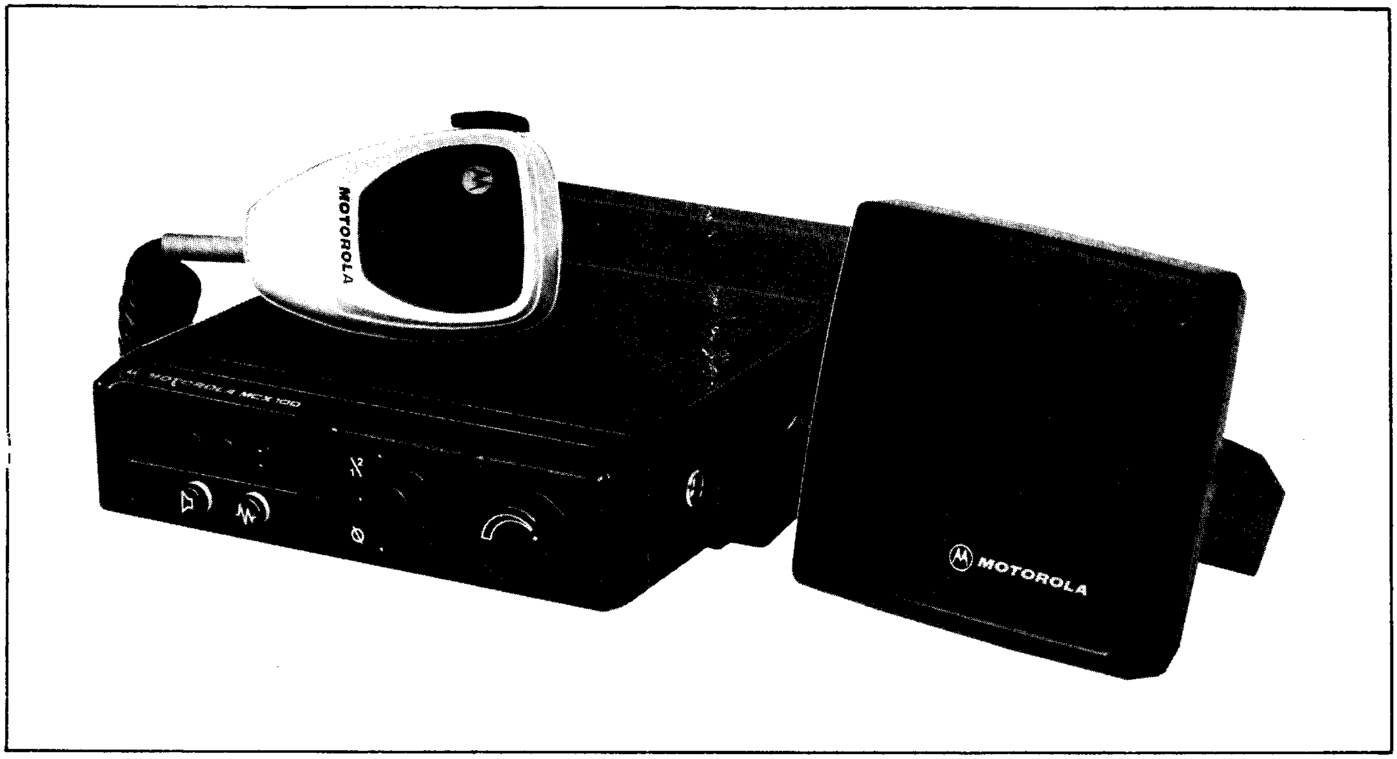
MOTOROLA

DVP™ MCX100™ Two-Way FM Radio

10 W and 30 W RF Power
136-174 MHz

"EXA" SERIES



THIS MANUAL HAS BEEN
DISCONTINUED

Instruction Manual

68P81063E25-O

MOTOROLA INC.
Communications
Sector

DVP MCX100

TWO-WAY FM RADIO
10 W AND 30 W RF POWER
136-174 MHz

CONTENTS

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

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MAINTENANCE AND ALIGNMENT

RECEIVER AND TRANSMITTER CIRCUITS

SYNTHESIZER AND VOLTAGE CONTROL OSCILLATOR (VCO) CIRCUITS

DIGITAL VOICE PROTECTION (*DVP*), *PRIVATE-LINE* (PL)/*DIGITAL PRIVATE-LINE* (DPL), AND TIME-OUT TIMER (TOT) CIRCUITS

MISCELLANEOUS

 (Pages v and vi are omitted due to irrelevancy)

PERFORMANCE SPECIFICATIONS

GENERAL

Number of Frequencies	2 to 32 channels, synthesized
Type of Squelch	1000 Series: Carrier Squelch 7000 Series: *Private-Line* and *Digital Private-Line* 9000 Series: *Select 5*
Primary Power	12 V dc nominal, negative ground
Dimensions	10 Watt Front Mount Models: 27.3cm L × 17.9cm W × 5.1cm H (10.7" L × 7" W × 2" H)
	30 Watt Front Mount Models : 32.4cm × 17.9cm W × 5.1cm H (12.8" L × 7" W × 2" H)
	10 Watt Remote Mount Models: 29.8cm L × 17.9cm W × 5.1cm H (11.7" L × 7" W × 2" H)
	30 Watt Remote Mount Models: 34.8cm L × 17.9cm W × 5.1cm H (13.7" L × 7" W × 2" H)
Weight	10 Watt Front Mount Models: 3.3 kg (7.3 lb.)
	30 Watt Front Mount Models: 3.6 kg (7.9 lb.)
	10 Watt Remote Mount Models: 3.9 kg (8.6 lb.)
	30 Watt Remote Mount Models: 4.2 kg (9.3 lb.)

			Typical Battery Current Drain (Less Options)		
Model Series	**Minimum RF Power Output**	**Frequency Range (MHz)**	**Standby @13.8 V**	**Receive at Rated Audio @13.8 V**	**Transmit at Rated Power @13.8 V**
D/T23EXA	10 Watts	136-174	350 mA	1.1A	3.0A
D/T43EXA	30 Watts	136-174	350 mA	1.1A	7.5A

TRANSMITTER

Output Impedance	50 Ohms
Frequency Stability	±0.0005% from −30°C to +60°C (±0.0002% optional) (+25 °C reference)
Spurious and Harmonics	10 Watt Models: 80 dB below carrier 30 Watt Models: 85 dB below carrier (less than 2 × 10^{-7} watts all models)
Modulation	(16F3) ±5 kHz for 100% @ 1000 Hz (20F3Y) ±4 kHz, coded mode
Audio Sensitivity	80 mV nominal for 60% system deviation
FM Noise	50 dB
Audio Response*	+1/−3 dB from 300 to 3000 Hz +1/−1.5 dB from 400 to 2700 Hz
Audio Distortion*	Less than 3% at 1000 Hz to 60% deviation
Frequency Separation	26 or 28 MHz

RECEIVER

Audio Output	EIA: 5 Watts @ 3% distortion
Input Impedance	50 Ohms
EIA Modulation Acceptance	±7 kHz
Frequency Stability	±0.0005% from −30°C to +60°C ambient (+25°C reference) (±0.0002% optional)
Squelch Sensitivity*	Carrier Squelch: 10 dBq (fixed) PL/DPL: 6 dBq (fixed)
Maximum Frequency Separation	4 MHz or 12 MHz in two 6 MHz "windows" with wide-spaced (dual) front end option B434.
Spurious and Image Rejection	85 dB
Sensitivity*	20 dB Quieting: 0.35 uV EIA SINAD: 0.28 uV
Intermodulation	80 dB
Selectivity	30 kHz Channel Spacing: 90 dB EIA 25 kHz Channel Spacing: 85 dB EIA

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

PERFORMANCE SPECIFICATIONS (Cont'd.)

SECURITY

Scrambler Type	Digital
Coding Method	Multi-Register Non-Linear Combiner
Number of Codes	2.36×10^{21} orthogonal (unique) codes
Synchronization	Self synchronizing (no preamble required)
Code Key Initialization	Random
Code Key Generation	External hand held microprocessor controlled code inserter (Cat. #T3010__X)
Code Storage	Volatile Electronic Memory
Number of Codes Per Radio	One (2nd related code optional)
Analog to Digital Conversion	Continuously Variable Slope Delta Modulation (CVSD)
Voice Sample Rate	12 Kilo Bits/Sec

*Specification applies to clear mode only. Performance in the private mode has been tailored to deliver optimum intelligibility and voice recognition.

FCC DESIGNATION

Model Series	Transmitter Power	Applicable Rules of Parts	Emissions Authorized	Type Acceptance Numbers
D/T23EXA	10 Watts	22, 90, 74	15F2, 16F3, 16F9, 20F3Y	ABZ9QBT3646
D/T43EXA	30 Watts			ABZ9QBT3647

Chassis Assembly Breakdown Chart

TLN2324B	Chassis Assembly
TRN4600A	Power Interconnect Board
TRN5365A	Power Interconnect Board
TRN4602A	Transmitter Feedthrough Plate
TRN4603A	Chassis Hardware

DVP VHF *MCX100* MOBILE RADIO

CARRIER AND PL/DPL SQUELCH

EXA SERIES MODELS

FRONT/REMOTE MOUNT

136-174 MHz

R1 = 136-162 MHz
R11 = 146-174 MHz

CODE:

- ● = ONE ITEM SUPPLIED WITH EACH RADIO
- ○ = ONE ITEM SUPPLIED WITH EVERY FIVE RADIOS
- ★ = TWO ITEMS SUPPLIED WITH EACH RADIO
- / = ONE ITEM SUPPLIED DEPENDENT UPON FREQUENCY

NOTES:

1. REFER TO SEPERATE BREAKDOWN CHART FOR LOW LEVEL KITS.
2. REFER TO ANTENNA INSTRUCTION SECTION 68P81110A47.

NOMENCLATURE:

MB D 2 3 EXA 1 J 00 K1

- K1 = 136-162 MHz; K2 = 146-174 MHz
- 00 = 25/30 kHz
- J = 2-32 FREQ.
- 1 = CARRIER SQUELCH; 7 = PL/DPL SQUELCH
- EXA = DIGITAL VOICE PROTECTION
- 3 = VHF; 4 = UHF
- 2 = 10 WATTS; 4 = 30 WATTS
- D = FRONT MOUNT; T = REMOTE MOUNT
- MB = INTERNATIONAL MODEL PREFIX (CANADA)

Model	Power (Watts)	Squelch	Mount
MBD23EXA1J00AK	10	CARRIER	FRONT
MBD43EXA1J00AK	30	CARRIER	FRONT
MBD23EXA7J00AK	10	PL/DPL	FRONT
MBD43EXA7J00AK	30	PL/DPL	FRONT
MBT23EXA1J00AK	10	CARRIER	REMOTE
MBT43EXA1J00AK	30	CARRIER	REMOTE
MBT23EXA7J00AK	10	PL/DPL	REMOTE
MBT43EXA7J00AK	30	PL/DPL	REMOTE

Item	Note	Description	MBD23EXA1J00AK	MBD43EXA1J00AK	MBD23EXA7J00AK	MBD43EXA7J00AK	MBT23EXA1J00AK	MBT43EXA1J00AK	MBT23EXA7J00AK	MBT43EXA7J00AK
TAD6111A	2	ANTENNA, 136-144 MHz	/	/	/	/	/	/	/	/
TAD6112A	2	ANTENNA, 144-152 MHz	/	/	/	/	/	/	/	/
TAD6113A	2	ANTENNA, 152-162 MHz	/	/	/	/	/	/	/	/
TAD6114A	2	ANTENNA, 162-174 MHz	/	/	/	/	/	/	/	/
TFD6431A		HARMONIC FILTER/ANTENNA SWITCH R1	/	/	/	/	/	/	/	/
TFD6432A		HARMONIC FILTER/ANTENNA SWITCH R11	/	/	/	/	/	/	/	/
TKN8158B		POWER CABLE	●	●	●	●				
TKN8173B		POWER CABLE, REMOTE RADIO, INT'L.					●	●	●	●
TKN8175A		POWER CABLE, CONTROL HEAD, INT'L.					●	●	●	●
TLD2441A	1	VCO ASSEMBLY, 136-162 MHz	/	/	/	/	/	/	/	/
TLD2442A	1	VCO ASSEMBLY, 146-174 MHz	/	/	/	/	/	/	/	/
TLD9132A		LOW LEVEL AMPLIFIER	●	●	●	●	●	●	●	●
TLD9142A		10 W POWER AMPLIFIER, 136-162 MHz	/	/	/	/	/	/	/	/
TLD9143A		10 W POWER AMPLIFIER, 146-174 MHz	/	/	/	/	/	/	/	/
TLN2324B	1	CHASSIS ASSEMBLY	●	●	●	●	●	●	●	●
TLN2334B	1	30 W PA AND HEAT SINK ASSEMBLY		●		●		●		●
TMN1024A	1	MICROPHONE, STANDARD	●	●						
TMN1025A	1	MICROPHONE, SIGNALING			●	●				
TMN1026A	1	MICROPHONE, STANDARD REMOTE					●	●		
TMN1027A	1	MICROPHONE, SIGNALING REMOTE							●	●
TRD6161B		SINGLE FRONT END, 136-162 MHz	/	/	/	/	/	/	/	/
TRD6162B		SINGLE FRONT END, 146-174 MHz	/	/	/	/	/	/	/	/
TRN4601A		SYNTHESIZER INTERCONNECT BOARD	●	●	●	●	●	●	●	●
TRN4604A		BUSY LIGHT KIT			●	●			●	●
TRN4606B		DISPLAY BOARD, 2-32 FREQ.	●	●	●	●	●	●	●	●
TRN4609A		SWITCH BOARD, 2-32 FREQ.	●	●	●	●				
TRN4620A		FRONT PANEL FRAME	●	●	●	●	●	●	●	●
TRN4623A		BUTTON PANEL, CARRIER SQUELCH	●	●			●	●		
TRN4624A		BUTTON PANEL, PL/DPL			●	●			●	●
TRN4644A		LENS, 2-32 FREQ.	●	●			●	●		
TRN4645A		LENS, 2-32 FREQ. W/BUSY LIGHT			●	●			●	●
TRN4660A		MONITOR SWITCH W/BUTTON			●	●			●	●
TRN4661A		SINGLE DISPLAY KIT	★	★	★	★	★	★	★	★
TRN4666A		PROM KIT			●	●			●	●
TRN4669A		SYNTHESIZER DIVIDER, IC	●	●	●	●	●	●	●	●
TRN4670A		SYNTHESIZER PROM - 32 CHANNEL	●	●	●	●	●	●	●	●
TRN4671A		TUNING TOOL KIT	○	○	○	○	○	○	○	○
TRN4672B		RADIO SET HARDWARE	●	●	●	●	●	●	●	●
TRN4675A		INSTALLATION KIT	●	●	●	●	●	●	●	●
TRN4695A		PA INTERCONNECT BOARD, 10 W	●		●		●		●	
TRN4696A		PA INTERCONNECT BOARD, 30 W		●		●		●		●
TRN4767A		REMOTE SWITCH BOARD, 2-32 FREQ.					●	●	●	●
TRN4772A		REMOTE HARDWARE KIT					●	●	●	●
TRN5241A		FRONT PANEL INTERCONNECT BOARD, STANDARD	●	●			●	●		
TRN5243A		SYNTHESIZER	●	●	●	●	●	●	●	●
TRN5244A		FRONT PANEL INTERCONNECT BOARD, SIGNALING			●	●			●	●
TRN6777B		*DVP* ENCRYPTION HYBRID	●	●	●	●	●	●	●	●
TSN6031A		SPEAKER	●	●	●	●	●	●	●	●
VKN4020A		*DVP* CARRIER SQUELCH CABLE	●	●			●	●		
VKN4024A		*DVP* PL CABLE			●	●			●	●
VKN4030A		*DVP* REMOTE INTERFACE CABLE					●	●	●	●
VKN4031A		*DVP* REMOTE CABLE (8 FT.)					●	●	●	●
VLN1009A	1	*DVP* CIRCUIT MODULE	●	●	●	●	●	●	●	●
VLN1011A	1	*DVP* BASIC REMOTE INTERFACE BOARD					●	●	●	●
VLN1024A	1	MULTICODE PL/DPL ASSY			●	●			●	●
VLN4123A		*DVP* FRONT PANEL	●	●	●	●	●	●	●	●
VLN4129A		*DVP* KEY LOADING KIT	●	●	●	●	●	●	●	●
VLN4130A		*DVP* TOP COVER	●	●	●	●	●	●	●	●
VLN4131A		*DVP* BOTTOM COVER	●	●	●	●	●	●	●	●
VLN4132A		*DVP* 10 W NAME PLATE	●		●		●		●	
VLN4136A		*DVP* 30 W NAME PLATE		●		●		●		●
VLN4147A		*DVP* VOLUME/FREQUENCY SWITCH PANEL	●	●	●	●	●	●	●	●
VLN4148A		*DVP* REMOTE INTERCONNECT BOARD	●	●	●	●	●	●	●	●
VRN4000A		*DVP* MAIN BOARD, 25/30 kHz	●	●	●	●	●	●	●	●

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INTERNAL OPTION TABLE

Option No.	Description	Kits Added	Kits Deleted
		All Models	
B303AA	Dual Code	VLN4124A	VLN4123A
B304AA	Proper Code	None	None
B434AA	Wide-Space Receiver (Dual Front End Range 1)	TLD4778A, TLN2461B	TRD6161B
B434AB	Wide-Space Receiver (Dual Front End Range 2)	TLD2462B, TRN4778A	TRN6162A
B462AA	*Fast-Lok* Synthesizer (Range 1)	TLD2541A, TRN5129A, TRN5218A	TRN4601A, TRN4669A, TLD2441A, TRN5243A
B462AB	*Fast-Lok* Synthesizer (Range 2)	TLD2542A, TRN5129A, TRN5218A	TLD2442A, TRN4601A, TRN4669A, TRN5243A
B310AA	Range 2 to Range 1	TFD6431A, TLD9142A, TLD2441A, TRD6161B	TFD6432A, TLD9143A, TLD2442A, TRD6162B
B310AB	Range 2 to Range 1 (Dual Front End)	TFD6431A, TLD9142A, TLD2441A, TLD2461B	TFD6432A, TLD9143A, TLD2442A, TLD2462B
B310AE	Range 2 to Range 1 (*Fast-Lok*)	TFD6431A, TLD9142A, TLD2541A, TRD6161B	TFD6432A, TLD9143A, TLD2542A, TRD6162B
B310AF	Range 2 to Range 1 (Dual Front End and *Fast-Lok*)	TFD6431A, TLD9142A, TLD2461B, TLD2541A	TFD6432A, TLD9143A, TLD2462B, TLD2542A
		Carrier Squelch Models	
B11AK	Time-Out Timer (60 seconds)	VKN4021A, TRN4615A, TRN5666A	VKN4020A
B287AA	Non-Standard Time-Out Timer	None	None
B313AE	Sel Singletone (Dash Mount)	VKN4026A, VLN1013A, TLN2394B, TRN4659A, TRN4661A, TRN4663A, TRN4666A, TRN5244A	TRN5241A, VKN4020A
B313AF	Sel Singletone (Remote Mount)	VKN4026A, VLN1014A, TLN2394B, TRN4659A, TRN4661A, TRN4663A, TRN4666A, VLN1012A, TRN5244A	VLN1011A, TRN5241A, VKN4020A
B75AA	Omit Time-Out Timer on Single-Tone Models	None	None
		PL/DPL Squelch Models	
B75AA	Omit Time-Out Timer	None	None
B287AA	Non-Standard Time-Out Timer	None	None
B463AJ	Selectable PL 1-10 Codes (Dash)	VLN1013A, TRN4661A, TRN4663A	None
B463AK	Selectable PL 1-10 Codes (Remote)	VLN1014A, TRN4661A, TRN4663A, VLN1012A	VLN1011A
B290AJ	Selectable PL 1-30 Codes (Dash)	VLN1013A, TRN4661A, TRN4664A, TRN4689A	None
B290AK	Selectable PL 1-30 Codes (Remote)	VLN1014A, TRN4661A, TRN4664A, TRN4689A, VLN1012A	VLN1011A
B446AA	Decode Only	None	None
B445AA	Tone Encode Only (Front Mount)	TMN1024A	TMN1025A, TRN4660A, TRN4604A
	Tone Encode Only (Remote Mount)	TMN1026A	TMN1027A, TRN4660A, TRN4604A
		Select 5 Signaling Models	
	Refer to *Select 5* Manual Supplement for *Select 5* Signaling option information.		
		Models with Channel Scan Monitor Option	
	Refer to *Channel Scan* Option Manual for *Channel Scan* Monitor option information.		

EXTERNAL OPTION TABLE

Option No.	Description	Kits Added	Kits Deleted
		Antennas	
B70AM	Omit Antenna	None	TAD6111/2/3/4*
B652AA	1/4 Wave Rooftop (Range 1)	TAD6280A	TAD6111/2/3*
B652AB	1/4 Wave Rooftop (Range 2)	TAD6290A	TAD6112/3/4*
		Installation	
B398AC	Spare Encryption Hybrid	VLN1017A	None
B71AR	Omit Std. Mobile Mic	None	TMN1024A
B71AS	Omit Mobile Sig. Mic	None	TMN1025A
B71AT	Omit Std. Remote Mic	None	TMN1026A
B71AU	Omit Remote Sig. Mic	None	TMN1027A
B87AH	Omit Speaker	None	TSN6031A
B161AY	Omit Bat Cbl	None	TKN8158B
B161BA	Omit Rem Bat Cbl	None	TKN8173B
B65AA	Omit Installation Kit	None	TRN4675A
B90CU	Omit Accessories (CS)	None	TAD6113A, TKN8158B, TMN1024A, TRN4675A, TSN6031A
B90CY	Omit Accessories (CS Remote)	None	TAD6113A, TKN8173B, TMN1026A, TRN4675A, TSN6031A
B90CZ	Omit Accessories (PL/SS Remote)	None	TAD6113A, TKN8173B, TMN1027A, TRN4675A, TSN6031A
B296AA	Mounting Tray W/Latches	TRN4678A	TRN4675A
B297AA	Mounting Tray W/RT Hand Lock	TRN4679A	TRN4675A
B113AD	Ignition Control of PTT (Front Mount)	TKN8160A	None
B113AF	Ignition Control of PTT (Remote Mount)	TKN8197A	None
B654AD	Remote Mounting Kit (17 ft.)	VKN4032A, TSN6032A	VKN4031A, TSN6031A
B654AF	Remote Control Head Cable (17 ft.)	VKN4032A	VKN4031A
B301AA	Alternate Mic Location (Std. Mic)	TMN1024A	TMN1026A
B301AB	Alternate Mic Location (Sig. Mic)	TMN1025A	TMN1027A
B465AA	Base Station Option	TRN4898A	TAD6113A, TKN8159B, TRN4675A, TSN6031A

* Actual kit depends upon radio model.

DESCRIPTION

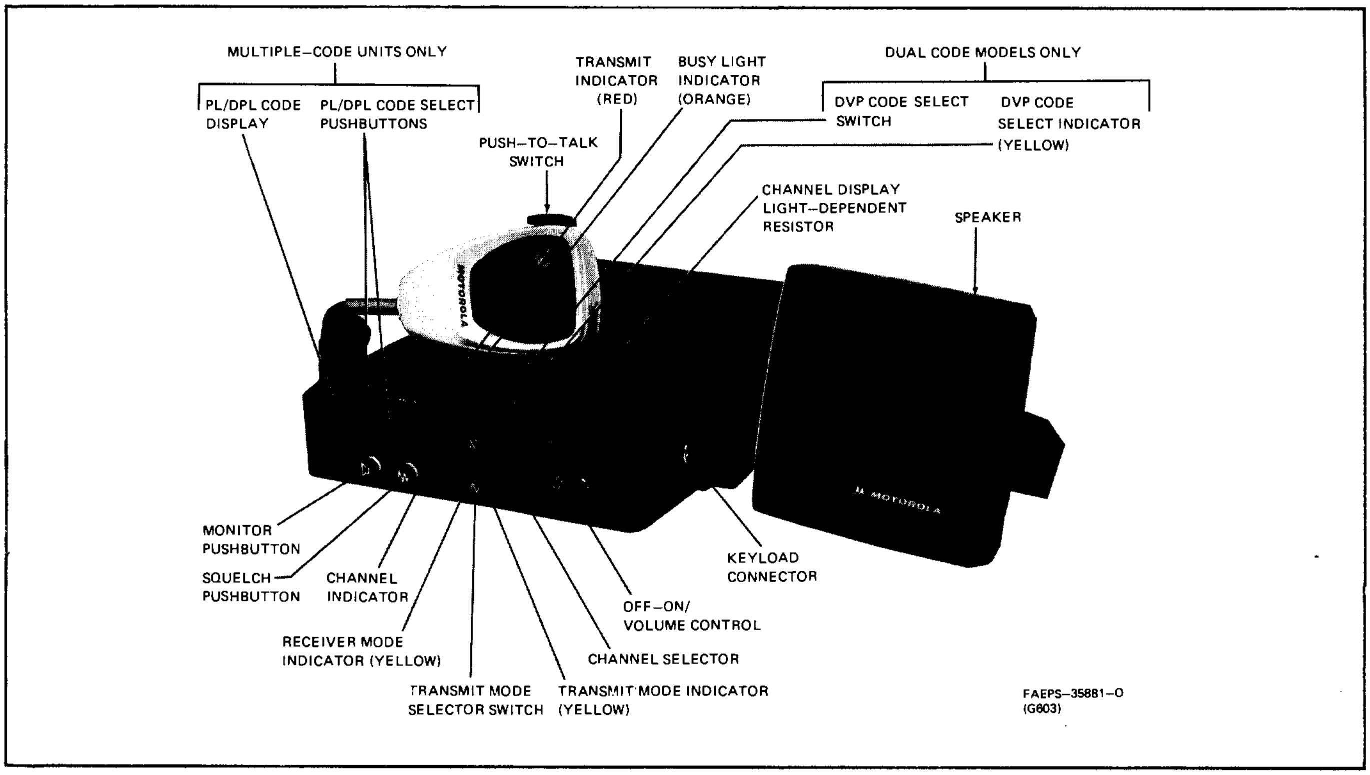


Figure 1.
Typical DVP MCX100 Radio Set Controls and Indicators

1. INTRODUCTION

1.1 The *DVP MCX100* Radio Set has been designed to meet worldwide radio frequency specifications. The radio set operates in the VHF frequency range of 136 to 174 MHz, and, depending on the model used, can provide rf power output of either 10 or 30 watts in systems employing minimum channel spacing of either 25 or 30 kHz. Up to 32 channels are available.

1.2 The extreme flexibility of the *DVP MCX100* radio in various system applications is provided by the availability of microprocessor-based signaling configurations. These are *Private-Line* (PL) tone-coded squelch, *Digital Private-Line* (DPL) coded squelch, and *Select 5* five-tone sequential signaling. Options to these signaling configurations are available to further customize the radio to the individual user.

1.3 Flexibility of the radio is also enhanced by the availability of several mounting configurations and options. Models are available which allow front mounting, either from above or below. Other models allow mounting the radio in a remote location such as the trunk or floor, using a remote control head. Special screws and locking hardware are available for all models to provide increased security from theft.

2. *DVP MCX100* OPTIONS

DVP MCX100 radios can include the following options:

- Time-out-timer to limit transmission duration (standard on PL/DPL and *Select 5* models).
- Dual Code option allows a second *DVP* key capability, with operator selection of either key.
- Proper Code option mutes the receiver audio whenever a *DVP* signal is received which was encrypted with a key different from that of the receiver.
- Special PL/DPL squelch signaling options such as Encode Only and Selectable PL allow special operator functions. Refer to the option chart in this manual for information on manual coverage.
- Special *Select 5* signaling options (refer to *Select 5* signaling manual supplement for details).
- Widespace (dual front end) receiver allows wider receiver overall channel spacing.
- *Fast-Lok* synthesizer allows for fast channel changing (included as part of priority *Channel Scan* option.)
- Ignition push-to-talk control to allow monitoring of radio while preventing unauthorized use of transmitter.
- *Channel Scan* monitor to allow monitoring of several channels simultaneously.
- Locking mounting hardware for greater security in radio installation.
- Base station accessories to allow use of radio as a base station.

Refer to the option chart in this manual for a list of available options and location of servicing information.

3. INSTRUCTION MANUALS

3.1 Installation, operation, and servicing information for the *DVP MCX100* radio is covered in this instruction manual. Service manuals may be ordered at time of equipment purchase, by contacting your Motorola service representative, or by writing to the following address:

Motorola, Incorporated
Communications Group Parts Department
1313 E. Algonquin Road
Schaumburg, Illinois 60196 U.S.A.

The option chart contained in this manual references manuals providing service information on particular options. The following is a brief description of the contents of manuals that may be required by the service technician.

3.2 This service manual contains all schematic diagrams, circuit board details, parts lists, and alignment information for *DVP* standard carrier, tone-coded *Private-Line* squelch, and *Digital Private-Line* squelch radio models, and information on certain options available for these models. Detailed theory of operation and maintenance procedures for the radio set are also contained in this manual.

3.3 The owner's manual packaged with each radio set provides detailed operating procedures.

3.4 All information on *Select 5* signaling is contained in a supplement to this manual. The supplement contains model information, schematic diagrams, circuit board details, parts lists, theory of operation, maintenance, and troubleshooting information for all *Select 5* signaling configurations and options.

3.5 Information on *Channel Scan* monitoring is contained in a supplement to this manual. The supplement contains kit information, schematic diagrams, circuit board details, parts lists, theory of operation, operating instructions, maintenance, and troubleshooting information for all *Channel Scan* monitoring configurations.

4. ELECTRICAL DESCRIPTION

4.1 RECEIVER

The standard *DVP MCX100* radio receiver uses a FET front end for high sensitivity and low noise, crystal filters for i-f selectivity, and integrated circuits for amplification, limiting, and detection. The standard front end provides a receive bandwidth of 4 MHz. An optional widespaced (dual) front end is available to allow a total receive bandwidth of 12 MHz; it provides two 6 MHz "windows" which may be independently tuned anywhere within the 136-to-162 or 146-to-174 MHz bands.

4.2 TRANSMITTER

The transmitter circuitry amplifies the frequency-modulated low level rf output from the frequency synthesizer, and contains power regulation and protection circuitry for the power amplifier. A harmonic filter is used to attenuate spurious radiations, and a non-mechanical PIN diode transmit-receive switch circuit is used for reliability.

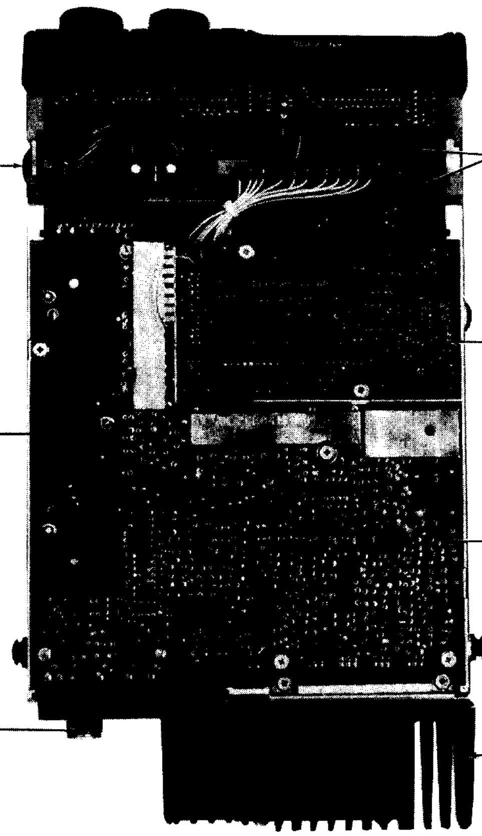


Figure 2.
DVP MCX100 Radio Top View with Cover Removed

4.3 FREQUENCY SYNTHESIZER

4.3.1 In the receive mode the digital frequency synthesizer generates the low side injection signal that is applied to the mixer. During transmission the synthesizer generates the low level frequency modulated signal that is applied to the transmitter low level amplifier stage.

4.3.2 The frequency synthesizer includes a reference oscillator, a frequency modulated (in transmit mode) voltage controlled oscillator (VCO), and frequency selecting logic circuitry. The logic circuitry controls the operating frequency of the phase-locked VCO. Frequency select data from the binary-coded front panel frequency switch is applied to the programmable read-only memory (PROM) integrated circuit on the synthesizer board. The PROM is programmed with customer-specified data which determines the transmit and receive frequencies for each position.

5. PHYSICAL CHARACTERISTICS
(Refer to Figures 1, 2 and 3)

5.1 The radio set is constructed in a rugged cast metal chassis with separate top and bottom covers. The front of the radio housing contains the control knobs, buttons, and indicators. The back of the radio housing contains the connectors for external power, microphone, antenna, and external option connections. 30 Watt models also have a heat sink on the back of the radio chassis for power transistor cooling.

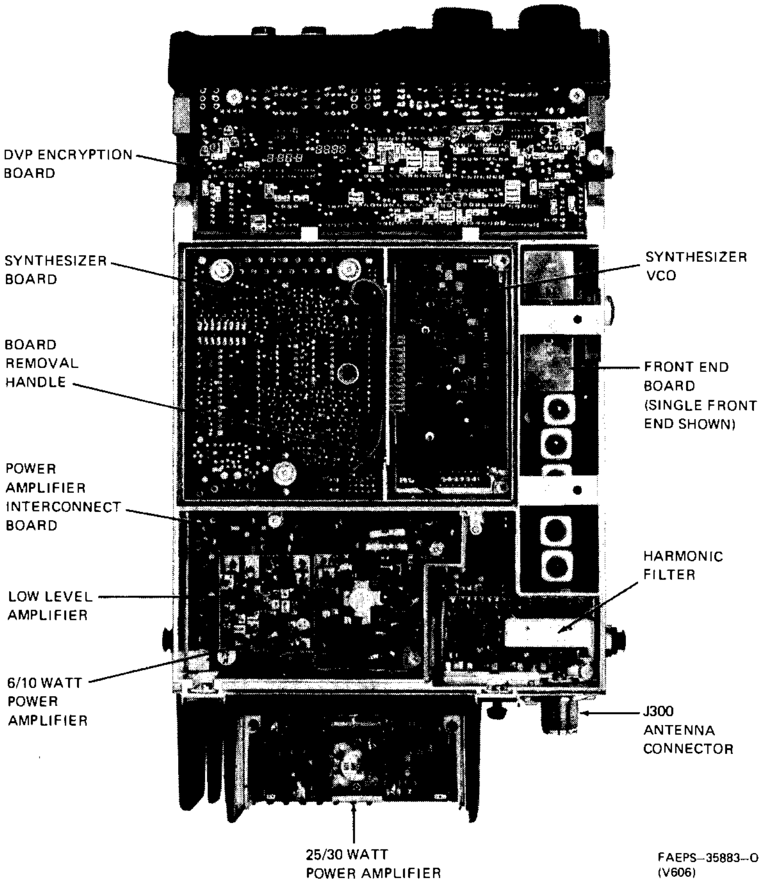


Figure 3.
DVP MCX100 Radio Bottom View with Cover Removed

5.2 Compartments inside the chassis isolate the PA, receiver front end, frequency synthesizer, option area, and main board from each other. Additional shields are mounted over sensitive components on the main board, and compartment shields are used over the synthesizer and power amplifier compartments.

5.3 The top and bottom covers are easily removed for service access. Most boards are connected to other radio circuitry with plug-in connectors, and may easily be removed from the radio for service or replacement by removing securing screws and pulling from the radio.

5.4 The front panel, switch, display, and circuit board assembly may easily be removed for service and testing without removing any circuit boards from the chassis.

6. SERVICE

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola service representative.

1. INTRODUCTION

This section of the manual describes the installation procedures for a front-mount and a remote-mount radio set. Procedures common to both radios are found under the heading ALL MODELS.

2. PREINSTALLATION TESTS

All *DVP MCX100* radio sets are thoroughly tested and inspected before shipment to customers. It is, however, suggested that the transmitter frequency, deviation, and power output be checked at the time of installation, after servicing, and periodically as required by applicable law. It is the license holder's responsibility that the operating parameters of his station comply with applicable laws governing radio communication equipment.

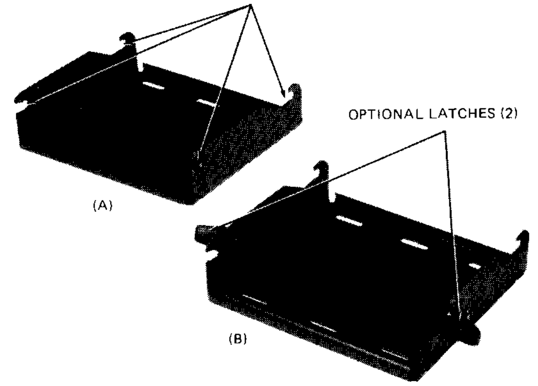


Figure 1. Mounting Trays

3. FRONT-MOUNT RADIO SETS

Step 1. Depending on the option ordered, front-mount radios may be mounted using either standard or optional trays. (Refer to Figure 1.)

Step 2. Mount the tray securely by means of the four (10 × 3/4") screws provided.

Step 3. Install the radio into the mounting tray using either the two mounting screws or the latches (depending on the type of tray ordered).

4. REMOTE-MOUNT RADIO SETS

Step 1. Mount the control head on the desired spot, using the mounting bracket provided.

Step 2. Install the transceiver mounting tray at the desired location, using the four (10 × 3/4") screws provided.

Step 3. Install the remote transceiver into the mounting tray, using either the mounting screws or latches (depending on the tray ordered).

Step 4. You may change the orientation of the cable at the control head end by removing the four screws, rotating the plastic assembly as required, and replacing the screws.

Step 5. Route the cable assembly from the control head to the transceiver; insert the cable connector into the mating connector on the transceiver and hold it in place by inserting the retaining clips through the slot in the protective connector shield on the transceiver.

5. ALL MODELS

Step 1. Install the loudspeaker in the desired location and connect it to the transceiver.

Step 2. For mobile units, mount the microphone hangup clip at the selected position. If the alternative microphone option or remote mount model has been ordered the microphone can be connected to the transceiver rather than to the remote-mount control head. For base station applications, the base microphone should be directly connected to the rear of the unit.

Step 3. Mount the antenna and route the coaxial cable to the radio set.

Step 4. Install the dc power cable in accordance with the instructions provided in Figures 2 through 4. MBB113 is the ignition control of PTT option.

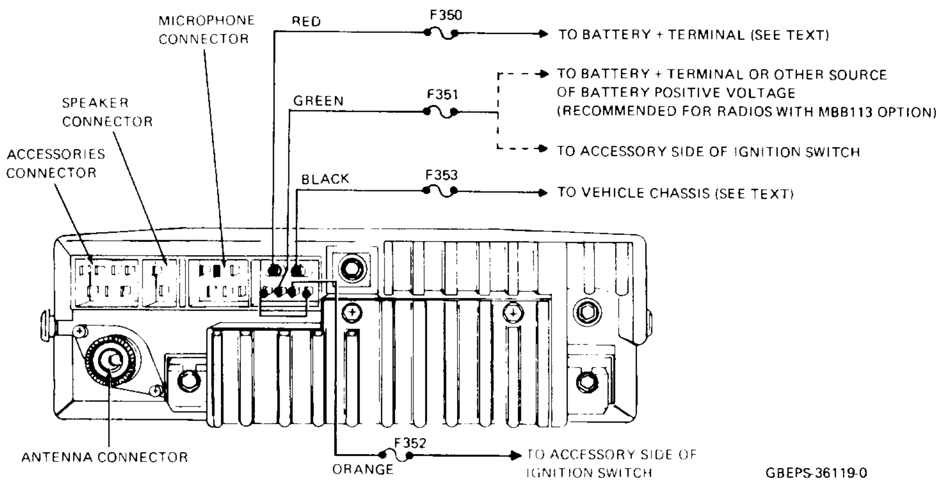


Figure 2. Power Lead Connections for Front Mount Mobile Radios

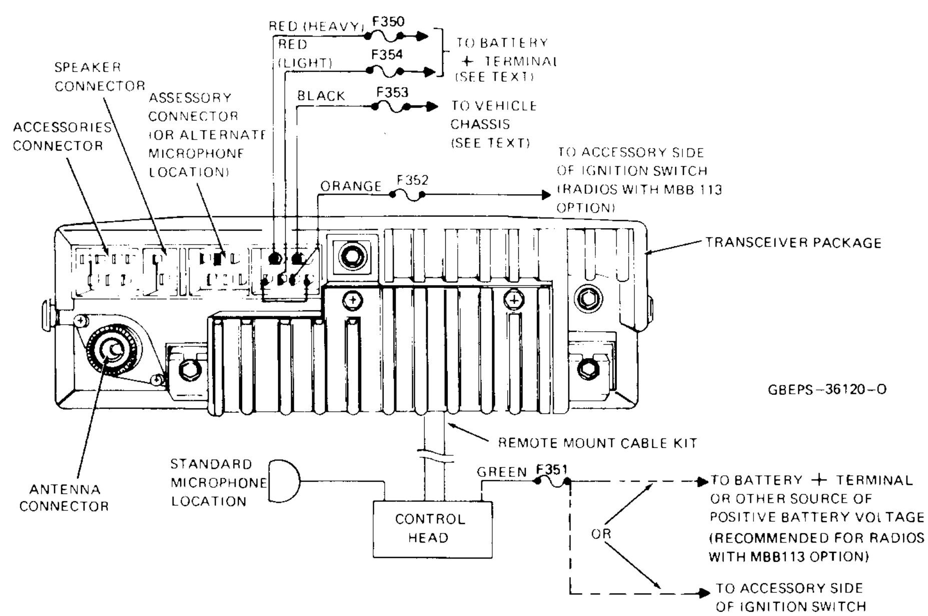


Figure 3. Power Lead Connections for Remote-Mount Radios

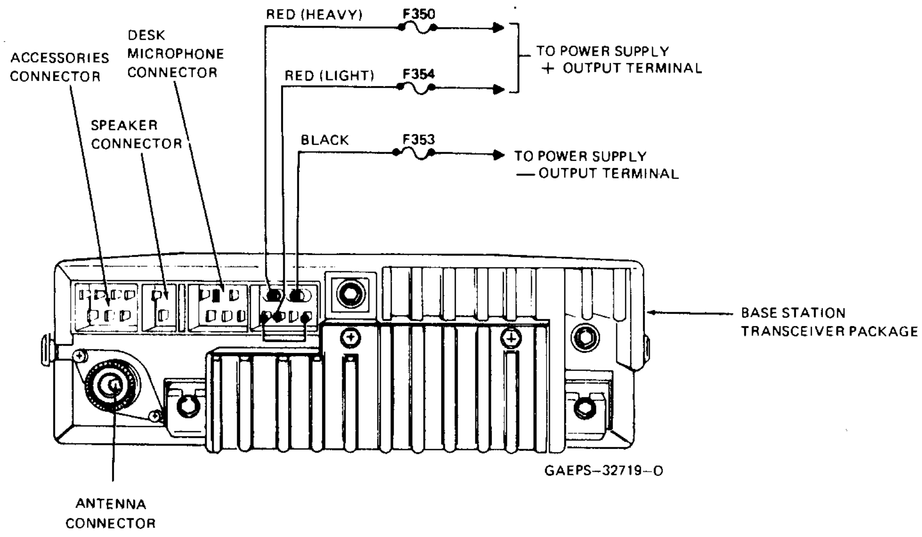


Figure 4. Power Lead Connections for Base Station Applications

INSTALLATION

MOTOROLA INC.
Communications
Sector

OPERATING INSTRUCTIONS

1. INTRODUCTION

The *DVP MCX100* FM Two-Way Radio is available in front-mount, remote-mount, and base station models.

