REALISTIC®

Service Manual

20-110

COMP-100

5-BAND FM SCANNING MONITOR RECEIVER WITH PROGRAMMABLE MEMORY

Catalog Number : 20-110

CUSTOM MANUFACTURED FOR RADIO SHACK A DIVISION OF TANDY CORPORATION

CONTENTS

SPECIFICATIONS

Description	Nominal spec.	Limit spec.
Frequency coverage (VHF Lo)	30 ~ 50 MHz	30 ~ 50 MHz
(VHF Hi)	150 ~ 172 MHz	150 ~ 172 MHz
(UHF Lo)	450 ~ 470 MHz	450 ~ 470 MHz
(UHF Mid)	470 ~ 490 MHz	470 ~ 490 MHz
(UHF Hi)	490 ~ 512 MHz	490 ~ 512 MHz
Scanning rate (Variable speed)	10 channel/sec.	Approx. 15 channel/sec.
Scan delay time	2 sec.	1.5 ~ 3 sec.
Sensitivity (VHF Lo)	1 μV for 20 dB quieting	2 μV for 20 dB quieting
(VHF Hi)	1 μV for 20 dB quieting	2 μV for 20 dB quieting
(UHF Lo)	2 μV for 20 dB quieting	4 μV for 20 dB quieting
(UHF Mid)	1 μV for 20 dB quieting	2 μV for 20 dB quieting
(UHF Hi)	2 μV for 20 dB quieting	4 μV for 20 dB quieting
Selectivity -6 dB	±9 kHz	±8 kHz
-50 dB	±17 kHz	±20 kHz
Spurious rejection		
(VHF Lo at 40 MHz)	More than 60 dB	More than 30 dB
(VHF Hi at 160 MHz)	More than 35 dB	More than 20 dB
(UHF at 480 MHz)	More than 16 dB	Not limited
IF rejection (10.7 MHz)	More than 60 dB	More than 50 dB
Image ratio (VHF Lo)	40 dB at 30 ~ 40 MHz 25 dB at 50 MHz	More than 20 dB
(VHF Hi)	70 dB at 160 ~ 170 MHz 60 dB at 150 MHz	More than 50 dB
(UHF)	20 dB at 480 MHz	Not limited
Modulation acceptance	±5 kHz	±7 kHz
Squelch sensitivity (Threshold)	Less than 1 μV	Less than 2 μV
Audio power output	2 watts Max.	More than 1.5 watts
Current drain (13.8 V DC)	850 mA (Squelched) 1000 mA (Max. volume, open squelch)	1000 mA 1200 mA

Description	Specification
Program channel	16 channels
IF frequency	30 ~ 52 MHz (UHF and VHF Hi), 10.7 MHz and 455 kHz
Antenna impedance	50 ohms
Built-in speaker	3" (7.6 cm) dynamic speaker
Power source and consumption	12 V DC Negative ground, 16 watts Max., 120 V AC, 30 watts Max.
Dimensions	Approx. 3-1/4" (H) x 10" (D) x 10-1/4" (W) (8 x 25 x 26 cm.)
Battery drain life	Approx. 6 months
Battery drain	Nominal 1μA Max 500μA
Battery life	Approx. 6 months

NOTE: *Nominal Specs represent the design specs; all units should be able to approximate these – some will exceed and some may drop slightly below these specs. Limit Specs represent the absolute worst condition which still might be considered acceptable; in no case should a unit perform to less than within any Limit Spec.*

COMP-100 does not require additional crystals to select frequencies as in previous scanners. This is because COMP-100 includes a PLL circuit and a memory circuit.
PLL is phase locked loop, which consists of a phase detector (ϕ det.), low pass filter (LPF) and voltage controlled oscillator (VCO). See Figure 1. The phase detector produces a voltage proportional to the phase difference between two input signals. This output voltage represents the frequency component of the input signal and also its harmonics plus extraneous noises. The low pass filter integrates the output voltage of the phase detector and then filters harmonics and noises. Then it produces a continuous voltage component in proportion to the phase difference. The VCO is an oscillator which controls oscillation frequency by a given control voltage. It is used to assure that the control voltage and the oscillation frequency are proportional. It is called "LOCKED" when input phase and output phase become the same. This frequency width, which keeps the locked condition and follows the input signal, is called "LOCKED RANGE".

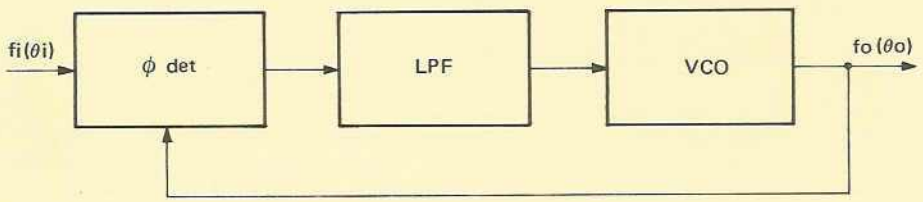


FIGURE 1.

Figure 2 shows a block diagram of the frequency synthesizer. This is not direct feed back, but this includes a 1/N programmable divider in the feedback loop.
Oscillation frequency (fo) of the VCO is decided by N times input frequency. So fo = N·fi. If the input signal (fi) is derived from a stable crystal oscillator frequency, this PLL system works as a frequency synthesizer. Reference frequency fo is divided by a code from the shift register.
The shift register shifts memory of the memory IC and transfers the code to the programmable counter.
The memory transfers a code to the shift register after memorizing the programmed code and read out/write on.

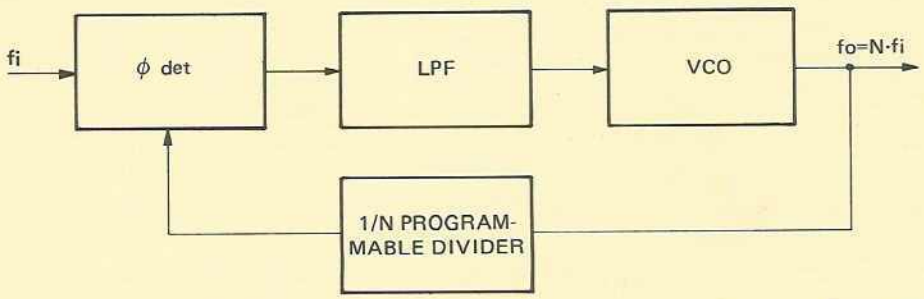
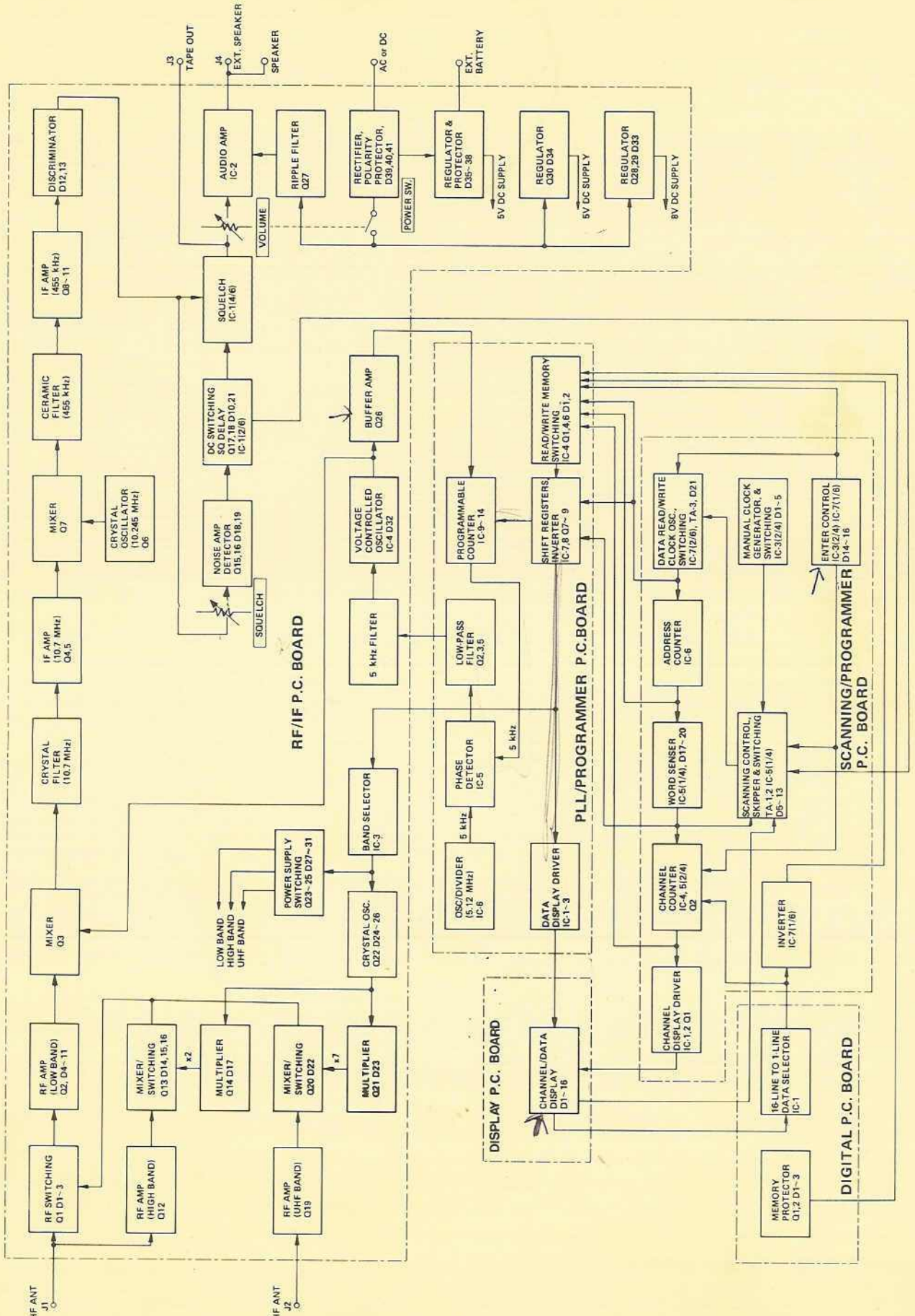


FIGURE 2.

IMPORTANT NOTE

The P.C. Boards of the COMP-100 utilize plated-through holes. Connections are made from one side of the board directly to the other through a hole, so that no soldering or jumper wires are required. Do not mistakenly think the factory forgot to solder some connections on these boards. We've prepared special extender boards for ease of servicing these boards (one extender available at each Service Center). Use it when servicing the inner P.C. Board, which can't be worked on without removing the other P.C. Boards.

BLOCK DIAGRAM



DISASSEMBLY DIAGRAM

Refer to Figure 3.
Step 1: Remove two bracket screws (A) and the bracket (B).
Step 2: Remove four screws (C) — two from each side of the cabinet.
Step 3: Open the cabinet.

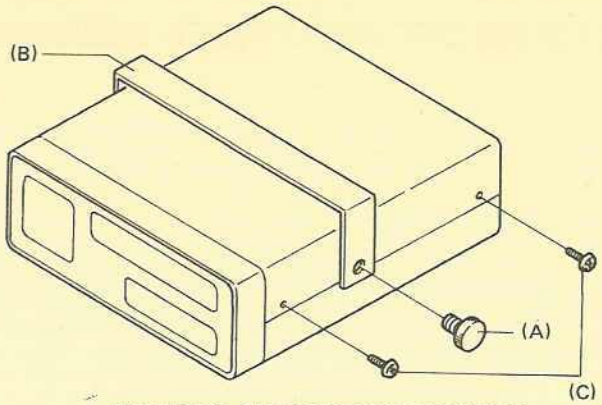


FIGURE 3. CHASSIS DISASSEMBLY

ALIGNMENT PREPARATION

Test equipment required
1. Oscilloscope (0 ~ 500 kHz, 0 ~ 50 MHz)
2. AC VTVM
3. DC VTVM
4. Frequency counter (60 MHz)
5. 8 ohm dummy load
6. Slow sweep generator with variable marker (10.7 MHz)
7. VHF sweep generator with variable marker (30 ~ 52 MHz, 148 ~ 174 MHz)
8. UHF sweep generator with variable marker (450 ~ 512 MHz)
9. FM signal generator (30 ~ 50 MHz, 150 ~ 172 MHz, 450 ~ 512 MHz)

NOTE 1: *Use non-metallic tuning tools.*
The test equipment and receiver should be warmed up at least 10 minutes before proceeding with alignment. Input signal from the generator should be kept as low as possible and still obtain usable output.

NOTE 2: *The 9-volt battery is required to hold the memory when AC is disconnected. Always be sure the unit is loaded with a fresh 9-volt battery or the pre-programmed channels will be lost (and will have to be re-programmed).*

NOTE 3: *The extension P.C.Boards are prepaired to check and/or repair the PLL/PROGRAMMER and SCANNING/PROGRAMMER P.C.Boards.*

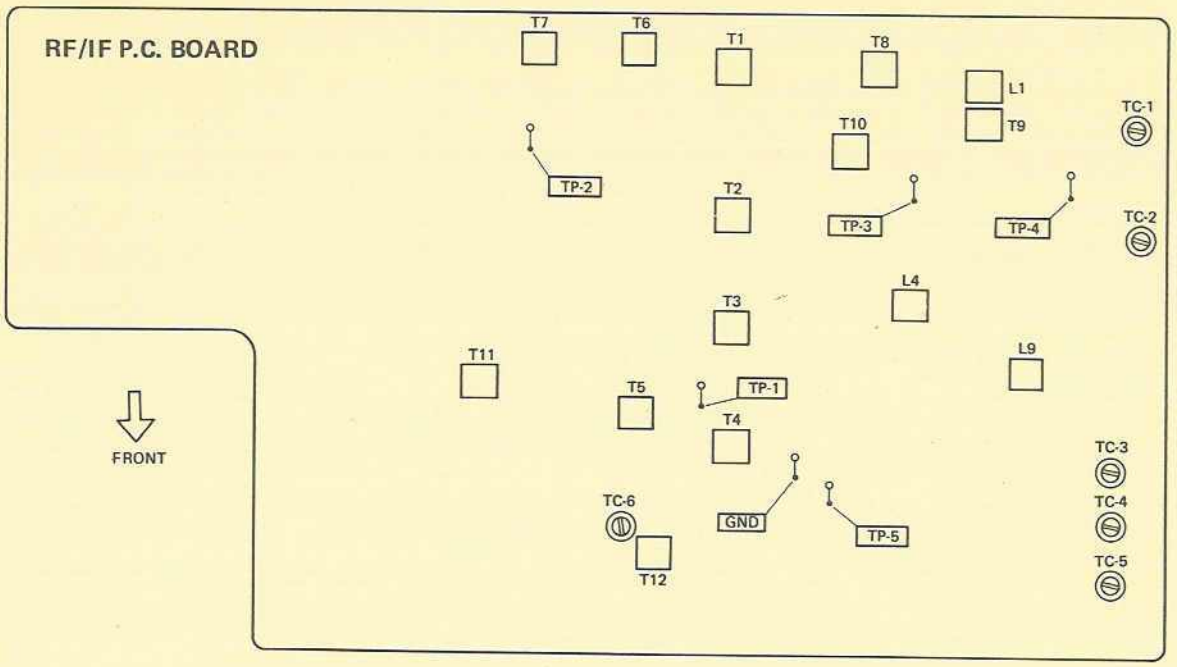
For PLL/PROGRAMMER P.C.Board	*MFR's Part No.*	*GE-22B-6321*
For SCANNING/PROGRAMMER P.C.Board	*MFR's Part No.*	*GE-22B-6322*

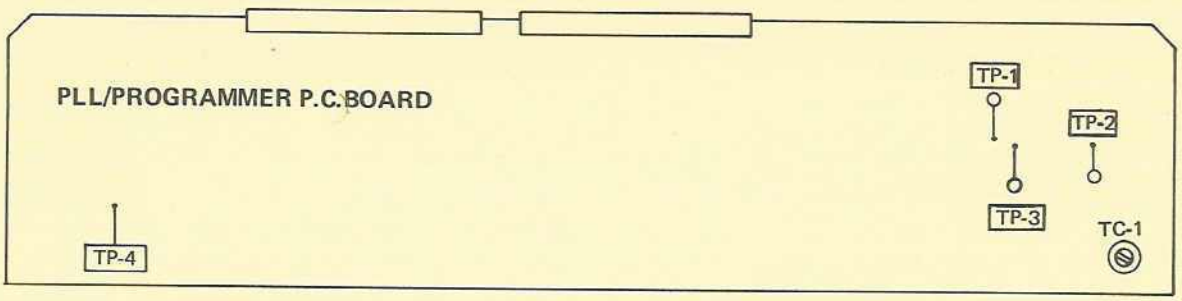
REFERENCE FREQUENCY OSC/DIVIDER ALIGNMENT

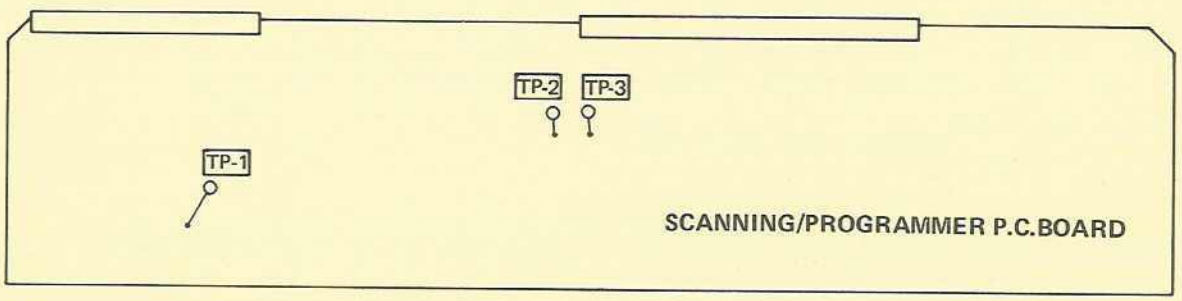
NOTE: *The reference frequency OSC/Divider circuit is on the PLL PROGRAMMER P.C. Board.*

Step 1: Connect Frequency Counter to TP-2 and ground.
Step 2: Adjust TC-1 (On the PLL/PROGRAMMER PCB) so that the frequency is 5.120000 MHz ±30 Hz.
Step 3: Connect Frequency Counter to TP-1 and ground. Read frequency on the frequency counter. Normal: 5.000 kHz.

ALIGNMENT AND TEST POINT POSITIONS







FREQUENCY CODE PROGRAMMING FOR ALIGNMENT PREPARATION

Before starting alignment, enter program code into channels 1 through 16 as follows: (See page 13 for procedure to enter code.)

Receiving Frequency	Channel/Digit Switches 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	VCO Frequency
VHF low																	
CH 1 30 MHz	*	*	*	4	*	*	7	*	9	10	11	*	*	*	*	*	40.700 MHz
CH 2 40 MHz	*	*	*	4	5	6	7	8	*	10	11	*	*	*	*	*	50.700 MHz
CH 3 50 MHz	*	*	*	*	5	*	7	8	9	10	11	*	*	*	*	*	60.700 MHz
CH 4 52 MHz	*	*	*	*	5	6	7	*	*	10	11	*	*	*	*	*	62.700 MHz
VHF high																	
CH 5 150 MHz	*	*	3	4	*	*	7	*	9	10	11	*	*	*	*	*	40.700 MHz
CH 6 160 MHz	*	*	3	4	5	6	7	8	*	10	11	*	*	*	*	*	50.700 MHz
CH 7 172 MHz	*	*	3	*	5	6	7	*	*	10	11	*	*	*	*	*	62.700 MHz
UHF low																	
CH 8 450 MHz	*	2	*	4	*	*	7	*	9	10	11	*	*	*	*	*	40.700 MHz
CH 9 460 MHz	*	2	*	4	5	6	7	8	*	10	11	*	*	*	*	*	50.700 MHz
CH10 470 MHz	*	2	*	*	5	*	7	8	9	10	11	*	*	*	*	*	60.700 MHz
UHF mid																	
CH11 470 MHz	*	2	3	4	*	*	7	*	9	10	11	*	*	*	*	*	40.700 MHz
CH12 480 MHz	*	2	3	4	5	6	7	8	*	10	11	*	*	*	*	*	50.700 MHz
CH13 490 MHz	*	2	3	*	5	*	7	8	9	10	11	*	*	*	*	*	60.700 MHz
UHF high																	
CH14 490 MHz	1	*	*	4	*	*	7	*	9	10	11	*	*	*	*	*	40.700 MHz
CH15 500 MHz	1	*	*	4	5	6	7	8	*	10	11	*	*	*	*	*	50.700 MHz
CH16 512 MHz	1	*	*	*	5	6	7	*	*	10	11	*	*	*	*	*	62.700 MHz

NOTE: *Code * = Button "in"*
Code Number = Button "out"

VOLTAGE CONTROLLED OSCILLATOR (VCO) ALIGNMENT

NOTE: *For this test you will MANUALLY select either channel 1, 2, 3 or 4.*

Step 1: Connect a DC VTVM and a Frequency Counter as shown in Figure 4.

Step 2: Select Channel 1 and adjust T12 for 0.4 V on the DC VTVM. The Frequency Counter should read 40.700000 MHz ± 600 Hz.

Step 3: Next, select Channel 3 and adjust TC-6 for 4 V on the DC VTVM. The Frequency Counter should read 60.700000 MHz ±600 Hz.

Step 4: Repeat steps 3 and 4 until no improvement is observed. Make sure that the Frequency Counter reads 40.700 MHz for CH 1,50.700 MHz for CH 2,60.700 MHz for CH 3 and 62.700 MHz for CH 4.

