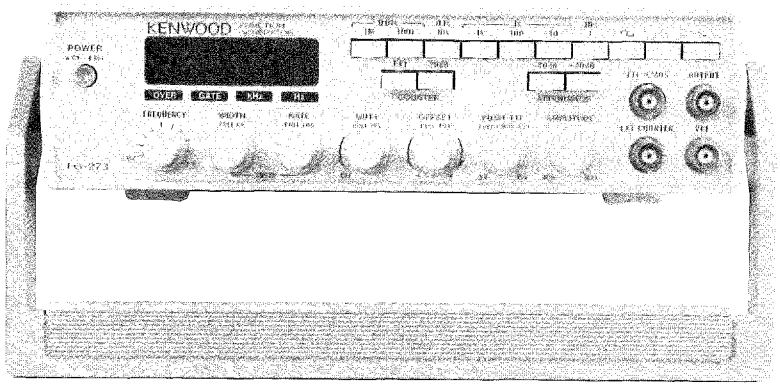
KENWOOD

FUNCTION GENERATOR

FG-273

SERVICE MANUAL

KENWOOD CORPORATION



WARNING

The following instructions are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than contained in the operating instructions unless you are qualified to do so.

CONTENTS

SPECIFICATIONS

Frequency Characteristics	
Outputs	Sine, square, triangle, pulse, ramp, TTL/CMOS square wave
Frequency range	0.02 Hz to 2 MHz in 7 frequency ranges (1/10/100/1k/10k/100k/1M)
Accuracy (1)	±1 digit, 4-digit max. (digital readout to output frequency)
Accuracy (2)	±5% of full scale (0.2 Hz to 2 MHz) (frequency dial to output frequency)
External frequency control (VCF)	
Input voltage	0 to +10 V DC. Frequency decreases with positive voltage
Variable frequency range	Greater than 1000:1
Variable symmetry	Variable over 1:1 to 40:1 range
DC offset	Continuously variable, maximum of ±10 V open circuit, ±5 V into 50 ohms.
Polarity	Inverted or non-inverted
Sine Wave	
Distortion	Less than 1%, 10 Hz to 100 kHz
Amplitude flatness	Within ±1.0 dB to 100 kHz at maximum output amplitude
Output	Variable amplitude
Square Wave	
Symmetry	Less than ±3% at 100 Hz
Rise and fall time	Less than 100 ns at maximum output
Output	Variable amplitude
Triangle Wave	
Linearity	Less than 1% at 100 Hz
Output	Variable amplitude
TTL Output	
Rise and fall time	Less than 25 ns
Output	TTL level
CMOS Output	
Rise and fall time	Less than 60 ns
Output	+5 to +15 V, continuously variable
Sweep Characteristics	
Internal	Linear or logarithm
Sweep rate	0.5 Hz (2 s) to 50 Hz (20 ms), continuously variable
Sweep width	Variable from 10:1 to 1000:1
External sweep	Front panel VCF jack, Input impedance is 11.5 kΩ.

SPECIFICATIONS

Frequency Counter Characteristics	
Frequency range	5 Hz to 10 MHz (10 s, 1 s, 0.1 s, 0.01 s)
Accuracy	±1 count time base accuracy
Stability	Less than ±20 ppm, 0°C to 40° C
Input sensitivity	30 mV rms, 5 Hz to 10 MHz
Maximum input voltage	150 V rms at 1 kHz
Input impedance	Approx. 500 kΩ [0 dB], Approx. 1 MΩ [20 dB]
Output	
Amplitude	20 Vp-p Open circuit, 10 Vp-p into 50 ohms.
Attenuator	Steps of −20 dB, −20 dB and −40 dB. Continuously variable
Impedance	50 ohms, ±10%
Power Requirements	
Input voltage	AC 100 V/120 V/220 V/240 V ±10%
Frequency	50 Hz/60 Hz
Power consumption	Approx. 20 VA
Environmental Conditions	
Storage	−20°C to 60°C, Less than 70% humidity
Operating	0°C to 40°C, Less than 80% humidity
Specification	23°C ±5°C, Less than 70% humidity
Dimensions and Weight	
Dimensions	240 (W)×64 (H)×190 (D) mm
Weight	1.8 kg
Accessories	
Instruction manual	×1
AC cord	×1
Fuse	0.3 A (slow-blow type)×1 0.2 A (fast-blow type)×1

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

SAFETY

SAFETY

Before connecting the instrument to a power source, carefully read the following information, then verify that the proper power cord is used and the proper line fuse is installed for power source. The specified voltage is shown near of the AC inlet. If the power cord is not applied for specified voltage, there is always a certain amount of danger from electric shock.

Line voltage

This instrument operates using ac-power input voltages that 100/120/220/240 V at frequencies from 50 Hz to 60 Hz.

Power cord

The ground wire of the 3-wire ac power plug places the chassis and housing of the instrument at earth ground. Do not attempt to defeat the ground wire connection or float the instrument; to do so may pose a great safety hazard. The appropriate power cord is supplied by an option that is specified when the instrument is ordered.
The optional power cords are shown as follows in Fig. 1.

Line fuse

The fuse holder is located on the rear panel and contains the line fuse. Verify that the proper fuse is installed by replacing the line fuse.

Voltage conversion

This instrument may be operated from either a 100 V to 240 V, 50/60 Hz power source. Use the following procedure to change from 100 to 240 volt operation or vice versa.

1. Replace fuse FS1 with a fuse of appropriate value, 0.3 A slow-blow type for 100 VAC to 120 VAC operation, 0.2 A fast-blow for 220 VAC to 240 VAC operation.
2. Reinsert it for appropriate voltage range.
3. When performing the reinsertion of fuse holder for the voltage conversion, the appropriate power cord should be used. (See Fig. 1.)

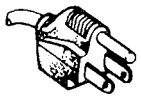
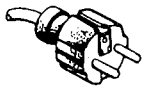
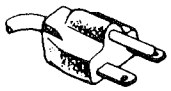
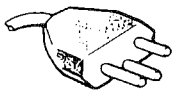
Plug configuration	Power cord and plug type	Factory installed instrument fuse	Line cord plug fuse	Parts No. for power cord and plate
	North American 120 volt/60 Hz Rated 15 amp (12 amp max; NEC)	0.3 A, 250 V Slow blow 6×30 mm	None	Cord: E30-1820-05
	Universal Europe 220 volt/50 Hz Rated 16 amp	0.2 A, 250 V Fast blow 6×30 mm	None	Cord: E30-1819-05
	U.K. 240 volt/50 Hz Rated 13 amp	0.2 A, 250 V Fast blow 6×30 mm	0.8 A Type C	–
	Australian 240 volt/50 Hz Rated 10 amp	0.2 A, 250 V Fast blow 6×30 mm	None	Cord: E30-1821-05
	North American 240 volt/60 Hz Rated 15 amp (12 amp max; NEC)	0.2 A, 250 V Fast blow 6×30 mm	None	–
	Switzerland 240 volt/50 Hz Rated 10 amp	0.2 A, 250 V Fast blow 6×30 mm	None	–

Fig. 1 Power Input Voltage Configuration

ADJUSTMENT

CASE DISASSEMBLY AND ASSEMBLY

1. To open the case, turn the unit upside down with the rubber feet facing up. (See Fig. 2)
2. Remove the four screws from the bottom case.
3. Carefully separate the two halves of the case and recalibrate the unit following the prescribed procedure.

