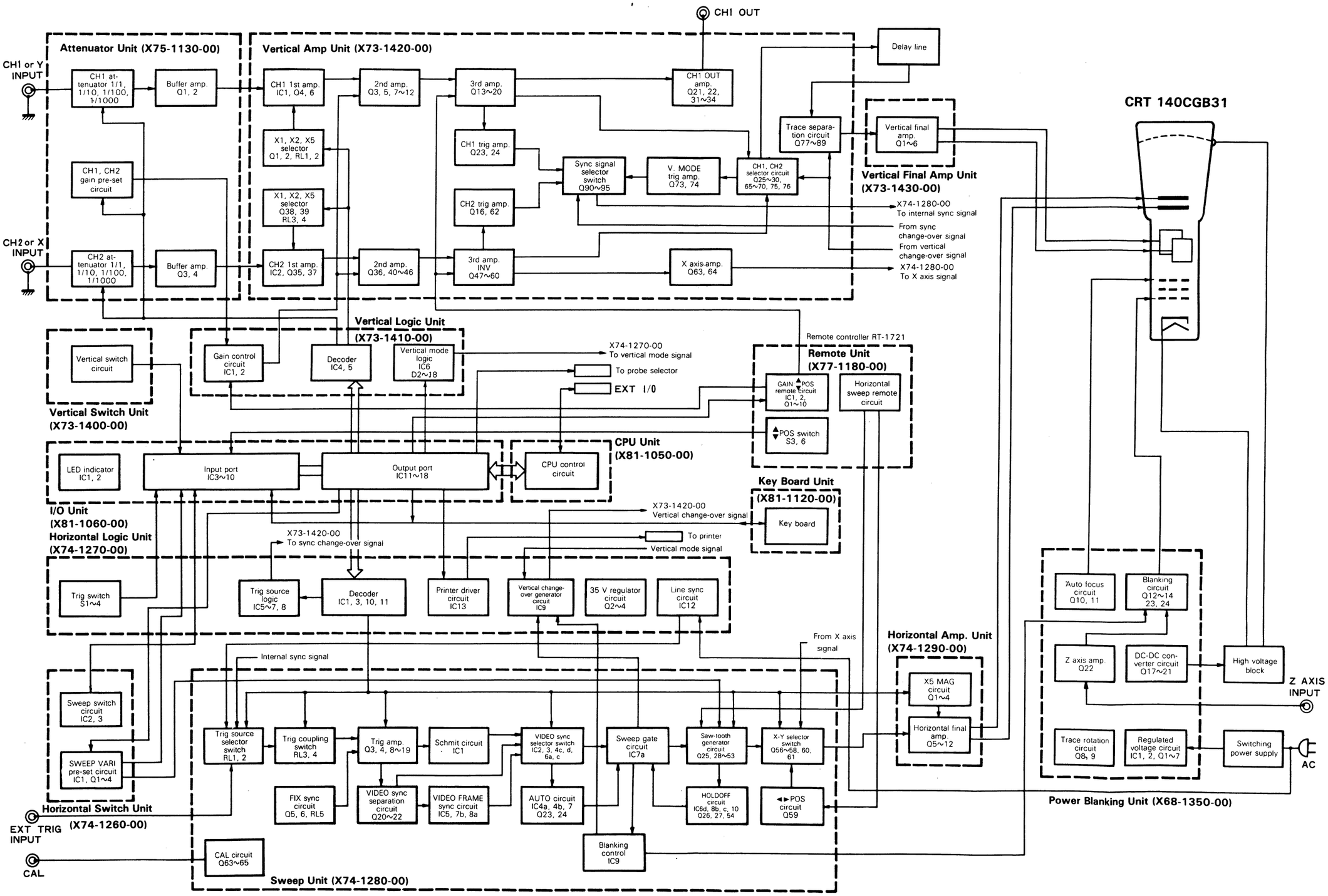


Fig. 6-10 Memory pack Timing

CIRCUIT DESCRIPTION

BLOCK DIAGRAM



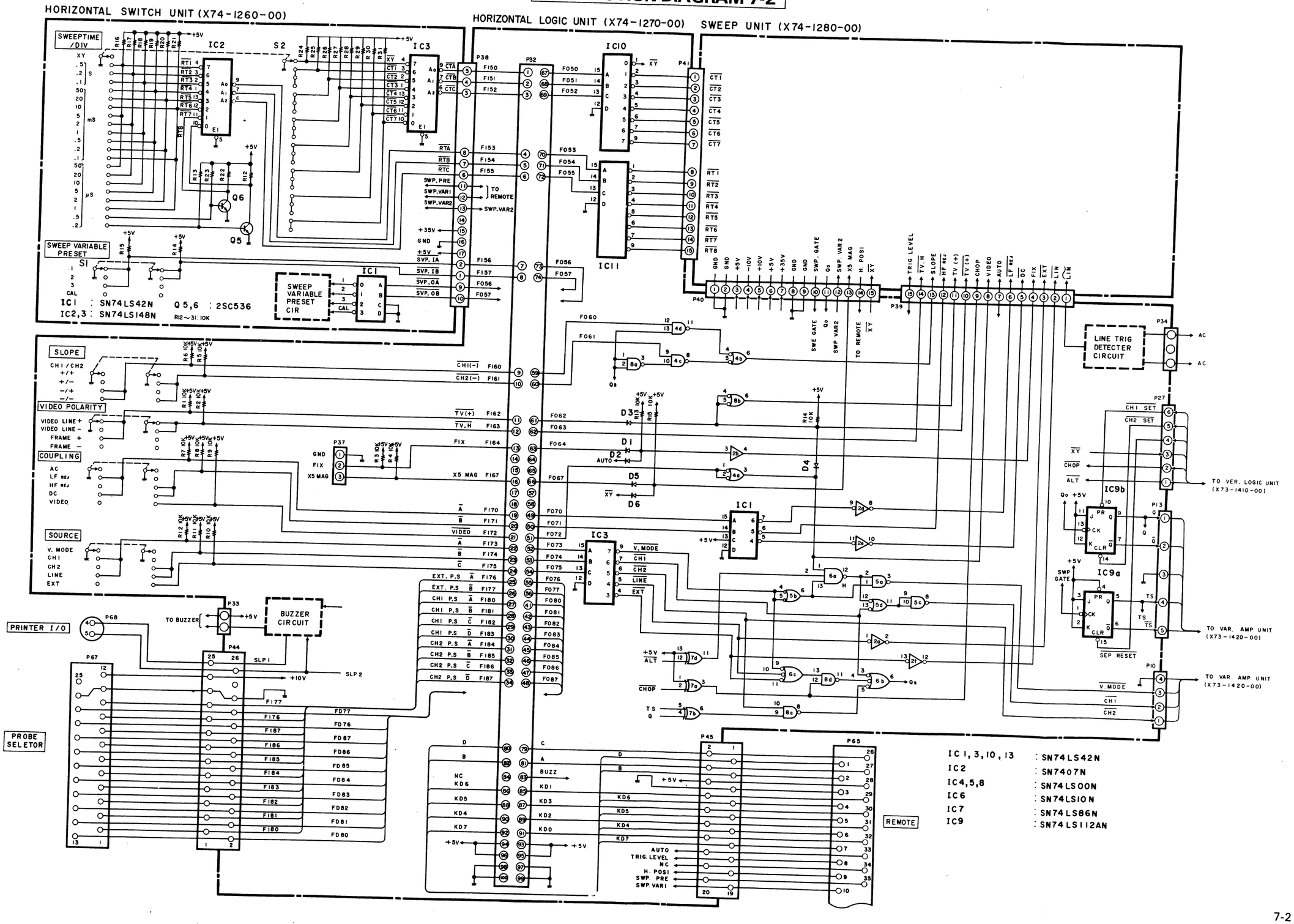
CONNECTION DIAGRAM 7-1

IC1,2 : MC14051BCP
IC3 : SN7407N
IC4,5 : SN74LS42N
IC6 : SN74LS00N
Q1 : 2SC536KNP(F)
D1,9 : DS442X
D2-8: IN60

VERTICAL SWITCH UNIT (X73-1400-00)
VERTICAL LOGIC UNIT (X73-1410-00)
I/O UNIT (X81-1060-00)
VERTICAL AMP UNIT (X73-1420-00)
ATT UNIT (X75-1130-00)
TO HORIZONTAL LOGIC UNIT (X74-1270-00)
REMOTE
P65
CH1 INPUT
CH2 INPUT
AC GND DC
CH1 GAIN PRESET
CH2 GAIN PRESET
VOLTS/DIV
MODE CH1 CH2 ALT CHOP ADD
CH2 INV
SEP
VAR PRESET
ATT 1/10 1/100 AC, GND, DC SEP. POSI
ATT X5, X2, X1
D1~4 : 1N60

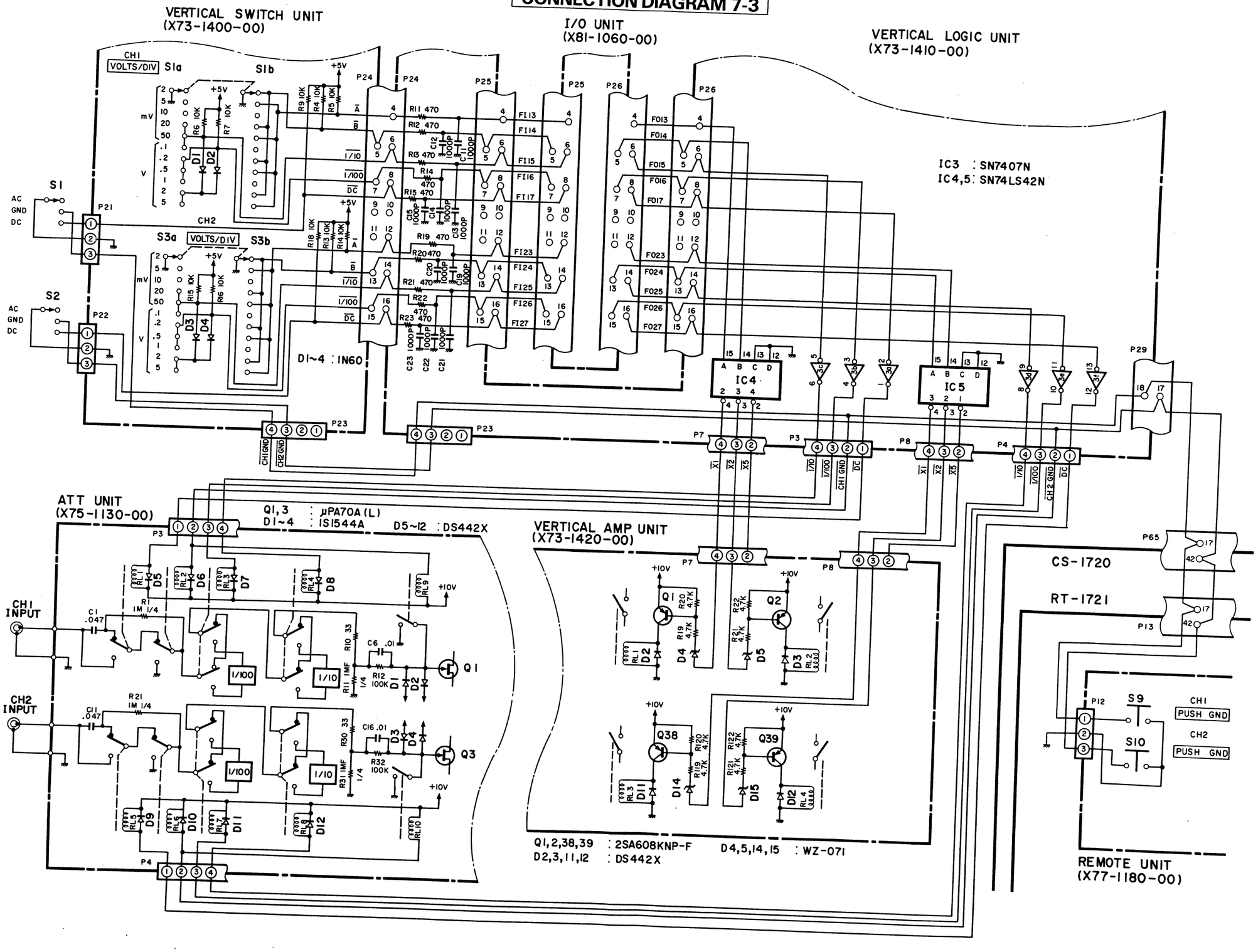
CIRCUIT DESCRIPTION

CONNECTION DIAGRAM 7-2

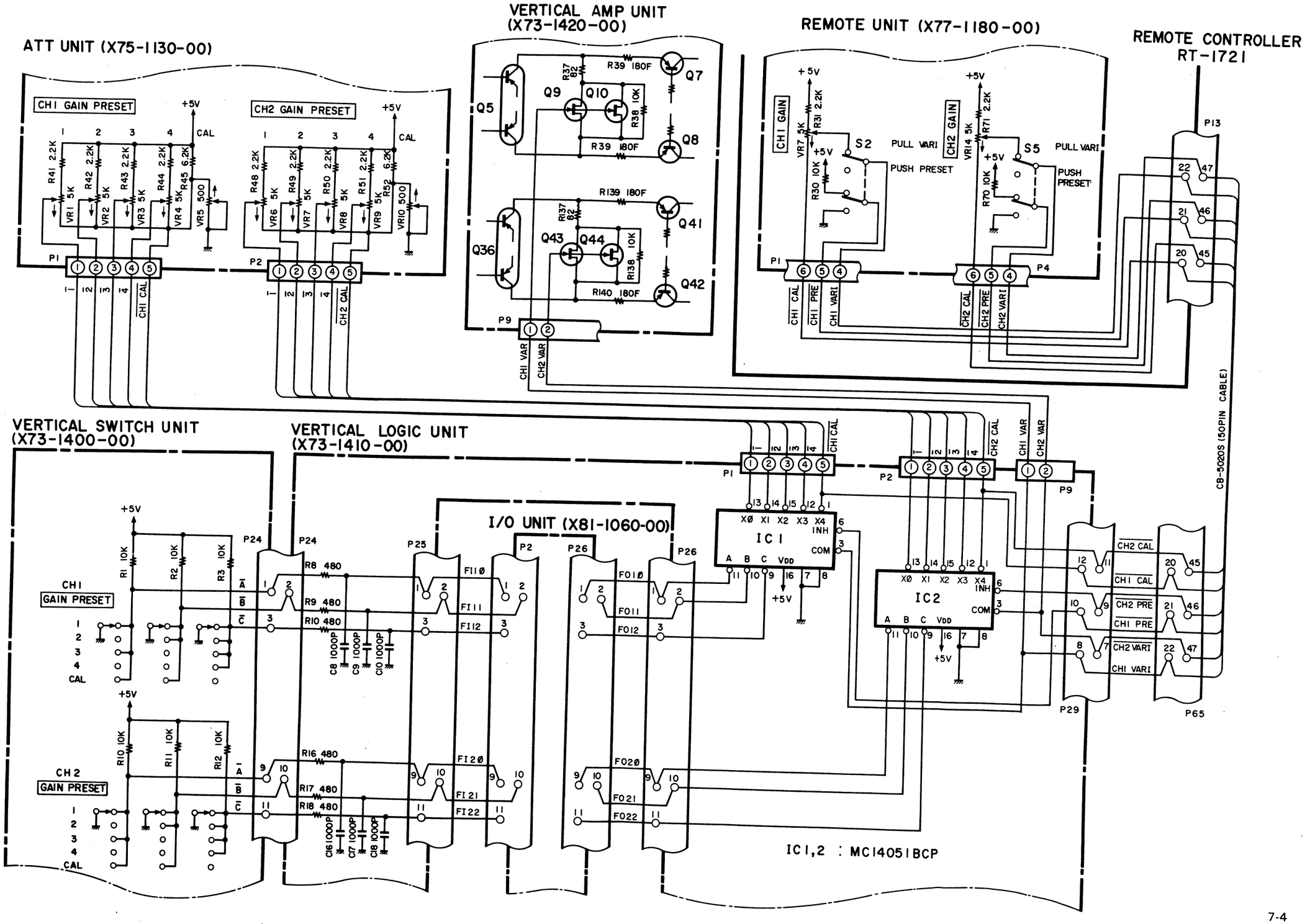


CIRCUIT DESCRIPTION

CONNECTION DIAGRAM 7-3



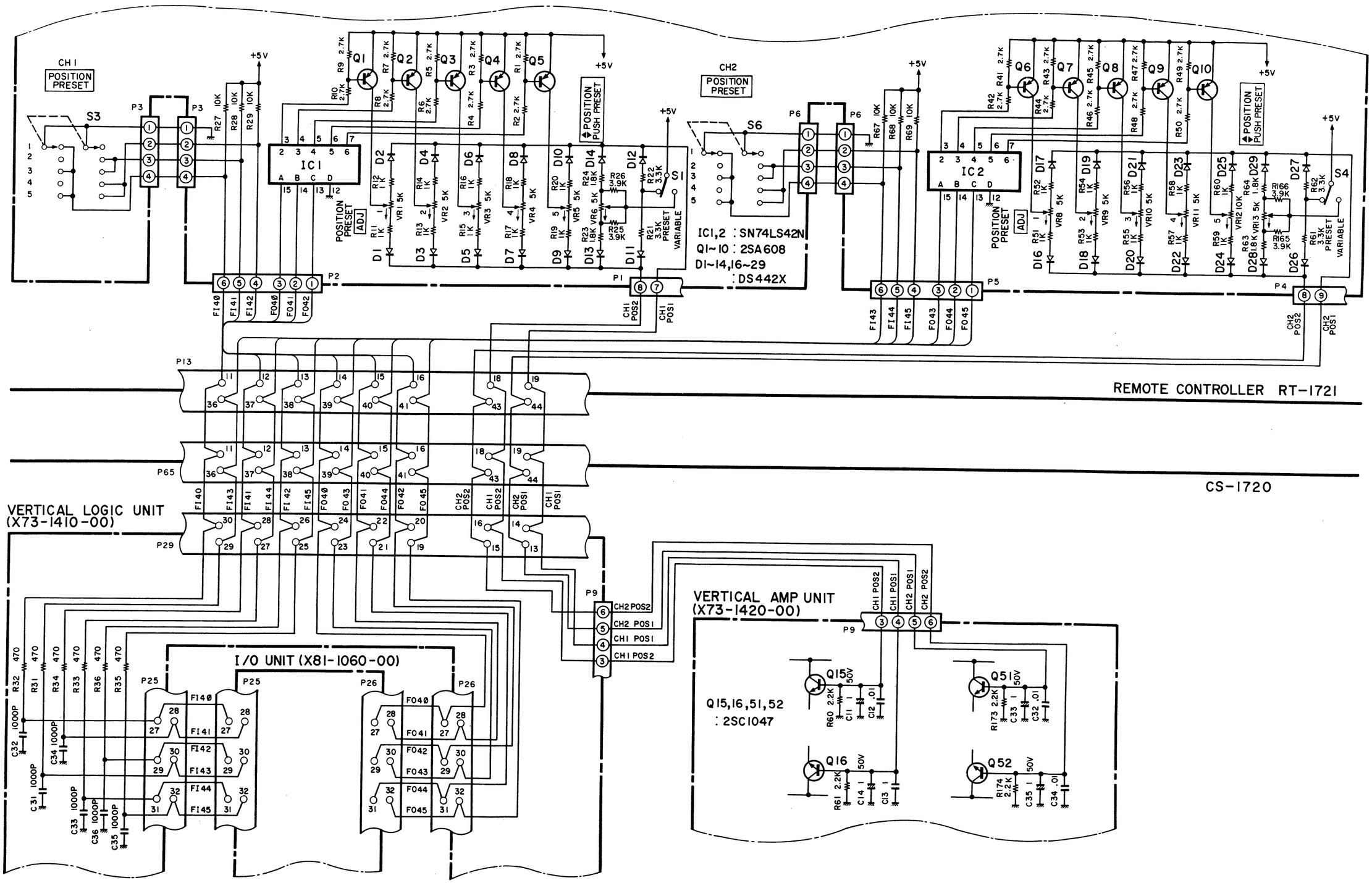
CONNECTION DIAGRAM 7-4



CIRCUIT DESCRIPTION

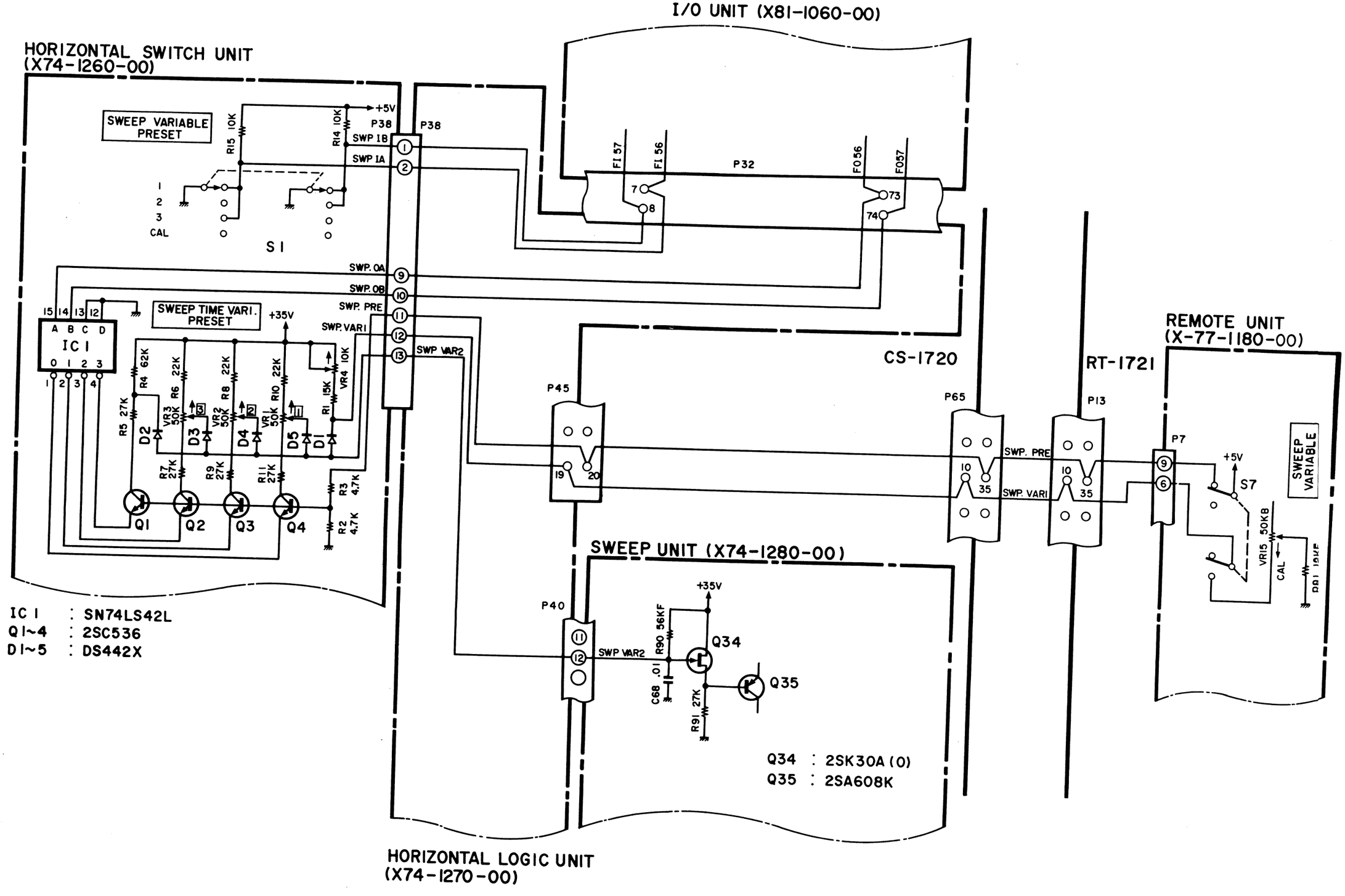
CONNECTION DIAGRAM 7-5

REMOTE UNIT (X77-1180-00)



CIRCUIT DESCRIPTION

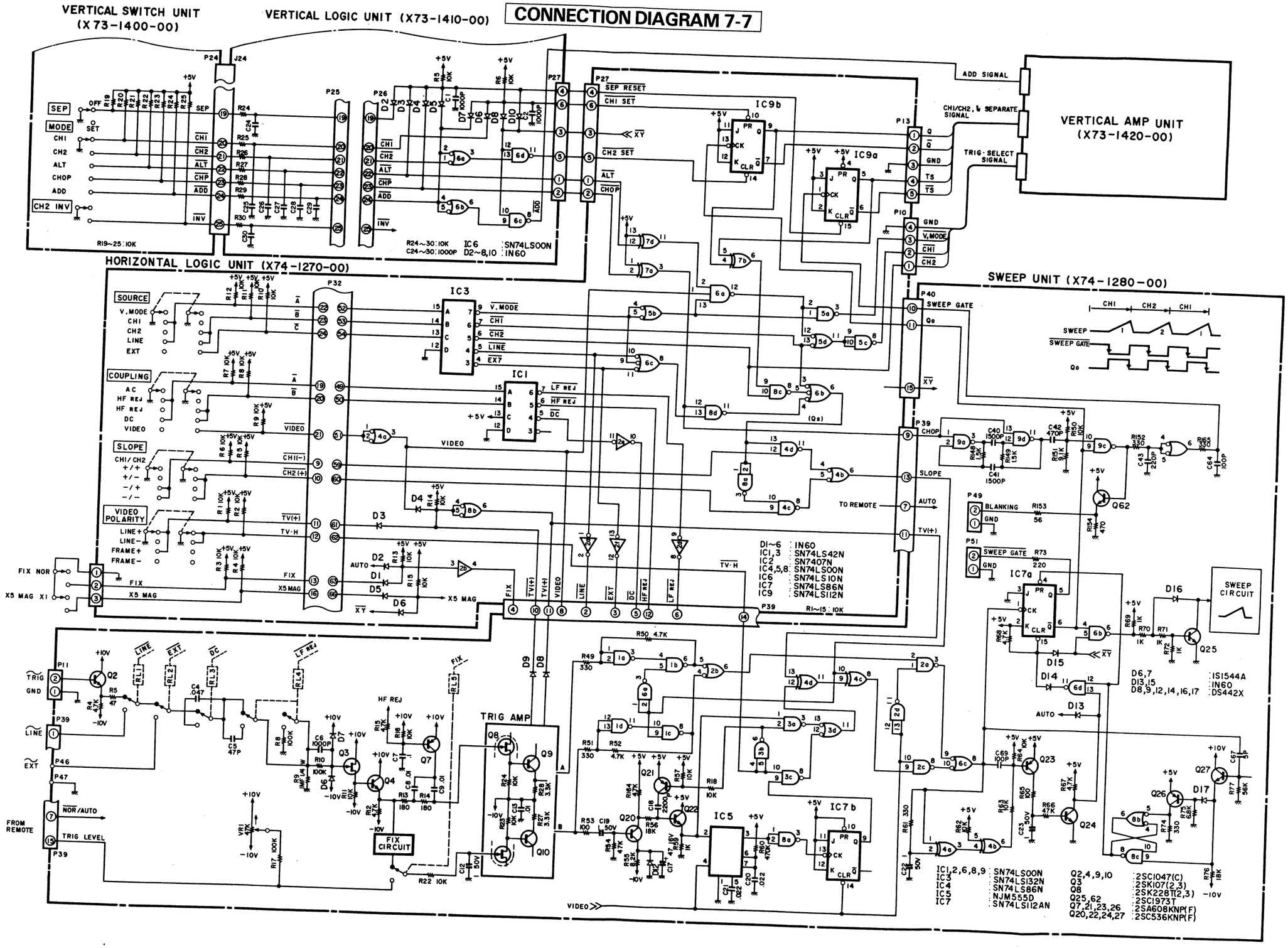
CONNECTION DIAGRAM 7-6



IC 1 : SN74LS42L
Q1~4 : 2SC536
D1~5 : DS442X

Q34 : 2SK30A (O)
Q35 : 2SA608K

CONNECTION DIAGRAM 7-7



MAINTENANCE

REMOVAL OF THE CASE

1. Remove the four phillips screws holding the cable wraps on the rear panel of the CS-1720, using a ⊕ screwdriver. Holding the front panel of the CS-1720, slide the case off backwards.
2. When replacing the unit in its case, slide it horizontally along the locating rails in the case base plate until the front panel is snug against the case.
3. Replace the cable wrap and screws, and tighten securely.

CAUTION

Potentially high voltage (6 kV) is applied to the CRT and anode cap. Before removing the case, ALWAYS switch off the power, and disconnect the power cable from the socket. If power is reconnected after removing the case BE EXTREMELY CAREFUL not to touch them with your hand or screwdriver.

REMOVAL OR REPLACEMENT OF THE CRT

1. When removing the CRT for repair or maintenance, NEVER remove the CRT band. Remove only the mounting screws, and gently slide the CRT backwards, raise the socket up. If the above procedure is followed, removal of the CRT is easily accomplished. Replacement can be done easily.
2. Insert the CRT carefully. After locating the CRT on the retaining rubbers, tighten the CRT retaining screws loosely. Fix the screws of CRT bands so the CRT is in parallel with the frame and then tighten the screws of CRT mounting hardwave.
3. As slots are provided in the CRT bracket, the CRT can be moved right and left, and back and force. As the bracket is inclined by 45°, the CRT can be positioned in an arbitrary position. To fix the CRT, tighten the CRT retaining screws loosely and fix the CRT to be in parallel with the frame. Then, finally, fix the CRT retaining screws tightly.

CAUTION:

A high tension voltage is remained at the anode of the CRT. Before removing the CRT, connect the anode to the ground via a 100 kΩ load for 5 seconds to discharge the voltage.

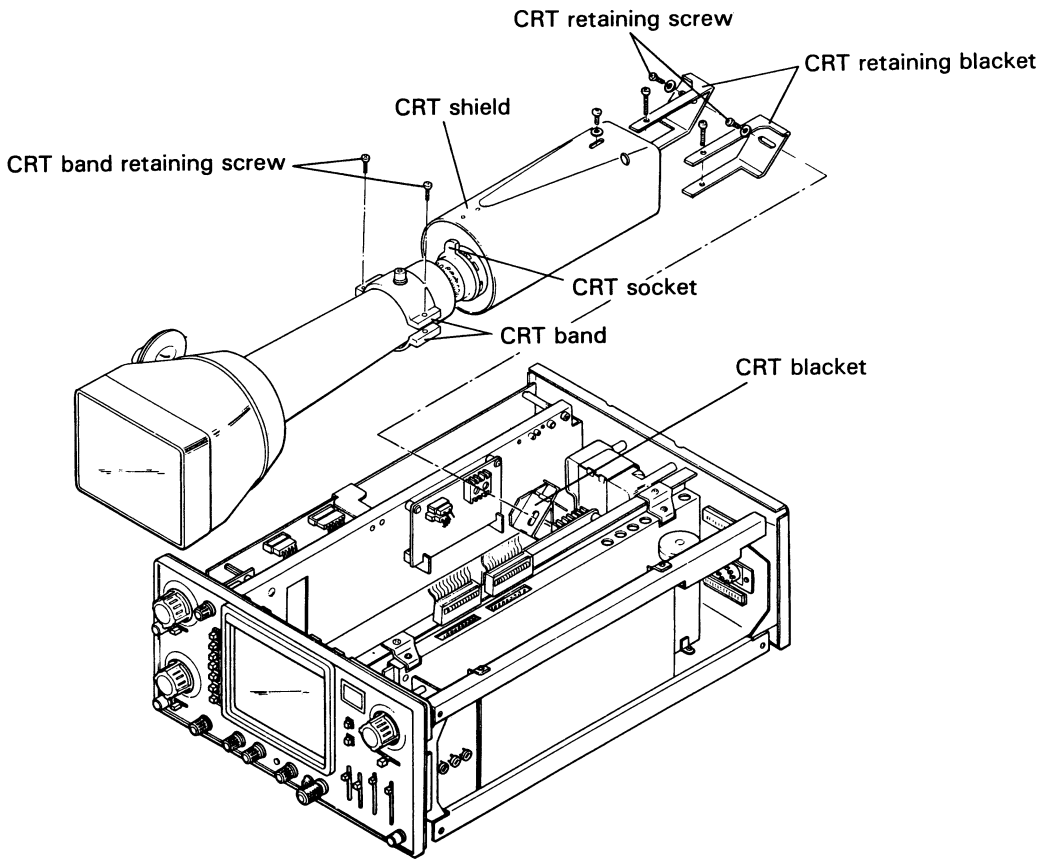


Fig. 8-1

MAINTENANCE

REPLACEMENT OF SWITCHING POWER SUPPLY

The switching power supply is in a shield case at the lower rear of the CS-1720. To remove the switching power supply, first remove the control and sweep units located on the right, and undo the screws holding the unit to the left/right frame.

REMOVING CONTROL UNIT

First take off the two flat cables on the top of the unit, the three screws and the retaining hex. nut for the seven segment STEP LEDs, thereafter remove the connector on the side of the unit. To replace the control unit, follow the reverse procedure.

NOTE

The control unit has CMOS and RAM backup, therefore be sure to avoid handling it, or any of the connected components, roughly.

REPLACING THE BATTERY

If the STEP LEDs flash on and off, it is an indication that the memory backup battery is low, and need replacing. In such a case, it must be changed in the control unit as soon as possible.

1. Remove the control unit from the body of the CS-1720 as previously described.
2. Remove the 8 screws on the shield case. The lithium battery is located on the right side of the P.C.B (X81-1050-00). If after checking the battery level it is less than 2 volts, replace with new battery, taking care to observe correct polarity, as shown on the component side of the printed circuit board.

NOTE

Note that if the backup battery of the Memory pack (MT-1725) is low, the STEP LEDs also flash, on and off.

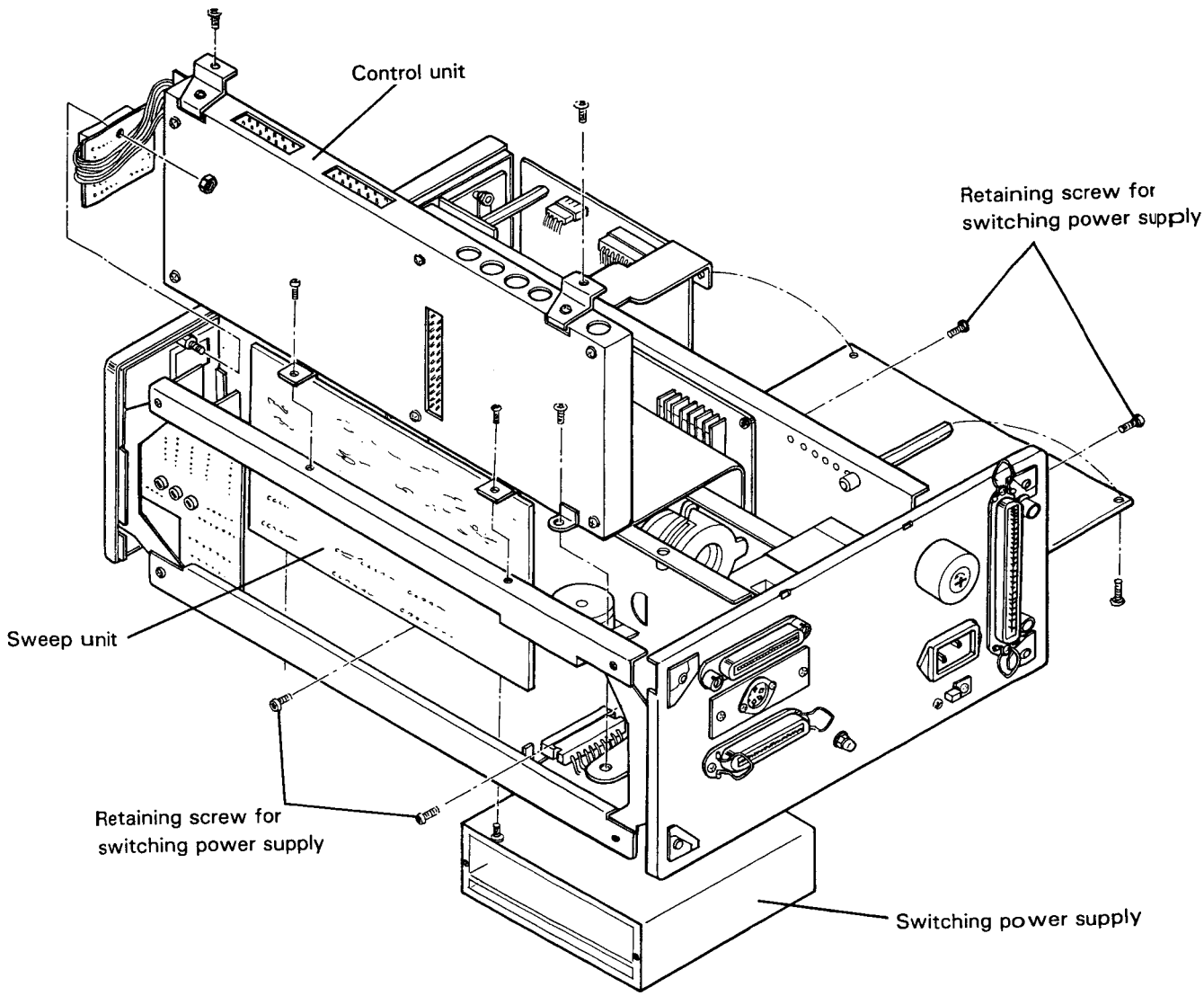


Fig. 8-2

ADJUSTMENT

To obtain the best performance, periodically accurately calibrate the unit.
Sometimes, only one mode need be calibrated, while at other times, all modes should be calibrated.
When one mode is calibrated, it must be noted that the other modes may be affected. When calibrating all modes, perform the calibration in the specified sequence.
The following calibration required an accurate measuring instrument and an insulated adjusting flat blade screwdriver. If they are not available, contact your dealer.
For optimum adjustment, turn the power on and warm up the CS-1720 sufficiently (more than 30 minutes) before starting.

CAUTION:
Calibrate the unit under the following condition.
Temperature: 10 – 35°C
Humidity: Less than 85%

POWER SUPPLY VOLTAGE

Before calibrating the unit, check the power supply voltage.
Voltage selector: LOW; 90 – 132V
High; 180 – 264V
50/60 Hz

TEST EQUIPMENT REQUIRED

The following instrument or their equivalent should be used for making adjustments.

Test Equipment	Model	Minimum Specification
Digital Multi-Meter	DL-720 (TRIO)	Impedance: More than 10 MΩ, Measuring range: 0.01V to 199V
Sine-Wave Generator	SG-502 (Tektronix)	Frequency: 10 Hz to 10 MHz, constant voltage over tuning range
Sine-Wave Generator	SG-503 (Tektronix)	Frequency: 50 kHz to 100 MHz, Output impedance: 50Ω, constant voltage over tuning range
Square-Wave Generator	PG-506 (Tektronix)	Output signal: 1 kHz, Amplitude: 10 mVp-p to 10 Vp-p, Accuracy: within ±1%, Rise time: 35μs or less (1 MHz, 1μs or less)
Q Meter	4343B (YHP)	–
Color Pattern Generator	CG-911 (TRIO)	–
Oscilloscope	475A (Tektronix)	Sensitivity: More than 5 mV Frequency response: More than 250 MHz
Time-Marker Generator	TG-501 (Tektronix)	Time mark: 0.5s to 0.1μs repetitive waveform, Accuracy: within 0.1%
High-Voltage Probe	–	Input Impedance: 1000 MΩ
Termination	TA-57 (TRIO)	Impedance: 50 Ω
Attenuator	011-0059-02	–20 dB attenuation (50Ω)
Power Meter	2041 (YEW)	–
Auto transformer (variable)	SD-265 (Tektronix)	–
Power Supply	PR-657 (TRIO)	Output voltage: 0 to 32 V Resolution: 1 mV
Digital Multimeter	8600A FLUKE	4-1/2 digit Resolution: 100 μV
Frequency Counter	FC-754A (TRIO)	–

PREPARATION FOR ADJUSTMENT

Control Setting

The control settings listed below must be used for each adjustment procedure. Exceptions to these settings will be noted as they occur. After completing a adjustment, return the controls to the following settings.

Power Section
POWER: ON

CRT Control Section
INTENSITY: Between 12 and 3 o'clock
FOCUS: Optimum position

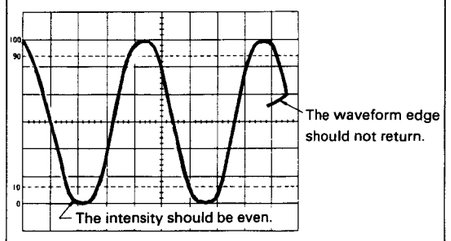
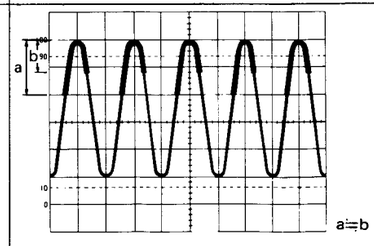
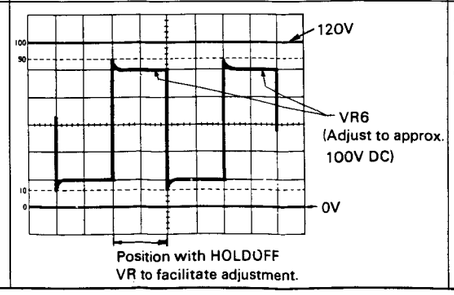
Vertical Section
AC-GND-DC (CH1 and CH2): AC
VOLTS/DIV (CH1 and CH2): 5V/div
GAIN PRESET (CH1 and CH2): CAL
MODE: CH1
SEP: OFF (▀)
CH2 INV: OFF (▀)

Horizontal Sweep Section
SWEEP TIME/DIV: 0.5ms/div
SWEEP TIME VARI PRESET: CAL
PUSH×5 MAG: ×1 (▀)

TRIG. Section
SOURCE: VERT MODE
COUPLING: AC
FIX/MANUAL: MANUAL (▀)
SLOPE CH1/CH2: +/+
VIDEO POLARITY: LINE; +

REMOTE Section (RT-1721)
GAIN PUSH PRESET (CH1 and CH2): PUSH, CAL
▲▼ POSITION PRESET (CH1 and CH2): 3 (trace centered)
▲▼ POSITION (CH1 and CH2): PUSH, 12 o'clock position
◄► POSITION: 12 o'clock position
SWEEP TIME VARI PRESET: PUSH, CAL
TRIG. LEVEL: PUSH, 12 o'clock position

ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td colspan="8">ADJUSTMENT OF POWER SUPPLY AND CRT</td></tr>
<tr><td>Checking o: Power Supply Voltage</td><td></td><td></td><td>DL-720</td><td></td><td>Measure and checking of voltage at P43 and P28
<table><tr><td></td><td>1P</td><td>2P</td><td>3P</td><td>4P</td><td>5P</td><td>6P</td><td>7P</td><td>8P</td></tr><tr><td>P28</td><td>+55V</td><td>+20V</td><td>GND</td><td>+5V</td><td>+5V</td><td>+10V</td><td>−10V</td><td></td></tr><tr><td>P43</td><td>+120V</td><td>+55V</td><td>+20V</td><td>GND</td><td>+5V</td><td>+5V</td><td>+10V</td><td>−10V</td></tr></table></td><td></td><td></td></tr>
<tr><td>Adjustment of −1.5kV</td><td>VR3</td><td>X68-1350</td><td>DL-720
High voltage probe</td><td></td><td>Measure the voltage on P60, 2P and adjust VR3 to obtain −1.5kV (1.500-1.505kV)</td><td></td><td></td></tr>
<tr><td>Coarse Adjustment of ASTIG and FOCUS</td><td>VR5</td><td>X68-1350</td><td></td><td>SWEEP TIME/DIV: X-Y
CH1, CH2, AC-GND-DC: GND
CH1, CH2, ▲▼ POSITION: Pulled out</td><td>1. Operate ▲▼ POSITION for CH1 and CH2 to position the sopt in the center of the CRT screen.
2. Adjust VR5 to make the spot round and smaller with locating FOCUS knob on the center.</td><td></td><td></td></tr>
<tr><td>Adjustment of INTENSITY</td><td>VR1</td><td>X68-1350</td><td></td><td>SWEEP TIME/DIV: X-Y
CH1, CH2, AC-GND-DC: GND
CH1, CH2, ▲▼ POSITION: Pulled out</td><td>Adjust VR1 so that the spot on the CRT screen disappears when INTENSITY is set in the position of 9:30-10:00</td><td></td><td></td></tr>
<tr><td>Adjustment of Blanking</td><td>TC2</td><td>X68-1350</td><td>SG-503</td><td>SWEEP TIME/DIV: 0.2μs
CH1, AC-GND-DC: DC
CH1, VOLTS/DIV: 1V
INTENSITY: Fully CW</td><td>1. Apply a 1MHz sine wave signal to CH1 input and operate ▲▼ POSITION and CH1 VOLTS/DIV to display a waveform of 6 divisions vertical amplitude.
2. Adjust TC2 so that the start point of waveform has even brightness and there is no retrace.</td><td> 
</td><td></td></tr>
<tr><td>Adjustment of Z-Axis Input Blanking</td><td>TC1</td><td>X68-1350</td><td>SG-503</td><td>SWEEP TIME/DIV: 5μs
CH1, AC-GND-DC: DC
CH1, VOLTS/DIV: 1V</td><td>1. Apply a 100 kHz, 5Vp-p sine wave signal to CH1 input to display a waveform of 5 divisions vertical amplitude.
2. Apply the same signal above to Z-axis input and turn INTENSITY to CCW so that the dark and bright area of the waveform are distinct.
3. Adjust TC1 so that the bright area of sine waveform is symmetrical to the peak point.</td><td> 
</td><td></td></tr>
<tr><td>Adjustment of Auto FOCUS Level</td><td>VR2</td><td>X68-1350</td><td>475A
Probe (1/10)</td><td>INTENSITY: Fully CW
SWEEP TIME/DIV: 20μs</td><td>1. Set the oscilloscope (475A) for the vertical axis sensitivity at 2V/div.
2. Observe the waveform of the auto focus display point on the AUTO FOCUS circuit (collector of Q10), and adjust VR2 so that the upper DC level of the square waveform is approx. 100V (more than 95V).</td><td> 
</td><td>Be sure that the AC-GND-DC selector switch of the oscilloscope (475A) is at "DC" position.</td></tr>
</table>

ADJUSTMENT

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Adjustment of Auto FOCUS waveform Forming	TC3	X68-1350	475A Probe (1/10)	INTENSITY: Fully CW CH1 AC-GND-DC: GND	Vary SWEEP TIME/DIV from 0.1 ms to 0.2 μs and adjust TC3 so that the start of trace become an ideal waveform.		
Adjustment of CRT Center	VR2	X73-1430		TRIG LEVEL: Pushed in	Short-circuit the test point (TP1) of X73-1420 and adjust VR2 so that the trace aligns with the horizontal center graticule line.		
Adjustment of Vertical Geometry	VR1	X73-1430	DL-720		Short the short-circuit the test point (TP1) of the X73-1420 and adjust VR1 for 28V±0.5V reading on the voltmeter.		
Adjustment of ASTIG and FOCUS	VR5	X68-1350		SWEEP TIME/DIV: X-Y CH1, CH2, AC-GND-DC: GND	1. Operate ▲▼ POSITION for CH1 and CH2 so that the spot is brought into the center of the screen. 2. Adjust VR5 to make the spot round and smaller. (Check) 1. Make sure that the spot grows larger when the FOCUS is turned CW or CCW. 2. Make sure that the FOCUS is in a centered position when the spot is smallest.		Be sure to bring the spot into the center of the screen. It may be difficult to obtain the correct adjusting position near the edge of the screen due to the CRT peripheral blur.
Adjustment of Trace Rotation	Trace rotation knob			MODE: CH1 TRIG LEVEL: AUTO CH1, AC-GND-DC: GND	1. Operate ▲▼ POSITION for CH1 to move the trace to the center of the screen. 2. Make adjustment to align the trace with the horizontal center graticule line.		
ADJUSTMENT OF VERTICAL AXIS							
Adjustment of CH1 ATT BAL	VR11	X75-1120		MODE: CH1 CH1, AC-GND-DC: DC TRIG LEVEL: AUTO	Adjust VR11 for minimum or zero movement to CH1 10mV reference line when set CH1 VOLTS/DIV to 2mV. (Check) Movement of trace in all ranges should be within ±0.1 div.		
Adjustment of CH2 ATT BAL	VR12	X75-1130		MODE: CH2 TRIG LEVEL: AUTO CH2, AC-GND-DC: DC	Adjustment is carried out as for CH1 ATT adjustment above.		
Adjustment of CH1 DC BAL	VR1	X73-1420		CH1, AC-GND-DC: GND CH1, VOLTS/DIV: 2mV CH1, GAIN: Pulled out	1. Turn CH1 GAIN to fully CCW. 2. Operate ▲▼ POSITION so that the trace aligns with the horizontal center graticule line on the screen. 3. Pull CH1 GAIN and turn to fully CW (CAL). If the trace moves vertically, adjust VR1 for minimum or zero movement. 4. Repeat above procedures. (Check) Movement of trace: within 0.2 div.		
Adjustment of CH2 DC BAL	VR4	X73-1420		CH2, AC-GND-DC: GND CH2, VOLTS/DIV: 2mV CH2, GAIN: Pulled out	Adjustment is carried out as for CH1 DC BAL adjustment above.		
Adjustment of CH1 GAIN VARI	VR5	X75-1130	PG-506 BNC-BNC cord	MODE: CH1 TRIG LEVEL: AUTO CH1, AC-GND-DC: DC CH1, VOLTS/DIV: 2mV CH1, GAIN: Pulled out, CAL	1. Apply a 1kHz, 10mVp-p square wave signal to CH1 input. 2. Operate CH1 ▲▼ POSITION to produce a waveform on the center of the screen. 3. Adjust VR5 to become the waveform smaller in 12 o'clock position by pulling the CH1 GAIN and turning CCW.		
Adjustment of CH2 GAIN VARI	VR10	X75-1130		MODE: CH2 TRIG LEVEL: AUTO CH2, AC-GND-DC: DC CH2, VOLTS/DIV: 2mV CH2, GAIN: Pulled out, CAL	Adjustment is carried out as for CH1 GAIN VARI adjustment above.		

ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td>Adjustment of CH1 GAIN</td><td>VR3</td><td>X74-1420</td><td>PG-506
BNC-BNC cord</td><td>MODE: CH1
CH1, AC-GND-DC: DC
CH1, VOLTS/DIV: 2mV
CH1, GAIN: Pulled out, CAL</td><td>1. Apply a 10mVp-p, 1kHz square wave signal to CH1 input.
2. Operate CH1 ▲▼ POSITION to display a waveform on the center of the screen.
3. Adjust VR3 so that the amplitude of waveform becomes 5 divisions.
(Check)
Turn CH1 VOLTS/DIV and apply a reference signal to display a 4 to 6 div amplitude waveform when the MODE CH1 and CH1 SEP pushbuttons are depressed respectively in all ranges.
Sensitivity error: within ±5%</td><td></td><td>(Reference)
Method of calculation of sensitivity error.

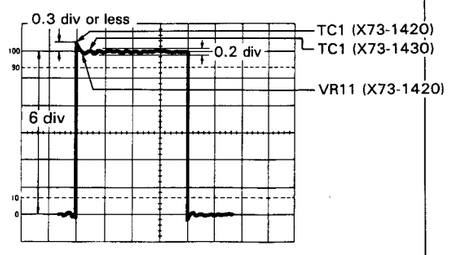
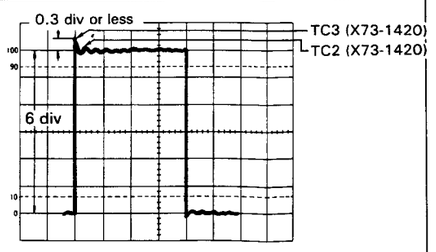
Sensitivity error
$=\frac{a-b}{b}\times 100\%$

a = CRT screen amplitude
b = Input signal voltage/ VOLTS/DIV settings</td></tr>
<tr><td>Adjustment of CH2 GAIN</td><td>VR9</td><td>X73-1420</td><td>PG-506
BNC-BNC cord</td><td>MODE: CH2
CH2, AC-GND-DC: DC
CH2, VOLTS/DIV: 2mV
CH2, GAIN: Pushed in, CAL</td><td>1. With MODE CH2, apply a 10mVp-p, 1kHz square wave signal to CH2 input.
2. Adjustment is carried out as for CH1 GAIN adjustment above.
(Check)
1. Turn CH2 VOLTS/DIV and apply a reference signal to display a 4 to 6 div vertical amplitude waveform when the MODE CH2 and CH2 SEP pushbuttons are depressed respectively in all ranges.
Check that the sensitivity error is within ±5%.
2. Apply a 10mVp-p, 1kHz square wave signal to both CH1 and CH2 inputs. Depress ADD and CH2 INV of MODE and select SOURCE switch to CH1. By using both CH1 and CH2 ▲▼ POSITION, two traces should align on the center of the screen.
Channel error between CH1 and CH2: 0.1 div at 1kHz.</td><td></td><td></td></tr>
<tr><td>Checking of CH1 and CH2 GAIN VARI</td><td></td><td></td><td>PG-506
BNC-BNC cord</td><td>CH1, CH2, AC-GND-DC: DC
CH1, CH2, VOLTS/DIV: 2mV
CH1, CH2, GAIN: Pulled out, CAL</td><td>1. With MODE CH1, apply a 10mVp-p, 1kHz square wave signal to CH1 input.
2. When the GAIN control is turned to fully CCW, the sensitivity should be within 1/2.5 in comparison with CAL position.
3. Select MODE to CH2, and carry out the same procedure as for CH1 above.</td><td></td><td></td></tr>
<tr><td>Checking of CH1 GAIN PRESET and Setting</td><td>VR1
VR2
VR3
VR4</td><td>X75-1130</td><td>PG-506</td><td>MODE: CH1
CH1, AC-GND-DC: DC
CH1, VOLTS/DIV: 2mV
CH1, GAIN: Pushed in, CAL</td><td>1. Apply a 10mVp-p, 1kHz square wave signal to CH1 input.
2. Set GAIN PRESET to position (1) and adjust VR1 so that its sensitivity becomes less than 1/2.5 when rotated GAIN PRESET adjustment control (1) on the left side panel to CCW.
3. Adjust VR2 to VR4 in the same procedure for step (1) and (2).
4. After checking the above procedure, adjust CH1 GAIN PRESET VR as in the table below.
<table>
<tr><td>GAIN PRESET</td><td>1</td><td>2</td><td>3</td><td>4</td><td>CAL</td></tr>
<tr><td>Setting (div)</td><td>MIN</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>Checking of CH2 GAIN PRESET and Setting</td><td>VR6
VR7
VR8
VR9</td><td>X75-1130</td><td>PG-506</td><td>MODE: CH2
CH2, AC-GND-DC; DC
CH2, VOLTS/DIV: 2mV
CH2, GAIN: Pushed in, CAL</td><td>Carry out the same procedure as for CH1 above.</td><td></td><td></td></tr>
</table>

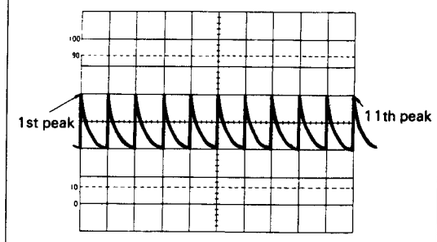
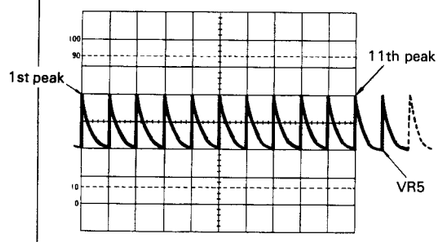
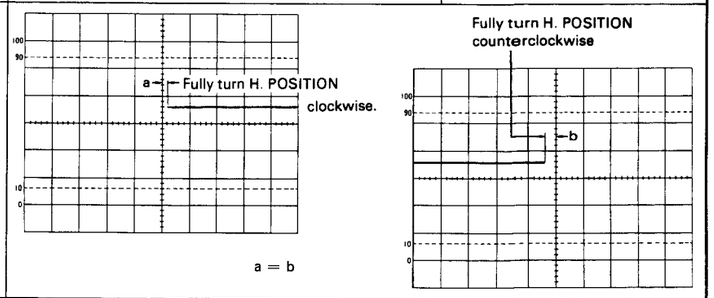
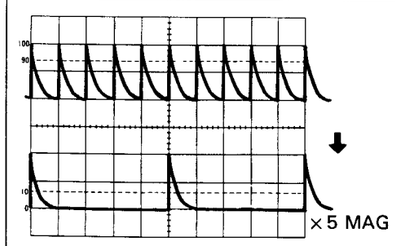
ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td>Adjustment of CH1 ▲▼ POSITION</td><td>VR2</td><td>X73-1420</td><td></td><td>MODE: CH1
CH1, AC-GND-DC: GND
CH1, ▲▼ POSITION: Pushed in, center
CH1, POSITION PRESET: 3, mechanical center</td><td>1. Adjust VR2 so that the trace aligns with the horizontal center graticule line on the screen.
(Check)
1. When CH1 POSITION PRESET through 1 to 5 is turned to fully CW, the trace must move upward more than 4 divisions and it must move downward more than 4 divisions when turned to fully CCW.
2. When CH1 ▲▼ POSITION is pulled out and turned to CW and CCW, the trace should move at least ±2 div from POSITION PRESET settings.
3. By adjusting VR for 1 to 5, CH1 POSITION PRESET settings should be as in the table below.
<table>
<tr><td>POSITION PRESET</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Trace position (div)</td><td>+4</td><td>+2</td><td>center</td><td>−2</td><td>−4</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>Adjustment of CH2 ▲▼ POSITION</td><td>VR5</td><td>X73-1420</td><td></td><td>MODE: CH2
CH2, AC-GND-DC: GND
CH2, ▲▼ POSITION: Pushed in, center
CH2, POSITION PRESET: 3, mechanical center</td><td>For CH2 adjustment and checking, carry out same procedure as for CH1 above.</td><td></td><td></td></tr>
<tr><td>Adjustment of CH2 INV Position</td><td>VR6</td><td>X73-1420</td><td></td><td>CH2, AC-GND-DC: GND
CH2, VOLTS/DIV: 2mV
CH2, INV: Pushed in</td><td>Adjust VR6 to bring the trace to its position at CH2 NORM.
(Check)
1. Vertical deviation between CH2 NORM and INV: within 1div
2. The trace should move more than 4 divisions upward when turned CH2 ▲▼ POSITION fully CW and it should move more than 4 divisions downward when turned fully CCW.</td><td></td><td></td></tr>
<tr><td>Checking of trace movement in DISPLAY MODE</td><td></td><td></td><td></td><td>CH1, CH2, AC-GND-DC: GND
CH1, CH2, VOLTS/DIV: 2mV</td><td>1. When changing the MODE switch from CH1 to CH2, ALT, CHOP or ADD, the trace movement should be within 0.2div.</td><td></td><td></td></tr>
<tr><td>Checking of SEPARATE PRESET and Setting</td><td>VR13</td><td>X75-1130</td><td>PG-506</td><td>CH1, CH2, AC-GND-DC: DC
CH1, CH2, VOLTS/DIV: 5mV
CH1, CH2, ▲▼ POSITION: center (main sweep)</td><td>1. Depress both CH1 and SEP pushbuttons of MODE or both CH2 and SEP pushbuttons. When turned SEPARATE PRESET (VR13) to CW on the left side panel, the SEP trace should move more than 4 divisions upward from main trace and when turned to CCW, it should move more than 4 divisions downward.
2. Set the SEP trace to −3div position to main trace using VR13.
3. Check the SEP trace moves together if turned CH1 or CH2 ▲▼ POSITION.
4. Select MODE to CH1 and apply a 10mV, 1kHz square wave signal to CH1 input. Check that in SLOPE CH1 side +/−, MAIN sweep, and in SLOPE CH2 side +/−, SUB sweep are both displayed.
5. When selected MODE to CH2 if applied the same signal to CH2 input, the MAIN and SUB sweeps are reversed.</td><td></td><td></td></tr>
<tr><td>Checking of Trace Movement in AC-GND-DC</td><td></td><td></td><td></td><td></td><td>In both CH1 and CH2 position, by using AC-GND-DC switch, trace movement should not vary beyond 0.1 div.</td><td></td><td></td></tr>
</table>

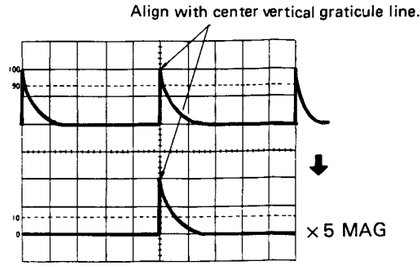
ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td>Adjustment of CH1 ATT and CH2 ATT</td><td></td><td>X75-1130</td><td>434B
PG-506</td><td>CH1, CH2, AC-GND-DC: DC</td><td>1. Shaping of waveform
Apply a 1kHz square wave signal to CH1 and CH2 inputs and adjust the oscillator output to display a waveform of 5 to 6 divisions vertical amplitude.
Make adjustment so that the waveform quality of each range is equal to that of the 2mV range.
2. Input capacitance
Connect a Q-meter to CH1 and CH2 inputs and make adjustment so that the input capacitance of each range is equal to that to the 2mV range. (37 ± 3pF)
<table><tr><th colspan="2">Sequence</th><th>Adjustment</th><th>Adj control</th></tr><tr><td rowspan="4">CH1</td><td>1</td><td>20 mV range Waveform shaping</td><td>TC4</td></tr><tr><td>2</td><td>20 mV range Input capacity</td><td>TC3</td></tr><tr><td>3</td><td>0.2 V range Waveform shaping</td><td>TC2</td></tr><tr><td>4</td><td>0.2 V range Input capacity</td><td>TC1</td></tr><tr><td rowspan="4">CH2</td><td>1</td><td>20 mV range Waveform shaping</td><td>TC8</td></tr><tr><td>2</td><td>20 mV range Input capacity</td><td>TC7</td></tr><tr><td>3</td><td>0.2 V range Waveform shaping</td><td>TC6</td></tr><tr><td>4</td><td>0.2 V range Input capacity</td><td>TC5</td></tr></table></td><td></td><td></td></tr>
<tr><td>Adjustment of CH1 Square Wave Characteristics</td><td>TC1
VR11
TC1</td><td>X73-1430
X73-1420
X73-1420</td><td>PG-506</td><td>CH1, AC-GND-DC: DC
CH1, VOLTS/DIV: 2mV</td><td>1. Apply a 100kHz short rise time square wave signal to CH1 input and adjust the oscillator output to display a waveform of 6 divisions vertical amplitude.
2. The waveform is shaped by carrying out adjustment in following order.
TC1.....low range adjustment
VR11.....mid and high ranges adjustment
TC1.....high range adjustment</td><td> 
</td><td></td></tr>
<tr><td>Adjustment of CH2 Square Waveform Characteristics</td><td>TC2
TC3</td><td>X73-1420
X73-1420</td><td>PG-506</td><td>MODE: CH2
CH2, AC-GND-DC: DC
CH2, VOLTS/DIV: 2mV</td><td>1. Apply the above same signal to CH2 input and adjust in the same way as for CH1 above.
TC2.....mid range adjustment
TC3.....high range adjustment
(Check)
1. Overshoot :less than 5%
2. Undershoot :less than 3.5%
3. Carry out adjustment for all range.</td><td> 
</td><td></td></tr>
<tr><td>Checking of CH1 and CH2 Frequency Characteristics</td><td></td><td></td><td>SG-503
50Ω coaxial cable
50Ω, 20dB attenuator</td><td>CH1, CH2, AC-GND-DC: DC</td><td>1. Turn CH1 VOLTS/DIV to 2mV and apply a 50kHz sine wave signal to CH1 input.
Adjust the oscillator output to display a waveform of 6 divisions vertical amplitude.
2. When the frequency is varied to 20MHz with the oscillator output remaining output, the amplitude on the screen must be over 4.25 divisions and there must be no sudden dips and peaks during attenuation.
3. Carry out the same way for CH2.</td><td></td><td></td></tr>
</table>

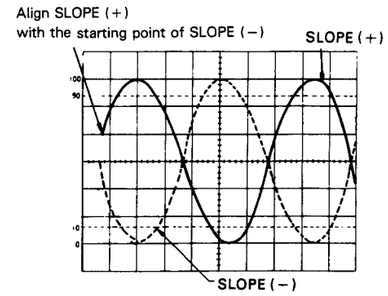
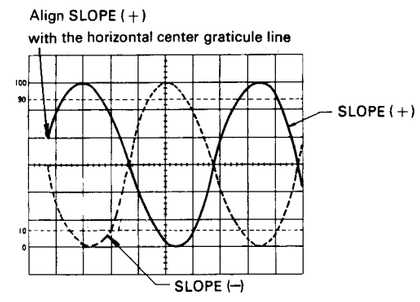
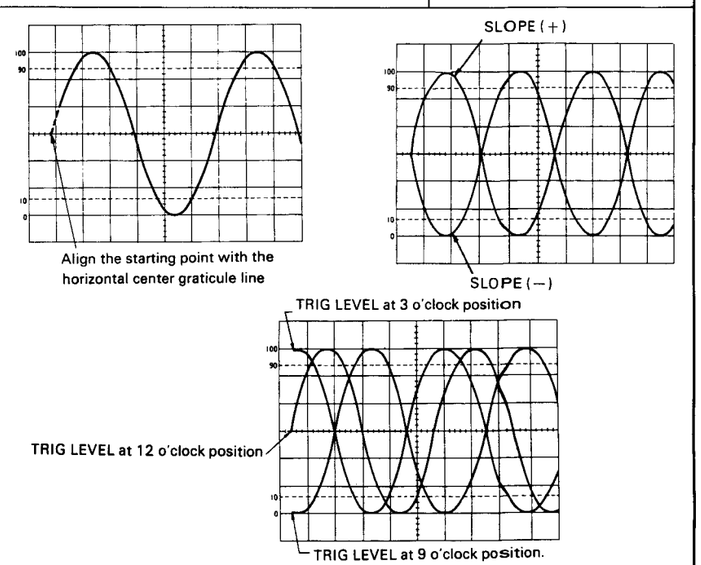
ADJUSTMENT

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
ADJUSTMENT OF HORIZONTAL SWEEP							
Adjustment of Sweep Time	VR4	X74-1280	TG-501	CH1, AC-GND-DC: AC CH1, VOLTS/DIV: 0.5V SWEEP TIME/DIV: 1ms SWEEP TIME VARI PRESET: CAL SWEEP TIME VARI: Pushed in, CAL	1. Apply a 0.1ms marker signal to CH1 input. 2. Operate ◄► POSITION to bring the first peak of the marker signal to left end of the graticule line and adjust VR4 for the 11th peak to the right end of the graticule line.		
Adjustment of SWEEP TIME VARI	VR4	X74-1260	TG-501	CH1, AC-GND-DC: AC CH1, VOLTS/DIV: 0.5V SWEEP TIME/DIV: 1ms SWEEP TIME VARI PRESET: CAL SWEEP TIME VARI: Pushed in, CAL	1. After carrying out the above adjustment, set SWEEP TIME VARI control to pulled out; CAL. 2. Adjust as for pushed in above.		
Adjustment of Sweep Length	VR5	X74-1280	TG-501	CH1, AC-GND-DC: AC CH1, VOLTS/DIV: 0.5V SWEEP TIME/DIV: 1ms SWEEP TIME VARI PRESET: CAL SWEEP TIME VARI: Pushed in, CAL	1. Apply a 1ms marker signal to CH1 input. 2. Adjust VR5 to display 11 peaks. (Check) Specification on all ranges: 10.5-13 div.		(Note) The waveform moves 2 div leftward and by turning ◄► POSITION to CCW and is able to observe 11th peak at the right end of the graticule line.
Adjustment of Sweep Position	VR6	X74-1280		TRIG LEVEL: Pushed in	1. Set CH1 AC-GND-DC to GND to bring the trace to the center of the CRT screen. 2. Turn ◄► POSITION to fully CW and measure the deviation between the start point of the trace and the center of the screen. 3. Turn ◄► POSITION to fully CCW and measure the deviation between the ending point of the trace and the center of the screen. Make adjustment so that these deviations will have the same width. Width error: within ±0.5 div		
Adjustment of ×5 MAG Gain	VR1	X74-1290	TG-501	CH1, AC-GND-DC: AC CH1, VOLTS/DIV: 0.5V SWEEP TIME/DIV: 1ms SWEEP TIME VARI: CAL	1. Apply a 1ms marker signal to CH1 input to display a waveform of about 2 divisions vertical amplitude. 2. Align the first peak of the marker signal with the left end of the graticule line and 11th peak with the right end and depress ×5 MAG knob. 3. Adjust VR1 so that the peak-to-peak distance is 5 divisions. (Check) Specification on all ranges: 5 times within ±5%		

ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td>Adjustment of ×5 MAG Center</td><td>VR2</td><td>X74-1290</td><td>TG-501</td><td>SWEEP TIME/DIV: 1ms
CH1, AC-GND-DC: AC
CH1, VOLTS/DIV: 0.5V
SWEEP TIME VARI: CAL</td><td>1. Apply a 5ms marker signal to CH1 input to display 3 peaks waveform.
2. Operate ◄► POSITION to bring the central peak to the vertical center graticule line.
3. Adjust VR2 so that the waveform will be aligned with vertical center graticule line when the × 5 MAG knob is depressed.
(Check)
When depressed and released alternately, check that the center of the waveform does not move.
Center deviation of × 5 MAG: within ± 1 div</td><td> 
</td><td></td></tr>
<tr><td>Adjustment of Sweep Time, 0.2μs</td><td>TC1</td><td>X74-1290</td><td>TG-501</td><td></td><td>1. With SWEEP TIME/DIV set to 0.2μs, apply a 0.2μs marker signal to CH1 input.
2. Adjust TC1 so that the each peak corresponds to each vertical graticule line.</td><td></td><td></td></tr>
<tr><td>Checking of Sweep Time Error in All Ranges</td><td></td><td></td><td></td><td></td><td>1. Apply a reference time marker signal for each range of SWEEP TIME/DIV.
2. Measure the time error rate and make sure that it is within the specification limits.
Specification: within ± 5%</td><td></td><td></td></tr>
<tr><td>Checking of SWEEP TIME VARI</td><td></td><td></td><td>TG-501</td><td>SWEEP TIME VARI PRESET: CAL
SWEEP TIME VARI: Pushed in, CAL</td><td>1. Apply a reference time marker signal for each range of SWEEP TIME/DIV and align each peak with the vertical graticule line.
2. When pulled out SWEEP TIME VARI and turned to fully CCW, sweep rate should be within 1/2.5 in comparison with CAL position.</td><td></td><td></td></tr>
<tr><td>Checking of SWEEP TIME VARI PRESET</td><td>VR1
VR2
VR3</td><td>X74-1260</td><td>TG-501</td><td>SWEEP TIME VARI PRESET: CAL
SWEEP TIME VARI: Pushed in, CAL</td><td>1. Apply a reference time marker signal for each range of SWEEP TIME/DIV and align each peak with the vertical graticule line.
2. Set SWEEP TIME PRESET to position (1) and adjust VR1 so that its sweep time rate becomes less than 1/2.5 when rotated SWEEP TIME PRESET adjustment control (1) on the right side panel to CCW.
3. Adjust VR2 and VR3 in the same procedure as the step for VR1.
4. After checking the above procedure, check that the value for PRESET (3), (2) and (1) are one division less in that order, as shown in the table below.
<table>
<tr><td>SWEEP TIME PRESET</td><td>1</td><td>2</td><td>3</td><td>CAL</td></tr>
<tr><td>Adj control</td><td>VR1</td><td>VR2</td><td>VR3</td><td>—</td></tr>
<tr><td>Setting (div)</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
</table></td><td></td><td></td></tr>
</table>

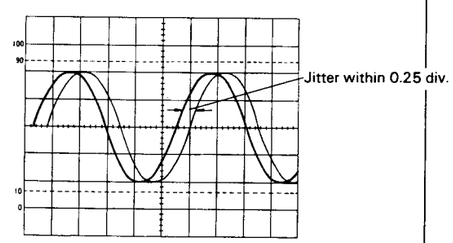
ADJUSTMENT

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
ADJUSTMENT OF TRIGGERING							
Adjustment of FIX Trig Slope	VR3	X74-1280	SG-502	CH1, AC-GND-DC: AC CH1, VOLTS/DIV: 5mV MODE: CH1 SWEEP TIME/DIV: 0.2ms MANUAL/FIX: FIX (▬) SOURCE: VERT MODE COUPLING: AC SLOPE: CH1 + TRIG LEVEL: Pushed in, AUTO	1. Apply a 1kHz sine wave signal to CH1 input and adjust the oscillator output to display a waveform of 4 to 6 divisions vertical amplitude. 2. Operate ▲▼ POSITION so that the waveform may have an amplitude equally above and below the horizontal center graticule line. 3. Adjust VR3 so that the start point of the waveform is the same for both when selected SLOPE CH1 (+) to (−) alternately.		
Adjustment of FIX Trig Center	VR2	X74-1280	SG-502	CH1, AC-GND-DC: AC CH1, VOLTS/DIV: 5mV MODE: CH1 SWEEP TIME/DIV: 0.2ms MANUAL/FIX: FIX (▬) SOURCE: VERT MODE COUPLING: AC SLOPE: CH1 + TRIG LEVEL: Pushed in, CAL	1. After carrying out the above, adjust VR2 so that the start point of waveform is on the horizontal center graticule line. 2. Adjust the oscillator output to display a waveform of less than 1 division vertical amplitude. Adjust VR2 (VR3) to obtain the stable synchronization when selected (+) to (−) alternately.		
Adjustment of Trig Level (1)	VR1	X74-1280	SG-502	CH1, CH2, AC-GND-DC: AC CH1, CH2, VOLTS/DIV: 5mV SWEEP TIME/DIV: 0.2ms MANUAL/FIX: MANUAL (▮) SOURCE: VERT MODE COUPLING: AC SLOPE CH1/CH2: +/+ TRIG LEVEL: Pushed in, AUTO MODE: CH1	1. Set TRIG LEVEL to 12 o'clock position. 2. Apply a 1kHz sine wave signal to CH1 input to display a waveform of 4 to 6 divisions vertical amplitude. 3. Operate ▲▼ POSITION to move the waveform so that its amplitude is equally above and below the horizontal center graticule line. 4. Adjust VR1 so that the start point of waveform is on the horizontal center graticule line. (Check) 1. When CH1 and CH2 SLOPE is alternately turned to (+) and (−), the start point must be always on the horizontal center graticule line. 2. With SLOPE remaining in the position of (+), when turned TRIG LEVEL to CW toward 3 o'clock from near 9 o'clock, the waveform is as shown at right. 3. Adjust the oscillator output so that the waveform amplitude becomes 0.5 division and make sure that synchronization can be obtained by TRIG LEVEL.		

