SERVICE MANUAL

OSCILLOSCOPE

SS-5712

Service Manual

B1211-811101(I)

IWATSU ELECTRIC CO., LTD.

Main Office: 7-41, 1-chome Kugayama Suginami-ku,
Tokyo, 168 Japan
Telephone: Tokyo 03-334-1111
Facsimile : Tokyo 03-332-6535

Overseas Operation Department: Yanagiya-Building 1-10, 2-chome Nihonbashi,
Chuo-ku, Tokyo, 103 Japan
Telephone: Tokyo 03-271-4271
Facsimile : Tokyo 03-271-1554
Telex : J24225 (TELEIWA)
Cable Address TELEIWATSU

U. S. A. Sales Office: Iwatsu Instruments Inc.
430 Commerce Boulevard, Carlstadt, N. J. 07072
Telephone: 201-935-5220
Facsimile : 201-935-2075
Telex : 7109890255

BEGINNING

Oscilloscope SS-5712 is an electronic measuring instrument that can provide a 4-phenomenon, 8-bright-line display with a frequency band width ranging from DC to 200 MHz.

The instruction manuals for SS-5712 comprise the operation manual and service manual. The service manual provides knowledges of circuit description, maintenance, check and adjustment, schematic diagram, and electrical & mechanical parts list.

Each section of this manual covers the following contents:

Section 1 describes electrical and physical specifications of SS-5712.
Section 2 describes the circuit description.
Section 3 describes the method for maintenance of SS-5712. Trouble-shooting flowchart is contained in this section.
Section 4 describes the check and adjustment.
Section 5 describes the schematic diagrams.
Section 6 describes the electrical parts list.

TABLE OF CONTENTS

Specifications

1-1 ELECTRICAL SPECIFICATIONS

1-1-1 Cathode-Ray Tube(CRT)

Shape	Rectangular, 6 inches
Display Area	8div x 10 div (1 div = 10mm), with internal illuminated graticule of parallax-free type
Phosphor	B31(Standard)
Accelerating Voltage	Approximately 20kV

1-1-2 Vertical Deflection System (Y Axis)

Modes

CH 1, CH 2, ALT, CHOP, ADD, QUAD (Quadruple)

CHOP switching rate: 1MHz±40%

Channels 1 and 2

Deflection Factor

1 mV/div to 5 V/div,in 12 calibrated steps in a 1-2-5 sequence

Accuracy:1 mV/div,2mV/div

±4% (+10°Cto+35°C)

±8% (−10°Cto+50°C)

5mV/div, 10mV/div

±2% (+10°Cto+35°C)

±5% (−10°Cto+50°C)

20mV/div to 5V/div

±2.5 % (+10°Cto+35°C)

±5.5 % (−10°Cto+50°C)

1 mv/div to 12.5 V/div continuously variable with the VARIABLE control

Frequency Response

DC to 200 MHz, −3 dB(10mV/div to 5 V/div)

DC to 200 MHz, −3.5 dB(5mV/div)

DC to 50 MHz, −3 dB(1mV/div, 2mV/div)

Notes

- 10°C to 35°C
- Bandwidth: The highest usable frequency is 20 MHz.
- AC coupling: The lowest usable freauency is 4Hz.

Rise Time

1.75 nsec or less

Pulse Response

Overshoot: 7.5%

Sag(at 1 kHz): 1%

Other distortion: 6%

(10 mV/div to 50 mV/div, 10°C to 35°C)

Signal Delay	Delay cable supplied
Input Coupling	AC, DC, GND (FREE RUN)
Input RC	Direct: 1 MΩ±1.5 %//21 pF±2pF With probe: 10 MΩ±2%//13pF±2pF
Maximum Input Voltage	Direct: 250 V (DC+peak AC) With probe: 600 V (DC+peak AC) (Refer to the instruction manual for the probe for the maximum input voltage where the probe is used.)
Drift	0.1 div/hour or 2 mV/hour, whichever is larger, 15 minutes after power is turned on (standard)
Polarity Inversion	CH 2 only
Common Mode Rejection Ratio	At 10 mV/div 50:1(1 kHz sine wave) 15:1(20 MHz sine wave)

Channels 3 and 4

Deflection Factor	0.1 V/div, 0.5 V/div, selectable Accuracy: ±4%(at 10°C to 35°C) ±8%(at −10°C to +50°C)
Frequency Response	DC to 200 MHz −3dB(0.1 V/div) DC to 200 MHz −3dB(0.5 V/div) Notes • 10°C to 35°C • Bandwidth: The highest usable frequency is 20 MHz. AC coupling: The lowest usable frequency is 4 Hz.
Pulse Response	**Table 1−1−2**

•Waveform Distortion	0.1V/div	0.5 V/div
Overshoot	10%	11%
Sag(at 1kHz)	2%	2%
Other distortion	7.5 %	7.5 %

Input Coupling	AC, DC
Input RC	Direct: 1MΩ± 1.5 %//22pF±3pF With probe: 10MΩ±2%//13pF±2pF
Maximum Input Voltage	Direct: 250 V(DC+peak AC) With probe: 600 V(DC+peak AC)

1-1-3 Triggering

A-Triggering

Signal Sources: CH 1, CH 2, CH 3, COMBI, NORM, LINE
(External trigger can be used by selecting CH 3 with SOURCE switch)

Coupling: AC, DC, HF REJ, LF REJ,
FIX, TV-H, TV-V

Slope: Positive-going (+),
negative-going(−)

Minimum Trigger Sensitivity

Table 1−1−3(1) (+10°C to +35°C)

Frequency	Sensitivity of CH1,CH2,CH3
DC to 10MHz	0.3 div
10MHz to 100MHz	1div
100 MHz to 200MHz	1.5 div

Notes

- FIX: 1 div at 100 Hz to 10 MHz,
  : 2 div at 10 MHz to 100 MHz Sine waves only
- TV-V, TV-H synchronizing signal level: 1 div or more on screen amplitude for a composite video signal composed of 7 parts video signal and 3 parts synchro nizing signal
- Trigger signals are attenuated in the following frequency ranges depending on coupling
  AC: 30 Hz or lower
  HF REJ: 10 kHz or higher
  LF REJ: 10 kHz or lower
- AUTO sweep mode: The lowest usable frequency is 50 Hz

B-Triggering

Signal Sources: RUNS AFTER DELAY, CH 1, CH 2, CH 4
(External trigger can be used by selecting CH 4 with SOURCE switch.)

Coupling: AC, DC, HF REJ, FIX

Slope: Positive-going(+),
negative-going(−)

Minimum Trigger Sensitivity

Table 1−1−3(2) (+10°C to +35°C)

Frequency	Sensitivity of CH1,CH2,CH4
DC to 10MHz	0.3 div
10MHz to 100MHz	1div
100 MHz to 200MHz	2div

- Fix: 1 div at 100 Hz to 10 MHz,
  : 2 div at 10 MHz to 100 MHz. Sine waves only
- HF REJ: Trigger signal is attenuated at 10 kHz or higher.

1-1-4 Hrizontal Deflection System (X Axis)

Modes	A, A INTEN, ALT, B (DLY'D), X–Y, TRIG'D X–Y (A), TRIG'D X–Y (B)
A-Sweep	
Sweep Mode	AUTO, NORM, SINGLE
Sweep Rates	10 nsec/div to 0.5 sec/divin 24 calibrated steps in a 1-2-5 sequence 10 nsec/div to 1.25 sec/div,continuously variable with the VARIABLE control Accuracy I (Over center 8 divisions): 10 ns/div to 0.5 c/div ±2% (+10°C to +35°C) 10 nc/div to 50 ms/div ±4% (−10°C to +50°C) 0.1 s/div to 0.5 s/div ±6% (−10°C to +50°C) Accuracy II (Over 2 of the center 8 divisions): 10 ns/div to 0.5 s/div ±5% (−10°C to +50°C)
Hold-Off Time	Variable with the HOLD OFF control
B-Sweep	
Delay	Continuous delay RUNS AFTER DELAY), triggered delay (CH 1, CH 2, CH 4)
Sweep Rates	10 nsec/div to 50 msec/div, 21 calibrated steps in a 1-2-5 sequence Accuracy I (Over center 8 divisions): 10 ns/div to 50 ms/div ±2% (+10°C to +35°C) 10 ns/div to 50 ms/div ±4% (−10°C to +50°C) Accuracy II (Over any 2 of the center 8 divisions): 10 ns/div to 50 ms/div ±5% (−10°C to +50°C)
Time Difference Measurement	0.2 μ sec/div to 5 sec/div Accuracy: ±1% of reading ±0.01 graduation (Minimum graduation of DELAY TIME MULT dial) (at 10°C to 35°C)
Delay Jitter	1/20,000 or less
Sweep Magnification	10 times (Maximum sweep rate:1 nsec/div) Accuracy I of magnified sweep rate(Over center 8 divisions): 10 ns/div to 50 ms/div±5%(+10℃to+35℃) 0.1 μs/div to 0.5 μs/div ±4%(+10℃to+35℃) 1 μs/div to 0.5 s/div ±3%(+10℃to+35℃) Accuracy II of magnified sweep rate (Over any 2 of the center 8 divisions): 10 ns/div to 50 ns/div ±10%(−10℃to+50℃) 0.1 μs/div to 0.5 μs/div ±6% (−10℃to+50℃) 1 μs/div to 0.5 s/div ±5%(−10℃to+50℃) Except following sweep rate from sweep start point. 25 div at 1 ns/div, 15 div at 2 ns/div, 6 div at 5 ns/div, 3 div at 10 ns/div, 1.5 div at 20 ns/div, 1 div at 50 ns/div to 50 ms/div.

1-1-5 X–Y Operation

Input	X Axis: CH 1, Y Axis: CH 2
X Axis	(Same as CH 1 except for the following)
Deflection Factor	Same as that of CH 1
	Accuracy: 1 mV/div,2mV/div ±5 % (+10°C to +35°C)
	±8 % (−10°C to +50°C)
	5mV/div to 5V/div ±3.5% (+10°C to +35°C)
	±5.5% (−10°C to +50°C)
Frequency Response	DC to 2MHz, −3dB (10°C to 35°C)
Input RC	Same as CH 1
Maximum input voltage	Same as CH 1
Y Axis	Same as CH 2
X–Y Phase Defference	3° or less (at DC to 100 kHz)

1-1-6 External Intensity Modulation (Z Axis)

Input Voltage	0.5 Vp−p
Polarity	Positive (decleases intensity),
	negative (inclease intensity)
Frequency Range	DC to 5 MHz
Input Resistance	5.1 kΩ ±10%
	Maximum Input Voltage 50 V(DC+peak AC)

1-1-7 Signal Outputs

Calibrator

Waveform	Square wave
Repetition Frequency	1 kHz
	Accuracy: ±1% (at 10°C to 35°C)
	±2% (at−10°C to +50°C)
Duty Ratio	40% to 60%
Output Voltage	0.6 V
	Accuracy: ±1% (at 10°C to 35°C)
	±1.5 % (at−10°C to +50°C)
Output Current	10 mA
	Accuracy: ±1% (at 10°C to 35°C)
	±2% (at −10°C to +50°C)

CH I OUT

Output Voltage	20 mV ±20% per div of amplitude on the CRT screen (at 50Ω terminated)
Frequency Response	DC to 100 MHz, −3dB
Output Resistance	50Ω±20%

A Gate Out

Output Voltage	Approximately +5 V (Base line: Approximately 0V)
Output Resistance	Approximately 2.7 kΩ

B Gate Out Same as A gate Out

1-1-8 Power Supply

Voltage Range	100V(90 to 110V)/ 115 V(103 to 128 V)/ 220 V(195 to 242 V)/ 230 V, 240 V(207 to 264 V)AC One of these voltage ranges can be selected with voltage selector plug.
Frequency Range	50 to 440 Hz
Power Consumption	Approximately 106 W(at 100 V AC)

1-2 WEIGHT AND DIMENSIONS

Weight	Approximately 11.5 kg (Without panel cover, accessories and accessories bag)
Dimensions	320 ± 2(W)x 160 ± 2(H)x 400 ± 2(L)(mm)

1-3 ENVIRONMENTAL CHARACTERISTICS

Operating Temperature	−10°C to +50°C
Operating Humidity	40°C, 90% Relative Humidity
Storage Temperature	−20°C to +70°C
Storage Humidity	70°C, 80% Relative Humidity
Altitude	Operating: 5,000 m maximum (atmospheric pressure 405mmHg) Non-operating: 15,000 m maximum (atmosphric pressure 90 mmHg)
Vibration	From 10 Hz to 55 Hz and back in 1 minute; double amplitude 0.63 mm; for 15 minutes each in vertical, horizontal,and longitudinal directions for a total of 45 minutes
Impact	One side is raised to an elevation angle of 45 (10 cm maximum), and let fall on a piece of hard wood. Each side is put to this test 3 times.
Drop	A package ready for transportation is dropped from a height of 90 cm

NOTES

Section 2

Circuit Description

This section describes operating principle of the SS-5712 according to block diagrams.

2-1 General Description

The circuit structure is illustrated in Fig. 2-1-1, where the flow of main signals, also, is shown. The structure of each printed circuit board and the flow of power supply is shown in Fig. 2-1-2 and the controll signals, in Fig. 2-1-3. Each block is used for driving the CRT's electron beams finally.

Preamplifiers for channel 1, 2, 3, and 4

The vertical deflection system has four independent preamplifiers. The preamplifiers for CH 1 and CH 2 combine an attenuator (VOLTS/DIV switch), and variable (VARIABLE control), to permit input deflection factor setting from 1 mV to 12.5 V per division of the graticule scale. The simplified attenuator provided for CH 3 and CH 4 permits input deflection factor setting to 0.1 V or 0.5 V. As an input signal is applied to the INPUT connector for each channel, it is converted to a balanced signal, which is amplified and led to the delay cable driver circuit.

Delay cable driver circuit

The delay cable driver circuit leads the balanced signal from each preamplifier to the vertical main amplifier individually or by time division through diode gate opening and closing (switching circuit).

Modes of leading the balanced signal can be selected by setting the vertical MODE switch: CH 1 or CH 2 independent, display of the sum of CH 1 and CH 2 or the difference between them, two-channel (CH 1 and CH 2) display by time division, four-channel (CH 1 through CH 4) display by time division.

Multi-channel display by time division comes in two modes of operation: ALT and CHOP. ALT is the mode for changing display channels for every sweep of horizontal axis, and CHOP is the mode for changing display channels for every 500 kHz by the pulse from the built-in chop pulse generator. In the CHOP mode, a chop blanking pulse is applied to the Z-axis amplifier to erase the transient phenomenon during channel switching.

The selected display signals are guided to the delay cable.

The delay cable delays the passing signal by about 100 ns. The delayed signal is guided to the vertical output amplifier.

Vertical main amplifier

The vertical main amplifier is used for driving the electron beams which scan the fluorescent face of the CRT screen in the vertical axis (Y-axis) direction, and amplifies input signals up to the inherent deflection factor of the CRT to make the vertical input deflection factor correspondent to the CRT scale.

Trigger signal circuit

The signals branched out from the vertical preamplifiers are led to the trigger signal amplifier circuits via trigger signal switching circuits for CH 1, CH 2, CH 3, CH 4, LINE (from the power circuit) and NORM (from the main amplifier after its electronic switching) signals.

TV trigger signal separator circuit

Suppose that a television composite signal is applied to the vertical preamplifier. If the input is directly applied to the trigger signal amplifier circuit as it is, stabilized synchronization cannot be expected because the video signal component changes. Thus, the video signal component is removed by feeding the input through the TV trigger signal separator circuit, and the vertical trigger signal (TV-V) and

horizontal trigger signal (TV-H) are separated by the time constant circuit composed of a resistor and capacitor. And after it, the stabilized synchronization is assured.

In TV trigger delay sweep, a horizontal trigger component is applied to the B trigger amplifier circuit.

A and B trigger amplifier circuits

The signals applied to the vertical preamplifiers are branched out and led to the A and B trigger amplifier circuits. Before reaching these amplifier circuits, however, the lowpass filter or highpass filter can be selected.

These trigger signals are applied to the A or B trigger amplifier circuit, where the signals are amplified to the proper sensitivity. The amplified signals are led to the sweep circuit via the pulse shaping circuit, which converts them to trigger pulses having a constant rise time and voltage.

A and B sawtooth generator circuits

The pulse generated by the A trigger pulse shaping circuit is applied to the A sawtooth generator circuit, and a sawtooth signal for horizontal axis sweep is generated when the sweep gate opens.

The B sawtooth generator circuit generates a sweep signal at a preset time after the operation of the A sawtooth generator circuit. The sweep by sawtooth B is called delayed sweep, which may be classified by the start timing of the B sawtooth generator circuit as follows:

Continuous delay sweep: Sawtooth B is generated when a pulse signal is generated by comparison of the voltage set with the delay multi-dial with sawtooth A.

Trigger delay sweep: Sawtooth B is generated by the first trigger signal B that reached after generation of a pulse signal by comparison of the voltage set with the delay multi-dial with sawtooth A.

As described above, sawtooth waveforms are generated by opening and closing the sweep gated, and sweep gate signals A and B generated at that time are led to the Z-axis amplifier.

Horizontal amplifier

The horizontal amplifier drives the electron beams which scan the fluorescent face of the CRT in the horizontal axis (X-axis) direction, and amplifies the input signals up to the inherent deflection factor to the CRT so that the sawtooth wave signal from the A and B sawtooth generator circuits will correspond to the time axis scale on the CRT screen.

Sweep signal A or B may be selected for the horizontal amplifier with the HORIZ DISPLAY switch A or A INTEN and B (DLY'D) input sweep signal A and sweep signal B respectively to the horizontal amplifier.

In ALT operation, sweep signals A and B are alternately selected by electronic switching every sweep, and input to the horizontal amplifier.

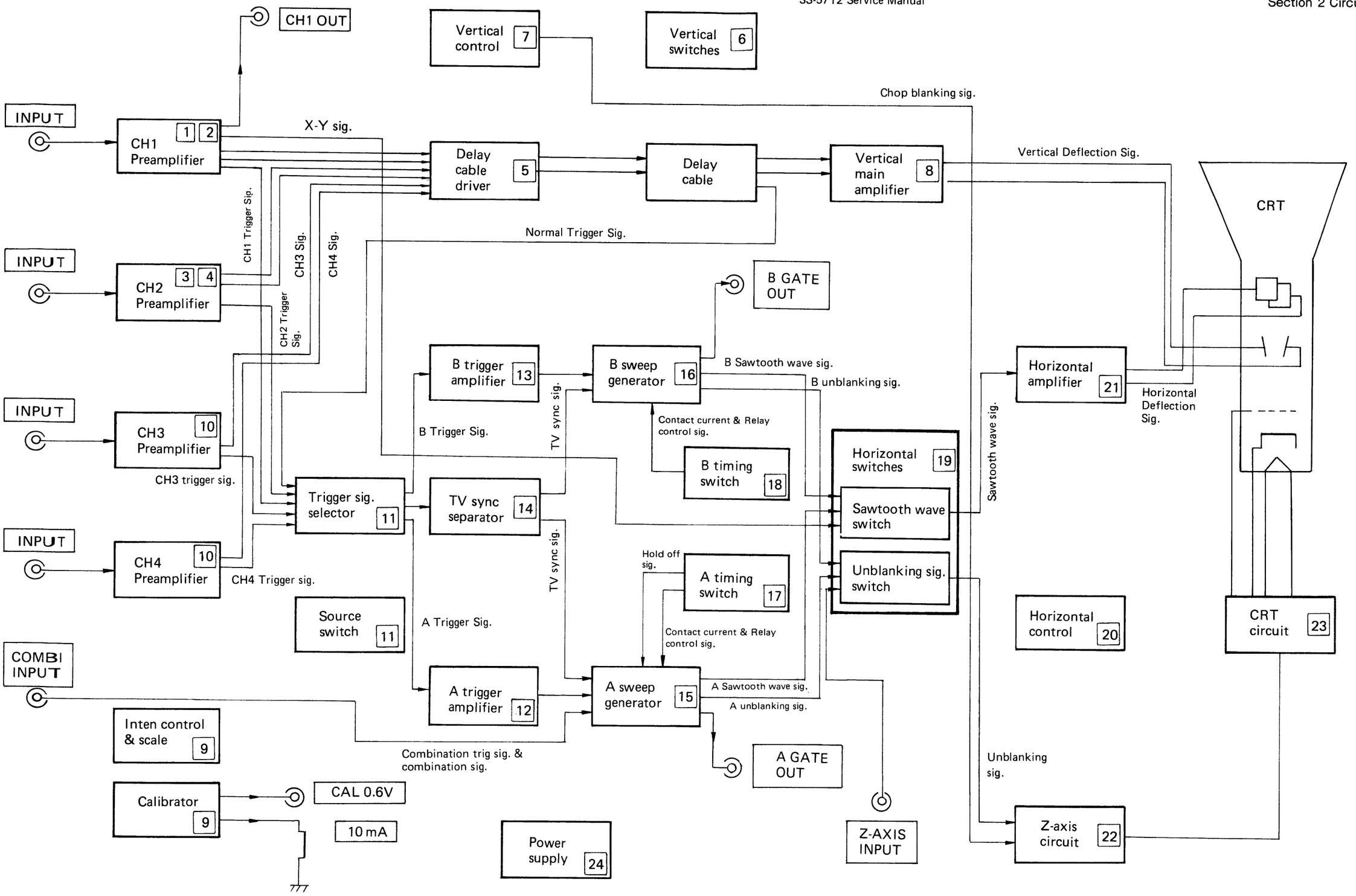
In X-Y operation, the signal input to the vertical preamplifier for CH 1 INPUT is led to the horizontal amplifier and the signal applied to CH 2 INPUT is led to the vertical amplifier. Thus, a Lissajours' figure can be displayed on the screen, by the signal applied to CH 1 INPUT (X-axis display) and the signal applied to CH 2 INPUT (Y-axis display).

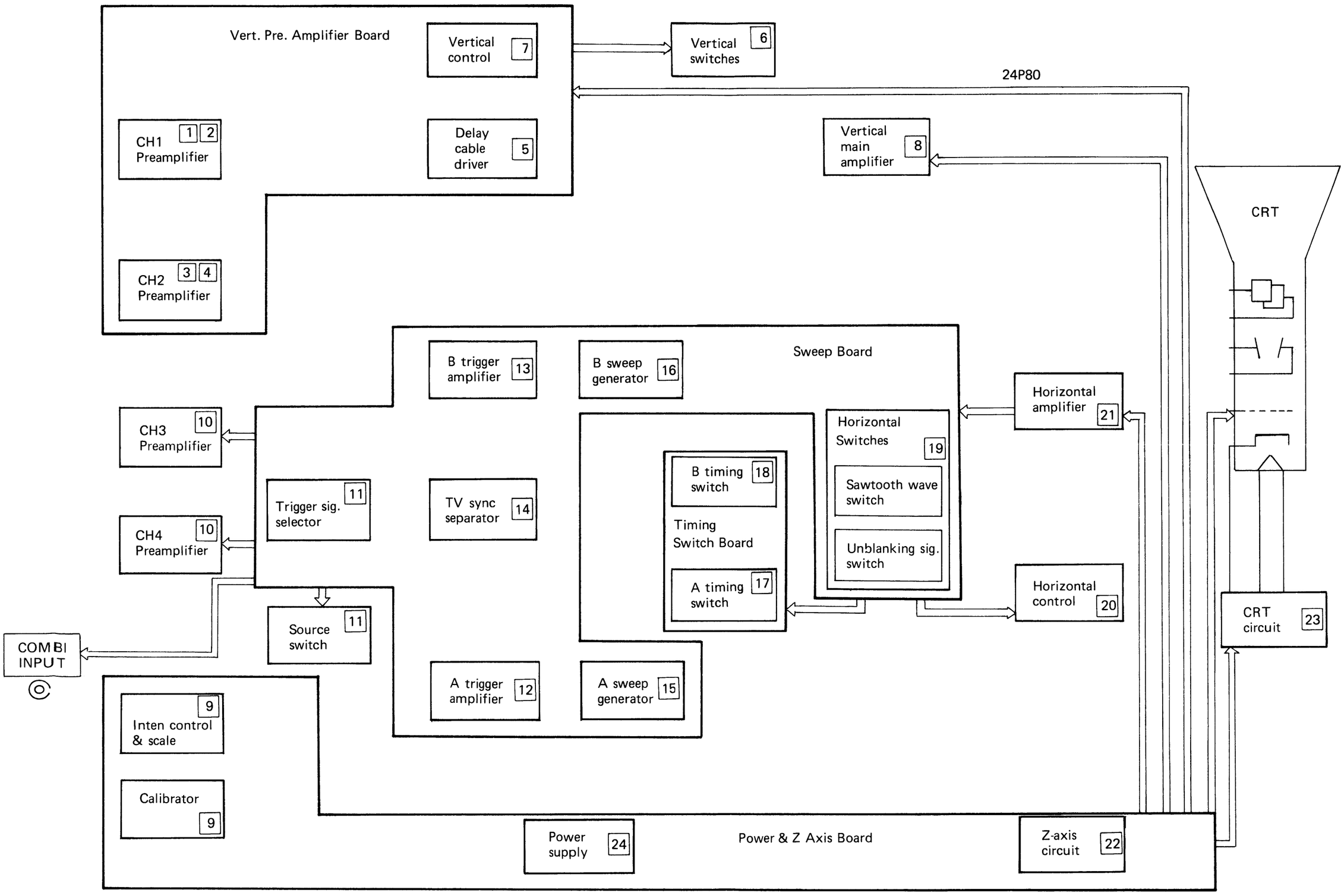
Z-axis amplifier

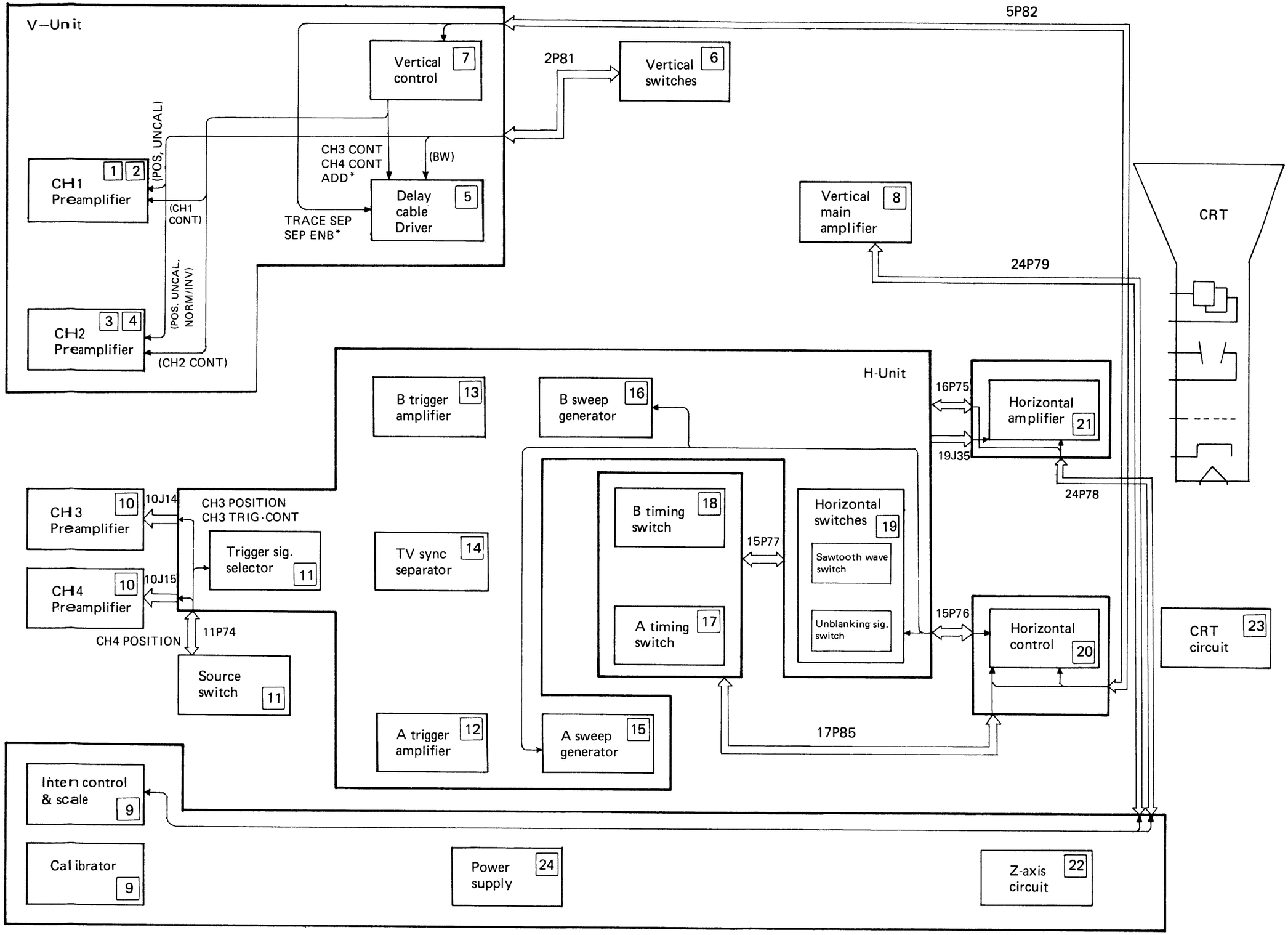
The Z-axis amplifier selects gate pulses from the A and B sawtooth generator circuits, amplifies the selected pulse, and generates a CRT intensity modulation signal. These gate pulses are called unblanking pulses because they eliminate retrace line.

The unblanking pulses vary in waveform according to HORIZ DISPLAY switch position. An unblanking pulse is generated from an A-gate waveform in the A sweep mode, from a combination with A-gate and B-gate waveforms in the A INTEN mode, and from a B-gate waveform in the B (DLY'D) sweep mode. In ALT sweep, unblanking pulses with the INTEN waveform and B-sweep waveform are alternately provided to the HORIZ DISPLAY switch by electronic switching every sweep, and input to the Z-axis amplifier.

In addition, the aforementioned chop blanking signal for erasing the transient phenomenon during chopping, and the signal applied to Z AXIS INPUT for intensity modulation from the outside are also provided to the Z-axis amplifier input.


CH1 OUT
Vertical control 7
Vertical switches 6
Chop blanking sig.
INPUT
CH1 Preamplifier 1 2
X-Y sig.
Delay cable driver 5
Delay cable
Vertical main amplifier 8
Vertical Deflection Sig.
CRT
CH1 Trigger Sig.
CH3 Sig.
CH4 Sig.
Normal Trigger Sig.
INPUT
CH2 Preamplifier 3 4
CH2 Trigger Sig.
B GATE OUT
B trigger amplifier 13
B sweep generator 16
B Sawtooth wave sig.
B unblanking sig.
Horizontal amplifier 21
Horizontal Deflection Sig.
INPUT
CH3 Preamplifier 10
CH3 trigger sig.
B Trigger Sig.
TV sync sig.
Contact current & Relay control sig.
B timing switch 18
Horizontal switches 19
Sawtooth wave sig.
Trigger sig. selector 11
TV sync separator 14
Sawtooth wave switch
INPUT
CH4 Preamplifier 10
CH4 Trigger sig.
TV sync sig.
Hold off sig.
A timing switch 17
Unblanking sig. switch
Source switch 11
A Trigger Sig.
Contact current & Relay control sig.
Horizontal control 20
CRT circuit 23
COMBI INPUT
A trigger amplifier 12
A sweep generator 15
A Sawtooth wave sig.
A unblanking sig.
Inten control & scale 9
Combination trig sig. & combination sig.
A GATE OUT
Unblanking sig.
Calibrator 9
CAL 0.6V
10 mA
Power supply 24
Z-AXIS INPUT
Z-axis circuit 22


Vert. Pre. Amplifier Board
Vertical control 7
Vertical switches 6
24P80
CH1 Preamplifier 1 2
Delay cable driver 5
Vertical main amplifier 8
CRT
CH2 Preamplifier 3 4
B trigger amplifier 13
B sweep generator 16
Sweep Board
Horizontal amplifier 21
CH3 Preamplifier 10
Horizontal Switches 19
B timing switch 18
Sawtooth wave switch
Trigger sig. selector 11
TV sync separator 14
CH4 Preamplifier 10
Timing Switch Board
Unblanking sig. switch
A timing switch 17
Horizontal control 20
CRT circuit 23
Source switch 11
COMBI INPUT
A trigger amplifier 12
A sweep generator 15
Inten control & scale 9
Calibrator 9
Power supply 24
Power & Z Axis Board
Z-axis circuit 22


V–Unit
Vertical control 7
2P81
Vertical switches 6
5P82
CH1 Preamplifier 1 2
(POS, UNCAL)
(CH1 CONT)
CH3 CONT
CH4 CONT
ADD*
(BW)
Delay cable Driver 5
TRACE SEP
SEP ENB*
Vertical main amplifier 8
24P79
CRT
CH2 Preamplifier 3 4
(POS, UNCAL, NORM/INV)
(CH2 CONT)
H-Unit
B trigger amplifier 13
B sweep generator 16
16P75
Horizontal amplifier 21
19J35
24P78
CH3 Preamplifier 10
10J14
CH3 POSITION
CH3 TRIG·CONT
Trigger sig. selector 11
TV sync separator 14
B timing switch 18
15P77
Horizontal switches 19
Sawtooth wave switch
CH4 Preamplifier 10
10J15
A timing switch 17
Unblanking sig. switch
15P76
Horizontal control 20
CRT circuit 23
CH4 POSITION
11P74
Source switch 11
A trigger amplifier 12
A sweep generator 15
17P85
Inten control & scale 9
Calibrator 9
Power supply 24
Z-axis circuit 22

If a positive signal of 0.5 V or more is applied to Z AXIS input, the CRT luminance lowers to permit intensity modulation. The INTEN control for adjusting overall intensity is also connected to the Z-axis amplifier input.

CRT circuit

The CRT circuit consists of a circuit which generates heater voltages and high voltages for generating and accelerating electron beams, and grid circuits around the CRT for proper focusing.

Low-voltage circuit

The low-voltage circuit generates the stabilized low voltage from commercial AC power to drive each circuit, and also supplies a line trigger signal to synchronize with the commercial AC power and the CRT scale illuminating power.

Calibration voltage and current generator circuit

This is a constant-voltage constant-current square wave generator, and is set to a repetition frequency of about 1 kHz. Using the signal generated by this circuit, probe phases can be adjusted and oscilloscope input sensitivity can be calibrated. Current probe phases can also be adjusted by means of the current loop in the rear panel.

2-2 VERTICAL DEFLECTION SYSTEM [1] to [8], [10]

2-2-1 Main Functions of Vertical Deflection System

The main functions are as follows.

1. Switching of input coupling; AC, GND or DC.
2. Switching of input sensitivity; ATT or VARIABLE.
3. Adjusting vertical display position (POSITION).
4. Switching of CH2 polarity.
5. Switching of displayed channel (switching circuit).
6. Switching of vertical deflection circuit bandwidth (BANDWIDTH).
7. Separation of signal.
8. Delay of signal.
9. Drive of vertical deflection board.

2-2-2 Circuit Description

Figure 2-2-2-(1) shows the block diagram of the vertical deflection system.

INPUT COUPLING CIRCUIT [1], [3]

Either the AC component or DC component of the input signal can be selected to be displayed.

When the GND input coupling is selected, the signal to be measured is separated from the vertical deflection circuit, the input of which is selected to GND.

SIGNAL ATTENUATOR [1], [3]

This is used to display low or high level inputs with optimum amplitude on the CRT.

The attenuator of the SS-5712 consists of two circuits. Attenuator 1S21 is provided with attenuation ratios of 1/1, 1/10 and 1/100, and the attenuator after the input buffer circuit is provided with ratios of 1/1, 1/2 and 1/5. The deflection factor, from 10 mV/div to 5 V/div, is obtained by the combination of these two amplifiers.

INPUT BUFFER [1], [3]

The input buffer circuit consists of 1Q10, 1Q11, 1Q12, 1Q19 and 1IC34. The circuit has a high impedance input and low impedance output, and its operation is as follows. The high-frequency component of the input signal passes through 1IC13, 1Q10 and 1Q11, while the gain of the low-

Figure 2-2-2-(1). Block diagram of the CH 1 vertical deflection amplifier

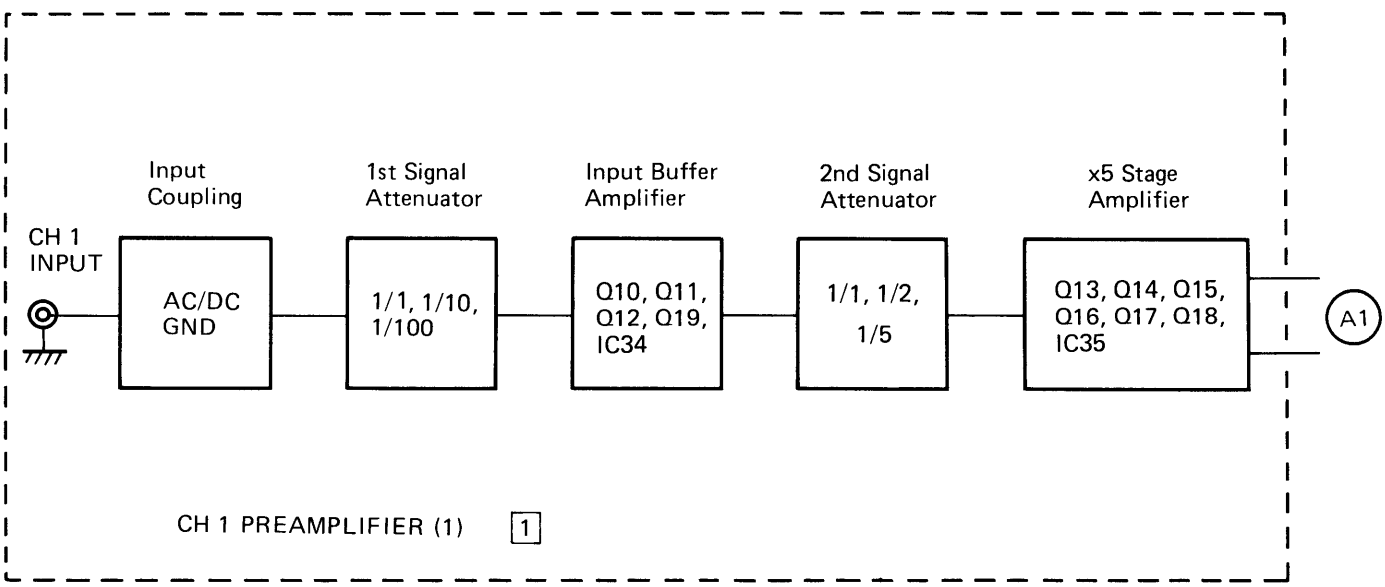
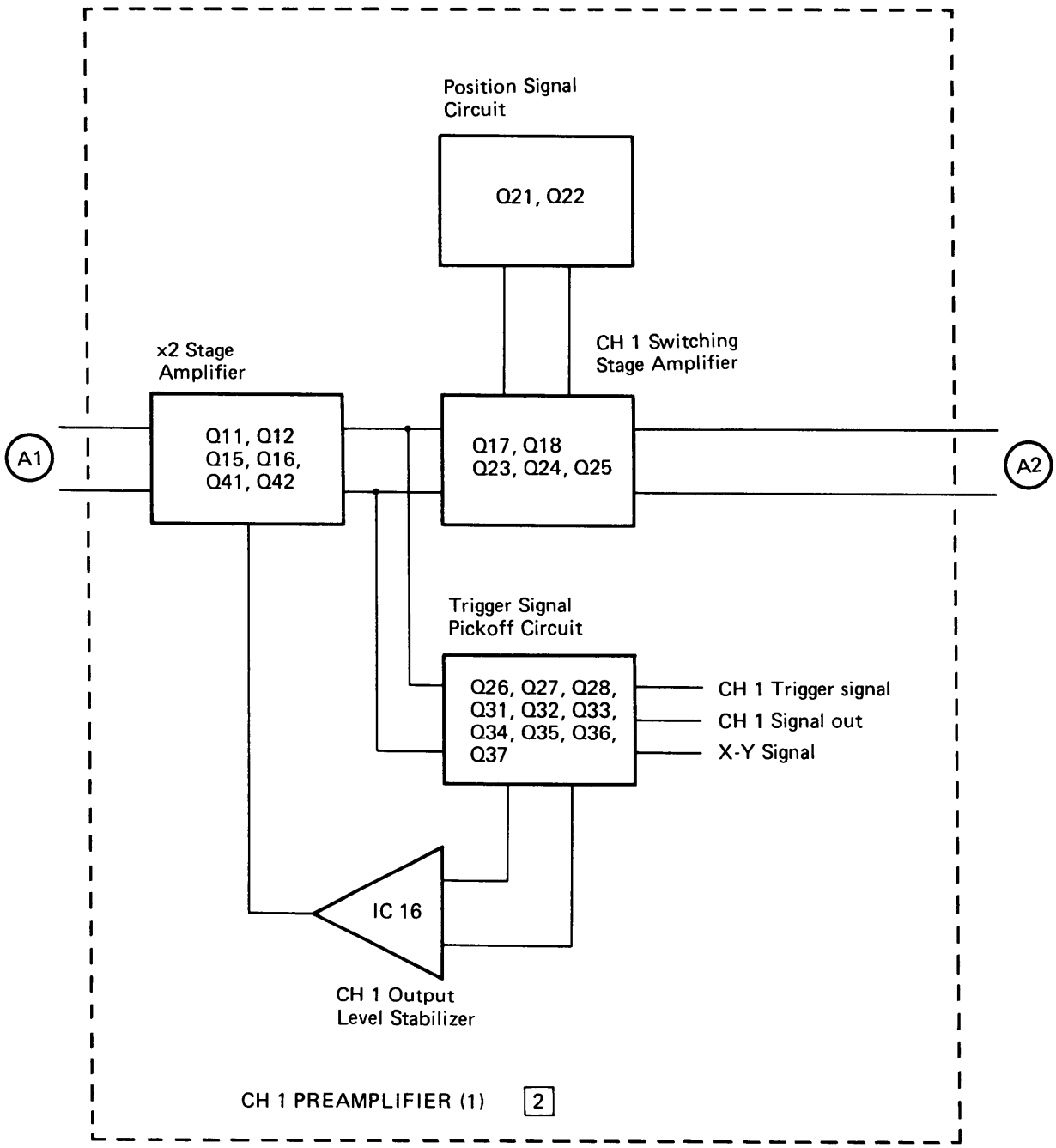


Figure 2-2-2-(2). Block diagram of the CH 1 vertical deflection amplifier



frequency component is determined by 1R12, 1R13, 1R26, 1R27 and 1R28. The input signal is divided by 1R12 and 1R13, and is applied to pin 3 of 1IC34. On the other hand, the signal at the emitter of 1Q11 is divided by 1R26, 1R27 and 1R28, and applied to pin 2 of 1IC34. Because 1IC34, 1Q11, 1Q12, 1Q19, 1R26, 1R28 and 1R27 form a negative-feedback amplifier, the emitter of 1Q11 outputs a voltage that makes the voltages at pins 2 and 3 of 1IC34 equal. 1R28 is adjusted to make the low and high frequency gains equal.

x5 STAGE AMPLIFIER [1], [3]

〈 Function 〉

This amplifier can switch between two gains: NORM and NORM x 5.

〈 Circuit Description 〉

The feedback circuit in 1IC35 is provided to maintain low drift even with high x5 gain.

The gain is boosted by 5 times when 1Q15 and 1Q16 are on. When they are off, 1R89 and 1R90 are connected to the −12V power supply so that the currents at 1Q17 and 1Q18 do not vary.

The operation of this circuit is similar to the previous input buffer circuit. The high-frequency components of the input signal pass through 1Q13, 1Q14, 1Q17 and 1Q18, while the low-frequency gain is determined by the feedback circuit in 1IC35. The amplifier composed of pins 5, 6 and 7 of 1IC35, 1R101, 1R102, 1R103 and 1R104 is used to convert the differential signal into a single-ended signal.

The input signal is divided by 1R57, 1R58 and 1R61. On the other hand, the signals from the collectors of 1Q17 and 1Q18 pass through the above-mentioned converter amp and attenuator 1R107 to 1R111, and are compared by a comparator connected to pins 1, 2 and 3 of 1IC35. The base of 1Q14 is controlled to make these two signals equal, and 1R112 is used to make the gains of the high and low frequency components the same.

x2 STAGE AMPLIFIER [2], [4]

〈 Functions 〉

This amplifier stage has two functions.

- Gain switching between NORM and NORM x 2.
- Continuous gain variation down to 1/2.5 (VARIABLE).

Figure 2-2-2-(3). Block diagram of the CH 2 vertical deflection amplifier

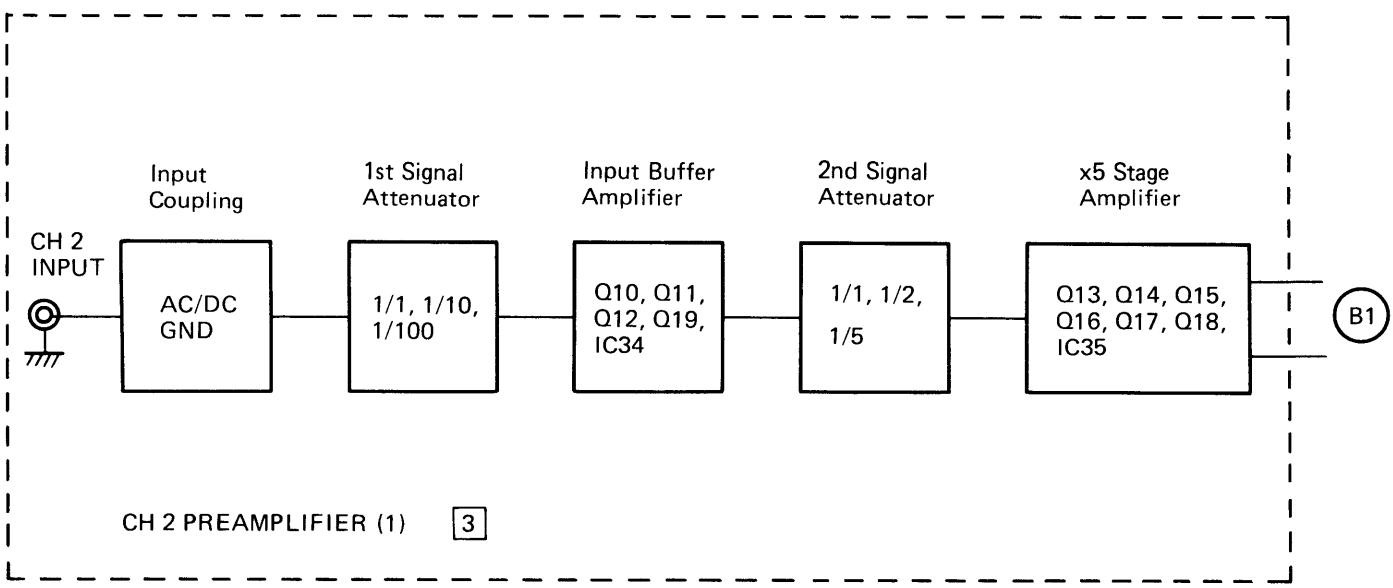
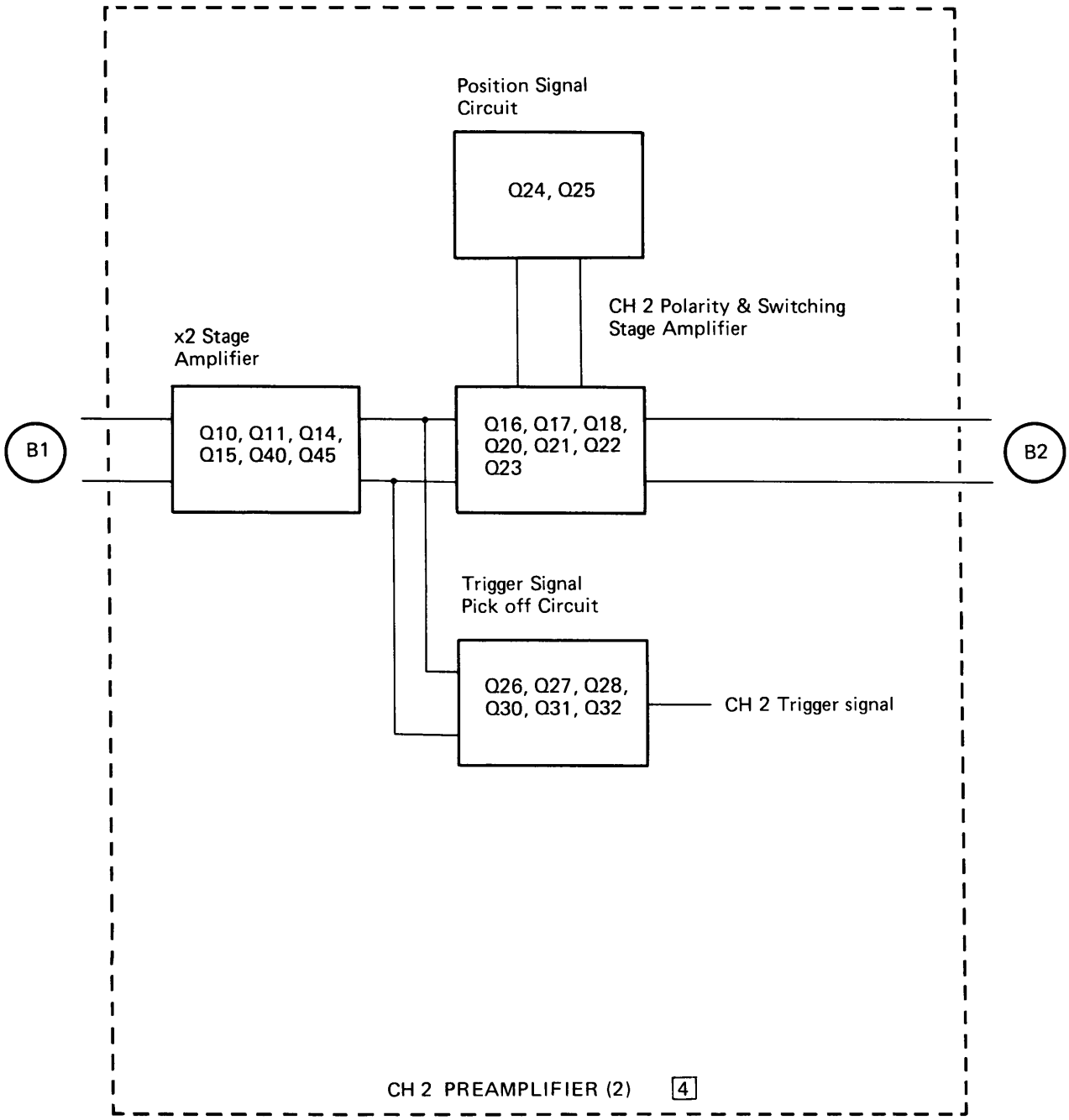


Figure 2-2-2-(4). Block diagram of the CH 2 vertical deflection amplifier



〈 Circuit Description 〉

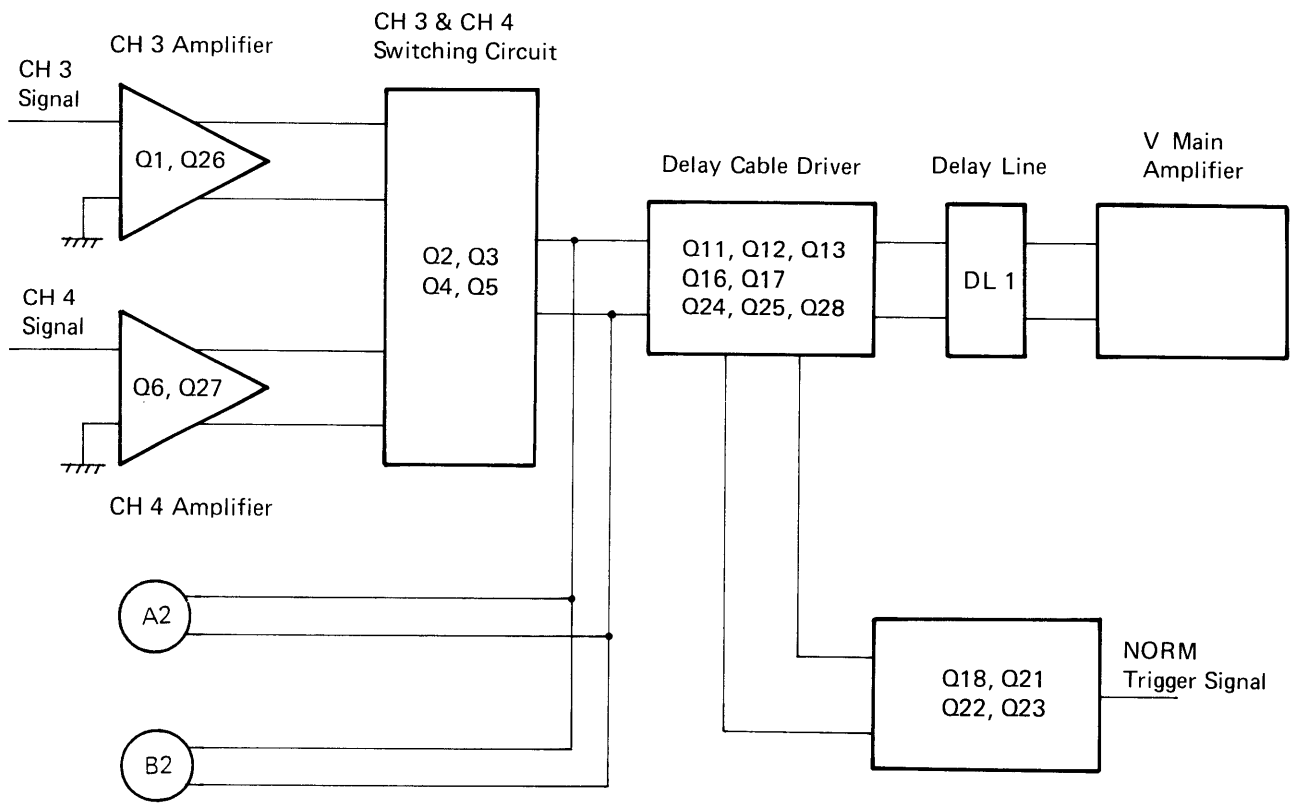
The deflection factors of 5, 2 and 1 mV/div are obtained by switching the x2 stage amp and x5 stage amp.

The signal current from the collector of 2Q11 mainly flows to 2R31 and 2R26. The current dividing ratio is varied by varying 2R27 which allows the gain to be varied continuously.

CH1 OUTPUT LEVEL STABILIZER

This circuit is provided for only the CH1 preamp circuit, and is composed of 2R111, 2R112, 2IC16, 2R101, 1R32 and 2R34. The average of the voltages at the collectors of 2Q26 and 2Q27 is detected by 2R111 and 2R112, and the currents of 2R32 and 2R34 are controlled to make the average voltage 0V. As a result, the factors causing the CH1 OUT level to vary in the circuitry prior to 2Q26 and 2Q27 are compensated.

Figure 2-2-2-(5). Block diagram of the delay cable driver



TRIGGER SIGNAL PICKOFF CIRCUIT [2], [4]

The internal trigger signal is separated from the input signal supplied from the output of x2 stage amp through the buffer composed of 2Q26 and 2Q27. The internal trigger signal obtained is amplified by 2Q28 and 2Q31.

The output from 2Q28 is applied to 2Q36 and 2Q37 via 2Q32, and that from 2Q37 is sent to the trigger circuit. On the other hand, the output from 2Q31 is amplified by 2Q33, and sent to the horizontal switching circuit as the X-Y signal. In modes other than the X-Y mode, 2Q35 turns on and 2Q33 turns off.

POSITION & POLARITY CIRCUIT [2], [4]

〈 Functions 〉

This circuit has the following three functions.

- Combination of position signal and input signal.
- Switching of displayed channel.
- Switching of CH2 polarity.

〈 Circuit Description 〉

The position signal is converted into a difference current signal by 2Q21 and 2Q22, and the current of the position signal is combined with the input signal by 2Q23 and 2Q25. 2Q24 is the CH1 signal control transistor. The potential at the base of 2Q23 is approx. 2.5V.

When CH1 CONT is H level (approx. +5V), 2D12 and 2D13 go off, and the CH1 signal is sent to the delay cable driver circuit via 2Q23 and 2Q25. At this time, the signals from the other channels are controlled so that only the CH1 signal is displayed on the CRT.

When CH1 CONT is L level (approx. +1V), 2D12 and 2D13 are on, 2Q23 and 2Q25 turn off, and the CH1 signal is not supplied to the next stage.

The operations of the position and channel switches are the same in the CH2 circuitry.

The operations of the position and channel switches are the same in the CH2 circuitry.

The polarity switching operation is as follows: When CH2 POLARITY SW S12 (6) is set to NORM, the potentials at the bases of 4Q20 and 4Q21 are set higher than those at 4Q22 and 4Q23 by the control signal. As a result, 4Q22 and 4Q23 turn on, and 4Q20 and 4Q21 turn off. The operation is inverted when the polarity is INV.

CH3 & CH4 AMPLIFIER [5]

〈 Functions 〉

The circuit has the two following functions.

- Amplification of the signal sent from CH3 or CH4 amplifier.
- Switching of channels.

〈 Circuit Description 〉

The signals sent from the CH3 and CH4 preamplifiers are amplified by 5Q1 and 5Q26, or 5Q6 and 5Q27. Each signal is sent to the switching circuit of D1 to D8, and 5Q4 and 5Q5 select either the CH3 or CH4 signal, which is sent to 5Q2 and 5Q3. 5D11 and 5D12 are provided to improve the load efficiency with respect to the CH1 and CH2 signals.

DELAY CABLE DRIVER [5]

〈 Functions 〉

This circuit has four functions.

- Driving the delay cable.
- Switching the bandwidth.
- Separation of the NORM trigger signal.
- Synthesis of trace separation signal.

〈 Circuit Description 〉

When the bandwidth is FULL, 5Q12 and 5Q13 are selected, and S51 and S52 are off.

When the bandwidth is set to 100 MHz, the signal passes through 5Q16 and 5Q17, and the bandwidth is limited by 5C84, 5R184, 5R84 and 5R87.

When the bandwidth is set to 20 MHz, 5D14 and 5D15 are on, so 5R89, 5C89, 5R90 and 5C90 are connected to the signal line.

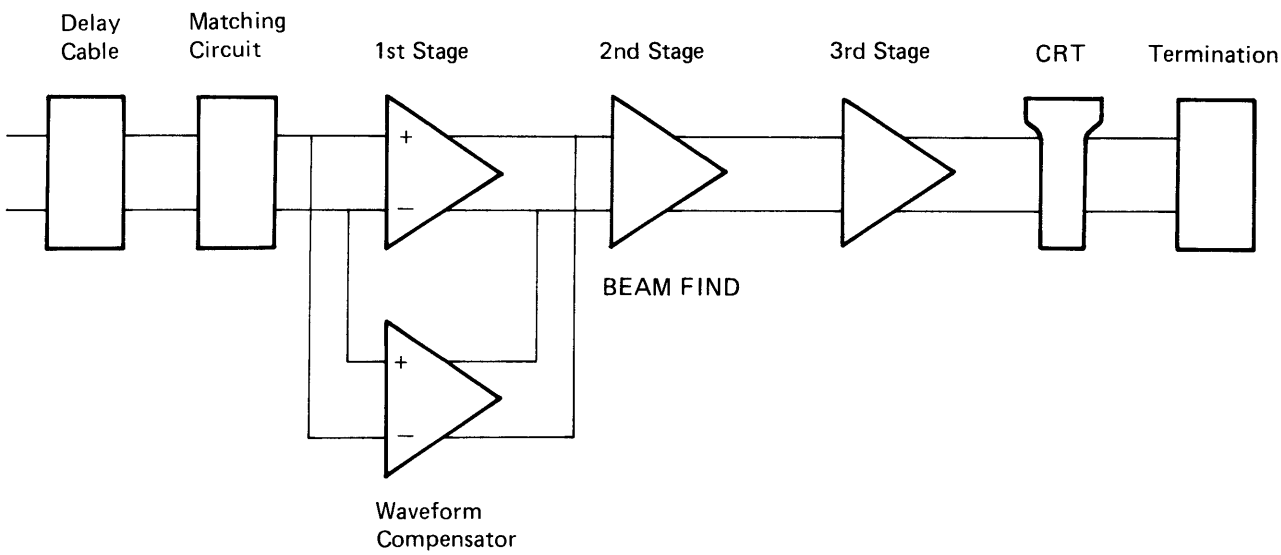
DELAY CABLE [5]

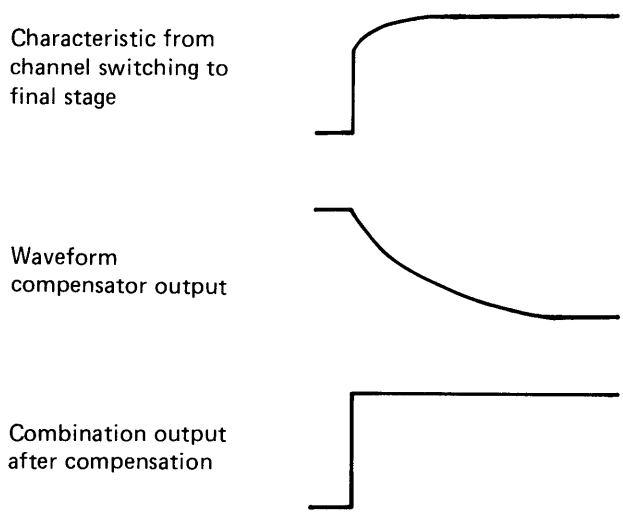
The delay cable is used to display the rise of the pulse waveform on the CRT.

A certain period is required after the portion to be observed is input into the INPUT connector until the signal reaches the vertical deflection board. A certain time lag is also required before the sweep signal, which is synchronized with the sync signal generated from the portion to be observed, reaches the horizontal deflection board.

Normally, the above delay in the horizontal deflection system is larger than the delay in the vertical deflection system, so the waveform should rise before sweeping starts. To prevent this, the vertical deflection system delay is made larger than the horizontal deflection system delay by using the delay cable, which delays the vertical signal after separating the sync signal. In fact, the length of the delay cable is made long enough taking the amplifier's rise time into consideration.

Figure 2-2-2-(6). Block diagram of the vertical main amplifier circuit





VERTICAL MAIN AMPLIFIER [8]

〈 Functions 〉

This circuit is used to amplify the input to a level high enough to deflect the CRT beam. It also has the beam finder function, and operates as the final stage of the delay cable.

〈 Circuit Description 〉

This circuit consists of a three-stage cascode-connected amplifier and waveform-compensator amplifier. Figure 2-2-2-(6) Shows the block diagram. 8R35, 8R37, 8L11, 8L12, 8C11, 8C12, 8R34 and 8R36 form the delay cable terminating circuit.

Waveform compensation is performed as follows. The output from the waveform compensator circuit is combined with the output from the 1st stage cascode amp with reversed phase. The frequency characteristic of the compensator circuit is set to amplify only the low-frequency component and the composition eliminates the low-frequency component from the 1st stage amp output. Waveform are shaped by controlling the amount that is eliminated.

Note that this compensates the period from channel switching until the final stage as well as the 1st stage.

The beam finder operation is performed as follows. The voltage at the cathode of 8D12 is normally −12V. When the BEAM FIND switch is pressed, the bias current of transistors 8Q26 and 8Q27 are limited by 8R116 so that, whatever the value of the input signal, the amplitude of the 2nd stage output is always small. 8R116 is set so that the display is always within the CRT screen area.

2-3 CALIBRATOR CIRCUIT [9]

The calibrator circuit outputs the 0.6V square-wave voltage and 10 mA square wave current. These outputs are used for the calibration of vertical deflection factor and for the adjustment of probe phase.

Figure 2-3-2-(1) Shows the block diagram of the circuit.

The oscillator circuit consists of 9IC12, 9R13, 9R14, 9C12, 9R12 and 9R15.

Figure 2-3-2-(2) shows the operation waveforms at the pins of 9IC12.

The oscillator output is divided by 9R16 and 9R18, and supplied to the base of 9Q20. 9Q19 is switched by the output from 9Q20. When pins 1 and 2 of 9P16 are connected, 9Q20 turns on regardless of the oscillator output, so the CAL output becomes 0.6V DC. This operation is used only when calibrating the CAL output.

Figure 2-3-2-(1). Block diagram of the calibrator circuit —

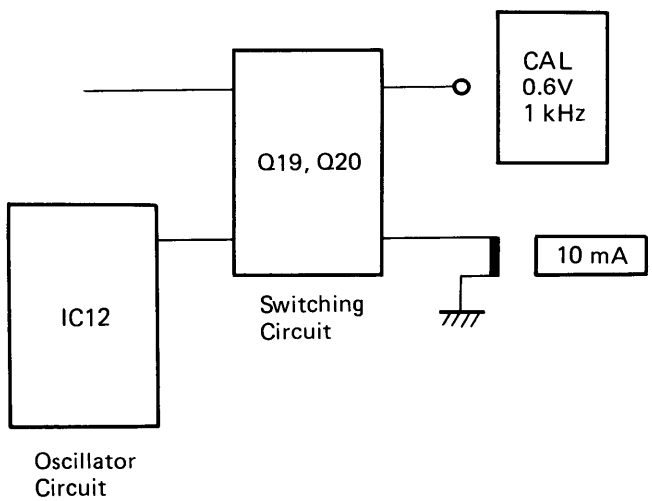
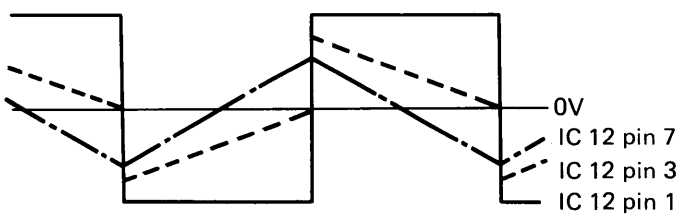


Figure 2-3-2-(2). Waveform of the oscillator circuit ——



2-4 TRIGGER CIRCUIT [11], [12], [13], [14], [15]

Figure 2-4-2-(1) shows the block diagram of the trigger circuit.

2-4-1 Main Functions

The trigger circuit has the following functions.

1. It generates two signals, A CH1 trigger signal and B CH1 trigger signal, from the CH1 trigger signal sent from the vertical preamplifier.
   A similar operation is also applied to the CH2 trigger signal.
2. For the A trigger circuit, it selects one of the CH1 trigger signal, CH2 trigger signal, normal trigger signal, CH3 trigger signal and line trigger signal.
   A similar operation is also performed for the B trigger circuit.
3. It selects the trigger signal input coupling by filtering the selected signal.
4. It separates the TV sync signal from a composite video signal.
   This function is selected by the above-mentioned A coupling.
5. It provides optimum hysterisis to the trigger signal for stable synchronization of signals including noise.
6. It sets the trigger level and slope.
   The sawtooth wave starts when the trigger signal passes a preset voltage in a preset direction. The voltage is referred to as the trigger level, and the direction is referred to as the trigger slope.

2-4-2 Trigger Circuit Description

Trigger signal selector [11]

Here the A trigger signal selector is described.

11Q61 and 11Q64 constitute the paraphase amplifier, and the output from 11Q64 is used as the A trigger signal, while the output from 11Q11 is used as the B trigger signal.

The output from 11Q64 is sent to the emitters of grounded base amplifiers 11Q71 and 11Q72. The potential of the base of 11Q72 is controlled by A CH1*. When A CH1* is 0V, the voltage at the base of 11Q72 is approx. 3V and 11Q72 turns on, while 11Q71 turns off. As a result, the CH1 trigger signal is selected as the A trigger signal and sent to the subsequent circuit. At this time, the A SOURCE switch prevents other signals from being input to the A trigger circuit. Operation is similar when other trigger signals are selected.

The selection of B trigger signal is performed in a similar way so the required, different signals can be selected for the A and B trigger circuits.

The A trigger signal is also supplied to the TV sync separator circuit.

Operation is different from the above when the A trigger source is LINE. All grounded base transistors used with other trigger signals turn off in this case, and the signal sent from the power circuit is supplied to 12R31 via 11S91.

A TRIGGER amplifier [12]

〈 Function 〉

The A trigger amplifier circuit selects the coupling, sets the trigger level and amplifies signals.

〈 Description 〉

The following describes operations with DC coupling.

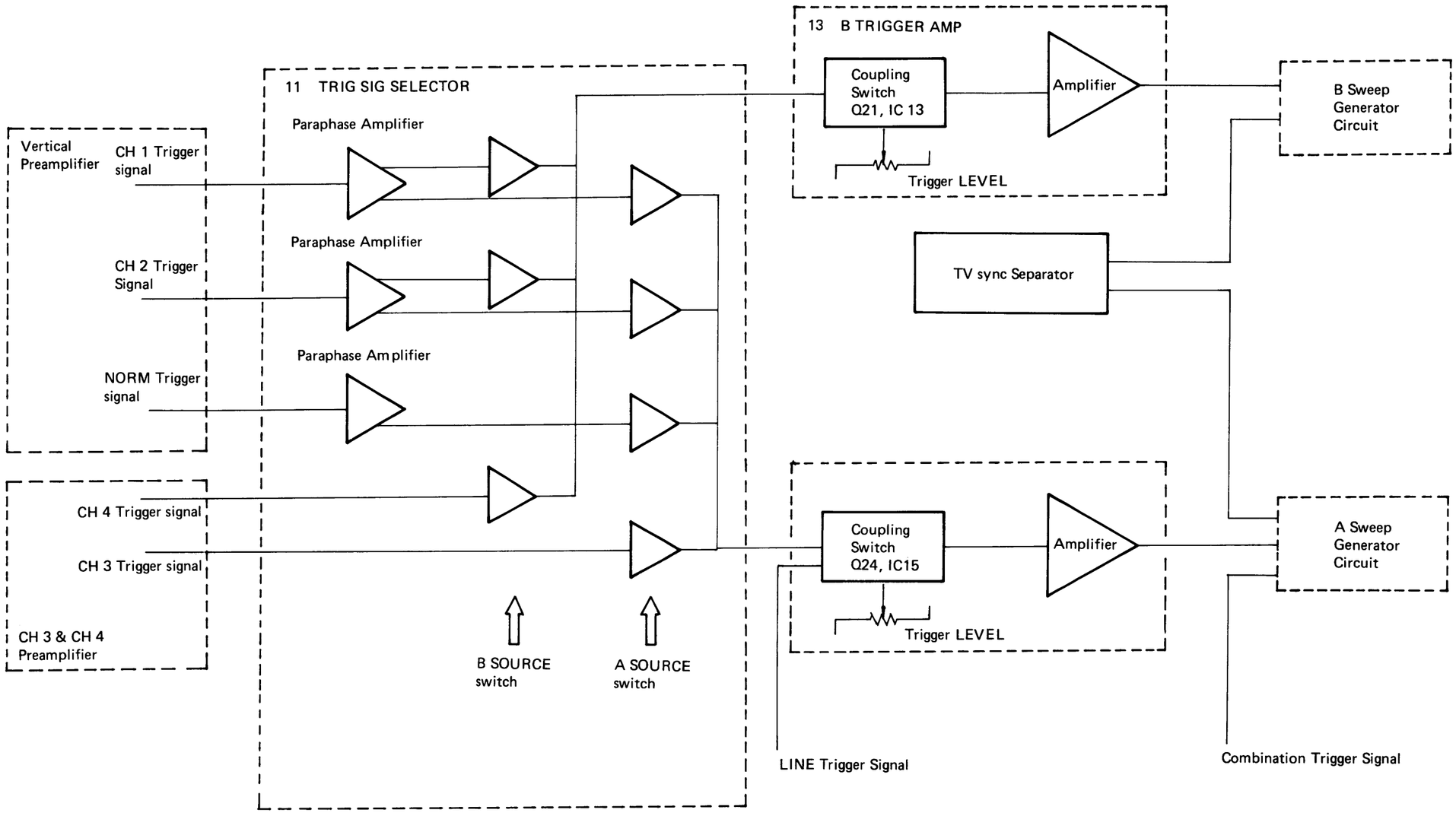
The high-frequency component of the trigger signal goes to the base of 12Q19 via 12Q24 and 12C33, while low-frequency components including the DC component go to pin 3 of 12IC15 via 12R30 and 12S11. This signal is amplified by 12IC15, with the gain largely determined by 12R14, 12R15 and 12R18.

On the other hand, the signal for the trigger level is also amplified by 12IC15, with the gain determined by 12R22, 12R18, 12R14 and 12R15.

As shown in the above, the output of 12IC15 is the sum of the trigger signal low frequency component, amplified by 12IC15, and the trigger level signal, also amplified by 12IC15. In other words, the trigger signal is level-shifted by the trigger level signal and output from 12IC15.

The output from 12IC15 is sent to the base of 12Q19 via 12R17. As described above, the signal input to 12Q19 is the trigger signal level-shifted by the trigger level signal.

Figure 2-4-2-(1). Block diagram of trigger circuit



With the trigger input coupling of AC, the low-frequency component of the trigger signal passes through 12C13 so that the DC component is cut off. In this case, the DC component of 12IC15 output depends solely on the trigger level signal.

With the LF REJ coupling, all the low-frequency components of the trigger signal are cut off by 12S11. In this case, only the high-frequency components are supplied to 12Q19.

With the HF REJ coupling, V_{BE} of 12Q24 is reverse-biased by 12R33 and 12R34, so that the high-frequency components of the trigger signal are not sent to 12Q19. In addition, a low-pass filter composed of 12R30 and 12C11 is provided so that 12Q19 is supplied with only the low-frequency components of the trigger signal. Note that, at this time, the DC component is also cut off.

When A COUPLING is FIX, the trigger level is fixed at approx. 0V. The A trigger level is fixed at approx. 0V because, when the A FIX LEVEL mode is selected, the A level is grounded via 12S11 (refer to TV SYNC SEPARATOR 14).

When A COUPLING is TV-H or TV-V, pin 2 of 12IC15 is connected to approx. +5V via 12D11. As a result, the voltage at the base of 12Q19 is clamped at approx. −3V by 12D81 and 12D82.

The dynamic range of the trigger signal at the base of 12R19 is sufficiently smaller than the clamp level, so that output from 12Q67 is always kept low (ECL level).

The above-mentioned operations are necessary for the following two main reasons:

- Due to the relationship between the polarities of the hysterisis & slope selector circuit output and TV sync separator output.
- Because the trigger amplifier cannot operate while the TV sync separator circuit is operating.

When the trigger source is set to COMBI, pin 2 of 12IC15 is maintained at approx. +5V for similar reasons. 12R81, 12D81 and 12D82 are required for protecting V_{BE} of 12Q19 from the inverted voltage.

The purpose of the trigger amplifier is to amplify the trigger signal to the level required by the hysterisis & slope selector circuit. The trigger amplifier shapes waveforms such as that of the trigger level signal.

The output from 12Q67 is at a level that can drive the ECL circuitry.

B TRIGGER amplifier 13

The operations of this circuit are similar to those of the A TRIGGER AMP circuit.

Although some polarities are inverted with respect to those in the A TRIGGER AMP, the purpose of operation is still the same.

