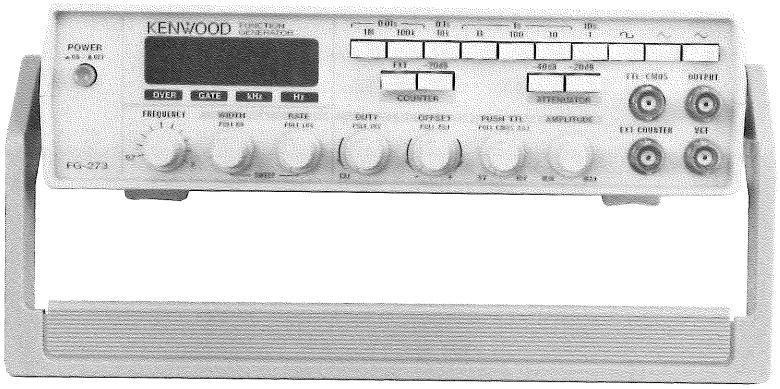
KENWOOD

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.**

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# 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<br>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.)

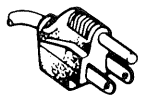
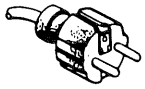
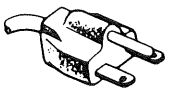
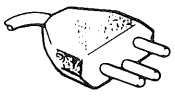
| Plug configuration | Power cord and plug type | Factory installed instrument fuse | Line cord plug fuse | Parts No. for power cord and plate |
|---|---|---|---|---|
|  | North American<br>120 volt/60 Hz<br>Rated 15 amp<br>(12 amp max; NEC) | 0.3 A, 250 V<br>Slow blow<br>6×30 mm | None | Cord:<br>E30-1820-05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

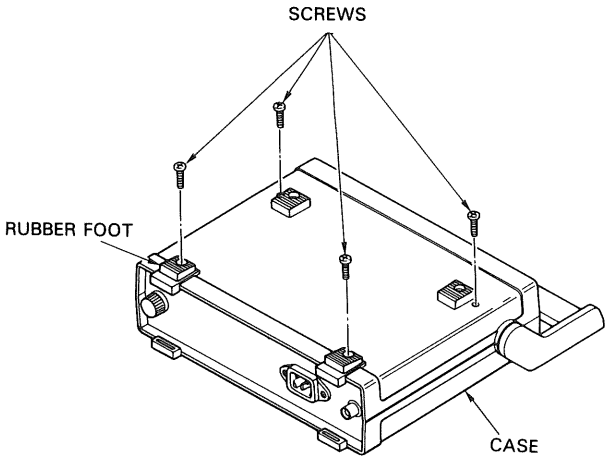



**Fig. 2**

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.)

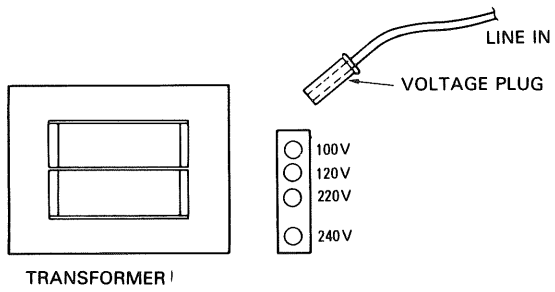



**Fig. 3**

## 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 |
| ⌇ | | |
| 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 | R1Z-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