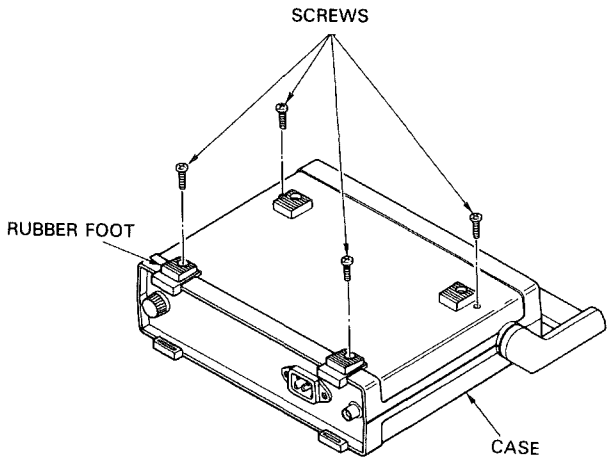


Fig. 2

4. To close the case, lower the bottom case and guide the front and rear panels into thier slots. Position the rubber feet as illustrated and screw the two halves of the case together.
   Do not overtighten screws.

100/120/220/240 VOLT CONVERSION

This instrument operates from a 100 V, 120 V, 220 V or 240 V AC, 50 to 60 Hz line-voltage source. The applied voltage is indicated on the rear panel. To convert from the specified voltage to other line voltages, replace the voltage plug position on PC Board, referring to the figure below and change the rear panel applied voltage indication. Also, be sure to replace the fuse to correspond to the line voltage 0.3 A slow-blow fuse for 100 V to 120 V operation and 0.2 A fast-blow fuse for 220 V to 240 V operation. If it is not wired to your local line voltage, set the power transformer wiring as shown below. (See Fig. 3.)

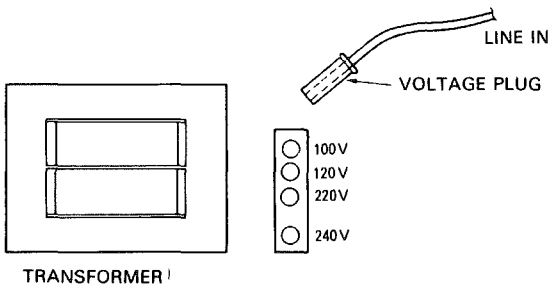


Fig. 3

TEST EQUIPMENT REQUIRED

- Digital Multimeter: KENWOOD DL-707 or equivalent
- Osilloscope: KENWOOD CS-1022 or equivalent
- Frequency Counter: KENWOOD FC-756 or equivalent
- Distortion Analyzer: Y.H.P 334A or equivalent
- DC Power Supply: KENWOOD PD18-10 or equivalent

AMPLIFIER INTERNAL DC OFFSET AND TRIANGLE WAVE AMPLITUDE ADJUSTMENT

1. Push function switch to OFF position, load 50 ohms.
2. Push range switch to OFF position, ATT switch OFF.
3. Amplitude to minimum.
4. Adjust R88 to get −5 mV at the main out BNC jack.
5. Push function switch to "TRIANGLE WAVE", setting amplitude VR at maximum.
6. Push range switch to 100 kHz.
7. Tuning the frequency dial to 1.0 position approximately.
8. Adjust the resistor R91 to get 10.4±0.1 Vp-p main output level and make sure the wave form are not clipping.
9. Check all range except MHz that triangle wave output amplitude more than 10.25 Vp-p.
10. Re-adjust resistor R91 to obtain 10.25 Vp-p output at any critical frequency point.
11. Repeat step 1 to 4 to maintain −5 mV DC voltage at main output BNC.

TRIANGLE WAVE FREQUENCY RESPONSE ADJUSTMENT

1. Push function switch to "TRIANGLE WAVE".
2. Push range switch to 1 MHz, amplitude VR MAX.
3. Tuning the frequency dial to 2.0 position approximately.
4. Load 50 ohms and ATT switch OFF.
5. Adjust the C13 to get 10.4±0.1 V main output level and make sure the wave form are not clipping.

SQUARE WAVE RISE & FALL TIME ADJUSTMENT

1. Push function switch to "SQUARE WAVE", amplitude VR MAX.
2. Push range switch to 100 kHz.
3. Tuning frequency dial to 2.0 position.
4. Load 50 ohms, ATT switch OFF.
5. In maximum output amplitude condition, adjust C25 to reduce over shoot phenomenon.
6. Push range switch to 1 MHz, check rise/fall time for less than 100 ns.
7. Repeat step 5, 6 to minimize over shoot and maintain rise/fall time.

SQUARE WAVE AMPLITUDE ADJUSTMENT

1. Push function switch to "SQUARE WAVE".
2. Push range switch to 1 MHz, amplitude VR MAX.
3. Tuning frequency dial to 2.0 position.
4. Load 50 ohms, ATT switch OFF.
5. Adjust R79 (square wave output amplitude) to get 10.4±0.1 Vp-p main output level.

ADJUSTMENT

SINE WAVE AMPLITUDE ADJUSTMENT

1. Push function switch to "SINE WAVE".
2. Push range switch to 100 kHz, dial scale setting at 1.0 position.
3. Load 50 ohms, ATT switch OFF, amplitude VR MAX.
4. Adjust R75 (sine wave output amplitude) to get 10.4±0.1 Vp-p level from main output and make sure the waveform do not clip on the top and bottom.

SINE WAVE, FREQUENCY RESPONSE ADJUSTMENT

1. Push function switch to "SINE WAVE".
2. Push range switch to 1 M, amplitude VR MAX.
3. Turn the frequency dial to 2.0 position approximately.
4. Load 50 ohms, ATT switch OFF.
5. Adjust C23 (sine wave response) to get 10.4±0.1 Vp-p level from main output and make sure the signal are not clipping.

SINE WAVE DISTORTION ADJUSTMENT

Set sweep width VR, rate VR, duty VR, offset VR to minimum situation. Offset VR press in to internal offset position.

1. Push function switch to "SINE WAVE".
2. Push range switch to 100 kHz.
3. Tuning frequency dial to 0.2 position.
4. Adjust R35 make potential equal (within ±10 mV) between Q5 gate and pin 10 of U5.
5. Adjust R11, R19 make DC voltage equal between pin 2 and pin 3 of both U1 and U2.
6. Push range switch to 100 Hz, adjust R45 CW to MAX.
7. Adjust R48 to reduce 20 Hz distortion.
8. Readjust R45 to reduce 20 Hz distortion.
9. Repeat step 7 and 8 to minimize 20 Hz distortion for less than 0.8%.
10. Push range switch to 100 kHz, setting frequency dial to 1.0 position.
11. Check distortion of 100 kHz for less than 0.8%.
12. Repeat step 7 to 8 for maintain distortion less than 0.8%.

FREQUENCY ACCURACY ADJUSTMENT

1. Push function switch to triangle wave.
2. Push range switch to 100 kHz, amplitude VR MAX.
3. Tuning frequency VR to 2.0 position.
4. Adjust R7 for a counter display reading 200 kHz.
5. Check all ranges accuracy and function are in full scale ±4.5%.
6. Repeat steps 4 and 5.
7. Tuning frequency VR to 0.2 position.
8. Check all function and frequency except MHz range frequency accuracy are in full scale ±4.5%.
9. Repeat steps 3 to 7 to complete step 8.