TV SYNC SEPARATOR 14

〈 Function 〉

This circuit has the two following functions.

1. In modes other than TV modes, it sends the signal corresponding to the slope switch setting to the slope selector circuit.
2. In the TV-H or TV-V mode, it separates the sync signal from the composite video signal and sends it to the slope selector circuit.

〈 Description 〉

Figure 2-4-2-(2) shows the block diagram of the TV sync separator circuit.

The circuit consisting of 14Q16, 14Q116 and 14Q17 is provided to switch the polarity. As the input to the sync separator circuit should be a composite video signal including a negative-polarity sync signal, this circuit selects the input signal polarity to match it.

Selection is performed by A polarity switch 14S21.

When positive (+) polarity is selected, 14Q17 goes off while 14D15 is conducting, and the signal input to 14Q16 is sent to 14Q22 after the polarity has been inverted.

When negative (−) polarity is selected, 14Q17 turns on while 14D15 is off, and the signal with the same phase is sent to the next stage.

The sync separator circuit operates as follows: The average level of the signal at the base of 14Q22 becomes approx. 0V via 14R20 and 14C20 .

In Figure 2-4-2-(3) a, the area of the upper hatched part is equal to that of the lower hatched part. The portion of the sync signal is amplified by 14Q22, with the gain roughly determined by 14R22 and 14R23.

14Q29 is biased so that the waveform at the base is as shown in Figure 2-4-2-(3) b. When the waveform at the base of 14Q29 becomes as shown in Figure 2-4-2-(3) c, the voltage at the cathode of 14D25 rises, the collector output of 14Q22 therefore increases, and the waveform at the base

of 14Q29 becomes as shown in Figure 2-4-2-(3) b. 14Q26 a buffer amp.

As has been seen, the circuit consisting of 14R26, 14Q26, 14D25 and 14C25 stabilized the sync separation operation even when the input signal varies in amplitude.

When the TV-V mode is selected, pin 15 of 14IC2 is grounded by 14C40.

14C40 and 14R40 form an integrator circuit, which integrates the H sync signal to obtain the V sync signal.

14IC2 (pins 11, 12, 13), 14D40 and 14R41 form a comparator with hysterisis, which is provided to shape the V sync signal waveform.

In the TV-V mode, the A sawtooth wave starts with the V sync signal.

In the TV-H mode, the A sawtooth wave starts with the H sync signal.

In either mode, the H sync signal is used as the B trigger signal.

HYSTERISIS & SLOPE SELECTOR CIRCUIT [15]

The trigger amplifier needs hysterisis for stable observation of low-frequency signals with a fast sweep rate.

The circuit consisting of 15R54 and 15IC11 (pins 13, 14, 15) is provided for the purpose. The hysterisis is determined by 12R68 and 15R54.

15IC11 (pins 9, 7, 10) is the slope selector circuit.

Figure 2-4-2-(4) shows the relationship between the slope selector circuit waveforms and the sawtooth wave.

2-5 SWEEP GENERATOR

2-5-1 A Sweep Generator [15]

2-5-5-1 Main Functions

The A sweep circuit has following functions.

1. Generation of jitter-free sweep gate signal.
2. Resetting of jitter-free circuit.
3. Detection of trig'd sweep.
4. Control of AUTO, NORM and SINGLE sweeps.
5. Control of holdoff time.
6. Setting of sweep start level.
7. Disconnection function, and control of integrator circuit according to sweep gate signal.
8. Buffer amplifier.
9. Setting of sweep length.
10. Supply of unblanking signal.
11. Supply of A gate out signal.
12. Supply of A-ends-B signal.
13. Stopping of sweep under control of B-ends-A signal.

2-5-1-2 Circuit Description

JITTER-FREE SWEEP GATE circuit and RESET circuit [15]

15IC13 is the jitter-free sweep gate circuit and 15IC21, 15Q76 and 15C72 form the reset circuit.

Figure 2-5-1-2 shows the block diagram.

When the trigger signal rises after the holdoff signal has gone Low, Q of the 1st gate turns Low. However, due to the delay between the input and output of the 1st gate, the 2nd gate is set when the trigger signal rises the next time. The R input and CK input of the 2nd gate are synchronized to perform this. In consequence, the synchronization relationship between the trigger signal and sweep gate signal is not disturbed by the holdoff signal.

The reset circuit releases the jitter-free circuit operation when the input signal frequency drops below the specified value. The 1st gate is set after a specified period after the holdoff signal goes Low, so that the sweep can be started with the first trigger signal.

Figure 2-4-2-(2). Block diagram of the TV sinc separator circuit

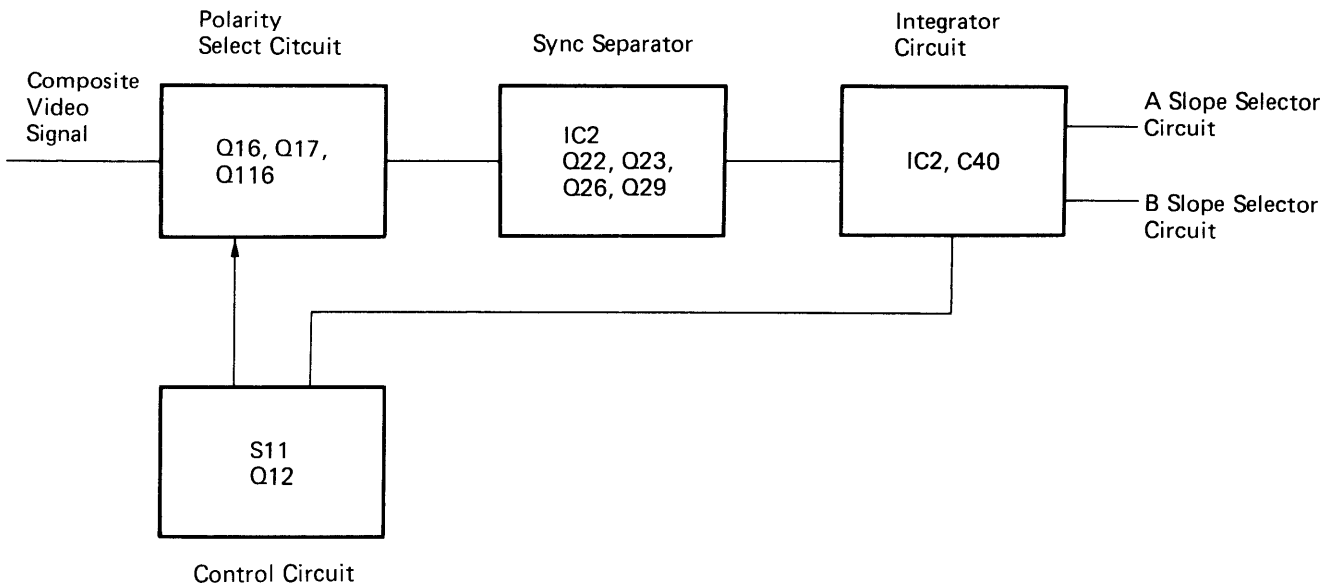


Figure 2-4-2-(3)

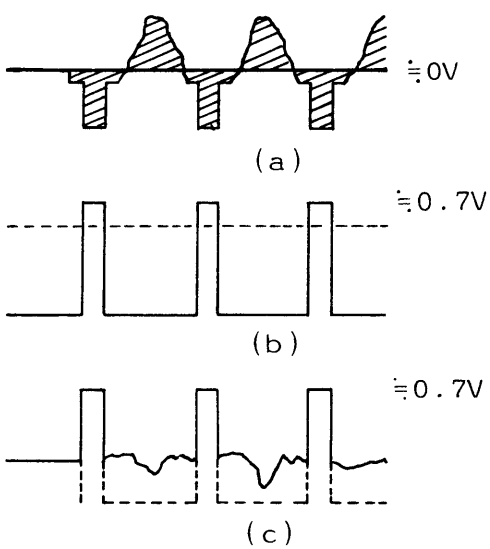


Figure 2-4-2-(4). Slope selector waveform and sawtooth wave

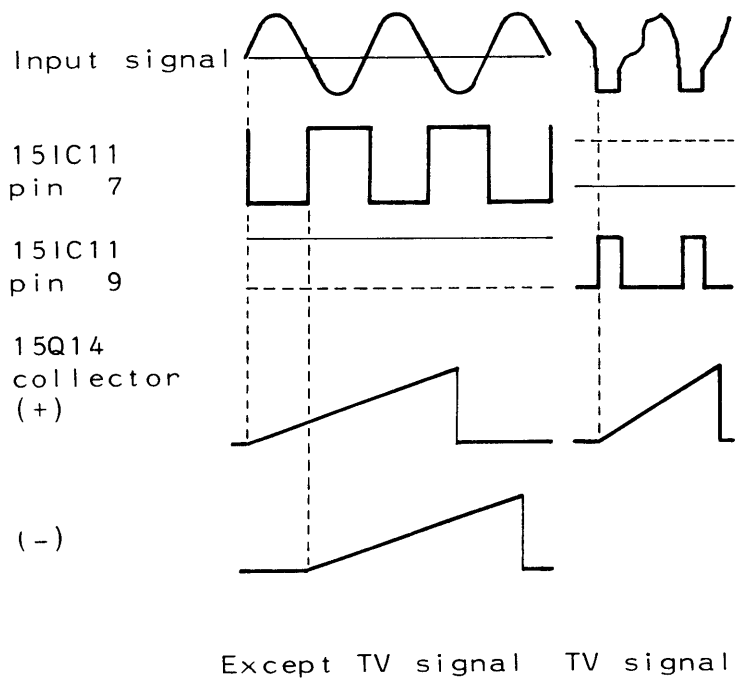
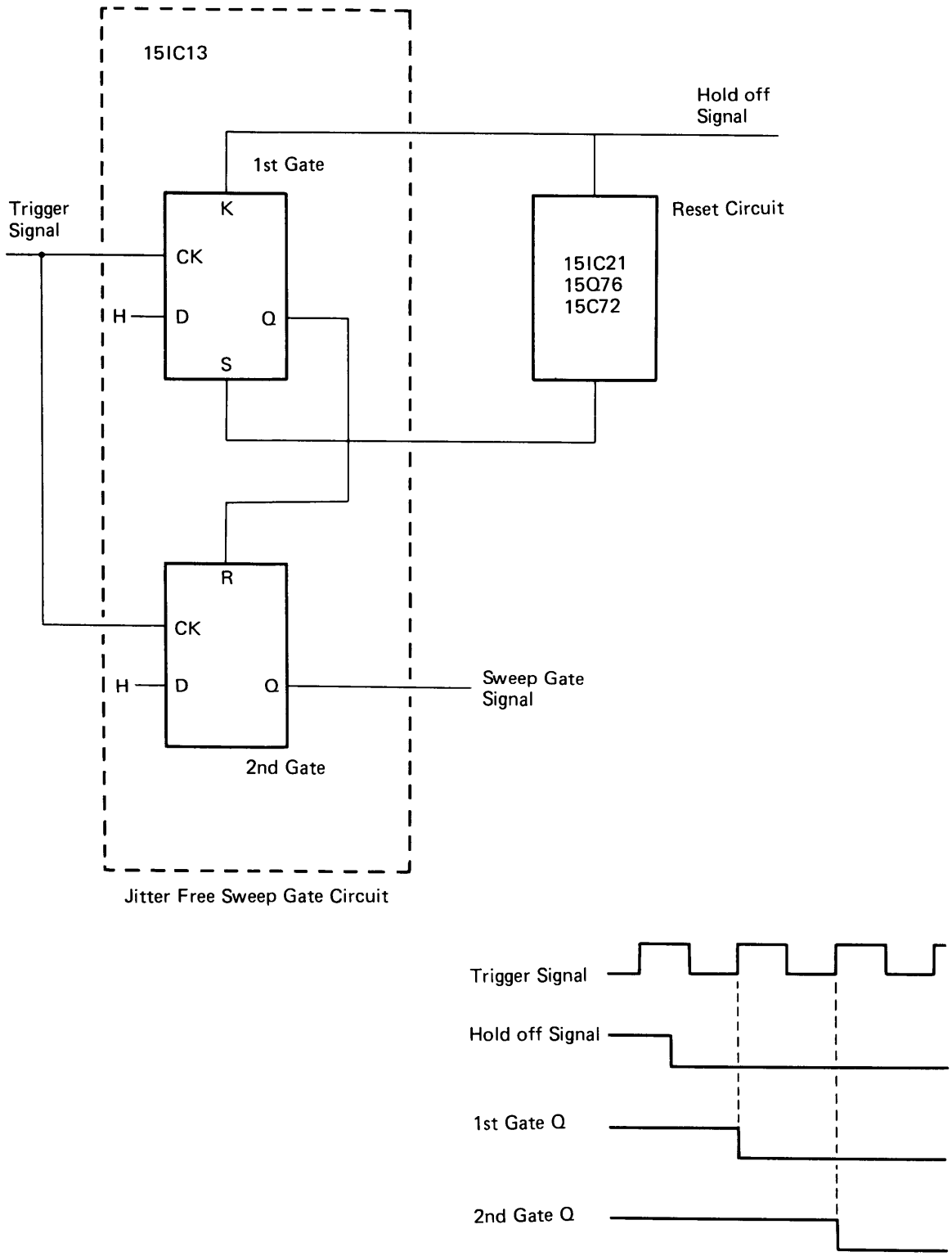


Figure 2-5-1-2. Block diagram of the jitter-free sweep gate circuit



AUTO CONTROL circuit [15]

〈 Functions 〉

The main function of this circuit is the judgement of TRIG'D or not triggered sweep.

〈 Circuit Description 〉

The auto control circuit consists of 15IC22, 15IC23, 15Q86, 15Q88 and 15C88. It recognizes the TRIG'D condition during the sweep period started by the trigger signal and within 20 ms after such sweep has ended.

When the A sweep mode is set to AUTO, pin 9 of 15IC22 goes Low, and pin 11 also goes Low when the TRIG'd condition ends. FREERUN ENABLE then goes High and pin 4 of 15IC15 goes Low. With this condition, the next sweep starts immediately after the holdoff time ends.

DISCONNECT AMPLIFIER and BUFFER AMPLIFIER [15]

The buffer amp consists of 15Q103, 15Q105 and 15Q104. This is a zero-offset circuit with high input impedance and low output impedance.

The sweep start voltage is determined by 15D101, 15Q102, 15D102, 15D103 and 15R101.

SWEEP LENGTH circuit [15]

This circuit consists of 15D45, 15Q44, 15R38, 15R39, 15R40 and 15IC18. Pins 3, 6 and 7 of 15IC18 function as a comparator.

HOLDOFF TIME control circuit [15]

The holdoff time control circuit consists of 15IC16, 15IC17, 15IC18, 15Q20, 15Q22 and 15Q23.

During sweeping, pin 5 of 15IC18 is –5V, 15D14 and 15D15 are on, 15Q15 is off, and both 15IC17 a and b are set (with Q "1" and Q "0"). When the determined length has been swept, pin 3 of 15IC18 goes High, 15IC17 is reset, 15D14 and 15D15 go off, so pin 5 of 15IC18 is charged via 15Q15. When the voltage at pin 5 of 15IC18 exceeds that at pin 4 of 15IC18, 15IC17a is reset and pin 9 of 15IC16 goes Low. When pin 3 of 15IC17 goes Low, 15C22 is discharged through 15R22 and, after a while, 15Q20 goes on. Pin 16 of 15IC16 then goes Low, 15IC17b is also set, and pin 12 of 15IC16 goes Low. As pin 13 of 15IC16 has already been Low, the hold off time ends at this moment. The holdoff time can be extended by 10 *times using 18R11.*

SINGLE-SWEEP control circuit [15]

When the A sweep mode is SINGLE, pin 11 of 15IC16 goes High, so 15IC17b is not reset even after the holdoff time. In this case, 15IC17b is set using 15Q33. When 15IC17b is set, 15Q30 goes off and SINGLE READY goes High.

2-5-2 B Sweep Generator [16]

2-5-2-1 Main Functions

The B sweep circuit has the following functions.

1. Setting of delay time.
2. Generation of sweep gate signal conforming to B sweep mode.
3. Setting of sweep start level.
4. Disconnection function, and control of integrator circuit according to sweep gate signal.
5. Buffer amplifier.
6. Setting of sweep length.
7. Supply of unblanking signal.
8. Supply of B gate out signal.
9. Supply of B-ends-A signal.
10. Stopping of sweep under control of A-ends-B signal.

2-5-2-2 Circuit Description

As many sections of the B sweep circuit are the same as the A sweep circuit, only differences will be described.

DELAY PICKOFF circuit [16]

This circuit includes the comparator, waveform shaper and comparison voltage generator. 16IC31 is the comparator, and the delay time is the time before the A sawtooth wave becomes the comparison voltage.

SWEEP GATE circuit [16]

The sweep gate circuit consists of 16IC43 and 16IC44. Sweeping starts when both pins 13 and 7 of 16IC44 go High. When the B sweep mode is RUNS AFT DELAY, 16IC43b is set (with Q of 16IC43 a and b "1" and Q "0"), so that the sweeping starts when the 16IC43a is set. In

modes other than RUNS AFT DELAY, sweeping does not start even when 16IC43a has been set, and 16IC43b is set by the following trigger signal so that sweeping is started by triggering.

The GND freerun signal turns pin 7 of 16IC44 High even when the B sweep mode is TRIG'D, so that freerunning occurs even with the triggered sweep mode. 16IC42 generates the B-ends-A pulse from the B sweep gate signal.

2-5-3 Timing Switch [17], [18]

2-5-3-1 Main Functions

This circuit has the following functions.

1. Formation of constant-voltage circuit and switching of its current value.
2. Switching of timing capacitors.
3. Switching of holdoff capacitors.
4. Generation of the above switching control signals, according to the timing switch.

2-5-3-2 Circuit Description

The constant-voltage circuit operates as follows.

The voltage value of the constant-voltage circuit is determined by the values of timing resistors and the voltage applied to it. The timing resistors are 17R30, 17R32, 17R36, and 17R46 and 17R40. When 17Q31 turns on, 17Q30 turns on and the voltage determined by 17Q27 is applied to 17R30. At this time, 17Q33, 17Q37 and 17Q41 are off. Other resistors are selected similarly.

On the other hand, the voltage applied to the timing resistors are determined by the selection of 17R57, 17R56, and 17R55 // 17R54. The operation is as follows. Pins 5, 6 and 7 of 17IC31, and 17R17 form a negative-feedback amplifier. Pin 6 of 17IC31 is common with pin 7 of 17IC32, and the voltage at pin 7 of 17IC31 can be switched by 17Q52 and 17Q53.

Assuming V_T is the voltage across pins 5 and 7 if 17IC31 when 17Q52 is on and 17Q53 is off, the above-mentioned voltage becomes $1/2V_T$ when 17Q52 is off and 17Q53 is on. When both 17Q52 and 17Q53 are off, the above voltage becomes $1/5V_T$.

Pins 1, 2 and 3 of 17IC32, 17R19, 17R45, 17D28 and 17Q27 also form a negative-feedback amplifier. 17Q28 is the constant-current circuit to supply the bias current. The voltage applied to 17R18 and 17R47 is divided at 17R47 and sent to 17R19, then amplified by the above-mentioned feedback amplifier. 17Q44 is used to compensate the saturation voltage of the timing resistor switching transistors. The voltage applied to the timing resistors are switched by 17Q52 and 17Q53, and the voltage ratios provided are 1:1/2:1/5.

In addition, the voltage applied to the timing resistors can be varies using 17R47.

The operations of the B timing switch circuit is the same as the A timing switch circuit so it is not described in this manual.

2-6 HORIZONTAL SWITCHES [19]

2-6-1 Main Functions

This circuit has two functions:

- Switching of horizontal deflection signals.
- Control of unblanking signal.

The second function will be described in "2.9 Z axis circuit".

2-6-2 Circuit Description

The horizontal deflection signals include the A sawtooth wave, B sawtooth wave and CH1 signal.

This circuit selects one of these signals according to the setting of the Horizontal Display switch, and sends it to the horizontal amplifier.

2-7 HORIZONTAL CONTROL CIRCUIT [20]

2-7-1 Main Functions

This circuit has two functions:

- Control if horizontal display.
- Control of A sweep mode.

2-7-2 Circuit Description

This circuit outputs the control signal for the selection of the sawtooth waves and unblanking signal according to the setting of the horizontal display switch.

The sweep end signal, generated by the A sweep circuit, is formed into pulses by the horizontal control circuit, and sent to the vertical switching circuit. The signal is used as the ALT pulse signal when the vertical display mode is ALT.

When the horizontal display mode is ALT, the waveform switching operation is different from other modes. When the vertical display mode is set for a one-trace display, the A sweep end signal is counted down to 1/2 to switch the sawtooth waves.

When the vertical display mode is set for a two-trace ALT display, the signal is counted down to 1/4. When it is set for a four-trace ALT display, the countdown ratio is 1/8.

For example, when the vertical display mode is four-trace ALT, waveforms are displayed first by four A sweeps then by four B sweeps, and this cycle is then repeated.

This circuit controls the A sweep generator circuit according to the A Sweep Mode switch setting. In the single sweep mode, the single reset signal resets the A sweep generator, which in turn sends back the single ready signal. The single reset signal is released when this circuit receives the single ready signal.

2-8 HORIZONTAL AMPLIFIER CIRCUIT [21]

The horizontal amplifier generates the signal driving the CRT's horizontal deflection plates.

2-8-1 Main Functions

The functions of this circuit are as follows.

- Conversion of the single-ended horizontal deflection signal into a differential signal, and its amplification to a level high enough to drive the CRT's deflection plates.
- x10 magnification for observation of desired section. This function is not available during X-Y operation.
- Horizontal shifting of displayed waveforms using the horizontal position signal.
- Beam finder function.
- Prevention of circuit malfunctions, such as saturation, by the magnifier or horizontal position signal.

2-8-2 Circuit Description

Figure 2-8-2-(1) shows the block diagram of the horizontal amplifier circuit.

The input amplifier consists of two sections; for the horizontal deflection signal and for the horizontal position signal.

While one converts the horizontal deflection signal which is a current signal into a voltage, the other supplies the voltage corresponding to the horizontal position signal to the next stage. Both amplifiers have a shunt feedback construction.

21Q23 and 21R105 make a circuit which widens the horizontal position variation range during X-Y operation. In X-Y operation, 21RL105 turns on and 12R20 and 21R105 are connected in parallel.

The second-stage amplifier has three functions; magnifier, paraphase and limiter functions.

The output from 21Q15 is converted by an amp composed of 21Q26 and 21Q38 into a differential signal. The potential at the base of 21Q38 is determined by 21Q19, i.e. the base of 21Q26 and 21Q38 are equal, the trace is displayed at the center of the CRT. In other words, the

section of the sawtooth wave to be displayed at the center can be selected by varying the potential at the base of 21Q38. When MAG is ON, 21RL35 increases the gain 10 times by decreasing the emitter feedback resistance, so that the display is magnified by 10 times to the left and right from the center of the CRT screen.

21Q29 is a constant-voltage circuit which determines the bias current to 21Q26 and 21Q38.

Even when the gain is boosted by 10 times with MAG ON, the maximum output amplitude is limited by the current determined by 21Q29. Because a narrow value is set by the dynamic ranges of the next and final stages, the amp does not malfunction due to horizontal position signal when MAG is ON.

When BEAM FIND is ON, the cathode of 21D73 is not connected to −12V. As a result, the current of 21Q29 decreases so the above-mentioned dynamic ranges are limited to match the CRT display area.

The output amplifier circuit is a shunt feedback amplifier. It is designed to have small DC current consumption and to enable a large amount of high-frequency current to flow. 21Q54 supplies the base current of 21Q46 so that the rise characteristic of the collector of 21Q56 is improved.

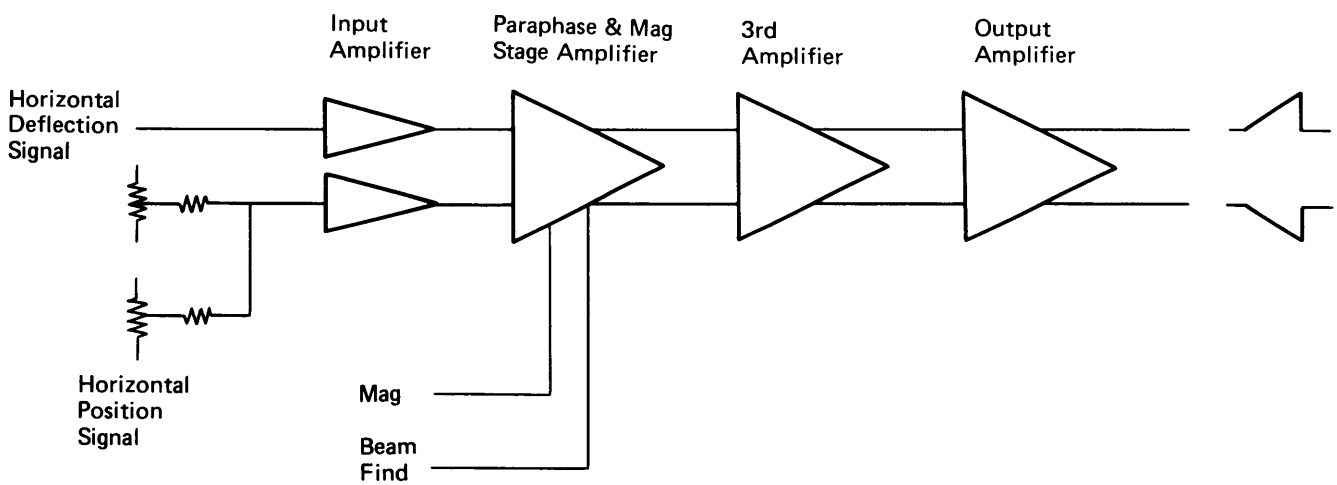
2-9 Z-AXIS CIRCUIT [9], [19], [22]

2-9-1 Main Functions

The Z-axis circuit has the following functions:

- Amplification of the unblanking signal that brightens trace lines and blanks out the retrace lines during A or B sweep.
- Amplifications of the chop blanking signal that erases transient phenomena appearing when the vertical mode is set to CHOP.
- Amplification of the external intensity modulation signal applied to the Z-AXIS input terminal.
- Adjustment of brightness by means of INTEN AND B INTEN.
- Further increases brightness by means of ENHANCE, when A-sweep time is in a range of 5 μs/div to 1 ns/div.
- AUTO FOCUS operation to adjust the focus voltage in association with INTEN operation.

Figure 2-8-2-(1). Block diagram of the horizontal amplifier circuit



2-9-2 Circuit Description

INTEN control circuit [9]

This circuit is provided to control the intensity variation range according to the TIME/DIV switch setting.

When the A sweep rate is from 0.5 s/div to 1 ms/div, A INTEN LMT* becomes 0V and 9Q28 turns on. As a result, when 9R30 A INTEN is rotated clockwise, the emitter of 9Q32 is clamped at approx. +3.5V. B INTEN CMT also performs a similar operation, and the maximum intensity is limited in this way.

On the other hand, when the A sweep rate is from 5 μs/div to 1 ns/div, ENHANCE ENABLE is approx. +5V. As a result, the output from 9IC1 can be inverted by 9S11. When pin 5 of 9IC1 is Low, 9Q33 turns on and the range of variation using 9TP28 is widened. This condition refers to ENHANCE ON, and the maximum intensity obtained by rotating INTEN clockwise is brighter than when ENHANCE is OFF.

When the A sweep rate is from 0.5 s/div to 10 μs/div, pin 1 of 9IC1 goes Low so that turning 9S11 on does not make ENHANCE ON.

INTEN control circuit [19]

This circuit makes it possible to control the intensity using B INTEN SIG only when the display is obtained using the B sweep.

Unblanking signal switch circuit

The primary function of this circuit is to switch between the A UNBLANKING and B UNBLANKING signals. Its secondary function is to convert the sweep gate signal into current. The unblanking signal selected by the control signal switches 19D18, 19D19, 19D21 and 19D22.

The third function is the Z AXIS IN input processing. The voltage signal input to this connector is converted into current by 19R27 and 19R28, and superimposed on the unblanking signal.

Z Axis amplifier circuit [22]

This circuit is used to amplify the unblanking signal to a level high enough to drive the CRT's electron beams and to supply it to the CRT circuit.

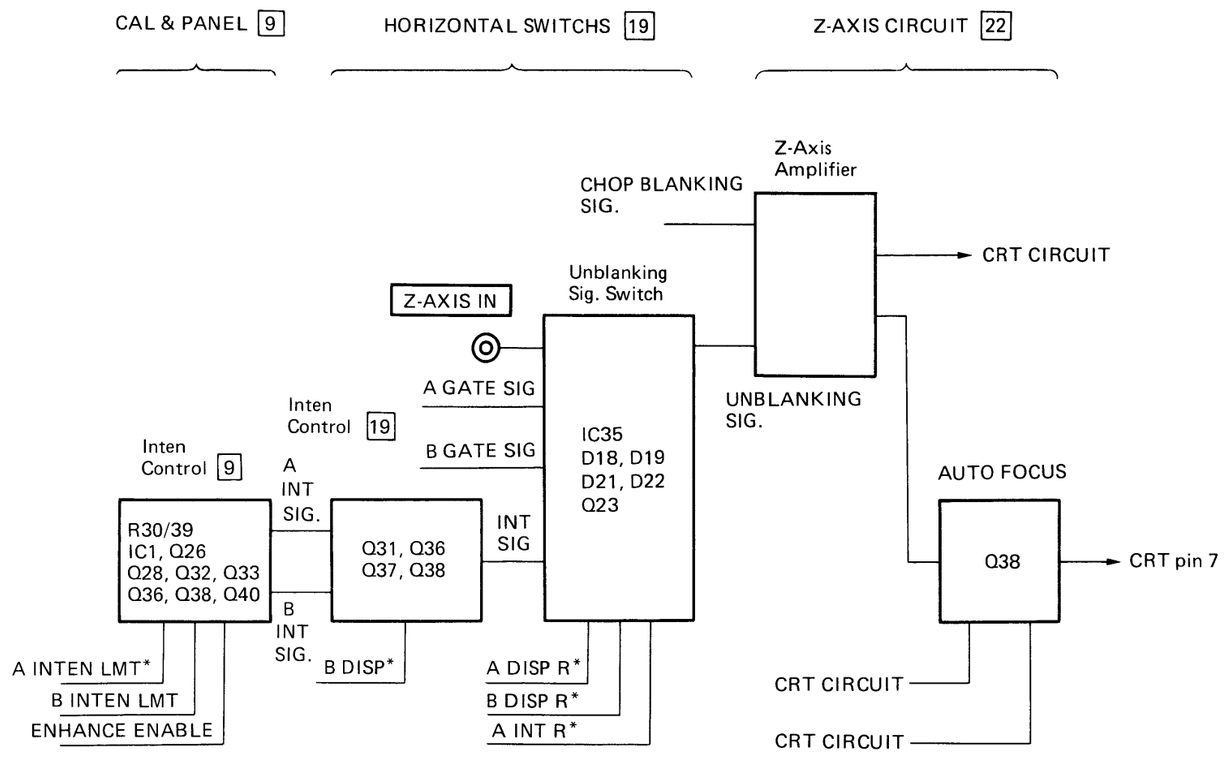
The unblanking signal is supplied to the grounded-base amplifier of 22Q17. 22Q17 and 11Q19 are designed to maintain the emitter voltage of 22Q17 constant; this is necessary to assure the switching of 19D18 and 19D19. The output from 22Q17 is amplified by the output amp, which is a feedback amplifier composed of 22Q28, 22Q29, 22Q30, 22Q22 and feedback resistors 22R35 and 22R36.

Auto FOCUS circuit [22]

This circuit is used to divide the Z axis amplifier circuit output and superimpose it to the CRT's focusing electrode voltage.

A voltage of approx. 1000V is supplied from the CRT circuit to between pins 3 and 7 of 22P22. 22Q38 is used to determine the potential of 22R41. The potential at pin 7 of 22P22, and thus the voltage at the CRT's focusing electrode which is pin 1 of 23P41, is determined as a result.

Figure 2-9-2-(1). Block diagram of Z-Axis circuit



2-10 CRT CIRCUIT [23]

2-10-1 Main Functions

The main function of the CRT circuit is to supply the bias voltage required for the CRT operation.

2-10-2 Circuit Description

Figure 2-10-2-(1) shows the block diagram.

The high-voltage oscillator is composed of 23Q13, 23D16, 23R16 and the primary winding of 23T11.

Positive feedback is applied to 23Q13 via the collector coil and base coil of 23T11. As a result, oscillation occurs at a repetition frequency of approx. 30 kHz, and a high voltage is generated in the secondary coil of 23T11. 23R31 and 23C31 are used to supply the base current of 23Q31.

23Q31 and 23Q38 start operation at the same time as the start of oscillation. When 23Q31 turns on, 23C31 is in parallel with 23C31 to facilitate the oscillations. 23Q31 turns off while the oscillation is normal, and 23C33 is disconnected from 23C31.

23D16 and 23R16 form a protection circuit which prevents the voltage between the base and emitter of 23Q13 from rising above the inverted voltage.

The high-voltage regulator circuit 23IC32 (1/2) performs control so that the high voltage generated by the high-voltage oscillator is regulated, independently of variations in the brightness and the primary voltage, so that the CRT cathode voltage is −2.45 kV and the CRT deflection factor is always kept constant. The regulator circuit consists of the error amplifier formed by 23IC32 (1/2), 23R33, 23R34 and 23R37, and the error detection circuit of 23R19, 23R35, 23R36 and 23R32 having the reference voltage of +40V.

The high-voltage oscillator circuit and regulator circuit form a negative-feedback amplifier, which controls the voltage applied to 23R19 so it is always 2.45 kV. The high-voltage limiter circuit is a protection circuit which stops the oscillator circuit's oscillation when an abnormally high voltage is generated for any reason. When the CRT's cathode voltage becomes −2.6 to −3.0 kV, 23Q44 turns on and the oscillation stops. However, the status of 23IC32 (1/2) is inverted temporarily after the oscillation stops, and 23Q44 turns off.

As shown above, when a malfunction occurs, oscillation becomes intermittent and the CRT display blinks.

The high-voltage limiter circuit consists of the Schmitt trigger circuit of 23IC32 (1/2), 23D49, 23R49, 23R50, 23R51 and 23R452, the detection circuit of 23R47, 23R48 and 23R46, and the control circuit of 23R45, 23R44, 23Q44, 23D45 and 23D44.

When the CRT cathode voltage exceeds −2.6 kV, the voltage at pin 6 of 23IC32[1/2] drops, the Schmitt trigger circuit inverts, and the voltage at pin 7 of 23IC32 inverts. This turns 23Q44 on and supplies the base current of 23Q13 through 23D44, and as a result, the oscillation stops and the CRT cathode voltage is controlled below −2.6 kV. When the oscillation has stopped, the voltage across 23C48 discharges through 23R48. This inverts the Schmitt circuit, and high-voltage oscillations start again. If, however, the CRT cathode voltage exceeds −2.6 kV again, the above-mentioned operation repeats itself, and this makes the high-voltage oscillation intermittent. As a result, the CRT screen becomes brighter intermittently.

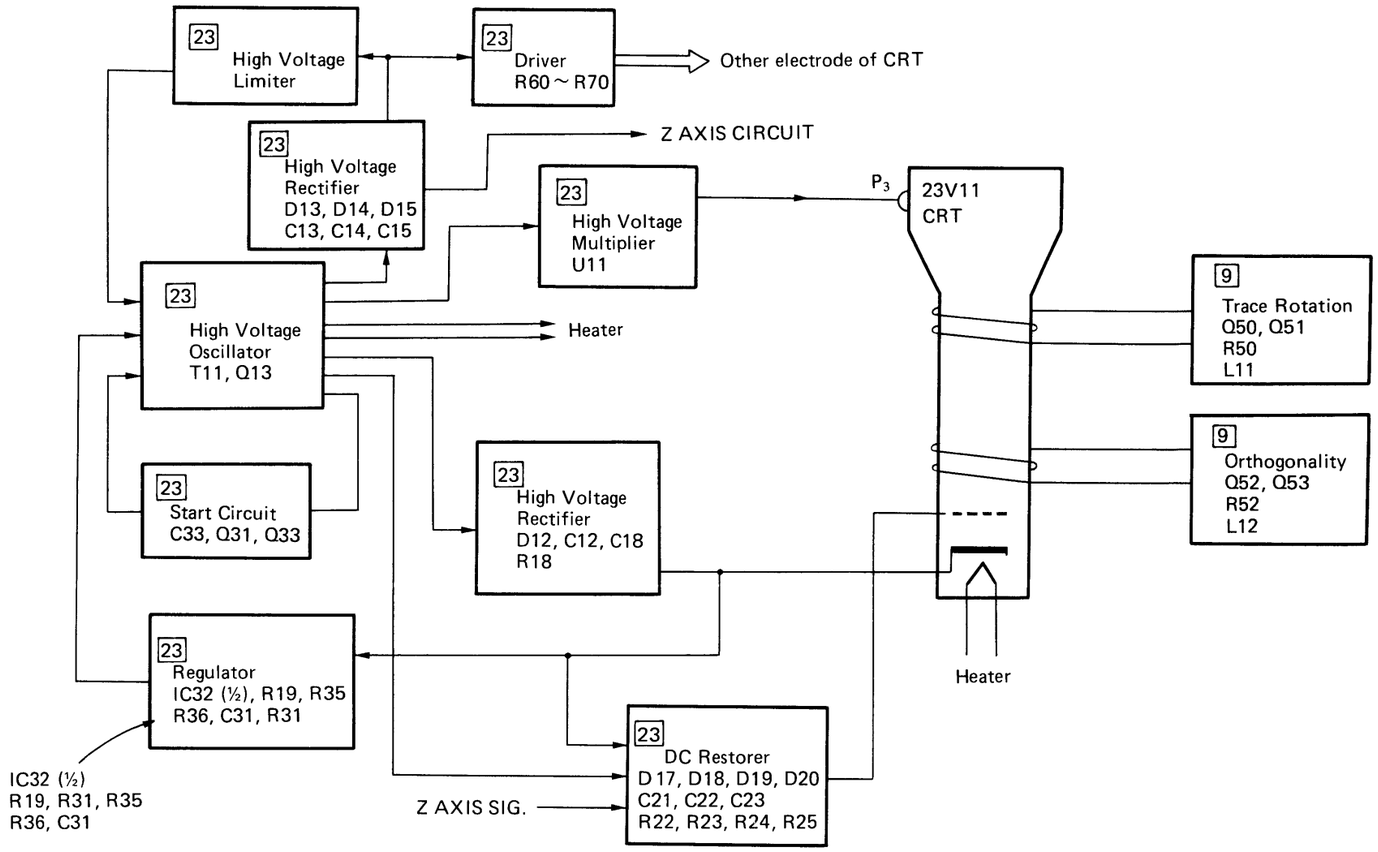
The high-voltage rectifier circuit includes four circuits. 23U11 is a x6 voltage multiplier circuit, which supplies a +17.55V voltage to the CRT's third electrode, P3.

23D12 and 23C12 form the CRT cathode current rectifier circuit. The cathode voltage, regulated at −2.45 kV, is also used as the reference power supply for the DC restorer circuit which generates the bias voltage of the CRT's grid electrode, G1.

The DC restorer circuit consists of 23D17, 23D18, 23D19, 23D20, 23C21, 23C22, 23C23, 23R22, 23R23, 23R24 and 23R25. The voltage at the anode of 23D20 is lower than that at the cathode of 23D19, by a value equal to the potential difference between the cathode voltage of 23D17 and the anode voltage of 23D18.

The CRT grid is biased at a lower voltage than the cathode voltage. This voltage is determined by the A axis circuit output voltage and 23R41 INTEN ADJ.

Figure 2-10-2-(1). Block diagram of CRT circuit



2-11 POWER SUPPLY [24]

2-11-1 General

Six regulated power supplies are provided for the stable operation of each circuit in this oscilloscope. The regulated power supply circuits provide stable low ripple output voltages that are not affected by load variations, and, if the outputs are grounded, damage is prevented by the protective circuit.

In the power input circuit, the supplied power is fed via fuses to the power selection plug. Depending on the setup of the power selection plug, two windings of the primary side of power transformer 24T11 are changed between series and parallel connections, so that 100V, 115V, 220V, 230V or 240V can be selected.

2-11-2 Circuit Description

The −12V power supply circuit operations are as follows. 24D52 is the Zener diode for the reference voltage.

The output from the −12V power supply circuit is divided by 24R52, 24R53 and 24R54, and the voltage is compared with the reference voltage.

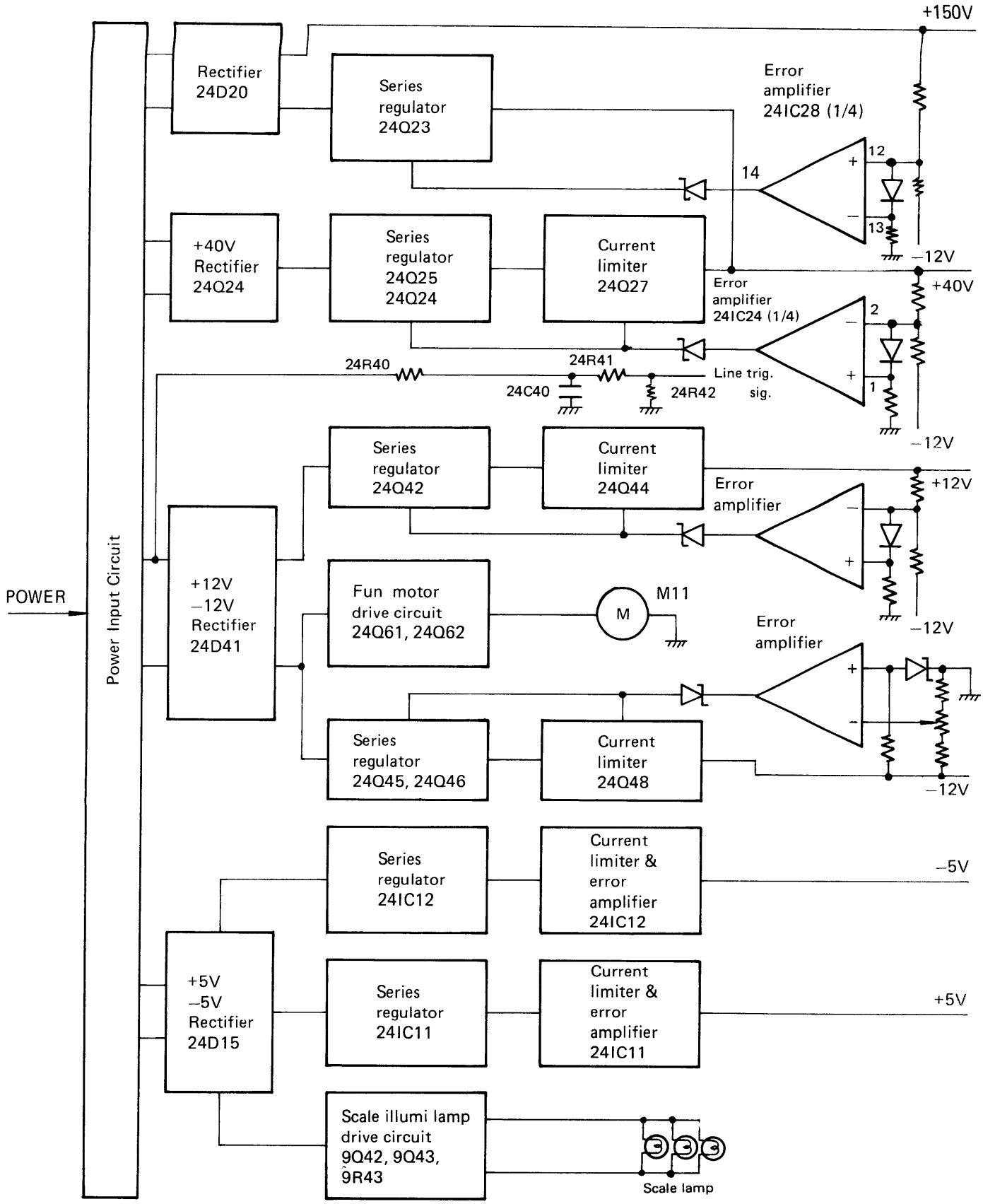
The difference between the above-mentioned two voltages is amplified by the error amplifier. The amplifier output controls the series regulator circuit, and the two voltage are controlled so they are always equal. 24Q15 is used to supply bias current to 24Q46 and 24D58.

24Q48 and 24R47 form the current limiter circuit. When the −12V circuit output current exceeds a specified level, 24Q48 turns on and limits the bias current for the series regulator circuit so that any further current increase is prevented.

−12V power supply is used as the reference voltage for power supply circuits other than the ±5V circuit. The operations of the +12V, +40V and +150V power supply circuits are almost the same as that of the −12V circuit.

The ICs used in the ±5V power supply circuit have the same functions as those in the −12V power supply circuit.

Figure 2-11-2-(1). Block diagram of the power supply circuit



NOTES

Section 3

Maintenance

This section describes the maintenance procedures for keeping the SS-5712 in good condition over a long period of time. If it becomes necessary to check and replace the circuit parts, refer to the Circuit Arrangement Diagrams.

Apart from the instructions given in this section, the proper operation procedures described in section 2 of Operating Manual must also be observed to assure long satisfactory operation.

3-1 PREVENTIVE MAINTENANCE

There are the preventive maintenance procedure for preventing troubles and keeping your oscilloscope clean and well for a long period of time.

3-1-1 Cleaning

The extent of dirt varies according to the ambient condition in which the instrument is used. The instrument should be cleaned as required. Dirt accumulated in the instrument causes overheating because it interrupts effective heat dissipation. It also damages the parts under high-humidity condition. A dirty switch contact or connector can cause faulty contact, and dirt accumulated on the inner circuit part can cause spark during the wet season.

The fluids suitable or unsuitable for cleaning the instrument are shown in table 3-1-1.

Table 3-1-1

Suitable fluids	Alcohol, water, neutral detergent
Unsuitable fluids	Acetone gasoline, ether, lacquer thinner, methylethyl ketone, chemicals containing ketone detergent

Cover Cleaning

Remove the covers, and clean them with detergent. Remove stains of grease using a soft cloth damped with one of the suitable fluids shown in Table 3-1-1.

Front Panel Cleaning

Wet a soft cloth with one of the suitable fluids shown in table 3-1-1, and clean the front panel with it. If alcohol is used, some traces might be left. The front panel can also be cleaned with detergent. In this case, it is necessary to wipe off the detergent left on the panel and the control knobs with a cloth dampened with water.

Inside Cleaning

The best way of cleaning the dirt accumulated in the instrument is to use an air compressor. Dirt which remains after blowing with air compressor can be removed by using a soft paint brush and blowing again with air compressor.

CRT and Filter Cleaning

The CRT screen and the filter can become dirty if they are used for a long time. Ordinary stains and fingerprints can be removed by wiping with a soft cloth. If they are terribly dirty, use a soft cloth dampened with alcohol.

3-1-2 If Unused for a Long Time

If you don't use the instrument for a long time, remove the probe, adaptor, etc. From it and put them in the accessories bag. Attach the supplied panel cover to it, put the dust cover on the oscilloscope, and store it in a place as dry as possible.

This can keep the instrument clean.

3-1-3 Checking

Inspect the inside of the instrument periodically for burnt resistors, faulty contacts, or damaged printed circuit boards. Major troubles can be prevented by repairing them immediately.

3-1-4 Periodic Adjustment

Periodic check and adjustment are necessary for keeping the instrument in accurate operating condition at all times. If the instrument is continuously used, check and adjust it about every 1000 hours. If it is not used so much, it may be check and adjusted about every one year.

3-1-5 Maintenance Aids

The maintenance aids listed in Table 3-1-5 include items required for performing most of the maintenance procedure in this instrument.

Table 3-1-5 Maintenance aids

Description	Specification	Usage
1. Soldering iron	15 to 25 W	General soldering and unsoldering
2. Crossdriver	2.6 mm	Assembly and disassembly
3. Torquedriver	4 kgf·cm (3 mm)	CRT replacement
	8 kgf·cm (3 mm)	Each screws
	1.5 kgf·cm (Hexagonal) (3 mm)	Coupling of Vertical VARIABLE replacement
4. Nutdriver	3 mm, 11 mm, 13 mm	Assembly and disassembly
5. Hexagonal wrench	3 mm	Knob replacement
6. Vacuum solder extractor	No static charge retention	Unsoldering static sensitive devices and components
7. Spray cleaner	No-noise	Switches cleaning

3-2 REMOVAL AND REPLACEMENT INSTRUCTIONS

PRECAUTION

To avoid electric shock, disconnect the instrument from the ac power source before removing or replacing any component or assembly.

3-2-1 Cover Removal

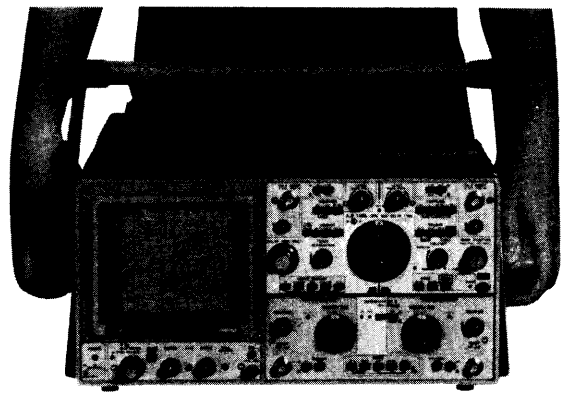
The covers must be removed before inspecting the inside or replacing faulty parts.

Be sure to remove the rear panel first in removing the covers. The rear panel can be removed by removing one each screws on the right and left of the panel. Then, remove the six screws from the top, left, and right sides of the top cover, and remove the cover by pulling it rear ward. (The front end of the top cover is inserted in a ditch behind the front panel.)

Remove one each screw in the front and rear parts of the bottom cover, and remove the bottom cover by pulling rearward. (The front end of the bottom cover is inserted in a ditch behind the front panel).

NOTE

When removing or attaching the top cover, widen on both root of the handle as shown in the figure below.



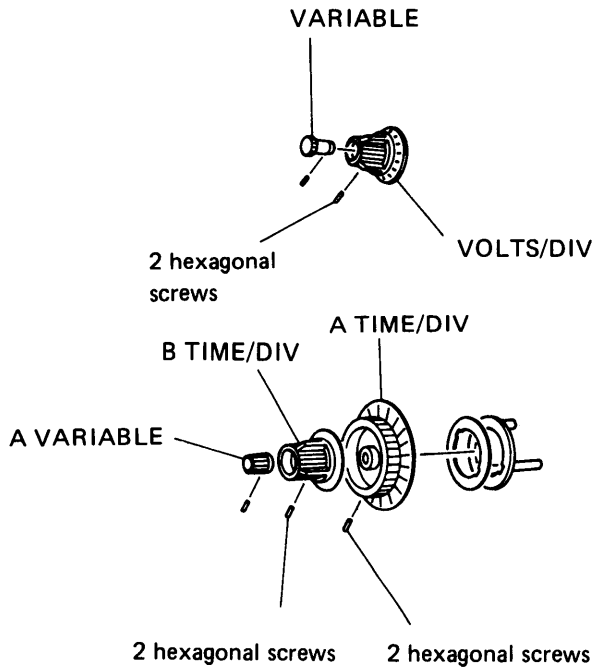
3-2-2 Knobs Replacement

(a) The knobs VOLTS/DIV, VOLTS/DIV VARIABLE, A and B TIME/DIV, A VARIABLE, ↔ POSITION FINE and DELAY TIME MULTI dial are all held with hexagonal screws. To remove the knobs, remove the hexagonal screw and pull.

(b) All other knobs can be removed just by pulling.

〈Note〉

CH3, CH4 ↕ POSITION control knobs can be removed by pulling too, after removal the V-Unit.



3-2-3 Front Panel A·B Removal

The front panels are composed of panel A and panel B. To replace the several printed circuit boards, remove the front panel A or front panel B.

The front panel A and front panel B removal procedure is as follows.

Front Panel A

1. Remove control knobs of the front panel A except CH3 and CH4 ↕ (POSITION) knobs.
2. Remove the four screws on the front panel A near the CH1, CH2, CH3 and CH4 INPUT connectors.

Front Panel B

1. Remove control knobs of the front panel B.
2. Remove the two screws on the front panel B of the left and right side.

Figure 3-2-3-(1). Front Panel A·B

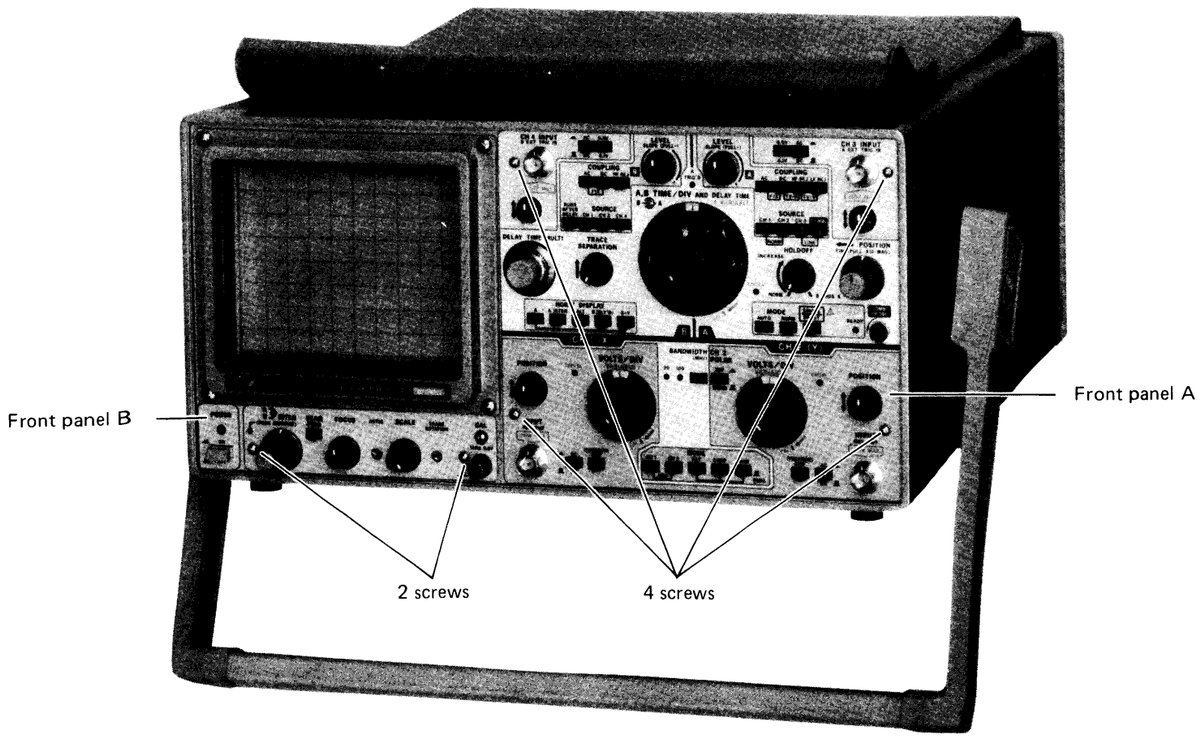
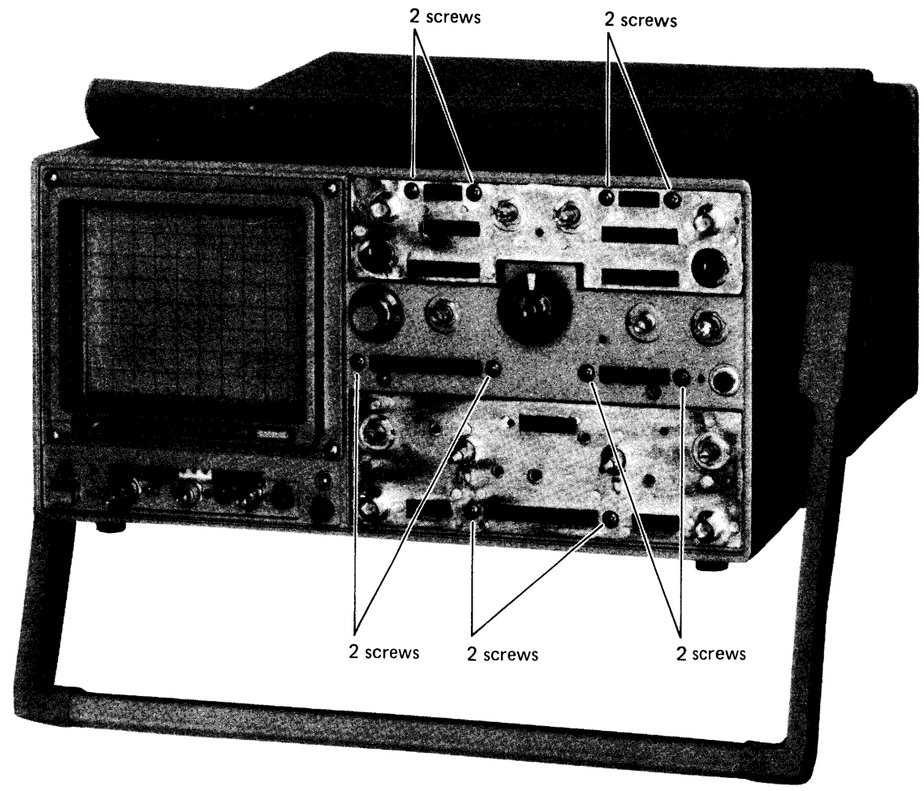


Figure 3-2-3-(2). Front sub panel

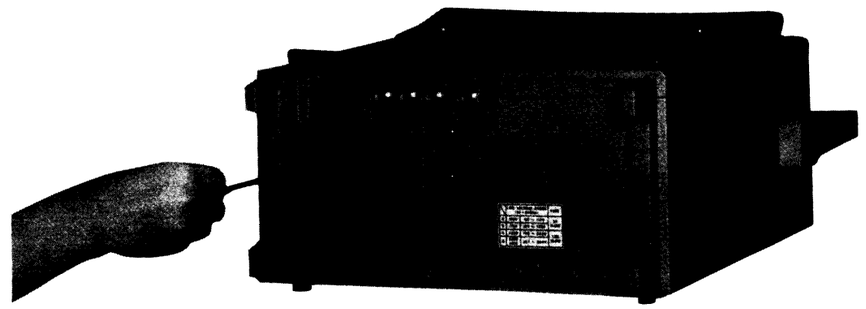


3-2-4 Rear Panel Removal

The rear panel can be removed as following procedure.

1. Remove the two screws on the rear panel.
2. Pull the rear panel to rearward.

Figure 3-2-4. Rear panel removal



3-2-5 Printed Circuit Board Replacement

To replace a faulty printed circuit board or a faulty parts on a printed circuit board, remove the printed circuit board.

The instrument has separate printed circuit boards for the V-unit, H-unit, and others.

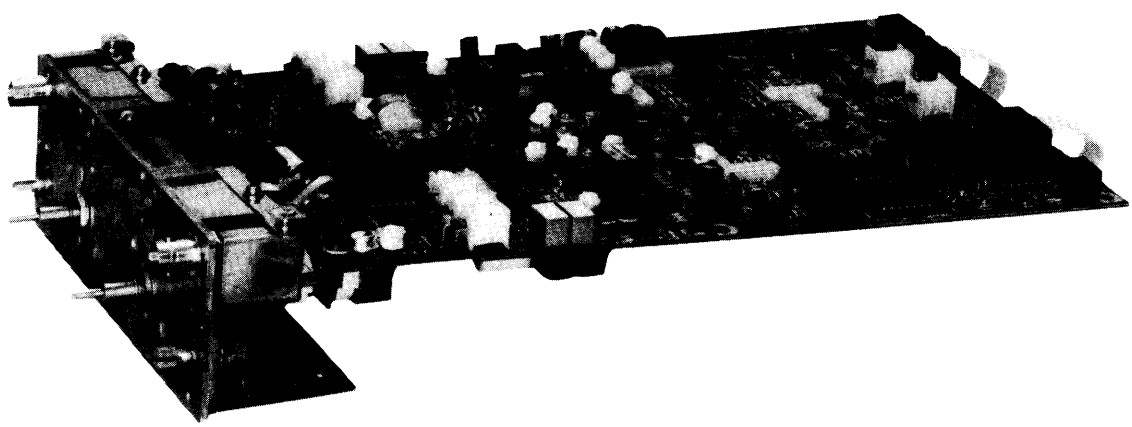
V-UNIT

The printed circuit board for the V-unit consists of the following circuits. (Refer to Figures 3-2-5-(1) and 3-2-5-(2)).

VERT PRE AMP BOARD
- CH1 preamplifiers (1), (2) [1], [2]
- CH2 preamplifiers (1), (2) [3], [4]
- Delay cable driver [5]
- Vertical control [7]

V SW BOARD
- Vertical switches [6]

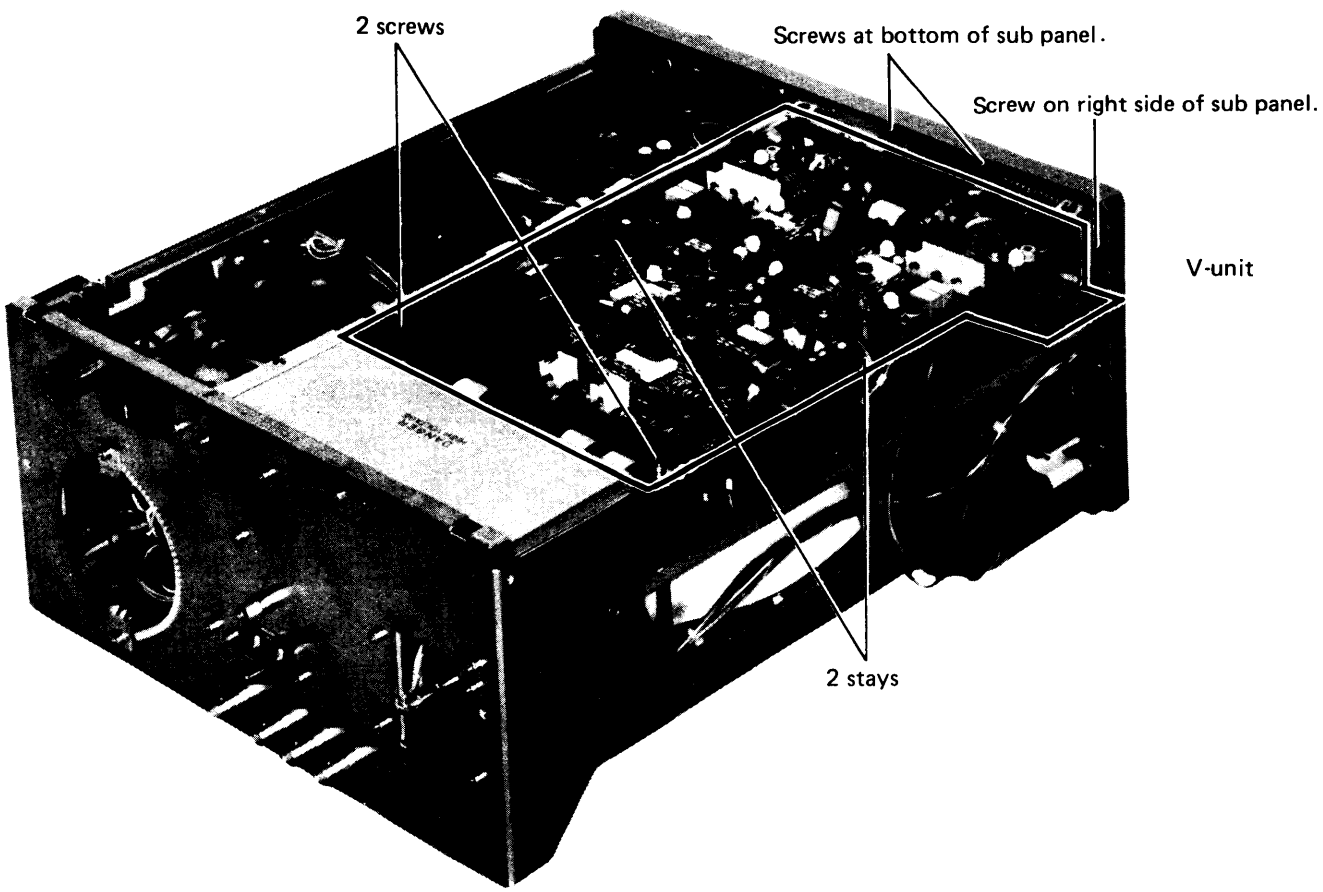
Figure 3-2-5-(1). V-Unit



The V-unit removal procedure is as follows.

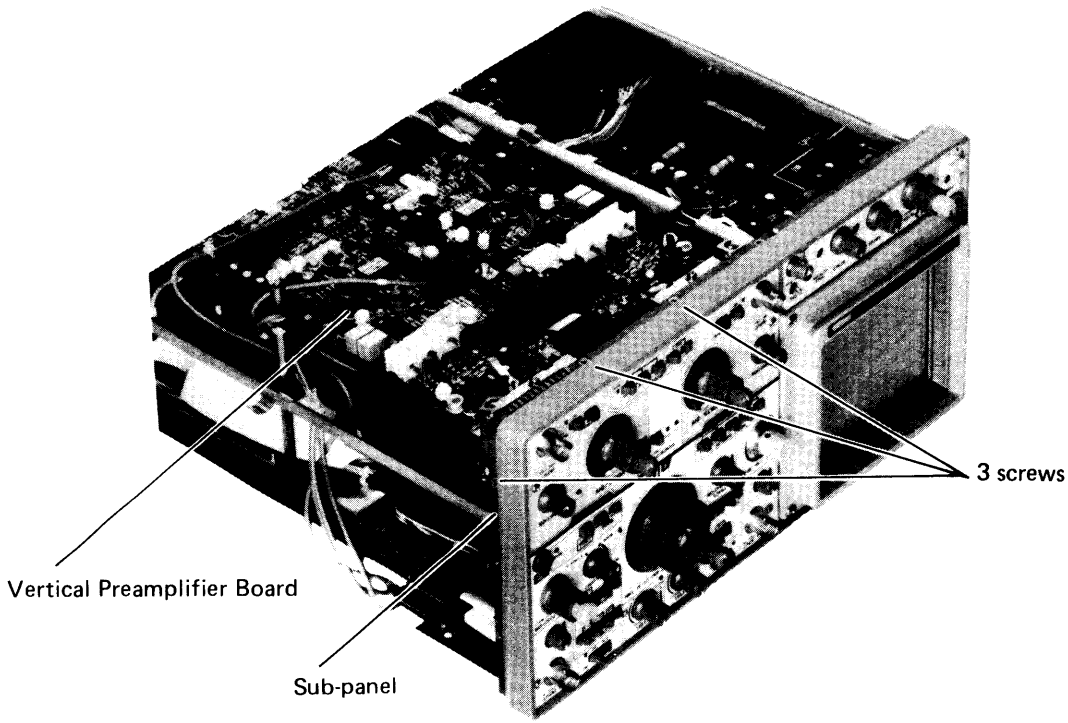
1. Remove the control knobs VOLTS/DIV, VARIABLE, and POSITION for CH1 and CH2.
2. Remove the two screws on the bottom of the sub panel and the screw form the right side of it. (Refer to Figure 3-2-5-(3)).
3. Remove the two screws over the CH1 and CH2 INPUT connectors on the front panel. (Refer to Figure 3-2-5-(3)).
4. Remove the connectors attached to this board.
5. Remove the soldered wires (Delay Cable).
6. Remove the four screws that fasten the printed circuit board.
7. Remove the two stays on the right and left side.
8. Remove the V-unit by sliding it rearward.

Figure 3-2-5-(2). External view of the V-Unit I



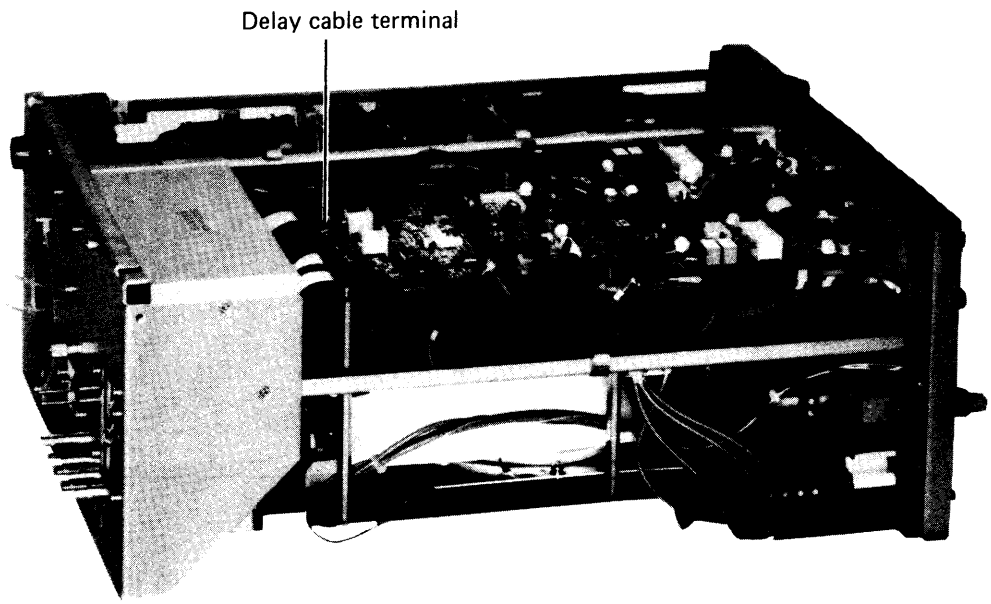
(This photo shows the instrument upside down.)

Figure 3-2-5-(3). External view of the V-Unit II



(This photo shows the instrument upside down.)

Figure 3-2-5-(4). External view of the V-Unit III



H-UNIT

The printed circuit board for H-unit consists of the following. (Refer to Figures 3-2-5-(5) and 3-2-5-(6)).

SWEEP BOARD	
A trigger amplifier	12
B trigger amplifier	13
TV sync separator	14
A sweep generator	15
B sweep generator	16
Horizontal switches	19
CH3 PREAMP	10
CH4 PREAMP	10
TRIG SIG SELECTOR	11

The H-unit removal procedure is as follows.

1. Remove the two screws on top of the sub panel and the screw on the right side of it. (Refer to Figure 3-2-5-(7)).
2. Remove the two screws over the CH3 and CH4 INPUT connectors on the front panel. (Refer to Figure 3-2-5-(7)).
3. Remove the A and B trigger LEVEL controls.
4. Disconnect the connectors for the leads that are connected to other printed circuit boards.
5. Remove the three screws that fasten the printed circuit board.
6. Remove the H-unit by sliding it rearward.

Figure 3-2-5-(5). H-Unit

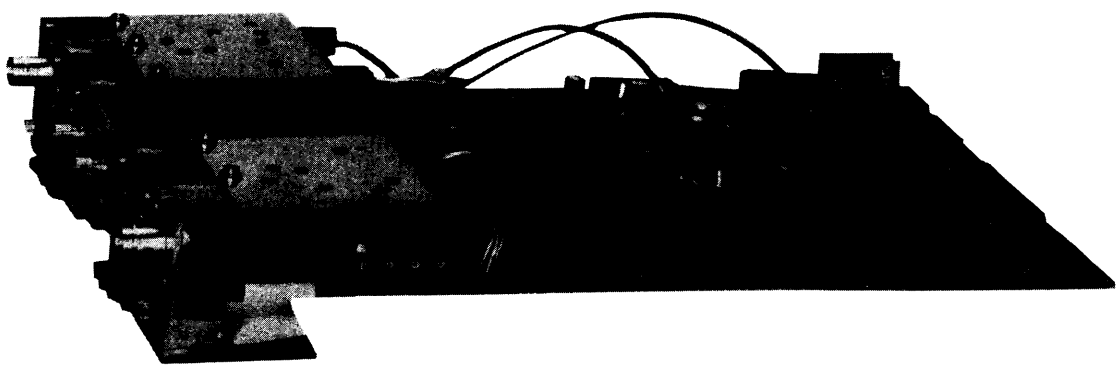


Figure 3-2-5-(6). External view of the H-Unit I

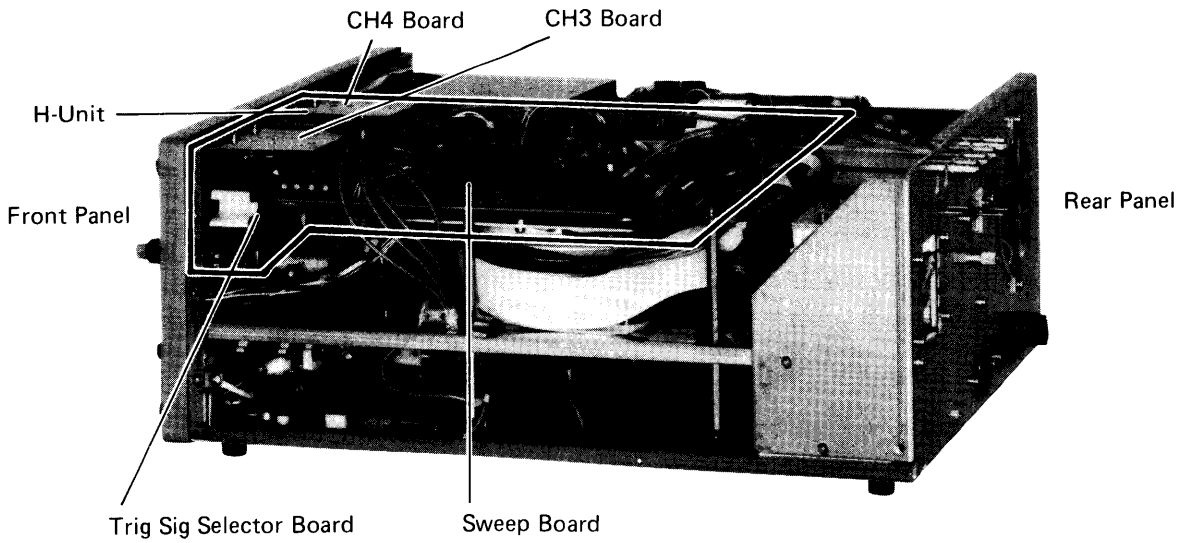
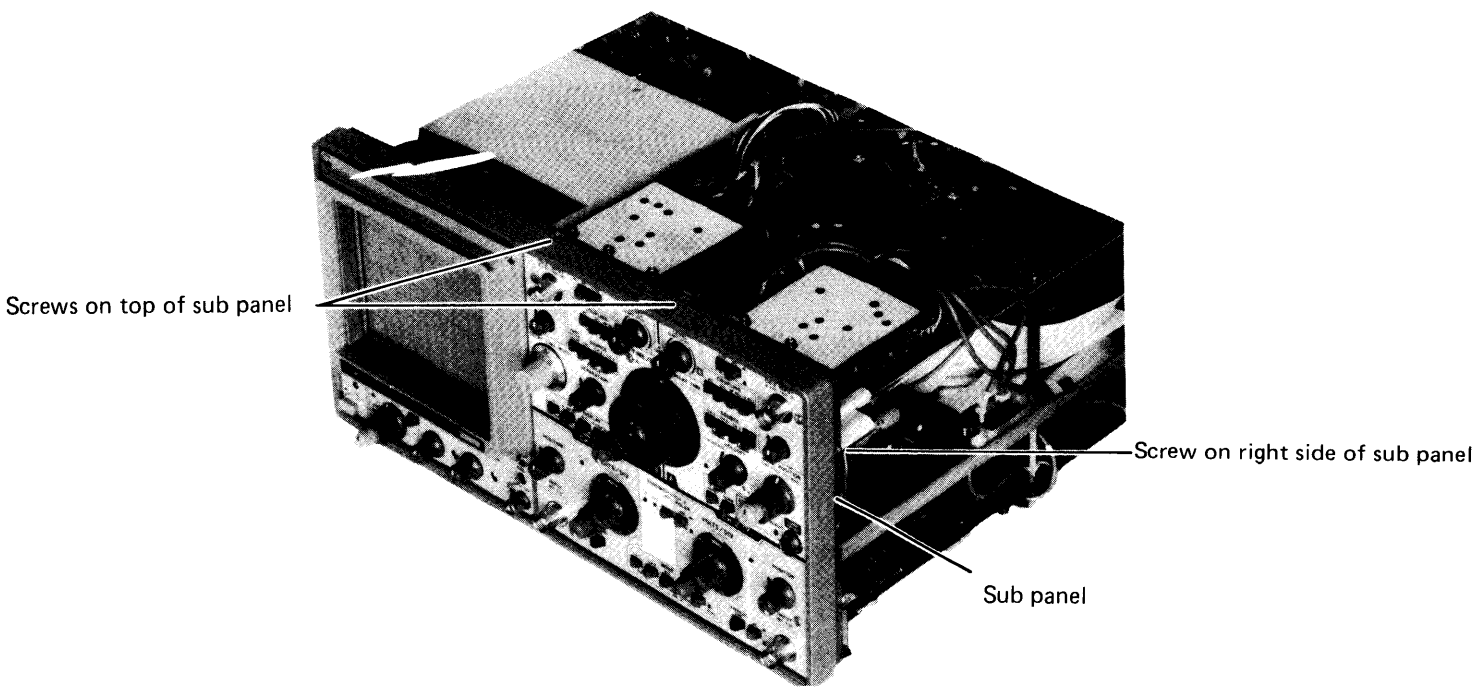


Figure 3-2-5-(7). External view of the H-Unit II



Top

(a) SWEEP BOARD

(A triger amplifier [12],
B trigger amplifier [13],
TV sync generator [14],
A sweep generator [15],
B sweep generator [16], and
Horizontal switches [19])

1. Remove the H-Unit.
2. Remove the CH3 and CH4 Boards. (Refer to CH3 and CH4 Boards removal described later.)
3. Remove the hexagonal nuts holding the trigger LEVEL controls.
4. Remove the three screws holding this board.
5. Remove the one connector attached to this board.

