handic 

SERVICE MANUAL
FOR
handic 0016

handic bolagen 

Telephone: 031-45 01 80 Telex: 2558
Box 156, S-421 22 V. Frölunda, Sweden

CONTENTS

SPECIFICATIONS

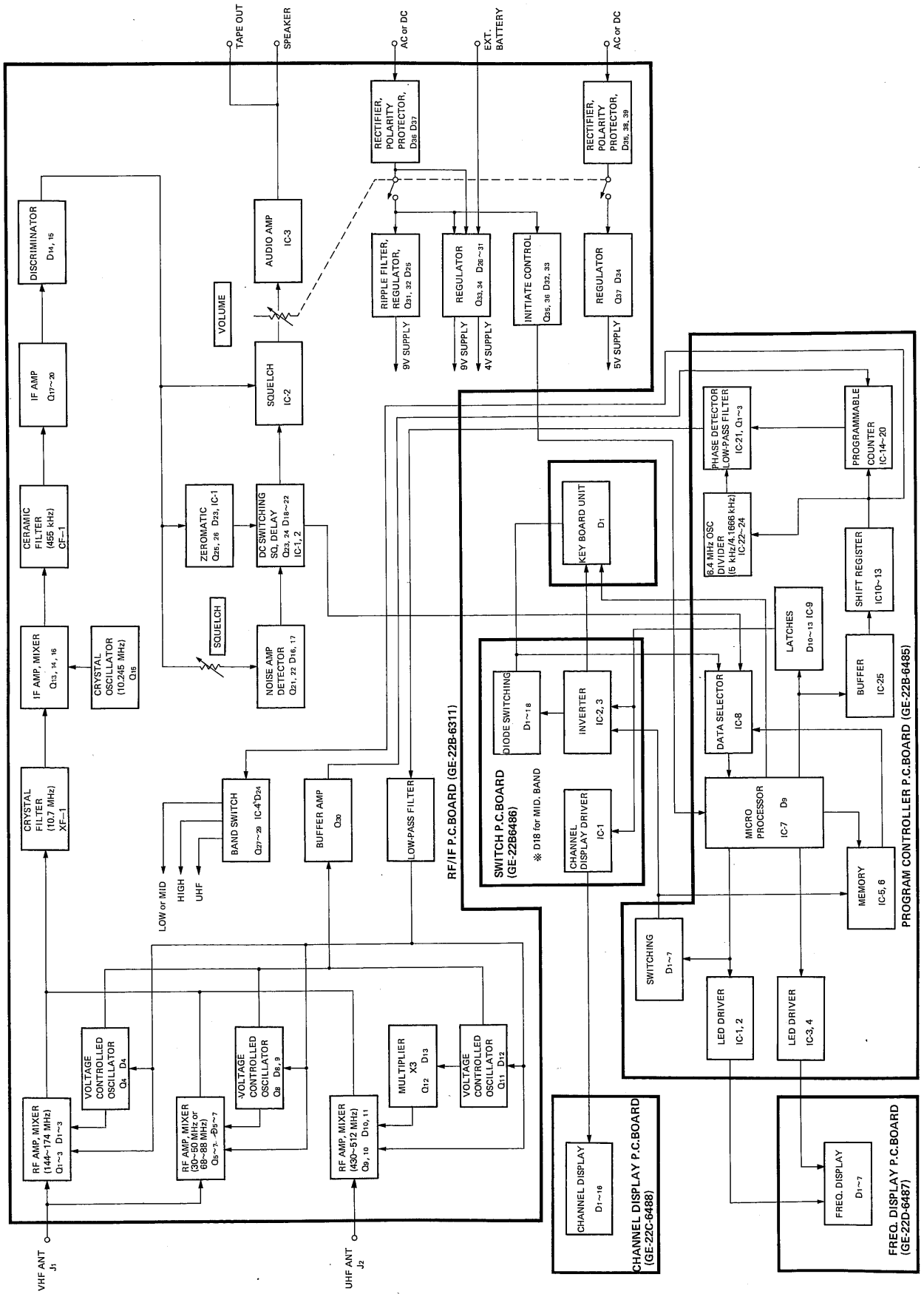
Description	Nominal Spec.	Limit Spec.
Frequency Coverage	30 ~ 50 MHz (5 kHz channel spacing) * or 68 ~ 88 MHz (5 kHz channel spacing) 144 ~ 174 MHz (5 kHz channel spacing 430 ~ 512 MHz (12.5 kHz channel spacing)	30 ~ 50MHz 68 ~ 88 MHz 144 ~ 174 MHz 430 ~ 512 MHz
Search Rate	10 channels/sec. (Fast) 1 channel/sec. (Slow)	7 ~ 13 channels/sec. 0.8 ~ 1.2 channel/sec.
Scan Delay Time	2 sec.	1.5 ~ 3 sec.
Sensitivity VHF LOW *(or MID) **VHF HIGH** **UHF**	0.5 μV 0.5 μV 1.0 μV	2 μV 2 μV 5 μV
Selectivity –6 dB **–50 dB**	$\pm$9 kHz $\pm$17 kHz	$\pm$10 kHz $\pm$18 kHz
Spurious Rejection **at 40 MHz*(or 78 MHz)** **at 160 MHz** **at 480 MHz**	 60 dB 60 dB 50 dB	 50 dB 50 dB 40 dB
IF Rejection 10.7 MHz	60 dB	50 dB
Modulation Acceptance	$\pm$7 kHz	$\pm$5 kHz
Signal to Noise Ratio **(100 μV 5 kHz Dev. at 1 kHz)** **VHF LOW *(or MID)** **VHF HIGH** **UHF**	 45 dB 45 dB 35 dB	 30 dB 30 dB 25 dB
Residual Noise (Vol. Min.)	3 mV	5 mV
Audio Output Power **(T.H.D. 10%)**	1.5 W	1.2 W

Description	Specification
Program channel	16 channel
Frequency display	7-Digit, 7-Segment LED
Receiving system	Direct Key entry, digital-controlled synthesizer, superheterodyne.
Speaker	65 m/m x 100 m/m Dynamic Speaker (8Ω)
Dimensions	Approx. 80(H) x 260(W) x 270(D) m/m
Weight	Approx. 7.3 Kg
Power Requirements	AC-120 volts 60 Hz 27 watts max. or DC 12 volts 18 watts max.
Accessory	Mounting bracket with screws

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.*

** VHF MID (68~88 MHz) range is for European and Australian Models.*

BLOCK DIAGRAM



PRINCIPLES OF OPERATION

This section of the Service Manual will give you a brief technical description of unique or special circuits which you might otherwise find hard to understand, not notice or be able to troubleshoot.
For complete information on operating the PRO-2001, refer to the Owner's Manual.

The PRO-2001 is designed for direct keyboard entry of desired receiving frequency, or for searching for any signal within the defined range of operation. Further, these frequencies are kept in memory. The memory and frequency generation functions are controlled by a dedicated Microprocessor IC and a PLL synthesizer.

The limits of receive frequency are pre-programmed into the μP and cover 30~50(or 68 ~88);144~174 and 430~512 MHz (selection of other frequencies is not possible – since the μP is dedicated only to these frequencies). Received channels are programmed in 5 kHz steps in the VHF bands and 12.5 kHz in the UHF band (these increments can not be changed – they are determined by the design of the μP). To obtain 66~88 MHz reception on USA/Canadian models, the diode switching circuit on the Switch P.C.BOARD would have to be changed.

The RF section incorporates a varactor-tuned oscillator, providing an electronically tracked "Automatic Tuning System". To further assure precise tuning, the discriminator circuitry includes an automatic center-tuning system in combination with a noise-type squelch (Zeromatic Tuning) which provides precise centering of discriminator tuning and resulting audio output. Zeromatic tuning is especially helpful for proper reception recovery during the Search mode. (It is not functional for the UHF band – due to frequency tolerance of the PLL reference crystal.)

The function of the PRO-2001 is basically divided into two modes:

A. Program Mode – load a keyboard-selected frequency into any one of the 16 switch-controlled channels.
B. Scanning Mode – normal scanning of the pre-programmed, switch-selected channels.

When power is applied, the PRO-2001 is automatically set to the Scanning mode and will start with the lowest channel number for which a button is pressed in.

Keyboard data signals are input through the Data Selector circuit, IC-8. The selected data is then fed into the μP (IC-7) via the K-input terminals. The data is then processed by the μP and is output to the O- and R-output terminals.

O-output is delivered to IC-3 and IC-4, which are the LED display segment drivers. R-output is delivered to IC-1 and IC-2, which are the LED display digit drivers. O- and R- outputs thus are used to light the LED display with the keyboard-entered frequency.

μP output from R9, R11~R15 (pins 39 and 1~5) is level-converted by Buffer IC-25 and BCD-coded through the Shift Register ICs (IC-10 thru IC-13, which are Hex D-type F.F. units) and processed to the Programmable Counter (IC-23) through ICs IC-14 thru IC-18 (R-S F.F. types) and IC-19 and IC-20 (which are the Counter Control ICs).

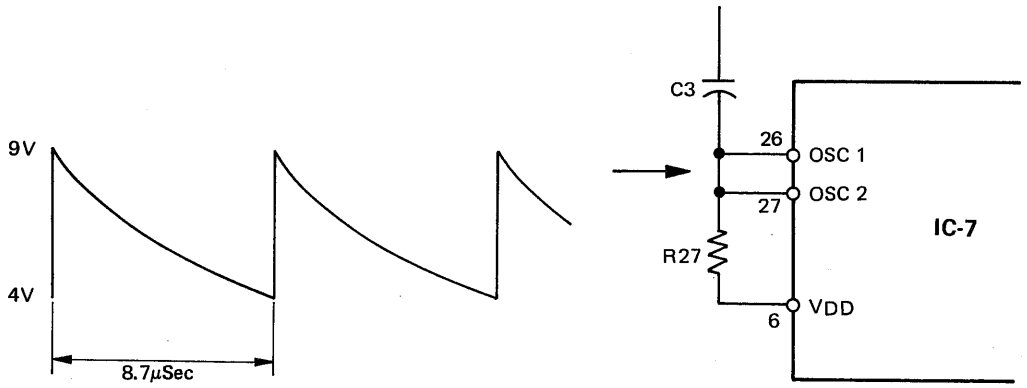
Outputs from the Reference Oscillator (IC-22) and the Programmable Counter (IC-23) are connected to the Phase/Frequency Detector (IC-21) and the Low Pass Filter circuitry (Q-1, Q-2 and Q-3) which all make up the P.L.L. System.

When a Channel push-button switch is pressed in, the channel signal is coded through diode-switching (D1 thru D16 [or D18] on the Switch P.C.B.). This coded signal is processed through the Data Selector (IC-8) into the μP via the K-input terminals. Output is from the R-output (pins 1 thru 5 and 39) through diodes D10~D13 and Latch IC-9. Output from IC-9 is fed to the Switch P.C.B. (IC-1) to light the appropriate channel LED.

When the ENTRY Key is pressed, output of R-output signals 0~6 is written into the Read/Write Memory ICs (IC-5 and IC-6) via switching diode array D1~7. Input to IC-5 and IC-6 is in parallel; output is serial.

μP's CLOCK OSCILLATOR FREQUENCY CIRCUIT

All functions of a μP are controlled from a clock pulse. The clock circuitry for the PRO-2001's μP is built into the μP chip (IC-7). External timing components (C3 and R27) are connected at pins 26 and 27.
All orders in the PRO-2001 are completed within 6 clock cycles. The μP ceases to function if the clock stops.



CLOCK PLUSE

MEMORY

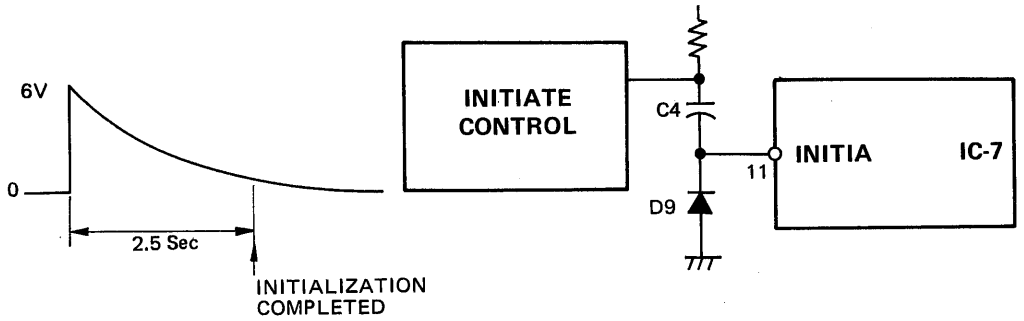
The data input via the Keyboard is temporarily written into a RAM Array in the μP IC. Pressing ENTER key transfers this data from the μP R0~R7 outputs into the Read/Write ICs (IC-5 & IC-6). All the following data can be stored in these ICs: receive frequency of CH1~16, Low and High Search frequency and Monitor frequency (from the RAM array). This data is protected from power-off erasure by the back-up 9-volt battery (rear of the PRO-2001).

INITIALIZATION

When power is first applied to a μP circuit, programming and control will start at a random point – unless the IC is properly initialized. As with most μP ICs, the μP used in the PRO-2001 has an input for initialization.

If B+ circuit rise time is slow or noise rides in on one of the data select lines, proper initialization is required. C 4 is connected to pin 11 of the μP and provides a high level voltage for the Initiate input.
D 9 diode is connected to ground from pin 11 and Initialization circuit (Q35, Q36, D31, D32 and D33) is provided to insure that pin 11 receives the proper level of voltage to properly reset (initialize) the μP even under conditions of rapid power-on, power-off.

If the initialization circuit is not functioning correctly, the data in Memory may be changed – or program control will be erratic.



ZEROMATIC TUNING SYSTEM

The Zeromatic circuit is a combination Noise-type Squelch and S-center detection from the FM discriminator circuit.

Referring to Figure A. If detection occurs at points 2 to 3, both Q25 and Q26 will be off and pin 9 of IC-1 will be at a Low level and audio will be off. The same is true for detection at points 4 to 5. However, if detection is between points 3 and 4, pin 9 of IC-1 receives a High level and audio will be on. Note that if a signal occurs at 1 or 6, pin 9 of IC-1 would also be at a high level. To avoid output under these conditions, the noise-type Squelch circuit is used to cut off the sound.

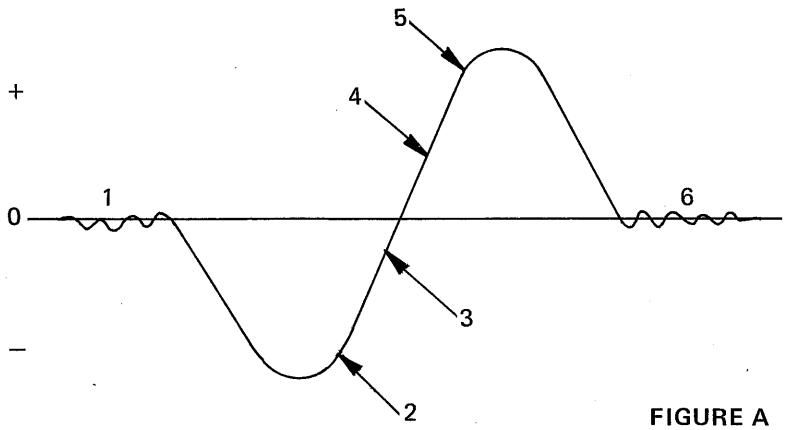
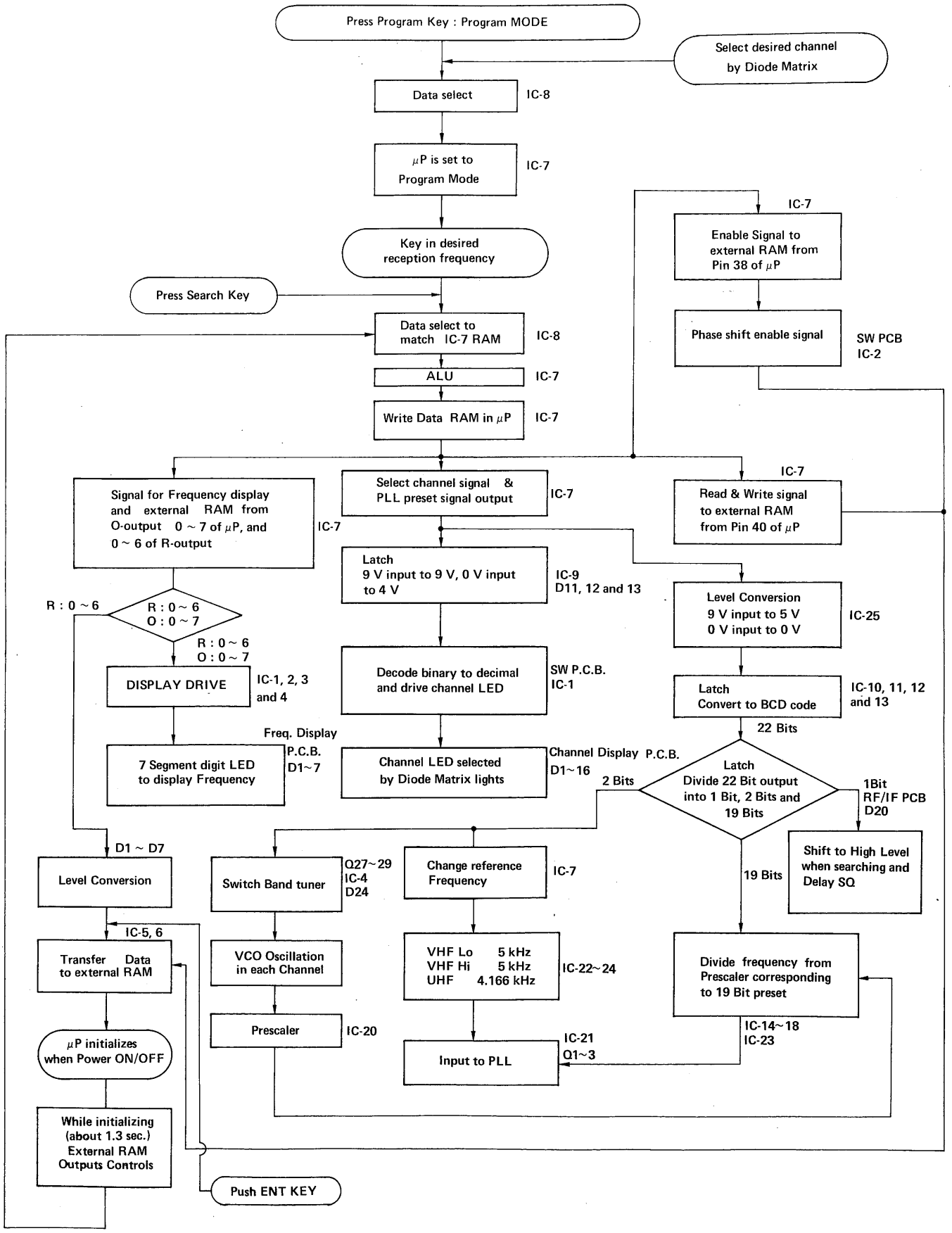


FIGURE A

SEARCH OPERATION

When Search Key (FS or SS) is pressed (their "code" is applied to μP K1, K2, K4 and K8 via Data Select IC-8. The ALU (arithmetic logic unit) portion of the μP starts Searching: by stepping up 5 kHz or 12.5 kHz in relation to each band. Search speed can be controlled fast or slow, by clock cycle in the μP. Searching works only when Squelch is "on". Zeromatic functions along with Squelch during tuning and reception (only when center-tuned will a signal be heard).

GENERAL BLOCK FLOW CHART (LOGIC SECTION IN SEARCH MODE)



PLL CIRCUIT

For the PRO-2001, three VCO circuits are used to obtain the required frequency mix for the 3 bands. Each VCO is automatically switched by appropriate Keyboard entry information.
Electronic bandswitching is accomplished by Q27, Q28, Q29, IC-4 and D24. This circuit switches the supply voltage for the RF Amplifiers and the VCOs.

VHF Low or Mid VCO Frequency = VHF Low/Mid Receiving Frequency + IF (10.7 MHz)
VHF High VCO Frequency = VHF High Receiving Frequency – IF (10.7 MHz)
UHF VCO Frequency = [UHF Receiving Frequency – IF (10.7 MHz)]/3
Band Switching Truth Table (IC-4 on RF/IF PCB) is as follows:

Pin No. / Band	IC-4 (Input)		IC-4 (Output)		
	5	4	11	8	6
Low	0	0	0	1	1
Mid	0	1	0	1	1
High	1	0	1	0	1
UHF	1	1	1	1	0

A section of the Reference Frequency Oscillator, consisting of IC-22, 23 & 24 is shown in the Block Diagram (the 6.4 MHz Oscillator/Divider). Channel steps are 5 kHz for VHF and 4.166 kHz for UHF.
A 6.4 MHz Xtal is used for the Reference Oscillator (VHF Lo/Mid/Hi: 6.4 MHz ÷ 1280 = 5 kHz. UHF: 6.4 ÷ 1536 = 4.166 kHz).

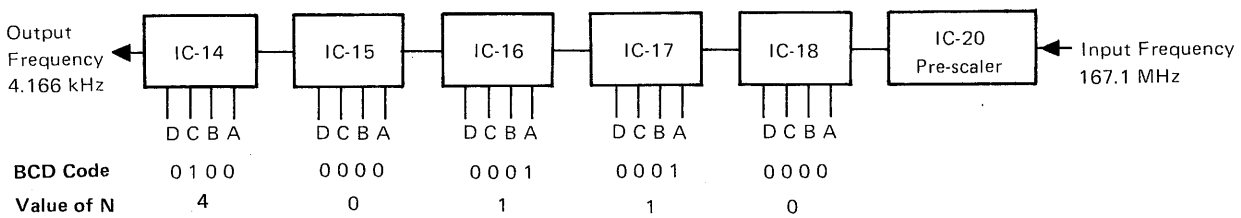
NOTE: Reference Oscillator increments for the UHF Band are tripled in Q12 to provide the 12.5 kHz reception increments.

IC-21, Q1, 2 & 3 make up the Phase-Detector and LPF circuitry. It is used to detect the phase difference between the Reference Frequency (5 kHz for VHF and 4.166 kHz for UHF) and output from the Programmable Counter (IC-14 thru 20). The Active LPF removes harmonic components of the Reference Frequency and any noise inherent in the signals being processed. This insures accurate and precise PLL Control.

