NOTE: This is the Canadian version of the PT300, for 132-174 MHz. It applies to the CP23DDC and CP33DDC models.

MOTOROLA

"HANDIE - TALKIE"

FM RADIOPHONE

TRANSISTORIZED PORTABLE

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MODEL CP33DDC-1130BM

CANADIAN MOTOROLA ELECTRONICS COMPANY

105 Bartley Drive, Toronto 16, Ontario

a division of Canman Industries Limited

68P70037M-O

Guaranteed PERFORMANCE SPECIFICATIONS

GENERAL

MODEL (P23 Series)	RECEIVER (Series)	TRANSMITTER (Series)	POWER SUPPLY	BATTERY DRAIN	RF POWER OUTPUT	AUDIO OUTPUT
SPEAKER - MIC.						
CP23DDC-1100BM	CNRD1130BB (1-Freq., 30 KC channel)	CNTD6070AA (1-Freq.)	CNPN6030B (Dry Battery)	STANDBY 4 MA at 14.0 volts	1.4 watts at nominal battery voltage (14.0 volts)	500 milliwatts
CP23DDC-1110BM		CNTD6070AB (2-Freq.)				
CP23DDC-1102BM		CNTD6070AA (1-Freq.)	CNPN6031A (Nickel-Cadmium)	RECEIVE 55 MA at 14.0 volts		
CP23DDC-1112BM		CNTD6070AB (2-Freq.)				
CP23DDC-1132BM	CNRD1130BB/* (2-Freq., 30 KC channel)			TRANSMIT 475 MA at 14.0 volts		
CP23DDC-1130BM			CNPN6030B (Dry Battery)			
HANDSET						
CP23DDC-1100BH	CNRD1150BB (1-Freq., 30 KC channel)	CNTD6070AA (1-Freq.)	CNPN6030B (Dry Battery)	STANDBY 4 MA at 14.0 volts		3 milliwatts
CP23DDC-1110BH		CNTD6070AB (2-Freq.)		RECEIVE 12 MA at 14.0 volts		
CP23DDC-1130BH	CNRD1150BB/* (2-Freq., 30 KC channel)					
CP23DDC-1102BH	CNRD1150BB (1-Freq., 30 KC channel)	CNTD6070AA (1-Freq.)	CNPN6031A (Nickel-Cadmium)	TRANSMIT 475 MA at 14.0 volts		
SPEAKER-HANDSET						
CP23DDC-1100BR	CNRD1130BB (1-Freq., 30 KC channel)	CNTD6070AA (1-Freq.)	CNPN6030B (Dry Battery)	STANDBY 4 MA at 14.0 volts		500 milliwatts
CP23DDC-1110BR		CNTD6070AB (2-Freq.)				
CP23DDC-1102BR		CNTD6070AA (1-Freq.)	CNPN6031A (Nickel-Cadmium)	RECEIVE 55 MA at 14.0 volts		
CP23DDC-1130 BR	CNRD1130BB/* (2-Freq., 30 KC channel)	CNTD6070AB (2-Freq.)	CNPN6030B (Dry Battery)	TRANSMIT 475 MA at 14.0 volts		

MODEL (P33 Series)	RECEIVER (Series)	TRANSMITTER (Series) WITH CNLD6170A SERIES POWER AMPLIFIER	POWER SUPPLY	BATTERY DRAIN	RF POWER OUTPUT	AUDIO OUTPUT
SPEAKER - MIC.						
CP33DDC-1100BM	CNRD1130BB (1-Freq., 30 KC channel)	CNTD6090AA (1-Freq.)	CNPN6030B (Dry Battery)	STANDBY 8 MA at 14.0 volts	3.0 watts at nominal battery voltage (13.5 volts)	500 milliwatts
CP33DDC-1110BM		CNTD6090AB (2-Freq.)				
CP33DDC-1102BM		CNTD6090AA (1-Freq.)	CNPN6031A (Nickel-Cadmium)			
CP33DDC-1112BM		CNTD6090AB (2-Freq.)				
CP33DDC-1132BM	CNRD1130BB/* (2-Freq., 30 KC channel)					
CP33DDC-1130BM			CNPN6030B (Dry Battery)	RECEIVE 55 MA at 14.0 volts		
SPEAKER-HANDSET						
CP33DDC-1100BR	CNRD1130BB (1-Freq., 30 KC channel)	CNTD6090AA (1-Freq.)	CNPN6030B (Dry Battery)			
CP33DDC-1110BR		CNTD6090AB (2-Freq.)		TRANSMIT 900 MA at 13.5 volts		
CP33DDC-1102BR		CNTD6090AA (1-Freq.)	CNPN6031A (Nickel-Cadmium)			
CP33DDC-1130BR	CNRD1130BB/* (2-Freq., 30 KC channel)	CNTD6090AB (2-Freq.)	CNPN6030B (Dry Battery)			

*CNLD6220A Series (F2) Oscillator Deck is incorporated in single frequency receivers to provide 2-frequency operation.

FREQUENCY	132-174 megacycles				
DIMENSIONS (excluding antenna)	MODELS	MODELS WITH DRY CELL BATTERIES		MODELS WITH NICKEL-CADMIUM BATTERY	
	Speaker-Microphone	9" x 7-3/4" x 3-3/4"		9" x 6-3/8" x 3-3/4"	
	Speaker-Handset	9" x 8-3/4" x 3-3/4"		9" x 7-3/8" x 3-3/4"	
	Handset	9" x 8-3/4" x 3-3/4"		9" x 7-3/8" x 3-3/4"	
WEIGHT	MODELS	MODELS WITH DRY CELL BATTERIES		MODELS WITH NICKEL-CADMIUM BATTERY	
		CR/MR/CP33 Series	CR/MR/CP23 Series	CR/MR/CP33 Series	CR/MR/CP23 Series
	Speaker-Microphone	7 lbs. 14 oz.	7 lbs. 7 oz.	6 lbs. 8 oz.	6 lbs. 1 oz.
	Speaker-Handset	8 lbs. 7 oz.	7 lbs. 15 oz.	7 lbs.	6 lbs. 9 oz.
	Handset	8 lbs. 4 oz.	7 lbs. 12 oz.	6 lbs. 13 oz.	6 lbs. 6 oz.

NOTES

1. Wide channel (60 KC channel spacing) models of "Handie-Talkie" Radiophones are also available, e.g., model CP23DDC-1000BM.
2. Models designated CR/MR23 or 33DDC Series are designed for Shock Mounting Rack installation (such as used in railroad applications) and are equipped with Power Supply model CNPN6033A (dry battery).
3. All P/R33DDC Series Radiophone models use high stability transmitter (frequency stability of ±0.0005%).
4. P/R23DDC Series Radiophones have frequency stability rating of ±0.0025%, except those identified by suffix "V" following the model number which use high stability transmitter model CNTD6080A Series with frequency stability of ±0.0005%.

D.O.T. LISTING NUMBERS

TRANSMITTERS:

Model CNTD6070AA/AB Series, 60 and 30 KC Channel: technically acceptable for licensing.
Model CNTD6080AA/AB Series (high stability), 60 KC Channel: type approval No. 109062081
Model CNTD6080AA/AB Series (high stability), 30 KC Channel: type approval No. 109264144
Model CNTD6090AA/AB Series (with CNLD6170A Series Power Amplifier), 60 KC Channel: type approval No. 109062082
Model CNTD6090AA/AB Series (with CNLD6170A Series Power Amplifier), 30 KC Channel: type approval No. 109264145

RECEIVERS:

All CNRD1130B Series and CNRD1150B Series are technically acceptable for licensing.

RECEIVER

BASIC UNIT	CNRD1130BA Series and CNRD1150BA Series	CNRD1130BB Series and CNRD1150BB Series
CHANNEL SPACING	60 KC (±15 KC Bandwidth)	30 KC (±5 KC Bandwidth)
MODULATION ACCEPTANCE	±15 KC (wide channel models)	±5 KC (split channel models)
SELECTIVITY	-80 DB at ±60 KC	-80 DB at ±30 KC
FILTER	NFN6006 AW	NFN6006 AS
FREQUENCY RANGE	1 fixed frequency within 132-150 MC band(CNRD1131BA/BB and CNRD1151BA/BB) 1 fixed frequency within 150-174 MC band(CNRD1132BA/BB and CNRD1152 BA/BB) 2 fixed frequencies within 132-150 MC band (CNRD1131BA/BB and CNRD1151BA/BB with CNLD6221AF2 Osc. Deck) 2 fixed frequencies within 150-174 MC band (CNRD1132BA/BB and CNRD1152BA/BB with CNLD6222AF2 Osc. Deck)	
SENSITIVITY	Less than 0.5 microvolt for 20 DB quieting; 0.35 microvolt for 12 DB SINAD (50 ohms RF input impedance)	
SPURIOUS AND IMAGE REJECTION	All spurious and image responses are attenuated 60 DB or more	
FREQUENCY STABILITY AND TEMPERATURE RANGE	±0.0025% from -30°C to +60°C (+25°C reference)	
SQUELCH	Noise compensated type, adjustable sensitivity. Threshold sensitivity is 0.25 microvolt.	
AUDIO OUTPUT	CNRD1130B Series models: 500 milliwatts to speaker at less than 10% distortion CNRD1150B Series models: 3 milliwatts to handset at less than 10% distortion	
TRANSISTOR COMPLEMENT	CNRD1130BA/BB Series models: 16 transistors CNRD1150BA/BB Series models: 14 transistors One additional transistor used in two frequency receivers	

TRANSMITTER

BASIC UNIT	CNTD6070AA/AB Series and CNTD6080AA/AB Series	CNTD6090 Series with CNLD6170A Series Power Amplifier
RF OUTPUT	1.4 watts at nominal battery voltage (14.0 volts)	3.0 watts at nominal battery voltage (13.5 volts)
SPURIOUS AND HARMONIC EMISSIONS	All spurious and harmonic emissions are attenuated at least 45 DB below carrier level.	All spurious and harmonic emissions are attenuated at least 48 DB below carrier level.
FREQUENCY RANGE	1 fixed frequency within 132-150 MC band (CNTD6071AA, CNTD6081AA and CNTD6091AA) 1 fixed frequency within 150-168 MC band (CNTD6072AA, CNTD6082AA and CNTD6092AA) 1 fixed frequency within 168-174 MC band (CNTD6073AA, CNTD6083AA and CNTD6093AA) 2 fixed frequencies within 132-150 MC band (CNTD6071AB, CNTD6081AB and CNTD6091AB) 2 fixed frequencies within 150-168 MC band (CNTD6072AB, CNTD6082AB and CNTD6092AB) 2 fixed frequencies within 168-174 MC band (CNTD6073AB, CNTD6083AB and CNTD6093AB)	
FREQUENCY STABILITY AND TEMPERATURE RANGE	CNTD6070A Series models: ±0.0025% from -30°C to +60°C (+25°C reference) CNTD6080A Series and CNTD6090A Series models: ±0.0005% from -30°C to +60°C (+25°C reference)	
MODULATION	±5 KC for 100% at 1000 CPS or ±15 KC for 100% at 1000 CPS	
CRYSTAL MULTIPLICATION	18 times	
OUTPUT IMPEDANCE	50 Ohms	
AUDIO SENSITIVITY	0.2 volts ±3 DB for 2/3 rated deviation at 1000 CPS	
FM NOISE	At least 50 DB below 2/3 rated deviation at 1000 CPS	
AUDIO RESPONSE	+1, -3 DB of 6 DB/octave pre-emphasis characteristic from 300 to 3000 CPS	
AUDIO DISTORTION	Less than 8% at 1000 CPS, 2/3 rated deviation	
TRANSISTOR COMPLEMENT	11 transistors in single frequency models 12 transistors in two-frequency models 6 transistors in CNLD6170A Series Power Amplifier	

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

GENERAL DESCRIPTION

INTRODUCTION

Motorola "Handie-Talkie" Radiophones are completely transistorized, compact, weather resistant, portable two-way FM radio stations for fixed frequency operation in the 132 to 174 mc band. Each contains a transistorized crystal controlled transmitter, receiver, operating power supply, control panel, whip antenna and carrying strap. Two series of "Handie-Talkie" Radiophones are described in this manual; P23 Series for light weight and maximum portability and P33 Series where higher RF power output is required. The P23 Series models provide 1.4 watts of RF power output at nominal battery voltage and have a minimum weight of 6 lbs. 1 oz. The P33 Series models deliver 3 watts of RF power output and weigh a minimum of 6 lbs. 8 oz. An additional RF power amplifier stage in P33 Series units provides the increased power output.

Both series of Radiophones are available with one or two-frequency receivers and one or two-frequency transmitters. Maximum channel separation without performance degradation is 1 megacycle for two-frequency transmitters and 300 kc for two-frequency receivers. Simultaneous channel selection of both transmitter and receiver is accomplished by a top-panel mounted F1-F2 switch. Model variations also include a choice of wide (60 kc) or split (30 kc) channel spacing operation and speaker-microphone, handset or speaker-handset options. The receiver of "handset" models has a power output of three milliwatts which is more than sufficient for handset operation. In speaker-microphone and speaker-handset models, the receiver incorporates a push-pull audio output stage capable of delivering up to 500 milliwatts of audio power to the speaker.

Three types of power supplies are employed in the various Radiophone models. Two power supply models use industrial "D" type dry cell batteries and differ only in the physical shape of the battery case, i.e., the "notched" model permits mounting of the Radiophone in a Shock Mounting Rack. The third model uses a rechargeable nickel-cadmium battery as the internal power source. All power supply models are interchangeable without wiring modifications and are equipped with convenient "snap-on" fasteners for quick interchange.

Featured in all Radiophone models is a top-panel mounted semi-automatic ON-OFF switch which turns off the Radiophone when the handset or microphone is placed in its cradle. "Speaker-microphone" models may be continuously monitored by placing the microphone face-up in its cradle. Other top-panel mounted controls include VOLUME and SQUELCH controls for the receiver and on two-frequency models, an F1-F2 switch.

Various kits are available as optional add-to accessories for all "Handie-Talkie" Radiophones, the more common kits being described and illustrated under "ACCESSORIES". When an accessory item is ordered, complete installation and operating instructions (where applicable) are included with the kit.

A list of the available Radiophone models and modules contained therein appears in the accompanying Performance Specifications. For model variations not listed by specific model number in the "General" section of the Performance Specifications table, refer to the NOTES below the table. All model variations are covered in this instruction manual.

Complete operating instructions, theory of operation, alignment procedures, intercabling and schematic diagrams follow the "General Description" section. Maintenance data is included in a section at the back of the manual and Motorola National Service Division information appears on the inside of the back cover. Any correspondence or communication in relation to this equipment must include complete model and serial numbers.

RECEIVER

The "Handie-Talkie" Radiophone receiver model CNRD1130BB Series is a completely transistorized printed circuit module utilizing 16 transistors in a double conversion superheterodyne circuit. The receiver operates at any fixed frequency in the 132 to 174 mc band with a channel separation of 30 kc. The RF section includes one RF amplifier stage, a diode 1st mixer, one 1st IF amplifier stage, transistor 2nd mixer, five 455 kc 2nd IF stages with a sealed "Permakay" IF filter, and a limiter stage. Two independent crystal controlled oscillators are used in the mixer stages for optimum frequency stability. Audio detection and amplification are performed by a phase discriminator and three audio amplifier stages; the output stage using push-pull transistors providing 500 milliwatts of audio power to a 50 ohm speaker. Noise cancellation is effected by a noise compensated, adjustable sensitivity squelch circuit.

Model CNRD1130BA Series Receiver is the wide channel version of the above model and is similar to the split channel receiver except that the IF filter is designed for 60 kc channel spacing operation.

Two-frequency versions of the basic single frequency split and wide channel receivers are available. In these receivers, an additional Oscillator Deck, model CNLD6220A Series is employed; the oscillator corresponding to the desired operating channel being selected by the F1-F2 switch on the Radiophone top panel.

The CNRD1150B Series Receivers are similar to the CNRD1130B Series models described above, except that they are intended for use in "handset" only Radiophone models. For this purpose, an audio output rating of three milliwatts is sufficient and the push-pull audio output stage incorporated in CNRD1130B Series models is omitted. In all other respects, both receiver models are identical.

TRANSMITTER

Model CNTD6070AA Series Transmitter used in P23DDC Series "Handie-Talkie" Radiophones is a compact, fully transistorized printed circuit module providing 1.4 watts of RF power output at a single fixed frequency in the 132 to 174 mc band. The unit operates from a 14 volt (nominal) dc power source and contains an audio section and an RF section. The audio section, consisting of an amplifier-limiter and an integrator stage, includes an Instantaneous Deviation Control (I.D.C.) circuit which permits a high level of modulation while preventing over deviation for normal microphone input levels. Maximum deviation as determined by channel spacing requirements is factory set by means of an I.D.C. control following the integrator. The RF section consists of a crystal controlled oscillator operating on a specific frequency in the 7.3 to 9.7 mc range, a phase modulator, two frequency triplers and a frequency doubler providing a frequency multiplication factor of 18. Following the frequency doubler are a driver amplifier, an intermediate power amplifier and a final amplifier stage.

Model CNTD6070AB Series Transmitter is a two-frequency version of the CNTD6070AA Series model and includes an additional crystal controlled oscillator circuit for two-frequency operation. The oscillator corresponding to the desired operating channel is selected by means of the F1-F2 switch on the Radiophone top panel.

The CNTD6080AA and AB Series transmitters are similar in performance to the CNTD6070AA and AB Series models, respectively, except for certain component variances for high stability operation (±0.0005% frequency stability). See "Guaranteed Performance Specifications" table.

CNTD6090AA and AB Series transmitters are one and two-frequency, respectively, high stability exciter units intended for use as a driver for the model CNLD6170A Series Power Amplifier in P33DDC Series "Handie-Talkie" Radiophones. The model CNLD6170A Power Amplifier utilizes six transistors to provide 3 watts RF power output with 13.5 volts dc input.

POWER SUPPLY

Power Supplies available for use with the "Handie-Talkie" Radiophone to provide operating voltage for the transmitter and receiver include models CNPN6030B and CNPN6033A, which use dry cell batteries; model CNPN6031A which uses a single rechargeable nickel-cadmium battery; and model XNPN6032A 117 volt ac power supply, available as an optional accessory. CNPN6030B and CNPN6033A Power Supplies both require model CNLN6310A Dry Battery Kit consisting of eleven No.1050 industrial "D" type dry cell batteries, series connected to provide 14.0 volts (nominal) dc output under full load conditions. The CNPN6033A model is electrically identical to the CNPN6030B Power Supply and differs only in the physical configuration of the battery case, i.e., the case is "notched" to permit installation of the "Handie-Talkie" Radiophone in a Shock Mounting Rack (such as used in railroad applications).

Model CNPN6031A Power Supply uses Nickel-Cadmium Battery Kit model CNLN6267A as the internal source of power for the "Handie-Talkie" Radiophone. When this power supply is used, operation of the Radiophone is also possible from either a 6 or 12 volt external battery operating in conjunction with model NLN6270A 6/12 Volt DC Vehicular Charging Unit. The Nickel-Cadmium Battery Kit consists of 11 hermetically sealed cells which are series connected to provide a nominal 14 volt output. The cells are enclosed in a case and fitted with a three pin receptacle.

Battery life expectancy under operating conditions of 10% transmit, 10% receive at rated audio output and 80% standby is approximately as follows: For P23 Series "Handie-Talkie" Radiophones, the CNPN6030B and CNPN6033A Power Supply with model CNLN6310A Dry Battery Kit will provide fourteen 8 hour days of operation, each separated by a 16 hour OFF period. For P33 Series Radiophones, these power packs will provide six 8 hour days of operation.

The CNPN6031A Power Supply (with one CNLN6267A Nickel-Cadmium Battery Kit) will furnish 16 hours of operation for P23 Series Radiophones or 8 hours of operation for P33 Series Radiophones before recharging is necessary. Note that in actual practice, transmit duty cycles are normally much smaller than previously stated and approach 2% rather than 10%. Also in many types of operation, the Radiophone does not remain turned on continuously. If this type of service is prevalent, battery life may be extended to many times the figures stated above.

ANTENNA

Model CNAD6120A, CNAD6121A and CNAD6122A Antennas are flexible steel whips terminated in a uhf connector at one end and a protective guard at the opposite end. The CNAD6120A measures 19-1/2" in length for operation in the 132 to 150.8 mc band. Model CNAD6121A is 18-1/2" long for operation in the 150.8 to 162 mc band and model CNAD6122A is 17-1/4" long for operation in the 162 to 174 mc band.

Note that the "Handie-Talkie" Radiophone may be used with a fixed or elevated antenna. The antenna circuit provides a 50 ohm termination at the antenna receptacle, therefore, any 50 ohm antenna resonant at the transmitter frequency can be used. The higher the antenna, the greater the area that can be covered.

MICROPHONE AND HANDSET

The CNMN6018A Microphone is a palm type transistorized dynamic microphone, equipped with a push-to-talk button for "keying" the Radiophone transmitter. The microphone is supplied with a rubber covered coiled cord which can be extended to approximately 5 ft., and a weatherproof connector which plugs into a four-prong receptacle on top of the Radiophone housing.

Model CNMN6017A and MNMN6017A Handsets are telephone type units containing a push-to-talk bar for "keying" the Radiophone transmitter, a carbon type microphone cartridge and a receiver cartridge. Supplied with each handset is a coiled cord and connector similar to those used with model CNMN6018A Microphone. Model MNMN6017A Handset is electrically identical to the CNMN6017A model, but includes a vapour barrier in front of the microphone cartridge to prevent moisture from forming and freezing on the cartridge during low temperature operation.

ACCESSORIES

The following table lists the various accessory items available for use with the "Handie-Talkie" Radiophones. Model CNLN6129A Carrying Strap is supplied with each Radiophone; the remaining accessories are optional.