2. CONTROLS AND INDICATORS

Figures 1, 2, and 3 show the various controls that are available on the *DVP MCX100* radio sets. Your particular radio may differ, depending on the model and options that have been ordered.

3. OPERATION

3.1 TO TURN RADIO SET ON

Turn the Off-on/Volume control clockwise until a click is heard. (In certain mobile installations, you may also be required to turn on the ignition switch of your vehicle.)

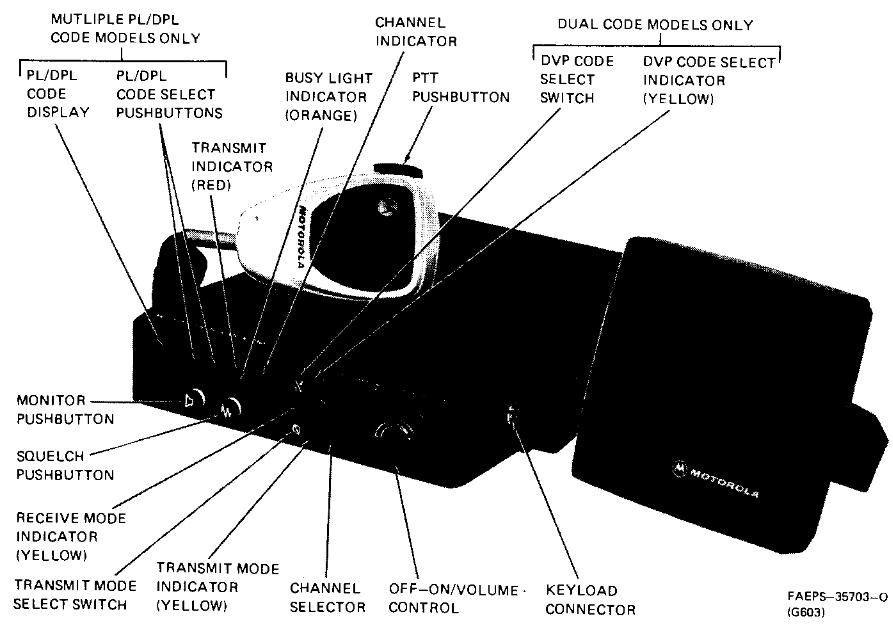


Figure 1. Front-Mount Radio Controls and Indicators (Typical)

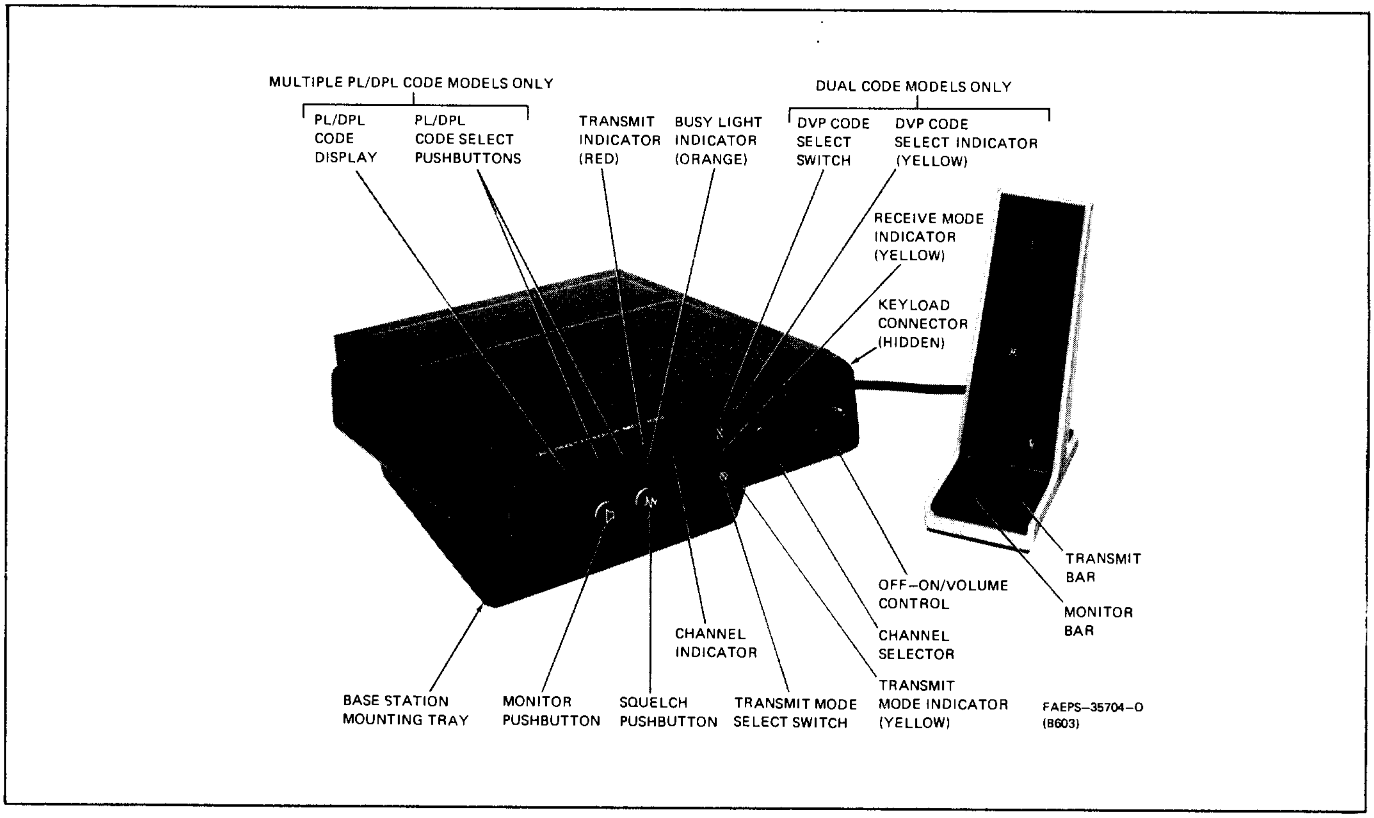
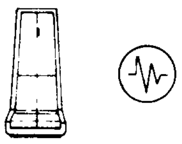


Figure 2. Base Station Radio Controls and Indicators (Typical)

PUSHBUTTON CONTROL SYMBOLS

Radio Type	**Base Station Models**	**Carrier Squelch Models**	***Private-Line* Squelch or *Digital Private-Line* Squelch Models**
Pushbutton Symbol			

3.2 TO RECEIVE

Use the following sequence to set the Off-on/Volume control of your radio to a comfortable listening level.

Step 1. Turn the Channel Selector to the desired channel as indicated by the Channel Indicator.

Step 2. Depress (push in) the Squelch and Monitor pushbuttons, depending on the model used (see Figures 1, 2, 3).

Step 3. Adjust the Off-on/Volume control until the background noise is at the desired level.

Step 4. After setting the volume level, push and release the pushbuttons to place them in the "out" position (white color showing). For a base station, you should release the Monitor pushbutton.

NOTE

When a private message is received, the Receive Mode Indicator should light and the speaker unmute. if the incoming message was encrypted with a key that is different from the radio key, noise will be heard from the speaker. In radios equipped with the Proper Code option, this noise will not be heard unless the microphone is off-hook or the Monitor pushbutton is depressed (pushed in).

3.3 TO TRANSMIT

NOTE

For mobile radios equipped with the ignition control of PTT option, the transmitter cannot be operated unless the vehicle ignition switch is turned on.

Step 1. Press the Transmit Mode Select switch to choose the private or standard mode. The Transmit Mode Indicator will light when the private mode is selected. On models with the Dual Code option, select the desired code for transmitting by pressing the *DVP* Code Select switch. The *DVP* Code Select Indicator will light when you have selected code 2.

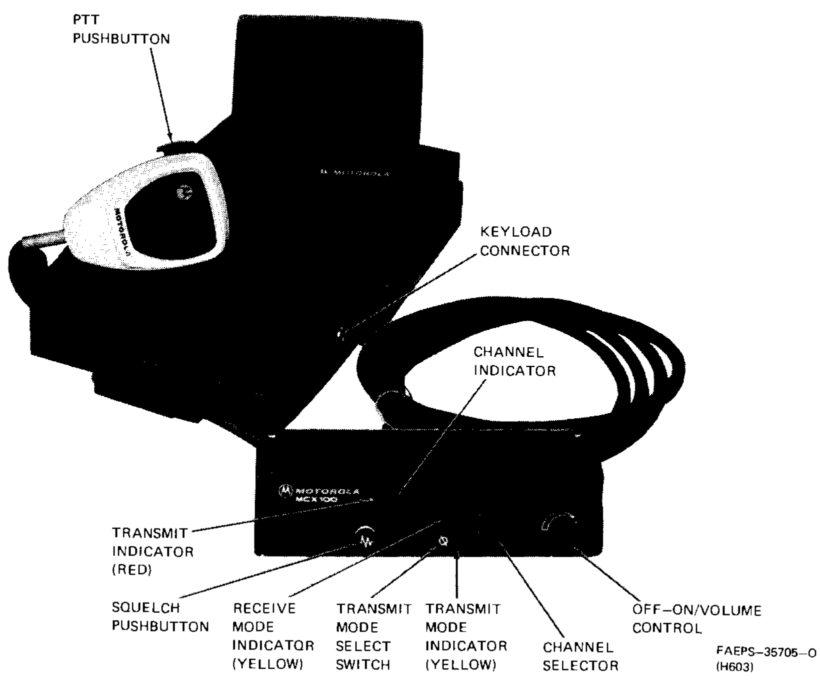


Figure 3. Remote-Mount Radio Controls and Indicators (Typical)

OPERATING INSTRUCTIONS

Step 2. Before starting transmission, monitor all traffic on the selected channel to ensure that it is not in use.

Step 3. To monitor on units with *Private-Line* and *Digital Private-Line* squelch, remove the mobile microphone from its hangup clip or depress the Monitor bar on the base station microphone. If the channel is clear, you may transmit your message.

Step 4. (For Single Tone models equipped with Call pushbutton only.) Before starting voice transmission, depress the Call pushbutton.

Step 5. Hold the microphone approximately 2 inches from your mouth, depress and hold the push-to-talk (PTT) pushbutton (or Transmit bar on base stations), and speak into the microphone. The Transmit Indicator lights. The transmitted audio will be either encrypted or non-encrypted, depending upon the mode setting. If the transmitted audio is non-encrypted, a short tone or "beep" will be heard immediately after the microphone is keyed. After finishing your message, release the PTT pushbutton to receive a reply.

Step 6. (Mobile units only.) After completing the call, place the microphone in the microphone hangup clip.

3.4 TO TURN RADIO SET OFF

Turn the Off-on/Volume control completely counterclockwise until a click is heard. (In certain mobile unit installations, the radio may also be turned off by turning off the vehicle ignition switch.)

4. ELECTRONIC ENCRYPTION KEY TRANSFER

Step 1. Turn the radio on and set the Off-on/Volume control to a comfortable listening level.

Step 2. Connect the cable from the Code Inserter to the Keyload Connector.

Step 3. Press the push-to-transfer switch on the side of the Code Inserter. The transfer is completed when a tone is heard from the speaker, and the message bEEP? appears on the Code Inserter display.

5. SELECTABLE SIGNALING OPTIONS

SELECTABLE *PRIVATE-LINE* (PL) OR *DIGITAL PRIVATE-LINE* (DPL) TONE-CODED SQUELCH OPTION (Applicable to *Private-Line* tone-coded or *Digital Private-Line* binary-coded squelch models only). Depending on the options ordered, the user may change the operating PL/DPL code (encode, decode, or both) of the radio set to permit its use in systems having different PL/DPL operating codes. The appropriate PL/DPL code is selected by using the PL/DPL Code Select pushbutton or pushbuttons and is indicated by the PL/DPL Code Display.

SELECTABLE SINGLE TONE ENCODER (Units with Single-Tone Encoder Option Only.) The Single Tone Select pushbutton is used to select the desired frequency of the encoder tone (10 tones are available). The Single Tone Display indicates the selected tone by means of a single digit (0 through 9). The encoder tone is transmitted with each activation of the Call pushbutton.

THEORY OF OPERATION

1. INTRODUCTION

1.1 This section describes the Theory of Operation of the *DVP MCX100* Radio Set. To help the serviceman more readily understand the discussion, the material is presented in three distinct levels: General Description, Functional Description, and Detailed Description.

- General Description — For ease of discussion, the circuits comprising the radio set are organized into seven functional groups. The General Description introduces the serviceman to these functional groups and gives a brief description of each. An accompanying block diagram outlines the functional groups, shows the relationship and signal flow between the groups, and the signal flow through the groups (where applicable).
- Functional Description — This description further details the operation of each functional group. A supporting functional block diagram accompanies each description to show the circuits, signals, and interconnections that go to make up the group.
- Detailed Description — The detailed description gives complete circuit descriptions for each functional group. In this description, the schematic diagrams in the diagrams section are used as references.

1.2 As an additional aid, an overall functional interconnection diagram of the radio set is provided in the manual.

2. GENERAL DESCRIPTION
(Refer to Figure 1)

2.1 The Front Mount Radio Set operates in the VHF frequency range of 136 to 174 MHz, and, depending on the model used, can provide rf power output of either 10 or 30 watts in systems employing minimum channel spacing of either 25 or 30 kHz. Models allowing use of up to 32 channels are available.

2.2 The seven functional groups that make up the *DVP MCX100* radio set are: receiver circuits, transmitter circuits, frequency synthesizer circuits, *DVP* (Digital Voice Protection) circuits, PL/DPL (*Private-Line/Digital Private-Line*) circuits, time-out timer circuits, and power distribution circuits. A brief description of each functional group is given in the following paragraphs.

2.3 RECEIVER CIRCUITS

2.3.1 The receiver circuits in the standard radio set use a single front end that utilizes FETs (field-effect transistors) for rf amplification, mixing, and i-f input stages for high sensitivity and low noise; crystal filters for i-f selectivity; and integrated circuits for amplication, limiting, and detection. The standard, single front end provides a receive bandwidth of 4 MHz.

2.3.2 An optional widespaced dual front end allows a total receive bandwidth of 12 MHz; it provides two 6 MHz "windows" which may be independently tuned anywhere within the 136 to 162 or 146 to 174 MHz bands. Tuning within each band is accomplished by two 6 MHz-wide tuneable helical filters. Selection of either the low range or high range 6 MHz filter is under the control of the frequency synthesizer circuits (front end select signal).

2.3.3 The receive rf from the antenna and the receive injection signal from the frequency synthesizer circuits are mixed in the single front end (or optional widespaced dual front end) to produce the 21.4 MHz i-f frequency. The i-f signal is amplified, filtered, and applied to a limiter/quadrature detector to recover the audio from the frequency-modulated carrier. The recovered audio is processed by low level audio and muting circuits. The receiver audio is then amplified by the audio amplifier and applied to the speaker.

2.3.4 The low level audio and muting circuits also process the sidetone/alert tone from the *DVP* circuits, the PL/DPL circuits (or optional time-out timer circuits) and the PL filtered audio (from the PL/DPL circuits). The audio muting circuits mute the receiver audio in response to control signals from the receiver squelch circuits (when no on-channel carrier is present); the transmitter circuits (when PTT is keyed); the frequency synthesizer circuits (when out-of-lock); the *DVP* circuits; or the PL/DPL circuits (when a valid tone-coded or binary-coded signal is not received). The *DVP* circuits, optional time-out timer circuit, or PL/DPL circuits can also gate audio to the speaker to allow insertion of sidetones or alert tones into the audio path.

2.3.5 The low level audio circuit also supplies an option receive audio signal to the *DVP* circuits for code detection and audio recovery. If the signal is not coded, the audio is routed either back to the low level audio circuits, or to the PL/DPL board (in radios so equipped) for tone decoding and filtering before being returned to the low level audio circuits. If the signal is coded, the *DVP* recovered audio is routed back to the low level audio circuits.

2.3.6 The squelch circuit incorporates a high-speed, variable closing-time constant that provides optimum squelch performance for both weak and strong signals. Pushing in the squelch pushbutton on the front panel defeats the carrier squelch circuits, unsquelching the receiver audio.

2.3.7 A front panel BUSY light is used in PL/DPL squelch or *Select 5* signaling models to indicate channel activity.

2.4 TRANSMITTER CIRCUITS

2.4.1 The transmitter circuits amplify the frequency-modulated low level rf output (transmit injection signal) from the frequency synthesizer circuits for radiation by the antenna. The transmit injection signal is applied to the low level amplifier (exciter), which supplies the rf drive for the 10 watt power amplifier. The final rf is applied through a harmonic filter/antenna switch to the antenna. In 30 watt models, the 10 watt power amplifier supplies the rf drive for the higher-powered amplifier.

2.4.2 A transmit power and level control circuit monitors the control voltage supplied by a directional coupler, located on the harmonic filter/antenna switch hybrid, to maintain the radiated rf output at a relatively constant level regardless of operating frequency, battery voltage, or temperature. A control circuit shuts down the transmitter if the synthesizer frequency goes out-of-lock (lock detect signal), or reduces output power to prevent damage to the rf final amplifier if a fault occurs in the antenna system.

2.4.3 PTT signals from the microphone, (which are processed by the *DVP* circuits, the PL/DPL circuits, or the optional time-out timer circuits, if present) are applied to a PTT logic circuit to control transmitter keying. A transmitter audio/IDC (instantaneous deviation control) circuit processes the microphone audio to produce the IDC audio. The microphone audio is also pre-emphasized in the transmit audio/IDC circuitry. If the radio is transmitting in the private mode, this audio is digitized and then encrypted by the *DVP* circuits. The encrypted bits are then used to modulate the VCO (voltage controlled oscillator), and the 14.4 MHz reference oscillator in the frequency synthesizer. If the radio is transmitting in the clear mode, the IDC audio directly modulates the VCO. In DPL radios, the PL/DPL circuits also generate a reference modulation signal which modulates the 14.4 MHz reference oscillator. By modulating the reference oscillator, the low frequency modulation capability of the radio is extended nearly to dc, a requirement for both *DVP* and DPL.

2.5 FREQUENCY SYNTHESIZER CIRCUITS

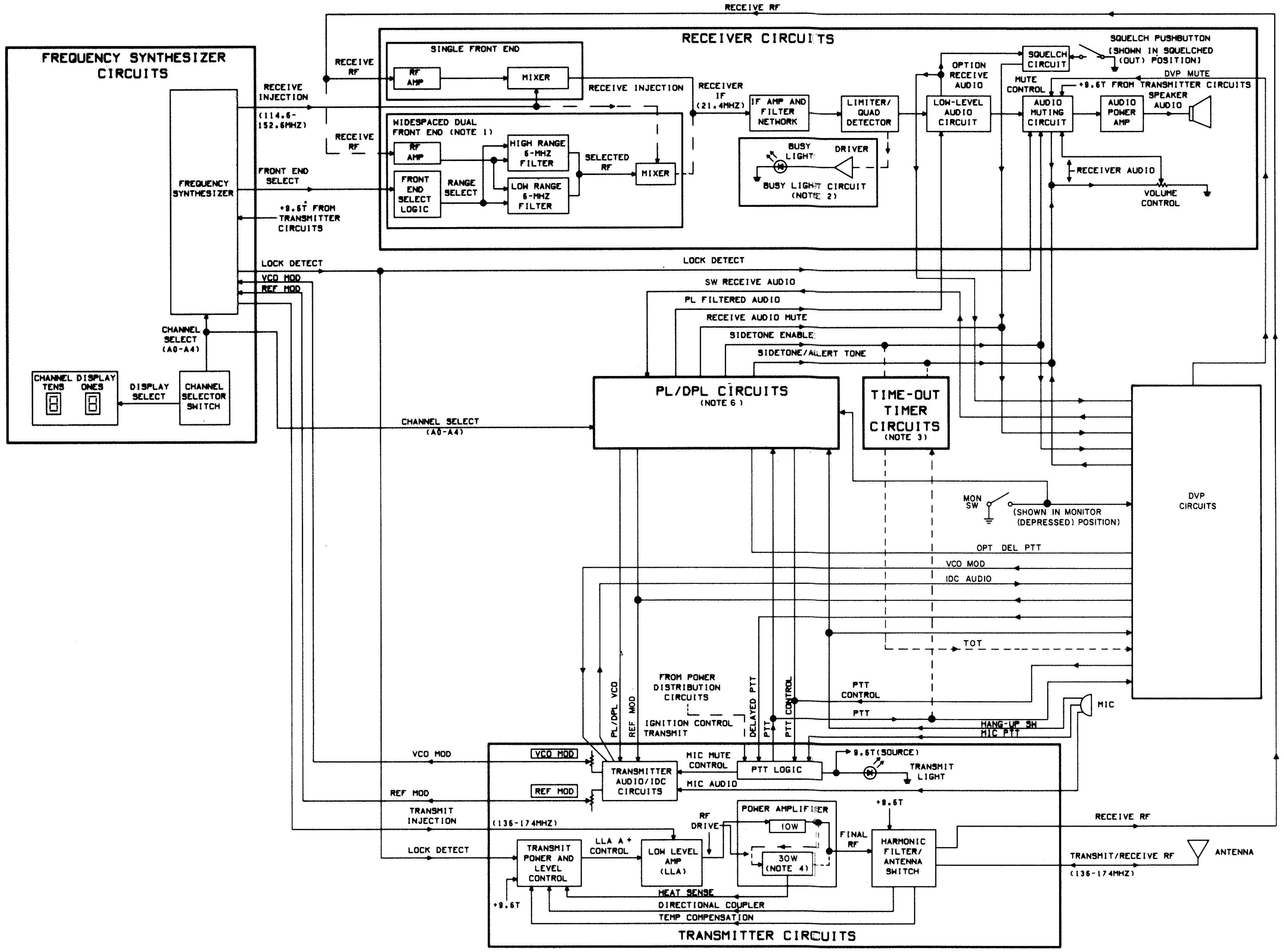
2.5.1 The frequency synthesizer circuits generate the low side receive injection frequency and the transmit injection signal. In the receive mode, the frequency synthesizer locks on a frequency that is 21.4 MHz (i-f frequency) lower than the desired receive frequency. In the transmit mode, the frequency synthesizer locks on the transmit output frequency. The frequency synthesizer is set to the transmit mode by the +9.6T keying voltage generated by the transmitter circuits.

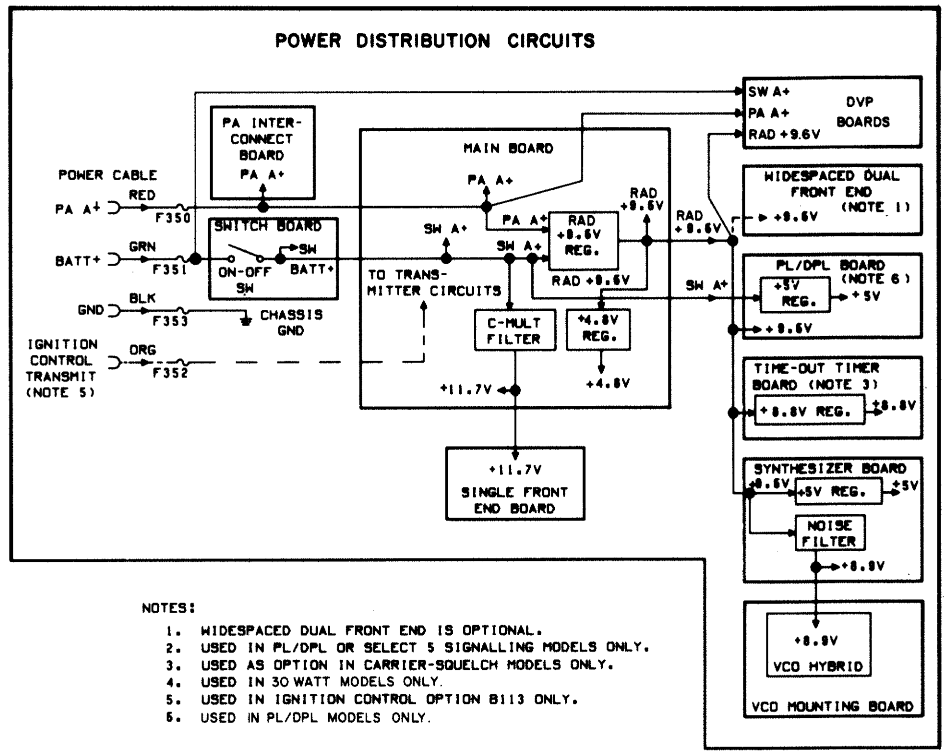
2.5.2 The frequency synthesizer employs a phase-locked-loop that maintains a constant VCO frequency (limited only by the frequency stability of the 14.4 MHz reference oscillator). Logic circuitry controls the operating frequency of the phase-locked VCO. Frequency select data from the front panel channel selector switch is applied to a plug-in PROM (programmable read-only memory) module. The PROM is factory-programmed or field-programmed with customer-specified data that determines the transmit and receive frequencies for each position of the channel selector switch. Channels can be added or changed by simply changing the PROM.

2.6 *DVP* CIRCUITS

2.6.1 The Digital Voice Protection (*DVP*) circuitry interfaces with the radio's audio circuits to add a high security scrambled voice mode. Microphone audio is digitized, transformed into cipher, and applied to the transmitter circuits. Similarly, received cipher is transformed into audio and applied to the speaker. Logic circuits and audio switches allow operation in either the private (coded) mode or the standard (clear) mode.

2.6.2 The private mode employs a digital non-linear coding scheme. Microphone audio is digitized by a Continuously Variable Slope Delta modulator (CVSD) whose output is applied to a non-linear digital





NOTES:
1. WIDESPACED DUAL FRONT END IS OPTIONAL.
2. USED IN PL/DPL OR SELECT 5 SIGNALLING MODELS ONLY.
3. USED AS OPTION IN CARRIER-SQUELCH MODELS ONLY.
4. USED IN 30 WATT MODELS ONLY.
5. USED IN IGNITION CONTROL OPTION 8113 ONLY.
6. USED IN PL/DPL MODELS ONLY.

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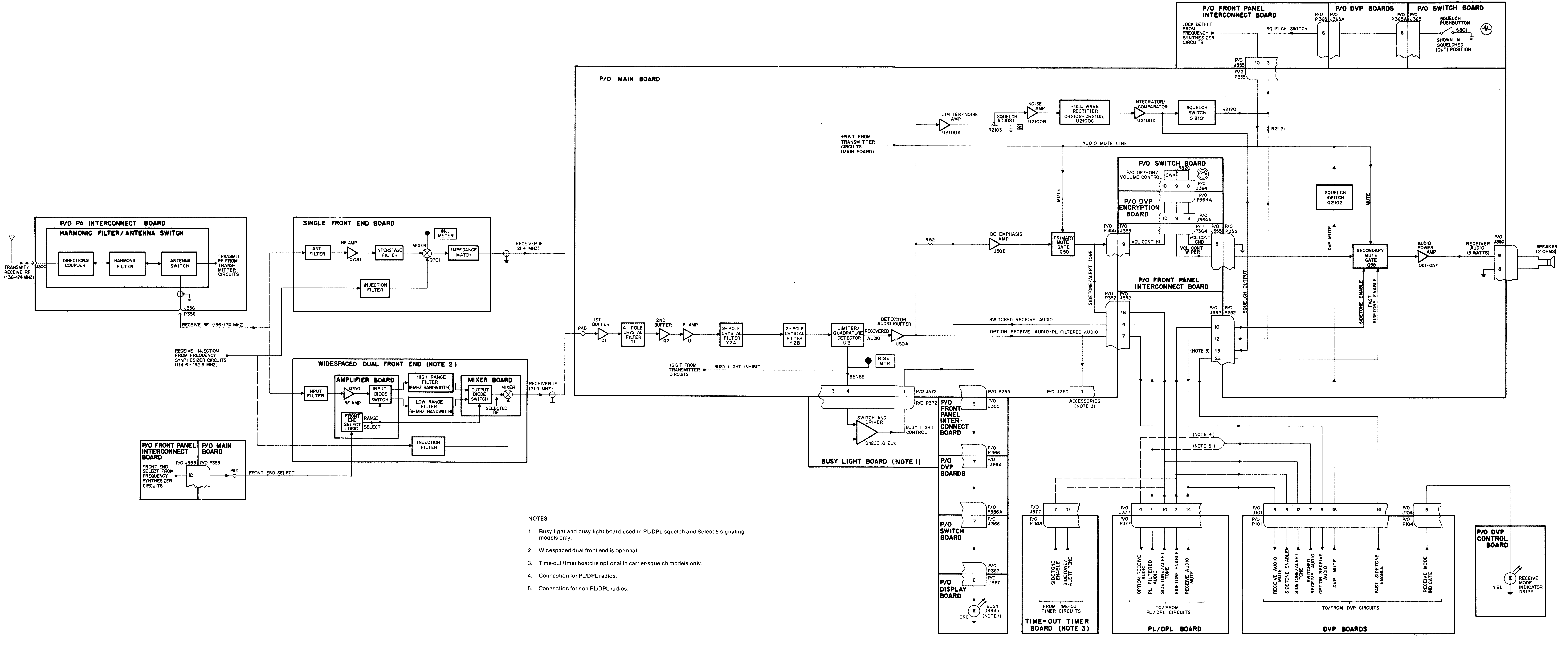
Figure 1. DVP MCX100 Front Mount Radio Set, Functional Block Diagram



NOTES:

1. Busy light and busy light board used in PL/DPL squelch and Select 5 signaling models only.
2. Widespaced dual front end is optional.
3. Time-out timer board is optional in carrier-squelch models only.
4. Connection for PL/DPL radios.
5. Connection for non-PL/DPL radios.

Figure 2. Receiver Circuits, Functional Block Diagram

encryption circuit. The encrypted data is then filtered and used to modulate the synthesizer. In the receive mode, cipher from the discriminator is applied to a decoder whose digital output is converted to an analog signal by the CVSD. A filter shapes the received audio before it is applied to the speaker amplifier circuit.

2.6.3 All Motorola *DVP* system components (base stations, mobiles, and portables) utilize a self synchronizing non-linear digital voice scrambling scheme with a capacity for 2.36×10^{21} unique orthogonal codes. Once loaded the chosen code is internally stored and completely unreadable. A single electronic key inserter (with appropriate interconnect cable) allows easy code insertion on any desired schedule. Selection of either private or standard transmissions may be made at the front panel by the operator.

2.6.4 Additional features are included to ensure operator convenience and flexibility.

- Fully automatic selection and front panel indication of private receive mode.
- Audible alert to remind the operator that he is initiating a standard transmission.

2.6.5 Optional functions are also available to expand the radio's capabilities. These are dual code capability and proper code detect circuitry.

2.7 PL/DPL CIRCUITS

2.7.1 The PL/DPL circuits encode (during transmit) and decode (during receive) the sub-audible *Private-Line* and *Digital Private-Line* squelch signals for compatibly-equipped radios. The *Private-Line* or *Digital Private-Line* coded squelch information is programmed into a code plug (used in single-code PL/DPL configurations), or a personality ROM (read-only-memory) used in multiple-code PL/DPL configurations. The *Private-Line* squelch eliminates annoying co-channel message reception by accepting only those signals with the proper, predetermined tone code. The *Digital Private-Line* squelch allows only those calls that use the proper system code to be heard. A front panel Monitor pushbutton, when pushed in, defeats the PL/DPL decoder circuits, allowing all activity on the channel to be monitored. The PL/DPL decoder circuits are also automatically defeated when the microphone is removed from its hang-up clip.

2.7.2 The PL/DPL circuits are controlled by a microcomputer which accomplishes all tone (or code) generation and detection digitally, eliminating all mechanical reed assemblies. The circuits also incorporate a time-out timer function that unkeys the transmitter after a predetermined interval. This prevents accidental (or intentional) repeater lock-up, or tying up a channel by prolonged transmitter keying. A sidetone/alert tone, audible in the speaker, warns the operator that the timer is shutting off the transmitter. The timer is reset instantly when the PTT button on the microphone is released.

2.8 TIME-OUT TIMER CIRCUITS

The time-out timer circuits are an option used in carrier squelch models. The circuits perform the same function as the time-out timer previously described in the PL/DPL circuit description.

2.9 POWER DISTRIBUTION CIRCUITS

The power distribution circuits supply and distribute all the necessary dc power required to operate the radio set. The radio set is designed for use in 12 V dc negative ground systems only. Power inverters are available for use in systems having different voltages or polarity. Input power is applied to the radio set via a three-wire fused power cable. A fourth fused wire is connected to the vehicle ignition switch in radios employing ignition control option B113. The Off-on/Volume switch on the front panel controls the application of power to the radio set.

3. FUNCTIONAL DESCRIPTION

3.1 RECEIVER CIRCUITS
(Refer to Figure 2)

The receiver circuits are functionally arranged into the single front end, the optional widespaced dual front end, and the main board receiver circuits.

3.1.1 Single Front End

The standard single front end is located on the single front end board. The single front end generates the receiver i-f signal using the receiver rf signal from the antenna switch in the transmitter circuits and the receiver injection signal from the frequency synthesizer circuits. The receiver rf is filtered by an antenna filter, amplified by rf amplifier Q700, filtered again by an interstage filter, and finally applied to mixer Q701. The receiver injection signal is also applied to the mixer, via an injection filter. The mixer combines the two signals to produce the 21.4 MHz receiver i-f signal which is applied through an impedance matching network to the receiver circuits on the main board.

3.1.2 Widespaced Dual Front End

3.1.2.1 The optional widespaced dual front end is housed in a metal casting that is mounted to the main board. Except for the helical filters, circuit components are mounted on an amplifier board and a mixer board, located inside the casting. The widespaced dual front end provides extended frequency coverage by switching the receiver rf between two, 6 MHz-wide, tuneable helical filters. Each filter can be tuned to any desired 6 MHz-wide frequency band within the frequency range of the radio. Switching between ranges is controlled by the front end select signal supplied by frequency synthesizer circuits. As in the single front end, the widespaced dual front end generates the receiver i-f signal using the receiver rf signal from the antenna switch in the transmitter circuits and the receiver injection signal from the frequency synthesizer circuits. The receiver rf is filtered by an input filter, amplified by rf amplifier Q750, and applied to an input diode switch. The input diode switch, together with an output diode switch, determine which rf frequency range is selected.

3.1.2.2 Frequency range selection is determined by the logic state of the front end select signal applied to the front end logic circuit. When the front end select signal is high, the front end logic circuit switches the input and output diode switches to a high-range condition. This routes the output from the rf amplifier through the high range filter to the mixer. When the front end select signal is low, amplified rf is switched to the mixer via the low range filter. Also applied to the mixer, via an injection filter, is the receiver injection signal. The mixer combines the two signals to produce the 21.4 MHz receiver i-f signal that is applied to the receiver circuits on the main board.

3.1.3 Main Board Receiver Circuits

The remainder of the receiver circuits are located on the main board and are functionally arranged into the following circuits: an i-f circuit, a limiter/quadrature detector, a low-level audio circuit, a audio muting circuit, an audio power amplifier, and a squelch circuit. Additionally, in PL/DPL squelch or *Select 5* signaling models, a busy light circuit is included.

3.1.3.1 I-F Circuit

The i-f circuit consists of two buffers, an i-f amplifier, and a series of crystal filters cut to a fundamental frequency of 21.4 MHz. The receiver i-f signal from the single front end (or the optional widespaced dual front end) is applied through first buffer Q1 to four-pole crystal filter Y1. The filtered i-f output from Y1 is buffered again by Q2, amplified by U1, and further filtered by two-pole crystal filters Y2A and Y2B. The amplified and filtered i-f output from Y2B is applied to limiter/quadrature detector U2.

3.1.3.2 Limiter/Quadrature Detector U2

Limiter/quadrature detector U2 is an integrated circuit that recovers the audio from the frequency-modulated carrier. The limiter/quadrature detector buffers the recovered audio and applies it to the low-level audio circuit. In PL/DPL or *Select 5* signaling models, it also supplies a sense signal to the busy light circuit to control the busy light on the front panel.

3.1.3.3 Low-Level Audio Circuit

The low-level audio circuit consists of detector audio buffer U50A and de-emphasis amplifier U50B. The recovered audio from the limiter/quadrature detector is applied through U50A to U50B. The recovered audio from U50A is also applied as the optional receive audio to the *DVP* circuits, and to accessories connector J350-1. If this is a *DVP* signal, the re-constructed audio is switched back into the low level audio path. If it is not a *DVP* signal, then it is routed, unchanged, back into the low level audio path. If the radio is equipped with PL/DPL the audio is then routed to the PL/DPL board. The PL/DPL circuits, in turn, inject the PL filtered audio signal into the recovered audio path between U50A and U50B. The recovered audio is amplified and de-emphasized by U50B and is applied to primary mute gate Q50 in the audio muting circuit.

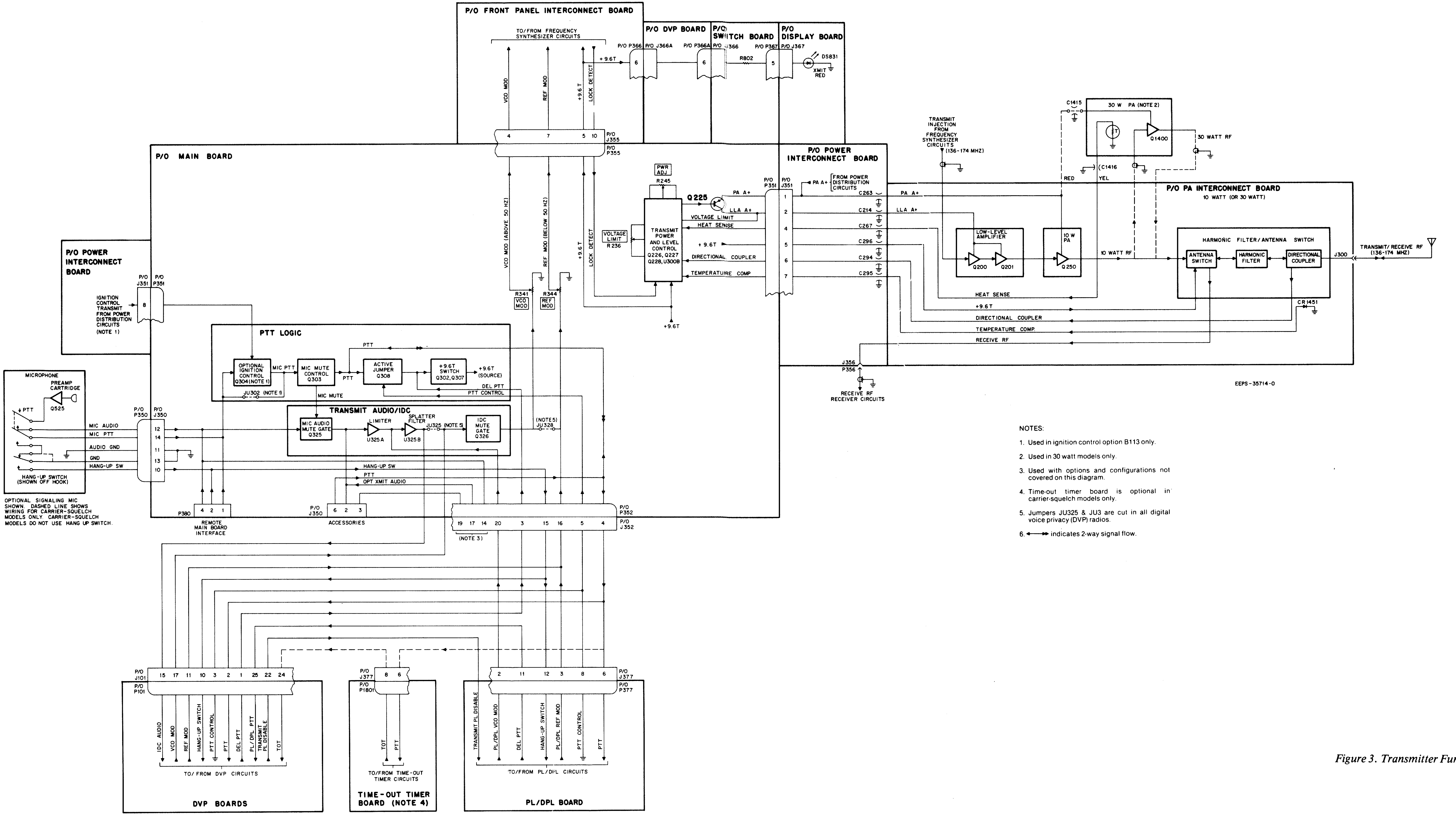
3.1.3.4 Audio Muting Circuit

3.1.3.4.1 Primary mute gate Q50 and secondary mute gate Q58 form the audio muting circuit. Audio inputs to the circuit are the recovered audio from the low-level audio circuit and the sidetone/alert tone from the *DVP* or PL/DPL circuits (or the time-out timer or *Select 5* signaling circuits). The sidetone/alert tone is inserted into the circuit, via the volume control, which is between Q50 and Q58.