1 M RANGE FREQUENCY ADJUSTMENT

1. Push function switch to triangle wave.
2. Push range switch to 1 MHz, amplitude VR MAX.
3. Tuning frequency VR to 2.0 position.
4. Adjust C8 for a counter display reading 2 MHz.
5. Tuning frequency VR to 0.2 position.
6. Check all function frequency accuracy is in full scale ±4.5%.
7. Repeat steps 3 to 5 to complete step 6.

COUNTER SENSITIVITY ADJUSTMENT

1. Push the counter INT/EXT switch to EXT mode, dial scale setting at cw max.
2. Set range switch at 1 M range. amplitude VR max, function switch setting at triangle.
3. Adjust R159 to make reading ".0" with no signal input to EXT counter input BNC jack.
4. Check counter sensitivity by 10 MHz 30 mV RMS.
5. Repeat step 3 and 4 to maintain both sensitivity spec and repress interfere of signal generator circuit.

COUNTER ACCURACY ADJUSTMENT

1. Warm-up the instrument at least thirty minutes.
2. Input 10 MHz 30 mVrms sine wave to EXT counter BNC connector.
3. Push the range mode switch to 1 k range (gate time 1 s) adjust C43 SVC to 000.000 kHz (OVER LED lights on simultaneously).

LOG SWEEP WIDTH ADJUSTMENT

1. Pull rate control VR and turn C.W.
2. Connect oscilloscope input to TP1.
3. Adjust R176 (470 ohm) to get +13.5/−0.5 V log wave form.

PARTS LIST

MISCELLANEOUS

REF.NO	PARTS NO	NAME & DESCRIPTION
	A02-0522-08	TOP CASE
	A02-0523-08	BOTTOM CASE
	A21-1132-08	DECORATIVE PANEL
	A22-0869-08	SUB PANEL
	A23-1686-08	REAR PANEL
	B41-0800-08	CAUTION LABEL
	B50-7660-00	INSTRUCTION MANUAL(JAPANESE)
	B50-7664-00	INSTRUCTION MANUAL(ENGLISH)
	E02-0103-15	IC SOCKET 14 PIN
	E02-0139-05	IC SOCKET 28 PIN
	E04-0251-05	BNC RECEPTACLE
	E18-0351-05	AC INLET 3 P
	E22-0482-08	CONNECTOR 4P(SELECT VOLTAGE)
	E30-1644-15	BS POWER CORD
	E30-1818-05	JIS POWER CORD
	E30-1819-05	CEE POWER CORD
	E30-1821-05	SAA POWER CORD
	E31-2931-08	WIRE ASS'Y 1P (FUSE TO PIN)
	E31-2932-08	WIRE ASS'Y 3P (J1,J4,J5)
	E31-2933-08	WIRE ASS'Y 2P (J3)
	E31-2934-08	WIRE ASS'Y 2P (J2)
	E31-2940-08	SHIELD CABLE 110MM
	E31-2942-08	SHIELD CABLE 130MM
	E31-2943-08	SHIELD CABLE 170MM
	E40-7025-08	PIN CONNECTOR 8 P
	E40-7026-08	PIN CONNECTOR 6 P
	E40-7029-08	PIN CONNECTOR 3 P
	E40-7030-08	PIN CONNECTOR 2 P
	F02-0517-08	HEAT SINK 19X19X10H
	F02-0518-08	HEAT SINK H=15MM
	F05-2012-05	FUSE 0.2A(FAST BLOW)
	F05-3017-05	FUSE 0.3A(SLOW BLOW)
	F09-0515-04	SHEET(COVERED ON CAUTION LABEL
	F20-0670-08	INSULATED FIBER
	F20-0671-08	INSULATOR FIBER 40X30X0.5T
	G02-0612-08	COIL SPRING
	G13-0724-08	SPONGE 20X40
	G13-0725-08	SPONGE 20X30X1T
	G16-0615-08	SHIELD PAPER
	H01-5885-08	CARTON BOX
	H12-0571-08	FOAMED PAD
	H20-1728-08	VIYNL COVER 320X340X0.06
	J02-0520-08	RUBBER FOOT(FRONT)
	J02-0521-08	RUBBER FOOT(REAR)
	J13-0507-08	FUSE HOLDER
	J25-5246-08	PCB (UNMOUNTED) 169X220
	J25-5247-08	PCB (UNMOUNTED) 160X37
	J25-5248-08	PCB (UNMOUNTED) 86X37
	J25-5281-08	PCB (UNMOUNTED) 23X63
	J30-0622-08	TRANSISTOR HOLDER
	J32-0882-08	HEX STUD L=44.2
	K01-0527-08	HANDLE
	K23-0810-08	KNOB
	K27-0541-08	PUSH BUTTON(POWER SWITCH)
	K27-0542-08	PUSH BUTTON,WHITE
	L01-9726-08	POWER TRANSFORMER
	L77-1035-08	CRYSTAL 10MHZ
	N09-0758-08	TAPPING SCREW(FRONT FOOT)3.5X8
	S40-1523-08	PUSH SWITCH(POWER) TV-3
	S42-0505-08	PUSH SWITCH(RANGE FUNCTION)
	S42-2515-08	PUSH SWITCH(COUNTER ATTENUATOR
	W02-0454-08	MAIN UNIT(MOUNTED)
	W02-0455-08	DISPLAY UNIT(MOUNTED)
	W02-0456-08	EXT VCF UNIT(MOUNTED)
	W02-0457-08	ATT. UNIT(MOUNTED)

SEMICONDUCTOR

REF.NO	PARTS NO	NAME & DESCRIPTION
D001	1N4148	DIODE
⟨		
D048	1N4148	DIODE
D049	1N4747A	DIODE, ZENER 20V
D050	1N4148	DIODE
D051	B30-0959-08	LED,RED
D052	1N4148	DIODE
D053	1N4148	DIODE
D054	B30-0959-08	LED,RED
⟩		

