MOTOROLA INC. COMMUNICATIONS DIVISION • **INSTRUCTION MANUAL**

APPLIES TO P21DDN AND P31DDN RADIOS

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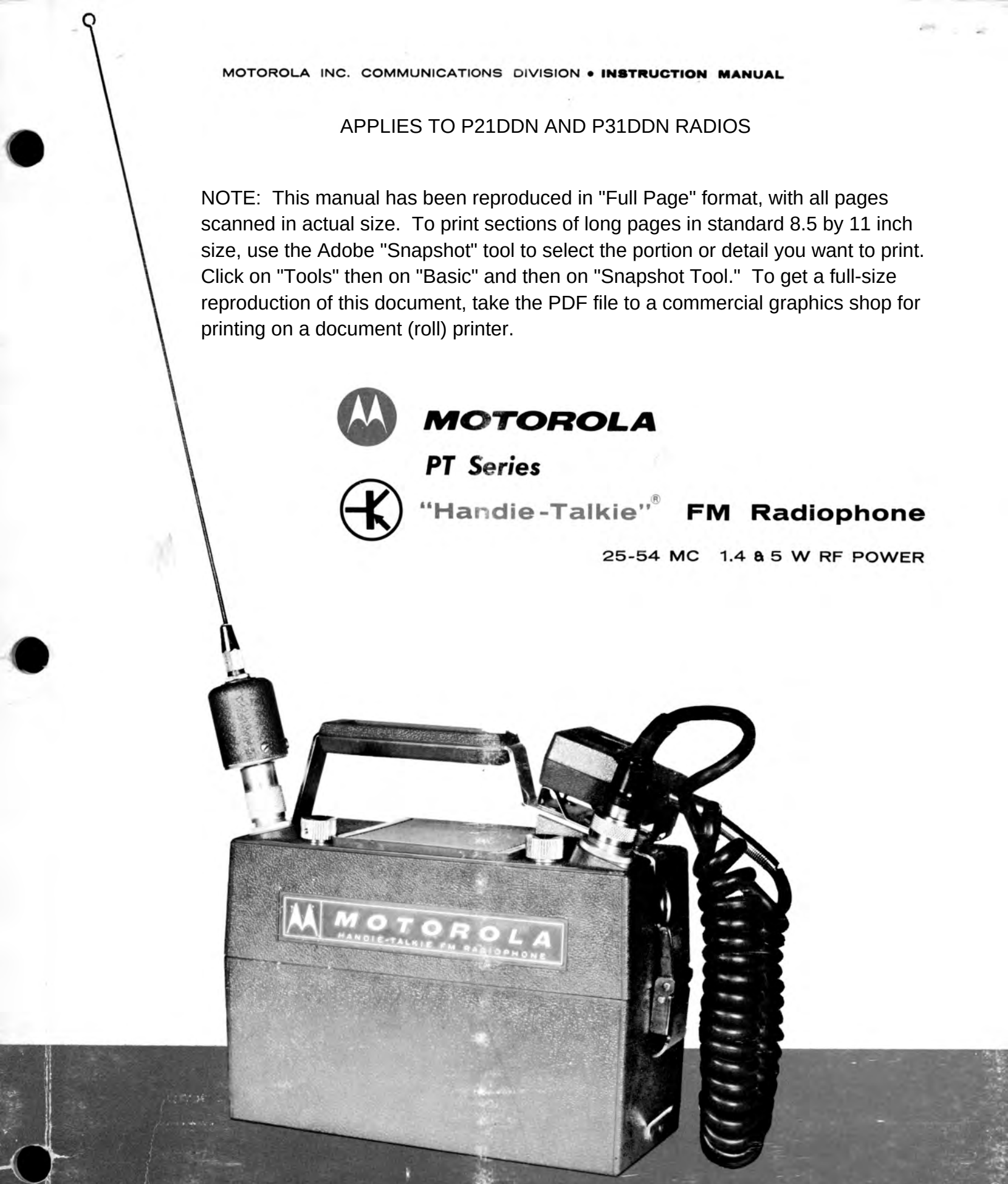
MOTOROLA

PT Series

"Handie-Talkie"® FM Radiophone

25-54 MC 1.4 & 5 W RF POWER



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MOTOROLA

HANDIE-TALKIE

FM RADIOPHONE

1.4 & 5.0 W RF POWER

25-54 MC

PORTABLE TRANSISTORIZED

Model P31DDC-1030AM

MOTOROLA INC. **Communications Division**

ENGINEERING PUBLICATIONS 4501 WEST AUGUSTA BOULEVARD CHICAGO, ILLINOIS 60651

Printed in U. S. A.
9/23/66-AP

68P81032A45
Issue - C

CONTENTS

GUARANTEED PERFORMANCE SPECIFICATIONS

GENERAL

MODELS		P31DDN-1000 Series	P31DDN-3000 Series	P21DDN-1000 Series	P21DDN-3000 Series
POWER SUPPLY		Eleven #1050 Industrial "D" cells or one 14.0 v nickel-cadmium battery.			
BATTERY DRAIN	Standby	4 ma at 14.0 v	10 ma at 14.0 v	4 ma at 14.0 v	10 ma at 14.0 v
	Receive	55 ma at 14.0 v	62 ma at 14.0 v	55 ma at 14.0 v (12 ma**)	62 ma at 14.0 v (19 ma**)
	Transmit	900 ma at 13.5 v	900 ma at 13.5 v	410 ma at 14.0 v	415 ma at 14.0 v
DIMENSIONS (excluding antenna) (with dry cell batteries)	Speaker-microphone	9" x 7-3/4" x 3-3/4"			
	Speaker-Handset	9" x 8-3/4" x 3-3/4"			
	Handset	9" x 8-3/4" x 3-3/4"			
DIMENSIONS (excluding antenna) (with nickel-cadmium batteries)	Speaker-microphone	9" x 6-3/8" x 3-3/4"			
	Speaker-Handset	9" x 7-3/8" x 3-3/4"			
	Handset	9" x 7-3/8" x 3-3/4"			
WEIGHT* (with dry cell batteries)	Speaker-microphone	7# 14 oz.	8#	7# 7 oz.	7# 9 oz.
	Speaker-Handset	8# 7 oz.	8# 9 oz.	7# 15 oz.	8# 1 oz.
	Handset	8# 4 oz.	8# 6 oz.	7# 12 oz.	7# 14 oz.
WEIGHT* (with nickel-cadmium batteries)	Speaker-microphone	6# 8 oz.	6# 10 oz.	6# 1 oz.	6# 3 oz.
	Speaker-Handset	7#	7# 2 oz.	6# 9 oz.	6# 11 oz.
	Handset	6# 13 oz.	6# 15 oz.	6# 6 oz.	6# 8 oz.

TRANSMITTER

CHASSIS MODEL	NTB6060 Series with NLB6120 Series Power Amplifier	NTB6050 Series
RF OUTPUT	5.0 w at nominal battery voltage (13.5 v)	1.4 w at nominal battery voltage (14.0 v)
FREQUENCY STABILITY	NTB6060 Series ±.002% from -30°C to +60°C (+25°C reference)	NTB6050 Series ±.0025% from -30°C to +60°C (+25°C reference)
MODULATION	16F3: ±5 kc for 100% at 1000 cps; or 36F3: ±15 kc for 100% at 1000 cps	
CRYSTAL MULTIPLICATION	16 times	
SPURIOUS AND HARMONICS	more than 52 db below carrier	more than 45 db below carrier
FM NOISE	At least 35 db below ±3.3 kc deviation at 1000 cps, or at least 40 db below ±10 kc 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 maximum deviation	

RECEIVER

MODULATION ACCEPTANCE*	±5 kc (split channel models) or ±15 kc (wide band models)			
SENSITIVITY	Less than 0.35 microvolt for 20 db quieting			
SPURIOUS AND IMAGE REJECTION	More than 70 db below carrier			
NOISE SQUELCH SENSITIVITY	Noise compensated type: adjustable sensitivity, will open at less than 0.18 microvolt			
TONE CODED SQUELCH SENSITIVITY		Fixed sensitivity will open at less than 0.18 microvolt		Fixed sensitivity will open at less than 0.18 microvolt
AUDIO OUTPUT	500 milliwatts to speaker or 3 milliwatts to handset at less than 10% distortion			
FREQUENCY STABILITY	±0.0025% from -30°C to +60°C (+25°C reference)			
SELECTIVITY	More than 60 db at ±20 kc or ±40 kc measured by the 20 db quieting method			
CHANNEL SPACING*	20 kc (±5 kc Bandwidth) 40 kc (±15 kc Bandwidth)			

*Tone-coded squelch available in split-channel models only
**Applies to handset models without loudspeaker

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

FCC LICENSE DESIGNATION: P31 Series CC1505
P21 Series CC1504B

MOTOROLA

MODEL CHART

FM "HANDIE-TALKIE" RADIOPHONES

25-54 MC 1.4 & 5.0 W RF POWER

LEGEND

- [X] = ONE ITEM INCLUDED
- ◪ = ONE ITEM INCLUDED WITH EVERY 5 (OR LESS) RADIO SETS
- ◪ = ONE ALTERNATE ITEM INCLUDED. CHOICE DEPENDENT UPON FREQUENCY
- [2] = TWO ITEMS INCLUDED
- [1] = ONE ALTERNATE ITEM INCLUDED (FACTORY OPTION)

*REPRESENTS A SERIES OF MODELS AND NOT A SPECIFIC MODEL. THE SPECIFIC MODEL, AS STAMPED ON THE CHASSIS, IS DETERMINED BY ITS APPLICATION.

ITEM	DESCRIPTION	REFERENCE DIAGRAM
*NRB1120AA	RECEIVER (1-FREQ) WIDE CHANNEL; CARRIER SQUELCH	63E81017A21
*NRB1120AB	RECEIVER (1-FREQ) SPLIT CHANNEL; CARRIER SQUELCH	63E81017A21
*NRB1120AC	RECEIVER (2-FREQ) WIDE CHANNEL; CARRIER SQUELCH	63E81017A21
*NRB1120AD	RECEIVER (2-FREQ) SPLIT CHANNEL; CARRIER SQUELCH	63E81017A21
*NRB1120AE	RECEIVER (1-FREQ) SPLIT CHANNEL; DUAL SQUELCH	63E81017A22
*NRB1120AH	RECEIVER (2-FREQ) SPLIT CHANNEL; DUAL SQUELCH	63E81017A22
*NTB6050AA	TRANSMITTER (1-FREQ) CARRIER SQUELCH	63E81017A21
*NTB6050AB	TRANSMITTER (2-FREQ) CARRIER SQUELCH	63E81017A21
*NTB6050AC	TRANSMITTER (1-FREQ) "PRIVATE-LINE" MODEL	63E81017A22
*NTB6050AD	TRANSMITTER (2-FREQ) "PRIVATE-LINE" MODEL	63E81017A22
*NTB6060AA	TRANSMITTER (1-FREQ) CARRIER SQUELCH	63E81017A21
*NTB6060AB	TRANSMITTER (2-FREQ) CARRIER SQUELCH	63E81017A21
*NTB6060AC	TRANSMITTER (1-FREQ) "PRIVATE-LINE" MODEL	63E81017A22
*NTB6060AD	TRANSMITTER (2-FREQ) "PRIVATE-LINE" MODEL	63E81017A22
NLN6141A	"PRIVATE-LINE" SQUELCH BOARD (25-42 MC)	63E81017A22
NLB6142A	"PRIVATE-LINE" SQUELCH BOARD (42-54 MC)	63E81017A22
NLB6120A	HI POWER FINAL AMPLIFIER	63E81017A21 & 22
NCN6039A	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6040A	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6040B	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6041A	CONTROL PANEL, 2-FREQ. XMIT, 1-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6042A	CONTROL PANEL, 2-FREQ. XMIT, 1-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6043A	CONTROL PANEL, 2-FREQ. XMIT, 2-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6043B	CONTROL PANEL, 2-FREQ. XMIT, 2-FREQ. RECEIVE CARRIER SQUELCH	
NCN6044A	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6044B	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE CARRIER SQUELCH	
NCN6045A	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6046A	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6047A	CONTROL PANEL, 2-FREQ. XMIT, 1-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6048A	CONTROL PANEL, 2-FREQ. XMIT, 1-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6049A	CONTROL PANEL, 2-FREQ. XMIT, 2-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6050A	CONTROL PANEL, 2-FREQ. XMIT, 2-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6051A	CONTROL PANEL, 2-FREQ. XMIT, 2-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6052A	CONTROL PANEL, 2-FREQ. XMIT, 1-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6053A	CONTROL PANEL, 2-FREQ. XMIT, 1-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6054A	CONTROL PANEL, 2-FREQ. XMIT, 2-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6054B	CONTROL PANEL, 2-FREQ. XMIT, 2-FREQ. RECEIVE CARRIER SQUELCH	
NCN6055A	CONTROL PANEL, 2-FREQ. XMIT, 2-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6039B	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6057A	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6058A	CONTROL PANEL, 2-FREQ. XMIT, 1-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6059A	CONTROL PANEL, 2-FREQ. XMIT, 1-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6060A	CONTROL PANEL, 2-FREQ. XMIT, 2-FREQ. RECEIVE CARRIER SQUELCH	63E81017A21
NCN6061A	CONTROL PANEL, 2-FREQ. XMIT, 2-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6065A	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NCN6065B	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE DUAL SQUELCH	63E81017A22
NLN6129A	CARRYING STRAP	
NLN6306A	UNIT HARDWARE KIT	
NLN6307A	UNIT HARDWARE KIT	
NLN6252A	TUNING TOOLS	
NMN6017A	HANDSET	
NMN6018A	MICROPHONE	
YM45	RECEIVER CONTROL CRYSTAL	
YM46	RECEIVER CONTROL CRYSTAL	
YN	RECEIVER IF CRYSTAL	
AB-2	TRANSMITTER CRYSTAL	
ABX-2	TRANSMITTER CRYSTAL	
TLN6492AA	"VIBRASENDER-SPONDER" UNIT	
NAB6141A	ANTENNA	
NAB6142A	ANTENNA	
NAB6143A	ANTENNA	
NAB6144A	ANTENNA	
NAB6145A	ANTENNA	
NLN6241A	"PRIVATE-LINE" HARDWARE KIT	
NLD6315A	BOTTOM PLATE KIT	
NCN6056A	CONTROL PANEL, 1-FREQ. XMIT, 1-FREQ. RECEIVE CARRIER SQUELCH	
NLN6496	KNOB KIT	

MODEL NUMBER	XMTR FREQ.	RCVR FREQ.	CHANNEL SPACING	TYPES OF SQUELCH
1.4 W RF OUTPUT SPEAKER-MICROPHONE MODELS				
P21DDN-1000AM	1	1	40 KC	CARRIER SQUELCH
P21DDN-1010AM	2	1	40 KC	CARRIER SQUELCH
P21DDN-1030AM	2	2	40 KC	CARRIER SQUELCH
P21DDN-1100AM	1	1	20 KC	CARRIER SQUELCH
P21DDN-1110AM	2	1	20 KC	CARRIER SQUELCH
P21DDN-1130AM	2	2	20 KC	CARRIER SQUELCH
P21DDN-3100AM	1	1	20 KC	DUAL SQUELCH
P21DDN-3110AM	2	1	20 KC	DUAL SQUELCH
P21DDN-3130AM	2	2	20 KC	DUAL SQUELCH
1.4 W RF OUTPUT SPEAKER-HANDSET MODELS				
P21DDN-1000AR	1	1	40 KC	CARRIER SQUELCH
P21DDN-1010AR	2	1	40 KC	CARRIER SQUELCH
P21DDN-1030AR	2	2	40 KC	CARRIER SQUELCH
P21DDN-1100AR	1	1	20 KC	CARRIER SQUELCH
P21DDN-1110AR	2	1	20 KC	CARRIER SQUELCH
P21DDN-1130AR	2	2	20 KC	CARRIER SQUELCH
P21DDN-3100AR	1	1	20 KC	DUAL SQUELCH
P21DDN-3110AR	2	1	20 KC	DUAL SQUELCH
P21DDN-3130AR	2	2	20 KC	DUAL SQUELCH
5.0 W RF OUTPUT SPEAKER-MICROPHONE MODELS				
P31DDN-1000AM	1	1	40 KC	CARRIER SQUELCH
P31DDN-1010AM	2	1	40 KC	CARRIER SQUELCH
P31DDN-1030AM	2	2	40 KC	CARRIER SQUELCH
P31DDN-1100AM	1	1	20 KC	CARRIER SQUELCH
P31DDN-1110AM	2	1	20 KC	CARRIER SQUELCH
P31DDN-1130AM	2	2	20 KC	CARRIER SQUELCH
P31DDN-3100AM	1	1	20 KC	DUAL SQUELCH
P31DDN-3110AM	2	1	20 KC	DUAL SQUELCH
P31DDN-3130AM	2	2	20 KC	DUAL SQUELCH
5.0 W RF OUTPUT SPEAKER-HANDSET MODELS				
P31DDN-1000AR	1	1	40 KC	CARRIER SQUELCH
P31DDN-1010AR	2	1	40 KC	CARRIER SQUELCH
P31DDN-1030AR	2	2	40 KC	CARRIER SQUELCH
P31DDN-1100AR	1	1	20 KC	CARRIER SQUELCH
P31DDN-1110AR	2	1	20 KC	CARRIER SQUELCH
P31DDN-1130AR	2	2	20 KC	CARRIER SQUELCH
P31DDN-3100AR	1	1	20 KC	DUAL SQUELCH
P31DDN-3110AR	2	1	20 KC	DUAL SQUELCH
P31DDN-3130AR	2	2	20 KC	DUAL SQUELCH

DESCRIPTION AND OPERATION

1. DESCRIPTION

The Motorola "Handie-Talkie" FM radiophone is a completely transistorized and weatherproof portable communications radio set. The radiophones are complete, self-powered, portable FM transmitter and receiver units for two-way communication. The advantages of the transistor -- reliability, lightweight, compact size, reduced maintenance and operating costs -- are fully utilized.

Motorola dual squelch "Private-Line" radios are especially useful when operating under crowded channel conditions. Several networks may share the same carrier frequency in the same area with a minimum of interference when each network uses a different "Private-Line" tone frequency.

Dual squelch "Private-Line" radios and carrier squelch radios are available in two series of models. The lighter weight P21 series for maximum portability and the P31 series where higher r-f power output is required. The P21 series units deliver 1.4 watts of r-f power at nominal battery voltage throughout the 25-54 mc band and weigh as little as 6 lbs. 1 oz. The P31 series units deliver 5 watts of r-f power output and weigh as little as 6 lbs. 8 oz. Both series of radiophones are available in one or two frequency models. Refer to the Model Chart in the front of this manual for a complete listing of the models available.

a. Power Supplies

Three power supplies are available for use with the radios described in this manual. They are not included as part of the radio set model, but are selected when ordering the "Handie-Talkie" unit. These power supplies can be used with both P21 and P31 Series radios and are as follows:

(1) NPN1007A Nickel-Cadmium Power Supply.

(2) NPN1008A Standard Dry Battery Power Supply.

(3) NPN1009A Standard Dry Battery Power Supply. (Used with NLN6135A Shockmount Rack).

Refer to the BATTERY REPLACEMENT AND CHARGING section of this manual for further information on these power supplies.

In addition to the above battery power units, a Model NPN6032A 117-volt ac power supply is available as an accessory item. (See accessory table.)

Power packs are changed by unsnapping two spring snaps located at the ends of the unit and separating the power pack from the radio section. Another power pack (dry battery, nickel-cadmium, or the 117-volt a-c power supply) can then be attached to the radio section to again form an integral package.

b. Antennas

The NAB6040A Series Antenna consists of a stainless steel whip 42" long and a removable loading coil. The loading coil consists of a series resonant tunable inductance. The combination of whip and loading coil produces a 1/4 wavelength antenna tunable within a given band of 25-54 mc range. Refer to the Model Chart for the specific frequency ranges of the antennas.

NOTE

The Motorola "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 to the transmitter frequency can be used. The higher the antenna, the greater the area that can be covered.

c. Handset

The NMN6017A Handset is supplied complete with a rubber covered coiled cord, which extends to about 5 ft., and a weatherproof connector. A push-to-talk bar on the handset turns the transmitter on. The handset connector plugs into a four-prong receptacle on top of the unit housing.

d. Microphone

The NMN6018A Microphone is supplied with a rubber covered coiled cord, which can be extended to about 5 ft., and a weatherproof connector. This palm type microphone is provided with

a push-to-talk button which turns on the transmitter. The microphone connector plugs into a four-prong receptacle located on top of the unit housing.

e. Brackets

Brackets at both ends of the "Handie-Talkie" FM radiophone are used for fastening the NLN6311A or NLN6312A Back Pack Harness to the unit for back pack operation. One set of mounting brackets is located near the top of the unit for fastening the shoulder straps of the harness. Another set is located near the bottom of the battery compartment for fastening the waist strap. Refer to the instructions packed with the back harness for installation of the harness on the radiophone.

2. PRE-OPERATIONAL NOTES

Use care when unpacking and handling the "Handie-Talkie" FM 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.

IMPORTANT

This equipment contains batteries. Extended storage of the equipment will reduce the operating performance due to reduction in battery voltage and life. Partially used dry batteries, if left standing for long periods, will leak electrolyte and may result in damage to the radio equipment. If equipment is to be stored for a long period of time, remove the batteries and store them in a cool place.

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

3. OPERATION

CAUTION

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

a. To Turn On

Remove the microphone or handset from the mounting bracket. The ON-OFF switch is located under 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 a-c power supplies, turn on and off with the ON-OFF switch on the radiophone housing. To turn on the a-c power supply always use the ON-OFF switch on the power supply housing.

b. To Adjust Receiver Audio Volume

Turn the squelch control fully counterclockwise. On dual squelch models, turn the "PL" OFF switch to the OFF position. Adjust the volume control until the desired volume is obtained from the speaker.

c. To Adjust Squelch Control

Turn the squelch control fully counterclockwise. On dual squelch models, turn the "PL" OFF switch to the OFF position. With no signal being received, turn the squelch control clockwise until the noise just cuts out (squelches).

d. "Private-Line" Operation (dual squelch models only)

For "Private-Line" operation, place the "PL" OFF switch in the "PL" position. All non-"Private-Line" and incorrectly coded "Private-Line" signals will then be blocked from the speaker. The squelch control is inoperative when the "PL" OFF switch is in the "PL" position and does not require adjustment.

NOTE

Before transmitting, momentarily place the "PL" OFF switch in the OFF position. This enables the operator to check for a clear channel and thus avoid breaking in on the transmission of another on-frequency unit.

e. To Monitor

To monitor all on-frequency transmissions, turn the unit on and adjust the volume and squelch controls to the proper levels. On dual squelch models, the "PL" OFF switch must be OFF. To

monitor only properly coded "Private-Line" transmissions, the "PL" OFF switch must be in the "PL" position.

NOTE

All models feature a semi-automatic ON-OFF switch that automatically turns the radio off when the microphone or handset is replaced in its holder. Continuous monitoring of the receiver in microphone equipped models may be accomplished by placing the microphone in its holder face up. In handset equipped models, continuous monitoring is accomplished by leaving the handset out of its holder. Continuous monitoring of the receiver while the handset is in its holder can be accomplished by replacing the standard ON-OFF switch with the NLN6496A Knob Kit. The knob kit is supplied with all handset models.

f. To Transmit

Hold the mouthpiece 1 to 2 inches from lips. Press the push-to-talk button in firmly and hold it. Speak slowly and clearly across the mouthpiece in a normal-to-loud voice. Release the button to listen. The receiver becomes inoperative when the push-to-talk button is pressed, therefore, the button must be released at the end of a transmission to receive.

NOTE

Additional range may be obtained when the radiophone is placed on the hood or top of a car. This furnishes a good ground plane for the antenna.

g. Frequency Selection
(Two-Frequency Models Only)

The rotary switch on the top of the unit may be turned to position F1 or F2 to select either of the two operating frequencies.

h. To Turn Off

Replacing the microphone or handset in the mounting bracket automatically turns the receiver off. If the NLN6496A Knob Kit is used with handset models, switch to the OFF position to turn the receiver off before replacing the handset.

i. Storage

Remove the batteries before storing the unit for a long period of time. If the radiophone is equipped with nickel-cadmium batteries, refer to the BATTERY REPLACEMENT AND CHARGING SECTION for care and storage of the batteries.

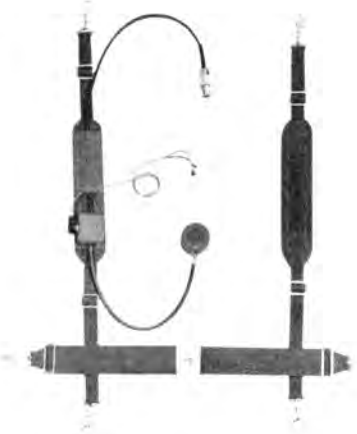
Control Location Detail

ACCESSORY TABLE

MODEL	DESCRIPTION
NPN6032A	117 V AC Power Supply
NLN6268A	Shock Mount Rack
NLN6129A	Carrying Strap
NLN6262A	Carrying Bag
P-7208-A	RF Dummy Load for P21 Series Radiophone
P-7208	RF Dummy Load for P31 Series Radiophone
NLN6145A	Dummy Load Antenna for P21 Series Radiophone
NLN6040A	Dummy Load Antenna for P31 Series Radiophone
NLN6311A	Back Pack Harness complete with microphone, earpiece and volume control
NLN6312A	Back Pack Harness less microphone, earpiece and volume control
NMN6009B	Headset and Microphone
NLN6480A	Nickel-Cadmium Battery Charger (requires NKN6110A or NKN6111A Charging Cable)
NKN6110A	Battery Charging Cable (for NPN6031A Power Supply and NLN6480A Battery Charger)
NKN6111A	Battery Charging Cable (for NPN6267A Battery Kit and NLN6480A Battery Charger)
TEKA-40	Power extension cable for easy repair and/or alignment
NLN6270A	6/12 V DC Vehicular Charging Unit
NKN6074A	6 V DC Vehicular Cable for NLN6270A Charging Unit
NKN6075A	12 V DC Vehicular Cable for NLN6270A Charging Unit
NKN6076A	12 V DC Cigarette Lighter Cable for NLN6270A Charging Unit
NKN6042A	Antenna Extension Cable (20" RG-58 A/U)
NAB6101A	Long Wire Antenna 25-30 mc
NAB6102A	Long Wire Antenna 30-36 mc
NAB6103A	Long Wire Antenna 36-42 mc
NAB6104A	Long Wire Antenna 42-48 mc
NAB6105A	Long Wire Antenna 48-54 mc
NEN6048A	Test Jig for Servicing Radiophone

ACCESSORIES

Carrying Case
Model NLN6262A
Weather Resistant Case



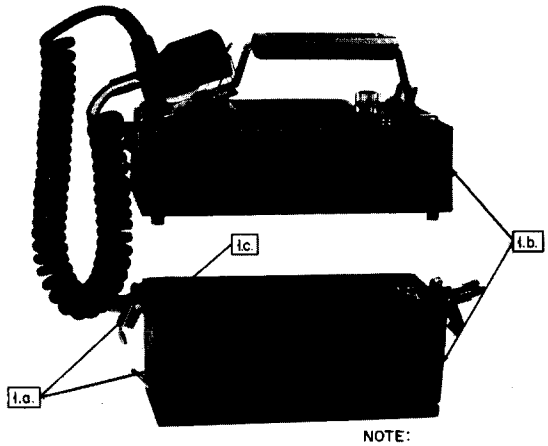
Back Pack Harness
Model NLN6311A
Kit is complete with microphone, earpiece and volume control.
Model NLN6312A
Same as NLN6311A less microphone and earpiece.

Nickel-Cadmium
Battery Charger
Model NLN6480A

Headset and Microphone
Model NMN6009B

BATTERY REPLACEMENT AND CHARGING

1. BATTERY REPLACEMENT PROCEDURE



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

Figure 1.

To replace all types of batteries, dry or nickel-cadmium type: (Refer to Fig. 1)

a. Unsnap the spring snap at each end of the radiophone.

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

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

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

e. To replace nickel-cadmium battery, proceed as follows:

(1) Remove two screws from corners of battery.

(2) Lift battery out of battery compartment.

(3) Remove three-prong plug from battery.

(4) 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 used supply at some later time. Additional power supplies can be purchased as separate accessories for fast changeover.

2. DRY BATTERIES

a. General

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 3-6 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 11 volts.

IMPORTANT

BATTERY VOLTAGES AND CAPACITY DECREASE MARKEDLY DURING LOW TEMPERATURE PERIODS.

b. Fuse Replacement

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

(1) Unsnap the spring snap at each end of the radiophone.

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

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

(4) Remove all batteries.

(5) Remove the screws from the battery separator and lift out.

(6) Unsolder the pigtail fuse from the under side of the battery separator.

(7) Solder a new fuse in place and reassemble.

3. NICKEL-CADMIUM BATTERIES

a. General

The battery comprises 11 hermetically sealed cells which are series connected to provide a nominal 14 volt output. The cells are cased, and fitted with a cable and connector.

The voltage of a nickel-cadmium battery remains approximately constant under load until the battery approaches the discharged condition. At this time, a marked decrease in this voltage occurs and the discharged condition (1.0 v per cell) is reached abruptly. These batteries should be recharged when the voltage under transmit load reaches 11.0 v.

NOTE

Battery voltage can not be measured at charging contacts.

b. Charging

The Motorola battery chargers and cables listed under ACCESSORIES at the front of this manual are recommended for charging these batteries. The use of other chargers will void the battery guarantee and may result in permanent damage to the batteries. Follow the charging instructions which accompany the charger.

c. Storage

The batteries may be stored at room temperature, in any state of charge without damage. These batteries are subject to self discharge however, and should be recharged after extended storage.

4. BATTERY LIFE

Under operating conditions of 10% transmit, 10% receive at rated audio output and 80% receive standby, dry batteries will give approximately the following life.

P21 Series	NPN1007A - Nickel-Cadmium Power Pack (one NLN6267A Battery Kit) -- 16 hours before recharging is necessary.
	NPN1008A, NPN1009A - Standard Power Packs (one NLN6310A Battery Kit) -- Fourteen 8-hour working days, each separated by a 16-hour off period.
P31 Series	NPN1007A - Nickel-Cadmium Power Pack (one NLN6267A Battery Kit) -- 8 hours before recharging is necessary.
	NPN1008A, NPN1009A - Standard Power Packs (one NLN6310A Battery Kit) -- Six 8-hour working days, each separated by a 16-hour off period.