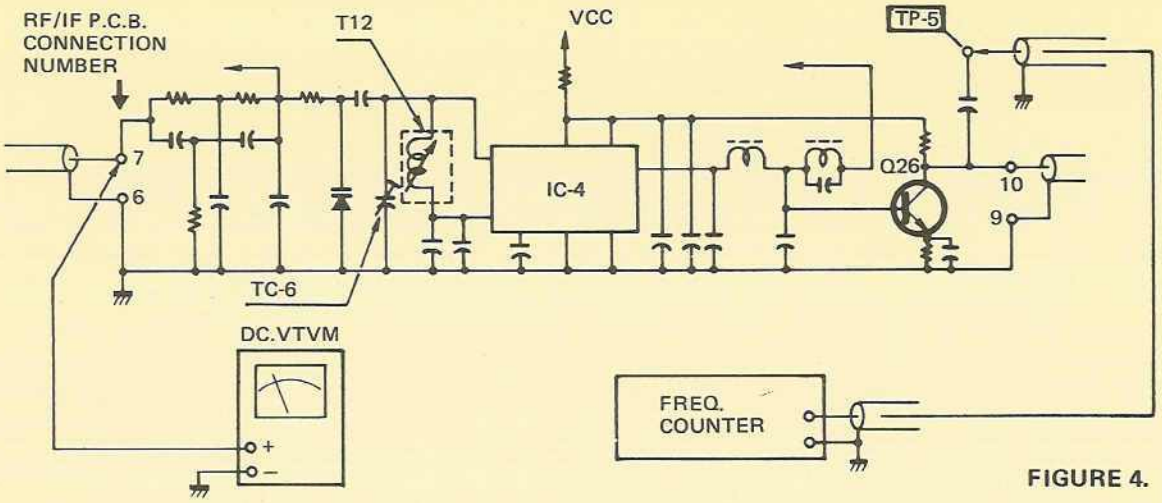


FIGURE 4.

VHF, UHF LOCAL OSCILLATOR FREQUENCY CHECK

NOTE: *For this test you will MANUALLY select either channel 1, 5, 8, 11 or 14.*

Step 1: Couple the frequency Counter through a pickup coil to oscillator coil L9. Refer to Figure 5.

Step 2: If necessary, adjust L9 as follows:
As you adjust this coil, you will note output increasing up to a certain point; further adjustment will cause output to drop off slightly and still further adjustment will cause the oscillator to drop out. Proper adjustment is at a point just before you get to maximum (on the side away from oscillator drop out).

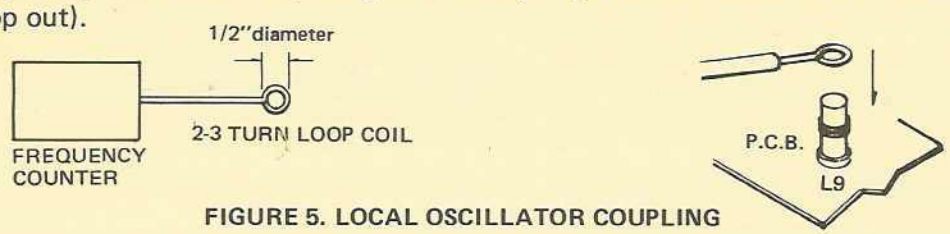


FIGURE 5. LOCAL OSCILLATOR COUPLING

Step 3: Adjust TC3, 4 and 5 for the following frequencies:

Channel	Adjust	Freq.
1	None	0
5	TC5	60.000000 MHz ±200 Hz
8	–	60.000000 MHz ±200 Hz
11	TC4	62.857500 MHz ±200 Hz
14	TC3	65.714642 MHz ±200 Hz

LOCAL OSCILLATOR FREQUENCY CHECK (10.245 MHz)

Step 1: Connect Frequency Counter through a 10 pF capacitor to Q6 Emitter circuit. Refer to Figure 6.

Step 2: Read frequency on the Frequency Counter. Normal: 10.245 MHz ±1 kHz.

NOTE: *Frequency Counter coupling capacitor should be as small a value as possible. Frequency Counter should be high impedance type.*

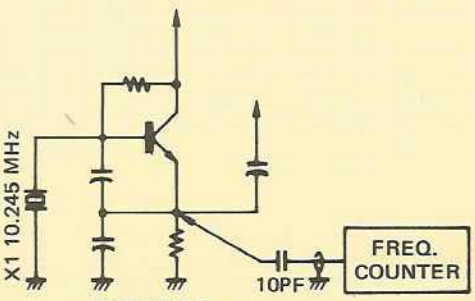


FIGURE 6.

IF SECTION ALIGNMENT

Step 1: Connect instruments as shown in Figure 7.
Step 2: Maintain Sweep Generator output at the lowest level possible to prevent overloading.

NOTE: *To perform the next adjustments, it is necessary to remove the Battery Compartment.*

Step 3: Adjust T4 and T5 for maximum output and adjust T6 and T7 so that the 455 kHz marker is in the center of the discriminator curve and for best linearity as shown in Figure 8.

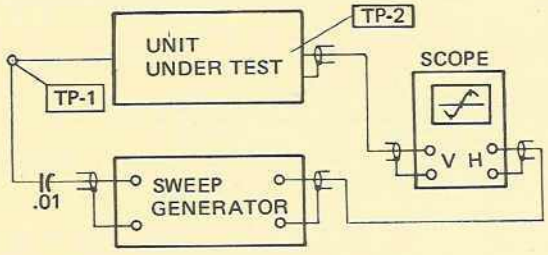


FIGURE 7. IF SECTION ALIGNMENT TEST EQPT. HOOK UP

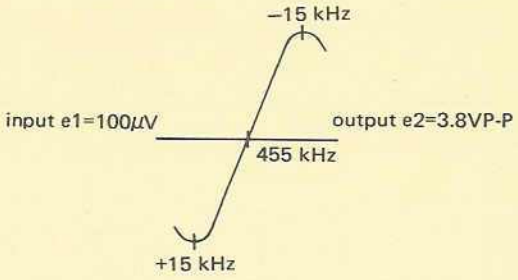


FIGURE 8. IF DISCRIMINATOR CURVE

VHF LOW BAND RF AMP ALIGNMENT

NOTE: *For this test you will MANUALLY select either channel 1, 2, 3 or 4.*

Step 1: Connect instruments as shown in Figure 9.
Step 2: Select Channel 1 with the MANUAL button.
Step 3: Adjust T1, T2 and T3 so that the 30 MHz marker is in the center of the curve and for maximum output.
Step 4: Select Channel 3. The Sweep Generator output should appear with the 50 MHz marker in the center of the curve. If necessary, readjust TC-6 by rechecking step 3 of the VCO alignment.
Step 5: Make sure that the output curves are similar to Figure 10 (for channels 1 thru 4).

NOTE: *It is difficult to track these 4 different frequencies, but differences of up to -6 dB are acceptable.*

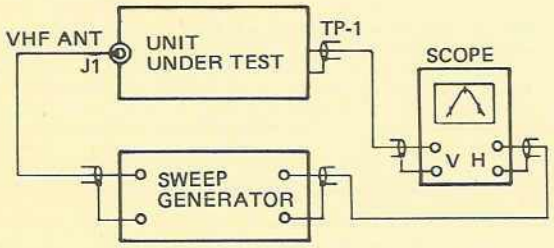


FIGURE 9. VHF LOW BAND RF TEST EQPT. HOOK UP

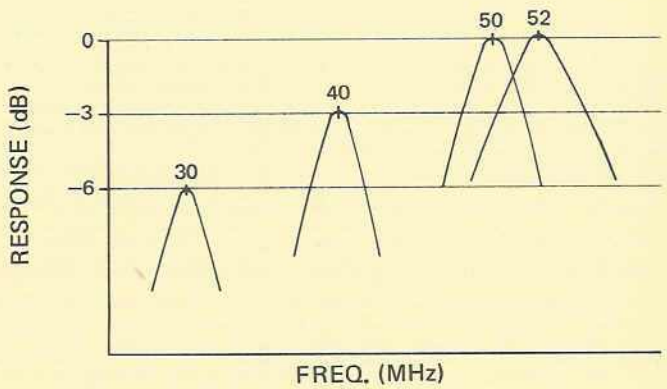


FIGURE 10.

VHF HI BAND RF AMP ALIGNMENT

NOTE: *For this test you will MANUALLY select either Channel 5, 6 or 7.*

Step 1: Connect instruments as shown in Figure 11.
Step 2: Adjust T8, 9, 10 and L1 for maximum output similar to the Figure 12 curve. This curve should be dropping down by about −3 dB for CH 5 to 7.

NOTE: *If you change the connection from TP-3 to TP-1, you should see a display similar to Figure 10 curve.*

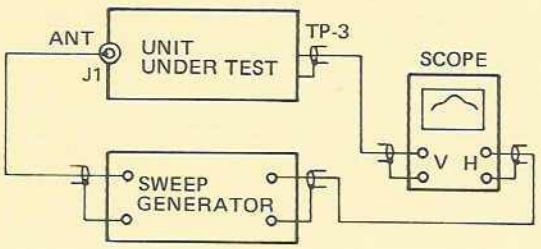


FIGURE 11. VHF HIGH BAND RF TEST EQPT. HOOK UP

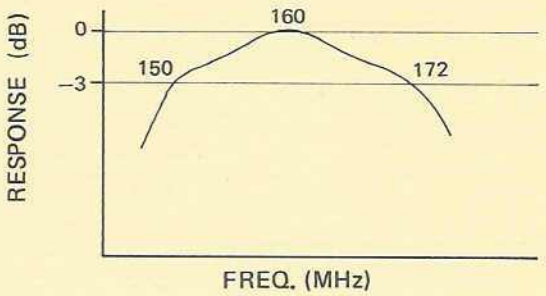


FIGURE 12.

UHF BAND RF AMP ALIGNMENT

NOTE: *For this test you will MANUALLY select either Channel 9, 12 or 15.*

Step 1: Connect instruments as shown in Figure 13.
Step 2: Set TC-2 to minimum capacitance.
Step 3: Adjust TC-1 for maximum output and best curve symmetry as shown in Figure 14.

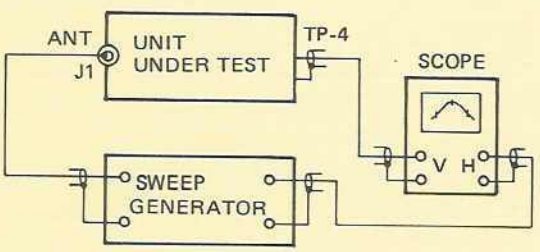


FIGURE 13. UHF BAND RF TEST EQPT. HOOK UP

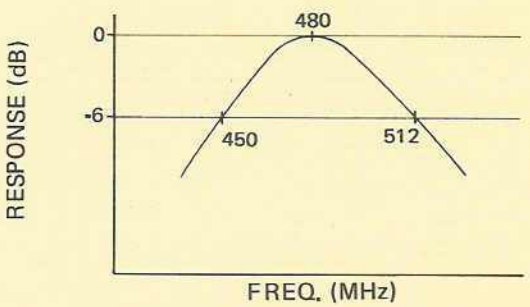


FIGURE 14.

VHF LOW/HIGH, UHF OVERALL ALIGNMENT AND SENSITIVITY MEASUREMENT

Step 1: Connect Signal Generator to ANTenna jack and AC VTVM with 8-ohm dummy load to EXT. SPeaKeR jack.

Step 2: Turn SQUELCH fully counterclockwise. Set for reception of the channels noted in the following chart. Set the SSG to the center of each band.

CH	BAND	FREQ.
2	VHF LO	40 MHz
6	VHF HI	160 MHz
9	UHF LO	460 MHz
12	UHF MID	480 MHz
15	UHF HI	500 MHz

Step 3: Set the Signal Generator frequency to 40 MHz (channel 2) and readjust T4 and T5 for maximum output.

Step 4: Set the Signal Generator frequency to 160 MHz (channel 6) and adjust L4 for maximum output.

Step 5: Set the Signal Generator frequency to 480 MHz (channel 12) and adjust L9 and TC-2 for maximum output.

Step 6: For each frequency/channel set the signal generator to each frequency, no modulation and minimum output, and set VOLUME control to 0 dB (0.775 V) reading on the VTVM.

Step 7: Increase output of the generator to obtain reading -20dB on the AC VTVM. The generator output now equals the 20 dB noise quieting sensitivity.

NOTE: *Alignment of T11 on the RF/IF P.C. Board is not required. It happens to be adjustable only because of ease of parts procurement and does not need any adjustment.*

OPERATION OF PLL/PROGRAMMER CIRCUIT

1. To program the National Weather Service station frequency 162.40 MHz, for example, select channel 1 with the MANUAL selector button. Slide the Program Door open and press in the PROGRAM button, then set the Digit switches in or out as shown below.

Indicator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
The code	*	*	3	*	*	*	7	*	*	10	11	*	*	*	*	*

Press to release Digit switches at 3, 7, 10 and 11.
All other switches are to remain pushed in.

2. After setting the Digit switches, press the ENTER button. The code is then memorized and displayed by the channel/program code indicators instantly. See Figure 15 for the timing diagram. The displays shown in the timing diagram can be seen whenever the ENTER button is pressed.
3. The memorized code controls the programmable counter (IC 9 ~ 14) thru shift register (IC 7, 8). The programmable counter divides VCO frequency by the given code.
4. The phase of the divided frequency and 5 kHz reference frequency are detected by phase detector IC-5. This phase difference controls VCO frequency.
5. TP-3 is a PROGRAMMABLE COUNTER output terminal, when in locked condition 5 kHz pulse signals appear.

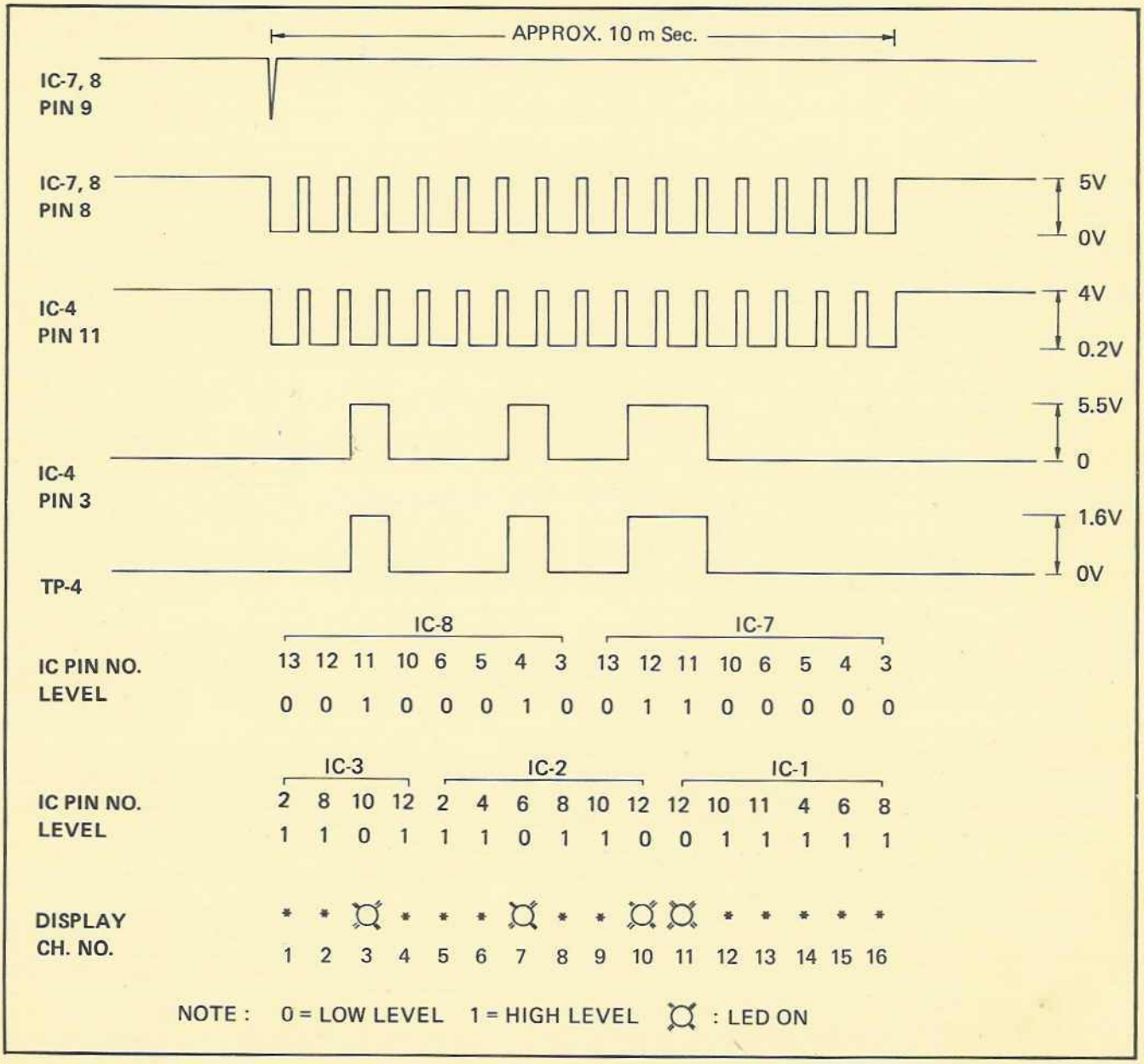


FIGURE 15.

OPERATION OF SCANNING/PROGRAMMER CIRCUIT

1. Data read-out and write-on Clock OSC (IC7 2/6, TA-3, D21) generates sixteen pulses.
2. After address counter IC-6 counts sixteen pulses, word senser (IC-5 1/4, D17 ~ 20) operate. Then channel counter counts the next pulse and LED display will read out the next channel.
3. Then word senser becomes H level and scanning control is driven from this signal. Scanning rate is decided by C5 (33 μF) on the Scanning/Programmer P.C. Board.
4. Channel counter and channel display-driver operation are the same as PRO-16A (20-165).
5. See Figure 16, for timing diagrams at each point.

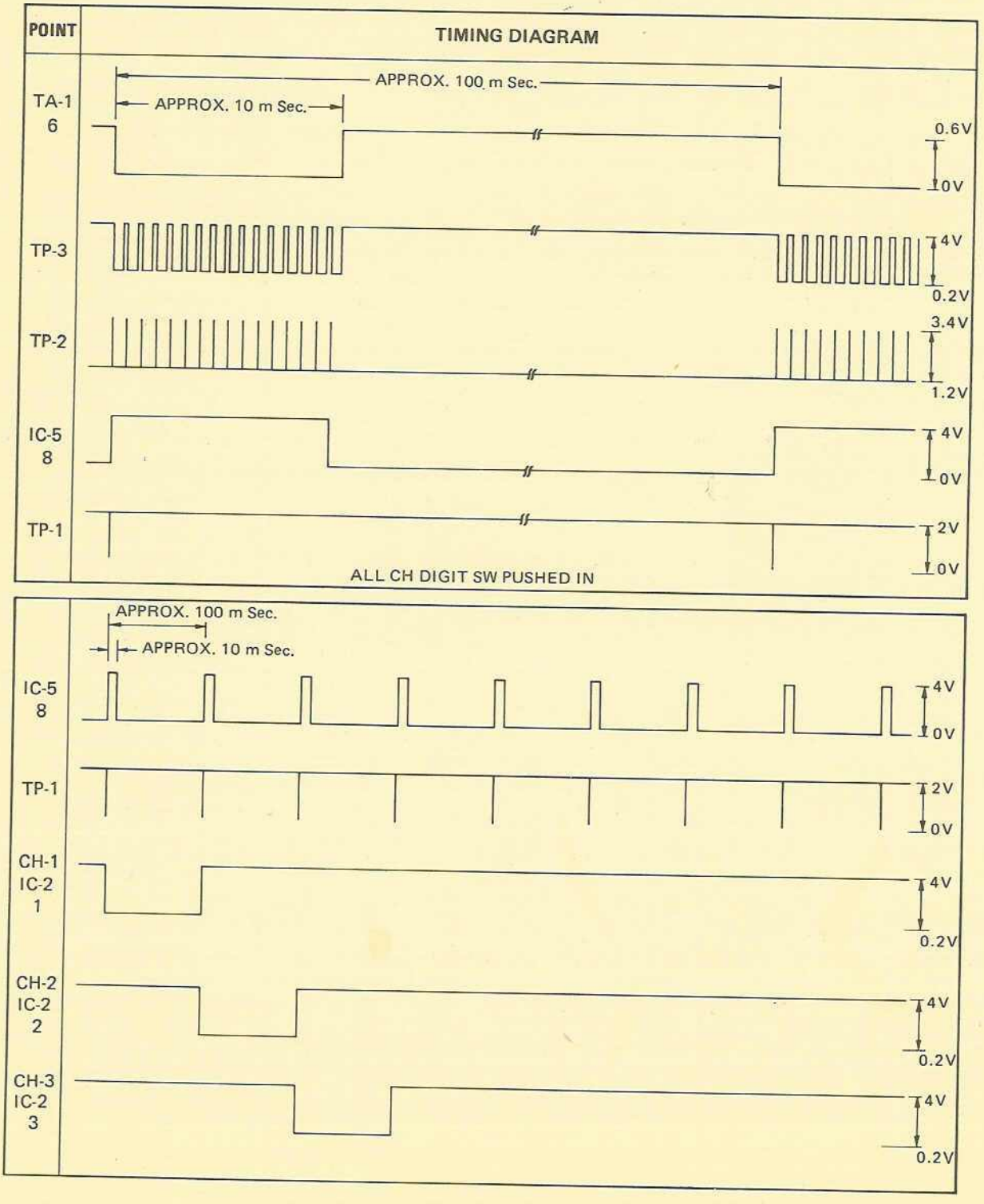


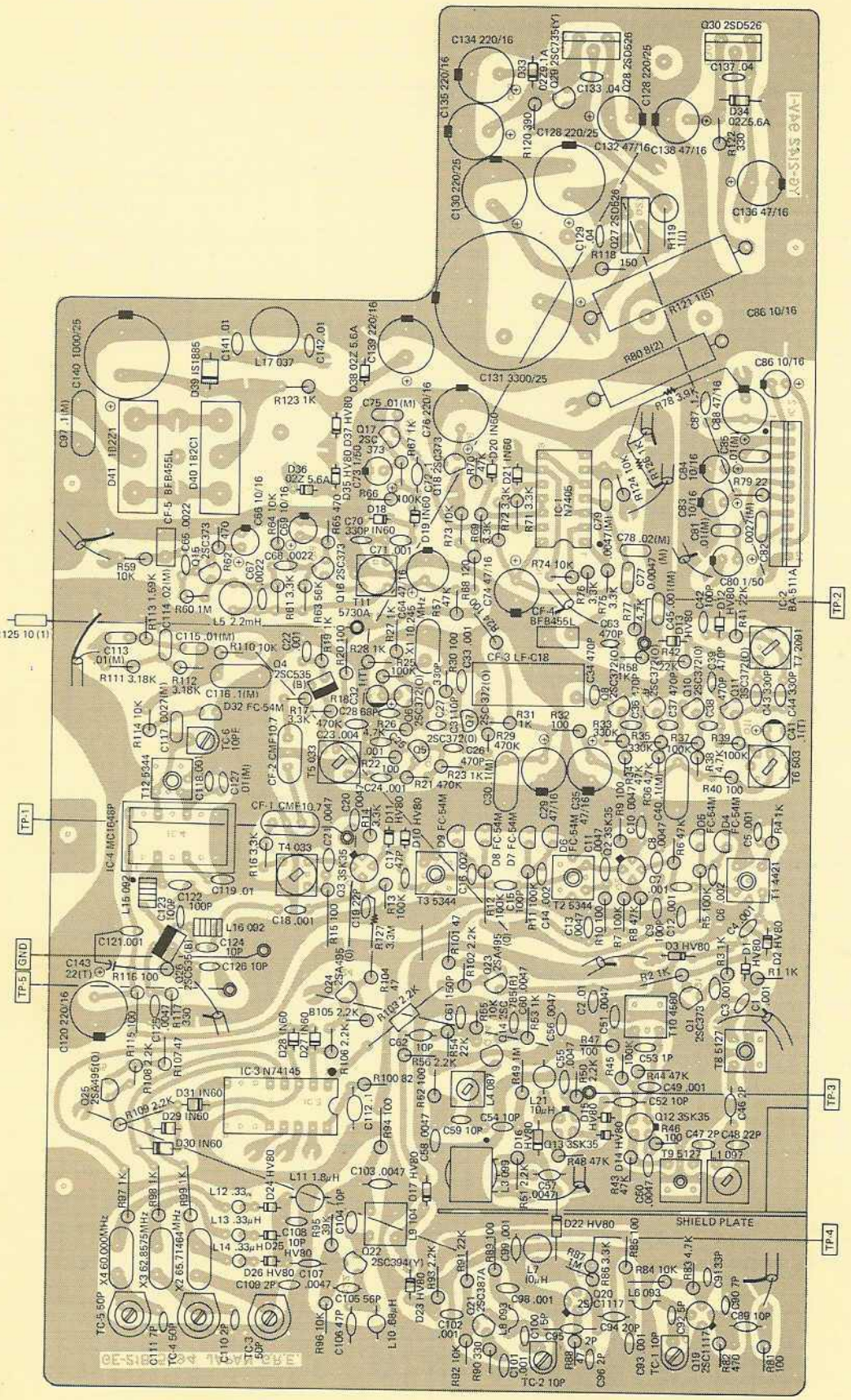
FIGURE 16.

