THIS MANUAL APPLIES TO THE FOLLOWING MODELS:
P23DEN (PT200) AND P33DEN (PT300)

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MOTOROLA

PT Series

"Handie-Talkie"® FM Radio

132-174 MC 2 & 5 W RF POWER

MANUAL 68P81032A40-E

MOTOROLA

FM RADIO

"HANDIE-TALKIE" ®

2.0 & 5.0 W RF POWER

132-174 MC

PORTABLE TRANSISTORIZED

Model P33DEN-1030AM

MOTOROLA INC. **Communications Division**

ENGINEERING PUBLICATIONS 4501 WEST AUGUSTA BOULEVARD CHICAGO, ILLINOIS 60651

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GUARANTEED PERFORMANCE SPECIFICATIONS

GENERAL

MODELS		P33DEN-1000 Series (PT 300)	P33DEN-3000 Series (PT 300)	P23DEN-1000 Series (PT 200)	P23DEN-3000 Series (PT 200)
POWER SUPPLY		Eleven #1150 Industrial "D" cells or one 14.0 v nickel-cadmium battery.			
BATTERY DRAIN	Standby	4 ma at 14.0 v	9 ma at 14.0 v	4 ma at 14.0 v	9 ma at 14.0 v
	Receive	55 ma at 14.0 v	62 ma at 14.0 v	55 ma at 14.0 v	62 ma at 14.0 v
	Transmit	900 ma at 13.5 v	905 ma at 13.5 v	475 ma at 14.5 v	480 ma at 14.5 v
BATTERY LIFE		6 days	6 days	12 days	12 days
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"			
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"			
WEIGHT* (with dry cell batteries)	Speaker-microphone	7# 10 oz.	7# 12 oz.	7# 5 oz.	7# 7 oz.
	Speaker-Handset	8# 2 oz.	8# 4 oz.	7# 13 oz.	7# 15 oz.
WEIGHT* (with nickel-cadmium batteries)	Speaker-microphone	6# 4 oz.	6# 6 oz.	6#	6# 2 oz.
	Speaker-Handset	6# 12 oz.	6# 14 oz.	6# 8 oz.	6# 10 oz.

TRANSMITTER

CHASSIS MODEL	NTD6121AA 22AA with NLD6260 Series Power Amplifier	NTD6121AA, 22AA
RF OUTPUT	5.0 w at nominal battery voltage (13.5 v)	2.0 w at nominal battery voltage (14.5 v)
FREQUENCY STABILITY	±.0005% from -30°C to +60°C (+25°C reference)	
MODULATION	16F3: ±5 kc for 100% at 1000 cps; or 36F3: ±15 kc for 1000% at 1000 cps	
CRYSTAL MULTIPLICATION	18 times	
SPURIOUS AND HARMONICS	more than 50 db below carrier	more than 46 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	

RECEIVER

MODULATION ACCEPTANCE*	±5 kc (split channel models) or ±15 kc (wide band models)			
SENSITIVITY	Less than 0.5 microvolt for 20 db quieting; .35 uv for 12 db SINAD			
SPURIOUS AND IMAGE REJECTION	More than 70 db below carrier; r-f image 60 db below carrier			
NOISE SQUELCH SENSITIVITY	Noise compensated type: adjustable sensitivity, will open at less than 0.25 volt			
TONE CODED SQUELCH SENSITIVITY		Fixed sensitivity will open at less than 0.25 microvolt		Fixed sensitivity will open at less than 0.25 microvolt
AUDIO OUTPUT	500 milliwatts to speaker at less than 10% distortion			
FREQUENCY STABILITY	±0.0025% from -30°C to +60°C (+25°C reference)			
SELECTIVITY	More than 80 db at the adjacent channel measured by the 20 db quieting method, 70 db by the EIA 2 Generator Method			
CHANNEL SPACING*	30 kc (±5 kc Bandwidth) 60 kc (±15 kc Bandwidth)			

*Tone-coded squelch available in split-channel models only

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE
FCC LICENSE DESIGNATION: P33 Series CC3514
P23 Series CC3513B

MOTOROLA

MODEL CHART
FOR
PT SERIES
"HANDIE-TALKIE" (R) FM RADIO
132-174 MC 2.0 AND 5.0 W RF POWER

LEGEND:

- [X] ONE ITEM INCLUDED
- ◢ ONE ITEM INCLUDED WITH EVERY FIVE (OR LESS) RADIO SETS
- [/] ONE ALTERNATE ITEM INCLUDED, CHOKE DEPENDENT ON FREQUENCY RANGE
- [2] TWO ITEMS INCLUDED

*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	MODEL NUMBER	XMTR FREQ.	RCVR FREQ.	CHANNEL SPACING	TYPE OF SQUELCH
*NRD1130BA	RECEIVER, WIDE CHANNEL, CARRIER SQUELCH	63E81032A41	P23DEN-1000AM	2.0 W (PT 200) SPEAKER-MICROPHONE MODELS 1	1	60 KC	CARRIER
*NRD1130BB	RECEIVER, SPLIT CHANNEL, CARRIER SQUELCH	63E81032A41	P23DEN-1010AM	2	1	60 KC	CARRIER
*NRD1130BF	RECEIVER, SPLIT CHANNEL, DUAL SQUELCH	63E81032A67	P23DEN-1030AM	2	2	60 KC	CARRIER
NTD6121AA	TRANSMITTER (132-150.8 MC)	63E81032A43	P23DEN-1100AM	1	1	30 KC	CARRIER
NTD6122AA	TRANSMITTER (150.8-174 MC)	63E81032A43	P23DEN-1110AM	2	1	30 KC	CARRIER
NLD6221A	RECEIVER 2ND FREQ. OSCILLATOR DECK, (132-150.8 MC)	63E81032A67, 41	P23DEN-1130AM	2	2	30 KC	CARRIER
NLD6222A	RECEIVER 2ND FREQ. OSCILLATOR DECK, (150.8-174 MC)	63E81032A67, 41	P23DEN-3100AM	1	2	30 KC	TONE-CODED
NLN6415A	TRANSMITTER 2ND FREQ. OSCILLATOR DECK	63E81032A43	P23DEN-3110AM	2	1	30 KC	TONE-CODED
NLD6210A	"PRIVATE-LINE" SQUELCH DECK		P23DEN-3130AM	2	1	30 KC	TONE-CODED
NLD6261A	HI POWER FINAL AMPLIFIER (132-150.8 MC)	63E81032A43	P23DEN-1000AR	2.0 W (PT 200) SPEAKER-HANDSET MODELS 1	1	60 KC	CARRIER
NLD6262A	HI POWER FINAL AMPLIFIER (150.8-174 MC)	63E81032A43	P23DEN-1010AR	2	1	60 KC	CARRIER
NLN6443A	AUTOMATIC DRIVE LIMITER DECK (P33 SERIES)	63E81032A43	P23DEN-1030AR	2	2	60 KC	CARRIER
NLN6456A	AUTOMATIC DRIVE LIMITER DECK (P23 SERIES)		P23DEN-1100AR	1	1	30 KC	CARRIER
NCN6039B	CONTROL PANEL, 1 FREQ. XMIT., 1 FREQ. REC. CARRIER SQUELCH	63D81032A44	P23DEN-1110AR	2	2	30 KC	CARRIER
NCN6040B	CONTROL PANEL, 1 FREQ. XMIT., 1 FREQ. REC. TONE-CODED SQUELCH	63D81032A58	P23DEN-1130AR	2	2	30 KC	CARRIER
NCN6043B	CONTROL PANEL, 2 FREQ. XMIT., 2 FREQ. REC. CARRIER SQUELCH	63D81032A44	P23DEN-3100AR	1	2	30 KC	TONE-CODED
NCN6044B	CONTROL PANEL, 1 FREQ. XMIT. 1 FREQ. REC. CARRIER SQUELCH	63D81032A44	P23DEN-3110AR	2	1	30 KC	TONE-CODED
NCN6050B	CONTROL PANEL, 2 FREQ. XMIT. 2 FREQ. REC. TONE-CODED SQUELCH	63D81032A58	P23DEN-3130AR	2	2	30 KC	TONE-CODED
NCN6054B	CONTROL PANEL, 2 FREQ. XMIT. 2 FREQ. REC. CARRIER SQUELCH	63D81032A44	P33DEN-1000AM	5.0 W (PT 300) SPEAKER-MICROPHONE MODELS 1	1	60 KC	CARRIER
NCN6055B	CONTROL PANEL, 2 FREQ. XMIT. 2 FREQ. REC. TONE-CODED SQUELCH	63D81032A58	P33DEN-1010AM	2	1	60 KC	CARRIER
NCN6065B	CONTROL PANEL, 1 FREQ. XMIT. 1 FREQ. REC. TONE-CODED SQUELCH	63D81032A58	P33DEN-1030AM	2	2	60 KC	CARRIER
NLN6425A	BOTTOM PLATE KIT		P33DEN-1100AM	1	1	30 KC	CARRIER
NLN6423A	UNIT HARDWARE KIT		P33DEN-1110AM	2	2	30 KC	CARRIER
NLN6424A	HARDWARE KIT, "PRIVATE-LINE" MODELS		P33DEN-1130AM	2	2	30 KC	CARRIER
NLN6428A	UNIT HARDWARE KIT		P33DEN-3100AM	1	2	30 KC	TONE-CODED
YMW-35	RECEIVER CONTROL CRYSTAL		P33DEN-3110AM	2	1	30 KC	TONE-CODED
YNW	RECEIVER IF CRYSTAL		P33DEN-3130AM	2	2	30 KC	TONE-CODED
NLD6230A	TRANSMITTER CONTROL CRYSTAL		P33DEN-1000AR	5.0 W (PT 300) SPEAKER-HANDSET MODELS 1	1	60 KC	CARRIER
TLN6492BA SERIES	"VIBRASPONDER" RESONANT REED		P33DEN-1010AR	2	1	60 KC	CARRIER
NAD6120A	ANTENNA; 132-150.8 MC		P33DEN-1030AR	2	2	60 KC	CARRIER
NAD6121A	ANTENNA; 150.8-162 MC		P33DEN-1100AR	1	1	30 KC	CARRIER
NAD6122A	ANTENNA; 162-174 MC		P33DEN-1110AR	2	2	30 KC	CARRIER
NLN6129A	CARRYING STRAP		P33DEN-1130AR	2	2	30 KC	CARRIER
NMN6017A	HANDSET	63E81032A43	P33DEN-3100AR	1	2	30 KC	TONE-CODED
NMN6018A	MICROPHONE	63E81032A43	P33DEN-3110AR	2	1	30 KC	TONE-CODED
NLN6435A	NAMEPLATE KIT		P33DEN-3130AR	2	2	30 KC	TONE-CODED
NLN6436A	NAMEPLATE KIT						
NLN6245A	TUNING TOOL KIT						
NLN6496A	KNOB KIT						
NLN6429A	TUNING TOOL KIT						
NLN6700A	UNIT HARDWARE KIT						
NLN6701A	UNIT HARDWARE KIT						
NLN6702A	UNIT HARDWARE KIT						
NLN6703A	UNIT HARDWARE KIT						
NLN6704A	UNIT HARDWARE KIT						
NLN6705A	UNIT HARDWARE KIT						
NLN6706A	UNIT HARDWARE KIT						
NLN6707A	UNIT HARDWARE KIT						
NLN6708A	UNIT HARDWARE KIT						
NLN6709A	UNIT HARDWARE KIT						

ACCESSORY TABLE

MODEL	DESCRIPTION
NPN6032A	117 VAC Power Supply
NLN6268A	Shock Mount Rack
NLN6129A	Carrying Strap
NLN6262A	Carrying Bag
P-7208-A	RF Dummy Load for P23 Series Radios
P-7208	RF Dummy Load for P33 Series Radios
NLN6145A	Dummy Load Antenna for P23 Series Radios
NLD6060A	Dummy Load Antenna for P33 Series Radios
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)
NKN6042A	Antenna Extension Cable (20' RG-58A/U)
NDD6000A	Antenna, vehicle rain gutter mounting, with 10' of RG-58A/U coaxial cable and connector.
TEKA-40	Power extension cable for easy repair and/or alignment
NLN6270A	6/12 VDC Vehicular Charging Unit
NKN6074A	6 VDC Vehicular Cable for NLN6270A Charging Unit
NKN6075A	12 VDC Vehicular Cable for NLN6270A Charging Unit
NKN6076A	12 VDC Cigarette Lighter Cable for NLN6270A Charging Unit
NEN6048B	Test Jig for aligning and testing radiophone
NKN6110A	Battery Charging Cable (for use with NPN6031A Power Supply and NLN6480A Battery Charger)
NKN6111A	Battery Charging Cable (for use with NLN6267A Battery Kit and NLN6480A Battery Charger)
NLN6137A	Squelch and Volume Locking Nut
TEKA-58A	Tuning Adapter and Power Cable for tuning and alignment

(Pages v and vi were omitted due to non-relevancy)

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.

HEADSET AND
MICROPHONE
Model NMN6009B

NICKEL-CADMIUM
BATTERY CHARGER
Model NLN6480A

DESCRIPTION AND OPERATION

1. DESCRIPTION

The Motorola "Handie-Talkie" FM radio is a completely transistorized and weatherproof portable communications radio set. The radios 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 "Private-Line" tone-coded squelch 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.

"Private-Line" tone-coded squelch radios and carrier squelch radios are available in two series of models. The lighter weight P23 (PT 200) Series for maximum portability and the P33 (PT 300) Series where higher r-f power output is required. The P23 Series deliver 2 watts of r-f power at nominal battery voltage throughout the 132-174 mc band and weigh as little as 6 lbs. The P33 Series units deliver 5 watts of r-f power output and weigh as little as 6 lbs. 4 oz. Both series of radios 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.

These radios incorporate a new concept in miniaturized circuitry, made possible by arranging components in discrete "decks" or layers on the printed circuit boards. As many as three layers are used in some portions of the unit.

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 P23 and P33 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 in railroad models)

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 117-volt a-c power supply is available as an accessory item.

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 Model NAD6120A, NAD6121A and NAD6122A Antennas are flexible steel whips terminated in uhf connectors. The NAD6120A is a 19-1/2" whip operating in the 132-150.8 mc range. The NAD6121A is an 18-1/2" whip operating in the 150.8-162 mc range. The NAD6122A is a 17-1/4" whip operating in the 162-174 mc range.

NOTE

The Motorola "Handie-Talkie" radio 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

Four side brackets (two per side) are provided on the radio set to allow attachment of the NLN6311A or the NLN6312A Back Carrying Harness Kit. This makes the unit transportable as a back pack. Instructions for attaching the harness are provided with the kit.

2. PRE-OPERATIONAL NOTES

Use care when unpacking and handling the "Handie-Talkie" FM radio. 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" radio 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 radio 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 monitorin 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 radio is placed on the hood or top

NOTE (Cont'd)

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

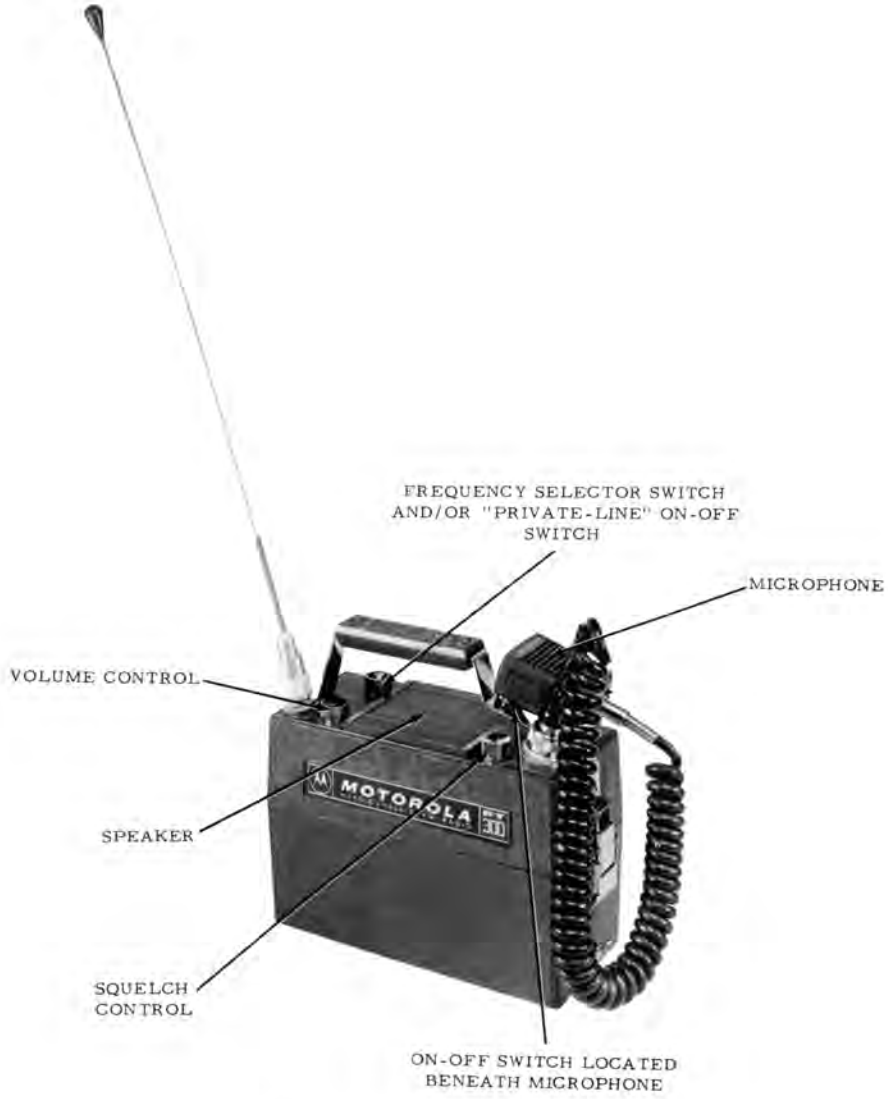
Replacing the microphone or handset in the mounting bracket automatically turns the receiver off.

NOTE

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 radio is equipped with nickel-cadmium batteries, refer to the BATTERY REPLACEMENT AND CHARGING SECTION for care and storage of the batteries.



Controls Location Detail

BATTERY REPLACEMENT AND CHARGING

1. BATTERY REPLACEMENT PROCEDURE

Figure 1.

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

> ***WARNING***
> Do not discard batteries in fire as they may explode.

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

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 radio.

(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 connected in series. 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:

P23 Series

- NPN1007A - Nickel-Cadmium Power Pack (with one NLN6267A Battery Kit) 16 hours before recharging is necessary.
- NPN1008A - Standard Power Pack (with one NLN6310A Battery Kit) - **twelve 8-hour working days each separated by a 16-hour off period.**
- **NPN1009A - Standard Power Pack used in railroad model radios (includes one NLN6310A Battery Kit) - twelve 8-hour working days, each separated by a 16-hour off period.**

P33 Series

- NPN1007A - Nickel-Cadmium Power Pack (with one NLN6267A Battery Kit) one 8 hour working day before recharging is necessary.
- NPN1008A - Standard Power Pack (with one NLN6310A Battery Kit) - 6, 8-hour working days each separated by a 16-hour off period.
- NPN1009A - Standard Power Pack used in railroad model radios (includes one NLN6310A Battery Kit) - 6, 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 in 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" FM radio consists of a crystal-controlled transmitter and receiver operating in the 132-174 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 P23 series models, the r-f section consists of a crystal-controlled oscillator, a modulator, two frequency tripliers, one frequency doubler, a driver amplifier and a final amplifier stage. In P33 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 three audio amplifiers.

Dual squelch "Private-Line" models include additional stages, some of which are shared by

both the transmitter and receiver. The common stages are a "Vibrasponder" circuit tone amplifier circuits and a "Vibrasponder" driver.

2. CIRCUIT THEORY

a. Transmitter

A dynamic microphone produces a low level audio output which is directly coupled to a pre-amplifier in the microphone housing. The output from this stage is capacitively coupled to the amplifier-clipper stage.

The amplifier-clipper and integrator stages comprise an "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 phase modulator results in a "flat" response being produced 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 is dependent only upon the amplitude of the integrator input. The audio signal amplitude is limited in the amplifier-clipper prior to insertion into the integrator, thereby limiting maximum deviation to a fixed value within the desired frequency range. Audio frequencies above 3000 cps are attenuated in a "splatter" filter, consisting of L116 and C114, prior to insertion into the integrator.

Oscillator stage Q101 (and Q201 in two-frequency transmitters) is a fundamental, crystal-controlled, anti-resonant circuit. It generates a radio frequency which is multiplied 18 times in succeeding stages to produce the desired carrier frequency. A variable capacitor across the crystal provides an adjustment (warping) of the operating frequency. The oscillator output is coupled to the modulator stage, Q102.

RF is applied to the base of modulator Q102 while audio is applied to the emitter. The internal r-f gain of Q102 is varied by (and at the rate of) the applied audio voltage. With a fixed phase shift circuit shunting the transistor and a variable phase shift being developed by the transistor, an overall variable phase shift is obtained at the output. The variable inductance in the output of the modulator stages 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.

