10

INSTRUCTION MANUAL

oscilloscope SS-5710

T5223-622500(L)



SS-5710

.

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Specifications

1-1 GENERAL

The SS-5710 is an oscilloscope with a frequency bandwidth of DC to 60 MHz that can display 8 traces on 4 channels. The SS-5710 is useful in a wide range of applications for not only production lines and maintenance and service purposes but also for the research and development of a variety of electronic devices. The features of the SS-5710 are as follows:

- In addition to display of 8 traces on 4 channels, the SS-5710 has an ADD function for measuring the sum of two signals and CH 2 POLAR for measurement of the difference between two signals.
- Both CH 1 and CH 2 have a high deflection factor of 1 mV/div (in the x5 MAG function), which permits accurate measurement of lower voltages.
- The horizontal deflection system has sweep rates up to 5 nS/div (in the x10 MAG function) so that even high-speed phenomena can be measured with accuracy.

The SS-5710 has delayed sweep, single sweep, ALT sweep, and X-Y operation functions, and a TV synchronizing signal separator circuit so that television and other composite video signal waveforms can be observed.

1-2 ELECTRICAL SPECIFICATIONS

1-2-1 Cathode-Ray Tube (CRT)

Shape	Rectangular, 6 inches		useable frequency is 4 Hz.
Dispaly Area	8 div x10 div (1 div = 10 mm),	Rise Time	5.8 nsec (calculated)
	with internal illuminated		5 mV/div
	graticule of parallax-free type		[Note]
Phosphor	B31 (Standard)		Rise time calculated fro
Accelerating Voltage	Approximately 15 kV		bandwidth x rise time = 0 .

1-2-2 Vertical Deflection System

Modes	CH 1, CH 2, ALT, CHOP, ADD, QUAD (Quadruple) CHOP switching rate: 300 kHz ±40%
Channels 1 and 2	
Deflection Factor	5 mV/div to 10 V/div, in
	11 calibrated steps in a 1-2-5
	sequence
	$\pm 5\%$ (at -10° C to 50° C)
	5 mV/div to 25 V/div.
	continuously variable with
	the VARIABLE control
	x5 MAG: 1 mV/div to 2 V/div
	in 11 calibrated steps
	Accuracy: ±4%
	(at 10° C to 35° C)
	±8%
	(at10° C to +50° C)
Frequency Response	DC to 60 MHz, –3 dB
	(5 mV/div to 0.2 V/div)
	DC to 20 MHz, –3 dB
	(1 mV/div, 2 mV/div
	in the x 5 MAG made
	AC coupling: The lowest
	useable frequency is 4 Hz.
Rise Time	5.8 nsec (calculated) at
	5 mV/div
	[Note]
	Rise time calculated from
	bandwidth x rise time = 0.35

Fulse Response	Overshoot: 5% or less Sag (at 1 kHz):1.5% or less	Input Coupling Input RC	AC, DC Direct:	
	Other distortions: 5% or less (5 mV/div, 10° C to 35° C)		1 MΩ±39 With probe	%//З2 рF ±ЗрF :
Signal Delay	Delay cable supplied		10 M Ω±	2%//15 pF ±2 pF
Input Coupling	AC. DC. GND	Maximum Input V	oltage	
Input RC	Direct:	•	Direct:	
	$1 M\Omega \pm 2\%//32 pF \pm 3 pF$		250 V (D	C +peak AC)
	With probe:		With probe	:
	$10 M \Omega \pm 2\% / / 15 pF \pm 2 pF$		600V (D	C +peak AC)
Maximum Input Volta	ae			- ,,
···	Direct:			
	400 V (DC +peak AC) With probe	1-2-3 Triggering		
	600 V (DC tpeak AC)	A-Triggering		
	(Refer to the instruction manual for the probe for the	Triggering Mode	AUTO, NO SINGLE/R	RM, ESET
	maximum input voltage where probe is used.)	Signal Source	CH 1, CH NORM (E	2, CH 3, LINE, xternal trigger can
Drift	0.5 div/hour (5 mV/div) or		be used b	y selecting CH 3
	2 div/hour (1 mV/div)		with SOUR	CE switch.)
	30 minutes after power is	Coupling	AC, DC, I	IF REJ, LF REJ,
	turned on (Standard)		FIX, TV-H	, TV-V
Common Mode Reject	tion Ratio	Slope	Possitive-go	ping (+),
	5 mV/div	•	Negative-go	ping (—)
	40 : 1 (1 kHz sine wave)	Minimum Trigger	Sensitivity	-
Polarity Inversion	15: 1 (5 MHz sine wave) CH 2 only		As shown i	n Table 1-1
	,	Table 1-1	(at 10°C to	o 35°C)
Channels 3 and 4			Sensiti	
Deflection Factor	0.1 V/div, 1 V/div, selectable Accuracy: ±4%	Frequency Range	CH 1, CH 2	CH 3, CH 4
	(at 10 °C to 35 °C)	DC to 1 kHz	1 div	1.5 div
Frequency Response	DC to 50 MHz, –3 dB	1 kHz to 2 MHz	0.5 div	1 div
	Notes	2 MHz to 20 MHz	1 div	1.5 div
	•10°C to 35°C	20 MHz to 60 MHz	1.5 div	2 div
	•AC coupling: The lowest usable frequency is 4 Hz.		Note	
Pulse Response	Overshoot: 10%		• Fix: 1 div	at 10 Hz to 2 MHz
	Sag (at 1 kHz): 2%		2 div at	2 MHz to 30 MHz
	Other Distortions: 10%		Sine wa	ve only
			• I V-V, T	-H synchronizing
			signal leve	1: 2.3 div or more
			on screen	amplitude for a
			composite	video signal

Hold-Off Time Sweep Delay Sweep Rates	Variable with the HOLDOFF control Continuous delay (RUNS AFTER DELAY), triggered delay 50 nsec/div to 50 nsec/div, in 19 calibrated steps in a 1-2-5 sequence Accuracy I (Over center 8 divisions): $\pm 3\%$ (at 10 ° C to 35° C) $\pm 5\%$ (at -10° C to +50° C) Accuracy II (Over 2 of the center 8 divisions): $\pm 5\%$ (at -10° C to +50° C) urement
Sweep Rates	Continuous delay (RUNS AFTER DELAY), triggered delay 50 nsec/div to 50 nsec/div, in 19 calibrated steps in a 1-2-5 sequence Accuracy I (Over center 8 divisions): $\pm 3\%$ (at 10 ° C to 35° C) $\pm 5\%$ (at -10° C to +50° C) Accuracy II (Over 2 of the center 8 divisions): $\pm 5\%$ (at -10° C to +50° C) urement
Sweep Rates Time Difference Mease	delay 50 nsec/div to 50 nsec/div, in 19 calibrated steps in a 1-2-5 sequence Accuracy I (Over center 8 divisions): $\pm 3\%$ (at 10 ° C to 35° C) $\pm 5\%$ (at -10° C to +50° C) Accuracy II (Over 2 of the center 8 divisions): $\pm 5\%$ (at -10° C to +50° C) urement
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Time Difference Measu	$\pm 3\%$ (at 10 ° C to 35° C) $\pm 5\%$ (at -10° C to +50°C) Accuracy II (Over 2 of the center 8 divisions): $\pm 5\%$ (at -10° C to +50° C) urement
Time Difference Measu	\pm 5% (at -10° C to +50°C) Accuracy II (Over 2 of the center 8 divisions): \pm 5% (at -10° C to +50° C) urement
Time Difference Meas	Accuracy II (Over 2 of the center 8 divisions): ±5% (at -10° C to +50° C) urement
Time Difference Meas	center 8 divisions): ±5% (at -10° C to +50° C) urement
Time Difference Meas	$\pm 5\%$ (at -10° C to $+50^{\circ}$ C) urement
Time Difference Meas	urement
	0.5 µsec to 5 sec
	Accuracy: $\pm 2\%$ of reading ± 0.01 graduation (Minimum graduation of DELAY TIME
	MULT dial)
Delay Jitter	1/20,000 or less
Sweep Magnification	10 times (Maximum sweep rate: 5 nsec/ div)
	Accuracy I of magnified sweep rate (Over center 8 divisions) $\pm 5\%$ at 50 nsec/div to 0.1 μ sec/div $\pm 4\%$ of 0.2 μ sec/div to 0.5 sec/div (at 10° C to 35° C) Accuracy II of magnified sweep rate (Over any 2 of the center 8 divisions): $\pm 10\%$ at 50 nsec/div to

$\pm 6\%$ at 0.2 μ sec/div to 0.5	Output Current	10 mA
sec/div (at 10° C to 35° C)		Accuracy: ±2%
(Except 25 nsec before and		(at 10° C to 35° C)
after sweep)		±3%
		(at10° C to 50 °C)

1-2-5 X-Y Operation

1-2-8 Power Supply

X Axis	(Same as CH 1 except for the			
	following)	Voltage Range	100V	(90 to 110 V)/
Deflection Factor	Same as that of CH 1		115V	(103 to 128 V)/
	Accuracy: ±5%		220V	(195 to 242 V)/
	(at 10°C to 35°C)		230, 24	0V(207 to 264 V)/
	±6%		AC	
	(at -10° C to +50 °C)		One of	these voltage ranges
Frequency Response	DC to 2 MHz, -3 dB		can be	selected with voltage
			selector	plug
Y Axis	same as CH 2	Frequency Range	50 to 44	10 Hz
		Power Consumption	Approx	imately 50 W
X-Y Phase Difference	3° or less (at DC to 50 kHz)		(at 100	VAC)

1-2-6 Z-Axis System

Sensitivity

0,5 Vp-p

1-3 PHYSICAL CHARACTERISTICS

Polarity	Positive decleases intensity.		
,	negative incleases intensity	Weight	Approximately 8.5 kg
Frequency Range DC to 3 MHz			(without panel cover and
Input Resistance	5 k Ω ±10%		accessories bag)
Maximum Input Voltage		Dimensions	320 ± 2 (W) x 160 ± 2 (H)
	50 V (DC +peak AC)		x 400 ± 2 (L) (mm)
			See Figure 1-1.

1-2-7 Calibrator

Waveform Repetition Frequency	Square wave 1 kHz Accuracy: ±30%	1-4	ENVIRONMENTA	L CHARACTERISTICS
Duty Ratio Output Voltage	(at 10 °C to 35 °C) 40% to 60% 0.3 V Accuracy: $\pm 1\%$ (at 10°C to 35°C) $\pm 2\%$ (at -10 °C to +50 °C)		Operating Temperature Operating Humidity Storage Temperature Storage Humidity	e –10 °C to –50 °C 40 °C, 90% Relative Humidity –20 °C to 70 °C 70 °C, 80% Relative Humidity

Altitude Operating: 5,000 m maximum		1-5	ACCESSORIES	
	hPa)		Power cord	1
	Non-operating: 15,000 m		Probe (SS-064)	2
	maximum (atmospheric		Fuse (FSA-1)	2
	pressure 90.4 hPa)		Panel cover	1
Vibration	From 10 Hz to 55 Hz and		Dust cover	1
	back in 1 minute;		Instruction Manual	1
	double amplitude 0.63 mm;		Accessories bag	1
	for 15 minutes each in			
	vertical, horizontal, and longi-			
	tudinal directions for a total			
	of 45 minute			
Impact	One side is raised to an			
	elevation angle of $45^{\circ}(10 \text{ cm})$			
	maximum), and let fall on a			
	piace of hard wood. Each side			
	is put to this test 3 times.			
Drop	A package ready for trans-			
	potation is dropped from a			
	height of 90 cm .			





Figure 1-2. Accessories Bag



When removing the accessories bag form the upper cover of the SS-5710, remove the four accessories bag mounting screws shown in Figure 1-2. Use the same screws for mounting the accessories bag on the upper cover again.

Operating Information

2-1 OPERATING PRECAUTIONS

Observe the following precautions in operating the SS-5710.

Ambient temperature and ventilation

The SS-5710 operates normally in the ambient temperature range of -10° C to $+50^{\circ}$ C. Be sure to use the SS-5710 within this range. Use of it outrange can result in some trouble. Do not place anything near the ventilating hole in the cover to block heat dissipation.

Line voltage check

Table 2 1

Before plugging the power cord to an electrical output, be sure to check its voltage. The SS-5710 can be used on the line voltage shown in Table 2-1, which can be selected with the voltage selector plug on the rear panel. Also check the fuse in the rear panel as shown in Table 2-1. Operating the SS-5710 on other than the specified voltages can result in breakdown.

Before changing the voltage selector plug, or replacing the fuse, be sure to unplug the power cord from the electrical outlet.

Set Position	Center Voltage	Voltage Range
А	100 V	90 to 110 V

1 A	90 to 110 V	100 V	А
slow-blow	103 to 128 V	115 V	В
0.5 A	195 to 242 V	220 V	С
slow-blow	207 to 264 V	230/240 V	D

Fuse

Be sure to replace the fuses with the correct ones.

The SS-5710 uses the fuses shown in Table 2-2 to protect the circuits from damage by overcurrent.

If any of these fuses is burnt out, carefully determine the cause, repair a defect if any, and replace it with the correct one. Never use fuses other then specified because it can cause not only troubles but danger.

Table 2-2

Circuit No.	Fuse Spec.	Function	Position
	1 A slow-blow	Voltage selector	
13 F 01		plug A or B	Rear panel
	0.5 A slow-blow	Voltage selector	See Figure
		plug C or D	2-4.
13F02	1 A slow-blow	CRT circuit protection	See Figure 2-1.

Use the supplied power cord.

Use the supplied 3-core power cord.

When operating the SS-5710 on the line voltage form a 2-core electrical outlet with the supplied 3-core power cord and a conversion adaptor, be sure to ground the ground terminal on the rear panel to prevent danger.

Signal applies to the probes and input connectors

Be sure to connect the probe ground leads and input



connector ground terminals to the ground voltage part of the object to be measured. If they are connected to other point, the ground leads or terminals will be shorted through the SS-5710 resulting in breakage of the measuring object or the SS-5710 (including its probes). This must be absolutely avoided.

Do not increase light intensity excessively

Do not increase the light intensity of traces or spot more than necessary. Excessive light intensity can not only result in eyes fatigue but, if left for a long time, burn the CRT phosphor surface.

Using the SS-5710 with the CRT screen up

The SS-5710 can be used with the CRT screen up as shown in Figurer 2-2 (a). Be careful not to bring the SS-5710 down by pulling hard the probes connected to the signal input connector.

2-2 OPERATION OF THE HANDLE

The carring-handle of the SS-5710 can be unlocked if the rotary part (root) the handle is pused inwards (in the arrow direction) as shown in Figure 2-2 (d).

If both the right and left ends are pushed, they can be unlocked together, and the handle can be turned as it is.



The handle can be positioned as desired for carrying (as shown in Figure 2-2 (d)) or as stand for signal observation (as shown in Figure 2-2 (c)).

Fold the handle back as shown in Figure 2-2 (b), if possible, when storing the SS-5710.

2-3 CONTROLS AND SWITCHES

The functions of the switches and controls on the front and rear panels are explained. Refer to Figure 2-3, 2-4, and 2-5.

The front panel is color-coded. The power supply, CRT, and vertical deflection controls are dark-olive; trigger and horizontal deflection controls are light-olive.

If the VARIABLE contols for vertical deflection factor and sweep rate are set to other than the CAL position, the indicator lamp lights to indicate non-calibration.

In the description of the switches, the word IN indicate their pushed position ($__$) and the word OUT their released position ($__$).



2-3-1 Front Panel

Power, CRT and Calibration controls

POWER ON/OFF

Power switch

INTEN

Adjust the brightness of traces or spot. Turning the control clockwise increases intensity, and turning it counter-clockwise decreases intensity.

BEAM FIND

Search the trace or spot positions. If the button is pushed when a trace or spot is outside the screen, it appears on the CRT screen.

FOCUS

Focus traces or spot.

SCALE

Adjust the brightness scale. Turning it clockwise brightens the scale, and turning it counterclockwise darkens the scale.

TRACE ROTATION

Adjust traces parallel to the horizontal graticule lines.

CAL 0.3 V

Signal output terminal of a square wave with a calibration voltage of 0.3 V and repetition frequency of 1 kHz. Use for adjusting vertical axis deflection factor and probe phase.

(Ground terminal for measurement)

Signal ground terminal for measurement. Connect it to the ground terminal of the circuit to be measured.

Vertical Deflection System

POSITION (PULL x5) (CH 1, CH 2)

For position adjustment and waveform magnification. Traces and spot can be positioned with this control. Turning the control clockwise moves traces or spot upward,

Turning the control clockwise moves traces or spot upward, and turning the control counterclockwise moves it down-

ward,.

When the control is pulled, the vertical deflection factor is magnified 5 times.

INPUT (CH 1, CH 2)

Connector for connecting a probe or cable to apply input signal to be measured.

The maximum input voltage is 400 V (DC + peak AC) where input signals are directly applied; or 600 V (DC + peak AC) where a probe is used.

(For the maximum input voltage where a probe is used, refer to the instruction manual for probe.)

AC-DC (CH 1, CH 2, CH 3, CH 4)

Switch for selecting a signal input coupling.

AC: The vertical deflection input is AC-coupled. Even if AC input signal is superimposed on DC signal, the DC component is blocked so only the AC component is allowed to pass.

DC: The vertical deflection input is DC-coupled. All the frequency components, including DC, are allowed to pass through.

GND (CH 1, CH 2)

When the GND position is selected, input signal is not connected to the vertical amplifier, but the input circuit of the vertical amplifier is grounded. (Input signal is not grounded.) Thus, the ground voltage (normally serving as a reference level for measurement) can be easily confirmed.

UNCAL (CH 1, CH 2)

If the VARIABLE control is set to other than the CAL position, this lamp lights to indicate non-calibration.

VOLTS/DIV (CH 1, CH 2)

Set the vertical deflection factor to select one of 11 positions from 5 mV/div to 10 V/div to suit input signal level. If the x5 MAG button is pushed in at 5 mV/div or 10 mV/div, a high deflection factor of 1 mV/div or 2 mV/div can be obtained. The VOLTS/DIV switches represent the voltage (of an input signal) per division of the scale on the CRT screen where the VARIABLE control is set to the CAL position.



Figure 2-4. Rear Panel



VARIABLE (CH 1, CH 2)

The VARIABLE controls are used to continuously attenuate the vertical deflection factor according to input signals. The deflection factor is 1/2.5 or more when the control is turned fully counterclockwise.

CH 2 POLAR INV/NORM

Select CH 2 polarity.

NORM when the button is OUT (\blacksquare) position; INV when the button is IN (\blacksquare), where the polarity is inverted.

MODE

These MODE button are used for switching vertical deflection operation. The following modes can be selected. CH 1: Only signal which is applied to CH 1 (x) INPUT is displayed on the CRT screen.

CH 2: Only signal which is applied to CH 2 (Y) INPUT is displayed on the CRT screen.

ALT: The two signals applied to CH 1 and CH 2 INPUT connectors are displayed on the CRT screen. This mode is suitable for observing waveforms where TIME/DIV is set to a position faster than 1 msec/div.

CHOP: The two signals applied to CH 1 and CH 2 INPUT connectors are displayed on the CRT screen. This mode is suitable for observing waveforms where TIME/DIV is set to a position slower than 1 msec/div.

ADD: The ADD mode is selected when both CH 1 and CH 2 buttons are simultaneously pushed in. This mode is used for observing the algebraic sum of the signals applied to CH 1 and CH 2 INPUT connectors or their difference. CH 1 \pm CH 2 can be selected with CH 2 POLAR.

QUAD: If the QUAD button is IN when the ALT or CHOP button is IN position, quadruple traces are displayed on the CRT screen. This mode is used for simultaneously displaying the signals applied to CH 1, CH 2, CH 3, and CH 4 INPUT connectors on the CRT screen. Either of the two following quad modes can be selected.

Quad-trace display in the ALT mode: If the ALT and QUAD buttons are pushed in, ALT operation takes place to display 4 signals on the CRT screen.

Quad-trace display in the CHOP mode: If the CHOP and QUAD button are pushed in, CHOP operation takes place to display 4 signals on the CRT screen.

If the HORIZ DISPLAY ALT button is IN during the above operations, the 4 signals are displayed on the CRT

screen. If the QUAD button is pushed again to the out (DUAL) position, the SS-5710 operates in the ALT or CHOP mode as indicated on the panel.

CH 3 INPUT (A EXT TRIG IN)

Connect a probe or cable for applying a signal input to be measured or an external trigger signal input for A-sweep. The maximum input voltage is 250 V (DC + peak AC) where the input signal is directly applied; or 600 V (DC + peak AC) where a probe (10 : 1) is used.

(For the maximum input voltage where a probe is used, refer to the instruction manual for probe.)

(CH 3, CH 4)

Select a trace vertical position for CH 3 (CH 4) with this control. Turning it clockwise moves a trace upward, and turning it counterclockwise moves it downward.

1 V - 0.1 V(CH 3, CH 4)

Select CH 3 (CH 4) deflection factor with this control. The value indicated represents a voltage per division of the graticule on the CRT screen.

CH 4 INPUT (B EXT TRIG IN)

Connect a probe or cable for applying a signal input to be measured or an external trigger signal input for B-sweep.

The maximum input voltage is $400 \vee (DC + peak AC)$ where the input is directly applied, or $600 \vee (DC + peak AC)$ where a probe (10 : 1) is used.

(For the maximum input voltage where a probe is used, refer to the instruction manual for probe.)

Horizontal Deflection Controls

HORIZ DISPLAY

The following modes can be selected with the horizontal deflection control buttons.

A: A sweep mode for normal waveform observation. Sweep time can be selected with the A TIME/DIV switch and A VARIABLE control.

A INTEN: A delayed sweep mode (in which a part of the input signal waveform is magnified for observation)

ALT: Alternate A INTEN sweep and B sweep

B (DLY'D): A sweep delay mode (in which the part selected by delayed sweep is magnified)

X-Y: A mode in which the SS-5710 is used as an X-Y scope, CH 1 serving as X axis and CH 2 as Y axis.

MODE

This button selects either of the following trigger modes. AUTO: In the AUTO mode, a sweep is started if trigger condition is readied; or a free-running sweep takes place otherwise.

NORM: In the NORM mode, a sweep is started if trigger condition is readied; or no sweep take place otherwise.

SINGLE/RESET: The single trigger mode. This button also has a RESET function so, no trigger signal, it puts the SS-5710 into a ready condition, which is indicated by the lighting of the READY lamp on the right.

READY

This lamp lights when the SS-5710 is in a ready state in the single sweep mode.

--- POSITION FINE (PULL x10 MAG)

This control has position adjusting and waveform magnifying functions.

It has two kinds of knobs for position adjustment: The large grey knob for coarse horizontal position adjustment, and the small red knob for fine horizontal position adjustment. Turning the knobs clockwise moves the waveform to the right-hand, and turning them counterclockwise moves it to the left-hand.

When the small red knob is pulled, the x10 MAG function is set to magnify the waveform 10 times in the horizontal direction.

COUPLING (A-Sweep)

For selecting an A-sweep trigger coupling (trigger circuit input coupling).

AC: AC coupling is selected. Trigger signal DC component is blocked. AC signal only is used for triggering.

DC: DC coupling is selected. DC can be used for triggering. HF REJ: Frequencies over approximately 10 kHz are attenuated by a lowpass filter. Suitable for observing signals cleared of high-frequency noise.

LF REJ: Highpass filter coupling to attenuate low frequencies under approximately 10 kHz.

Suitable for observing signals cleared a low-frequency noise.

FIX: If both the AC and DC buttons are simultaneously pushed in, the trigger level is fixed nearly at the zero point. Thus, it is not necessary to operate the LEVEL control. TV-H: If both the DC and HF REJ buttons are simultaneously pushed in, TV-H coupling is selected. This trigger coupling is used for ovserving a composite video signal waveform over a period of 1 H by triggering with a television horizontal trigger pulse.

TV-V: If both the HF REJ and LF REJ buttons are simultaneously pushed in, TV-V coupling is selected. This trigger coupling is used for observing a composite video signal waveform over a period of 1 V by triggering with a television vertical trigger pulse.

SOURCE (A-Sweep)

Select the SOURCE of A-sweep trigger signal.

CH 1: The input signal applied to CH 1 INPUT is branched out as internal trigger signal.

CH 2: The input signal applied to CH 2 INPUT is branched out as internal trigger signal.

CH 3: The input signal applied to CH 3 INPUT is branched out as internal /external trigger signal.

LINE: The SS-5710's power line signal is used as trigger signals. This mode is used for observing line signals and line harmonics.

NORM: If both the CH 1 and CH 2 buttons are simultaneously pushed in, the NORM mode is selected, in which the signal for the waveform displayed on the CRT screen in connection with a vertical mode is used as a trigger signal. (For a detailed description of trigger signal selection, refer to the subsequent paragraph on triggering.)

HOLDOFF

This control is used for stabilized synchronization of complex (composite) pulse waveforms. Turning the control fully counterclockwise to NORM minimizes the holdoff period, and turning it clockwise continuously increases the holdoff period.

LEVEL SLOPE (PULL-) (A-Trigger, B-Trigger)

This control has trigger level setting and trigger slope selecting functions.

Push it for positive-going slope trigger level selection; or pull it for negative-going slope trigger level selection.

A TRIG'D

This lamp lights to indicate a triggering state.

A, B TIME/DIV and DELAY TIME

The outer knob is for A TIME/DIV and DELAY TIME, and the inner knob for B TIME/DIV.

The A TIME/DIV AND DELAY TIME control has 22 A-sweep positions from 50 nsec/div to 0.5 sec/div, and selects delays in A INTEN sweep or B (DLY'D) sweep.

The value of each position of the control represents a sweep rate and delay time per division on the CRT screen where the A VARIABLE control is turned fully clockwise to the CAL position.

The B TIME/DIV control has 19 B-sweep positions from 50 nsec/div to 50 msec/div, but no VARIABLE control.

A VARIABLE

Provides continuously the varies A-sweep rate. If the control is turned fully counterclockwise, the value of where the TIME/DIV switch is set at least 2.5 times or more.

A UNCAL

This lamp lights to indicate that A sweep rate is uncalibrating state when A VARIABLE control is out of CAL position.

DELAY TIME MULT

This potentio-meter selects the amount of delay time between the start of A sweep and the start of B sweep.

COUPLING (B-Sweep)

For selecting a B-trigger coupling (trigger circuit coupling).

If the DC and HF REJ buttons are simultaneously pushed in, TV-H is selected.

All functions are the same as those of A-sweep except for LF REJ, TV-V and FIX.

SOURCE (B -Sweep)

The SOURCE buttons are used for selecting B-sweep trigger signals and a type of delay (continuous delay or triggered delay).

RUNS AFTER DELAY: When the button is IN, RUNS AFTER DELAY is selected for continuous delay.

CH 1: Function is the same as that of A-sweep.

CH 2: Function is the same as that of A-sweep.

CH 4: The input signal applied to CH 4 INPUT is branched out as trigger signal. This function corresponds to the external trigger function of a dual-trace oscilloscope.

(If the CH 1, CH 2, or CH 4 button is pushed in, the triggered delay mode is selected.)

TRACE SEPARATION

This control is used for moving the B-sweep waveform above the A INTEN sweep waveform on the CRT screen when the HORIZ DELAY button ALT is IN. If the contol is turned fully counterclockwise, the A INTEN sweep and B-sweep waveforms overlap, and when the control is turned fully clockwise, the B-sweep wavefrom moves 4 divisions or more.

2-3-2 Rear Panel

Z AXIS INPUT

Apply a signal for external intensity modulation to this input terminal. The maximum input voltage is 50 V (DC + peak AC).

CAL 10 mA

A square wave current of 1 kHz, 10 mA flows through the current loop terminal in the arrow direction (from right to left). Use its current output for checking and calibrating the current probe.

\perp (Ground terminal for protection)

Ground terminal for protecting the oscilloscope. When supplying a line voltage from a 2-core electrical outlet, be sure to connect this terminal to the ground for preventing danger.

AC LINE INPUT

AC voltage is supplied to this connector. Connect the supplied power cord to it.

A.B.C.D (Voltage Selector plug)

Set the voltage selector plug's arrow mark to one of the A, B, C or D position to suit the AC line voltage. Refer to the table of line voltage ranges.

FUSE

Fuse holder.

2-3-3 Bottom Cover

GAIN

This is for adjusting vertical deflection factor.

x5 BAL

This is for adjusting vertial deflection position when the PULL x5 MAG is pushed or pulled.

VARIABLE BAL

This is for adjusting the movement of vertical trace position when the vertical deflection VARIABLE control is turned.





2-4 OPERATING INSTRUCTIONS

The basic operating instructions for the SS-5710 used for observing voltage waveforms are explained below.

2-4-1 Basic Operation for Signal Observation

The follwoing procedure applies where a CAL 0.3 V signal is applied to CH 1 INPUT with the supplied probe for observation.

Turning POWER On

Before connecting the power cord, check the AC line voltage with a voltmeter, and set the voltage selector plug to the proper position to suit the line voltage.

- 1. Set the POWER to OFF position, and connect the power cord to the AC LINE INPUT connector on the rear panel and an electrical outlet.
- 2. Set the controls as follows. See Figure 2-6 and 2-7. A INTEN Midrange MODE (Vertical) CH 1

Figure 2-6. Power, CRT and Calibration c	ontrols — —
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AC-DC (CH 1)	AC			
POSITION (CH 1)	Midrange			
HORIZ DISPLAY	А			
MODE (Horizontal)	AUTO			
	Midrange			
FINE (PULL x10 MAG)				

Midrange (button IN)

3. Push the POWER button up to the ON position. A trace is displayed in about 15 seconds. Adjust its intensity as appropriately with the INTEN control.

