

Clegg

**VHF-FM 25WATTS
144 TO 148MHz**

PLL AMATEUR TRANSCEIVER



FM-28

OWNER'S MANUAL

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SECTION 1. SPECIFICATIONS

GENERAL

Frequency Coverage	: 144.00 to 147.995 MHz in 5 KHz steps
Frequency Control	: Digitally synthesized PLL system
Frequency Stability	: Temperature: Less than 30 Hz/°C Voltage: Less than 100 Hz for ±15% change
Semiconductor Complement	: 4 Transistors; 11 FETs' 13 IC's 4 LED Displays, 29 Diodes
Modulation Type	: 16F3
Supply Voltage	: 13.8V DC ±15%, Negative ground
Current Drain	: Transmit: Hi (7A) LO (2A) Receive: .8A Average
Antenna Impedance	: 50 ohms nominal
Size	: 2-5/8(H) x 6-5/8(W) x 10-3/4(D) (exclusive of controls)
Weight	: Approx. 7 lbs. net; 9 lbs. shipping

TRANSMITTER

Frequency Control	: Hetrodyne generated by product of Phase locked VCO and OFFSET Crystal.
Transmit Frequency Offset	: Panel selectable for ±600 KHz; SIMPLEX and 2 optional non-standard Repeater Offsets
Modulation	: Direct FM; Adjustable 3 to 15 KHz deviation (Factory set at 5 KHz)
Audio Input	: 600 ohms
Microphone	: 600 ohm dynamic with push to talk switch
Power Output	: HI Position 25 watts LO Position Adjustable from .25 to 4 watts (Approx.)
Spurious Outputs	: Down 66 dB (typical) 60 dB (min)
Duty Cycle	: 50% HI POWER; 100% LO POWER

RECEIVER

Frequency Scheme	: Dual conversion superhetrodyne with 16.9 MHz and .455 MHz IF
Sensitivity	: .3 μ V (max) for 12 dB SINAD .2 μ V Squelch threshold
Spurious Response	: -65 dB (min)
Selectivity	: 14 KHz at -3 dB 25 KHz at -70 dB
Audio Output Power	: 1.5 watts (min) at 10% THD
Audio Output Impedance	: 8 ohms

ACCESSORIES

The following accessories for the Clegg FM-28 are included:

1) Microphone (dynamic type)	1
2) Microphone hanger	1
3) Spare fuse (7A)	1
4) Mobile bracket and hardware	1
5) Instruction Manual	1
6) External Speaker plug	1
7) Accessory plug	1
8) Desk mounting bracket	1
9) DC Power Cables	1

SECTION 2. GENERAL INFORMATION

The FM-28 is a 25 watt, frequency synthesized solid state radio set providing transmission and reception over the 144 to 148 MHz range.

Frequency control employing state of the art digital circuitry combined with a precision phase locked VCO provides 800 receive channels in 5 KHz increments. Receive frequency is displayed in large bright LED numerics.

A unique feature of the FM-28 is its transmit frequency flexibility wherein non-standard Repeater splits up to ± 1.5 MHz can be accommodated as the standard ± 600 KHz and SIMPLEX.

Although basically designed for mobile applications the FM-28 in conjunction with a Clegg 031, 031A or 060 model Power Supply makes an ideal base station.

Construction is modularized with individual, easily accessible PC boards for each functional circuit section.

SECTION 3. INSTALLATION

3.1 Unpacking:

Carefully remove your transceiver from the packing carton and examine it for signs of shipping damage. Should any shipping damage be apparent, notify the delivering carrier and CLEG immediately, stating the full extent of the damage. It is recommended you keep the shipping carton for future storage, moving, or reshipment. Accessory hardware, cables, etc., are packed with the transceiver. Make sure you have not overlooked anything.

3.2 Location:

Where you place the transceiver in your automobile is not critical and should be governed by convenience and accessibility. Since the unit is so compact, many mobile possibilities present themselves. In general, the mobile mounting bracket will provide you with some guide as to placement. Any place where it can be mounted with metal screws, bolts, or pop-rivets will work. For base station operation, the bracket for desk-top operation places controls at a comfortable position and the internal speaker in an efficient position.

3.3 Power Requirements:

VOLTAGE IN EXCESS OF 16V will cause damage to the FM-28. Check supply voltage before connecting power cord!

The FM-28 is supplied ready to operate from any regulated 13.8V DC, 7.0 ampere negative ground source. An automobile, 12 volt, negative ground, system is usually more than adequate. Some note must be taken, however, to the condition of the vehicle's electrical system. Problems such as low battery, worn generator/alternator, poor voltage regulator, etc., will impair operation of your FM-28 as well as the vehicle.

It is recommended that the DC power cable supplied with the FM-28 be wired directly to the vehicle battery terminals. Be certain to observe correct polarity; RED wire is POSITIVE (+) and BLACK wire is NEGATIVE (-). Do not attempt to install the FM-28 in a vehicle employing POSITIVE GROUND ignition system.

Where temporary mobile installation is made and it is not practical to wire directly to the vehicle battery operation is possible in some vehicles by employing such expedients as a cigar lighter adapter. However, less than full performance of the FM-28 will likely be attained, particularly in the HI PWR transmit mode.

In selecting a base station power supply it is imperative that the unit be sufficiently regulated so that its no load voltage not exceed 15.8 volts and voltage at 7 amps load not drop below 13 volts. Output hum and ripple should be less than 100 millivolts.

The Clegg Model 060 is ideally suited as an economical, reliable station supply for the FM-28.

3.4 Antenna:

The most important single item that will influence the performance of any communication system is the antenna. For that reason, a good, high-quality antenna of 50 ohms impedance is recommended. When adjusting your antenna, whether mobile or fixed, by all means follow the manufacturer's instructions. There are some pitfalls to be aware of. For example, do not attempt to adjust an antenna for lowest VSWR when using a VSWR meter not engineered for VHF applications. Such readings will invariably have a substantial at 144 MGz. Rather, use an in line meter similar to the Drake WV-4 or Bird Model 23 with VHF cartridge. Further, when adjusting a mobile antenna, do so with the motor running preferably above normal idling speed. This will insure proper voltage level to the transceiver.

Do not become alarmed if your transceiver fails to transmit at times during the antenna tune up procedure. Remember, your transceiver has a built-in Automatic Protection Circuit (APC) that will disable the transmitter if excessive VSWR, or an open or shorted coaxial line or connector, or other antenna deficiency is present.

The RF coaxial connector on the rear chassis mates with a standard PL-259 connector.

CLEGG COMMUNICATIONS stocks a substantial line of 2 meter antennas and beams. Our sales department will be pleased to advise you as to the best choice for your specific application.

3.5 Microphone:

A high quality dynamic microphone is supplied with your transceiver. Merely plug it into the proper receptacle on the front panel. Should you wish to use a different microphone, make certain it is of the low impedance type (600 ohms). Particular care should be exercised in wiring as the internal electronic switching system is dependant upon it. See the schematic for the proper hook up. Under no circumstances use a "gain pre-amp" type microphone. The audio system in your transceiver is more than adequate and additional pre-amplification is unnecessary. To use this class of microphone is to invite distortion and unsatisfactory operation of the transceiver.

SECTION 4. CONTROL FUNCTIONS

4.1 FRONT PANEL CONTROLS



- 4.1.1 ON-OFF/VOLUME CONTROL:** Applies power to receiver and adjusts desired level of sound
- 4.1.2 SQUELCH CONTROL:** Silences background noise in the absence of a received signal when properly adjusted. Rotation in clockwise direction increases SQUELCH threshold.
- 4.1.3 TX PWR SWITCH:**
 - "LOW" position : transmitter operates at 1 watt output level.
 - "HIGH" position : transmitter operates at full power output.
- 4.1.4 10 KHz SELECTOR SWITCH:** The inner switch selects the desired frequency in 10 KHz increments from 0 to 9 and simultaneously activates LED display on the channel window.
- 4.1.5 100 KHz SELECTOR SWITCH:** The outer switch selects the desired frequency in 100 KHz increments from 0 to 9 and simultaneously activates LED display on the channel window.
- 4.1.6 MHz SELECTOR SWITCH:** This four position rotary switch selects the desired frequency in 1 MHz increments from 144 to 147 and simultaneously activates LED display on the channel window.
Note that the digits "14" are fixed and back-lighted when the power is "ON".

4.1.7 RPT/SPX SWITCH

RPT position: Activates TX OFFSET function for displacing transmitter output frequency from receiver frequency for Repeater access and operation. Also activates REPEAT INDICATOR LIGHT.

SPX position: Disables OFFSET function and places both transmitter and receiver on identical frequencies.

4.1.8 TX OFFSET SWITCH: This control selects the frequency difference between the displayed receiver frequency and the transmitter output frequency. (Typically -600 KHz for repeaters below 147 MHz and +600 KHz for repeaters above 147 MHz). To accommodate non-standard repeaters positions A and B can be used by installation of appropriate offset crystals available from Clegg.

4.1.9 5 KHz SWITCH: This switch increases operating frequency by 5 KHz and simultaneously activates 6th digit in LED display on the channel window.

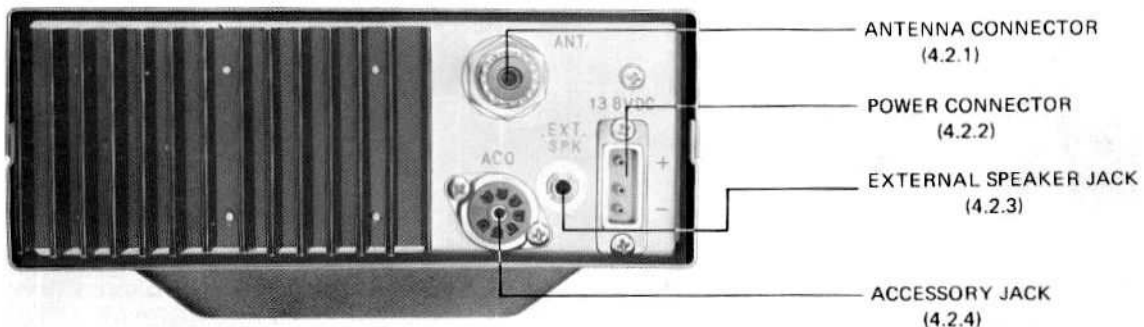
4.1.10 S/RP PWR METER: Shows signal strength of the received signal and relative transmitter RF output power.

4.1.11 REPEAT INDICATOR LIGHT: Lights brightly when RPT/SPX switch is in RPT mode.

4.1.12 TX INDICATOR LIGHT: Lights brightly when transmitting.

4.1.13 MICROPHONE JACK: Accepts 4 prong mike plug supplied on microphone.

4.2 REAR PANEL CONTROLS



4.2.1 ANTENNA CONNECTOR: Accepts standard PL-259 coaxial connector

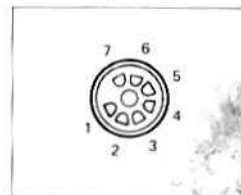
4.2.2 POWER CONNECTOR: Accepts polarized power cord for 13.8V Supply.

4.2.3 EXTERNAL SPEAKER JACK: This jack mates with the accessory Ext. speaker plug supplied for external 8 ohm speaker on headset use. The use of this jack will disable the internal speaker.

4.2.4 ACCESSORY JACK:

Accepts 7 pin plug for interconnecting various accessory devices to the transceiver.

1. Tone Input
2. Keyed DC, High on TX
3. Unkeyed DC
4. Remote PTT control
5. TIE POINT (DO NOT USE)
6. Discriminator Meter
7. Ground



SECTION 5. OPERATING INSTRUCTIONS

5.1. INITIAL PREPARATIONS

- 5.1.1 Connect the microphone to the microphone jack
- 5.1.2 Connect the antenna to the antenna coax connector. Make sure the coax line is of the correct impedance (50 ohms) and is neither shorted nor open circuited.
- 5.1.3 Make sure the volume control is in the off position and the squelch control is in the maximum counterclockwise position. The red lead should be connected to the positive side of the power source and the black lead to the negative side. If these leads are improperly connected, the FM-28 will not function. No damage will be incurred since protection is provided in the FM-28 for this purpose.

5.2. OPERATION

- 5.2.1 Rotate the volume control clockwise a few degrees until the switch snaps into the ON position, and LED frequency display on the channel window and S/Rf meter will be illuminated.
- 5.2.2 Adjust MHz, 100 KHz and 10 KHz selector switches to the desired frequency.

5.3. RECEIVER

- 5.3.1 Advance the volume control to the desired audio level.
- 5.3.2 Carefully adjust the squelch control clockwise until the audio noise just disappears. This is the proper squelch threshold setting and must be done when no signal is present. Your transceiver will now remain silent until an incoming signal is received which opens the squelch. If the squelch is unstable due to the reception of a weak or unstable station, adjust the squelch control further until the proper threshold is obtained.
- 5.3.3 The S meter indicates the signal strength of the incoming stations and is calibrated in S units. An input signal of approximately 5 μ V will provide an S9 reading.