CHANNEL COUNTER/DISPLAY DRIVER TRUTH TABLES

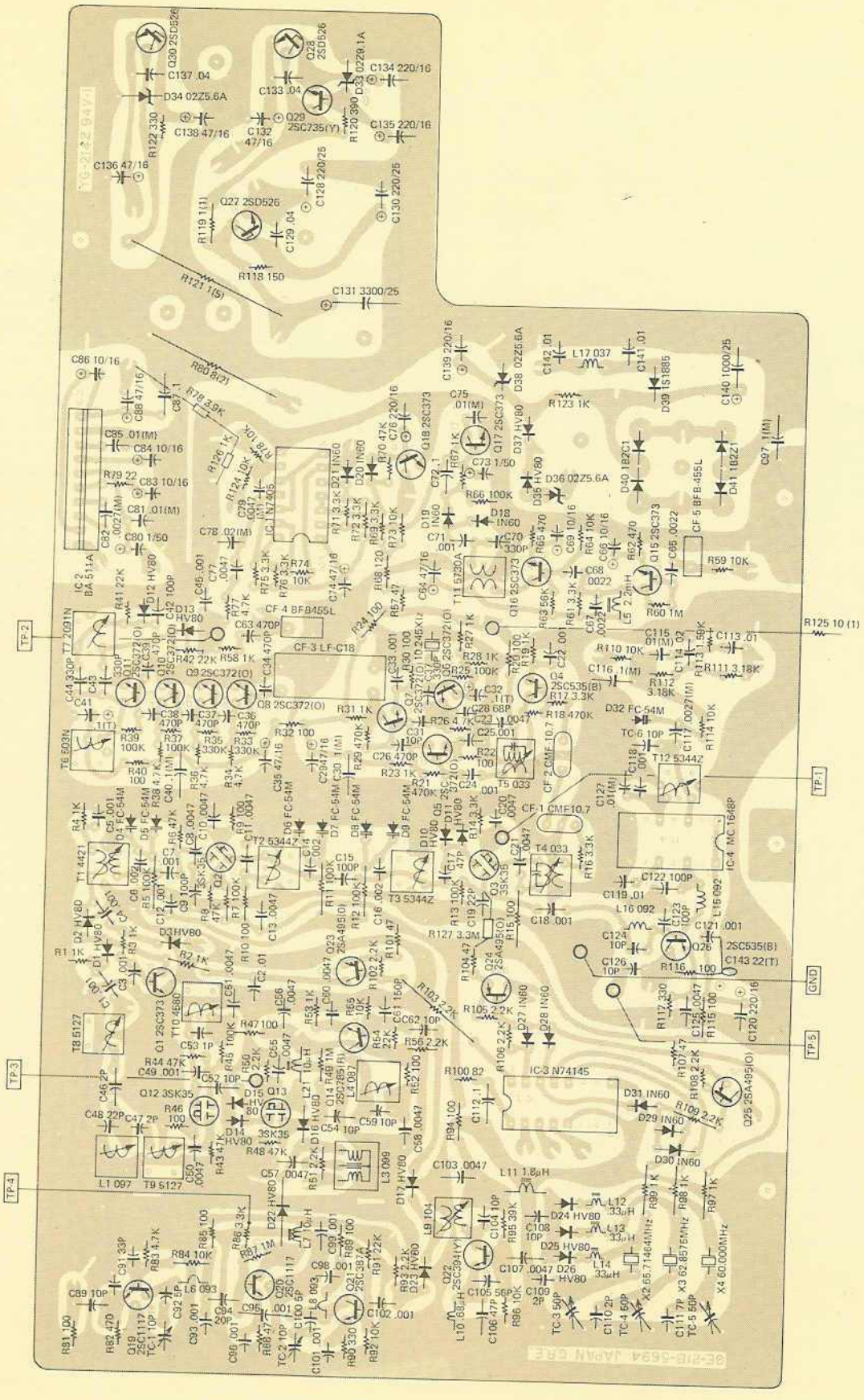
Channel No. \ Pin No.	IC-4					IC-2								IC-1								
	14	12	9	8	11	1	2	3	4	5	6	7	9	12	1	2	3	4	5	6	7	9
CH. 1	↓	0	0	0	0	*0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CH. 2	↓	1	0	0	0	1	*0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CH. 3	↓	0	1	0	0	1	1	*0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CH. 4	↓	1	1	0	0	1	1	1	*0	1	1	1	1	1	1	1	1	1	1	1	1	1
CH. 5	↓	0	0	1	0	1	1	1	1	*0	1	1	1	1	1	1	1	1	1	1	1	1
CH. 6	↓	1	0	1	0	1	1	1	1	1	*0	1	1	1	1	1	1	1	1	1	1	1
CH. 7	↓	0	1	1	0	1	1	1	1	1	1	*0	1	1	1	1	1	1	1	1	1	1
CH. 8	↓	1	1	1	0	1	1	1	1	1	1	1	*0	1	1	1	1	1	1	1	1	1
CH. 9	↓	0	0	0	1	1	1	1	1	1	1	1	1	0	*0	1	1	1	1	1	1	1
CH. 10	↓	1	0	0	1	1	1	1	1	1	1	1	1	0	1	*0	1	1	1	1	1	1
CH. 11	↓	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	*0	1	1	1	1	1
CH. 12	↓	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	*0	1	1	1	1
CH. 13	↓	0	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	*0	1	1	1
CH. 14	↓	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	*0	1	1
CH. 15	↓	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	*0	1
CH. 16	↓	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	*0

Note: ↓ = Transition from high to low level 0 = low level 1 = high level marked* = Display (LED) "on"

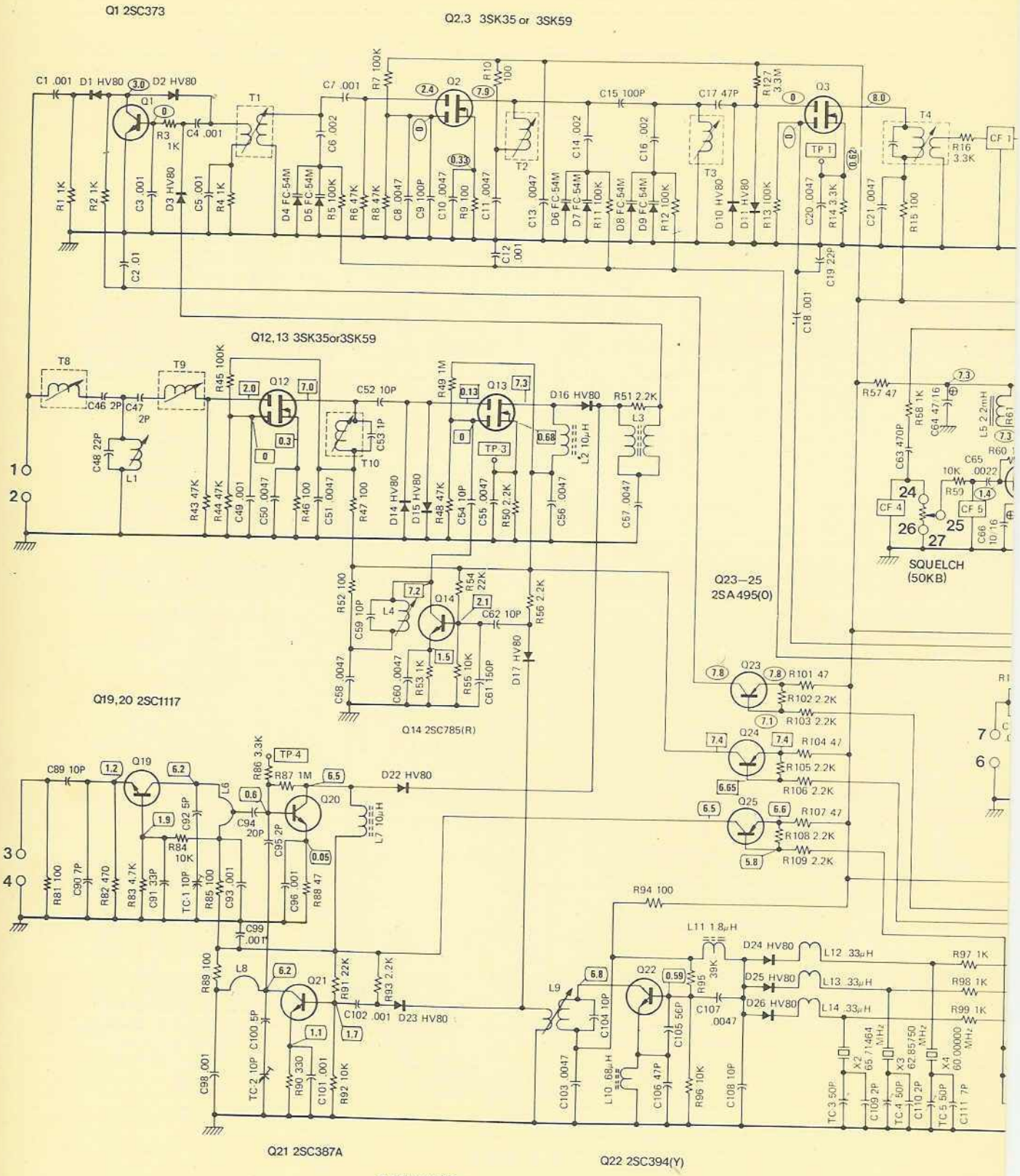
RF/IF P.C. BOARD (TOP VIEW)



RF/IF P.C. BOARD (BOTTOM VIEW)

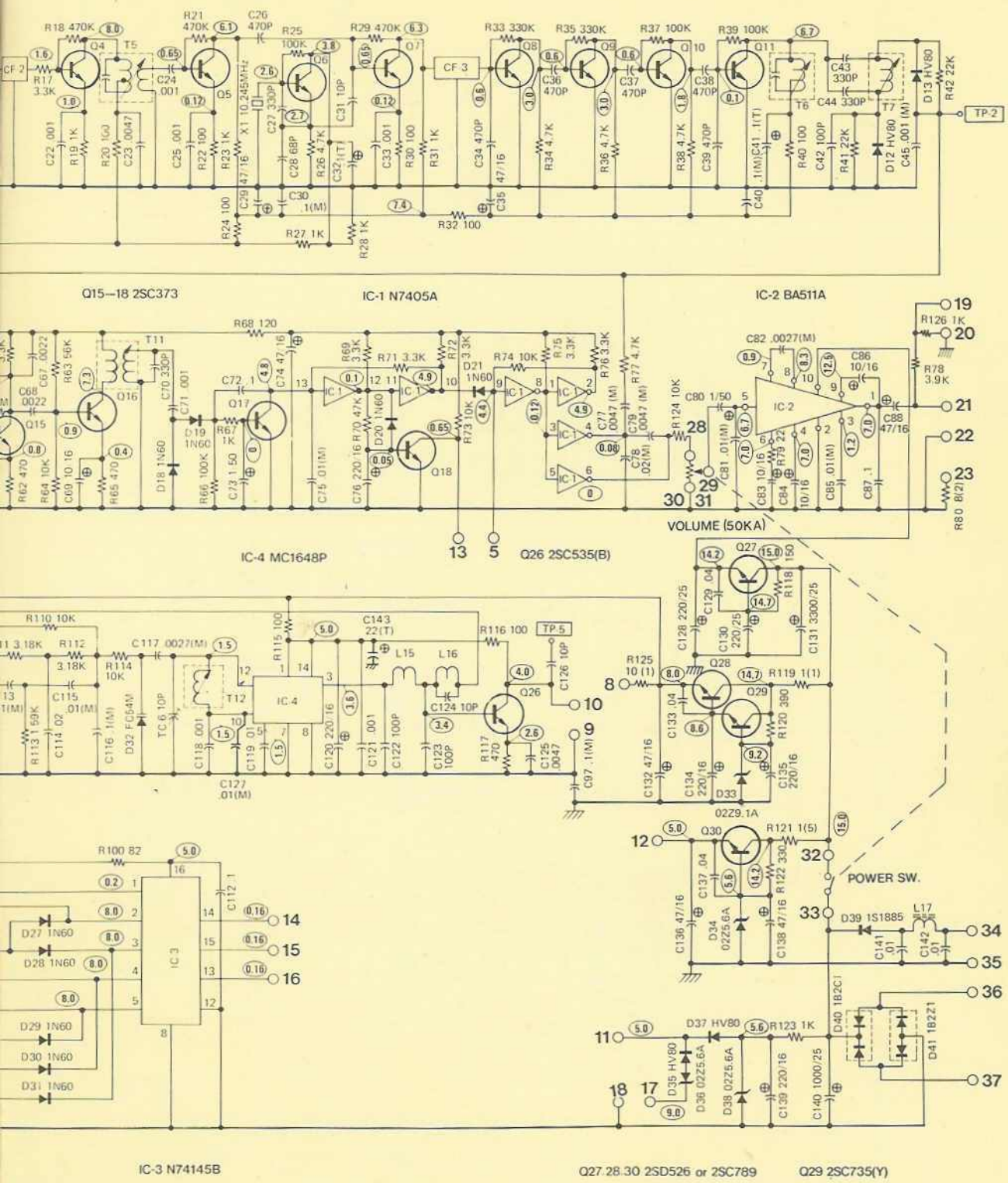


RF/IF P.C. BOARD SCHEMATIC DIAGRAM



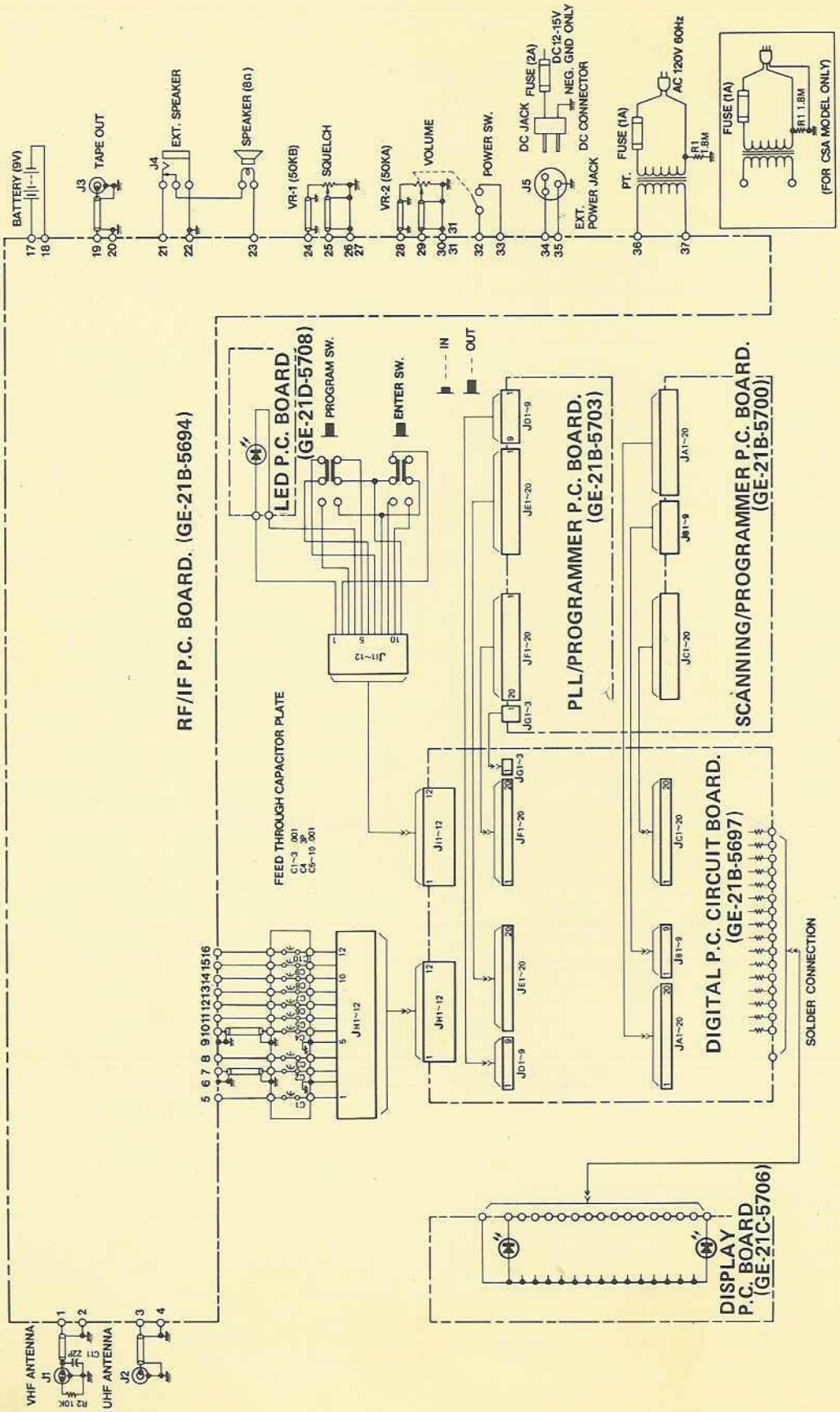
REMARKS

1. RESISTANCE VALUES IN OHMS (K=1,000), (M=1,000,000)
2. CAPACITANCE VALUES IN μF (P=μμF)
3. (T) TANTALUM CAPACITOR
4. (M) MYLAR CAPACITOR
5. ⬭ THIS (100KΩ/V) VOLUME A
   ▭ THIS
   ⬭ THIS

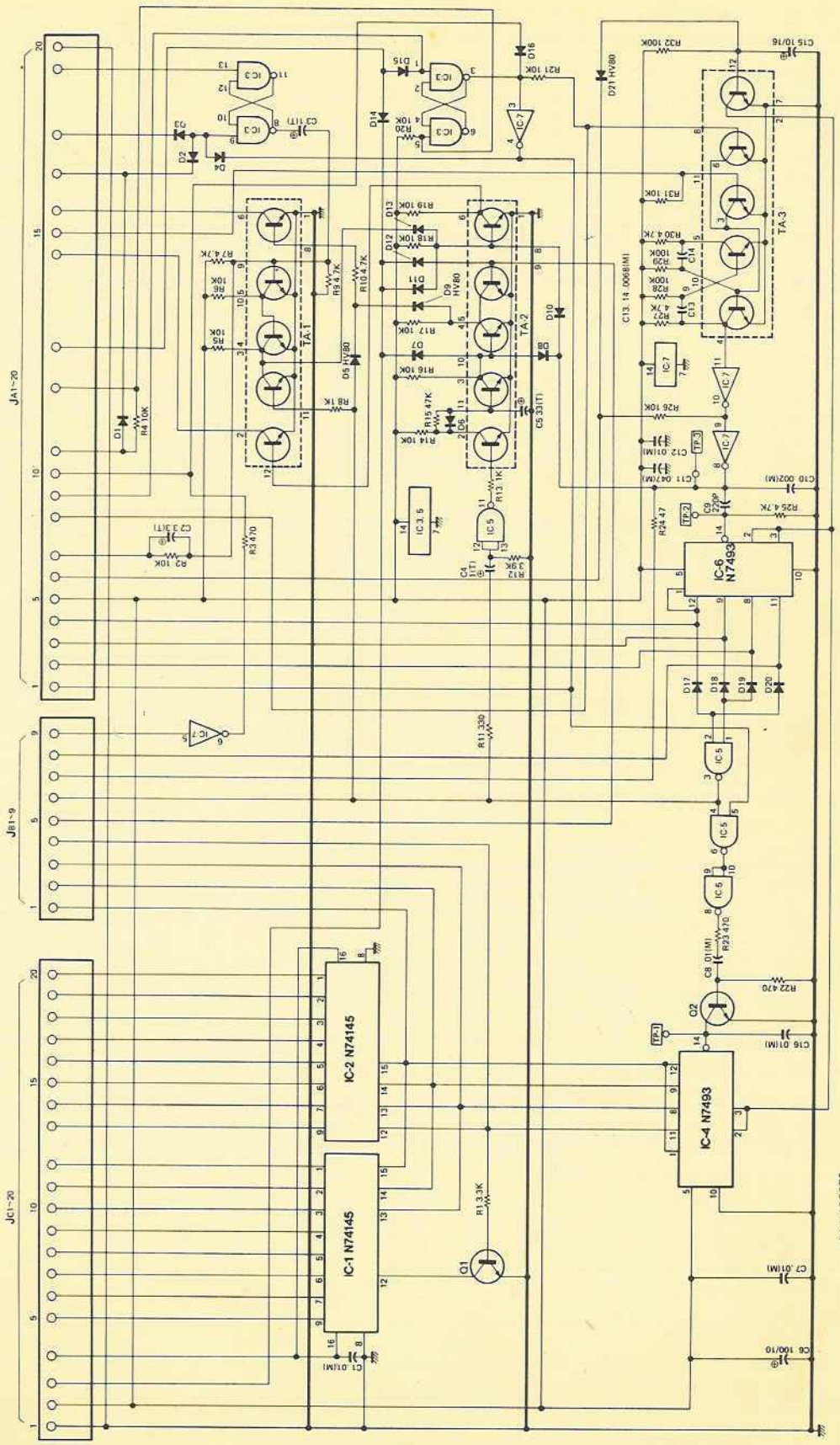


SYMBOL INDICATES DC VOLTAGE MEASURED WITH DC VOLTMETER
UNDER FOLLOWING CONDITIONS: CH-1 LO BAND, MANUAL OPERATION,
T MINIMUM AND SQUELCH "OUT".
SYMBOL INDICATES VOLTAGES FOR HIGH BAND OPERATION.
SYMBOL INDICATES VOLTAGES FOR UHF BAND OPERATION.