Focusing

4. Set the A TIME/DIV switch to the 1 msec/div position, and adjust the FOCUS control to make the trace clear and sharp.

Applying signals and triggering

5. Set the controls as follows.

COUPLING (A-Sweep)	AC
SOURCE (A-Sweep)	CH 1
VOLTS/DIV (CH 1)	5 mV
VARIABLE (CH 1)	CAL

Figure 2-7. Vertical Deflection and Horizontal Deflection Controls





- 6. Using the supplied probe, connect CH 1 INPUT to the CAL. 0.3 V terminal.
- Turn the LEVEL (A-Sweep) control to nearly the midrange, and a 6-division calibration voltage waveform is displayed on the CRT screen. It is triggered by internal trigger (AC coupling) in the AUTO mode.

For a detailed description of triggering, refer to Triggering in a subsequent paragraph.

Deflection Factor Setting

 As VOLTS/DIV switch is turned form 10 mV, 20 mV, and on to 10 V, the deflection factor decreases so that the waveform amplitude on the CRT screen becomes small. The amplitude also decreases when the VARIABLE control is turned counterclockwise.

Adjust the input deflection factor with the VOLTS/DIV switch and VARIABLE control so that the input signal has an amplitude easy to be observed on the CRT screen.

Sweep Rate Setting (A-Sweep)

9. As the A TIME/DIV switch is turned from 0.5 msec, 0.2 msec and on the 50 nsec, the displayed waveform that can be observed decreases. There are kinds of signals to be measured. To observe various signals on a suitable cycle, set an appropriate sweep rate with the A TIME/DIV switch and A VARIABLE control. For the sweep rate setting procedure, refer to the subsequent paragraph

Figure 2-8. Calibrator waveform



on sweep rate setting.

The basic operation procedures for observing signal waveforms have been described above.

2-4-2 Applying Signals

Apply the signals to be observed to CH 1, CH 2, CH 3, and/or CH 4 INPUT connectors.

Generally a passive probe is used for applying a signal to the oscilloscope.

The use of a probe prevents the waveforms on the CRT screen from being adversely affected by the induction of an external electric field. If a 10 : 1 probe is used, the input impedance is higher than where a 1:1 probe is used, and thus the load effect on the signal source is lessened. This permits accurate waveform observation in spite of a high signal source impedance.

The 10:1 probe, however, attenuates the input signal to 1/10 so the VOLTS/DIV readings of input signal amplitude must be multiplied by 10.

The 1:1 probe is suitable for observing low-frequency low-level signals because a large load effect is produced on high-frequency signals.

(For a detailed description of the probe, refer to Section 3 MEASURING PROCEDURES and the instruction manual for probe.)

2-4-3 Signal Input Coupling Selection

Kinds of signals, including DC, AC, and AC superimposed on DC, may be applied for observation. For accurate observation of these kinds of signals, select the proper signal input coupling with the AC-DC switch.

(See Figure 2-9 and 2-10.)

AC Coupling:

In AC coupling, a DC signal is blocked by a capacior so that only the AC signal passes it. Thus, the AC signal waveform will be out of the screen by the DC voltage so it can be observed with its amplitude increased on the screen. If a signal with a low repetition frequency is observed in the AC coupling mode, a sag appears in the waveform if the signal is a square wave; or if it is a sine wave, the amplitude on the screen is attenuated about -3 dB

per 4 Hz from the actual one.

DC Coupling:

DC coupling is selected for observing all the frequency components of a signal input.

Ground Coupling:

The input of the vertical amplifier circuit is grounded so a ground level trace is displayed on the screen. The ground level normally serves as reference level in measurements.

2-4-4 Vertical Deflection Factor Setting

To observe a signal waveform, it must be displayed with an appropriate amplitude on the CRT screen.

The CH 1 and CH 2 VOLTS/DIV switches are deflection factor select switches, and their VARIABLE controls are for fine adjustment of deflection factor. (See Figure 2-9.)

If the VARIABLE controls are turned fully clockwise to the CAL position, the positions of the VOLTS/DIV switches directly indicate the selected deflection factors, which represent the voltage per division of the screen scale for the signal waveforms displayed.

The deflection factor select switches for CH 3 and CH 4 have two position, 0.1 V/div and 1 V/div, but no VARIA-BLE controls. (See figure 2-10.)

Figure 2-9. CH 1 VOLTS/DIV switch and VARIABLE

2-4-5 Triggering

It is necessary to have a correct understanding of the triggering procedure in using an oscilloscope.

The triggering procedure for A-sweep (where the HORIZ DISPLAY button A is IN) is described below. The triggering procedure for B-sweep that is necessary in delayed sweep operation is described in the subsequent paragraph on Waveform Magnification Operation.

The following must be set for A-sweep triggering. • Trigger Signal

Selects CH 1, CH 2, CH 3, NORM, or LINE with the SOURCE button.

Trigger Coupling

Selects AC, DC, HF REJ, LF REJ, FIX, TV-H, or TV-V with the COUPLING button.

- Trigger system
 Selects AUTO, NORM, or SINGLE-RESET with the MODE switch.
- Slope

Selects either positive-going (+) or negative-going (--).

•Level

control

Selects a suitable trigger level.

Hold off

Selects a suitable HOLD OFF time.

A detailed description of the above 6 items is given below.

Trigger Signal

To observe an input signal waveform, it is necessary to

Figure 2-10. CH 3 0.1 V-1 V and AC-DC switches -





SS-5710

apply an input signal, or a signal which has a constant time relationship with the input signal (called a trigger signal), to the trigger circuit to drive it.

Select internal trigger (CH 1, CH 2, CH 3, NORM), external trigger (CH 3), or line trigger (LINE) with the SOURCE button.

Input signal applied to input connector is brached off from vertical deflection system and method that applies it to the trigger circuit is called internal trigger.

The input signal is also used as internal trigger circuit. Thus, operation is simple.

The method of applying an external input signal, or a signal which has a constant time relationship with the input signal, to the trigger circuit is called external trigger. External trigger has the following advantages.

 External trigger is unaffected by the channel to which an input signal is applied. In the internal trigger mode, the trigger signal amplitude changes whenever the deflection factor is changed, and thus the trigger level must be adjusted accodingly. In the external trigger mode, once trigger condition is established, the signals remain synchronized even if the signal to be measured changes in amplitude.

 If desired a specific time before, or after, an input signal waveform, apply this signal as trigger to EXT TRIG IN (CH 3) so that the desired waveform can be observed.

The mothod of applying a line waveform from the built-in power transformer to the trigger circuit is called line trigger, which is used for observing line waveforms and line high frequencies.

Internal Trigger (CH 1, CH 2, CH 3, NORM)

If SOURCE CH 1 is selected, the input signal that is applied to CH 1 is used as trigger signal.

If SOURCE CH 2 or CH 3 is selected, the input signal that is applied to CH 2 or CH 3 is used as trigger signal.

If SOURCE NORM (CH and CH 2 pushed in simultaneously) is selected, the input signal applied to CH 1 is used as trigger signal in the CH 1 vertical mode, or the input signal applied to CH 2 is used as trigger signal in the CH 2 vertical mode. In the ALT vertical mode, the input signal applied to CH 1 triggers CH 1, and that applied to CH 2 triggers CH 2. Alternate use of trigger signals to suit the display on the screen is convenient for comparison of waveforms. In the CHOP or ADD mode, use CH 1, CH 2, or CH 3 instead of NORM because trigger is generally unstable.

External Trigger (CH 3)

If SOURCE CH 3 is selected, the input signal that is applied to CH 3 is INPUT (A EXT TRIG IN) is used as external trigger signal.

Line Trigger (LINE)

If SOURCE LINE is selected, line trigger is available.

Trigger Coupling

The COUPLING button is used for selecting a coupling for the trigger circuit input. AC, DC, HF REJ, LF REJ, FIX, TV-H, or TV-V can be selected. Select one of them steady triggering according to the kind of trigger signal(AC, DC, composite video signal, etc.).

AC: The trigger circuit input is AC-coupled so the DC component of the trigger signal is blocked. Thus, only the AC component of the trigger signal is used for triggering. Generally, AC coupling is convenient, but triggering is difficult if the trigger frequency is below 10 Hz.

DC: The trigger circuit input is DC-coupled for DC triggering. If a AC trigger signal is superimposed on DC, whose voltage is outside the trigger level range, trigger is ineffective.

HF REJ: The trigger circuit input comprises a lowpass filter which rejects high-frequency trigger signals (over about 10kHz) and high-frequency noises mixed with highfrequency signals and passes only low-frequency components.

LF REJ: The trigger circuit input comprises a high pass filter which rejects low-frequency trigger signals (over about 10 kHz) and low-frequency noises mixed with the trigger signals, and passes only high-frequency components.

FIX: The trigger circuit input is AC-coupled and the trigger level is fixed nearly at 0 V, so trigger takes place without operating the LEVEL control.

TV-H: Uses a television horizontal synchronization pulse for triggering in observing signals over a period of 1H.

TV-V: Uses a television vertical synchronization pulse for triggering in observing composite video signals over a period of 1 V.

Trigger System

The SS-5710 offers selection of the trigger mode of AUTO, NORM, or SINGLE/RESET.

AUTO: Auto trigger is selected. If a trigger signal with the

proper frequency and level is applied to the trigger circuit, trigger condition can be readed by turning the LEVEL control to an appropriate trigger level. In the following cases, however, free-running sweeps occur due to the absence of trigger condition.

- 1. No trigger signal.
- 2. A tigger signal too small.
- 3. The LEVEL control set out of the trigger signal used.
- 4. A trigger signal with a frequency below 50 Hz.

NORM: Normal trigger is selected. If a trigger signal with the proper frequency level is applied to the trigger circuit, trigger condition can be readied by turning the LEVEL control to an appropriate triggerlevel.

In the following cases, however, sweeps stop and the instrument gets into a ready condition due to the absence of trigger condition.

1. No trigger signal.

2. A trigger signal too small for the LEVEL control to match its level.

3. The LEVEL control set out of the trigger signal used. SINGLE-RESET: Single sweep mode. For details, refer to the subsequent description of the single sweep mode.

SLOPE

Push the LEVEL control for triggering from a positivegoing slope, or pull it for triggering from negative-going slope.

LEVEL

If the LEVEL control is nearly at the midrange trigger level is set place at neary 0 V.

The trigger level moves in the positive (+) direction as the LEVEL control is turned clockwise, or in the negative (-) direction as the control is turned counterclockwise. (See Figure 2-11.)

In the coupling mode FIX, the trigger level is fixed nearly at 0 V. Thus, it is not neccessary to operate the LEVEL control for triggering.

HOLDOFF

Complex waveforms of a pulse train may appear overlapped despite synchronization depending on sweep rate setting.

If that occurs, turn the HOLDOFF control from the NORM position (fully counterclockwise) toward INCREASE to change the holdoff time. If the HOLDOFF control is



adjusted to start a sweep at the basic input signal cycle, the wave-forms are displayed in a way easy to observed.

2-4-6 Sweep Rate Setting

Many kinds of signals, some with a low repetition frequency and some with a high one, and some pulses with a fast rise and some with a low rise, may be measured. To measure these kinds of signals, it is necessary to select a suitable sweep rate.

When measuring signals with a low repetition frequency or slow rise pulses, for example, select a low sweep rate; and when measuring signal with a high repetition frequency or fast rise pulses, select a high sweep rate.

If the HORIZ DISPLAY mode A is selected, A-sweep (normal sweep) takes place. In this case, operate the A-sweep controls.

The sweep rate control used in the A-sweep mode is A TIME/DIV, and its VARIABLE control is for sweep rate fine adjustment. (see Figure 2-12.)

If the A VARIABLE control is turned fully clockwise to the CAL position, each position of the A TIME/DIV switch directly represents the sweep rate it indicates. If the A VARIABLE control is turned fully counterclockwise, the sweep rate pointed by the A TIME/DIV switch

Figure 2-12. TIME/DIV and A VARIABLE Controls -----



is 2.5 times the indicated value or less.

The sweep rate control used in the B-sweep mode is B TIME/DIV, which has no VARIABLE control.

2-5 APPLIED OPERATIONS FOR SIGNAL OBSERVATION

The Oscilloscope SS-5710 has various convenient functions for signal observation. The following operating instructions for observing signals by use of its various functions are based on the assumption that you have sufficiently understood the basic operation procedures.

2-5-1 Operation for Dual-trace Observation

As described in the section on basic operations, the SS-5710 used as a dual-trace oscilloscope can display two signals to be measured on the CRT screen. Either ALT (alternate sweep) or CHOP (chopped sweep) can be selected for dual-trace observation. By using the ALT or CHOP mode as appropriate, dual-trace observation can be made at rates ranging from low to high speed.

Dual-Trace observation in the ALT mode

The ALT mode is suitable for observing two signals that have a high frequency. In this mode, a sweep occurs alternately between CH 1 and CH 2 so dual traces can be observed by applying two signals to CH 1 and CH 2 INPUT connectors.

The alternate sweep mode covers the full TIME/DIV range so a slow sweep rate makes dual-trace observation difficult.

Select the CHOP mode mentioned below when observing low-frequency signals.

Dual-Trace observation in the CHOP mode

The CHOP mode is suitable for dual-trace observation of low-frequency signals. CH 1 and CH 2 sweep are switched from one to the other about every 300 kHz so that, contrary to the ALT mode, it is difficult to observe highfrequency signals because their traces turn into dotted lines. Use the ALT mode for high-frequency signals.

2-5-2 Operation for Observation of the Sum of Two Signals or Their Difference

Observation in the ADD Mode

The ADD mode is selected if the vertical MODE buttons CH 1 and CH 2 are simultaneously pushed in. If signals are applied then to CH 1 and CH 2 INPUT connectors, the sum of the two signals (CH 1 + CH 2) can be observed. If the CH 2 POLAR button is pushed in to the INV position then, the difference between the two signals [(CH 1) + (-CH 2)] can be observed.

The deflection factor can be independently adjusted

Figure 2-13. Dual-trace observation in the ALT mode





for CH 1 and CH 2 in the ADD mode so select a range to suit the purpose.

In the ADD mode, the POSITION controls for CH 1 and CH 2 may be used for adjusting trace positions, but for accurate measurement, the two POSITION controls should be kept nearly at the center.

2-5-3 Operation for Quadruple-Trace Observation

The SS-5710 can simultaneously display up to four

Figure 2-15. Quadruple-trace observation -----



Figure 2-16. Quadruple-trace observation in the ALT mode



signals on the CRT screen aside form the dual-trace capability.

If the vertical MODE buttons ALT and QUAD, or CHOP and QUAD are simultaneously pushed in, traces for CH 1, CH 2, CH 3, and CH 4 are displayed on the CRT screen. Thus, by applying the four signals to be measured to the respective input connectors, the four signals can be simultaneously observed.

If the HORIZ DISPLAY mode ALT is selected under this condition, 8 traces are displayed on the screen as shown in Figure 2-13, giving A INTEN and B sweeps for the respective channels.

The vertical axis of quadruple traces is displayed by chopped operation if the vertical MODE buttons CHOP and QUAD are pushed in, or by alternate operation if the vertical MODE buttons ALT and QUAD are pushed in. When observing signal faster than 1 msec/div, push the vertical MODE buttons CHOP and QUAD IN. When observing signal slower than 1 msec/div, push the vertical MODE buttons ALT and QUAD IN.

2-5-4 Operation for Enlarging Waveform on the CRT Screen

Waveforms on the CRT screen can be partially magnified timewise (in the horizontal axis direction) for detailed observation by any of the following three methods.

- To use a fast sweep tate
- To use the x10 MAG function to magnify.
- To use the delayed sweep function to magnify.

These are explained in detailed below.

Using a fast sweep rate

Use a fast sweep rate to magnify the leading end of the waveform on the screen timewise. If the center part or tailing end of the waveform is magnified by using a fast sweep rated, those parts will go out of the CRT screen. In such a case, use the x10 MAG function to magnify the waveform.

Magnifying waveforms by x10 MAG

This method is mainly used to magnify the center part or tailing end of waveforms timewise.

Move the desired part to the center of the CRT screen

with the horizontal POSITION control, and pull the FINE (PULL x10 MAG) knob so the desired part is magnified 10 times in the horizontal direction. The trace length at this time is approximately 10 divisions on the CRT screen, but is actually increased to approximately 100 divisions, and can be observed from end to end with the horizontal POSITION and FINE controls.

This method is simple, but magnification is limited to 10 times. The sweep rate to be used for extended observation is the value indicated by the TIME/DIV switch multiplied by 1/10.

Thus, the fastest sweep rate can be extended to 5 nsec/div.

Extending waveform by delayed sweep

The method of magnifying waveform in above paragraph is simple. It can increases the displayed sweep speed by 10 times, but it is limited to 10 times.

The method of magnifying waveform by delayed sweep can magnify every part of the waveform displayed magnifier ratio between A sweep and B sweep is determined by

A TIME/DIV (sec/div)

B TIME/DIV (sec/div)

but this method is limited frequency of input signal. If an input signal has a high frequency and if the A TIME/ DIV switch is at the fastest speed before magnification, the waveform cannot be magnified any more.

Therefore, delayed sweep magnified is suitable for enlarging the desired part of an input signal that has a relatively low frequency.

Delayed sweep magnification comes in continuous delay and trigger delay as described below.

Continuous Delay: Operation for continuous delay is as follows:

- Select the HORIZ DISPLAY mode A , apply an input signal, and triggering.
- 2. Turn the B TIME/DIV switch to a position faster than the A TIME/DIV switch.
- 3. Select the B-sweep SOURCE mode RUNS AFTER DELAY.
- 4. Select the HORIZ DISPLAY mode A INTEN'

If the DELAY TIME MULT dial is turned clockwise after taking the above steps, a particularly intensity maduration part appears as shown in the upper waveform of Figure 2-17, and moves continuously from left to right. If this intensity moduration part is moved to a position where is measured, and if the HORIZ DISPLAY mode B (DLY'D) is selected, that part can be magnified fully on the CRT screen as shown in the lower waveform of Figure 2-17.

Use the B TIME/DIV switch for selecting a B (DLY'D) sweep rate. The magnification ratio increases as the sweep rate is increased. If the magnification ratio is raised so much delay jitter showns, making waveform observation difficult. Thus, there are limitations on magnified waveform observation by countinuous delay due to delay jitter. In such a case, use the trigger delay described below if a higher magnification ratio is desired.

The delay time of the magnified part can be calculated by multiplying the indicated value of A TIME/DIV switch by the indicated value of the DELAY TIME MULT dial. Trigger Delay: Trigger delay can be selected if the B-sweep SOURCE switch is set to CH 1, CH 2 or CH 4 (if a trigger signal is applied to CH 4). Delayed magnification can be made by B-sweep triggering and performing the same steps of operation as those of continuous delay.





The magnified part (B-sweep) in trigger delay starts at a trigger point subsequent to the delay time selected with the DELAY TIME MULT dial. The trigger point moves as DELAY TIME MULT is turned.

If DELAY TIME MULT is turned during a B (DLY'D) sweep, the waveform may appear still, but actually you are watching the part selected in the A INTEN sweep mode.

B-Sweep Trigger

The B-sweep trigger controls include B-sweep COUPLING SOURCE, and LEVEL.

The LEVEL and COUPLING (except for LF REJ, TV-V) functions and operations are the same as the A-sweep LEVEL and COUPLING functions and operations. The SOURCE button is used for selecting a trigger signal. RUNS AFTER DELAY is for continuous delay; and CH 1, CH 2 and CH 4 (external trigger function of the conventional oscilloscope) are for trigger delay. If CH 4 is selected, apply a trigger signal to CH 4 INPUT. If CH 1, CH 2 is selected, the same function as in the A-sweep mode is performed.

2-5-5 Operation for ALT Sweep

In the ALT sweep mode, an A INTEN sweep and a delayed B-sweep occur alternately. Thus, a non-magnified part and a magnified part can be simultaneously observed. The operation procedure is as follows:

- 1. Select the HORIZ DISPLAY mode A, apply an input signal, and synchronize.
- 2. Set B TIME/DIV switch to a position faster than that of A TIME/DIV switch.
- 3. Set the B-sweep SOURCE switch to RUNS AFTER DELAY.
- 4. Set the HORIZ DISPLAY switch to ALT.
- 5. Move the B-sweep waveform to the position where the A-sweep waveform is measured, using the DELAY TIME MULT dial.
- 6. Turn the B TIME/DIV switch, and magnify.
- 7. Move the B-sweep waveform (magnified waveform) to a point where it is easy to observe as shown in Figure 2-18, using TRACE SEPARATION.
- Note. If TRACE SEPERATION is turned fully counterclockwise, the A-sweep waveform and B-sweep (magnifi-

ed) waveform are completely double. When it is turned fully clockwise, the B-waveform moves about 4 divisions or more above the A-sweep waveform.

The delay time of the magnified part can be easily obtained in the same sweep by the formula shown in the above paragraph on waveform magnification by delay. If the magnification ratio is increased, jitter shows on the CRT screen. In that case, set the SOURCE button to other than RUNS AFTER DELAY for trigger delay as in B (DLY'D) sweep.

2-5-6 Operation for Observing Television Composite Video Signal Waveforms

The SS-5710 has a television synchronizing separator circuit so that television and other composite video signal waveforms can be displayed. The operation procedure is as follows.

Figure 2-18. TRACE SEPARATION Adjustment -----



Observation by Normal Sweep

1. Set the controls as follows:

HORIZ DISPLAY	A
Vertical MODE	CH 1 or CH 2 (whichever
	a signal is applied to)
COUPLING	TV-V (when observing a V
	signal)
	TV-H (when observing an H
	signal), or
SOURCE	CH 1 or CH 2 (whichever
(internal trigger)	a signal is applied to) or

Figure 2-19. Where H Trigger Signal is Positive



Figure 2-20. Where V Trigger Signal is Positive -

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NORM (external trigger) CH 3 (Apply a signal to CH 3 INPUT.)

- 2. Apply the composite signal to be measured to CH 1. CH 2 or CH 3.
- 3. Adjust so that the composite video signal waveform has an amplitude of 1 division or more (30% of the trigger signal component) on the screen.
- 4. Selects the horizontal mode AUTO or NORM.
- Turns the SLOPE control to the position if the trigger signal component of the composite video signal measured is positive-going; or to the + position if it is negativegoing, (Refer to Figure 2-19 and 2-20.)
- 6. Turn the TIME/DIV switch to display the desired part of the signal on the screen.

Magnified Observation by Delayed Sweep

- 1. In continuation of the above steps, set the HORIZ DISPALY switch to A INTEN.
- 2. Turn A TIME/DIV switch to 2 msec/div.
- 3. When observing by continuous delay, set the B-sweep SOURCE button to RUNS AFTER DELAY; or when trigger delay is desired, set it to CH 1 or CH 2 or CH 4. (Apply the trigger signal to CH 4 INPUT if CH 4 is selected.)
- 4. Select the desired part to be magnified, using DELAY TIME MULT.
- 5. Set the HORIZ DISPLAY switch to B (DLY'D), and select the desired magnification ratio with B TIME/DIV switch.
- 6. The SS-5710 has no 1st-2nd field switching function,

Figure 2-21. Example of Repeated Sweep and Single Sweep Waveforms



Single Sweep

Repeated Sweep

but it can be accomplished with an accuracy of about 50% by shifting the AC-DC button or by pushing or pulling the SLOPE control.

2-5-7 Operation for Single Sweep

In observing discharge waveforms or fast-speed transient phenomena, such as the chatterings of an operating relay, the waveforms are displayed one upon another. If waveform is displayed at a slower sweep rate, transient phenomena can not be observed in detail. If the signale sweep function is used for obsering such phenomena, the transient phenomena can be observed without being double and photographed. (See Figure 2-21.)

The basic operation procedure for single sweep using a calibrate or voltage is described below.

- 1. Select the HORIZ DISPLAY mode A and the horizontal mode NORM.
- 2. Using one of the supplied probes, apply a CAL 0.3 V to INPUT, set VOLTS/DIV to 5 mV and synchronize.
- 3. Select the horizontal mode SINGLE, and push the SINGLE/RESET button, and confirm that only a single sweep takes place.
- 4. Disconnect the input signal, and push the SINGLE/ RESET button. Confirm that the READY lamp on the right lights.

If the READY lamp lights after these steps, the oscilloscope is in a sweep standby state, ready to make a single sweep if a trigger signal is applied. (The oscilloscope may not be in a standby state if the LEVEL control is at some

Figure 2-22. Lissajou's Figure of Sine Wave —



point near the center. If so, turn the LEVEL control slightly counterclockwise or clockwise.) If a transient signal is applied to the oscilloscope, it sweeps only once, display the correct waveform.

The single sweep function is effective also in the A INTEN and B (DLY'D) sweep modes. If an external trigger signal is applied and the same operations as in the internal trigger mode are taken, a single sweep is also available. A dual-trace simultaneous single sweep can be mode in the CHOP mode, but, not in the ALT mode.

2-5-8 Operation for Use as X-Y Scope

By performing operations for use as an X-Y scope, phase differences, Lissajours' figures of various frequency ratios, and hysteresis curves can be observed.

The SS-5710 operates as an X-Y scope, and a spot appear nearly at the center of the screen when the HORIZ DISPLAY mode X-Y is selected.

If signals are applied to CH 1 and CH 2 INPUTs, the signal applied to CH 1 drives the horizontal axis (X) and the signal applied to CH 2 drives the vertical (Y) axis, thus desc ribing a Lissajous' figure.

The X-axis deflection factor is adjusted with the CH 1 VOLTS/DIV switch and its VARIABLE control; and the Y-axis deflection factor with the CH 2 VOLTS/DIV switch control and its VARIABLE contol. If the VARIABLE controls are set to the CAL position, the deflection factors are as indicated by the VOLTS/DIV switches,. Vertical position can be adjusted with the CH 2 POSITION

Figure 2-23. Lissajou's Figures of Various Frequency Ratios

control, and horizontal position with the ---- POSITION control and its FINE controls

Figure 2-22 and 2-23 show Lissajou's figure of measuring sine waves and different frequencies. As shown in these figures, varied waveforms are displayed depending on phase difference and frequency ratio. These waveforms are observed still.

Figure 2-24 shows examples Lissajou's figure of difference waveforms.

2-5-9 Z Axis System

In addition to the vertical (Y) axis and horizontal (X) axis, there is also a Z axis (which modulates intensity but does not affect the waveform displayed) for displaying electrical phenomena. The SS-5710 has Z AXIS INPUT on the rear panel which is fed to the CRT circuit to modulate the intensity of waveform displayed on the CRT screen.

If an input voltage of 0.5 Vp-p or more is applied, the intensity is modulated. A negative input signal increases the intensity, and a positive input signal decreases it. The frequency range is from DC to 3 MHz, and the maximum input it voltage is 50 V (DC + peak AC.)

A time reference for the waveform displayed can be obtained by applying a time marker to Z AXIS INPUT. Sweep rate can be calibrated by use of the time marker, even if observing input signal at uncalibrated sweep rate.

Figure 2-24. Lissajou's Figure of Different Waveforms ----



(Frequency ratio 1 : 1)



Notes -----

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Measuring Instructions

3-1 ADJUSTMENTS NECESSARY BEFORE MEASUREMENT

It may be necessary to adjust the adjusters on the front panel and bottom before attempting measurements in order to assure accuracy of measurements. In case of measuring with a probe, its phase adjustment is necessary. Whichever the case, the adjusting screwdriver (supplied as an accessory to the probes) may be used for adjustment purposes.

About 30 minutes of warmup is recommended for stabilizing operation before adjusting the controls and probe phase.

3-1-1 TRACE ROTATION Adjustment

Trace may become not parallel to the graticule lines on the CRT screen due to geomagnetic effect or other cause.

If that occurs, display a trace on the CRT screen, move it to the center of the screen with POSITION, and adjust the trace parallel to the graticule lines with TRACE ROTA-TION. Before making this adjustment, install the SS-5710 in the normal place of use for measurements.

3-1-2 GAIN Adjustment (CH 1, CH 2)

Vertical deflection check and adjustment are necessary to assure accuracy of voltage measurements.

The check and adjustment method is as follows. Set VOLTS/DIV switch to 5 mV, and connect INPUT to the CAL 0.3 V output terminal with an accessory probe. Check that the amplitude of the waveform displayed on the CRT screen is 6 divisions. If it is not rating, adjust it with the GAIN. (See Figure 2-5.)

3-1-3 x5 BAL Adjustment (CH 1, CH 2)

If ambient temperature fluctuations are variable, the vertical position of a trace can shift when **POSITION** is pushed or pulled.

If that occurs, adjust the X5 BAL while pushing and pulling POSITION so that the trace will not deviate from its vertical position. (See Figure 2-5.)

3-1-4 VARIABLE BAL Adjustment (CH 1, CH 2)

If ambient temperature fluctuations are variable, the vertical position of a trace may shift when the vertical deflection VARIABLE control is turned.

If that occurs, adjust the VARIABLE BAL while turning the VARIABLE control so that the trace will not deviate from its vertical position. (See Figure 2-5.)

3-1-5 Probe Phase Adjustment

10: 1 Passive probe phase adjustment

The following probes can be used for the SS-5710: Type SS-0011 (1.5 m long) with an attenuation ratio of 10 : 1; SS-0001 (1 m long), SS-0002 (1.5 m long), and SS-0003 (2 m long), the later three with an attenuation ratio of 1 : 1. (Those probes with an attenuation ratio of 1 : 1 are optional.)

A mismatched probe phase can result in measuring the wrong waveform. Be sure to correctly adjust the probe before use.