5.4. TRANSMITTER

The operation of the transmitter and receiver is controlled by the push-to-talk switch located on the side of the microphone. When depressed, the transmitter is placed into operation and, at the same time, the receiver becomes inoperative.

- 5.4.1 Place the REPEAT/SIMPLEX switch in either the REPEAT or SIMPLEX position. In the REPEAT position, TX OFFSET switch is activated and REPEAT INDICATOR LIGHT illuminates. In the -600 position on TX OFFSET switch, the transceiver transmits at the frequency of -600 KHz than Receiver frequency and in the +600 position, the transceiver transmits at the frequency of +600 KHz. Position A and B provide capability to use the FM-28 with non-standard repeater pairs. Consult Clegg Sales Dept.
- 5.4.2 Place the HI-LOW power switch in either the HI or LOW position dependent on the range of desired communications. In the HI position, the transceiver operates at full 25 watt output. In the LOW position, the transceiver operates at one watt of power. (The HI-LOW power switch can be set to the LOW power position and the power output can be adjusted between .1 and 4 watts by means of internal potentiometer RT-552 accessible with bottom cover removal).
- 5.4.3 When pushing the PTT (push to talk) button on the microphone, the TX INDICATOR LIGHT is illuminated and the METER provides an indication of relative power output of the transmitter. The pointer will be on or near the red mark on the meter scale when on high power and just a little over 1 on low power when the antenna SWR is acceptably low.

* NOTE: Do not attempt to transmit unless your antenna is properly connected.

SECTION 6. CIRCUIT DESCRIPTION

6.1 RECEIVER CIRCUIT

- 6.1.1 **RF Unit:** Signal from the antenna connector passes through the dual-tuned band pass filter, and is amplified by Q101, and fed into FT101 a 3-section helical resonator. The signal is then mixed with signal from the VCO unit by Q102 first mixer, and produces first IF 16.9MHz.
- 6.1.2 **IF Unit:** Signal from the RF unit passes through FT151 4-Pole monolithic crystal filter, and is amplified by Q151 first IF AMP., and is mixed with signal from Q153, 16.445 MHz. Second IF passes through FT152 ceramic filter, and is limited in amplification by IC151 and 152. The AF signal is detected by FT153 ceramic discriminator, and fed into the AF unit.
- 6.1.3 **AF Unit:** AF signal from the IF unit is amplified by Q203 and IC202, and drives the speaker, while noise signal from the IF unit is amplified by IC201 and Q201, and detected by D201 and D202, and drives switching transistor. Q202 controls Q203 AF amplifier and activates squelch.

6.2 TRANSMITTER CIRCUIT

- 6.2.1 **Tx Driver Stage Unit:** Signal from the VCO and Signal which is selected from X701 to X705 and oscillated by Q706 in IF unit are mixed with balanced mixer Q401 and Q402, and produce mixer output in the 146 MHz band. That signal is then amplified by Q403, Q404 and Q405, and drives the final unit.
- 6.2.2 **Final Unit:** Output from the transmit driver unit amplified by Q451, Q452 and Q453 into a 25 watt output which is supplied into the APC unit. Signal from the final unit passes through the SWR Bridge, diode switch D503 and D504, and also passes through 3-section low pass filter, and produces 25 watt output which is supplied into the APC unit.

6.3 PHASE LOCKED LOOP CIRCUIT

- 6.3.1 **Local Unit:** Crystals X251 and X252 are selected by switching transistors Q251 and Q252, and are oscillated by Q253. Oscillation output is multiplied three times by Q254, and again multiplied three time by Q255, and then it is fed into PLL mixer Q256. Simultaneously fed into Q256 is the output of VCO unit, and PLL IF (4.000–5.995 MHz) is produced.
- 6.3.2 **Counter Unit:** The PLL IF is amplified by Q304 generated by Q303 and fed into IC304. This signal is divided in half by IC304. It is then program-divided by 301, to produce an output of 25 KHz. On the other hand, X301(10.24 MHz) is oscillated by Q306, and fed into IC304 through driver Q305. Here again, the signal frequency is divided in half by IC304, and fed into IC301, where the output of 1/1024 (5 KHz) is produced.
- 6.3.3 **VCO Unit:** The difference output from the counter unit passes through the active low pass filter (Q351 through Q353), and goes into the VCO D351, D352 and Q354, and controls the VCO frequency. The output of the VCO is amplified by Q356, and fed into the local unit PLL mixer Q256. On the other hand, the output of the VCO is also amplified by Q355, which produces the local frequency for both transmit and receive.
- 6.3.4 **Display Unit:** The desired BCD code is selected by the channel selector, and decoded by IC651 through IC653, and it drives the LED display.

6.4 POWER SUPPLY CIRCUIT

DC input from the power connector is regulated by Q551 through Q553, and 13.6V DC is selected for transmit and receive. Q557 and Q558 are worked as protector circuit. When the excessive power happens to be supplied in transmit or receive, Q558 is automatically cut off and protects the circuits from the damage. IC801 is used for a 5V regulator for the TTL and C-MOS. Q554, Q555 and Q801 regulate the final unit as high-low power controller. D553, D554 and Q556 are activated by APC unit, and unlock signal of the counter unit, and regulate Q555 to shut down the transmit power.

SECTION 7. ALIGNMENT PROCEDURE

7.1 GENERAL

THE FM-28 HAS BEEN FACTORY ALIGNED USING TECHNIQUES AND TEST EQUIPMENTS NOT NORMALLY AVAILABLE TO THE SERVICE TECHNICIAN. IT SHOULD NOT BE NECESSARY TO PERFORM ANY ALIGNMENT ON THE UNIT AS RECEIVED FROM THE FACTORY. IN THE EVENT OF COMPONENT FAILURE, ANY REALIGNMENT WILL BE MINIMAL. IF IT APPEARS THAT ANY LARGE DEGREE OF REALIGNMENT IS REQUIRED, THOROUGHLY CHECK THE REPLACEMENT COMPONENT BEFORE PROCEEDING.

7.2 PHASE LOCKED LOOP CIRCUIT

7.2.1 Equipment Required:

- a) 13.8V DC Power Source (3A).
- b) Synchroscope (DC to more than 150 MHz)
- c) Frequency Counter (More than 150 MHz)

7.2.2 Set up:

- a) Initial front panel controls should be set in the following manner.

* POWER SWITCH (OFF—Volume)	: Off
* 10KHz & 100KHz SELECTOR SWITCH	: Any position
* BAND MHz SELECTOR SWITCH	: Any position
* 5 KHz SWITCH	: Either position
* REPEAT-SIMPLEX SWITCH	: Simplex
* TX OFFSET SWITCH	: Any position
* HI-LOW SWITCH	: Either position

- b) Connect the power cable to the 13.8V DC power source.

- c) In the VCO unit.

- c-1) Remove the wire of either J353 or J303
- c-2) Remove the connector plug of J352 and connect to Synchroscope using coaxial cable with 2-P connector to be fitted to the terminals. 6 (HOT) and 7 (GROUND).
- c-3) Connect VTVM and 200K ohm variable resistor to TP351 as described below:

7.2.3 Procedure:

- a) Apply power to the unit.
- b) Adjust 200K ohm variable resistor connected to TP351 for 5.5 Volt VTVM reading and L352 for $131.1 \text{ MHz} \pm 0.2 \text{ MHz}$ frequency counter reading.
- c) Adjust 200 K ohm variable resistor for $129.1 \text{ MHz} \pm 0.2 \text{ MHz}$ frequency counter reading and L354 for maximum synchroscope amplitude.
- d) Remove the connector from J352 6 and 7 and reconnect it to J352 4 and 5. Then, adjust L353 for maximum.
- e) Connect TP251 to 10 : 1 probe of synchroscope and adjust L253 and 254 for maximum synchroscope amplitude, and adjust them so as to be within 20% of amplitude difference when 145 and 146 MHz bands are alternately switched.
- f) As for TP-252, adjust L255 and 256, the same to above.

g) Conduct frequency adjustment in the following manner:

1) Connect frequency counter to the plug (P401) of J401.

2) Measure and adjust frequency on following channels.

* 144.005 MHz: f = 127.105 MHz.	CT254
* 144.000 MHz: f = 127.100 MHz.	CT251
* 147.005 MHz: f = 130.105 MHz.	CT253
* 147.000 MHz: f = 147.000 MHz.	CT252

NOTE: Repeat the procedures 144.005 MHz, 144.000 MHz and 147.005 MHz, 147.990 MHz.

7.3 RECEIVER

7.3.1 Equipment Required:

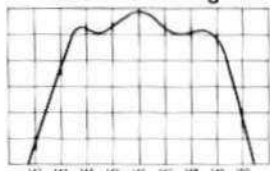
- a) 13.8V DC Power Source (3A)
- b) VHF Sweep generator and all accessories
- c) Signal generator (144–148 MHz)
- d) AF measurement equipments — 4 ohm dummy load
V.T.V.M.
Oscilloscope
Distortion Meter
Audio Oscillator
- e) DC Volt Meter

7.3.2 Set-up:

- a) Initial front panel controls should be set in the following manner:
 - * POWER SWITCH (Off-volume) : Off
 - * SQUELCH CONTROL : Fully counterclockwise
 - * OTHER SWITCHES : Any position
- b) Connect the power cable to the 13.8V DC power source.
- c) Connect all of AF measurement equipments (See 7.3.1 – d) to external speaker jack.
- d) Detach J351 in VCO unit.
- e) Connect 'scope vertical to case of Q102
- f) Connect RF cable from sweep generator to ANT connector and adjust to 146 MHz center freq. with about 12 MHz sweep width.

7.3.3 Procedure:

- a) Apply power to the unit and turn on power switch.
- b) Adjust L101, L102 and FT101 to obtain a wave form as illustrated below on the following measurement conditions.



- * Input level 5.6 mV rms
- * Marker Increment by 1 MHz
- * Center frequency 146 MHz
- * Oscilloscope x 1 range (max.)

- c) Then, detach the sweep generator and remove the cable from the case of Q102 in RF unit, and connect the signal generator (146.00 MHz, 3.3 KHz deviation at AF 1 KHz) to the antenna terminal and replace J351 in VCO unit. Set MHz, 100 KHz and 10 KHz controls to 146.00.

- d) Increase the output level of the signal generator for one third reading of indicator on the S-Meter scale and adjust L103, L104, L151 and L152 several times for the peak power.
- e) Adjust the signal generator for the 5 μ V input and adjust RT152 to make the meter read 5S.
- f) Adjust RT151 for convenient SQUELCH control range.

7.4 TRANSMITTER

7.4.1 Equipment Required:

- a) 13.8V DC power source (8A)
- b) RF power meter (Bird Watt Meter 50W 150 MHz)
- c) Frequency Counter (More than 150 MHz)
- d) FM Linear detector
- e) AF distortion meter
- f) VTVM
- g) AF oscillator
- h) Spectrum analyzer (1.2G Hz)
- i) Microphone or TX Switch
- j) DC volt meter
- k) Feed through dummy load (more than 30 watts)
- l) RF attenuator

7.4.2 Set-up:

- a) Initial front panel controls should be set in the following manner:

* POWER SWITCH (OFF-volume)	:	Off
* HI-LOW SWITCH	:	HI Position
* RPT/SPX SWITCH	:	SPX
* OTHER SWITCHES	:	Any position
- b) Connect the power cable to the 13.8V DC power source.
- c) Connect the power meter to the antenna terminal.
- d) Connect the FM linear detector and the frequency counter.
- e) Connect the TX switch, the AF oscillator and the VTVM to the microphone connector (Mike connector pin No. 1 – Audio, 2 & 3 – Ground, 4 – PTT.).

