# SERVICE MANUAL

# Bearcat III

## FM MONITOR RECEIVER

### MODEL BC 3-L, H, U, T, L/H, L/U, H/U, L/T, H/T

MADE IN U.S.A.


Patent No. 3, 531, 724

Electra COMPANY

DIVISION OF MASCO CORPORATION

CUMBERLAND, INDIANA 46229

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## GENERAL DESCRIPTION

The Bearcat III is a table and mobile model, single or dual band FM monitor receiver providing automatic scanning of 8 channels in one or two of the three Public Safety/Business Bands at 30-50MHz, 146-174MHz and 450-512MHz.

Its features include: provisions for one or two plug-in RF modules; 8 plug-in crystals in any combination may be used; high speed automatic or manual scanning; channel switches to omit scanning of undesired channels; solid state Light Emitting Diode channel indicators; combination squelch and sensitivity control; front-mounted 3" x 5" speaker; external speaker jack; cables for 117Vac or 12Vdc operation; and operation from a single telescoping or outside antenna.

The most advanced developments in solid state circuitry are incorporated in this receiver; dual-gate MOS Field Effect RF and mixer transistors provide low noise and low cross-modulation. Single conversion into monolithic quartz crystal I-F filters reduces spurious responses and radiation and improves selectivity; linear integrated circuits provide I-F gain, detection, audio amplification and output; TTL I.C. multivibrators and gates provide scanning logic; desired channels are scanned with no time lost scanning unwanted channels.

## SPECIFICATIONS

**Size:** 9"W x 3 5/8"H x 6 1/8"D

**Weight:** 5 lbs.

**Cabinet:** Heavy duty vinyl-clad steel. Non-sliding feet.

**Power Requirements:** 117Vac, 12W; 13.8Vdc, 6W.

**Audio Output:** 3W rms, voice (Power protected at 1.5W on continuous tones). External speaker connector provided.

**Antenna:** Telescoping antenna (supplied). Connector provided for outside or mobile antenna.

**Input Impedance:** 50-70 ohms.

**Sensitivity:** H and L bands: readable at .25 microvolt for ±5KHz deviation, .7 microvolt for 20 db signal-to-noise ratio: U Band slightly less.

**Channels:** Up to 8 crystal-controlled channels (in one or two bands) may be scanned automatically or selected individually or in any combination.

**Frequency Range:**

| | | |
|---|---|---|
| Low Band: | * | 30-50 MHz, total spread 15 MHz |
| High Band: | * | 146-174 MHz, total spread 24 MHz |
| UHF Band: | | 450-470 MHz, total spread 20 MHz |
| T Band: | | 470-512 MHz |

(*Factory-supplied alignment for Low band is 33-48 MHz. High band is supplied with 150-174 MHz alignment. Other alignments are available on special request.)

**Scan Rate:** Approximately 25 channels per second.

**Crystals:** Miniature plug-in type HC-25/U for easy user installation.

**Accessories Supplied:** All-band telescoping antenna / Universal mobile mounting bracket / 117 Vac power cable / 13.8 Vdc power cable (Connects to "Accessory" or "Radio" fuse block. FOR USE WITH NEGATIVE GROUND SYSTEMS ONLY).

**Front Panel Features:** Squelch control / Volume On-Off control / combined Manual-Scan Channel Select Switch / 8 channel switches / 8 Light Emitting Diode channel indicators / Forward-facing 3" x 5" speaker.

**Listed by Underwriters' Laboratories, Inc.**
**Certified under FCC Reg. Part 15**

## INSTALLATION INSTRUCTIONS

This receiver is shipped complete with the necessary accessories for mobile or table use. As a fixed receiver in areas of fair-to-good signal strength, the telescoping whip antenna supplied, may be used on all bands.

If an outside antenna is necessary for fringe reception, you may use a 155MHz antenna on all bands, a 40MHz antenna for L and L/H models or a 460MHz antenna on U models only. External antennas should be coupled to the receiver by 50 ohm coaxial cable, such as RG-58 A/U, using the supplied automotive type connector. Suitable antennas are available at most radio dealers.

The noise generated by the auto electrical system and other parts of the car is sometimes a problem, particularly in areas of low signal strength. The subject of noise elimination is too lengthy to deal with adequately in this instruction book.

It is recommended for those who wish to become familiar with the subject to purchase "The Radio Amateur's Handbook" or "The Mobile Manual" published by the American Radio Relay League and sold by most electronic parts stores. It is further recommended that the vehicle be taken to a service center which specializes in VHF-UHF two way radio communications equipment for correction of a noise problem.

## MOBILE INSTALLATION

This receiver may be installed in any car, truck, boat, etc., having a 12 VOLT NEGATIVE GROUND SYSTEM.

In some areas it is illegal for unauthorized persons to receive police communications on a mobile receiver. The user of this radio is responsible for obtaining any necessary authorization through local agencies and Electra Company cannot be responsible for any illegal installation or usage.

1. Place the mobile mounting bracket under the dash to hold the receiver in the desired position.
2. Mark and drill two holes using a 7/64 drill bit and secure the bracket with the No. 6 self-tapping screws.
3. Insert the two plastic "T" washers, flanges turned inward, in the desired pair of mounting holes and secure the receiver in place with the two ¼-20 bolts and two ¼" ID x 9/16" OD flat washers.
4. Attach the DC power cable and connect it to the "accessory" or "radio" terminal on the fuse block.
5. External mobile antennas may be used as described above. The automotive antenna may be used fully extended for L, H or L/H models. It should be reduced to approximately 18" for U models.

## OPERATION

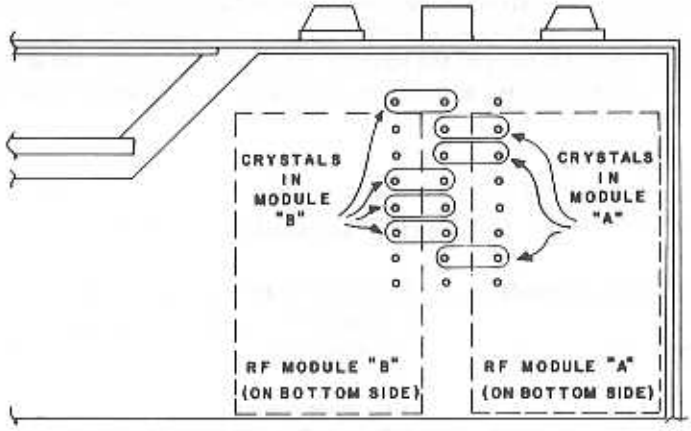
1. With the power cable and antenna properly connected, turn the receiver ON by rotating the "VOLUME" control clockwise.
2. Place the 8 channel switches in the up (ON) position.
3. Set the "MANUAL-SCAN" switch on "MANUAL."
4. Adjust the "SQUELCH" control clockwise until the rushing noise is heard. Then adjust the "SQUELCH" control counter-clockwise until the rushing noise disappears.
5. Press the "MANUAL-SCAN" switch downward and continue to step through all channels. If the noise should "break the squelch" on any channel, adjust the squelch control counterclockwise again slightly to quiet the receiver. THIS MUST BE DONE BETWEEN STATION TRANSMISSIONS.
6. The "MANUAL-SCAN" switch may now be used to select and monitor any desired channel.
7. To sample all channels automatically, return the "MANUAL-SCAN" switch to "SCAN." Any channel may be omitted as desired by moving the individual channel switch downward (off).

## CRYSTAL INSTALLATION

**(Disconnect power before removing cabinet / leave power off while installing crystals.)**

To remove the cabinet, first remove the screw at the bottom rear edge. Push the rear panel forward through the cabinet. The components and crystal sockets are in full view and easily accessible.

The three crystal pin sockets at the front are for channel No. 1. The second row of 3 is for channel 2 etc. Each crystal will be installed between the center row and one outside row. The outside rows connect to the r-f module nearest them on the opposite side of the board. Only one outside row will be used when only one r-f module is used. A total of eight crystals may be used. They may be installed in any order and in either band as long as each crystal frequency is proper for the particular module to which it is connected.




L, H or U modules may be in either position.

Figure 1

Remove the crystal by a gentle pull upward. Insert the crystal by aligning the pins with the sockets and pushing straight down. DO NOT BEND THE SOCKETS. THESE MINIATURE SOCKETS ARE MADE OF SPRING BRONZE AND WILL BREAK OFF IF BENT EXCESSIVELY.

**NOTE: Do not install two crystals of the same frequency.**

Rigid quality standards are applied to crystals furnished by Electra Company to assure full performance, therefore our warranty does not include correcting poor operation caused from other sources.

Unless ordered otherwise the "U" alignment spread is 450MHz to 470MHz, the "H" 150MHz to 174MHz, and the "L" 33MHz to 48MHz. New frequencies may be added within these spreads.

## CRYSTAL FORMULAS

"H" $\frac{\text{Received frequency - 10.80 MHz}}{3} = \text{crystal frequency}$

Example: $\frac{155.01 \text{ MHz} - 10.80 \text{ MHz}}{3} = 48.07000 \text{ MHz}$

"L" Received frequency + 10.80 MHz = crystal frequency

Example: 35.80 MHz + 10.80 MHz = 46.60000 MHz

"U & T" $\frac{\text{Received frequency - 10.80 MHz}}{9} = \text{crystal frequency}$

Example: $\frac{453.250 \text{ MHz} - 10.80 \text{MHz}}{9} = 49.16111 \text{ MHz}$

## USER HINTS

Radio equipment usually operates in an environment of man-made electro-magnetic noise which radiates from power lines, fluorescent lights, motors, appliances, ignition systems, etc. Modern radios are designed to minimize interference from such sources but operation may be affected under conditions of unusually strong noise.

Distant weak, "skip" or noise signals may be received by this receiver because of its high sensitivity. Whenever such conditions interrupt scanning or whenever a very busy channel prevents reception of other desired signals, the affected channel may be by-passed by means of its individual panel switch.

*(Continued on page 4)*

*Continued from page 3*

The squelch control functions in the normal manner and, in addition, as it is rotated counterclockwise farther, it becomes a sensitivity control. By careful setting, it can accept weak signals or can be adjusted to receive only medium or strong signals. Interference from weak signals on the same channel may be reduced in this manner.