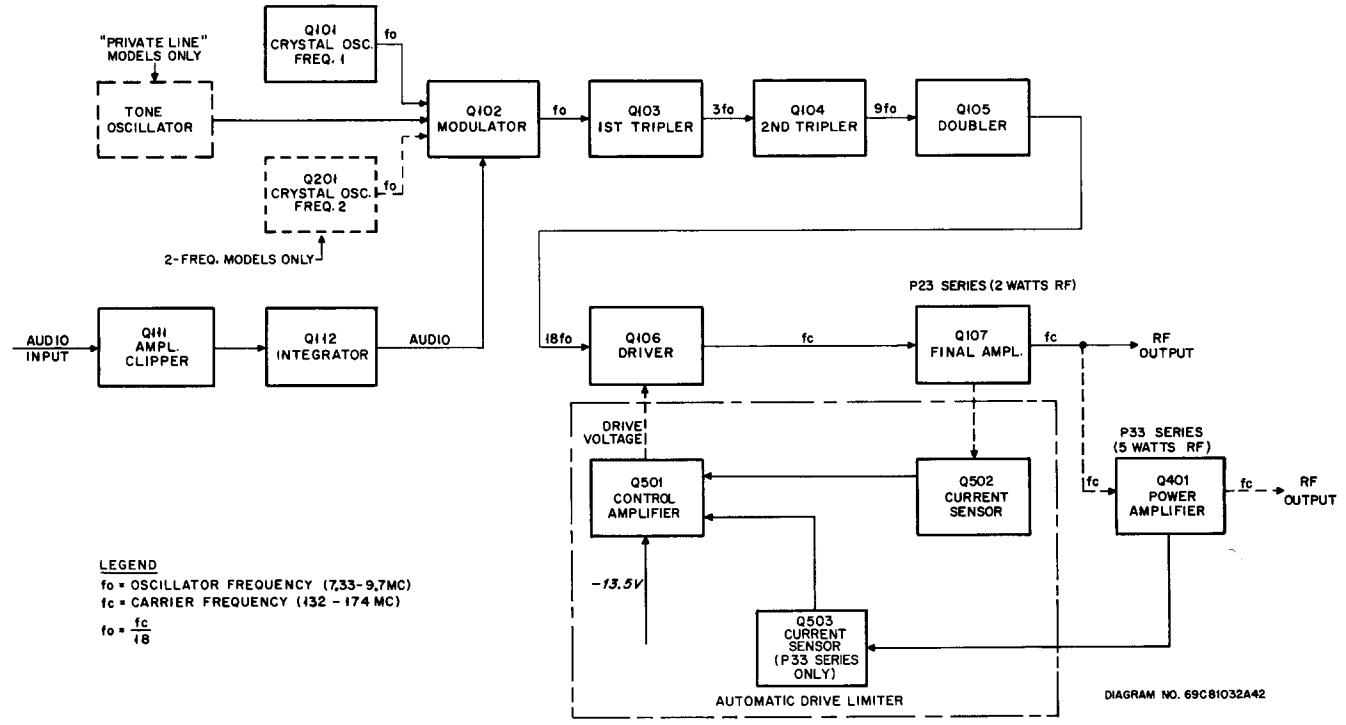
Transistor frequency multipliers, or class B amplifiers in general, do not require forward biasing. Without signal drive, a zero-biased class B frequency multiplier stage will not draw any emitter current. With drive present, the transistor will draw current and this current is easily monitored by measuring the d-c voltage developed across the emitter resistor. An exception to this is the first tripler 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.

After multiplication, the r-f signal is applied to the driver-amplifier, Q106. The gain of this stage is controlled by the DRIVE ADJ control and the action of the "Automatic Drive Limiter" circuit, Q106 provides the proper amount of r-f power to drive Q107, the final amplifier. In the P23 Series (2.0 watts), the output of final amplifier Q107 is coupled through a harmonic filter directly to the antenna.

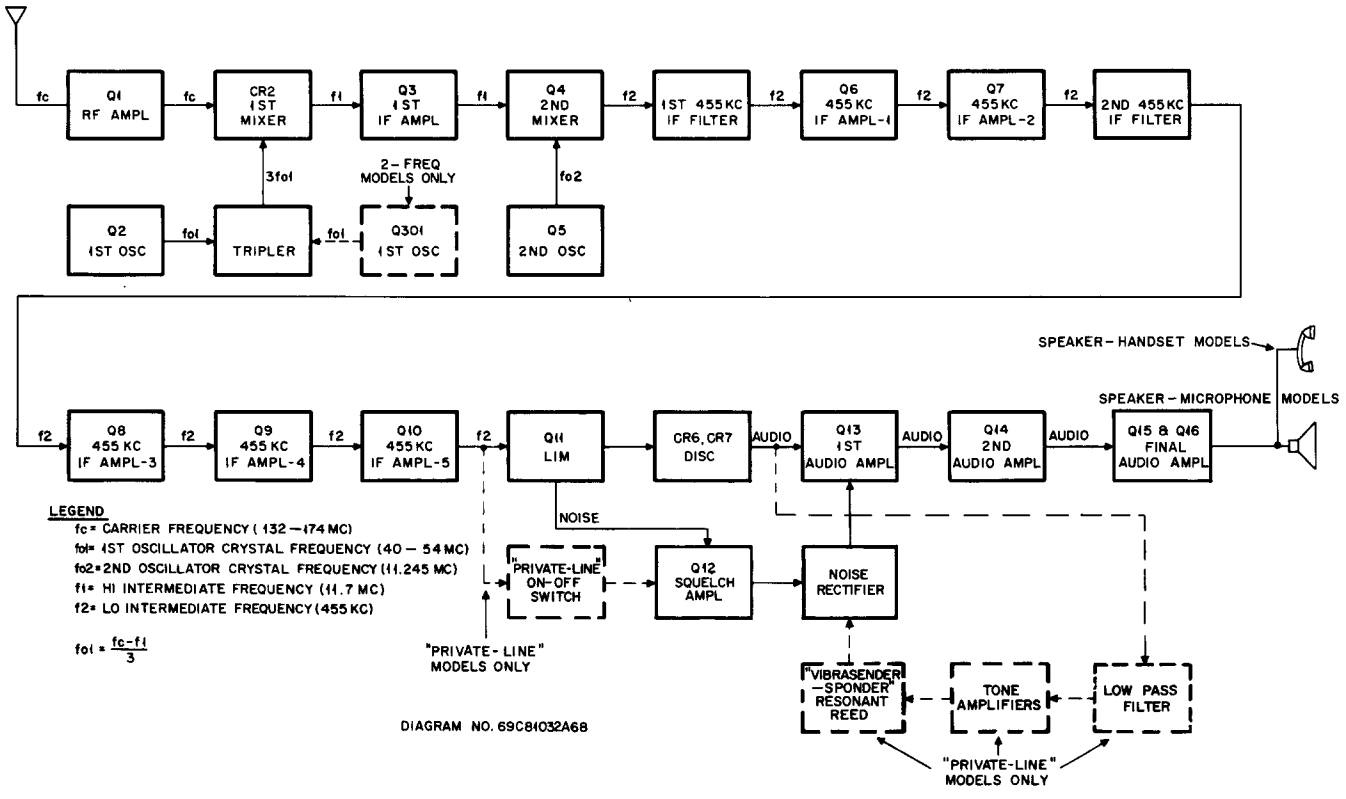
In the P33 Series units (5.0 watts), Q107 functions as an intermediate power amplifier. The output of Q107 is coupled to a final amplifier stage, consisting of Q401 and its associated components, for amplification to the higher power level. The r-f signal is then filtered by a harmonic filter consisting of C408 through C411 and L406 through L408 and coupled through the contacts of the antenna relay to the antenna.

The "Automatic Drive Limiter" ("ADL") circuit protects the driver and power amplifier transistors from being damaged by excessive current. This condition can exist if the transmitter is keyed with its resonant circuits misaligned, the output circuit shorted or the antenna removed. In addition, the "ADL" circuit maintains the proper output power level of the transmitter when a "fresh" battery, with its higher terminal voltage, is placed in the unit. The feature results in the rated power output of the transmitter being maintained, but with less drive power required, thereby conserving the battery. The P33 Series radios contain an additional current sensor stage in the "ADL" circuit which senses excessive current in the power amplifier transistor.

In operation, transistor Q501 is normally saturated and Q502 (and Q503 in P33 Series) is normally cut off. Assume, for example, that the



Transmitter Block Diagram



Receiver Block Diagram

final amplifier, Q107, begins drawing excessive current due to a short in the output circuit.

The current flow path for this stage is from the power source, through resistor R503, chokes L502 and L113, to the emitter. As the current increases, the voltage at the junction of R503 and CR502 goes positive (i.e., less negative). CR501 and CR502 are normally conducting to saturation. As the potential at the junction of CR502 and R503 changes in the positive direction, it is coupled through CR502 and CR501 to the base of Q502, allowing the transistor to conduct. As stated previously, Q501 is normally conducting to saturation, with forward bias being established by the voltage divider consisting of R501 and R502. When Q502 conducts, it forms a low resistance path to the negative power source potential. This results in the forward bias of Q501 being reduced and a decrease in the transistor's conduction. As Q501 conduction decreases, its collector will approach a less negative potential which is applied, through L111, R118 and R117, to the emitter of the driver transistor, Q106. The conduction of Q106 will now decrease, providing less drive power for the final amplifier Q107, thereby limiting its emitter current. The operation of the second current sensor in the P33 Series, Q503 is identical to that of Q502. It senses excessive current in the final power amplifier stage, Q401, and reduces the drive voltage from Q106 to the final amplifier, Q107. This, in turn, reduces the drive to Q401, the final power amplifier, thereby limiting current flow in the transistor. The "ADL" circuit will return the transmitter final stages to their normal operating condition when the excessive current condition has been corrected.

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.

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 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 "Vibrasponder" 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 by tone amplifiers and fed into the modulator circuit. It is then coupled, with the audio signal, to modulate the oscillator frequency.

With the "Private-Line" switch in the OFF position, the receiver squelch action is performed as in any standard, noise-operated squelch unit. Moving the "Private-Line" switch to the ON position injects a portion of the 455 kc i-f signal into the squelch circuit. The signal is amplified, rectified and applied as positive bias to the emitter of the audio input stage, cutting the stage off. This i-f signal will always be present, even when an r-f carrier is not being received. Therefore, whenever the "Private-Line" switch is in the ON position, and a properly coded r-f carrier is not being received, the audio stages will be cut off.

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, detected, and coupled to drive the "Vibrasponder" unit. The "Vibrasponder" resonant reeds used in these "Handie-Talkie" radios are of the two coil, single tine type. When a tone is applied across the input coil at the reed mechanical resonant frequency, the reed will vibrate strongly, acting as an electro-mechnical coupling between the input and output coil. Therefore, the reed can be considered to be a very narrow band-pass filter which passes only the desired tone.

The signal from the "Vibrasponder" unit output coil is then detected and applied as negative bias to the emitter of the audio input stage, allowing it to conduct and unsquelch the audio amplifiers. In dual squelch receivers, 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 radio 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 Motorola T1034C FM 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 TEKA-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

RECOMMENDED TEST EQUIPMENT

S1059A
Test Set

TEK-23
Power Supply

RF Dummy Load
P-7208 for P33 Series units
P-7208-A for P23 Series units

DC Multimeter

Transistorized AC
Voltmeter

TEK-1A
Transistorized Tone
Generator

T1034C
Signal Generator

S1301A Precision Wide Band Oscilloscope

Dummy Load Antenna
NLN6145A for P23 Series units
NLD6060A for P33 Series units

Test Jig
Model NEN6048B

TEST EQUIPMENT CHART (Cont'd)

EQUIPMENT	USED FOR
Motorola NLN6245A Alignment Tool Kit (supplied with the radio)	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-58A Tuning and Power Adapter Cable	Connecting external power supply to radio for servicing
Motorola NEN6048B Test Jig	Holding the radio for alignment or testing

2. TEST PROCEDURE

When a radio 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 than 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. The recommended procedure is to replace, or recharge the batteries if the voltage 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 P33 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 P23 series transmitter, when properly tuned and operating at 14.0 v d-c, will produce 2 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 4. 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 connec-

tor 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 0.5 microvolt or less. Refer to the Alignment Procedure.

(2) Squelch Check

With no r-f input signal, set the squelch control until the speaker noise justs 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.

NOTE

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

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

RECEIVER RF AND IF STAGE MEASUREMENTS CHART

NOTES

1. Output readings taken with a Motorola Transistorized AC Voltmeter, or equivalent.
2. The carrier frequency is injected at the antenna receptacle using an adapter cable coupled to a Motorola Model T1034C Signal Generator, or equivalent.
3. The 1st 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	-	Base of Q8 (M1)	-58 dbm (0.001 v)
-	Noise	-	Base of Q10 (M2)	-12 dbm (0.19 v)
-	Noise	-	Base of Q11 (M3)	-10 dbm (0.245 v)

RECEIVER RF AND IF STAGE MEASUREMENTS CHART (Cont'd)

FREQUENCY	UV INPUT	PROCEDURE	OUTPUT AT	READING (NOTE 1)
-	Noise	- (Short collector of Q1 to collector coil ground with 100 uuf capacitor)	Base of Q8 (M1)	-62 dbm (0.0006 v)
-	Noise	- (Short collector of Q2 to collector coil ground with .02 uf capacitor)	Base of Q8 (M1)	-72 dbm (0.0002 v)
Carrier	6	Connect input to external antenna connector	Base of Q8 (M1)	-29 dbm (0.028 v)
Carrier	6	Connect input to external antenna connector	Input to second section of 455 kc filter	-20 dbm (0.077 v)
Carrier	100	Connect input to external antenna connector	Output of 1st section of 455 kc filter	-42 dbm (0.0062 v)
1st i-f	6	Connect input to 1st IF-1 (top of L6)	Base of Q8 (M1)	-29 dbm (0.028 v)
1st i-f	1000	Connect input to 1st IF-5 (top of T2 primary)	Base of Q8 (M1)	-33 dbm (0.017 v)

AUDIO AMPLIFIER MEASUREMENTS CHART

NOTES

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

AUDIO AMPLIFIER MEASUREMENTS CHART (Cont'd)

FREQUENCY	VOLTS INPUT	INPUT TO	OUTPUT AT	READING	REMARKS
1000 cps	.02 (-32 dbm)	GRN-RED lead (top of volume control)	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-hand-set 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 recep.
			Secondary of transformer (T3)	-2 dbm (0.6 v)	

4. TRANSMITTER SERVICE NOTES

The following information will aid the serviceman in troubleshooting the radio 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 test leads or an ohm scale of less than X100.

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 radio 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. It is recommended that the heavy signal flow line (shown on the schematic diagram) be followed through the r-f stages.

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 de-

veloped across the emitter resistor. In the transmitter, these checks are made using test points M1, M2 and M3. The 1st tripler stage Q103 operates at a very low signal level. Therefore, a small amount of forward bias is supplied to increase the gain of this stage.

e. Driver and Final Amplifiers

When tuning up the final amplifiers, it may be necessary to retune some previously tuned circuits. This includes coils L108, L109, and capacitors C135, C139 (all models), C401, C402, C403 and C404 (P33 series only). All these components interact to some extent. By using care in tuning these stages, rated power output will be obtained with minimum current drain.

CAUTION

DO NOT USE A METAL SCREWDRIVER WHEN ADJUSTING C401, C402, C403, C404 AND R118.

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, Q108, 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.

5. SERVICE AND REPAIR

Complete removal of the printed circuit boards for access to the components is not necessary. Once the bottom plate has been removed, the receiver and transmitter boards can be folded out of the housing. The "Private-Line" squelch deck frequency and second oscillator decks (if used) are mounted on the component side of the receiver and transmitter boards. To gain access to the components, remove the mounting screws and fold the decks away. The "ADL" board is accessible once the receiver board is folded out of the housing. Remove the screws that mount it to the housing and fold it away from the housing wall for access to components. If board removal is necessary, observe standard servicing practices, such as tagging of leads and identification of connecting points.

a. General Disassembly (Refer to Fig. 2)

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

(1) Remove the battery compartment as described in the BATTERY REPLACEMENT AND CHARGING SECTION

(2) Turn the radio upside down and loosen the two captive cover screws.

(3) Lift the radio compartment cover up.

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

(5) Access to the power amplifier (P33 series only) is accomplished by loosening two additional captive mounting screws.

b. Final Power Amplifier Transistor Removal Procedure (P33 Series Only)

IMPORTANT

The placement of components on this chassis is critical. When replacing the power transistor, Q401, the disassembly procedure outlined in the following steps should be followed as closely as possible. (Refer to Figure 5.).

NOTE

The letters and numbers that appear on the drawing indicate corresponding steps in the following procedure. Example: 5b(1) in Figure 5. indicates the location of points discussed in subparagraph 5b (1).

(1) Unsolder three leads and ground tab.

(2) Remove transistor mounting nut.

(3) Remove six (6) screws.

(4) Lift assembly from mounting plate.

(5) Unsolder the transistor leads. Care should be taken as not to reposition the coil connected to the collector lead during the unsoldering process.

(6) Remove transistor.

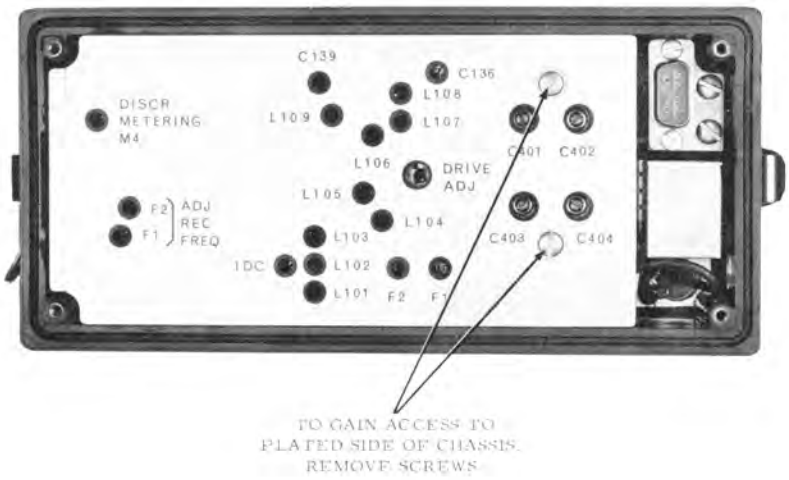
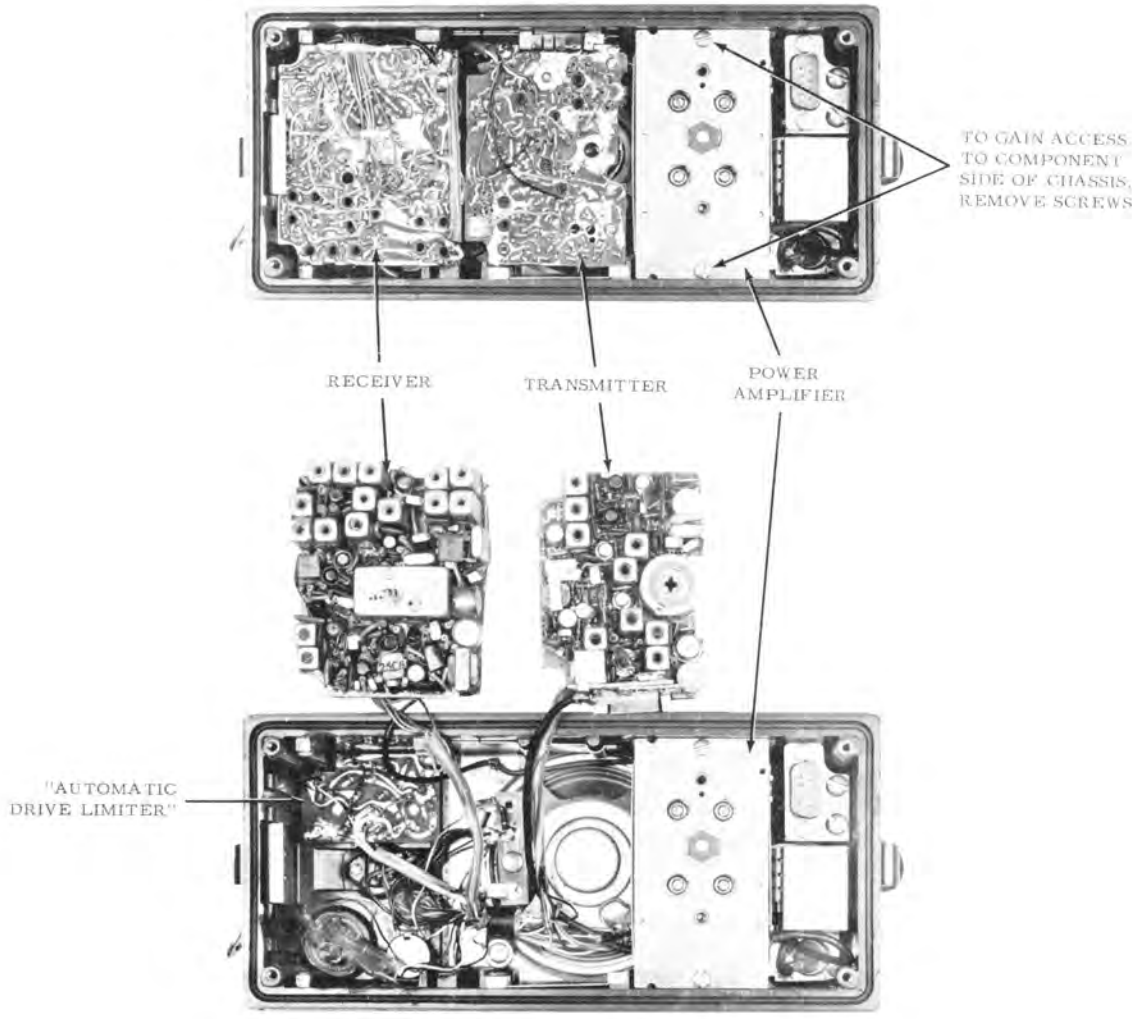


Figure 2



Figures 3 & 4

(7) Remove sleeving from transistor stud (turn sleeve counterclockwise).

(8) To reassemble the unit proceed as follows:

(a) Replace sleeving on transistor stud.

(b) Place the transistor in the block (on mounting plate) and replace mounting nut (do not tighten).

(c) Position the assembly (see par. 5b(4) over the transistor, making sure that the emitter lead is directly in line with the capacitor tab. Tighten the mounting nut.

(d) Complete the reassembly procedure by reversing steps 5b(5), 5b(3) and 5b(1).