First, set VOLTS/DIV to 5 mV., connect the probe to INPUT and the CAL 0.3 V output terminal so that a calibration voltage waveform with an amplitude of 6 divisions is displayed on the CRT screen.

Next, turn the variable capacitor of the probe. The waveform changes as shown in figure 3-1 b or c. Adjust the variable capacitor correctly until the waveform is as shown in Figure 3-1 a.

Current probe sensitivity check

Figure 3-1. Probe phase waveforms

When using a current probe for measurement, check its sensitivity beforehand.

Read the instruction manual for the current probe for the checking procedure. The SS-5710 has the CAL 10 mA current loop termianl on the rear panel, where a square wave current of 10 mA flows in the arrow direction.

3-2 MEASURING METHODES

3-2-1 Voltage Measurement

Quantitative Measurement

The quantitative measurement of voltage can be made by setting the VOLTS/DIV VARIABLE control to the CAL position. The measured value can be calculated by Equation (3-1)or (3-2).






- a. Measurement with the x1 position of the probe;
 - Voltage (V) = VOLTS/DIV setting value (V/div)

x Displayed amplitude of input signal (div)

b. Measurement with the x10 position of the probe:

Voltage (V) = VOLTS/DIV setting value (V/div)

x Displayed amplitude of input signal (div) x10 (3-2)

DC Voltage Measurement

This instrument functions as a high input resistance, high sensitivity, quick response DC volt meter in order to measure DC voltage. Measurement procedure is as follows:

- 1. Set the sweep MODE switch to AUTO. and select a sweep rate so that the trace may not flicker.
- 2. Set the AC-GND-DC switch to GND. The vertical position of the trace in this case is used as 0-volt reference line as shown in Figure. 3-2. Adjust the vertical POSITION control in order to place the trace exctly on a horizontal graticule, which facilitates the reading of signal voltage.
- 3. Set the AC-GND-DC switch to DC, and apply the voltage to be measured to the input connector. The vertical diaplacement of the trace gives the voltage amplitude of the signal. When the trace shifts upward, the measured voltage is positive with regard to the ground potential. When the trace shifts downward, the voltage is negative. The voltage can be obtained by Equation (3-1) or (3-2).

AC Voltage Measurement

The measurement of the voltage waveform is performed as follows; Set the VOLTS/DIV switch in order to obtain the amplitude for easy reading, read the amplitude as shown in Figure 3-3 and calculate by Equation (3-1) or (3-2).

When the waveform superimposed on DC current is measured, set the AC-GND-DC switch to DC in order to measure the value including DC component, or set this switch to AC in order to measure AC component only.

The measured value by means of this procedure is peak value (Vp-p). Effective value (Vrms) of a sine wave signal can be given by Equation (3-3.)

Effective voltage (V rms) =
$$\frac{\text{Peak voltage (V p-p)}}{2\sqrt{2}}$$
 ...(3-3)

3-2-2 Current Measurement

Phanomena that can be observed by direct input application to the oscilloscope are voltage phenomena. All electrical phenomena other than voltage phenomena, such as mechanical vibrations and all others, require conversion into voltages for applying to INPUT.

In current measurements, a resistor of a known value is added to the circuit to be measured, and voltage variations at both ends of the resistor are observed on the CRT screen of the oscilloscope. The current value is calculated from the relationship V = IR. The resistor to be added to the circuit must have a resistance within a range in which the circuit will not change in operating condition. In case a resistor cannot be added to the circuit to be measured for reasons of operation, a current probe may be used for measuring currents without disconnecting the circuit. As shown in Figure 3-4, the current at the measuring point is detected by the core and secondary winding, and is applied to the vertical deflection system of the oscilloscope.

When measuring a small current, the output of the secondary winding is amplified and then applied. When measuring a large current, a shunt is inserted to apply a divided current. Otherwise, the core will be saturated. This method, however, is subject to limitation in frequency bandwidth. That is, it is unusable for high-frequency signals. if the circuit is ungrounded, a single inptut cannot assure

Figure 3-4. Current waveform measurement with current probe



accurate current measurement. That is, a differential input amplifier is necessary in that case. As mentioned in the paragraph on Operation for observation of the Sum of Two Signals or their Differnce, the SS-5710 can be used for differentical observation. This capability may be used in the following way. Select the vertical mode ADD, and CH 2 POLAR INV. Connect a probe to CH 1 and CH2 INPUTs, and its tips to both ends of the resistor inserted. Turn the VOLTS/DIV switches for CH 1 and CH 2 to the same position. The waveforms for both ends of the resistor i e., current waveforms, can now be observed.

3-2-3 Time Measurement

The time interval of two points on a signal waveform can be calculated as follows: Set the TIME/DIV VARIABLE control to CAL. read the setting values of the TIME/DIV and x5 MAG switches and calculate the time by Equation (3-4).

- Time (s) = TIME/DIV setting value (s/div)
 - x Length corresponding to the time to be measured (div)
 - x Reciprocal number of x5 MAG setting

Where, the reciprocal number of the x5 MAG setting value is 1 when the sweep is not magnified, and 1/5 when the sweep is magnified.

Figure 3-5. Pulsewidth measurement -



3-4

Pulsewidth Measurement

The basic pulsewidth measurement procedure is as follows:

- Display the pulse waveform vertically so that the distance between the top part of the pulse waveform and the horizontal center line of the graticule may be equal to the distance between the bottom part of the pulse and the horizontal center line as shown in Figure 3-4.
- 2. Set TIME/DIV switch in order to make the easy observation of the signal.
- 3. Read the distance between centers of rising and falling edges, i.e., the distance between two points at which pulse edges cross the horizontal center line of the graticule. Calculate the pulsewidth by Equation (3-4).

Rise (or Fall) Time Measurement

The rise (or fall) time measurement of the pulses is obtained as follows.

- 1. Display the pulse waveform vertically and horizontally in the same manner as for the pulsewidth measurement procedure.
- 2. Turn the horizontal POSITION control in order to set the upper 10% point of the waveform on the vertical center line of the graticule. (In Figure 3-5, the upper 10% point is 0.4 division below the top of the pulse since the displayed amplitude is 4 divisions.) Read the distance T₁ between the vertical center line and the point at which the rising (or falling) edge crosses the

Figure 3-6. Rise (or fall) time measurement -----



horizontal center line.

- 3. Shift and set the lower 10% point of the waveform to the vertical center line of the graticule as shown by the dotted line in Figure 3-5. Read the distance T₂ between the vertical center line and the point at which the rising (or falling) edge crosses the horizontal center line.
- 4. Calculate the rise (or fall) time by substituting the sum of T 1 and T 2 for Equation (3-4).

3-2-4 Frequency Measurement

Of the frequency measurement procedure, there are the following methods.

The first method: Calculate the one-cycle time (interval) of the input signal by Equation (3-4) as shown in Figure 3-6, and obtain th frequency by Equation (3-5).

Frequency (Hz) = $\frac{1 (c)}{Period (s)}$ (3-5)

The second method: Count the repetition number N per 10 divisions in the viewing area, and calculate the frequency by Equation (3-6).

Frequency (Hz)

N (c) TIME/DIV setting value (s/div) x 10 (div)

Figure 3-7. Frequency measurement (1) -----



When N is large (30 to 50), the second method can give a higher accuracy level than that obtained with the first method. This accuracy is approximately equal to the rated accuracy of sweep rate. However, when N is small, the count below decimal point becomes very ambiguous, which results in considerable error.

For the measurement of comparatively low frequencies having a simple pattern such as sine wave, square wave, triangle wave, and sawtooth wave, measurement with high accuracy can be effected by the follwing method: Operate the oscilloscope as an X-Y scope, make the Lissajou's pattern by applying the signal of which frequency is known, and read the necessay value.

3-2-5 Phase Difference Measurement

Of the measurement of phase difference between two signals, there are the follwing two methods:

The first one is the Lissajou's pattern method by using the instrument as an X-Y scope. The phase difference of signals can be calculated form the amplitudes A and B of the pattern shown if Figure 3-8 and by Equation (3-7). Phase defference (deg) = $\sin \frac{-1}{B} \frac{A}{B}$(3-7)

The second method is an application of dual-trace function Figure 3-9 shows an example of dual-trace display of leading and lagging sine wave signals having the same

Figure 3-8. Frequency measurement (2)



frequency. In this case, the SOURCE switch must be set to a channel which is connected to the leading signal, and set the TIME/DIV switch so that the length of 1-cycle of the displayed sine wave may be 9 divisions.

Then, 1-division graticule represents a waveform phase of 40° (1 cycle = 2π =360°). The phase difference between the two signals can be easily calculated by Equation (3-8).

Figure 3-9 Phase difference measurement using

Lissajou's pattern



Figure 3-10. Phase difference measurement by dual-trace display



Section 4

Theory of Operation

This section describes the function and operation of each circuit in reference to the SS-5710 block diagram shown in figure 4-1-1.

4-1 GENERAL

The circuit construction of the SS-5710 is shown in figure 4-1-1. Each block is used for driving the CRT's electron beams finally.

4-1-1 Preamplifiers for Channels 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), variable (VARIABLE control), and magnifier (PULL X 5 MAG switch) 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 1 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.

4-1-2 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.

Modes of leading the balanced signal can be selected by setting the vertical MODE switch: CH 1 or CH 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 every sweep or horizontal axis, and CHOP is the mode for changing display channels every 300 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.

4-1-3 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.

4-1-4 Trigger Signal Amplifier

The signals branched out from the vertical preamplifiers are led to the trigger amplifier, where the signals are amplified to the deflection factor required for the A and B trigger circuits.

The instrument has trigger signal amplifiers for CH 1, CH 2, CH 3, CH 4, LINE (from the power circuit), and NORM (from the main amplifer after electonic switching).

In TV trigger delay sweep, the vertical trigger component is led to the A trigger circuit and the horizontal trigger component to the B trigger circuit.

Section 4 Theory of Operation

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Figure 4-1-1. SS-5710 Overall block diagram

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SS-5710

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4-1-5 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.

4-1-6 A and B Trigger Circuits

The A and B trigger circuits adjust the input trigger signals to an appropriate level, generate a sharp trigger pulse which starts at an arbitrary point of the input signals, and sends the pulse to the sweep circuit. Any of the following signals can be selected.

A trigger circuit: CH1, CH 2, CH 3, NORM, LINE, TV-V, TV-H B trigger circuit: CH 1, CH 2, CH 4, TV-H

4-1-7 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 waved 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.

4-1-8 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 trigger signals 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 led is to the horizontal amplifier via the trigger amplifier and the signal applied to CH 2 INPUT is led to the horizontal amplifier. Thus, a Lissajous' 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).

4-1-9 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 bacause they eliminate horizontal sweepback.

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 of 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 A 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.

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.

4-1-10 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.

4-1-11 Low-Voltage Circuit

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

4-1-12 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.

4-2 VERTICAL DEFLECTION SYSTEM

4-2-1 Single Input Circuit and Attenuator 1

The oscillator must measure various voltages (varying from extremely low to very high voltage, dc voltages, ac voltages, and dc-ac mixed voltages). The oscillator has attenuators for amplifying the input signals to an easy-toread sensitivities and a change-over switch for selecting an AC connection (for rejecting the dc components) and a DC connection (for passing all components).

A signal to be measured is fed to the Input connector through a probe or a cable. The oscillator can receive up to 250 V (dc + ac peak) (directly through a cable) or up to 600 V (dc + ac peak) (using a 10:1 probe).

The AC/DC/GND switch is used to select a connection of the vertical deflecting system for the input signal. The setting positions of the switch are as follows:

- AC: An ac connection is formed in the vertical deflecting system by IC01. The ac connection rejects any dc components of the input signal and passes dc components unconditionally.
- DC: A dc connection is formed in the vertical deflecting system. The dc connection passes all components of the input signal (including the dc components).
- GND: The input to the attenuator is grounded, that is, the input signal is not connected the attenuator. The ground potential is easily checked.

The attenuator attenuates the input signal to adjust its magnitude to a proper sensitivity (5 mV/division to 10 V/ division, 11 steps).

5 mV/division and 10 mV/division in the x5 MAG mode respectively represent 1 mV/division and 2 mV/division (when the Variable control is set to CAL (clockwise end).

4-2-2 Preamplifiers (CH 1 and CH 2) 2, 3

These amplifiers amplify balanced signals to the vertical deflecting sensitivity of the CRT corresponding to the value set by the attenuator.

In this case, the input signal is converted into a lowimpedance output in order to amplify the frequency of the input signal in the wide range.

Figure 4-1-2 shows the block diagram of preamplifiers CH1 and CH2.

The input signal is fed to low-impedance converter 1Q01 through the attenuator and converted into a low-impedance output. (An input signal having a high impedance (1 M Ω) cannot be amplified in a wide frequency range.)

The emitter-coupled symmetric amplifier (2Q02, 2Q03, 2Q04, and 2Q05) amplifies the input signal and generates an output of a reversed polarity (a symmetric balanced signal). The magnifier x5 MAG (2S03), 2Q01, 2Q02, and 2Q03 work to multiply the vertical deflecting sensitivity by 5. The output of the preamplifier is sent to the post-amplifier (2Q06, 2Q07, 2Q08, and 2Q09) to be amplified once more.

The output of the preamplifier is branched to base of 2Q10 and 2Q11 and output as a CH1 trigger signal and an X-axis signal (for X-Y scope operation) by the emitter of 2Q15.

Figure 4-1-2. Block diagram of CH1 and CH2 preamplifiers

The CH1 trigger signal is sent to the A and B trigger signal amplifiers through the coupling switches.

The X-axis signal is sent to the horizontal controller. The signal amplified by the postamplifier is sent to the switching circuit.

The vertical position on the CRT screen is changed by varying emitter voltages (2008 and 2007) by variable resistor 2R36.

The CH2 polarity block (3S02) reverses the polarity of the input signal. At NORM, the signal is fed to emitters of 3Q08 and 3Q17 and output from their collectors with the reversed polarity. At INVERT, 3Q08 and 3Q17 are disabled and the signal is fed to emitters of 3Q09 and 3Q16. The signal is output from their collectors with the same polarity. The output signal is connected in the reversed manner to the switching circuit and sent to the deflecting plate of the CRT.

The CH trigger signal is output from the emitter of 3Q15 and sent to the A and B trigger signal amplifiers through A and B coupling switches.



Figure 4-3 shows the block diagram of preamplifiers CH3 and CH4.

Their functions and operations are almost the same as those of CH1 and CH2, but the GND setting position is disabled and the attenuator has 0.1 V/division and 1 V/division only.

The input signal is fed to the gate of 4Q01 of the lowimpedance converter through the attenuator, converted into a low-impedance output by 4Q01, and fed to the emitter-connected symmetric amplifier (4Q02, 4Q05, 4Q03, and 4Q04). The amplifier amplifies the signal. The amplified signal is sent to the switching circuit.

The CH3 trigger signal branched from the emitter of 4Q02 is fed to 4Q06 and output as a low-impedance signal to the A-trigger source switch.

The CH4 trigger signal branched from the emitter of 4Q08 is fed to 4Q12 and output as a low-impedance signal to the B-trigger source switch.

Vertical position on the CRT (CH3 position) is changed by vaying collector voltages of 4Q03 and 4Q04 by variable resistor 4R21. Vertical position on the CRT (CH4 position) is changed by varying collector voltages of 4Q07 and 4Q10 by variable resistor 4R51.

4-2-4 Switching Circuit 6

The basic operation of the switching circuit is as follows: (See Figure 4-1-4.)

CH1: When the vertical MODE switch is set to CH1, a high voltage is fed to the anodes of 5D06 and 5D07 through 6D04. The diodes are forward-biased and become conductive (ON). Accordingly, the cathode potential is increased to make 5D05 and 5D07 inconductive (OFF). Thus the signal from CH2 is rejected. A low voltage is fed to the anodes of 5D02 and 5D03 through 6D05. The diodes are backward-biased and become inconductive. 5Q01 and 5Q04 are conductive by a forward bias voltage. Thus the signal from CH1 only is fed to the amplifier.





CH2: When the Vertical MODE switch is set to CH2, a high voltage is fed to the anodes of 5D02 and 5D03 through 6Q05. The diodes are forward-biased and become conductive (ON). Accordingly, the cathode potential is increased to make 5D01 and 5D04 inconductive (OFF). Thus the signal from CH2 is rejected. A low voltage is fed to the anodes of 5D06 and 5D07 through 6Q04.

The diodes are forward-biased and become conductive. Thus the signal from CH2 only is fed to the amplifier.

ALT: When the Vertical MODE switch is set to ALT, Alternate pulses are sent from the horizontal controller to the vertical controller each time one horizontal sweep of CH1 or CH2 is made. Then the pulses are sent to the switching circuit. Instantaneous on-off switchings are repatedly performed by biasing the CH1 and CH2 switching circuit. Thus the signals from CH1 and CH2 are alternately displayed on the screen. This mode is fit for observing two signals having relatively high frequencies.

CHOP: When the Vertical MODE switch is set to ALT. 6IC01 and 6IC03 work as an astable multivibrator. Its switching frequency is determined by time constants of 6R17, 6R18, 6C03, and 6C04. By these time constants, 6IC01 and 6IC03 perform on-off switchings to alternate CH1 and CH2 signals and send the signals to the delay cable drive amplifier.

The delay cable drive amplifier performs on-off switchings every $3.3 \ \mu s$ (300 kHz).

This mode is fit for observing two signals having relatively low frequencies.

A chop blanking pulse eliminates the transient which occurs when the traces of CH1 and CH2 signals change. The chop blanking pulse is sent to the Z-axis amplifier through amplifier 6IC02.

ADD: When the Vertical MODE switch is set to ADD, the sum of signals fed to both CH1 and CH2 preamplifiers is displayed on the screen.

6D01 is made inconductive so that a high voltage may be applied to anodes of 5D01, 5D04, 5D05, and 5D08 through 5R03, 5R04, 5R09, 5R05, 5R06, and 5R10.

A current is not sent to 6Q01 (while a current is sent to 6Q01 through 5R01 and 5R02 at CH1 or CH2 mode). 5D01, 5D04, 5D05, and 5D08 are forward-biased and become conductive, so that the balanced signals of CH1 and CH2 preamplifiers are sent to the delay cable drive circuit concurrently. When the CH2 POLAR switch is set

to INV in this state, the polarity of the CH2 input signal is reversed and the output of the switching circuit is displayed as a difference of input signals (to CH1 and CH2 preamplifiers) on the CRT screen.

QUAD: When the Vertical MODE switch is set to QUAD after setting the switch to ALT or CHOP, a quadtrace operation is set and input signals of preamplifiers CH1, CH2, CH3, and CH4 are displayed on the CRT screen.

ALT and QUAD

At the ALT and QUAD modes, retrace lines of CH1 to CH4 are sequentially displayed on the CRT screen. While a sweep of a channel is being performed, sweeps of the other channels are inhibited. That is, while a CH1 sweep is being performed, CH2 to CH4 sweeps are inhibited (their switching circuits are made inactive). After the completion of the CH1 sweep, the CH2 sweep starts and the other channels' sweeps are inhibited. In the similar way, the CH3 and CH4 sweeps are performed and these steps are repeated.

CHOP and QUAD

At the CHOP and QUAD modes, retrace lines of CH1 to CH4 are displayed on the CRT screen in the same manner as at the ALT and QUAD modes. The switching frequency is approximately 150 kHz.

4-2-5 Delay Cable Driver Amplifier and Vertical Main Amplifier 5

Figure 4-1-5 shows the block diagram of the delay cable driver amplifier and the vertical main amplifier. Signals sent from preamplifiers (CH1, CH2, CH3, and CH4) are sent to the switching circuit. The vertical controller controls the vertical axis mode.

Balanced signals from the switching circuit are sent to the delay cable driver amplifier and amplified there (by 5Q01 and 5Q02). The amplified signals are sent to the delay cable. The delay cable delays the transmission time by a predetermined time. Then the signal is sent to the vertical main amplifier (at the last stage).

When the B-Source switch is set to RUNS AFTER DELAY, B sweep is delayed continuously and other range sweep is delayed synchronously.

The Coupling switch is used to select a connection between the trigger signal source and a trigger signal amplifier. When the switch is set to AC, an ac connection is formed and its dc component is removed by capacitor 7C01. Thus the synchronization is done regardless of the dc components.

When the switch is set to DC, a dc connection is formed. Thus the synchronization is made by the dc components.

When the switch is set to HF REJ, a low-pass filter comprising 7R02 and 7C03 attenuates frequencies of about 10 kHz or higher. This mode is very useful in observing signals which contain high-frequency noises.

When the switch is set to LF REJ, a high-pass filter comprising 7R03 and 7C02 attenuates frequencies of about 10 kH or lower.

When the switch is set to FIX, the synchronization level is fixed. Thus the synchronization is done without manipulating the level.

When the switch is set to TV-H, the TV trigger signal separator is actuated in synchronization with the TV-H signal so that the composite video signal can be observed for one horizontal trace.

When the switch is set to TV-V, the TV trigger signal separator is actuated in synchronization with the TV-V signal so that the composite video signal can be observed for one vertical trace.

B TRIGGER SIGNAL AMPLIFIER:

Similarly, a B trigger pulse signal is applied to the base of 7Q19, output as a TTL-level signal from the collector of 7Q19 to the B-sweep generator.

When the Horizontal mode switch is set to AUTO or NORM, the AUTO TRIG circuit (71C02, 71C03, and 71C04) receives a trigger pulse signal and sets the Auto Trigger state or the Norm Trigger state. The stable multi-vibrator (71C02 and 71C04) has a time constant (about 30 ms) determined by 7C20, 7C21, 7R58, 7R59, and 71C02.

When no signal is present or the set trigger level exceeds the predtermined range in the AUTO horizontal mode, a sweep is running freely.

When no signal is present and the set trigger level exceeds the predetermined range in the NORM horizontal mode, a sweep is stopped. TRIG'D 7D11 lights in sync operation. The Auto Trigger circuit outputs a trigger pulse signal at pin 6 of 7IC03 to the A-sweep oscillator.

4-2-5 Delay Cable Driver Amplifier 5

The delay cable drive amplifier forms a postamplifier for outputs of the preamplifiers CH1 to CH4 and a compound amplifier. The compound amplifier makes the impedance of each input signal lower by a negative feedback of 5R03, 5R04, 5R05, and 5R06 to prevent the reduction of frequency characteristics and sends the low-impedance output to the delay cable.

Figure 4-1-4. Block diagram of Delay Cable Driver Amplifier and Vertical Main Amplifier



4-2-6 Delay Cable 5

The delay cable is provided to delay the transmission time of a vertical input signal so that the vertical input signal and the horizontal input signal can reach vertical and

Figure 4-1-5. Switching circuit -

horizontal deflecting plates at the same time. The delay cable delays input signals by about 100 ns so that the leading edge of the input waveform may be observed at an internal period.



4-2-7 Vertical Main Amplifier 5

The main vertical amplifier amplifies the signal sent from the delay cable to a proper vertical deflecting magnitude on the CRT screen, makes the low impedance of the signal higher, and then sends it to the vertical deflecting plate of the CRT.

A compensating circuit (5R55, 5R82, 5C14, and 5C21) is formed to suppress a ringing and distortions on signal waveforms.

4-3 TRIGGER CIRCUIT

The trigger signal amplifier selects a trigger signal source by the Source switch and a connection of a trigger signal source and a trigger signal amplifier by the Coupling switch and amplifies the selected trigger signal as a trigger pulse signal to a sufficient amplitude. The amplifier and separater for TV trigger signals separate TV-H and TV-V trigger signals from TV composite video signals and amplifies them in order to stabilize the TV composite video signals.

Figure 4-1-6 shows the block diagram of A and B trigger signal amplifiers.

Figure 4-1-6. Block diagram of A and B trigger signal amplifiers



4-3-1 A and B Trigger Signal Amplifier 7

A TRIGGER SIGNAL AMPLIFIER:

The Source switch is used to select a trigger signal source. As already mentioned, when the Source switch is set to CH1, CH2, CH3, or CH4, the input signal is connected to the selected channel.

When the switch is set to NORM, a signal being displayed on the CRT screen in the selected vertical mode is a trigger signal.

When the switch is set to LINE, the power line signal is a trigger signal. This mode is very convenient to observe line frequencies and higher harmonics.

4-3-2 TV Synch Signal Separator Circuit 7

Figure 4-1-7 shows the block diagram of the TV sync signal separator.

This separator extracts a trigger signal from the incoming TV composite video signal, amplifies the signal, then separates it into horizontal (TV-H) and vertical (TV-V) trigger signals.

The TV-H and TV-V pulse signals are sent to the A trigger signal amplifier and the TV-H pulse signal is sent to the B trigger signal amplifier.

When the SLOPE switch is set to "+" for the positive trigger pulse of the TV composite video signal given to the base of 7Q04 (polarity switch), a signal from the emitter of 7Q04 is sent to the base of 7Q06 (amplifier) with the same

Figure 4-1-7. Block diagram of TV Trigger signal separator

 SLOPE
 Amplifier
 7C45

 Switch
 7
 7

 7
 0.04
 0.05

 S01
 0.06
 7

polarity.

When the SLOPE switch is set to "-" for the negative trigger pulse, the signal from the collector of 7Q04 is fed to the base of 7Q06.

Polarities of the trigger pulses of the TV composite video signal applied to the base of 7006 are positive. The signal is amplified by 7006 and output as trigger pulses having negative polarity from the collector. 7005 receives only negative trigger pulse component (cutting off the positive component) and outputs a signal with the reserved polarity from the collector.

The output TV-V and TV-H pulse signals are differentiated by 7C45 and 7R18. The TV-H pulse signal is sent to the A-grigger signal amplifier through 7D01 and then to the B-trigger signal amplifier through 7D15. The TV-V pulse signal passing through 7R19 is integrated by 7C06, 7R21, 7C29, and 7R93 and then fed to the A-trigger signal amplifier.

The low impedance converter (7Q01, 7Q02, and 7Q03) converts a high-impedance signal into a low-impedance signal and outputs the signal from the emitter of 7Q03. The signal is then converted into a balanced signal by 7Q07 and 7Q08, amplified by 7Q09 and 7Q10, then fed to the polarity-switching and waveform-shaping circuit.

4-3-3 POLARITY Selector and Waveform Shaper 7

Figure 4-1-8 shows the circuit diagram of the polarity switching and waveform shaping circuit (7IC01).

Figure 4-1-8. SLOPE switching and waveform shaping circuit



The A-trigger signal is fed to A of 7IC01, shaped into a trigger pulses there, and output from pin 10 of 7IC01. The polarity of the trigger pulse signal is switched by B of 7IC01. The magnitude of hysteresis for shaping the waveform of the trigger pulse signal is determined by 7R38 and the output impedance of the trigger signal amplifier.

The shaped trigger pulse signal is sent to the ECL-to-TTL translator (7Q17 and 7Q18).

The ECL-to-TTL translator converts pulse level from ECL to TTL. 7Q17 receives a trigger pulse signal of ECL level at its base and outputs a trigger pulse signal of TTL level from its collector. The signal is then sent to the AUTO TRIG circuit.

4-4 SAWTOOTH-WAVE GENERATOR CIRCUIT

4-4-1 A Sweep Generator 8, 10

Figure 4-1-9 shows the block diagram of the A sweep generator.

Figure 4-1-9. Block diagram of A-sweep generator circuit -

The sweep generator generates a sawtooth-wave (for synchronized sweep) in synchronism with a signal to be measured and a sawtooth-wave (for free-running sweep) independent of the signal to be measured.

The sawtooth oscillator takes three operation modes: AUTO, NORM, and Single Sweep (by Horizontal Mode switch). The sweep generator generates the following signals:

• Saw tooth wave

The sawtooth-wave is fed to the horizontal amplifier, amplified there, and then sent to the horizontal deflecting plate of the CRT.

The sawtooth-wave is also sent to the B sawtooth generator to generate delayed pulses.

Unblanking signal

The unblanking signal brightens the sweep trace and eliminates return trace. The unblanking signal is sent to the Z-axis amplifier, amplified there, and sent to the CRT.

Gate pulse signal

A gate pulse signal which is positive during the rise time of a sawtooth-waveform is amplified and output.

The sweep generator is designed to start sweeping when



the output of a trigger pulse signal changes from low to high. Polarity of the trigger signal changes according to the setting of the SLOPE switch, as shown in Table 4-1-1.

The B-sweep generator operates when the HORIZ DISPLAY siwtch is set to A INTEN, ALT, and B (DLY'D).

The B-sweep generator starts a predetermined time after the A-sweep generator started sweeping. This delay time is determined by the A TIME/DIV and DELAY TIME MULT switches. When the B SOURCE switch is set to CH1, CH2, or CH4 (synchronization delay), The Delay Pick-Off pulse signal is fed to the sweep controller after the predetermined time and B-sweep is started by the trigger pulse signal.

When the switch is set to RUNS AFTER DELAY (continuous delay), the Delay Pick Off pulse signal is fed to the sweep controller after the predetermined time and at the same time B-sweeping starts.





The B-sweep generator generates the following signals:

Saw tooth wave

The sawtooth-wave is fed to the horizontal amplifier, amplified there, and then sent to the horizontal deflecting plate of the CRT.

Unblanking signal

The unblanking signal brightens the sweep trace and eliminates return trace. The unblanking signal is sent to the Z-axis amplifier, amplified there, and sent to the CRT.

Gate pulse signal

A gate pulse signal which is positive during the rise time of a saw-tooth waveform

The Delay Pick Off Comparator (9Q10, 9Q11, 9Q11, 8IC01, 9IC02, and 9IC03) has the following functions:

- Sends a Delay Pick Off pulse signal to the sweep controller a predetermined time after the A-sweeping was started.
- Aborts the current sweeping when the A-sweeping is terminated.