3.1.3.4.2 The audio muting circuit gates the receiver audio on and off in response to four signals:

- the high lock detector (VCO lock) signal from the frequency synthesizer circuits;
- the +9.6T keying voltage from the transmitter PTT logic circuit;
- the sidetone enable signal from the *DVP*, PL/DPL, time-out timer, or *Select 5* circuits;
- the *DVP* mute signal which is a combination of *DVP* muting functions and the receive audio mute signal from the PL/DPL or *Select 5* circuits, and the squelch signal developed by the receiver squelch circuit.

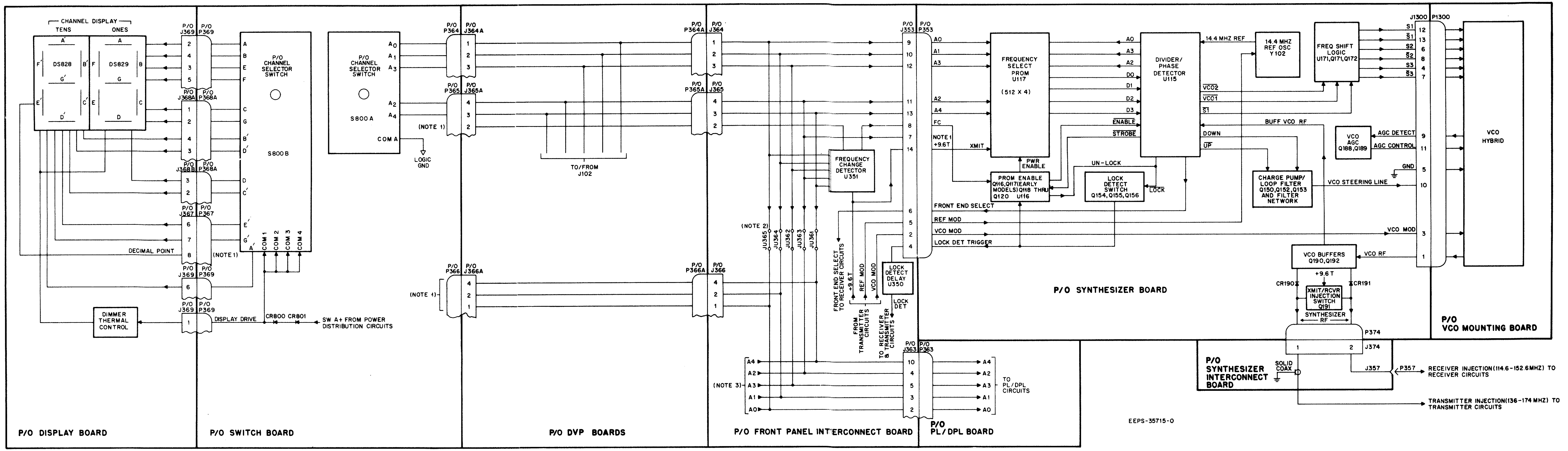
3.1.3.4.3 When no mute signal is applied to the audio mute line, series mute gate Q50 is on and shunt mute gate Q58 is off. This allows receiver audio from the low-level audio circuit to be applied through the volume control to the audio power amplifier. If the audio mute line is driven high, the audio is muted. This occurs when the synthesizer frequency is out-of-lock, the transmitter is keyed, the *DVP* circuitry has not detected a coded message, the PL/DPL circuit (or *Select 5* signaling circuits) have not decoded a correct signal, or the receiver quieting level is insufficient to open the squelch circuit.



NOTES:

1. Used in ignition control option B113 only.
2. Used in 30 watt models only.
3. Used with options and configurations not covered on this diagram.
4. Time-out timer board is optional in carrier-squelch models only.
5. Jumpers JU325 & JU3 are cut in all digital voice privacy (DVP) radios.
6. ←→ indicates 2-way signal flow.

Figure 3. Transmitter Functional Diagram



NOTES:

1. Used with options and configurations not covered on this diagram.
2. Jumper JU361 used for multi-PL/DPL models only. Jumpers JU361-JU365 are removed in selectable PL/DPL option only.
3. In selectable PL/DPL option only, channel select address A0-A4 initiated by selectable PL/DPL board.

Figure 4. Frequency Synthesizer Functional Diagram

3.1.3.4.4 To allow the sidetone/alert tone to be inserted into the audio path when the recovered audio is muted, the sidetone enable signal is activated (goes low). This allows the sidetone/alert tone to be routed through the volume control to the audio power amplifier.

3.1.3.5 Audio Power Amplifier

The audio power amplifier consists of transistors Q51 through Q57. It supplies up to five watts of audio power to the speaker. A discrete design is used for low noise, high alternator whine rejection, and maximum possible audio output swing.

3.1.3.6 Squelch Circuit

3.1.3.6.1 The squelch circuit consists of four operational amplifiers, a full-wave rectifier, two squelch switch transistors, a variable time-constant stage, and the front panel squelch pushbutton. The recovered audio output from detector buffer U50A in the low-level audio circuit is applied to audio-captured limiter/noise amplifier U2100A. The output from U2100A is applied through SQ (squelch adjust) potentiometer R2103 (which adjusts the noise quieting level at which the squelch operates) to a second amplifier, U2100B. The amplified output from U2100B is detected by a full-wave rectifier to produce an average dc voltage at the output of the third amplifier, U2100C. The output voltage at U2100C is proportional to the receiver quieting level. This dc quieting level voltage is then compared to a fixed dc reference voltage by integrator/comparator U2100D. When the quieting level dc voltage is below the reference voltage (carrier signal absent), U2100D turns on squelch switch Q2101. This drives the receive audio mute line high. The receive audio mute line goes to the *DVP* board which then outputs a high on the *DVP* mute line. This turns on squelch buffer Q2102 which mutes the receiver. When the quieting level rises above the reference voltage (carrier signal present), squelch switch Q2101 and Q2102 turns off, putting a low on the receive audio mute line. This signal then goes to the *DVP* board, which puts a low on the *DVP* mute line, turning off Q2102 and unmuting the receiver. If the squelch pushbutton is pushed in (unsquelch position) the output at current driver Q2101 is grounded, preventing the squelch signal going to the *DVP* board from indicating a squelch condition, regardless of the noise quieting level.

3.1.3.6.2 The receive audio mute signal is also controlled by the PL/DPL (or *Select 5*) circuits. When a proper PL/DPL code is not received the receive audio mute signal goes high, causing the *DVP* board to put a high on the *DVP* mute line, muting the radio. When a valid PL/DPL code is detected, the PL/DPL circuits provide an active low on the receive audio mute line. This causes the *DVP* board to unmute the radio. The PL/DPL circuitry can prevent Q2101 from muting the receive audio, even though the level of noise quieting is below the squelch circuit opening threshold.

3.1.3.6.3 Variable time constant stage Q2100 (not shown in block diagram) provides a high speed closing time constant for strong signals, eliminating the noise bursts normally heard at the end of a transmission. The time constant increases during very weak signal conditions to eliminate the chatter that is often heard when signals fade. The variable time constant is controlled by the dc quieting level voltage from U2100C.

3.1.3.7 Busy Light Circuit

The busy light circuit controls the lighting of the front panel busy light in PL/DPL squelch or *Select 5* signaling models. The circuit is contained on the busy light board, which is mounted on the main board. The circuit consists of level detector Q1200 and driver Q1201, and uses the sense signal developed by limiter/quadrature detector U2, and the squelch output from U2100D to light the busy light, indicating channel activity.

3.2 TRANSMITTER CIRCUITS (Refer to Figure 3)

3.2.1 Circuit Boards

3.2.1.1 The transmitter circuits are arranged into functional groups that are mounted on the main board and the PA interconnect board. Two PA interconnect boards can be used, depending on the transmitter power output. In 10 watt models, a 10 watt PA interconnect board is used. In 30 watt models, a 30 watt interconnect board is used.

3.2.1.2 The main board contains part of the PTT logic circuit, the transmit audio/IDC (instantaneous deviation control) circuit, and the transmit power level and control circuit. The 10 watt PA interconnect board contains the low level amplifier, the 10 watt power amplifier, and the harmonic filter/antenna switch. The 30 watt PA interconnect board contains the same three functional groups just mentioned; in addition, the 30 watt power amplifier, mounted in the external heat sink, is added. In this high-power version, the 10 watt power amplifier drives the 30 watt power amplifier.

3.2.2 PTT Logic Circuit

3.2.2.1 The PTT logic circuit supplies the +9.6T keying voltage to the transmitter and mutes the microphone audio during receive and unmutes the audio during transmit. The 9.6T keying voltage also switches the frequency synthesizer circuits to the transmit mode, mutes the receiver audio circuits, and lights the transmit indicator on the front panel to indicate that the radio set is transmitting.

3.2.2.2 The PTT logic circuit can be controlled from any of several sources:

- the microphone,
- the *DVP* circuits,
- the PL/DPL circuits,
- the time-out timer circuits (used as an option in carrier squelch models only),
- the vehicle ignition switch (with ignition control option B113 only),
- and external accessories connected at the rear of the radio, using J350 pins 1 through 7.

Mic audio transmissions are inhibited while a PTT is being generated by a *Select 5* signaling option or externally connected accessory. This prevents microphone noise from being inserted into the transmitter audio path when data (or optional *Select 5* signaling) transmissions are being made.

3.2.2.3 Pressing the push-to-talk button on the microphone supplies a mic PTT signal (via J350-14 in front-mount radios, or via P380-1 in remote mount radios), through jumper JU302, to mic mute control stage Q303. This enables Q303, which activates in turn, two signals. One signal is the mic mute enabling signal which is routed to mic audio mute gate Q325 in the transmit audio/IDC circuit. The gate allows microphone audio to be applied to the transmitter audio circuits. The second signal is the PTT enabling signal that tells the *DVP*, PL/DPL and time-out timer circuits that the radio is being keyed. The *DVP* board will then pull the delayed PTT line low. This is the signal which actually enables the +9.6T switches Q302 and Q307. When these switches are enabled, the +9.6T keying voltage is generated.

3.2.2.4 In radios having the ignition control option, jumper JU302 is cut and Q304 is added, allowing the vehicle switched ignition voltage to control the PTT logic circuit, via ignition control stage Q304. Ignition voltage is supplied to the radio via an additional (orange) wire.

3.2.3 Transmit Audio/IDC Circuit

3.2.3.1 The transmit audio/IDC circuit processes the microphone audio to ensure that the proper level of audio drive is supplied to the VCO hybrid in the frequency synthesizer circuits. When the radio is transmitting clear mode, the IDC audio directly modulates the VCO. In PL/DPL radios the low frequency PL/DPL encode (tone) signal from the PL/DPL circuits is combined with the microphone audio and is routed, via IDC deviation control and compensation circuits, to the VCO hybrid. A second modulation signal is routed to the 14.4 MHz reference oscillator in the frequency synthesizer to obtain low frequency transmit response. When the radio is transmitting in private mode, the IDC audio is routed to the *DVP* board, and converted to a digital signal which is then encrypted. This signal is splatter filtered and then modulates both the VCO and the 14.4 MHz reference oscillator.

3.2.3.2 Microphone audio is applied to mic mute gate Q325, via connector P350-12 in front mount radios, or via connector J380-4 in remote mount radios. The mic mute gate applies the audio to limiter U325A, via a pre-emphasis network. Transmit audio from options or accessories can also be injected into the input path of U325A, without pre-emphasis, via connectors J350-2 or P352-17. The output from U325A is applied to the input of splatter filter U325B. Inserted into this audio path is the PL/DPL VCO-modulation tone input from the PL/DPL circuits.

3.2.3.3 The output from the splatter filter is sent to the *DVP* board. If the radio is transmitting in clear mode, the audio is routed back to IDC mute gate Q326, which is open in the receive mode. The deviation level of the clear mode transmit audio is adjusted by VCO MOD potentiometer R341. The IDC audio then continues to the frequency synthesizer circuits to drive the VCO hybrid. If the radio is transmitting in private mode, the IDC audio is converted by U103 (on the *DVP* board) to a digital waveform. This digital waveform is then encrypted by HY101 and splatter filtered by U102. The deviation level of the transmitted *DVP* data is adjusted by potentiometer R158. From R158 the *DVP* data is sent back into the transmit path at IDC mute gate Q326, and from there on to the frequency synthesizer VCO hybrid. The VCO allows transmissions which carry information above 50 Hz.

3.2.3.4 Both *DVP* and DPL signals modulate the 14.4 MHz reference oscillator. The reference oscillator allows transmissions which carry information below 50 Hz. The level of the DPL modulation signal is adjusted by potentiometer R344 before being routed to the reference oscillator. The level of the *DVP* modulation signal is adjusted by potentiometer R159 on the *DVP* board. The *DVP* signal then gets routed to the reference oscillator.

3.2.4 Transmit Power and Level Control Circuit

3.2.4.1 The control circuit provides power leveling and protection for the final power amplifier circuits in the transmitter. The circuit acts as a control loop to protect the power amplifier against possible damage due to excessive temperature (in 30 watt models) or excessive reflected rf output power. If a possible excessive temperature condition should occur, or if the rf output power exceeds a preset level, or if excessive antenna mismatch is present, the circuit reduces the gain of the low level amplifier, hence the rf drive level to the final power amplifier. The circuit also disables the rf drive (by removing the LLA A+ source voltage) if the frequency synthesizer goes out-of-lock. Short circuit protection removes the LLA voltage if a short circuit occurs on the LLA A+ line.

3.2.4.2 The transmit power and level control circuit consists of transistors Q225, Q226, Q227, Q228, and differential amplifier U300B. The temperature sensing signals supplied to the control circuit are the temperature compensation and heat sense monitoring signals. The temperature compensation monitoring signal is developed by negative-coefficient diode CR1451, mounted near the directional coupler. The heat sense signal is developed by a thermistor located in the 30 watt power amplifier only. The rf output power is monitored at the directional coupler. The directional coupler signal is a dc voltage that represents the weighted sum of the forward and reflected power. If any of these signals indicate a fault, the voltage variation on the directional coupler signal line is compared by differential amplifier U300B to a fixed dc reference. The amplifier then causes the control circuit to reduce the LLA A+ voltage, hence the rf output power, until the fault is stabilized. PWR ADJ potentiometer R245 presets the rf output level by setting a dc reference voltage for the differential amplifier. Voltage limit potentiometer R236 sets an upper limit on the LLA A+ voltage available to the LLA, to prevent damage to the 10 watt PA due to overdrive from the LLA.

3.2.5 Low Level Amplifier

The low level amplifier is a two-stage, non-linear amplifier that supplies the rf drive for the 10 watt power amplifier. The input to the low level amplifier is the 136 to 174 MHz transmit injection signal from the frequency synthesizer circuits. The signal is amplified by amplifiers Q200 and Q201 to produce the rf drive output. The gain of the amplifiers is controlled by the LLA A+ operating voltage supplied and regulated by the transmit power level and control circuit. By controlling the gain, hence the rf drive, the rf output power is maintained within prescribed limits.

3.2.6 10 Watt Power Amplifier

The 10 watt power amplifier consists of a single, non-linear stage Q250 that supplies the final rf output for low power transmitters. Operating power for the amplifier is the PA A+ voltage supplied by the power distribution circuits. The rf output from the power amplifier is applied to the input of the harmonic filter/antenna switch. In models using the 30 watt power amplifier, the rf output serves as the final rf drive for the high power amplifier.

3.2.7 30 Watt Power Amplifier

This power amplifier provides the final rf output for high power transmitters. The amplifier consists of a single, non-linear stage, Q1400. The PA A+ voltage is supplied by the power distribution circuits. Temperature protection is provided by a thermistor located near the amplifier. A temperature in excess of 120°C, monitored by the heat sense signal, causes the power level and control circuit to reduce the rf output power to bring the temperature within safe limits. The final rf output from the amplifier is applied to the harmonic filter/antenna switch.

3.2.8 Harmonic Filter/Antenna Switch

3.2.8.1 The harmonic filter/antenna switch attenuates harmonics of the assigned transmit frequency during transmit mode, and helps attenuate higher-frequency spurious responses of the receiver during receive mode. It also switches the antenna between the transmit signal path and receive signal path.

3.2.8.2 When the transmitter is in the transmit mode, the final rf output is routed through the transmit port of the antenna switch, the harmonic filter, and directional coupler to the antenna. In the receive mode, the receive rf from the antenna is directed through the directional coupler and harmonic filter to the receive port of the antenna switch. The receive rf is then routed to the front end of the receiver. The directional coupler signal monitors the forward versus reflected power allowing the transmit power level and control circuit to keep the rf output power level within the preset level.

3.3 STANDARD-LOCK FREQUENCY SYNTHESIZER CIRCUITS
(Refer to Figure 4)

The frequency synthesizer circuits are functionally arranged into the channel selection and display circuits, the synthesizer board circuits, and the VCO hybrid circuits.

3.3.1 Channel Selection and Display Circuits

3.3.1.1 The channel selection and display circuits consist of the front panel channel selector switch and the channel display. The channel selector switch is located on the switch board and the channel display is located on the display board. The channel display consists of two, seven-segment LED displays. A dimmer/thermal control circuit on the display board automatically adjusts the LED's intensity to suit ambient light conditions. The circuit is powered by the SW A+ voltage supplied by the power distribution circuits. The SW A+ voltage is applied to the dimmer/thermal control circuit via diodes CR800 and CR801 on the switch board.

3.3.1.2 The channel selector switch encodes the selected channel in five binary bits and supplies the data on address lines A0 through A4 to frequency select PROM U117 on the synthesizer board. The five address lines are also fed to the PL/DPL circuits for encoding the information on the selected channel for transmisison. In selectable PL/DPL options only, the encoded address data for the PL/DPL circuits is generated by a selectable PL/DPL board. In this option, jumpers JU361 through JU365 on the front panel interconnect board are removed to disconnect the channel selctor switch from the PL/DPL circuits.

3.3.2 Synthesizer Board Circuits

The synthesizer board circuits include nine circuits: a 14.4 MHz reference oscillator, frequency select PROM U117, divider/phase detector U115, a PROM enable circuit, a lock detect switch circuit, a charge pump and loop filter circuit, a frequency shift logic circuit, the VCO buffers and transmit/receive injection switch, and a VCO AGC circuit.

3.3.2.1 14.4 MHz Reference Oscillator

The 14.4 MHz reference oscillator is a high-accuracy, temperature compensated crystal reference oscillator. The output of the reference oscillator is applied to divider/phase detector U115 to generate the reference frequency used to control the VCO frequency. The reference modulation signal from the transmitter circuits modulate the oscillator.

3.3.2.2 Frequency Select PROM, U117

3.3.2.2.1 Frequency select PROM (programmable read-only memory) U117 is a plug-in memory device that stores information regarding transmit and receive frequencies as well as filter selection for dual front end. Changes in any of the parameters can easily be affected by simply replacing the PROM with another factory-programmed PROM having the required information.

3.3.2.2.2 Addressing for the PROM is applied on address lines A0 through A4 by the channel selector switch, and by the +9.6T keying voltage from the transmitter circuits. When the +9.6T keying voltage is high, the data transferred out of the PROM contains transmit frequency information. The data is applied to divider/phase detector U115 via a four-bit data bus, D0 through D3. The data for each channel consists of six 4-bit words. The PROM only applies the data to U115 when a power enable voltage (+5 V dc) is applied to the PROM by the PROM enable circuit.

3.3.2.3 Divider/Phase Detector U115

3.3.2.3.1 Divider/phase detector U115 contains the negative feedback, phase-locked-loop circuitry that controls the VCO frequency. The divider/phase detector contains a reference divider, a loop divider, and a phase detector. The reference dividier divides down in frequency the 14.4 MHz reference oscillator signal and applies it as the reference frequency input to the phase detector. The loop divider divides down (in frequency) the negative feedback input, which is the buffered VCO rf signal originating at the VCO in the VCO hybrid. This signal is applied as the loop frequency input to the phase detector. The phase detector compares the phase difference between the two frequencies and generates error pulses on the $\overline{\text{UP}}$ and DOWN output lines that are proportional to any phase difference. (Phase is used as the controlling variable since small phase errors may exist in the locked-loop but frequency errors cannot.) The $\overline{\text{UP}}$ and DOWN error pulses are applied, via the charge pump and loop filter circuit, to the VCO steering line (which controls the VCO frequency) to complete the feedback loop.

3.3.2.3.2 The action of the negative feedback loop can be explained as follows. If the output frequency goes high, the loop frequency output also goes high, thus causing a leading phase displacement on the phase detector loop input. Since the reference signal phase does not change, the phase detector detects this condition and cause the generation of error pulses on the DOWN line. This is reflected on the VCO steering line to cause a reduction in frequency, thus compensating for the original frequency difference. The divider/phase detector also supplies a monitoring $\overline{\text{LOCK}}$ signal to the lock detect switch to indicate if the synthesizer frequency is, or is not, locked onto the correct frequency.

3.3.2.3.3 The divider/phase detector also supplies data outputs $\overline{\text{S1}}$, $\overline{\text{VCO1}}$, and $\overline{\text{VCO2}}$ to the frequency shift logic circuit. These data lines are used to select the VCO band shift "window", which is the VCO sub-range frequency required by the selected operating frequency. The divider/phase detector also feeds a front end select signal to the optional widespaced dual front end in the receiver circuits. The front end select signal activates the correct frequency-range filter in the widespaced dual front end depending on the receive frequency of the selected channel.

3.3.2.4 PROM Enable Circuit

The PROM enable circuit and frequency change detector, consisting of ICs U116 and U351, allows divider/phase detector U115 to address the PROM. A pulse on the FC line from frequency change detector U351 on the front panel interconnect board causes the PROM to be addressed by U115. The PROM is addressed when any of the following occur.

- The transmitter is keyed (+9.6T at U351 causes FC pulse to occur).
- The frequency is changed (sensed by a change of state on any (A0-A4) address line applied to U351).
- The synthesizer goes out-of-lock (active lock detector output from lock detector switch circuit).

When one of these conditions occur, the PROM enable circuit applies an enable signal to U115, and U115 responds by returning a $\overline{\text{STROBE}}$ signal. The $\overline{\text{STROBE}}$ signal activates the PROM enable circuit, and the PROM enable circuit activates the PROM by applying +5 V dc operating power to its Vcc input. The PROM enable circuit also sends a synthesizer out-of-lock signal to the lock detect switch circuit. This ensures that the circuit develops an active lock detector output if only the transmitter is keyed or if the frequency is changed.

3.3.2.5 Lock Detect Switch Circuit

The lock detect switch circuit consists of transistors Q154, Q155, Q156 on the synthesizer board and of U350 and Q350 on the Front Panel Interconnect Board (identified as lock detect delay). The circuit generates an active lock detector output signal that disables the receiver (in the receive mode) or the transmitter (in the transmit mode) if the synthesizer frequency goes out-of-lock. The circuit disables the receiver (or transmitter) when an un-lock condition is sensed by divider/phase detector U115, or if the un-lock condition is forced by the PROM enable circuit.

3.3.2.6 Charge Pump and Loop Filter Circuit

The charge pump and loop filter circuit consists of transistors Q150, Q152, and Q153 and an associated filter network. The circuit changes the $\overline{\text{UP}}$ or DOWN error pulses from divider/phase detector U115 to a corresponding dc voltage. The dc voltage is then filtered to become the VCO steering line voltage used to control the frequency of the VCO. As part of the negative feedback phase-locked-loop, the charge pump and loop filter circuit control the closed-loop response and removes noise from the divider/phase detector output.

3.3.2.7 Frequency Shift Logic Circuit

The frequency shift logic circuit consists of transistors Q171 and Q172, and IC U171. The circuit controls the switching of the VCO to the sub-range frequencies at which it operates for a selected channel. These sub-range frequencies, or band shift "windows", are encoded in the PROM, read-out to divider/phase detector U115, applied from U115 on the $\overline{\text{S1}}$, $\overline{\text{VCO1}}$, and $\overline{\text{VCO2}}$ data lines, and are applied to the frequency shift logic circuit. The circuit then supplies six outputs to PIN (diode) switches in the VCO hybrid. Depending on the logic states of the six outputs (S1 and $\overline{\text{S1}}$; S2 and $\overline{\text{S2}}$; and S3 and $\overline{\text{S3}}$), the PIN diodes switch the VCO to the correct sub-range frequency.

3.3.2.8 VCO Buffers and Transmit/Receive Injection Switch

The VCO buffers consist of transistors Q190 and Q192. The transmit/receive switch consists of transistor Q191. The buffers receive the VCO rf feedback signal from the VCO. The buffered signal is applied to the loop divider in divider/phase detector U115 to generate the loop frequency used to control the VCO frequency. The buffers also feed the VCO rf feedback signal to either the transmit or receive injection ports on the synthesizer interconnect board. Transmission along either port is controlled by the +9.6T keying voltage applied to the transmit/receive injection switch. A high +9.6T keying voltage (transmit mode) causes the injection switch to forward bias diode CR190, routing the VCO rf to the transmit injection port at connector P344-1. From the port, the signal is fed, via a coaxial cable, to the low level amplifier in the transmitter. A low +9.6T keying voltage (receive mode) forward biases diode CR191, thus routing the VCO rf to the receive injection port at connector J357. From the port, the signal is fed as the receiver injection signal to the mixer in the receiver.

3.3.2.9 VCO AGC Circuit

The VCO AGC circuit consists of transistors Q188 and Q189. The circuit stabilizes the VCO gain by maintaining a constant rf level in the VCO tank circuit. A dc sample of the VCO rf output is applied to the VCO AGC circuit as the AGC detect signal. If the signal varies, the circuit feeds an AGC control signal back to the VCO tank circuit to maintain a constant VCO rf output.

3.4 *FAST-LOK* FREQUENCY SYNTHESIZER CIRCUITS (Refer to Figure 5.)

The frequency synthesizer circuits are functionally arranged into the channel selection and display circuits, the synthesizer board circuits, the VCO hybrid circuits and the synthesizer rf amplifier circuit.

3.4.1 Channel Selection and Display Circuits

The channel selection and display circuits used with the *Fast-Lok* synthesizer are the same as the circuits used with the standard lock synthesizer. Refer to the channel selection and display circuits paragraphs in the standard lock frequency synthesizer section.

3.4.2 Synthesizer Board Circuits

The synthesizer board circuits include eight circuits; a 14.4 MHz reference oscillator, frequency select PROM U116, divider U115, phase detector U140, an adaptive loop filter, a PROM enable circuit, a frequency shift logic circuit, and a VCO AGC circuit.

3.4.2.1 14.4 MHz Reference Oscillator

The 14.4 MHz reference oscillator U101 is a 2 ppm, temperature-compensated crystal oscillator. The output of the reference oscillator is applied to divider U115 to generate the reference frequency used to control the VCO frequency. The reference modulation signal from the transmitter circuits modulates the oscillator.

3.4.2.2 Frequency Select PROM, U116

3.4.2.2.1 Frequency select PROM (programmable read-only memory) U116 is a plug-in memory device that stores information regarding transmit and receive frequencies as well as filter selection for optional dual front end. Changes in any of the parameters can easily be affected by simply replacing the PROM with another factory-programmed PROM having the required information.

3.4.2.2.2 Addressing for the PROM is applied on address lines A0 through A4 by the channel selector switch, and by the 9.6T keying voltage from the transmitter circuits. When the 9.6T keying voltage is high, the data transferred out of the PROM contains transmit frequency information. The data is applied to divider/phase detector U115 via a four-bit data bus, D0 through D3. The data for each channel consists of six 4-bit words. The PROM only applies the data to U115 when a power enable voltage (+5 V dc) is applied to the PROM by the PROM enable circuit.

3.4.2.3 PROM Enable/Frequency Change Detector

The PROM enable circuit and frequency change detector, consisting of U116, U351, Q115, Q117 and Q118 allow divider U115 to address the PROM. A pulse on the FC line from frequency change detector U351 on the front panel interconnect board causes the PROM to be addressed by U115. The PROM is addressed when any of the following occur.

- The transmitter is keyed (+9.6T at U351 causes FC pulse to occur)
- The frequency is changed (sensed by a change of state on any (A0-A4) address line applied to U351).
- The synthesizer goes out-of-lock (sensed by phase detector U140 internal lock detect circuit).

When one of these conditions occur, phase detector $\overline{\text{ADAPT}}$ output U140-10 goes high. This applies an $\overline{\text{ENABLE}}$ signal to U115-28 via Q117, and U115 responds by returning a $\overline{\text{STROBE}}$ signal. The $\overline{\text{STROBE}}$ signal activates the PROM enable circuit, and the PROM enable circuit activates the PROM by applying +5 V dc operating power to its Vcc input.

3.4.2.4 Divider U115

3.4.2.4.1 The divider circuit contains two programmable dividers and control circuitry. The reference divider acts upon the 14.4 MHz reference oscillator input. This divider is set by the PROM input data to divide the input frequency down to a reference frequency of 4.167 kHz, 5.00 kHz, or 6.25 kHz. The loop divider is set by the PROM input data to divide the desired VCO feedback frequency down to the reference frequency. The loop (divided VCO) signal and the reference signal are then coupled to the phase detector circuit.

3.4.2.4.2 The divider also supplies data outputs $\overline{\text{SO}}$, $\overline{\text{VCO1}}$, and $\overline{\text{VCO2}}$ to the frequency shift logic circuit. The $\overline{\text{SO}}$ output is routed through a synchronizing "D" flip-flop on phase detector U140. These data lines are used to select the VCO band shift "window", which is the VCO sub-range frequency required by the selected operating frequency. The divider also feeds a front end select signal ($\overline{\text{S1}}$) to the optional widespaced dual front end in the receiver circuits. The front end select signal activates the correct frequency-range filter in the widespaced dual front end depending on the receive frequency of the selected channel.

3.4.2.5 Phase Detector U140

3.4.2.5.1 Phase detector U140 compares the reference and loop frequency outputs of the divider circuit and uses this information to generate a dc control signal that is coupled through the adaptive loop filter to tune the VCO.

3.4.2.5.2 The phase detector also monitors the status of the frequency change (FC) line (P353-8) and uses this information to generate the control signal for the adaptive loop filter. A "D" flip-flop (U140-11, 6) synchronizes the divider $\overline{\text{SO}}$ output to the rising edge of the loop (divided VCO) pulse.

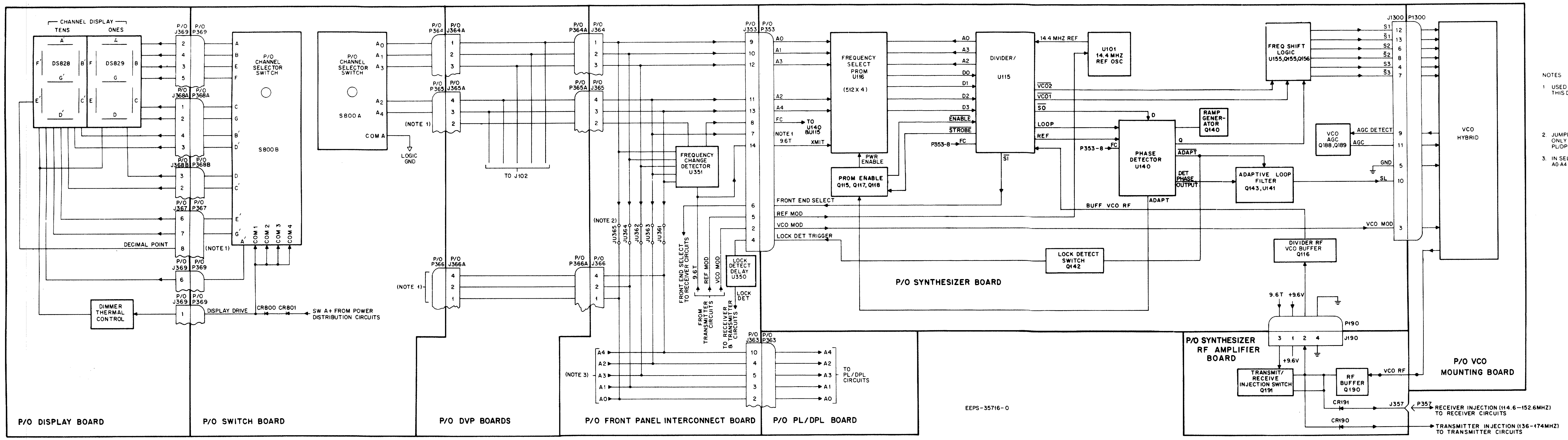
3.4.2.6 Adaptive Loop Filter

3.4.2.6.1 The adaptive loop filter is a low-pass filter in the steering line between the phase detector and the VCO. This filter removes noise and variations in the steering line level to prevent unwanted modulation of the VCO.

3.4.2.6.2 The adaptive loop filter, which is connected to the phase detector output line (U140-15), is controlled by the phase detector to operate in either of two modes, either the Adapt or the Receive/Transmit mode is selected depending upon the state of the synthesizer at a given time. The Receive/Transmit mode is selected for transmitting and receiving while the Adapt mode is entered during any period when the synthesizer changes frequency.

3.4.2.7 Frequency Shift Logic Circuit

The frequency shift logic circuit consists of transistors Q155 and Q156, and IC U155. The circuit controls the switching of the VCO to the sub-range frequencies at which it operates for a selected channel. These sub-range frequencies, or band shift "windows", are encoded in the PROM, read-out to divider U115, applied from U115 on the $\overline{\text{SO}}$, (via U140) $\overline{\text{VCO1}}$, and $\overline{\text{VCO2}}$ data lines, and are applied to the frequency shift logic circuit. The circuit then supplies six outputs to PIN (diode) switches in the VCO hybrid. Depending on the logic states of the six outputs (S1 and $\overline{\text{S1}}$; S2 and



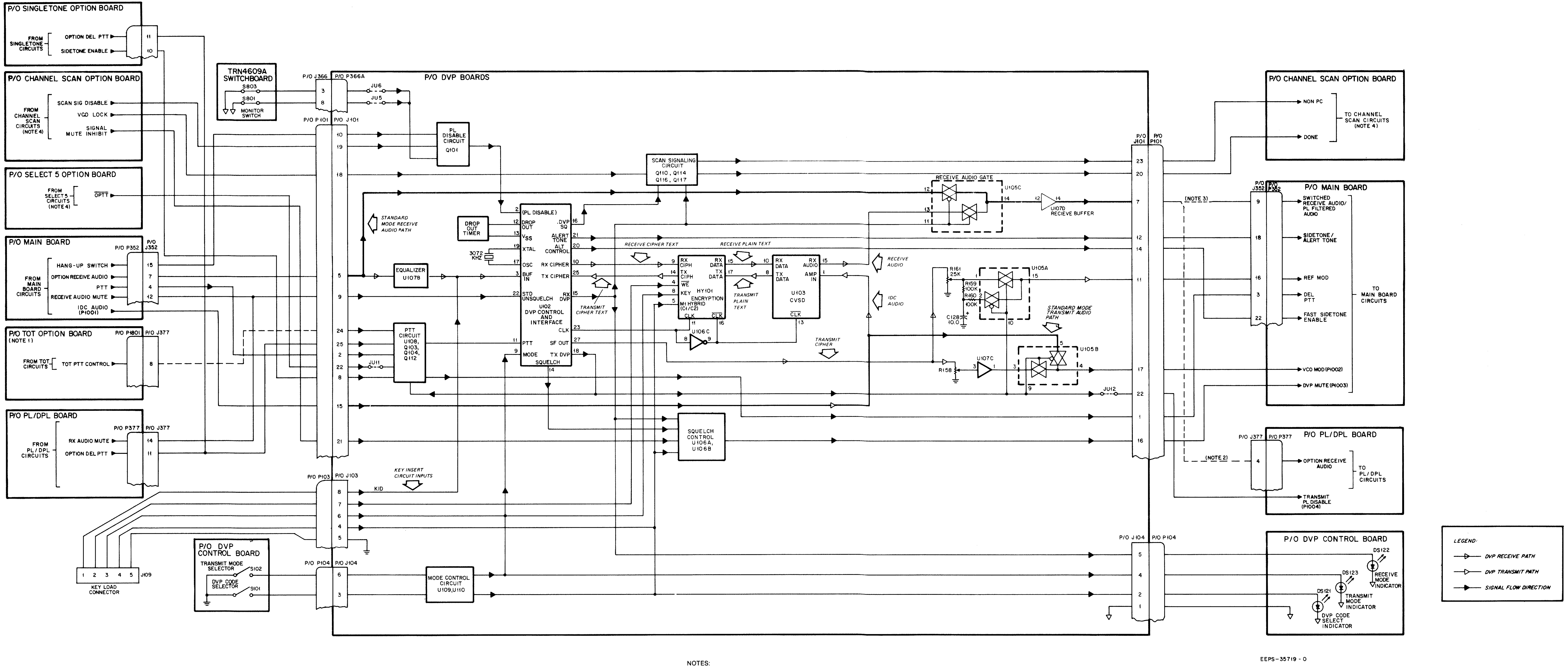
NOTES

1. USED WITH OPTIONS AND CONFIGURATIONS NOT COVERED ON THIS DIAGRAM

2. JUMPER JU361 USED FOR 32-CHANNEL MULTI-PL/DPL MODELS ONLY. JUMPERS JU361-JU365 ARE REMOVED IN SELECTABLE PL/DPL OPTION ONLY

3. IN SELECTABLE PL/DPL OPTION ONLY. CHANNEL SELECT ADDRESS A0-A4 INITIATED BY SELECTABLE PL/DPL BOARD

*Figure 5. **Fast-Lok** Synthesizer Functional Block Diagram*



NOTES:

1. Time-out timer board is optional in carrier squelch models only.
2. Connection for PL/DPL radios.
3. Connection for non PL/DPL radios.
4. Option not covered in this manual.

Figure 6. Digital Voice Protection Circuits Functional Block Diagram

$\overline{S2}$; and S3 and $\overline{S3}$), the PIN diodes switch the VCO to the correct sub-range frequency.

3.4.2.8 VCO AGC Circuit

The VCO AGC circuit consists of transistors Q170, Q171 and Q1300. The circuit stabilizes the VCO gain by maintaining a constant rf level in the VCO tank circuit. A dc sample of the VCO rf output is applied to the VCO AGC circuit as the AGC DETECT signal. If the signal varies, the circuit feeds an AGC control signal back to the VCO tank circuit to maintain a constant VCO rf output.

3.4.3 Synthesizer RF Amplifier Board

RF buffer Q190 raises the VCO rf output level, feeding the transmit/receive injection switch as well as providing the VCO frequency feedback signal to divider U115 via buffer transistor Q116 on the synthesizer board. The transmit/receive injection switch consists of PIN diodes CR190 and CR191 and transmit/receive injection switch Q191. Transmission along either port is controlled by the 9.6T keying voltage applied to Q191. A high 9.6T keying voltage (transmit mode) forward biases CR191, routing the VCO rf to the transmit injection port at connector P374-1. From the port, the signal is fed, via a coaxial cable, to the low level amplifier in the transmiter. A low 9.6T keying voltage (receive mode) turns on transistor Q191, forward biasing CR190, routing the VCO rf to the receive injection port at connector J357. From the port, the signal is fed as the receiver injection signal to the mixer in the receiver.

3.4.4 Voltage Controlled Oscillator

The voltage controlled oscillator (VCO) used with the *Fast-Lok* synthesizer is the same as the VCO utilized with the standard lock synthesizer with the addition of a feedthrough capacitor/filter wall. Refer to the VCO description paragraphs in the standard lock synthesizer section for operation information.

3.5 *DVP* CIRCUITS
(Refer to Figure 6.)

The *DVP* circuitry is contained on two boards located within the radio housing just behind the front panel circuitry. The boards use CMOS integrated circuits to perform the audio switching and control functions which are necessary to control the *MCX100* radio. A 5-pin connector at the side of the radio allows loading an electronic encryption key into the *DVP* circuitry. Switches and indicators necessary to control the *DVP* circuitry are conveniently located on the radio front panel.

3.5.1 *DVP* Definitions

The following is a definition of some of the terminology used in explaining *DVP* operation and circuitry.

- ALERT TONE is sounded at the speaker when the operator transmits in the standard mode. The tone alerts the operator that the transmission is not encrypted. The alert consists of a 750 Hz tone for about 80 milliseconds.

- CIPHER TEXT refers to the digital waveform which represents the encrypted audio.

- CODE is the word sometimes used in place of the correct term which is key (see key).

- CODE INSERTER is an electronic device used to load an electronic encryption key into *DVP* equipped radios.

- CROSSOVER JITTER is the ratio of crossover time (X) to whole bit time (T). See Figure 7. For example, with X equal to 0.55cm and T equal to 3.5cm, the crossover jitter is 15.7%.

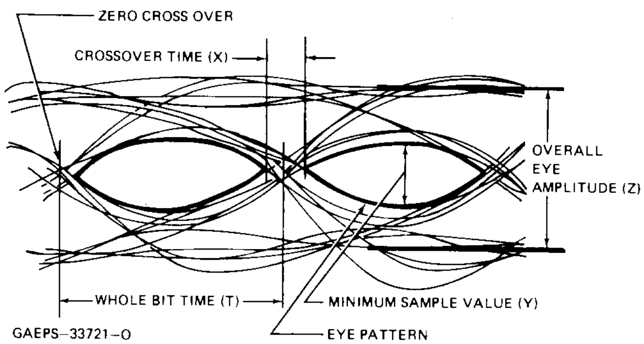


Figure 7. Cipher Text Waveform

- DECRYPTION converts cipher text to plain text.

- DUAL CODE is a second key capability. The key is stored in the Code 1 position. The Code 2 position electronically alters the stored key. An operator control selects either Code 1 or Code 2.