NOTE

When resoldering the transistor emitter lead, keep it as short as possible and

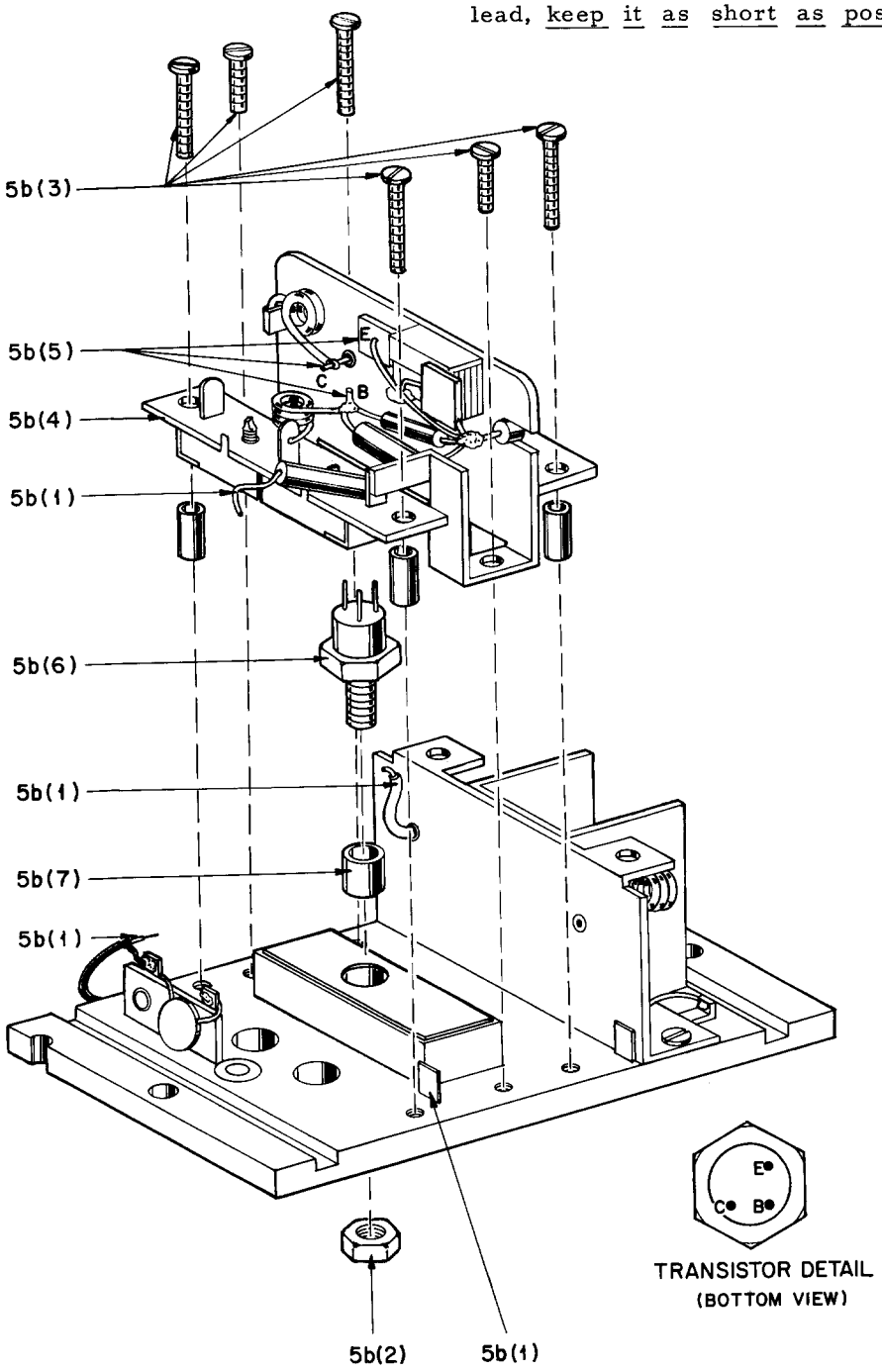


Figure 5.

NOTE (Cont'd)

solder it on the tab close to the capacitor body.

c. Final Amplifier Transistor Removal Procedure (P23 and P33 Series)

The procedure outlined below should be followed as closely as possible when replacing the power transistor (Q107) in this amplifier.

(1) Unsolder the emitter and sleeved leads connected to the base-emitter choke.

(2) Bend the choke up away from the transistor.

(3) Unsolder the transistor base and collector leads.

(4) Bend the capacitor tab back toward the mounting plate, away from the transistor. Note the position of this tab in respect to the transistor emitter lead. It must be returned to this position after the transistor is replaced.

(5) Remove the transistor mounting nut and take out transistor.

(6) To replace the transistor, reverse the preceeding steps. As stated previously, the capacitor tab must be repositioned over the emitter lead. Keep this lead as short as possible.

d. Repair Techniques

(1) Construction

The transmitter, receiver, "ADL" and "Private-Line" squelch decks are mounted on separate printed circuit boards. These boards are the etched copper type with special eyelets in all component mounting holes. This type of board is far superior to the metal foil plated type due to the binding properties of the copper plating to the glass epoxy board. In addition, the special eyelets used in the component mounting holes act as mechanical strain relief members, thereby removing strain from the actual printed circuit.

In the past, servicemen have been lead to believe that printed circuits are extremely fragile and that a low wattage soldering iron should be used to prevent damage to the board. This is a misconception. Experience has shown that using a low heat iron has, in many cases, caused the damage the serviceman was trying to prevent. The temperature of the connection must be raised until the solder flows freely around the board eyelet. This usually takes a considerable length of time with a low wattage soldering iron. During this period, heat is conducted away from the eyelet by the printed wiring causing them, in some instances, to break away from the board. Therefore, it is preferable that a high-heat iron be used which will heat the connection rapidly to the point where the solder flows freely. Obviously, an iron this hot should not be held on the connection longer than necessary. The soldering iron supplied with the Motorola TEK-4A Printed Circuit Repair Kit is recommended for most work on these boards.

Breaks in the printed circuit wiring can be repaired by bridging the gap with solder. Remove the resin coating covering the printed wiring with solvent before soldering. Areas of damaged circuitry that cannot be practically repaired with a solder bridge can be replaced with a piece of hook-up wire. The hook-up wire should be routed along the original path of the printed circuit to avoid any lead dressing problems in critical areas.

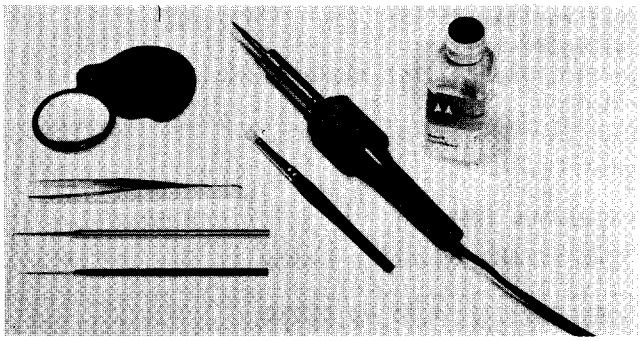
(2) Component Removal

The various components are arranged in "decks" or layers, with those least susceptible to failure on the lower level. At times, however, it may be necessary to remove other components in order to service the faulty one. Special care should be taken during troubleshooting to be as certain as possible that the suspected component is the faulty one. This special care will eliminate unnecessary unsoldering and removal of parts which may weaken or damage the eyelet board.

When removing resistor, capacitors and similar components, heat the connection to be loosened until the solder is molten. Then brush away, or shake off as much of the molten solder as possible. If the leads are bent over, use a soldering aid tool or a knife to straighten them. It may be necessary to apply the soldering iron while doing this. While applying the soldering iron, wiggle the component gently to free it, then lift it from the board. Be sure the component lead is free before trying to remove it or the eyelet circuit board might be damaged. Install the new component and solder it in place. Use solvent to remove excess flux after soldering.

(3) Servicing Aids

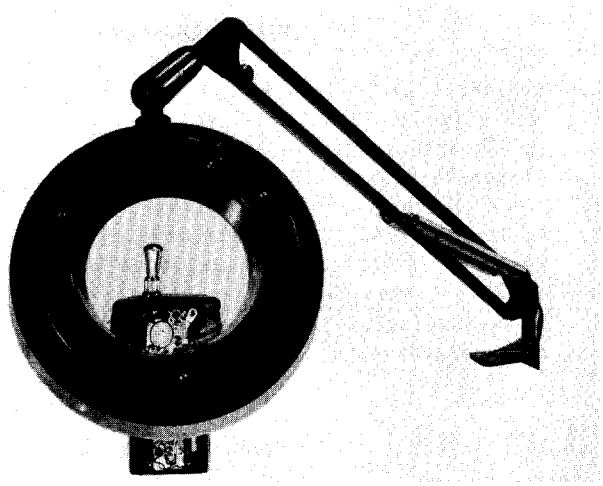
Motorola has available several items which can be used to aid in parts replacement and repair of printed circuit board.



TEK-4A Printed Circuit Repair Kit

(a) Magnifying Glass

Miniaturization requires precision work both in manufacture and in field service. Adequate concentration of light and magnifications 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 Source are most satisfactory devices for use in servicing miniature equipment in the shop. The large illuminated magnifying glass makes it easy to see any portion of the small components found on the printed circuit board. Refer to the accompany illustration.



TEKA-12 Magnifying Glass & Built-In Light Source

(b) Printed Circuit Repair Kit

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

(4) Alignment Notes

When replacing crystals, realign the radio as described in the alignment procedures in this manual. Also, if any component in a tunable stage is replaced, relaign the associated, the preceding, and the following stages.

NOTE

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

TEST EQUIPMENT REQUIRED FOR TRANSMITTER ALIGNMENT

1. Motorola NLN6429A Alignment Tools (supplied).
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 T1130A Series FM Station Monitor or equivalent.
6. Motorola TEK-1A Transistorized Tone Oscillator or equivalent.
7. Motorola T1014B Precision Wide Band Oscilloscope or Model T1015A General Purpose Oscilloscope or equivalent.
8. Motorola Model S1056A-9A or TU546 Series Portable Test Set (or equivalent).
9. Motorola Model TEKA-58A Tuning and Power Adapter Cable.

HOW TO SET-UP THE S1056A-9A TEST SET WITH THE TEKA-58A TUNING AND POWER ADAPTER CABLE FOR MONITORING POWER AMPLIFIER CURRENT AND RF DRIVE

1. Place the oscillator and meter reversing switch on the test set in the OFF position.
2. Plug the red phone-plug, on the accessory cable supplied with the test set, into the METER socket on the test set.
3. Plug the black phone-plug on the other end of the accessory cable into the phone-jack connector on the tuning and power adapter cable.
4. The scale used to obtain meter readings is determined by the position of the selector switch on the tuning and power adapter cable as follows:

a. Adapter cable switched to the DRIVE position use the 0-50 ua scale.
b. Adapter cable switched to the PA CURRENT position use the 0-1000 scale and ma for the unit of measurement.

5. No meter readings are obtained when used with P23 Series Radio sets.

NOMINAL VOLTAGE READINGS

NOTE

The following readings apply to a fully tuned transmitter with 13.5 v dc input.

METER POINT	M1 BRN	M2 RED	M3 ORG	TUNING ADAPTER METERING POINT	
				DRIVE	P.A. CURRENT
READING (V DC)	-3.0	-10	-13.0*	20 ua	600 ma

*With "ADL" circuit disabled and R118 turned fully clockwise.

PRELIMINARY SET-UP FOR TRANSMITTER ALIGNMENT

1. Remove the cover from the radio section of the unit.
2. When aligning a two-frequency unit, align on the primary or higher of the two frequencies.
3. The dc multimeter ground lead should be connected to a convenient ground. (Positive terminal on power supply).
4. For complete alignment, the radio set power supply should be removed and a 14 volt dc power supply with ammeter should be connected to the radio set battery plug via the tuning and power adapter cable. All tuning slugs except L101 should be unscrewed so that they are flush with the printed circuit board.
5. IMPORTANT: Preset capacitors C135 and C139 to the position shown on the METERING AND ALIGNMENT POINTS detail (maximum capacity). Preset capacitors C401, C402, C403 and C404 several turns counterclockwise.
6. Remove the antenna by unscrewing it from the receptacle. Connect a wattmeter to the external ANT. jack using the test cable.
7. The unit is now set up for transmitter alignment. Proceed with STEP 1 of the transmitter alignment procedure.

CAUTION

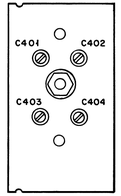
Make transmitter power tuning adjustments only when radio is connected to the wattmeter. Attempting to tune the transmitter for other than setting frequency while the antenna is connected may result in exceeding the maximum safe current ratings within the radio.

FREQUENCY CALCULATIONS

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

TRANSMITTER ALIGNMENT PROCEDURE

STEP	TEST EQUIPMENT	METER POINT & COLOR	ADJUSTMENT	PROCEDURE
1	DC Multimeter	Power Supply Terminals	R118	P23 SERIES AND P33 SERIES Set the PA CURRENT-DRIVE switch on the tuning adapter to the DRIVE position. Adjust the power supply voltage to -12 volts dc with the transmitter keyed. Note: P33 Series - Make voltage adjustment with the tuning adapter in the DRIVE position.
2	DC Multimeter	M1 (BRN)	L102, T1 1st Tripler	P23 SERIES AND P33 SERIES SINGLE FREQUENCY TRANSMITTER: Adjust L102 for a peak reading and then adjust T1 for a peak reading. Repeak several times to obtain maximum reading. This circuit is tuned to three times the crystal frequency. TWO FREQUENCY TRANSMITTER: Adjust L102 for a peak reading on the higher frequency and adjust T1 for a peak reading on the lower frequency. Switch between the two frequencies; adjust L102 and T1 until a balance is obtained in the readings.
3	DC Multimeter	M2 (RED)	L103, L104 2nd Tripler	NOTE Turn L105 three turns clockwise prior to adjusting L103 and L104. P23 SERIES AND P33 SERIES Adjust coils L103 and L104 for a maximum dip. Readjust several times to insure maximum dip has been obtained. This circuit is tuned to nine times the crystal frequency.
4	DC Multimeter	M3 (ORG)	R118, L105, L106 Doubler	P23 SERIES AND P33 SERIES Adjust R118 to mid-rotation to increase meter sensitivity. Adjust coils L105 and L106 for a maximum dip. Return R118 to its full-clockwise position (minimum resistance). Readjust several times to insure maximum dip has been obtained. This circuit is tuned to eighteen times the crystal frequency.
5	Test Set with Tuning Adapter	Tuning Adapter switched to DRIVE position	L107, L108 C401, C402 C135, C139	P33 SERIES ONLY Adjust L107, L108, C401 and C402 for maximum dc reading. If no indication is obtained, adjust L107, C135, L108 and C139 for a maximum current reading, then adjust C401 and C402 for maximum dc reading.
6	DC Multimeter	Positive to M3, negative to B-	Power Supply	P23 AND P33 SERIES Note reading on multimeter. Increase the power supply voltage to -17 volts dc. The multimeter reading should increase by 1 volt minimum. If a 1 volt increase is not noted on the multimeter, the Automatic Drive Limiter is not functioning. Restore the ADL to operation before proceeding with alignment. Return the input voltage to 14.5 volts dc for the P23 Series or 13.5 volts dc for the P33 Series.
7	RF Wattmeter and Test Set with Tuning Adapter	Tuning Adapter switched to PA CURRENT position	C403, C404	P33 SERIES ONLY Adjust C403 and C404 for a maximum reading on wattmeter. (P.A. Current reading should be approximately 600 ma.)
8	RF Wattmeter	---	L107, L108 C135, C139	P23 SERIES ONLY Adjust L107, L108, C135 and C139 for a maximum reading.
9	RF Wattmeter and Power Supply Ammeter	Total input current	R118 C403, C404 L108, C139	P33 SERIES ONLY Adjust R118 for approximately 5 watts output. Adjust C403, C404, L108 and C139 for maximum power output. Repeak C403 for maximum power and minimize input current by readjusting C404, R118, and L108. Repeat this step until 5 watts output, at minimum input current, is obtained. NOTE DO NOT EXCEED 900 MA TOTAL CURRENT DRAIN (including relay current).
10	RF Wattmeter and Power Supply Ammeter	Total input current	L108, C139, C107, C135	P23 SERIES ONLY Adjust R118 for approximately 2.0 watts output. Repeak L108, C139, L107 and C135 for maximum output while minimizing the input current. Readjust R118 and repeat this step several times until 2.0 watts is obtained with minimum current drain. It may be necessary to repeak L105 and L106 for maximum power. NOTE DO NOT EXCEED 475 MA TOTAL CURRENT DRAIN (including relay current).
11	RF Wattmeter and Power Supply Ammeter	Total input current	C404, R118	P33 AND P23 SERIES Increase the power supply voltage to 16.8 volts d-c. The power output must be greater than 2.0 watts for the P23 Series or 5.0 watts for the P33 Series. The input current should not exceed 500 ma for the P23 Series or 1000 ma for the P33 Series. Adjust R118 to obtain this limit. Repeat Step 9 and this step until the rated power is obtained without exceeding the maximum specified current. Replace the bottom plate on the radio and tighten securely.
12	---	---	---	P23 SERIES AND P33 SERIES OSCILLATOR: C101 is preset to the assigned frequency at the factory. Do not readjust C101 unless the crystal is replaced or the setting was accidentally changed. If it is necessary to readjust C101, set up the frequency monitor for frequency measurement, and adjust C101 for zero reading on the monitor CARRIER FREQUENCY meter. Place the bottom plate on the transmitter unit and tighten securely. IMPORTANT - When the bottom plate is attached, the frequency may shift, therefore, recheck the carrier frequency on the frequency monitor. If necessary, repeat this adjustment and recheck procedure compensating for the variations until a zero meter reading is obtained with the bottom plate securely attached to unit. TWO-FREQUENCY TRANSMITTER ONLY OSCILLATOR NO. 2: Use the same procedure as above, substituting C201 for C101.
13	---	---	---	P23 SERIES AND P33 SERIES DEVIATION CHECK: See IDC ADJUSTMENT procedure on the reverse side of this chart for adjusting the IDC control and the "Private-Line" tone deviation.



AEPD-11899-A

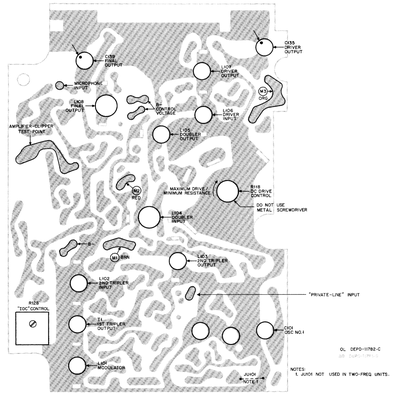
POWER AMPLIFIER (P33 SERIES ONLY)

CAUTION

DO NOT USE METAL SCREWDRIVER FOR ADJUSTMENT

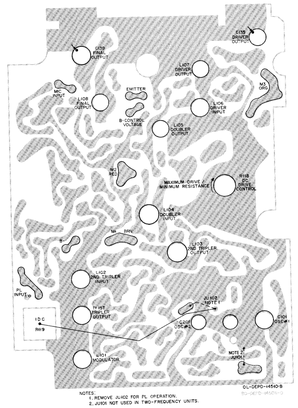
NOTE

Arrowheads indicate the position of the color dot for maximum capacity on C135 and C139.



METERING AND ALIGNMENT POINTS FOR

MODEL	SUFFIX
NTD6121AA	-1 AND EARLIER
NTD6122AA	-1 AND EARLIER



METERING AND ALIGNMENT POINTS FOR

MODEL	SUFFIX
NTD6121AA	-2 AND LATER
NTD6122AA	-2 AND LATER

"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 T1130A 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, it has 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 monitor 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 T1130A Series FM Station Monitor or equivalent.

b. Motorola Transistorized AC Voltmeter or equivalent.

c. Motorola Model TEK-1A Transistorized Tone Generator, 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 use with "Private-Line" models.

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.

Proceed as follows:

a. Connect the oscilloscope to the monitor oscilloscope terminals, and set up the controls in accordance with the monitor instruction manual.

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 in the IDC circuit). A 0.33 uf capacitor should be placed in series with the tone generator output. Refer to the photograph on the reverse side of this sheet for the location of the 1000 cps test tone injection point. 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.

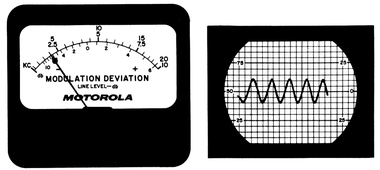


Figure 1.
Oscilloscope Calibration for
Split-Channel Transmitter

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. Carrier Squelch Models

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

NOTE

For 2-frequency models, adjust deviation for the F1 channel first. Then check the deviation for the F2 channel and if necessary, adjust R204 for the proper level.

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

(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 2/3 full deviation will indicate a weak audio transistor or other lack of audio gain.

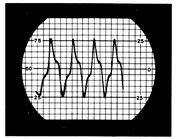


Figure 2.
5 kc Peak Deviation as seen on the Oscilloscope
(NOTE: Waveform is clipped fully)

b. "Private-Line" Models

(1) Remove "Vibrasponder" 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 L1 until a symmetrical waveform is obtained. Readjust the IDC control.

(4) Reduce the 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 "Vibrasponder" unit in its socket.

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

NOTE

If the tone deviation is not within the limits specified in the preceding step, adjust R711 (on the "Private-Line" Squelch Deck) for proper deviation. Refer to "IDC" adjustment procedure for proper setting of this control.

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 below, 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 Q111). 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.

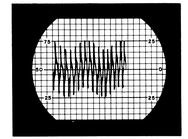


Figure 3.
5 kc Peak Deviation for Combined PL Tone and
1000 CPS Modulation

(10) Reduce the 1000 cps input to 0.25 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 T1021A Portable Frequency Meter and the S1058A or S1059A Portable Test Set (with deviation meter). These units, properly used, permit accurate measurement and setting of transmitter deviation from a peak-reading meter which is unaffected by waveform. An oscilloscope is not required. With these devices, 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 overdeviation will interfere with the user on the adjacent channel, and underdeviation may reduce system range.