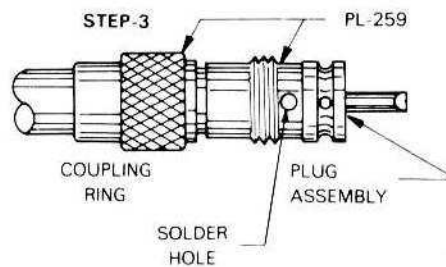
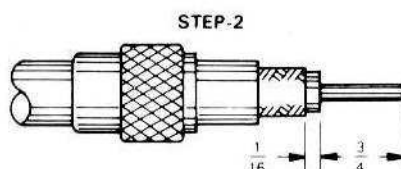
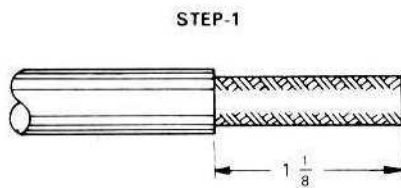
7.4.3 Procedure:

- a) Before the power switch is on, make the preliminary adjustment as follows :
 - a-1) Adjust L401 through L407 so that the core enters about 1.2mm below the can.
 - a-2) Turn the semi-fixed resistors as follows:

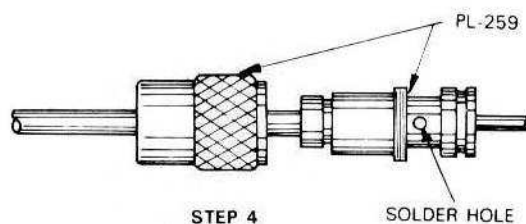
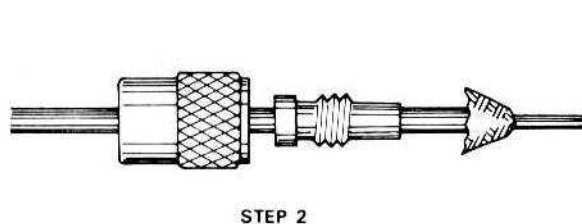
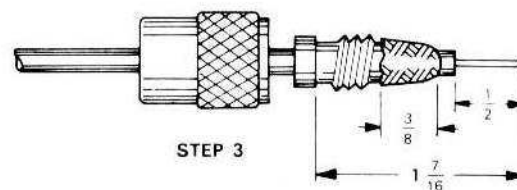
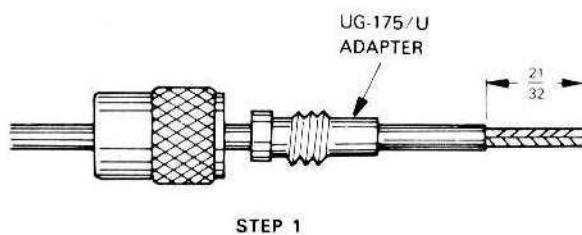
RT551 and RT553	:	Fully clockwise
RT351 and RT552	:	Fully counterclockwise
RT401	:	Middle position
 - a-3) Set the trimmer CT401, CT402, CT451, CT452, CT453; CT454 and CT501 at the position of half capacitance.
- b) Turn on the power switch and set the channel to the 146.00 MHz.
- c) Keep the unit in TX with the microphone or the TX switch and adjust L401 through L406 for the maximum voltage at the TP401.

- d) Adjust L407, CT401 and CT402 for the maximum reading on the 13.8V DC power source meter.
- e) Adjust CT451, CT452 and CT453 for the maximum reading on the RF power meter.
- f) Repeat the above step c) through e) adjustments repeatedly.
- g) Feed the output power of feed through dummy load to the spectrum analyzer through the RF attenuator.
- h) Connect J502 (APC output in APC unit) to the DC volt meter.
- i) Repeat the following adjustments several times respectively, at 146.00 SX
 - i-1) Adjust RT551 for 27 watts on RF power meter
 - i-2) Adjust CT501 and RT501 for the minimum swing on DC volt meter
 - i-3) Adjust CT452 CT453 and CT454 for the maximum power on the RF power meter.
 - i-4) Adjust RT502 for the middle reading of Red mark on P/S meter of the unit.
- j) Adjust CT701 and set the frequency to the 146.00 MHz.
- k) Press the RPT/SPX switch and set the TX OFFSET switch to the 600 position, and adjust CT702 for the 145.400 MHz.
- l) Set the TX OFFSET switch to the +600 position and adjust CT703 for the 146.600 MHz.
- m) Set in the HI-LOW switch to the low position and adjust RT551 for 1.5W on RF power meter.
- n) Feed AF 1 KHz 100mV from the microphone connector and adjust RT 351 for 5 KHz on FM linear detector.
- o) Feed the AF signal to the pin No.1 and 7 (Ground) in the accessory jack and check the modulation is activated.
- p) Remove the RF power meter from the antenna connector and adjust RT553 for 2.5 amperes on the 13.6V DC power source meter.
- q) Again connect the RF power meter to the antenna connector and just adjust CT454 to minimize the power difference during 144 to 147.900 MHz.
- r) Observe that under all operating conditions spectrum Analyzer indicates no spurious outputs in excess of -60 dB referenced to desired output.

COAXIAL CONNECTOR ASSEMBLY DETAIL

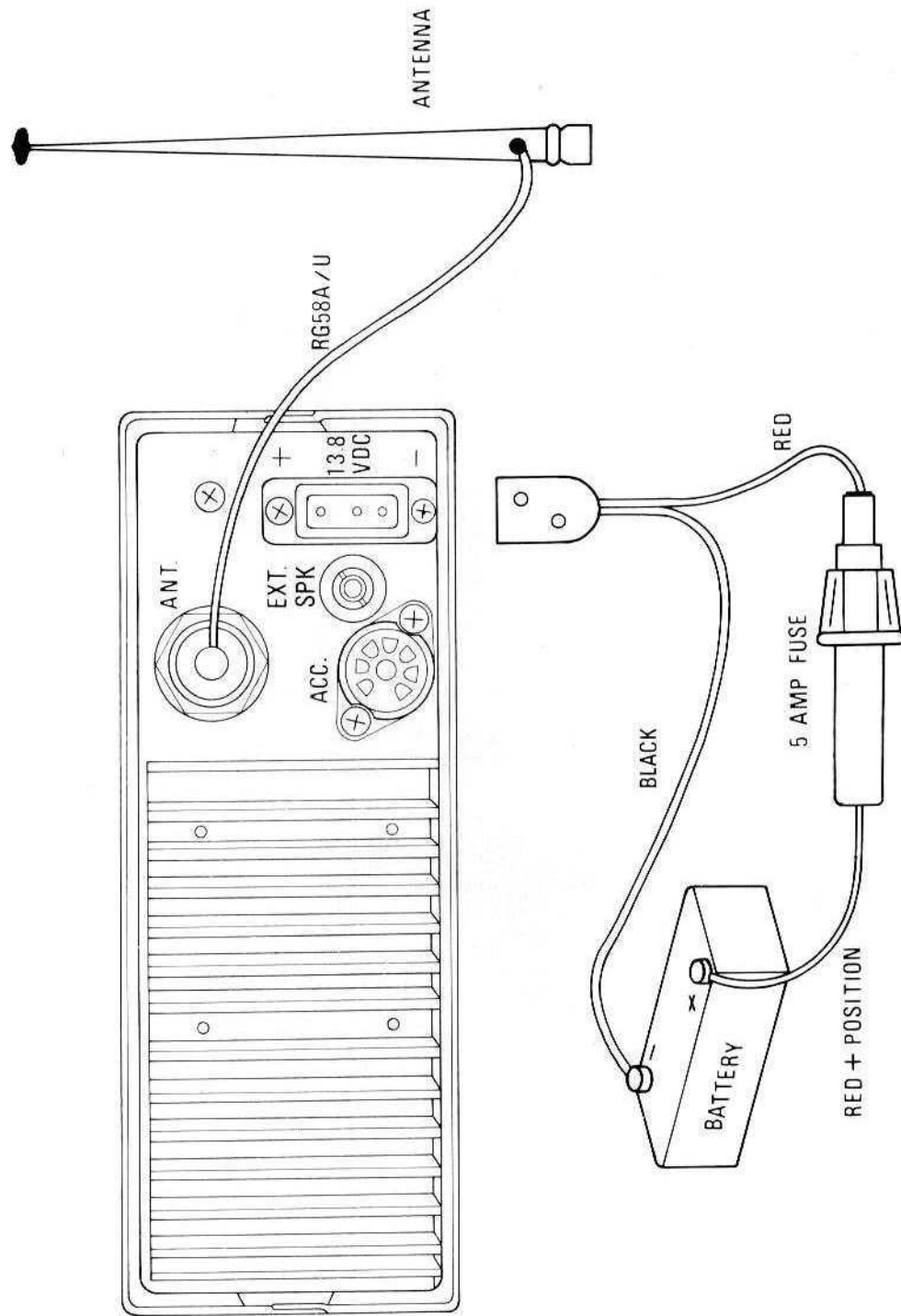


ASSEMBLING ANTENNA PLUG TO RG-58U OR EQUIVALENT.



ASSEMBLING ANTENNA PLUG TO RG-58U OR OTHER $\frac{1}{4}$ " COAXIAL CABLE

INSTALLATION DIAGRAM



FREQUENCY CHART

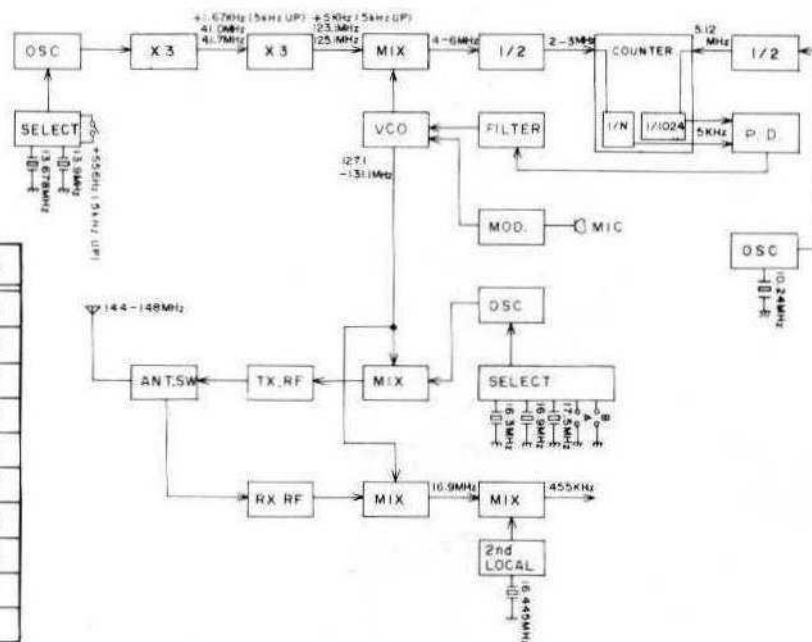
Channel Designator	Local Crystal Frequency	PLL IF Frequency	Divided & BCD CODE Ratio [N]	Out put Frequency
14[A] . [B] [C]				
A=4 or 5	13.67778	[A] . [B] [C] MHz	[A] [B] [C]	14[A] . [B] [C] MHz
A=6 or 7	13.90000	do.	do.	-16.9MHz
14[A] . [B] [C] 5				
A=4 or 5	13.67833	do.	do.	do.
A=6 or 7	13.90056	do.	do.	do.

Channel Designator	Local Crystal Frequency	PLL IF Frequency	Divided Ratio [N]	Out put Frequency
	+5K	+5K		+5K
144.00 2 144.99	5	13.67778	4.000 2 4.990	127.100 2 128.090
145.00 2 145.99			5.000 2 5.990	128.100 2 129.090
146.00 2 146.99			4.000 2 4.990	129.100 2 130.090
147.00 2 147.99			5.000 2 5.990	130.100 2 131.090

* Frequencies are in MHz.

BCD CODE

	A	B	C	D
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7				0
8	1		0	1
9			0	1



The schematic diagram illustrates the internal circuitry of a portable radio receiver, divided into several functional units:

- RF UNIT:** Includes components for RF input, such as 3SK45 RF, FT101, and 3SK45 MIX.
- AF UNIT:** Contains audio frequency stages, including 2SC458 AF, 2SC1675, and 2SC1675 OSC.
- IF UNIT:** Features intermediate frequency stages, including 3SK45 IF AMP, 2SC1675 2nd MIX, and 2SC1675 2nd LO OSC.
- VCO UNIT:** Includes a variable capacitor (VC) and associated circuitry for frequency tuning.
- LOCAL UNIT:** Contains local oscillator stages, including 2SC1675 MULT, 2SC1675 OSC, and 2SC1675 MIX.
- APC UNIT:** Includes automatic power control stages, including 2SC1675 MULT, 2SC1675 OSC, and 2SC1675 MIX.
- FINAL UNIT:** Contains the final audio output stage, including 2SC1675 PA and 2SC1675 OSC.
- YOUNGER UNIT:** Includes a youngling stage, including 2SC1675 MIX, 2SC1675 AMP, and 2SC1675 OSC.
- LED UNIT:** Includes a light-emitting diode (LED) driver stage, including 2SC1675 MIX, 2SC1675 AMP, and 2SC1675 OSC.
- DECODER UNIT:** Includes a decoder stage, including 2SC1675 MIX, 2SC1675 AMP, and 2SC1675 OSC.
- COUNTER UNIT:** Includes a counter stage, including 2SC1675 MIX, 2SC1675 AMP, and 2SC1675 OSC.
- POWER SUPPLY UNIT:** Includes a power supply stage, including 2SC1675 MIX, 2SC1675 AMP, and 2SC1675 OSC.

The diagram also shows various other components such as capacitors (C), inductors (L), and resistors (R), as well as a speaker (SP) and an antenna (ANT).

VOLTAGE CHART

Note.

1. Measured at 146.00 MHz.
2. Measured by DC voltmeter 50K ohm/V.
3. B; Base, E;Emitter, C; Collector, G; Gate, S; Source, D; Drain.