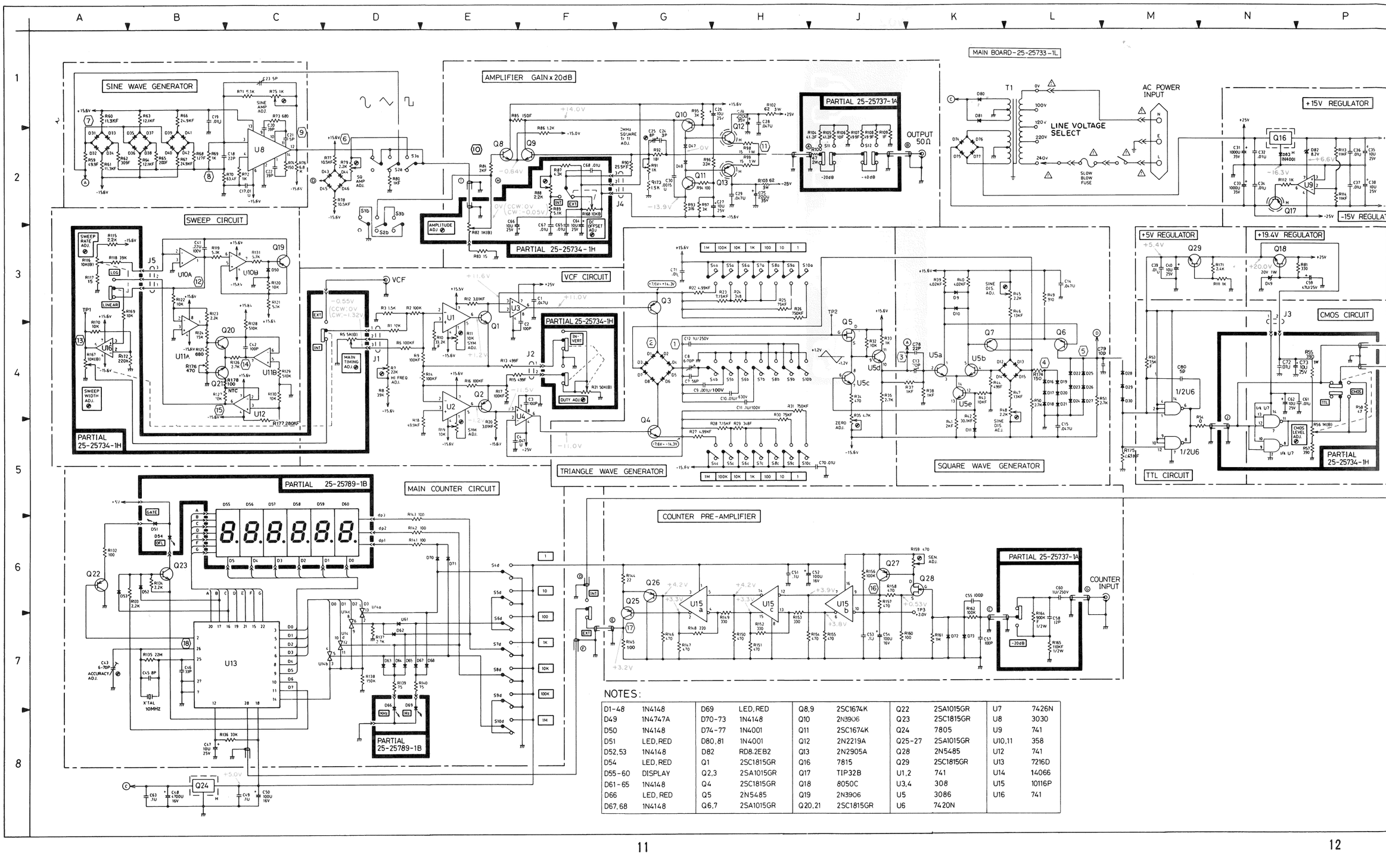
| REF.NO | PARTS NO | NAME & DESCRIPTION | | | |
|---|---|---|---|---|---|
| R158 | RD14BB2C471J | RES. CARBON | 470 | 5% | 1/6W |
| R159 | R12-0058-05 | RES. SEMI FIXED | 470 B | | |
| R160 | RD14BB2C101J | RES. CARBON | 100 | 5% | 1/6W |
| R161 | RD14BB2C105J | RES. CARBON | 1M | 5% | 1/6W |
| R162 | 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 | R01-3521-08 | V.R. WITH SW | 10KB | | |
| R168 | R01-3521-08 | 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 |