TEST EQUIPMENT REQUIRED FOR RECEIVER ALIGNMENT

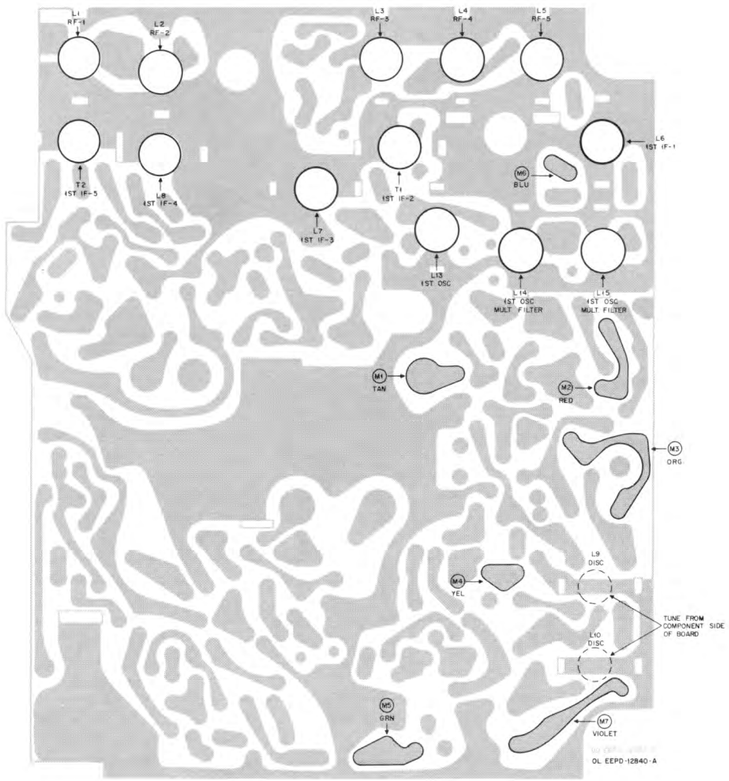
1. Motorola DC Multimeter with r-f probe or equivalent.
2. Motorola Transistorized AC Voltmeter or equivalent.
3. Motorola T1034C Signal Generator or equivalent.
4. Motorola S1056A-9A or TU546 Series Test Set with 455 kc crystal or equivalent crystal-controlled oscillator.
5. Motorola NLN6245A Alignment Tool (supplied).

PRELIMINARY SET-UP FOR RECEIVER ALIGNMENT

1. Remove the plate that covers 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

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



METERING AND
ALIGNMENT POINTS

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 radio and set the squelch control for maximum noise.

STEP	TEST EQUIPMENT	METER POINT & COLOR CODE	ADJUSTMENT	PROCEDURE
1A	DC multimeter	M-6 (BLU)	L13 1st Osc (F1) L14 Mult. Filter L15 Mult. Filter	Tune L13, L14 and L15 for min. d-c reading on the meter.
1B 2-freq. models only	DC multimeter	M-6 (BLU)	L301 1st Osc (F2)	Place the frequency selector switch in the F1 position and proceed as in STEP 1A above. Place the frequency selector switch in the F2 position and tune L301 for min. 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 receiver input. 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 910 kc below the carrier.
5	T1034C Signal Generator and a-c voltmeter	M-1 (TAN)	T2, L8, L7, T1, L6, L5, L4, L3, L2, L1	Tune these slugs successively for a maximum meter reading. Keep the meter reading below -20 dbm on the a-c voltmeter.
6A	DC multimeter	M-4 (YEL)	L13 1st Osc	Use the base station transmitter or a frequency standard as a signal source and adjust L13 for a zero d-c reading.
6B 2-freq. models only	DC multimeter	M-4 (YEL)	L301 1st Osc (F2)	Place the frequency selector switch in the F1 position and proceed as in STEP 6A above. Place the frequency selector switch in the F2 position and adjust L301 for a zero d-c reading.
7	T1034C Signal Generator and a-c voltmeter	Pin #4 of microphone connector	Signal Generator	Set squelch control for maximum noise. Adjust the volume control for an output voltage of 0.44 v a-c (noise only - no signal input). Zero the signal generator on the discriminator. Increase the signal intensity until the noise reading is reduced to one-tenth of the reading with no signal (maximum noise). Read the attenuator scale in microvolts (should be less than 0.5 microvolts). This is the 20 db quieting sensitivity.

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

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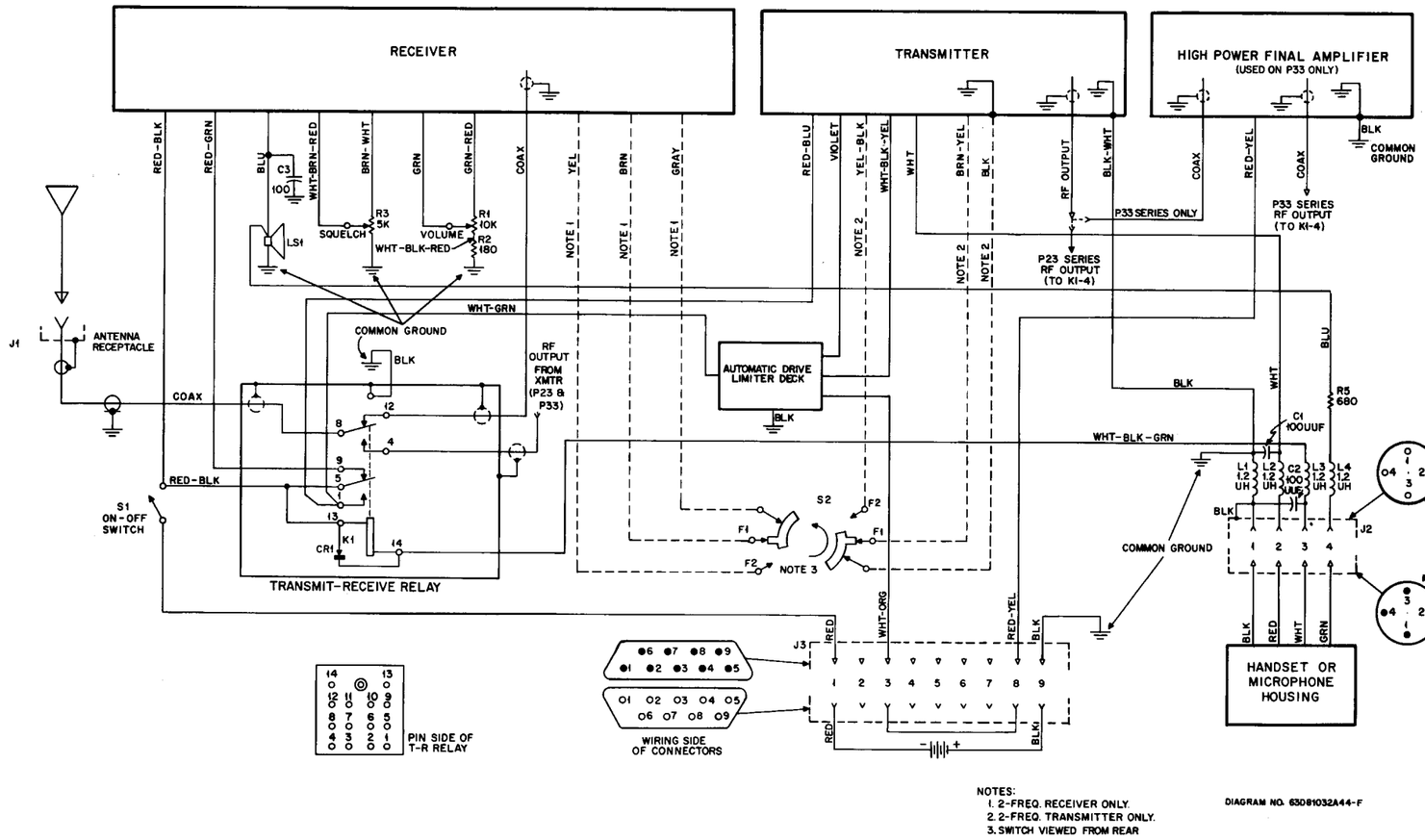


NOTES:
1. 2-FREQ. RECEIVER ONLY.
2. 2-FREQ. TRANSMITTER ONLY.
3. SWITCH VIEWED FROM REAR

DIAGRAM NO. 63D81032A44-F

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

CONTROL PANEL

NCN6039B
NCN6043B

NCN6044B
NCN6054B

EPD-12030-B

		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1	48C82392B03	silicon
		CONNECTOR, receptacle:
J1	9C82817E01	female; coax; uhf type
J2	1V80715A85	female; 4 cont; does not incl. 2A482070 NUT, ring; knurled
J3	28C82846E01	male; 9 cont.
		RELAY, armature; hermetically sealed:
K1	80C83202B01	13.6 v d-c; 4 form "C"; coil res 160
		LOUDSPEAKER, permanent magnet:
LS1	50D83205B01	3" square; 50 ohms imp.
		RESISTOR,
R1	18C82816E02	var: 10K ±10%; weatherproof
R2	6K129662	fixed: 180 ±10%; 1/4 w
R3	18C82816E01	var: 5K ±10%; weatherproof
		SWITCH,
S1	40B82851E01	toggle: spst; weather-resistant
S2	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)
	36B82628H14	KNOB, control: does not incl. 3S114064 SET SCREW: 4-40 x 3/16" Allen 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)

NLN6428A Components Kit (P23 Series)
NLN6423A Components Kit (P33 Series) EPD-12031-C

		CAPACITOR, fixed:
C1, 3	21K861436	100 uuf ±10%; 75 v; N750
C2	21K831125	100 uuf ±10%; 300 v; N750
		COIL, RF:
L1, 2, 3, 4	24C82000E21	choke; 1.2 uh; sleeved
		RESISTOR, fixed:
R5	6R6040	680 ±10%; 1/2 w

NOTE:

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

Carrier Squelch Models
Intercabling Diagram
Motorola No. 63D81032A44-F

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

NCN6040B Control Panel
NCN6050B Control Panel
NCN6055B Control Panel
NCN6065B Control Panel EPD-12045-B

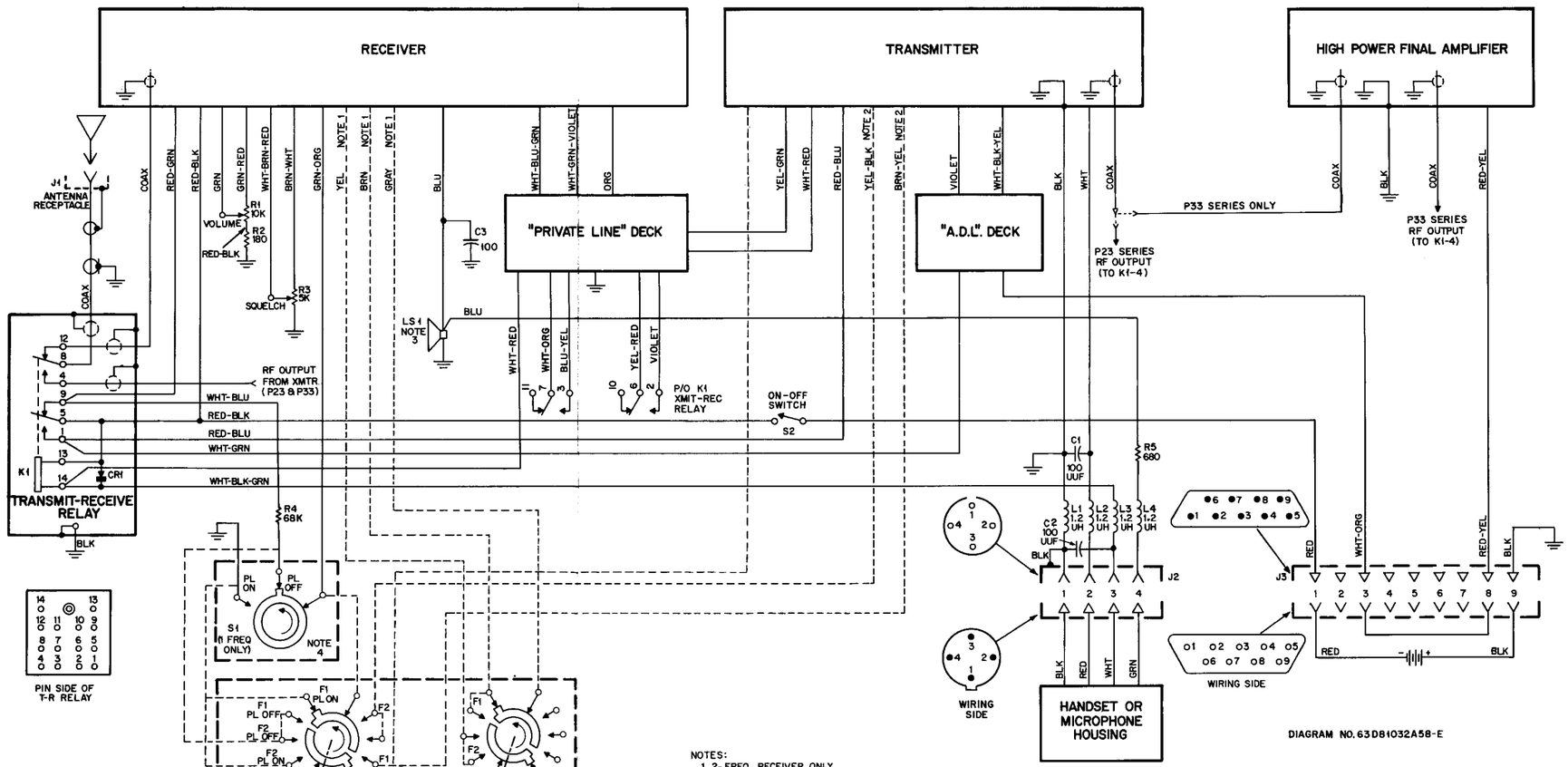
		SEMICONDUCTOR DEVICE, diode:
CR1	48C82392B03	silicon
		CONNECTOR, receptacle:
J1	9C82817E01	female; single cont.
J2	9B82413B01	female; 4 cont.
J3	28C82846E01	male; 9 cont.
		RELAY, armature:
K1	80C83202B01	2 form "C"; coil res 160 ohms; 13.6 v
		SPEAKER, dynamic:
LS1	50D83205B01	coil imped. 50 ohms; 3" dia.; weatherproof
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1	18C82816E02	var; 10K; 0.12 w @ 55° C
R2	6S129662	180 ±10%
R3	18C82816E01	var; 5K; 0.12 w @ 55° C
R4	6S129144	68K
		SWITCH:
S1	40C82843E01 or 40C82891E01	rotary; dp 2p (Models NCN6040B & NCN6065B) rotary; 3p 4p (Models NCN6050B & NCN6055B)
S2	40B82851B01	toggle; 1 form "A"
	NON-REFERENCED ITEMS	
	38B82807E01	BUTTON
	36B82628H14	KNOB, control (used on S1)
	36B82628H13	KNOB, control (used on R1 and R3)

NLN6428A Components Kit (P23 Series)
NLN6423A Components Kit (P33 Series) EPD-12031-C

		CAPACITOR, fixed:
C1, 3	21K861436	100 uuf ±10%; 75 v; N750
C2	21K831125	100 uuf ±10%; 300 v; N750
		COIL, RF:
L1, 2, 3, 4	24C82000E21	choke; 1.2 uh; sleeved
		RESISTOR, fixed:
R5	6R6040	680 ±10%; 1/2 w

NOTE:

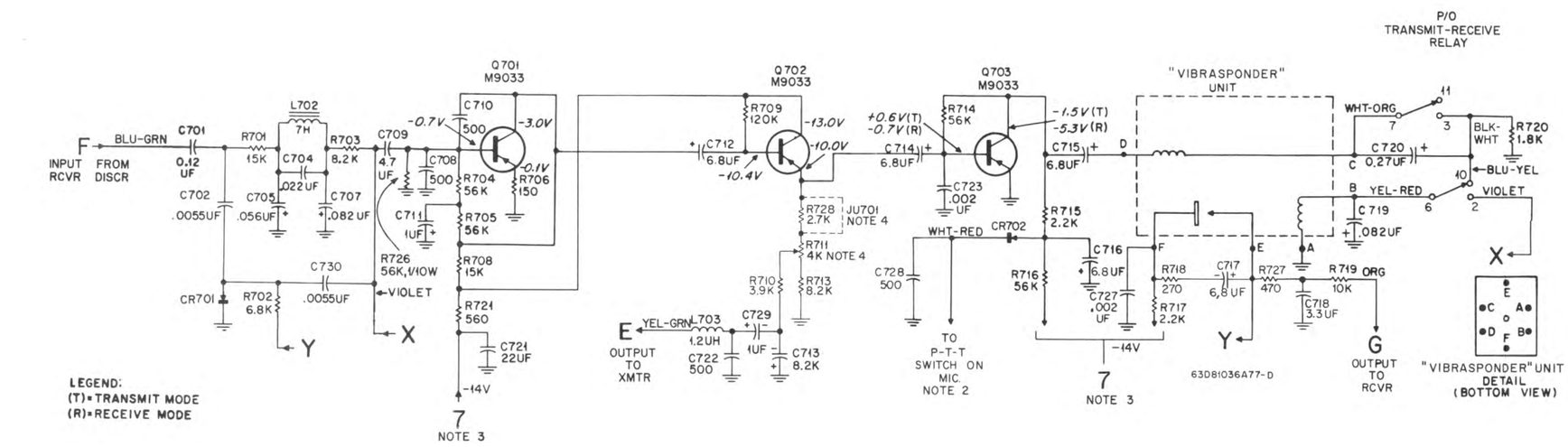
Replacement transistors and diodes must be ordered by Motorola part number only for optimum performance.

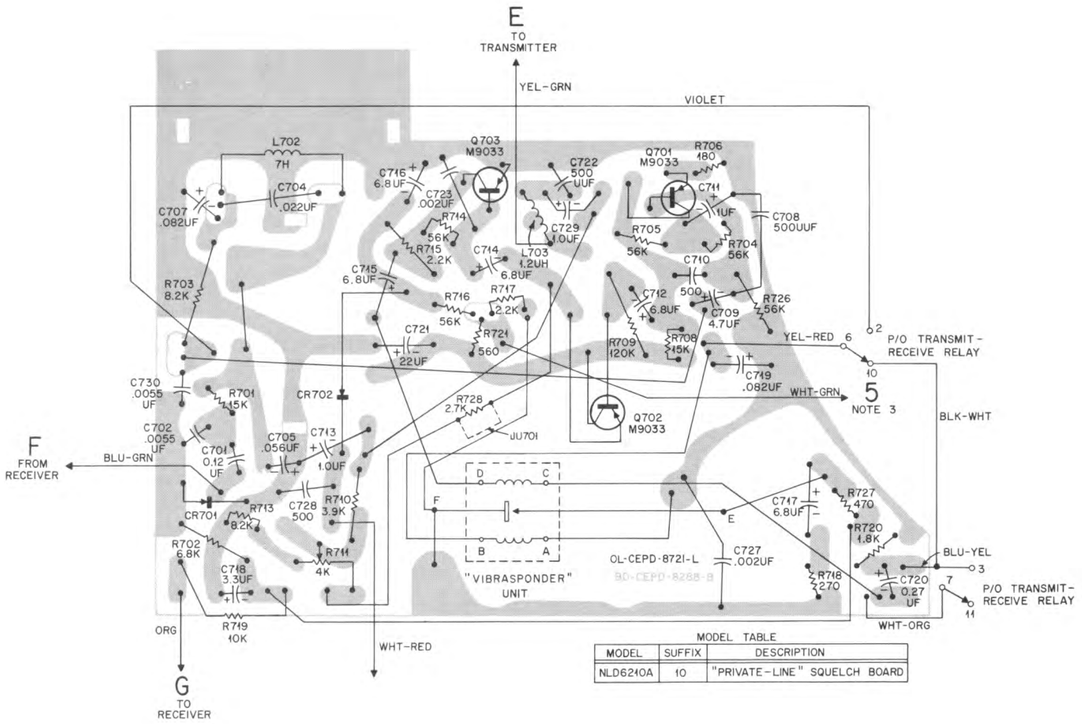


NOTES:
1. 2-FREQ. RECEIVER ONLY.
2. 2-FREQ. TRANSMITTER ONLY.
3. SPEAKER AND GROUND OMITTED IN HANDSET MODELS.
4. SWITCH VIEWED FROM REAR

DIAGRAM NO. 63D81032A58-E

"Private-Line" Tone-Coded Models
Intercabling Diagram
Motorola No. 63D81032A58-E





MODEL TABLE

MODEL	SUFFIX	DESCRIPTION
NLD6210A	10	"PRIVATE-LINE" SQUELCH BOARD

NOTES

1. UNLESS OTHERWISE SPECIFIED: RESISTOR VALUES ARE IN OHMS; K-1000, CAPACITOR VALUES ARE IN MICRO-MICROFARADS.
2. REFER TO INTERCABLING DIAGRAM FOR "PRIVATE-LINE" TONE-CODED SQUELCH MODELS.
3. REFER TO B- NETWORK ON "PRIVATE-LINE" RECEIVER SCHEMATIC DIAGRAM.
4. REFER TO "IDC" ADJUSTMENT PROCEDURE FOR PROPER SETTING OF THIS CONTROL. JUMPER JU701 MAY BE REMOVED IF GREATER ADJUSTMENT RANGE IS NEEDED.