Note that most actual transmit duty cycles are much smaller and approach 2% rather than 10%. Also is many types of operation, the unit is not kept turned on continuously. If this type of service is prevalent, battery life may be extended to many times those mentioned previously.

THEORY OF OPERATION

1. GENERAL

The "Handie-Talkie" radiophone consists of a crystal controlled transmitter and receiver operating in the 25-54 mc frequency range. The transmitter contains an audio section and an r-f section. The audio section consists of an amplifier-limiter and an integrator stage. In P21 series models, the r-f section consists of a crystal-controlled oscillator, a modulator, two frequency doublers, one frequency quadrupler, a driver amplifier, a power amplifier stage and a current limiter stage. In P31 series models, an additional chassis containing a power amplifier is added.

The receiver is a double-conversion, superheterodyne unit consisting of one r-f amplifier,

two oscillators, two mixers, one first i-f amplifier, five second i-f amplifiers, a 455 kc filter, a limiter, discriminator, squelch amplifier, noise rectifier and two audio amplifiers. Speaker versions use a third stage of audio amplification.

Dual squelch "Private-Line" models include additional stages, some of which are shared by both the transmitter and receiver. The common stages are a "Vibrasender-sponder" circuit, tone amplifier circuits and a "Vibrasender-sponder" driver. High and low pass filters are unique to the receiver and a diode modulator is unique to the P21 series transmitter.

2. CIRCUIT THEORY

a. Transmitter

A reluctance microphone produces a low level audio output which is directly coupled to a preamplifier, Q501, which is contained in the microphone housing. The output from this stage is capacitively coupled to the amplifier-clipper stage, Q110.

The amplifier-clipper and the integrator stages are part of the "Instantaneous Deviation Control" (IDC) circuit. Since the transmitter is phase modulated, the frequency deviation is dependent upon both the amplitude and frequency of the audio signal applied to the modulator. The combination of the integrator and the phase modulator has a "flat" response since the pre-emphasis characteristic of the phase modulator is offset by the de-emphasis of the integrator. Therefore, the frequency deviation of the modulator system is only dependent upon the amplitude of the input to the integrator. The amplitude of the audio signal is limited in the amplifier-clipper stage before reaching the integrator, thereby limiting maximum deviation to a fixed value within the desired frequency range. Audio frequencies above 3000 cps are attenuated in the "splatter" filter before reaching the integrator.

Oscillator stage, Q101 (and Q201 in 2-frequency units) is a fundamental, crystal-controlled, anti-resonant oscillator circuit. It generates a radio frequency which is multiplied 16 times in the succeeding stages to produce the desired carrier frequency. A variable capacitor across the crystal permits a fine tuning adjustment (warping) for the proper operating frequency. The oscillator output is coupled to the modulator stage Q102.

RF is applied to the base and collector while audio is applied to the emitter of the modulator transistor. The internal r-f gain of transistor, Q102, is varied by the applied audio voltage. With a fixed phase shift circuit shunting the transistor and a variable phase shift through the transistor, an overall variable phase shift is obtained at the output. The variable inductance in the output of the modulator stage allows matching of the output reactance of the stage to insure minimum distortion and maximum linear deviation. Generally, phase modulators are capable of modulating with low distortion over a small phase angle. This necessitates the addition of frequency multiplier stages which increase the frequency deviation to the desired value.

Transistor frequency multipliers, or class B amplifiers, in general do not require forward biasing. Without signal drive, zero-biased class B frequency multiplier stages will not draw any emitter current. With drive present, the transistor will draw current and this current is easily monitored by measuring the d-c voltage developed across the emitter resistor. An exception to this is the first doubler stage, Q103, where since the signal input level is very low, a small amount of forward bias is supplied to increase the gain of the stage.

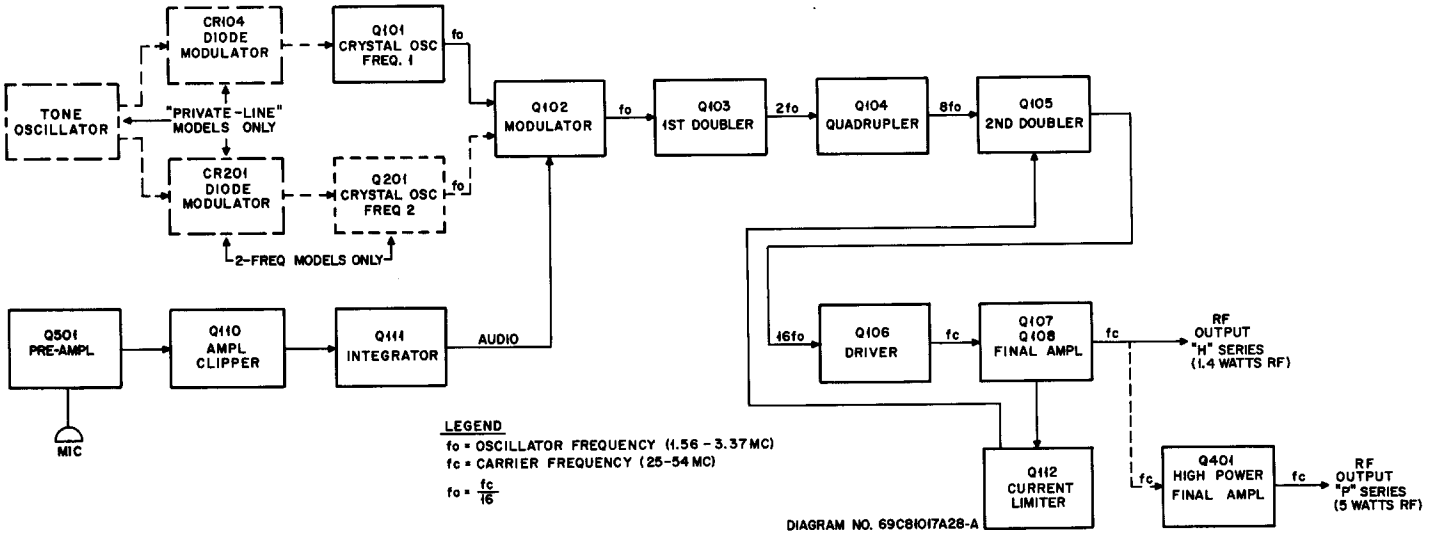
The driver, Q106, provides the proper amount of r-f voltage to drive Q107 and Q108, the power amplifier. In P21 series units, the output power from this stage is coupled directly to the antenna.

In P31 series units, Q107 and Q108 function as an intermediate power amplifier. The output from Q107 and Q108 is coupled to final power amplifier Q401. This higher output is then coupled to the antenna via the transmit-receive relay.

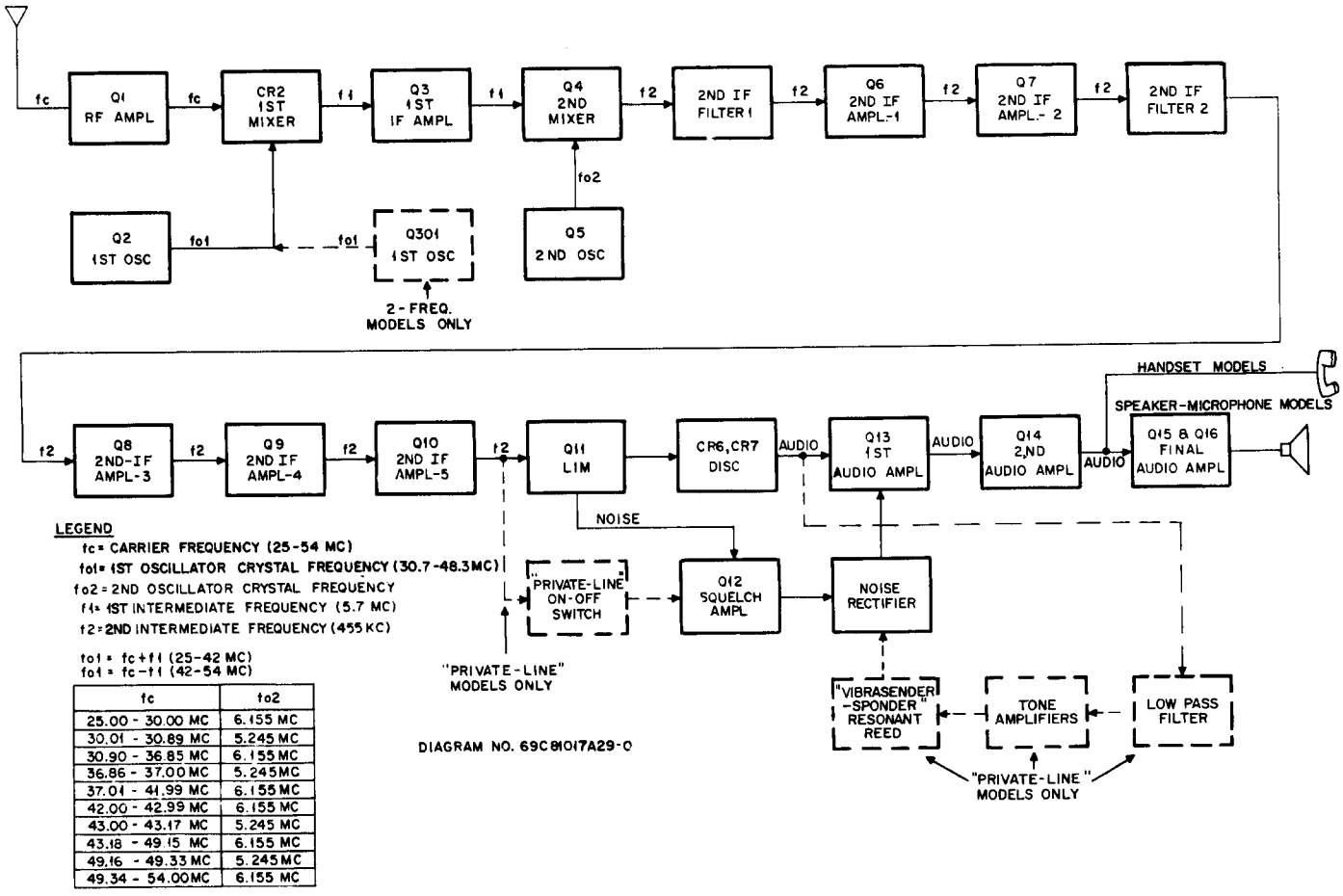
b. Receiver

The signal from the antenna is coupled to the r-f amplifier, Q1, where it is amplified before being injected into the first mixer. The oscillator Q2, is a crystal-controlled, series-resonant type. The crystal frequency is multiplied three times before being injected into the mixer. There, the incoming r-f signal and the oscillator frequency mix to produce the first intermediate frequency.

The first i-f signal is amplified in the next stage, Q3, and fed to the second mixer. The second mixer combines the first i-f signal and the output of the 2nd oscillator to produce the second i-f signal of 455 kc.



Transmitter Block Diagram



fc	fo2
25.00 - 30.00 MC	6.155 MC
30.01 - 30.89 MC	5.245 MC
30.90 - 36.85 MC	6.155 MC
36.86 - 37.00 MC	5.245 MC
37.01 - 41.99 MC	6.155 MC
42.00 - 42.99 MC	6.155 MC
43.00 - 43.17 MC	5.245 MC
43.18 - 49.15 MC	6.155 MC
49.16 - 49.33 MC	5.245 MC
49.34 - 54.00 MC	6.155 MC

Receiver Block Diagram

The 455 kc signal is selected in the first section of the "Permakay" filter, amplified in the two following stages, Q6 and Q7, and selected again in the second section of the "Permakay" filter. The 455 kc signal is then amplified in the next three stages.

The limiter stage removes any AM noise present on the incoming signal. The discriminator translates the variations of frequency of the i-f signal to an audio frequency signal which is then coupled to the first audio amplifier.

Squelch action is provided by taking the noise produced at the supply voltage decoupling point of the limiter, removing the residual 455 kc signal, amplifying that portion of the noise above the normal voice frequency range, rectifying this noise and applying it as positive bias to the base of the audio output stage. When the receiver is not quieted (in the absence of an r-f carrier), this bias cuts off the audio output stage and eliminates the speaker noise. The degree of squelch action is regulated by a potentiometer.

The audio section consists of two low power amplifier stages in series where the recovered audio is amplified to 3 milliwatts. These two stages are directly coupled so that when the first stage is back biased by the squelch rectifier circuit, the second stage is also turned off. The output of the second stage is coupled to the handset earpiece and provides 3 milliwatts of audio power.

In versions using a speaker, the audio output of the second stage is coupled to a power stage which amplifies the audio signal to 500 milliwatts.

c. Dual Squelch "Private-Line" Transmitters And Receivers

The controlling element in the "Private-Line" circuit is the "Vibrasender-sponder" unit. The unit acts similar to a control crystal in an oscillator stage. When the transmitter is keyed a resonant reed inside the unit vibrates at a predetermined frequency. The resulting tone is then amplified in tone amplifiers which raise the signal to the proper level to drive the diode modulator, CR104. The diode modulator varies the first oscillator frequency at the tone frequency rate. Modulation is accomplished by varying the effective resistance of the modulator diode. This in turn, varies the effective reactance of a capacitor in parallel with the crystal which modulates the oscillator frequency.

In the receive mode of operation with the "Private-Line" switch in the OFF position, the squelch circuit detects noise on the receiver channel. This noise is amplified in the squelch amplifier and rectified. The resulting current overcomes the forward bias to turn off the 1st audio transistor. Moving the "Private-Line" switch to the ON position changes the bias on the 1st audio transistor to a condition where it is biased off. The normal squelch circuitry now has no effect for it can only bias the transistor off further.

When a properly coded "Private-Line" carrier comes on the air, the tone signal is sent to the "Private-Line" circuitry where it is amplified by the three transistor stages which drive the "Vibrasender-sponder" unit. The contacts in this reed will then close and a negative d-c voltage is sent to the 1st audio transistor where it is used to bias this transistor to a conducting condition, unsquelching the audio amplifiers.

This receiver makes use of two separate and distinct squelch circuits, i. e., tone-coded squelch and noise squelch. On dual squelch receivers, when the incoming signal is properly tone-coded, the squelch sensitivity is never greater than the tone-coded squelch sensitivity.

MAINTENANCE

1. TEST EQUIPMENT

All the required test equipment for aligning and testing the "Handie-Talkie" FM radiophone is listed in the following TEST EQUIPMENT CHART. The listed items or their equivalents may be used.

TEST EQUIPMENT CHART

EQUIPMENT	USED FOR
Motorola DC Multimeter with r-f probe.	All d-c and r-f measurements. Monitoring the input current when external power supply is used.
Motorola AC Voltmeter FM signal generator - Motorola T1034C Signal Generator.	All a-c signal measurements. Alignment of all r-f and first i-f stages, 20 db quieting sensitivity measurements.
455 kc crystal-controlled oscillator - Motorola S1056A-9A or TU546 Series Test Set with 455 kc crystal.	Alignment of 455 kc i-f limiter and discriminator stages.
Audio generator - Motorola TEK-1A Transistorized Tone Generator, 1000 cps.	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 r-f output power measurements.
Motorola NLN6252A Alignment Tool (supplied with the radiophone)	Adjusting the variable capacitors and tuning coil slugs.
DC power supply capable of supplying -14 v d-c at 1.5 amperes (optional) Motorola TEK-23 Power Supply.	Supplying d-c power to the unit during extended servicing.
Motorola Model TEKA-40 Power Extension Cable.	Connecting batteries to radio for servicing.
Motorola NEN6048A Test Jig	Holding the radiophone for alignment or testing.

2. 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. With the transmitter turned on (keyed), check the battery voltage. A convenient way to do 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 then 11 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

RECOMMENDED TEST EQUIPMENT

S1059A Test Set

P-7208 for P31 Series Units
P-7208-A for P21 Series Units
RF Dummy Load

DC Multimeter

Transistorized AC Voltmeter

TEK-1A
Transistorized Tone
Generator

T1034C
Signal Generator

T1015A
General Purpose
Oscilloscope

T1014C
Precision Wide Band
Oscilloscope

NLN6252A
Tuning Tool

NLN6145A for P21 Series Units
NLD6060A for P31 Series Units
Dummy Load Antenna

is below 11 volts under load. Refer to the BATTERY REPLACEMENT AND CHARGING section of this manual for additional information.

NOTE

Only the nickel-cadmium batteries are rechargeable.

b. Check Overall Transmitter Operation

If the battery voltage is sufficient, check the overall performance of the transmitter. A good overall check of the transmitter is the r-f 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 P31 series transmitter, when properly tuned and operating at 13.5 v d-c, will produce 5.0 w r-f output into a 50-ohm load. A P21 series transmitter, when properly tuned and operating at 14.0 v d-c, will produce 1.4 w r-f 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 paragraph 5. TRANSMITTER SERVICE NOTES.

c. Check Overall Receiver Operation

(1) 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 r-f 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 a-c voltmeter with no r-f signal received at the antenna.

NOTE

On handset models not incorporating a speaker, a 120-ohm resistor must be connected across the a-c 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 0.35 microvolts or less. Refer to the Alignment Procedure.

(2) Squelch Check

With no r-f 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 (1).

(3) 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.

3. DISASSEMBLY PROCEDURE

(Refer to Figures 2-4)

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 AND CHARGING SECTION.

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 (P31 series only) is accomplished by loosening two additional captive mounting screws.

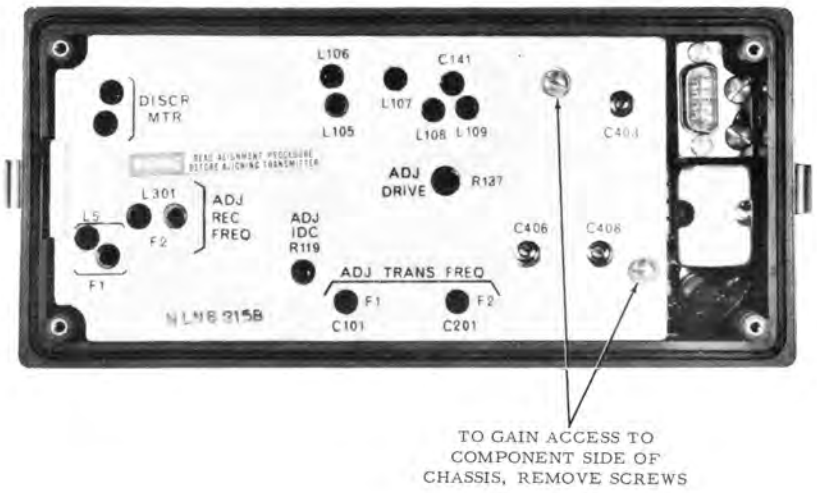


Figure 2.

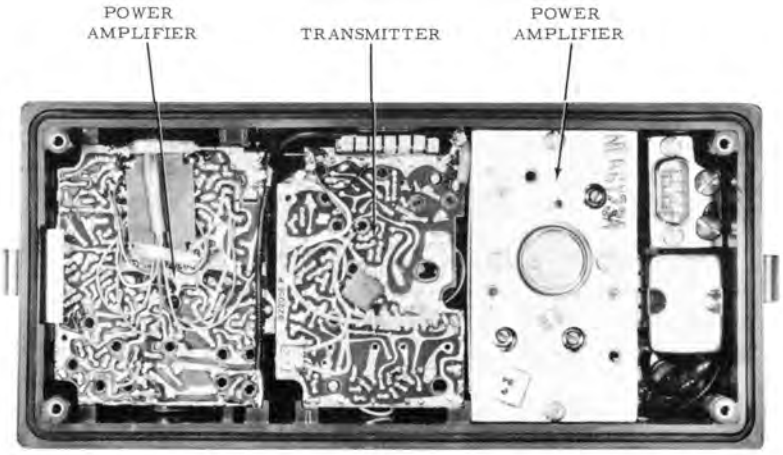


Figure 3.

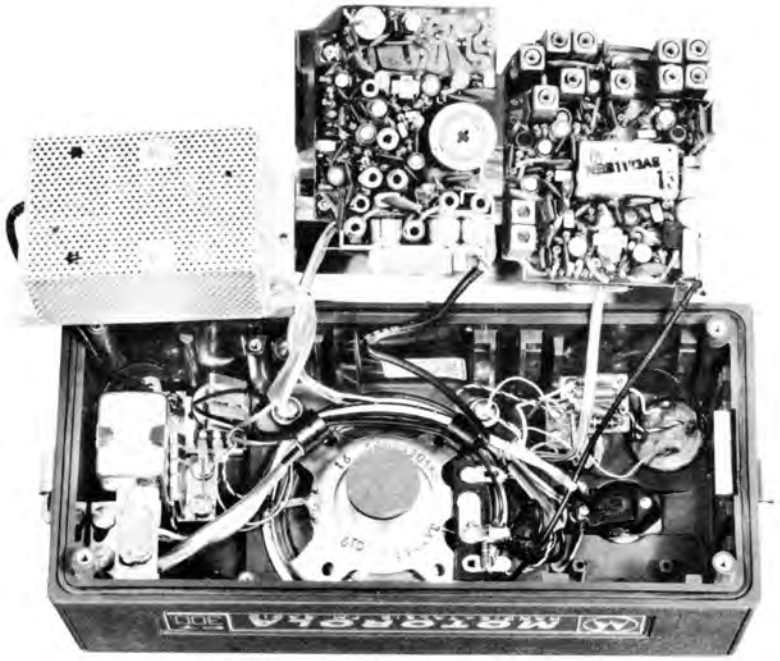


Figure 4.

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.

4. RECEIVER STAGE ANALYSIS

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

a. 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 chart, the schematic diagram, and the wiring diagrams at the back of this manual.

b. 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 AUDIO AMPLIFIER MEASUREMENTS CHART and RF AND IF STAGE MEASUREMENTS CHART.

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 a-c voltmeter, or equivalent.
5. All measurements made with -14.0 volts d-c input.

FREQUENCY	VOLTS INPUT	INPUT TO	OUTPUT AT	READING	REMARKS
1000 cps	.02 (-32 dbm)	GRN-RED lead (top of volume control)	Base of Q13	-41 dbm (0.007 v)	Volume control set at maximum
			Collector of Q13	-9 dbm (0.28 v)	
			Base of Q14	-21 dbm (0.07 v)	
			Collector of Q14	+17 dbm (5.6 v)	Volume control set at maximum. Spkr-mic & Spkr-handset models only
			Bases of Q15 and Q16	+17 dbm (5.6 v)	
			Emitters of Q15 and Q16	+16 dbm (5.0 v)	Spkr-mic & Spkr-handset models only
			Collector of Q14	+10 dbm (2.4 v)	Handset models only. Volume control set at maximum. A 120 ohm resistor connected from pin 4 to pin 1 of the mic receptacle.
			Secondary of transformer (T3)	-2 dbm (0.6 v)	

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 i-f signal is injected at the points indicated in the chart using a 50 ohm coaxial cable and a series connected .02 uf capacitor.
4. All readings taken with -14.0 volts d-c input.

FREQUENCY	UV INPUT	PROCEDURE	OUTPUT AT	READING (NOTE 1)
-	Noise	-	output of 2nd section of 455 kc filter	-55 dbm (0.0014 v)
-	Noise	-	Base of Q10 (M2)	-5 dbm (0.44 v)
-	Noise	-	Base of Q11 (M3)	-10 dbm (0.245 v)
-	Noise	- (Short collector of Q1 to collector coil ground with .002 uf capacitor)	Base of Q8 (M1)	-59 dbm (0.0009 v)
-	Noise	- (Short collector of Q3 to ground with .02 uf capacitor)	output of 2nd section of 455 kc filter	-70 dbm (0.00025 v)
Carrier	3	Connect input to external antenna connector	output of 2nd section of 455 kc filter	-30 dbm (0.025 v)
Carrier	3	Connect input to external antenna connector	Input to second section of 455 kc filter	-25 dbm (0.045 v)
Carrier	20	Connect input to external antenna connector	Output of 1st section of 455 kc filter	-50 dbm (0.0025 v)
5.7 mc	3	Connect input to top of T3 (primary)	output of 2nd section of 455 kc filter	-40 dbm (0.0077 v)
5.7 mc	10,000	Connect input to top of T5 (primary)	output of 2nd section of 455 kc filter	-30 dbm (0.025 v)

5. TRANSMITTER SERVICE NOTES

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.

a. Metering Points

The test points on the printed circuit board are supplied for ease in checking. These points are indicated on the schematic diagram, wiring diagrams, 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 d-c input.

b. DC Voltage Measurements

If the r-f power output is lower than normal for a fully tuned transmitter, the d-c 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 d-c appearing across the test leads.

The transistor is a dependable component and is not subjected 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 d-c voltages are correct, the signal should be traced through the circuit to show any possibility of breaks in the signal path.

c. RF Signal Tracing

An r-f probe attachment for a d-c multimeter may be used to good advantage in checking the radiophone transmitter. The presence of r-f can be checked throughout the r-f 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 r-f stages, as indicated on the schematic diagram, is recommended.

d. 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 d-c voltage developed across the emitter resistor. In the transmitter, these checks are made using test points M1 and M2. The 1st doubler 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.

e. Driver and Final Amplifiers

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 and capacitor C141, (all models) C403, C406 and C408 (P31 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.

f. 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. The audio circuit is a transistorized version of the Motorola audio and IDC circuit. External audio test signals can be coupled into the amplifier-clipper stage, Q110, through a 0.1 microfarad capacitor. In this manner, the audio circuitry can be signal traced.

The IDC control is a printed circuit potentiometer. Care should be taken when setting this control for the proper deviation.

CAUTION

Do not use a sharp metallic tool to adjust the IDC control. This may result in damage to the carbon track which could alter the resistance of the control.

6. REPAIR

The information contained in the following paragraphs will aid the serviceman in repairing the "Handie-Talkie" FM radiophone.

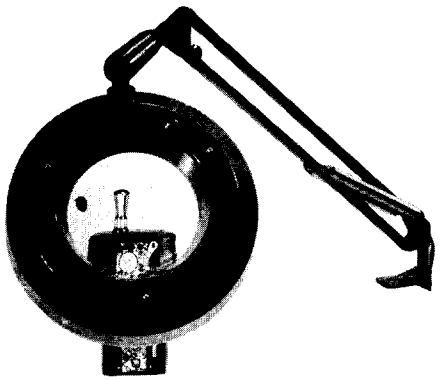
a. Construction

The various stages of the receiver and transmitter are built on printed circuit boards. The power amplifier is built on a standard metal chassis. These printed circuit boards and chassis mount and interconnect the components which comprise the radiophone. The boards may be easily removed from the housing for servicing. Refer to the paragraph on disassembly procedure. Components may be located by referring to the wiring diagrams and the parts location details at the back of this manual.

Do not apply the soldering iron repeatedly to the same spot in the printed circuit board as this will break down the plating. If a break exists in a printed circuit, it can be repaired by the addition of a jumper across the break. If a printed circuit should be damaged, refer to the TEK-4 Printed Circuit Repair Kit instruction manual for information on printed circuit repair practices.

b. Servicing Aids

Motorola has available several items which can be used to aid in parts replacement and repair of the printed circuit board.



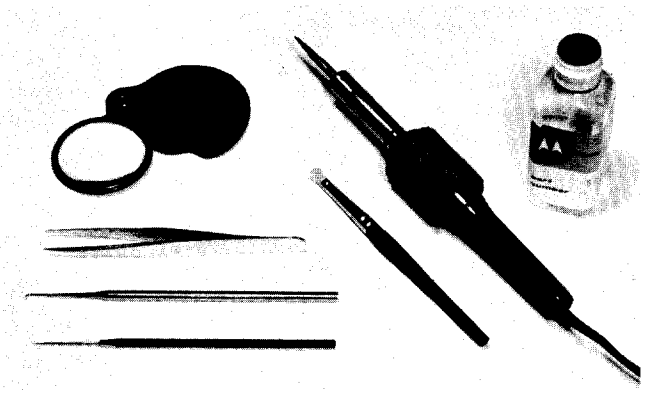
TEKA-12 Magnifying Glass & Built-In Light Source

(1) Magnifying Glass

Miniaturization requires precision work both in manufacture and in field service. Adequate concentration of light and magnification are aids to service by enabling a visual examination of connections and miniature parts. The TEKA-27 or TEKA-12 Magnifying Glass & Built-In Light Sources are most satisfactory devices for use in servicing miniature equipment in the shop. This large illuminated magnifying glass makes it easy to see any portion of the small components found on the printed circuit board. Refer to the accompanying illustration.

(2) Printed Circuit Repair Kit

The TEK-4A Printed Circuit Repair Kit supplies most of the basic tools needed for work on printed circuitry and miniature components. Refer to the accompanying illustration.



TEK-4A Printed Circuit Repair Kit

NOTE

The needle point tiplet for the soldering element may be filed to an even finer point to avoid damaging the closely knit printed circuitry.

c. 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. The alignment information is contained on the Alignment Procedure sheet toward the back of this manual. Refer to the Alignment Procedure sheet when a crystal is replaced or a new carrier frequency is required.

TEST EQUIPMENT REQUIRED FOR TRANSMITTER ALIGNMENT

1. Motorola NLN6252A Alignment Tool (supplied) or equivalent.
2. Motorola DC Multimeter with r-f probe or equivalent.
3. RF Wattmeter (50-ohm impedance).
4. Motorola TEK-23 Power Supply or equivalent.
5. Motorola Model T1100A 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 -13.5 v d-c input.

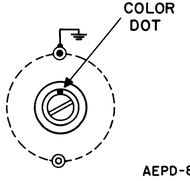
METER POINT	M1 BRN	M2 RED
READING (V DC)	-1.7	-2.5

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 d-c multimeter ground lead should be connected to a convenient ground.
4. For complete alignment, the battery should be removed and a 15 volt d-c 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. Remove the antenna by unscrewing it from the receptacle. Connect a wattmeter to the external antenna receptacle.
6. Tuning capacitors on power amplifier should be set as shown in the photograph.
7. The drive adjustment, R137, should be set for minimum resistance (fully clockwise).