- ENCRYPTED VOICE COMMUNICATION is called private mode, secure mode, cipher, or cipher text depending on the context in which the term is used. In this mode, the audio signal is converted to a digital signal and encrypted before transmission. At the receiver, the receiver signal is decrypted, and the resulting digital signal is used to reconstruct the audio waveform.

- ENCRYPTION converts plain text to cipher text.

- END-OF-MESSAGE (EOM) signal is a short burst of 6 kHz sine wave transmitted at the end of a private mode message by a *DVP* radio. EOM lasts for the interval usually used for the PL reverse burst signal which is about 180 milliseconds. The EOM signal functions as a squelch closure.

- EYE OPENING is the ratio of the minimum sample value to the overall eye amplitude expressed as a percentage. See Figure 7. For example, with Y equal to 1.0cm and Z equal to 2.5cm, the eye opening is 40.0%.

- EYE PATTERN is transmit cipher text converted by the splatter filter. See Figure 7. The term eye pattern is used because the oscilloscope trace vaguely resembles the shape of the human eye.

- KEY consists of a sequence of bits that are electronically stored in the encryption module. The key is transferred to the module through the 5-pin connector on the side of the radio. The key is sometimes referred to as the electronic key to distinguish it from a physical key such as a car key. The key is sometimes casually referred to as a code.

- PLAIN TEXT refers to the digital waveform which represents the non-encrypted audio.

- QUALITY OF RECEIVED SIGNAL is expressed by an error rate or probability of error. This number expresses the probability that any bit that is recovered by the receiver is in error. The error rate measures the quality of a private mode signal in much the same way that quieting or SINAD measure the quality of a standard mode signal. For *DVP* radios the error rate is usually measured for plain text rather than cipher text since it is easier to measure. For plain text messages to be intelligible in the *DVP MCX100*, the error rate should be less than 5%.

- SPLATTER FILTER converts the transmit cipher text signal to an eye pattern signal.

- STANDARD VOICE COMMUNICATION is called standard mode, clear mode, bypass mode, or plain text depending on the context in which the term is used. In this mode of operation, the audio signal is transmitted exactly like an FM two-way radio normally transmits an audio signal.

- TURN-OFF-CODE (TOC) is the term sometimes used instead of end-of-message (EOM).

- ZERO CROSSOVER corresponds to the transition point between bits. See Figure 7.

3.5.2 *DVP* Signal Routing

3.5.2.1 The *DVP* circuitry controls both the receive and transmit portions of the *DVP MCX100* radio. When the radio is receiving, the *DVP* circuitry checks the signal. If the signal is coded, decrypted audio is routed to the radio speaker. If the signal is not coded, discriminator audio is routed to the radio speaker. When the radio is transmitting, the *DVP* circuitry will route either IDC audio or *DVP* cipher to the radio modulating circuitry, depending upon the front panel mode setting.

3.5.2.2 Buffered discriminator output is routed to the *DVP* circuitry for code detection and audio reconstruction. It first goes through an equalizer and is then applied to U102. If the signal is *DVP* code, U102 reclocks the signal to recover the cipher text. The cipher text then goes to the encryption hybrid where it is decrypted to produce the plain text. The plain text is then routed to the CVSD, where the audio is reconstructed. U102 will then switch U105C so that decrypted audio is routed back into the radio low level audio path. If the incoming signal is not *DVP* code, U102 does not switch U105C and the buffered discriminator signal is routed back into the low level audio path.

3.5.2.3 IDC audio is routed to the *DVP* circuitry to be digitized by the CVSD. The output of the CVSD (the plain text) goes to the encryption hybrid. The hybrid encrypts the plain text to produce cipher text. From the hybrid, the cipher text passes through a splatter filter on U102 and then goes to the deviation adjustment potentiometers, R158 and R161. The *DVP* signal then goes to analog switches U105A and U105B. If the radio is set for coded transmission, and the *DVP* circuitry has received an active PTT signal, U105A and U105B will be switched so that the *DVP* signal is passed back into the radio transmit circuitry. If the radio is set for clear transmission, the IDC audio will be passed back into the radio transmit circuitry by U105A.

3.6 PL/DPL CIRCUITS
(Refer to Figure 8)

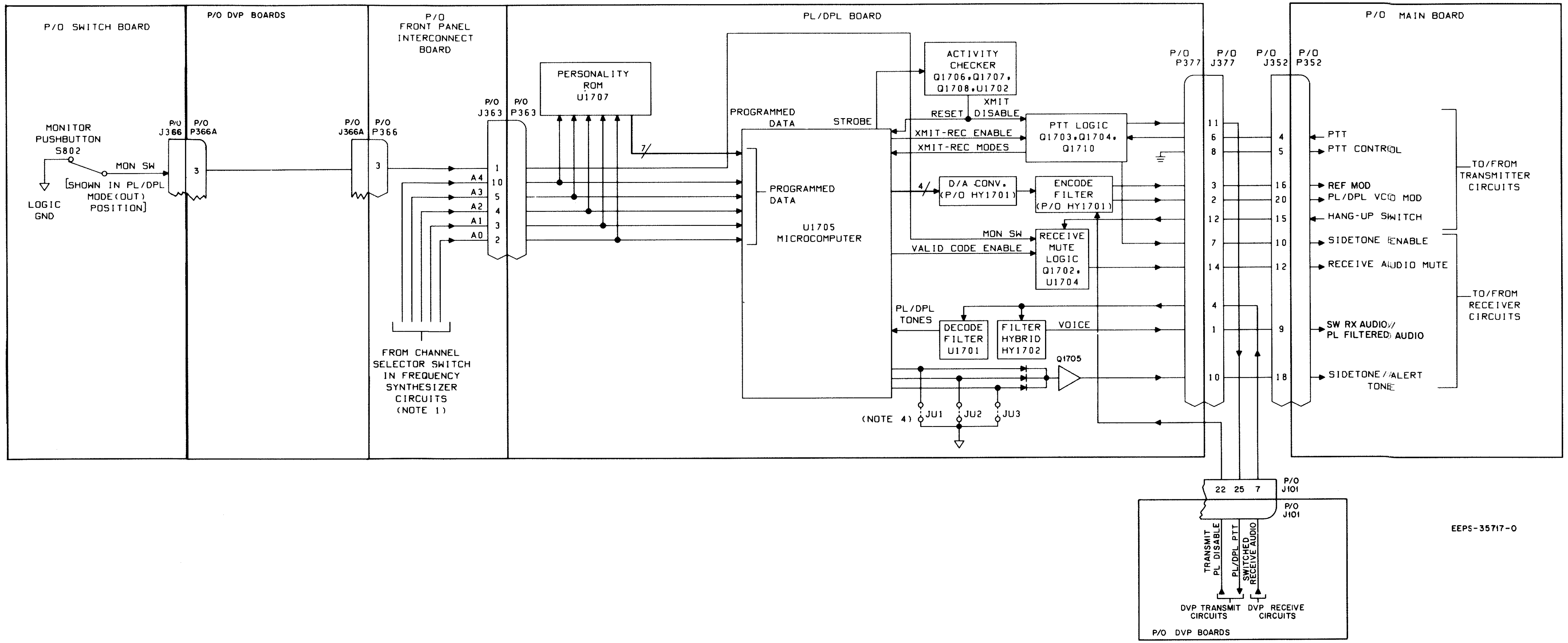
3.6.1 Squelch Code Systems

3.6.1.1 The PL/DPL (*Private-Line/Digital Private-Line*) circuits greatly improve the privacy of communications for a number of private users that may be sharing an rf channel. The circuits encode (transmit) and decode (receive) PL (tone coded) and DPL (binary-coded) squelch signals to unsquelch compatably-equipped radios. The use of a personality ROM (read only memory), allows PL and DPL signaling tones to be mixed (transmit in one code scheme and receive in another on the same channel).

3.6.1.2 The PL/DPL coded squelch circuits unsquelch the receiver upon receipt of a properly coded signal. In the PL mode, a sub-audible tone frequency is detected, whereas in the DPL circuits, a 23-bit binary code word is detected. In either case, the code is transmitted continuously during the transmit mode, to unsquelch the receiver. Other receivers operating on the same rf channel but not compatable with the code signal remain squelched. In both systems, the code signal frequency is below the 300 to 3000 Hz audio band and is therefore not heard in the speaker.

3.6.2 Microcomputer and Memory

3.6.2.1 An 8-bit, 40-pin microcomputer and a personality ROM control the PL/DPL decoding



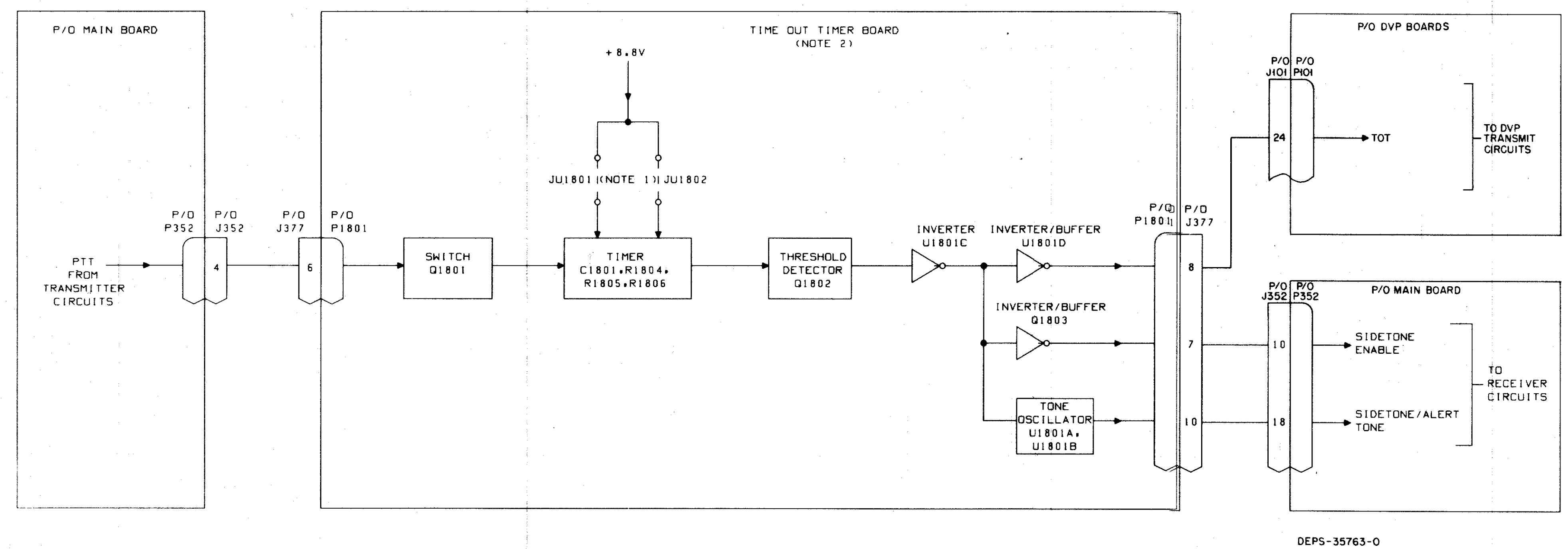
NOTES:

1. IN SELECTABLE PL/DPL OPTION ONLY, ADDRESS A0-A4 INITIATED BY SELECTABLE PL/DPL BOARD INSTEAD OF CHANNEL SELECTOR SWITCH.

2. JUMPERS JU1, JU2, & JU3 DETERMINE TIME-OUT TIME, AS FOLLOWS:

JUMPERS			TIME-OUT TIME
JU1	JU2	JU3	
IN	OUT	OUT	15 SEC
OUT	OUT	OUT	30 SEC
OUT	IN	OUT	60 SEC
IN	IN	OUT	90 SEC
OUT	OUT	IN	2-1/2 MIN
IN	OUT	IN	5 MIN
OUT	IN	IN	NONE

Figure 8. PL/DPL Circuits, Functional Diagram



NOTES:

1. JUMPERS JU1801 AND JU1802 DETERMINE TIME-OUT TIME, AS FOLLOWS:

JUMPER		TIME-OUT TIME(SEC)
JU1801	JU1802	
IN	IN	15
OUT	IN	30
OUT	OUT	60

2. TIME-OUT TIMER BOARD IS OPTIONAL IN CARRIER-SQUELCH MODELS ONLY.

Figure 9. Time-Out Timer Circuits, Functional Diagram

and encoding functions. The personality ROM is factory-programmed with user-specified operating parameters. For single and multi-code operation, changing codes is accomplished by removing the personality ROM and inserting another ROM.

3.6.2.2 The microcomputer accesses the personality ROM whenever it requires information to control its operation. Software programming within the microcomputer then directs the decoding and encoding processes. In multiple PL/DPL squelch models, channel selection data is applied to the personality ROM on five address lines (A0-A4) encoded by the channel select switch on the front panel. In selectable PL/DPL squelch models only, the five address lines are encoded by a selectable PL/DPL board.

3.6.3 Decoding

3.6.3.1 An inactive PTT signal from the microphone initiates the decode process. The inactive signal causes PTT logic circuit Q1703 to set the microcomputer to the receive mode. The option receive audio from the receiver circuits is applied to the microcomputer, via low pass decode filter U1701. This allows only the PL or DPL tones (or codes) to be applied to the microcomputer for decoding. The PL or DPL tones (or codes) are removed from the optional receive audio by high pass filter hybrid HY1702. The filtered output, containing voice only, is the PL filtered audio that is inserted into the receiver low level audio stages.

3.6.3.2 When the microcomputer is set to the receive mode, and a valid PL or DPL code is decoded, the microcomputer enables receive mute logic circuit Q1702 and U1704. The circuit then supplies an active low receive audio mute signal to the receiver circuits to unmute the audio. The decoder circuits can be bypassed to allow all signals on the channel to be monitored. This permits a check of a selected channel to see if it is in use before transmitting. Pushing in the Monitor pushbutton on the front panel disables the PL/DPL decoder circuits. This allows the receiver carrier squelch circuit to control the receiver audio. Leaving the microphone off-hook performs the same function, via the hang-up switch signal applied to the receive mute logic circuit.

3.6.4 Encoding

3.6.4.1 An active microphone PTT signal applied to the PTT logic circuit activates the encoding process. The circuit applies a signal to the microcomputer, setting it to the transmit mode. The microcomputer responds by applying a delayed PTT signal to the *DVP* PTT logic circuits on the *DVP* board, keying the transmitter. When microphone PTT is released, the delayed PTT signal remains low for a preprogrammed time interval, during which the "reverse-burst" or turn-off code is transmitted. At the end of this interval, the transmitter dekeys.

3.6.4.2 During encoding, the microcomputer begins timing the duration of the transmission, and times out (dekeys the transmitter automatically) at the end of a user-specified interval. Up to seven time-out intervals can be selected for the time-out-timer, depending on the inclusion or exclusion of jumpers JU1, JU2, and JU3 in the circuit. When time-out occurs, the sidetone enable signal is activated, and the sidetone/alert tone is heard in the speaker.

3.6.4.3 The microcomputer applies PL or DPL signaling information on four digital data lines. For PL tone transmission, the digital data is converted to an analog signal by a D/A (digital-to-analog) converter in hybrid HY1701. The PL/DPL signal is filtered by a low-pass encode filter, also part of hybrid HY1701. The PL or DPL signal produced is then applied to the transmitter audio/IDC curcuits and also to the reference oscillator/IDC circuit. The levels at these two points are controlled by potentiometers.

3.6.5 Activity Checker

This circuit resets the microcomputer if a microcomputer fault occurs. During normal operation, the microcomputer applies strobe pulses to activity checker Q1707 and U1702. If strobe pulses are not generated for 15 milliseconds, indicating a microcomputer fault, the activity checker generates a reset pulse to reset the microcomputer. The reset pulse is also applied to the PTT logic circuit to unkey the transmitter during the microcomputer fault. The reset pulse is disabled when the microcomputer is again operating properly.

3.7 TIME-OUT TIMER CIRCUITS (Refer to Figure 9)

3.7.1 The time-out timer circuit is used as an option in carrier-squelch models. The circuit dekeys the transmitter after a predetermined period of time and allows the sidetone/alert tone signal to be heard in the speaker. The time-out timer circuit consists essentially of a 33 Hz clock generator, a 775 Hz tone oscillator, and a counter to count the clock pulses.

3.7.2 The time-out timer circuits produce three output signals: the TOT control signal that unkeys the transmitter; the sidetone enable signal that unmutes the receiver audio; and the sidetone/alert tone signal that is inserted into the receiver audio line when the receiver is unmuted. The circuits are controlled by the PTT signal generated by PTT logic in the transmitter circuits.

3.7.3 When the transmitter is not being keyed, the PTT signal is high and the time-out timer circuits are in the reset condition. In this state, the outputs from the circuits allow the transmitter to be keyed while preventing the sidetone/alert tone from being heard in the speaker. As soon as the transmitter is keyed, the PTT signal goes low, taking the counter (U1802) out of reset. U1802 then counts the clock pulses generated by U1801C. When the selected output of U1802 goes high, the clock oscillator (U1801C and U1801D) is inhibited and stops clocking the counter. The high output of the counter enables the 775 Hz tone oscillator, causing the tone to be inserted into the receiver sidetone path. The output high of the counter also drives the sidetone enable buffer (Q1803), and the TOT PTT control buffer (Q1802). Q1803 pulls the sidetone enable signal low, allowing the 775 Hz tone to be heard in the speaker, and Q1802 applies a low TOT PTT control signal to the *DVP* PTT circuitry, causing the radio to stop transmitting.

3.7.4 The time-out timer circuits remain in this state until the PTT signal goes high again (microphone dekeyed). This resets the counter, causing its output to go low again. This enables the clock generator, disables the tone oscillator and the transistor drivers, and allows the transmitter to be keyed again.

3.8 REMOTE MOUNT CIRCUITS
(Refer to Figure 10.)

3.8.1 Functions

3.8.1.1 Most of the control head functions in the remote mount models operate in the same manner as the front panel functions do in front mount models. The only difference is that these functions are performed through a 36-conductor interconnect cable. The following functions operate identically in both front mount and remote mount radios.

- *DVP* control
- Channel select lines
- Monitor, or Secondary Call/External Alarm pushbutton
- Call Pushbutton
- Call light indicator
- 10/100 Call or Selectable PL/DPL Code Select pushbuttons
- *Select 5* signaling thumbwheel switches.

3.8.1.2 The following functions operate differently in remote mount models.

- Power on-off
- Monitor pushbutton
- Busy light indicator
- Transmit indicator
- PTT (when used with control head microphone)
- Volume

The above functions require processing by the remote interface board for operation. Refer to Figure 8. Three wires in the interconnect cable (marked A, B, and C) perform multiple functions. The functions they perform are determined by the dc voltage level on the lines.

3.8.1.3 Lines A and C use comparators on the interface board to decode the function to be performed. Comparators on the interface board are biased such that the voltage on the line determines if the comparator output is in the high state (approximately 11.5 V dc) or low state (approximately 1.4 V dc).

3.8.1.4 Line B sources current (transmit mode) to the control head or sinks current (busy mode) from the control head, depending on the state of the 9.6 T line and busy line from the radio.

Line	Functions
A	Power On-off/Squelch
B	Transmit/Busy Indicators
C	PTT/Microphone Audio

3.8.2 Power On-Off/Squelch

3.8.2.1 Refer to the remote mount functional diagram and function chart (Figure 8). When the control head on-off switch (part of Off-on/Volume control) is closed, 4.8 V is present on line A which activates the on-off comparator, Q2201 and Q2203, on the remote interface board. The output of the comparator drives Q2202 into saturation, turning on the radio. Note that the + BATT return for the control head is provided through the ground wire in the 36-conductor interconnect cable. If this cable is not connected to the transceiver, the contol head is inactive.

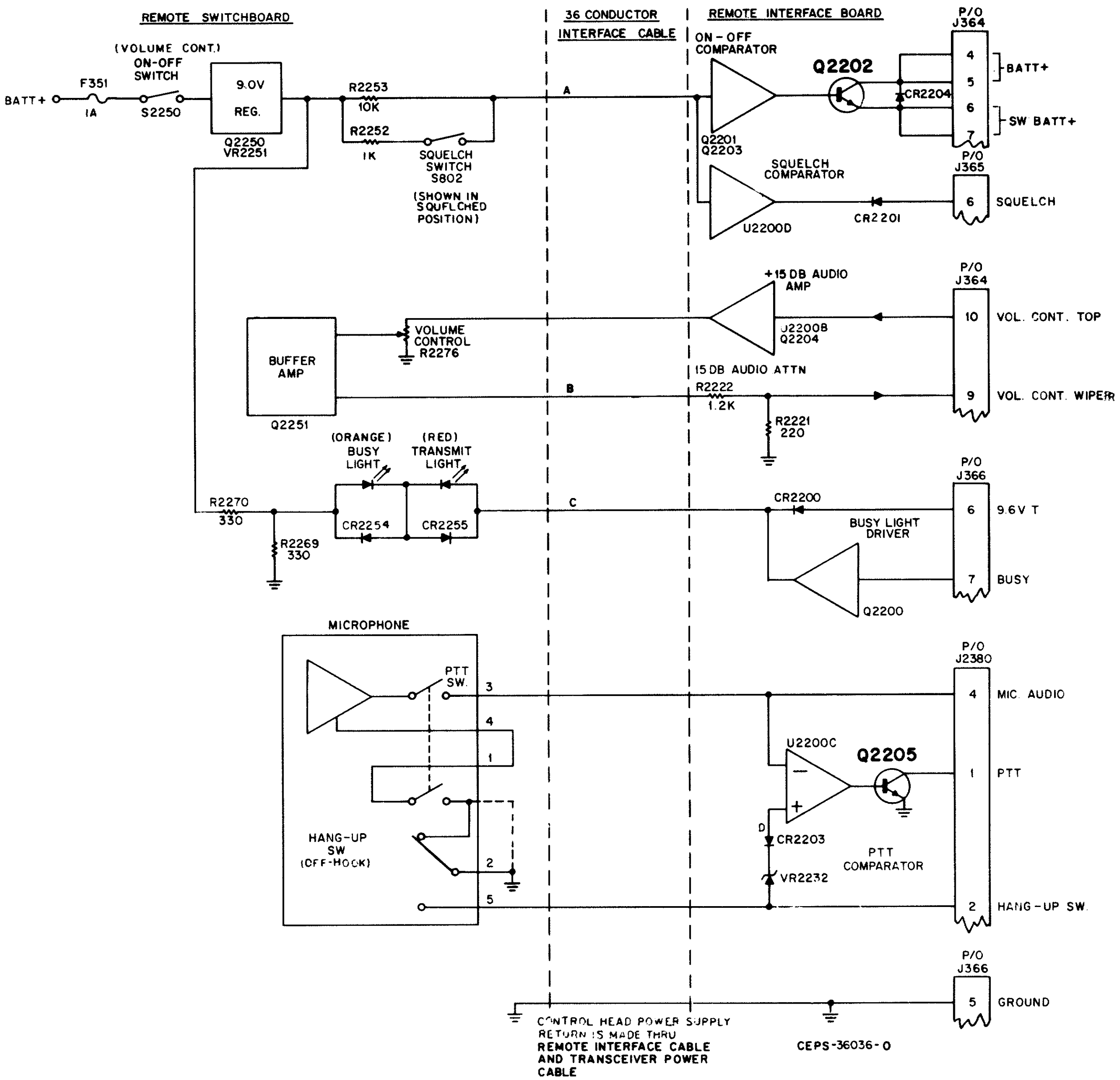
3.8.2.2 With the Squelch push button out (radio squelched) the output of the squelch comparator, U2200D, is high. Pushing the squelch button in (radio unsquelched) raises the voltage on line A to 8.3 V dc and causes the output of U2200D to go low. The on-off comparator is not effected by the Squelch pushbutton.

3.8.3 Busy/Transmit Indicators

In the transmit mode, 9.6 T is applied to line B through CR2200 on the remote interface board. This causes the Transmit LED in the control head to become forward biased (ON) and the Busy indicator reverse biased (OFF). In the busy mode, line B is pulled low by Q2200, causing the Busy indicator LED to become forward biased and the Transmit indicator LED reverse biased. When the radio is not in the transmit mode, or the channel is not busy, both diodes are off, CR2200 is reverse biased and Q2200 is in cutoff, preventing current from flowing through the LEDs. Both the Transmit and Busy indicator LEDs cannot be on at the same time.

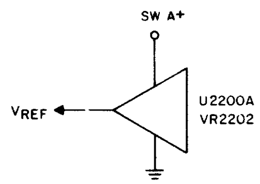
3.8.4 PTT/Microphone Audio

3.8.4.1 The microphone in the control head controls the PTT line via the PTT comparator,



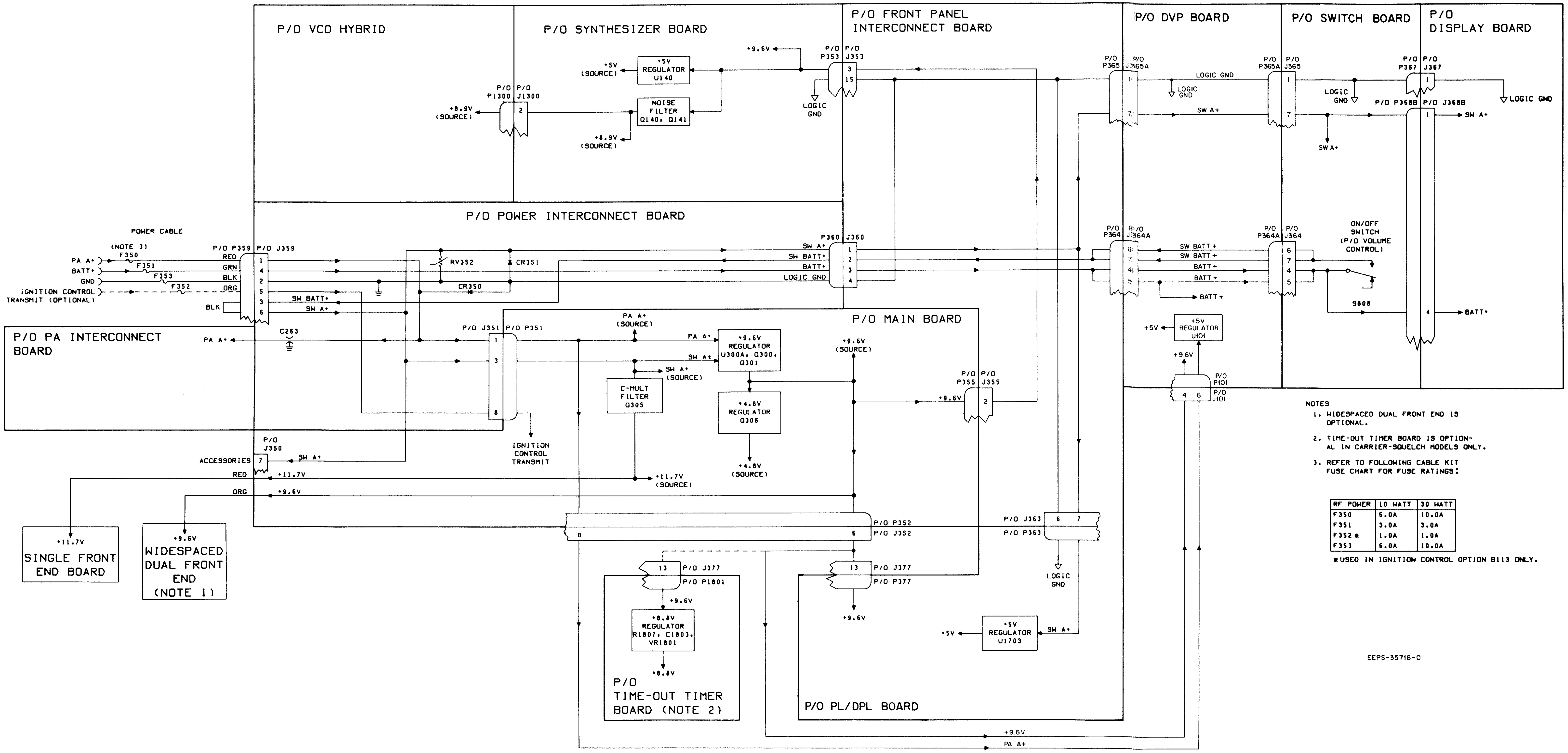
REMOTE FUNCTIONAL CHART

	SIGNAL LEVEL	FUNCTION
A	4.8V POWER ON, SQUELCHED 8.3V POWER ON, UNSQUELCHED 0V POWER OFF	ON-OFF/SQUELCH
B	8.3V TRANSMIT LED ON 0.6V BUSY LED ON 3.0V BOTH LED'S OFF	BUSY/TRANSMIT INDICATORS
C	9.6V PTT LINE HIGH (REC.) 5.75V PTT LINE LOW (XMIT)	PTT/MIC AUDIO
D	7.1V MIC OFF HOOK 3.0V MIC ON HOOK	HANG-UP



INTERFACE BOARD REFERENCE VOLTAGE FOR COMPARATORS

Figure 10. Remote Mount Circuits Functional Diagram



NOTES

1. WIDESPACED DUAL FRONT END IS OPTIONAL.
2. TIME-OUT TIMER BOARD IS OPTIONAL IN CARRIER-SQUELCH MODELS ONLY.
3. REFER TO FOLLOWING CABLE KIT FUSE CHART FOR FUSE RATINGS:

RF POWER	10 WATT	30 WATT
F350	6.0A	10.0A
F351	3.0A	3.0A
F352 *	1.0A	1.0A
F353	6.0A	10.0A

* USED IN IGNITION CONTROL OPTION 8113 ONLY.

Figure 11. Power Distribution Circuits Functional Diagram

U2200C, and Q2205 on the remote interface board. The PTT comparator senses the dc voltage on line C in the functional diagram. If the microphone is off-hook and the PTT switch is pressed, the voltage on line C drops from 9.6 V to 5.8 V causing the output of U2200C to go high, saturating Q2205. Q2205 pulls the PTT line low which keys the transmitter. While transmitting, line C also carries the microphone audio to the radio IDC circuitry.

3.8.4.2 If the control head has a signaling microphone and is on-hook, the microphone ground is broken by the hang-up switch, prventing line C from dropping in voltage when the microphone PTT switch is pressed. The output of U2200C remains low, preventing the transmitter from keying up.

3.8.4.3 The diode network on the non-inverting input of U2200C permits a signaling microphone to be connected at the radio instead of at the control head. With a signaling microphone connected at the radio, the voltage on line C goes low (5.8 V) when the microphone PTT switch is pressed, regardless of if the microphone is on-hook or off-hook. To prevent the transmitter from keying on-hook, the non-inverting input of U2200C is pulled low (lower than the inverting input) through CR2203, VR2232 and the hang up switch. The output of U2200C remains low, preventing the transmitter from keying.

3.8.5 Volume Control

To minimize noise pick-up in the interconnect cable, the receiver audio is amplified 15 dB and buffered by U2200B and Q2204 on the interface board before being applied to the volume control in the control head. The volume control applies the audio signal to an emitter follower, Q2251, which returns the signal to a 15 dB attenuator on the interface board.

3.9 POWER DISTRIBUTION CIRCUITS
(Refer to Figure 11.)

3.9.1 General

3.9.1.1 The power distribution circuits supply the necessary dc power to the boards that make up the *DVP MCX100* radio set. Regulators and filters on various boards are provided to supply regulated and filtered voltages, where necessary.

3.9.1.2 Primary input power from the vehicle in the form of BATT+ (green wire), PA A+ (red wire), and ground (black wire) is applied to connector J359. The wires are in a power input cable; J359 is on the power interconnect board. Ignition control option B113 uses a fourth wire (orange) for "ignition control of transmit". Each wire is fused. Refer to the Installation section of this manual for power lead connections.

3.9.1.3 The BATT+ voltage is routed through the power interconnect board and front panel interconnect board to the front panel power on/off switch. The BATT+ voltage is also routed through the switch board to the display board to provide power to multiple-code memory circuits. When the power switch is set to the on position, the BATT+ voltage is applied to the SW BATT+ line. This voltage is applied through the front panel interconnect board and power interconnect board to connector P359. A small wire jumper on plug P359 applies the SW BATT+ voltage to the SW A+ line. The SW A+ voltage, in turn, is routed along several paths.

3.9.1.4 One SW A+ path is through connector J351 to the main board. On the main board, the SW A+ voltage is also applied to accessories connector J350-7 for equipment connected to this jack. A second path for the SW A + voltage is through the power interconnect board to the front panel interconnect board where it is again distributed. One path is through the *DVP* encryption board to the switch board and display board. Another path is to the PL/DPL board, or other option boards mounted in the same location.

3.9.1.5 The PA A+ voltage is routed, via the power interconnect board, to the PA interconnect board through feedthrough-capacitor C263, where it supplies operating voltage to the 10 watt PA and, in 30 watt models, the high-power PA mounted in the external heat sink. PA A+ voltage is also supplied, through J351, to the main board, where it serves as the voltage source for the 9.6 volt regulator, the transmitter power control circuit, and the receiver audio power amplifier. PA A+ also goes to J352 where it gets routed to the *DVP* boards.

3.9.1.6 Reverse polarity and transient voltage protection is provided by diodes CR350 and CR351, and varistor RV352. The black ground lead is connected directly to the chassis via the power interconnect board. A separate logic ground (for digital circuitry in the radio) is connected to the chassis at the same point.

3.9.1.7 The optional ignition control of transmit input is supplied to circuitry on the main board via J351.

3.9.2 Main Board Regulators and Filter

3.9.2.1 A +9.6 V regulator, a +4.8 V regulator, and a C-multiplier filter are located on the main board. The +9.6 V regulator regulates the PA A+ input voltage and is turned on by the SW A+ input voltage. The regulator consists of U300A, Q300, and Q301. It supplies regulated +9.6 V dc to the main board, the synthesizer board, the optional widespaced dual front end, the *DVP* boards and the optional PL/DPL or time-out timer boards.

3.9.2.2 The +4.8 V regulator, Q306, converts the regulated +9.6 V dc to a regulated +4.8 V dc. The regulator provides a temperature-compensated, low-impedance bias supply for IC's in the audio and squelch stages of the receiver and transmitter circuits on the main board, and *DVP* boards.

3.9.2.3 The C-multiplier filter consists of transistor Q305. It filters and reduces the SW A+ voltage to +11.7 V dc and supplies it to the receiver i-f circuits on the main board, and to circuits on the single front end board.

3.9.3 Synthesizer Board Regulator and Filter

A +5 V IC regulator and a noise filter are located on the synthesizer board. The +5 V regulator, U140, provides regulated +5 V dc to the logic circuits on the board. The noise filter, including transistors Q140 and Q141, reduces the +9.6 V dc to 8.9 V dc and supplies it to the VCO and to various circuits on the synthesizer board.

3.9.4 *DVP* Board Regulator

Regulator U101 is a regulator which supplies +5 V dc to some of the logic circuits on the *DVP* boards.

3.9.5 PL/DPL Time-Out Timer Board Regulator

Regulator U1703 is an IC that provides regulated +5 V dc to logic circuits on the board.

3.9.6 Time-Out Timer Board

The +8.8 V regulator on this board consists simply of Zener diode VR1801, resistor R1807, and capacitor C1803. The circuit provides regulated and filtered +8.8 V dc to circuits on the board.

4. DETAILED DESCRIPTION

NOTE

The schematic diagrams referenced in the Detailed Description are located in the Diagrams section of this manual.

4.1 RECEIVER CIRCUITS

4.1.1 Single Front End
(Refer to Single Front End schematic diagram)

4.1.1.1 The standard single front end is located on the single front end board. The single front end consists of an antenna filter, an rf amplifier, an interstage filter, an injection filter, and a mixer. Depending on the kit used, the single front end provides a 4 MHz receive bandwidth, tuneable within the 136 to 162 MHz (TRD6161B) or 146 to 174 MHz (TRD6162B) band.

4.1.1.2 Receiver rf from the receive port of the antenna switch in the transmitter circuits is routed to the input of the antenna filter. The antenna filter is tuned by coils RF1 (L700) and RF2 (L701). The rf output from the filter is amplified approximately 10 dB by rf amplifier Q700 before being applied to the interstage filter. This filter is tuned by coils RF3 (L703), RF4 (L704), and RF5 (L705). The filtered rf output is applied to the gate of N-channel JFET (junction field-effect transistor) mixer Q701. A second input to the mixer is the low side receiver injection signal generated by the frequency synthesizer circuits in the receive mode. The receiver injection signal is applied to the mixer via the injection filter. Coils LO1 (L710), LO2 (L709), and LO3 (L708) tune this filter. The INJ METER point provides a dc voltage (typically between 2.1 to 3.5 V dc) that is proportional to the mixer source current flowing through resistor R703. The INJ METER point is used to tune the receiver injection filter for maximum injection drive to the mixer.

4.1.1.3 The receiver injection signal output from the injection filter is applied to the source of mixer Q701. The mixer combines the receiver rf and the receiver injection signal to produce the 21.4 MHz receiver i-f signal. The i-f output from the mixer drain is applied through a 50-ohm impedance matching network to the input of the receiver i-f circuit on the main board. The mixer characteristics are optimized to produce excellent intermodulation immunity.

4.1.2 Widespaced Dual Front End
(Refer to Widespaced Dual Front End schematic diagram)

4.1.2.1 The optional widespaced dual front end is housed in a metal casting that contains the amplifier board, the mixer board, and the tuneable helical filter coils. Depending on the kit used, the widespaced dual front end provides extended frequency coverage, consisting of two 6 MHz-wide "windows" tuneable anywhere within the range of 136 to 162 MHz (Range I) or 146 to 174 MHz (Range II). The extended coverage is provided by low-range and high-range three-cell helical filters, each 6 MHz wide, that can be tuned to any desired center frequency within one of these ranges. Selection of the appropriate (low-range or high-range) filter is made by the front end select signal generated by the frequency synthesizer circuit in the receive mode. Figure 12 illustrates two examples of the tuning capability of the widespaced dual front end. One example illustrates tuning for continuous 12 MHz coverage, and the other illustrates tuning for two 6 MHz "windows".

4.1.2.2 Receiver rf from the antenna switch is applied to the input filter. The input filter is approximately 30 MHz wide and is factory-tuned by coils

L701, L702, and L703. The filtered rf output is amplified approximately 12 dB by wideband rf amplifier Q750. Diode CR751 protects Q750 against high level rf signals or transients. The rf output from Q750 is then switched to either the high-range or low-range filter, depending on the biasing of the input PIN didoe switch (CR752 through CR755) and the output PIN diode switch (CR761 and CR762). Biasing, in turn, is controlled by the front end select signal.

4.1.2.3 The front end select signal is applied to the front end select logic circuit consisting of differential amplifiers U750A and U750B. When the front end select signal is low (typically 0.2 V dc), the output from U750A is also low (2.7 V dc), and the output from U750B is high (5.8 V dc). This combination of voltage levels turns on diodes CR753 and CR755 in the input diode switch, and diode CR762 in the output diode switch. (The remaining diodes in the input and output diode switches are reverse biased, and are therefore turned off.) When CR753 and CR762 are turned on, CR753 switches the rf output from Q750 to the low-range filter, and CR762 applies the filtered output to the mixer. When CR755 turns on, it switches the input of the high-range filter to rf ground through capacitor C756, further isolating the two filters. Low-range filter coils L704, L705, and L706 tune the filter, and the low-range test point serves as the rf monitoring port while tuning.

4.1.2.4 When the front end select signal is high (typically 6.9 V dc), the front end select logic circuit changes state. This turns on diodes CR752 and CR754 in the input diode switch, and diode CR761 in the output diode switch. In this condition, CR752 switches the rf output from Q750 to the high-range filter, and CR761 transfers the filtered output to the mixer. Diode CR754 switches the input of the low-range filter to rf ground. The high-range filter is tuned by coils L707, L708, and L709. The high-range test point serves as the monitoring port for the filter.

4.1.2.5 The mixer is configured as a broadband, double-balanced mixer. It consists of matched quad diode CR760 and transformers T760 and T761. Transformer T760 couples the selected rf signal to the mixer network while T761 couples the receiver injection signal to the mixer network. The receiver injection signal, which is generated by the frequency synthesizer circuits in the receive mode, is applied to the mixer, via the injection filter. The injection filter is approximately 30 MHz wide and is factory-tuned by coils L710, L711, and L712. The filtered injection signal is applied to the mixer network to produce the 21.4 MHz receiver i-f that is applied to the receiver i-f circuit on the main board.

4.1.3 Main Board Receiver Circuits

(Refer to Main Board and Power Interconnect Board schematic diagrams)

4.1.3.1 I-F Circuit

Several stages of filtering and amplification are provided by the i-f circuit. Selective i-f filtering is accomplished using dual-resonator, mode-coupled, monolithic crystals cut to a fundamental frequency of 21.4 MHz. Each crystal filter, consisting of two poles, is mounted in a single i-f can. Due to the inherent piezoelectric properties of the crystal material, input signals selectively produce mechanical vibrations that propagate through the device. At the output, the same piezoelectric property selectively converts the mechanical vibrations into the i-f electrical signal.

4.1.3.1.1 Figure 13 is a simplified diagram showing the coupling effect of the piezoelectric properties. The figure shows that the high "Q" of the crystals create steep skirts that result in excellent on-channel intelligibility and off-channel signal rejection. The i-f circuit requires no tuning and makes extensive use of shielding to minimize unwanted pick-up by the high-gain stages.

4.1.3.1.2 The 21.4 MHz signal from the single front end (or optional widespaced dual front end) is applied to first buffer Q1. The buffer provides a constant 50-ohm impedance match between the mixer and four-pole crystal filters Y1A and Y1B. This impedance match is maintained even though the crystal filter impedance varies widely for only a few kHz deviation from the i-f frequency. Capacitors C24 and C25, across Y1A and Y1B, improve the adjacent channel selectivity.

4.1.3.1.3 The output from the crystal filters is applied to second buffer Q2. The buffer, together with resistor R3, serves as an impedance termination for the crystal filters, and improves the system noise figure. The i-f signal is amplified by wideband integrated circuit amplifier U1, and is further filtered by two-pole crystal filters Y2A and Y2B. The filtered output is applied through an r-c matching network to integrated circuit limiter/quadrature detector U2.