Dual Gate MOS – FET

#	Name	G1	G2	S	D	Remarks
Q101	3SK45-B	0	3.9	0.3	12.8	
102	do	0	0	0.2	12.3	
151	do	0.7	1.8	0.8	6.0	
256	do	0	0	0.3	5.5	
355	do	0	3.1	0	6.2	
356	do	0	3.1	0.7	6.7	
401	do	0	0	0.3	12.0	
402	do	0	0	0.3	12.0	
403	do	0	4.3	0	11.8	

Bipolar Transistor & J–FET

#	Name	B/G		E/S		C/D		Remarks
Q152	2SC1675-L	1.9		1.3		11.5		
153	do	3.0		2.7		6.6		
201	2SC458-C	1.0		0.5		5.5		
202	do	0	(0.6)	0	(0)	1.3	(0)	() : SQ Max.
203	do	1.3	(0)	0.7	(0)	4.4	(13.2)	() : SQ Max.
			ç1.6'		ç5'		ç13.2'	çç ; TX.
253	2SC1675-L	3.5		3.3		7.3		
254	do	2.2		2.6		7.2		
257	2SC763-C	1.5		0.9		5.7		
301	2SC458-C	0.4		0		2.3		
302	2SA733-P	4.7		4.8		0		
303	2SC763-C	0.1		0		2.3		
304	2SC1675-L	1.4		0.9		1.8		
305	2SC763-C	0.1		0		2.4		
306	2SC1675-L	2.0		1.9		4.5		
351	2SC458-LGC	1.2		0.6		7.4		
352	do	0.6		0		4.1		
353	do	4.0		3.4		7.4		
354	2SK55-D	0		0.5		7.0		
357	2SC458-C	7.3		6.9		13.5		
404	2SC763-C	0.7		1.0		9.6		
405	2SC2053	0.5		0		9.1		
451	2SC1970	0.3	(-0.2)	0	(0)	11.2	(2.5)	() ; Low Power
452	2SC1972	0	(0)	0	(0)	11.2	(2.5)	do
453	2SC1946	0		0		12.7		
551	2SB544-E	13.5	(12.9)	13.5	(13.5)	0	(13.5)	() : TX
552	2SA733-P	12.9	(13.5)	13.5	(13.5)	13.5	(0)	do
553	2SD400-E	13.5	(0)	13.5	(0)	13.5	(13.5)	do

Bipolar Transistor & J-FET

#	Name	B/G	E/S	C/D	Remarks
557	2SA733-P	13.2	13.8	13.2	
558	2SB544-E	13.2	13.8	13.8	
706	2SC1675-L	6.0	5.6	13.5	

Bipolar Transistor

#	Name	B	E	C	Remarks
Q554	2SA733-P	12.9	13.8	13.8	Normal operating at Hi-power.
		13.8	13.8	3.3	Normal operating at Low-power.
		13.8	13.8	0	Controlled by APC or unlocked signal.
555	2SC458-C	5.8	5.3	13.2	Normal operating at Hi-power.
		1.0	0.6	13.8	Normal operating at Low-power.
		0	0	13.8	Controlled by APC or unlocked signal.
556	2SC458-C	0	0	5.8	Normal operating at Hi-power.
		0	0	1.0	Normal operating at Hi-power.
		0.6	0	0	Controlled by APC or unlocked signal.
801	2SD313-E	13.8	11.2	13.8	Normal operating at Hi-power.
		3.3	2.5	13.8	Normal operating at Low-power.
		0	0	13.8	Controlled by APC or unlocked signal.

Linier IC

#	Name	Pin number									
		#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
IC151	TA7060	1.4	1.4	0	7.6	7.4	—	—	—	—	—
152	TA7061AP	1.8	1.8	5.7	0	7.1	1.6	1.7	—	—	—
201	TA7063P	1.3	0.6	0.1	0	0.7	5.2	8.0	—	—	—
202	TA7204P	0	6.3	13.8	7.7	1.3	11.3	13.1	6.3	6.2	4.6
351	MC78L08CP	13.8	7.4	0	—	—	—	—	—	—	—
352	TA7061AP	1.9	1.9	11.4	0	11.2	1.9	1.9	—	—	—
801	μPC143G05	13.8	4.9	0	—	—	—	—	—	—	—

Digital IC

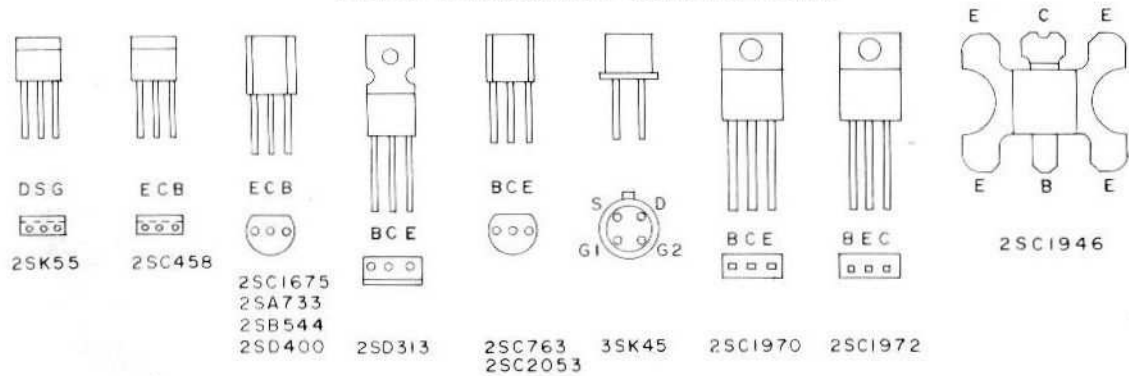
IC302 μPC1008C		IC303 N7473A		IC651 N7447A		IC652 N7447A		IC653 N7447A		IC301 μPD857CW	
Pin		Pin		Pin		Pin		Pin		Pin	
1	0.1	1	2.3	1	4.9	1	0.4	1	0.4	1	0.4
2	4.0	2	—	2	4.9	2	0.4	2	0.4	2	0.4
3	2.3	3	—	3	—	3	—	3	—	3	0.4
4	4.0	4	4.8	4	—	4	—	4	—	4	0.4
5	4.6	5	2.4	5	—	5	—	5	—	5	0.4
6	—	6	—	6	0	6	0.4	6	0.4	6	0.4
7	0	7	—	7	0.5	7	0.4	7	0.4	7	0.4
8	—	8	—	8	0	8	0	8	0	8	0.4
9	—	9	1.8	9	0.1	9	0.1	9	0.1	9	0
10	1.3	10	4.8	10	0.1	10	0.1	10	0.1	10	0
11	4.0	11	0	11	0.1	11	0.1	11	0.1	11	4.8
12	—	12	—	12	0.3	12	0.1	12	0.1	12	4.8

Digital IC

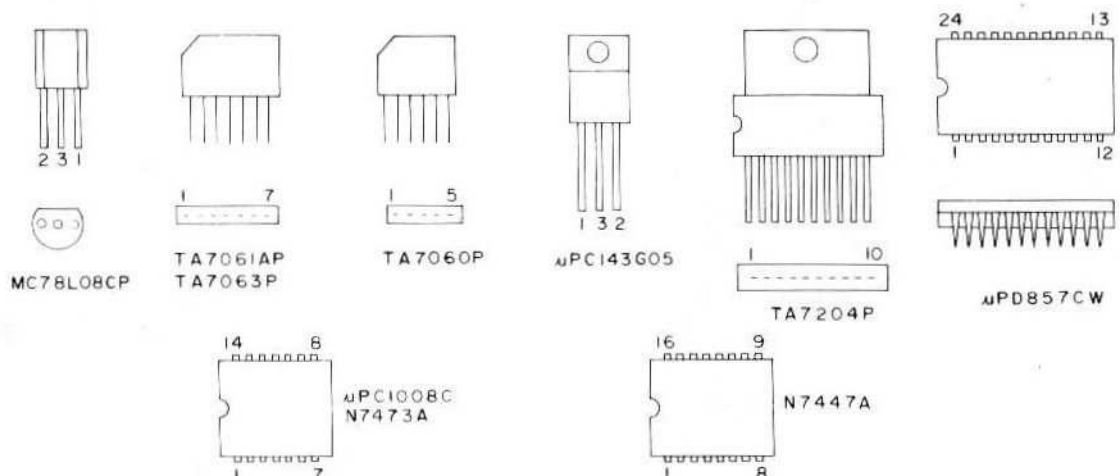
IC302 μ PC1008C		IC303 N7473A		IC651 N7447A		IC652 N7447A		IC653 N7447A		IC301 μ PD857CW	
Pin		Pin		Pin		Pin		Pin		Pin	
13	4.0	13	1.8	13	0.3	13	0.1	13	0.1	13	0.1
14	4.8	14	—	14	0.1	14	0.3	14	0.3	14	1.8
				15	0.1	15	0.1	15	0.1	15	0
				16	4.9	16	4.9	16	4.9	16	—
										17	—
										18	1.8
										19	2.1
										20	0
										21	—
										22	—
										23	0
										24	—