An A sawtooth signal is fed to the base of 9Q10 and then pin 3 of 9IC01 (Delay Pick Off comparator). 9R33 (Delay Time Mult) is used to set a voltage (reference voltage) to the delay time (a constant time after the Asweeping started). When the A sawtooth-wave reaches a predetermined voltage level, the oscillator generates a Delay Pick Off pulse signal and feeds it to the sweep controller. Thus the B-sweeping is started.

The oscillator also sends a pulse signal to the sweep controller according to the setting of B SOURCE switch (RUND AFTER DELAY and TRIGGER'D DELAY).

Figure 4-1-12 shows the timing chart of the oscillator. When the HORIZ DISPLAY switch is set to A and X-Y, a sweep inhibit signal is sent to the sweep controller.

When the Horizontal Mode switch is set to SINGLE/ RESET, the sweep controller stops sweeping and waits for a trigger pulse signal. When a trigger pulse signal is applied, the controller performs only one sweep (single sweep operation). While the controller waits for a trigger pulse signal, the READY LED is on.

The Timing circuit determines the sweep speed (by the A TIME/DIV). The saw-tooth generator is composed of 10Q01, resistors and capacitors of the timing switches.

When the disconnect amplifier 8Q04 is off, the capacitor is charged by the constant current of 10Q01.

The terminal voltage of the capacitor is sent to the sweep controller through the buffer amplifier (8Q07) and Hold-Off generator.

When the saw tooth waveform reaches the predetermined level, the sweep controller turns on the Disconnect amplifier. This is the sweep-inhibition state.

Then the timing capacitor discharges and the amplitude of a saw-tooth waveform falls down to the start level. The Sweep-Start comparator 8Q09 feeds the output of the buffer amplifier (8Q07 and 8Q08) back to the Disconnect amplifier, discharges the timing capacitor down to a predetermined level (start level), and keeps the level.

A constant time required between two consecutive sweeps is set by the Hold-Off generator.

At a constant time after the completion of a sweep, the output of the Hold-Off generator makes the sweep controller wait for a trigger pulse signal.

The sweep controller (8IC02) receives a sweep start signal and turns off the Disconnect amplifier. Then the next sweep starts. The unblanking signal and a gate signal are output from the sweep controller and the gate signal is sent through pin 3 of 8IC03. The output of the sweep generator is sent to the Delay Pick-Off circuit and a horizontal amplifier through the horizontal controller.

The Hold-Off generator (81C01 and 8Q02) receives a saw-tooth signal and generates a Hold-Off signal (Sweep Inhibit signal). The signal is sent to the sweep controller. The capacitors and resistors of the Hold-Off generator determine the duration of the Hold-Off signal.

These capacitors are selected by the timing switches. The resistor (8R03) is a variable resistor.

A-Sweep Length resistor 8R04 is used to set the length of the sweep line. Voltage comparator 8IC01 detects a Hold-Off Start voltage and an end voltage to determine the hold-off time. (See Figure 4-1-10.)

4-4-2 B Sweep Generator 9, 10

Figure 4-11 shows the block diagram of the B-sweep generator. This section describes circuits specific to the B-sweep generator. (For circuits having the same functions as those of the A-sweep generator, see 4.4.a.)





Figure 4-1-12. Timing chart



4-5 HORIZONTAL DEFLECTION SYSTEM

Figure 4-1-13 shows the block diagram of the horizontal amplifier.

The horizontal amplifier amplifies either of the following signals to fully deflect the electron beam horizontally on the CRT screen:

- A or b sawtooth-wave
- Signal applied to the Input terminal of the CH1 preamplifier (in X-Y scope operation)

Signals to be fed to the Input Common Emitter amplifier (11001 and 11D02) are selected by setting the HORIZ DISPLAY (to control the horizontal axis).

When the HORIZ DISPLAY switch is set to A, a high voltage is applied from the cathode of 11D01 to the cathode of 11D04. Thus, 11D04 is made off and 11D01 is made on to introduce the A sawtooth-wave. A low voltage is applied from the cathodes of 11D02 and 11D03 to the cathodes of 11D05 and 11D06. Thus 11D02 and 11D03 are made off and the B sawtooth-wave and the X-Y signal are suppressed.

The Input Common Emitter amplifier amplifies the incoming signal and outputs it from the collector. The output signal is partially fed back to the base through 11R13 and 11R16 (the negative feedback circuit).

The negative feedback circuit is provided to improve frequency characteristics and make them stable.

The signal applied to the feedback circuit is converted into a current and fed from collectors of 11Q01 and 11Q02 to their bases. Thus the current passing through the feedback resistor is changed into a voltage amplitude. The POSITION and FINE (11R09 and 11R10) resistors changes the current applied to the base of 11Q01 to adjust the horizontal position of the electron beam on the CRT. The Gain Setting and Limiting amplifier (11Q03 and 11Q04) has the following functions:

- The differential amplifier composed of 11Q03 and 11Q04 receives a signal at the base of 11Q03, amplifies it, and outputs two signals of different polarities from collectors of 11Q03 and 11Q04.
- The PULL x10 MAG magnifier switches emitter resistors 11Q03 and 11Q04 by reed relay 11RL01 to change gains.

When the magnifier is set to PULL x10 MAG, 11RL01 switch is made on. The resistance between emitters of 11Q03 and 11Q04 is about one tenth of the resistance between emitters of 11R25 and 11R26 in the NORM state because of a serial connection of 11R23, 11R24, 11R25, and 11R26.

As the result, the output voltages of 11Q03 and 11Q04 are amplified ten times and sent to the bases of 11Q07 and 11Q08.



Figure 4-1-13. Block diagram of horizontal amplifier -

The output amplifier (11Q05 to 11Q10) amplifies the incoming signal enough to deflect the electron beam horizontally on the CRT screen.

A negative feedback circuit (11R31, 11R32, 11R33, and 11R34) receives a part of the amplified signal and outputs a stable signal, improving the frequency characteristics.

The amplified output signal is fed to the horizontal deflecting plate of the CRT.

4-6 Z AXIS AMPLIFIER and CRT CIRCUIT 14

Figure 4-1-14 shows the block diagram of the Z-axis amplifier and the CRT circuit.

The Z-axis amplifier (14Q10 to 14Q13) has the following functions:

- Illuminates A and B sweep traces and amplifies unblanking signals to eliminate return traces.
- Amplifies a chop blanking signal to eliminate transients which occur in the CHOP vertical mode.
- Amplifies an external-brightness controlling signal which was fed to the input terminal of the Z-axis amplifier.
- Amplifies the Time Marker signal.
- Adjust the intensity of sweep traces by the INTEN.

A signal to the Z-axis amplifier is first applied to the emitter of 14Q10 (a base-grounded amplifier having low input impedance). 14D12 and 14D13 work to keep 14Q12 and 14Q13 unsaturated. The signal output from 14Q10 is fed to the base of 14Q11, amplified there, and output from the emitter of 14Q11. One part of the signal is sent to the base of 14Q13 through 11D14 and amplified there. Another part of the signal is sent to the base of 14Q12 through 14C23 (passing the high-frequency component) and amplified there. Resistors 14R42 and 14R43 form a feedback amplifier and sends the output signal to the grid of the CRT.

The CRT circuit generates a high voltage for giving a high biasing voltage to plates of the CRT and deflecting the electron beam to draw rasters on the CRT screen. Biasing voltages to be supplied to the CRT vary from about +12.55 kV to -2.45 kV.

The high voltage oscillator is composed of 14Q01, 14Q02, 14Q16, and primary winding 14T01 (oscillating transformer). 14Q01 oscillates in about 30 kHz by a positive feedback from the collector winding to the base winding of the oscillating transformer (14T01, thus generating a high voltage at the secondary winding.

series regulator to be controlled by the -10 V power supply.

Figure 4-1-14. Block diagram of the Z-Axis amplifier and the CRT -



14C02, 14R52, and 14R02 supplies a current to the base of 14Q01.

14C99 and 14Q16 operate at the beginning of oscillation. During oscillation, 14Q16 becomes off.

14D02, 14D01, and 14R01 forms a protection circuit for keeping the voltage under the backward voltage between the base and the emitter of 14Q01.

The high voltage regulator (14IC01) is provided to keep the cathode voltage of the CRT to -2.45 kV independently of the fluctuation of the primary voltage and change of intensity (using a high voltage generated by the high voltage oscillator). Thus the deflecting sensitivity on the CRT is kept fixed.

The high voltage regulator is composed of an error amplifier comprising 14IC01, 14R03, 14R04, and 14R05 and an error amplifier comprising 14R12, 14R13, 14R14, 14R07, and 14R08. 14IC01 operates to keep the voltage between both ends of each resistor (14R12, 14R13, and 14R14) at -2.45 kV. The output of 14IC01 is sent through 14R02 to control the base current of 14Q01 (oscillation amplitude).

The high voltage rectifier is composed of a 6-times voltage rectifier (for supplying +12.5 kV to the third anode P3), a half-wave rectifier (for supplying a cathode voltage and the first grid voltage, and circuits (pin 1 of the focusing plate, pin 8 of ASTIG plate, and pin 2 geometry plate).

The Trace Rotation circuit is composed of 14Q14, 14Q15, 14R26, and 14L01. A current is applied to the rotation coil on the CRT neck and the generated magnetic field deflects the electron beam on the CRT.

14Q14 and 14Q15 reduce the current which passes through 14R26.

4-7 POWER SUPPLY 13

Figure 4-1-15 shows the low-voltage supply circuit. There are five regulated power supplies to make the oscilloscope work well. Each regulated power supply has stable output voltage which will not be affected by the fluctuation of loads and very few ripples. The power supply is protected against mis-grounding. In the power input circuit, a power is first applied to the power switching plug through a fuse. The power switching plug has five voltage settings (100 V, 115 V, 220 V, 230 V, and 240 V) which are determined by connecting two primary windings of 13T01 (power transformer) serially or parallelly.

The -10 V rectifier supplies a reference voltage for the other regulated power supplies (except for +5V rectifier). The voltage output from the power transformer is full-wave-rectified by 13D04 (rectifier) and smoothed by 13C16 and 13C20 (electrolytic capacitors) into a direct current. The positive component of the smoothed voltage is sent to the series regulator (to be controlled by the +10 V power supply) and the negative component is sent to the

The current limiter 13Q73 is controlled by error amplifier 13IC03 (1/2). In the error amplifier, Zener voltage -5.6 V of 13D15 (Zener diode) is sent to pin 5 of 13IC03 as a reference voltage. Voltage set by 13R41 (variable resistor) is fed to pin 6 of 13IC03. By this voltage, the output of pin 7 of 13IC03 controls the base current of 13Q09 (series regulator).

13Q12 is a low-current protector.

The +5 V power circuit 13IC01 and 13D01 receives the incoming voltage at 13D01 (rectifier), full-wave-rectifies it, smoothes it by 13C06 (electrolytic capacitor), and sends to 13IC01 (series regulator and error amplifier). The operation of 13IC01 is almost the same as that of the -10 V regulator. 13IC01 outputs a regulated voltage of +5 V. The other power circuits (+10 V, +47 V, and +100 V) receives -10 V as a reference voltage and outputs their regulated voltages. Their circuit configuration is almost the same as that of the -10 V power circuit.

Scale lamp:

A voltage from the power transformer is lowered to about 6.3 V by 21R03 and 13R04 (Scale Ilum) and fed to the scale lamp on the CRT. Its intensity is adjusted by 13R04 (variable resistor).

Line trigger signal:

Output voltage of the power transformer is sent to the grigger signal amplifier through 13C02, 13R02, and 13R01.





4-8 CALIBRATOR 13



Figure 4-1-16 shows the calibrator.

The calibrator receives a voltage of +10 V and outputs 0.3 V, 10 mA (square waveform). The output voltage and current are used to calibrate the vertical deflecting sensitivity and to adjust the phase of the probe. Emitter resistors 13R09 and 13R12 of the calibrator (13Q01 and 13Q02) and a capacitor 13C03 forms an oscillator. Oscillation is caused by charging and discharging of 13C03 through 13R09 and 13R12. 13Q01 and 13Q02 repeat on-off switchings (about 1 kHz). A square signal is output from the collector of 13Q02 and fed to the base of 13Q03 and +10 V is fed to the emitter. A square signal fed to 13Q03 is output from the collector, performing on-off switchings when passing through the transistor. 13R13, 13R14, and 13R15 forms a voltage divider, through which a current of 10 mA flows. 13R14 (CAL ADJ) is adjusted to send 0.3 V to the output terminal. A current of 10 mA flows a loop terminal.



Maintenance

This section describes the maintenance procedures for keeping the SS-5710 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 must also be observed to assure long satisfactory operation.

5-1 PREVENTIVE MAINTENANCE

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

5-1-1 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 5-1.

Table 5-1

Suitable fluids	Alcohol, water, neutral detergent			
Unsuitable	Acetone gasoline, ether, lacque			
fluido	thinner, methylethyl ketone,			
	chemicals containing ketone deter-			
	gent			

Cover Cleanig

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 5-1.

Front Panel Cleaning

Wet a soft cloth with one of the suitable fluids shown in table 5-1, 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.

5-1-2 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 supplied bag. Attach the supplied panel cover to it, put the dust cover on the device, and store it in a place as dry as possibele.

This can keep the instrument clean.

5-1-3 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.

5-1-4 Periodic Adjustment

Periodic inspection and adjustments are necessary for keeping the instrument in accurate operating condition at all times. If the instrument is continuously used, inspect and adjust it about every 1000 hours. If it is not used so much, it may be inspected and adjusted about every six months.

5-2 PARTS REPLACEMENT

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

5-2-1 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 the two 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 in its front and rear parts, and slide the cover slightly to rear ward. Next, widen on both root of the handle and pull up the cover.

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

5-2-2 Printed Circuit Board Removal

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

5-2-3 Printed Circuit Board Parts Replacement

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 8.)

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.

5-2-4 Replacing Resistors, Diodes or IC's

In replacing a transistor, diode, or IC, make sure of the electrodes. (See tables 5-4, 5-5, and 5-6.)

Particularly, transistors must be replaced with ones that have good performance. The transistors that have been specially selected are moted in the schematic diagrams.

5-2-5 Power Transistor Replacement

The power transistors for the instrument are mounted on the rear sub panel. In replacing any of them, remove the rear panel, and remove the screw that fastens the transistor. The power transistors are connected with a connector.

In installing a new transistor, first wind heat dissipating silicon rubber (TC-30) around the transistor to assure satisfactory heat dissipation between the transistor and sub panel, and install the transistor. Be sure to insert it into the connector in the correct direction. (Connect the brown lead of the connector to pin 1 of the transistor, and the orange lead one to pin 2 of the transistor.)

5-2-6 CRT Replacement

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 anode cap after discharging it because it might retain a high voltage charge.
- 4. Disconnect the wires from the delfection pin.
 - The blue and yellow leads are for vertical deflection, the white and black leads for horizontal deflection, and the red lead is for the negative electrode of 03. Disconnect the leads with care so that they will not be rewired 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).
- 7. Remove the four screws that fasten the printed circuit board (V main amplifer) 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 6 Performance (Check) and Adjustment.

5-2-7 High-Voltage Power Transformer Replacement

Care must be taken in replacing the high-voltage power transformer which supplies high voltage to the CRT because the CRT cicuit may be live with high voltage. The removal procedure is as follows:

- 1. Remove the rear panel, and top and bottom covers.
- 2. Remove the two screws that fasten the high-voltage case, and remove the case.
- 3. Remove the three screws that fasten the printed circuit board for the high-voltage circuit, disengage the printed circuit board connector and transistor connector, and remove the printed circuit board.
- 4. The high-voltage power transformer is soldered on the printed circuit board. It must be unsoldered by using a soldering iron. When the high-voltage power transformer has been replaced, readjustment is necessary.

5-2-8 Replacing Control Knobs and Rotary Switches

The control knobs and rotary switches are mounted on the printed circuit boards and the front sub panel. Their replacement procedure is as follows:

- 1. Remove the screw from the printed circuit board on which the control knob or rotary switch to be replaced is mounted.
- Disengage the connector that is connected to the printed circuit board.
- 3. Remove the control knob or rotary switch.
- Remove the nut which fastens the contol or rotary switch, and remove it together with the printed circuit board.
- 5. Melt the solder that fastens the control or rotary switch, using a sodering iron. Reverse the above procedure for installing them.

Section 5 Maintenance

Check and Adjustment

6-1 GENERAL

Correct measurement requires the normal operation of each circuit in SS-5710 and satisfactory maintenance of their performance.

With the regular performance check and adjustment, SS-5710 can develop its functions in a reliable manner for a long period of service. This section describes the appropriate method of check and adjustment.

6-2 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-5710 are six months.

6-3 PRECAUTIONS FOR CHECK AND ADJUSTMENT

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

- a. In each check and adjustment items, the description for the control knob manipulation presupposes the setting completed for item 6-6 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.
- b. 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).
- c. The low-voltage power is supplied to all circuits. If its voltage or ripple goes outside the specified values, then other performance will be affected. In check and adjustment, therefore, check the low-voltage power supply first.
- d. The CRT has a high-voltage. For its check and adjustment, be careful not to catch an electric shock.
- e. The adjuster has the circuit numbers. To make the circuit clear, the number in the boxes of the circuit diagrams are described before the circuit number.

6-4 EQUIPMENT REQUIRED

The check and adjustment requires the equipment and accessories as described in table 6-4-1. The equipment must have the performance equal to or greater than those described in the table. The signal input connector of SS-5710 is BNC. If the terminator or signal output terminal is other than BNC, prepare a converter connector.

Table 6-4-1	List of	equipment	required
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Equipment	Minimum Specifications	Purpose	Recommended Model
Scope calibrator • Standard-amplitude signal level • Time-mark generator • Sine wave generator • Square wave generator	: 6mV to 60V ±0.5% or less : 20nsec to 2 sec ±0.05% or less : 1kHz ± 20% Frequency range : 50Hz to 200kHz Rise time	Vertical, triggering and horizontal checks and adjustments	lwatsu SC-340 TEKTRONIX PG506 Calibration Generator TG501 Time-Mark Generator (TM500-series power module mainframe is needed)
• Fast rise signal generator	: 5nsec or less Repetition : 50Hz to 200kHz Rise time : 0.35nsec or less		
Standard signal generator	Frequency : 50kHz to 60MHz Output level : 60mV or more	Bandwidth and phase dif- ference checks and adjustments	HP 8654A/B TEKTRONIX SG503 Leveled Sine-Wave Generator
Digital volt-meter	Range : DC to 200VDC ± 0.05% + 1 dgt	Power supply checks and adjustments	lwatsu SC-7401 HP 3465A/B
High-voltage probe (For digital volt-meter	Range : DC to 15kVDC ± 3% + 1 dgt	High-voltage power supply check and adjustment	lwatsu High-voltage probe HP 34111A
Test Oscilloscope and x1 probe (x1 probe is optional accessory)	Bandwidth : DC to 1MHz Minimum defection factor: 1mV/div	Power supply ripple check and general troubleshooting	a. Iwatsu SS-5212 TEKTRONIX 213 Oscilloscope b. Iwatsu SS-0001/0002 TEKTRONIX P6101 Probe (x1)

Equipment	Minimum Specifications	Purpose	Recommended Model
Frequency counter	Range: 10Hz to 1.5MHz Resolution: 1Hz	Repetition rate of calibra- tor check	lwatsu SC-7101 HP 5300/5301A
Voltage regulator		AC line voltage range check	
Termination (2 required)	Impedance: 50 Ω	Signal termination	lwatsu BB-50M1
x10 Attenuator	Ratio: x10 Impedance: 50 Ω	Vertical compensation and triggering check	lwatsu AA-20B
x2 Attnuator	Ratio: x2 Impedance: 50 Ω	Vertical compensation and triggering check	Iwatsu AA-06B
Divider		Signal interconnection	lwatsu B-50D3
Cable (2 required)	Impedance: 50 Ω Length: 120mm	Signal interconnection	lwatsu BB-120C
Supplied x 10 probe		Signal interconnection	lwatsu SS-0011
Screwdriver		Adjust variable resistors and capacitors	lwatsu Probe accessory

Table 6-4-1 List of equipment required (cont.)

The check and adjustment items are shown in Table 6-5-1.

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 6-5-1 Items and interactions

Order	Order Checks and adjustments items		Page	Checks and adjustments affected
	Power s			
1	6-7-1	Power supply DC leve I (voltage range)	6-6	All items
2	6-7-2	Power supply DC level II (ripple voltage)	6-7	
- 3	6-7-3	AC line voltage range	6-8	
4	6-7-4	High-voltage power supply	6-9	All items
5	6-7-5	Intensity	6-10	6-7-6
6	6-7-6	Focus	6-11	
7	6-7-7	Pattern distortion	6-12	6-9-1, 6-9-2, 6-11-1, 6-11-3, 6-11-8
	Calibra	tor output		
8	6-8-1	Output voltage	6-14	
9	6-8-2	Repetition rate	6-15	
	Vertica	I deflection system		
10	6-9-1	x5 balance	6-16	6-9-2, 6-9-4, 6-9-8 to 6-9-11, 6-10-1, 6-10-2, 6-12-1
11	6-9-2	VARIABLE balance	6-16	6-9-1, 6-9-3, 6-9-4, 6-9-8 to 6-9-11, 6-10-1, 6-10-2,
40			0.17	
12	6-9-3	Deflection factor I (CH I · CH2)	6-17	6-9-1, 6-9-2, 6-9-4, 6-9-8 to 6-9-20, 6-10-1, 6-10-2, 6-12-1
13	6-9-4	CH2 polarity balance and position center	6-19	6-9-1 to 6-9-3, 6-9-6, 6-9-8 to 6-9-11, 6-10-1, 6-10-2, 6-12-1
14	6-9-5	Attenuator compensation I (CH1 · CH2)	6-20	
15	6-9-6	Deflection factor II (CH3 · CH4)	6-22	
16	6-9-7	Attenuator compensation II (CH3 • CH4)	6-23	
17	6-9-8	Square wave response I (Sag)	6-24	
18	6-9-9	Square wave response II (Overshoot and others)	6-26	6-9-10
19	6-9-10	Bandwidth	6-28	
20	6-9-11	Linearity	6-29	

Table 6-5-1 Items and interactions (cont.)

Order	Checks and adjustments items	Page	Checks and adjustments affected
	Trigger system		
21	6-10-1 A triggering	6-30	
22	6-10-2 B triggering	6-31	
	Horizontal deflection system		
23	6-11-1 Sweep rate	6-32	6-11-2 to 6-11-7, 6-12-1, 6-12-2
24	6-11-2 Magnification center	6-34	6-11-5, 6-12-1
25	6-11-3 Magnified sweep rate	6-35	6-12-1
26	6-11-4 Sweep trace length	6-36	
27	6-11-5 B sweep start	6-37	
28	6-11-6 Start and stop of delay	6-38	
29	6-11-7 Jitter	6-40	
	X-Y operation		
30	6-12-1 Deflection factor and intensity lev	vel 6-42	
31	6-12-2 Phase difference	6-43	

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6-6 PREPARATION

Before making check and adjustment, prepare the following:

- a. Set the ambient temperature at $23^{\circ}C \pm 5^{\circ}C$.
- b. Before turning the power on, set the switches and control knobs as shown in the table at the left.

6-7 POWER SUPPLY AND CRT CHECK AND ADJUSTMENT

6-7-1 Power Supply DC Level I (Voltage Range)

İtem		Descriptio
Rating		
	DC power voltage	Output voltage range
	- 10V	Within ±0.05V
	+ 10V	Within ±0.15V
	+ 47V	Within ±0.94V
	+ 100V	Within ±4 V
	+ 5V	Within ±0.25V
Check and Adjustment	Measure the voltage acro the values is within the -10V ADJ (see figure 6- Note: The design is such range	oss the measurement posit rated values. If the voltage 7-2). Check voltages at oth n that by adjusting -10V, o
Related Items	All items	

Precaution

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

Switches and controles	Setting
POWER	OFF
INTEN	Slightly right of the midrange
FOCUS	Midrange
SCALE	Full clockwise turn
VERTICAL MODE	CH1
POSITION (PULL ×5 MAG)	Midrange (Push)
(CH1 • 2)	
VOLTS/DIV (CH1 • 2)	5 mV
VARIABLE (CH1 • 2)	CAL
AC-DC (CH1 •2)	DC
GND (CH1 • 2)	OUT
CH2 POLAR	NORM
POSITION (CH3 • 4)	Midrange
POSITION	Midrange
FINE (PULL x10 MAG)	Midrange (Push)
COUPLING (A · B)	AC
SOURCE (A • B)	CH1
HOLDOFF	NORM
HORIZONTAL MODE	AUTO
LEVEL SLOPE (PULL)	Midrange (Push)
(A • B triggering)	
A TIME/DIV	1 mS
A VARIABLE	CAL
HORIZ DISPLAY	A
DELAY TIME MULT	Full counter-clock-
	wise turn

- c. Set the voltage switch on the rear panel to meet the line voltage. Connect the power cord to the plug socket of the line. If the line voltage is outside the operating range of SS-5710, set the voltage within the range using a voltage regulator.
- d. Turn POWER switch on to supply power, adjust INTEN to provide the proper intensity and trace, and keep the condition for about 30 minutes to warm up the machine.

SS-5710

on		
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tion (see figure 6-7-2) and the ground and check that is outside the rated value, adjust "-10V" with 13R41 ner locations again.

other voltages can be set within the specification

Item			Description
Rating			
		Ripple voltage	
	- 100	0.5 mVp-p or less	
	+ 10V		
	+ 47V	1 mVp-p or less	
	+ 100V	2 mVp-p or less	
	+ 5V	20 mVp-p or less	
Setting	Stop the sweep by s	setting HORIZ mod	e to SINGLE.
Check	Connect a x 1 probe	e to the oscilloscope	and check the ripple voltage or each power supply.
Related items	All items		

6-7-2 Power Supply DC Level II (Ripple voltage)

ltem	Description				
Rating	The CRT waveform must be sufficienty	Table			
	stable within the voltage range shown in the right.	Set position	Center voltage	Voltage range	Fuse used
		A	100V	90 to 110V	1. 0
		В	115V	103 to 128V	A SIOW-DIOW TUSE
		С	220∨	195to 242V	0.5A slow-blow fuse
		D	230/240∨	207 to 264∨	
Connection	SS-5710				}=
Setting	With A TIME/DIV being set to 10ms, swing the amplitude 6 div.				
Check	PRECAUTION In exchange of the power switching plug or replacing fuses, remove the power cord from the line plug socket. When exchanging the voltage plug, remove the rear panel. Using a voltage regulator, change the AC supply voltage continuously in the rated range, and check that ripple or intensity modulation does not appear on the CRT waveform.				cord from ange, and check that
CRT waveform	Normal waveform	Abn	ormal wavef	orm	

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6-7-4 High-Voltage Power Supply

ltem	Description								
Rating Check and Adjustment	The voltage between the CRT cathode and ground must be within -2.45kV \pm 5%.								
	PRECAUTION If the error of the CRT cathode voltage is within ±5%, do not make adjustment, except when all items are adjusted.								
	Using a digital multimeter (with a high-voltage probe), measure the voltage between the CRT cathode and the ground (see figure 6-7-1), and check that the voltage is within $-2.45 \text{ kV} \pm 5\%$. If the result is outside the rated value, adjust the voltage with 14R07 HV ADJ (see figure 6-7-2).								
Related items	All items								

Figure 6-7-1. Testpoint Location (CATHODE of CRT) -



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6-7-5 Intensity

ltem	Description								
Rating	With INTEN being so clockwise turn, the t	et midrange, the prop race must disappear.	per intensity trace	must appear; with the INTEN full counter-					
Setting		5710		-					
	HORIZ DISPLAY	INTENT position	Trace or spot						
		Midrange	Proper trace	-					
	A	Full counter-clock- wise turn	Trace disappears	-					
	X-Y	Full clockwise turn	Trace appears	-					
Check and adjustment	If the check result s	hows an improper ir	ntensity, adjust it v	vith 14R17 INTEN ADJ (see figure 6-7-2).					
Related items	6-7-6								

6-7-6 Focus

ltem	Description							
Rating Connection Setting	Good convergence in both ranges of 60° from the midrange of the FOCUS control.							
	SS-5710 Sine wave generator (SC-340) UTPUT ULL IkHz Coaxial cable							
	Swing the amplitude by 6 div.							
Check and adjustment	Check that the convergence is good on both ranges 60° from the midrange of FOCUS control. If the convergence is not good, adjust it with 14R21 ASTIG (see figure 6-7-2).							
Related items	6-7-5.							