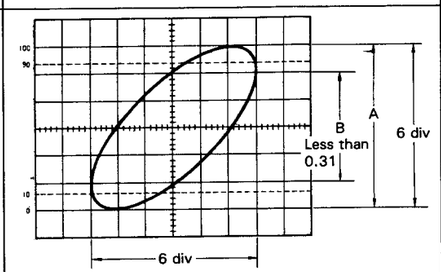
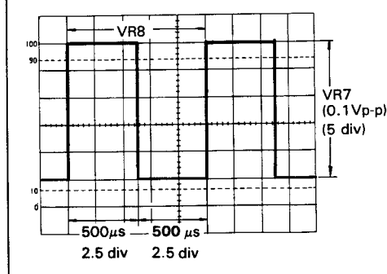
ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td>Adjustment of Trig Level (2)</td><td>VR10
VR12
VR13</td><td>X73-1420</td><td>SG-502</td><td>CH1, CH2, AC-GND-DC: AC
CH1, CH2, VOLTS/DIV: 5mV
SWEEP TIME/DIV: 0.2ms
MANUAL/FIX: MANUAL (■)
SOURCE: VERT MODE
COUPLING: AC
SLOPE CH1/CH2: +/+
TRIG LEVEL: Pushed in, AUTO
MODE: CH1</td><td>1. Apply a 1kHz sine wave signal to CH1 input to display a waveform of 4 to 6 divisions vertical amplitude.
2. Operate ▲▼ POSITION to move the waveform so that its amplitude is equally above and below the horizontal center graticule line.
3. Operate TRIG LEVEL knob so that the start point of the waveform is on the horizontal center graticule line.
4. When COUPLING is changed from AC to DC in each range of SOURCE in VERT MODE, CH1 and CH2, adjust VR10, VR12 and VR13 so that the start point of the waveform is located on the horizontal center graticule line.
VERT MODE.....VR10
CH1.....VR12
CH2.....VR13
5. Adjust the oscillator output to display a sine waveform of less than 1 division amplitude and carry out step (4) above again in the center of the screen.</td><td></td><td></td></tr>
<tr><td>Checking of Trig Sensitivity</td><td></td><td></td><td>SG-502
SG-503
CG-911</td><td></td><td>(I) INT
1. Apply a sine wave signal to CH1 input, vary the oscillator output and operate TRIG LEVEL to measure the minimum synchronization amplitude on the screen.
Confirm synchronization by each check frequency.
2. Check CH2 as for CH1 above.
(II) VIDEO
1. Apply a VIDEO signal to CH1 input, vary the oscillator output and operate TRIG LEVEL to measure and check the minimum synchronization amplitude on the screen.
Confirm synchronization by each check frequency.
2. Check CH2 as for CH1 above.
(III) EXT
1. Apply a signal synchronized to CH1 input to EXT input and adjust the oscillator output to measure and check the minimum amplitude.
2. Check CH2 as for CH1 above.</td><td></td><td></td></tr>
<tr><td>Checking of Trig Source</td><td></td><td></td><td></td><td></td><td>The selection of trigger signal should be carried out according to combination of vertical axis mode and source as follows.
<table>
<tr><th rowspan="2">SOURCE / VERT MODE</th><th colspan="2">VERT MODE</th><th rowspan="2">CH1</th><th rowspan="2">CH2</th><th rowspan="2">LINE</th><th rowspan="2">EXT</th></tr>
<tr><th>EXCLUDING VERT MODE</th><th>VIDEO</th></tr>
<tr><td>CH1</td><td>CH1</td><td>CH1</td><td rowspan="5">CH1</td><td rowspan="5">CH2</td><td rowspan="5">LINE</td><td rowspan="5">EXT</td></tr>
<tr><td>CH2</td><td>CH2</td><td>CH2</td></tr>
<tr><td rowspan="2">ALT</td><td>CH1 : CH1</td><td>CH1</td></tr>
<tr><td>CH2 : CH2</td><td>See note (1)</td></tr>
<tr><td>CHOP</td><td colspan="2">See note (2)</td></tr>
<tr><td>ADD</td><td>(CH1 + CH2)</td><td>(CH1 + CH2)</td><td colspan="4"></td></tr>
</table>
(Note)
1. In the case of VIDEO FRAME, the alternate trace of CH1 and CH2 appear on the screen, but both CH1 and CH2 display are triggered with CH1 signal only.
2. As the CHOP change-over signal becomes the trigger signal, triggering is not properly carried out.
In this case, set SOURCE excluding VERT MODE.</td><td></td><td></td></tr>
</table>

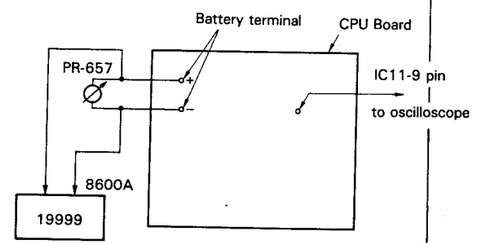
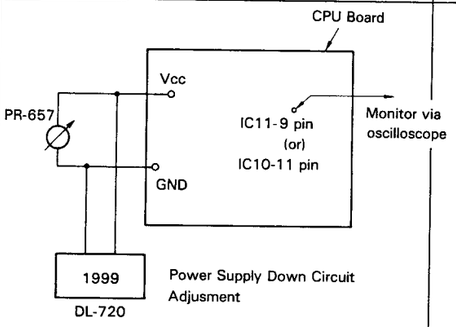
ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td>Checking of Trig Slope</td><td></td><td></td><td></td><td></td><td>1. The setting of trig slope is described according to combination of vertical axis mode and source.
Check that the trigger signal is operated in SLOPE CH1 +/− and CH2 +/− as follows.
<table>
<tr><th>SEPA-RATE</th><th>SOURCE / VERT MODE</th><th>VERT MODE</th><th>CH1</th><th>CH2</th><th>LINE, EXT</th></tr>
<tr><td rowspan="2">ON</td><td>CH1</td><td>Main:CH1 +/−
Sub:CH2 +/−</td><td rowspan="2">CH1 +/−</td><td rowspan="2">CH2 +/−</td><td>Main:CH1 +/−
Sub:CH2 +/−</td></tr>
<tr><td>CH2</td><td>Main:CH2 +/−
Sub:CH1 +/−</td><td>Main:CH2 +/−
Sub:CH1 +/−</td></tr>
<tr><td rowspan="5">OFF</td><td>CH1</td><td>CH1 +/−</td><td rowspan="5">CH1 +/−</td><td rowspan="5">CH2 +/−</td><td>CH1 +/−</td></tr>
<tr><td>CH2</td><td>CH2 +/−</td><td>CH2 +/−</td></tr>
<tr><td>ALT</td><td>CH1:CH1 +/−
CH2:CH2 +/−</td><td>CH1:CH1 +/−
CH2:CH2 +/−</td></tr>
<tr><td>CHOP</td><td rowspan="2">CH1 +/−</td><td>CH1 +/−</td></tr>
<tr><td>ADD</td><td></td></tr>
</table>
2. In the case of VIDEO, FRAME, check that the odd and even fields can be selected.</td><td></td><td></td></tr>
<tr><td>Checking of Trig Mode</td><td></td><td></td><td></td><td></td><td>The trig mode is decided according to combination of FIX/MANUAL, TRIG LEVEL and AUTO/NORMAL as shown table below.
<table>
<tr><th>FIX/MANUAL \ TRIG LEVEL</th><th>AUTO (PUSH)</th><th>NORMAL (PULL)</th></tr>
<tr><td>FIX</td><td>Auto sweep
Level fix</td><td>Triggered sweep
Level adjustable</td></tr>
<tr><td>MANUAL</td><td>Auto sweep
Level adjustable</td><td>Triggered sweep
Level adjustable</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>Checking of Jitter</td><td></td><td></td><td>SG-503</td><td>CH1, AC-GND-DC: AC
CH1, VOLTS/DIV: 5mV
SWEEP TIME/DIV: 0.2ms
×5 MAG: Pushed in
MANUAL/FIX: MANUAL (■)
SOURCE: CH1
COUPLING: CH1</td><td>1. Apply a 20MHz sine wave signal to CH1 input and adjust the oscillator output to display a waveform of 4 divisions vertical amplitude.
2. Operate TRIG LEVEL to find a point where the jitter is minimized.
Jitter: within 0.25div</td><td> 
</td><td></td></tr>
<tr><td colspan="8">ADJUSTMENT OF X-Y OPERATION</td></tr>
<tr><td>Adjustment of X axis Gain</td><td>VR7</td><td>X73-1420</td><td>PG-506</td><td>CH1, AC-GND-DC: GND
CH2, AC-GND-DC: AC
CH2, VOLTS/DIV: 2mV
SWEEP TIME/DIV: X-Y</td><td>Apply a 10mVp-p square wave signal to CH2 input and adjust VR7 to display a waveform of 5 divisions vertical amplitude.
(Check)
Specification: 5 div within ±5%</td><td></td><td></td></tr>
</table>

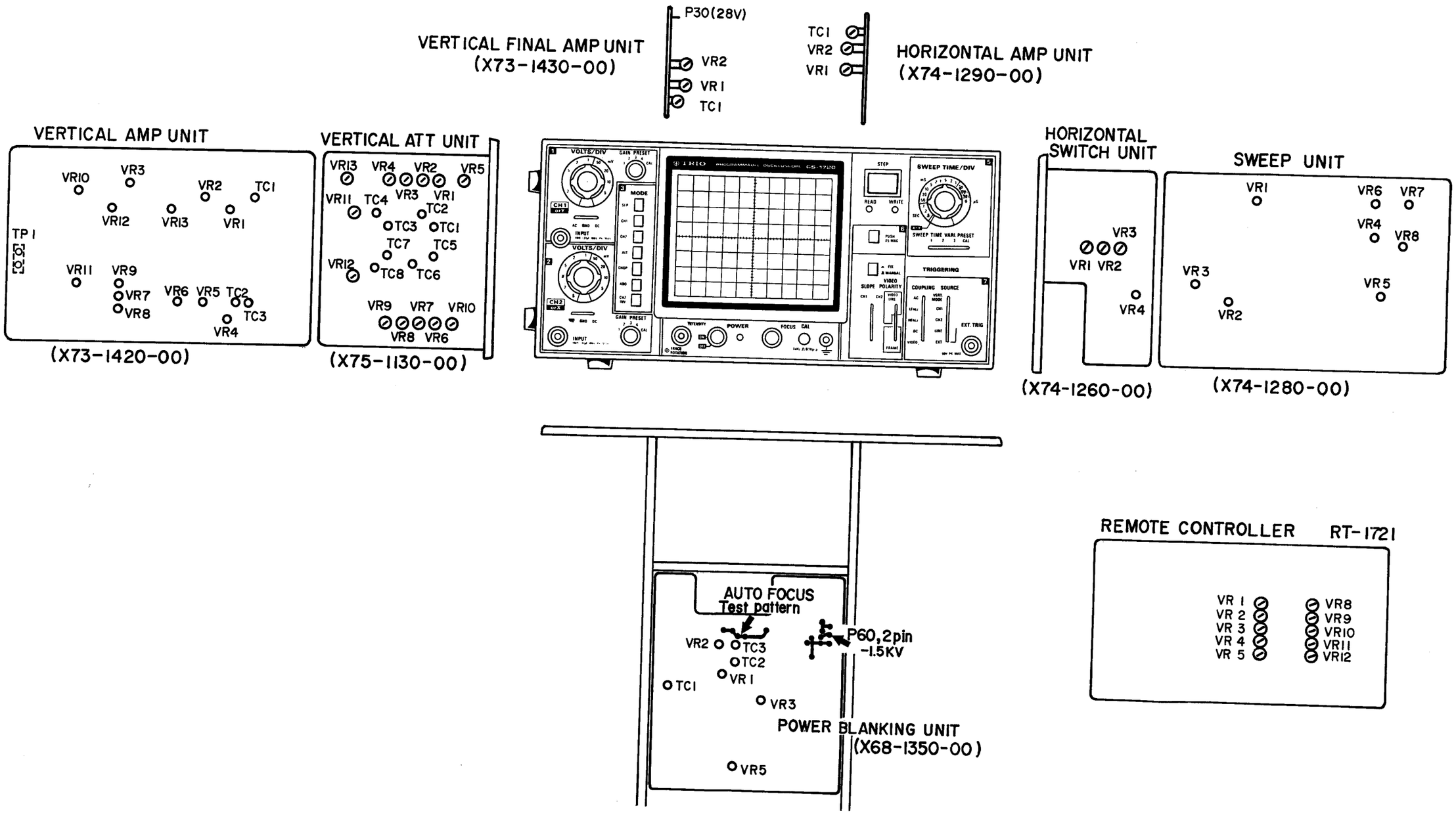
ADJUSTMENT

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Adjustment of X axis Position Center	VR8	X73-1420		CH1, CH2, AC-GND-DC: GND CH1, CH2, VOLTS/DIV: 2mV MODE: ALT SOURCE: CH1	1. Operate ▲▼ POSITION to align the traces on the horizontal center graticule line. 2. When selected SWEEP TIME/DIV to X-Y, adjust VR8 to bring the spot on the center of the CRT screen. (Check) 1. When ◄► POSITION is turned to CCW, the spot should move leftward more than 5 divisions and to CW, it should move rightward more than 5 divisions. Error between the spot and the center of the screen: within ±1div from the center of the screen.		
Checking of X axis Frequency Characteristics			SG-502	CH2, AC-GND-DC: DC CH2, VOLTS/DIV: 2mV SWEEP TIME/DIV: X-Y	1. Apply a 1kHz sine wave signal to CH2 input and adjust the oscillator output to display a waveform of 10 divisions vertical amplitude on the screen. 2. When the frequency is varied to 2MHz without changing the oscillator output, the amplitude must be more than 7.1 divisions (−3dB). Frequency characteristic: DC-2MHz (−3dB)		
Checking of X-Y Phase difference			SG-502	CH1, CH2, AC-GND-DC: AC CH1, CH2, VOLTS/DIV: 2mV	1. Operate CH1 and CH2 to align the traces on the horizontal center graticule line. 2. Apply a 100kHz sine wave signal to both CH1 and CH2 inputs to display a waveform of 6 divisions vertical amplitude on the screen. 3. When selected SWEEP TIME/DIV to X-Y, check the value of (B) referring to Lissajous' waveform should be within 0.31. Specification: less than 3° at 100kHz		$\sin\phi = \frac{B}{A}$ ϕ = Phase angle
Adjustment of CAL Output	VR7 VR8		X74-1280	CH1, AC-GND-DC: DC CH1, VOLTS/DIV: 0.2mV	1. Apply the CAL terminal voltage to CH1 input and adjust VR7 so the value becomes 0.1V±2%. 2. Adjust VR8 so that the frequency becomes 1kHz. Specifications: frequency; 1kHz±5% output voltage; 0.1Vp-p±2% duty ratio; (50±2)%		
Checking of CH1 OUT Frequency Characteristic			SG-503 475A 50Ω termination	CH1, AC-GND-DC: AC CH1, VOLTS/DIV: 2mV	1. Apply a 50kHz sine wave signal to CH1 input and adjust the oscillator output to display a waveform of 8 divisions vertical amplitude. 2. Connect the CH1 OUT to CH1 input of oscilloscope (475A) through 50Ω termination to display a waveform of 5 to 6 divisions vertical amplitude on the screen. (475A vertical sensitivity; 0.2V/div, AC coupling) 3. When the frequency is varied to 20MHz without changing the oscillator output, the amplitude of 475A must be within 5.6 divisions (−3dB).		
Checking of CH1 OUT output voltage and output impedance			SG-503 475A 50Ω termination	CH1, AC-GND-DC: AC CH1, VOLTS/DIV: 2mV	1. When applied a 50kHz sine wave signal to CH1 input, the amplitude of 475A must be more than 800mVp-p. 2. When disconnected 50Ω termination from 475A input, the amplitude must be 2 times. Specifications: output voltage; more than 100mVp-p/div output impedance; 50Ω±20%		

ADJUSTMENT

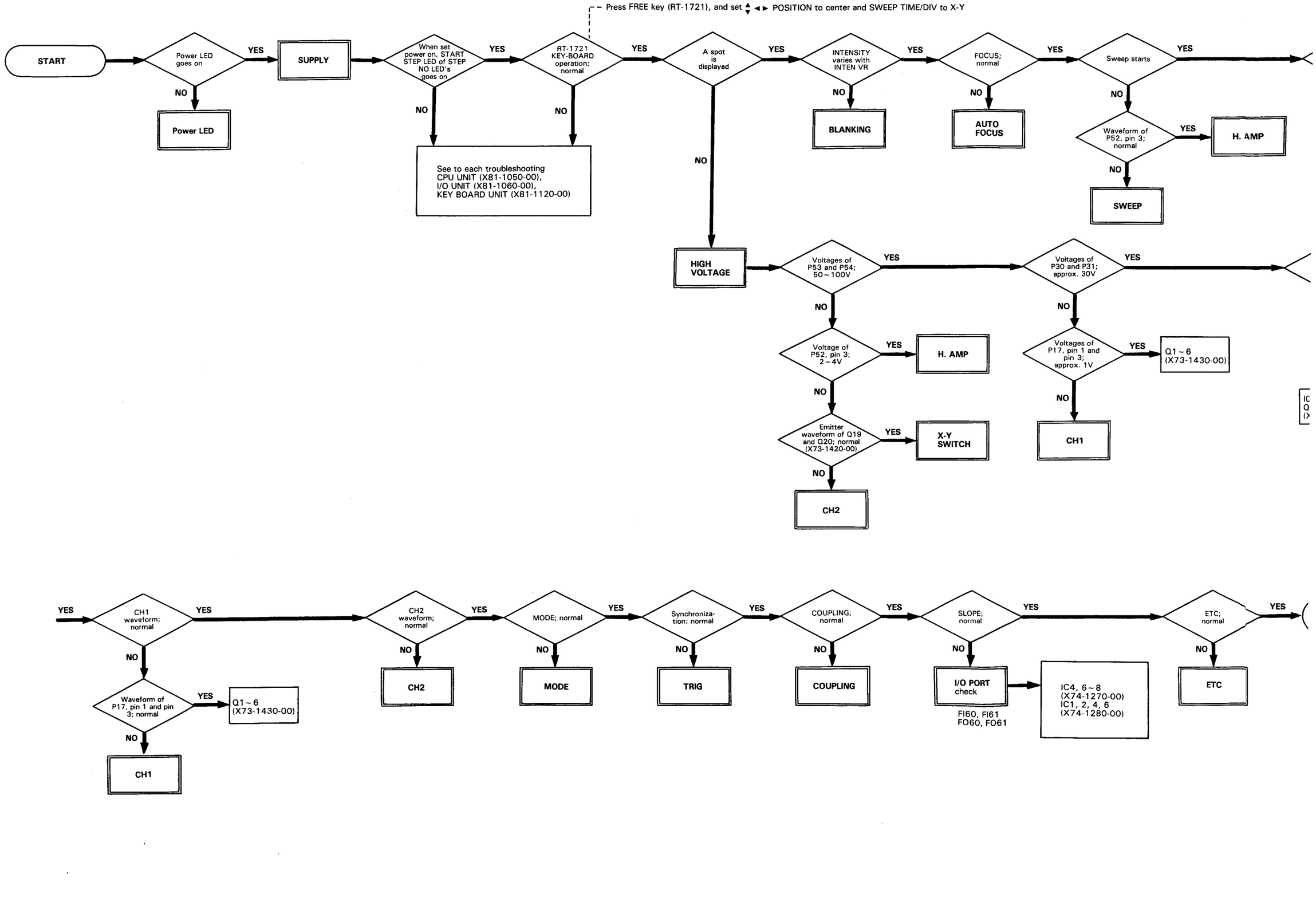
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Checking of SWEEP OUT Operation	P50	X74-1280	475A 50Ω termination	SWEEP TIME/DIV: 1ms	1. When observed the waveform at P50, using 475A through 50Ω termination, the amplitude must be more than 1Vp-p. (475A vertical sensitivity; 1mV/div, AC coupling) 2. When disconnected 50Ω termination from 475A input, the amplitude must be 2 times. Specifications: output voltage; more than 1Vp-p (50Ω terminate) output impedance; 50Ω±20%		
Checking of SWEEP GATE Operation	P51	X74-1280			Measure the waveform of P51 and check that the square waveform synchronized to SWEEP OUT is taken out. The output voltage is TTL level and in the case of sweep operation, is zero level.		
ADJUSTMENT OF CPU BOARD							
Battery Down Detection Circuit	VR1	X81-1050	PR-657 8600A 475A		The same with respect to memory pack 1. Connect the PR-657 in place of the battery and monitor its output with the 8600A. Also monitor the 9 pin of IC11 above the CPU board with the oscilloscope. Set the PR-657 at 2.5 V and turn VR1 so that the output of the 9 pin is at low level. 2. Next turn VR1 until the 9 pin changes from low to high level, then stop VR1 at the high level point. Finally, slowly lower the PR-657 output from 5 V and confirm that the voltage is at 2.5 V±20 mV when the 9 pin changes from low to high level.	 Adjustment wiring (Battery down detection circuit)	
Power Supply Down Circuit	VR2	X81-1050	PR-657 DL-720 475A		1. Connect the PR-657 as the CPU board power supply, and monitor its voltage with DL-720. Set the PR-657 at 4.7 V and turn VR2 so that the IC11, 6 pin is at low level. 2. Next, turn VR2 so that the 6 pin of IC11 changes from low to high level, then stop VR2 at the high level point. Finally, set the PR-657 at 5 V, slowly lower the voltage and confirm that the voltage reversing from low to high is at 4.7 V±50 mV.		

ADJUSTMENT

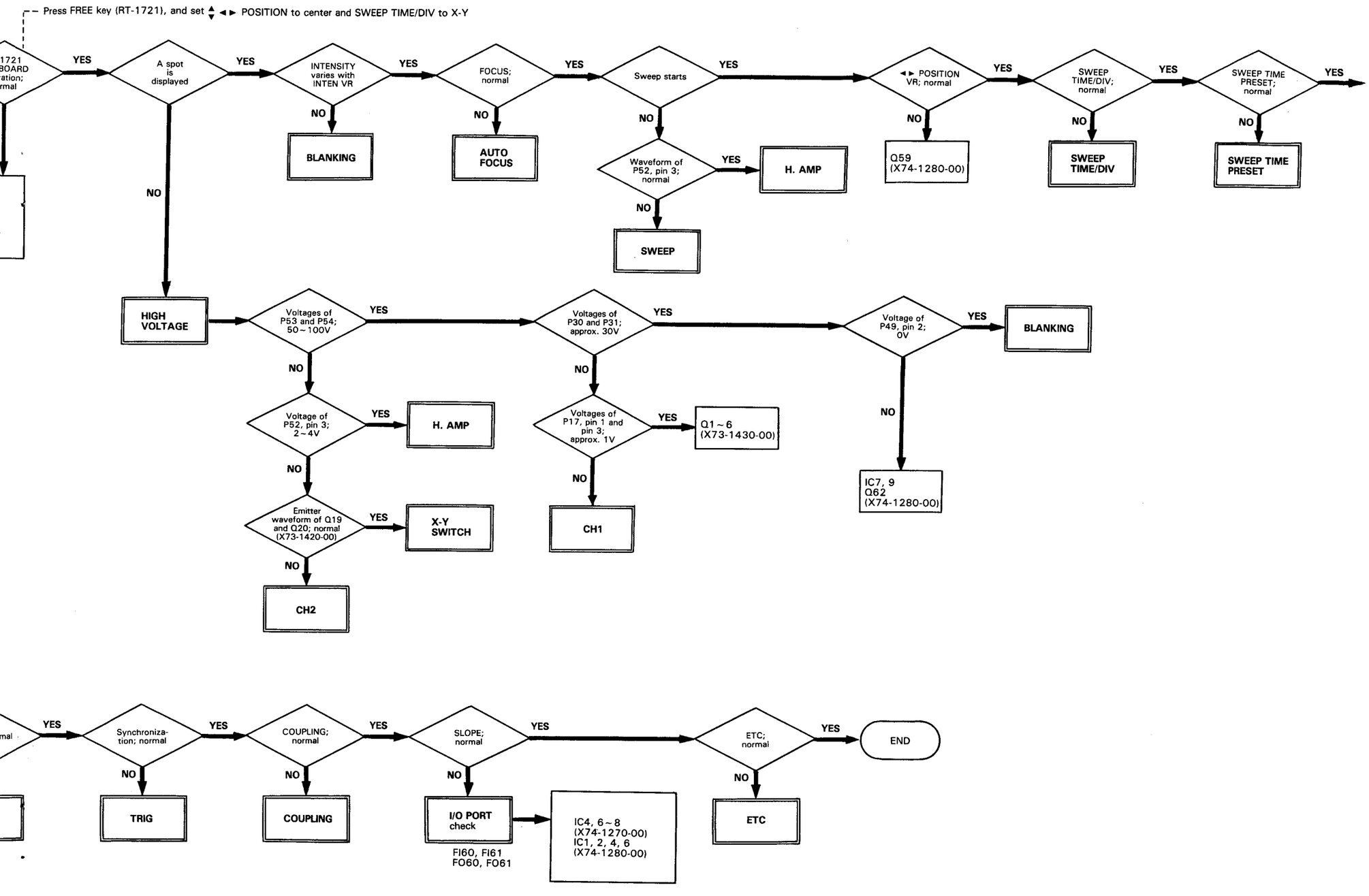


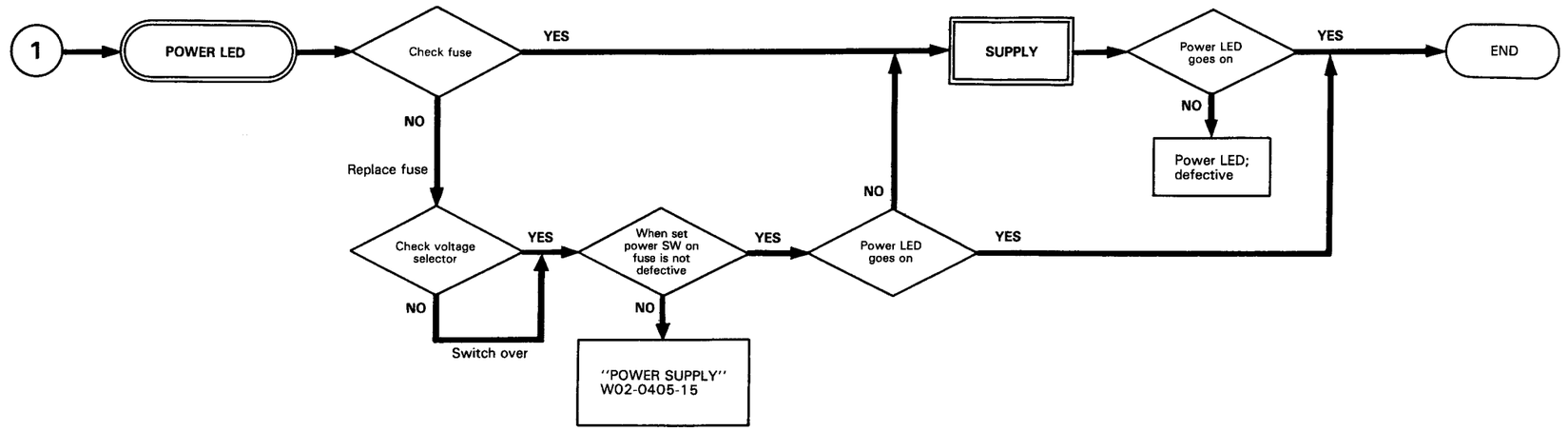
LOCATION OF ADJUSTMENT CONTROL

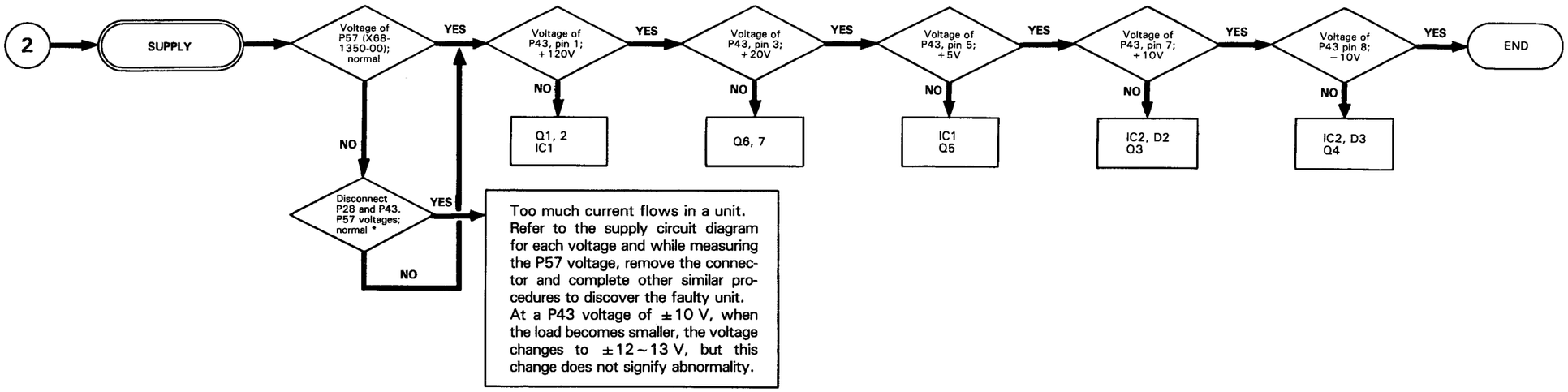
TROUBLESHOOTING



TROUBLESHOOTING



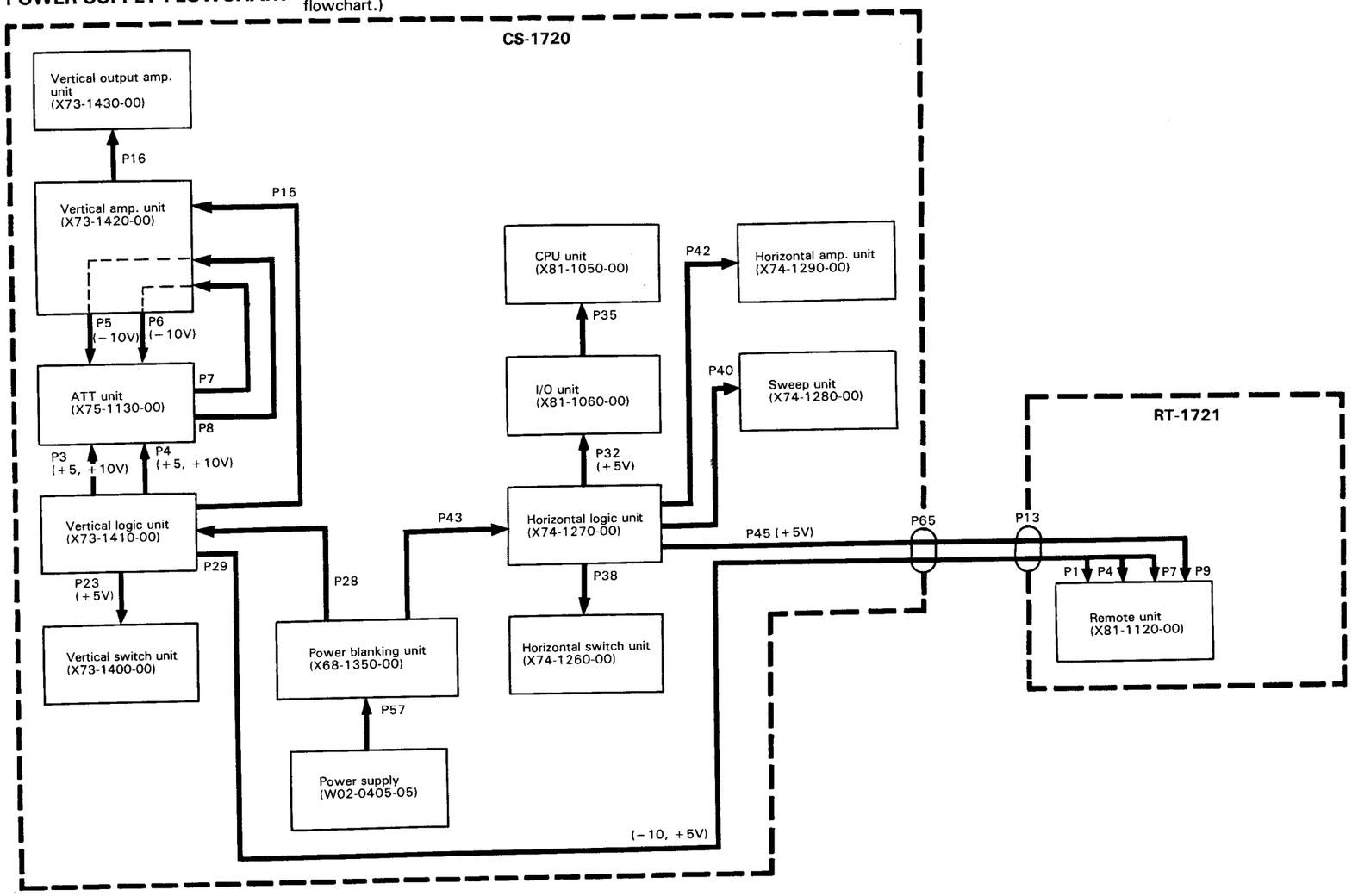


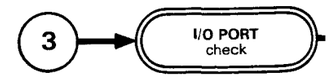


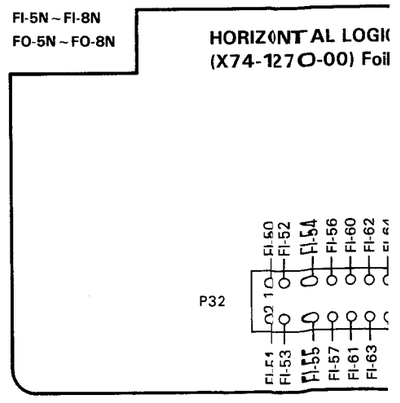
*Be sure to measure for short time and connect P28 and P43 immediately.

POWER SUPPLY FLOWCHART

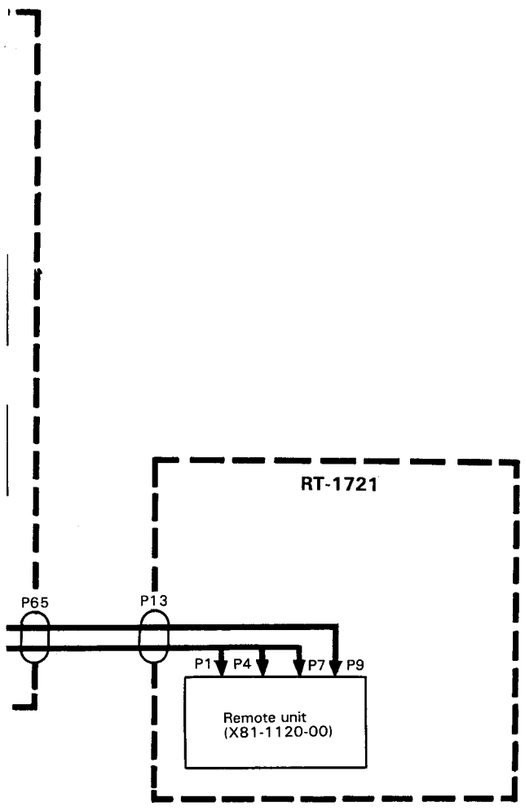
(If the power supply voltage is not normal, find the defective unit referring to the below flowchart.)

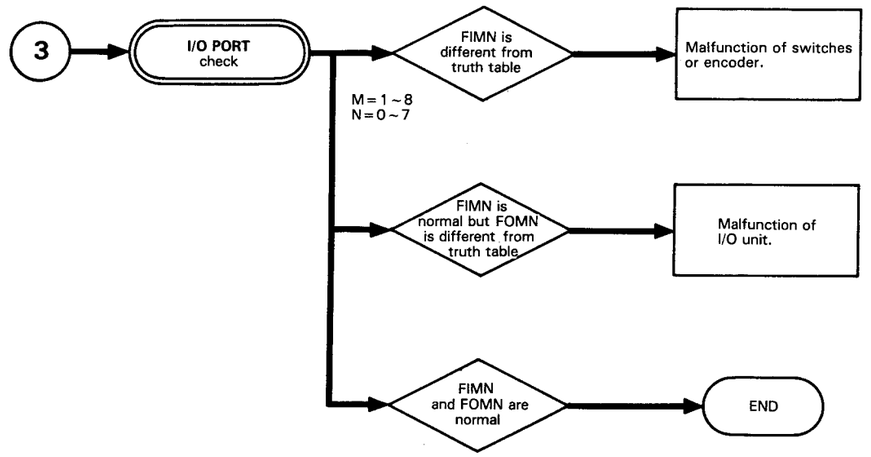






he below





Note:

(1) Select the remote controller (RT-1721) to FREE position.

(2) Before checking of I/O PORT, carry out the following procedures.

(a) FI-1N~FI-4N (X73-1410-00) (N=0~7)
Remove the connector of flat cable connected to P25 and check the voltage of P25.

(b) FO-1N~FO-4N (X81-1060-00)
Remove the connector of flat cable connected to P26 and check the voltage of P26.

(c) FI-5N~FI-8N, FO-5N~FO-8N (X74-1270-00)
Check the voltage of P32 (Horizontal Logic Unit).

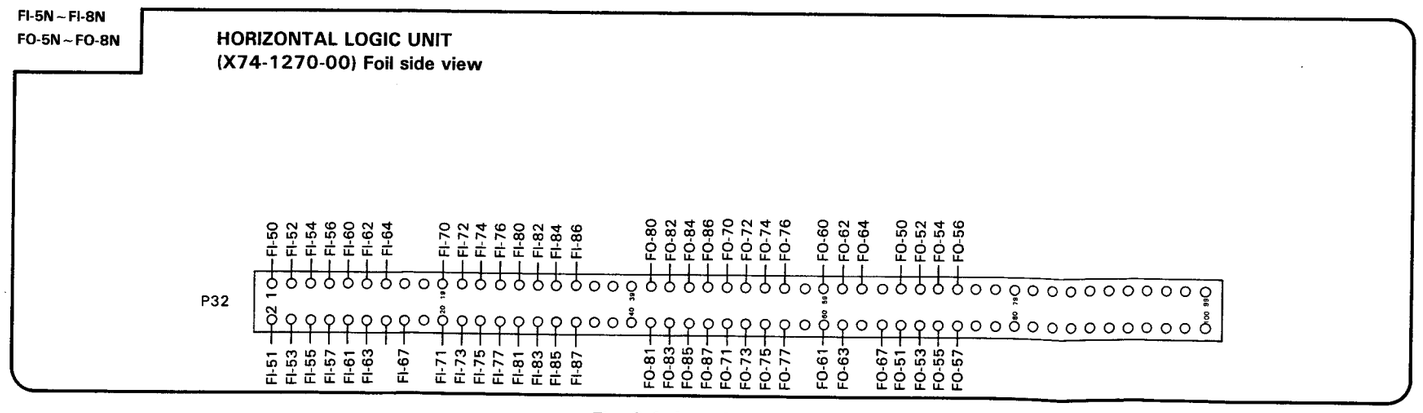


Fig. 9-1 Location of I/O Port

Table 9-1 Input/Output Port Map

bit 7 6 5 4 3 2 1 0

1 FI-1 FO-1

CH1 AC/DC	CH1 VOLTS / DIV					CH1 GAIN PRESET		
$\overline{DC}$	$\overline{1/100}$	$\overline{1/10}$	$\overline{B}$	$\overline{A}$		C	B	A

2 FI-2 FO-2

CH2 AC/DC	CH2 VOLTS / DIV					CH2 GAIN PRESET		
$\overline{DC}$	$\overline{1/100}$	$\overline{1/10}$	$\overline{B}$	$\overline{A}$		C	B	A

3 FI-3 FO-3

MODE							
	$\overline{INV}$	$\overline{ADD}$	$\overline{CHOP}$	$\overline{ALT}$	$\overline{CH2}$	$\overline{CH1}$	SEP

4 FI-4 FO-4

	CH2 POSITION PRESET			CH1 POSITION PRESET		
	$\overline{C}$	$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$

5 FI-5 FO-5

SWEEP TIME VARI. PRESET		SWEEP TIME / DIV (RT)			SWEEP TIME / DIV (CT)		
$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$

6 FI-6 FO-6

×5 MAG		FIX	VIDEO POLARITY		SLOPE	
×5MAG		FIX	$\overline{TVH}$	$\overline{TV(+)}$	$\overline{CH2(-)}$	$\overline{CH1(-)}$

7 FI-7 FO-7

EXT. TRIG*		SOURCE			COUPLING		
$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$

8 FI-8 FO-8

CH2 INPUT*				CH1 INPUT*			
$\overline{D}$	$\overline{C}$	$\overline{B}$	$\overline{A}$	$\overline{D}$	$\overline{C}$	$\overline{B}$	$\overline{A}$

*For Using Probe Selector

Table 9-2 Control Signal Truth Table

1 FI-1 / FO-1

		CH1 AC/DC	CH1 VOLTS / DIV				CH1 GAIN PRESET		
		$\overline{DC}$	$\overline{1/100}$	$\overline{1/10}$	$\overline{B}$	$\overline{A}$	C	B	A
CH1 AC-GND-DC	AC	H							
	DC	L							
CH1 VOLTS/DIV	5V		L	L	H	L			
	2V		L	L	L	H			
	1V		L	H	H	H			
	0.5V		L	H	H	L			
	0.2V		L	H	L	H			
	0.1V		H	L	H	H			
	50mV		H	L	H	L			
	20mV		H	L	L	H			
	10mV		H	H	H	H			
	5mV		H	H	H	L			
	2mV		H	H	L	H			
CH1 GAIN VARIABLE PRESET	1						L	L	L
	2						L	L	H
	3						L	H	L
	4						L	H	H
	CAL						H	L	L

2 FI-2 / FO-2

		CH2 AC/DC	CH2 VOLTS / DIV				CH2 GAIN PRESET		
		$\overline{DC}$	$\overline{1/100}$	$\overline{1/10}$	$\overline{B}$	$\overline{A}$	C	B	A
CH2 AC-GND-DC	AC	H							
	DC	L							
CH2 VOLTS/DIV	5V		L	L	H	L			
	2V		L	L	L	H			
	1V		L	H	H	H			
	0.5V		L	H	H	L			
	0.2V		L	H	L	H			
	0.1V		H	L	H	H			
	50mV		H	L	H	L			
	20mV		H	L	L	H			
	10mV		H	H	H	H			
	5mV		H	H	H	L			
	2mV		H	H	L	H			
CH2 GAIN VARIABLE PRESET	1						L	L	L
	2						L	L	H
	3						L	H	L
	4						L	H	H
	CAL						H	L	L

3 FI-3 / FO-3

			INV	ADD
MODE	CH2 INV	OFF	H	
		ON	L	
	CH1			H
	CH2			H
	ALT			H
	CHOP			H
	ADD			L
	SEP	OFF		
		ON		

5 FI-5 / FO-5

		SWEEP TIME VARI. PRESET		SWEEP TIME / DIV (RT)			SWEEP TIME / DIV (CT)		
		$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$
SWEEP TIME VARI. PRESET	1	L	L						
	2	L	H						
	3	H	L						
	CAL	H	H						
SWEEP TIME/DIV	X-Y			H	H	H	L	L	L
	.5s			L	L	L	L	L	H
	.2s			L	L	H	L	L	H
	.1s			L	H	L	L	L	H
	50ms			L	H	H	L	H	L
	20ms			H	L	L	L	H	L
	10ms			H	L	H	L	H	L
	5ms			L	L	L	L	H	H
	2ms			L	L	H	L	H	H
	1ms			L	H	L	L	H	H
	.5ms			L	H	H	H	L	L
	.2ms			H	L	L	H	L	L
	.1ms			H	L	H	H	L	L
	50μs			L	L	L	H	L	H
	20μs			L	L	H	H	L	H
	10μs			L	H	L	H	L	H
	5μs			L	H	H	H	H	L
	2μs			H	L	L	H	H	L
	1μs			H	L	H	H	H	L
	.5μs			H	H	L	H	H	H
	.2μs			H	H	H	H	H	H

6 FI-6 / FO-6

		×5 MAG		FIX	VIDEO POLARITY		SLOPE	
		×5MAG		FIX	$\overline{TVH}$	$\overline{TV(+)}$	$\overline{CH2(-)}$	$\overline{CH1(-)}$
×5MAG	ON	H						
	OFF	L						
FIX	ON			H				
	OFF			L				
VIDEO POLARITY	LINE +				L	L		
	LINE −				L	H		
	FRAME +				H	L		
	FRAME −				H	H		
SLOPE	CH1/CH2 +/+						H	H
	−/+						L	H
	+/−						H	L
	−/−						L	L

7 FI-7 / FO-7

		EXT. TRIG*		SOURCE			COUPLING		
		$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$
EXT* TRIG	OFF	H	H						
	1	H	L						
	2	L	H						
	3	L	L						
SOURCE	V. MODE			H	H	H			
	CH1			H	H	L			
	CH2			H	L	H			
	LINE			H	L	L			
	EXT.			L	H	H			
COUPLING	AC						H	H	H
	LF Rej						H	H	L
	HF Rej						H	L	H
	DC						H	L	L
	VIDEO						L	H	H

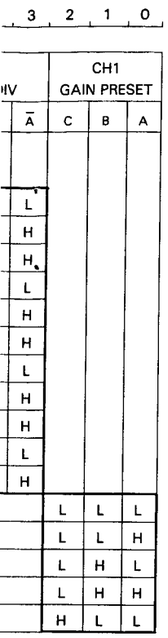
*For Using Probe Selector.

8 FI-8 / FO-8

(For using probe selector)

		CH2 INPUT		
		$\overline{D}$	$\overline{C}$	$\overline{B}$
CH2 INPUT	1	L	L	L
	2	L	L	L
	3	L	L	H
	4	L	L	H
	5	L	H	L
ONLY RU-1723	6	L	H	L
	7	L	H	H
	8	L	H	H
	9	H	L	L
	10	H	L	L
CH1 INPUT	1			
	2			
	3			
	4			
	5			
ONLY RU-1723	6			
	7			
	8			
	9			
	10			

TROUBLESHOOTING



3	2	1	0		
				CH1 GAIN PRESET	
			$\overline{A}$	C	B	A
			L			
			H			
			H			
			L			
			H			
			H			
			L			
			H			
			L			
			H			
				L	L	L
				L	L	H
				L	H	L
				L	H	H
				H	L	L

2

FI -2– 7 6 5 4 3 2 1 0
FO-2–

		CH2 AC/DC	CH2 VOLTS / DIV				CH2 GAIN PRESET		
		$\overline{DC}$	1/100	1/10	$\overline{B}$	$\overline{A}$	C	B	A
CH2 AC-GND-DC	AC	H							
	DC	L							
CH2 VOLTS/DIV	5V		L	L	H	L			
	2V		L	L	L	H			
	1V		L	H	H	H			
	0.5V		L	H	H	L			
	0.2V		L	H	L	H			
	0.1V		H	L	H	H			
	50mV		H	L	H	L			
	20mV		H	L	L	H			
	10mV		H	H	H	H			
	5mV		H	H	H	L			
	2mV		H	H	L	H			
CH2 GAIN VARIABLE PRESET	1						L	L	L
	2						L	L	H
	3						L	H	L
	4						L	H	H
	CAL						H	L	L

3

FI -3– 7 6 5 4 3 2 1 0
FO-3–

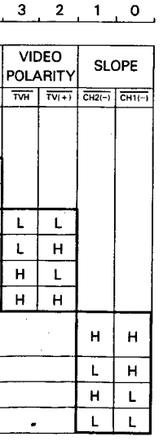
			MODE						
			INV	ADD	CHOP	ALT	CH2	CH1	SEP
MODE	CH2 INV	OFF	H						
		ON	L						
	CH1			H	H	H	H	L	
	CH2			H	H	H	L	H	
	ALT			H	H	L	H	H	
	CHOP			H	L	H	H	H	
	ADD			L	H	H	H	H	
	SEP	OFF							L
		ON							H

4

FI -4– 7 6 5 4 3 2 1 0
FO-4–

		CH2 POSITION PRESET			CH1 POSITION PRESET		
		$\overline{C}$	$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$
CH2 POSITION PRESET	1	H	H	L			
	2	H	L	H			
	3	H	L	L			
	4	L	H	H			
	5	L	H	L			
CH1 POSITION PRESET	1				H	H	L
	2				H	L	H
	3				H	L	L
	4				L	H	H
	5				L	H	L

Fig. 9-2 Location of Test Point



3	2	1	0		
				VIDEO POLARITY		SLOPE	
				TVH	TV(+)	CH2(–)	CH1(–)
			L	L			
			L	H			
			H	L			
			H	H			
						H	H
						L	H
						H	L
						L	L

7

FI -7– 7 6 5 4 3 2 1 0
FO-7–

		EXT. TRIG*		SOURCE			COUPLING		
		$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$	$\overline{C}$	$\overline{B}$	$\overline{A}$
EXT* TRIG	OFF	H	H						
	1	H	L						
	2	L	H						
	3	L	L						
SOURCE	V. MODE			H	H	H			
	CH1			H	H	L			
	CH2			H	L	H			
	LINE			H	L	L			
	EXT.			L	H	H			
COUPLING	AC						H	H	H
	LF Rej						H	H	L
	HF Rej						H	L	H
	DC						H	L	L
	VIDEO						L	H	H

*For Using Probe Selector.

