



**OSCILLOSCOPE
OS-9020G
SERVICE MANUAL**

OS-9000,3000SRS 변경내용

	Previous Model name	New Model Name	Part No. Before change	Part No. After Change	Before change	After change	
NO	변경전모델명	변경후모델명	변경전품목번호	변경후품목번호	변경전 품명	변경후 품명	수량
15	OS-902PB	OS-502PB	369-101	369-101-2	KNOB 3	KNOB 3,WHITE	3
16	OS-902PB	OS-502PB	369-102	369-102-1	KNOB 4 V/D	KNOB 4 V/D,WHITE	2
17	OS-902PB	OS-502PB	369-103	369-103-3	KNOB 5 A T/D	KNOB 5 A T/D,WHITE	1
18	OS-902PB	OS-502PB	369-104	369-104-1	KNOB 6 L/H	KNOB 6 L/H,WHITE	1
19	OS-902PB	OS-502PB	369-105R1	369-105-1	KNOB B T/D REV1	KNOB B T/D ,WHITE	1
20	OS-902PB	OS-502PB	369-106-1R2	369-106-2	KNOB B T/D 2	KNOB B T/D 2,WHITE	1
21	OS-902PB	OS-502PB	369-107R2	369-107-1	EXT ROD	EXT ROD,WHITE	3
22	OS-902PB	OS-502PB	397-001-1	397-001-2	REAR FOOT	REAR FOOT GRAY	4
23	OS-902PB	OS-502PB	397-002-1	397-002-2	DOWN FOOT	DOWN FOOT GRAY	4
24	OS-902PB	OS-502PB	415-539-C	415-539-A	READOUT OSCOPE	CARTON BOX OSCOPE	1
25	OS-902PB	OS-502PB	587-043-2	587-043-1	(자재목록불요)FILTER	FILTER ,BLUE	1
1	OS-9020P	OS-9020	215-134	215-134-1	FRONT CASE	FRONT CASE,WHITE	1
2	OS-9020P	OS-9020	219-197-2R3	219-197-5	COVER TOP STEEL 9020P	COVER TOP STEEL 9020	1
3	OS-9020P	OS-9020	219-198R3	219-198-1	COVER BOTTOM	COVER BOTTOM,WHITE	1
4	OS-9020P	OS-9020	242-275-5	242-275-11	REAR PLATE OS9020P	REAR PLATE OS9020	1
5	OS-9020P	OS-9020	247-152R3	247-169	FRONT PANEL OS9020P	FRONT PANEL OS9020	1
6	OS-9020P	OS-9020	277-675-10	277-709-1	NAME LABEL OS9020P	NAME LABEL OS9020	1
7	OS-9020P	OS-9020	282-522-1K	282-528-3K	MANUAL OP OS9020P KOR	MANUAL OP OS9020 KOR	1
8	OS-9020P	OS-9020	282-522-1R1	282-528-3	MANUAL OP OS9020P ENG	MANUAL OP OS9020 ENG	1
9	OS-9020P	OS-9020	282-522S	282-528-3S	MANUAL SVC OS9020P	MANUAL SVC OS9020	1
10	OS-9020P	OS-9020	367-429R2	367-429-1	HANDLE	HANDLE,WHITE	1
11	OS-9020P	OS-9020	369-038-1	369-038-2	KNOB POWER SW	KNOB POWER SW,SKY BLUE	1
12	OS-9020P	OS-9020	369-101-1	369-100-1	KNOB 2	KNOB 2,WHITE	7
13	OS-9020P	OS-9020	369-101	369-101-2	KNOB 3	KNOB 3,WHITE	2
14	OS-9020P	OS-9020	369-102	369-102-1	KNOB 4 V/D	KNOB 4 V/D,WHITE	2
15	OS-9020P	OS-9020	369-103-1	369-103-4	KNOB A T/D	KNOB A T/D BELTON,WHITE	1
16	OS-9020P	OS-9020	369-112	369-112-1	KNOB EKT	KNOB EKT,WHITE	1
17	OS-9020P	OS-9020	369-113	369-113-1	KNOB SLIDE	KNOB SLIDE,WHITE	4
18	OS-9020P	OS-9020	369-114	369-114-1	KNOB SLIDE	KNOB SLIDE,WHITE	6
19	OS-9020P	OS-9020	397-001-1	397-001-2	REAR FOOT	REAR FOOT GRAY	4
20	OS-9020P	OS-9020	397-002-1	397-002-2	DOWN FOOT	DOWN FOOT GRAY	4
21	OS-9020P	OS-9020	587-043-2	587-043-1	(자재목록불요)FILTER	FILTER ,BLUE	1
1	OS-9020G	OS-5020G	215-134	215-134-1	FRONT CASE	FRONT CASE,WHITE	1
2	OS-9020G	OS-5020G	219-197-3R3	219-197-6	COVER TOP STEEL	COVER TOP STEEL,WHITE	1
3	OS-9020G	OS-5020G	219-198R3	219-198-1	COVER BOTTOM	COVER BOTTOM,WHITE	1
4	OS-9020G	OS-5020G	242-245-1	242-245-4	PLATE RUBBER 1	PLATE RUBBER 1,WHITE	5
5	OS-9020G	OS-5020G	242-275-1R14	242-275-7	REAR PLATE OS9020G	REAR PLATE OS5020G	1
6	OS-9020G	OS-5020G	247-145R4	247-168	FRONT PANEL OS9020G	FRONT PANEL OS5020G	1
7	OS-9020G	OS-5020G	277-675-7	277-709-3	NAME LABEL OS9020G	NAME LABEL OS5020G	1
8	OS-9020G	OS-5020G	282-515-3K	282-528-2K	MANUAL OP OS9020G KOR	MANUAL OP OS5020G KOR	1
9	OS-9020G	OS-5020G	282-515-3R1	282-528-2	MANUAL OP OS9020G ENG	MANUAL OP OS5020G ENG	1
10	OS-9020G	OS-5020G	282-515S	282-528-2S	MANUAL SVC OS9020G	MANUAL SVC OS5020G	1
11	OS-9020G	OS-5020G	367-429R2	367-429-1	HANDLE	HANDLE,WHITE	1
12	OS-9020G	OS-5020G	369-038-1	369-038-2	KNOB POWER SW	KNOB POWER SW,SKY BLUE	1
13	OS-9020G	OS-5020G	369-055-1R4	369-055-2	CONTROL KNOB	CONTROL KNOB,WHITE	10
14	OS-9020G	OS-5020G	369-100	369-100-1	KNOB 2	KNOB 2,WHITE	5
15	OS-9020G	OS-5020G	369-101	369-101-2	KNOB 3	KNOB 3,WHITE	4
16	OS-9020G	OS-5020G	369-102	369-102-1	KNOB 4 V/D	KNOB 4 V/D,WHITE	2
17	OS-9020G	OS-5020G	369-103-1	369-103-4	KNOB A T/D	KNOB A T/D BELTON,WHITE	1
18	OS-9020G	OS-5020G	369-104	369-104-1	KNOB 6 L/H	KNOB 6 L/H,WHITE	2
19	OS-9020G	OS-5020G	369-107R2	369-107-1	EXT ROD	EXT ROD,WHITE	2
20	OS-9020G	OS-5020G	397-001-1	397-001-2	REAR FOOT	REAR FOOT GRAY	4
21	OS-9020G	OS-5020G	397-002-1	397-002-2	DOWN FOOT	DOWN FOOT GRAY	4
22	OS-9020G	OS-5020G	587-043-2	587-043-1	(자재목록불요)FILTER	FILTER ,BLUE	1
1	OS-9020A	OS-9020A	215-134	215-134-1	FRONT CASE	FRONT CASE,WHITE	1
2	OS-9020A	OS-9020A	219-197-3R3	219-197-6	COVER TOP STEEL	COVER TOP STEEL,WHITE	1
3	OS-9020A	OS-9020A	219-198R3	219-198-1	COVER BOTTOM	COVER BOTTOM,WHITE	1
4	OS-9020A	OS-9020A	242-275-4R14	242-275-10	REAR PLATE OS9020A	REAR PLATE OS9020A	1
5	OS-9020A	OS-9020A	242-305R4	242-305-1	RUBBER PLATE	RUBBER PLATE,WHITE	3
6	OS-9020A	OS-9020A	247-154-1	247-162	FRONT PANEL OS9020A	FRONT PANEL OS9020A,GRAY	1
7	OS-9020A	OS-9020A	277-675-2	277-709-2	NAME LABEL OS9020A	NAME LABEL OS9020A	1
8	OS-9020A	OS-9020A	282-521-7K	282-528-1K	MANUAL OP OS9000SRS KOR	MANUAL OP OS5000SRS KOR	1
9	OS-9020A	OS-9020A	282-521-7R2	282-528-1	MANUAL OP OS9000SRS ENG	MANUAL OP OS5000SRS ENG	1
10	OS-9020A	OS-9020A	282-521S	282-528-1S	MANUAL SVC OS9000SRS	MANUAL SVC OS5000SRS	1
11	OS-9020A	OS-9020A	367-429R2	367-429-1	HANDLE	HANDLE,WHITE	1
12	OS-9020A	OS-9020A	369-038-1	369-038-2	KNOB POWER SW	KNOB POWER SW,SKY BLUE	1
13	OS-9020A	OS-9020A	369-100	369-100-1	KNOB 2	KNOB 2,WHITE	4
14	OS-9020A	OS-9020A	369-101	369-101-2	KNOB 3	KNOB 3,WHITE	3
15	OS-9020A	OS-9020A	369-102	369-102-1	KNOB 4 V/D	KNOB 4 V/D,WHITE	2
16	OS-9020A	OS-9020A	369-103-2	369-103-5	KNOB A T/D	KNOB A T/D NOBLE,WHITE	1
17	OS-9020A	OS-9020A	369-104	369-104-1	KNOB 6 L/H	KNOB 6 L/H,WHITE	1
18	OS-9020A	OS-9020A	369-107R2	369-107-1	EXT ROD	EXT ROD,WHITE	2

Servicing Precautions

Please read all instructions in the service manual throughly before servicing.

Disconnect power cord from power source before opening the enclosure.

Instructions

1. To maintain the precision and reliability of the product use it in the standard setting (temperature 10 ° -35 ° centigrade, humidity 45%~85%)
2. After turning on power, please allow a **15-minute** pre-heating period before use.
3. Triple-line power cord is to be used for the product. But when you are using the doubleline cord, make sure to connect the earth terminal of the product to the earth at the power source for safety.
4. For quality improvement the exterior design and specifications of the product can be changed without prior notice.

Warranty

Warranty service covers a period of one year from the date of original purchase.

In case of technical failure within a year, repair service will be provided by our service **center** or sales outlet free of charge.

We charge for repairs after the one year warranty period expires.

When the failure is a result of user's neglect, natural disaster or accident, we charge for repairs regardless of the warranty period.

Notice

This Service Manual describes the most typical product of this model. If there are any specific differences between this Manual and the servicing unit, please contact Goldstar Precision sales office in your area.

LG Precision Co., Ltd.

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1. GENERAL

This product of OS-9020G is as shown on Fig.1 and to generate triangular wave, sine wave and rectangular wave which have the frequency range and DC offset function from 0.1Hz to 1MHz as well as the waveform meter that has frequency range from DC to 20MHz and is a multipurpose portable oscilloscope mounted by a function producer that generates otherwise pills of total level of the same frequency as above.