FET, TRANSISTOR & IC TERMINAL GUIDE

FET & TRANSISTOR CONNECTIONS

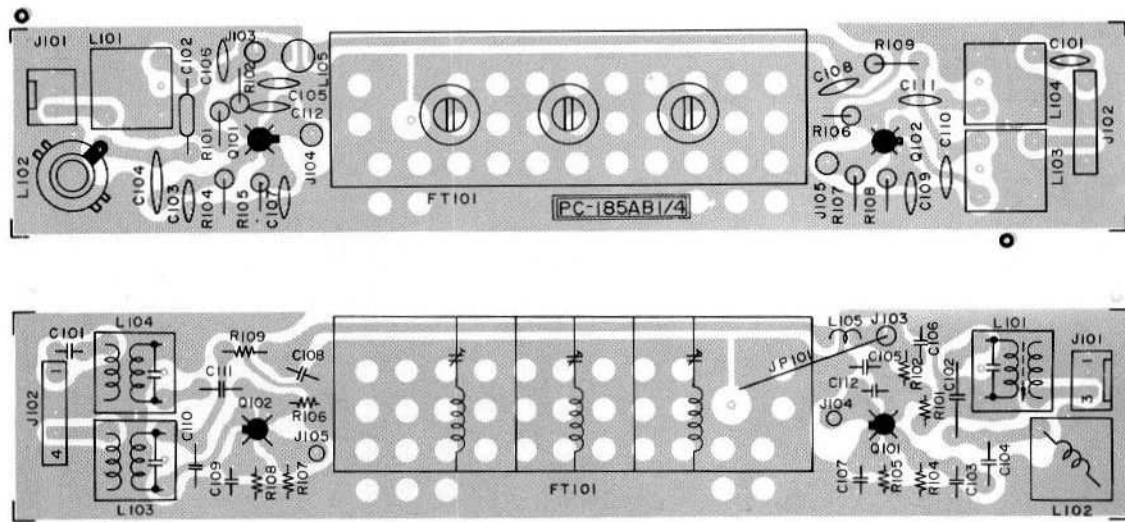


INTEGRATED CIRCUIT CONNECTIONS

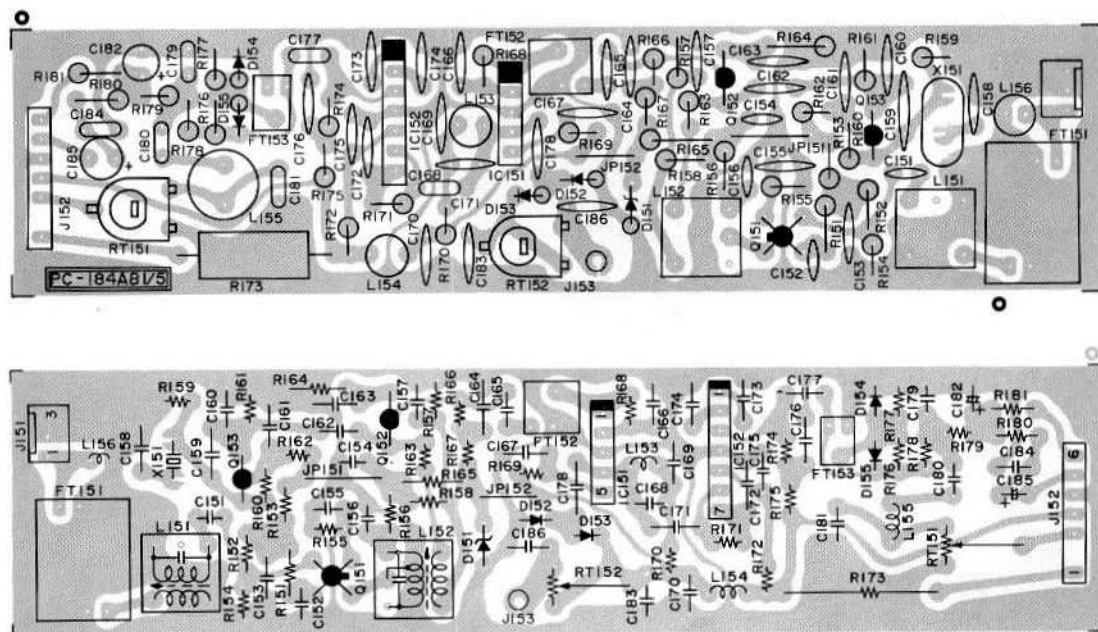


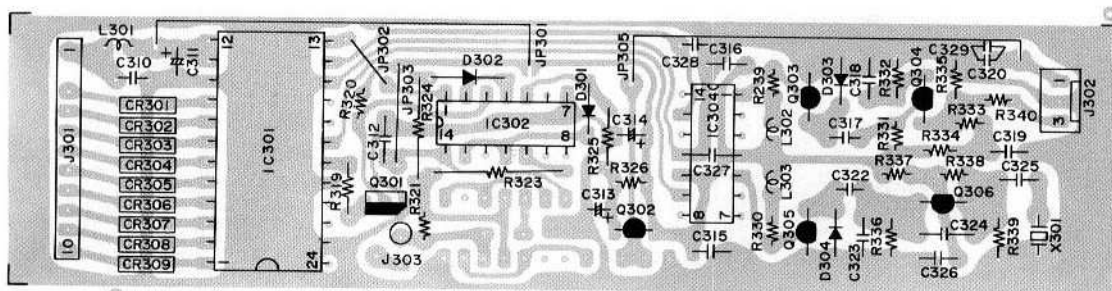
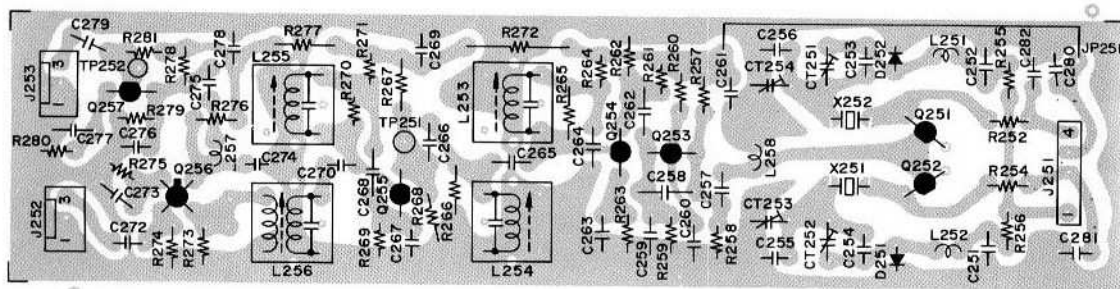
PRINTED CIRCUIT BOARD DETAIL

RF Unit PC – 185 1/4

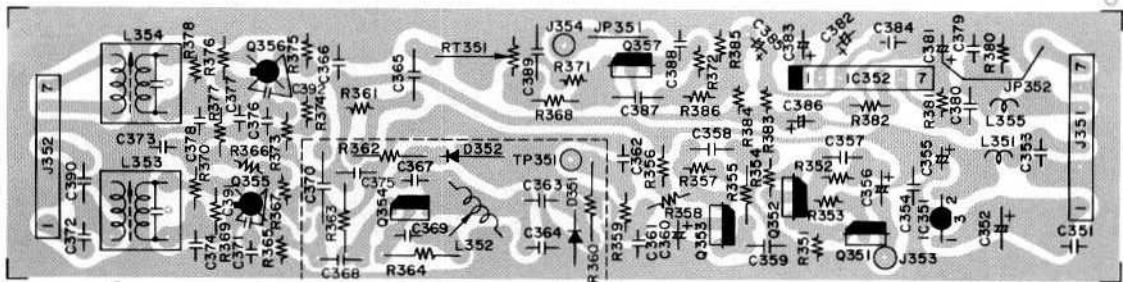
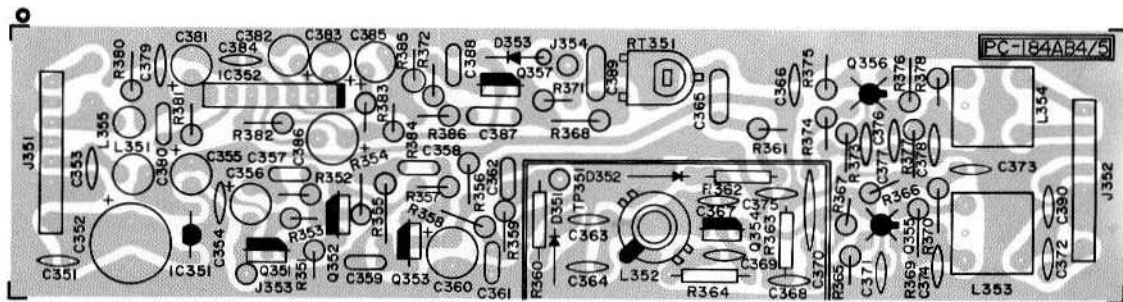


IF Unit PC – 184 1/5

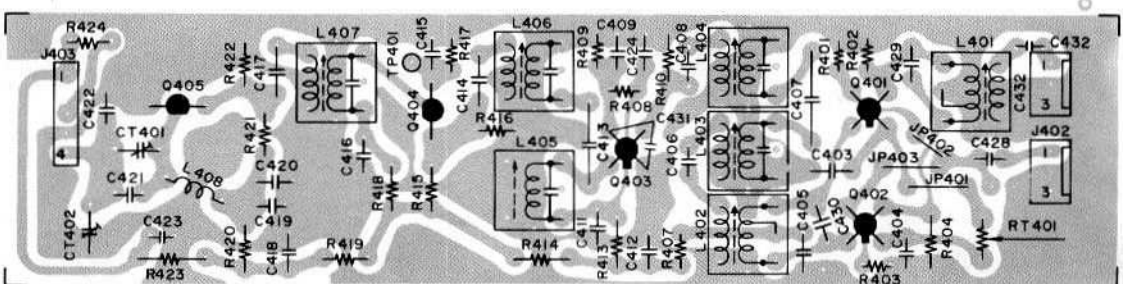
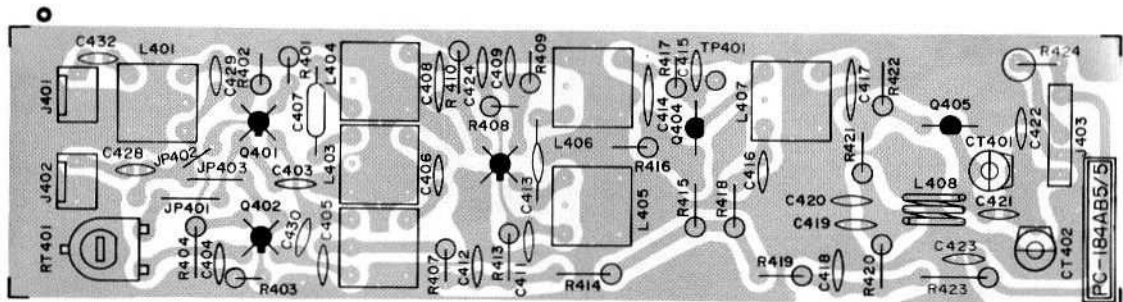




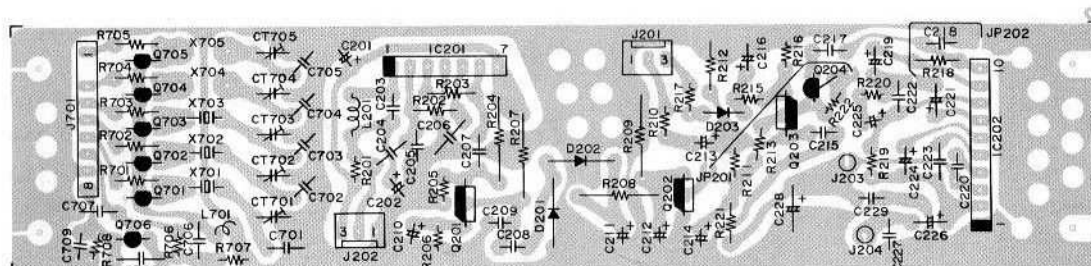
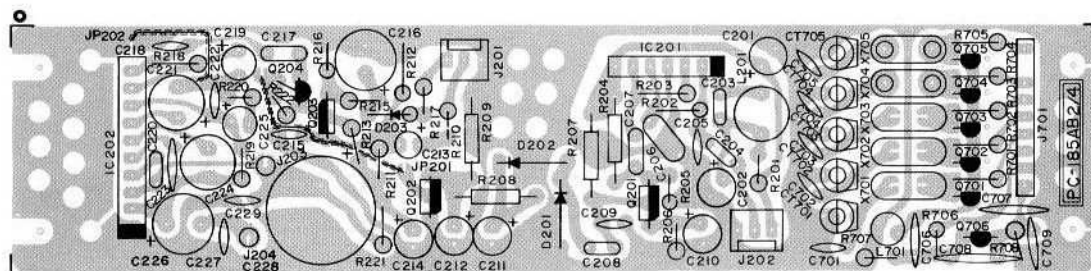
VCO Unit PC – 184 4/5



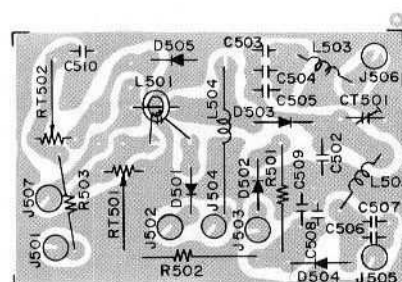
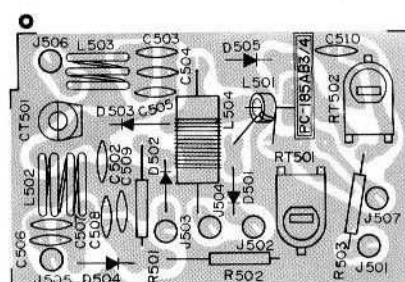
TX Driver Unit PC – 184 5/5



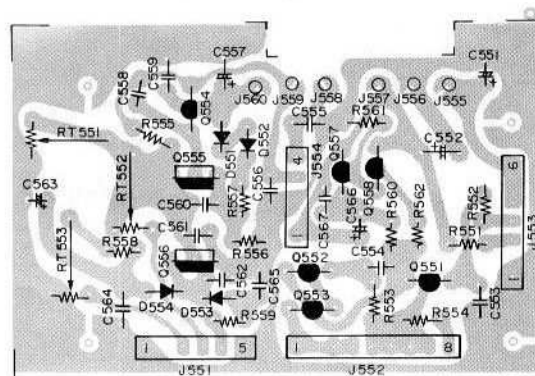
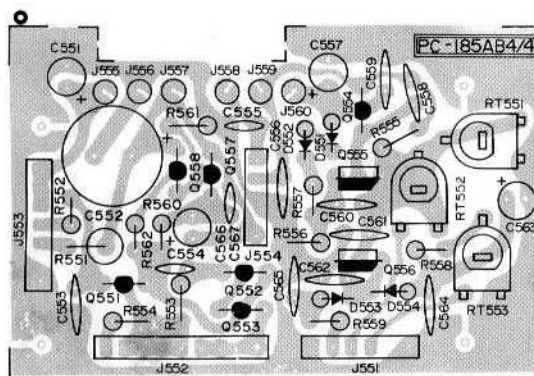
AF Unit PC – 185 2/4