FREQUENCY CALCULATIONS

$f_o = \frac{f_c}{16}$ where: f_o = oscillator frequency and f_c = carrier frequency

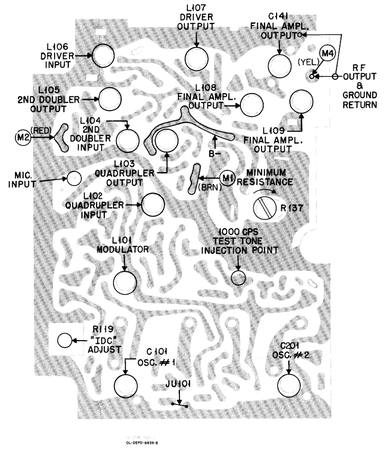


AEPD-8291-0

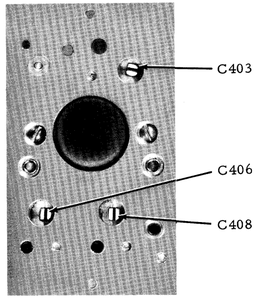
CAPACITOR
DETAIL

NOTE

To adjust C141, C101 or C201 for maximum capacity, turn screwdriver slot so color dot is nearest the grounded side of the capacitor housing.



METERING AND
ALIGNMENT POINTS



AEPD-8876-O

POWER AMPLIFIER

ALIGNMENT PROCEDURE

STEP	TEST EQUIPMENT	METER POINT & COLOR	ADJUSTMENT	PROCEDURE
1	-----	-----	-----	Key the transmitter and adjust the power supply voltage to -12 volts d-c.
2	DC multimeter	M1(BRN)	L102 1st Doubler	Adjust L102 for a maximum reading. This circuit is tuned to twice the crystal frequency.
3	DC multimeter	M2 (RED)	L103 L104 Quadrupler	QUADRUPLER: NOTE - When aligning the Quadrupler coil L103 in the 30-42 mc and the 42-54 mc band, it is possible to tune the coil to the incorrect harmonic at the upper and lower ends of the frequency range. Place the multimeter probe on meter point M2. At 30 mc in the 30-42 mc (M) band, or 42 mc in the 42-54 mc (H) band tune to 4th peak At 33 mc in the 30-42 mc (M) band, or 45 mc in the 42-54 mc (H) band tune to 3rd peak At 36 mc in the 30-42 mc (M) band, or 48 mc in the 42-54 mc (H) band tune to 2nd peak At 42 mc in the 30-42 mc (M) band, or 54 mc in the 42-54 mc (H) band tune to 1st peak At a frequency between those given above, tune to the peak(s) for the next higher frequency, for example: at 50 mc tune to 1st real peak. (If no peaks are obtained, turn the slug of L104 into the coil about 1/8".) Adjust L104 for a maximum reading.
4	DC multimeter	M2 (RED)	L105 2nd Doubler	Adjust L105 for a minimum reading. This circuit is tuned to 16 times the crystal frequency.
5	RF probe	M4	C141, L105, L106	Adjust C141 for maximum output. (If no reading can be obtained, tune L106 for a maximum reading and readjust C141.) Peak L105 and L106 for a maximum reading.
6	RF probe	M4	L107, L108, L109	Adjust L107, L108, L109 for a maximum reading. (If L108 and L109 cannot be adjusted for such a reading turn the slugs of each coil into the form about 1/8", and readjust them.)
7	RF wattmeter	-----	C406, C408, C403	Adjust C406, C408 and C403, in that order for maximum power output.
8	RF wattmeter	-----	L106, L107, L108, C141, C403, C406, C408	Replace the cover plate and repeak L106, L107, L108, C141, C403, C406 and C408 for maximum power output

ALIGNMENT PROCEDURE (CONT'D)

STEP	TEST EQUIPMENT	METER POINT & COLOR	ADJUSTMENT	PROCEDURE
9	RF wattmeter	-----	L108, L109, C403, C406, C408	Increase the power supply voltage to -13.5 volts d-c and adjust L108, L109, C403, C406, and C408 for 5.0 watts output while minimizing current. NOTE: For optimum performance, adjust C408 for proper current while peaking C406 for power output. Once proper power and current levels are reached, do not repeak C408. DO NOT EXCEED 900 MA TOTAL CURRENT DRAIN INCLUDING RELAY CURRENT.
10	RF wattmeter	-----	L108, L109, C403, C406, C408, R137	If current drain exceeds 900 ma total, decrease current by rotating drive adjusting resistor, R137, and repeating STEP 9.
11	-----	-----	-----	OSCILLATOR: C101 is preset to the assigned frequency at the factory. Do not readjust 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 replace the cover plate on the unit and tighten securely. Adjust C101 for zero reading on the monitor CARRIER FREQUENCY meter. IMPORTANT - When the cover plate is attached, the frequency may shift; therefore, always set the carrier frequency on the frequency monitor with the cover plate attached. TWO-FREQUENCY TRANSMITTERS ONLY OSCILLATOR NO. 2: Use the same procedure as above, substituting C201 for C101.
12	-----	-----	L101	DEVIATION CHECK: See "IDC" ADJUSTMENT PROCEDURE on the reverse side of this chart.
13	-----	-----	-----	ANTENNA PEAKING: Completely assemble unit. Perform the antenna peaking procedure while connected to an external power supply set for 14.0 v d-c. Each power supply lead must be isolated by an r-f choke (Motorola Part No. 24C83961B01) at the radio. Connect the loading coil and antenna to the antenna receptacle and turn the core in the antenna loading coil clockwise until it is stopped. Slowly adjust the core in the loading coil counterclockwise until a peak is reached on the field strength meter.

"IDC" ADJUSTMENT (PREFERRED METHOD USING OSCILLOSCOPE)

1. INTRODUCTION

Accuracy of test equipment is of prime importance to any user of radio communications equipment; but of equal importance is a knowledge of the characteristics of the measuring equipment under various conditions. The Motorola Model T1100A Series FM Station Monitor is the leader in the field with respect to sensitivity, accuracy under conditions of variation in r-f signal level line voltage, and other environmental conditions. In common with most other meters, however, they have the characteristic of responding differently to different wave shapes. Therefore, the use of most present-day deviation meters can lead to confusion and errors in deviation setting, if the pitfalls are unknown or disregarded.

The "ideal" deviation indicator would be one which would respond instantaneously to the peak value of the modulation deviation, regardless of waveform. The only device which meets all these requirements is an oscilloscope. It responds instantaneously, and it shows the peak value of any waveform, no matter how complex. Properly calibrated, an oscilloscope is the most accurate and reliable means for measuring and setting transmitter deviation.

The oscilloscope must be used in conjunction with a receiver which has a stable discriminator characteristic, since the oscilloscope displays the demodulated signal. In addition to the oscilloscope a receiver and a means to accurately calibrate the system is required. The Motorola monitors fill these requirements, since they provide both a sensitive receiver with the proper discriminator characteristic and a reliable means of calibrating the oscilloscope. They have convenient terminals on the front panel for connection of the oscilloscope. Furthermore, the Motorola FM Station Monitor is provided with two modulation meter scales, 0-20 kc for wide-band systems, and 0-10 kc for split-channel systems.

Split-channel conversion kits are available for modification of older models, so that they too are provided with convenient oscilloscope terminals and can be more accurate measurement devices for such systems.

2. TEST EQUIPMENT REQUIRED

a. Motorola T1100A Series FM Station Monitor (or equivalent)

b. Motorola Transistorized AC Voltmeter (or equivalent)

c. Motorola Model TEK-1A Transistorized Tone Generator, 400 & 1000 cps (or equivalent)

d. Motorola Model T1015A General Purpose Oscilloscope, Motorola Model T1014B Precision Wide Band Oscilloscope (or equivalent)

e. Motorola Model S1056A-9A or TU546 Series Portable Test Set (or equivalent) for "Private-Line" models only

3. OSCILLOSCOPE CALIBRATION

The first step in the measurement of transmitter deviation is to calibrate the oscilloscope. This can be done by using the transmitter which is to be measured. A "Private-Line" unit can be used for this purpose if the tone oscillator is disabled by removal of the "Vibrasender-sponder" unit. This is necessary since the "Private-Line" tone contributes to the maximum deviation.

Proceed as follows:

a. The oscilloscope should be connected to the monitor oscilloscope terminals, and the monitor controls should be set up in accordance with the monitor instruction manuls.

b. Turn the IDC control on the transmitter chassis to the full clockwise position.

c. Feed a 1000 cps test tone into pin 2 of the microphone input jack (base of the amplifier-clipper stage Q110 in the IDC circuit). A 0.33 uf capacitor should be placed in series with the tone generator output. Modulate the transmitter with this tone so adjusted that the deviation as read on the FM monitor deviation meter is 2 kc (6 kc in a wide-band system). 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 excellent for this purpose.

d. Adjust the vertical gain of the oscilloscope so that the total recovered audio pattern occupies some convenient height, e.g., four small squares. (12 squares in a wide-band system.) The split-channel indication is shown in figure 1.

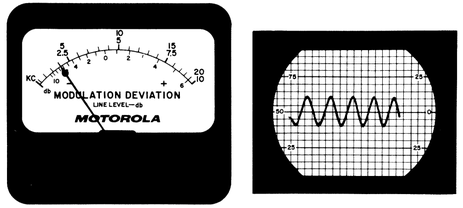


Figure 1.
Oscilloscope Calibration for
Split-Channel Transmitter

Having calibrated the oscilloscope, there is no further need for the modulation deviation meter and its reading should be ignored from this point on. It has already performed its important function of calibrating the oscilloscope.

With the oscilloscope calibrated as indicated, a recovered signal which occupies 10 squares (peak-to-peak) is equivalent to ±5 kc deviation. For wide-band systems, a recovered signal occupying 30 squares (peak-to-peak) is equivalent to ±15 kc deviation.

4. MEASUREMENT AND SETTING OF TRANSMITTER DEVIATION

a. Models for Carrier Squelch Application

Once the oscilloscope has been calibrated the transmitter deviation can be properly adjusted by the following method:

(1) Adjust the 1000 cps input signal to 1.5 volt. This should drive the IDC circuit into full clip See Figure 2.

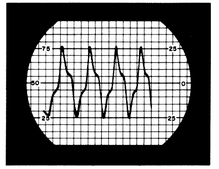


Figure 2.
5 KC Peak Deviation as seen on the Oscilloscope
(NOTE: Waveform is clipped fully)

(2) With this input signal level adjust the IDC control on the transmitter to provide a peak-to-peak recovered signal on the oscilloscope of 10 squares, which is equivalent to ±5 kc deviation as shown in figure 2. A wide-band system should be adjusted for 30 squares (±15 kc). If the waveform under the above conditions does not resemble the waveform shown in figure 2 adjust L101 until a symmetrical waveform is obtained. Re-adjust the IDC control.

(3) Reduce 1000 cps input to 0.3 volt. Essentially full deviation should still be observed on the oscilloscope. Less than full deviation may indicate a weak audio transistor or other lack of audio gain.

b. "Private-Line" Models

(1) Remove "Vibrasender-sponder" resonant reed from its socket.

(2) Adjust the 1000 cps input signal to 1.5 volts. This should drive the IDC circuit into full clip. See Figure 2.

(3) With this input signal level adjust the IDC control on the transmitter to provide a peak-to-peak recovered signal on the oscilloscope of 10 squares, which is equivalent to ±5 kc deviation as shown in figure 2. If the waveform under the above conditions does not resemble the waveform shown in figure 2, adjust L101 until a symmetrical waveform is obtained. Re-adjust the IDC control.

(4) Reduce 1000 cps input to 0.3 volt. Essentially full deviation should still be observed on the oscilloscope. Less than full deviation may indicate a weak audio transistor or other lack of audio gain.

(5) Remove the 1000 cps tone signal. Insert the "Vibrasender-sponder" unit in its socket.

(6) Check the "Private-Line" tone deviation. This may be read directly from the oscilloscope by pressing the transmitter on switch on the test set. The tone deviation should be 0.5 to 1 kc.

NOTE

If the tone deviation is less than 0.5 kc with jumper JU1 on position 2 (see circuit board diagram), move the jumper to position 3. If the deviation is greater than 1.0 kc, move the jumper to position 1M for the 30-42 mc band or 1H for the 42-54 mc band. Always choose the jumper position which produces a tone deviation between 0.5 and 1.0 kc.

Due to a slight increase in discriminator response at the lower frequencies, the oscilloscope will read high, thus, an indication of 1.4 to 2.8 squares (peak-to-peak) is equivalent to 0.5 to 1 kc. This slight variation is only important when checking tone deviation. When setting maximum transmitter deviation as described in the following paragraphs, it may be ignored.

(7) Apply a 1000 cps test tone to pin 2 of the microphone input jack (base of the amplifier-clipper stage Q110). Place a 0.33 uf capacitor in series with the tone generator output.

(8) Adjust the 1000 cps input signal level for 1 volt and note the resultant combined deviation of the 1000 cps modulation and tone signal modulation on the oscilloscope.

(9) The IDC control on the transmitter should be adjusted to provide a peak-to-peak combined signal of 10 squares, equivalent to full 5 kc as shown in figure 3.

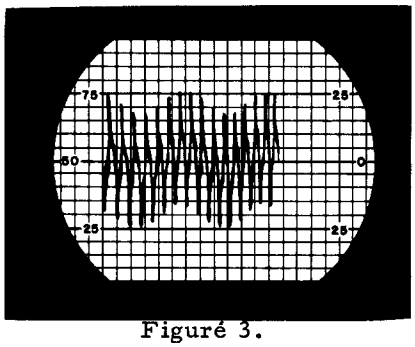


Figure 3.
5 KC Peak Deviation for Combined PL Tone and
1000 CPS Modulation

(10) Reduce the 1000 cps input to 0.35 volt. Essentially full combined 1000 cps tone and "Private-Line" tone deviation should still be observed on the oscilloscope. Less than full combined deviation may indicate a defective transistor or other lack of audio gain.

5. EMERGENCY MEASUREMENT OF DEVIATION

If an audio oscillator is not available, a loud sustained whistle of approximately 1000 cycles can be used for a rough measurement of deviation. If this rough check indicates the need for resetting deviation, do so only under controlled conditions, using a 1000 cps tone as previously indicated. The calibration of the oscilloscope should always be performed with a steady controlled signal. Do not attempt to calibrate the oscilloscope with a sustained whistle as waveform distortion will prevent an accurate calibration.

6. OTHER MEANS FOR MEASUREMENT OF DEVIATION

Another accurate means of measuring transmitter deviation is to use the Motorola T1020A Portable Frequency and Deviation Meter. This unit, properly used, permits the accurate measurement and setting of transmitter deviation from a peak-reading meter which is unaffected by waveform. An oscilloscope is not required with this instrument. With this device, the transmitter deviation can be measured accurately even with voice modulation.

7. MICROPHONE LEVELS

If the modulation level in the system still appears to be too low after setting deviation as indicated above, check the microphone and audio amplifier.

The foregoing procedure will insure that the transmitter will comply with FCC requirements for maximum deviation.

The importance of the correct deviation setting can not be overemphasized. Optimum system performance demands accurate deviation setting, both from the standpoint that over deviation will interfere with the user on the adjacent channel, and underdeviation may reduce system range.

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TEST EQUIPMENT REQUIRED FOR TRANSMITTER ALIGNMENT

1. Motorola NLN6252A Alignment Tool (supplied) or equivalent.
2. Motorola DC Multimeter with r-f probe or equivalent.
3. RF Wattmeter (50-ohm impedance).
4. Motorola TEK-23 Power Supply or equivalent.
5. Motorola Model T1100A 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 v d-c input.

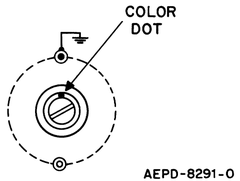
METER POINT	M1 BRN	M2 RED
READING (V DC)	-1.7	-2.5

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 d-c multimeter ground lead should be connected to a convenient ground.
4. For complete alignment, the battery should be removed and a 15 volt d-c 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. Remove the antenna by unscrewing it from the receptacle. Connect a wattmeter to the external antenna receptacle.

FREQUENCY CALCULATIONS

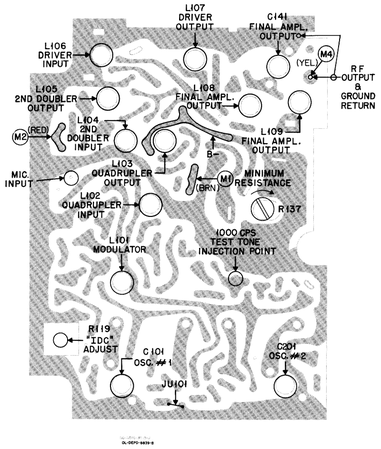
$f_o = \frac{f_c}{16}$ where: f_o = oscillator frequency and f_c = carrier frequency



CAPACITOR DETAIL

NOTE

To adjust C141, C101 or C201 for maximum capacity, turn screwdriver slot so color dot is nearest the grounded side of the capacitor housing.



METERING AND ALIGNMENT POINTS

ALIGNMENT PROCEDURE

STEP	TEST EQUIPMENT	METER POINT & COLOR	ADJUSTMENT	PROCEDURE
1	----	----	----	Key the transmitter and adjust the power supply voltage to -12 volts d-c.
2	DC multimeter	M1 (BRN)	L102 1st Doubler	Adjust L102 for a maximum reading. This circuit is tuned to twice the crystal frequency.
3	DC multimeter	M2 (RED)	L103 L104 Quadrupler	QUADRUPLER: ***NOTE*** - When aligning the Quadrupler coil L103 in the 30-42 mc and the 42-54 mc band, it is possible to tune the coil to the incorrect harmonic at the upper and lower ends of the frequency range. Place the multimeter probe on meter point M2. At 30 mc in the 30-42 mc (M) band, or 42 mc in the 42-54 mc (H) band tune to 4th peak At 33 mc in the 30-42 mc (M) band, or 45 mc in the 42-54 mc (H) band tune to 3rd peak At 36 mc in the 30-42 mc (M) band, or 48 mc in the 42-54 mc (H) band tune to 2nd peak At 42 mc in the 30-42 mc (M) band, or 54 mc in the 42-54 mc (H) band tune to 1st peak At a frequency between those given above, tune to the peak(s) for the next higher frequency, for example; at 50 mc tune to 1st real peak. (If no peaks are obtained, turn the slug of L104 into the coil about 1/8".) Adjust L104 for a maximum reading.
4	DC multimeter	M2 (RED)	L105 2nd Doubler	Adjust L105 for a minimum reading. This circuit is tuned to 16 times the crystal frequency.
5	RF wattmeter	----	C141, L105, L106	Adjust C141 for maximum output. (If no reading can be obtained, tune L106 for a maximum reading and readjust C141.) Peak L105 and L106 for a maximum reading.
6	RF wattmeter	----	L107, L108, L109	Adjust L107, L108, L109 for a maximum reading. (If L108 and L109 cannot be adjusted for such a reading turn the slugs of each coil into the form about 1/8", and readjust them.)
7	----	----	L108, L109	Increase the power supply voltage to -14 v d-c and adjust L108 and L109 for a maximum reading.
8	----	----	----	Replace the cover plate and repeat Step 6.
9	----	----	----	ANTENNA PEAKING: Completely assemble unit. Perform the antenna peaking procedure while connected to an external power supply set for 14.0 v d-c. Each power supply lead must be isolated by an r-f choke (Motorola Part No. 24C83961B01) at the radio. Connect the loading coil and antenna to the antenna receptacle and turn the core in the antenna loading coil clockwise until it is stopped. Slowly adjust the core in the loading coil counterclockwise until a peak is reached on the field strength meter.
10	----	----	----	OSCILLATOR: C101 is preset to the assigned frequency at the factory. Do not readjust 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 replace the cover plate on the unit and tighten securely. Adjust C101 for zero reading on the monitor CARRIER FREQUENCY meter. Replace the back cover on the transmitter unit and tighten securely. ***IMPORTANT*** - When the cover plate is attached, the frequency may shift; therefore, always set the carrier frequency on the frequency monitor with the cover plate attached. TWO-FREQUENCY TRANSMITTERS ONLY OSCILLATOR No. 2: Use the same procedure as above, substituting C201 for C101.
11	----	----	L101	DEVIATION CHECK: See "IDC" ADJUSTMENT PROCEDURE on the reverse side of this chart.

"IDC" ADJUSTMENT (PREFERRED METHOD USING OSCILLOSCOPE)

1. INTRODUCTION

Accuracy of test equipment is of prime importance to any user of radio communications equipment; but of equal importance is a knowledge of the characteristics of the measuring equipment under various conditions. The Motorola Model T1100A Series FM Station Monitor is the leader in the field with respect to sensitivity, accuracy under conditions of variation in r-f signal level line voltage, and other environmental conditions. In common with most other meters, however, they have the characteristic of responding differently to different wave shapes. Therefore, the use of most present-day deviation meters can lead to confusion and errors in deviation setting, if the pitfalls are unknown or disregarded.

The "ideal" deviation indicator would be one which would respond instantaneously to the peak value of the modulation deviation, regardless of waveform. The only device which meets all these requirements is an oscilloscope. It responds instantaneously, and it shows the peak value of any waveform, no matter how complex. Properly calibrated, an oscilloscope is the most accurate and reliable means for measuring and setting transmitter deviation.

The oscilloscope must be used in conjunction with a receiver which has a stable discriminator characteristic, since the oscilloscope displays the demodulated signal. In addition to the oscilloscope a receiver and a means to accurately calibrate the system is required. The Motorola monitors fill these requirements, since they provide both a sensitive receiver with the proper discriminator characteristic and a reliable means of calibrating the oscilloscope. They have convenient terminals on the front panel for connection of the oscilloscope. Furthermore, the Motorola FM Station Monitor is provided with two modulation meter scales, 0-20 kc for wide-band systems, and 0-10 kc for split-channel systems.

Split-channel conversion kits are available for modification of older models, so that they too are provided with convenient oscilloscope terminals and can be more accurate measurement devices for such systems.

2. TEST EQUIPMENT REQUIRED

a. Motorola T1100A Series FM Station Monitor (or equivalent)

b. Motorola Transistorized AC Voltmeter (or equivalent)

c. Motorola Model TEK-1A Transistorized Tone Generator, 400 & 1000 cps (or equivalent)

d. Motorola Model T1015A General Purpose Oscilloscope, Motorola Model T1014B Precision Wide Band Oscilloscope (or equivalent)

e. Motorola Model S1056A-9A or TU546 Series Portable Test Set (or equivalent) for "Private-Line" models only

3. OSCILLOSCOPE CALIBRATION

The first step in the measurement of transmitter deviation is to calibrate the oscilloscope. This can be done by using the transmitter which is to be measured. A "Private-Line" unit can be used for this purpose if the tone oscillator is disabled by removal of the "Vibrasender-sponder" unit. This is necessary since the "Private-Line" tone contributes to the maximum deviation.

Proceed as follows:

a. The oscilloscope should be connected to the monitor oscilloscope terminals, and the monitor controls should be set up in accordance with the monitor instruction manuls.

b. Turn the IDC control on the transmitter chassis to the full clockwise position.

c. Feed a 1000 cps test tone into pin 2 of the microphone input jack (base of the amplifier-clipper stage Q110 in the IDC circuit). A 0.33 uf capacitor should be placed in series with the tone generator output. Modulate the transmitter with this tone so adjusted that the deviation as read on the FM monitor deviation meter is 2 kc (6 kc in a wide-band system). 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 excellent for this purpose.

d. Adjust the vertical gain of the oscilloscope so that the total recovered audio pattern occupies some convenient height, e.g., four small squares. (12 squares in a wide-band system.) The split-channel indication is shown in figure 1.

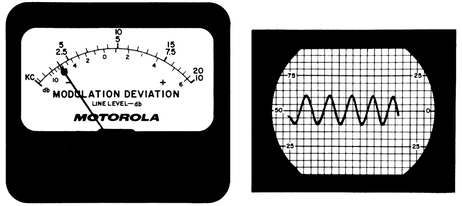


Figure 1.
Oscilloscope Calibration for
Split-Channel Transmitter

Having calibrated the oscilloscope, there is no further need for the modulation deviation meter and its reading should be ignored from this point on. It has already performed its important function of calibrating the oscilloscope.

With the oscilloscope calibrated as indicated, a recovered signal which occupies 10 squares (peak-to-peak) is equivalent to ±5 kc deviation. For wide-band systems, a recovered signal occupying 30 squares (peak-to-peak) is equivalent to ±15 kc deviation.

4. MEASUREMENT AND SETTING OF TRANSMITTER DEVIATION

a. Models for Carrier Squelch Application

Once the oscilloscope has been calibrated the transmitter deviation can be properly adjusted by the following method:

(1) Adjust the 1000 cps input signal to 1.5 volt. This should drive the IDC circuit into full clip See Figure 2.

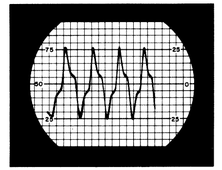


Figure 2.
5 KC Peak Deviation as seen on the Oscilloscope
(NOTE: Waveform is clipped fully)

(2) With this input signal level adjust the IDC control on the transmitter to provide a peak-to-peak recovered signal on the oscilloscope of 10 squares, which is equivalent to ±5 kc deviation as shown in figure 2. A wide-band system should be adjusted for 30 squares (±15 kc). If the waveform under the above conditions does not resemble the waveform shown in figure 2 adjust L101 until a symmetrical waveform is obtained. Re-adjust the IDC control.

(3) Reduce 1000 cps input to 0.3 volt. Essentially full deviation should still be observed on the oscilloscope. Less than full deviation may indicate a weak audio transistor or other lack of audio gain.

b. "Private-Line" Models

(1) Remove "Vibrasender-sponder" resonant reed from its socket.

(2) Adjust the 1000 cps input signal to 1.5 volts. This should drive the IDC circuit into full clip. See Figure 2.

(3) With this input signal level adjust the IDC control on the transmitter to provide a peak-to-peak recovered signal on the oscilloscope of 10 squares, which is equivalent to ±5 kc deviation as shown in figure 2. If the waveform under the above conditions does not resemble the waveform shown in figure 2, adjust L101 until a symmetrical waveform is obtained. Re-adjust the IDC control.

(4) Reduce 1000 cps input to 0.3 volt. Essentially full deviation should still be observed on the oscilloscope. Less than full deviation may indicate a weak audio transistor or other lack of audio gain.

(5) Remove the 1000 cps tone signal. Insert the "Vibrasender-sponder" unit in its socket.

(6) Check the "Private-Line" tone deviation. This may be read directly from the oscilloscope by pressing the transmitter on switch on the test set. The tone deviation should be 0.5 to 1 kc.

NOTE

If the tone deviation is less than 0.5 kc with jumper JU1 on position 2 (see circuit board diagram), move the jumper to position 3. If the deviation is greater than 1.0 kc, move the jumper to position 1M for the 30-42 mc band or 1H for the 42-54 mc band. Always choose the jumper position which produces a tone deviation between 0.5 and 1.0 kc.

Due to a slight increase in discriminator response at the lower frequencies, the oscilloscope will read high, thus, an indication of 1.4 to 2.8 squares (peak-to-peak) is equivalent to 0.5 to 1 kc. This slight variation is only important when checking tone deviation. When setting maximum transmitter deviation as described in the following paragraphs, it may be ignored.

(7) Apply a 1000 cps test tone to pin 2 of the microphone input jack (base of the amplifier-clipper stage Q110). Place a 0.33 uf capacitor in series with the tone generator output.

(8) Adjust the 1000 cps input signal level for 1 volt and note the resultant combined deviation of the 1000 cps modulation and tone signal modulation on the oscilloscope.

(9) The IDC control on the transmitter should be adjusted to provide a peak-to-peak combined signal of 10 squares, equivalent to full 5 kc as shown in figure 3.

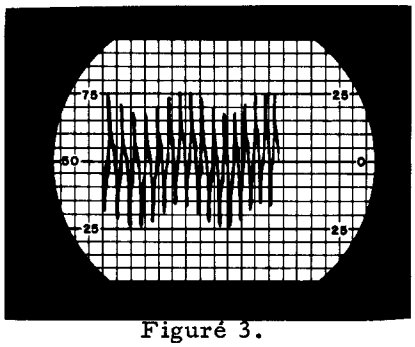


Figure 3.
5 KC Peak Deviation for Combined PL Tone and
1000 CPS Modulation

(10) Reduce the 1000 cps input to 0.35 volt. Essentially full combined 1000 cps tone and "Private-Line" tone deviation should still be observed on the oscilloscope. Less than full combined deviation may indicate a defective transistor or other lack of audio gain.

5. EMERGENCY MEASUREMENT OF DEVIATION

If an audio oscillator is not available, a loud sustained whistle of approximately 1000 cycles can be used for a rough measurement of deviation. If this rough check indicates the need for resetting deviation, do so only under controlled conditions, using a 1000 cps tone as previously indicated. The calibration of the oscilloscope should always be performed with a steady controlled signal. Do not attempt to calibrate the oscilloscope with a sustained whistle as waveform distortion will prevent an accurate calibration.

6. OTHER MEANS FOR MEASUREMENT OF DEVIATION

Another accurate means of measuring transmitter deviation is to use the Motorola T1020A Portable Frequency and Deviation Meter. This unit, properly used, permits the accurate measurement and setting of transmitter deviation from a peak-reading meter which is unaffected by waveform. An oscilloscope is not required with this instrument. With this device, the transmitter deviation can be measured accurately even with voice modulation.

7. MICROPHONE LEVELS

If the modulation level in the system still appears to be too low after setting deviation as indicated above, check the microphone and audio amplifier.

The foregoing procedure will insure that the transmitter will comply with FCC requirements for maximum deviation.

The importance of the correct deviation setting can not be overemphasized. Optimum system performance demands accurate deviation setting, both from the standpoint that over deviation will interfere with the user on the adjacent channel, and underdeviation may reduce system range.

(Page 26 is blank)

TEST EQUIPMENT REQUIRED FOR RECEIVER ALIGNMENT

1. Motorola DC Multimeter with r-f probe.
2. Motorola Transistorized AC Voltmeter or equivalent.
3. Motorola T1034C Signal Generator or equivalent.
4. Motorola S1056A-9A or TU546 Series Test Set with 455 kc crystal or equivalent crystal-controlled oscillator.
5. Motorola NLN6252A Alignment Tool (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 d-c multimeter ground lead should be connected to a convenient ground.