REF.NO	PARTS NO	NAME & DESCRIPTION
D061	1N4148	DIODE
D062	1N4148	DIODE
D063	1N4148	DIODE
D064	1N4148	DIODE
D065	1N4148	DIODE
D066	B30-0959-08	LED,RED
D067	1N4148	DIODE
D068	1N4148	DIODE
D069	B30-0959-08	LED,RED
D070	1N4148	DIODE
D071	1N4148	DIODE
D072	1N4148	DIODE
D073	1N4148	DIODE
D074	1N4001	DIODE
D075	1N4001	DIODE
D076	1N4001	DIODE
D077	1N4001	DIODE
D080	1N4001	DIODE
D081	1N4001	DIODE
D082	RD8.2E(B2)	DIODE, ZENER 8.2V
D083	1N4001	DIODE
Q001	2SC1815(GR)	TR. SI, NPN
Q002	2SA1015(GR)	TR. SI, PNP
Q003	2SA1015(GR)	TR. SI, PNP
Q004	2SC1815(GR)	TR. SI, NPN
Q005	2N5485	FET, N-CHANNEL
Q006	2SA1015(GR)	TR. SI, PNP
Q007	2SA1015(GR)	TR. SI, PNP
Q008	2SC1674(K)	TR. SI, NPN
Q009	2SC1674(K)	TR. SI, NPN
Q010	2N3906	TR, SI, PNP
Q011	2SC1674(K)	TR. SI, NPN
Q012	2N2219A	TR. SI, NPN
Q013	2N2905A	TR. SI, PNP
Q016	LM7815	IC, 3-TERMINAL POSI. REGULATOR
Q017	TIP32B	TR. SI, PNP
Q018	8050C	TR.
Q019	2N3906	TR, SI, PNP
Q020	2SC1815(GR)	TR. SI, NPN
Q021	2SC1815(GR)	TR. SI, NPN
Q022	2SA1015(GR)	TR. SI, PNP
Q023	2SC1815(GR)	TR. SI, NPN
Q024	LM7805	IC, 3-TERMINAL POSI. REGULATOR
Q025	2SA1015(GR)	TR. SI, PNP
Q026	2SA1015(GR)	TR. SI, PNP
Q027	2SA1015(GR)	TR. SI, PNP
Q028	2N5485	FET, N-CHANNEL
Q029	2SC1815(GR)	TR. SI, NPN
Q055	B30-0960-08	DISPLAY(ORANGE)
Q056	B30-0960-08	DISPLAY(ORANGE)
Q057	B30-0960-08	DISPLAY(ORANGE)
Q058	B30-0960-08	DISPLAY(ORANGE)
Q059	B30-0960-08	DISPLAY(ORANGE)
Q060	B30-0960-08	DISPLAY(ORANGE)
U001	UA741	IC, OP AMP.
U002	UA741	IC, OP AMP.
U003	UA308	IC, OP AMP.
U004	UA308	IC, OP AMP.
U005	CA3086	IC, NPN TRANSISTOR ARRAY
U006	SN7420N	IC, DUAL 4-INPUT NAND GATE
U007	SN7426N	IC, QUAD. 2-INPUT NAND GATE
U008	CA3030	IC, OP AMP.
U009	UA741	IC, OP AMP.
U010	LM358	IC, DUAL OP AMP.
U011	LM358	IC, DUAL OP AMP.
U012	UA741	IC, OP AMP.
U013	ICM7216D	IC,8-DIGIT FREQ. COUNTER/TIMER
U014	MC14066	IC, QUAD. ANALOG SW/QUAD. MPX
U015	MC10116P	IC, TRIPLE LINE RECEIVER
U016	UA741	IC, OP AMP.