In cases of strong interfering noise or signals it may be desirable to reduce the length of the antenna to reduce noise pickup below a critical level. This may be very effective in medium and strong signal areas.

Single-channel operation may be obtained as described under Operating Instructions. It may also be accomplished with the "MANUAL-SCAN" switch in either position by locking out all but the desired channel. This assures that the radio will always be on that channel even when turned OFF and ON. Continuous-carrier signals such as the NOAA weather broadcasts on 162.55MHz, which are available in many areas, may be received when desired by use of the individual channel switches.

In mobile service the commonly encountered poor reception conditions are signal fading, nearby faulty ignition systems, power lines and proximity to strong signals. Careful setting of the squelch control will minimize these conditions.

When moving or shipping the radio, remove the telescoping antenna to avoid damage to it or to the internal circuit assemblies.

## RADIO SERVICES

Local Government
Highway Maintenance
Forestry-Conservation
Motion Pictures
Special Industrial
Telephone Maintenance
Automobile Emergency
Public Mobile Radio
Mobile Telephones

Special Emergency
—Hospitals
—Ambulances
—Physicians
—Disaster Relief
—School Buses
Power
Petroleum
Forest Products

Police
Fire
Press
Business
Railroad
Taxicab
Marine
Manufacturers
Motor Carrier
Rural Radio

## UL SAFETY REQUIREMENTS

UL safety requirements are designed in and their approval is obtained and maintained at considerable effort and expense, including regular factory inspections. This is also important in mobile applications, since the insurance companies cover burned automobiles as well as homes and businesses. Take care that service repairs do not cause hazards.

## FULL BAND COVERAGE

One outstanding feature of considerable significance that seems generally to have been very poorly understood is the full band coverage in each band.

This full band coverage was not obtained by simply widening up the front end of the radio to receive everything. Actually, the RF selectivity was reduced from some 12 or 15 megacycles as in the old models to 1 or 2 megahertz in the Bearcat III. Figure 1 is a graphic depiction of the spectrum of each of the three bands in question. The low band consists of approximately a thousand channels covering 20MHz between 30 and 50MHz, fifty channels per MHz. The high band, including the two meter ham band, has a total spread of 28MHz, approximately 1800 channels with 66 channels per MHz; and the UHF band from 450 to 470, a total of 20 MHz or 800 channels, 40 channels per MHz.

Let's use the low band for our examples. The conventional technique is shown by the dotted lines of Figure 2 where a spread of approximately 7 MHz is covered somewhere in the band. In this example, we show it from 33 to 40 MHz. A crystal may be turned on at 33 or 40 or at any channel in between and normal operation should result. A crystal turned on above 40 will have decreasing sensitivity and possibly not operate at all. In contrast, the circuitry of the Bearcat III causes the tuning of the front-end to follow the pattern of curve A when a crystal is turned on at 33MHz. When a 40MHz crystal is turned on, the tuning moves immediately to that of curve B and when a 48MHz crystal is turned on, the tuning moves immediately to curve C.

This automatic tuning provides not only the full sensitivity performance across the wide band spread, but also provides additional rejection to other signals in the band or strong signals outside the band. This "track-tuning" is accomplished by some very unusual circuitry on the RF modules. The antenna circuit, the adjustable coils, the voltage-variable capacitance diodes and the blue trimmer resistor are all precisely aligned simultaneously across the entire band. This same description applies generally to the H module, but the U module is much more conventional because of inherent broad band circuitry.