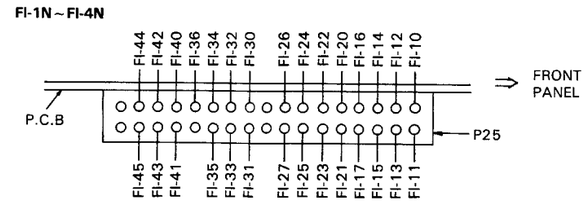
8

FI -8– 7 6 5 4 3 2 1 0
FO-8–

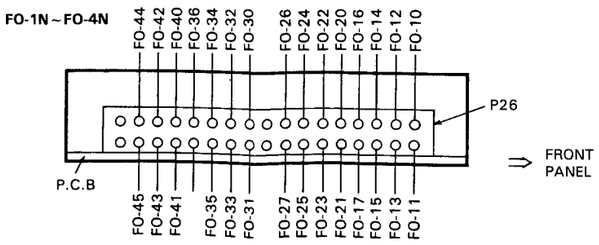
(For using probe selector)

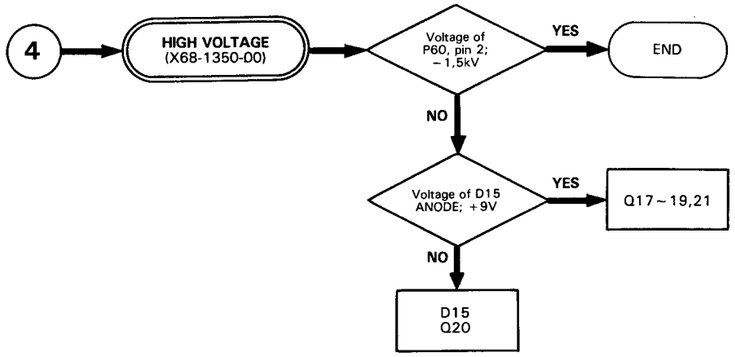
		CH2 INPUT				CH1 INPUT			
		$\overline{D}$	$\overline{C}$	$\overline{B}$	$\overline{A}$	$\overline{D}$	$\overline{C}$	$\overline{B}$	$\overline{A}$
CH2 INPUT	1	L	L	L	L				
	2	L	L	L	H				
	3	L	L	H	L				
	4	L	L	H	H				
	5	L	H	L	L				
ONLY RU-1723	6	L	H	L	H				
	7	L	H	H	L				
	8	L	H	H	H				
	9	H	L	L	L				
	10	H	L	L	H				
CH1 INPUT	1					L	L	L	L
	2					L	L	L	H
	3					L	L	H	L
	4					L	L	H	H
	5					L	H	L	L
ONLY RU-1723	6					L	H	L	H
	7					L	H	H	L
	8					L	H	H	H
	9					H	L	L	L
	10					H	L	L	H

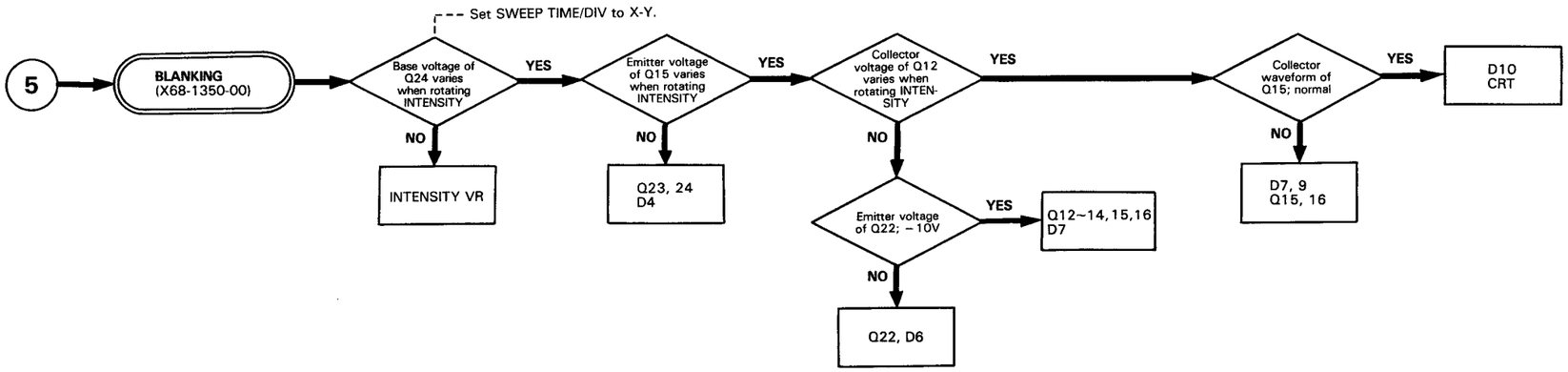
VERTICAL LOGIC UNIT
X73-1410-00

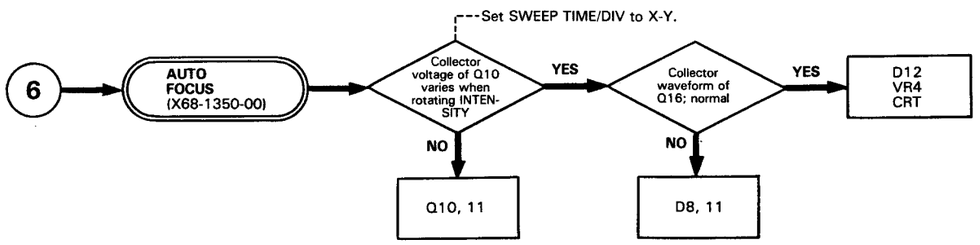


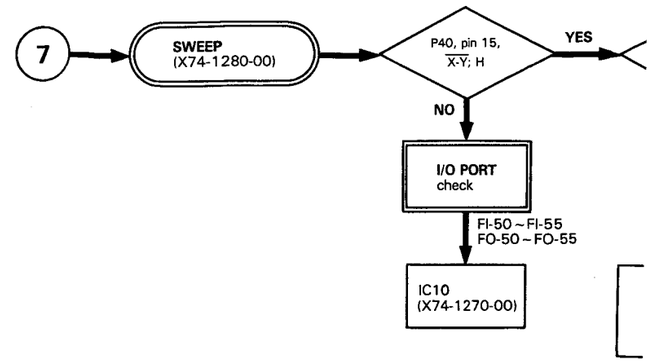
I/O UNIT
X81-1060-00

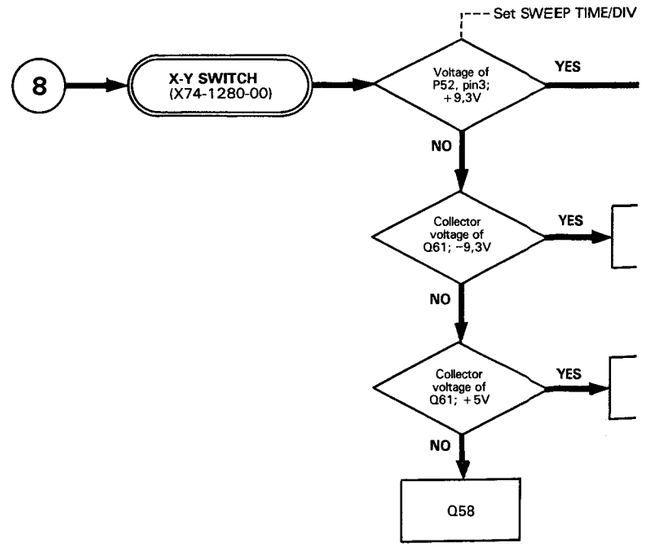



4
HIGH VOLTAGE
(X68-1350-00)
Voltage of P60, pin 2; −1,5kV
YES
END
NO
Voltage of D15 ANODE; +9V
YES
Q17~19,21
NO
D15
Q20

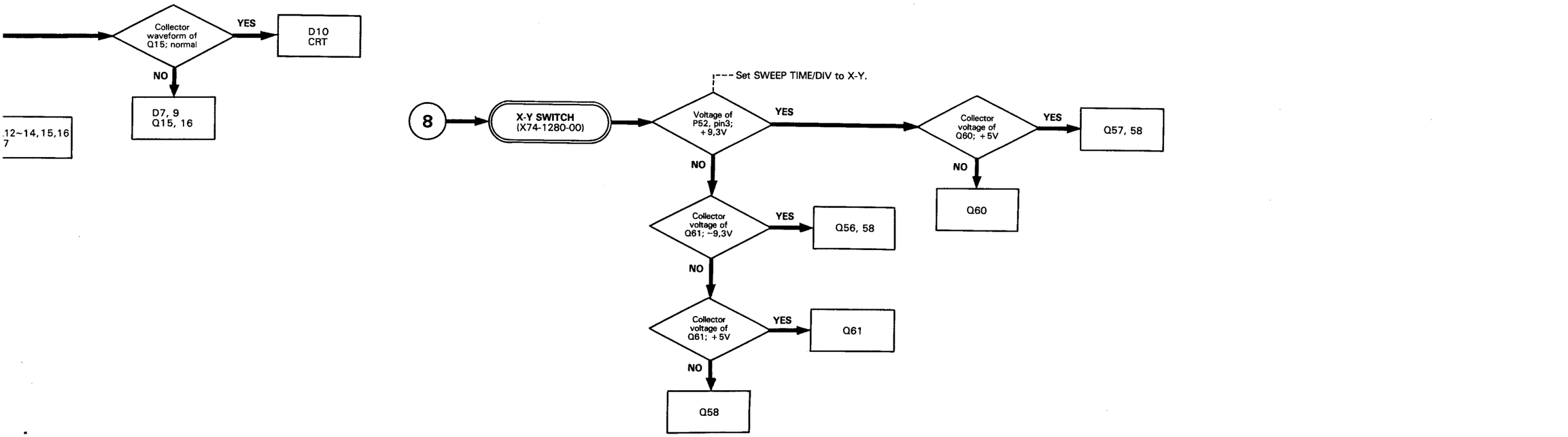

5
BLANKING
(X68-1350-00)
Set SWEEP TIME/DIV to X-Y.
Base voltage of Q24 varies when rotating INTENSITY
YES
NO
INTENSITY VR
Emitter voltage of Q15 varies when rotating INTENSITY
YES
NO
Q23, 24
D4
Collector voltage of Q12 varies when rotating INTENSITY
YES
NO
Emitter voltage of Q22; −10V
YES
Q12~14,15,16
D7
NO
Q22, D6
Collector waveform of Q15; normal
YES
D10
CRT
NO
D7, 9
Q15, 16

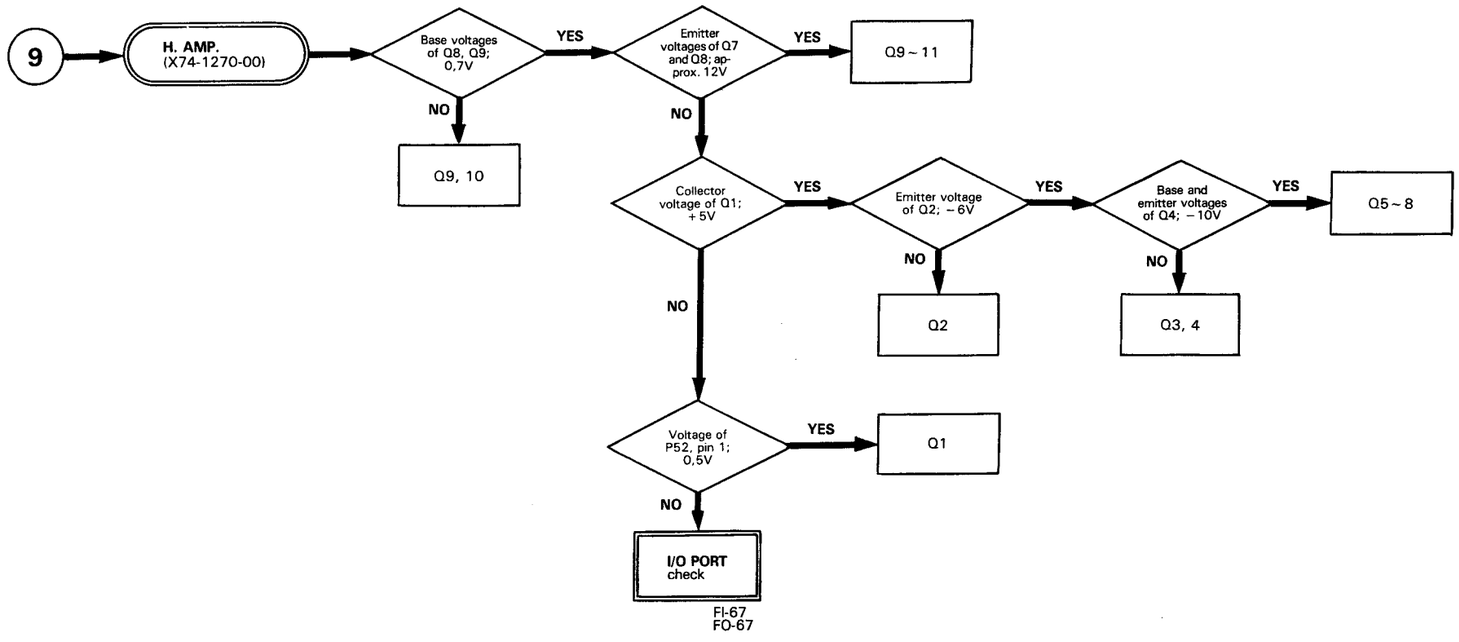

6
AUTO FOCUS
(X68-1350-00)
Set SWEEP TIME/DIV to X-Y.
Collector voltage of Q10 varies when rotating INTENSITY
YES
NO
Q10, 11
Collector waveform of Q16; normal
YES
NO
D8, 11
D12
VR4
CRT

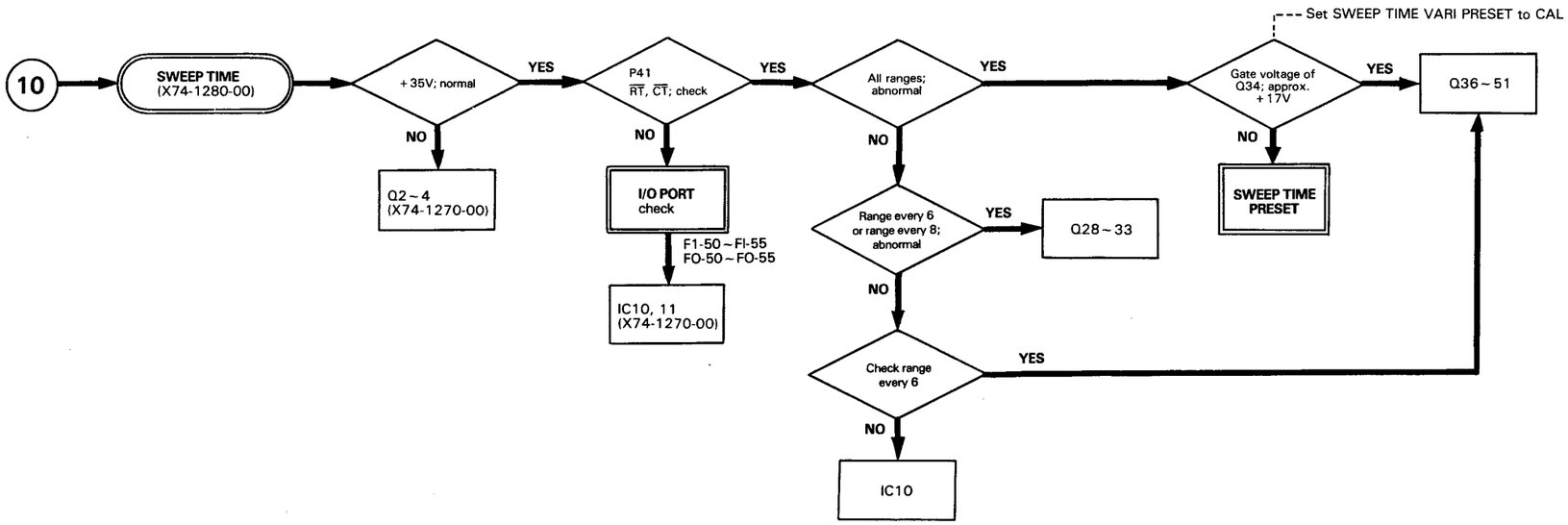

7
SWEEP
(X74-1280-00)
P40, pin 15, X-Y; H
YES
NO
I/O PORT
check
FI-50~FI-55
FO-50~FO-55
IC10
(X74-1270-00)

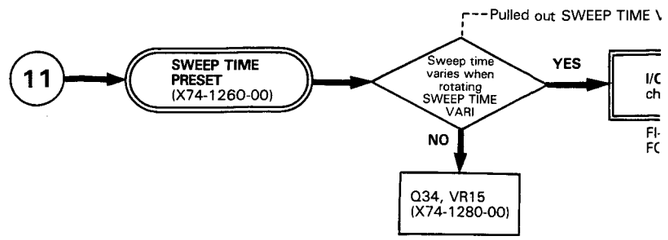

8
X-Y SWITCH
(X74-1280-00)
Set SWEEP TIME/DIV
Voltage of P52, pin3; +9,3V
YES
NO
Collector voltage of Q61; −9,3V
YES
NO
Collector voltage of Q61; +5V
YES
NO
Q58

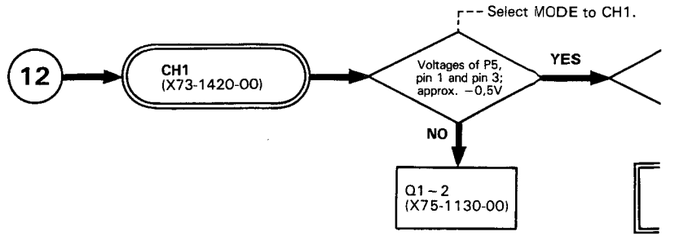
TROUBLESHOOTING











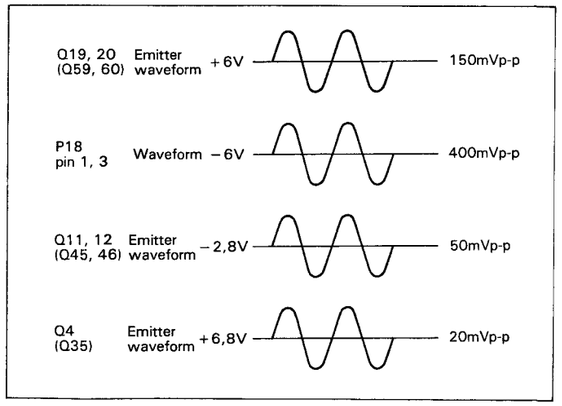
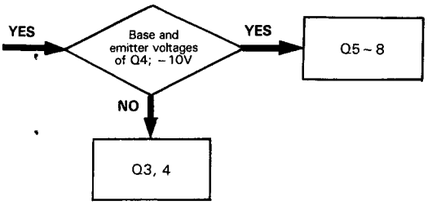


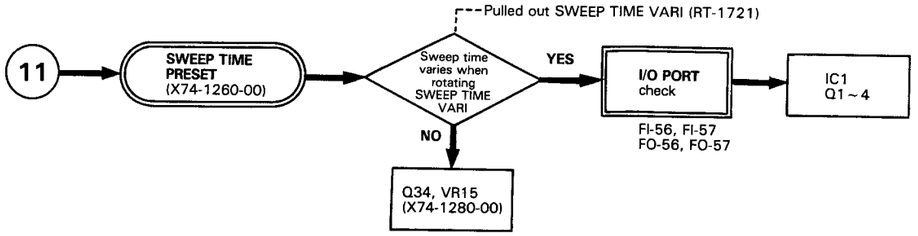
Fig. 9-3

P41

	$\overline{RT}$								$\overline{CT}$						
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7
X-Y	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
.5s	L	H	H	H	H	H	H	H	L	H	H	H	H	H	H
.2s	H	L	H	H	H	H	H	H	L	H	H	H	H	H	H
.1s	H	H	L	H	H	H	H	H	L	H	H	H	H	H	H
50ms	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H
20ms	H	H	H	H	L	H	H	H	H	L	H	H	H	H	H
10ms	H	H	H	H	H	L	H	H	H	L	H	H	H	H	H

TROUBLESHOOTING





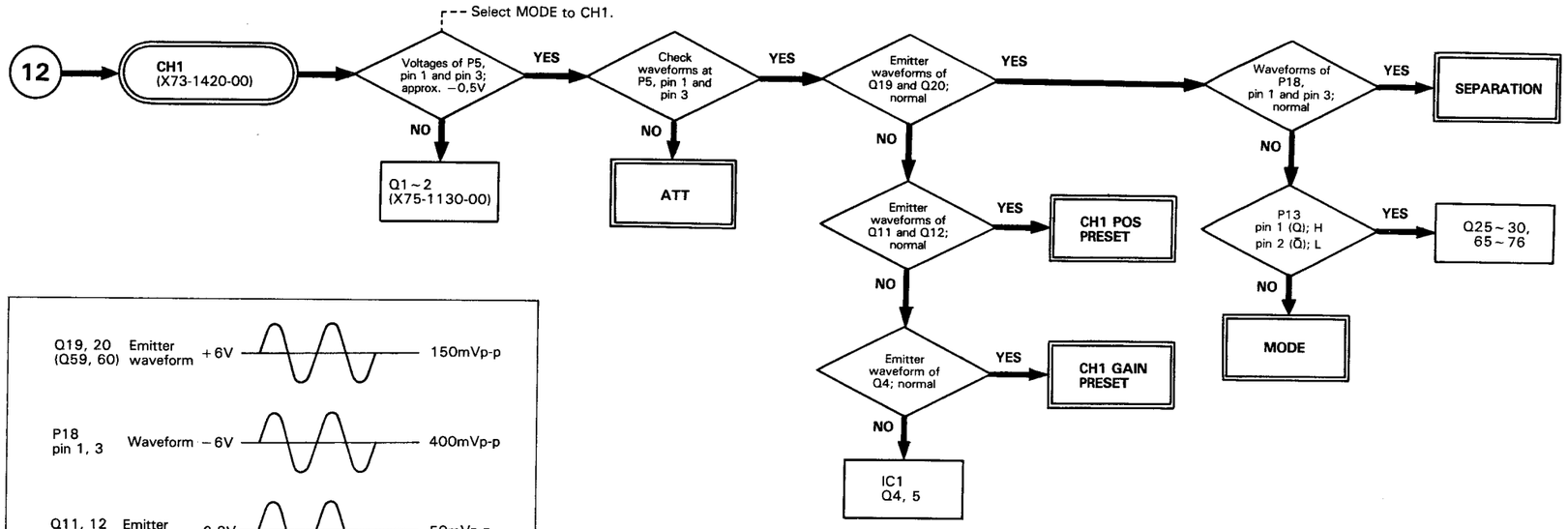


Fig. 9-3

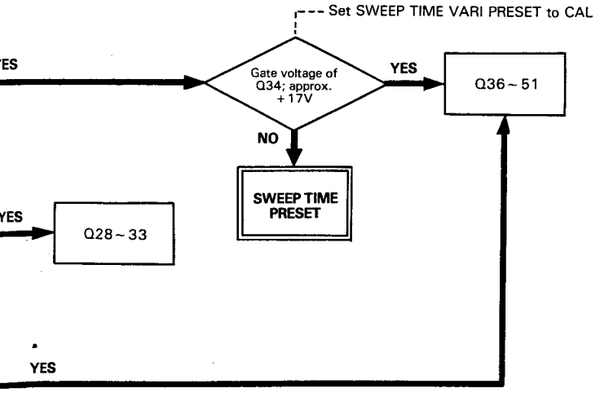


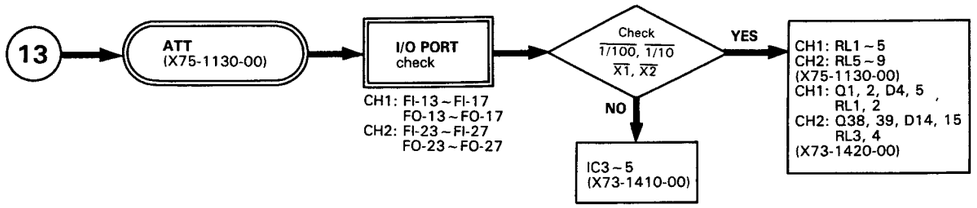
Table 9-3 Sweep Time/Div — $\overline{RT}$, $\overline{CT}$ Truth Table

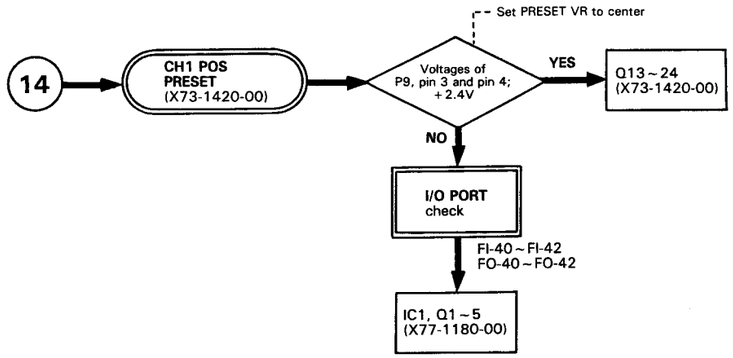
P41

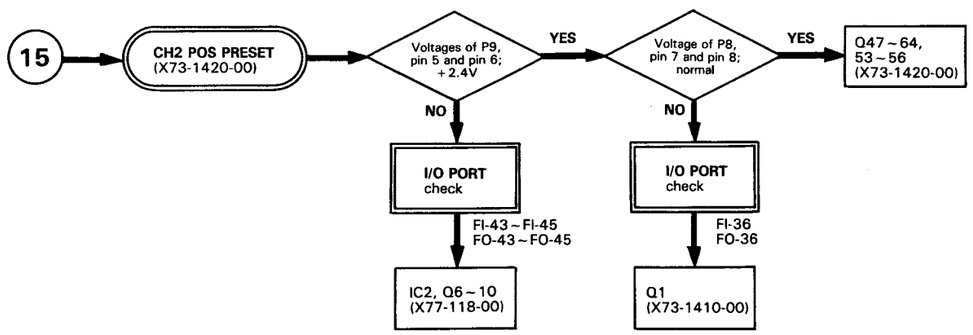
	$\overline{RT}$								$\overline{CT}$						
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7
X-Y	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
.5s	L	H	H	H	H	H	H	H	L	H	H	H	H	H	H
.2s	H	L	H	H	H	H	H	H	L	H	H	H	H	H	H
.1s	H	H	L	H	H	H	H	H	L	H	H	H	H	H	H
50ms	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H
20ms	H	H	H	H	L	H	H	H	H	L	H	H	H	H	H
10ms	H	H	H	H	H	L	H	H	H	L	H	H	H	H	H

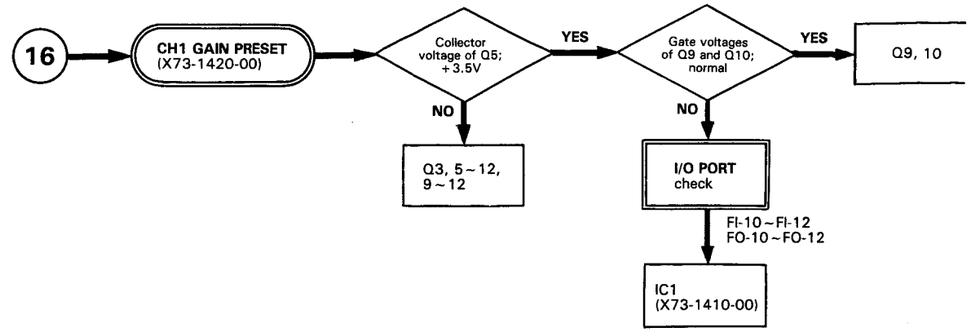
	$\overline{RT}$								$\overline{CT}$						
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7
5ms	L	H	H	H	H	H	H	H	H	H	L	H	H	H	H
2ms	H	L	H	H	H	H	H	H	H	H	L	H	H	H	H
1ms	H	H	L	H	H	H	H	H	H	H	L	H	H	H	H
.5ms	H	H	H	L	H	H	H	H	H	H	H	L	H	H	H
.2ms	H	H	H	H	L	H	H	H	H	H	H	L	H	H	H
.1ms	H	H	H	H	H	L	H	H	H	H	H	L	H	H	H
50μs	L	H	H	H	H	H	H	H	H	H	H	H	L	H	H

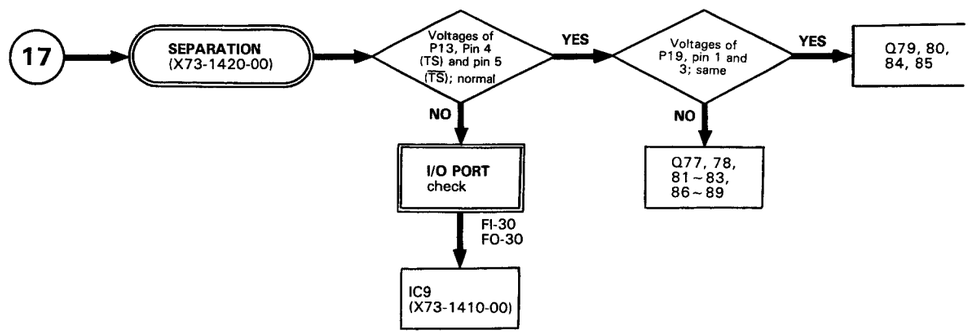
	$\overline{RT}$								$\overline{CT}$						
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7
20μs	H	L	H	H	H	H	H	H	H	H	H	H	L	H	H
10μs	H	H	L	H	H	H	H	H	H	H	H	H	L	H	H
5μs	H	H	H	L	H	H	H	H	H	H	H	H	H	L	H
2μs	H	H	H	H	L	H	H	H	H	H	H	H	H	L	H
1μs	H	H	H	H	H	L	H	H	H	H	H	H	H	L	H
.5μs	H	H	H	H	H	H	L	H	H	H	H	H	H	H	L
.2μs	H	H	H	H	H	H	H	L	H	H	H	H	H	H	L

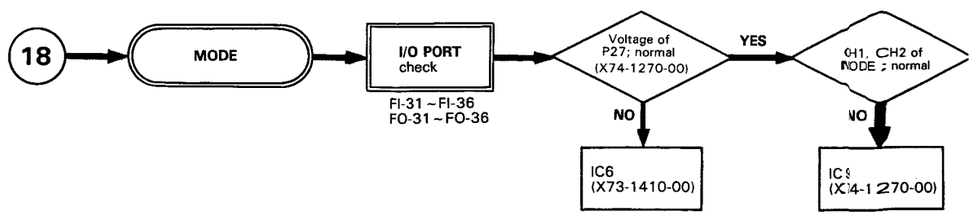

13
ATT
(X75-1130-00)
I/O PORT
check
CH1: FI-13 ~ FI-17
FO-13 ~ FO-17
CH2: FI-23 ~ FI-27
FO-23 ~ FO-27
Check
1/100, 1/10
X1, X2
YES
NO
CH1: RL1 ~ 5
CH2: RL5 ~ 9
(X75-1130-00)
CH1: Q1, 2, D4, 5
RL1, 2
CH2: Q38, 39, D14, 15
RL3, 4
(X73-1420-00)
IC3 ~ 5
(X73-1410-00)

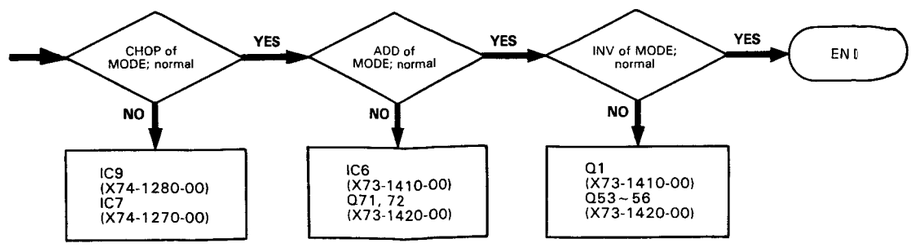

14
CH1 POS
PRESET
(X73-1420-00)
Set PRESET VR to center
Voltages of
P9, pin 3 and pin 4;
+2.4V
YES
NO
Q13 ~ 24
(X73-1420-00)
I/O PORT
check
FI-40 ~ FI-42
FO-40 ~ FO-42
IC1, Q1 ~ 5
(X77-1180-00)

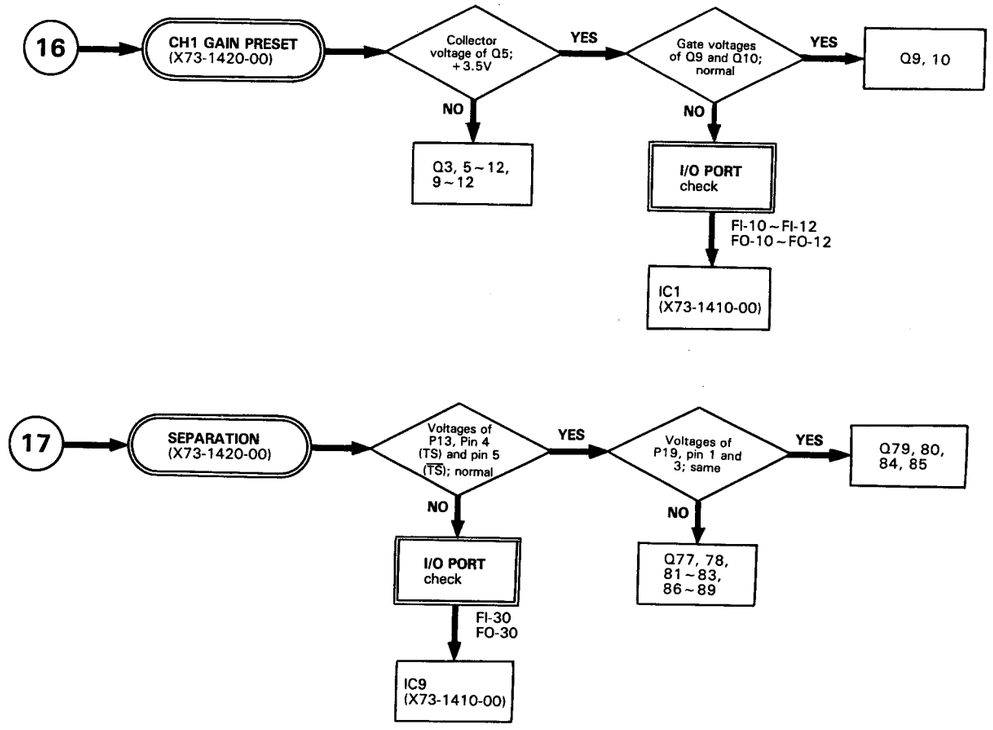

15
CH2 POS PRESET
(X73-1420-00)
Voltages of P9,
pin 5 and pin 6;
+2.4V
YES
Voltage of P8,
pin 7 and pin 8;
normal
YES
Q47 ~ 64,
53 ~ 56
(X73-1420-00)
NO
NO
I/O PORT
check
FI-43 ~ FI-45
FO-43 ~ FO-45
IC2, Q6 ~ 10
(X77-118-00)
I/O PORT
check
FI-36
FO-36
Q1
(X73-1410-00)


16
CH1 GAIN PRESET
(X73-1420-00)
Collector
voltage of Q5;
+3.5V
YES
Gate voltages
of Q9 and Q10;
normal
YES
Q9, 10
NO
NO
Q3, 5 ~ 12,
9 ~ 12
I/O PORT
check
FI-10 ~ FI-12
FO-10 ~ FO-12
IC1
(X73-1410-00)


17
SEPARATION
(X73-1420-00)
Voltages of
P13, Pin 4
(TS) and pin 5
(TS); normal
YES
Voltages of
P19, pin 1 and
3; same
YES
Q79, 80,
84, 85
NO
NO
I/O PORT
check
FI-30
FO-30
Q77, 78,
81 ~ 83,
86 ~ 89
IC9
(X73-1410-00)


18
MODE
I/O PORT
check
FI-31 ~ FI-36
FO-31 ~ FO-36
Voltage of
P27; normal
(X74-1270-00)
YES
CH1, CH2 of
MODE ; normal
NO
NO
IC6
(X73-1410-00)
IC8
(X74-1270-00)


CHOP of
MODE; normal
YES
ADD of
MODE; normal
YES
INV of MODE;
normal
YES
END
NO
NO
NO
IC9
(X74-1280-00)
IC7
(X74-1270-00)
IC6
(X73-1410-00)
Q71, 72
(X73-1420-00)
Q1
(X73-1410-00)
Q53 ~ 56
(X73-1420-00)



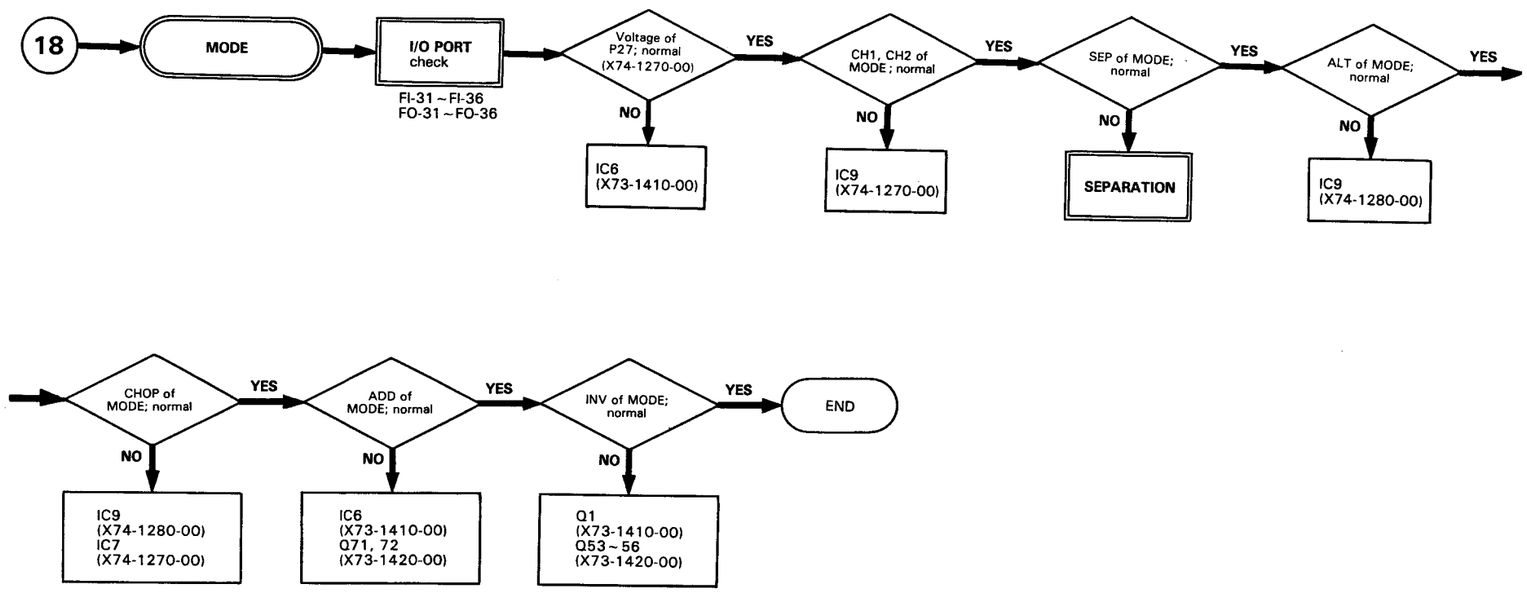
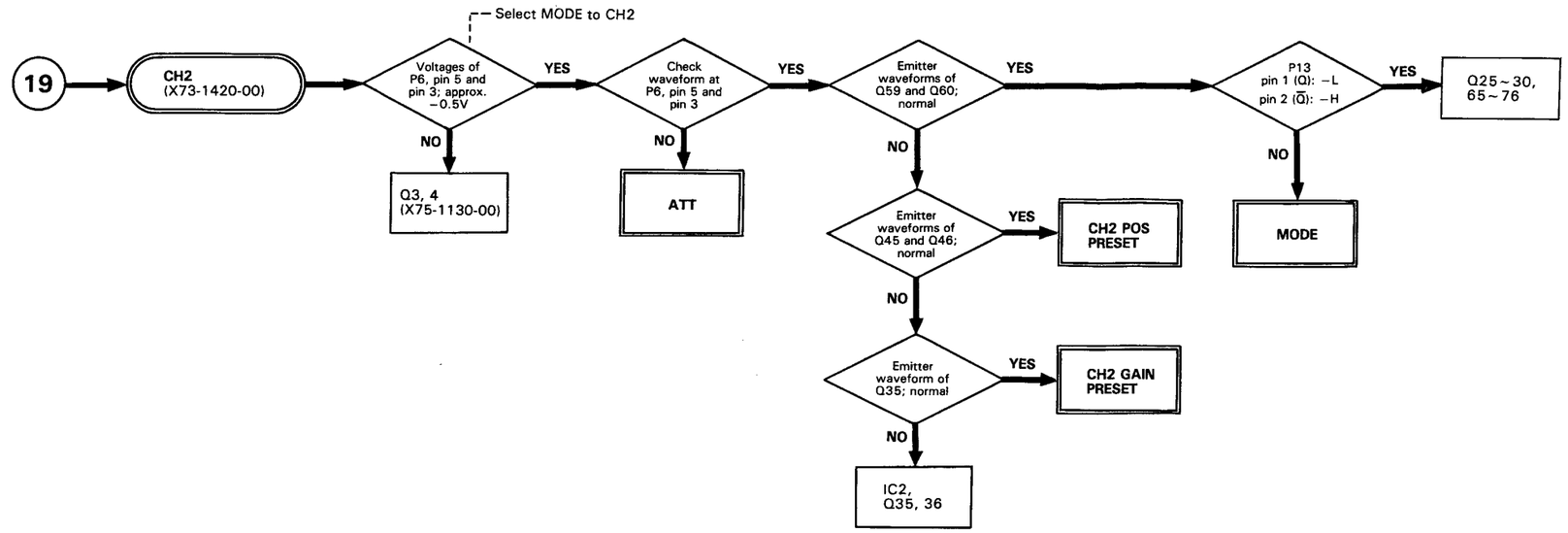
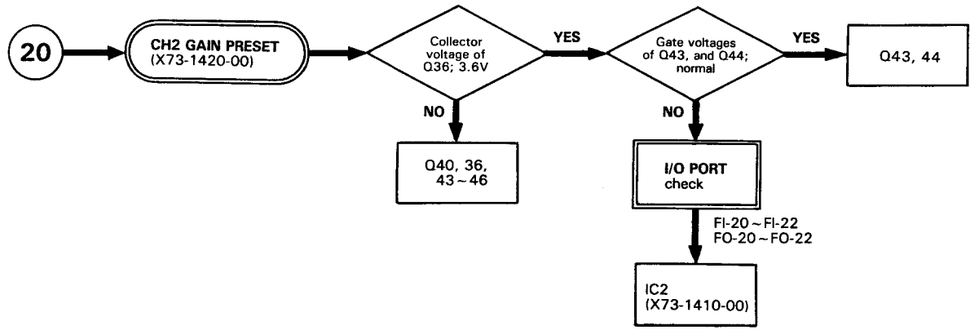


Table 9-4 Volts/Div Truth Table

		$\overline{1/100}$*	$\overline{1/10}$*	$\overline{\times 1}$	$\overline{\times 2}$
VOLTS/ DIV	2mV	H	H	H	H
	5mV	H	H	H	L
	10mV	H	H	L	H
	20mV	H	L	H	H
	50mV	H	L	H	L
	.1V	H	L	L	H
	.2V	L	H	H	H
	.5V	L	H	H	L
	1V	L	H	L	H
	2V	L	L	H	H
	5V	L	L	H	L

*H: +10V





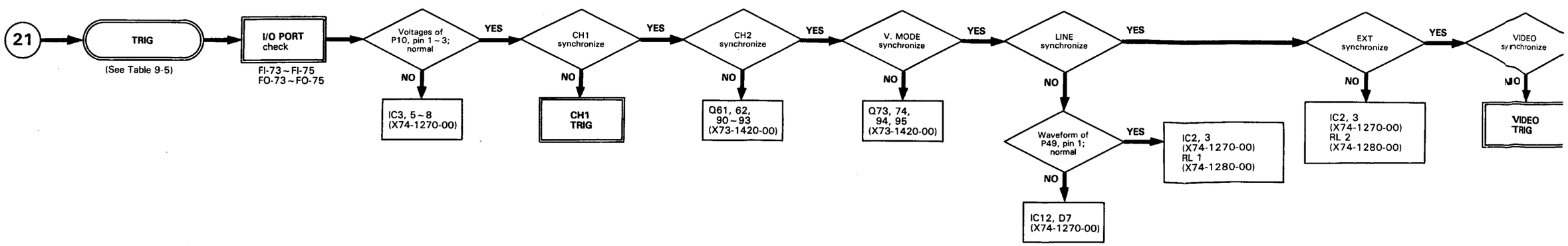


Table 9-5 Trig

P10 / SOURCE	PIN 1 CH2	PIN CH
CH1	H	L
CH2	L	H
V. MODE	H	H
LINE, EXT	H	H

Horizontal Logic Unit (X74-1270-

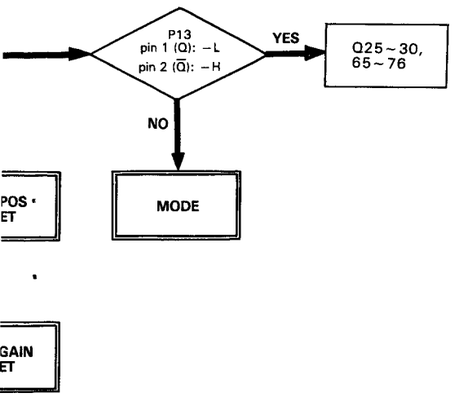
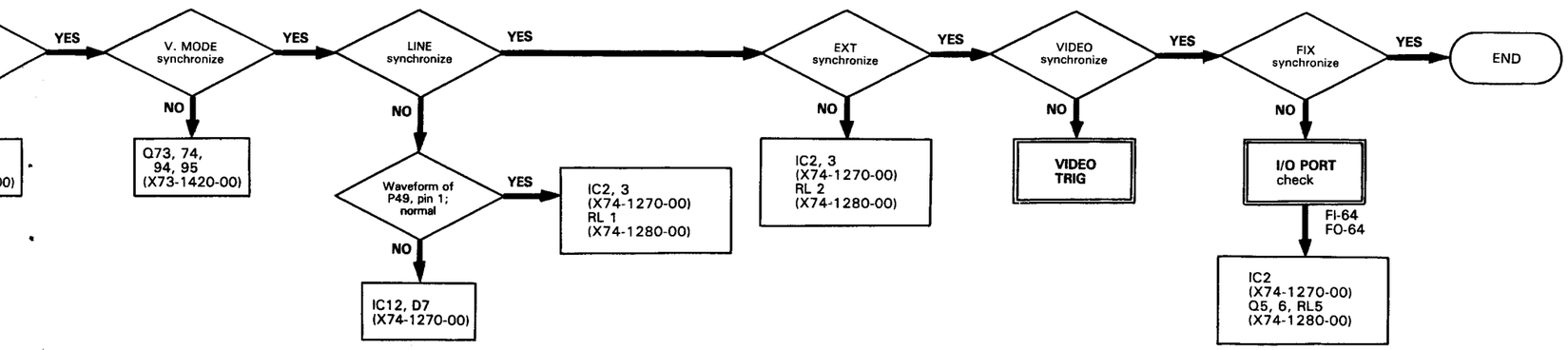
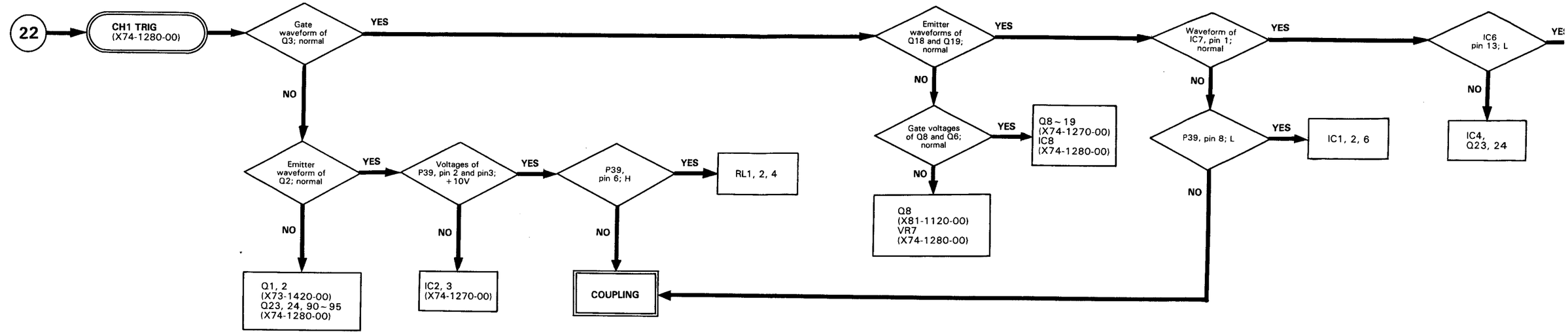


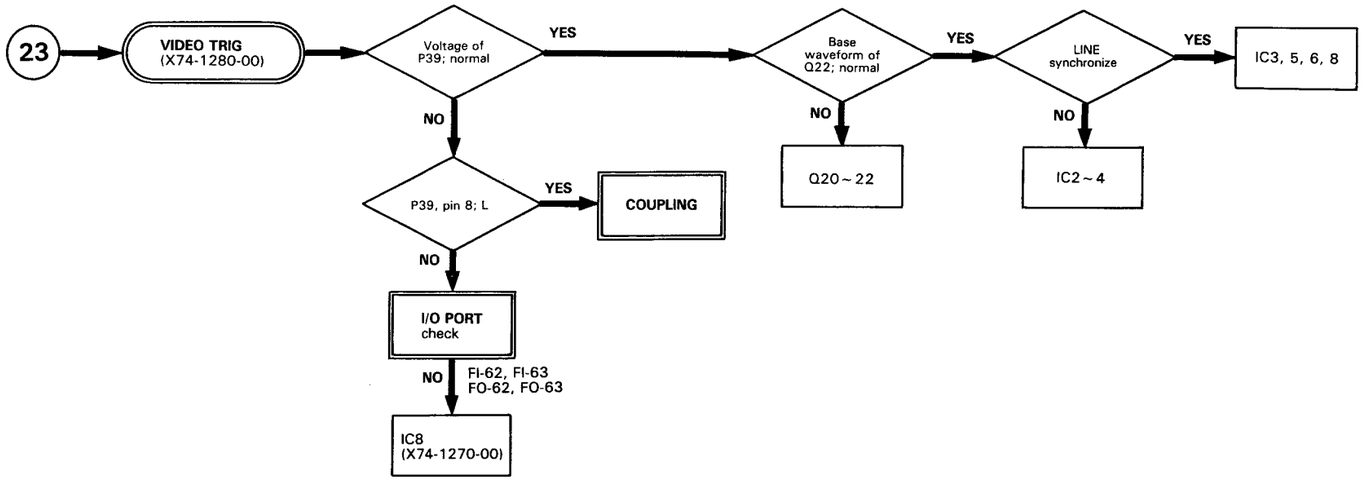
Table 9-5 Trig

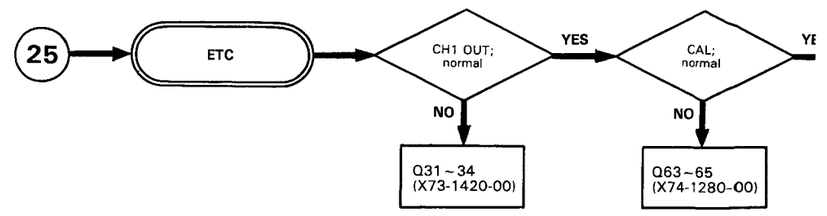
P10 / SOURCE	PIN 1 CH2	PIN 2 CH1	PIN 3 V. MODE
CH1	H	L	H
CH2	L	H	H
V. MODE	H	H	L
LINE, EXT	H	H	H

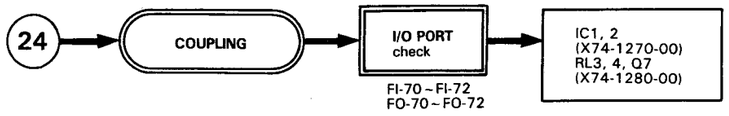
Horizontal Logic Unit (X74-1270-00)




22
CH1 TRIG
(X74-1280-00)
Gate waveform of Q3; normal
YES
NO
Emitter waveform of Q2; normal
YES
NO
Q1, 2
(X73-1420-00)
Q23, 24, 90~95
(X74-1280-00)
Voltages of P39, pin 2 and pin3; +10V
YES
NO
IC2, 3
(X74-1270-00)
P39, pin 6; H
YES
NO
COUPLING
RL1, 2, 4
Emitter waveforms of Q18 and Q19; normal
YES
NO
Gate voltages of Q8 and Q6; normal
YES
NO
Q8~19
(X74-1270-00)
IC8
(X74-1280-00)
Q8
(X81-1120-00)
VR7
(X74-1280-00)
Waveform of IC7, pin 1; normal
YES
NO
P39, pin 8; L
YES
NO
IC1, 2, 6
IC6 pin 13; L
YES
NO
IC4, Q23, 24


23
VIDEO TRIG
(X74-1280-00)
Voltage of P39; normal
YES
NO
P39, pin 8; L
YES
COUPLING
NO
I/O PORT
check
NO
FI-62, FI-63
FO-62, FO-63
IC8
(X74-1270-00)
Base waveform of Q22; normal
YES
NO
Q20~22
LINE synchronize
YES
NO
IC2~4
IC3, 5, 6, 8


25
ETC
CH1 OUT; normal
YES
NO
Q31~34
(X73-1420-00)
CAL; normal
YES
NO
Q63~65
(X74-1280-00)


24
COUPLING
I/O PORT
check
FI-70~FI-72
FO-70~FO-72
IC1, 2
(X74-1270-00)
RL3, 4, Q7
(X74-1280-00)

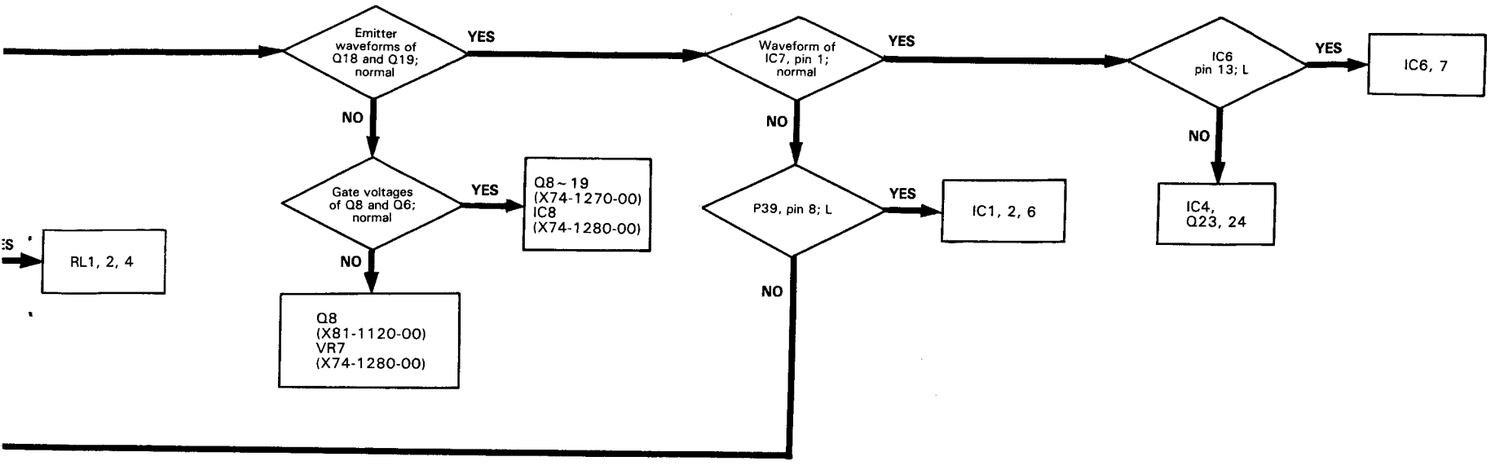
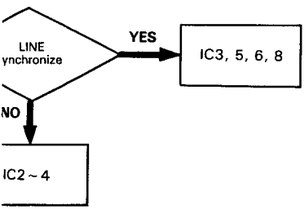
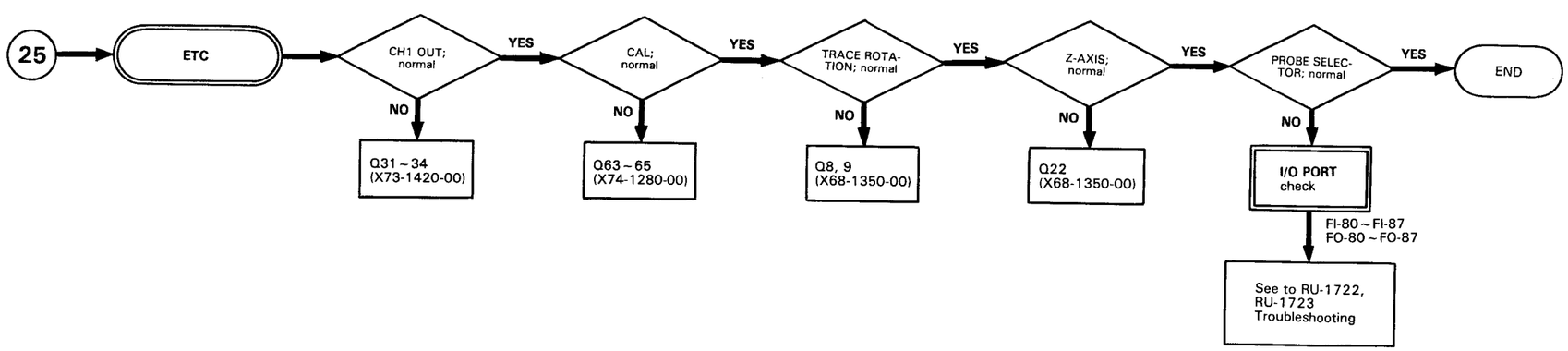


Table 9-6 P39 Pin 8 Video trig

P39 / VIDEO POLARITY	PIN 8 VIDEO	PIN 10 $\overline{TV(+)}$	PIN 11 $\overline{TV(-)}$	PIN 14 $\overline{TVH}$
LINE +	H	L	H	L
LINE −	H	H	L	L
FRAME +	H	L	H	H
FRAME −	H	H	L	H





7. Reverse bit shift pattern test
   The same procedures as the above test is performed while shifting to the left. If errors occur, perform HLT at address FC.

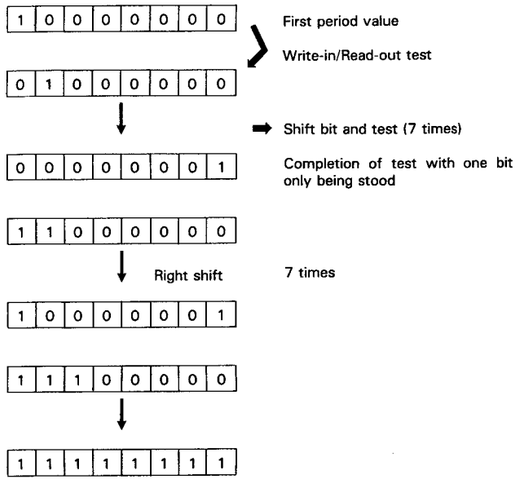


Table 9-7 Bit Shift Test (Right Shift)

RAM address \ Bit	7	6	5	4	3	2	1	0
0	0	1	0	1	0	1	0	1
1	1	0	1	0	1	0	1	0
2	0	1	0	1	0	1	0	1
3	1	0	1	0	1	0	1	0
4	0	1	0	1	0	1	0	1
5	1	0	1	0	1	0	1	0

* Witness of neighbor influence by use of the fact that when a change to 0, 1, 0, 1 is made in the address column of the same bit, the neighboring addresses of the same address change to 0, 1, 0, 1.

Table 9-8 Checker Pattern

Cycle 1

Address	Date
0	0 0
1	0 1
2	0 2
3	0 3
4	0 4
5	0 5
6	0 6
7	0 7
8	0 8

Cycle 2

Address	Date
0	0 1
1	0 2
2	0 3
3	0 4
4	0 5
5	0 6
6	0 7
7	0 8
8	0 9

Cycle 256

Address	Date
0	0 2
1	0 3
2	0 4
3	0 5
4	0 6
5	0 7
6	0 8
7	0 9
8	0 A

Table 9-9 Address Increment Pattern

AFTER ALL TESTS HAVE BEEN COMPLETED, THE SAME TESTS ARE PERFORMED AGAIN FROM THE BEGINNING.

Test purposes

(1) 1. (all 0 test) and 2. (all 1 test) to determine if basic read/write is possible.

(2) 3. (Checker pattern test) and 4. (Reverse checker pattern test) to determine if there is influence from neighboring bits on the data line.

(3) 5. (Increment pattern test) examines if there is influence from the address line; for example, to discover a short in the address line.

(4) 6. (Bit shift pattern test) and 7. (Reverse bit shift pattern test) are performed to discover irregular line shorts and influence from surrounding addresses.

Table 9-10 RAM Test For CS-1720

```
                        EQU RAM=@1000   ; START OF RAM AREA
                        EQU BYTE=@400   ; RAM AREA'S SIZE
                        ORG 00
                ; ALL 0 TEST
0000  210010            LXI HL RAM      ; SET RAM START
0003  010004            LXI BC BYTE     ; SET BYTE COUNTER
0006  1600              MVI D 0 ; SET DATA
0008  72        RT1     MOV M D
0009  23                INX HL
000A  0B                DCX BC
000B  79                MOV A C
000C  B0                ORA B
000D  C20800            JNZ RT1
                ; READ TEST
0010  210010            LXI HL RAM
0013  010004            LXI BC BYTE
0016  7E        RT3     MOV A M
0017  BA                CMP D
0018  CA1C00            JZ RT2
001B  76                HLT     ; ERROR
001C  23        RT2     INX HL
001D  0B                DCX BC
001E  79                MOV A C
001F  B0                ORA B   ; END ?
0020  C21600            JNZ RT3
                ;
                ; ALL 1 TEST
                ;
0023  210010            LXI HL RAM
0026  010004            LXI BC BYTE
0029  16FF              MVI D @0FF
002B  72        RT4     MOV M D
002C  23                INX HL
002D  0B                DCX BC
002E  79                MOV A C
002F  B0                ORA B
0030  C22B00            JNZ RT4
                ; READ TEST
0033  210010            LXI HL RAM
0036  010004            LXI BC BYTE
0039  7E        RT5     MOV A M ; GET DATA FROM RAM
003A  BA                CMP D   ; TEST MATCH
003B  CA3F00            JZ RT6  ; YES MUTCH
003E  76                HLT     ; ERROR
003F  23        RT6     INX HL
0040  0B                DCX BC
0041  79                MOV A C
0042  B0                ORA B
0043  C23900            JNZ RT5
                ;
                ; CHECKER PATTERN
                ;
0046  210010            LXI HL RAM
0049  010004            LXI BC BYTE
004C  1655              MVI D @55       PATTERN
004E  72        RT7     MOV M D
004F  7A                MOV A D
0050  2F                CMA
0051  57                MOV D A ; COMPLEMENT DATA SET
0052  23                INX HL
0053  0B                DCX BC
0054  79                MOV A C
0055  B0                ORA B
0056  C24E00            JNZ RT7
                ; READ TEST
0059  210010            LXI HL RAM
005C  010004            LXI BC BYTE
005F  1655              MVI D @55
0061  7E        RT8     MOV A M
0062  BA                CMP D   ; TEST MUTCH ?
0063  CA6700            JZ RT9  ; YES JMP
0066  76                HLT     ; ERROR
0067  23        RT9     INX HL
0068  7A                MOV A D
0069  2F                CMA
006A  57                MOV D A
006B  0B                DCX BC
006C  79                MOV A C
006D  B0                ORA B
006E  C26100            JNZ RT8
                ;
                ; INVERS CHECKER PATTERN
                ;
0071  210010            LXI HL RAM
0074  010004            LXI BC BYTE
0077  16AA              MVI D @0AA
0079  72        RT10    MOV M D
007A  7A                MOV A D
007B  2F                CMA
007C  57                MOV D A
007D  23                INX HL
007E  0B                DCX BC
007F  79                MOV A C
0080  B0                ORA B
0081  C27900            JNZ RT10
                ; READ TEST
0084  210010            LXI HL RAM
0087  010004            LXI BC BYTE
008A  16AA              MVI D @0AA
008C  7E        RT11    MOV A M
008D  BA                CMP D
008E  CA9200            JZ RT12
0091  76                HLT     ; NO MUTCH
0092  23        RT12    INX HL
0093  7A                MOV A D
0094  2F                CMA
0095  57                MOV D A
0096  0B                DCX BC
0097  79                MOV A C
0098  B0                ORA B
0099  C28C00            JNZ RT11
                ;
                ; INC PATTERN
                ;
009C  110000            LXI DE 00
009F  210010    RT14    LXI HL RAM
00A2  010004            LXI BC BYTE
```

TROUBLESHOOTING

TROUBLESHOOTING OF CPU UNIT (X81-1050-00)

THE CPU BOARD DOES NOT RUN AT ALL

1. Check power supply voltage. Should be less than 5 V ± 5%.
2. Confirm the levels of the S 1 and S 0 terminals of μPD8085. Measure with the oscilloscope and check to see if both stop at zero level. If, when both are at zero level, the trap terminal is at high level, there may be trouble with the power supply detector circuit, or the detector level may not be set up properly.
3. Monitor the CLK terminal of μPD8085 with the oscilloscope. A 50% duty 1.79 MHz square wave should be obtained at this terminal. If it does not appear, monitor the x1 and x2 terminals with the oscilloscope to see if a sine wave signal of about 3.58 MHz is obtained. If it is not obtained, there may be malfunctioning of μPD8085 or ceramic resonator.
4. Confirm that the μPD8085 RESET OUT terminal is at low level. If it remains at high level and the above-mentioned clock operation is running normally, check if the $\overline{\text{RESET IN}}$ terminal of μPD8085 changes between low and high according to whether the power supply is on or off. If it does not change, there may be malfunctioning of C10, D7, and R21; if it changes, μPD8085 may be malfunctioning.
5. Confirm that the HLDA terminal of μPD8085 is at low level. If it is at high level, see if the HLD terminal is at high level. If the latter is at high level, there may be a problem with R20 or jumper resistor.
6. If none of the above mentioned problems apply, have the test programme chart (Table 9-7) run through the CPU board only. See the programme explanation for the method of analysis.

DISPLAY FIGURES DO NOT MATCH INPUT FIGURES

1. Specified segment does not light up or stays lit.
   a) If, when changing the display number, the position of the segment which remains lit or unlit changes, the problem may be with the LED driver; if the position remains fixed, there may be a disconnection in the wiring or in the LED itself or there may be short.
   b) Make confirmation by test programming after repairs.
2. Numbers do not appear when number keys are pushed, or numbers appear when other than number keys are pushed.
   a) Have the test programme run. If numbers appear according to the prescribed pattern, the problem is in the keyboard.
   b) When numbers do not appear as prescribed in the test programme, there are two main sources of trouble.
      1) Trouble in the data bus.
      2) IC of the LED drive is malfunctioning.

      In the first case, there is faulty operation of some function when the keys are operated. For the second case, confirm with the oscilloscope that strobe signals are being received at IC1 and IC5 of the I/O board. If they are not being received, check the connection between the I/O board and the CPU board and check the operation of IC1 of the CPU board.
3. Switch condition as set at the CS-1720 panel cannot be realized. There are cases, in which several switches, not all switches, do not function as set.
   a) Check the connection of the flat cable above the CPU unit and the connection of the card edge connector.
   b) Remove the CPU unit and input a short card as a substitute; short the connector over the vertical switch panel with a flat cable and confirm that the switch set-up is normal. If there is an abnormality the trouble is with the switch unit.
   c) Set the test programme in the CPU unit and test the I/O board. If there are no abnormalities, examine the memory with the memory test programme.

THE LEDS OF STEP SEQUENCE A, B, C, D DO NOT LIGHT UP

1. First push each key of A, B, C, D and check if the corresponding LED lights up.
2. When all the LEDs stay lit or unlit regardless of which any key is pushed and there are no abnormalities in the functioning of the other keys, confirm that the terminals corresponding to A, B, C, D LEDs of IC21 on the I/O board change in response to changes in pushing the A-D keys. If the LED remains unlit, the LED is malfunctioning, this means that the resistance to LED controlled current is disconnected or +5 V is not applied to the LED on the keyboard. If the voltage of IC21 output terminal does not change, check with the oscilloscope to see if strobe signal is being received at the 11 pin. When the LEDs remain the same in spite of being supplied, check to see if the 1 pin is at low level. If it is not low level, none of the LEDs will light up and the READ/WRITE LED will also not light up. If the 1 pin is at low level, test the memory with the memory test programme.

THE BUZZER KEEPS SOUNDING

Confirm that the RT-1721 REMOTE BOX is connected adequately to the CS-1720. Next, push the keys of step sequence A, B, C, D. If the buzzer stops, the cause is too much noise from the RAM bit within the CS-1720. If it does not stop, check the Q1 operation of the horizontal mother board and the operation of the PHOTO-COUPLER TL521-1. If their operations are normal, the CPU board itself may be operating erratically. Examine the operation of the CPU board and the I/O board.

LIGHTING OF THE READ/WRITE LED IS ABNORMAL

1. See if there is any change in the operation level of the

LED current restriction resistance (R19, R20), Q1, Q2 with alternately pushing the READ and ALL WRT keys. If conditions are normal, in like manner, while watching the 5 and 2 pins of IC21 on the I/O board, and observe if there is a change between high and low levels when alternately pushing the above-mentioned keys.

2. If there is no change in this latter case, check the strobe signal of the 11 pin of IC21. If there is no such signal, check the operation of the 3 pin of IC1 on the CPU board.
3. If conditions in the above cases are normal, there may be trouble with the data bus above the I/O board or malfunctioning of RAM and ROM. Therefore, test RAM and ROM. If these two checks are positive, execute the I/O board test programming.

WARNING SIGNAL WHEN BATTERY IS 2.6 V OR MORE, OR 2.5 V OR LESS

1. Check the level of the RST5.5 terminal of μPD8085 on the CPU board. If normal, confirm that operation of the aforesaid corresponds to battery voltage.
2. The following may cause warning signals when the battery is 2.6 V or over.
   a) Incorrect operation of the IC4 comparator
   b) Malfunctioning of Q2
   c) Faulty VR1 adjustment
   d) Malfunctioning of D3
3. The following may cause warning signals when the battery is 2.5 V or below.
   a) Malfunctioning of IC4
   b) Q2 Base-Emitter short
   c) Short in ground somewhere between D5 and connector
   d) Opening of D3
   e) R5 disconnection

PRINTER CANNOT BE DRIVEN

1. Check the printer unit and the cable.
2. Remove the cable, press the printer key and confirm that the buzzer sounds. If it does not, there may be a problem with R25 above the horizontal mother board, faulty connection between the CPU and I/O boards by the connector, or malfunctioning of Q4 above the CPU board.
3. If the buzzer sounds when the printer key is pressed even though the cable is attached, the problem may be a disconnection in the wiring to the DIN connector within the CS-1720 or a short in the D diode above the horizontal mother board.

MEMORY PACK

1. When the finish buzzer does not sound even though the LOAD key is pressed from the memory pack, transmit dummy data one time via the save key and press the LOAD key once again. If the finish buzzer does not sound, there may be cable disconnection (including cable connector within CS-1720), faulty operation of IC1 or IC2 within the MEMORY PACK. For IC malfunctions, make confirmation with test programme.
2. The contents of the MEMORY PACK do not change after different contents are written in. Two distinct cases become apparent.
   a) When the contents of all the steps are loaded, they all become the same.
   b) The contents are not same but there is not change after writing in. In the case a), the problem may be that the IC3 counter does not operate or that the counter reset does not function. For the former, confirm that the count-up clock has been inputted into the 10 pin of IC3; For the later, examine the 11 pin of IC3. For the case b), it may be that the $\overline{WE}$ terminal is not receiving a signal from IC2.

MEMORY TEST PROGRAMME

Perform tests by conducting write-in and read-out according to each pattern type throughout the entire memory area. If malfunctions occur, perform HLT. Since the HLT address varies according to each pattern, the pattern at stopping time can be judged by examining the stopped address.

1. All 0 test
   Perform test writing in all 0 throughout the memory area and seeing if all addresses become 0. If there is an error, perform HLT. The HLT address becomes 1 B.
2. All 1 test
   Write in 1 throughout the entire area and check if all addresses become 1. If there is an error, HLT is performed. The HLT address becomes 3 E.
3. Checker pattern test
   Write in 0 1 0 1 0 1 0 1 in the odd-number addresses and 1 0 1 0 1 0 1 0 in the even-number addresses.
   If there is an error, perform HLT at address 66.
4. Reverse checker pattern test
   In reverse of the above procedure, write in 1 0 1 0 1 0 1 0 in the odd-number addresses and 0 1 0 1 0 1 0 1 in the even-number addresses. If there is an error, perform HLT at address 91.
5. Increment pattern test
   Test all addresses by writing in +1 data to each address as it advances. +1 is added to the first period value of each test cycle for a total of 256 cycles. If errors occur, perform HLT at address BB.
6. Bit shift pattern test
   First stand one bit only to one address and perform write-in/read-out test. Next, after performing read/write test for each bit when all bit have been shifted to the right, stand two bits to perform the same procedure. The test continues until all bits are at 1. This procedure is conducted at all addresses. If errors occur, stop at address D9.