MASTER INTER-CONNECT DIAGRAM

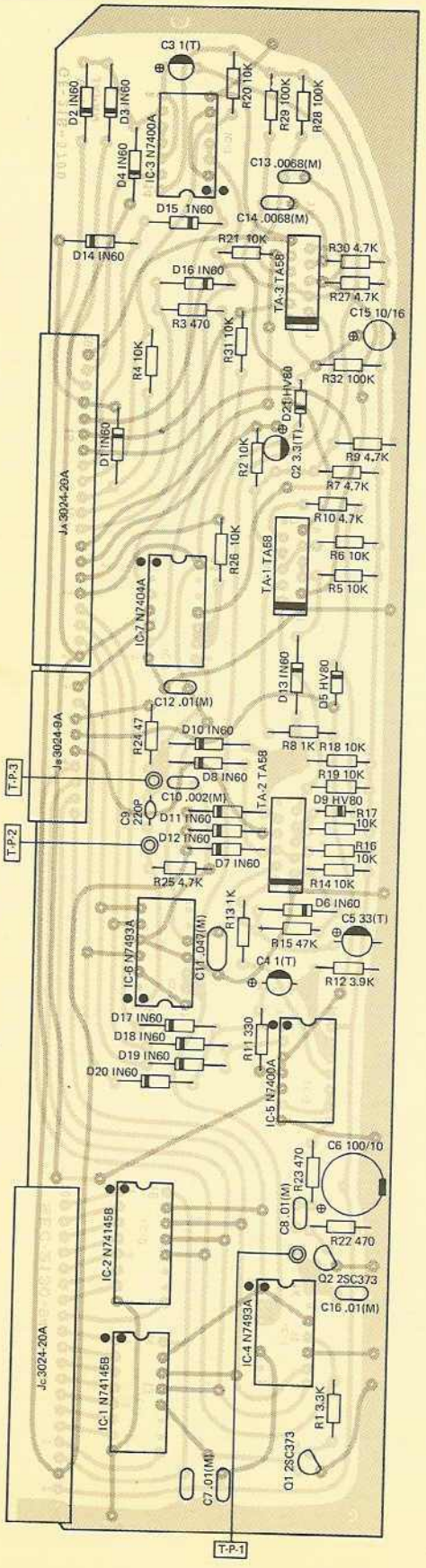


SCANNING/PROGRAMMER P.C. BOARD SCHEMATIC DIAGRAM

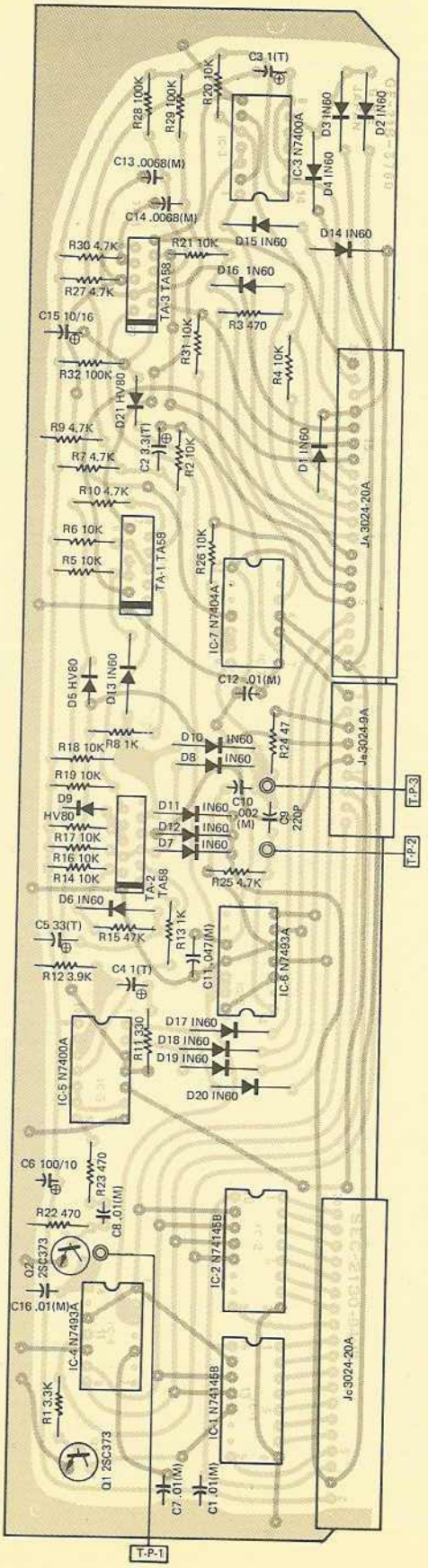


SCANNING/PROGRAMMER P.C. BOARD

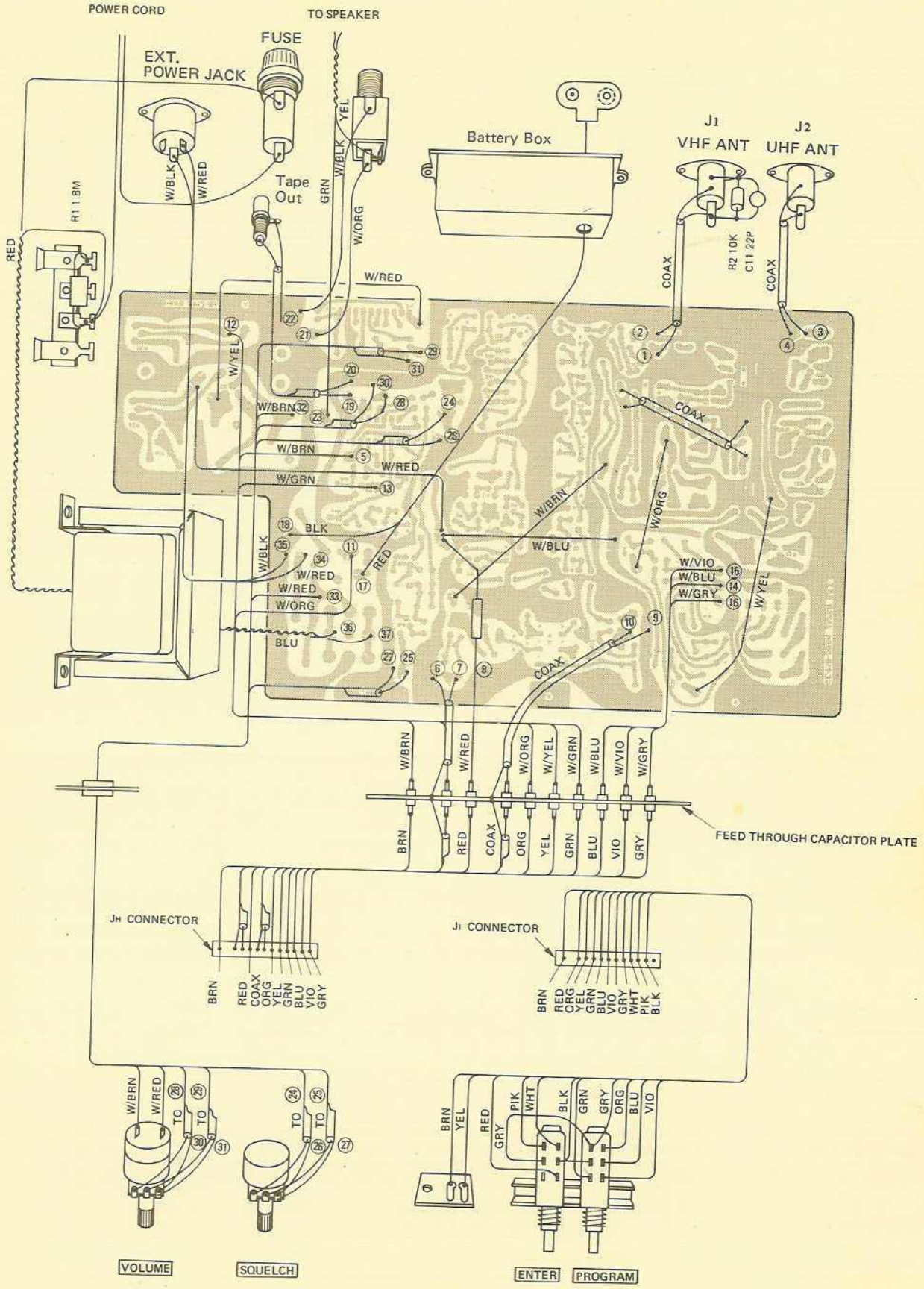
(TOP VIEW)



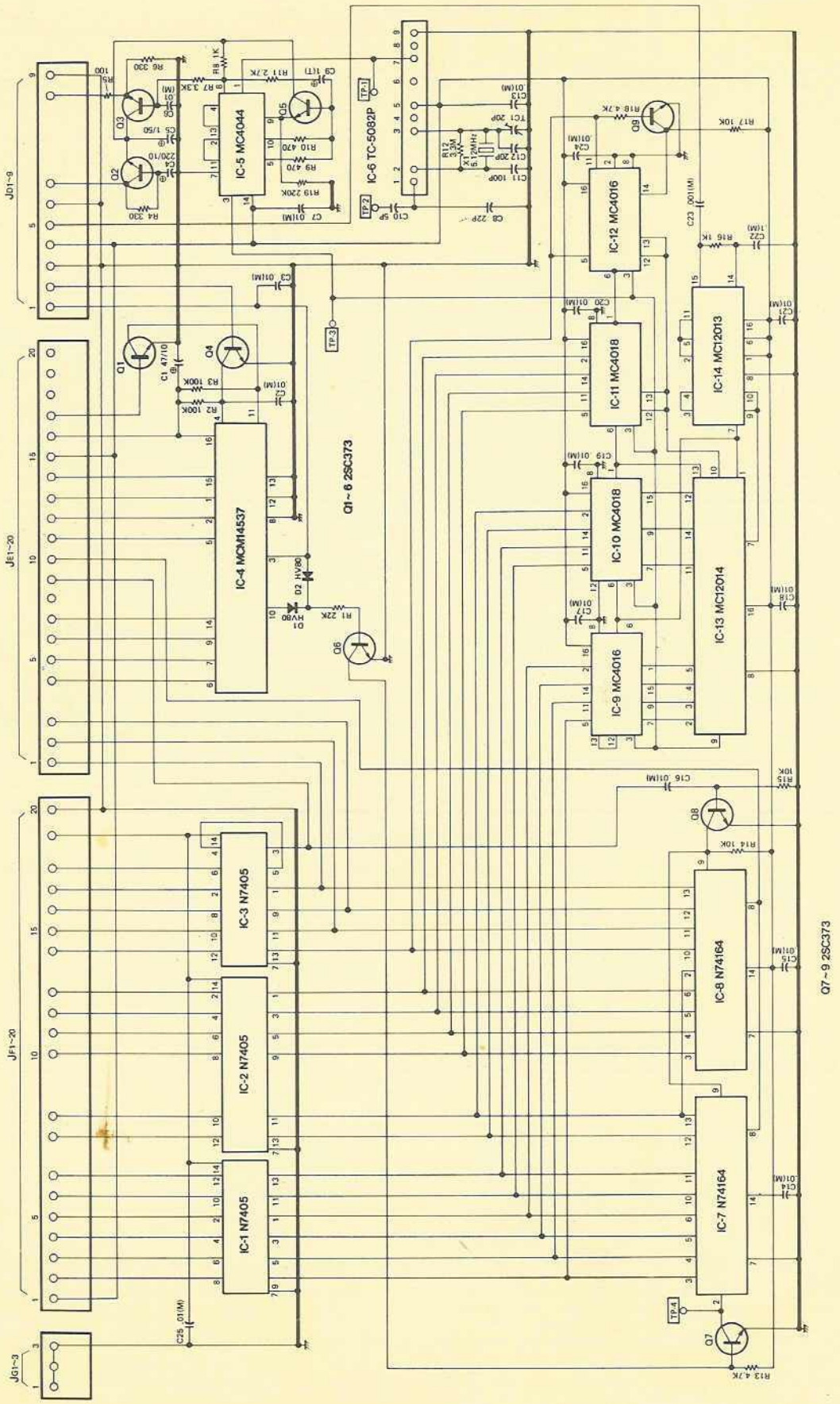
(BOTTOM VIEW)



WIRING DIAGRAM

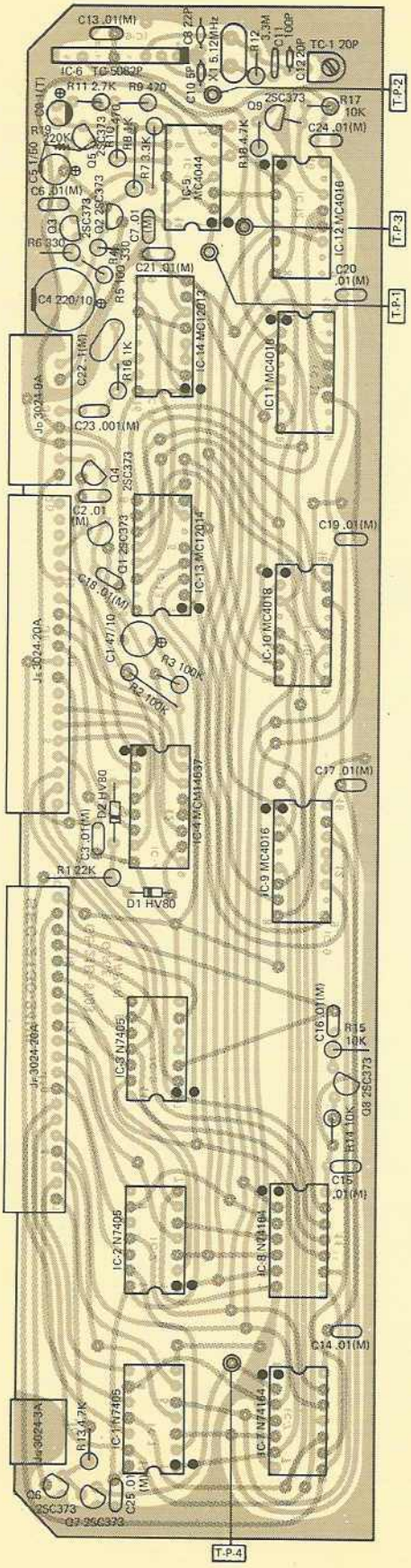


PLL/PROGRAMMER P.C. BOARD SCHEMATIC DIAGRAM

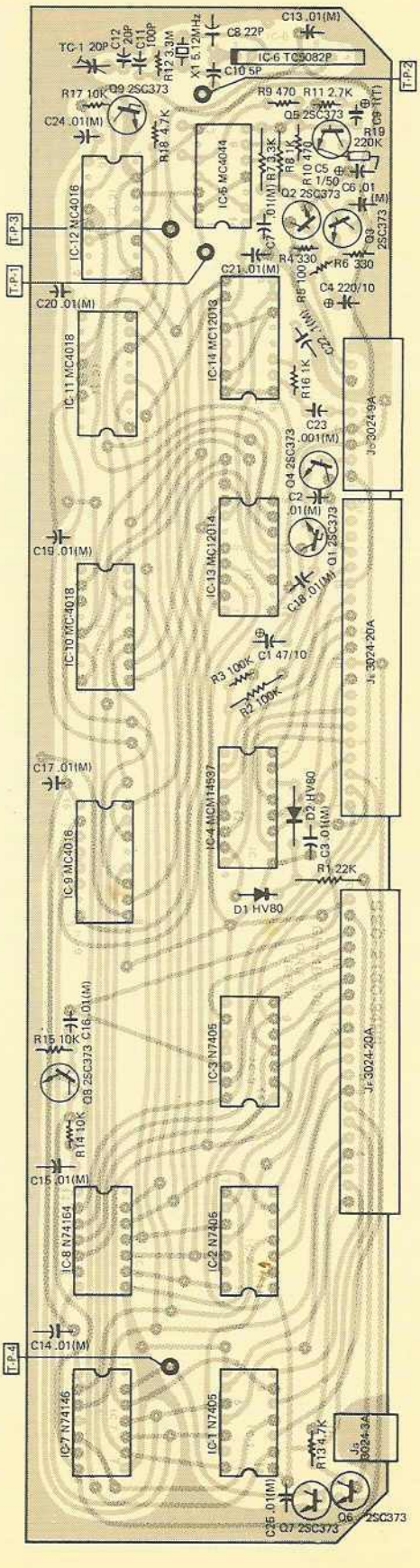


PLL/PROGRAMMER P.C. BOARD

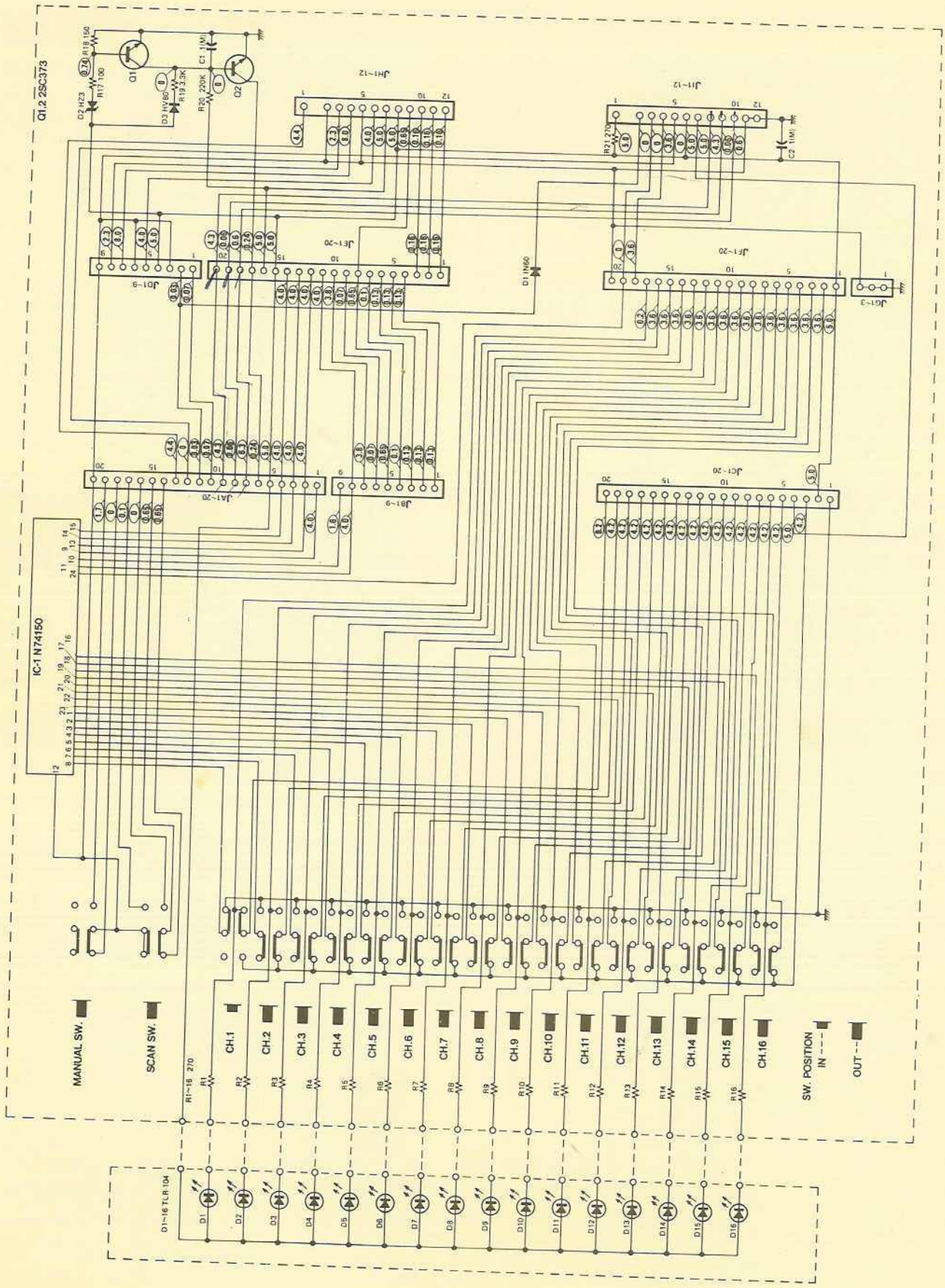
(TOP VIEW)



(BOTTOM VIEW)