6-7-7 Pattern Distortion

ltem	Description The vertical and horizontal deflection of trace are within the range shown in the figure at the right.							
Rating								
						8 div × 10 div	7.90 div	
						9.88 div		
Connection	SS-5710							
			CH	PUT	Stand	OUTPUT 10MHz Coaxial cable		
Setting			\$\$.5710	Input	signal			
	Sequence	Channel	HORIZ DISPLAY	Waveform	Frequency	Amplitude on CRT screen		
	1	CH2	А	-	-	8 div or more		
	2		X-Y	Sine	1kHz	10 div or more		
Check and adjustment	 Check the horizontal deflection of trace on the top and bottom of scale. Check the vertical deflection of trace on the right and left ends of scale. If the check result shows a great distortion, adjust it with 14R20 GEOMETRY (see figure 6-7-2). 							
Related items	6-9-1, 6-9-2	2, 6-11-1, 6-	11-3, 6-12-1					

6-7-7 Pattern Distortion (Cont.)

ltem	Description
CRT	
waveform	

Figure 6-7-2. Adjustment and Testpoint Locations (POWER SUPPLY and CRT)





Section 6 Check and Adjustment

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6-8 CALIBRATOR OUTPUT

6-8-1 Output Voltage



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SS-5710

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6-8-2 Repetition Rate



Figure 6-8-1. Adjustment locations (CALIBRATOR OUT)



6-9 VERTICAL DEFLECTION SYSTEM CHECK AND ADJUSTMENT

6-9-1 x 5 Balance

ltem	Description							
Setting Check and adjustment	Set GNDs of CH1 • CH2 to IN (push).							
	Turn pull x5 MAG by push-pull and check that the trace does not move. If CH1 moves, adjust is with 2R01 CH1 BAL ADJ; if CH2 moves, adjust it with 3R01 CH2 BAL (see figure 6-9-2).							
Related items	6-9-2, 6-9-4, 6-9-8, 6-9-10, 6-9-11, 6-10-1, 6-10-2, 6-12-1							

6-9-2 Variable Balance

ltem	Description						
Setting	Set GNDs of CH1 • CH2 to IN (Push).						
Check and adjustment	Change VARIABLE and check that the trace does not move. If CH1 moves, adjust it with 2R22 CH1 VAR BAL (see figure 6-9-2); if CH2 moves, adjust it with 3R22 CH2 VAR BAL (see figure 6-9-2).						
Related items	6-9-1, 6-9-3, 6-9-4, 6-9-8, 6-9-10, 6-9-11, 6-10-1, 6-10-2, 6-12-1						

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6-9-3 Deflection Factor I (CH1 · CH2)

	Description						
Rating	At x 1: ± At x 5: ±	2% 4%					
Connection		SS-5	710	Standard-amplitude signal (SC-340)			amplitude signal
			CH1 INPUT	CH2 II	NPUT	OU Coax	TPUT ial cable
Setting	Sequence	SS-5710		Input signal	Amplitude op	Calibrator	
		Channel	VOLTS/DIV	Voltage	CRT screen	Cricuit No.	Name
	1	CH1				2R30	CH1 GAIN
		CH2	- 5mV	30 m V	6 div ± 2%	3R30	CH2 GAIN
	2	CH1			6 div ±4%	2R06	CH1 × 5 GAIN
		CH2	- 5 m V*	6 m V		3R06	CH2 × 5 GAIN
			10 m V*	12 mV			
			10 m V	60 m V			
			20 m V	120 mV			
			50 m V	0.3 V			
			0.1 V	0.6 V		-	
	3	сн1 • сн2	0.2 V	1.2 V	6 dìv ± 2%	_	-
			0.5 V	3 V			
			1 V	6 V			
			2 V	12 V			
			5 V	30 V			
			10.1	60 V			

ltem	Description								
Check and adjustment Related items	 Check that the amplitude of CRT waveform is within ± 2%. If the check result shows that CH1 has a great error, adjust 2R30 CH1 GAIN (see figure 6-9-2); if CH2 has a great error, adjust 3R30 CH2 GAIN (see figure 6-9-2). Set VOLTS/DIV to 1mV (pull "× 5MAG" and input voltage to 6mV, and check that the amplitude of CRT waveform is within 6 div ± 4%. If the check result shows that CH1 has a great error, adjust 2R06 CH1 x 5 GAIN (see figure 6-9- 2); if CH2 has a great error, adjust 3R06 CH2 x 5 GAIN (see figure 6-9-2). Then check the amplitude by switching VOLTS/DIV and input voltage. 								
	PRECAUTION Item 6-9-1, 6-9-2, and 6-9-3 affect one another, so repeat the adjustment for these items. By adjusting items 1 and 2, the 2mV, 10mV, and succeeding ranges can be set within the rated values.								
	6-9-1, 6-9-2, 6-9-4, 6-9-8 to 6-9-11, 6-10-1, 6-10-2, 6-12-1								

6-9-4 CH2 Polarity Balance and Position Center

ltem	Description						
Setting	Set CH1 · CH2 GNDs to IN (push).						
Check and adjustment	Switch CH2 POLAR to INV • NORM and check that the trace motion is within ± 2 div. If the check result shows a great movement, adjust it with 3R71 CH2 POL BAL (see figure 6-9-2). Then, set CH2 POSITION to the midrange. If the trace is not positioned on the horizontal center line, adjust it with 5R46 POS CENT (see figure 6-9-2).						
Related items	6-9-1 to 6-9-3, 6-9-6, 6-9-8 to 6-9-11, 6-10-1, 6-10-2, 6-12-1						

.

6-9-5 Attenuator Compensation I (CH1·CH2)

ltem			De	scription					
Rating	Through Probe	Within ± 2% Within ± 3%							
Connection	SS	-5710		Square wave generator (SC-340) CH2 INPUT OUTPUT OUTPUT OUTPUT 0.3V ML 1kHz 10:1 prot					
Setting				Input signal	······	Amplitude on			
	Sequence	Channel	Voltage	Waveform	Frequency	CRT screen			
	1		0.3V			6 div			
	2	CH1+CH2	Set to VOLTS/DIV	Square wave	1 KHZ	Amplitude easy to observe			
Check and adjustment	 Check the flatness of the square wave. If the flatness is improper, adjust the phase of "x 10 probe" with the variable capacitor. Switch the VOLTS/DIV and input voltage, and check and adjust the phase of the attenuator with respective variable capacitors (see figure 6-9-1). Note: The design is such that the above adjustment sets other ranges in the rated values. 								
Related items	6-9-8, 6-9-9,	, 6-9-10, 6-9-11							



6-9-5 Attenuator Compensation I (Cont.)

Figure 6-9-1. Adjustment location (Attenuator compensation)



6-9-6 Deflection Factor II (CH3 · CH4)

ltem			1	Description	<u> </u>			
Rating	± 4%							
Connection	SS-5710 CH4 INPUT CH3 INPUT Standard-amplitude signal (SC-340) OUTPUT 0.6V W 1kHz							
Setting					Amplitude op	Calibrator		
	Channel	Channel VERT MODE		Voltage	CRT screen	Circuit No.	Name	
		ALT and QUAD IN (push)	0.1V	0.6V	6 div ±4%	4R17	CH3 GAIN	
	СНЗ		1 V	6 V		_	_	
			0.1V	0.6V		4R47	CH4 GAIN	
			1 V	6 V	1	_	_	
Check and adjustment	Check 1 If the c adjust 4R4	that the amplitud heck result show 7 CH4 GAIN (so	de of CRT way is that CH3 ha se figure 6-9-2	veform is within as a great error, a ?).	6 div ± 4%. djust 4R17 CH3 (GAIN; if CH4 h	as a great error,	

6-9-7 Attenuator Compensation II (CH3 · CH4)

İtem	Description									
Rating	± 3% or le	55								
Connection	SS-5710 CH4 INPUT CH3 INPUT								OUTPUT	ator 10:1 probe
Setting		1	Input signal			Calibrator				
	Sequence	Channel	VOLTS/	VERT MODE	Voltage	Waveform	Frequency	Amplitude on CRT screen	Circuit No.	Remarks
	1		0.1V		6V	Square				Adjust ''x 10 probe''
		СНЗ	11/		601/		1kHz	6 div	4C02	Probe
			10	and	000				4C03	Through
	3		0.1V	IN (push)	6V	wave			-	Adjust "x 10 probe"
	4	CH4	11/	(push)	60V				4C16	Probe
									4C17	Through
Check and adjustment	 Check the flatness of CH3. If the flatness is improper, adjust the phase of "x 10 probe" with the variable capacitor. Check the attenuator phase. If improper, make adjustment with 4C03 and 4C02 (figure 6-9-2). Check and adjust CH4 using the step 1. Check in the same way as step 2; if improper, make adjustment with 4C17 and 4C16 (see figure 6-9-2). 								tor. gure 6-9-2). 6 (see figure 6-9-2).	
Related items	See item 6	-9-5.								
CRT waveform	See 6-9-5.	(Page 6-2	21)							

6-9-8 Square Wave Response I (Sag)

ltem				Descri	ption				
Rating	CH1 • CH2 CH3 • CH4	CH1・CH2 (5mV/DIV): 1.5% CH3・CH4 (0.1V/DIV): 2%							
Connection	SS-5710 CH4 INPUT CH3 INPUT 50 Ω termination CH2 INPUT CH1 INPUT CH1 INPUT CH1 INPUT CH2 I								
Setting		SS-5710		Input signa	1	Amplitude on			
	Sequence	Channel	Voltage Waveform		Frequency	CRT screen			
	1	CH1 • CH2	30mV	Square	60Hz 1kHz				
	2	CH3 • CH4	600mV	wave	and 250kHz	6 div			
Check Related items	1. Set the w 2. Check th 6-9-9 to 6-9	vaveform at t e CH3 and C 9-11	he center o H4 in the s	f the screen ame way.	and check sag	s of CH1 and CH2.			
CRT waveform	60Hz				1kHz				

6-9-8 Square Wave Response I (Cont.)

ltem	Description								
CRT waveform	250kHz								
Reference		 A: Basic amplitude: sag = a/A (or a'/A') x 100% a: Sag: Take the greater value of a/A and a'/A' (by MEA-27, Japanese Electric Machinery Industry Association) 							

6-9-9 Square Wave Response II (Overshoot and Others)

ltem				Descri	ption				
Rating	CH1·CH2 (5mV/DIV): 5% CH3·CH4 (0.1V/DIV): 10%								
Connection		SS-5710	CH4 IN 50 Ω termination	Fast rise signal generator (SC-340)					
		SS-5710 Channel CH1 • CH2 CH3 • CH4	Inpu Voltage 30mV 600mV	It signal Frequency 100kHz	Amplitude on CRT screen 6 div	Calibrator Circuit No. 5R54, 5R82, 5C14 5C21, 3C10			
Check and adjustment	1. Adjust distorsio If the 5R54, 5 After 2. Check C The a	the output v on. check resul R82, 5C14, a adjusting CH CH3 and CH4 use of these of CH4). After a	voltage so It does not and 5C21 (I1, check C calibrators i adjustment	that the CR t satisfy the see figure 6-S CH2. If the ra PRE is shared by C , check the b	Γ amplitude sw rating, adjust ()-2). ting is not satisf ECAUTION CH1, CH2, CH3 andwidth descri	ings 6 div and check overshoot and o CH1 overshoot and other distortions fied, adjust it with 3C10 (figure 6-9-2) , and CH4 (3C10 is for CH2, CH3 bed in the following item,	other with).		
Related items	6-9-10, 6-9	-11				3	J 		



6-9-9 Square Wave Response II (Cont.)

6-9-10 Bandwidth

ltem				Descriptio	n		
Rating	CH1 · CH2	5mV/div to 0 1mV/div to 2 0 1V/div to 1	0.2V/div DC t mV/div DC t	o 60MHz ~3 o 20MHz -3 o 50MHz -3	dB dB dB		
Connection		SS-5710	CH4 INPUT	CH3 INPUT	c	Non-double investor	
		CH	50 Ω termination	CH2 IN	PUT		
					50 Ω Coa	kial cable	
Setting				1			
	Sequence	Channel	VOLTS/DIV	Voltage	Unput signal Waveform	Frequency	Amplitude on CRT screen
	1					50kHz	6 div
	2		5mV	30m V		60MHz	4.25 div or more
	1	CH1 · CH2		<u> </u>	1	50kHz	6 div
	2	1	1mV	6mV	sine	20MHz	4.25 div or more
	1		<u> </u>		1	50kHz	6 div
	2	CH3 · CH4	0.1V	0.6V		50MHz	4.25 div or more
Check	1. Set the 6 div. 2. Then, ch If the ba	reference free ange the freq indwidth is o	quency to 50k uency correspo utside the rated	Hz and adju Inding to eac d values, rea	ust the signal of the signal o	generator so th read the amplifiss of "Square W	4.25 div or more hat the amplitude ude.

6-9-11 Linearity

Figure 6-9-1. Location of calibrators (Vertical deflection system)

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SS-5710

Section 6 Check and Adjustment

6-10 TIRGGER SYSTEM CHECK AND ADJUSTMENT

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6-10-1 A Triggering

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Item	Description											
Connection		:	SS-5710 Sine wave generator (SC-340) CH1 INPUT CH2 i20mV or 5mV M 1kHz									
Setting							Amplia Calib		librator			
	Sequence Item	VERT MODE	A	A COUPLING	Voltage	Wave- form	Fre- quency	tude on CRT screen	Circuit No.	Name		
1	1	CH1 trigger	H1 gger CH1 CH1 DC 20 FIX 5		 		4 div	7R26	A TRIG 0 ADJ			
	2			СН1	DC	20mV	Sine	1kHz		2R54	CH1 TRIG ADJ	
	3				FIX	5mV			1 div	7R28	FIX	
	4	CH2	0110	CH2	AC	20				1 div	3R54	CH2 TRIG ADJ
	5	trigger	CH2	NORM	DC	20m V			4 div	5R26	NORM TRIG ADJ	
Check and adjustment	1. Set th horizo If th Also c 2. Switch If the 3. Switch to 1 c change	e LEVE ntal cent he check heck at S n A swee check re n A swee liv. If no	L of A S ter line of C result sh SLOPE pu p COUPL sult shows p COUPL ot triggere	Sweep at the scale. ows a great ish-pull that ING to DC is a great sep ING to FI ed, adjust i EL of A sw	ne center and t separation, i t ''+'' and ''-' and check th baration, adju X and check t with 7R28 weep.	d check th adjust it w 'are switc nat the trig st it with that the tr FIX. At t	nat the s ith 7R26 hed sym ger occu 2R54 CH igger occ this time	weep star S A TRIG metrically rs at the s 11 TRIG , curs when , check th	rt point i 0 ADJ (7. same leve ADJ (see the scree hat the t	s locate see figur l for AC figure (en ampl rigger p	ed near the re 6-10-1). C of step 1. S-10-1). itude is set oint is not	

SS-5710

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SS-5710

6-10-1 A Triggering (Cont.)

ltem	Description						
Check and adjustment	 4. Check CH2 using the step 1. If the check result shows a great separation, adjust it with 3R54 CH2 TRIG ADJ (see figure 6-10-1). 5. Set A sweep SQURCE to NORM and switch A sweep CQUPLING to AC, then check that the trigger 						
	occurs at the same AC level of step 4. If the check result shows a great separation, adjust it with 5R26 NORM TRIG ADJ (see figure 6-10-1).						

6-10-2 B triggering



Figure 6-10-1. Location of calibrators (Trigger system)





Section 6 Check and Adjustment

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6-11 HORIZONTAL DEFLECTION SYSTEM CHECK AND ADJUSTMENT

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6-11-1 Sweep Rate

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	Description								
Rating	A sweep								
	I. At sci	reen center	8 div: 50 nS	S/div to 5 mS/div	v ± 3%				
	10 mS/div to 0.5 S/div ± 4%								
	II. At any 2 div within 8 div from the screen center: ± 5%								
	B sweep								
	I. At sci	reen center a	div:		± 3%				
	II. At an	y 2 div with	in 8 div from	m the screen cen	iter: ± 5%				
Connection		SS-571	0		Time (SC-	e-mark gener 340)	ator		
					MMM	3			
Setting			s	SS-5710	Input signal	Calib	rator		
Setting	Sequence	Item	HORIZ DISPLAY	SS-5710 TIME/DIV	NNMM Input signal Repetition	Calib	rator Name		
Setting	Sequence	Item	S HORIZ DISPLAY	SS-5710 TIME/DIV 1 mS	Input signal Repetition 1 mS	Calib Circuit No.	rator Name NORM		
Setting	Sequence	I tem A sweep	HORIZ DISPLAY A	SS-5710 TIME/DIV 1 mS 10 μS to 0.5 S	Input signal Repetition 1 mS	Calib Circuit No. 11R25	rator Name NORM GAIN		
Setting	Sequence	Item A sweep	S HORIZ DISPLAY A	SS-5710 TIME/DIV 1 mS 10 μS to 0.5 S 50 nS to 5 μS	MMM Input signal Repetition 1 mS Set TIME/DIV	Calib Circuit No. 11R25 8C51	rator Name NORM GAIN		
Setting	Sequence 1 2 3 4	Item A sweep	S HORIZ DISPLAY A	SS-5710 TIME/DIV 1 mS 10 μS to 0.5 S 50 nS to 5 μS 1 mS	MMM Input signal Repetition 1 mS Set TIME/DIV 1 mS	Calib Circuit No. 11R25 8C51	rator Name NORM GAIN – B SWEEP		
Setting	Sequence	Item A sweep	S HORIZ DISPLAY A	S-5710 TIME/DIV 1 mS 10 μS to 0.5 S 50 nS to 5 μS 1 mS 10 nS to 50 mS	MMM Input signal Repetition 1 mS Set TIME/DIV 1 mS	Calib Circuit No. 11R25 8C51 10R19	Name NORM GAIN 		

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6-11-1 Sweep Rate (Cont.)

ltem	Description									
Check and adjustment	 Set the start pulse on the line 1 div to the right of the scale left end, then check errors of I and II. Switch REPETITION to A TIME/DIV and check the error of I and II between 10 μS to 0.5 S. If the sweep time error is great in the same direction, adjust with 11R25 NORM GAIN (see figure 6-11-1). Switch REPETITION to TIME/DIV and check the error of I and II between 50nS to 5 μS. If the error is great, adjust with 8C51 (see figure 6-11-1). Set HORIZ DISPLAY to B (DLY'D) and check in the same way as step 1. Switch REPETITION to B TIME/DIV and check errors of I and II between 10 μS to 50 mS. If the sweep time error is great in the same direction, adjust with 10R19 B SWEEP CAL (see figure 6-11-1). Switch REPETITION to B TIME/DIV and check errors of I and II between 50 nS to 5μS. If the sweep time error is great in the same direction, adjust with 10R19 B SWEEP CAL (see figure 6-11-1). Switch REPETITION to B TIME/DIV and check errors of I and II between 50 nS to 5μS. If the error is great between 50 nS/div and 5 μS/div, adjust with 9C51 (see figure 6-11-1). 									
Related items	6-11-2 to 6-11-7, 6-12-1, 6-12-2									
CRT waveforms	Sweep time error I	Sweep time error II								
	$sweep time error ratio = \frac{a-b}{a} \times 100 (\%)$ Sweep time error ratio = where a: effective horizontal surface total scale length (8 div) b: measured value of time marker corresponding to "a".	$sweep time error ratio = \frac{a-b}{a} \times 100 (\%)$ Sweep time error ratio = where a: any 2 div in effective horizontal surface b: measured value of time marker corresponding to "a".								

6-11-2 Magnification Center

ltem	Descript	ion
Connection	CAL 0.3V	
Setting	Swing CRT amplitude by 6 div.	
Check and adjustment	With the horizontal POSITION, set the sweep center line of scale, pull FINE (PULL x 10 MAG) If the motion width is great, adjust it with 11F	start point (rise of CAL waveform) to the vartical , and check the motion of the sweep start point. 21 MAG CENTER (see figure 6-11-1).
Related items	6-11-5, 6-12-1.	
CRT waveform		x 10 MAG

6-11-3 Magnified Sweep Rate

ltem	Description								
Rating	I. At the sc	reen center	8 div:	50 0.2	50 nS/div to 0.1 μ S/div ± 5% 0.2 μ S/div to 0.5 S/div ± 4%				
	II. At any 2	div within	8 div from the screer	n center: 50	nS/div to 0.1 μ S/div	±10%			
				0.2	μS/div to 0.5 S/div	± 6%			
				Rer in I	nove, however, 25 nS • II.	S before and at	ter the sweep		
Connection		SS-571	0		Time-mark gener (SC-340)	rator			
			CH1 INP	UT M	OUTPUT				
Setting	SC 6710					Calib	rator		
	Sequence				Benetition	Circuit No	Name		
				1 mS	1 mS				
	1	A		20 µS to 0.5	s l	- 11R24	MAG GAIN		
		A sweep		50 nS	Set to TIME/DIV	11007 11010			
		B sweep	B (DLY'D)	50 nS to 50 n	nS	_	_		
					·	L	·		
Check and adjustment	1. Pull FINE If the ch 11R24 M 2. If the erro 3. Check B s	 Pull FINE (PULL x 10 MAG) to take trigger and check errors from the rated values for I and II. If the check result shows that the errors in each range are great in the same direction, adjust it with 11R24 MAG GAIN (see figure 6-11-1). If the error is great in 50 S range, adjust it with 11C07 and 11C10 (see figure 6-11-1). Check B sweep in the same way. 							
Related items	6-12-1								
CRT waveform	See 6-11-1 (I	Page 6-33).							

6-11-4 Sweep Trace Length

ltem			Desci	ription			
Rating	11.5 to 14 c	łiv					
Connection		SS-5710		Time-mark generator (SC-340)			
					OUTP 1mS	UT	
Setting		SS-57	10		ional		
	ltem	HORIZ DISPLAY	A TIME/DIV	Repetition rate	Wave form		
	A sweep	A	1 mS				
	B sweep	B (DLY'D)	1 mS	1 1 mS	Pulse		
Check and adjustment	Check that If the error	a trace contains 11. is great in A sweep,	5 to 14 pulses. , adjust 8R04 A	SWEEP LENG	TH (see figure	e 6-11-1).	
	If the error	is great in B sweep,	adjust 9R03 B	SWEEP LENG	TH (see figure	: 6-11-1).	

6-11-5 B Sweep Start

ltem	Description					
Setting		ALT				
	B TIME/DIV B sweep source	U.5 mS RUNS AFTER DELAY				
Check and adjustment	Turn TRACE SEF at this time, both sta vertical line of the sca If the check result	PARATION and move B sweep trace to a little above A INTEN sweep trace. Check rt points of A INTEN sweep trace and B sweep trace are at the same position on the ale. shows a separation, adjust it with 9R15 B SWEEP START (see figure 6-11-1).				

Item	Description										
Rating	At 0.5 μS/div to 5 S/div										
Connection		Time-mark generator (SC-340)									
					лт MM	M					
Setting and		SS-5710			Input signal		Calibrator		_		
calibrator	Sequence	HORIZ DISPLAY	B TIME /DIV	B sweep source	Waveform	Repetition rate	Circuit No.	Name	-		
	1		5 S	RUNS AFTER DELAY	PULSE	0.2 mS	9R26	DELAY START	-		
	2	AINTEN				1 mS	9R23	DELAY STOP	-		
Check and adjustment	1. Turn DE sweep is I 2. Set repet B sweep i If the 1); step 2	 Turn DELAY TIME MULT dial counterclockwise and set the dial scale to 0.40, then check that B sweep is located at the third pulse from the sweep start. Set repetition rate to 1 mS, turn the dial clockwise and set the dial scale to 10.00, then check that B sweep is located at the 11th pulse. If the check result shows a great error, adjust step 1 with 9R26 DELAY START (see figure 6-11-1); step 2 with 9R23 DELAY STOP (see figure 6-11-1). 									



6-11-6 Start and Stop of Delay (Cont.)

6-11-7 Jitter

ltem	Description								
Rating	1/20,000 or less								
Connection		SS-5710)		Square wave generator (SC-340)				
					1ms				
Setting		SS-5710		input	t signal	· · · · · · · · · · · · · · · · · · ·			
	HORIZ DISPLAY	B TIME/ DIV	B TIME/ B sweep DIV source		Repetition rate	CRT amplitude			
	B (DLY'D)	0.5 µS	RUNS AFTER DELAY	Square wave	1 mS	2 div			
Check	Turn DELAY center, and ch	TIME MU leck that jit	LT dial slowly i ter is within 1 d	near 1.00 an	d 10.00 so tha	nt the pulse rise is	drawn on the screen		
CRT waveform		T = 1 c	T		A TIME/DIV B TIME/DIV DELAY TIM	΄ 1mS 0.5 μS E MULT dial scal	e near 10.00		

Figure 6-11-1. Location of calibrators (Horizontal deflection system)



Section 6 Check and Adjustment

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6-12 X-Y OPERATION

6-12-1 Deflection Factor and Intensity Level

	Description										
Rating	X-axis (sam Y-axis (sam	X-axis (same as CH2 VOLTS/DIV): ± 2% Y-axis (same as CH1 VOLTS/DIV): ± 5%									
Connection		SS-5	710		Square wave generator (SC-340)						
		CH1 (X) INPUT OUTPUT 30mV 1kHz									
Setting		SS-5710		Input signal		Amplitude	Calibrator				
	Sequence	Channel	HORIZ DISPLAY	AC-DC GND	Voltage	Waveform	Fre- quency	on CRT screen	Circuit No.	Name	
	1		A	DC				6 div	-	-	
	2	СН1	X-Y		30 m V	wave	1 kHz	6 div ± 5%	11R05	X-Y GAIN	
				GND				Spot	THUB	X-Y LEVEL	
										and the second sec	
Check and adjustment	1. Swing the 2. Switch H If the che 3. Set CH1 near the If the ch LEVEL (e CRT amp ORIZ DIS eck result s to GND a vertical cer eck result see figure f	Ditude by 6 PLAY to X- hows a grea nd check th nter line. shows that 6-12-1).	div and Y and cl t error, a nat the s the spo	set the s neck tha ndjust it pot (if s t is far f	weep start (t horizontal with 11R05 pot does no from the ve	point to I amplitu 5 X-Y G/ ot appea ertical ce	the left side ade is 6 div ± AIN (see figu ar, turn INTE nter line, ad	of scale. 5%. re 6-12-1) EN clockw just it wit	vise) is locate h 11R06 X-	



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6-12-2 Phase Difference



Figure 6-12-1. Location of calibrators (X-Y operation)

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Section 6 Check and Adjustment

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SS-5710

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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 "VOL-TAGE & WAVEFORM READING CONDITIONS" noted on the schematic diagram. Beside, the asterisks maked on the diagram show the point measured by the exceptional settings.
- 3. The waveforms starting from the negative slope are measured by setting the SLOPE switch of a test oscillo-scope to (-).
- 4. The switches and controls of this instrument is set as follows:

—Power supply & CRT circuit—		-Trigger system-	
POWER	ON	SOURCE	CH1
SCALE	Arbitrary position	COUPLING	AC
INTEN	Best desired	LEVEL-SLOPE (pull-)	Push, Trigger
FOCUS	Best focused display		

-Vertical deflection	n 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	Α
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

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0.2 mS



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* SS-5710/SS-5710C /SS-571	OD
CH-2 PRE-AMPLIFIER	3
BBWSS24022102	з









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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 ATTE-NUATOR, 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
Cer Ceramic
Poly Polyethytel film
Elect Aluminum electrolytic chemical
Elect. tan , .Tan-talum electrolytic chemical
condenser
[The symbol F (farad) is omitted]
ResResistor
W.W Wire wound
Comp Composition
[The symbol Ω (ohm) is omitted]
FET
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
VarVariable

		IWATSU PART NO		IT ENC
CH1 & CH	2 ATTENUATOR		1C40	Sa
			1C41	Sa
1C01	Cap., 0.047 μ, ±20%, 200∨, Poly.	DCF160291	1C42	Sa
1C02	Cap., 1000p, ±10%, 500∨, Cer.	DCC151811	1C61	Ca
1C03	Cap., 22 μ , ± 20%, 25V, Elect.	DCE229041	1C62	Sa
1C04	Cap., 2.5 ~22.5p, Var., 250V, Ce	r. DCV019592	1C63	Ca
1C05	Same as 1C04		1C64	Sa
1C06	Cap., 2 ~8p, Var., 250V, Cer.	DCV019612	1C98	Ca
1C07	Same as 1C04		1C99	Sar
1C08	Same as 1C04			
1C09	Cap., 2 ~12p, Var., 250V, Cer.	DCV019602	1R01	Re
1C10	Cap., 68p, ±5%, 50V, Cer.	DCC233601	1R02	Sa
1C11	Cap., 5p, ±0.25p, 500V, Cer.	DCC250901	1R03	Sai
1C12	Same as 1C04		1R05	Sa
1C13	Same as 1C06		1R06	Sa
1C14	Cap., 470p, ± 5%, 50∨, Cer.	DCC237481	1R07	Re
1C15	Cap., 1p, ±0.25p, 50V, Cer.	DCC230301	1R08	Re
1C16	Same as 1C04		1 R09	Re
1C17	Same as 1C06		1R10	Sa
1C18	Cap., 390p, ±5%, 50V, Cer.	DCC235101	1R11	Re
1C19	Cap., 2700p, ±5%, 50V, Cer.	DCC237491	1R12	Re
1C20	Same as 1C09		1R13	Re
1C21	Same as 1C01		1R14	Re
1C22	Same as 1CO2		1R15	Re
1C23	Same as 1CO3		1R16	Re
1C24	Cap., 2.5p,~22.5p, Var., 250V, C	er.	1R17	Re
		DCV019592	1R18	Re
1C25	Same as 1C24		1R19	Re
1C26	Same as 1C06		1R20	Re
1C27	Same as 1C24		1R21	Re
1C28	Same as 1C24		1R22	Re
1C29	Same as 1C09		1R23	Re
1C30	Same as 1C10		1R24	Re
1C31	Same as 1C11		1R25	Re
1C32	Same as 1C24		1R26	Re
1C33	Same as 1C06		1R27	Sa
1C34	Same as 1C14		1R28	Re
1C35	Same as 1C15		1R29	Re
1C36	Same as 1C24		1R30	Re
1C37	Same as 1C06		1R31	Sa
1C38	Same as 1C38		1R32	Sa
1C39	Same as 1C19		1833	Sa