Table 9-10 RAM Test For CS-1720

```
                        EQU RAM=@1000    ; START OF RAM AREA
                        EQU BYTE=@400    ; RAM AREA'S SIZE
                        ORG 00
                ; ALL 0 TEST
0000  210010            LXI HL RAM       ; SET RAM START
0003  010004            LXI BC BYTE      ; SET BYTE COUNTER
0006  1600              MVI D 0 ; SET DATA
0008  72        RT1     MOV M D
0009  23                INX HL
000A  0B                DCX BC
000B  79                MOV A C
000C  B0                ORA B
000D  C20800            JNZ RT1
                ; READ TEST
0010  210010            LXI HL RAM
0013  010004            LXI BC BYTE
0016  7E        RT3     MOV A M
0017  BA                CMP D
0018  CA1C00            JZ RT2
001B  76                HLT      ; ERROR
001C  23        RT2     INX HL
001D  0B                DCX BC
001E  79                MOV A C
001F  B0                ORA B    ; END ?
0020  C21600            JNZ RT3
                ;
                ; ALL 1 TEST
                ;
0023  210010            LXI HL RAM
0026  010004            LXI BC BYTE
0029  16FF              MVI D @0FF
002B  72        RT4     MOV M D
002C  23                INX HL
002D  0B                DCX BC
002E  79                MOV A C
002F  B0                ORA B
0030  C22B00            JNZ RT4
                ; READ TEST
0033  210010            LXI HL RAM
0036  010004            LXI BC BYTE
0039  7E        RT5     MOV A M ; GET DATA FROM RAM
003A  BA                CMP D    ; TEST MATCH
003B  CA3F00            JZ RT6   ; YES MUTCH
003E  76                HLT      ; ERROR
003F  23        RT6     INX HL
0040  0B                DCX BC
0041  79                MOV A C
0042  B0                ORA B
0043  C23900            JNZ RT5
                ;
                ; CHECKER PATTERN
                ;
0046  210010            LXI HL RAM
0049  010004            LXI BC BYTE
004C  1655              MVI D @55          PATTERN
004E  72        RT7     MOV M D
004F  7A                MOV A D
0050  2F                CMA
0051  57                MOV D A ; COMPLEMENT DATA SET
0052  23                INX HL
0053  0B                DCX BC
0054  79                MOV A C
0055  B0                ORA B
0056  C24E00            JNZ RT7
                ; READ TEST
0059  210010            LXI HL RAM
005C  010004            LXI BC BYTE
005F  1655              MVI D @55
0061  7E        RT8     MOV A M
0062  BA                CMP D    ; TEST MUTCH ?
0063  CA6700            JZ RT9   ; YES JMP
0066  76                HLT      ; ERROR
0067  23        RT9     INX HL
0068  7A                MOV A D
0069  2F                CMA
006A  57                MOV D A
006B  0B                DCX BC
006C  79                MOV A C
006D  B0                ORA B
006E  C26100            JNZ RT8
                ;
                ; INVERS CHECKER PATTERN
                ;
0071  210010            LXI HL RAM
0074  010004            LXI BC BYTE
0077  16AA              MVI D @0AA
0079  72        RT10    MOV M D
007A  7A                MOV A D
007B  2F                CMA
007C  57                MOV D A
007D  23                INX HL
007E  0B                DCX BC
007F  79                MOV A C
0080  B0                ORA B
0081  C27900            JNZ RT10
                ; READ TEST
0084  210010            LXI HL RAM
0087  010004            LXI BC BYTE
008A  16AA              MVI D @0AA
008C  7E        RT11    MOV A M
008D  BA                CMP D
008E  CA9200            JZ RT12
0091  76                HLT      ; NO MUTCH
0092  23        RT12    INX HL
0093  7A                MOV A D
0094  2F                CMA
0095  57                MOV D A
0096  0B                DCX BC
0097  79                MOV A C
0098  B0                ORA B
0099  C28C00            JNZ RT11
                ;
                ; INC PATTERN
                ;
009C  110000            LXI DE 00
009F  210010    RT14    LXI HL RAM
00A2  010004            LXI BC BYTE
00A5  53                MOV D E
00A6  72        RT13    MOV M D
00A7  14                INR D
00A8  23                INX HL
00A9  0B                DCX BC
00AA  79                MOV A C
00AB  B0                ORA B
00AC  C2A600            JNZ RT13
                ; READ TEST
00AF  210010            LXI HL RAM
00B2  010004            LXI BC BYTE
00B5  53                MOV D E
00B6  7E        RT15    MOV A M
00B7  BA                CMP D
00B8  CABC00            JZ RT16
00BB  76                HLT      ; NO MUTCH
00BC  23        RT16    INX HL
00BD  14                INR D
00BE  0B                DCX BC
00BF  79                MOV A C
00C0  B0                ORA B
00C1  C2B600            JNZ RT15
                ; NEXT PATTERN
00C4  1D                DCR E
00C5  C29F00            JNZ RT14
                ;
                ; BIT SHIFT PATTERN
                ;
00C8  210010            LXI HL RAM
00CB  010004            LXI BC BYTE
00CE  AF        RT19    XRA A
00CF  110808            LXI DE @808
00D2  37        RT18    STC
00D3  1F                RAR
00D4  77        RT17    MOV M A
00D5  BE                CMP M
00D6  CADA00            JZ RT23
00D9  76                HLT      ; NOT MUTCH
00DA  0F        RT23    RRC
00DB  1D                DCR E
00DC  C2D400            JNZ RT17
00DF  0F                RRC
00E0  15                DCR D
00E1  C2D200            JNZ RT18
00E4  23                INX HL
00E5  0B                DCX BC
00E6  79                MOV A C
00E7  B0                ORA B
00E8  C2CE00            JNZ RT19
                ;
                ; REVERSE PATTERN TEST
                ; FOR EACH ADDRES
00EB  210010            LXI HL RAM
00EE  010004            LXI BC BYTE
00F1  AF        RT20    XRA A
00F2  110808            LXI DE @808
00F5  37        RT21    STC
00F6  17                RAL
00F7  77        RT22    MOV M A
00F8  BE                CMP M
00F9  CAFD00            JZ RT24
00FC  76                HLT      ; NOT MUTCH
00FD  07        RT24    RLC
00FE  1D                DCR E
00FF  C2F700            JNZ RT22
0102  07                RLC
0103  15                DCR D
0104  C2F500            JNZ RT21
0107  23                INX HL
0108  0B                DCX BC
0109  79                MOV A C
010A  B0                ORA B
010B  C2F100            JNZ RT20
010E  C30000            JMP 00
                        END
```

I/O PORT TEST

Test Forms

0. All 0 test
1. All 1 test
2. Checker pattern test
3. Reverse checker pattern test
4. Increment pattern test

The contents are the same as that of the memory test.

The I/O port test is performed by shorting the input/output port of each address and connecting the printer. If there is no abnormality, the buzzer sounds at the end, and the CPU performs HLT.

If errors occur, print the following in the printer for each error.

Test pattern	displayed by 0 ~ 4
Board	displayed by 0 ~ 7
Data sent out	displayed by 00 ~ FF
Data received	displayed by 00 ~ FF (abnormal data)

Pin to be shorted		Pin to be shorted	
1	67	19	49
2	68	20	50
3	69	21	51
4	70	22	52
5	71	23	53
6	72	24	54
7	73	25	55
8	74	26	56
9	59	27	41
10	59	28	42
11	61	29	43
12	62	30	44
13	63	31	45
14	64	32	46
15	65	33	47
16	66	34	48

The P32 side should be treated as shown in the table above; for the P25 and P26 side, connection is made after reversing to right/left the flat cable with the connector attached.

Table 9-11 I/O Port P32 Short Method

Table 9-12 I/O Port Test

```
                        EQU     LED8=@5000
                        EQU     RAM=@1000
                        EQU     STACK=@1400
                        EQU     BYTE=8
                        EQU     IOP=@8000
                        EQU     COUNT=@1000+9
                        ORG 00
                ;
0000  310014            LXI SP STACK
0003  AF                XRA A
0004  320050            STA LED8
0007  320910            STA COUNT
                ;
                ; ALL 0 TEST
                ;
000A  210010            LXI HL RAM
000D  010800            LXI BC BYTE
0010  1600              MVI D 0
0012  72        RT0     MOV M D
0013  23                INX HL
0014  0D                DCR C
0015  C21200            JNZ RT0
                ;
                ; END OFF WRITE
                ;
0018  CDA200            CALL TRANS
001B  CDBA00            CALL VER
001E  CD9A00            CALL UPC
                ;
                ; ALL 1 TEST
                ;
0021  210010            LXI HL RAM
0024  010800            LXI BC BYTE
0027  16FF              MVI D @FF
0029  72        RT2     MOV M D
002A  23                INX HL
002B  0D                DCR C
002C  C22900            JNZ RT2
                ;
002F  CDA200            CALL TRANS
0032  CDBA00            CALL VER
0035  CD9A00            CALL UPC
                ;
                ; TEST CHECKER
                ;
0038  210010            LXI HL RAM
003B  010800            LXI BC BYTE
003E  1655              MVI D @55
0040  72        RT3     MOV M D
0041  23                INX HL
0042  7A                MOV A D
0043  2F                CMA
0044  57                MOV D A
0045  0D                DCR C
0046  C24000            JNZ RT3
                ;
0049  CDA200            CALL TRANS
004C  CDBA00            CALL VER
004F  CD9A00            CALL UPC
                ;
                ; INVERS PATTERN
                ;
0052  210010            LXI HL RAM
0055  010800            LXI BC BYTE
0058  16AA              MVI  D @AA
005A  72        RT4     MOV M D
005B  23                INX HL
005C  7A                MOV A D
005D  2F                CMA
005E  57                MOV D A
005F  0D                DCR C
0060  C25A00            JNZ RT4
                ;
0063  CDA200            CALL TRANS
0066  CDBA00            CALL VER
0069  CD9A00            CALL UPC
                ;
                ; INC PATTERN
                ;
006C  110000            LXI DE 0
006F  210010    RT5     LXI HL RAM
0072  010800            LXI BC BYTE
0075  53                MOV D E
0076  72        RT6     MOV M D
0077  23                INX HL
0078  14                INR D
0079  0D                DCR C
007A  C27600            JNZ RT6
                ;
007D  CDA200            CALL TRANS
0080  CDBA00            CALL VER
0083  CD9A00            CALL UPC
                ;
0086  1D                DCR E
0087  C26F00            JNZ RT5
008A  3EFF              MVI A @FF
008C  320050            STA LED8
008F  110080            LXI DE @8000
0092  CD5101            CALL WA11M
0095  AF                XRA A
0096  320050            STA LED8
0099  76                HLT
                ;
                ; MODE COUNTER UP
                ;
009A  3A0910    UPC     LDA COUNT
009D  3C                INR A
009E  320910            STA COUNT
00A1  C9                RET
                ;
                ; TRANS TO RAM TO IO PORT
                ;
00A2  D5        TRANS   PUSH DE
00A3  E5                PUSH HL
00A4  C5                PUSH BC
00A5  210010            LXI HL RAM
00A8  110080            LXI DE IOP
00AB  010800            LXI BC BYTE
00AE  7E        TRANS1  MOV A M
00AF  12                STAX DE
00B0  23                INX HL
00B1  13                INX DE
00B2  0D                DCR C
00B3  C2AE00            JNZ TRANS1
00B6  C1                POP BC
00B7  E1                POP HL
00B8  D1                POP DE
00B9  C9                RET
                ;
                ; VERIFY TEST
                ;
00BA  E5        VER     PUSH HL
00BB  D5                PUSH DE
00BC  C5                PUSH BC
00BD  210010            LXI HL RAM
00C0  010800            LXI BC BYTE
00C3  110080            LXI DE IOP
00C6  1A        VER0    LDAX DE
00C7  BE                CMP M
00C8  CA0501            JZ VER1
                ;
00CB  E5                PUSH HL
00CC  C5                PUSH BC
00CD  C5                PUSH BC
00CE  0E00              MVI C 0
00D0  CD2E01            CALL COUT
00D3  3A0910            LDA COUNT
00D6  CD0F01            CALL AOUT
00D9  0E20              MVI C @20
00DB  CD2E01            CALL COUT
00DE  C1                POP BC
00DF  7D                MOV  A L
00E0  CD0F01            CALL AOUT
00E3  0E20              MVI C @20
00E5  CD2E01            CALL COUT
00E8  7E                MOV A M
00E9  CD0F01            CALL AOUT
00EC  0E20              MVI C @20
00EE  CD2E01            CALL COUT
00F1  1A                LDAX DE
00F2  CD0F01            CALL AOUT
00F5  0E0D              MVI C @0D
00F7  CD2E01            CALL COUT
00FA  01FFFF    WAIT    LXI BC @FFFF
00FD  0B        WAIT1   DCX BC
00FE  79                MOV A C
00FF  B0                ORA B
0100  C2FD00            JNZ WAIT1
0103  C1                POP BC
0104  E1                POP HL
                ;
0105  23        VER1    INX HL
0106  13                INX DE
0107  0D                DCR C
0108  C2C600            JNZ VER0
010B  C1                POP BC
010C  D1                POP DE
010D  E1                POP HL
010E  C9                RET
                ;
                ; ACC OUT
                ;
010F  F5        AOUT    PUSH PSW
0110  1F                RAR
0111  1F                RAR
0112  1F                RAR
0113  1F                RAR
0114  CD2401            CALL ASCII
0117  4F                MOV C A
0118  CD2E01            CALL COUT
011B  F1                POP PSW
011C  CD2401            CALL ASCII
011F  4F                MOV C A
0120  CD2E01            CALL COUT
0123  C9                RET
                ;
                ; CONVERT ASCII
                ;
0124  E60F      ASCII   ANI @0F
0126  C630              ADI @30
0128  FE3A              CPI @3A
012A  D8                RC
012B  C607              ADI 7
012D  C9                RET
                ;
                ; COUT
                ;
012E  F5        COUT    PUSH PSW
012F  3EC0              MVI A @C0
0131  0608              MVI B 8
0133  30        CO5     SIM
0134  111E00            LXI DE @1E
0137  CD5101            CALL WA11M
013A  79                MOV A C
013B  1F                RAR
013C  4F                MOV C A
013D  3E80              MVI A @80
013F  1F                RAR
0140  EE80              XRI @80
0142  05                DCR B
0143  F23301            JP CO5
0146  3E40              MVI A @40
0148  30                SIM
0149  113E00            LXI DE @3E
014C  CD5101            CALL WA11M
014F  D1                POP DE
0150  C9                RET
                ;
0151  1B        WA11M   DCX DE
0152  7B                MOV A  E
0153  B2                ORA D
0154  C25101            JNZ WA11M
0157  C9                RET
                        END
```

KEY BOARD TEST

By pressing each key, the corresponding number is displayed on the 7 segment LED above the I/O board. The keys and displayed numbers are shown below.

Key number	Value	Key number	Value
ϕ	22	SCAN	05
1	15	D	28
2	16	DOWN	30
3	17	A	07
4	08	FREE	06
5	09	EXT	13
6	10	LOAD	26
7	01	SAVE	19
8	02	PRNT	12
9	03	Blank	20
START	23	Blank	27
END	24		
PART WRT	11		
ALL WRT	18		
READ	25		
STO	04		
B	14		
C	21		
RST	29		
UP	31		

Table 9-13

Table 9-14 Key Test For RT-1721

```
                        EQU     STACK=@1400
                        EQU     LED8=@5000
                        EQU     MASK6=@1D
                        EQU     EMPTY=@80
                        EQU     KERT=@6000
                        EQU     LED7=@4000
                        EQU     KROW=@3000

                        ORG 00
0000  3EF8              MVI A @F8
0002  320050            STA LED8
0005  AF                XRA A
0006  320040            STA LED7
0009  C35A00            JMP START

                        ORG @34
0034  F3        RSTK    DI
0035  F5                PUSH PSW
0036  C5                PUSH BC
0037  E5                PUSH HL
0038  D5                PUSH DE
0039  3E1F              MVI A @1F
003B  30                SIM
003C  3A0010            LDA KEYBF
003F  87                ADD A
0040  D25400            JNC RSTB
0043  CD9500    RSTA    CALL KDEC
0046  0600              MVI B 0
0048  4F                MOV C A
0049  21CF00            LXI HL TBL
004C  09                DAD BC
004D  7E                MOV A M
004E  320040            STA LED7
0051  CD8F00            CALL KCOA0
0054  D1        RSTB    POP DE
0055  E1                POP HL
0056  C1                POP BC
0057  F1                POP PSW
0058  FB                EI
0059  C9                RET

                ; MAIN PROGARM START

005A  310014    START   LXI SP STACK
005D  AF                XRA A
005E  2F                CMA
005F  320040            STA LED7
0062  3E1D              MVI A MASK6
0064  30                SIM
0065  CD8F00            CALL KCOA0
0068  FB        SCAN    EI
0069  CDC500            CALL WA10M
006C  F3                DI
006D  CD7300            CALL KSCAN
0070  C36800            JMP SCAN

0073  3A0060    KSCAN   LDA KERT
0076  E608              ANI 8
0078  C0                RNZ
0079  CD8C00    KSCA2   CALL KCOA4
007C  3A0110            LDA KDRIV
007F  07                RLC
0080  DA8500            JC KSCA1
0083  3EEF      KSCA0   MVI A @EF
0085  320030    KSCA1   STA KROW
0088  320110            STA KDRIV
008B  C9                RET

008C  3E1D      KCOA4   MVI A MASK6
008E  30                SIM
008F  3E80      KCOA0   MVI A EMPTY
0091  320010    KCOA2   STA KEYBF
0094  C9                RET

0095  CDC500    KDEC    CALL WA10M
0098  3A0060            LDA KERT
009B  E607              ANI 7
009D  47                MOV B A
009E  CDC500            CALL WA10M
00A1  3A0060            LDA KERT
00A4  E607              ANI 7
00A6  B8                CMP B
00A7  C28F00            JNZ KCOA0
00AA  320210            STA KRET
00AD  210000            LXI HL 0
00B0  3A0110            LDA KDRIV
00B3  87        DECA    ADD A
00B4  D2BB00            JNC ENDEC
00B7  2C                INR L
00B8  C3B300            JMP DECA

00BB  3A0210    ENDEC   LDA KRET
00BE  29                DAD HL
00BF  29                DAD HL
00C0  29                DAD HL
00C1  85                ADD L
00C2  C39100            JMP KCOA2

00C5  110002    WA10M   LXI DE @200
00C8  1B        WA11M   DCX DE
00C9  7B                MOV A E
00CA  B2                ORA D
00CB  C2C800            JNZ WA11M
00CE  C9                RET

00CF  22        TBL     @22
00D0  15                @15
00D1  16                @16
00D2  17                @17
00D3  08                @08
00D4  09                @09
00D5  10                @10
00D6  01                @01
00D7  02                @02
00D8  03                @03
00D9  23                @23

00DA  24                @24
00DB  11                @11
00DC  18                @18
00DD  25                @25
00DE  04                @04
00DF  14                @14
00E0  21                @21
00E1  29                @29
00E2  31                @31
00E3  05                @05
00E4  28                @28
00E5  30                @30
00E6  07                @07
00E7  06                @06
00E8  13                @13
00E9  26                @26
00EA  19                @19
00EB  12                @12
00EC  20                @20
00ED  27                @27

                        ORG @1000
1000            KEYBF   BLK 1
1001            KDRIV   BLK 1
1002            KRET    BLK 1
                        END
```

LED TEST

After displaying figures 00 ~ 99 on the 7 segment LED, light the WRITE LED and the READ LED in sequence, sound the buzzer, and light the A, B, C, D step sequence LED.

Repeat the same process.

LED And A, B, C, D, LED And 7 Seg LED Disp

```
                        EQU     LED7=84000
                        EQU     LED8=85000
                        ORG 00
0000  310014            LXI SP @1400

0003  0E64    LEDT0     MVI C @64
0005  AF                XRA A
0006  320040  LEDT      STA LED7
0009  CD2500            CALL WA100M
000C  C601              ADI 1
000E  27                DAA
000F  0D                DCR C
0010  C20600            JNZ LEDT
0013  0E08              MVI C 8
0015  3E01              MVI A 1
0017  320050  LEDT1     STA LED8
001A  CD2500            CALL WA100M
001D  87                ADD A
001E  0D                DCR C
001F  C21700            JNZ LEDT1
0022  C30300            JMP LEDT0

0025  110008  WA100M    LXI DE @800
0028  1B      WA101M    DCX DE
0029  7B                MOV A E
002A  B2                ORA D
002B  C22800            JNZ WA101M
002E  C9                RET
                        END
```

MEMORY PACK TEST

The test process is the same as that of the memory test within the CS-1720. Results are displayed above printer as follows:

- The error-producing address which corresponds to the CS-1720 memory.
- Data at normal times
- Incorrect data

The procedure is first to write in on the memory the same pattern as that of the memory test, transmit it to the memory pack, and compare this pattern with the memory within the CS-1720.
The address when errors are generated must be converted from the memory address within CS-1720 to the real address above the memory pack.

SWITCH PROCEDURE

Real address = (address $-8000+1)\times 2$
(Note: numbers are expressed in hexadecimal digits)
Example: When an error occurs at address 8010,

$8010-8000+1=11$

$11\times 2=22$

As this shows, the error was generated at memory pack address 22.

TROUBLESHOOTING

Ram Pack Test All Pattern

```
                ;
                EQU RAM=@1000
                EQU STACK=@1400
                EQU BYTE=@200
                EQU RESET=@6000
                EQU PACK=@7000
                ;
                ORG 00
0000  310014    LXI SP STACK    ; SET STACK POINTER
                ;
                ; ALL 0 READ WRITE TEST
                ;
0003  210010    LXI HL RAM
0006  010002    LXI BC BYTE
0009  1600      MVI D 00
000B  72    RT1 MOV M D
000C  23        INX HL
000D  0B        DCX BC
000E  79        MOV A C
000F  B0        ORA B
0010  C20B00    JNZ RT1
                ; END OF INTERNAL RAM WRITE
0013  CD8100    CALL TRANS      ; TRANS TO RAM PACK
0016  CDA400    CALL VER        ; VERIFY TEST
                ;
                ; ALL 1 TEST
                ;
0019  210010    LXI HL RAM
001C  010002    LXI BC BYTE
001F  16FF      MVI D @0FF
0021  72    RT2 MOV M D
0022  23        INX HL
0023  0B        DCX BC
0024  79        MOV A C
0025  B0        ORA B
0026  C22100    JNZ RT2
                ;
0029  CD8100    CALL TRANS
002C  CDA400    CALL VER        ; VERIFY TEST
                ;
                ; TEST CHECKER PATTERN
                ;
002F  210010    LXI HL RAM
0032  010002    LXI BC BYTE
0035  1655      MVI D @55
0037  72    RT3 MOV M D
0038  23        INX HL
0039  7A        MOV A D
003A  2F        CMA
003B  57        MOV D A
003C  0B        DCX BC
003D  79        MOV A C
003E  B0        ORA B
003F  C23700    JNZ RT3
                ;
0042  CD8100    CALL TRANS
0045  CDA400    CALL VER
                ;
                ; INVERS CHECKER
                ;
0048  210010    LXI HL RAM
004B  010002    LXI BC BYTE
004E  16AA      MVI D @0AA
0050  72    RT4 MOV M D
0051  23        INX HL
0052  7A        MOV A D
0053  2F        CMA
0054  57        MOV D A
0055  0B        DCX BC
0056  79        MOV A C
0057  B0        ORA B
0058  C25000    JNZ RT4
                ;
005B  CD8100    CALL TRANS
005E  CDA400    CALL VER
                ;
                ; INC PATTERN
                ;
0061  110000    LXI DE 0
0064  210010 RT5 LXI HL RAM
0067  010002    LXI BC BYTE
006A  53        MOV D E
006B  72    RT6 MOV M D
006C  14        INR D
006D  23        INX HL
006E  0B        DCX BC
006F  79        MOV A C
0070  B0        ORA B
0071  C26B00    JNZ RT6
                ;
0074  CD8100    CALL TRANS
0077  CDA400    CALL VER
                ;
007A  1D        DCR E
007B  C26400    JNZ RT5 ; TEST AGAIN
                ;
007E  C30000    JMP 00
                ;
                ; TRANS TO RAM PACK
                ;
0081  D5    TRANS   PUSH DE
0082  E5            PUSH HL
0083  C5            PUSH BC
0084  320060        STA RESET
0087  210010        LXI HL RAM
008A  010002        LXI BC BYTE     ; SET BYTE COUNTER
008D  7E    TRANS1  MOV A M
008E  1F            RAR
008F  1F            RAR
0090  1F            RAR
0091  1F            RAR
0092  320070        STA PACK
0095  7E            MOV A M
0096  320070        STA PACK
0099  23            INX HL
009A  0B            DCX BC
009B  79            MOV A C
009C  B0            ORA B
009D  C28D00        JNZ TRANS1
00A0  C1            POP BC
00A1  E1            POP HL
00A2  D1            POP DE
00A3  C9            RET
                ;
                ; VERIFY CHECK
                ;
00A4  E5    VER     PUSH HL
00A5  D5            PUSH DE
00A6  C5            PUSH BC
00A7  210010        LXI HL RAM
00AA  010002        LXI BC BYTE
00AD  320060        STA RESET
00B0  3A0070 VER0   LDA PACK        ; GET DATA FROM RAM PACK
00B3  87            ADD A
00B4  87            ADD A
00B5  87            ADD A
00B6  87            ADD A
00B7  57            MOV D A ; SAVE DATA HIGH 4 BIT
00B8  3A0070        LDA PACK
00BB  E60F          ANI @0F
00BD  B2            ORA D   ; GET DATA 8 BIT
00BE  BE            CMP M   ; TEST COMPARE
00BF  CAFA00        JZ VER1
                ;
00C2  C5            PUSH BC
00C3  F5            PUSH PSW
00C4  C5            PUSH BC
00C5  0E00          MVI C 00
00C7  CD0501        CALL COUT
00CA  0E20          MVI C @20
00CC  CD0501        CALL COUT
00CF  C1            POP BC
00D0  7C            MOV A H
00D1  CD2F01        CALL AOUT
00D4  7D            MOV A L
00D5  CD2F01        CALL AOUT
00D8  0E20          MVI C @20
00DA  CD0501        CALL COUT
00DD  7E            MOV A M
00DE  CD2F01        CALL AOUT
00E1  0E20          MVI C @20
00E3  CD0501        CALL COUT
00E6  F1            POP PSW
00E7  CD2F01        CALL AOUT
00EA  0E0D          MVI C @0D
00EC  CD0501        CALL COUT
00EF  01FFFF WAIT   LXI BC @FFFF
00F2  0B     WAIT1  DCX BC
00F3  79            MOV A C
00F4  B0            ORA B
00F5  C2F200        JNZ WAIT1
00F8  C1            POP BC
00F9  E1            POP HL
00FA  23     VER1   INX HL
00FB  0B            DCX BC
00FC  79            MOV A C
00FD  B0            ORA B
00FE  C2B000        JNZ VER0
0101  C1            POP BC
0102  D1            POP DE
0103  E1            POP HL
0104  C9            RET
                ;
                ; C OUT
                ;
0105  D5    COUT    PUSH DE
0106  0EC0          MVI C @C0
0108  0608          MVI B 8
010A  30    CO5     SIM
010B  111E00        LXI DE @1E
010E  CD2801        CALL WA11M
0111  79            MOV A C
0112  1F            RAR
0113  4F            MOV C A
0114  3E80          MVI A @80
0116  1F            RAR
0117  EE80          XRI @80
0119  05            DCR B
011A  F20A01        JP CO5
011D  3E40          MVI A @40
011F  30            SIM
0120  113E00        LXI DE @3E
0123  CD2801        CALL WA11M
0126  D1            POP DE
0127  C9            RET
                ;
0128  1B    WA11M   DCX DE
0129  7B            MOV A E
012A  B2            ORA D
012B  C22801        JNZ WA11M
012E  C9            RET
                ;
                ; ACC OUT
                ;
012F  F5    AOUT    PUSH PSW
0130  1F            RAR
0131  1F            RAR
0132  1F            RAR
0133  1F            RAR
0134  CD4401        CALL ASCII
0137  4F            MOV C A
0138  CD0501        CALL COUT
013B  F1            POP PSW
013C  CD4401        CALL ASCII
013F  4F            MOV C A
0140  CD0501        CALL COUT
0143  C9            RET
                ;
                ; CONVERT ASCII
                ;
0144  E60F  ASCII   ANI @0F
0146  C630          ADI @30
0148  FE3A          CPI @3A
014A  D8            RC
014B  C607          ADI 7
014D  C9            RET
                    END
```

PARTS LIST

Unless otherwise specified, all resistors are ±5%, 1/6W and all capacitor's voltage ratings are 50WV.

The specifications and parts list and schematic diagram may be changed without notice owing to a technical innovation.

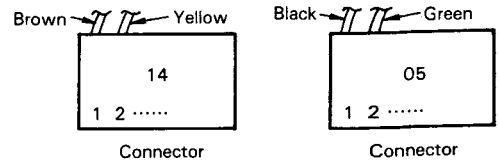
ABBREVIATIONS

Resistor	
RD	Carbon
RN	Metal film
RC	Solid
VR	Variable or Semi-fixed
Capacitor	
CC	Ceramic
CK	Ceramic
CE	Electrolytic
CM	Mica
CQ	Mylar (Polypropylen)
TC	Ceramic trimmer
Semiconductor	
TR	Transistor
FET	Field effect transistor

The part No. of each connector is stamped or color-coded. The color-coding is as follows.

Black	Brown	Red	Orange	Yellow	Green	Blue	Purple	Grey	White
0	1	2	3	4	5	6	7	8	9

Example



Each connector can be classified by the color of pin 1 and pin 2.

PARTS LIST

ATTENUATOR UNIT (X75-1130-00)

Fig. & Index No.	Ref. No.	Parts No.	Description			
B-2	R1	RD14BB2E105J	RD	1MΩ	±5%	1/4W
B-2	R2	RN14BK2H9903F	RN	990kΩ	±1%	1/2W
	R3	No use				
C-2	R4	RN14BK2E1012F	RN	10.1kΩ	±1%	1/4W
C-2	R5	RD14BB2C180J	RD	18Ω		
	R6	No use				
C-2	R7	RN14BK2H9003F	RN	900kΩ	±1%	1/2W
C-2	R8	RN14BK2E1113F	RN	111kΩ	±1%	1/4W
C-2	R9	RD14BB2C560J	RD	56Ω		
C-2	R10	RD14BB2C330J	RD	33Ω		
C-2	R11	RN14BK2E1004F	RN	1MΩ	±1%	1/4W
C-2	R12	RD14BB2E104J	RD	100kΩ	±5%	1/4W
C-2	R13	RD14BB2C101J	RD	100Ω		
D-1	R14	RN14BK2B1202F	RN	12kΩ	±1%	1/8W
D-2	R15	RN14BK2B1202F	RN	12kΩ	±1%	1/8W
D-2	R16	RD14BB2C470J	RD	47Ω		
D-2	R17	RD14BB2C470J	RD	47Ω		
D-2	R18	RD14BB2C332J	RD	3.3kΩ		
D-2	R19	RD14BB2C332J	RD	3.3kΩ		
	R20	No use				
B-3	R21	RD14BB2E105J	RD	1MΩ	±5%	1/4W
B-3	R22	RN14BK2H9903F	RN	990kΩ	±1%	1/2W
	R23	No use				
C-3	R24	RN14BK2E1012F	RN	10.1kΩ	±1%	1/4W
C-3	R25	RD14BB2C180J	RD	18Ω		
	R26	No use				
C-3	R27	RN14BK2H9003F	RN	900kΩ	±1%	1/2W
C-3	R28	RN14BK2E1113F	RN	111kΩ	±1%	1/4W
C-3	R29	RD14BB2C560J	RD	56Ω		
C-3	R30	RD14BB2C330J	RD	33Ω		
C-3	R31	RN14BK2E1004F	RN	1MΩ	±1%	1/4W
C-3	R32	RD14BB2E104J	RD	100kΩ	±5%	1/4W
C-3	R33	RD14BB2C101J	RD	100Ω		
D-3	R34	RN14BK2B1202F	RN	12kΩ	±1%	1/8W
D-3	R35	RN14BK2B1202F	RN	12kΩ	±1%	1/8W
D-3	R36	RD14BB2C470J	RD	47Ω		
D-3	R37	RD14BB2C470J	RD	47Ω		
D-3	R38	RD14BB2C332J	RD	3.3kΩ		
D-3	R39	RD14BB2C332J	RD	3.3KΩ		
	R40	No use				
B-1	R41	RD14BB2C222J	RD	2.2kΩ		
B-1	R42	RD14BB2C222J	RD	2.2kΩ		
C-1	R43	RD14BB2C222J	RD	2.2kΩ		
C-1	R44	RD14BB2C222J	RD	2.2kΩ		
B-1	R45	RD14BB2C622J	RD	6.2kΩ		
D-1	R46	RD14BB2C102J	RD	1KΩ		
D-1	R47	RD14BB2C103J	RD	10kΩ		
B-4	R48	RD14BB2C222J	RD	2.2kΩ		
B-4	R49	RD14BB2C222J	RD	2.2kΩ		
C-4	R50	RD14BB2C222J	RD	2.2kΩ		
C-4	R51	RD14BB2C222J	RD	2.2kΩ		
B-4	R52	RD14BB2C622J	RD	6.2kΩ		
B-1	VR1	R12-2405-05	VR	5kΩB		
B-1	VR2	R12-2405-05	VR	5kΩB		
C-1	VR3	R12-2405-05	VR	5kΩB		
C-1	VR4	R12-2405-05	VR	5kΩB		
B-1	VR5	R12-0531-05	VR	500ΩB		
B-4	VR6	R12-2405-05	VR	5kΩB		
B-4	VR7	R12-2405-05	VR	5kΩB		
C-4	VR8	R12-2405-05	VR	5kΩB		
C-4	VR9	R12-2405-05	VR	5kΩB		
B-4	VR10	R12-0531-05	VR	500ΩB		
D-2	VR11	R12-1510-05	VR	1kΩB		
D-3	VR12	R12-1510-05	VR	1kΩB		
D-1	VR13	R12-2405-05	VR	5kΩB		
B-2	C1	C91-0501-05	Metal film	0.047μF	±10%	630V
B-2	C2	CC45CH1H020C	CC	2pF	±0.25pF	
	C3	No use				
C-2	C4	CM93BD2A151J	CM	150pF	±5%	100V
C-2	C5	CM93BD2A330J	CM	33pF	±5%	100V
C-2	C6	C91-0502-05	Metal film	0.01μF	±10%	630V
	C7	No use				
D-2	C8	CEO4W1A470M	CE	47μF		10V
D-2	C9	CEO4W1C220M	CE	22μF		16V
A-1	C10	CEO4W1C470M	CE	47μF		16V
B-3	C11	C91-0501-05	Metal film	0.047μF	±10%	630V
B-3	C12	CC45CH1H020C	CC	2pF	±0.25pF	
	C13	No use				

Fig. & Index No.	Ref. No.	Parts No.	Description			
C-3	C14	CM93BD2A151J	CM	150pF	±5%	100V
C-3	C15	CM93BD2A330J	CM	33pF	±5%	100V
C-3	C16	C91-0502-05	Metal film	0.01μF	±10%	630V
	C17	No use				
D-3	C18	CEO4W1A470M	CE	47μF		10V
D-3	C19	CEO4W1C220M	CE	22μF		16V
A-3	C20	CEO4W1C470M	CE	47μF		16V
D-1	C21	CE041C470M	CE	47μF		16V
C-1	C22	CEO4W1C220M	CE	22μF		16V
D-1	C23	CEO4W1C220M	CE	22μF		16V
D-1	C24	CK45B1H472K	CK	4700pF	±10%	
C-1	C25	CK45B1H472K	CK	4700pF	±10%	
B-1	C26	CK45B1H472K	CK	4700pF	±10%	
B-1	C27	CK45B1H472K	CK	4700pF	±10%	
C-1	C28	CK45B1H472K	CK	4700pF	±10%	
C-1	C29	CK45B1H472K	CK	4700pF	±10%	
B-1	C30	CK45B1H472K	CK	4700pF	±10%	
C-1	C31	CK45B1H472K	CK	4700pF	±10%	
D-4	C32	CEO4W1C470M	CE	47μF		16V
C-4	C33	CEO4W1C220M	CE	22μF		16V
D-4	C34	CK45B1H472K	CK	4700pF	±10%	
D-4	C35	CK45B1H472K	CK	4700pF	±10%	
C-4	C36	CK45B1H472K	CK	4700pF	±10%	
B-3	C37	CK45B1H472K	CK	4700pF	±10%	
B-3	C38	CK45B1H472K	CK	4700pF	±10%	
C-3	C39	CK45B1H472K	CK	4700pF	±10%	
C-3	C40	CK45B1H472K	CK	4700pF	±10%	
B-3	C41	CK45B1H472K	CK	4700pF	±10%	
C-3	C42	CK45B1H472K	CK	4700pF	±10%	
B-2	TC1	C05-0405-05	TC	20pF		
B-2	TC2	C05-0403-05	TC	6pF		
C-2	TC3	C05-0405-05	TC	20pF		
C-2	TC4	C05-0403-05	TC	6pF		
B-3	TC5	C05-0405-05	TC	20pF		
B-3	TC6	C05-0403-05	TC	6pF		
C-3	TC7	C05-0405-05	TC	20pF		
C-3	TC8	C05-0403-05	TC	6pF		
C-1	L1	L40-4701-03	Ferri inductor	47μH		
D-1	L2	L40-4701-03	Ferri inductor	47μH		
C-4	L3	L40-4701-03	Ferri inductor	47μH		
D-4	L4	L40-4701-03	Ferri inductor	47μH		
B-2	RL1	S51-1510-05	Relay			
B-2	RL2	S51-1510-05	Relay			
B-2	RL3	S51-2504-05	Relay			
C-2	RL4	S51-2504-05	Relay			
B-3	RL5	S51-1510-05	Relay			
B-3	RL6	S51-1510-05	Relay			
B-3	RL7	S51-2504-05	Relay			
C-3	RL8	S51-2504-05	Relay			
D-1	RL9	S51-1509-05	Relay			
D-3	RL10	S51-1509-05	Relay			
D-2	Q1		TR	μPA70A (L)		
D-2	Q2		TR	2SC1963		
D-3	Q3		TR	μPA70A (L)		
D-3	Q4		TR	2SC1963		
C-1	D1		Diode	1S1544A		
C-1	D2		Diode	1S1544A		
C-3	D3		Diode	1S1544A		
C-3	D4		Diode	1S1544A		
B-1	D5		Diode	DS442X		
B-1	D6		Diode	DS442X		
B-1	D7		Diode	DS442X		
C-1	D8		Diode	DS442X		
B-3	D9		Diode	DS442X		
B-3	D10		Diode	DS442X		
B-3	D11		Diode	DS442X		
C-3	D12		Diode	DS442X		
D-1	D13		Diode	WZ-075		
B-1	P1	E40-0576-05	Pin connector 5P			
B-4	P2	E40-0576-05	Pin connector 5P			
C-1	P3	E40-0876-05	Pin connector 8P			
C-4	P4	E40-0776-05	Pin connector 7P			
D-2	P5	E40-0576-05	Pin connector 5P			

PARTS LIST

VERTICAL AMPLIFIER UNIT (X73-1420-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
D-3	P6	E40-0576-05	Pin connector 5P
		F11-0974-14	Shield case
		J32-0826-04	Hex post
		J25-2939-12	Printed circuit board

Fig. & Index No.	Ref. No.	Parts No.	Description			
E-2	R1	RD14BB2C470J	RD	47Ω		
E-2	R2	RD14BB2C470J	RD	47Ω		
E-2	R3	RN14BK2B75ROF	RN	75Ω	±1%	1/8W
E-2	R4	RN14BK2B75ROF	RN	75Ω	±1%	1/8W
E-3	R5	RD14BB2C101J	RD	100Ω		
E-3	R6	RD14BB2C101J	RD	100Ω		
E-3	R7	RD14BB2C392J	RD	3.9kΩ		
E-3	R8	RD14BB2C472J	RD	4.7kΩ		
E-3	R9	RD14BB2C102J	RD	1kΩ		
E-3	R10	RD14BB2C391J	RD	390Ω		
E-2	R11	RN14BK2B4300F	RN	430Ω	±1%	1/8W
E-2	R12	RN14BK2B4300F	RN	430Ω	±1%	1/8W
E-3	R13	RN14BK2B2400F	RN	240Ω	±1%	1/8W
E-3	R14	RN14BK2B68ROF	RN	68Ω	±1%	1/8W
D-3	R15	RD14BB2C332J	RD	3.3kΩ		
D-3	R16	RN14BK2B1200F	RN	120Ω	±1%	1/8W
D-3	R17	RD14BB2C470J	RD	47Ω		
D-3	R18	RD14BB2C470J	RD	47Ω		
E-2	R19	RD14BB2C472J	RD	4.7kΩ		
E-2	R20	RD14BB2C472J	RD	4.7kΩ		
E-2	R21	RD14BB2C472J	RD	4.7kΩ		
D-2	R22	RD14BB2C472J	RD	4.7kΩ		
E-2	R23	RD14BB2C472J	RD	4.7kΩ		
E-2	R24	RD14BB2C512J	RD	5.1kΩ		
E-2	R25	RD14BB2C361J	RD	360Ω		
D-2	R26	RD14BB2C332J	RD	3.3kΩ		
D-2	R27	RD14BB2C113J	RD	11kΩ		
D-2	R28	RD14BB2C471J	RD	470Ω		
D-3	R29	RD14BB2C472J	RD	4.7kΩ		
D-3	R30	RD14BB2C472J	RD	4.7kΩ		
D-3	R31	RD14BB2C470J	RD	47Ω		
D-3	R32	RD14BB2C470J	RD	47Ω		
D-2	R33	RD14BB2C272J	RD	2.7kΩ		
D-2	R34	RD14BB2C681J	RD	680Ω		
D-2	R35	RD14BB2C681J	RD	680Ω		
D-2	R36	RD14BB2C681J	RD	680Ω		
D-3	R37	RD14BB2C820J	RD	82Ω		
D-2	R38	RD14BB2C103J	RD	10kΩ		
D-3	R39	RN14BK2B1800F	RN	180Ω	±1%	1/8W
D-2	R40	RN14BK2B1800F	RN	180Ω	±1%	1/8W
D-2	R41	RD14BB2C101J	RD	100Ω		
D-3	R42	RD14BB2C101J	RD	100Ω		
D-2	R43	RD14BB2C272J	RD	2.7kΩ		
D-3	R44	RD14BB2C222J	RD	2.2kΩ		
D-3	R45	RN14BK2B1801F	RN	1.8kΩ	±1%	1/8W
D-2	R46	RN14BK2B1801F	RN	1.8kΩ	±1%	1/8W
D-3	R47	RD14BB2C362J	RD	3.6kΩ		
D-3	R48	RD14BB2C470J	RD	47Ω		
D-3	R49	RD14BB2C470J	RD	47Ω		
D-3	R50	RD14BB2C222J	RD	2.2kΩ		
D-3	R51	RD14BB2C222J	RD	2.2kΩ		
D-3	R52	RD14BB2C470J	RD	47Ω		
D-3	R53	RD14BB2C470J	RD	47Ω		
D-2	R54	RN14BK2B1001F	RN	1kΩ	±1%	1/8W
D-2	R55	RN14BK2B1001F	RN	1kΩ	±1%	1/8W
D-2	R56	RD14BB2C301J	RD	300Ω		
C-2	R57	RD14BB2C123J	RD	12kΩ		
C-3	R58	RD14BB2C123J	RD	12kΩ		
D-3	R59	RD14BB2C222J	RD	2.2kΩ		
D-3	R60	RD14BB2C222J	RD	2.2kΩ		
D-2	R61	RD14BB2C222J	RD	2.2kΩ		
C-3	R62	RD14BB2C101J	RD	100Ω		
C-2	R63	RD14BB2C101J	RD	100Ω		
C-2	R64	RD14BB2C222J	RD	2.2kΩ		
C-3	R65	RN14BK2B4700F	RN	470Ω	±1%	1/8W
C-2	R66	RN14BK2B4700F	RN	470Ω	±1%	1/8W
C-3	R67	RD14BB2C470J	RD	47Ω		
C-2	R68	RD14BB2C470J	RD	47Ω		
C-3	R69	RD14BB2C392J	RD	3.9kΩ		
C-2	R70	RD14BB2C392J	RD	3.9kΩ		
C-3	R71	RD14BB2C470J	RD	47Ω		
C-2	R72	RD14BB2C470J	RD	47Ω		
C-3	R73	RD14BB2C271J	RD	270Ω		
C-2	R74	RD14BB2C331J	RD	330Ω		
C-2	R75	RD14BB2C182J	RD	1.8kΩ		
C-3	R76	RD14BB2C182J	RD	1.8kΩ		
C-3	R77	RD14BB2C470J	RD	47Ω		
C-2	R78	RD14BB2C470J	RD	47Ω		
C-3	R79	RD14BB2C151J	RD	150Ω		
C-3	R80	RD14BB2C182J	RD	1.8kΩ		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Description			
C-3	R81	RD14BB2C182J	RD	1.8kΩ		
C-3	R82	RD14BB2C470J	RD	47Ω		
C-2	R83	RD14BB2C470J	RD	47Ω		
C-2	R84	RD14BB2C151J	RD	150Ω		
C-2	R85	RN14BK2B6800F	RN	680Ω	±1%	1/8W
C-2	R86	RN14BK2B6800F	RN	680Ω	±1%	1/8W
C-3	R87	RD14BB2C101J	RD	100Ω		
C-3	R88	RD14BB2C101J	RD	100Ω		
C-3	R89	RD14BB2C472J	RD	4.7kΩ		
C-3	R90	RD14BB2C101J	RD	100Ω		
C-2	R91	RD14BB2C101J	RD	100Ω		
C-3	R92	RD14BB2C472J	RD	4.7kΩ		
C-3	R93	RD14BB2C472J	RD	4.7kΩ		
B-3	R94	RD14BB2C102J	RD	1kΩ		
B-3	R95	RD14BB2C562J	RD	5.6kΩ		
B-3	R96	RD14BB2C562J	RD	5.6kΩ		
B-3	R97	RD14BB2C101J	RD	100Ω		
B-3	R98	RD14BB2C101J	RD	100Ω		
B-2	R99	RD14BB2C472J	RD	4.7kΩ		
C-2	R100	RD14BB2C222J	RD	2.2kΩ		
E-1	R101	RD14BB2C470J	RD	47Ω		
E-1	R102	RD14BB2C470J	RD	47Ω		
E-1	R103	RN14BK2B75ROF	RN	75Ω	±1%	1/8W
E-1	R104	RN14BK2B75ROF	RN	75Ω	±1%	1/8W
E-2	R105	RD14BB2C101J	RD	100Ω		
E-2	R106	RD14BB2C101J	RD	100Ω		
E-2	R107	RD14BB2C392J	RD	3.9kΩ		
E-2	R108	RD14BB2C472J	RD	4.7kΩ		
E-2	R109	RD14BB2C102J	RD	1kΩ		
E-1	R110	RD14BB2C391J	RD	390Ω		
E-1	R111	RN14BK2B4300F	RN	430Ω	±1%	1/8W
E-1	R112	RN14BK2B4300F	RN	430Ω	±1%	1/8W
E-2	R113	RN14BK2B2400F	RN	240Ω	±1%	1/8W
E-2	R114	RN14BK2B68ROF	RN	68Ω	±1%	1/8W
D-1	R115	RD14BB2C332J	RD	3.3kΩ		
D-1	R116	RN14BK2B1200F	RN	120Ω	±1%	1/8W
D-1	R117	RD14BB2C470J	RD	47Ω		
D-1	R118	RD14BB2C470J	RD	47Ω		
E-1	R119	RD14BB2C472J	RD	4.7kΩ		
E-1	R120	RD14BB2C472J	RD	4.7kΩ		
E-1	R121	RD14BB2C472J	RD	4.7kΩ		
D-1	R122	RD14BB2C472J	RD	4.7kΩ		
E-1	R123	RD14BB2C472J	RD	4.7kΩ		
E-1	R124	RD14BB2C512J	RD	5.1kΩ		
E-1	R125	RD14BB2C361J	RD	360Ω		
D-1	R126	RD14BB2C332J	RD	3.3kΩ		
D-1	R127	RD14BB2C113J	RD	11kΩ		
D-1	R128	RD14BB2C471J	RD	470Ω		
D-2	R129	RD14BB2C472J	RD	4.7kΩ		
D-2	R130	RD14BB2C472J	RD	4.7kΩ		
D-2	R131	RD14BB2C470J	RD	47Ω		
D-2	R132	RD14BB2C470J	RD	47Ω		
D-1	R133	RD14BB2C222J	RD	2.2kΩ		
D-1	R134	RD14BB2C681J	RD	680Ω		
D-1	R135	RD14BB2C681J	RD	680Ω		
D-1	R136	RD14BB2C681J	RD	680Ω		
D-2	R137	RD14BB2C820J	RD	82Ω		
D-1	R138	RD14BB2C103J	RD	10kΩ		
D-2	R139	RN14BK2B1800F	RN	180Ω	±1%	1/8W
D-1	R140	RN14BK2B1800F	RN	180Ω	±1%	1/8W
D-1	R141	RD14BB2C101J	RD	100Ω		
D-2	R142	RD14BB2C101J	RD	100Ω		
D-1	R143	RD14BB2C272J	RD	2.7kΩ		
D-2	R144	RD14BB2C222J	RD	2.2kΩ		
D-2	R145	RN14BK2B1801F	RN	1.8kΩ	±1%	1/8W
D-1	R146	RN14BK2B1801F	RN	1.8kΩ	±1%	1/8W
D-2	R147	RD14BB2C362J	RD	3.6kΩ		
D-2	R148	RD14BB2C470J	RD	47Ω		
D-2	R149	RD14BB2C470J	RD	47Ω		
D-2	R150	RD14BB2C222J	RD	2.2kΩ		
D-2	R151	RD14BB2C222J	RD	2.2kΩ		
D-2	R152	RD14BB2C470J	RD	47Ω		
D-2	R153	RD14BB2C470J	RD	47Ω		
D-2	R154	RD14BB2C470J	RD	47Ω		
D-2	R155	RD14BB2C470J	RD	47Ω		
D-1	R156	RN14BK2B1001F	RN	1kΩ	±1%	1/8W
D-1	R157	RN14BK2B1001F	RN	1kΩ	±1%	1/8W
D-1	R158	RN14BK2B3000F	RN	300Ω	±1%	1/8W
D-1	R159	RN14BK2B1001F	RN	1kΩ	±1%	1/8W
D-1	R160	RN14BK2B1001F	RN	1kΩ	±1%	1/8W

Fig. & Index No.	Ref. No.	Parts No.	Description			
C-1	R161	RN14BK2B3000F	RN	300Ω	±1%	1/8W
D-1	R162	RD14BB2C472J	RD	4.7kΩ		
D-1	R163	RD14BB2C472J	RD	4.7kΩ		
D-1	R164	RD14BB2C103J	RD	10kΩ		
D-1	R165	RD14BB2C103J	RD	10kΩ		
C-1	R166	RD14BB2C472J	RD	4.7kΩ		
C-1	R167	RD14BB2C472J	RD	4.7kΩ		
C-1	R168	RD14BB2C103J	RD	10kΩ		
C-1	R169	RD14BB2C103J	RD	10kΩ		
C-2	R170	RD14BB2C123J	RD	12kΩ		
C-1	R171	RD14BB2C123J	RD	12kΩ		
C-2	R172	RD14BB2C222J	RD	2.2kΩ		
C-2	R173	RD14BB2C222J	RD	2.2kΩ		
C-1	R174	RD14BB2C222J	RD	2.2kΩ		
C-2	R175	RD14BB2C101J	RD	100Ω		
C-1	R176	RD14BB2C101J	RD	100Ω		
C-1	R177	RD14BB2C222J	RD	2.2kΩ		
C-2	R178	RN14BK2B4700F	RN	470Ω	±1%	1/8W
C-1	R179	RN14BK2B4700F	RN	470Ω	±1%	1/8W
C-2	R180	RD14BB2C470J	RD	47Ω		
C-1	R181	RD14BB2C470J	RD	47Ω		
C-2	R182	RD14BB2C392J	RD	3.9kΩ		
C-1	R183	RD14BB2C392J	RD	3.9kΩ		
C-2	R184	RD14BB2C151J	RD	150Ω		
C-2	R185	RD14BB2C470J	RD	47Ω		
C-1	R186	RD14BB2C470J	RD	47Ω		
C-2	R187	RD14BB2C182J	RD	1.8kΩ		
C-1	R188	RD14BB2C182J	RD	1.8kΩ		
C-2	R189	RD14BB2C471J	RD	470Ω		
C-1	R190	RD14BB2C471J	RD	470Ω		
C-1	R191	RD14BB2C221J	RD	220Ω		
C-1	R192	RD14BB2C102J	RD	1kΩ		
C-1	R193	RD14BB2C102J	RD	1kΩ		
C-1	R194	RD14BB2C151J	RD	150Ω		
C-2	R195	RD14BB2C470J	RD	47Ω		
C-1	R196	RD14BB2C470J	RD	47Ω		
C-1	R197	RN14BK2B6800F	RN	680Ω	±1%	1/8W
C-1	R198	RN14BK2B6800F	RN	680Ω	±1%	1/8W
C-2	R199	RD14BB2C101J	RD	100Ω		
B-1	R200	RD14BB2C101J	RD	100Ω		
B-2	R201	RD14BB2C472J	RD	4.7kΩ		
B-1	R202	RD14BB2C101J	RD	100Ω		
B-2	R203	RD14BB2C101J	RD	100Ω		
B-2	R204	RD14BB2C472J	RD	4.7kΩ		
B-1	R205	RD14BB2C472J	RD	4.7kΩ		
C-2	R206	RD14BB2C222J	RD	2.2kΩ		
B-3	R207	RN14BK2B1001F	RN	1kΩ	±1%	1/8W
B-2	R208	RN14BK2B1001F	RN	1kΩ	±1%	1/8W
B-3	R209	RN14BK2B1001F	RN	1kΩ	±1%	1/8W
B-2	R210	RN14BK2B1001F	RN	1kΩ	±1%	1/8W
B-3	R211	RD14BB2C223J	RD	22kΩ		
B-2	R212	RD14BB2C472J	RD	4.7kΩ		
B-2	R213	RD14BB2C472J	RD	4.7kΩ		
B-2	R214	RD14BB2C472J	RD	4.7kΩ		
B-3	R215	RD14BB2C470J	RD	47Ω		
B-2	R216	RD14BB2C470J	RD	47Ω		
B-3	R217	RD14BB2C102J	RD	1kΩ		
B-2	R218	RD14BB2C102J	RD	1kΩ		
B-2	R219	RD14BB2C102J	RD	1kΩ		
B-3	R220	RD14BB2C470J	RD	47Ω		
B-2	R221	RD14BB2C470J	RD	47Ω		
B-3	R222	RD14BB2C221J	RD	220Ω		
B-2	R223	RD14BB2C221J	RD	220Ω		
B-3	R224	RD14BB2C910J	RD	91Ω		
B-2	R225	RD14BB2C910J	RD	91Ω		
B-1	R226	RD14BB2C181J	RD	180Ω		
B-2	R227	RD14BB2C470J	RD	47Ω		
B-1	R228	RD14BB2C470J	RD	47Ω		
B-1	R229	RD14BB2C272J	RD	2.7kΩ		
B-1	R230	RD14BB2C333J	RD	33kΩ		
B-1	R231	RD14BB2C301J	RD	300Ω		
B-1	R232	RD14BB2C301J	RD	300Ω		
B-1	R233	RD14BB2C271J	RD	270Ω		
B-2	R234	RD14BB2C202J	RD	2kΩ		
B-1	R235	RD14BB2C234J	RD	2kΩ		
B-2	R236	RN14BK2B4700F	RN	470Ω	±1%	1/8W
B-1	R237	RN14BK2B4700F	RN	470Ω	±1%	1/8W
B-2	R238	RD14BB2C102J	RD	1kΩ		
B-2	R239	RD14BB2C100J	RD	10Ω		
B-1	R240	RD14BB2C121J	RD	120Ω		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Description
B-1	R241	RD14BB2C101J	RD 100Ω
B-2	R242	RD14BB2C361J	RD 360Ω
B-1	R243	RD14BB2C103J	RD 10kΩ
B-1	R244	RD14BB2C222J	RD 2.2kΩ
B-1	R245	RD14BB2C152J	RD 1.5kΩ
B-2	R246	RD14BB2C392J	RD 3.9kΩ
A-1	R247	RD14BB2C222J	RD 2.2kΩ
A-2	R248	RD14BB2C182J	RD 1.8kΩ
A-2	R249	RD14BB2C470J	RD 47Ω
B-2	R250	RD14BB2C470J	RD 47Ω
B-1	R251	RD14BB2C470J	RD 47Ω
A-1	R252	RD14BB2C470J	RD 47Ω
B-2	R253	RD14BB2C472J	RD 4.7kΩ
B-2	R254	RD14BB2C472J	RD 4.7kΩ
B-2	R255	RD14BB2C472J	RD 4.7kΩ
B-2	R256	RD14BB2C472J	RD 4.7kΩ
B-2	R257	RD14BB2C472J	RD 4.7kΩ
B-2	R258	RD14BB2C472J	RD 4.7kΩ
C-2	R259	RD14BB2C472J	RD 4.7kΩ
C-2	R260	RD14BB2C101J	RD 100Ω
C-2	R261	RD14BB2C472J	RD 4.7kΩ
C-2	R262	RD14BB2C472J	RD 4.7kΩ
D-2	R263	RD14BB2C101J	RD 100Ω
D-2	R264	RD14BB2C472J	RD 4.7kΩ
B-2	R265	RD14BB2C472J	RD 4.7kΩ
B-2	R266	RD14BB2C472J	RD 4.7kΩ
B-2	R267	RD14BB2C101J	RD 100Ω
B-2	R268	RD14BB2C472J	RD 4.7kΩ
B-2	R269	RD14BB2C331J	RD 330Ω
C-2	R270	RD14BB2C222J	RD 2.2kΩ
C-2	R271	RD14BB2C222J	RD 2.2kΩ
C-2	R272	RD14BB2C183J	RD 18kΩ
B-1	R273	RD14BB2C183J	RD 18kΩ
B-2	R274	RD14BB2C332J	RD 3.3kΩ
B-3	R275	RD14BB2C104J	RD 100kΩ
C-3	R276	RD14BB2C104J	RD 100kΩ
D-2	VR1	R12-0502-05	VR 100ΩB
D-2	VR2	R12-0511-05	VR 220ΩB
C-3	VR3	R12-0511-05	VR 220ΩB
D-1	VR4	R12-0502-05	VR 100ΩB
D-1	VR5	R12-0511-05	VR 220ΩB
D-1	VR6	R12-0511-05	VR 220ΩB
C-1	VR7	R12-0511-05	VR 220ΩB
C-1	VR8	R12-1037-05	VR 3.3kΩB
C-2	VR9	R12-0511-05	VR 220ΩB
B-3	VR10	R12-1037-05	VR 3.3kΩB
B-2	VR11	R12-1033-05	VR 2.2kΩB
C-2	VR12	R12-1033-05	VR 2.2kΩB
C-2	VR13	R12-1033-05	VR 2.2kΩB
	C1	No use	
E-2	C2	CE04W1C470M	CE 47μF 16V
E-2	C3	CK45B1H103K	CK 0.01μF ±10%
E-2	C4	CE04W1C470M	CE 47μF 16V
D-2	C5	CC45CH1H180J	CC 18pF ±5%
D-3	C6	CK45B1H103K	CK 0.01μF ±10%
D-2	C7	CE04BW1H010M	CE 1μF 50V
D-2	C8	CK45B1H103K	CK 0.01μF ±10%
D-2	C9	CK45B1H103K	CK 0.01μF ±10%
D-2	C10	CC45CH1H150J	CC 15pF ±5%
D-3	C11	CE04BW1H010M	CE 1μF 50V
C-3	C12	CK45B1H103K	CK 0.01μF ±10%
D-2	C13	CK45B1H103K	CK 0.01μF ±10%
D-2	C14	CE04BW1H010M	CE 1μF 50V
C-3	C15	CC45CH1H150J	CC 15pF ±5%
C-2	C16	CK45B1H103K	CK 0.01μF ±10%
C-3	C17	CC45CH1H120J	CC 12pF ±5%
B-2	C18	CK45B1H103K	CK 0.01μF ±10%
A-2	C19	CE04W1C470M	CE 47μF 16V
B-2	C20	CK45B1H103K	CK 0.01μF ±10%
A-2	C21	CE04W1C470M	CE 47μF 16V
A-3	C22	CE04W1A102M	CE 1000μF 10V
B-3	C23	CK45B1H103K	CK 0.01μF ±10%
E-1	C24	CC45CH1H070D	CC 7pF ±0.5pF
E-1	C25	CE04W1C470M	CE 47μF 16V
E-1	C26	CK45B1H103K	CK 0.01μF ±10%
E-1	C27	CE04W1C470M	CE 47μF 16V
D-2	C28	CE04BW1H010M	CE 1μF 50V
D-1	C29	CK45B1H103K	CK 0.01μF ±10%

Fig. & Index No.	Ref. No.	Parts No.	Description
D-1	C30	CC45CH1H220J	CC 22pF ±5%
C-1	C31	CC45CH1H220J	CC 22pF ±5%
C-2	C32	CK45B1H103K	CK 0.01μF ±10%
C-2	C33	CE04BW1H010M	CE 1μF 50V
C-1	C34	CK45B1H103K	CK 0.01μF ±10%
D-2	C35	CE04BW1H010M	CE 1μF 50V
C-2	C36	CK45B1H103K	CK 0.01μF ±10%
C-2	C37	CK45B1H103K	CK 0.01μF ±10%
C-1	C38	CK45B1H103K	CK 0.01μF ±10%
C-1	C39	CC45SL1H101J	CC 100pF ±5%
C-2	C40	CC45SL1H101J	CC 100pF ±5%
C-1	C41	CK45B1H103K	CK 0.01μF ±10%
C-1	C42	CC45CH1H120J	CC 12pF ±5%
B-3	C43	CK45B1H103K	CK 0.01μF ±10%
B-1	C44	CC45CH1H470J	CC 47pF ±5%
B-1	C45	CC45CH1H560J	CC 56pF ±5%
B-1	C46	CC45CH1H100D	CC 10pF ±0.5pF
B-1	C47	CC45SL1H331J	CC 330pF ±5%
B-1	C48	CK45B1H103K	CK 0.01μF ±10%
B-2	C49	CK45B1H102K	CK 1000pF ±10%
B-1	C50	CK45B1H103K	CK 0.01μF ±10%
B-2	C51	CC45SL1H220J	CC 22pF ±5%
B-2	C52	CC45SL1H220J	CC 22pF ±5%
B-2	C53	CK45B1H103K	CK 0.01μF ±10%
C-2	C54	CK45B1H103K	CK 0.01μF ±10%
D-2	C55	CK45B1H103K	CK 0.01μF ±10%
B-2	C56	CK45B1H103K	CK 0.01μF ±10%
B-2	C57	CK45B1H103K	CK 0.01μF ±10%
C-1	C58	CE04W1C470M	CE 47μF 16V
B-1	C59	CK45B1H103K	CK 0.01μF ±10%
B-1	C60	CE04W1C470M	CE 47μF 16V
B-1	C61	CK45B1H103K	CK 0.01μF ±10%
B-1	C62	CE04W1C470M	CE 47μF 16V
B-1	C63	CK45B1H103K	CK 0.01μF ±10%
C-3	C64	CK45B1H103K	CK 0.01μF ±10%
C-2	C65	CK45B1H103K	CK 0.01μF ±10%
D-2	C66	CK45B1H103K	CK 0.01μF ±10%
C-3	C67	CC45SL1H221J	CC 220pF ±5%
C-2	C68	CC45SL1H221J	CC 220pF ±5%
B-3	C69	CC45CH1H150J	CC 15pF ±5%
B-2	C70	CC45CH1H150J	CC 15pF ±5%
	C71	No use	
	C72	No use	
B-2	C73	CC45CH1H100D	CC 10pF ±0.5pF
D-2	C74	CK45B1H103K	CK 0.01μF ±10%
E-3	C75	CC45CH1H100D	CC 10pF ±0.5pF
E-3	C76	CC45CH1H180J	CC 18pF ±5%
E-2	C77	CC45CH1H100D	CC 10pF ±0.5pF
E-2	C78	CC45CH1H180J	CC 18pF ±5%
B-1	C79	CK45B1H103K	CK 0.01μF ±10%
B-3	C80	CK45B1H103K	CK 0.01μF ±10%
C-2	C81	CK45B1H103K	CK 0.01μF ±10%
A-2	C82	CC45CH1H220J	CC 22pF ±5%
B-2	C83	CK45B1H102K	CK 1000pF ±10%
D-2	TC1	C05-0505-05	TC 20pF
D-1	TC2	C05-0405-05	TC 20pF
D-1	TC3	C05-0405-05	TC 20pF
E-2	L1	L40-1511-03	Ferri inductor 150μH
E-3	L2	L40-1092-01	Ferri inductor 1μH
E-1	L3	L40-1511-03	Ferri inductor 150μH
E-1	L4	L40-1092-01	Ferri inductor 1μH
C-1	L5	L40-4701-03	Ferri inductor 47μH
B-1	L6	L40-4701-03	Ferri inductor 47μH
B-1	L7	L40-4701-03	Ferri inductor 47μH
E-3	RL1	S51-1509-05	Lead relay
E-3	RL2	S51-1509-05	Lead relay
E-1	RL3	S51-1509-05	Lead relay
E-1	RL4	S51-1509-05	Lead relay
E-2	Q1		TR 2SA608KNP (F)
E-2	Q2		TR 2SA608KNP (F)
D-2	Q3		TR 2SA608KNP (F)
D-3	Q4		TR 2SC1963
D-3	Q5		TR 2SA884
E-2	Q6		TR 2SC536KNP (F)
D-3	Q7		TR 2SA838 (C)
D-3	Q8		TR 2SA838 (C)