The Programmable Counter is made up of IC-14 thru IC-20. The five MC4016s (Dual R-S FF) each can count from 0~9; since they are connected in series, this provides a count capability of up to 99999.
However, the function and counts are μP-controlled to be within the specified frequency ranges of the PRO-2001. The value of N can be calculated as follows:

VHF Lo or Mid Band ..... VCO Frequency ÷ 5 kHz = N value
VHF Hi Band ..... VCO Frequency ÷ 5 kHz = N value
UHF Band ..... VCO Frequency ÷ 4.166 kHz = N value

Example : BCD code from the Programmable Counter when receiving 512 MHz
(512 MHz – 10.7 MHz) ÷ 3 = 167.1 MHz (VCO Frequency)
167.1 MHz ÷ 4.166 kHz = 40110.417 (N value)



PROGRAMMABLE COUNTER PRE-SET FORMAT AND CONVERSION FORMULA FOR OUTPUT DATA

- **Output Data Format**

S	SW	N
1 BIT	2 BITS	19 BITS

← 22 BITS →

Length of Format: 22 bits
S : 1 bit (1 in SEARCH mode, 0 for all other modes)
SW: 2 bits [VHF Lo/Mid/Hi, UHF Band setting (0, 1, 2, 3)]
N : 19 bits BCD code

Example : 30 MHz input (not in Search mode)

	S	SW		N																	
	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
PIN NO.	15	12	14	15	14	11	5	2	14	11	5	2	14	11	5	2	14	11	5	2	14	11	5
IC NO.	IC-13		IC-10	IC-14			IC-15				IC-16				IC-17				IC-18				

- **Conversion Formula**

VHF Lo or Mid ..... $\frac{Fr + 10.7\ MHz}{5\ kHz} = N$

VHF Hi ..... $\frac{Fr - 10.7\ MHz}{5\ kHz} = N$

UHF..... $\frac{Fr - 10.7\ MHz}{3 \times 4.166\ kHz} = N$

Fr = Receive Frequency (MHz)

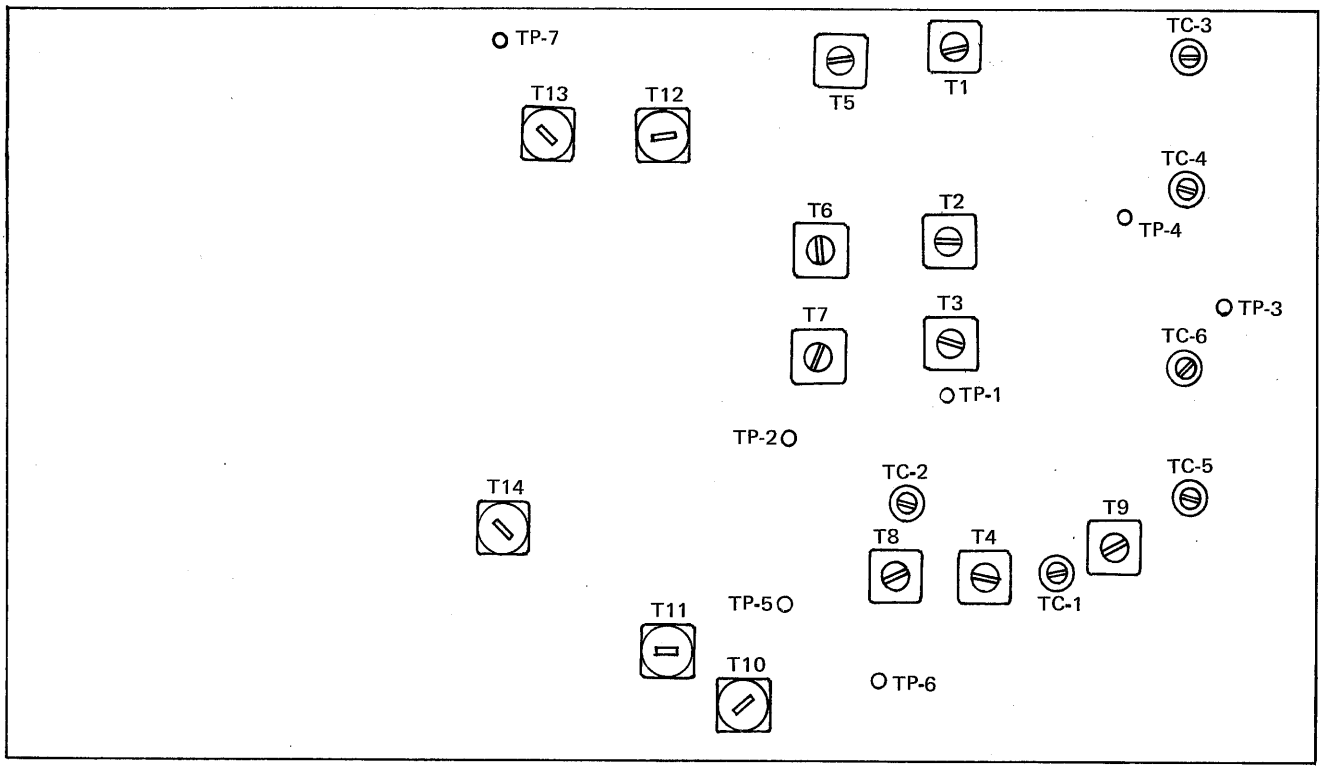
NOTE: *μP is a processing comparator. It compares a reception frequency input (Fr) with each reception band and detects and outputs a code for the applicable band. The detection output consists of 2 bits.*
19 bits which determine N are derived per upper formula : the processing is done in μP, and latch circuits in ICs 14 ~ 18 code BCD.

- **Table showing Band Switch and N Value**

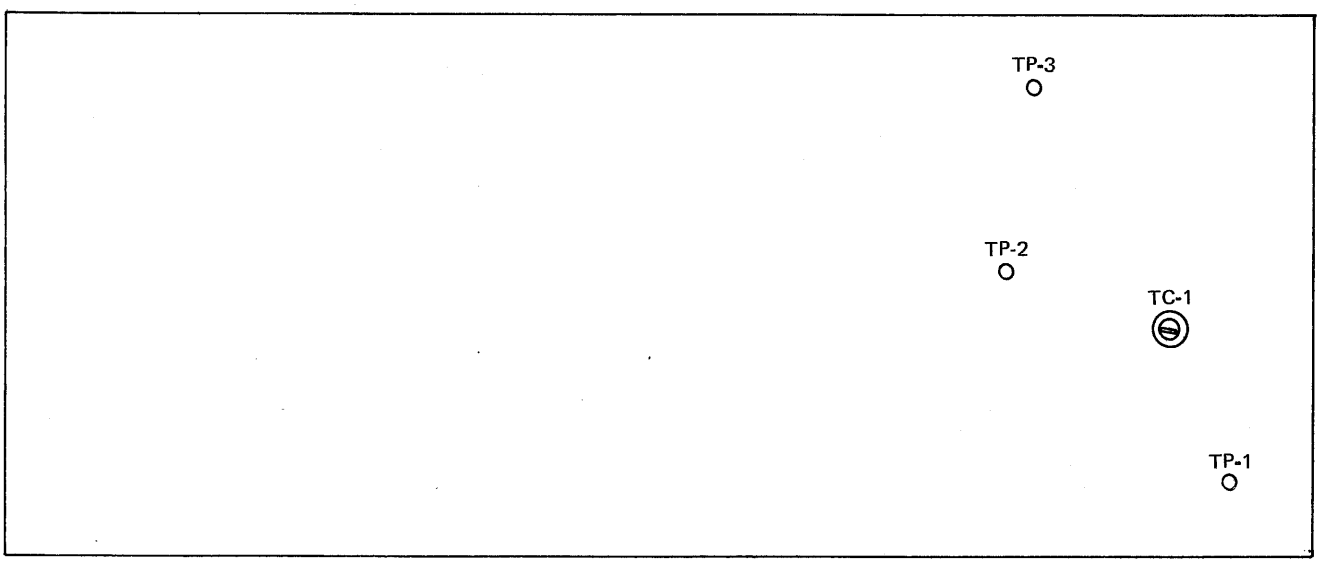
BAND	BAND SW	FREQ. (MHz)	VALUE OF N
VHF Lo	0	30	0 8 1 4 0
		50	1 2 1 4 0
VHF Mid	1	68	1 5 7 4 0
		88	1 9 7 4 0
VHF Hi	2	144	2 6 6 6 0
		174	3 2 6 6 0
UHF	3	430	3 3 5 4 4
		512	4 0 1 1 0

All numbers are in BCD code.

ALIGNMENT AND TEST POINT POSITIONS



RF/IF P.C. BOARD



PROGRAM CONTROLLER P.C. BOARD

FIGURE 1

DISASSEMBLY

Refer to Figure 2.
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.

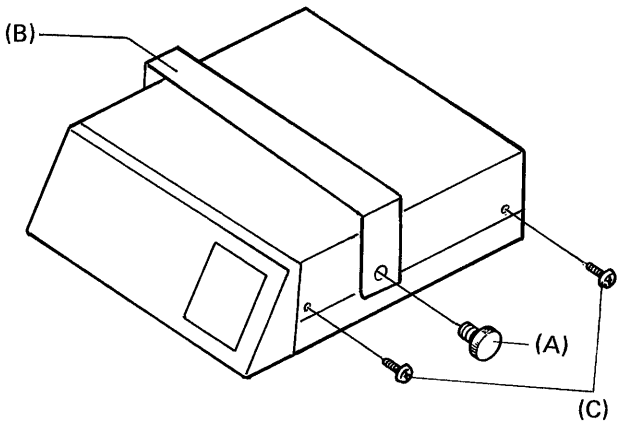


FIGURE 2. CHASSIS DISASSEMBLY

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 – 50 MHz, 144 – 174 MHz)
8. UHF sweep generator with variable marker (430 – 512 MHz)
9. FM signal generator (30 – 50 MHz, 144 – 174 MHz, 430 – 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: *For servicing of VHF Mid band of European/Australian models, see Appendix on page 57.*

REFERENCE FREQUENCY OSC/DIVIDER ALIGNMENT

NOTE: *The Reference Frequency OSC/Divider circuit is on PROGRAM CONTROLLER P.C. BOARD.*

Before starting alignment, program CH 1, 2 and 3 as follows:

CH 1	30 MHz (or 68 MHz for European and Australian models)
CH 2	144 MHz
CH 3	430 MHz

NOTE: *Check TP-3 first, connect Frequency Counter to TP-3. If readings are 5.000kHz for CH 1 and CH 2 operation, 4.166 .... kHz for CH 3, Reference Frequency OSC/Divider section is O.K. and needs no alignment.*

Step 1: Connect Frequency Counter to TP-1 and ground.
Step 2: Adjust TC-1 (on the PROGRAM CONTROLLER PCB) so that the frequency is 6.40000 MHz ±10 Hz.
Step 3: Connect Frequency Counter to TP-2 and ground. Read frequency on the frequency counter.
Normal: 5.000 kHz for CH 1 and CH 2 operation, 4.16666 . . . . kHz for CH 3.

IF SECTION ALIGNMENT

Step 1: Connect instruments as shown in Figure 3.
Step 2: Maintain Sweep Generator output at the lowest level possible to prevent overloading.
Step 3: Adjust T10 and T11 for maximum output and adjust T12 and T13 so that the 455 kHz marker is in the center of the discriminator curve and for best linearity as shown in Figure 4.

NOTE: *The 455 kHz Marker must be set at exactly 0V (this is part of the Zeromatic circuit function).*

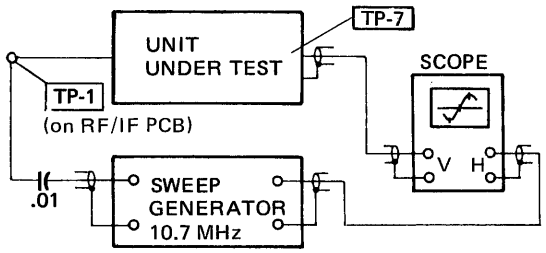


FIGURE 3. IF SECTION ALIGNMENT TEST EQPT HOOK UP

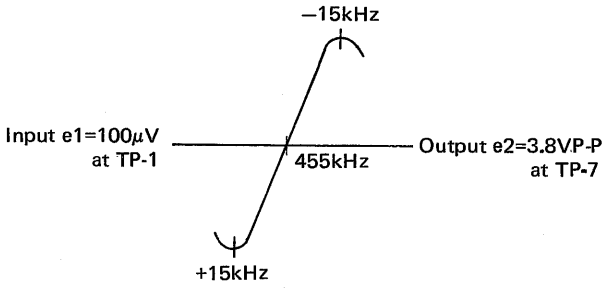


FIGURE 4. IF DISCRIMINATOR CURVE

FREQUENCY PROGRAMMING FOR ALIGNMENT PREPARATION

Before starting alignment, program the following frequencies into channels 1 through 11:

Receive Frequency	VCO Frequency (TP-6)	VCO Lock Voltage (TP-4)
VHF Low		
CH 1 30 MHz	40.700 MHz	0.6 V
CH 2 40 MHz	50.700 MHz	2.7 ± 0.2 V
CH 3 50 MHz	60.700 MHz	6.0 V
VHF High		
CH 4 144 MHz	133.300 MHz	1.0 V
CH 5 150 MHz	139.300 MHz	1.8 ± 0.2 V
CH 6 174 MHz	163.300 MHz	5.5 V
UHF		
CH 7 430 MHz	139.766 MHz	0.6 V
CH 8 450 MHz	146.433 MHz	1.3 ± 0.2 V
CH 9 470 MHz	153.100 MHz	2.3 ± 0.2 V
CH 10 490 MHz	159.766 MHz	3.8 ± 0.2 V
CH 11 512 MHz	167.100 MHz	6.0 V

VCO ALIGNMENT

NOTE: *The VCO circuit is on the RF/IF P.C. Board.*

VHF LO BAND

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

Step 1: Connect a DC VTVM to TP-4 and ground, and a Frequency Counter to TP-6 and ground.
Step 2: Select Channel 3 and adjust TC-2 for 6.0V on the DC VTVM. The Frequency Counter should read 60.700000 MHz ±100 Hz.
Step 3: Next, select Channel 1 and adjust T8 for 0.6V on the DC VTVM. The Frequency Counter should read 40.700000 MHz ±100 Hz.
Step 4: Repeat steps 2 and 3 until no improvement is observed. Make sure that the Frequency Counter reads 40.700 MHz for Channel 1, 60.700 MHz for Channel 3.
Step 5: Select Channel 2, the DC VTVM should show 2.7V ±0.2V and Frequency Counter should show 50.700 MHz ±100 Hz. If the frequency is over ±100 Hz readjust TC-1 on the PROGRAM CONTROLLER P.C. BOARD (Not on RF/IF P.C. BOARD). Then recheck steps 1-4.

VHF HI BAND

NOTE 1: *For this test you will MANUALLY select Channel 4, 5 or 6.*
2: *Alignment of this section must be done only after VHF LO (or MID) BAND alignment is completed.*

Step 1: Connect a DC VTVM to TP-4 and ground, and a Frequency Counter to TP-6 and ground.
Step 2: Select Channel 6 and adjust TC-1 for 5.5V. The Frequency Counter should read 163.300 MHz ±600 Hz.
Step 3: Next, select Channel 4 and adjust T4 for 1.0V. The Frequency Counter should read 133.300 MHz ±600 Hz.
Step 4: Repeat steps 2 and 3 until no improvement is observed. Make sure that the VTVM reads 5.5V at Channel 6 and 1.0 V at Channel 4.
Step 5: Select Channel 5, the VTVM should read 1.8V ±0.2V and Frequency Counter should read 139.300 MHz ±600 Hz. If not within these torerances, return to VHF LO (or MID) BAND Alignment.

UHF BAND

NOTE 1: *For this test you will MANUALLY select Channel 7, 8, 9, 10 or 11.*
2: *Alignment of this section must be done only after VHF LO (or MID) BAND alignment is completed.*

Step 1: Connect a DC VTVM to TP-4 and ground, and a Frequency Counter to TP-6 and ground.
Step 2: Select Channel 11 and adjust TC-5 for 6.0V. The Frequency Counter should read 167.100 MHz ±600 Hz.
Step 3: Next, select Channel 7 and adjust T9 for 0.6V. The Frequency Counter should read 139.766 MHz ±600 Hz.
Step 4: Repeat steps 2 and 3 until no improvement is observed. Make sure that the VTVM reads 6.0V at Channel 11 and 0.6V at Channel 7.
Select Channel 8, the VTVM should read 1.3 ±0.2V.
Step 5: Select Channel 9, the VTVM should read 2.3 ±0.2V and Frequency Counter should read 153.100 MHz±600 Hz.
Select Channel 10, the VTVM should read 3.8 ±0.2V and Frequency Counter should read 159.766 MHz ±600 Hz.
If not within these torerances, return to LO (or MID) BAND Alignment.

RF AMP ALIGNMENT

VHF LOW BAND

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

Step 1: Connect instruments as shown below.
Step 2: Select Channel 1 with the MANUAL switch.
Step 3: Adjust T5, T6 and T7 so that the 68 MHz marker is in the center of the curve and for maximum output.
Step 4: Make sure that the output curves are similar to Figure below (for Channels 1 thru 3).

NOTE 1: *It is difficult to track these 3 different frequencies – differences of up to –6 dB are acceptable.*
NOTE 2: *Set the sweep generator as follows:*
Marker frequency to 30, 40 and 50 MHz.
Sweep bandwidth to 40 ±15 MHz.
Input signal from the sweep generator should be kept as low as possible and still obtain usable output.

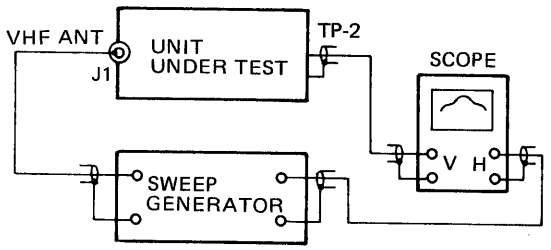


FIGURE 5

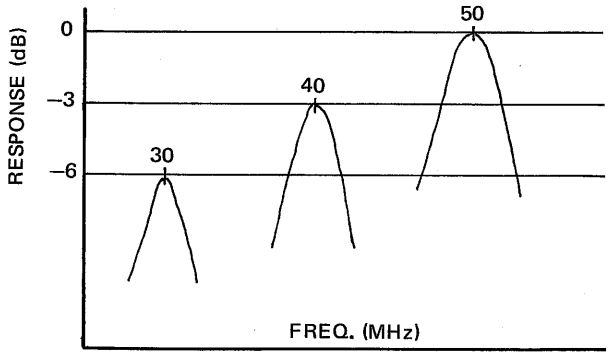


FIGURE 6

VHF HI BAND

NOTE: *For this test you will MANUALLY select channel 4, 5 or 6.*

Step 1: Connect instruments as shown in Figure 7.
Step 2: Select Channel 5 with the MANUAL button.
Step 3: Adjust T1, T2 and T3 so that the 150 MHz marker is in the center of the curve and for maximum output.
Step 4: Make sure that the output curves are similar to Figure 8 (for channels 4 thru 6).

NOTE 1: *It is difficut to track these 3 different frequencies – differences of up to –6 dB are acceptable.*
NOTE 2: *During above alignment procedure you will notice the local oscillator beat on the scope. This shows the local oscillator is operating.*
NOTE 3: *Set sweep generator as follows:*
Marker frequency to 144, 150 and 174 MHz.
Sweep bandwidth to 160 ±20 MHz.
Input signal from the sweep generator should be kept as low as possible and still obtain usable output.

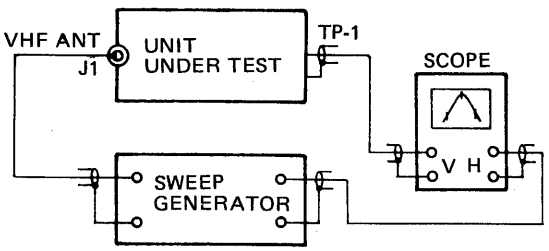


FIGURE 7

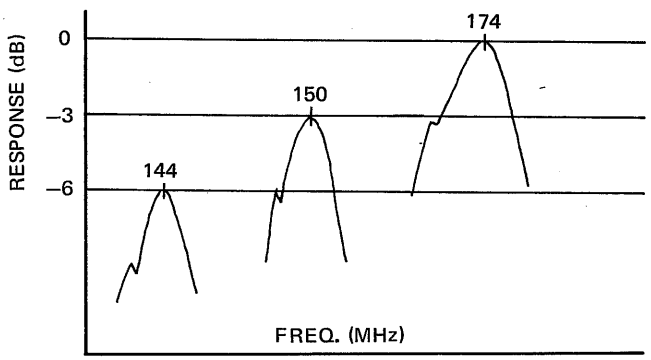


FIGURE 8

UHF BAND

NOTE: *For this test you will MANUALLY select channel 7, 8, 9, 10 or 11.*

Step 1: Connect instruments as shown in Figure 9.
Step 2: Select Channel 11 with the MANUAL button.
Step 3: Adjust TC-3 and TC-4 so that the 512 MHz marker is in the center of the curve and for maximum output.
Step 4: Make sure that the output curves are similar to Figure 10 (for channels 7 thru 11).

NOTE 1: *It is difficult to track these 5 different frequencies – differences of up to –6 dB are acceptable.*
NOTE 2: *During above alignment procedure you will notice the local oscillator beat on the scope. This shows the local oscillator is operating.*
NOTE 3: *Set sweep generator as follows:*
Marker frequency to 430, 450, 470, 490 and 512 MHz.
Sweep bandwidth to 470 ±50 MHz.
Input signal from the sweep generator should be kept as low as possible and still obtain usable output.

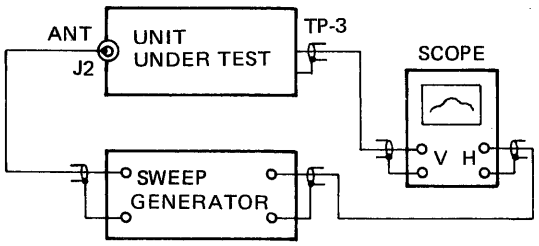


FIGURE 9

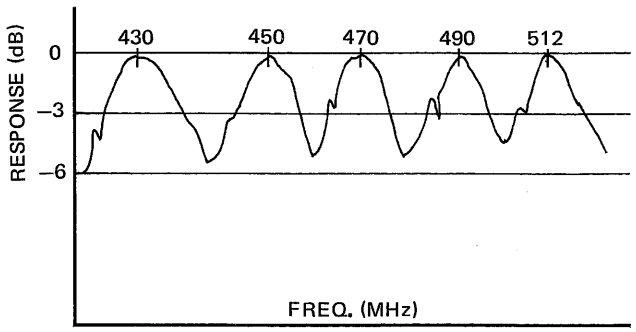


FIGURE 10

OVERALL ALIGNMENT AND SENSITIVITY MEASUREMENT

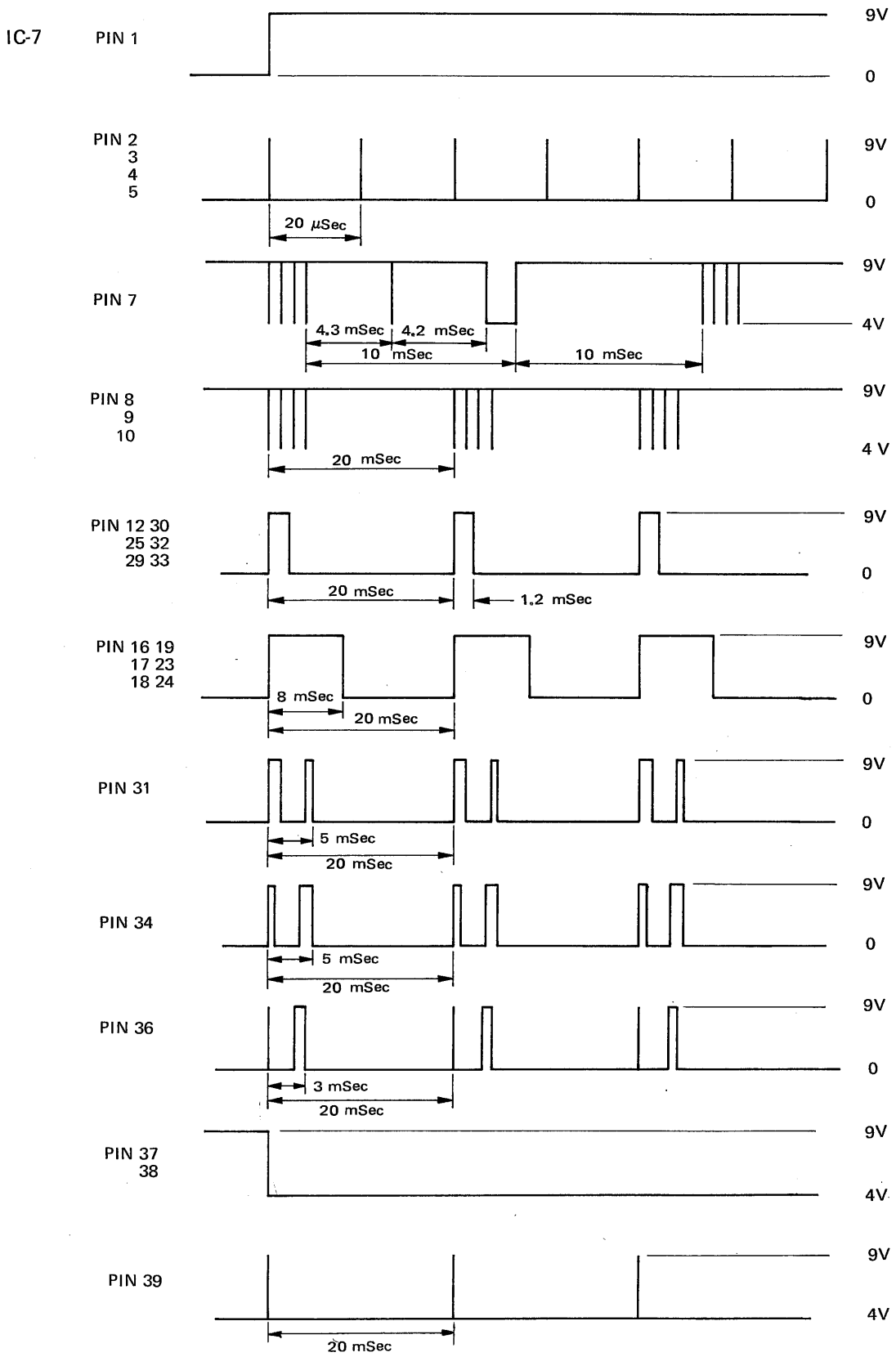
Step 1: Connect Signal Generator to ANTenna jack and AC VTVM with 8 ohm dummy load to EXT. SPeaKeR jack.
Step 2: Turn SQUELCH fully counterclockwise. Set for reception of the channels noted in the following chart. Set the SSG to the center of each band.