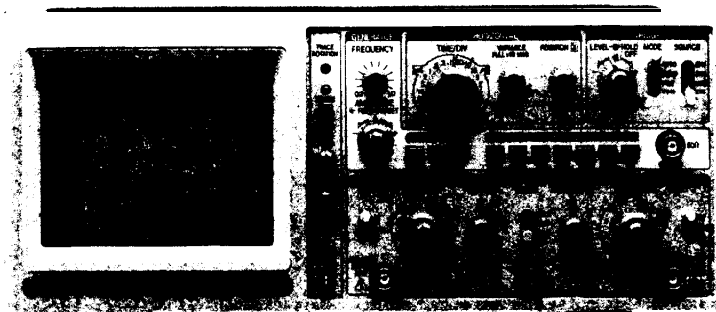


Fig. 1. OS-9020G Oscilloscope

2. OS-9020G SPECIFICATIONS

PARTS	SPECIFICATIONS
* CRT	
1) Configuration and useful screen	6-inch rectangular screen with internal graticule ; 8x10 Div (1 div = 1 Cm) , marking for measurement of rise time. 2mm subdivisions along the central axis.
2) Accelerating potential	approx. +1.9 KVDC (ref. cathode)
3) Phosphor	P31 (standard)
4) Focussing	possible
5) Trace rotation	provided
6) Intensity control	provided
* Vertical Deflection	
1) Band-width (-3dB) DC coupled	DC to 20MHz normal (x1) DC to 7MHz magnified (x5)
AC coupled	10Hz to 20MHz normal (x1) 10Hz to 7MHz magnified (x5)
2) Modes	CH1, CH2, ADD, DUAL (CHOP ; Time/div switch - 0.2s to 5mS. ALT ; Time/div switch - 2mS to 0.2uS)
3) Deflection Factor	5mV/div to 5V/div in 10 calibrated steps of a 1-2-5 sequence continuously variable between steps at least 1:2.5 (x5 MAG ; 1mV/div to 1V/div in 10 calibrated steps.)
4) Accuracy	normal ; ±3%, magnified ; ±5%
5) Input impedance	approx. 1M-ohm in parallel with 25pF
6) Maximum input voltage	Direct ; 250V(DC+peak AC), with probe ; refer to probe specification
7) Input coupling	DC - GND - AC
8) Rise time	17.5nS or less (50nS or less: at x5 MAG)
9) Clil out	20mV/div into 50 ohms ; Dc to 10MHz (-3dB)
10) Polarity invertior	CH2 only
* Horizontal Deflection	
1) Display modes	x1 , x10 , X-Y
2) Time base A	0.2us - 0.2S/div in 19 calibrated steps, 1-2-5 sequence. uncalibrated continuous control between steps at least 1:2.5
3) Hold-off time	variable with the holdoff control

PARTS	SPECIFICATIONS											
4) Sweep magnification	10 times (maximum sweep rate ; 20nS/div) Note ; 50nS/div, 20nS/div of TIME BASE are uncalibrated.											
5) Accuracy	±3%, ±5% (0°C to 50°C), additional error for magnifier ±2%											
* Trigger System												
1) Modes	auto , norm , TV-V , TV-H											
2) Source	CH1 , CH2 , LINE , EXT											
3) Coupling	AC											
4) Slope	+ or -											
5) Sensitivity and Frequency range	<table><tr><td></td><td>20Hz - 2MHz</td><td>2MHz - 20MHz</td></tr><tr><td>INT</td><td>0.5 div</td><td>1.5 div</td></tr><tr><td>EXT</td><td>0.2 vp-p</td><td>0.8 Vp-p</td></tr></table>				20Hz - 2MHz	2MHz - 20MHz	INT	0.5 div	1.5 div	EXT	0.2 vp-p	0.8 Vp-p
	20Hz - 2MHz	2MHz - 20MHz										
INT	0.5 div	1.5 div										
EXT	0.2 vp-p	0.8 Vp-p										
AUTO, NORM												
TV-VW-H	at least 1 div or 1.0Vp-p											
6) External trigger input impedance	approx. 1M-ohm in parallel with 25pF											
Max. input voltage	250V (DC + AC peak)											
* X-Y Operation												
1) X-axis	(same as CH1 except for the following) Deflection factor ; same as that of CH1 Accuracy ; ±5% Frequency response; DC to 500KHz (-3dB)											
2) Y-axis	same as CH2											
3) X-Y phase deff.	3" or less (at DC to 50KHz)											
* Calibrator (probe adj)	approx. 1KHz frequency , 0.5V (±3%) square wave duty ratio : 50%											
* Function Generator												
1) Frequency Range	0.1 Hz to 1 MHz (7 range)											
2) Output Waveform	sine , triangle , square											
3) Frequency stability	±0.5% (1/10/100/1K/10K/100K range) ±1% (1M range) [after 15 minutes late power on											
4) Frequency variable	10 : 1 Min.											
5) Output impedance	50 Ω ±10% (TTL output ; FAN-OUT 20 ea)											

PARTS	SPECIFICATIONS											
6) Output Voltage	14Vp-p Min. (open circuit) - continuous variable DC OFFSET provided (open circuit ; ±6V Min.) TTL LEVEL (square wave only) ; 3Vp-p Min.											
7) Sinewave distortion & jittering	2% Max. (10Hz - 100KHz) / 10Hz (100Hz range 0.1) less than 1/33											
8) Duty ratio	50±3% Max. (at 1KHz; max. output level)											
9) Square wave rise & fall time	50Ω output ; 120nS Max. (at max. output LEVEL into 50Ω) TTL output ; 25nS Max.											
* Power Supply												
1) Voltage range	<table><tr><td>voltage range</td><td>fuse</td></tr><tr><td>100 (90 - 110V) / AC</td><td>2A250V</td></tr><tr><td>120 (108 - 132V) / AC</td><td>2A250V</td></tr><tr><td>220 (198 - 242V) / AC</td><td>1A250V</td></tr><tr><td>230 (207 - 250V) / AC</td><td>1A250V</td></tr></table>		voltage range	fuse	100 (90 - 110V) / AC	2A250V	120 (108 - 132V) / AC	2A250V	220 (198 - 242V) / AC	1A250V	230 (207 - 250V) / AC	1A250V
voltage range	fuse											
100 (90 - 110V) / AC	2A250V											
120 (108 - 132V) / AC	2A250V											
220 (198 - 242V) / AC	1A250V											
230 (207 - 250V) / AC	1A250V											
2) Frequency	50 / 60Hz											
3) Power consumption	approx. 45W											
* Physical Characteristics												
1) Weight	7.4Kg											
2) Dimension	320 mm (W) x 140 mm (H) x 430 mm (L)											
* Environmental Characteristics												
1) Temperature range for rated operation	+10 ° C to +35 ° C (+50 ° F to +95 ° F)											
2) Max. ambient operating temp.	0 ° C to +40 ° C (+32 ° F to +104 ° F)											
3) Max. storage temerature	-20" C to +70 ° C (-4" F to +158° F)											
4) Humidity range for rated operation	45% to 85% RH											
5) Max.ambient operating humidity	35% to 85% RH											

3. ACCESSORIES

(1) Cable (BNC to CLIP)	-----	1
(2) Probe (Option)	-----	2
(3) Fuse (2A for 100V or 120V set or 1A for 220V and 230V set)	-----	1
(4) Power supply code	-----	1
(5) Operation manual	-----	1

4. PREVENTIVE MAINTENANCE

Preventive maintenance, when performed on a regular basis, can prevent instrument breakdown and may improve the reliability of the oscilloscope. The severity of environment to which this instrument is subjected will determine the frequency of maintenance. A convenient time to perform preventive maintenance is preceding recalibration of the instrument.

Disassembly

Remove the top cover and the bottom cover of the instrument. Most of the internal parts of the instrument are now accessible, if access to the front of the circuit board are necessary, remove the knobs from the external control shafts on the board.

Cleaning

The instrument should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause component breakdown.

The covers provide protection against dust in the interior of the instrument. Loose dust accumulated on these covers can be removed with a soft cloth or small brush.

Dirt that remains can be removed with a soft cloth dampened in a mild detergent and water solution. abrasive cleaners should not be used. Cleaning the interior should only be occasionally necessary. The best way to clean the interior is to blow off the dust with a dry, **low-**velocity stream of air. A soft-bristle brush or a cottontipped applicator is useful for cleaning in narrow spaces or for cleaning more delicate components.

Visual Inspection

The instrument should be inspected occasionally for such defects as **brocken** connections, improperly seated transistors, damaged circuit boards, and heat-damaged parts. the corrective procedure for most visible defects is apparent ; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument ; therefore, correcting the cause of the overheating is important to prevent **recurrence** of the damage.

5. CIRCUIT DESCRIPTION

The block diagram (page 51) shows the overall relationship between all of the circuits. Complete schematics of each circuit are also given in section **schematics** diagrams (page 52 to 68). Refer to these diagrams throughout the following circuit description for electrical values and relationship.

ATTENUATOR

Signals applied to the input connector can be either AC coupled or DC coupled, or they can be disconnected to the internal circuit when S201 (**S301**) is GND position.

Attenuation is determined by the setting of the VOLT / DIV switch.

The attenuator that is controlled by the VOLT / DIV switch has $\div 1/2$, $\div 1$, $\div 10$, 3100 circuit.

$\div 2$, $\div 5$, $\div 10$ circuits are in RA201 (RA301) and $\div 10$, $\div 100$ circuits are between S202 (S302) and S203 (S303).

CH1 (CH2) INPUT AMPLIFIER

Signal from the input attenuator is connected to source follower **Q201** (**Q301**). When excessively high-amplitude signals are applied to the source follower, the signals will be **Q202** (**Q302**) and the gate-source junction of **Q201** (**Q301**). When **S202D** (**S302D**) is open (**PULL \times 5MAG**), the signal that is feed back to OP AMP through **R239** (**R328**) amplifies the output signal of **Q204** (**Q304**) by 5 times.

And the signal of Q206 (Q306) base is converted from a single-ended signal to a paraphrase signal by differential amplifier.

CH1 (CH2) PREAMP & TRIGGER PICK OFF

Vertical preamp circuits provide control of vertical position.

They also contain a stage to provide a sample of the input signal to the trigger preamp circuit for internal triggering from the CH1 or CH2 signal only. And the trigger preamp of CH1 provides the CH1 input signal to the horizontal amplifier in the X-Y position of the TIME / DIV switch.

The trigger preamp circuit amplifies the internal trigger signal to the level necessary to drive the trigger generator circuit.

VERTICAL CONTROL

The **vertical** switching circuit determines the input signal or combination of input signals to be connected to the vertical main amp.

Input signal combinations that can be displayed are selected by D FLIP-FLOP that is controlled by the vertical mode switches and the X-Y position of the TIME / DIV switch.

In the DUAL modes, both channels are alternately displayed on a shared time basis.

VERTICAL MAIN AMPLIFIER

The vertical main amplifier circuit provides the final amplification for the vertical deflection signal before it is applied to the vertical deflection plates of the CRT.

TRIGGER GENERATOR

The Trigger Generator circuit produces trigger pulses to start the sweep generator circuit.