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Description
D-2	Q9		FET 2SK30A (GR)
D-2	Q10		FET 2SK68A (M)
D-3	Q11		TR 2SC1047 (C)
D-3	Q12		TR 2SC1047 (C)
D-2	Q13		TR 2SC1047 (C)
D-2	Q14		TR 2SC1047 (C)
D-3	Q15		TR 2SC1047 (C)
D-2	Q16		TR 2SC1047 (C)
C-3	Q17		TR 2SC1047 (C)
C-2	Q18		TR 2SC1047 (C)
C-3	Q19		TR 2SC1047 (C)
C-2	Q20		TR 2SC1047 (C)
C-3	Q21		TR 2SA838 (C)
C-2	Q22		TR 2SA838 (C)
C-3	Q23		TR 2SA838 (C)
C-2	Q24		TR 2SA838 (C)
C-3	Q25		TR 2SA838 (C)
C-2	Q26		TR 2SA838 (C)
C-3	Q27		TR 2SA838 (C)
C-3	Q28		TR 2SA838 (C)
C-2	Q29		TR 2SA838 (C)
C-2	Q30		TR 2SA838 (C)
B-3	Q31		TR 2SC1047 (C)
B-3	Q32		TR 2SA838 (C)
B-3	Q33		TR 2SC1973 (T)
B-3	Q34		TR 2SA684
D-2	Q35		TR 2SC1963
D-1	Q36		TR 2SA884
E-1	Q37		TR 2SC536KNP (F)
E-1	Q38		TR 2SA608KNP (F)
D-1	Q39		TR 2SA608KNP (F)
D-1	Q40		TR 2SA608KNP (F)
D-2	Q41		TR 2SA608KNP (F)
D-2	Q42		TR 2SA608KNP (F)
D-1	Q43		FET 2SK30 (A) (GR)
D-1	Q44		FET 2SK68A (M)
D-2	Q45		TR 2SC1047 (C)
D-2	Q46		TR 2SC1047 (C)
D-2	Q47		TR 2SC1047 (C)
D-2	Q48		TR 2SC1047 (C)
C-2	Q49		TR 2SC1047 (C)
C-2	Q50		TR 2SC1047 (C)
C-2	Q51		TR 2SC1047 (C)
C-1	Q52		TR 2SC1047 (C)
D-1	Q53		TR 2SA608KNP (F)
D-1	Q54		TR 2SC536KNP (F)
C-1	Q55		TR 2SA608KNP (F)
C-1	Q56		TR 2SC536KNP (F)
C-2	Q57		TR 2SC1047 (C)
C-1	Q58		TR 2SC1047 (C)
C-2	Q59		TR 2SC1047 (C)
C-1	Q60		TR 2SC1047 (C)
C-2	Q61		TR 2SA838 (C)
C-1	Q62		TR 2SA838 (C)
C-2	Q63		TR 2SA838 (C)
C-1	Q64		TR 2SA838 (C)
C-2	Q65		TR 2SA838 (C)
C-1	Q66		TR 2SA838 (C)
B-2	Q67		TR 2SA838 (C)
B-2	Q68		TR 2SA838 (C)
B-1	Q69		TR 2SA838 (C)
B-1	Q70		TR 2SA838 (C)
B-2	Q71		TR 2SA608KNP (F)
B-2	Q72		TR 2SC536KNP (F)
B-3	Q73		TR 2SC1047 (C)
B-2	Q74		TR 2SC1047 (C)
B-3	Q75		TR 2SC1973 (T)
B-2	Q76		TR 2SC1973 (T)
B-2	Q77		TR 2SC1047 (C)
B-1	Q78		TR 2SC1047 (C)
B-2	Q79		TR 2SA608KNP (F)
B-2	Q80		TR 2SA608KNP (F)
B-2	Q81		TR 2SA838 (C)
B-1	Q82		TR 2SA838 (C)
B-1	Q83		TR 2SC536KNP (F)
B-2	Q84		TR 2SC536KNP (F)
B-1	Q85		TR 2SA608KNP (F)
A-2	Q86		TR 2SA838 (C)
B-2	Q87		TR 2SC1047 (C)
B-1	Q88		TR 2SC1047 (C)

Fig. & Index No.	Ref. No.	Parts No.	Description
B-1	Q89		TR 2SA838 (C)
C-2	Q90		TR 2SC1047 (C)
C-2	Q91		TR 2SC1047 (C)
C-2	Q92		TR 2SC1047 (C)
C-2	Q93		TR 2SC1047 (C)
B-2	Q94		TR 2SC1047 (C)
B-2	Q95		TR 2SC1047 (C)
E-3	IC1		IC CA3102E
E-2	IC2		IC CA3102E
E-2	D1		Diode DS442X
E-2	D2		Diode DS442X
D-2	D3		Diode DS442X
E-2	D4		Diode WZ-071
E-2	D5		Diode WZ-071
D-2	D6		Diode DS442X
D-2	D7		Diode DS442X
B-3	D8		Diode WZ-050
B-3	D9		Diode YZ-030
E-1	D10		Diode DS442X
E-1	D11		Diode DS442X
D-1	D12		Diode DS442X
D-1	D13		Diode DS442X
E-1	D14		Diode WZ-071
E-1	D15		Diode WZ-071
D-1	D16		Diode DS442X
C-3	D17		Diode WZ-071
C-2	D18		Diode DS442X
B-2	D19		Diode WZ-071
B-3	D20		Diode DS442X
B-2	D21		Diode DS442X
B-2	D22		Diode WZ-071
B-2	D23		Diode WZ-071
B-2	D24		Diode DS442X
B-2	D25		Diode DS442X
B-2	D26		Diode DS442X
B-1	D27		Diode DS442X
B-1	D28		Diode DS442X
B-1	D29		Diode DS442X
B-1	D30		Diode DS442X
B-2	D31		Diode DS442X
B-1	D32		Diode DS442X
B-2	D33		Diode DS442X
A-2	TP1	E40-0211-05	Pin connector 2P
E-2	P5	E40-0576-05	Pin connector 5P
E-1	P6	E40-0576-05	Pin connector 5P
E-2	P7	E40-0676-05	Pin connector 6P
D-1	P8	E40-0876-05	Pin connector 8P
C-2	P9	E40-0676-05	Pin connector 6P
C-2	P10	E40-0476-05	Pin connector 4P
C-2	P11	E40-0276-05	Pin connector 2P
C-2	P12	E40-0276-05	Pin connector 2P
B-2	P13	E40-0576-05	Pin connector 5P
B-2	P14	E40-0376-05	Pin connector 3P
C-1	P15	E40-0776-05	Pin connector 7P
A-1	P16	E40-0576-05	Pin connector 5P
A-2	P17	E40-0376-05	Pin connector 3P
B-2	P18	E40-0376-05	Pin connector 3P
B-3	P19	E40-0376-05	Pin connector 3P
A-2	P20	E40-0276-05	Pin connector 2P
		J25-2942-12	Printed circuit board

PARTS LIST

VERTICAL OUTPUT AMP UNIT (X73-1430-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
	R1	No use	
C-2	R2	RD14BB2C472J	RD 4.7kΩ
C-2	R3	RD14BB2C391J	RD 390Ω
C-2	R4	RD14BB2C473J	RD 47kΩ
C-2	R5	RD14BB2C223J	RD 22kΩ
C-2	R6	RD14BB2E161J	RD 160Ω ±5% 1/4W
C-3	R7	RD14BB2C472J	RD 4.7kΩ
C-3	R8	RD14BB2C391J	RD 390Ω
C-3	R9	RD14BB2C473J	RD 47kΩ
C-3	R10	RD14BB2C223J	RD 22kΩ
C-3	R11	RD14BB2E161J	RD 160Ω ±5% 1/4W
D-3	R12	RD14BB2C101J	RD 100Ω
D-2	R13	RD14BB2C470J	RD 47Ω
D-3	R14	RD14BB2C470J	RD 47Ω
D-2	R15	RD14BB2C223J	RD 22kΩ
D-3	R16	RD14BB2C223J	RD 22kΩ
E-2	R17	RD14BB2C331J	RD 330Ω
E-3	R18	RD14BB2C331J	RD 330Ω
C-3	VR1	R12-3039-05	VR 10kΩB
C-3	VR2	R12-3503-05	VR 22kΩB
C-2	C1	CC45CH1H100D	CC 10pF ±0.5pF
B-3	C2	CC45CH1H100D	CC 10pF ±0.5pF
C-3	C3	CC45CH1H070D	CC 7pF ±0.5pF
C-2	C4	CC45CH1H010C	CC 1pF ±0.25pF
C-2	C5	CC45CH1H010C	CC 1pF ±0.25pF
C-2	C6	CK45B1H103K	CK 0.01μF ±10%
C-4	C7	CK45B1H103K	CK 0.01μF ±10%
C-3	C8	CC45CH1H010C	CC 1pF ±0.25pF
C-3	C9	CC45CH1H010C	CC 1pF ±0.25pF
D-4	C10	CK45B1H103K	CK 0.01μF ±10%
E-2	C11	CK45B2H472K	CK 4700pF ±10% 500V
E-3	C12	CK45B2H472K	CK 4700pF ±10% 500V
E-2	C13	CK45B2H472K	CK 4700pF ±10% 500V
D-4	C14	CK45B2H472K	CK 4700pF ±10% 500V
E-2	C15	CK45B2H472K	CK 4700pF ±10% 500V
B-3	C16	CE04W1C470M	CE 47μF 16V
B-3	C17	CE04W1C470M	CE 47μF 16V
B-3	C18	CE04W1C470M	CE 47μF 16V
B-3	C19	CE04W2A100M	CE 10μF 100V
C-2	TC1	C05-0412-05	TC 20pF
C-2	Q1		TR 2SC1973 (T)
C-3	Q2		TR 2SC1973 (T)
D-2	Q3		TR 2SC805-2 (3)
D-5	Q4		TR 2SC805-2 (3)
D-2	Q5		TR 2SA923-2 (2, 3)
D-5	Q6		TR 2SA923-2 (2, 3)
E-2	D1		Diode DS442X
E-2	D2		Diode WZ-050
E-3	D3		Diode DS442X
E-3	D4		Diode WZ-050
B-2	P16	E40-0576-05	Pin connector 5P
B-2	P17	E40-0376-05	Pin connector 3P
E-2	P30	E23-0512-05	Terminal 1P
E-3	P31	E23-0512-05	Terminal 1P
		F01-0827-04	Heat sink
		J30-0605-05	Spacer
		J25-2949-03	Printed circuit board

VERTICAL SWITCH UNIT (X73-1400-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
E-2	R1	RD14BB2C103J	RD 10kΩ
E-2	R2	RD14BB2C103J	RD 10kΩ
E-2	R3	RD14BB2C103J	RD 10kΩ
D-2	R4	RD14BB2C103J	RD 10kΩ
D-1	R5	RD14BB2C103J	RD 10kΩ
E-2	R6	RD14BB2C103J	RD 10kΩ
E-2	R7	RD14BB2C103J	RD 10kΩ
B-3	R8	RD14BB2C103J	RD 10kΩ
E-2	R9	RD14BB2C103J	RD 10kΩ
B-2	R10	RD14BB2C103J	RD 10kΩ
B-2	R11	RD14BB2C103J	RD 10kΩ
B-2	R12	RD14BB2C103J	RD 10kΩ
B-2	R13	RD14BB2C103J	RD 10kΩ
B-3	R14	RD14BB2C103J	RD 10kΩ
B-3	R15	RD14BB2C103J	RD 10kΩ
B-3	R16	RD14BB2C103J	RD 10kΩ
B-3	R17	RD14BB2C103J	RD 10kΩ
C-3	R18	RD14BB2C103J	RD 10kΩ
E-2	R19	RD14BB2C103J	RD 10kΩ
D-2	R20	RD14BB2C103J	RD 10kΩ
D-2	R21	RD14BB2C103J	RD 10kΩ
C-2	R22	RD14BB2C103J	RD 10kΩ
C-2	R23	RD14BB2C103J	RD 10kΩ
C-2	R24	RD14BB2C103J	RD 10kΩ
B-2	R25	RD14BB2C103J	RD 10kΩ
A-3	C1	CS15E0J470M	Tantalum 47μF 6.3V
A-3	C2	CK45B1H103K	CK 0.01μF ±10%
B-3	C3	CK45B1H103K	CK 0.01μF ±10%
E-3	C4	CK45B1H103K	CK 0.01μF ±10%
E-2	D1		Diode 1N60
E-2	D2		Diode 1N60
B-2	D3		Diode 1N60
B-2	D4		Diode 1N60
C-3	P21	E40-0376-05	Pin connector 3P
C-3	P22	E40-0376-05	Pin connector 3P
B-3	P23	E40-0477-05	Pin connector 4P
E-3	P24	E10-2661-05	Pin connector 26P
E-1	S1	S01-1514-05	Rotary switch
E-2	S2	S01-2507-05	Rotary switch
C-1	S3	S01-1514-05	Rotary switch
A-2	S4	S01-2507-05	Rotary switch
C-2	S5	S42-7502-05	Push switch
		J25-2944-03	Printed circuit board

PARTS LIST

VERTICAL LOGIC UNIT (X73-1410-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
C-4	R1	RD14BB2C472J	RD 4.7kΩ
C-4	R2	RD14BB2C472J	RD 4.7kΩ
C-4	R3	RD14BB2C103J	RD 10kΩ
C-4	R4	RD14BB2C103J	RD 10kΩ
B-4	R5	RD14BB2C103J	RD 10kΩ
B-4	R6	RD14BB2C103J	RD 10kΩ
D-5	R7	RD14BB2C471J	RD 470Ω
G-1	R8	RD14BB2C471J	RD 470Ω
G-2	R9	RD14BB2C471J	RD 470Ω
G-2	R10	RD14BB2C471J	RD 470Ω
G-2	R11	RD14BB2C471J	RD 470Ω
G-2	R12	RD14BB2C471J	RD 470Ω
G-2	R13	RD14BB2C471J	RD 470Ω
G-2	R14	RD14BB2C471J	RD 470Ω
G-2	R15	RD14BB2C471J	RD 470Ω
G-2	R16	RD14BB2C471J	RD 470Ω
G-2	R17	RD14BB2C471J	RD 470Ω
G-2	R18	RD14BB2C471J	RD 470Ω
G-2	R19	RD14BB2C471J	RD 470Ω
G-3	R20	RD14BB2C471J	RD 470Ω
G-3	R21	RD14BB2C471J	RD 470Ω
F-4	R22	RD14BB2C471J	RD 470Ω
F-4	R23	RD14BB2C471J	RD 470Ω
E-3	R24	RD14BB2C471J	RD 470Ω
E-3	R25	RD14BB2C471J	RD 470Ω
E-3	R26	RD14BB2C471J	RD 470Ω
E-3	R27	RD14BB2C471J	RD 470Ω
E-3	R28	RD14BB2C471J	RD 470Ω
E-3	R29	RD14BB2C471J	RD 470Ω
E-3	R30	RD14BB2C471J	RD 470Ω
D-2	R31	RD14BB2C471J	RD 470Ω
D-2	R32	RD14BB2C471J	RD 470Ω
D-2	R33	RD14BB2C471J	RD 470Ω
D-2	R34	RD14BB2C471J	RD 470Ω
D-2	R35	RD14BB2C471J	RD 470Ω
D-2	R36	RD14BB2C471J	RD 470Ω
B-3	C1	CK45B1H102K	CK 1000pF ±10%
B-3	C2	CK45B1H102K	CK 1000pF ±10%
D-5	C3	CK45B1H102K	CK 1000pF ±10%
A-4	C4	CK45B1H103K	CK 0.01μF ±10%
B-4	C5	CE04W1C101M	CE 100μF 16V
B-4	C6	CE04W1E470M	CE 47μF 25V
B-5	C7	CE04W1E470M	CE 47μF 25V
G-2	C8	CK45B1H102K	CK 1000pF ±10%
G-3	C9	CK45B1H102K	CK 1000pF ±10%
F-2	C10	CK45B1H102K	CK 1000pF ±10%
F-2	C11	CK45B1H102K	CK 1000pF ±10%
F-2	C12	CK45B1H102K	CK 1000pF ±10%
F-2	C13	CK45B1H102K	CK 1000pF ±10%
F-2	C14	CK45B1H102K	CK 1000pF ±10%
F-2	C15	CK45B1H102K	CK 1000pF ±10%
F-2	C16	CK45B1H102K	CK 1000pF ±10%
F-2	C17	CK45B1H102K	CK 1000pF ±10%
F-2	C18	CK45B1H102K	CK 1000pF ±10%
F-2	C19	CK45B1H102K	CK 1000pF ±10%
F-2	C20	CK45B1H102K	CK 1000pF ±10%
F-3	C21	CK45B1H102K	CK 1000pF ±10%
F-2	C22	CK45B1H102K	CK 1000pF ±10%
F-2	C23	CK45B1H102K	CK 1000pF ±10%
F-2	C24	CK45B1H102K	CK 1000pF ±10%
E-2	C25	CK45B1H102K	CK 1000pF ±10%
E-2	C26	CK45B1H102K	CK 1000pF ±10%
E-2	C27	CK45B1H102K	CK 1000pF ±10%
E-2	C28	CK45B1H102K	CK 1000pF ±10%
E-2	C29	CK45B1H102K	CK 1000pF ±10%
E-2	C30	CK45B1H102K	CK 1000pF ±10%
E-2	C31	CK45B1H102K	CK 1000pF ±10%
E-2	C32	CK45B1H102K	CK 1000pF ±10%
E-2	C33	CK45B1H102K	CK 1000pF ±10%
E-2	C34	CK45B1H102K	CK 1000pF ±10%
E-2	C35	CK45B1H102K	CK 1000pF ±10%
E-2	C36	CK45B1H102K	CK 1000pF ±10%
C-5	C37	CK45B1H103K	CK 0.01μF ±10%
E-5	C38	CK45B1H103K	CK 0.01μF ±10%
F-5	C39	CK45B1H103K	CK 0.01μF ±10%
B-4	L1	L40-1511-03	Ferri inductor 150μH
B-4	L2	L40-1011-04	Ferri inductor 100μH
B-5	L3	L40-1511-03	Ferri inductor 150μH

Fig. & Index No.	Ref. No.	Parts No.	Description
C-4	Q1		TR 2SC536KNP (F)
C-4	D1		Diode DS442X
C-3	D2		Diode IN60
C-3	D3		Diode IN60
C-3	D4		Diode IN60
C-3	D5		Diode IN60
C-3	D6		Diode IN60
B-3	D7		Diode IN60
C-4	D8		Diode IN60
C-4	D9		Diode DS442X
C-4	D10		Diode 1N60
F-3	IC1		IC MC14051BCP
F-4	IC2		IC MC14051BCP
E-4	IC3		IC SN7407N
D-3	IC4		IC SN74LS42N
D-4	IC5		IC SN74LS42N
C-4	IC6		IC SN74LS00N
G-3	P1	E40-0576-05	Pin connector 5P
G-5	P2	E40-0576-05	Pin connector 5P
E-3	P3	E40-0876-05	Pin connector 8P
E-5	P4	E40-0776-05	Pin connector 7P
D-3	P7	E40-0676-05	Pin connector 6P
D-5	P8	E40-0876-05	Pin connector 8P
B-3	P9	E40-0676-05	Pin connector 6P
C-3	P14	E40-0376-05	Pin connector 3P
A-4	P15	E40-0776-05	Pin connector 7P
G-4	P23	E40-0476-05	Pin connector 4P
F-2	P25	E40-3486-05	Pin connector 34P
C-2	P26	E40-3486-05	Pin connector 34P
C-5	P27	E40-0676-05	Pin connector 6P
A-4	P28	E40-0776-05	Pin connector 7P
A-3	P29	E40-3086-05	Pin connector 30P
G-3	J24	E10-2662-05	Pin connector 26P
		J25-2945-12	Printed circuit board

PARTS LIST

SWEEP UNIT (X74-1280-00)

Fig. & Index No.	Ref. No.	Parts No.	Description			
D-1	R1	RD14BB2C221J	RD	220Ω		
D-1	R2	RD14BB2C102J	RD	1kΩ		
D-1	R3	RD14BB2C470J	RD	47Ω		
D-1	R4	RD14BB2C472J	RD	4.7kΩ		
D-1	R5	RD14BB2C470J	RD	47Ω		
E-1	R6	RD14BB2C102J	RD	1kΩ		
E-1	R7	RD14BB2C470J	RD	47Ω		
E-2	R8	RD14BB2C104J	RD	100kΩ		
E-2	R9	RN14BK2E1004F	RN	1MΩ	±1%	1/4W
E-2	R10	RD14BB2C104J	RD	100kΩ		
E-2	R11	RD14BB2C103J	RD	10kΩ		
E-2	R12	RD14BB2C472J	RD	4.7kΩ		
E-2	R13	RD14BB2C181J	RD	180Ω		
E-2	R14	RD14BB2C181J	RD	180Ω		
D-2	R15	RD14BB2C472J	RD	4.7kΩ		
D-2	R16	RD14BB2C103J	RD	10kΩ		
D-1	R17	RD14BB2C104J	RD	100kΩ		
D-2	R18	RD14BB2C474J	RD	470kΩ		
D-2	R19	RD14BB2C474J	RD	470kΩ		
D-2	R20	RD14BB2C154J	RD	150kΩ		
D-2	R21	RD14BB2C154J	RD	150kΩ		
D-2	R22	RD14BB2C103J	RD	10kΩ		
D-2	R23	RD14BB2C103J	RD	10kΩ		
E-2	R24	RD14BB2C103J	RD	10kΩ		
E-2	R25	RD14BB2C470J	RD	47Ω		
D-2	R26	RD14BB2C470J	RD	47Ω		
D-2	R27	RD14BB2C332J	RD	3.3kΩ		
E-2	R28	RD14BB2C332J	RD	3.3kΩ		
E-2	R29	RD14BB2C470J	RD	47Ω		
D-2	R30	RD14BB2C470J	RD	47Ω		
E-2	R31	RD14BB2C471J	RD	470Ω		
E-3	R32	RD14BB2C101J	RD	100Ω		
E-2	R33	RD14BB2C101J	RD	100Ω		
E-3	R34	RD14BB2C562J	RD	5.6kΩ		
E-3	R35	RD14BB2C472J	RD	4.7kΩ		
E-3	R36	RD14BB2C681J	RD	680Ω		
D-3	R37	RD14BB2C101J	RD	100Ω		
D-3	R38	RD14BB2C101J	RD	100Ω		
D-3	R39	RD14BB2C472J	RD	4.7kΩ		
D-3	R40	RD14BB2C101J	RD	100Ω		
D-3	R41	RD14BB2C101J	RD	100Ω		
D-3	R42	RD14BB2C472J	RD	4.7kΩ		
D-3	R43	RD14BB2C102J	RD	1kΩ		
E-3	R44	RD14BB2C102J	RD	1kΩ		
E-3	R45	RD14BB2C470J	RD	47Ω		
E-3	R46	RD14BB2C222J	RD	2.2kΩ		
D-3	R47	RD14BB2C222J	RD	2.2kΩ		
D-3	R48	RD14BB2C470J	RD	47Ω		
D-2	R49	RD14BB2C331J	RD	330Ω		
D-2	R50	RD14BB2C472J	RD	4.7kΩ		
D-2	R51	RD14BB2C331J	RD	330Ω		
D-2	R52	RD14BB2C472J	RD	4.7kΩ		
D-3	R53	RD14BB2C101J	RD	100Ω		
D-3	R54	RD14BB2C473J	RD	47kΩ		
D-3	R55	RD14BB2C822J	RD	8.2kΩ		
D-3	R56	RD14BB2C183J	RD	18kΩ		
D-3	R57	RD14BB2C103J	RD	10kΩ		
D-3	R58	RD14BB2C103J	RD	10kΩ		
D-3	R59	RD14BB2C102J	RD	1kΩ		
D-2	R60	RD14BB2C474J	RD	470kΩ		
D-1	R61	RD14BB2C331J	RD	330Ω		
D-1	R62	RD14BB2C103J	RD	10kΩ		
C-1	R63	RD14BB2C103J	RD	10kΩ		
C-1	R64	RD14BB2C103J	RD	10kΩ		
C-1	R65	RD14BB2C101J	RD	100Ω		
C-1	R66	RD14BB2C473J	RD	47kΩ		
C-1	R67	RD14BB2C472J	RD	4.7kΩ		
C-2	R68	RD14BB2C472J	RD	4.7kΩ		
B-2	R69	RD14BB2C102J	RD	1kΩ		
B-2	R70	RD14BB2C102J	RD	1kΩ		
B-2	R71	RD14BB2C102J	RD	1kΩ		
B-2	R72	RD14BB2C102J	RD	1kΩ		
C-1	R73	RD14BB2C221J	RD	220Ω		
B-2	R74	RD14BB2C331J	RD	330Ω		
B-3	R75	RD14BB2C682J	RD	6.8kΩ		
B-2	R76	RD14BB2C183J	RD	18kΩ		
B-2	R77	RD14BB2C563J	RD	56kΩ		
B-3	R78	RD14BB2C103J	RD	10kΩ		
B-3	R79	RD14BB2C103J	RD	10kΩ		
B-3	R80	RD14BB2C103J	RD	10kΩ		
B-3	R81	RD14BB2C103J	RD	10kΩ		
B-3	R82	RD14BB2C103J	RD	10kΩ		
B-3	R83	RD14BB2C103J	RD	10kΩ		
B-3	R84	RD14BB2C103J	RD	10kΩ		
B-3	R85	RD14BB2C103J	RD	10kΩ		
B-3	R86	RD14BB2C103J	RD	10kΩ		
B-3	R87	RD14BB2C103J	RD	10kΩ		
B-3	R88	RD14BB2C103J	RD	10kΩ		
B-3	R89	RD14BB2C103J	RD	10kΩ		
B-2	R90	RN14BK2B5602F	RN	56kΩ	±1%	1/8W
B-2	R91	RD14BB2C273J	RD	27kΩ		
A-2	R92	RN14BK2E1004F	RN	1MΩ	±1%	1/4W
A-2	R93	RN14BK2B2003F	RN	200kΩ	±1%	1/8W
A-2	R94	RN14BK2B2003F	RN	200kΩ	±1%	1/8W
A-2	R95	RN14BK2B2003F	RN	200kΩ	±1%	1/8W
A-3	R96	RN14BK2B1003F	RN	100kΩ	±1%	1/8W
A-3	R97	RN14BK2B2002F	RN	20kΩ	±1%	1/8W
A-3	R98	RN14BK2B2002F	RN	20kΩ	±1%	1/8W
A-3	R99	RN14BK2B2002F	RN	20kΩ	±1%	1/8W
A-3	R100	RN14BK2B1002F	RN	10kΩ	±1%	1/8W
A-3	R101	RN14BK2B3901F	RN	3.9kΩ	±1%	1/8W
A-2	R102	RD14BB2C473J	RD	47kΩ		
A-2	R103	RD14BB2C473J	RD	47kΩ		
A-2	R104	RD14BB2C473J	RD	47kΩ		
A-2	R105	RD14BB2C473J	RD	47kΩ		
A-3	R106	RD14BB2C473J	RD	47kΩ		
A-2	R107	RD14BB2C473J	RD	47kΩ		
A-3	R108	RD14BB2C473J	RD	47kΩ		
A-3	R109	RD14BB2C473J	RD	47kΩ		
A-3	R110	RD14BB2C473J	RD	47kΩ		
A-3	R111	RD14BB2C473J	RD	47kΩ		
A-3	R112	RD14BB2C473J	RD	47kΩ		
A-3	R113	RD14BB2C473J	RD	47kΩ		
A-3	R114	RD14BB2C473J	RD	47kΩ		
A-3	R115	RD14BB2C473J	RD	47kΩ		
A-3	R116	RD14BB2C473J	RD	47kΩ		
A-3	R117	RD14BB2C473J	RD	47kΩ		
A-2	R118	RD14BB2C472J	RD	4.7kΩ		
A-2	R119	RD14BB2C472J	RD	4.7kΩ		
B-2	R120	RD14BB2C101J	RD	100Ω		
B-2	R121	RD14BB2C273J	RD	27kΩ		
B-2	R122	RD14BB2C470J	RD	47Ω		
B-2	R123	RD14BB2C103J	RD	10kΩ		
B-2	R124	RD14BB2C222J	RD	2.2kΩ		
B-3	R125	RD14BB2C103J	RD	10kΩ		
B-2	R126	RD14BB2C103J	RD	10kΩ		
B-2	R127	RD14BB2C222J	RD	2.2kΩ		
B-2	R128	RD14BB2C472J	RD	4.7kΩ		
B-1	R129	RD14BB2C101J	RD	100Ω		
C-1	R130	RD14BB2C101J	RD	100Ω		
B-2	R131	RD14BB2C332J	RD	3.3kΩ		
B-2	R132	RD14BB2C681J	RD	680Ω		
A-2	R133	RD14BB2C682J	RD	6.8kΩ		
	R134	No use				
B-2	R135	RD14BB2C122J	RD	1.2kΩ		
A-1	R136	RD14BB2C682J	RD	6.8kΩ		
A-2	R137	RD14BB2C682J	RD	6.8kΩ		
B-1	R138	RD14BB2C222J	RD	2.2kΩ		
B-1	R139	RD14BB2C470J	RD	47Ω		
B-1	R140	RD14BB2C392J	RD	3.9kΩ		
B-1	R141	RD14BB2C470J	RD	47Ω		
B-2	R142	RD14BB2C102J	RD	1kΩ		
B-2	R143	RD14BB2C102J	RD	1kΩ		
A-1	R144	RD14BB2C103J	RD	10kΩ		
A-1	R145	RD14BB2C103J	RD	10kΩ		
A-2	R146	RD14BB2C103J	RD	10kΩ		
A-2	R147	RD14BB2C103J	RD	10kΩ		
C-2	R148	RD14BB2C152J	RD	1.5kΩ		
C-2	R149	RD14BB2C152J	RD	1.5kΩ		
C-2	R150	RD14BB2C103J	RD	10kΩ		
C-2	R151	RD14BB2C912J	RD	9.1kΩ		
C-1	R152	RD14BB2C331J	RD	330Ω		
C-2	R153	RD14BB2C560J	RD	56Ω		
C-1	R154	RD14BB2C471J	RD	470Ω		
A-1	R155	RN14BK2B3900F	RN	390Ω	±1%	1/8W
A-1	R156	RN14BK2B1002F	RN	10kΩ	±1%	1/8W
A-2	R157	RD14BB2C104J	RD	100kΩ		
A-2	R158	RD14BB2C103J	RD	10kΩ		
A-2	R159	RD14BB2C393J	RD	39kΩ		
A-2	R160	RN14BK2B7502F	RN	75kΩ	±1%	1/8W

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Description			
A-2	R161	RN14BK2B7502F	RN	75kΩ	±1%	1/8W
A-2	R162	RD14BB2C393J	RD	39kΩ		
A-2	R163	RD14BB2C103J	RD	10kΩ		
D-3	R164	RD14BB2C472J	RD	4.7kΩ		
C-2	R165	RD14BB2C331J	RD	330Ω		
A-2	R166	RD14BB2C332J	RD	3.3kΩ		
A-2	R167	RD14BB2C332J	RD	3.3kΩ		
D-1	VR1	R12-3052-05	VR	47kΩB		
E-3	VR2	R12-0502-05	VR	100ΩB		
E-2	VR3	R12-1029-05	VR	1kΩB		
B-2	VR4	R12-1033-05	VR	2.2kΩB		
B-3	VR5	R12-3041-05	VR	10kΩB		
B-2	VR6	R12-0060-05	VR	330ΩB		
A-1	VR7	R12-1029-05	VR	1kΩB		
A-2	VR8	R12-3507-05	VR	15kΩB		
D-1	C1	CE04W1A470M	CE	47μF		10V
D-1	C2	CE04W1C470M	CE	47μF		16V
E-1	C3	CE04BW1H010M	CE	1μF		50V
E-1	C4	CQ93M1H473K	CQ	0.047μF	±10%	
E-2	C5	CC45CH1H470J	CC	47pF	±5%	
E-2	C6	CK45B1H102K	CK	1000pF	±10%	
D-2	C7	C-90-0298-05	Semiconductor ceramic			
				0.1μF		12V
D-2	C8	CK45B1H103K	CK	0.01μF	±10%	
D-2	C9	CK45B1H103K	CK	0.01μF	±10%	
D-2	C10	CE04BW1H010M	CE	1μF		50V
D-2	C11	CE04BW1H010M	CE	1μF		50V
D-2	C12	CE04BW1H010M	CE	1μF		50V
D-2	C13	CK45B1H103K	CK	0.01μF	±10%	
E-3	C14	CC45CH1H220J	CC	22pF	±5%	
E-3	C15	CK45B1H103K	CK	0.01μF	±10%	
D-3	C16	CK45B1H103K	CK	0.01μF	±10%	
D-3	C17	CE04W1C470M	CE	47μF		16V
D-3	C18	CQ93M1H222K	CQ	2200pF	±10%	
D-3	C19	CE04BW1H010M	CE	1μF		50V
D-2	C20	CQ93M1H223K	CQ	0.022μF	±10%	
C-3	C21	CQ93M1H223K	CQ	0.022μF	±10%	
D-1	C22	CE04BW1H010M	CE	1μF		50V
C-1	C23	CE04BW1H010M	CE	1μF		50V
C-3	C24	CE04W1C100M	CE	10μF		16V
C-3	C25	CE04BW1H010M	CE	1μF		50V
C-3	C26	C90-0298-05	Semiconductor ceramic			
				0.1μF		12V
C-3	C27	CK45B1H103K	CK	0.01μF	±10%	
C-3	C28	CK45B1H102K	CK	1000pF	±10%	
C-3	C29	CC45CH1H680J	CC	68pF	±5%	
B-1	C30	C91-0547-05	Polyesterene	10μF	±1%	100V
B-2	C31	CQ93BP2A104F	CQ (polypropylen)	0.1μF	±1%	100V
B-2	C32	CQ93M1H222K	CQ	2200pF	±10%	
B-2	C33	CQ93M1H473K	CQ	0.047μF	±10%	
B-2	C34	CQ93BP2A102F	CQ (polypropylen)	1000pF	±1%	100V
B-2	C35	CE04W1A101M	CE	100μF		10V
A-2	C36	CK45B1H103K	CK	0.01μF	±10%	
B-2	C37	CE04BW1H010M	CE	1μF		50V
B-1	C38	CE04W1C101M	CE	100μF		16V
B-1	C39	CE04BW1H010M	CE	1μF		50V
C-2	C40	CQ93M1H152K	CQ	1500pF	±10%	
C-1	C41	CQ93M1H152K	CQ	1500pF	±10%	
C-2	C42	CC45SL1H471J	CC	470pF	±5%	
C-1	C43	CC45SL1H221J	CC	220pF	±5%	
A-2	C44	CQ93BP2A103F	CQ (polypropylen)	0.01μF	±1%	100V
A-2	C45	CQ93BP2A103F	CQ (polypropylen)	0.01μF	±1%	100V
E-3	C46	CE04W1C470M	CE	47μF		16V
E-3	C47	CE04W1C470M	CE	47μF		16V
C-1	C48	CE04W1A470M	CE	47μF		10V2
B-2	C49	CE04W1H100M	CE	10μF		50V
C-3	C50	CK45B1H103K	CK	0.01μF	±10%	
C-3	C51	CK45B1H103K	CK	0.01μF	±10%	
C-2	C52	CK45B1H103K	CK	0.01μF	±10%	
C-2	C53	CK45B1H103K	CK	0.01μF	±10%	
C-2	C54	CK45B1H103K	CK	0.01μF	±10%	
D-3	C55	CK45B1H103K	CK	0.01μF	±10%	
D-2	C56	CK45B1H103K	CK	0.01μF	±10%	
D-2	C57	CK45B1H103K	CK	0.01μF	±10%	
D-2	C58	CK45B1H103K	CK	0.01μF	±10%	
D-1	C59	CK45B1H103K	CK	0.01μF	±10%	
A-1	C60	CE04W1C470M	CE	47μF		16V
C-2	C61	CK45B1H103K	CK	0.01μF	±10%	

Fig. & Index No.	Ref. No.	Parts No.	Description			
C-2	C62	CK45B1H103K	CK	0.01μF	±10%	
C-1	C63	CE04W1C470M	CE	47μF		16V
C-3	C64	CC45SL1H101J	CC	100pF	±5%	
B-2	C65	CC45CH1H180J	CC	18pF	±5%	
B-3	C66	CK45B1H103K	CK	0.01μF	±10%	
C-2	C67	CC45CH1H050C	CC	5pF	±0.5pF	
B-2	C68	CK45B1H103K	CK	0.01μF	±10%	
C-1	C69	CC45SL1H101J	CC	100pF	±5%	
A-2	C70	CE04W1C220M	CE	22μF		16V
D-1	L1	L40-4701-03	Ferri inductor	47μH		
D-1	L2	L40-4701-03	Ferri inductor	47μH		
A-1	L3	L40-4701-03	Ferri inductor	100μH		
E-3	L4	L40-4701-03	Ferri inductor	47μH		
B-3	L5	L40-4701-03	Ferri inductor	47μH		
C-1	L6	L40-4701-03	Ferri inductor	47μH		
E-1	RL1	S51-1020-05	Relay			
E-1	RL2	S51-1020-05	Relay			
E-2	RL3	S51-1020-05	Relay			
E-2	RL4	S51-2408-05	Relay			
E-2	RL5	S51-1020-05	Relay			
D-1	Q1		TR	2SA838 (C)		
D-1	Q2		TR	2SC1047 (C)		
E-2	Q3		TR	2SK107 (2,3)		
E-2	Q4		TR	2SC1047 (C)		
E-2	Q5		TR	2SC536KNP (F)		
E-2	Q6		TR	2SA608KNP (F)		
D-2	Q7		TR	2SA608KNP (C)		
D-2	Q8		FET	2SK228T (2,3)		
E-2	Q9		TR	2SC1047 (C)		
D-2	Q10		TR	2SC1047 (C)		
E-2	Q11		TR	2SC1047 (C)		
D-2	Q12		TR	2SC1047 (C)		
E-3	Q13		TR	2SC536KNP (F)		
E-3	Q14		TR	2SC1047 (C)		
E-3	Q15		TR	2SC1047 (C)		
D-3	Q16		TR	2SC1047 (C)		
D-3	Q17		TR	2SC1047 (C)		
E-3	Q18		TR	2SC1047 (C)		
D-3	Q19		TR	2SC1047 (C)		
D-3	Q20		TR	2SC536KNP (F)		
D-3	Q21		TR	2SA608KNP (F)		
D-3	Q22		TR	2SC536KNP (F)		
C-1	Q23		TR	2SA608KNP (F)		
C-1	Q24		TR	2SC536KNP (F)		
B-2	Q25		TR	2SC1973 (T)		
B-3	Q26		TR	2SA608KNP (F)		
B-3	Q27		TR	2SC536KNP (F)		
B-3	Q28		TR	2SA608KNP (F)		
B-2	Q29		TR	2SC536KNP (F)		
B-3	Q30		TR	2SA608KNP (F)		
B-2	Q31		TR	2SC536KNP (F)		
B-3	Q32		TR	2SA608KNP (F)		
B-2	Q33		TR	2SC536KNP (F)		
B-2	Q34		FET	2SK30A (O)		
B-2	Q35		TR	2SA608KNP (F)		
A-2	Q36		TR	2SA608KNP (F)		
A-2	Q37		TR	2SA608KNP (F)		
A-2	Q38		TR	2SA608KNP (F)		
A-3	Q39		TR	2SA608KNP (F)		
A-3	Q40		TR	2SA608KNP (F)		
A-3	Q41		TR	2SA608KNP (F)		
A-3	Q42		TR	2SA608KNP (F)		
A-3	Q43		TR	2SA608KNP (F)		
A-2	Q44		TR	2SC536KNP (F)		
A-2	Q45		TR	2SC536KNP (F)		
A-2	Q46		TR	2SC536KNP (F)		
A-3	Q47		TR	2SC536KNP (F)		
A-3	Q48		TR	2SC536KNP (F)		
A-3	Q49		TR	2SC536KNP (F)		
A-3	Q50		TR	2SC536KNP (F)		
A-3	Q51		TR	2SC536KNP (F)		
B-2	Q52		FET	2SK30A (O)		
B-2	Q53		TR	2SC1973 (T)		
B-2	Q54		TR	2SC536KNP (F)		
B-1	Q55		TR	2SC1973 (T)		
B-2	Q56		TR	2SC1047 (C)		
B-2	Q57		TR	2SC1047 (C)		

PARTS LIST

HORIZONTAL OUTPUT AMP UNIT (X74-1290-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
B-1	Q58		TR 2SC1047 (C)
B-2	Q59		TR 2SA608KNP (F)
A-2	Q60		TR 2SA608KNP (F)
A-2	Q61		TR 2SA608KNP (F)
C-2	Q62		TR 2SC1973 (T)
A-2	Q63		TR 2SA608KNP (F)
A-2	Q64		TR 2SA608KNP (F)
A-2	Q65		TR 2SA608KNP (F)
D-2	1C1		IC SN74LS00N
D-2	1C2		IC SN74LS00N
D-2	1C3		IC SN74LS132N
D-1	1C4		IC SN74LS86N
D-3	1C5		IC NJM555D
C-2	1C6		IC SN74LS00N
C-2	1C7		IC SN74LS112AN
C-3	1C8		IC SN74LS00N
C-2	1C9		IC SN74LS00N
C-3	1C10		IC SN7407N
E-1	D1		Diode DS442X
E-1	D2		Diode DS442X
E-3	D3		Diode DS442X
E-3	D4		Diode DS442X
E-1	D5		Diode DS442X
E-2	D6		Diode 1S1544A
E-2	D7		Diode 1S1544A
D-2	D8		Diode DS442X
D-3	D9		Diode DS442X
D-3	D10		Diode WZ-061
E-3	D11		Diode WZ-061
D-3	D12		Diode DS442X
D-2	D13		Diode 1N60
C-2	D14		Diode DS442X
C-2	D15		Diode 1N60
B-2	D16		Diode DS442X
B-3	D17		Diode DS442X
B-3	D18		Diode DS442X
B-3	D19		Diode DS442X
B-3	D20		Diode DS442X
B-3	D21		Diode DS442X
B-3	D22		Diode DS442X
B-3	D23		Diode DS442X
B-3	D24		Diode DS442X
B-2	D25		Diode DS442X
A-1	D26		Diode DS442X
A-2	D27		Diode DS442X
B-1	D28		Diode DS442X
B-2	D29		Diode DS442X
A-2	D30		Diode 1N60
A-2	D31		Diode DS442X
A-2	D32		Diode DS442X
B-2	D33		Diode DS442X
E-1	P11	E40-0276-05	Pin connector 2P
A-1	P12	E40-0276-05	Pin connector 2P
E-3	P39	E40-1516-05	Pin connector 15P
C-3	P40	E40-1516-05	Pin connector 15P
B-3	P41	E40-1516-05	Pin connector 15P
A-1	P48	E40-0276-05	Pin connector 2P
C-1	P49	E40-0276-05	Pin connector 2P
B-1	P50	E40-0276-05	Pin connector 2P
C-1	P51	E40-0276-05	Pin connector 2P
B-1	P52	E40-0376-05	Pin connector 3P
		J25-2950-12	Printed circuit board

Fig. & Index No.	Ref. No.	Parts No.	Description
D-3	R1	RD14BB2C103J	RD 10kΩ
D-3	R2	RD14BB2C103J	RD 10kΩ
D-2	R3	RD14BB2C103J	RD 10kΩ
D-3	R4	RD14BB2C912J	RD 9.1kΩ
D-3	R5	RD14BB2C472J	RD 4.7kΩ
D-3	R6	RD14BB2C103J	RD 10kΩ
D-3	R7	RD14BB2C221J	RD 220Ω
D-2	R8	RD14BB2C912J	RD 9.1kΩ
D-3	R9	RD14BB2C221J	RD 220Ω
D-3	R10	RD14BB2C472J	RD 4.7kΩ
D-2	R11	RD14BB2C101J	RD 100Ω
C-2	R12	RD14BB2C470J	RD 47Ω
C-3	R13	RD14BB2C271J	RD 270Ω
C-3	R14	RD14BB2C271J	RD 270Ω
C-2	R15	RD14BB2C221J	RD 220Ω
C-3	R16	RD14BB2C221J	RD 220Ω
C-4	R17	RD14BB2C222J	RD 2.2kΩ
C-4	R18	RD14BB2C332J	RD 3.3kΩ
C-3	R19	RN14BK2E7500F	RN 750Ω ±1% 1/4W
C-2	R20	RN14BK2E7500F	RN 750Ω ±1% 1/4W
C-2	R21	RD14BB2C473J	RD 47kΩ
C-2	R22	RD14BB2B472J	RD 4.7kΩ
C-2	R23	RD14BB2C470J	RD 47Ω
C-3	R24	RD14BB2C470J	RD 47Ω
C-3	R25	RD14BB2C472J	RD 4.7kΩ
C-3	R26	RD14BB2C473J	RD 47kΩ
B-2	R27	RD14BB2C332J	RD 3.3kΩ
B-3	R28	RD14BB2C332J	RD 3.3kΩ
B-2	R29	RD14BB2C272J	RD 2.7kΩ
B-3	R30	RD14BB2C272J	RD 2.7kΩ
B-2	R31	RD14BB2C332J	RD 3.3kΩ
B-3	R32	RD14BB2C124J	RD 120kΩ
B-2	R33	RD14BB2C332J	RD 3.3kΩ
B-3	R34	RD14BB2C124J	RD 120kΩ
A-2	R35	RD14BB2C331J	RD 330Ω
A-3	R36	RD14BB2C331J	RD 330Ω
D-2	VR1	R12-0514-05	VR 150ΩB
C-2	VR2	R12-0501-05	VR 100ΩB
E-3	C1	CE04W1C470M	CE 47μF 16V
E-3	C2	CE04W1C470M	CE 47μF 16V
E-3	C3	CE04W1C470M	CE 47μF 16V
E-2	C4	CE04W1E470M	CE 47μF 25V
E-3	C5	CE04W2C3R3M	CE 3.3μF 160V
C-2	C6	CC45CH2H010C	CC 1pF ±0.25pF 500V
C-2	C7	CC45CH1H330J	CC 33pF ±5%
C-3	C8	CC45CH1H470J	CC 47pF +5%
C-3	C9	CC45CH2H010C	CC 1pF ±0.25pF 500V
B-3	C10	CK45B1H103K	CK 0.01μF ±10%
B-3	C11	CK45B2H472K	CK 4700pF ±10% 500V
B-2	C12	CK45B2H472K	CK 4700pF ±10% 500V
A-2	C13	CK45B1H103K	CK 0.01μF ±10%
A-3	C14	CK45B2H472K	CK 4700pF ±10% 500V
A-3	C15	CK45B1H103K	CK 0.01μF ±10%
C-4	C16	CK45B1H103K	CK 0.01μF ±10%
C-2	TC1	C05-0412-05	TC 20pF
D-2	L1	L04-2211-03	Ferri inductor 220μH
E-2	L2	L04-2211-03	Ferri inductor 220μH
E-2	L3	L04-2211-03	Ferri inductor 220μH
D-2	L4	L04-2211-03	Ferri inductor 220μH
D-3	Q1		TR 2SA608KNP(F)
D-3	Q2		TR 2SC536KNP(F)
D-2	Q3		TR 2SA608KNP(F)
D-2	Q4		TR 2SC6536NP(F)
C-2	Q5		TR 2SC1973(T)
C-3	Q6		TR 2SC1973(T)
B-2	Q7		TR 2SC1973(T)
B-3	Q8		TR 2SC1973(T)
B-2	Q9		TR 2SC805A-2(3)
B-3	Q10		TR 2SC805A-2(3)
B-2	Q11		TR 2SA923-2(2,3)
B-3	Q12		TR 2SA923-2(2,3)
D-2	D1		Diode DS442X
D-2	D2		Diode DS442X
D-2	D3		Diode DS442X

PARTS LIST

HORIZONTAL SWITCH UNIT (X74-1260-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
C-3	D4		Diode DS442X
C-3	D5		Diode DS442X
C-3	D6		Diode DS442X
C-3	D7		Diode WZ-071
C-3	D8		Diode DS442X
C-2	D9		Diode DS442X
C-2	D10		Diode DS442X
C-3	D11		Diode DS442X
C-3	D12		Diode DS442X
E-2	P42	E40-0776-05	Pin connector 7P
E-2	P52	E40-0376-05	Pin connector 3P
A-3	P53	E23-0512-05	Terminal 1P
A-2	P54	E23-0512-05	Terminal 1P
		J30-0605-05	Spacer
		F01-0827-04	Heat sink
		J25-2949-03	Printed circuit board

Fig. & Index No.	Ref. No.	Parts No.	Description
B-1	R1	RD14BB2C153J	RD 15kΩ
B-1	R2	RD14BB2C472J	RD 4.7kΩ
B-2	R3	RD14BB2C472J	RD 4.7kΩ
B-1	R4	RD14BB2C623J	RD 62kΩ
B-1	R5	RD14BB2C273J	RD 27kΩ
B-1	R6	RD14BB2C223J	RD 22kΩ
B-1	R7	RD14BB2C273J	RD 27kΩ
B-1	R8	RD14BB2C223J	RD 22kΩ
B-2	R9	RD14BB2C273J	RD 27kΩ
B-2	R10	RD14BB2C223J	RD 22kΩ
B-2	R11	RD14BB2C273J	RD 27kΩ
C-1	R12	RD14BB2C103J	RD 10kΩ
C-1	R13	RD14BB2C103J	RD 10kΩ
C-2	R14	RD14BB2C103J	RD 10kΩ
B-2	R15	RD14BB2C103J	RD 10kΩ
C-1	R16	RD14BB2C103J	RD 10kΩ
C-1	R17	RD14BB2C103J	RD 10kΩ
C-1	R18	RD14BB2C103J	RD 10kΩ
C-1	R19	RD14BB2C103J	RD 10kΩ
C-1	R20	RD14BB2C103J	RD 10kΩ
C-1	R21	RD14BB2C103J	RD 10kΩ
C-1	R22	RD14BB2C103J	RD 10kΩ
C-1	R23	RD14BB2C103J	RD 10kΩ
C-2	R24	RD14BB2C103J	RD 10kΩ
C-2	R25	RD14BB2C103J	RD 10kΩ
C-2	R26	RD14BB2C103J	RD 10kΩ
C-2	R27	RD14BB2C103J	RD 10kΩ
C-2	R28	RD14BB2C103J	RD 10kΩ
C-2	R29	RD14BB2C103J	RD 10kΩ
C-2	R30	RD14BB2C103J	RD 10kΩ
C-2	R31	RD14BB2C103J	RD 10kΩ
B-2	VR1	R12-4505-05	VR 50kΩB
B-1	VR2	R12-4505-05	VR 50kΩB
B-1	VR3	R12-4505-05	VR 50kΩB
B-1	VR4	R12-3041-05	VR 10kΩB
A-1	C1	CE04W1A470M	CE 47μF 10V
A-1	C2	CK45B1H103K	CK 0.01μF ±10%
C-1	C3	CK45B1H103K	CK 0.01μF ±10%
B-1	Q1		TR 2SC536KNP(F)
B-1	Q2		TR 2SC536KNP(F)
B-2	Q3		TR 2SC536KNP(F)
B-2	Q4		TR 2SC536KNP(F)
C-1	Q5		TR 2SC536KNP(F)
C-1	Q6		TR 2SC536KNP(F)
B-1	D1		Diode DS442X
B-1	D2		Diode DS442X
B-1	D3		Diode DS442X
B-1	D4		Diode DS442X
C-2	D5		Diode DS442X
A-1	IC1		IC SN74LS42N
C-1	IC2		IC SN74LS148N
C-2	IC3		IC SN74LS148N
C-2	S1	S37-2005-05	Lever switch
B-2	S2	S01-2508-05	Rotary switch
A-1	P38	E40-1716-05	Pin connector 17P
		J25-2946-05	Printed circuit board

PARTS LIST

HORIZONTAL LOGIC UNIT (X74-1270-00)

Fig. & Index No.	Ref. No.	Parts No.	Description		
A-1	R1	RD14BB2C103J	RD	10kΩ	
B-1	R2	RD14BB2C103J	RD	10kΩ	
B-1	R3	RD14BB2C103J	RD	10kΩ	
B-1	R4	RD14BB2C103J	RD	10kΩ	
B-1	R5	RD14BB2C103J	RD	10kΩ	
B-1	R6	RD14BB2C103J	RD	10kΩ	
A-1	R7	RD14BB2C103J	RD	10kΩ	
B-1	R8	RD14BB2C103J	RD	10kΩ	
B-1	R9	RD14BB2C103J	RD	10kΩ	
B-1	R10	RD14BB2C103J	RD	10kΩ	
B-1	R11	RD14BB2C103J	RD	10kΩ	
B-1	R12	RD14BB2C103J	RD	10kΩ	
C-2	R13	RD14BB2C103J	RD	10kΩ	
D-2	R14	RD14BB2C103J	RD	10kΩ	
E-2	R15	RD14BB2C103J	RD	10kΩ	
E-2	R16	RD14BB2C223J	RD	22kΩ	
E-2	R17	RD14BB2C103J	RD	10kΩ	
F-2	R18	RD14BB2C102J	RD	1kΩ	
F-2	R19	RD14BB2C183J	RD	18kΩ	
F-2	R20	RD14BB2C472J	RD	4.7kΩ	
F-2	R21	RN14BK2E2702F	RN	27kΩ ±1%	1/4W
F-2	R22	RN14BK2E1102F	RN	11kΩ ±1%	1/4W
F-2	R23	RD14BB2C103J	RD	10kΩ	
F-2	R24	RD14BB2C102J	RD	1kΩ	
F-2	R25	RD14BB2C221J	RD	220Ω	
F-2	C1	CE04W1C101M	CE	100μF	16V
F-2	C2	CE04W1C101M	CE	100μF	16V
B-2	C3	CE04W1C101M	CE	100μF	16V
B-1	C4	CK45B1H103K	CK	0.01μF ±10%	
B-2	C5	CK45B1H103K	CK	0.01μF ±10%	
C-1	C6	CK45B1H103K	CK	0.01μF ±10%	
D-1	C7	CK45B1H103K	CK	0.01μF ±10%	
D-2	C8	CK45B1H103K	CK	0.01μF ±10%	
E-1	C9	CK45B1H103K	CK	0.01μF ±10%	
E-2	C10	CK45B1H103K	CK	0.01μF ±10%	
F-2	C11	CE04W1C470M	CE	47μF	16V
G-2	C12	CE04W1H010M	CE	1μF	50V
F-2	L1	L40-1011-04	Ferri inductor	10μH	
F-2	Q1		TR	2SC536KNP(F)	
F-2	Q2		TR	2SC536KNP(F)	
F-2	Q3		TR	2SC536KNP(F)	
F-2	Q4		TR	2SC2910(S,T)	
C-2	D1		Diode	1N60	
C-2	D2		Diode	1N60	
C-2	D3		Diode	1N60	
C-2	D4		Diode	1N60	
E-2	D5		Diode	1N60	
E-2	D6		Diode	1N60	
G-2	D7		Diode	DS442X	
F-2	D8		Diode	DS442X	
C-1	IC1		IC	SN74LS42N	
C-2	IC2		IC	SN7407N	
C-1	IC3		IC	SN74LS42N	
C-2	IC4		IC	SN74LS00N	
D-1	IC5		IC	SN74LS00N	
D-2	IC6		IC	SN74LS10N	
D-1	IC7		IC	SN74LS86N	
D-2	IC8		IC	SN74LS00N	
E-1	IC9		IC	SN74LS112AN	
E-2	IC10		IC	SN74LS42N	
E-2	IC11		IC	SN74LS42N	
F-2	IC12		IC	ON3101	
F-2	IC13		IC	TLP521-1	
A-1	S1	S37-2005-05	Lever switch		
A-1	S2	S37-2005-05	Lever switch		
A-2	S3	S33-2501-05	Lever switch		
A-2	S4	S33-2501-05	Lever switch		
D-2	P10	E40-0476-05	Pin connector 4P		
E-2	P13	E40-0576-05	Pin connector 5P		
D-2	P27	E40-0676-05	Pin connector 6P		
D-1	P32	E10-0061-05	Pin connector 100P		
F-2	P33	E40-0276-05	Pin connector 2P		
G-1	P34	E40-0377-05	Pin connector 3P		

Fig. & Index No.	Ref. No.	Parts No.	Description
B-2	P37	E40-0376-05	Pin connector 3P
B-2	P38	E40-1711-05	Pin connector 17P
C-2	P39	E40-1511-05	Pin connector 15P
D-2	P40	E40-1511-05	Pin connector 15P
E-2	P41	E40-1511-05	Pin connector 15P
F-1	P42	E40-0776-05	Pin connector 7P
F-2	P43	E40-0876-05	Pin connector 8P
G-1	P44	E40-2686-05	Pin connector 26P
F-1	P45	E40-2085-05	Pin connector 20P
		J25-2947-12	Printed circuit board

PARTS LIST

POWER BLANKING UNIT (X68-1350-00)

Fig. & Index No.	Ref. No.	Parts No.	Description			
B-5	R1	RN14BK2B5102F	RN	51kF	±1%	1/8W
B-5	R2	RN14BK2B5101F	RN	5.1kΩ	±1%	1/8W
A-4	R3	RD14BB2C102J	RD	1kΩ		
B-4	R4	RD14BB2C562J	RD	5.6kΩ		
B-4	R5	RD14BB2C101J	RD	100Ω		
B-4	R6	RD14BB2C102J	RD	1kΩ		
C-4	R7	RN14BK2B1303F	RN	130kΩ	±1%	1/8W
B-4	R8	RN14BK2B5601F	RN	5.6kΩ	±1%	1/8W
B-4	R9	RD14BB2C221J	RD	220Ω		
C-3	R10	RD14BB2C392J	RD	3.9kΩ		
C-4	R11	RN14BK2B5101F	RN	5.1kΩ	±1%	1/8W
C-4	R12	RN14BK2B5101F	RN	5.1kΩ	±1%	1/8W
B-3	R13	RD14BB2C331J	RD	330Ω		
C-3	R14	RD14BB2C392J	RD	3.9kΩ		
C-3	R15	RN14BK2B1301F	RN	1.3kΩ	±1%	1/8W
C-3	R16	RN14BK2B3901F	RN	3.9kΩ	±1%	1/8W
B-4	R17	RD14BB2C561J	RD	560Ω		
C-4	R18	RD14BB2C222J	RD	2.2kΩ		
A-5	R19	RD14BB2E100J	RD	10Ω	±5%	1/4W
B-5	R20	RN14BK2B1302F	RN	13kΩ	±1%	1/8W
B-5	R21	RN14BK2B8201F	RN	8.2kΩ	±1%	1/8W
F-5	R22	RD14BB2C221J	RD	220Ω		
B-2	R23	RD14BB2E101J	RD	100Ω	±5%	1/4W
E-3	R24	RD14BB2C332J	RD	3.3kΩ		
E-3	R25	RD14BB2C561J	RD	560Ω		
E-3	R26	RD14BB2C124J	RD	120kΩ		
E-3	R27	RD14BB2C124J	RD	120kΩ		
E-3	R28	RD14BB2C470J	RD	47Ω		
E-4	R29	RD14BB2C221J	RD	220Ω		
E-4	R30	RD14BB2C823J	RD	82kΩ		
E-4	R31	RD14BB2C562J	RD	5.6kΩ		
D-3	R32	RD14BB2C124J	RD	120kΩ		
D-3	R33	RD14BB2C562J	RD	5.6kΩ		
D-3	R34	RD14BB2C561J	RD	560Ω		
D-4	R35	RD14BB2C103J	RD	10kΩ		
E-3	R36	RD14BB2C753J	RD	75kΩ		
D-4	R37	RD14BB2C122J	RD	1.2kΩ		
E-3	R38	RD14BB2C470J	RD	47Ω		
C-3	R39	RD14BB2C683J	RD	68kΩ		
C-3	R40	RD14BB2C683J	RD	68kΩ		
C-2	R41	RD14BB2C102J	RD	1kΩ		
C-3	R42	RD14BB2C102J	RD	1kΩ		
C-3	R43	RD14BB2C103J	RD	10kΩ		
C-3	R44	RD14BB2C102J	RD	1kΩ		
E-1	R45	R92-0755-05	Metal graze	3MΩ	±5%	1/2W
D-1	R46	R92-0756-05	Metal graze	47MΩ	±5%	1/2W
C-2	R47	RD14BB2C683J	RD	68kΩ		
C-2	R48	R92-0793-05	Metal graze	15MΩ	±5%	1//2W
F-1	R49	RC05GF2H565J	RC	5.6MΩ	±5%	1/2W
F-2	R50	RC05GF2H156J	RC	15MΩ	±5%	1/2W
B-1	R51	RD14BB2C103J	RD	10kΩ		
B-1	R52	RD14BB2C103J	RD	10kΩ		
B-1	R53	RD14BB2C102J	RD	1kΩ		
B-1	R54	RD14BB2C472J	RD	4.7kΩ		
A-4	R55	RD14BB2C331J	RD	330Ω		
D-4	R56	RD14BB2C332J	RD	3.3kΩ		
D-4	R57	RD14BB2C332J	RD	3.3kΩ		
D-4	R58	RD14BB2C682J	RD	6.8kΩ		
E-4	R59	RD14BB2C221J	RD	220Ω		
E-4	R60	RD14BB2C472J	RD	4.7kΩ		
E-4	R61	RD14BB2E101J	RD	100Ω	±5%	1/4W
E-4	R62	RD14BB2C332J	RD	3.3kΩ		
E-4	R63	RD14BB2C152J	RD	1.5kΩ		
F-5	R64	RD14BB2C102J	RD	1kΩ		
F-5	R65	RD14BB2C562J	RD	5.6kΩ		
E-5	R66	RD14BB2C510J	RD	51Ω		
E-5	R67	RD14BB2C222J	RD	2.2kΩ		
E-5	R68	RD14BB2C471J	RD	470Ω		
A-3	R69	RD14BB2C562J	RD	5.6kΩ		
B-2	R70	RD14BB2C102J	RD	1kΩ		
D-4	VR1	R12-3507-05	VR	15kΩB		
E-4	VR2	R12-3507-05	VR	15kΩB		
C-2	VR3	R12-3042-05	VR	47kΩB		
G-1	VR4	R05-8001-05	VR	3MΩB		
A-3	VR5	R12-5501-05	VR	150kΩB		
C-5	C1	CK45B1H103K	CK	0.01μF	±10%	
B-5	C2	CE04W1V100M	CE	10μF		35V
C-5	C3	CE04W1J330M	CE	33μF		63V

Fig. & Index No.	Ref. No.	Parts No.	Description			
B-5	C4	CE04W2C3R3M	CE	3.3μF		160V
C-5	C5	CE04W2C3R3M	CE	3.3μF		160V
C-4	C6	CE04W1C330M	CE	33μF		16V
C-3	C7	C91-0549-05	Tantalum	1μF		35V
C-4	C8	CE04W1E101M	CE	100μF		25V
C-3	C9	CE04W1E101M	CE	100μF		25V
C-4	C10	CE04W1A221M	CE	220μF		10V
B-5	C11	CE04W1V100M	CE	10μF		35V
A-5	C12	CK45B1H103K	CK	0.01μF	±10%	
C-5	C13	CE04W1V470M	CE	47μF		35V
B-3	C14	CK45B1H103K	CK	0.01μF	±10%	
D-3	C15	CK45B2H472K	CK	4700pF	±10%	500V
E-3	C16	CK45B2H472K	CK	4700pF	±10%	500V
E-4	C17	CC45CH2H010C	CC	1pF	±0.25pF	500V
E-3	C18	CK45B1H103K	CK	0.01μF	±10%	
C-3	C19	CE04W2C3R3M	CE	3.3μF		160V
D-3	C20	CK45B2H472K	CK	4700pF	±10%	500V
D-3	C21	CK45B1H103K	CK	0.01μF	±10%	
E-3	C22	CC45CH2H010C	CC	1pF	±0.25pF	500V
E-2	C23	CK45E3D103P	CK	0.01μF	+100% −0%	2000V
E-2	C24	CK45E3D103P	CK	0.01μF	+100% −0%	2000V
D-2	C25	CK45E3D103P	CK	0.01μF	+100% −0%	2000V
D-2	C26	CK45E3D103P	CK	0.01μF	+100% −0%	2000V
C-2	C27	CK45B1H472K	CK	4700pF	±10%	
C-2	C28	CE04W1E470M	CE	47μF		25V
C-1	C29	CK45E3D102P	CK	1000pF	+100% −0%	2000V
F-1	C30	CK45E3D102P	CK	1000pF	+100% −0%	2000V
F-1	C31	CK45E3D103P	CK	0.01μF	+100% −0%	2000V
D-1	C32	CK45E3D103P	CK	0.01μF	+100% −0%	2000V
C-1	C33	CQ93M1H154K	CQ	0.15μF	±10%	
C-2	C34	CK45B1H472K	CK	4700pF	±10%	
C-2	C35	CE04W1E470M	CE	47μF		25V
C-1	C36	CK45B1H103K	CK	0.01μF	±10%	
B-2	C37	CK45B1H103K	CK	0.01μF	±10%	
B-1	C38	CQ93M1H472K	CQ	4700pF	±10%	
B-1	C39	CK45B1H103K	CK	0.01μF	±10%	
B-1	C40	CE04W1E470M	CE	47μF		25V
B-2	C41	CE04W1E470M	CE	47μF		25V
E-4	C42	CC45CH1H100D	CC	10pF	±0.5pF	
E-5	C43	CK45B1H472K	CK	4700pF	±10%	
F-5	C44	C91-0549-05	Tantalum	1μF		35V
E-5	C45	CC45CH1H680J	CC	68pF	±5%	
B-2	C46	CK45B2H222K	CK	2200pF	±10%	500V
D-4	C47	CE04W1E101M	CE	100μF		25V
D-4	C48	CK45B1H103K	CK	0.01μF	±10%	
D-4	C49	CE04W1A221M	CE	220μF		10V
D-4	C50	CK45B1H103K	CK	0.01μF	±10%	
D-5	TC1	C05-0405-05	TC	20pF		
E-4	TC2	C05-0405-05	TC	20pF		
E-4	TC3	C05-0403-05	TC	6pF		
C-5	L1	L40-1011-04	Ferri-inductor	100μH		
C-3	L2	L40-1001-01	Ferri-inductor	10μH		
C-5	L3	L40-1011-04	Ferri-inductor	100μH		
C-4	L4	L40-1011-04	Ferri-inductor	100μH		
C-4	L5	L40-1011-04	Ferri-inductor	100μH		
C-4	L6	L40-1011-04	Ferri-inductor	100μH		
B-2	L7	L40-1011-03	Ferri-inductor	100μH		
B-1	L8	L40-1011-04	Ferri-inductor	100μH		
B-2	L9	L40-1011-04	Ferri-inductor	100μH		
D-1	NL1		Neon lamp NE-2B			
D-1	NL2		Neon lamp NE-2B			
E-1	NL3		Neon lamp NE-2B			
E-1	NL4		Neon lamp NE-2B			
B-4	Q1		TR	2SC1913 (Q, R)		
B-4	Q2		TR	2SC1505 (L)		
C-4	Q3		TR	2SB633 (E)		
C-3	Q4		TR	2SD613 (E)		
C-4	Q5		TR	2SB633 (E)		