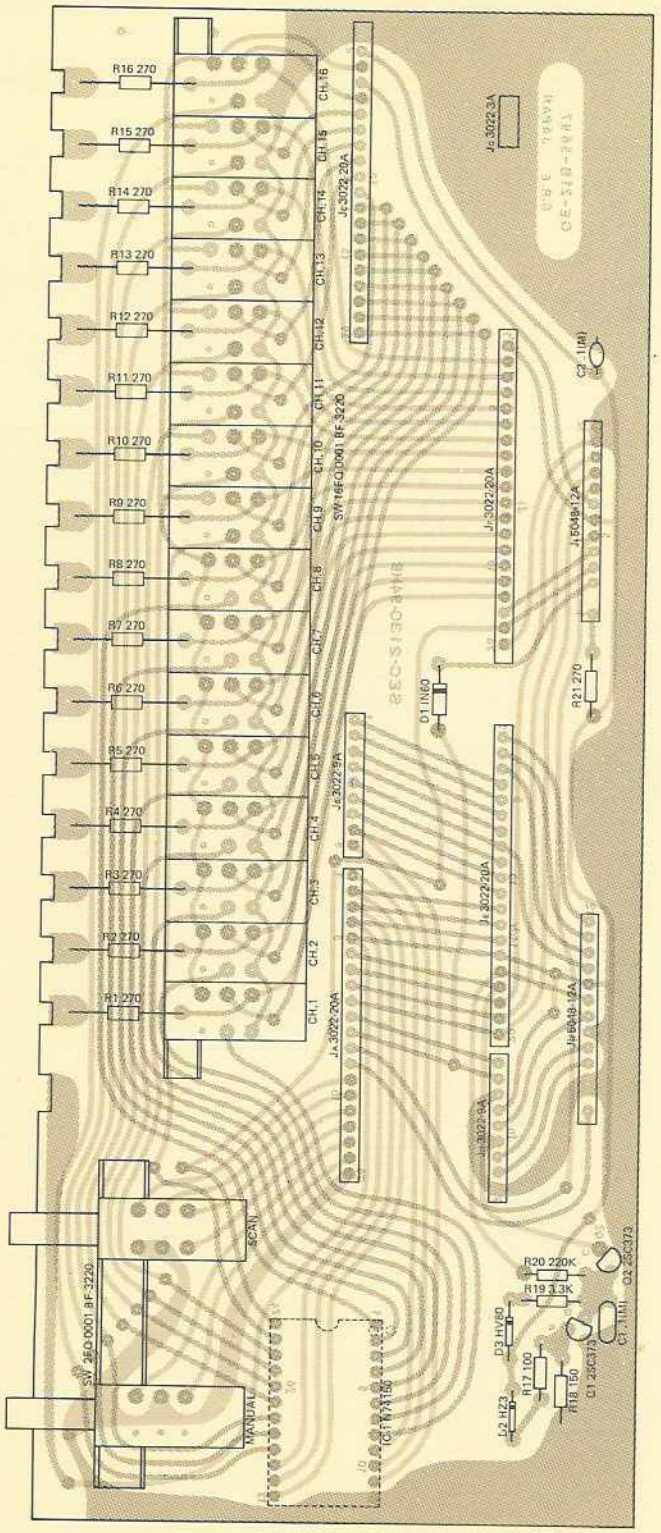


DIGITAL/DISPLAY P.C. BOARDS SCHEMATIC DIAGRAM

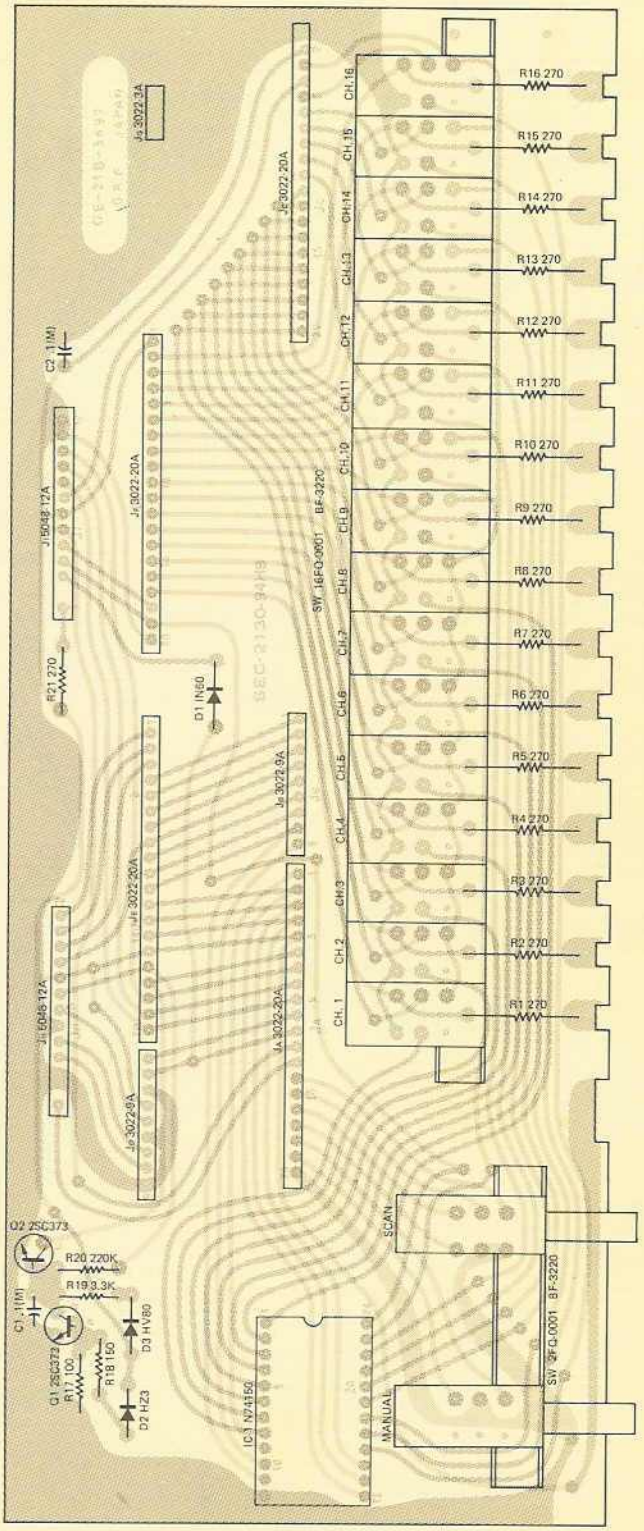


DIGITAL P.C. BOARD

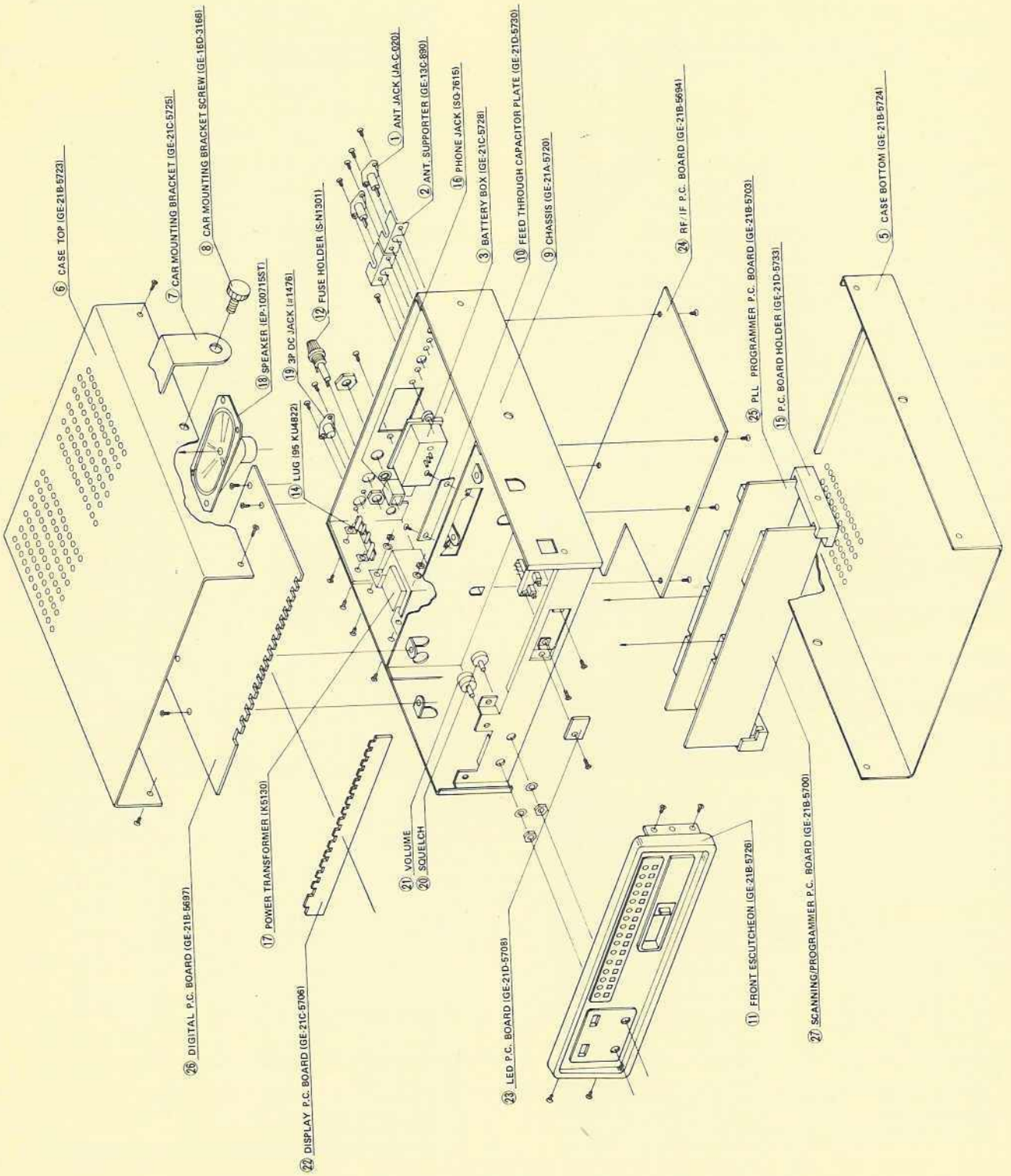
(TOP VIEW)

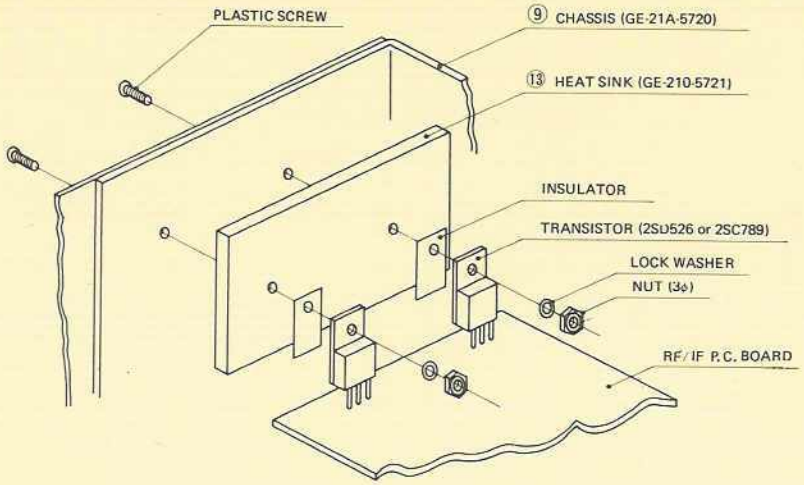


(BOTTOM VIEW)

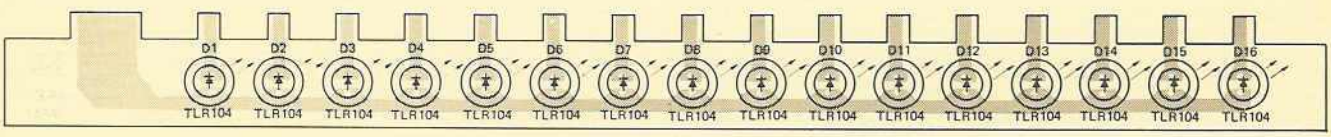


EXPLODED VIEW

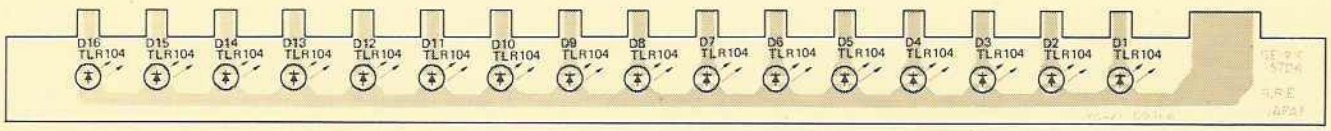




DISPLAY P.C. BOARD
(TOP VIEW)

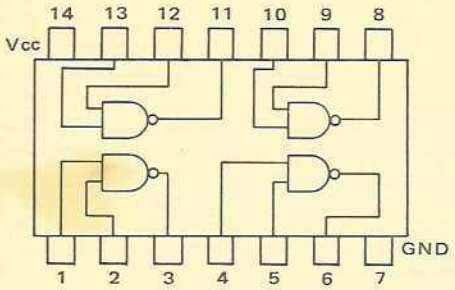


(BOTTOM VIEW)

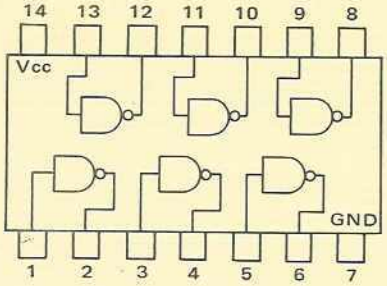


IC PIN CONFIGURATIONS

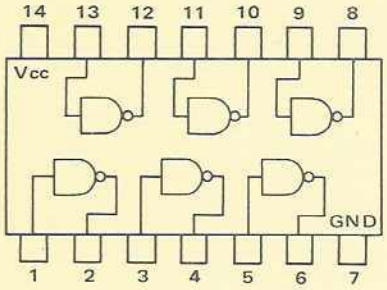
N7400



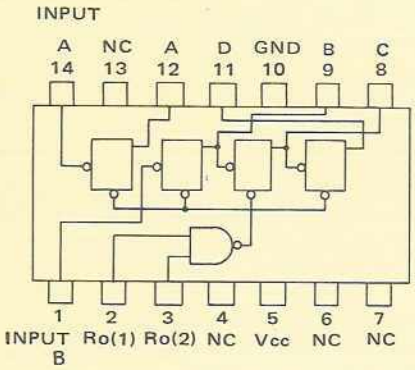
N7404



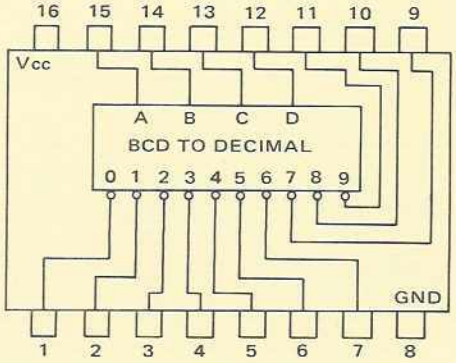
N7405



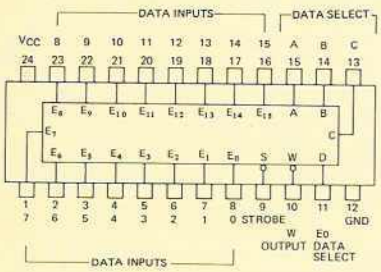
N7493

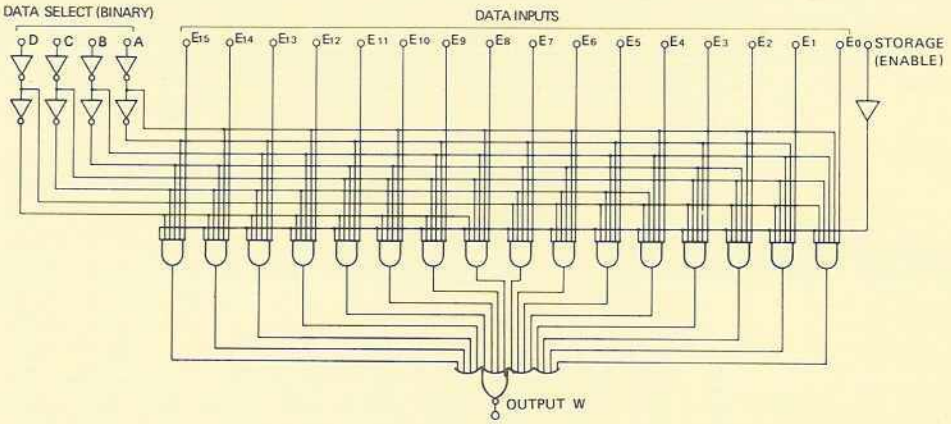


N74145

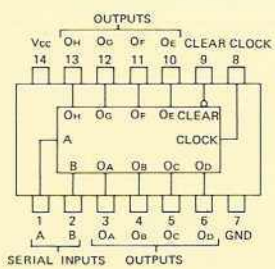


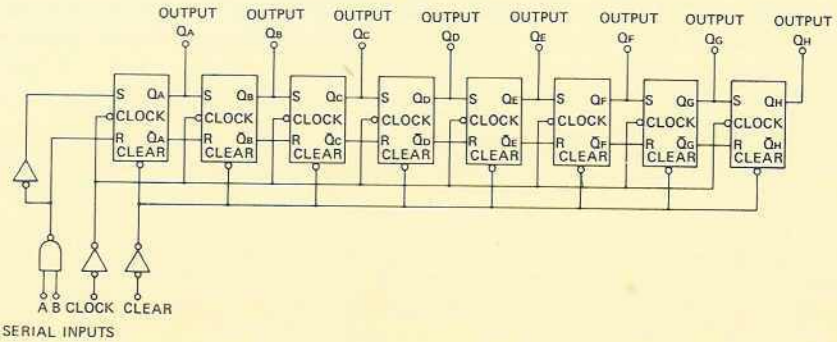
N74150



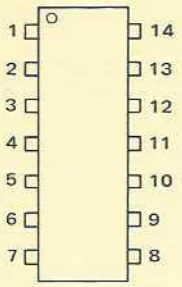


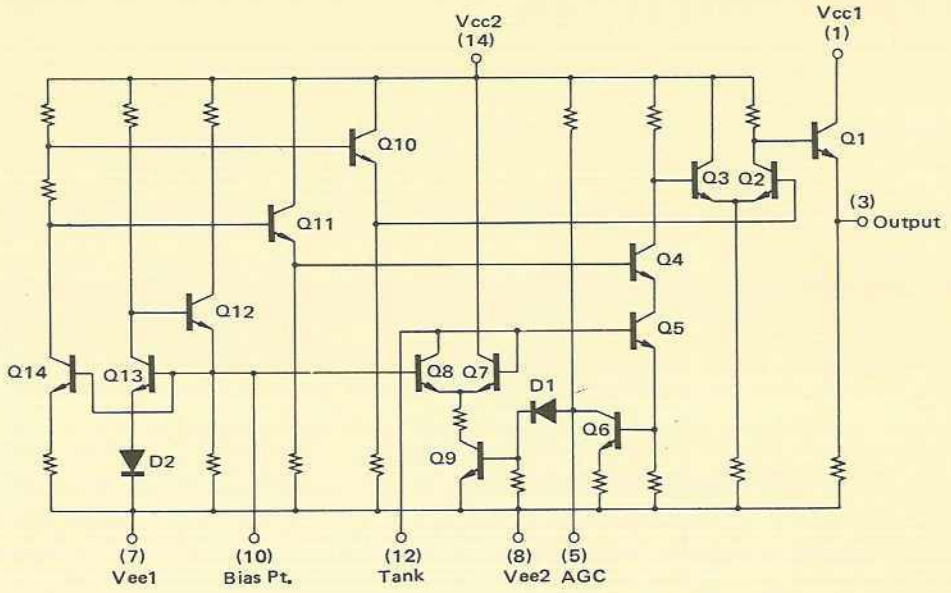
N74164



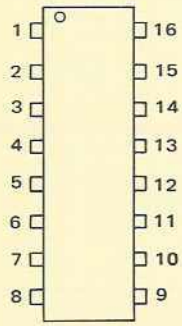


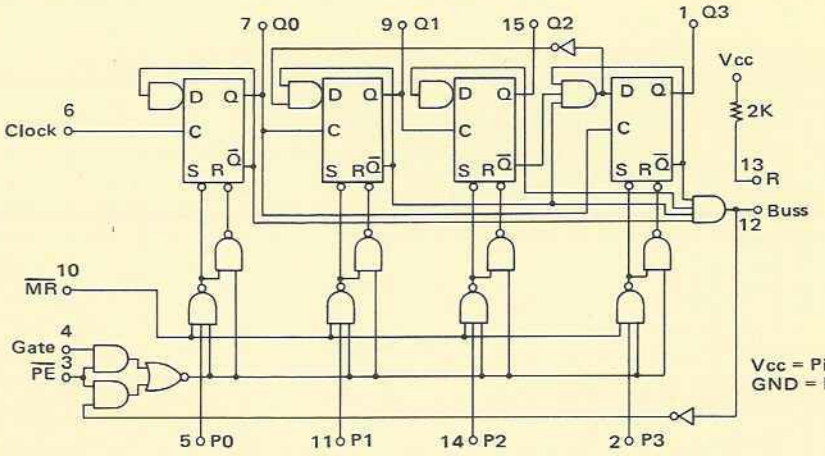
MC1648





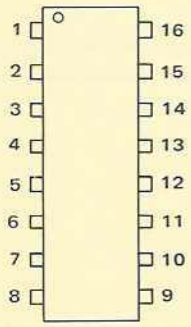
MC4016P

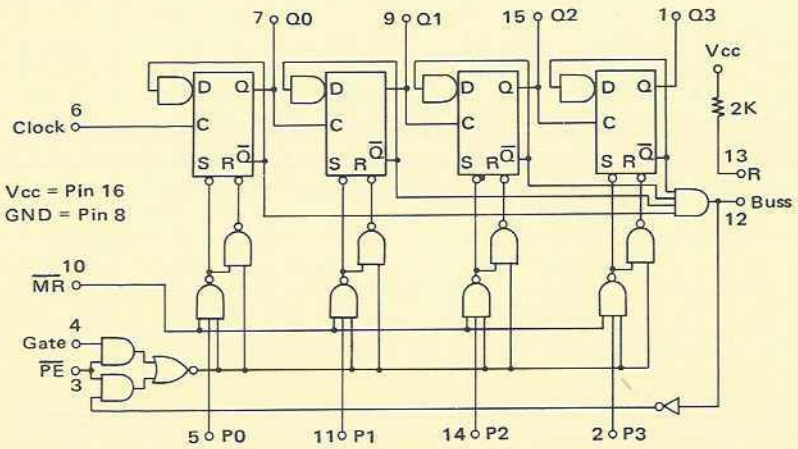




COUNT	OUTPUT			
	Q3	Q2	Q1	Q0
9	1	0	0	1
8	1	0	0	0
7	0	1	1	1
6	0	1	1	0
5	0	1	0	1
4	0	1	0	0
3	0	0	1	1
2	0	0	1	0
1	0	0	0	1
0	0	0	0	0