CH	BAND	FREQ.
2	VHF LO (MID)	40 MHz (78 MHz)
5	VHF HI	150 MHz
9	UHF	470 MHz
11	UHF	512 MHz

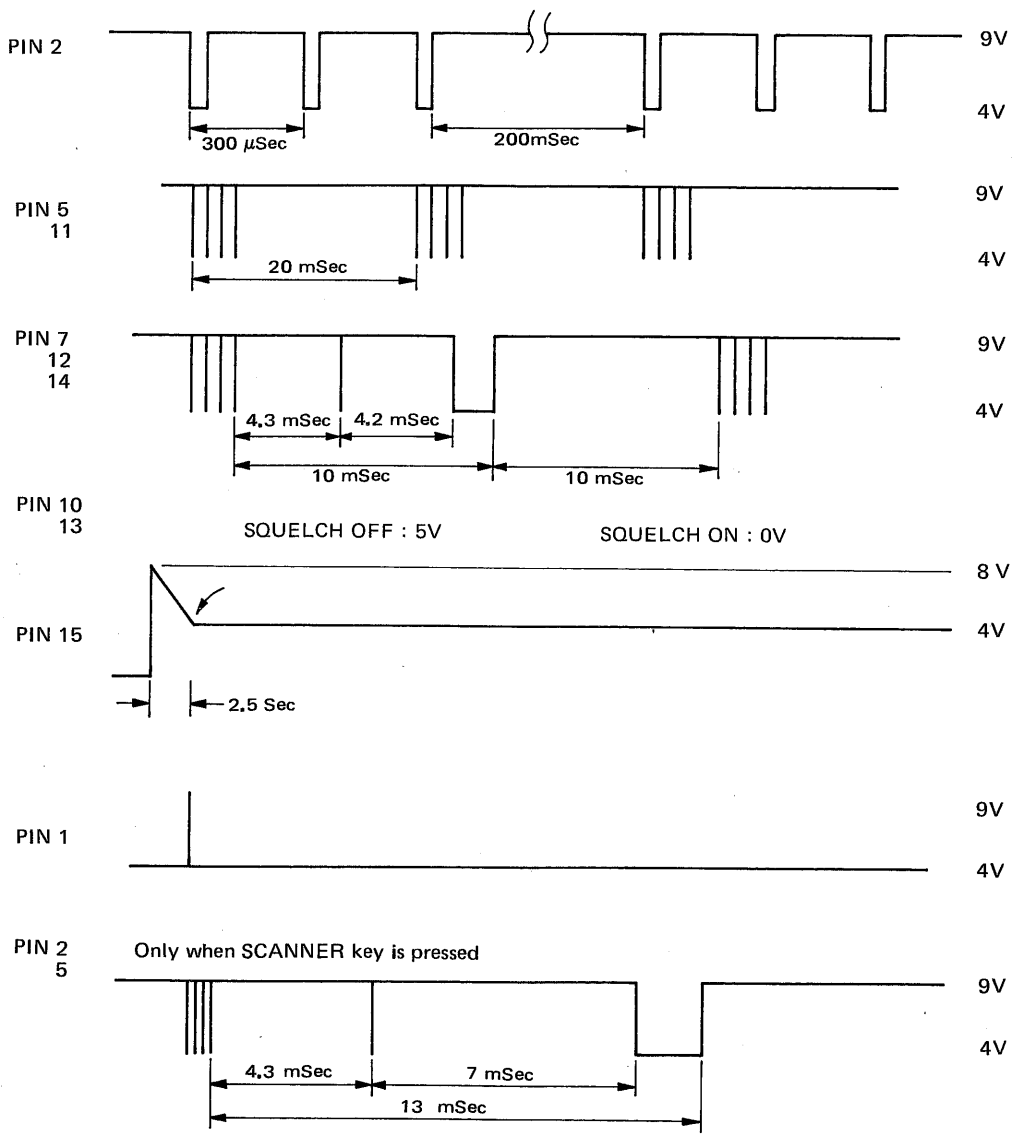
Step 3: Set the Signal Generator frequency to 512 MHz (channel 11) and adjust TC-6, readjust T10 and T11 for maximum output.
Step 4: For each frequency/channel set signal generator to each frequency, 30% modulation and 1 μV output, and set VOLUME control to 0 dB (0.775 V) reading on the VTVM.
Step 5: Turn off the modulation and measure the (S+N)/N ratio.

NOTE: *Alignment of T14 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.*

VOLTAGES AND LEVELS FOR IC-7 AND IC-8



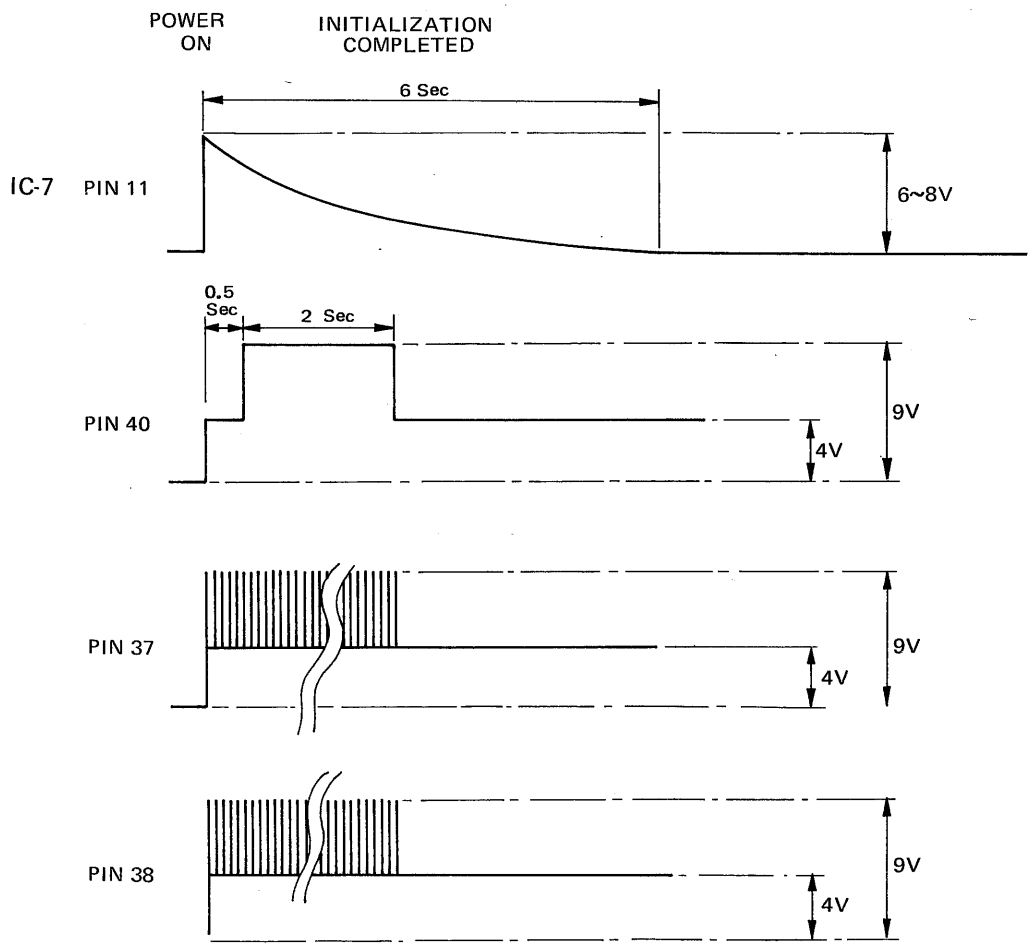
IC-8


PIN 2
9V
4V
300 µSec
200mSec
PIN 5
11
9V
4V
20 mSec
PIN 7
12
14
9V
4V
4.3 mSec
4.2 mSec
10 mSec
10 mSec
PIN 10
13
SQUELCH OFF : 5V
SQUELCH ON : 0V
8 V
PIN 15
4V
2.5 Sec
9V
PIN 1
4V
PIN 2
5
Only when SCANNER key is pressed
9V
4V
4.3 mSec
7 mSec
13 mSec

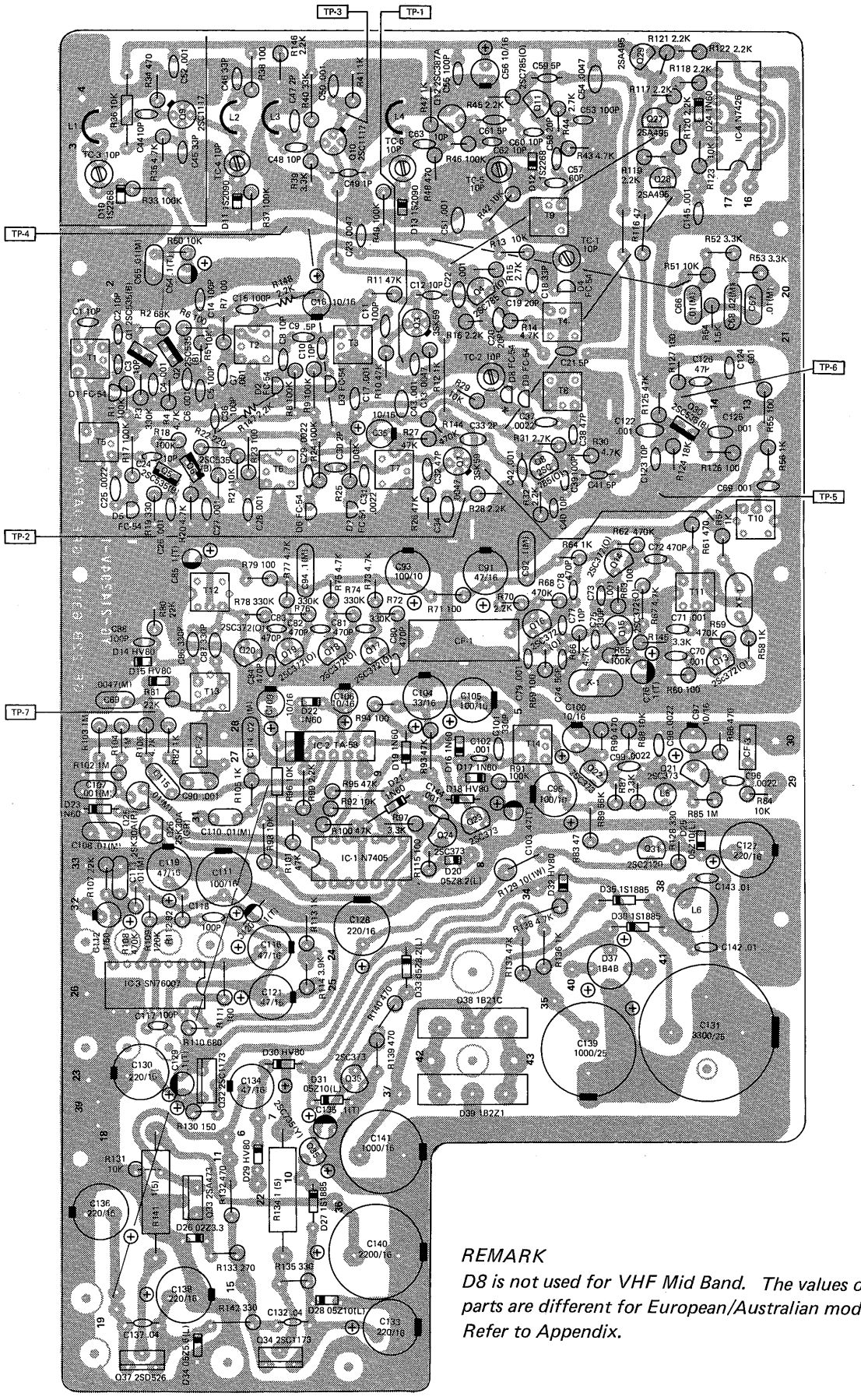
VOLTAGE LEVELS FOR IC-7 PINS AFTER INITIALIZATION

	Pin Number	Low Level	High Level
K-input	7, 8, 9, 10	4 V	9 V
O-output	12, 16, 17, 18, 19, 23, 24, 25	0 V	9 V
R-output	1, 2, 3, 4, 5, 29, 30, 31, 32, 33, 34, 36	0 V	9 V
K-input	37, 38, 40	See figure below	
O-output	11	See figure below	
R-output	39	4 V	9 V

NOTE : *Voltages on K-input, O-output and R-output terminals of IC-7 are not steady-state DC levels; they can only be checked with a multi-channel Scope. The pulse-timing and wave-form will depend on the internal function of the μP.*



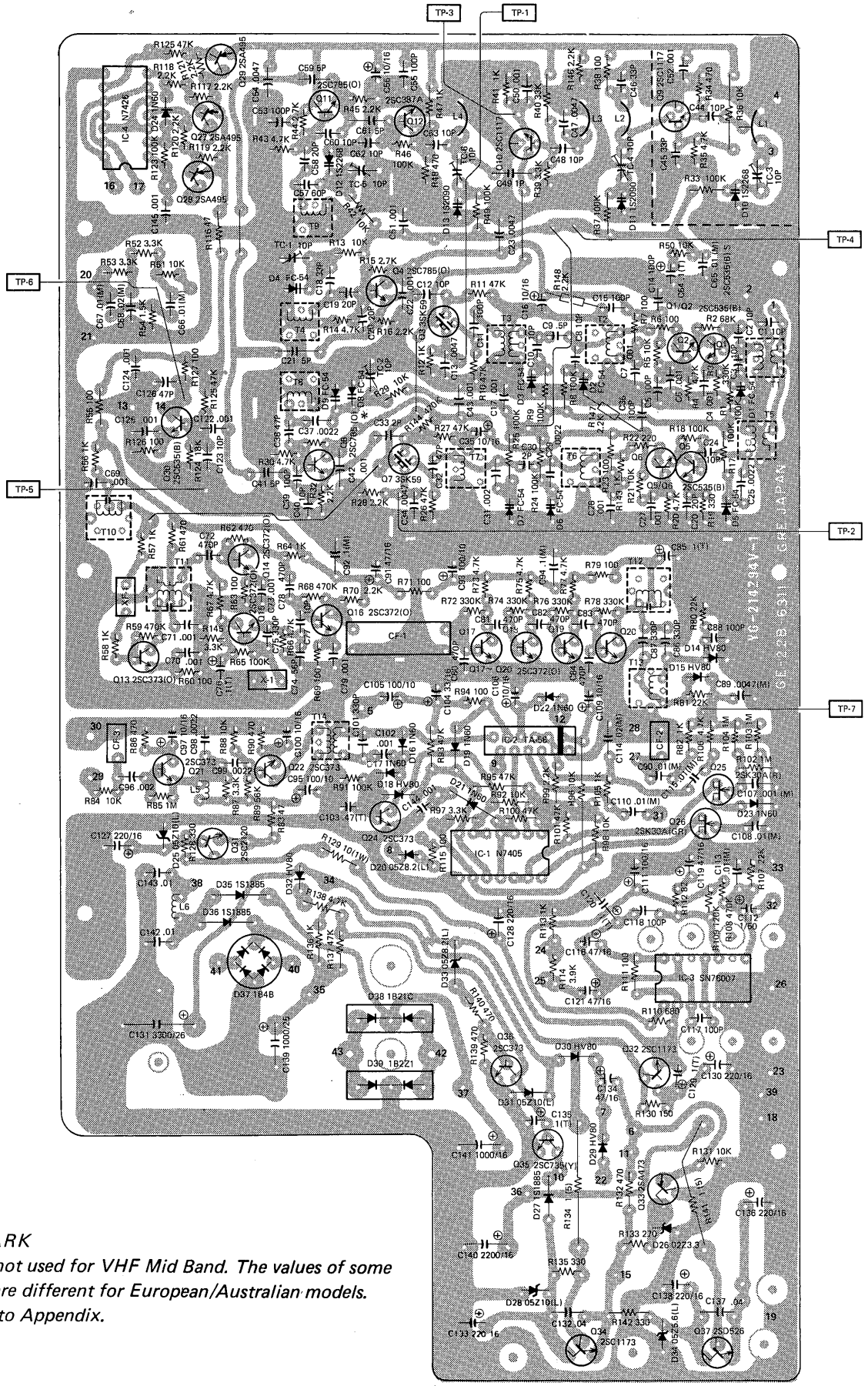
RF/IF P.C.BOARD (TOP VIEW)



REMARK

D8 is not used for VHF Mid Band. The values of some parts are different for European/Australian models. Refer to Appendix.

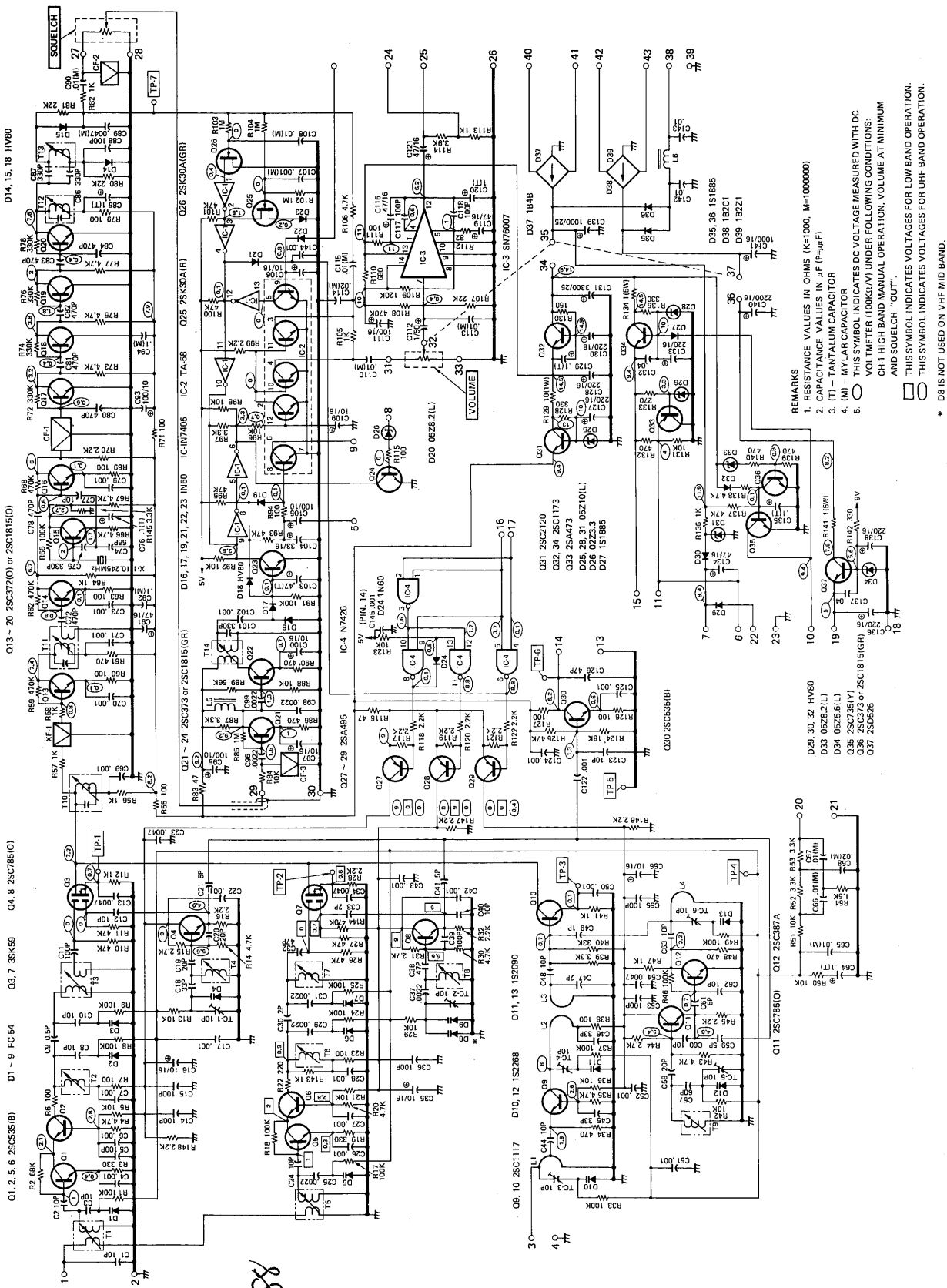
RF/IF P.C.BOARD (BOTTOM VIEW)



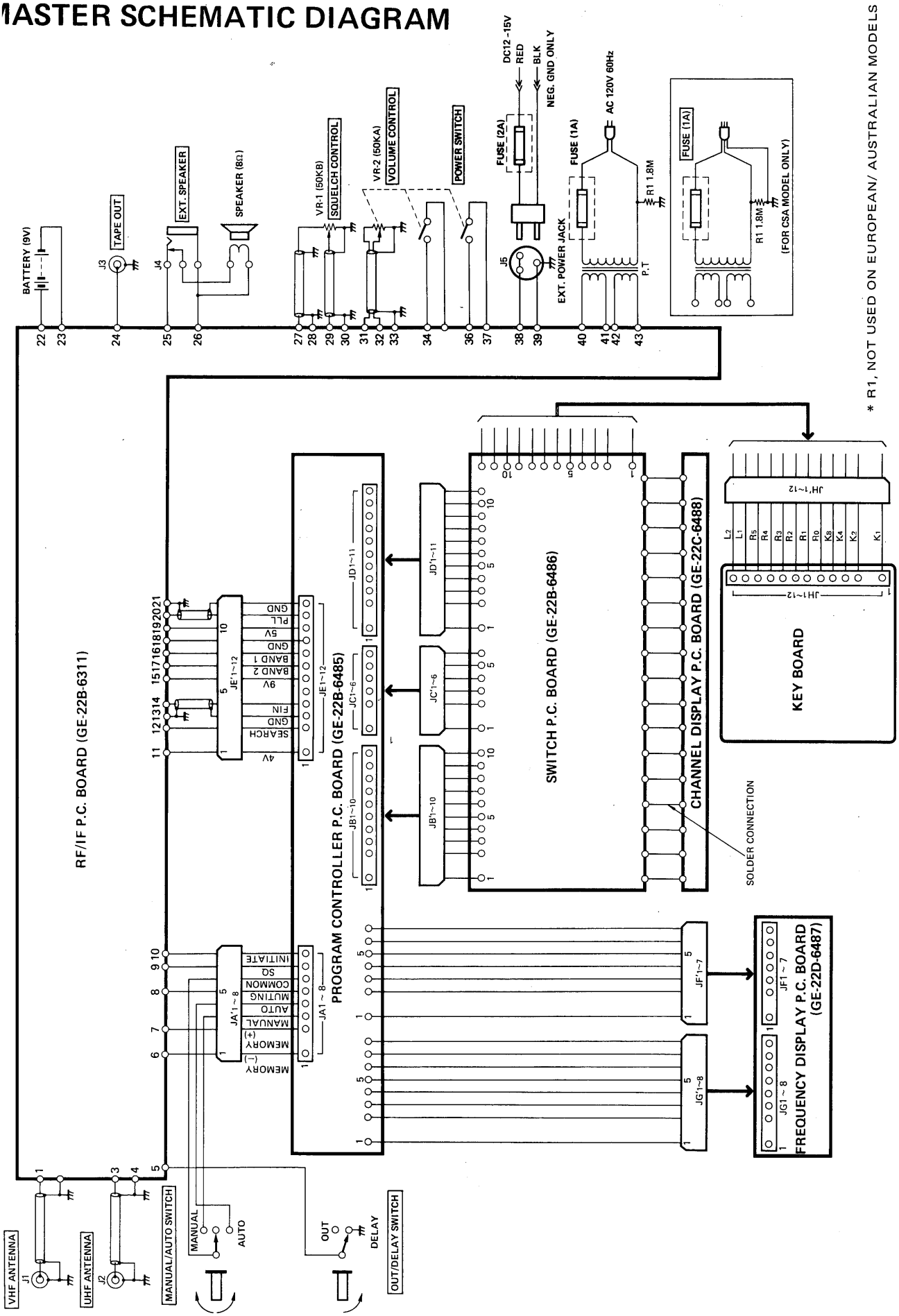
REMARK

D8 is not used for VHF Mid Band. The values of some parts are different for European/Australian models. Refer to Appendix.