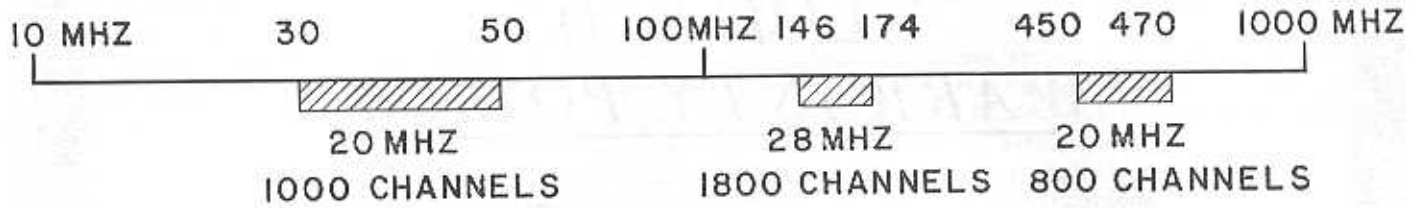



FIG. 1

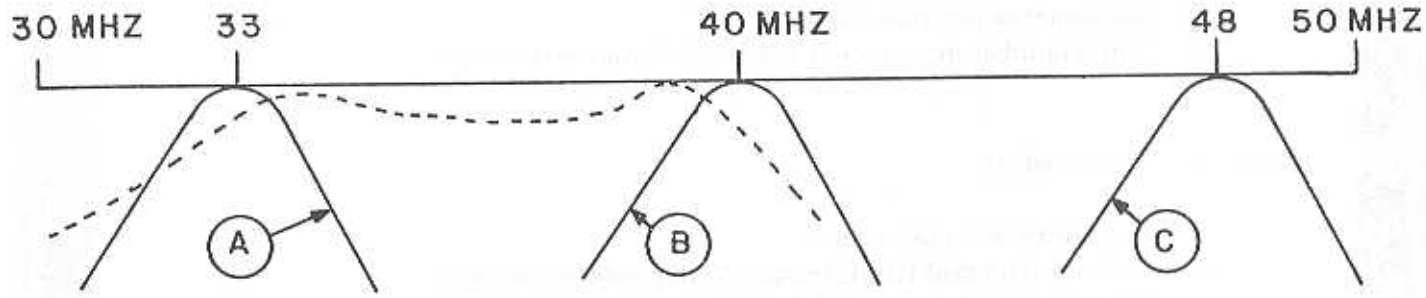



FIG. 2

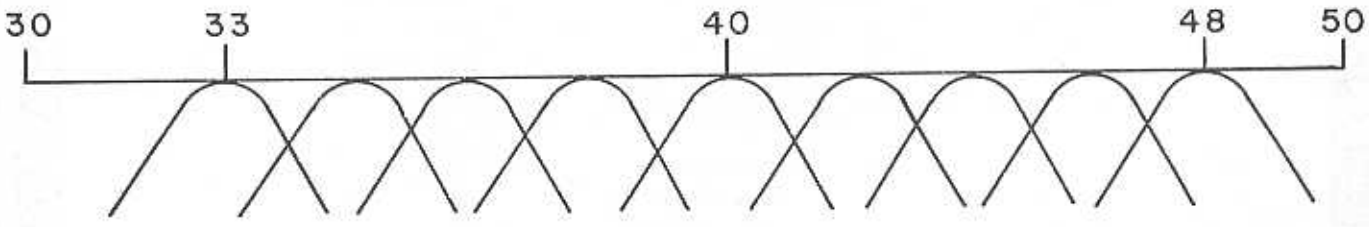



FIG. 2b

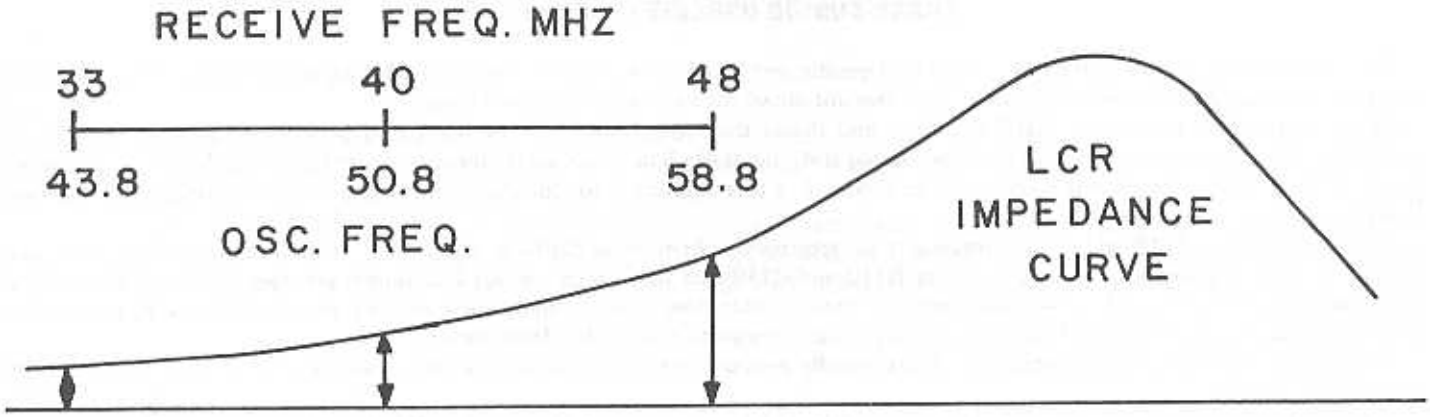



FIG. 3

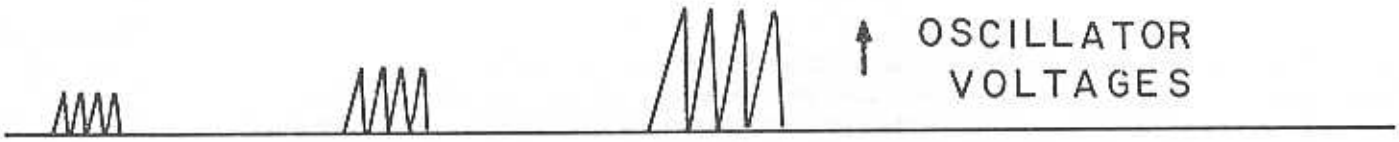



FIG. 4

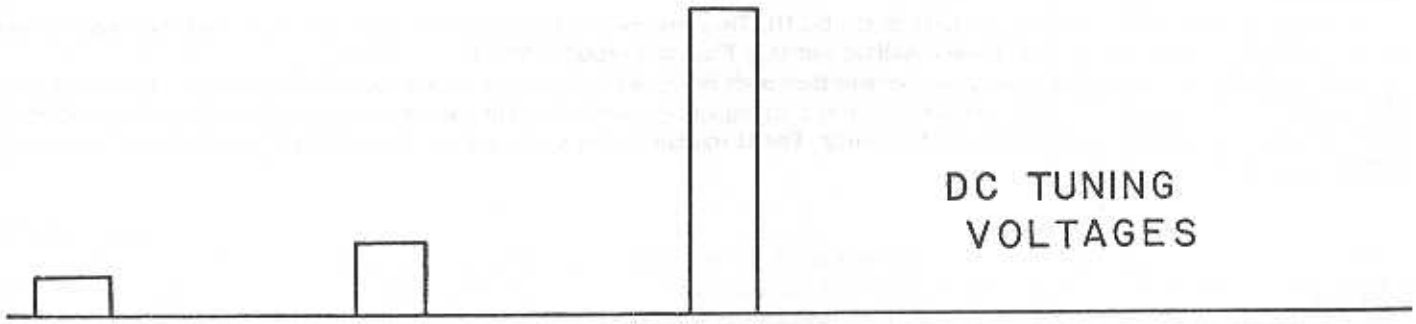



FIG. 5

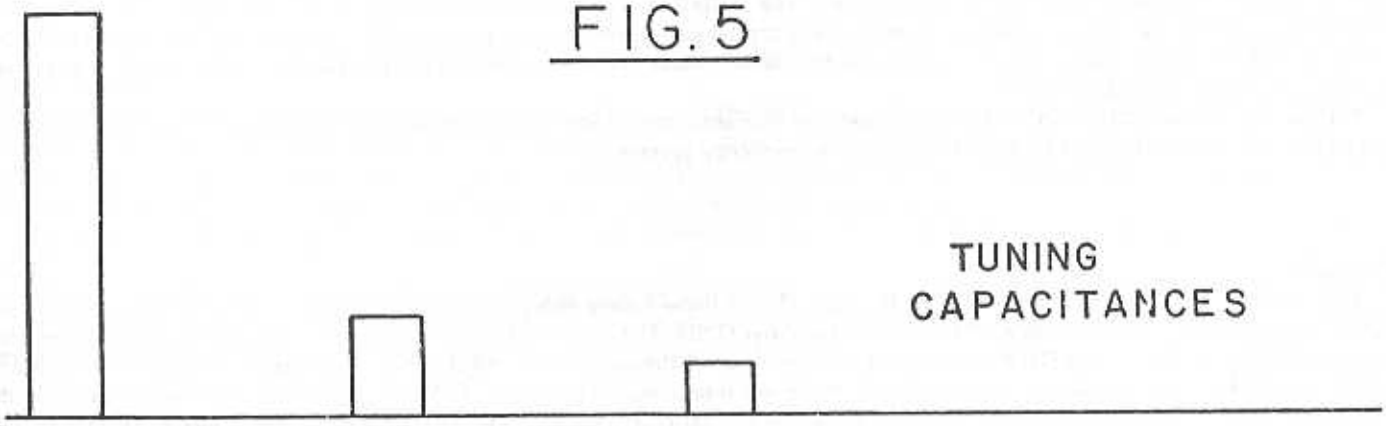



FIG. 6

## TRACK-TUNING (CIRCUIT DESCRIPTION)

To follow the track-tuning in detail, use the Schematic and figures 3, 4, 5 and 6. The LCR tracking circuit L105, C116 and R116 produces the impedance curve of Figure 3. It is resonant above the oscillator frequency range.

When a crystal is turned on, Q103 oscillates and drives the input, Pin 1, of the IC-101 to produce outputs at both Pin 5 and Pin 7. The output from Pin 7 is used for mixing and that at Pin 5 develops oscillator voltage across the tracking LCR circuit of the amplitude shown for various frequencies in Figure 4, a low amplitude for low frequencies and higher amplitudes for high frequencies.

Trimmer resistor R118 adjusts the threshold of detector-amplifier stage Q104 to rectify the desired amount of the oscillator voltage of Figure 4, amplify it as D-C across R119 and C118 and apply it as various D-C tuning voltages, shown in Figure 5, to VVC diodes C102 and C108. The capacitance of these diodes then varies in the inverse manner shown in Figure 6, providing a high capacitance to tune a lower frequency and lower capacitance to tune higher frequencies.

The entire automatic tuning sequence occurs rapidly enough that it can follow scanning rates far in excess of the normal 25 channels-per-second.

The 3H module performs in the same manner except the tuning voltage is applied to D1 to short out the low-band antenna loading coil and to C213 to track-tune the 3rd harmonic of the oscillator for mixing purposes.

## CIRCUIT DESCIPTION

### RF Modules

There are three basic RF modules available in the BC III. They may be used in any combination of one or two. The modules are the L module (30-50MHz), H module (146-174MHz) and U & T module (450-512MHz).

The L and H module circuitry is very similar and they both incorporate the use of a track-tuned RF system. A tuning voltage is generated in these modules through a crystal OSC and a tuning voltage generator. The tuning voltage tunes the front end and other stages in these RF modules to the received frequency. The U module incorporates a broad band RF design which will cover any 20MHz spread in the U or T bands.

### L Module

The received signal enters the L module through J2 and immediately enters a voltage-tunable tank circuit, L101 (brown coil) and C102 (tuning diode), which drives a MOSFET RF amplifier Q101. The output of this RF amplifier is another voltage-tunable tank circuit L102 (violet) and C108 (tuning diode). The output of this circuit drives mixer Q102 with output IF signal on J5 (10.8MHz). Q103 is the crystal oscillator transistor the crystal connection being made via J4. The output of the crystal oscillator drives IC-101 through bypass capacitor C114. IC-101 drives mixer Q102 through coupling capacitor C110 and tuning voltage generator circuit Q104 through Pin 5.

The adjustment of L105 and R118 determines the characteristic of the tuning voltage and when properly matched with the tuning of L101 and L102 provides a track-tuned radio frequency system.

### H Module

The received signal enters the H module through J2 and immediately enters a voltage - tunable tank C201 (orange coil) and C202 (tuning diode), which drives a MOSFET RF amplifier Q201. The output of this RF amplifier is another voltage-tunable tank circuit L203 (yellow coil) and C208 (tuning diode), which tunes the gate of RF mixer Q202. The output of Q202 mixer is the IF signal (10.8MHz), which makes connection with the main board assembly via J5. Q203 is the crystal oscillator transistor the crystal connection being made via J4. The output of the crystal oscillator drives IC-201 through bypass capacitor C215. IC-201 drives mixer Q202 through a voltage tuned trippler tank C213-214 and L205 via bypass capacitor C210. IC-201 also drives tuning voltage generator circuit Q204 through Pin 5.

The adjustment of L206 and R218 determines the characteristic of the tuning voltage and when properly matched with the tuning of L201, L203, L205 provides a track-tuned radio frequency system.

### U/T Module

The received signal enters the U/T module through J2 and is coupled into the input tank L301/C302 by way of C301. The signal then enters Q301 the RF amplifier and leaves through the tuned output tank L303/C307. The signal here is applied to mixer Q302 and into IF amplifier Q303 through J5 into main board IF.

Q304 is the crystal oscillator transistor, the crystal connection being made via J4. The output of this stage drives the first tripler through coupling capacitor C313. The output of the first tripler, Q305, drives the second tripler Q306 via collector tank circuit of 1st tripler Q305. The output of this tripler drives a tuned circuit C320 and L306 which drives the mixer FET Q302.

### BC III Main Board

The BC III Main Board is equipped to receive 2 RF modules (RF-A and RF-B) via P2, P3, P4, P5, P6, and P7. Pins P3 and P7 are ground. Pin P6 supplies power to the RF Module (+10v). Pin 4 makes crystal connection to oscillator. P2 is the RF input from the antenna — at this point the H and U modules supply a DC voltage to D1 via P2 to turn it on thus shorting out LI (the L band loading coil). P5 is the 10.8 IF output. This output drives a tuned IF tank T1 on the main board.

### Main Board IF Section

This circuitry includes T1, IC-1, FL1 and FL2, T2, T3 and IC-2. The IF signal enters the main board via P5. The IF signal is at 10.8MHz. The signal is tuned by 10.8MHz tank T1. The adjustment of this coal is primarily a peaking adjustment. The output of T1 is coupled through C5 and R42 into IF amplifier IC-1. The output is through a self-resonant choke L3 and into crystal band pass filter FL1 and FL2. It was designed to have a relatively flat band pass with very steeop skirts. To reject adjacent channel and other interference adjacent to the band pass frequency. The signal then enters T2. T2 is primarily a ripple adjustment. The signal then passes into IC-2, the IF limiting and a quadrature detector circuit. The discriminator adjustment is achieved by proper adjustment of T3.

### Main Board Audio Section

The audio de-emphasis is achieved in IC-2 with capacitor C15 (.01mf - 2.1KHz de-emphasis). The low level audio output is on Pin 1 of IC-2 and then goes to volume control POT R18 and squelch transistor Q5. The audio signal then enters audio amplifier IC-3, its output drives the speaker through C27.

### Scanning Circuitry

The heart of the scanning circuitry is the scanning oscillator Q7-Q8. Its output drives the counting D type flip-flops at Pin 11 of IC-4. IC-6 and IC-7 decode the output of IC-4 and IC-5 and turn on each LED at that specific count. Note: The outputs of IC-6 and IC-7 also sequentially ground one side of each crystal — so that crystal is enabled in the oscillator. When the squelch signal is enabled Q4 turns and disables the scanning oscillator through R26 at Q7.

### Squelch Circuitry

The squelch circuit in the BC III is a carrier squelch system. The detected RF carrier is the indication that a signal is being received. The carrier is detected in the IF at Pin 10 of IC-2. The detecting diode is D7. As the carrier level increases the voltage on TP2 becomes less positive. As the voltage on the base of Q3 goes more negative, the collector of Q3 goes greater than .7v— and turns Q4 on and stops scanning circuitry (via R26), on channel where carrier was detected.

The adjustment of the squelch control R11 varies the carrier level at which this will happen as well as varying the gain if IC-1 through D6 and R2.