ACCESSORY TABLE

MODEL	DESCRIPTION
XNPN6032A	117 VAC Power Supply
NLN6268A	Shock Mount Rack
CNLN6129A	Carrying Strap
NLN6262A	Carrying Bag
P-7208-A	RF Dummy Load for P23 Series Radiophones
P-7208	RF Dummy Load for P33 Series Radiophones
NLN6145A	Dummy Load Antenna for P23 Series Radiophones
NLD6060A	Dummy Load Antenna for P33 Series Radiophones
NLN6311A	Back Pack Harness complete with microphone, earpiece and volume control
NLN6312A	Back Pack Harness less microphone, earpiece and volume control
NMN6009A	Headset and Microphone
XNLN6029A	Nickel-Cadmium Battery Charger (requires NKN6078A Battery Charger Adapter)
NKN6079A	Battery Charger Cable Kit (for use with CNPN6031A Power Supply and XNLN6029A Battery Charger)
NKN6080A	Battery Charger Cable Kit (for use with CNLN6267A Battery Kit and XNLN6029A Battery Charger)
NKN6042A	Antenna Extension Cable (20 ft RG-58A/U)
NDD6000A	Antenna, vehicle rain gutter mounting, with 10 ft of RG-58A/U coaxial cable and connector
TEKA-40	Power extension cable for easy repair and/or alignment
NLN6270A	6/12 VDC Vehicular Charging Unit
NKN6074A	6 VDC Vehicular Cable for NLN6270A Charging Unit
NKN6075A	12 VDC Vehicular Cable for NLN6270A Charging Unit
NKN6076A	12 VDC Cigarette Lighter Cable for NLN6270A Charging Unit
NEN6048B (ST455)	Test Jig for aligning and testing radiophone
NKN6078A	Battery Charger Adapter (for XNLN6029A Nickel-Cadmium Battery Charger)
NLN6137A	Squelch and Volume Locking Nut
TEKA-53	Power test cable (for use with TEKA-23 Power Supply for alignment and servicing)

ACCESSORIES

CARRYING CASE
Model NLN6262A
Weather resistant case

TEST JIG
Model NEN6048B

RF DUMMY LOAD
Model P-7208
For P33 Series units
Model P-7208-A
For P23 Series units

DUMMY LOAD ANTENNA
Model NLN6145A
For P23 Series units
Model NLD6060A
For P33 Series units

POWER TEST CABLE
Model TEKA-53
Used with TEKA-23
Power Supply for
Alignment and Servicing

BACK PACK HARNESS
Model NLN6311A
Kit is complete with microphone, earpiece and volume control.
Model NLN6312A
Same as NLN6311A less microphone and earpiece.

HEADSET AND
MICROPHONE
Model NMN6009A

POWER EXTENSION CABLE
Model TEKA-40
Permits Radio to be serviced
when separated from power pack.

NICKEL-CADMIUM
BATTERY CHARGER
Model NLN6029A

OPERATING INSTRUCTIONS

UNPACKING

Use care when unpacking and handling the "Handie-Talkie" Radiophone. Open the shipping carton and carefully remove all items. Check the contents to be sure that all items have been included.

Inspect the equipment thoroughly as soon as possible after delivery. If any part of the equipment has been damaged in transit, report the extent of damage to the transportation company immediately.

CAUTION

This equipment contains batteries. Since all batteries have a finite shelf life, extended storage of the equipment will reduce operating performance because of reduced battery voltage and life. If the equipment is to be stored for a long period of time, remove the batteries and store them in a cool, dry place.

Instructions for battery removal and replacement are included in the "Maintenance" section of this manual.

OPERATION

The Motorola "Handie-Talkie" Radiophone is shipped from the factory completely assembled and ready for use, except for the installation of the antenna.

CAUTION

Do not key the Radiophone transmitter unless the antenna, dummy load or equivalent is connected to the antenna receptacle.

A) TO TURN ON

Remove the microphone or handset from its holder. The ON-OFF switch is located beneath the microphone or mouthpiece end of the handset. Press down on the side of the switch labeled PUSH ON. This places the receiver in operation.

NOTE

All power supplies except the ac power supplies turn on and off with the ON-OFF switch on the Radiophone top panel. To turn on the ac power supply, always use the ON-OFF switch on the power supply housing.

B) TO ADJUST THE SQUELCH AND VOLUME CONTROLS

The SQUELCH control must be adjusted carefully to ensure proper operation of the receiver, since its setting determines the minimum signal strength required to open the receiver squelch circuit. To adjust the squelch, turn the SQUELCH control fully counterclockwise. Advance the VOLUME control clockwise until a loud "rushing" noise is heard from the speaker or handset. With no signal (noise alone) being received, slowly rotate the SQUELCH control clockwise until the noise just cuts out. This is the threshold setting for maximum squelch sensitivity. Turning the control beyond this point may block out weak signals which should be heard.

After the SQUELCH control is properly adjusted, set the VOLUME control to the desired listening level while receiving a signal.

C) TO MONITOR

To monitor all on-frequency signals, turn the Radiophone on and adjust the VOLUME and SQUELCH controls for proper reception. Continuous monitoring of the receiver in microphone equipped models may be accomplished by placing the microphone face up in its holder.

D) TO TRANSMIT

Hold the microphone or handset mouthpiece one to two inches from the lips. Press the push-to-talk button in firmly and hold it in. Speak slowly and clearly across the mouthpiece in a normal-to-loud voice. The receiver is inoperative when the push-to-talk button is pressed.

NOTE

Additional range may be obtained by placing the Radiophone on the hood or top of a car. This provides a good ground plane for the antenna.

E) FREQUENCY SELECTION (Two-Frequency Models Only)

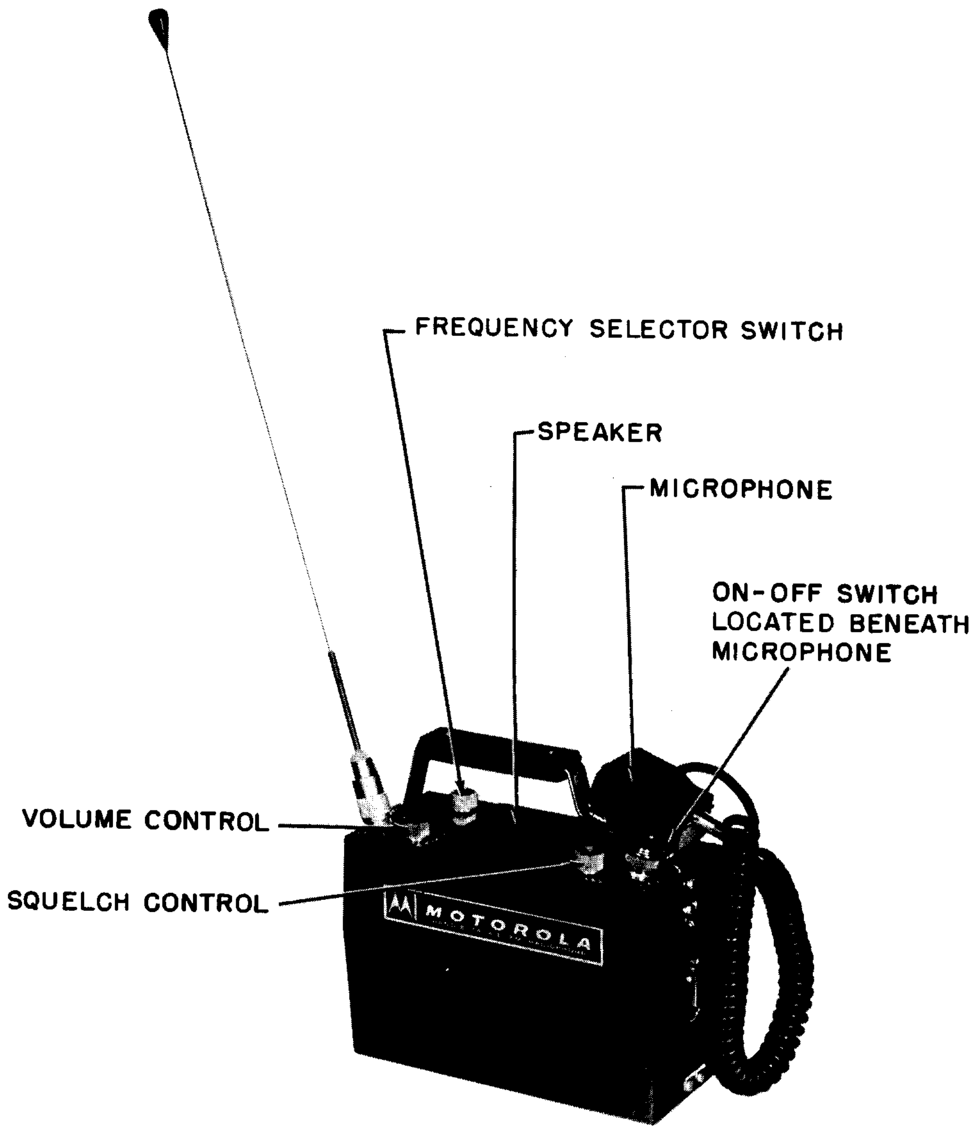
The rotary switch on top of the Radiophone may be turned to position F1 or F2 to select either of the two operating frequencies. If the Radiophone receiver and transmitter are both two-frequency models, operation of the F1-F2 switch will change transmitter and receiver frequencies simultaneously.

F) TO TURN OFF

All models feature a semi-automatic ON-OFF switch which automatically turns off the Radiophone when the microphone or handset is replaced in its holder. Note that the microphone must be placed face down in its holder to turn the equipment off.

G) STORAGE

Remove the batteries if the Radiophone is to be stored for a long period of time. If the unit is equipped with a nickel-cadmium battery, refer to the storage instructions for the CNLN6267A Battery Kit included in the "Maintenance" section.



CONTROLS LOCATION DETAIL

THEORY OF OPERATION

FUNCTIONAL OPERATION

The overall operation of the "Handie-Talkie" Radiophone is illustrated in the Intercabling Diagram. Battery voltage to the Radiophone receiver and transmitter is controlled by the semi-automatic ON-OFF switch. When this switch is in the ON position, battery voltage (14 volts dc, nominal) is applied to the receiver audio stages and via normally closed contacts of the transmit-receive relay to the receiver RF and IF stages. This places the receiver in operation (Radiophone on "standby").

Operation of the microphone or handset push-to-talk switch with the Radiophone on "standby" causes the transmit-receive relay to operate and this relay in turn provides the following functions:

A) Disconnects battery voltage from the receiver RF and IF stages, thus muting the receiver.

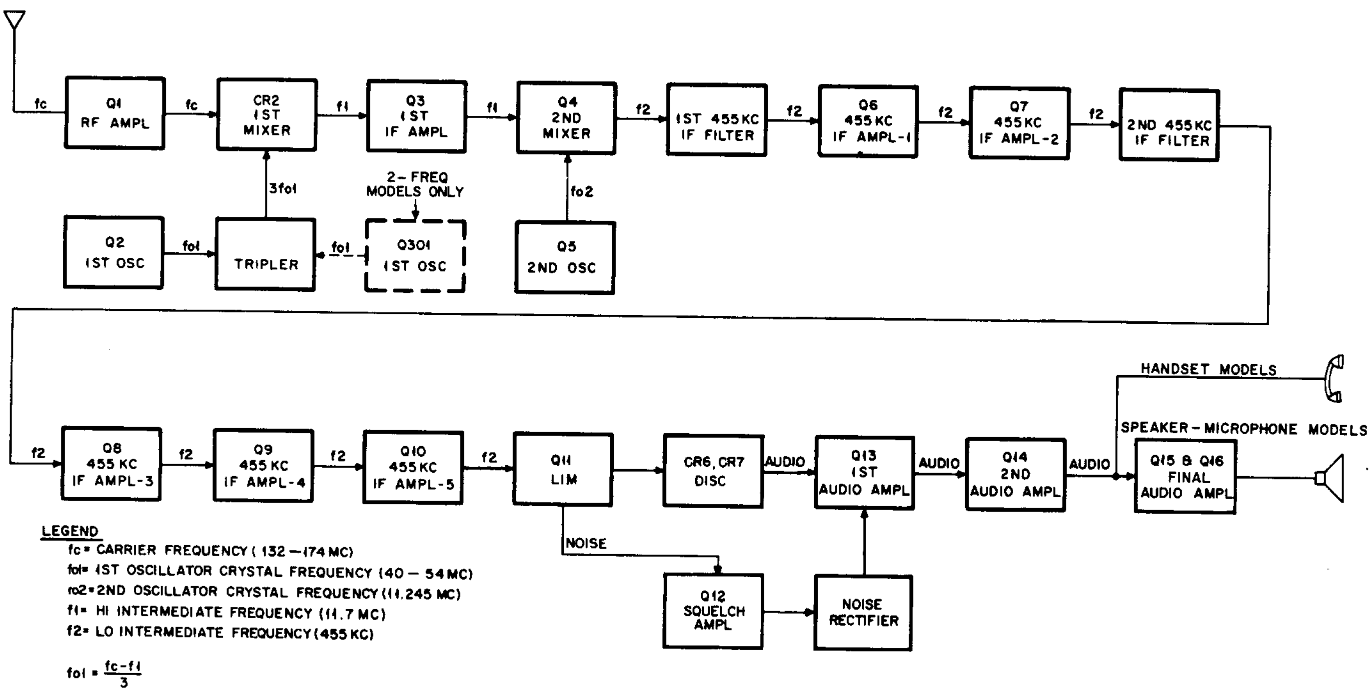
B) Applies battery voltage to the transmitter.

C) Transfers the antenna from the receiver to the transmitter, placing the transmitter carrier "on the air".

When the push-to-talk button is released, the transmit-receive relay is de-energized, the transmitter goes "off the air" and the receiver is placed in operation.

RECEIVER

The receiver operates in accordance with basic FM receiver operation theory. Refer to the accompanying block diagram and receiver schematic while following the stage-by-stage description.



RECEIVER BLOCK DIAGRAM

A) RF AMPLIFIER AND 1ST MIXER

The RF amplifier portion of the receiver uses a single common-emitter transistor stage and five tuned circuits to provide the necessary sensitivity and selectivity for optimum signal to noise ratio. RF signals from the antenna are fed to the base of transistor Q1 via two impedance matching tuned circuits; the diode CR1 protecting transistor Q1 from possible damage caused by excessive input voltages (static charges on the antenna, etc.). Forward bias for Q1 is established by the voltage divider resistors R1 and R2, with R3 providing dc stabilization. The output of Q1 if fed via three tuned circuits to the mixer diode CR2; the first and third tuned circuits being tapped for impedance matching.

The mixer circuit heterodynes the signal from the RF amplifier with the third multiple of the 1st oscillator frequency to produce the 1st IF frequency of 11.7 mc. Note that the third multiple of the local oscillator is 11.7 mc below the RF carrier frequency. These frequency relationships can be shown as follows:

f_c (RF carrier freq.) $-3f_{o1}$ (1st oscillator freq.) = 11.7 mc (1st IF freq.)

$$f_{o1} = \frac{f_c - 11.7 \text{ mc}}{3}$$

B) 1ST OSCILLATOR AND MULTIPLIER

A crystal controlled series resonant type oscillator with associated crystal diode multiplier is used to provide local oscillator injection to the 1st mixer of single-frequency receivers. Two-frequency receivers use two identical oscillator and multiplier circuits; the oscillator corresponding to the desired operating channel being activated by grounding the emitter circuit of the stage via the F1-F2 switch.

In this oscillator circuit, the series tuned crystal functions as part of the oscillator resonant circuit. The resonant circuit is connected between the collector of the oscillator transistor and ground with capacitors C15 and C16 (oscillator F1) shunting the circuit. The necessary feedback for circuit oscillation is provided through the emitter-base circuit, since the emitter is connected to the junction of the two capacitors and effectively taps the tuned circuit. The Q of the resonant circuit is determined mainly by the crystal which appears as a low impedance only when the tuned circuit currents coincide with the natural resonant frequency of the crystal. Thus the frequency of oscillation of the circuit is held very stable. Voltage divider resistors R5 and R6 in the transistor base circuit establish proper biasing conditions for initiating circuit oscillation. Note that the oscillator tuned circuit is tapped to accommodate the wide range of crystal frequencies.

A crystal diode frequency multiplier (CR3) followed by two tuned circuits tuned to the third harmonic of the crystal furnishes the necessary signal to the mixer diode CR2. Note that a portion of the rectified RF signal appearing at the diode is filtered by C23 and used for metering purposes.

C) 1ST IF AMPLIFIER

The 1st IF amplifier stage uses a common-emitter amplifier circuit; the 11.7 mc input tuned circuit being tapped for impedance matching purposes. This circuit provides considerable gain and is neutralized for maximum stability by capacitor C25 connected from the output tuned circuit to the base of Q3. Forward base bias is established by resistors R11 and R12 with R13 providing dc stabilization. Four hi-Q tuned circuits are used between the 1st IF amplifier stage and the 2nd mixer for maximum image rejection.

D) 2ND OSCILLATOR AND 2ND MIXER

The 2nd oscillator circuit is crystal controlled at a frequency of 11.245 mc or 12.155 mc, depending on the assigned carrier frequency of the receiver. The crystal is connected directly between the collector and base of oscillator transistor Q5 with voltage divider network R19 and R60 providing proper biasing conditions for initiating circuit oscillation. The oscillator frequency is determined primarily by the resonant frequency of the crystal which functions as part of the resonant circuit between the base and collector of Q5. Capacitors C39 and C40 form a voltage divider connected in parallel with the resonant circuit (crystal) and the emitter is connected to the junction of these capacitors. The emitter, therefore, is tapped across a portion of the resonant circuit thereby providing the necessary feedback to sustain oscillation. The output of the oscillator is taken from the emitter via capacitor C41.

The 11.7 mc 1st IF signal and the output of the 2nd oscillator are fed to the base of the 2nd mixer transistor Q4. Operating bias for this stage is established by the voltage divider R15 and R16 with the emitter being effectively grounded. The output of the 2nd mixer is the difference between the 2nd oscillator frequency and the 1st IF frequency, i.e., 455 kc, the 2nd IF frequency. This relationship is expressed as follows:

11,700 kc (1st IF freq.) - 11,245 kc (2nd osc. freq.) = 455 kc (2nd IF freq.)

or 12,155 kc (2nd osc. freq.) -11,700 kc (1st IF freq.) = 455 kc (2nd IF freq.)

E) 2ND IF AMPLIFIER

The 2nd IF amplifier section consists of five R-C coupled transistor amplifier stages and a 455 kc "Permakay" filter. This section of the receiver does not incorporate tuned circuits since the necessary selectivity is achieved in the filter. The "Permakay" filter is permanently tuned and sealed at the factory and greatly attenuates any signals outside of the 455 kc passband. Intermediate frequency signals from the 2nd mixer stage are fed through the 1st section of the filter to transistor Q6, where they are amplified. This transistor operates in the common-emitter mode; proper biasing conditions being established by resistor R21. The gain of this stage is comparatively low and neutralization is not required.

The output of the 1st stage appears across collector load resistor R22 and is capacitively coupled to the base of the 2nd amplifier stage, Q7. Transistor Q7 provides further amplification to the IF signal. The output of Q7 is passed through the 2nd section of the "Permakay" filter to the base of the 3rd amplifier stage Q8. The 2nd, 3rd, 4th and 5th stages function in the same manner as the 1st stage except that they are required to handle successively higher signal levels. Sufficient output is obtained from the last stage to drive the limiter stage to full saturation. It is important to note that the 2nd IF stages are "stacked" in series across the A- supply, resulting in an operating voltage of less than 3 volts per stage. Decoupling between stages is provided by voltage dropping resistors and bypass capacitors. This practice also applies to the other receiver stages.

F) LIMITER

The limiter stage is similar in performance to the 2nd IF amplifier stages except that the input signal is of much greater amplitude. With large amplitude input signals applied to the limiter, the base is driven negative with respect to the emitter (on negative half cycles), increasing the emitter-collector current to its saturation value. On positive half cycles, the base is driven positive, thus placing reverse bias at the emitter-base junction and cutting off the transistor. With large input signals, therefore, the limiter produces an output signal of constant amplitude and ensures full limiting even on weak RF input signals. Diode CR4 limits the amplitude of the negative input signal to the base of the limiter transistor.

G) DISCRIMINATOR

A phase discriminator is used in this receiver; the necessary voltages for phase detection being obtained from the preceding limiter stage by two methods. In the presence of an IF signal, a voltage is obtained from the collector circuit of the limiter through a tap in coil L9 and coupled via capacitor C54 and a tap in coil L10 to the two crystal diodes CR6 and CR7. This directly transferred signal appears as approximately equal positive voltages on the diode cathodes. An additional IF signal is produced by inductive coupling between coil L9 and a winding on coil L10. Coil L9 in the limiter circuit and coil L10 in the discriminator circuit are tuned to resonate at the IF frequency. At resonance, the voltages induced in coil L10 and applied to the diodes are equal in amplitude, phase shifted 90° from the directly transferred reference voltage and 180° from each other, as illustrated in figure 1. Diode resistors R37 and R38 provide a return path for the induced currents.

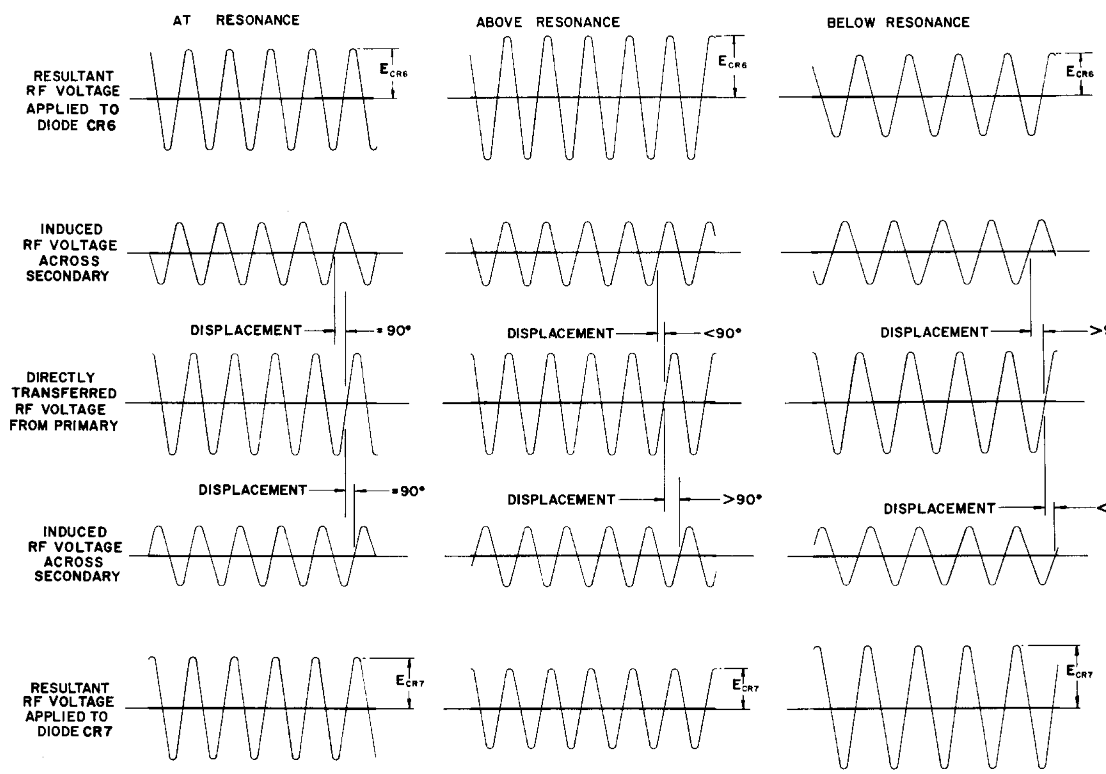


FIGURE 1

The VOLUME control and associated components represent a common external load for the diodes. The diode currents, however, pass through this load in opposite directions, so that the resultant audio output voltage is determined by the difference between the rectified currents. At center frequency, the diode currents are equal and opposite resulting in zero output from the discriminator.