4. For complete alignment, the battery should be removed and a 15 volt d-c 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

LEGEND

f_c = carrier frequency (25-54 mc)

f_{01} = 1st oscillator crystal frequency (30.7-48.3 mc)

f_{02} = 2nd oscillator frequency

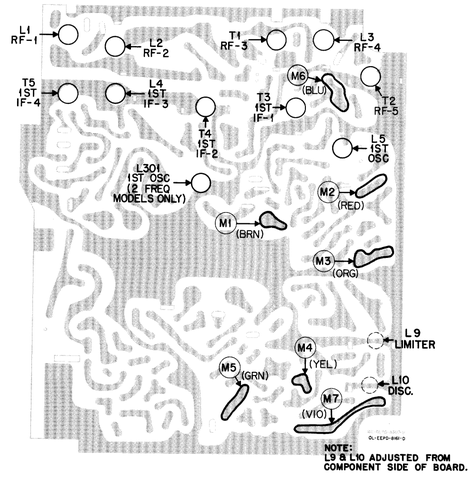
f_1 = 1st intermediate frequency (5.7 mc)

f_2 = 2nd intermediate frequency (455 kc)

$f_{01} = f_c + f_1$ (25-42 mc)

$f_{01} = f_c - f_1$ (42-54 mc)

f_c	f_{02}
25.00-30.00 mc	6.155 mc
30.02-30.86 mc	5.245 mc
30.90-36.84 mc	6.155 mc
36.86-37.00 mc	5.245 mc
37.02-41.98 mc	6.155 mc
42.00-42.98 mc	6.155 mc
43.00-43.16 mc	5.245 mc
43.18-49.14 mc	6.155 mc
49.16-49.32 mc	5.245 mc
49.34-54.00 mc	6.155 mc



ALIGNMENT PROCEDURE

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
1	DC multimeter with r-f probe	M-6 (BLU)	L5 1st Osc	Tune L5 for max. d-c 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 d-c reading.
3	DC multimeter and 455 kc crystal osc	M-4 (YEL)	L10 Disc.	Tune L10 for a zero d-c 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 d-c multimeter	M-4 (YEL)	Signal Generator to carrier frequency	Connect the signal generator to the test jig. Set the attenuator for 5,000 microvolts and adjust the signal frequency for a zero d-c reading on the meter. *Do not set the frequency to the 2nd i-f image frequency.
5	T1034C Signal Generator and a-c voltmeter	M-1 (BRN)	L1, L2, T1, L3, T2, T3, T4, L4, T5	Tune these slugs successively for a maximum meter reading. Keep the meter reading below -30 dbm on the a-c voltmeter.
6	DC multimeter	M-4 (YEL)	L5 1st Osc	Use the base station transmitter or a frequency standard as a signal source and adjust L5 for a zero d-c reading. NOTE: Set JU2 (and JU3 on 2-freq.) to tap ① or ② to obtain proper frequency.
7	T1034C Signal Generator and a-c voltmeter.	Pin #4 of Mic. connector	Signal Generator for 20 db quieting sensitivity	A 120 ohm resistor must be connected across the a-c voltmeter (handset only models). Set squelch control for maximum noise. Connect the adapter cable from the voltmeter to the antenna receptacle. Adjust the volume control for an output voltage of 0.44 v a-c (noise only-no signal input) for receivers with speakers and 0.12 v a-c for handset only models. Using the test set this reading should be about 50 ua with the multiplier switch in the 0.2 v a-c position. 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 0.35 microvolts). This is the 20 db quieting sensitivity.

*CAUTION: After adjusting the signal generator to the carrier in the 42-54 mc (H) band look for the image frequency at 910 kc below this setting if the 2nd oscillator frequency is 5.245 mc or 910 kc above this setting if the 2nd oscillator frequency is 6.155 mc. After adjusting the signal generator to the carrier in 25-30 mc (L) band or 30-42 mc (M) band look for the image frequency 910 kc above this setting if the 2nd oscillator frequency is 5.245 mc or 910 kc below this setting if the 2nd oscillator frequency is 6.155 mc. This is a check on the accuracy of the setting. Upon locating the image, return to the proper setting for the carrier frequency.

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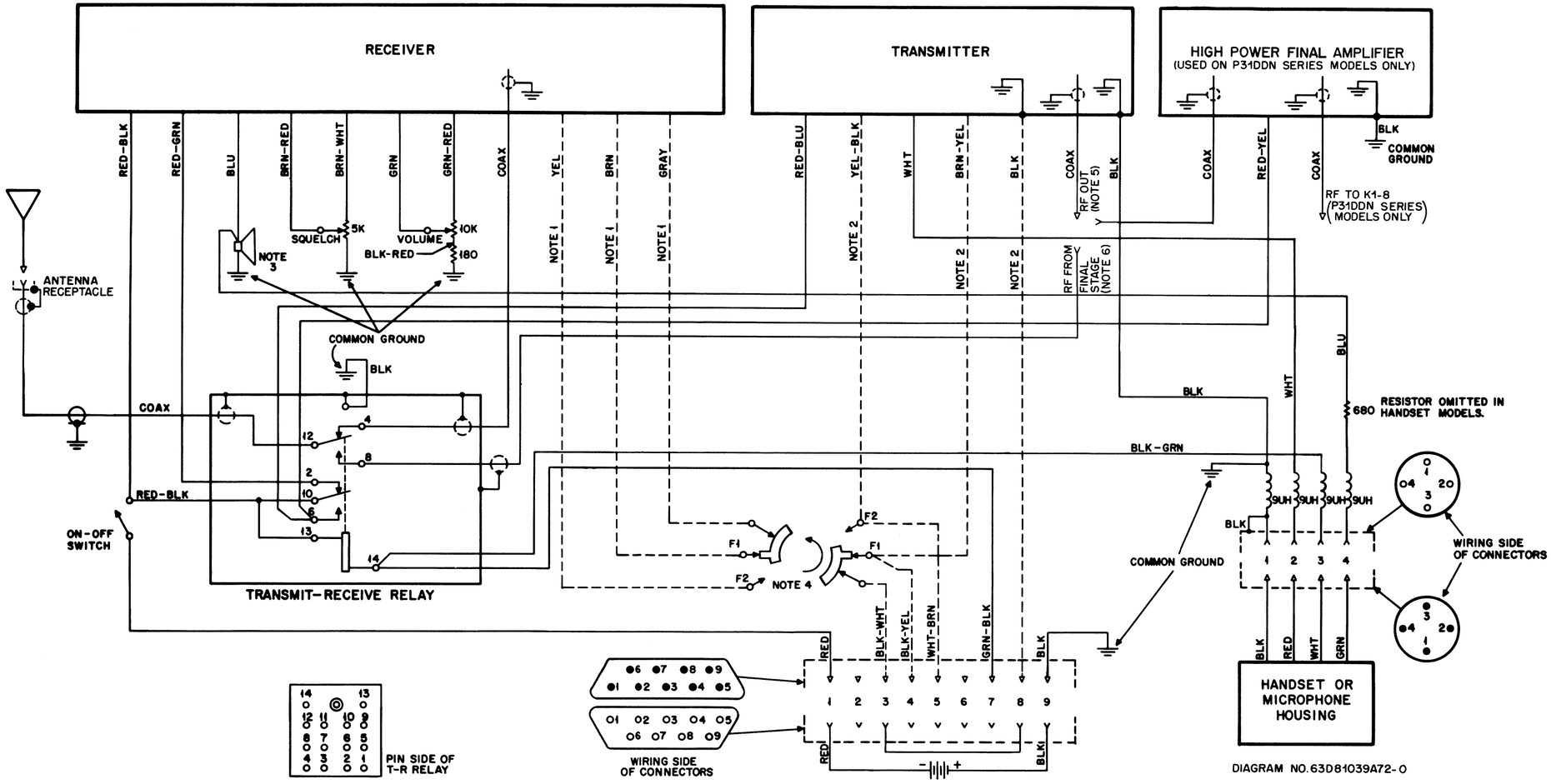


APPLICABLE CONTROL PANELS	
NCN6039A	NCN6049A
NCN6041A	NCN6052A
NCN6043A	NCN6054A
NCN6044A	NCN6056A
NCN6045A	NCN6058A
NCN6047A	NCN6060A

NOTES:

1. 2-FREQ. RECEIVER ONLY.
2. 2-FREQ. TRANSMITTER ONLY.
3. SPEAKER AND GROUND OMITTED IN HANDSET MODELS.
4. SWITCH VIEWED FROM THE REAR.
5. TO K1-8 IN P21DDN SERIES MODELS OR TO HIGH POWER FINAL AMPLIFIER IN P31DDN SERIES MODELS.
6. CONNECTED TO THE RF OUTPUT OF THE TRANSMITTER IN P21DDN SERIES MODELS OR TO HIGH POWER FINAL AMPLIFIER IN P31DDN SERIES MODELS.

EPD-13959-O

P21/P31DDN-1000 Series
Intercabling Diagram
Motorola No. 63D81039A72-O
9/23/66-AP

APPLICABLE CONTROL PANELS	
NCN6043B	NCN6054B
NCN6044B	

NOTES:

1. 2-FREQ. RECEIVER ONLY.
2. 2-FREQ. TRANSMITTER ONLY.
3. SPEAKER AND GROUND OMITTED IN HANDSET MODELS.
4. SWITCH VIEWED FROM THE REAR.
5. TO K1-4 IN P21DDN SERIES MODELS OR TO HIGH POWER FINAL AMPLIFIER IN P31DDN SERIES MODELS.
6. CONNECTED TO THE RF OUTPUT OF THE TRANSMITTER IN P21DDN SERIES MODELS OR TO HIGH POWER FINAL AMPLIFIER IN P31DDN SERIES MODELS.

EPD-13960-O

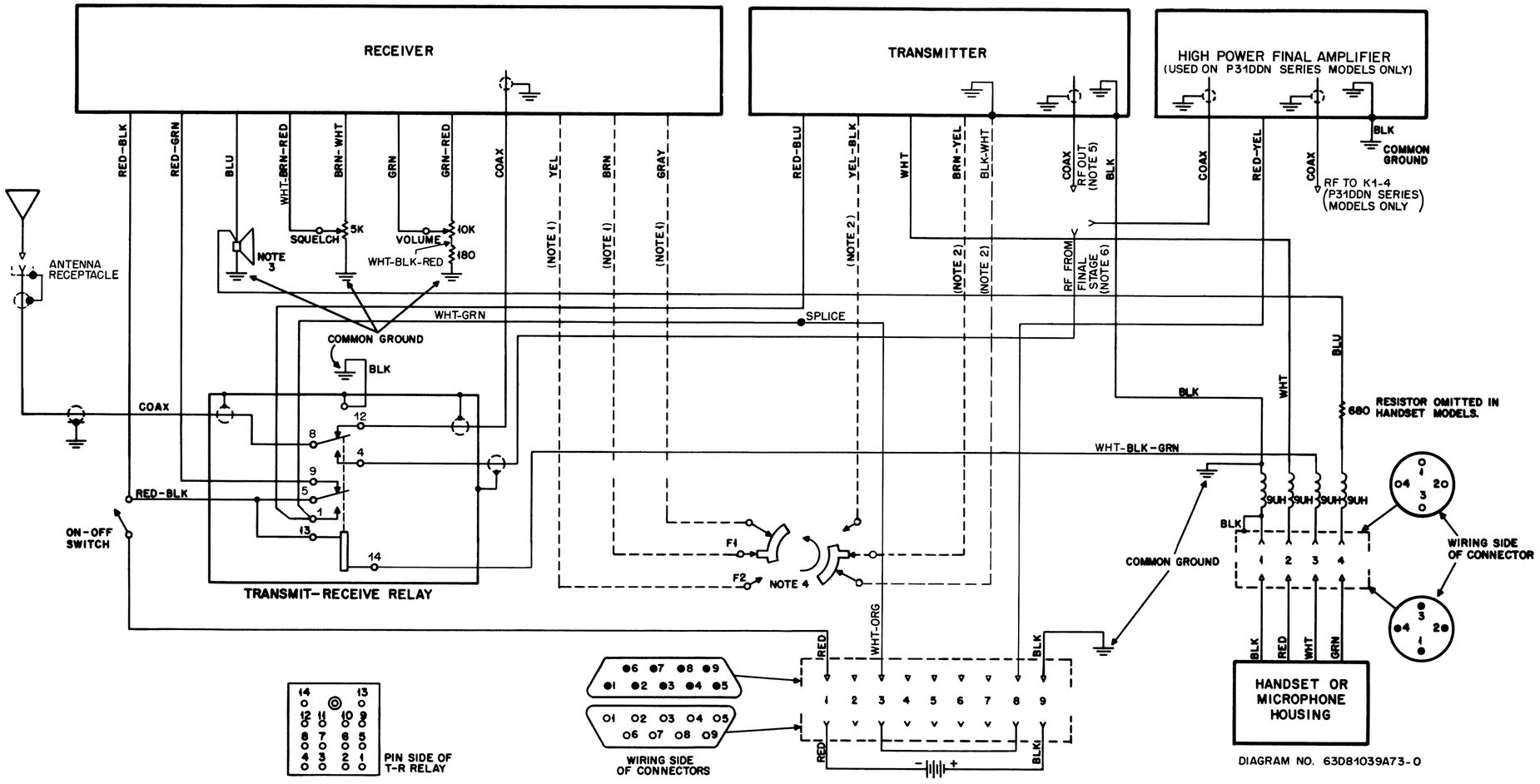
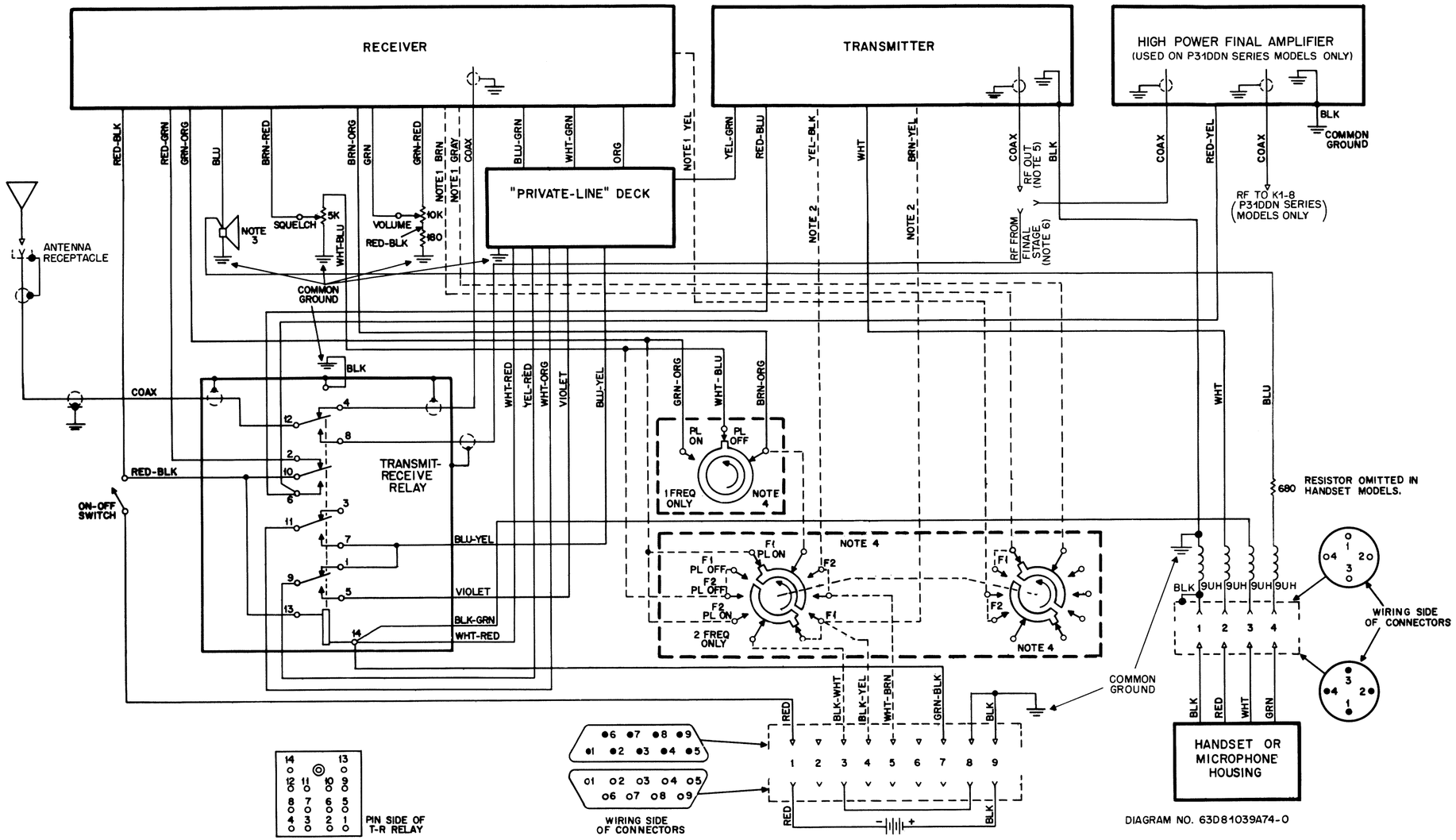


DIAGRAM NO. 63D81039A73-O



APPLICABLE CONTROL PANELS	
NCN6040A	NCN6053A
NCN6042A	NCN6055A
NCN6046A	NCN6057A
NCN6048A	NCN6059A
NCN6050A	NCN6061A
NCN6051A	NCN6065A

NOTES:

1. 2-FREQ. RECEIVER ONLY.
2. 2-FREQ. TRANSMITTER ONLY.
3. SPEAKER AND GROUND OMITTED IN HANDSET MODELS.
4. SWITCH VIEWED FROM THE REAR.
5. TO K1-8 IN P21DDN SERIES MODELS OR TO HIGH POWER FINAL AMPLIFIER IN P31DDN SERIES MODELS.
6. CONNECTED TO THE RF OUTPUT OF THE TRANSMITTER IN P21DDN SERIES MODELS OR TO HIGH POWER FINAL AMPLIFIER IN P31DDN SERIES MODELS.

EPD-13961-O

DIAGRAM NO. 63D81039A74-O

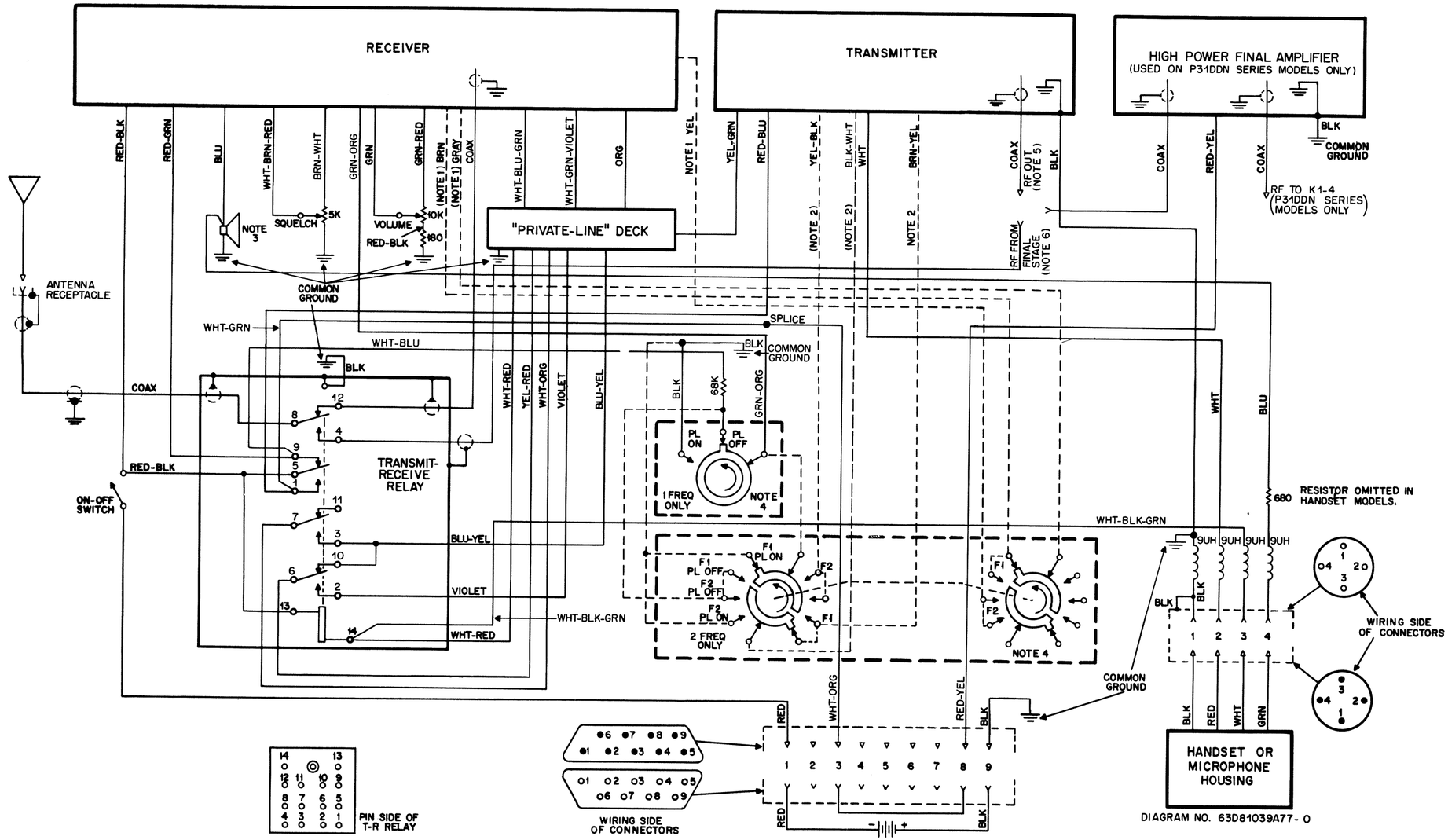
P21/P31DDN-3000 Series
Intercabling Diagram
Motorola No. 63D81039A74-O
9/23/66-AP

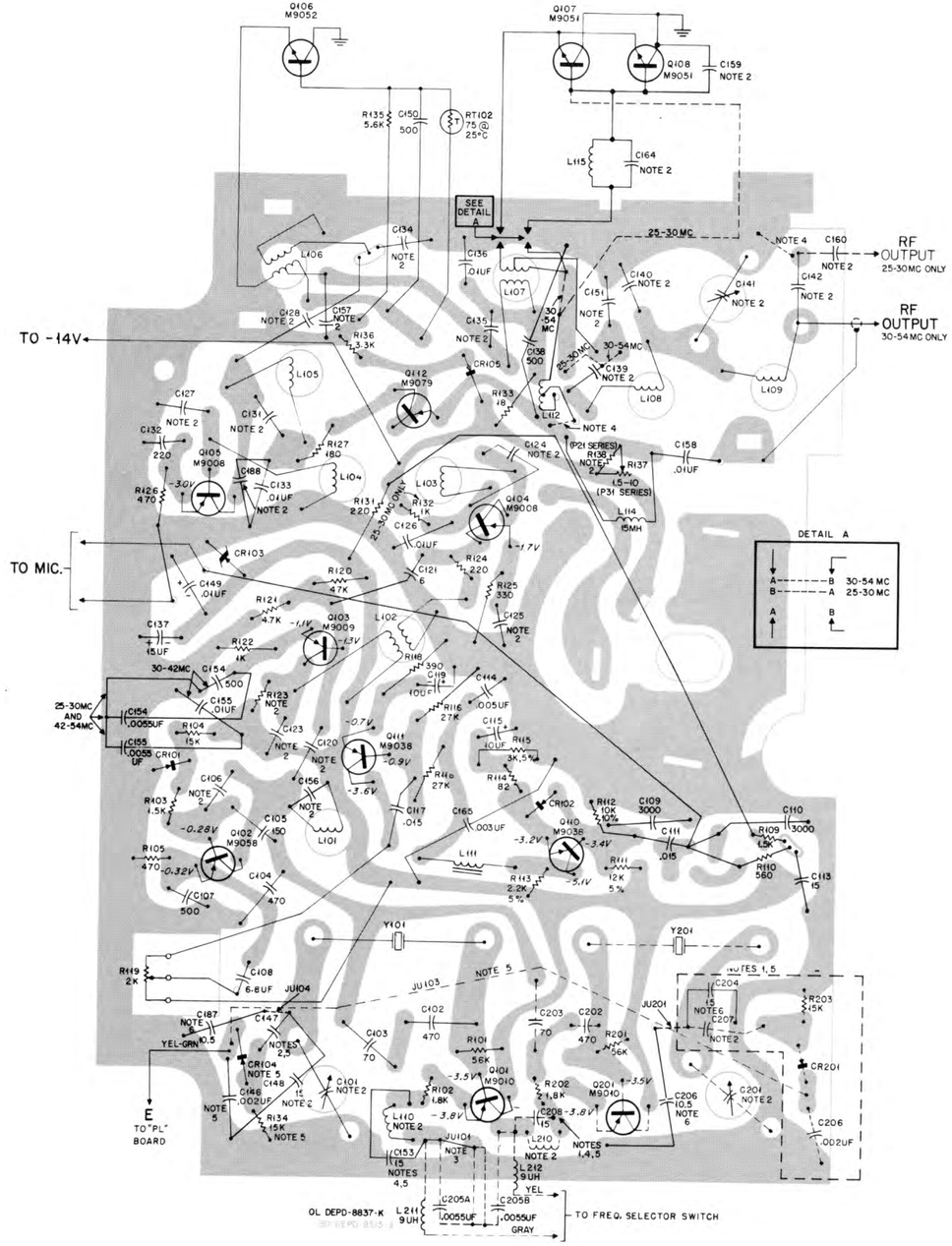
APPLICABLE CONTROL PANELS	
NCN6040B	NCN6065B

NOTES:

1. 2-FREQ. RECEIVER ONLY.
2. 2-FREQ. TRANSMITTER ONLY.
3. SPEAKER AND GROUND OMITTED IN HANDSET MODELS.
4. SWITCH VIEWED FROM THE REAR.
5. TO K1-4 IN P21DDN SERIES MODELS OR TO HIGH POWER FINAL AMPLIFIER IN P31DDN SERIES MODELS.
6. CONNECTED TO THE RF OUTPUT OF THE TRANSMITTER IN P21DDN SERIES MODELS OR TO HIGH POWER FINAL AMPLIFIER IN P31DDN SERIES MODELS.

EPD-13962-O





NOTES:

1. DASHED CIRCUITRY USED IN TWO FREQUENCY OPERATION ONLY.
2. REFER TO PARTS LISTS FOR COMPONENT VALUES.
3. USED ON 1-FREQ. MODELS ONLY.
4. APPEARS ON 30-42 MC UNITS ONLY.
5. USED IN "PRIVATE-LINE" MODELS ONLY
6. USED IN CARRIER SQUELCH MODELS ONLY.
7. USED IN NTB6060 SERIES ONLY.

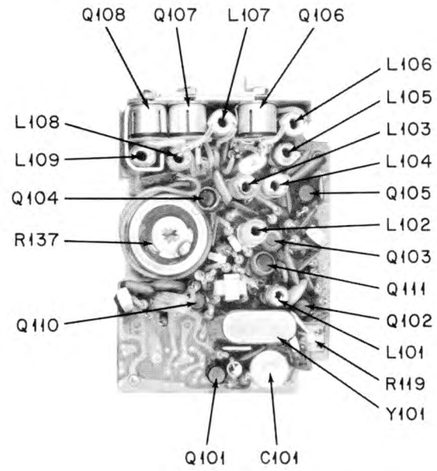
MODEL	SUFFIX
NTB6051AC	1
NTB6052AC	3
NTB6061AC	1
NTB6062AC	3

FOR UNITS SUFFIXED LATER THAN INDICATED IN THIS CHART, REFER TO CIRCUIT BOARD DIAGRAM EPD-13429.