When the channel switches are in the down position, skipping that channel, the output of IC-6 and IC-7 drives the base of Q6 low and turns it on for the channel that is skipped. This forces a much higher current through R25 which speeds up the scan oscillator, Q7 - Q8, so much that it appears that the channel was skipped.

## ALIGNMENT
### I-F Section

Alignment of the I-F system consists of optimizing the input and output networks and balancing the detector output. The bandpass and center frequency are established by quartz crystal filters and "peaking" the coils can result in bandpass ripple or poor sensitivity. Field alignment should not be necessary but the procedure is given for general information.

### EQUIPMENT NEEDED

**Oscilloscope**
**Sweep generator with 10.79, 10.80 and 10.81MHz markers**

1. Connect sweep generator to TP-1 through a lpf capacitor.
2. Connect oscilloscope to TP-2 and remove C36.
3. Maintain output of 10.8MHz sweep generator at a low level to prevent distortion from overloading.
4. Adjust T1 and T2 for maximum output, and minimum ripple. See Figure 2.

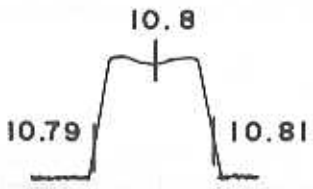



Figure 2

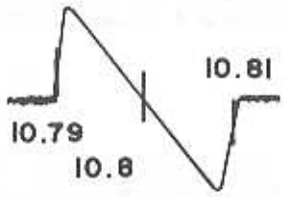



Figure 3

5. Connect scope to pin TP-3 and adjust T3 so that 10.8MHz is in center of discriminator curve and for best linearity. See Figure 3.

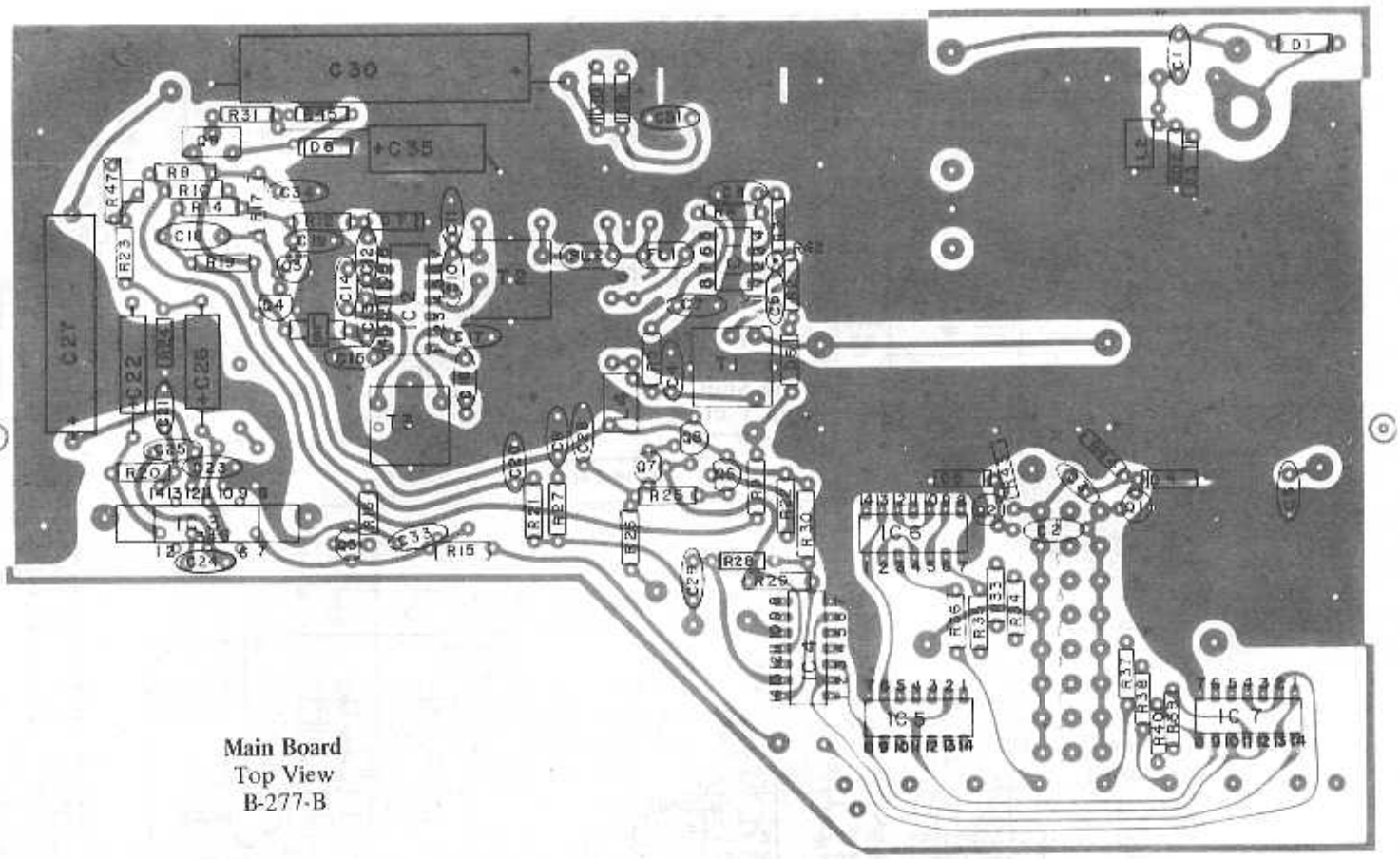
**ALTERNATE METHOD:** I-F alignment may be checked using a Measurements Model 800 Generator or equivalent tuned to an operating frequency and swept ±25kc. Markers are not essential since center frequency is determined by the filter.

### R-F SECTION

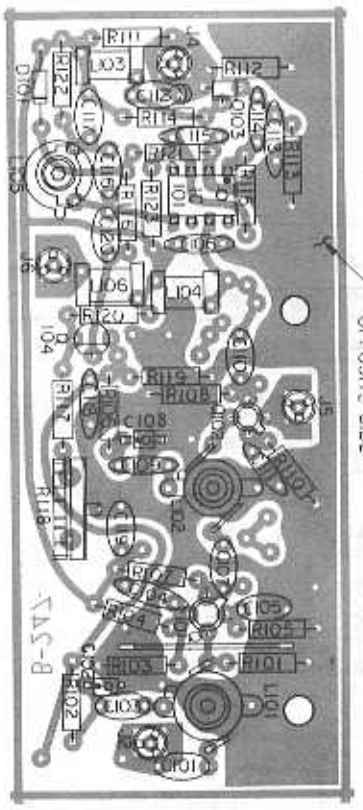
DO NOT ATTEMPT ALIGNMENT OR "PEAKING" OF R-F MODULES.

The R-F alignment points are adjusted and sealed at the factory and should not be disturbed. Factory alignment involves multi-frequency signal generation systems, add-on test modules, output indicators and training beyond the scope of normal service activities.

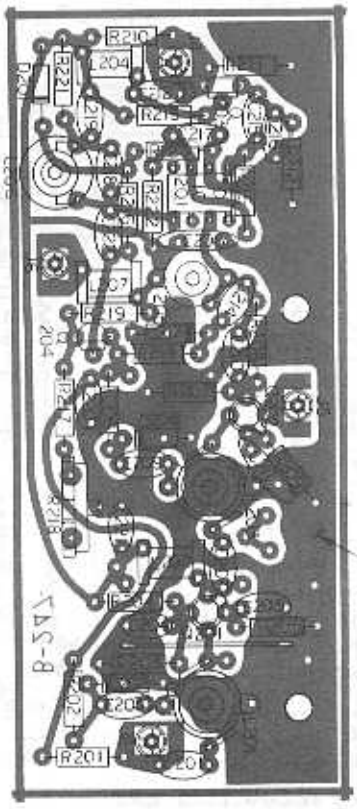
The unique R-F system includes electronic tracking of R-F and oscillator circuits for maximum performance over a wide range of frequencies. THIS PERFORMANCE CAN BE DESTROYED BY AN ATTEMPT TO "PEAK UP" OR "TWEAK" OR "OPTIMIZE," ETC.