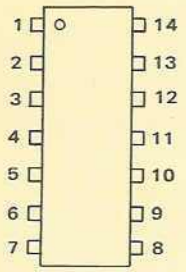
MC4018P

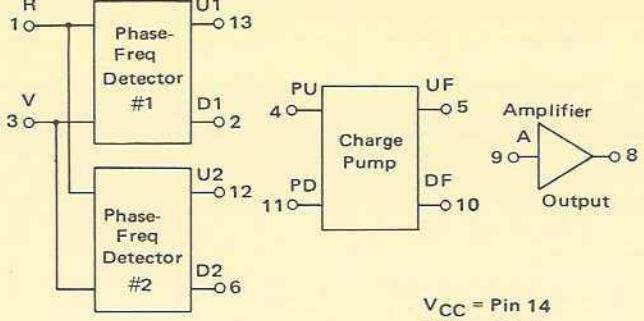




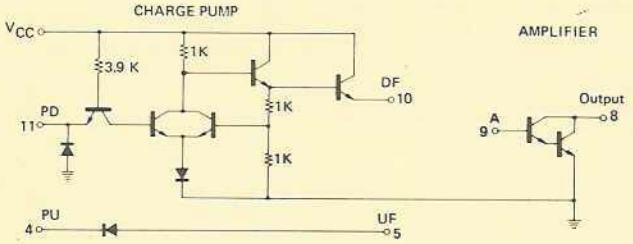
COUNT	OUTPUT			
	Q1	Q2	Q1	Q0
15	1	1	1	1
14	1	1	1	0
13	1	1	0	1
12	1	1	0	0
11	1	0	1	1
10	1	0	1	0
9	1	0	0	1
8	1	0	0	0
7	0	1	1	1
6	0	1	1	0
5	0	1	0	1
4	0	1	0	0
3	0	0	1	1
2	0	0	1	0
1	0	0	0	0

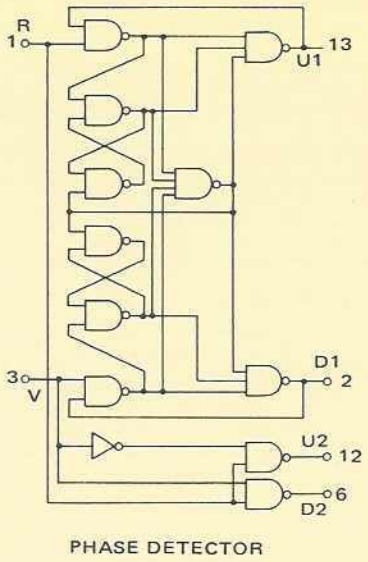
MC4044





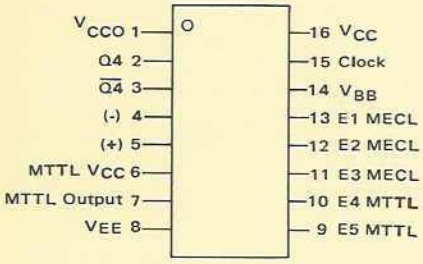
V_{CC} = Pin 14
GND = Pin 7

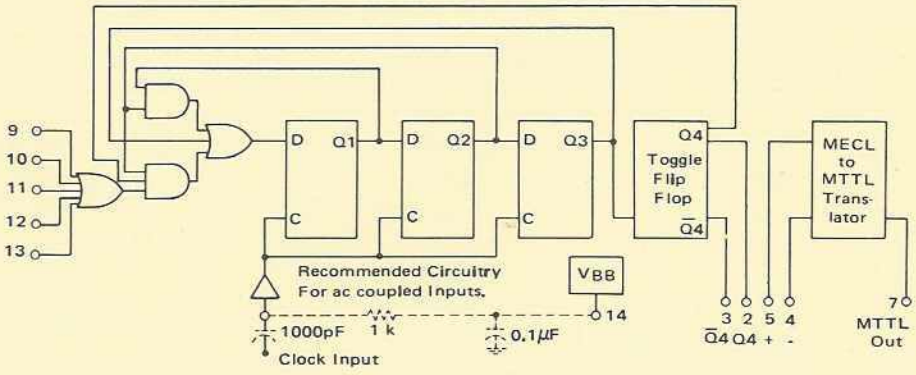




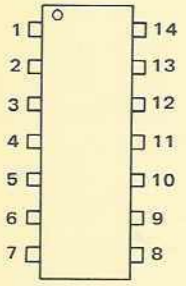
PHASE DETECTOR

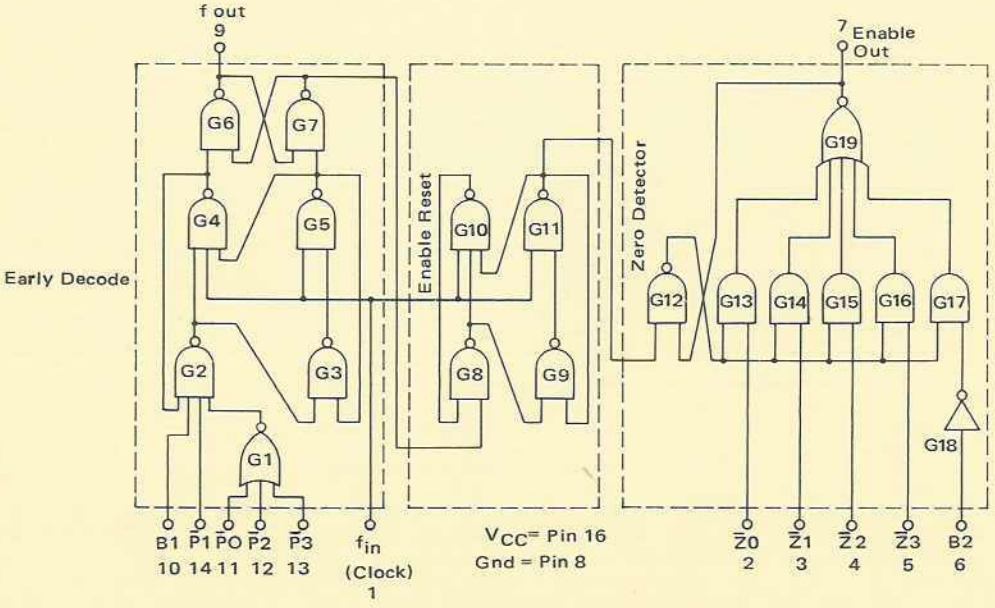
MC12013





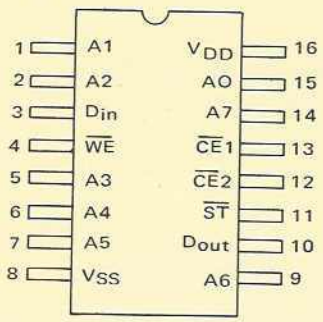
MC12014

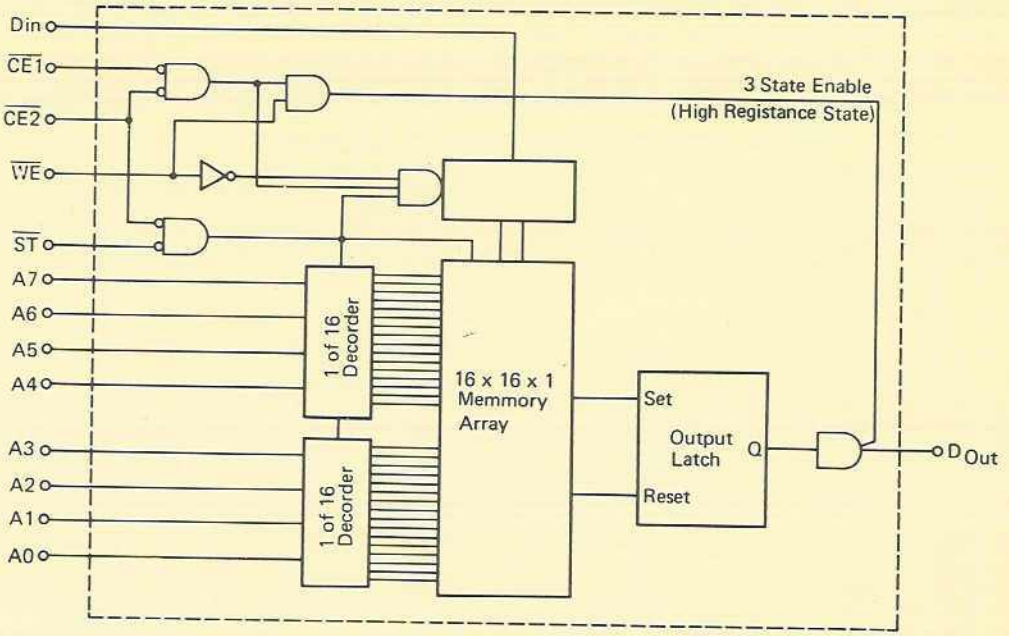




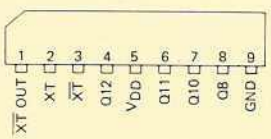
V_{CC}= Pin 16
Gnd = Pin 8

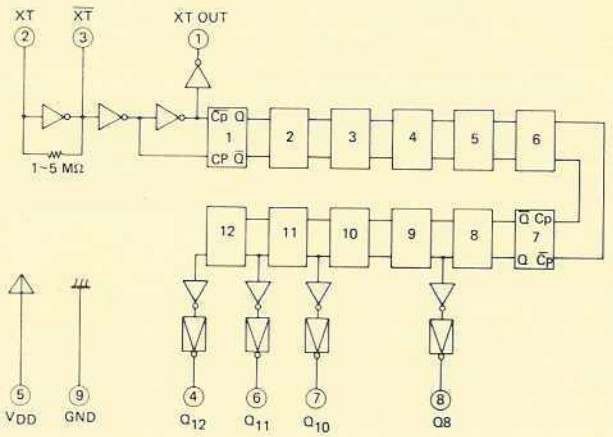
MCM14537



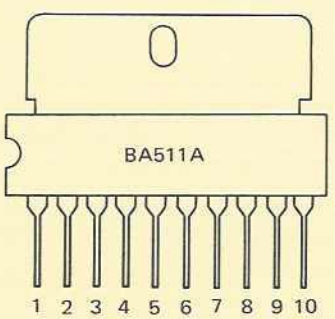


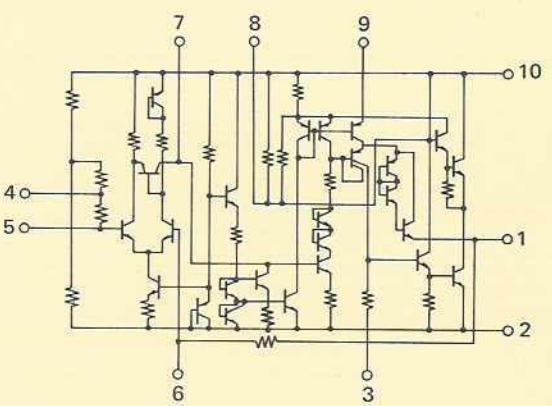
TC5082



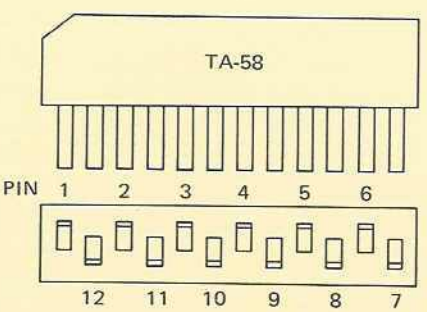


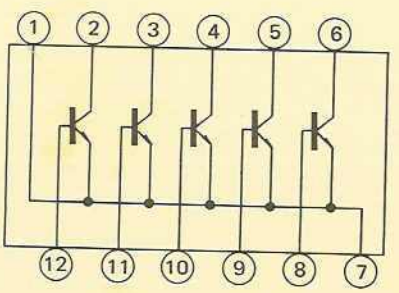
BA-511A





TA-58

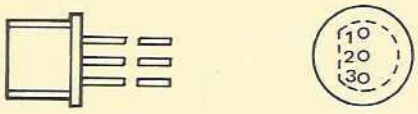




SEMICONDUCTOR LEAD IDENTIFICATIONS

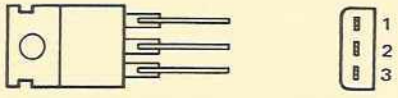
(A) : 2SA495(O), 2SC372(O), 2SC373, 2SC387(A), 2SC394(Y), 2SC785(R), 2SC735(Y)
(B) : 2SC535(B)
(C) : 2SC789, 2SD526
(D) : 2SC1117
(E) : 3SK35, 3SK59

(A)



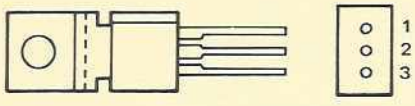
(A)
1. Emitter
2. Collector
3. Base

(B)



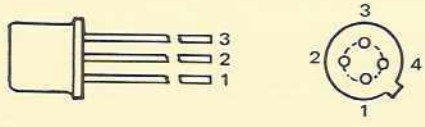
(B)
1. Emitter
2. Collector
3. Base

(C)



(C)
1. Base
2. Collector (Heat Sink)
3. Emitter

(D)
(E)



(D) (E)
1. Emitter
2. Base
3. Collector
4. Case

TROUBLESHOOTING

Symptom	Possible cause
1) Channel Indicator LED does not light and no sound output. Volume Control : MAX. Channel/Digit Switches : Pushed-in Squelch Control : Extreme CCW	1) Faulty line power cord. 2) Defective power transformer. 3) Defective power switch. 4) DC or AC line fuse blown. 5) Defective diodes D39 ~ D41 on RF/IF P.C. Board. 6) Defective voltage regulator circuit component on RF/IF P.C. Board.
2) Channel Indicator LED lights but no sound. Volume Control : MAX. Squelch Control : Extreme CCW Channel/Digit Switches : Pushed-in	1) Defective speaker or speaker jack. 2) Faulty AF amplifier circuit component on RF/IF P.C. Board. 3) Faulty IF amplifier circuit component on RF/IF P.C. Board.
3) Sound but channel lamp does not light. Volume Control : MAX. Squelch Control : Extreme CCW Channel/Digit Switches : Pushed-in	1) Defective Channel/Digit switch or defective display circuit component. 2) Defective 5 V Regulator circuit component on RF/IF P.C. Board.
4) Does not scan and Squelch does not operate.	1) Defective Squelch control. 2) Defective IF amplifier circuit on RF/IF P.C. Board. 3) Defective noise amplifier, noise detector and/or integrated circuit IC-1 on RF/IF P.C. Board.
5) Does not scan but Squelch operates.	1) Defective SCANNING/PROGRAMMER P.C. Board. 2) Defective SCAN or MANUAL switch or faulty associated circuit component.
6) MANUAL selector does not operate but auto SCAN operates.	1) Defective MANUAL switch or associated circuit component. 2) Defective D3 and integrated circuit IC-3 or transistor array TA-1 on SCANNING/PROGRAMMER P.C. Board.
7) Auto SCAN does not operate but MANUAL selector operates.	1) Defective SCAN switch or associated circuit component.
8) Skipper does not operate.	1) Defective Channel/Digit switch. 2) Faulty diodes D7, D11 and D12 or skipper circuit component on SCANNING/PROGRAMMER P.C. Board.
9) Delay does not operate.	1) Faulty diode D-20 or Electrolytic capacitor C76 on RF/IF P.C. Board.

Symptom	Possible cause
10) PROGRAM does not operate or makes mistakes in read out and/or write on.	1) Defective PROGRAM switch, ENTER switch and/or associated circuit component. 2) Defective Channel/Digit switch. 3) Defective integrated circuit IC-1 on DIGITAL P.C. Board. 4) Defective SCANNING/PROGRAMMER P.C. Board component parts. 5) Defective PLL/PROGRAMMER P.C. Board component parts. 6) Faulty memory integrated circuit IC-4 and/or associated circuit component parts on the PLL/PROGRAMMER P.C. Board. 7) Faulty integrated circuit IC-1, 2, 3, 7, 8, and/or associated circuit components parts on the PLL/PROGRAMMER P.C. Board. 8) Faulty DISPLAY P.C. Board.
11) Memory operates but after a certain period the read out memory becomes faulty.	1) Weak battery (9 volt) 2) Defective diode D35 ~ 38 and/or associated circuit component on RF/IF P.C. Board. 3) Faulty memory IC, IC-4 or associated circuit component on PLL/PROGRAMMER P.C. Board.
12) Program memory operates but in case of repeated moving of power switch to ON and OFF the memory read out becomes faulty.	1) Weak battery (9 volt) 2) Faulty memory protector Q1, 2 and/or associated circuit component on DIGITAL P.C. Board. 3) Faulty power supply and regulator circuit component parts on RF/IF P.C. Board.
13) Program memory operates in read out and write on but unit does not operate on any bands.	1) Defective integrated circuit IC-5, 6, 9 ~ 14 and transistor Q2, 3, 5 or PLL circuit component parts of PLL/PROGRAMMER P.C. Board. 2) Defective VCO circuit component parts on RF/IF P.C. Board. 3) Defective band selector (IC-3) and power supply switching circuit component parts on RF/IF P.C. Board. 4) Defective Low band RF amp and/or mixer circuit component on RF/IF P.C. Board.
14) VHF Hi band does not operate but VHF Lo and program are OK.	1) Defective band selector (IC-3) and/or power supply switching circuit component parts on RF/IF P.C. Board. 2) Faulty crystal X-4 (60.000 MHz) and OSC circuit component parts on RF/IF P.C. Board. 3) Faulty RF switching circuit component on RF/IF P.C. Board. 4) Defective high band RF amp, mixer and buffer amp circuit component on RF/IF P.C. Board.

Symptom	Possible cause
15) UHF Lo, Mid Hi does not operate but VHF Lo and Hi are OK.	1) Defective band selector (IC-3) and/or power supply switching circuit component parts on RF/IF P.C. Board. 2) Faulty diode D22, 23 and/or tripler (Q21) circuit component on RF/IF P.C. Board. 3) Defective UHF RF amp and/or mixer circuit component on RF/IF P.C. Board.
16) UHF Mid band does not operate but VHF Lo and UHF Lo are OK.	1) Defective band selector (IC-3) or diode D25, D31 on RF/IF P.C. Board. 2) Defective crystal X-3 (62.85750 MHz) and/or associated circuit component parts on RF/IF P.C. Board.
17) UHF Hi does not operate but VHF Lo, Hi and UHF Lo, Mid are OK.	1) Defective band selector (IC-3) or diode D26, D29 on RF/IF P.C. Board. 2) Defective crystal X-2 (65.71464 MHz) and/or associated circuit component parts on RF/IF P.C. Board.
18) VCO does not oscillate correct frequency.	1) Faulty crystal X-1 and/or integrated circuit IC-6 of PLL/PROGRAMMER CIRCUIT. 2) Defective programmable counter circuit, phase detector circuit and/or associated circuit component of PLL/PROGRAMMER P.C. Board. 3) Faulty 5 kHz filter and/or buffer amp (Q26) circuit component parts on RF/IF P.C. Board. 4) Defective VCO IC-4 and/or varicap D32 or associated circuit component on RF/IF P.C. Board.