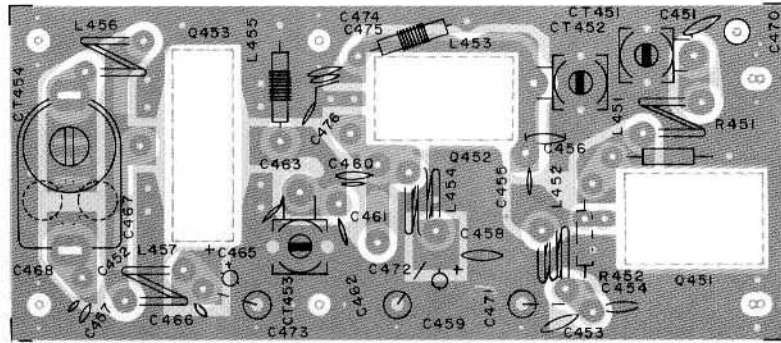
APC Unit PC — 185 3/4



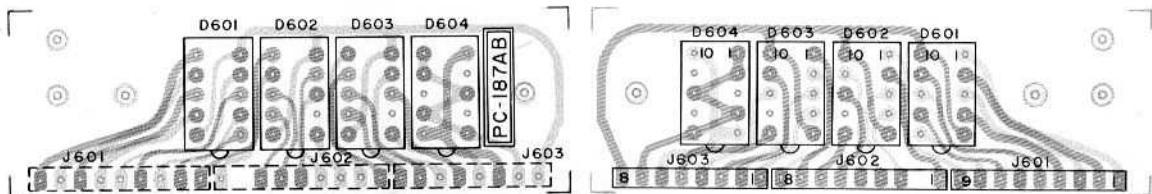
Power Supply Unit PC – 185 4/4



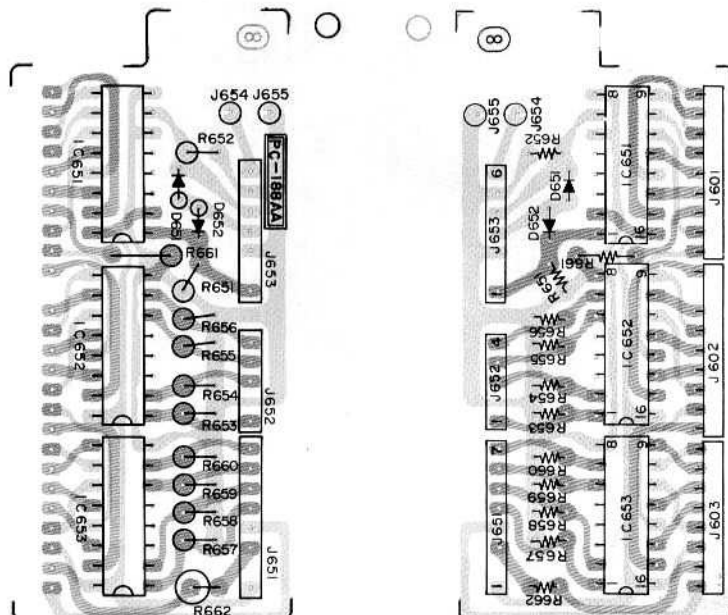
Final Unit PC – 186



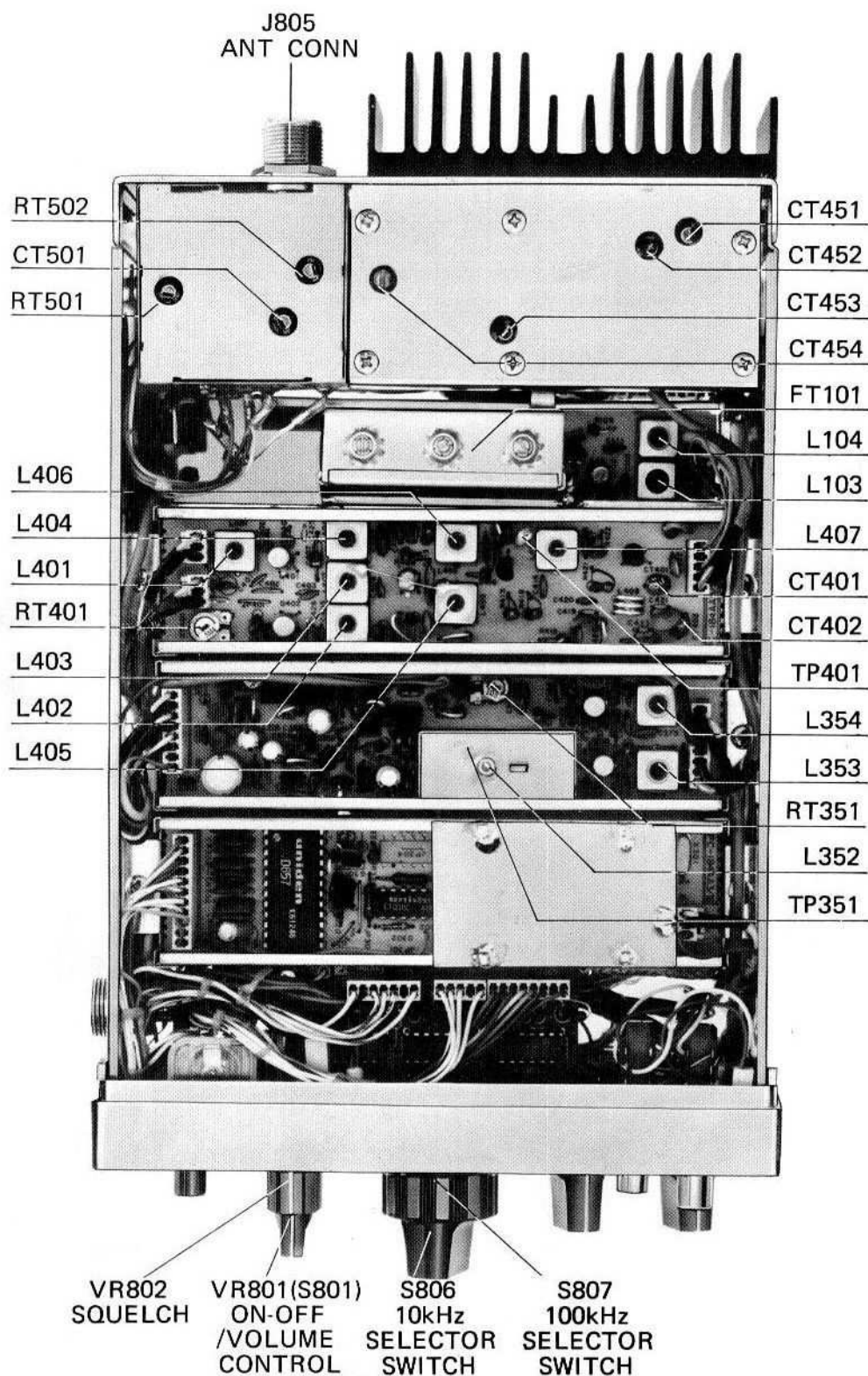
LED Unit PC – 187



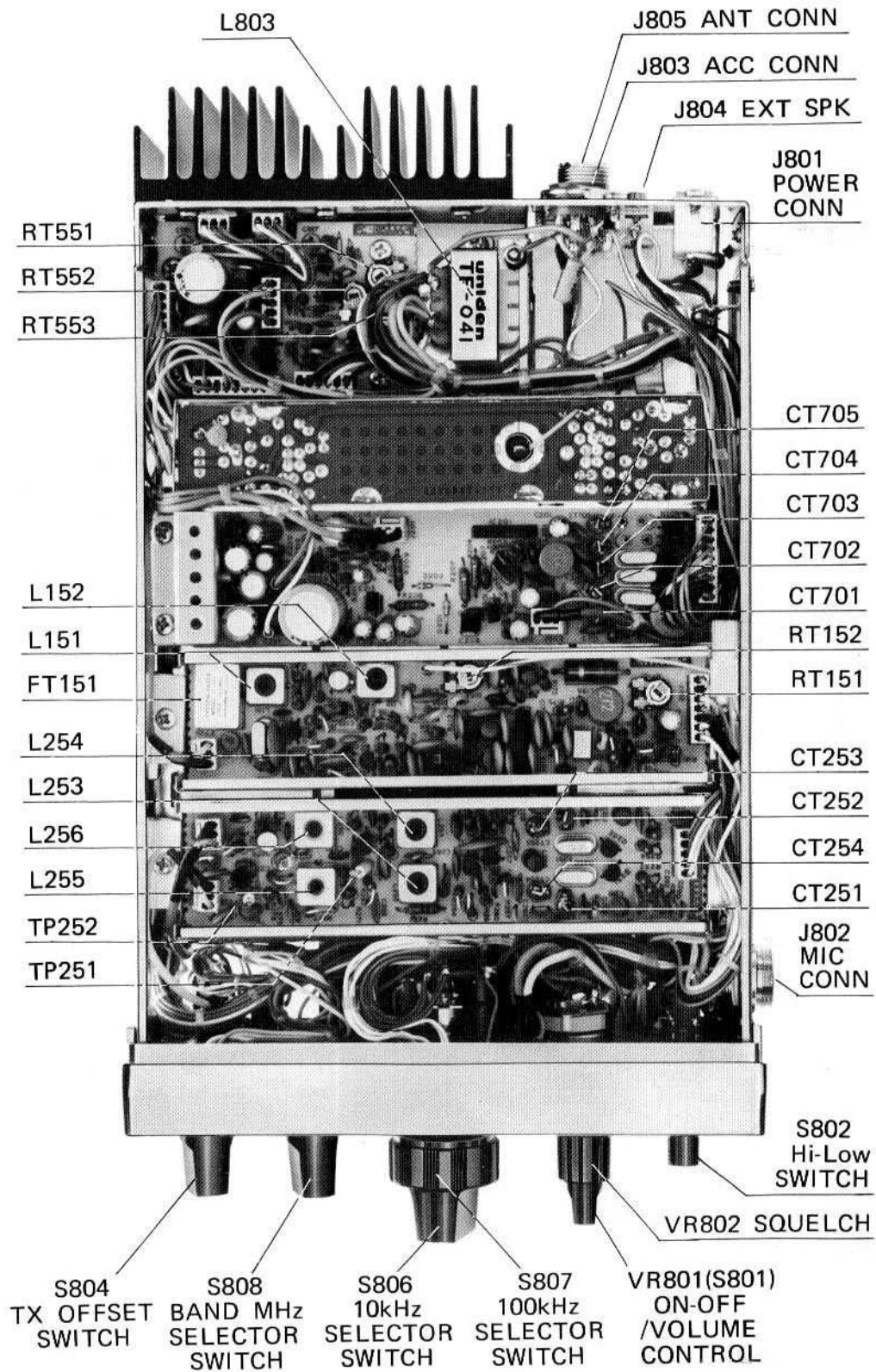
Decoder Unit PC – 188



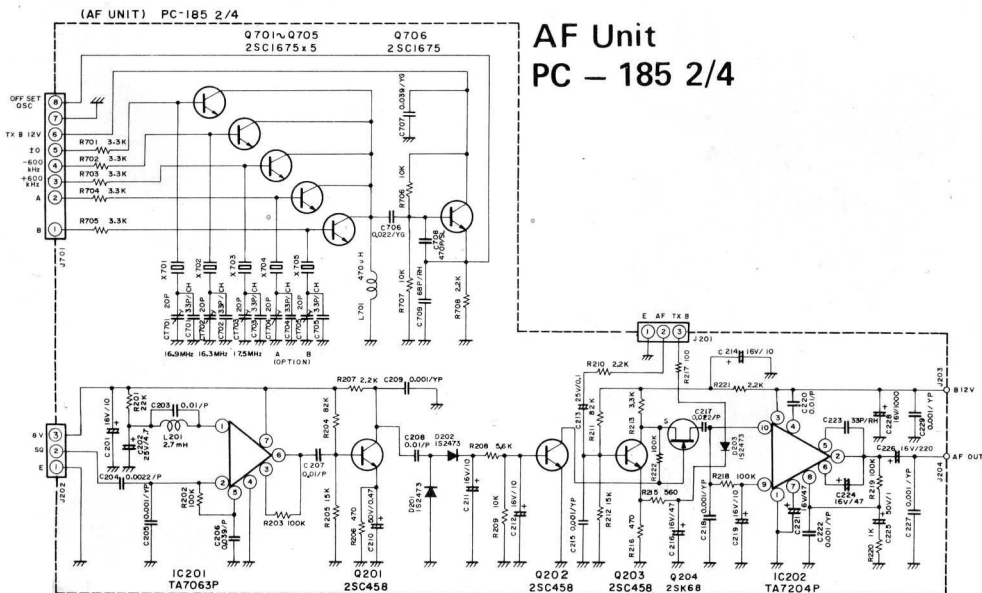
TOP VIEW OF CHASSIS DETAIL



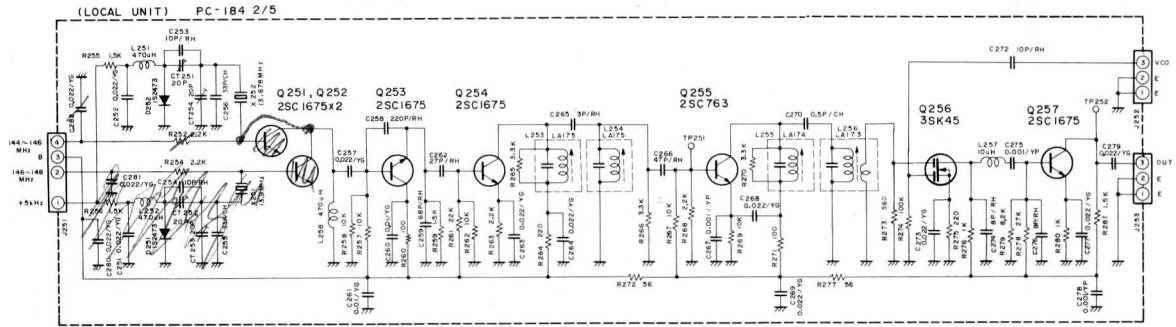
BOTTOM VIEW OF CHASSIS DETAIL



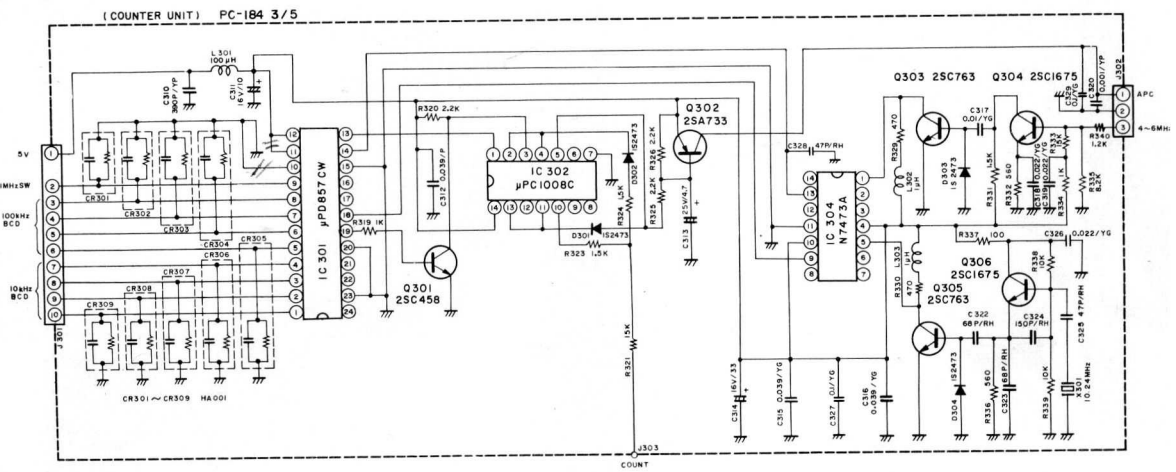
RF Unit PC – 185 1/4



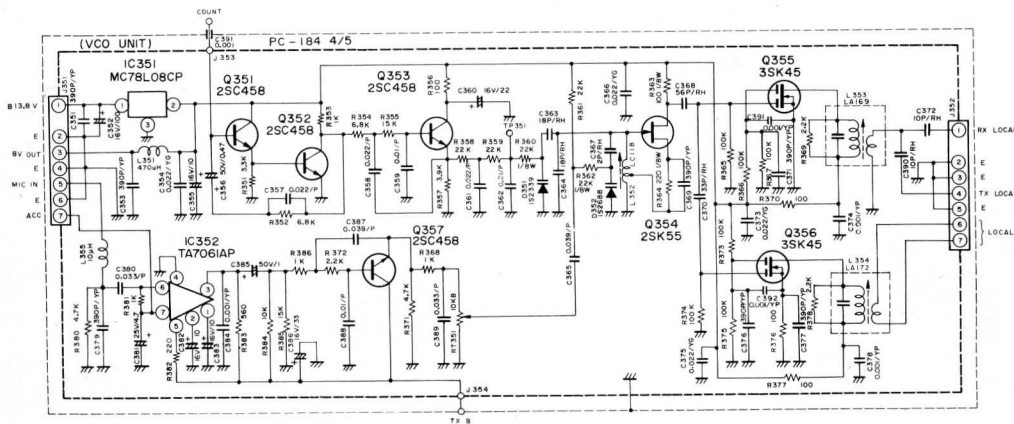
LOCAL Unit PC – 184 2/5



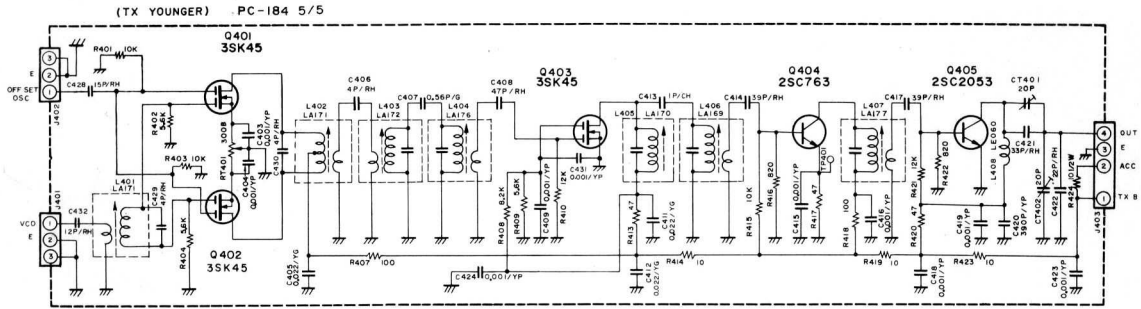
Counter Unit PC – 184 3/5



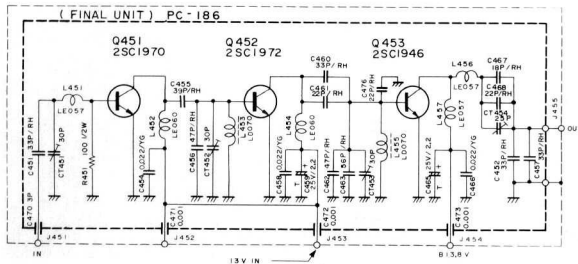
VCO Unit PC – 184 4/5



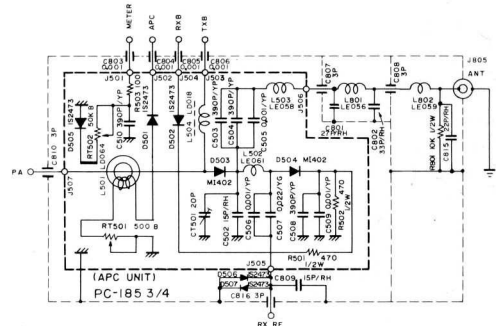
TX Driver Unit PC – 184 5/5



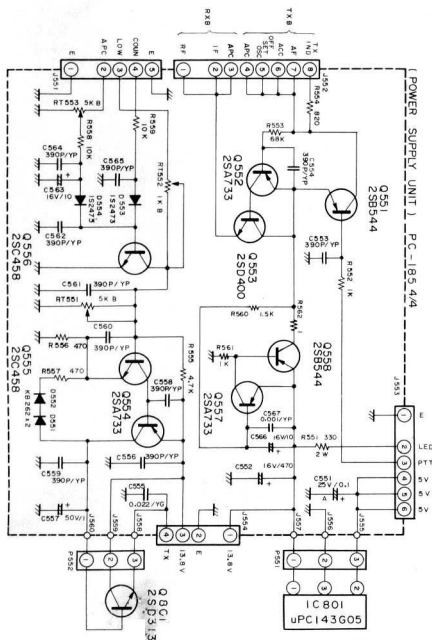
Final Unit PC – 186



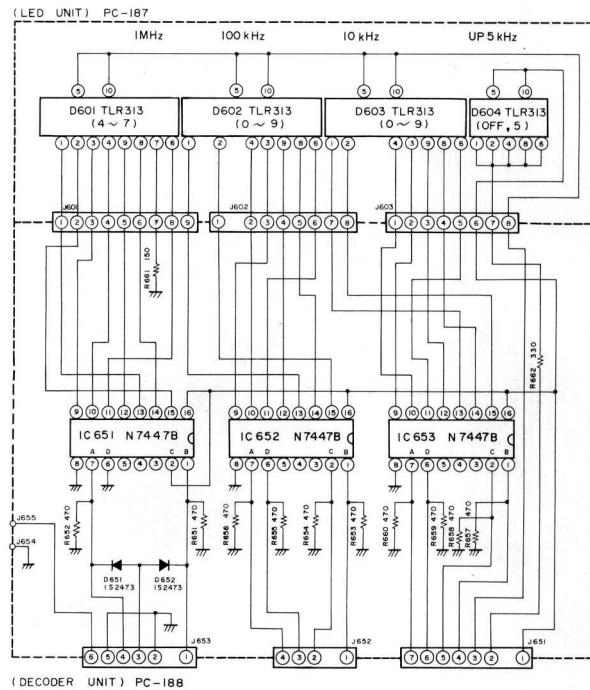
APC Unit PC – 185 3/4



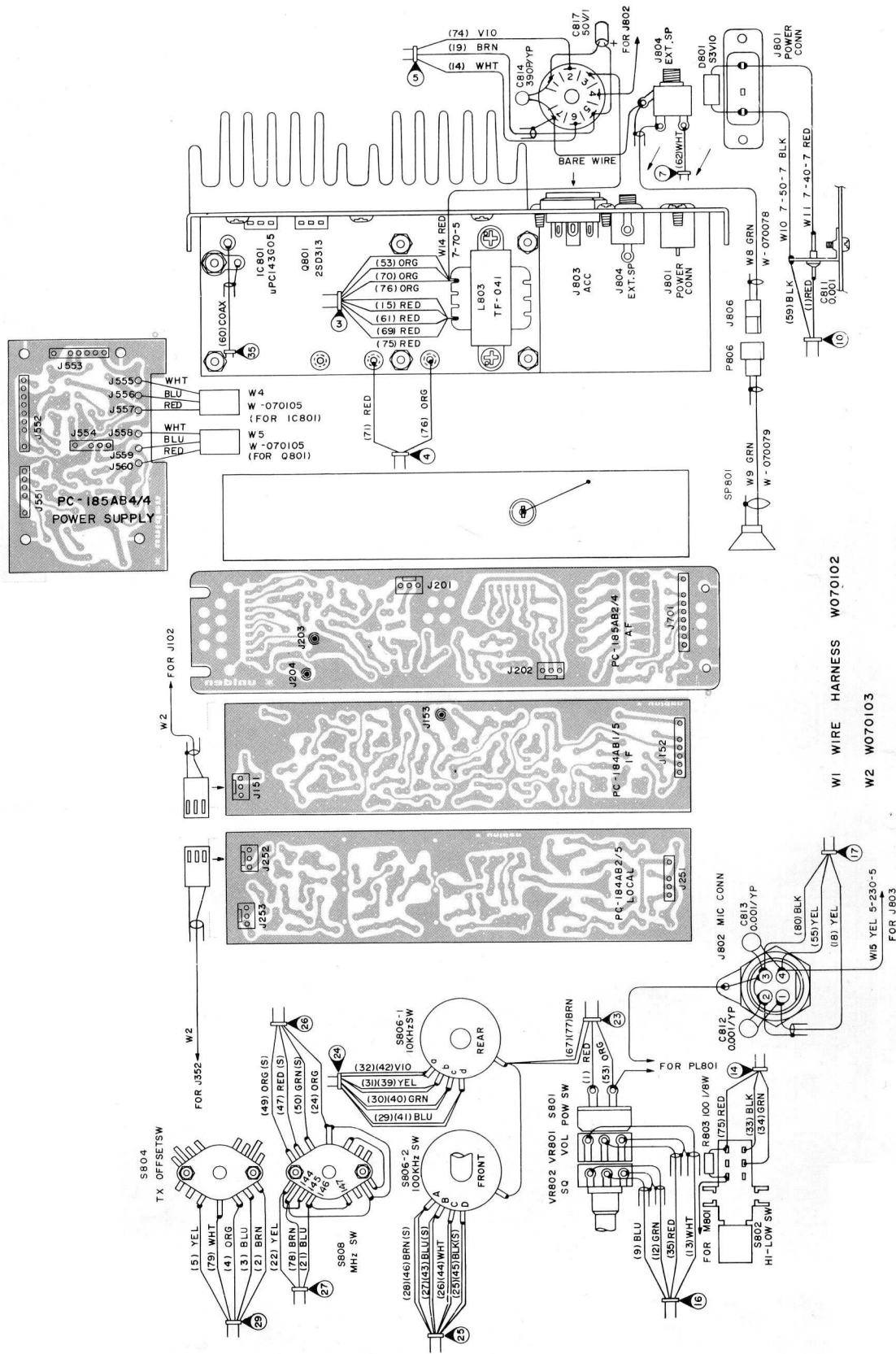
Power Supply Unit PC – 185 4/4



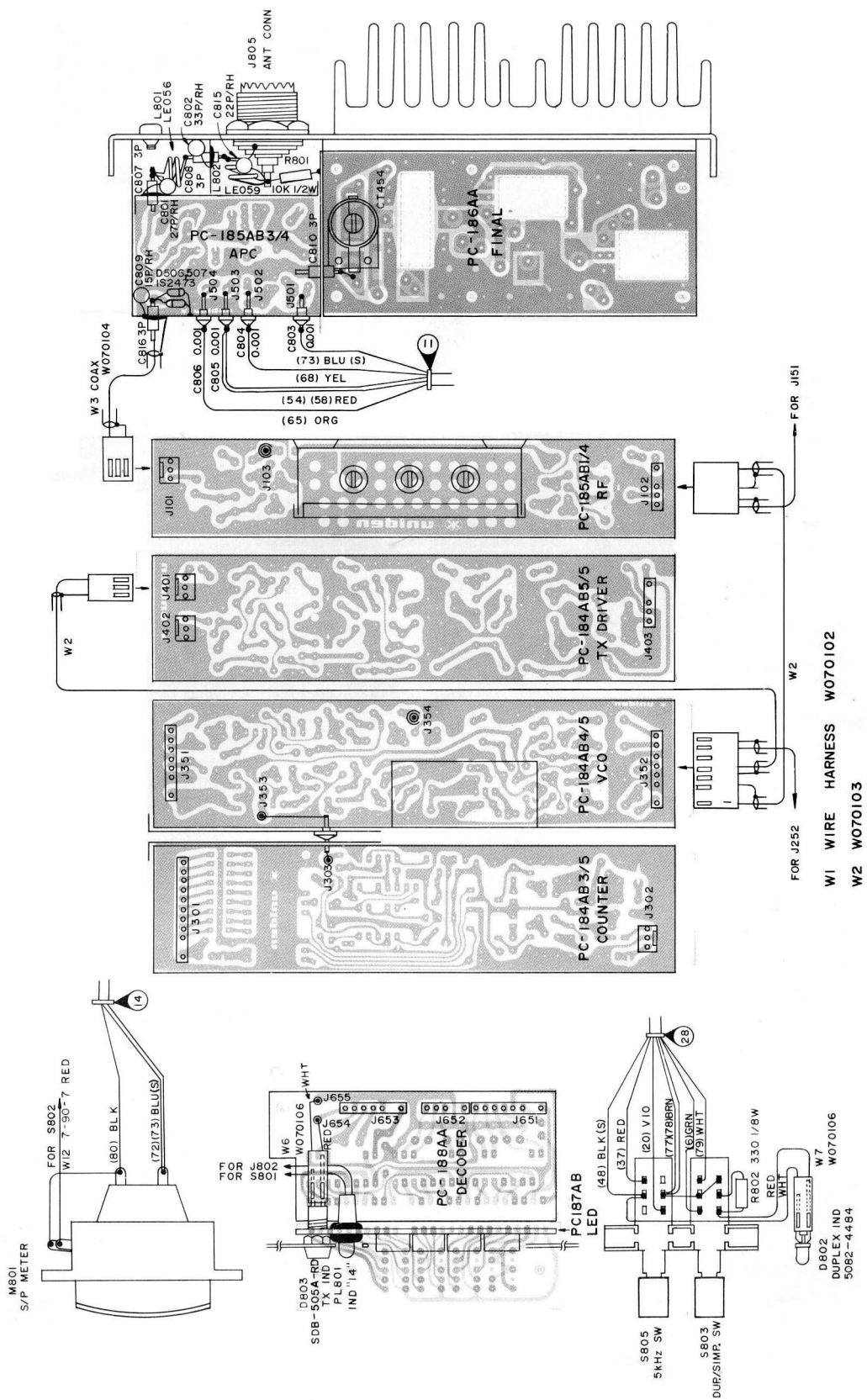
LED Unit PC – 187 Decoder Unit PC – 188



WIRING DIAGRAM



WIRING DIAGRAM



PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	REF. NO.	DESCRIPTION	PART NO.
CASE PARTS			INDUCTANCE		
1	Case, Top		L103, 151	Coil LA-151	
2	Case, Bottom		L152	Coil LA-135	
3	Mounting Bracket		L101, 406, 353, 104	Coil LA-169	
4	Chassis, Main				
5	Chassis, I Rear		L407	Coil LA-177	
6	Panel, Front				
7	Shield Case (Herical)		L102	Coil LC-117	
8	Shield Plate		L405	Coil LA-170	
9	Shield Case (A)		L402, 401	Coil LA-171	
10	Cover, Final		L403, 354	Coil LA-172	
11	Shield Case, APC		L404	Coil LA-176	
12	Lid, Shield (A), APC		L256	Coil LA-173	
13	Lid, Shield (B), APC		L255	Coil LA-174	
14	Heat Sink, I.C. 202		L253, 254	Coil LA-175	
15	Plate, Shield, VCO		L801	Coil LE-056	
16	Holder, Speaker		L451, 456, 457	Coil LE-057	
17	Heat Sink, Final		L503	Coil LE-058	
18	Stand		L802	Coil LE-059	
19	Holder, P.C.B.		L408, 452, 454	Coil LE-060	
20	Knob, 100Khz selector		L502	Coil LE-061	
21	Knob, 10Khz Selector		L352	Coil LC-118	
22	Knob, Band Selector & TX offset		L257, 355	Micro Inductor 10μH	
23	Knob, Volume		L301	Micro Inductor 100μH	
24	Knob, Squelch		L153	Micro Inductor 390μH	
25	Plate name, Brand		L105, 154, 251, 252	Micro Inductor LZ2012 470μH	
26	Heat Sink, Chassis		258, 351, 701		
27	Window, Frequency		L302, 303	Micro Inductor LZ2013 1μH	
28	Label, FCC		L156	Micro Inductor LZ2011 5.6μH	
J802	Jack, Microphone JK-058		L155, 201	Micro Inductor LZ2014 2.7μH	
J805	Connector, Antenna JK-035		L803	Choke Transformer TF-041	
J804	Jack, Ext Speaker JK-010		L504	Coil LD-018	
J801	Jack, DC Power JK-059		L501	Coil LD-064	
J803	Accessory Jack SK-019		L453, 455	Coil LD-070	
	Label, Serial No., Display Box				
	Label, Serial No., Chassis				
	Label, Warning, DC Power Cord				
	Plate, Mike				
MISCELLANEOUS			SEMICONDUCTORS		