EPD-13472-O

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
M	NTB6051AA-5 NTB6052AA-7 NTB6053AA-6 NTB6061AA-5 NTB6062AA-7 NTB6063AA-6 NTB6051AB-5 NTB6052AB-8 NTB6053AB-6 NTB6061AB-5 NTB6062AB-8 NTB6063AB-6 NTB6051AC-1 NTB6052AC-3 NTB6053AC-5 NTB6061AC-1 NTB6062AC-3 NTB6063AC-5 NTB6051AD-2 NTB6052AD-4 NTB6053AD-4 NTB6061AD-2 NTB6062AD-4 NTB6063AD-4		ADDED MODEL TABLE.	BELOW CKT. BOARD
N	NTB6051AA-5 NTB6052AA-7 NTB6053AA-6 NTB6061AA-5 NTB6062AA-7 NTB6063AA-6 NTB6051AB-5 NTB6052AB-8 NTB6053AB-6 NTB6061AB-5 NTB6062AB-8 NTB6063AB-6 NTB6051AC-1 NTB6052AC-3 NTB6053AC-5 NTB6061AC-1 NTB6062AC-3 NTB6063AC-5 NTB6051AD-2 NTB6052AD-4 NTB6053AD-4 NTB6061AD-2 NTB6062AD-4 NTB6063AD-4		ADDED NOTES	



AEPD-9005-O

MODEL TABLE

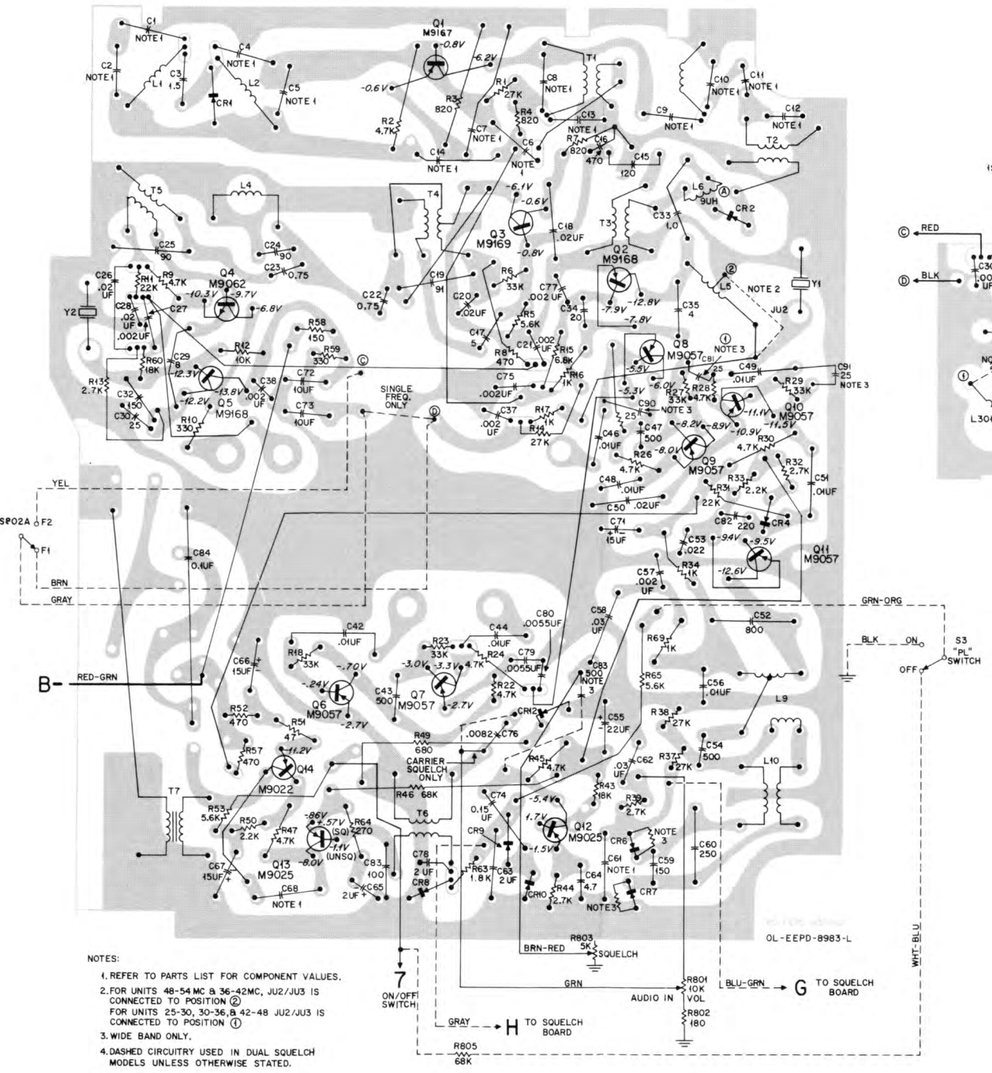
SERIES	MODEL NO.	CHASSIS SUFFIX	NO. OF FREQ.	FREQUENCY RANGE	RF POWER OUTPUT
NTB6050AA	NTB6051AA	5	1	25-30 MC	1.4 W
	NTB6052AA	7	1	30-42 MC	1.4 W
	NTB6053AA	6	1	42-54 MC	1.4 W
NTB6050AB	NTB6051AB	5	2	25-30 MC	1.4 W
	NTB6052AB	8	2	30-42 MC	1.4 W
	NTB6053AB	6	2	42-54 MC	1.4 W
NTB6060AA	NTB6061AA	5	1	25-30 MC	5 W
	NTB6062AA	7	1	30-42 MC	5 W
	NTB6063AA	6	1	42-54 MC	5 W
NTB6060AB	NTB6061AB	5	2	25-30 MC	5 W
	NTB6062AB	8	2	30-42 MC	5 W
	NTB6063AB	6	2	42-54 MC	5 W
NTB6050AC	NTB6051AC	1	1	25-30 MC	1.4 W
	NTB6052AC	3	1	30-42 MC	1.4 W
	NTB6053AC	5	1	42-54 MC	1.4 W
NTB6050AD	NTB6051AD	2	2	25-30 MC	1.4 W
	NTB6052AD	4	2	30-42 MC	1.4 W
	NTB6053AD	4	2	42-54 MC	1.4 W
NTB6060AC	NTB6061AC	1	1	25-30 MC	5 W
	NTB6062AC	3	1	30-42 MC	5 W
	NTB6063AC	5	1	42-54 MC	5 W
NTB6060AD	NTB6061AD	2	2	25-30 MC	5 W
	NTB6062AD	4	2	30-42 MC	5 W
	NTB6063AD	4	2	42-54 MC	5 W

EPD-15503-O

Transmitter Printed Circuit Board
And Wiring Diagram
Motorola No. EPD-8838-N
9/23/66-AP

MODEL TABLE (HANDSET ONLY)

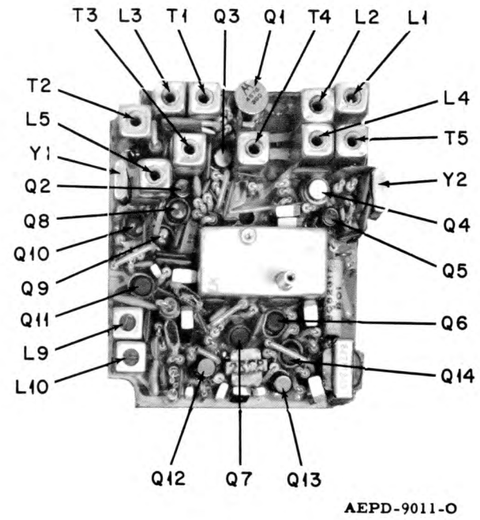
MODEL NERIES	NO. OF FREQ	CHANNEL WIDTH	TYPE OF SQUELCH
NRB1150AA	1	40KC	CARRIER
NRB1150AB	1	20KC	
NRB1150AC	2	40KC	
NRB1150AD	2	20KC	
NRB1150AF	1	20KC	DUAL



NOTES:

1. REFER TO PARTS LIST FOR COMPONENT VALUES.
2. FOR UNITS 48-54 MC & 36-42MC, JU2/JU3 IS CONNECTED TO POSITION ②
   FOR UNITS 25-30, 30-36, & 42-48 JU2/JU3 IS CONNECTED TO POSITION ①
3. WIDE BAND ONLY.
4. DASHED CIRCUITRY USED IN DUAL SQUELCH MODELS UNLESS OTHERWISE STATED.

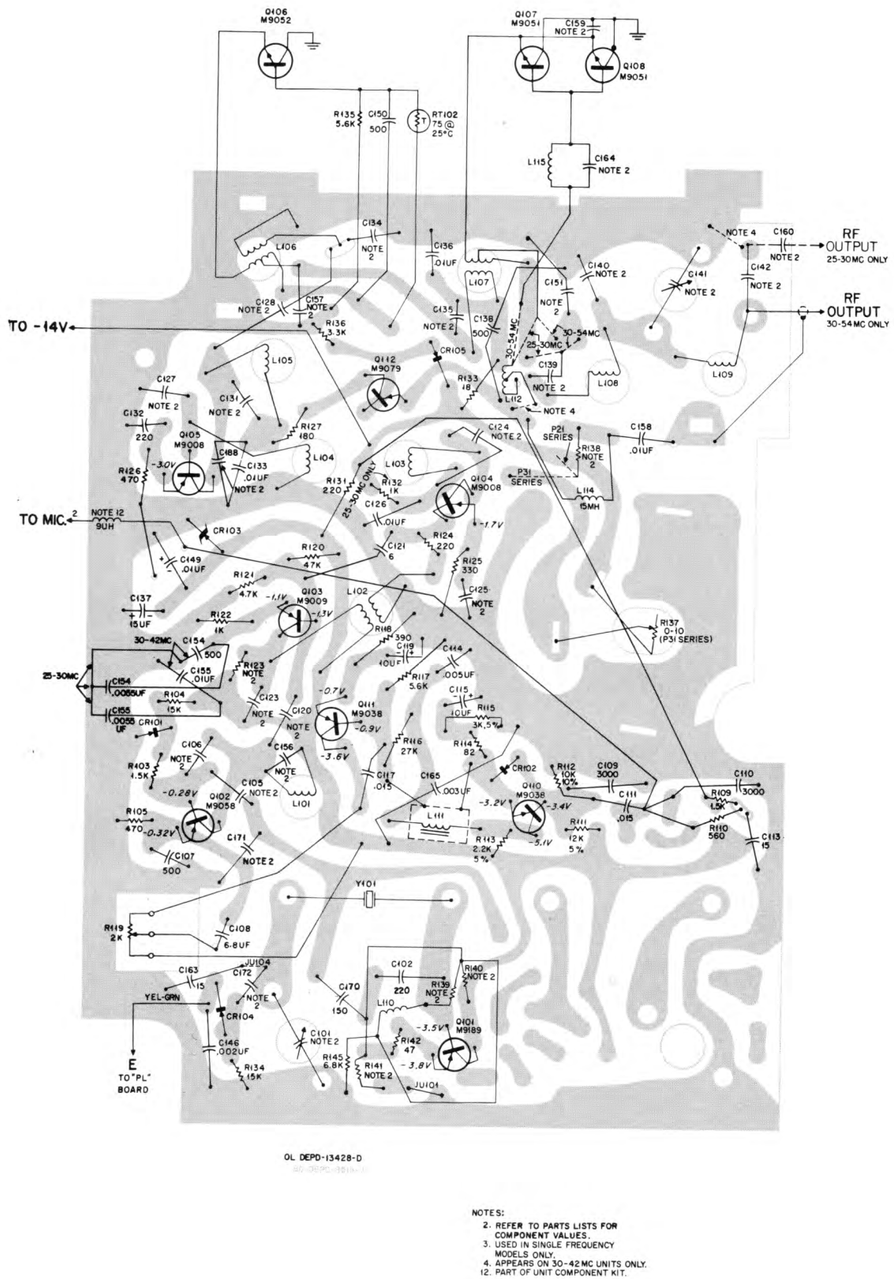
Handset Models Only
Receiver Printed Circuit Board
And Wiring Diagram
Motorola No. EPD-8978-M
9/23/66-AP



AEPD-9011-O

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
K	NRB1151AF-8 NRB1152AF-7 NRB1153AF-7	C61	WAS 21K861443, .01 uf	LOWER RIGHT OF Q12
L	NRB1151AF-8 NRB1152AF-7 NRB1153AF-7	R805	R805 WAS R66	BOTTOM CENTER OF BD.
M	NRB1151AA-8 NRB1152AA-7 NRB1153AA-7 NRB1151AB-7 NRB1153AB-6 NRB1151AC-8 NRB1152AC-7 NRB1153AC-7 NRB1151AD-7 NRB1153AD-6 NRB1151AF-8 NRB1152AF-7 NRB1153AF-7	C17	WAS 21D82877B17, 5 uuf	CENTER OF BOARD
		C86	ADDED 100 uuf	TOP MIDDLE OF BD.
		Q3	WAS 48R869238, TYPE M9238	
		R63	WAS 6K129269, 1.8K	Q13 BASE CKT.

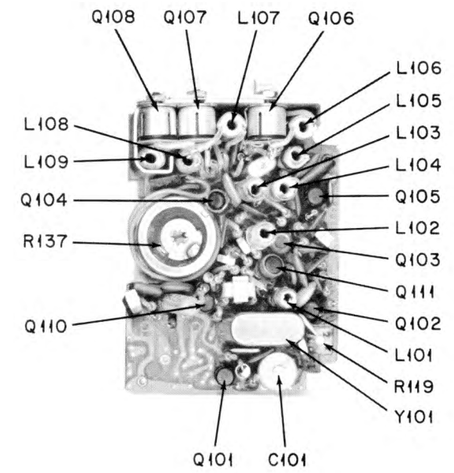


OL DEPD-13428-D

NOTES:
2. REFER TO PARTS LISTS FOR COMPONENT VALUES.
3. USED IN SINGLE FREQUENCY MODELS ONLY.
4. APPEARS ON 30-42 MC UNITS ONLY.
12. PART OF UNIT COMPONENT KIT.

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
E	NTB6051AA-7 NTB6052AA-9 NTB6053AA-8 NTB6051AB-7 NTB6052AB-10 NTB6053AB-8 NTB6061AA-7 NTB6062AA-9 NTB6063AA-8 NTB6061AB-7 NTB6062AB-10 NTB6063AB-8 NTB6051AC-6 NTB6052AC-9 NTB6061AC-6 NTB6062AC-9	L111	WAS 24B82872B01	Q110 COLLECTOR
F	NTB6051AA-7 NTB6052AA-9 NTB6053AA-8 NTB6051AB-7 NTB6052AB-10 NTB6053AB-8 NTB6061AA-7 NTB6062AA-9 NTB6063AA-8 NTB6061AB-7 NTB6062AB-10 NTB6063AB-8 NTB6051AC-6 NTB6052AC-9 NTB6061AC-6 NTB6062AC-9		9 uh WAS 9 mh	LEFT CENTER OF BOARD



AEPD-9005-O

MODEL TABLE

SERIES	MODEL NO.	CHASSIS SUFFIX	NO. OF FREQ.	FREQUENCY RANGE	RF POWER OUTPUT
NTB6050AC	NTB6051AC	6	1	25-30 MC	1.4 W
	NTB6052AC	9	1	30-42 MC	1.4 W
NTB6050AD	NTB6051AD	2	2	25-30 MC	1.4 W
	NTB6052AD	4	2	30-42 MC	1.4 W
	NTB6053AD	4	2	42-54 MC	1.4 W
NTB6060AC	NTB6061AC	6	1	25-30 MC	5 W
	NTB6062AC	9	1	30-42 MC	5 W
NTB6060AD	NTB6061AD	2	2	25-30 MC	5 W
	NTB6062AD	4	2	30-42 MC	5 W
	NTB6063AD	4	2	42-54 MC	5 W

EPD-15463-O

MODEL	SUFFIX
NTB6051AC	2
NTB6052AC	4
NTB6061AC	2
NTB6062AC	4

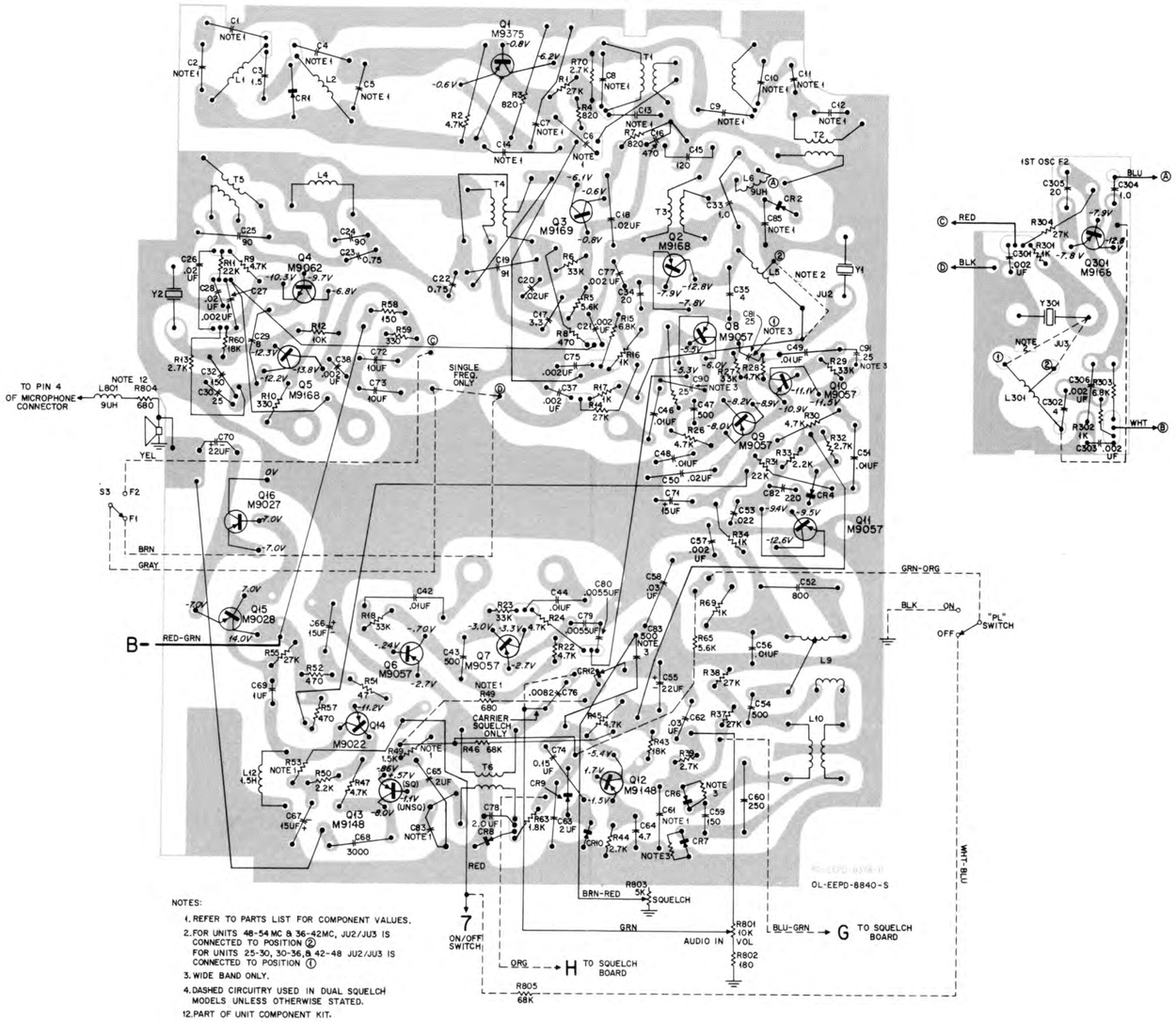
FOR UNITS SUFFIXED EARLIER THAN INDICATED IN THIS CHART, REFER TO CIRCUIT BOARD DIAGRAM EPD-8838.

EPD-13473-O

Transmitter Printed Circuit Board
And Wiring Diagram
Motorola No. EPD-13429-F
9/23/66-AP

MODEL TABLE (SPEAKER MODELS)

MODEL SERIES	NO. OF FREQ	CHANNEL WIDTH	TYPE OF SQUELCH
NRB1120AA		40 KC	CARRIER
NRB1120AB		20 KC	
NRB1120AC		40 KC	
NRB1120AD		20 KC	
NRB1120AF	1	20 KC	DUAL
NRB1120AH	2	20 KC	



NOTES:

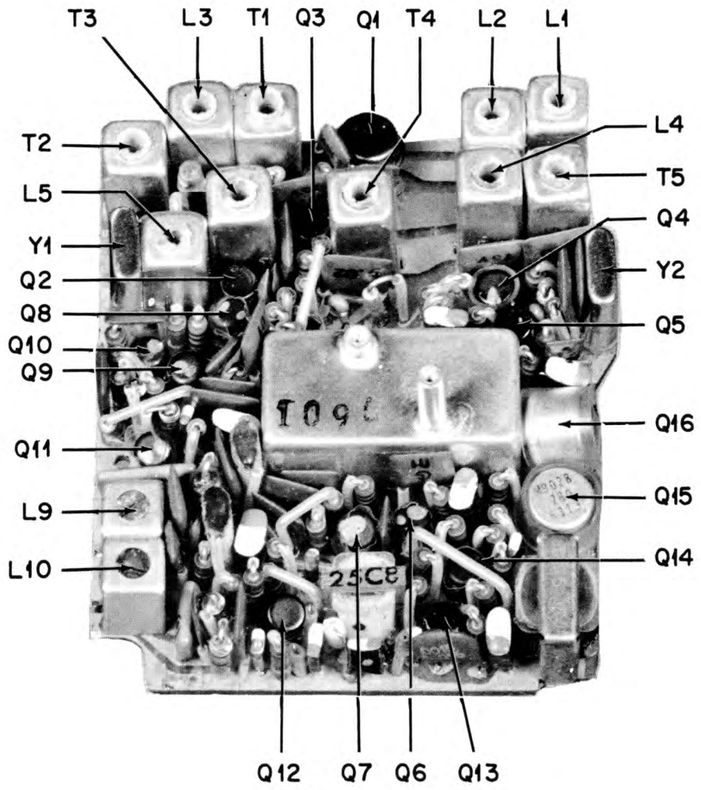
1. REFER TO PARTS LIST FOR COMPONENT VALUES.
2. FOR UNITS 48-54 MC & 36-42MC, JU2/JU3 IS CONNECTED TO POSITION ②
   FOR UNITS 25-30, 30-36 & 42-48 JU2/JU3 IS CONNECTED TO POSITION ①
3. WIDE BAND ONLY.
4. DASHED CIRCUITRY USED IN DUAL SQUELCH MODELS UNLESS OTHERWISE STATED.

12. PART OF UNIT COMPONENT KIT.

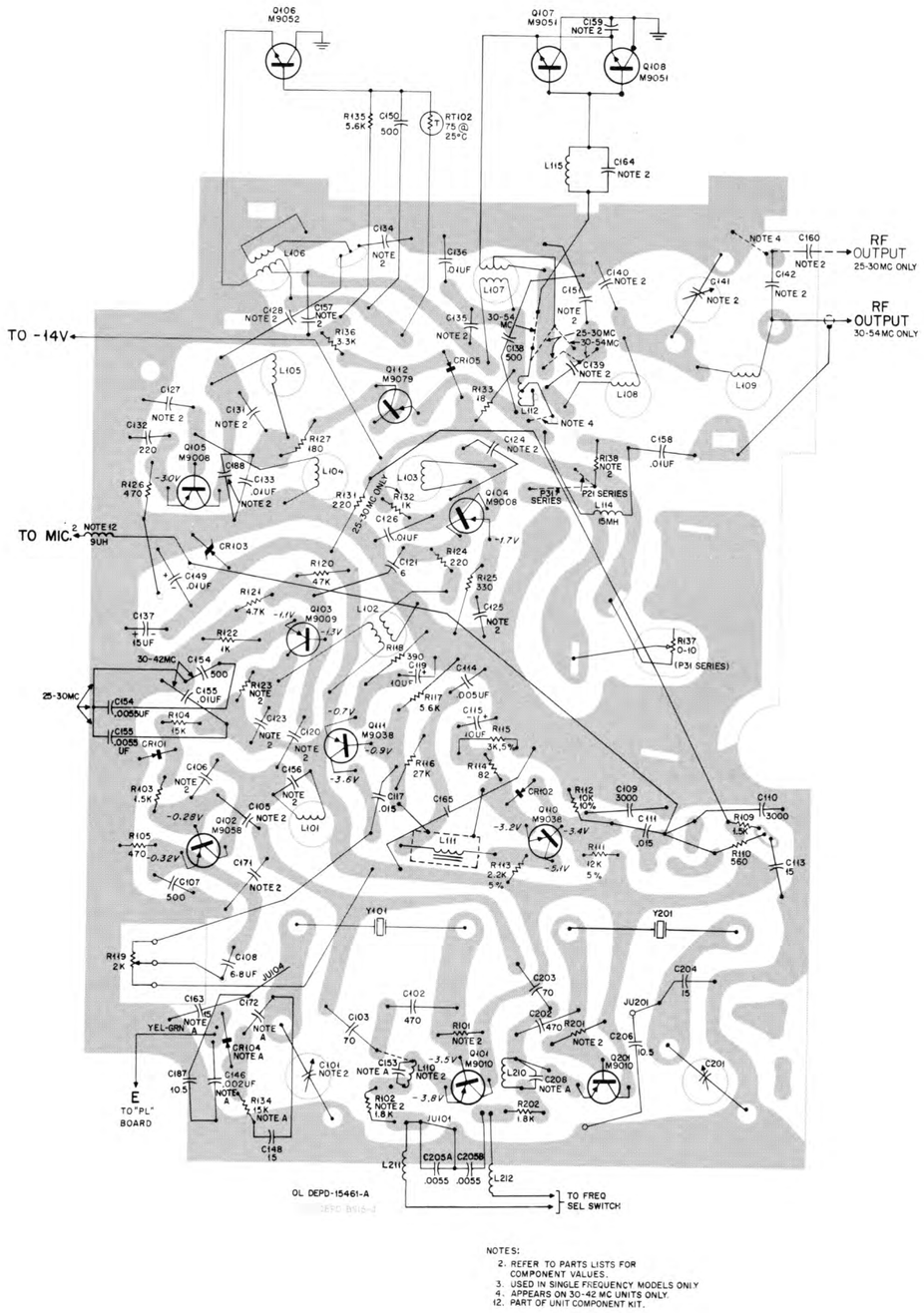
Speaker-Microphone and
Speaker-Handset Models
Receiver Printed Circuit Board
And Wiring Diagram
Motorola No. EPD-8841-R
9/23/66-AP

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
P	NRB1121AC-12 NRB1122AC-15 NRB1123AC-15 NRB1121AD-11 NRB1122AD-14 NRB1123AD-13	R70	WAS 2.2K	Q1 COLLECTOR
R	NRB1121AA-12 NRB1122AA-15 NRB1123AA-15 NRB1121AB-11 NRB1122AB-14 NRB1123AB-13	C17	WAS 21D82877B17, 5 uuf	CENTER OF BOARD
		C86	ADDED 100 uuf	TOP MIDDLE OF BD.
		Q3	WAS 48R869238, TYPE M9238	
	NRB1121AC-12 NRB1122AC-15 NRB1123AC-15 NRB1121AD-11 NRB1122AD-14 NRB1123AD-13 NRB1121AF-12 NRB1122AF-15 NRB1123AF-14 NRB1121AH-7 NRB1122AH-6 NRB1123AH-6	R63	WAS 6K129269, 1.8K	Q13 BASE CKT.



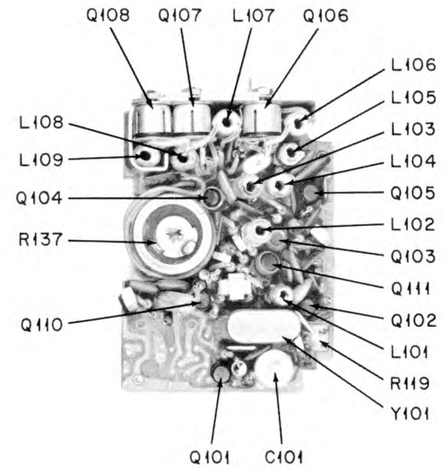
RECEIVER PRINTED CIRCUIT BOARD AEPD-8482-O



NOTES:
2. REFER TO PARTS LISTS FOR COMPONENT VALUES.
3. USED IN SINGLE FREQUENCY MODELS ONLY
4. APPEARS ON 30-42 MC UNITS ONLY.
12. PART OF UNIT COMPONENT KIT.