EPD-12694-B

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

"Private-Line" Squelch Deck
Schematic Diagram and
Printed Circuit Board Detail
Motorola No. EPD-12685-F

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	NLD6210A-7		"VIBRASPONDER" WAS "VIBRASENDER-SPONDER"	
B	NLD6210A-8	C716	WAS 23D82397D16 22 uf	Q703 COLLECTOR CIRCUIT
C	NLD6210A-9	R710	WAS 6S127803 10K; 1/4 W	Q702 EMITTER
		R728	ADDED	
C1	NLD6210A-9		JU701 REFERENCE ADDED TO NOTE 4.	NOTES
D	NLD6210A-9		RELOCATED WAS CONNECTED BETWEEN GROUND AND JUNCTION OF R721, -14 V.	PARTIAL SCHEMATIC
E	NLD6210A-9		REMOVE NMN6017A HANDSET	PARTS LIST
F	NLD6210A-10	C702, 730	WAS 21C82724H01	PARTS LIST

PARTS LIST

NLD6210A "Private-Line" Squelch Deck EPD-12688-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf; ±10%; unl stated
C701	23D82397D20	0.12 ±20%; 35 v; non-polarized
C702, 730	21C82213E03	0055; +100-0%; 75 v
C704	23D82397D13	.022; 6 v
C705	23D82397D10	.056; 35 v
C707, 719	23D82397D14	.082; 20 v
C708, 722	21K861441	500 uuf ±10%; 75 v; N4700
C709	23D82397D05	4.7 +40-20%; 3 v
C710, 728	21K847065	500 uuf; GMV; 250 v
C711, 713, 729	23D82397D07	1 +40-20%; 15 v
C712, 714, 716	23D82397D23	6.8 ±20%; 20 v
C715, 717	23D82397D09	6.8 +40-20%; 10 v
C718	23D82397D28	3.3; 20 v
C720	23D82397D25	0.27; 20 v
C721	23D82397D16	22 ±20%; 15 v
C723	21K861442	.002 +100-20%; 75 v
C727	21K831126	.002 GMV: 300 v
		SEMICONDUCTOR DEVICE, diode: NOTE
CR701	48C82392B03	silicon
CR702	48C82178A01	germanium
		REACTOR: AF choke:
L702	25C82750D02	7 h
		COIL, RF: choke:
L703	24D82723H01	1.2 uh
		TRANSISTOR: NOTE
Q701, 702, 703	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, 713	6S185B90	8.2K
R704, 705, 714, 716, 726	6S185C01	56K
R706	6S185B70	180
R709	6S185C05	120K
R710	6S129232	3.9K; 1/4 w
R711	18C82876B01	var; 4K ±20%; 1/20 w
R715, 717	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
R727	6K127801	470; 1/4 w
R728	6S185B84	2.7K
NON-REFERENCED ITEM		
	1V80724A84	PRINTED CIRCUIT BD. ASSY.

NOTE:

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

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
A	NRD1131BA-5 NRD1132BA-4	C90, 91	ADDED	Q8 & Q10 COLL. CKT.	EPD-11929-O
		C81	WAS 21K865197	Q9 COLL. CKT.	
B	NRD1131BA-6 NRD1132BA-5 NRD1131BB-5 NRD1132BB-4	R37	WAS 6K127806, 1/4 W	PARTS LIST	NONE
B1			ADDED POWER SUPPLY MODEL TABLE		
C	NRD1131BA-7 NRD1132BA-6	C25	WAS 21D82877B17, 5 uuf	Q3 BASE	EPD-10465-F
D	NRD1131BA-8 NRD1132BA-7 NRD1131BB-7 NRD1132BB-6	R2	WAS 6K127804, 4.7K; 1/4 W	PARTS LIST	EPD-10465-G
		R32	WAS 6K128688, 2.7K; 1/4 W		
		C89	REMOVED FOR 150.8-174 MC (ONLY)		
		R6	WAS 6K128687, 6.8K; 1/4 W		
		R8	WAS 6K127802, 1K; 1/4 W		
		R59	WAS 6K129775, 330; 1/4 W		
		R25	WAS 6K127807, 33K; 1/4 W		
D1	NLN6234A	C87	WAS C83	PARTS LIST	NONE
		R35, 36	WERE 6K128563 1/10 W		
D2	NRD1131BA-8 NRD1132BA-7 NRD1131BB-7 NRD1132BB-6	Q1	WAS 48R869223 M9223	RF AMP	EPD-10465-H
			EXTENSIVE PART NUMBER CHANGES	PARTS LIST	NONE
	NPN1007A	C601, 602	ADDED	J601-1 P601-1	
		Q3	WAS 48R869238, M9238	PARTS LIST	
E	NRD6111BA-7 NRD6112BA-6	Q1	WAS 48R869223, M9223	RF AMP	NONE
F	NRD1131BA-9 NRD1132BA-8 NRD1131BB-8 NRD1132BB-7	Q3	WAS 48R869238, M9238	IF AMP	EPD-10465-J
G	NRD6111BA-9 NRD6112BA-8	Q15	WAS 48R869028, M9028	FINAL AUDIO AMP	EPD-10465-K
		Q16	WAS 48R869027, M9027		
G1	NRD6111BA-9 NRD6112BA-8	Q1	TRANSISTOR DETAIL REVISED	BELOW NOTES	NONE
H	NCN6044B-1 NCN6054B-1 NCN6039B-1 NCN6043B-1 NCN6065B-1	CR1	ADDED	ACROSS TRANSMIT-RECEIVE RELAY	NONE
J	NRD1131BA-11 NRD1132BA-10 NRD1131BB-10 NRD1132BB-9	C23, 24	WERE 21C831126, .002 uf	PARTS LIST	NONE
		C59	WAS 21D82877B02, 150 uuf		
K	NRD1131BA-12 NRD1132BA-11 NRD1131BB-11 NRD1132BB-10	CR3	WAS 48C82363E05	PARTS LIST	NONE
L	NRD1131BB-12	C29 C30, 31	WAS 21C82450B22 WAS 21C82450B24	PARTS LIST PARTS LIST	NONE NONE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

LEGEND
L = 132-150.8 MC
H = 150.8-174 MC

NRD6111BA Receiver Circuit Board (132-150.8 MC) 1-Freq.
NRD6112BA Receiver Circuit Board (150.8-174 MC) 1-Freq.

EPD-10771-J

		CAPACITOR, fixed: uuf; ±10% 75 v; unl stated
C1L	21K861462	15; N150
C1H, 4L, 19L, 9L	21K861431	12; N150
C2L	21K861434	40; N150
C2H, 5L	21D82877B06	30; N150
C3	21C82450B22	0.75; 500 v
C4H, 9H, 19H	21K867807	8 ±5%; N080
C5H, 16	21D82877B01	24; N150
C6, 12, 18, 83	21K861437	100; N2200
C7, 8	21C82450B26	0.3; 500 v
C10L, 11L	21K861430	10; N150
C10H, 11H	21D82877B13	7; ±5%; N150
C14, 36, 38, 75	21K861442	.002 uf +100-20%
C15L	21D82877B17	5 ±5%; N150
C15H	21K861427	4; N150
C17L, 88H	21K861603	3.3; NP0
C17H	21D82450B28	1
C20L, 40	21K865197	25; NP0
C20H	21K861432	20; N150
C21	21K864522	90; N080
C22, 39	21D82877B02	150; N1400
C23, 24	21K861442	.002 uf +100-20%; 75 v
C25	21D82877B09	3.8 ±.25 uuf; NP0
C26, 34, 89L	21K864521	30; N750
C27	21K861436	100; N750
C28, 37, 42, 44, 45, 46, 48, 49, 51, 56, 61, 86	21K861443	.01 uf +100-20%
C29	21D82450B42	0.75; 500 v
C30, 31	21D82450B43	0.47; 500 v
C32, 33	21K864067	80; N150
C35, 50	21K861444	.02 uf +100-20%
C41	21K861429	8; N150
C43, 47, 54	21K847065	500 GMV; 250 v
C52	21D82239E02	800 ±5%; 200 v
C53	23C82397D06	0.22 uf +40-20%; 35 v
C55, 70	23C82397D16	22 uf ±20%; 15 v
C57	21K864457	.002 uf +100-20%
C58, 62	8C82317B03	.03 uf; 50 v
C59	21D82877B05	150 ±10%; 75 v; N750
C60	21K859943	250 ±5%; 500 v
C63, 79	23D82397D19	2 uf +40-20%; 8 v
C64	23C82397D05	4.7 uf +40-20%; 3 v
C65	23D82397D32	2 uf +40-20%; 8 v
C66, 67, 71	23C82397D17	15 uf ±20%; 20 v
C68	21C82187B16	3000; 100 v
C69	23C82397D07	1 uf +40-20%; 15 v
C72	23C82397D31	10 uf ±20%; 20 v
C73	23C82397D15	10 uf ±20%; 20 v
C74	23C82397D08	0.15 uf +40-20%; 35 v
C82	21K868829	220
C88L	21D82877B07	2.2; N150
		SEMICONDUCTOR DEVICE, diode: NOTE I
CR1	48C82363E03	silicon
CR2	48K859464	germanium
CR3	48C82363E05	silicon
CR4, 6, 7	48C82178A01	germanium
CR8, 9, 10	48C82392B03	silicon
		COIL ASSEMBLY, RF:
L1L	24V80903A02	incl C1L, C3 and 24C82710H01 COIL, RF: VIO-BRN: 76B82451B04 CORE, tuning
L1H	24V80903A01	incl C1H, C3 and 24C82710H01 COIL, RF: VIO-BRN; 76B82451B04 CORE, tuning
L3L	24V80903A68	incl C7, C9L, and 24C82711H09 COIL, RF: ORG-ORG; 76B82451B04 CORE, tuning
L3H	24V80903A03	incl C7, C9H and 24C82711H01 COIL, RF: VIO-RED; does not incl 76B82451B04 CORE, tuning
L5L	24V80903A06	incl C8, C11L, CR2 and 24C82711H03 COIL RF: VIO-ORG; 76B82451B04 CORE, tuning
L5H	24V80903A05	incl C8, C11H, CR2 and 24C82711H03 COIL, RF: VIO-ORG; 76B82451B04 CORE, tuning
L14L	24V80903A08	incl C17L, C88L, CR3 and 24C82710H07 COIL, RF: VIO-GRN; does not incl 76B82451B04 CORE, tuning
L14H	24V80903A07	incl C17H, C88H, CR3 and 24C82710H02 COIL, RF: 76B82451B04 CORE, tuning
L15L	24V80903A10	incl C19L and 24C82710H02 COIL, RF: VIO-GRN 76B82451B04 CORE, tuning
L15H	24V80903A09	incl C19H and 24C82710H02 COIL, RF: VIO-GRN; 76B82451B04 CORE, tuning
		COIL, RF: adjustable;
L2, 4	24C82710H01	VIO-BRN; includes 76B82451B04 CORE, tuning
L6	24C82711H02	VIO-BLU; does not incl 76B82451B04 CORE, tuning, does not incl 76A82686D01 SLEEVE, iron (long)
L7, 8	24C82710H03	VIO-GRAY; includes 76K847160 CORE, tuning, does not incl 76A82686D01 SLEEVE, iron (long)
L9	24C82695D01	pri: 1,2 w/center tap (5) sec: 3,4 (tuning core incl)
L10	24C82696D01	bifilar winding (incl tuning core)
L13L	24C82711H05	VIO-BLK; includes 76B82451B02 CORE, tuning, does not incl 76A82686D01 SLEEVE, iron (long)
L13H	24C82711H04	VIO-YEL; includes 76B82451B02 CORE, tuning, does not incl 76A82686D01 SLEEVE, iron (long)
		REACTOR:
L12	25B82751D01	AF choke; 1.5 h
		TRANSISTOR: NOTE I
Q1	48K869375	P-N-P; type M9375
Q2, 5	48R869168	P-N-P; type M9168
Q3	48R869169	P-N-P; type M9169
Q4	48R869062	N-P-N; type M9062
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	48R869475	P-N-P; type M9475
Q16	48R869476	N-P-N; type M9476
		RESISTOR, fixed: ±10%; 1/4 w unl stated
R1, 43	6K128904	18K
R2	6S185B87	4.7K; 1/8 w
R3, 4	6K128432	820
R5, 21, 23, 27, 29	6K127807	33K
R6	6S185B89	6.8K; 1/8 w
R7	6K128599	680
R8	6S185B79	1K; 1/8 w
R9	6S129230	12K
R10	6K129863	390
R11, 38, 54, 55	6K127806	27K
R12, 65	6K129433	5.6K
R13	6K129818	820 ±5%
R14, 52, 57	6K127801	470
R15	6K128902	47K
R16	6K128687	6.8K
R18	6K129775	330
R19	6K129225	10K
R20, 39, 44	6K128688	2.7K
R22, 24, 26, 28, 30, 45, 47	6K127804	4.7K
R25	6S185B97	33K; 1/8 w
R31	6K128685	22K
R32	6S185B84	2.7K; 1/8 w
R33, 50	6K128689	2.2K
R34, 69	6K127802	1K
R37	6S185B96	27K; 1/8 w
R46	6K129144	68K
R49	6K127803	1.5K ±10%
R51	6K129233	47
R53	6K127804	4.7K
R58	6K129862	150
R59	6S185B73	330; 1/8 w
R60	6K128686	8.2K
R62	6K129269	1.8K
		TRANSFORMER
T1	24C82712H02	RF: VIO-WHT; incl 76K861425 CORE, tuning, does not incl 76A82686D01 SLEEVE, iron (long)
T2	24C82712H01	RF: VIO-VIO incl 76K847160 CORE, tuning, does not incl 76A82686D01 SLEEVE, iron (long)
T3	1V80729A40	AF: coded GRN; incl: pri: 1K max; sec: res 200 max.
		CRYSTAL UNIT, quartz: NOTE II
Y1	YMW-35	receiver control
Y2	YNW	11.245 mc
	NON-REFERENCED ITEM	
	26B82671D01	SHIELD, coil: 14 req'd.

NLN6234A Resistor-Capacitor Kit (60 KC) EPD-10772-C

R35, 36	6S185B93	RESISTOR, fixed: 15K ±10%; 1/8 w
C81, 90, 91	21K865197	CAPACITOR, fixed: uuf; 25 ±10%; 75 v; N150
C87	21K847065	500 GMV; 250 v

FILTER EPD-12003-O

Z1	NFN6006AS NFN6006AW	FILTER, IF: bandpass; 30 kc bandpass; 60 kc

NLD6221A 2nd Freq Oscillator (132-150.8 mc)
NLD6222A 2nd Freq. Oscillator (150.8-174 mc) EPD-10774-B

		CAPACITOR, fixed: 75 v, unless stated
C301	21K861427	4 uuf ±10%; N150
C302	21D82877B01	24 uuf ±10%; N150
C303	21K861442	.002 uf +100-20%
		SEMICONDUCTOR DEVICE, diode: NOTE I
CR301	48C82363E05	silicon
		COIL ASSEMBLY:
L301	24C82711H04	coded V10-YEL; includes 76B82451B02 CORE, tuning
		TRANSISTOR: SEE NOTE I
Q301	48R869168	P-N-P; type M9168
		RESISTOR, fixed: ±10%; 1/4 w;
R301	6K127802	1K
R302	6K128599	680
		CRYSTAL UNIT, quartz: NOTE II
Y301	YMW-35	

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

NPN6031A Power Supply (less battery) Nickel-Cadmium

EPD-12127-B

		SEMICONDUCTOR DEVICE, diode: NOTE
CR601	48C82095C01	silicon
CR601, 602	21C82187B16 or21K850446	.003 ±10%; 100 v .003 ±25%; 250 v
		FUSE, cartridge:
F601	65A82496G01	3 amp/32 v; 1/4" x 5/8"
		CONNECTOR, receptacle:
J601	9C82847E01	female; 9 cont.
		CONNECTOR, plug:
P601	28A82488G01	male; 2 cont.
P602	28A16313	male; 3 cont.
		FUSEHOLDER ASSY:
XF601	1V80731A03	single fuse mtg
	NON-REFERENCED ITEMS	
	1V80731A01	HOUSING ASSY. (riveted)
	64B82653G01	PLATE, door
	41A82652G01	SPRING, torsion
	22A82651G01	PIN, pivot
	14A82650G01	INSULATOR
	38A868379	TAB, batter plug

NPN6033A Power Supply (less battery) Dry
NPN6030B Power Supply (less battery) Dry

EPD-12128-A

		FUSE, cartridge:
F601	65R132923	3 amp./250 v
		CONNECTOR, receptacle:
J601	9C82847E01	female; 9 cont
		CAPACITOR, fixed:
C601, 602, 603, 604, 605	21C82187B16	.003 uf ±5%; 100 v
C606	21K800802	2 sections c/o
C606A, 606B		.001 uf GMV +100% max; 500 v same as C606 except c/o
C607		C607A, C607B
	NON-REFERENCED ITEMS	
	1V80731A83	HOUSING ASSY. (riveted) NPN1009A
	1V80735A56	HOUSING ASSY. (riveted) NPN1007A
	1V80731A85	BATTERY HOLDER ASSY. (riveted) NPN1009A
	1V80735A58	BATTERY HOLDER ASSY. (riveted) NPN1007A
	1V80731A87	BATTERY COVER ASSY. (riveted) NPN1009A
	1V80735A60	BATTERY COVER ASSY. (riveted) NPN1007A

NLN6310A Battery Kit EPD-12129-O

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

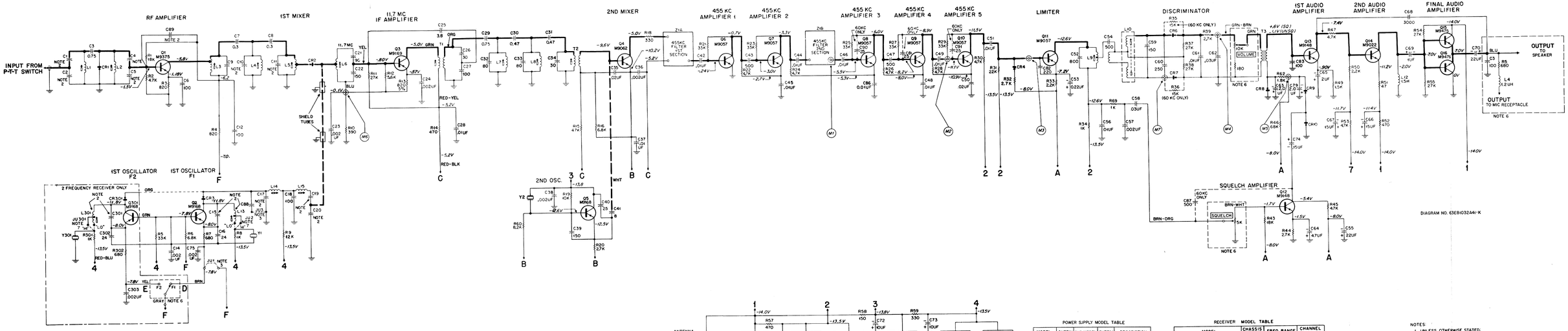
NLN6267A Battery Kit (Nickel Cadmium) EPD-12130-O

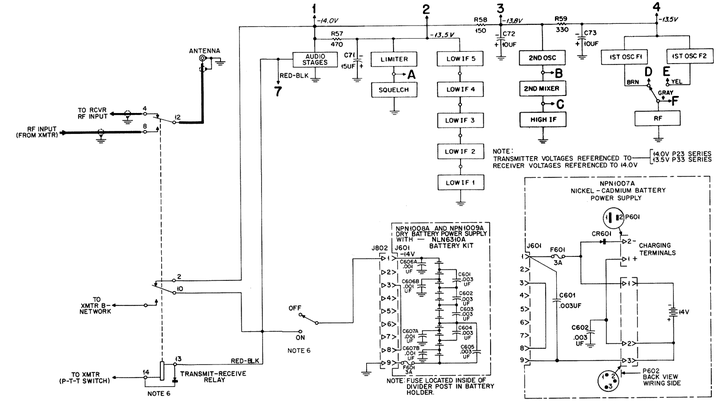
	60D82447G01	BATTERY, nickel cadmium; 14 volt
	75A82588G01	PAD, rubber: 2 supplied

NOTES:

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

II. Crystals are part of the complete radio set model (not part of the receiver model). When ordering crystal units, specify carrier frequency, crystal frequency and crystal part (type) number.