When the incoming IF signal deviates above resonance, the discriminator tuned circuit is inductive and phase shift occurs as shown in figure 1. The resultant voltage at the cathode of one diode (E_{CR6}) will be larger than the resultant voltage at the cathode of the second diode, (E_{CR7}) and the difference in current flow through the common load will produce an audio output voltage. In the below resonance condition, the discriminator tuned circuit is capacitive and phase shift occurs in the opposite direction. E_{CR6} will now be smaller than E_{CR7} and an audio output voltage will be produced across the common load which is opposite in polarity to that produced in the above resonance condition. The amplitude of the audio output voltage is dependent upon the amount of frequency deviation and resultant phase shift.

H) NOISE ACTUATED SQUELCH CIRCUIT

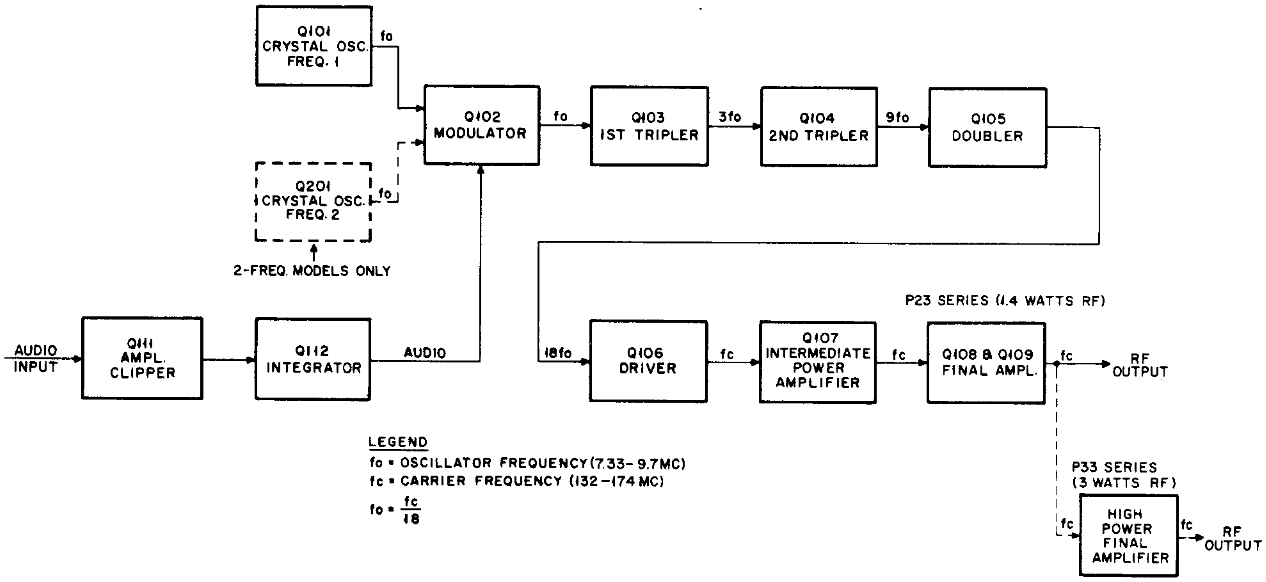
This circuit, when properly adjusted, eliminates the "rushing" noise which would otherwise be heard in the speaker during intervals between received transmissions. The noise actuated squelch circuit includes a squelch amplifier, Q12 and voltage doubler noise rectifier diodes CR8, CR9 and CR10. Noise signals produced at the supply voltage decoupling point of the limiter stage are fed through an R-C filter to remove the residual 455 kc signal, through a level control, i.e., the SQUELCH control, to the base of transistor Q12. In the absence of a received RF carrier and with the SQUELCH control at threshold, the noise signals are amplified by the squelch amplifier transistor, rectified by crystal diodes CR9 and CR10 and fed as reverse bias (positive voltage) to the base of the 1st audio amplifier transistor Q13. The amplitude of this dc voltage is dependent upon diode CR8 and the setting of the SQUELCH control, and at threshold the dc voltage is just sufficient to cut off the audio transistor. This prevents any signals in the discriminator output from reaching the speaker.

When an on-frequency signal is received, the receiver noise is greatly reduced (quieting) and the rectified noise voltage drops to a low value permitting the audio transistor base to be forward biased for normal operation via the -8 volt supply line and resistor R46. Audio signals in the discriminator output will now be amplified and applied to the speaker.

I) AUDIO CIRCUIT

Audio signals from the discriminator are coupled to the 1st audio amplifier stage through the VOLUME control (located on the radiophone top panel) and the input transformer, T3. The VOLUME control varies the level of signal applied to the base of audio transistor Q13. After amplification, the audio signals are direct coupled to the 2nd audio stage Q14, for further amplification. Because of direct coupling between these stages, the 2nd stage will be cut off when the 1st stage is back biased by the squelch rectifier circuit. In "handset only" radiophone models, the output of the 2nd audio amplifier stage is transformer coupled (via T4) to the handset connector on the radiophone top panel. The audio stage is capable of delivering better than 3 milliwatts of audio power to the handset receiver cartridge, which is more than adequate for handset operation. In "speaker-microphone" and "speaker-handset" radiophone models, the output of the 2nd audio amplifier stage is developed across the inductive load L12 and capacitively coupled to the final audio output stage. Note that the audio output stage employs a PNP and an NPN transistor connected in push-pull and biased for class B operation. The current drain, therefore, is negligible when no signal is fed to the stage.

The output rating of the final audio amplifier is 500 milliwatts. This output is taken from the transistor emitter circuit and fed via a large capacitor to the 50 ohm speaker located on the radiophone top panel. Resistor R804, connected from the speaker to the microphone connector, furnishes audio output at a reduced level to the handset of "speaker-handset" radiophone models.



TRANSMITTER BLOCK DIAGRAM

TRANSMITTER

The following stage-by-stage description should be read in conjunction with the accompanying block diagram and transmitter schematic diagram.

A) AUDIO AMPLIFIER AND INSTANTANEOUS DEVIATION CONTROL (I.D.C) CIRCUIT

The transistorized dynamic microphone or handset used for modulating the transmitter connects to the microphone (or handset) connector on the radiophone top panel. Operating voltage for the microphone transistorized preamplifier or handset carbon cartridge is obtained from the radiophone power supply via a voltage divider network in the input circuit of the amplifier-clipper stage. Resistor R110 in conjunction with capacitor C148 provide a load of approximately 600 ohms for the microphone cartridge. The amplifier-clipper stage and integrator stage comprise the "Instantaneous Deviation Control" (I.D.C.) circuit. Since the transmitter employs phase modulation which inherently provides a rising 6 db per octave audio deviation characteristic, speech signals from the microphone preamplifier or handset must be amplified and limited in a manner compatible with the rising deviation characteristic. In conjunction with the FM receiver de-emphasis network, this characteristic provides a transmission improvement in signal-to-noise ratio for the low energy content, high frequency intelligibility components of speech.

A 6 db per octave rising gain characteristic is provided by the amplifier-clipper stage, with the operating point of the transistor chosen to limit the positive and negative peaks of audio to a predetermined level. Diode CR102 connected between the base and emitter of Q111 ensures correct base biasing conditions. Further amplification of speech signals is provided by the integrator. In this stage the distribution of speech frequency components is restored to normal and any resulting harmonic components are attenuated by the roll-off characteristics of the circuit. Choke-capacitor filter L116 and C114 in the integrator input circuit attenuate audio frequencies above 3000 cps to reduce the possibility of these frequencies modulating the transmitter and causing adjacent channel splatter. The I.D.C. control, R119, functions as a modulator gain control and is factory adjusted for the required amount of transmitter deviation as dictated by channel width requirements.

B) OSCILLATOR

Oscillator stage, Q101, is a fundamental, crystal controlled, anti-resonant oscillator circuit generating a specific frequency in the 7.3 to 9.7 mc range. Single frequency transmitters use one oscillator, whereas two-frequency transmitters use two identical oscillator circuits (Q101 and Q201), the desired operating channel being selected by grounding the appropriate oscillator emitter circuit via the F1-F2 switch on the radiophone top panel.

In this oscillator circuit, the crystal forms part of the parallel tuned circuit between the base of the transistor and ground. The transistor emitter connects to the junction of two series capacitors connected across the crystal, thus effectively tapping the tuned circuit to provide the necessary feedback for circuit oscillation. The crystal is inherently very stable and the use of temperature compensating components to match crystal characteristics provides the additional high degree of stability required in 3 watt and 1.4 watt high stability radiophone models. Starting bias for the oscillator is provided by the resistor connected between collector and base. Because of slight variations in component values from circuit-to-circuit which could alter crystal frequency, a variable capacitor is used across the crystal permitting it to be tuned exactly on-frequency (warping). The oscillator output is coupled to the base of the modulator transistor Q102.

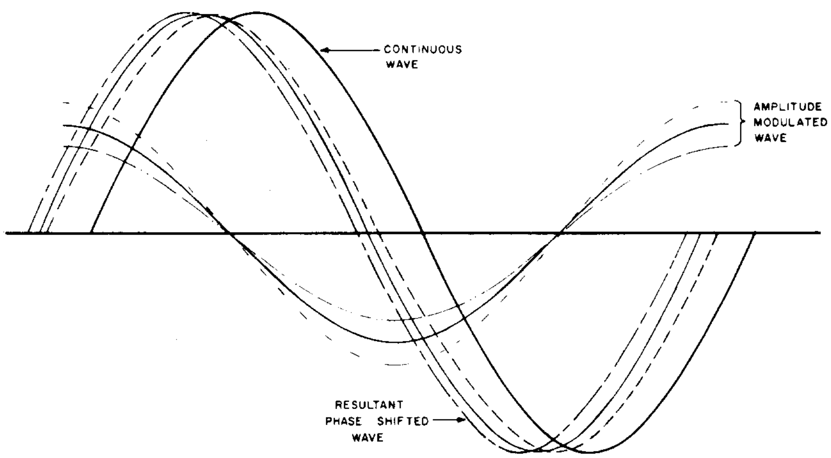


FIGURE 2

C) MODULATOR

RF is applied to the base and collector while audio is applied to the emitter of the modulator transistor. Temporarily ignoring the base-to-collector capacitor C106, the modulator circuit resembles a simple amplitude modulator with the internal gain of the transistor being varied by the applied audio voltage. Capacitor C106 shunting the modulator transistor applies direct drive from the oscillator to the modulator collector.

When a continuous wave is mixed with a phase shifted, partially amplitude modulated wave of the same frequency, an essentially constant amplitude wave is produced having a phase variation proportional to the modulation amplitude, i.e., phase modulation. See figure 2. Since a change of phase is equivalent to a change of frequency, a similarity exists to frequency modulation. However, as the rate of change of phase is dependent on modulation frequency, the degree of frequency modulation varies and provides the inherent pre-emphasis referred to in paragraph (A) "Audio Amplifier and I.D.C. Circuit", when the transmitter is used in conjunction with an FM receiver.

The inherent modulator transistor phase shift together with the phase shift produced by the inductive load provide the correct relationship for mixing the amplitude modulated output at the modulator collector with the direct drive from the oscillator via C106 to produce phase modulation as illustrated in figure 2. Generally, phase modulators are capable of modulating with low distortion over a small phase angle. This deviation is increased to the desired value by the frequency multiplier stages following the modulator.

D) FREQUENCY MULTIPLIER STAGES

Including the 1st and 2nd tripler and doubler stages, there are three stages of frequency multiplication in this transmitter producing an output frequency of 18 times the crystal frequency and a corresponding increase in carrier deviation. These stages are inductively coupled by tuned transformers which are tuned to the 2nd or 3rd multiple, as applicable, of the input frequency.

For maximum efficiency, these stages operate as class B amplifiers which normally do not require forward biasing. Without signal drive, zero-biased class B frequency multiplier stages will not draw emitter current. With drive present, the transistors will draw current and this current is easily monitored by measuring the dc voltage across the emitter resistor. An exception to this is the first tripler stage where forward bias is developed by resistors R120 and R121 to increase the gain of the stage, since the input signal level is very low.

E) DRIVER AND AMPLIFIER STAGES

Driver stage, Q106, provides the necessary RF output level for driving the intermediate power amplifier (IPA). The IPA, Q107, and power amplifiers, Q108 and Q109, increase the power output to 1.4 watts at nominal battery voltage. As in the frequency multiplier stages, forward biasing is not required in these stages. In low power "Handie-Talkie" Radiophones (P23 Series), the output of the power amplifier is fed through a harmonic filter to the transmit-receive relay and antenna. In high power radiophones (3 watt, P33 Series) the power amplifier stage serves as a driver for the model CNLD6170A Series Power Amplifier Deck. In either case, the circuit operation of the power amplifier stage remains the same. Capacitor C140 is set for the rated power output with minimum current and maximum efficiency.

F) MODEL CNLD6170A SERIES POWER AMPLIFIER DECK (3 Watt "Handie-Talkie" models only)

The CNLD6170A Series Power Amplifier is a compact sub-assembly utilizing six transistors connected in parallel to provide 3 watts of RF power output at nominal battery voltage. This amplifier uses tuned input and output tank circuits and filters for harmonic rejection. Ballast lamps, RB401, RB402 in the A- circuit provides some degree of current regulation for protection of the power transistors. The output from the power amplifier is fed through the transmit-receive relay contacts to the ANT. connector of the radiophone. This relay is energized when the transmitter push-to-talk circuit is completed and transfers the radiophone antenna from the receiver RF input terminals to the transmitter output. It is important that the power amplifier output circuit be properly terminated by an antenna or dummy load during operation to prevent possible damage to the amplifier transistors.

POWER SUPPLY

VOLTAGE REGULATOR (P23 Series Radiophones only)

Model CNLN6335A Voltage Regulator is a protective device incorporated in all P23 Series "Handie-Talkie" Radiophones (1.4 watt RF output models). The CNLN6335A consists of an adjustable, single transistor voltage regulator circuit assembled in a compact sub-chassis and located in the position occupied by the Power Amplifier Deck of P33 Series Radiophones. The purpose of the device is to maintain the battery voltage applied to the transmitter final amplifier transistors at the proper value for optimum performance of the unit. If the voltage regulator circuit were not used, the relatively high voltage produced by fresh dry cell batteries in the power supply could cause the final amplifier transistors in the transmitter to draw excessive current, resulting in possible damage. As the batteries are used, their output voltage gradually decreases, and under these conditions, the voltage regulator permits maximum battery voltage to be applied to the final amplifier stage. In P33 Series Radiophones (3 watt RF output models), the total battery drain under transmit conditions is relatively large and the inherent internal resistance of the batteries in conjunction with the ballast lamp and series resistor in the exciter final amplifier A- supply circuit limits final amplifier transistor current to a safe value.

The voltage regulator circuit provides shunt regulation, i.e., the higher the battery voltage, the more current will pass through the regulator. Refer to the transmitter schematic diagram. The circuit consists of transistor Q407, potentiometer R402, zener diode CR401 and associated components. Potentiometer R402 is factory set for -14.0 volts dc input to the transmitter final amplifier stage, with transistor Q407 operating near the cut-off point. Should the A- voltage exceed -14.0 volts, zener diode CR401 will conduct sufficient current to forward bias transistor Q407 for increased conduction. The resultant current flow through resistor R403 and the transistor collector-emitter junction causes an increase in the voltage drop across the power supply ballast lamp, thus reducing the A- voltage to the pre-determined value.

A recommended procedure for setting the voltage regulator potentiometer is included in the "Maintenance" section of this manual.

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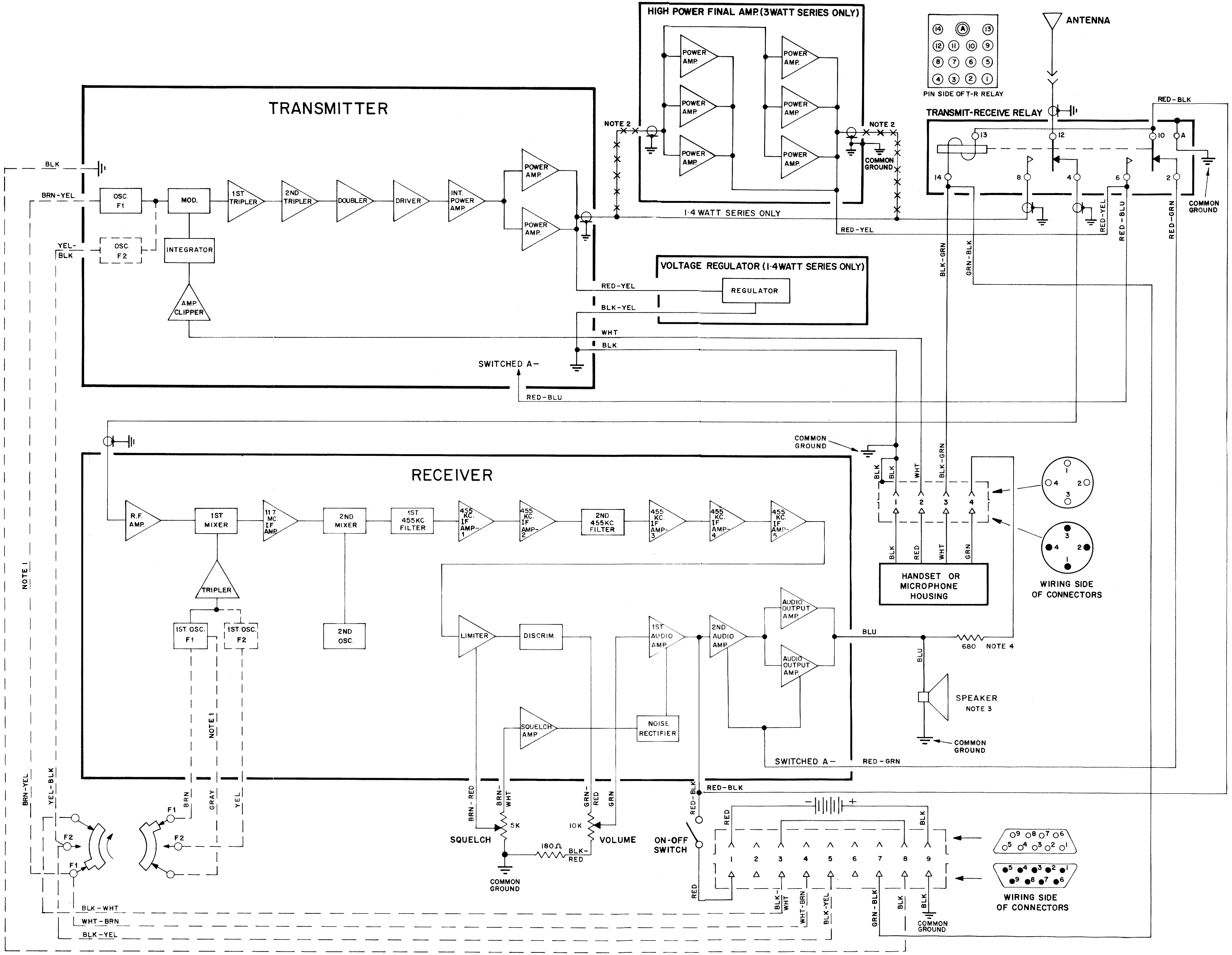

NOTES:

1. CIRCUITRY THUS — — — USED ON 2 FREQ. ONLY.
2. CIRCUITRY THUS —×—×— USED ON 3 WATT SERIES ONLY.
3. SPEAKER & GROUND OMITTED IN HANDSET ONLY MODELS.
4. RESISTOR OMITTED IN HANDSET ONLY MODELS. A DIRECT CONNECTION EXISTS TO PIN 4 OF THE HANDSET CONNECTOR.

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P23 AND P33 SERIES "HANDIE-TALKIE"

INTERCABLING DIAGRAM

63E00177M-O

RECEIVER ALIGNMENT

TEST EQUIPMENT REQUIRED FOR RECEIVER ALIGNMENT

1. Motorola DC Multimeter with RF probe (or equivalent).
2. Motorola Transistorized AC Voltmeter (or equivalent).
3. Motorola T1034C Signal Generator (or equivalent).
4. Motorola S1056A-59A or TU546 Series Portable Test Set with 455 kc crystal (or equivalent crystal-controlled oscillator).
5. Motorola CNLN6245A Alignment Tools (supplied).

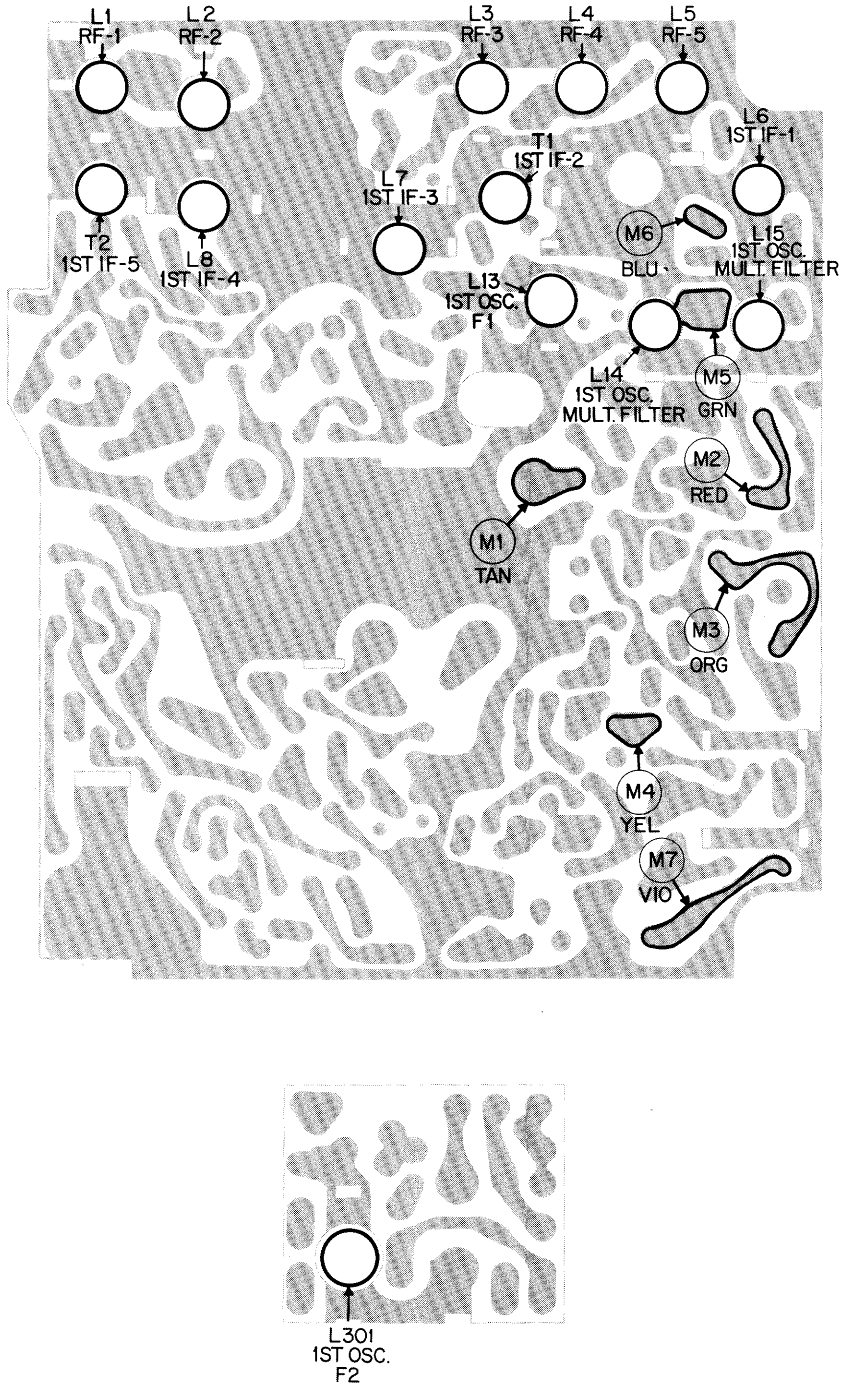
PRELIMINARY SET-UP FOR RECEIVER ALIGNMENT

1. Remove the cover from the radio section of the unit.
2. When aligning a two-frequency unit, align on the primary or higher of the two frequencies.
3. The dc multimeter ground lead should be connected to a convenient ground.
4. For complete alignment, the battery should be removed and a 15 volt dc power supply and ammeter connected to the battery plug. All tuning slugs should be unscrewed so they protrude 1/8 inch above the printed circuit board.
5. Remove the antenna by unscrewing it from the receptacle. Connect a signal generator to the antenna receptacle.