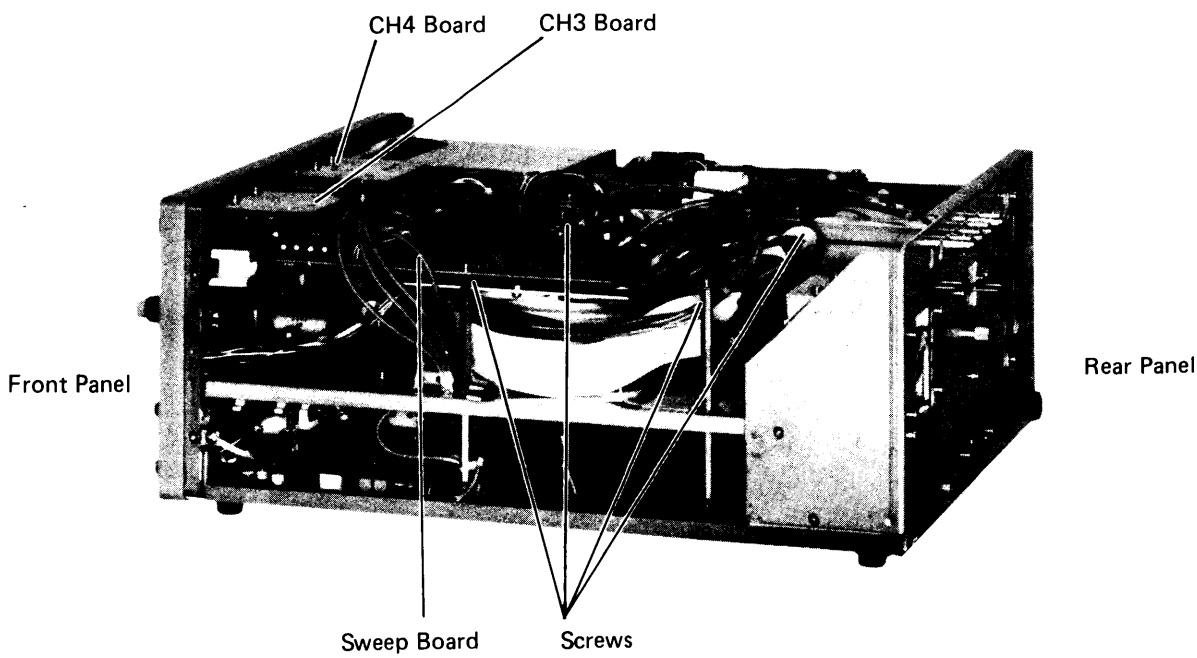
(b) CH3 BOARD (CH3 preamplifier [10])

1. Remove the H-Unit.
2. Remove the two screws holding this board on the front of the diecasting.
3. Remove the one screws holding cables.
4. Remove the three connectors attached to this board.

(c) CH4 BOARD (CH4 preamplifier [10])

1. Remove the H-Unit.
2. Remove the three screws holding this board on the front and top of the diecasting.
3. Remove the three connectors attached to this board.

Figure 3-2-5-(8). Printed circuit board replacement I (Top I)

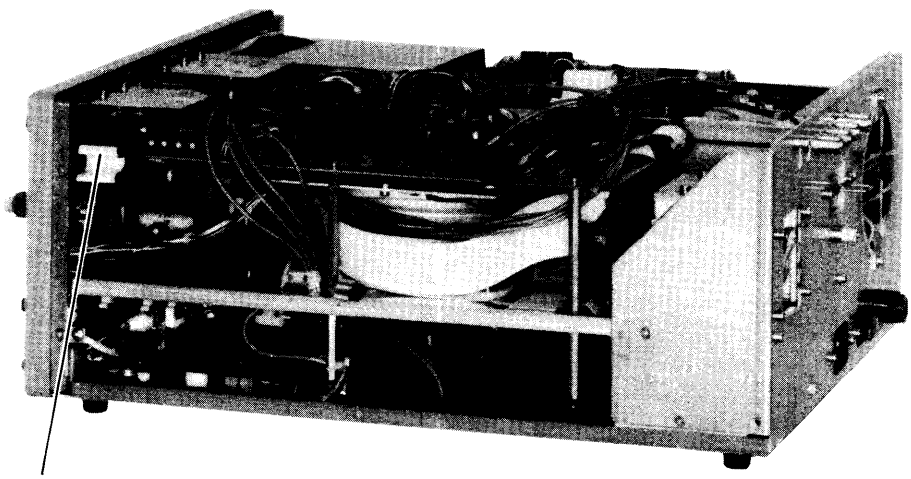


(d) TRIG SIG SELECTOR BOARD

(Trigger signal selector [11])

1. Remove the H-Unit.
2. Remove the CH3 and CH4 ↕ control knobs on the front panel.
3. Remove the hexagonal nuts holding the ↕ position variable resistor.
4. Remove the two screws holding this board on the front of the diecasting.
5. Remove the connector attached to this board.
6. Remove the soldered flat-cable.

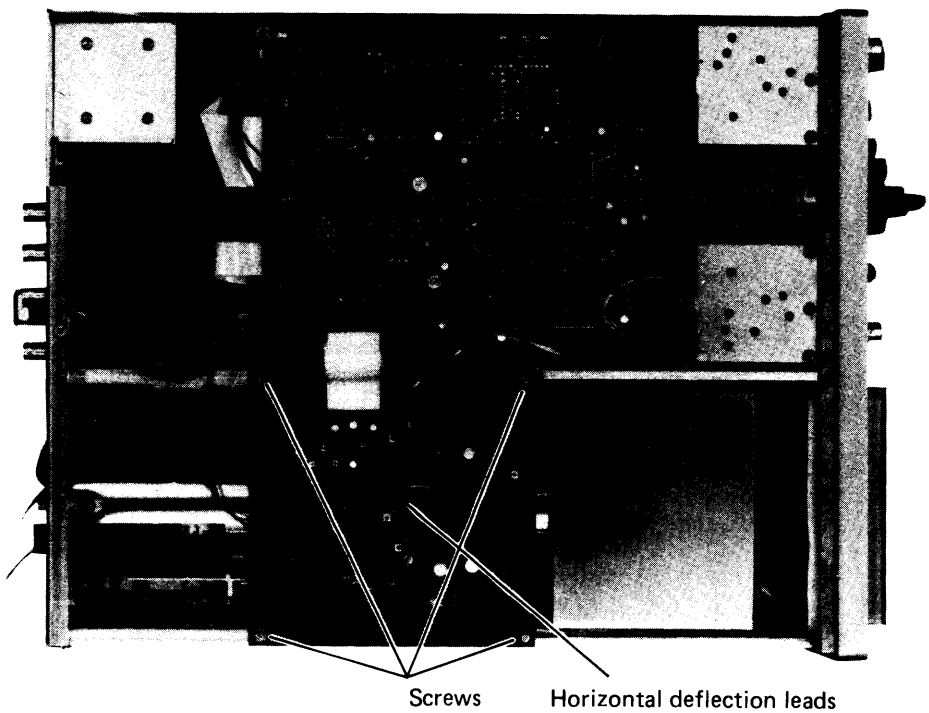
Figure 3-2-5-(9). External view of the H-Unit III



(e) HORIZ AMP BOARD (Horizontal amplifier [21])

1. Remove the connectors attached to this board.
2. Remove the four screws holding this board.

Figure 3-2-5-(10). Printed circuit board replacement II (Top II)



Left

(f) V-MAIN AMP BOARD (Vertical main amplifier [8])

1. Remove the soldered wires (Delay cable).
2. Remove the connector attached to this board.
3. Remove the two screws on the left side frame fastening the stays.
4. Remove the three screws holding this board.

Center

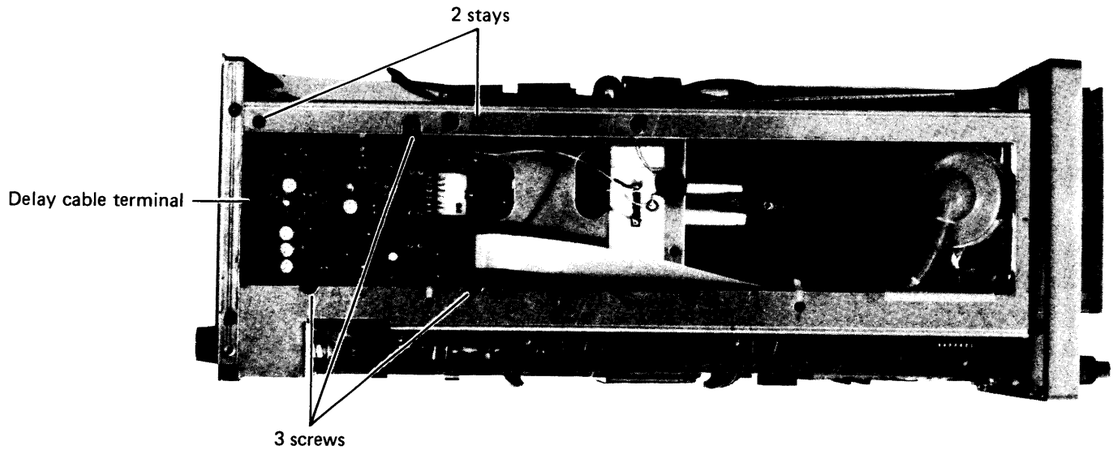
(g) A·B TIMING SW BOARD
(A Timing switch [17] and
B Timing switch [18])

1. Remove the H-Unit.
2. Remove the connectors attached to this board.
3. Remove the front panel A.
4. Remove the hexagonal nuts holding the controls and awitch of ↔ POSITION, HOLDOFF, TRACE SEPARATION and A, B TIME/DIV.

(h) Sweep MODE and HORIZONTAL DISPLAY BOARD
(Horiz control [20])

1. Remove the H-Unit.
2. Remove the A·B TIMING SW board.
3. Remove the connectors attached to this board.
4. Remove the front panel A.
5. Remove the four screws holding this board on the front of the front sub-panel.
6. Remove the two screws holding this board.

Figure 3-2-5-(11). Printed circuit board replacement III (Left)



Bottom

(i) Vertical BOARD

(CH1 preamplifier (1), (2) [1], [2],
CH2 preamplifier (1), (2) [3], [4],
Delay cable driver [5] and
Vertical control [7])

1. Remove the V-Unit.
2. Remove the hexagonal nuts holding the switches of the VOLTS/DIV.
3. Remove the two screws holding the MODE switch on the front of the front sub-panel.

(j) Vertical switch BOARD

(Vertical switches [6])

1. Remove the V-Unit.
2. Remove the hexagonal nuts holding the CH1 and CH2 ‡ POSITION controls.

Figure 3-2-5-(12). Printed circuit board replacement IV (Bottom I)

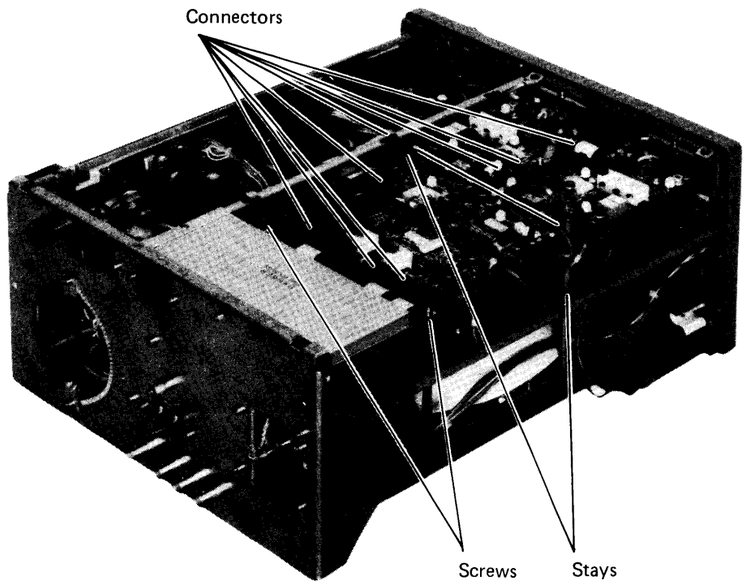
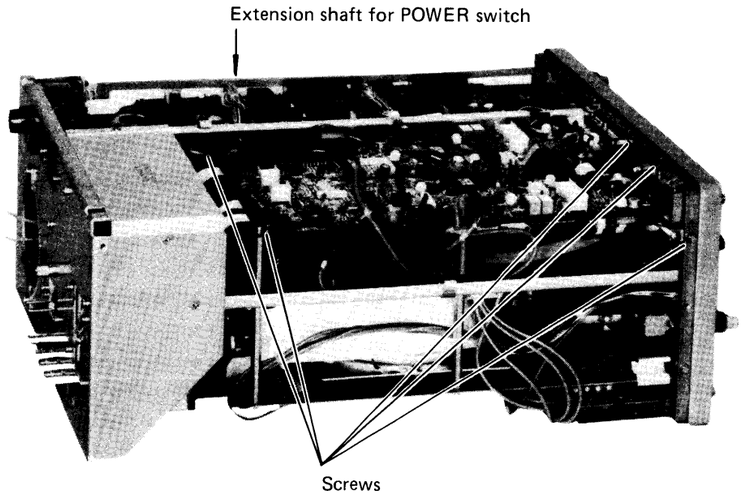


Figure 3-2-5-(13). Printed circuit board replacement V (Bottom II)

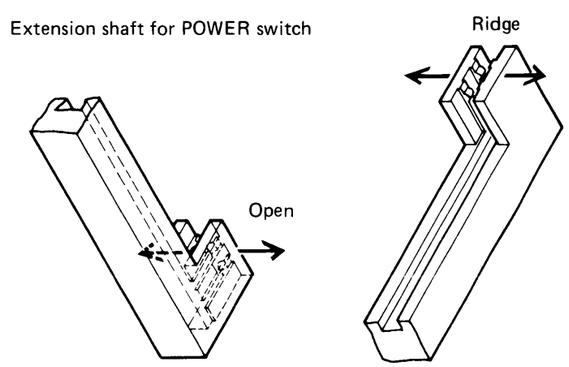


(k) CAL & PANEL, Z-AMP, CRT CIRCUIT & POWER SUPPLY BOARD

(Cal and panel [9],
Z axis circuit [22],
CRT circuit [23], and
Power supply [24])

1. Remove the connectors attached to this board.
2. Remove the front panel B.
3. Remove the hexagonal nuts holding the controls of A·B INTEN, FOCUS and SCALE.
4. Remove the four screws holding this board.
5. Open the end of the extension shaft at the junction of the POWER switch and extension shaft (see Figure 3-2-4-(14)) and move in the direction of the arrow to remove the extension shaft. Note that if moved without opening the end, the ridge holding the switch will be scraped and the switch will become loose. Also open the end of the extension shaft when attaching it to the switch.

Figure 3-2-5-(14). Extension shaft for POWER switch removal



(I) High Voltage BOARD
(CRT circuit [23])

1. Remove the two screws holding the shield case.
2. Remove the shield case.
3. Remove the connectors attached to this board.
4. Remove the anode cap after discharging it because it might retain a high voltage charge.
5. Remove the three screws holding this board.

Figure 3-2-5-(15). External view of the high-voltage circuit

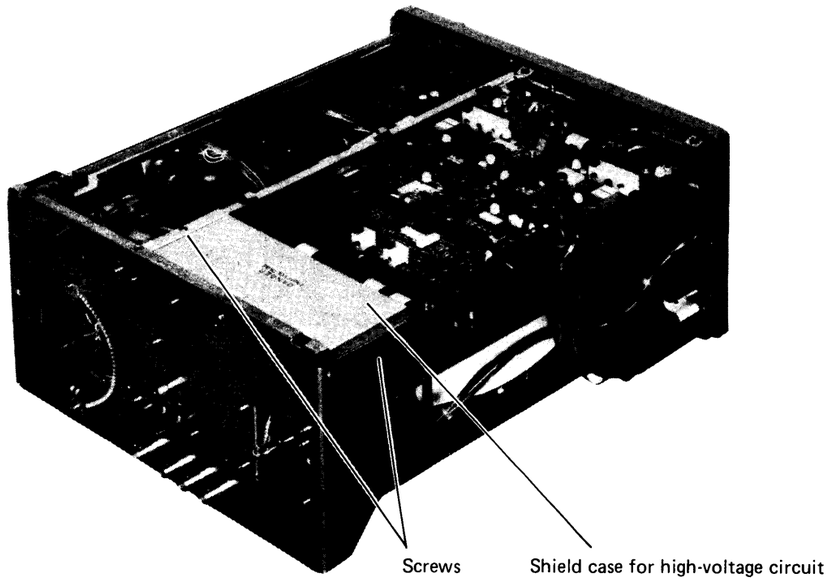
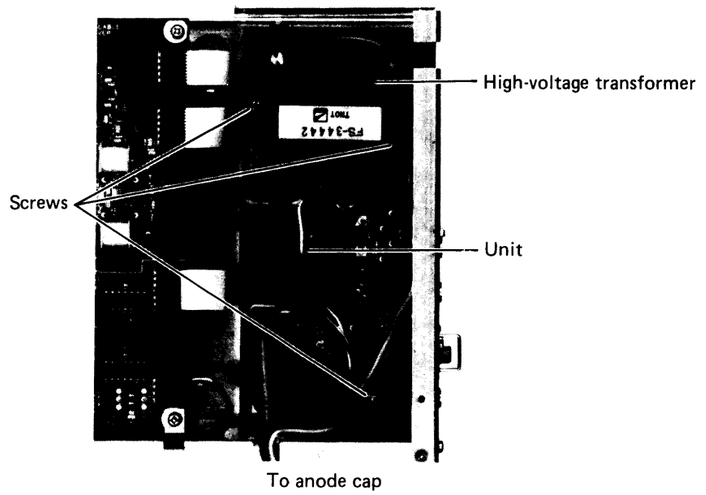


Figure 3-2-5-(16). Printed circuit board replacement VI (Bottom II)



3-2-6 Part Replacement

The replacement procedures for faulty parts detected by circuit inspection are described here. Be sure to disconnect the power cord from the electrical outer before replacing any faulty parts.

(a) Parts on Printed Circuit Board

In replacing diodes, transistors, IC's, resistors, or capacitors, on a printed circuit board, use your soldering iron carefully so that neither the copper foil of the printed circuit board will be peeled off nor any parts on the circuit board will be damaged.

Because the semiconductors, such as transistors and diodes, are not thermal-resistant, pinch the leads with tweezers and solder them quickly component so that the heat of the soldering iron will not be directly conveyed to the semiconductor. Diodes and transistors used for replacement must have good performance.

The resistors, capacitors, and other passive elements used in the instrument are carefully selected so any replacement parts to be used in their place must have good ones. (See the parts list in section 6.)

Electrode contact of transistor or diode and serious variation of their characteristics may incidentally make a resistor burn or a capacitor short-circuit. If such a trouble should occur, eliminate the cause of it before replacing the faulty part.

(b) Transistors, Diodes or IC's

In replacing a transistor, diode, or IC, make sure of the electrodes. (see Table 3-3-1-(1) to 3-3-1-(5))

Particularly, transistors must be replaced with ones that have good performance.

(c) Switches

VOLTS/DIV rotary switches

1. Remove the vertical board. (See 3-2-5-(i))
2. Melt the solder that fastens the printed circuit board by using a soldering iron, and remove the switches.

TIME/DIV rotary switch

1. Remove the A·B TIMING board. (See 3-2-5-(g))
2. Melt the solder that fastens the printed circuit board by using a soldering iron, and remove the switches.

Vertical MODE and AC-DC, GND pushbutton switches.

1. Remove the vertical board. (See 3-2-5-(i))
2. Melt the solder that fastens the printed circuit board by using a soldering iron, and remove the switches.

Trigger COUPLING pushbutton switches

1. Remove the SWEEP board. (See 3-2-5-(a))
2. Melt the solder that fastens the printed circuit board by using a soldering iron, and remove the switches.

Sweep MODE and HORIZ DISPLAY pushbutton switches

1. Remove the Sweep MODE and HORIZONTAL DISPLAY board. (See 3-2-5-(h))
2. Melt the solder that fastens the printed circuit board by using a soldering iron, and remove the switches.

CH3, CH4 attenuator and AC-DC pushbutton switch

1. Remove the CH3, CH4 board. (See 3-2-5-(b) and (c))
2. Melt the solder that fastens the printed circuit board by using a soldering iron, and remove the switches.

Trigger SOURCE pushbutton switches

1. Remove the TRIGGER SELECTOR boards. (See 3-2-5-(d))
2. Melt the solder that fastens the printed circuit board by using a soldering iron, and remove the switches.

BANDWIDTH and CH2 POLAR pushbutton switches

1. Remove the Vertical switch board. (See 3-2-5-(j))
2. Melt the solder that fastens the printed circuit board by using a soldering iron, and remove the switches.

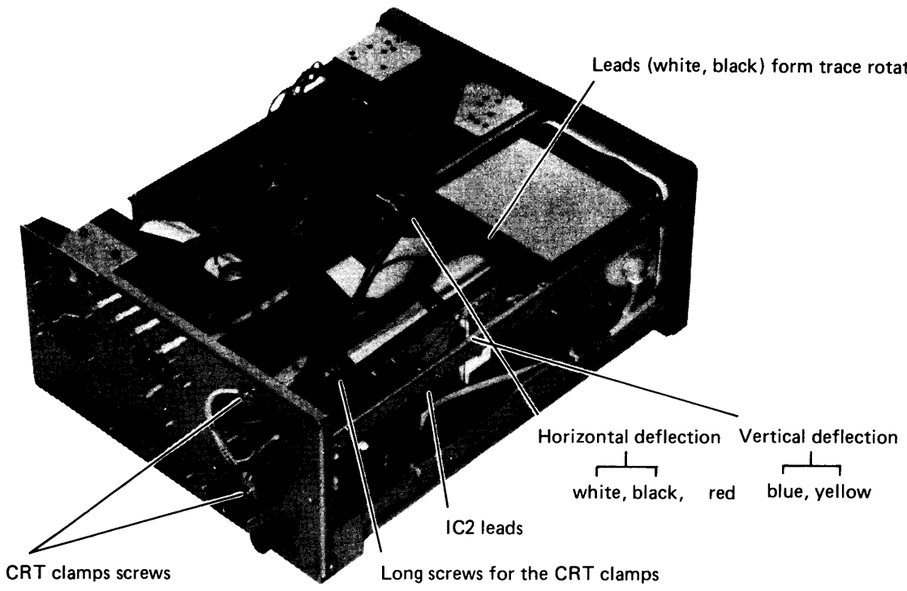
(d) CRT

Handle the CRT carefully in replacing it because it will be damaged easily by dropping or shock. Care must be also taken not to apply too much strain to the deflection pin to prevent the glass from cracking.

The CRT removal procedure is as follows:

1. Remove the rear panel and the top cover.
2. Disconnect the CRT socket.
3. Remove the ande cap after discharging it because if might retain a high voltage charge.
4. Disconnect the wires from the deflection pin.
   The blue and yellow leads and leads of IC2 are for vertical deflection, the white and black leads for horizontal deflection, and the red lead is for the negative electrode of Q3 – of V11 (CRT).
   Disconnect the leads with care so that they will not be rewind to the deflection pin in the wrong way.
5. Disengage the connector at the tip for the trace rotation coil leads (white, black).
6. Pull out the ORTHO leads (green blue).

Figure 3-2-6-(1). CRT and its peripheral parts I

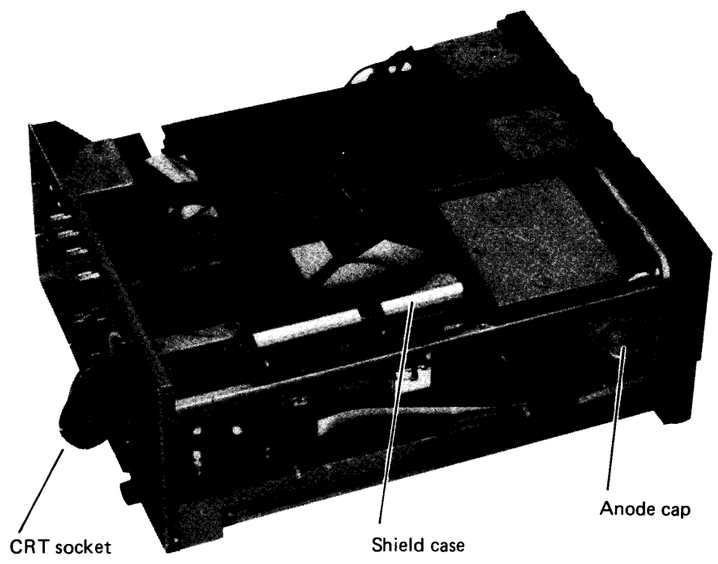


7. Remove the four screws that fasten the printed circuit board (V main amplifier) over the CRT, and lift it slightly.
8. Remove the two screws that fasten the CRT clamps to the rear sub panel.
9. Loosen the long screws for the CRT clamps that fasten the CRT.
10. Slightly pull the CRT and shield case rearward, lift the front end of the CRT and pull it forward until it comes out.
11. Pull the CRT carefully from the shield case.
    Reverse the above procedure for installing the CRT. If the CRT has been replaced, readjustments must be made by referring to section 4 Check and Adjustment.

NOTE

Use a torque driver to tighten the screws holding the CRT supporting plate B. Set the torque at 4 kgf cm and alternately tighten the two screws. Do not apply force greater than 4 kgf cm.

Figure 3-2-6-(2). CRT and its peripheral parts II



(e) Power Transformer

1. Remove the H and V units. (See 3-2-5)
2. Remove the high voltage board. (See 3-2-5-(I)).
3. Remove the four screws holding the transformer.
4. Remove the transformer and shield case.

(f) High Voltage Transformer Replacement

1. Remove the two screws and remove the high voltage shield case.
2. Remove the high voltage board.
3. Remove the solders from the soldered locations on the high voltage board.

(g) Power Transistors

1. Remove the four screws on the rear sub panel. (Refer to Figure 3-2-6-(3))
2. Remove the four screws on the shield case of the power transistors. (Refer to Figure 3-2-6-(4))
3. Remove the four screws on the fun.

Figure 3-2-6-(3). Power transistors replacement I

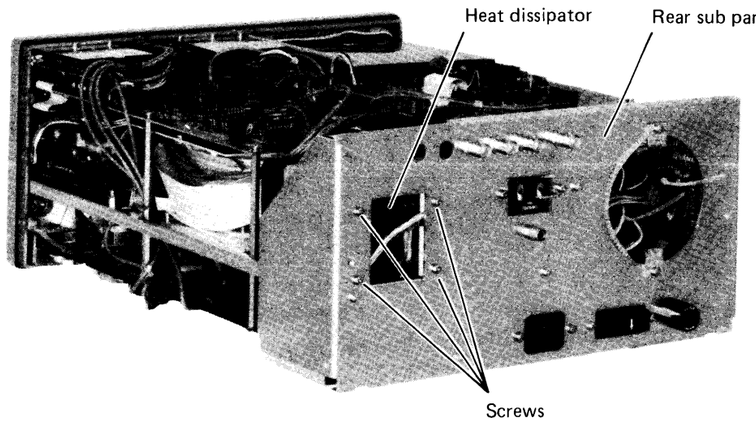
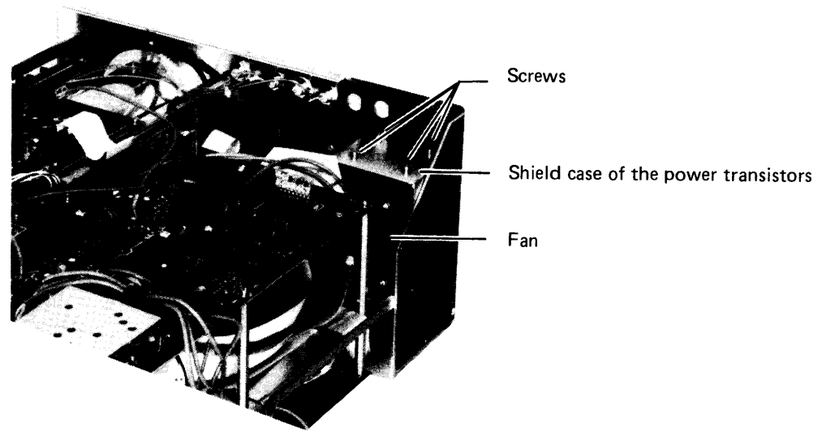


Figure 3-2-6-(4). Power transistors replacement II



3-3 TROUBLESHOOTING

3-3-1 Troubleshooting Reference

Schematic Diagrams

In this manual, schematic diagrams are grouped, in general, with the circuit blocks classified in Figure 2-1-1 to 2-1-3.

Circuit Layout

Layout of circuits on the printed circuit boards is shown in Figure 3-3-1-(1) to 3-3-1-(4). Use the photographs for inspection.

Parts Layout

Refer to part No. printed on the printed circuit board to identify parts mounted on the board.

Electrodes Marking of Diodes Transistors and FET

Table 3-3-1-(1) to 3-3-1-(5) show the electrodes marking of diodes and transistors, by type.

Color Code of Resistors

Most of the resistors in the circuit are color coded by resistance value. See Figure 3-3-1-(4) for the color code.

3-3-2 Instruments Required for Troubleshooting

The following instruments are required at least for troubleshooting of this oscilloscope.

(1) Multimeter
- Input resistance : 10 MΩ
- Voltage range : 0 to 300V and special position for 2 kV
- Ohm-range : 0 to 10 MΩ

(2) Transistor curve tracer

(3) Oscilloscope
- Frequency responce: DC to 100 MHz
- Deflection factor : 5 mV/div

3-3-3 Troubleshooting Steps

The first thing in troubleshooting is to examine if a irregular event like "a circuit trouble" is really due to a troubles within the circuit, or caused by external events. For example, certain irregular operations will occur, in a normal oscilloscope, if the line voltage is out of the rated voltage range, or a signal input connector is affected by induction of an external signal.

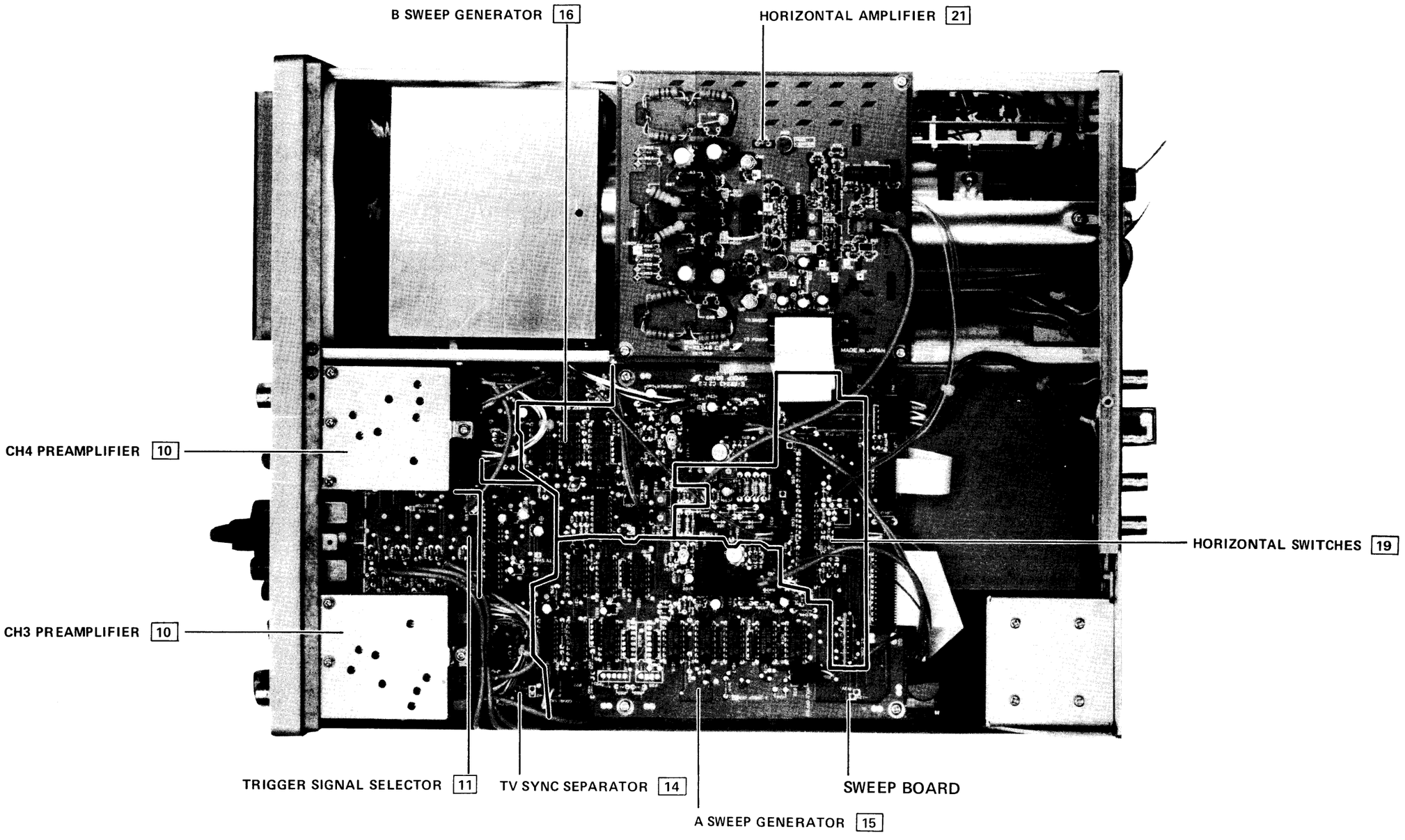
Then, repeatability of the trouble must be checked. For example, when sweep is normal but an irregular signal is displayed with a signal supplied to the signal input connector, the other signal must be supplied to the input to check if the same irregular display occurs (if it occurs, the oscilloscope is responsible for the trouble).

When troubles persist against these preparatory checks, the following actual steps must be performed.

1. Remove the covers from the instrument and ascertain the circuit which has the trouble by the troubleshooting flow chart shown in Figure 3-3-3.
2. Visually inspect parts, wirings, coupling of connectors, soldering and copper foils of the circuit board, which are suspect.
3. Check the action of the ascertained circuit by using a multimeter or test oscilloscope and refering the voltages and waveforms shown in the schematic diagram.
4. Finally, check suspect parts for the trouble by using a multimeter or curve tracer and replace the defective parts.

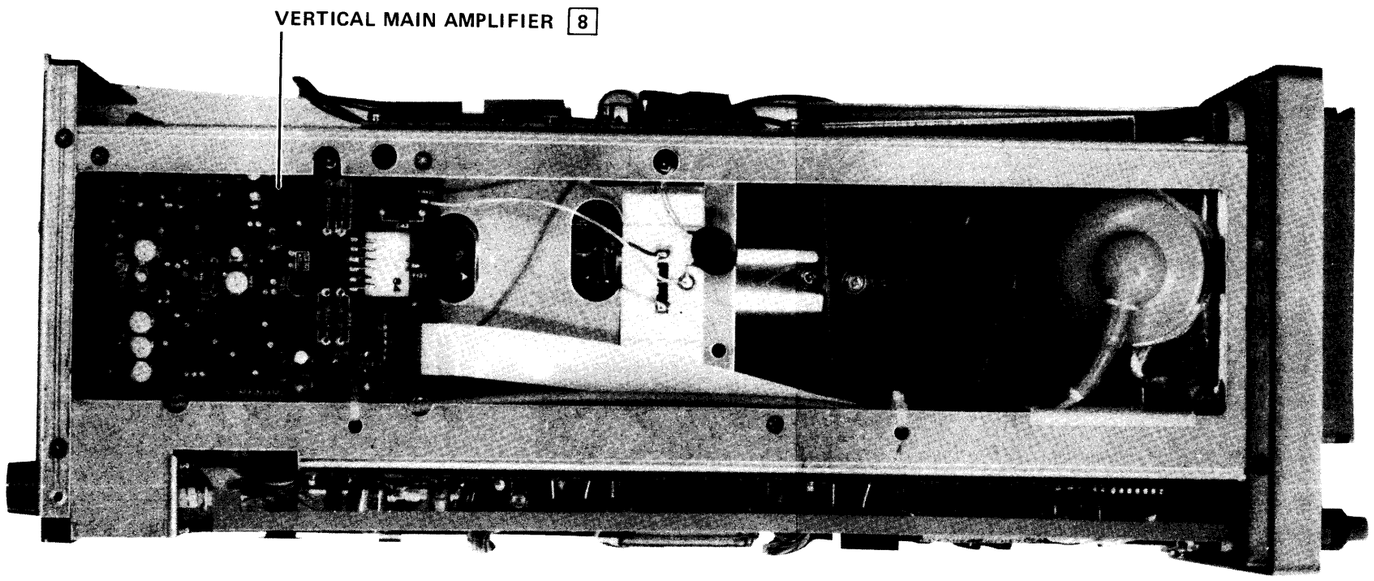
SS—5712 Service Manual Section 3 Maintenance

Figure 3-3-1-(1). Circuit layout (Top)



SS—5712 Service Manual Section 3 Maintenance

Figure 3-3-1-(2). Circuit layout (Left side)



SS—5712 Service Manual Section 3 Maintenance

Figure 3-3-1-(3). Circuit layout (Bottom)

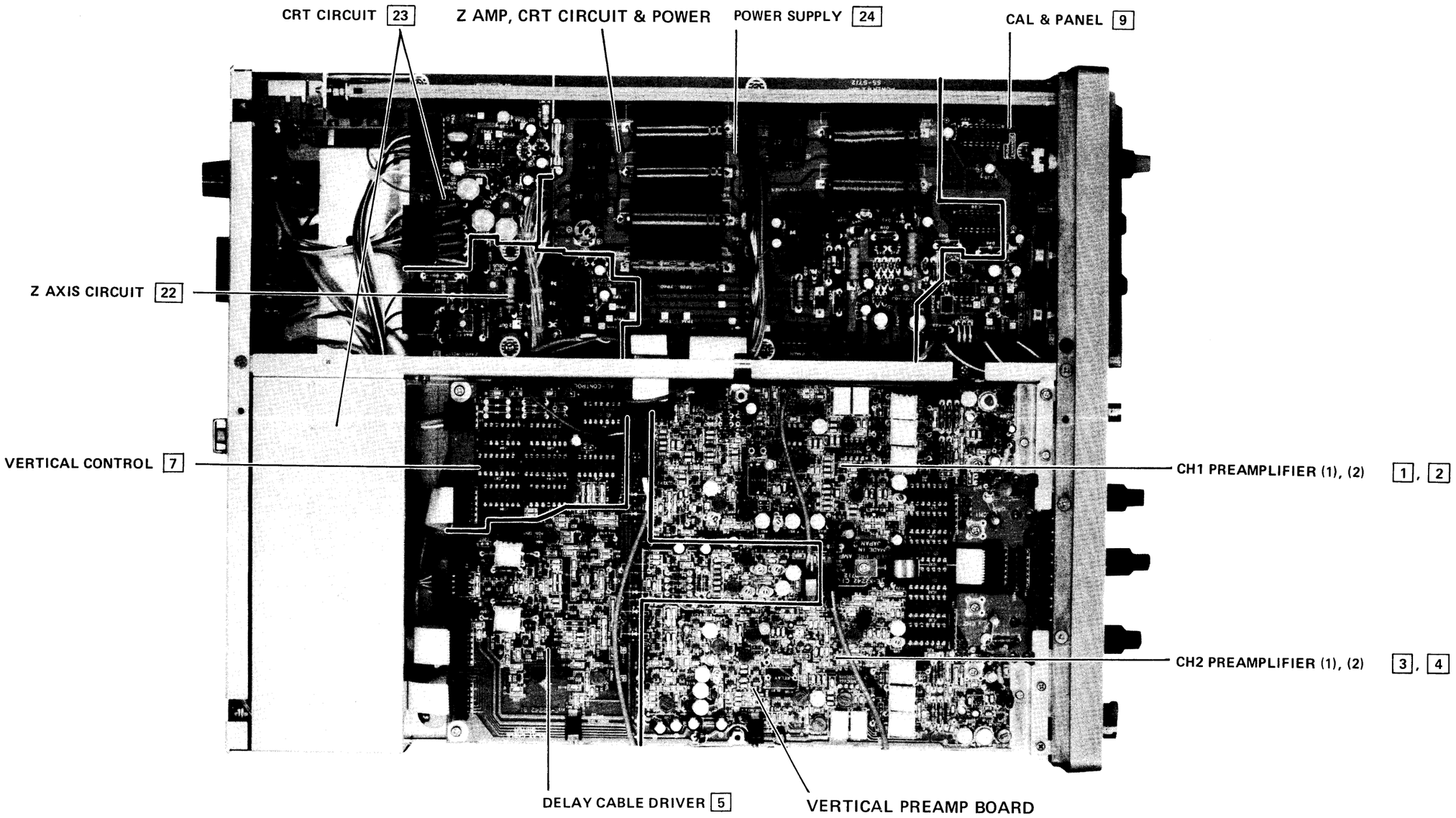


Table 3-3-1-(1) Marking of diode electrode

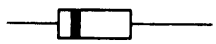
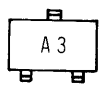
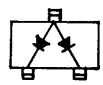
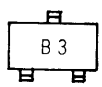
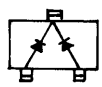
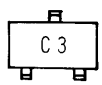
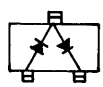
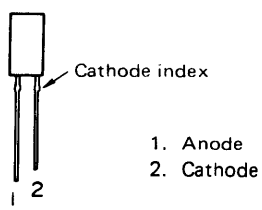
Type of diode	Electrode marking	Polarity or connection
1S953 1S1544A 1SS97 SHV-20 SM-05-20FRZ SM-1A-002		
1SV69		
RD type		
1SS181		
1SS184		
1SS226		
TLR206 TLG206		

Table 3-3-1-(2) Marking of transistor electrode

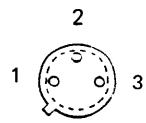
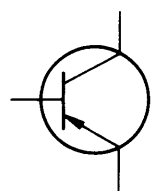
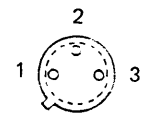
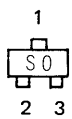
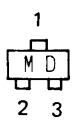
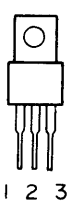
Type of transistor	Electrode marking	Connection
2SA578	 1. Emitter 2. Collector 3. Base	
2SA712	 1. Emitter 2. Base 3. Collector (case)	
2SA1015	 1 2 3 (Bottom view) 1. Emitter 2. Collector 3. Base	
2SA988 2SA1206 2N3905	 1 2 3 (Bottom view) 1. Emitter 2. Base 3. Collector	
2SA1162	 1. Collector 2. Base 3. Emitter	
2SA1245	 1. Collector 2. Base 3. Emitter	
2SA1406	 1. Emitter 2. Collector 3. Base	
2SA1106 2SB940	 1. Base 2. Collector 3. Emitter	

Table 3-3-1-(3) Marking of transistor electrode

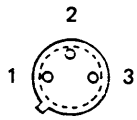
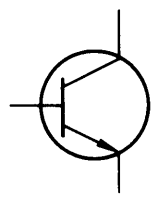
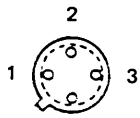
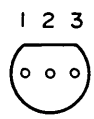
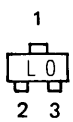
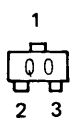
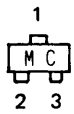
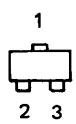
Type of transistor	Electrode marking	Connection
2SC1216 2SC1217	 1. Emitter 2. Base 3. Collector (case)	
2SC1254	 1. Emitter 2. Base 3. Collector 4. Case	
2SC1815	 1. Emitter 2. Collector 3. Base	
2SC2037	 1. Emitter 2. Base 3. Collector	
2SC2712	 1. Collector 2. Base 3. Emitter	
2SC2714	 1. Collector 2. Base 3. Emitter	
2SC3099	 1. Collector 2. Base 3. Emitter	
2SC3356	 1. Collector 2. Base 3. Emitter	

Table 3-3-1-(4) Marking of transistor electrode

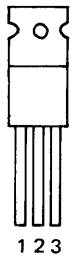
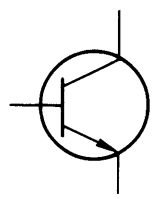
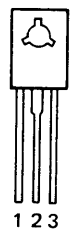
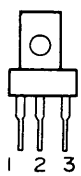
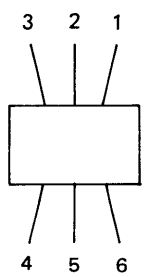
Type of transistor	Electrode marking	Connection
2SC2334L	 1. Base 2. Collector 3. Emitter	
2SC1904 2SC3600	 1. Emitter 2. Collector 3. Base	
2SC2581 2SD1264 2SD1266	 1. Base 2. Collector 3. Emitter	
2SC3065F	 1. Base 1 2. Collector 1 3. Emitter 1 4. Emitter 2 5. Collector 2 6. Base 2	

Table 3-3-1-(5) Marking of transistor electrode

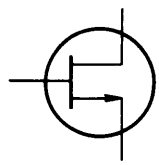
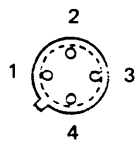
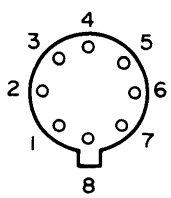
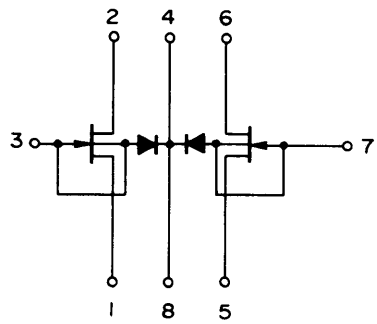
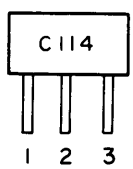
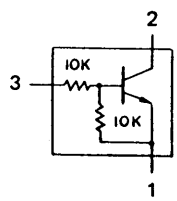
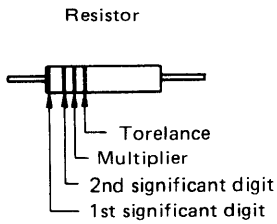
Type of transistor	Electrode marking	Connection
2SK30AY	 1. Source 2. Gate 3. Drain	
2SK141 2SK1412A	 1. Source 2. Drain 3. Gate 4. Case	
μPA61AM	 1. Source 1 2. Drain 1 3. Gate 1 4. Sub 5. Source 2 6. Drain 2 7. Gate 2 8. Sub	
DTC114EK	 1. Emitter 2. Collector 3. Base	

Table 3-1-1-(6) Color coading of resistor



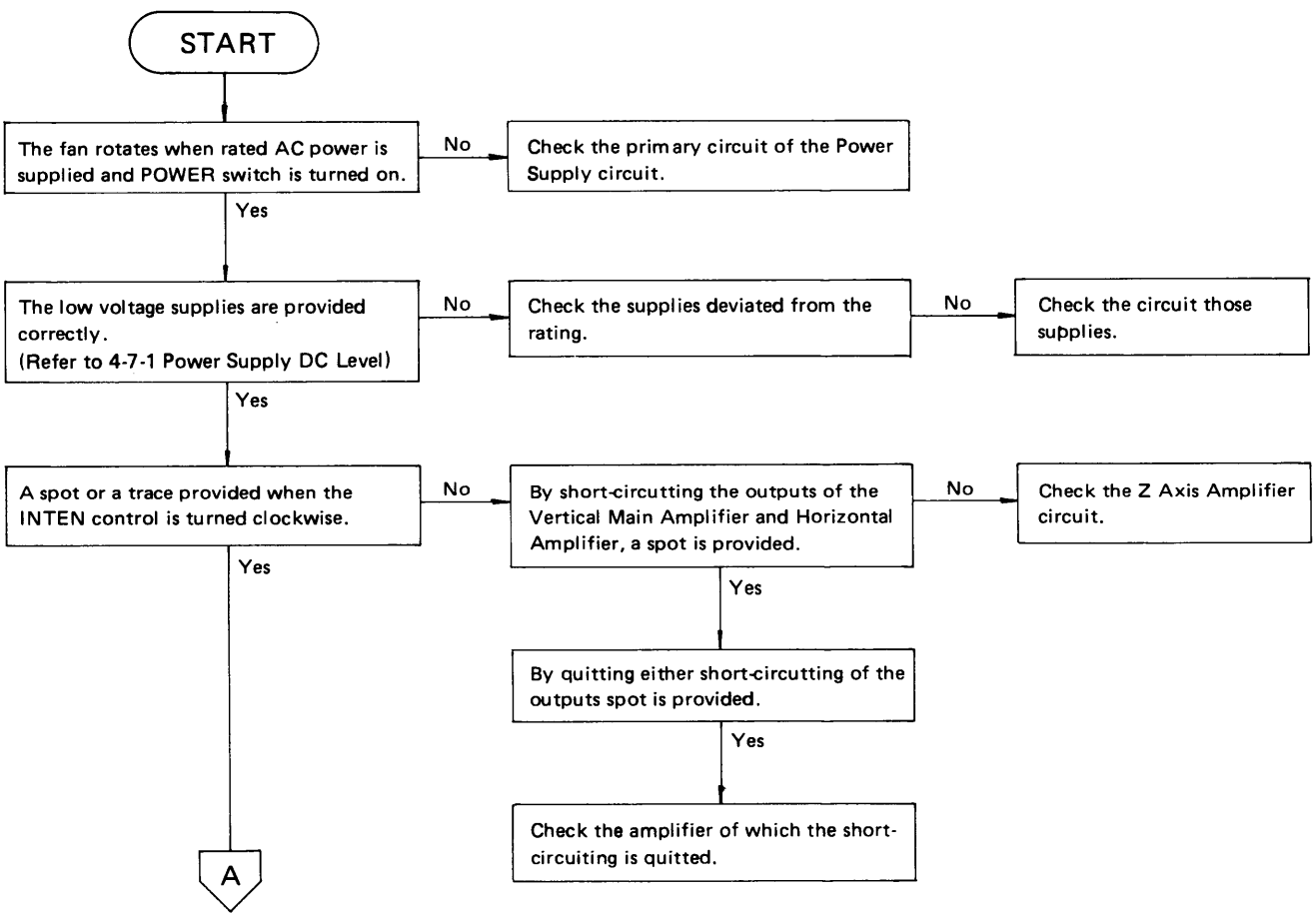
Color	Resistance value		Tolerance for resistor
	1st or 2nd significant digit	Multiplier	
BLK	0	1	–
BRN	1	10	± 1
RED	2	10^2	± 2
ORG	3	10^3	–
YEL	4	10^4	–
GRN	5	10^5	–
BLU	6	10^6	–
VLT	7	10^7	–
GRY	8	10^8	–
WHI	9	10^9	–
GOLD	–	10^{-1}	± 5
SILVER	–	10^{-2}	± 10
No color	–	–	± 20

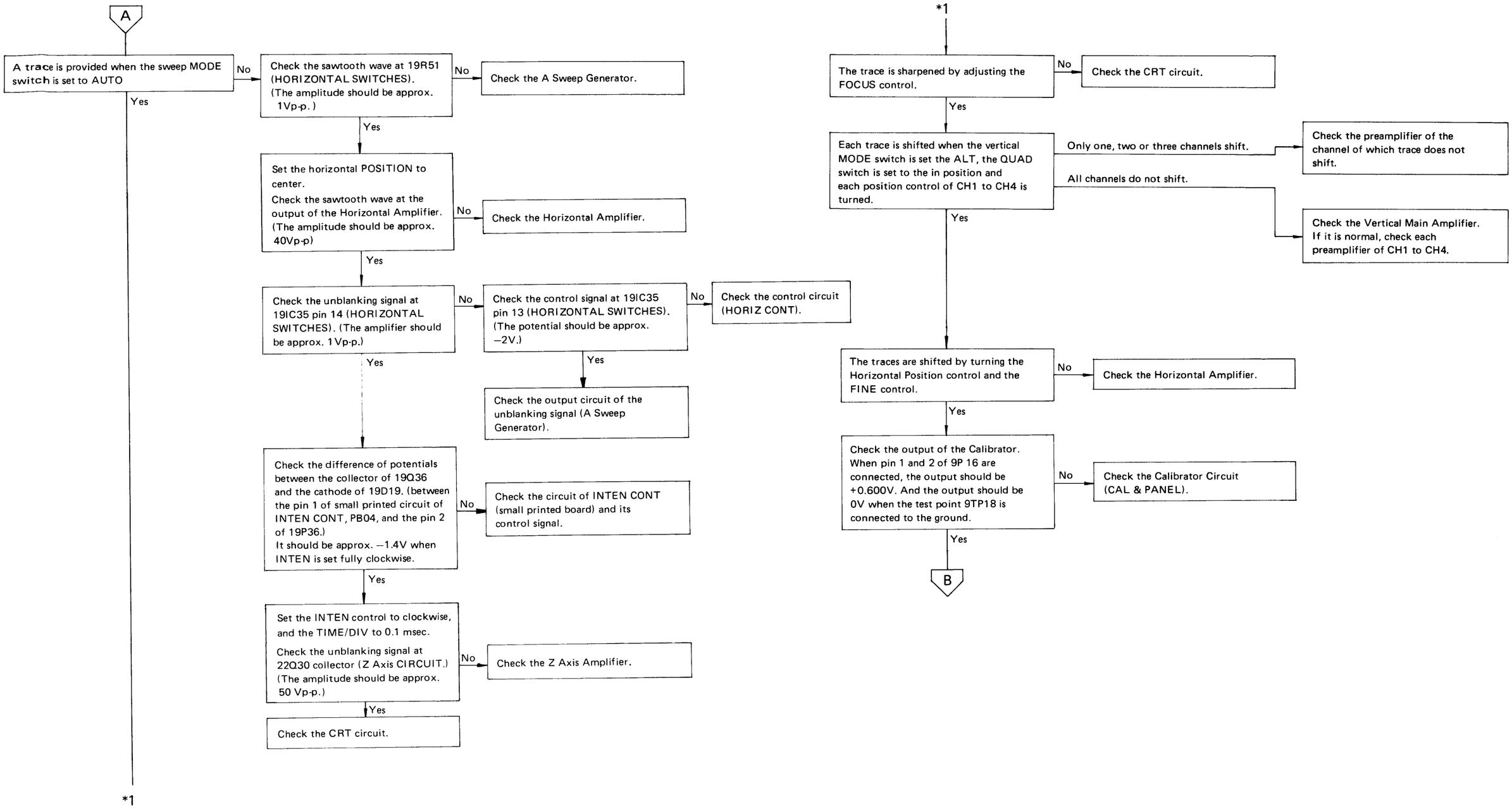
TROUBLESHOOTING FLOW CHART

Oscilloscope Section

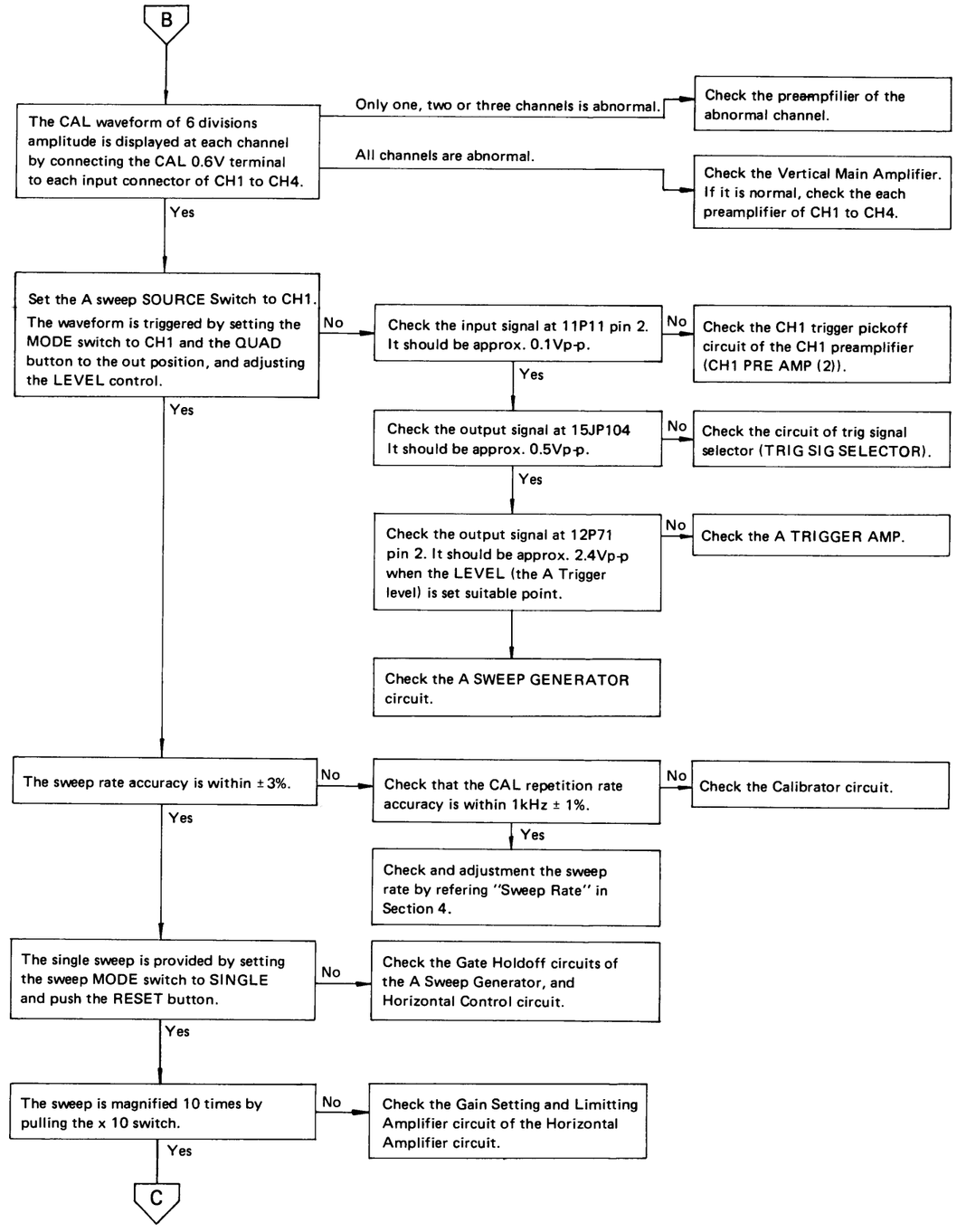
First, set the switches and controls as follows;

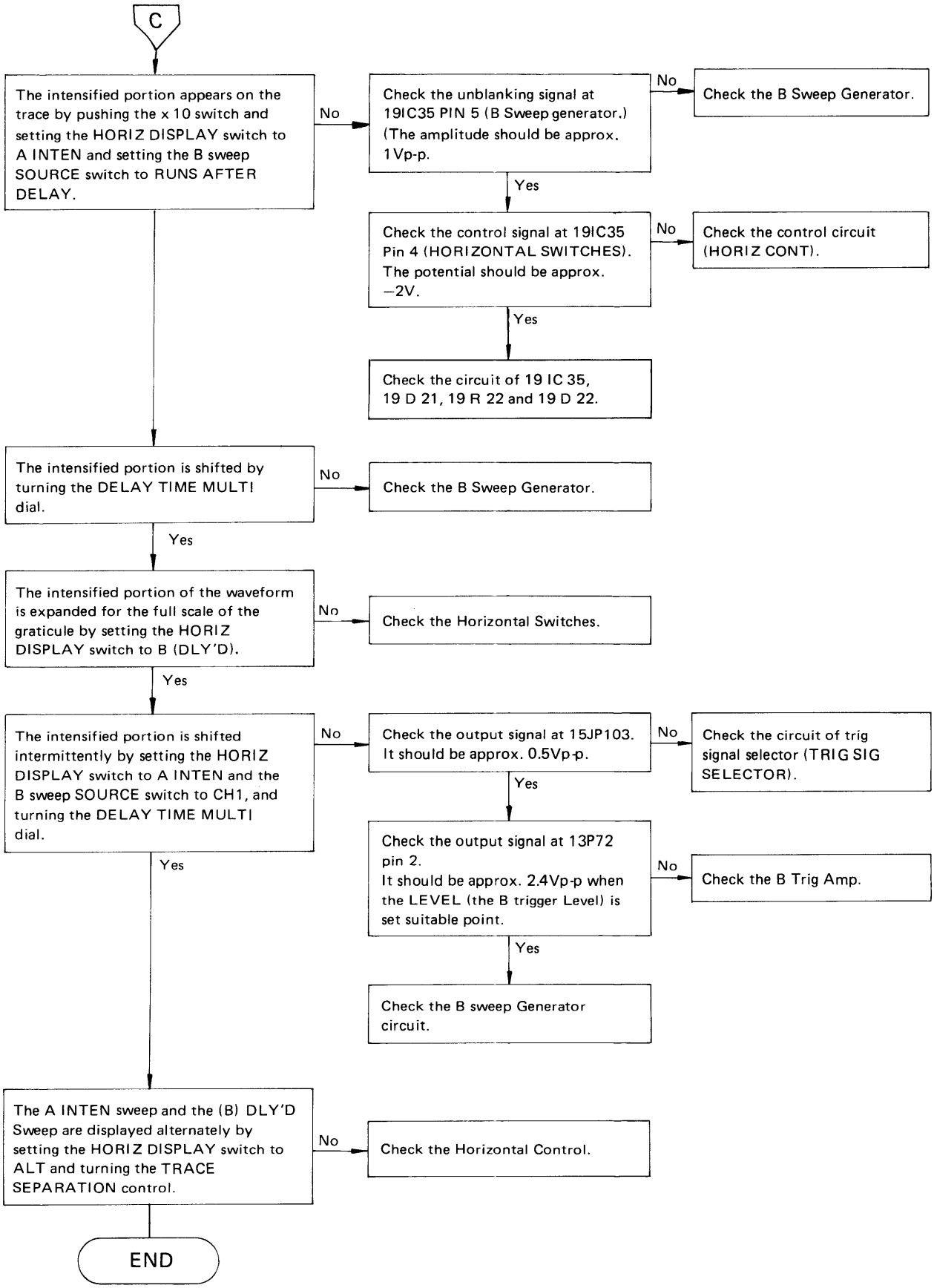
INTEN	Mid-position	SOURCE (A, B)	CH1
FOCUS	Mid-position	HOLDOFF	Fully counterclockwise
SCALE	Fully clockwise	MODE (sweep)	AUTO
MODE (vertical)	CH1	LEVEL/SLOPE (A, B)	Push, Mid-position
POSITION (CH1, CH2)	Mid-position	A TIME/DIV	1 msec
VOLTS/DIV (CH1, CH2)	0.1V	B TIME/DIV	0.1 msec
VARIABLE (CH1, CH2)	CAL	A VARIABLE	CAL
AC-DC, GND (CH1, CH2)	DC	HORIZ DISPLAY	A
CH2 POLAR	Out	DELAY TIME MULT	Fully counterclockwise
POSITION (CH3, CH4)	Mid-position	TRACE SEPARATION	Fully counterclockwise
POSITION	Mid-position	0.1V-0.5V (CH3, CH4)	0.1V
FINE (PULL x10 MAG)	Push, Mid-position	AC-DC (CH3, CH4)	DC
COUPLING (A, B)	AC		




A
A trace is provided when the sweep MODE switch is set to AUTO
No
Check the sawtooth wave at 19R51 (HORIZONTAL SWITCHES). (The amplitude should be approx. 1Vp-p.)
No
Check the A Sweep Generator.
Yes
Set the horizontal POSITION to center.
Check the sawtooth wave at the output of the Horizontal Amplifier. (The amplitude should be approx. 40Vp-p)
No
Check the Horizontal Amplifier.
Yes
Check the unblanking signal at 19IC35 pin 14 (HORIZONTAL SWITCHES). (The amplifier should be approx. 1Vp-p.)
No
Check the control signal at 19IC35 pin 13 (HORIZONTAL SWITCHES). (The potential should be approx. −2V.)
No
Check the control circuit (HORIZ CONT).
Yes
Check the output circuit of the unblanking signal (A Sweep Generator).
Yes
Check the difference of potentials between the collector of 19Q36 and the cathode of 19D19. (between the pin 1 of small printed circuit of INTEN CONT, PB04, and the pin 2 of 19P36.)
It should be approx. −1.4V when INTEN is set fully clockwise.
No
Check the circuit of INTEN CONT (small printed board) and its control signal.
Yes
Set the INTEN control to clockwise, and the TIME/DIV to 0.1 msec.
Check the unblanking signal at 22Q30 collector (Z Axis CIRCUIT.) (The amplitude should be approx. 50 Vp-p.)
No
Check the Z Axis Amplifier.
Yes
Check the CRT circuit.
*1
*1
The trace is sharpened by adjusting the FOCUS control.
No
Check the CRT circuit.
Yes
Each trace is shifted when the vertical MODE switch is set the ALT, the QUAD switch is set to the in position and each position control of CH1 to CH4 is turned.
Only one, two or three channels shift.
Check the preamplifier of the channel of which trace does not shift.
All channels do not shift.
Check the Vertical Main Amplifier. If it is normal, check each preamplifier of CH1 to CH4.
Yes
The traces are shifted by turning the Horizontal Position control and the FINE control.
No
Check the Horizontal Amplifier.
Yes
Check the output of the Calibrator. When pin 1 and 2 of 9P 16 are connected, the output should be +0.600V. And the output should be 0V when the test point 9TP18 is connected to the ground.
No
Check the Calibrator Circuit (CAL & PANEL).
Yes
B

SS–5712 Service Manual




C
The intensified portion appears on the trace by pushing the x 10 switch and setting the HORIZ DISPLAY switch to A INTEN and setting the B sweep SOURCE switch to RUNS AFTER DELAY.
No
Check the unblanking signal at 19IC35 PIN 5 (B Sweep generator.) (The amplitude should be approx. 1Vp-p.
No
Check the B Sweep Generator.
Yes
Check the control signal at 19IC35 Pin 4 (HORIZONTAL SWITCHES). The potential should be approx. −2V.
No
Check the control circuit (HORIZ CONT).
Yes
Check the circuit of 19 IC 35, 19 D 21, 19 R 22 and 19 D 22.
The intensified portion is shifted by turning the DELAY TIME MULTI dial.
No
Check the B Sweep Generator.
Yes
The intensified portion of the waveform is expanded for the full scale of the graticule by setting the HORIZ DISPLAY switch to B (DLY'D).
No
Check the Horizontal Switches.
Yes
The intensified portion is shifted intermittently by setting the HORIZ DISPLAY switch to A INTEN and the B sweep SOURCE switch to CH1, and turning the DELAY TIME MULTI dial.
No
Check the output signal at 15JP103. It should be approx. 0.5Vp-p.
No
Check the circuit of trig signal selector (TRIG SIG SELECTOR).
Yes
Check the output signal at 13P72 pin 2. It should be approx. 2.4Vp-p when the LEVEL (the B trigger Level) is set suitable point.
No
Check the B Trig Amp.
Yes
Check the B sweep Generator circuit.
Yes
The A INTEN sweep and the (B) DLY'D Sweep are displayed alternately by setting the HORIZ DISPLAY switch to ALT and turning the TRACE SEPARATION control.
No
Check the Horizontal Control.
END

NOTES

Section 4

Check and Adjustment

4-1 GENERAL

Correct measurement requires the normal operation of each circuit in SS-5712 and satisfactory maintenance of their performance.

With the regular performance check and adjustment, SS-5712 can develop its functions in a reliable manner for a long period of service. This section describes the appropriate method of check and adjustment.

4-2 PERIOD OF CHECK AND ADJUSTMENT

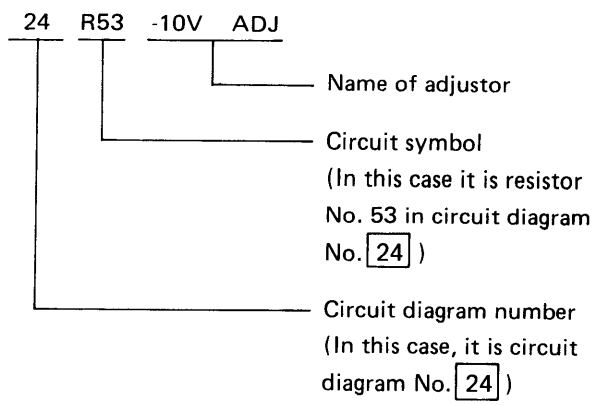
The regular and periodical check and adjustment of performance is necessary for correct measurement. The proper check intervals for SS-5712 are one year.

4-3 PRECAUTIONS FOR CHECK AND ADJUSTMENT

For the check and adjustment, pay attention to the following:

1. In each check and adjustment items, the description for the control knib manipulation presupposes the setting completed for from "4-6 Preparation". Whether the check and adjustment are carried out for all items or for limited items, make sure to start the operation from the point where the setting has been made according to the preparation for check and adjustment.
2. Some signal generator outputs at a 50 Ω termination; so using a coaxial cable with characteristic impedance of 50 Ω (e.g. BB-120 by Iwatsu), terminate the cable end at the scope side with a 50 Ω terminator (e.g. BB-50M1 by Iwatsu).
3. The low-voltage power is supplied to all circuits. If its voltage or ripple goes outside the specified values, then other specification will be affected. In check and adjustment, therefore, check the low-voltage power supply first.
4. The CRT has a high-voltage. For its check and adjustment, be careful not to catch an electric shock.
5. In the pictures in the check and adjustment sections, the letters and numbers on the adjusting instruments have the following meanings:

< Example >



4-4 EQUIPMENT REQUIRED

The check and adjustment requires the equipment and accessoreis as described in Table 4-4-1. The equipment nust have the specifications equal to or greater than those described in the table.

The signal input connector of SS-5712 is BNC. If the terminator or signal output terminal is other than BNC, prepare a converter connector.

Table 4-4-1 List of equipment required

Equipment	Minimum Specifications	Purpose	Recommended Model	
			Iwatsu	Equivalent
1. Scope calibrator • Calibration voltage generator • Time-mark generator • Repetion interval • Sine wave generator • Repetion ratio generator • Fast rise signal generator	: 0.12mV to 60V ± 0.5% or less : 20nsec to 2 sec ± 0.05% or less : 1 kHz ± 20% or less Frequency range : 50Hz to 200kHz Rise time : 5nsec or less Repetition : 50Hz to 200kHz Rise time : 300 ps or less	Vertical, triggering and horizontal checks and adjustments	SC-340	
2. Standard signal generator	Frequency : 50kHz to 200MHz Output level : 60 mV or more	Pattern distortion, bandwidth check and adjustment of phase difference during X-Y operation		
3. Digital volt-meter	Range : DC to 200VDC ± 0.2% + 1 dgt	Low-voltage power supply checks and adjustment	SC-7401	
4. High-voltage probe	Range : DC to 15kVDC ± 3% + 1 dgt	Check and adjustment of CRT voltage	High-voltage probe (SC-7401 option)	

Table 4-4-1 List of equipment required (cont.)

Equipment	Minimum Specifications	Purpose	Recommended Model	
			Iwatsu	Equivalent
5. Test Oscilloscope	Bandwidth : DC to 20MHz Minimum defection factor: 1mV/div	Low-voltage power supply checks and adjustments	SS-5702	
6. Attenuation rate of oscilloscope probe	1:1	Low-voltage power supply checks and adjustments	SS-0001 ~ 3	
7. Frequency counter	Range: 10Hz to 1.5MHz Resolution: 1Hz	Check and adjustment of CRT voltage	SC-7101	
8. Voltage regulator		AC line voltage range check		
9. Termination (2 required)	Impedance: 50Ω	Signal termination	BB-50MI	
10. 6dB divider		Signal interconnection	B-50D3	
11. BNC coaxial cable (2 required)	Impedance: 50Ω Length: 120mm	Signal input	BB-120C	
12. Supplied probe Attenuation ratio	10:1	Signal input	SS-0060	
13. Screwdriver (Attached to probe)		Adjust variable resistors and capacitors		

4-5 CHECK AND ADJUSTMENT ITEMS

The check and adjustment items are shown in Table 4-5-1.
The right column indicates items that may be affected by adjustment.
Together with one item, also check and adjust other items that may be affected by that item.
In check and adjustment of all items, do them in the following sequence:

Table 4-5-1 Items and interactions

Order	Checks and adjustments items		Page	Checks and adjustments affected
	4-7 Power supply and CRT			
1	4-7-1	Power supply DC level	4-8	All items
2	4-7-2	AC line voltage range	4-10	All items
3	4-7-3	High-voltage power supply	4-11	4-7-4, 4-7-5, 4-9-2, 4-9-4, 4-9-11, 4-10-1, 4-12-1
4	4-7-4	Intensity	4-12	4-7-7
5	4-7-5	Focus	4-13	
6	4-7-6	The parallel of the horizontal trace and the horizontal scale (TRACE ROTATION)	4-14	
7	4-7-7	The parallel of the vertical trace and the vertical scale (ORTHOGONALITY)	4-15	
8	4-7-8	Pattern distortion	4-16	
	4-8 Calibrator output			
9	4-8-1	Output voltage	4-18	
10	4-8-2	Repetition rate	4-18	
	4-9 Vertical Deflection System			
11	4-9-1	Pulse response 1 (CH1·CH2 sag at 10 mV/Div)	4-20	
12	4-9-2	Deflection factor I (CH1·CH2)	4-22	4-10-1
13	4-9-3	Pulse response II (CH1·CH2 sag at 1mV/Div)	4-24	4-9-2
14	4-9-4	Deflection factor II (CH3·CH4)	4-26	
15	4-9-5	Pulse response III (Over shoot and others)	4-28	
16	4-9-6	Frequency response	4-29	
17	4-9-7	Attenuator compensation	4-30	
18	4-9-8	Vertical position balance	4-32	
19	4-9-9	Position center I (CH1·CH2)	4-34	
20	4-9-10	Position center II (CH3·CH4)	4-34	
21	4-9-11	Linearity	4-36	

Table 4-5-1 Items and interactions (Cont.)