PARTS LIST

CPU UNIT(X81-1050-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
B-5	Q6		TR 2SC1505 (L)
B-5	Q7		TR 2SC536KNP (F)
B-3	Q8		TR 2SC536KNP (F)
B-3	Q9		TR 2SA608KNP (F)
E-3	Q10		TR 2SA1208 (S, T)
E-3	Q11		TR 2SC2910 (S, T)
D-3	Q12		TR 2SA923-2-(2, 3)
D-4	Q13		TR 2SC1215 (T, S)
E-3	Q14		TR 2SC805A-2-(2, 3)
C-2	Q15		TR 2SC2910 (S, T)
C-3	Q16		TR 2SC2910 (S, T)
B-1	Q17		TR 2SC536KNP (F)
C-1	Q18		TR 2SC536KNP (F)
B-1	Q19		TR 2SA608KNP (F)
C-1	Q20		FET 2SK19-BL
B-1	Q21		TR 2SD613 (E)
D-5	Q22		TR 2SC1047 (C)
E-4	Q23		TR 2SC1215 (T, S)
E-5	Q24		TR 2SC1215 (T, S)
E-4	IC1		IC NJM4558D
B-3	IC2		IC NJM4558D
B-4	D1		Diode DS442X
B-3	D2		Diode WZ-120
B-3	D3		Diode WZ-120
E-4	D4		Diode WZ-120
E-4	D5		Diode DS442X
D-5	D6		Diode WZ-090
D-3	D7		Diode 1SS83
E-3	D8		Diode 1SS83
D-2	D9		Diode W06C
D-1	D10		Diode W06C
F-1	D11		Diode W06C
F-1	D12		Diode W06C
B-1	D13		Diode DS442X
C-1	D14		Diode DS442X
C-1	D15		Diode WZ-090
B-1	D16		Diode DS442X
D-5	P28	E40-0776-05	Pin connector 7P
D-5	P43	E40-0876-05	Pin connector 8P
E-5	P49	E40-0276-05	Pin connector 2P
F-5	P55	E40-0376-05	Pin connector 3P
F-5	P56	E40-0276-05	Pin connector 2P
A-5	P57	E40-0746-05	Pin connector 7P
C-2	P58	E40-0276-05	Pin connector 2P
A-2	P59	E40-0276-05	Pin connector 2P
D-1	P60	E40-0332-05	Pin connector 3P
A-1	P61	E40-0703-05	Pin connector 7P
D-5	P62	E40-0276-05	Pin connector 2P
C-3	P64	E40-0376-05	Pin connector 3P
		F01-0826-05	Heat sink
		F02-0503-04	Heat sink
		F20-0516-05	Rubber sheet
		J21-2930-04	Bracket for VR
		J30-0605-05	Spacer for TR
		J25-2948-12	Printed circuit board
	S1	S59-2503-05	Power switch

Fig. & Index No.	Ref. No.	Parts No.	Description
B-1	R1	RD14BB2C272J	RD 2.7kΩ
B-1	R2	RD14BB2C681J	RD 680Ω
B-1	R3	RD14BB2C472J	RD 4.7kΩ
B-2	R4	R90-0608-05	Resistor alay 4.7kΩ×5
B-1	R5	RD14BB2C331J	RD 330Ω
B-1	R6	RD14BB2C332J	RD 3.3kΩ
B-3	R7	RD14BB2C472J	RD 4.7kΩ
B-1	R8	RD14BB2C222J	RD 2.2kΩ
B-1	R9	RD14BB2C474J	RD 470kΩ
B-1	R10	RD14BB2C682J	RD 6.8kΩ
B-1	R11	RD14BB2C102J	RD 1kΩ
B-1	R12	RD14BB2C391J	RD 390Ω
C-1	R13	RD14BB2C472J	RD 4.7kΩ
C-1	R14	RD14BB2C122J	RD 1.2kΩ
A-2	R15	R90-0609-05	Resistor alay 4.7kΩ×8
C-1	R16	RD14BB2C221J	RD 220Ω
C-1	R17	RD14BB2C472J	RD 4.7kΩ
C-1	R18	RD14BB2C472J	RD 4.7kΩ
D-1	R19	RD14BB2C472J	RD 4.7kΩ
D-2	R20	RD14BB2C472J	RD 4.7kΩ
D-2	R21	RD14BB2C563J	RD 56kΩ
C-1	R22	RD14BB2C101J	RD 100Ω
B-1	R23	RD14BB2C103J	RD 10kΩ
B-1	R24	RD14BB2C103J	RD 10kΩ
B-1	VR1	R12-1513-05	VR 2kΩB
B-1	VR2	R12-1512-05	VR 1kΩB
B-2	C1	CE04W1A470M	CE 47μF 10V
B-3	C2	CK45B1H103K	CK 0.01μF ±10%
B-3	C3	CK45B1H103K	CK 0.01μF ±10%
A-2	C4	C91-0549-05	Tantalum 1μF 35V
C-1	C5	C90-0298-05	Semi conductor ceramic 0.1μF 12V
C-1	C6	C91-0549-05	Tantalum 1μF 35V
C-2	C7	C91-0549-05	Tantalum 1μF 35V
D-2	C8	CK45B1H103K	CK 0.01μF ±10%
D-1	C9	CE04W1A470M	CE 47μF 10V
D-2	C10	CE04W1A470M	CE 47μF 10V
B-1	Q1		TR 2SC945(Q)
C-1	Q2		TR 2SC536KNP(F)
C-1	Q3		TR 2SC536KNP(F)
B-1	Q4		TR 2SC536KNP(F)
B-1	D1		Diode 1S1544A
B-1	D2		Diode 1S1544A
B-1	D3		Diode WZ-032
B-1	D4		Diode DS442X
B-1	D5		Diode DS442X
C-1	D6		Diode WZ-032
D-2	D7		Diode DS442X
B-3	IC1		IC M74LS32P
B-2	IC2		IC MB8414EM
B-3	IC3		IC M74LS138P
B-1	IC4		IC TL061CP
B-2	IC5		IC MB8414EM
C-3	IC6		IC MB8516EC
C-1	IC7		IC M74LS00P
C-3	IC8		IC M74LS373P
A-2	IC9		IC MB74LS245M
C-1	IC10		IC M74LS367AP
C-2	IC11		IC μPD8085AC
	X1	L78-0102-05	Ceramic resonator
		E02-0132-05	IC socket
		E02-0133-05	IC socket
		E02-2401-05	IC socket
A-2	P35	E10-4061-05	Pin connector 40P
A-2	P36	E40-3085-05	Pin connector 30P
		J25-2931-12	Printed circuit board

PARTS LIST

I/O UNIT (X81-1060-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
B-1	R1	RD14BB2C391J	RD 390Ω
B-2	R2	RD14BB2C391J	RD 390Ω
B-2	R3	RD14BB2C391J	RD 390Ω
B-2	R4	RD14BB2C391J	RD 390Ω
B-1	R5	RD14BB2C391J	RD 390Ω
B-1	R6	RD14BB2C391J	RD 390Ω
B-2	R7	RD14BB2C391J	RD 390Ω
B-2	R8	RD14BB2C391J	RD 390Ω
B-2	R9	RD14BB2C391J	RD 390Ω
B-2	R10	RD14BB2C391J	RD 390Ω
B-1	R11	RD14BB2C391J	RD 390Ω
B-1	R12	RD14BB2C391J	RD 390Ω
B-1	R13	RD14BB2C391J	RD 390Ω
B-1	R14	RD14BB2C391J	RD 390Ω
B-1	R15	RD14BB2C103J	RD 10kΩ
B-1	R16	RD14BB2C223J	RD 22kΩ
B-2	R17	RD14BB2C223J	RD 22kΩ
B-2	R18	RD14BB2C103J	RD 10kΩ
A-1	R19	RD14BB2C391J	RD 390Ω
A-1	R20	RD14BB2C391J	RD 390Ω
B-2	C1	CK45B1H103K	CK 0.01μF ±10%
C-2	C2	CK45B1H103K	CK 0.01μF ±10%
C-1	C3	CK45B1H103K	CK 0.01μF ±10%
C-2	C4	CK45B1H103K	CK 0.01μF ±10%
D-1	C5	CK45B1H103K	CK 0.01μF ±10%
D-2	C6	CK45B1H103K	CK 0.01μF ±10%
E-2	C7	CK45B1H103K	CK 0.01μF ±10%
E-1	C8	CK45B1H103K	CK 0.01μF ±10%
F-2	C9	CK45B1H103K	CK 0.01μF ±10%
B-1	C10	C91-0549-05	Tantalum 1μF 35V
B-2	C11	C91-0549-05	Tantalum 1μF 35V
E-1	C12	C91-0549-05	Tantalum 1μF 35V
E-1	C13	CE02W1A470M	CE 47μF 10V
E-2	C14	CE04W1A470M	CE 47μF 10V
B-1	Q1		TR 2SC536KNP (F)
B-2	Q2		TR 2SC536KNP (F)
A-1	D1		Diode TLR320
A-1	D2		Diode PG4133SX
A-1	D3		Diode GD-4-505RD
B-1	IC1		IC TC4511BP
B-2	IC2		IC TC4511BP
B-1	IC3		IC M74LS373P
B-2	IC4		IC M74LS373P
C-1	IC5		IC M74LS373P
C-2	IC6		IC M74LS373P
C-1	IC7		IC M74LS373P
C-2	IC8		IC M74LS373P
C-1	IC9		IC M74LS373P
C-2	IC10		IC M74LS373P
D-1	IC11		IC M74LS374P
D-2	IC12		IC M74LS374P
D-1	IC13		IC M74LS374P
D-2	IC14		IC M74LS374P
D-1	IC15		IC M74LS374P
D-2	IC16		IC M74LS374P
E-1	IC17		IC M74LS374P
E-2	IC18		IC M74LS374P
E-1	IC19		IC M74LS138P
E-1	IC20		IC M74LS02P
E-2	IC21		IC M74LS374P
E-1	IC22		IC M74LS138P
E-1	IC23		IC M74LS196P
E-2	IC24		IC M74LS126P
C-1	P25	E40-3486-05	Pin connector 34P
D-1	P26	E40-3486-05	Pin connector 34P
C-2	P32	E10-0061-05	Pin connector 100P
F-1	J35	E10-4062-05	Connector 40P
		J25-2933-12	Printed circuit board

PARTS LIST

CS-1720 MAIN CHASSIS

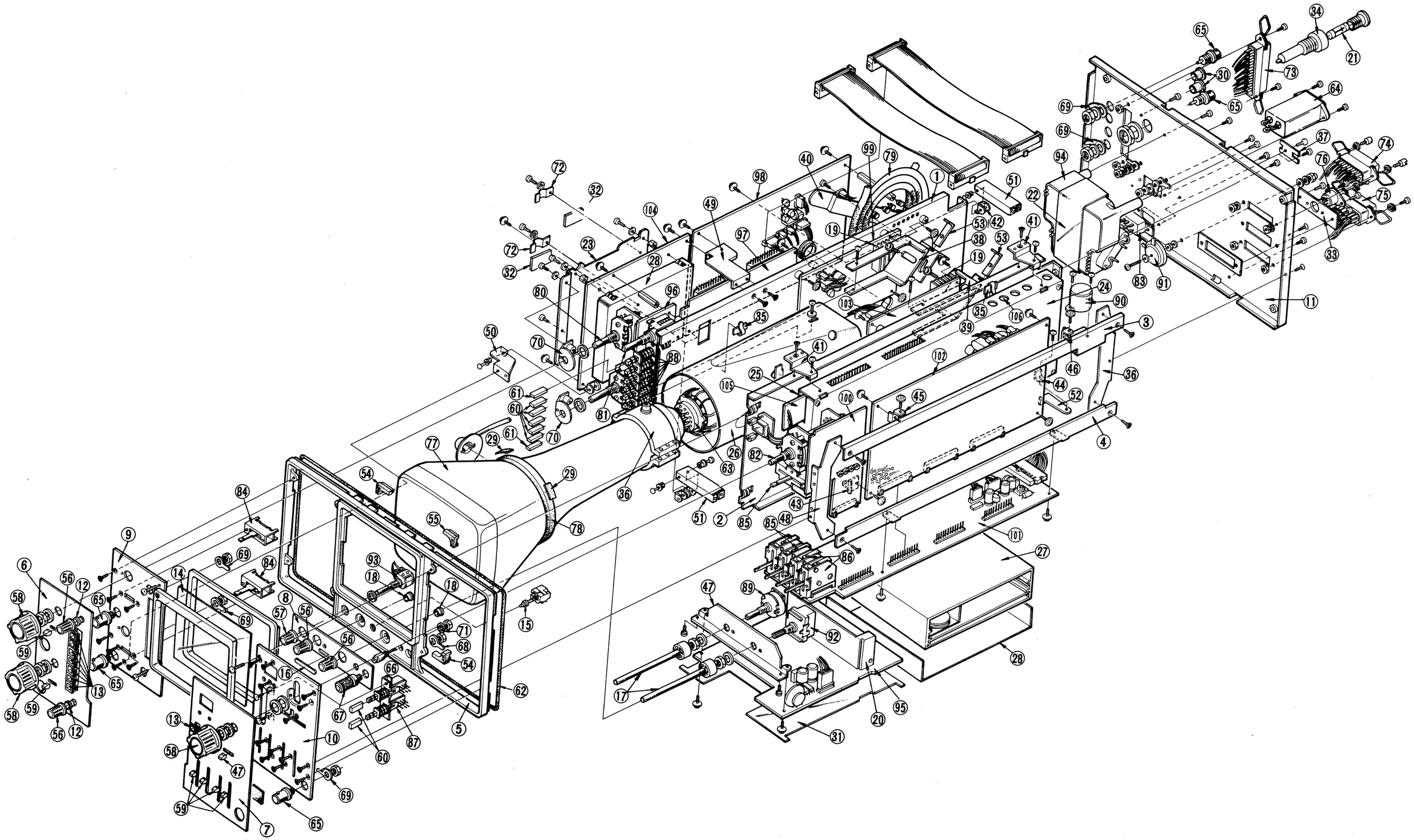
Fig. & Index No.	Parts No.	Description
1-1	A13-0749-12	Frame (L)
1-2	A13-0750-12	Frame (R)
1-3	A13-0751-12	Frame
1-4	A13-0752-12	Frame
1-5	A20-2756-15	Die casting panel
1-6	A21-1002-04	Decorative panel
1-7	A21-1003-04	Decorative panel
1-8	A21-1004-04	Decorative panel
1-9	A22-0821-03	Sub panel (L)
1-10	A22-0822-13	Sub panel (R)
1-11	A23-1634-12	Rear panel
1-12	B07-0701-04	Push escutcheon
1-13	B07-0706-04	Push escutcheon
1-14	B19-0717-03	Filter
1-15	B30-0930-15	LED
1-16	B40-2765-04	Name plate (serial No.)
1-17	D21-0903-04	Extension shaft
1-18	D23-0801-04	Bearing
1-19	F01-0827-04	Heat sink
1-20	F02-0503-04	Heat sink
1-21	F05-1224-05	Fuse (1.2A)
1-22	F10-1557-04	Earth band
1-23	F10-1556-14	Shield plate
1-24	F11-0971-02	Shield case (cover)
1-25	F11-0972-02	Shield case
1-26	F11-0973-02	Shield cover for CRT
1-27	W02-0405-15	Switching power supply
1-28	F11-0963-03	Shield case
1-29	F15-0714-04	Felt
1-30	F19-0709-05	Rubber cap
1-31	F20-0636-04	Insulation sheet
1-32	F20-0613-04	Insulation sheet
1-33	F19-0710-04	Mounting plate for DIN connector
1-34	J13-0033-15	Fuse holder
1-35	J19-1620-05	Cord keeper
1-36	J19-1623-04	CRT band
1-37	J19-1624-04	Stopper plate
1-38	J21-2925-03	Bracket for CRT
1-39	J21-2926-03	Bracket for CRT
1-40	J21-2871-14	Bracket for DL
1-41	J21-2947-04	Bracket for shield case
1-42	J29-2905-04	Bracket
1-43	J21-2948-04	Bracket
1-44	J21-2949-04	Bracket
1-45	J21-2950-04	Bracket
1-46	J21-2951-04	Bracket
1-47	J21-2930-04	Bracket for VR
1-48	J21-2942-14	Bracket
1-49	J21-2945-04	Bracket for p.c.b.
1-50	J21-2943-14	Bracket for p.c.b.
1-51	J21-2944-04	Bracket for p.c.b.
1-52	J21-2946-04	Bracket for shield case
1-53	J29-0505-04	Retainer clamp
1-54	J42-0517-04	Mounting rubber for CRT
1-55	J42-0518-04	Mounting rubber for CRT
1-56	K21-0832-14	Knob
1-57	K21-0833-14	Knob
1-58	K21-0845-03	Knob
1-59	K27-0526-04	Lever knob
1-60	K27-0504-04	Push knob
1-61	K27-0505-04	Push knob
1-62	002-0006-05	Shield gasket
1-63	E01-1403-05	CRT socket
1-64	E03-0201-05	Power connector
1-65	E04-0251-05	BNC receptacle
1-66	E21-0654-04	CAL terminal
1-67	E21-0657-04	Metal terminal
1-68	E23-0015-04	Earth lug
1-69	E23-0513-05	Earth lug
1-70	E23-0518-04	Earth plate
1-71	E23-0520-05	Earth lug
1-72	E23-0522-14	Earth plate
1-73	E08-5081-05	Receptacle
1-74	E08-2483-05	Receptacle
1-75	E08-2482-05	Receptacle
1-76	E06-0751-05	DIN socket
1-77		CRT 140CGB31
1-78	L39-0516-05	Rotator coil
1-79	L76-0105-05	Delay line
1-80	S01-1514-05	Rotary switch
1-81	S01-2507-05	Rotary switch
1-82	S01-2508-05	Rotary switch
1-83	S31-2004-05	Slide switch
1-84	S31-2506-05	Slide switch
1-85	S33-2501-05	Lever switch
1-86	S37-2005-05	Lever switch
1-87	S42-2509-05	Push switch
1-88	S42-7502-05	Push switch
1-89	S59-2503-05	Power switch
1-90	T99-0501-05	Buzzer
1-91		Power thermistor 4W-25
1-92	R05-8001-05	Variable res. 3MΩB
1-93	R19-9503-05	Variable res. 1kΩB/10kΩB
1-94	W02-0406-05	High voltage power block
1-95	X68-1350-00	Power blanking unit
	J25-2948-12	Printed circuit board
1-96	X73-1400-00	Vertical switch unit
	J25-2944-03	Printed circuit board
1-97	X73-1410-00	Vertical logic unit
	J25-2945-12	Printed circuit board
1-98	X73-1420-00	Vertical amplifier unit
	J25-2942-12	Printed circuit board
1-99	X73-1430-00	Vertical output amp unit
	J25-2949-03	Printed circuit board
1-100	X74-1260-00	Horizontal switch unit
	J25-2946-03	Printed circuit board
1-101	X74-1270-00	Horizontal logic unit
	J25-2945-12	Printed circuit board
1-102	X74-1280-00	Sweep unit
	J25-2950-12	Printed circuit board
1-103	X74-1290-00	Horizontal output amp unit
	J25-2949-03	Printed circuit board
1-104	X75-1130-00	Attenuator unit
	J25-2939-12	Printed circuit board
1-105	X81-1060-00	I/O unit
	J25-2933-12	Printed circuit board
1-106	X81-1050-00	CPU unit
	J25-2931-12	Printed circuit board

PARTS LIST

Ref. No.	Parts No.	Description
	A01-0889-02	Case
	B07-0710-02	Rear escutcheon
	B42-1835-04	Voltage indication sheet (90 ~ 132V)
	B42-1836-04	Voltage indication sheet (180 ~ 264V)
	B50-2964-00	Instruction manual
	F20-0627-04	Insulation sheet for lithium battery
	J02-0507-05	Leg (bottom)
	J02-0512-05	Leg (side)
	J32-0824-04	Hex post (54mm)
	J32-0825-04	Hex post (32mm)
	J32-0827-04	Hex post (7.5mm)
	J32-0828-04	Hex post (13.9mm)
	J42-0038-04	Rubber cap X5
	J61-0049-05	Cable band
	J59-0402-05	Nylon rivet
	K01-0058-25	Handle
	H01-2954-04	Carton box
	H10-2812-12	Pad (formed styrene)
	H20-1713-14	Pad (carton)
	E29-0504-05	Teflon terminal
	E30-1818-05	JIS cord
	E30-1819-05	CEE cord
	E30-1821-05	SAA cord
J1	E31-2235-05	Lead wire/connector 5P
J2	E31-2236-05	Lead wire/connector 5P
J3	E31-2237-05	Lead wire/connector 8P
J4	E31-2238-05	Lead wire/connector 7P
J5	E31-2239-05	Lead wire/connector 5P
J6	E31-2240-05	Lead wire/connector 5P
J7	E31-2241-05	Lead wire/connector 6P
J8	E31-2242-05	Lead wire/connector 8P
J9	E31-2243-05	Lead wire/connector 6P
J10	E31-2260-05	Lead wire/connector 4P
J11	E31-2244-05	Lead wire/connector 2P
J12	E31-2245-05	Lead wire/connector 2P
J13	E31-2246-05	Lead wire/connector 5P
J14	E31-2247-05	Lead wire/connector 3P
J15	E31-2248-05	Lead wire/connector 7P
J16	E31-2249-05	Lead wire/connector 5P
J17	E31-2250-05	Lead wire/connector 3P
J18	E31-2251-05	Lead wire/connector 3P
J19	E31-2252-05	Lead wire/connector 3P
J20	E31-2253-05	Lead wire/connector 2P
J21	E31-2254-05	Lead wire/connector 3P
J22	E31-2255-05	Lead wire/connector 3P
J23	E31-2256-05	Lead wire/connector 4P
J24	No use	
J25	E31-2257-05	Lead wire/connector 34P
J26	E31-2257-05	Lead wire/connector 34P
J27	E31-2258-05	Lead wire/connector 6P
J28	E31-2259-05	Lead wire/connector 7P
J29	No use	
J30	E31-2261-05	Lead wire/connector 1P
J31	E31-2275-05	Lead wire/connector 1P
J32		
J33	E31-2262-05	Lead wire/connector 2P
J34	E31-2263-05	Lead wire/connector 3P
J35	No use	
J36	No use	
J37	E31-2265-05	Lead wire/connector 3P
J38	No use	
J39	No use	
J40	No use	
J41	No use	
J42	E31-2266-05	Lead wire/connector 7P
J43	E31-2267-05	Lead wire/connector 8P
J44	No use	
J45	No use	
J46	E31-2269-05	Lead wire/connector 1P
J47	E31-2269-05	Lead wire/connector 1P
J48	E31-2270-05	Lead wire/connector 2P
J49	E31-2271-05	Lead wire/connector 2P
J50	No use	
J51	No use	
J52	E31-2274-05	Lead wire/connector 3P
J53	E31-2261-05	Lead wire/connector 1P
J54	E31-2275-05	Lead wire/connector 1P
J55	E31-2276-05	Lead wire/connector 3P
J56	E31-2277-05	Lead wire/connector 2P
J57	No use	
J58	No use	

Ref. No.	Parts No.	Description			
J59	E31-2278-05	Lead wire/connector 2P			
J60	E31-2279-05	Lead wire/connector 3P			
J61	No use				
J62	E31-2280-05	Lead wire/connector 2P			
J63	E31-2281-05	Lead wire/connector 5P			
J64	E31-2282-05	Lead wire/connector 3P			
	E31-0564-05	Lead wire/connector 1P			
P65	E31-2283-05	Lead wire/receptacle			
P66	E31-2284-05	Lead wire/receptacle			
P67	E31-2285-05	Lead wire/receptacle			
P68	E31-2268-05	Lead wire/receptacle			
R1	RN14BK2E1200F	Metal film res.	120Ω	±1%	1/4W
R2	RN14BK2H1503F	Metal film res.	150kΩ	±1%	1/2W
R3	RN14BK2H1503F	Metal film res.	150kΩ	±1%	1/2W
C1	CK45E3D472P	Ceramic cap.	4700pF	+100% −0%	2000V
C2	CK45E3D472P	Ceramic cap.	4700pF	+100% −0%	2000V
C3	C91-0551-05	Metal film cap.	0.22μF		600V
	W02-0405-15	Switching power supply			
	W09-0403-05	Lithium battery 3V			
	Y87-1250-00	Probe PC-29			

DISASSEMBLY/PARTS LIST (1)



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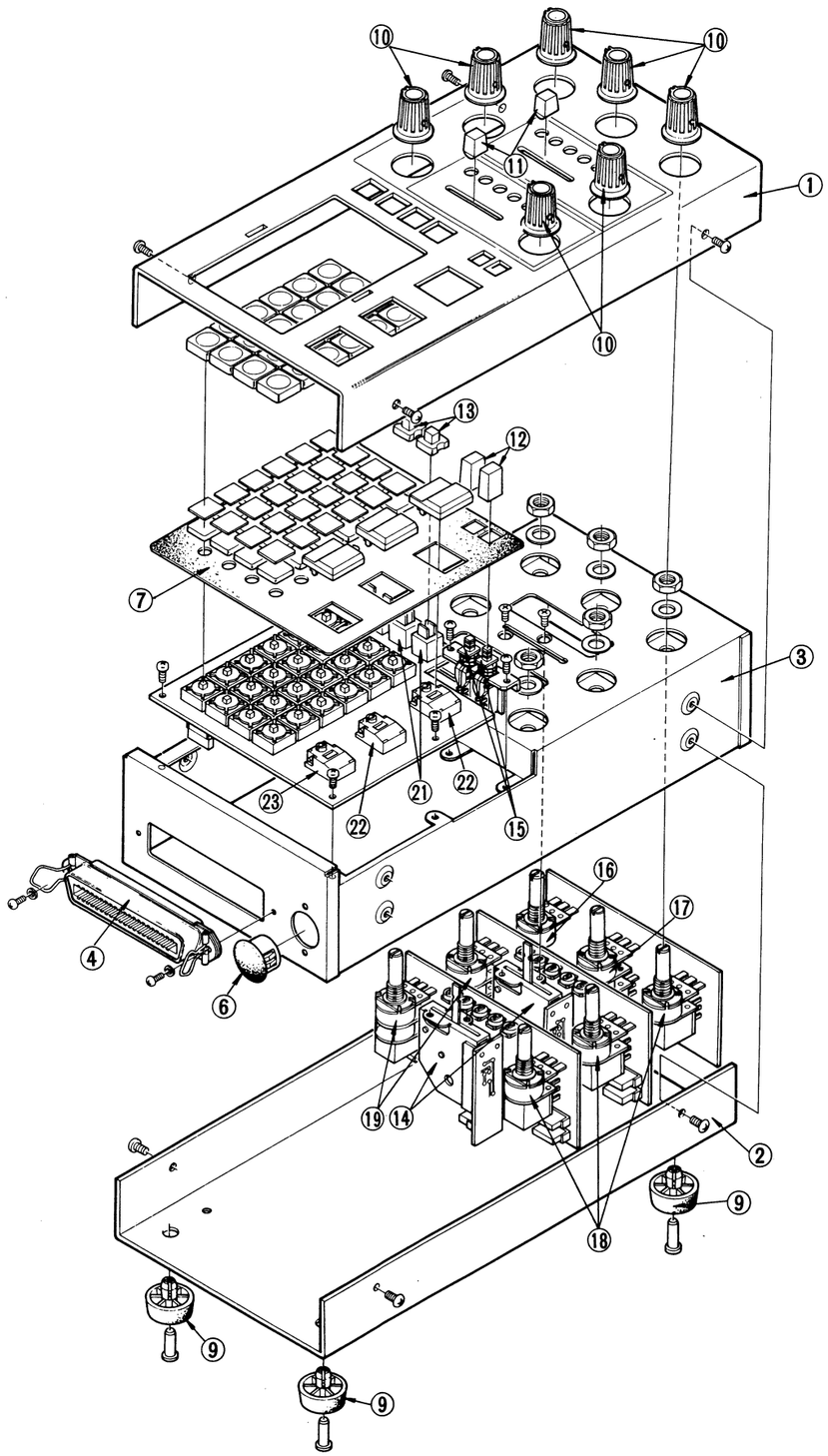

PARTS LIST

REMOTE CONTROLLER (RT-1721)

Fig. & Index No.	Parts No.	Description
2-1	A01-0878-03	Case (top)
2-2	A01-0879-03	Case (bottom)
2-3	A10-1431-02	Chassis
2-4	E08-5081-05	Receptacle 50P
2-5	F07-0920-04	Button cover
2-6	F19-0708-05	Bushing
2-7	F15-0718-04	Blind sheet
2-8	F20-0635-04	Insulation sheet
2-9	J02-0507-05	Leg
2-10	K21-0820-04	Knob
2-11	K27-0502-04	Lever knob
2-12	K27-0504-04	Push knob (grey)
2-13	K27-0524-04	Push knob
2-14	S33-2501-05	Lever switch
2-15	S42-2510-05	Push switch
2-16	R01-2503-05	Variable res. 10kΩB
2-17	R01-4505-05	Variable res. 50kΩB
2-18	R01-2504-05	Variable res. 5kΩB
2-19	R01-2513-05	Variable res. 5kΩB
2-20	S40-1507-05	Tact switch
2-21	S40-1504-05	Tact switch
2-22	S40-1508-05	Digitast switch
2-23	S40-1509-05	Digitast switch
	B40-2737-04	Name plate (serial No.)
	B41-0737-04	Caution sheet
	E30-1842-05	Cable CB-5020S
	E31-2231-15	Lead wire/receptacle
	E31-2232-05	Lead wire/connector
	B42-1840-04	Key board indication sheet (7)
	B42-1841-04	Key board indication sheet (4)
	B42-1842-04	Key board indication sheet (1)
	B42-1843-04	Key board indication sheet (0)
	B42-1844-04	Key board indication sheet (8)
	B42-1845-04	Key board indication sheet (5)
	B42-1846-04	Key board indication sheet (2)
	B42-1847-04	Key board indication sheet (STRT)
	B42-1848-04	Key board indication sheet (9)
	B42-1849-04	Key board indication sheet (6)
	B42-1850-04	Key board indication sheet (3)
	B42-1851-04	Key board indication sheet (END)
	B42-1852-04	Key board indication sheet (STO)
	B42-1853-04	Key board indication sheet (PART WRT)
	B42-1854-04	Key board indication sheet (ALL WRT)
	B42-1855-04	Key board indication sheet (READ)
	B42-1856-04	Key board indication sheet (SCAN)
	B42-1857-04	Key board indication sheet (PRNT)
	B42-1858-04	Key board indication sheet (SAVE)
	B42-1859-04	Key board indication sheet (LOAD)
	B42-1860-04	Key board indication sheet (FREE)
	B42-1861-04	Key board indication sheet (EXT)
	B42-1864-04	Key board indication sheet
	X77-1180-00	Remote unit
	X81-1120-00	Key board unit
	H01-2938-04	Carton box
	H12-0538-04	Pad
	H25-0820-04	Polyethylene bag
	H10-2814-02	Pad (foamed styrene)

REMOTE UNIT (X77-1180-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
A-2	R1	RD14BB2C272J	RD 2.7kΩ
A-2	R2	RD14BB2C272J	RD 2.7kΩ
A-2	R3	RD14BB2C272J	RD 2.7kΩ
A-2	R4	RD14BB2C272J	RD 2.7kΩ
A-2	R5	RD14BB2C272J	RD 2.7kΩ
A-2	R6	RD14BB2C272J	RD 2.7kΩ
A-2	R7	RD14BB2C272J	RD 2.7kΩ
A-3	R8	RD14BB2C272J	RD 2.7kΩ
A-3	R9	RD14BB2C272J	RD 2.7kΩ
A-3	R10	RD14BB2C272J	RD 2.7kΩ
B-2	R11	RD14BB2C102J	RD 1kΩ
B-2	R12	RD14BB2C102J	RD 1kΩ
B-2	R13	RD14BB2C102J	RD 1kΩ
B-2	R14	RD14BB2C102J	RD 1kΩ
B-2	R15	RD14BB2C102J	RD 1kΩ
B-2	R16	RD14BB2C102J	RD 1kΩ
B-3	R17	RD14BB2C102J	RD 1kΩ
B-3	R18	RD14BB2C102J	RD 1kΩ
B-3	R19	RD14BB2C102J	RD 1kΩ
B-3	R20	RD14BB2C102J	RD 1kΩ
B-3	R21	RD14BB2C332J	RD 3.3kΩ
B-3	R22	RD14BB2C332J	RD 3.3kΩ
B-3	R23	RD14BB2C182J	RD 1.8kΩ
B-3	R24	RD14BB2C182J	RD 1.8kΩ
B-3	R25	RD14BB2C392J	RD 3.9kΩ
B-3	R26	RD14BB2C392J	RD 3.9kΩ
A-4	R27	RD14BB2C103J	RD 10kΩ
A-4	R28	RD14BB2C103J	RD 10kΩ
A-3	R29	RD14BB2C103J	RD 10kΩ
A-1	R30	RD14BB2C103J	RD 10kΩ
B-2	R31	RD14BB2C222J	RD 2.2kΩ
	R32	No use	
	R33	No use	
	R34	No use	
	R35	No use	
	R36	No use	
	R37	No use	
	R38	No use	
	R39	No use	
	R40	No use	
C-2	R41	RD14BB2C272J	RD 2.7kΩ
C-2	R42	RD14BB2C272J	RD 2.7kΩ
C-2	R43	RD14BB2C272J	RD 2.7kΩ
C-2	R44	RD14BB2C272J	RD 2.7kΩ
C-2	R45	RD14BB2C272J	RD 2.7kΩ
C-2	R46	RD14BB2C272J	RD 2.7kΩ
C-2	R47	RD14BB2C272J	RD 2.7kΩ
B-3	R48	RD14BB2C272J	RD 2.7kΩ
B-3	R49	RD14BB2C272J	RD 2.7kΩ
B-3	R50	RD14BB2C272J	RD 2.7kΩ
C-2	R51	RD14BB2C102J	RD 1kΩ
C-2	R52	RD14BB2C102J	RD 1kΩ
C-2	R53	RD14BB2C102J	RD 1kΩ
C-2	R54	RD14BB2C102J	RD 1kΩ
C-2	R55	RD14BB2C102J	RD 1kΩ
C-2	R56	RD14BB2C102J	RD 1kΩ
C-3	R57	RD14BB2C102J	RD 1kΩ
C-3	R58	RD14BB2C102J	RD 1kΩ
C-3	R59	RD14BB2C102J	RD 1kΩ
C-3	R60	RD14BB2C102J	RD 1kΩ
C-3	R61	RD14BB2C332J	RD 3.3kΩ
C-3	R62	RD14BB2C332J	RD 3.3kΩ
C-3	R63	RD14BB2C182J	RD 1.8kΩ
C-3	R64	RD14BB2C182J	RD 1.8kΩ
C-3	R65	RD14BB2C392J	RD 3.9kΩ
C-3	R66	RD14BB2C392J	RD 3.9kΩ
C-4	R67	RD14BB2C103J	RD 10kΩ
C-4	R68	RD14BB2C103J	RD 10kΩ
C-3	R69	RD14BB2C103J	RD 10kΩ
C-1	R70	RD14BB2C103J	RD 10kΩ
C-2	R71	RD14BB2C222J	RD 2.2kΩ
	R72	No use	
	R73	No use	
	R74	No use	
	R75	No use	
	R76	No use	
	R77	No use	
	R78	No use	
	R79	No use	
	R80	No use	

Fig Inde
D-2
D-2
D-3
D-3
B-2
B-2
B-2
B-3
B-3
B-3
B-2
C-2
C-2
C-2
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C-3
C-2
D-2
D-2
D-3
A-1
C-1
D-3
A-2
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C-2
C-2
B-3
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C-3
C-3
C-3
A-3
B-3
A-1
C-1
D-1
D-1
A-2
A-3
A-3
B-2

PARTS LIST

KEY BOARD UNIT (X81-1120-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
A-3	R1	RD14BB2C333J	RD 33kΩ
B-3	R2	RD14BB2C333J	RD 33kΩ
B-3	R3	RD14BB2C333J	RD 33kΩ
B-3	R4	RD14BB2C333J	RD 33kΩ
C-3	R5	RD14BB2C333J	RD 33kΩ
C-3	R6	RD14BB2C333J	RD 33kΩ
C-3	R7	RD14BB2C333J	RD 33kΩ
C-3	R8	RD14BB2C333J	RD 33kΩ
C-1	R9	RD14BB2C391J	RD 390Ω
C-2	R10	RD14BB2C391J	RD 390Ω
C-2	R11	RD14BB2C391J	RD 390Ω
C-2	R12	RD14BB2C391J	RD 390Ω
C-1	C1	CK45B1H222K	CK 2200pF ±10%
C-1	C2	CK45B1H222K	CK 2200pF ±10%
C-2	C3	CK45B1H222K	CK 2200pF ±10%
C-2	C4	CK45B1H222K	CK 2200pF ±10%
A-3	C5	C90-0298-05	Semiconductor ceramic 0.1μF 12V
A-2	D1		Diode 1N60
A-3	D2		Diode 1N60
A-2	D3		Diode 1N60
A-2	D4		Diode 1N60
B-3	IC1		IC SN74LS148N
A-1	S1	S40-1507-05	Tact switch
A-2	S2	S40-1507-05	Tact switch
A-2	S3	S40-1507-05	Tact switch
A-2	S4	S40-1507-05	Tact switch
A-1	S5	S40-1507-05	Tact switch
A-2	S6	S40-1507-05	Tact switch
A-2	S7	S40-1507-05	Tact switch
A-2	S8	S40-1507-05	Tact switch
B-1	S9	S40-1507-05	Tact switch
B-2	S10	S40-1507-05	Tact switch
B-2	S11	S40-1507-05	Tact switch
B-2	S12	S40-1507-05	Tact switch
B-1	S13	S40-1507-05	Tact switch
B-2	S14	S40-1507-05	Tact switch
B-2	S15	S40-1507-05	Tact switch
B-2	S16	S40-1507-05	Tact switch
B-1	S17	S40-1507-05	Tact switch
B-2	S18	S40-1507-05	Tact switch
B-2	S19	S40-1507-05	Tact switch
B-2	S20	S40-1507-05	Tact switch
C-1	S21	S40-1507-05	Tact switch
C-2	S22	S40-1507-05	Tact switch
C-2	S23	S40-1507-05	Tact switch
C-2	S24	S40-1507-05	Tact switch
C-1	S25	S40-1504-05	Tact switch
C-2	S26	S40-1504-05	Tact switch
C-2	S27	S40-1504-05	Tact switch
C-2	S28	S40-1504-05	Tact switch
A-3	S29	S40-1509-05	Digital switch
B-3	S30	S40-1508-05	Digital switch
C-3	S31	S40-1508-05	Digital switch
A-3	P8	E40-0676-05	Pin connector 6P
C-3	P9	E40-0576-05	Pin connector 5P
C-3	P10	E40-0476-05	Pin connector 4P
B-3	P11	E40-0376-05	Pin connector 3P
		J25-2941-02	Printed circuit board

MEMORY PACK (MT-1725)

Ref. No.	Parts No.	Description
	A01-0875-04	Case
	A50-0502-04	Side panel
	A50-0503-04	Side panel
	B42-1839-04	Name plate (serial No.)
	G13-0707-04	Cushion
	H01-2935-03	Carton box
	H03-1858-04	Carton box
	H21-0802-04	Protective sheet
	H25-0016-00	Polyethylene bag
	W09-0403-05	Lithium battery
	X81-1070-00	Memory unit

MEMORY UNIT (X81-1070-00)

Fig. & Index No.	Ref. No.	Parts No.	Description
R1	A-2	RD14BB2C472J	RD 4.7kΩ
R2	A-2	RD14BB2C561J	RD 560Ω
R3	A-2	RD14BB2C272J	RD 2.7kΩ
R4	B-2	RD14BB2C224J	RD 220kΩ
R5	B-2	RD14BB2C331J	RD 330Ω
R6	B-2	RD14BB2C474J	RD 470kΩ
R7	B-1	RD14BB2C103J	RD 10kΩ
R8	B-2	RD14BB2C472J	RD 4.7kΩ
R9	B-2	RD14BB2C472J	RD 4.7kΩ
R10	B-2	RD14BB2C222J	RD 2.2kΩ
R11	B-2	RN14BK2B6801F	RN 6.8kΩ ±1% 1/8W
VR1	B-2	R-12-1511-05	VR 2kΩB
C1	A-2	C91-0549-05	Tantalum 1μF 35V
C2	B-2	CK45B1H103K	CK 0.01μF ±10%
C3	B-1	CK45B1H103K	CK 0.01μF ±10%
C4	B-1	CC45CH1H680J	CC 68pF ±5%
Q1	A-2		TR 2SC945 (Q)
D1	A-2		Diode 1S1544A
D2	B-2		Diode 1S1544A
D3	B-2		Diode WZ-032
IC1	A-1		IC M5L8216P
IC2	A-1		IC MB8414EM
IC3	B-1		IC TC4040BP
IC4	B-1		IC TC4001BP
IC5	B-2		IC TL061CP
P1		E09-2482-05	Plug
		J25-2930-04	Printed circuit board

PARTS LIST

Ref. No.	Parts No.	Description
R1	RN14BK2B1202F	RN 12kΩ ±1% 1/8W
R2	RD14BB2C472J	RD 4.7kΩ
R3	RD14BB2C472J	RD 4.7kΩ
R4	RD14BB2C123J	RD 12kΩ
VR1	R12-2509-05	VR 5kΩB
VR2	R12-2509-05	VR 5kΩB
VR3	R12-2509-05	VR 5kΩB
VR4	R12-2509-05	VR 5kΩB
VR5	R12-2509-05	VR 5kΩB
VR6	R01-2504-05	VR 5kΩB (S1)
VR7	R01-2513-05	VR 5kΩB (S2)
VR8	R12-2509-05	VR 5kΩB
VR9	R12-2509-05	VR 5kΩB
VR10	R12-2509-05	VR 5kΩB
VR11	R12-2509-05	VR 5kΩB
VR12	R12-2509-05	VR 5kΩB
VR13	R01-2504-05	VR 5kΩB (S4)
VR14	R01-2513-05	VR 5kΩB (S5)
VR15	R01-4505-05	VR 50kΩB (S7)
VR16	R01-4505-05	VR 5kΩB (S7)
VR17	R01-2504-05	VR 5kΩB (S8)
C1	CK45B1H103K	CK 0.01μF ±10%
C2	CK45B1H103K	CK 0.01μF ±10%
C3	CK45B1H103K	CK 0.01μF ±10%
Q1		TR 2SA608KNP (F)
Q2		TR 2SA608KNP (F)
Q3		TR 2SA608KNP (F)
Q4		TR 2SA608KNP (F)
Q5		TR 2SA608KNP (F)
Q6		TR 2SA608KNP (F)
Q7		TR 2SA608KNP (F)
Q8		TR 2SA608KNP (F)
Q9		TR 2SA608KNP (F)
Q10		TR 2SA608KNP (F)
D1		Diode DS442X
D2		Diode DS442X
D3		Diode DS442X
D4		Diode DS442X
D5		Diode DS442X
D6		Diode DS442X
D7		Diode DS442X
D8		Diode DS442X
D9		Diode DS442X
D10		Diode DS442X
D11		Diode DS442X
D12		Diode DS442X
D13		Diode DS442X
D14		Diode DS442X
D15		Diode DS442X
D16		Diode DS442X
D17		Diode DS442X
D18		Diode DS442X
D19		Diode DS442X
D20		Diode DS442X
D21		Diode DS442X
D22		Diode DS442X
D23		Diode DS442X
D24		Diode DS442X
D25		Diode DS442X
D26		Diode DS442X
D27		Diode DS442X
D28		Diode DS442X
D29		Diode DS442X
D30		Diode DS442X
D31		Diode DS442X
D32		Diode DS442X
D33		Diode DS442X
D34		Diode DS442X
D35		Diode DS442X
D36		Diode DS442X
D37		Diode DS442X
D38		Diode DS442X
D39		Diode DS442X
D40		Diode DS442X
IC1		IC SN74LS42N
IC2		IC SN74LS42N
S1	S33-2501-05	Lever switch
S2	S33-2501-05	Lever switch
S3	S42-2510-05	Push switch
S4	S42-2510-05	Push switch
P1	E40-0876-05	Pin connector 8P
P2	E40-0676-05	Pin connector 6P
P3	E40-0476-05	Pin connector 4P
P4	E40-0876-05	Pin connector 8P

No use

Fig. & Index No.	Ref. No.	Parts No.	Description
B-3	P5	E40-0676-05	Pin connector 6P
B-3	P6	E40-0476-05	Pin connector 4P
D-2	P7	E40-0976-05	Pin connector 9P
D-1	P12	E40-0376-05	Pin connector 3P
		J25-2940-02	Printed circuit board

VOLTAGES AND WAVEFORMS

The voltages and waveforms are measured on each schematic diagram as follows;

TEST EQUIPMENT

Digital multimeter : DL-720 (TRIO)
Oscilloscope : CS-2100 (TRIO)
Sine wave generator : SG-502 (TEKTRONIX)

Voltage Measurements
Voltage measurements are taken with no signal applied and the trace positioned to the center horizontal graticule line. The digital multimeter common should be connected to chassis ground at the nearest measurement point.

Waveform Condition
Waveforms are measured with 1 kHz 10 mVp-p sine wave applied CH1 input.

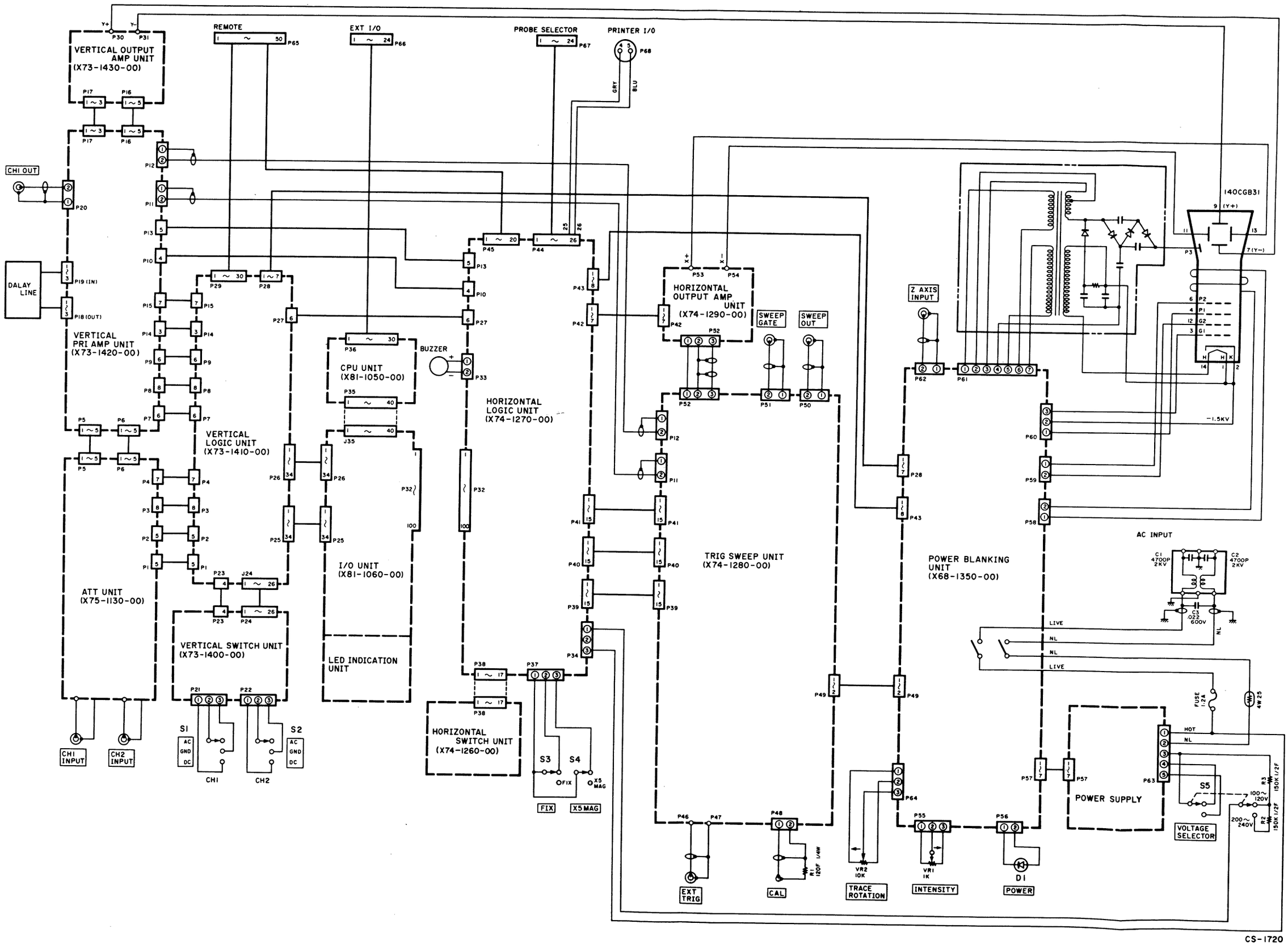
CONTROL SETTINGS

INTENSITY	Midrange
FOCUS	Midrange
▲▼ POSITION	Midrange
VOLTS/DIV	2 mV
V. VARI	CAL
CW2 INV	OFF (▁▇▁)
V. MODE	Unless otherwise specified CH1 and SEP OFF (▁▇▁)
COUPLING	AC
SLOPE	CH1 +/+
TRIG MODE	AUTO
SWEEP TIME/DIV	1 ms
SWEEP TIME VARI	CAL
◄► POSITION	Midrange
X5MAG	OFF (▁▇▁)

NOTE:

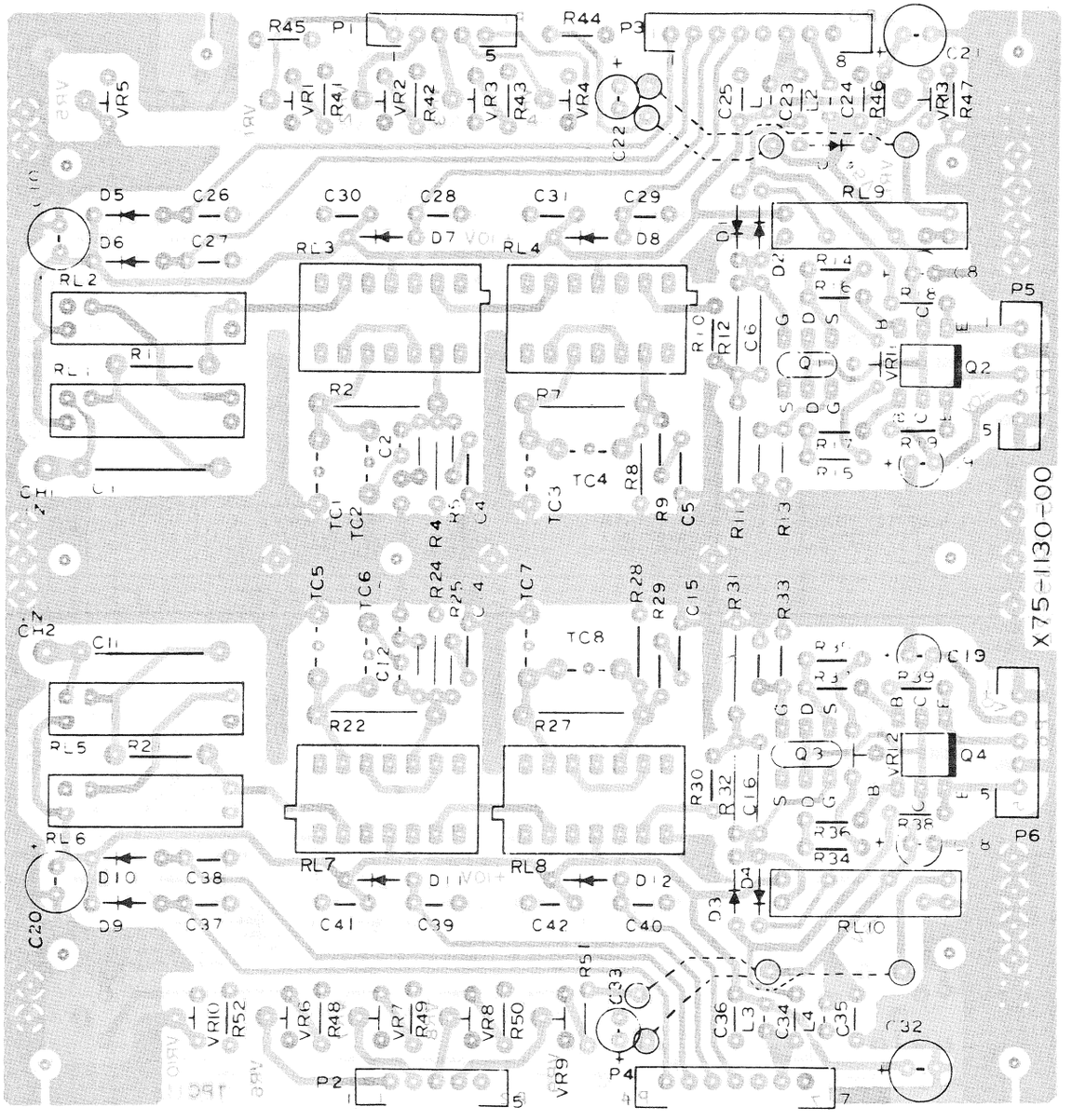
In differencial circuit, the voltages and waveforms are shown only CH1

SCHEMATIC DIAGRAM

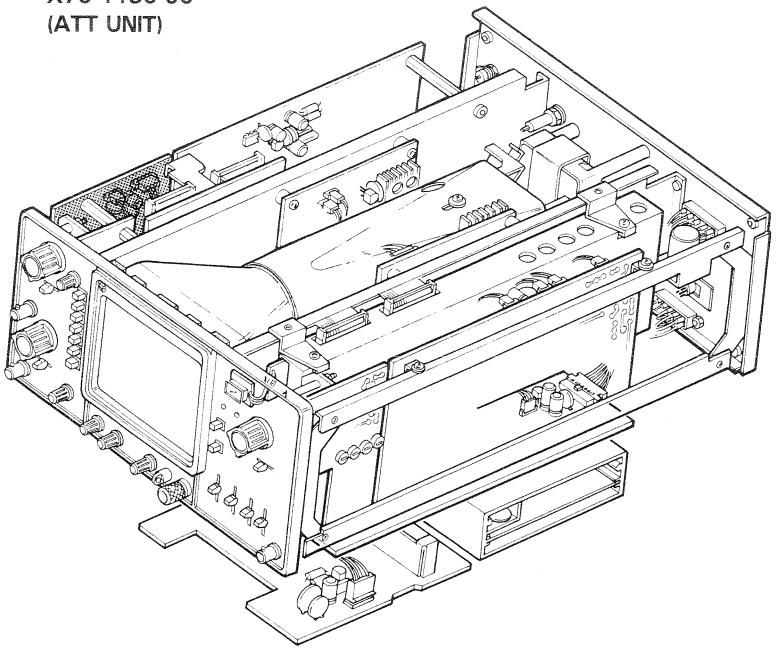


P.C. BOARD

X75-1130-00

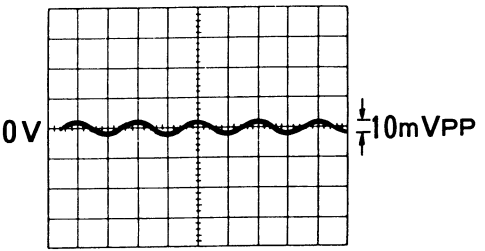


X75-1130-00
(ATT UNIT)



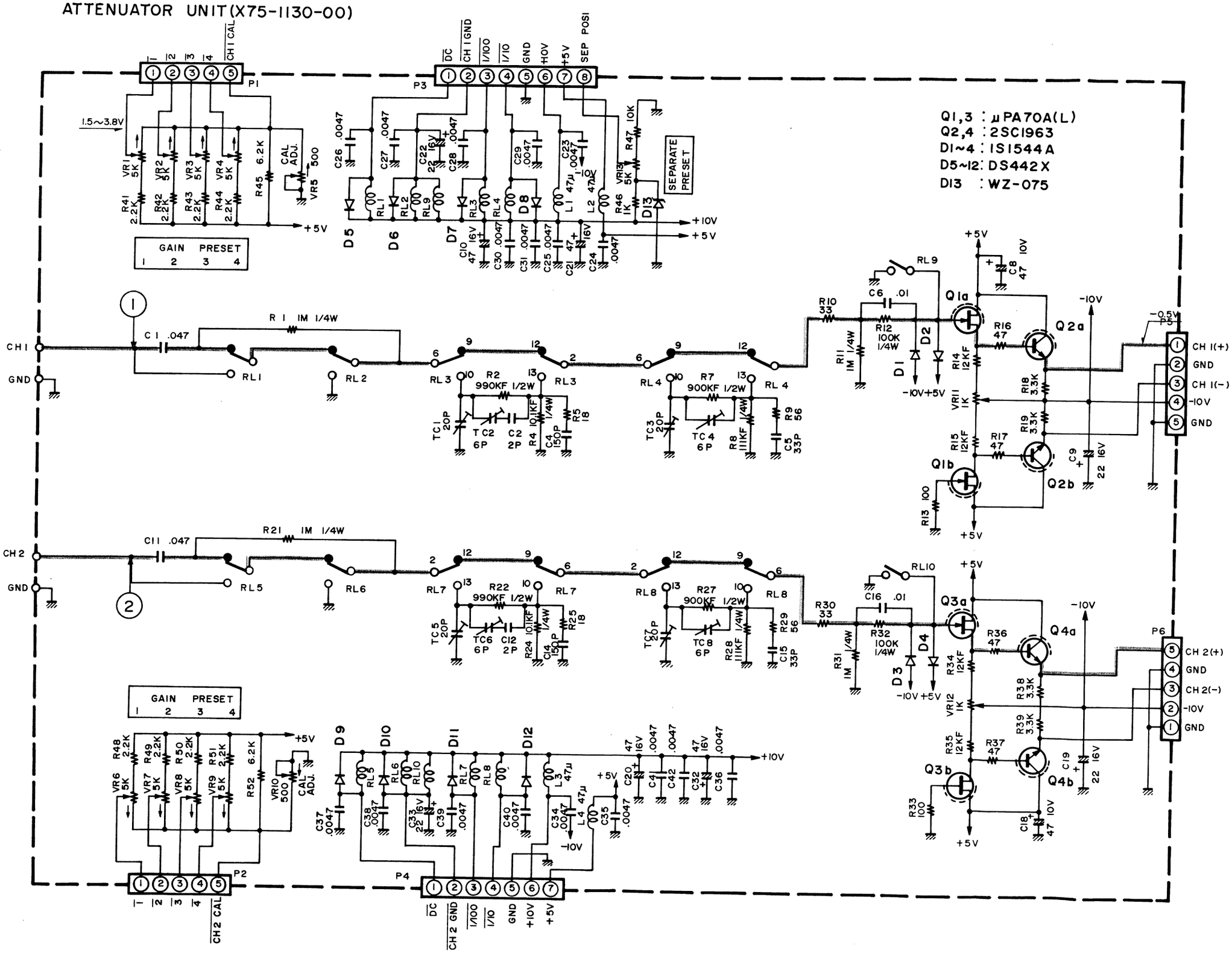
WAVEFORM

①②



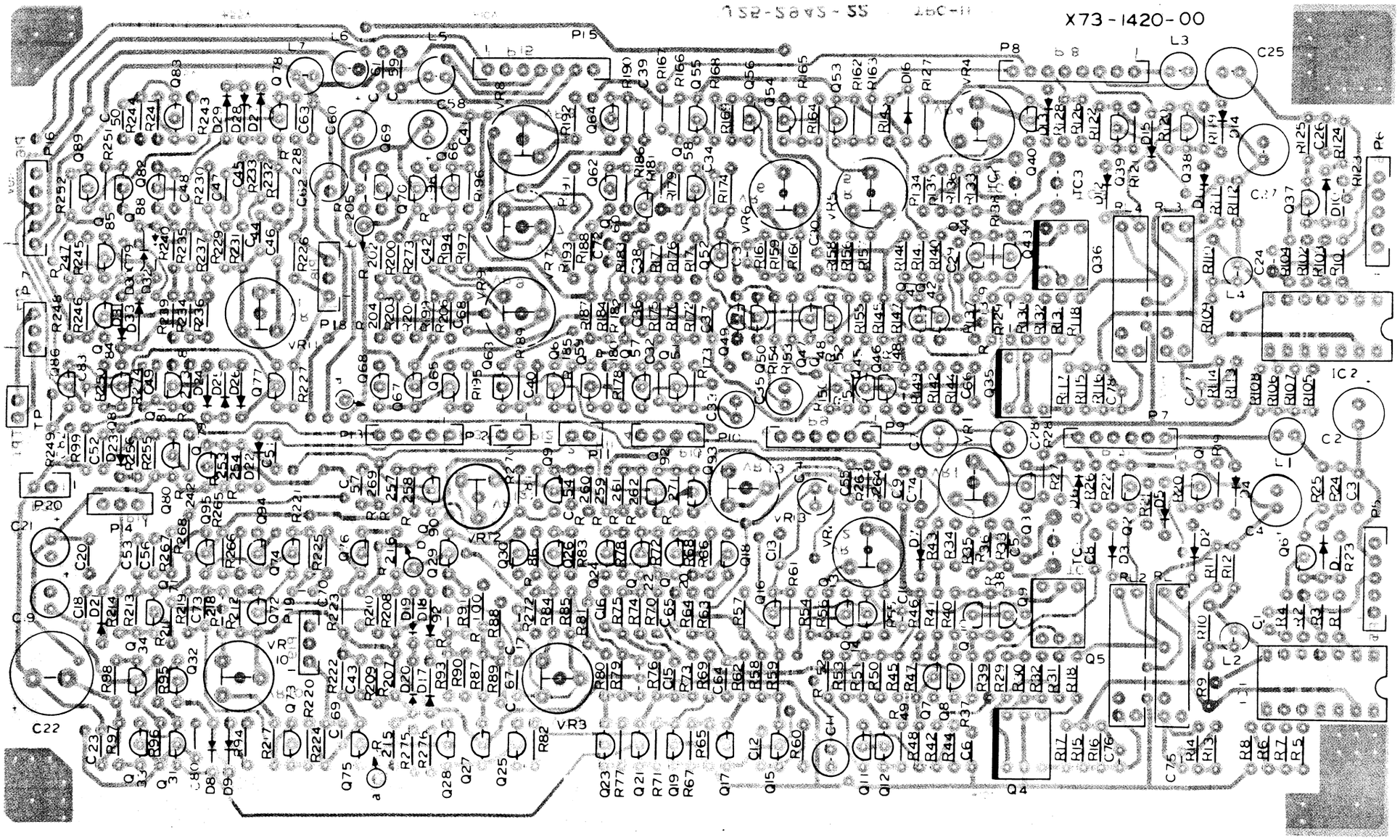
SCHEMATIC DIAGRAM

X75-1130-00

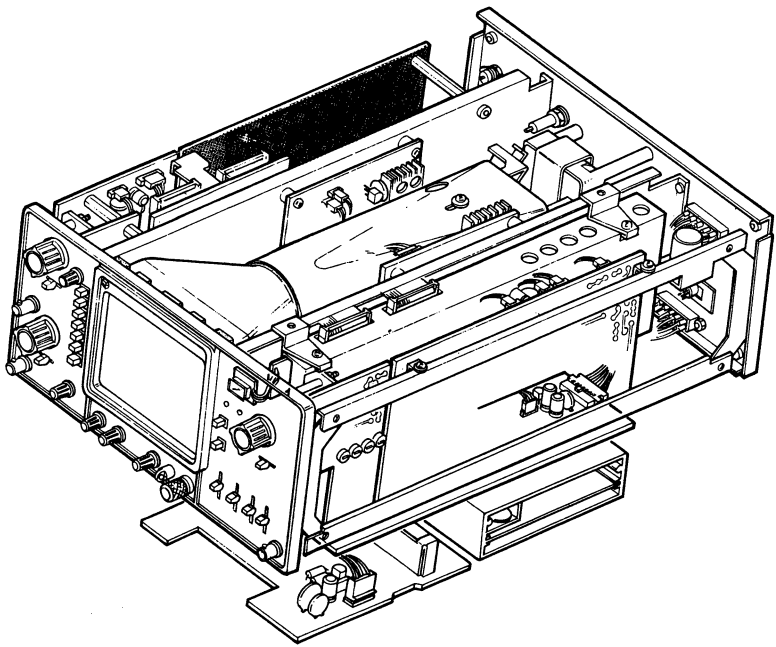


P.C. BOARD

X73-1420-00

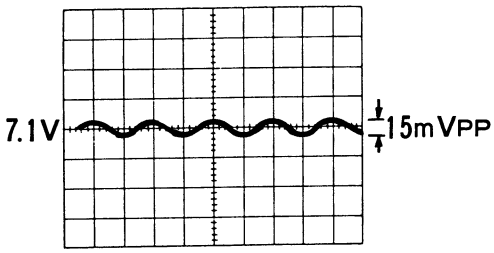


X73-1420-00
(VERTICAL AMP. UNIT)