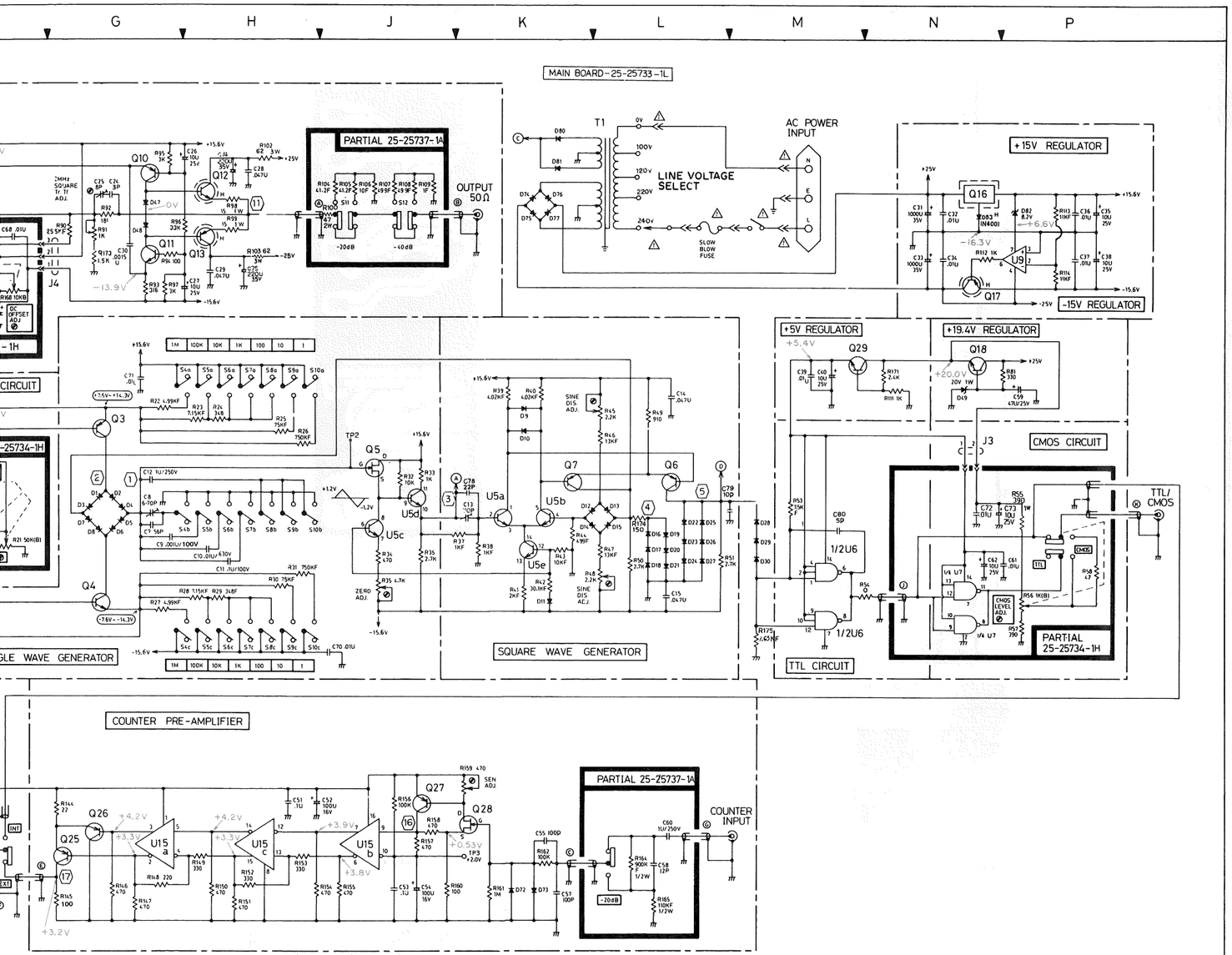
# SCHEMATIC DIAGRAM




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