The Trigger Generator circuit consists of the trigger source, trigger mode switch, TV **synchronization** circuit, trigger amplifier, U603 and etc. The Trigger Source Switch selects one signal of the signals from the vertical trigger preamps, power line source applied to this instrument, external trigger input BNC connector connected to front panel.

The Trigger Generator Circuit has the circuit to control the trigger level and slope.

The signal type is AC.

The Trigger mode Switch determines the operating mode for the trigger generator circuit.

In the NORM mode, the sweep signal is generated only the trigger signal is generated, Operation in the AUTO, TV-V mode is the same operation as NORM mode, except that a free running trace is displayed when a trigger pulse is not present or the amplitude of the trigger signal is not adequate. The Base Signal of Q605 which enters through three switches, Q601, Q602 and etc., is amplified by Q604, Q605.

The amplified signal, the collector signal of Q604, enters the NO.2 pin of U603, outputs in NO.8 pin of U603.

The NO.8 pin signal of U603 is called trigger signal or trigger pulse.

SWEEP GENERATOR

Sweep generator circuit consists of sweep gate circuit and miller integrator. The sweep gate is on, a very little negative going signal is generated in the gate of **Q612**, input Miller Integrator, by R-C network.

The signal in the gate of **Q612** is amplified by Miller Integrator, the amplified signal appears in the Emitter of **Q614**, is called sweep signal and enters the Base of **Q627** through R732.

This sweep signal is generated on command (trigger pulse) from the trigger generator circuit.

The sweep gate circuit produces an unblanking gate to unblank the CRT during sweep time.

HORIZONTAL OUTPUT AMPLIFIER

The Horizontal Output Amplifier provides the final signal amplification to drive the CRT horizontal deflection plates.

The Horizontal Output Amplifier consists of six cascade stage amplifiers. The first stage horizontal main amplifier has a low input impedance and requires very little voltage change at the input to produce the desired output change.

The output signal from complementary amplifier Q638, Q639 drives the right **horizontal deflection plate**.

The output signal from complementary amplifier Q636, **Q637** drives the left horizontal deflection plate.

The Horizontal Output Amplifier has the horizontal magnification and the horizontal position functions.

In all position of the TIME / DIV select switch except X-Y the input signal of the horizontal output amplifier is the sawtooth signal from the sweep generator. In the X-Y position of the TIME / DIV select switch the input signal of the Horizontal Output Amplifier is the signal from the channel 1 preamp circuit of the vertical deflection system.

POWER SUPPLY

The low voltage Power Supply Circuit provides five regulated sources (-12 Volts, +5 Volts, +12 Volts, +55 Volts, +140 Volts) and two unregulated source (195 Volts, +28Volts) used to operate the vertical deflection system, horizontal deflection system and CRT driving circuit.

CRT CIRCUIT

The CRT Circuit provides the voltage levels and control circuits to operate CRT. The circuitry consists of the z-axis amplifier, high voltage oscillator, high voltage regulator, high voltage rectifier and the CRT controls.

The Probe adj. circuit produces a square wave output signal with accurate amplitude and frequency.

This output signal available as a square wave Voltage at the 0.5Vp-p (1KHz) connector.

FUNCTION GENERATOR CIRCUIT

The basic waveform generated in the function generator circuit is the triangle wave.

This is accomplished by charging and then discharging a capacitor by equal magnitude currents.

A dual comparator and flip flop (U4, SN75107A) determine whether the capacitor (C16, C17, C18, C20, C21, C27) is being charged or discharged.

when the voltage on the capacitor reaches the positive limit, the charging current is switched off and the capacitor discharges until the lower limit is reached at which time the charging current is then reapplied.

the output of the dual comparator is a square wave.

To produce a sine wave, the triangle wave is shaped by a special amplifier. (Q8, Q9, Q10, Q13)

Range switching is accomplished by changing the magnitude of the current sources (U1, U2, Q1, Q3, Q6) and the timing capacitor.

Dial frequency tuning (VR8) is done by changing the magnitude of the current sources.

A frequency change of over a 10:1 is possible with the frequency Dial.

6. CALIBRATION

Goldstar Precision provides complete instrument repair and calibration at our overseas office and authorized dealer. Contact your local **Goldstar** Precision office or representative.

6-1. Calibration interval

To maintain instrument accuracy, perform the calibration of the OS-9020G Units at least every 1000 hours of operations or every six months if used frequently.

6-2. Test equipment required

The following test equipment (Table 6-1) and accessories, or equivalent, are required for the complete calibration of the OS-9020G Units. The given specifications for the test equipment are the minimum necessary for accurate calibration. Therefore, the specifications of any test equipment used must meet or exceed the listed specifications. All the test equipment is assumed to be correctly calibrated and operating within the listed specification. Operating instructions for the test equipment are not given in this procedure. Refer to the instruction manual for the test equipment if more information is needed.

6-3. Preliminary procedure

This instrument should be calibrated at an ambient temperature of $+20^{\circ}\text{C}$ ($\pm 5^{\circ}\text{C}$) for best overall accuracy.

1. Connect the instrument to AC line voltage, 50/60Hz line source.
2. Set the instrument controls as given in the Preliminary Control Setting. Allow at least fifteen minutes of warmup before proceeding.
3. See the Adjustment Locations in the pullout pages.

6-4. Preliminary control settings

Preset the instrument controls to the settings given below, when starting the calibration procedures.

Controls	Settings	Controls	Settings
① FOCUS	Midrange	⑪ PULLx10MAG	Normal, (pushed in)
② TRACE ROTATION	As desired	⑫ TIME/DIV	1 mS
③ SCALE ILLUM	Fully counterclockwise	- TRIG -	
- VERTICAL -		⑬ LEVEL	Midrange, normal
④ V-POSITION	Midrange	⑭ SLOPE	+ Normal
⑤ V-VARIABLE	CAL(fully clockwise pushed in)	⑮ MODE	Auto
⑥ INPUT COUPLING	GND (AC-GND-DC)	⑯ HOLDOFF	Fully counterclockwise
		⑰ TRIG SOURCE	CH1
⑦ VOLTS/DIV	5 □ V/DIV	- FUNCTION GENERATOR -	
⑧ V-MODE	CH1	⑱ AMPLITUDE	full counterclockwise
⑨ CH2 INVERT	Normal (Pushed In)	⑲ RANGE SW.	1
- HORIZONTAL -		⑳ FREQ. DIAL	0.1
㉑ H-POSITION	Midrange	㉑ OFFSET	PUSH

6-5. Initial starting procedure

1. Push the POWER switch.
2. Wait a few seconds for the cathode ray tube (CRT) to warm up.
A trace should appear on the display of the CRT.
3. If the trace disappears, increase (clockwise) the INTENSITY control setting until the trace is easily observed.
4. Adjust FOCUS control for the best focused display.
5. Readjust POSITION controls if necessary, to **center** the trace.

POWER SUPPLY SYSTEM

NOTE : Before you begin, see ADJUSTMENT LOCATIONS in the pullout pages.

Control settings

Preset the controls as given in the Preliminary Control Settings.

[1] Check Low-voltage Supply, if necessary.

- a. Connect the digital voltmeter (DVM) from the **+12** volt line.
: **+11.75V** to **+12.25V** (+12V point of horizontal board)
- b. Connect the DVM from the -12 volt line.
: **-11.75V** to **-12.25V** (-12V point of horizontal board)
- c. Connect the DVM from the +5 volt line.
: **+4.75V** to **+5.25V** (+5V point of horizontal board)
- d. Connect the DVM from the +55 volt line.
: **+54 V** to **+58 V** (+55V point of horizontal board)
- e. Connect the DVM from the +140 volt line.
: **+135 v** to **+143 v** (+140V point of horizontal board)
- f. Connect the DVM from the +195 volt line.
: **+190 v** to **+210 v** (+195V point of horizontal board)

[2] Adjust Low-voltage Supply.

Adjust the **VR901** for DVM reading of -12V ($\pm 0.1V$).

[3] Check High-voltage Supply.

- a. **Connect** the DVM to the H.V test point (CRT SOCKET B/D **-K(20M)**) by High-voltage Probe.
- b. Check for DVM reading as -1805V ~ -1995V
- c. Adjust the **VR618** for DVM reading of -1900V ($\pm 20V$).
(Horizontal B/D p/n ; 513-547 used only)

DISPLAY

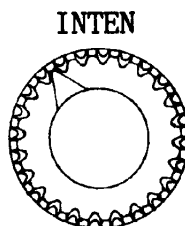
Control Setting

Preset the controls as given in the Preliminary Control Setting.

[4] Check/Adjust CRT Bias.

Set the **TIME/DIV** switch to the **1mS**

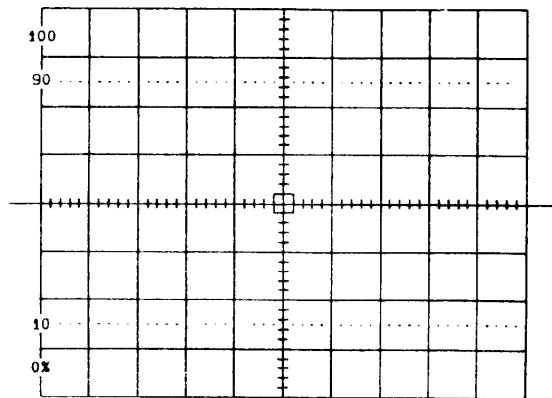
- a. Rotate the **INTENSITY** to the direction of 10 o'clock as shown.



- b. Observe the trace of CRT.
- c. Adjust the CRT Bias Adjustment VR617 so that the trace makes an appear.

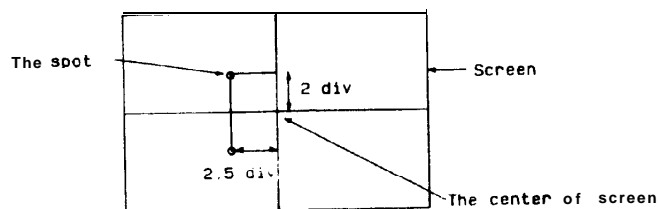
[5] Check/Adjust Trace Rotation.

- a. Check that the trace is parallel to the horizontal **center** line.
- b. Adjust the TRACE ROTATION for a trace that is parallel with the horizontal graticule lines.



[6] Check/Adjust **ASTIGmatism** and FOCUS

- a. Vertical Mode switch to the CH2 [X-Y] position, and Display switch to the [X-Y] position, and AC-GND-DC to GND.
- b. Set the INTENSITY control for a small spot, as the following figure, using position controls.



- c. Check that the spot is round.
- d. Adjust the FOCUS adjustment and ASTIG adjustment VR616 for a round spot.

H O R I Z O N T A L S Y S T E M

Control settings

Preset the controls as given in the Preliminary Control Settings.

[7] Check/Adjust Horizontal Gain.

- a. Set the input AC-GND-DC to DC.
- b. Set the **TIME/DIV** switch to the 1ms.
- c. Check that the time marks align with the graticule line over the center eight **DIVisions**, within 3%.
- d. Adjust the H GAIN adjustment **VR611** so that the time marks align with the center eight graticule lines.

[8] Check/Adjust Horizontal **x 10 MAG** Gain.

- a. Set the **TIME/DIV** switch to the 1mS.
- b. Set **x 10 MAG** (Pull out the VARIABLE control).
- c. Check that the one-cycle time marks align with the ten division graticule lines, within 5%.
- d. Adjust the MAG GAIN adjustment **VR612** so that the one-cycle time marks align with the ten division graticule lines.
- e. Push in the VARIABLE control after check and adjustment.