CIRCUIT	DESCRIPTION	IWATSU PART NO.
1C40	Same as 1C09	
1C41	Same as 1C03	
1C42	Same as 1C03	
1C61	Cap., 100p, ±5%, 50V, Cer.	DCC239051
1C62	Same as 1C61	
1C63	Cap., 33p, ± 10%, 500∨, Cer.	DCC252801
1C64	Same as 1C63	
1C98	Cap., 0.01μ, ±10%, 50V, Cer.	DCC133571
1C99	Same as 1C98	
1R01	Res., 10, ± 5%, ¼W, Carbon	DRD134351
1R02	Same as 1R01	
1R03	Same as 1R01	
1R05	Same as 1R01	
1R06	Same as 1R01	
1R07	Res., 470,± 5%, ¼W, Carbon	DRD135471
1R08	Res., 220, ± 5%, ¼W, Carbon	DRD139321
1R09	Res., 100, ±1%, ¼W, Metal	DRE939561
1R10	Same as 1R09	
1R11	Res., 3.3k,± 5%, ¼W, Carbon	DRD139501
1R12	Res., 500k, ± 0.5%, ¼W, Metal	DRE139701
1R13	Res., 1M, ±0.5%, ¼W, Metal	DRE139741
1R14	Res., 750k, ±0.5%, ¼W, Metal	DRE139911
1R15	Res., 333k, ±0.5%, ¼W, Metal	DRE139881
1R16	Res., 900k, ± 0.5%, ¼W, Metal	DRE139721
1R17	Res., 111k, ±0.5%, ¼W, Metal	DRE233941
1R18	Res., 990k,± 0.5%, ¼W, Metal	DRE139731
1R19	Res., 10.1k, ±0.5%, ¼W, Metal	DRE233611
1R20	Res., 360, ±5%, ¼W, Carbon	DRD237721
1R21	Res., 18,± 5%, ¼W, Carbon	DRD237411
1R22	Res., 91, ±5%, ¼W, Carbon	DRD237821
1823	Res., 999k,±0.5%, ¼W, Metal	DRE139891
1R24	Res., 1.001k, ±0.5%, ¼W, Metal	DRE233241
1R25	Res., 160, ± 5%, ¼W, Carbon	DRD237641
1R26	Res., 5.6,± 5%, ¼W, Carbon	DRD237291
1827	Same as 1R13	
1828	Res., 91, ± 5%, ¼W, Carbon	DRD134581
1829	Res., 45, ±5%, ¼W, Carbon	DRD134501
1830	res., 13,± 5%, 4W, Carbon	DRD134381
1831		
1833	Same as 1R01	

CIRCUIT REFERE	NCE	DESCRIPTION	IWATSU PART NO.	CIRCUI REFER	T DESCRIPTION ENCE	IWATSU PART NO.
1R35	Same as 1R	01		1R58	Same as 1R28	
1R36	Same as 1R	01		1R59	Same as 1R29	
1R37	Same as 1R	07		1R60	Same as 1R30	
1R38	Same as 1 R	08		1R61	Res., 47, ± 5%, ¼W, Carbon	DRD139261
1R39	Same as 1 R	09		1R62	Same as 1R61	
1R40	Same as 1 R	109		1R67	Same as 1R30	
1R41	Same as 1 F	11				
1R42	Same as 1 R	12		1D01	Diode, 1S1544A	DDD010341
1R43	Same as 1 R	13		1D02	Same as 1D01	
1R44	Same as 1 R	14		1D03	Diode, 1S953	DDD010821
1R45	Same as 1 F	15		1D04	Same as 1D03	
1R46	Same as 1 R	16				
1R47	Same as 1 R	17		1001	Transistor, μ PA61M	DTR295281
1R48	Same as 1 R	18		1Q02	Transistor, 2SC1834	DTR131031
1R49	Same as 1 R	19		1003	Same as 1Q01	
1R50	Same as 1 R	20		1004	Same as 1Q02	
1R51	Same as 1 R	21				
1R52	Same as 1 R	22		1S01	Push switch, SUJ20A	DSW014851
1R53	Same as 1 R	23		1S02	Rotaly switch, PS22BH4-5-11	DSW034651
1R54	Same as 1F	324		1S03	Same as 1S01	
1R55	Same as 1 R	25		1S04	Same as 1SO2	
1R56	Same as 1R	26				
1R57	Same as 1 R	13		1J01	Connector, BNC080	DCN040711
				1J02	Same as 1J01	

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	T DESCRIPTION	IWATSU PART NO.	CIRCUI ⁻ REFERI	T DESCRIPTION ENCE	IWATSU PART NO.
CH1 PRI			2R09	Same as 2R08	
			2R10	Res., 3.3k, ±5%, ¼W, Carbon	DRD139471
2C01	Cap., 1000p, ±10%, 50V, Poly.	DCF129071	2R11	Same as 2R10	
2C02	Cap., 6p, ±0.5%, 50V, Cer.	DCC239091	2R12	Res., 330, ±5%, ¼W, Carbon	DRD139351
2C03	Cap., 390p, ±5%, 50V, Cer.	DCC235101	2R13	Same as 2R12	
2C04	Same as 2C01		2R14	Res., 1.2k, ± 5%, ¼W, Carbon	DRD139421
2C05	Same as 2C01		2R15	Same as 2R14	
2C06	Cap., 0.01 μ , +80% \sim $-20%$, 50V,	Cer.	2R16	Res., 22, ±5%, ¼W, Carbon	DRD139231
		DCC139501	2R17	Res., 1k, Var., 0.1W, Carbon	DRV147281
2C08	Same as 2C01		2R18	Same as 2R16	
2C09	Same as 2C01		2R19	Res., 47, ±1%, ¼W, Metal	DRE939511
2C10	Cap., 2 ~12p, Var., 250V, Cer.	DCV019602	2R20	Res., 4.7k, ±5%, ¼W, Carbon	DRD139151
2C11	Cap., 2.5~ 22.5p, Var., 250V, Ce	r.	2R21	Res., 470, ±5%, ¼W, Carbon	DRD139371
		DCV019592	2R22	Same as 2R20	
2C12	Same as 2C06		2R23	Res., 22, ±1%, ¼W, Metal	DRE130431
2C13	Cap., 0.01 μ , \pm 10%, 50V, Cer.	DCC133571	2R24	Same as 2R14	
2C15	Cap., 100p, ± 5%, 50V, Cer.	DCC239051	2R25	Same as 2R07	
2C16	Same as 2C06		2R26	Same as 2R21	
2C17	Same as 2C06		2R27	Same as 2R07	
2C18	Same as 2C06		2R28	Same as 2R14	
2C19	Same as 2C06		2R29	Same as 2R03	
2C22	Same as 2C06		2R30	Res., 470, Var., 0.5W, Cermet	DRV430561
2C23	Cap., 22 μ, +150%~ -10%, 25V,	Elect.	2R31	Res., 390, ±5%, ¼W, Carbon	DRD134731
		DCE225151	2R32	Same as 2R31	
2C24	Same as 2C06		2R33	Res., 220, ±5%, ¼W, Carbon	DRD139321
2C25	Cap., 22µ , ±20%, 25V, Elect.	DCE229041	2R34	Same as 2R33	
2C29	Same as 2C06		2R35	Same as 2R20	
2C98	Same as 2C01		2R36	Res., 2k, Var., 0.2W, Carbon	DRV146871
2C99	Same as 2C01		2R37	Same as 2R33	
2C99	Same as 2C01		2R38	Same as 2R20	
2C99A	Cap., 10p, ±0.5%, 50V, Cer.	DCC231701	2R39	Res., 4.7k, ± 5%, ¼W, Carbon	DRD139521
			2R40	Res., 1k, ± 5%, ¼W, Carbon	DRD139141
2L01	Coil, OP-03-03-1H	DCL320251	2R41	Same as 2R39	
			2R42	Res., 7.5k, ±5%, ¼W, Carbon	DRD139571
2R01	Res., 22k, Var., 0.5W, Cermet	DRV430701	2R43	Same as 2R10	
2R02	Res., 22k, ±1%, ¼W, Metal	DRE939061	2R44	Res., 47, ±5%, ¼W, Carbon	DRD139261
2R03	Res., 220, ±1%, ¼W, Metal	DRE939601	2R45	Same as 2R44	
2R04	Res., 3.9k, ±5%, ¼W, Carbon	DRD139501	2R46	Same as 2R40	
2R05	Res., 100, ±15%, Thermistor	DDD080201	2R47	Same as 2R33	
2R06	Res., 100, Var., 0.5W, Cermet	DRV430541	2R48	Same as 2R40	
2R07	Res., 150, ±1%, ¼W, Metal	DRE939581	2R49	Res., 33, ±1%, ¼W, Metal	DRE939491
2R08	Res., 100, ±5%, ¼W, Carbon	DRD139291	2R50	Same as 2R40	

CIRCUIT REFERE	DESCRIPTION	IWATSU PART NO.	CIRCU REFER	IT DESCRIPTION	IWATSU PART NO.
2R51	Same as 2R40		2001	Transistor, 2SC1834	DTR131031
2R52	Res., 1k, ±1%, ¼W, Metal	DRE939071	2002	Transistor, 2SC2037	DTR137591
2R53	Res., 2,4k, ± 5%, ¼W, Carbon	DRD139461	2003	Same as 2002	2
2R54	Res., 1k, Var., 0.5W, Cermet	DRV430571	2004	Transistor, 2SA1206	DTR115301
2R55	Same as 2R33		2005	Same as 2004	
2R56	Same as 2R53		2006	Same as 2002	
2R57	Res., 22, ± 5%, ¼W, Carbon	DRD237431	2007	Same as 2002	
2R61	Res., 10, ± 5%, ¼W, Carbon	DRD139211	2008	Same as 2Q01	
2R62	Same as 2R61		2009	Same as 2001	
2R63	Same as 2R61		2Q10	Same as 2004	
2R64	Same as 2R61		2011	Same as 2004	
2R65	Res., 7.5, ±1%, ¼W, Metal	DRE535701	2Q12	Same as 2Q02	
2R67	Res., 1k, ±5%, ¼W, Carbon	DRD139141	2013	Same as 2Q02	
2R98	Res., 33, ± 5%, ¼W, Carbon	DRD134471	2Q14	Transistor, 2SC1907	DTR137611
2R99	Same as 2R98		2015	Same as 2Q14	
2D01	LED., TLR206	DDD070181	2J01	Connector, M36-M87-02	DCN034601
2D02	Diode, 1S953	DDD010821	2J02	Same as 2J01	
			2J03	Connector, M36-M87-04	DCN034621
			2P01	Connector, M36-02-30-114P	DCN034851
			2P02	Same as 2P01	
			2P03	Connector, M36-04-30-114P	DCN034871

	DESCRIPTION	IWATSU PART NO.	CIRCUI REFER	T DESCRIPTION ENCE	IWATSU PART NO.
CH2 PRE			3R08	Res., 100, ±5%, ¼W, Carbon	DRD139291
			3R09	Same as 3R08	
3C01	Cap., 1000p. ±10%, 50V, Poly	DCF129071	3R10	Res., 2.4k, ± 5%, ¼W, Carbon	DRD139471
3C02	Cap., 6p. ±0.5p. 50V. Cer.	DCC239091	3R11	Same as 3R10	
3C03	Cap., 390p, ±5%, 50V, Cer.	DCC235101	3R12	Res., 330, ± 5%, ¼W, Carbon	DRD139351
3C04	Same as 3CO1		3R13	Same as 3R12	
3C05	Same as 3C01		3R14	Res., 1.2k, ± 5%, ¼W, Carbon	DRD139421
3C06	Cap., 0.01 μ , +80% \sim -20%, 50 \vee	, Cer.	3R15	Same as 3R14	
	·	DCC139501	3R16	Res., 22, ± 5%, ¼W, Carbon	DRD139231
3C08	Same as 3C01		3R17	Res., 1k, Var., 0.1W, Carbon	DRV147281
3C09	Same as 3C01		3R18	Same as 3R16	
3C10	Cap., 2 ~ 12p, Var., 250V, Cer.	DCV019602	3R19	Res., 47, ± 1%, ¼W, Metal	DRE939511
3C11	Cap., 2.5 ~22.5p, Var., 250V, C	er.	3R20	Res., 4.7k, ± 5%, ¼W, Carbon	DRD139151
		DCV019592	3R21	Res., 470, ± 5%, ¼W, Carbon	DRD139371
3C12	Same as 3C06		3R22	Same as 3R06	
3C13	Cap., 0.01μ , $\pm 10\%$, 50V, Cer.	DCC133571	3R23	Res., 22, ± 1%, ¼W, Metal	DRE939511
3C15	Cap., 100p, ± 5%, 50V, Cer.	DCC239051	3R24	Same as 3R14	
3C16	Same as 3C06		3R25	Same as 3R07	
3C17	Same as 3C06		3R26	Same as 3R21	
3C18	Same as 3C06		3R27	Same as 3R07	
3C19	Same as 3C06		3R28	Same as 3R14	
3C22	Same as 3C06		3R29	Same as 3R03	
3C23	Cap., 22 μ , \pm 20%, 25V, Elect.	DCE229041	3R30	Res., 470, Var., 0.5W, Cermet	DRV430561
3C24	Same as 3C06		3R31	Same as 3R12	
3C25	Cap., 22µ, 150% ∼−10%, 25V,	Elect.	3R32	Res., 390,± 5%, ¼W, Carbon	DRD134731
		DCE225151	3R33	Res., 220, ± 5%, ¼W, Carbon	DRD139321
3C29	Same as 3C06		3R34	Same as 3R33	
3C31	Cap., 0.01μ , $\pm 10\%$, 50V, Cer.	DCC133571	3R35	Same as 3R20	
3C98	Same as 3C01		3R36	Res., 2k, Var., 0.2W, Carbon	DRV146871
3C99	Same as 3C01		3R37	Same as 3R33	
3C99A	Cap., 10p, ±0.5p, 50V, Cer.	DCC231701	3R38	Same as 3R20	
			3R39	Res., 3.9k, <u>+</u> 5%, ¼W, Carbon	DRD139521
3L01	Coil, OP-03-03-1H	DCL320251	3R40	Same as 3R04	
3L02	Same as 3L01		3R41	Same as 3R39	
			3R42	Res., 7.5k, ± 5%, ¼W, Carbon	DRD139571
2R01	Res., 22k, Var., 0.5W, Cermet	DRV430701	3R43	Same as 3R10	
3R02	Res., 22k, ±1%, ¼W, Metal	DRE939061	3R44	Res., 47, ± 5%, ¼W, Carbon	DRD139061
3R03	Res., 220, ±1%, ¼W, Metal	DRE939601	3R45	Same as 3R44	
3R04	Res., 3.3k, ±5%, ¼W, Carbon	DRD139501	3R46	Res., 1k, ± 5%, ¼W, Carbon	DRD139141
3R05	Res., 200, ±15%, Thermistor	DDD080201	3R47	Same as 3R33	
3R06	Res., 100, Var., 0.5W, Cermet	DRV430541	3R48	Same as 3R46	
3R07	Res., 150, ±1%, ¼W, Metal	DRE939581	3R49	Res., 33k, ± 1%, ¼W, Metal	DRE939491

	T DESCRIPTION ENCE	IWATSU PART NO.	CIRCUI REFER	T DESCRIPTION ENCE	IWATSU PART NO.
3R50	Same as 3R46		3001	Transistor, 2SC1834	DTR131031
3R51	Same as 3R46		3002	Transistor, 2SC2037	DTR137591
3R52	Same as 3R46		3003	Same as 3Q02	
3R53	Res., 2.2k,± 5%, ¼W, Carbon	DRD139461	3004	Transistor, 2SA1206	DTR115301
3R54	Res., 1k, Var., 0.5W, Cermet	DRV430571	3005	Same as 3Q04	
3R55	Same as 3R33		3006	Same as 3002	
3R56	Same as 3R53		3007	Same as 3Q02	
3R57	Same as 3R16		3008	Same as 3Q01	
3R61	Res., 10, ± 5%, ¼W, Carbon	DRD139211	3009	Same as 3Q01	
3R62	Same as 3R61		3Q10	Same as 3Q04	
3R63	Same as 3R61		3Q11	Same as 3Q04	
3R63A	Same as 3R46		3012	Transistor, 2SC2037	DTR137591
3R64	Same as 3R61		3013	Same as 3Q12	
3R65	Res., 1.5k, ± 5%, ¼W, Carbon	DRD139431	3Q14	Transistor, 2SC1907	DTR137611
3R66	Same as 3R65		3Q15	Same as 3Q14	
3R72	Res., 3.9k, ±5%, ¼W, Carbon	DRD139521	3Q16	Same as 3Q01	
3R73	Same as 3R04		3Q 17	Same as 3Q01	
3R98	Res., 10, ± 5%, ¼W, Carbon	DRD134351			
3R99	Same as 3R98		3J01	Connector, M36-M87-02	DCN034601
3D01	LED., TLR206	DDD070181	3P01	Connector, M36-02-30-114P	DCN034851
3D02	Diode, 1S953	DDD010821			
			3S02	Switch, SUJ12A	DSW014831

CIRCUIT REFERE	DESCRIPTION	IWATSU PART NO.	CIRCUIT	DESCRIPTION	IWATSU PART NO.
CH3 & C	H4 ATTENUATOR & PRE-AMPL	IFIER	4R01	Res., 47, ±5%, ¼W, Carbon	DRD139261
			4R02	Res., 900k, ±0.5%, ¼W, Metal	DRE139721
4C01	Cap., 0.047μ , ±20%, 200V, Poly	· DCF160291	4R03	Res., 111k, ±0.5%, ¼W, Metal	DRE233941
4C02	Cap., 2.5 ~22.5p, Var., 250V, Ce	er.	4R04	Res., 470k, ± 5%, ¼W, Carbon	DRD139931
		DCV019592	4R05	Res., 1M, ± 0.5%, ¼W, Metal	DRE139741
4C03	Cap., 2 \sim 8p, Var., 250V, Cer.	DCV019612	4R06	Res., 220, ±0.5%, ¼W, Carbon	DRD139321
4C04	Cap., 8p,±0.5p, 500V, Cer.	DCC251301	4R07	Res., 100, ±1%, ¼W, Metal	DRE939561
4C05	Cap., 16p, ±5%, 500∨, Cer.	DCC252101	4R08	Same as 4R07	
4C06	Cap., 1000p, ±10%, 500V, Cer.	DCC151811	4R09	Res.,680, ± 1%, ¼W, Metal	DRE939631
4C07	Cap., 22 μ , ±20%, 25V, Elect.	DCE225151	4R10	Res., 1.5k, ± 5%, ¼W, Carbon	DRD139431
4C10	Cap., 0.01 μ , +80% \sim -20%, 50V	, Cer.	4R11	Res., 33, ± 5%, ¼W, Carbon	DRD139911
		DCC139501	4R12	Same as 4R06	
4C12	Same as 4C10		4R13	Res., 1.2k, ±1%, ¼W, Metal	DRE939291
4C13	Same as 4C10		4R14	Same as 4R13	
4C14	Cap., 3.8~28.5p, Var., 250V, Cer	. DCV019742	4R15	Same as 4R09	
4C15	Same as 4C01		4R16	Res., 330, ±1%, ¼W, Metal	DRE939621
4C16	Same as 4C02		4R17	Res., 470, Var., 0.5W, Carbon	DRV430561
4C17	Same as 4C03		4R18	Res., 750, ±5%, ¼W, Carbon	DRD139401
4C18	Same as 4C04		4R19	Same as 4R18	
4C19	Same as 4C05		4R20	Res., 5.1k, ± 5%, ¼W, Carbon	DRD139531
4C20	Same as 4C06		4R21	Res., 2k, Var., 0.05% Carbon	DRV131431
4C21	Cap., 22 µ, ±20%, 25V, Elect.	DCE229041	4R22	Same as 4R20	
4C24	Same as 4C10		4R23	Res., 15, ±5%, ¼W, Carbon	DRD139221
4C26	Same as 4C10		4R24	Res., 470, ±1%, ¼W, Metal	DRE939121
4C27	Same as 4C10		4R25	Res., 220, ±1%, ¼W, Metal	DRE939601
4C28	Same as 4C14		4R26	Same as 4R06	
4C30	Same as 4C10		4R31	Same as 4R01	
4C31	Same as 4C10		4R32	Same as 4R02	
4C32	Same as 4C10		4R33	Same as 4R03	
4C33	Same as 4C10		4R34	Same as 4R04	
4C34	Same as 4C10		4R35	Same as 4R05	
4C35	Same as 4C10		4R36	Same as 4R06	
4C36	Same as 4C10		4R37	Same as 4R07	
4C37	Same as 4C10		4R38	Same as 4R07	
4C38	Same as 4C10		4R39	Same as 4R09	
4C39	Same as 4C10		4R40	Same as 4R10	
4C40	Same as 4C10		4R41	Same as 4R11	
4C41	Same as 4C10		4R42	Same as 4R06	
4C42	Same as 4C10		4R43	Same as 4R13	
4C96	Cap., 5p, ±0.25p, 50∨, Cer.	DCC230901	4R44	Same as 4R13	
4C97	Same as 4C96		4R45	Same as 4R09	
			4R46	Same as 4R16	

4Q08

4009

4Q10

4Q11

4012

Same as 4Q02

Same as 4Q03

Same as 4Q03

Same as 4Q02

Same as 4Q06

CIRCUIT REFERENCE		DESCRIPTION	IWATSU PART NO.	CIRCUI REFERI	TENCE	DESCRIPTION	IWATSU PART NO.	
4R47	Same as	4R17		4J01	Connector	, BNC080	DCN040711	
4R48	Same as	4R18		4J02	Same as 4J	01		
4R49	Same as	4R18		4J01	Connector	, M36-M87-05	DCN034631	
4R50	Same as 4	IR20		4J02	Same as 4J	01		
4R51	Same as 4	R21		4J03	Connector	, M36-M87-02	DCN034601	
4R52	Same as 4	1R20		4J04	Same as 4J	103		
4853	Same as 4	1R23		4J05	Connector	, M36-M87-08	DCN034511	
4R54	Same as 4	1R24		4J06	Connector	, M36-M87-03	DCN034611	
4R55	Same as 4	1R25		4J07	Same as 4J	106		
4R56	Same as 4	1R06		4J08	Same as 4J	06		
4R60	Res. 10.	±5%, ¼W, Carbon	DRD139211	4J09	Same as 4J	06		
4R61	Same as 4	1R60						
4R62	Same as 4	1R60		4P01	Connector	, M36-05-30-114P	DCN034881	
4R63	Same as 4	1R60		4P02	Same as 4F	201		
4R93	Res. 1k	±5% 1/8W. Carbon	DRD225041	4P03	Connector	, M36-02-30-114P	DCN034851	
4R94	Res., 33.	± 5%, ¼W, Carbon	DRD237471	4P04	Same as 4F	203		
4R95	Same as 4	1R94		4P05	Connector	, M33-08-30-134P	DCN034801	
4R95	Same as 4	1R94		4P06	Connector	, M36-03-30-134P	DCN034911	
4896	Same as 4	1R94		4P07	Same as 4F	206		
4R97	Same as 4	1R94		4P08	Connector	, M36-03-30-114P	DCN034861	
4R98	Res. 220), ± 5%, ¼W, Carbon	DRD237671	4P09	Same as 4F	208		
4R99	Same as 4	1R98						
				4S01	Push switch	n, SUJ25A	DSW014861	
4D01	Diode, 19	S1544A	DDD010341	4S02	Push switch	n, SUJ45A	DSW014901	
4D02	Same as 4	1D01		4S03	Same as 4S	01		
				4S04	Same as 4S	02		
4Q01	Transisto	r,	DTR295281					
4002	Transisto	r, 2SC1834	DTR131031					
4003	Transisto	r, 2SC1907	DTR137611					
4004	Same as 4	1003						
4005	Same as 4	1002						
4006	Transisto	r, 2SA1206	DTR115301					
4Q07	Same as 4	1Q01						
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CIRCUIT	DESCRIPTION	IWATSU PART NO.	CIRCUI REFER	T DESCRIPTION	IWATSU PART NO.
VERTIC	AL MAIN AMPLIFIER		5R08	Res., 100, ±5%, ¼W, Carbon	DRD139291
			5R09	Res., 510, ±1%, ¼W, Metal	DRE939131
5C03	Cap., 10 μ, ±10%, 6.3V, Elect.	DCE910071	5R10	Same as 5R09	
5C04	Cap., 0.01 μ , ±10%, 50V, Poly.	DCF129051	5R11	Res., 20k, ± 5%, ¼W, Carbon	DRD238141
5C05	Cap., 68p, ±5%, 50V, Cer.	DCC233601	5R12	Res., 33k, ± 5%, ¼W, Carbon	DRD238191
5C07	Cap., 0.01 μ , +80%, $\sim -20\%$, 50	V, Cer.	5R13	Res., 27k, ± 5%, ¼W, Carbon	DRD238171
		DCC139501	5R14	Res., 220, ± 5%, ¼W, Carbon	DRD139321
5C11	Same as 5C07		5R15	Same as 5R14	
5C14	Cap., 5 ~40p, Var., 250V, Cer.	DCV019752	5R16	Res., 100, ± 5%, ¼W, Carbon	DRD237591
5C15	Cap., 2200p, ±10%, 50V, Poly.	DCF129061	5R17	Res., 1k, ± 5%, ¼W, Carbon	DRD237831
5C16	Cap., 75p, ± 5%, 50∨, Cer.	DCC233701	5R18	Same as 5R17	
5C17	Cap., 56p, ±5%, 50V, Cer.	DCC239251	5R19	Res., 47, ±5%, ¼W, Carbon	DRD237511
5C20	Cap., 22μ, ±20%, 25V, Elect.	DCE225151	5R20	Same as 5R19	
5C21	Cap., 2 ~12p, Var., 250V, Cer.	DCV019592	5R21	Res., 33, ±5%, ¼W, Carbon	DRD139911
5C23	Same as 5C23		5R22	Same as 5R17	
5C24	Same as 5C23		5R23	Same as 5R17	
5C25	Same as 5C23		5R24	Res., 330, ±5%, ¼W, Carbon	DRD139351
5C30	Cap., 390p, ± 5%, 50V, Cer.	DCC235101	5R25	Res., 1k, ±5%, ¼W, Carbon	DRD237831
5C31	Cap., 2.2 μ, ±20%, 50V, Elect.	DCE249131	5R26	Res., 1k, Var., 0.5W, Cermet	DRV430751
5C33	Same as 5C23		5R27	Res., 220, ±5%, ¼W, Carbon	DRD237671
5C35	Cap., 100p, ±5%, 50V, Cer.	DCC239051	5R28	Res., 3.3k, ± 5%, ¼W, Carbon	DRD237951
5C36	Cap., 1000p, ±10%, 50V, Poly.	DCF129071	5R29	Res., 220, ±5%, ¼W, Carbon	DRD139321
5C37	Same as 5C36		5R30	Res., 10, ±5%, ¼W, Carbon	DRD237351
5C38	Cap., 150p, ±5%, 50V, Cer.	DCC239021	5R31	Res., 10, ± 5%, ¼W, Carbon	DRD139211
5C39	Same as 5C38		5R32	Res., 220, ± 5%, ¼W, Carbon	DRD237671
5C95	Same as 5C23		5R33	Res., 2.2k, ±5%, ¼W, Carbon	DRD139461
5C98	Cap., 22p, ±5%, 50V, Cer.	DCC239121	5R34	Res., 3.9k, ±5%, ¼W, Carbon	DRD139521
5C99	Cap., 12p, ±5%, 50V, Cer.	DCC231901	5R35	Same as 5R34	
			5R36	Res., 1k, ± 5%, ¼W, Carbon	DRD139141
5L01	Peaking coil	DCL151301	5R37	Same as 5R36	
5L02	Same as 5L01		5R41	Res., 100, ±1%, ¼W, Metal	DRE939561
5L03	Choking coil, 82007	DCL111331	5R42	Same as 5R41	
5L04	Same as 5L03		5R43	Res., 470, ±5%, ¼W, Carbon	DRD139371
			5R44	Res., 82, ±1%, ¼W, Metal	DRE939541
5DL01	Delay cable, CD-3A 80cm	KHB048111	5R45	Res., 560, ± 5%, ¼W, Carbon	DRD139121
			5R46	Res., 220, Var., 0.5W, Cermet	DRV430551
5R01	Res., 510,±1%, ¼W, Metal	DRE535421	5R47	Res., 47, ±5%, ¼W, Carbon	DRD139261
5R02	Same as 5R01		5R48	Res., 180, ±1%, ¼W, Metal	DRE939011
5R03	Res., 270, ±1%, ¼W, Metal	DRE535351	5R49	Same as 5R48	
5R04	Res., 240, ±1%, ¼W, Metal	DRE535341	5R50	Same as 5R47	
5R05	Same as 5R03		5R51	Res., 75, ±1%, ¼W, Metal	DRE130561
5R06	Same as 5R04		5R52	Res., 1.2k, ±5%, ¼W, Carbon	DRD139421