WAVEFORM

①



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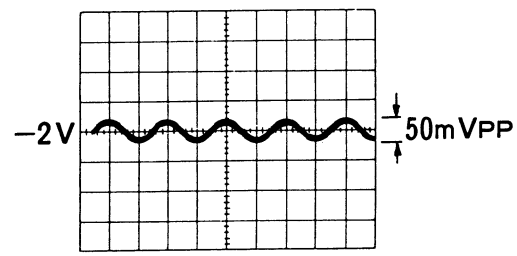

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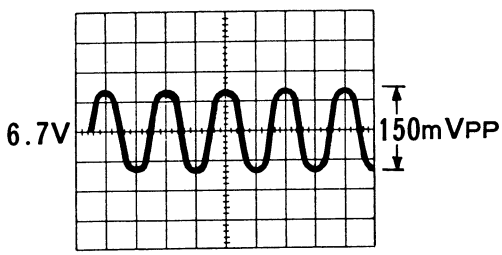

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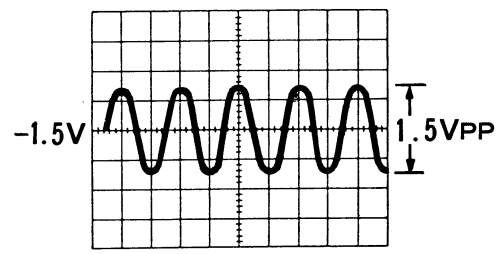

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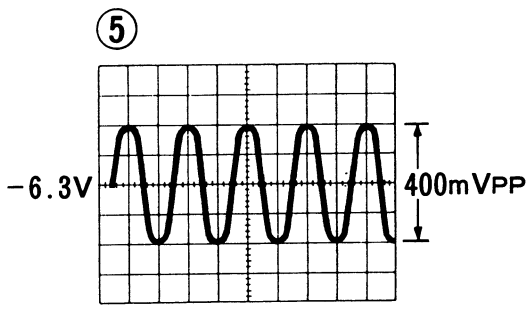

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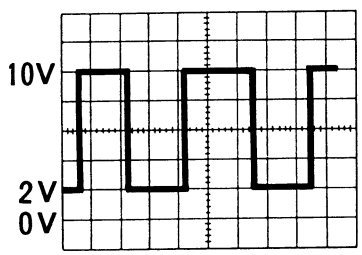
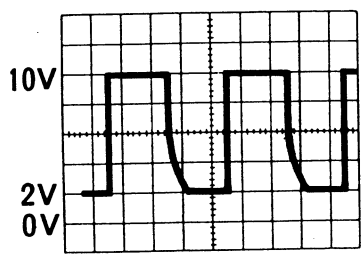


SEP:ON

⑦



SEP:ON

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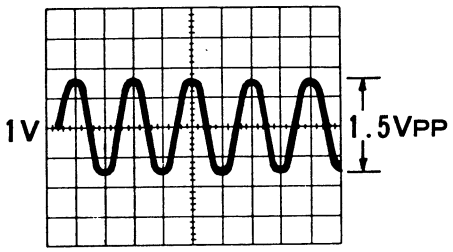
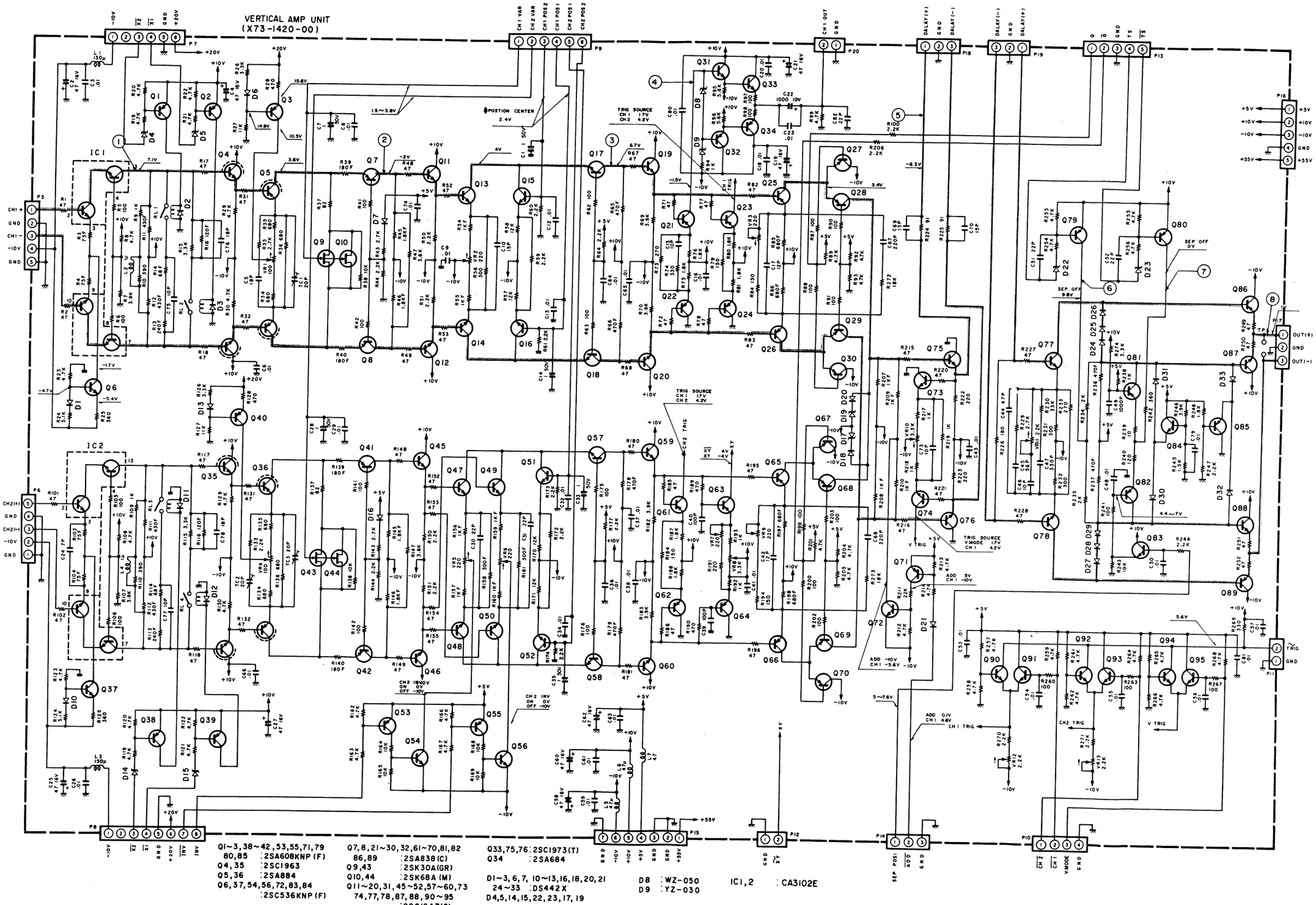


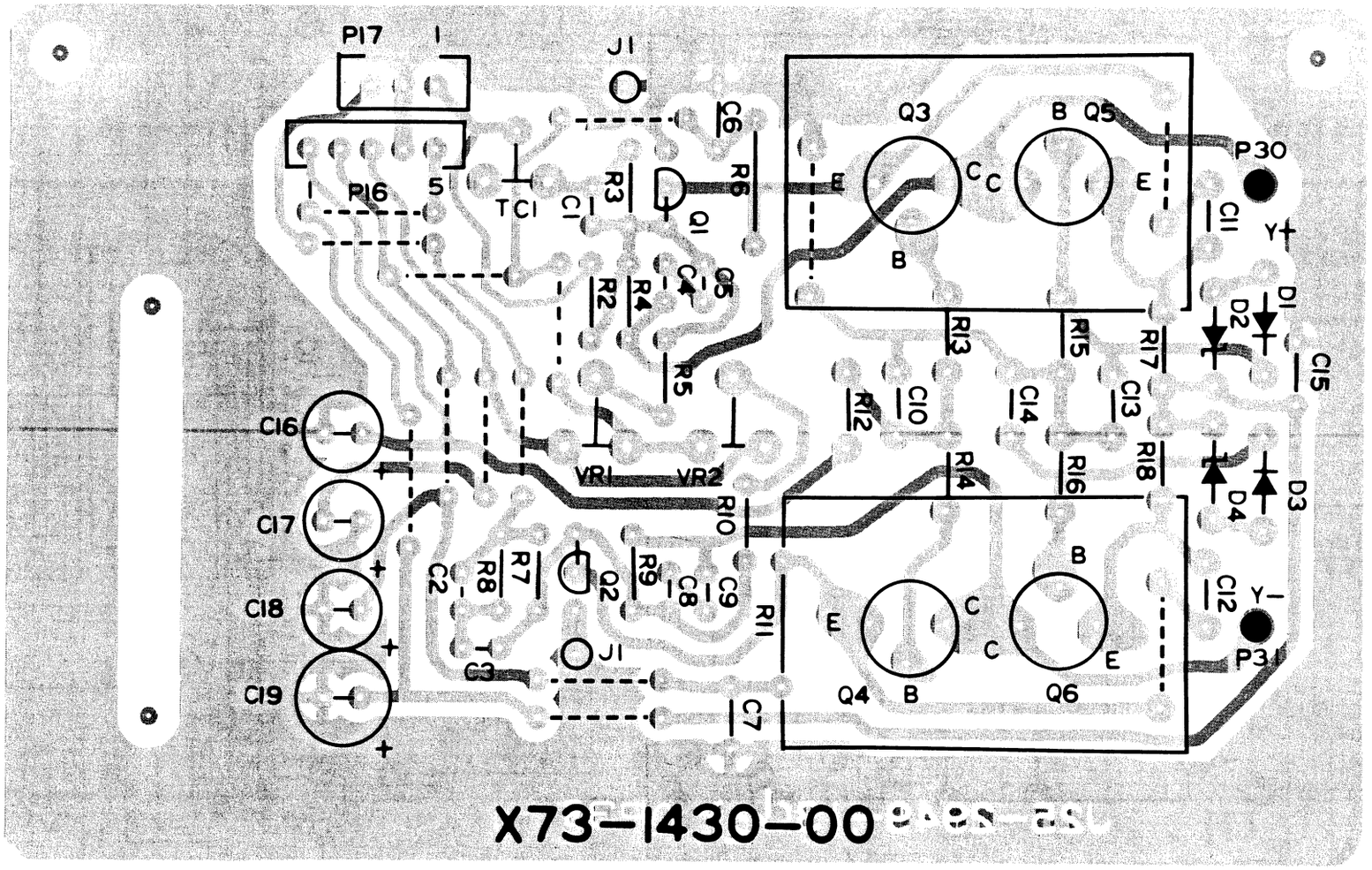
SCHEMATIC DIAGRAM

X73-1420-00

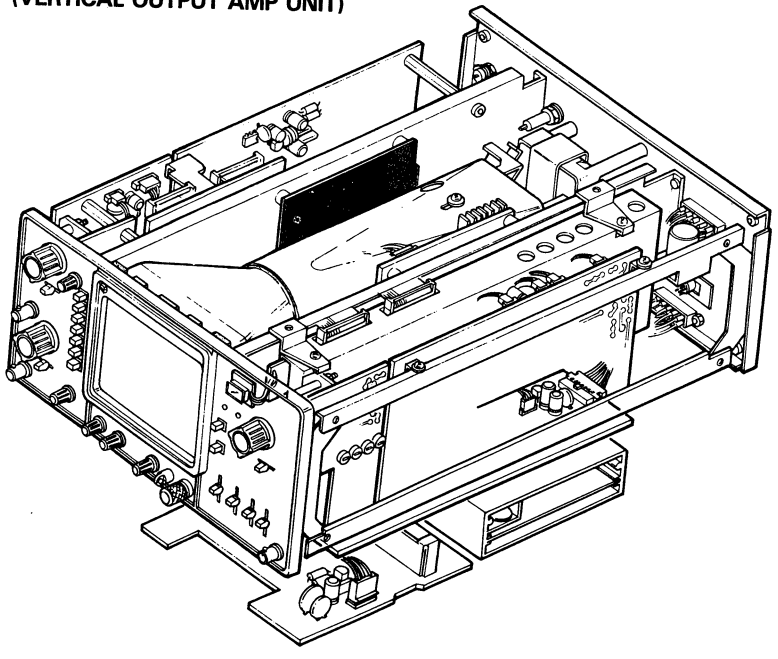


P.C. BOARD

X73-1430-00

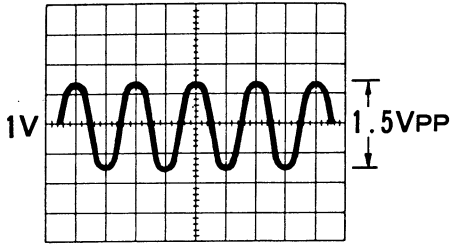


X73-1430-00
(VERTICAL OUTPUT AMP UNIT)



WAVEFORM

①



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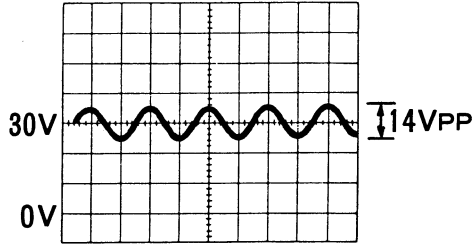
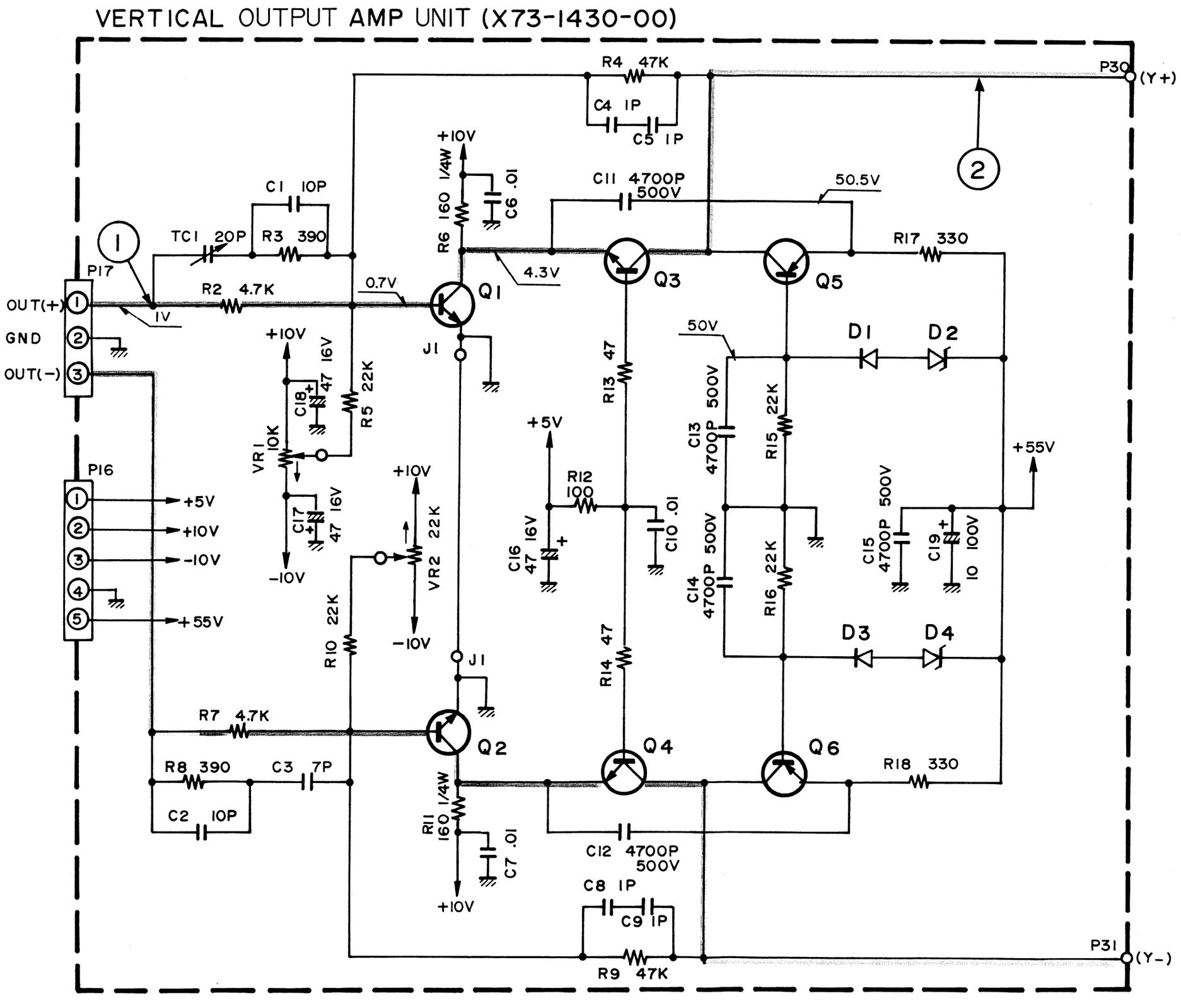


SCHEMATIC DIAGRAM

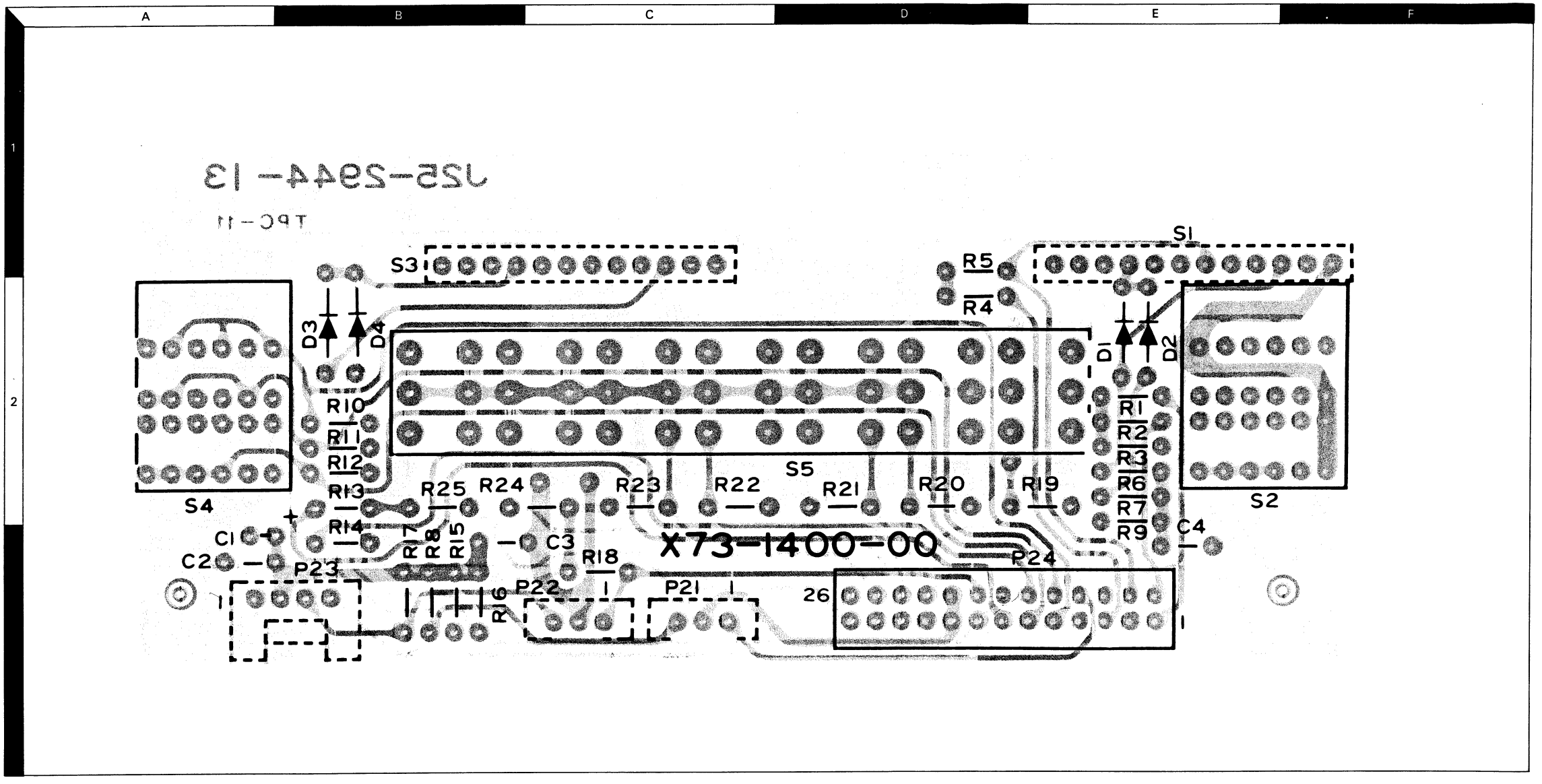
X73-1430-00



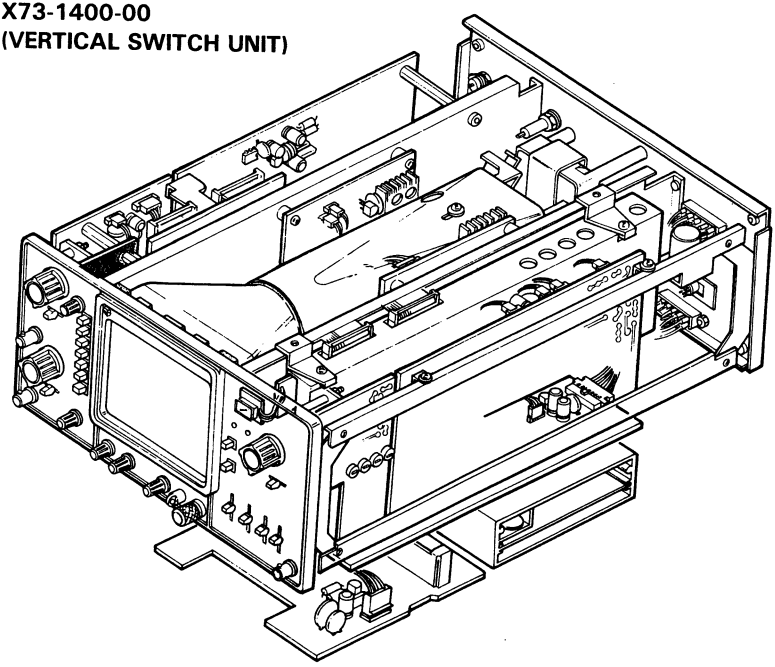
Q1,2 :2SC1973(T)
Q3,4 :2SC805A-2(3)
Q5,6 :2SA923-2(2,3)
D1,3 :DS442X
D2,4 :WZ-050

P.C. BOARD

X73-1400-00

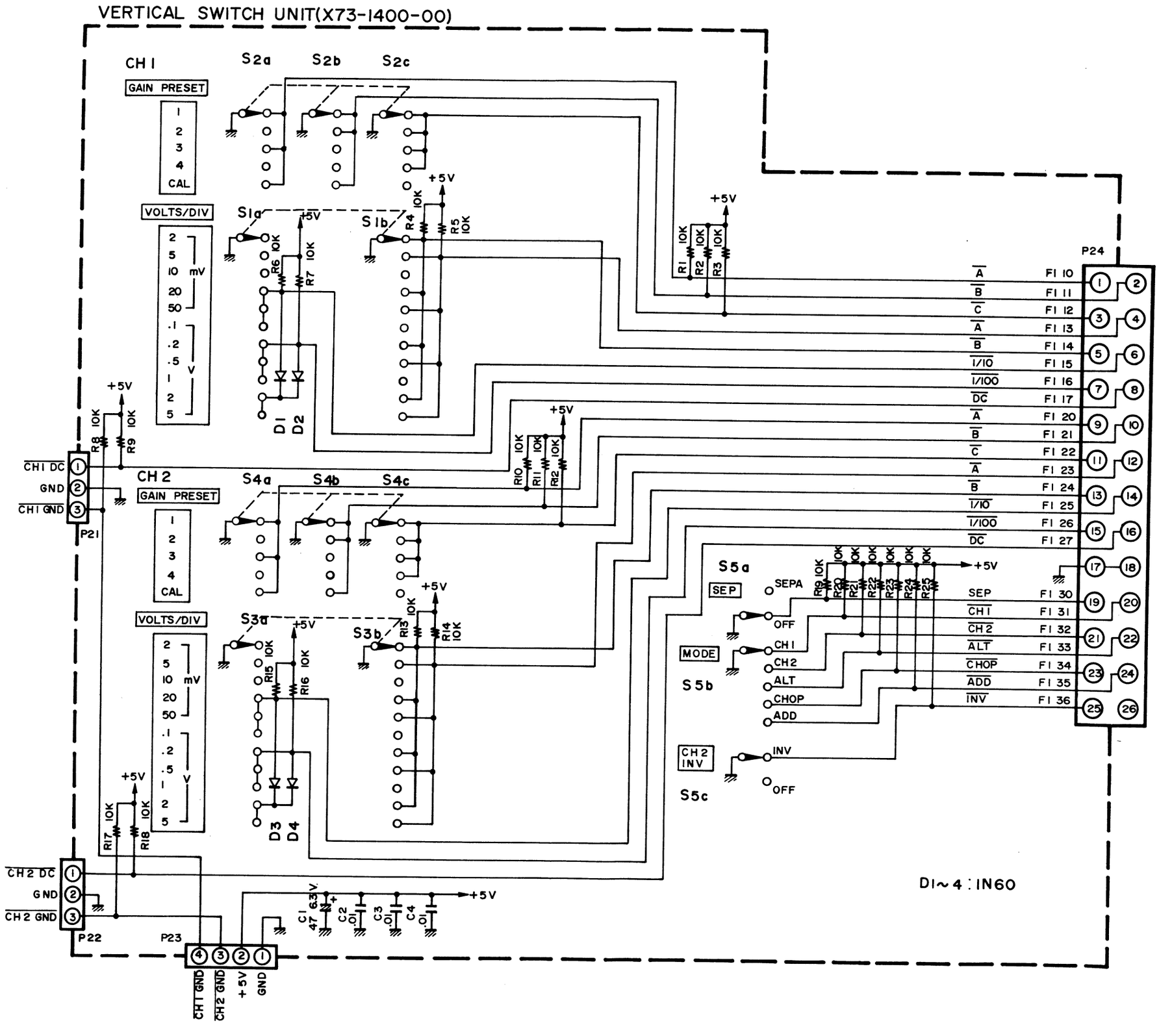


X73-1400-00
(VERTICAL SWITCH UNIT)



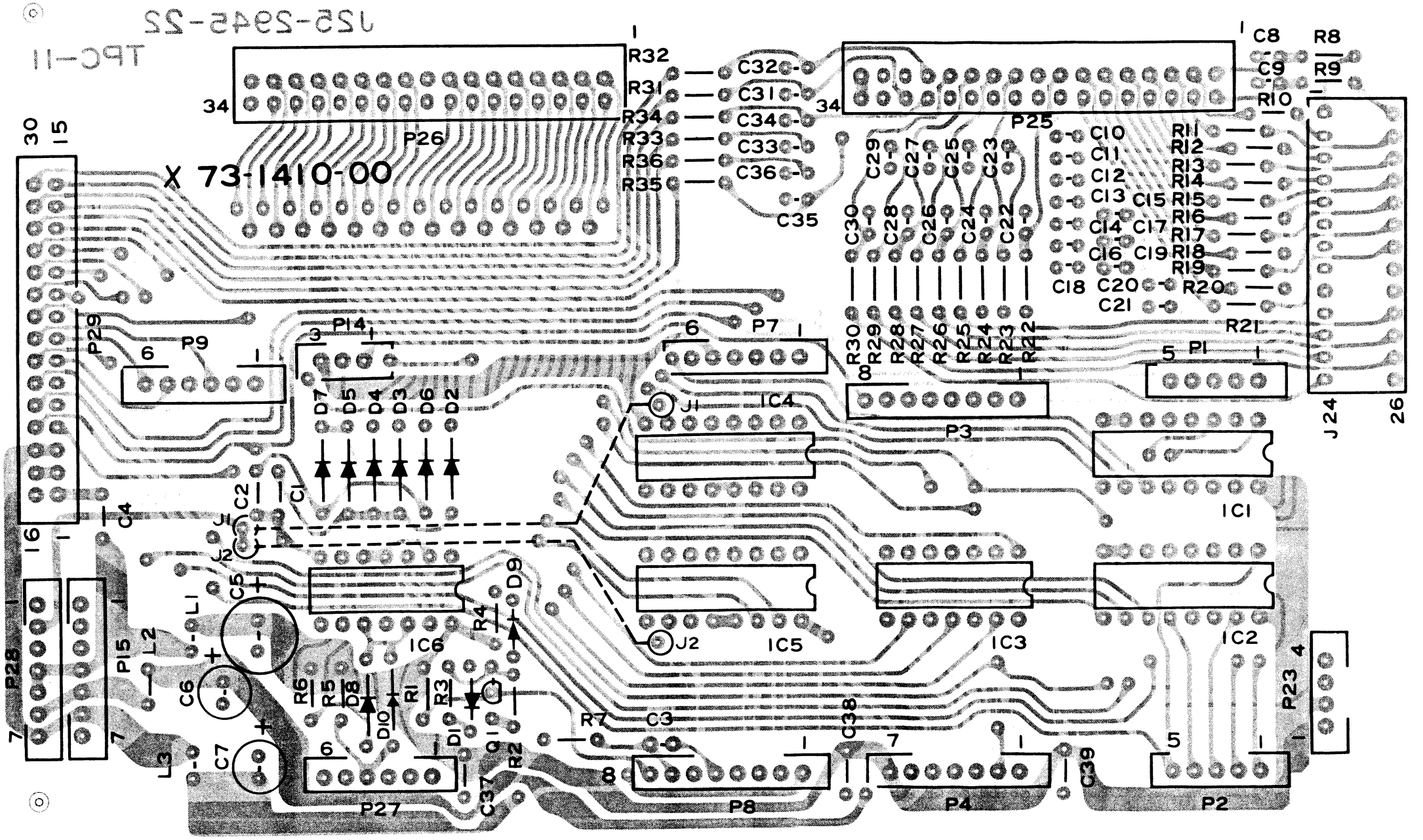
SCHEMATIC DIAGRAM

X73-1400-00

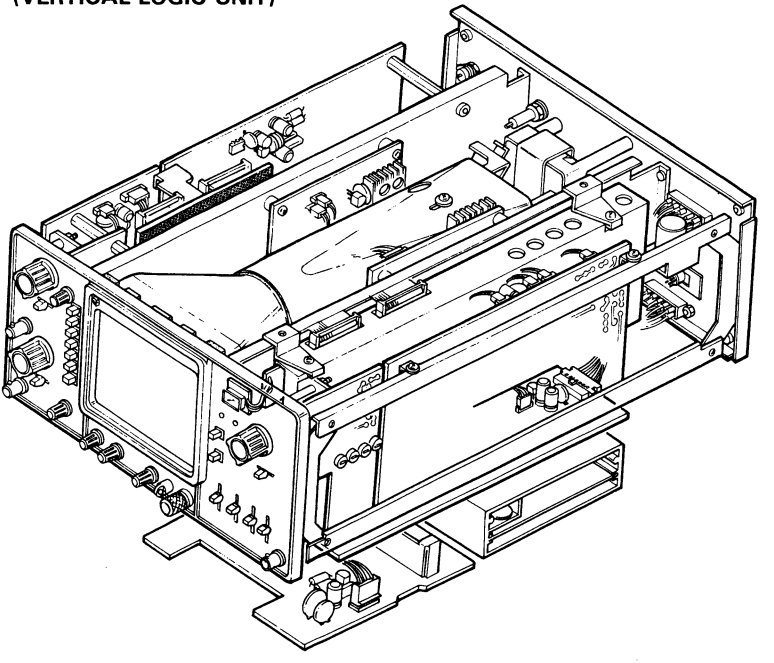


P.C. BOARD

X73-1410-00



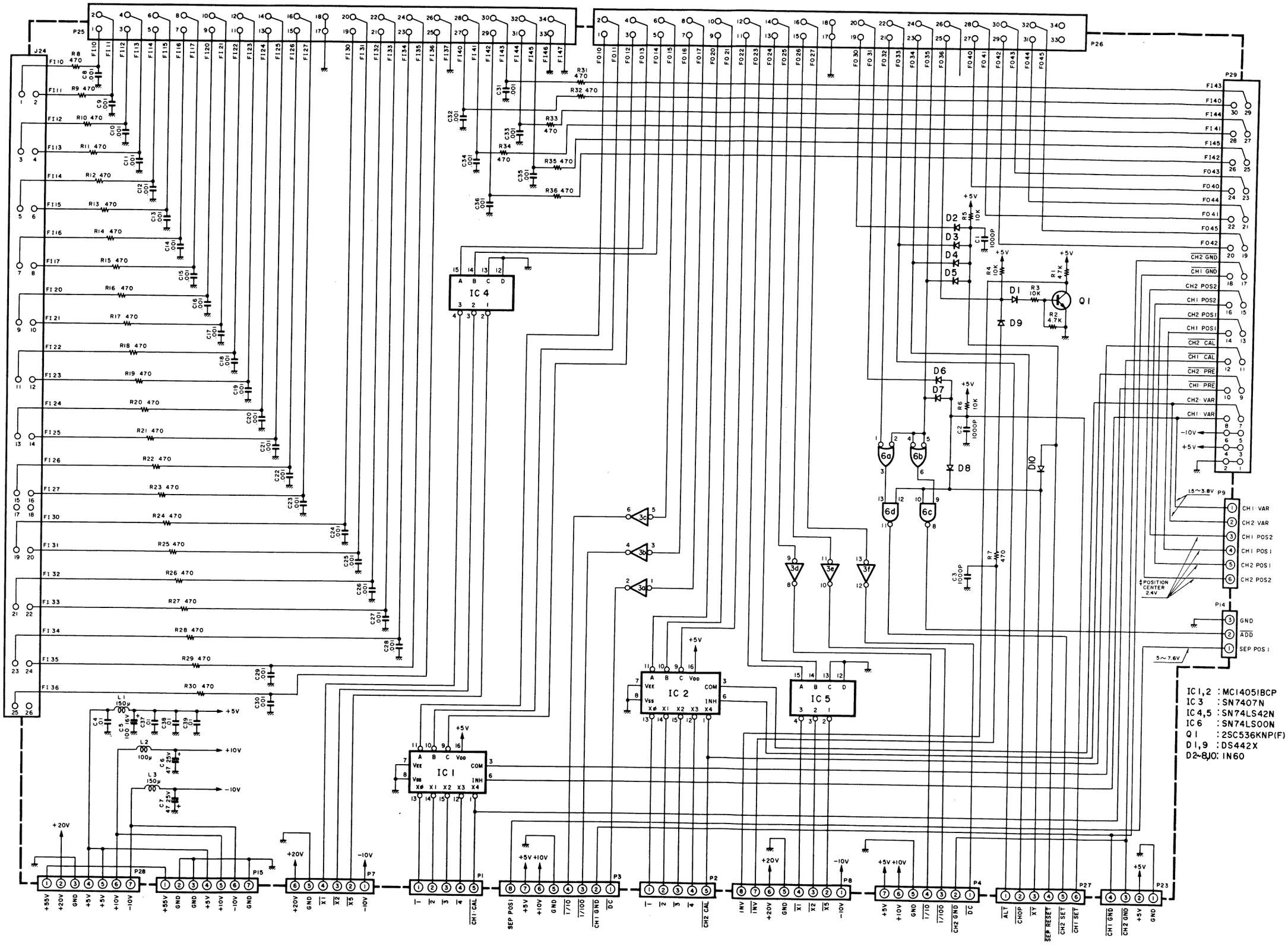
X73-1410-00
(VERTICAL LOGIC UNIT)



SCHEMATIC DIAGRAM

X73-1410-00

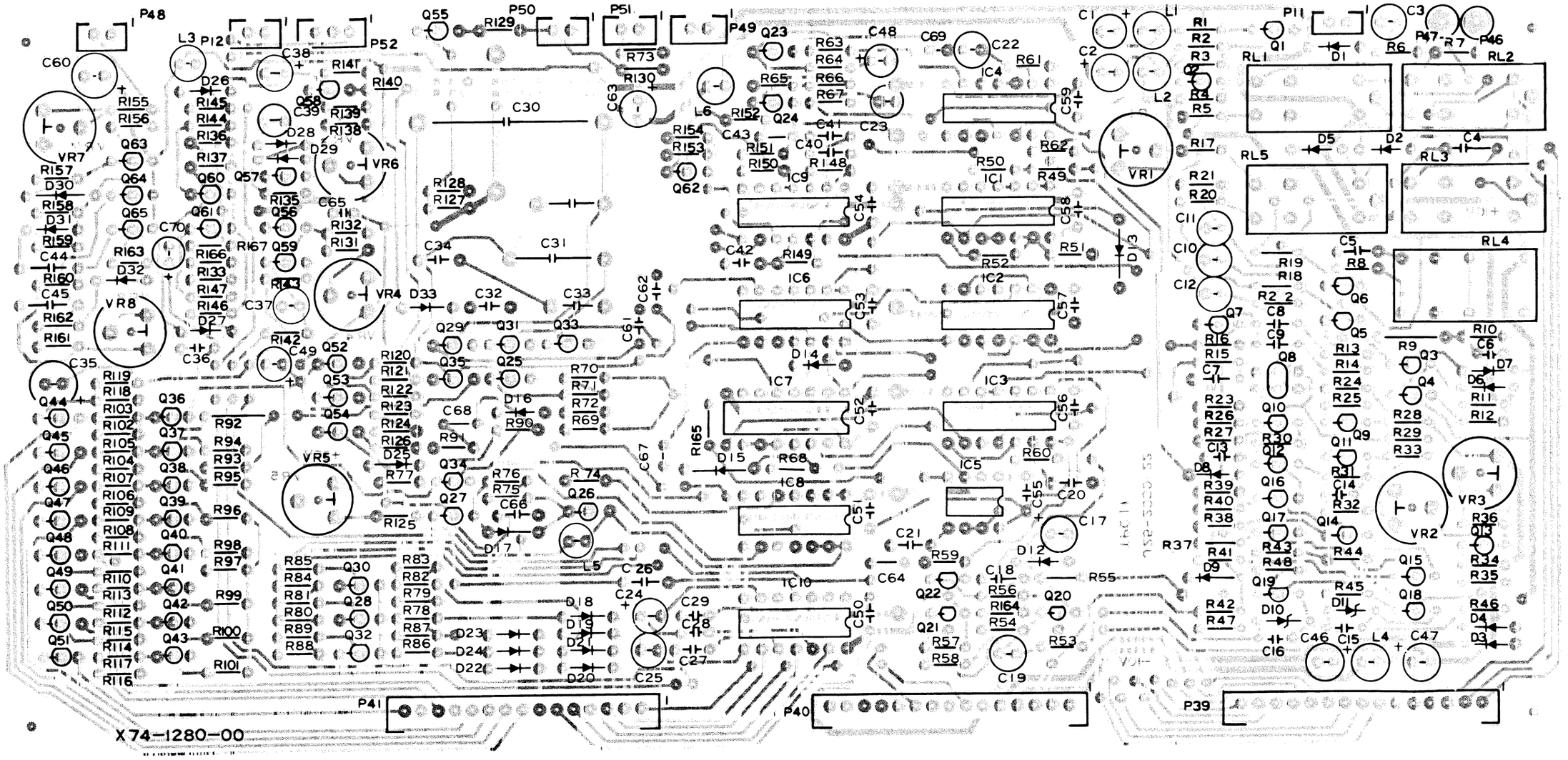
VERTICAL LOGIC UNIT (X73-1410-00)



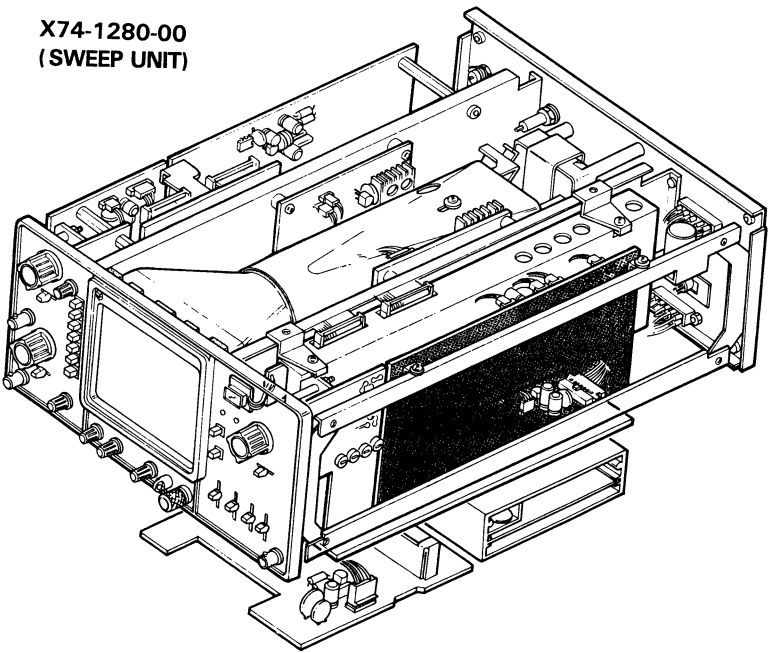
IC 1,2 : MC14051BCP
IC 3 : SN7407N
IC 4,5 : SN74LS42N
IC 6 : SN74LS00N
Q 1 : 2SC536KNP(F)
D 1,9 : DS442X
D 2~8,10 : IN60

P.C. BOARD

X74-1280-00

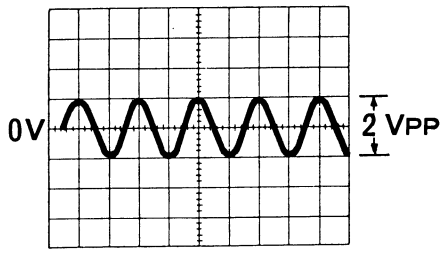


X74-1280-00
(SWEEP UNIT)

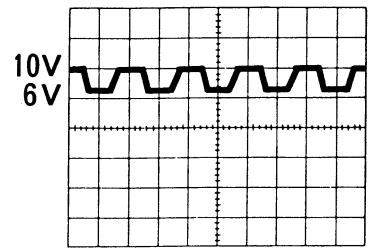


WAVEFORM

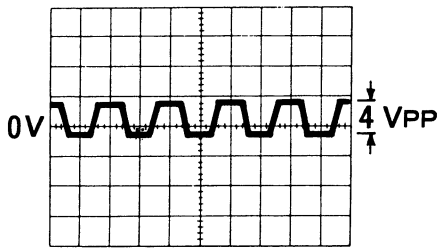
① ②



③ ④



⑤ ⑥



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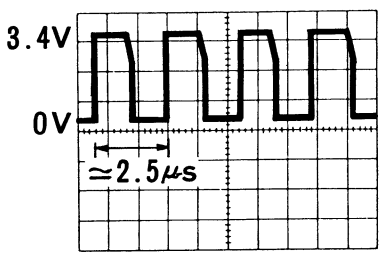
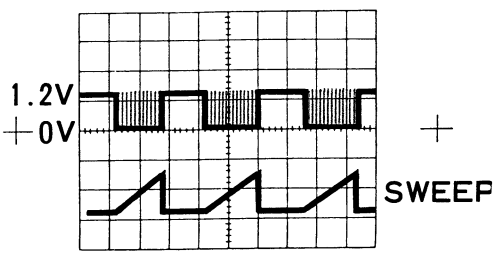
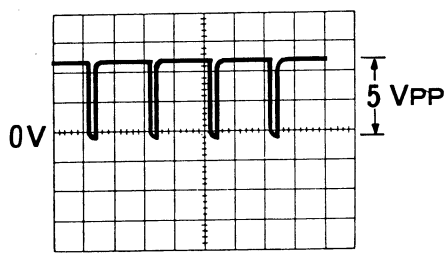


MODE: CHOP

⑧

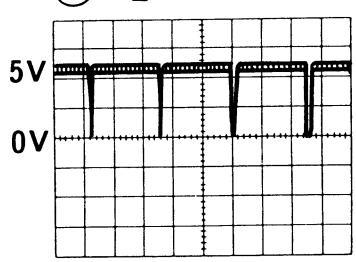


⑨-1



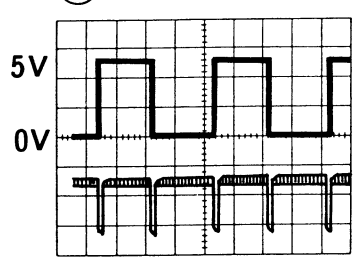
VIDEO LINE

⑨-2



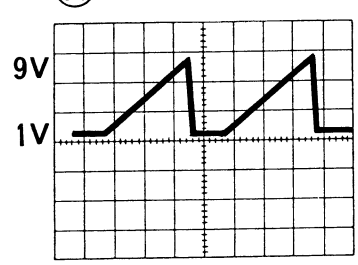
VIDEO FRAME

⑩

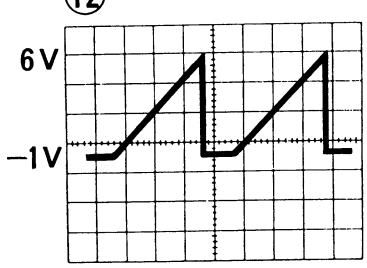


VIDEO FRAME

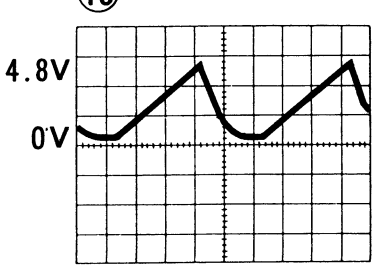
⑪



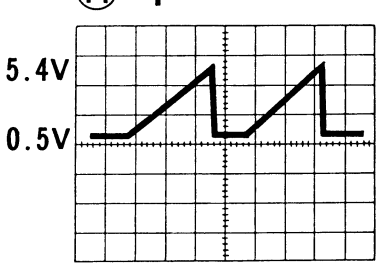
⑫



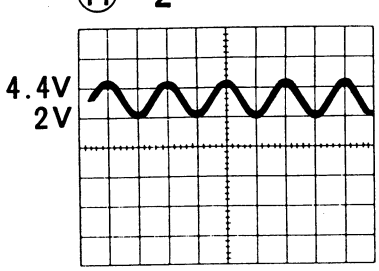
⑬



⑭-1

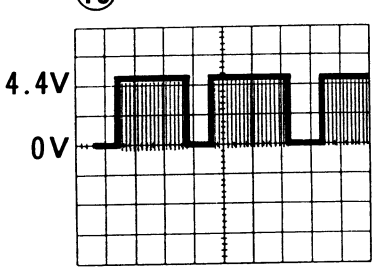


⑭-2



XY

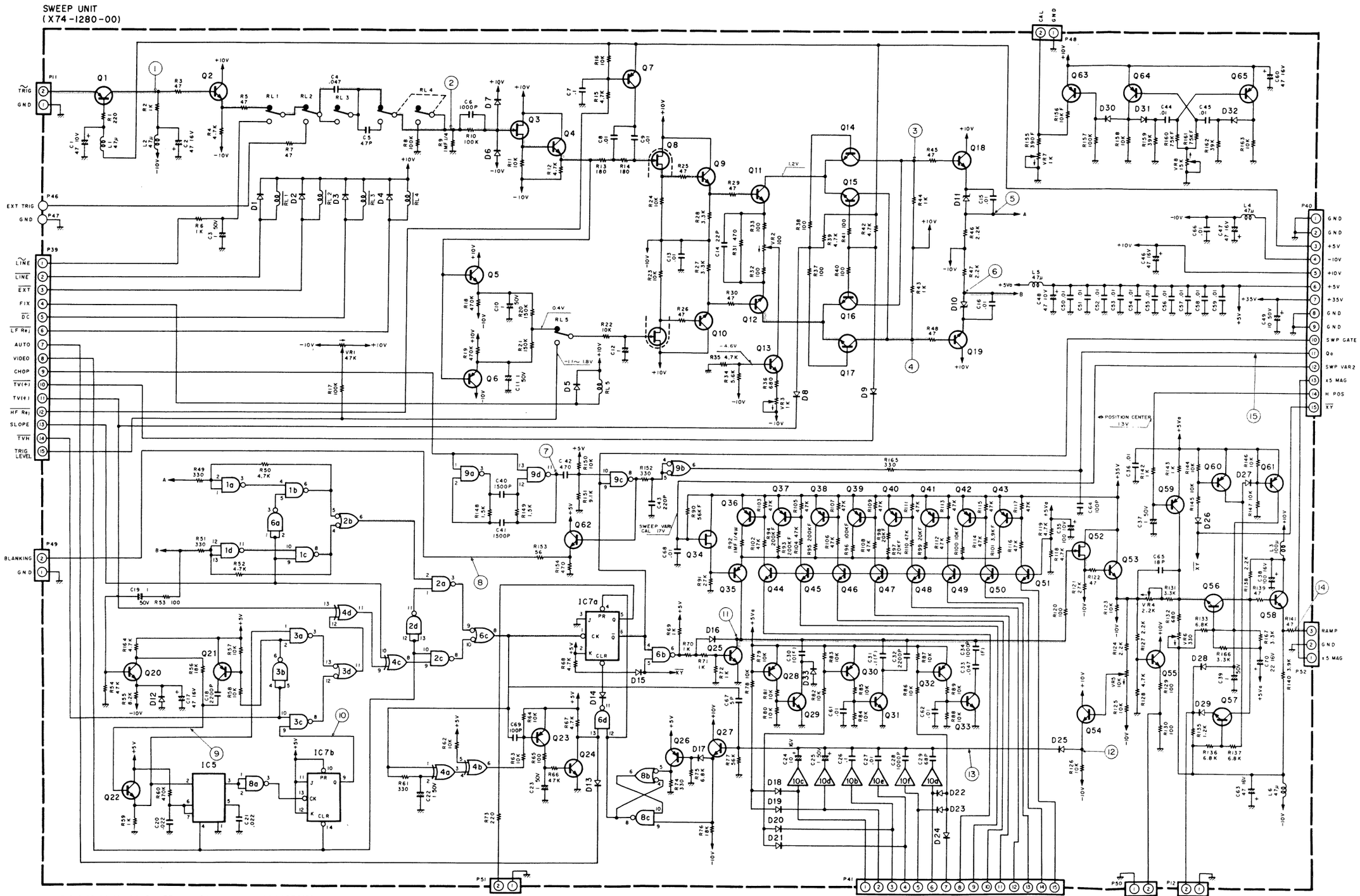
⑮



NOTE: ▨ CHOP OPERATION

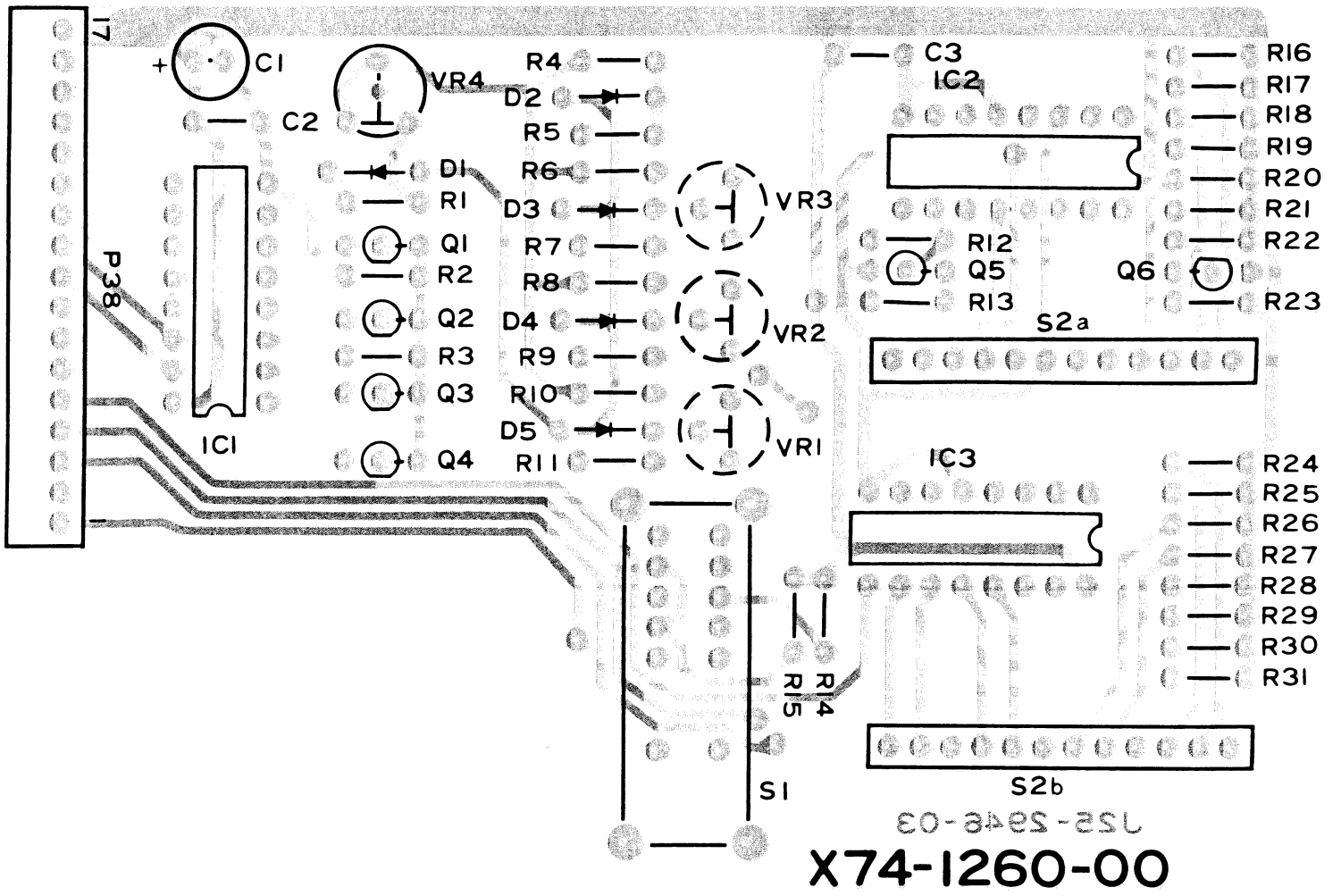
SCHEMATIC DIAGRAM

X74-1280-00

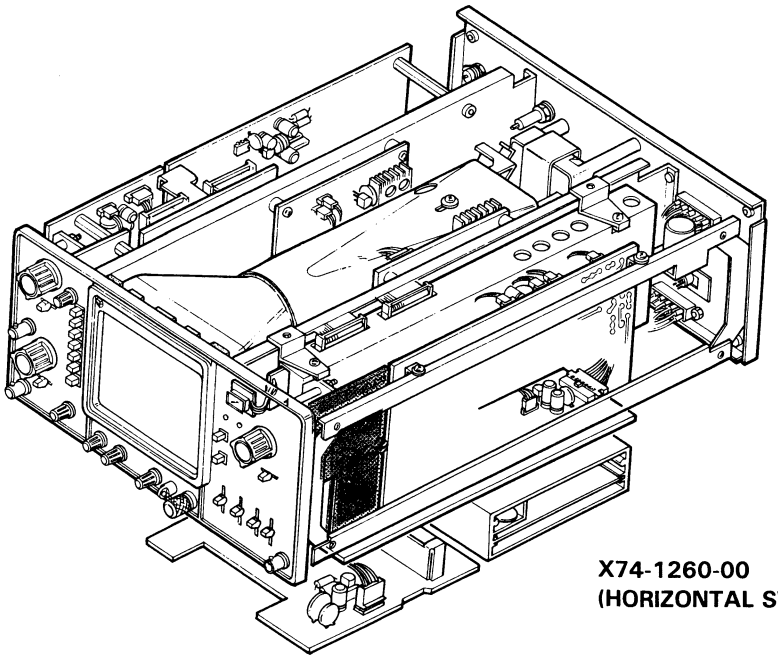


P.C. BOARD

X74-1260-00



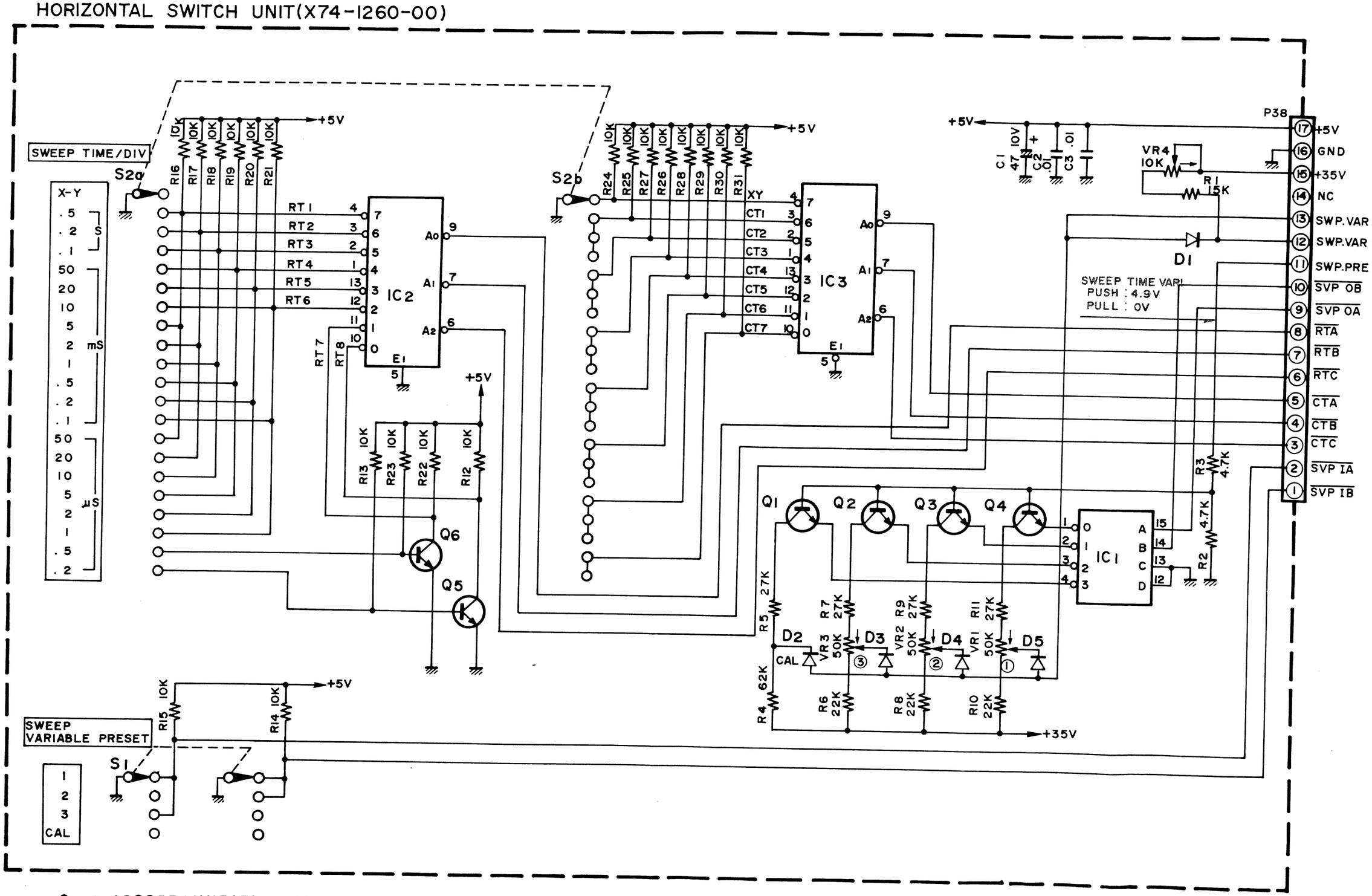
X74-1260-00



X74-1260-00
(HORIZONTAL SWITCH UNIT)

SCHEMATIC DIAGRAM

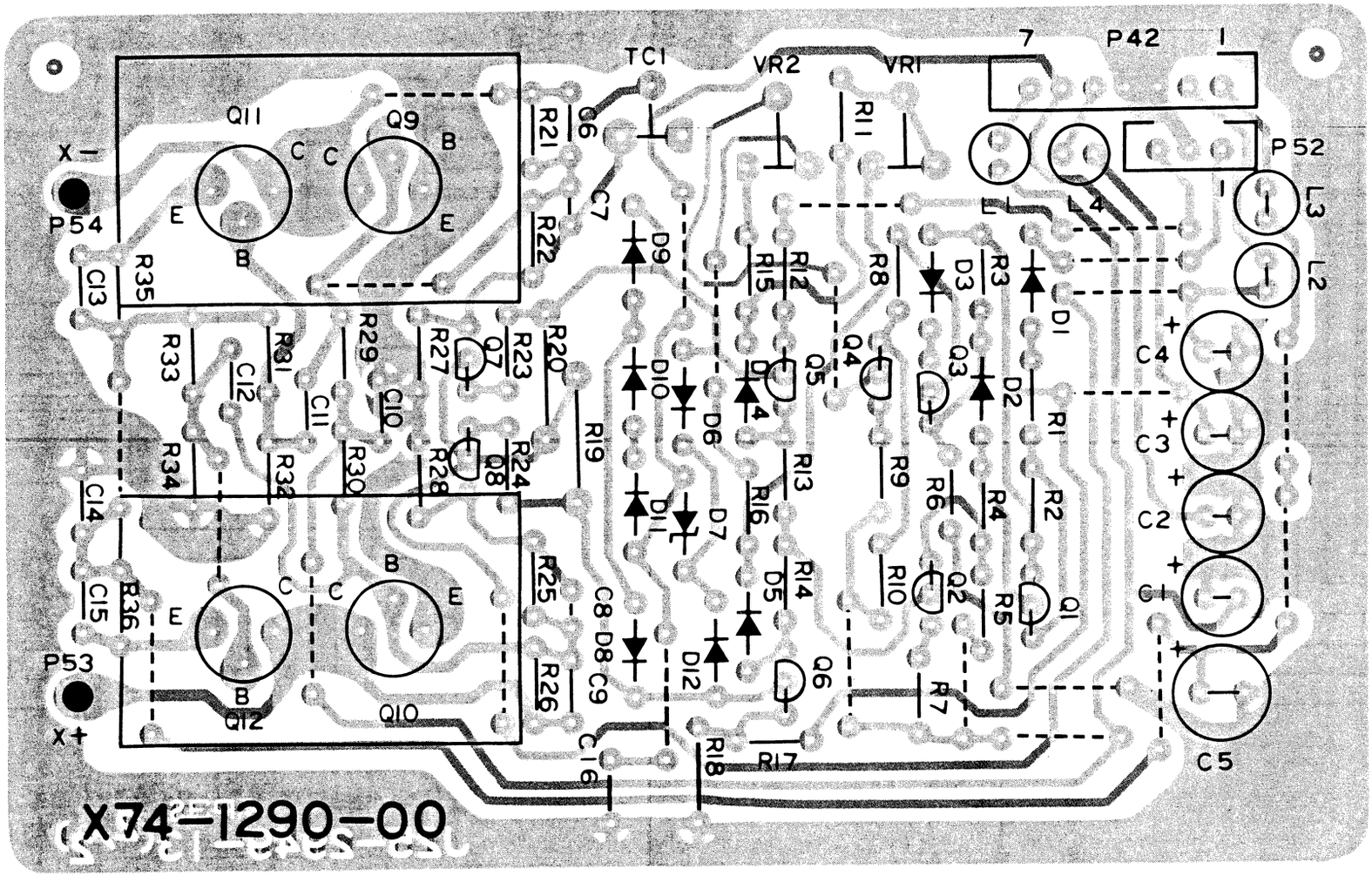
X74-1260-00



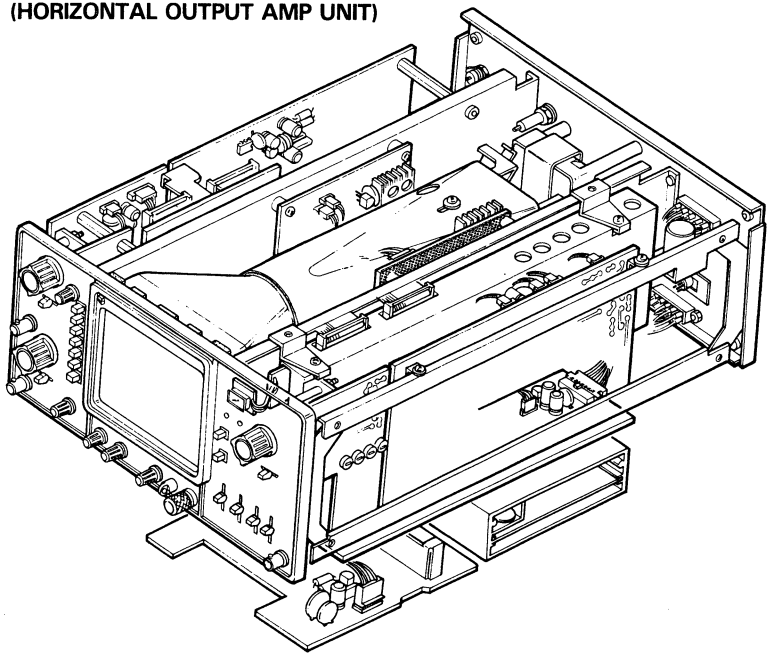
Q1~6 : 2SC536KNP(F) IC1 : SN74LS42N IC2,3 : SN74LS148N D1~5 : DS442X