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	NTB6051AA-7 NTB6052AA-9 NTB6053AA-8 NTB6051AB-7 NTB6052AB-10 NTB6053AB-8 NTB6061AA-7 NTB6062AA-9 NTB6063AA-8 NTB6061AB-7 NTB6062AB-10 NTB6063AB-8 NTB6053AC-7 NTB6063AC-7	Q101, 201	WERE M9189	BOTTOM OF BOARD



AEPD-9005-O

MODEL TABLE

SERIES	MODEL NO.	CHASSIS SUFFIX	NO. OF FREQ.	FREQUENCY RANGE	RF POWER OUTPUT
NTB6050AA	NTB6051AA	7	1	25-30 MC	1.4 W
	NTB6052AA	9	1	30-42 MC	1.4 W
	NTB6053AA	8	1	42-54 MC	1.4 W
NTB6050AB	NTB6051AB	7	2	25-30 MC	1.4 W
	NTB6052AB	10	2	30-42 MC	1.4 W
	NTB6053AB	8	2	42-54 MC	1.4 W
NTB6060AA	NTB6061AA	7	1	25-30 MC	5 W
	NTB6062AA	9	1	30-42 MC	5 W
	NTB6063AA	8	1	42-54 MC	5 W
NTB6060AB	NTB6061AB	7	2	25-30 MC	5 W
	NTB6062AB	10	2	30-42 MC	5 W
	NTB6063AB	8	2	42-54 MC	5 W
NTB6050AC	NTB6053AC	7	2	42-54 MC	5 W
NTB6060AC	NTB6063AC	7	2	42-54 MC	5 W

EPD-15462-O

Transmitter Printed Circuit Board
And Wiring Diagram
Motorola No. EPD-15460-A
9/23/66-AP

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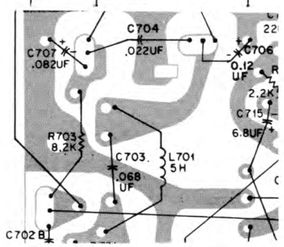
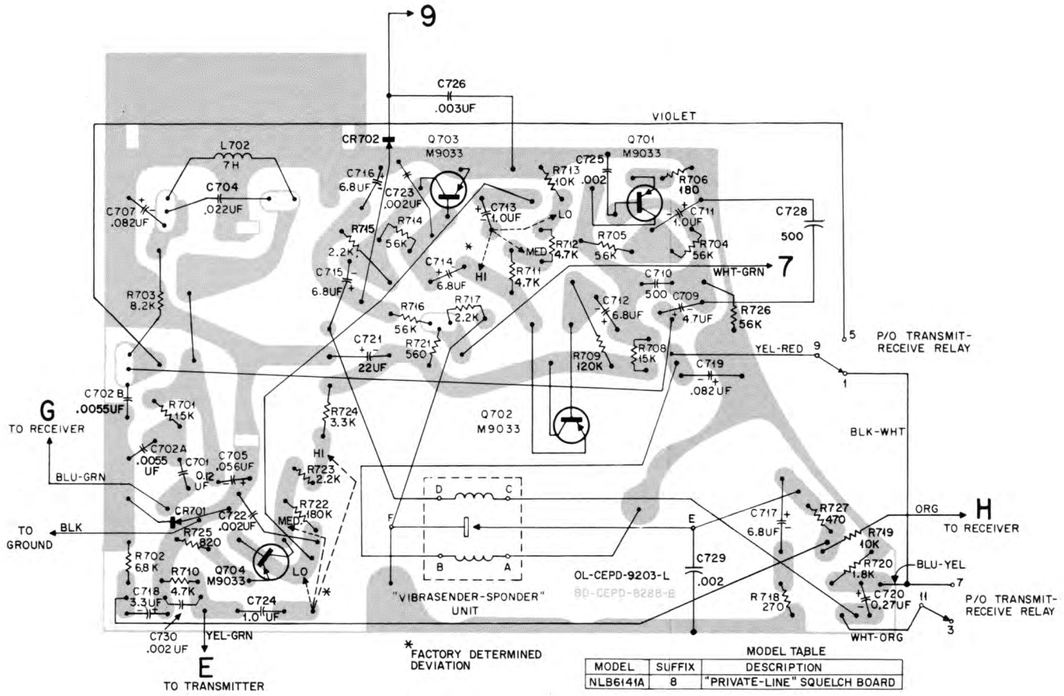
REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	NLB6141A-1	C727	ADDED 21K831126 .02 uf	"VIBRA-SENDER-SPONDER" UNIT CONTACT A
B	NLB6141A-2	R719	WAS 6K127806 (27K)	"VIBRA-SENDER-SPONDER" RESONANT REED CONTACT E
C	NLB6141A-3	C718	WAS 23D82397D07	LOWER LEFT OF BOARD
D	NLB6141A-3	C729	ADDED	"VIBRA-SENDER-SPONDER" UNIT CONTACT E
E	NLB6141A-4	R706	WAS 6K129862, 150 OHMS	Q701 EMITTER
		R726	ADDED 56K OHMS	Q701 BASE
F	NLB6141A-5	R727	ADDED 470 OHMS	LOWER RIGHT OF BOARD
G	NLB6141A-6	C702A, 702B	WAS 21B861469, DUAL .01 uf	LOWER LEFT OF BOARD
H	NLB6141A-7	C730	ADDED	LOWER LEFT OF BOARD
J	NLB6141A-7	C703	REMOVED 23D82397D11, .068 uf	UPPER LEFT OF BD
		C706	REMOVED 23 23D82397D12, 0.12 uf	
		L701	REPLACED 25C82750D01, CHOKE 5H WITH JUMPER CKT WAS AS SHOWN BELOW	



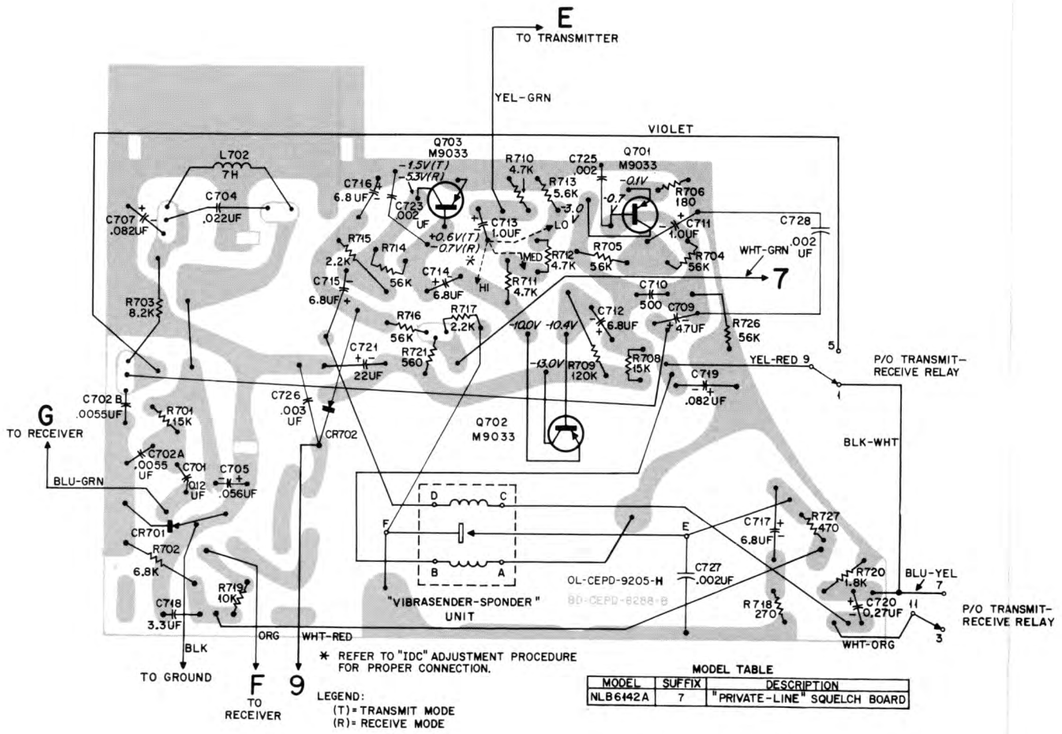
		R701, R708	WERE 6S127805, 1/4 W	PARTS LIST
		R703	WAS 6S128686, 1/4 W	
		R704, 705, 714, 716	WERE 6K129242, 1/4 W	
		R726	WAS 6K128570, 1/10 W	
		R706	WAS 6K129662, 1/4 W	
		R709	WAS 6K128987, 1/4 W	
		R710, 711, 712	WERE 6S127804, 1/4 W	
		R713	WAS 6K128558, 1/10 W	
		R721	WAS 6K129620, 1/4 W	
		R727	WAS 6K128545, 1/10 W	
		R715, 717, 723	WERE 6S128689, 1/4 W	
K	NLB6141A-8	C716	WAS 23D82397D16, 22 uf, 15 V	TOP LEFT OF BOARD



MODEL TABLE

MODEL	SUFFIX	DESCRIPTION
NLB6141A	8	"PRIVATE-LINE" SQUELCH BOARD

Model NLB6141A 25-42 MC "Private-Line"
Printed Circuit Board & Wiring Diagram
Motorola No. EPD-9204-K
9/23/66-AP

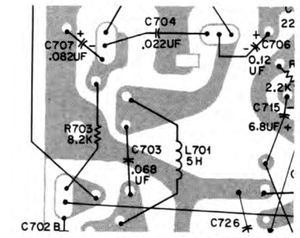


MODEL TABLE

MODEL	SUFFIX	DESCRIPTION
NLB6142A	7	"PRIVATE-LINE" SQUELCH BOARD

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	NLB6142A-1	C727	ADDED 21K831126 .02 uf	"VIBRA-SENDER-SPONDER" UNIT CONTACT A
B	NLB6142A-2	R719	WAS 6K127906 (27K)	"VIBRA-SENDER-SPONDER" RESONANT REED CONTACT E
C	NLB6142A-3	C718	WAS 23D82397D07 1 uf	LOWER LEFT OF BOARD
D	NLB6142A-4	R706	WAS 6K129862, 150 OHMS	Q701 EMIT-TER
		R726	ADDED 56K OHMS	Q701 BASE
E	NLB6142A-5	R727	ADDED 470 OHMS	LOWER RIGHT OF BOARD
F	NLB6142A-6	C702A, 702B	WAS 21B861469, DUAL .01 uf	LOWER LEFT OF BOARD
G	NLB6142A-6	C703	REMOVED 23D82397D11, .068 uf	UPPER LEFT OF BD.
		C706	REMOVED 23D82397D12, 0.12 uf	
		L701	REPLACED 25C82750D01, CHOKE 5H WITH JUMPER. CKT WAS AS SHOWN BELOW	



		R701, 708	WERE 6S127805, 1/4 W	PARTS LIST
		R703	WAS 6S128686, 1/4 W	
		R704, 705, 714, 716	WERE 6K129242, 1/4 W	
		R726	WAS 6K128570, 1/10 W	
		R706	WAS 6K129662, 1/4 W	
		R709	WAS 6K128987, 1/4 W	
		R710, 711, 712	WERE 6S127804, 1/4 W	
		R713	WAS 6K128558, 1/10 W	
		R721	WAS 6K129620, 1/4 W	
		R715, 717, 723	WERE 6S128689, 1/4 W	
H	NLB6142A-7	C716	WAS 22 uf, 23D82397D16 15 V	Q703 EMIT-TER

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
AK	NTB6051AA-7 NTB6052AA-9 NTB6053AA-8 NTB6051AB-7 NTB6052AB-10 NTB6053AB-8 NTB6061AA-7 NTB6062AA-9 NTB6063AA-8 NTB6061AB-7 NTB6062AB-10 NTB6063AB-8	L111	WAS 25B82872B01	PARTS LIST	XMTR. CKT. BD. EPD-13429-E
AK1	NRB1121AA-11 NRB1122AA-14	C17	WAS 21D82877B17, 5 uuf; N150	Q3 BASE	EPD-8978-M, EPD-8841-R
	NRB1123AA-14	C86	ADDED 100 uuf	Q13 BASE	
	NRB1121AB-10 NRB1122AB-13 NRB1123AB-12	Q3	WAS 48R869238, TYPE M9238	1ST IF AMP	
	NRB1121AC-11 NRB1122AC-14 NRB1123AC-14 NRB1121AD-10 NRB1122AD-13 NRB1123AD-12	R63	WAS 6K129269, 1.8K	PARTS LIST	
	NTB6051AA-7 NTB6052AA-9	Q101, 201	WERE 48R869189, TYPE M9189	OSC.	EPD-8838-N, EPD-15460-A
	NTB6053AA-8 NTB6051AB-7	C124H	WAS 21D82877B02, 150 uuf	PARTS LIST	
	NTB6052AB-10 NTB6053AB-8	C125M	WAS 21K847065, 500 uuf		
	NTB6061AA-7 NTB6062AA-9	C135M	WAS 21K861435, 70 uuf		
	NTB6063AA-8 NTB6061AB-7	C139M	WAS 21K861441, 500 uuf		
	NTB6062AB-10 NTB6063AB-8	C148	ADDED 15 uuf		
	NPN6030B	C601 THRU 605	WERE 21C82187B16	PARTS LIST	NONE
	NPN6031A	C601, 602	ADDED .003 uf	LOWER RIGHT OF DIAG.	NONE
	NLN6234A-3	C81, 90, 91	WERE 50 uuf	PARTS LIST	EPD-8978-M
		R35, 36	WERE 6K128563, 15K, 1/10 W		

PARTS LIST for Schematic Diagram 63E81017A21-AK1

LEGEND
L = 25-30 MC
M = 30-42 MC
H = 42-54 MC

RECEIVER

NRB1121AA	NRB1121AD	NRB1151AC
NRB1122AA	NRB1122AD	NRB1152AC
NRB1123AA	NRB1123AD	NRB1153AC
NRB1121AB	NRB1151AA	NRB1151AD
NRB1122AB	NRB1152AA	NRB1152AD
NRB1123AB	NRB1153AA	NRB1153AD
NRB1121AC	NRB1151AB	
NRB1122AC	NRB1152AB	
NRB1123AC	NRB1153AB	

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uuf ±10%; 75 v; unl. stated
C1L, 1M, 10M	21K861433	36; N150
C1H, 10H, 12H	21K861462	15; N150
C2L, 2H, 32, 59	21D82877B02	150; N1400
C2M, 82	21K868829	220; N1400
C3	21C82450B27	1.5; 500 v
C4L	21K861433	36; N150; handset models
	or21K861434	40; N150; speaker models
C4M, 5M, 81	21K864013	50; N150
C4H, 34, 305	21K861432	20; N150
C5L	21K861435	70; N150
C5H, 8M, 12M	21D82877B06	30; N150
C6, 9L, 11L	21C82450B30	1.8 ±5%
C7L, 7M, 13L, 13M, 14L, 14M, 21, 27, 31, 37, 75, 77, 301, 303, 306	21K861442	.002 uf +100-20%
C7H, 13H, 14H, 43, 47, 54, 83	21K847065	500 GMV; 250 v
C8L	21D82877B01	24; N150
C8H	21K861431	12; N150
C9H, 11H	21C82450B24	0.47; 500 v
C9M, 11M, 33, 304	21C82450B28	1.0; 500 v
C10L, 12L	21D82877B01	24; N150; handset models
	or21D82877B06	30; N150; speaker models
C15	21D82877B15	120; N150
C16	21K861440	470; N2200
C17	21K861603	3.3 ±5%; NP0
C18, 20, 26, 28, 50	21K861444	.02 uf +100-20%
C19	21D82877B14	91; N470
C22, 23	21C82450B22	0.75; 500 v
C24, 25	21K864522	90; N080
C29	21K861429	8; N150
C30	21K865197	25; N150
C33, 304	21C82450B28	1.0; 500 v
C35, 302	21K861427	4; N150
C42, 44, 46, 48, 49, 51, 56, 61, 79, 80	21K861443	.01 uf +100-20%
C52	21D82239E02	800 ±5%; 200 v
C53	23D82397D06	0.22 uf +40-20%; 35 v
C55	23D82397D16	22 uf ±20%; 15 v
C57	21K864457	.002 uf +100-20%
C58, 62	8C82317B03	.03 uf; 50 v
C60	21D82239E03	250 ±5%; 200 v
C63, 78	23D82397D19	2 uf +40-20%; 8 v
C64	23D82397D05	4.7 uf +40-20%; 3 v
C65	23D82397D19	2 uf +40-20%; 8 v
C66, 67, 71	23D82397D17	15 uf ±20%; 20 v
C68	21C82187B16	3000; 100 v (speaker models)
	or21D82428B09	4700; 100 v (handset models)
C69	23D82397D07	1 uf +40-20%; 15 v
C70	23D82397D16	22 uf ±20%; 15 v (speaker models)
C72, 73	23D82397D15	10 uf ±20%; 20 v
C74	23D82397D08	0.15 uf +40-20%; 35 v
C84	8C82317B01	0.1 uf; 100 v
C85L, 85M	21K861426	2.2; N150
C86	21K861437	100; N2200

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SEMICONDUCTOR DEVICE, diode: NOTE I
CR1	48C82363E03	silicon
CR2	48C859464	germanium
CR4, 6, 7	48C82178A01	germanium
CR8, 9, 10	48C82363E02	silicon
		COIL, RF:
L1L, 2L, 3L	24C82765D07	GRN-RED; does not incl 76K861425 CORE, tuning
L1M, 1H, 2M, 2H, 3M, 3H	24C82765D06	GRN-BRN; does not incl 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
L4	24C82765D05	GRN-GRA; does not incl 76K847160 CORE, tuning or 76A82686D01 SLEEVE, iron
L5M, 301M	24C82766D08	BLU-RED; does not incl 76A82686D02 CORE, tuning
L5L, 5H, 301L, 301H	24C82766D04	BLU-GRA; does not incl 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
L6	24C847920	choke; 9 uh
L9	24B82695D01	limiter; c/o; pri: term. no. 1 and 2 with no. 5 center tap; sec: term. no. 3 and 4
L10	24B82696D01	discriminator; 455 kc; incl tuning core
L12	25B82751D01	choke; 1.5 h
		TRANSISTOR: NOTE I
Q1	48R869375	P-N-P; type M9375
Q2, 5, 301	48R869168	P-N-P; type M9168
Q3	48R869169	N-P-N; type M9169
Q4	48K869062	N-P-N; type M9062 BLU
Q6, 7, 8, 9, 10, 11	48R869057	P-N-P; type M9057
Q12, 13	48R869148	P-N-P; type M9148
Q14	48R869022	N-P-N; type M9022
Q15	48R869028	P-N-P; type M9028
Q16	48R869027	N-P-N; type M9027
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R1, 14, 37, 38, 304	6K127806	27K
R2, 9, 22, 24, 26, 28, 30, 45, 47	6K127804	4.7K
R3, 4, 7	6K129432	820
R5	6K129433	5.6K
R6, 21, 23, 25, 27, 29	6K127807	33K
R8, 52, 57	6K127801	470
R10, 59	6K129775	330
R11, 31	6K128685	22K
R12	6K129225	10K
R13, 32, 39, 44	6K128688	2.7K
R15, 303	6K128687	6.8K
R16, 17, 34, 69, 301, 302	6K127802	1K
R33, 50	6K128689	2.2K
R43, 60	6K128904	18K
R46	6K129144	68K
R49	6K127803	1.5K
R51	6K129233	47
R53	6K129433	5.6K; handset models
	or6K127804	4.7K; speaker models
R54, 55	6K127806	27K; speaker models
R58	6K129862	150
R63	6K128552	1.8K; 1/10 w
R64	6K129753	100; handset models
R70	6S185B84	2.7K; 1/8 w
		TRANSFORMER:
T1L	24C82767D06	GRN-BLK; does not incl 76K861425 CORE, tuning
T1M, 1H	24C82767D03	GRN-ORG; does not incl 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
T2L	24C82767D07	GRN-VIO; does not incl 76K861425 CORE, tuning
T2M, 2H	24C82767D04	GRN-GRN; does not incl 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
T3, 5	24C82767D05	GRN-BLU; does not incl 76K847160 CORE, tuning or 76A82686D01 SLEEVE, iron

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
T4	24C82207G01	RED-RED; does not incl 76K847160 CORE, tuning or 76A82686D01 SLEEVE, iron
T6	25B82699D01	audio input; BLU dot; c/o; pri: coil res. 1340; imped. 10K sec: coil res. 348; imped. 1K
T7	25B82893E01	audio; pri: imped. 1200; res. 125; sec: imped. 120; res. 12
		CRYSTAL UNIT, quartz: NOTE II
Y1, 301	YM45	25-42 mc
	or YM46	42-54 mc
Y2	YN	5.245 or 6.155 mc

NLN6234A Resistor Kit (Wide Channel Spacing)

		CAPACITOR, fixed:
C81, 90, 91	21K865197	25 ±10%; 75 v; N150
C83	21K847065	500 GMV; 250 v
		RESISTOR, fixed: ±10%; 1/8 w unl stated
R35, 36	6S185B93	15K

FILTER

		FILTER, IF:
Z1	NFN6006AS	bandpass; 20 kc
	NFN6006AW	bandpass; 40 kc
NON-REFERENCED ITEMS		
	26B82671D01	SHIELD, coil: 10 req'd
	14A82271E01	INSULATOR, coil shield; used with L1, 2, 3, 5, T1, 2

NOTES:

1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS, ±10%; 1/4 WATT, K=1000.
   ALL CAPACITOR VALUES ARE IN MICROMICROFARADS.
2. REFER TO PARTS LIST FOR COMPONENT VALUE.
3. USED IN SINGLE FREQUENCY MODELS ONLY.
4. PART OF HOUSING.
5. REFER TO RECEIVER PRINTED CIRCUIT BOARD AND WIRING DIAGRAM FOR PROPER TAP.
6. ALL VOLTAGE READINGS REFERENCED TO CHASSIS GROUND. DC READINGS TAKEN WITH A MOTOROLA DC MULTIMETER.
7. FREQUENCY CALCULATIONS:

   TRANSMITTER: $f_0 = \frac{f_c}{16}$

   RECEIVER: f_c = CARRIER FREQUENCY (25-54 MC)

   f_{01} = 1ST OSCILLATOR CRYSTAL FREQUENCY (30.7-48.3 MC)

   f_{02} = 2ND OSCILLATOR CRYSTAL FREQUENCY (REFER TO CHART ON BLOCK DIAGRAM)

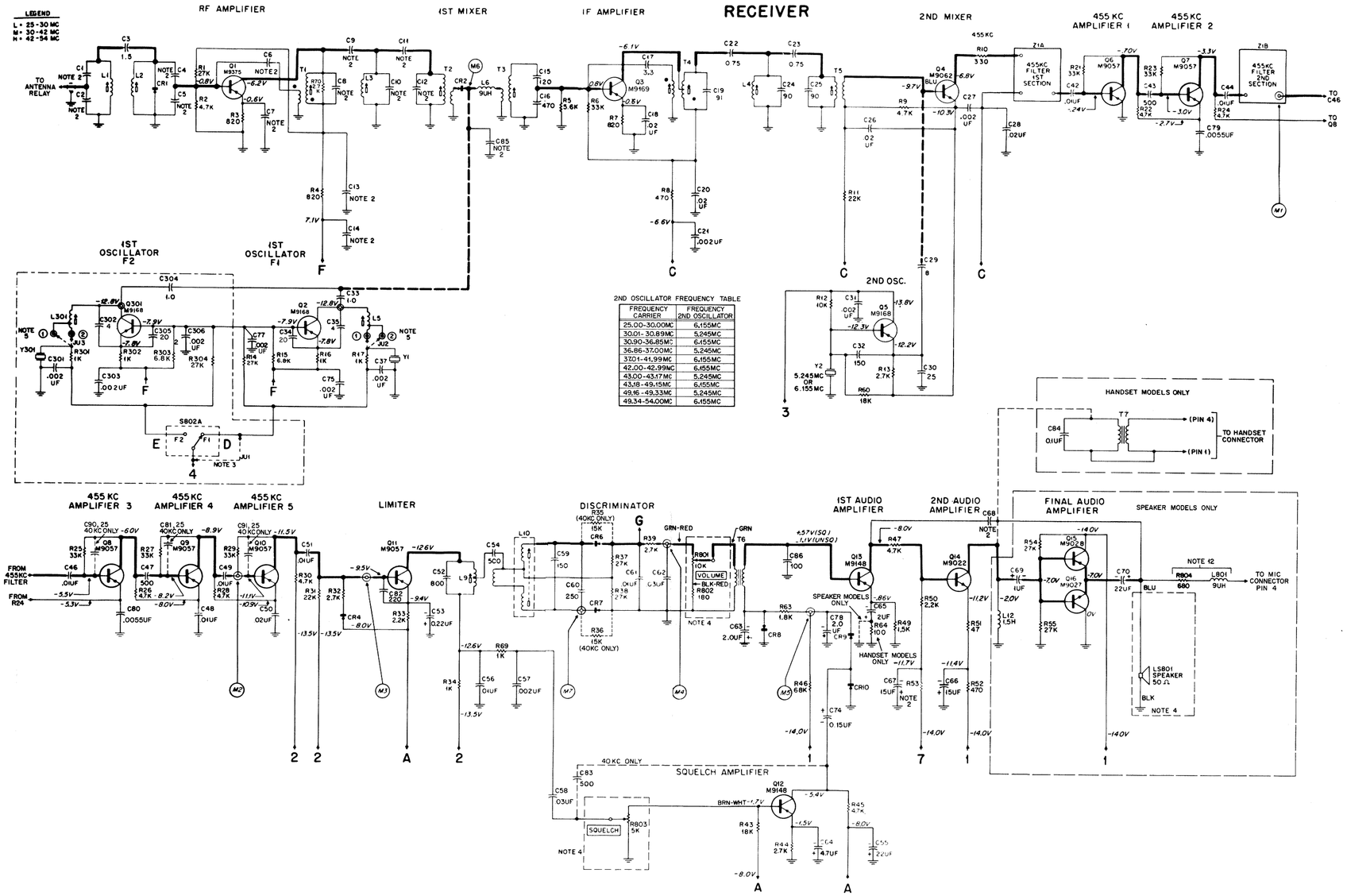
   f_1 = 1ST INTERMEDIATE FREQUENCY (5.7 MC)

   f_2 = 2ND INTERMEDIATE FREQUENCY (455 KC)

   $f_{01} = f_c + f_1$ (25-42 MC)

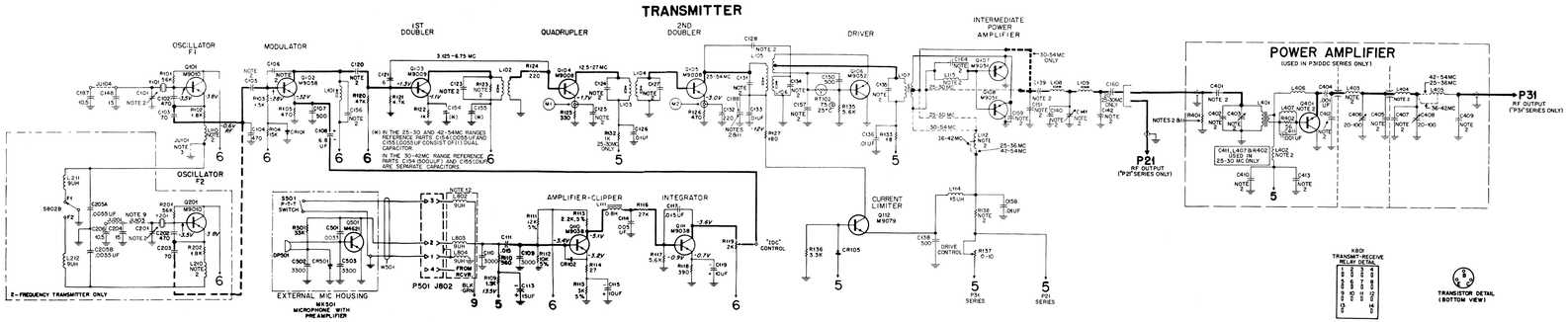
   $f_{02} = f_c - f_1$ (42-54 MC)
8. HANDSET MODELS ONLY.
9. JU103 MAY OR MAY NOT EXIST DEPENDING UPON OPERATING FREQUENCY.
10. REFER TO BATTERY REPLACEMENT AND CHARGING SECTION OF THE INSTRUCTION MANUAL FOR LOCATION OF FUSE.
11. NOT USED IN 42-54 MC RANGE.
12. PART OF UNIT COMPONENT KIT.

EPD-8874-D



PREVIOUS REVISIONS SHOWN
ON FRONT OF THIS DIAGRAM

25-54 MC "Handie-Talkie" FM Radio
Carrier Squelch Schematic Diagram
Motorola No. 63E81017A21-AK1
(Sheet 1 of 2)
9/23/66-AP



TRANSMITTERS

SERIES	MODEL NO.	CHASSIS SUFFIX	NO. OF FREQ.	FREQUENCY RANGE	RF POWER OUTPUT
NTB6050AA	NTB6051AA	7	1	25-30 MC	1.4 W
	NTB6052AA	9	1	30-42 MC	1.4 W
	NTB6053AA	8	1	42-54 MC	1.4 W
NTB6050AB	NTB6051AB	7	2	25-30 MC	1.4 W
	NTB6052AB	10	2	30-42 MC	1.4 W
	NTB6053AB	8	2	42-54 MC	1.4 W
NTB6040AA	NTB6061AA	7	1	25-30 MC	5 W
	NTB6062AA	9	1	30-42 MC	5 W
	NTB6063AA	8	1	42-54 MC	5 W
NTB6040AB	NTB6061AB	7	2	25-30 MC	5 W
	NTB6062AB	10	2	30-42 MC	5 W
	NTB6063AB	8	2	42-54 MC	5 W

CONTROL PANELS

MODEL NUMBER	SUFFIX	XMTR. FREQ.	RCVR. FREQ.	HANDSET	SPEAKER	MICROPHONE	RF POWER OUTPUT
NGN6023A		1	1	X			1.4 W
NGN6025A		2	1	X			1.4 W
NGN6026A		2	2	X			1.4 W
NCN6039A		1	1		X	X	1.4 W
NCN6041A		2	1		X	X	1.4 W
NCN6043A		2	2		X	X	1.4 W
NCN6044A		1	1	X	X		1.4 W
NCN6045A		1	1		X	X	5 W
NCN6047A		2	1		X	X	5 W
NCN6049A		2	2		X	X	5 W
NCN6052A		1	1	X	X		1.4 W
NCN6054A		2	2	X	X		1.4 W
NCN6056A		1	1	X	X		5 W
NCN6058A		2	1	X	X		5 W
NCN6060A		2	2	X	X		5 W
NCN6039B		1	1		X	X	1.4 W
NCN6043B		2	2		X	X	1.4 W
NCN6044B		1	1	X	X		1.4 W
NCN6054B		2	2	X	X		1.4 W

RECEIVERS

SERIES	MODEL NO.	CHASSIS SUFFIX	NO. OF FREQ.	CHANNEL SPACING	FREQUENCY RANGE	USED WITH
NRB1120AA	NRB1121AA	12	1	40 KC	25-30 MC	SPEAKER
	NRB1122AA	15	1	40 KC	30-42 MC	SPEAKER
	NRB1123AA	15	1	40 KC	42-54 MC	SPEAKER
NRB1120AB	NRB1121AB	11	1	20 KC	25-30 MC	SPEAKER
	NRB1122AB	14	1	20 KC	30-52 MC	SPEAKER
	NRB1123AB	13	1	20 KC	42-54 MC	SPEAKER
NRB1120AC	NRB1121AC	12	2	40 KC	25-30 MC	SPEAKER
	NRB1122AC	15	2	40 KC	30-42 MC	SPEAKER
	NRB1123AC	15	2	40 KC	42-54 MC	SPEAKER
NRB1120AD	NRB1121AD	11	2	20 KC	25-30 MC	SPEAKER
	NRB1122AD	14	2	20 KC	30-42 MC	SPEAKER
	NRB1123AD	13	2	20 KC	42-54 MC	SPEAKER
NRB1150AA	NRB1151AA	8	1	40 KC	25-30 MC	HANDSET ONLY
	NRB1152AA	7	1	40 KC	30-42 MC	HANDSET ONLY
	NRB1153AA	7	1	40 KC	42-54 MC	HANDSET ONLY
NRB1150AB	NRB1151AB	7	1	20 KC	25-30 MC	HANDSET ONLY
	NRB1152AB	6	1	20 KC	30-42 MC	HANDSET ONLY
	NRB1153AB	6	1	20 KC	42-54 MC	HANDSET ONLY
NRB1150AC	NRB1151AC	8	2	40 KC	25-30 MC	HANDSET ONLY
	NRB1152AC	7	2	40 KC	30-42 MC	HANDSET ONLY
	NRB1153AC	7	2	40 KC	42-50 MC	HANDSET ONLY
NRB1150AD	NRB1151AD	7	2	20 KC	25-30 MC	HANDSET ONLY
	NRB1152AD	6	2	20 KC	30-42 MC	HANDSET ONLY
	NRB1153AD	6	2	20 KC	42-54 MC	HANDSET ONLY

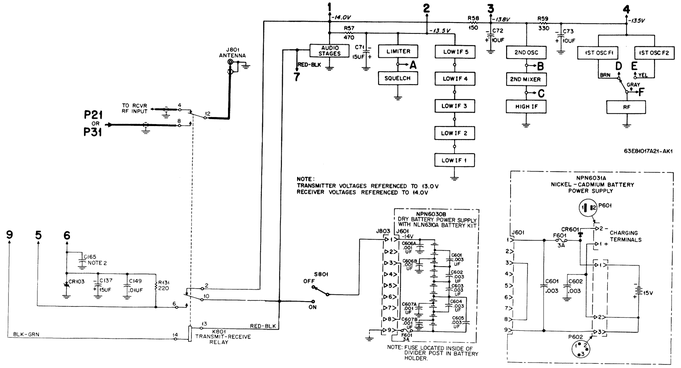
POWER AMPLIFIERS

MODEL NO.	CHASSIS SUFFIX	FREQUENCY RANGE
NLB6121A	2	25-30 MC
NLB6122A	2	30-42 MC
NLB6123A	1	42-54 MC

POWER SUPPLIES

MODEL NO.	CHASSIS SUFFIX	TYPE OF BATTERIES
NPN6030B		DRY
NPN6031A		NICKEL-CADMIUM

EPD-8847-M



63E81017A21-AK1

25-54 MC "Handie-Talkie" FM Radio
Carrier Squelch Schematic Diagram
Motorola No. 63E81017A21-AK1
(Sheet 2 of 2)
9/23/66-AP