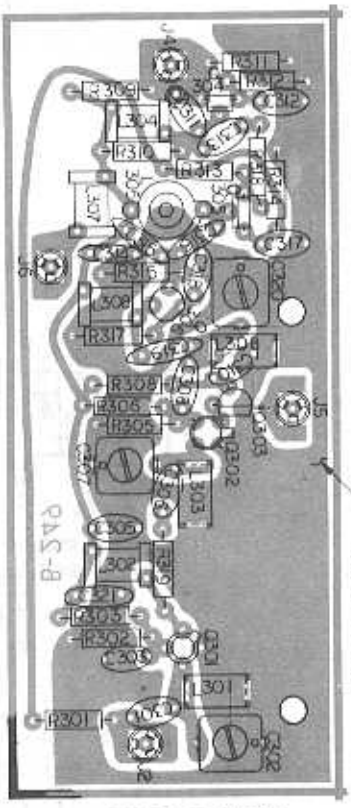

**Main Board**
Top View
B-277-B



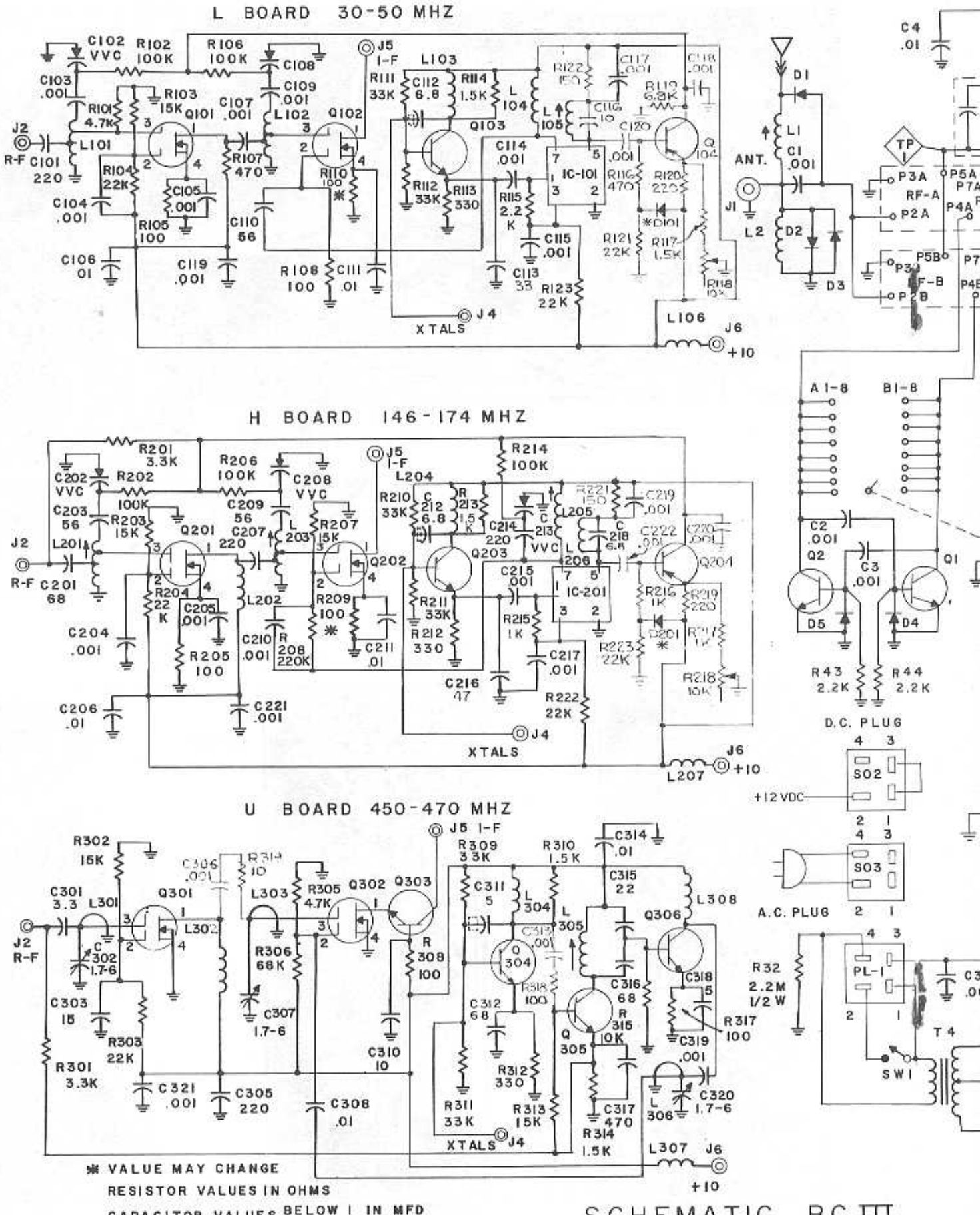

**LO BAND**
3 L MODULE
Top View
B-255-B




**HI BAND**
3 H MODULE
Top View
B-253-D




**UHF & T BAND**
3 U/T MODULE
Top View
B-250-B




* VALUE MAY CHANGE

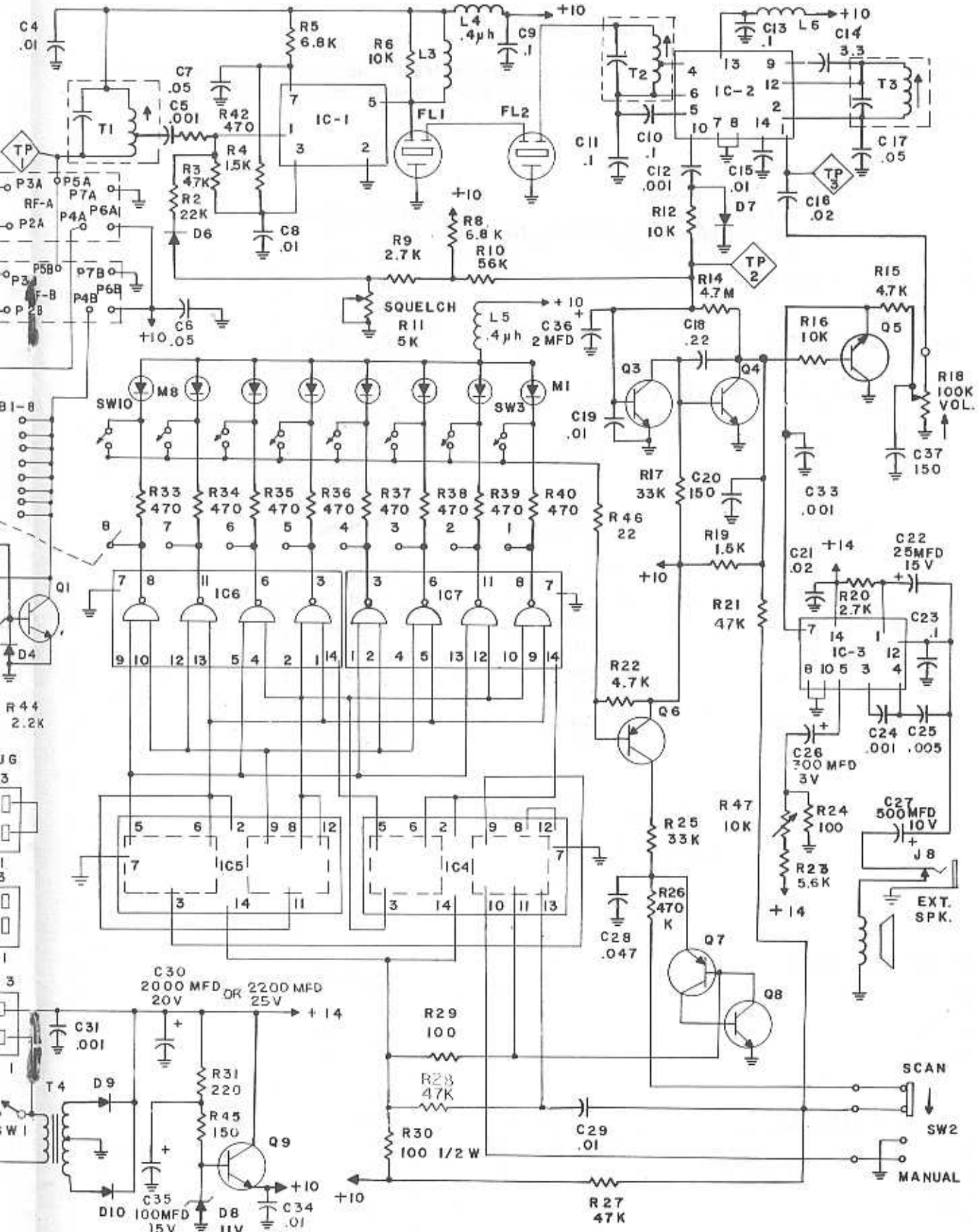
RESISTOR VALUES IN OHMS

CAPACITOR VALUES BELOW 1 IN MFD
ABOVE 1 IN pf

UNLESS OTHERWISE SPECIFIED

C-257-J

SCHEMATIC BC III




VALUE CHART FOR T—MODULE

| | MHZ | C306 | C308 | C312 | C315 | C316 | Q301 | L301 |
|---|---|---|---|---|---|---|---|---|
| T1 | 470-485 | | | | | | | |
| T2 | 475-495 | | | | 15PF | 100PF | | |
| T3 | 485-512 | 10PF | 10PF | 47PF | 15PF | 100PF | 3N204 | L303 |

## TEST STANDARDS

Our published specifications are conservative, especially relating to sensitivity. The H and L modules are listed, .7 microvolts for 20 db signal-to-noise ratio with +5KHz deviation. In our test department the limit is .6 microvolts with +3KHz deviation which is almost twice the advertised sensitivity as a limit.

## BC III TEST SPECIFICATIONS

**SQUELCH:** Lock in sensitivity at threshold equal to or less than the RF board sensitivity.

**HUM:** .005 volts maximum fully squelched.

**SENSITIVITY:** Measured in microvolts for 20 db signal-to-noise ratio

| | Low | Center | Hi |
|---|---|---|---|
| L Band | 30 mc<br>.6 | 40 mc<br>.6 | 50 mc<br>.6 |
| H Band | 150 mc<br>.6 | 160 mc<br>.6 | 170 mc<br>.6 |
| U Band | 450 mc<br>1.8 | 460 mc<br>1.4 | 470 mc<br>1.8 |
| T1 Band | 470 mc<br>1.6 | 478 mc<br>1.6 | 485 mc<br>2.0 |
| T2 Band | 475 mc<br>1.6 | 485 mc<br>1.6 | 495 mc<br>2.0 |
| T3 Band | 495 mc<br>1.6 | 504 mc<br>1.6 | 512 mc<br>2.0 |

## CRYSTAL FREQUENCY TOLERANCE

L +/- 2KC
H +/- 1.4KC
U +/- 600 cycles
T +/- 600 cycles

## RECEIVED FREQUENCY TOLERANCE

L +/- 2KC
H +/- 4.2KC
U +/- 5.4KC
T +/- 5.4KC

## VOLTAGE CHART

The Voltage Chart may be used as an approximate guide in following circuit operation or locating a defective stage. You should be familiar with the entire manual before attempting measurements.