FREQUENCY CALCULATIONS

$f_{01} = \frac{f_c - 11.7 \text{ mc}}{3}$ where f_{01} = 1st oscillator frequency and f_c = carrier frequency.

Carrier Frequency (MC) F_c	2nd Osc. Xtal Freq. (MC) F_{02}
132.00 - 134.00	11.245
134.001 - 136.0	12.155
136.001 - 145.0	11.245
145.001 - 145.50	12.155
145.501 - 146.00	11.245
146.001 - 150.80	12.155
150.801 - 157.0	11.245
157.001 - 157.60	12.155
157.601 - 168.00	11.245
168.001 - 169.0	12.155
169.001 - 174.0	11.245



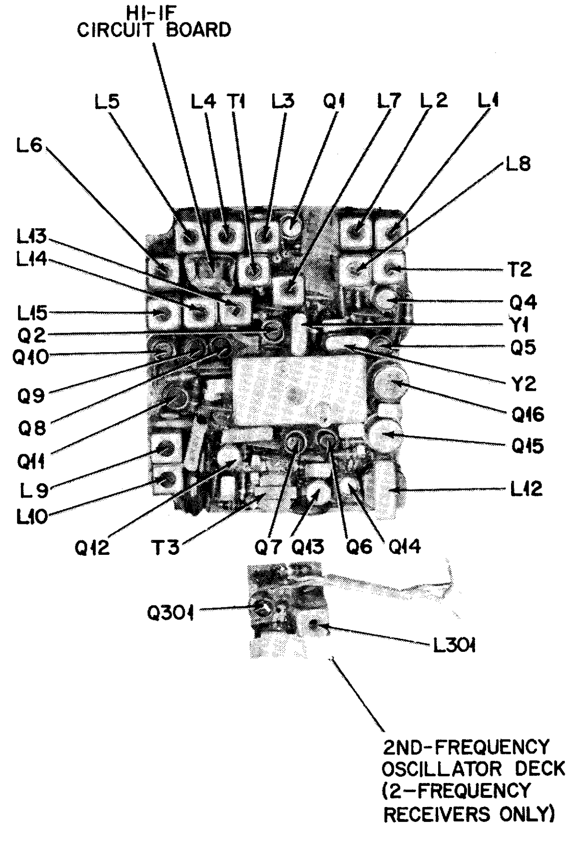
METERING AND ALIGNMENT POINTS

NOTES

1. All slugs should be tuned to the peak nearest the printed circuit board end of the coil.
2. Turn on the radiophone and set the SQUELCH control for maximum noise.

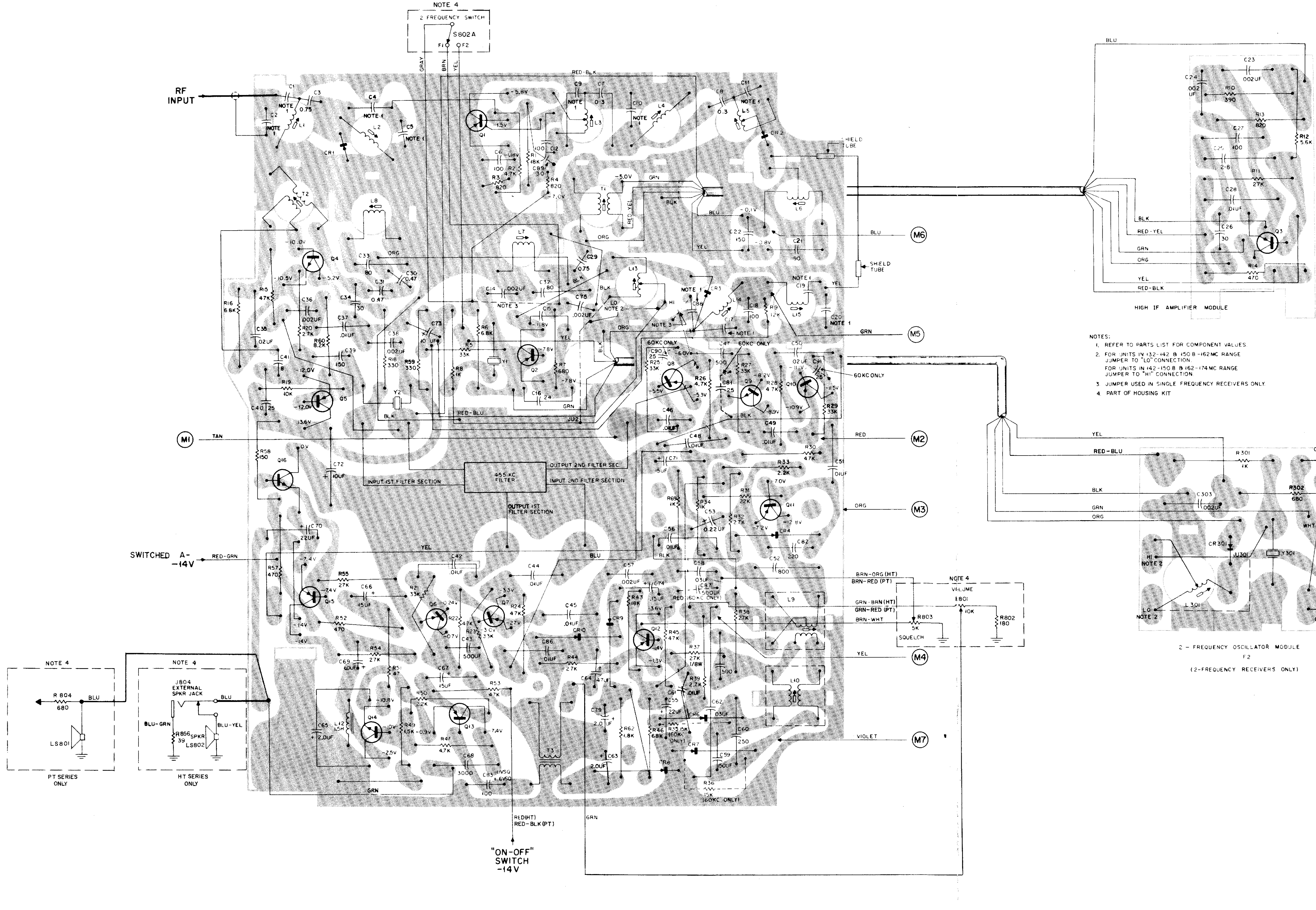
STEP	TEST EQUIPMENT	METER POINT & COLOR CODE	ADJUSTMENT	PROCEDURE
1A	DC multimeter with RF probe	M-5 (GRN) M-6 (BLU)	L13 1st Osc. (F1) L14 Mult. Filter L15 Mult. Filter	Tune L13 for maximum dc reading on the meter (meter point M-5). Tune L13, L14 and L15 for minimum dc reading on the meter (meter point M-6).
1B 2-Freq. models only	DC multimeter with RF probe	M-6 (BLU)	L301 1st Osc. (F2)	Place the frequency selector switch in the F1 position and proceed as in STEP 1A above. Place the frequency selector switch in the F2 position and tune L301 for minimum dc reading on the meter.
2	DC multimeter and 455 kc crystal Osc.	M-7 (VIO)	L9 Limiter	Couple a 455 kc signal into the 455 kc filter input terminals. Tune L9 for a maximum positive dc reading.
3	DC multimeter and 455 kc crystal Osc.	M-4 (YEL)	L10 Disc.	Tune L10 for a zero dc meter reading. ***NOTE*** : As the slug is moved into the discriminator coil, the meter reading may move slowly through zero and then sharply return through zero again. Tune the slug to the latter point.
4	T1034C Signal Generator and dc multimeter	M-4 (YEL)	Signal Generator to carrier frequency	Connect the signal generator to the receiver input. Set the attenuator for 5,000 microvolts and adjust the signal frequency for a zero dc reading on the meter. *Do not set the frequency to the 2nd IF image 910 kc below the carrier (11.245 mc, 2nd osc.) or 910 kc above the carrier (12.155 mc, 2nd osc.).
5	T1034C Signal Generator and ac voltmeter	M-1 (TAN)	T2, L8, L7, T1, L6, L5, L4, L3, L2, L1	Tune these slugs successively for a maximum meter reading. Keep the meter reading below -20 dbm on the ac voltmeter.
6A	DC multimeter	M-4 (YEL)	L13 1st Osc. (F1)	Use the base station transmitter or a frequency standard as a signal source and adjust L13 for a zero dc reading.
6B 2-Freq. models only	DC multimeter	M-4 (YEL)	L301 1st Osc. (F2)	Place the frequency selector switch in the F1 position and proceed as in STEP 6A above. Place the frequency selector switch in the F2 position and adjust L301 for a zero dc reading.
7	T1034C Signal Generator and ac voltmeter. In handset models, connect 120 ohm resistor across ac voltmeter terminals	Pin #4 of microphone connector	Signal Generator	Set squelch control for maximum noise. Adjust the volume control for an output voltage of 0.17 volt ac (noise only - no signal input). Zero the signal generator on the discriminator. Increase the signal intensity until the noise reading is reduced to one-tenth of the reading with no signal (maximum noise). Read the attenuator scale in microvolts (should be less than 0.5 microvolts). This is the 20 db quieting sensitivity.

***** ***CAUTION*** : After adjusting the signal generator to the carrier, look for the image frequency at 910 kc below or above this setting. This is a check on the accuracy of the setting. Upon locating the image, return to the proper setting for the carrier frequency.

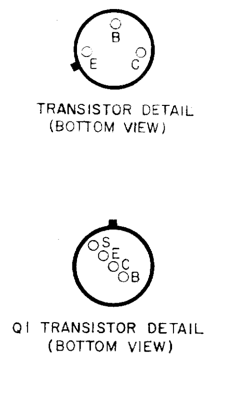


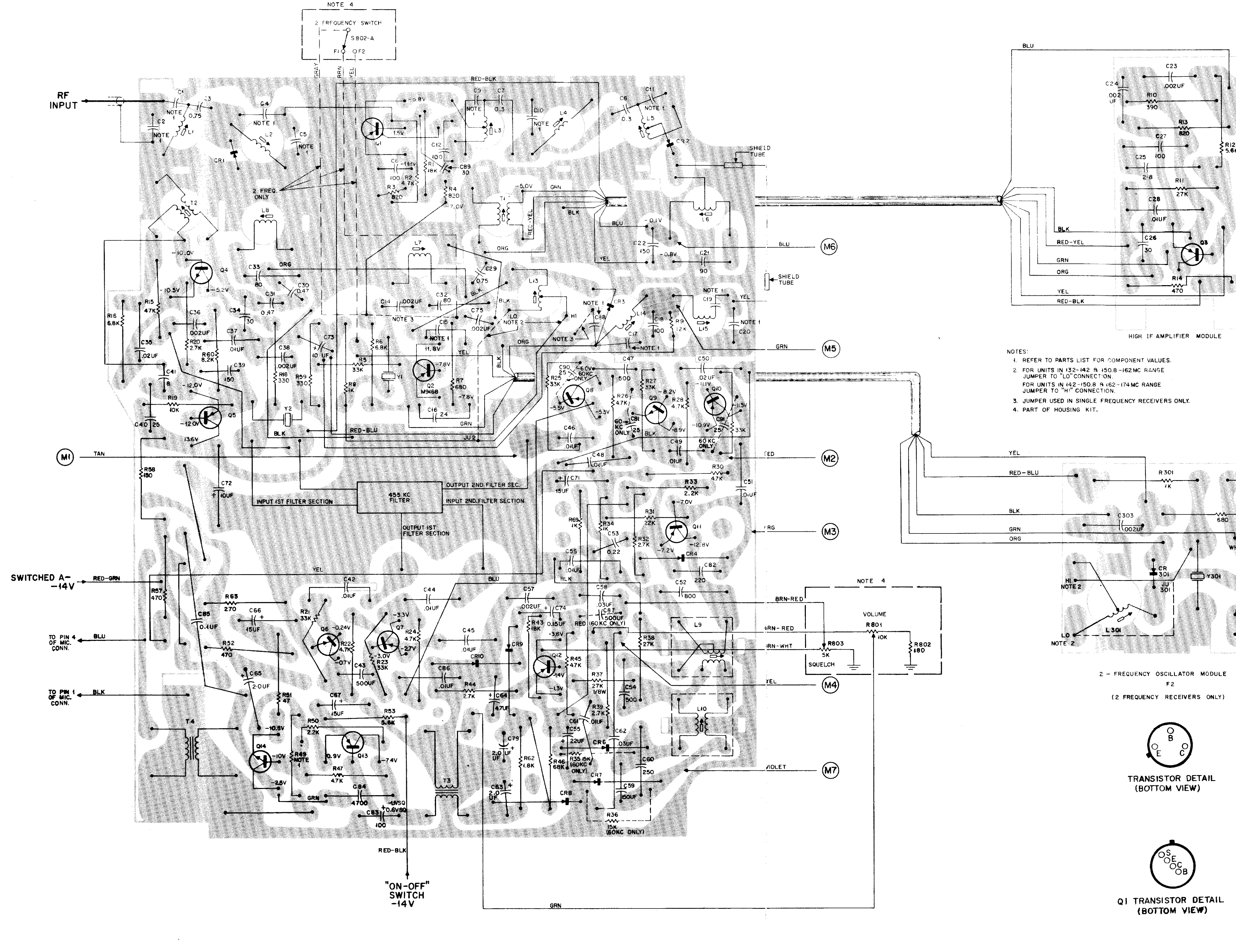
CNRD1130B SERIES AND CNRD1150B SERIES RECEIVER

PRINTED CIRCUIT BOARD DETAIL



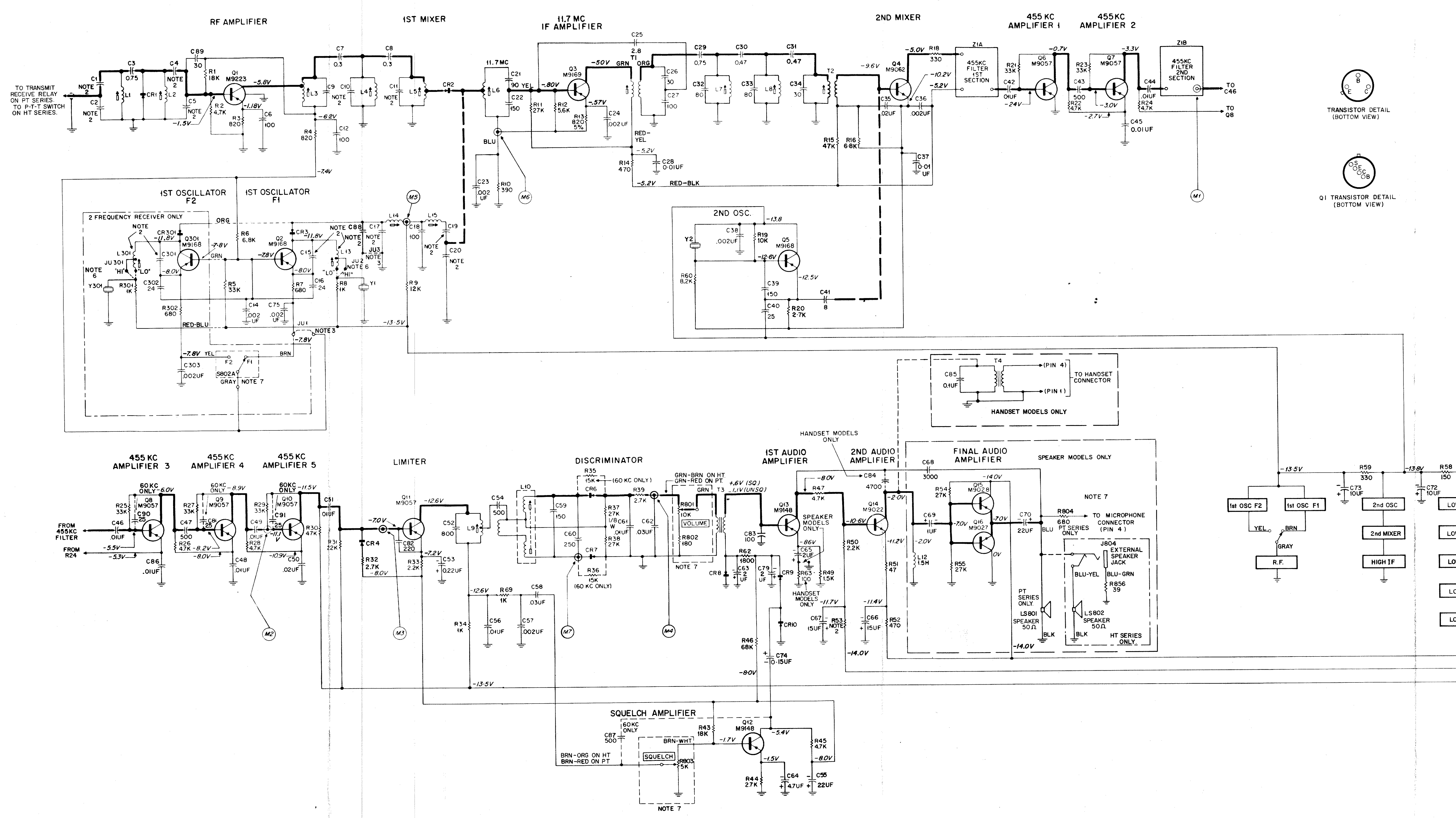
CNRD1130B SERIES RECEIVER

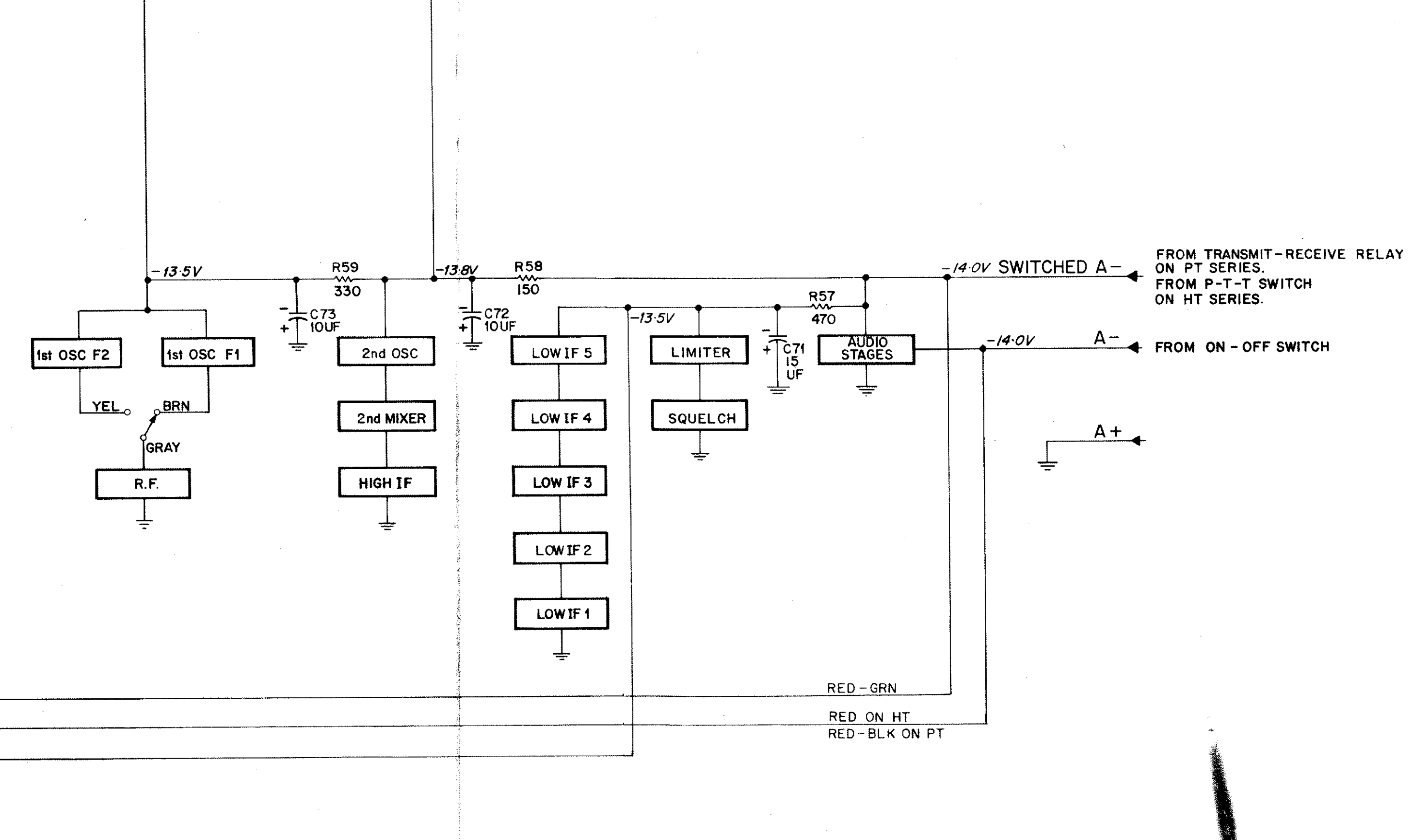




CNRD1150B SERIES RECEIVER

RECEIVER





2ND OSCILLATOR FREQUENCY TABLE

CARRIER FREQ.(fc) IN MCS.	2ND OSC. XTAL FREQ.(fo2) IN MCS.
132·00 – 134·00	11·245
134·001 – 136·00	12·155
136·001 – 145·00	11·245
145·001 – 145·50	12·155
145·501 – 146·00	11·245
146·001 – 150·80	12·155
150·801 – 157·00	11·245
157·001 – 157·60	12·155
157·601 – 168·00	11·245
168·001 – 169·00	12·155
169·001 – 174·00	11·245

MODEL TABLE (NOTE 8)

MODEL	OUTPUT POWER	FREQUENCY RANGE	CHANNEL SPACING	FREQ.
CNRD1131BA	500MW	132 – 150·8 MCs	60 KCs	1 OR 2
CNRD1132BA	500MW	150·8 – 174 MCs	60 KCs	1 OR 2
CNRD1131BB	500MW	132 – 150·8 MCs	30 KCs	1 OR 2
CNRD1132BB	500MW	150·8 – 174 MCs	30 KCs	1 OR 2
CNRD1151BA	3 MW	132 – 150·8 MCs	60 KCs	1 OR 2
CNRD1152BA	3 MW	150·8 – 174 MCs	60 KCs	1 OR 2
CNRD1151BB	3 MW	132 – 150·8 MCs	30 KCs	1 OR 2
CNRD1152BB	3 MW	150·8 – 174 MCs	30 KCs	1 OR 2

NOTES:

1. UNLESS OTHERWISE STATED:
   ALL RESISTOR VALUES ARE IN OHMS ±10%, 1/4W. K=1000
   ALL CAPACITOR VALUES ARE IN PICOFARADS.
2. REFER TO PARTS LIST FOR COMPONENT VALUES. (L=132-150·8MC., H=150·8-174MC.)
3. USED IN SINGLE FREQUENCY MODELS ONLY.
4. FREQUENCY CALCULATION:
   $$fo = \frac{fc - 11.7MC}{3}$$
   SEE 2ND OSCILLATOR FREQUENCY TABLE.
5. ALL VOLTAGE READINGS REFERENCED TO CHASSIS GROUND WITH 14.0V INPUT. DC READINGS TAKEN WITH A MOTOROLA DC MULTIMETER.
6. FOR UNITS IN 132 – 142 AND 150·8 – 162 MC RANGE, JUMPER TO "LO" CONNECTION. FOR UNITS IN 142 – 150·8 AND 162 – 174 MC RANGE, JUMPER TO "HI" CONNECTION.
7. COMPONENTS WITH 800 SERIES NUMBERS ARE PART OF HOUSING KIT.
8. TWO-FREQUENCY RECEIVERS INCLUDE CNLD6220A SERIES F2 OSCILLATOR DECK.