 | | |

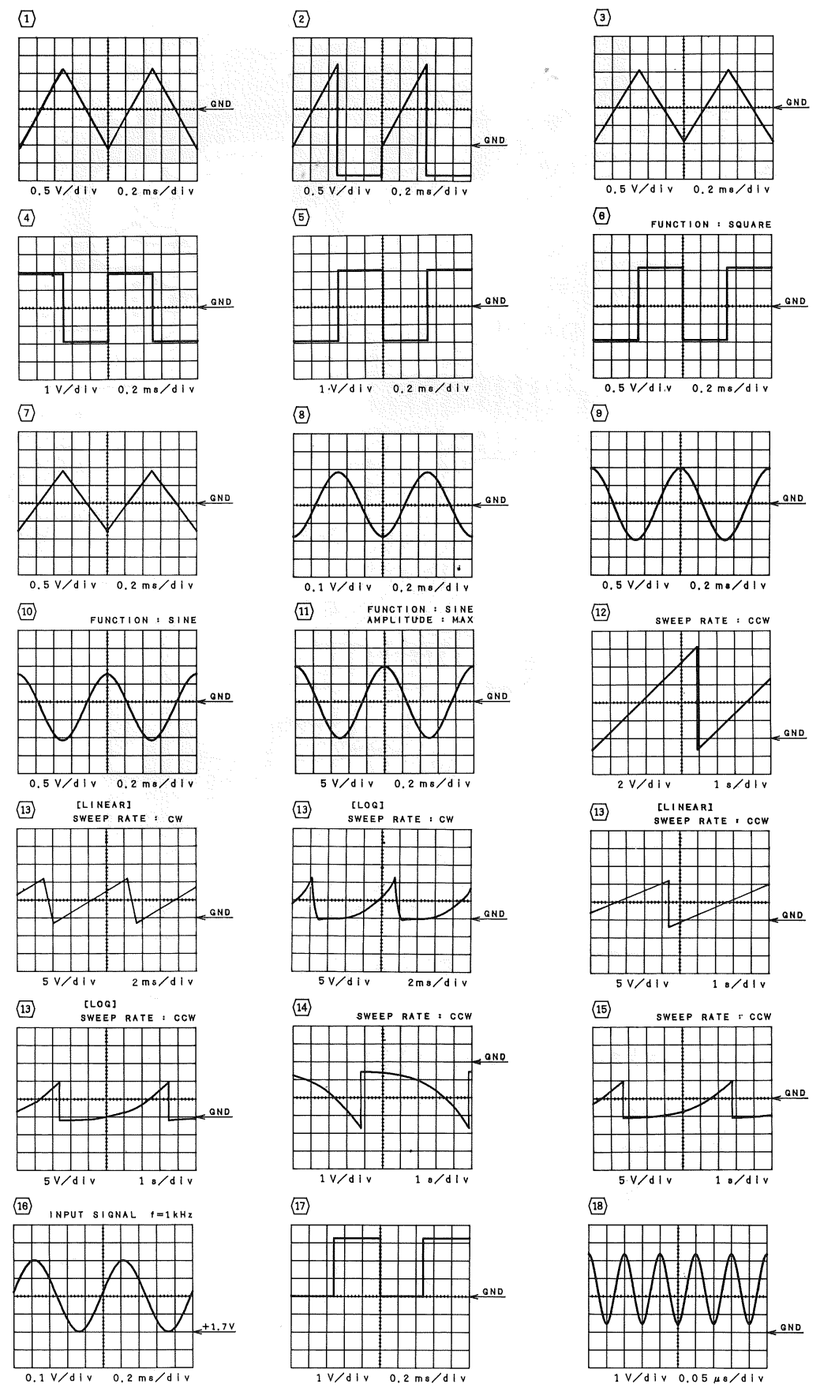
# SCHEMATIC DIAGRAM




NOTES:

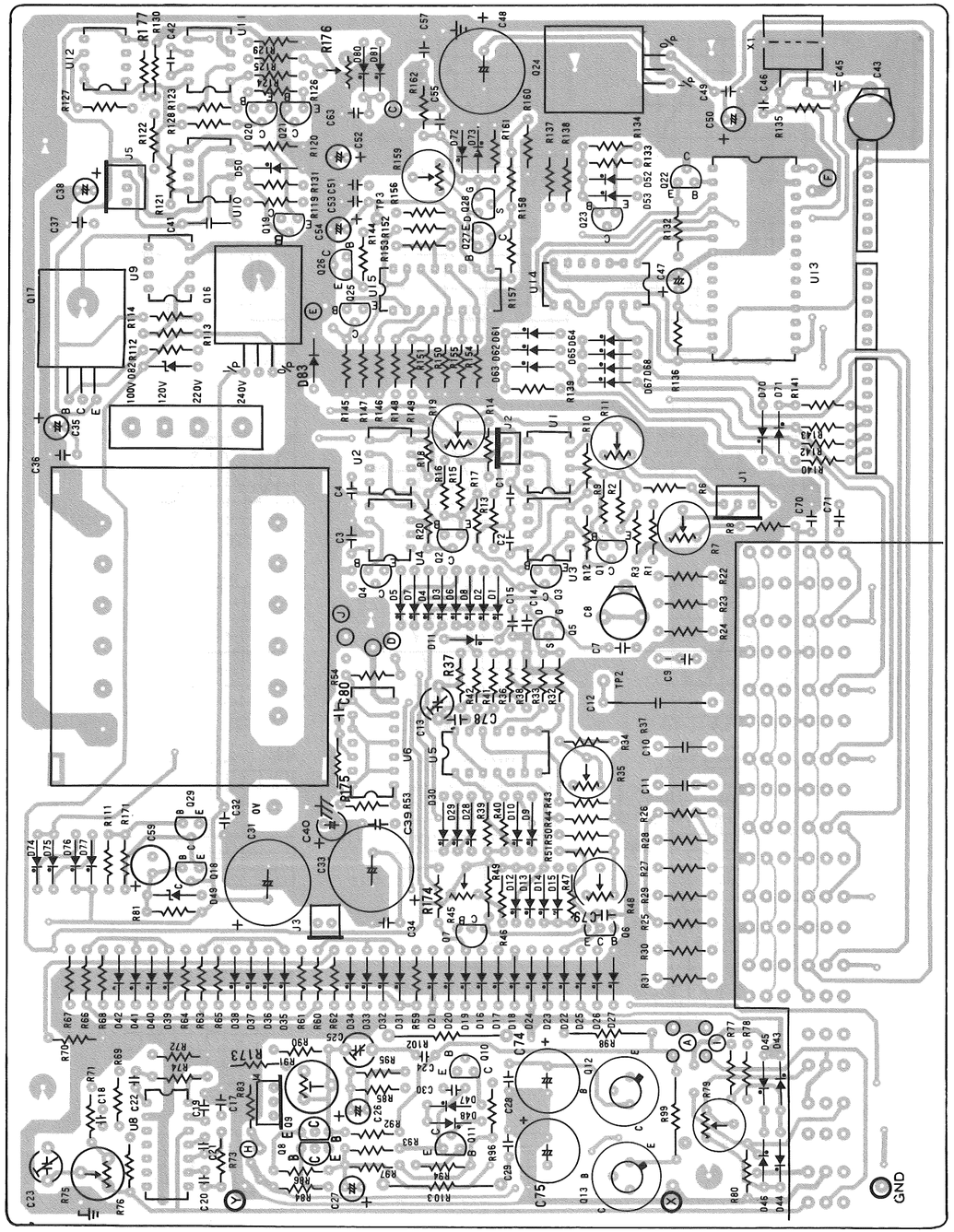
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D1-48 | 1N4148 | D69 | LED,RED | Q8,9 | 2SC1674K | Q22 | 2SA1015GR | U7 | 7426N |
| D49 | 1N4747A | D70-73 | 1N4148 | Q10 | 2N3906 | Q23 | 2SC1815GR | U8 | 3030 |
| D50 | 1N4148 | D74-77 | 1N4001 | Q11 | 2SC1674K | Q24 | 7805 | 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 | | |



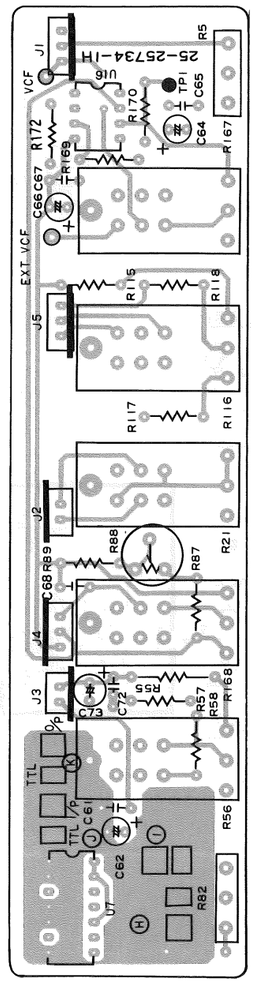


# P.C. BOARD

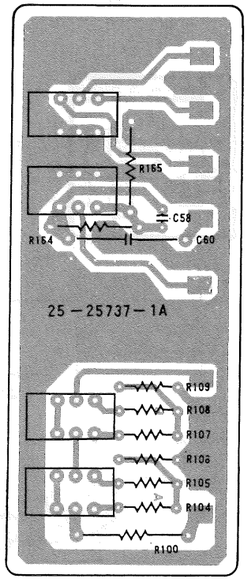
## MAIN UNIT (W02-0454-08)



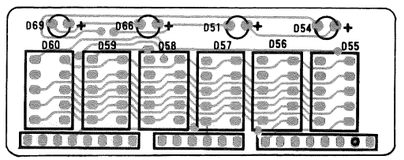

## EXT VCF UNIT (W02-0456-08)




## ATT. UNIT (W02-0457-08)




## DISPLAY UNIT (W02-0455-08)



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