| TRANSISTOR VOLTAGES | | | | |
|---|---|---|---|---|
| Q# | E | B | C | |
| ‡ 1 | GND | .2/0 | 0/3.2 | |
| ‡ 2 | GND | 0/.2 | 3.2/0 | |
| # 3 | GND | .4/.6 | .7/0 | |
| # 4 | GND | .7/0 | .01/9 | |
| † 5 | 0 | .01/.7 | GND | |
| † 6 | 10.2 | 10.2 | 4.0/.9 | |
| 7 | 4.0/.9 | 5.8 | .5 | |
| 8 | GND | .5 | 5.8 | |
| 9 | 11.0 | 11.5 | 16.0 | |
| 103 | 3.0 | 3.6 | 10.3 | |
| 104 | 7.4 | 10.0 | 9.6 | |
| 203 | 2.9 | 3.6 | 10.2 | |
| 204 | .6 | 9.9 | 9.6 | |
| 303 | 9.6 | 10.3 | 10.3 | |
| 304 | 2.9 | 3.4 | 10.3 | |
| 305 | 6.9 | 5.5 | 10.2 | |
| 306 | .15 | -.25 | 9.0 | |
| --- | 1 | 2 | 3 | 4 |
| 101 | 8.2 | 3.8 | 0 | .08 |
| 102 | 10.2 | .16 | 0 | .05 |
| 201 | 10.2 | 4.3 | 0 | .2 |
| 202 | 10.2 | .7 | 0 | .24 |
| 301 | 10.3 | 4.2 | 0 | .14 |
| 302 | 9.6 | .65 | 0 | .13 |

| INTEGRATED CIRCUIT VOLTAGES | | | | | | | |
|---|---|---|---|---|---|---|---|
| PIN NO. | I.C. NUMBER 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | 1.6 | 4.6 | 13 | NC | NC | 5.0 | .1 |
| 2 | GND | 3.5 | NC | 4.4 | 5.0 | 5.0 | .1 |
| 3 | 1.4 | NC | 9.1 | 5.0 | .1 | 9.0 | 9.0 |
| 4 | NC | 1.4 | .7 | 1.5 | NC | 5.0 | .1 |
| 5 | 10 | 1.4 | .5 | .1 | .1 | .1 | 5.0 |
| 6 | NC | 1.4 | NC | 4.4 | 5.0 | 9.0 | 9.0 |
| 7 | 1.6 | GND | 0 | GND | GND | GND | GND |
| 8 | NC | GND | GND | 4.4 | 5.0 | 9.0 | .2 |
| 9 | | .14 | NC | .1 | .1 | .1 | 5.0 |
| 10 | | 1.4 | GND | 1.4 | NC | .1 | 5.0 |
| 11 | | NC | .5 | 6.2 | 5.0 | 9.0 | 9.0 |
| 12 | | 3.5 | 7.9 | 4.4 | 5.0 | .1 | 5.0 |
| 13 | | 10 | 0 | 5.5 | NC | 5.0 | .1 |
| 14 | | 5.3 | 15 | 6.2 | 6.2 | .1 | 4.4 |

Voltages are measured with "Manual-Scan" switch in manual position, "Volume" control counterclockwise and "Squelch" counterclockwise except:

# Squelch control CW/CCW
† Scanning/Manual
‡ Crystal operating on A/B side

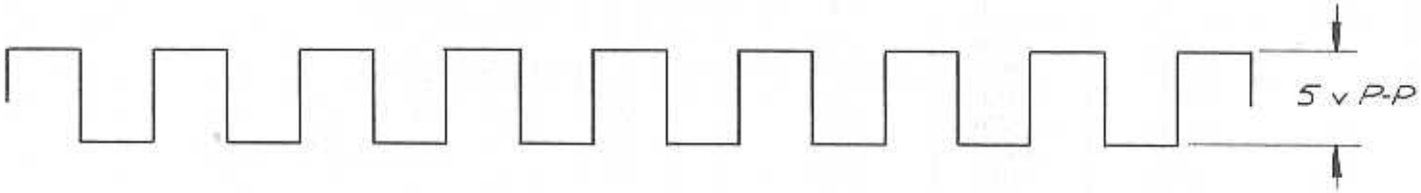
| | COUNT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| I.C. No. | PIN | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 4 | 5 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| | 6 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| | 8* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 9* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 5 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| | 6 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| | 8 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| | 9 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 7 | 8 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 11 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 6 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| | 3 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 6 | 3 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| | 6 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| | 11 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |

## LOGIC CHART

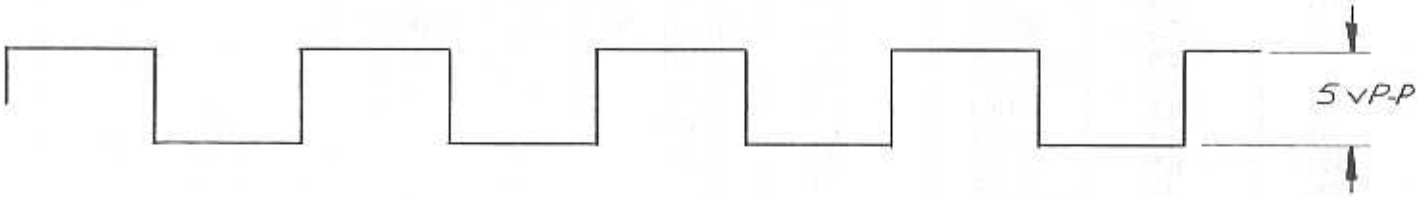
The logic sequence for counting is shown by "0" under .5v and "1" over 4v. IC-4 pins 8 and 9 (*) change state on each movement, up or down, of the "Manual-Scan" Switch.