PARTS LIST

RESISTOR

REF.NO	PARTS NO	NAME & DESCRIPTION			
R001	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R002	RN14BK2C1003F	RES. METAL FILM	100K	1%	1/6W
R003	RD14BB2C152J	RES. CARBON	1.5K	5%	1/6W
R004	NO USE				
R005	R01-2522-08	V.R.	5KB		
R006	RN14BK2C1003F	RES. METAL FILM	100K	1%	1/6W
R007	R12-3040-05	RES. SEMI FIXED	22K B		
R008	RD14BB2C393J	RES. CARBON	39K	5%	1/6W
R009	RN14BK2C1003F	RES. METAL FILM	100K	1%	1/6W
R010	RN14BK2C3322F	RES. METAL FILM	33.2K	1%	1/6W
R011	R12-3041-05	RES. SEMI FIXED	10KB		
R012	RN14BK2C3011F	RES. METAL FILM	3.01K	1%	1/6W
R013	RN14BK2C4990F	RES. METAL FILM	499	1%	1/6W
R014	RN14BK2C1003F	RES. METAL FILM	100K	1%	1/6W
R015	RN14BK2C4990F	RES. METAL FILM	499	1%	1/6W
R016	RN14BK2C1003F	RES. METAL FILM	100K	1%	1/6W
R017	RN14BK2C1003F	RES. METAL FILM	100K	1%	1/6W
R018	RN14BK2C4992F	RES. METAL FILM	49.9K	1%	1/6W
R019	R12-3041-05	RES. SEMI FIXED	10KB		
R020	RN14BK2C3011F	RES. METAL FILM	3.01K	1%	1/6W
R021	R01-4508-08	V.R. WITH SW	50KB		
R022	RN14BK2C4991F	RES. METAL FILM	4.99K	1%	1/6W
R023	RN14BK2C7151F	RES. METAL FILM	7.15K	1%	1/6W
R024	RN14BK2C3480F	RES. METAL FILM	348	1%	1/6W
R025	RN14BK2C7502F	RES. METAL FILM	75K	1%	1/6W
R026	RN14BK2C7503F	RES. METAL FILM	750K	1%	1/6W
R027	RN14BK2C4991F	RES. METAL FILM	4.99K	1%	1/6W
R028	RN14BK2C7151F	RES. METAL FILM	7.15K	1%	1/6W
R029	RN14BK2C3480F	RES. METAL FILM	348	1%	1/6W
R030	RN14BK2C7502F	RES. METAL FILM	75K	1%	1/6W
R031	RN14BK2C7503F	RES. METAL FILM	750K	1%	1/6W
R032	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R033	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R034	RD14BB2C471J	RES. CARBON	470	5%	1/6W
R035	R12-1028-05	RES. SEMI FIXED	4.7KB		
R036	RD14BB2C272J	RES. CARBON	2.7K	5%	1/6W
R037	RN14BK2C1001F	RES. METAL FILM	1K	1%	1/6W
R038	RN14BK2C1001F	RES. METAL FILM	1K	1%	1/6W
R039	RN14BK2C4021F	RES. METAL FILM	4.02K	1%	1/6W
R040	RN14BK2C4021F	RES. METAL FILM	4.02K	1%	1/6W
R041	RN14BK2C2001F	RES. METAL FILM	2K	1%	1/6W
R042	RN14BK2C3012F	RES. METAL FILM	30.1K	1%	1/6W
R043	RN14BK2C1002F	RES. METAL FILM	10K	1%	1/6W
R044	RN14BK2C4990F	RES. METAL FILM	499	1%	1/6W
R045	R12-1033-05	RES. SEMI FIXED	2.2K B		
R046	RN14BK2C1302F	RES. METAL FILM	13K	1%	1/6W
R047	RN14BK2C1302F	RES. METAL FILM	13K	1%	1/6W
R048	R12-1033-05	RES. SEMI FIXED	2.2K B		
R049	RD14BB2C910J	RES. CARBON	91	5%	1/6W
R050	RD14BB2C272J	RES. CARBON	2.7K	5%	1/6W
R051	RD14BB2C272J	RES. CARBON	2.7K	5%	1/6W
R052	NO USE				
R053	RN14BK2C7501F	RES. METAL FILM	7.5K	1%	1/6W
R054	R92-1061-05	JUMPING RES.	ZERO OHM		
R055	RS14AB3A391J	RES. METAL FILM	390	5%	1W
R056	R01-1518-08	V.R. WITH SW	1KB		
R057	RD14BB2C391J	RES. CARBON	390	5%	1/6W
R058	RD14BB2C470J	RES. CARBON	47	5%	1/6W
R059	RN14BK2C49R9F	RES. METAL FILM	49.9	1%	1/6W
R060	RN14BK2C1132F	RES. METAL FILM	11.3K	1%	1/6W
R061	RN14BK2C1132F	RES. METAL FILM	11.3K	1%	1/6W
R062	RN14BK2C3090F	RES. METAL FILM	309	1%	1/6W
R063	RN14BK2C1212F	RES. METAL FILM	12.1K	1%	1/6W
R064	RN14BK2C1212F	RES. METAL FILM	12.1K	1%	1/6W
R065	RN14BK2C2000F	RES. METAL FILM	200	1%	1/6W
R066	RN14BK2C2492F	RES. METAL FILM	24.9K	1%	1/6W
R067	RN14BK2C2492F	RES. METAL FILM	24.9K	1%	1/6W
R068	RN14BK2C1270F	RES. METAL FILM	127	1%	1/6W
R069	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R070	RN14BK2C63R4F	RES. METAL FILM	63.4	1%	1/6W
R071	RD14BB2C512J	RES. CARBON	5.1K	5%	1/6W
R072	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R073	RD14BB2C681J	RES. CARBON	680	5%	1/6W
R074	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R075	R12-1029-05	RES. SEMI FIXED	1K B		
R076	RD14BB2C682J	RES. CARBON	6.8K	5%	1/6W
R077	RN14BK2C1052F	RES. METAL FILM	10.5K	1%	1/6W
R078	RN14BK2C1052F	RES. METAL FILM	10.5K	1%	1/6W
R079	R12-1033-05	RES. SEMI FIXED	2.2K B		
R080	RN14BK2C1001F	RES. METAL FILM	1K	1%	1/6W
R081	RD14BB2C331J	RES. CARBON	330	5%	1/6W
R082	R01-1517-08	V.R.	1KB		
R083	RD14BB2C150J	RES. CARBON	15	5%	1/6W
R084	RN14BK2C2001F	RES. METAL FILM	2K	1%	1/6W
R085	RN14BK2C1500F	RES. METAL FILM	150	1%	1/6W
R086	RD14BB2C122J	RES. CARBON	1.2K	5%	1/6W
R087	RD14BB2C432J	RES. CARBON	4.3K	5%	1/6W
R088	R12-1033-05	RES. SEMI FIXED	2.2K B		
R089	RD14BB2C512J	RES. CARBON	5.1K	5%	1/6W
R090	RN14BK2C2552F	RES. METAL FILM	25.5K	1%	1/6W
R091	R12-1029-05	RES. SEMI FIXED	1K B		
R092	RD14BB2C183J	RES. CARBON	18K	5%	1/6W
R093	RN14BK2C3160F	RES. METAL FILM	316	1%	1/6W
R094	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R095	RD14BB2C302J	RES. CARBON	3K	5%	1/6W
R096	RD14BB2C333J	RES. CARBON	33K	5%	1/6W
R097	RD14BB2C302J	RES. CARBON	3K	5%	1/6W
R098	RS14AB3A150J	RES. METAL FILM	15	5%	1W
R099	RS14AB3A150J	RES. METAL FILM	15	5%	1W
R100	RS14AB3D470J	RES. METAL FILM	47	5%	2W
R101	NO USE				
R102	RS14AB3F620J	RES. METAL FILM	62	5%	3W
R103	RS14AB3F620J	RES. METAL FILM	62	5%	3W
R104	RN14BK2C41R2F	RES. METAL FILM	41.2	1%	1/6W
R105	RN14BK2C41R2F	RES. METAL FILM	41.2	1%	1/6W
R106	RN14BK2C10R0F	RES. METAL FILM	10.0	1%	1/6W
R107	RN14BK2C49R9F	RES. METAL FILM	49.9	1%	1/6W
R108	RN14BK2C49R9F	RES. METAL FILM	49.9	1%	1/6W
R109	R92-1425-08	RES. METAL FILM	1	1%	1/6W
R110	NO USE				
R111	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R112	RD14BB2C102J	RES. CARBON	1K	5%	1/6W
R113	RN14BK2C1102F	RES. METAL FILM	11K	1%	1/6W
R114	RN14BK2C1102F	RES. METAL FILM	11K	1%	1/6W
R115	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R116	R01-3521-08	V.R. WITH SW	10KB		
R117	RD14BB2C150J	RES. CARBON	15	5%	1/6W
R118	RD14BB2C393J	RES. CARBON	39K	5%	1/6W
R119	RD14BB2C512J	RES. CARBON	5.1K	5%	1/6W
R120	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R121	RD14BB2C512J	RES. CARBON	5.1K	5%	1/6W
R122	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R123	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R124	RD14BB2C153J	RES. CARBON	15K	5%	1/6W
R125	RD14BB2C681J	RES. CARBON	680	5%	1/6W
R126	RD14BB2C272J	RES. CARBON	2.7K	5%	1/6W
R127	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R128	RD14BB2C514J	RES. CARBON	510K	5%	1/6W
R129	RD14BB2C514J	RES. CARBON	510K	5%	1/6W
R130	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R131	RD14BB2C512J	RES. CARBON	5.1K	5%	1/6W
R132	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R133	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R134	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R135	R92-1423-08	RES. METAL GLAZE	22M	5%	1/6W
R136	RD14BB2C333J	RES. CARBON	33K	5%	1/6W
R137	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R138	RD14BB2C154J	RES. CARBON	150K	5%	1/6W
R139	RD14BB2C750J	RES. CARBON	75	5%	1/6W
R140	RD14BB2C750J	RES. CARBON	75	5%	1/6W
R141	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R142	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R143	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R144	RD14BB2C220J	RES. CARBON	22	5%	1/6W
R145	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R146	RD14BB2C471J	RES. CARBON	470	5%	1/6W
R147	RD14BB2C471J	RES. CARBON	470	5%	1/6W
R148	RD14BB2C221J	RES. CARBON	220	5%	1/6W
R149	RD14BB2C331J	RES. CARBON	330	5%	1/6W
R150	RD14BB2C471J	RES. CARBON	470	5%	1/6W
R151	RD14BB2C471J	RES. CARBON	470	5%	1/6W
R152	RD14BB2C331J	RES. CARBON	330	5%	1/6W
R153	RD14BB2C331J	RES. CARBON	330	5%	1/6W
R154	RD14BB2C471J	RES. CARBON	470	5%	1/6W
R155	RD14BB2C471J	RES. CARBON	470	5%	1/6W
R156	RD14BB2C104J	RES. CARBON	100K	5%	1/6W
R157	RD14BB2C471J	RES. CARBON	470	5%	1/6W