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		LEGEND L = 25-30 MC M = 30-42 MC H = 42-54 MC TRANSMITTER
NTB6051AA NTB6052AA NTB6053AA NTB6051AB NTB6052AB NTB6053AB	NTB6061AA NTB6062AA NTB6063AA NTB6061AB NTB6062AB NTB6063AB	
		CAPACITOR, fixed: uuf ±10%; 75 v; unl stated
C101, 141, 201	20C82399D04	var: 5.5-18; 200 v; NP0
C102, 104, 202	21K861440	470; N2200
C103, 135M, 140L, 142M, 156L, 203	21K861435	70; N150
C105L, 105H, 106M, 106H,	21D82877B02	150; N1400
C105M	21K865922	390; 500 v
C107, 125H, 139M, 150	21K847065	500 GMV; 250 v
C108	23C82397D09	6.8 uf +40-20%; 10 v
C109, 110	21K858108	3000 ±25%; 250 v
C111	8K854329	.015 uf; 250 v
C113, 137	23C82397D17	15 uf ±20%; 20 v
C114	8C82548E03	.005 uf; 100 v
C115, 119	23C82397D03	10 uf ±20%; 6 v
C117	8C82548E02	.015 uf; 100 v
C120L, 120H, 139H, 156M, 156H	21K861436	100; N750
C120M, 132	21K861438	220; N1400
C121, 128H	21K861428	6; N150
C123L, 124L, 127L, 127M	21D82877B35	220; N470
C123M, 131M	21K868384	100; N150
C123H, 131H, 134H	21K864013	50; N150
C124M	21D82239E03	250 ±5%; 200 v
C125L	21K831126	.002 uf GMV; 300 v
C126, 133, 136, 138, 149, 155M, 158	21K861443	.01 uf +100-20%
C127H, 134L	21D82877B15	120; N150
C128M	21K861427	4; N150
C131L	21K864012	60; N150
C124H	21D82877B05	150; N750

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C134M	21K864067	80; N150
C135L	21K868384	100; N150
C135H, 159L	21K861434	40; N150
C139L, 157L, 160L	21K861432	20; N150
C138, 125M, 154M	21K861441	500; N4700
C140M, 140H, 148, 204	21D82877B19	15 ±5%; NP0
C141L	20C82399D07	var; 15-60; 200 v; N1500
C141M, 141H	20C82399D04	var; 5.5-18; 200 v; NP0
C151H	21K861430	10; N150
C154L, 154H, 155L, 155H	21C82724H01	dual sect.; each section c/o: 5500 +100-20%
C164H	21K858108	.003 uf ±25%; 250 v
C164L, M	21C82040D12	800 uuf ±5%; 25 v
C187, 206	21D82877B11	10, 5 ±5%; NP0
C188L, M	23D82397D07	1.0 uf +40-10%; 15 v
C205	21C82724H01	dual sect.; c/o; 5500 +100-20%
C205A C205B		5500 +100-20%
GR101, 102	48C82178A01	SEMICONDUCTOR DEVICE, diode: (NOTE 1) germanium
GR103	48C82256C08	zener type
GR105	48C82392B12	silicon
L101L, M	24C82901B04	COIL, RF: does not incl. 76K83565 CORE, tuning modulator
L101H	24C82901B05	modulator; GRN-YEL
L102	24B82194C01	1st doubler; RED
L103L, 104L	24C82904B19	quadrupler output; 2nd doubler input
L103M, 103H	24C82904B14	quadrupler output; 2nd doubler output
L104M, 104H	24C82904B15	2nd doubler input
L105L	24C82904B20	2nd doubler
L105M, 105H	24C82904B12	2nd doubler output
L106L	24B82648G01	driver input
L106M, 106H, 107M, 107H	24B82209E01	driver input; final ampl. input
L107L	24B82737E01	final ampl. input
L108L, 108M, 109L, 109M	24C82904B21	final ampl. output
L108H, 109H	24C82904B01	final ampl. output
L110L, 210L	24D82549D03	choke; 1 mh
L110M, 110H, 210M, 210H	24D82549D10	choke; 390 uh
L111	25B82872B02	choke; 0.8 h
L112L	24A890687	choke; 2 uh
L112M	24A82228G01	choke; 1.2 uh
L112H	24C82000E08	choke; 0.31 uh; sleeved
L114	24D82549D09	choke; 15 uh
L115	24C83961B01	choke; 3 turns, coded BRN
L211, 212	24C82000E03	choke; 9 uh
Q101, 201	48R869010	TRANSISTOR: (NOTE 1) P-N-P; type M9010
Q102	48R869058	P-N-P; type M9058
Q103	48R869009	P-N-P; type M9009
Q104, 105	48R869008	P-N-P; type M9008
Q106	48R869052	N-P-N; type M9052
Q107, 108	48R869051	N-P-N; type M9051
Q110, 111	48R869038	P-N-P; type M9038
Q112	48R869079	N-P-N; type M9079
R101, 201	6KR129242	RESISTOR, fixed: ±10%; 1/4 w; unl. stated 56K
R102, 202	6KR129269	1.8K
R103, 109	6KR127803	1.5K
R104, 123L, 123M	6KR127805	15K
R105, 126	6KR127801	470
R110	6KR129620	560
R111	6KR129887	12K ±5%
R112	6KR129668	10K ±5%
R113	6KR129804	2.2K ±5%
R114	6KS131594	27
R115	6KS124A60	3K ±5%
R116	6KR127806	27K
R117	6KR129433	5.6K
R118	6KR129863	390

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R119	18D82876B04	var; 2K ±15%; 1/20 w
R120	6KR128902	47K
R121	6KR127804	4.7K
R122, 132L	6KR127802	1K
R123H	6KR129225	10K
R124, 131	6KR127800	220
R125	6KR127775	330
R127	6KR129662	180
R133	6KR131650	18
R135	6KR129433	5.6K
R136	6KR129231	3.3K
R137	18C82035B17	var; 10 ±20%; 1.5 w
R138L	17A82036G25	2.5 ±3%; 2 w
R138M, 138H	17A82035G26	2 ±3%; 2 w
RT102	6B859699	THERMISTOR: 75 ohms @ 25°C
Y101, 201	ABX-2	CRYSTAL UNIT, quartz; NOTE II xmtr. control
	26A82609E01	NON-REFERENCED ITEMS HEAT SINK; 3 req'd
NGN6023A NGN6025A NGN6026A NGN6039A NCN6041A	NCN6043A NCN6044A NCN6045A NCN6047A NCN6049A	NCN6052A NCN6054A NCN6056A NCN6058A NCN6060A
J801	9C82817E01	CONNECTOR, receptacle: female; coaxial; uhf type
J803	28C82846E01	male; 9 contact
K801	80C82860E01	RELAY, armature; hermetically sealed; 13.6 v d-c; 4 form "C"; coil res. 160
LS801	50D82808E01	LOUDSPEAKER, permanent magnet; 3", square; 50 ohms impedance
R801	18C82816E02	RESISTOR, var; 10K ±10%; weatherproof
R802	6KR129662	fixed: 180 ±10%; 1/4 w
R803	18C82816E01	var; 15K ±10%; weatherproof
S801	40B82851E01	SWITCH: toggle; spst; weather-resistant
S802	40C82843E01	rotary; 2 pole; 2 position; non-shorting (2-freq.)
		NON-REFERENCED ITEMS
	1V80727A11	HANDLE ASSY, incl. mic. holding clip (for models NCN6039A, NCN6041A, NCN6043A, NCN6045A, NCN6047A and NCN6049A)
	1V80729A93	HANDLE ASSY.: incl. handset holder (for models NCN6044A, NCN6052A, NCN6054A, NCN6056A, NCN6058A, NCN6060A, NGN6023A, NGN6025A and NGN6026A)
	42K861179	CLAMP, cable: 2 req'd
	42A82143C02	CLAMP, cable
	32B82855E01	GASKET, rubber: housing seal
	36B82812E03	KNOB, control: 2 req'd. (vol. & sq.)
	36B82804E01	GASKET: (speaker mtg.)
	35B82803E01	CLOTH, grille
	13C82815E01	GRILLE (1-freq. models)
	13C82815E04	GRILLE (2-freq models)
	1V80727A10	HOUSING ASSY.: incl handle (for models NCN6041A, NCN6043A and NCN6045A)
	1V80731A68	HOUSING ASSY.: incl. handle (for models NCN6041A, NCN6047A and NCN6049A)
	1V80729A94	HOUSING ASSY.: incl. handle (for models NCN6044A, NCN6056A and NGN6023A)
	1V80731A67	HOUSING ASSY.: incl. handle (for models NCN6052A, NCN6054A, NCN6058A, NCN6060A, NGN6025A and NGN6026A)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CONTROL PANEL
NCN6039B NCN6043B NCN6044B NCN6054B		
J801	9C82817E01	CONNECTOR, receptacle: female; coax; uhf type
J802	1V80715A85	female; 4 cont; does not incl. 2A48207O NUT, ring; knurled
J803	28C82846E01	male; 9 cont.
K801	80C83202B01	RELAY, armature; hermetically sealed: 13.6 v d-c; 4 form "C", coil res 160
LS801	50D83205B01	LOUDSPEAKER, permanent magnet: 3" square; 50 ohms imp.
R801	18C82816E02	RESISTOR, var: 10K ±10%; weatherproof
R802	6KR129662	fixed: 180 ±10%; 1/4 w
R803	18C82816E01	var: 5K ±10%; weatherproof
S801	40B82851E01	SWITCH, toggle: spst; weather-resistant
S802	40C82843E01	rotary; 2 pole; 2 position; non-shorting (2-freq.)
		NON-REFERENCED ITEMS
	1V80727A11	HANDLE ASSY. incl mic. holding clip (for NCN6039B & NCN6043B)
	1V80729A93	HANDLE ASSY. incl handset holder (for NCN6044B & NCN6054B)
	42K861179	CLAMP, cable: 2 req'd
	32B82855E01	GASKET, rubber: housing seal
	36B82628H13	KNOB, control: 2 req'd (vol. & sq)
	36B82812E03	KNOB, control: does not incl 3A83174C01 SET SCREW: fluted head (F1-F2 switch)
	32B82804E01	GASKET: (speaker mtg.)
	35B82803E01	CLOTH, grille
	13C82815E01	GRILLE (1-freq models)
	13C82815E04	GRILLE (2-freq models)
	1V80749A97	HOUSING ASSY.: incl handle (for NCN6039B)
	1V80749A98	HOUSING ASSY.: incl handle (for NCN6043B)
	1V80729A94	HOUSING ASSY.: incl handle (for NCN6044B)
	1V80731A67	HOUSING ASSY.: incl handle (for NCN6054B)

NLN6306A Unit Component Kit
NLN6307A Unit Component Kit

J802	1V80715A85	CONNECTOR, receptacle: female; 4 contact; does not incl. 2A81180 NUT, knurled
R804	6KR6040	RESISTOR, fixed: 680 ±10%; 1/2 w
L801 thru 804	24C82000E03	COIL, RF; choke: assembly: 9 uh

NMN6018A Microphone (plug-in; transistorized) MK501

A501	1V80727A19	AMPLIFIER, AF: incl. C501, C502, C503, CR501, Q501, R501 and 1V80727A20 BOARD, circuit component mtg.
C501, 502, 503	21D82428B10	CAPACITOR, fixed: .0033 ±10%; 100 v
CR501	48C82178A01	SEMICONDUCTOR DEVICE, diode: NOTE I germanium

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
DP501	59C82857E01 or59C82864E01	CARTRIDGE, microphone reluctance type
P501		CONNECTOR, plug: p/o W501
Q501	48R134621	TRANSISTOR, NOTE I P-N-P; type M4621
R501	6K127807	RESISTOR, fixed: 33K ±10%; 1/4 w
S501	40C82863E01	SWITCH, push; single pole normally open
W501	30D82565B04	CORD, microphone, incl ref part P501 and a coiled 4 conductor; stranded cord
		NON-REFERENCED ITEMS
	15C82828E01	HOUSING, microphone: (front)
	15C82827E01	HOUSING, microphone (rear)
	41B82856E01	SPRING, backup
	38B82833E01	BUTTON, push
	35A82853E01	DIAPHRAGM, microphone
	4C82418B22	WASHER, insulating
	75A82852E01	PAD, rubber; 1.24" dia.
	75A82192A02	PAD, rubber; 0.562" dia.
	64A82826E01	PLATE, tapped
	7B82801E01	BRACKET, hold-down
	32A82661C02	GASKET
	42B82831E01	CLAMP, cable
	1V80727A18	SPRING AND BUSHING ASSY.
	43K475873	SPACER

NLB6121A RF Amplifier (25-30 MC)
NLB6122A RF Amplifier (30-42 MC)
NLB6123A RF Amplifier (42-54 MC)

		CAPACITOR, fixed: uuf unl. stated
C401L	21D82537B19	60 ±5%; 100 v; N150
C401M	21D82610C07	51; 200 v; N150
C401H	21K410089	27 ±10%; 500 v
C402L	21K840711	51 ±5%; 500 v
C402M	21K840365	24 ±5%; 500 v
C402H, 407H	21K859211	47 ±5%; 300 v
C403L, 403M, 406L, 406, 408	20C82109C01	var: 20-100; 350 v; NZ100
C403H	20K840719	var: 8-50; 200 v
C404, 411L	21C82187B14	.001 uf ±10%; 200 v
C405, 405M	21K861435	70 ±10%; 75 v; N150
C405H	21D82610C05	57 ±5%; 200 v; N150
C407L	21K840713	120 ±5%; 500 v
C407M	21K861436	100 ±10%; 75 v; N750
C409L, 409M	21D82355B13	51 ±5%; 500 v; N1500
C409H	21D82355B14	62 ±5%; 500 v; N1500
C410L	21D82426B10	.0033 ±10%; 100 v
C410M	21K858108	3000 ±25%; 250 v
C410H	21K858107	1500 ±25%; 250 v
C412L	21D82355B09	33 uf ±5%; 500 v; NP0
C413L	21C82372C03	0.1 uf +80-20%; 25 v
L401L	24B83349D01	COIL, RF: input coil assembly
L401M	24V82643G01	input coil assembly
L401H	24B82640G01	input coil assembly
L402L, 402M, 402H	24V80900A86	choke; 1.02 uh
L403L, 403M	24A82813E01	coil, output
L403H	24A82818G01	coil, output
L404	24A82819G01	coil, output
L405L, 405M	24C82000E15	choke; tapped output
L405H	24C82000E14	choke, output
L406L, 406M	24B82122D04	choke; filter 3 turns
L406H	24B82122D07	2 turns
Q401L, 401M	48R869101	TRANSISTOR: NOTE I P-N-P; type M9101
Q401H	48R869102	P-N-P; type M9102
R401L, M	6R6330	RESISTOR, fixed: ±10%; 1 w 150

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		NPN6031A Power Supply (less battery) Nickel-Cadmium
C601	21C82187B16 or21K850446	CAPACITOR, fixed: 3000 -10%; 100 v 3000 ±25%; 250 v
CR601	48C82095C01	SEMICONDUCTOR DEVICE, diode: NOTE I silicon
F601	65A82496G01	FUSE, cartridge: 3 amp/32 v; 1/4" x 5/8"
J601	9C82847E01	CONNECTOR, receptacle: female; 9 contact
P601 P602	28A82488G01 28A16313	CONNECTOR, plug: male; 2 contact male; 3 contact
XF601	1V80731A03	FUSEHOLDER ASSY.: single fuse mounting
		NON-REFERENCED ITEMS
	1V80731A01	HOUSING ASSY. (riveted)
	64B82653G01	PLATE, door
	41A82652G01	SPRING, torsion
	22A82651G01	PIN; pivot
	14A82650G01	INSULATOR
	38A868379	TAB, battery plug

NPN6030B Power Supply (less battery) Dry

C601, 602, 603, 604, 605	21C82187B16	CAPACITOR, fixed: .003 uf ±5%; 100 v
C606, 607 C606A, 607A,	21K800802	dual sect; c/o; .001 uf GMV +100% max; 500 v
C606B, 607B		.001 uf GMV +100% max; 500 v
F601	65R132923	FUSE, cartridge: 3 amp/250 v
J601	9C82847E01	CONNECTOR, receptacle: female; 9 contact
		NON-REFERENCED ITEMS
	1V80731A83	HOUSING ASSY. (riveted)
	1V80731A85	BATTERY HOLDER ASSY. (riveted)
	1V80731A87	BATTERY COVER ASSY. (riveted)

NLN6310A Battery Kit (dry)

	60B82455G01	BATTERY, dry; 1.5 v; 11 req'd.

NMN6017A Handset

	55P82446G01	HANDLE, handset
	15P82446G02	CAP, transmitter
	15P82446G03	CAP, receiver
	40P82446G04	SWITCH, push-to-talk
	59P82446G05	CARTRIDGE, receiver
	59P82446G06	CARTRIDGE, transmitter
	37A842245	SLEEVE, strain relief
	30D82565B19	CORD, handset

NMN6018A Microphone (plug-in; transistorized) MK501

A501	1V80727A19	AMPLIFIER, AF: incl C501, C502, C503, CR501, Q501, R501 and 1V80727A20 BOARD, circuit component mtg
C501, 502, 503	21D82428B10	CAPACITOR, fixed: .0033 ±10%; 100 v
CR501	48C82178A01	SEMICONDUCTOR DEVICE, diode: NOTE I germanium

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
DP501	59C82857E01 or59C82864E01	CARTRIDGE, microphone reluctance type
P501		CONNECTOR, plug: p/o W501
Q501	48R134621	TRANSISTOR, NOTE I P-N-P; type M4621
R501	6K127807	RESISTOR, fixed: 33K ±10%; 1/4 w
S501	40C82863E01	SWITCH, push; single pole normally open
W501	30D82565B04	CORD, microphone, incl ref part P501 and a coiled 4 conductor; stranded cord
		NON-REFERENCED ITEMS
	15C82828E01	HOUSING, microphone: (front)
	15C82827E01	HOUSING, microphone: (rear)
	41B82856E01	SPRING, backup
	38B82833E01	BUTTON, push
	35A82853E01	DIAPHRAGM, microphone
	4C82418B22	WASHER, insulating
	75A82852E01	PAD, rubber; 1.24" dia.
	75A82192A02	PAD, rubber; 0.562"dia.
	64A82826E01	PLATE, tapped
	7B82801E01	BRACKET, hold-down
	32A82661C02	GASKET
	42B82831E01	CLAMP, cable
	1V80727A18	SPRING AND BUSHING ASSY.
	43K475873	SPACER

NOTES:

I. Replacement transistors and diodes must be ordered by Motorola part number only for optimum performance.

II. Crystals are part of the Radio Set Model only. When ordering crystal units specify car. freq.(s), crystal freq.(s) and crystal type number.

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
AN	NTB6051AC-5 NTB6052AC-8 NTB6053AC-6 NTB6061AC-5 NTB6062AC-8 NTB6063AC-6	R138L	WAS 17A82069G02 2.5; 1 W	PARTS LIST	XMTR CKT BD EPD-13429-D
		R138M, 138H	WERE 17A82069G01 2; 1 W		
AP	NTB6051AC-6 NTB6052AC-9 NTB6053AC-7 NTB6061AC-6 NTB6062AC-9 NTB6063AC-7	L111	WAS 24B82872B01	PARTS LIST	XMTR CKT BD EPD-13429-E
AR	NLB6141A-8 NLB6142A-7	C716	WAS 23D82397D16, 22 uf, 15 V	Q703 COLLECTOR	EPD-9204-K, EPD-9206-H
AR1	NRB1121AF-13 NRB1122AF-16 NRB1123AF-15 NRB1151AF-8 NRB1152AF-7 NRB1153AF-7 NRB1121AH-7 NRB1122AH-6 NRB1123AH-6	C17	WAS 21D82877B17 5 uuf; N150	Q3 BASE	EPD-8838-N, EPD-13429-F, EPD-15460-A
		Q3	WAS 48R869238, TYPE M9238	1ST IF AMPL.	
		R49	WAS 6K127801, 470 OHMS	Q13 EMITTER	
		R63	WAS 6K129269, 1.8K	PARTS LIST	
		R64	WAS 6K129753 470 OHMS		
	NTB6051AC-6 NTB6052AC-9 NTB6053AC-7 NTB6051AD-2 NTB6052AD-5 NTB6053AD-4 NTB6061AC-6 NTB606ZAD-5 NTB6063AD-4	C125M	WAS 21K847065, 500 uuf	PARTS LIST	
		C131M	ADDED 100 uuf		
		C139M	WAS C139		
		C124H	ADDED 150 uuf		
		C163, 204, 211	ADDED 15 uuf		
	NPN6031A	C601, 602	ADDED .003 uf	LOWER RIGHT OF DIAG.	NONE
	NLN6306A NLN6307A	L801 THRU 804	WERE 24C847920, 9 uh		NONE

PARTS LIST for Schematic Diagram 63E81017A22-AR1

LEGEND
L = 25-30 MC
M = 30-42 MC
H = 42-54 MC

NRB1121AF, NRB1151AF Receiver Circuit Board (25-30 MC) 1-Freq.
NRB1122AF, NRB1152AF Receiver Circuit Board (30-42 MC) 1-Freq.
NRB1123AF, NRB1153AF Receiver Circuit Board (42-54 MC) 1-Freq.
NRB1151AH Receiver Circuit Board (25-30 MC) 2-Freq.
NRB1152AH Receiver Circuit Board (30-42 MC) 2-Freq.
NRB1153AH Receiver Circuit Board (42-54 MC) 2-Freq.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uuf ±10%; 75 v; unl stated
C1L, 1M, 10M	21K861433	36; N150
C1H, 10H, 12H,	21K861462	15; N150
C2L, 2H, 32, 59	21D82877B02	150; N1400
C2M, 82	21K868829	220; N1400
C3	21C82450B27	1.5; 500 v
C4L	21K861433 or21K861434	36; N150; handset models 40; N150; speaker models
C4M, 5M	21K864013	50; N150
C4H, 34, 305	21K861432	20; N150
C5L	21K861435	70; N150
C5H, 8M, 12M,	21D82877B06	30; N150
C6, 9L, 11L	21C82450B30	1.8 ±5%; 500 v
C7L, 7M, 13L, 13M, 14L, 14M, 21, 27, 31, 37, 75, 77, 301, 303, 306	21K861442	.002 uf +100-20%
C7H, 13H, 14H, 43, 47, 54	21K847065	500 GMV; 250 v
C8L	21D82877B01	24; N150
C8H	21K861431	12; N150
C9M, 11M, 33, 304	21C82450D28	1.0; 500 v
C9H, 11H	21C82450B24	0.47; 500 v
C10L, 12L	21D82877B01 or21D82877B06	24; N150; handset models 30; N150; speaker models
C15	21D82877B15	120; N150
C16	21K861440	470; N2200
C17	21K861603	3.3 ±5%; NP0
C18, 20, 26, 28, 50	21K861444	.02 uf +100-20%
C19	21D82877B14	91; N470
C22, 23	21C82450B22	0.75; 500 v
C24, 25	21K864522	90; N080
C29	21K861429	8; N150
C30	21K865197	25; N150
C33, 304	21C82450B28	1.0; 500 v
C34L, 305L	21K861432	20; N150
C35, 302	21K861427	4; N150
C42, 44, 46, 48, 49, 51, 56, 79, 80	21K861443	.01 uf +100-20%
C52	21D82239E02	800 ±5%; 200 v
C53	23C82397D06	0.22 uf +40-20%; 35 v
C55	23C82397D16	22 uf ±20%; 15 v
C57	21K864457	.002 uf +100-20%
C58, 62	8C82317B03	.03 uf; 50 v
C60	21D82239E03	250 ±5%; 200 v
C61	21K861441	500
C63, 78	23D82397D19	2 uf +40-20%; 8 v
C64	23D82397D05	4.7 uf +40-20%; 3 v
C65	23D82397D19	2 uf +40-20%; 8 v
C66, 67, 71	23D82397D17	15 uf ±20%; 20 v
C68	21C82187B16 or21D82428B09	3000; 100 v (speaker models) 4700; 100 v (handset models)
C69	23D82397D07	1 uf +40-20%; 15 v
C70	23D82397D16	22 uf ±20%; 15 v (speaker models)
C72, 73	23D82397D15	10 uf ±20%; 20 v
C74	23D82397D08	0.15 uf +40-20%; 35 v
C76	8C82317B06	.0082 uf; 100 v
C83	21K861437	100; N2200
C84	8C82317B01	0.1 uf ; 100 v
C85L, 85M	21K861426	2.2; N150

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SEMICONDUCTOR DEVICE, diode; NOTE I
CR1	48C82363E03	silicon
CR2	48C859464	germanium
CR4, 6, 7	48C82178A01	germanium
CR8, 9, 10	48C82363E02	silicon
CR12	48C82392B03	silicon
		COIL, RF:
L1L, 2L, 3L	24C82765D07	GRN-RED; does not incl. 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
L1M, 1H, 2M, 2H, 3M, 3H	24C82765D06	GRN-BRN; does not incl. 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
L4	24C82765D05	GRN-GRA; does not incl. 76K847160 CORE, tuning or 76A82686D01 SLEEVE, iron
L5L, 5H, 301L, 301H	24C82766D04	BLU-GRAY; does not incl. 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
L5M, 301M	24C82766D08	BLU-RED; does not incl. 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
L6	24C847920	choke; 9 uh
L9	24B82695D01	limiter; c/o pri: term. No. 1 and 2 with No. 5 center tap sec: term. No. 3 and 4
L10	24B82696D01	discriminator; 455 kc; incl. tuning core
L12	25B82751D01	choke; 1.5 h
L13	48C82392B03	silicon
		TRANSISTOR: NOTE I
Q1	48R869375	P-N-P; type M9375
Q2, 5, 301	48R869168	P-N-P; type M9168
Q3	48R869169	P-N-P; type M9169
Q4	48K869062	N-P-N; type M9062; BLU
Q6, 7, 8, 9, 10, 11	48R869057	P-N-P; type M9057
Q12, 13	48R869148	P-N-P; type M9148
Q14	48R869022	N-P-N; type M9022
Q15	48R869028	P-N-P; type M9028
Q16	48R869027	N-P-N; type M9027
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R1,14,37,38,304	6K127806	27K
R2, 9, 22, 24, 26, 28, 30, 45, 47	6K127804	4.7K
R3, 4, 7	6K129432	820
R5, 65	6K129433	5.6K
R6, 21, 23, 25, 27, 29	6K127807	33K
R8, 52, 57	6K127801	470
R10, 59	6K129775	330
R11, 31	6K128685	22K
R12	6K129225	10K
R13,32,39,44	6K128688	2.7K
R15, 303	6K128687	6.8K
R16,17,34,69, 301, 302	6K127802	1K
R33, 50	6K128689	2.2K
R43, 60	6K128904	18K
R46	6K129144	68K
R49	6S124A45	680 ±5%; 1/4 w
R51	6K129233	47
R53	6K129433 or6K127804	5.6K; handset models 4.7K; speaker models
R54, 55	6K127806	27K; speaker models
R58	6K129862	150
R63	6K128552	1.8K; 1/8 w
R64	6K129753	100; handset models
R70	6S185B84	2.7K; 1/8 w
		TRANSFORMER,
T1L	24C82767D06	GRN-BLK; does not incl. 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
T1M, 1H	24C82767D03	GRN-ORG; does not incl. 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
T2L	24C82767D07	GRN-VIO; does not incl. 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
T2M, 2H	24C82767D04	GRN-GRN; does not incl. 76K861425 CORE, tuning or 76A82686D02 SLEEVE, iron
T3, 5	24C82767D05	GRN-BLU; does not incl. 76K847164 CORE, tuning or 76A82686D01 SLEEVE, iron
T4	24C82207G01	RED-RED; does not incl. 76K847164 CORE, tuning or 76A82686D01 SLEEVE, iron
T6	1V80729A40	ASSY. audio input; GRN dot; c/o; pri: coil res. 1K; imped. 10K; sec: coil res. 200 imped. 1.2K
T7	25B82893E01	audio: pri: imped. 1200; res. 125; sec: imped. 120; res. 12
		CRYSTAL UNIT, quartz: NOTE II
Y1	YM45 orYM46	25-42 mc 42-54 mc
Y2	YN	5.245 or 6.155 mc

FILTER

Z1	NFN6006AS	FILTER, IF: bandpass
NON-REFERENCED ITEMS		
	26B82671D01 14A82271E01	SHIELD, coil: 10 req'd INSULATOR, coil shield: used with L1, 2, 3, 5, T1, 2

NLB6141A "Private-Line" Squelch Deck (25-42 MC)
NLB6142A "Private-Line" Squelch Deck (42-54 MC)

		CAPACITOR, fixed: uf; ±10%; unl stated
C701	23D82397D20	0.12 ±20%; 35 v; non-polarized
C702	21C82724H01	dual sect.; c/o:
C702A		.0055 +100-20%; 75 v
C702B		.0055 +100-20%; 75 v
C704	23D82397D13	.022; 6 v
C705	23D82397D10	.056; 35 v
C707, 719	23D82397D14	.082; 20 v
C709	23D82397D05	4.7 +40-20%; 3 v
C710	21K847065	500 uuf GMV; 250 v
C711, 713, 724	23D82397D07	1 +40-20%; 15 v
C712, 714, 716	23D82397D23	6.8 ±20%; 20 v
C715, 717	23D82397D09	6.8 +40-20%; 10 v
C721	23D82397D16	22 ±20%; 15 v
C718, C720	23D82397D28 23D82397D25	3.3 ±20%; 20 v 0.27; 20 v
C722,723,729,730	21K861442	.002 +100-20%; 75 v
C726	21K858108	.003 ±25%; 250 v
C727	21K831126	.002 GMV; 300 v
C728	21K861441	500 uuf; 75 v; N4700
		SEMICONDUCTOR DEVICE, diode: NOTE I
CR701	48C82392B03	silicon
CR702	48C82187A01	germanium
		COIL, RF: choke:
L702	25C82750D02	7 h
		TRANSISTOR: NOTE I
Q701, 702, 703, 704	48R869033	P-N-P; type M9033
		RESISTOR, fixed: ±10%; 1/8 w; unl stated
R701, 708	6S185B93	15K
R702	6K128687	6.8K; 1/4 w
R703	6S185B90	8.2K
R704, 705, 714, 716, 726	6S185C01	56K
R706	6S185B70	180
R709	6S185C05	120K
R710,711,712	6S185B87	4.7K
R713	6S185B88	5.6K
R715,717,723	6S185B83	2.2K
R718	6S129752	270; 1/4 w
R719	6K129225	10K; 1/4 w
R720	6S129269	1.8K; 1/4 w
R721	6S185B76	560
R722	6K129229	180K; 1/4 w
R724	6K129231	3.3K; 1/4 w
R725	6K129432	820; 1/4 w
R727	6S185B75 or6K127801	470; (NLB6141A) 470; 1/4 w (NLB6142A)