## WAVE FORMS OF SCANNING CIRCUITRY


JCT. OF R25-26 & C28

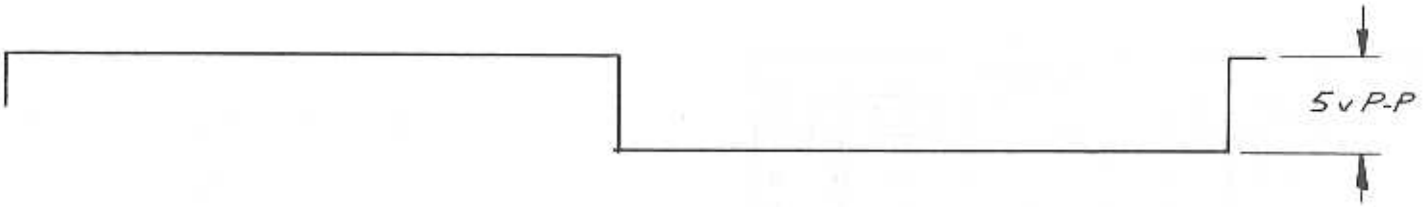



PIN Nº 9 OF IC 4

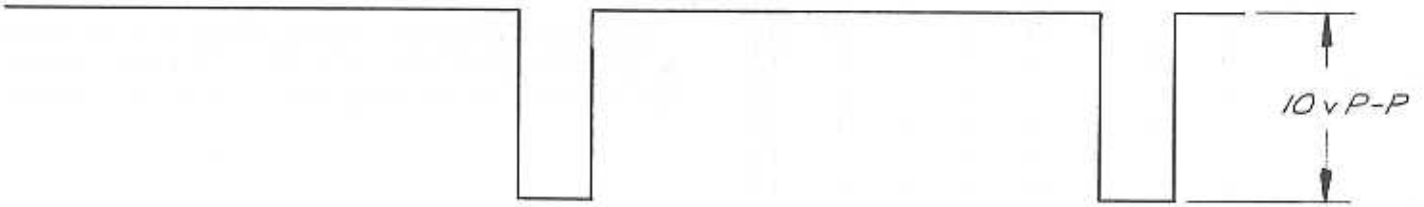



PIN #5 OR #6 OF IC 5


PIN #8 OR #9 OF IC 5

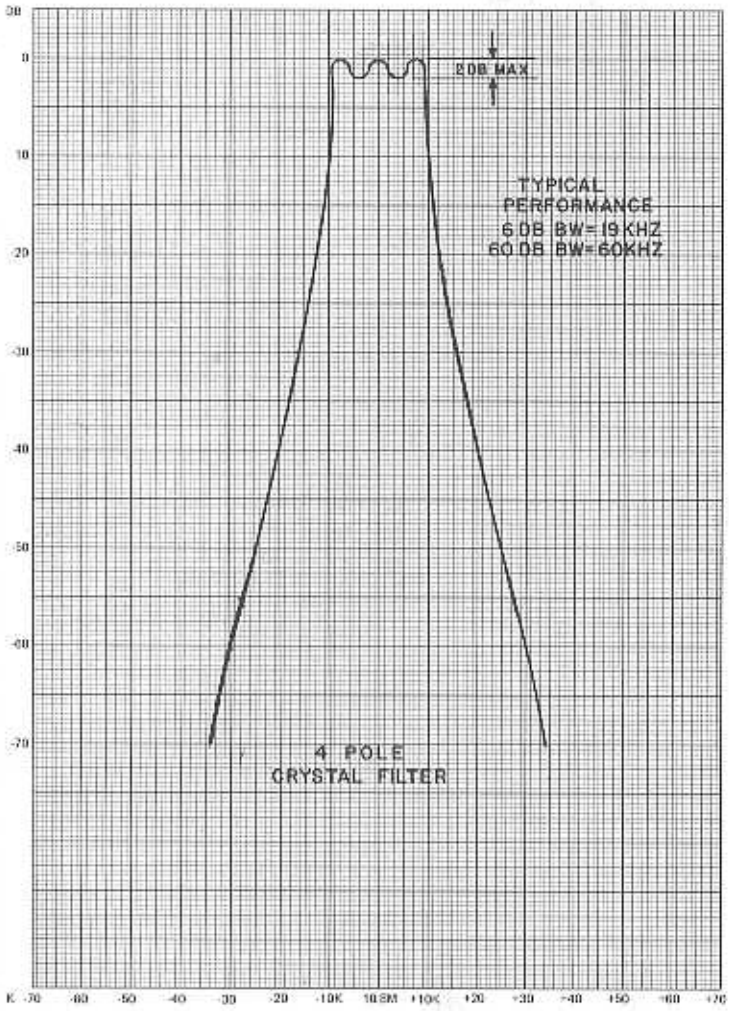



PIN #5 OR #6 OF IC 4

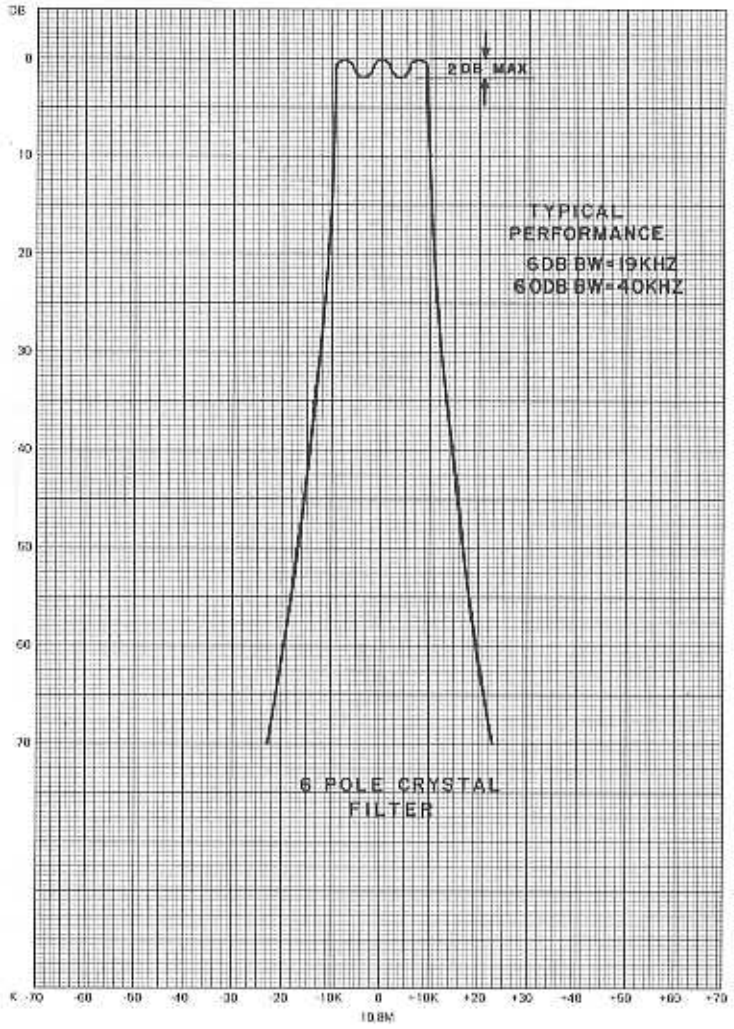


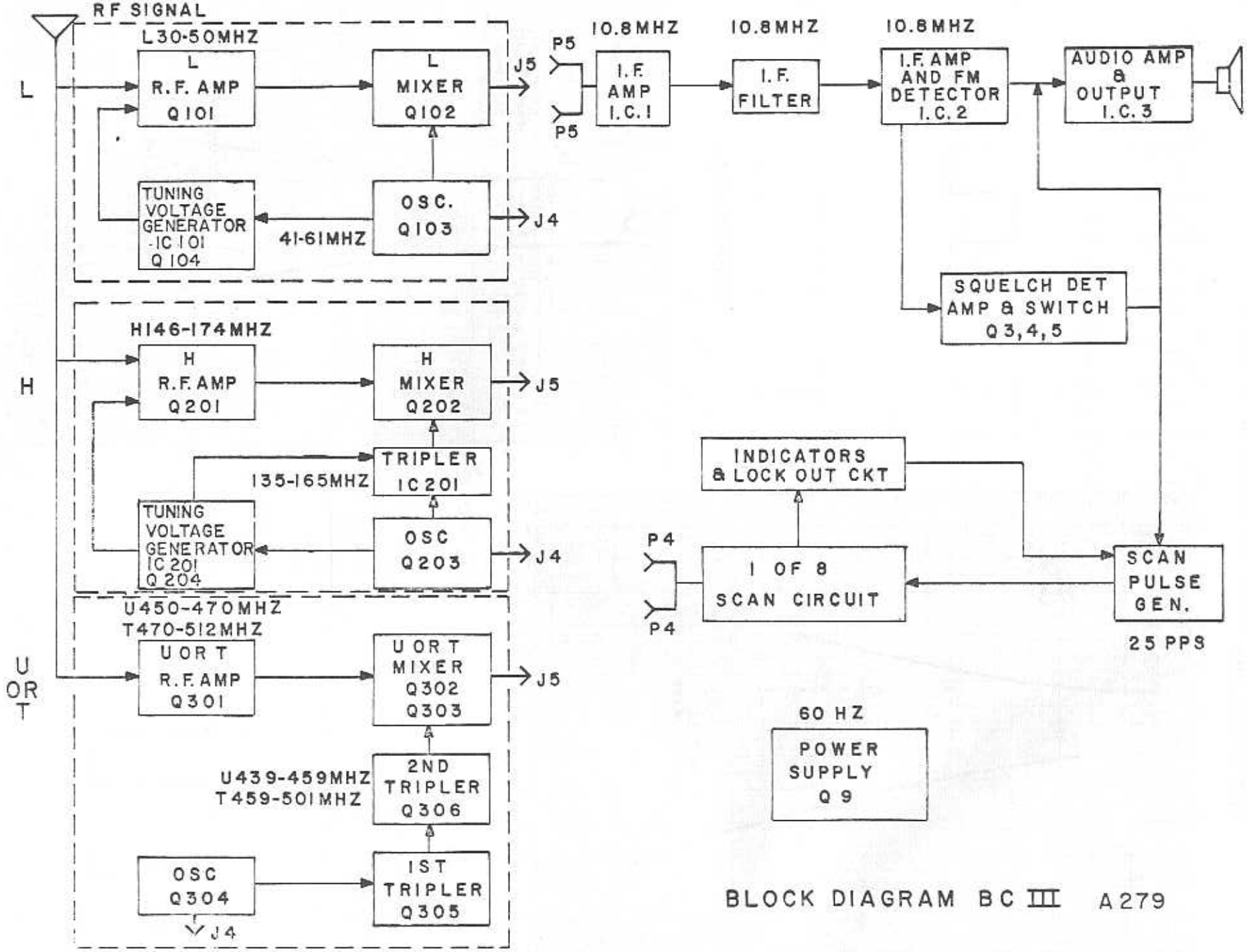

PINS #3-6-8-11 (OUTPUTS)
OF IC 6 & IC 7

## IF RESPONSE 4 POLE




## IF RESPONSE 6 POLE






BLOCK DIAGRAM BC III A279

| SYMPTOMS | CURES |
|---|---|
| Some channels will not disable | C.T. of corresponding switch not soldered |
| Some channels will not light | Check corresponding LED for open<br>Check corresponding resistor for open<br>(R33-R40) |
| All LED's on at same time<br>(Switches in on position) | Q6 |
| All LED's on with switches in off position | R46, Q6 |
| Scan rate does not increase when channels are disabled | Q6 |
| No scan but manual OK | Q7 or Q8 |
| One channel stays lit at all times and/or when one channel is disabled all LED's light at the same time. | Remove all RF modules and check for symptom. If still present change corresponding output IC. If no longer present check for short in crystal sockets. |
| Two LED's lighting at the same time | IC-4 or IC-5 |
| Only 1 thru 4 LED's lighting | IC-4 or IC-7 |
| Only 5 thru 8 LED's are lighting | IC-4 or IC-6 |
| Only 1, 3, 5 & 7 LED's are lighting | IC-5 |
| Only 2, 4, 6 & 8 LED's are lighting | IC-5 |
| Hum and no lights | D8, C30, Q9 |
| No power | AC Cord<br>Q9, D8, SW1 |
| Low Power Supply Voltage | Q9, D8, D9, D10, FL1, IC-3,<br>T1, C30, L5<br>Shorted to chassis |
| Excessive hum | R47 misadjusted<br>C30, D9, D10<br>IC-3 |
| Squelch not controlling scan circuit | Wire broken off squelch control<br>Q3, Q4 |
| Squelch controlling scan but no audio | Ext. Spk. Jack<br>Spk, IC-3 |
| No manual scan but auto scan works | Ground on SW 2, Not soldered<br>Dirty contacts on SW 2 |
| Scanning noise in audio | Q5 |
| No reception (But squelch noise is normal) | RF Modules, Q1, Q2, D4, D5,<br>C2, C3, D1, L1, D2, D3, C1 |
| Only one RF Module receiving | RF Module D1, D2, D3, D4,<br>D5, C2, C3, L3, L1, Q1, Q2 |
| Note: If a new module does not correct the difficulty, remove working module and install in the other position. If module works, check cross lock out (Q1, Q2, C2, C3, D4, D5) | |
| No reception | T1, T2, T3, IC-1, IC-2, FL1, FL2, L3, L6 |
| Note: If unit has no IF, inject a signal at junction of C5 and R42 (inject signal by placing finger at this junction). If signal is detected then T1 is probably defective. | |
| If no signal is detected, then inject the signal at Pin 5 of IC-1. If signal is detected, then IC-1 is probably defective. | |
| If no signal is detected, then inject the signal at the output of FL2. If signal is detected, then FL1 or FL2 is probably defective. | |
| If no signal is detected, then IC2 or T3 is probably defective. | |

# SERVICE PARTS LIST

(PRICES SUBJECT TO CHANGE WITHOUT NOTICE)

## MAIN BOARD

| Ref. No. | Resistors, ¼W 10% | List Price |
|---|---|---|
| R-2 | 22k | $ .25 |
| R-3, 22, 15 | 4.7k | .25 |
| R-4, 19 | 1.5k | .25 |
| R-5, 8 | 6.8k | .25 |
| R-6, 12, 16 | 10k | .25 |
| R-10 | 56k | .25 |
| R-14 | 4.7 Meg | .25 |
| R-17, 25 | 33k | .25 |
| R-20, 9 | 2.7k, ¼W, 5% | .50 |
| R-21, 27, 28 | 47k | .25 |
| R-23 | 5.6k | .25 |
| R-24, 29 | 100 | .25 |
| R-26 | 470k | .25 |
| R-31 | 220 | .25 |
| R-33 thru R-40, 42 | 470 | .25 |
| R-43, 44 | 2.2k | .25 |
| R-45 | 150 | .25 |
| R-46 | 22 | .25 |
| R-47 | 10k Var 20% | .75 |
| R-32 | 2.2 MEG. ½W 10% | .25 |
| R-11 | 5k Squelch Cont | 1.50 |
| R-18 | 100k Vol. Cont. w/Switch | 2.00 |
| R-30 | 100 ohm ½W 5% | .50 |
| | **Capacitors** | |
| C-1, 2, 3, 5, 12, 24, 31, 33 | .001mf GMV Cer. 50WV or greater | .50 |
| C-4, 8, 15, 19, 29, 34 | .01mf. 20% Disc. Cer | .50 |
| C-6, 7, 17 | .05 +80%-20% Disc Cer | .50 |
| C-9, 10, 11, 13, 23 | .1mf. GMV Disc. Cer. | .50 |
| C-14 | 3.3pf 10% Disc. Cer. | .50 |
| C-16, 21 | .02mf. 20% Disc. Cer. | .50 |
| C-18 | .22mf. 10% Mylar | .50 |
| C-20, 37 | 150pf 20% Disc. Cer | .50 |
| C-22 | 25mf 15V Lytic | 1.00 |
| C-25 | .005mf +80%-20% Disc. Cer | .50 |
| C-26 | 300mf. 3V Lytic | 1.00 |
| C-27 | 500mf. 10V Lytic | 1.00 |
| C-28 | .047mf 10% Mylar | .50 |
| C-30 | 2000mf. 20V Lytic | 1.50 |
| C-35 | 100mf. 15V Lytic | 1.00 |
| C-36 | 2mf. 35V Lytic | .75 |