Order	Checks and adjustments items	Page	Checks and adjustments affected
	X-Y Operation		
22	4-10-1 Spot location and deflection factor	4-37	4-9-11
23	4-10-2 Phase difference	4-38	4-9-11
	Trigger System		
24	4-11-1 A Trigger (CH1·CH2 and CH3)	4-40	4-9-11
25	4-11-2 B Trigger (CH1·CH2 and CH4)	4-42	
	Horizontal Deflection System		
26	4-12-1 Sweep rate and sweep magnification	4-40	4-10-1, 4-12-3
27	4-12-2 Delay start and stop	4-50	
28	4-12-3 Delay jitter	4-52	

4-6 PREPARATION

Precaution
Open the page to the left and refer to the contents when making check and adjustment of each item.

Table 4-6-1 Switch and Control Knob Setting Before Check and Adjustment

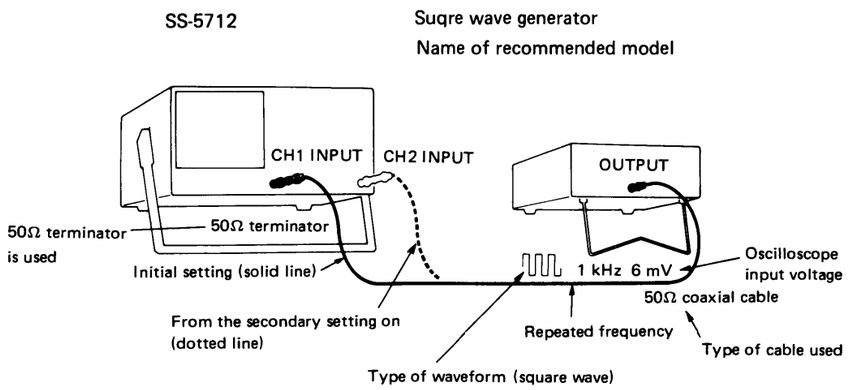
Switches and controls	Setting
A INTEN	Slightly right of the midrange
B INTEN	Midrange
FOCUS	Midrange
SCALE	Full clockwise turn
VERTICAL MODE	CH1
‡ POSITION (CH1·2·3·4)	Midrange
VOLTS/DIV (CH1·2)	10 mV
VARIABLE (CH1·2)	CAL (Push)
AC-DC (CH1·2·3·4)	DC
BAND WIDTH	FULL
CH2 POLAR	NORM
0.1V-0.5V (CH3·4)	0.1V
↔ POSITION	Midrange
FINE (PULL x 10 MAG)	Midrange (Push)
COUPLING (A·B Sweep)	AC
SOURCE (A·B Sweep	CH1
HORIZONTAL MODE	AUTO
HIROZ DISPLAY	A
A TIME/DIV	1 mS
B TIME/DIV	1 mS
A VARIABLE	CAL
LEVEL (A·B Sweep)	Midrange (Push)
SLOPE (PULL)	
DELAY TIME MULTI	Full counterclockwise turn
HOLD OFF	Full counterclockwise turn
TRACE SEPARATION	Full counterclockwise turn

Before making check and adjustment, prepare the following:

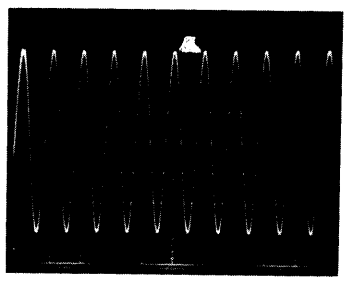
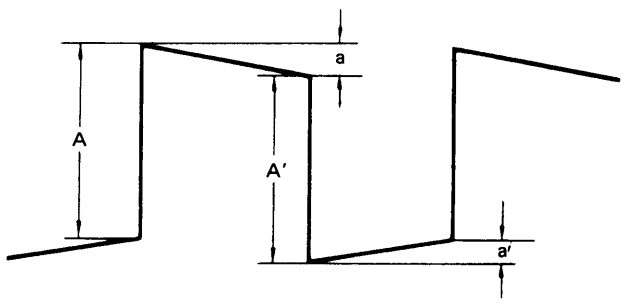
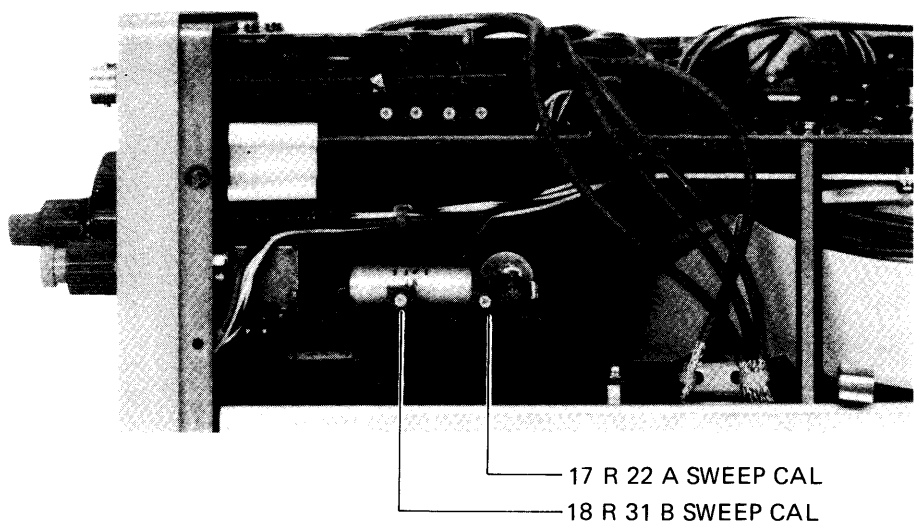
1. Set the ambient temperature at 23°C ± 5°C.
2. Before turning the power on, set the switches and control knobs as shown in the table at the left.
   Use the switch and control knob settings shown in Table 4-6-1 when performing inspections and calibrations described in and after paragraph 4-7-1. If settings different from those specified in this table are used, the will be specified in each paragraph concerned.
3. Set the voltage select plug on the rear panel to meet the line voltage. Connect the power cord plug to the receptacle of the line. If the line voltage is outside the operating range of SS-5712, set the voltage within the range using a voltage regulator.

Guide to check and adjustment columns

Item	Description
Rating	± 3% ← Rating required for check and adjustment
Connection	Illustration for signal input/output connections
Setting	HORIZ DISPLAY : A A TIME/DIV : 1 mS ← Switch and control knob settings not specified here are set as shown in Table 4-6-1. Some items are repeated here, however. Time marker (input signal) : 1 mS ← Initial setting of input signal.
Adjustment sequence	Name of calibrator 1. Adjust FOCUS, ASTIG, **23 R 70 FOCUS 1** and **22 R 44 FOCUS 2** to give the best focus to the waveform on the CRT. 2. Adjust with **22 R 38 AUTO FOCUS** so that the focus does not extremely deviate when the intencity is raised by INTEN. Check and adjustment procedure First check whether the focus is within the rating or not, and only when it is found to be out of the rating, adjust it using the specified regulator.



Guide to check and adjustment columns (Cont.)

Item	Description
CRT waveform	Correct focusing waveform ← State of waveform  Input signal: Sine wave ← Type of waveform 1 kHz ← Repeated frequency 60 mV ← Input voltage
Reference	Reference data for check and adjustment  $\text{Sag} = \frac{a}{A}$ (or $\frac{a'}{A'}$) x 100%, either $\frac{a}{A}$ or $\frac{a'}{A'}$ whichever larger is adopted.
Check and adjustment locations	Right side view ← Indicates the unit is viewed from the right. Shows the check and adjustment locations such as the test points stated in the adjustment sequence column. (Sometimes adjustment locations only are shown.) 

4-7 POWER SUPPLY AND CRT CHECK AND ADJUSTMENT

4-7-1 Power Supply DC Level

Item

Rating

Connection

Description

DC voltage	Range of output voltage	Ripple voltage
– 12V	± 0.12V	0.5mV
– 5V	± 0.2 V	1 mV
+ 5V	± 0.1 V	1 mV
+ 12V	± 0.36V	1 mV
+ 40V	± 1.2 V	2 mV
+150V	± 4.5 V	2 mV

—— RANGE OF OUTPUT VOLTAGE ——

1. Measure the voltage between the measurement point and the ground with the digital volt meter.
2. If the voltage is out of rating value adjust –12V with **24 R 53 –12V ADJ.**
3. Check voltage at other locations again.

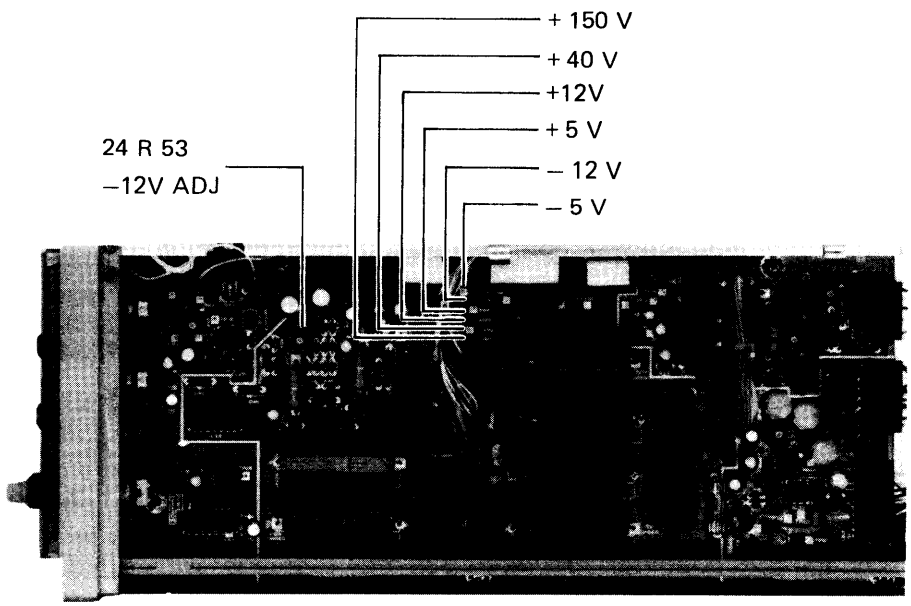
< Note >

The design is such that by adjusting –12V, other voltages can be set within the specification range.

—— RIPPLE VOLTAGE ——

4. Set the sweep MODE to SINGLE.
5. Connect the 1:1 ratio probe to the INPUT connector of the test oscilloscope. Check the ripple voltage of each.

4-7-1 *Power Supply DC Level (Cont.)*

Item	Description
Check point and adjustment location	Bottom view (POWER & ZMP) 

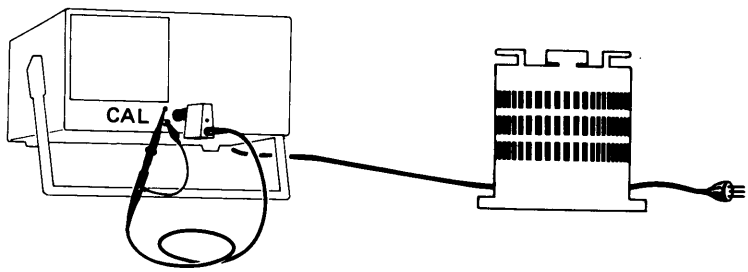
4-7-2 AC Line Voltage Range

Item	Description
Rating	The CRT waveform must be sufficiently stable within the voltage range shown in the right table.

Set position	Center voltage	Voltage range	Fuse used
A	100V	90 to 110V	3A slowblown fuse
B	115V	103 to 128V	
C	220V	195 to 242V	1.5A slowblown fuse
D	230/240V	207 to 264V	

Connection

SS-5712 Voltage regulator



Setting

A TIME/DIV: 10 mSEC

Check sequence

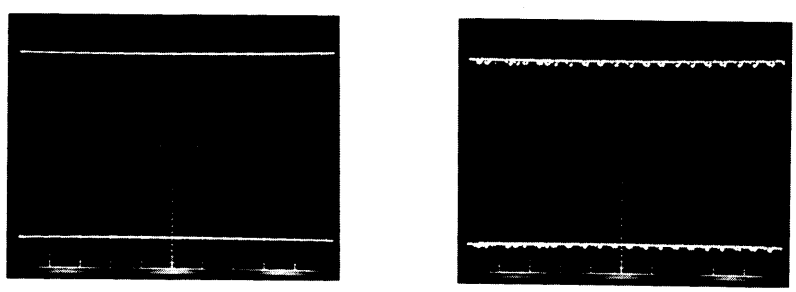
Precaution

In exchange of the voltage select plug or replacing fuses, remove the power cord from the receptacle of the line. When exchanging the voltage select plug, remove the rear panel.

Using a voltage regulator, change the AC supply voltage continuously in the rated range, and check that ripper or intensity modulation does not appear on the CRT waveform.

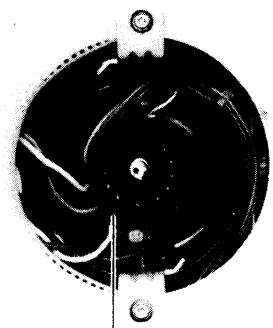
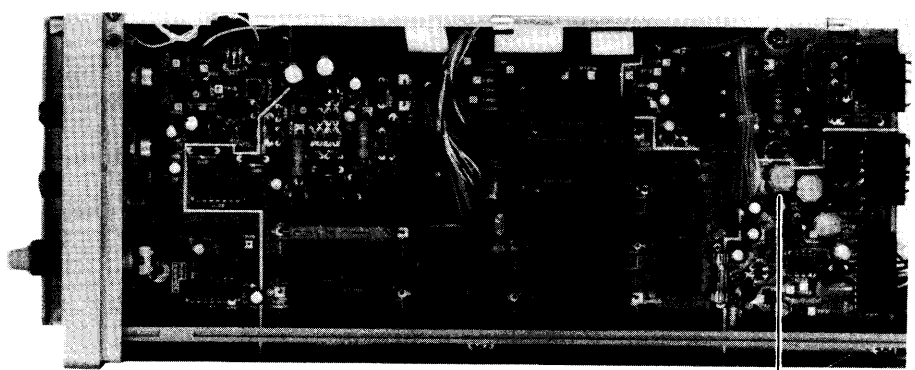
CRT waveform

Normal waveform Abnormal waveform

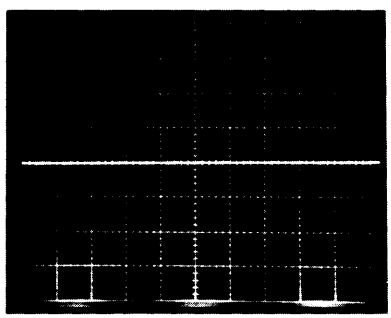
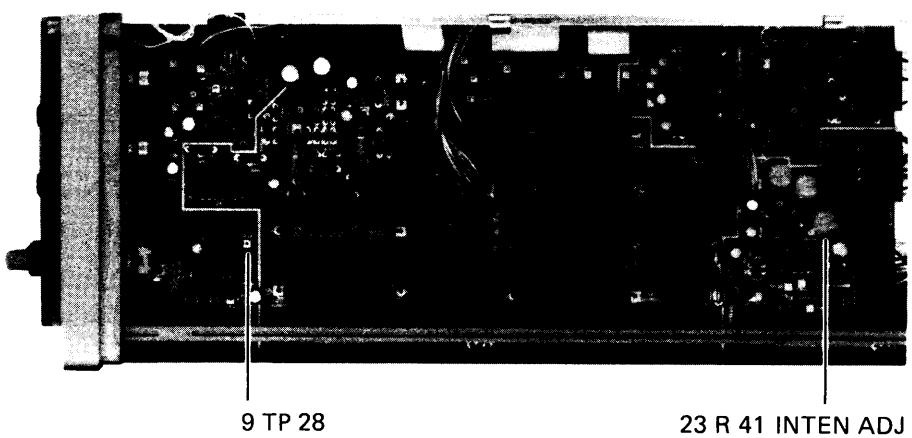


Input signal
: CAL voltage

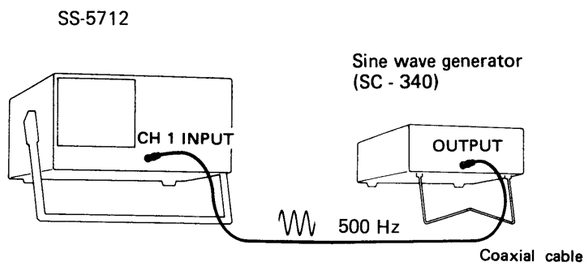
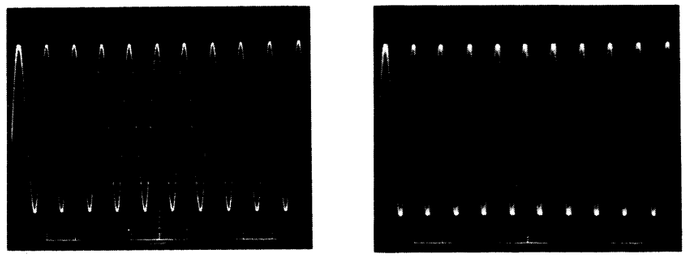
4-7-3 High-Voltage Power Supply

Item	Description
Rating	−2.45 kV ± 5% (between the CRT cathode and ground)
Check and Adjustment sequence	*Precaution* *If the error of the CRT cathode voltage is within ± 5%, do not made adjustment, except when all items or deflection factor and sweep rate are adjusted.* 1. Using a digital multimeter (with a high-voltage probe), measure the voltage between the CRT cathode and the ground, and check that the voltage is within −2.45 kV ± 5%. 2. If the result is outside the rated value, adjust the voltage with 23 R35 HV ADJ.
Check point and adjustment location	 Rear view CRT pin 2 Bottom view (POWER & Z AMP)  23 R 35 HV ADJ

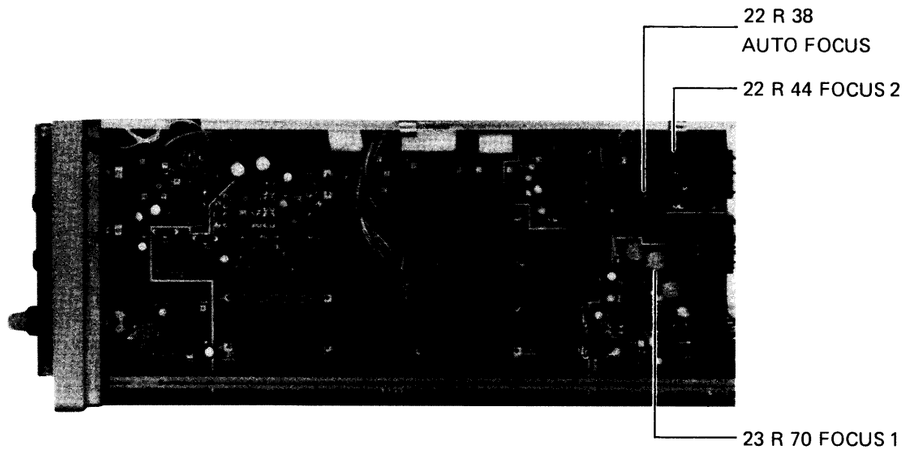
4-7-4 Intensity

Item	Description
Rating	With INTEN being set midrange, the proper intensity trace must appear; with the INTEN full counter-clockwise turn, the trace must disappear.
Setting	Vertical MODE : CH1 or CH2 HORIZ DISPLAY : A Horizontal MODE : AUTO TIME/DIV : 1m SEC
Adjustment sequence	1. Set A INTEN control (on the front panel) so that the voltage of 9TP28 check point becomes + 10.3V ± 0.1V. 2. Adjust with **23 R 41 INTEN ADJ** that the trace must be dimly recognized.
CRT waveform	
Check point and adjustment location	Bottom view (POWER & Z AMP)  9 TP 28 23 R 41 INTEN ADJ

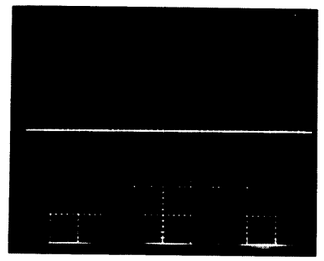
4-7-5 Focus

Item	Description
Rating	The focus shall not deviate during INTEN adjustment. The best focus shall be obtained within 45° ranges to the right and left from the center.
Connection	
Setting	INTEN : Trace must appear dimly A TIME/DIV : 1m SEC FOCUS : Midrange
Adjustment sequence	1. Adjust FOCUS, ASTIG, **23 R 70 FOCUS 1** and **22 R 44 FOCUS 2** to give the best focus to the waveform on the CRT. 2. Adjust with **22 R 38 AUTO FOCUS** so that the focus does not extremely deviate when the intensity is raised by INTEN.
CRT waveform	Correct focusing waveform Incorrect focus waveform  Input signal : Sine wave 500 Hz

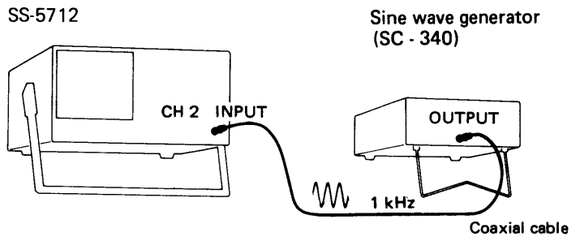
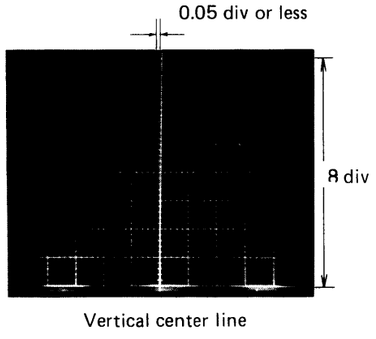
4-7-5 Focus (Cont.)

Item	Description
Adjustment location	Bottom view (POWER & Z AMP) 

4-7-6 The parallel of the Horizontal Trace and the Horizontal Scale (TRACE ROTATION)

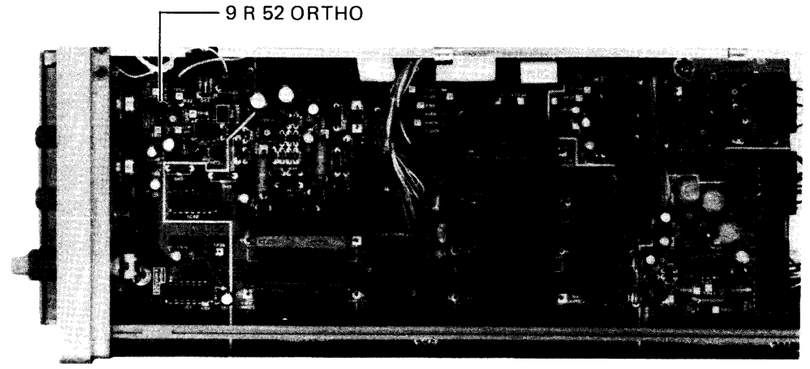
Item	Description
Rating	The horizontal trace and the horizontal scale lines should be parallel at the center of the screen.
Check and adjustment sequence	*Precaution* *As the angle of the trace is affected to some degree by the earth's magnetism, check and adjust after the SS-5712 is set in position for measurement.* 1. Superimpose the trace on the horizontal center line of the scale (use POSITION control) and check that both are parallel. 2. If they are not pallallel, adjust with TRACE ROTATION (on the front panel).
CRT waveform	The horizontal trace has a tile against the horizontal center line 

4-7-7 The Parallel of the Vertical Trace and the Vertical Scale (ORTHOGONALITY)

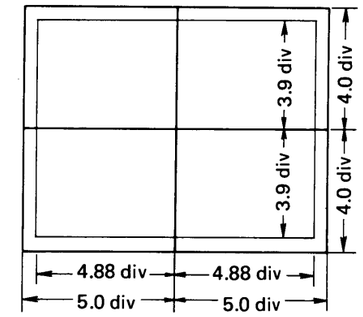
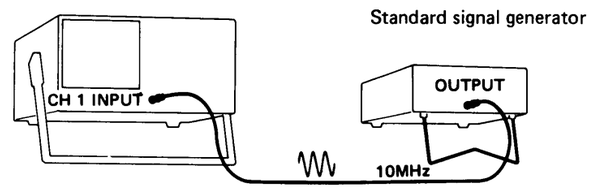
Item	Description
Rating	Shear of the vertical trace and vertical center line should be 0.05 div/8 div or less.
Connection	
Setting	HORIZ DISPLAY : X-Y
Adjustment sequence	Adjust with **9 R 52 ORTHO** so that a shear of the vertical trace and vertical center line.
CRT waveform	 Vertical center line

SS-5712 Service Manual Section 4 Check and Adjustment

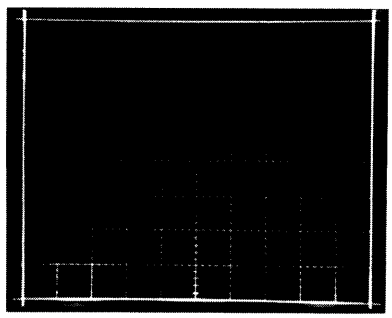
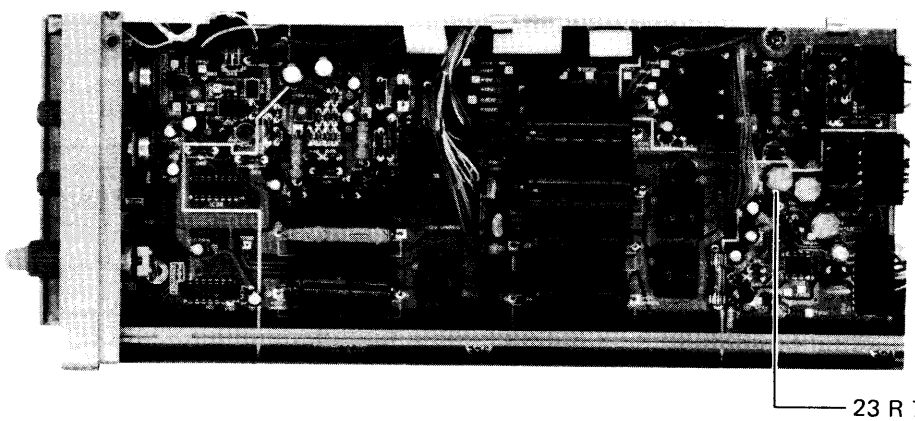
4-7-7 The Parallel of the Vertical Trace and Vertical Scale (ORTHOGONALITY) (Cont.)

Item	Description
Adjustment location	Bottom view (POWER & Z AMP) 

4-7-8 Pattern Distortion

Item	Description
Rating	Vertical and horizontal trace should be within the range shown in the figure at the right. 
Connection	SS-5712  Coaxial cable
Setting	HORIZ DISPLAY : A INTEN A TIME/DIV : 1m SEC B TIME/DIV : 20 n SEC HOLDOFF : B ENDS A
	1. Shift the horizontal trace with the ↕ POSITION control to the top or bottom of horizontal scale. 2. Shift the vertical trace with the ↔ position control to the left or right ends of vertical scale. 3. If the distortion is out of rating, adjust with **23 R 71 PATTERN.**

4-7-8 Pattern Distortion (Cont.)

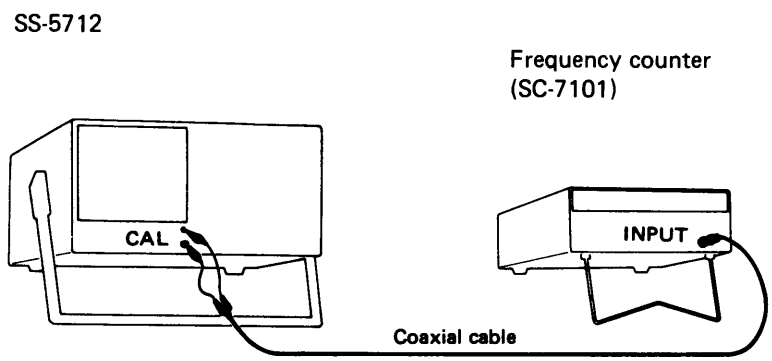
Item	Description
CRT waveform	 Input signal: Sine wave 10 kHz <Note> Left side picture is photographed with four times exposure
Adjustment location	Bottom view (POWER & Z AMP) 

4-8 CALIBRATOR OUTPUT

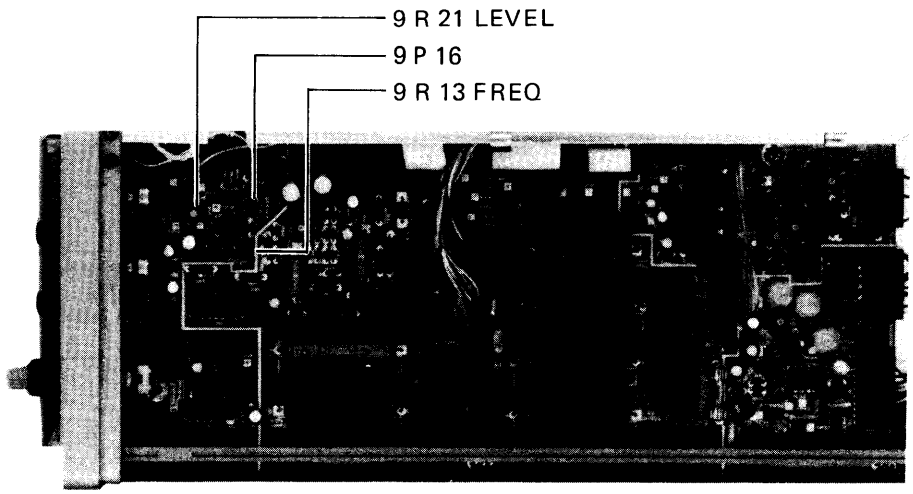
4-8-1 Output Voltage

Item	Description
Rating	0.6V ± 1%
Check and adjustment sequence	1. Short test terminals Pin 1 and Pin 2 of the 9 P 16 SERVICE. 2. Use a digital multimeter to measure the voltage between the CAL 0.6V terminal and GND. 3. Check that this voltage is between 0.594V and 0.606V and adjust with 9 R 21 LEVEL, if out of the rating.

4-8-2 Repetition Rate

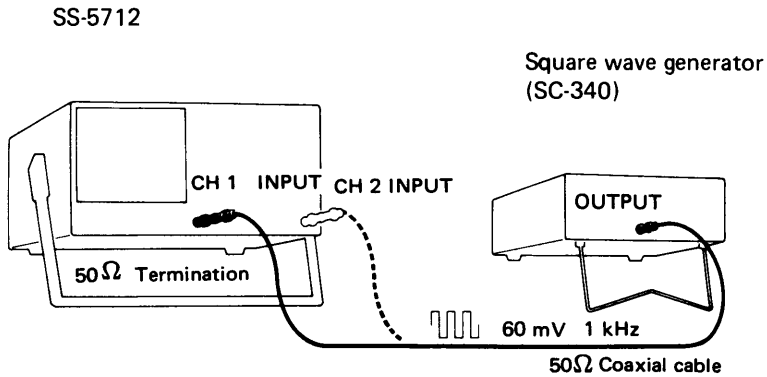
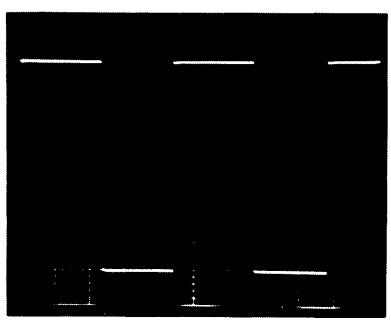
Item	Description
Rating	1 kHz ± 1%
Connection	
Check	Check that the calculated value is within 1 kHz ± 1%. If it is not, adjust with 9 R 13 FREQ.

4-8 Calibrator Output (Cont.)

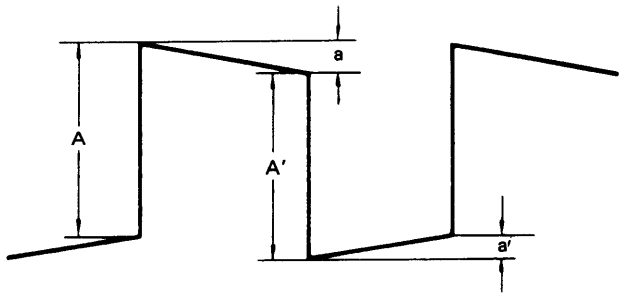
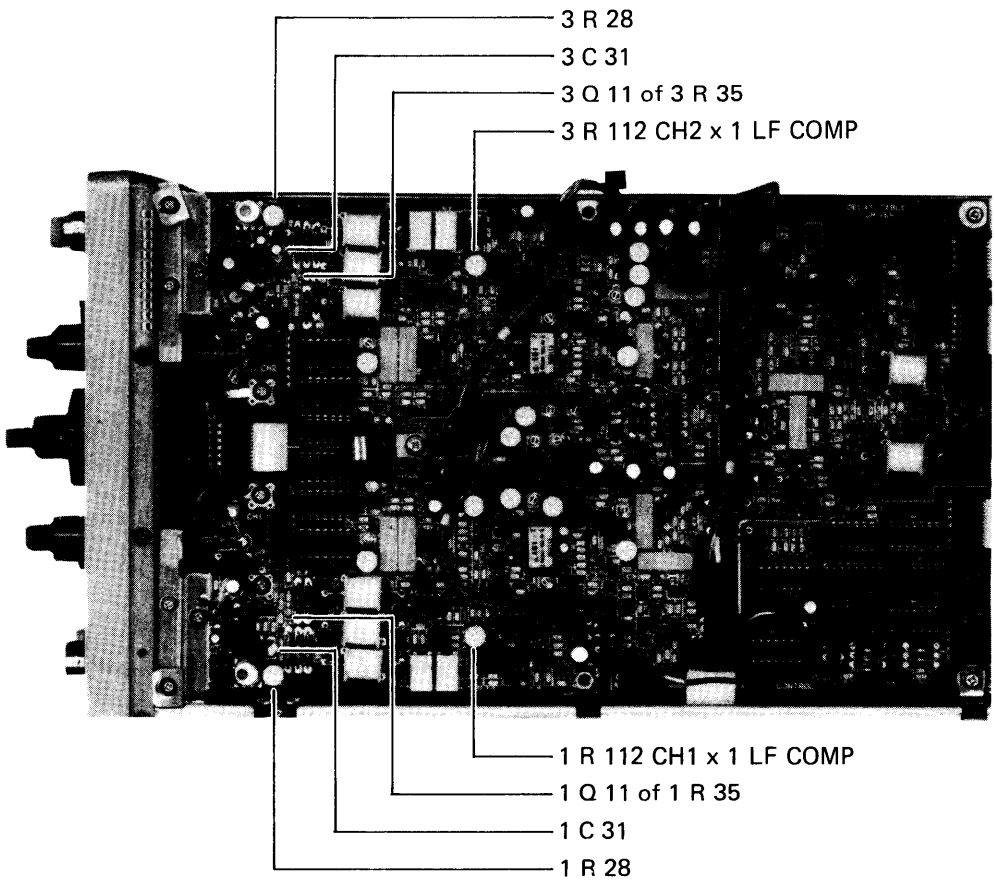
Item	Description
Check point and adjustment location	Bottom view (POWER & Z AMP) 

4-9 VERTICAL DEFLECTION SYSTEM

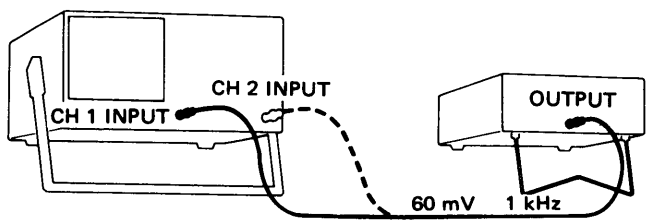
4-9-1 Pulse Response I (CH1·CH2 sag at 10 mV/DIV)

Item	Description
Rating	1% (at 1 kHz)
Connection	
Setting	VOLTS/DIV (CH1·CH2): 10 mV AC-DC-GND : DC
Adjustment sequence	1. Measure the waveforms at position of 1R35·1Q11 terminal (CH1) and 3R35·3Q11 terminal (CH2) with the test oscilloscope. 2. If the displayed waveforms are tilted, adjust with **1 R 28** and **1 C 31** for CH1, and **3 R 28** and **3 C 31** for CH2. 3. Adjust with **1 R 112 CH1 x 1 LF COMP** and **3 R 112 CH2 x 1 LF COMP** so that the displayed waveform will become flatness.
CRT waveform	 Input signal : Square waveform 1 kHz 60 mV

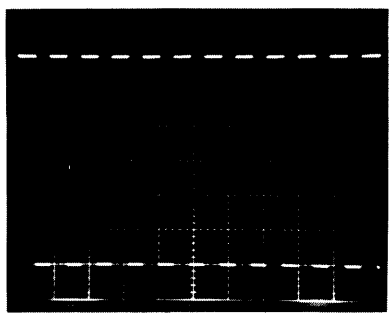
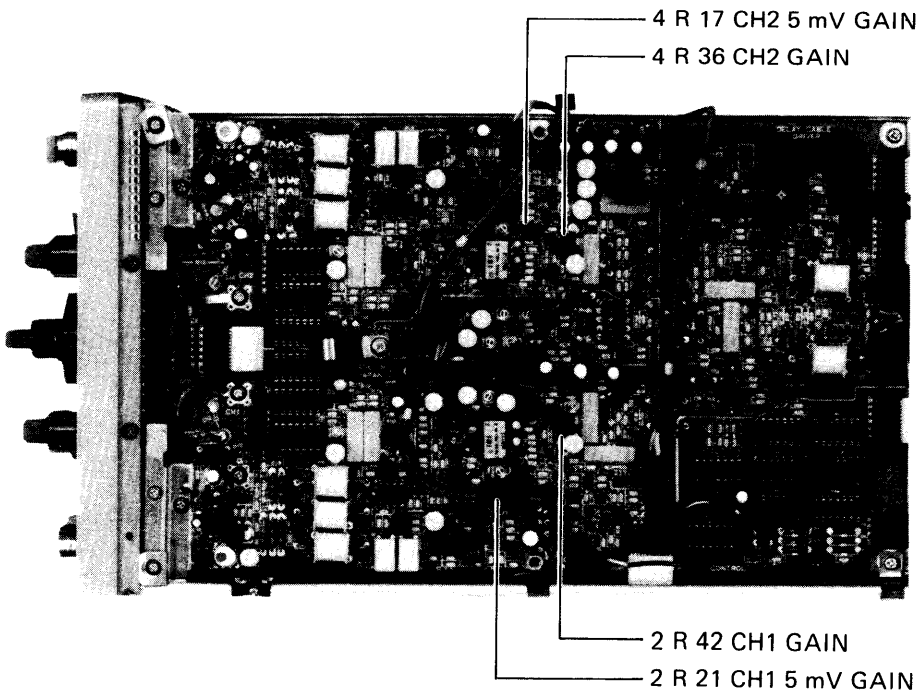
4-9-1 Pulse Response I (CH1·CH2 sag at 10 mV/DIV) (Cont.)

Item	Description
Reference	 A : Basic amplitude Sag = $\frac{a}{A}$ (or $\frac{a'}{A'}$) x 100% a : Sag The larger or $\frac{a}{A}$ or $\frac{a'}{A'}$ is taken. (Electronic Machinery Industry Association MEA-27)
Check point and adjustment location	Bottom view (VERTICAL CONTROL) 

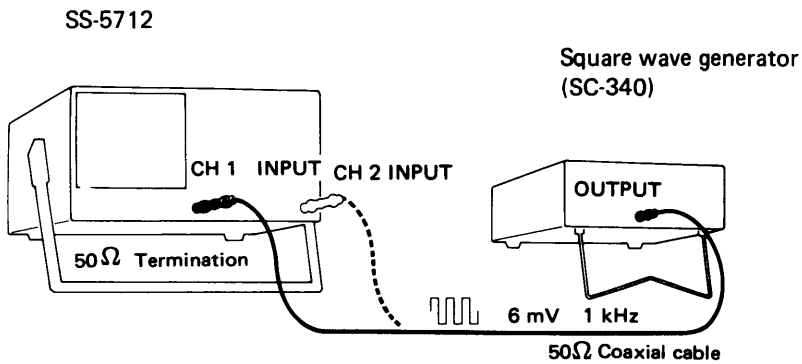
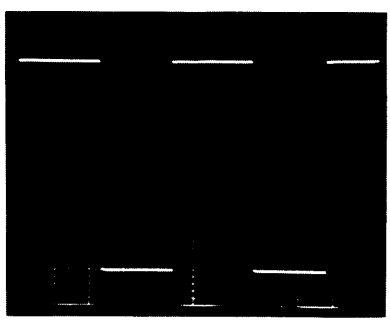
4-9-2 Deflection Factor I (CH1·CH2)

Item	Description
Rating	1mV/div, 2mV/div 4% 5mV/div, 10mV/div 2% 20mV/div to 5V/div 2.5%
Connection	SS-5712 Standard-amplitude signal level (SC-340) 
Adjustment sequence	**——— 10mV/div ———** 1. Adjust the amplitude of displayed waveform to 6 div with the **2 R 42 CH1 GAIN** and **4 R 36 CH2 GAIN.** **——— 5mV/div ———** 2. Adjust the output voltage of CALIBRATOR to 30 mV. 3. Adjust the amplitude of displayed waveform to 6 div with the **2 R 21 CH1 5mV GAIN** and **4 R 17 CH2 5mV GAIN.** **——— 20mV/div ~ 5V/div ———** 4. Check the deflection factor between 20mV to 5V ranges by adjusting the output voltage of CALIBRATOR. **——— 1mV/div, 2mV/div ———** 5. Check the deflection factor of 1mV and 2mV ranges by adjusting the output voltage of CALIBRATOR. *CAUTION* *The equipment is designed so that the 20mV/div and lower ranges are corrected automatically when adjustments 10mV/div and 5mV/div are performed.*

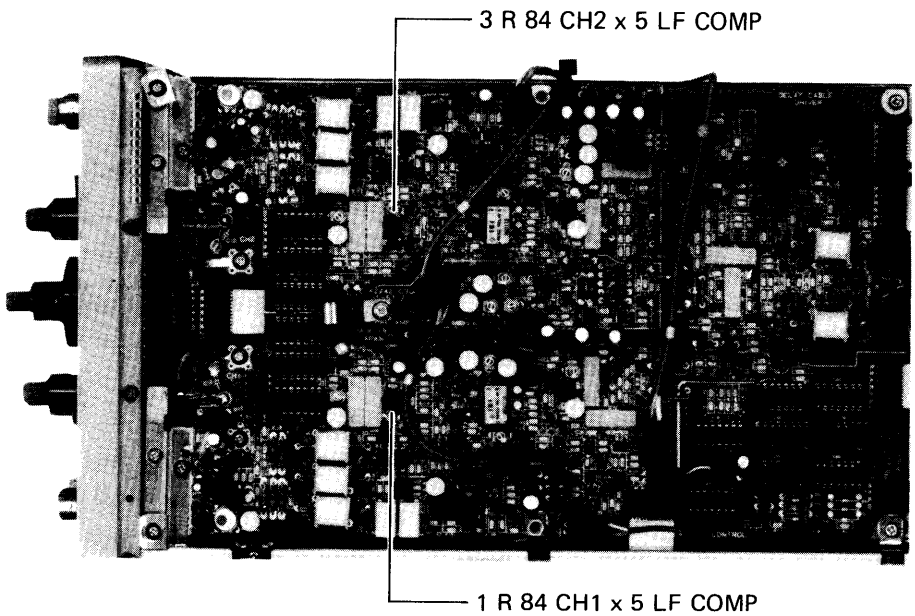
4-9-2 Deflection Factor I (CH1·CH2) (Cont.)

Item	Description
CRT waveform	 Input signal : Square wave 1 kHz
Adjustment location	Bottom view (VERTICAL CONTROL) 

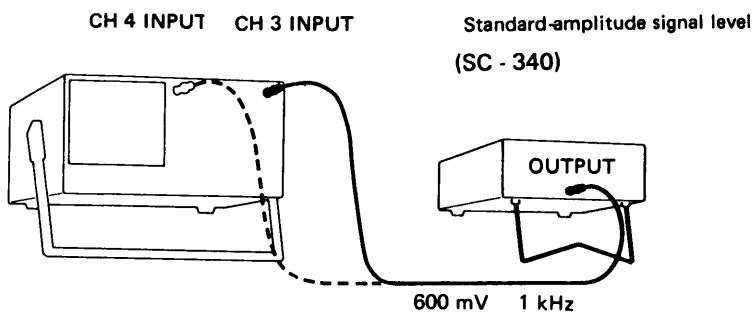
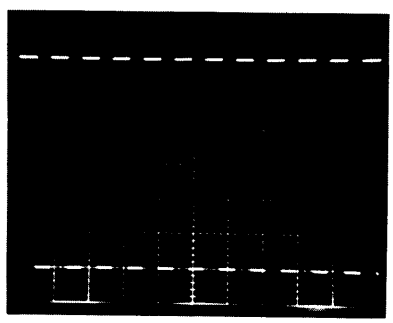
4-9-3 Pulse Response II (CH1·CH2 sag at 1mV/div)

Item	Description
Rating	± 3%
Connection	
Adjustment sequence	Adjust with **1 R 84 CH1 x 5 LF COMP** and **3 R 84 CH2 x 5 LF COMP** so that the displayed waveform will become flatness.
CRT waveform	 Input signal : Square wave 1 kHz 6 mV

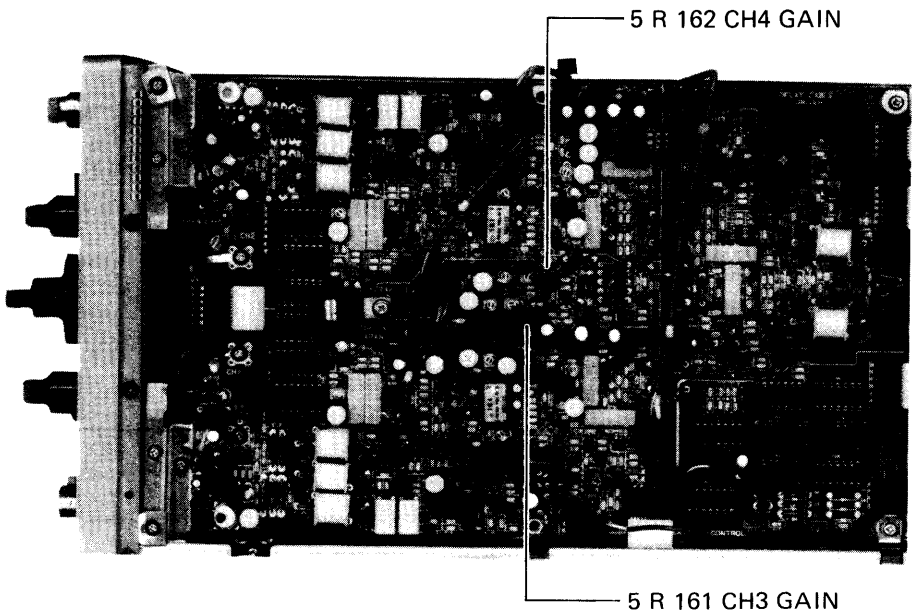
4-9-3 Pulse Response II (CH1·CH2 sag at 1mV/div) (Cont.)

Item	Description
Adjustment waveform	Bottom view (VERTICAL CONTROL) 

4-9-4 Deflection Factor II (CH3·CH4)

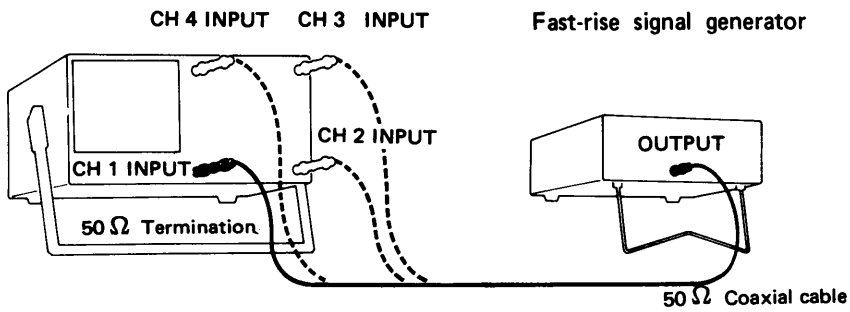
Item	Description
Rating	±4% or less
Connection	SS-5712 
Setting	CH3·CH4 0.1V–0.5V: 0.1V
Adjustment sequence	1. Adjust the amplitude of displayed waveform to 6 div with the **5 R 161 CH3 GAIN** and **5 R 162 CH4 GAIN** by setting the output voltage of CALIBRATOR to 0.6V. 2. Check the deflection factor of 0.5V range by adjusting the output voltage of CALIBRATOR.
CRT waveform	 Input signal : Square wave 1 kHz 0.6V

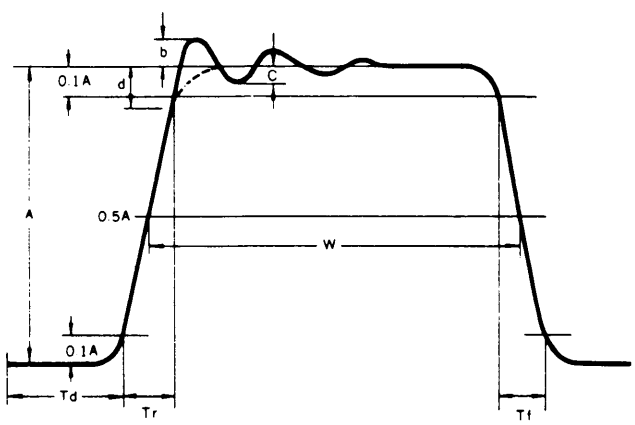
4-9-4 Deflection Factor II (CH3·CH4) (Cont.)

Item	Description
Adjustment location	Bottom view (VERTICAL CONTROL) 

4-9-5 Pulse Response III (overshoot and others)

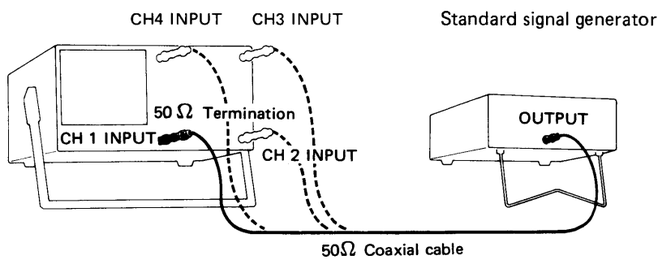
Item	Description			
Rating	CH1·CH2	Overshoot	7.5% or less	(10 mV/div)
		Other waveform distortion	6% or less	(10 mV/div)
	CH3·CH4	Overshoot	10% or less	(0.1V/div)
		Other waveform distortion	7.5% or less	(0.1V/div)
Connection	SS-5712			
Adjustment sequence	1. Set the CH1·CH2 VOLTS/DIV switch to 10 mV range, and check the overshoot and other waveform distortion. 2. Set the CH3·CH4 0.1V–0.5V switch to 0.1V range, and check the overshoot and other waveform distortion.			
Reference				



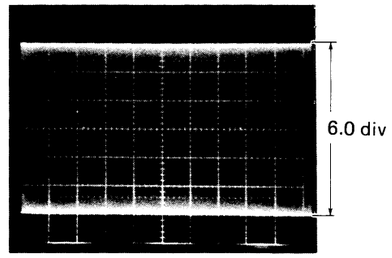
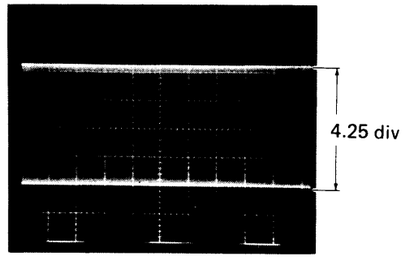


A: Basic amplitude
b/A: Overshoot
c/A: Ringing
W: Pulsewidth
Tr: Right time
Tf: Fall time
d/A: Rounding
Td: Signal delay time

4-9-6 Frequency Response

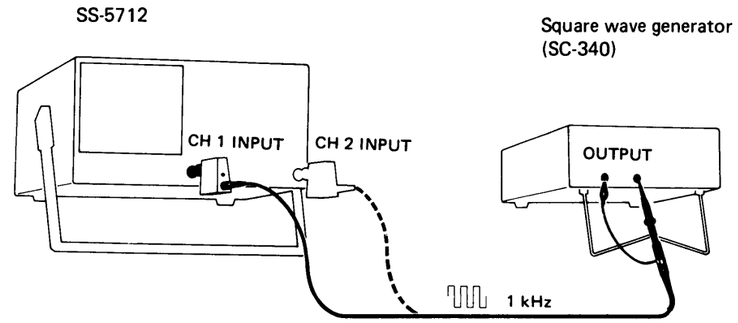
Item	Description
Rating	CH1 CH2 10 mV/div to 5V/div — DC to 200MHz — −3 dB 1 mV/div, 2 mV/div — DC to 50MHz — −3 dB 5 mV/div — DC to 200MHz — −3.5 dB CH3 CH4 0.1 V/div — DC to 200MHz — −3 dB 0.5 V/div — DC to 200MHz — −3.5 dB
Connection	SS-5712 
Setting	VOLTS/DIV (CH1·CH2) : 10 mV and 1 mV VOLTS/DIV (CH3·CH4) : 0.1V
Adjustment sequence	1. Set the reference frequency to 50 kHz and adjust the signal generator so that the amplitude swings 6 div. 2. Change the frequency corresponding to each rating, and read the amplitude.

4-9-6 Frequence Response (Cont.)

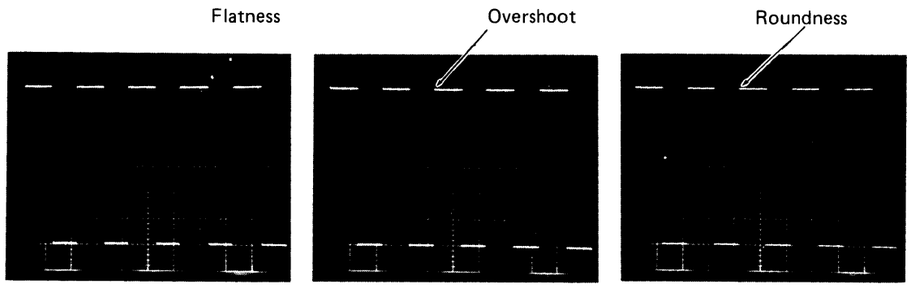
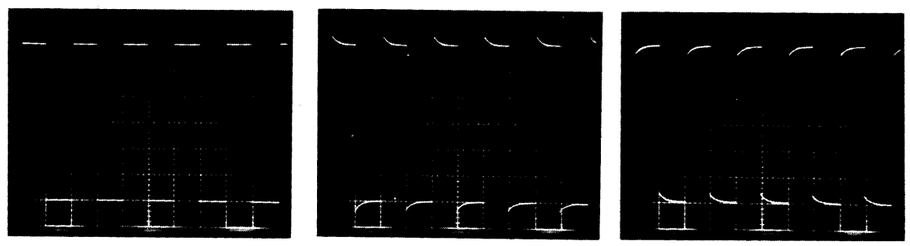
Item	Description
CRT waveform	Amplitude when the reference frequency (50 kHz) is applied  Amplitude when the rating frequence is applied. (−3 dB amplitude) 
Reference	Amplitude-decibel conversion table with a reference amplitude set to 6 div. is shown below.

Amplitude (div)	6.0	4.4	4.3	4.25	4.2	4.1	4.0
Decibel (dB)	0	−2.7	−2.9	−3.0	−3.1	−3.3	−3.5

4-9-7 Attenuator Compensation

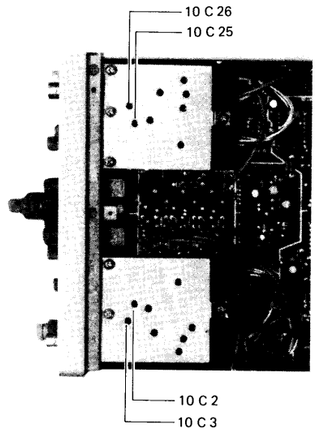
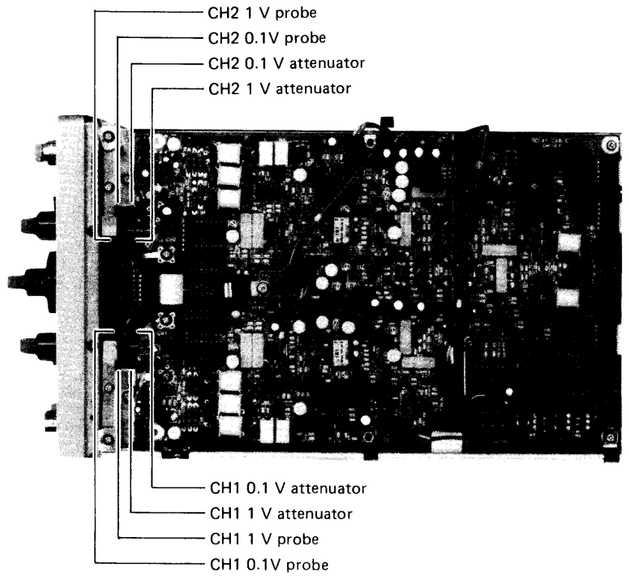
Item	Description
Rating	1% or less
Connection	
Adjustment sequence	**——— CH1·CH2 ———** 1. Set the VOLTS/DIV switch to 10mV, and adjust the probe compensation with variable capacitor of probe. 2. Set the VOLTS/DIV switch to 0.1V, and adjust the probe and attenuator compensation with variable capacitors. (Refer to picture of Bottom view.) 3. Set the VOLTS/DIV switch to 1V, and adjust the probe and attenuator compensation with variable capacitors. (Refer to picture of Bottom view.) 4. Check the other ranges of probe and attenuator compensation. **——— CH3 ———** 5. Set the 0.1V–0.5V switch to 0.1V, and adjust the probe compensation with variable capacitor of probe. 6. Set the 0.1V–0.5V switch to 0.5V, and adjust the probe compensation with variable capacitor of probe, and adjust the attenuator compensation with **10 C 2.** **——— CH4 ———** 7. Set the 0.1V–0.5V switch to 0.1V and adjust the probe compensation with variable capacitor of probe. 8. Set the 0.1V–0.5V switch to 0.5V, and adjust the probe compensation with variable capacitor of probe, and adjust the attenuator compensation with **10 C 25.**

4-9-7 Attenuator Compensation (Cont.)

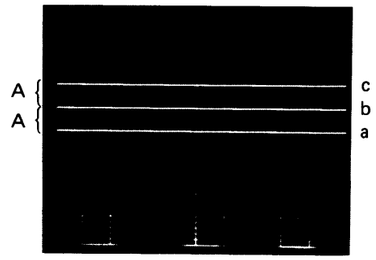
Item	Description
CRT waveform	Through compensation (Input signal: 1kHz)  (a) Proper (b) Improper (over compensation) (c) Improper (under compensation)
	Probe compensation (Input signal: 1kHz)  (a) Proper (b) Improper (over compensation) (c) Improper (under compensation)

SS-5712 Service Manual Section 4 Check and Adjustment

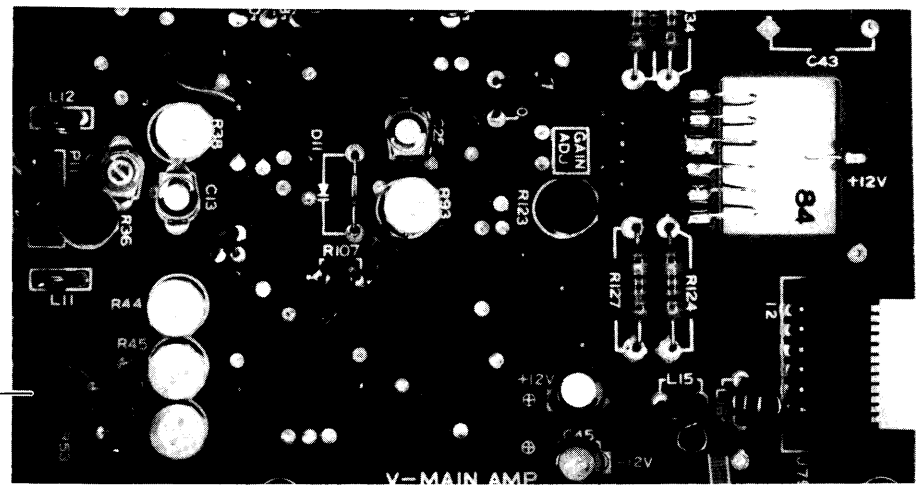
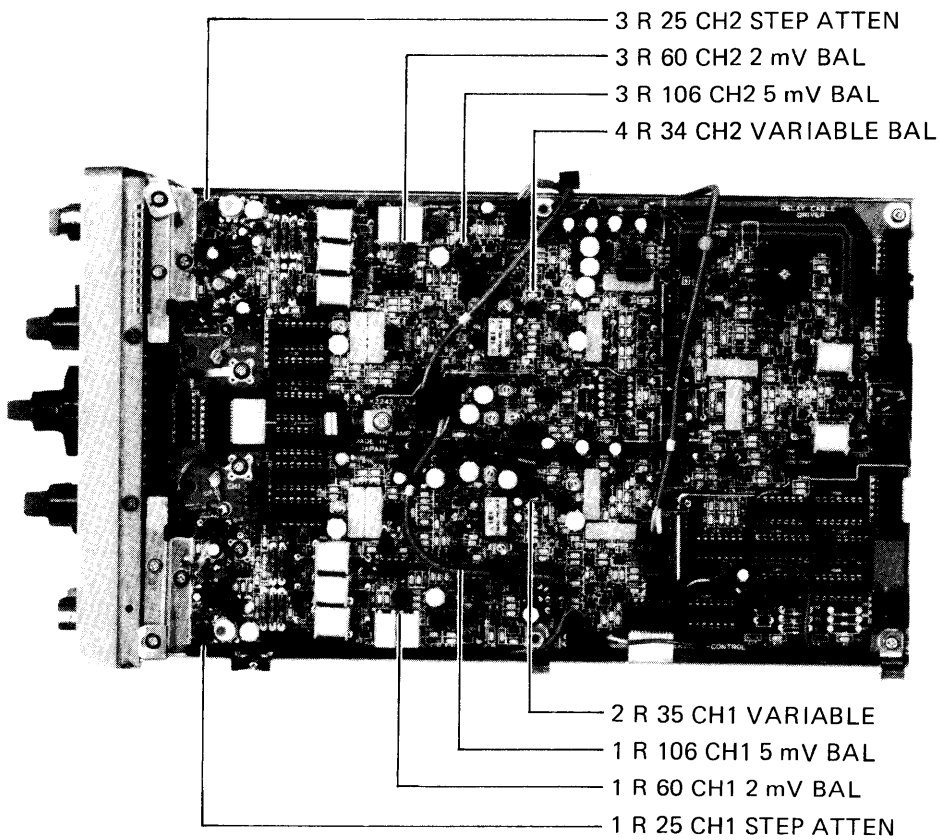
4-9-7 Attenuator Compensation (Cont.)

Item	Description
Adjustment location	Top view (SWEEP BOARD)  Bottom view (VERTICAL CONTROL) 

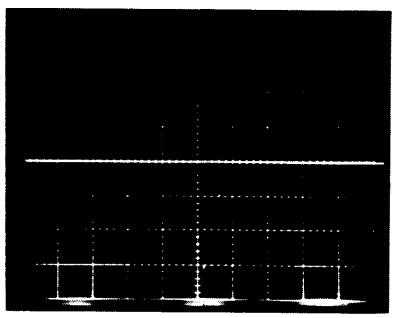
4-9-8 Vertical Position Balance

Item	Description
Rating	**1. ADD BALANCE ADJ** (1) Set the vertical MODE to the ALT position. (2) Set the trace to the center of the CRT screen by adjusting CH1 and CH2 POSITIONs. (3) Adjust with **8 R 53 BAL** so that the trace does not move when the vertical MODE is switched to ADD.  a. Set the trace to the center of the CRT screen by adjusting ↕ POSITION. b. Assume that the trace moves by "A" div when the vertical MODE is switched to ADD. c. Move it further by "A" div by adjusting the ADD BAL. d. Set the trace to the center of the CRT screen by adjusting ↕ POSITION. e. Repeat the above procedure until the trace position becomes stable. **2. STEP ATTEN ADJ** Adjust with **1 R 25 CH1 STEP ATTEN** and **3 R 25 CH2 STEP ATTEN** so that the trace does not move when 50 mV is switched to 0.1V and vice versa. **3. 2 mV BALANCE ADJ** (1) Adjust with **1 R 60 CH 1 2 mV BAL** and **3 R 60 CH 2 2 mV BAL** so that the trace does not move when the voltage is switched from 5mV to 2mV and vice versa. (2) Check whether the trace moves or not when the voltage is switched to 1mV. **4. 5 mV BALANCE ADJ** Adjust with **1 R 106 CH 1 5 mV BAL** and **3 R 106 CH 2 5 mV BAL** so that the trace does not move when the voltage is switched from 10mV to 5mV and vice versa. *CAUTION* *Because the 2 mV and 5 mV BAL adjustments affect each other, repeat these adjustments.* **5. VARIABLE BALANCE** (1) Adjust with **2 R 35 CH 1 VARIABLE BAL** and **4 R 34 CH 2 VARIABLE BAL** so that the trace does not move when the VARIABLE knob is fully turned counterclockwise at 10 mV. (2) Check whether the movement of the trace is within 3 div at each voltage of 5 mV, 2 mV and 1 mV.

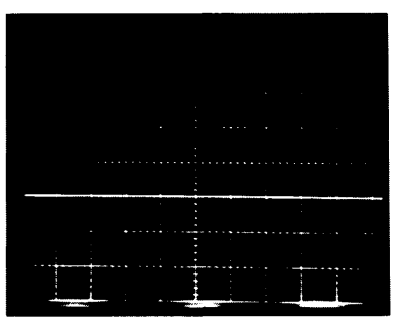
4-9-8 Vertical Position Balance (Cont.)

Item	Description
Adjustment location	Left side view (V-MAIN AMP)  Bottom view (VERTICAL CONTROL) 

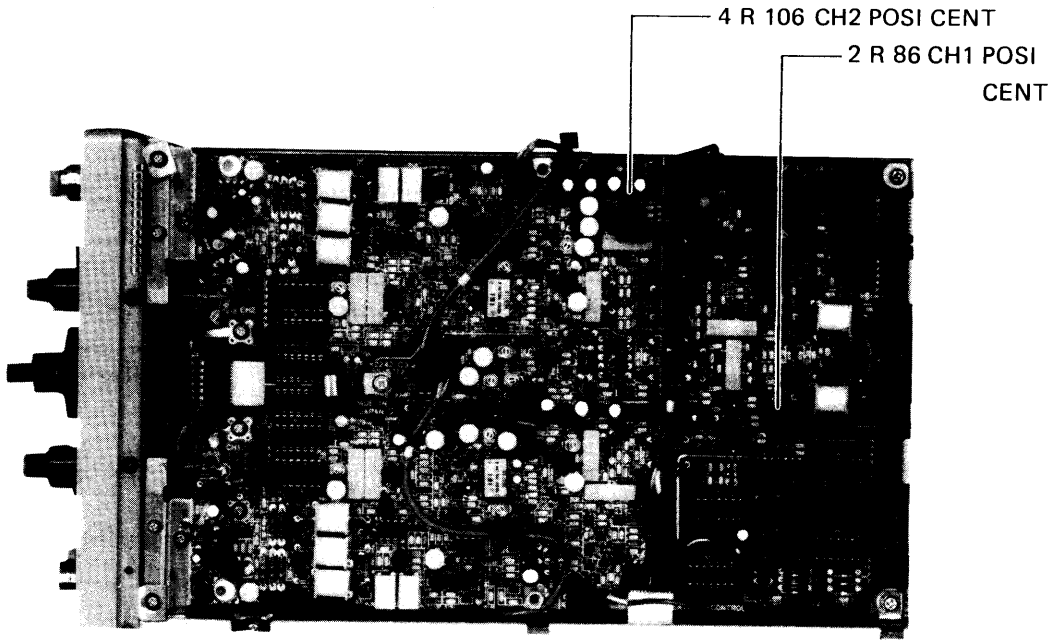
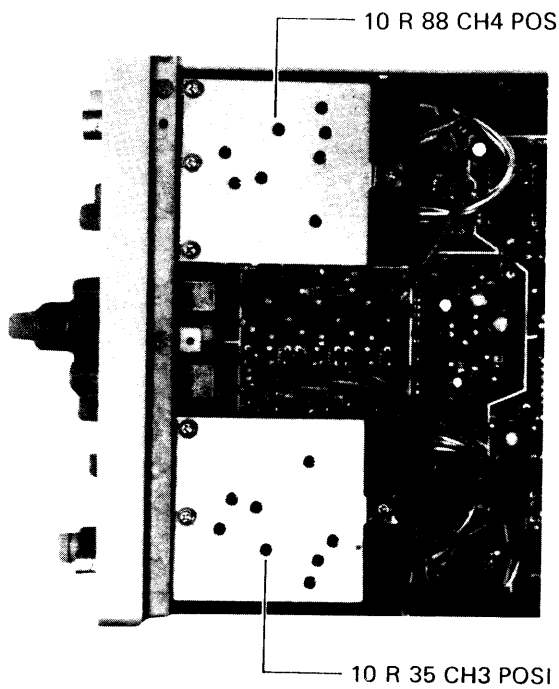
4-9-9 Position Center I (CH1·CH2)

Item	Description
Adjustment sequence	1. Set the CH1 and CH2 ↕ POSITION to their center positions. 2. Adjust with **2 R 86 CH1 POSI CENT** and **4 R 106 CH2 POSI CENT** that the CH1 and CH2 traces are the horizontal center line.
CRT waveform	 Horizontal center line

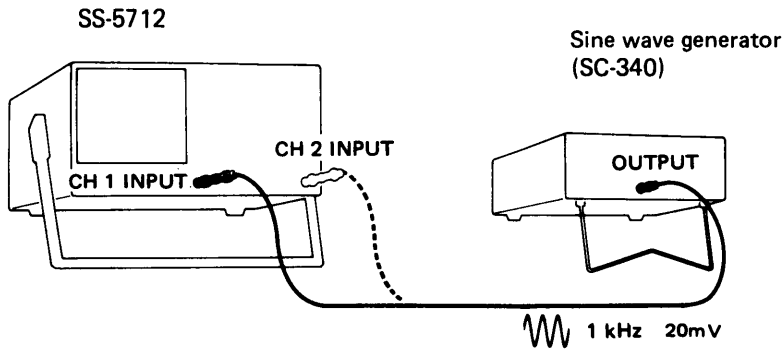
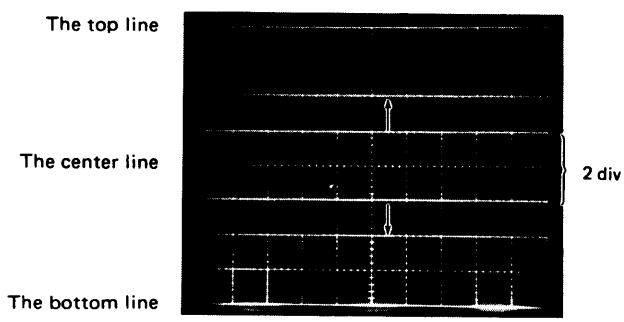
4-9-10 Position Center II (CH3·CH4)

Item	Description
Adjustment sequence	1. Set ALT or QUAD of vert MODE, and set the ↕ POSITION to center position. 2. Adjust with **10 R 35 CH3 POSI CENT** and **10 R 88 CH4 POSI CENT** that the CH1 and CH2 traces are one division below the horizontal centerline.
CRT waveform	 Horizontal center line one division below

4-9-9, 4-9-10 Position Center (Cont.)