PARTS LIST

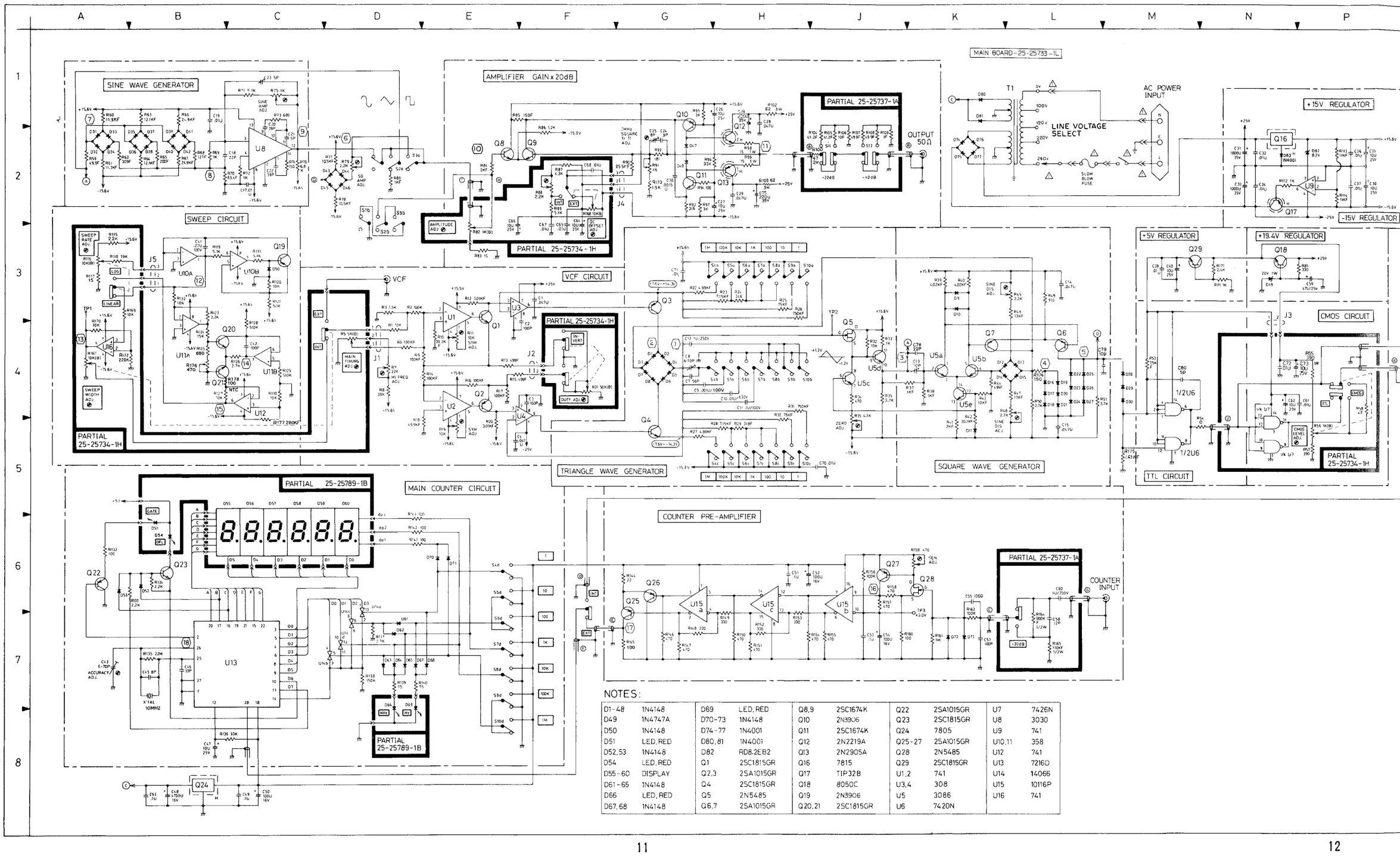
REF.NO	PARTS NO	NAME & DESCRIPTION			
R158	RD14BB2C471J	RES. CARBON	470	5%	1/6W
R159	R12-0058-05	RES. SEMI FIXED	470 B		
R160	RD14BB2C101J	RES. CARBON	100	5%	1/6W
R161	RD14BB2C105J	RES. CARBON	1M	5%	1/6W
R162	RD14BB2C104J	RES. CARBON	100K	5%	1/6W
R163	NO USE				
R164	R92-1424-08	RES. METAL FILM	900K	1%	1/6W
R165	RN14BK2H1103F	RES. METAL FILM	110K	1%	1/2W
R166	NO USE				
R167	RO1-3521-08	V.R. WITH SW	10KB		
R168	RO1-3521-08	V.R. WITH SW	10KB		
R169	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R170	RD14BB2C103J	RES. CARBON	10K	5%	1/6W
R171	RD14BB2C242J	RES. CARBON	2.4K	5%	1/6W
R172	RD14BB2C224J	RES. CARBON	220K	5%	1/6W
R173	RD14BB2C152J	RES. CARBON	1.5K	5%	1/6W
R174	RD14BB2C151J	RES. CARBON	150	5%	1/6W
R175	RN14BK2C1651F	RES. METAL FILM	1.65K	1%	1/6W
R176	R12-0058-05	RES. SEMI FIXED	470 B		
R177	RN14BK2C2803F	RES. METAL FILM	280K	1%	1/6W
R178	R92-1430-08	TERMISTOR,NTC	100 OHM		

CAPACITOR

REF.NO	PARTS NO	NAME & DESCRIPTION			
C001	CK45F1H473Z	CAP. CERAMIC	0.047		50V
C002	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C003	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C004	CK45F1H473Z	CAP. CERAMIC	0.047		50V
C007	CC45CH1H560J	CAP. CERAMIC	56P	5%	50V
C008	C05-0451-08	CAP. TRIMMER	70PF		
C009	C91-1259-08	CAP. POLYE FILM	0.001	2%	100V
C010	C91-1258-08	CAP. METAL FILM	0.01	2%	630V
C011	C91-1257-08	CAP. METAL FILM	0.1	2%	100V
C012	C91-1262-08	CAP. METAL FILM	1	2%	250V
C013	C05-0466-08	CAP. TRIMMER	70PF		
C014	CK45F1H473Z	CAP. CERAMIC	0.047		50V
C015	CK45F1H473Z	CAP. CERAMIC	0.047		50V
C016	NO USE				
C017	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C018	CC45CH1H220J	CAP. CERAMIC	22P	5%	50V
C019	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C020	CC45CH1H390J	CAP. CERAMIC	39P	5%	50V
C021	CC45CH1H050C	CAP. CERAMIC	5P	0.25P	50V
C022	CC45CH1H390J	CAP. CERAMIC	39P	5%	50V
C023	C05-0465-08	CAP. TRIMMER	5PF		
C024	CC45CH1H030C	CAP. CERAMIC	3P	0.25P	50V
C025	C05-0450-08	CAP. TRIMMER	8PF		
C026	CE04EW1E100M	CAP. ELECTRO	10	20%	25V
C027	CE04EW1E100M	CAP. ELECTRO	10	20%	25V
C028	CK45F1H473Z	CAP. CERAMIC	0.047		50V
C029	CK45F1H473Z	CAP. CERAMIC	0.047		50V
C030	CK45B1H152K	CAP. CERAMIC	1500P	10%	50V
C031	CE04EW1V102M	CAP. ELECTRO	1000	20%	35V
C032	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C033	CE04EW1V102M	CAP. ELECTRO	1000	20%	35V
C034	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C035	CE04EW1E100M	CAP. ELECTRO	10	20%	25V
C036	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C037	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C038	CE04EW1E100M	CAP. ELECTRO	10	20%	25V
C039	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C040	CE04EW1E100M	CAP. ELECTRO	10	20%	25V
C041	C91-1260-08	CAP. METAL FILM	0.22	10%	100V
C042	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C043	C05-0451-08	CAP. TRIMMER	70PF		
C044	NO USE				
C045	CC45CH1H080D	CAP. CERAMIC	8P	0.5P	50V
C046	CC45CH1H330J	CAP. CERAMIC	33P	5%	50V
C047	CE04EW1E100M	CAP. ELECTRO	10	20%	25V
C048	CE04EW1C472M	CAP. ELECTRO	4700	20%	16V
C049	C91-1261-08	CAP./MULTILAYER	0.1		100V
C050	CE04EW1C101M	CAP. ELECTRO	100	20%	16V
C051	CK45F1H104Z	CAP. CERAMIC	0.1		50V
C052	CE04EW1C101M	CAP. ELECTRO	100	20%	16V
C053	CK45F1H104Z	CAP. CERAMIC	0.1		50V
C054	CE04EW1C101M	CAP. ELECTRO	100	20%	16V
C055	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C056	NO USE				