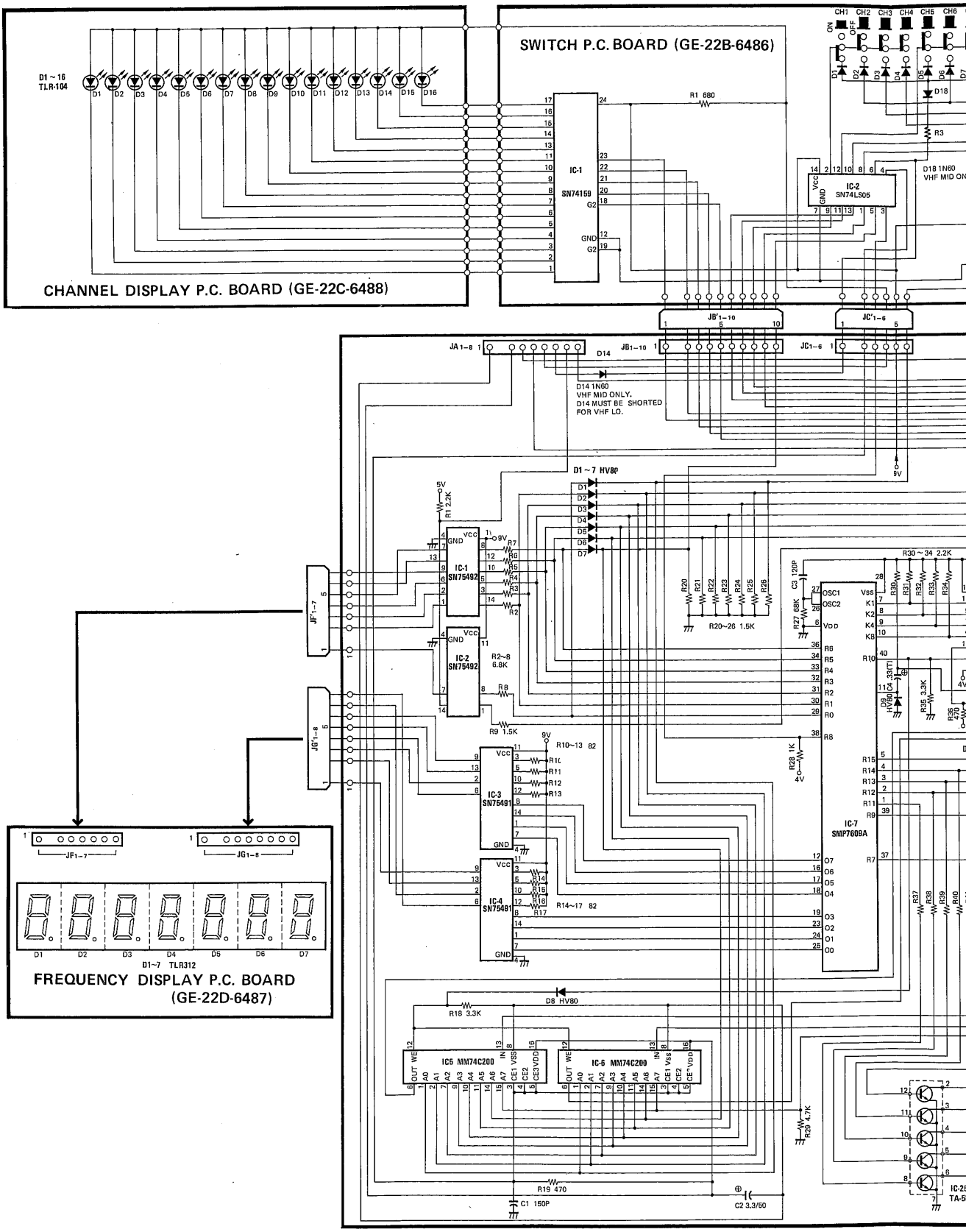
RF/IF P.C.BOARD SCHEMATIC DIAGRAM

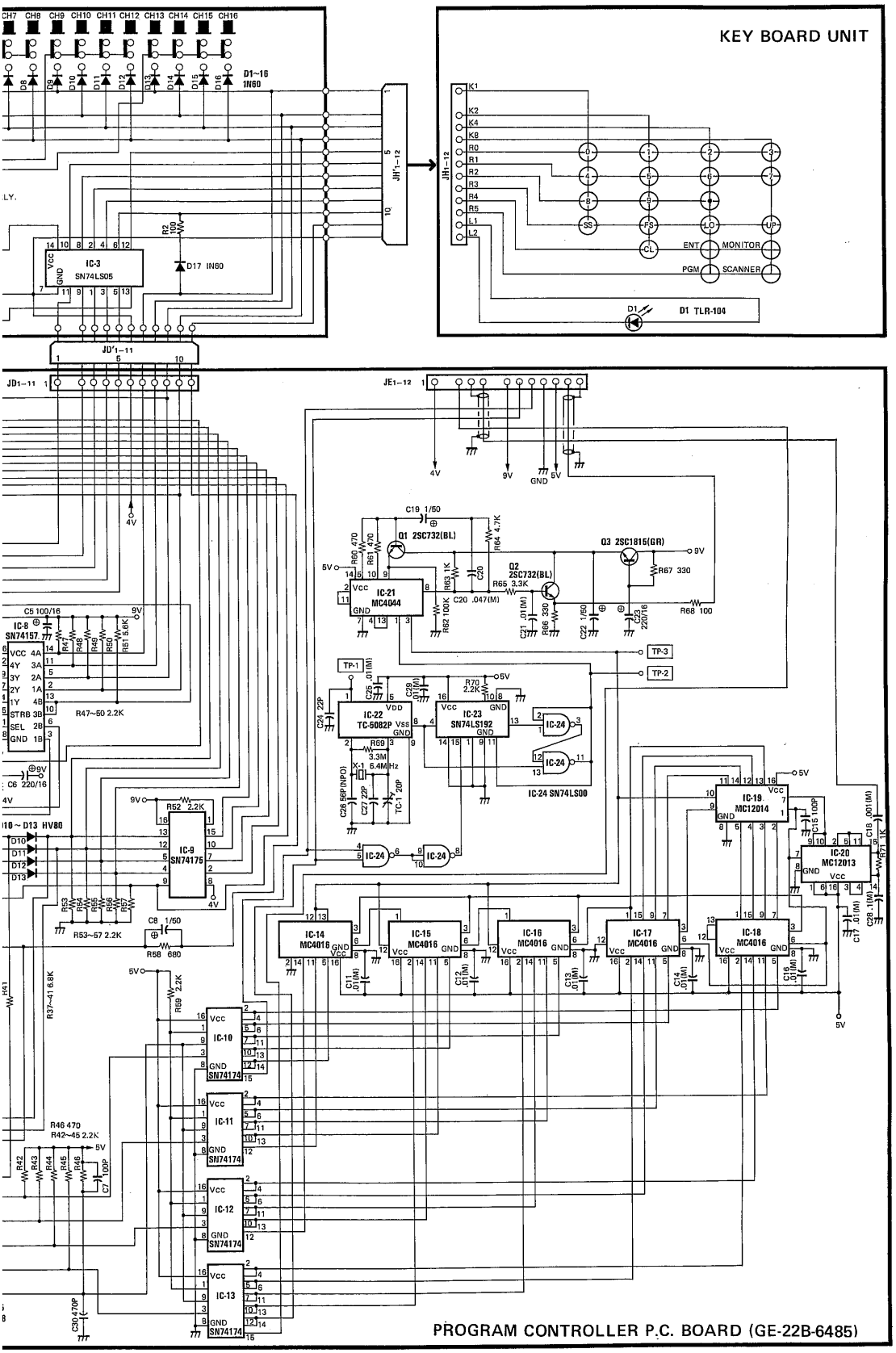


MASTER SCHEMATIC DIAGRAM

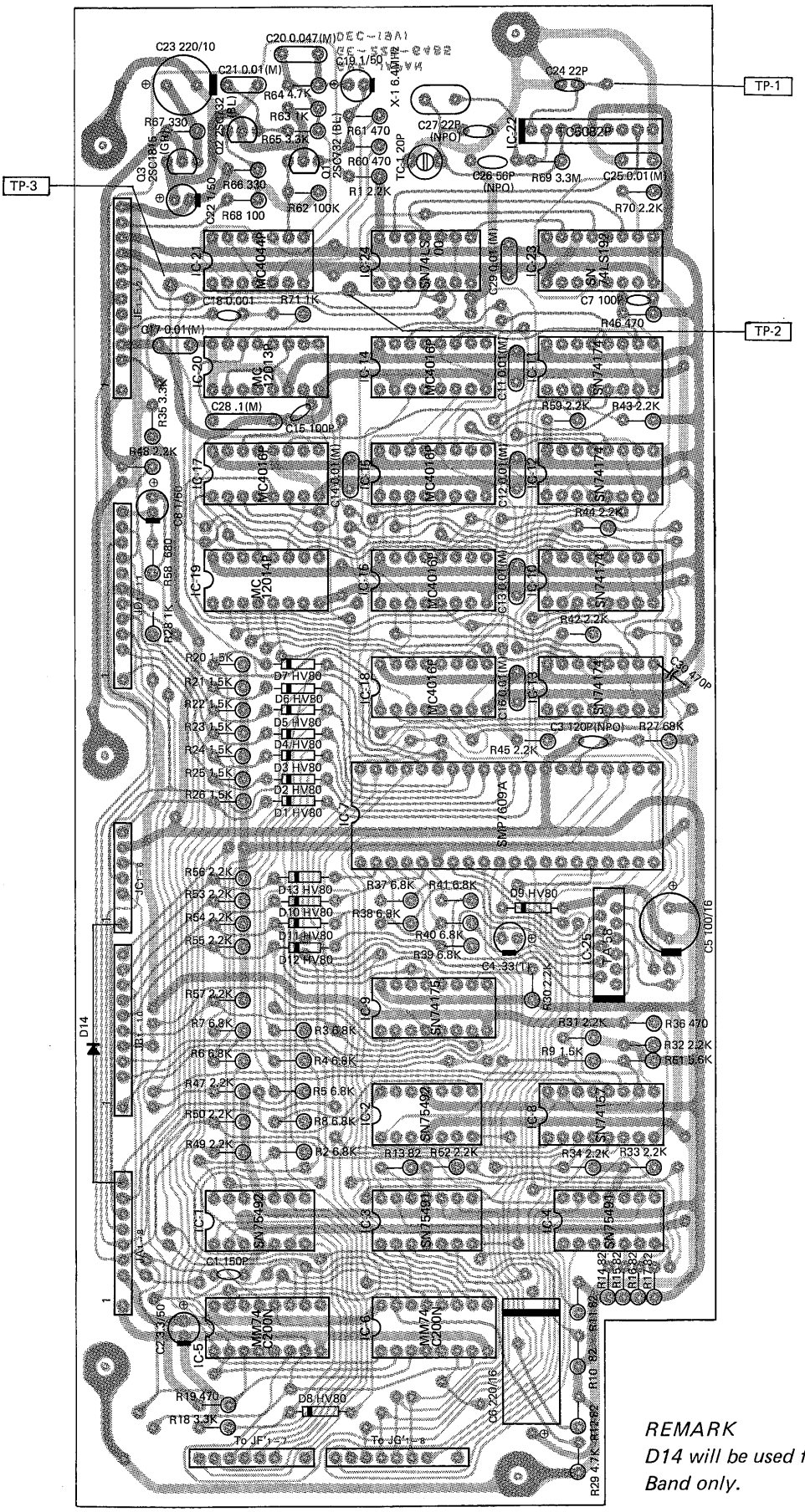


DIGITAL CONTROL, DISPLAY SCHEMATIC DIAGRAM



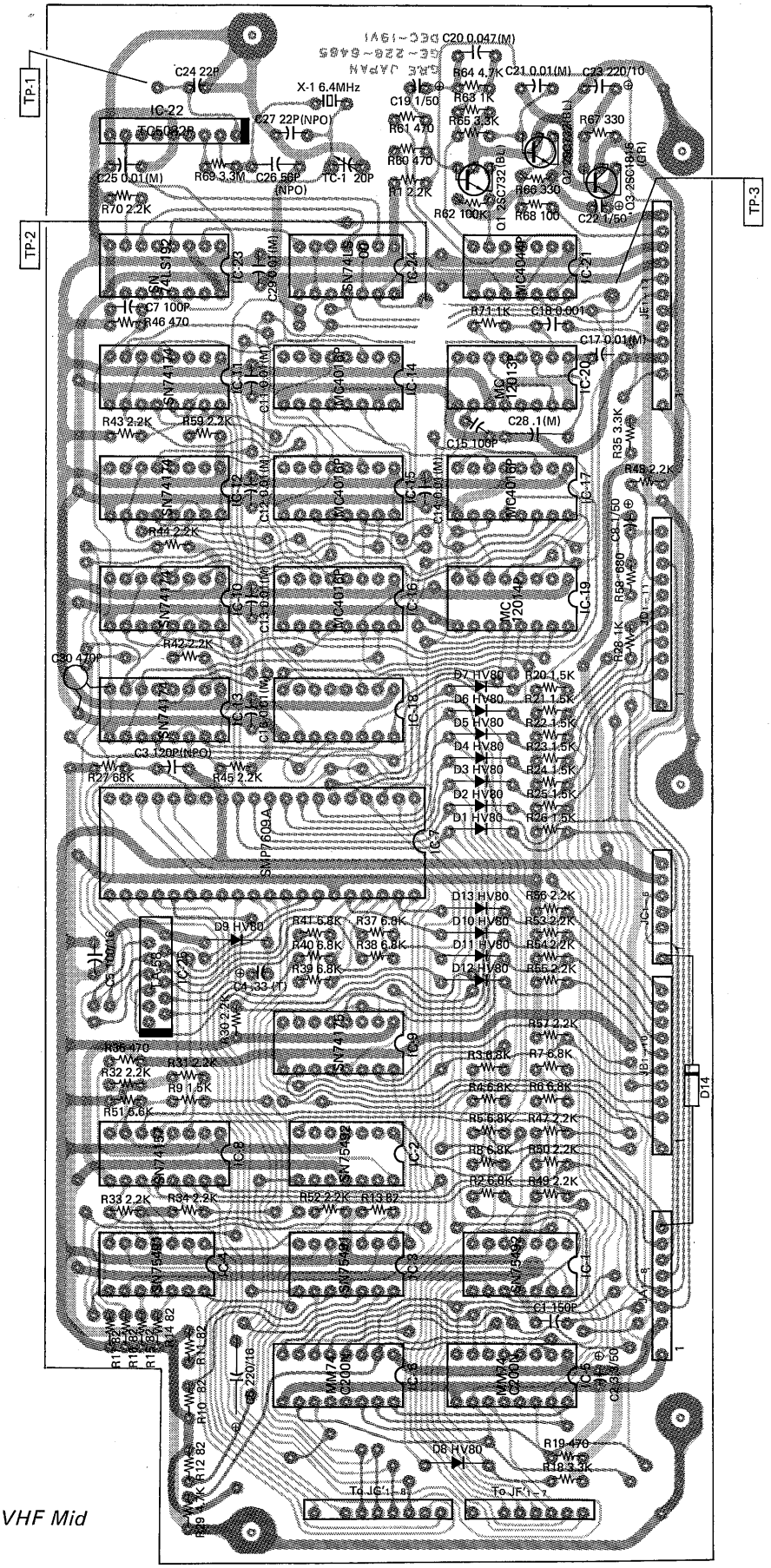

KEY BOARD UNIT
D1 TLR-104
PROGRAM CONTROLLER P.C. BOARD (GE-22B-6485)

PROGRAM CONTROLLER P.C.BOARD (TOP VIEW)



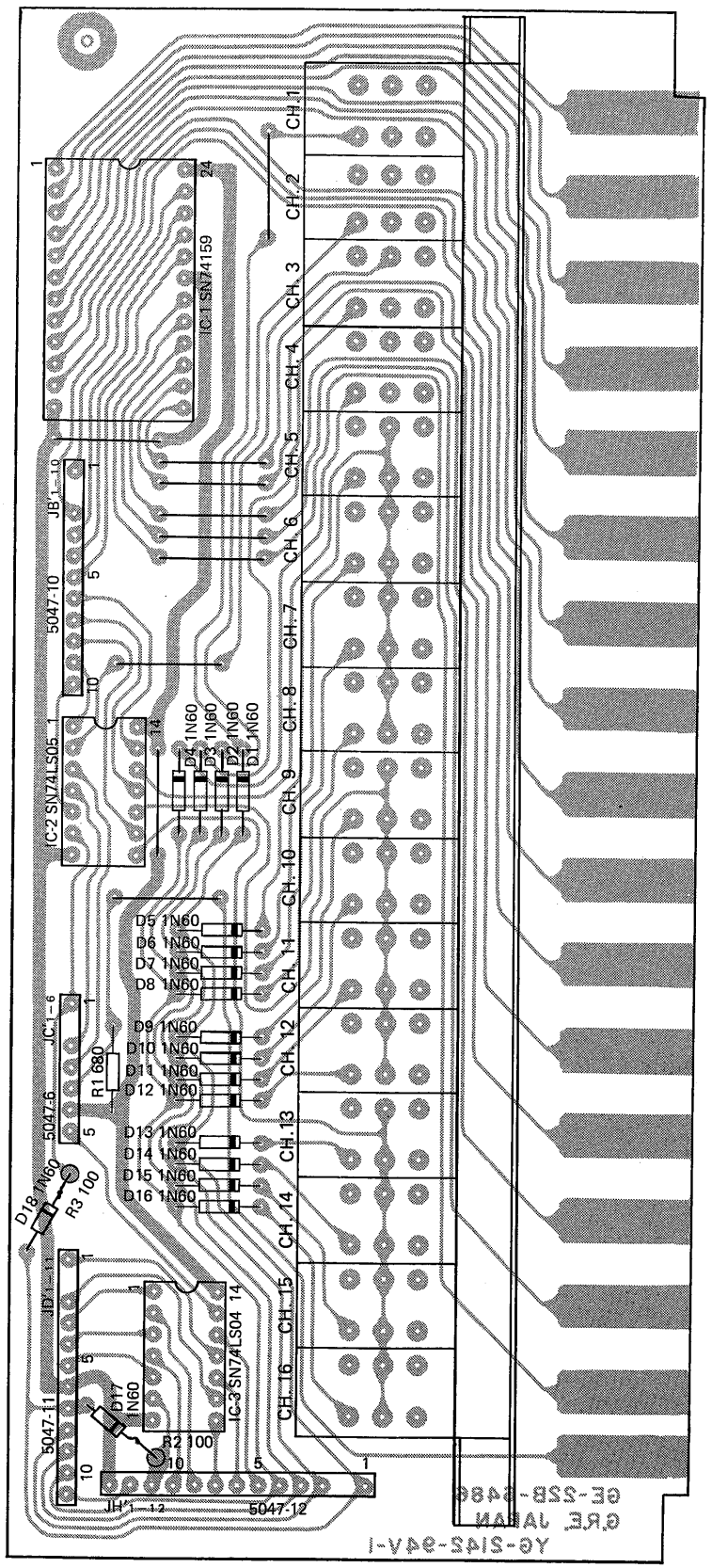
REMARK
D14 will be used for VHF Mid Band only.