CNRD1130B SERIES AND CNRD1150B SERIES
"HANDIE-TALKIE" RECEIVER 23
SCHEMATIC DIAGRAM 63E00246M-O

CNRD1130B SERIES RECEIVER (SPEAKER MODELS)

AND CNRD1150B SERIES RECEIVER (HANDSET MODELS)

PARTS LIST

(Schematic Diagram 63E00246M)

LEGEND: L = 136-150.8 MC; H = 150.8-174 MC

REFERENCE SYMBOL	PART NO.	DESCRIPTION
		CAPACITOR, Fixed, uuF, ±10%, 75 VDCW, unless otherwise stated:
C 1H, 4L, 9L, 19L	21K861431	12
C 1L	21K861462	15
C 2H, 5L	21D82877B06	30
C 2L	21K861434	40
C 3, 29	21C82450B22	0.75, 500 VDCW
C 4H, 9H, 19H	21K867807	8 ±5%
C 5H, 16	21D82877B01	24
C 6, 12, 18, 83	21K861437	100
C 7, 8	21C82450B26	0.3, 500 VDCW
C 10H, 11H	21D82877B13	7 ±5%
C 10L, 11L	21K861430	10
C 14, 36, 38, 75	21K861442	.002 uF +100-20%
C 15H	21K861427	4
C 15L	21D82877B17	5 ±5%
C 17H	21D82450B28	1
C 17L, 88H	21K861603	3.3
C 20H	21K861432	20
C 20L, 40	21K865197	25
C 21	21K864522	90
C 22, 39, 59	21D82877B02	150
C 23, 24	21C831126	.002 uF GMV, 300 VDCW
C 25	21D82877B08	2.8 ±0.25
C 26, 34, 89	21K864521	30
C 27	21K861436	100
C 28, 37, 42, 44, 45, 46, 48, 49, 51, 56, 61, 86	21K861443	.01 uF +100-20%
C 30, 31	21C82450B24	0.47, 500 VDCW
C 32, 33	21K864067	80
C 35, 50	21K861444	.02 uF +100-20%
C 41	21K861429	8
C 43, 47, 54	21K847065	500 GMV, 250 VDCW
C 52	21D82239E02	800 ±5%, 200 VDCW
C 53	23D82397D06	0.22 uF +40-20%, 35 VDCW
C 55, 70	23D82397D16	22 uF ±20%, 15 VDCW
C 57	21K864457	.002 uF +100-20%
C 58, 62	8C82317B03	.03 uF, 50 VDCW
C 60	21K859943	250 ±5%, 500 VDCW
C 63, 79	23D82397D19	2 uF +40-20%, 8 VDCW
C 64	23D82397D05	4.7 uF +40-20%, 3 VDCW
C 65	23D82397D32	2 uF +40-20%, 8 VDCW
C 66, 67, 71	23D82397D17	15 uF ±20%, 20 VDCW
C 68	21C82187B16	3000, 100 VDCW
C 69	23D82397D07	1 uF +40-20%, 15 VDCW
C 72	23D82397D31	10 uF ±20%, 20 VDCW
C 73	23D82397D15	10 uF ±20%, 20 VDCW
C 74	23D82397D08	0.15 uF +40-20%, 35 VDCW
C 82	21K868829	220
C 84	21D82428B09	4700, 100 VDCW (handset models only)
C 85	8C82317B01	0.1 uF, 100 VDCW (handset models only)
C 88L	21D82877B07	2.2

REFERENCE SYMBOL	PART NO.	DESCRIPTION
		SEMICONDUCTOR DEVICE, Diode: (NOTE 1)
CR 1	48C82363E03	Silicon
CR 2	48C859464	Germanium
CR 3	48C82363E01	Silicon
CR 4, 6, 7	48C82178A01	Germanium
CR 8, 9, 10	48C82392B03	Silicon
		COIL, RF, Assembly:
L 1H	24V80903A01	Includes C1H, C3 and 24C82710H01 COIL, RF, VIO-BRN; does not include 76B82451B04 CORE, tuning
L 1L	24V80903A02	Includes C1L, C3 and 24C82710H01 COIL, RF, VIO-BRN; does not include 76B82451B04 CORE, tuning
L 2, 4	24C82710H01	VIO-BRN; does not include 76B82451B04 CORE, tuning
L 3H	24V80903A03	Includes C7, C9H and 24C82711H01 COIL, RF, VIO-RED, does not include 76B82451B04 CORE, tuning
L 3L	24V80903A68	Includes C7, C9L and 24C82711H09 COIL, RF, ORG-ORG; does not include 76B82451B04 CORE, tuning
L 5H	24V80903A05	Includes C8, C11H, CR2 and 24C82711H03 COIL, RF, VIO-ORG; does not include 76B82451B04 CORE, tuning
L 5L	24V80903A06	Includes C8, C11L, CR2 and 24C82711H03 COIL, RF, VIO-ORG; does not include 76B82451B04 CORE, tuning
L 6	24C82711H02	VIO-BLU; does not include 76K847160 CORE tuning, or 76A82686D01 SLEEVE, Iron (long)
L 7, 8	24C82710H03	VIO-GRAY; does not include 76K847160 CORE, tuning, or 76A82686D01 SLEEVE, Iron (long)
L 9	24C82695D01	Primary coded 1, 2 with center tap 5; secondary coded 3, 4 includes tuning core
L 10	24C82696D01	Bifilar winding, includes tuning core
L 13H	24C82711H04	VIO-YEL; does not include 76B82451B02 CORE, tuning or 76A82686D01 SLEEVE, Iron (long)
L 13L	24C82711H05	VIO-BLK; does not include 76B82451B02 CORE, tuning or 76A82686D01 SLEEVE, Iron (long)
L 14H	24V80903A07	Includes C17H, C88H, CR3 and 24C82710H02 COIL, RF VIO-GRN; does not include 76B82451B04 CORE, tuning
L 14L	24V80903A08	Includes C17L, C88L, CR3 and 24C82710H02 COIL, RF, VIO-GRN; does not include 76B82451B04 CORE, tuning
L 15H	24V80903A09	Includes C19H and 24C82710H02 COIL, RF, VIO-GRN; does not include 76B82451B04 CORE, tuning
L 15L	24V80903A10	Includes C19L and 24C82710H02 COIL, RF, VIO-GRN; does not include 76B82451B04 CORE, tuning
		REACTOR
L 12	25B82751D01	Choke, AF, 1.5 Henry
		TRANSISTOR (NOTE 1)
Q 1	48R869223	P-N-P, type M9223
Q 2, 5	48R869168	P-N-P, type M9168
Q 3	48R869169	P-N-P, type M9169
Q 4	48K869062	N-P-N, type M9062
Q 6, 7, 8, 9, 10, 11	48R869057	P-N-P, type M9057
Q 12, 13	48R869148	P-N-P, type M9148
Q 14	48R869022	N-P-N, type M9022
Q 15	48R869028	P-N-P, type M9028
Q 16	48R869027	N-P-N, type M9027
		RESISTOR, Fixed, composition, ohms, ±10%, 1/4 Watt, unless otherwise stated:
R 1, 43	6K128904	18K
R 2, 22, 24, 26, 28, 30, 45, 47	6K127804	4.7K
R 3, 4	6K129432	820

REFERENCE SYMBOL	PART NO.	DESCRIPTION
R 5, 21, 23, 25, 27, 29	6K127807	33K
R 6, 16	6K128687	6.8K
R 7	6K128599	680
R 8, 34, 69	6K127802	1K
R 9	6K129230	12K
R 10	6K129863	390
R 11, 38, 54, 55	6K127806	27K
R 12	6K129433	5.6K
R 13	6K129818	820 ±5%
R 14, 52, 57	6K127801	470
R 15	6K128902	47K
R 18, 59	6K129775	330
R 19	6K129225	10K
R 20, 32, 39, 44	6K128688	2.7K
R 31	6K128685	22K
R 33, 50	6K128689	2.2K
R 37	6S185B96	27K, 1/8 Watt
R 46	6K129144	68K
R 49	6K127803	1.5K
R 51	6K129233	47
R 53	6K127804	4.7K (speaker models only)
	or	
	6K129433	5.6K (handset models only)
R 58	6K129862	150
R 60	6K128686	8.2K
R 62	6K129269	1.8K
R 63	6K129753	100 (handset models only)
		TRANSFORMER
T 1	24C82712H02	RF, VIO-WHT; does not include 76K861425 CORE, tuning or 76A82686D01 SLEEVE, Iron (long)
T 2	24C82712H01	RF, VIO-VIO; does not include 76K847160 CORE, tuning or 76A82686D01 SLEEVE, Iron (long)
T 3	25C82699D01	Audio input; consists of: primary, impedance 10K Ohms, resistance 1.34K Ohms; secondary, impedance 1K ohm, resistance 348 Ohms, coded BLU
T 4	25B82893E01	Audio; primary side coded; primary impedance 1200 Ohms, resistance 125 Ohms; secondary impedance 120 Ohms, resistance, 12 Ohms (handset models only)
		CRYSTAL UNIT, Quartz: (NOTE 1)
Y 1	YMW-35	Receiver control
Y 2	YNW	69B00019M08 (11.245 MC) or 69B00019M10 (12.122 MC)
		FILTER, IF;
Z 1	NFN6006AS	Bandpass, 30 KC (CNRD1130/1150BB Series models only)
	or	
	NFN6006AW	Bandpass, 60 KC (CNRD1130/1150BA Series models only)
NON-REFERENCED PARTS		
	14A82271E01	INSULATOR, Coil shield, used with L13, 301
	26B82671D01	SHIELD, Coil, 14 required
CNLN6234A COMPONENTS KIT (CNRD1130/1150BA SERIES MODELS ONLY)		
		CAPACITOR, Fixed:
C 81, 90, 91	21K865197	25 uuF ±10%, 75 VDCW
C 87	21K847065	500 uuF GMV, 250 VDCW

REFERENCE SYMBOL	PART NO.	DESCRIPTION
		RESISTOR, Fixed:
R 35, 36	6K128563	15K Ohms, ±10%, 1/10 Watt
CNLD6221A 2ND FREQ. OSCILLATOR (132-150.8 MC) CNLD6222A 2ND FREQ. OSCILLATOR (150.8-174 MC)		
		CAPACITOR, Fixed, 75 VDCW:
C 301H	21K861427	4 uuF ±10%
C 301L	21K864014	5 uuF ±10%
C 302	21D82877B01	24 uuF ±10%
C 303	21K861442	0.002 uF +100-20%
		SEMICONDUCTOR DEVICE, Diode: (NOTE 1)
CR 301	48C82363E01	Silicon
		COIL, RF, Assembly:
L 301H	24C82711H04	VIO-YEL; does not include 76B82451B02 CORE, tuning or 76A82586D02 SLEEVE, Iron (short)
L 301L	24C82711H05	VIO-BLK; does not include 76B82451B02 CORE, tuning or 76A82586D02 SLEEVE, Iron (short)
		TRANSISTOR (NOTE 1)
Q 301	48R869168	P-N-P, type M9168
		RESISTOR, Fixed, composition, ohms, ±10%, 1/4 Watt:
R 301	6K127802	1K
R 302	6K128599	680
		CRYSTAL UNIT, Quartz: (NOTE 1)
Y 301	YMW-35	Receiver control

NOTE

1. To retain optimum performance, replacement transistors, crystal diodes and quartz crystals must be ordered from the Motorola National Service Division by part number. When ordering quartz crystals, carrier frequency(s) and crystal frequency(s) must be specified.

TRANSMITTER ALIGNMENT

NOTE

READ PRELIMINARY SET-UP FOR TRANSMITTER ALIGNMENT BEFORE ALIGNING TRANSMITTER.

TEST EQUIPMENT REQUIRED FOR TRANSMITTER ALIGNMENT

1. Motorola CNLN6245A Alignment Tools (supplied) or equivalent.
2. Motorola DC Multimeter with RF probe (or equivalent).
3. RF Wattmeter with 50 ohms impedance (P-7208 or P-7208-A RF Dummy Load used in conjunction with Motorola S1056A-59A or TU546 Series Portable Test Set).
4. Motorola T1012A or TEK-23 Power Supply (or equivalent).
5. Motorola Model T1130A Series FM Station Monitor (or equivalent).
6. Motorola TEK-1A Transistorized Tone Oscillator (or equivalent).
7. Motorola T1014B Precision Wide Band Oscilloscope or Model T1015A General Purpose Oscilloscope (or equivalent).

NOMINAL VOLTAGE READINGS

NOTE

The following readings apply to a fully tuned transmitter with -14 volts DC input.

METER POINT	M1 BRN	M2 RED	M3 ORG	M4 YEL	M5 GRN
READING (VDC)	-1.8	-3.2	-0.3	-0.9*	-8.0*

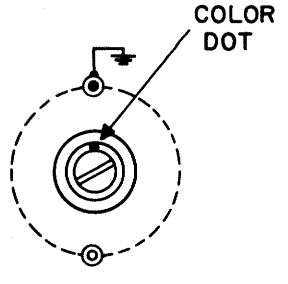
(*MEASUREMENT MADE WITH RF PROBE)

PRELIMINARY SET-UP FOR TRANSMITTER ALIGNMENT

1. Remove the cover from the radio section of the unit.
2. When aligning a two-frequency unit, align on the primary or higher of the two frequencies.
3. The dc multimeter ground lead should be connected to a convenient ground.
4. For complete alignment, the battery should be removed and a 15 volt dc power supply and ammeter connected to the battery plug. All tuning slugs except L101 should be unscrewed so they protrude 1/8 inch above the printed circuit board.
5. ***IMPORTANT:*** Preset capacitors C402, C404 and C405 to the position shown on the POWER AMPLIFIER photograph.
6. Remove the antenna by unscrewing it from the receptacle. Connect a wattmeter to the antenna receptacle.
7. Observe the 12 volt tune-up procedure in STEP 1 of the alignment procedure.

FREQUENCY CALCULATIONS

$f_o = \frac{f_c}{18}$ Where: f_o = oscillator frequency and f_c = carrier frequency



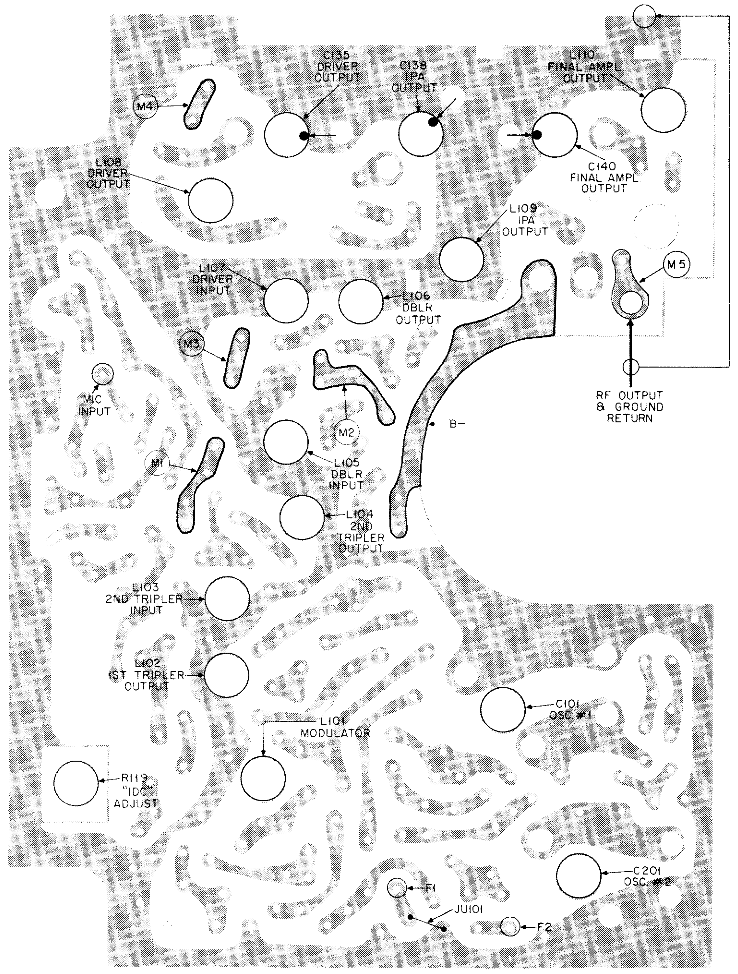
CAPACITOR DETAIL

NOTE

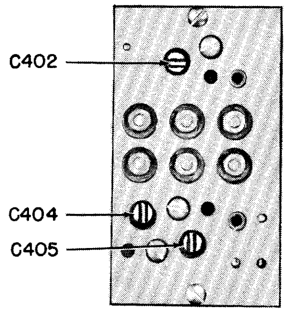
To adjust C135, C138, C140, C101 or C201 for maximum capacity, turn screwdriver slot so color dot is nearest the grounded side of the capacitor housing.

NOTE

Arrowheads indicate the position of the color dot for maximum capacity on C135, C138, and C140.