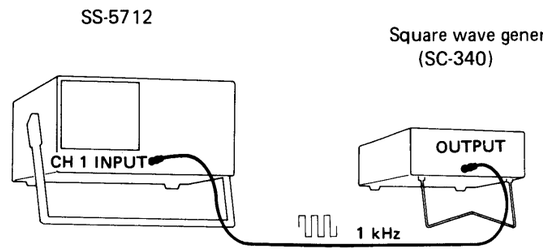
Item	Description
Adjustment location	Bottom view (VERTICAL CONTROL)  Top view (SWEEP BOARD) 

4-9-11 Linearity

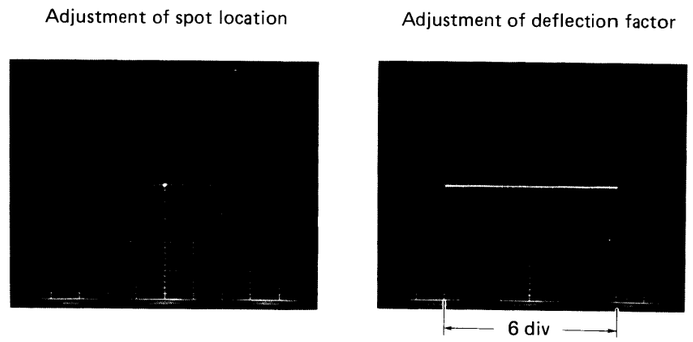
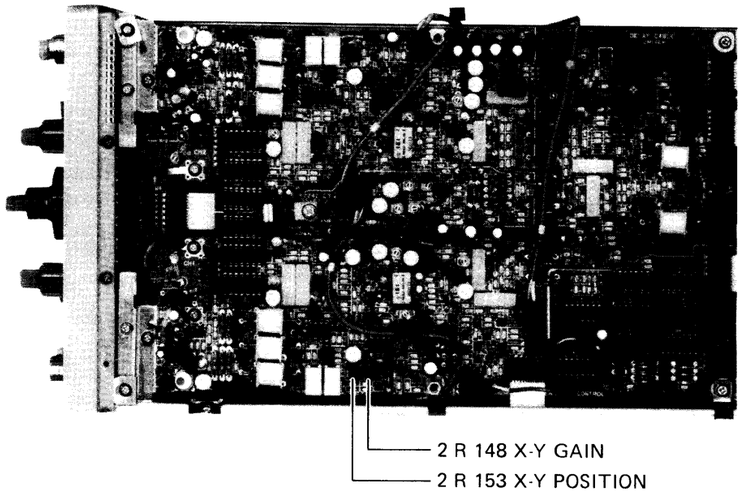
Item	Description
Rating	Within ± 3% (at 1 kHz)
Connection	
Setting	VOLTS/DIV (CH1·CH2) : 10mV
Adjustment sequence	1. Swing amplitude by 2 div at the screen center. 2. Shift the waveform within 2 div at the top and bottom of the scale with ↕ POSITION control. 3. Check that the amplitude change is within ± 3%.
CRT waveform	 Input signal: Sine wave 1 kHz 20 mV

4-10 X-Y OPERATION

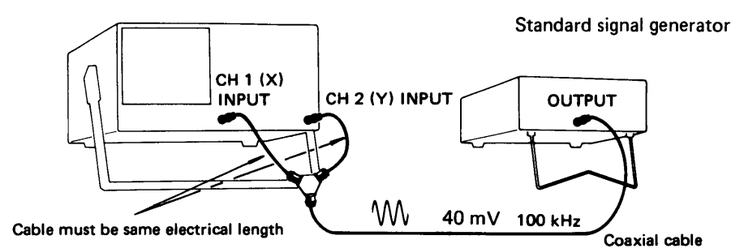
4-10-1 Spot Location and Deflection Factor

Item	Description
Rating	Spot location ± 1.5 div from center of graticule Deflection factor 1 mV/div, 2 mV/div ± 5% (+ 10°C ~ + 35°C) 5 mV/div ~ 5 V/div ± 3.5% (+ 10°C ~ + 35°C)
Connection	
Setting	HORIZ DISPLAY : X-Y CH1 VOLTS/DIV: 10 mV
Adjustment sequence	**——— Adjustment of spot location ———** 1. Set the ↔ POSITION and FINE control to center, and CH1 AC-DC-GND switch to GND. 2. Adjust with **2 R 153 X-Y POSITION** so that the spot is on the center position of the graticule. **——— Adjustment of deflection factor ———** 3. Set the CH1 AC-DC-GND to DC and adjust with **2 R 148 X-Y GAIN** so that the amplitude becomes ± 3 div from the center of the CRT screen (in the horizontal axis direction). Adjust the position with the POSITION control if necessary. 4. With the same settings as in item 1 above, check whether the spot is located with ± 1.5 div from the center of the CRT screen. 5. If the result of the check is out of the rating, repeat the adjustments in item 2 and 3.

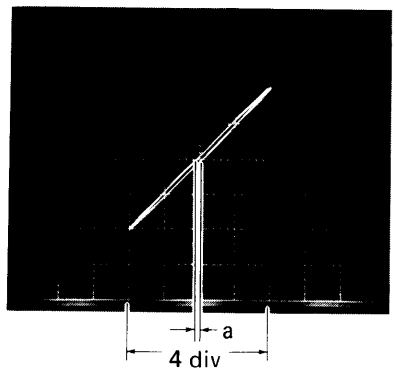
4-10-1 Spot Location and Deflection Factor (Cont.)

Item	Description
CRT waveform	
Adjustment location	Bottom view (VERTICAL CONTROL) 

4-10-2 Phase Difference

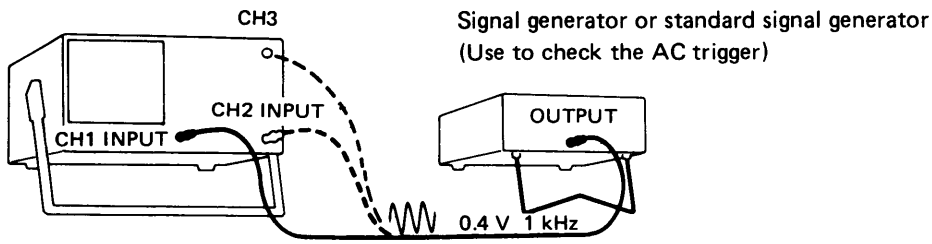
Item	Description
Rating	Within 3° (DC to 100 kHz sine wave)
Connection	SS-5712 
Setting	HORIZ DISPLAY: X-Y CH1·CH2 AC-DC-GND: DC CH1·CH2 VOLTS/DIV: 10mV
Check	Read "a" on the screen and check the reading is less than 0.2 div.

4-10-2 Phase Difference (Cont.)

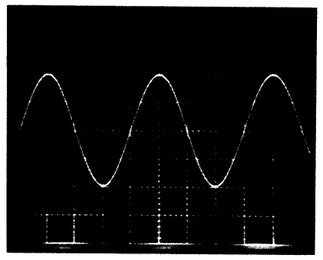
Item	Description
CRT waveform	 Input signal: Sine wave 100 kHz 40 mV

4-11 TRIGGER SYSTEM

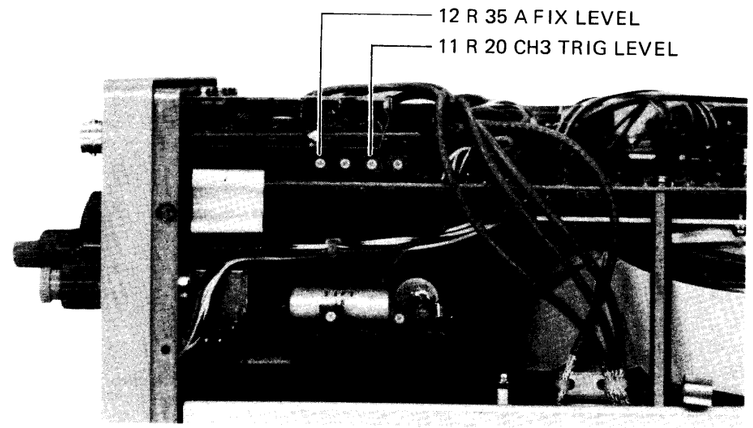
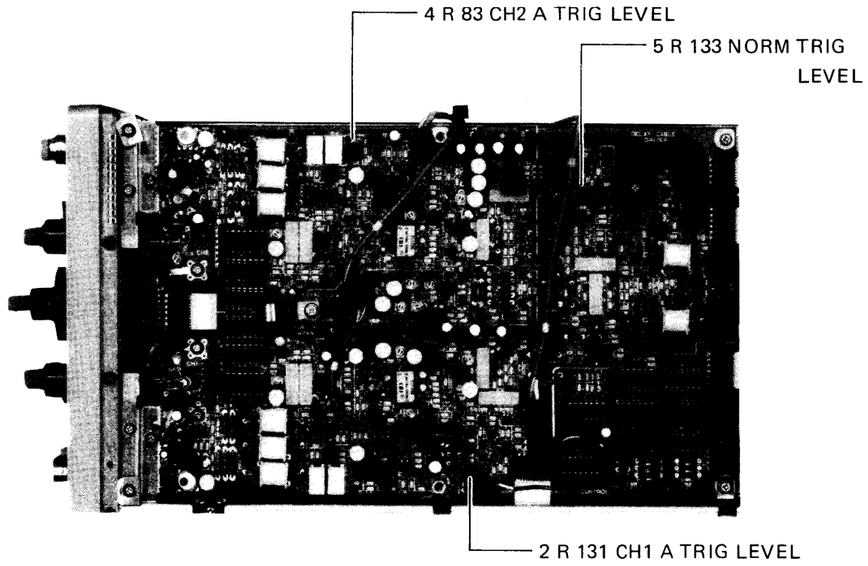
4-11-1 A Trigger (CH1, CH2 and CH3)

Item	Description
Rating	DC ~ 10 MHz : (The lowest usable frequency is 100 Hz at AC coupling) 10 MHz ~ 100 MHz : 1 div 100 MHz ~ 200 MHz : 1.5 div
Connection	SS-5712 
Setting	HORIZ DISPLAY : A Vertical MODE : CH1 CH1 VOLTS/DIV : 0.1 V CH2 VOLTS/DIV : 0.1 V CH3 0.1V–0.5 V : 0.1 V A SLOPE : + A COUPLING : FIX A SOURCE : CH1 A LEVEL : Miarange
Adjustment sequence	**——— Adjustment of triggering level ———** 1. FIX level Adjust with **12 R 35 A FIX LEVEL** so that the trigger is set at the center of the input signal amplitude. 2. CH1 level Set the A COUPLING to DC and adjust with **2 R 131 CH1 A TRIG LEVEL** so that the trigger is set at the center of the input signal amplitude.

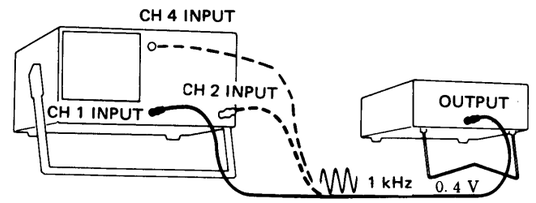
4-11-1 A Trigger (CH1, CH2 and CH3) (Cont.)

Item	Description
Adjustment sequence (Cont.)	3. CH2 level (1) Connect the signal to CH2. (2) Set the A SOURCE control to CH2 and adjust with **4 R 83 CH 2 A TRIG LEVEL** so that the trigger is set at the center of the input signal implitude. 4. NORM level Set the ASOURCE control to NORM and adjust with **5 R 133 NORM TRIG LEVEL** so that the trigger is set at the center of the imput signal amplitude. 5. CH3 level (1) Connect the input signal to CH3. (2) Set the vertical MODE to CHOP or QUAD and A SOURCE to CH3. (3) Adjust with **11 R 20 CH 3 TRIG LEVEL** so that the trigger is set at the center of the input signal amplitude. **——— AC trigger check ———** 6. AC trigger Set the A COUPLING to AC and check whether the trigger is set within the rating.
CRT waveform	Adjustment of trigger level  Input signal: Sine wave 1 kHz 0.4 V

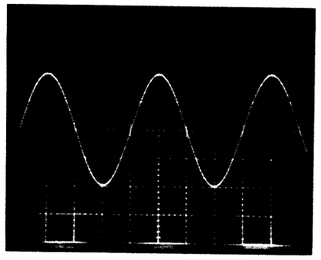
4-11-1 Trigger (CH1, CH2 and CH3) (Cont.)

Item	Description
Adjustment location	Right side view  Bottom view (VERTICAL CONTROL) 

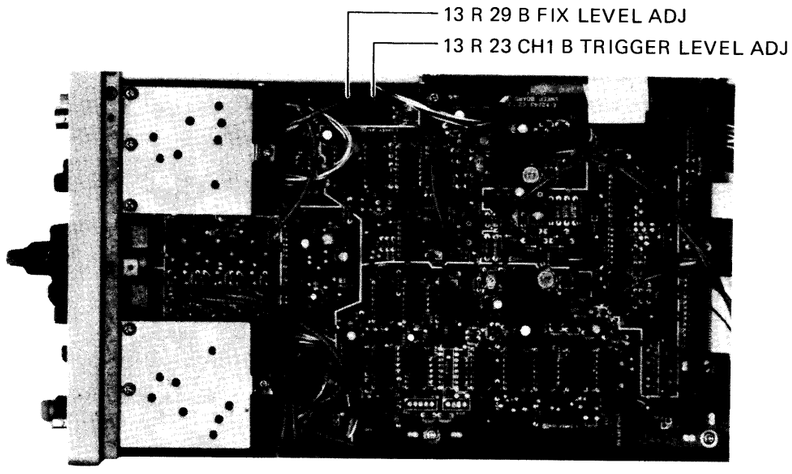
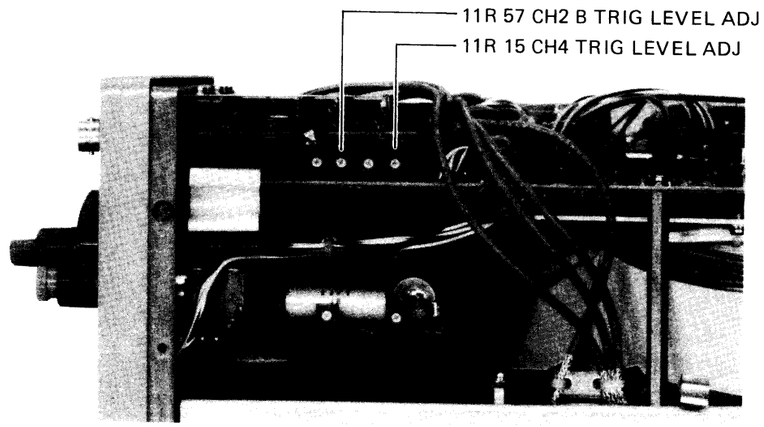
4-11-2 B Trigger (CH1, CH2 and CH4)

Item	Description
Rating	DC ~ 10 MHz : 0.3 div (The lowest usable frequency is 100 Hz at AC coupling) 10 MHz ~ 100 MHz : 1 div 100 MHz ~ 200 MHz : 1.5 div
Connection	SS-5712 Sine wave generator or Standard signal generator (Use to check the AC trigger) 
Setting	HORIZ DISPLAY : B (DLY'D) Vertical MODE : CH1 CH1 VOLTS/DIV : 0.1V CH2 VOLTS/DIV : 0.1V CH4 0.1V/0.5V : 0.1V B SLOPE : + B COUPLING : FIX B SOURCE : CH1 B LEVEL : Midrange
Adjustment sequence	**——Adjustment of triggering level ——** 1. FIX level Adjustment with **13 R 29 B FIX LEVEL ADJ** so that the trigger is set at the center of the input signal amplitude. 2. CH1 level Set the B COUPLING to DC and adjust with **13 R 23 CH1 B TRIG LEVEL ADJ** so that the trigger is set at the center of the input signal amplitude.

4-11-2 B Trigger (CH1, CH2 and CH4) (Cont.)

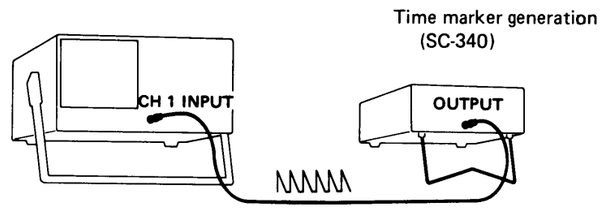
Item	Description
Adjustment sequence (Cont.)	3. CH2 level (1) Connect the signal to CH2. (2) Set the B SOURCE control to CH2 and adjust with **11 R 57 CH2 B TRIG LEVEL** so that the trigger is set at the center of the input signal implitude. 4. CH4 level (1) Connect the input signal to CH4. (2) Set the vertical MODE to CHOP or QUAD and B SOURCE to CH4. (3) Adjust with **11 R 15 CH4 TRIG LEVEL** so that the trigger is set at the center of the input signal amplitude. **—— AC trigger check ——** 5. AC trigger Set the B COUPLING to AC and check whether the trigger is set within the rating.
CRT waveform	Adjustment of trigger level  Input signal: Sine wave 1 kHz 0.4 V

4-11-2 B Trigger (CH1, CH2 and CH4 (Cont.)

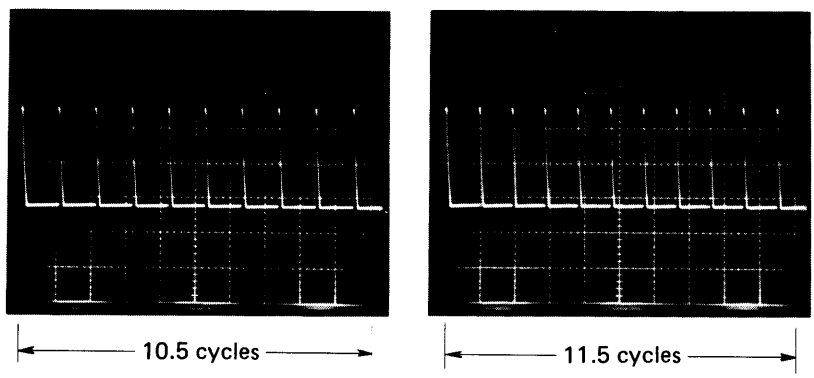
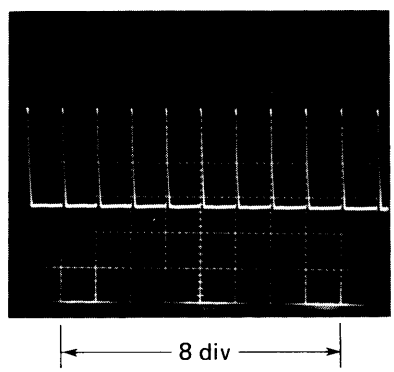
Item	Description
Adjustment location	Top view (SWEEP BOARD)  Right side view 

4-12 HORIZONTAL DEFLECTION SYSTEM

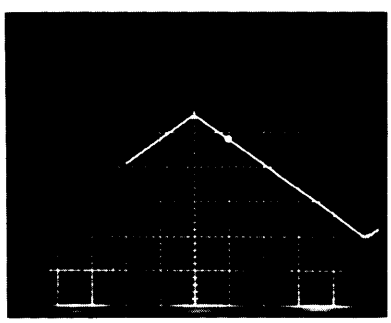
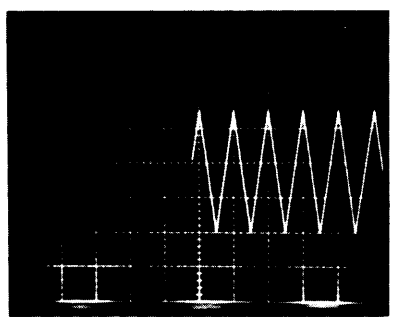
4-12-1 Sweep Rate and Sweep Magnification

Item	Description
Rating	A·B sweep rating at NORM (x1) (at 8 div at center of screen) 10 ns/div ~ 0.5 s/div ± 2% (+ 10°C ~ + 35°C) A·B sweep rating at MAG ON (x 10) (at 8 div at center of screen) 10 ns/div ~ 50 ns/div ± 5% (+ 10°C ~ + 35°C) 0.1 μs/div ~ 0.5 μs/div ± 4% (+ 10°C ~ + 35°C) 1 μs/div ~ 0.5 s/div ± 3% (+ 10°C ~+ 35°C)
Connection	SS-5712 
Setting and adjustment sequence	**——— Adjustment of A 1 mS/div ———** HORIZ DISPLAY : A A TIME/DIV : 1 mSEC Time marker (input signal) : 1 ms 1. LEVEL (1) Set the horizontal MODE control to SINGLE. (2) Adjust with ↔ POSITION (on the front panel) so that the voltages at 21 J 58 and 21 J 68 are the same. (3) Adjust with **21 R 45 LEVEL** so that the voltage at 21 J 58 is 75 V.

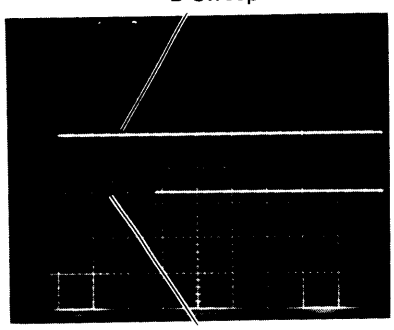
4-12-1 *Sweep Rate and Sweep Magnification (Cont.)*

Item	Description
Setting and adjustment sequence (Cont.)	2. A SWEEP CAL (1) Set the horizontal MODE control to AUTO and set the trigger. (2) Adjust with **17 R 22 A SWEEP CAL** so that a pulse string containing 11 ± 0.5 cycles are displayed on the CRT screen (in the range shown below).  Input signal: Time marker 1 ms 3. GAIN Adjust the sweep rate across the center 8 div of the CRT screen with **21 R 33 GAIN.**  Input signal: Time marker 1 ms **—— Adjustment of A 0.5 μs ——** HORIZ DISPLAY : A A TIME/DIV : 0.5 μSEC Time marker (input signal) : 0.5 μs 4. 0.5 μs ADJ Adjust the sweep rate across the center 8 div of the CRT screen with **15 C 104.**

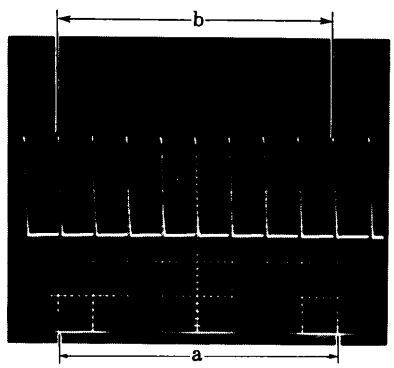
4-12-1 Sweep Rate and Sweep Magnification (Cont.)

Item	Description
Setting and adjustment sequence (Cont.)	**——— Adjustment of MAG ———** PULL x 10 MAG : Pull (MAG ON) Time marker (input signal) : 0.1 ms 5. MAG GAIN Adjust the sweep rate across the center 8 div of the CRT screen with **21 R 35 MAG GAIN.** 6. MAG CENT (1) Set the peak of the first pulse to the center of the CRT screen with the ↔ POSITION control. (2) Press the PULL x 10 MAG control (set to the MAG OFF position) and check whether the movement of the peak of the first pulse is within 1 div or not. (3) If it moves more than 1 div as the result of check, set the peak of the pulse to the center of the CRT screen with **21R83 MAG CENT.** If it does not become less than I div, repeat the adjustments. (1) Setting with x 10 MAG  (3) Adjustment with x1  Input signal: Time marker 1 ms **——— Adjustment of B 1ms/div ———** HORIZ DISPLAY : B (DLY'D) A TIME/DIV : 2 mSEC B TIME/DIV : 1 mSEC PUSS x 10 MAG : Push (MAG OFF) Time marker (input signal) : 1 ms 7. B SWEEP CAL Adjust the sweep rate across the center 8 div of the CRT screen with **18 R 31 B SWEEP CAL.**

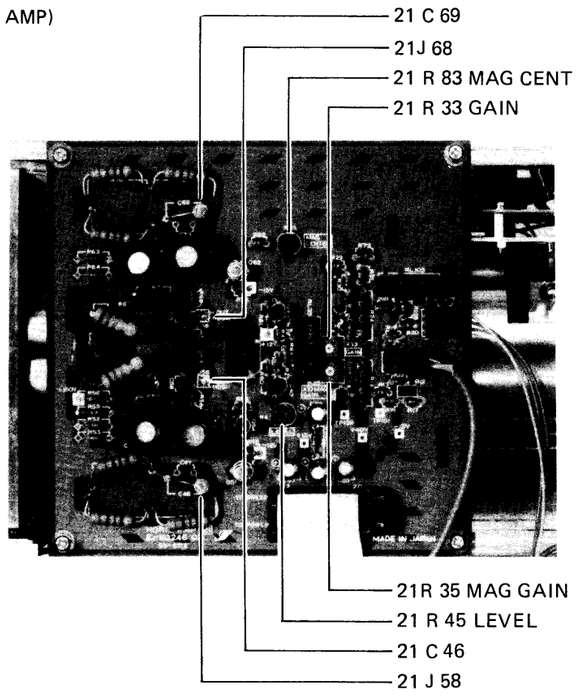
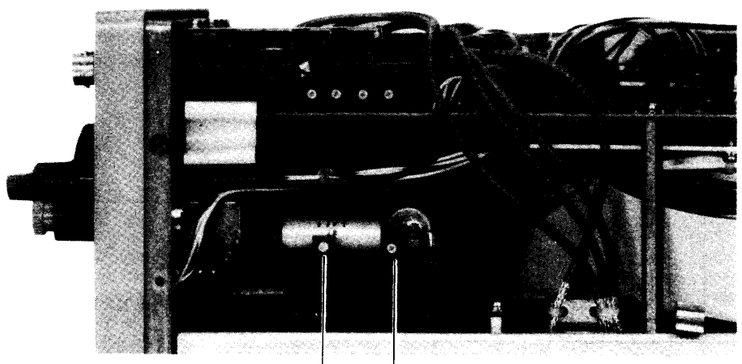
4-12-1 Sweep Rate and Sweep Magnification (Cont.)

Item	Description
Setting and adjustment (Cont.)	**——— Adjustment of A·B sweep start ———** HORIZ DISPLAY : ALT A TIME/DIV : 1m SEC B TIME/DIV : 1m SEC PULL x 10 MAG : Pull (MAG ON) 8. B SWEEP START ADJ Adjust the difference of A and B sweep start point within ± 1 div with **19 R 48 B START.** 〈 Reference 〉 Check and adjustment can be easy to shift the trace of A and B sweep with the TRACE SEPARATION. B Sweep  A Sweep **——— Adjustment of B 0.5μs/div. ———** HORIZ DISPLAY : B A TIME/DIV : 1 μSEC B TIME/DIV : 0.5 μSEC 9. B 0.5 μs ADJ Adjust the sweep rate across the center 8 div of the CRT screen with **16 C 75.**

4-12-1 Sweep Rate and Sweep Magnification (Cont.)

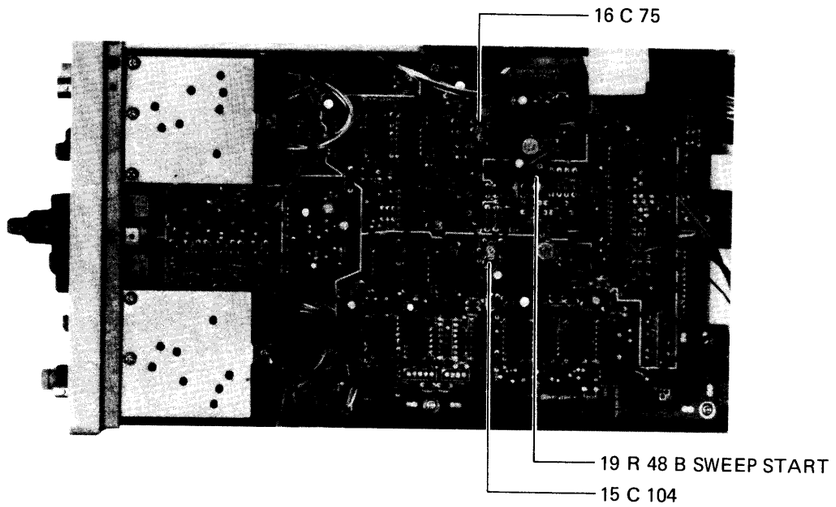
Item	Description
Setting and adjustment sequence (Cont.)	**——— High-speed linearity adjustment ———** HORIZ DISPLAY : A PULL x 10 MAG : Pull (ON) Timer marker (input signal) : 2 ns and 5 ns 10. 21 C 46 and 21 C 69 Adjust the sweeping time across the center 8 div of the CRT screen with **21 C 46** and **21 C 69.**
Reference	Sweeping time error rate = $\frac{a-b}{a}$ x 100 (%) a : Horizontal effective area scale length b : Measured value on the time marker corresponding to a.  Calculation of the error in the waveform on the CRT screen at the left. a : 8 div b : 7.9 div Error = $\frac{(8-7.9)}{8}$ = div x 100 (%) = 1.25%

4-12-1 Sweep Rate and Sweep Magnification (Cont.)

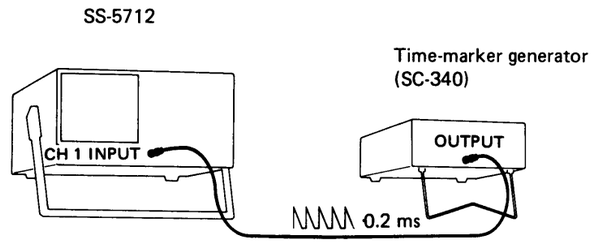
Item	Description
Adjustment location	Top view (HORIZ AMP)  Right side view 

SS-5712 Service Manual Section 4 Check and Adjustment

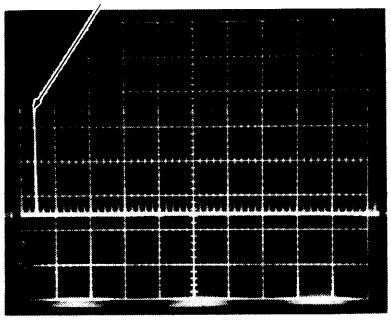
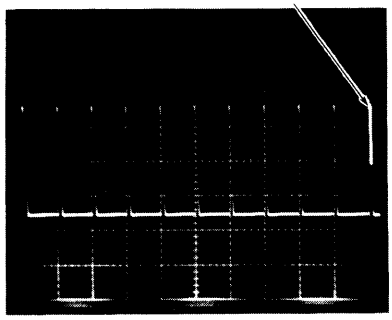
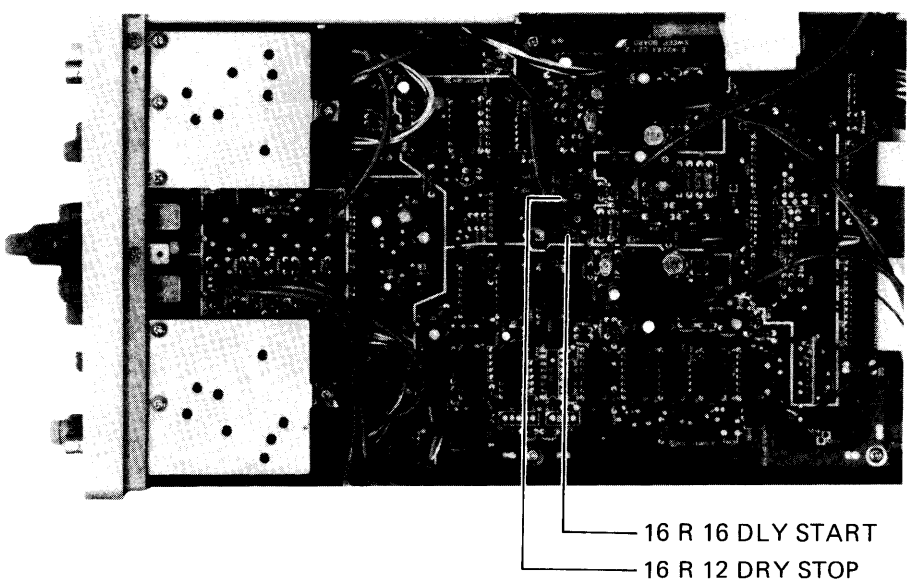
4-12-1 Sweep Rate and Sweep Magnification (Cont.)

Item	Description
Adjustment location	Top view (SWEEP BOARD) 

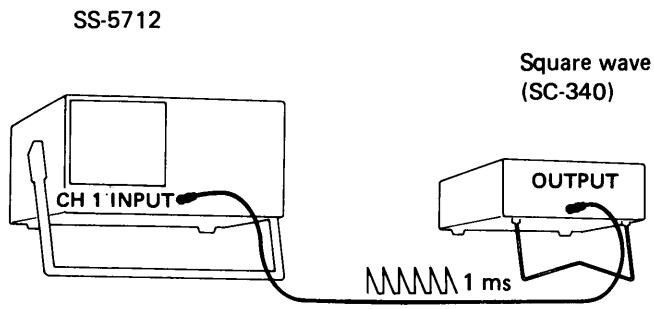
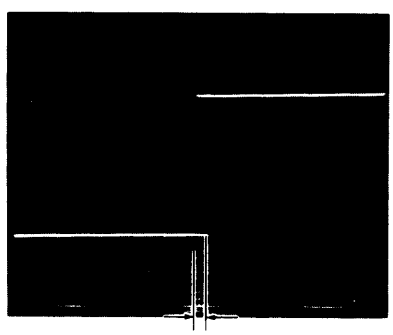
4-12-2 DLY START and STOP

Item	Description
Rating	± 1% of reading ±0.01 scale (DELAY TIME MULTI dial minimum scale)
Connection	
Setting	HORIZ DISPLAY : A INTEN A TIME/DIV : 1m SEC B TIME/DIV : 5 μSEC B SOURCE : RUNS AFTER DELAY Time Marker (Input signal) : 0.2 ms
Adjustment sequence	**——— DELAY START ———** 1. Set the DELAY TIME MULTI dial to 0.40. 2. Check that the B sweep is at the 3rd pulse from sweep start. 3. If out of the rating, adjust with **16 R 16 DLY START.** **——— DELAY STOP ———** 4. Set the time marker to 1 ms. 5. Set the DELAY TIME MULTI dial to 10.00. 6. Check that the B sweep is at the 11th pulse. 7. If out of the rating, adjust with **16 R 12 DLY STOP.** *Precaution* *As items 1 and 2 effect each other, the adjustments should be repeated a number of times.*

4-12-2 DLY START and STOP (Cont.)

Item	Description
CRT waveform	Start point of DELAY TIME MULTI B Sweep  Input signal Time marker 0.2 ms Stop point of DELAY TIME MULTI B Sweep  Input signal Timer marker 1 ms
Adjustment location	Top view (SWEEP BOARD) 

4-12-3 Delay Jitter

Item	Description
Rating	1/20,000 or less
Connection	
Setting	HORIZ DISPLAY : B B SOURCE : RUNS AFTER DELAY A TIME/DIV : 1m SEC B TIME/DIV : 0.5 μSEC
Adjustment sequence	1. Gradually turn the DELAY TIME MULTI dial towards 2.00 and 10.00 so that the 2nd and the 11th time marker is displayed on the screen. 2. Check that width of jitter is 1 div or less.
CRT waveform	 Jitter (within 1 div)

Section 5

Schematic Diagrams

Voltages and Waveforms

In the schematic diagrams, the voltages and waveforms in the normal operation of the instrument are as shown.

They are useful for troubleshooting.

These voltages and waveforms are measured according to the following conditions:

1. The CAL 1KHz 0.6V connector is connected to the INPUT connector by 10 : 1 passive prove as the test signal.

2. Exceptions in the controls setting are shown by "VOLTAGE & WAVEFORM READING CONDITIONS" noted on the schematic diagram. Beside, the asterisks maked on the diagram show the point measured by the excepitional settings.

3. The waveforms starting from the negative slope are measured by setting the SLOPE switch of a test oscilloscope to (—).

4. The switches and controls of this instrument is set as follows:

—Power supply & CRT circuit—

POWER	ON
SCALE	Arbitrary position
INTEN	Best desired
FOCUS	Best focused display

—Vertical deflection system—

AC-GND-DC (CH1-2)	DC
VOLTS/DIV	10mV/div
VARIABLE (CH1-2)	CAL
AC-DC	DC
0.1V-1V	0.1V
POSITION (CH1,2,3,4)	Mid position
MODE	CH1
CH2 POLAR	NORM (▀)
BANDWIDTH	FULL (▀)

—Horizontal deflection system—

HORIZONTAL	A
MODE	AUTO
A TIME/DIV	1mS/div
A VARIABLE	CAL
B TIME/DIV	1mS/div
DELAY TIME MULT	Counter-clockwise Set the start portion of the trace to the left-end of vertical graticule.
FINE (Pull x 10 MAG)	Push Mid position
HOLD OFF	NORM (Counter-clockwise)

—Trigger system—

SOURCE	CH1
COUPLING	AC
LEVEL-SLOPE (pull—)	Push, Trigger

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
HORIZONTAL SWITCHES [19]		
19C18	Cap., 22p, 5%, 50V, Cer.	DCC815191
19C50	Cap., 150p, 5%, 50V, Cer.	DCC815291
19C52	Cap., 33μ, 20%, 25V Elect.	DCE929141
19C53	Same as 19R52	
19C55	Same as 19R52	
19R18	Res., 470K, ±5%, 1/4W, Carbon	DRD939211
19R19	Res., 7.5K, ±1%, 1/5W, Metal	DRE999821
19R20	Res., 10K, ±1%, 1/5W, Metal	DRE999371
19R21	Res., 2.0K, ±5%, 1/4W, Carbon	DRD939621
19R22	Res., 51K, ±1%, 1/5W, Metal	DRE999571
19R23	Res., 200K, ±5%, 1/8W, Carbon	DRZ840421
19R24	Same as 19R23	
19R25	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
19R26	Res., 27K, ±5%, 1/8W, Carbon	DRZ840931
19R27	Res., 2.4K, ±1%, 1/5W, Metal	DRE999791
19R28	Res., 2.7K, ±1%, 1/5W, Metal	DRE999301
19R48	Res., 20K Var., 0.5W, Metal	DRV410571
19R49	Res., 30K, ±1%, 1/4W, Metal	DRE938771
19R50	Res., 3.4K, ±1%, 1/4W, Metal	DRE939421
19R51	Same as 19R50	
19R52	Res., 3K, ±1%, 1/4W, Metal	DRZ939031
19R53	Res., 3.3K ±1%, 1/5W, Metal	DRE999311
19R54	Same as 19R20	
19R55	Res., 3.6K, ±1%, 1/5W, Metal	DRE999551
19R126	Res., 22K, ±1%, 1/5W, Metal	DRE999411
19R150	Res., 470K, ±1%, 1/4W, Metal	DRE938221
19R151	Same as 19R150	
19D18	Diode, 1SS 97	DDD010451
19D19	Same as 19D18	
19D21	Same as 19D18	
19D22	Same as 19D18	
19D25	Diode, 1SS 181 TE85L	DDD810061
19D53	Diode, 1S 953 TA21R	DDD010821
19D55	Same as 19D53	
19D56	Same as 19D18	
19D57	Same as 19D53	
19D58	Same as 19D53	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
19Q23	Transistor, S–DTR810031	
19Q52	Same as 19Q23	
19Q53	Same as 19Q23	
19IC35	IC, F10105DC	DIC310041
19IC45	IC, SN 74LS02N	DIC140031
19IC55	Same as 19IC35	
19J33	Connector, M36M87-02	DCN034851
19J35	Connector, M36M87-03	DCN034611
19J36	Same as 19J36	
19J40	BNC Connector, BNC 080	DCN040711
19P33	Connector, S-DCN034851	DCN034851
19P35	Connector, S-DCN34501	DCN034861
19P36	Connector, S-DCN034501	DCN034901
19JP11	Jumper Wire, MCR18-JPW TD84N	DRZ841601

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
HORIZONTAL CONTROL [20]		
20C1	Cap., 33μ, −10~+15%, 25V, Elect.	DCE929141
20C2	Same as 20C1	
20C3	Cap., 33p, ±5%, 50V, Cer.	DCC815331
20C4	Cap., 0.01μ, ±10%, 50V, Cer.	DCC810171
20C5	Same as 20C4	
20C6	Same as 20C4	
20C7	Same as 20C4	
20C8	Same as 20C4	
20C9	Same as 20C4	
20C10	Same as 20C4	
20C11	Same as 20C4	
20C12	Same as 20C4	
20C13	Same as 20C4	
20C14	Same as 20C4	
20C15	Same as 20C4	
20C16	Same as 20C4	
20C17	Same as 20C4	
20C18	Same as 20C4	
20C19	Same as 20C4	
20C20	Same as 20C4	
20C21	Same as 20C4	
20C22	Same as 20C4	
20C51	Cap., 0.01μ, −20~+80%, 50V, Elect.	DCC139511
20R1	Res., 27K, ±5%, 1/8W, Carbon	DRZ840731
20R2	Same as 20R1	
20R3	Same as 20R1	
20R4	Same as 20R1	
20R5	Same as 20R1	
20R8	Same as 20R1	
20R9	Same as 20R1	
20R10	Same as 20R1	
20R11	Same as 20R1	
20R12	Same as 20R1	
20R13	Same as 20R1	
20R14	Same as 20R1	
20R15	Same as 20R1	
20R17	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
20R18	Same as 20R1	
20R19	Same as 20R1	
20R20	Same as 20R1	
20R21	Same as 20R1	
20R22	Same as 20R1	
20R23	Same as 20R1	
20R24	Same as 20R1	
20R25	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
20R26	Same as 20R25	
20R27	Same as 20R1	
20R28	Res., 3.9K, ±5%, 1/8W, Carbon	DRZ840731
20R29	Res., 2.2K, ±5%, 1/8W, Carbon	DRZ840671
20R30	Same as 20R29	
20R31	Same as 20R29	
20R32	Same as 20R29	
20R33	Same as 20R29	
20R34	Same as 20R1	
20R37	Same as 20R1	
20R38	Same as 20R1	
20R39	Same as 20R1	
20R40	Same as 20R17	
20R41	Same as 20R17	
20R42	Same as 20R17	
20R43	Same as 20R17	
20R44	Same as 20R25	
20R45	Res., 1.0K, ± 5%, 1/8W, Carbon	DRZ840591
20R46	Same as 20R1	
20R47	Same as 20R1	
20R48	Same as 20R1	
20RA1	Resistors array, 2.7K, ±5%, 1/8W, Metal	DFB016231
20RA2	Same as 20RA1	
20S2	Switch, KSE5-10-10	DSW014441
20S2	Switch, KSE3-6-10	DSW014421
20LED1	LED, TLR206	DDD070181
20Q1	Transistor, DTC114EK, T-96	DTR890011
20IC1D	IC, SN 74LS86N	DIC140871
20IC2C	IC, SN 74LS02N	DIC140031

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
20IC2D	IC, SN 74LS04N	DIC140051			
20IC3B	IC, SN 74LS27N	DIC140281			
20IC3C	Same as 20IC2D				
20IC3D	IC, SN 74LS74AN	DIC140751			
20IC4A	Same as 20IC2C				
20IC4B	Same as 20IC3D				
20IC4C	IC, SN 74LS00N	DIC140011			
20IC4D	Same as 20IC4C				
20IC5B	Same as 20IC2D				
20IC5C	IC, SN 74LS10N	DIC140111			
20IC5D	Same as 20IC5C				
20J76	Connector, ZC-127	DCN032791			
20J82	Connector, ZC=110	DCN032741			
20J85	Connector, ZC=112	DCN032741			

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
HORIZONTAL AMPLIFIER [21]		
21C12	Cap., 0.01μ, ±10%, 50V, Cer.	DCC810171
21C14	Same as 21C12	
21C20	Cap., 0.1μ, +80~-20%, 50V, Cer.	DCC810621
21C24	Same as 21C12	
21C26	Same as 21C12	
21C29	Same as 21C12	
21C31	Same as 21C12	
21C38	Same as 21C12	
21C39	Cap., 33μ, ±20%, 25V, Elect.	DCE929141
21C45	Same as 21C12	
21C46	Cap., 0.5~1.5p, Var., 500V, Cer.	DCV020231
21C48	Same as 21C12	
21C49	Cap., 0.047μ, ±10%, 50V, Cer.	DCC132901
21C50	Same as 21C12	
21C51	Cap., 100p, ±5%, 50V Cer.	DCC815271
21C52	Cap., 4700p, ±10%,500V, Cer.	DCC152901
21C54	Same as 21C12	
21C56	Cap., 0.01μ, −20~+80%, 500V, Cer.	DCC153511
21C57	Cap., 0.1μ, ±20%, 250V, Film	DCF158021
21C58	Cap., 1p, ±0.25p, 500V, Cer.	DCC259101
21C62	Res., 1000p, ±10%, 50V, Cer.	DCC810051
21C63	Same as 21C52	
21C66	Same as 21C52	
21C67	Same as 21C57	
21C68	Same as 21C58	
21C69	Same as 21C46	
21C72	Same as 21C12	
21C73	Same as 21C12	
21C80	Cap., 4.7μ, ±20%, 63V, Elect.	DCE949111
21C81	Same as 21C39	
21C82	Same as 21C12	
21C83	Same as 21C12	DRV411931
21C84	Same as 21C12	
21C101	Same as 21C12	
21C102	Same as 21C12	
21L49	Coil, OP-03-03-1H	DCL320251
21L50	Same as 21L49	
21L64	Same as 21L49	
21L65	Same as 21L49	
21R11	Res., 33, ±5%, 1/8W, Carbon	DRZ840231
21R12	Res., 3.6K, ±1%, 1/5W, Metal	DRE999551
21R13	Res., 1.3K, ±1%, 1/5W, Metal	DRE999711
21R14	Res., 3.6K, ±1%, 1/2W, Metal	DRE140961
21R15	Res., 47, ±5%, 1/8W, Carbon	DRZ840271
21R16	Res., 560, ±1%, 1/5W, Metal	DRE999221
21R17	Res., 56, ±1%, 1/5W, Metal	DRE999101
21R18	Res., 4.3K, ±1%, 1/5W, Metal	DRE999521
21R19	Res., 620, ±1%, 1/5W, Metal	DRE999761
21R20	Res., 2.7K, ±1%, 1/5W, Metal	DRE999301
21R21	Same as 21R13	
21R22	Same as 21R15	
21R24	Same as 21R24	
21R25	Res., 240, ±1%, 1/5W, Metal	DRE999601
21R26	Res., 510, ±5%, 1/8W, Carbon	DRZ840521
21R27	Same as 21R15	
21R28	Res., 3.0K, ±1%, 1/5W, Metal	DRE999511
21R29	Same as 21R29	
21R30	Res., 18K, ±1%, 1/5W, Metal	DRE999401
21R31	Res., 180K, ±1%, 1/5W, Metal	DRE998061
21R33	Res., 500, Var., 0.5W, Metal	DRV410521
21R34	Res., 820, ±1%, 1/5W, Metal	DRE999241
21R35	Res., 100, Var., 0.5W, Metal	DRV410501
21R36	Same as 21R17	
21R37	Same as 21R28	
21R38	Same as 21R26	
21R39	Same as 21R25	
21R40	Same as 21R15	
21R41	Res., 130, ±1%, 1/5W, Metal	DRE999721
21R43	Same as 21R41	
21R44	Res., 300, ±1%, 1/5W, Metal	DRE999501
21R45	Res., 200, Var., 0.3W, Metal	DRV411731
21R46	Res., 3.3K, ±2%, 1W, Metal	DRE153851
21R47	Same as 21R46	
21R48	Same as 21R46	
21R49	Same as 21R13	
21R50	Res., 130, ±50%, 1/8W, Carbon	DRZ840381
21R51	Same as 21R50	
21R52	Res., 150K, ±1%, 1/5W, Metal	DRE998041
21R53	Same as 21R52	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
21R54	Same as 21R13	
21R55	Res., 3.0K, ±1%, 1/5W, Metal	DRE999511
21R56	Res., 360, ±1%, 1/5W, Metal	DRE999611
21R57	Res., 12K, ±5%, 2W, Metal	DRS231071
21R58	Res., 24, ±5%, 1/4W, Carbon	DRD939871
21R62	Same as 21R50	
21R63	Same as 21R52	
21R64	Same as 21R52	
21R65	Same as 21R55	
21R66	Same as 21R56	
21R67	Same as 21R57	
21R68	Same as 21R58	
21R69	Same as 21R46	
21R70	Same as 21R46	
21R71	Same as 21R46	
21R72	Same as 21R13	
21R73	Res., 43K, ±1%, 1/5W, Metal	DRE999591
21R80	Res., 39K, ±1%, 1/8W, Metal	
21R81	Same as 21R80	
21R82	Res., 12K, ±1%, 1/5W, Metal	DRE999381
21R83	Res., 10K, Var., 0.3W, Metal	DRV411931
21R100	Res., 10K, ±5%, 1/4W, Carbon	DRD939371
21R101	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
21R102	Same as 21R101	
21R105	Res., 47K, ±1%, 1/5W, Metal	DRE999331
21R106	Same as 21R12	
21D39	Diode, RD9.1EB I TA21R	DDD031001
21D73	Diode, 1SS 181 TE85L	DDD810071
21D101	Diode, 1SS 181 TE85L	DDD810061
21D102	Same as 21D101	
21D151	Same as 21D73	
21Q15	Transistor, 2SC3099 TE85L	DTR830091
21Q19	Same as 21Q15	
21Q23	Transistor, 2SC2712G TE85L	DTR830051
21Q26	Transistor, 2N3905	DTR150011
21Q29	Transistor, 2SA1162Y TE85L	DTR810041
21Q38	Same as 21Q26	
21Q40	Transistor, 2SC2037	DTR137591
21Q43	Same as 21Q40	
21Q49	Transistor, 2SC1217	DTR130811
21Q51	Transistor, 2SC1216	DTR130791
21Q54	Transistor, 2SA1206	DTR115301
21Q56	Transistor, 2SA712	DTR110571
21Q62	Same as 21Q51	
21Q63	Same as 21Q49	
21Q64	Same as 21Q56	
21Q101	Transistor, DTC114EK T-96	DTR890011
21Q102	Same as 21Q23	
21Q103	Same as 21Q101	
21Q104	Same as 21Q23	
21Q105	Same as 21Q23	
21RL35	Reed relay, RRF-51A12D	DKD065261
21RL105	Same as 21RL35	
21J27	Connector, MCR18-JPW TD84N	DRZ841601
21J34	Connector, M36M87-02	DCN034601
21J35	Connector, M36M87-03	DCN034611
21J58	Connector, WD22-1B	DCN033821
21J68	Same as 21J58	
21J72	Same as 21J27	
21J75	Connector, ZC-020	DCN032701
21J78	Same as 21J75	
21J82	Same as 21J27	
21P12	Connector, 65507-136	DCN033501
21P34	Connector, M36-02-30-134P	DCN034901
21P35	Connector, M36-03-30-134P	DCN034911

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
Z AXIS CIRCUIT [22]		
22C17	Cap., 0.1p, ±10%, 50V, Cer.	DCC810171
22C21	Cap., 4700p, ±10%, 500V, Cer.	DCC152901
22C22	Cap., 0.1μ, ±20%, 200V Film	DCF158021
22C23	Same as 22C22	
22C26	Cap., 4700p, ±10%, 50V, Cer.	DCC810131
22C27	Cap., 0.5~1.5p, Var., 500V Cer.	DCV020231
22C28	Cap., 33μ, ±20%, 25V, Elect.	DCE929141
22C29	Same as 22C28	
22C33	Cap., 27p, ±5%, 50V, Cer.	DCC815201
22C37	Cap., 10p, ±0.5p, 50V, Cer.	DCC815151
22C38	Same as 22C22	
22C40	Cap., 0.047μ, ±20%, 630V, Film	DCF171131
22C45	Cap., 0.01μ, ±20%, 630V, Film	DCF170201
22R12	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
22R13	Res., 11K, ±5%, 1/8W, Carbon	DRZ840841
22R14	Res., 1.2K, ±5%, 1/8W, Carbon	DRZ840611
22R15	Res., 43K, ±5%, 1/8W, Carbon	DRZ840261
22R16	Res., 3.3K, ±5%, 1/8W, Carbon	DRZ840711
22R17	Res., 47, ±5%, 1/8W, Carbon	DRZ840271
22R18	Res., 300, ±5%, 1/8W, Carbon	DRZ840461
22R19	Res., 8.2K, ±5%, 1/8W, Carbon	DRZ840811
22R20	Res., 1.0K, ±5%, 1/8W, Carbon	DRZ840591
22R21	Same as 22R16	
22R22	Res., 560, ±5%, 1/8W, Carbon	DRZ840531
22R23	Res., 36K, ±1%, 1/5W, Metal	DRE999861
22R24	Res., 39K, ±1%, 1/5W, Metal	DRE999441
22R25	Res., 2.0K, ±5%, 1/8W, Carbon	DRZ840661
22R27	Res., 15K, ±5%, 2W, Metal	DRS231311
22R28	Res., 100, ±50%, 1/8W, Carbon	DRZ840351
22R29	Same as 22R28	
22R30	Same as 22R25	
22R32	Res., 33K, ±5%, 1/8W, Carbon	DRZ840951
22R33	Res., 3.6K, ±5%, 1/8W, Carbon	
22R34	Res., 10, ±5%, 1/8W, Carbon	DRZ840111
22R35	Res., 16K, ±1%, 1/2W, Metal	DRE949051
22R36	Res., 8.2K, ±1%, 1/5W, Metal	DRE999361
22R37	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
22R38	Res., 50K, Var., 0.5W, Metal	DRV410581
22R39	Res., 20K, ±1%, 1/2W, Metal	DRE949111
22R40	Same as 22R12	
22R41	Same as 22R12	
22R42	Res., 220K, ±1%, 1/2W, Metal	DRE949031
22R43	Res., 160K, ±1%, 1/2W, Metal	DRE949071
22R44	Res., 100K, Var., 0.5W, Metal	DRV410591
22R45	Res., 240K, ±1%, 1/2W, Metal	DRE949081
22D12	Diode, 1SS181 TE85L	DDD810061
22D17	Diode, 1SS226 TE85L	DDD810081
22D34	Diode, SM-05-20FR2 TA21R	DDD029061
22D38	Same as 22D12	
22D39	Diode, RD20M-TIB B	DDD830231
22Q12	Transistor, 2SA1162Y TE85L	DTR810041
22Q17	Transistor, 2SC2714 TE85L	DTR830081
22Q19	Same as 22Q12	
22Q22	Transistor, 2SA1406	DTR116221
22Q28	Same as 22Q12	
22Q29	Transistor, 2SC3099 TE85L	DTR830091
22Q30	Transistor, 2SC3600	DTR135791
22Q38	Transistor, 2SC1904G/B	DTR137051
22J21	Connector, M36M87-02	DCN034601
22J22	Connector, M31M87-07	DCN034501
22J35	Same as 22J21	
22P21	Connector, M36M87-01	DCN034851
22P22	Connector, M33-07-30-134P	DCN034791
22P35	Same as 22P21	
22JP17	Jumper wire, MCR18-JPW TD84N	DRZ841601

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
CRT CIRCUIT [23]		
23C31	Cap., 0.015μ, ±10%, 50V, Film	DCF129031
23C33	Cap., 0.01μ, ±10%, 50V, Film	DCF129601
23C34	Cap., 0.01μ, ±10%, 50V, Cer.	DCC810171
23C36	Cap., 0.068μ, ±10%, 50V, Film	DCF129241
23C39	Cap., 1μ, −10~+15%, 50V, Elect.	DCE244711
23C41	Cap., 1μ, −10~+15%, 250V, Elect.	DCE270251
23C43	Cap., 0.01μ, ±10%, 50V, Cer.	DCC810171
23C46	Cap., 330μ, ±20%, 25V, Elect.	DCE929111
23C48	Cap., 4.7μ, ±20%, 63V, Elect.	DCE949111
23C49	Same as 23C43	
23C55	Same as 23C48	
23C56	Same as 23C46	
23C57	Same as 23C46	
23C60	Cap., 0.01μ, +100~−0%, 500V, Cer.	DCC153511
23C63	Same as 23C60	
23C65	Same as 23C60	
23C70	Same as 23C60	
23C71	Same as 23C60	
23R31	Res., 2.2K, ±5%, 1/8W, Carbon	DRZ840671
23R32	Res., 33K, ±5%, 1/8W, Carbon	DRZ840951
23R33	Res., 220K, ±5%, 1/8W, Carbon	DRZ841151
23R34	Same as 23R33	
23R35	Res., 200K, Var., 0.5W, Metal	DRV410601
23R36	Res., 180K, ±1%, 1/5W, Metal	DRE998061
23R37	Res., 3.9K, ±5%, 1/8W, Carbon	DRZ840731
23R38	Res., 18K, ±5%, 1/8W, Carbon	DRZ840891
23R39	Res., 180, ±5%, 1/8W, Carbon	DRZ840411
23R40	Res., 82K, ±5%, 1/8W, Carbon	DRZ841051
23R41	Res., 200K, Var., 0.5W, Metal	DRV420240
23R42	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
23R43	Res., 1.8K, ±5%, 1/8W, Carbon	DRZ840651
23R44	Res., 39K, ±5%, 1/8W, Carbon	DRZ840971
23R45	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
23R46	Same as 23R40	
23R47	Res., 2.2M, ±5%, 1/2W, Metal	DRG940311
23R48	Same as 23R32	
23R49	Same as 23R40	
23R50	Res., 15K, ±1%, 1/5W, Metal	DRE999391
23R51	Res., 2.7K, ±1%, 1/5W, Metal	DRE999301
23R52	Res., 4.7K, ±1%, 1/5W, Metal	DRE999331
23R60	Res. 200K, Var., 0.5W, Cermet	DRV350211
23R61	Res., 100K, ±5%, 1/8W, Carbon	DRZ841071
23R62	Res., 180K, ±5%,1/8W, Carbon	DRZ841131
23R63	Same as 23R62	
23R64	Same as 23R61	
23R65	Res., 200K, Var., 0.125W, Carbon	DRV145941
23R66	Same as 23R62	
23R67	Same as 23R62	
23R68	Res., 51K, ±5%, 1/8W, Carbon	DRZ841001
23R69	Res., 47K, ±5%, 1/8W, Carbon	DRZ840991
23R70	Same as 23R41	
23R71	Same as 23R41	
23D32	Diode, 1SS226 TE85L	DDD810081
23D38	Diode, 1SS184 TE85L	DDD810071
23D44	Diode, 1SS181 TE85L	DDD810061
23D45	Same as 23D44	
23D49	Same as 23D38	
23Q31	Transistor, 2SC2712G TE85	DTR830051
23Q38	Transistor, 2SA1162Y TE85	DTR810041
23Q44	Same as 23Q31	
23IC32	IC, μPC251C	DIC610091
23J41	Connector, M31M87-09	DCN034521
23J42	Connector, WP22-1B	DCN033821
23J43	Connector, M31M87-10	DCN034531
23P41	Connector, M33-09-30-134P	DCN034811
23P43	Connector, M33-10-30-134P	DCN034821
23JP18	Jumper Wire, MCR18-JPW TD84N	DRZ841601
23JP19	Same as 23JP18	
23JP20	Same as 23JP18	
23JP21	Same as 23JP18	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
23C11	Cap., 0.01μ, −20~+80%, 3KV, Cer.	DCC173501
23C12	Same as 23C11	
23C13	Cap., 0.047μ, ±20%, 3KV, Film	DCF171131
23C14	Cap., 1000p, ±20%, 3KV, Cer.	DCC171831
23C15	Same as 23C11	
23C16	Cap., 47μ, −10~+150%, 100V, Elect.	DCE255091
23C18	Same as 23C11	
23C19	Same as 23C14	
23C20	Same as 23C11	
23C21	Same as 23C14	
23C22	Same as 23C11	
23C23	Cap., 100p, ±10%, 500V, Cer.	DCC259141
23C91	Cap., 0.01μ, +80~−20%, 500V, Cer.	DCC153511
23C92	Same as 23C91	
23R12	Res., 100K, ±5%, 1/4W, Carbon	DRD939491
23R16	Res., 330, ±5%, 1/4W, Carbon	DRD939191
23R18	Res., 10K, ±5%, 1/4W, Carbon	DRD939371
23R19	Res., 15, ±5%, 1/2W, Carbon	DRG163291
23R20	Same as 23R18	
23R22	Res., 10, ±5%, 1/2W, Carbon	DRG940321
23R23	Res., 180K, ±5%, 1/4W, Carbon	DRD939521
23R24	Same as 23R23	
23R25	Same as 23R23	
23D12	Diode, SHV-20	DDD021441
23D13	Diode, SM-05-20FRZ TA21R	DDD029061
23D14	Same as 23D13	
23D15	Same as 23D13	
23D16	Diode, 1S953 TA21R	DDD010821
23D17	Same as 23D13	
23D18	Same as 23D13	
23D19	Same as 23D13	
23D20	Same as 23D13	
23Q13	Transistor, 2SC2334L	DTR137621
23J11	Connector, L=360	KHB041511
23J51	Connector, M36M87-04	DCN034621
23J52	Connector, M36M87-03	DCN034611
23J53	Connector, M31M87-12	DCN034541
23J54	Connector, M36M87-02	DCN034601
23J55	Connector, M36M87-03	DCN034611
23P51	Connector, M36-04-30-114P	DCN034871
23P52	Connector, M36-03-30-114P	DCN034861
23P53	Connector, M33-12, 30-114P	DCN034731
23P54	Connector, M36-02-30-114P	DCN034851
23P55	Connector, M36-03-30-114P	DCN034861
23T11	High Voltage Transformer, FS-34442	DCL220351
23U11	High Voltage Unit, MSL3587A	DES050563
23V11	Neon Bracket Lamp, NL-235D	DET016121
23V21	CRT, S-8213 B31C	DLP025171

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
POWER SUPPLY [24]		
24C11	Cap., 33μ, ±20%, 25V, Elect.	DCE929141
24C12	Same as 24C11	
24C13	Cap., 0.1μ, ±10%, 50V, Film	DCF129601
24C14	Same as 24C13	
24C15	Cap., 4700μ, ±50%, 16V, Elect.	DCE920711
24C16	Same as 24C15 Elect.	
24C20	Cap., 100p, −10~+150%, 250V, Elect.	DCE170751
24C24	Cap., 2200μ, ±20%, 63V, Elect.	DCE945261
24C27	Cap., 0.01μ, 10%, 50V, Cer.	DCC810171
24C29	Same as 24C27	
24C30	Cap., 4.7μ, −10~+15%, 250V, Elect.	DCE270401
24C31	Same as 24C30	
24C34	Cap., 4.7μ, ±20%, 63V, Elect.	DCE925461
24C40	Same as 24C27	
24C41	Cap., 4700μ, ±20%, 25V, Elect.	DCE925461
24C42	Same as 24C41	
24C44	Same as 24C27	
24C48	Same as 24C54	
24C49	Same as 24C27	
24C54	Same as 24C54	
24C61	Cap., 0.01μ −20~+80%, 3KV, Cer.	DCC173501
24R13	Res., 39K, ±5%, 1/8W, Carbon	DRZ840971
24R20	Res., 91K, ±5%, 1/8W, Carbon	DRZ841061
24R21	Same as 24R20	
24R22	Same as 24R20	
24R23	Same as 24R20	
24R24	Res., 82K, ±5%, 1/8W, Carbon	DRZ841051
24R25	Res., 51K, ±5%, 1/8W, Carbon	DRZ841001
24R26	Res., 1.0K, ±5%, 1/8W, Carbon	DRZ840591
24R27	Res., 1.5, ±5%, 1W, Metal	DRS221381
24R28	Res., 18K, ±5%, 1/8W, Carbon	DRZ840891
24R29	Res., 33K, ±1%, 1/2W, Metal	DRE949061
24R30	Res., 82K, ±1%,1/5W, Metal	DRE994481
24R31	Res., 68K, ±1%, 1/5W, Metal	DRE999471
24R32	Res., 12K, ±1%, 1/5W, Metal	DRE999381
24R33	Res., 6.8K, ±5%, 1/8W, Metal	DRZ840791
24R34	Res., 20K, ±1%, 1/5W, Metal	DRE999581
24R35	Same as 24R34	
24R36	Same as 24R33	
24R37	Same as 24R32	
24R40	Same as 24R24	
24R41	Same as 24R24	
24R42	Same as 24R26	
24R43	Same as 24R13	
24R44	Res., 0.33, ±5%, 2W, Metal	DRS231301
24R45	Res., 18K, ±5%, 1/4W, Carbon	DRD939401
24R46	Same as 24R45	
24R47	Same as 24R44	
24R48	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
24R49	Same as 24R32	
24R50	Same as 24R32	
24R51	Same as 24R33	
24R52	Res., 3.9K, ±1%, 1/5W, Metal	DRE999321
24R53	Res.,	DRV410531
24R54	Res., 5.6K, ±1%, 1/5W, Metal	DRE999341
24R55	Res., 9.1K, ±1%, 1/5W, Metal	DRE999901
24R61	Same as 24R26	
24R62	Res., 560, ±5%, 1/8W, Carbon	DRZ840531
24R63	Res., 11K, ±5%, 1/8W, Carbon	DRZ840841
24D15	Diode, S4VB10	DDD023311
24D20	Diode, 1G4B1	DDD021031
24D24	Same as 24R15	
24D28	Diode, RD18EB TA21R	DDD03701
24D29	Diode, RD39EB TA21R	DDD031151
24D30	Diode, SM-1A-02 TA21R	DDD010771
24D33	Diode, 1SS184 TE85L	DDD810071
24D34	Same as 24D30	
24D36	Same as 24D33	
24D41	Same as 24D15	
24D46	Same as 24D28	
24D48	Diode, TLG-104	DDD071111
24D49	Diode, RD12EB TA21R	DDD031791
24D51	Same as 24D33	
24D52	Diode, RD5.6EB2 TA21R	DDD032021
24D61	Diode, RD12M-TIB B	DDD830181
24Q23	Transistor, 2SB940	DTR125461
24Q24	Transistor, 2SC2581	DTR135161

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
24Q25	Transistor, 2SC1264	DTR145861
24Q27	Transistor, 2SC1815GR TPE R1	DTR139011
24Q42	Same as 24R24	
24Q43	Transistor, 2SD1266P/Q	DTR145851
24Q44	Same as 24Q27	
24Q45	Transistor, 2SK30A-Y	DTR210141
24Q46	Same as 24Q23	
24Q47	Transistor, 2SA1106	DTR115061
24Q48	Transistor, 2SA1015Y TPER1	DTR119011
24Q61	Same as 24Q23	
24Q62	Same as 24Q48	
24IC11	IC, SI-3052V	DIC652751
24IC12	IC, μPC 1630H(NES)	DIC650111
24IC28	IC, μPC 451C	DIC610101
24S11	Switch, SDGA3P-B	DSW016541
24J31	Connector, M36M87-03	DCN034611
24J32	Connector, M31M87-10	DCN034531
24J33	Connector, M36M87-06	DCN034641
24J34	Connector, M31M87-12	DCN034541
24J35	Connector, M36M87-02	DCN034601
24J41	Connector, S-17220-04	DCN093521
24J78	Connector, 2C-020	DCN032701
24J79	Connector, 2C-012	DCN032661
24J80	Same as 24J79	
24P31	Connector, M36-03-30-114P	DCN034861
24P32	Connector, M33-10-30-114P	DCN034721
24P33	Connector, M36-06-30-114P	DCN034891
24P34	Connector, M33-12-30-114P	DCN034731
24P35	Connector, M36-02-30-114P	DCN034851
24P41	Connector, X-17213	DCN093511
24P42	Connector, NC-173A	DCN013311
24P78	Flat cable, SMCD-20x300-BDx10	KHB070911
24P79	Flat cable, SMCD-12x350-BDx10(2.7)P1.25	KHB077111
24P80	Flat cable, SMCD-12x50-BOX10(2.7)P1.25	KHB070611
24T11	Transformer, FS-35910	DCL212301

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
24F11	Fuse, FSA-3	DFU020161
24F12	Fuse, FSA-1	DFU020141
24M11	Fan Motor, DF60B12-006	DMT620221

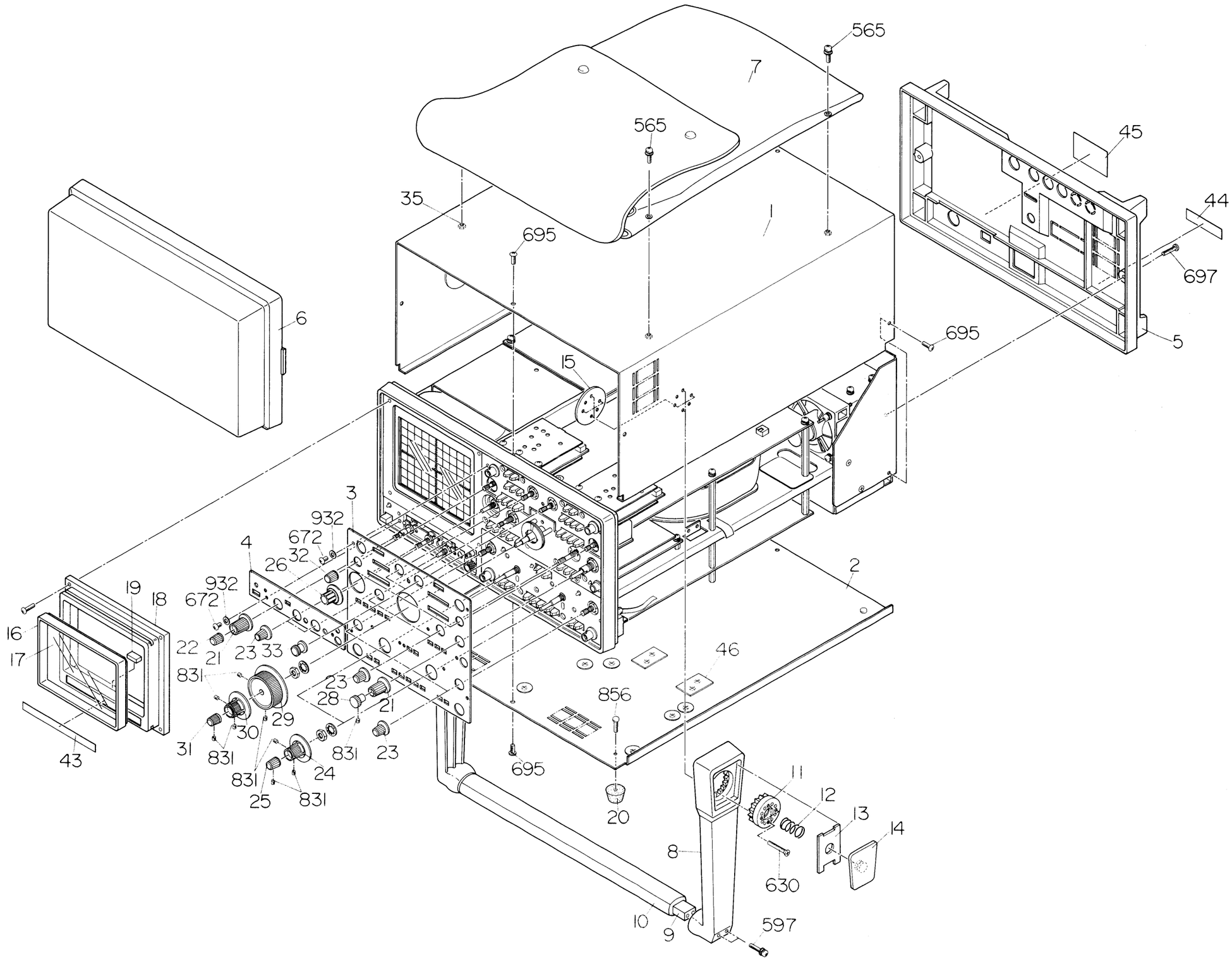
Section 7

Mechanical Parts List and Illustrations

INDEX NO	NAME & DESCRIPTION	Q'ty	IWATSU PART NO.
1	COVER, top	1	KBA570551
2	COVER, bottom	1	KBA570651
3	PANEL A, front	1	KPA165631
4	PANEL B, front	1	KPA165811
5	PANEL, rear	1	KCM077311
6	PANEL COVER	1	KCM059921
7	ACCESSORIES BAG	1	KLT028111
8	HANDLE, arm	2	KCM059431
9	HANDLE, bar	1	KMM198011
10	COVER, handle	1	KCM059731
11	GEAR, stater	2	KCM059611
12	SPLING, handle arm	2	KSR012611
13	STOPPER, handle arm spring	2	KBA508121
14	COVER, handle arm	2	KCM059521
15	FIXED METAL PLATE, stater gear	2	KBA512521
16	FRAME, filter	1	KCM060411
17	FILTER, blue	1	KPL102811
18	BEZEL B2	1	KCM060321
19	STOPPER, filter	1	KPL013411
20	FOOT	4	KGM007931
21	KNOB, S181580DGA	2	KCM061011
22	KNOB, K101160SW	1	KCM061111
23	KNOB, K141360SG	6	KCM061411
24	KNOB, A301760DGD	2	KCM078821
25	KNOB, N101230SR	2	KCM075611
26	MULTI-DIAL (electric part)		
27	KNOB, S181580DGA	2	KCM061011
28	KNOB, N111230SWP	1	KCM066211
29	KNOB, A471560DGD	1	KCM078611
30	KNOB, A301540DGD	1	KCM078711
31	KNOB, N101220SR	1	KCM060811
32	KNOB, K101160SG	2	KCM061211
33	KNOB, K141360SGP	2	KCM061511
35	NUT-SERT, 9508-03	4	MSQ910011
43	NAME PLATE, title, SS-5712	1	KRA125721
44	NAME PLATE B, serial number	1	ARA002711
45	NAME PLATE C, line voltage range	1	KRA131011
46	COVER, NS6	10	MBU000721
565	SCREW, SM5-3 x 8		MSM530081
597	SCREW, KP-3 x 12S		MKP130121
630	SCREW, KD (+) 3 x 18S	8	MKD130181
672	SCREW, KT-2 x 6B		MKT220062

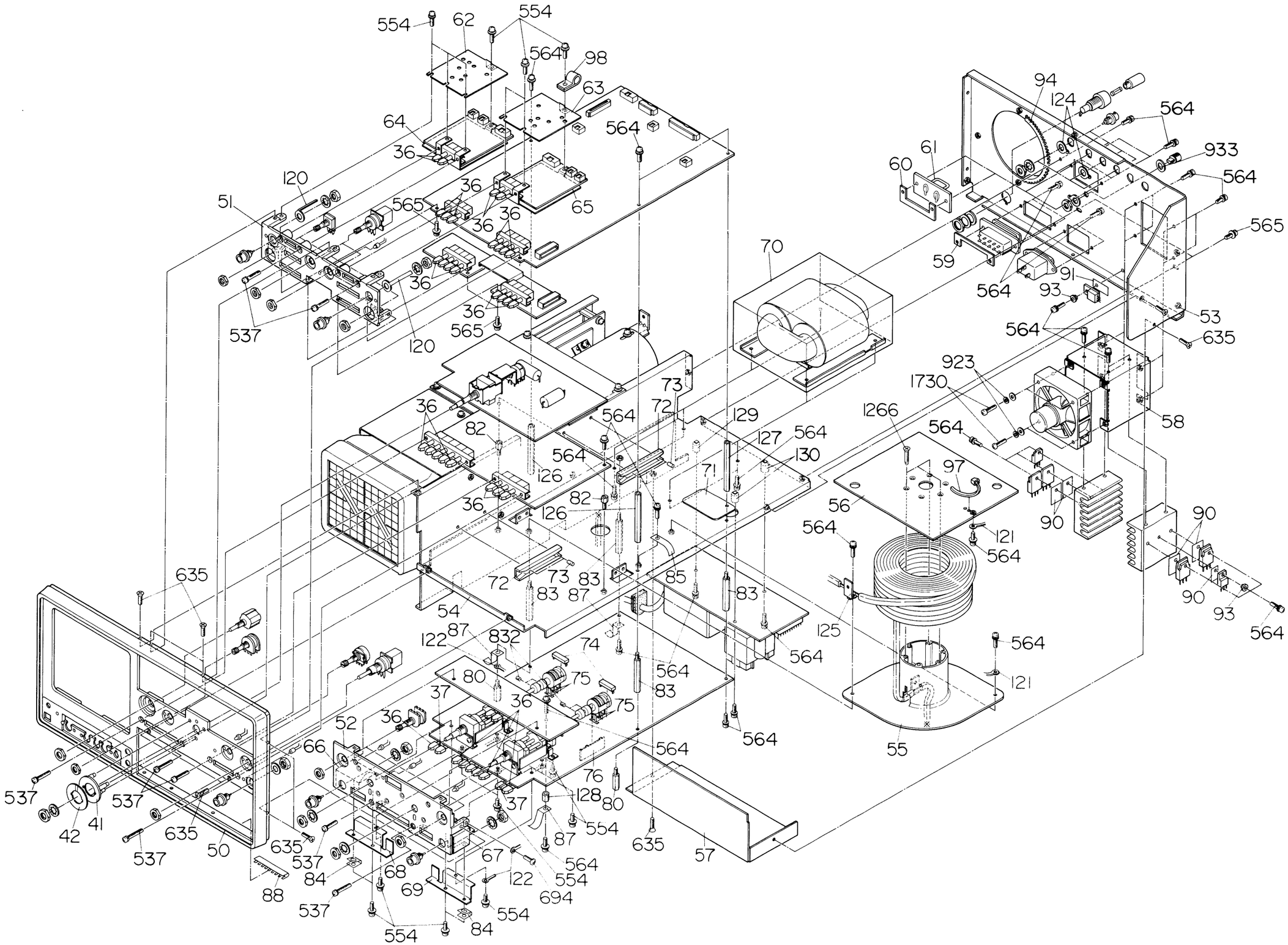
Section 7 Mechanical Parts List and Illustrations SS–5712 Service Manual

INDEX NO	NAME & DESCRIPTION	Q.ty	IWATSU PART NO
695	SCREW, KT-3 x 8B		MKT230082
696	SCREW, KH-3 x 8S		
697	SCREW, KT-3 x 12B		MKT230125
831	SCREW, HL-3 x 3		MHL130039
856	SCREW, RH-3 x 10A	4	MSQ930223
932	NYLON WASHER, W-2		KPL102411

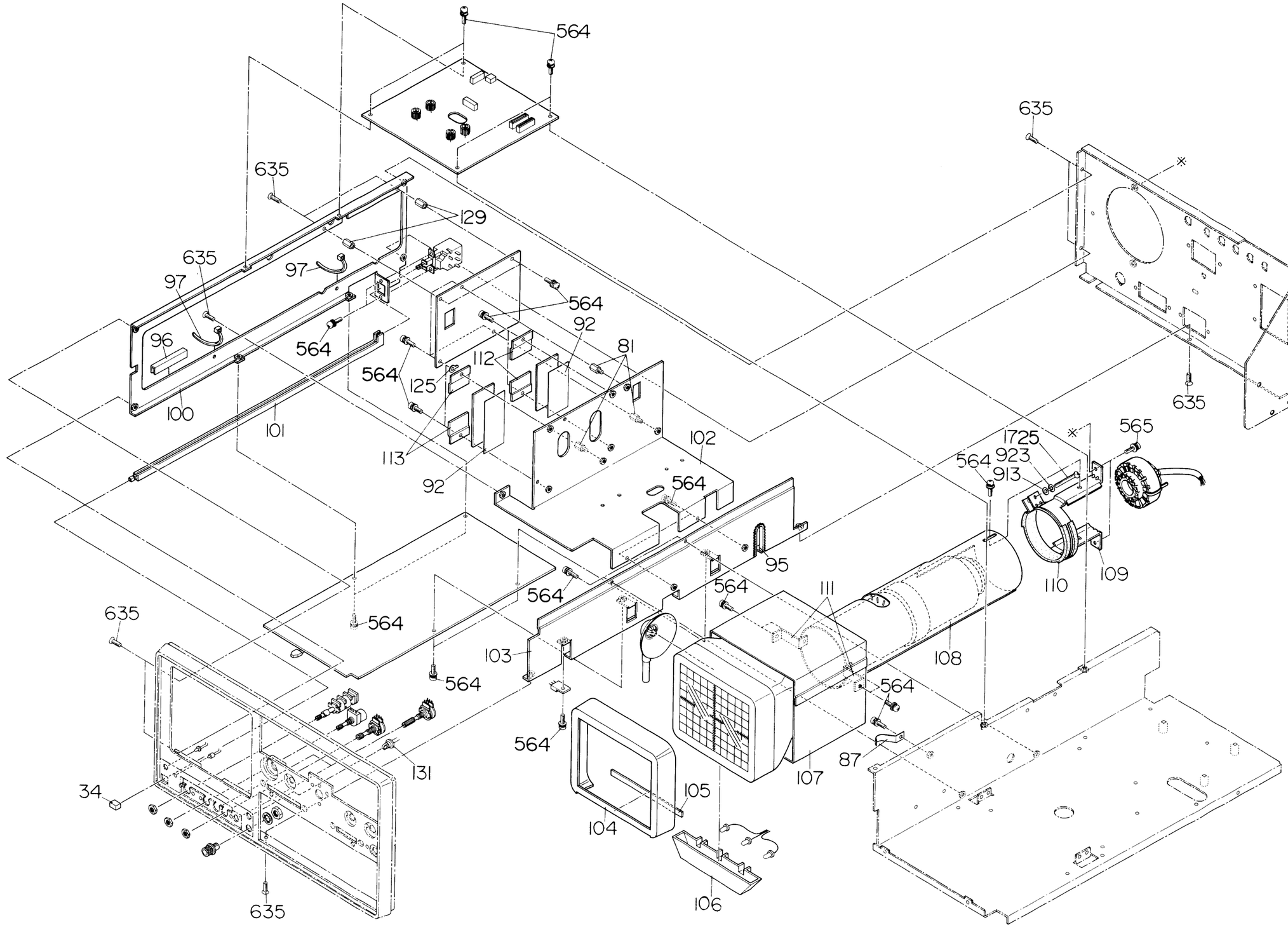

565
7
565
45
35
1
695
44
697
6
695
5
15
3
932
672
4
32
26
2
19
18
932
672
16
22
21
23
33
17
831
23
46
28
21
856
29
30
31
831
831
24
23
695
20
831
25
831
11
12
13
14
8
630
10
9
597
43

INDEX NO	NAME & DESCRIPTION	Q'ty	IWATSU PART NO.
36	PS KNOB D1	37	KCM062011
37	PS KNOB D2	2	KCM062111
41	STOPPER, Timing panel	1	KCM061811
42	PANEL, Timing	1	KPA158511
50	SUB-PANEL, front	1	KPA141841
51	H SUB-PANEL	1	KPA141931
52	V SUB-PANEL	1	KPA166111
53	SUB-PANEL, rear	1	KPA166221
54	SHASSIS	1	KBA572151
55	BOBBIN, Delay cable	1	KCM078921
56	COVER, delay cable bobbin	1	KBA589821
57	SHIELDED CASE, High-voltage	1	KBA572011
58	ATTACHMENT CASE, fan	1	KBA572521
59	SEAT PLATE	1	KBA526611
60	CP SEAT PLATE	1	KBA526711
61	TERMINAL, calibrated current	1	KPS009511
62	ATTEN SHIELD PLATE H	1	KBA571121
63	ATTEN SHIELD PLATE F	1	KBA571321
64	ATTEN SHIELD PLATE G	1	KBA571211
65	ATTEN SHIELD PLATE E	1	KBA571411
66	ATTEN SHIELD PLATE A	1	KBA571811
67	ATTEN SHIELD PLATE C	1	KBA571611
68	ATTEN SHIELD PLATE B	1	KBA571721
69	ATTEN SHIELD PLATE D	1	KBA571521
70	SHIELDED CASE, power transformer (Electric part)		
71	FIX PLATE, flat cable	1	KBA619011
72	GUAID A	2	KCM065311
73	LOCK PIN, GUAID A	4	KCM066411
74	CASE, THERMO-COUPLE	17	KCM079121
75	INSULATION PLATE, stay	4	KLT028411
80	STAY	2	KMM218811
82	STAY B	2	KMM198721
83	STAY C	4	KMM198811
84	SPRING C, ground	4	KBA212711
85	SPRING A, ground	1	KBA526021
87	SPRING, ground	3	KBA520831
88	SPRING, ground, 97-135-A		MZT000561
90	HEAT DISSIPATER, AC-254 (Electric part)		
91	HEAT DISSIPATER (Electric part)		
93	BUSHING, Type M		
94	BUSHING, KG-024		MBU000501
97	BAND, CV70		
98	BAND, SL-4N		MHK001491

INDEX NO	NAME & DESCRIPTION	Q'ty	IWATSU PART NO
120	LUG, BNC	2	KPS010011
121	LUG, both end, 100mm		KPS009811
122	LUG, both end, 70mm		KPS009711
124	LUG, 10.2ϕ	3	KPS004311
125	LUG, 3ϕ		
126	STAY, SHB (5.5) (62.5) 30B0	2	KMM218711
127	STAY, SHB (5.5) 6130B0	1	KMM233711
128	STAY, SBH (5.5) 830B0		
129	STAY, SBH (5.5) 2230B0	2	AMM474711
130	STAY	3	AMM627811
537	SCREW, SM1-3 x 12CT		MSM130121
554	SCREW, SM1-2.6 x 6CT		MSM126061
564	SCREW, SM4-3 x 8CT		MSM430081
565	SCREW, SM5-3 x 8		MSM530081
635	SCREW, KD-3 x 8S		MKD130081
694	SCREW, KT (+) 3 x 8B		MKT230082
832	SCREW, HL-3 x 4		MHL130049
923	WASHER, PW-3S		MPW130001
933	WASHER, WS09 (1.5) 62B0	1	KMM199611
1266	SCREW, TD-3 x 8		
1730	SCREW, KP (+) 3 x 28S		MKP130281


554
62
554
564
98
63
64
564
36
120
51
36
565
36
65
36
36
36
565
537
120
70
94
124
564
933
564
565
61
60
59
564
91
93
53
564
635
923
1730
58
1266
564
97
56
90
121
564
90
90
93
564
125
564
121
55
564
564
564
564
73
72
129
127
564
130
71
126
82
36
564
82
126
36
73
72
83
83
87
85
83
54
635
122
87
832
74
80
75
37
36
75
83
36
52
564
564
66
76
128
80
37
554
87
635
57
537
537
537
42
41
635
50
537
635
537
67
564
68
554
84
122
69
694
537
554
554
84

INDEX NO	NAME & DESCRIPTION	Q'ty	IWATSU PART NO.
34	PS KNOB C1	1	KCM061911
81	STAY	3	KMM218911
87	SPRING, ground	3	KBA520831
92	HEAT DISSIPATER (L = 60)		
95	BUSHING, KG-016		MBU000561
96	EDGING, CE-016		MBU000131
97	BAND, CV-70		
100	FRAME	1	KBA571021
101	EXTENSION SHAFT, POWER switch	1	KCM065221
102	HEAT DISSIPATER	1	KBA572221
103	CRT SHIELDED PLATE	1	KBA571941
104	CUSHION, CRT	1	KGM009631
105	ADHESIVE TAPE, both side		
106	SCALE ILLUM LAMP PLATE	1	KCM056111
107	SHIELD CASE A	1	KBA513221
108	SHIELD CASE B	1	KBA570811
109	CRT FIX BAND	1	KBA570911
110	CRT FIXED RUBBER	1	KGM009511
111	SUSPENSION A, CRT shielded case A and B	2	KBA513421
112	ATTACHMENT PLATE C2	2	KBA572311
113	ATTACHMENT PLATE C3	2	KBA572411
129	STAY, SBH5.5 2230B0	2	AMM474711
131	TERMINAL, CAL	1	DTA010871
564	SCREW, SM4-3 x 8CT		MSM430081
565	SCREW, SM5-3 x 8		MSM530081
635	SCREW, KD-3 x 8S		MKD130081
913	WASHER, PW-3B		MPW230002
923	SPRING WASHER, SW-3PB		MSW430003
1725	SCREW, KP (+) 3 x 25S		MKP130251


564
635
129
635
97
97
564
96
564
92
81
112
564
125
100
101
113
102
92
564
95
564
564
111
635
564
103
108
564
564
87
131
34
105
104
107
106
635
635
565
1725
564
923
913
110
109
*
*

Section 6

Electrical Parts List

Ordering Information

Replacement parts may be ordered through an IWATSU representative of directly from the factory. To be certain of receiving the proper parts, a ways include the following information with the order:

a. Model Number and serial number of the instrument on which the parts will be installed.
b. Circuit reference number and subassembly name, if applicable for which the part is inteded. If the part does not have a circuit reference, the description from the parts list should be used.
c. Iwatsu part number.