TRANSMITTERS

SERIES	MODEL NO.	CHASSIS SUFFIX	NO. OF FREQ.	FREQUENCY RANGE	RF POWER OUTPUT
NTB6050AC	NTB6051AC	6	1	25-30 MC	1.4 W
	NTB6052AC	9	1	30-42 MC	1.4 W
	NTB6053AC	7	1	42-54 MC	1.4 W
NTB6050AD	NTB6051AD	2	2	25-30 MC	1.4 W
	NTB6052AD	4	2	30-42 MC	1.4 W
	NTB6053AD	4	2	42-54 MC	1.4 W
NTB6060AC	NTB6061AC	6	1	25-30 MC	5 W
	NTB6062AC	9	1	30-42 MC	5 W
	NTB6063AC	7	1	42-54 MC	5 W
NTB6060AD	NTB6061AD	2	2	25-30 MC	5 W
	NTB6062AD	4	2	30-42 MC	5 W
	NTB6063AD	4	2	42-54 MC	5 W

RECEIVERS

SERIES	MODEL NO.	CHASSIS SUFFIX	NO. OF FREQ.	CHANNEL SPACING	FREQUENCY RANGE	USED WITH
NRB1120AF	NRB1121AF	13	1	20 KC	25-30 MC	HANDSET ONLY
	NRB1122AF	16	1	20 KC	30-42 MC	HANDSET ONLY
	NRB1123AF	15	1	20 KC	42-54 MC	HANDSET ONLY
NRB1150AF	NRB1151AF	8	1	20 KC	25-30 MC	SPEAKER
	NRB1152AF	7	1	20 KC	30-42 MC	SPEAKER
	NRB1153AF	7	1	20 KC	42-54 MC	SPEAKER
NRB1120AH	NRB1121AH	7	2	20 KC	25-30 MC	SPEAKER
	NRB1122AH	6	2	20 KC	30-42 MC	SPEAKER
	NRB1123AH	6	2	20 KC	42-54 MC	SPEAKER

POWER SUPPLIES

MODEL NO.	CHASSIS SUFFIX	TYPE OF BATTERIES
NPN6030B		DRY
NPN6031A		NICKEL-CADMIUM

"PRIVATE-LINE" DECK

MODEL	CHASSIS SUFFIX
NLB6141A	7
NLB6142A	6

EPD-9020-P

POWER AMPLIFIERS

MODEL NO.	CHASSIS SUFFIX	FREQUENCY RANGE
NLB6121A	2	25-30 MC
NLB6122A	2	30-42 MC
NLB6123A	1	42-54 MC

CONTROL PANELS

MODEL NO.	CHASSIS SUFFIX	XMTR. FREQ.	RCVR. FREQ.	HANDSET	SPEAKER	MICROPHONE	RF POWER OUTPUT
NGN6024A	1	1	1	X			1.4 W
NCN6040A	1	1	1		X	X	1.4 W
NCN6042A	1	2	1		X	X	1.4 W
NCN6046A	1	1	1		X	X	5 W
NCN6048A	1	2	1		X	X	5 W
NCN6050A	1	2	2		X	X	1.4 W
NCN6051A	1	2	2		X	X	5 W
NCN6053A	1	2	1	X	X		1.4 W
NCN6055A	1	2	2	X	X		1.4 W
NCN6057A	1	1	1	X	X		5 W
NCN6059A	1	2	1	X	X		5 W
NCN6061A	1	2	2	X	X		5 W
NCN6065A	1	2	2	X	X		1.4 W
NCN6040B		1	1		X	X	1.4 W
NCN6050B		2	2		X	X	1.4 W
NCN6055B		2	2	X	X		1.4 W
NCN6065B		2	2	X	X		1.4 W

NOTES:

1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS, ±10%; 1/4 WATT, K=1000.
   ALL CAPACITOR VALUES ARE IN MICROMICROFARADS.
2. REFER TO PARTS LIST FOR COMPONENT VALUE.
3. USED IN SINGLE FREQUENCY MODELS ONLY.
4. PART OF HOUSING.
5. REFER TO RECEIVER PRINTED CIRCUIT BOARD AND WIRING DIAGRAM FOR PROPER TAP.
6. ALL VOLTAGE READINGS REFERENCED TO CHASSIS GROUND. DC READINGS TAKEN WITH A MOTOROLA DC MULTIMETER.
7. FREQUENCY CALCULATIONS:

   TRANSMITTER: $f_0 = \frac{f_c}{16}$

   RECEIVER: f_c = CARRIER FREQUENCY (25-54 MC)

   f_{01} = 1ST OSCILLATOR CRYSTAL FREQUENCY (30.7-48.3 MC)

   f_{02} = 2ND OSCILLATOR CRYSTAL FREQUENCY (REFER TO CHART ON BLOCK DIAGRAM)

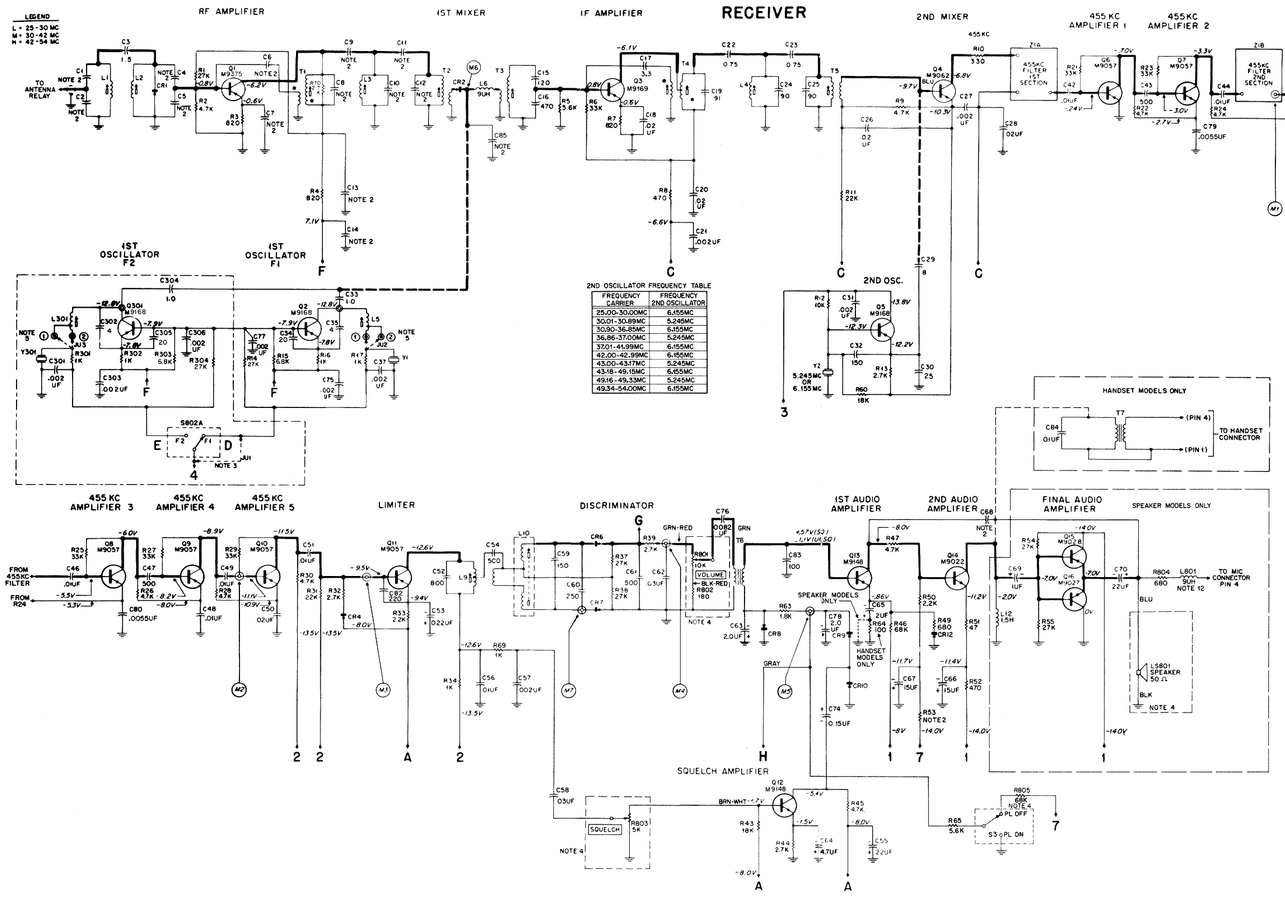
   f_1 = 1ST INTERMEDIATE FREQUENCY (5.7 MC)

   f_2 = 2ND INTERMEDIATE FREQUENCY (455 KC)

   $f_{01} = f_c + f_1$ (25-42 MC)

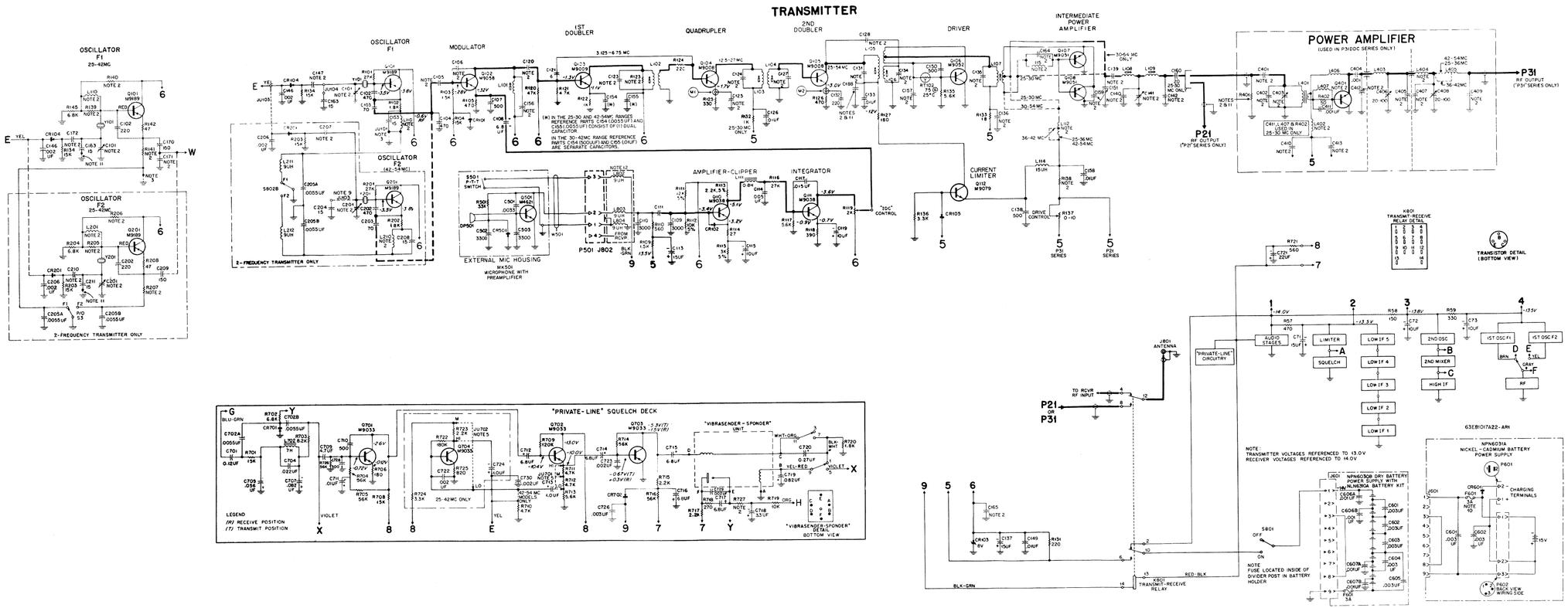
   $f_{02} = f_c - f_1$ (42-54 MC)
8. HANDSET MODELS ONLY.
9. JU103 MAY OR MAY NOT EXIST DEPENDING UPON OPERATING FREQUENCY.
10. REFER TO BATTERY REPLACEMENT AND CHARGING SECTION OF THE INSTRUCTION MANUAL FOR LOCATION OF FUSE.
11. NOT USED IN 42-54 MC RANGE.
12. PART OF UNIT COMPONENT KIT.

EPD-8874-D



PREVIOUS REVISIONS SHOWN
ON FRONT OF THIS DIAGRAM

25-54 MC "Handie-Talkie" FM Radio
Dual Squelch "Private-Line"
Schematic Diagram
Motorola No. 63E81017A22-AR1
(Sheet 1 of 2)
9/23/66-AP



25-54 MC "Handie-Talkie" FM Radio
Dual Squelch "Private-Line"
Schematic Diagram
Motorola No. 63E81017A22-AR1
(Sheet 2 of 2)
9/23/66-AP

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NON-REFERENCED ITEM		
	1V80724A84	PRINTED CIRCUIT BD. ASS'Y.

NTB6051AC, NTB6061AC Transmitter (25-30 MC) 1-Freq.
NTB6052AC, NTB6062AC Transmitter (30-42 MC) 1-Freq.
NTB6053AC, NTB6063AC Transmitter (42-54 MC) 1-Freq.
NTB6051AD, NTB6061AD Transmitter (25-30 MC) 2-Freq.
NTB6052AD, NTB6062AD Transmitter (30-42 MC) 2-Freq.
NTB6053AD, NTB6063AD Transmitter (42-54 MC) 2-Freq.

		CAPACITOR, fixed: uuf ±10%; 75 v; unl stated
C101L, 141M, 141H, 201L	20C82399D04	var; 5.5-18; 200 v; NP0
C101M	20C82399D05	var; 9-35; 200 v; N650
C101H, 201M, 201H	20C82399D06	var; 3-15; 200 v; N650
C102L, 102M, 120L, 202L, 202M	21K868829	220; N1400
C102H, 104H	21K861440	470; N2200
C103, 140L, 142M, 156L, 203	21K861435	70; N150
C105H, 106M, 106H	21D82877B02	150; N1400
C105M	21K865922	390; 500 v
C107, 125H, 139M, 150	21K847065	500 GMV; 25 v
C108	23C82397D09	6.8 uf +40-20%; 10 v
C109, 110	21K858108	3000 ±25%; 250 v
C111	8K854329	.015 uf; 250 v
C113, 137	23C82397D17	15 uf ±20%; 20 v
C114	8C82548E03	.005 uf; 100 v
C115, 119	23C82397D03	10 uf ±20%; 6 v
C117	8C82548E02	0.15 uf; 100 v
C120H, 139H, 156M, 156H	21K861436	100; N750
C120M, 132, 106L	21K861438	220; N1400
C121, 128H	21K861428	6; N150
C123L, 124L, 127L, 127M	21D82877B35	220; N470
C123M, 131M	21K868384	100; N150
C123H, 131H, 134H	21K864013	50; N150
C124M	21D82239E03	250 ±5%; 200 v
C125L	21K831126	.002 uf GMV; 300 v
C126, 133, 136, 149, 155M, 158	21K861443	.01 uf +100-20%
C127H, 134L	21D82877B15	120; N150
C128M	21K861427	4; N150
C131L	21K864012	60; N150
C134M, 135M	21K864067	80; N150
C135L	21K868384	100; N150
C135H, 159L	21K861434	40; N150
C139L, 157L, 160L	21K861432	20; N150
C125M, 138, 154M	21K86144!	500; N4700
C140M, 140H, C141L	21D82877B19	15 ±5%; NP0
C142H	20C82399D07	var; 15-60; 200 v; N1500
C146, 206	21D82877B18	30 ±5%; NP0
C147, 207, 124H	21K86144Z	.002 uf +100-20%
C151H	21D82877B05	150; N750
C153H, 163, 208H, 204, 211	21K861430	10; N150
C154L, 154H, 155L, 155H, 205A, 205B	21K861462	15; N150
C164H	21C82724H01	dual sect.; c/o: each sect: 5500 +100-20%
C164L, 164M	21K858108	.003 uf ±25%; 250 v
C170, 172M	21C82040D12	800 uuf ±5%; 25 v
C171L	21D82877B34	150; NP0
C171M	21D82239E03	250; N150
C172L	21K861436	100; N750
C188L, 188M	21K861435	70
	23D82397D07	1.0 uf +40-10%; 15 v
CR101, 102	48C82178A01	SEMICONDUCTOR DEVICE, diode: NOTE I germanium
CR103	48C82256C08	zener type
CR104, 201	48C863140	silicon
CR105	48C82392B12	silicon
L101L, 101M	24C82901B04	COIL, RF: does not incl. 76K835565 CORE, tuning modulator
L101H	24C82901B05	modulator; GRN-YEL

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
L102	24B82194C01	1st doubler; RED
L103, 104L	24C82904B19	quadrupler output; 2nd doubler input
L103M, 103H	24C82904B14	quadrupler output; 2nd doubler output
L104M, 104H	24C82904B15	2nd doubler input
L105	24C82904B20	2nd doubler
L105M, 105H	24C82904B12	2nd doubler output
L106L	24B82648G01	driver input; final ampl. input
L106M, 106H, 107M, 107H	24B82209E01	driver input; final ampl. input
L107L	24B82737E01	final ampl. input
L108L, 108M, 109L, 109M	24C82904B21	final ampl. output
L108, 109H	24C82904B01	final ampl. output
L110L, 201L	24C82187B14	choke; 6.8 uh
L110M, 201M	24D82549D03	choke; 1 mh
L110H, 210H	24D82549D10	choke; 390 uh
L111	25B82872B02	choke; 0.8 h
L112L	24A890687	choke; 2 uh
L112M	24A82228G01	choke; 1.2 uh
L112H	24C82000E08	choke; 0.31 uh; sleeved
L114	24D82549D09	choke; 15 uh
L115	24C83961B01	choke; 3 turns; coded BRN
L211, 212	24C82000E03	choke; 9 uh
Q101, 201	48R869189	TRANSISTOR: NOTE I P-N-P; type M9189
Q102	48R869058	P-N-P; type M9058
Q103	48R869009	P-N-P; type M9009
Q104, 105	48R869008	P-N-P; type M9008
Q106	48R869052	N-P-N; type M9052
Q107, 108	48R869051	N-P-N; type M9051
Q110, 111	48R869038	P-N-P; type M9038
Q112	48R869079	N-P-N; type M9079
R101, 201	6K127806	RESISTOR, fixed ±10%; 1/4 w; unl, stated 27K
R102, 141M, 202, 207M	6R129269	1.8K
R103	6K127803	1.5K
R104, 123L, 123M, 134, 203	6K127805	15K
R105, 126	6R127801	470
R106, 123H	6K129225	10K
R108	6R129753	100
R109	6K128903	39K
R110, 206L, 207L	6K128689	2.2K
R111	6K129887	12K ±5%
R112	6K129668	10K ±5%
R113	6R129804	2.2K ±5%
R114	6S131594	27
R115	6S124A60	3K ±5%
R116, 139M 205M	6K127806	27K
R117, 135	6K129433	5.6K
R118	6K129863	390
R119	18B82876B04	var; 2K ±15%; 1/20 w
R120	6K128902	47K
R121	6K127804	4.7K
R122, 132L	6K127802	1K
R124, 131	6K127800	220
R125	6K127775	330
R127	6K129662	180
R132M, 132H	6K129620	560
R133	6K131650	18
R136	6K129231	3.3K
R137	18D82035B17	var; 10
R138L	17A82035G25	2.5 ±3%; 2 w
R138M, 138H	17A82035A26	2 ±3%; 2 w
R139L, 205L	6K129242	56K
R140M, 145L, 204L, 206M	6K128687	6.8K
R142L, 142M, 208L, 208M	6K129233	47
RT102	6B859699	THERMISTOR: 75 ohms @ 25°C
Y101, 201	ABS-2	CRYSTAL UNIT, quartz: NOTE II xmtr. control
NON-REFERENCED ITEM		
	26A82609E01	HEAT SINK; 3 req'd

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NLB6121A RF Amplifier (25-30 MC) NLB6122A RF Amplifier (30-42 MC) NLB6123A RF Amplifier (42-54 MC)		
C401L	21D82537B19	CAPACITOR, fixed: uuf; unl. stated 60 ±5%; 100 v; N150
C401M	21D82610C07	51; 200 v; N150
C401H	21K410089	27 ±10%; 500 v
C402L	21K840711	51 ±5%; 500 v
C402M	21K840365	24 ±5%; 500 v
C402H, 407H	21K859211	47 ±5%; 300 v
C403L, 403M, 406L, 406,408	20C82109C01	var; 20-100; 350 v; N2100
C403H	20K840719	var; 8-50; 200 v
C404, 411L	21C82187B14	.001 uf ±10%; 200 v
C405, 405M	21K861435	70 ±10%; 75 v; N150
C405H	21D82610C05	57 ±5%; 200 v; N150
C407L	21K840713	120 ±5%; 500 v
C407M	21K861436	100 ±10%; 75 v; N750
C409L, 409M	21D82355B13	51 ±5%; 500 v; N1500
C409H	21D82355B14	62 ±5%; 500 v; N1500
C410L	21D82426B10	.0033 ±10%; 100 v
C410M	21K858108	3000 ±25%; 250 v
C410H	21K858107	1500 ±25%; 250 v
C412L	21D82355B09	33 uf ±5%; 500 v; NP0
C413L	21C82372C03	0.1 uf +80-20%; 25 v
L401L	24B83349D01	COIL, RF: input coil assembly
L401M	24V82643G01	input coil assembly
L401H	24B82640G01	input coil assembly
L402L, 402M, 402H	24V80900A86	choke; 1.02 uh
L403L, 403M	24A82813E01	coil, output
L403H	24A82818G01	coil, output
L404	24A82819G01	coil, output
L405L, 405M	24C82000E15	choke; tapped output
L405H	24C82000E14	choke; output
L406L	24B82122D04	choke; filter; 3 turns
L406H	24B82122D07	2 turns
Q401L, 401M	48R869101	TRANSISTOR: NOTE I P-N-P; type M9101
Q401H	48R869102	P-N-P; type M9102
R401L, M	6R6330	RESISTOR, fixed: ±10%; 1 w 150

CONTROL PANEL

NGN6024A	NCN6048A	NCN6055A
NCN6040A	NCN6050A	NCN6057A
NCN6042A	NCN6051A	NCN6059A
NCN6046A	NCN6053A	NCN6061A
J801	9C82817E01	CONNECTOR, receptacle: female; coaxial; uhf type
J803	28C82846E01	male; 9 contact
K801	80C82860E01	RELAY, armature; hermetically sealed; 13.6 v d-c; 4 form "C"; coil res 160
LS801	50D82808E01	LOUDSPEAKER, permanent magnet; 3", square; 50 ohms impedance
R801	18C82816E02	RESISTOR, var; 10K ±10%; weatherproof
R802	6K129662	fixed: 180 ±10%; 1/4 w
R803	18C82816E01	var: 15K ±10%; weatherproof
S801	40B82851E01	SWITCH, toggle; spst; weather-resistant
S802	40C82843E01	rotary; 2 pole; 2 position; non-shorting (1-freq.)
	or40C82890E01	rotary; 2 pole; 4 position; non-shorting (2-freq.)
NON-REFERENCED ITEMS		
	1V80727A11	HANDLE ASSY.: incl. mic. holding clip (for models NCN6040A, NCN6042A, NCN6046A, NCN6048A, NCN6050A and NCN6051A)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1V80729A93	HANDLE ASSY.: incl. handset holder (for models NCN6053A, NCN6055A, NCN6057A, NCN6059A, NCN6061A, NGN6024A)
	42K861179	CLAMP, cable; 2 req'd
	42A82143C02	CLAMP, cable
	32B82855E01	GASKET, rubber; housing seal
	36B82812E03	KNOB, control; 2 req'd (vol. & sq.)
	36B82812E01	KNOB, control; ("PL"ON-OFF)
	36B82804E01	GASKET; (speaker mtg.)
	35B82803E01	CLOTH, grille
	13C82815E03	GRILLE (1-freq. models)
	13C82815E02	GRILLE (2-freq. models)
	1V80731A68	HOUSING ASSY.: incl. handle (for models NCN6040A, NCN6042A, NCN6048A, NCN6050A and NCN6051A)
	1V80731A67	HOUSING ASSY.: incl. handle (for models NCN6051A, NCN6053A, NCN6055A, NCN6057A, NCN6059A, NCN6061A and NGN6024A)

NCN6040B Control Panel
NCN6050B Control Panel
NCN6055B Control Panel
NCN6065B Control Panel

J801	9C82817E01	CONNECTOR, receptacle: female; single cont.
J802	9B82413D01	female; 4 cont.
J803	28C82846E01	male; 9 cont.
K801	80C83202B01	RELAY, armature 2 form "C"; coil res 160 ohms; 13.6 v
LS801	50D83205B01	SPEAKER, dynamic: coil imped. 50 ohms; 3" dia. weatherproof
R801	18C82816E02	RESISTOR, fixed: ±10%; 1/4 w; unl stated var; 10K; 0.12 w @ 55°C
R802	6S129662	180 ±10%
R803	18C82816E01	var; 5K; 0.12 w @ 55°C
R805	6S129144	68K
S801	40C82843E01	SWITCH: rotary; dp 2p (Models NCN6040B & NCN6065B)
	or40C82891E01	rotary; 3p 4p (Models NCN6050B & NCN6055B)
S802	40B82851B01	toggle; 1 form "A"
NON-REFERENCED ITEMS		
	38B82807E01	BUTTON
	36B82628H14	KNOB, control (used on S801)
	36B82628H13	KNOB, control (used on R801 and R803)

NPN6031A Power Supply (less battery) Nickel-Cadmium

C601, 602	21C82187B16 or21K850446	CAPACITOR, fixed: 3000 -10%; 100 v 3000 ±25%; 250 v
CR601	48C82095C01	SEMICONDUCTOR DEVICE, diode: NOTE I silicon
F601	65A82496G01	FUSE, cartridge: 3 amp; 32 v; 1/4" x 5/8"
J601	9C82847E01	CONNECTOR, receptacle: female; 9 cont.
P601	28A82488G01	CONNECTOR, plug: male; 2 cont.
P602	28A16313	male; 3 cont.
XF601	1V80731A03	FUSEHOLDER ASSY: single fuse Mtg.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NON-REFERENCED ITEMS		
	1V80731A01	HOUSING ASSY. (riveted)
	46B82653G01	PLATE, door
	41A82652G01	SPRING, torsion
	22A82651G01	PIN, pivot
	14A82650G01	INSULATOR
	38A868379	TAB, battery plug

NPN6030B Power Supply (less battery) Dry

C601, 602, 603, 604, 605	21C82187B16	CAPACITOR, fixed: .003 uf ±5%; 100 v
C606, 607 C606A, 607A C606B, 607B	21K800802	dual sect.: c/o: .001 uf GMV +100% max: 500 v .001 uf GMV +100% max: 500 v
F601	65R132923	FUSE, cartridge: 3 amp, 1250 v
J601	9C82847E01	CONNECTOR receptacle: female; 9 contact
NON-REFERENCED ITEMS		
	1V80731A83	HOUSING ASSY. (riveted)
	1V80731A85	BATTERY HOLDER ASSY. (riveted)
	1V80731A87	BATTERY COVER ASSY. (riveted)

NLN6310A Battery Kit (Dry)

	60B82455G01	BATTERY, dry: 1.5 v; 11 req'd

NMN6017A Handset

	55P82446G01	HANDLE, handset
	15P82446G02	CAP, transmitter
	15P82446G03	CAP, receiver
	40P82446G04	SWITCH, push-to-talk
	59P82446G05	CARTRIDGE, receiver
	59P82446G06	CARTRIDGE, transmitter
	37A842245	SLEEVE, strain relief
	30D82565B19	CORD, handset

NMN6018A Microphone (plug-in; transistorized) MK501

A501	1V80727A19	AMPLIFIER, AF: incl C501, C502, C503, CR501, Q501, R501 and 1V80727A20 BOARD, circuit component mtg
C501, 502, 503	21D82428B10	CAPACITOR, fixed: .0033 ±10%; 100 v
CR501	48C82178A01	SEMICONDUCTOR DEVICE, diode: NOTE I germanium
DP501	59C82857E01 or59C82864E01	CARTRIDGE, microphone reluctance type
F501		CONNECTOR, plug: p/o W501
Q501	48R134621	TRANSISTOR, NOTE I P-N-P; type M4621
R501	6K127807	RESISTOR, fixed: 33K ±10%; 1/4 w
S501	40C82863E01	SWITCH, push; single pole normally open
W501	30D82565B04	CORD, microphone, incl ref part P501 and a coiled 4 conductor; stranded cord
NON-REFERENCED ITEMS		
	15C82828E01	HOUSING, microphone: (front)
	15C82827E01	HOUSING, microphone; (rear)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	41B82856E01	SPRING, backup
	38B82833E01	BUTTON, push
	35A82853E01	DIAPHRAGM, microphone
	4C82418B22	WASHER, insulating
	75A82852E01	PAD, rubber, 1.24" dia.
	75A82192A02	PAD, rubber, 0.562" dia.
	64A82826E01	PLATE, tapped
	7B82801E01	BRACKET, hold-down
	32A82661C02	GASKET
	42B82831E01	CLAMP, cable
	1V80727A18	SPRING AND BUSHING ASSY.
	43K475873	SPACER

NLN6306A Unit Component Kit
NLN6307A Unit Component Kit

J802	1V80715A85	CONNECTOR, receptacle female; 4 contact; does not incl. 2A81180 NUT knurled
R804	6R6040	RESISTOR, fixed: 680 ±10%; 1/2 w
L801 thru 804	24C82000E03	COIL, RF; choke: assembly; 9 uh

NOTES:

I. Replacement transistors and diodes must be ordered by Motorola part number only for optimum performance.

II. Crystals are part of the Radio Set Model only. When ordering crystal units specify car. freq.(s), crystal freq.(s) and crystal type number.

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