REF.NO	PARTS NO	NAME & DESCRIPTION			
C057	CC45CH1H101J	CAP. CERAMIC	100P	5%	50V
C058	CC45CH1H120J	CAP. CERAMIC	12P	5%	50V
C059	CE04EW1E470M	CAP. ELECTRO	47	20%	25V
C060	C91-1256-08	CAP. METAL FILM	1	10%	250V
C061	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C062	CE04EW1E100M	CAP. ELECTRO	10	20%	25V
C063	CK45F1H104Z	CAP. CERAMIC	0.1		50V
C064	CE04EW1E100M	CAP. ELECTRO	10	20%	25V
C065	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C066	CE04EW1E100M	CAP. ELECTRO	10	20%	25V
C067	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C068	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C069	NO USE				
C070	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C071	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C072	CK45F1H103Z	CAP. CERAMIC	0.01		50V
C073	CE04EW1E100M	CAP. ELECTRO	10	20%	25V
C074	CE04EW1V221M	CAP. ELECTRO	220	20%	35V
C075	CE04EW1V221M	CAP. ELECTRO	220	20%	35V
C078	CC45CH1H220J	CAP. CERAMIC	22P	5%	50V
C079	CC45CH1H100D	CAP. CERAMIC	10P	0.5P	50V
C080	CC45CH1H050C	CAP. CERAMIC	5P	0.25P	50V

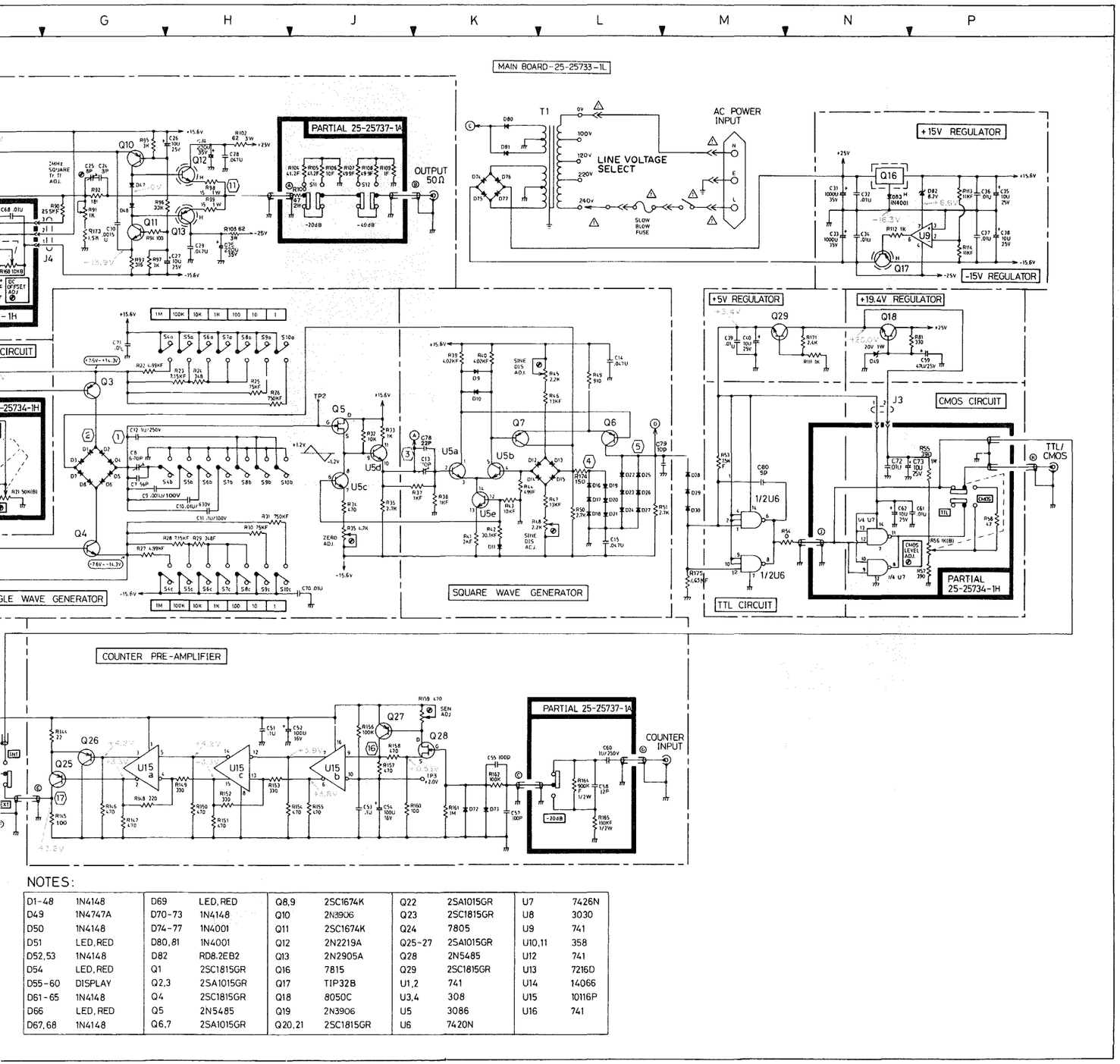
SCHEMATIC DIAGRAM



NOTES:

D1-48	1N4148	D69	LED,RED	Q8,9	2SC1674K	Q22	2SA1015GR	U7	7426N
D49	1N4747A	D70-73	1N4148	Q10	2N3906	Q23	2SC1815GR	U8	3030
D50	1N4148	D74-77	1N4001	Q11	2SC1674K	Q24	7805	U9	741
D51	LED,RED	D80,81	1N4001	Q12	2N2219A	Q25-27	2SA1015GR	U10,11	358
D52,53	1N4148	D82	RD8.2EB2	Q13	2N2905A	Q28	2N5485	U12	741
D54	LED,RED	Q1	2SC1815GR	Q16	7815	Q29	2SC1815GR	U13	7216D
D55-60	DISPLAY	Q2,3	2SA1015GR	Q17	TIP32B	U1,2	741	U14	14066
D61-65	1N4148	Q4	2SC1815GR	Q18	8050C	U3,4	308	U15	10116P
D66	LED,RED	Q5	2N5485	Q19	2N3906	U5	3086	U16	741
D67,68	1N4148	Q6,7	2SA1015GR	Q20,21	2SC1815GR	U6	7420N		

SCHEMATIC DIAGRAM



NOTES:

D1-48	1N4148	D69	LED, RED	Q8,9	2SC1674K	Q22	2SA1015GR	U7	7426N
D49	1N4747A	D70-73	1N4148	Q10	2N3906	Q23	2SC1815GR	U8	3030
D50	1N4148	D74-77	1N4001	Q11	2SC1674K	Q24	7805	U9	741
D51	LED, RED	D80, 81	1N4001	Q12	2N2219A	Q25-27	2SA1015GR	U10,11	358
D52,53	1N4148	D82	RD8.2EB2	Q13	2N2905A	Q28	2N5485	U12	741
D54	LED, RED	Q1	2SC1815GR	Q16	7815	Q29	2SC1815GR	U13	7216D
D55-60	DISPLAY	Q2,3	2SA1015GR	Q17	TIP32B	U1,2	741	U14	14066
D61-65	1N4148	Q4	2SC1815GR	Q18	8050C	U3,4	308	U15	10116P
D66	LED, RED	Q5	2N5485	Q19	2N3906	U5	3086	U16	741
D67,68	1N4148	Q6,7	2SA1015GR	Q20,21	2SC1815GR	U6	7420N		