For factory repair, contact the IWATSU agent and include the following information:

a. Model number and serial number of the instrument on which the work is to be performed.
b. Details concerning the nature of the malfunction, or, type of repair desired.
Shipping instructions will be sent to you promptly.

How to Use This Parts List

The part list is divided into subsections corresponding to the schematic diagrams such as CH 1, & CH 2 ATTENUATOR, CH 1, CH 2 PRE-AMPLIFIER, CH 3 & CH 4 ATTENUATOR & PRE-AMPLIFIER, VERTICAL MAIN AMPLIFIER, VERTICAL CONTROL, A & B TRIGGER GENERATOR, A. B SWEEP GENERATOR, A & B TIMING CIRCUIT, HORIZONTAL AMPLIFIER, HORIZONTAL CONTROL, POWER SUPPLY & CALIBRATOR, Z AXIS & CRT CIRCUIT.

Component locations can be determined from the schematic diagrams, each component appears only once in the parts list. At the beginning of each subsection are listed part number for any complete subassemblies in that category that are available replacement parts. These subassemblies may include individually-listed components; care should be taken to pinpoint malfunctions to the exact replacement parts actually needed and thus avoid the time and cost involved in "over-repair".

Abbreviations

Cap. . . . . .Capacitor
Cer . . . . . .Ceramic
Poly . . . . . .Polyethytel film
Elect. . . . . .Aluminum electrolytic chemical
Elect. tan. . . . . .Tan-talum electrolytic chemical condenser
[The symbol F (farad) is omitted]
Res. . . . . .Resistor
W.W . . . . . .Wire wound
Comp . . . . . .Composition
[The symbol Ω (ohm) is omitted]
FET . . . . . .Field Effect Transistor
Diode . . . . . .
T. diode. . . . . .Tunnel diode
Z.diode . . . . . .Zenner diode
S.B.diode. . . . . .Schottky barrier diode
V.C. diode . . . . . .Variable capacitance diode
L.E.D . . . . . .Light emission diode
IC. . . . . .Integrated Circuit
Var. . . . . .Variable

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
CH 1 PREAMPLIFIER (1) [1]		
IC01	Cap., 10000p, ±10%, 50V, Cer.	DCC810171
IC02	Same as IC01	
IC03	Same as IC01	
IC04	Same as IC01	
IC05	Same as IC01	
IC06	Same as IC01	
IC10	Cap., 0.047μ, ±20%, 250V, Film	DCF160291
IC11	Cap., 9p, ±5%, 50V, Cer.	DCC231501
IC12	Cap., 0.5~1.5p, Var., 1V, Film	DCV020231
IC13	Cap., 1000p, ±10%, 500V, Cer.	DCC151801
IC14	Same as IC01	
IC15	Same as IC01	
IC16	Same as IC01	
IC20	Cap., 0.033μ, ±10%, 50V, Film	DCF129091
IC21	Cap., 10μ, 10V, Elect.	DCE929021
IC23	Same as IC01	
IC24	Cap., 0.0022μ, ±10%, 50V, Film	DCF129061
IC26	Cap., 120p, ±5%, 50V, Cer.	DCC239261
IC31	Cap., 2~12p, Var., 250V, Cer.	DCV019601
IC32	Cap., 22p, ±5%, 50V, Cer.	DCC815191
IC40	Cap., 2p, ±0.25p, 50V, Cer.	DCC815041
IC41	Cap., 4p, ±0.25p, 50V, Cer.	DCC815081
IC43	Cap., 1p, ±0.25p, 50V, Cer.	DCC815021
IC46	Same as IC01	
IC48	Same as IC01	
IC55	Same as IC01	
IC62	Cap., 100p, ±5%, 50V, Cer.	DCC239051
IC65	Same as IC40	
IC66	Cap., 2.5~22.5p, Var, 250V, Cer.	DCV019591
IC67	Cap., 10p, ±0.5p, 50V, Cer.	DCC815151
IC68	Cap., 3p, ±0.25p, 50V, Cer.	DCC815061
IC72	Same as IC01	
IC78	Same as IC01	
IC82	Cap., 22000p, ±10%, 50V, Cer.	DCC810211
IC83	Cap., 220p, ±5%, 50V, Cer.	DCC815311
IC87	Same as IC41	
IC88	Same as IC41	
IC99	Cap., 39p, ±5%, 5V, Cer.	DCC815221
IC104	Cap., 100p, ±5%, 50V, Cer.	DCC815271
IC151	Same as IC01	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
1R10	Res., 470, ± 5%, 1/4W, Carbon	DRD939211
1R11	Res., 68, ±5%, 1/4W, Carbon	DRD939111
1R12	Res., 820K, ±0.5%, 1/4W, Metal	DRE938211
1R13	Res., 180K, ±1%, 1/8W, Metal	DRZ847581
1R14	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
1R15	Res., 51, ±5%, 1/4W, Carbon	DRD939881
1R16	Res., 10M, ± 5%, 1/4W, Metal	DRG330231
1R17	Res., Thermistor 112101-2	DDD080331
1R18	Same as 1R14	
1R19	Res., 330, ±5%, 1/8W, Carbon	DRZ840471
1R20	Res., 200, ±5%, 1/8W, Carbon	DRZ840421
1R21	Res., 30, ±5%, 1/8W, Carbon	DRZ840221
1R22	Res., 1.2K, ±5% , 1/8W, Carbon	DRZ840611
1R23	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
1R24	Res., 2.4K, ±5%, 1/8W, Carbon	DRZ840681
1R25	Res., 20K, Var., 0.3W, Metal	DRV411901
1R26	Res., 820K, ±1%, 1/8W, Metal	DRZ847591
1R27	Res., 6.2K, ±5%, 1/8W, Carbon	DRZ841121
1R28	Res., 50K, Var., 0.3W, Metal	DRV412061
1R31	Res., 10, ±1%, 1/8W, Metal	DRZ847641
1R32	Res., 2.2K, ±5%, 1/8W, Carbon	DRZ840671
1R33	Res., 12, ±1%, 1/8W, Metal	DRZ847651
1R34	Res., 18, ±1%, 1/8W, Metal	DRZ847661
1R35	Res., 120, ±0.5%, 1/4W, Metal	DRE938181
1R36	Same as 1R35	
1R37	Res., 150, ±0.5%, 1/4W, Metal	DRE938191
1R38	Res., 100, ±0.5%, 1/4W, Metal	DRE938171
1R40	Res., 36, ±5%, 1/8W, Carbon	DRZ840241
1R41	Res., 110, ±5%, 1/8W, Carbon	DRZ840361
1R42	Res., 200, ±5%, 1/4W, Metal	DRE938201
1R43	Res., 51, ±5%, 1/8W, Carbon	DRZ840281
1R45	Res., 560, ±5%, 1/8W, Carbon	DRZ840531
1R46	Same as 1R45	
1R48	Same as 1R14	
1R51	Res., 82, ±5%, 1/8W, Carbon	DRZ840331
1R52	Res., 510, ±5%, 1/8W, Carbon	DRZ840521
1R53	Same as 1R52	
1R54	Same as 1R52	
1R55	Same as 1R52	
1R56	Same as 1R14	
1R57	Res., 18K, ±5%, 1/8W, Carbon	DRZ840891
1R58	Same as 1R57	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
1R59	Res., 20K, ±5%, 1/8W, Carbon	DRZ840901
1R60	Same as 1R25	
1R61	Same as 1R14	
1R62	Same as 1R32	
1R65	Same as 1R14	
1R66	Res., B100, Var., 0.3W, Metal	DRV412001
1R68	Res., 56, ±5%, 1/8W, Carbon	DRZ840291
1R70	Res., 270, ±5%, 1/8W, Carbon	DRZ840451
1R71	Same as 1R70	
1R72	Same as 1R70	
1R73	Same as 1R70	
1R74	Same as 1R70	
1R75	Same as 1R70	
1R76	Same as 1R70	
1R77	Same as 1R70	
1R78	Res., 1.8K, ±5%, 1/8W, Carbon	DRZ840651
1R79	Same as 1R78	
1R80	Same as 1R43	
1R81	Res., Thermistor, 15D22	DDD080411
1R82	Res., 240, ±5%, 1/8W, Carbon	DCC810211
1R84	Res., B100, Var., 0.3W, Metal	DRV411721
1R87	Same as 1R51	
1R88	Same as 1R51	
1R89	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
1R90	Same as 1R89	
1R91	Res., 47, ±5%, 1/10W, Carbon	DRZ830241
1R92	Same as 1R91	
1R93	Res., 6.2K, ±5%, 1/8W, Carbon	DRZ840781
1R94	Same as 1R24	
1R95	Res., 750, ±5%, 1/8W, Carbon	DRZ840561
1R96	Same as 1R95	
1R97	Same as 1R95	
1R98	Same as 1R95	
1R99	Res., 6.8K, ±5%, 1/8W, Carbon	DRZ840791
1R100	Res., 390, ±5%, 1/8W, Carbon	DRZ840491
1R101	Res., 10K, ±1%, 1/8W, Metal	DRZ847561
1R102	Same as 1R101	
1R103	Same as 1R101	
1R104	Same as 1R101	
1R105	Res., 470K, ±5%, 1/8W, Carbon	DRZ841231
1R106	Res., B50K, Var., 0.3W, Metal	DRV411971
1R107	Res., 1K, ±1%, 1/8W, Metal	DRZ847541
1R108	Res., 24, ±1%, 1/8W, Metal	DRZ847671
1R109	Res., 220, ±1%, 1/8W, Metal	DRZ847521
1R110	Res., 33K, ±5%, 1/8W, Carbon	DRZ840951
1R111	Res., 8.2K, ±5%, 1/8W, Carbon	DRZ840811
1R112	Res., B5K, Var., 0.3W, Metal	DRV412051
1R120	Same as 1R59	
1R121	Res., 100K, ±5%, 1/8W, Carbon	DRZ841071
1R122	Same as 1R121	
1R123	Same as 1R89	
1R124	Res., Thermistor, 112103-2	DDD080161
1RA02	Res., 10K, ±5%, 1/8W	DFB015561
1D03	Diode, 1SS 184 TE85L	DDD810071
1D04	Same as 1D03	
1D05	Same as 1D03	
1D10	Diode, 1S 1544A	DDD010341
1D11	Same as 1D10	
1D12	Same as 1D10	
1Q10	Transistor, 2SK141L2A	DTR215321
1Q11	Transistor, 2SC3099TE85L	DTR830091
1Q12	Transistor, 2SC2714TE85L	DTR830081
1Q13	Transistor, 2SC3356-T1B	DTR830071
1Q14	Same as 1Q13	
1Q15	Same as 1Q11	
1Q16	Same as 1Q11	
1Q17	Transistor, 2SA1245MDTE85L	DTR810021
1Q18	Same as 1Q17	
1Q19	Transistor, 2SA1162Y TE85L	DTR810041
1IC31	IC, SN 7406N	DIC110071
1IC32	IC, SN74LS02N	DIC140031
1IC33	IC, SN74LS27N	DIC140281
1IC34	IC, LF355H-S4	DIC613661
1IC35	IC, μPC251C	DIC610091
1S03	Switch, KSE1-2-00LLDM	DSW015371
1S04	Same as 1S03	
1S11	Switch, ORD229	DKD065891
1S12	Same as 1S11	
1S13	Same as 1S11	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
1RL7	Relay, SY-12	DKD027301			
1RL8	Same as 1RL7				
1RL11	Coil, MB-7-2-12VDC	DCL112021			
1RL12	Same as 1RL11				
1RL13	Same as 1RL11				
1J11	BNC Connector, BNC080	DCN040711			

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
CH 1 PREAMPLIFIER (2) [2]		
2C01	Cap., 33μ, 33μ 25V, Elect	DCE929141
2C02	Same as 2C01	
2C03	Same as 2C01	
2C04	Same as 2C01	
2C05	Same as 2C01	
2C07	Cap., 10000P, ±10%, 50V, Cer.	DCC810171
2C12	Cap., 5p, ±0.25p, 50V, Cer.	DCC815101
2C14	Cap., 2~8p, Var., 250V, Cer.	DCV019611
2C16	Same as 2C07	
2C18	Cap., 2200p, ±0.5%, 50V, Film	DCF129061
2C21	Cap., 120p, ±5%, 50V, Cer.	DCC239261
2C22	Cap., 5~40p, Var., 250V, Cer.	DCV019751
2C23	Cap., 27p, ±5%, 50V, Cer.	DCC815201
2C26	Same as 2C12	
2C27		
2C33	Same as 2C07	
2C34	Cap., 330p, ±5%, 50V, Cer.	DCC815331
2C35	Cap., 3300p, ±10%, 50V, Film	DCF129021
2C36	Cap., 10p,	
2C37	Cap., 33p, ±5%, 50V, Cer.	DCC815211
2C38	Same as 2C37	
2C41	Cap., 68p, ±5%, 50V, Cer.	DCC815251
2C42	Cap., 1000p, ±10%, 50V, Cer.	DCC810051
2C43	Cap., 47p, ±5%, 50V, Cer.	DCC815231
2C44	Cap., 2p, ±0.25p, 50V, Cer.	DCC815041
2C45	Cap., 120p, ±5%, 50V, Cer.	DCC815281
2C56	Same as 2C07	
2C85	Same as 2C07	
2C95	Same as 2C44	
2C101	Same as 2C07	
2C141	Same as 2C07	
2C152	Same as 2C07	
2C202	Cap., 4p, ±0.25p, 50V, Cer.	DCC815081
2C203	Same as 2C202	
2C207	Same as 2C42	
2C208	Same as 2C42	
2C211	Cap., 8p, ±0.5p, 50V, Cer.	DCC815131
2C212	Cap., 3p, ±0.25p, 50V, Cer.	DCC815061
2L01	Coil, 3T	DCL150441
2L02	Same as 2L01	
2L03	Same as 2L01	
2R11	Res., 22, ±5%, 1/8W, Carbon	DRZ840191
2R12	Res., 560, ±5%, 1/8W, Carbon	DRZ840531
2R14	Res., 150, ±5%, 1/8W, Carbon	DRZ840391
2R15	Same as 2R12	
2R16	Same as 2R11	
2R17	Res., 200, ±5%, 1/8W, Carbon	DRZ840421
2R18	Res., 68, ±5%, 1/8W, Carbon	DRZ840311
2R21	Res., B100, Var., 0.3W, Metal	DRV411721
2R26	Res., 47, ±5%, 1/8W, Carbon	DRZ840271
2R28	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
2R31	Same as 2R26	
2R32	Res., 1.0K, ±5%, 1/8W, Carbon	DRZ840591
2R33	Same as 2R28	
2R34	Same as 2R32	
2R35	Same as 2R21	
2R36	Res., 3.9K, ±5%, 1/8W, Carbon	DRZ840731
2R37	Res., 2.4K, ±5%, 1/8W, Carbon	DRZ840681
2R38	Res., 470, ±5%	DRZ830241
2R41	Same as 2R38	
2R42	Res., B200, Var., 0.3W, Metal	DRV411731
2R43	Same as 2R12	
2R44	Res., 620, ±5%, 1/8W, Carbon	DRZ840541
2R45	Same as 2R44	
2R46	Same as 2R44	
2R47	Same as 2R44	
2R48	Res., B10K, Var., 0.3W, Metal	DRV411991
2R51	Same as 2R48	
2R53	Res., B2K, Var., 0.3W, Metal	DRV412041
2R57	Res., 680, ±5%, 1/8W, Carbon	DRZ840551
2R58	Same as 2R57	
2R62	Same as 2R57	
2R63	Same as 2R57	
2R64	Res., 30, ±5%, 1/8W, Carbon	DRZ840221
2R65	Same as 2R64	
2R67	Res., B500, Var., 0.3W, Metal	DRV412021
2R68	Res., 180, ±5%, 1/8W, Carbon	DRZ840411
2R71	Res., 360, ±5%, 1/8W, Carbon	DRZ840481
2R72	Res., 330, ±5%, 1/8W, Carbon	DRZ840471
2R73	Res., 6.2K, ±5%, 1/8W, Carbon	DRZ840781

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
2R74	Res., 5.1K, ±5%, 1/8W, Carbon	DRZ840761
2R75	Res., 1.5K, ±5%, 1/8W, Carbon	DRZ840631
2R76	Same as 2R72	
2R77	Same as 2R75	
2R78	Same as 2R28	
2R81	Same as 2R28	
2R82	Res., 4.3K, ±5%, 1/8W, Carbon	DRZ840741
2R83	Res., 15K, ±5%, 1/8W, Carbon	DRZ840871
2R84	Same as 2R83	
2R85	Same as 2R74	
2R86	Res., B20K, Var., 0.3W, Metal	DRV411901
2R87	Same as 2R71	
2R88	Same as 2R72	
2R93	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
2R94	Same as 2R38	
2R95	Same as 2R38	
2R96	Same as 2R74	
2R97	Res., 1.2K, ±5%, 1/8W, Carbon	DRZ840611
2R98	Same as 2R17	
2R101	Same as 2R17	
2R103	Same as 2R32	
2R104	Same as 2R26	
2R105	Same as 2R26	
2R106	Same as 2R28	
2R107	Res., 3.3K, ±5%, 1/8W, Carbon	DRZ840711
2R108	Same as 2R107	
2R111	Res., 2K, ±5%, 1/8W, Carbon	DRZ840661
2R112	Same as 2R11	
2R113	Res., 160, ±5%, 1/8W, Carbon	DRZ840401
2R114	Res., 1.8K, ±5%, 1/4W, Carbon	DRD939281
2R115	Res., 2.7K, ±5%, 1/4W, Carbon	DRD939301
2R116	Res., 6.8K, ±5%, 1/4W, Carbon	DRD939351
2R117	Res., 16K, ±5%, 1/4W, Carbon	DRD938081
2R118	Res., 750, ±5%, 1/8W, Carbon	DRZ840561
2R121	Same as 2R118	
2R122	Same as 2R118	
2R123	Same as 2R118	
2R124	Same as 2R44	
2R125	Same as 2R14	
2R126	Same as 2R75	
2R127	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
2R128	Same as 2R111	
2R129	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
2R131	Res., B5K, Var., 0.3W, Metal	DRV411891
2R132	Same as 2R26	
2R133	Same as 2R28	
2R134	Same as 2R28	
2R135	Same as 2R26	
2R136	Same as 2R118	
2R137	Same as 2R118	
2R138	Same as 2R118	
2R141	Same as 2R118	
2R142	Same as 2R26	
2R143	Same as 2R26	
2R144	Res., 240, ±5%, 1/8W, Carbon	DRZ840441
2R145	Same as 2R93	
2R146	Res., 1.8K, ±5%, 1/8W, Carbon	DRZ840651
2R147	Same as 2R28	
2R148	Res., B500, Var., 0.3W, Metal	DRV411921
2R151	Same as 2R146	
2R152	Res., 4.7K, ±5%, 1/8W, Carbon	DRZ840751
2R153	Res., B1K, Var., 0.3W, Metal	DRV411911
2R154	Same as 2R75	
2R155	Same as 2R152	
2R156	Same as 2R82	
2R157	Same as 2R111	
2R161	Res., 33, ±5%, 1/8W, Carbon	DRZ840231
2R162	Res., 820, ±5%, 1/8W, Carbon	DRZ840571
2R163	Same as 2R161	
2R164	Same as 2R162	
2R165	Same as 2R28	
2R166	Same as 2R72	
2R167	Same as 2R72	
2R168	Same as 2R28	
2R171	Same as 2R73	
2R172	Same as 2R64	
2R173	Same as 2R64	
2R202	Same as 2R26	
2R203	Same as 2R26	
2R205	Same as 2R162	
2R206	Same as 2R162	
2R207	Res., 270, ±5%, 1/8W, Carbon	DRZ840451
2R208	Same as 2R207	
2R209	Same as 2R28	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
2R210	Same as 2R28	
2R211	Res., 56, ±5%, 1/8W, Carbon	DRZ840291
2R212	Same as 2R26	
2R215	Same as 2R12	
2R228	Same as 2R28	
2R233	Same as 2 R28	
2R251	Res., 22, ±1%, 1/4W, Carbon	DRE130431
2R252	Same as 2R251	
2D12	Diode, 1SS97	DDD010451
2D13	Same as 2D12	
2D16	Diode, 1S953	DDD010821
2D17	Diode, 1SS226	DDD810081
2D18	Same as 2D17	
2D19	Diode, 1SS184	DDD810071
2Q11	Transistor, 2SC3356-T1B	DTR830071
2Q12	Same as 2Q11	
2Q15	Transistor, 2SA 1245MD	DTR810021
2Q16	Same as 2Q15	
2Q17	Transistor, 2SC3099 TE85L	DTR830091
2Q18	Same as 2Q17	
2Q21	Transistor, 2SA1162Y TE85L	DTR810041
2Q22	Same as 2Q21	
2Q23	Same as 2Q15	
2Q24	Same as 2Q21	
2Q25	Same as 2Q15	
2Q26	Same as 2Q17	
2Q27	Same as 2Q17	
2Q28	Same as 2Q17	
2Q31	Same as 2Q17	
2Q32	Same as 2Q15	
2Q33	Same as 2Q21	
2Q34	Same as 2Q21	
2IC16	IC, μPC 151C	DIC610021
2RL21	Switch, RE0113	DKD065841
2J10	Connector, M36 M87-02	DCN034601
2J11	Same as 2J10	
2J33	Same as 2J10	
2J81	Connector, ZC-112	DCN032741
2J100	Connector, BNC 080	DCN040711
2P10	Connector, M36-02-30-134P	DCN034901
2P11	Same as 2P10	
2P33	Same as 2P10	
2P81	Connector, SMCD-12 x 300-ADX/10	KHB071211
2JP12	MCR18-JPW	DRZ841601

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
CH 2 PREAMPLIFIER (1) [3]		
3C01	Cap., 10000p, ±10%, 50V, Cer.	DCC810171
3C02	Same as 3C01	
3C03	Same as 3C01	
3C04	Same as 3C01	
3C05	Same as 3C01	
3C06	Same as 3C01	
3C10		
3C11	Cap., 9p, ±0.5p, 50V, Cer.	DCC231501
3C12	Cap., 0.5 ~ 1.5p, Var., 500V, Cer.	DCV020231
3C13	Cap., 1000p, ±10%, 500V, Cer.	DCC151801
3C14	Same as 3C01	
3C15	Same as 3C01	
3C16	Same as 3C01	
3C20	Cap., 33000p, ±10%, 50V, Film	DCF129091
3C21	Cap., 10μ, 16V	
3C23	Same as 3C01	
3C24	Cap., 2200p, ±10%, 500V, Film	DCF129061
3C26	Cap., 120p, ±5%, 50V, Cer.	DCC239261
3C31	Cap., 2 ~ 12p, Var., 250V, Cer.	DCV019601
3C32	Cap., 22p, ±5%, 50V, Cer.	DCC815191
3C40	Cap., 2p, ±0.25p, 50V, Cer.	DCC815041
3C41	Cap., 4p, ±0.25p, 50V, Cer.	DCC815081
3C43	Cap., 1p, ±0.25p, 50V, Cer.	DCC815021
3C48	Same as 3C01	
3C62	Cap., 100p, ±5%, 50V, Cer.	DCC239051
3C65	Same as 3C40	
3C66	Cap., 2.5 ~ 22.5p, Var., 250V, Cer.	DCV019591
3C67	Cap., 10p, ±0.5%, 50V, Cer.	DCC815151
3C68	Cap., 3p, ±0.25p, 50V, Cer.	DCC815061
3C76	Same as 3C01	
3C78	Same as 3C01	
3C82	Cap., 22000p, ±10%, 50V, Cer.	DCC810211
3C83	Cap., 220p, ±5%, 50V, Cer.	DCC815311
3C87	Same as 3C41	
3C88	Same as 3C41	
3C89	Same as 3C01	
3C90	Same as 3C01	
3C97	Same as 3C01	
3C99	Cap., 39p, ±5%, 50V, Cer.	DCC815221
3C104	Cap., 100p, ±5%, 50V, Cer.	DCC815271
3C151	Same as 3C01	
3L11	Coil, MB-72-12VDC	DCL112021
3L12	Same as 3L11	
3L13	Same as 3L11	
3R10	Res., 470, ±5%, 1/4W, Carbon	DRD939211
3R11	Res., 68, ±5%, 1/4W, Carbon	DRD939111
3R12	Res., 820K, ±0.5%, 1/4W, Metal	DRE938211
3R13	Res., 180K, ±1%,1/8W, Metal	DRZ847581
3R14	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
3R15	Res., 51, ±5%, 1/4W, Carbon	DRD939881
3R16	Res., 10M, ±5%, 1/4W, Metal	DRG330231
3R17	Res., 100, ±5%, Thermistor	DDD080331
3R18	Same as 3R14	
3R19	Res., 330, ±5%, 1/8W, Carbon	DRZ840471
3R20	Res., 200, ±5%, 1/8W, Carbon	DRZ840421
3R21	Res., 30, ±5%, 1/8W, Carbon	DRZ840221
3R22	Res., 1.2K, ±5%, 1/8W, Carbon	DRZ840611
3R23	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
3R24	Res., 2.4K, ±5%, 1/8W, Carbon	DRZ840681
3R25	Res., B20, Var., 0.3W, Metal	DRV411901
3R26	Res., 820K, ±1%, 1/8W, Metal	DRZ847591
3R27	Res., 160K, ±5%, 1/8W, Carbon	DRZ841121
3R28	Res., B50K,Var., 0.3W, Metal	DRV412061
3R31	Res., 10, ±1%, 1/8W, Metal	DRZ847641
3R32	Res., 2.2K, ±5%, 1/8W, Carbon	DRZ840671
3R33	Res., 12, ±1%, 1/8W, Metal	DRZ847651
3R34	Res., 18, ±1%, 1/8W, Metal	DRZ847661
3R35	Res., 120, ±0.5%, 1/4W, Metal	DRE938181
3R36	Same as 3R35	
3R37	Res., 150, ±0.5%, 1/4W, Metal	DRE938191
3R38	Res., 100, ±0.5%, 1/4W, Metal	DRE938171
3R40	Res., 36, ±5%, 1/8W, Carbon	DRZ840241
3R41	Res., 110, ±5%, 1/8W, Carbon	DRZ840361
3R42	Res., 220, ±0.5%, 1/4W, Metal	DRE938201
3R43	Res., 51, ±5%, 1/8W, Carbon	DRZ840281
3R45	Res., 560, ±5%, 1/8W, Carbon	DRZ840531
3R46	Same as 3R45	
3R48	Same as 3R14	
3R51	Res., 82, ±5%, 1/8W, Carbon	DRZ840331
3R52	Res., 510, ±5%, 1/8W, Carbon	DRZ840521
3R53	Same as 3R52	
3R54	Same as 3R52	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
3R55	Same as 3R52	
3R56	Same as 3R14	
3R57	Res., 18K, ±5% 1/8W, Carbon	DRZ840891
3R58	Same as 3R57	
3R59	Res., 20K, ±5%,1/8W, Carbon	DRZ840901
3R60	Same as 3R25	
3R61	Same as 3R14	
3R62	Same as 3R32	
3R65	Same as 3R14	
3R66	Res., B100, Var., 0.3W, Metal	DRV412001
3R68	Res., 56, ±5%, 1/8W, Carbon	DRZ840291
3R70	Res., 270, ±5%, 1/8W, Carbon	DRZ840451
3R71	Same as 3R70	
3R72	Same as 3R70	
3R73	Same as 3R70	
3R74	Same as 3R70	
3R75	Same as 3R70	
3R76	Same as 3R70	
3R77	Same as 3R70	
3R78	Res., 1.8K, ±5%, 1/8W, Carbon	DRZ840651
3R79	Same as 3R78	
3R80	Same as 3R43	
3R81		
3R82	Res., 240, ±5%, 1/8W, Carbon	DRZ840441
3R84	Res., B100, Var., 0.3W, Metal	DRV411721
3R87	Same as 3R51	
3R88	Same as 3R51	
3R89	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
3R90	Same as 3R89	
3R91	Res., 47, ±5%, 1/10W, Metal	DRZ830241
3R92	Same as 3R91	
3R93	Res., 6.2K, ±5%, 1/8W, Carbon	DRZ840781
3R94	Same as 3R24	
3R95	Res., 750, ±5%, 1/8W, Carbon	DRZ840561
3R96	Same as 3R95	
3R97	Same as 3R95	
3R98	Same as 3R95	
3R99	Res., 6.8K, ±5%, 1/8W, Carbon	DRZ840791
3R100	Res., 390, ±5%, 1/8W, Carbon	DRZ840491
3R101	Res., 10K, ±1%, 1/8W, Metal	DRZ847561
3R102	Same as 3R101	
3R103	Same as 3R101	
3R104	Same as 3R101	
3R105	Res., 470K, ±5%, 1/8W, Carbon	DRZ841231
3R106	Res., B50K, Var., 0.3W, Metal	DRV411971
3R107	Res., 1K, ±1%, 1/8W, Metal	DRZ847541
3R108	Res., 24, ±1%, 1/8W, Metal	DRZ847671
3R109	Res., 220, ±1%, 1/8W, Metal	DRZ847521
3R110	Res., 33K, ±5%, 1/8W, Carbon	DRZ840951
3R111	Res., 8.2K, ±5%, 1/8W, Carbon	DRZ840811
3R112	Res., B5K, Var., 0.3W, Metal	DRV412051
3R120	Same as 3R59	
3R121	Res., 100K, ±5%, 1/8W, Carbon	DRZ841071
3R122	Same as 3R121	
3RA2	Res., Resistors array, 10K, ±5%	DFB015561
3D03	Diode, 1SS184	DDD810071
3D04	Same as 3D03	
3D05	Same as 3D03	
3D10	Diode, 1S1544A	DDD010341
3D11	Same as 3D10	
3D12	Same as 3D10	
3Q10	Transistor, 2SK 141L2A	DTR215321
3Q11	Transistor, 2SC3099	DTR830091
3Q12	Transistor, 2SC2714	DTR830081
3Q13	Transistor, 2SC3356	DTR830071
3Q14	Same as 3Q11	
3Q15	Transistor, 2SA1245MD	DTR810021
3Q16	Same as 3Q11	
3Q17	Same as 3Q13	
3Q18	Same as 3Q15	
3Q19	Transistor, 2SA1162Y	DTR810041
3IC31	IC, SN7406N	DIC110071
3IC32	IC, SN74LS02N	DIC140031
3IC33	IC, SN74LS27N	DIC140281
3IC34	IC, LF 355H-S4	DIC613661
3IC35	IC, μPC 251C	
3S03	Switch, KSE1-2-00 LLDM	DSW015371
3S04	Same as 3S03	
3S11	Switch, ORD229	DKD065891

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
3S12	Same as 3S11				
3S13	Same as 3S11				
3RL07	Relay, SY-12	DKD027301			
3RL08	Same as 3RL07				
3J21	BNC080	DCN040711			

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
CH 2 PREAMPLIFIER (2) [4]		
4C01		DCE929141
4C02	Same as 4C01	
4C03	Same as 4C01	
4C04	Same as 4C01	
4C05	Same as 4C01	
4C07	Cap., 10000p, ±10%, 50V, Cer.	DCC810171
4C11	Cap., 5p, ±0.25p, 50V, Cer.	DCC815101
3C13	Cap., 2 ~ 8p, Var., 250V, Cer.	DCV019611
4C15	Same as 4C07	
4C17	Cap., 2 ~ 12p, Var., 250V, Cer.	DCV019601
4C18	Cap., 5p, ±0.25p, 50V, Cer.	DCC815101
4C24	Cap., 2p, ±0.25p, 50V, Cer.	DCC815041
4C25	Cap., 270p, ±5%, 50V, Cer.	DCC815321
4C26	Cap., 3300p, ±10%, 50V, Cer.	DCC810111
4C27	Cap., 33p, ±5%, 50V, Cer.	DCC815211
4C31	Cap., 5 ~ 40p, Var., 250V, Cer.	DCV019751
4C33	Cap., 3p, ±0.25p, 50V, Cer.	DCC815061
4C34	Cap., 47p, ±5%, 50V, Cer.	DCC815231
4C35	Cap., 27p, ±5%, 50V, Cer.	DCC815201
4C42	Cap., 120p, ±5%, 50V, Cer.	DCC239261
4C43	Cap., 2200p, ±10%, 50V, Film	DCF129061
4C91	Same as 4C07	
4C131	Same as 4C24	
4C132	Same as 4C24	
4C203	Cap., 4p, ±0.25p, 50V, Cer.	DCC815081
4C207	Cap., 1000p, ±10%, 50V, Cer.	DCC810051
4C208	Same as 4C207	
4C210	Same as 4C07	
4C211	Same as 4C33	
4R10	Res., 22, ±5%, 1/8W, Carbon	DRZ840191
4R11	Res., 560, ±5%, 1/8W, Carbon	DRZ840531
4R13	Same as 4R11	
4R14	Res., 150, ±5%, 1/8W, Carbon	DRZ840391
4R15	Res., 200, ±5%. 1/8W, Carbon	DRZ840421
4R16	Res., 68, ±5%, 1/8W, Carbon	DRZ840311
4R17	Res., B100, Var., 0.3W, Metal	DRV411721
4R23	Same as 4R10	
4R24	Res., 47, ±5%, 1/8W, Carbon	DRZ840271
4R26	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
4R27	Same as 4R26	
4R28	Same as 4R24	
4R30	Res., 3.9K, ±5%, 1/8W, Carbon	DRZ840731
4R31	Res., 2.4K, ±5%, 1/8W, Carbon	DRZ840681
4R32	Res., 47, ±5%, 1/10W, Metal	DRZ830241
4R33	Same as 4R32	
4R34	Same as 4R17	
4R35	Same as 4R11	
4R36	Res., B200, Var., 0.3W, Metal	DRV411731
4R37	Res., 680, ±5%, 1/8W, Carbon	DRZ840551
4R38	Same as 4R37	
4R41	Res., 30, ±5%, 1/8W, Carbon	DRZ840221
4R42	Res., B200, Var., 0.3W, Metal	DRV412011
4R43	Same as 4R41	
4R44	Res., 180, ±5%, 1/8W, Carbon	DRZ840411
4R45	Res., 330, ±5%, 1/8W, Carbon	DRZ840471
4R46	Res., 360, ±5%, 1/8W, Carbon	DRZ840481
4R47	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
4R52	Same as 4R24	
4R53	Same as 4R24	
4R54	Same as 4R24	
4R55	Same as 4R24	
4R56	Res., 6.8K, ±5%, 1/8W, Carbon	DRZ840791
4R57	Res., 5.1K, ±5%, 1/8W, Carbon	DRZ840761
4R58	Res., 1.2K, ±5%, 1/8W, Carbon	DRZ840611
4R60	Same as 4R57	
4R61	Same as 4R15	
4R62	Same as 4R58	
4R63	Same as 4R24	
4R64	Same as 4R24	
4R65	Same as 4R26	
4R66	Res., 3.3K, ±5%, 1/8W, Carbon	DRZ840711
4R67	Same as 4R66	
4R68	Res., 620, ±5%, 1/8W, Carbon	DRZ840541
4R70	Res., 160, ±5%, 1/8W, Carbon	DRZ840401
4R71	Same as 4R57	
4R72	Same as 4R56	
4R73	Res., 3K, ±5%, 1/8W, Carbon	DRZ840701
4R74	Same as 4R73	
4R75	Same as 4R73	
4R76	Same as 4R73	
4R77	Res., 240, ±5%, 1/8W, Carbon	DRZ840441

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
4R78	Res., 1.5K, ±5%, 1/8W, Carbon	DRZ840631
4R80	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
4R81	Res., 2K, ±5%, 1/8W, Carbon	DRZ840661
4R82	Res., 150, ±5%, 1/8W, Carbon	DRZ840391
4R83	Res., B5K, Var., 0.3W, Metal	DRV411891
4R84	Same as 4R26	
4R85	Same as 4R24	
4R86	Same as 4R73	
4R87	Same as 4R73	
4R88	Same as 4R37	
4R90	Same as 4R37	
4R92	Same as 4R57	
4R94	Same as 4R26	
4R95	Same as 4R78	
4R96	Res., 390, ±5%, 1/8W, Carbon	DRZ840491
4R97	Same as 4R45	
4R98	Same as 4R46	
4R100	Same as 4R78	
4R101	Same as 4R26	
4R102	Res., 15K, ±5%, 1/8W, Carbon	DRZ840871
4R103	Same as 4R102	
4R104	Same as 4R57	
4R105	Res., 4.3K, ±5%, 1/8W, Carbon	DRZ840741
4R106	Res., B20K, Var., 0.3W, Metal	DRV411901
4R107	Same as 4R56	
4R111	Res., B2K, Var., 0.3W, Metal	DRV412041
4R112	Res., B10K, Var., 0.3W, Metal	DRV411991
4R113	Same as 4R112	
4R115	Same as 4R68	
4R116	Same as 4R11	
4R117	Same as 4R68	
4R118	Same as 4R11	
4R121	Res., 33, ±5%, 1/8W, Carbon	DRZ840231
4R122	Same as 4R45	
4R123	Res., 820, ±5%, 1/8W, Carbon	DRZ840571
4R124	Same as 4R121	
4R125	Same as 4R45	
4R126	Same as 4R123	
4R127	Res., 30, ±5%, 1/8W, Carbon	DRZ840221
4R128	Same as 4R127	
4R131	Same as 4R24	
4R132	Same as 4R24	
4R133	Same as 4R93	
4R134	Same as 4R24	
4R135	Res., 1.8K, ±5%, 1/8W, Carbon	DRZ840651
4R188	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
4R203	Same as 4R24	
4R205	Same as 4R123	
4R206	Same as 4R123	
4R207	Res., 270, ±5%, 1/8W, Carbon	DRZ840451
4R208	Same as 4R207	
4R211	Same as 4R11	
4R213	Same as 4R11	
4R214	Res., 56, ±5%, 1/8W, Carbon	DRZ840291
4R226	Res., 110, ±5%, 1/8W, Carbon	DRZ840361
4R227	Same as 4R226	
4R236	Same as 4R26	
4R237	Same as 4R26	
4R251	Res., 22, ±1%, 1/4W, Metal	DRE130431
4R252	Same as 4R251	
4D11	Diode 1SS 97	DDD010451
4D12	Same as 4D11	
4D15	Diode, 1SS 184	DDD810071
4Q10	Transistor, 2SC3356-T1B	DTR830071
4Q11	Same as 4Q10	
4Q14	Transistor, 2SA1245MD	DTR810021
4Q15	Same as 4Q14	
4Q16	Transistor, 2SC3099	DTR830091
4Q17	Same as 4Q16	
4Q18	Transistor, 2SA1162	DTR810031
4Q20	Same as 4Q14	
4Q21	Same as 4Q14	
4Q22	Same as 4Q14	
4Q23	Same as 4Q14	
4Q24	Same as 4Q18	
4Q25	Same as 4Q18	
4Q26	Same as 4Q16	
4Q27	Same as 4Q16	
4Q28	Same as 4Q16	
4Q30	Same as 4Q16	
4Q31	Same as 4Q14	
4Q32	Same as 4Q16	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
4Q40	Same as 4Q16				
4Q45	Same as 4Q16				
4RL21	Switch, RE0113	DKD065841			
4J12	Connector, M36-M87-02	DCN034601			
4J80	Connector, ZC-112	DCN032741			
4P12	Connector, M36-02-30-134p	DCN034901			

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
DELAY CABLE DRIVER [5]		
5C03	Cap., 5 ~ 40p, Var., 250V, Cer.	DCV019751
5C04	Cap., 2.5 ~ 22.5p, Var., 250V, Cer.	DCV019591
5C06	Cap., 6p, ±0.5p 50V, Cer.	DCC815111
5C19	Cap., 1000p, ±10%, 50V, Cer.	DCC810051
5C20	Same as 5C19	
5C33	Same as 5C03	
5C36	Same as 5C06	
5C39	Same as 5C19	
5C40	Same as 5C19	
5C45	Cap., 10000p, ±10%, 50V, Cer.	DCC810171
5C54	Same as 5C45	
5C57	Same as 5C45	
5C64	Same as 5C45	
5C67	Cap., 15p, ±5%, 50V, Cer.	DCC815171
5C68	Cap., 4p, ±0.25p, 50V, Cer.	DCC815081
5C76	Cap., 5p, ±0.25p, 50V, Cer.	DCC815101
5C83	Same as 5C76	
5C84	Cap., 7p, ±0.5p, 50V, Cer.	DCC815121
5C85	Cap., 390p, ±5%, 50V, Cer.	DCC815341
5C86	Same as 5C85	
5C89	Cap., 150p, ±5%, 50V, Cer.	DCC815291
5C90	Same as 5C89	
5C111	Same as 5C45	
5C118	Cap., 1p, ±0.25p, 50V, Cer.	DCC815021
5C121	Cap., 3p, ±0.25p, 50V, Cer.	DCC815061
5C137	Cap., 33p, ±5%, 50V, Cer.	DCC815211
5C171	Cap., 2p, ±0.25p, 50V, Cer.	DCC815041
5C172	Same as 5C171	
5C173	Same as 5C171	
5C174	Same as 5C171	
5C175	Same as 5C171	
5C176	Same as 5C171	
5C201	Cap., 9p, ±0.5%, 50V, Cer.	DCC815141
5C202	Same as 7C45	
5C205	Res., 2p, ±0.25p, 50V, Carbon	DCC230501
5C210	Same as 5C45	
5C220	Same as 5C45	
5C221	Same as 5C45	
5C222	Same as 5C45	
5C223	Same as 5C45	
5C230	Same as 5C45	
5C231	Same as 5C45	
5L51	Coil, MB-72-12VDC	DCL112021
5L52	Same as 5L51	
5R03	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
5R04	Res., B200, Var., 0.3W, Metal	DRV412011
5R05	Res., 51, ±5%, 1/8W, Carbon	DRZ840281
5R06	Res., 820, ±5%, 1/8W, Carbon	DRZ840571
5R07	Same as 5R06	
5R08	Same as 5R06	
5R09	Same as 5R05	
5R10	Res., 82, ±5%, 1/8W, Carbon	DRZ840331
5R11	Same as 5R06	
5R12	Same as 5R03	
5R13	Res., 240, ±5%, 1/8W, Carbon	DRZ840441
5R14	Res., 270, ±5%, 1/8W, Carbon	DRZ840451
5R15	Same as 5R13	
5R16	Same as 5R14	
5R18	Res., 47p, ±5%, 1/10W, Metal	DRZ830241
5R19	Res., 75, ±5%, 1/8W, Carbon	DRZ840321
5R20	Same as 5R19	
5R21	Same as 5R18	
5R22	Res., 5.1K, ±5%, 1/8W, Carbon	DRZ840761
5R23	Res., 1. 2K, ±5%, 1/8W, Carbon	DRZ840611
5R24	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
5R25	Res., 200, ±5%, 1/8W, Carbon	DRZ840421
5R27	Same as 5R24	
5R28	Same as 5R25	
5R29	Res., 51, ±5%, 1/4W, Carbon	DRD939881
5R30	Same as 5R10	
5R33	Same as 5R03	
5R34	Same as 5R04	
5R35	Same as 5R05	
5R36	Same as 5R06	
5R37	Same as 5R06	
5R38	Same as 5R06	
5R39	Same as 5R19	
5R40	Same as 5R19	
5R41	Same as 5R06	
5R42	Res., 100, ±5%, 1/4W, Carbon	DRD939131
5R43	Same as 5R13	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
5R44	Same as 5R14	
5R45	Same as 5R13	
5R46	Same as 5R14	
5R47	Res., 130, ±5%, 1/8W, Carbon	DRZ840381
5R48	Same as 5R47	
5R51	Same as 5R06	
5R52	Same as 5R06	
5R53	Same as 5R06	
5R54	Same as 5R06	
5R55	Res., 560, ±5%, 1/8W, Carbon	DRZ840531
5R56	Same as 5R55	
5R57	Same as 5R55	
5R58	Same as 5R55	
5R61	Same as 5R55	
5R62	Same as 5R55	
5R63	Res., 3K, ±5%, 1/8W, Carbon	DRZ840701
5R64	Same as 5R24	
5R65	Same as 5R63	
5R66	Res., 33, ±5%, 1/8W, Carbon	DRZ840231
5R67	Res., 20, ±5%, 1/8W, Carbon	DRZ840181
5R68	Res., 56, ±5%, 1/8W, Carbon	DRZ840291
5R69	Res., 39K, ±5%, 1/8W, Carbon	DRZ840971
5R70	Res., 10K, ±5%, 1/4W, Carbon	DRD939371
5R71	Same as 5R66	
5R72	Same as 5R23	
5R73	Same as 5R23	
5R74	Same as 5R23	
5R75	Same as 5R23	
5R76	Same as 5R10	
5R77	Same as 5R23	
5R78	Same as 5R23	
5R81	Same as 5R23	
5R82	Same as 5R23	
5R83	Same as 5R10	
5R84	Res., 75, ±5%,1/4W, Carbon	DRD138961
5R85	Res., 620, ±5%, 1/8W, Carbon	DRZ840541
5R86	Res., 330, ±5%, 1/8W, Carbon	DRZ840471
5R87	Same as 5R84	
5R88	Same as 5R18	
5R89	Res., 220, ±5%, 1/10W, Metal	DRZ830121
5R90	Same as 5R89	
5R91	Same as 5R18	
5R92	Same as 5R18	
5R93	Same as 5R18	
5R94	Same as 5R05	
5R95	Res,, 100K, ±5%,1/8W, Carbon	DRZ841071
5R108	Res., 510, ±5%, 1/8W, Carbon	DRZ840521
5R111	Same as 5R108	
5R112	Same as 5R108	
5R113	Same as 5R108	
5R114	Same as 5R67	
5R115	Same as 5R85	
5R116	Same as 5R67	
5R117	Same as 5R13	
5R118	Res., 160, ±5%, 1/8W, Carbon	DRZ840401
5R121	Res., 47, ±5%, 1/8W, Carbon	DRZ840271
5R123	Same as 5R63	
5R124	Same as 5R63	
5R125	Same as 5R63	
5R126	Same as 5R63	
5R127	Res., 1.5K, ±5%, 1/8W, Carbon	DRZ840631
5R128	Same as 5R127	
5R130	Res., 6.2K, ±5%, 1/8W, Carbon	DRZ840781
5R131	Res., 150, ±5%, 1/8W, Carbon	DRZ840391
5R132	Res., 2K, ±5%, 1/8W, Carbon	DRZ840661
5R133	Res., B5K, Var., 0.3W, Metal	DRV411891
5R134	Same as 5R03	
5R135	Same as 5R63	
5R136	Same as 5R63	
5R137	Same as 5R121	
5R138	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
5R141	Res., 3.6K, ±5%, 1/8W, Carbon	DRZ840721
5R142	Same as 5R138	
5R143	Same as 5R141	
5R144	Res., 1.6K, ±5%, 1/8W, Carbon	DRZ840641
5R145	Same as 5R144	
5R146	Same as 5R24	
5R148	Same as 5R05	
5R152	Same as 5R95	
5R153	Res., 20K, ±5%, 1/8W, Carbon	DRZ840901
5R161	Res., B100, Var., 0.3W, Metal	DRV411721
5R162	Same as 5R161	
5R171	Same as 5R121	
5R172	Same as 5R121	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
5R173	Res., 91, ±5%, 1/8W, Carbon	DRZ840341
5R174	Same as 5R173	
5R175	Same as 5R173	
5R176	Same as 5R173	
5R184	Same as 5R68	
5R201	Same as 5R68	
5R205	Res., 62, ±5%, 1/4W, Carbon	DRD938151
5D01	Diode, 1SS97	DDD010451
5D02	Same as 5D01	
5D03	Same as 5D01	
5D04	Same as 5D01	
5D05	Same as 5D01	
5D06	Same as 5D01	
5D07	Same as 5D01	
5D08	Same as 5D01	
5D11	Same as 5D01	
5D12	Same as 5D01	
5D13	Diode, 1SS181	DDD810061
5D14	Diode, 1SS184	DDD810071
5D15	Diode, 1SS226	DDD810081
5D16	Same as 5D13	
5D17	Same as 5D15	
5D67	Diode, 1SV69	DDD011101
5Q01	Transistor, 2SC3099	DTR830091
5Q02	Transistor, 2SA1245MD	DTR810021
5Q03	Same as 5Q02	
5Q04	Same as 5Q04	
5Q05	Same as 5Q04	
5Q06	Same as 5Q01	
5Q07	Same as 5Q04	
5Q08	Transistor, 2SC2712G	DTR830051
5Q11	Transistor, 2SC3356	DTR830071
5Q12	Same as 5Q02	
5Q13	Same as 5Q02	
5Q16	Same as 5Q02	
5Q17	Same as 5Q02	
5Q18	Same as 5Q01	
5Q21	Same as 5Q01	
5Q22	Same as 5Q02	
5Q23	Same as 5Q01	
5Q24	Same as 5Q08	
5Q25	Same as 5Q04	
5Q26	Same as 5Q01	
5Q28	Same as 5Q11	
5Q85	Same as 5Q04	
5S51	Switch, DRD229	DKD065891
5S52	Same as 5S51	
5J11	Connector, M36-M87-02	DCN034601
5J13	Same as 5J11	
5J17	Same as 5J11	
5J82	Connector, ZC-110	DCN032731
5P11	Connector, M36-02-30-134P	DCN034901
5P13	Same as 5P11	
5P17	Same as 5P11	
5P31	Connector, 65507-136	DCN033501
5P82	SMCD-10 x 250-BDX10P1.25	KHB070811
5DL01	VDL-2X110.8-100Ω	KHB043011

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
VERTICAL SWITCHES [6]					
6C19	Cap., 1μ, , 50V, Elect.	DCE949011			
6R11	Res., 10K,	DRV145931			
6R13	Res., 8.2K, ±1%, 1/4W, Metal	DRE999361			
6R16	Res., 3K, ±5%, 1/4W, Carbon	DRD939631			
6R17	Res., 10K, ±5%, 1/4W, Carbon	DRD939371			
6R18	Res., 100K, ±5%, 1/4W, Carbon	DRD939491			
6R19	Res., 20K, ±5%, 1/4W, Carbon	DRD938091			
6R20	Same as 6R17				
6R21	Same as 6R16				
6R22	Same as 6R16				
6R24	Same as 6R24				
6R27	Same as 6R16				
6D16	Diode, TLR206	DDD070181			
6D19	Diode, 1S953	DDD010821			
6D21	Same as 6D16				
6D22	Same as 6D16				
6D27	Same as 6D16				
6Q19	Transistor, 2SC1815GR	DTR139011			
6IC11	IC, CD 4071BE	DIC410641			
6IC12	IC, CD 4027BE	DIC410261			
6S12	Switch, KSE1-2-00LLDM	DSW015371			
6S13	Switch, KSE1-2-00NLDM	DSW015381			
6J81	Connector, ZC-112	DCN032741			

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
VERTICAL CONTROL [7]		
7C01	Cap., 120p, ±5%, 50V, Cer.	DCC239261
7C02	Same as 7C01	
7C03	Cap., 10000p, ±10%, 50V, Cer.	DCC810171
7C04	Same as 7C03	
7C05	Same as 7C03	
7C07	Same as 7C03	
7C08	Same as 7C03	
7C09	Cap.,	
7C10	Same as 7C03	
7C17	Same as 7C03	
7C21	Same as 7C03	
7C22	Same as 7C03	
7R01	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
7R02	Same as 7R01	
7R03	Res., 8.2K, ±5%, 1/8W, Carbon	DRZ840811
7R04	Res., 1.8K, ±5%, 1/8W, Carbon	DRZ840651
7R05	Same as 7R03	
7R06	Same as 7R04	
7R07	Res., 430, ±5%, 1/8W, Carbon	DRZ840501
7R08	Res., 2.2K, ±5%, 1/8W, Carbon	DRZ840671
7R11	Same as 7R07	
7R12	Same as 7R08	
7R13	Same as 7R08	
7R15	Same as 7R08	
7R17	Res., 3.6K, ±5%, 1/8W, Carbon	DRZ840721
7R21	Res., 33, ±5%, 1/8W, Carbon	DRZ840231
7R22	Same as 7R21	
7RA81		
7RA82		
7D01	Diode, 1S953	DDD010821
7D02	Diode, 1SS97	DDD010451
7D03	Same as 7D02	
7IC81	IC, SN74LS09N	DIC140101
7IC82	IC, SN74LS02N	DIC140031
7IC83	IC, SN74LS32N	DIC140331
7IC84	IC, SN74LS112N	DIC141111
7IC85	IC, SN74LS00N	DIC140011
7IC86	Same as 7IC83	
7IC87	IC, SN 74 LS10N	DIC140111
7IC88	IC, SN 74 LS04N	DIC140051
7S81	Switch, KSE5-10-10	DSW015471
7J21	Connector, M36M87-04	DCN034621
7J90	Connector, ZC-112	DCN032741
7J91	Same as 7J90	
7P21	Connector, M36-04-30-134P	DCN034921
7P90	SMCD-12 x 300 - AD x 10P1.25	KHB071211

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
VERTICAL MAIN AMPLIFIER [8]		
8C11	Cap., 4p, ±0.25p, 50V, Cer.	DCC815081
8C12	Same as 8C11	
8C13	Cap., 2 ~ 12p, Var., 250V, Cer.	DCV019601
8C14	Cap., 2 ~ 8p, Var., 250V, Cer.	DCV019611
8C15	Cap., 390p, ±5%, 50V, Cer.	DCC815341
8C16	Cap., 1000p, ±10%, 50V, Film	DCF129071
8C17	Cap., 10000p, ±10%, 50V, Film	DCF129051
8C22	Cap., 10000p, ±10%, 50V, Cer.	DCC810171
8C24	Cap., 27p, ±5%, 50V, Cer.	DCC815201
8C25	Same as 8C13	
8C27	Cap., 1000p, ±10%, 50V, Cer.	DCC810051
8C28	Same as 8C27	
8C30	Cap., 1000p, ±10%, 50V, Film	DCF129071
8C31	Cap., 10000p, ±10%, 50V, Film	DCF129051
8C32	Cap., 0.1μ, ±10%, 50V, Film	DCF129131
8C33	Cap., 1μ, 50V, Elect	DCE949191
8C34		
8C35		
8C36	Same as 8C22	
8C37	Same as 8C11	
8C38	Same as 8C11	
8C41	Same as 8C11	
8C42	Same as 8C11	
8C43	Cap., 10000p, +80 ~ -20%, 500V, Cer.	DCC153511
8C44		
8C45		
8C50	Same as 8C22	
8C51	Same as 8C22	
8C52	Same as 8C22	
8C53	Same as 8C22	
8C55	Same as 8C22	
8C112	Cap., 180p, ±5%, 50V, Cer.	DCC815301
8C183	Cap., 3p, ±0.25p, 50V, Cer.	DCC239071
8C184	Same as 8C183	
8L11	Coil	DCL150181
8L12	Same as 8L11	
8L13	Coil	DCL150171
8L14	Same as 8L13	
8L15	Coil 3T	DCL150441
8L16	Same as 8L15	
8R28	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
8R31	Same as 8R28	
8R32	Same as 8R28	
8R33	Res., 33, ±5%, 1/8W, Carbon	DRZ840231
8R34	Res., 390, ±5%, 1/8W, Carbon	DRZ840491
8R35	Res., 56, ±5%, 1/8W, Carbon	DRZ840291
8R36	Res., B5K, Var., 0.3W, Metal	DRV411891
8R37	Same as 8R35	
8R38	Res., B500, Var., 0.3W, Metal	DRV412021
8R41	Res., 62, ±5%, 1/8W, Carbon	DRZ840301
8R42	Res., 30, ±5%, 1/8W, Carbon	DRZ840221
8R43	Same as 8R42	
8R44	Res., B1K, Var., 0.3W, Metal	DRV412031
8R45	Res., B5K, Var., 0.3W, Metal	DRV412051
8R46	Same as 4R45	
8R51	Res., 300, ±5%, 1/8W, Carbon	DRZ840461
8R52	Same as 4R51	
8R53	Res., B500, Var., 0.3W, Metal	DRV411921
8R54	Same as 4R51	
8R55	Same as 4R51	
8R56	Same as 4R28	
8R57	Same as 4R28	
8R58	Same as 4R28	
8R61	Same as 8R33	
8R62	Res., 470, ±5%, 1/8W, Carbon	DRZ840511
8R63	Same as 8R62	
8R64	Res., 62K, ±5%, 1/8W, Carbon	DRZ841021
8R65	Same as 8R64	
8R66	Res., 3.9K, ±5%, 1/8W, Carbon	DRZ840731
8R67	Res., 20K, ±5%, 1/8W, Carbon	DRZ840901
8R68	Same as 8R67	
8R70	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
8R71	Same as 8R70	
8R72	Res., 220K, ±5%, 1/4W, Carbon	DRD939531
8R73	Res., 180K, ±5%, 1/4W, Carbon	DRD939521
8R74	Res., 160K, ±1%, 1/4W, Metal	DRE998051
8R75	Res., 110K, ±5%, 1/8W, Carbon	DRZ841081
8R76	Res., 75K, ±5%, 1/8W, Carbon	DRZ841041
8R77	Res., 240K, ±5%, 1/8W, Carbon	DRZ841161

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
8R78	Same as 8R34	
8R81	Same as 8R62	
8R82	Same as 8R34	
8R83	Res., 620, ±5%, 1/10W, Metal	DRZ830781
8R84	Same as 8R28	
8R85	Res., 330, ±5%, 1/10W, Metal	DRZ830231
8R86	Res., 560, ±5%, 1/10W, Metal	DRZ830251
8R87	Same as 8R86	
8R88	Res., 820, ±5%, 1/8W, Carbon	DRZ840571
8R91	Same as 8R62	
8R92	Res., 47, ±5%, 1/8W, Carbon	DRZ840271
8R93	Res., B2K, Var., 0.3W, Metal	DRV412041
8R94	Same as 8R92	
8R95	Res., 270, ±5%, 1/8W, Carbon	DRZ840451
8R96	Same as 8R95	
8R97	Same as 8R95	
8R98	Same as 8R95	
8R99	Res., 510, ±5%, 1/8W, Carbon	DRZ840521
8R100		
8R101	Same as 8R95	
8R102	Same as 8R95	
8R103	Same as 8R99	
8R104	Same as 8R62	
8R105	Res., 470, ±5%, 1/10W, Metal	DRZ830241
8R106	Same as 8R105	
8R107		
8R108	Same as 8R83	
8R109	Res., 2.4K, ±5%, 1/8W, Carbon	DRZ840681
8R110	Res., 39K, ±5%, 1/8W, Carbon	DRZ840971
8R111	Same as 8R62	
8R112	Res., 510, ±5%, 1/8W, Carbon	DRZ840521
8R114	Same as 8R28	
8R115	Same as 8R85	
8R116	Res., 3K, ±5%, 1/8W, Carbon	DRZ840701
8R117	Same as 8R95	
8R118	Same as 8R95	
8R121	Res., 270, ±5%, 1/8W, Carbon	DRZ840451
8R122	Res., 240, ±5%, 1/8W, Carbon	DRZ840441
8R123	Same as 8R36	
8R124	Res., 200, ±1%, 1/2W, Metal	DRE949101
8R125	Same as 8R86	
8R126	Res., 22, ±5%, 1/8W, Carbon	DRZ840191
8R127	Res., 180, ±1%, 1/2W, Metal	DRE949091
8R128	Same as 8R86	
8R131	Same as 8R127	
8R132	Same as 8R86	
8R133	Same as 8R126	
8R134	Same as 8R124	
8R135	Same as 8R86	
8R136	Same as 8R92	
8R143	Same as 8R126	
8R144	Same as 8R126	
8D11	Diode, 1SV 69	DDD011101
8D12	Diode, 1SS 184	DDD810071
8Q16	Transistor, 2SC 3099	DTR830091
8Q17	Same as 8Q16	
8Q18	Transistor, 2SC2712G	DTR830051
8Q21	Same as 8Q18	
8Q22	Transistor, 2SA1162Y	DTR810041
8Q23	Same as 8Q22	
8Q24	Transistor, 2SA 1245MD	DTR810021
8Q25	Same as 8Q24	
8Q26	Transistor, 2SC3356	DTR830071
8Q27	Same as 8Q26	
8Q28	Same as 8Q26	
8Q31	Same as 8Q26	
8IC02	IC, HIC C2	DIC830021
8IC03	IC, HIC C3	DIC830031
8J79	Connector, ZC-112	DCN032741
8P11		
8JP11	MCR18-JPW	DRZ841601
8JP12	Same as 8JP11	
8JP13	Same as 8JP11	
8JP14	Same as 8JP11	
8JP15	Same as 8JP11	
8JP16	Same as 8JP11	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
CALIBRATOR & PANEL [9]		
9C11	Cap., 100p, ±20%, 25V, Elect.	DCE229071
9C12	Cap., 1000p, ±5p, 50V, Film	DCF129251
9C24	Cap., 0.01p, ±10%, 50V, Cer.	DCC810171
9C25	Cap., 33μ, ±20%, 25V, Elect.	DCE929141
9C26	Same as 9C24	
9C27	Same as 9C24	
9C35	Same as 9C25	
9C60	Same as 9C24	
9C61	Same as 9C25	
9C62	Same as 9C24	
9C63	Same as 9C25	
9L11	Coil	DCL140111
9L12	Coil	DCL140181
9R11	Res., 2.2, ±5%, 1/8W, Metal	DRZ847381
8R12	Res., 6.8K, ±5%, 1/8W, Carbon	DRZ840791
9R13	Res., 100K, Var., 0.3W, Metal	DRV411961
9R14	Res., 300K, ±1%, 1/4W, Metal	DRE998111
9R15	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
9R16	Same as 9R12	
9R17	Res., 4.7K, ±5%, 1/8W, Carbon	DRZ840751
9R18	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
9R19	Same as 9R18	
9R20	Same as 9R12	
9R21	Res., 200K, Var., 0.5W, Metal	DRV410511
9R22	Res., 1.0K, ±1%, 1/4W, Metal	DRE999011
9R23	Res., 60, ±0.5%, 1/8W, Metal	DRE239111
9R24	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
9R25	Same as 9R17	
9R26	Same as 9R15	
9R27	Res., 750, ±5%, 1/8W, Carbon	DRZ840561
9R28	Same as 9R15	
9R29	Same as 9R15	
9R30	Res., B50K, Var., 0.1W, Carbon	DRV147391
9R31	Same as 9R12	
9R32	Res., 2K, ±5%, 1/8W, Carbon	DRZ840661
9R33	Same as 9R15	
9R35	Same as 9R15	
9R36	Same as 9R15	
9R37	Same as 9R15	
9R38	Same as 9R15	
9R40	Same as 9R32	
9R41	Same as 9R18	
9R42	Same as 9R12	
9R43	Res., B20K Var., 0.125W, Carbon	DRV145971
9R44	Res., 1.5K, ±5% 1/8W, Carbon	DRZ840631
9R45	Res., 1.0K, ±5% 1/8W, Carbon	DRZ840591
9R50	Res., B20K, Var., 0.125W Carbon	DRV145951
9R51	Res., 360, ±5%, 1/8W, Carbon	DRZ840481
9R52	Res., 20K, Var., 0.3W, Metal	DRV411901
9R53	Res., 470, ±5%, 1/8W Carbon	DRZ840511
9D26	Diode 1SS 184	DDD810071
9D27	Diode, TLR206	DDD070181
9D29	Same as 9D26	
9D35	Diode 1SS 181	DDD810061
9D38	Same as 9D26	
9Q19	Transistor, 2SA1162Y	DTR810041
9Q20	Transistor, 2SC2712G	DTR830051
9Q26	Same as 9Q20	
9Q28	Same as 9Q19	
9Q32	Same as 9Q20	
9Q33	Same as 9Q20	
9Q36	Transistor, DTC114EK	DTR890011
9Q38	Same as 9Q19	
9Q40	Same as 9Q20	
9Q42	Same as 9Q20	
9Q43	Transistor, 2SD1266P/Q	DTR145851
9Q50	Same as 9Q20	
9Q51	Same as 9Q19	
9Q52	Same as 9Q20	
9Q53	Same as 9Q19	
9IC01	IC, SN 74LS74AN	DIC140751
9IC12	IC, μPC 251C	DIC610091
9S12	Switch, KSE1-2-00NLDM	DSW015381
9J12	Connector, M36-M87-02	DCN034601
9J13	Same as 9J12	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
9J14	Terminal, WP22-1B	DCN033821			
9J15	Same as 9J12				
9P12	Connector, M36-02-30-114P	DCN034851			
9P13	Same as 9P12				
9P15	Same as 9P12				
9P16					
9LP11	Lamp, BQ064-22012A	DLP016092			
9LP12	Same as 9LP11				
9LP13	Same as 9LP11				
9JP11	Jumper Wire, MCR18-JPW TD84N	DRZ841601			
9JP14	Same as 9JP11				
9JP15	Same as 9JP11				
9JP16	Same as 9JP11				