PROGRAM CONTROLLER P.C.BOARD (BOTTOM VIEW)



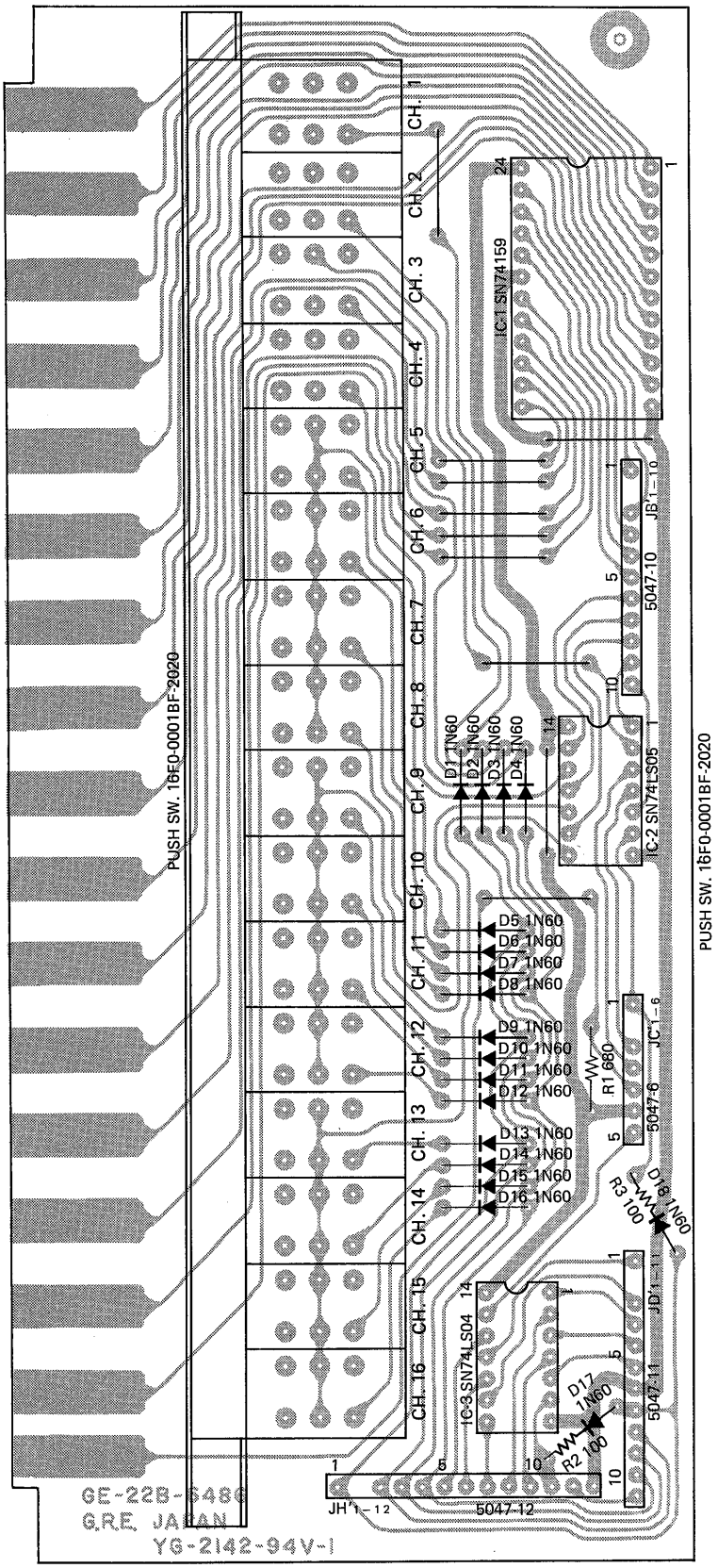
REMARK
D14 will be used for VHF Mid Band only.

SWITCH P.C.BOARD (TOP VIEW)



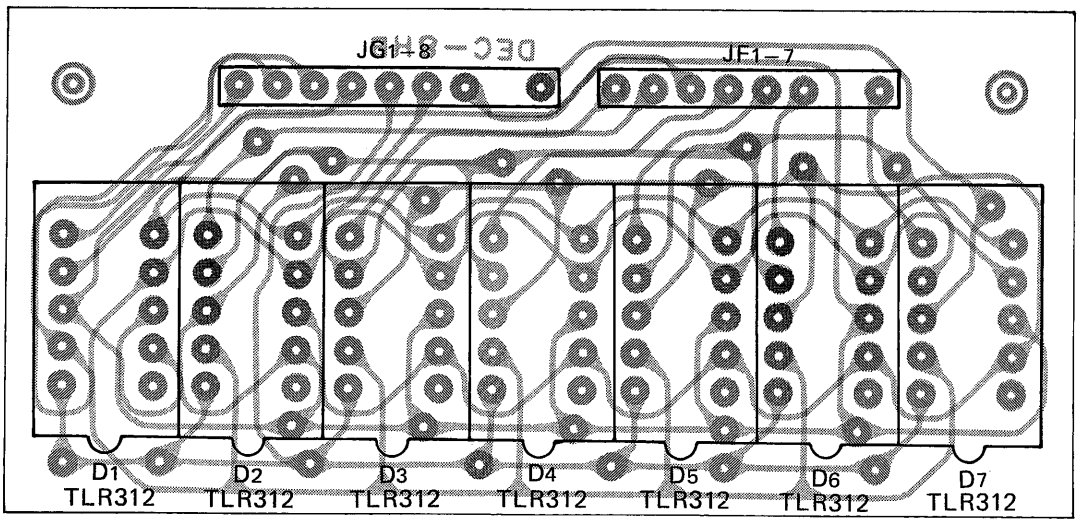
REMARK
D18 will be used for VHF Mid Band only.

SWITCH P.C.BOARD (BOTTOM VIEW)

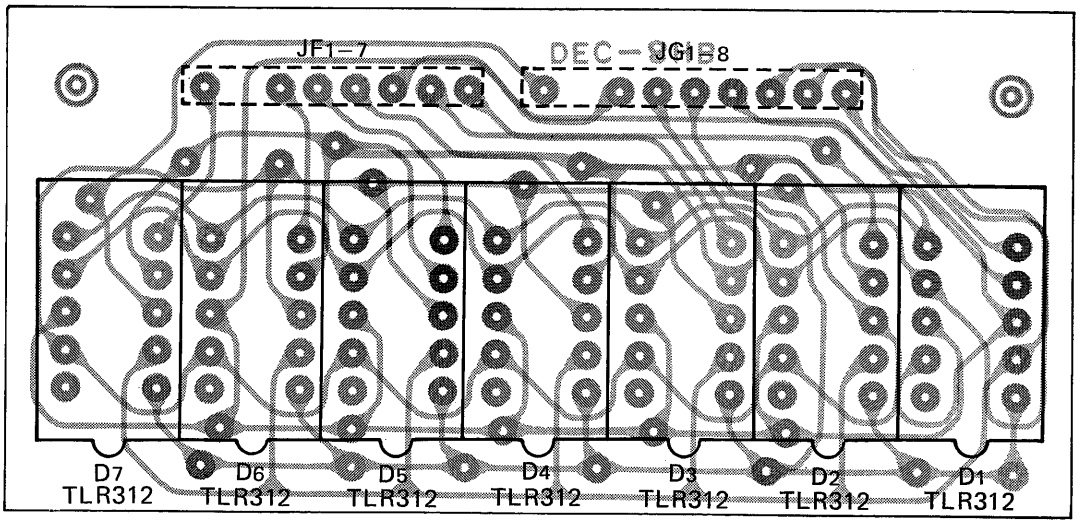


REMARK
D18 will be used for VHF Mid Band only.

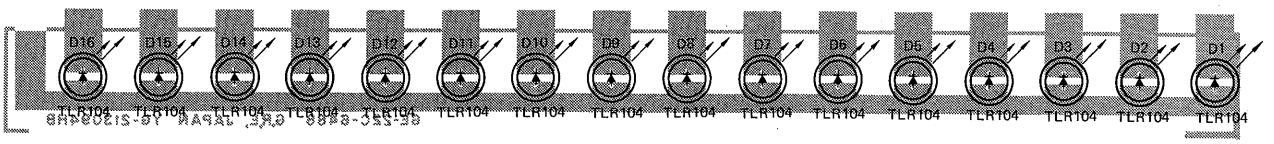
FREQUENCY DISPLAY P.C.BOARD (TOP VIEW)



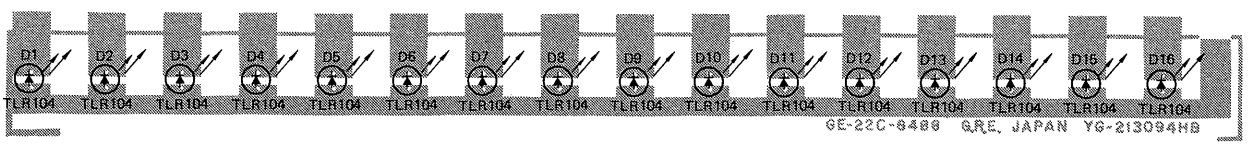
FREQUENCY DISPLAY P.C.BOARD (BOTTOM VIEW)



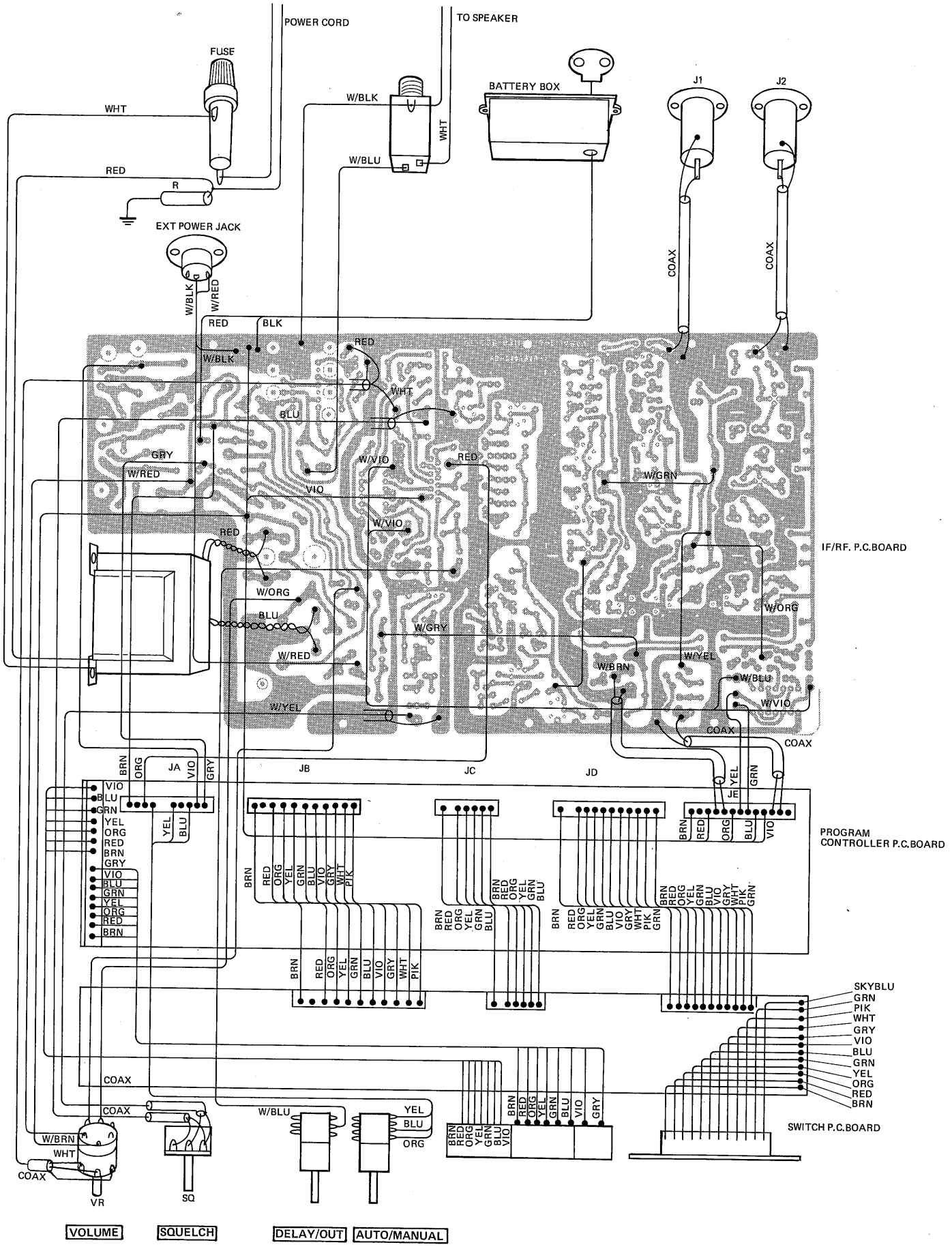
CHANNEL DISPLAY P.C.BOARD (TOP VIEW)



CHANNEL DISPLAY P.C.BOARD (BOTTOM VIEW)



WIRING DIAGRAM



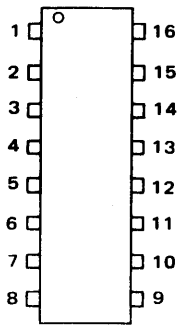
TROUBLESHOOTING

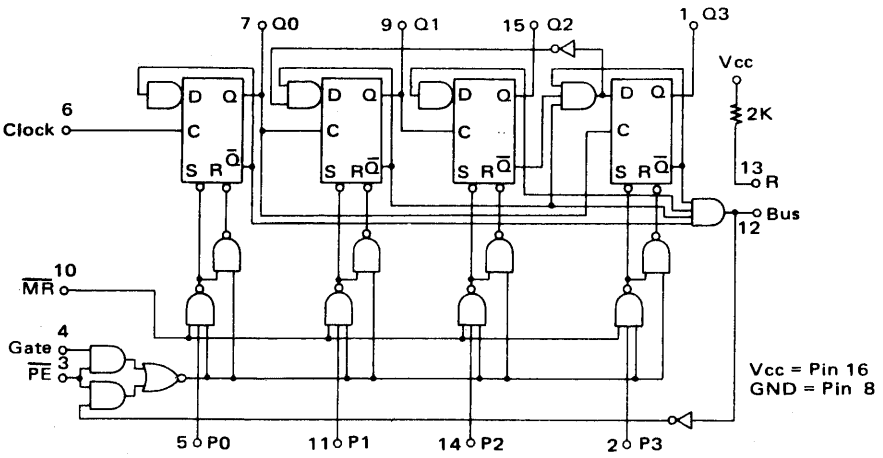
Symptom	Possible cause
1) Channel indicator LED does not light and no sound Volume control : MAX. Squelch control : CCW Channel switch : Pushed-in	1) Faulty line cord. 2) Defective power transformer. 3) Defective power switch 4) DC or AC line fuse blown 5) Defective diodes D37-38 on RF/IF P.C. Board. 6) Defective voltage regulator circuit component on RF/IF P.C. Board.
2) Channel display and Frequency display light but no sound Volume control : MAX. Squelch control : CCW Channel switch : 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. 4) Faulty noise amplifier, Detector and/or squelch circuit component on RF/IF P.C. Board.
3) Sound but channel display and Frequency display do not light. Volume control : MAX. Squelch control : CCW Channel switch : Pushed-in	1) Defective Q33 ~ 37 or voltage regulator circuit component on RF/IF P.C. Board. 2) Faulty connector JE component on program controller P.C. Board. 3) Faulty program controller 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, Detector and/or integrated circuit IC-1, IC-2 on RF/IF P.C. Board.
5) Does not scan but Squelch operates	1) Defective program controller P.C. Board. 2) Defective selector switch or associated circuit component.
6) AUTO scan does not operate but MANUAL selector operates.	1) Defective selector switch or faulty associated circuit component. 2) Defective integrated circuit IC-2 on RF/IF P.C.Board. 3) Defective integrated circuit IC-2 on program controller P.C.Board
7) Channel display lights but Frequency display does not light.	1) Defective connector JG, JF or Frequency display P.C. Board. 2) Defective integrated circuit IC-1 ~ IC-4 on program controller P.C. Board. 3) Defective μP IC-7 O-output and/or associated circuit component.
8) Frequency display lights but channel display does not light.	1) Defective connector JB, JC and JD or switch P.C. Board. 2) Defective integrated circuit IC-1 on switch P.C. Board. 3) Defective channel display P.C. Board. 4) Defective integrated circuit IC-9 on program controller P.C. Board.
9) Delay does not operate	1) Defective DELAY switch 2) Faulty diode D19 or Electrolytic capacitor C105 on RF/IF P.C. Board.
10) PROGRAM does not operate	1) Defective KEY Board or connector JH or associated circuit component. 2) Defective integrated circuit IC-2, 3 or diode D1 ~ 17 on switch P.C. Board. 3) Defective program controller P.C. Board component part. 4) Defective Frequency display component part. 5) Defective initiate control component on RF/IF P.C. Board. 6) Defective switch P.C. Board component parts.

Symptom	Possible cause
11) Memory operates but after a period the read-out memory becomes faulty.	1) Weak battery (9 volt) 2) Defective diode D29 ~ 31 and/or associated circuit component on RF/IF P.C. Board. 3) Faulty memory IC, IC-5, 6 or associated circuit component on program controller P.C. Board.
12) Program memory operates but with repeated power ON and OFF the memory read-out becomes faulty.	1) Weak battery (9 volt) 2) Faulty power and regulator circuit component parts on RF/IF P.C. Board. 3) Faulty memory IC, IC-5, 6 and/or associated circuit component on program controller P.C. Board.
13) VHF Low band does not operate but can program VHF Hi and UHF OK.	1) Defective low band RF amplifier, mixer and/or VCO circuit component on RF/IF P.C. Board. 2) Defective band switch circuit component part on RF/IF P.C. Board. 3) Defective integrated circuit IC-10 ~ 25 and/or associated circuit component on program controller P.C.Board.
14) VHF Hi band does not operate but can program VHF/Lo and UHF OK.	1) Defective Hi band RF amplifier mixer and/or VCO circuit component on RF/IF P.C. Board. 2) Defective band switch circuit component part on RF/IF P.C. Board. 3) Defective IC IC-10 ~ 25 and/or associated circuit component on program controller P.C. Board.
15) UHF band does not operate but can program Lo/Hi OK.	1) Defective UHF band RF amplifier, mixer and/or VCO circuit component on RF/IF P.C. Board. 2) Defective band switch circuit component part on RF/IF P.C. Board. 3) Defective IC IC-10 ~ 25 and/or associated circuit component on program controller P.C. Board.
16) VCO does not oscillate at correct frequency	1) Defective IC IC-10 ~ 25 and/or associated circuit component on program controller P.C. Board. 2) Defective 6.4MHz OSC/DIVIDER circuit component part on program controller P.C. Board. 3) Faulty Low-PASS FILTER and/or BUFFER AMP circuit component part on RF/IF P.C. Board. 4) Faulty VCO circuit component part on RF/IF P.C. Board.