[9] Check/Adjust MAG CENT.

- a. Set the TIME/DIV switch to the 1 mS.
- b. Being the VARIABLE control is in pulled out state (X10 MAG), the left end of the trace is brought to the center point and then the VARIABLE is depressed.
- c. Observe the movement of the left end of the trace.
- d. Adjust the MAG CENT adjustment **VR614** for the movement of the end of the trace within $\pm 0.2\text{DIV}$.

[10] Check/Adjust low spaced sweep accuracy.

- a. Set the time mark generator for 5mS time marks.
- b. Set the **TIME/DIV** switch to 5mS.
- c. Check that the time marks align with the graticule line over the middle eighth divisions, whth 3%.
- d. Adjust the **5mS/DIV** adjustment **VR606** so that the time marks coincide with the middle eight graticule lines.

[11] Check/Adjust High speed sweep accuracy.

- a. Set the input coupling switch to DC.
- b. Set the time mark generator for **10 μ S** time marks.
- c. Set the **TIME/DIV** switch to the **10 μ S**.
- d. Check that the time marks align with the graticule lines over the middle eigh divisions.
- e. Adjust **VC601** that the time marks coincide with middle eight graticule lines.

VERTICAL SYSTEM

Control settings

Preset the controls as given in the Preliminary Control Settings.

[14] Check/Adjust DC Balance (Step attenuator balance).

- a. Set the **VOLTS/DIV** switch to the 5mV position.
- b. Position the trace to the horizontal center line.
- c. Change the **PULL x5MAG** switch to the **1mV** position.
- d. Check that the trace is within 0.1 division of the horizontal center line.
- e. Adjust the CH1 (CH2) DC BAL adjustment, VR201 (CH1) or VR301 (CH2), for a trace at the horizontal center line.
- f. Repeat part (a) through (e) until less than 0.05 division shift is noted when changing the **VOLTS/DIV** setting.

[15] Check/Adjust ADD BALANCE.

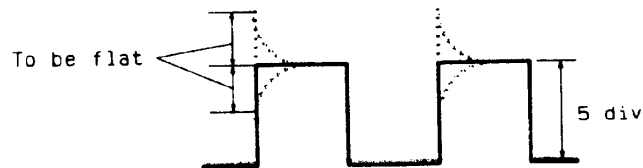
- a. Set the **TIME/DIV** switch to the **1mS** position.
- b. Set the CH1 and CH2 AC-GND-DC switches to GND.
- c. Set the **V-MODE** switch to [CH1].
- d. Next, Adjust the vertical Position control that the trace is identical with the horizontal center graticule line.
- e. Set the **V-MODE** switch to [CH2].
- f. Next, Adjust the vertical Position control that the trace is identical with the horizontal center graticule line.
- g. Set the **V-MODE** switch to [ADD].
- h. Check that the trace is identical with the horizontal center graticule line within ± 0.5 division.
- i. Adjust the **ADD BALANCE** adjustment VR501 for two times of the difference with the horizontal center graticule line.

[16] Check/Adjust Vertical Position Center.

- a. Confirm the vertical **POSITION** control at the midrange.
- b. Check that the trace is within 1 division.
- c. Adjust the Position Center adjustment VR203 (CH1), VR303 (CH2) for a trace at the horizontal center line.

[17] Check/Adjust X1 AC GAIN.

- a. Set the TIME/DIV switch to the **1mS** position.
- b. Set the VOLTWDIV switch to the **10mV** position.
- c. Set the AC-GND-DC switch to DC.
- d. Connect the square-wave generator(using **1KHz** output range).
- e. Adjust the output amplitude of that generator for 5 division deflection of screen.
- f. Check that the high-voltage level of pulse is flat.



- g. Adjust the X1 AC GAIN adjustment **VR202(CH1)**, **VR302(CH2)** for a flat level.

[18] Check/Adjust Vertical Gain.

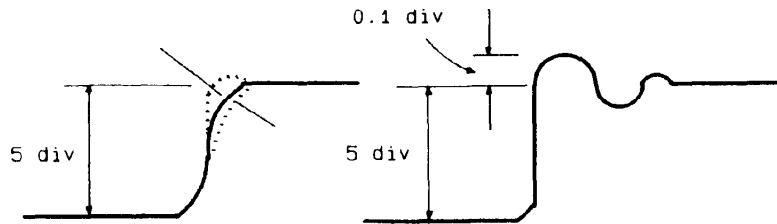
- a. Set the VOLTWDIV switch to the **10mV** position and AC-GND-DC switch to DC.
- b. Connect the standard amplitude calibrator to the input Connector.
- c. Set the standard amplitude calibrator for a **50mVp-p** signal.
- d. Check for a display of five divisions.
- e. Adjust the GAIN adjustment **VR204 (CH1)**, **VR304 (CH2)** for a display of 5 divisions within 3%.
- f. Check all the VOLTWDIV switch settings.

[19] Check/Adjust Input Capacity (**ATT: ÷ 1**).

- a. Set the VOLTWDIV switch to the **10mV** position.
- b. Set the AC-GND-DC switch to DC.
- c. Connect the L-C meter to the input terminals.
- d. Check the input capacity for approximately 25pF.

[20] Check/Adjust Vertical Step Response.

- a. Set the VOLTWDIV switch to the **10mV** position.
- b. Set the **TIME/DIV** switch to the **0.2 μ S** position.
- c. Connect the fast-rise, positive output (**50mV, 1MHz**) of the square-wave generator to the input. Use a **50 Ω** termination and cable.
- d. Set the square-wave generator to **1MHz**. Adjust the square-wave generator output for a 5 divisions display.
- e. CH1 : Adjust the VC503 for a square-wave that is flat.
Then, adjust VC501 for over-shoot that is **+0.15DIV**.
CH2 : Adjust the VC306 for over-shoot that is **+0.15DIV**.



[21] Check/Adjust Attenuation Compensation ($ATT \div 10, \div 100$).

- Set the AC-GND-DC switch to DC.
- Connect the square-wave generator to the CH1 (CH2) input terminals, check for a square-wave that is flat (flat top) under the following settings.

ATT	VOLTWDIV	The square-wave generator output
$\div 10$	0.1 v	0.5 V
$\div 100$	1 V	5 v

- Adjust the trimmer condenser for a square-wave (flat top) under the following settings.

ATT	VOLTWDIV	The square-wave generator output	Adjust CH1 (CH2)
$\div 10$	0.1 v	0.5 V	VC204 (VC304)
$\div 100$	1 v	5 v	VC203 (VC303)

[22] Check/Adjust Input Capacity.

- Connect the L-C meter to the input connector.
- Check the input capacity for a approximately 25pF.
- Adjust the trimmer condensers for a 25 pF input capacity under the following settings.

ATT	VOLTWDIV	Adjust CH1 (CH2)
$\div 1$	5 mV	(VC305)
$\div 10$	0.1 v	VC201 (VC301)
$\div 100$	1 v	VC202 (VC302)

TRIGGERING SYSTEM

[23] Check/Adjust TRIG CENT.

- a. Set the TRIG SOURCE switch to the **CH1**, the TRIG SLOPE knob pushed in, the **VOLTS/DIV** switch to **10mV** and the **TIME/DIV** switch to the **20 μ S.**
- b. Connect the sine-wave generator to the input connector for a **0.3DIV** (**50KHz**).
- c. Set the TRIG LEVEL knob to the midposition.
- d. Adjust the VR605 so that synchronization is effected on the waveform, **0.3DIV** on the screen.
- e. Next, set the TRIG SLOPE to -(pulled out state) and insure that synchronization is effected. After confirmation, leave the TRIG-SLOPE in the depressed state. Readjust when stepped out.

[24] X-Y Operation

[24-1] Check/Adjust X Gain.

- a. Set the V-MODE switch to **CH2**, the **TIME/DIV** switch to the **[X-Y]**, the AC-GND-DC switch of CH1 to DC, the AC-GND-DC switch of CH2 to GND.
- b. Set the **VOLTS/DIV** switch to the **10mV**, with X1 GAIN.
- c. Connect the standard amplitude calibrator to the CH1 input connector.
- d. Set the standard amplitude calibrator for a 50mV.
- e. Check for a display of 5 divisions.
- f. Adjust the X GAIN adjustment **VR610** for a display of 5 divisions within 5%.

[24-2] Check/Adjust X Position Center.

- a. Set the **TIME/DIV** switch to the **[X-Y]**, the V-MODE switch to CH2 the horizontal POSITION control to the midposition and the AC-GND-DC switch to GND.
- b. Check to see that round spot is near the center graticule and is within 0.2 division against the horizontal line.
- c. Adjust the X CENT adjustment VR609 to position spot at the graticule center.

PROBE ADJUST

[25] Check/Adjust Probe Adjust terminal (**0.5Vp-p, 1KHz**).

- a. Connect the Probe Adjust terminal to the Digital Frequency Counter.
- b. Check for the Probe Adjust frequency of **1KHz**, within 20%.
- c. Next, connect the Probe Adjust terminal to the oscilloscope.
- d. Check for the Probe Adjust output of **0.5V**, within 3%.
- e. Adjust the **0.5V** adjustment **VR1101** for the Probe Adjust output of 0.495 to **0.505V**.

FUNCTION GENERATOR SYSTEM

[26] CHECK/ADJUST SYMMETRY

a. Setting of equipment for adjustment

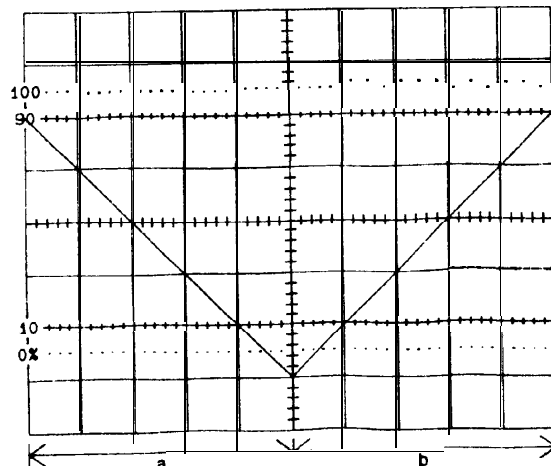
* FUNCTION GENERATOR

FUNCTION	SINE ()	SQUARE ()	TRIANGLE (*)
RANGE	1 () 10 () 100 () 1K (*) 10K () 100K () 1M ()		
FREQ. DIAL	0.1 ()		1.0 (*)
AMPLITUDE	FULLY CCW (MIN) ()		FULLY CW (MAX) (*)
OFFSET	PUSH (*)		
	PULL ()	FULLY ccw ()	FULLY CW ()
OUTPUT	TTL ()		50 Ω (*)

* OSCILLOSCOPE

VOLTS/DIV	50 mV/DIV ()	2 V/DIV (*)
TIME/DIV	50 μ S/DIV (*)	0.2 mS/DIV () 1 mS/DIV ()
COUPLING	DC (*)	GND () AC ()

- b. Connect output terminal of F/G (50 Ω) and input terminal of oscilloscope with BNC to BNC cable.
- c. To adjust VR2 (symmetry) of F/G so that may show as the following figure on the oscilloscope screen as adjusting as to be full of the oscilloscope screen by a cycle of triangular wave as turning knob of SWP var of the oscilloscope



* Adjust the length of a & b may be equal (in the time axis).