(1) 0.5 V/div 0.2 ms/div

(2) 0.5 V/div 0.2 ms/div

(3) 0.5 V/div 0.2 ms/div

(4) 1 V/div 0.2 ms/div

(5) 1 V/div 0.2 ms/div

(6) FUNCTION : SQUARE
0.5 V/div 0.2 ms/div

(7) 0.5 V/div 0.2 ms/div

(8) 0.1 V/div 0.2 ms/div

(9) 0.5 V/div 0.2 ms/div

(10) FUNCTION : SINE
0.5 V/div 0.2 ms/div

(11) FUNCTION : SINE
AMPLITUDE : MAX
5 V/div 0.2 ms/div

(12) SWEEP RATE : CCW
2 V/div 1 s/div

(13) [LINEAR]
SWEEP RATE : CW
5 V/div 2 ms/div

(13) [LOG]
SWEEP RATE : CW
5 V/div 2ms/div

(13) [LINEAR]
SWEEP RATE : CCW
5 V/div 1 s/div

(13) [LOG]
SWEEP RATE : CCW
5 V/div 1 s/div

(14) SWEEP RATE : CCW
1 V/div 1 s/div

(15) SWEEP RATE : CCW
5 V/div 1 s/div

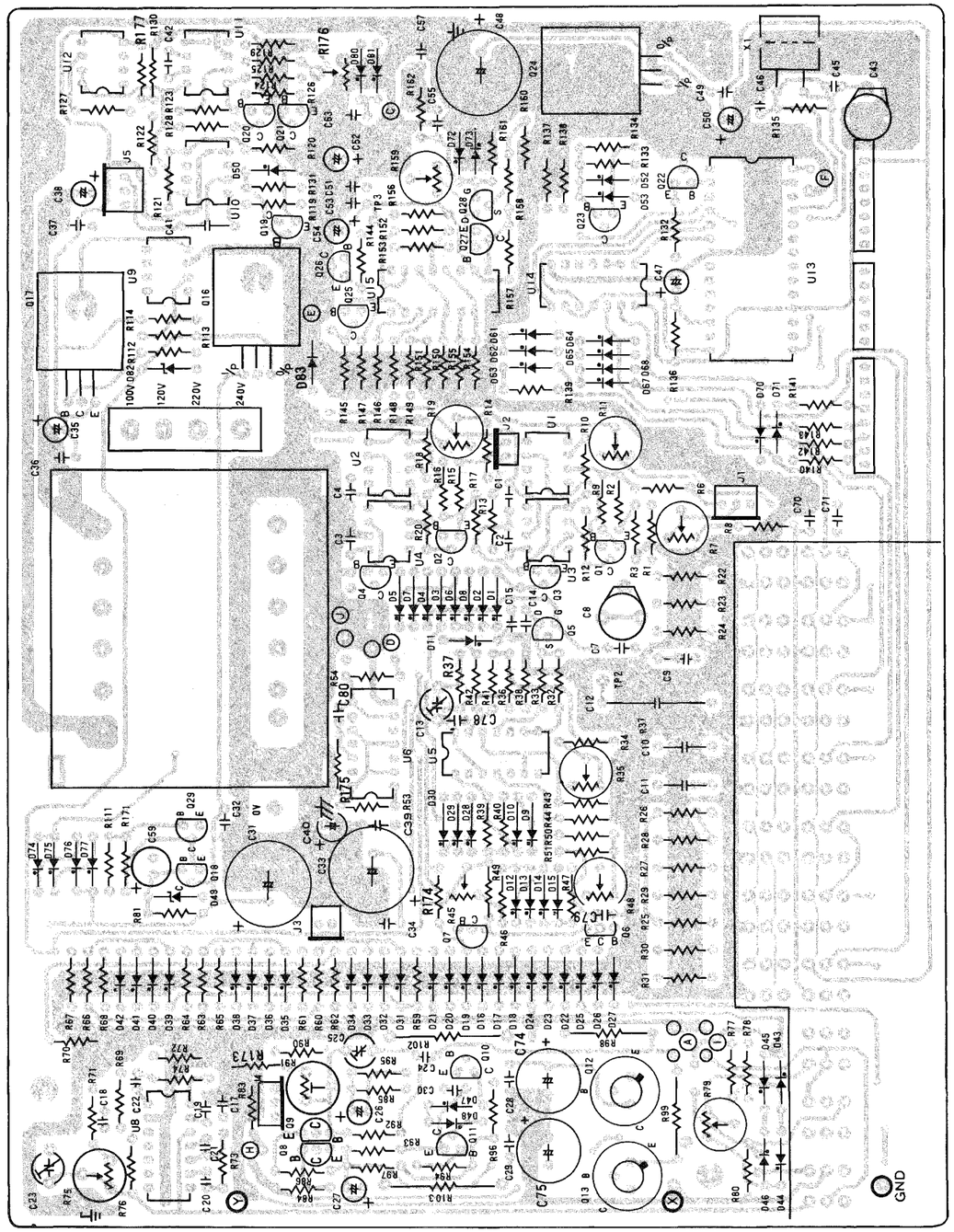
(16) INPUT SIGNAL f=1kHz
0.1 V/div 0.2 ms/div

(17) 1 V/div 0.2 ms/div

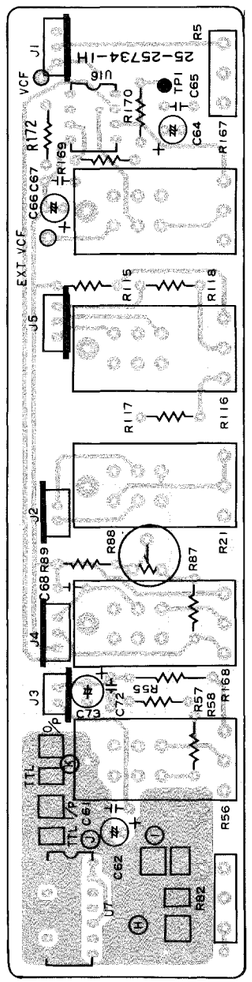
(18) 1 V/div 0.05 μs/div

P.C. BOARD

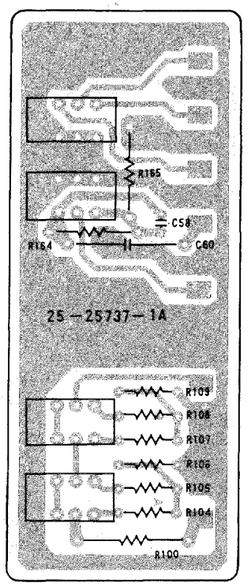
MAIN UNIT (W02-0454-08)



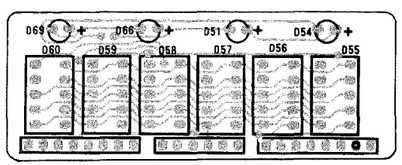
EXT VCF UNIT (W02-0456-08)



ATT. UNIT (W02-0457-08)



DISPLAY UNIT (W02-0455-08)



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