4.1.3.2 Limiter/Quadrature Detector

4.1.3.2.1 Limiter/quadrature detector U2 is a 16-pin, monolithic integrated circuit that includes three stages of i-f amplification, a quadrature fm detector that recovers the audio from the frequency-modulated carrier, and an audio preamplifier. The limiter/quadrature detector includes approximately

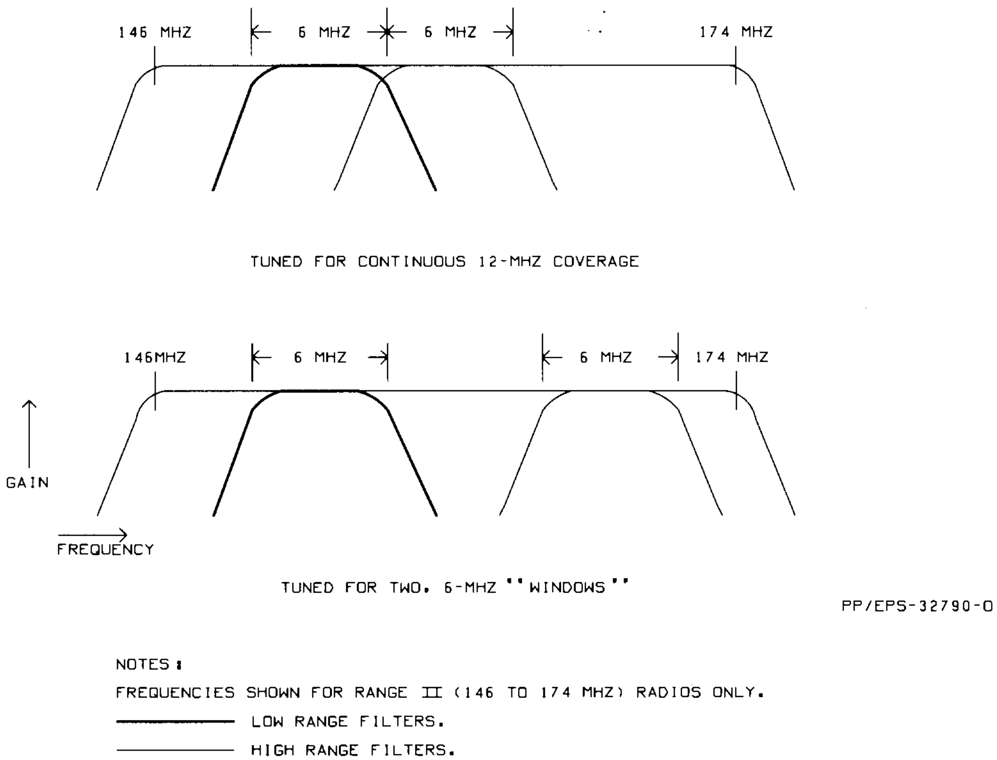


Figure 12. Widespaced Dual Front End Tuning Capability

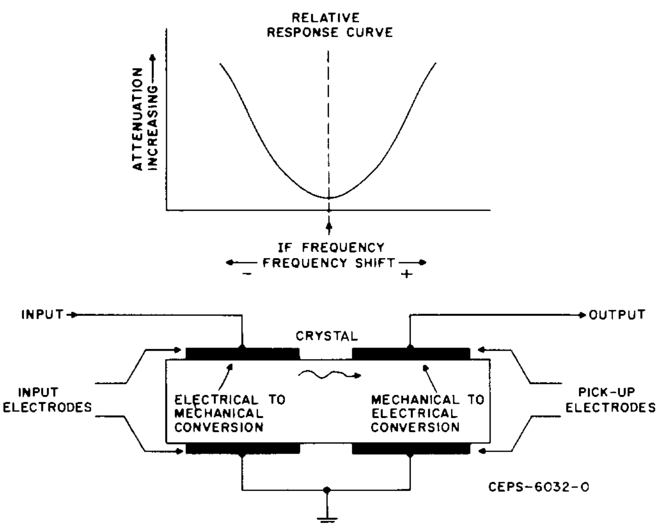


Figure 13. Simplified Piezoelectric Coupling Diagram

85 dB of i-f gain, and produces a recovered audio output level of 16 mV rms per one kHz deviation. The polarity of the output is positive, producing an increasing positive voltage for increasing frequency. The recovered audio output level is adjusted for maximum output by quad coil L5.

4.1.3.2.2 The limiter/quadrature detector also develops a dc output voltage that is proportional to the rf input. This voltage is monitored at the RISE METER point for receiver alignment. For PL/DPL squelch or *Select 5* singaling models, the dc output voltage also serves as the carrier level sense signal that lights the BUSY light on the front panel. (Refer to the paragraph that describes Busy light circuit.) The recovered audio output from the limiter/quadrature detector is applied to detector buffer U50A in the low-level audio circuit.

4.1.3.3 Low-Level Audio Circuit

4.1.3.3.1 Detector buffer U50A serves as an audio operational amplifier whose gain is flat from 0.1 Hz to 100 kHz. The gain is determined by selected resistor R50 and feedback resistor R51. The audio output from U50A is applied to second operational amplifier U50B, which serves as a de-emphasis amplifier. The audio output from U50A is also applied as the option receive audio signal to the *DVP* circuitry, the PL/DPL circuit, accessory connector J350-1, and the squelch circuit. If the *DVP* circuitry detects a coded transmission, it switches decoded audio back into the audio path. If the *DVP* circuitry does not detect code, it passes the low level audio untouched. From the *DVP* board, the audio routing depends on whether or not the radio is equipped with PL/DPL. If the radio has the PL/DPL option, the audio from the *DVP* board is routed to the PL/DPL board for tone decoding and filtering. The PL filtered audio is then injected back into the low-level audio path at the input of U50B (junction of R52 and R53). If the radio is not equipped with PL/DPL, the audio from the *DVP* board is injected back into the low-level audio path at the same junction (U50B, R52 and R53). In either case, R52 is effectively an open circuit because of the low output impedance of either the PL filter or the *DVP* buffer.

4.1.3.3.2 The de-emphasis network is formed by resistor R55 and capacitor C55. Capacitor C53 attenuates frequencies beyond 3 kHz, and C54 reduces low frequency noise that may appear on the receiver injection signal inserted into the front end by the frequency synthesizer circuits. Capacitor C54 also helps eliminate PL tones that may appear on the PL filtered audio line when a PL channel is in use. The audio output from U50B is applied to primary mute gate Q50 in the audio muting circuit.

4.1.3.4 Audio Muting Circuit

4.1.3.4.1 Primary mute gate Q50 and secondary mute gate Q58 form the main components of the audio muting circuit. The circuit can be gated on (unmuted) and off (muted) by four signals.

- The high lock detector (VCO lock) signal from the frequency synthesizer circuits;
- The +9.6T keying voltage from the transmitter PTT logic circuit;
- The *DVP* muting signal which is a combination of *DVP* muting functions, the receive audio mute signal from the PL/DPL or *Select 5* circuits, and the squelch mute signal developed by the receiver;
- The sidetone enable signal from the *DVP* circuits, the PL/DPL, time-out timer, or *Select 5* circuits;

If a mute signal is not supplied by the frequency synthesizer, transmitter, or *DVP* circuitry, the audio path is gated on as follows.

4.1.3.4.2 De-emphasis Amplifier

U50B supplies a low-impedance, +4.8 V dc source voltage to the emitter of Q50. The base current for Q50 flows through resistor R56 to ground, saturating Q50. Therefore, the audio applied to the emitter of Q50 also appears at the collector of Q50. The base voltage of Q50 is applied, via resistor R76 and Zener diode VR54, to the base of Q58, but because the base voltage of Q50 is lower than the breakdown voltage of VR54, Q58 is cut off. This allows audio from the collector of Q50 to pass through the volume control and, via capacitors C64 and C59, to the audio power amplifier.

4.1.3.4.3 If the synthesizer frequency is out-of-lock, a high voltage is applied to the base of Q50 via diode CR302. Since the emitter of Q50 is maintained at +4.8 V dc by U50B, Q50 is cut off. The high voltage at the base of Q50B is also applied, via R76 and VR54, to the base of Q58. Since VR54 is now conducting, Q58 becomes saturated. The combined attenuation of cut-off series gate Q50, and saturated shunt gate Q58, is in excess of 100 dB.

NOTE

Refer to the "TP9 Mute Voltage Chart" on the schematic diagram for voltage levels at test point 9.

4.1.3.4.4 In a similar manner to that just described, muting also occurs under the following conditions.

- During transmit, the 9.6T keying voltage from the transmitter circuits is applied to the base of Q50B, via diode CR303.
- With no on-channel carrier and the squelch pushbutton at the front panel in the squelched (out) position, the squelch circuit supplies a high voltage (+8.4 V) to Q50, via Q2101, the *DVP* muting circuitry and Q2102 in the squelch circuitry.
- In PL/DPL squelch or *Select 5* signaling models, audio is muted in the signaling squelch mode of operation by a high receive audio mute signal applied from the signaling board. This signal goes to the *DVP* muting circuitry, via P352-12, which puts a high on Q2102, muting the receive audio.

4.1.3.4.5 To allow sidetone to be inserted into the audio path when the receiver audio is muted, the sidetone enable signal goes to ground. This turns off Q58 and allows the sidetone/alert tone from the *DVP*, the PL/DPL, time-out timer, or *Select 5* signaling circuits to be inserted through the volume control to the audio power amplifier. The sidetone level is automatically reduced if the receiver is suddenly unsquelched due to an on-channel signal; as Q50 turns on to unmute the receiver audio, the resistive combination of R60 and 2,000 ohm volume control R819 is effectively reduced to approximately 440 ohms, thus lowering the sidetone level supplied to the volume control.

4.1.3.5 Audio Power Amplifier

4.1.3.5.1 The receiver audio is amplified by the audio power amplifier, which is composed of transistors Q51 through Q57. The amplifier residual noise level is at least 40 dB lower than that of currently available integrated circuit amplifiers and supplies five watts of power to the 2 ohm speaker.

4.1.3.5.2 Transistor Q52 is a current source used to provide a constant base biasing current to the output stages as the A+ supply voltage varies between +10.8 and +16.5 V dc. Resistors R61 and R62, and capacitors C57 and C58 attenuate noise and alternator whine present on the SW A+ voltage source used to bias Q51. This achieves an alternator whine rejection considerably greater than that obtainable with integrated circuit power amplifiers.

4.1.3.5.3 Capacitors C64 and C59, and resistor R73 form a two-pole, active high-pass filter using the audio power amplifier as the gain element. This configuration achieves rapid attenuation of noise, hum, and PL tones below 300 Hz without affecting response above 300 Hz.

4.1.3.6 Squelch Circuit

4.1.3.6.1 The squelch circuit consists essentially of an integrated circuit containing four operational amplifiers, a full-wave rectifier, a variable time constant circuit, and two current drivers. The audio output from detector buffer U50A is coupled through capacitor C51 to first amplifier U2100A. This amplifier operates as an audio-captured limiter that reduces high frequency modulation noise. The output from U2100A is adjusted by SQ (squelch adjust) potentiometer R2103, which controls the noise queting level at which the squelch operates. The audio is then applied to second amplifier U2100B. Amplifier U2100B amplifies squelch noise above 12 kHz, and also acts as a temperature-compensated stage whose gain varies with temperature to track changes in characteristics of diodes CR2102 through CR2105. These diodes form the full-wave rectifier that increases the operating speed of the squelch circuit by detecting both positive and negative noise spikes. This produces a dc output from third operational amplifier U2100C that is proportional to the receiver quieting level.

4.1.3.6.2 Operational amplifier U2100D integrates the dc output from U2100C using resistor R2111 and capacitor C2107 and compares the dc average with a fixed reference voltage at pin 13 of U2100D. The reference voltage is determined by resistors R2113 and R2114. When the carrier signal is absent, the dc voltage at pin 3 is below the reference voltage, causing the output from U2100D to go high. This turns on current driver Q2101, which applies a high to the *DVP* muting circuitry, via P352-12. This causes the *DVP* circuitry to put a high on the base of Q2102, supplying a high voltage to Q50, and muting the receive audio. When the carrier signal is present and quieting occurs, the dc voltage at pin 3 rises above the reference voltage. This drives the output of U2100D low, turning off Q2101 and applying a low to the *DVP* muting circuitry. The *DVP* muting circuitry then applies a low to the base of Q2102, unmuting the receive audio. The squelch circuit is defeated by pushing the squelch pushbutton in. This prevents Q2101 from applying a high to the *DVP* board, thus keeping the audio unmuted.

4.1.3.6.3 The receiver audio can also be muted or unmuted by the receive audio mute signal supplied by the PL/DPL Squelch or *Select 5* signaling circuits. When a valid PL/DPL code is not detected, the receive audio mute signal at connector P352-12 is high. This applies a high to the *DVP* muting circuitry, which responds by putting a high voltage on the base of Q2102, muting the receiver.

4.1.3.6.4 In PL/DPL radios, the PL/DPL decoder circuit unmutes the audio by supplying an active low receive audio mute signal to the *DVP* mute circuitry, via connector P352-12. For weak signals, the squelch circuit would otherwise mute the audio with a high voltage from the emitter of Q2101. This enables reception of weak signals that are below the squelch circuit threshold of 10 dBq, but are above the decode threshold of the PL/DPL decoder circuit (approximately 6 dBq.).

4.1.3.6.5 Transistor Q2100 reduces squelch closing time depending on the strength of the carrier signal. The closing time is determined by the charging time (r-c time constant) of resistor R2116 and capacitor C2109. For weak carrier signals, a longer time constant is produced (approximately 200 milliseconds); for stronger signals, a faster time constant is produced (approximately 0.1 milliseconds). As the carrier level increases, the dc output from U2100C increases proportionally. This turns on Q2100, reducing the charge through C2109 and allowing the base of Q2101 to follow the output of U2100D. For dekey of strong signals, sudden negative-going spikes at the output of U2100C rapidly turn off Q2100 via diode CR2106. This causes positive pulses at the base of Q2101, muting the audio fast enough that no squelch tail is heard. The base of Q2101 is maintained high by the output of U2100D, via resistor R2116.

4.1.3.7 Busy Light Circuit
(Refer to Main Board and Power Interconnect Board)

4.1.3.7.1 The Busy light circuit is mounted on the Busy light board and is used in PL/DPL squelch or *Select 5* signaling models. The circuit controls the Busy liht on the front panel. The Busy light is an orange LED that lights to indicate that a channel is in use.

4.1.3.7.2 The Busy light circuit is controlled by the sense signal developed by limiter/quadrature detector U2, the squelch output of U2100D, and the 9.6T keying voltage. The sense signal is a dc voltage that varies in proportion to the signal level present in the receiver i-f. In single front end receivers, the sense signal varies from approximately 2.1 V dc (no receiver i-f signal) to 4.6 V dc (strong receiver i-f signal). In widespaced dual front end receivers, the no-signal voltage is approximately 1.5 V dc.

4.1.3.7.3 In the absense of an on-channel signal, the sense voltage of the base of switch Q1200 is below the reference voltage at its emitter. The reference voltage is determined by BUSY LIGHT ADJ potentiometer R1202. A clockwise adjustment reduces the threshold sensitivity. The reference voltage keeps switch Q1200, current driver Q1201, and the Busy light off. When a signal is present in the receiver i-f, the increased sense voltage turns on switch Q1200. This turns on current driver Q1201, supplying current to the LED via resistors R1206 and R1207, causing it to illuminate. The emitter of Q1200 is returned to the 9.6T keying voltage rather than to ground to prevent the Busy light from turning on due to transmitter sideband noise present in the receiver i-f during transmit.

4.1.3.7.4 The squelch output of U2100D is used to insure that the Busy LED does not turn on unless the squelch circuitry has also determined that carrier is present. This prevents the LED from turning on when the radio is in a very noisy rf environment where the sense signal would rise high enough to turn on the LED, even though the radio is not receiving a transmission. The collector of Q2103 forces the busy light control signal low (LED off) unless the squelch circuit detects carrier.

4.2 TRANSMITTER CIRCUITS

4.2.1 PTT Logic Circuit

(Refer to Main Board and Power Interconnect Board)

4.2.1.1 The PTT logic circuit generates the 9.6T voltage (keyed +9.6 V dc) used to key the transmitter. The circuit also mutes the microphone audio supplied to the transmit audio/IDC circuit during receive and unmutes the audio during transmit.

4.2.1.2 The PTT logic consists of ignition control stage Q304 (used in models with ignition control option B113 only), mic mute control Q303, active jumper Q308, and 9.6T switch Q302 and Q307. The 9.6T keying voltage is generated at the common collectors of Q302 and Q307. In the receive mode, Q302 is held off and Q307 is held on due to voltage divider network R310, R311, R316, and R317. The 9.6T keying voltage is, therefore, low (near ground potential).

4.2.1.3 The PTT logic circuit can be controlled by any of six sources.

- The microphone, via J350-14 in front mount radios or P380-1 in remote mount radios,
- The *DVP* circuitry,
- The PL/DPL squelch or *Select 5* signaling circuits,
- The time-out timer circuits (when used as an option in carrier-squelch models only),
- The vehicle's ignition switch (in ignition control option B113 only), or
- Accessories connected externally via J350-6.

4.2.1.4 Pressing the microphone push-to-talk button supplies a mic PTT ground signal, via J350-14 and jumper JU302, to mic mute control Q303. (In remote mount radios, the mic PTT signal from connector P380-1 is also applied to Q303 along this path.) Transistor Q303 turns on due to the base-emitter current flowing through it, and supplies a low mic mute signal to turn on mic audio mute gate Q325 via R327 in the transmit audio/IDC circuit. Turning on Q325 allows microphone audio to be passed to the audio circuits. With the ignition control option, jumper JU302 is cut, R313 and Q304 are added, and Q303 is controlled by ignition control transistor Q304. In this option, the positive voltage from the vehicle's ignition switch, routed to the radio via an additional orange wire, supplies current to the base of Q304 via R313. This allows the mic PTT signal to key Q303, via the saturated stage Q304.

4.2.1.5 In carrier-squelch radios, when Q303 is keyed via a low mic PTT signal at the emitter (TP44), the base voltage (TP43) goes low. This supplies a low PTT signal to the *DVP* PTT circuitry via P352-4. The *DVP* PTT circuitry grounds P352-5, the base of Q308. This allows the *DVP* circuitry to control the 9.6T generating transistors, Q302 and Q307 via P352-3 (TP41). When PTT goes low, the *DVP* circuitry puts a low on the base of Q302 and Q307, providing the 9.6T keying voltage (actually 9.5 V dc due to Q302's saturation voltage) at the collector of Q302 (TP39).

4.2.1.6 In carrier-squelch models with the time-out timer option, operation is similar to above, except that the time-out timer also has an input to the *DVP* PTT circuitry. The time-out timer monitors the voltage at TP43, low with the microphone keyed, via P352-4. At time-out, the timer circuit puts a low on the TOT line (J101-24) going to the *DVP* PTT circuitry. This causes the *DVP* circuitry to remove the low on the base of Q302 and Q307, removing the 9.6T keying voltage.

4.2.1.7 In PL/DPL squelch models, the PL/DPL circuits monitor mic PTT status via P352-4. When the mic PTT signal goes low, the PL/DPL circuitry then supplies an option delayed PTT low signal to the *DVP* PTT circuitry, via J101-25. The *DVP* circuitry then controls the 9.6T keying voltage via J352-3.

4.2.1.8 Radios with *Select 5* signaling or with external accessories connected via J350 key the transmitter by supplying a low at TP43 via P352-4 (*Select 5)* or J350-6 (accessories). This keys the transmitter via a low PTT signal to the *DVP* PTT circuitry. Also, because Q303 base is grounded, this stage as well as Q325 cannot turn on, muting microphone audio during transmissions initiated by *Select 5* signaling or accessory circuits.

4.2.2 Transmit Audio/IDC Circuit

(Refer to the Main Board and Power Interconnect Board)

4.2.2.1 The transmit audio/IDC circuit consists of mic audio mute gate Q325, operational amplifier/limiter U325A, splatter filter U325B, *DVP* audio switch U105A and B and IDC mute gate Q326.

4.2.2.2 Audio is applied to mic audio mute gate Q325 from the microphone, via connector P350-12 (front mount radios), or connector P380-4 (remote mount radios). When Q325 is turned on by the low mic mute signal from the PTT logic circuit (Q303), the audio output from Q325 is applied through pre-emphasis network C326 and R328 to operational amplifier/limiter U325A. Transmit audio from options or accessories can also be inserted into the audio path via connectors J350-2 and P352-17. Resistor R329 and capacitor C327 provide a flat response for the option transmit audio. Diode CR325 limits the audio output from U325A to a symmetrical waveshape centered at approximately 4.8 V dc. Resistors R331, R332, and R333 form a 6 dB attenuation pad that prevents the full-limited output of U325A from causing clipping in the output of splatter filter U325B. Capacitor C333 and inductor L325 reduce adjacent channel splatter by filtering harmonics above the audio passband.

4.2.2.3 The PL/DPL signals from the PL/DPL circuits are inserted into the audio input of the splatter filter, via connector P352-20, at the junction of resistors R331 through R334. PL/DPL insertion after the limiter maintains constant PL deviation regardless of the degree of limiting.

4.2.2.4 The output from the splatter filter goes to the *DVP* circuitry via J1001 (IDC AUDIO) and J101-15. If it is a coded transmission the audio is converted to a digital waveform by U103, encrypted by HY101, and splatter filtered by U102. The signal then goes to potentiometers R158 and R161. R158 adjusts the level of *DVP* signal sent back into the VCO modulation path to Q326, via J101-17 and J1002 (VCO MOD). R161 adjusts the level of *DVP* signal sent to the 14.4 MHz reference oscillator via J352-16. If the transmission is in a clear mode, the audio comes back unaltered from the *DVP* circuitry to Q326, via J101-17 and J1002 (VCO MOD). IDC mute gate Q326 is cut off in the receive mode due to the absence of the 9.6T keying voltage at its base. When cut off, Q326 prevents noise in the IDC stages from modulating the VCO. During transmit, the gate is turned on as the 9.6T keying voltage is applied to its base via R337. The output from the gate is coupled through capacitor C331 to VCO MOD potentiometer R341, which adjusts the deviation level of the VCO modulation. The output from the potentiometer is the VCO modulation signal used to drive the VCO hybrid in the frequency synthesizer circuits. If the radio has the PL/DPL option, the PL/DPL circuitry will also modulate the 14.4 MHz reference oscillator. The reference modulation signal is sent from the PL/DPL circuitry via J352-16 to the REF MOD level-adjust potentiometer R344, and from there to the 14.4 MHz oscillator in the frequency synthesizer circuitry.

4.2.2.5 The two modulating signals carry information at different frequencies. The VCO modulation line carries information above 50 Hz and the reference modulation line carries information below 50 Hz. Two IDC outputs are used because, due to the nature of the frequency synthesizer correction loop, the VCO cannot be modulated below 50 Hz without the loop tracking out the signal, resulting in no modulation of the synthesizer VCO. However, by modulating the reference oscillator with frequencies below 50 Hz, the synthesizer correction loop can track frequency changes down to nearly 0 Hz. This technique, called "dual port modulation", allows modulation to take place over a very wide range of frequencies, while maintaining practical amounts of loop filtering and reasonable lock times.

4.2.3 Transmit Power and Level Control Circuit

(Refer to Main Board and Power Interconnect Board)

4.2.3.1 The transmit power and level control circuit consists of differential amplifier U300B and transistors Q225 through Q228. The circuits form a control loop that reduces or inhibits the rf drive, therefore the transmitter rf output power, if any of the following occurs.

- LLA (low level amplifier) A+ voltage, which controls rf drive available from the low level amplifier, exceeds a preset maximum limit;
- Short-circuit in LLA A+ line;
- RF output power becomes excessive;
- Load mismatch becomes excessive;
- Overtemperature conditions exists (25/30 watt power amplifier only);
- Synthesizer goes out-of-lock.

4.2.3.2 The directional coupler signal monitors the rf output power, the temperature compensation signal monitors the directional coupler temperature, the heat sense signal monitors the temperature of the 30 watt power amplifier, and the lock detect signal monitors synthesizer lock condition.

4.2.3.3 Transistor Q225 utilizes the PA A+ voltage to supply the regulated LLA A+ voltage to the low level amplifier. Differential amplifier U300B compares any parameter changes to a fixed dc reference voltage and develops a correction signal that adjusts the LLA A+ voltage, to offset the changes. The fixed dc reference voltage determined by resistor network R238, R239, R240 and voltage limit potentiometer R236, is applied to the positive input of U300B. The sensing voltage appears at the negative input of U300B. The dc level at this input is determined by the voltage divider circuit of R243, R244, and R246, and PWR ADJ potentiometer R245. The PWR ADJ potentiometer sets the rf output power level of the transmitter. Once set, the loop maintains this output power. During normal operation, the voltage levels at both the positive and negative inputs of U300B is approximately +5 V dc.

4.2.3.4 If the rf output power increases, the directional coupler monitoring signal decreases. This lowers the dc level at the negative input of U300B, causing the output from U300B to increase. This decreases the current through Q227, causing the output from series-pass transistors Q225 and Q226 to decrease. This lowers the LLA A+ voltage, reducing the gain of the low level amplifier. With lowered gain, the rf drive is reduced, causing the rf output power to be reduced to the desired level. As a result, a constant power level independent of frequency and temperature is maintained.

4.2.3.5 In the 30 watt power amplifier only, the negative input of U300B also samples the heat sense monitoring signal developed by the thermistor (RT1401) mounted near the power transistor. If the temperature rises above 120°C the heat sense monitoring voltage decreases. This causes diode CR227 to conduct, reducing the voltage at the negative input of U300B. This, in turn, causes the correction loop to reduce the LLA A+ voltage until the temperature is stabilized.

4.2.3.6 The LLA + voltage is made self-limiting by voltage limit adjust potentiometer R236, resistor R237, and diode CR226. If the LLA A+ voltage rises above the level set by potentiometer R236, diode CR226 conducts, increasing the voltage at the positive input of U300B. This increases the output from U300B, causing the correction loop to reduce the LLA A+ voltage to the preset level. The positive input of U300B is also controlled by the temperature compensation monitoring signal developed by a temperature- sensitive diode (CR1451) located near the directional coupler. Increased temperature at the directional coupler causes the correction loop to reduce the LLA A+ voltage.

4.2.3.7 The LLA A+ voltage is disabled if the synthesizer goes out-of-lock. Normally, the lock detect signal from the frequency synthesizer circuits is low. This keeps Q228 switched off, which keeps the LLA A+ voltage on. If the synthesizer goes out-of-lock, the lock detect signal goes high. This switches on Q228, which applies a ground to the base of Q226. This turns off Q225 and Q226, disabling the LLA A+ voltage.

4.2.3.8 The LLA A+ voltage is also turned off if the LLA A+ line is short-circuited to ground. Diode CR225 becomes forward biased at this time, turning off Q225 and Q226.

4.2.3.9 The LLA A+ voltage is disabled during receive mode. Because the 9.6T keying voltage is absent, the negative input of U300B is forced low, causing the output from U300B to rise towards the PA A+ supply voltage. This effectively removes the drive from the base of Q226, allowing the PA A+ voltage, via resistor R225, to keep Q225 off.

4.2.4 Low Level Amplifier

(Refer to Power Amplifier schematic diagram)

The low level amplifier supplies the rf drive for the 10 watt power amplifier. The 136 to 174 MHz transmit injection signal from the frequency synthesizer circuits is applied through a 3 dB resistor pad to the input of the low level amplifier. The pad, comprised of resistors R1451, R1452, and R1453, attenuates and isolates the synthesizer from low level amplifier input impedance variations. The injection signal is passed through a high pass filter network to remove low frequency spurious signals before being applied to the two-stage, non-linear amplifiers Q200 and Q201. Collector power for the two stages is the LLA A+ voltage supplied by the transmitter power and level control circuit, via feedthrough capacitor C214 on the feedthrough plate. The LLA A+ voltage controls the gain of the low level amplifier and is precisely regulated to maintain the rf output power level at the preset level. The 2.2 watt output from the amplifier is applied through an attenuation network composed of resistors R1454 through R1457, to the input of the 10 watt power amplifier. The attenuation is 2.3 dB in 10 watt transmitters; 1 dB in 30 watt transmitters. The pad isolates the low level amplifier from input variations of the power amplifier.

4.2.5 10 Watt Power Amplifier

(Refer to Power Amplifier schematic diagram)

4.2.5.1 The 10 watt power amplifier consists of a single non-linear amplifier stage, Q250. The power amplifier produces the final rf output for the low power *DVP MCX100* radio set. In radio sets that use the 30 watt power amplifier, the 10 watt unit is used to drive this high power amplifier. Operating voltage for the power amplifier is the PA A+ voltage suppied by the power distribution circuit. The voltage is applied via feedthrough capacitor C263 on the feedthrough plate.

4.2.5.2 The rf output from the 10 watt power amplifier is applied along a microstrip transmission line to the harmonic filter/antenna switch. The length of the microstrip is selected to maximize the attenuation of second harmonics.

4.2.6 30 Watt Power Amplifier
(Refer to Power Amplifier schematic diagram)

4.2.6.1 The 30 watt power amplifier is driven by the 10 watt power amplifier via a coaxial cable. The 30 watt power amplifier uses a single, non-linear power transistor, Q1400. The PA A+ voltage from the power distribution circuits supplies the operating voltage for the power amplifier. Thermistor RT1400 is mounted near the power transistor. RT1400 controls the output power of the transmitter to keep the temperature within safe limits.

4.2.6.2 The temperature of Q1400 is monitored by the heat sense signal returned to the transmit power and level control circuit via feedthrough capacitors C1416 (on the 30 watt power amplifier) and C267 (on the feedthrough plate). If the temperature reaches 120 °C, the resistance of RT1400 decreases. This is reflected on the heat sense monitoring signal to cause the control circuit to reduce the output power until the temperature is stabilized. The final rf output from the power amplifier is routed to the harmonic filter/antenna switch hybrid on the PA interconnect board.

4.2.7 Harmonic Filter/Antenna Switch
(Refer to Power Amplifier schematic diagram)

4.2.7.1 The 10 watt rf signal (or the 30 watt rf signal) is applied to the input port of the antenna switch. The antenna switch is controlled by the 9.6T keying signal generated by the PTT logic circuit. The signal is supplied via feedthrough capacitor C296 on the feedthrough plate.

4.2.7.2 With the radio set in the transmit mode, the 9.6T keying signal is enabled. The antenna switch directs the rf signal through the transmit port of the switch, through the harmonic filter and directional coupler to the antenna. In the receive mode, the 9.6T keying signal is grounded. Incoming receive rf is then reflected back through the directional coupler and harmonic filter, and through the receive port of the antenna switch to the input of the receiver front end. The harmonic filter removes spurious signals generated by the power amplifiers and the antenna switch by presenting a high VSWR (voltage standing wave ratio) load to all frequencies above the VHF range.

4.2.7.3 The directional coupler is a microstrip that senses forward and reflected power in the rf output line. The forward and reflected ports of the coupler are directed to their respective detector circuits where the signals are filtered, rectified, weighted, and summed to produce a dc voltage that is proportional to the sum of the forward and reflected power. This dc voltage, which decreases with increased power, is the directional coupler monitoring signal that is returned to the transmit power and level control circuit, via feedthrough capacitor C294 on the feedthrough plate. If the rf output power increases to a level that could damage the power amplifier circuits, the directional coupler monitoring signal causes the control circuit to reduce the rf output power to a safe level.

4.2.7.4 The temperature of the directional coupler is monitored by diode CR1451. The diode sends a temperature compensation monitoring signal to the transmit power and level control circuit via feedthrough capacitor C295 on the feedthrough plate. As directional coupler temperature varies, due to ambient conditions or dissipation, the changing forward voltage drop of CR1451 is sensed by the transmit power and level control circuit. The changing voltage drop acts to offset the rf output power variations which would otherwise occur due to temperature-induced changing characteristics of the directional coupler.

4.3 FREQUENCY SYNTHESIZER CIRCUITS

The frequency synthesizer consists of the channel selection and display circuits, the synthesizer board circuits, and the VCO hybrid circuits. The channel selection and display circuits, which include the front panel channel selector switch and LED display, are covered in the functional description of the frequency synthesizer circuits and are not detailed here.

4.3.1 Synthesizer Board Circuits

NOTE

Except for the divider/phase detector (U115) circuit description, the following descriptions refer to the schematic diagrams in the Synthesizer section.

4.3.1.1 14.4 MHz Reference Oscillator

The 14.4 MHz reference oscillator provides a stable reference for the frequency synthesizer. The oscillator is completely self-contained and nonserviceable. During transmit operation, low frequency (below 50 Hz) *DVP* and DPL signals are routed directly to the reference oscillator. This is required because divider/phase detector U115 can track low frequency modulation, and prevent direct low frequency audio (frequencies required for *DVP* and DPL) from modulating the VCO.

4.3.1.2 Frequency Select PROM

Frequency selection data (factory or field programmed) in the PROM is addressed by five binary bits from the channel selector switch via five address lines, A0 through A4. The five bits comprise the channel select word.

NOTE

On the synthesizer schematic diagram, use the address line designations on the outside of the U117 symbol. The designations inside the symbol do not correspond to the channel select address lines.

Frequency selection in the PROM is further determined by the presence or absence of transmitter keying signal, 9.6T, at pin 5 of the PROM as follows:

- Presence of 9.6T: data words specify transmit frequency
- Absence of 9.6T: data words specify receive frequency.

Data words transfer from PROM U117, to divider U115, when a +5 volt enable signal at pin 15 (VCC) coincides with arrival of a word select signal (three address bits, A0-A2) from the divider. Frequency data is transferred to the divider by six 4-bit words on data lines D0 through D3.

4.3.1.3 PROM Enable Circuit

4.3.1.3.1 The PROM enable circuit allows divider/phase detector U115 to address the PROM for either of three conditions:

- The transmitter is keyed.
- The frequency is changed.
- The synthesizer goes out-of-lock.

When the transmitter is keyed the PROM enable circuit is controlled by the 9.6T keying voltage, either directly or via U351, depending on the model. When the frequency is changed the circuit is controlled by the A0 address line from the channel selector switch, or by the output (FC) of frequency change detector U351, depending on the model. If the synthesizer goes out-of-lock, the circuit is controlled by the lock detect switch.

4.3.1.3.2 The PROM enable circuit used with the TRN5243A synthesizer consists of IC U116 and output inverters Q118, Q119, and Q120. The 9.6T keying voltage or a change in frequency is sensed by frequency change detector U351. U351 produces a positive going pulse on the FC line for every change in an input line (A0-A4 or 9.6T). The positive pulse sets flip-flop U116A and U116B, causing the output to go high. This turns on Q118, driving Q118 output low.

4.3.1.3.3 The output of Q118 is connected to the $\overline{\text{LOCK}}$ output line of divider U115. The output of Q118 is driven low and forces the lock detector switch into an out-of-lock condition. This causes the lock detect switch to generate a high lock detect signal that is fed back to series-connected NOR gates U116C and U116D. The high output from NOR gate U116D turns on Q120, driving its output low, and resets flip-flop U116A and B. The low output of Q120 is the read enable signal applied to the enable input of U115. With the enable input activated, U115 outputs a 10 microsecond low $\overline{\text{STROBE}}$ signal that reoccurs every 200 microseconds. The low $\overline{\text{STROBE}}$ signal turns on Q119. When Q119 turns on, it turns on Q115, and when Q115 turns on, it supplies +5 V dc enabling voltage to the VCC pin of the PROM. With the PROM enabled, frequency data is read from the PROM to the divider U115.

4.3.1.3.4 When the synthesizer locks onto the correct frequency, the $\overline{\text{LOCK}}$ output from U115 goes high. This disables the enable input to U115, disabling in turn the $\overline{\text{STROBE}}$ output from U115. With the $\overline{\text{STROBE}}$ output disabled, power is removed from the PROM, and the PROM enable circuit reverts to its initial condition.

4.3.1.4 Divider/Phase Detector

(Refer to Synthesizer section 68P81045E88, in the service manual.) The divider/phase detector contains the following circuits:

- multiplex control
- six 4-bit latches
- loop divider (programmable)
- phase detector
- reference divider (programmable)

4.3.1.4.1 Multiplex Control

The multiplex control circuit performs three functions:

- Three address bits on lines A0 through A2 select 4-bit words in the PROM. The selected 4-bit words containing frequency data are transferred from the PROM to the six 4-bit latches.
- An ENABLE signal initiates generation of 10 microsecond $\overline{\text{STROBE}}$ signals that reoccur every 200 microseconds.
- Produces a LATCH CONTROL signal that determines which data words are stored in each of the six latch registers.

4.3.1.4.2 Latch Circuits

4.3.1.4.2.1 The six 4-bit latches are activated when the multiplex control circuit receives the active (low) enable signal from the PROM enable circuit. The multiplex control circuit also applies a latch control to the six 4-bit latches.

4.3.1.4.2.2 The information stored in the six 4-bit latches determines the values (A and B) for the counters in the loop divider. The stored information also determines the output levels of the S1, $\overline{VCO1}$, and $\overline{VCO2}$ signals appearing at pins 17, 19, and 20, respectively, of U115. These signals are applied to the frequency shift logic circuit to determine at which sub-range the VCO operates.

4.3.1.4.2.3 The $\overline{S0}$ signal from the latch registers, appearing at pin 18, is used only with dual front end receiver models. The signal is used to select one of two 6 MHz filters at the front end of the receiver. When the $\overline{S0}$ signal is low, the low range 6 MHz filter is switched into the rf signal path. When the $\overline{S0}$ signal is high, the high range 6 MHz filter is switched into the rf signal path.

4.3.1.4.3 Loop Divider

The loop divider contains a double-programmable dual modulus counter. The counter acts as a programmable divider for the VCO rf feedback signal from the VCO output by dividing by 64 for a programmable number of (A) cycles, and then by 63 for another programmable number of (B) cycles. Divider rf buffer Q192 isolates the VCO rf feedback signal from the divider. The loop divider divides the VCO feedback signal by 64 "A" times and by 63 "B" times. The output of the loop divider counters is the loop frequency signal that is applied as the second input to the phase detector. The loop frequency signal is the VCO output signal frequency divided by (64A and 63B). The loop frequency is applied to one input of the phase detector.

4.3.1.4.4 Reference Divider

The reference divider divides the 14.4 MHz signal from the reference oscillator to any of three reference frequencies: 4.166 kHz, 5.0 kHz, or 6.25 kHz. These frequencies are determined by the channel spacing of the *DVP MCX100* radio set. The reference frequency is applied as one input to the phase detector.

4.3.1.4.5 Phase Detector

The phase detector compares the reference and loop frequency outputs from the two dividers for frequency and phase. The phase detector uses the frequency and phase relationships to produce pulses for the $\overline{UP}$ and DOWN output lines. If the loop frequency is lower than the reference frequency, the phase detector produces a number of $\overline{UP}$ error pulses that is proportional to the amount of error. If the loop frequency is higher than the reference frequency, the phase detector produces DOWN error pulses. The $\overline{UP}$ and DOWN error pulses are applied to the charge pump and loop filter circuit to affect the output frequency of the VCO. The output of the phase detector continues to adjust the VCO output frequency until the loop frequency equals the reference frequency. The synthesizer is then "locked" on frequency and a logic high is generated at the $\overline{LOCK}$ output of the phase detector. The logic high is applied to the lock detect switch. The lock detect switch controls the various transmitter and receiver circuits that are disabled when the synthesizer is out of lock.

4.3.1.5 Lock Detect Switch Circuit

4.3.1.5.1 The lock detect switch monitors the $\overline{LOCK}$ output from divider/phase detector U115. When the $\overline{LOCK}$ output is high, the synthesizer is locked onto the correct frequency, and when it is low, the synthesizer is out-of-lock. When the synthesizer goes out-of-lock, the lock detect switch supplies a high LOCK DET signal to disable the transmitter (during the transmit mode) or to disable the receiver (during the receiver mode). The high LOCK DET TRIGGER output is also applied to the PROM enable circuit to energize the PROM.

4.3.1.5.2 The lock detect switch consists of Schmitt trigger Q154 and Q155, and inverter Q156. The LOCK DET TRIGGER signal is developed at the collector of Q156. When the $\overline{LOCK}$ output from U115 is high (synthesizer in-lock), the high output keeps Q154 on and Q155 off. When Q155 is off, Q156 is also off, thus keeping its collector output low.

4.3.1.5.3 When the $\overline{LOCK}$ output from U115 goes low (synthesizer frequency out-of-lock), the low error pulses are filtered by integrator network R159 and C156. When the pulses are wide enough, the dc voltage at the junction of R159 and C156 falls below the threshold voltage of the Schmitt trigger, causing it to change state. This turns on Q156, driving its output high, thus activating the LOCK DET TRIGGER signal. The Schmitt trigger returns to its original state when the charge on capacitor C156 is sufficiently high to turn on Q154.

4.3.1.5.4 Radios using the TRN5243A Synthesizer Board and TRN5241A/TRN5244A Front Panel Interconnect Board also contain lock detect delay IC U350. U350 outputs a pulse of longer duration than the lock detect pulse, to make sure that the synthesizer in radios equipped with the *Channel Scan* monitor option is locked before squelch status is checked.

4.3.1.6 Charge Pump And Loop Filter Circuit

4.3.1.6.1 The charge pump and loop filter circuit converts the $\overline{UP}$ and DOWN pulses generated by divider/phase detector U115 to the dc VCO steering line voltage. The VCO steering line voltage determines the operating frequency of the VCO. Pulses on the $\overline{UP}$ line increase the VCO steering line voltage (increasing the VCO operating frequency), whereas pulses on the DOWN line decrease the VCO steering line voltage (decreasing the VCO operating frequency).

4.3.1.6.2 The VCO steering line voltage is developed by transistors Q150, Q152, and Q153. Transistors Q152 and Q153 comprise the charge pump that serves as the current source to increase or decrease the amount of charge on loop filter capacitor C150. Capacitor C150 and resistor R156 form the loop filter that controls the stability and response of the VCO feedback loop. Transistor Q150 serves to limit the voltage on the U115 $\overline{UP}$ line to 5 V dc.