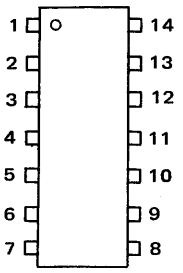
INTEGRATED CIRCUIT LEAD IDENTIFICATION

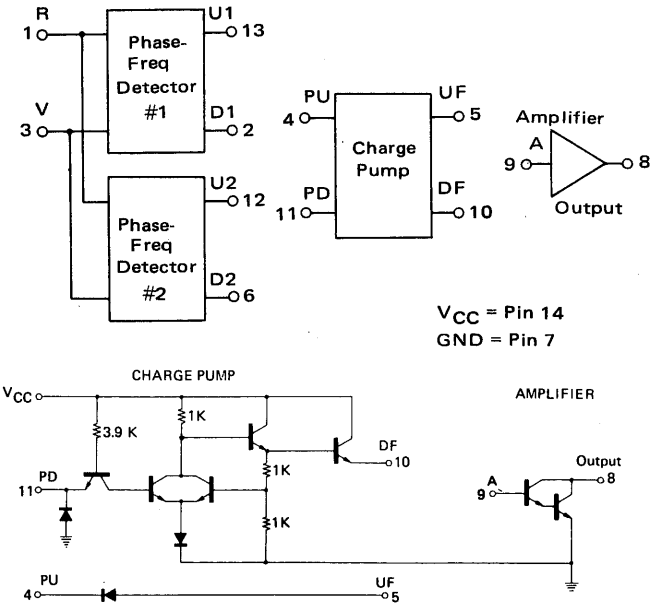
MC4016P

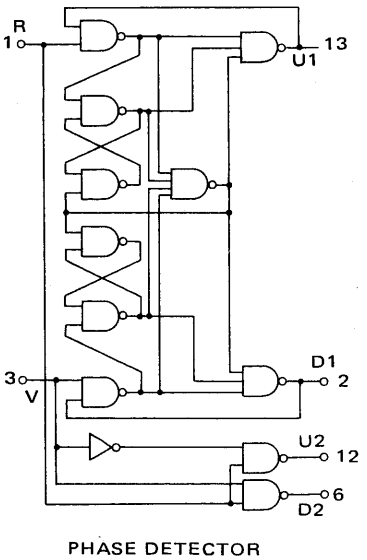




MC4044

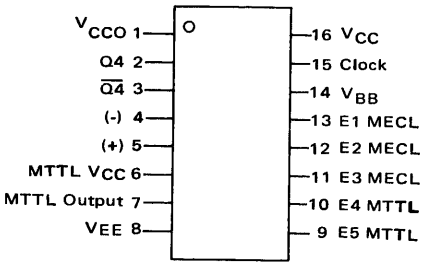


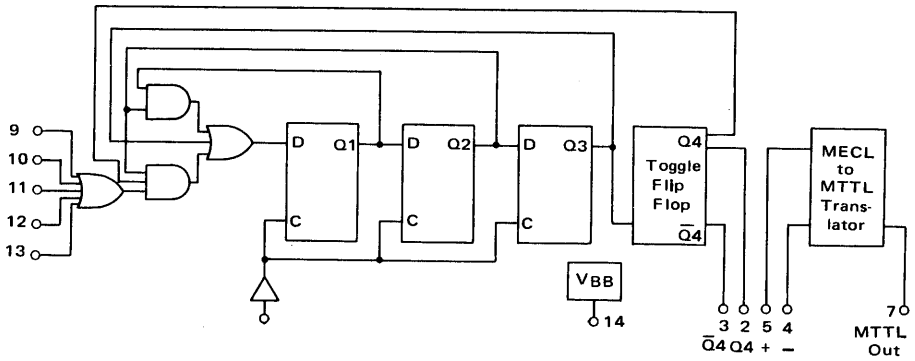




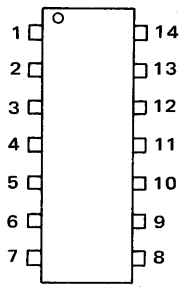
PHASE DETECTOR

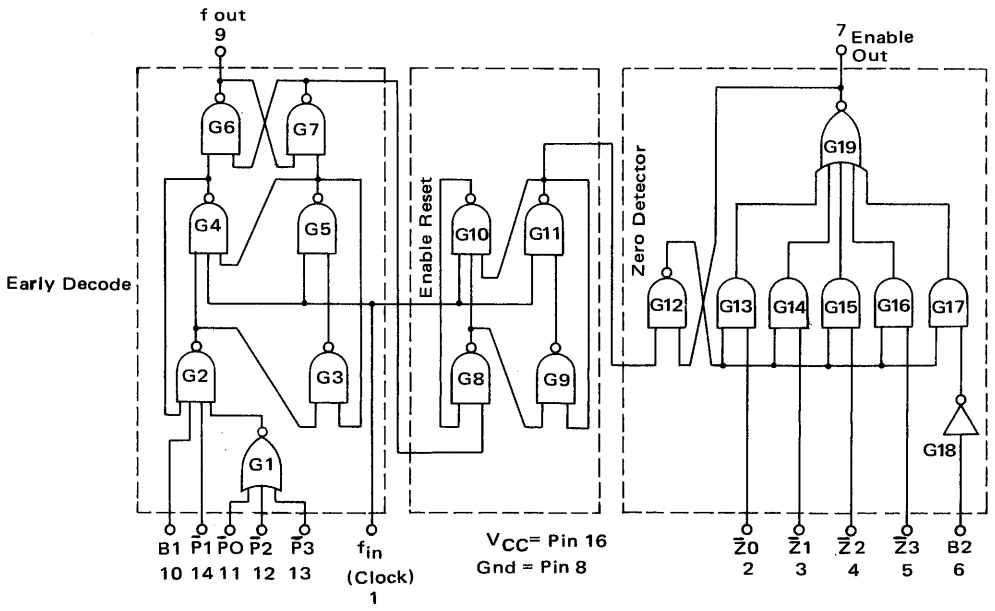
MC12013



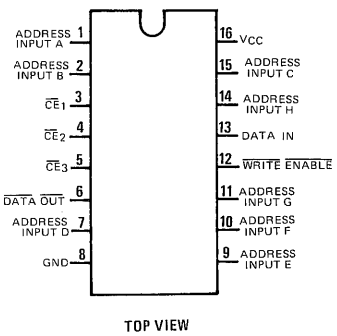


MC12014

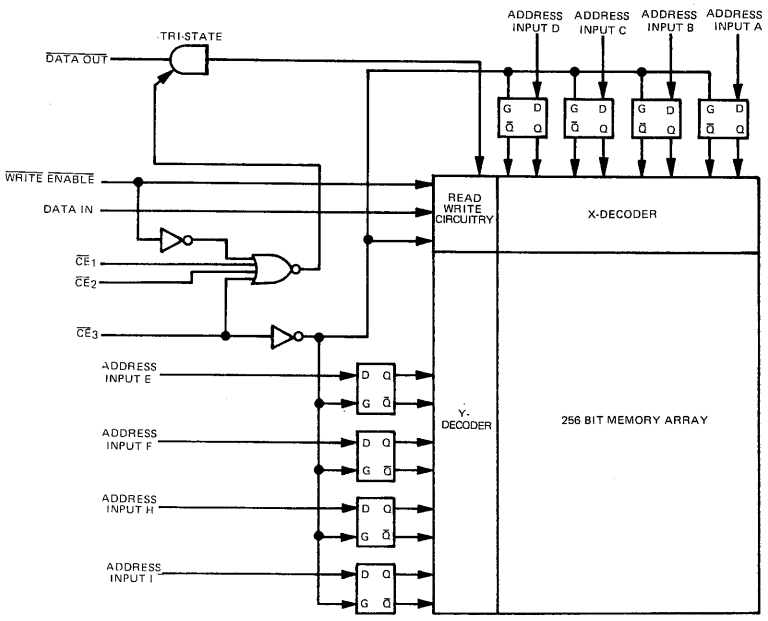




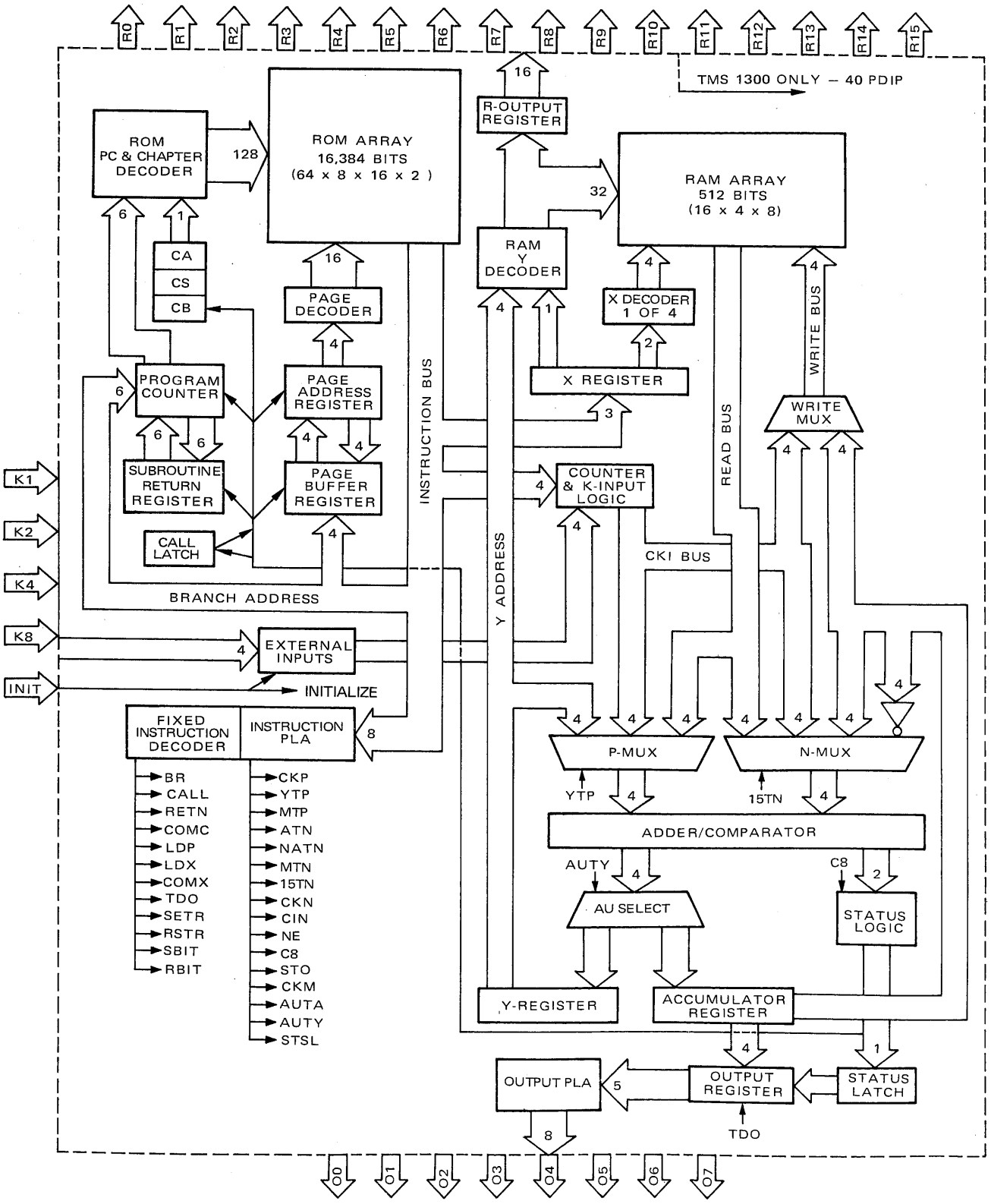
MM74C200N



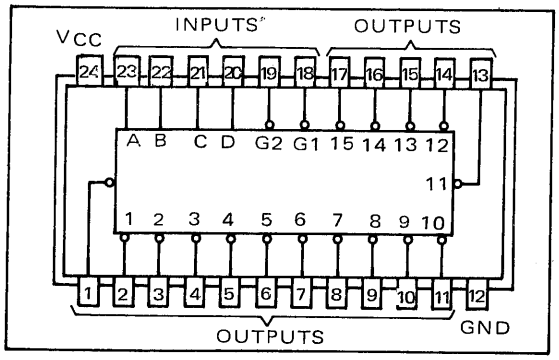
TOP VIEW



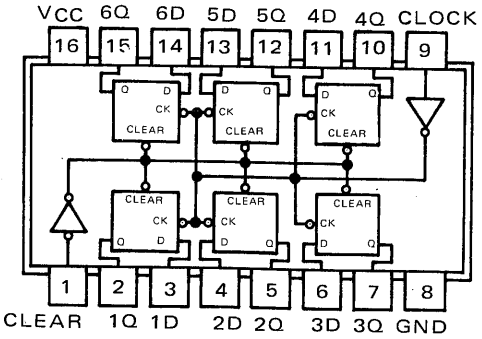

R10 R9 R8 R7 R6 NC R5 R4 R3 R2 R1 R0 VSS OSC 2 OSC 1 O0 O1 O2 NC NC
40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
R11 R12 R13 R14 R15 VDD K1 K2 K4 K8 INIT O7 NC NC NC O6 O5 O4 O3 NC


R0 R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15
TMS 1300 ONLY – 40 PDIP
ROM PC & CHAPTER DECODER
128
ROM ARRAY 16,384 BITS (64 x 8 x 16 x 2)
16
R-OUTPUT REGISTER
32
RAM ARRAY 512 BITS (16 x 4 x 8)
CA
CS
CB
PAGE DECODER
RAM Y DECODER
X DECODER 1 OF 4
WRITE BUS
PROGRAM COUNTER
PAGE ADDRESS REGISTER
X REGISTER
WRITE MUX
INSTRUCTION BUS
READ BUS
SUBROUTINE RETURN REGISTER
PAGE BUFFER REGISTER
COUNTER & K-INPUT LOGIC
CALL LATCH
CKI BUS
Y ADDRESS
BRANCH ADDRESS
K1
K2
K4
K8
INIT
EXTERNAL INPUTS
INITIALIZE
FIXED INSTRUCTION DECODER
INSTRUCTION PLA
BR CALL RETN COMC LDP LDX COMX TDO SETR RSTR SBIT RBIT
CKP YTP MTP ATN NATN MTN 15TN CKN CIN NE C8 STO CKM AUTA AUTY STSL
P-MUX
N-MUX
YTP
15TN
ADDER/COMPARATOR
AUTY
C8
AU SELECT
STATUS LOGIC
Y-REGISTER
ACCUMULATOR REGISTER
OUTPUT PLA
OUTPUT REGISTER
STATUS LATCH
TDO
O0 O1 O2 O3 O4 O5 O6 O7

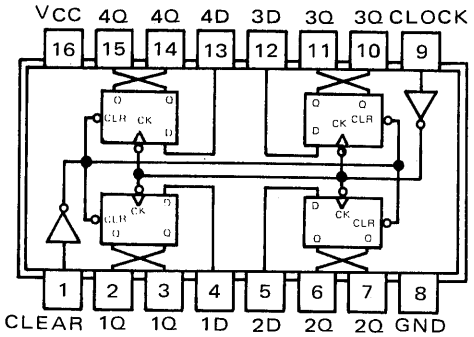
SN74159

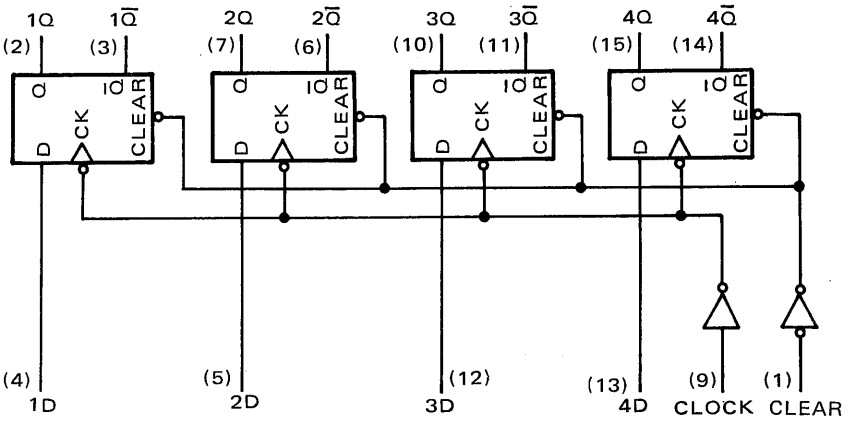


SN74174

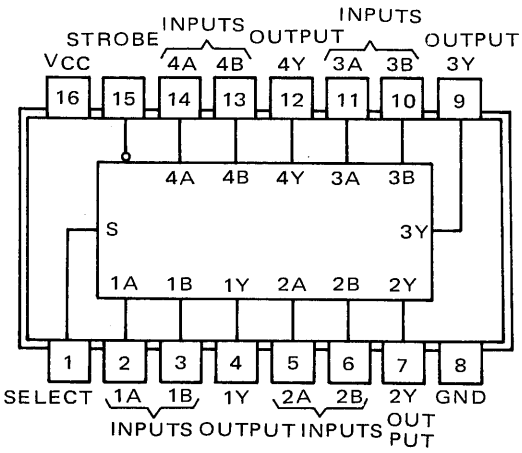


SN75491

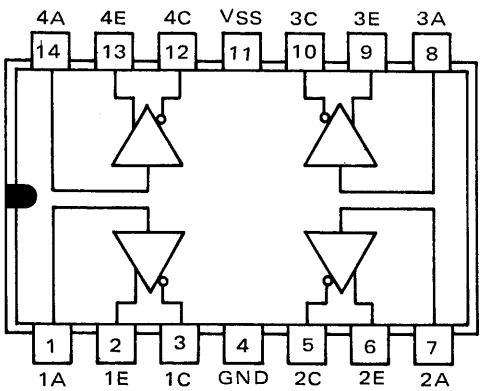


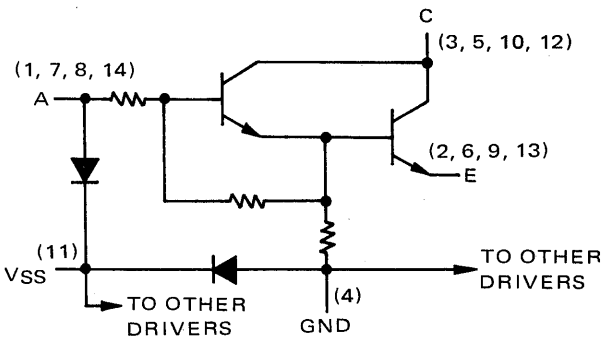


SN74157

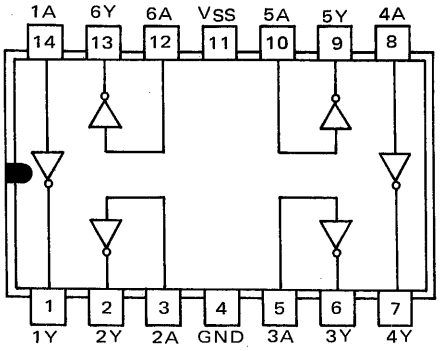


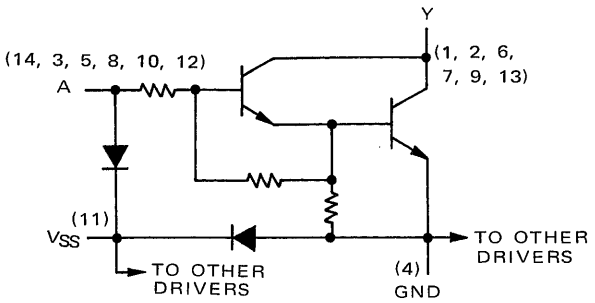
SN75491



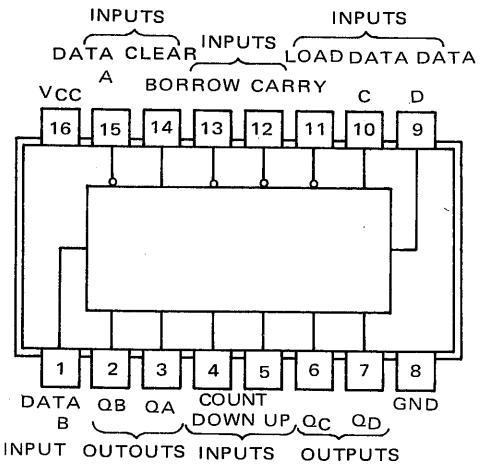


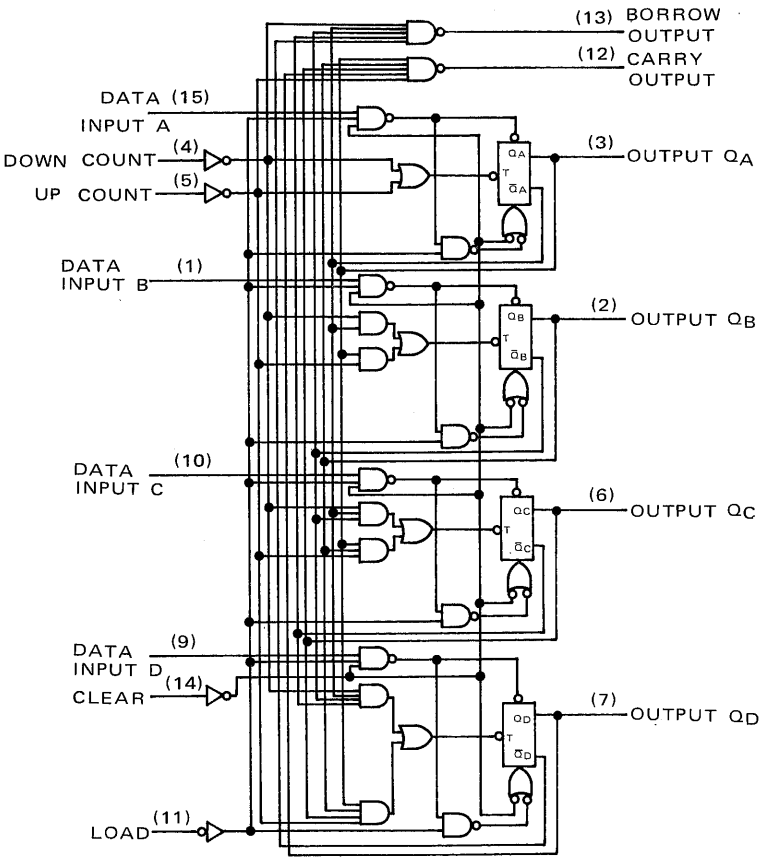
SN75492



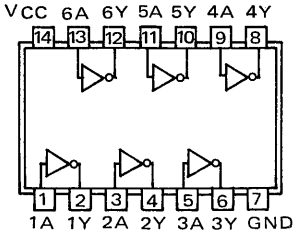


SN74LS192

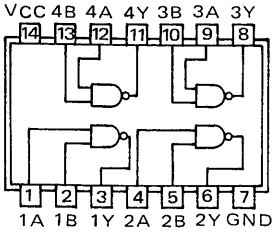




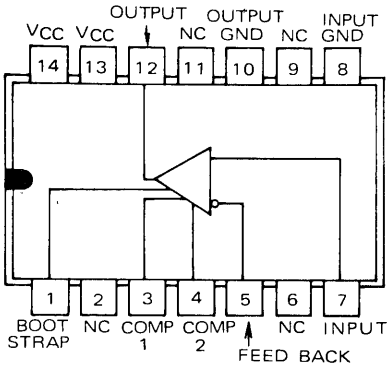
SN7400, SN74LS00

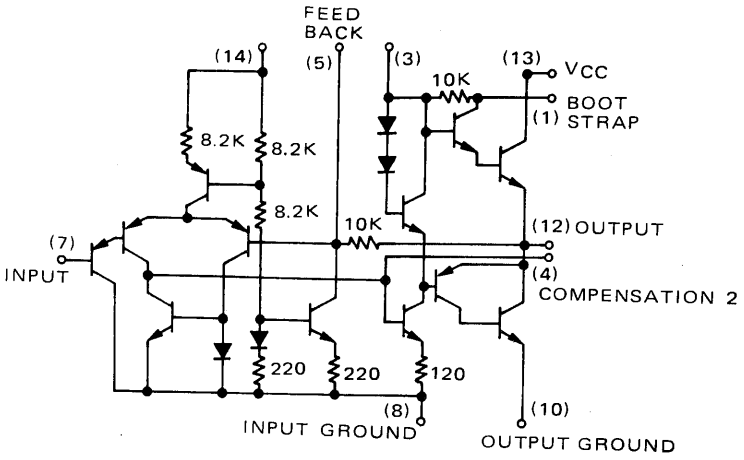


SN7405

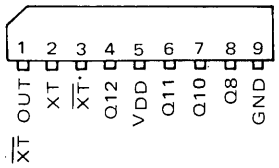


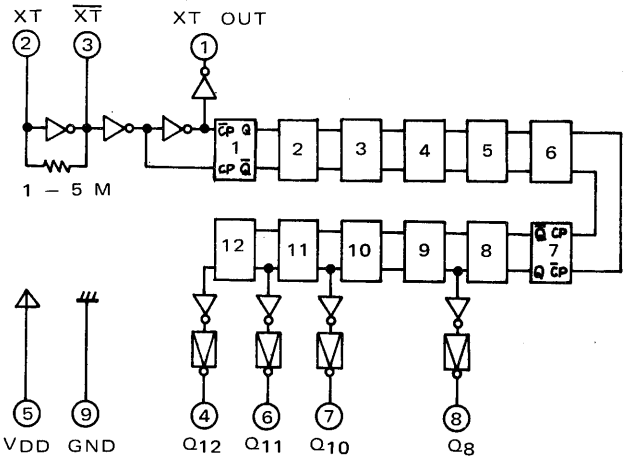
SN76007



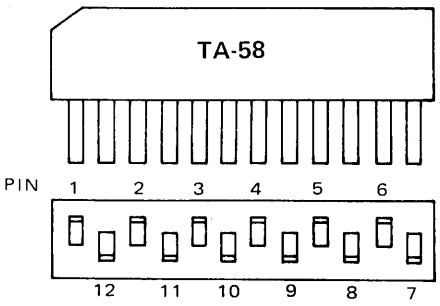


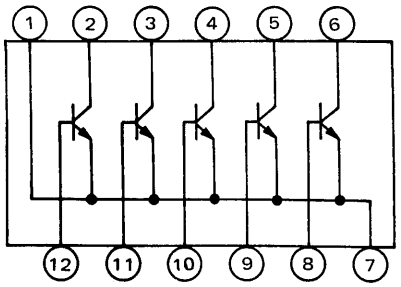
TC-5082



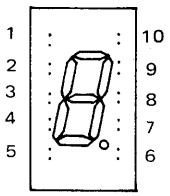


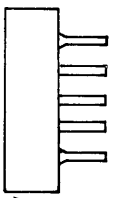
TA-58

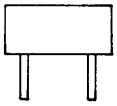


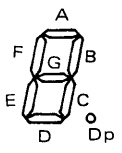


TLR-312

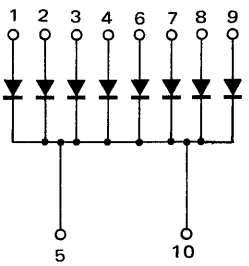








1	SEGMENT A
2	SEGMENT F
3	SEGMENT E
4	SEGMENT D
5	COMMON CATHODE
6	SEGMENT C
7	Dp ANODE
8	SEGMENT G
9	SEGMENT B
10	COMMON CATHODE



SEMICONDUCTOR LEAD IDENTIFICATION

A) 2SC372(O), 2SC373, 2SC387, 2SC732, 2SC785, 2SA495, 2SC735(Y)