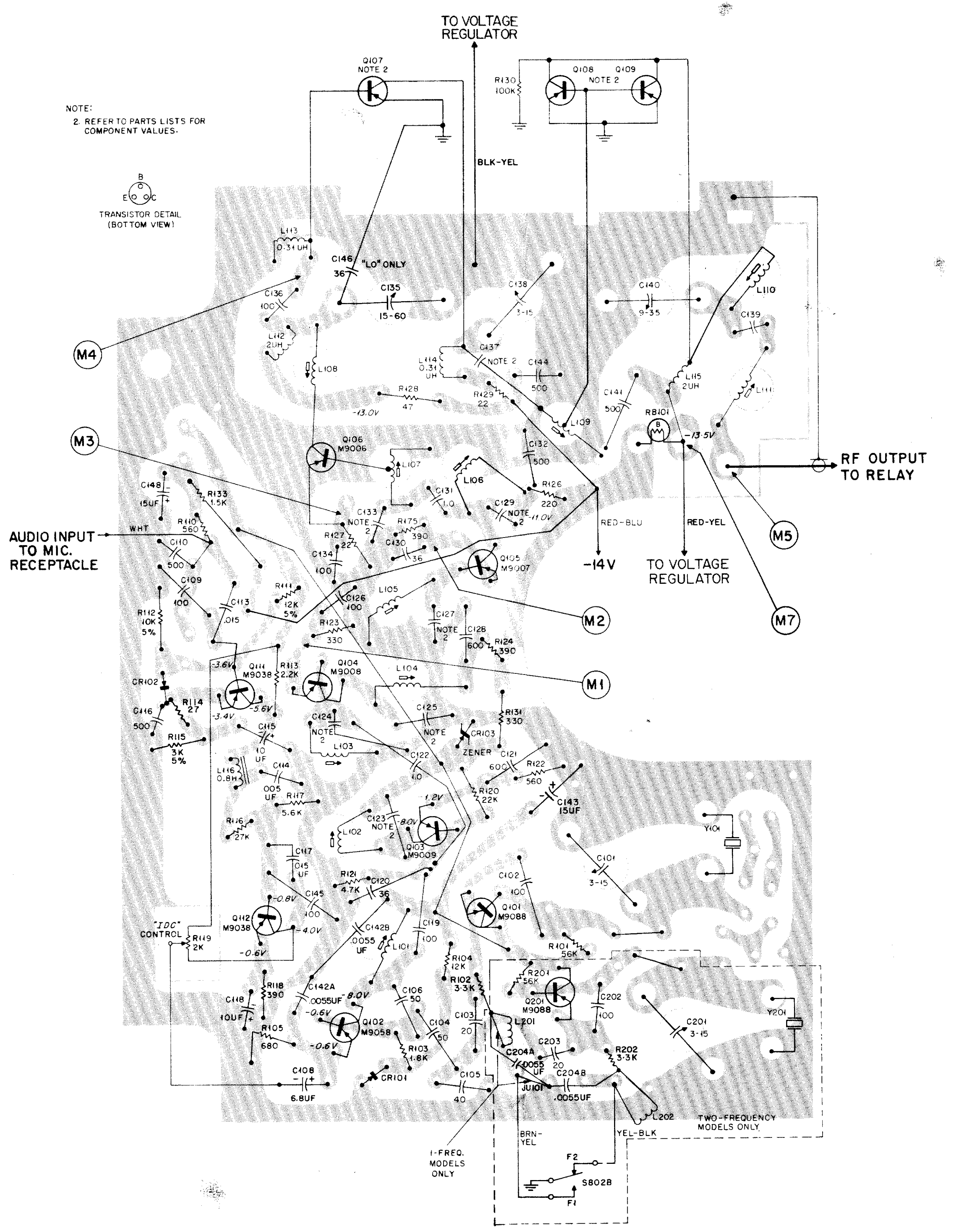


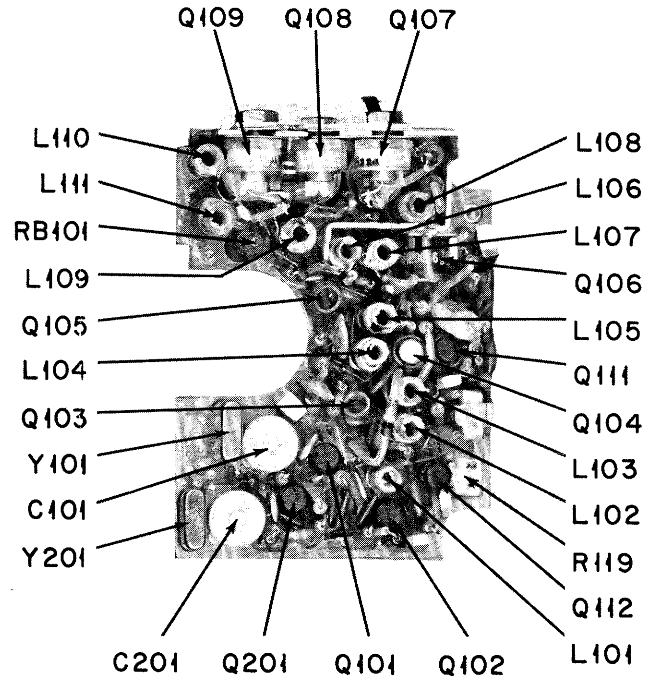
METERING AND ALIGNMENT POINTS



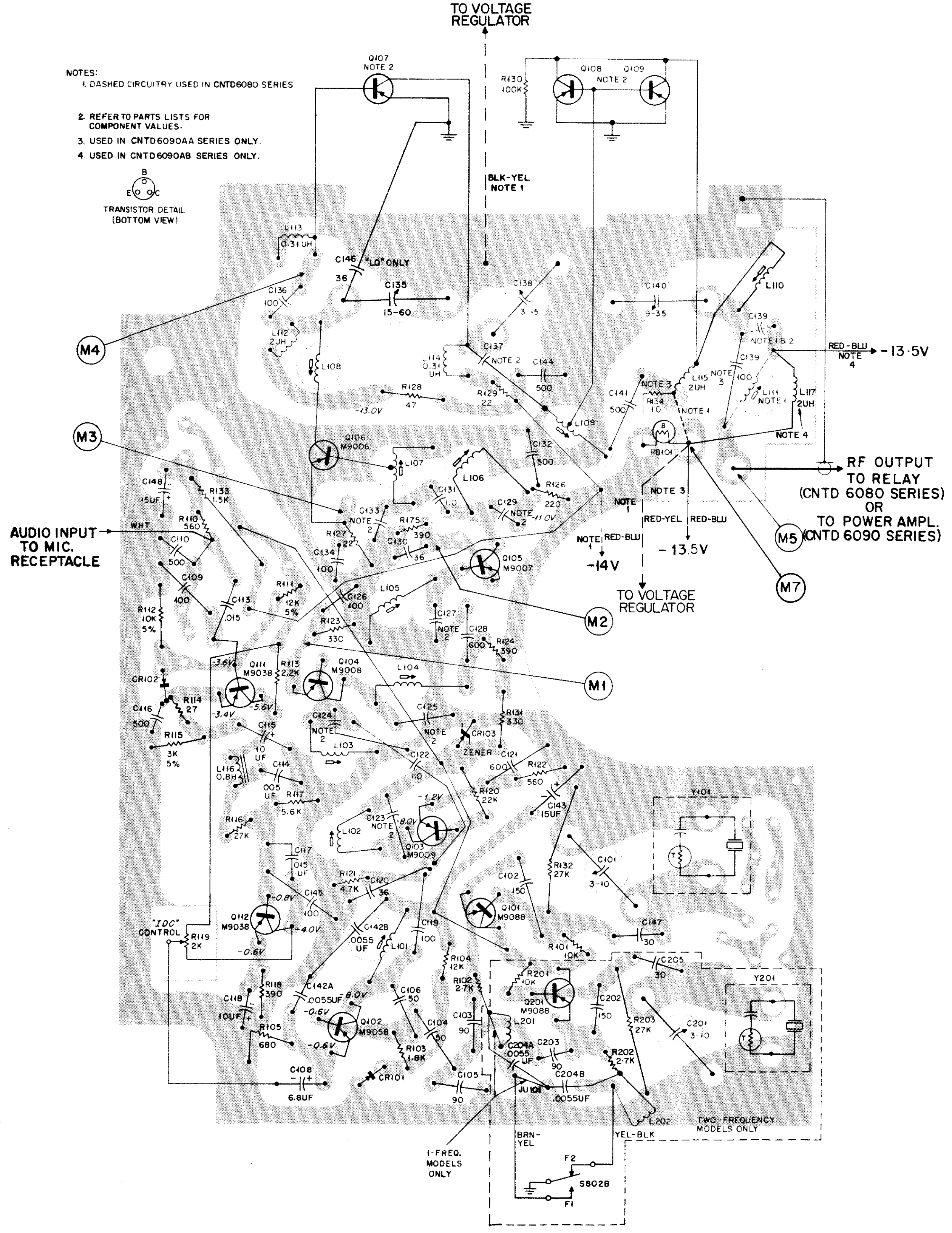
POWER AMPLIFIER

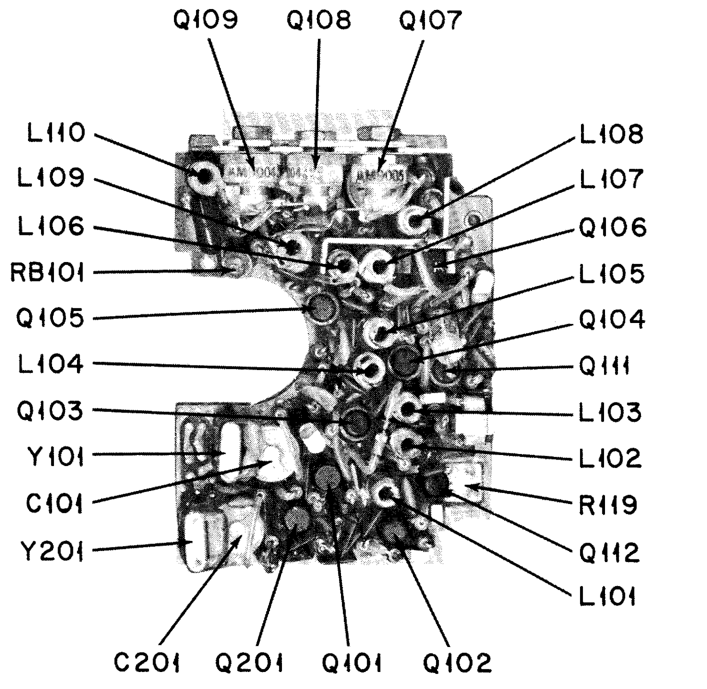
STEP	TEST EQUIP-MENT	METER POINT & COLOR	ADJUSTMENT	PROCEDURE
1	-----	-----	-----	P23 SERIES AND P33 SERIES Adjust the power supply voltage to -12 volts dc with transmitter keyed.
2	DC Multimeter	M1 (BRN)	L102 L103 1st Tripler	P23 SERIES AND P33 SERIES Adjust L103 and then L102 for maximum reading. Repeak several times to obtain maximum reading. This circuit is tuned to three times the crystal frequency.
3	DC Multimeter	M2 (RED)	L104 L105 2nd Tripler	P23 SERIES AND P33 SERIES Adjust coils L104 and L105 for a maximum reading. Repeak several times to obtain maximum reading. This circuit is tuned to nine times the crystal frequency.
4	DC Multimeter	M3 (ORG)	L106 L107 Doubler	P23 SERIES AND P33 SERIES Adjust coils L106 and L107 for a maximum reading. Repeak several times to obtain maximum reading. This circuit is tuned to eighteen times the crystal frequency.
5	DC Multimeter with RF probe	M4 (YEL)	L108 C135 Driver	P23 SERIES AND P33 SERIES Adjust L108 and C135 for maximum RF reading. After peaking, readjust C135 for a reading of 3/4 maximum.
6	RF Wattmeter	-----	C402	P33 SERIES ONLY Adjust C402 for a maximum reading. If no power output is obtained, adjust C140 for maximum capacity and proceed to Step 7.
7	DC Multimeter with RF probe	M5 (GRN)	L109 L110 C138	P23 SERIES AND P33 SERIES Adjust L109, L110 and C138 for a maximum reading. If no indication is obtained, adjust C140 for some indication and then adjust L110, C140, L109 and C138 for a maximum reading.
8	RF Wattmeter	-----	C404 C405 C402	P33 SERIES ONLY Adjust C404 and C405 for maximum reading. Next, adjust C402 for a maximum reading.
9	RF Wattmeter	-----	L109 L110 C138 C140	P33 SERIES ONLY Repeak L109, L110, C138 and C140 for a maximum reading.
10	-----	-----	-----	P23 SERIES AND P33 SERIES Increase the power supply voltage to -13.5 volts dc.
11	RF Wattmeter	-----	C404 C405 C402	P33 SERIES ONLY Repeat Step 8
12	RF Wattmeter	-----	-----	P33 SERIES ONLY Adjust C135 for approximately 3.0 watts output. Repeak L108 after each change in C135. Repeak L110, C140, L109, C138 and L108 for maximum output while minimizing the input current. Readjust C135 and repeat this step several times until 3.0 watts is obtained with minimum current drain. ***NOTE*** - DO NOT EXCEED 900 MA TOTAL CURRENT DRAIN (including relay current). P23 SERIES ONLY Adjust C135 for approximately 1.4 watts output. Repeak L108 after each change in C135. Repeak L110, C140, L109, C138 and L108 for maximum output while minimizing the input current. Readjust C135 and repeat this step several times until 1.4 watts is obtained with minimum current drain. ***NOTE*** - DO NOT EXCEED 475 MA TOTAL CURRENT DRAIN (including relay current).
13	RF Wattmeter	-----	C404 C405 C402	P33 SERIES ONLY Repeat Step 8. Detune C404 by 100 milliwatts on the low current side. Increase the output to rated power by increasing the drive with C135. Do not readjust C404.
14	-----	-----	-----	P23 SERIES AND P33 SERIES OSCILLATOR: C101 is preset to the assigned frequency at the factory. Do not readjust C101 unless the crystal is replaced or the setting was accidentally changed. If it is necessary to readjust C101, set up the frequency monitor for frequency measurement, and adjust C101 for zero reading on the monitor CARRIER FREQUENCY meter. Place the back cover on the transmitter unit and tighten securely. ***IMPORTANT:*** When the cover plate is attached, the frequency may shift, therefore, recheck the carrier frequency on the frequency monitor. If necessary, repeat this adjustment and recheck procedure compensating for the variations until a zero meter reading is obtained with back cover securely attached to unit. TWO-FREQUENCY TRANSMITTER ONLY OSCILLATOR NO. 2: Use the same procedure as above, substituting C201 for C101.
15	-----	-----	-----	P23 SERIES AND P33 SERIES DEVIATION CHECK: See IDC CONTROL ADJUSTMENT procedure in the "Maintenance" section of this manual.





CNTD6070AA AND AB SERIES TRANSMITTER



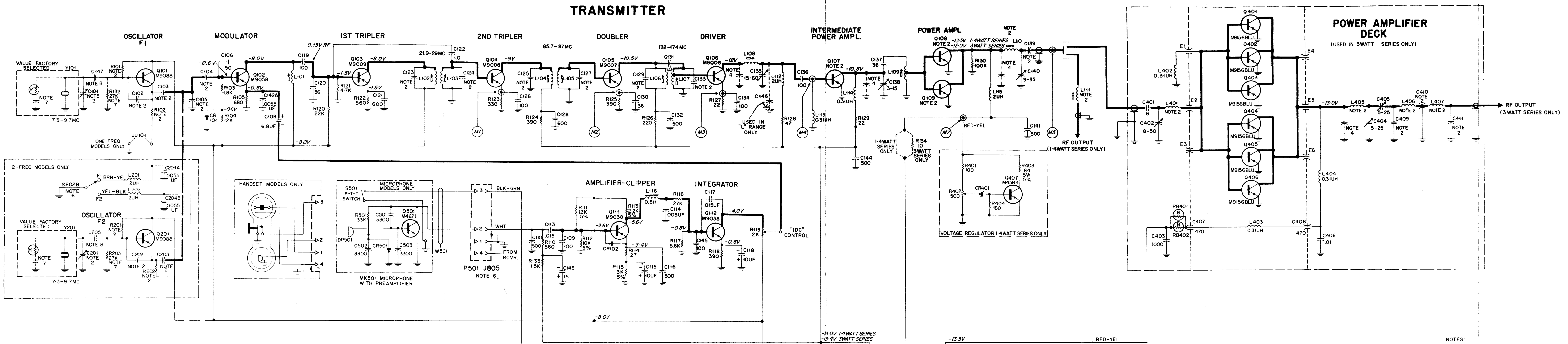


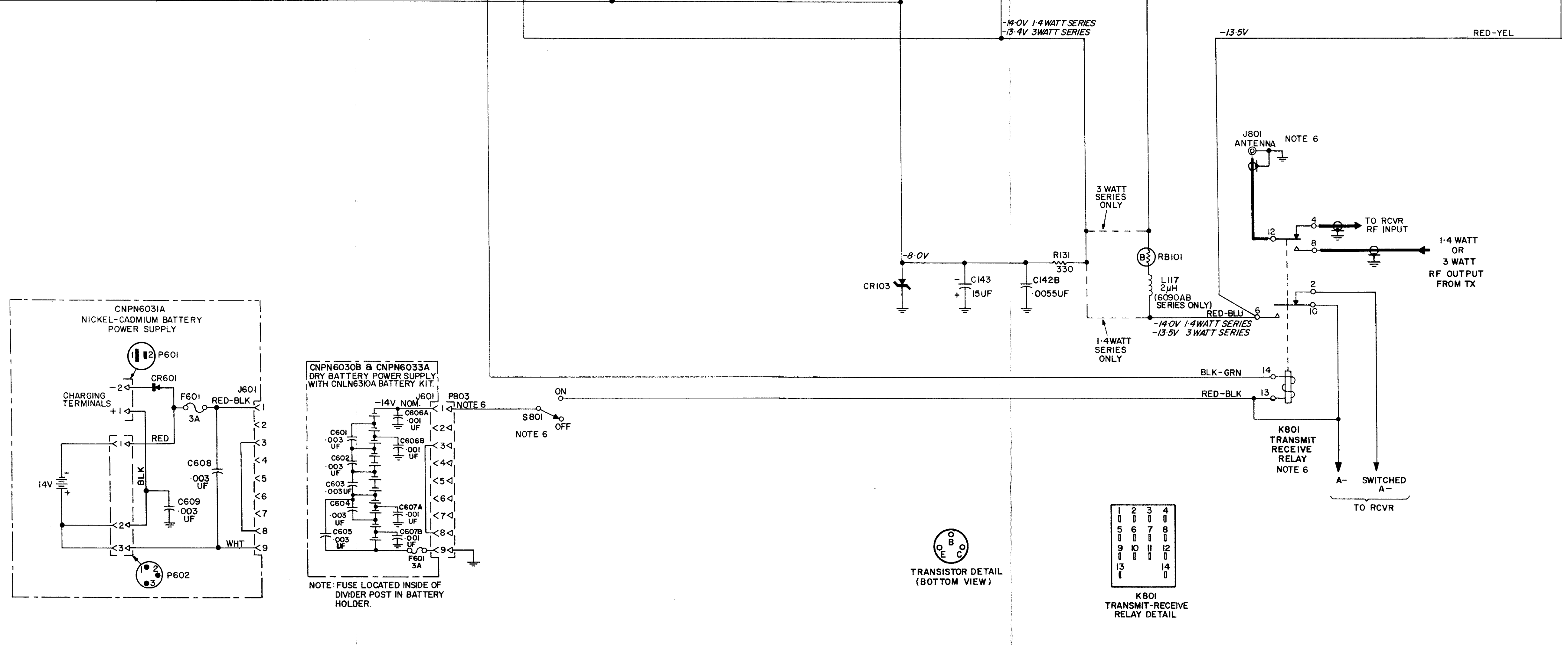
CNTD6080AA AND AB SERIES TRANSMITTER
CNTD6090AA AND AB SERIES TRANSMITTER

CNTD6070/6080/6090AA AND AB SERIES TRANSMITTER

PRINTED CIRCUIT BOARD DETAIL

TRANSMITTER





NOTES:

1. UNLESS OTHERWISE STATED:
   ALL RESISTOR VALUES ARE IN OHMS ± 10%, 1/4 W. K = 1000.
   ALL CAPACITOR VALUES ARE IN PICOFARADS.
2. REFER TO PARTS LIST FOR COMPONENT VALUE.
   (L = 132–150·8MC., M = 150·8–168MC., H = 168–174MC.)
3. FREQUENCY CALCULATION:
   $$fo = \frac{fc}{18}$$
4. THIS IS AN INHERENT CAPACITY WHICH IS PART OF THE HEAT SINK ASSEMBLY.
5. ALL VOLTAGE READINGS REFERENCED TO CHASSIS GROUND. DC READINGS TAKEN WITH A MOTOROLA DC MULTIMETER.
6. COMPONENTS WITH 800 SERIES NUMBERS ARE PART OF HOUSING KIT.
7. OMITTED IN MODEL CNTD6070 SERIES.
8. OMITTED IN MODEL CNTD6070 SERIES. A DIRECT CONNECTION EXISTS BETWEEN THE CRYSTAL AND THE BASE OF THE OSCILLATOR TRANSISTOR.

MODEL TABLES.

TRANSMITTERS

SERIES	MODEL NO.	NO. OF FREQ	FREQUENCY RANGE	OSCILLATOR STABILITY	RF POWER OUTPUT
CNTD6070AA	CNTD6071AA	1	132–150·8 MC	·0025%	1·4W
	CNTD6072AA	1	150·8–168 MC.		
	CNTD6073AA	1	168–174 MC.		
CNTD6070AB	CNTD6071AB	2	132–150·8 MC.		
	CNTD6072AB	2	150·8–168 MC.		
	CNTD6073AB	2	168–174 MC.		
CNTD6080AA	CNTD6081AA	1	132–150·8 MC.	·0005%	
	CNTD6082AA	1	150·8–168 MC.		
	CNTD6083AA	1	168–174 MC.		
CNTD6080AB	CNTD6081AB	2	132–150·8 MC.		
	CNTD6082AB	2	150·8–168 MC		
	CNTD6083AB	2	168–174 MC.		
CNTD6090AA	CNTD6091AA	1	132–150·8 MC.		(EXCITER FOR) 3·0W
	CNTD6092AA	1	150·8–168 MC.		
	CNTD6093AA	1	168–174 MC.		
CNTD6090AB	CNTD6091AB	2	132–150·8 MC.		
	CNTD6092AB	2	150·8–168 MC.		
	CNTD6093AB	2	168–174 MC.		

POWER SUPPLIES

MODEL NO.	TYPE OF BATTERIES
CNPN6030B	DRY
CNPN6031A	NICKEL-CADMIUM
CNPN6033A	DRY (R.R.)

POWER AMPLIFIERS

MODEL NO.	FREQUENCY RANGE
CNLD6171A	132 – 150·8MC.
CNLD6172A	150·8–174 MC.

CONTROL PANELS

MODEL NO.	NO. OF FREQ.	HANDSET	SPEAKER	MIC.
CNGN6023A	1	X		
CNGN6026A	2	X		
CNCN6039A	1		X	X
CNCN6044A	1	X	X	
CNCN6049A	2		X	X
CNCN6060A	2	X	X	

CNTD6070/6080/6090AA AND AB SERIES

"HANDIE-TALKIE" TRANSMITTER

SCHEMATIC DIAGRAM 63E00175M-A

CNTD6070/6080/6090A SERIES TRANSMITTER

PARTS LIST

(Schematic Diagram 63E00175M)

NOTE: Control Panel, Power Supplies, Voltage Regulator, Microphone and Handset parts are included.