POWER SUPPLY MODEL TABLE

MODEL	SUFFIX	SUB-MODEL	SUFFIX	DESCRIPTION
NPN1007A		NP86031A		POWER SUPPLY
		NLN6207A		BATTERY KIT
NPN1008A		NP86030B		POWER SUPPLY
		NL86310A		BATTERY KIT
NPN1009A		NP86033A		POWER SUPPLY
		NL86310A		BATTERY KIT

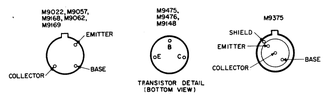
RECEIVER MODEL TABLE

MODEL		CHASSIS SUFFIX	FREQ. RANGE	CHANNEL SPACING
RECEIVER	NRD1131BA	11	132-150.8 MC	60 KC
	NRD1132BA	10	150.8-174 MC	60 KC
	NRD1131BB	10	132-150.8 MC	30 KC
	NRD1132BB	9	150.8-174 MC	30 KC
2ND FREQ. OSCILLATOR MODULE	NLD6221A		132-150.8MC	
	NLD6222A		150.8-174MC	

2ND OSCILLATOR FREQUENCY TABLE

CARRIER FREQ. (fc) IN MC	2ND OSC. XTAL FREQ. (fo2) IN MC
132.00-134.00	11.245
134.001-136.00	12.155
136.001-145.00	11.245
145.001-145.50	12.155
145.501-146.00	11.245
146.001-150.80	12.155
150.801-157.00	11.245
157.001-157.60	12.155
157.601-168.00	11.245
168.001-169.00	12.155
169.001-174.00	11.245

NOTES:
1. UNLESS OTHERWISE STATED:
   ALL CAPACITOR VALUES ARE IN MICROMICROFARADS.
2. REFER TO PARTS LIST FOR COMPONENT VALUE.
3. USED IN SINGLE FREQUENCY MODELS ONLY.
4. FREQUENCY CALCULATIONS:
   RECEIVER: fc = fo2 - fo1 (1ST LO)
   SEE 2ND OSCILLATOR FREQUENCY TABLE.
5. ALL VOLTAGE READINGS REFERENCED TO CHASSIS GROUND. DC READINGS TAKEN WITH A MOTOROLA DC MULTIMETER.
6. PART OF CONTROL PANEL ⑧ INTERCABLING DIAGRAM.
7. FOR UNITS IN 132-142 AND 150.8-162 MC RANGE JUMPER TO "LO" CONNECTION FOR UNITS IN 142-150.8 AND 162-174 MC RANGE JUMPER TO "HI" CONNECTION



PREVIOUS REVISIONS AND PARTS LIST SHOWN ON FRONT OF THIS DIAGRAM

Carrier Squelch Receiver
Schematic Diagram
Motorola No. 63E81032A41-L

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
A	NRD1131BF-5 NRD1132BF-4	R37	WAS 6K127806, 1/4 W	PARTS LIST	NONE
A1			POWER SUPPLY MODEL TABLE ADDED		
B	NRD1131BF-6 NRD1132BF-5	C25	WAS 21D82877B17, 5 uuf	Q3 BASE	RCVR CKT. BD. EPD-10650-F
C	NRD1131BF-7 NRD1132BF-6	R2	WAS 6K127804, 4.7K; 1/4 W	PARTS LIST	RCVR CKT. BD. EPD-10650-G
		R32	WAS 6K128688, 2.7K; 1/4 W		
		C89	REMOVED FOR 150.8-174 MC (ONLY)		
		R6	WAS 6K128689, 6.8K; 1/4 W		
		R8	WAS 6K127802, 1K; 1/4 W		
		R59	WAS 6K129775, 330; 1/4 W		
		R25	WAS 6K127807, 33K; 1/4 W		
C1	NRD1131BF-7 NRD1132BF-6	Q1	WAS 48R869223, M9223	RF AMP	EPD-10465-H
		R49	WAS 6K127803 1.5K	EMITTER Q13	
			EXTENSIVE PART NUMBER CHANGES	PARTS LIST	NONE
	NPN1007A	C601, C602	ADDED	J601-1 P601-1	
		Q3	WAS 48R869238, M9238	PARTS LIST	
D	NRD6111BF-7 NRD6112BF-6	Q1	WAS 48R869223, M9223	RF AMP	NONE
E	NRD1131BF-8 NRD1132BF-7	Q3	WAS 48R869238, M9238	IF AMP	EPD-10465-J
F	NRD6111BF-9 NRD6112BF-8	Q15	WAS 48R869028, M9028	FINAL AUDIO AMP	EPD-10465-K
		Q16	WAS 48R869027, M9027		
F1	NRD6111BF-9 NRD6112BF-8	Q1	TRANSISTOR DE-TAIL REVISED	NOTES	NONE
G	NCN6040B-1 NCN6050B-1	CR1	ADDED ACROSS K1 COIL	K1	NONE
H	NRD1131BF-10 NRD1132BF-9	C23, 24	WERE 21C831126, .002 uf	PARTS LIST	NONE
		C59	WAS 21D82877B02, 150 uuf		
J	NRD1131BF-11 NRD1132BF-10	CR3	WAS 48C82363E01	PARTS LIST	NONE
K	NRD1132BF-11	C29 C30, 31	WAS 21C82450B22 WAS 21C82450B24	PARTS LIST	NONE

PARTS LIST

LEGEND

L = 132-150.8 MC H = 150.8-174 MC

NRD6111BF Receiver Circuit Board (136-150.8 MC)
NRD6112BF Receiver Circuit Board (150.8-174 MC) EPD-10775-J

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uuf; ±10%; 75 v;
C1L	21K861462	15; N150
C1H, 4L, 19L, 9L	21K861431	12; N150
C2L	21K861434	40; N150
C2H, 5L	21D82877B06	30; N150
C3	21C82450B22	0.75; 500 v
C4H, 9H, 19H	21D82877B07	8 ±5%; N080
C5H, 16	21D82877B01	24; N150
C6, 12, 18, 83	21K861437	100; N2200
C7, 8	21C82450B26	0.3; 500 v
C10L, 11L	21K861430	10; N150
C10H, 11H	21D82877B13	7 ±5%; N150
C14, 36, 38, 75	21K861442	.002 uf +100-20%
C15L	21D82877B17	5 ±5%; N150
C17L, 88H	21K861603	3.3; NP0
C17H	21D82450B28	1
C20L, 40	21K865197	25; NP0
C20H	21K861432	20; N150
C21	21K864522	90; N080
C22, 39	21D82877B02	150; N1400
C23, 24	21K861442	.002 uf +100-20%
C25	21D82877B09	3.8 ±25 uuf; NP0
C26, 34, 89L	21K864521	30; N750
C27	21K861436	100; N750
C28, 37, 42, 44, 45, 46, 48, 49, 51, 56, 61, 86	21K861443	.01 uf +100-20%
C29	21D82450B42	0.75; 500 v
C30, 31	21D82450B43	0.47; 500 v
C32, 33	21K864067	80; N150
C35, 50	21K861444	.02 uf +100-20%
C41	21K861429	8; N150
C43, 47, 54	21K847065	500 GMV; 250 v
C52	21D82239E02	800 ±5%; 200 v
C53	23C82397D06	0.22 uf +40-20%; 35 v
C55, 70	23C82397D16	22 uf ±20%; 15 v
C57	21K864457	.002 uf +100-20%
C58, 62	8C82317B03	.03 uf; 50 v
C59	21D82877B05	150; N750
C60	21K859943	250 ±5%; 500 v
C63, 79	23D82397D19	2 uf +40-20%; 8 v
C64	23C82397D05	4.7 uf +40-20%; 3 v
C65	23D82397D32	2 uf +40-20%; 8 v
C66, 67, 71	23C82397D17	15 uf ±20%; 20 v
C68	21C82187B16	3000; 100 v
C69	23C82397D07	1 uf +40-20%; 15 v
C72	23C82397D31	10 uf ±20%; 20 v
C73	23C82397D15	10 uf ±20%; 20 v
C74	23C82397D08	0.15 uf +40-20%; 35 v
C76	8C82317B06	.0082 uf ±10%; 100 v
C82	21K868829	220
C88L	21D82877B07	2.2; N150
		SEMICONDUCTOR DEVICE, diode: NOTE I
CR1	48C82363E03	silicon
CR2	48K859464	germanium
CR3	48C82363E05	silicon
CR4, 6, 7	48C82178A01	germanium
CR8, 9, 10, 12	48C82392B03	silicon
		COIL ASSEMBLY, RF:
L1L	24V80903A02	incl C1L, C3 and 24C82710H01 COIL, RF: VIO-BRN; 76B82451B04 CORE, tuning
L1H	24V80903A01	incl C1H, C3 and 24C82710H01 COIL, RF: VIO-BRN; 76B82451B04 CORE, tuning
L3L	24V80903A68	incl C7, C9L and 24C82711H09 COIL, RF: ORG-ORG; 76B82451B04 CORE, tuning
L3H	24V80903A03	incl C7, C9H and 24C82711H01 COIL, RF: VIO-RED; 76B82451B04 CORE, tuning
L5L	24V80903A06	incl C8, C11L, CR2 and 24C82711H03 COIL, RF: VIO-ORG; 76B82451B04 CORE, tuning
L5H	24V80903A05	incl C8, C11H, CR2 and 24C82711H03 COIL, RF: VIO-ORG; 76B82451B04 CORE, tuning
L14L	24V80903A08	incl C17L, C88L, CR3 and 24C82710H02 COIL, RF: VIO-GRN; 76B82451B04 CORE, tuning
L14H	24V80903A07	incl C17H, C88H, CR3 and 24C82710H02 COIL, RF: 76B82451B04 CORE, tuning
L15L	24V80903A10	incl C19L and 24C82710H02 COIL, RF: VIO-GRN; 76B82451B04 CORE, tuning
L15H	24V80903A09	incl C19H and 24C82710H02 COIL, RF: VIO-GRN; 76B82451B04 CORE, tuning
		COIL, RF: adjustable:
L2, 4	24C82710H01	VIO-BRN; includes 76B82451B04 CORE, tuning
L6	24C82711H02	VIO-BLU; includes 76B82451B04 CORE, tuning, does not incl 76A82686D01 SLEEVE, iron (long)
L7, 8	24C82710H03	VIO-GRAY; includes 76K847160 CORE, tuning, does not incl 76A82686D01 SLEEVE, iron (long)
L9	24C82695D01	pri: 1, 2 w/center tap (5) sec: 3, 4 (tuning core incl)
L10	24C82696D01	bifilar winding (incl tuning core)
L13L	24C82711H05	VIO-BLK; includes 76B82451B02 CORE, tuning, does not incl 76A82686D01 SLEEVE, iron (long)
L13H	24C82711H04	VIO-YEL; includes 76B82451B02 CORE, tuning does not incl 76A82686D01 SLEEVE, iron (long)
		REACTOR:
L12	25B82751D01	AF choke: 1.5 h
		TRANSISTOR: NOTE I
Q1	48K869375	P-N-P; type M9375
Q2, 5	48R869168	P-N-P; type M9168
Q3	48R869169	P-N-P; type M9169
Q4	48R869062	N-P-N; type M9062
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	48R869475	P-N-P; type M9475
Q16	48R869476	N-P-N; type M9476
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R1, 43	6K128904	18K
R2	6S185B87	4.7K; 1/8 w
R3, 4	6K129432	820
R5, 21, 23, 27, 29	6K127807	33K
R6	6S185B89	6.8K; 1/8 w
R7	6K128599	680
R8	6S185B79	1K; 1/8 w
R9	6S129230	12K
R10	6K129863	390
R11, 38, 54, 55	6K127806	27K
R12	6K129433	5.6K
R13	6K129818	820 ±5%
R14, 52, 57	6K127801	470
R15	6K128902	47K
R16	6S128687	6.8K
R18	6K129775	330
R19	6K129225	10K
R20, 39, 44	6K128688	2.7K
R22, 24, 26, 28, 30, 45, 47	6K127804	4.7K
R25	6S185B97	33K; 1/8 w
R31	6K128685	22K
R32	6S185B84	2.7K; 1/8 w
R33, 50	6K128689	2.2K
R34, 69	6K127802	1K
R37	6S185B96	27K; 1/8 w
R46	6K129144	68K
R49	6S129984	680 ±5%
R51	6K129233	47
R53	6K127804	4.7K
R58	6K129862	150
R59	6S185B73	330; 1/8 w

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R60	6K128686	8.2K
R62	6K129269	1.8K
		TRANSFORMER, RF:
T1	24C82712H02	VIO-WHT; incl 76K861425 CORE, tuning nor 76A82686D01 SLEEVE, iron (long)
T2	24C82712H01	VIO-VIO; incl 76K847160 CORE, tuning, does not incl 76A82686D01 SLEEVE, iron (long)
T3	25B82699D01	TRANSFORMER, AF: audio input; c/o pri: imped. 10K ohms, res 1.34K ohms sec: imped. 1K ohms; res 348 ohms, coded BLU
		CRYSTAL UNIT, quartz: NOTE II
Y1	YMW-35	receiver control
Y2	YNW	11.245 mc
		NON-REFERENCED ITEMS
	1V80725A08	PRINTED CIRCUIT BD. ASSY. (2-Freq. Osc.)
	26B82671D01	SHIELD, coil: 14 req'd

FILTER EPD-12005-O

Z1	NFN6006AS	FILTER, IF: bandpass; 30 kc

NPN6031A Power Supply (less battery) Nickel-Cadmium EPD-12127-B

		SEMICONDUCTOR DEVICE, diode: NOTE
CR601	48C82095C01	silicon
CR601, 602	21C82187B16 or21K850446	.003 ±10%; 100 v .003 ±25%; 250 v
		FUSE, cartridge:
F601	65A82496G01	3 amp/32 v; 1/4" x 5/8"
		CONNECTOR, receptacle:
J601	9C82847E01	female; 9 cont.
		CONNECTOR, plug:
P601	28A82488G01	male; 2 cont.
P602	28A16313	male; 3 cont.
		FUSEHOLDER ASSY:
XF601	1V80731A03	single fuse mtg
		NON-REFERENCED ITEMS
	1V80731A01	HOUSING ASSY. (riveted)
	64B82653G01	PLATE, door
	41A82652G01	SPRING, torsion
	22A82651G01	PIN, pivot
	14A82650G01	INSULATOR
	38A868379	TAB, batter plug

NPN6033A Power Supply (less battery) Dry
NPN6030B Power Supply (less battery) Dry EPD-12128-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
F601	65R132923	FUSE, cartridge: 3 amp, 250 v
J601	9C82847E01	CONNECTOR, receptacle: female; 9 cont
C601, 602, 603, 604, 605 C606 C606A, 606B C607	21C82187B16 21K300802	CAPACITOR, fixed: .003 uf ±5%; 100 v 2 sections c/o .001 uf GMV +100% max; 500 v same as C606 except c/o C607A, C607B
		NON-REFERENCED ITEMS
	1V80731A83	HOUSING ASSY. (riveted) NPN1009A
	1V80735A56	HOUSING ASSY, (riveted) NPN1007A
	1V80731A85	BATTERY HOLDER ASSY. (riveted) NPN1009A
	1V80735A58	BATTERY HOLDER ASSY. (riveted) NPN1007A
	1V80731A87	BATTERY COVER ASSY. (riveted) NPN1009A
	1V80735A60	BATTERY COVER ASSY. (riveted) NPN1007A

NLN6310A Battery Kit EPD-12129-O

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

NLN6267A Battery Kit (Nickel Cadmium) EPD-12130-O

	60D82447G01	BATTERY, nickel cadmium; 14 volt
	75A82588G01	PAD, rubber: 2 supplied

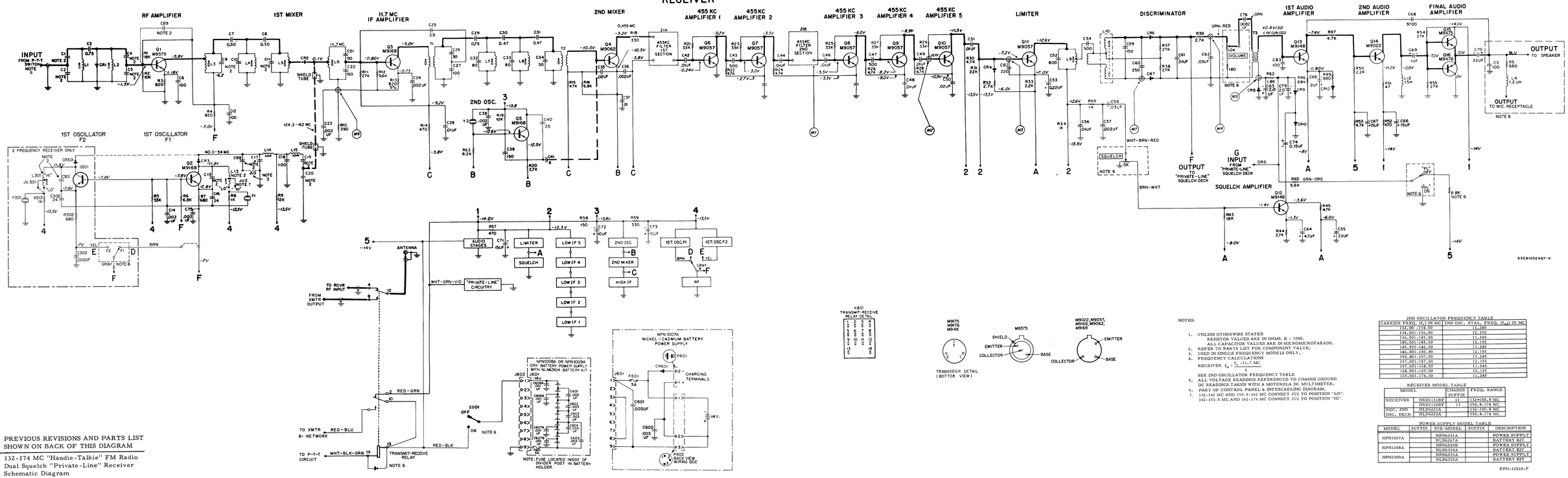
NLD6221A 2nd Freq. Oscillator (132-150.8 mc)
NLD6222A 2nd Freq. Oscillator (150.8-174 mc) EPD-12143-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C301L	21D82877B17	CAPACITOR, fixed: 75 v 5 uuf ±5%; N150
C301H	21K861427	4 uuf ±10%; N150
C302	21D82877B01	24 uuf ±10%; N150
C303	21K861442	.002 uf +100-20%
		SEMICONDUCTOR DEVICE, diode: NOTE 1
CR301	48C82363E01	silicon
		COIL, RF:
L301L	24C82766D08	VIO-BLK; does not incl 76B82451B02 CORE, tuning
L301H	24C82766D05	VIO-YEL; does not incl 76B82451B02 CORE, tuning
		TRANSISTOR: NOTE 1
Q301	48R869168	P-N-P; type M9168
		RESISTOR, fixed: ±10%; 1/4 w
R301	6K127802	1K
R302	6K128599	680
		CRYSTAL UNIT, quartz: NOTE II
Y301	YMW-35	receiver control

NOTES:

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

II Crystals are part of the complete radio set model (not part of the receiver model). When ordering crystal units, specify carrier frequency, crystal frequency and crystal part (type) number.



PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

132-174 MC "Handie-Talkie" FM Radio
Dual Squelch "Private-Line" Receiver
Schematic Diagram
Motorola No. 63E81032A67-K

NOTES:

1. UNLESS OTHERWISE STATED
   RESISTOR VALUES ARE IN OHMS, K = 1000.
   ALL CAPACITOR VALUES ARE IN MICROMICROFARADS.
2. REFER TO PARTS LIST FOR COMPONENT VALUE.
3. USED IN SINGLE FREQUENCY MODELS ONLY.
4. FREQUENCY CALCULATIONS
   RECEIVER $f_O = \frac{f_C}{3} \pm 11.7$ MC
   SEE 2ND OSCILLATOR FREQUENCY TABLE
5. ALL VOLTAGE READINGS REFERENCED TO CHASSIS GROUND
   DC READINGS TAKEN WITH A MOTOROLA DC MULTIMETER.
6. PART OF CONTROL PANEL & INTERCABLING DIAGRAM.
7. 132-142 MC AND 150.8-162 MC CONNECT JU2 TO POSITION "LO".
   142-150.8 MC AND 162-174 MC CONNECT JU2 TO POSITION "HI".