B) 2SK30A

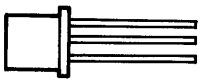
C) 2SC535B

D) 2SC1815(Y), 2SC1815(GR), 2SC2120

E) 2SD526, 2SC1173, 2SA473

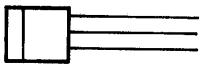
F) 3SK59

G) 2SC1117

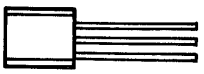


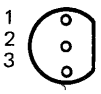
(A)
1 : Emitter
2 : Collector
3 : Base

(B)
1 : Source
2 : Gate
3 : Drain

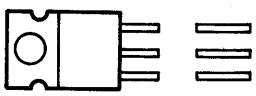


(C)
1 : Emitter
2 : Collector
3 : Base

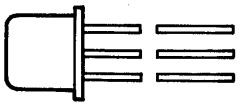


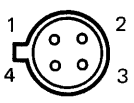


(D)
1 : Emitter
2 : Collector
3 : Base



(E)
1 : Emitter
2 : Collector
3 : Base





(F)
1 : Drain
2 : Gate 2
3 : Gate 1
4 : Source

(G)
1 : Emitter
2 : Base
3 : Collector
4 : Shield

RF/IF P.C.BOARD PARTS LIST

Ref. No.	Description				RS Part Number	MFR's Part Number
			CAPACITORS			
C1	Ceramic	10pF	50WV	±0.5pF		FC-50
C2	Ceramic	10pF	50WV	±5%		FC-50
C3	Ceramic	10pF	50WV	±0.5pF		FC-50
C4	Ceramic	0.001μF	50WV	±20%		SCP-60
C5	Ceramic	100pF	50WV	±5%		FC-70
C6	Ceramic	0.001μF	50WV	±20%		SCP-60
C7	Ceramic	0.001μF	50WV	±20%		SCP-60
C8	Ceramic	10pF	50WV	±0.5pF		FC-50
C9	Ceramic	0.5pF	50WV	±0.25pF		AK-50
C10	Ceramic	10pF	50WV	±0.5pF		FC-50
C11	Ceramic	100pF	50WV	±5%		PC-70
C12	Ceramic	10pF	50WV	±0.5pF		FC-50
C13	Ceramic	0.0047μF	50WV	+80~−20%		SCP-100
C14	Ceramic	100pF	50WV	±5%		FC-70
C15	Ceramic	100pF	50WV	±5%		FC-70
C16	Electrolytic	10μF	16WV			CE04W1C000F
C17	Ceramic	0.001μF	50WV	±20%		SCP-60
C18	Ceramic	33pF	50WV	±5%		FC-80
C19	Ceramic	20pF	50WV	±5%		FC-80
C20	Ceramic	20pF	50WV	±5%		FC-80
C21	Ceramic	5pF	50WV	±0.5pF		FC-80
C22	Ceramic	0.001μF	50WV	±20%		SCP-60
C23	Ceramic	0.0047μF	50WV	+80~−20%		SCP-100
C24	Ceramic	10pF	50WV	±0.5pF		FC-50
C25	Ceramic	0.0022μF	50WV	±20%		SCP-80
C26	Ceramic	0.001μF	50WV	±20%		SCP-60
C27	Ceramic	0.001μF	50WV	±20%		SCP-60
C28	Ceramic	0.001μF	50WV	±20%		SCP-60
C29	Ceramic	0.0022μF	50WV	±20%		SCP-80
C30	Ceramic	2pF	50WV	±0.25pF		FC-50
C31	Ceramic	0.0022μF	50WV	±20%		SCP-80
C32	Ceramic	47pF	50WV	±10%		FC-50
C33	Ceramic	2pF	50WV	±0.25pF		FC-50
C34	Ceramic	0.0047μF	50WV	+80~−20%		SCP-100
C35	Electrolytic	10μF	16WV			CE04W1C00F
C36	Ceramic	100pF	50WV	±5%		FC-70
C37	Ceramic	0.0022μF	50WV	+20~−80%		SCP-80
C38	Ceramic	47pF	50WV	±10%		FC-50
C39	Ceramic	100pF	50WV	±5%		FC-70
C40	Ceramic	10pF	50WV	±0.5pF		FC-50
C41	Ceramic	5pF	50WV	±0.5pF		FC-50
C42	Ceramic	0.001μF	50WV	±20%		SCP-60
C43	Ceramic	0.001μF	50WV	±20%		SCP-60
C44	Ceramic	10pF	50WV	±0.5pF		FC-50
C45	Ceramic	33pF	50WV	±5%		FC-50
C46	Ceramic	33pF	50WV	±5%		FC-50
C47	Ceramic	2pF	50WV	±0.25pF		FC-50
C48	Ceramic	10pF	50WV	±0.5pF		FC-50
C49	Ceramic	1pF	50WV	±0.25pF		FC-50
C50	Ceramic	0.001μF	50WV	±20%		SCP-60

Ref. No.	Description				RS Part Number	MFR's Part Number
C51	Ceramic	0.001μF	50WV	±20%		SCP-60
C52	Ceramic	0.001μF	50WV	±20%		SCP-60
C53	Ceramic	100pF	50WV	±5%		FC-70
C54	Ceramic	0.0047μF	50WV	+80~−20%		SCP-100
C55	Ceramic	100pF	50WV	±5%		FC-70
C56	Electrolytic	10μF	16WV			CE04W1C00F
C57	Ceramic	60pF	50WV	±10%		FC-50
C58	Ceramic	20pF	50WV	±5%		FC-50
C59	Ceramic	5pF	50WV	±0.25pF		FC-50
C60	Ceramic	10pF	50WV	±0.5pF		FC-50
C61	Ceramic	5pF	50WV	±0.25pF		FC-50
C62	Ceramic	10pF	50WV	±0.5pF		FC-50
C63	Ceramic	10pF	50WV	±0.5pF		FC-50
C64	Tantalum	0.1μF	35WV	±20%		CS15E1V0R2M
C65	Mylar	0.01μF	50WV	±10%		
C66	Mylar	0.01μF	50WV	±10%		
C67	Mylar	0.01μF	50WV	±10%		
C68	Mylar	0.02μF	50WV	±10%		
C69	Ceramic	0.001μF	50WV	±20%		SCP-60
C70	Ceramic	0.001μF	50WV	±20%		SCP-60
C71	Ceramic	0.001μF	50WV	±20%		SCP-60
C72	Ceramic	470pF	50WV	±10%		SCP-50
C73	Ceramic	0.001μF	50WV	±20%		SCP-60
C74	Ceramic	56pF	50WV	±5%		FC-60
C75	Ceramic	330pF	50WV	±10%		SCP-50
C76	Tantalum	0.1μF	35WV	±20%		CS15E1V0R1M
C77	Ceramic	10pF	50WV	±0.5pF		FC-50
C78	Ceramic	470pF	50WV	±10%		SCP-50
C79	Ceramic	0.001μF	50WV	±20%		SCP-60
C80	Ceramic	470pF	50WV	±10%		SCP-50
C81	Ceramic	470pF	50WV	±10%		SCP-50
C82	Ceramic	470pF	50WV	±10%		SCP-50
C83	Ceramic	470pF	50WV	±10%		SCP-50
C84	Ceramic	470pF	50WV	±10%		SCP-50
C85	Tantalum	1μF	35WV	±20%		CS15E1V010M1S
C86	Ceramic	330pF	50WV	±5%		SCU-100
C87	Ceramic	330pF	50WV	±5%		SCU-100
C88	Ceramic	100pF	50WV	±5%		FC-70
C89	Mylar	0.0047μF	50WV	±10%		
C90	Mylar	0.01μF	50WV	±10%		
C91	Electrolytic	47μF	16WV			CE04W1C470B
C92	Mylar	0.1μF	50WV	±10%		
C93	Electrolytic	100μF	10WV			CE04W1C101B
C94	Mylar	0.1μF	50WV	±10%		
C95	Electrolytic	100μF	10WV			CE04W1C470B
C96	Ceramic	0.0022μF	50WV	±20%		SCP-80
C97	Electrolytic	10μF	16WV			CE04W1C00F
C98	Ceramic	0.0022μF	50WV	±20%		SCP-80
C99	Ceramic	0.0022μF	50WV	±20%		SCP-80
C100	Electrolytic	10μF	16WV			CE04W1C330C

Ref. No.	Description				RS Part Number	MFR's Part Number
C101	Ceramic	330pF	50WV	±10%		SCP-50
C102	Ceramic	0.001μF	50WV	±20%		SCP-60
C103	Tantalum	0.47μF	35WV	±20%		CS15E1V0R47M
C104	Electrolytic	33μF	16WV			CE04W1C330C
C105	Electrolytic	100μF	10WV			CE04W1A101A
C106	Electrolytic	10μF	16WV			CE04W1C00F
C107	Mylar	0.001μF	50WV	±10%		
C108	Mylar	0.01μF	50WV	±10%		
C109	Electrolytic	10μF	16WV			CE04W1C00F
C110	Mylar	0.01μF	50WV	±10%		
C111	Electrolytic	100μF	16WV			CE04W1C101F
C112	Electrolytic	1μF	50WV			CE04W1H010
C113	Mylar	0.01μF	50WV	±10%		
C114	Mylar	0.02μF	50WV	±10%		
C115	Mylar	0.01μF	50WV	±10%		
C116	Electrolytic	47μF	16WV			CE04W1C470B
C117	Ceramic	100pF	50WV	±5%		FC-70
C118	Ceramic	100pF	50WV	±5%		FC-70
C119	Electrolytic	47μF	16WV			CE04W1C470B
C120	Tantalum	1μF	35WV	±20%		CS15EV010MIS
C121	Electrolytic	47μF	16WV			CE04W1C470B
C122	Ceramic	0.001μF	50WV	±20%		SCP-60
C123	Ceramic	10pF	50WV	±0.5pF		FC-50
C124	Ceramic	0.001μF	50WV	±20%		SCP-60
C125	Ceramic	0.001μF	50WV	±20%		SCP-60
C126	Ceramic	47pF	50WV	±10%		FC-50
C127	Electrolytic	220μF	16WV			CE04W1C221E
C128	Electrolytic	220μF	16WV			CE04W1C221E
C129	Tantalum	0.1μF	35WV	±20%		CS15E1V0R1M
C130	Electrolytic	220μF	16WV			CE04W1C221E
C131	Electrolytic	3300μF	25WV			1E332
C132	Ceramic	0.04μF	25WV	+80~−20%		MC-100
C133	Electrolytic	220μF	16WV			CE04W1C221E
C134	Electrolytic	47μF	16WV			CE04W1C470B
C135	Tantalum	0.1μF	35WV	±20%		CS15E1V0R1M
C136	Electrolytic	220μF	16WV			CE04W1C221E
C137	Ceramic	0.04μF	25WV	+80~−20%		MC-100
C138	Electrolytic	220μF	16WV			CE04W1C221E
C139	Electrolytic	1000μF	25WV			CE04W1E102C
C140	Electrolytic	2200μF	16WV			CE04W1C222G
C141	Electrolytic	1000μF	16WV			CE04W1C1028
C142	Ceramic	0.01μF	25WV	+80~−20%		MC-70
C143	Ceramic	0.01μF	25WV	+80~−20%		MC-70
C144	Ceramic	0.001μF	50WV	±20%		
C145	Ceramic	0.001μF	50WV	±20%		

Ref. No.	Description	RS Part Number	MFR's Part Number
	COILS/TRANSFORMERS/FILTERS/CRYSTAL		
L1	UHF RF Coil	CA-4916	GR-M-545
L2	UHF RF Coil	CA-4916	GR-M-545
L3	UHF RF Coil	CA-4916	GR-M-545
L4	UHF RF Coil	CA-4916	GR-M-545
L5	R.F.C. (2.2mH)	C-0727	FL-7H
L6	Choke Coil	CA-3182	3B-037
T1	HI RF Transformer	CA-4913	113SN-5066
T2	HI RF Transformer	CA-4913	113SN-5066
T3	HI RF Transformer	CA-4913	113SN-5066
T4	HI OSC Transformer	CA-4915	199SN-10012
T5	LO RF Transformer	CA-4911	113KN-5341
T6	LO RF Transformer	CA-4912	113KN-5342
T7	LO RF Transformer	CA-4912	113KN-5342
T8	LO OSC Transformer	CA-4914	GR-N-544
T9	UHF OSC Transformer	CA-4915	199SN-10012
T10	IF Transformer	CA-7246	119LC-4700 33N3
T11	IF Transformer	CA-7246	119LC-4700 33N3
T12	IF Transformer	CA-7247	7MC-452503N4
T13	IF Transformer	CA-2997	7MC-2091N
T14	Noise AMP Transformer	CA-3489	126LN-5730A
XF-1	Crystal Filter	C-0846	10M15A or MF10R
CF-1	Ceramic Filter	C-0733	LF-C18
CF-2	Ceramic Filter	C-0671	BFB-455L or EF-A8
CF-3	Ceramic Filter	C-0671	BFB-455L or EF-A8
X-1	Crystal 10.245 MHz		
	RESISTORS		
R1	Carbon film 100KΩ 1/4W ±5%	NEE0371	ERD-25VJ-104
R2	Carbon film 68KΩ 1/4W ±5%	NEE0354	ERD-25VJ-683
R3	Carbon film 330Ω 1/4W ±5%	NEE0159	ERD-25VJ-331
R4	Carbon film 4.7KΩ 1/4W ±5%	NEE0247	ERD-25VJ-472
R5	Carbon film 10KΩ 1/4W ±5%	NEE0281	ERD-25VJ-103
R6	Carbon film 100Ω 1/4W ±5%	NEE0132	ERD-25VJ-101
R7	Carbon film 100Ω 1/4W ±5%	NEE0132	ERD-25VJ-101
R8	Carbon film 100KΩ 1/4W ±5%	NEE0371	ERD-25VJ-104
R9	Carbon film 100KΩ 1/4W ±5%	NEE0371	ERD-25VJ-104
R10	Carbon film 47KΩ 1/4W ±5%	NEE0340	ERD-25VJ-473
R11	Carbon film 47kΩ 1/4W ±5%	NEE0340	ERD-25VJ-473
R12	Carbon film 1KΩ 1/4W ±5%	NEE0196	ERD-25VJ-102
R13	Carbon film 10KΩ 1/4W ±5%	NEE0281	ERD-25VJ-103
R14	Carbon film 4.7KΩ 1/4W ±5%	NEE0247	ERD-25VJ-472
R15	Carbon film 2.7KΩ 1/4W ±5%	NEE0224	ERD-25VJ-272
R16	Carbon film 2.2KΩ 1/4W ±5%	NEE0216	ERD-25VJ-222
R17	Carbon film 100KΩ 1/4W ±5%	NEE0371	ERD-25VJ-104
R18	Carbon film 100KΩ 1/4W ±5%	NEE0371	ERD-25VJ-104
R19	Carbon film 330Ω 1/4W ±5%	NEE0159	ERD-25VJ-331
R20	Carbon film 4.7KΩ 1/4W ±5%	NEE0247	ERD-25VJ-472

Ref. No.	Description				RS Part Number	MFR's Part Number
R21	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R22	Carbon film	220Ω	1/4W	±5%	NEE0149	ERD-24VJ-221
R23	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R24	Carbon film	100KΩ	1/4W	±5%	NEE0371	ERD-25VJ-104
R25	Carbon film	100KΩ	1/4W	±5%	NEE0371	ERD-25VJ-104
R26	Carbon film	47KΩ	1/4W	±5%	NEE0340	ERD-25VJ-473
R27	Carbon film	47KΩ	1/4W	±5%	NEE0340	ERD-25VJ-473
R28	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R29	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R30	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R31	Carbon film	2.7KΩ	1/4W	±5%	NEE0224	ERD-25VJ-272
R32	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R33	Carbon film	100KΩ	1/4W	±5%	NEE0371	ERD-25VJ-104
R34	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R35	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R36	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R37	Carbon film	100KΩ	1/4W	±5%	NEE0371	ERD-25VJ-104
R38	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R39	Carbon film	3.3KΩ	1/4W	±5%	NEE0230	ERD-25VJ-332
R40	Carbon film	33KΩ	1/4W	±5%	NEE0324	ERD-25VJ-333
R41	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R42	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R43	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R44	Carbon film	2.7KΩ	1/4W	±5%	NEE0224	ERD-25VJ-272
R45	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R46	Carbon film	100KΩ	1/4W	±5%	NEE0371	ERD-25VJ-104
R47	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R48	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R49	Carbon film	100KΩ	1/4W	±5%	NEE0371	ERD-25VJ-104
R50	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R51	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R52	Carbon film	3.3KΩ	1/4W	±5%	NEE0230	ERD-25VJ-332
R53	Carbon film	3.3KΩ	1/4W	±5%	NEE0230	ERD-25VJ-332
R54	Carbon film	1.5KΩ	1/4W	±5%	NEE0206	ERD-25VJ-152
R55	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R56	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R57	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R58	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R59	Carbon film	470KΩ	1/4W	±5%	NEE0423	ERD-25VJ-474
R60	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R61	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R62	Carbon film	470KΩ	1/4W	±5%	NEE0423	ERD-25VJ-474
R63	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R64	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R65	Carbon film	100KΩ	1/4W	±5%	NEE0371	ERD-25VJ-104
R66	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R67	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R68	Carbon film	470KΩ	1/4W	±5%	NEE0423	ERD-25VJ-474
R69	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R70	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R71	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R72	Carbon film	330KΩ	1/4W	±5%	NEE0410	ERD-25VJ-334

Ref. No.	Description				RS Part Number	MFR's Part Number
R73	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R74	Carbon film	330KΩ	1/4W	±5%	NEE0410	ERD-25VJ-334
R75	Carbon film	4.7KΩ	1/4W	±5%	NEE0240	ERD-25VJ-472
R76	Carbon film	330KΩ	1/4W	±5%	NEE0410	ERD-25VJ-334
R77	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R78	Carbon film	330KΩ	1/4W	±5%	NEE0410	ERD-25VJ-334
R79	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R80	Carbon film	22KΩ	1/4W	±5%	NEE0311	ERD-25VJ-223
R81	Carbon film	22KΩ	1/4W	±5%	NEE0311	ERD-25VJ-223
R82	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R83	Carbon film	47Ω	1/4W	±5%	NEE0096	ERD-25VJ-470
R84	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R85	Carbon film	1MΩ	1/4W	±5%	NEE0445	ERD-25VJ-105
R86	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R87	Carbon film	3.3KΩ	1/4W	±5%	NEE0230	ERD-25VJ-332
R88	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R89	Carbon film	56KΩ	1/4W	±5%	NEE0345	ERD-25VJ-563
R90	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R91	Carbon film	100KΩ	1/4W	±5%	NEE0371	ERD-25VJ-104
R92	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R93	Carbon film	47KΩ	1/4W	±5%	NEE0340	ERD-25VJ-473
R94	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R95	Carbon film	47KΩ	1/4W	±5%	NEE0340	ERD-25VJ-473
R96	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R97	Carbon film	3.3KΩ	1/4W	±5%	NEE0230	ERD-25VJ-332
R98	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R99	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R100	Carbon film	47KΩ	1/4W	±5%	NEE0340	ERD-25VJ-473
R101	Carbon film	47KΩ	1/4W	±5%	NEE0340	ERD-25VJ-473
R102	Carbon film	1MΩ	1/4W	±5%	NEE0445	ERD-25VJ-105
R103	Carbon film	1MΩ	1/4W	±5%	NEE0445	ERD-25VJ-105
R104	Carbon film	1MΩ	1/4W	±5%	NEE0445	ERD-25VJ-105
R105	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R106	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R107	Carbon film	22KΩ	1/4W	±5%	NEE0311	ERD-25VJ-223
R108	Carbon film	470KΩ	1/4W	±5%	NEE0423	ERD-25VJ-474
R109	Carbon film	120KΩ	1/4W	±5%	NEE0375	ERD-25VJ-124
R110	Carbon film	680Ω	1/4W	±5%	NEE0183	ERD-25VJ-681
R111	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R112	Carbon film	82Ω	1/4W	±5%	NEE0122	ERD-25VJ-820
R113	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R114	Carbon film	3.9KΩ	1/4W	±5%	NEE0237	ERD-25VJ-392
R115	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R116	Carbon film	47Ω	1/4W	±5%	NEE0099	ERD-25VJ-470
R117	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R118	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R119	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R120	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R121	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R122	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R123	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R124	Carbon film	18KΩ	1/4W	±5%	NEE0303	ERD-25VJ-183

Ref. No.	Description				RS Part Number	MFR's Part Number
R125	Carbon film	47KΩ	1/4W	±5%	NEE0340	ERD-25VJ-473
R126	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R127	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R128	Carbon film	330Ω	1/4W	±5%	NEE0159	ERD-25VJ-331
R129	Carbon film	10Ω	1W	±5%	NFG0063	ERX-1ANJ-100
R130	Carbon film	150Ω	1/4W	±5%	NEE0142	ERD-25VJ-151
R131	Carbon film	10KΩ	1/4W	±5%	NEE0281	ERD-25VJ-103
R132	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R133	Carbon film	270Ω	1/4W	±5%	NEE0155	ERD-25VJ-271
R134	Metal film	1Ω	5W	±5%	NFK0022	ERF-5SK-1R0
R135	Carbon film	330Ω	1/4W	±5%	NEE0159	ERD-25VJ-331
R136	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R137	Carbon film	47KΩ	1/4W	±5%	NEE0340	ERD-25VJ-473
R138	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R139	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R140	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R141	Metal film	1Ω	5W	±5%	NFK0022	ERF-5SK-1R0
R142	Carbon film	330Ω	1/4W	±5%	NEE0159	ERD-25VJ-331
R143	Carbon film	1KΩ	1/2W	±5%		ERD-50VJ-102
R144	Carbon film	470KΩ	1/4W	±5%	NEE0423	ERD-25VJ-474
R145	Carbon film	3.3KΩ	1/4W	±5%	NEE0230	ERD-25VJ-332
R146	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R147	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R148	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
	SEMICONDUCTORS					
Q1	Transistor	Silicon				2SC535(B)
Q2	Transistor	Silicon				2SC535(B)
Q3	F.E.T.	Silicon				3SK59
Q4	Transistor	Silicon				2SC785(O)
Q5	Transistor	Silicon				2SC535(B)
Q6	Transistor	Silicon				2SC535(B)
Q7	F.E.T.	Silicon				3SK59
Q8	Transistor	Silicon				2SC785(O)
Q9	Transistor	Silicon				2SC1117
Q10	Transistor	Silicon				2SC1117
Q11	Transistor	Silicon				2SC785(O)
Q12	Transistor	Silicon				2SC387A
Q13	Transistor	Silicon				2SC372(O) or 2SC1815
Q14	Transistor	Silicon				2SC372(O) or 2SC1815
Q15	Transistor	Silicon				2SC372(O) or 2SC1815
Q16	Transistor	Silicon				2SC372(O) or 2SC1815
Q17	Transistor	Silicon				2SC372(O) or 2SC1815
Q18	Transistor	Silicon				2SC372(O) or 2SC1815
Q19	Transistor	Silicon				2SC372(O) or 2SC1815

Ref. No.	Description		RS Part Number	MFR's Part Number
Q20	Transistor	Silicon		2SC372(O) or 2SC1815
Q21	Transistor	Silicon		2SC373 or 2SC1815(GR)
Q22	Transistor	Silicon		2SC373 or 2SC1815(GR)
Q23	Transistor	Silicon		2SC373 or 2SC1815(GR)
Q24	Transistor	Silicon		2SC373 or 2SC1815(GR)
Q25	F.E.T.	Silicon		2SK30A(R)
Q26	F.E.T.	Silicon		2SK30A(GR)
Q27	Transistor	Silicon		2SA495
Q28	Transistor	Silicon		2SA495
Q29	Transistor	Silicon		2SA495
Q30	Transistor	Silicon		2SC535(B)
Q31	Transistor	Silicon		2SC2120
Q32	Transistor	Silicon		2SC1173
Q33	Transistor	Silicon		2SA473
Q34	Transistor	Silicon		2SC1173
Q35	Transistor	Silicon		2SC735(Y)
Q36	Transistor	Silicon		2SC1815(GR) or 2SC373
Q37	Transistor	Silicon		2SD526
D1	Diode	Variable capacitor	DX-0548	FC-54
D2	Diode	Variable capacitor	DX-0548	FC-54
D3	Diode	Variable capacitor	DX-0548	FC-54
D4	Diode	Variable capacitor	DX-0548	FC-54
D5	Diode	Variable capacitor	DX-0548	FC-54
D6	Diode	Variable capacitor	DX-0548	FC-54
D7	Diode	Variable capacitor	DX-0548	FC-54
D8	Diode	Variable capacitor	DX-0548	FC-54
D9	Diode	Variable capacitor	DX-0548	FC-54
D10	Diode	Variable capacitor	DX-1030	1S2268
D11	Diode	Variable capacitor	DX-1031	1S2090
D12	Diode	Variable capacitor	DX-1030	1S2268
D13	Diode	Variable capacitor	DX-1031	1S2090
D14	Diode	Silicon	DX-0150	HV-80
D15	Diode	Silicon	DX-0150	HV-80
D16	Diode	Germanium	DX-0161	1N60
D17	Diode	Germanium	DX-0161	1N60
D18	Diode	Silicon	DX-0150	HV-80
D19	Diode	Germanium	DX-0161	1N60
D20	Diode	Zener	DX-1033	05Z8.2(L)
D21	Diode	Germanium	DX-0161	1N60
D22	Diode	Germanium	DX-0161	1N60
D23	Diode	Germanium	DX-0161	1N60
D24	Diode	Germanium	DX-0161	1N60
D25	Diode	Zener	DX-1034	05Z10(L)
D26	Diode	Zener	DX-1035	02BZ3.3
D27	Diode	Silicon	DX-0282	1S1885
D28	Diode	Zener	DX-1034	05Z10(L)
D29	Diode	Silicon	DX-0150	HV-80