CIRCUIT REFERE	DESCRIPTION	IWATSU PART NO.	CIRCUI REFERI	T DESCRIPTION ENCE	IWATSU PART NO.
5R53	Same as 5R52		5D14	Same as 5D01	
5R54	Res., 22k, Var., 0.5W, Cermet	DRV430701	5D15	Same as 5D01	
5R55	Res., 8.2k, ±5%, ¼W, Carbon	DRD139581	5D16	Same as 5D01	
5R56	Res., 5.1k, ±5%, ¼W, Carbon	DRD139531	5D18	Same as 5D01	
5R57	Res., 1.5k, ±5%, ¼W, Carbon	DRD139431	5D19	Same as 5D01	
5R60	Res., 68k, ±5%, ¼W, Carbon	DRD139841	5D 20	Same as 5D01	
5R61	Res., 220, ±1%, ¼W, Metal	DRE939601	5D21	Same as 5D01	
5R62	Same as 5R61		5D22	Same as 5D01	
5R63	Res., 51, ±1%, ¼W, Metal	DRE130521	5D23	Diode, 1S1658	DDD011011
5R64	Res., 430, ± 5%, 1W, Metal	DRS220851	5D24	Same as 5D01	
5R65	Same as 5R64		5D25	Same as 5D23	
5R66	Res., 33, ±5%, ¼W, Carbon	DRD139911			
5R67	Same as 5R14		5001	Transistor, 2S2037	DTR137591
5R68	Same as 5R14		5Q02	Same as 5Q01	
5R69	Res., 240, ± 5%, 2W, Metal	DRS230831	5003	Transistor, 2SC1834	DTR131031
5R70	Sameas 5R69		5Q04	Same as 5Q03	
5R71	Same as 5R69		5005	Transistor, 2SA1206	DTR115301
5R72	Same as 5R69		5Q06	Same as 5005	
5R75	Same as 5R52		5007	Transistor, 2N3905	DTR150011
5R76	Res., 5k, ±15%, Thermistor	DDD080191	5Q08	Same as 5Q05	
5R77	Res., 10k, ± 5%, ¼W, Carbon	DRD139161	5009	Same as 5Q05	
5R78	Same as 5R77		5010	Same as 5Q01	
5R79	Same as 5R77		5Q11	Same as 5Q01	
5R80	Res., 150, ± 5%, ¼W, Carbon	DRD139101	5012	Transistor, 2SC1387	DTR137701
5R81	Same as 5R80		5013	Same as 5Q12	
5R82	Res., 100, Var., 0.5W, Cermet	DRV430541	5Q14	Transistor, 2SC1412	DTR130901
5R83	Same as 5R08		5Q15	Same as 5Q14	
5R99	Res., 430, ±5%, ¼W, Carbon	DRD237741	5016	Transistor, 2SC1815GR	DTR139011
			5Q17	Same as 5Q16	
5D01	Diode, 1S953	DDD010821	5018	Same as 5Q16	
5D02	Same as 5D01		5019	Same as 5Q16	
5D03	Same as 5D01		5020	Same as 5Q16	
5D04	Same as 5D01				
5D05	Same as 5D01		5J01	Connector, M36-M87-02	DCN034601
5D06	Same as 5D01		5J02	Connector, M36-M87-03	DCN034611
5D07	Same as 5D01		5J03	Connector, M36-M87-06	DCN034641
5D08	Same as 5D01				
5D09	Same as 5D01		5P01	Connector, M36-02-30-114P	DCN034851
5D10	Same as 5D01		5P02	Connector, M36-03-30-134P	DCN034911
5D11	Same as 5D01		5P03	Connector, M36-06-30-114P	DCN034891
5D12	Same as 5D01		5P04	Connector, M33-03-30-114P	DCN034651
5D13	Same as 5D01		5P05	Same as 5P04	

CIRCUIT	DESCRIPTION	IWATSU PART NO.		T DESCRIPTION ENCE	IWATSU PART NO.
VERTICA	AL CONTROL		6RA01	Resistors-array, 6-4.7k Ω k	DFB011361
			6RA02	Resistors-array, 4-4.7k Ω k	DFB011151
6C01	Cap., 22p, ± 5%, 50V, Cer.	DCC239121			
6C02	Same as 6C01		6D01	Diode, 1k34A	DDD010101
6C03	Same as 6C01		6D02	Same as 6D01	
6C04	Cap., 220P, ± 5%, 50V, Cer.	DCC239171	6D03	Diode, 1S953	DDD010821
6C05	Cap., 33p, ± 5%, 50V, Cer.	DCC239011	6D04	Same as 6D03	
6C06	Cap., 0.01 μ , +80%, ~ -20%, 50%	V, Cer.	6D05	Same as 6D03	
		DCC139501	6D06	Same as 6D01	
6C07	Cap., 100p, ± 5%, 50V, Cer.	DCC239051			
6C08	Cap., 22 μ , ± 20%, 25V, Elect.	DCE229041	6Q01	Transistor, 2SA1015Y	DTR119011
6C09	Same as 6C06		6002	Transistor, 2SC1815GR	DTR139011
6C10	Same as 6C10		6Q03	Same as 6Q02	
6C11	Cap., 22 μ , ± 20%, 25V, Elect.	DCE225151	6Q04	Same as 6002	
6C96	Cap., 220p, ±10%, 50V, Cer.	DCC139061	6Q05	Same as 6Q02	
6C97	Cap., 120p, ±10%, 50V, Cer.	DCC130301			
6C99	Same as 6C06		6IC01	IC, SN74LS04N	DIC140091
			61C02	IC, SN74LS08N	DIC140091
6R01	Res., 33, ±5%, ¼W, Carbon	DRD139911	61C03	IC, SN74LS00N	DIC140011
6R08	Res., 22k, ± 5%, ¼W, Carbon	DRD139641	61C04	Same as 61C03	
6R09	Res., 10k, ± 5%, ¼W, Carbon	DRD139161	61C05	IC, SN74LS112N	DIC14111
6R10	Res., 220, ±5%, ¼W, Carbon	DRD237671			
6R11	Same as 6R10		6S01	Push switch, SUJ50A	DSW014921
6R12	Same as 6R01				
6R17	Res, 1k, ±5%, ¼W, Carbon	DRD139141	6J01	Connector, M31-M87-10	DCN034531
6R18	Res., 220, ±5%, ¼W, Carbon	DRD139321	6J02	Connector, M36-M87-02	DNC034601
6R19	Res., 820, ±5%, ¼W, Carbon	DRD237811	6J03	Connector, M36-M87-03	DCN034611
6R20	Same as 6R10				
6R21	Same as 6R10		6P01	Connector, M33-10-30-114P	DCN034721
6R22	Same as 6R10		6P02	Connector, M36-02-30-114P	DCN034851
6R23	Same as 6R10		6P03	Connector, M36-03-30-114P	DCN034861
6R24	Same as 6R10				
6R25	Same as 6R18				
6R26	Same as 6R18				

6R98

Same as 6R10

CIRCUIT		IWATSU PART NO.	CIRCUI	T DESCRIPTION ENCE	IWATSU PART NO.
A&BT	RIGGER GENERATOR		7C45	Cap., 0.1 μ , ±10%, 50V, Poly	. DCF120351
			7C46	Same as 7C02	
7C01	Cap., 0.22 μ + 10%, 50V, Poly,	DCF127231	7C47	Same as 7C04	
7C02	Cap., 100p, ±5%, 50V, Cer.	DCC239051	7C48	Same as 7C05	
7C03	Cap., 330p, ± 5%, 50V, Cer.	DCC234901	7C62	Same as 7C34	
7C04	Cap., 0.01μ , +80% ~ -20%, 50V	, Cer.	7C95	Cap., 0.01μ, ±10%, 50V, Ce	r. DCC133571
		DCC139501	7C96	Cap., 220p, ±10%, 50V, Cer.	DCC130701
7C05	Cap., 2.2 μ, ±20%, 40V, Elect.	DCE232311	7C97	Same as 7C96	
7C06	Cap., 0.047µ, ±10%, 50V, Poly.	DCF129081	7C98	Same as 7C96	
7C07	Same as 7C04		7C99	Same as 7C96	
7C08	Same as 7C04				
7C09	Same as 7C04		7R01	Res., 22, ± 5%, ¼W, Carbon	DRD139751
7C10	Same as 7C04		7R02	Res., 100k, ±5%, ¼W, Carbo	n DRD1 39751
7C11	Same as 7C04		7R03	Same as 7R02	
7C12	Same as 7C01		7R04	Res., 3.9k, ±5%, ¼W, Carbon	DRD139521
7C13	Same as 7C03		7R05	Same as 7R04	
7C14	Same as 7C04		7R06	Res., 220, ±5%, ¼W, Carbon	DRD139321
7C15	Same as 7C04		7R07	Same as 7R04	
7C16	Same as 7C04		7R08	Res., 1.5k, ± 5%, ¼W, Carbor	DRD139431
7C17	Same as 7C04		7R09	Res., 3.3k, ±5%, ¼W, Carbor	DRD139501
7C18	Same as 7C04		7R10	Res., 4.7k, ± 5%, ¼W, Carbor	DRD139151
7C19	Cap., 22μ , $\pm 20\%$, $25V$, Elect.	DCE229041	7R13	Same as 7R01	
7C20	Same as 7C05		7R14	Res., 330k ±5%, ¼W, Carbor	DRD139851
7C21	Same as 7C05		7R15	Res., 51k, ±5%, ¼W, Carbon	DRD139721
7C22	Same as 7C06		7R16	Same as 7R02	
7C23	Same as 7C06		7R17	Res., 1.3k, ± 5%, ¼W, Carbon	DRD138751
7C24	Same as 7C02		7R18	Res., 470k, ± 5%, ¼W, Carbo	n DRD139931
7C25	Same as 7C19		7R19	Res., 18k, ±5%, ¼W, Carbon	DRD139631
7C27	Same as 7C19		7R21	Res., 15k, ±5%, ¼W, Carbon	DRD139611
7C28	Cap., 47, ±5%, 50V, Cer.	DCC233201	7R22	Res., 50k, Var., 0.2W, Carbor	DRV146811
7C29	Same as 7C22		7R23	Res., 3.3k, ±1%, ¼W, Metal	DRE939661
7C30	Same as 7C04		7R24	Res., 330, ±1%, ¼W, Metal	DRE939621
7C33	Same as 7C19		7R25	Same as 7R23	
7C34	Cap., 22 μ, ± 20%, 25V, Elect.	DCE225151	7R26	Res., 47k, Var., 0.5W, Cermet	DRV430601
7C35	Same as 7C34		7R28	Same as 7R26	
7C36	Same as 7C19		7R29	Same as 7R23	
7C37	Same as 7C04		7R30	Same as 7R06	
7C38	Same as 7C04		7R31	Res., 47, ±5%, ¼W, Carbon	DRD139261
7C39	Same as 7C04		7R32	Res., 2.2k, ±5%, ¼W, Carbon	DRD139461
7C40	Same as 7C19		7R33	Same as 7R32	
7C43	Same as 7C19		7R34	Same as 7R31	
7C44	Same as 7C34		7R35	Res., 470, ± 5%, ¼W, Carbon	DRD139371

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CIRCUIT	DESCRIPTION	IWATSU PART NO.	CIRCUIT REFERE	DESCRIPTION	IWATSU PART NO.	
7R36	Res., 150, ± 5%, ¼W, Carbon	DRD139101	7R84	Same as 7R82		
7R37	Same as 7R32		7R85	Res., 10, ± 5%, ¼W, Carbon	DRD139211	
7R38	Same as 7R06		7R86	Same as 7R85		
7R39	Same as 7R02		7R87	Same as 7R85		
7R41	Same as 7R01		7R88	Same as 7R85		
7R42	Res., 390,±5%, ¼W, Carbon	DRD139361	7R89	Same as 7R82		
7R43	Same as 7R06		7R90	Res., 91, ± 5%, ¼W, Carbon	DRD134581	
7R44	Same as 7R32		7R91	Same as 7R90		
7R45	Same as 7R31		7R92	Same as 7R36		
7R46	Same as 7R36		7R93	Same as 7R01		
7R47	Same as 7R06		7R94	Res., 150, ± 5%, ¼W, Carbon	DRD237631	
7R48	Same as 7R35					
7R49	Same as 7R32		7D01	Diode, 1S953	DDD010051	
7R50	Same as 7R31		7D02	Same as 7D01		
7R51	Same as 7R24		7D03	Same as 7D01		
7R52	Same as 7R23		7D04	Diode, 1S953 TA21R	DDD010821	
7R53	Same as 7R26		7D05	Same as 7D04		
7R54	Same as 7R23		7D06	Same as 7D04		
7R55	Same as 7R22		7007	Same as 7D04		
7R57	Same as 7R36		7D08	Same as 7D04		
7R58	Res., 1k, ±5%, ¼W, Carbon	DRD139141	7D09	Same as 7D04		
7R59	Same as 7R58		7D10	Same as 7D01		
7R60	Same as 7R35		7D11	LED, TLG206	DDD071121	
7R61	Same as 7R58		7D12	Same as 7D04		
7R62	Same as 7R58		7D13	Z.Diode, RD4.7EB	DDD033511	
7R63	Res., 330, ±5%, ¼W, Carbon	DRD139351	7D14	Diode, RD4.7EB TA21A	DDD031771	
7R64	Res., 680, ± 5%, ¼W, Carbon	DRD139391	7D15	Same as 7D04		
7R65	Res., 750, ±5%, ¼W, Carbon	DRD139401	7D16	Same as 7D01		
7R67	Same as 7R63					
7R68	Res., 47k, ±5%, ¼W, Carbon	DRD139171	7001	Transistor, 2SK117-GR	DTR215311	
7R69	Same as 7R64		7002	Transistor, 2SC1815GR	DTR139011	
7R70	Same as 7R64		7003	Transistor, 2S1834	DTR131031	
7R71	Same as 7R64		7004	Same as 7Q02		
7R72	Same as 7R63		7Q05	Transistor, 2SA1015Y	DTR119011	
7R73	Same as 7R06		7006	Same as 7002		
7R74	Same as 7R02		7007	Same as 7002		
7R75	Same as 7R58		7008	Same as 7Q02		
7R76	Res., 100,± 5%, ¼W, Carbon	DRD139291	7009	Tranistor, 2SC2037	DTR137591	
7R79	Res., 5.1k, ¼W, Carbon	DRD139531	7010	Same as 7Q09		
7R80	Same as 7R01		7011	Same as 7Q01		
7R82	Res., 680, ±5%, ¼W, Carbon	DRD237791	7012	Same as 7Q03		
7R83	Same as 7R82		7013	Same as 7Q02		

CIRCUIT	NCE	DESCRIPTION	IWATSU PART NO.	CIRCUI	T ENCE	DESCRIPTION	IWATSU PART NO.
7Q14 7Q15 7Q16	Same as 7 Same as 7	Q02 Q09		7J01 7J02 7J04	Connector, Same as 7J	M36-M87-04 01 M26 M87 02	DCN034621
7Q17 7Q17 7Q18 7Q19	Same as 7 Transistor Same as 7 Same as 7	, 2SA1206 Q02 Q17	DTR115301	7J05 7J06 7J07	Connector, Connector, Same as 7J(Same as 7J(M36-M87-05 D1 D1	DCN034631
7IC01	IC, F1010	7DC	DIC310051	7P01 7P02	Connector, Same as 7P(M36-04-30-114P 01	DCN034871
71C02 71C03 71C04	IC, SN74L IC, SN74L IC, SN74C	.S96N .SOON ON	DIC140971 DIC170011 DIC110011	7P04 7P05 7P06 7P07	Connector, Connector, Connector, Same as 7P(M36-02-30-114P M36-05-30-114P M36-04-30-114P 06	DCN034851 DCN034931 DCN043921
7S02 7S04	Switch, Sl Switch, Sl	JJ45A JJ35A	DSW014891 DSW014881	7P08 7P09	Same as 7P(Same as 7P(04 04	

CIRCUIT REFERE		IWATSU PART NO.	CIRCUIT	DESCRIPTION	IWATSU PART NO.
A SWEEP	GENERATOR		8R15	Res., 1.6k, ±5%, ¼W, Carbon	DRD138761
			8R16	Res., 4.7k, ±5%, ¼W, Carbon	DRD1 39151
8C01	Cap., 220p, ±5%, 50V, Cer.	DCC234501	8R17	Same as 8R11	
8C02	Cap., 15p, ±5%, 50V, Cer.	DCC239221	8R18	Res., 3.3k, ±1%, ¼W, Metal	DCE939661
8C03	Same as 8C02		8R19	Res., 1.2k, ±1%, ¼W, Metal	DCE939291
8C04	Cap., 100p, ±10%, 50V, Cer.	DCC139031	8R20	Same as 8R01	
8C05	Cap., 0.01 μ , +80%, ~ -20%, 50V,	Cer.	8R21	Same as 8R01	
		DCC139501	8R22	Res., 330, ±5%, ¼W, Carbon	DCD139351
8C06	Same as 8C05		8R23	Same as 8R01	
8C07	Same as 8C04		8R24	Same as 8R01	
8C08	Same as 8C05		8R25	Res., 47k, ± 5%, ¼W, Carbon	DRD139171
8C09	Same as 8C05		8R26	Same as 8R25	
8C11	Cap., 22 μ, +20%, 25V, Elect.	DCE229041	8R27	Res., 10, ± 5%, ¼W, Carbon	DRD139211
8C12	Same as 8C11		8R30	Same as 8R25	
8C13	Same as 8C11		8R99	Res., 2.2k, ± 5%, ¼W, Carbon	DRD134911
8C14	Same as 8C05				
8C15	Same as 8C05		8D01	Diode, 1S953 TA21R	DDD010821
8C16	Same as 8C05		8D02	Same as 8D01	
8C17	Same as 8C05		8D03	Diode, 1SS97	DDD010451
8C50	Cap., 56p, ± 5%, 50V, Cer.	DCC239251	8D04	Diode, RD5.6EB1 TA21R	DDD031141
8C51	Cap., 4 ~ 34p, Var., 250V, Cer.	DCV019541	8D05	Diode, RD13EB TA21R	DDD031801
8C97	Cap., 10p, ± 0.5p, 50V, Cer.	DCC239041	8D06	LED., TLR206	DDD070181
8C98	Same as 8C97				
8C99	Cap., 68p, ±5%, 50V, Cer.	DCC233601	8Q01	Transistor, 2SC1815GR	DTR139011
			8002	Same as 8Q01	
8R01	Res., 4.7k, ±5%, ¼W, Carbon	DRD139151	8003	Transistor, 2SC1834	DTR131031
8R02	Res., 100k, ±10%, ¼W, Carbon	DRD139751	8Q04	Same as 8Q03	
8R03	Res., 500k, Var., 0.2W, Carbon	DRV146861	8Q05	Transistor, 2N3905	DTR150011
8R04	Res., 1k, Var., 0.5W, Cermet	DRV430571	8006	Transistor, 2SK30A-Y	DTR210141
8R05	Res., 1.8k, ±5%, ¼W, Carbon	DRD139441	8007	Same as 8Q06	
8R06	Res., 15k, ±5%, ¼W, Carbon	DRD139611	8008	Same as 8001	
8R07	Same as 8R06		8009	Same as 8Q05	
8R08	Res., 2.2k, ± 5%, ¼W, Carbon	DRD139461			
8R09	Same as 8R08		8IC01	IC, SN7413N	DIC110141
8R10	Res., 10k, ±5%, ¼W, Carbon	DRD139161	8IC02	IC, SN74S74N	DIC170211
8R11	Res., 100 ±5%, ¼W, Carbon	DRD139291	8IC03	IC, SN7410N	DIC110111
8R12	Res., 12k, ±5%, ¼W, Carbon	DRD139601			
8R13	Same as 8R10		8S01	Switch, SUJ30A	DSW014871
8R14	Res., 510, ±5%, ¼W, Carbon	DRD139381			

CIRCUI REFERI	T ENCE	DESCRIPTION	IWATSU PART NO.	CIRCUI REFER	T ENCE	DESCRIPTION	IWATSU PART NO.
8J01	Connecto	r, M31-M87-08	DCN034511	8P01	Conne	ctor, M33-08-30-114P	DCN034701
8J02	Same as 8	J01		8P02	Conne	ctor, M33-08-30-134P	DCN034801
8J03	Connecto	r, M36-M87-05	DCN034631	8P03	Conne	ctor, M36-05-30-114P	DCN034881
				8P04	Conne	ctor, M36-02-30-114P	DCN034851
				8P05	Same a	as 8P04	

CIRCUIT	DESCRIPTION	IWATSU PART NO.		DESCRIPTION	IWATSU PART NO.
B SWEEP	GENERATOR		9R17	Res., 470, ± 5%, ¼W, Carbon	DRD139371
			9R18	Same as 9R10	
9C01	Cap., 5p, ± 0.25%, 50V, Cer.	DCC230901	9R19	Res., 330, ± 5%, ¼W, Carbon	DRD139351
9C02	Same as 9C01		9R20	Same as 9R10	
9C03	Cap., 0.01 μ , +80%, \sim -20%, 50V	, Cer.	9R21	Same as 9R01	
		DCC153511	9R22	Res., 22k, ±5%, ¼W, Carbon	DRD139641
9C04	Cap., 100p, ±10%, 50V, Cer.	DCC139031	9R23	Res., 10k, Var., 0.5W, Cermet	DRV430591
9C05	Cap., 0.01µ, +80%∼ -20%, 50∨	, Cer.	9R24	Res., 18k, ± 1%, ¼W, Metal	DRE939351
		DCC139501	9R25	Same as 9R05	
9C06	Same as 9C05		9R26	Same as 9R15	
9C08	Same as 9C05		9R27	Same as 9R10	
9C09	Cap., 22µ , ±20%, 25V, Elect.	DCE229041	9R28	Same as 9R01	
9C10	Same as 9C09		9R29	Same as 9R01	
9C11	Same as 9C05		9R30	Same as 9R01	
9C12	Cap., 120p, ±10%, 50V, Cer.	DCC130301	9R31	Res., 4.7k,±5%, ¼W, Carbon	DRD139151
9C13	Same as 9C05		9R32	Res., 10, ±5%, ¼W, Carbon	DRD139211
9C14	Same as 9C09		9R33	Res., 10k,Var., 1.5W, W.W.	DRV770351
9C15	Same as 9C05		9R99	Res., 220, ±5%, ¼W, Carbon	DRD134671
9C16	Same as 9C05				
9C49	Same as 9C05		9D01	Diode, 1k34A	DDD010101
9C50	Cap., 56p, ± 5%, 50∨, Cer.	DCC239251	9D02	Diode, 1S953 TA21R	DDD010821
9C51	Cap., 4 ~34p, Var., 250, Cer.	DCV019541	9D03	Diode, 1SS97	DDD010451
9C97	Cap., 10p, ±0.5p, 50∨, Cer.	DCC231701	9D04	Diode, RD5.6E1 TA21R	DDD031141
			9D05	Diode, RD13EB TA21R	DDD031801
9R01	Res., 4.7k,± 5%, ¼W, Carbon	DRD139151	9D06	Same as 9D02	
9R02	Res., 1.8k, ± 5%, ¼W, Carbon	DRD139441	9D07	Same as 9D01	
9R03	Res., 1k, Var., 0.5W, Cermet	DRV430571	9D09	Diode, RD3.9EB TA21R	DDD030951
9R04	Res., 10k, ±5%, ¼W, Carbon	DRD139161			
9R05	Res., 15k, ± 5%, ¼W, Carbon	DRD139611	9001	Transistor, 2SC1815GR	DTR139011
9R06	Same as 9R01		9Q03	Transistor, 2SC1834	DTR131031
9R07	Res., 2.2k, ±5%, ¼W, Carbon	DRD139461	9004	Same as 9003	
9R08	Same as 9R07		9005	Transistor, 2N3905	DTR150011
9R09	Res., 47k, ± 5%, ¼W, Carbon	DRD139171	9006	Transistor, 2SK30A -Y	DTR210141
9R10	Res., 100, ±5%, ¼W, Carbon	DRD139291	9007	Same as 9006	
9R11	Same as 9R10		9008	Same as 9001	
9R12	Res., 12k, ±5%, ¼W, Carbon	DRD139601	9009	Same as 9005	
9R13	Same as 9R04		9Q10	Same as 9Q01	
9R14	Res., 510, ±5%, ¼W, Carbon	DRD139381	9Q11	Same as 9Q01	
9R15	Res., 2.2k, Var., 0.5W, Cermet	DRV430581	9Q12	Transistor, 2SA1015Y	DTR119011
9R16	Res., 1k, ±5%, ¼W, Carbon	DRD139141			

CIRCUIT	NCE	DESCRIPTION	IWATSU PART NO.	CIRCUI REFER	ENCE	DESCRIPTION	IWATSU PART NO.
9IC01	IC, TL810	ICP	DIC630731	9P01	Connec	tor, M36-02-30-114P	DCN034851
9IC02	IC, SN74S	00N	DIC174001	9P03	Connec	tor, M36-03-30-114P	DCN034861
91C03	Same as 9	102		9P04	Same as	s 9P01	
9J01	Connector	r, M36-M87-02	DCN034601				
9J03	Connecto	r, M36-M87-03	DCN034611				

CIRCUIT	DESCRIPTION	IWATSU PART NO.	CIRCUIT	DESCRIPTION	IWATSU PART NO.
A & B TI	MING CIRCUIT		10R15	Res., 6.8k, ±1%, ¼W, Metal	DRE939331
			10R16	Res., 33k, ±10%, ¼W, Metal	DRE939091
10C01	Cap., 2.2 μ, ± 20%, 50V, Elect.	DCE249131	10R17	Same as 10R16	
10C02	Cap., 0.22 μ, ±20%, 50V, Poly.	DCF120391	10R18	Res., 27k, ±1%, ¼W, Metal	DRE939361
10C03	Cap., 0.022μ , $\pm 20\%$, 50V, Poly.	DCF129041	10R19	Res., 2.2k, Var., 0.5W, Cermet	DRV430581
10C04	Cap., 2200p, ± 20%, 50V, Poly.	DCF129061	10R20	Res., 5.6k, ±1%, ¼W, Metal	DRE939671
10C08	Cap., 1μ, ±0.5%, 250V, Poly.	DCF260151	10R21	Same as 10R02	
10C09	Cap., 0.1 μ , ±1%, 50V, Poly.	DCF420271	10R22	Same as 10R03	
10C10	Cap., 9900p, ±0.25%, 50V, Poly	. DCF125791	10R23	Same as 10R04	
10C11	Cap., 900p, ±0.25%, 50V, Poly.	DCF125801	10R24	Same as 10R05	
10C12	Cap., 0.01μ , +80%, $\sim -20\%$, 50	V, Cer.	10R25	Same as 10R06	
		DCC139501	10R26	Same as 10R06	
10C13	Same as 10C12		10R27	Same as 10R08	
10C14	Same as 10C01		10R28	Same as 10R09	
10C19	Same as 10C09		10R29	Same as 10R10	
10C20	Same as 10C10		10R30	Same as 10R11	
10C21	Same as 10C11		10R31	Same as 10R12	
			10R32	Res., 50k, Var., 0.1W, Carbon	DRV147401
10R01	Res., 10, ±5%, ¼W, Carbon	DRD139211	10R33	Res., 13k, ± 5%, ¼W, Carbon	DRD138911
10R02	Res., 7.5M, ±1%, ½W, Metal	DRE560141	10R34	Res., 10k, ± 5%, ¼W, Carbon	DRD139161
10R03	Res., 2 .5M ±1%, ½W, Metal	DRE560131	10 R 35	Same as 10R01	
10R04	Res., 1.25M, ±1%, ½W, Metal	DRE560121	10R99	Same as 10R01	
10R05	Res., 750k, ±0.5%, ¼W, Metal	DRE139911			
10R06	Res., 250k, ±0.5%, ¼W, Metal	DRE139691	10D01	Diode, 1S953 TA21R	DDD010821
10R07	Same as 10R06		10D02	Same as 10D01	
10R08	Res., 126.2k, ±0.5%, 1/8W, Meta	I	10D03	LED., TLR206	DDD070181
		DRE229141			
10R09	Res., 55.6k, ±0.5%, 1/8W, Metal	DRE229131	10001	Transistor, 2S3905	DTR150011
10R10	Res., 25k, ±0.5%, 1/8W, Metal	DRE223651	10002	Same 10Q01	
10R11	Res., 12.5k, ±0.5%, 1/8W, Metal	DRE229111			
10R12	Res., 10, ±5%, ¼W, Carbon	DRD139321	10S01	Rotary switch,	DSW034621
10R13	Res., 470, ±5%, ¼W, Carbon	DRD139371		PS22BH3-6-22/H2-4-19/50kB	
10R14	Res., 7.5k, ±1%, ¼W, Metal	DRE939801			