[27] CHECK/ADJUST SINE WAVE DISTORTION

a. Setting of equipment for adjustment

• FUNCTION GENERATOR

FUNCTION	SINE (•)	SQUARE ()	TRIANGLE()
RANGE	1 () 10 () 100 () 1K (*) 10K () 100K () 1M ()		
FREQ. DIAL	0.1 ()		1.0 (•)
AMPLITUDE	FULLY CCW (MIN) ()		FULLYCW (MAX) (•)
OFFSET	PUSH (•)		
	PULL ()	FULLY ccw ()	FULLYCW ()
OUTPUT	TTL ()		50 Ω (•)

* OSCILLOSCOPE

VOLTS/DIV	50 mV/DIV ()	5 V/DIV (•)
TIME/DIV	0.1mS/DIV (•)	0.2 mS/DIV () 1 mS/DIV ()
COUPLING	DC (•)	GND () AC ()

- Connect by BNC to clip cable the **optput** terminal of F/G and AF input terminal of distortion factor **meter (DFM)**.
- To adjust so that the hairline of meter may indicate 100% by adjusting set ref level Knob of the DFM.
- To adjust 'Reject fundamental' Knobs (3 each) of **DFM** so that the hairline of meter be the minimum as gradually lowering the switch (**S1**) to **100%**, **30%**, 10% and 5% located under METER upon aligning the function switch of DFM to 'distortion + noise' (to **100kHz**)
- To switch to 1% position for **S1** of **DFM** and adjust VR4 (Sin) and VR5 (Sin-Bal) of F/G so that hairline of the meter may be the minimum. If the adjustment to 1% or less cannot be made in this instance to exactly adjust again the No.1 item as the fundamental symmetry 1 was wrong

[28] CHECK/ADJUST SINE WAVE OR SQUARE WAVE AMPLITUDE

a. Equipment setting for adjustment

* FUNCTION GENERATOR

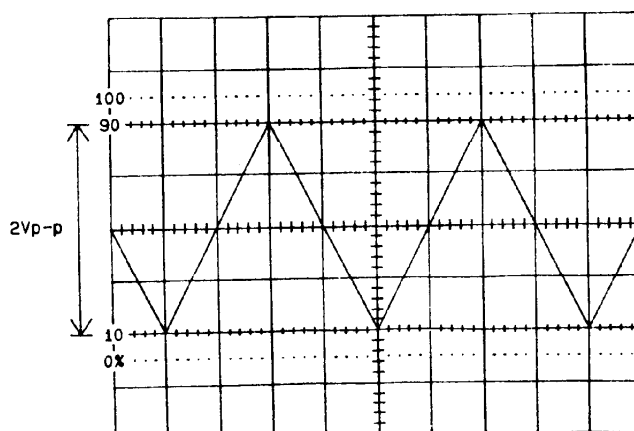
FUNCTION	SINE ()	SQUARE ()	TRIANGLE (*)
RANGE	1 () 10 () 100 () 1K (*) 10K () 100K () 1M ()		
FREQ. DIAL	0.1 ()		1.0 (*)
AMPLITUDE	FULLY CCW (MIN) ()		FULLY CW (MAX) (*)
OFFSET	PUSH (*)		
	PULL ()	FULLY CCW ()	FULLY CW ()
OUTPUT	TTL ()		50 Ω (*)

* OSCILLOSCOPE

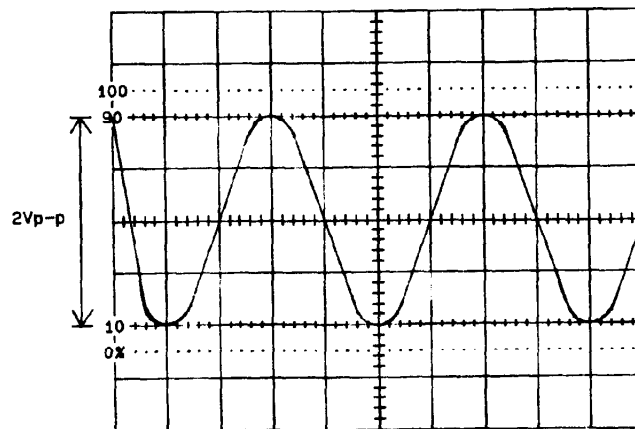
VOLTS/DIV	50 mV/DIV ()	0.5 V/DIV (*)	5 V/DIV ()
TIME/DIV	50 μ S/DIV ()	0.2 ms/DIV ()	1 ms/DIV (*)
COUPLING	DC (*)	GND ()	AC ()

b. Connect output terminal of F/G and input terminal of oscilloscope with BNC to BNC cable.

c. Adjust amplitude by 2 Vp-p so that the oscilloscope screen may be equal to the figure as shown.



- d. To switch range of F/G by sine.
- e. Adjust VR3 (S-gain) so that the maximum value of sine position at **2Vp-p** on the oscilloscope screen.
- f. Adjust **VR6** (S-level) so that Sine level may be positioned by 2 intervals up & down on the GND as **center** on the oscilloscope screen.



- g. Switch the function of F/G to square.
- h. Adjust **VR7** (square level) so that the oscilloscope screen may be **2Vp-p** as the following figure shown.

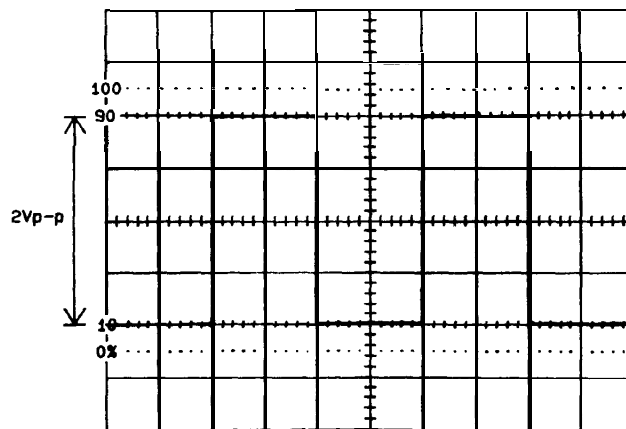


Table 6-1.

TEST EQUIPMENT REQUIRED

Description	Minimum Specification	Example of Usage
1. Constant Amplitude Signal Generator	50KHz reference frequency ; maximum frequency 70MHz ; Variable amplitude	Check horizontal, vertical and trigger bandwidth.
2. Standard Amplitude Calibrator	Amplitude accuracy : 0.25% , Variable amplitude ; 5mV to 40V ; frequency : 1KHz square wave	Check horizontal and Vertical gain.
3. Square - wave Generator	Variable frequency : 10Hz to 1MHz ; output amplitude : 10mV to 100V	Check probe and vertical compensation.
4. Digital Multimeter	0.1% accuracy	Check power supply.
5. Digital Frequency Counter	0.1% accuracy	Check CAL frequency. and function Generator frequency.
6. TimeMark Generator	0.1% accuracy	Check horizontal timing.
7. Cable	Impedance : 50Ω ; type : RG-58/U ; length : 42 inches ; connectors : BNC.	External trigger operation check. Horizontal gain check and adjustment.
8. Termination	Impedance : 50Ω ; Connectors : BNC.	Vertical Amplifier compensati -on checks and adjustment.
9. Attenuator	Ratio : 10X ; connectors : BNC ; impedance : 50Ω	Vertical Amplifier bandwidth check.
10. T - Connector	Connectors : BNC.	External trigger operation checks.
11. DISTORTION FACTOR METER		Function Generator sin wave check.

7. SEMICONDUCTOR LEAD CONFIGURATION

Table Marking for transistor electrode (bottom view)





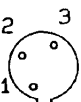
Type of transistor	Electrode marking
2N3904 2SA1206 2N3906 KSC 1674Y 2SC2901	 1. Emitter 2. Base 3. Collector
2SK304E	 1. Source 2. Gate 3. Drain
2SC1907 2SC3468E KTA1015Y KTC1815Y KTA1266Y KTC3198Y 2SA1029D 2SA1371E	 1. Emitter 2. Collector 3. Base
2SC2026 2SC3779	 1. Base 2. Emitter 3. Collector
2N2219 2N2905A	 1. Emitter 2. Base 3. Collector

Table Marking for transistor electrode (front view)


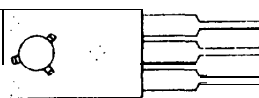
Type of transistor	Electrode marking
2SB546Y 2SB861C 2SD362R 2SD613D KSD288-Y	 1. Base 2. Collector 3. Emitter
2SC3503E 2SA1381E	 1. Emitter 2. Collector 3. Base

Table Marking for diode electrode

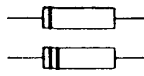



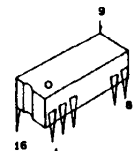
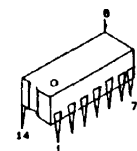
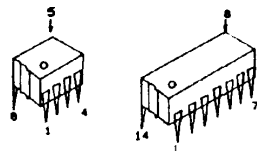
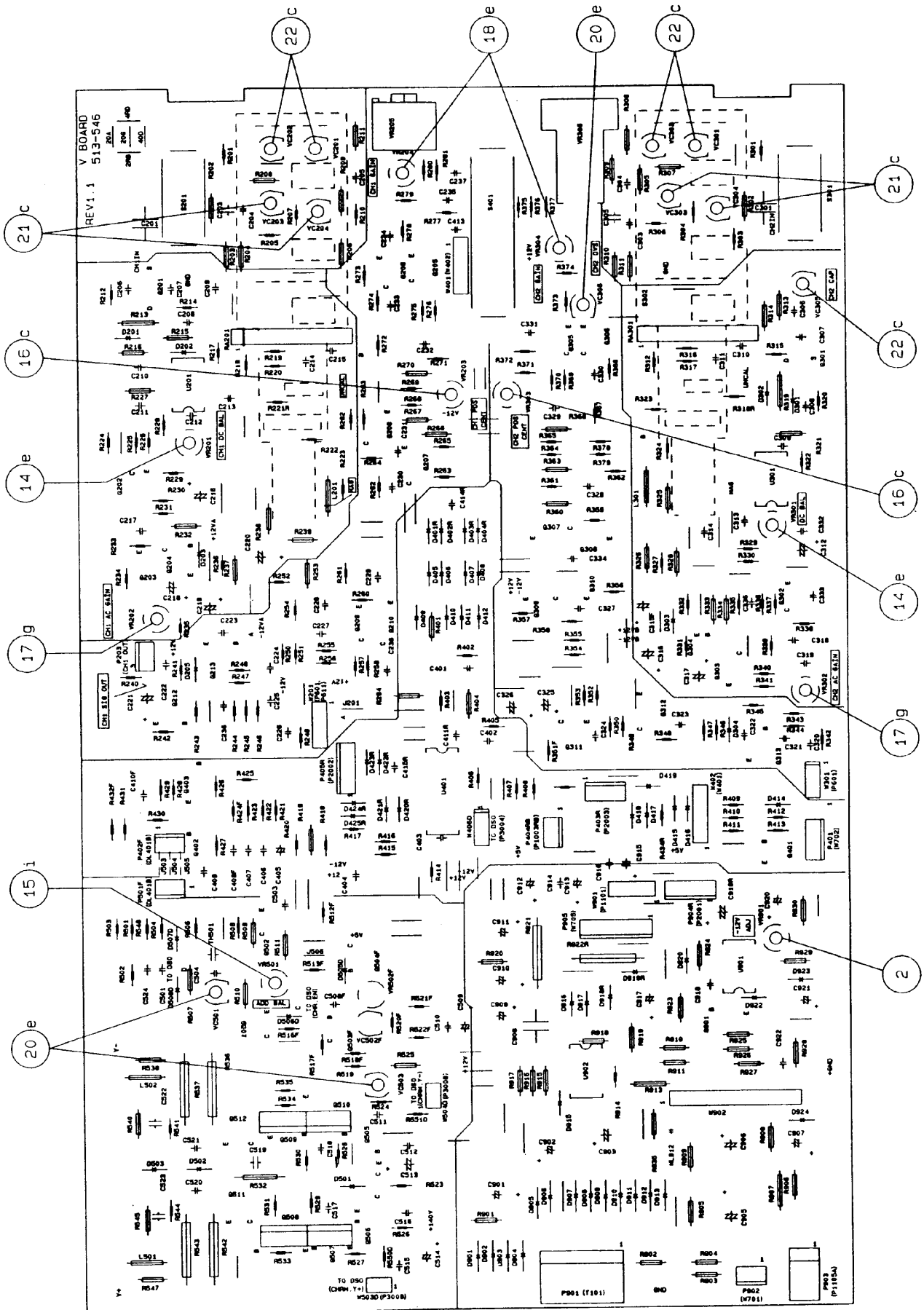
Type of diode	Electrode marking	Polarity
MA185 IN4003 1N4148 1S953 1SS88 1SS133 ESJA52-12		
DZ-5.1B DZ-5.6B DZ-6.8B DZ-7.5B DZ-8.2B DZ-12B DZ-22B		