4.3.1.6.3 The dc output from the charge pump is filtered by reisistors R157 and R158; capacitors C151 and C152; and inductor L127. The filter removes undesireable noise and variations from divider/phase detector U115 that would otherwise modulate the VCO. The filtered dc VCO steering line voltage is applied to the VCO to adjust its frequency.

4.3.1.7 Frequency Shift Logic Circuit

4.3.1.7.1 The *DVP MCX100* radio set provides extended frequency coverage in two ranges: 136 to 162 MHz (Range I) and 146 to 174 MHz (Range II). To allow the VCO to operate within this wide frequency band, the two frequency ranges are divided into two sub-ranges. For Range 1, the VCO operating sub-range is 114.6 to 162.0 MHz. For Range II, the VCO operating sub-range is 124.6 to 174.0 MHz. To select the proper VCO sub-range, the frequency shift logic circuit develops 16 discrete switching conditions on six data lines. The data lines control PIN (diode) switches in the VCO hybrid that switch (shift) the VCO to the proper sub-range frequency. The VCO is shifted up or down in increments of 6.2 MHz, 12.4 MHz, or 24.8 MHz.

4.3.1.7.2 The frequency shift logic circuit consists of transistors Q171 and Q172, and IC U171. The circuit is controlled by the $\overline{VCO1}$, $\overline{VCO2}$, and $\overline{S1}$ data outputs from divider/phase detector U115, the frequency and shift information is initially stored in the PROM and is transferred into U115 as a four-bit word.

4.3.1.7.3 The $\overline{VCO1}$, $\overline{VCO2}$, and $\overline{S1}$ data outputs from U115 develop corresponding frequency range shift signals, designated S3, S2, and S1, respectively, used to control the frequency shift. Each frequency range switch signal, in turn, consists of complimentary logic outputs. Logic outputs S3, and $\overline{S3}$ control the 6 MHz shift. Logic outputs S2 and $\overline{S2}$ control the 12 MHz shift, and logic outputs S1 and $\overline{S1}$ control the 24.8 MHz shift. Transistors Q171 and Q172 generate the S3 and $\overline{S3}$ logic outputs, whereas U171 generates the remaining logic outputs. When a logic output is high, it is at +8 V dc. When it is low, it is at ground. The logic outputs are applied on the six data lines to the PIN switching decodes to shift the VCO to the proper sub-range frequency.

4.3.1.7.4 Depending on the frequency shift selected, the dc voltage on the VCO steering line (between +3 and + 8 V dc) is shifted up or down by 5 V dc. Since the voltage level on the VCO steering line determines the VCO operating frequency within the sub-range, the frequency shift changes the VCO operating frequency accordingly. An increase in the VCO steering line voltage increases the VCO operating frequency. Conversely, a decrease in the VCO steering line voltage decreases the VCO operating frequency.

4.3.1.7.5 Table 1 tabulates the eight descrete switching conductors outputted by the frequency shift logic circuit. For each switching condition, the table shows the logic states of the S1, S2, and S3 frequency range select signals, and the sub-range frequency at which the VCO is operating.

Table 1.
Frequency Shifting of VCO Sub-Range Frequencies

Switching Condition	Frequency Range Select Signals S1	S2	S3	VCO Sub-Range Range I	Range II
1	0	0	1	114.6 to 120.595	124.6 to 130.595
2	0	0	0	120.6 to 126.595	130.6 to 136.795
3	0	1	1	126.6 to 132.495	136.8 to 142.995
4	0	1	0	132.5 to 138.395	143.0 to 149.195
5	1	0	1	138.4 to 144.295	149.2 to 155.395
6	1	0	0	144.3 to 150.195	155.4 to 161.595
7	1	1	1	150.2 to 156.095	161.6 to 167.795
8	1	1	0	156.1 to 162.0	167.8 to 174.0

4.3.1.8 VCO Buffers And Transmit/Receive Injection Switch

4.3.1.8.1 The VCO Buffers and transmit/receive injection switch route the rf output from the VCO to either the transmit or receive injection ports on the synthesizer board. The VCO buffers isolate the VCO tank circuits from varying loads and noise generated by the transmit/receive switch.

4.3.1.8.2 The VCO buffers consist of transmit/receive buffer Q190 and divider rf buffer Q192. The rf output from the VCO is applied to the base of Q190. The amplified VCO rf is then applied to the anodes of PIN diodes CR190 and CR191. Diode CR190 is in the transmit injection line and diode CR191 is in the receive injection line. Depending on the biasing of the diodes, amplified VCO rf is switched to either the transmit or receive injection line.

4.3.1.8.3 The biasing of the diodes is controlled by transmit/receive injection switch Q191. When the transmitter is keyed, the 9.6T keying voltage is applied to the cathode of CR190 and to the base of Q191. The 9.6T applied to CR190 forward biases the diode, switching the amplified VCO rf to the transmit injection port. From this port, the signal is applied as the 136 to 174 MHz transmitter injection signal to the low level amplifier in the transmitter. The 9.6T voltage applied to Q191 turns on Q190, effectively reverse-biasing CR191. In the absence of the 9.6T keying voltage (signal low) the reverse action takes place. Diode CR191 becomes forward biased, switching amplified VCO rf to the receive injection port. The output is the 114.4 to 152.6 MHz receive injection signal that is routed to the mixer in the receiver.

4.3.1.8.4 The amplified VCO rf output from Q191 is also applied to divider rf buffer Q192. The output from Q192 is a buffered VCO rf signal that is applied to the loop divider in divider/phase detector U115 to generate the loop frequency signal.

4.3.1.9 VCO AGC Circuit

The VCO AGC circuit provides a constant rf level in the VCO tank circuit. The VCO AGC circuit consists of transistors Q188 and Q189. A rectified dc sample of the VCO rf output is applied as the AGC detect signal to the base of Q189. If the level of the signal increases, indicating a rise in the VCO rf output, Q189 conducts more, causing a corresponding decrease in the current flow through current driver Q188. Since the collector output of Q188 is the AGC control signal coupled to the source of the VCO FET, the decreased AGC control curent reduces the VCO tank voltage to offset the increased rf output. Conversely, a corresponding decrease in the VCO rf level would cause the AGC control signal to rise, increasing the VCO tank voltage and raising the VCO rf level.

4.3.2 VCO Hybrid Circuits
(Refer to Synthesizer schematic diagram)

The VCO hybrid circuits are functionaly arranged into the VCO steering line, the PIN (diode) switches, the VCO modulator, and the VCO.

4.3.2.1 VCO Steering Line

4.3.2.1.1 The dc voltage on the VCO steering line determines the operating frequency of the VCO within the sub-range selected by the frequency shift logic circuit. The steering line output is determined by the $\overline{\text{UP}}$ and DOWN pulses generated by divider/phase detector U115 (on the synthesizer board), and which is converted and filtered to a dc voltage by the charge pump and loop filter circuit (also on the synthesizer board). The dc voltage is applied to the network of varactor diodes that control the frequency of the VCO. When the VCO frequency is not equal to the desired frequency, the dc voltage on the VCO steering line steps to another level to change the VCO operating frequency. When the VCO locks to the desired frequency, the VCO steering line maintains a constant voltage level.

4.3.2.1.2 The varactor diode network consists of CR1301 through CR1304. Capacitor C1307 couples the varactor network to the VCO tank circuit, via the VCO transmission line. The varactor network is configured to prevent high level rf from the VCO transmission line from being rectified by the varactor diodes. This eliminates noise that might otherwise modulate the VCO.

4.3.2.1.3 The capacitance of the varactor diodes determines the reactance of the VCO tank circuit, and therefore the operating frequency. The dc voltage level present on the VCO steering line determines the capacitance of the varactor diodes. Variations in their capacitance therefore change the VCO tank circuit reactance, varying the VCO operating frequency. The range of levels present on the VCO steering line extends from +3 to +8 V dc. An increase in VCO steering line voltage causes the capacitance of the varactor diodes to decrease and the VCO frequency to increase. Conversely, a decrease in VCO steering line voltage causes an increase in the capacitance of the varactor diodes and a reduction of the VCO frequency.

4.3.2.2 PIN (Diode) Switches

4.3.2.2.1 The PIN diodes switch the VCO to the proper sub-range operating frequency by removing or inserting capacitive or inductive elements of the VCO tank circuit, via the transmission line. When the PIN diodes are off (reverse biased), they effectively create an rf open circuit between the capacitive or inductive elements and the transmission line. When the PIN diodes are on (forward biased), they effectively create an rf short circuit to the transmission line, inserting the capacitive or inductive elements into the VCO tank circuit. Inserting capacitive elements decreases the VCO operating frequency. Inserting inductive elements increases the VCO operating frequency.

4.3.2.2.2 The PIN diodes are controlled by the 6.2 MHz, 12.4 MHz, and 24.8 MHz frequency range shift signals generated by the frequency shift logic circuit on the synthesizer board. The 6.2 MHz shift is initiated by the S3 frequency range shift signals S3 and $\overline{\text{S3}}$. When the S3 line is low (ground) and the $\overline{\text{S3}}$ line is high (+8 V dc), PIN diode CR1306 is reverse biased. This effectively uncouples capacitor C1300 from the VCO tank circuit. When the logic states of the S3 and $\overline{\text{S3}}$ lines change, CR1306 becomes forward biased, effectively inserting C1300 into the VCO tank circuit. This decreased capacitance causes the VCO frequency to shift upwards by 6.2 MHz.

4.3.2.2.3 PIN diode CR1320 controls the 12.4 MHz shift by removing or inserting inductor L1309 and a short, series-connected transmission line to the VCO tank circuit. The 12.4 MHz shift is initiated by the S2 frequency range shift signals S2 and $\overline{\text{S2}}$. When the S2 line is high and the $\overline{\text{S2}}$ line is low, inductor L1309 and the short transmission line (an inductive element) are inserted into the VCO tank circuit. This parallel inductance shifts the VCO frequency up by 12.4 MHz.

4.3.2.2.4 PIN diodes CR1340 and CR1341 control the 24.8 MHz shift, which is initiated by the S1 frequency range shift signals S1 and $\overline{\text{S1}}$. Before the 24.8 MHz shift is initiated, the S1 line is low and the $\overline{\text{S1}}$ line is high. This turns on CR1340, effectively short circuiting a second VCO transmission line to rf ground, via capacitor C1340 and C1325. This removes the second VCO transmission line from the VCO tank circuit, and prevents it from resonating due to stray capacitance to prevent noise from being introduced into the VCO tank circuit. When the 24.8 MHz frequency shift is activated, the S1 line goes high and the $\overline{S1}$ line goes low. This turns on diode CR1341, connecting the two VCO transmission lines together, via capacitors C1340 and C1341. This effectively shortens the VCO transmission line, decreasing the inductance of the VCO tank circuit, and thus shifting the VCO frequency up by 24.8 Hz.

4.3.2.2.5 Because of coupling losses between the VCO tank circuit and shifting elements during shifts (approximately 6 MHz), compensation must be provided. To reduce the coupling loss when the 12.4 MHz shift is initiated while a 28.4 MHz shift is in effect, compensating diode CR1312 is provided. When the S1 line controlling the 24.8 MHz shift is high and the $\overline{S1}$ line is low, diode CR1312 is turned on. This effectively disconnects the short transmission line from inductor L1309.

4.3.2.2.6 Capacitor C1302 provides steering line compensation for S1 shift. The varactor diodes and capacitor C1307 are connected to one side of the transmission line. Sensitivity of the varactor diodes is reduced when the S1 transmission line is added to the VCO tank. With capacitor C1300 in parallel with C1307, the sensitivity of the varactors to the VCO is maintained.

4.3.2.3 VCO Modulator

4.3.2.3.1 The VCO is modulated by the VCO modulation signal (transmit audio signal) supplied by the transmitter circuits. The VCO modulation signal carries microphone audio (and PL or DPL signals, if present) whose frequencies are above 50 Hz. (Frequencies below 50 Hz are on the VCO reference signal supplied only to the 2 PPM 14.4 MHz reference oscillator on the synthesizer board.) The VCO is modulated with the VCO modulation signal by varactor diode CR1300. The VCO modulation signal increases and decreases the capacitance of CR1300, thus changing the frequency of the VCO (direct frequency modulation).

4.3.2.3.2 Because the VCO can operate over a wide range of frequencies, the sensitivity of the VCO is subject to slight drifting. This is due to changes in the VCO steering line voltage, or to coupling losses that occur in the VCO tank circuit when the PIN diode switches shift the VCO to a new sub-range frequency. To compensate for this drift, and to maintain the modulation level constant throughout the range of the VCO frequencies, compensation is provided for the VCO steering line voltage and for frequency shifts. To compensate for changes in the VCO steering line voltage, a second varactor is used. This varactor CR1305, is connected in series with varactor CR1300 and the VCO steering line. As the VCO steering line voltage changes, the capacitance of CR1305 changes, thus altering the capacitance in the VCO tank circuit.

4.3.2.3.3 To compensate for frequency shifts, the dc bias on varactor CR1300 is varied. This is accomplished by a modulation compensation network composed of resistors R1310, R1311, and R1312; and diodes CR1307, CR1308, and CR1309. The network is controlled by the S1, S2, and $\overline{S3}$ frequency range shift signals. Depending on the logic states of these signals, the dc bias on CR1300 changes, changing the varactor sensitivity to audio levels.

4.3.2.4 VCO

4.3.2.4.1 The VCO generates frequency modulated transmit injection and stable receive injection frequencies. The operating frequency range of the VCO extends from 21.4 MHz below the radio operating frequency (to provide low-side receiver injection at the lowest radio operating frequency) continuously to the highest radio operating frequency. The VCO also provides a feedback signal at the injection frequency that is used by divider/phase detector U115 on the synthesizer board to generate the loop frequency signal.

4.3.2.4.2 Transistor Q1300 is the amplifying element of a grounded-gate oscillator. The oscillator operates in the VHF frequency band at the desired injection frequency. The drain of Q1300 is coupled to a microstrip transmission line through capacitor C1308.

4.3.2.4.3 The VCO tank circuit is composed of capacitors C1309, C1313, and C1327; the transmission line; and the capacitive and inductive elements inserted into, or removed from, the VCO tank circuit by the PIN switching diodes. The transmission line serves as the inductive component of the VCO tank circuit. Microstrip plates attached to the tranmsission line act as tuning capacitors on the VCO tank circuit. Factory-tuned tuning jumpers R1 and R2 are also attached to the transmission line to tune the VCO tank circuit.

4.3.2.4.4 The VCO rf output signal from the tank circuit is coupled through capacitor C1308 to the transmission line. The rf passes through the transmission line and is coupled into the VCO output buffer Q1330, via capacitor C1330. The output buffer feeds the VCO rf signal to the transmit/receive rf buffer on the synthesizer board. The rf signal present at this point is either a low-side receiver injection signal 21.4 MHz below the receiver operating frequency, or a transmitter injection signal at the desired transmitter operating frequency.

4.3.2.4.5 An AGC circuit is used to maintain constant rf levels in the VCO tank circuit to ensure consistent sideband noise characteristics across the entire frequency band. A sample of the VCO rf signal is rectified by diode CR1310 to provide a dc voltage with level proportional to the VCO rf level. The rectified dc voltage is applied to the AGC circuit on the synthesizer board. the AGC circuit returns a dc control voltage that maintains the VCO tank voltage constant (approximately 3 V rms).

4.4 *FAST-LOK* FREQUENCY SYNTHESIZER CIRCUIT

The *Fast-Lok* frequency synthesizer consists of the channel selection and display circuits, the synthesizer board circuits, the synthesizer output amplifier circuit, and the VCO hybrid circuits. The channel selection and display circuits, which include the front panel channel selector switch and LED display, are covered in the functional description of the standard lock frequency synthesizer circuits and are not detailed here.

4.4.1 Synthesizer Board Circuits

NOTE

Except for the divider U115 and phase detector U140 circuit descriptions, the following descriptions refer to the schematic diagrams in the *Fast-Lok* Frequency Synthesizer section.

4.4.1.1 14.4 MHz Reference Oscillator

The 14.4 MHz reference oscillator provides a stable (±2 ppm) reference for the frequency synthesizer. The oscillator is completely self contained and non-servicable. During transmit operation, low frequency (below 50 Hz) *DVP* or DPL signals (ref mod) are routed directly to the oscillator. This is required because the divider/phase detector (U115/U140) can track low-frequency modulation, to prevent direct low-frequency audio (used in *DVP* and DPL signaling) from modulating the VCO.

4.4.1.2 Frequency Select PROM

Frequency selection data (factory or field programmed) in the PROM is addressed by five binary bits from the channel selector switch via five address lines, A0 through A4. The five bits comprise the channel select word.

NOTE

On the synthesizer schematic diagram, use the address line designations on the outside of the U116 symbol. The designations inside the symbol do not correspond to the channel select address lines.

Frequency selection in the PROM is further determined by the presence or absence of transmitter keying signal, 9.6T, at pin 5 of the PROM as follows:

- Presence of 9.6T: data words specify transmit frequency
- Absence of 9.6T: data words specify receive frequency

Data words transfer from PROM U116 to divider U115, when a +5 volt enable signal at pin 16 (VCC) coincides with arrival of a word select signal (three address bits, A0-A2) from the divider. Frequency data is transferred to the divider by six 4-bit words on data lines D0 through D3.

4.4.1.3 PROM Enable Circuit

4.4.1.3.1 The PROM enable circuit allows divider U115 to address the PROM when any of the following occur:

- The transmitter is keyed.
- The frequency is changed.
- The synthesizer goes out of lock.

If the transmitter is keyed or the frequency is changed, frequency change detector U351 on the front panel interconnect board emits a positive going pulse of approximately 5 usec duration. This pulse is sensed at phase detector U140-5 and causes the phase detector ADAPT output (U140-10) to go high. If the synthesizer goes out of lock, circuitry within phase detector U140 senses the out-of-lock condition and causes the $\overline{\text{ADAPT}}$ output (U140-7) to go low.

4.4.1.3.2 The PROM enable circuit consists of a portion of phase detector U140 as well as transistors Q115, Q117 and Q118. Transmit PTT, frequency change, or synthesizer out-of-lock causes phase detector ADAPT output U140-10 to go high. This turns on Q117, providing low $\overline{\text{READ ENABLE}}$ signal to divider U115-28. With the $\overline{\text{READ ENABLE}}$ input activated, U115 applies a 10 microsecond low $\overline{\text{STROBE}}$ signal that recurs every 200 microseconds. The low $\overline{\text{STROBE}}$ signal turns on Q118. When Q118 turns on, it turns on Q115, and when Q115 turns on, it supplies +5 V dc enabling voltage to the Vcc pin of the PROM. With the PROM enabled, frequency data is read from the PROM to the divider U115.

4.4.1.3.3 At the end of the three millisecond adapt interval the phase detector ADAPT output goes low. This turns off Q117, disabling the $\overline{\text{READ ENABLE}}$ input to U115. With the $\overline{\text{STROBE}}$ output disabled, power is removed from the PROM.

4.4.1.4 Lock Detect Switch Circuit

4.4.1.4.1 The lock detect switch monitors the $\overline{\text{ADAPT}}$ output from phase detector U140. When the $\overline{\text{ADAPT}}$ output is high, the synthesizer is locked onto the correct frequency, and when it is low, the synthesizer is out-of-lock. When the synthesizer goes out-of-lock, the lock detect switch supplies a high LOCK DETECT signal to disable the transmitter (during the transmit mode) or to disable the receiver (during the transmit mode) or to disable the receiver (during the receive mode).

4.4.1.4.2 The lock detect switch consists of inverter Q142. The LOCK DET TRIGGER signal is developed at the collector of Q142. The LOCK DET TRIGGER signal is routed through CR351 to become the LOCK DET signal for the radio set.

4.4.1.5 Divider

(Refer to functional diagram in Synthesizer section.) The divider contains the following circuits:

- multiplex control
- six 4-bit latches
- loop divider (programmable)
- reference divider (programmable)

4.4.1.5.1 Multiplex Control

The multiplex control circuit performs three functions:

- Three address bits on lines AO through A2 select 4-bit words in the PROM. The selected 4-bit words containing frequency data are transferred from the PROM to the six 4-bit latches.
- An ENABLE signal initiates generation of 10 microsecond $\overline{\text{STROBE}}$ signals that reoccur every 200 microseconds.
- Produces a LATCH CONTROL signal that determines which data words are stored in each of the six latch registers.

4.4.1.5.2 Latch Circuits

4.4.1.5.2.1 The six 4-bit latches are activated by a latch control when the multiplex control circuit receives the active (low) enable signal from the PROM enable circuit.

4.4.1.5.2.2 The information stored in the six 4-bit latches determines the values (A and B) for the counters in the loop divider. The stored information also determines the output levels of the $\overline{\text{SO}}$, $\overline{\text{VCO1}}$, and $\overline{\text{VCO2}}$ signals appearing at pins 17, 19, and 20, respectively, of U115. These signals are applied to the frequency shift logic circuit to determine at which sub-range the VCO operates.

4.4.1.5.2.3 The $\overline{\text{S1}}$ signal from the latch registers, appearing at pin 18, is used only with dual front end receiver models. The signal is used to select one of two 6 MHz filters at the front end of the receiver. When the $\overline{\text{S1}}$ signal is low, the low range 6 MHz filter is switched into the rf signal path. When the $\overline{\text{S1}}$ signal is high, the high range 6 MHz filter is switched into the rf signal path.

4.4.1.5.3 Loop Divider

The loop divider contains a double-programmable dual modulus counter. The counter acts as a programmable divider for the VCO rf feedback signal from the VCO output by dividing by 64 for a programmable number of (A) cycles, and then by 63 for another programmable number of (B) cycles. Divider rf buffer Q116 isolates the VCO rf feedback signal from the divider. The loop divider divides the VCO feedback signal by 64 "A" times and by 63 "B" times. The output of the loop divider counters is the loop frequency signal that is applied as the second input to the phase detector. The loop frequency signal is the VCO output signal frequency divided by (64A plus 63B).

4.4.1.5.4 Reference Divider

The reference divider divides the 14.4 MHz signal from the reference oscillator to any of three reference frequencies: 4.166 kHz, 5.0 kHz, or 6.25 kHz. These frequencies are determined by the channel spacing of the *DVP MCX100* radio set. The reference frequency is applied as one input to the phase detector.

4.4.1.6 Phase Detector
(Refer to functional diagram)

4.4.1.6.1 Phase detector U140 compares the reference and loop frequency outputs of the divider circuit and uses this information to generate a dc output signal that controls the VCO frequency. The phase detector also monitors the frequency change (FC) line and uses this information to generate control signals for the adaptive filter.

4.4.1.6.2 The phase detector output signal level is controlled by the length of time between the positive transition of the reference signal and the positive transition of the loop signal. When the reference signal goes high (at U140-2), the ramp generator (Q140) turns on, maintaining a constant current through C142. This constant current generates a linear rise (ramp) in the voltage at U140-24. The rise of the ramp voltage halts when the LOOP signal (at U140-23) switches to a high level, causing Q140 to turn off.

4.4.1.6.3 The positive transition of the loop signal, in addition to halting the ramp generator, resets an internal sample timing circuit. The ramp voltage is held constant for a period of time determined by the sample timing capacitor, C141. During this time, the two hold capacitors (C143 and C144) are charged to a level determined by the ramp voltage. At the end of the sample time, ramp capacitor C142 is discharged in preparation for the next cycle.

4.4.1.6.4 The accumulated charge on the hold capacitors is used to control the conduction of a push-pull output driver. The output driver consists of an internal NPN transistor and an external PNP transistor controlled by the signal at U140-17. The PHASE DET OUTPUT signal at U140-15 is coupled, via the adaptive loop filter, to the VCO, where it controls the generation of injection frequencies.

4.4.1.6.5 In addition, the phase detector generates the control signals for the adaptive filter and PROM enable circuits. When changing operating channels while in the receive mode or changing from the transmit mode to the receive mode, the FC pulse (at U140-5) causes the ADAPT line to go high and the $\overline{\text{ADAPT}}$ line to go low for approximately 3.0 milliseconds.

4.4.1.6.6 To achieve maximum switching speed, the $\overline{\text{SO}}$, $\overline{\text{VCO1}}$, and $\overline{\text{VCO2}}$ signals must shift the VCO subrange coincident with the rising edge of the loop (divided VCO) pulse at U140-23. $\overline{\text{VCO1}}$ and $\overline{\text{VCO2}}$ are synchronized to the loop pulse internally within divider U115. The $\overline{\text{SO}}$ output of divider U115-17 is fed to the input of a D flip-flop within phase detector U104-11. This flip-flop is clocked by the loop pulse, allowing its output to respond to an $\overline{\text{SO}}$ change only at the rising edge of the loop pulse. The synchronized $\overline{\text{SO}}$ flip-flop output U140-6 is fed to frequency shift driver U155-10.

4.4.1.7 Adaptive Loop Filter

4.4.1.7.1 The adaptive loop filter is a low-pass filter in the steering line between the phase detector and the VCO. This filter removes noise and variations in the steering line level to prevent unwanted modulation of the VCO.

4.4.1.7.2 The adaptive filter, which is connected to the PHASE DET OUTPUT line (U140-15) is controlled by the phase detector to operate in either of two modes. Each mode requires different filter characteristics, and these characteristics are changed by transmission gates which switch filter components into and out of the steering line signal path, as determined by the phase detector.

4.4.1.7.3 When the synthesizer is in the normal transmit or receive mode, the phase detector drives $\overline{\text{ADAPT}}$ high, turning off Q143. All four transmission gates (U141A, B, C, D) are off. The natural loop frequency of the synthesizer in this mode is approximately 35 Hz. The adaptive loop filter stays in this mode as long as the radio is transmitting or receiving. In this mode the steering line is filtered by R147, a shunt path consisting of R148, C145 and C146, and by R149 and C147. The signal passes to the VCO via RF filter L143 an C147.

4.4.1.7.4 When the synthesizer is in the Adapt mode, the phase detector drives $\overline{\text{ADAPT}}$ low, turning on Q143. This causes the collector of Q143 to go high, turning on all four transmission gates U141A, B, C, D. The synthesizer has a high natural loop frequency in this mode allowing it to change frequencies rapidly. The adaptive filter switches into this mode for approximately 3.0 milliseconds as the radio changes from the transmit mode to the receive mode or from one receive frequency to another (for example, when changing the operating channel of the radio). In the adapt mode, the greater part of the adaptive loop filter is shorted by transmission gate U141A, and the phase detector output is connected to C147. When the filter is in the Adapt mode, C146 and C147 are being charged. The accumulated charge on C147 prevents the VCO from changing frequencies while the mode is changed from adapt to normal receive/transmit operation. C147 always remains connected to the steering line. The signal passes to the VCO via the RF filter comprised of L143 and C159.

4.5 *DVP* CIRCUITS

(Refer to *DVP* schematic diagram)

The electrical circuits of the *DVP* control boards are subdivided into the following: power supply and regulator, clock, receive audio, squelch, push-to-talk (PTT), transmit audio, key insertion, and mode control circuits.

4.5.1 Power Supplies and Regulators

Three different voltage suplies are used on the *DVP* boards. Regulated 9.6 volts powers most of the *DVP* circuitry and comes from the radio 9.6 V regulator circuitry, via P352-6. SW A+ powers the front panel indicator LEDs and comes from P364A-5. PA A+ powers the 5 volt regulator (U101) and comes from P352-8.

4.5.2 Clock

The clock generating circuitry is contained within U102, the *DVP* Control and Interface I.C. This I.C. contains a high frequency oscillator, a prescaler, and a phase-locked loop for frequency generation and division. Crystal Y101 at pins 17 and 19 maintains the oscillator frequency at 3,072 kHz. This frequency is divided by 256 in the prescaler and phase-locked loop to produce the system 12 kHz clock. The prescaler divides by 4, and the phase-locked loop divides by either 63, 64 or 65 depending on whether incoming data transitions are late, absent, or early with respect to the system 12 kHz clock. The 12 kHz clock output of the phase-locked loop keeps the CVSD (U103) and the encryption hybrid (HY101) synchronized for *DVP* functions.

4.5.3 Receive Audio

4.5.3.1 The buffered discriminator output is routed to the *DVP* board via P352-7 and J101-5. If the discriminator output is not a *DVP* signal, it is gated through U105C to buffer U107D and back to the radio audio path via J101-7. The discriminator data also goes to the *DVP* equalizer filter which is formed by U107B and an amplifier contained in U102 (between pins 3 and 5). The filter shapes the eye pattern to create a greater eye opening at U102-5. In general, the eye opening at U102-5 should be about 10% more than the eye opening of the incoming discriminator data.

4.5.3.2 Pin 5 of U102 is internally connected to a limiter whose output is on U102-6. This output swings between supply voltage and ground. Feedback from the limiter to the amplifier input through R120 gives a small amount of hysteresis that causes small crossover distortions on the amplifier output on U102-5. This positive feedback prevents any clock synchronous noise from causing false code detects on very quiet standard mode signals. In addition, switched bias output on U102-8 turns off when code is detected and turns on when no code is detected. This allows the amplifier and limiter to quickly adapt to off channel signals and lowers the initial error rate. This output goes through R121 to modify the voltage on C106. All the dc voltages on U102-3, 4, 5, and 6 are within 0.1 volt of each other, and they are biased internally to half the supply voltage.

4.5.3.3 The limiter output of U102 is internally used to synchronize the clock and operate the code detector. The clock is synchronized with a digital phase-locked loop which effectively divides an internal 64 X clock signal by 63, 64, or 65 depending on whether the limiter transitions are late, absent, or early respectively. This produces a 12 kHz clock on U102-23 which clocks the encryption hybrid (U8) and the CVSD (U7). The clock maintains board synchronization. If the clock should fail for any reason, much of the rest of the *DVP* circuitry becomes inoperable.

4.5.3.4 The clock is used inside U102 to reclock the limiter output at the center of the bits. This signal is called receive cipher and comes out of U102-10. This cipher text goes into the encryption hybrid on HY101-9. HY101 decrypts the cipher and outputs plain text on HY101-15. The plain text goes to the CVSD, U103-10.

4.5.3.5 The CVSD reconstructs the audio by low pass filtering the plain text with an internal FIR filter and multiplying the result by the step size voltage on U103-6. The step size is determined by an internal detector that increases the step size when 3 zeros in a row are detected or when 3 ones in a row are detected. This condition is referred to as slope overload and indicates that the step size is too small. The reconstructed audio output goes out U103-15 to analog switch U105C.

4.5.3.6 The audio gate (U105C) then switches either buffered discriminator or CVSD receive audio back into the radio audio path via J101-7.

4.5.4 Squelch

4.5.4.1 The squelch circuit consists of the *DVP* Interface and Control IC (U102), the CVSD (U103) detector, U106A and U106B. The majority of the squelch circuit is in U102 and consists of two detectors. These detectors are called phase-lock and correlation. The phase-lock detector measures the synchronization of the limiter output with the 12 kHz clock. There will be a phase-lock indication for most periodic signals, EOM, and cipher. The correlation detector measures the randomness of the limiter output. Most standard mode signals are correlated as are most tones and EOM. With these two detectors, U102 can determine the kind of discriminator signal being received.

4.5.4.2 The proper code detector in U103 is another correlation detector which measures the correlation of the received plain text. For signals which decrypt to produce intelligible plain text, the degree of correlation will be high; and the detector output on U103-14 will go high. For signals that are noisy or decrypted with the wrong key, the degree of correlation is low; and U103-14 is low. This signal goes to U102-28 and is used in the squelch decision. The PL disable input at U102-2 also affects the squelch decision. If this pin is high, U102 will ignore the CVSD proper code detector signal, and will unsquelch for all coded signals. U102-2 will be high if the radio is not configured for proper code, or if the microphone is off-hook, or if the monitor switch (in radios so equipped) is depressed. Two other signals also affect the squelch output (pin 14) of U102. These are: 1) the squelch input from the carrier squelch or PL circuitry, and 2) an input from the *DVP* drop out timer on pins 12 and 13 of U102. The input from the carrier squelch or PL circuitry goes to U107A via P352-12 and J101-9. U107A is configured as a comparator so that the squelch input at U102-22 will be a digital signal. This input tells U102 what state the standard radio squelch is in.

4.5.4.3 Once U6 has determined the type of signal at the discriminator, it can set its squelch output, U102-14. If the signal is not coded, U102 will squelch or unsquelch the radio according to its input from the standard radio squelch (U102-22). If the signal is *DVP* code then the outputs from U102 will be affected by the drop out timer, PL disable, and the proper code input from U103. When a private mode message is received, (U102-15) will go high. U102-16 and U102-14 outputs will go high if either the PL disable input is high, or if proper code is detected by U103. In addition, the drop out timer is activated by charging up C124 on U102-12. If EOM id detected, the drop timer is cancelled by discharging C124, U102-15 output stays high, U102-16 and U102-14 will go low. If noise is detected, the drop out timer is delayed by allowing C124 to discharge through R126. During the delay, U102-15 remains high. U102-14 and U102-16 will stay high if either the PL disable is high or proper code is detected. This drop out delay provides fade protection for private mode signals. When the drop out timer times out, U102-14, U102-15 and U102-16 will go low. When a standard mode message is detected, both U102-15 and U102-16 will go low, and the drop out timer is cancelled by discharging C124.

4.5.4.4 U106A and U106B form the last stage of the *DVP* squelch circuitry. These two gates perform the following functions: 1) remove squelch tails after a *DVP* signal has been received, 2) provide a means for option accessories to control the radio squelch while the radio is receiving a *DVP* transmission, and 3) allow verification tone to be heard during key insertion. U106-6 is the *DVP* squelch output and this is routed back to the radio squelch circuit via P101-16 and J1003.

4.5.5 Push-To-Talk (PTT) Circuitry

4.5.5.1 The PTT circuitry on the *DVP* board consists mainly of U108, Q103, Q104 and part of the interface and control IC (U102). When an active PTT occurs, the PTT flow on the *DVP* board will depend on whether the radio is set to standard or private transmit mode.

4.5.5.2 In standard transmit mode the following actions occur. U108-4 will go low, causing U108-3 and U108-6 to go high. When U108-6 goes high, U108-5 will go low and turn Q112 on. The emitter of Q112 is connected to the radio PTT circuitry, via P352-3, and causes the transmitter to key. When the PTT is released, Q112 turns off, causing the transmitter to turn off.

4.5.5.3 When the radio is in the private transmit mode, the following actions will occur. U108-4 will go low, causing U108-3 to go high, and U108-1 to go low. This supplies an active low PTT to U102-11, causing U102 to be set to transmit mode. U102-18 will then go high, causing the following actions: 1) analog switches U105A and U105B will be set so that *DVP* cipher is sent back into the transmit path, 2) Q111 turns on and its emitter goes high, 3) the collector of Q113 goes low and puts the encryption hybrid (HY101) into transmit mode, 4) U108-7 goes high. The emitter of Q111 is connected via P101 and J1004 to the PL encode filter (if radio is PL equipped). When this signal goes high, it prevents the PL filter from sending PL tones into the transmit path. This is prevented because the PL tones would interfere with the *DVP* cipher being transmitted. When U108-7 goes high, U108-5 will go low and turn on Q112. This causes the transmitter to key. When the active PTT is released, U102-11 will go high. This causes U102 to stop sending cipher and to start sending EOM. U102-18 is sustained high for an additional 180 milliseconds while EOM is being transmitted. After EOM, U102-18 will go low, causing the transmitter to turn off.

4.5.6 Transmit Audio

4.5.6.1 When the radio is set to standard mode, IDC audio comes in via J1001 and J101-15. It then goes through transmission gate U105B and right back into the transmit path via J101-18 and J1002.

4.5.6.2 When the radio is set to private mode, the IDC audio goes to an amplifier on U103 (the CVSD). The CVSD transmit circuit consists of an amplifier from U103-1 to U103-18 followed by a limiter output on U103-16. The limiter output is reclocked through a 3-bit decision rule register to control the compand output on U7-7. The compand output is integrated by R144 and C114 to make the step size voltage which goes in on U103-6. The step size is modulated by the limiter output to create the pulse amplitude modulated (PAM) output on U103-5. The PAM output is compared to the mic amplifier output by the feedback through R153 and C116. The result of the loop is that the PAM output is a digital reconstructed version of the mic amplifier output. The CVSD amplifier output on U103-18 is therefore the amplified difference between mic audio and reconstructed mic audio. The TX DATA on U103-8 is a reclocked limited version of the error and the compand output on U103-7 which is just TX DATA after passing through the register for the 3-bit rule. TX DATA on U103-8 is the transmit plain text.

4.5.6.3 The transmit plain text goes into the encryption hybrid on HY101-17 where it is encrypted. The resulting cipher text comes out HY101-14. This goes through a splatter filter on U102-25 and comes out on U102-27. The splatter filter is carefully constructed to produce an eye pattern with no overshoot, 80% eye opening, and zero crossover jitter. The splatter filter runs on the splatter filter supply connected to U102-26. It is worth noting that EOM always comes out of the splatter filter except when transmitting cipher in the private mode.

4.5.6.4 The splatter filter output (U102-27) goes to two deviation control pots, R158 and R161. R158 controls the amplitude of signal sent back into the VCO modulation path and R161 controls the amplitude of signal sent back into the reference oscillator path. The wiper of R158 is coupled through C119 to buffer U107C. The output is U107C goes through transmission gate U105B and the VCO via P101-17 and J1002. The wiper of R161 goes to transmission gate U105A, then to the reference oscillator via P101-11 and P352-16. Note that with this circuit arrangement the private mode deviation is controlled by the *DVP* potentiometers and by the standard radio deviation adjustment potentiometers, R341 and R344. The deviation adjustment should therefore be carried out in two steps. First the standard mode deviation should be adjusted as it is done in a standard radio. The private mode reference oscillator adjustment should then be set by R161 so that the modulation is 4 Vp-p at the reference oscillator input (P355-7). Then the private mode deviation should be adjusted by turning R158 for 4 kHz of deviation.

4.5.7 Key Insertion

4.5.7.1 The key insertion circuit consists of the 5-pin key insert connector and the encryption hybrid (HY101). Three signal lines, one control and one ground line go into the 5-pin connector. The three signals are key insert data (KID), write enable bar ($\overline{WE}$), and key (KEY). The control line is key insert ground (KIG). KIG is connected to the ground wire in the key insert cable that connects to the 5-pin connector. When the cable is connected the KIG line is pulled to ground and M1 on HY101 is grounded. For dual code radios, M1 is high for code 2 and low for code 1. For single code radios with a TRN6777B Encryption Hybrid, M1 must be pulled low. Since key insertion works on code 1, the KIG signal ensures reliable key insertion even for dual code radios.

4.5.7.2 The key insertion process is straight forward. The $\overline{WE}$ and KEY signals go directly into the encryption hybrid on HY101-4 and 8 respectively. When key bits are being transferred over the KEY line to the encryption hybrid, the $\overline{WE}$ line must go low to enable the write process in the encryption hybrid. For that interval, the clock must be synchronized with the key bits. The clock synchronization is done by sending KID to U102-3. KID swamps out the discriminator signal and goes through the phase-lock loop for clock synchronization. After the key has been inserted into the encryption hybrid, the code inserter sends an encrypted tone via the KID line to the hybrid. If the key insertion was successful, the hybrid will decrypt the tone and it will be heard in the speaker. The message "BEEP?" will then appear in the code inserter display to remind you to listen for the tone.

4.5.8 Mode Control Circuitry

4.5.8.1 The *DVP* mode controlling circuitry consists mainly of the *DVP* Control Board, the 6-pin connector J104, U109 and U110. The *DVP* Control Board sits just behind the radio front panel, beside the radio channel selector switch. It holds the switches and LED's necessary to control and indicate the mode of the *DVP* circuitry. U110A and U110B are used to buffer and "square-up" the signal coming from the switches on the *DVP* Control Board before it is applied to the clock inputs of U109. U109A and U109B are configured as toggle flip-flops, whose outputs will toggle from one state to the other whenever they are clocked. U109A controls the transmit mode of U102, and in radios equipped with the Dual Code option, U109B controls whether the encryption hybrid is in Code 1 or Code 2.

4.5.8.2 When the output of U109A is high, U102 will be set to private transmit mode, and when its output is low, U102 will be set to standard transmit mode. The output of U109A is changed by pressing and releasing S102 on the radio front panel. This sends a single clock pulse to U109A (via J104-6 and U110A) and causes the output of U109A to change state. This changes the transmit mode of U102. When the output of U109A is high, buffer U110B will apply a high to the base of Q106. Q106 then turns on DS123 (on the *DVP* Control Board) via J104-4, indicating that the radio is in private transmit mode.

4.5.8.3 In radios equipped with the Dual Code option, U109B controls whether the radio is in Code 1 or Code 2. When S101 is depressed, a single clock pulse is applied to the clock input of U109B (via J104-3 and U110D). This causes its output to change state, changing the encryption hybrid from Code 1 or Code 2 or vice-versa. When HY101-5 is high, the encryption hybrid will be set to Code 2, and the output of U110E will be high. This causes Q107 to turn on DS121 on the *DVP* Control Board (via J104-2), indicating that the encryption hybrid is in Code 2.

4.5.8.4 When the radio is receiving a private message, U102-15 will be high. This causes Q109 to turn on DS122 on the *DVP* Control Board (via J104-5), to indicate that a private message is being received.

4.6 PL/DPL CIRCUITS
(Refer to PL/DPL Encoder/Decoder Schematic Diagram)

The operation of *Private-Line* or *Digital Private-Line* circuits is controlled by a single-chip, 8-bit, 40-pin microcomputer, U1705.The system uses a personality ROM preprogrammed in accordance with user-specified parameters. Software programming within the microcomputer controls the operation of the decoding, encoding, and microcomputer self-test circuits. The microcomputer is clocked by a 4 MHz oscillator, using externally-connected crystal Y1.

4.6.1 Decoding

The decoding process uses high and low-pass filters to separate the coded tones from the composite audio signal that is received. The coded tones are shaped into square waves and processed by the microcomputer and memory. If the received code corresponds to the preprogrammed code in the memory, the receiver audio circuit is unmuted. If the received code does not match the preprogrammed code in memory, the receiver audio circuit remains muted.