NOTE: *Recheck to see that each connector is connected firmly.*

PARTS LIST

CHASSIS ASSEMBLY PARTS LIST

Ref. No.	Description			RS Part Number	MFR's Part Number
			CAPACITORS		
C1	Feed through	0.001μF	+80 ~ -20%		PL-102BN
C2	Feed through	0.001μF	+80 ~ -20%		PL-102BN
C3	Feed through	0.001μF	+80 ~ -20%		PL-102BN
C4	Feed through	3pF	±0.5pF		1HB3635L0300DE
C5	Feed through	0.001μF	+80 ~ -20%		PL-102BN
C6	Feed through	0.001μF	+80 ~ -20%		PL-102BN
C7	Feed through	0.001μF	+80 ~ -20%		PL-102BN
C8	Feed through	0.001μF	+80 ~ -20%		PL-102BN
C9	Feed through	0.001μF	+80 ~ -20%		PL-102BN
C10	Feed through	0.001μF	+80 ~ -20%		PL-102BN
C11	Ceramic	22pF	±5%		FC-50
			MISCELLANEOUS		
	AC cord UL listed			W-1907	6 feet (BLK)
①	ANT. jack			J-0566	JA-C-020
②	ANT. supporter				GE-13C-890
③	Battery box			B-0258	GE-21D-5728
④	Battery box cover			CB-0172	GE-21D-5729
	Battery snap			B-0259	
⑤	Case (bottom)			Z3275	GE-21B-5724
⑥	Case (top)			Z3275	GE-21B-5723
	Case pad				GE-21D-5981
⑦	Car mounting bracket			MB-0160	GE-21C-5725
⑧	Car mounting bracket screw			HS-0379	GE-16D-3166
⑨	Chassis			Z-3274	GE-21A-5720
JH	Connector ass'y			HB-5499	5047-12A
JI	Connector ass'y			HB-5500	5047-12B
	Cord band				NO.5125
	Cord holder			HB-1515	GE-18D-4215
	Strain relief			HB-1649	NO.5121
	DC cable (with fuse holder)			W-1908	GE-19D-4719
⑩	Feed through capacitor plate			HB-5494	GE-21D-5730
	Foot			F-0065	NO.7101
⑪	Front escutcheon assembly				
	Fuse UL listed			HF-0018	1A
	Fuse				2A
⑫	Fuse holder UL listed			F-1069	SN1301
⑬	Heat sink (A)			HH-0197	GE-21D-5721
	Heat sink (B)			HH-0196	GE-21D-5722
	Line cord strain relief			H-2542	SR-3P-4
⑭	Lug terminal UL listed			HB-5498	95KU4822
	Nylon bushings				B-500-375
⑮	P.C. Board holder			HB-5495	GE-21D-5733
⑯	Phone jack			J-0030	SG-7615
⑰	Power transformer UL listed			TA-0594	K5130
	Push knob (black)			K-2383	10105(BLK)
	Push knob (ivory)			K-2382	GE-21D-5732
	Push switch			S-7295	2F0-0009DF2020
	RCA jack			J-0801	LR205-2

Ref. No.	Description	RS Part Number	MFR's Part Number
⑱	Speaker	S-4529	EP-100715ST
	Speaker pad		GE-21D-5982
	Styrofoam pad for battery		GE-21D-5795
	Styrofoam pad for P.C. Board		GE-21D-5776
⑲	3P DC jack	J-0900	#1476
	Volume knob	K2381	GE-20D-5313
	Screws		
	Pan head tapping screw		3 mm. x 6 mm.
	Pan head tapping screw		3 mm. x 8 mm.
	Pan head screw		3 mm. x 4 mm.
	Pan head screw		3 mm. x 6 mm.
	Pan head screw		3 mm. x 8 mm.
	Pan head screw		4 mm. x 8 mm.
	Bind head screw (Black)		3 mm. x 8 mm.
	Flat countersunk head screw		3 mm. x 6 mm.
	Pan head plastic screw		3 mm. x 10 mm.
	Nut		3 mm.
	Nut		4 mm.
	Nut		7 mm.
	Nut		9 mm.
	Lock washer		3 mm.
	Lock washer		4 mm.
	Flat washer		7 mm.
	Flat washer		9 mm.
	RESISTORS		
R1	Carbon film 1.8MΩ 1/2W ±20%		ERD-12TJ-185
R2	Carbon film 10KΩ 1/8W ±5%		ERD-18TJ-103
	POTENTIOMETERS		
⑳	Potentiometer SQUELCH	P-1714	VM10A-50KΩB25
㉑	Potentiometer VOLUME	P-1713	VM11A975-5M1411-50KA

CANADA MODEL

Ref. No.	Description	RS Part Number	MFR's Part Number
	AC cord CSA listed		
	Line cord strain relief		SR-594

RF/IF P.C. BOARD PARTS LIST

Ref. No.	Description			RS Part Number	MFR's Part Number
		CAPACITORS			
C1	Ceramic	0.001μF	±20%		SCP-60
C2	Ceramic	0.01μF	+80 ~ -20%		MC-70
C3	Ceramic	0.001μF	±20%		SCP-60
C4	Ceramic	0.001μF	±20%		SCP-60
C5	Ceramic	0.001μF	±20%		SCP-60
C6	Ceramic	0.002μF	±20%		SCP-80
C7	Ceramic	0.001μF	±20%		SCP-60
C8	Ceramic	0.0047μF	+80 ~ -20%		SCP-100
C9	Ceramic	100pF	±10%		FC-70
C10	Ceramic	0.0047μF	+80 ~ -20%		SCP-80
C11	Ceramic	0.0047μF	+80 ~ -20%		SCP-80
C12	Ceramic	0.001μF	±20%		SCP-60
C13	Ceramic	0.0047μF	+80 ~ -20%		SCP-80
C14	Ceramic	0.002μF	±20%		SCP-60
C15	Ceramic	100pF	±10%		FC-70
C16	Ceramic	0.002μF	±20%		SCP-80
C17	Ceramic	47pF	±10%		FCC-100
C18	Ceramic	0.001μF	±20%		SCP-60
C19	Ceramic	22pF	±5%		FC-50
C20	Ceramic	0.0047μF	+80 ~ -20%		SCP-100
C21	Ceramic	0.0047μF	+80 ~ -20%		SCP-100
C22	Ceramic	0.001μF	±20%		SCP-60
C23	Ceramic	0.0047μF	+80 ~ -20%		SCP-100
C24	Ceramic	0.001μF	±20%		SCP-60
C25	Ceramic	0.001μF	±20%		SCP-60
C26	Ceramic	470pF	±10%		SCP-50
C27	Ceramic	330pF	±10%		SCP-50
C28	Ceramic	68pF	±10%		FC-70
C29	Electrolytic	47μF 16WV	+50 ~ -10%		CE04W1C470B
C30	Mylar	0.1μF	±10%		
C31	Ceramic	10pF	±0.5pF		FC-50
C32	Tantalum	0.1μF 35WV	±20%		CS15E1V0R1M
C33	Ceramic	0.001μF	±20%		SCP-60
C34	Ceramic	470pF	±10%		SCP-50
C35	Electrolytic	47μF 16WV	+50 ~ -10%		CE04W1C470B
C36	Ceramic	470pF	±10%		SCP-50
C37	Ceramic	470pF	±10%		SCP-50
C38	Ceramic	470pF	±10%		SCP-50
C39	Ceramic	470pF	±10%		SCP-50
C40	Mylar	0.1μF	±10%		
C41	Tantalum	0.1μF 35WV	±20%		CS15E1V0R1M
C42	Ceramic	100pF	±10%		FC-70
C43	Ceramic	330pF	±5%		SCU-100
C44	Ceramic	330pF	±5%		SCU-100
C45	Mylar	0.001μF	±10%		
C46	Ceramic	2pF	±0.5pF		FC-50
C47	Ceramic	2pF	±0.5pF		FC-50
C48	Ceramic	22pF	±5%		FC-50
C49	Ceramic	0.001μF	±20%		SCP-60
C50	Ceramic	0.0047μF	+80 ~ -20%		SCP-100

Ref. No.	Description			RS Part Number	MFR's Part Number
C51	Ceramic	0.0047μF	+80 ~ -20%		SCP-100
C52	Ceramic	10pF	±0.5pF		PC-50
C53	Ceramic	1pF	±0.5pF		FC-50
C54	Ceramic	10pF	±0.5pF		FC-50
C55	Ceramic	0.0047μF	+80 ~ -20%		SCP-100
C56	Ceramic	0.0047μF	+80 ~ -20%		SCP-100
C57	Ceramic	0.0047μF	+80 ~ -20%		SCP-100
C58	Ceramic	0.0047μF	+80 ~ -20%		SCP-100
C59	Ceramic	10pF	+0.5pF		FC-50
C60	Ceramic	0.0047μF	+80 ~ -20%		SCP-100
C61	Ceramic	150pF	+10%		PC-80
C62	Ceramic	10pF	±0.5pF		FC-50
C63	Ceramic	470pF	±10%		SCP-50
C64	Electrolytic	47μF 16WV	+50 ~ -10%		CE04W1C470B
C65	Ceramic	0.002μF	±20%		SCP-80
C66	Electrolytic	10μF 16WV	+50 ~ -10%		CE04W1C100F
C67	Ceramic	0.0022μF	±20%		SCP-80
C68	Ceramic	0.0022μF	±20%		SCP-80
C69	Electrolytic	10μF 16WV	+50 ~ -10%		CE04W1C100F
C70	Ceramic	330pF	±10%		SCP-50
C71	Ceramic	0.001μF	±20%		SCP-60
C72	Ceramic	0.1μF	+80 ~ -20%		MC-135
C73	Electrolytic	1μF 50WV	+75 ~ -10%		CE04W1H010
C74	Electrolytic	47μF 16WV	+50 ~ -10%		CE04W1C470B
C75	Mylar	0.01μF	±10%		
C76	Electrolytic	220μF 16WV	+50 ~ -10%		CE04W1E221C
C77	Mylar	0.0047μF	±10%		
C78	Mylar	0.02μF	±10%		
C79	Mylar	0.0047μF	±10%		
C80	Electrolytic	1μF 50WV	+75 ~ -10%		CE04W1H010
C81	Mylar	0.01μF	±10%		
C82	Mylar	0.0027μF	±10%		
C83	Electrolytic	10μF 16WV	+50 ~ -10%		CE04W1C100F
C84	Electrolytic	10μF 16WV	+50 ~ -10%		CE04W1C100F
C85	Mylar	0.01μF	±10%		
C86	Electrolytic	10μF 16WV	+50 ~ -10%		CD04W1C100F
C87	Ceramic	0.1μF	+80 ~ -20%		MC-135
C88	Electrolytic	47μF 16WV	+50 ~ -10%		CE04W1C470B
C89	Ceramic	10pF	±0.5pF		FC-50
C90	Ceramic	7pF	±0.5pF		FC-50
C91	Ceramic	33pF	±5%		FC-50
C92	Ceramic	5pF	±5%		FC-50
C93	Ceramic	0.001μF	±20%		SCP-60
C94	Ceramic	20pF	±5%		FC-50
C95	Ceramic	2pF	±0.5pF		FC-50
C96	Ceramic	0.001μF	±20%		SCP-60
C97	Mylar	0.1μF	±10%		
C98	Ceramic	0.001μF	±10%		SCP-60
C99	Ceramic	0.001μF	±10%		SCP-60
C100	Ceramic	5pF	±0.5pF		FC-50
C101	Ceramic	0.001μF	±20%		SCP-60
C102	Ceramic	0.001μF	±20%		SCP-60

Ref. No.	Description				RS Part Number	MFR's Part Number
C103	Ceramic	0.0047μF		+80 ~ -20%		SCP-100
C104	Ceramic	10pF		±0.5pF		FC-50
C105	Ceramic	56pF		±10%		FCC-100
C106	Ceramic	47pF		±10%		FCC-100
C107	Ceramic	0.0047μF		+80 ~ -20%		SCP-100
C108	Ceramic	10pF		±0.5pF		FC-50
C109	Ceramic	2pF		±0.5pF		FC-50
C110	Ceramic	2pF		±0.5pF		FC-50
C111	Ceramic	7pF		±0.5pF		FC-50
C112	Ceramic	0.1μF		+ 80 ~ -20%		MC-135
C113	Mylar	0.01μF		±10%		
C114	Mylar	0.02μF		±10%		
C115	Mylar	0.01μF		±10%		
C116	Mylar	0.1μF		±10%		
C117	Mylar	0.0027μF		±10%		
C118	Ceramic	0.001μF		±20%		SCP-100
C119	Ceramic	0.01μF		+80 ~ -20%		MC-70
C120	Electrolytic	220μF	16WV	+50 ~ -10%		CE04W1C221E
C121	Ceramic	0.001μF		±20%		SCP-60
C122	Ceramic	100pF		±10%		FC-70
C123	Ceramic	100pF		±10%		FC-70
C124	Ceramic	10pF		±0.5pF		FC-50
C125	Ceramic	0.0047μF		+80 ~ -20%		SCP-100
C126	Ceramic	10pF		±0.5pF		FC-50
C127	Mylar	0.01μF		±10%		
C128	Electrolytic	220μF	25WV	+50 ~ -10%		CE04W1E221C
C129	Ceramic	0.04μF		+80 ~ -20%		MC-100
C130	Electrolytic	220μF	25WV	+50 ~ -10%		CE04W1E221C
C131	Electrolytic	3300μF	25WV	+50 ~ -10%		1E332
C132	Electrolytic	47μF	16WV	+50 ~ -10%		CE04W1C470B
C133	Ceramic	0.04μF		+80 ~ -20%		MC-100
C134	Electrolytic	220μF	16WV	+50 ~ -10%		CE04W1C221E
C135	Electrolytic	220μF	16WV	+50 ~ -10%		CE04W1C221E
C136	Electrolytic	47μF	16WV	+50 ~ -10%		CE04W1C470B
C137	Ceramic	0.04μF		+80 ~ -20%		MC-100
C138	Electrolytic	47μF	16WV	+50 ~ -10%		CE04W1C470B
C139	Electrolytic	220μF	16WV	+50 ~ -10%		CE04W1C221E
C140	Electrolytic	1000μF	25WV	+50 ~ -10%		CE04W1E102C
C141	Ceramic	0.01μF		+80 ~ -20%		MC-70
C142	Ceramic	0.01μF		+80 ~ -20%		MC-70
C143	Tantalum	22μF	6.3WV	±20%		CS15EOJ22OMIS
TC-1	Trimmer	10pF			C-0729	ECV-1ZW10X52
TC-2	Trimmer	10pF			C-0729	ECV-1ZW10X52
TC-3	Trimmer	50pF			C-0561	ECV-1ZW50X32
TC-4	Trimmer	50pF			C-0561	ECV-1ZW50X32
TC-5	Trimmer	50pF			C-0561	ECV-1ZW50X32
TC-6	Trimmer	10pF			C-0561	ECV-1ZW10X52

Ref. No.	Description	RS Part Number	MFR's Part Number
	COIL/TRANSFORMERS/FILTERS/CRYSTALS		
T1	VHF Lo RF coil	CA-4549	113KN-4427
T2	VHF Lo RF coil	CA-3482	113KN-5344Z
T3	VHF Lo RF coil	CA-3482	113KN-5344Z
T4	IFT 10.7 MHz	CA-4653	119LC-470033N3
T5	IFT 10.7 MHz	CA-4653	119LC-470033N3
T6	IFT coil	CA-3484	7MC-452503N
T7	Discriminator coil	CA-2997	7MC-2091N
T8	VHF Hi RF coil	CA-3481	113KN-5127Z
T9	VHF Hi RF coil	CA-3481	113KN-5127Z
T10	VHF Hi RF coil	CA-4547	113SN-4580X
T11	Coil	CA-3483	126LN-5730A
T12	VCO coil	CA-3482	113KN-5344Z
L1	VHF RF coil	CA-3486	6.5SN0-097
L2	RFC 10 μH	C-0728	LF4-100K
L3	Balun coil	CA-3487	6.5SN0-099
L4	VHF OSC coil	CA-4546	6.5SN0-087
L5	RFC 2.2mH	C-727	FL-7H
L6	UHF Tank coil	CA-4654	8LNR-093
L7	RFC 10 μH	C-0728	LF4-100K
L8	UHF Tank coil	CA-4654	8LNR-093
L9	VHF OSC coil	CA-3485	6.5SN0-104
L10	RFC .68 μH	CB-2190	EL0606-R68M
L11	RFC 1.8 μH	CA-2909	LF4-1R8K
L12	RFC .33 μH	C-0726	FL-3H
L13	RFC .33 μH	C-0726	FL-3H
L14	RFC .33 μH	C-0726	FL-3H
L15	RFC .2 μH	CA-3488	4LNC-092
L16	RFC .2 μH	CA-3488	4LNC-092
L17	Choke coil 18 μH	CA-3182	3B-037
CF-1	Crystal filter 10.7 MHz	C-0725	CMF-10.7 or 10M15B
CF-2	Crystal filter 10.7 MHz	C-0725	CMF-10.7 or 10M15B
CF-3	Ceramic filter 455 kHz		LF-C18
CF-4	Ceramic filter 455 kHz	C-0578	BFB455L or EF-A8
CF-5	Ceramic filter 455 kHz	C-0578	BFB455L or EF-A8
X1	Crystal 10.245 MHz		
X2	Crystal 65.71464 MHz		
X3	Crystal 62.85750 MHz		
X4	Crystal 60.00000 MHz		
	MISCELLANEOUS		
	Test pin	J-6461	CTP
	IC socket		C831402
	Shield plate		CE-21D-5910
	Ceramic stand off L = 10 mm.		
	Ceramic stand off L = 20 mm.		
㉔	P.C. Board		GE-21B-5694
	VCO shief plate with insulator		GE-21D-6070/6071

Ref. No.	Description			RS Part Number	MFR's Part Number
		SEMICONDUCTORS			
D1	Diode	Silicon		HV80	HV80
D2	Diode	Silicon		HV80	HV80
D3	Diode	Silicon		HV80	HV80
D4	Diode	Variable capacitor		FC-54M	FC-54M
D5	Diode	Variable capacitor		FC-54M	FC-54M
D6	Diode	Variable capacitor		FC-54M	FC-54M
D7	Diode	Variable capacitor		FC-54M	FC-54M
D8	Diode	Variable capacitor		FC-54M	FC-54M
D9	Diode	Variable capacitor		FC-54M	FC-54M
D10	Diode	Silicon		HV80	HV80
D11	Diode	Silicon		HV80	HV80
D12	Diode	Silicon		HV80	HV80
D13	Diode	Silicon		HV80	HV80
D14	Diode	Silicon		HV80	HV80
D15	Diode	Silicon		HV80	HV80
D16	Diode	Silicon		HV80	HV80
D17	Diode	Silicon		HV80	HV80
D18	Diode	Germanium		1N60	1N60
D19	Diode	Germanium		1N60	1N60
D20	Diode	Germanium		1N60	1N60
D21	Diode	Germanium		1N60	1N60
D22	Diode	Silicon		HV80	HV80
D23	Diode	Silicon		HV80	HV80
D24	Diode	Silicon		HV80	HV80
D25	Diode	Silicon		HV80	HV80
D26	Diode	Silicon		HV80	HV80
D27	Diode	Germanium		1N60	1N60
D28	Diode	Germanium		1N60	1N60
D29	Diode	Germanium		1N60	1N60
D30	Diode	Germanium		1N60	1N60
D31	Diode	Germanium		1N60	1N60
D32	Diode	Variable capacitor		FC-54M	FC-54M
D33	Diode	Zener (9.1V)		02Z9.1A	02Z9.1A
D34	Diode	Zener (5.6V)		02Z5.6A	02Z5.6A
D35	Diode	Silicon		HV80	HV80
D36	Diode	Zener (5.6V)		02Z5.6A	02Z5.6A
D37	Diode	Silicon		HV80	HV80
D38	Diode	Zener (5.6V)		02Z5.6A	02Z5.6A
D39	Diode	Silicon		1S1885	1S1885
D40	Diode	Silicon		1B2C1	1B2C1
D41	Diode	Silicon		1B2Z1	1B2Z1
Q1	Transistor	Silicon	Toshiba	2SC373	2SC373
Q2	FET	Silicon	Toshiba	3SK35 or 3SK59	3SK35 or 3SK59
Q3	FET	Silicon	Toshiba	3SK35 or 3SK59	3SK35 or 3SK59
Q4	Transistor	Silicon	Hitachi	2SC535(B)	2SC535(B)
Q5	Transistor	Silicon	Toshiba	2SC372(0)	2SC372(0)
Q6	Transistor	Silicon	Toshiba	2SC372(0)	2SC372(0)
Q7	Transistor	Silicon	Toshiba	2SC372(0)	2SC372(0)
Q8	Transistor	Silicon	Toshiba	2SC372(0)	2SC372(0)

Ref. No.	Description				RS Part Number	MFR's Part Number
Q9	Transistor	Silicon		Toshiba	2SC272(0)	2SC372(0)
Q10	Transistor	Silicon		Toshiba	2SC372(0)	2SC372(0)
Q11	Transistor	Silicon		Toshiba	2SC372(0)	2SC372(0)
Q12	FET	Silicon		Toshiba	3SK35 or 3SK59	3SK35 or 3SK59
Q13	FET	Silicon		Toshiba	3SK35 or 3SK59	3SK35 or 3SK59
Q14	Transistor	Silicon		Toshiba	2SC785(R)	2SC785(R)
Q15	Transistor	Silicon		Toshiba	2SC373	2SC373
Q16	Transistor	Silicon		Toshiba	2SC373	2SC373
Q17	Transistor	Silicon		Toshiba	2SC373	2SC373
Q18	Transistor	Silicon		Toshiba	2SC373	2SC373
Q19	Transistor	Silicon		Hitachi	2SC1117	2SC1117
Q20	Transistor	Silicon		Hitachi	2SC1117	2SC1117
Q21	Transistor	Silicon		Toshiba	2SC387A	2SC387A
Q22	Transistor	Silicon		Toshiba	2SC394(Y)	2SC394(Y)
Q23	Transistor	Silicon		Toshiba	2SA495(0)	2SA495(0)
Q24	Transistor	Silicon		Toshiba	2SA495(0)	2SA495(0)
Q25	Transistor	Silicon		Toshiba	2SA495(0)	2SA495(0)
Q26	Transistor	Silicon		Hitachi	2SC535(B)	2SC535(B)
Q27	Transistor	Silicon		Toshiba	2SD526 or 2SC789	2SD526 or 2SC789
Q28	Transistor	Silicon		Toshiba	2SD526 or 2SC789	2SD526 or 2SC789
Q29	Transistor	Silicon		Toshiba	2SC735(Y)	2SC735(Y)
Q30	Transistor	Silicon		Toshiba	2SD526 or 2SC789	2SD526 or 2SC789
IC-1	Integrated circuit				N7405A	N7405A
IC-2	Integrated circuit				BA-511A	BA-511A
IC-3	Integrated circuit				N74145B	N74145B
IC-4	Integrated circuit				MC1648P	MC1648P
	RESISTORS					
R1	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R2	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R3	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R4	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R5	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R6	Carbon film	47KΩ	1/8W	±5%		ERD-18VJ-473
R7	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R8	Carbon film	47KΩ	1/8W	±5%		ERD-18VJ-473
R9	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R10	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R11	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R12	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R13	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R14	Carbon film	3.3KΩ	1/8W	±5%		ERD-18VJ-332
R15	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R16	Carbon film	3.3KΩ	1/8W	±5%		ERD-18VJ-332
R17	Carbon film	3.3KΩ	1/8W	±5%		ERD-18VJ-332
R18	Carbon film	470KΩ	1/8W	±5%		ERD-18VJ-474
R19	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R20	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R21	Carbon film	470KΩ	1/8W	±5%		ERD-18VJ-474
R22	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101