Table Marking for ICs

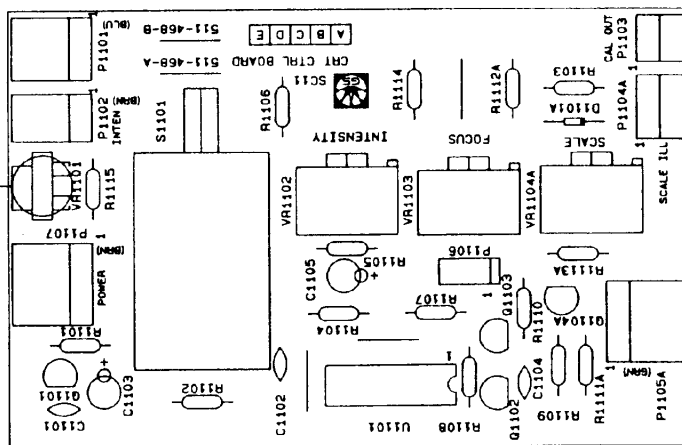
Type of IC	Package outline
CD4503BCP	
SN75107A/B GL324	
Others	

8. ELECTRICAL PARTS ARRANGEMENT

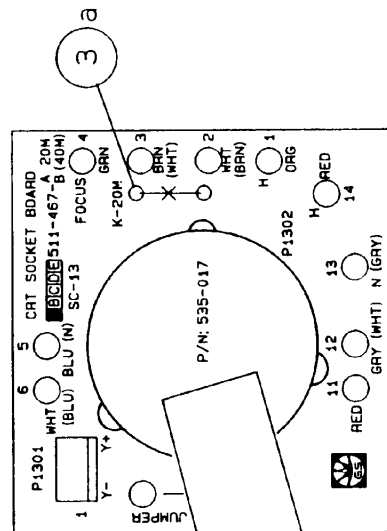


SC2-5, VERTICAL BOARD

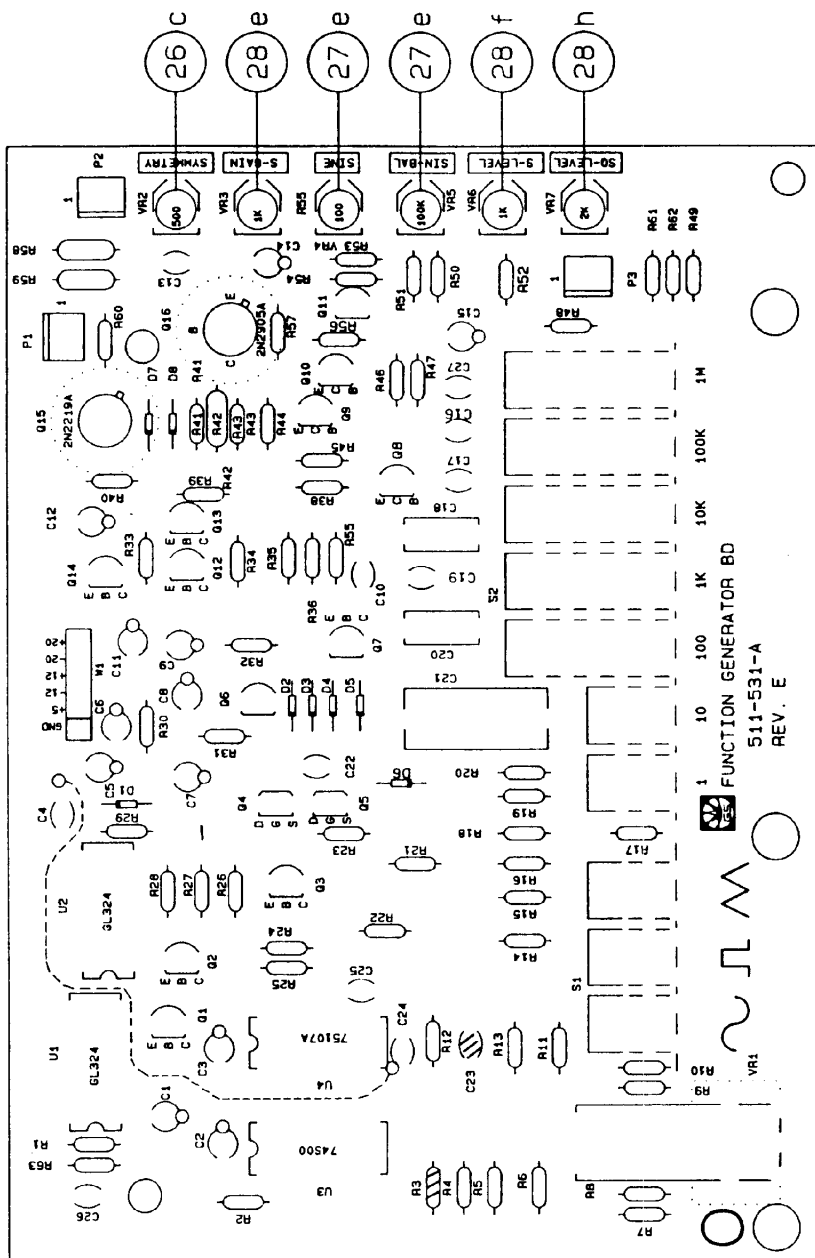
25 e



SC11. CRT CONTROL BOARD



SC13. CRT SOCKET BOARD



SC30. FUNCTION GENERATOR BOARD

9. ELECTRICAL PARTS LIST

(1). ATTENUATORS

PAGE : 1

NO.	FND NO	DESCRIPTION & SPEC.	P / N	NO.	FND NO	DESCRIPTION & SPEC.	P / N
1	C201	CAP M, F, 400V, K, Ø. 047UF	CH2GL473K	2	C203	CAP CER, 50V, J, 270PF	CK1HL271J
3	C204	CAP CER, 50V, J, 220PF	CK1HL221J	4	C205	CAP CER, 50V, J, 47PF(T, C BLACK)	CT1HL470J
5	C301	CAP M, F, 400V, K, Ø. 047UF	CH2GL473K	6	C303	CAP CER, 50V, J, 220PF	CK1HL221J
7	C304	CAP CER, 50V, J, 47PF(T, C BLACK)	CT1HL470J	8	C305	CAP CER, 50V, J, 270PF	CK1HL271J
9	R201	RES C, F, 1/8W, 5%, 22	RD0AP220J	10	R202	RES M, F, 1/4W, Ø. 5%, 10. 1K	RMBP1012D
11	R203	RES M, F, 1/4W, 1%, 15	RMBP15R0F	12	R204	RES C, F, 1/4W, 5%, 27	RD0BP270J
13	R205	RES C, F, 1/8W, 5%, 27	RD0AP270J	14	R206	RES M, F, 1/4W, Ø. 5%, 111K	RMBP1113D
15	R207	RES C, F, 1/8W, 5%, 10	RD0AP100J	16	R208	RES M, F, 1/4W, Ø. 5%, 990K	RMBP9903D
17	R209	RES M, F, 1/4W, Ø. 5%, 900K	RMBP9003D	18	R210	RES C, F, 1/8W, 5%, 150	RD0AP151J
19	R211	RES C, F, 1/4W, 5%, 82	RD0BP820J	20	R301	RES C, F, 1/8W, 5%, 22	RD0AP220J
21	R302	RES M, F, 1/4W, Ø. 5%, 900K	RMBP9003D	22	R303	RES C, F, 1/8W, 5%, 150	RD0AP151J
23	R304	RES C, F, 1/8W, 5%, 10	RD0AP100J	24	R305	RES M, F, 1/4W, Ø. 5%, 111K	RMBP1113D
25	R306	RES C, F, 1/8W, 5%, 27	RD0AP270J	26	R307	RES M, F, 1/4W, Ø. 5%, 990K	RMBP9903D
27	R308	RES C, F, 1/4W, 5%, 82	RD0BP820J	28	R309	RES M, F, 1/4W, Ø. 5%, 10. 1K	RMBP1012D
29	R310	RES M, F, 1/4W, 1%, 15	RMBP15R0F	30	R311	RES C, F, 1/4W, 5%, 27	RD0BP270J
31	S201	SWITCH LEVER, SLLR-523NO	521-096	32	S202	SW ROTARY, ADR255SA, E773-1036	522-029
33	S301	SWITCH LEVER, SLLR-523NO	521-096	34	S302	SW ROTARY, ADR255SA, E773-1036	522-029
35	VC201	CAP TRIMMER, TZ03N100NR, WHT	581-133-2	36	VC202	CAP TRIMMER, TZ03N100NR, WHT	581-133-2
37	VC203	CAP TRIMMER, TZ03N100NR, WHT	581-133-2	38	VC204	CAP TRIMMER, TZ03N100NR, WHT	581-133-2
39	VC301	CAP TRIMMER, TZ03N100NR, WHT	581-133-2	40	VC302	CAP TRIMMER, TZ03N100NR, WHT	581-133-2
41	VC303	CAP TRIMMER, TZ03N100NR, WHT	581-133-2	42	VC304	CAP TRIMMER, TZ03N100NR, WHT	581-133-2

(2). CH1 INPUT AMP.