2ND OSCILLATOR FREQUENCY TABLE

CARRIER FREQ. (f_C) IN MC	2ND OSC. XTAL. FREQ. (f_{XO}) IN MC
132.00-134.00	11.245
134.001-136.00	12.155
136.001-145.00	11.245
145.001-145.50	12.155
145.501-146.00	11.245
146.001-150.00	12.155
150.801-157.00	11.245
157.001-157.60	12.155
157.601-168.00	11.245
168.001-169.00	12.155
169.001-174.00	11.245

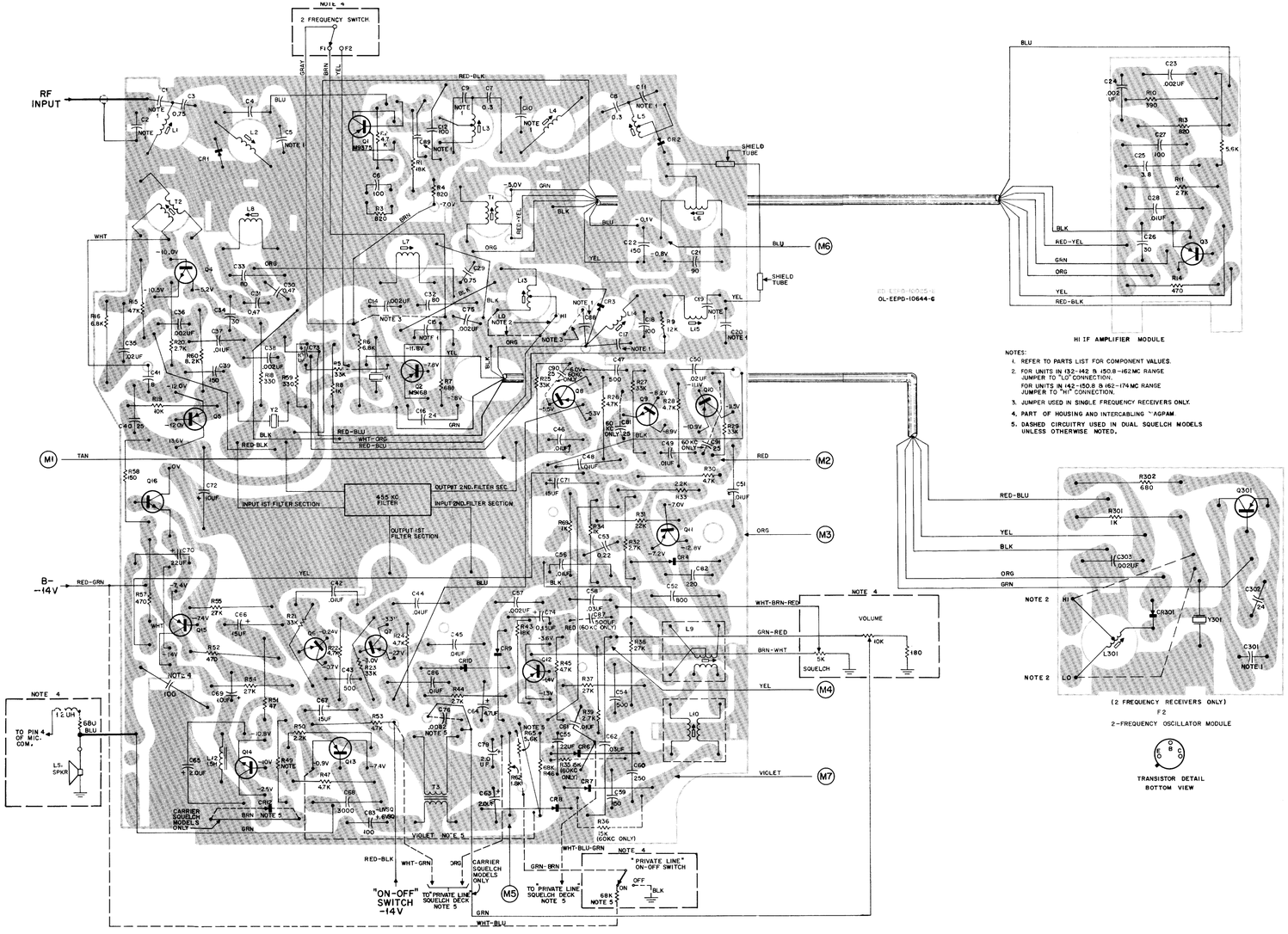
RECEIVER MODEL TABLE

MODEL		CHASSIS SUFFIX	FREQ. RANGE
RECEIVER	NRD1131BF	11	132-150.8 MC
	NRD1132BF	11	150.8-174 MC
REC. 2ND OSC. DECK	NLD6221A		132-150.8 MC
	NLD6222A		150.8-174 MC

POWER SUPPLY MODEL TABLE

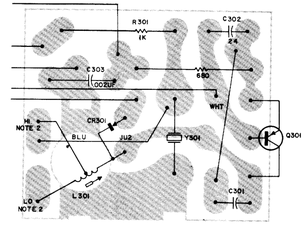
MODEL	SUFFIX	SUB-MODEL	SUFFIX	DESCRIPTION
NPN1007A		NPN6031A		POWER SUPPLY
		NLN6267A		BATTERY KIT
NPN1008A		NPN6030B		POWER SUPPLY
		NLN6310A		BATTERY KIT
NPN1009A		NPN6033A		POWER SUPPLY
		NLN6310A		BATTERY KIT

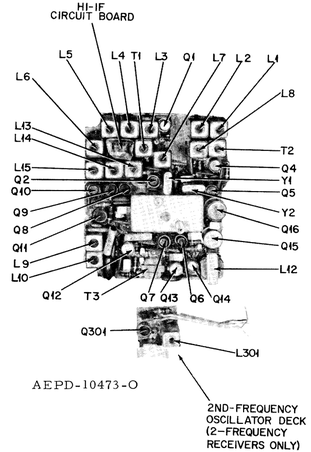
EPD-11028-F



REVISIONS

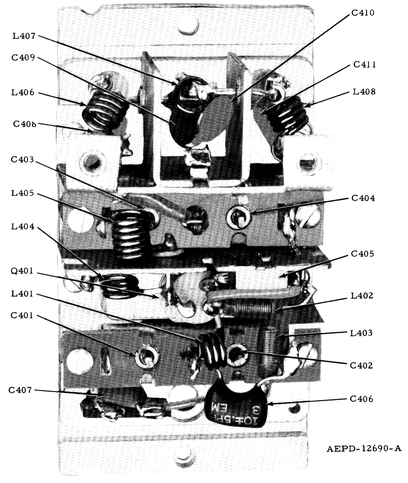
DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	NRD1131BA-3 NRD1132BA-2 NRD1131BB-3 NRD1132BB-2 NRD1131BF-3 NRD1132BF-2	Q3	WAS 48R869030 TYPE M9030	HI IF AMPL. MODULE
		C25	WAS 21D82877B08, 2.8 uuf	Q3 BASE
B	NRD1131BA-4 NRD1132BA-3 NRD1131BB-4 NRD1132BB-3 NRD1131BF-4 NRD1132BF-3	Q1	WAS 48R869029 TYPE M9029	PARTS LIST
		R2	WAS 6K129225, 10K	Q1 BASE
		C89	ADDED 30 uuf	
C	NRD1131BA-5 NRD1132BA-4	C81	WAS 21K864013, 50 uuf	Q9 BASE
		C90	ADDED 25 uuf	Q8 BASE
		C91		Q10 BASE
D	NRD1131BA-6 NRD1132BA-5 NRD1131BB-5 NRD1132BB-4 NRD1131BF-5 NRD1132BF-4	R37	WAS 6K127806, 27K, 1/4 W	PARTS LIST
E	NLD6221A NLD6222A		REVISED PRINTED CIRCUIT BOARD CIRCUIT WAS AS SHOWN BELOW	2ND. FREQ. OSC.
F	NRD1131BA-7 NRD1132BA-6	C25	WAS 21D82877B17, 5 uuf	Q3 BASE HI-IF AMPL. MOD.
G	NRD1131BA-8 NRD1132BA-7 NRD1131BB-7 NRD1132BB-6 NRD1131BF-7 NRD1132BF-6	R2	WAS 6K127804, 4.7K; 1/4 W	PARTS LIST
		R32	WAS 6K128688, 2.7K; 1/4 W	
		C89	REMOVED FOR 150.8-174 MC. (ONLY)	
		R6	WAS 6K128689, 6.8K; 1/4 W	
		R8	WAS 6K127802, 1K; 1/4 W	
		R39	WAS 6K129775, 330; 1/4 W	
		R25	WAS 6K127807, 33K; 1/4 W	
H	NRD1131BA-8 NRD1132BA-7 NRD1131BB-7 NRD1132BB-6 NRD1131BF-7 NRD1132BF-6	Q1	WAS 48R869223, M9223	RF AMP
		C69	POLARITY WAS REVERSED	Q14 COLLECTOR
J	NRD1131BA-9 NRD1132BA-8 NRD1131BB-8 NRD1132BB-7 NRD1131BF-8 NRD1132BF-7	Q3	WAS 48R869169, TYPE M9169	PARTS LIST
K	NRD1131BA-10 NRD1132BA-9 NRD1131BB-9 NRD1132BB-8 NRD1131BF-9 NRD1132BF-8	Q15	WAS 48R869028, TYPE M9028	PARTS LIST
		Q16	WAS 48R869027, TYPE M9027	PARTS LIST



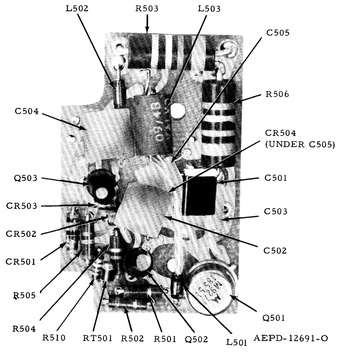


AEPD-10473-O

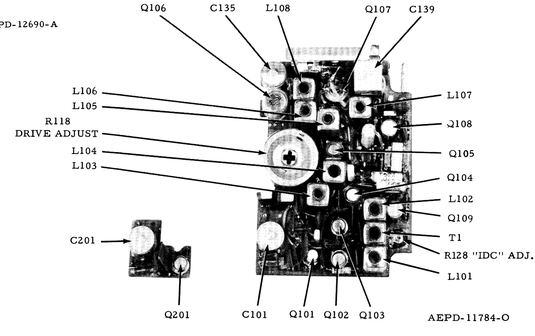
"Handie-Talkie" FM Radio Receiver Printed Circuit Board and Wiring Diagram Motorola No. EPD-10465-K



POWER AMPLIFIER
(P33 SERIES ONLY)



"AUTOMATIC DRIVE LIMITER" DECK



SECOND FREQUENCY OSCILLATOR DECK
AND TRANSMITTER CIRCUIT BOARD

REVISIONS

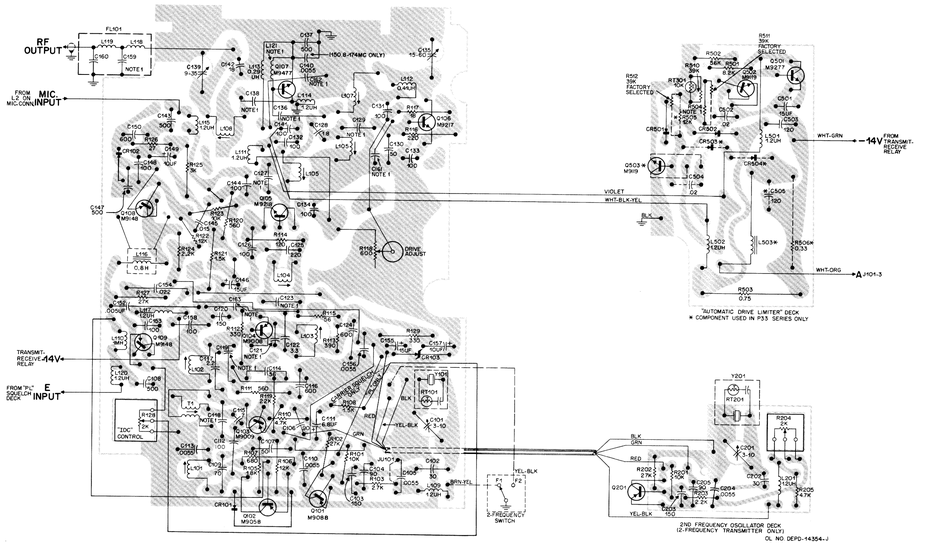
DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	NTD6121AA-2 NTD6122AA-2	Q107	WAS 48R869213	TOP OF CKT. BD.
B	NTD6121AA-2 NTD6122AA-2		PRINTED COMPONENT OVERLAY REPLACED,	Q108 BASE
C	NTD6121AA-3 NTD6122AA-3	L116	WAS 25B82872B01	PARTS LIST
D		L402, 403	WERE REVERSED	PWR. AMPL. DETAIL
E	NTD6121AA-4	C161	ADDED .0055 uf	UPPER RIGHT OF BD.
		C162	ADDED .0055 uf	UPPER MIDDLE OF BD.
		C163	ADDED 1500 uuf	CENTER OF BD.
F	NTD6121AA-5	Q107	WAS 48R869407, TYPE M9407	PARTS LIST
G	NTD6121AA-6 NTD6122AA-5		MINOR PLATING CHANGE, ELECTRICALLY THE CIRCUIT IS UNCHANGED.	CIRCUIT BOARD
H	NLD6443A	R504, 505	WERE 6K12702, 15K	UPPER RIGHT OF CKT. BD.
J	NLN6443A-4	R504, 505	WERE 6K12988, 12K	LOWER LEFT OF BD
		R511, 512	6K12903, 39K ADDED	

MODEL TABLE

MODEL	SUFFIX
NTD6121AA	2
NTD6122AA	2
NLN6443A	3
NLN6456A	2
NLN6415A	1

FOR UNITS SUFFIXED EARLIER THAN INDICATED IN THE ASSOCIATED MODEL TABLE, REFER TO EPD-11724.

EPD-14472-O

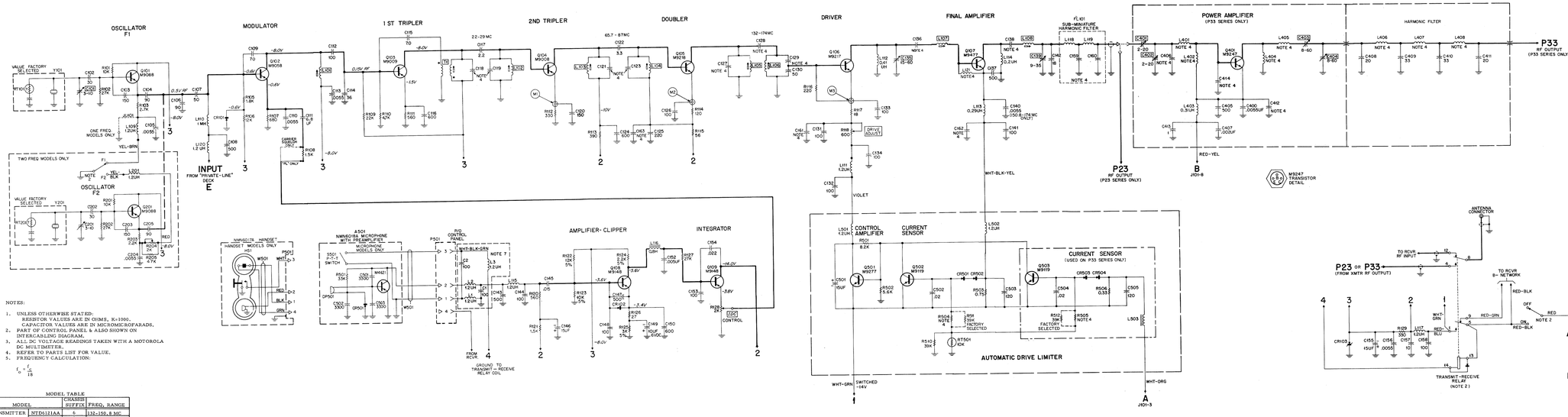


NOTES:

1. REFER TO PARTS LIST FOR VALUE.

EPD-20391-O

Transmitter Printed Circuit Board
and Wiring Diagram
Motorola No. EPD-14355-J



NOTES:

1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS, K=1000.
   CAPACITOR VALUES ARE IN MICROMICROFARADS,
2. PART OF CONTROL PANEL & ALSO SHOWN ON INTERCABLING DIAGRAM.
3. ALL DC VOLTAGE READINGS TAKEN WITH A MOTOROLA DC MULTIMETER.
4. REFER TO PARTS LIST FOR VALUE.
5. FREQUENCY CALCULATION:

$$f_o = \frac{f_c}{18}$$

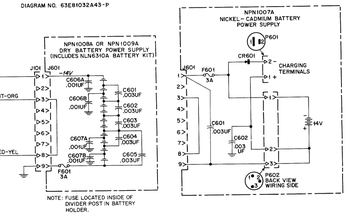
MODEL TABLE

MODEL		CHASSIS SUFFIX	FREQ. RANGE
TRANSMITTER	NTD6121AA	6	132-150.8 MC
	NTD6125AA	5	150.8-174 MC
TRANSMITTER 2ND FREQ. OSC. DECK	NLN6415A	1	
HI-POWER FINAL AMP.	NLD6261A	1	132-150.8 MC
	NLD6262A	1	150.8-174 MC
AUTOMATIC DRIVE LIMITER	NLN6443A	4	
	NLN6455A	2	
HANDSET	NMN5017A		
MICROPHONE	NMN6018A		

MODEL	SUFFIX	SUB-MODEL	SUFFIX	DESCRIPTION
NPN1007A		NPN6031A		POWER SUPPLY
		NLN6263A		BATTERY KIT
NPN1008A		NPN6031B		POWER SUPPLY
		NLN6310A		BATTERY KIT
NPN1009A		NPN6031A		POWER SUPPLY
		NPN6310A		BATTERY KIT

EPD-12027-J

DIAGRAM NO. 63E81032A43-P



PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

"Handie-Talkie" FM Radio
Transmitter Schematic Diagram
Motorola No. 63E81032A43-P

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
C	NLD6261A-1 NLD6262A-1	C413	ADDED 0.1 uuf	POWER AMPLIFIER	NONE
D	NTD6121AA-1	C140	REMOVED 21C822136E03 .0055 uf (132-150.8 MC)	PARTS LIST	EPD-11724-G
D1			REVISED MODEL TABLE		
D2	NTD6121AA-1 NTD6122AA-1	L114	WAS 24D82723H01, 1.2 uh	Q107 COLLECTOR	EPD-11724-D
		C128	WAS 21D82450B30, 1.8 uuf (132-150.8 MC)	Q105 COLLECTOR	
		L118	WAS 24D83728B01, 75 uh	PARTS LIST	
		L119	WAS 24D83728B02, 75 uh		
		C129	WAS 21K861431, 12 uuf (132-150.8 MC)		
		C136	WAS 21D82877B46, 18 uuf OR 21K861431, 12 uuf		
		C138	WAS 21K861430, 10 uuf (132-150.8 MC)		
		C159	WAS 21D82877B06, 30 uuf (132-150.8 MC)		
		C160	WAS 21K861462, 15 uuf (132-150.8 MC)		
		C123	WAS 21K861433, 36 uuf (132-150.8 MC)		
		C127	WAS 21K861430, 10 uuf (132-150.8 MC)		
		C130	WAS 21K861433, 36 uuf (132-150.8 MC)	Q106 BASE	
		R119	REMOVED 6S129754, 33 OHMS, REPLACED BY L121	Q107 BASE	
		L121	ADDED, REPLACES R119		
		L107	WAS 24V80904A72, 4 TURNS (132-150.8 MC)	PARTS LIST	
E	NLN6443A-3 NLN6456A-2	R503	WAS 17C82036G13, 0.75 ±5%; 2 W	PARTS LIST	EPD-11724-E
		R506	WAS 17C82036G15, 0.33 ±5%; 2 W		
		R510	WAS 6S185B98, 39K ±10%; 1/8 W		
F	NLN6415A-1	R203 R204	WAS 6S185B84, 2.7K ADDED VAR, 2K	Q201 EMITTER	XMTR CKT BD EPD-14355-O
		R205	ADDED 4.7K		
G	NTD6121AA-2 NTD6122AA-2	Q107	WAS 48K869213, M9213	FINAL AMPL	NONE
H	NTD6121AA-3 NTD6122AA-3	L116	WAS 25B82872B01	PARTS LIST	
H1	NTD6121AA-3 NTD6122AA-3	L1 L2 L3 C1 C2	ADDED XMTR POR-TION OF NLN6428A AND/OR NLN6423A COMPONENTS KIT 1.2 uh, 100 uuf	P501-1 P501-2 P501-3 P501-3 P501-2	
	NLD6261A-1 NLD6262A-1	R401 C414	REMOVED 6S129860, 56 ADDED	Q401 BASE	
	NPN1007A	C601, C602	ADDED	J601-1, P601-1	
J	NTD6121AA-4	C161 C162 C163	ADDED .0055 uf (132-150.8 MC ONLY) ADDED .0055 uf (132-150.8 MC ONLY) ADDED 1500 uuf (132-150.8 MC ONLY)	Q106 EMITTER CIRCUIT Q107 EMITTER CIRCUIT Q105 EMITTER CIRCUIT	EPD-14355-E
K	NTD6121AA-5 NTD6122AA-4	Q107	WAS 48R869407, TYPE M9407	FINAL AMPLIFIER	EPD-14355-F
L	NTD6121AA-6 NTD6122AA-5		CIRCUIT BOARD PLATING REVISED; ELECTRICALLY THE CIRCUIT IS UNCHANGED		EPD-14355-G
M	NCN6040B-1 NCN6050B-1	CR1	ADDED	K1	NONE
N	NLD6443A	R504, 505	WERE 6S129236, 15K	Q502 BASE	EPD-14355-H
P	NLN6443A-4	R504, 505 R511, 512	WERE 6K129887, 12K 6K128903; 39K ADDED	Q502 BASE	EPD-14355-J

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

NTD6121AA Xmtr. Chassis 132-150.8 MC
NTD6122AA Xmtr. Chassis 150.8-174 MC EPD-12132-F