4.6.1.1 PTT Circuit

4.6.1.1.1 Decoding is in process at any time an active microphone PTT signal is absent at the base of inverter Q1703. When the PTT signal is absent (high), Q1703 turns on, developing a low at the collector. The low output is applied through diode CR1708 to inverter Q1710, turning it off. The output from Q1710 is the sidetone enable signal applied to the muting circuits in the receiver. When Q1710 is off, the sidetone enable signal is not grounded, allowing the primary and secondary mute gates on the main board to operate simultaneously.

4.6.1.1.2 The low output from Q1703 is also applied to pin 17 of the microcomputer, setting it to the receive mode. In the receive mode, the microcomputer outputs a low signal at pin 37 that turns off inverter Q1704. The output from Q1704 is the delayed PTT signal that is supplied to the *DVP* PTT circuits to key and unkey the transmitter. When Q1704 is off, the delayed PTT signal is high, unkeying the transmitter. Diode CR1709 prevents the high output from Q1704 from turning on inverter Q1710.

4.6.1.2 High-Pass Voice Filter

The option receive audio from the *DVP* circuits is applied along two paths. One path is through a two stage, high pass decode filter, hybrid HY1702, to remove the PL or DPL signaling tones from the option receive audio. The output from HY1702 is PL filtered audio containing voice only that is inserted into the receiver audio. The low output impedance of HY1702 allows direct connection to the receiver low-level audio path without requiring the use of jumpers.

4.6.1.3 Low-Pass Decode Filter

4.6.1.3.1 The second option receive audio path is through dual operational amplifiers U1701D and U1701A, which are configured as low pass filters. The filters attenuate frequencies above 200 Hz (noise and voice) allowing only the low frequency PL or DPL signals to pass. The filter provide a different cutoff frequency for PL tones or DPL signals: 220 Hz for PL tones and 140 Hz for DPL signals. The cutoff frequencies are determined by transistors Q1701 and Q1709, which are controlled in turn, by the signal level output at pin 36 of the microcomputer. When the microcomputer is set to the receive mode, pin 31 outputs one of two voltage levels: 0.05 V dc for PL tones or 3.9 V dc for DPL signals. Transistors Q1701 and Q1709 therefore respond accordingly to control the cutoff frequencies at the two filters.

4.6.1.3.2 The filtered output from second-stage filter U1701A is applied to operational amplifier/limiter U1701B to produce a square wave output signal. The square wave signal is inverted by an inverter stage in D/A (digital-to-analog) hybrid HY1701 and is applied to pin 16 of the microcomputer.

4.6.1.4 Receive Mute Control

4.6.1.4.1 The microcomputer, having encoded a valid code programmed by the code plug (or personality ROM), and having been set to the receive mode, produces a high output at pin 35. This turns on PL/DPL mute switch Q1702, causing a low signal to be applied to the input (pin 12) of non-inverting three-state buffer U1704. This IC can provide three output conditions, active high, active low, or an open circuit. The output from U1704 (pin 11) is the receive audio mute signal that is applied to the receiver audio to mute or unmute the audio. When the receive audio mute signal is high (a valid PL or DPL signal not received) the receiver audio is muted. When the signal is in the high impedance state, receiver audio muting is controlled by the carrier squelch circuit, allowing all signals on a channel to be heard. When the input to U1704 is low (indicating a valid code) the receive audio output from U1704 is also low, thereby unmuting the receiver audio and allowing only the valid PL or DPL message to be heard. The active-low output of U1704 overrides control of the audio mute line by the carrier squelch circuits, allowing signals to be heard even if below the carrier squelch opening threshold.

4.6.1.4.2 The receive audio mute signal can be set to the high impedence state (disabled) if either the front panel Monitor pushbutton is pushed on or if the microphone is off-hook. Normally with the Monitor pushbutton in the PL/DPL squelch model (out position), or the microphone on-hook, ground is applied to the disabling input (pin 15) of U1704. From the Monitor pushbutton, the ground is the monitor switch signal applied to pin 15 via diode CR1703. From the microphone, the ground is the hang-up switch signal applied through diode CR1704. The ground keeps U1704 enabled allowing only valid PL or DPL squelch signals to be monitored. Pushing in the Monitor pushbutton, or leaving the microphone off-hook effectively disables U1704. This sets its output to the high impedance state allowing all signals on a channel to be monitored.

4.6.2 Encoding

The encoding process uses preprogrammed codes stored in personality ROM. Coded digital bits are converted to low frequency analog code signals. The analog code signals modulate the VCO in the frequency synthesizer. Time-out timer and sidetone alert functions are also provided in conjunction with encoding.

4.6.2.1 PTT Circuit

Encoding is activated by the transmitter circuits when the push-to-talk button on the microphone is pressed. This supplies a low PTT signal to switch Q1703, turning it off. The high output developed by Q1703 is applied to pin 17 of the microcomputer, setting it to the transmit mode. The high output from Q1703 has no effect on the state of switch Q1710 (which is off at this time) due to the reverse bias of blocking diode CR1708.

4.6.2.2 Delayed PTT

When the microcomputer is set to the transmit mode, it responds by outputting a high signal at pin 37. This turns inverter Q1704 on, driving its delayed PTT output signal to ground, and keying the transmitter via the option del PTT signal to the *DVP* PTT circuitry. The ground output from Q1704 is also applied through diode CR1709 to inverter Q1710. Since Q1710 is already off at this time, the ground keeps Q1710 off. After a microcomputer-controlled delay time, which is coded by the personality ROM, the high output from pin 37 goes low. The delay time is either 150 milliseconds for PL signaling tones or 180 milliseconds for DPL signaling codes. After the programmed delay, the low output from pin 37 turns off Q1704, driving the delayed PTT output signal high and unkeying the transmitter. With the ground output from Q1704 removed from the base of Q1710, Q1710 turns on, driving its output low. This produces an active sidetone enable signal that is applied to the volume control circuits in the receiver to unmute the audio.

4.6.2.3 Time-Out Timer

4.6.2.3.1 During encoding, software programming directs the microcomputer to enable the three data outputs that control the time-out time function. These outputs appear at pins 18, 19, and 26 of the microcomputer. The time-out time is determined by jumpers JU1, JU2, and JU3, and depending on whether they are in or out of the circuit. Up to seven time-out intervals can be preprogrammed, as shown in Table 2.

Table 2. Time-Out Selection

Jumpers JU1	JU2	JU3	Time-Out Timer
In	Out	Out	15 Seconds
Out	Out	Out	30 Seconds
Out	In	Out	60 Seconds
In	In	Out	90 Seconds
Out	Out	In	2-1/2 Minutes
In	Out	In	5 Minutes
Out	In	In	None

4.6.2.3.2 When the three data outputs are enabled, square wave pulses appear at the base of Q1705, producing a square wave output at its collector. A low pass encode filter network, composed of resistors R1715 and R1716, and capacitor C1711 converts the square wave pulses to an 800 Hz triangular waveshape that is the time-out timer alert tone. The alert tone is inserted into the receiver audio, via the volume control. Because the receiver audio path between the volume control and the speaker is unmuted by the low sidetone enable signal, the time-out timer alert tone is heard in the speaker.

4.6.2.3.3 The time-out timer circuits can be reset by momentarily releasing the push-to-talk button on the microphone. This action turns on switch Q1703, grounding pin 17 of the microcomputer. This sets the microcomputer to the receive mode disabling the three time-out timer data outputs at pins 18, 19, and 26 of the microcomputer.

4.6.2.4 Digital/Analog Converter

During encoding, the microcomputer outputs the PL or DPL signaling codes as four data bits at pins 3 through 6 of the microcomputer. The four data bits are applied to a D/A (digital-to-analog) converter in hybrid filter HY1701. The D/A converter is a resistive ladder network that converts the PL or DPL digital data to an ac analog signal. The ac analog signal is filtered by two low pass filter stages, also part of hybrid HY1701, that have a cutoff frequency of 360 Hz. The filtered output is then divided into two signals that are used to modulate the VCO in the frequency synthesizer circuits. One signal, coupled through capacitor C1718, is the reference signal that carries signaling information below 50 Hz. The other signal, coupled through capacitor C1712, is the PL and DPL VCO modulation signal that carries information above 50 Hz. The VCO modulation signal is routed via the transmit audio/IDC circuits in the transmitter, to the synthesizer. When PL signaling tones are being encoded, only the PL/DPL VCO output is required by the VCO. When DPL signaling tones are being encoded, both the VCO modulation and reference modulation outputs are necessary. Resistor R1705, connected to pin 13 of HY1701, is factory-selected to produce a frequency deviation of 550 ± 50 Hz.

4.6.3 Activity Checker

4.6.3.1 The microcomputer activity checker circuit consists of the circuitry of Q1706, Q1707, and U1702. The activity checker is controlled by the strobe output pulse appearing at pin 7 of the microcomputer. Normally, strobe pulses are generated every 4 milliseconds. The pulses are sensed by Q1707, which drives U1702. This causes the output of U1702 (pin 8) to be at ground and the reset pulse supplied to pin 39 of the microcomputer to be disabled (high). If a microcomputer fault occurs, software programming within the microcomputer prevents strobe pulses from being generated for 15 milliseconds. This causes 31 Hz square wave pulses to be generated at the output of U1702. The pulses are inverted by Q1706 and are applied to the reset line to reset the microcomputer causing it to restart its operation. The microcomputer resets until the fault is remedied and 4 millisecond strobe pulses are again generated.

4.6.3.2 The square wave output from the activity checker is also used during transmit to unkey the transmitter when a microcomputer fault occurs. The square wave pulses are integrated by capacitor C1715 and resistor R1734, which turns on inverter Q1708. This turns off Q1704, driving its delayed PTT output signal high. This disables the delayed PTT signal and unkeys the transmitter.

4.6.3.3 The actvity checker also incorporates a built-in power-up function that automatically causes a reset at power turn-on, to ensure that the microcomputer starts properly when radio set power is turned on.

4.6.4 Microcomputer Test Program

4.6.4.1 A built-in test program may be used to verify the operation of the microcomputer, and provide a test signal for troubleshooting the PL/DPL board circuitry. To activate the test mode, turn on the radio set power, ground TP6 (U1705-6), and ground TP5 (U1705-38) in order. In test mode, the microcomputer outputs square waves at all I/O ports. The period of the square wave signal at each bit (pin) of the microcomputer is twice the period of the preceding bit, with the shortest period at the lowest numerical bit (such as P0-0) being 88 microseconds. The test waveform series at all ports (P0, P1, P4, and P5) is the same, and all are synchronized.

4.6.4.2 Because external circuitry normally grounds certain microcomputer ports, the test pattern may appear to be missing at the PTT port (P1-0 at U1705-17) or at some of the channel select ports, depending on the position of the channel select switch. To observe the test program waveform at the PTT port, press the microphone push-to-talk button. To observe the waveforms at the channel select ports, it is necessary to unground the channel select lines in question by selecting channels that cause a high on the line being tested, or by lifting the desired microcomputer pin from the socket.

4.6.4.3 To stop the test program, remove both ground connections at the test points.

4.7 TIME-OUT TIMER

(Refer to Time-Out Timer schematic diagram)

4.7.1 The time-out timer is an option used in carrier squelch models only. The time-out timer circuit board is located in the option area of the chassis. The purpose of the time-out timer is to unkey the transmitter and alert the operator after a predetermined period of transmit time. The time-out timer is reset ever time the microphone PTT button is pressed and released.

4.7.2 The time-out timer circuits are controlled by the PTT logic in the transmitter circuits. The PTT signal is applied to counter U1802. When the PTT signal goes low, it takes the counter out of reset. The counter then starts counting the 33 Hz clock signal generated by U1801C and U1801D. JU1 through JU5 determine the allowable duration of the transmission, and only one of them should be in. Refer to the schematic diagram for a table giving jumper status and time-out times.

4.7.3 When the selected output of U1802 goes high, it does four things: 1) it enables the 775 Hz tone oscillator formed by U1801A and U1801B, 2) it disables the 33 Hz clock generator formed by U1801B and U1801C, 3) it turns on Q1803, and 4) it turns on Q1802.

4.7.4 The collector of Q1802 then goes low, applying a low to the TOT PTT control signal, P1801-8. This signal goes to the *DVP* PTT circuitry via J101-24, and causes the *DVP* circuitry to dekey the transmitter. The collector of Q1803 applies a low to the sidetone enable signal via P1801-7 and P352-10, allowing the 775 Hz tone being inserted into the receiver sidetone (via P1801-10 and J352-18) path to be heard.

4.7.5 The time-out timer circuitry remains in this state until the PTT signal goes high (microphone PTT button is released). This puts the counter into the reset mode again, and all of its output go low. This disables the 775 Hz tone oscillator, re-enables the 33 Hz clock generator, and turns off Q1802 and Q1803. When Q1802 turns off, it no longer disables the *DVP* PTT circuitry and the transmitter may then be keyed again.

4.8 POWER DISTRIBUTION CIRCUITS

(Refer to Main Board and Power Interconnect Board Schematic Diagram)

4.8.1 The +9.6 V regulator is the source for distribution of regulated 9.6 volts. The regulator consists of operational amplifier U300A (which functions as a differential amplifier), series pass transistor Q300, and driver transistor Q301. The differential amplifier samples a percentage of the +9.6 V dc output from the series pass transistor, as determined by divider R307 and R308. The sample is compared to a fixed dc reference voltage, and controls the conduction of transistors Q301 and Q300 to keep the sample and reference voltages equal. A constant +9.6 volt output is thereby maintained. Operating voltages for the regulator are the PA A+ voltage and the SW A+ voltage. The PA A+ voltage is supplied to the series pass device, Q300. The SW A+ voltage turns on U300A when the front panel Off-on/Volume control is set to the on position, thus turning on the regulator.

4.8.2 Transistors Q300 and Q301 produce the +9.6 V dc output voltage from the PA A+ input. A portion of the +9.6 V dc output (approximately 52%, determined by 1% resistors R307 and R308) is fed back to the negative (-) input, pin 2, of the differential amplifier. The voltage at pin 2 is the sample voltage. The fixed reference voltage of +5.03 V dc appears at the positive (+) input, pin 3. The reference voltage is established by Zener diode VR301. The Zener diode is biased by resistor R303 for best temperature compensation.

4.8.3 When the output from Q300 and Q301 is +9.6 V dc, the sample voltage is the same as the reference voltage (+5.03 V dc). If the +9.6 V dc output increases, the sample voltage at the negative input rises above the reference voltage at the positive input, causing the output from U300A to decrease. This decreases the current through Q301, causing the current through Q300 to decrease and the output voltage to decrease, until +9.6 volts is obtained. As the output voltage decreases below +9.6 V dc, the sample voltage at the negative input of U300A decreases; the output of U300A increases, and Q301 and Q300 conduct harder, raising output voltage back to +9.6 volts.

4.8.4 Diode CR300 provides short-circuit protection for Q300 and Q301 by turning them off if the regulated output is shorted to ground. The regulator can withstand an indefinite short in this condition; the output of U300A is internally short-circuit protected. Resistors R301 and R302 reduce the voltage gain of Q300 and Q301 for increased stability. Resistor R306 and capacitor C304 filter high frequency Zener noise.

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SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES

Many of the integrated circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. *However, CMOS circuits can be damaged by improper handling of the modules even in a system.*

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

1. Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch *both* hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

NOTE
Wearing Conductive Wrist Strap (Motorola No. RSX-4015A) will minimize static buildup during servicing.

WARNING
When wearing Conductive Wrist Strap, be careful near sources of high voltage. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentially touching high voltage sources.

2. Whenever possible, avoid touching any electrically conductive parts of the circuit module with your hands.

3. Normally, circuit modules can be inserted or removed with power applied to the unit. However, check the INSTALLATION and MAINTENANCE sections of the manual as well as the module schematic diagram to insure there are no objections to this practice.

4. When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

5. All electrically powered test equipment should be grounded. *Apply* the *ground lead* from the test equipment to the circuit module *before* connecting the *test probe*. Similarly, *disconnect* the *test probe prior* to removing the *ground lead.*

6. If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through 100k of resistance.

WARNING
If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

7. When soldering, be sure the soldering iron is grounded.

8. Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

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9. When replacing a CMOS integrated circuit device, leave the device in its metal rail container or conductive foam until it is to be inserted into the printed circuit module.

10. All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.

11. Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a simlar material (aluminum foil may be used). NEVER USE NON-CONDUCTIVE MATERIAL for packaging these modules.

1. INTRODUCTION

This section contains recommended test equipment lists, assembly breakdown descriptions, preventive maintenance, and instructions for operational checkout, assembly/disassembly, repairs, and troubleshooting for the *DVP MCX100* Radio. All assemblies and subassemblies are repairable to the component level except the eight hybrid assemblies. The hybrid assemblies are listed below.

- voltage controlled oscillator (VCO)
- low level amplifier (LLA)
- 10 watt power amplifier (10 W PA)
- harmonic filter/antenna switch
- 30 watt power amplifier (30 W PA)
- digital/analog converter (D/A converter) (PL/DPL models only)
- *Private-Line* or *Digital Private-Line* filter (PL filter) (PL/DPL models only)
- *DVP* Encryption Hybrid

2. TEST EQUIPMENT

2.1 REQUIRED TEST EQUIPMENT

Refer to Table 1 for recommended test equipment required for general servicing of the *DVP MCX100* Radio.

CAUTION

The poor regulation and/or transient response of many bench power supplies can apply excessive voltage to high power radios when going from the transmit to receive condition. **Avoid using these supplies or damage to the radio may result.** Such supplies can also cause improper radio operation due to loss of regulation. The following bench supplies are approved for testing the *DVP MCX100* radio:

- Motorola R1011 High Current Power Supply

CAUTION (Cont'd.)

- Motorola T1261 Transistorized 24-Volt to 12-Volt Converter driven by Motorola T1012 Power Supply
- 12-Volt automotive battery with Motorola T1012 Power Supply used as a battery charger. The power supply provides sufficient power to maintain the voltage under full load conditions, and the battery can absorb the over-voltage upon dekeying.

2.2 ADDITIONAL TEST EQUIPMENT

The equipment listed in Table 1 is sufficient to repair, adjust, and align *DVP MCX100* Radios and to verify basic performance. However, to accurately verify all radio specifications, additional test equipment or equipment with better specifications may be required. Refer to Table 2.

2.3 PROM PROGRAMMING EQUIPMENT

The PROM assemblies may be programmed in the field, as well as at the factory. To properly program PROMs for the *DVP MCX100* radio, the following equipment is necessary.

- R1801 Digital Analyzer/Controller with Reader/-Programmer
- RTL5818 Adapter Board for Frequency, PL/DPL, and *Channel Scan* PROMs
- RTL5820 Adapter Board for *Select 5* Signaling
- RTL4805 Application Program Kit for Frequency PROMs
- RTL4806 Application Program Kit for PL/DPL PROMs
- RTL4807 Application Program Kit for *Select 5* PROMs
- RTL4079 Application program Kit for *Channel Scan* PROMS

Table 1. Recommended Test Equipment for DVP MCX100 Radio Servicing

General Type	Application	Recommended Model	Minimum Specifications
AC-DC VOM	DC voltage measurements, general	Motorola T1010	Measurement range: 0-15 V dc Sensitivity: 20,000 ohms/volt
DC Multimeter	DC voltage readings requiring a high input resistance meter	Motorola S1063	Measurement range: 0-15 V dc Input resistance: 11 megohms
Distortion Analyzer	Hewlett-Packard Model 331A	Distortion and SINAD measurements	Average-responding detector
AC Voltmeter	Audio voltage measurements	Motorola S1053	Measurement range: 0-10 V ac Input resistance: 10 megohms
RF Voltmeter	RF voltage measurements	Motorola S1339	Measurement range: 100 uV-3 V from 1 MHz-512 MHz Inputs: 50-ohm and high impedance
Oscilloscope	Waveform observation	Motorola R1004	Vertical sensitivity: 5 mV-10 V/division Horizontal time base: 0.2 usec. — 0.5 sec/division
RF Wattmeter	Transmitter output power measurement	Motorola S1350 with appropriate element and T1013 RF Dummy Load	Measurement range: 0-250 Watts
Frequency/Deviation Meter	Transmit frequency and deviation modulation measurement	Motorola R2001 Communications System Analyzer with high stability oscillator (HS suffix). Frequency calibration recommended every 6 months or less.	Measurement range: 134-174 MHz 100 Hz Resolution 0-100 kHz Deviation
RF Signal Generator	Receiver alignment and troubleshooting	Motorola R-2001 Communications System Analyzer	Measurement Range: 134-174 MHz 100 Hz Resolution Output Level: 1 uV to 1 V rms
PL Tone Generator*	Tone Coded *Private-Line* decoder troubleshooting	Motorola R-2001 Communications System Analyzer or Motorola R-1100 Code Synthesizer (Single stand-alone instrument)	Frequency range: 50 Hz - 9.999 kHz Output Level: 0-3 V rms
Audio Signal Generator	Audio circuit troubleshooting	Motorola S1067	Frequency range: 20 Hz-20 kHz Output level: 50 mV-1 V
DPL Test Set**	*Digital Private-Line* encoder-decoder troubleshooting	Motorola SLN6413	
Speaker/Load	Receiver alignment and measurement	TSN6031 Speaker Kit with RPX4134 Modification Kit	
Tuning Tool Kit	Receiver and transmitter alignment	Motorola TRN4671	
DC Power Supply	DC power for shop service	Motorola R1011	1-20 V dc 0-40 A
Front Panel Extender	Troubleshooting	Motorola RTK4036	
DVP Test Set	*DVP* Troubleshooting	Motorola R1012	

*Required for tone-coded *Private-Line* models only
**Required for *Digital Private-Line* models only

NOTE

All test equipment with the exception of the DPL test set, tuning tool kit, dc power supply, *DVP* test set, and front panel extender, may be replaced by the Motorola R2001 Communications System Analyzer.

Table 2. Additional Test Equipment

General Type	Recommended Model	Application	Minimum Specifications
Low Noise RF signal generators (2 required)	Hewlett-Packard Model 8640B with option H60, "Low Single Sideband Noise"	Receiver Intermodulation and Adjacent-Channel Selectivity measurements	SSB noise 142 dB/ Hz below carrier (20 kHz offset 1 Hz bandwidth)
Broadband Signal Combiner, 50 ohm	Anzac T-1000	Receiver Intermodulation and Adjacent-Channel Selectivity measurements	25 dB minimum isolation
Three-port resistive combiner, 50 ohm	Measurements M501 or equivalent	Three-generator Intermodulation measurements	
Psophometer	Hewlett-Packard Model 3556A	CEPT method SINAD measurements	
Spectrum Analyzer	Hewlett-Packard Model 141T Mainframe with 8554L and 8552A Heads	Transmitter spurs and harmonics	60 dB (minimum) dynamic range (30 kHz bandwidth); storage and/or manual scan capability are desirable.
20 dB thruline pad, 50 ohms		Transmitter spurs and harmonics	35 watt minimum continuous power rating
10 dB thruline pad, 50 ohms		Transmitter spurs and harmonics	
Tunable notch filter, 50 ohms		Transmitter spurs and harmonics	30 dB minimum notch depth, tunable 136-174 MHz

Refer to the manuals provided with the above equipment for programming procedures.

3. DESCRIPTIONS

3.1 CONSTRUCTION AND ACCESSIBILITY

3.1.1 The *DVP MCX100* Radio is semi-modular. It is constructed and housed in a durable cast metal chassis with separate top and bottom covers. The front panel of the radio set housing contains all operating controls and indicators (front mount models). In remote mount radios, all controls and indicators are located in the control head. The rear of the front mount radio chassis contains the connectors for dc power input, microphone, speaker, antenna, and selected accessories. The rear of the remote mount radio chassis contains connectors for the dc input power, speaker, and antenna. A microphone may be installed at the rear of the radio in place of the control head microphone. This is offered as an option (alternate microphone location). The connector for the control cable is on the front of the remote mount chassis. High power models (30 watt) have a heat sink on the back of the chassis for power amplifier cooling.

3.1.2 The radio set is designed to make most assemblies readily accessible by removing the top cover, bottom cover, synthesizer cover, and PA shield. Refer to Figures 1 and 2. The assemblies for the radio set are listed below.

- main board
- option board (if used)
- external heat sink
- power amplifier interconnect board
- frequency synthesizer (consists of synthesizer board and VCO hybrid)
- 30 watt power amplifier
- front end (single or dual) (mounted on main board) (single front end shown)
- *DVP* Encryption Board
- *DVP* Interface Board

3.1.3 Access to additional assemblies is made possible by removal of the front panel assembly, and the main board. Refer to Figure 3. The assemblies shown in Figure 3 are listed below.

- front panel interconnect board
- switch board
- display board
- power interconnect board
- *DVP* Encryption Board
- *DVP* Interface Board

An assembly not shown is the remote interface board, for remote mount units only. This board is housed in a metal casting which mounts to the front of the chassis assembly, in place of the front panel assembly used in front mount units.

3.2 POWER AMPLIFIER (PA) INTERCONNECT BOARD

The PA interconnect board provides physical mounting and electrical interconnection of:

- the low level amplifier hybrid,
- the 10 watt power amplifier hybrid, and
- the harmonic filter/antenna switch hybrid.

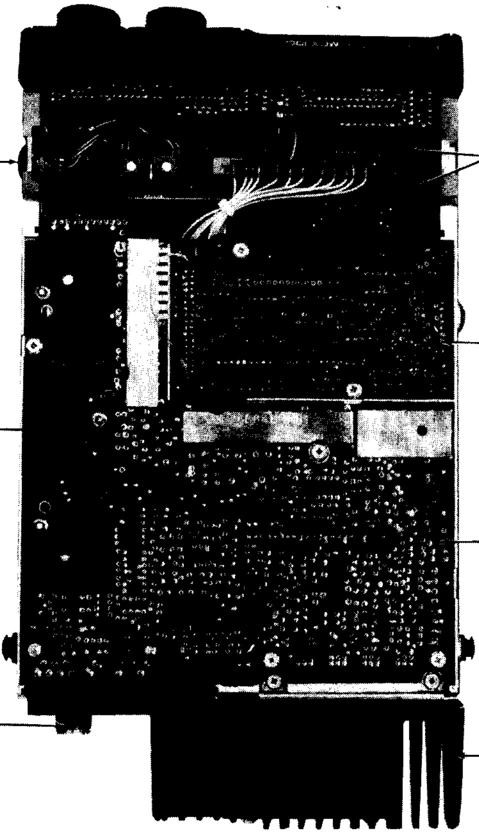


Figure 1. DVP MCX100 Radio Set-Top Cover Removed

The PA interconnect board is located on the bottom of the chassis, adjacent to the rear wall. All transmitter circuits except push-to-talk logic (PTT), transmit audio/instantaneous deviation control (IDC), and transmit power and level control are located on these hybrids.

3.3 EXTERNAL HEAT SINK (Refer to Figure 1)

The external heat sink is used only with the 30 watt models. The heat sink is attached to the rear of the radio set chassis, and houses the 30 watt power amplifier hybrid.

3.4 30 WATT POWER AMPLIFIER (Refer to Figure 2)

The 30 watt power amplifier hybrid is used with 30 watt models only. The amplifier is mounted inside the external heat sink and is accessed by removing the bottom cover of the heat sink.

3.5 FREQUENCY SYNTHESIZER

3.5.1 The standard lock frequency synthesizer consists of two assemblies: the synthesizer board and the VCO. The two assemblies are located side by side on the bottom of the radio set and are accessed by removing the synthesizer cover. The synthesizer board contains:

- A reference oscillator,
- Frequency selection logic circuits,
- The frequency select PROM, and
- Miscellaneous buffering, filtering, and control circuitry.

The VCO hybrid assembly contains:

- The voltage controlled oscillator circuit,
- Buffer,
- Range shift circuitry, and
- Varactor diodes, which produce frequency modulation of the VCO.

3.5.2 The *Fast-Lok* synthesizer consists of the two assemblies previously described for the standard lock frequency synthesizer and an rf synthesizer amplifier board. The synthesizer rf amplifier board is visible and accessible only after the synthesizer board is removed. The synthesizer rf amplifier board contains:

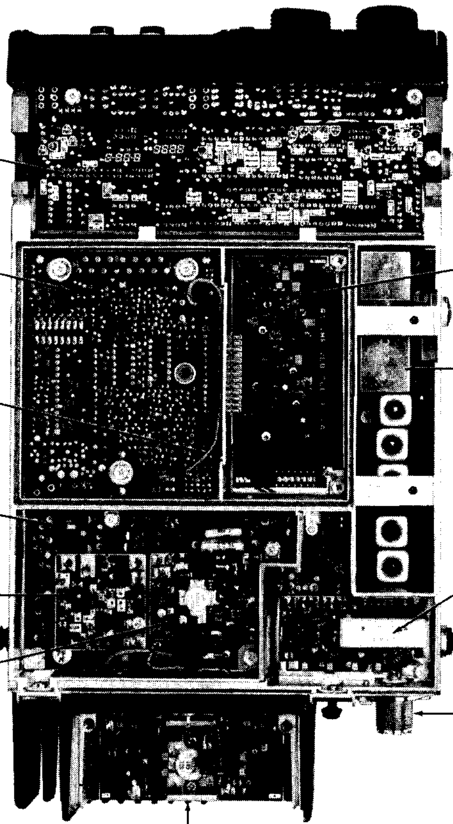


Figure 2. DVP MCX100 Radio Set-Bottom Cover Removed

- the output rf amplifier/buffer,
- the transmit/receive injection switch, and
- the injection switch driver circuitry.

3.6 MAIN BOARD
(Refer to Figure 1)

The main board is located on the top of the radio set in the rear and to the left. The main board contains receiver circuits, voltage regulation circuits, and the following transmitter circuits:

- portions of the push-to-talk logic,
- transmit audio/IDC, and
- transmit power and level control.

3.7 FRONT PANEL INTERCONNECT BOARD
(Refer to Figure 3)

The front panel interconnect board provides for the connections between the *DVP* encryption board, power interconnect board, synthesizer board, and main board. The front panel interconnect board is located in a slot at the front of the radio chassis accessable by removing the front panel casting and the *DVP* circuit module.

NOTE
In remote mount models, the front panel casting is replaced by the remote mount interface casting which contains the remote interface board. The remote interface board plugs into the *DVP* encryption board when the remote mount interface casting is mounted to the front of the radio.

3.8 DISPLAY BOARD
(Refer to Figure 3)

The display board contains visual indicators, and is mounted vertically in the front of the front panel casting (front mount models only).

NOTE
In remote mount models, the display board is located in the control head.

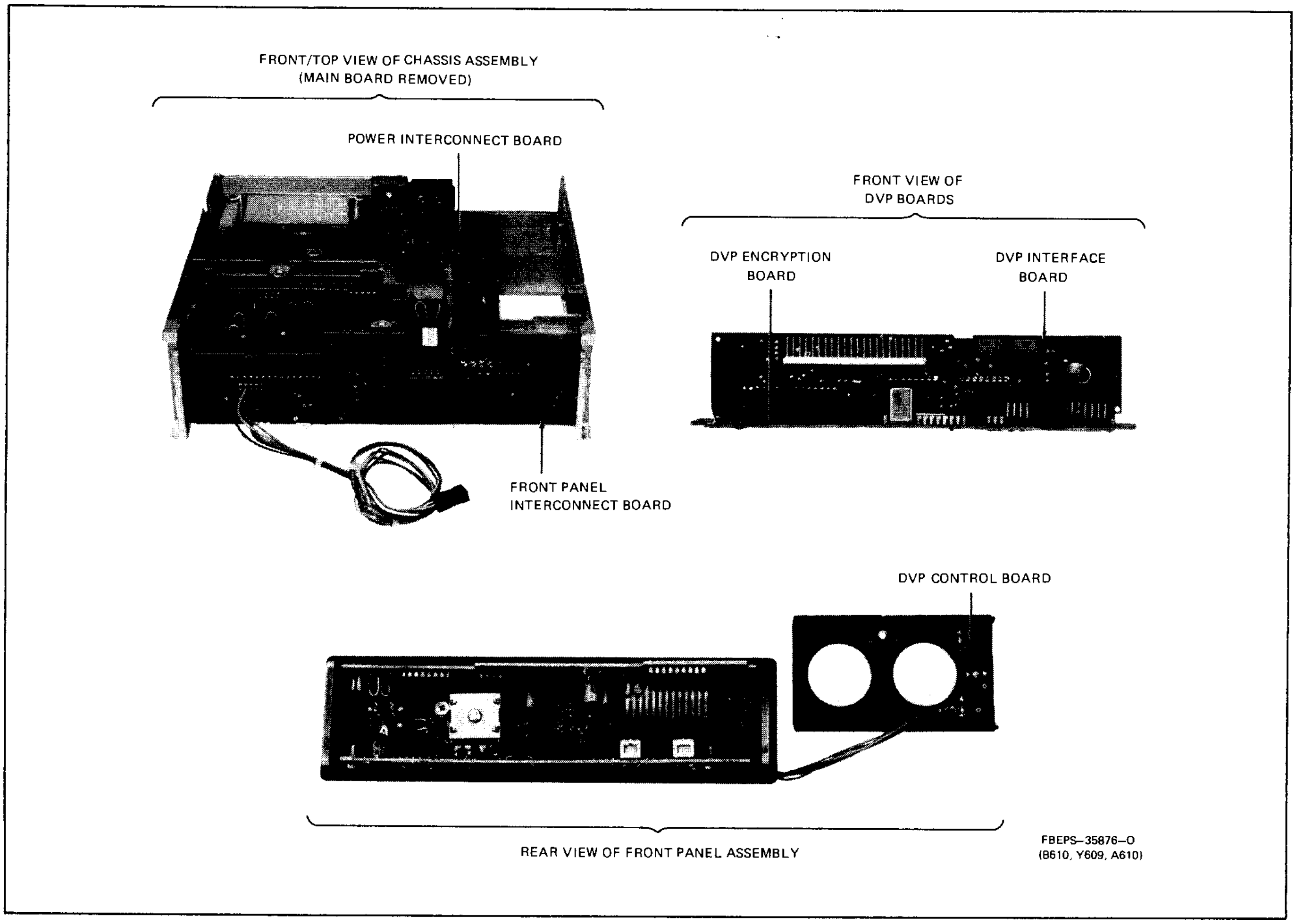


Figure 3. Chassis, DVP Circuitry, and Front Panel Assemblies

3.9 SWITCH BOARD
(Refer to Figure 3)

The switch board contains operating controls and switches and is mounted horizontally at the bottom of the front panel casting (front mount models only.)

NOTE

In remote mount models, the switch board is located in the control head.

3.10 POWER INTERCONNECT BOARD
(Refer to Figure 3)

The power interconnect board provides power distribution for the radio. This board is located below the main board and to the rear of the front panel interconnect board.

3.11 FRONT END
(Refer to Figure 2)

The front end contains the rf amplifier, mixer, and tuned filters which provide selectivity. The front end is attached to the main board. A single front end board (standard) or a dual front end casting (optional) are provided with each radio model.

3.12 OPTION BOARDS

Some models may contain one or two of the following option boards:

- PL encoder/decoder with time-out timer,
- Time-out timer,
- *Select 5* Single Board,
- *Select 5* Double Board, or
- *Channel-Scan* monitor.

Option boards are mounted in the option area located on the top of the radio in front of the main board as shown in Figure 1.

3.13 *DVP* INTERFACE BOARD AND *DVP* ENCRYPTION BOARD
(Refer to Figure 1)

The *DVP* encryption board is mounted horizontally between the front panel interconnect board and the switch board. The *DVP* interface board is mounted vertically on the top side of the *DVP* encryption board. The *DVP* interface board and the *DVP* encryption board perform the following functions:

- encoding of clear audio for transmission,
- decoding of encrypted received audio,
- portions of the push-to-talk logic, and
- radio muting logic.

The *DVP* encryption board also provides for the feed-thru of signals between the switch board and the fromt panel inteconnect board.

3.14 *DVP* CONTROL BOARD
(Refer to Figure 3)

The *DVP* control board provides visual indicators and operating controls for use with *DVP* circuitry. This board is heat-staked to the front panel of the radio.

4. MODEL, NOMENCLATURE, AND OPTION DATA

To determine the options, kits, assemblies, and subassemblies contained in various models, refer to the model breakdown charts and parts lists in this manual.

5. PREVENTIVE MAINTENANCE

5.1 INITIAL CHECKS

5.1.1 It is recommended that the transmitter channel frequencies be checked and the reference oscillator adjusted, if necessary, after the first, third, seventh, and twelfth months, and yearly thereafter. This compensates for crystal aging. If the reference oscillator crystal (or channel element) is replaced, the above schedule should be repeated for the first year.

5.1.2 At initial installation and yearly thereafter, perform the power output and the EIA modulation sensitivity transmitter tests and the 12 dB EIA SINAD and squelch sensitivity receiver tests using the procedures in this section.

5.1.3 Record these readings each time they are made and compare them with previous readings to detect possible deterioration.

5.1.4 If it is determined that adjustments or alignment is required, refer to the appropriate procedures in this manual.

5.2 ROUTINE CHECKS

Step 1. Check all controls for freedom of movement.

Step 2. Check all connectors and cables for fraying, loose connections, and bent pins.

Step 3. Remove all dust and dirt with a lint-free cloth and a non-abrasive cleaner.

Step 4. Verify proper dc input voltage.

Step 5. Check transmitter frequency, deviation, and power output periodically or as required by law, using the procedures in this section.

Step 6. Verify that front panel display indicates selected channel.

Step 7. Verify that all controls operate as specified in the owners manual.

6. MINIMUM PERFORMANCE VERIFICATION

6.1 TEST SETUP

Prior to troubleshooting or performing maintenance, connect radio set as illustrated in the test setup diagrams in Figures 4, 5, and 6, as applicable. Refer to the Owners Manual for general operating instructions.

NOTE

Unless otherwise specified, all tests are performed at 25 ± 2° C, using a power supply voltage of 13.8 V dc for 10 watt models and 13.6 V dc for 30 watt models.

6.2 PRELIMINARY PROCEDURE

After ensuring proper test setup, perform the following procedure.

Step 1. Verify proper input voltage.

Step 2. Turn Off-on/Volume switch to the on position.

Step 3. Verify that channel indicators illuminate.

6.3 PRELIMINARY RECEIVER TEST

NOTE

Test 6.3.1 through 6.3.4 are performed in the clear mode. Test 6.3.5 through 6.3.7 are performed in the coded mode.

6.3.1 <u>20 dB Quieting Sensitivity Test</u>

Step 1. Ensure that no rf input is present.

Step 2. Set Off-on/Volume control for 1 V rms noise at 2 ohm speaker/or load. This is the 0 dB reference level.

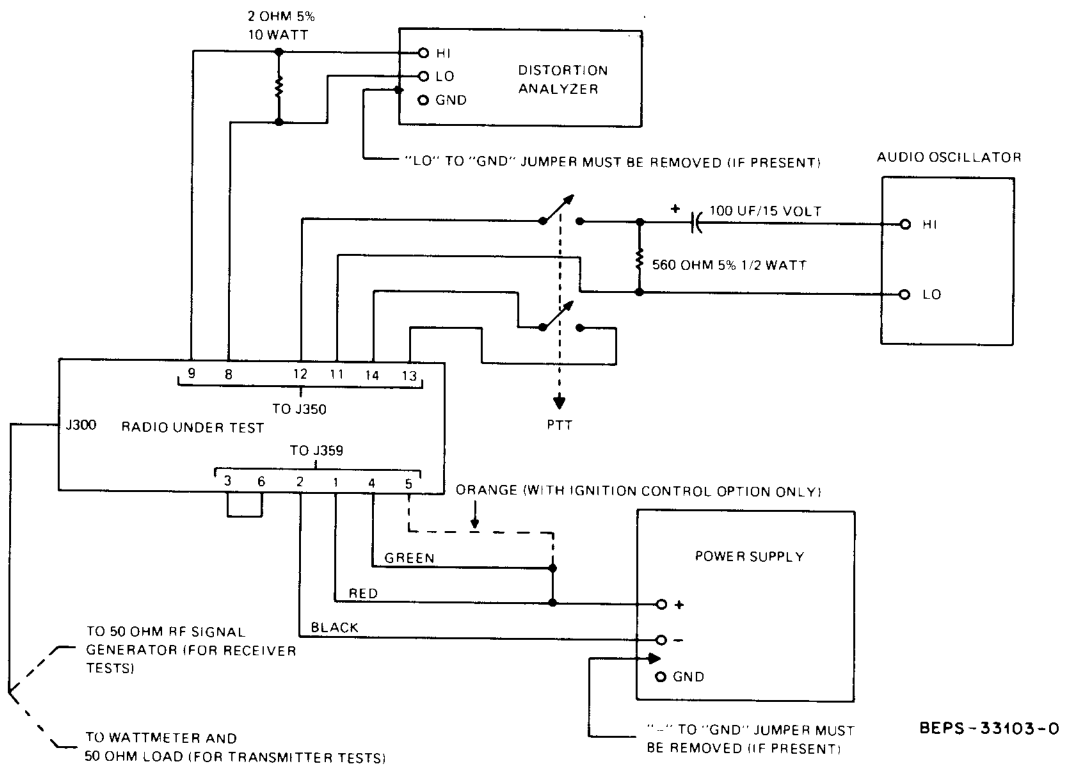


Figure 4. Bench Test Setup for DVP MCX100 Front-Mount Radios

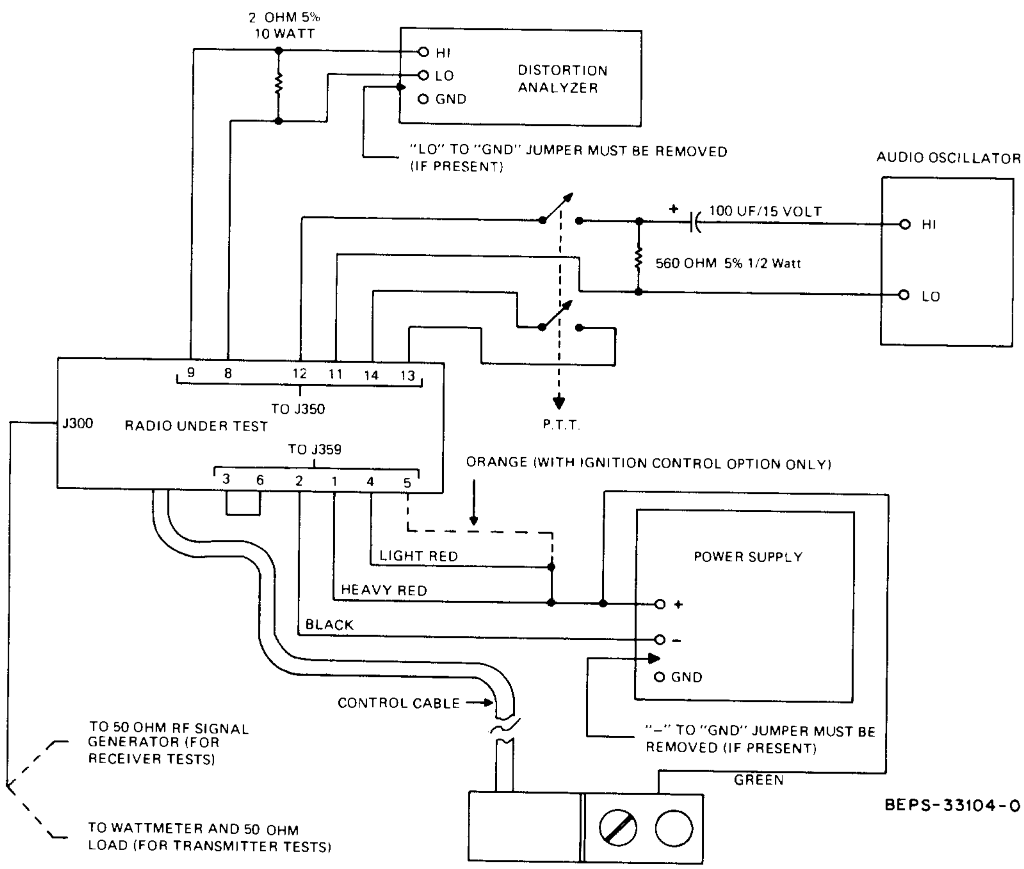


Figure 5. Bench Test Setup for DVP MCX100 Remote-Mount Radios

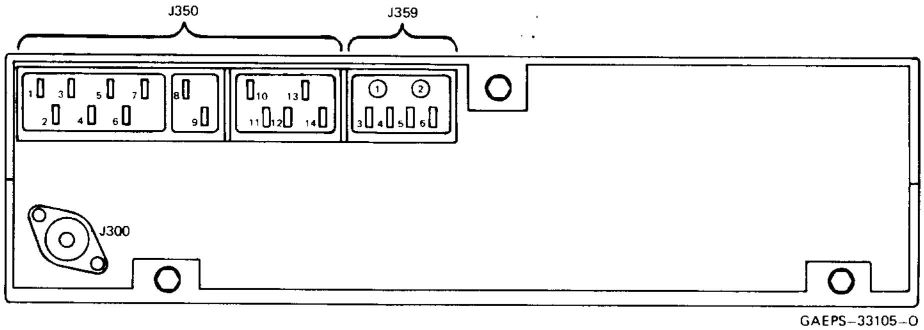


Figure 6. Pin Number Identification (Rear View of DVP MCX100 Radio)

Step 3. Increase on-channel generator level until noise level is decreased by 20 dB. Note generator rf level; should be 0.35 uV maximum (all channels).