PAGE : 2

NO.	FND NO	DESCRIPTION & SPEC.	P / N	NO.	FND NO	DESCRIPTION & SPEC.	P / N
1	C206	CAP CER, 50V, J, 100PF(T. C BLACK)	CT1HL101J	2	C207	CAP CER, 50V, Z, 0.01UF	CK1HL103Z
3	C208	CAP CER, 500V, K, 1000PF	CK2HL102K	4	C209	CAP CER, 500V, C, 4PF(T. C BLACK)	CT2HL040C
5	C211	CAP CER, 50V, Z, 0.01UF	CK1HL103Z	6	C212	CAP CER, 50V, K, 1000PF	CK1HL102K
7	C213	CAP CER, 50V, Z, 0.01UF	CK1HL103Z	8	C215	CAP CER, 50V, J, 22PF(T. C BLACK)	CT1HL220J
9	C216	CAP ELE, 16V, M, 47UF(SM)	CE1CL476M	10	C218	CAP ELE, 16V, M, 47UF(SM)	CE1CL476M
11	C219	CAP ELE, 16V, M, 47UF(SM)	CE1CL476M	12	C220	CAP ELE, 16V, M, 47UF(SM)	CE1CL476M
13	C240	CAP CER, 50V, K, 180PF	CK1HL181K	14	D201	DIODE, 1SS133	585-120
15	D202	DIODE, 1SS133	585-120	16	D203	DIODE ZENER, DZ-7.5B	585-075
17	L201	INDUCTOR, 0.47UH/LAL04NAR47M	628-178	18	Q201	FET, 2SK304-E	611-140
19	Q202	TRANSISTOR, KSC1674-Y	611-130-1	20	Q203	TRANSISTOR, KSC1674-Y	611-130-1
21	Q204	TRANSISTOR, 2SA1029-D	611-133	22	R212	RES M. F, 1/8W, 1%, 68	RMAP68R0F
23	R213	RES M. G, 1/2W, 5%, 16M	RG0CP166J	24	R214	RES C. F, 1/8W, 5%, 10	RD0AP100J
25	R215	RES M. F, 1/4W, 0.5%, 500K	RMBP5003D	26	R216	RES M. F, 1/4W, 0.5%, 500K	RMBP5003D
27	R217	RES C. F, 1/8W, 5%, 10	RD0AP100J	28	R218	RES M. F, 1/8W, 1%, 750	RMAP7500F
29	R220	RES C. F, 1/8W, 5%, 1K	RD0AP102J	30	R222	RES C. F, 1/8W, 5%, 430	RD0AP431J
31	R225	RES M. F, 1/8W, 1%, 121	RMAP1210F	32	R226	RES C. F, 1/8W, 5%, 10	RD0AP100J
33	R227	RES M. F, 1/4W, 0.5%, 3K	RMBP3001D	34	R228	RES C. F, 1/8W, 5%, 22K	RD0AP223J
35	R229	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J	36	R230	RES C. F, 1/8W, 5%, 2.2K	RD0AP222J
37	R231	RES M. F, 1/8W, 1%, 10K	RMAP1002F	38	R232	RES M. F, 1/4W, 1%, 3.3K	RMBP3301F
39	R233	RES M. F, 1/8W, 1%, 3.9K	RMAP3901F	40	R234	RES C. F, 1/8W, 5%, 430	RD0AP431J
41	R235	RES C. F, 1/8W, 5%, 10	RD0AP100J	42	R236	RES M. F, 1/8W, 1%, 4.7K	RMAP4701F
43	R237	RES M. F, 1/4W, 1%, 820	RMBP8200F	44	R238	RES M. F, 1/4W, 0.5%, 60K	RMBP6002D
45	R239	RES M. F, 1/4W, 0.5%, 12K	RMBP1202D	46	R250	RES C. F, 1/8W, 5%, 10	RD0AP100J
47	R252	RES M. F, 1/8W, 0.5%, 680	RMAP6800D	48	R253	RES M. F, 1/4W, 0.5%, 68	RMBP68R0D
49	RA201	RES ARRAY, RA-OSC-V	591-325	50	U201	IC OP AMP, TL071CP MOTOROLA	591-279-2
51	VR201	RES SR, VG068TL1B-20KB	572-324-1	52	VR202	RES SR, VG068TL1B-200B	572-316-1

(3). CH2 INPUT AMP.

PAGE : 3

NO.	FND NO	DESCRIPTION & SPEC.	P / N	NO.	FND NO	DESCRIPTION & SPEC.	P / N
1	C306	CAP CER, 500V, K, 1000PF	CK2HL102K	2	C307	CAP CER, 50V, Z, 0.01UF	CK1HL103Z
3	C308	CAP CER, 50V, J, 100PF(T. C BLACK)	CT1HL101J	4	C309	CAP CER, 50V, K, 1000PF	CK1HL102K
5	C310	CAP CER, 50V, J, 22PF(T. C BLACK)	CT1HL220J	6	C312	CAP ELE, 16V, M, 47UF(SM)	CE1CL476M
7	C313	CAP CER, 50V, D, 5PF(T. C BLACK)	CT1HL050D	8	C314	CAP CER, 50V, Z, 0.01UF	CK1HL103Z
9	C316	CAP ELE, 16V, M, 47UF(SM)	CE1CL476M	10	C317	CAP ELE, 16V, M, 47UF(SM)	CE1CL476M
11	C332	CAP CER, 50V, Z, 0.01UF	CK1HL103Z	12	CR313	CAP CER, 500V, C, 2PF	CK2HL020C
13	D301	DIODE, 1SS133	585-120	14	D302	DIODE, 1SS133	585-120
15	D303	DIODE ZENER, DZ-7.5B	585-075	16	L301	INDUCTOR, 0.47UH/LAL04NAR47M	628-178
17	Q301	FET, 2SK304-E	611-140	18	Q302	TRANSISTOR, KSC1674-Y	611-130-1
19	Q303	TRANSISTOR, KSC1674-Y	611-130-1	20	Q304	TRANSISTOR, 2SA1029-D	611-133
21	R312	RES M. F, 1/8W, 1%, 750	RMAP7500F	22	R313	RES M. F, 1/4W, 0.5%, 500K	RMBP5003D
23	R314	RES M. F, 1/4W, 0.5%, 500K	RMBP5003D	24	R315	RES C. F, 1/8W, 5%, 10	RD0AP100J
25	R317	RES C. F, 1/8W, 5%, 1K	RD0AP102J	26	R319	RES M. G, 1/2W, 5%, 16M	RG0CP166J
27	R320	RES M. F, 1/8W, 1%, 68	RMAP68R0F	28	R321	RES M. F, 1/4W, 0.5%, 3K	RMBP3001D
29	R322	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J	30	R322	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J
31	R323	RES C. F, 1/8W, 5%, 430	RD0AP431J	32	R325	RES M. F, 1/4W, 0.5%, 60K	RMBP6002D
33	R326	RES M. F, 1/4W, 0.5%, 68	RMBP68R0D	34	R327	RES M. F, 1/8W, 0.5%, 680	RMAP6800D
35	R328	RES M. F, 1/4W, 0.5%, 12K	RMBP1202D	36	R329	RES C. F, 1/8W, 5%, 22K	RD0AP223J
37	R330	RES C. F, 1/8W, 5%, 10	RD0AP100J	38	R331	RES M. F, 1/8W, 1%, 4.7K	RMAP4701F
39	R332	RES C. F, 1/8W, 5%, 10	RD0AP100J	40	R333	RES M. F, 1/4W, 1%, 3.3K	RMBP3301F
41	R334	RES M. F, 1/4W, 1%, 820	RMBP8200F	42	R335	RES C. F, 1/8W, 5%, 12K	RD0AP123J
43	R336	RES C. F, 1/8W, 5%, 2.2K	RD0AP222J	44	R337	RES M. F, 1/8W, 1%, 10K	RMAP1002F
45	R338	RES M. F, 1/8W, 1%, 121	RMAP1210F	46	R339	RES M. F, 1/8W, 1%, 3.9K	RMAP3901F
47	R341	RES C. F, 1/8W, 5%, 430	RD0AP431J	48	R354	RES C. F, 1/8W, 5%, 10	RD0AP100J
49	R355	RES C. F, 1/8W, 5%, 10	RD0AP100J	50	RA301	RES ARRAY, RA-OSC-V	591-325
51	U301	IC OP AMP, TL071CP MOTOROLA	591-279-2	52	VC305	CAP TRIMMER, TZ03Z070NR, BLU	581-213
53	VR301	RES SR, VG068TL1B-20KB	572-324-1	54	VR302	RES SR, VG068TL1B-200B	572-316-1

(4). CH1 PREAMP. & TRIGGER PICK-OFF

PAGE : 4

NO.	FND NO	DESCRIPTION & SPEC.	P / N	NO.	FND NO	DESCRIPTION & SPEC.	P / N
1	C221	CAP ELE, 16V, M, 47UF(SM)	CE1CL476M	2	C222	CAP CER, 50V, Z, 0. 01UF	CK1HL103Z
3	C223	CAP CER, 50V, Z, 0. 01UF	CK1HL103Z	4	C225	CAP CER, 50V, J, 470PF	CK1HL471J
5	C226	CAP CER, 50V, J, 33PF	CK1HL330J	6	C227	CAP CER, 50V, J, 470PF	CK1HL471J
7	C229	CAP CER, 50V, J, 82PF(T. C BLACK)	CT1HL820J	8	C230	CAP CER, 50V, D, 3PF(T. C BLACK)	CT1HL030D
9	C231	CAP CER, 50V, Z, 0. 01UF	CK1HL103Z	10	C232	CAP CER, 50V, J, 15PF(T. C BLACK)	CT1HL150J
11	C233	CAP CER, 50V, J, 15PF(T. C BLACK)	CT1HL150J	12	C234	CAP CER, 50V, J, 33PF(T. C BLACK)	CT1HL330J
13	C235	CAP CER, 50V, Z, 0. 01UF	CK1HL103Z	14	C237	CAP CER, 50V, Z, 0. 01UF	CK1HL103Z
15	C238	CAP CER, 25V, Z, 0. 1UF	CK1EL104Z	16	D205	DIODE ZENER, DZ-6. 8B	585-161
17	P203	CONNECTOR WAFER, LA-0640-03	531-002-9	18	Q205	TRANSISTOR, 2N3904	611-006-1
19	Q206	TRANSISTOR, 2N3904	611-006-1	20	Q207	TRANSISTOR, 2N3906	611-022-1
21	Q208	TRANSISTOR, 2N3906	611-022-1	22	Q209	TRANSISTOR, 2N3906	611-022-1
23	Q210	TRANSISTOR, 2N3906	611-022-1	24	Q212	TRANSISTOR, KTC3198-Y	611-001-1
25	Q213	TRANSISTOR, 2SC1907	611-184	26	R240	RES M. F, 1/8W, 1%, 86. 6	RMAP86R6F
27	R241	RES C. F, 1/8W, 5%, 470	RD0AP471J	28	R242	RES C. F, 1/8W, 5%, 100	RD0AP101J
29	R243	RES C. F, 1/8W, 5%, 1K	RD0AP102J	30	R244	RES C. F, 1/8W, 5%, 47	RD0AP470J
31	R245	RES M. F, 1/8W, 1%, 2K	RMAP2001F	32	R246	RES C. F, 1/8W, 5%, 10	RD0AP100J
33	R248	RES M. F, 1/8W, 1%, 1K	RMAP1001F	34	R249	RES C. F, 1/8W, 5%, 1. 8K	RD0AP182J
35	R251	RES M. F, 1/8W, 1%, 1. 5K	RMAP1501F	36	R255	RES C. F, 1/8W, 5%, 220	RD0AP221J
37	R256	RES M. F, 1/8W, 1%, 1. 5K	RMAP1501F	38	R257	RES C. F, 1/8W, 5%, 4. 7K	RD0AP472J
39	R258	RES C. F, 1/8W, 5%, 4. 7K	RD0AP472J	40	R260	RES C. F, 1/8W, 5%, 47	RD0AP470J
41	R261	RES C. F, 1/8W, 5%, 10	RD0AP100J	42	R262	RES C. F, 1/8W, 5%, 47	RD0AP470J
43	R263	RES C. F, 1/8W, 5%, 1K	RD0AP102J	44	R264	RES C. F, 1/8W, 5%, 47	RD0AP470J
45	R265	RES C. F, 1/8W, 5%, 1. 5K	RD0AP152J	46	R266	RES M. F, 1/4W, 1%, 1. 5K	RMBP1501F
47	R267	RES M. F, 1/4W, 1%, 1. 5K	RMBP1501F	48	R268	RES C. F, 1/8W, 5%, 4. 7K	RD0AP472J
49	R269	RES C. F, 1/8W, 5%, 4. 7K	RD0AP472J	50	R270	RES C. F, 1/4W, 5%, 820K	RD0BP824J
51	R271	RES C. F, 1/8W, 5%, 22K	RD0AP223J	52	R272	RES C. F, 1/8W, 5%, 22	RD0AP220J
53	R273	RES C. F, 1/8W, 5%, 2. 7K	RD0AP272J	54	R274	RES C. F, 1/8W, 5%, 1K	RD0AP102J
55	R275	RES C. F, 1/8W, 5%, 22	RD0AP220J	56	R276	RES C. F, 1/8W, 5%, 1K	RD0AP102J
57	R277	RES C. F, 1/8W, 5%, 100	RD0AP101J	58	R278	RES M. F, 1/8W, 1%, 68	RMAP68R0F
59	R279	RES C. F, 1/8W, 5%, 10	RD0AP100J	60	R280	RES C. F, 1/8W, 5%, 120	RD0AP121J
61	R281	RES C. F, 1/8W, 5%, 2. 7K	RD0AP272J	62	R282	RES C. F, 1/8W, 5%, 100	RD0AP101J
63	R283	RES C. F, 1/8W, 5%, 100	RD0AP101J	64	R284	RES C. F, 1/4W, 5%, 22	RD0BP220J
65	VR203	RES SR, VG068TL1B-50KB	572-320-1	66	VR204	RES SR, VG068TL1B-100B	572-327
67	VR205	RES VAR, K162A00-10KB X2	571-308				