REFERENCE SYMBOL	PART NO.	DESCRIPTION
LEGEND: CNTD6071, 81, 91AA TRANSMITTER (132-150.8 MC) 1-FREQUENCY ("L") CNTD6072, 82, 92AA TRANSMITTER (150.8-162 MC) 1-FREQUENCY ("M") CNTD6073, 83, 93AA TRANSMITTER (162-174 MC) 1-FREQUENCY ("H") CNTD6071, 81, 91AB TRANSMITTER (132-150.8 MC) 2-FREQUENCY ("L") CNTD6072, 82, 92AB TRANSMITTER (150.8-162 MC 2-FREQUENCY ("M") CNTD6073, 83, 93AB TRANSMITTER (162-174 MC) 2-FREQUENCY ("H")		
TRANSMITTER COMPONENTS		
		CAPACITOR, Fixed, uuF, ±10%, 75 VDCW, unless otherwise stated: (See NOTE)
C 101	20C82399D06	Variable, 3-15, 200 VDCW, BLU (CNTD6070 Series only)
	or	
	20C82399D08	Variable, 3-10, 200 VDCW, GRAY (CNTD6080, CNTD6090 Series only)
C 102, 202	21K861436	100 (CNTD6070 Series only)
	or	
	21D82877B34	150, 50 VDCW (CNTD6080, CNTD6090 Series only)
C 103, 203	21K861432	20 (CNTD6070 Series only)
	or	
	21D82877B33	90, 50 VDCW (CNTD6080, CNTD6090 Series only)
C 104	21K864013	50 (CNTD6070 Series only)
	or	
	21D82877B31	50, 50 VDCW (CNTD6080, CNTD6090 Series only)
C 105	21K861434	40 (CNTD6070 Series only)
	or	
	21D82877B33	90, 50 VDCW (CNTD6080, CNTD6090 Series only)
C 106	21K864013	50
C 108	23D82397D09	6.8 uF +40-20%, 10 VDCW
C 109, 126, 134, 136, 145	21K861437	100
C 110	21K861441	500
C 113	8K854329	0.015 uF, 200 VDCW
C 114	8C82548E03	0.005 uF, 100 VDCW
C 115, 118	23C82397D03	10 uF ±20%, 6 VDCW
C 116, 132, 141, 144	21K847065	500 GMV, 250 VDCW
C 117	8C82548E02	0.015 uF, 100 VDCW
C 119	21K861436	100
C 120, 125L, 130, 137, 146L	21K861433	36
C 121, 128	21K851299	600, 600 VDCW
C 122, 131	21C82450B28	1.0, 500 VDCW
C 123L, 124L	21K861435	70
C 123M, 123H, 124M, 124H	21K864012	60
C 125M, 125H, 127M, 127H	21K865197	25
C 127L	21D82877B06	30
C 129L	21K861462	15
C 129M, 129H	21K861429	8
C 133L	21K861430	10
C 133M, 133H	21K861428	6
C 135	20C82399D07	Variable, 15-60, 500 VDCW, VIOLET
C 138	20C82399D06	Variable, 3-15, 200 VDCW, BLU

REFERENCE SYMBOL	PART NO.	DESCRIPTION
C 139L	21D82877B08	2.8 ±0.25 uuF (CNTD6070, CNTD6080 Series only)
	or	
	21K840046	100, 500 VDCW (CNTD6090 Series only)
C 139M	21K864014	5 (CNTD6070, CNTD6080 Series only)
	or	
	21K840046	100, 500 VDCW (CNTD6090 Series only)
C 139H	21K861427	4 (CNTD6070, CNTD6080 Series only)
	or	
	21K840046	100, 500 VDCW (CNTD6090 Series only)
C 140	20C82399D05	Variable, 9-35, 500 VDCW, GRN
C 142, 204	21C82724H01	2 section; consisting of:
C 142A, 204A		0.0055 uF +100-20%
C 142B, 204B		0.0055 uF +100-20%
C 143, 148	23C82397D17	15 uF ±20%, 20 VDCW
C 147, 205	21D82877B06	30 (CNTD6080, CNTD6090 Series only)
C 201	20C82399D06	Variable, 3-15, 200 VDCW, BLU (CNTD6070 Series only)
	or	
	20C82399D08	Variable, 3-10, 200 VDCW, GRAY (CNTD6080, CNTD6090 Series only)
		SEMICONDUCTOR DEVICE, Diode: (See NOTE)
CR 101	48C82392B03	Silicon
CR 102	48C82178A01	Germanium
CR 103	48C82256C08	Zener
		COIL
L 101	24C82901B06	BLK; does not include 76B82451B02 CORE, tuning, YEL
L 102, 103	24C82904B13	RED-RED; does not include 76K861425 CORE, tuning
L 104, 105	24C82904B17	YEL-BLK; does not include 76K861425 CORE, tuning
L 106	24C82904B16	GRAY-BLK; does not include 76K861425 CORE, tuning
L 107	24B82180E01	Driver input; does not include 76K861425 CORE, tuning
L 108	24C82904B06	RED-GRN; does not include 76K861425 CORE, tuning
L 109	24B82755D01	PA output; does not include 76K861425 CORE, tuning
L 110L	24C82904B04	Final Amplifier, BRN; does not include 76B82451B04 CORE, tuning (CNTD6070, CNTD6080 Series only)
L 110M, 110H	24B82754D01	Final Amplifier; does not include 76K861425 CORE, tuning
L 111L	24C82904B18	RF output, GRAY-RED; does not include 76K861425 CORE, tuning
L 111M, 111H	24C82904B12	RF output; VIO-GRAY; does not include 76B82451B04 CORE, tuning (CNTD6070, CNTD6080 Series only)
L 112, 115, 201, 202	24C82000E07	Choke, RF, 2 uH, sleeved
L 113, 114	24C82000E08	Choke, RF, 0.31 uH, sleeved
L 116	25B82872B01	Choke, audio, 0.8 Henry
L 117	24C82000E07	Choke, RF, 2 uH, sleeved (CNTD6090AB Series only)
		TRANSISTOR, P-N-P: (See NOTE)
Q 101, 201	48R869088	Type M9088
Q 102	48R869058	Type M9058
Q 103	48R869009	Type M9009
Q 104	48R869008	Type M9008
Q 105	48R869007	Type M9007
Q 106	48R869006	Type M9006
Q 107L, 107M	48T00011M01	Type M9005-011M, BRN or 48T00011M09
Q 107H	48T00011M09	Type M9005-011M, WHT
Q 108L, 109L	48T00011M04	Type M9152-011M, YEL or 48T00011M02, or 48T00011M03 (CNTD6071, CNTD6081 Series only)
	or	
	48T00011M08	Type M9157-011M, GRAY or 48T00011M05/M07 (CNTD6091 Series only)
Q 108M, 109M	48T00011M02	Type M9152-011M, RED (CNTD6072, CNTD6082 Series only)
	or	
	48T00011M07	Type M9157-011M, VIOLET, or 48T00011M05 (CNTD6092 Series only)
Q 108H, 109H	48T00011M03	Type M9152-011M, ORG (CNTD6073, CNTD6083 Series only)
	or	
	48T00011M05	Type M9157-011M, GRN (CNTD6093 Series only)
Q 111, 112	48R869038	Type M9038

REFERENCE SYMBOL	PART NO.	DESCRIPTION
		RESISTOR, Fixed, composition, ±10%, 1/4 Watt, unless otherwise stated:
R 101, 201	6K129242	56K Ohms (CNTD6070 Series only)
	or	
	6K129225	10K Ohms (CNTD6080, CNTD6090 Series only)
R 102, 202	6K129231	3.3K Ohms (CNTD6070 Series only)
	or	
	6K126868	2.7K Ohms (CNTD6080, CNTD6090 Series only)
R 103	6K129269	1.8K Ohms
R 104	6K129230	12K Ohms
R 105	6K128599	680 Ohms
R 110, 122	6K129620	560 Ohms
R 111	6K129887	12K Ohms ±5%
R 112	6K129688	10K Ohms ±5%
R 113	6K129804	2.2K Ohms ±5%
R 114	6K131594	27 Ohms
R 115	6S124A60	3K Ohms ±5%
R 116	6K127806	27K Ohms
R 117	6K129433	5.6K Ohms
R 118, 124, 125	6K129863	390 Ohms
R 119	18B82876B04	Variable, 2K Ohms, printed circuit type
R 120	6K128685	22K Ohms
R 121	6K127804	4.7K Ohms
R 123, 131	6K129775	330 Ohms
R 126	6K127800	220 Ohms
R 127, 129	6K131641	22 Ohms
R 128	6K129233	47 Ohms
R 130	6K129226	100K Ohms
R 132, 203	6K127806	27K Ohms (CNTD6080, CNTD6090 Series only)
R 133	6K127803	1.5K Ohms
R 134	6K129755	10 Ohms (CNTD6090 Series only)
		RESISTOR, Current regulating:
RB 101	65B82085D01	Ballast Lamp
		CRYSTAL UNIT, Quartz: (See NOTE)
Y 101, 201	CNLD6230A	Frequency control, 7.3 to 9.7 MC (CNTD6080, CNTD6090 Series only)
	or	
	Type YN419	Frequency control, 7.3 to 9.7 MC (CNTD6070 Series only)
NON-REFERENCED ITEMS		
	1V80724A99	HEAT SINK BRACKET ASSEMBLY
CNLD6171A RF AMPLIFIER (132-150.8 MC) ("L") CNLD6172A RF AMPLIFIER (150.8-174 MC) ("M" and "H")		
		CAPACITOR, Fixed, uuF, unless otherwise stated: (See NOTE)
C 401	21K840848	6 ±0.5 uuF, 500 VDCW
C 402	20K840719	Variable, 8-50, 350 VDCW
C 403	21B85886	1000 GMV, 500 VDCW
C 404, 405	20K848235	Variable, 5-25, 350 VDCW
C 406	21K861443	0.01 uF +100-20%, 75 VDCW
C 407, 408	21C821474	470 ±20%, 500 VDCW
C 409L, 411L	21C82880E02	15 ±10%, 500 VDCW
C 409M, 409H, 411M, 411H	21C82880E01	13 ±10%, 500 VDCW
C 410L	21C82881E02	30 ±10%, 500 VDCW
C 410M, 410H	21C82881E01	26 ±10%, 500 VDCW
		TERMINAL, Feed-thru:
E 1, 3, 4, 6	29A82872E01	Flange stud
E 2, 5	29A82873E01	Hook stud

REFERENCE SYMBOL	PART NO.	DESCRIPTION
		COIL, RF:
L 401	24A82874E01	Tuning, input
L 402, 403, 404	24C82000E04	Choke, 0.31 uH; includes sleeve
L 405	24A82875E01	Tuning, output
L 406L, 407L	24A82892E01	Filter
L 406M, 406H, 407M, 407H	24A82877E01	Filter
		TRANSISTOR, P-N-P: (See NOTE)
Q 401 to 406	48T00011M06	Type M9156-011M, BLUE
		RESISTOR, Current regulating:
RB 401, 402	65B82085D01	Ballast Lamp
CONTROL PANEL Models CNGN6023A, CNGN6026A, CNCN6039A, CNCN6044A, CNCN6049A and CNCN6060A		
		CONNECTOR, Receptacle, female:
J 801	9C82817E01	Coaxial, single contact, UHF, chassis mounted
J 805	1V80715A85	4 contact, chassis mounted; does not include 2A81180 NUT, ring, knurled
		CONNECTOR, Plug, male:
P 803	28C82846E01	9 contact, chassis mounted
		RELAY, Armature, hermetically sealed:
K 801	80C82860E01	13.6 Volt DC, coil resistance: 160 Ohms, contact arrangement: 4 form "C"
		LOUDSPEAKER, Permanent magnet:
LS 801	50D82808E01	3 inches square; voice coil: 50 Ohms impedance
		RESISTOR
R 801	18C82816E02	Variable, 10K Ohms ±10%, weatherproof
R 802	6K129662	Fixed, composition, 180 Ohms ±10%, 1/4 Watt
R 803	18C82816E01	Variable, 5K Ohms ±10%, weatherproof
R 804	6R6040	Fixed, composition, 680 Ohms ±10%, 1/2 Watt
		SWITCH
S 801	40B82857E01	Toggle, SPST, weather-resistant
S 802	40C82843E01	Rotary, 2 pole, 2 position, non-shorting (2-Frequency models only)
NON-REFERENCED ITEMS		
	1V80727A11	HANDLE ASSEMBLY; includes microphone holding clip (for CNCN6039A, CNCN6049A)
	1V80729A93	HANDLE ASSEMBLY; includes handset holder (for CNCN6044A, CNCN6060A, CNGN6023A, CNGN6026A)
	42K861179	CLAMP, Cable; 3 required
	32B82855E01	GASKET, Rubber, housing seal
	36B82812E03	KNOB, Control; 2 required (volume and squelch)
	36B82812E03	KNOB, Control (F1-F2 switch)
	32B82860E01	GASKET, Speaker mounting
	35B82802E01	CLOTH, Grille
	13C82815E01	GRILLE (1-Freq. models)
	13C82815E04	GRILLE (2-Freq. models)
	1V80727A10	HOUSING ASSEMBLY; includes handle (for CNCN6039A)
	1V80731A68	HOUSING ASSEMBLY; includes handle (for CNCN6049A)
	1V80729A94	HOUSING ASSEMBLY; includes handle (for CNCN6044A, CNGN6023A)
	1V80731A67	HOUSING ASSEMBLY; includes handle (for CNCN6060A, CNGN6026A)
CNLN6035A VOLTAGE REGULATOR KIT		
		SEMICONDUCTOR DEVICE (See NOTE)
CR 401	48C82256C08	Diode, zener

REFERENCE SYMBOL	PART NO.	DESCRIPTION
Q 407	48K134584	TRANSISTOR (See NOTE) P-N-P, type M4584, GRN
		RESISTOR
R 401	6K129753	Fixed, composition, 100 Ohms ±10%, 1/4 Watt
R 402	18C82035B07	Variable, 500 Ohms ±20%
R 403	17C82291B12	Fixed, wire-wound, 84 Ohms ±5%, 5 Watt
R 404	6K129662	Fixed, composition, 180 Ohms ±10%, 1/4 Watt
NON-REFERENCED ITEMS		
	1V80733A47	HEAT SINK PLATE ASSEMBLY
	14K865854	INSULATOR, Mica, transistor
CNMN6018A AND MNMN6018A MICROPHONE (Plug-in, transistorized)		
C 501, 502, 503	21D82428B10	CAPACITOR, Fixed, ceramic, disc: 0.0033 uF ±10%, 100 VDCW
CR 501	48C82178A01	SEMICONDUCTOR DEVICE (See NOTE) Germanium
DF 501	59C82857E01 or 59C82864E01	CARTRIDGE, Microphone: Reluctance type
MK 501	1V80727A19	MICROPHONE ASSEMBLY Preamplifier, AF; includes C501, C502, C503, CR501, Q501, R501 and 1V80727A20 BOARD, circuit component mounting
P 501	28K881189	CONNECTOR, Plug, male, 4 contact: Cable mounted, (MNMN6018A only) or part of W501 (CNMN6018A only)
Q 501	48K134621	TRANSISTOR (See NOTE) P-N-P, type M4621
R 501	6K127807	RESISTOR Fixed, composition, 33K Ohms ±10%, 1/4 Watt
S 501	40C82863E01	SWITCH Push, single pole, normally open
W 501	30D82565B77	CORD, Microphone, coil, 4 conductor, stranded: Includes P501 (CNMN6018A) or 30B00013M01, less P501 (MNMN6018A)
NON-REFERENCED ITEMS		
	15C82828E01	HOUSING, Microphone (front)
	15C82827E01	HOUSING, Microphone (rear)
	41B82836E01	SPRING, Backup
	38B82833E01	BUTTON, Push
	35A82853E01	DIAPHRAGM, Microphone
	4C82418B22	WASHER, Insulating
	73A82852E01	PAD, Rubber, 1.24" diameter
	75A82192A02	PAD, Rubber, 0.562" diameter
	64A82826E01	PLATE, Tapped
	7B82801E01	BRACKET, Hold-down
	32A82661C02	GASKET
	42B82831E01	CLAMP, Cable
	1V80727A18	SPRING AND BUSHING ASSEMBLY
	43K472873	SPACER
CNMN6017A AND MNMN6017A HANDSET (Carbon Type)		
	50D82433G01	HANDSET; includes transmitter and receiver cartridge
	49A00001M	VAPOUR BARRIER (MNMN6017A Models only)

REFERENCE SYMBOL	PART NO.	DESCRIPTION
CNPN6031A POWER SUPPLY (less battery) NICKEL-CADMIUM		
C 608, 609	21C82187B16	CAPACITOR, Fixed, ceramic disc: 0.003 uF ±10%, 100 VDCW
CR 601	48C82095C01	SEMICONDUCTOR DEVICE (See NOTE) Diode, silicon
F 601	65A82496G01	FUSE, Cartridge: 3 Amp, 32 Volt, 1/4" x 5/8"
J 601	9C82847E01	CONNECTOR, Receptacle: Female, 9 contact, chassis mounted
		CONNECTOR, Plug:
P 601	28A82488G01	Male, 2 contact, chassis mounted
P 602	28A16313	Male, 3 contact, chassis mounted
XF 601	1V80731A03	FUSEHOLDER ASSEMBLY Single fuse mounting; for F601
NON-REFERENCED ITEMS		
	1V80731A01	HOUSING ASSEMBLY
	64B82653G01	PLATE, Door
	45A82652G01	SPRING, Torsion
	22A82651E01	PIN, Pivot
	14A82650G01	INSULATOR
	3BA88879	TAB, Battery plug
CNPN6030B POWER SUPPLY (less batteries) DRY BATTERY CNPN6033A POWER SUPPLY (less batteries) DRY BATTERY		
C 601, 602, 603, 604, 605	21C82187B16	CAPACITOR, Fixed, ceramic disc: 0.003 uF ±10%, 100 VDCW
C 606, 607	21K850802	Dual, 0.001 uF -0 +100%, 500 VDCW, each section
F 601	65R112923	FUSE, Cartridge: 3 Amp, 250 Volt, pigtail type
J 601	9C82847E01	CONNECTOR, Receptacle: Female, 9 contact, chassis mounted
NON-REFERENCED ITEMS		
	1V80231A83	HOUSING ASSEMBLY (CNPN6030B Model only)
	1V80235A56	HOUSING ASSEMBLY (CNPN6033A Model only)
	1V80231A85	BATTERY HOLDER ASSEMBLY (CNPN6030B Model only)
	1V80235A58	BATTERY HOLDER ASSEMBLY (CNPN6033A Model only)
	1V80231A87	BATTERY COVER ASSEMBLY (CNPN6030B Model only)
	1V80235A60	BATTERY COVER ASSEMBLY (CNPN6033A Model only)

NOTE

To retain optimum performance, replacement transistors, crystal diodes, quartz crystals and capacitors must be ordered from the Motorola National Service Division by part number. When ordering quartz crystals, carrier frequency(s) and crystal frequency(s) must be specified. All capacitors requiring replacement must be replaced with capacitors having the same temperature coefficient as the originals.

MAINTENANCE

BATTERY REPLACEMENT PROCEDURE

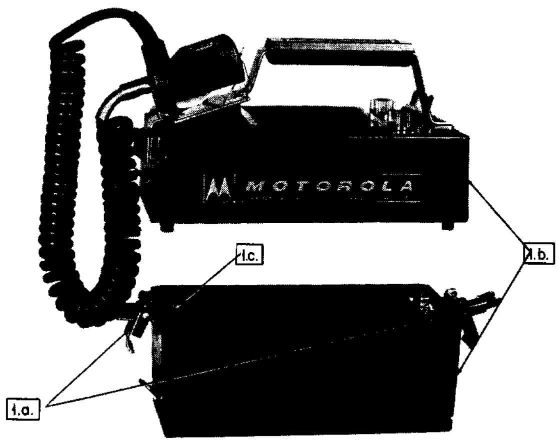
1) GENERAL (See Figure 3)

To replace dry batteries or the nickel-cadmium battery, the radiophone power supply must be disassembled as follows:

a) Release the spring snap fastener at each end of the radiophone.

b) Pull bottom section of radio (power supply) down and away from upper section.

c) Remove the battery compartment cover by releasing the 1/4 turn captive screw and lifting the cover up.



NOTE:
LETTERS AND NUMBERS IN BOXES REFER TO SPECIFIC PARAGRAPHS IN THE TEXT.

FIGURE 3

2) DRY BATTERIES

To replace dry batteries, first remove the old batteries by turning the battery compartment upside down. Replace the new batteries in the compartment so that the flat (negative) end of the batteries make contact with the springs and the tip (positive) end of the batteries make contact with the flat contact surfaces.

3) NICKEL-CADMIUM BATTERY

To replace the nickel-cadmium battery, proceed as follows:

a) Remove the screws from two corners of the battery.

b) Lift battery out of battery compartment.

c) Remove three-prong plug from battery.

d) Insert new battery by reversing this procedure.

Fast battery replacement can be accomplished by changing the entire power supply and replacing the batteries in the detached power supply at a later time. Additional power supplies can be purchased as separate accessories for fast change-over.

BATTERY NOTES

1) DRY BATTERIES

All batteries, dry and wet, have a finite shelf life. Storing them for long periods of time reduces their closed circuit voltage and operating life. In some cases, when stored too long, dry batteries may leak electrolyte after partial use and damage the radio. Therefore, if radio equipment is to be stored for long periods of time, remove the batteries and store separately in a cool place. Never store batteries in a warm place as heat increases their chemical action and shortens life.

Shelf life of a dry battery is approximately 3 to 6 months, therefore, they should be put into use within 3 months after purchase. The batteries can be tested at the battery terminals under transmit load conditions.

The batteries should be replaced when the voltage under transmit load conditions is below 12 volts.

IMPORTANT

Battery voltages and capacity decrease markedly during low temperature operation.

2) NICKEL-CADMIUM BATTERIES

a) General

The operational characteristics of a nickel-cadmium battery under load are rather unique. The load voltage remains approximately constant until the battery approaches the discharged condition. At this time, there is a marked decrease in the load voltage and the discharged condition is reached abruptly. Metering to determine the state of charge of this type of battery is difficult and is not normally performed.

b) Storage

The battery requires no special storage precautions; it may be stored in any condition of charge or discharge without detrimental effects such as sulphation in lead-acid storage batteries. However, for storage periods in excess of approximately six months, it is recommended that the battery be kept in a discharged state since a general characteristic of a rechargeable battery is self-discharge.

It is difficult to predict charge retention after extended periods of storage. If the battery is to be used on an emergency basis after unknown storage periods, it is recommended that it be initially charged at the full charging rate then trickle charged until need for the battery arises.

c) Charging

Because of the sealed construction, the battery does not require the addition of electrolyte during its service life. Hence, the major maintenance problems normally associated with rechargeable batteries are completely eliminated. Maintenance consists only of recharging the battery and keeping the battery and its contacts clean.

The sealed-cell construction of the battery requires that the charger be designed as an integral part of the overall system. This is very important because damage to the battery will result if overcharge is continued beyond certain limits. Only an approved charger (see ACCESSORY TABLE) can be used, otherwise the manufacturer's warranty covering the replacement of the battery during its service life is void.

CAUTION

Avoid accidental short circuits. Sustained high rate discharges will damage the battery.

3) BATTERY LIFE

Under operating conditions of 10% transmit, 10% receive at rated audio output and 80% receive standby, battery life expectancy is approximately as shown in the following table. Note that in actual practice, transmit duty cycles are smaller than stated and approach 2% rather than 10%. Furthermore, in many types of operation, the unit does not remain on continuously. If this type of service is prevalent, battery life may be extended to many times the figures stated in the table.

RADIOPHONE	POWER SUPPLY	APPROXIMATE BATTERY LIFE
P23 Series	CNPN6030B or CNPN6033A with CNLN6310A Dry Battery Kit.	14 eight hour days each separated by 16 hour OFF period.
P33 Series		6 eight hour days each separated by 16 hour OFF period.
P23 Series	CNPN6031A with CNLN6267A Nickel-Cadmium Battery Kit.	16 hours before recharging is necessary.
P33 Series		8 hours before recharging is necessary.

FUSE REPLACEMENT

To replace the fuse in the battery compartment, proceed as follows:

1) Release the spring snap fastener at each end of the radiophone.

2) Pull bottom section of radio (power supply) down and away from upper section.

3) Remove the battery compartment cover by releasing the 1/4 turn captive screw and lifting the cover up.

4) In dry battery type power supplies, remove all batteries. Remove the screws from the battery separator and lift out.

5) Unsolder the pigtail fuse from the underside of the battery separator. Solder a new fuse of proper rating in place and reassemble.

6) In nickel-cadmium type power supplies, the fuse is located in a clip type fuseholder in one corner of the housing.

RECOMMENDED TEST EQUIPMENT

The necessary test equipment recommended for aligning and testing the "Handie-Talkie" Radiophone is listed in the following table and illustrations. These items or their equivalents may be used.