Ref. No.	Description	RS Part Number	MFR's Part Number
D30	Diode Silicon	DX-0150	HV-80
D31	Diode Zener	DX-1034	05Z10(L)
D32	Diode Silicon	DX-0150	HV-80
D33	Diode Zener	DX-1033	05Z8.2(L)
D34	Diode Zener	DX-1032	05Z5.6(L)
D35	Diode Silicon	DX-0282	1S1885
D36	Diode Silicon	DX-0282	1S1885
D37	Rectifier Silicon	DX-0995	1B4B or 1B4B1
D38	Rectifier Silicon	DX-0704	1B2C1
D39	Rectifier Silicon	DX-0705	1B2Z1
IC-1	Integrated circuit	MX-3302	SN7405
IC-2	Integrated circuit	MX-3415	TA-58
IC-3	Integrated circuit	MX-3440	SN76007
IC-4	Integrated circuit	MX-3478	SN7426
	TRIMMER CAPACITORS/P.C.BOARD		
TC-1	Ceramic trimmer 10pF		ECV-1ZW10X53
TC-2	Ceramic trimmer 10pF		ECV-1ZW10X53
TC-3	Ceramic trimmer 10pF		ECV-1ZW10X53
TC-4	Ceramic trimmer 10pF		ECV-1ZW10X53
TC-5	Ceramic trimmer 10pF		ECV-1ZW10X53
TC-6	Ceramic trimmer 10pF		ECV-1ZW10X53
	RF/IF P.C. Board Assembly	X-7630	GE-22A-6710

PROGRAM CONTROLLER P.C.BOARD PARTS LIST

Ref. No.	Description				RS Part Number	MFR's Part Number
			CAPACITORS			
C1	Ceramic	150pF	50WV	±10%		FC-70
C2	Electrolytic	3.3μF	50WV			CE041H3R3B
C3	Ceramic	120pF	50WV	±10%		FCC-70
C4	Tantalum	0.33μF	35WV	±20%		1S15E1VR33M1S
C5	Electrolytic	100μF	16WV			CE041C101F
C6	Electrolytic	220μF	16WV			CE02W-1C221B
C7	Ceramic	100pF	50WV	±5%		FCC-70
C8	Electrolytic	1μF	50WV			CE04W1H010
C9		Not used				
C10		Not used				
C11	Mylar	0.01μF	50WV	±10%		
C12	Mylar	0.01μF	50WV	±10%		
C13	Mylar	0.01μF	50WV	±10%		
C14	Mylar	0.01μF	50WV	±10%		
C15	Ceramic	100pF	50WV	±10%		FC-70
C16	Mylar	0.01μF	50WV	±10%		
C17	Mylar	0.01μF	50WV	±10%		
C18	Mylar	0.001μF	50WV	±10%		
C19	Electrolytic	1μF	50WV			CE04W1H010
C20	Mylar	0.047μF	50WV	±10%		
C21	Mylar	0.01μF	50WV	±10%		
C22	Electrolytic	1μF	50WV			CE04W1H010
C23	Electrolytic	220μF	10WV			CE041C221F
C24	Ceramic	22pF	50WV	±5%		FC-50
C25	Mylar	0.01μF	50WV	±10%		
C26	Ceramic	56pF	50WV	±5%		FCC-60
C27	Ceramic	22pF	50WV	±5%		FCC-50
C28	Mylar	0.1μF	50WV	±10%		
C29	Mylar	0.01μF	50WV			
C30	Ceramic	470pF	50WV	±10%		SCP-50
			CRYSTAL/TRIMMER/CONNECTOR/PROGRAM CONTROLLER/P.C. BOARD			
X-1	Crystal (6.4MHz)					
TC-1	Ceramic Trimmer 20pF				C-0729	ECV-1ZW20X53
	Program Controller P.C. Board Assembly					GE-22A-6713
JA1-8	P.C. Board Connector				J-6491	5048-08A
JB1-10	P.C. Board Connector				J-4541	5048-10A
JC1-6	P.C. Board Connector				J-4542	5048-06A
JD1-11	P.C. Board Connector				J-4543	5048-11A
JE1-12	P.C. Board Connector				HB-5493	5048-12A
JF1-7	P.C. Board Connector				J-4544	5047-7
JG1-8	P.C. Board Connector				J-6490	5047-8

NOTE : *On some units 16 pin IC Sockets (Mfr's P/N C841602) are used for IC14 ~ IC18.*

Ref. No.	Description				RS Part Number	MFR's Part Number
			RESISTORS			
R1	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R2	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R3	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R4	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R5	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R6	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R7	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R8	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R9	Carbon film	1.5KΩ	1/4W	±5%	NEE0206	ERD-25VJ-152
R10	Carbon film	82Ω	1/4W	±5%	NEE0122	ERD-25VJ-820
R11	Carbon film	82Ω	1/4W	±5%	NEE0122	ERD-25VJ-820
R12	Carbon film	82Ω	1/4W	±5%	NEE0122	ERD-25VJ-820
R13	Carbon film	82Ω	1/4W	±5%	NEE0122	ERD-25VJ-820
R14	Carbon film	82Ω	1/4W	±5%	NEE0122	ERD-25VJ-820
R15	Carbon film	82Ω	1/4W	±5%	NEE0122	ERD-25VJ-820
R16	Carbon film	82Ω	1/4W	±5%	NEE0122	ERD-25VJ-820
R17	Carbon film	82Ω	1/4W	±5%	NEE0122	ERD-25VJ-820
R18	Carbon film	3.3KΩ	1/4W	±5%	NEE0230	ERD-25VJ-332
R19	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R20	Carbon film	1.5KΩ	1/4W	±5%	NEE0206	ERD-25VJ-152
R21	Carbon film	1.5KΩ	1/4W	±5%	NEE0206	ERD-25VJ-152
R22	Carbon film	1.5KΩ	1/4W	±5%	NEE0206	ERD-25VJ-152
R23	Carbon film	1.5KΩ	1/4W	±5%	NEE0206	ERD-25VJ-152
R24	Carbon film	1.5KΩ	1/4W	±5%	NEE0206	ERD-25VJ-152
R25	Carbon film	1.5KΩ	1/4W	±5%	NEE0206	ERD-25VJ-152
R26	Carbon film	1.5KΩ	1/4W	±5%	NEE0206	ERD-25VJ-152
R27	Carbon film	68KΩ	1/4W	±5%	NEE0354	ERD-25VJ-683
R28	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R29	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R30	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R31	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R32	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R33	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R34	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R35	Carbon film	3.3KΩ	1/4W	±5%	NEE0230	ERD-25VJ-332
R36	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R37	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R38	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R39	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R40	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R41	Carbon film	6.8KΩ	1/4W	±5%	NEE0262	ERD-25VJ-682
R42	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R43	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R44	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R45	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R46	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R47	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R48	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R49	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R50	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222

Ref. No.	Description				RS Part Number	MFR's Part Number
R51	Carbon film	5.6KΩ	1/4W	±5%	NEE0257	ERD-25VJ-562
R52	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R53	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R54	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R55	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R56	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R57	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R58	Carbon film	680Ω	1/4W	±5%	NEE0183	ERD-25VJ-681
R59	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R60	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R61	Carbon film	470Ω	1/4W	±5%	NEE0169	ERD-25VJ-471
R62	Carbon film	100KΩ	1/4W	±5%	NEE0371	ERD-25VJ-104
R63	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
R64	Carbon film	4.7KΩ	1/4W	±5%	NEE0247	ERD-25VJ-472
R65	Carbon film	3.3KΩ	1/4W	±5%	NEE0230	ERD-25VJ-332
R66	Carbon film	330Ω	1/4W	±5%	NEE0159	ERD-25VJ-331
R67	Carbon film	330Ω	1/4W	±5%	NEE0159	ERD-25VJ-331
R68	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R69	Carbon film	3.3MΩ	1/4W	±5%	NEE0458	ERD-25VJ-335
R70	Carbon film	2.2KΩ	1/4W	±5%	NEE0216	ERD-25VJ-222
R71	Carbon film	1KΩ	1/4W	±5%	NEE0196	ERD-25VJ-102
	SEMICONDUCTORS					
Q1	Transistor	Silicon				2SC732(BL)
Q2	Transistor	Silicon				2SC732(BL)
Q3	Transistor	Silicon				2SC1815(GR) or 2SC373
D1	Diode	Silicon			DX-0150	HV-80
D2	Diode	Silicon			DX-0150	HV-80
D3	Diode	Silicon			DX-0150	HV-80
D4	Diode	Silicon			DX-0150	HV-80
D5	Diode	Silicon			DX-0150	HV-80
D6	Diode	Silicon			DX-0150	HV-80
D7	Diode	Silicon			DX-0150	HV-80
D8	Diode	Silicon			DX-0150	HV-80
D9	Diode	Silicon			DX-0150	HV-80
D10	Diode	Silicon			DX-0150	HV-80
D11	Diode	Silicon			DX-0150	HV-80
D12	Diode	Silicon			DX-0150	HV-80
D13	Diode	Silicon			DX-0150	HV-80
IC-1	Integrated circuit				MX-0002	SN75492
IC-2	Integrated circuit				MX-0002	SN75492
IC-3	Integrated circuit				MX-0001	SN75491
IC-4	Integrated circuit				MX-0001	SN75491
IC-5	Integrated circuit				MX-3480	MM74C200N
IC-6	Integrated circuit				MY-3480	MM74C200N
IC-7	Integrated circuit				MX-3475	SMP7609A
IC-8	Integrated circuit				MX-3474	SN74157N
IC-9	Integrated circuit				MX-3473	SN74175
IC-10	Integrated circuit				MX-3472	SN74174
IC-11	Integrated circuit				MX-3472	SN74174
IC-12	Integrated circuit				MX-3472	SN74174
IC-13	Integrated circuit				MX-3472	SN74174

Ref. No.	Description	RS Part Number	MFR's Part Number
IC-14	Integrated circuit	MX-3247	MC4016P
IC-15	Integrated circuit	MX-3247	MC4016P
IC-16	Integrated circuit	MX-3247	MC4016P
IC-17	Integrated circuit	MX-3247	MC4016P
IC-18	Integrated circuit	MX-3247	MC4016P
IC-19	Integrated circuit	MX-3252	MC12014P
IC-20	Integrated circuit	MX-3251	MC12013P
IC-21	Integrated circuit	MX-3249	MC4044P
IC-22	Integrated circuit	MX-3365	TC5082P
IC-23	Integrated circuit	MX-3471	SN74LS192
IC-24	Integrated circuit	MX-3479	SN74LS00
IC-25	Integrated circuit	MX-0548	TA-58

SWITCH P.C.BOARD PARTS LIST

Ref. No.	Description				RS Part Number	MFR's Part Number
	CONNECTORS/SWITCH P.C. BOARD					
JB1-10	P.C.B. Connector				J-4537	5047-10
JC1-6	P.C.B. Connector				J-4538	5047-6
JD1-11	P.C.B. Connector				J-4539	5047-11
JH1-12	P.C.B. Connector				J-4540	5047-12
	Push switch				S-7347	16F0-0001BF-2020
	Switch P.C. Board Assembly				X-7631	GE-22A-6709
	SEMICONDUCTORS/RESISTOR					
D1	Diode	Germanium			DX-0161	1N60
D2	Diode	Germanium			DX-0161	1N60
D3	Diode	Germanium			DX-0161	1N60
D4	Diode	Germanium			DX-0161	1N60
D5	Diode	Germanium			DX-0161	1N60
D6	Diode	Germanium			DX-0161	1N60
D7	Diode	Germanium			DX-0161	1N60
D8	Diode	Germanium			DX-0161	1N60
D9	Diode	Germanium			DX-0161	1N60
D10	Diode	Germanium			DX-0161	1N60
D11	Diode	Germanium			DX-0161	1N60
D12	Diode	Germanium			DX-0161	1N60
D13	Diode	Germanium			DX-0161	1N60
D14	Diode	Germanium			DX-0161	1N60
D15	Diode	Germanium			DX-0161	1N60
D16	Diode	Germanium			DX-0161	1N60
D17	Diode	Germanium			DX-0161	1N60
IC-1	Integrated circuit				MX-3477	SN74159
IC-2	Integrated circuit				MX-3476	SN74LS05
IC-3	Integrated circuit				MX-3476	SN74LS05
R1	Carbon film	680Ω	1/4W	±5%	NEE0183	ERD-25TJ-681
R2	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101
R3	Carbon film	100Ω	1/4W	±5%	NEE0132	ERD-25VJ-101

FREQUENCY P.C.BOARD PARTS LIST

Ref. No.	Description	RS Part Number	MFR's Part Number
	CONNECTORS/LED		
D1	LED	L-0860	TLR312
D2	LED	L-0860	TLR312
D3	LED	L-0860	TLR312
D4	LED	L-0860	TLR312
D5	LED	L-0860	TLR312
D6	LED	L-0860	TLR312
D7	LED	L-0860	TLR312
JG1-8	P.C. Board connector	J-6491	5048-08A
JF1-7	P.C. Board connector	J-6490	5048-07A
	FREQ. Display P.C. Board Assembly	X-7632	GE-22A-6710

KEYBOARD PARTS LIST

Ref. No.	Description	RS Part Number	MFR's Part Number
D1	LED	L-0740	TLR-104C or TLR-104D
	Key board	K-2822	SCF56031
JH1-12	P.C. Board connector		5048-12A
	Key Board P.C. Board Assembly	X-7633	GE-22A-6711

CHANNEL DISPLAY P.C.BOARD PARTS LIST

Ref. No.	Description	RS Part Number	MFR's Part Number
D1	LED	L-0740	TLR-104C or TLR-104D
D2	LED	L-0740	TLR-104C or TLR-104D
D3	LED	L-0740	TLR-104C or TLR-104D
D4	LED	L-0740	TLR-104C or TLR-104D
D5	LED	L-0740	TLR-104C or TLR-104D
D6	LED	L-0740	TLR-104C or TLR-104D
D7	LED	L-0740	TLR-104C or TLR-104D
D8	LED	L-0740	TLR-104C or TLR-104D
D9	LED	L-0740	TLR-104C or TLR-104D
D10	LED	L-0740	TLR-104C or TLR-104D
D11	LED	L-0740	TLR-104C or TLR-104D
D12	LED	L-0740	TLR-104C or TLR-104D
D13	LED	L-0740	TLR-104C or TLR-104D
D14	LED	L-0740	TLR-104C or TLR-104D
D15	LED	L-0740	TLR-104C or TLR-104D
D16	LED	L-0740	TLR-104C or TLR-104D
	CH. Display P.C. Board Assembly	X-7634	GE-22A-6712

CHASSIS ASSEMBLY PARTS LIST

Ref. No.	Description	RS Part Number	MFR's Part Number
	MISCELLANEOUS		
①	Antenna supporter		GE-13C-890
②	Antenna jack	J-0566	JA-C-20
③	Battery box	B-0307	GE-21D-5728
④	Case (bottom)	Z-3275	GE-21B-5724
⑤	Case (top)	Z-3275	GE-21B-5723
⑥	Car mounting bracket	MB-0160	GE-21C-5725
⑦	Car mounting bracket screw (L=12m/m)	HD-1234	GE-16D-3166
⑧	Chassis		GE-22A-6541
⑨	Escutcheon Assembly		GE-22A-6706
	Front Escutcheon		GE-22B-6459
	LED window		GE-22B-6461
	Inside Escutcheon		GE-22B-6460
	Escutcheon fiber		GE-22D-6677
⑩	Fuse holder	F-1069	S-N1301
⑪	IF/RF P.C. Board		GE-22B-6311
⑫	Program controller P.C. Board		GE-22B-6485
⑬	Switch P.C. Board		GE-22C-6488
⑭	Frequency display P.C. Board		GE-22D-6487
⑮	Channel display P.C. Board		GE-22C-6488
⑯	Power transformer	TA-0655	TK1170
⑰	Not used		
⑱	EXT. Speaker jack	J-0030	SG-7615
⑲	Key board	S-4529	EP-100715ST
⑳	Speaker	S-4592	EP-100715ST
㉑	Volume 50KΩA	P-1848	VM11A-50KA-20A
㉒	Squelch 50KΩA	P-0818	VM10A-50KB-20A
㉓	Foot		No. 7101
㉔	Volume knob	K2381/ 2823	GE-22D-5313
㉕	Squelch knob	K2381/ 2823	GE-22D-5313
	Auto manual switch	S-5051	MLS-G-1(WHT)
	AC Cord	W-1973	6 feet UL
	Battery notice label		GE-21D-5859
	Bonnet himelon		GE-21D-5911
	Bonnet pad		GE-21D-5981
	Battery snap		1 Type
	Battery box cover	DB-0172	GE-21D-5529
	Cord binder		No. 5121
	Caution label		GE-15D-1940
	Cord holder		GE-18D-1215
	Cord band		No. 5125
	Delay switch	S-5052	MLS-A-2-2(WHT)
	DC cable ass'y		GE-22A-6705
	Fuse 1A UL listed		
	Front end shield plate		GE-22D-6637
	Front end shield fiber		GE-22D-6638
	Heat sink		GE-21D-5721
	Handle spacer		GE-19D-4815
	Line cord strain relief		SR-3P-4
	Lever switch himelon		GE-20D-5090
	Low pass filter shield plate		GE-22D-6682
	Low pass filter shield fiber		GE-22D-6681
	Model label		GE-22D-6572

Ref. No.	Description	RS Part Number	MFR's Part Number
	Nyron bushing		OCB-500
	Push knob (channel switch knob)	K-2824	GE-22D-6578
	Poly case		GE-22B-6576
	RF shield plate		GE-22D-6575
	Switch P.C.B. hanger		GE-21C-5728
	Knob spacer (5.5ϕ × 12ϕ (BLK))		
	Speaker pad		GE-21D-5982
	3P DC jack	J-0929	No. 1476
	Tape out jack	J-0801	LR205-2
	VCO shield plate		GE-22D-6574
	VCO shield fiber		GE-22D-6877
JA1-8	P.C. Board Connector		5047-08
JE1-12	P.C. Board Connector		5047-12

APPENDIX

VHF-MID Band Alignment for European/Australian models

FREQUENCY PROGRAMMING FOR ALIGNMENT PREPARATION

Before starting alignment, program the following frequencies into channel 1 through 3 instead of those stated on Page 13.

Receive Frequency	VCO Frequency (TP-6)	VCO Lock Voltage (TP-4)
VHF Mid		
CH 1 68 MHz	78.700 MHz	0.7 V
CH 2 78 MHz	88.700 MHz	2.7 ± 0.2V
CH 3 88 MHz	98.700 MHz	6.0 V

VCO ALIGNMENT

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

Step 1: Connect a DC VTVM to TP-4 and ground, and a Frequency Counter to TP-6 and ground.
Step 2: Select Channel 3 and adjust TC-2 for 6.0V on the DC VTVM. The Frequency Counter should read 98.700000 MHz ± 100 Hz.
Step 3: Next, select Channel 1 and adjust T8 for 0.7V on the DC VTVM. The Frequency Counter should read 78.700000 MHz ± 100 Hz.
Step 4: Repeat Steps 2 and 3 until no improvement is observed. Make sure that the Frequency Counter reads 78.700000 MHz for Channel 1, 98.700000 MHz for Channel 3.
Step 5: Select Channel 2, the DC VTVM should slow 2.7V ± 0.2V and Frequency Counter should show 88.700 MHz ± 100 Hz. If the frequency is over ±100 Hz readjust TC-1 on the PROGRAM CONTROLLER P.C. BOARD (Not on RF/IF P.C. BOARD). Then recheck Steps 1 ~ 4.

RF AMP ALIGNMENT

VHF MID BAND

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

Step 1: Connect instruments as shown below.
Step 2: Select Channel 1 with the MANUAL switch.
Step 3: Adjust T5. T6 and T7 so that the 68 MHz marker is in the center of the curve and for maximum output.
Step 4: Make sure that the output curves are similar to Figure below (for Channels 1 thru 3).

NOTE 1: *It is difficult to track these 3 different frequencies – differences of up to –6 dB are acceptable.*
NOTE 2: *Set the sweep generator as follows:*
Marker frequency to 68, 78 and 88 MHz.
Sweep bandwidth to 78 ± 15 MHz.
Input signal from the sweep generator should be kept as low as possible and still obtain usable output.

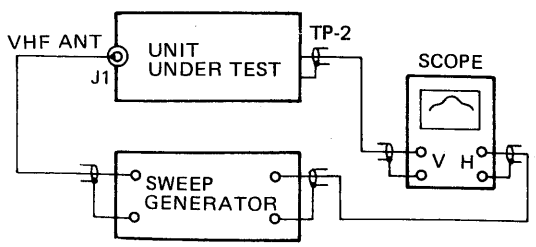


FIGURE 5

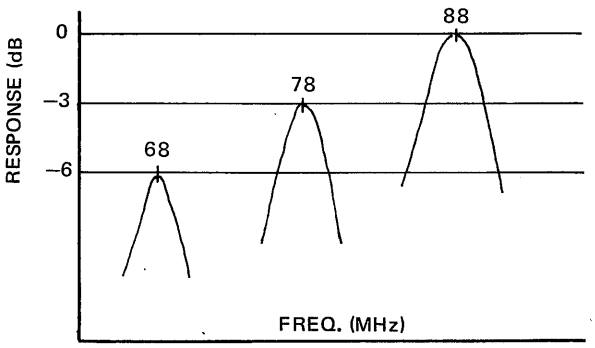


FIGURE 6

Following revisions to be made on Parts List

RF/ IF P.C. BOARD PARTS LIST

Page 41

Ref. No.	Description				RS Part Number	MFR's Part Number
C25	Ceramic	27pF	50WV	±10%		FC-50
C29	Ceramic	27pF	50WV	±10%		FC-50
C30	Ceramic	27pF	50WV	±10%		FC-50
C31	Ceramic	0.5pF	50WV	±0.25pF		AK-50
C33	Ceramic	3pF	50WV	±0.5pF		FC-50
C37	Ceramic	47pF	50WV	±10%		FC-50
C38	Ceramic	20pF	50WV	±10%		FC-50
C39	Ceramic	47pF	50WV	±10%		FC-50
C40	Ceramic	5pF	50WV	±0.5pF		FC-50

Page 44

T5	MID RF Transformer		GR-N533
T6	MID RF Transformer		GR-N533
T7	MID RF Transformer		GR-N533

Page 48

D8	Not used		

PROGRAM CONTROLLER P.C.BOARD PARTS LIST

Page 52

D14	Diode Germanium		1N60

SWITCH P.C. BOARD PARTS LIST

Page 53

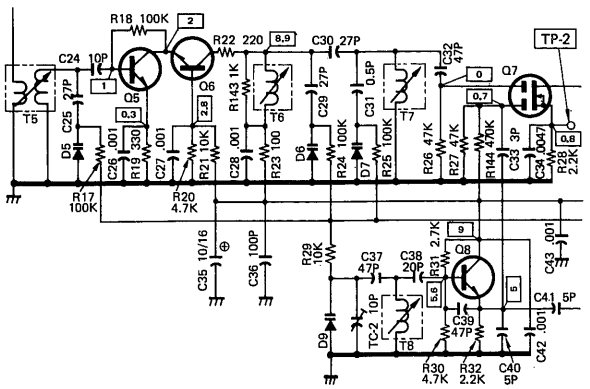
D18	Diode Germanium		1N60

CHASSIS ASSEMBLY PARTS LIST

Page 55

⑯	Power transformer		K6096
	AC Cord		HAR CLASS2
	Model label		GE-22D-6908
BTF-1	Trap filter		20LTR-141
R1	Not used		

RF/ IF P.C. BOARD MID BAND FRONT-END SCHEMATIC DIAGRAM



EXPLODED VIEW