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
CH 3 & CH 4 PREAMPLIFIER [10]		
10C01	Cap., 0.047μ, ±20%, 250V, Film	DCF160291
10C02	Cap., 2~8p, Var., 250V, Cer.	DCV019611
10C03	Same as 10C02	
10C04	Cap., 6p, ±0.5p, 500V, Cer.	DCC251001
10C05	Cap., 0.01μ, ±10%, 50V, Cer.	DCC810171
10C06	Same as 10C05	
10C07	Cap., 1.5~5.5p, Var., 250V, Cer.	DCV019721
10C08	Cap., 15p, ±5p, 50V, Cer.	DCC239221
10C09	Same as 10C04	
10C10	Cap., 0.5p, ±0.25p, 500V, Cer.	DCC250101
10C11	Cap., 0.1μ, −20~+80%, 10V, Cer.	DCC810621
10C12	Cap., 1000p, ±10%, 50V, Cer.	DCC810051
10C13	Cap., 1000p, ±10%, 500V, Cer.	DCC159011
10C14	Cap., 24p, ±5%, 500V, Cer.	DCC252501
10C15	Cap., 10p, ±0.5p, 50V, Cer.	DCC815151
10C16	Cap., 1.5p, ±0.25p, 50V, Cer.	DCC230401
10C17	Cap., 68p, ±5%, 50V, Cer.	DCC233601
10C19	Same as 10C12	
10C20	Same as 10C01	
10C21	Same as 10C11	
10C23	Same as 10C11	
10C24	Same as 10C11	
10C25	Same as 10C02	
10C26	Same as 10C02	
10C28	Same as 10C05	
10V30	Same as 10C04	
10C31	Same as 10C05	
10C32	Same as 10C07	
10C33	Same as 10C08	
10C34	Same as 10C11	
10C35	Same as 10C12	
10C36	Same as 10C13	
10C38	Same as 10C15	
10C41	Same as 10C10	
10C42	Cap., 0.022μ, ±10%, 50V, Film	DCF120271
10C43	Cap., 75p, −20~+80%, 50V, Cer.	DCC233701
10C44	Same as 10C11	
10C45	Same as 10C11	
10C46	Same as 10C11	
10C47	Same as 10C05	
10C49	Same as 10C04	
10C52	Same as 10C14	
10C53	Cap., 3p, ±0.25p, 500V, Cer.	DCC250701
10C54	Cap., 3.3~20.5p, Var., 250V, Cer.	N800±300ppm/°C DCV019591
10C55	Same as 10C16	
10C56	Same as 10C54	
10C59	Cap., 1000p, ±10%, 50V, Cer.	DCC139051
10C61	Same as 10C54	
10C62	Same as 10C54	
10C67	Same as 10C05	
10C68	Same as 10C05	
10C95	Cap., 1000p, ±10%, 50V, Cer.	DCC131801
10C99	Cap., 27p, ±5%, 50V, Cer.	DCC232601
10C101	Cap., 1500p, ±10%, 50V, Film	DCF120131
10C103	Cap., 10p, ±0.5p, 50V, Cer.	DCC231701
10C111	Same as 10C101	
10C113	Cap., 7p, ±0.5p, 50V, Cer.	DCC231101
10C115	Same as 10C99	
10C201	Cap., 33p, ±5%, 50V, Cer.	DCC232801
10C202	Same as 10C201	
10R01	Res., 22, ±5%, 1/4W, Carbon	DRD939051
10R02	Res., 22, ±5%, 1/8W, Carbon	DRZ840191
10R03	Same as 10R02	
10R04	Res., 10, ±5%, 1/8W, Carbon	DRZ840111
10R05	Res., 100, ±5%, 1/4W, Carbon	DRD939131
10R06	Same as 10R05	
10R07	Res., 800K, ±0.5%, 1/4W, Metal	DRE139711
10R08	Res., 250K, ±0.5%, 1/4W, Metal	DRE938051
10R09	Res., 130, ±5%, 1/4W, Carbon	DRD939901
10R10	Res., 220, ±5%, 1/8W, Carbon	DRZ840431
10R11	Res., 4.7, ±5%, 1/8W, Carbon	DRZ840271
10R13	Res., 62, ±1%, 1/4W, Metal	DRE999681
10R14	Res., 820K, ±0.5%, 1/4W, Metal	DRE938211
10R16	Res., 180K, ±0.5%, 1/4W, Metal	DRE998351
10R17	Same as 10R16	
10R18	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
10R19	Res., B100, Var., 0.5W, Cermet	DRV410501
10R20	Same as 10R02	
10R21	Res., 1.0M, ±5%, 1/8W, Carbon	DRZ841311
10R22	Res., 2.4K, ±5%, 1/8W, Carbon	DRZ840681

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
10R23	Res., 300, ±5%, 1/8W, Carbon	DRZ840461
10R24	Res., 3.6K, ±5%, 1/8W, Carbon	DRZ840721
10R25	Res., 200, ±5%, 1/8W, Carbon	DRZ840421
10R26	Same as 10R18	
10R27	Res., 560, ±5%, 1/8W, Carbon	DRZ840531
10R28	Res., 820K, ±0.5%, 1/4W, Metal	DRE998381
10R29	Res., B5K, Var., 0.5W, Cermet	DRV410551
10R30	Same as 10R10	
10R32	Res., 56, ±5%, 1/8W, Carbon	DRZ840291
10R33	Same as 10R18	
10R34	Res., 2.4K, ±5%, 1/4W, Carbon	DRD938031
10R35	Res., B10K, Var., 0.3W, Metal	DRV411931
10R36	Res., 470, ±1%, 1/4W, Metal	DRE999211
10R37	Res., 390, ±1%, 1/4W, Metal	DRE999201
10R38	Res., 120, ±5%, 1/8W, Carbon	DRZ840371
10R39	Same as 10R19	
10R40	Same as 10R09	
10R42	Res., 1.3K, ±1%, 1/4W, Metal	DRE999771
10R43	Same as 10R42	
10R44	Same as 10R05	
10R47	Res., 1.0K, ±5%, 1/8W, Carbon	DRZ840591
10R48	Res., 1.5K, ±5%, 1/8W, Carbon	DRZ840631
10R50	Same as 10R27	
10R51	Res., 2.2K, ±5%, 1/8W, Carbon	DRZ840671
10R52	Same as 10R47	
10R53	Res., 1.3K, ±5%, 1/4W, Carbon	DRD938011
10R54	Same as 10R01	
10R55	Same as 10R02	
10R56	Same as 10R02	
10R57	Same as 10R04	
10R58	Same as 10R05	
10R60	Res., 560, ±5%, 1/8W, Carbon	DRZ840531
10R61	Same as 10R05	
10R62	Same as 10R07	
10R63	Same as 10R08	
10R64	Same as 10R11	
10R66	Res., 62, ±5%, 1/4W, Carbon	DRD938151
10R67	Same as 10R14	
10R70	Res., 110, ±5%, 1/4W, Carbon	DRD939891
10R71	Same as 10R16	
10R72	Same as 10R16	
10R73	Same as 10R18	
10R74	Same as 10R21	
10R75	Same as 10R22	
10R76	Res., 300, ±5%, 1/4W, Carbon	DRD939831
10R77	Same as 10R24	
10R78	Same as 10R25	
10R81	Same as 10R18	
10R82	Same as 10R60	
10R83	Same as 10R28	
10R85	Res., 56, ±5%, 1/8W, Carbon	DRZ840291
10R86	Same as 10R18	
10R87	Same as 10R34	
10R88	Same as 10R35	
10R91	Same as 10R36	
10R92	Same as 10R36	
10R93	Same as 10R38	
10R94	Same as 10R29	
10R95	Same as 10R42	
10R96	Same as 10R42	
10R97	Same as 10R47	
10R98	Same as 10R51	
10R99	Res., 36, ±5%, 1/4W, Carbon	DRD938201
10R101	Res., 3K, ±5%, 1/4W, Carbon	DRD939631
10R102	Same as 10R48	
10R103	Same as 10R47	
10R104	Res., 3.9K, ±5%, 1/8W, Carbon	DRZ840731
10R105	Same as 10R18	
10R106	Same as 10R53	
10R111	Same as 10R101	
10R112	Same as 10R47	
10R115	Same as 10R99	
10R116	Res., 82, ±5%, Carbon	DRD939121
10R117	Same as 10R05	
10R118	Same as 10R01	
10R155	Same as 10R116	
10D01	Diode, 1S1544A	
10D02	Same as 10D01	
10D03	Same as 10D01	
10D04	Same as 10D01	
10D05	Same as 10D01	
10D06	Same as 10D01	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
10Q01	Transistor, 2SK141L 2A	DTR215321			
10Q02	Transistor, 2SC3099 TE85L	DTR830091			
10Q03	Transistor, 2SC2712G TE85	DTR830051			
10Q04	Same as 10Q04				
10Q05	Same as 10Q04				
10Q06	Transistor, 2SA1245MD, TE85L	DTR810021			
10Q07	Same as 10Q06				
10Q08	Same as 10Q01				
10Q11	Same as 10Q02				
10Q12	Same as 10Q03				
10Q13	Same as 10Q02				
10Q14	Same as 10Q02				
10Q15	Same as 10Q06				
10Q16	Same as 10Q06				
10Q20	Same as 10Q3				
10Q117	Transistor, 2SA1206	DTR115301			
10IC01	IC, LF412CN (NS)	DIC613261			
10IC02	Same as 10IC01				
10S01	Push Switch KSE2-6-7.5 LLDB	DSW014391			
10S02	Same as 10S01				
10P11	Connector, M36-02-30-134P	DCN034901			
10P12	Same as 10P11				
10P14	Connector, M36-06-30-134P	DCN034941			
10P15	Connector, M36-05-30-134P	DCN034931			
10P16	Same as 10P11				
10P17	Same as 10P11				
10J01	BNC Connector, BNC080	DCN040711			
10J02	Same as 10J01				
10J11	Connector, M36M87-02	DCN034601			
10J14	Connector, M36M87-06	DCN034641			
10J15	Connector, M36M87-05	DCN034631			
10J17	Same as 10J11				

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
TRIGGER SIGNAL SELECTOR [11]		
11C11	Cap., 0.01μ, ±10%, 50V, Cer.	DCC810171
11C12	Same as 11C11	
11C14	Cap., 1000p, ±10%, 50V, Cer.	DCC810051
11C17	Same as 11C11	
11C25	Cap., 47p, ±5PF, 50V, Cer.	DCC815231
11C29	Same as 11C11	
11C33	Same as 11C11	
11C45	Same as 11C25	
11C49	Same as 11C11	
11C53	Same as 11C11	
11C55	Same as 11C11	
11C65	Same as 11C25	
11C73	Same as 11C11	
11C75	Same as 11C11	
11C81	Same as 11C11	
11C82	Same as 11C11	
11C83	Same as 11C11	
11C84	Same as 11C11	
11C85	Same as 11C11	
11C86	Same as 11C11	
11C87	Same as 11C11	
11C91	Same as 11C11	
11C92	Same as 11C11	
11C93	Same as 11C11	
11C94	Same as 11C11	
11C101	Same as 11C11	
11C102	Same as 11C11	
11C103	Same as 11C15	
11R11	Res., 1.0K, ±5%, 1/8W, Carbon	DRZ840591
11R12	Res., 1.5K, ±5%, 1/8W, Carbon	DRZ840631
11R13	Res., 43, ±5%, 1/8W, Carbon	DRZ840261
11R14	Res., 6.2K, ±5%, 1/8W, Carbon	DRZ840781
11R15	Res., B20K, Var., 0.5W, ±100ppm/°C, Cermet	DRV415571
11R16	Same as 11R11	
11R17	Same as 11R12	
11R18	Same as 11R13	
11R19	Same as 11R14	
11R20	Same as 11R15	
11R21	Res., 820, ±1%, 1/4W, Metal	DRE999241
11R22	Res., 51, ±5%, 1/8W, Carbon	DRZ840281
11R23	Same as 11R22	
11R24	Same as 11R21	
11R25	Same as 11R22	
11R26	Res., 2.4K, ±1%, 1/4W, Metal	DRE999791
11R27	Same as 11R26	
11R28	Res., 3.9K, ±5%, 1/8W, Carbon	DRZ840731
11R29	Same as 11R11	
11R30	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
11R31	Same as 11R30	
11R32	Same as 11R11	
11R33	Same as 11R12	
11R41	Same as 11R21	
11R42	Same as 11R22	
11R43	Same as 11R22	
11R44	Same as 11R21	
11R45	Same as 11R22	
11R46	Same as 11R26	
11R47	Same as 11R26	
11R48	Same as 11R28	
11R49	Same as 11R11	
11R50	Same as 11R30	
11R51	Same as 11R30	
11R52	Same as 11R11	
11R53	Same as 11R12	
11R54	Same as 11R11	
11R55	Same as 11R12	
11R56	Same as 11R14	
11R57	Same as 11R15	
11R61	Same as 11R21	
11R62	Same as 11R22	
11R63	Same as 11R22	
11R64	Same as 11R21	
11R65	Same as 11R22	
11R66	Same as 11R26	
11R67	Same as 11R26	
11R68	Same as 11R28	
11R69	Same as 11R11	
11R70	Same as 11R30	
11R71	Same as 11R30	
11R72	Same as 11R11	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
11R73	Same as 11R12				
11R74	Same as 11R11				
11R75	Same as 11R12				
11D43	Diode, 1S953	DDD010821			
11Q12	Transistor, 2SA 1245MD	DTR810021			
11Q17	Same as 11Q12				
11Q21	Transistor, 2SC3099	DTR830091			
11Q24	Same as 11Q21				
11Q30	Same as 11Q12				
11Q31	Same as 11Q12				
11Q32	Same as 11Q12				
11Q41	Same as 11Q21				
11Q44	Same as 11Q21				
11Q50	Same as 11Q12				
11Q51	Same as 11Q12				
11Q52	Same as 11Q12				
11Q54	Same as 11Q12				
11Q61	Same as 11Q21				
11Q64	Same as 11Q21				
11Q70	Same as 11Q12				
11Q71	Same as 11Q12				
11Q72	Same as 11Q12				
11Q74	Same as 11Q12				
11J11	Connector, M36-M87-02	DCN034601			
11J12	Same as 11J11				
11J13	Same as 11J11				
11J74	Connector, ZC-116	DCN032761			
11J112	Same as 11J11				
11J16	Same as 11J11				
11P11	Connector, M36-02-30-114P	DCN034851			
11P12	Same as 11P11				
11P13	Same as 11P11				
11P74	Connector, SMCD-16X50-ADX10P1.25	KHB071111			
11JP11	MCR18-JPW	DRZ841601			
11JP12	Same as 11JP11				

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
SOURCE SWITCH [11]					
11C93	Cap., 2p, ±0.25PF, 50V, Cer.	DCC239061			
11R91	Res., B20K, Var., 0.05W, Carbon	DRV131412			
11R92	Res., 6.8K, ±5%, 1/4W, Carbon	DRD939351			
11R93	Res., 51, ±5%, 1/4W, Carbon	DRD939881			
11R95	Same as 11R91				
11R96	Same as 11R92				
11R111	Res., 1K, ±5%, 1/4W, Carbon	DRD939251			
11R112	Same as 11R111				
11R113	Res., 1.3K, ±5%, 1/4W, Carbon	DRD938011			
11R114	Res., 7.5K, ±5%, 1/4W, Carbon	DRD939661			
11Q111	Transistor, 2SA1015Y	DTR119011			
11J73	Connector, ZC-116	DCN032761			
11S91	Switch, KSE4-8-7.5	DSW015431			
11S92	Same as 11S91				
11FP11	Flat cable (Jumper wire), 7/0.16(OM-1) x 10 x 60P2S5	KHB073411			

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
A TRIGGER AMPLIFIER [12]		
12C11	Cap., 2200p, ±10%, 50V, Film	DCF129061
12C12	Cap., 1000p, ±10%, 50V, Cer.	DCC810171
12C13	Cap., 1p, ±0.1p, 50V, Elect.	DCE244711
12C15	Cap., 1000p, ±10%, 50V, Cer.	DCC810051
12C16	Cap., 100p, ±5%, 50V, Cer.	DCC815271
12C24	Same as 12C15	
12C31	Same as 12C15	
12C33	Res., 68000p, ±10%, 50V, Film	DCF129241
12C40	Same as 12C12	
12C42	Same as 12C12	
12C43	Cap., 8p, ±0.5p, 50V, Cer.	DCC815131
12C46	Same as 12C12	
12C50	Same as 12C12	
12C52	Same as 12C12	
12C56	Same as 12C12	
12C57	Cap., 15p, ±5%, 50V, Cer.	DCC815171
12C60	Same as 12C12	
12C64	Same as 12C12	
12C66	Same as 12C43	
12C70	Cap., 33μ, ±20%, 25V, Elect.	DCE929141
12C71	Same as 12C70	
12C80	Same as 12C12	
12C81	Same as 12C12	
12C89	Cap., 2p, ±0.25%, 50V, Cer.	DCC815041
12R11	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
12R12	Same as 12R11	
12R13	Res., 22K, ±5%, 1/8W, Carbon	DRZ840911
12R14	Res., 18K, ±5%, 1/8W, Carbon	DRZ840891
12R15	Res., 3.3K, ±5%, 1/8W, Carbon	DRZ840711
12R16	Res., 33, ±5%, 1/8W, Carbon	DRZ840231
12R17	Res., 430, ±5%, 1/8W, Carbon	DRZ840501
12R18	Res., 3.9K, ±5%, 1/8W, Carbon	DRZ840731
12R19	Same as 12R16	
12R20	Same as 12R16	
12R21	Res., B50K, Var., 0.3W, Carbon	DRV146811
12R22	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
12R23	Same as 12R11	
12R24	Res., 110, ±5%, 1/8W, Carbon	DRZ840361
12R25	Res., 1.5K, ±5%, 1/8W, Carbon	DRZ840631
12R26	Res., 300, ±5%, 1/8W, Carbon	DRZ840461
12R27	Res., 20K, Var., Metal	DRV415571
12R28	Same as 12R11	
12R29	Res., 2.4K, ±5%, 1/8W, Carbon	DRZ840681
12R30	Same as 12R15	
12R31	Res., 1.0K, ±5%, 1/8W, Carbon	DRZ840591
12R32	Res., 47, ±5%, 1/8W, Carbon	DRZ840271
12R33	Res., 39K, ±5%, 1/8W, Carbon	DRZ840971
12R34	Res., 12K, ±5%, 1/8W, Carbon	DRZ840851
12R35	Res., B50K, Var., 0.5W, ±100ppm/°C, Cermet	DRV415581
12R36	Res., 6.8K, ±5%, 1/8W, Carbon	DRZ840791
12R37	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
12R40	Same as 12R16	
12R41	Res., 270, ±5%, 1/8W, Carbon	DRZ840451
12R42	Res., 2.7K, ±1%, 1/4W, Metal	DRE999301
12R43	Res., 51, ±5%, 1/8W, Carbon	DRZ840281
12R44	Same as 12R42	
12R45	Same as 12R41	
12R46	Same as 12R16	
12R47	Res., 680, ±1%, 1/4W, Metal	DRE999231
12R48	Same as 12R47	
12R49	Same as 12R16	
12R50	Same as 12R16	
12R51	Same as 12R16	
12R52	Res., 150, ±1%, 1/4W, Metal	DRE999151
12R53	Res., 150, ±5%, 1/8W, Carbon	DRZ840391
12R54	Same as 12R53	
12R55	Same as 12R16	
12R56	Res., 2.4K, ±1%, 1/4W, Metal	DRE999791
12R57	Same as 12R37	
12R58	Same as 12R56	
12R59	Same as 12R52	
12R60	Res., 820, ±1%, 1/4W, Metal	DRE999241
12R61	Same as 12R16	
12R62	Same as 12R37	
12R63	Same as 12R52	
12R64	Same as 12R60	
12R65	Same as 12R60	
12R66	Same as 12R43	
12R67	Same as 12R16	
12R68	Same as 12R52	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
12R70	Res., 2.2, ±5%, 1/4W, Carbon	DRD939751			
12R71	Same as 12R70				
12R89	Same as 12R32				
12D11	Diode, 1SS 181	DDD810061			
12D81	Diode, RD2.4M-T1B	DDD830011			
12D82	Same as 12D11				
12Q12	Transistor, 2SA1162Y	DTR810041			
12Q19	Transistor, 2SC3099	DTR830091			
12Q20	Same as 12Q19	DTR830091			
12Q24	Same as 12Q19				
12Q49	Transistor, 2SA1245MD	DTR810021			
12Q50	Same as 12Q49				
12Q51	Same as 12Q49				
12Q55	Same as 12Q49				
12Q61	Same as 12Q19				
12Q67	Same as 12Q19				
12IC15	IC, μPC 151C	DIC610021			
12J11	MCR 18-JPW	DRZ841601			
12J12	Same as 12J11				
12J13	Same as 12J11				
12S11	Switch, KSE4-8-7.5	DSW015431			
12P71	Connector, Header (Straight), 65507-136	DCN033501			

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
B TRIGGER AMPLIFIER [13]		
13C11	Cap., 2200p, ±10%, 50V, Film	DCF129061
13C12	Cap., 1p, ±0.1p, 50V, Elect.	DCE244711
13C13	Cap., 0.01μ, ±10%, 50V, Cer.	DCC810171
13C14	Cap., 100p, ±5%, 50V, Cer.	DCC815271
13C21	Cap., 1000p, ±10%, 50V, Cer.	DCC810051
13C26	Same as 13C21	
13C27	Cap., 0.068μ, ±10%, 50V, Film	DCF129241
13C42	Cap., 8p, ±0.5p, 50V, Cer.	DCC815131
13C43	Same as 13C13	
13C45	Same as 13C13	
13C52	Same as 13C13	
13C54	Same as 13C13	
13C57	Cap., 15p, ±5%, 50V, Cer.	DCC815171
13C58	Same as 13C13	
13C60	Same as 13C13	
13C63	Same as 13C13	
13C65	Same as 13C42	
13C69	Same as 13C13	
13C71	Cap.,	DCE929141
13C72	Same as 13C71	
13C80	Same as 13C13	
13C81	Same as 13C13	
13R11	Res., 22K, ±5%, 1/8W, Carbon	DRZ840911
13R12	Res., 18K, ±5%, 1/8W, Carbon	DRZ840891
13R13	Res., 3.3K, ±5%, 1/8W, Carbon	DRZ840711
13R14	Res., 33, ±5%, 1/8W, Carbon	DRZ840231
13R15	Res., 3.9K, ±5%, 1/8W, Carbon	DRZ840731
13R16	Res., 430, ±5%, 1/8W, Carbon	DRZ840501
13R17	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
13R18	Res., B50K, Var., 0.3W, Metal	DRV146811
13R19	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
13R20	Res., 1.5K, ±5%, 1/8W, Carbon	DRZ840631
13R21	Res., 110, ±5%, 1/8W, Carbon	DRZ840361
13R22	Res., 300, ±5%, 1/8W, Carbon	DRZ840461
13R23	Res., 20K, Var., 0.3W, Metal	DRV411901
13R24	Same as 13R19	
13R25	Res., 2.4K, ±5%, 1/8W, Carbon	DRZ840681
13R26	Same as 13R13	
13R27	Res., 39K, ±5%, 1/8W, Carbon	DRZ840971
13R28	Res., 12K, ±5%, 1/8W, Carbon	DRZ840851
13R29	Res., B50K, Var., 0.3W, Metal	DRV411971
13R30	Res., 6.8K, ±5%, 1/8W, Carbon	DRZ840791
13R31	Res., 47, ±5%, 1/8W, Carbon	DRZ840271
13R32	Same as 13R31	
13R40	Same as 13R14	
13R41	Same as 13R14	
13R42	Res., 51, ±5%, 1/8W, Carbon	DRZ840281
13R43	Res., 2.7K, ±1%, 1/4W, Metal	DRE999301
13R44	Same as 13R43	
13R45	Same as 13R14	
13R46	Res., 270, ±5%, 1/8W, Carbon	DRZ840451
13R47	Res., 680, ±1%, 1/4W, Metal	DRE999231
13R48	Same as 13R14	
13R49	Same as 13R14	
13R50	Res., 150, ±5%, 1/8W, Carbon	DRZ840391
13R51	Same as 13R46	
13R52	Same as 13R14	
13R53	Same as 13R47	
13R54	Same as 13R14	
13R55	Same as 13R50	
13R56	Same as 13R14	
13R57	Res., 100, ±5%, 1/8W, Carbon	DRZ840351
13R58	Res., 2.4K, ±1%, 1/4W, Metal	DRE999791
13R59	Same as 13R58	
13R60	Res., 150, ±1%, 1/4W, Metal	DRE999151
13R61	Same as 13R14	
13R62	Same as 13R60	
13R63	Res., 820, ±1%, 1/4W, Metal	DRE999241
13R64	Same as 13R63	
13R65	Same as 13R42	
13R66	Same as 13R14	
13R67	Same as 13R60	
13R68	Same as 13R57	
13R69	Same as 13R60	
13R70	Same as 13R63	
13R71	Res., 2.2, ±5%, 1/4W, Carbon	DRD939751
13R72	Same as 13R71	
13R81	Res., 2.2K, ±5%, 1/8W, Carbon	DRZ840671
13D11	Diode, 1S953	DDD010821
13D81	Diode, RD2.4M-T1BB	DDD830011
13D82	Diode, 1SS181	DDD810061

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
TV SYNCHRONIZATION SEPARATOR	[14]	
14C14	Cap., 0.01μ, ±10%, 50V, Cer.	DCC810511
14C17	Cap., 33μ, 20%, 25V, Elect.	DCE929141
14C20	Cap., 1p, ±0.1p, 50V, Elect.	DCE244711
14C22	Cap., 47p, ±5%, 50V, Cer.	DCC815351
14C24	Cap., 2.2μ, ±20%, 50V, Elect.	DCE949051
14C25	Cap., 47p, ±20%, 25V, Elect.	
14C30	Cap., 0.01μ, ±5%, 50V, Cer.	DCC810171
14C31	Same as 14C30	
14C40	Cap., 0.047μ, ±10%, 50V, Film	DCF129111
14C140	Cap., 1000p, ±10%, 50V, Cer.	DCC815861
14R10	Res., 3.3K, ±5%, 1/4W, Carbon	DRD939311
14R11	Res., 8.2K, ±5%, 1/8W, Carbon	DRZ840811
14R12	Same as 14R11	
14R13	Res., 22, ±5%, 1/8W, Carbon	DRZ840671
14R14	Res., 18K, ±5%, 1/8W, Carbon	DRZ840891
14R15	Same as 14R14	
14R16	Res., 6.8K, ±5%, 1/8W, Carbon	DRZ840791
14R17	Res., 2.7K ±5%, 1/8W, Carbon	DRZ840691
14R18	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
14R19	Same as 14R13	
14R20	Res., 150K, ±5%, 1/8W, Carbon	DRZ841111
14R21	Res., 82, ±5%, 1/8W, Carbon	DRZ841051
14R22	Res., 680, ±5%, 1/8W, Carbon	DRZ840551
14R23	Res., 39K, ±5%, 1/8W, Carbon	DRZ840971
14R24	Res., 7.5K, ±5%, 1/8W, Carbon	DRZ840801
14R25	Same as 14R18	
14R26	Same as 14R18	
14R27	Same as 14R20	
14R28	Same as 14R28	
14R29	Res., 12K, ±5%, 1/8W, Carbon	DRZ840851
14R30	Same as 14R18	
14R31	Same as 14R18	
14R40	Res., 470, 5%, 1/8W, Carbon	DRZ840511
14R41	Res., 1.0K, 5%, 1/8W, Carbon	DRZ840591
14R42	Res., 2.7, 5% 1/8W, Carbon	DRZ840691
14R43	Same as 14R13	
14R44	Same as 14R17	
14R45	Same as 14R17	
14R46	Same as 14R13	
14R47	Same as 14R17	
14R110	Res., 1.6K, ±5%, 1/4W, Carbon	DRD830661
14R117	Res., 3.3K, ±5%, 1/4W, Carbon	DRZ840711
14R140	Res., 16K, ±5%, 1/4W, Carbon	DRD830401
14D11	Diode, 1SS 184 TE85L	DDD810071
14D13	Diode, 1SS 181 TE85L	DDD810061
14D15	Same as 14D13	
14D25	Diode, RD4.7M TIB B	DDD830081
14D40	Same as 14D11	
14Q12	Transistor, 25A1162Y TE85	DTR810041
14Q16	Same as 14Q12	
14Q17	Same as 14Q12	
14Q22	Same as 14Q12	
14Q23	Transistor, 25C 2712G TE85	DTR830051
14Q26	Same as 14Q23	
14Q29	Same as 14Q23	
14Q116	Same as 14Q23	
14IC1	IC, SN74LS02N	DIC140031
14IC2	IC, SN74LS08N	DIC140091

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
A SWEEP GENERATOR [15]		
15C22	Cap., 22p, ±5PF, 50V, Cer.	DCC815191
15C44	Cap., 0.01μ, ±10%, 50V, Cer.	DCC810171
15C70	Cap., 12p, ±5%, 50V, Cer.	DCC815161
15C72	Cap., 100p, ±5%, 50V, Cer.	DCC815271
15C73	Cap., 68p, ±5%, 50V, Cer.	DCC815251
15C88	Cap., 4.7p, ±5p, 25V, Elect.	DCE929031
15C102	Cap., 27p, ±5%, 50V, Mica	DCM132311
15C104	Cap., 2.5 ~ 22.5p, Var., 250V, Cer.	DCV019591
15C105	Cap., 0.01μ, ±5%, 50V, Film	DCF125931
15C106	Cap., 4.7p, ±20%, 63V, Elect	DCE949111
15C109	Same as 15C44	
15C151	Cap., 33μ, ±20%, 225V, Elect	DCE929141
15C152	Same as 15C44	
15C153	Same as 15C44	
15C154	Same as 15C44	
15C155	Same as 15C44	
15C156	Same as 15C44	
15C157	Same as 15C44	
15C159	Same as 15C44	
15C201	Same as 15C	
15C202	Same as 15C44	
15C203	Same as 15C44	
15C204	Same as 15C44	
15C205	Same as 15C44	
15L201	Coil, 3T	DCL150441
15R12	Res., 6.8K, ±5%, 1/8W, Carbon	DRZ840791
15R13	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
15R14	Same as 15R13	
15R15	Res., 7.5K, ±5% 1/8W, Carbon	DRZ840801
15R16	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
15R17	Res., 2.2K, ±5%, 1/8W, Carbon	DRZ840671
15R18	Same as 15R13	
15R19	Res., 2.0K, ±5%, 1/8W, Carbon	DRZ840661
15R20	Res., 300, ±5%, 1/8W, Carbon	DRZ840461
15R21	Res., 1.0K, ±5%, 1/8W, Carbon	DRZ840591
15R22	Res., 1.0K, ±5%, 1/8W, Carbon	DRD939251
15R23	Same as 15R17	
15R24	Res., 3.3K, ±5%, 1/8W, Carbon	DRD939311
15R27	Res., 750, ±5%, 1/8W, Carbon	DRZ840561
15R28	Same as 15R21	
15R30	Res., 3.3K, ±5%, 1/8W, Carbon	DRZ840711
15R31	Same as 15R21	
15R34	Same as 15R19	
15R35	Same as 15R19	
15R37	Same as 15R21	
15R38	Res., 6.2K, ±1%, 1/5W, Metal	DRE999811
15R39	Res., 680, ±1%, 1/5W, Metal	DRE999231
15R40	Res., 8.2K, ±1%, 1/5W, Metal	DRE999361
15R41	Same as 15R16	
15R42	Same as 15R17	
15R43	Same as 15R13	
15R44	Res., 100, ±5%, 1/4W, Carbon	DRD939139
15R45	Res., 22K, ±5%, 1/4W, Carbon	DRZ840911
15R49	Res., 33, ±5%, 1/8W, Carbon	DRD840231
15R50	Res., 27K, ±5%, 1/4W Carbon	DRD939301
15R51	Same as 15R17	
15R52	Res., 5.6K, ±5%, 1/4W, Carbon	DRD939341
15R53	Same as 15R49	
15R54	Res., 200, ±5%, 1/8W, Carbon	DRZ840421
15R55	Same as 15R20	
15R56	Res., 3.9K, ±5%, 1/8W, Carbon	DRZ840111
15R57	Res., 4.7K, ±5%. 1/8W, Carbon	DRZ840751
15R58	Res., 10K, ±5%, 1/8W, Carbon	DRZ830361
15R59	Res., 82, ±5%, 1/4W, Carbon	DRD939121
15R60	Res., 130, ±5%, 1/4W, Carbon	DRD939901
15R61	Same as 15R20	
15R65	Same as 15R60	
15R66	Same as 15R59	
15R71	Same as 15R19	
15R72	Same as 15R56	
15R73	Same as 15R21	
15R74	Res., 1.3K, ±5%, 1/8W, Carbon	DRZ840621
15R75	Res., 3.6K, ±5%, 1/8W, Carbon	DRZ840721
15R76	Res., 12K, ±5%, 1/4W, Carbon	DRD939381
15R77	Same as 19	
15R78	Same as 19	
15R84	Res., 12K, ±5%, 1/4W, Carbon	DRD939381
15R85	Res., 1.2K, ±5%, 1/8W, Carbon	DRZ840611
15R86	Res., 5.1K, ±5%, 1/4W, Carbon	DRD939651
15R87	Res., 1.5K, ±5%, 1/8W, Carbon	DRZ840631

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
15R88	Res., 6.2K, ±5%, 1/8W, Carbon	DRZ840781
15R89	Same as 15R21	
15R90	Same as 15R17	
15R91	Same as 15R19	
15R92	Same as 15R16	
15R93	Same as 15R27	
15R94	Res., 4.3K, ±5%, 1/8W, Carbon	DRZ840741
15R95	Same as 15R21	
15R96	Same as 15R22	
15R98	Res., 390, ±5%, 1/4W, Carbon	DRD939201
15R99	Res., 4.3K, ±1%, 1/4W, Metal	DRE999521
15R100	Res., 620, ±1%, 1/4W, Metal	DRE999761
15R101	Res., 5.1K, ±1%, 1/4W, Metal	DRE999801
15R102	Res., 680, ±5%, 1/8W, Carbon	DRZ840551
15R103	Res., 220, ±5%, 1/8W, Carbon	DRZ840431
15R104	Same as 15R16	
15R105	Same as 15R56	
15R106	Same as 15R16	
15R108	Same as 15R56	
15R109	Res., 27K, ±1%, 1/8W, Carbon	DRZ840931
15R138	Res., 91K, ±1%, 1/4W, Metal	DRE999891
15R211	Res., 5.6K, ±5%, 1/8, Carbon	DRZ830341
15RA36	Res., 2.2K, ±5%, 1/8W, Resistors array	DFB016061
15RA53	Same as 15RA36	
15RA64	Same as 15RA36	
15RA67	Same as 15RA36	
15RA81	Same as 15RA36	
15D13	Diode, 1SS181 TE85L	DDD810061
15D14	Same as 15D13	
15D15	Diode, 1SS184 TE85L	DDD810071
15D30	Same as 15D13	
15D32	Same as 15D13	
15D45	Diode, RD-5,6M-TIB B	DDD830101
15D56	Same as 15D15	
15D76	Same as 15D15	
15D86	Same as 15D15	
15D89	Diode, 1S953 TA21R	DDD010821
15D90	LED, TLG-206	DDD071121
15D94	Same as 15D94	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
15D101	Diode, 1S1544A	DDD010341
15D102	Same as 15D101	
15D103	Diode 1SS95	DDD010451
15D104	Diode, RD10M-T1B B	DDD830161
15D105	Same as 15R104	
15D113	Same as 15D15	
15D211	Same as 15D15	
15Q15	Transistor, 25A 1162Y TE85L	DTR810041
15Q18	Same as 15Q15	
15Q20	Transistor, 25C 2712G TE85L	DTR830051
15Q22	Same as 15Q15	
15Q23	Same as 15Q20	
15Q30	Same as 15Q20	
15Q33	Same as 15Q20	
15Q42	Same as 15Q15	
15Q44	Same as 15Q20	
15Q52	Same as 15Q15	
15Q76	Same as 15Q15	
15Q86	Same as 15Q15	
15Q88	Same as 15Q20	
15Q89	Same as 15Q15	
15Q94	Same as 15Q20	
15Q98	Transistor, 25C3099 TE85L	DTR830091
15Q102	Transistor, 25C1254	DTR130861
15Q103	Transistor, μPA61AM	DTR295281
15Q104	Same as 15Q20	
15Q105	Transistor, 25C3065F (DP6A)	DTR135861
15Q107	Same as 15Q20	
15Q109	Transistor, DTC 114EK T-96	DTR890011
15Q211	Same as 15Q20	
15IC11	IC., MC 10H107L	DIC322221
15IC12	IC., MC 10H105L	DIC322211
15IC13	IC., MC 10H131L	DIC322241
15IC15	IC., F10105DC	DIC310041
15IC16	Same as 15IC15	
15IC16	Same as 15IC15	
15ID17	IC., F10131DC	DIC310081
15IC18	IC., F10115DC	DIC310191
15IC19	Same as 15IC15	
15IC21	Same as 15IC15	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
15IC22	Same as 15IC15				
15IC23	Same as 15IC15				
15RL1	Relay, RRF-51 A12D	DKD065261			
15J20	Connector, HR10A-7R-65(01)	DCN010711			
15J21	Connector, M36M87-02	DCN034601			
15J24	Connector, M36M87-04	DCN034621			
15J31	Connector, M36M87-03	DCN034611			
15J33	Same as 15J21				
15J40	Connector, BNC 080	DCN040711			
15J41	Connector, M36M87-06	DCN34641			
15J76	Connector, ZC-127	DCN032791			
15J77	Connector, ZC-112	DCN032741			
15JP11	Jumper Wire MCR18-JPW TD84N	DRZ841601			
15JP101	Jumper Wire 25Z O W TA21N	DRD138921			
15JP102	Same as 15JP101				
15JP103	Same as 15JP101				
15JP104	Same as 15JP101				
15JP105	Same as 15JP101				
15JP106	Same as 15JP101				
15JP107	Same as 15JP101				
15JP108	Same as 15JP101				
15JP109	Same as 15JP101				
15P21	Connector, M36-02-30-114P	DCN034851			
15P22	Connector, M36-03-30-114P	DCN034861			
15P24	Connector, M36-04-30-114P	DCN034871			
15P31	Connector, M36-03-30-134P	DCN034911			
15P33	Connector, M36-02-30-134P	DCN034901			
15P41	Connector, M36-06-30-134P	DCN034941			
15P42	Connector, M36-06-30-114P	DCN034891			
15P43	Same as 15P21				
15P44	Connector, M36-05-30-114P	DCN034881			
15P76	Flat cable, SMCD-27X300-ADX10	KHB057811			
15P77	Flat cable, SMCD-12X300-ADX10 (2.7)	KHB070611			

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
B SWEEP GENERATOR 16		
16C14	Cap., 0.01μ, ±5%, 50V, Cer.	DCC810171
16C24	Cap., 56p, ±5%, 50V, Cer.	DCC815241
16C27	Same as 16C14	
16C47	Cap., 100p, ±5%, 50V, Cer.	DCC815271
16C48	Cap., 22p, ±5%, 50V, Cer.	DCC815191
16C63	Cap., 27p, ±5%, 50V, Mica	DCM132311
16C74	Cap., 4.7μ Var., 63V, Elect.	DCE949111
16C75	Cap., 205p, Var., 250V, Cer.	DCV019591
16C76	Cap., 0.01μ, ±5%, 50V, Film	DCF125931
16C77	Same as 16C14	
16C80	Cap., 33p, ±20%, 25V, Elect.	DCE929141
16C81	Same as 16C14	
16C82	Same as 16C80	
16R11	Res., B10K, Var., 2W, ±20ppm/°C, Cermet	DRV770371
16R12	Res., B2K, Var., 0.5W, ±100ppm/°C, Cermet	DRV410541
16R13	Res., 3.3K, ±1%, Metal	DRE999311
16R14	Res., 1.0K, ±5%, 1/8W, Carbon	DRZ840591
16R15	Res., 8.2K, ±1%, 1/5W, Metal	DRE999361
16R16	Res., B1K, Var., 0.5W, ±100ppm/°C, Cermet	DRV410531
16R20	Res., 1.8K, ±5%, 1/4W, Carbon	DRD939281
16R21	Res., 27K, ±5%, 1/8W, Carbon	DRZ840931
16R22	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
16R23	Res., 820, ±5%, 1/8W, Carbon	DRZ840571
16R24	Res., 12K, ±5%, 1/8W, Carbon	DRZ840851
16R25	Same as 16R21	
16R26	Res., 100K, ±5%, 1/8W, Carbon	DRZ840351
16R27	Same as 16R22	
16R28	Res., 8.2K, ±5%, 1/4W, Carbon	DRD939361
16R29	Same as 16R14	
16R30	Same as 16R26	
16R31	Res., 1.0K, ±1%, 1/4W, Carbon	DRE999251
16R32	Res., 9.1K ±1%, 1/5, Metal	DRE999901
16R33	Res., 200 ±5%, 1/8W, Carbon	DRZ840421
16R34	Same as 16R14	
16R35	Res., 300, ±5%, 1/8W, Carbon	DRZ840461
16R36	Res., 82, ±5%, 1/4W, Carbon	DRD939121
16R37	Res., 130, ±5%, 1/4W, Carbon	DRD939901
16R38	Same as 16R36	
16R39	Same as 39R37	
16R40	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
16R41	Res., 3.3K, ±5%, 1/8W, Carbon	DRZ840711
16R42	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
16R43	Same as 16R35	
16R44	Res., 2.0K, ±5%, 1/8W, Carbon	DRZ840661
16R46	Same as 16R14	
16R47	Same as 16R14	
16R48	Same as 16R44	
16R49	Res., 6.2K, ±1%, 1/5W, Metal	DRE999811
16R50	Res., 680, ±1%, 1/5W, Metal	DRE999231
16R51	Res., 8.2K, ±1%, 1/5W, Metal	DRE999361
16R52	Res., 100, ±5%, 1/4W, Carbon	DRD939131
16R53	Res., 22K, ±5%, 1/8W, Carbon	DRZ840911
16R55	Res., 3.0K, ±1%, 1/5W, Metal	DRE999511
16R56	Res., 510, ±5%, 1/10W, Carbon	DRZ830141
16R60	Res., 390, ±5%, 1/4W, Carbon	DRD939201
16R61	Res., 620, ±1%, 1/5W, Metal	DRE999761
16R62	Res., 4.3K, ±1%, 1/5W, Metal	DRE999521
16R63	Res., 5.1K, ±1%, 1/5W, Metal	DRE999801
16R64	Res., 680, ±5%, 1/8W, Carbon	DRZ840551
16R70	Same as 16R44	
16R73	Res., 220, ±5%, 1/8W, Carbon	DRZ840431
16R74	Same as 16R22	
16R76	Same as 16R21	
16R147	Same as 16R44	
16L82	Coil, 3T	DCL15442
16D50	Diode, 1SS181 TE85L	DDD810061
16D53	Diode, RD5.6M-T1B.B	DDD830101
16D42	Diode, 1S953 TA21R	DDD010821
16D46	Same as 16D42	
16D62	Diode, 1S154 4A	DDD010341
16D63	Same as 16D62	
16D64	Diode 1SS97	DDD010451
16D70	Same as 16D42	
16D74	Diode, RD10M-T1B B	DDD830101
16D75	Same as 16D74	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
16RA44		DFB016061			
16Q21	Transistor, 25A 1162Y, TE85	DTR810041			
16Q24	Same as 16Q21				
16Q42	Same as 16Q21				
16Q52	Transistor, 25C 27112G TE85	DTR830051			
16Q60	Transistor, 25C 3099 TE85L	DTR830091			
16Q64	Transistor, 25C 1254	DTR130861			
16Q73	Transistor, 25C 3065F (DP6A)	DTR135861			
16Q74	Same as 16Q52				
16Q76	Transistor, DTC 114EK T-96	DTR890011			
16Q80	Transistor, μPA 61AM	DTR295281			
16IC31	IC, HA1127	DTR190631			
16IC41	IC, MA10H107L	DIC322221			
16IC42	IC, F10105DC	DIC310041			
16IC43	IC, MC10H131L	DIC322241			
16IC44	IC, F10115DC	DIC310191			
16RL76	Relay, RRF-51 A12D	DKD065261			
16J32	Connector, M36M87-03	DCN034611			
16J37	Same as 16J32				
16J40	BNC Connector, BNC 080	DCN040711			
16J75	Connector, ZC-020	DCN032701			
16P32	Connector, M36-03-30-134P	DCN34911			
16P37	Connector, M36-03-30-114P	DCN034861			
16P44	Connector, M36-03-30-134P	DCN034871			
16P75	Connector, SMCD-20X60-BDX10(2.7)P1.25	KHB070711			

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
A TIMING SWITCH [17]		
17C48	Cap., 1μ, ±0.25PF, 50V, Film	DCF420281
17C66	Cap., 47p, ±20%, 63V, Elect.	DCF949111
17C67	Cap., 1μ, ±20%, 50V, Elect.	DCE249051
17C68	Cap., 0.047μ, ±10%, 50V, Cer.	DCC810251
17C69	Cap., 0.01μ, ±10%, 50V, Cer.	DCC810171
17C70	Cap., 4700p, ±10%, 50V, Cer.	DCC810131
17C80	Cap., 0.01μ, +80~-20%, 50V, Cer.	DCC139511
17C81	Same as 17C69	
17C82	Cap., 33μ, ±20%, 25V, Elect.	DCE929141
17C83	Same as 17C69	
17C84	Same as 17C82	
17C85	Same as 17C69	
17R11	Res., 20K, ±5%, 1/8W, Carbon	DRZ840661
17R12	Res., 27K, ±5%, 1/8W, Carbon	DRZ840931
17R13	Same as 17R12	
17R14	Same as 17R12	
17R15	Same as 17R12	
17R16	Res., 1.0K, ±5%, 1/8W, Carbon	DRZ840591
17R17	Res., 18K, ±0.5%, 1/5W, Metal	DRE998291
17R18	Res., 47K ±1%, 1/5W, Metal	DRE999451
17R19	Same as 17R17	
17R20	Res., 6.8K, ±5%, 1/4W, Carbon	DRD939351
17R21	Res., 22K, ±1%, 1/5W, Metal	DRE999411
17R22	Res., B 2K, Var., 0.5W, ±100ppm/°C, Cermet	DRV415541
17R23	Res., 18K, ±1%, 1/5W, Metal	DRE999401
17R25	Res., 22K, ±5%, 1/8W, Carbon	DRZ840911
17R28	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
17R29	Same as 17R12	
17R30	Res., 2.2 ±20%, 1/5W, Metal	DRE948091
17R31	Same as 17R28	
17R32	Res., 220K, ±0.5%, 1/5W, Metal	DRE998361
17R33	Same as 17R28	
17R34	Same as 17R12	
17R35	Same as 17R28	
17R36	Res., 22K, ±0.5%, 1/5%, Metal	DRE998301
17R37	Same as 17R28	
17R38	Same as 17R12	
17R39	Same as 17R28	
17R40	Res., 2.2K, ±10%, 500V, Metal	DRE948081
17R41	Same as 17R28	DRE948081
17R42	Same as 17R12	
17R43	Same as 17R28	
17R44	Same as 17R12	
17R45	Res., 6.2K, ±0.5%, 1/5W, Metal	DRE998281
17R46	Res., 430K, ±0.5%, 1/5W, Metal	DRE998371
17R48	Res., 2.7K, ±5%, 1/4W, Carbon	DRD939301
17R52	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
17R53	Same as 17R52	
17R54	Res., 160K, ±0.5%, 1/5W, Metal	DRE998341
17R55	Same as 17R54	
17R56	Res., 30K, ±0.5%, 1/5W, Metal	DRE998321
17R57	Res., 120K, ±0.5%, 1/5W, Metal	DRE998331
17R59	Res., 2.7K, ±5%, 1/8W, Carbon	DRZ840691
17R60	Res., 2.7K, ±5%, 1/4W, Carbon	DRZ939301
17R61	Res., 4.7K, ±5%, 1/8W, Carbon	DRZ840751
17R62	Same as 17R61	
17R63	Same as 17R61	
17R64	Same as 17R61	
17R65	Same as 17R61	
17R66	Same as 17R61	
17R67	Same as 17R61	
17R68	Same as 17R61	
17R69	Same as 17R61	
17R70	Same as 17R61	
17R161	Same as 17R12	
17R162	Same as 17R12	
17R165	Same as 17R12	
17D16	Diode, TLR206	
17D28	Diode, RD4.3EB TA21R	
17Q20	Transistor, DTC 114EK T-96	DTR890011
17Q25	Same as 17Q20	
17Q27	Transistor, 2SC 2712G TE85	DTR830051
17Q28	Transistor, 2SK 141L2A	DTR215321
17Q30	Transistor, 2SA 988EA/FA TRB	DTR119051
17Q31	Same as 17Q27	
17Q33	Same as 17Q30	
17Q34	Same as 17Q27	
17Q37	Same as 17Q30	

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
17Q38	Same as 17Q27				
17Q41	Same as 17Q30				
17Q42	Same as 17Q27				
17Q44	Same as 17Q30				
17Q48	Transistor, 2SA578	DTR110331			
17Q52	Same as 17Q27				
17Q53	Same as 17Q27				
17Q59	Same as 17Q20				
17Q60	Same as 17Q20				
17Q66	Transistor, 25A 1162Y TE85	DTR810041			
17Q67	Same as 17Q66				
17Q68	Same as 17Q66				
17Q69	Same as 17Q66				
17Q70	Same as 17Q66				
17Q161	Same as 17Q20				
17IC11	IC, SN74LS42N	DIC140431			
17IC12	IC, SN74LS12N	DIC140131			
17IC13	IC, SN74LS10N	DIC140111			
17IC14	IC, SN74LS02N	DIC140031			
17IC31	IC, LF 412CN (NS)	DIC613261			
17IC32	Same as 17IC31				
17S11	Switch, BCM24(1-24)021(4-24)02/100K	DSW033431			
17R47	Res., B100K, Var., 0.1W, Carbon S11	Ganged with DRV147431			
17RL60	Reed Relay, RRF-51 A12D	DKD065261			
17J31	Connector, M36-03-30-114P	DCN034861			
17J33	Connector, M36-02-30-114P	DCN034851			
17J77	Connector, ZC-012	DCN032661			
17J85	Connector, M36M87-03	DCN032741			
17P31	Connector, M36-03-30-114P	DCN034861			
17P33	Connector, M36-02-30-114P	DCN034851			
17P85	Connector, SMCD-12 x 50-ADX 10(2.7)P1.25	KHB071011			

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART No.
B TIMING SWITCH [18]		
18C16	Cap., 0.01μ, ±10%, 50V, Film	DCF129551
18C52	Cap., 1μ, ±0.25PF, 50V, Film	DCF420281
18R10	Res., 30K, ±5%, 1/4W, Carbon	DRD939681
18R11	Res., 100K, Var., 0.125W, Carbon	DRV146831
18R12	Res., 50K, Var., 0.125W, Carbon	DRV145961
18R13	Res., 10K, ±5%, 1/4W, Carbon	DRD939371
18R14	Res., 56K, ±1%, 1/5W, Metal	DRV146842
18R15	Res., 56K, ±1%, 1/5W,	DRE999341
18R16	Same as 18R16	
18R17	Res., 56K, ±5%, 1/4W, Carbon	DRD939461
18R20	Res., 2.0K, ±5%, 1/8W, Carbon	DRZ840661
18R21	Res., 27K, ±5%, 1/8W, Carbon	DRZ840931
18R22	Same as 18R21	
18R23	Same as 18R21	
18R24	Same as 18R21	
18R25	Res., 160K, ±0.5%, 1/5W, Metal	DRE998341
18R26	Same as 18R25	
18R27	Res., 300K, ±0.5%, 1/5W, Metal	DRE998321
18R28	Res., 120K, ±0.5%, 1/5W, Metal	DRE998331
18R30	Res., 27K, ±1%, 1/5W, Metal	DRE999411
18R31	Res., B2K, Var., 0.5W, ±100ppm/°C, Cermet	DRV415541
18R32	Res., 18K, ±1%, 1/5W, Metal	DRE999401
18R37	Res., 220K, ±0.5%, 1/5W, Metal	DRE998361
18R38	Res., 10K, ±5%, 1/8W, Carbon	DRZ840831
18R39	Same as 18R21	
18R40	Same as 18R38	
18R41	Res., 22K, ±5%, 1/5W, Metal	DRE998301
18R42	Same as	
18R43	Same as 18R21	
18R44	Same as 18R38	
18R45	Res., 430K, ±0.5%, 1/5W, Metal	DRE998371
18R46	Res., 2.2K, ±0.5%, 1/5W, Metal	DRE948081
18R47	Same as 18R38	
18R48	Same as 18R21	
18R49	Same as 18R38	
18R50	Res., 24K, 0.5%, 1/5W, Metal	DRE998311
18R51	Same as 18R21	
18R52	Res., 1.0K, ±5%, 1/4W, Carbon	DRD939251
18R55	Res., 2.7K, ±5%,1/8W, Carbon	DRZ840691
18R56	Res., 5.6K, ±5%, 1/8W, Carbon	DRZ840771
18R57	Same as 18R56	
18R58	Same as 18R55	
18D35	Diode, LF412CN (NS)	DDD613261
18Q34	Transistor, 2SC2712G TE85L	DTR830051
18Q35	Transistor, 2SK 141L2A	DTR215321
18Q37	Transistor, 2SA988EA/FA TRB	DTR119051
18Q39	Same as 18Q34	
18Q42	Same as 18Q37	
18Q43	Same as 18Q34	
18Q47	Same as 18Q37	
18Q48	Same as 18Q34	
18Q51	Same as 18Q37	
18Q52	Transistor, 2SA578	DTR110331
18Q55	Transistor, DTC 114EK T-96	DTR890011
18Q56	Same as 18Q34	
18Q57	Same as 18Q34	
18Q58	Same as 18Q55	
18IC21	IC, SN74LS42N	DIC140431
18IC22	IC, SN74LS10N	DIC140111
18IC23	Same as 18IC22	
18IC24	IC, SN74LS02N	DIC140031
18IC32	IC, LF 412CN	DIC613261
18RL52	Relay, RRF-51 A12P	DKD065261
18J32	Connector, M36M87-03	DCN034611
18PF32	Connector, M36M87-03	DCN034611

V/div	S3	S2	S1	S0
1 mV	0	0	0	0
2 mV	0	0	0	1
5	0	0	1	0
10	0	1	0	0
20	0	1	0	1
50	0	1	1	0
100	1	0	0	0
200	1	0	0	1
500	1	0	1	0
1	1	1	0	0
2	1	1	0	1
5	1	1	1	0

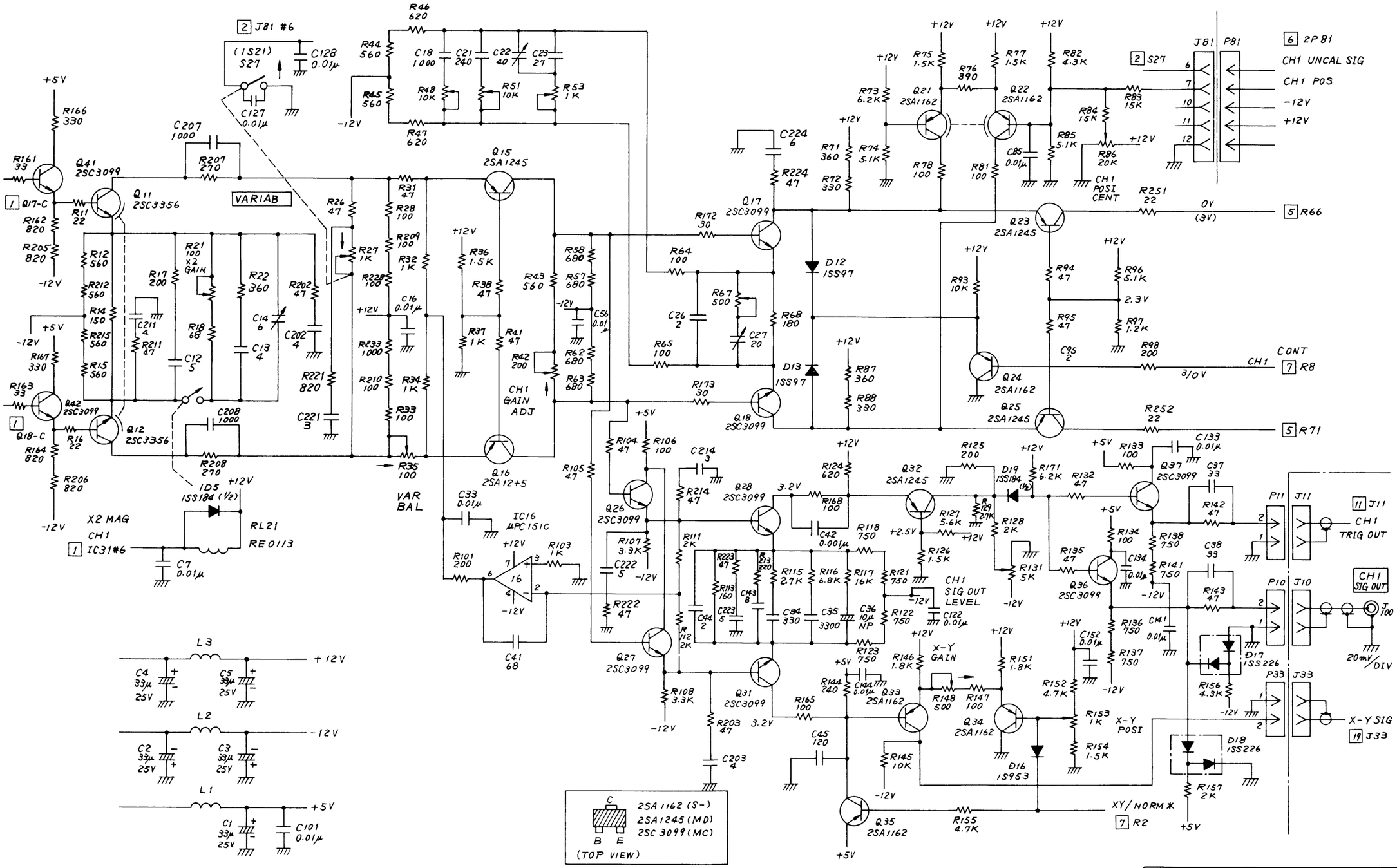
IC NO	IC NAME	VCC	GND
31	7406	14	7
32	74LS02	14	7
33	74LS27	14	7

PB 01 VERT PRE AMP

SS-5712

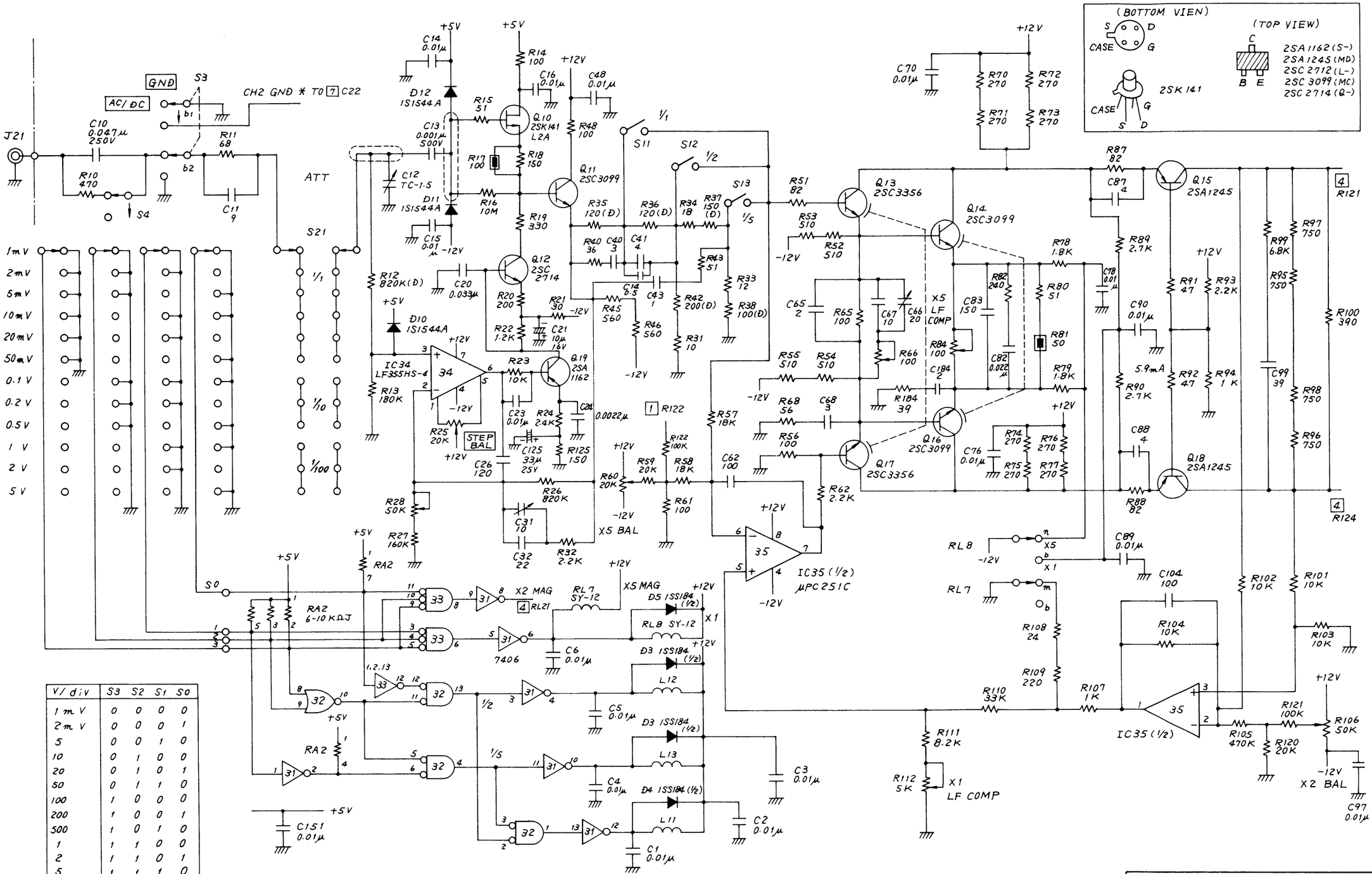
CH1 PREAMP(1) 1

BBWSS24097102 2



PB01 VERT PRE AMP

SS5712	
CH1 PRE AMP(2)	2
BBWSS24082102	2



V/div	S3	S2	S1	S0
1mV	0	0	0	0
2mV	0	0	0	1
5	0	0	1	0
10	0	1	0	0
20	0	1	0	1
50	0	1	1	0
100	1	0	0	0
200	1	0	0	1
500	1	0	1	0
1	1	1	0	0
2	1	1	0	1
5	1	1	1	0

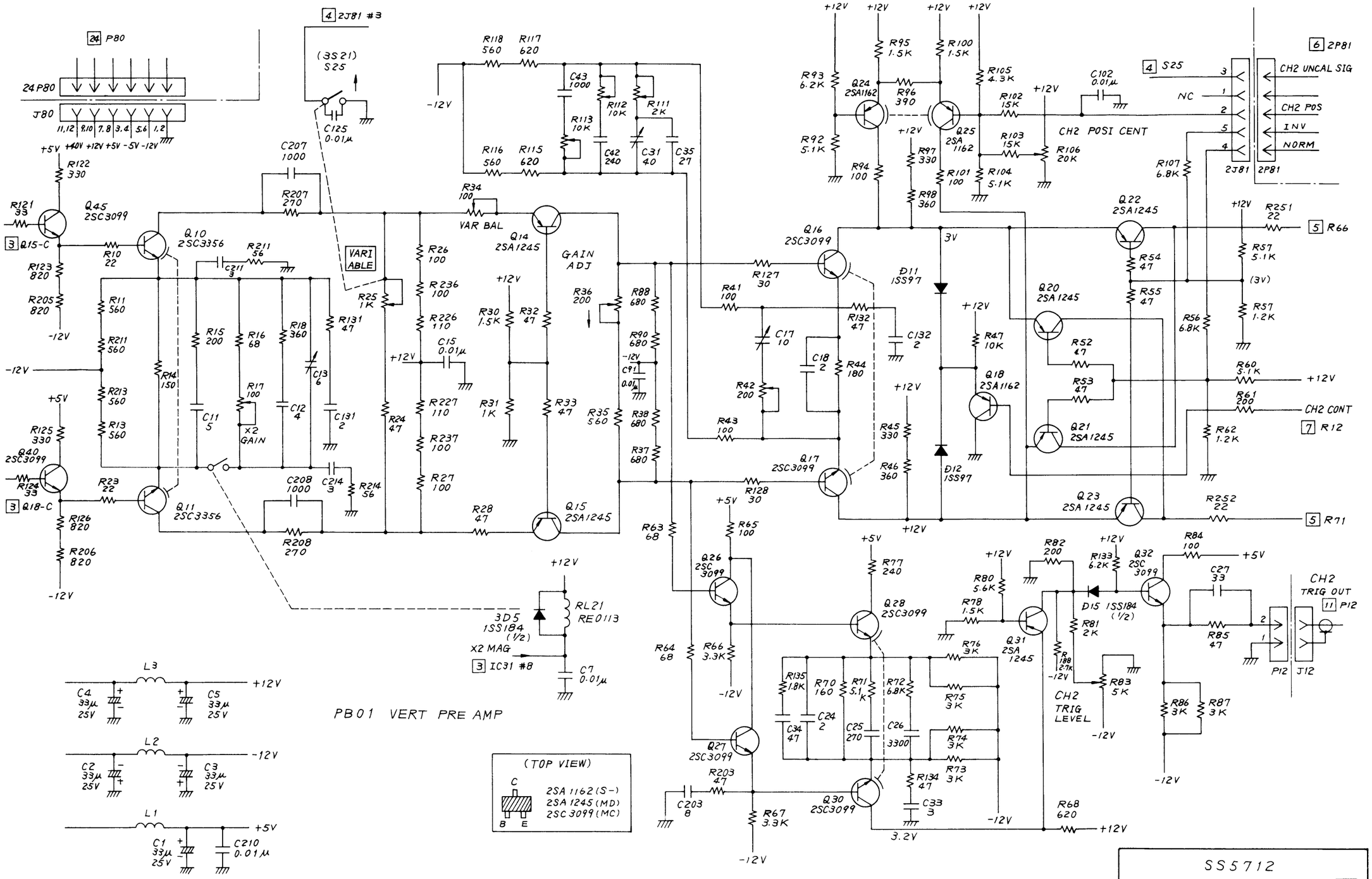
PB01 VERT PRE AMP

IC NO	IC NAME	VCC	GND
31	7406	14	7
32	74LS02	14	7
33	74LS27	14	7

SS5712

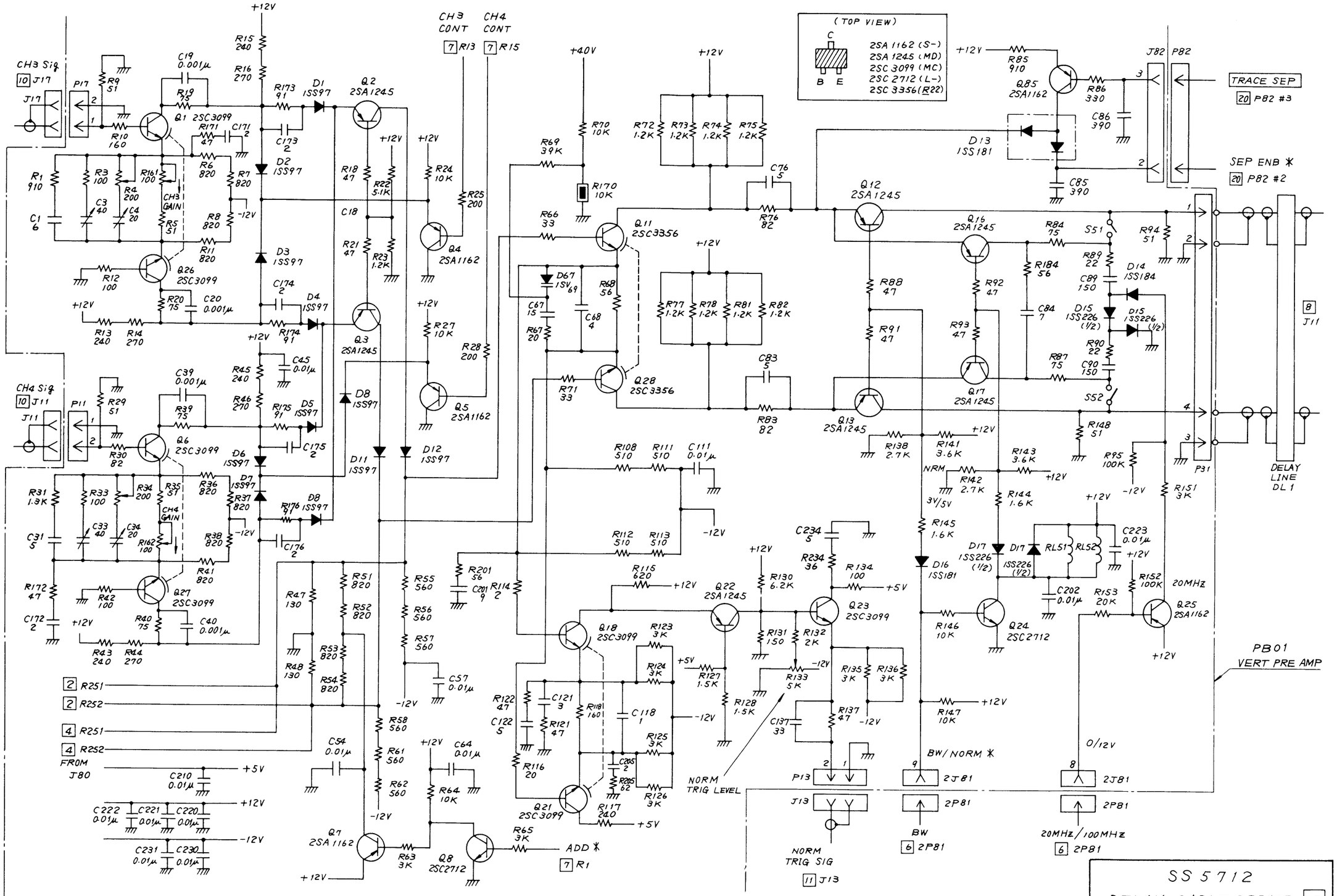
CH2 PREAMP (1) 3

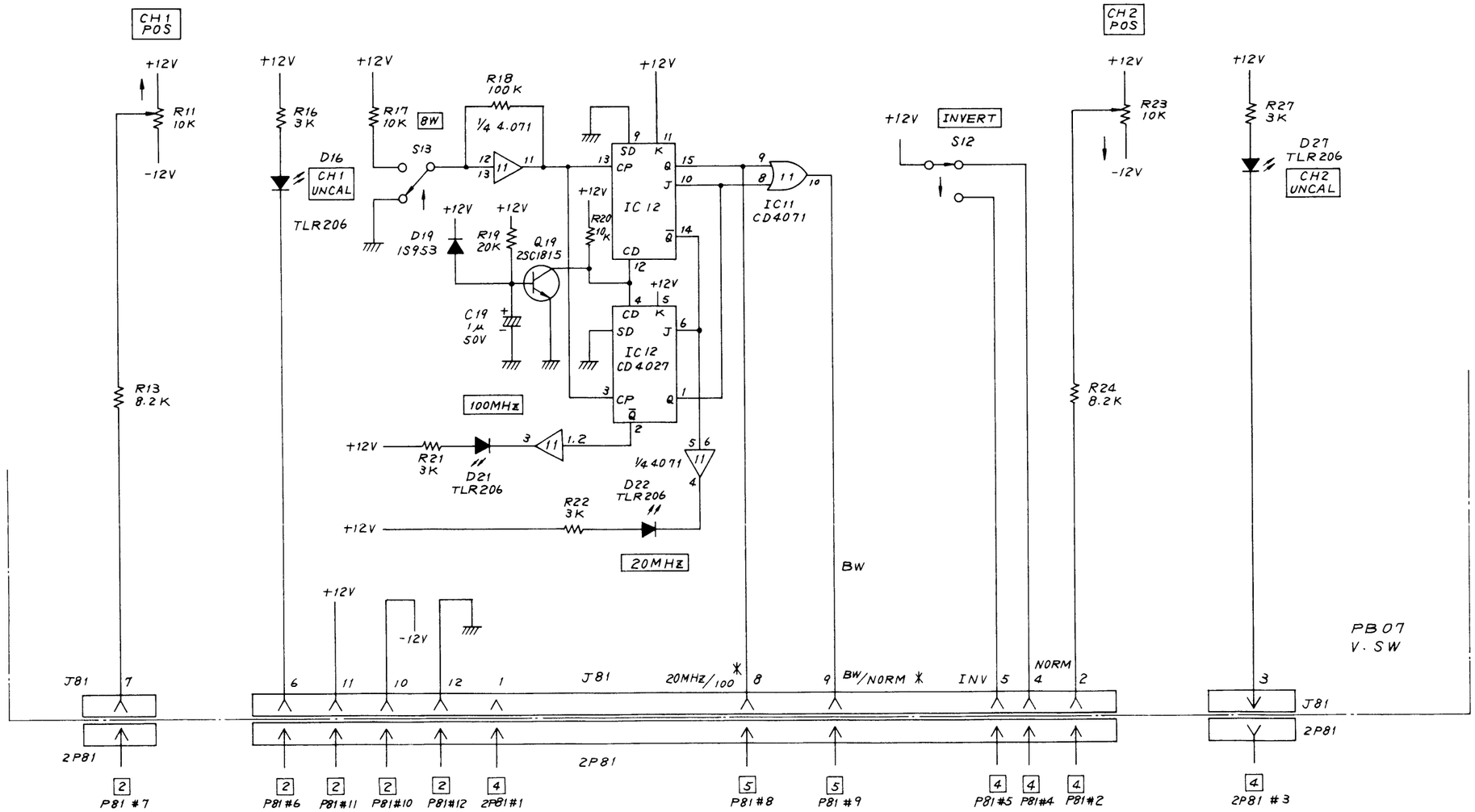
BBWSS24083102 2



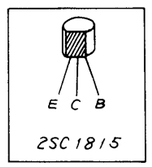
PB01 VERT PRE AMP

SS5712 CH2 PREAMP (2)	4
BBWSS24084102	2


CH3 Sig
10 J17
CH4 Sig
10 J11
CH3 CONT
7 R13
CH4 CONT
7 R15
+12V
+40V
-12V
(TOP VIEW)
2SA1162 (S-)
2SA1245 (MD)
2SC3099 (MC)
2SC2712 (L-)
2SC3356 (R22)
TRACE SEP
20 P82 #3
SEP ENB *
20 P82 #2
8 J11
DELAY LINE DL1
PB01 VERT PRE AMP
NORM TRIG LEVEL
NORM TRIG SIG
11 J13
BW/NORM *
BW
6 2P81
20MHz/100MHz
6 2P81
FROM J80
2 R251
2 R252
4 R251
4 R252
ADD *
7 R1
Q1 2SC3099
Q2 2SA1245
Q3 2SA1245
Q4 2SA1162
Q5 2SA1162
Q6 2SC3099
Q7 2SA1162
Q8 2SC2712
Q11 2SC3356
Q12 2SA1245
Q13 2SA1245
Q15 2SA1245
Q17 2SA1245
Q18 2SC3099
Q21 2SC3099
Q22 2SA1245
Q23 2SC3099
Q24 2SC2712
Q25 2SA1162
Q26 2SC3099
Q27 2SC3099
Q28 2SC3356
Q85 2SA1162
D1 ISS97
D2 ISS97
D3 ISS97
D4 ISS97
D5 ISS97
D6 ISS97
D7 ISS97
D8 ISS97
D11 ISS97
D12 ISS97
D13 ISS181
D14 ISS184
D15 ISS226 (1/2)
D16 ISS181
D17 ISS226 (1/2)
D67 1SV69
CH GAIN
P17
P11
P13
P31
J13
J80
J82
P82
S51
S52
SS 5712
DELAY CABLE DRIVER 5
BBWSS24085102 2