(5). CH2 PREAMP. & TRIGGER PICK-OFF

PAGE : 5

NO.	FND NO	DESCRIPTION & SPEC.	P / N	NO.	FND NO	DESCRIPTION & SPEC.	P / N
1	C320	CAP CER, 50V, J, 470PF	CK1HL471J	2	C322	CAP CER, 50V, Z, 0.01UF	CK1HL103Z
3	C323	CAP CER, 50V, J, 470PF	CK1HL471J	4	C324	CAP CER, 50V, J, 82PF(T. C BLACK)	CT1HL820J
5	C327	CAP CER, 50V, Z, 0.01UF	CK1HL103Z	6	C328	CAP CER, 50V, Z, 0.01UF	CK1HL103Z
7	C329	CAP CER, 50V, J, 15PF(T. C BLACK)	CT1HL150J	8	C330	CAP CER, 50V, J, 15PF(T. C BLACK)	CT1HL150J
9	C331	CAP CER, 50V, Z, 0.01UF	CK1HL103Z	10	D304	DIODE ZENER, DZ-6.8B	585-161
11	Q305	TRANSISTOR, 2N3904	611-006-1	12	Q306	TRANSISTOR, 2N3904	611-006-1
13	Q307	TRANSISTOR, 2N3906	611-022-1	14	Q308	TRANSISTOR, 2N3906	611-022-1
15	Q309	TRANSISTOR, 2N3906	611-022-1	16	Q310	TRANSISTOR, 2N3906	611-022-1
17	Q311	TRANSISTOR, 2N3906	611-022-1	18	Q312	TRANSISTOR, 2N3906	611-022-1
19	Q313	TRANSISTOR, 2SC1907	611-184	20	R342	RES C. F, 1/8W, 5%, 10	RD0AP100J
21	R344	RES M. F, 1/8W, 1%, 1K	RMAP1001F	22	R345	RES M. F, 1/8W, 1%, 2K	RMAP2001F
23	R346	RES M. F, 1/8W, 1%, 1.5K	RMAP1501F	24	R347	RES M. F, 1/8W, 1%, 1.5K	RMAP1501F
25	R348	RES C. F, 1/8W, 5%, 220	RD0AP221J	26	R349	RES C. F, 1/8W, 5%, 10	RD0AP100J
27	R350	RES C. F, 1/8W, 5%, 47	RD0AP470J	28	R352	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J
29	R353	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J	30	R356	RES C. F, 1/8W, 5%, 47	RD0AP470J
31	R357	RES M. F, 1/8W, 1%, 1.5K	RMAP1501F	32	R358	RES M. F, 1/8W, 1%, 1K	RMAP1001F
33	R359	RES M. F, 1/8W, 1%, 1K	RMAP1001F	34	R360	RES M. F, 1/4W, 1%, 1.5K	RMBP1501F
35	R361	RES M. F, 1/8W, 1%, 1.5K	RMAP1501F	36	R362	RES C. F, 1/8W, 5%, 47	RD0AP470J
37	R363	RES M. F, 1/4W, 1%, 1.5K	RMBP1501F	38	R364	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J
39	R365	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J	40	R366	RES C. F, 1/4W, 5%, 820K	RD0BP824J
41	R367	RES C. F, 1/8W, 5%, 120	RD0AP121J	42	R368	RES C. F, 1/8W, 5%, 1K	RD0AP102J
43	R369	RES C. F, 1/8W, 5%, 1.2K	RD0AP122J	44	R370	RES C. F, 1/8W, 5%, 22	RD0AP220J
45	R371	RES C. F, 1/8W, 5%, 22K	RD0AP223J	46	R372	RES C. F, 1/8W, 5%, 100	RD0AP101J
47	R373	RES M. F, 1/8W, 1%, 68	RMAP68R0F	48	R374	RES C. F, 1/8W, 5%, 10	RD0AP100J
49	R375	RES C. F, 1/8W, 5%, 2.7K	RD0AP272J	50	R376	RES C. F, 1/8W, 5%, 120	RD0AP121J
51	R377	RES C. F, 1/8W, 5%, 2.7K	RD0AP272J	52	R378	RES C. F, 1/8W, 5%, 100	RD0AP101J
53	R379	RES C. F, 1/8W, 5%, 100	RD0AP101J	54	VC306	CAP TRIMMER, TZ03P450NR, YEL	581-132-3
55	VR303	RES SR, VG068TL1B-50KB	572-320-1	56	VR304	RES SR, VG068TL1B-100B	572-327
57	VR306	RES VAR, V16L4 PCB(E113-10061)	571-057	58	W301	WIRING HARNESS, WH101	550-621-B

(6). VERTICAL CONTROL

PAGE : 6

NO.	FND NO	DESCRIPTION & SPEC.	P / N	NO.	FND NO	DESCRIPTION & SPEC.	P / N
1	C401	CAP CER, 50V, J, 680PF	CK1HL681J	2	C402	CAP CER, 50V, J, 680PF	CK1HL681J
3	C403	CAP CER, 50V, Z, 0.01UF	CK1HL103Z	4	C404	CAP CER, 50V, Z, 0.01UF	CK1HL103Z
5	C405	CAP ELE, 50V, M, 1UF(BP)	581-117	6	C406	CAP CER, 50V, K, 5600PF	CK1HL562K
7	C407	CAP CER, 50V, J, 220PF	CK1HL221J	8	C408F	CAP CER, 50V, J, 220PF	CK1HL221J
9	C409	CAP CER, 50V, Z, 0.01UF	CK1HL103Z	10	C413	CAP CER, 50V, Z, 0.01UF	CK1HL103Z
11	D405	DIODE, 1SS133	585-120	12	D406	DIODE, 1SS133	585-120
13	D407	DIODE, 1SS133	585-120	14	D408	DIODE, 1SS133	585-120
15	D409	DIODE, 1SS133	585-120	16	D410	DIODE, 1SS133	585-120
17	D411	DIODE, 1SS133	585-120	18	D412	DIODE, 1SS133	585-120
19	D414	DIODE, 1N4148 OR DS4148	585-002	20	D415	DIODE, 1N4148 OR DS4148	585-002
21	D416	DIODE, 1N4148 OR DS4148	585-002	22	D417	DIODE, 1SS133	585-120
23	P401	CONNECTOR WAFER, LW-0640-04	531-003-7	24	Q401	TRANSISTOR, KTC3198-Y	611-001-1
25	Q402	TRANSISTOR, 2SC1907	611-184	26	Q403	TRANSISTOR, 2SC1907	611-184
27	R401	RES C. F, 1/4W, 5%, 27	RD0BP270J	28	R402	RES C. F, 1/8W, 5%, 1.8K	RD0AP182J
29	R403	RES C. F, 1/8W, 5%, 220	RD0AP221J	30	R404	RES C. F, 1/4W, 5%, 27	RD0BP270J
31	R405	RES C. F, 1/8W, 5%, 1.8K	RD0AP182J	32	R406	RES C. F, 1/8W, 5%, 220	RD0AP221J
33	R409	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J	34	R410	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J
35	R411	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J	36	R412	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J
37	R413	RES C. F, 1/8W, 5%, 4.7K	RD0AP472J	38	R414	RES C. F, 1/8W, 5%, 10	RD0AP100J
39	R415	RES M. F, 1/8W, 1%, 300	RMAP3000F	40	R416	RES M. F, 1/8W, 1%, 300	RMAP3000F
41	R417	RES M. F, 1/8W, 1%, 2.7K	RMAP2701F	42	R418	RES M. F, 1/8W, 1%, 2.7K	RMAP2701F
43	R419	RES M. F, 1/4W, 1%, 1.2K	RMBP1201F	44	R420	RES M. F, 1/8W, 1%, 332	RMAP3320F
45	R421	RES C. F, 1/8W, 5%, 82K	RD0AP823J	46	R422	RES C. F, 1/8W, 5%, 100K	RD0AP104J
47	R423	RES C. F, 1/8W, 5%, 200K	RD0AP204J	48	R424F	RES C. F, 1/8W, 5%, 22K	RD0AP223J
49	R425	RES M. F, 1/8W, 1%, 332	RMAP3320F	50	R426	RES M. F, 1/8W, 1%, 332	RMAP3320F
51	R427	RES M. F, 1/8W, 1%, 332	RMAP3320F	52	R428	RES M. F, 1/8W, 1%, 2K	RMAP2001F
53	R429	RES M. F, 1/8W, 1%, 86.6	RMAP86R6F	54	R430	RES M. F, 1/8W, 1%, 2K	RMAP2001F
55	R431	RES M. F, 1/8W, 1%, 86.6	RMAP86R6F	56	S401	SWITCH LEVER, SLLR-524NO	521-100
57	U401	IC TTL, GD74LS74AP GSS	591-163-9	58	W402	WIRING HARNESS, WH120	550-640-A