	Microphone MK-045		IC152, 352	IC TS-7061AP	
SP801	Speaker SP-045		IC151	IC TA-7060P	
M801	Meter MT-066		IC201	IC TA-7063P	
X704, 705	Crystal Socket SK-010		IC202	IC TA-7204P	
TP351, 251, 252, 401	Test Terminal TP-019		IC351	IC MC-78L08cp	
P801	Plug, Ext. Speaker (PG-003)		IC801	IC μPC-143G05	
PL-801	Pilot Lamp PL-053		IC301	IC μPD-857CW	
P801	DC Power Plug PG-003 ACC.		IC302	IC μPC-1008C	
F801	Fuse 6A FS-006		IC304	IC N-7473A	
	Microphone Hanger YY-016		IC651, 652, 653	IC N-7447B	
	Accessory Plug PG-033				
	Styroform Holder, Front		Q101, 102, 151, 256,	FET 3SK45-B	
	Styroform Holder, Back		355, 356, 401, 402, 403		
	Display Box		Q354	FET 2SK-55-D	
	Owner's Guide		Q351, 352, 353	Transistor 2SC458LGC	
			Q201, 202, 203, 301,	Transistor 2SC458C	
			357, 555, 556		
			Q152, 153, 251, 252,	Transistor 2SC1675-L	
			253, 254, 257, 304,		
			306, 701, 702, 703,		
			704, 705, 706		
			Q255, 303, 305, 404	Transistor 2SS763-C	
			Q302, 552, 554, 557	Transistor 2SA733-P	
			Q551, 558	Transistor 2SB544-E	
			Q553	Transistor 2SD400-E	
			Q801	Transistor 2SD313-E	
			Q405	Transistor 2SC2053	
			Q451	Transistor 2SC1970	
			Q452	Transistor 2SC1972	
			Q453	Transistor 2SC1946	
			D203, 251, 252, 303,	Diode 1S2473	
			304, 553, 554, 651,		
			652		
			D201, 202, 301, 302,	Diode 1S2473	
			501, 502, 505, 506		
			507		
			D152, 153, 154, 155	Diode 1N-60P	
			D151	Zener Diode BZ-081	
			D351	Varicap 1S2339G	
			D352	Varicap 1S2688F	
			D503, 504	Diode MI-402	
			D601, 602, 603, 604	LED TLR-313	
			D803	LED SDB-505A RD	
			D802	LED 5082-4484	
			O551, 552	Varistor KB-262	
			D801	Diode 3SV-10	
SWITCHES & CONTROLS					
S-804, 808	Rotary Switch, Band MHz, & TX offset SR-041				
S806	Rotary Switch, 100KHz & 10KHz Selector, SR-142				
S-803	Push Switch, 5KHz up & Duplex/Simplex				
S-802	Switch, Power Hi-Low SW-050				
VR-801/802 (S-801)	Control, Volume/Squelch with Switch RV-179				

REF. NO.	DESCRIPTION	PART NO.
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RESISTORS

All Resistors not shown on this parts list are carbon 1/4W, see schematic for specific values.

R-451	Carbon 100 Ohm 1/2WJ
R-501, 502	Carbon 470 Ohm 1/2WJ
R-801	Carbon 10K Ohm 1/2WJ
R-424	Carbon 10 Ohm 1/2WJ
R-802	Carbon 330 Ohm 1/8WJ
R-364	Carbon 220 Ohm 1/8WJ
R-803, 363	Carbon 100 Ohm 1/8WJ
R-360, 362	Carbon 22K Ohm 1/8WJ
R-173	Solid 82 Ohm 1WJ
R-551	Metalized Resistor 330 Ohm 2WJ
RT-501	Semi-Fixed RV-182 500 Ohm
RT-551, 553	Semi-Fixed RV-182 5K Ohm
RT-152, 351	Semi-Fixed RV-182 10K Ohm
RT-151, 502	Semi-fixed RV-182 50K Ohm
RT-401	Semi-fixed RV-189 300 Ohm
RT-552	Semi-fixed RV-182 1K Ohm

CAPACITORS

All capacitors not shown on this parts list are ceramic, 50V, see schematic for specific values.

C-470, 807, 808, 810 816	Feed through CZ-023 3P
C-391, 471, 472, 473 803, 804, 805, 806 811	Feed through CZ-024 0.001P
C-407	Minic 0.56P 500VK
C-102	Minic 1P 500VK