	DESCRIPTION	IWATSU PART NO.	CIRCUI	T DESCRIPTION ENCE	IWATSU PART NO.
HORIZO			11R11	Res., 180k, ±5%, ¼W, Carbon	DRD139871
			11R12	Res., 13k, ± 5%, ¼W, Carbon	DRD138911
11C01	$Cap., 0.01 \mu, \pm 10\%, 50V, Cer.$	DCC133571	11R13	Res., 5.6k, ±1%, ¼W, Metal	DRE939671
11C02	Same as 11C01		11R14	Res., 3.3k, ±1%, ¼W, Metal	DRE939661
11C03	Cap., 22p, ±20%, 25V, Elect.	DCE229041	11R15	Same as 11R14	
11C04	Same as 11C01		11R16	Same as 11R13	
11C05	Same as 11C01		11R17	Res., 10k, ± 5%, ¼W, Carbon	DRD139161
11C07	Cap., 1.3 ~3p, Var., 250V, Cer.	DCV019672	11R18	Same as 11R17	
11C08	Cap., 5p, ±0.25p, 50V, Cer.	DCC230901	11R19	Same as 11R03	
11C09	Same as 11C01		11R20	Res., 100, ± 5%, ¼W, Carbon	DRD139291
11C10	Same as 11C07		11R21	Res., 2.2k, Var., 0.5W, Cermet	DRV430581
11C12	Same as 11C08		11R22	Same as 11R03	
11C13	Same as 11C01		11R23	Res., 68, ±1%, ¼W, Carbon	DRE939531
11C14	Cap., 0.01 μ , +80% \sim –20%, 50V	/, Cer.	11R24	Res., 100, Var., 0.5W, Cermet	DRV430541
		DCC139501	11R25	Res., 470, Var., 0.5W, Cermet	DRV430561
11C16	Same as 11C14		11R26	Res., 1.5k, ±1%, ¼W, Metal	DRE130861
11C17	Same as 11C14		11R27	Res., 910, ±1%, ¼W, Metal	DRE939281
11C18	Same as 11C14		11R28	Same as 11R27	
11C19	Same as 11C03		11R29	Res., 15k, ± 5%, ¼W, Carbon	DRD139611
11C20	Same as 11C03		11R30	Res., 12 k, ± 5%, ¼W, Carbon	DRD139601
11C22	Same as 11C14		11R31	Res., 7.5k, ±1%, ¼W, Metal	DRE141041
11C23	Cap., 100p, +80%~-20%, 50V, 0	Cer.DDC159501	11R32	Same as 11R31	
11C24	Same as 11C23		11R33	Same as 11R31	
11C97	Cap., 2p, ±0.25p, 500V, Cer.	DCC250501	11R34	Same as 11R31	
11C98	Same as 11C97		11R35	Res., 24k, ± 5%, 1W, Metal	DRS221891
11C99	Same as 11C14		11R36	Same as 11R20	
			11R37	Same as 11R20	
11R01	Res., 10k, ±1%, ¼W, Metal	DRE939301	11R38	Res., 15k, ±5%, 1W, Metal	DRS221231
11R02	Res., 6.8k, ±1%, ¼W, Metal	DRE939331	11R39	Res., 33, ±5%, ¼W, Carbon	DRD139911
11R03	Res., 8.2k, ±5%, ¼W, Carbon	DRD139581	11R40	Same as 11R39	
11R04	Same as 11R03		11R41	Res., 4.7k, ±5%, ¼W, Carbon	DRD139151
11R05	Res., 4.7k, Var., 0.5W, Cermet	DRV430621	11R50	Same as 11R39	
11R06	Res., 1k, Var., 0.5W, Cermet	DRV430571	11R51	Same as 11R39	
11R07	Res., 3k, ±1%, ¼W, Metal	DRE939031	11R52	Res., 5.1k, ±5%, ¼W, Carbon	DRD139531
11R09	Res., (10k, 50k), Var., 1/8W	DRV146841	11R53	Res., 11k, ± 5%, ¼W, Carbon	DRD138951
(11R10,	11S10) Carbon, with switch		11R54	Res., 3.3k, ± 5%, ¼W, Carbon	DRD139501

CIRCU REFEF	RENCE	DESCRIPTION	IWATSU PART NO.	CIRCUIT	r di Ence di	ESCRIPTION	IWATSU PART NO.
11D01	Diode, 1S9	53 TA21R	DDD010821	11004	Same as 11Q0	3	
11D02	Same as 11	D01		11Q05	Transistor, 2S	C1904GB	DTR137051
11D03	Same as 11	D01		11006	Same as 11Q0	5	
11D04	Same as 11	D01		11Q07	Transistor, 2S	C1907	DTR137611
11D05	Same as 11	D01		11008	Same as 1100	7	
11D06	Same as 11	D01		11Q09	Same as 1100	5	
11D07	Same as 11	D01		11Q10	Same as 11Q0	5	
11D08	Same s 11	D01					
11D09	Same as 11	D01		11RL01	Relay, MZ4.59	6	DKD026541
11D10	Same as 11	D01					
11D11	Same as 11	D01		11J01	Connector, M3	36-M87-03	DCN034611
11D12	Same as 11	D01		11J02	Same as 11J01		
11D13	Same as 11	D01		11J03	Connector, M3	31-M87-07	DCN034501
11D14	Diode, DR	5.6EB1 TA21R	DDD031141				
				11P01	Connector, M3	36-03-30-114P	DCN034861
11001	Transistor,	2SC1815GR	DTR139011	11P02	Connector, M3	86-03-30-134P	DCN034911
11002	Same as 11	Q01		11P03	Connector, M3	3-07-30-134P	DCN034791
11Q03	Transistor,	2N3905	DTR150011				

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CIRCUIT REFERE	DESCRIPTION	IWATSU PART NO.	CIRCU REFERE	IT DESC INCE	RIPTION	IWATSU PART NO.
HORIZO	NTAL CONTROL		12D01	Diode, 1S953 TA	21A	DDD010821
			12D02	Same as 12D01		
12C01	Cap., 1000p, ±20%, 50∨, Cer.	DCC139051	12D03	Same as 12D01		
12C02	Cap., 56p, ± 5%, 50V, Cer.	DCC233401	12D04	Same as 12D01		
12C03	Same as 12C02		12D05	Same as 12D01		
12C04	Cap., 0.01μ , +80% $\sim -20\%$, 50V,	, Cer.	12D06	Same as 12D01		
	•••••••	DCC139501	12D07	Same as 12D01		
12C06	Cap., 22 μ , ±20%, 25V, Elect.	DCE229041	12D08	Same as 12D01		
12C07	Same as 12C04		12D09	Same as 12D01		
12C08	Same as 12C04		12D10	Diode, 1k34A		DDD010101
12C09	Same as 12C04		12D11	Same as 12D10		
12C10	Same as 12C04		12D12	Same as 12D10		
12C13	Same as 12C04		12D13	Same as 12D10		
12C99	Cap., 330p, ±20%, 50∨, Cer.	DCC139021	12D15	Same as 12D10		
			12D16	Same as 12D10		
12R01	Res., 1.1k, ±1%, ¼W, Metal	DRE939771	12D17	Same as 12D01		
12R02	Res., 1.5k, ±1%, ¼W, Metal	DRE939641				
12R03	Res., 5.6k, ±1%, ¼W, Metal	DRE939671	12IC01	IC, SN7410N		DIC110111
12R04	Same as 12R01		12IC02	IC, SN7407N		DIC110081
12R05	Res., 330,± 5%, ¼W, Carbon	DRD139351	121C03	IC, SN7400N		DIC110011
12R06	Res., 4.7k, ± 5%, ¼W, Carbon	DRD139151				
12R08	Same as 12R06		1 2S01	Switch, SUJ50A		DSW014911
12R09	Same as 12R06					
12R10	Same as 12R06		12J03	Connector, M36-I	M87-05	DCN034631
12R11	Same as 12R06		12J04	Connector, M36-I	M87-04	DCN034621
12R12	Same as 12R06		12J05	Connector, M36-I	M87-03	DCN034611
12R13	Res., 15k, ± 5%, ¼W, Carbon	DRD139611				
12R14	Same as 12R06		12P01	Connector, FF-12	2-002	DCN030701
12R15	Same as 12R06		12P02	Connector, FF-12	2-002	DCN030691
12R16	Same as 12R06		12P03	Connector, M36-0)5-30-114P	DCN034881
12R17	Same as 12R06		12P04	Connector, M36-0)4-30-114P	DCN034871
12R19	Same as 12R06		12P05	Connector, M36-0)3-30-114P	DCN034861
12R20	Same as 12R06					
12R22	Res., 360, ±5%, ¼W, Carbon	DRD138731				
12R23	Res., 39k, ±5%, ¼W, Carbon	DRD139701				
12R24	Res., 50k, Var., 1/8W, Carbon	DRV146821				
12R96	Res., 10k, <u>+</u> 5%, ¼W, Carbon	DRD139161				
12R97	Res., 1k, ± 5%, ¼W, Carbon	DRD237831				

DRD237861

Res., 1.3k, ± 5%, ¼W, Carbon

12R98

	DESCRIPTION	IWATSU PART NO.
POWER S	UPPLY & CALIBRATOR	
13C01	Cap., 0.047 μ, ±10%, 50V, Poly.	DCF129111
13C02	Cap., 0.01μ , + 80% ~ -20%, 50V	, Cer.
		DCC139501
13C03	Same as 13C01	
13C04	Cap., 100μ , $\pm 20\%$, $25V$, Elect.	DCE229071
13C05	Cap., 1000p, ± 20%, 50V, Cer.	DCC139051
13C06	Cap., 4700μ, ±20%, 16V, Elect.	DCE920711
13C07	Same as 13C04	
13C08	Cap., 470μ , $\pm 20\%$, 100V, Elect.	DCE950101
13C09	Same as 13C02	
13C11	Cap., 10μ , ± 20%, 160V, Elect.	DCE265021
13C12	Same as 13C08	
13C13	Same as 13C02	
13C15	Same as 13C11	
13C16	Cap., 2200 μ , ± 20%, 35V, Elect.	DCE925311
13C17	Same as 13C02	
13C18	Same as 13C02	
13C19	Same as 13C04	
13C20	Same as 13C16	
13C21	Cap., 22μ , $\pm 20\%$, $25V$, Elect.	DCE229041
13C22	Same as 13C02	
13C23	Same as 13C04	
13C24	Same as 13C02	
13C30	Same as 13C04	
13R01	Res., 1k, ± 5%, ¼W, Carbon	DRD139141
13R02	Res., 2.2M, ±5%, ¼W, Carbon	DRD139831
13R03	Res., 4.7, ±5%, 2W, Metal	DRS231121
13R04	Res., 50, Var., 0.5W, Carbon	DRV350201
13R06	Res., 12k, ±5%, ¼W, Carbon	DRD139601
13R07	Res., 10k, <u>+</u> 5%, ¼W, Carbon	DRD139161
13R08	Same as 13R07	
13R09	Same as 13R06	
13R10	Same as 13R01	
13R12	Same as 13R07	
13R13	Res., 820, ±1%, ¼W, Metal	DRE939151
13R14	Res., 220, Var., 0.5W, Cermet	DRV430551
13R15	Res., 30, ±1%, ¼W, Metal	DRE130461
13R16	Res., 22k, <u>+</u> 5%, ¼W, Carbon	DRD139641
13R17	Res., 220k, ±5%, ¼W, Carbon	DRD139791

	T DESCRIPTION	IWATSU PART NO.
13R18	Res., 150, ±5%, ¼W, Carbon	DRD139101
13R19	Res., 330, ± 5%, ¼W, Carbon	DRD139351
13R20	Res., 10k, ±1%, ¼W, Metal	DRE939301
13R21	Res., 100k, ±1%, ¼W, Metal	DRE939191
13R22	Same as 13R20	
13R23	Same as 13R17	
13R24	Res., 10k, ± 5%, ½W, Carbon	DRD145071
13R25	Res., 4.7k, ±5%, 1W, Metal	DRS221221
13R26	Res., 2.2, ± 5%, ¼W, Carbon	DRD138881
13R27	Same as 13R20	
13R28	Res., 47k, ±1%, ¼W, Metal	DRE939371
13R29	Same as 13R20	
13R30	Res., 47k, ±5%, ¼W, Carbon	DRD139171
13R31	Same as 13R25	
13R32	Res., 1.2k, ± 5%, 1W, Metal	DRS221211
13R33	Res., 4.7k, ±1%, ¼W,Metal	DRE939471
13R34	Same as 13R20	
13R35	Same as 13R20	
13R36	Same as 13R30	
13R37	Res., 470, ±5%, ¼W, Carbon	
		DRD139371
13R38	Res., 0.68, ±5%, ¼W, Metal	DRS221131
13R39	Same as 13R33	
13R40	Same as 13R33	
13R41	Res., 1k, Var., 0.5W, Cermet	DRV430571
13R42	Same as 13R33	
13R43	Same as 13R18	
13R44	Res., 360, ±5%, ¼W, Carbon	DRD138731
13R45	Same as 13R01	
13D01	Diode, 1G4B1	DDD021031
13D02	Same as 13D01	
13D03	Same as 13D01	
13D04	Same as 13D01	
13D05	Diode, 1S953 TA21R	DDD010821
13D06	Diode, RD24EB TA21R	DDD032281
13D07	Same as 13D06	
13D08	Same as 13D05	
13D09	Diode, V06E	DDD020061
13D10	Same as 13D06	
13D11	Same as 13D06	
13D12	Same as 13D05	

CIRCUIT	T DESCRIPTION ENCE	IWATSU PART NO.	CIRCUI	T DESCRIPTION NCE	IWATSU PART NO.
13D13	Diode, RD5.6EB1 TA21R	DDD031141	13L02	Line voltage range, S-17220-04	DCN093521
13D14	Same as 13D05		13J03	Connector, M31-M86-10	DCN034531
13D15	Same as 13D13		13J04	Connector, M31-M87-12	DCN034541
13D16	Diode, RD13EB TA21R	DDD031801	13J05	Connector, M36-M87-04	DCN034621
13D17	LED., TLG-104	DDD071111	13J06	Same as 13J05	
			13J07	Connector, M36-M87-05	DCN034631
13Q01	Transistor, 2SC1815GR	DTR139011	13J08	Connector, M31-M87-07	DCN034501
13Q02	Same as 13Q01		13J09	Connector, M36-M87-02	DCN034601
13Q03	Transistor, 2SA1015Y	DTR119011	13J10	Connector, M36-M87-06	DCN034641
13Q04	Transistor, 2SB861C	DTR125181	13J11	Same as 13J09	
13005	Transistor, 2SD1137	DTR145711	13J12	Same as 13J09	
13Q06	Same as 13Q01		13J13	Same as 13J09	
13Q07	Transistor, 2SC1061C	DTR130661			
13Q08	Same as 13Q01		13P01	Connector, CM-3	DCN013361
13Q09	Same as 13Q03		13P02	Connector, X-17213	DCN093511
13Q10	Same as 13Q03		13P03	Connector, M33-10-30-114P	DCN034721
13011	Transistor, 2SB857C	DTR125231	13P04	Connector, M33-12-30-114P	DCN034731
13Q12	F.E.T., 2SK30A-Y	DTR210141	13P05	Connector, M36-04-30-114P	DCN034871
			13P06	Same as 13P05	
13IC01	IC, μPC14305H	DIC650021	13P07	Connector, M36-05-30-114P	DCN034881
13IC02	IC, NJM4558D	DIC613031	13P08	Connector, M33-07-30-114P	DCN034691
13IC03	Same as 13IC02		13P09	Connector, M36-02-30-114P	DCN034851
			13P10	Connector, M36-06-30-114P	DCN034891
13S01	Switch, SDG5P-E	DSW016531	13P11	Same as 13P09	
13S02	Switch, SUJ12A	DSW014841	13P12	Same as 13P09	
			13P13	Same as 13P09	
13PL01	Scale Illumination Lamp	DLP016092			
13PL02	Same as 13PL01		13T01	Power Transformer, FS-34437	DCL212381
13PL03	Same as 13PL01				
			13F01	Fuse FSA-1	DFU020141
			13F02	Same as 13F01	

CIRCUIT	DESCRIPTION		CIRCUIT
KEFEKEN	UE	PART NO.	NEFENS
Z AXIS & (CRT CIRCUIT		14R10
			14R11
14C01	Cap., 47 μ , ± 20%, 100V, Elect.	DCE255091	13R12
14C02	Cap., 0.015p, ±10%, 50V, Poly	DCF129031	14R13
14C03	Cap., 10μ , ± 20%, 160V, Elect.	DCE265021	14R14
14C04	Cap., 0.01μ , +80% ~ -20%, 3kV	/, Cer.	14R15
		DCC173501	14R16
14C05	Same as 14C04		14R17
14C06	Same as 14C04		14R18
14C07	Cap., 1000p, ± 20%, 3kV, Cer.	DCC171831	14R19
14C08	Cap., 0.22 μ, ±10%, 50V, Poly.	DCE120391	14R20
14C09	Cap., 100p, ±10%, 500V, Cer.	DCC259141	14R21
14C10	Same as 13C07		14R22
14C11	Cap., 4700p, ± 20%, 3k∨, Cer.	DCC172911	14R23
14C13	Cap., 0.01 μ , +80% \sim -20%, 50	/, Cer.	14R24
		DCC139501	14R26
14C14	Cap., 1000p, $\pm 10\%$, 500V, Cer.	DCC159011	
14C15	Same as 14C14		14R30
14C16	Same as 14C13		14R31
14C20	Same as 14C13		14R32
14C21	Cap., 22p, ±5%, 50V, Cer.	DCC239121	14R34
14C22	Same as 14C13		14R35
14C23	Cap., 0.022 μ , ±10%, 200V, Pol	у.	14R36
		DCF150271	14R37
14C24	Cap., 22μ , $\pm 20\%$, $25V$, Elect.	DCE229041	14R38
14C25	Same as 14C24		14R39
14C26	Same as 14C13		14R40
14C96	Same as 14C14		14R41
14C98	Cap., 22μ , $\pm 20\%$, $25V$, Elect.	DCE225151	14R42
14C99	Cap., 0.1μ , ±20%, 50V, Poly.	DCF120351	14R43
			14R44
14L01	Rotation Coil	DCL140111	14R45
			14R46
14R01	Res., 510, ± 5%, ¼W, Carbon	DRD139381	14R47
14R02	Res., 680, ± 5%, ¼W, Carbon	DRD139391	14R48
14R03	Res., 100k, ± 5%, ¼W, Carbon	DRD139751	14R49
14R04	Res., 430k, ± 5%, ¼W, Carbon	DRD139021	14R50
14R05	Res., 2k, ± 5%, ¼W, Carbon	DRD139451	14R51
14R06	Res., 1k, ±5%, ¼W, Carbon	DRD139141	14R52
14R07	Res., 100k, Var., 0.5W, Cermet	DRV430631	14R53
14R08	Res., 430k, ±1%, ¼W, Metal	DRE131461	14R96
14R09	Res., 10k, ± 5%, ¼W, Carbon	DRD139161	14R97

RCUIT	DESCRIPTION	IWATSU PART NO.
R10	Res., 2.2, ±5%, ¼W, Carbon	DRD138881
R11	Same as 14R03	
R12	Res., 2.2M, ±5%, 1W, Metal	DRG940311
R13	Res., 2M, Var., 1.5W, Cermet	DRV350231
R14	Res., 7.5M, ±5%, 2W, Metal	DRG950111
R15	Res., 1M, ± 5%, ¼W, Carbon	DRD238551
R16	Res., 16M, ±5%, 1W, Metal	DRG940291
R17	Same as 14R07	
R18	Res., 22k, ± 5%, ¼W, Carbon	DRD139641
R19	Res., 39k, ±5%, ¼W, Carbon	DRD139701
R20	Same as 14R07	
R21	Same as 14R07	
R22	Res., 27k, ± 5%, ¼W, Carbon	DRD139661
R23	Res., 47k, ±5%, ¼W, Carbon	DRD139171
R24	Res., 330, ± 5%, ¼W, Carbon	DRD139351
R26	Res., (20k, 20k), Var., 0.05W, C	arbon
		DRV131421
R30	Res., 4.7k, ±5%, 1W, Metal	DRS221221
R31	Res., 3.3k, ± 5%, ¼W, Carbon	DRD139501
R32	Same as 14R06	
R34	Res., 10k, Var., 1.5W, Cermet	DRV350221
R35	Res., 470k, ±5%, ¼W, Carbon	DRD139371
R36	Res., 3.3k, ±1%, ¼W, Metal	DRE939661
R37	Res., 750, ±1%, ¼W, Metal	DRE130801
R38	Res., 1.5k, ± 5%, ¼W, Carbon	DRD139431
R39	Res., 4.7k, ± 5%, ¼W, Carbon	DRD139151
R40	Res., 1M, ± 5%, ¼W, Carbon	DRD139821
R41	Same as 14R01	
R42	Res., 68k, ±5%, ¼W,Carbon	DRD139731
R43	Same as 14R42	
R44	Res., 100, ± 5%, ¼W, Carbon	DRD139291
R45	Same as 14R06	
R46	Same as 14R31	
R47	Same as 14R24	
R48	Same as 14R03	
R49	Same as 14R44	
R50	Res., 82k, ± 5%, ¼W, Carbon	DRD139741
R51	Same as 14R09	
R52	Res., 47, ± 5%, ¼W, Carbon	DRD139261
R53	Res., 56k, ±1%, ¼W, Metal	DRE939381
R96	Res,. 15k, ± 5%, ¼W, Carbon	DRD135111
R97	Same as 14R09	

CIRCUI	T DESCRIPTION ENCE	IWATSU PART NO.	CIRCUI	T ENCE	DESCRIPTION	IWATSU PART NO.
14R98	Res., 22k, ± 5%, ¼W, Carbon	DRD238151	14IC01	IC, NJM 45	58D	DIC613031
14R99	Res., 10k, ±5%, ¼W, Carbon	DRD238071	14J01	Connector,	M36-M87-06	DCN034641
			14J02	Connector,	M36-M87-02	DCN034601
14D01	Diode, 1S953 TA21R	DDD010821	14J03	Same as 14.	J02	
14D02	Same as 14D01		14J05	Same as 14	J02	
14D03	Diode, HVT-30S	DDD021421	14J06	Same as 14.	J02	
14D04	Diode, ESJA35-12	DDD022111	14J07	Same as 14.	J02	
14D05	Same as 14D04		14J08	Connector,	M36-M87-04	DCN034621
14D06	Same as 14D04		14J11	Same as 14.	JO1	
14D07	Same as 14D04		14J12	Same as 14.	J02	
14D10	Same as 14D01		14J13	Same as 14.	J02	
14D11	Same as 14D01		14J14	Connector,	M36-M87-05	DCN034631
14D12	Same as 14D01		14J15	Connector,	M31-M87-08	DCN034511
14D13	Same as 14D01		14J20	Connector,	BNC080	DCN040711
14D14	Diode, RD3.0EB TA21R	DDD032241				
14D15	Same as 14D01		14P01	Connector,	M36-06-30-114P	DCN034891
14D16	Same as 14D01		14P02	Connector,	M36-02-30-114P	DCN034851
			14P03	Same as 14	202	
14D15A	High Voltage Block, MSL-3585A	DES050551	14P05	Same as 14	202	
			14P06	Same as 14	202	
14Q01	Transistor, 2SC2SC2502	DTR137651	14P07	Same as 14	202	
14002	Transistor, 2SC1834	DTR131031	14P08	Connector,	M36-04-30-134P	DCN034921
14Q10	Same as 14Q02		14P11	Same as 14F	201	
14Q11	Transistor, 2SC1815GR	DTR139011	14P12	Same as 14F	202	
14Q12	Transistor, 2SB648AC	DTR125191	14P13	Same as 14F	02	
14Q13	Transistor, 2SD668AC	DTR145381	14P14	Connector,	M36-05-30-114P	DCN034881
14Q14	Same as 14Q11		14P15	Connector,	M36-08-30-114P	DCN034701
14015	Transistor, 2SA1015Y	DTR119011	14P16	Same as 14F	02	
14Q16	Same as 14Q11					
			14T01	High Voltag FS-34442	e Transformer,	DCL220351

14NE1

14V01 Cathode Ray Tube, S-8551B31 DET016051

Neon Lamp, NL-235D

DLP025171

CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART NO.	CIRCUIT REFERENCE	DESCRIPTION	IWATSU PART NO.
PRINTED CIRCUIT	BOARD		POWER BOARD		KPN190321
			HV & TRIGGER BO	DARD	KPN190431
VERTICAL BOARD)	KPN190121	MAIN BOARD		KPN190521
HORIZONTAL BOA	ARD	KPN190221			

Mechanical Parts List and Illustration

INDEX NO.	NAME AND DESCRIPTION	Qʻty	IWATSU PART NO.
1	COVER, upper	1	KBA512931
2	COVER, lower	1	KBA518211
3	PANEL A, Front	1	KPA142331
4	PANEL B, front	1	KPA142511
5	PANEL, rear	1	KCM062221
6	ACCESORY BAG		KLT021721
7	HANDLE, arm	2	KCM059431
8	HANDLE, bar	1	KMM198011
9	COVER, handle bar	1	KCM059731
10	COVER', handle arm	2	KCM059521
11	GEAR, stater	2	KCM059611
12	SPRING, handle arm	2	KSR012611
13	STOPPER, handle arm spring	2	KBA508121
14	FIXED METAL PLATE, stater gear	2	KBA512521
15	NAME PLATE, serial number	1	ARA002711
16	NAME PLATE, line voltage range	1	KRA103921
17	FOOT, rubber 16 ϕ	4	KGM007931
18	RH – 3X10A	4	MSQ930223
19	N101220SR	3	KCM060811
20	A301540DGB	1	KCM062411
21	A471560DGB	1	KCM062321
22	TIMING PANEL	1	KPA142121
23	TIMING PANEL SUPPORT B	1	KCM061811
24	A301760DGB	2	KCM062511
25	N111230SWP	1	KCM066211
26	S18150DGA	1	KCM061011
27	K141360SGP	4	KCM061511
28	K141360SG	5	KCM061411
29	MULTI – DIAL	1	DRV990131
30	K101160SG	2	KCM061211
102	KD (+) 3 x 18S	8	MKD130181
103	KP (+) 3 x 12S		MKP130121
105	КТ (+) 2 x 4B		MKT220042
106	KT (+) 3 x 8B		MKT230082
114	SM5 – 3 x 8		MSM530081
115	HL – 3 x 3S		MHL130039
120	SW — 3S		MSW130001
121	W – 3S		MWW130001
122	NYLON W - 2 (DM- 7100)	6	KPL102411
130	NUTSERT M3	4	MSQ910011

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Figure 9-1

9–3

Section 9	Mechanical Parts List	
Figure 9-2		
INDEX NO.	NAME AND DESCRIPTION	
31	COVER, panel	
32	SUB PANEL, front	
33	CHASSIS	
34	FRAME	
35	SUB PANEL, rear	
36	CRT SHIELD PLATE	
37	CASE, high voltage	
38	SHIELD PLATE, CH2	
39	SEAT PLAE, transformer	
40	STOPPER, transistor	
41	SILICON RUBBER, heat dissipater 25m/m	
42	SEAT PLATE, CP	
43	SEAT PLATE, line voltage selector	
44	SEAT PLATE, INLET	
45	PS KNOB CI, POWER	
46	JOINT	
47	ROD, power switch	
48	INSULATE COUPLING 8-16	
49	SPRING, ground	
50	SPRING A, ground	
51	GUIDE, printed circuit board 11633-1	
52	BAND	
64	BUSHING KG-024	
77	CP OUTPUT TERMINAL	
82	TERMINAL, CAL	
100	KD (+) 3 x 6S	
101	KD (+) 3 x 8S	
110	SM1-3 × 6	
111	SMI-3 x 8 CT	
114	SM5-3 x 8	
116	HL - 3 x 4S	
117	KP (+) 3 x 10S	
120	SW –3S	
121	W -3S	
123	WASHER, WS09 (1.5) 62BO	
125	STAY, 9mm (Ganged with 33)	
126	STAY, 18.5mm (Ganged with 33)	

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IWATSU PART NO.

	KCM059921
1	KPA141841
1	KBA516061
1	KBA513751
1	KPA142251
1	KBA516831
1	KBA516921
1	KBA517431
1	KBA516721
2	KBA516411
	527510003
1	KBA526711
1	KBA526611
1	KBA526511
1	KCM061911
1	KCM006621
1	KMM198311
1	KCM006521
1	KBA520821
1	KBA526011
3	MZT900381
	MHK000961
1	MBU000501
1	KPS009511
1	DTA010871
	MKD130061
	MKD130081
20	MSM130061
	MSM130081
	MSM530081
	MHL130049
	MKP130101
	MSW130001
	MWW130001
1	KMM199611
3	AMM627811
2	KMM198211





Figure 9-2

Section 9	Mechanical Parts List	
Figure 9-3		
INDEX NO.	NAME AND DESCRIPTION	
55	LUG 10.2 <i>φ</i>	
56	SUB PANEL, H	
57	SUB PANEL, V	
58	ATT SHIELD PLATE A	
59	ATT SHIELD PLATE B	
60	SHIELD PLATE	
61	PCB ATTACHMENT BOARD, power supply	
62	STAY D, screw	
63	STAY B, screw	
78	PS KNOB D1	
79	PS KNOB D2	
100	KD (+) 3 x 6S	
101	KD (+) 3 x 8S	
109	SM1–2.6 x 6CT	
110	SM1 –3 x 6	
112	SM1 –3 x 12CT	
113	SM5 –3 x 6	
114	SM5 –3 × 8	
119	KP (+) 3 x 14S	
120	SW_3S	
124	W-3S	

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IWATSU PART NO.

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2	KPS004311
1	KPA141931
1	KPA142721
1	KBA525621
1	KBA525721
1	KBA517361
1	KBA529711
1	KMM200711
7	KMM198721
36	KCM062001
2	KCM062111
	MKD130061
	MKD130081
	MSM126061
20	MSM130061
10	MSM130121
50	MSM530061
	MSM530081
	MKP130141
	MSW130001
	MWW130001

منعتھ بر SS-5710



Figure 9-3

Section 9	Mechanical Parts List	
Figure 9-4		
INDEX NO.	NAME AND DESCRIPTION	
52	BAND, CU-70	
65	BEZEL B2	
66	FILTER FRAME B2, BEZEL b2	
67	FILTER APLATE B	
68	STOPPER, filter	
69	CUSHION, CRT	
70	B (SS-5421)	
71	SHIELD CASE A	
72	SHIELD CASE B	
73	SUSPENSION A, CRT shielded case A and B	
74	SUSPENSION B, CRT shielded case A and B	
75	CRT FIX BAND	
76	CRT FIX RUBBER	
77	NAME PLATE, title, SS-5710	
104	KP (+) 3 x 25S	
107	KT (+) 3 x 10B	
111	SM13 x 8CT	
113	SM5 –3 × 6	
114	SM53×8	
120	SW-3S	

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IWATSU PART NO.

	MHK000961
1	KCM060321
1	KCM060411
1	KPL014811
1	KPL013411
1	KGM009631
1	KCM056111
1	KBA513221
1	KBA517211
2	KBA513421
1	KBA513521
1	KBA513621
1	KGM009511
1	KRA103521
1	MKP130251
	MKT230102
	MSM130081
50	MSM530061
	MSM530081
	MSW130001





Figure 9-4

IWATEU ELECTRIC CO., LTD.

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