Ref. No.	Description				RS Part Number	MFR's Part Number
R23	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R24	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R25	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R26	Carbon film	4.7KΩ	1/8W	±5%		ERD-18VJ-472
R27	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R28	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R29	Carbon film	470KΩ	1/8W	±5%		ERD-18VJ-474
R30	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R31	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R32	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R33	Carbon film	330KΩ	1/8W	±5%		ERD-18VJ-334
R34	Carbon film	4.7KΩ	1/8W	±5%		ERD-18VJ-472
R35	Carbon film	330KΩ	1/8W	±5%		ERD-18VJ-334
R36	Carbon film	4.7KΩ	1/8W	±5%		ERD-18VJ-472
R37	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R38	Carbon film	4.7KΩ	1/8W	±5%		ERD-18VJ-472
R39	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R40	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R41	Carbon film	22KΩ	1/8W	±5%		ERD-18VJ-223
R42	Carbon film	22KΩ	1/8W	±5%		ERD-18VJ-223
R43	Carbon film	47KΩ	1/8W	±5%		ERD-18VJ-473
R44	Carbon film	47KΩ	1/8W	±5%		ERD-18VJ-473
R45	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R46	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R47	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R48	Carbon film	47KΩ	1/8W	±5%		ERD-18VJ-473
R49	Carbon film	1MΩ	1/8W	±5%		ERD-18VJ-105
R50	Carbon film	2.2KΩ	1/8W	±5%		ERD-18VJ-222
R51	Carbon film	2.2KΩ	1/8W	±5%		ERD-18VJ-222
R52	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R53	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R54	Carbon film	22KΩ	1/8W	±5%		ERD-18VJ-223
R55	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R56	Carbon film	2.2KΩ	1/8W	±5%		ERD-18VJ-222
R57	Carbon film	47Ω	1/8W	±5%		ERD-18VJ-470
R58	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R59	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R60	Carbon film	1MΩ	1/8W	±5%		ERD-18VJ-105
R61	Carbon film	3.3KΩ	1/8W	±5%		ERD-18VJ-332
R62	Carbon film	470Ω	1/8W	±5%		ERD-18VJ-471
R63	Carbon film	56KΩ	1/8W	±5%		ERD-18VJ-563
R64	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R65	Carbon film	470Ω	1/8W	±5%		ERD-18VJ-471
R66	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R67	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R68	Carbon film	120Ω	1/8W	±5%		ERD-18VJ-121
R69	Carbon film	3.3KΩ	1/8W	±5%		ERD-18VJ-332
R70	Carbon film	47KΩ	1/8W	±5%		ERD-18VJ-473
R71	Carbon film	3.3KΩ	1/8W	±5%		ERD-18VJ-332
R72	Carbon film	3.3KΩ	1/8W	±5%		ERD-18VJ-332
R73	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R74	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103

Ref. No.	Description				RS Part Number	MFR's Part Number
R75	Carbon film	3.3KΩ	1/8W	±5%		ERD-18VJ-332
R76	Carbon film	3.3KΩ	1/8W	±5%		ERD-18VJ-332
R77	Carbon film	4.7KΩ	1/8W	±5%		ERD-18VJ-472
R78	Carbon film	3.9KΩ	1/8W	±5%		ERD-18TJ-392
R79	Carbon film	22Ω	1/8W	±5%		ERD-18VJ-220
R80	Metal film	8Ω	2W	±10%		ERF-2SK8R0
R81	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R82	Carbon film	470Ω	1/8W	±5%		ERD-18VJ-471
R83	Carbon film	4.7KΩ	1/8W	±5%		ERD-18VJ-472
R84	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R85	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R86	Carbon film	3.3KΩ	1/8W	±5%		ERD-18TJ-332
R87	Carbon film	1MΩ	1/8W	±5%		ERD-18VJ-105
R88	Carbon film	47Ω	1/8W	±5%		ERD-18V-470
R89	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R90	Carbon film	330Ω	1/8W	±5%		ERD-18VJ-331
R91	Carbon film	22KΩ	1/8W	±5%		ERD-18VJ-223
R92	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R93	Carbon film	2.2KΩ	1/8W	±5%		ERD-18VJ-222
R94	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R95	Carbon film	39KΩ	1/8W	±5%		ERD-18VJ-393
R96	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R97	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R98	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R99	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R100	Carbon film	82Ω	1/8W	±5%		ERD-18VJ-820
R101	Carbon film	47Ω	1/8W	±5%		ERD-18VJ-470
R102	Carbon film	2.2KΩ	1/8W	±5%		ERD-18VJ-222
R103	Carbon film	2.2KΩ	1/8W	±5%		ERD-18TJ-222
R104	Carbon film	47Ω	1/8W	±5%		ERD-18VJ-470
R105	Carbon film	2.2KΩ	1/8W	±5%		ERD-18VJ-222
R106	Carbon film	2.2KΩ	1/8W	±5%		ERD-18VJ-222
R107	Carbon film	47Ω	1/8W	±5%		ERD-18VJ-470
R108	Carbon film	2.2KΩ	1/8W	±5%		ERD-18VJ-222
R109	Carbon film	2.2KΩ	1/8W	±5%		ERD-18VJ-222
R110	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R111	Carbon film	3.18KΩ	1/8W	±1%		CRB1/4FX
R112	Carbon film	3.18KΩ	1/8W	±1%		CRB1/4FX
R113	Carbon film	1.59KΩ	1/8W	±1%		CRB1/4FX
R114	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R115	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R116	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R117	Carbon film	470Ω	1/8W	±5%		ERD-18VJ-471
R118	Carbon film	150Ω	1/8W	±5%		ERD-18VJ-151
R119	Metal film	1Ω	1W	±5%		ERX-1ANJ1R0
R120	Carbon film	390Ω	1/8W	±5%		ERD-18VJ-391
R121	Metal film	1Ω	5W	±10%		ERF-5SK1R0
R122	Carbon film	330Ω	1/8W	±5%		ERD-18VJ-331
R123	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R124	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R125	Metal film	10Ω	1W	±5%		ERX-1ANJ100
R126	Carbon film	1KΩ	1/8W	±5%		ERD-18TJ-102
R127	Carbon film	3.3MΩ	1/8W	±5%		ERD-18TJ-335

DISPLAY P.C. BOARD PARTS LIST

Ref. No.	Description	RS Part Number	MFR's Part Number
	SEMICONDUCTORS		
D1	Light emitting diode	L-0740	TLR-104 (C or D)
D2	Light emitting diode	L-0740	TLR-104 (C or D)
D3	Light emitting diode	L-0740	TLR-104 (C or D)
D4	Light emitting diode	L-0740	TLR-104 (C or D)
D5	Light emitting diode	L-0740	TLR-104 (C or D)
D6	Light emitting diode	L-0740	TLR-104 (C or D)
D7	Light emitting diode	L-0740	TLR-104 (C or D)
D8	Light emitting diode	L-0740	TLR-104 (C or D)
D9	Light emitting diode	L-0740	TLR-104 (C or D)
D10	Light emitting diode	L-0740	TLR-104 (C or D)
D11	Light emitting diode	L-0740	TLR-104 (C or D)
D12	Light emitting diode	L-0740	TLR-104 (C or D)
D13	Light emitting diode	L-0740	TLR-104 (C or D)
D14	Light emitting diode	L-0740	TLR-104 (C or D)
D15	Light emitting diode	L-0740	TLR-104 (C or D)
D16	Light emitting diode	L-0740	TLR-104 (C or D)
	MISCELLANEOUS		
	P.C. Board holder		GE-11D-593
㉒	P.C. Board		GE-21C-5706

LED P.C. BOARD PARTS LIST

Ref. No.	Description	RS Part Number	MFR's Part Number
D1	Light emitting diode	L-0740	TLR-104 (C or D)
㉓	P.C. Board		GE-21D-5708

DIGITAL P.C. BOARD PARTS LIST

Ref. No.	Description				RS Part Number	MFR's Part Number
	CAPACITORS					
C1	Mylar	0.1μF		±10%		
C2	Mylar	0.1μF		±10%		
	MISCELLANEOUS					
	Push switch				S-7293	2FQ-0001DF-3220
	Push switch				S-7294	16FQ-0001BF-3220
J_A	P.C. Board connector				HB-5490	3022-20A
J_B	P.C. Board connector				HB-5491	3022-9A
J_C	P.C. Board connector				HB-5490	3022-20A
J_D	P.C. Board connector				HB-5491	3022-9A
J_E	P.C. Board connector				HB-5490	3022-20A
J_F	P.C. Board connector				HB-5490	3022-20A
J_G	P.C. Board connector				HB-5492	3022-3A
J_H	P.C. Board connector				HB-5493	5048-12A
J_I	P.C. Board connector				HB-5493	5048-12A
㉖	P.C. Board					GE-21B-5697
	RESISTORS					
R1	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R2	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R3	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R4	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R5	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R6	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R7	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R8	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R9	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R10	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R11	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R12	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R13	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R14	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R15	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R16	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
R17	Carbon film	100Ω	1/8W	±5%		ERD-18TJ-101
R18	Carbon film	150Ω	1/8W	±5%		ERD-18TJ-151
R19	Carbon film	3.3KΩ	1/8W	±5%		ERD-18TJ-332
R20	Carbon film	220KΩ	1/8W	±5%		ERD-18TJ-224
R21	Carbon film	270Ω	1/8W	±5%		ERD-18TJ-271
	SEMICONDUCTORS					
D1	Diode	Germanium			1N60	1N60
D2	Diode	Zener			HZ3-C	HZ3-C
D3	Diode	Silicon			HV80	HV80
1C-1	Integrated circuit				N74150	N74150
Q1	Transistor	Silicon	Toshiba		2SC373	2SC373
Q2	Transistor	Silicon	Toshiba		2SC373	2SC373

PLL/PROGRAMMER P.C. BOARD PARTS LIST

Ref. No.	Description				RS Part Number	MFR's Part Number
			CAPACITORS			
C1	Electrolytic	47μF	10WV	+50 ~ -10%		CE04W1A470B
C2	Mylar	0.01μF		±10%		
C3	Mylar	0.01μF		±10%		
C4	Electrolytic	220μF	10WV	+50 ~ -10%		CE04W1A221E
C5	Electrolytic	1μF	50WV	+75 ~ -10%		CE04W1H010
C6	Mylar	0.01μF		±10%		
C7	Mylar	0.01μF		±10%		
C8	Ceramic	22pF		± 5%		FC-50
C9	Tantalum	1μF	35WV	±20%		CS15E1E010M1S
C10	Ceramic	5pF		±0.5pF		FC-50
C11	Ceramic	100pF		±10%		FC-70
C12	Ceramic	20pF		±5%		FC-50
C13	Mylar	0.01μF		±10%		
C14	Mylar	0.01μF		±10%		
C15	Mylar	0.01μF		±10%		
C16	Mylar	0.01μF		±10%		
C17	Mylar	0.01μF		±10%		
C18	Mylar	0.01μF		±10%		
C19	Mylar	0.01μF		±10%		
C20	Mylar	0.01μF		±10%		
C21	Mylar	0.01μF		±10%		
C22	Mylar	0.1μF		±10%		
C23	Mylar	0.001μF		±10%		
C24	Mylar	0.01μF		±10%		
C25	Mylar	0.01μF		±10%		
TC-1	Trimmer	20pF			C-0730	ECV-1ZW20X53
			MISCELLANEOUS			
JD	P.C. Board connector				HB-5489	3024-9A
JE	P.C. Board connector				HB-5488	3024-20A
JF	P.C. Board connector				HB-5488	3024-20A
JG	P.C. Board connector					3024-3A
(25)	P.C. Board					GE-21B-5703
X1	Crystal 5.12 MHz					
	IC socket					C831402
	IC socket				J-6462	C831602
	Test pin				HB-3996	CTP
			RESISTORS			
R1	Carbon film	22KΩ	1/8W	±5%		ERD-18VJ-223
R2	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R3	Carbon film	100KΩ	1/8W	±5%		ERD-18VJ-104
R4	Carbon film	330Ω	1/8W	±5%		ERD-18VJ-331
R5	Carbon film	100Ω	1/8W	±5%		ERD-18VJ-101
R6	Carbon film	330Ω	1/8W	±5%		ERD-18VJ-331

Ref. No.	Description				RS Part Number	MFR's Part Number
R7	Carbon film	3.3KΩ	1/8W	±5%		ERD-18VJ-332
R8	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R9	Carbon film	470Ω	1/8W	±5%		ERD-18VJ-471
R10	Carbon film	470Ω	1/8W	±5%		ERD-18VJ-471
R11	Carbon film	2.7KΩ	1/8W	±5%		ERD-18VJ-272
R12	Carbon film	3.3MΩ	1/8W	±5%		ERD-18VJ-335
R13	Carbon film	4.7KΩ	1/8W	±5%		ERD-18VJ-472
R14	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R15	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R16	Carbon film	1KΩ	1/8W	±5%		ERD-18VJ-102
R17	Carbon film	10KΩ	1/8W	±5%		ERD-18VJ-103
R18	Carbon film	4.7KΩ	1/8W	±5%		ERD-18VJ-472
R19	Carbon film	220KΩ	1/8W	±5%		ERD-18TJ-224
			SEMICONDUCTORS			
IC-1	Integrated circuit				N7405	N7405
IC-2	Integrated circuit				N7405	N7405
IC-3	Integrated circuit				N7405	N7405
IC-4	Integrated circuit				MCM14537	MCM14537
IC-5	Integrated circuit				MC4044	MC4044
IC-6	Integrated circuit				TC-5082P	TC-5082P
IC-7	Integrated circuit				N74164	N74164
IC-8	Integrated circuit				N74164	N74164
IC-9	Integrated circuit				MC4016P	MC4016P
IC-10	Integrated circuit				MC4018P	MC4018P
IC-11	Integrated circuit				MC4018P	MC4018P
IC-12	Integrated circuit				MC4016P	MC4016P
IC-13	Integrated circuit				MC12014	MC12014
IC-14	Integrated circuit				MC12013	MC12013
D1	Diode	Silicon			HV80	HV80
D2	Diode	Silicon			HV80	HV80
Q1	Transistor	Silicon	Toshiba		2SC373	2SC373
Q2	Transistor	Silicon	Toshiba		2SC373	2SC373
Q3	Transistor	Silicon	Toshiba		2SC373	2SC373
Q4	Transistor	Silicon	Toshiba		2SC373	2SC373
Q5	Transistor	Silicon	Toshiba		2SC373	2SC373
Q6	Transistor	Silicon	Toshiba		2SC373	2SC373
Q7	Transistor	Silicon	Toshiba		2SC373	2SC373
Q8	Transistor	Silicon	Toshiba		2SC373	2SC373
Q9	Transistor	Silicon	Toshiba		2SC373	2SC373

SCANNING/PROGRAMMER P.C. BOARD PARTS LIST

Ref. No.	Description				RS Part Number	MFR's Part Number
			CAPACITORS			
C1	Mylar	0.01μF		±10%		CS15E1A3R3M1S
C2	Tantalum	3.3μF	10WV	±20%		CS15E1E010M1S
C3	Tantalum	1μF	35WV	±20%		CS15E1E010M1S
C4	Tantalum	1μF	35WV	±20%		CS15E0J330M1S
C5	Tantalum	33μF	6.3WV	±20%		CE04W1A101A
C6	Electrolytic	100μF	10WV	+50 ~ -10%		
C7	Mylar	0.01μF		±10%		
C8	Mylar	0.01μF		±10%		FC-80
C9	Ceramic	220pF		±10%		
C10	Mylar	0.002μF		±10%		
C11	Mylar	0.047μF		±10%		
C12	Mylar	0.01μF		±10%		
C13	Mylar	0.0068μF		±10%		
C14	Mylar	0.0068μF		±10%		
C15	Electrolytic	10μF	16WV	+50 ~ -10%		CE04W1C100F
C16	Mylar	0.01μF		±10%		
			RESISTORS			
R1	Carbon film	3.3KΩ	1/8W	±5%		ERD-18TJ-332
R2	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R3	Carbon film	470Ω	1/8W	±5%		ERD-18TJ-471
R4	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R5	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R6	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R7	Carbon film	4.7KΩ	1/8W	±5%		ERD-18TJ-472
R8	Carbon film	1KΩ	1/8W	±5%		ERD-18TJ-102
R9	Carbon film	4.7KΩ	1/8W	±5%		ERD-18TJ-472
R10	Carbon film	4.7KΩ	1/8W	±5%		ERD-18TJ-472
R11	Carbon film	330Ω	1/8W	±5%		ERD-18TJ-331
R12	Carbon film	3.9KΩ	1/8W	±5%		ERD-18TJ-392
R13	Carbon film	1KΩ	1/8W	±5%		ERD-18TJ-102
R14	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R15	Carbon film	47KΩ	1/8W	±5%		ERD-18TJ-473
R16	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R17	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R18	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R19	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R20	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R21	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R22	Carbon film	470Ω	1/8W	±5%		ERD-18TJ-471
R23	Carbon film	470Ω	1/8W	±5%		ERD-18TJ-471
R24	Carbon film	47Ω	1/8W	±5%		ERD-18TJ-470
R25	Carbon film	4.7KΩ	1/8W	±5%		ERD-18TJ-472
R26	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R27	Carbon film	4.7KΩ	1/8W	±5%		ERD-18TJ-472
R28	Carbon film	100KΩ	1/8W	±5%		ERD-18TJ-104
R29	Carbon film	100KΩ	1/8W	±5%		ERD-18TJ-104
R30	Carbon film	4.7KΩ	1/8W	±5%		ERD-18TJ-472
R31	Carbon film	10KΩ	1/8W	±5%		ERD-18TJ-103
R32	Carbon film	100KΩ	1/8W	±5%		ERD-18TJ-104

Ref. No.	Description			RS Part Number	MFR's Part Number
		SEMICONDUCTORS			
D1	Diode	Germanium		1N60	1N60
D2	Diode	Germanium		1N60	1N60
D3	Diode	Germanium		1N60	1N60
D4	Diode	Geramanium		1N60	1N60
D5	Diode	Silicon		HV80	HV80
D6	Diode	Germanium		1N60	1N60
D7	Diode	Germanium		1N60	1N60
D8	Diode	Germanium		1N60	1N60
D9	Diode	Silicon		HV80	HV80
D10	Diode	Germanium		1N60	1N60
D11	Diode	Germanium		1N60	1N60
D12	Diode	Germanium		1N60	1N60
D13	Diode	Germanium		1N60	1N60
D14	Diode	Germanium		2N60	1N60
D15	Diode	Germanium		1N60	1N60
D16	Diode	Germanium		1N60	1N60
D17	Diode	Germanium		1N60	1N60
D18	Diode	Germanium		1N60	1N60
D19	Diode	Germanium		1N60	1N60
D20	Diode	Germanium		1N60	1N60
D21	Diode	Silicon		HV80	HV80
IC-1	Integrated circuit			N74145	N74145
IC-2	Integrated circuit			N74145	N74145
IC-3	Integrated circuit			N7400	N7400
IC-4	Integrated circuit			N7493	N7493
IC-5	Integrated circuit			N7400	N7400
IC-6	Integrated circuit			N7493	N7493
IC-7	Integrated circuit			N7404	N7404
Q1	Transistor	Silicon	Toshiba	2SC373	2SC373
Q2	Transistor	Silicon	Toshiba	2SC373	2SC373
TA-1	Transistor	Array		TA-58	TA-58
TA-2	Transistor	Array		TA-58	TA-58
TA-3	Transistor	Array		TA-58	TA-58
		MISCELLANEOUS			
	IC socket				C831402
	IC socket			J-6462	C831602
	Test pin			HB-3996	CTP
J_A	P.C. Board connector				3024-20A
J_B	P.C. Board connector				3024-9A
J_C	P.C. Board connector				3024-20A
㉗	P.C. Board				GE-21B-5700

HOW THE COMP-100 CIRCUIT FUNCTIONS

Refer to page 4 for basic concept of PLL circuits. Also refer to page 5 Block Diagram.

The value of "N" for COMP-100 can be varied from 8,140 to 12,540: thus $f\phi$ of VCO can be varied from 40.7 MHz to 62.7 MHz ($f\phi$ = N x fi [5 kHz]).

The input signal (fi) is generated by X1 5.12 MHz on the PLL/PROGRAMMER P.C. Board. This is divided by 1,024 through IC-6, to produce frequency of 5 kHz.

The receiving frequency is first mixed with local oscillator frequency (derived from X2, X3 or X4, through doubler Q14 or x7 multiplier Q21 on the RF/IF P.C. Board). This is mixed with $f\phi$ of VCO to produce the IF, 10.7 MHz. The choice of crystals and multiplier is made by IC-3 on RF/IF P.C. Board in accordance with the band selected.

Let's say we want to tune to 460.4 MHz. IC-3 selects X4 (60.000000 MHz) and x7 multiplier Q21. So the local oscillator frequency is 420 MHz. This is mixed with receiving frequency and produces 40.4 MHz. Now, $f\phi$ of VCO must be 51.1 MHz in order to obtain 10.7 MHz IF (40.4 MHz + 10.7 MHz). Therefore, N must be 10,220 (= 51.1 MHz divided by fi 5 kHz).

Thus, to calculate "N", use this formula:

$$N = \frac{fo\ (VCO)}{fi\ \ (5\ kHz)} = \frac{\text{Receiving frequency} - \text{local oscillator frequency} + IF\ (10.7\ MHz)}{5\ kHz}$$

In the example above:

$$N = \frac{460.4 - 420 + 10.7}{0.005} = 10{,}220$$

You will note that by varying the local oscillator frequency we can get more frequencies than variance of $f\phi$ would allow.

For VHF lo : no local oscillator frequency
VHF hi : 120 MHz (X4 and Q14)
UHF lo : 420 MHz (X4 and Q21)
UHF mid : 440.0025 MHz (X3 and Q21)
UHF hi : 460.0025 MHz (X2 and Q21)

These local oscillator frequencies are the number X on page 12 of Owner's Manual.

Then how can we enter the choice of local oscillator frequency and the value of "N"?
That's where the binary frequency code comes in.

The first three digits determine the frequency band. Refer to page 12 of Owner's Manual.

The remaining 13 digits determine the "N". Calculation system uses two base of 16 groups and one base of 10 group.

First, divide "N" by 2560 (= 16 x 16 x 10)

Let's use above example here also.

$$\frac{10{,}220}{2{,}560} = 3.9921875$$

And the rest is outlined in Owner's Manual pages 12 and 13. We've simplified the calculation in Owner's Manual by combining above two formulas into one.

You might be interested in knowing what frequency increment each of the code digits represents. This chart shows you the "values" assigned to each of the numbers in the last three groups:

Code Group	2				3				4			
Digit No.	5	6	7	8	9	10	11	12	13	14	15	16
Digit LED lit	MHz 6.4	MHz 3.2	MHz 1.6	MHz 0.8	MHz 0.4	MHz 0.2	MHz 0.1	MHz 0.05	MHz 0.04	MHz 0.02	MHz 0.01	MHz 0.005
Digit LED not lit	0	0	0	0	0	0	0	0	0	0	0	0

RADIO SHACK A DIVISION OF TANDY CORPORATION

U.S.A.: FORT WORTH, TEXAS 76102
CANADA: BARRIE, ONTARIO, CANADA L4M 4W5

TANDY CORPORATION

AUSTRALIA	BELGIUM	U. K.
280-316 VICTORIA ROAD RYDALMERE, N.S.W. 2116	PARC INDUSTRIEL DE NANINNE 5140 NANINNE	BILSTON ROAD WEDNESBURY, STAFFS WS10 7JN

2A7

Printed in Japan