P.C. BOARD

X74-1290-00

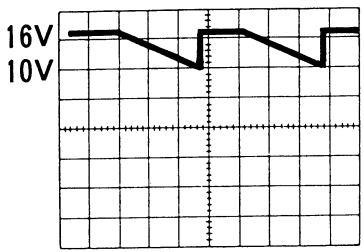


X74-1290-00
(HORIZONTAL OUTPUT AMP UNIT)



WAVEFORM

①



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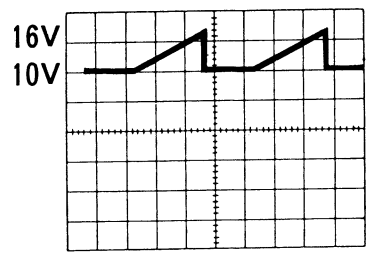
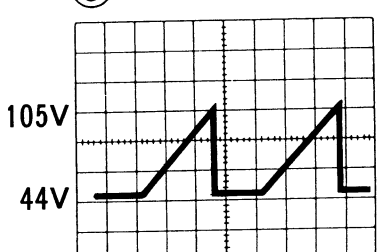


③



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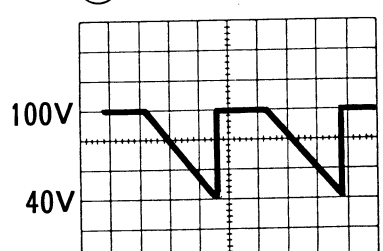
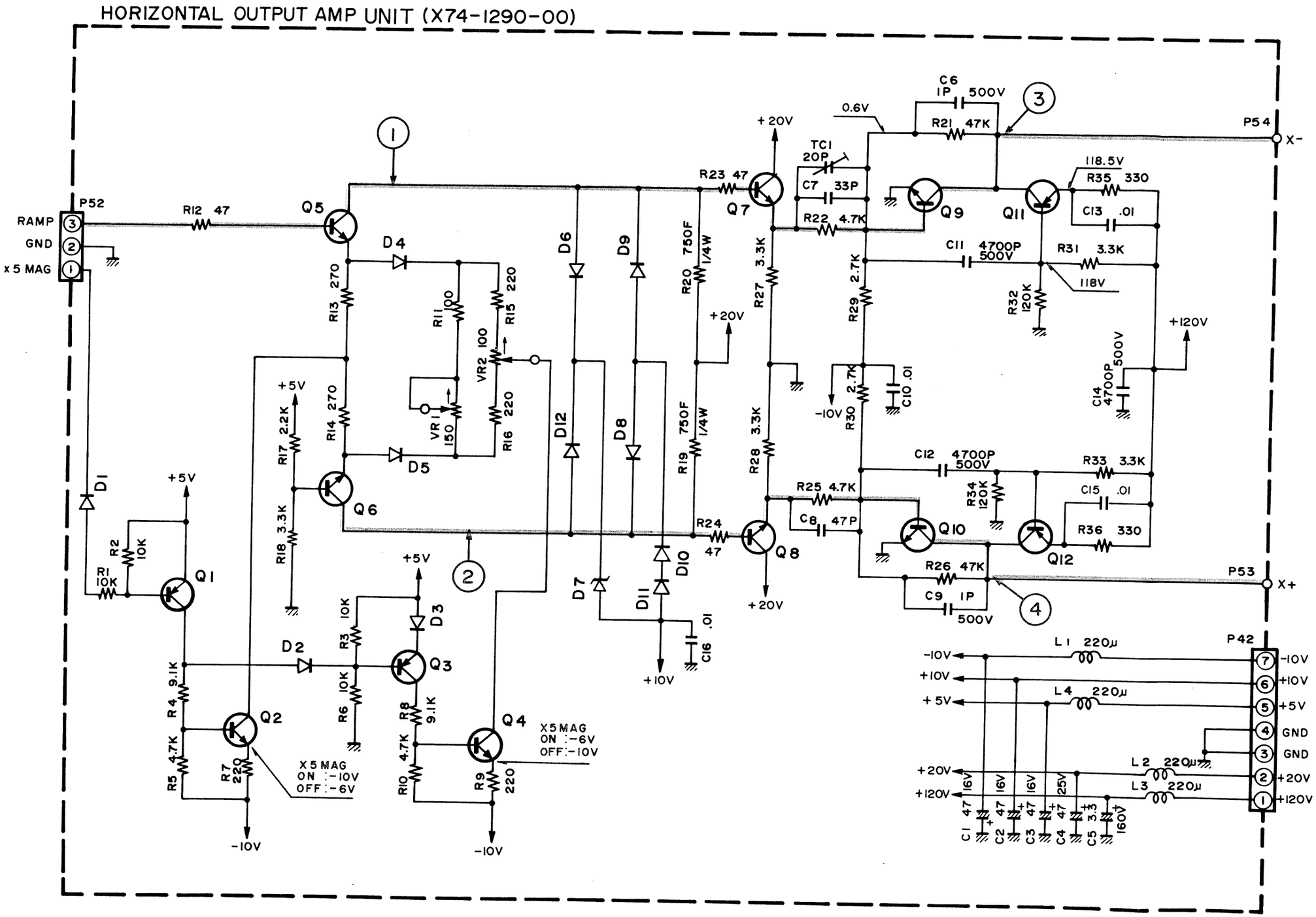


SCHEMATIC DIAGRAM

X74-1290-00

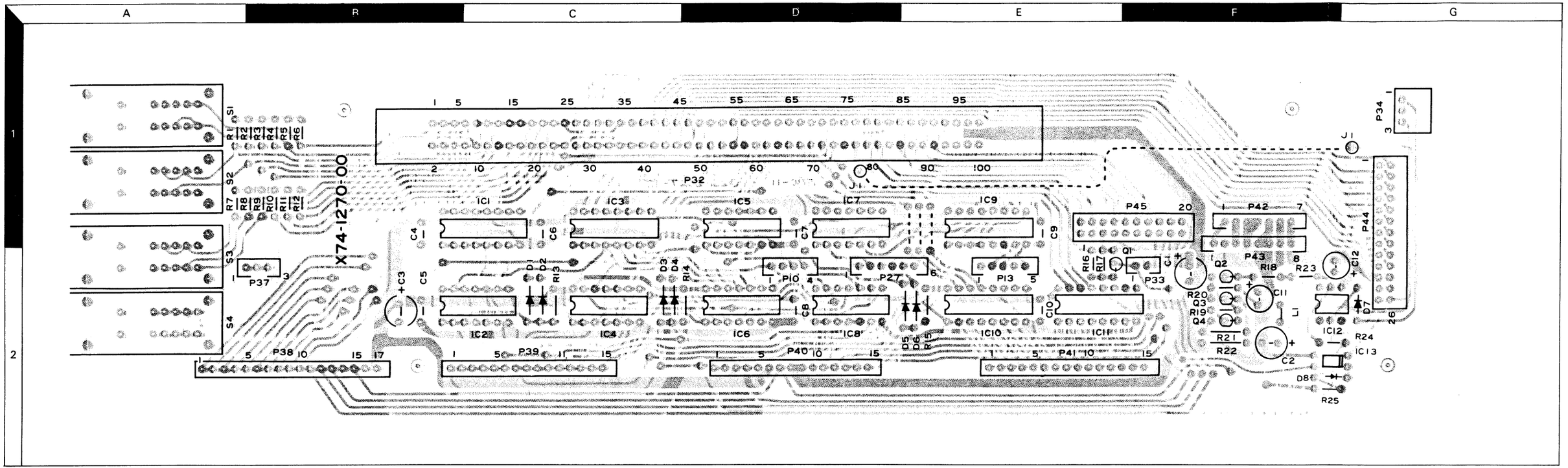


Q1,3 : 2SA608KNP(F)
Q2,4 : 2SC536KNP(F)
Q5~8 : 2SC1973(T)
Q9,10 : 2SC805A-2(3)
Q11,12 : 2SA923-2(2,3)

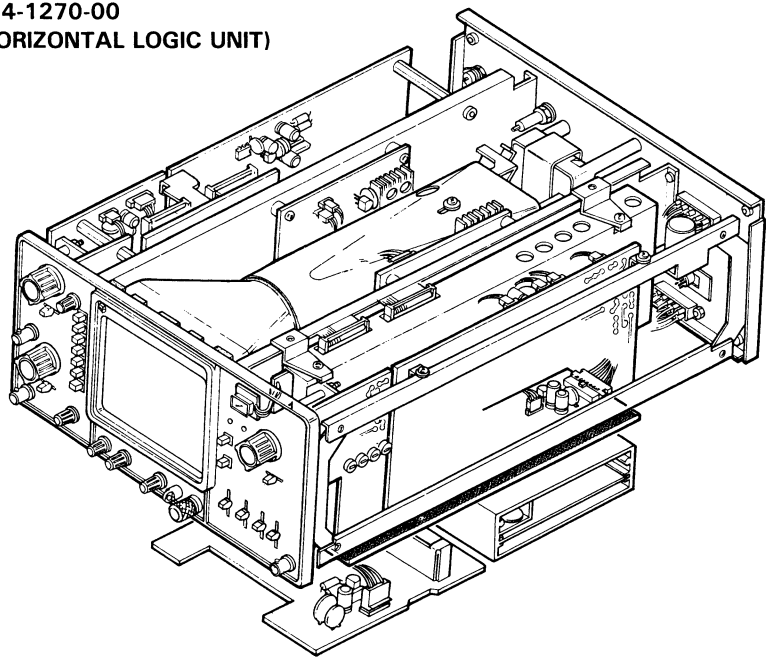
D1~6, 8~12 : DS442X
D7 : WZ-071

P.C. BOARD

X74-1270-00

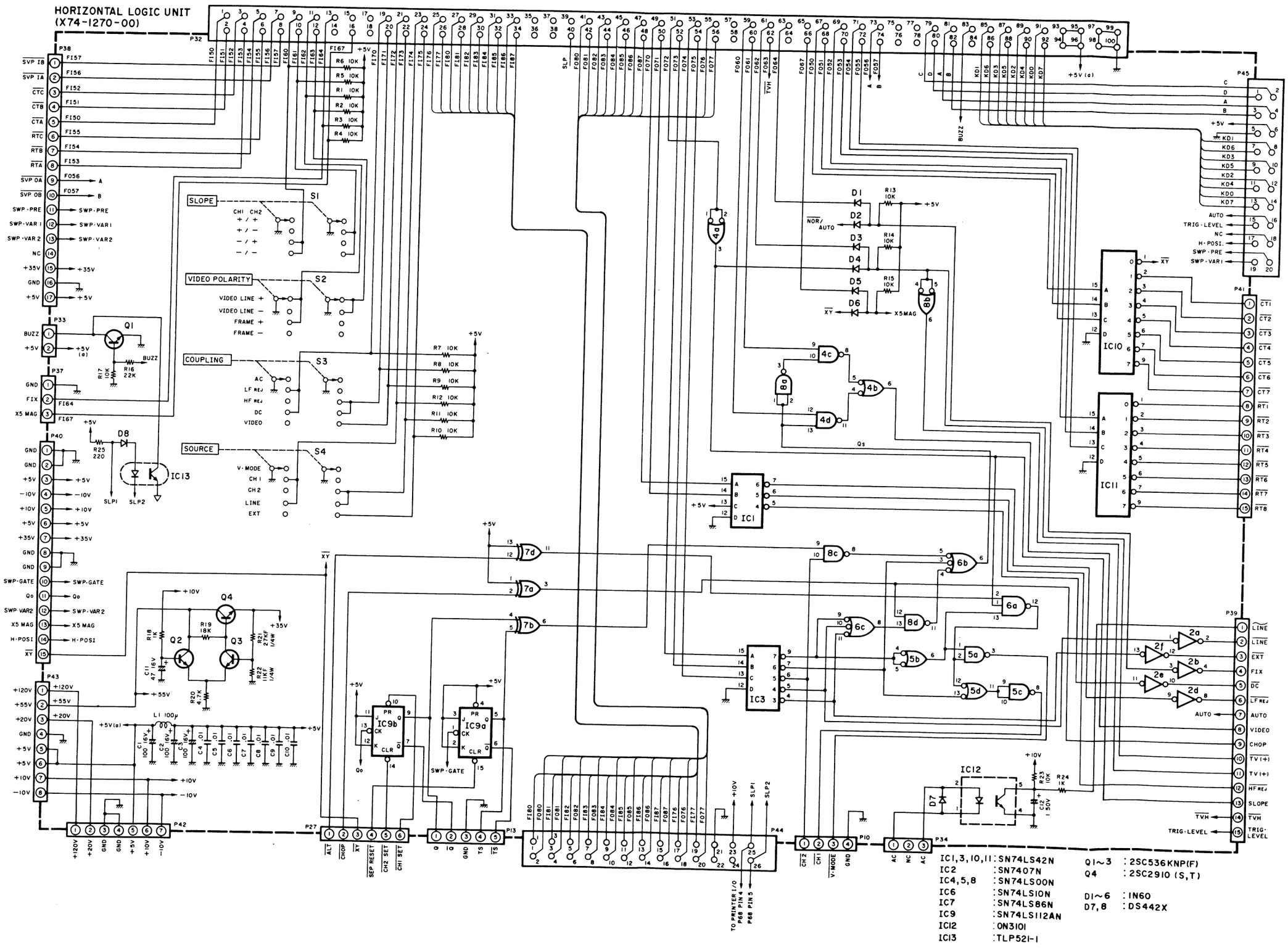


X74-1270-00
(HORIZONTAL LOGIC UNIT)



SCHEMATIC DIAGRAM

X74-1270-00



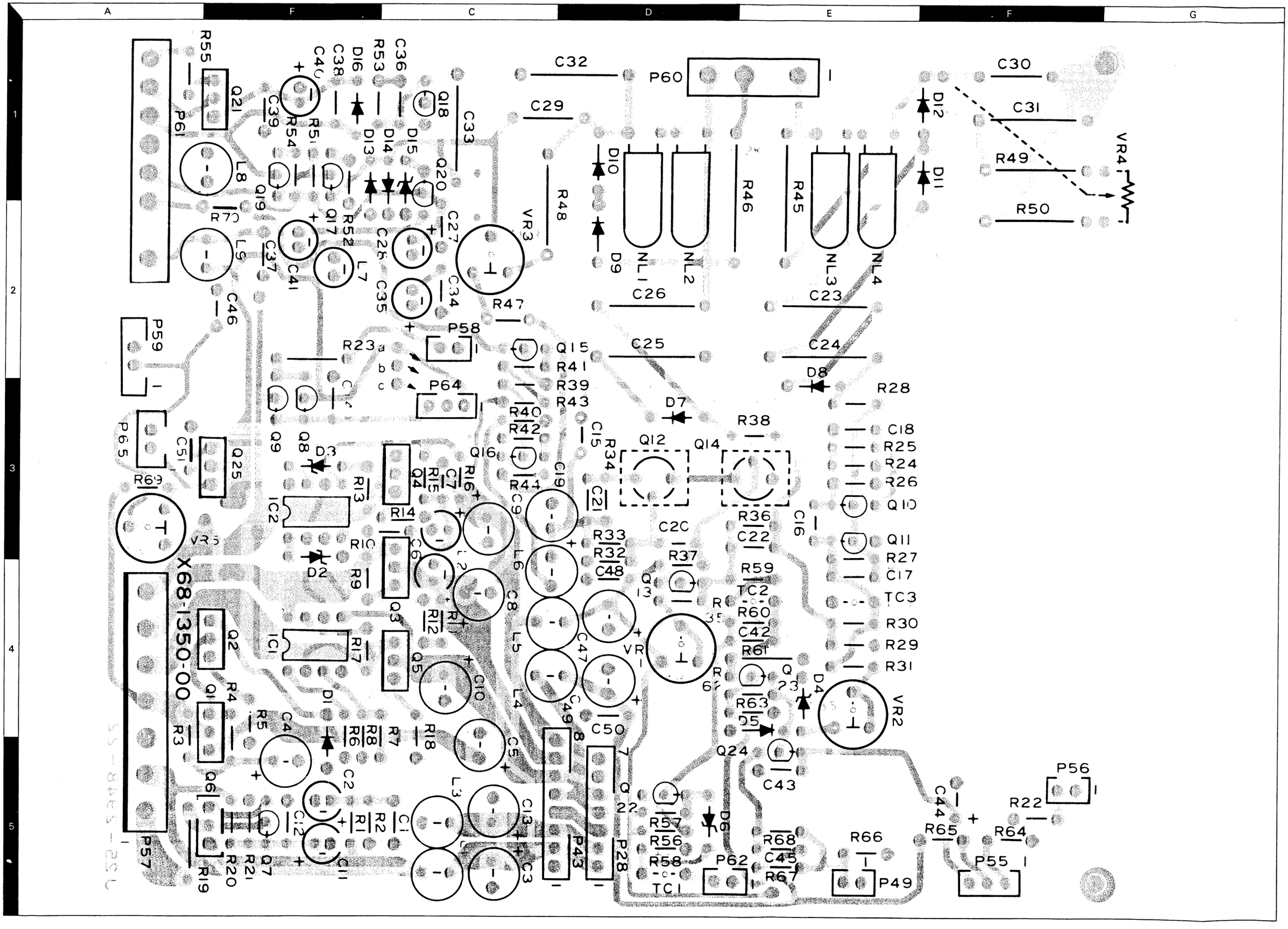
IC1,3,10,11 : SN74LS42N
IC2 : SN7407N
IC4,5,8 : SN74LS00N
IC6 : SN74LS10N
IC7 : SN74LS86N
IC9 : SN74LS112AN
IC12 : ON3101
IC13 : TLP521-1

Q1~3 : 2SC536KNP(F)
Q4 : 2SC2910 (S,T)

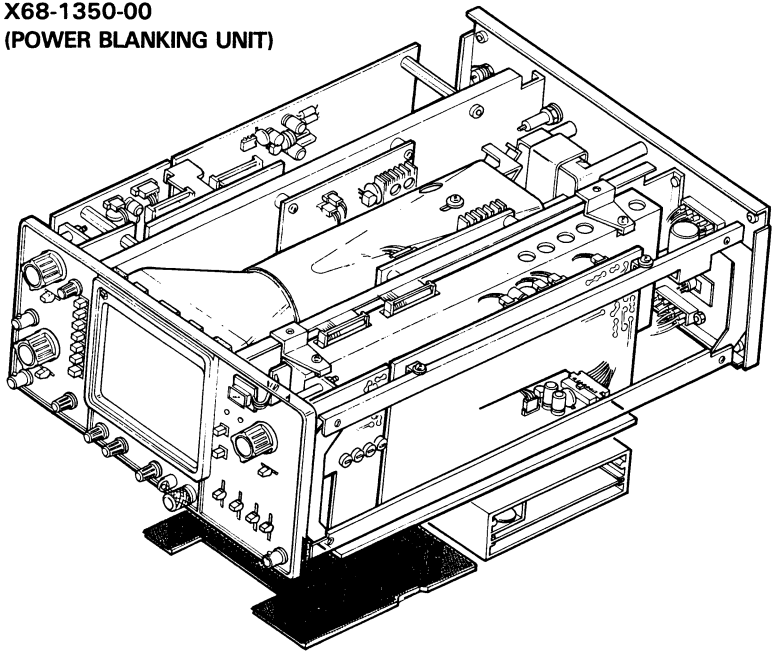
D1~6 : 1N60
D7,8 : DS442X

P.C. BOARD

X68-1350-00



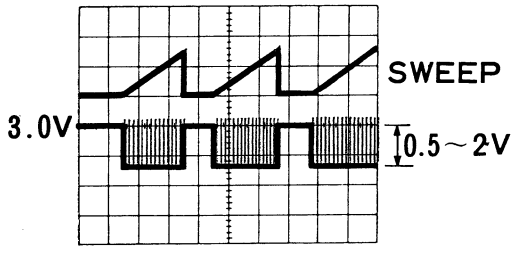
X68-1350-00
(POWER BLANKING UNIT)



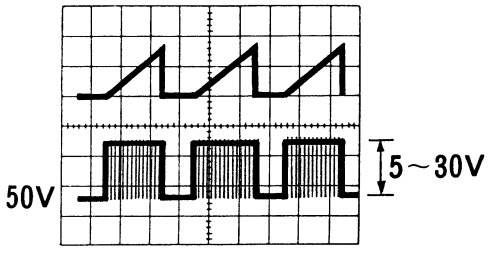
WAVEFORM

NOTE: ▒▒▒ CHOP OPERATION

①



②



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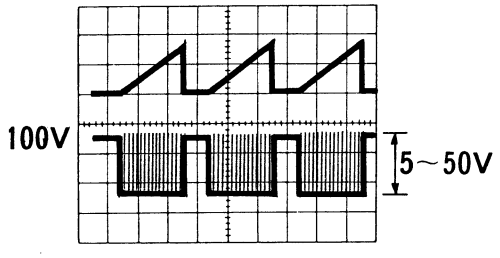

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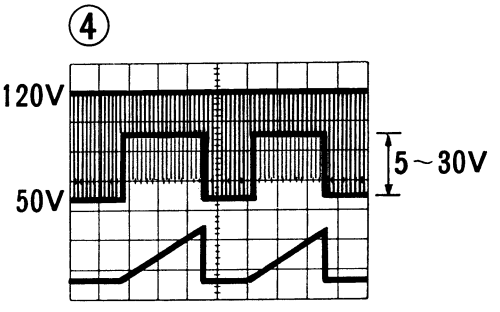

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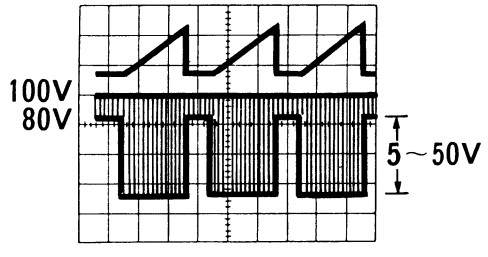

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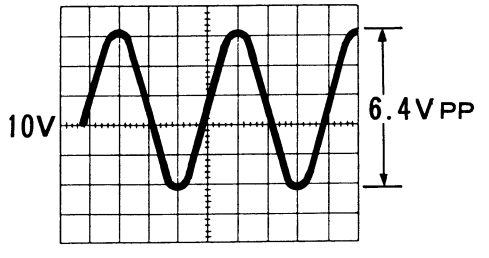

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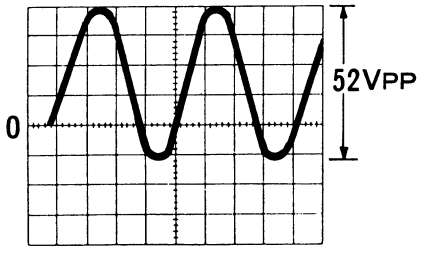
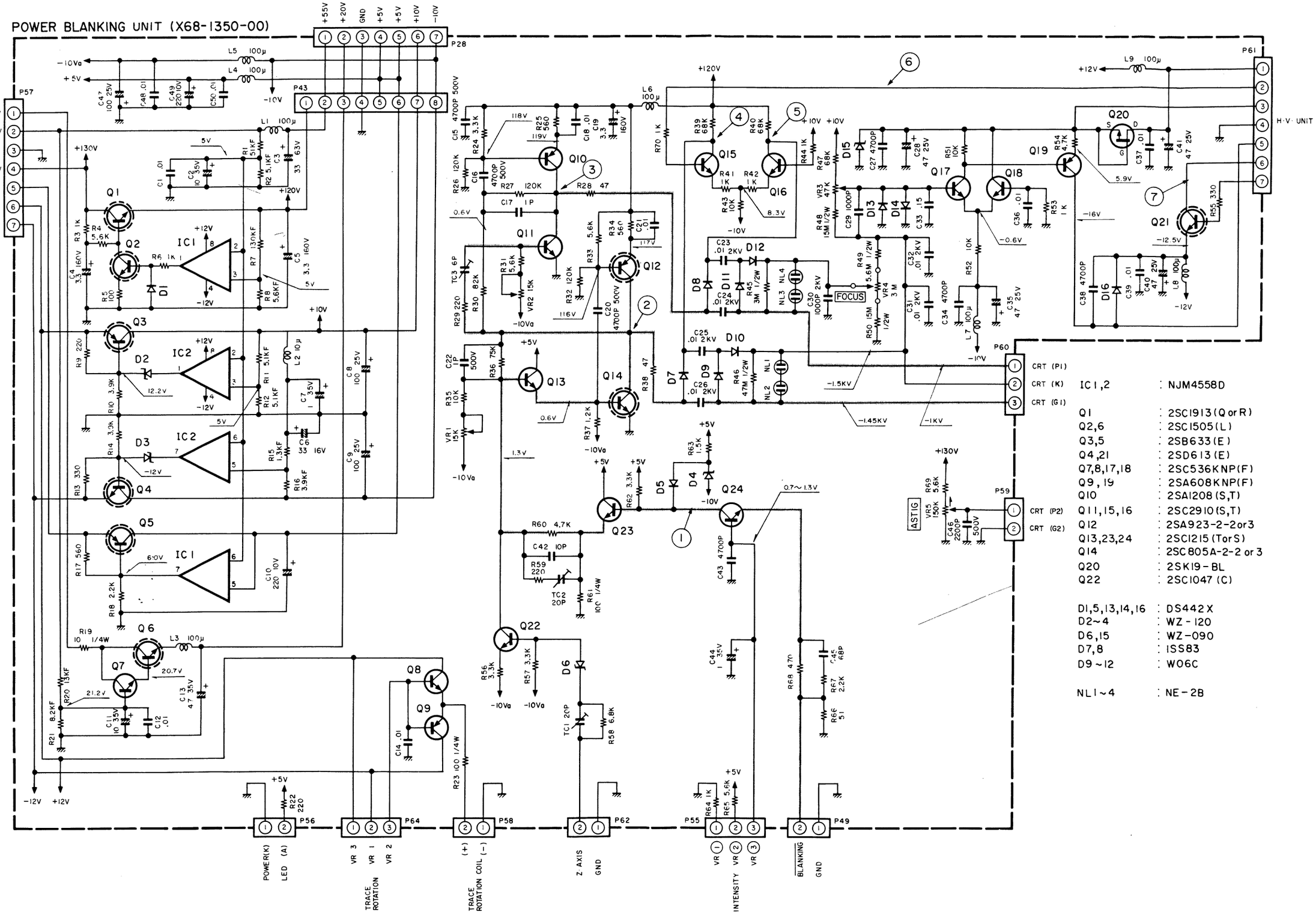


SCHEMATIC DIAGRAM

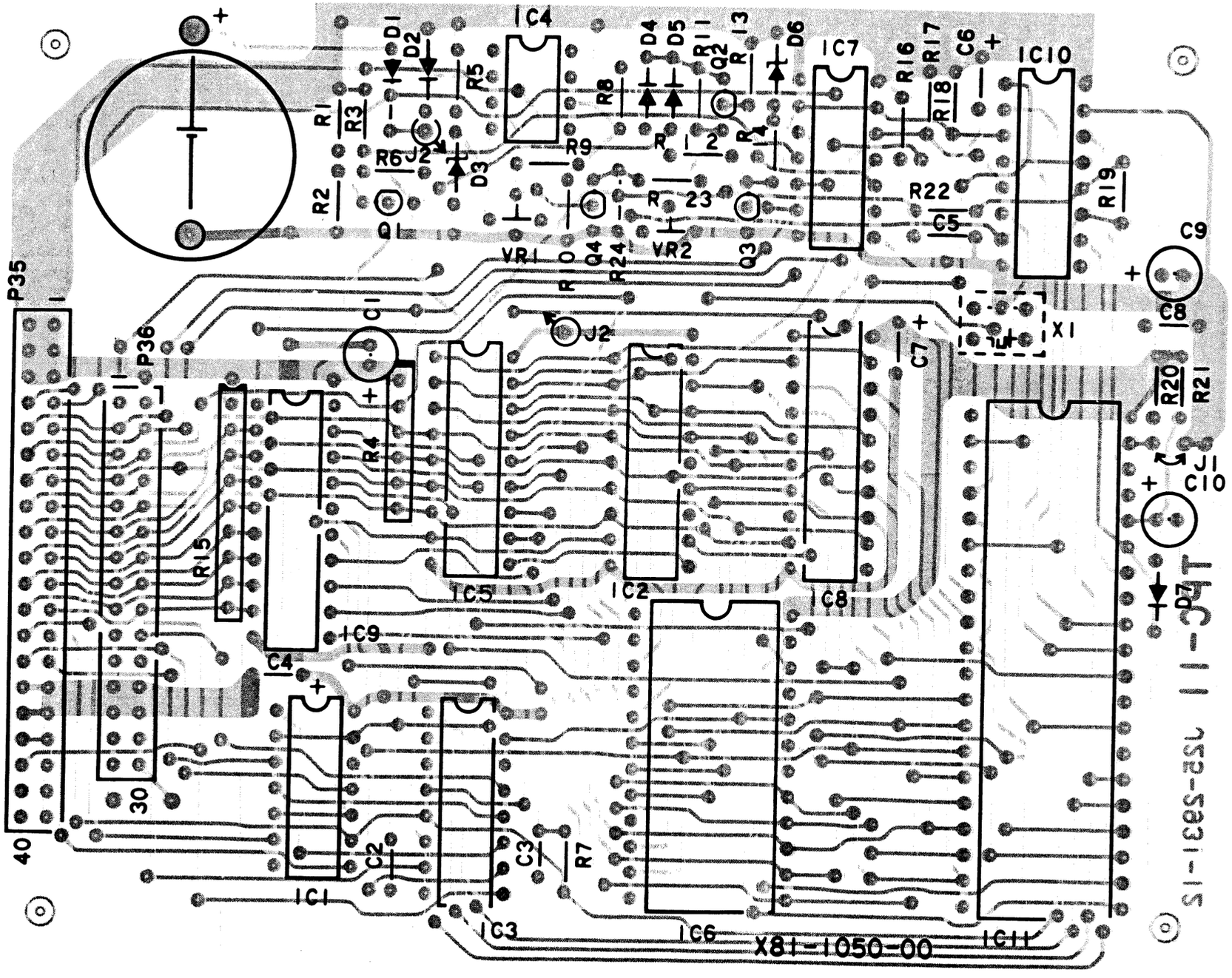
X68-1350-00



IC1,2	: NJM4558D
Q1	: 2SC1913(Q or R)
Q2,6	: 2SC1505(L)
Q3,5	: 2SB633(E)
Q4,21	: 2SD613(E)
Q7,8,17,18	: 2SC536KNP(F)
Q9, 19	: 2SA608KNP(F)
Q10	: 2SA1208(S,T)
Q11,15,16	: 2SC2910(S,T)
Q12	: 2SA923-2-2or3
Q13,23,24	: 2SC1215(TorS)
Q14	: 2SC805A-2-2 or 3
Q20	: 2SK19-BL
Q22	: 2SC1047(C)
D1,5,13,14,16	: DS442X
D2~4	: WZ-120
D6,15	: WZ-090
D7,8	: 1SS83
D9~12	: W06C
NL1~4	: NE-2B

P.C. BOARD

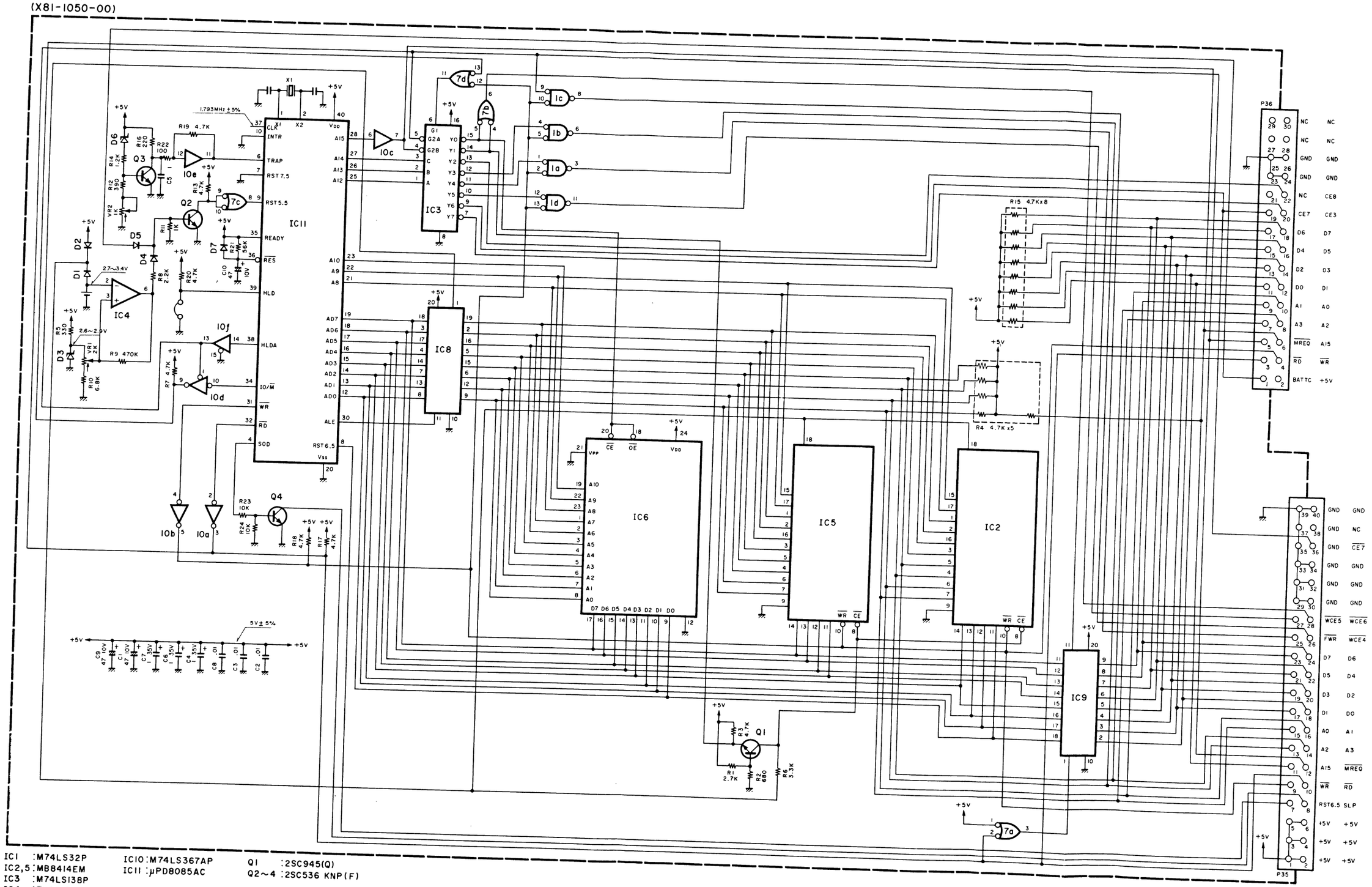
X81-1050-00



SCHEMATIC DIAGRAM

X81-1050-00

CPU UNIT
(X81-1050-00)



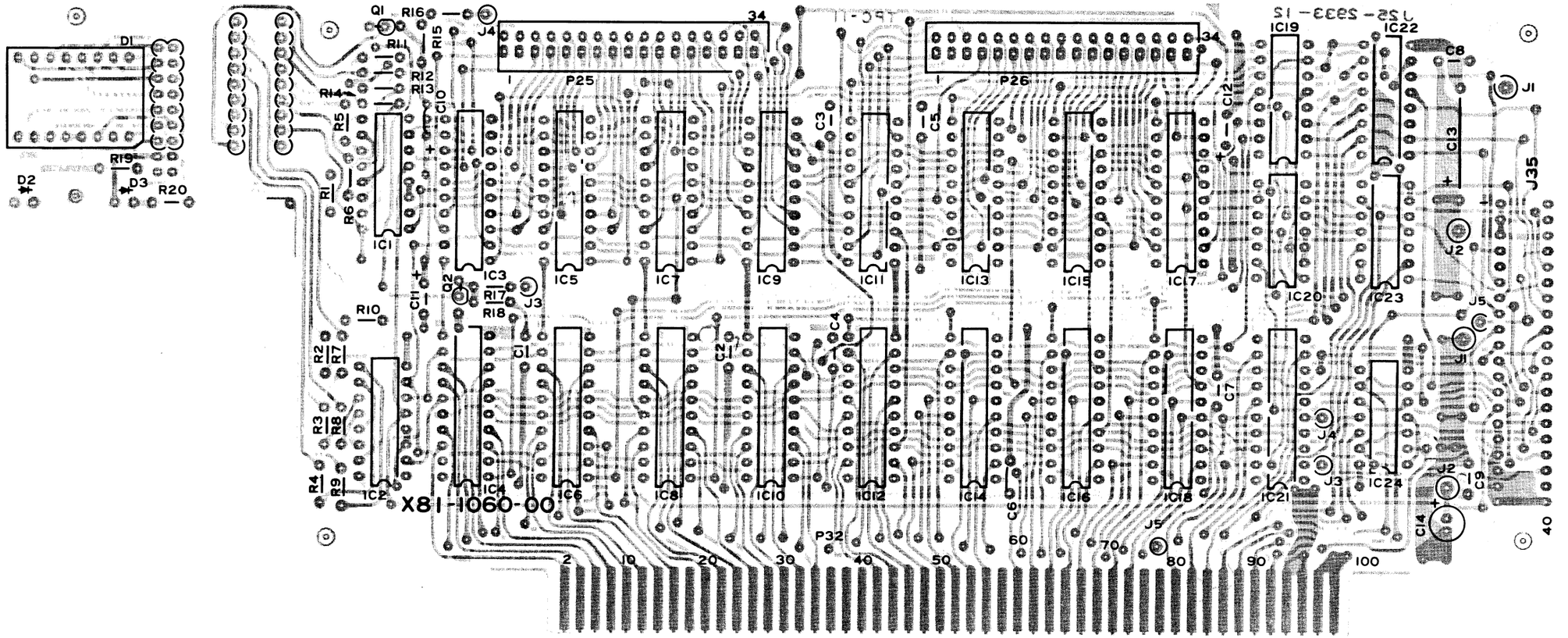
IC1 :M74LS32P
IC2,5 :MB8414EM
IC3 :M74LS138P
IC4 :TL061C
IC6 :MB8516EC
IC7 :M74LS00P
IC8 :M74LS373P
IC9 :MB74LS245M
IC10 :M74LS367AP
IC11 :μPD8085AC

Q1 :2SC945(Q)
Q2~4 :2SC536 KNP(F)

D1,2 :1S1544A
D3,6 :WZ-032
D4,5,7 :DS442X

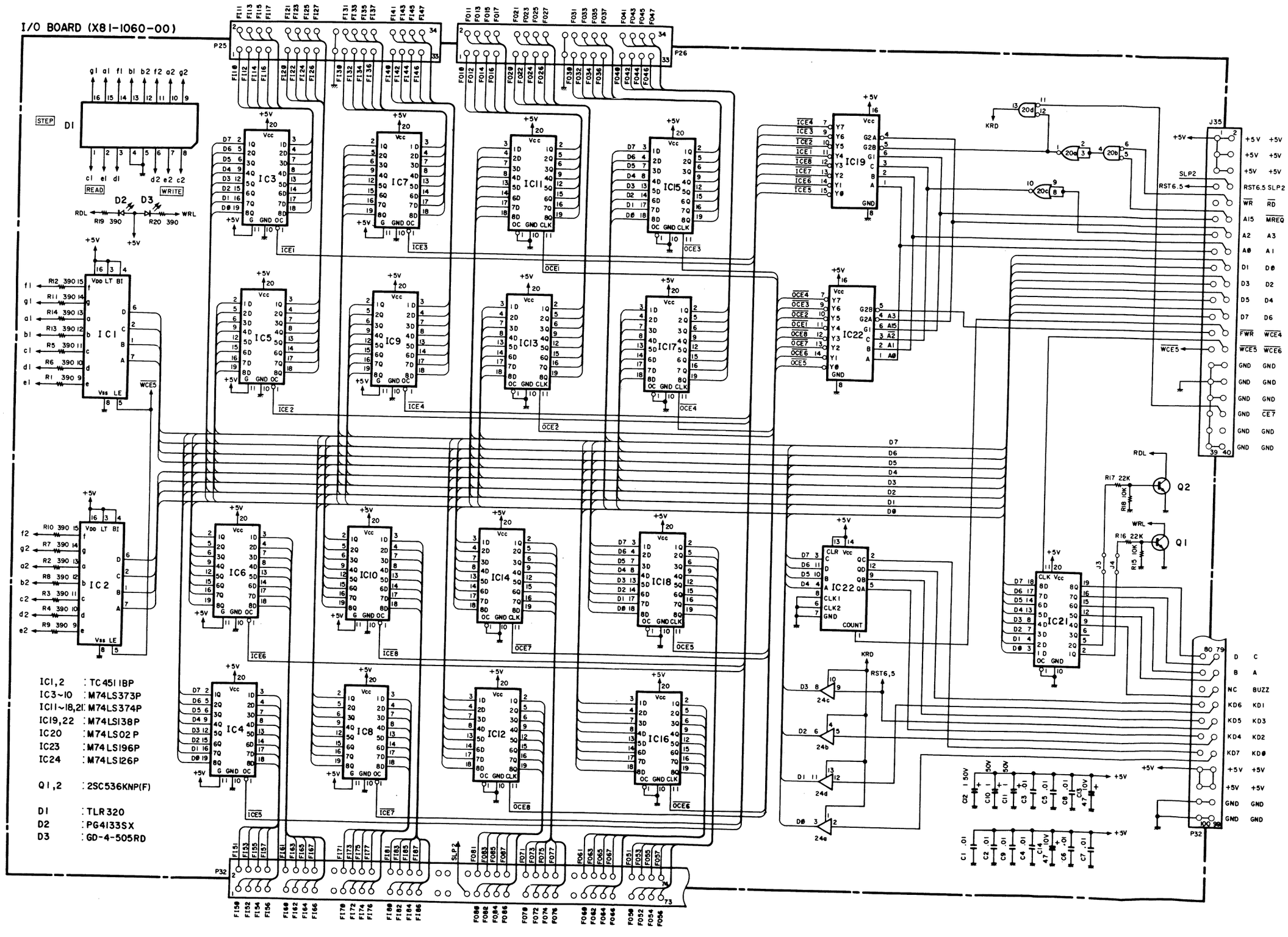
P.C. BOARD

X81-1060-00



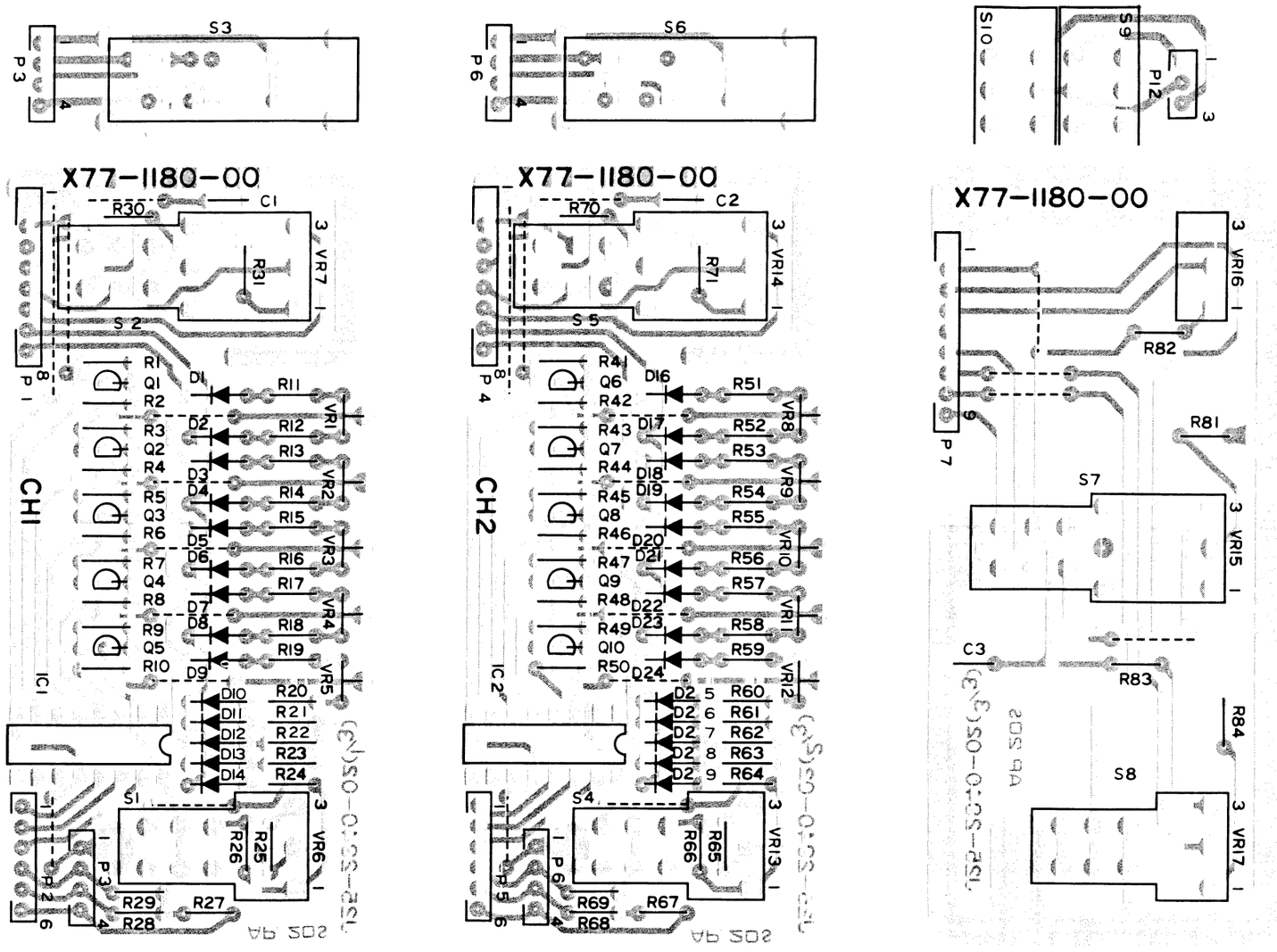
SCHEMATIC DIAGRAM

X81-1060-00



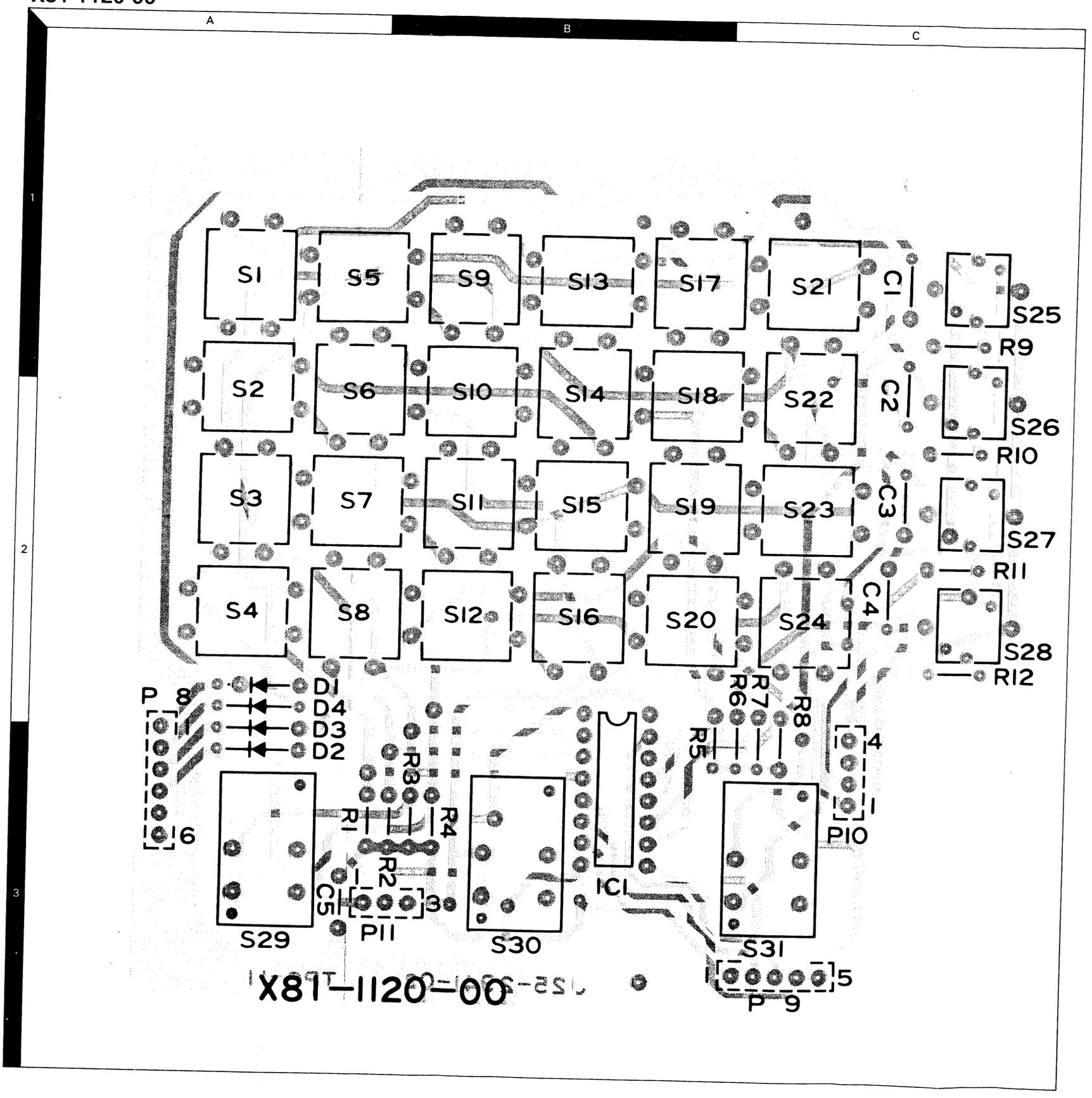
P.C. BOARD

RT-1721 X77-1180-00



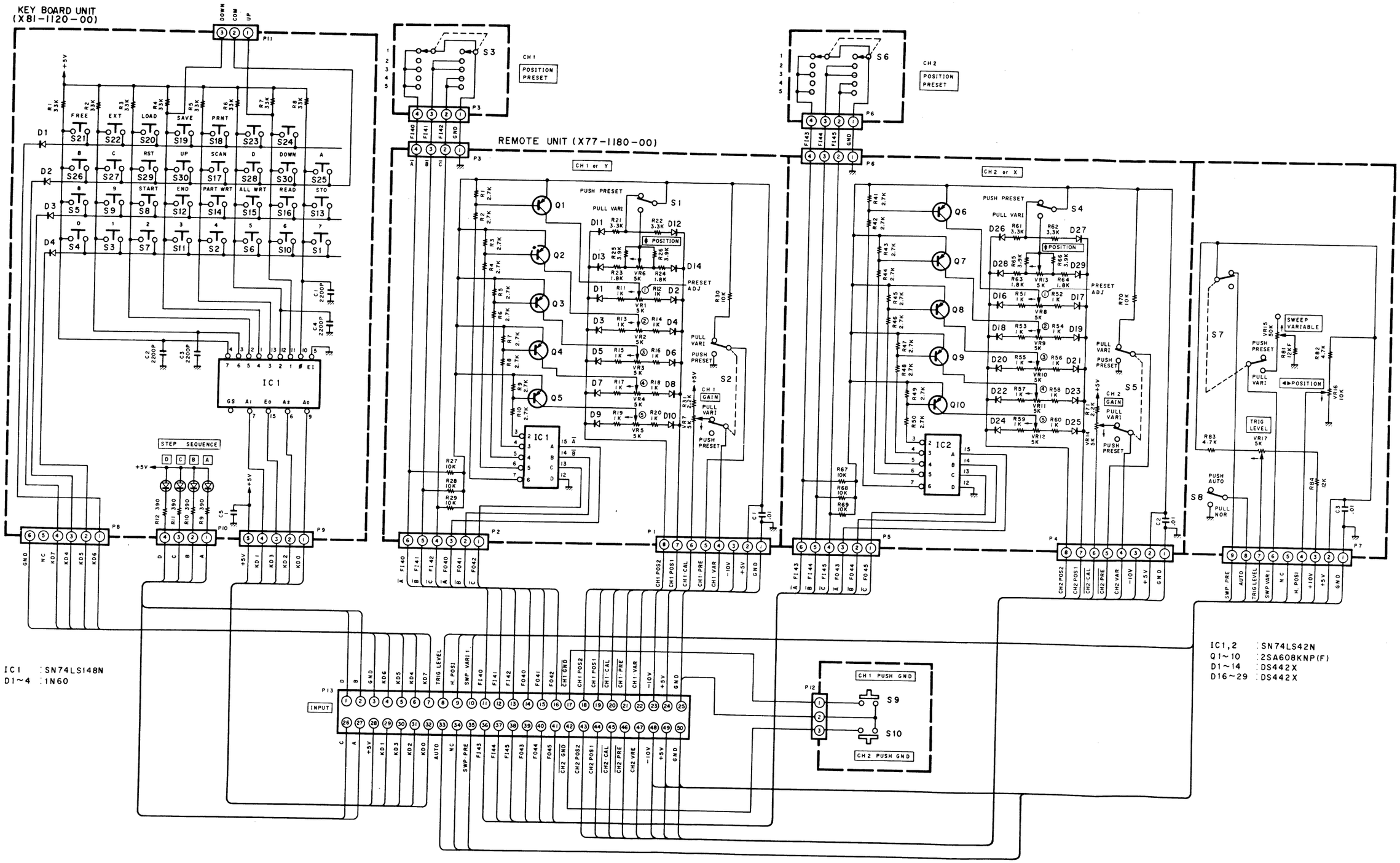
P.C. BOARD

X81-1120-00



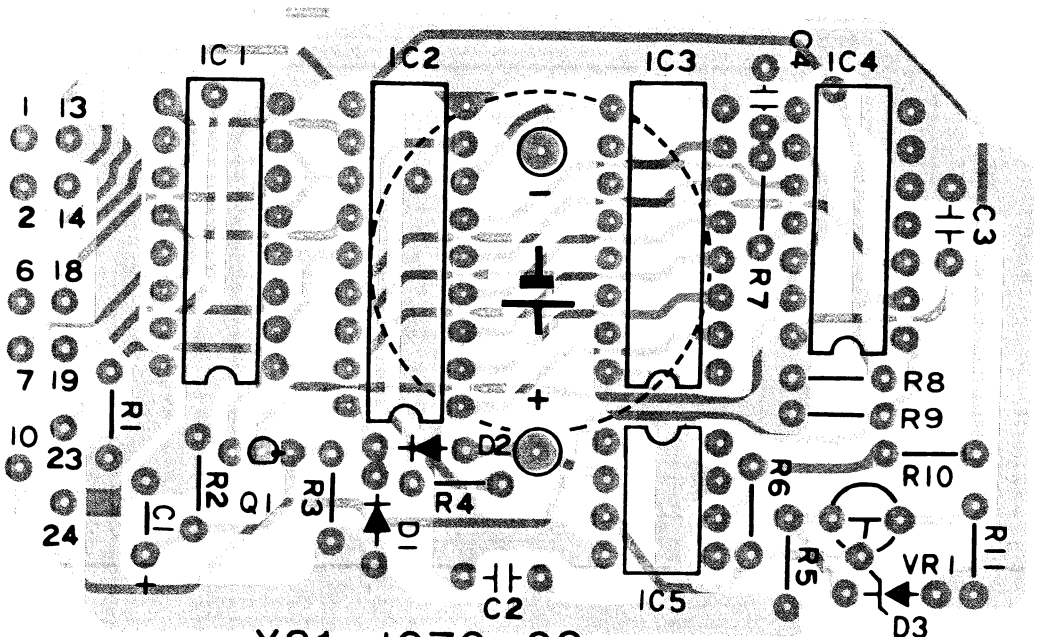
SCHEMATIC DIAGRAM

RT-1721



P.C. BOARD

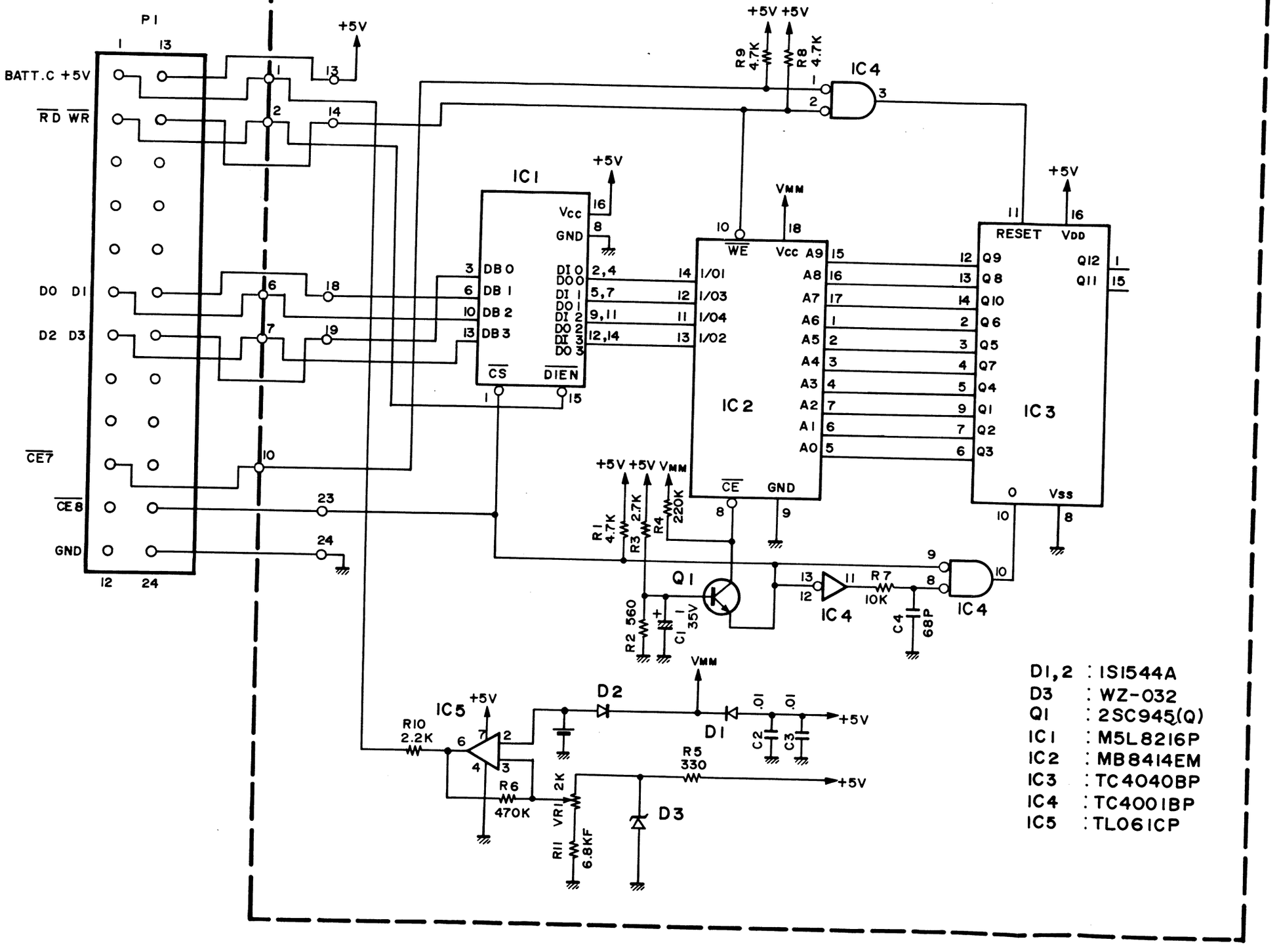
X81-1070-00



SCHEMATIC DIAGRAM

MT-1725

X81-1070-00



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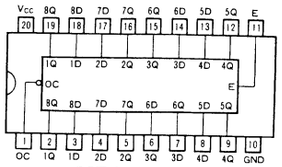
D3 : WZ-032
Q1 : 2SC945(Q)
IC1 : M5L8216P
IC2 : MB8414EM
IC3 : TC4040BP
IC4 : TC4001BP
IC5 : TL061CP

SEMICONDUCTORS

TTL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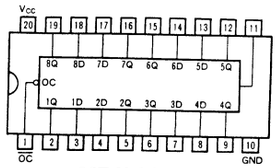
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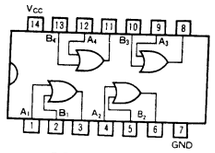
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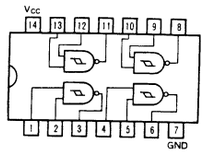
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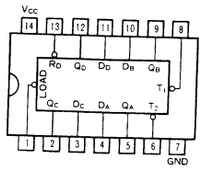
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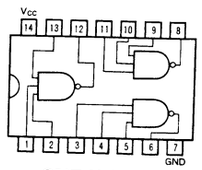
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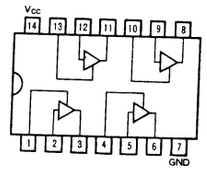
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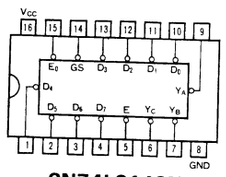
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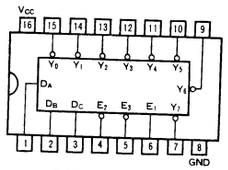
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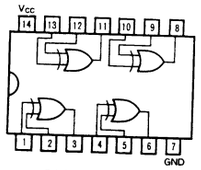
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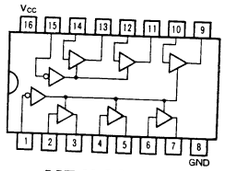
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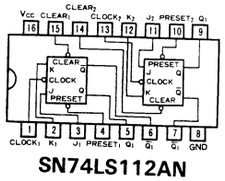
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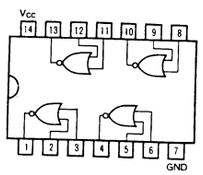
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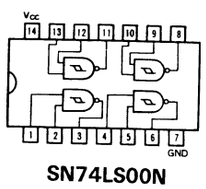
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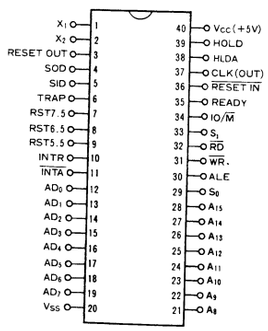
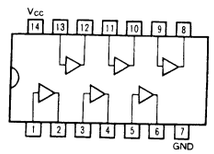
N MOS



μP-D8085AC

C MOS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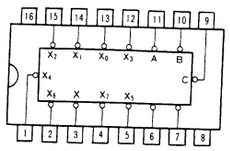
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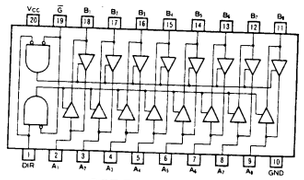
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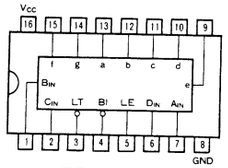
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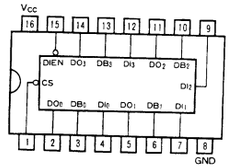
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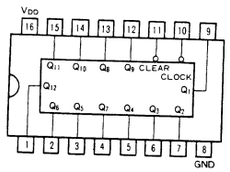
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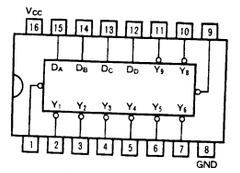
C MOS RAM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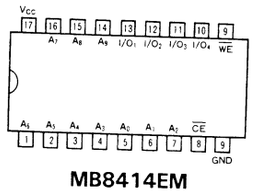
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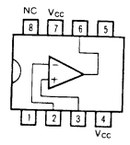
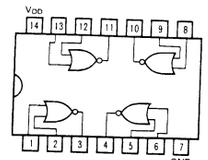
OP AMP


TL061CP

P ROM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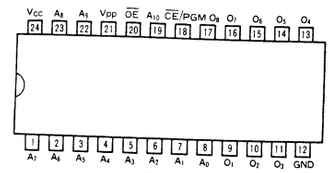
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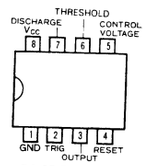
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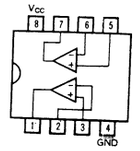
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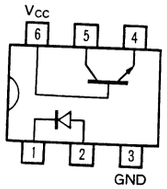
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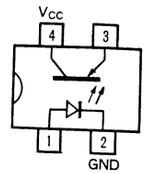
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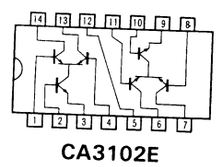
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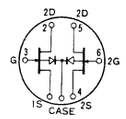
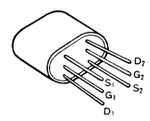
FET


μPA70A (L)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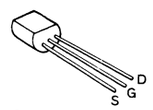
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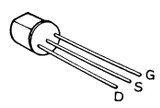
2SK68A (M)
2SK107 (2, 3)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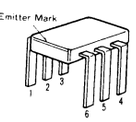
TRANSISTOR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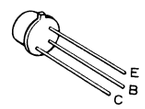
2SC1963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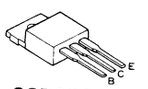
2SC805A2—2 or 3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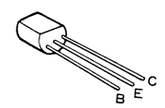
2SC1505 (L)
2SD613 (E)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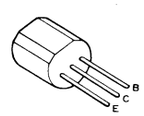
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2SC2910 (S, T)

2SA608KNP (F) 2SC536KNP (F)
2SA838 (C) 2SC1047 (C)
2SA684 2SC1215 (Tors)
2SC2910 2SC1973 (T)

2SC1019 (Q, R)
2SC1913 (Q, R)