IC. NO	IC NAME	VCC	GND
11	CD 4071	14	7
12	CD 4027	16	8

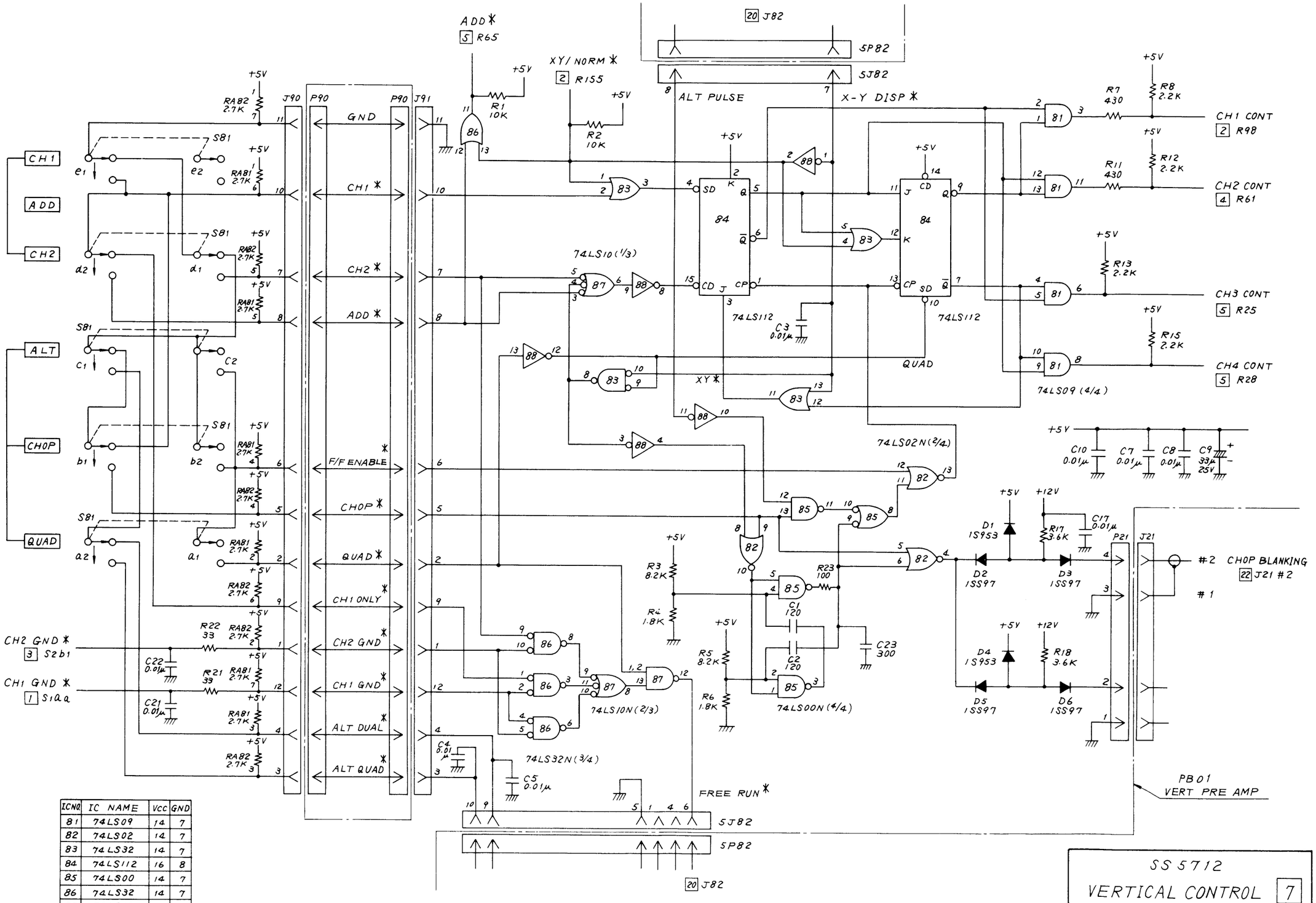


20MHz	BW	
0	0	NORM
0	1	100MHz
1	1	20MHz

SS5712

VERT SWITCHES 6

BBWSS40014105 2



ICNO	IC NAME	VCC	GND
81	74LS09	14	7
82	74LS02	14	7
83	74LS32	14	7
84	74LS112	16	8
85	74LS00	14	7
86	74LS32	14	7
87	74LS10	14	7
88	74LS04	14	7

SS 5712
VERTICAL CONTROL 7

BBWSS10029102 2

PB04

V MAIN AMP

(TOP VIEW)

C
B E

2SA 1162 (S-)
2SA 1245 (MD)
2SC 3099 (MC)
2SC 3356 (R22)
2SC 2712 (L-)

24P79 J79

5 DL1

A

B

L11 2T (CT)

L12 2T (CT)

C11 4

C12 4

R35 56

R36 5K

R34 390

R37 56

R33 33

R61 33

Q16 2SC3099

Q17 2SC3099

R42 30

R41 62

R43 30

C13 10

C14 6

R38 500

C15 390

C16 0.001µ

C17 0.01µ

R44 2K

R45 5K

R46 5K

R51 300

R52 300

C22 0.01µ

BAL

R53 500

-12V

R54 300

R55 300

+12V

R28 100

R31 100

R32 100

R56 100

R57 100

R58 100

C184 3

R108 62

Q25 2SA1245

R114 100

R115 33

Q24 2SA1245

R83 62

C183 3

R84 100

R85 33

Q26 2SC3356

R143 22

Q28 2SC3356

C226 2

R226 56

D11 1SV69

R95 270

R96 270

R97 270

R99 510

R93 2K

C24 27

C125 15

C25 10

R92 47

R94 47

R98 270

R101 270

R100 500

R102 270

R86 56

R88 820

C23 2

R91 470

R87 56

R110 39K

-12V

R109 2.4K

R107 10K

R105 47

R103 510

R104 470

R106 47

GAIN ADJ

R123 5K

R122 240

R62 470

R63 470

JP13

Q18 2SC2712

Q21 2SC2712

R67 20K

C27 0.001µ

R70 10K

R64 62K

R66 4.3K

R65 62K

R71 10K

C28 0.001µ

R68 20K

C30 0.001µ

R73 180K

R72 220K

C32 0.1µ

R75 110K

C31 0.01µ

R74 160K

C33 1µ NP 50V

C34 10µ NP 16V

R76 75K

C35 33µ NP 25V

Q22 2SA1162

R111 470

R112 510

C112 180

R78 390

+12V

R77 240K

R81 470

JP15

Q23 2SA1162

R82 390

+12V

R144 22

Q31 2SC3356

C36 0.01µ

R116 3K

-12V

D12 1SS184

JP22

3,4

J79

24P79

BEAM FINDER

9 24P79

-12V

R124 200 1/2W

C37 4

R125 56

R126 22

R127 180 1/2W

C38 4

R128 56

R131 180 1/2W

C41 4

R132 56

R133 22

R134 200 1/2W

C42 4

R135 56

R117 270

R121 270

R118 270

+12V

C59 0.01µ

R136 47

IC2

C2

L13 6T

R137 200

157

IC3

C3

+40V

C43 0.01µ 500V

157

L14 6T

R142 200

J79 24P79

24P79

L15

3,4

C44 33µ 25V

C50 0.01µ

C51 0.01µ

C52 0.01µ

C55 0.01µ

L16

5,6

C45 33µ 25V

7,8

1,2

+40V

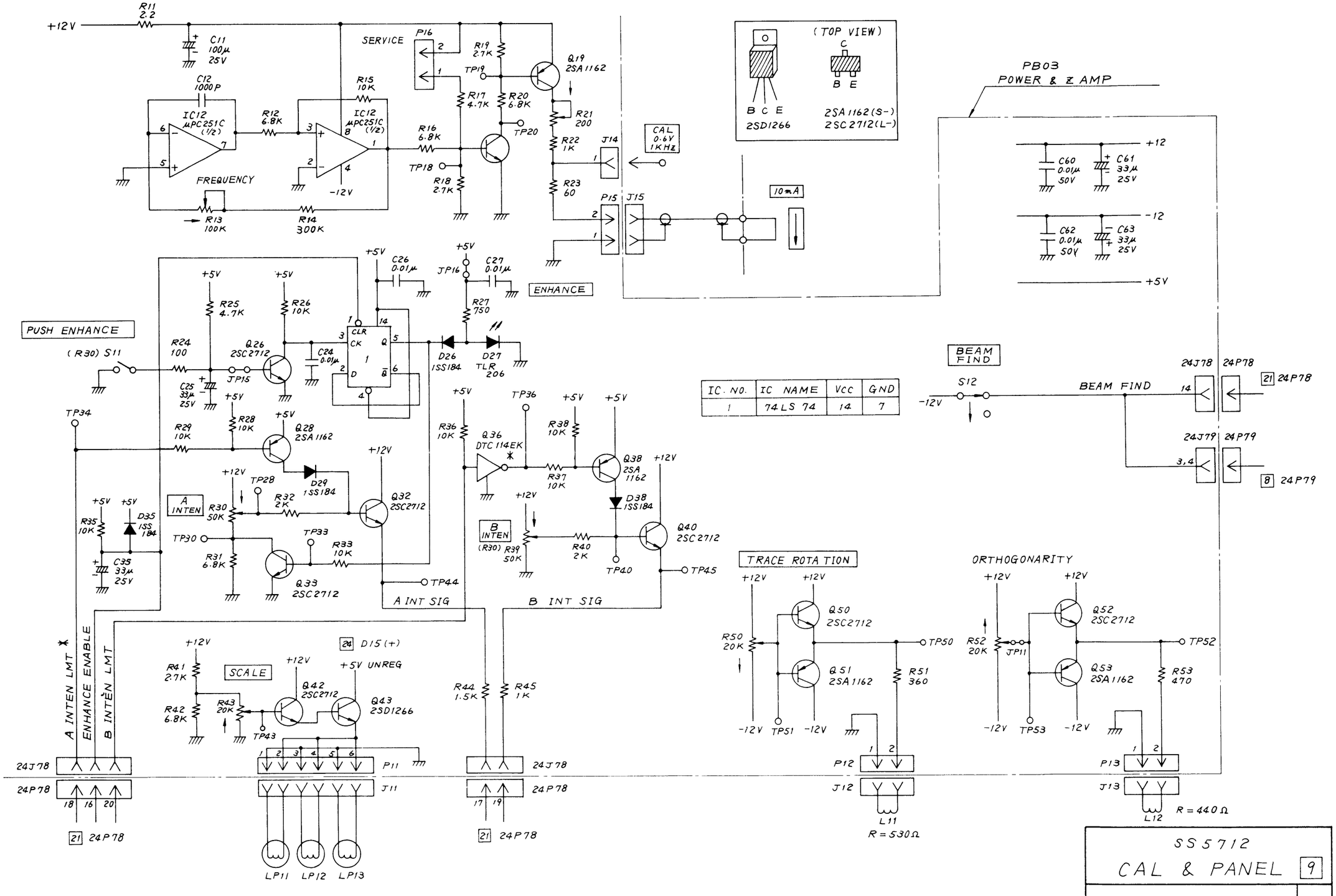
-12V

+12V

SS5712

VERT MAIN AMP 8

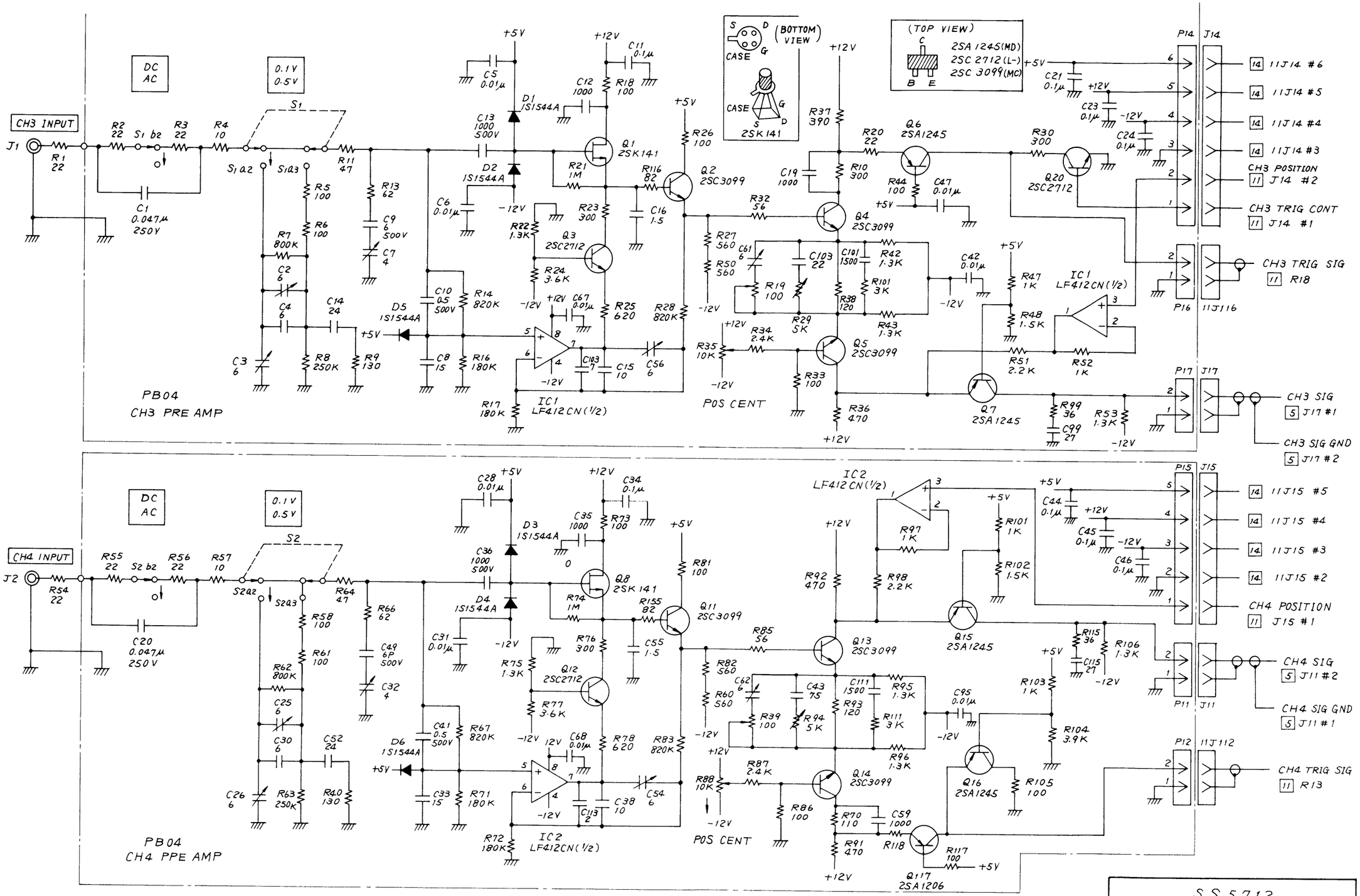
BBWSS24086102 2



IC. NO.	IC NAME	VCC	GND
1	74LS74	14	7

SS5712
CAL & PANEL 9

BBWSS40017102 2



SS 5712	
CH3 & CH4 PREAMP	10
BBWSS24087102	2

C (TOP VIEW)
2SA1245(MD)
2SC3099(MC)
B E

PB07
A SOURCE

CH3 POSITION
+12V
R91 20K
R92 6.8K
-12V
S91
A SOURCE
CH1
NORM
CH2
CH3
LINE
COMB

J73 P74 P74 J74

10 J15 #1
CH4
POSITION

10 11J112
CH4
TRIG SIG

5 J13
NORM
TRIG SIG

4 J12
CH 2
TRIG SIG

2 J11
CH1
TRIG SIG

10 J14 #2
CH3
POSITION

10 11J116
CH3
TRIG SIG

10 J14 #1

(20mv/DIV)

CH3 TRIG CONT

C14 1000
C103 0.01μ

J13 P13
J12 P12
J11 P11

+12V
R21 820
R22 51
C25 47
R23 51
R24 820
Q21 2SC3099
R25 51
Q24 2SC3099
R26 2.4K
R27 2.4K
-12V
+5V
R29 1K
R28 3.9K
Q31 2SA1245
R30 100
R31 100
Q30 2SA1245
C15 0.01μ
R14 3K
CH4 TRIG LEVEL ADJ
R15 20K
R32 1K
Q32 2SA1245
R33 1.5K
C33 0.01μ
A NORM ✱

R41 820
R42 51
C45 47
R43 51
R44 820
Q41 2SC3099
R45 51
Q44 2SC3099
R46 2.4K
R47 2.4K
R49 1K
R48 3.9K
Q51 2SA1245
R50 100
R51 100
Q50 2SA 1245
Q54 2SA1245
R54 1K
R52 1K
R55 1.5K
R53 1.5K
Q52 2SA1245
C53 0.01μ
C55 0.01μ
A CH2 ✱

R61 820
R62 51
C65 47
R63 51
R64 820
Q61 2SC3099
R65 51
Q64 2SC3099
R66 2.4K
R67 2.4K
R69 1K
R68 3.9K
Q71 2SA1245
R70 100
R71 100
Q70 2SA 1245
R74 1K
R72 1K
R75 1.5K
R73 1.5K
Q74 2SA1245
Q72 2SA1245
C73 0.01μ
C75 0.01μ
A CH1 ✱
A CH3 ✱
JP11
JP12
C17 0.01μ

+5V
R16 1K
R18 43
JP13
R19 3K
C20 0.01μ
R20 20K
Q17 2SA1245
R17 1.5K
-12V
CH3 TRIG LEVEL ADJ
14 R10
A TRIG SIG FOR TY.

12 R26
A TRIG. SIG

13 R22
B TRIG. SIG.

B SOURCE S92
RUNS AFTER DELAY
CH1
CH2
CH4
R93 51
C93 2
FP11
9 B CH2 ✱
8 B CH1 ✱
10 B CH4 ✱
7
6
2 +12V
1 -12V
3
4,5
R95 20K
R96 6.8K
-12V
+12
CH4 POSITION
PB07
B SOURCE

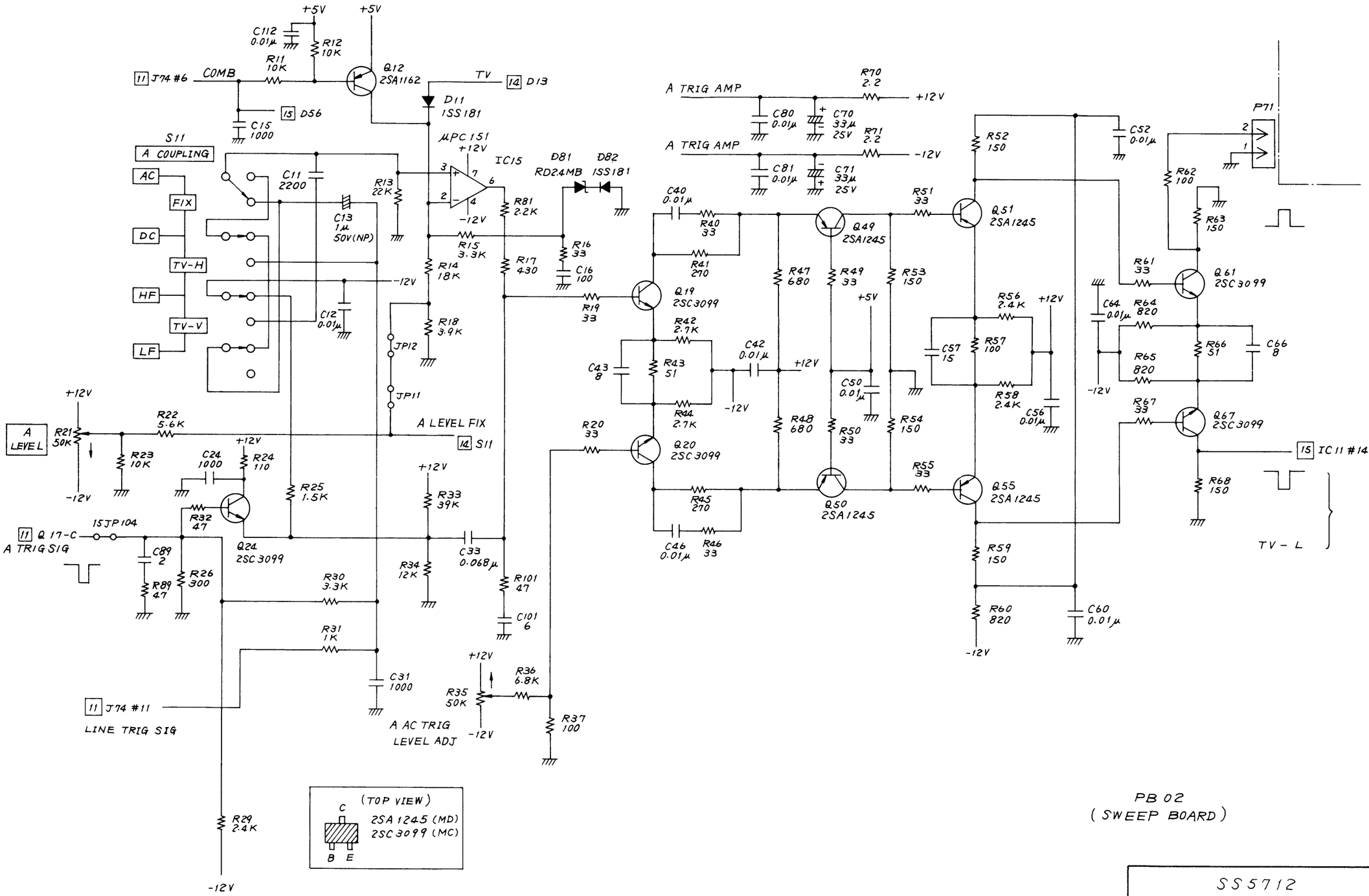
12 R11
6 COMB
11
16
15
7
13
12
10
14
8
4
C12 0.01μ
D43 1S953
RUNS AFT DLY
16 IC43 #12
C101 0.01μ
LINE TRIG SIG
12 R31
R56 6.2K
+12V
-12V
R57 20K
CH2 B TRIG LEVEL

C49 C29 C11 0.01μ
-5V
C87 C86 C85 C84 C83 C82 C81 0.01μ
-12V
C94 C93 C92 C91 0.01μ
+12V

P74 J74

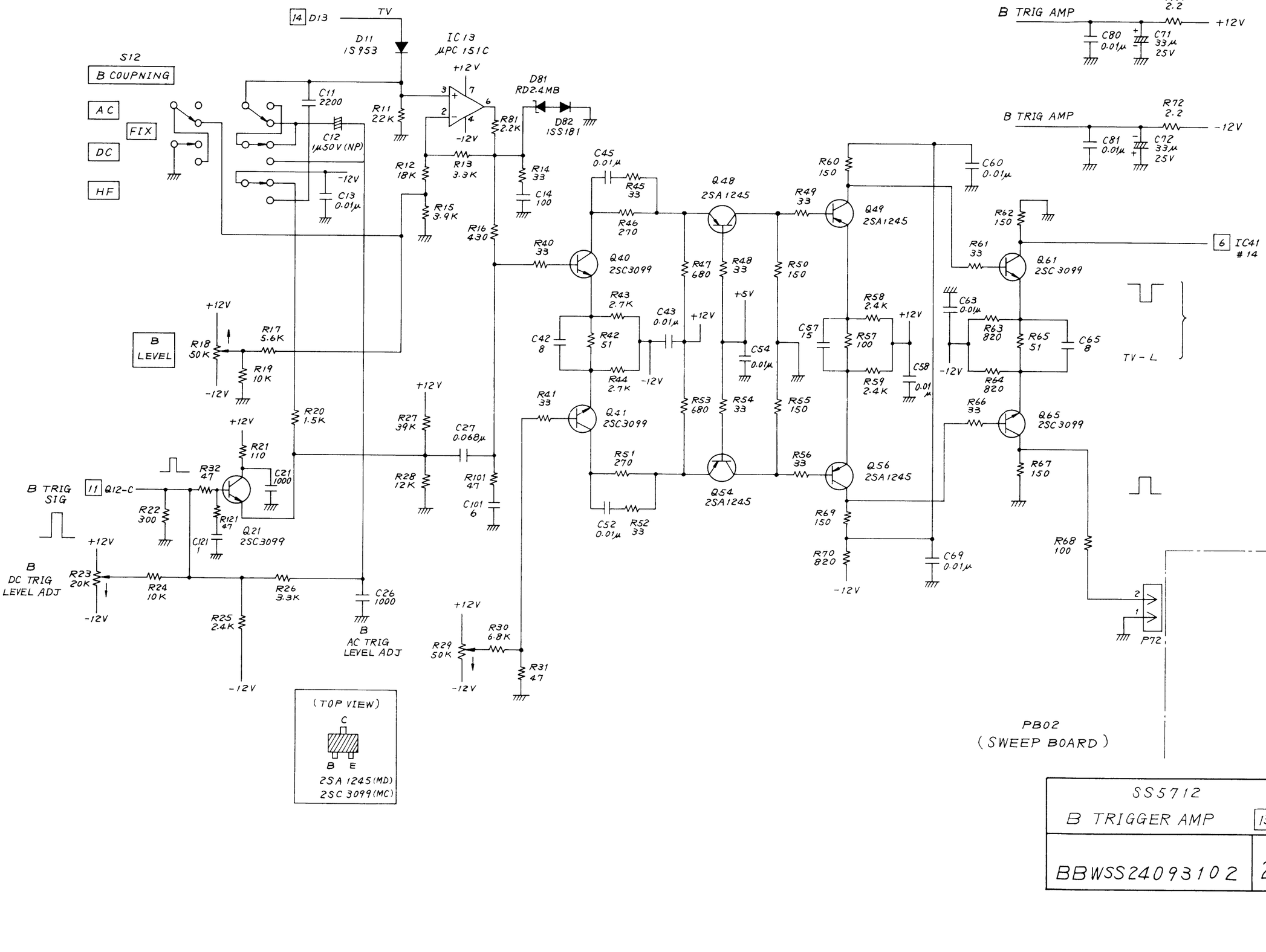
PB02
SWEEP BOARD

SS 5712
TRIG SIG SELECTOR 11
BBWSS24090102 2

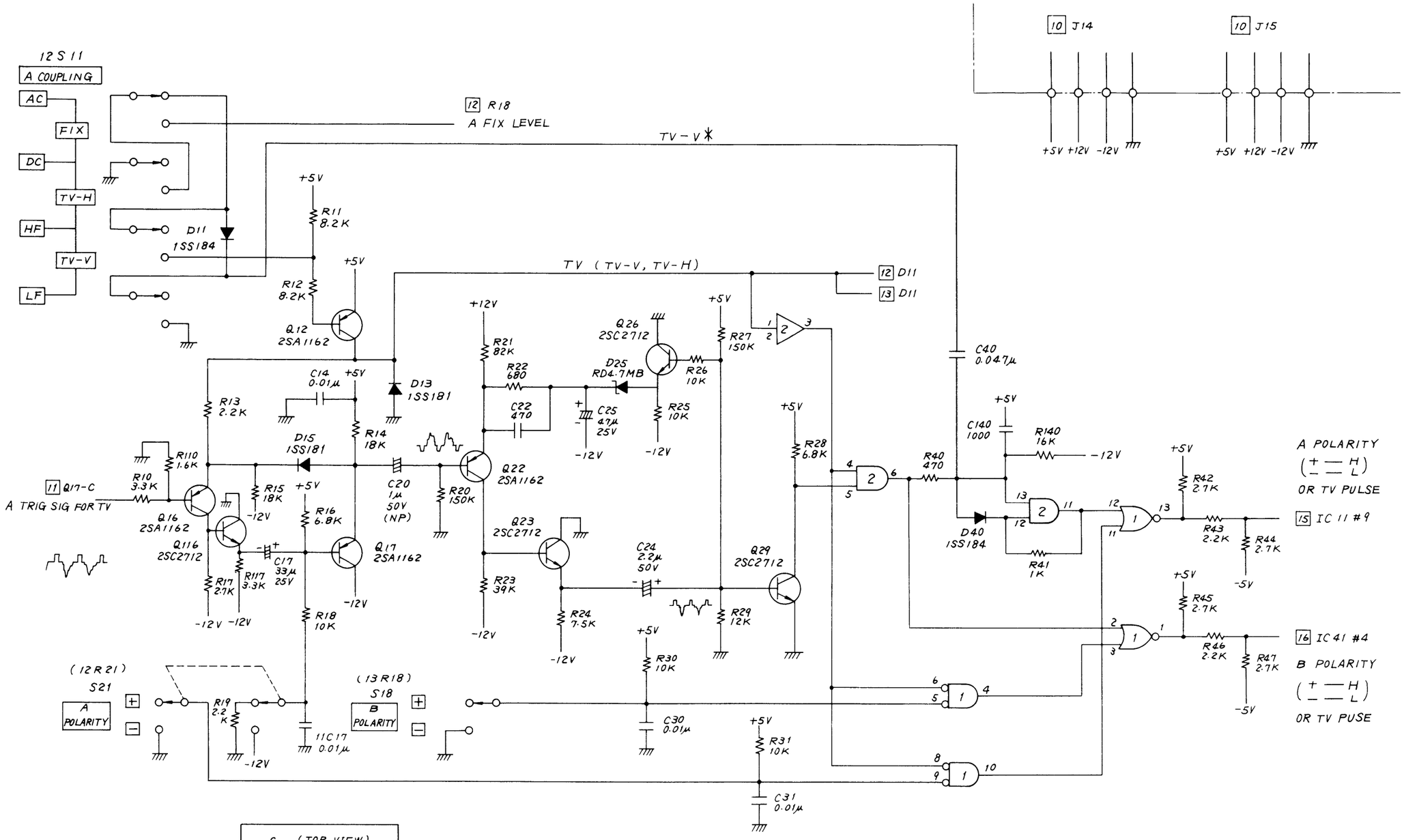


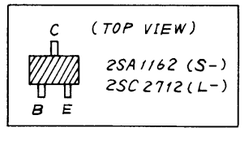
PB 02
(SWEEP BOARD)

SS5712	
A TRIGGER AMP 12	
BBWSS24092102	2



SS5712	
B TRIGGER AMP	13
BBWSS24093102	2

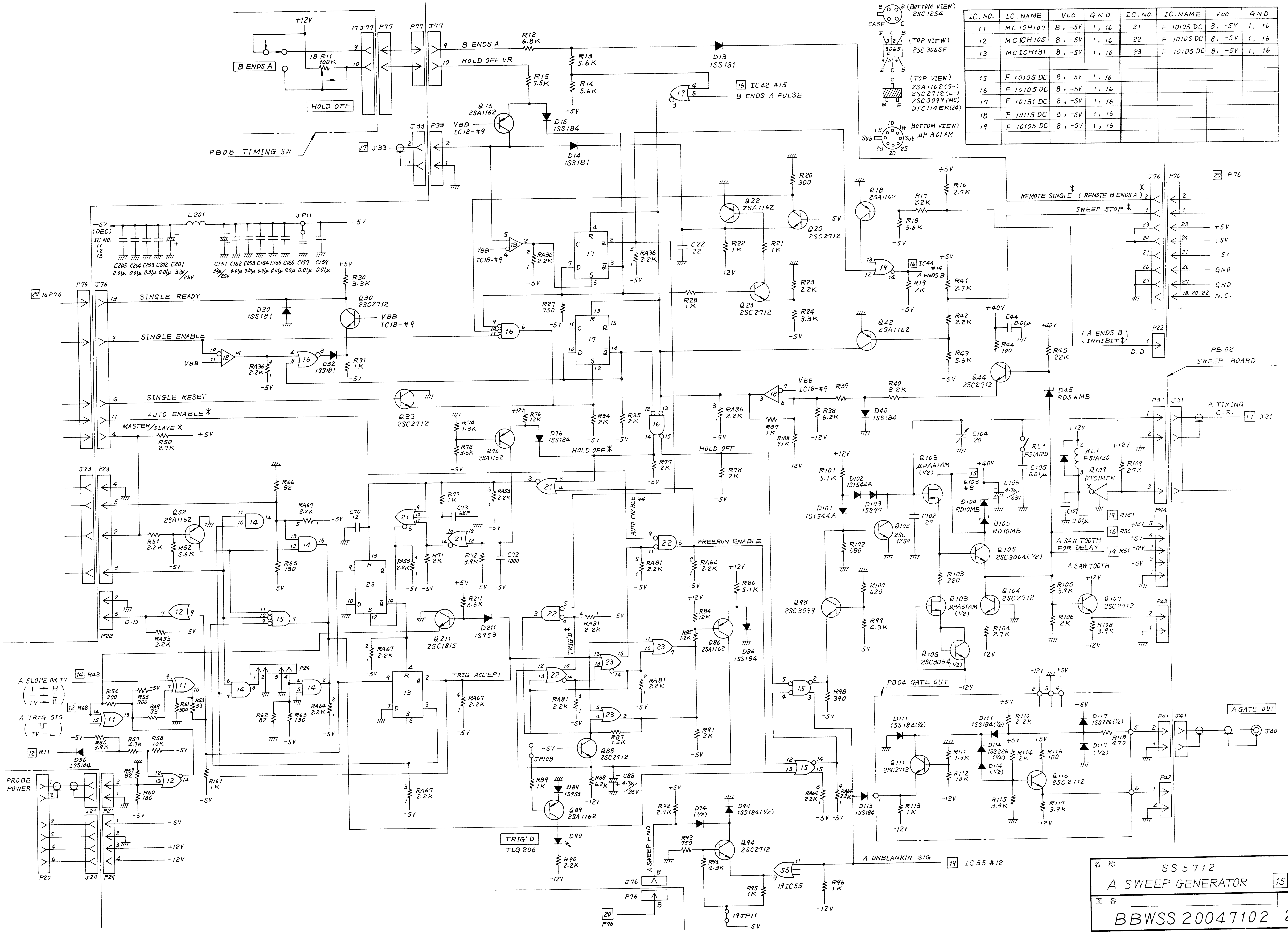




IC. NO.	IC NAME	VCC	GND
1	74LS02	14, +5V	7
2	74LS08	14, +5V	7

PB02
(SWEEP BOARD)

SS5712 TV SYNC SEPARATOR	14
BBWSS34020102	2



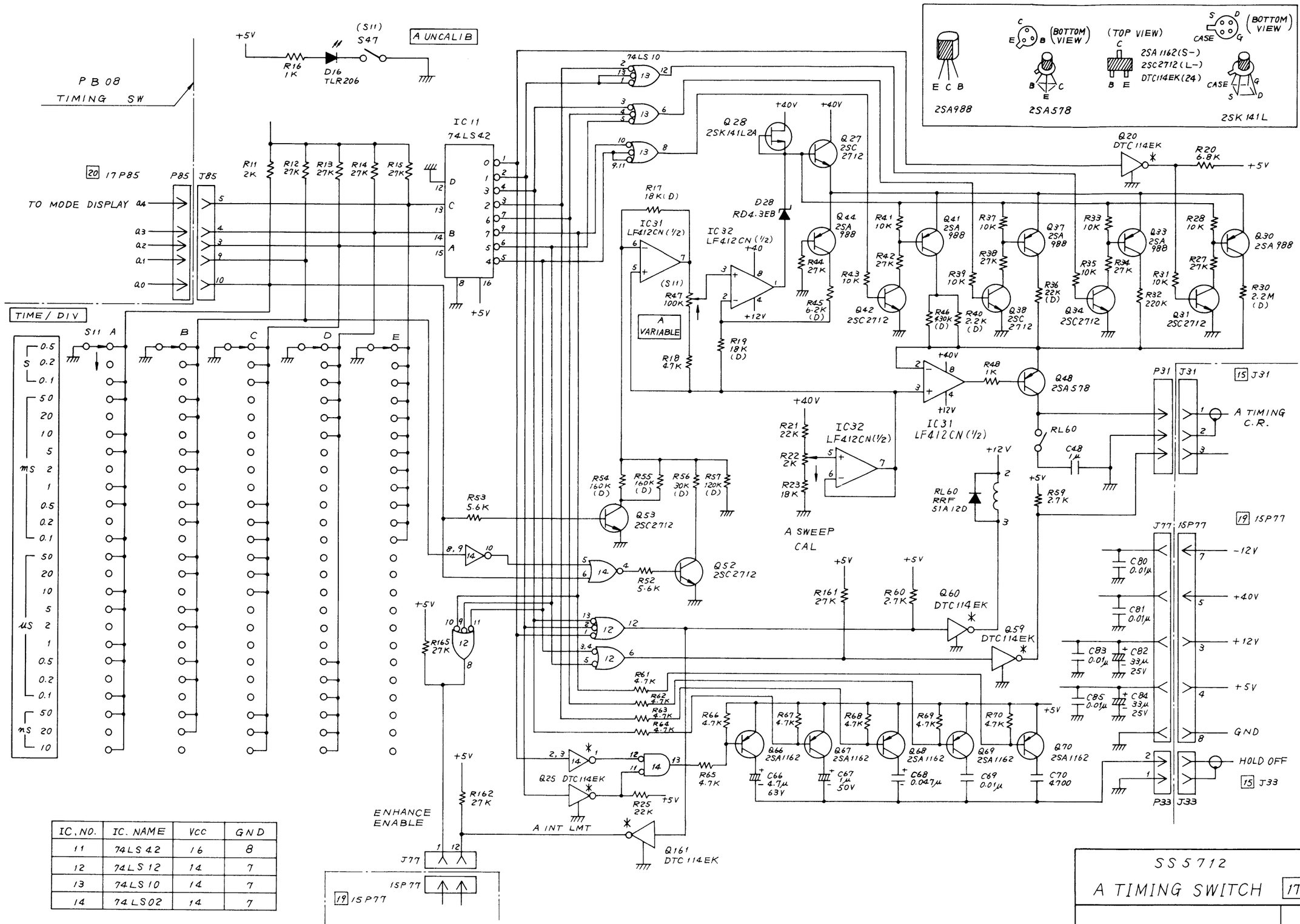
IC. NO.	IC. NAME	Vcc	GND	IC. NO.	IC. NAME	Vcc	GND
11	MC10H107	8, -5V	1, 16	21	F 10105 DC	8, -5V	1, 16
12	MC10H105	8, -5V	1, 16	22	F 10105 DC	8, -5V	1, 16
13	MC10H131	8, -5V	1, 16	23	F 10105 DC	8, -5V	1, 16
15	F 10105 DC	8, -5V	1, 16				
16	F 10105 DC	8, -5V	1, 16				
17	F 10131 DC	8, -5V	1, 16				
18	F 10115 DC	8, -5V	1, 16				
19	F 10105 DC	8, -5V	1, 16				

名称 SS5712
A SWEEP GENERATOR 15
図番 BBWSS 20047102 2

IC. NO.	IC NAME	Vcc	GND
31	HA 1127	——	——
41	MC 10H107	8 , -5V	1 , 16
42	F10105 DC	8 , -5V	1 , 16
43	MC 10H131	8 , -5V	1 , 16
44	F10105 DC	8 , -5V	1 , 16

DELAY TIME MULTI
DLY STOP ADJ
J37 P37
R11 10K
R12 2K
R13 4.3K
R14 1K
+12V
C14 0.01μ
R15 8.2K
R16 1K
DLY START ADJ
R20 1.8K
20 P76
B INHIBIT (ECL)
15P76 15J76
D46 1S953
+40V
R21 27K
R25 27K
R26 100
C27 0.01μ
R27 2.7K
R28 8.2K
R29 1K
R30 100
A SAWTOOTH FOR DELAY
15 R105
Q21 2SA1162
Q24 2SA1162
R24 2K
C24 56
R22 2.7K
R23 820
-5V
31
R31 1K
R32 9.1K
R55 3K
-12V
(TOP VIEW) (BOTTOM VIEW)
2SA1162(S-) 2SC2712(L-) 2SC3099(MC)
DTC114EK(24)
μPA61AM
(BOTTOM VIEW) 2SC1254
(TOP VIEW) 2SC3065F
(DEC) IC NO.4 42.43
L82
C82 33μ 25V
C81 0.01μ
C80 33μ 25V
J75 P75 21 P75
1,2 GND
15 LIN SIG
11,12 +40V
9,10 +12V
5,6 -12V
7,8 +5V
3,4 -5V
11 J74-#9
PB02 SWEEP BOARD
B POL OR TV SYNC
(+ —H — —L TV— —)
4 R46
15JP106
B TRIG
13 R67
TV -L
R33 200
R34 1K
R35 300
R36 82
R37 130
R38 82
R39 130
R43 300
R56 51
P44
15 IC19-#14 A ENDS B
R46 1K
R44A 2.2K
R44 2K
VBB (9)
R47 1K
C47 100
R147 2K
R48 2K
C48 22
15 IC 19 #5 B ENDS A PULSE
R49 6.2K
R50 680
R51 8.2K
DS0 1SS181
R52 100
R53 22K
Q52 2SC2712
D53 RD5,6EB
PB02 SWEEP BOARD
P32 J32 18 J32
19 R50 B SAWTOOTH
RL76 RF51A12D
C74 4.7μ 63V
C75 20
C76 10000
R63 5.1K
1SS97
D62 1S1544A
D63 D64 1S1544A
C63 56
Q64 2SC1254
R64 680
Q80 μPA61AM (1/2)
16 Q80#8
D74 RD 10MB
D75 RD10MB
Q73 2SC3064 (1/2)
R73 220
R74 2.7K
Q74 2SC2712
+12V
RL76 RF51A12D
R76 27K
Q76 DTC114EK
19 R150
C77 0.01μ
15P42
15P41
B GATE OUT
J40
PB04 GATE OUT
Q60 2SC3099
R61 620
R62 4.3K
+5V
R114 2K
R115 3.9K
R116 100
Q116 2SC2712
D114(1/2) 1SS226
D111 (1/2)
D111(1/2) 1SS184
Q111 2SC2712
R111 1.3K
R112 10K
R113 1K
R117 3.9K
R110 2.2K
D117(1/2) 1SS276
D117(1/2)
R118 470
D70 1S953
R70 2K
UNBLANKING SIG
19 IC 55 #5
11 J74 #8
RUNS AFT DLY
20 P76
FREE RUN
15P76 15J76
R40 5.6K
R41 3.3K
R42 10K
Q42 2SA1162
D42 1S953

SS5712
B SWEEP GENERATOR 16
BBWSS20048102 2

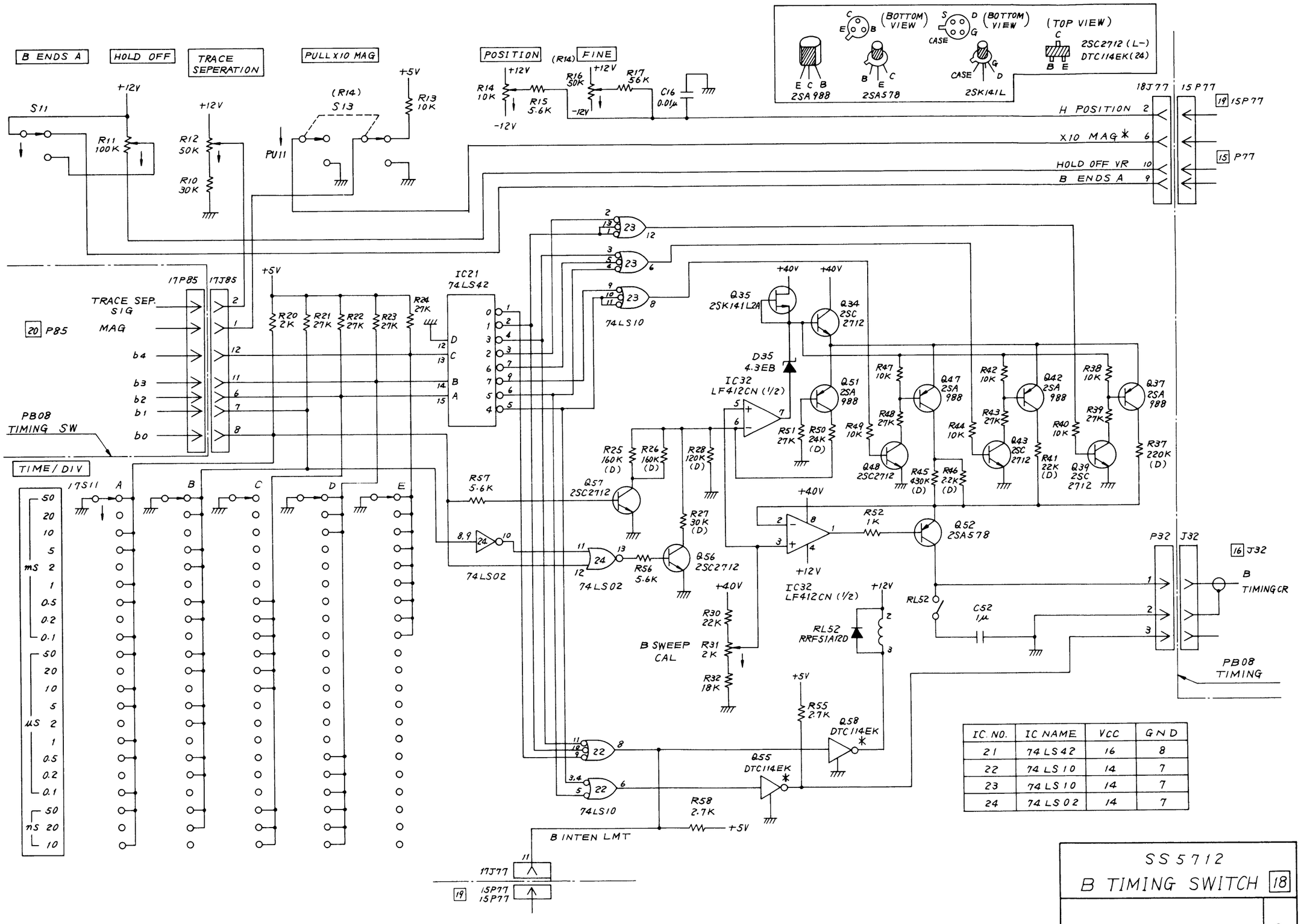


IC. NO.	IC. NAME	Vcc	GND
11	74LS42	16	8
12	74LS12	14	7
13	74LS10	14	7
14	74LS02	14	7

SS 5712

A TIMING SWITCH 17

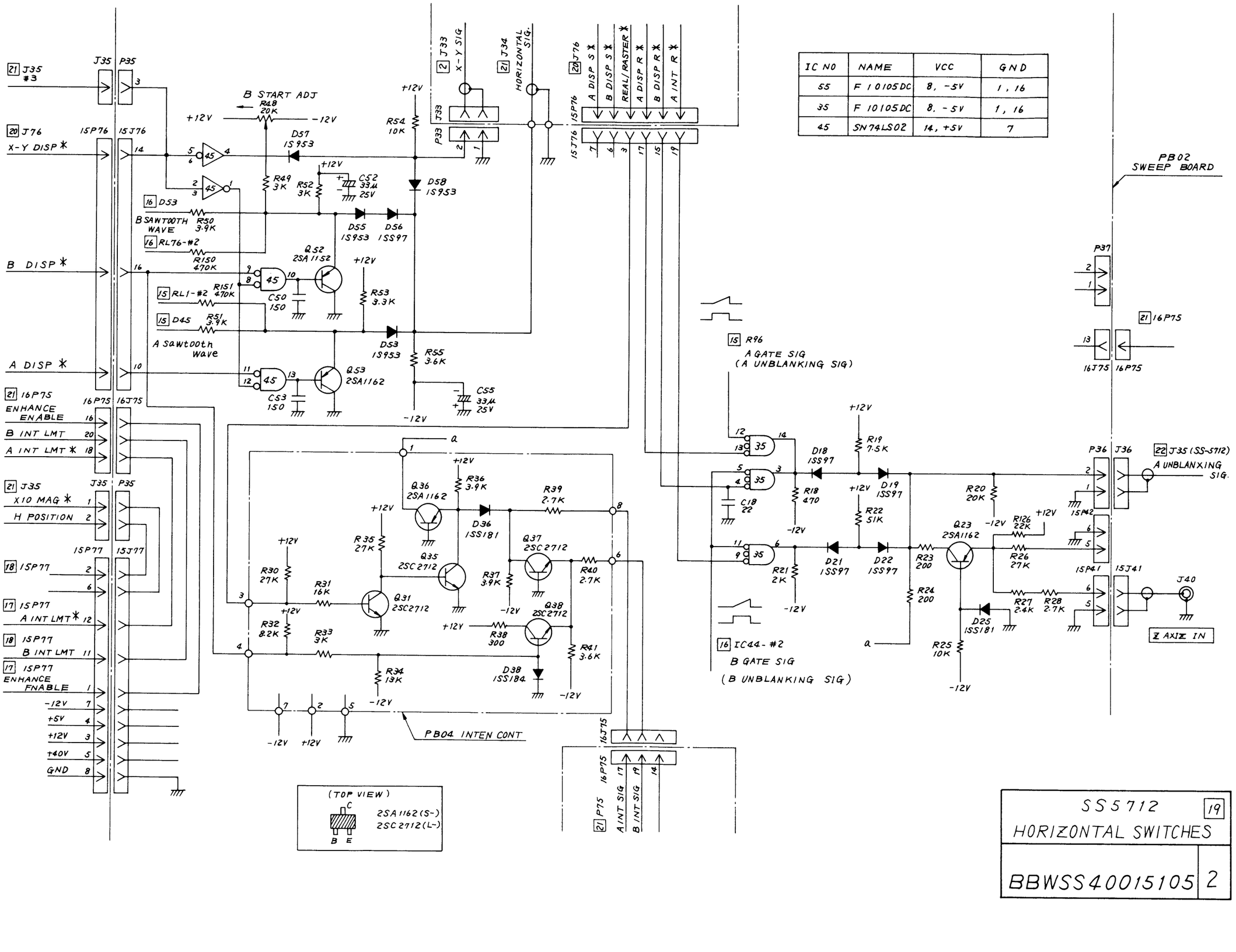
BBWSS20049105 2



IC. NO.	IC NAME	VCC	GND
21	74 LS 42	16	8
22	74 LS 10	14	7
23	74 LS 10	14	7
24	74 LS 02	14	7

SS 5712
B TIMING SWITCH 18

BBWSS 20050105 2



IC NO	NAME	VCC	GND
55	F 10105DC	8, -5V	1, 16
35	F 10105DC	8, -5V	1, 16
45	SN74LS02	14, +5V	7

SS5712 19

HORIZONTAL SWITCHES

BBWSS40015105 2

PB 09 HORIZ. CONTROL

C5 0.01μ, C14 0.01μ, C6 0.01μ, C15 0.01μ, C7 0.01μ, C16 0.01μ, C8 0.01μ, C17 0.01μ, C9 0.01μ, C18 0.01μ, C10 0.01μ, C19 0.01μ, C11 0.01μ, C20 0.01μ, C12 0.01μ, C21 0.01μ, C13 0.01μ, C22 0.01μ

S1-1 SUJ50A, S1-2 SUJ50A, S1-3 SUJ50A, S1-4 SUJ50A, S1-5 SUJ50A, S1-6 SUJ50A, S1-7 SUJ50A, S1-8 SUJ50A, S1-9 SUJ50A, S1-10 SUJ50A

A, A INT, ALT, B DLYD, X-Y

R19 27K, R22 27K, R20 27K, R23 27K, R21 27K, R24 27K, R37 27K

ASB A SWEEP END

ALT

XYD XY DISP *

AD A DISP

SR SINGLE READY

PXY

REAL/RASTER *

RMT SINGLE *

MODE

AUTO

NORM

SIGLE

S2-2 SUJ30A, S2-4 SUJ30A, S2-6 SUJ30A

TR1 DTC114EK

R18 27K, R38 27K, R39 27K, R34 27K, R46 27K, R48 27K, R44 2.7K, R42 5.6K, R40 5.6K, R26 2.7K, R43 5.6K, R41 5.6K, R27 27K, R5 27K, R45 1K, R25 2.7K, R28 3.9K, R17 5.6K

IC4B-2 LS74, IC4B-1 LS74, IC3D-1 LS74, IC3D-2 LS74, IC4C-3 LS00, IC4A-1 LS02, IC4A-2 LS02, IC3B-3 LS27, IC4A-3 LS02, IC3C LS04, IC4D-1 LS00, IC2D-5 LS04, IC4D-2 LS00, IC4D-3 LS00, IC4D-4 LS00, IC3C-3 LS04, IC4C-4 LS00, IC3C-4 LS04, IC3C-1 LS04, IC3C-2 LS04, IC2D-1 LS04, IC2D-2 LS04, IC2D-3 LS04, IC2C-2 LS02, IC2D-4 LS04, IC3C-5 LS04, IC1D-3 LS86, IC1D-4 LS86, IC2C-3 LS02, IC2C-4 LS02, IC5C-1 LS10, IC5D-1 LS10, IC5D-2 LS10, IC5D-3 LS10, IC5C-2 LS10, IC5C-3 LS10, IC4C-1 LS00, IC5B-6 LS04, IC4C-2 LS00, IC5B-2 LS04, IC5B-3 LS04, IC5B-4 LS04, IC4A-4 LS02, IC5B-5 LS04

#B+ALT+X-Y

C51 0.01μ, C3 330P, C1 33μ 25V, C4 0.01μ, C2 33μ 25V

R13 27K, R9 27K MAG, R12 27K, R1 27K, R8 27K, R10 27K, R4 27K, R11 27K, R3 27K, R14 27K, R15 27K

MAG *, A0, A1, A2, A3, A4, B0, B1, B2, B3, B4

FRAME SEP. SIG

ALT DUAL *, ALT QUAD *, X-Y DISP *, ALT PULS, X-Y DISP *, A DISP *, B DISP *, A SWEEP END

FREE RUN *

AUTO ENABLE *

SINGLE ENABLE, SINGLE READY, SINGLE RESET, REAL / RASTER

READY

LED1 TLR206, R49 680

R47 27K, RB 27K, RA1-3 2.7K, RA1-2 2.7K, RA1-1 2.7K, RA1-4 2.7K, RA1-5 2.7K, R31 2.2K, R32 2.2K, R33 2.2K, R30 2.2K, R29 2.2K, RA2-3 2.7K, RA2-2 2.7K, RA2-1 2.7K, RA2-4 2.7K, RA2-5 2.7K

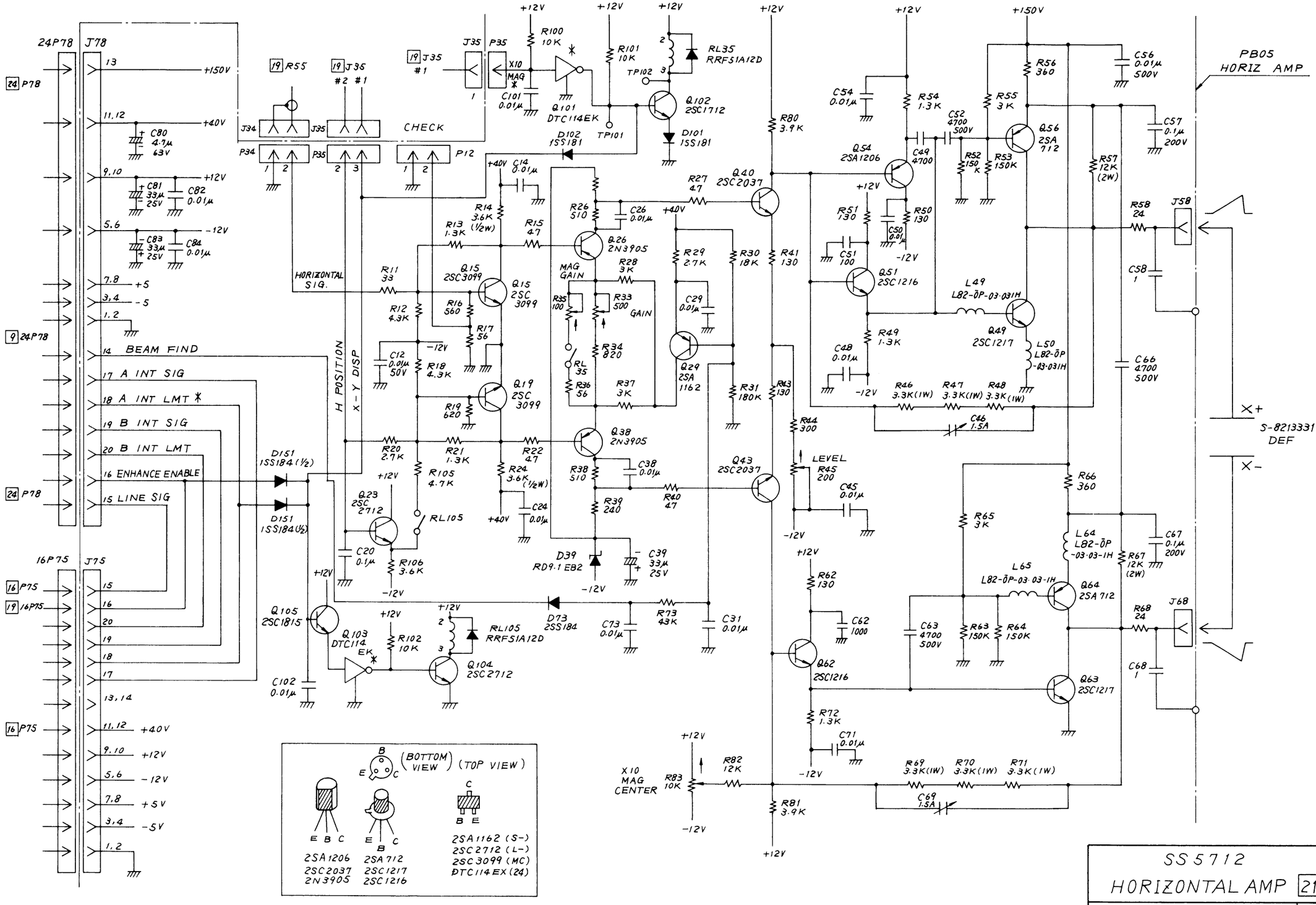
B DISP R *, A DISP R *, A INT R *, B DISP S *, A DISP S *

J85, 17P85, J82, SP82, J76, 15P76, J76

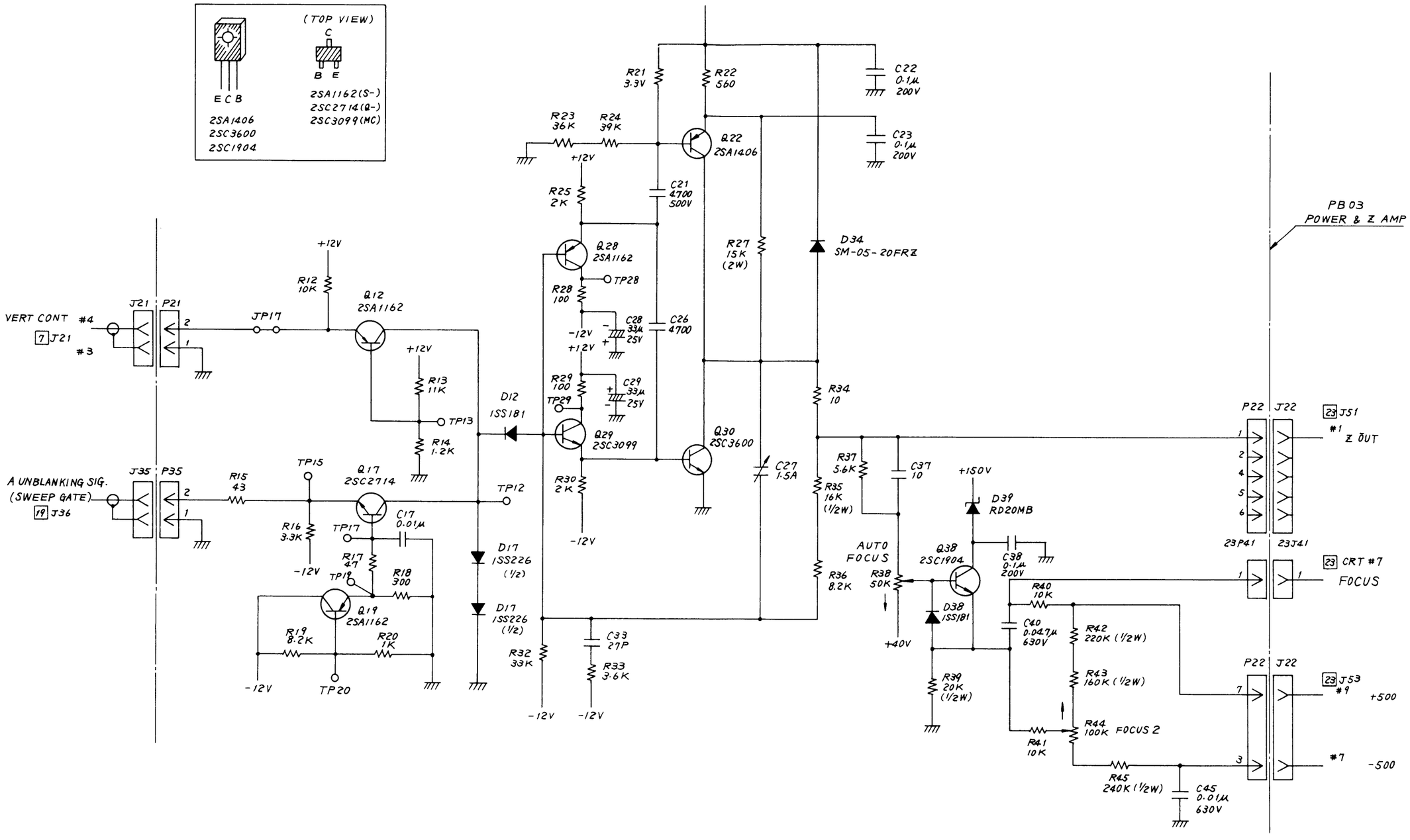
18 17P 78, 17 P78, 18 17P78, 5 P82, 7 SP82, 5 P82, 7 SP82, 15 P76, 15 J76

(TOP VIEW) DTC114EK (24) C B E

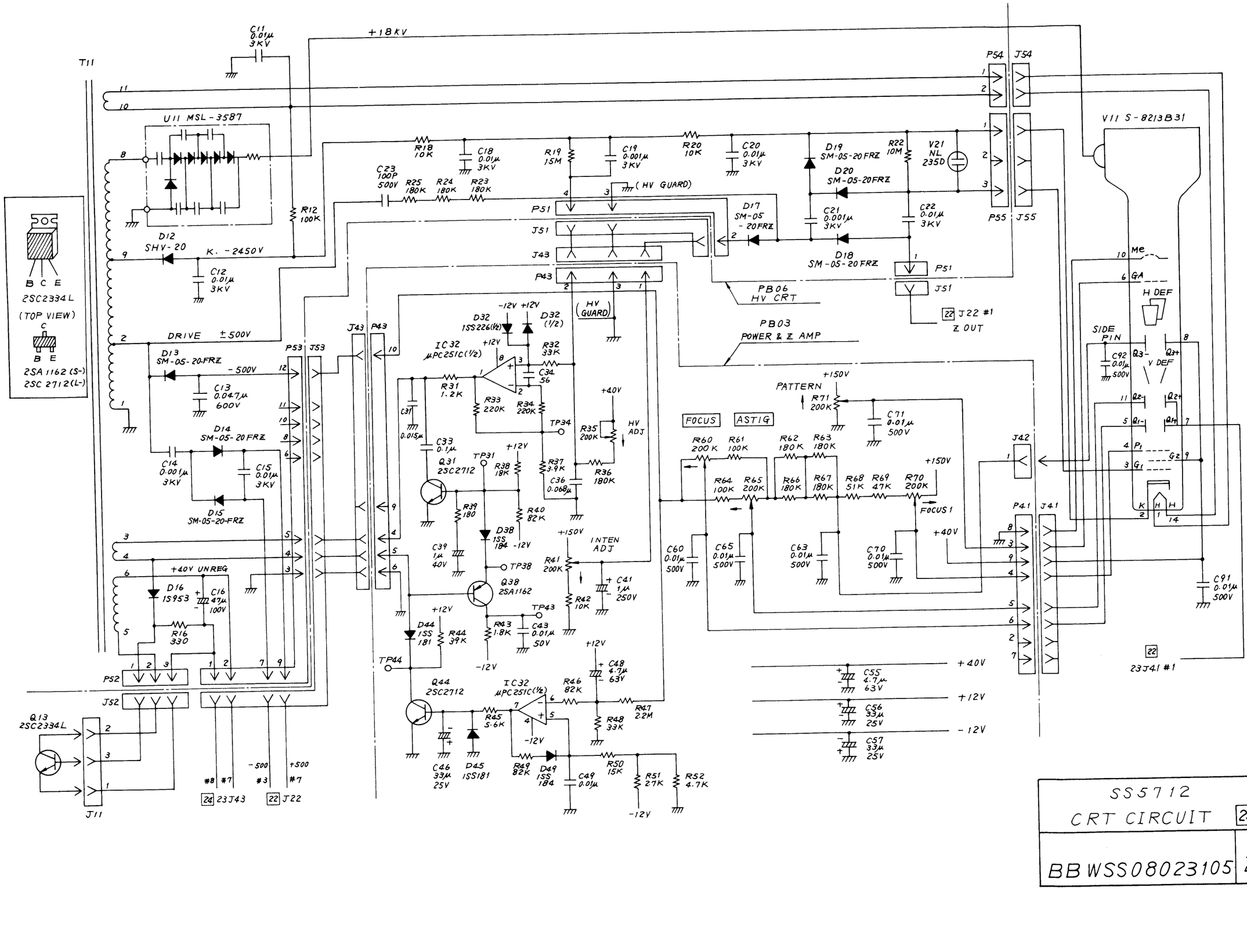
名称	SS 5712
	HORIZ CONTROL 20
図番	BBWSS10030102 2



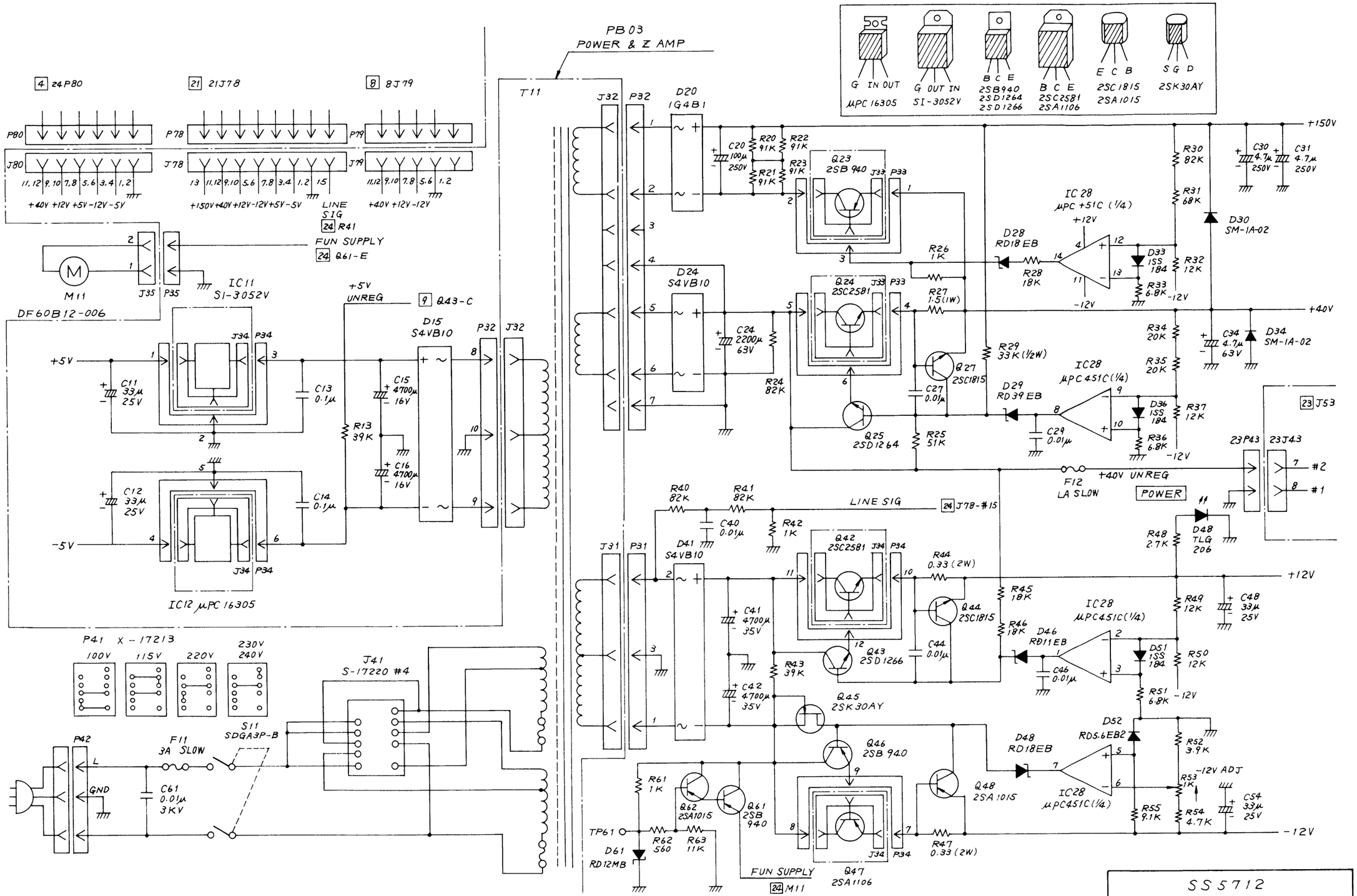
SS 5712 HORIZONTAL AMP	21
BBWSS24094102	2



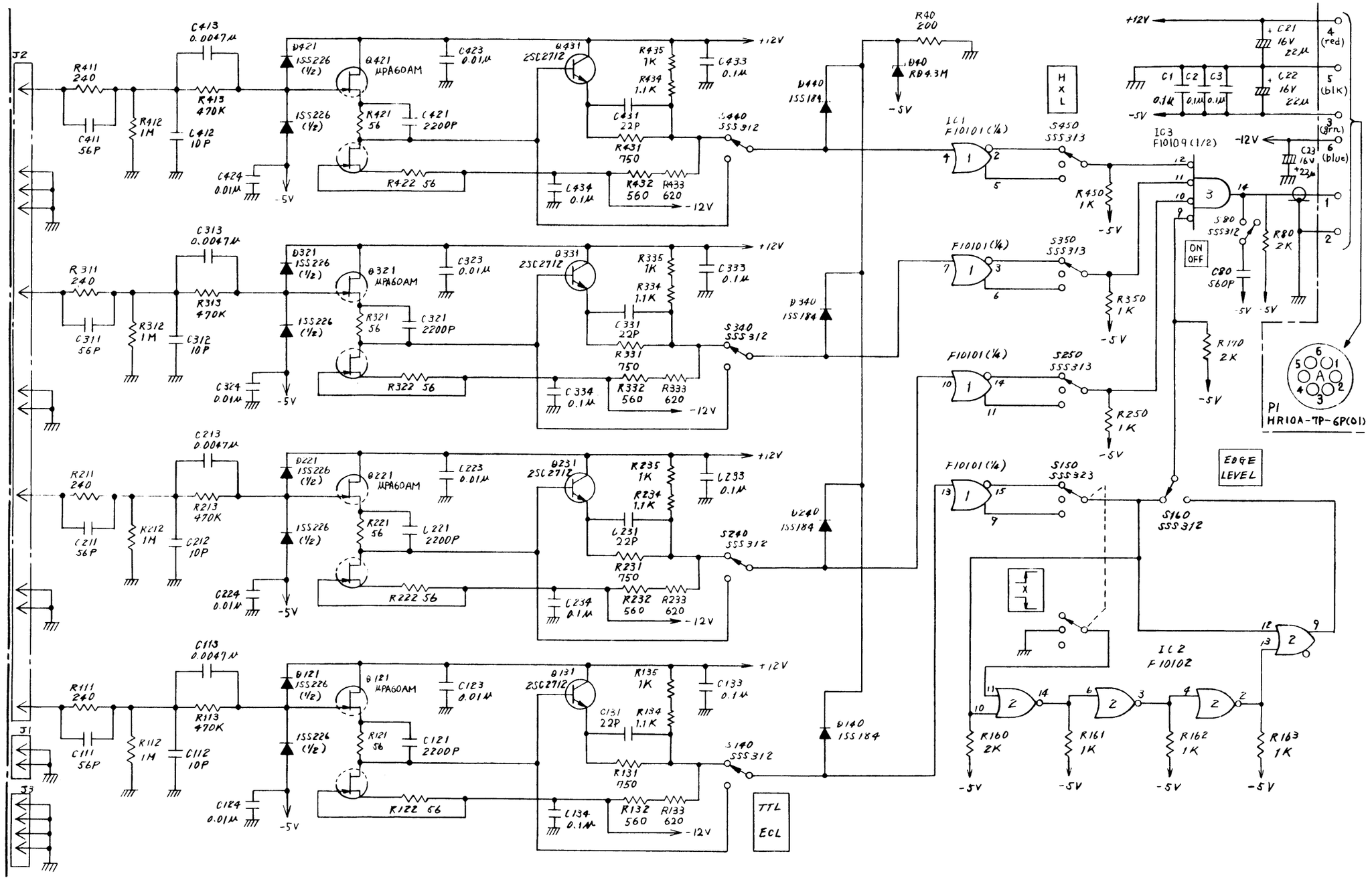
SS 5712	
Z AXIS CIRCUIT	22
BBWSS24095102	2



SS5712	
CRT CIRCUIT	23
BBWSS08023105	2



SS5712	
POWER SUPPLY	24
BBWSS08026105	2



SS-0071

COMBINATION PROBE

BBWSS22007105