| Ref. No. | Semi-Conductors | List Price |
|---|---|---|
| Q-1, 2 | 2N3563 F. C. | .75 |
| Q-3, 4, 5, 8 | MPS3393 Mot. | .75 |
| Q-6, 7 | MPS3640 | .75 |
| Q-9 | TIP-29 T.I. | 1.50 |
| D-1, 2, 3, 6 | 1N4148 or 1N914 | .50 |
| D-4, 5, 7 | IN34A | .50 |
| D-8 | IN5241B 11V 5% | 1.00 |
| D-9, 10 | IN4001 | .50 |
| I.C.-1 | LM703LN Nat. | 1.50 |
| I.C.-2 | SN76643N or ULN2111 A | 4.00 |
| I.C.-3 | TA-611C S.G.S. | 5.00 |
| I.C.-4, 5 | SN-7474 | 2.00 |
| I.C.-6, 7 | SN-7426 | 1.00 |
| M-1 thru 8 | A-259 Light Emitting Diode | 1.50 |
| | **Inductors** | |
| L-1 | A-219-1 Loading Coil | 1.00 |
| L-2 | A-218-1 RF Choke | .50 |
| L-3, 6 | A-205-1 RF Choke | .50 |
| L-4 | A-218-2 RF Choke | .50 |
| L-5 | A-261 | .50 |
| T-1, 2 | B-217-2 I.F. Coil | 2.00 |
| T-4 | B-202 Power Transformer | 3.00 |

| Ref. No. | Miscellaneous | List Price |
|---|---|---|
| Y-1 thru Y-8 | A-135 Crystal (Frequencies as required) | 5.00 |
| FI-1, 2 | A-226-1 Crystal Filter | 10.00 |
| SW-3 thru 10 | B-335-1 Slide Switch, SPDT | .75 |
| J-1 | Antenna Connector A-362 | .75 |
| | Antenna Plug A-127 | .75 |
| J-8 | Ext. Speaker Jack No. 3512A | 1.00 |
| PL-1 | Power Connector A-560 | 1.00 |
| SO-2 | Power Socket S-3304 FHTM | 1.00 |
| | B-290 DC Cord Assembly | 1.50 |
| SO-3 | B-261 AC Cord Assembly | 1.50 |
| | Mobile Mounting Kit | 2.00 |
| SP-1 | B248-2 Speaker 3" x 5" 8 ohm. | 3.00 |
| | A-138-2 Telescoping Antenna | 1.50 |
| | B-228-1 Front Panel | 1.75 |
| | C223-1 Trim | 3.00 |
| | C203-1 Wrap Assembly | 7.50 |
| | A-237 Antenna Bushing | .75 |
| | Knob RB-155-840 | .75 |

## "L" MODULE

| | Resistors, ¼W 10% | |
|---|---|---|
| R-101 | 4.7k | $ .25 |
| R-102, 106 | 100k | .25 |
| R-103 | 15k | .25 |
| R-104, 121 | 22k | .25 |
| R-105, 108, 110 | 100 | .25 |
| R-107 | 470 | .25 |
| R-111, 112 | 33k | .25 |
| R-113 | 330 | .25 |
| R-114, 117 | 1.5k | .25 |
| R-115 | 2.2k | .25 |
| R-116 | 470, 5% | .25 |
| R-119 | 6.8k | .25 |
| R-120 | 220 | .25 |
| R-122 | 150 | .25 |
| R-123 | 22k | .25 |
| R-118 | 10k variable 20% | .75 |
| | **Capacitors** | |
| C-101 | 220pf 20% Disc. Cer. | .50 |
| C-102, 108 | A-225-1 VVC | 1.50 |
| C-103, 104, 105, 107, 109, 114, 115, 117, 118, 119, 120 | .001mf GMC Cer 50 WV or greater | .50 |
| C-106, 111 | .01mf. 20% Disc. Cer. | .50 |
| C-110 | 56pf 10% Disc. Cer. | .50 |
| C-113 | 33pf 10% Disc. Cer. | .50 |
| C-112 | 6.8pf 10% Disc. Cer. | .50 |
| C-116 | 10pf 10% Disc. Cer. | .50 |
| | **Semi-Conductors** | |
| Q-101, 102 | 3N201 T.I. or 40601 R.C.A. | 2.50 |
| Q-103 | 2SC684 | .75 |
| Q-104 | MPS3640 | .75 |
| D-101 | 1N914 or 1N4148 | .50 |
| I.C.-101 | LM703LN Nat. | 1.50 |
| | **Inductors** | |
| L-101 | B-208-1 Antenna Coil | 1.00 |
| L-102 | B-208-2 RF Coil | 1.00 |
| L-103 | A-218-2 RF Choke | .50 |
| L-104, 106 | A-218-1 RF Choke | .50 |
| L-105 | B-209-2 Tracking Coil | 1.00 |

## SERVICE PARTS LIST
(Continued)

| Ref. No. | | List Price |
|---|---|---|
| "H" MODULE | | |
| | Resistors, ¼W. 10% | |
| R-201 | 3.3k | .25 |
| R-202, 206, 214 | 100k | .25 |
| R-207 | 15k | .25 |
| R-204, 203 | 22k | .25 |
| R-208 | 220k | .25 |
| R-209, 205 | 100 | .25 |
| R-210, 211 | 33k | .25 |
| R-212 | 330 | .25 |
| R-213 | 1.5k | .25 |
| R-216 | 910 5% | .50 |
| R-217, 215 | 1k | .25 |
| R-219 | 220 | .25 |
| R-221 | 150 | .25 |
| R-222 | 22k | .25 |
| R-218 | 10k variable 20% | .75 |
| | Capacitors | |
| C-201 | 68pf 10% Disc. Cer. | .50 |
| C-202, 208, 213 | A-258-1 VVC | .50 |
| C-203, 209 | 56pf 10% Disc. Cer | .50 |
| C-207, 214 | 220pf 20% Disc. Cer. | .50 |
| C-216 | 47pf 10% Disc. Cer | .50 |
| C-204, 205, 210, 215 217, 219, 220, 221, 222 | .001mf GMV Cer 50WV or greater | .50 |
| C-206, 211 | .01mf. 20% Disc. Cer. | .50 |
| C-212, 218 | 6.8pf 5% Disc. Cer | .50 |
| | Semi-Conductors | |
| Q201, 202 | 3N201 T.I. or 40601 R.C.A. | 2.50 |
| Q-203 | 2SC684 | .75 |
| Q-204 | MPS3640 | .75 |
| D-201 | 1N914 or 1N414B | .50 |
| I.C.-201 | LM703LN Nat. | 1.50 |
| | Inductors | |
| L-201 | B-208-3 Antenna Coil | 1.00 |
| L-202 | A-218-3 RF Choke | .50 |
| L-203 | B-208-4 RF Coil | 1.00 |
| L-204 | A-218-2 RF Choke | .50 |
| L-205 | B-220-1 Osc. Coil | 1.00 |
| L-206 | B-209-1 Tracking Coil | 1.00 |
| L-207 | A-218-1 RF Choke | .50 |

| | | |
|---|---|---|
| "U" MODULE | | |
| | Resistors, ¼W. 10% | |
| R-301 | 3.3k | .25 |
| R-302,313 | 15k | .25 |
| R-303 | 22k | .25 |
| R-305 | 4.7k | .25 |
| R-306 | 68k | .25 |
| R-308, 317, 318 | 100 | .25 |
| R-309, 311 | 33k | .25 |
| R-312 | 330 | .25 |
| R-310, 314 | 1.5k | .25 |
| R-315 | 10k | .25 |
| R-316 | 1k | .25 |
| R319 | 10 | .25 |
| | Capacitors | |
| C-301 | 3.3pf 10% Disc. Cer. | .50 |
| C-302, 307, 320 | 1.7-6pf variable | .75 |
| C-303 | 15pf 10% Disc. Cer | .50 |
| C-305 | 220pf 20% Disc. Cer. | .50 |
| C-306, 313, 319, 321 | .001mf GMV Cer 50WV or greater | .50 |
| C-308, 314 | .01mf. 20% Disc. Cer. | .50 |
| C-310 | 10pf 10% Disc. Cer. | .50 |
| C-311 | 5pf 5% Disc. Cer. | .50 |
| C-312, 316 | 68pf 5% Disc. Cer | .50 |
| C-315 | 22pf 10% Disc. Cer | .50 |
| C-317 | 470pf 20% Disc. Cer. | .50 |
| C-318 | 5pf 10% Disc. Cer. | |
| | Semi-Conductors | |
| Q-301, 302 | 3N201 T.I. or 40601 R.C.A. | 2.50 |
| Q-303 | MPS3393 MOT | .75 |
| Q-306 | 2N3563 F.C. | .75 |
| Q-305, 304 | 2SC684 | .75 |
| | Inductors | |
| L-301 | A-221-1 Antenna Coil | .75 |
| L-302, 308 | A-218-4 RF Choke | .50 |
| L-303, 306 | A-221-2 RF Coil | .75 |
| L-304 | A-218-2 RF Choke | .50 |
| L-305 | B-220-2 RF Coil | .75 |
| L-307 | A-218-1 RF Choke | .50 |

Replacement parts may be ordered directly from:
Electra Co. - P. O. Box 29243 - 300 S. County Line Rd. - Cumberland, Ind. 46229
Cash order for parts will be shipped prepaid.