C-213, 551	Aluminium 0.1μ 25V
C-182	Aluminium 0.22μ 16V
C-459, 465	Tantalum 2.2μ 25V
CR-301, 302, 303, 304 305, 306, 307, 308 309	C.R. Components HA-001
C-210, 356	Electrolytic 0.47μ 50V
C-185, 225, 385, 557	Electrolytic 1.00μ 50V
C-202, 381, 313	Electrolytic 4.70μ 25V
C-201, 211, 212, 214 219, 311, 355, 382 383, 563, 566	Electrolytic 10.00μ 16V
C-360	Electrolytic 22.00μ 16V
C-314, 386	Electrolytic 33.00μ 16V
C-216, 221, 224	Electrolytic 47.00μ 16V
C-352	Electrolytic 100.00μ 16V
C-226	Electrolytic 220.00μ 16V
C-552	Electrolytic 470.00μ 16V
C-228	Electrolytic 1000.00μ 16V
C-204	Mylar 0.0022μ 50VK
C-177, 179, 181	Mylar 0.001μ 50VK
C-171, 180, 184, 203 207, 208, 220, 359 362, 388	Mylar 0.01μ 50VK
C-217, 357, 358, 361	Mylar 0.022μ 50VK
C-205, 312, 365, 387	Mylar 0.039μ 50VK
C-152, 153, 154, 155 156, 157, 161, 260 261, 317, 321	Ceramic 0.01μ 25V ZY
C-165, 251, 252, 257 263, 264, 268, 269 273, 277, 279, 318 319, 326, 354, 366 373, 375, 507, 555 706, 280, 281, 282	Ceramic 0.022μ 25V ZYG
C-163, 164, 166, 167 169, 170, 172, 173 174, 175, 176, 183 186, 315, 316, 707	Ceramic 0.039μ 25V ZYG
CT-451, 452, 453	Trimmer CV-024 30P
CT-251, 252, 253 254, 401, 402 501, 701, 702 703, 704, 705	Trimmer CV-028 20P
CT-454	Trimmer CV-037 25P

REF. NO.	DESCRIPTION	PART NO.
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CONNECTOR WAFER-ASS'Y

J-101, 151, 202, 252 253, 302, 401, 402 201	Wafer 5045-03A 3pin
J-102, 251, 403, 554 652	Wafer 5048-04A 4pin
J-551	Wafer 5048-05A 5pin
J-553, 653, 152	Wafer 5048-06A 6pin
J-351, 352, 651	Wafer 5048-07A 7pin
J-701, 552	Wafer 5048-08A 8pin
J-602	Wafer 5049-08A 8pin
J-301	Wafer 5048-10A 10pin
J-153, 203, 204, 354 103	Terminal Pin TP-027
J-603	Wafer 3094-8A
J-601	Wafer 3094-9A

CONNECTOR HOUSING ASS'Y

P-102, 251, 403, 554 652	Housing SD-5047-4
P-551	Housing SD-5047-5
P-152, 553, 653	Housing SD-5047-6
P-351, 352, 651	Housing SD-5047-7
P-552, 701	Housing SD-5047-8
P-301	Housing SD-5047-10
P-101, 151, 202, 252 201, 253, 302, 401 402	Housing SD-5051-3
P-555, 556	Housing SD-3021-3
P-153, 203, 204, 354	Housing 1855TL
P-655	Housing SD-3021-2
P-555, 556	Housing SD-3021-3

NOTE: When ordering parts, it is essential to specify the correct model number and serial number of the

LIMITED WARRANTY

Clegg Communications Corp. will repair or replace, at its option, and without charge, and FM-28 transceiver which fails due to defect in material or workmanship within 90 days of shipment to the purchaser.

The responsibility of the purchaser under this warranty is to return the product, freight prepaid, to Clegg Communications Corp., 208 Centerville Road, Lancaster PA 17603, along with sufficient information to define the specific malfunction.

This warranty gives you specific legal rights. You may have additional rights which vary from state to state.

**CLEGG DIV. OF ISC
208 CENTERVILLE RD.
LANCASTER. PA 17603**