TEST EQUIPMENT TABLE

EQUIPMENT	USED FOR
Motorola DC Multimeter with RF probe.	All dc and RF measurements. Monitoring the input current when external power supply is used.
Motorola AC Voltmeter FM Signal Generator - Motorola T1034C Signal Generator.	All ac signal measurements. Alignment of all RF and first IF stages, 20 db quieting sensitivity measurements.
455 kc crystal-controlled oscillator - Motorola S1056A-59A or TU546 Series Test Set with 455 kc crystal.	Alignment of 455 kc IF limiter and discriminator stages.
Audio generator - Motorola TEKA-1A. Motorola model T1130A Series FM Station Monitor.	IDC Adjustment
Oscilloscope - Motorola T1015A General Purpose Oscilloscope or Motorola T1014B Precision Wide Band Oscilloscope.	IDC Adjustment
Motorola Model P-7208 or P-7208-A RF Dummy Load and a field strength meter.	All RF output power measurements.
Motorola CNLN6245A Alignment Tool (supplied with the radiophone).	Adjusting the variable capacitors and tuning coil slugs.
DC power supply capable of supplying -14 volts dc at 1.5 amperes (optional) Motorola T1012A or TEK-23 Power Supply.	Supplying dc power to the unit during extended servicing.
Motorola Model TEKA-40 Power Extension Cable.	Connecting batteries to radio for servicing.
Motorola NEN6048B Test Jig (ST455 Vice).	Holding the radiophone for alignment or testing.
Motorola TEKA-53 Power Test Cable.	Connecting TEK-23 Power Supply to radio.

RECOMMENDED TEST EQUIPMENT

S1059A
TEST SET

T1012A
POWER SUPPLY

P-7208 for P33 Series units
P-7208-A for P23 Series units
RF DUMMY LOAD

S1063A
DC MULTIMETER

S1051B
TRANSISTORIZED AC
VOLTMETER

TEK-1A
TRANSISTORIZED TONE
GENERATOR

T1034B
SIGNAL GENERATOR

T1015A
GENERAL PURPOSE
OSCILLOSCOPE

T1014B
PRECISION WIDE BAND
OSCILLOSCOPE

NLN6245A
TUNING TOOL

NLN6145A for P23 Series units
NLD6060A for P33 Series units
DUMMY LOAD ANTENNA

RADIO SET SERVICING

1) TEST PROCEDURE

When a radiophone requires servicing, use the following procedures to localize the fault.

a) Check Batteries

The first step in localizing the trouble is to check the battery voltage under load, i.e., with the transmitter turned on (keyed). A convenient method of doing this is to separate the battery compartment and radio compartment. Using the TEKA-40 Power Extension Cable (or equivalent), connect the batteries to the radio.

CAUTION

Do not key transmitter unless antenna, dummy load, or equivalent is connected to the antenna receptacle.

Place the voltmeter ground lead on a convenient ground and measure the voltage at the transmitter A- input while the transmitter is keyed. The measured loaded voltage should be not less than 12 volts for either the dry or nickel-cadmium batteries. Even though the transmitter may operate at this lower voltage, its operation would be marginal and for only a short additional period of time. The recommended procedure is to replace, or recharge the batteries if the voltage is below 12 volts under load. Refer to the BATTERY NOTES for additional information.

NOTE

Only the nickel-cadmium batteries are rechargeable.

b) Adjusting the Voltage Regulator (P23 Series Radiophones only)

A Voltage Regulator, model CNLN6335A is incorporated in P23 Series Radiophones. This device is adjusted for proper operation and sealed at the factory. In the event that the radiophone has been abused or tampered with, or as a test for proper operation, check the adjustment as follows:

(i) To gain access to the voltage regulator, disassemble the radiophone as described under DISASSEMBLY PROCEDURE, following.

(ii) Install new dry cell batteries or fully charged nickel-cadmium battery in the power supply. The battery voltage should read approximately 16.8 volts.

(iii) Refer to the transmitter printed circuit board detail and locate test point M7 (violet). Connect a dc multimeter between test point M7 and ground.

(iv) Key the transmitter and check the voltage reading. The voltage should not exceed -15.0 volts dc. If the voltage reading exceeds -15.0 volts or is less than -14.0 volts, the regulator should be readjusted.

(v) To adjust the regulator, disconnect the battery(s) and connect an adjustable dc power supply (Motorola T1012A or TEK-23) to terminals 1 and 9 of the radiophone connector, P803.

(vi) Key the transmitter and set the power supply output voltage to -15.0 volts dc. Connect dc multimeter between test point M7 and the negative side of the power supply.

(vii) Turn voltage regulator potentiometer, R402, fully clockwise. Key the transmitter and slowly turn the potentiometer counterclockwise until the reading on the dc multimeter increases by 0.25 volt.

(viii) Set the power supply output voltage to -14.0 volts dc with the transmitter keyed. Connect the dc multimeter between test point M7 and ground, and note the voltage. If the voltage reading is less than -13.5 volts dc with the transmitter keyed, recheck the regulator potentiometer setting.

(ix) Increase the power supply output voltage to 16.8 volts. With the dc multimeter connected between test point M7 and ground, the reading should not exceed -15.0 volts with the transmitter keyed.

(x) Seal the regulator potentiometer shaft with glyptal (or equivalent) and reassemble the voltage regulator to the radiophone.

c) Check Overall Transmitter Operation

If the battery voltage is sufficient, and the voltage regulator is functioning properly (P23 Series only), check the overall performance of the transmitter. A good overall check of the transmitter is the RF power output measurement. This one check indicates the proper operation of all the transmitter stages (oscillator, frequency multipliers, drivers and final amplifier) with the exception of the modulator and audio circuitry. A P33 Series radiophone transmitter, when properly tuned and operating at 13.5 volts dc, will produce 3.0 watts RF output into a 50 ohm load. A P23 Series radiophone transmitter, when properly tuned and operating at 14.0 volts dc, will produce 1.4 watts RF output into a 50 ohm load. It may be necessary to retune the output circuits slightly to match the 50 ohm load. This measurement should be made using a 50 ohm wattmeter connected to one end of the 50 ohm test cable with the other end connected to the antenna receptacle.

For further details, refer to the Transmitter Alignment Procedure. If the power output is less than indicated in the chart, further checking is required. Refer to TRANSMITTER SERVICING.

d) Check Overall Receiver Operation

(i) 20 DB Quieting Sensitivity Check

A good overall check of the receiver operation is the 20 db quieting sensitivity measurement. This check will indicate that the receiver has sufficient gain and that all the included circuitry is working properly. The quieting signal is that RF signal input necessary to reduce the audio output at the speaker by 20 decibels. The measurement should be made in the absence of extraneous signals. Since the receiver squelch circuitry reduces the noise at the speaker, the SQUELCH control should be set for maximum noise while making this measurement.

The actual measurement is made by observing the noise voltage at the microphone connector on an ac voltmeter with no RF signal received at the antenna.

NOTE

On handset models not incorporating a speaker, a 120 ohm resistor must be connected across the ac voltmeter terminals.

Sufficient carrier signal from a recommended signal generator is then introduced via the antenna receptacle to reduce the noise output voltage to 1/10 of the previous reading. If all circuitry is operating properly, the quieting signal should be 0.5 microvolt or less. Refer to the Receiver Alignment Procedure.

(ii) Squelch Check

With no RF input signal, set the SQUELCH control until the speaker noise just cuts out (threshold squelch). Sufficient carrier signal from a recommended signal generator is then introduced until speaker noise is just heard. The signal level at which the squelch begins to open should be less than one-half the 20 db quieting sensitivity voltage measured in subparagraph (i).

(iii) Audio Check

The last check to be made is the audio check. This procedure will test the audio circuits exclusive of the squelch circuitry. Refer to the AUDIO AMPLIFIER MEASUREMENTS CHART, which appears later in this manual, for typical measurements and procedures.

2) DISASSEMBLY PROCEDURE (Refer to Disassembly Photographs)

To gain access to the transmitter and receiver printed circuit boards, proceed as follows:

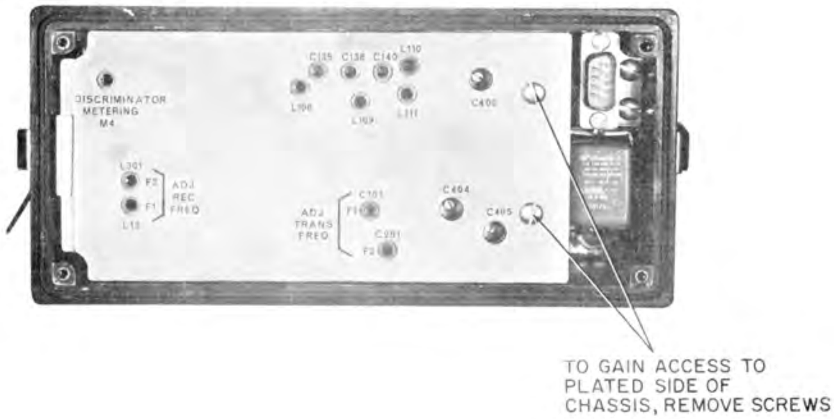
a) Remove the battery compartment as described in the BATTERY REPLACEMENT PROCEDURE.

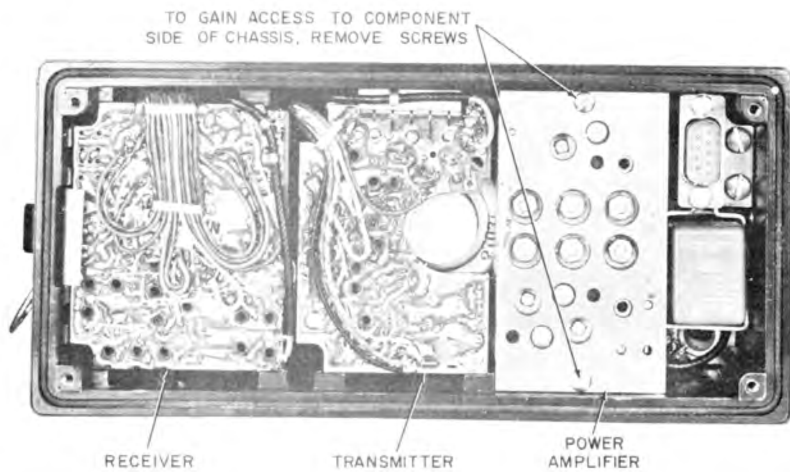
b) Turn the radiophone upside down and loosen the two captive cover screws.

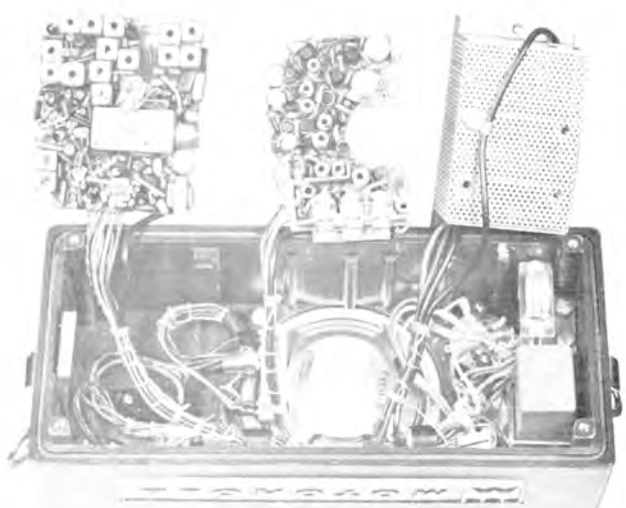
c) Lift the radio compartment cover up.

d) The transmitter and receiver printed circuit boards are now accessible. They may be lifted up and out for access to the component side.

e) Access to the power amplifier (P33 Series only) or voltage regulator (P23 Series only) is accomplished by loosening two additional mounting screws.


DISCRIMINATOR METERING M4
C135 C138 C140 L110
L106 L109 L111
C400
L301 F2 F1 L13 ADJ REC FREQ
ADJ TRANS FREQ C101 F1 C201 F2
C404
C405
TO GAIN ACCESS TO PLATED SIDE OF CHASSIS, REMOVE SCREWS


TO GAIN ACCESS TO COMPONENT SIDE OF CHASSIS, REMOVE SCREWS
RECEIVER
TRANSMITTER
POWER AMPLIFIER



RECEIVER SERVICING

The information contained in the following paragraphs will aid the serviceman in localizing the trouble to a particular stage.

1) TEST POINTS

The test points on the printed circuitry are color coded for easy location. The locations of these test points may be seen on the Alignment Procedure, the schematic diagram, and the printed circuit board detail in this manual.

2) STAGE MEASUREMENTS CHARTS

In addition to the 20 db quieting sensitivity measurement, all stage gain measurements can be checked against those shown in the following RF AND IF STAGE MEASUREMENTS CHART and AUDIO AMPLIFIER MEASUREMENTS CHART.

RECEIVER RF AND IF STAGE MEASUREMENTS CHART

NOTES

1. Output readings taken with a Motorola transistorized ac voltmeter, or equivalent.
2. The carrier frequency is injected at the antenna receptacle using an adapter cable coupled to a Motorola Model T1034C Signal Generator, or equivalent.
3. The 1st IF signal is injected at the points indicated in the chart using a 50 ohm coaxial cable and a series connected 0.02 uf capacitor.
4. All readings taken with -14.0 volts dc input.

FREQUENCY	UV INPUT	PROCEDURE	OUTPUT AT	READING (NOTE 1)
-	Noise	-	Base of Q8 (M1)	-58 dbm (0.001 V)
-	Noise	-	Base of Q10 (M2)	-12 dbm (0.19 V)
-	Noise	-	Base of Q11 (M3)	-10 dbm (0.245 V)
-	Noise	- (Short collector of Q1 to collector coil ground with 100 uuf capacitor)	Base of Q8 (M1)	-62 dbm (0.0006 V)
-	Noise	- (Short collector of Q2 to collector coil ground with 0.02 uf capacitor)	Base of Q8 (M1)	-72 dbm (0.0002 V)
Carrier	6	Connect input to external antenna connector	Base of Q8 (M1)	-29 dbm (0.028 V)
Carrier	6	Connect input to external antenna connector	Input to second section of 455 kc filter	-20 dbm (0.077 V)
Carrier	100	Connect input to external antenna connector	Output of 1st section of 455 kc filter	-42 dbm (0.0062 V)
1st IF	6	Connect input to 1st IF-1 (top of L6)	Base of Q8 (M1)	-29 dbm (0.028V)
1st IF	1000	Connect input to 1st IF-5 (top of T2 primary)	Base of Q8 (M1)	-33 dbm (0.017 V)

AUDIO AMPLIFIER MEASUREMENTS CHART

NOTES

1. Remove the GRN-RED lead from test point M4.
2. Connect an audio oscillator capable of generating 1000 cps, to this GRN-RED lead with a 47K ohm resistor in series.
3. Set the frequency and voltage according to the chart below. The input voltage is measured at the junction of the 47K ohm resistor and GRN-RED lead.
4. The output readings are referenced to ground unless otherwise indicated and are taken with a Motorola transistorized ac voltmeter, or equivalent.
5. All measurements made with -14.0 volts dc input.

<table>
<tr><th>FREQUENCY</th><th>VOLTS INPUT</th><th>INPUT TO</th><th>OUTPUT AT</th><th>READING</th><th>REMARKS</th></tr>
<tr><td rowspan="8">1000 cps</td><td rowspan="8">0.02
(-32 dbm)</td><td rowspan="8">GRN-RED lead (top of volume control)</td><td>Base of Q13</td><td>-41 dbm
(0.007 V)</td><td rowspan="3">Volume control set at maximum.</td></tr>
<tr><td>Collector of Q13</td><td>-9 dbm
(0.28 V)</td></tr>
<tr><td>Base of Q14</td><td>-21 dbm
(0.07 V)</td></tr>
<tr><td>Collector of Q14</td><td>+17 dbm
(5.6 V)</td><td rowspan="2">Volume control set at maximum. Spkr-mic & Spkr-handset models only.</td></tr>
<tr><td>Bases of Q15 and Q16</td><td>+17 dbm
(5.6 V)</td></tr>
<tr><td>Emitters of Q15 and Q16</td><td>+16 dbm
(5.0 V)</td><td>Spkr-mic & Spkr-handset models only.</td></tr>
<tr><td>Collector of Q14</td><td>+10 dbm
(2.4 V)</td><td rowspan="2">Handset models only. Volume control set at maximum. A 120 ohm resistor connected from pin 4 to pin 1 of the MIC receptacle.</td></tr>
<tr><td>Secondary of transformer (T3)</td><td>-2 dbm
(0.6 V)</td></tr>
</table>

NOTE

To aid circuit tracing, the components side of the circuit board is screened in the pattern of the etched circuitry. This paint does not conduct and has no electrical function.

TRANSMITTER SERVICING

The following information will aid the serviceman in troubleshooting the radiophone transmitter.

CAUTION

Do not key transmitter unless antenna, dummy load or equivalent is connected to the antenna receptacle.

1) METERING POINTS

The test points on the printed circuit board are supplied for ease in checking. These points are indicated on the schematic diagram, printed circuit board detail, and the photograph on the Alignment Procedure. The chart on the Alignment Procedure provides nominal voltage readings corresponding to these test points for a fully tuned transmitter with -14 volts dc input.

2) DC VOLTAGE MEASUREMENTS

If the RF power output is lower than normal for a fully tuned transmitter, the dc voltages on the printed circuit board should be checked. These voltages should all be referenced to ground.

CAUTION

When checking a transistor, either in or out of the circuit, do not use an ohmmeter having more than 1.5 volts dc appearing across the test leads.

The transistor is a dependable component and is not subject to replacement as frequently as tubes. Therefore, the serviceman is cautioned not to replace transistors before a thorough check is made. The transistor terminal voltages should be checked first. If these voltages are not reasonably close to those specified, the associated components should be checked. A low impedance meter should not be used for measurement. If all dc voltages are correct, the signal should be traced through the circuit to show any possibility of breaks in the signal path.

3) RF SIGNAL TRACING

An RF probe attachment for a dc multimeter may be used to good advantage in checking the radiophone transmitter. The presence of RF can be checked throughout the RF circuitry for continuity of signal path. This would include the oscillator, modulator, frequency multipliers, and the driver and final amplifier. Following the heavy signal flow line through the RF stages, as indicated on the schematic diagram, is recommended.

4) FREQUENCY MULTIPLIERS

Transistor frequency multipliers, or class B amplifiers in general, do not require forward biasing. Without signal drive, a zero-biased, class B frequency multiplier stage will not draw any emitter current. With drive present, the transistor will draw current and this current is monitored best by measuring the dc voltage developed across the emitter resistor. In the transmitter, these checks are made using test points M1, M2 and M3. The 1st tripler stage, Q103, operates at a very low signal level, therefore, a small amount of forward bias is supplied to increase the gain of this stage.

5) DRIVER, IPA AND FINAL AMPLIFIERS

The intermediate power amplifier (IPA) stage, Q107, has a metering point M4, which is used as an RF metering point to indicate the presence of RF voltage at the base of the transistor. When tuning up the driver, the intermediate power amplifiers and the final amplifiers, it may be necessary to retune previously tuned circuits. This includes coils L107, L108, L109, L110 and capacitors C135, C138, (all models), C402, C404 and C405 (P33 Series only). All these components interact to some extent. By using care in tuning these stages, rated power output will be obtained with minimum current drain.

6) AUDIO CIRCUITS

If the transmitter does not modulate properly, the audio circuits should be checked to make sure that the audio modulating voltage is reaching the modulator. External audio test signals can be coupled into the amplifier-clipper stage, Q111, through a 0.1 microfarad capacitor. In this manner, the audio circuitry can be signal traced.

7) ALIGNMENT NOTES

If any element in a tunable stage is replaced or repaired, the associated stage should be aligned along with the stage that precedes and follows it. Refer to the Alignment Procedure sheet when a crystal is replaced or a new carrier frequency is required.

8) I.D.C. CONTROL ADJUSTMENT

a) GENERAL

It is very important that the I.D.C. control be accurately set for the correct carrier deviation determined by channel spacing requirements, e.g., ±5 kc for 30 kc channel spacing. This will ensure optimum system performance since over-deviation could cause interference on an adjacent channel and under-deviation may reduce system efficiency.

b) TEST PROCEDURE

The Motorola model T-1130A/F4MU-24B Series Frequency Monitor offers the high degree of accuracy required for measurement of transmitter deviation. A characteristic of the instrument, however, is that the meter scale is calibrated in peak voltage based on a sine wave input signal. When the input waveform departs from a pure sine wave, the meter reading does not indicate the actual energy level of the signal.

For absolutely accurate I.D.C. control adjustment, a suitable oscilloscope should be used in conjunction with the Frequency Monitor. In this manner the peak value of any waveform can be set visually since the oscilloscope responds instantaneously to input signals. Proceed as follows:

i) Connect the oscilloscope to the frequency monitor oscilloscope terminals and set up the instruments in accordance with the frequency monitor instruction manual.

ii) Turn the I.D.C. control on the transmitter module fully clockwise.

iii) Key the transmitter as required by connecting a jumper between pins 1 and 3 of the microphone connector.

iv) Feed a 1000 cps test tone signal into pin 2 of the microphone connector (base of the amplifier-clipper stage in the I.D.C. circuit). A 0.33 uf capacitor should be connected in series with the tone generator output. Refer to the METERING AND ALIGNMENT POINTS detail on the Transmitter Alignment sheet for the location of the 1000 cps test tone injection point. An audio oscillator must be used for generation of this tone since a sinusoidal waveform is very important. The Motorola TEK-1A Transistorized Tone Generator is recommended. Modulate the transmitter with this tone such that the deviation as read on the FM monitor deviation meter is 2 kc (split channel) or 6 kc (wide channel).

v) Adjust the vertical gain of the oscilloscope so that the total pattern occupies a convenient height, e.g., 4 divisions (split channel) or 12 divisions (wide channel). The oscilloscope is now calibrated. Adjust transmitter deviation as follows:

  a) Increase the 1000 cps test tone signal to 1.5 volts rms. This will drive the I.D.C. circuit into full clip.

  b) With this input signal level, adjust the I.D.C. control on the transmitter to provide a 10 division peak-to-peak signal on the oscilloscope for ±5 kc deviation or 30 divisions for ±15 kc deviation.

  c) Reduce the 1000 cps input level to 0.3 volt rms. The oscilloscope should now indicate approximately 2/3 full-rated deviation. Less than 2/3 full-rated deviation indicates lack of audio gain.

NOTE

The waveform should be symmetrical for this test. If the waveform is not symmetrical, adjust coil L101 for minimum distortion. Readjust the I.D.C. control.

c) ALTERNATE MEANS OF MEASURING DEVIATION

Another accurate means of measuring transmitter deviation is to use the Motorola T1020A Portable Frequency and Deviation Meter or the Motorola S1062A Deviation Meter (installed in S1058A and S1059A Motorola Portable Test Sets or available separately for installation in TU546, S1056A or S1057A Portable Test Sets). These units permit accurate measurement and setting of transmitter deviation from a peak-reading meter, which is unaffected by waveform. An oscilloscope is not required with these instruments.

END OF DOCUMENT