		CAPACITOR, fixed: uuf; unl stated
C101	20C82399D08	var; 3-10; NP0
C102	21D82877B06	30 ±10%; N150
C103	21D82877B34	150 ±10%; NP0
C104, 106	21D82877B33	90 ±10%; NP0
C105, 110, 113, 156	21C82213E03	.0055 uf +100-0%; 75 v
C107	21D82877B31	50 ±10%; NP0
C108, 143, 147	21K847065	500 +100-0%; 25 v
C109	21K861435	70 ±10%; N150
C111	21C82397D09	6.8 uf +40-20%; 10 v
C112, 126, 133, 144, 153, 158	21K861436	100 ±10%; N750
C114	21K861433	36 ±10%; N150
C115	21D82877B13	7 ±5%; N150
C116, 124, 150	21K851299	600 ±10%; 600 v
C117	21K861425	2.2 ±10%; N150
C118, 119	21K861435	70 ±10%; N150; (132-150.8 mc)
	or21K864012	60 ±10%; N150 (150.8-174 mc)
C120	21D82877B05	150 ±10%; N750
C121	21K864013	50 ±10%; N150 (132-150.8 mc)
	or21K861433	36 ±10%; N150 (150.8-174 mc)
C122	21K861603	3.3 ±.25; NP0
C123	21K861434	40 ±10%; N150 (132-150.8 mc)
	or21K865197	25 ±10%; N150 (150.8-174 mc)
C125	21K861438	220 ±10%; N1400
C127	21K861429	8 ±10%; N150 (132-150.8 mc)
	or21D82877B13	7 ±10%; N150 (150.8-174 mc)
C128	21K861426	2.2 ±10%; N150 (132-150.8 mc)
	or21D82450B30	1.8 ±10%; 500 v (150.8-174 mc)
C129	21K861462	15 ±10%; N150 (132-150.8 mc)
	or21K861431	12 ±10%; N150 (150.8-174 mc)
C130	21K861435	70 ±10%; N150 (132-150.8 mc)
	or21K864013	50 ±10%; N150 (150.8-174 mc)
C131, 132, 134, 141, 148	21K861437	100 ±10%; N2200
C135	20C82399D07	15-60; N1500
C136	21K861462	15 ±10%; N150
C137	21C82880E22	500 ±10%; 350 v
C138	21K861462	15 ±10%; N150 (132-150.8 mc)
	or21K861429	8 ±10%; N150 (150.8-174 mc)
C139	20C82399D05	var; 9-35; N650
C140	21C82213E03	.0055 uf +100-0%; 75 v (150.8-174 mc)
C142	21D82877B46	18 ±10%; N150
C145	8C82548E02	.015 uf ±10%; 100 v
C146, 155	23C82397D17	15 uf ±20%; 20 v
C149	23C82397D03	10 uf ±20%; 6 v
C152	8C82548E03	.005 uf ±10%; 100 v
C154	8C82548E04	.022 uf ±10%; 100 v
C157	23D82397D15	10 uf ±20%; 20 v
C159	21D82877B01	24 ±10%; N150 (132-150.8 mc)
	or21K861432	20 ±10%; N150 (150.8-174 mc)
C160	21K861431	12 ±10%; N150 (132-150.8 mc)
	or21K861430	10 ±10%; N150 (150.8-174 mc)
C161, 162	21C82213E03	.0055 uf +100-0%; 75 v (132-150.8 mc)
C163	21K858107	1500 ±25%; 250 v (132-150.8 mc)
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101	48C82392B03	silicon
CR102	48C82178A01	germanium
CR103	48D82256C08	zener; (7.79-8.61 v)
		COIL, RF:
L101	24V80904A41	7.0 uh; coded BLK-YEL
L102	24V80904A37	coded; BLK-BLK; 11 turns
L103, 104	24V80904A39	coded; BLK-RED; 5 turns
L105, 106	24V80904A72	coded; BLK-YEL; 4 turns
L107	24V80904A39 (132-150.8 mc)	coded; BLK-RED; 5 turns
	or24V80904A72 (150.8-174 mc)	coded; BLK-YEL; 4 turns
L108	24V80904A73	coded; BLK-GRN; 6 turns
L109, 111, 115, 117, 120	24D82723H01	choke; 1.2 uh
L110	24D82549D03	choke; 1 mh
L112	24D82723H05	choke; 0.41 uh
L113	24D82723H04	choke; 0.29 uh
L114	24D82723H11	choke; 0.2 uh
L116	25B82872B02	choke; audio; 0.8 h
L118	24D82723H13 or24D82723H15	85 uh (132-150.8 mc) 75 uh (150.8-174 mc)
L119	24D82723H12 or24D82723H14	85 uh (132-150.8 mc) 75 uh (150.8-174 mc)
L121	24C83961B01	choke; ferrite
		TRANSISTOR: (SEE NOTE)
Q101	48R869088	P-N-P; type M9088
Q102	48R869058	P-N-P; type M9058
Q103	48R869009	P-N-P; type M9009
Q104	48R869008	P-N-P; type M9008
Q105	48R869218	N-P-N; type M9218
Q106	48R869217	N-P-N; type M9217
Q107	48R869477	N-P-N; type M9477
Q108, 109	48R869148	P-N-P; type M9148
		RESISTOR, fixed: ±10%; 1/4 w
R101	6S185B91	10K; 1/8 w
R102	6S185B96	27K; 1/8 w
R103	6S185B84	2.7K; 1/8 w
R105	6S129269	1.8K
R106	6S129230	12K
R107	6S128599	680
R108	6S185B81	1.5K; 1/8 w
R109	6S128685	22K
R110	6S185B87	4.7K; 1/8 w
R111, 120	6S129620	560
R112, 129	6S129775	330
R113	6S185B74	390; 1/8 w
R114	6S129617	120
R115	6S185B64	56; 1/8 w
R116	6S127800	220
R117	6S131650	18
R118	18C82035B15	var; 600
R121	6S127803	1.5K
R122	6S185A75	12K ±5%; 1/8 w
R123	6S185A73	10K ±5%; 1/8 w
R124	6S185A57	2.2K ±5%; 1/8 w
R125	6S124A60	3K ±5%
R126	6S185B60	27; 1/8 w
R127	6S127806	27K
R128	18C82876B04	var; 2K
R130	6S185B63	47; 1/8 w
		TRANSFORMER
T1	24V80904A42	1st Tripler; coded; BLK; does not incl 76K861425 CORE, tuning
		FILTER, harmonic:
Z101	1V80752A87	incl; ref parts C159, 160, L118, 119
		NON-REFERENCED ITEMS
	26B82671D07	SHIELD, coil, 9 req'd
	2A83325B01	NUT, transistor mtg.
	76A82686D02	SLEEVE, iron

NLN6443A Automatic Drive Limiter (P33 Series)
NLN6456A Automatic Drive Limiter (P23 Series) EPD-12133-F

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C501	23D82397D17	15 uf ±20%; 20 v
C502, 504	21C82213E02	.02 uf ±10%; 75 v
C503, 505	21D82877B15	120 uuf ±10%; 75 v; N150
C511	23D82397D15	10 uf ±10%; 20 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR501, 502, 503, 504	48C82178A10	germanium; coded V10
		COIL, RF:
L501, 502	23D82723H01	choke; 1.2 uh
L503	24B83977B01	choke; ferrite
		TRANSISTOR: N-P-N: (SEE NOTE)
Q501	48R869277	type M9277
Q502, 503	48R869119	type M9119
		RESISTOR, fixed: ±5%; 1/4 w unl stated
R501	6S129983	8.2K
R502	6S129982	5.6K
R503	17C82291B22	0.75 ±1%; 2 w
R504	6K128904 or 6S129526	18K (P33 Series) 33K (P23 Series)
R505	6K128904	18K
R506	17C82291B23	0.33 ±1%; 2 w
R510	6S185A87	39K ±5%; 1/8 w
R511, 512	6K128903	39K
		THERMISTOR:
RT501	6B82696B01	10K ±10%; @25°C

NLN6415A XMTR, Osc. (F2) EPD-12134-B

		CAPACITOR, fixed: uuf
C201	20C82399D08	var: 3-10; 200 v; NP0
C202	21D82877B06	30 ±10%; 75 v N150
C203	21D82877B34	150; ±10%; 50 v; NP0
C204	21C82213E03	.0055 uf +100-0%; 75 v
C205	21D82877B33	90 ±10%; 50 v; NP0
		COIL, RF: choke; (sleeved);
L201	24C82000E21	1.2 uh
		TRANSISTOR; SEE NOTE
Q201	48R869088	P-N-P; type M9088
		RESISTOR, fixed: ±10%; 1/8 w
R201	6S185B91	10K
R202	6S185B96	27K
R203	6S185B83	2.2K
R204	18C82876B04	var. 2K ±15%; 1/20 w
R205	6S185B87	4.7K

NMN6017A Handset (Plug-In, Carbon) EPD-12135-O

HS501	50D82433G01	HANDSET, carbon: incl. P501, W501 & 55P82446G01 HANDLE, 15P82446G02 CAP, transmitter, 15P82446G03 CAP, receiver, 40P82446G04 SWITCH, spst; normally open 59P82446G05 CARTRIDGE, transmitter, 4K84985 WASHER, strain relief, 37A842245 SLEEVE, strain relief
		CONNECTOR, plug:
P501		p/o W501
		CORD, handset:
W501	30D82565B19	coiled; 4-conductor; incl ref part P501

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

NMN6018A Microphone (Plug-In; Transistorized) EPD-12136-O

		AMPLIFIER, AF:
A501	1V80727A19	incl. C501, 502, 503, CR501, Q501, R501, and 1V80727A20 BOARD, circuit
		CAPACITOR, fixed:
C501	21K861442	.02 uf +100-20%; 75 v
C502, 503	21D82428B10 or21C82213E01	.0033 uf .0033 uf ±20%; 75 v
		SEMICONDUCTOR DEVICE, diode: NOTE
CR501	48C82178A01	germanium
		CARTRIDGE, microphone:
DP501	59C82857E01 or59C82864E01	reluctance type
		CONNECTOR, plug:
P501		p/o W501
		TRANSISTOR: NOTE
Q501	48R134621	P-N-P; type M4621
		RESISTOR, fixed:
R501	6K127807	33K ±10%; 1/4 w
		SWITCH, push:
S501	40C82863E01	single pole normally open
		CORD, microphone:
W501	30D82565B04	incl ref part P501 and a coiled 4 conductor; str. cord

NPN6031A Power Supply (less battery) Nickel-Cadmium EPD-12127-B

		SEMICONDUCTOR DEVICE, diode: NOTE
CR601	48C82095C01	silicon
CR601, 602	21C82187B16 or21K850446	.003 ±10%; 100 v .003 ±25%; 250 v
		FUSE, cartridge:
F601	65A82496G01	3 amp/32 v; 1/4" x 5/8"
		CONNECTOR, receptacle:
J601	9C82847E01	female; 9 cont.
		CONNECTOR, plug:
P601	28A82488G01	male; 2 cont.
P602	28A16313	male; 3 cont.
		FUSEHOLDER ASSY:
XF601	1V80731A03	single fuse mtg
		NON-REFERENCED ITEMS
	1V80731A01	HOUSING ASSY. (riveted)
	64B82653G01	PLATE, door
	41A82652G01	SPRING, torsion
	22A82651G01	PIN, pivot
	14A82650G01	INSULATOR
	38A868379	TAB, batter plug

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

NPN6033A Power Supply (less battery) Dry
NPN6030B Power Supply (less battery) Dry EPD-12128-A

F601	65R132923	FUSE, cartridge: 3 amp, 7250 v
J601	9C82847E01	CONNECTOR, receptacle: female; 9 cont
C601, 602, 603, 604, 605 C606 C606A, 606B C607	21C82187B16 21K800802	CAPACITOR, fixed: .003 uf ±5%; 100 v 2 sections c/o .001 uf GMV +100% max; 500 v same as C606 except c/o C607A, C607B
		NON-REFERENCED ITEMS
	1V80731A83	HOUSING ASSY. (riveted) NPN1009A
	1V80735A56	HOUSING ASSY. (riveted) NPN1007A
	1V80731A85	BATTERY HOLDER ASSY. (riveted) NPN1009A
	1V80735A58	BATTERY HOLDER ASSY. (riveted) NPN1007A
	1V80731A87	BATTERY COVER ASSY. (riveted) NPN1009A
	1V80735A60	BATTERY COVER ASSY. (riveted) NPN1007A

NLN6310A Battery Kit EPD-12129-O

	60D82455G01	BATTERY, dry: single cell; 1.5 v; 11 req'd.

NLN6267A Battery Kit (Nickel Cadmium) EPD-12130-O

	60D82447G01	BATTERY, nickel cadmium; 14 volt
	75A82588G01	PAD, rubber: 2 supplied

NLD6230A Crystal Kit EPD-12389-O

Y101, 201	NLD6230A	CRYSTAL UNIT, quartz: (SEE NOTE) transmitter control; sealed unit; incl compensation components (field replacement of these components not recommended)

NOTE:

Crystals are part of the complete radio set model (not part of the transmitter). When ordering crystal units, specify carrier frequency, crystal part (type) number.

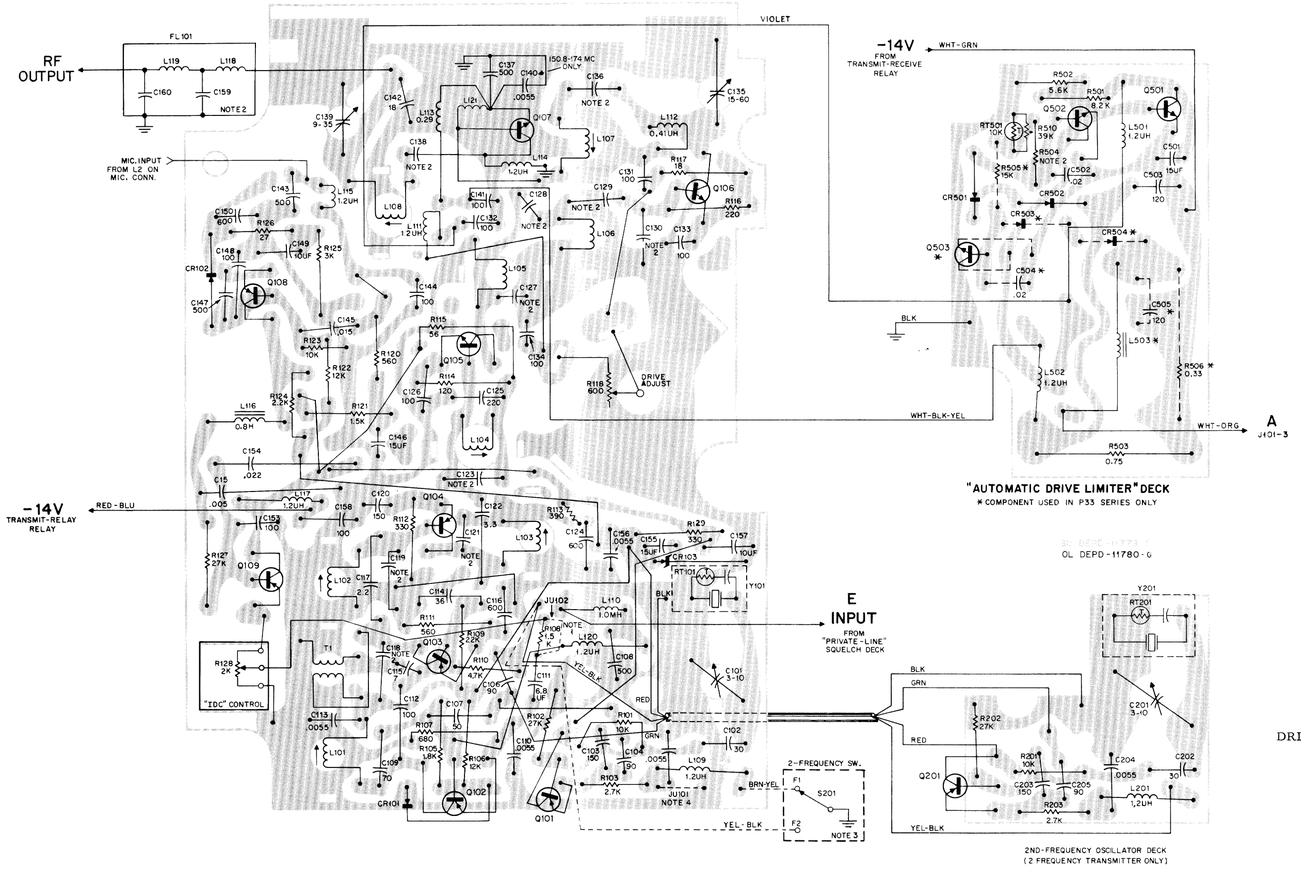
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

NLD6261A Power Ampl. 132-150.8 MC
NLD6262A Power Ampl. 150.8-174 MC EPD-12364-D

		CAPACITOR, fixed: uuf; unl stated
C400	21C82213E03	.0055 uf +100-0%; 75 v
C401, 402	20C83201B01	var. 2-20 uuf; 100 v; coded BRN
C403, 404	20C83201B02	var. 8-80 uuf; 100 v; coded RED
C405	21D82880E19	500 ±10%; 350 v
C406	21K859936	15 ±5%; 500 v; 132-150.8 mc
C407	21K855384	.002 uf ±15%; 250 v
C408, 411	21K859698	20 ±5%; 500 v
C409, 410	21D82355B09	33 ±5%; NP0
C412	21D82877B05	150 ±10%; 75 v; N750; 132-150.8 mc only
C413	21C82372C03	0.1 +80-20%; 25 v
C414	21K847770	80 ±10%; N750; 150.8-174 mc only
		COIL, RF:
L401	24C83203B12	3 turns
L402	24C83961B01	3 turns
L403	24C82000E04	choke; 0.31 uh
L404	24C83203B12 or24C83203B05	3 turns; 132-150.8 mc 2 turns; 150.8-174 mc
L405	24C83203B08 or24C83203B11	5 turns; 132-150.8 mc 6 turns; 150.8-174 mc
L406, 408	24C83203B06	4 turns
L407	24C83203B07	4-1/2 turns
		TRANSISTOR: (SEE NOTE)
Q401	48R869247	N-P-N; type M9247
		RESISTOR, fixed:
R401	6S129860	56 ±10%; 1/4 w (132-150.8 mc)

NOTE:

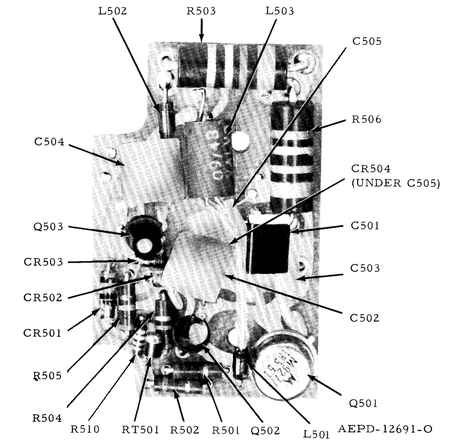
Replacement transistors and diodes must be ordered by Motorola part number only for optimum performance.



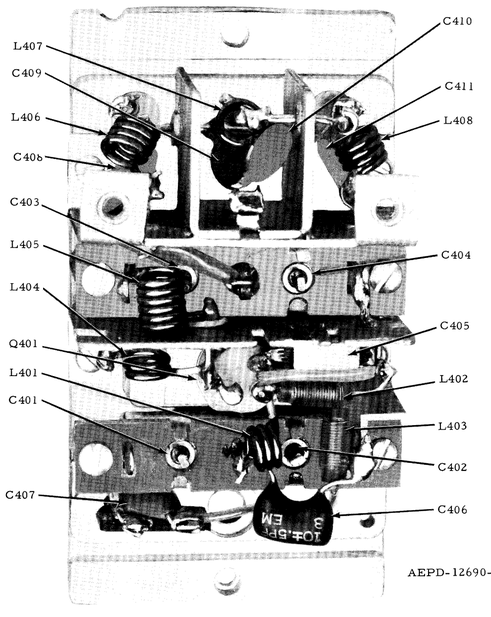
NOTES:

1. JUMPER JU102 REMOVED IN "PRIVATE-LINE" TONE-CODED SQUELCH MODELS.
2. REFER TO PARTS LIST FOR VALUE.
3. PART OF HOUSING KIT IN TWO-FREQUENCY MODELS ONLY.
4. ONE-FREQUENCY MODELS ONLY.

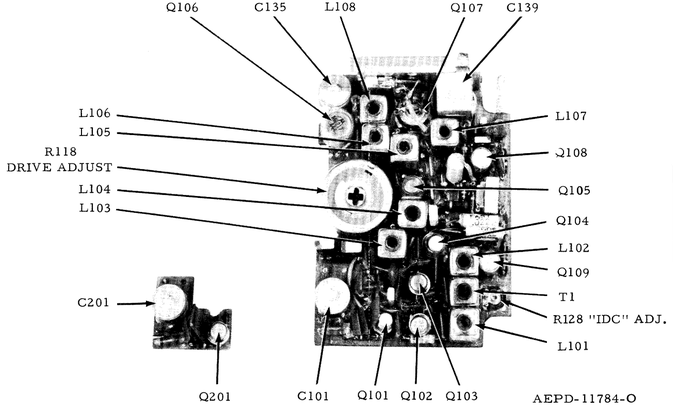
EPD-14034-O



"AUTOMATIC DRIVE LIMITER" DECK



POWER AMPLIFIER (P33 SERIES ONLY)



SECOND FREQUENCY OSCILLATOR DECK AND TRANSMITTER CIRCUIT BOARD

MODEL TABLE

MODEL	SUFFIX
NTD6121AA	1
NTD6122AA	1
NLN6443A	3
NLN6456A	2
NLN6415A	

FOR UNITS SUFFIXED LATER THAN INDICATED IN THE ASSOCIATED MODEL TABLE REFER TO EPD-14355

EPD-14471-O

Transmitter Printed Circuit Board and Wiring Diagram Motorola No. EPD-11724-H

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	NTD6121AA NTD6122AA-1	R104	REMOVED 6S185B84, 2.7K	LOWER RIGHT OF XMTR BD
		L110	WAS 24D82723H01, 1.2 uh	
		L120	ADDED 1.2 uh	
	NLN6443A-1	L503	WAS 24K800484, 0.31 uh	AUTO DRIVE LIMITER DECK
B	NLN6443A-2 NLN6456A-1	CR505	REMOVED 48C82256C08	AUTO DRIVE LIMITER DECK
		Q504	REMOVED 48R869119, M9119	
		R501	WAS 6S129981, 3.3K (P23 SERIES)	
		R502	WAS 6S129983, 8.2K (P23 SERIES)	
		R507	REMOVED 6S129754, 33	
		R508	REMOVED 6S129779	
		R509	REMOVED 6S128687, 6.8K	
		L501, 502	ADDED 1.2 uh	
C	NTD6121AA-1	C140	REMOVED 21C82213E03, .0055 uf (136-150.8 MC)	PARTS LIST
D	NTD6121AA-1 NTD6122AA-1	L114	WAS 24D82723H01, 1.2 uh	Q107 COLLECTOR
		C128	WAS 21D82450B30, 1.8 uuf (132-150.8 MC)	BELOW Q107
		L118	WAS 24B83728B01, 75 uh	PARTS LIST
		L119	WAS 24B83728B02, 75 uh	
		L107	WAS 24V80904A72, 4-TURNS (132-150.8 MC)	
		C129	WAS 21K861431, 12 uuf (132-150.8 MC)	
		C136	WAS 21D82877B46, 18 uuf OR 21K861431, 12 uuf	
		C159	WAS 21D82877B06, 30 uuf (132-150.8 MC)	
		C160	WAS 21K861462, 15 uuf (132-150.8 MC)	
		C123	WAS 21K861433, 36 uuf (132-150.8 MC)	
		C127	WAS 21K861430, 10 uuf (132-150.8 MC)	
		C130	WAS 21K864013, 50 uuf (132-150.8 MC)	Q106 BASE
		R119	REMOVED 6S185B64, 56 OHMS. REPLACED BY L121	Q107 BASE
		L121	ADDED REPLACES R119	
E	NLN6443A-3 NLN6456A-2	R503	WAS 17C82036G13, 0.75 ±5%; 2 W	PARTS LIST
		R506	WAS 17C82036G15, 0.33 ±5%; 2 W	
		R510	WAS 6S185B98, 39K ±10%; 1/8 W	
F	NLN6443A-3 NLN6456A-2		ADDED NOTES	
G	NLN6415A-1		EXTENSIVE CIRCUIT BOARD CHANGES REFER TO EPD-14355-O	
H		L402, 403	WERE REVERSED	PWR. AMPL. DETAIL

END OF DOCUMENT