6.3.2 12 dB EIA SINAD Test

Step 1. Apply on-channel 1 mV rf signal, modulated with 1kHz at 60% of full system deviation.

Step 2. Adjust Off-on/Volume control for 5 watts output (3.16 V rms at 2 ohm load).

Step 3. Note the difference between levels at the 2 ohm load when a 1 kHz bandstop filter is switched into and out of the distortion analyzer circuit.

Step 4. Reduce the generator rf level until the difference noted in Step 3 is 12 dB (12 dB SINAD is obtained). Generator rf level should be 0.28 uV maximum on all channels.

NOTE

Local government or industry standards may refer to this test as the SND/ND test and may require the use of a psophometric weighting network. Refer to local specifications or regulations.

6.3.3 Squelch Opening Sensitivity Test

Step 1. Ensure that there is no rf input.

Step 2. Adjust Off-on/Volume control for 1 V rms of noise across the 2 ohm load (0 dB reference).

Step 3. Place the squelch defeat pushbutton (⊛) in the out position (white collar showing).

Step 4. Increase unmodulated rf generator level slowly until speaker just remains unmuted.

Step 5. Verify that the amount of noise quieting is between 9 and 11 dB for all channels.

6.3.4 Busy Light Sensitivity Test (7000-9000 Series Models Only)

Step 1. Ensure that there is no rf input.

Step 2. Adjust Off-on/Volume control for 1.0 volts rms of noise across the 2 ohm load (0 dB reference).

Step 3. Apply an on-channel, unmodulated rf signal, slowly increasing the level until the front panel Busy Light indicator (orange LED) just illuminates.

Step 4. Verify that the amount of noise quieting is at least 20 dB and no greater than 26 dB.

6.3.5 *DVP* Harmonic Distortion

Step 1. Using a R1012 *DVP* test set, program the radio under test with a key.

Step 2. With the R1012 encoder on 1 kHz, modulate an rf generator with the encode output of the R1012. Deviation should be set for 4 kHz peak. RF level should be set to 1 mV.

Step 3. Adjust Off/on Volume control on the radio for 3.16 V rms across a 2 ohm load.

Step 4. Measure the total harmonic distortion. 5% is typical while 6% is the maximum limit (see note).

6.3.6 *DVP* EOM

Step 1. Perform Steps 1 and 2 of test 6.3.5.

Step 2. Make sure that the squelch button is out (white collar showing).

Step 3. At this time you should hear a 1 kHz tone from the radio (see note). Pressing the EOM button on the R1012 to "Burst" and releasing it should result in momentary quieting at the radio speaker.

NOTE
Many RF generators are in use which have insufficient low frequency response for testing *DVP* radios. This may result in bit errors at the receiving radio. If bit errors occur a "popping" or "clicking" sound will be heard at the test radio speaker. Note that when a bit error occurs the harmonic distortion will be very high.

6.3.7 *DVP* Receive Mode Indicator

Step 1. Perform Steps 1 and 2 of test 6.3.5.

Step 2. The yellow receive coded mode indicator should be illuminated.

Step 3. Turn the rf generator off. The indicator light should go off after approximately 1 second.

6.4 SECONDARY RECEIVER TESTS

NOTE
Secondary receiver tests are performed in the clear mode.

6.4.1 Audio Power Output and Distortion

Step 1. Apply on-channel 1 mV rf signal modulated with 1 kHz at 60% of full system deviation.

Step 2. Adjust Off-on/Volume control for 3.16 V rms across 2 ohm load.

Step 3. Measure total harmonic distortion. The maximum limit for total harmonic distortion is 3 percent.

6.4.2 Modulation Acceptance Bandwidth

Step 1. Apply on-channel signal at 1 mV modulated with 1 kHz at 60% of full system deviation.

Step 2. Adjust Off-on/Volume control for 0.5 watts (1 V rms across 2 ohm load).

Step 3. Reduce generator rf level until 12 dB SINAD is obtained.

Step 4. Increase generator rf level by 6 dB and increase deviation until 12 dB SINAD is again obtained.

Step 5. The deviation level corresponds to the modulation acceptance bandwidth which must be equal to or greater than 7 kHz.

6.4.3 Receiver Spurious Response Rejection

Step 1. Connect two signal generators to the receiver input with a broadband signal combiner.

Step 2. Apply an on-channel rf signal having 1 kHz modulation at 60% of full system deviation, with the rf level adjusted to produce 12 dB SINAD at a reference audio output level of 3.16 V rms across the 2 ohm load.

Step 3. Adjust the second signal generator to generate an "undesired" signal. The undesired signal should include the following:

- Image frequency (42.8 MHz below receiver frequency),
- Half i-f (10.7 MHz below the receive frequency), and
- i-f (21.4 MHz).

Step 4. Modulate the undesired signal with 400 Hz at 60% of full system deviation. Adjust the rf level of the generator until the level is 85 dB above the level of desired signal generator output.

Step 5. Vary the frequency of the undesired-signal generator between 500 kHz and 1000 MHz.

Step 6. Note any frequency at which a spurious response is noted (other than frequencies within one channel separation from the desired receiver).

Step 7. Adjust the rf level of the undesired-signal generator (at the frequency of the spurious response) to degrade the 12 dB SINAD level to 6 dB SINAD. The difference between the two generator levels should be greater than or equal to 85 dB.

NOTE
Spurious responses should be checked on all channels for all three of the following types of undesired signals: image frequency, half i-f, i-f.

6.4.4 Adjacent Channel Selectivity Test (EIA Method)

Step 1. Connect two generators to the receiver antenna input using a broadband signal combiner.

Step 2. Adjust generator 1 to provide an on-channel signal, with generator 2 rf output level at zero.

Step 3. Modulate the on-channel signal with 1 kHz at 60% of full system deviation at an rf level that produces 12 dB SINAD. Audio reference across 2 ohm load should be 3.16 V rms.

Step 4. Adjust generator 2 for the frequency of the adjacent channel, modulated with 400 Hz at 60% of full system deviation.

NOTE
The adjacent channel is one channel spacing above or below the on-channel receive frequency.

Step 5. Increase the rf level of generator 2 until the 12 dB SINAD level is degraded to 6 dB SINAD.

Step 6. Measure the output level of both rf generators. The difference between the two levels should be:

- 85 dB minimum for units with 25 kHz channel spacing.
- 90 dB minimum for units with 30 kHz channel spacing.

NOTE
For correct measurements, generator 2 must have very low sideband noise.

6.4.5 Receiver Intermodulation Attenuation Test

Step 1. Connect two signal generators to the receive antenna input using a broadband signal combiner.

Step 2. Set generator 2 rf output level to zero.

Step 3. Adjust generator 1 for an on-channel signal, modulated with 1 kHz at 60% of full system deviation.

Step 4. Adjust the rf level of generator 1 to obtain 12 dB SINAD (audio output reference level should be 3.16 V rms across a 2 ohm load).

Step 5. Record the rf level of generator 1.

Step 6. Tune generator 1 to a frequency above the channel frequency by an amount equal to TWICE the channel spacing for the unit being tested.

Step 7. Tune generator 2 to a frequency above the channel frequency by an amount EQUAL to the channel spacing for the unit being tested.

Step 8. Adjust the output level of generator 2 to the same level as recorded previously for generator 1. Generator 2 should be unmodulated.

Step 9. Simultaneously increase the rf levels of both generators until 12 dB SINAD is obtained again.

Step 10. Calculate the difference in dB between the rf levels of either generator and the level recorded for generator 1 in Step 5.

Step 11. Repeat the above procedure with both generators tuned below the channel frequency instead of above it.

Note that the difference calculated in Step 10 should be greater than or equal to 80.

NOTE
For correct measurements, generator 2 must have very low sideband noise.

6.5 PRIMARY TRANSMITTER TESTS

NOTE
Primary Transmitter tests 6.5.1 through 6.5.3 are performed in the clear mode. Primary Transmitter tests 6.5.4 through 6.5.6 are performed in the coded mode.

6.5.1 Transmitter RF Power Output

Step 1. Refer to Table 3 and find the power set level which corresponds to the power rating of the unit being checked.

Table 3. Power Set Levels

Power Rating (Watts)	Power Set Level (Watts)	Supply Voltage (Volts)
10.0	10.5 min.	13.80
30.0	31.0 min.	13.60

Step 2. Measure the transmitter rf output power on each channel. The power output should not be less than the level listed.

Step 3. Ensure that the supply voltage level is adjusted to the level shown in Table 3.

6.5.2 Transmitter Frequency

Step 1. Couple the transmitter RF output to the input of a frequency counter or service monitor using appropriate attenuation.

Step 2. Measure the transmitter frequency on each channel.

Step 3. The measured frequency on any channel should be within ±200 Hz of the specified customer frequency for that channel.

6.5.3 EIA Modulation Sensitivity Test

Step 1. Apply a 1 kHz signal to the microphone audio input and key the transmitter.

CAUTION
An antenna or suitable rf load should be connected to the antenna connector.

Step 2. Observe the modulation on an oscilloscope connected to the output of a standard test receiver (with no de-emphasis).

Step 3. Adjust the audio oscillator until the peak-to-peak amplitude of the waveform is 60% of full system deviation.

Step 4. Measure the oscillator level at the microphone audio input while the transmitter is still being keyed. The audio input should be between 55 mV rms and 105 mV rms.

6.5.4 *DVP* Transmit

Step 1. Using a R1012 *DVP* test set, program the radio under test with a key.

Step 2. Connect the modulation output of a standard test receiver to the decode input of the R1012.

Step 3. Connect a suitable rf load to the test radio.

Step 4. Using the radio microphone talk into the test radio while transmitting in the coded mode. You should hear the microphone audio at the R1012 speaker.

NOTE
Many test receivers have sufficient low frequency response for testing *DVP* radios. This may result in bit errors at the receiving R1012. These bit errors will cause a "popping" or "clicking" sound from the R1012 speaker.

6.5.5 *DVP* EOM

Step 1. Repeat Steps 1,2 and 3 of 6.5.4.

Step 2. Using the radio microphone transmit with the test radio in coded mode. Upon dekeying the test radio the EOM indicator on the R1012 should momentarily be illuminated.

6.5.6 *DVP* Alert Tone

Step 1. Place the radio in the transmit clear mode.

Step 2. Connect a suitable rf load to the test radio.

Step 3. Transmit with the test radio. At the beginning of each transmission you should hear a 750 Hz tone from the speaker of the test radio (alert tone).

6.6 SECONDARY TRANSMITTER TESTS

NOTE
The secondary transmitter tests are performed in the clear mode.

6.6.1 Spurious and Harmonic Attenuation

Step 1. Connect the transmitter output to a spectrum analyzer through a suitable attenuator and establish a 0 dB reference. Recommended analyzer settings: 30 kHz bandwidth, 1 MHz/div scan width, and 10 kHz video filter.

Step 2. Insert a notch filter tuned to the carrier frequency between the analyzer and the attenuator. the notch filter should be capable of at least 30 dB attenuation of the carrier frequency.

Step 3. Reduce the spectrum analyzer attenuation so that responses of −90 dB can be observed. Note the frequency and vertical position of a spurious or harmonic response.

Step 4. Disconnect the transmitter from the analyzer. Connect an rf signal generator to the analyzer.

Step 5. Adjust the rf signal generator for the frequency and output level necessary to product a response identical to the one notes in Step 3.

Step 6. Note the level of the rf generator. For 10 watt radios the maximum allowable level is −80 dBc. For 30 watt radios the maximum allowable level is −85 dBc.

Step 7. Repeat Steps 4 through 6 for all spurious and harmonic responses.

6.6.2 Modulation Limiting Characteristics

Step 1. Connect an audio oscillator to the microphone audio input. Adjust the oscillator output level (while the transmitter is keyed) to 1.2 V rms.

CAUTION
An antenna or suitable rf load should be connected to the antenna connector.

Step 2. Connect an oscilloscope to the output of a standard test receiver (with no de-emphasis).

Step 3. Vary the frequency of the oscillator between 300 and 3000 Hz while maintaining the output level given in Step 1. Observe the deviation on the oscilloscope while the frequency is varied. The deviation should be between 70% and 100% of full system deviation (5 kHz).

NOTE
The peak-deviation frequency is typically 2700 Hz for models with a full system deviation of 5 kHz.

NOTE
When performing the following tests (6.6.3 through 6.6.5) on PL/DPL model radios, it will be necessary to inhibit transmission of the PL tone or DPL code to obtain correct results. This can be done by selecting a non-PL/DPL channel (multiple PL/DPL models) or by removing J377 from P377 on the PL/DPL board while performing these tests.

6.6.3 Transmitter Hum and Noise

Step 1. Connect an audio oscillator to the microphone audio input. Adjust the oscillator to provide 1 kHz modulation at 60% of full system deviation.

Step 2. Connect an ac voltmeter to the deemphasized output of a standard test receiver. Note the meter reading.

Step 3. Disconnect or switch off the audio oscillator and note the meter reading. The reading should be no higher than 50 dB below that measured in the previous step.

6.6.4 Transmitter Audio Frequency Response

Step 1. Connect an audio oscillator to the microphone audio input. Adjust the oscillator output level while the transmitter is keyed to 50 mV rms.

CAUTION
An antenna or suitable rf load should be connected to the antenna connector.

Step 2. Connect an ac voltmeter to the output of a standard test receiver (with no de-emphasis). Use 1000 Hz as the 0 dB reference.

Step 3. Vary the frequency of the oscillator between 300 and 3000 Hz while maintaining the oscillator output level given in Step 1. Observe the level on the voltmeter while the frequency is varied. The meter readings should not deviate by more than +1/−1.5 dB from the typical 6 dB per octave preemphasis characteristic between the frequencies of 400 and 2700 Hz. The meter readings should not deviate by more than +1/−3 dB from the typical 6 dB per octave preemphasis characteristic between the frequencies of 300 and 400 Hz and between the frequencies of 2700 and 3000 Hz.

6.6.5 Transmitter Distortion

Step 1. Connect a distortion analyzer to the deemphasized output of a standard test receiver.

Step 2. Modulate the transmitter with a 1000 Hz tone at 60% of full system deviation.

Step 3. Measure the total harmonic distortion.

The total harmonic distortion should not exceed 3%.

NOTE
Reconnect J/P 377 if this was unplugged prior to the above tests.

7. ASSEMBLY, REMOVAL AND REPLACEMENT

7.1 GENERAL

7.1.1 Refer to the *DVP MCX100* Exploded Views and Mechanical Parts Lists drawing in this manual. The radio set exploded view shows attachment of assemblies to the chassis. Many of the assemblies may be removed/replaced by carefully disconnecting/connecting the cables and removing/securing the attaching hardware. Refer to the following paragraphs for procedures applicable to specific assemblies involving special precautions and steps that may not be obvious. The power interconnect board and the power amplifier interconnect board can not be removed. Replacement of components on these boards, if necessary, should be done from the exposed side of the board. The leads of the replacement part must be properly trimmed prior to insetion to avoid short-circuits to the chassis. It is recommended that a spacer be placed between the board and chassis, if possible, to prevent solder from flowing below the board and touching the chassis.

7.1.2 During reassembly of the radio, it is very important to tighten all screws to the correct torque. Correct torque is essential for reliable electrical and mechanical performance. Too little torque may result in intermittent ground connections, microphonics, or insufficient heat sinking. Too much torque may cause stripping of the threads in the chassis. Recommended screw torque specifications for all fasteners in the *DVP MCX100* radio are listed in Table 4.

Table 4. Screw Torque Specifications

Screw Size	Application	Maximum Torque
M2.5 × 0.45	30 Watt final transistor; option board regulators; main board heat sink devices (4); front panel dimmer pass device.	6 ± 1 In-Lbs.
M4 × 0.7 × 9	30 Watt heat sink to chassis mtg.; top and bottom cover screws	20 ± 2 In-Lbs.
M3 × 0.5 × 10	Synthesizer cover	14 ± 2 In-Lbs.
M3 × 0.5 × 8	All other applications not listed above	12 ± 2 In-Lbs.
	10 Watt RF final mtg. stud	5 ± 1 In-Lbs.

7.1.3 Before a screw is reinserted, check the threads for foreign material. If the threads are damaged or if foreign material is present which cannot be removed, the screw should be discarded and a new one inserted. Damaged or clogged threads on a screw may damage the threads in the chassis.

CAUTION
The hybrid assemblies are not field-repairable. Attempts to repair a hybrid module will void the warranty.

7.2 STANDARD SYNTHESIZER VCO REPLACEMENT; TLD2441A, TLD2442A

Perform the following replacement steps:

Step 1. Remove three screws holding synthesizer board in casting.

Step 2. Use pull string on synthesizer board to remove board from casting. Pull straight up to avoid bending the connector pins.

Step 3. Remove two screws on shield wall between synthesizer and VCO compartments.

Step 4. Remove two screws on VCO/carrier assembly. Lift VCO out of compartment.

Step 5. Place new VCO in compartment. Replace two screws on VCO/carrier assembly, and tighten to 12 ±2 inch-pounds.

CAUTION

DO NOT over-tighten the screws in Step 5. The screw threads in the casting could be stripped if too much torque is applied.

Step 6. Replace shield wall and screws. Tighten to 12 ±2 inch-pounds.

Step 7. Replace synthesizer board and screws. Tighten to 12 ±2 inch-pounds.

7.3 STANDARD SYNTHESIZER BOARD REPLACEMENT TRN5243A

Perform the following replacement steps.

Step 1. Remove three screws holding synthesizer board in casting.

Step 2. Use pull string on synthesizer board to remove board from casting. Pull straight up to avoid bending the connector pins.

NOTE

The synthesizer has two field-replaceable integrated circuits (ICs); the divider (U115), and the PROM (U117). Replacment is described in Steps 3 through 6.

Step 3. The divider IC may be replaced by inserting a small round tool into the two holes opposite U115 on the solder side of the synthesizer board, and exerting pressure until the IC breaks free from the socket.

Step 4. The PROM IC may be replaced by inserting a thin flatbladed screwdriver between the PROM IC and the socket. Gently pry the PROM out of the socket.

Step 5. When placing either U115 or U117, bend the IC pins enough to allow them to line up with the socket holes.

Step 6. Replace IC's with firm pressure toward center of IC. Be sure to observe correct orientation as indicated by the circuit board legend.

Step 7. Replace synthesizer board and screws. Tighten screws to 12 ±2 inch-pounds.

7.4 *FAST-LOK* SYNTHESIZER VCO REPLACEMENT; TLD2541A, TLD2542A

Perform the following replacement steps.

Step 1. Remove three screws holding synthesizer board in casting.

Step 2. Use pull string on synthesizer board to remove board from casting. Pull straight up to avoid bending the connector pins.

Step 3. Remove two screws on shield wall between synthesizer and VCO compartments and remove wall.

Step 4. Remove two screws on VCO/carrier assembly. Lift VCO out of compartment.

Step 5. Unsolder bare wire interconnection between synthesizer rf amplifier board and VCO interconnect board. Lift VCO out of compartment.

NOTE

If adequate clearance cannot be made by tilting the VCO, remove the synthesizer rf amplifier board (refer to Synthesizer RF Amplifier Board Replacement paragraph).

Step 6. Place new VCO in compartment. Replace synthesizer rf amplifier board if required. Replace two screws on VCO/carrier assembly, and tighten to 12 ±2 inch-pounds.

CAUTION

DO NOT over-tighten the screws in Step 6. The screw threads in the casting could be stripped if too much torque is applied.

Step 7. Replace shield wall and screws. Tighten to 12 ±2 inch-pounds.

Step 8. Replace synthesizer board and screws. Tighten to 12 ±2 inch-pounds.

7.5 *FAST-LOK* SYNTHESIZER BOARD REPLACEMENT; TRN5129A

Perform the following replacement steps.

Step 1. Remove three screws holding synthesizer board in casting.

Step 2. Use pull string on synthesizer board to remove board from casting. Pull straight up to avoid bending the connector pins.

NOTE

The synthesizer has two field-replaceable integrated circuits (ICs); the divider (U115), and the PROM (U116). Replacement is described in Steps 3 through 6.

Step 3. The divider IC may be replaced by inserting a thin flat-blade screwdriver between the divider IC and the phase detector IC. (The phase detector IC, U140, is mounted beneath the divider IC.) Gently pry the divider out of its socket taking care not to damage the phase detector IC. An IC extractor tool may also be used.

Step 4. The PROM IC may be replaced by inserting a thin flatbladed screwdriver between the PROM IC and the socket. Gently pry the PROM out of the socket.

Step 5. When placing either U115 or U117, bend the IC pins enough to allow them to line up with the socket holes.

Step 6. Replace ICs with firm pressure toward center of IC. Be sure to observe correct orientation as indicated by the circuit board legend.

NOTE

When inserting the divider IC, prevent the socket from spreading by holding the two sides together with a pair of pliers.

Step 7. Replace synthesizer board and screws. Tighten screws to 12 ±2 inch-pounds.

7.6 SYNTHESIZER RF AMPLIFIER BOARD REPLACEMENT; TRN5218A

Perform the following replacement steps:

Step 1. Remove the synthesizer board as described in the *Fast-Lok* Synthesizer Board Replacement paragraph.

Step 2. Unsolder the connections to the rf buffer board from the VCO interconnect board, jack J357 and the transmit injection solid coax. Take care not to damage the plated-through holes into which these connections are soldered.

Step 3. Remove two screws on shield wall between synthesizer and VCO compartments, and remove wall.

Step 4. Lift synthesizer rf amplifier board straight up to remove it from the synthesizer compartment.

Step 5. Position new board in place. Make sure that the board is seated properly and solder three connections unsoldered in Step 2.

Step 6. Replace shield wall and screws. Tighten to 12 ±2 inch-pounds.

Step 7. Replace synthesizer board and screws. Tighten to 12 ±2 inch-pounds.

7.7 TRANSMITTER MODULE REPLACEMENT

CAUTION

Before installing a transmitter hybrid module, make sure all connection pins are straight, and have no solder fillet around the base that would prevent the hybrid from sitting flat. Failure to do so could damage the hybrid and void the warranty.

7.7.1 General

The following general procedures should be used to ensure safe replacement of a defective module, and proper transmitter operation.

- Use a low power soldering iron (approximately 40 watts).
- Use only 2% silver solder on all hybrids.
- Use "solder wick" or a bulb type solder sucker to remove and clean solder from connection pins.
- The transmitter alignment procedure should be performed after any transmitter hybrid is replaced.

7.7.2 Low Level Amplifier, TLD9132A

Perform the following replacement steps.

Step 1. Unsolder the six connection pins.

Step 2. Using a small screwdriver remove the module by alternately lifting at the two circuit board cutout locations. Do not pull on any hybrid components. Lift module straight up to prevent damage to transistor on underside of board; the transistor is secured in a clip.

Step 3. Clean the six connection pins and circuit board pads of any excess solder and straighten the pins if necessary.

Step 4. Place the new module over the pins to check for alignment.

Step 5. Press Q201 into heat sink using the blunt end of a non-metallic tuning tool. Apply pressure directly on top of Q201. When seated properly there should be no more than 0.05 inches gap between the module and the circuit board.

Step 6. Bridge solder between the six connection pins and their associated hybrid pads so solder is wicked around 25% of the pin.

7.7.3 10 Watt Amplifier; TLD9142A, TLD9143A

Perform the following replacement steps.

Step 1. Unsolder the five connection pins.

Step 2. Remove the main board (see main board removal/replacement procedure).

Step 3. Remove the transistor stud nut.

Step 4. From the main board side, gently tap on the stud of the transistor to remove the module.

Step 5. Clean the five connection pins and circuit board pads of any excess solder and straighten the pins if necessary.

Step 6. Install the new module being careful to check for pin alignment. Be sure to apply thermal compound to the stud of the transistor where it contacts the chassis.

Step 7. Replace the transistor stud nut and tighten to a torque of 5 ± 1 inch-pounds.

Step 8. Bridge solder between the five connection pins and their associated hybrid pads so solder is wicked around 25% of the pin.

7.7.4 30 Watt Amplifier; TLD9151A

Perform the following replacement steps.

NOTE

All soldering in the removal of this module is done at the hybrid end of the wires and coaxial cables.

Step 1. Unsolder the input and output coaxial cables so they are clear of the hybrid.

Step 2. Unsolder the jumper going to thermistor RT1400.

Step 3. Unsolder the feed network L1403.

Step 4. Unsolder the solder lug next to thermistor RT1400.

Step 5. Remove the two screws holding transistor Q1400 (M1156).

Step 6. Remove the module.

Step 7. Put thermal compound on the flange of the new module device where it contacts the heat sink.

Step 8. Slide the new module into the heat sink making sure it clears all connecting wires and cables.

Step 9. Install the Q1400 (M1156) mounting screws and torque to 6 ± 1 inch-pounds.

Step 10. Reconnect all wires and coaxial cables.

7.7.5 Harmonic Filter; TFD6431A, TFD6432A

Perform the following replacement steps.

Step 1. (30 watt radio only.) Unsolder the center conductor of the high power PA output coax where it goes into the PA interconnect board. Next unsolder the coaxial shield and lift it from between the two ground pins. Clean excess solder from pins and center conductor hole.

Step 2. Unsolder the five connector pins.

Step 3. Remove the wall between the harmonic filter and 10 watt amplifier.

Step 4. Remove the screw in the corner next to the antenna connector.

Step 5. Unsolder the jumper from the antenna connector to the hybrid. Remove the coil-capacitor-lug assembly if necessary. Remove the module.

Step 6. Clean the five connector pins and circuit board pads of any excess solder and straighten the pins if necessary.

Step 7. Install the new module, being careful to check for pin alignment.

Step 8. Replace the wall between the filter and 6/10 watt amplifier. Torque screws to 12 ± 2 inch-pounds.

Step 9. Replace the corner screw making sure it goes through the solder lug. Torque to 12 ± 2 inch-pounds.

Step 10. Resolder the jumper going to the antenna pad on the hybrid. Resolder the coil-capacitor assembly to the antenna connector if necessary. All leads in this area must be less than 1/8 inch in length.

Step 11. Bridge solder between the five connection pins and their associated hybrid pads so solder is wicked around 25 % of the pin.

Step 12. Resolder the high power PA coaxial cable to the PA interconnect board if necessary.

7.8 MAIN BOARD REMOVAL/REPLACEMENT

7.8.1 Main Board Removal

Perform the following removal steps.

Step 1A. Remove radio top cover.

Step 1B. (For dual front end radios only.) Remove radio bottom cover.

Step 2. Remove four screws securing main board to chassis; two of the screws pass through the heat sink adjacent to edge of board.

NOTE
DO NOT remove two screws securing main board to heatsink. These two screws are identified by the legend DO NOT REMOVE on the main board.

Step 3. (For dual front end radios only.) Remove two screws on bottom of radio securing dual front end to chassis crossbars.

Step 4. Remove main board by lifting alternately:

- Rear connector, J350.
- Front of board near 12-pin connector, P355.
- Side of board near 8-pin connector P351 by placing finger or non-marring tool in slot on side of chassis.

Step 5. Remove the 3 "push-pin" connectors from the main board leading to J101. Remove 22-pin connector J352, by pulling straight out to avoid bending pins of P352.

Step 6. (For remote-mount radios only.) Remove 4-pin connector, J380, located near rear connector J350.

Step 7. Lift main board part way, avoiding thermal grease on heat sink.

Step 8. Disconnect two coaxial cables from connectors under the board. Use gas pliers to twist slightly, while pulling straight up.

Step 9. Lift main boad completely away from chassis.

Step 10. Wipe thermal grease from heatsink with cloth or tissue, to avoid contact with clothing and hands while servicing board.

7.8.2 Main Board Replacement

Perform the following replacement steps.

Step 1. Plug front-end antenna coaxial cable (ANT) into connector on power interconnect board, observing legend (cable towards front of radio).

CAUTION
Seat plug fully into socket. Wrong orientation of connector, or failure to seat plug fully, will damage main board components.

Step 2. Plug injection coaxial cable (INJ) into connector on chassis. Observe orientation legend stamped into chassis.

CAUTION
Seat plug fully into socket. Wrong orientation of connector, or failure to seat plug fully, will damage main board components.

Step 3. (For remote mount radios only.) Install 4-pin connector J380. Connector is keyed; wires come out toward front of radio.

NOTE
The 3-wire cable is routed through the signaling option area. Radios with 2-board options, cable is routed between upper and lower signaling boards; route wire such that it is not pinched in upper-to-lower board connector.

Step 4. Reconnect the 3 "push-pin" connectors to the main board from J101. Install 22-pin connector J352. Connector is not keyed; orange dot on connector and square pad on main board indicate pin 1; wire length prohibits backwards-insertion. Be sure connector is not offset one or two pins to either side.

Step 5. Apply thermal grease to heat sink and chassis if it was wiped off during servicing.

Step 6. Place main board in chassis. Simultaneously align front 12-pin connector, side 8-pin connector, and rear connector into slot in chassis. Push board fully down into chassis. Avoid pinched wires.

Step 7. Install two screws securing heat sink to chassis. Tighten to 12 ±2 inch-pounds.

CAUTION
Correct torque is essential to ensure proper radio performance. Too little torque may result in intermittent ground connections. Too much torque may cause stripping of the casting threads.

Step 8. Install remaining two screws securing main board to mounting bosses. Tighten to 12 ±2 inch-pounds.

Step 9. (For dual front end radios only.) Install two screws on bottom of chassis securing dual front end casting to chassis crossbars. Tighten to 12 ±2 inch-pounds.

Step 10A. Replace radio top cover. Tighten screw to 20 ±2 inch-pounds.

Step 10B. (For dual front end radios only.) Replace radio bottom cover. Tighten screws to 20 ±2 inch-pounds.

7.9 CONTROL HEAD PLUG REMOVAL

CAUTION

Do not pull the cable plug out of the mating connector on the radio set, until the retainer clip is released. One or both of the mating connectors may break if the clip is not released.

The control head cable connector on remote mount radio sets is secured by a retainer clip. This clip automatically engages when the plug is inserted into its mating receptacle in the front of the radio. Refer to Figure 7. To remove the cable connector, push the clip toward the center of the plug while pulling the plug straight away from the mating connector. There is an access slot at the end of the cover. A tool, such as a small flat-bladed screwdriver, may be inserted through the slot to push on the retainer clip.

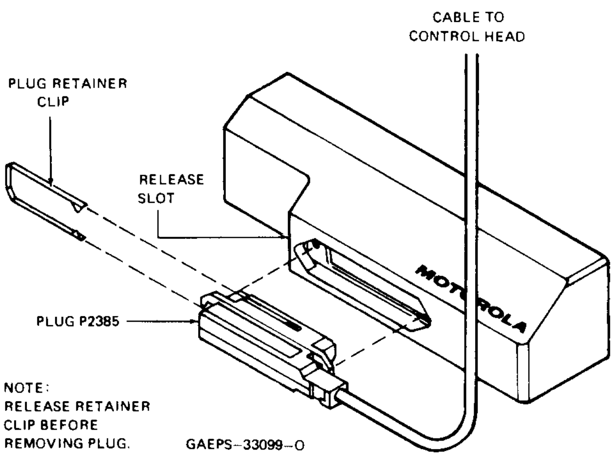


Figure 7. Control Head Plug

7.10 *DVP* ENCRYPTION HYBRID REPLACEMENT; TRN6777B

Perform the following replacement steps.

Step 1. Remove the radio top cover.

Step 2. Remove the cable attached to the *DVP* interface board.

Step 3. Lift the *DVP* interface board up and remove it from the radio.

Step 4. Replace the encryption hybrid. Make sure that the component side of the new hybrid faces the *DVP* interface board.

Step 5. Install the *DVP* interface board, taking care that the hybrid clip seats properly.

Step 6. Reconnect the cable kit to the *DVP* interface board.

Step 7. Install the radio top cover.

8. TROUBLESHOOTING PROCEDURES

8.1 TROUBLESHOOTING DATA

Troubleshooting data is shown in a set of "do and don't" notations, as well as troubleshooting diagrams and tables.

8.1.1 Do's and Don't's of Servicing

The notes listed below generally apply to the main board.

- Do replace both Q302 and Q307 if either device fails.
- Do use floating (non-chassis ground) power supply and audio distortion analyzer to avoid audio ground loops.
- Do always install at least one main board heat sink screw when testing, since major ground path to board is via heat sink.
- Do adjust transmitter deviation according to procedure in service manual. Adjusting for full system deviation at 1 kHz causes over-deviation at 2700 Hz.
- Do reference all test equipment ground leads to the chassis.
- Do turn off power supply (not radio) when repairing main board since supply voltage is present on boards with radio off.
- Do remove and reinstall solder-side shields by soldering and unsoldering from the solder-side of the circuit board.

- Don't short 9.6 T line to ground while transmitter is keyed.
- Don't short 11.7 V supply line to ground.
- Don't short 4.8 V supply line to ground.
- Don't connect test equipment ground clips to quad coil shield or to detector solder-side shield (area of U2 and L5).

Figure 8. Transmitter Troubleshooting Chart

- Don't use double-kinked stand-up resistors where single-kinked style is required unless leads are bent to avoid shorting between the two kinks.
- Don't allow flux-dissolving board cleaners to flow down into pot or coil adjustment holes since they may cause freezing of slugs, breakage of slugs, or intermittent pot operation.
- Don't overtighten mounting screws during reassembly; overtightening may strip the threaded screw halves.

8.1.2 Diagrams and Tables

The following troubleshooting Figures and Tables indicate possible problem areas, and provide aid in isolation of the problems.

Figure 8 —	Transmitter Troubleshooting Chart
Figure 9 —	I-F Gain Test Graph
Table 5 —	Receiver and Main Board Troubleshooting Procedures, According to Symptom
Table 6 —	Standard VCO and Synthesizer Troubleshooting Procedures, According to Symptom
Table 7 —	Standard VCO and Synthesizer Troubleshooting Procedures, According to Circuit Block
Table 8 —	*Fast-Lok* VCO and Synthesizer Troubleshooting Procedures, According to Symptom
Table 9 —	*Fast-Lok* VCO and Synthesizer Troubleshooting Procedures, According to Circuit Block
Table 10 —	*DVP* Troubleshooting Procedures, According to Symptom

8.1.3 Special Troubleshooting Test Procedures

8.1.3.1 I-F Gain Test

Two methods can be used to test the i-f gain of the receiver. Use the method most convenient or appropriate to accomplish the test.

- Method 1

Step 1. Connect an rf signal generator, via a 50 ohm coaxial cable, to the i-f input on the main board (center conductor to TP1, shield to ground; temporarily disconnect the center conductor of the front end i-f output coaxial cable from TP1). Set the signal generator for a 21.4 MHz (±200 Hz), unmodulated output signal.

Step 2. Connect a dc voltmeter from the rise meter point on the main board to ground. Vary the output level of the signal generator between −120 dBm and −50 dBm, in 10 dB intervals, and note the readings obtained on the dc voltmeter.

Step 3. Referring to Figure 9, plot a similar graph showing the dc voltmeter readings obtained; compare the plotted graph with the graph shown in in the figure.

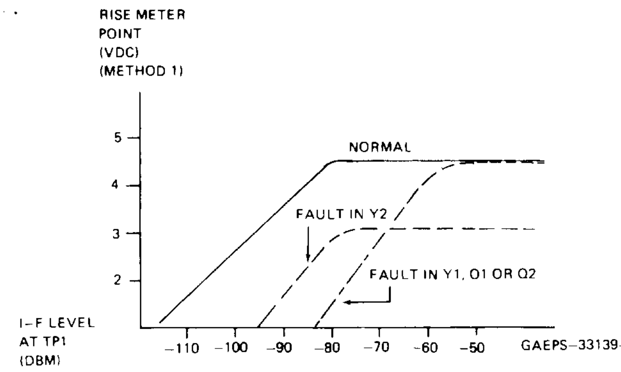


Figure 9. I-F Gain Test Graph

If an abnormal result is obtained, Figure 9 also isolates the fault to a specific component(s).

Step 4. Be sure to reconnect the center conductor of the front end i-f output coaxial cable to TP1 when test is completed.

- Method 2

Step 1. Connect an rf signal generator to the antenna connector and connect a high-impedance rf millivoltmeter between test point TP1 and ground on the main board. (Do not disconnect the front end i-f coaxial cable from TP1.)

Step 2. With the rf generator adjusted to produce an unmodulated, on-channel (±200 Hz) signal, vary generator output level to obtain dBm levels between −120 dBm and −50 dBm, as read on the rf millivoltmeter. Note the readings obtained at approximately 10 dBm intervals.

Step 3. Perform Step 3 in the Method 1 procedure.

8.1.3.2 Synthesizer VCO Range Shift Tests

It is possible to verify proper range shift operation of the VCO, as controlled by logic voltages originating on the synthesizer board.

Step 1. Determine the desired VCO operating frequency for a given channel. In the transmit mode, the VCO frquency is the same as the assigned transmit frequency for that channel. In the receive mode, the VCO frequency is 21.400 MHz lower than the assigned receiver frequency for that channel.

Step 2. Refer to Table 1, "Frequency Shifting of VCO Sub-Range Frequencies", in the Synthesizer Detailed Description (part of the Theory of Operation section).

Step 3. Compare the specified voltage levels for S1, S2, and S3 (corresponding to the VCO operating frequency as determined in Step 1) with those measured in the radio under test. "0" indicates logic low, less than

0.8 V dc; and '1' indicates logic high, between 8.0 and 8.9 V dc. If voltages are correct, there may be a fault in the range-shifting circuitry on the VCO hybrid. If the voltages are incorrect, there is a fault in the frequency select switch or circuitry on the synthesizer board.

NOTE

If this is done while servicing, be sure to remove the jumper before placing the radio back into operation.

8.1.3.3 Disabling Transmitter RF Output

While performing certain testing or troubleshooting procedures, it may be necessary or desirable to key the transmitter PTT without producing RF output. The transmitter can be defeated by soldering a short jumper wire across Q228, emitter to collector. This prevents LLA A + from being produced when PTT or MIC PTT is grounded, thus inhibiting rf power output.

Table 5. Receiver and Main Board Troubleshooting Procedures According to Symptom

Symptom	Possible Cause	Correction or Test
A. Radio does not turn on (no thump heard in speaker at turn on). Displays do not light.	1. Green lead not connected to voltage source. 2. Fuse F351 blown. 3. Jumper in power plug broken. 4. Loss of continuity between power board and on-off switch.	1,2. Check for A + at P360-3 on power board. 3,4. Jumper between P360-2 and P360-1.
B. Radio does not turn on (no thump heard in speaker at turn on). Displays light.	1. Heavy red lead (PA A +) not connected to voltage source. 2. Fuse F350 blown. 3. Audio power amp failure.	1, 2 Check for PA A + at main board (P351-1). 3. Verify dc voltages in audio PA starting with TP13.
C. No audio or does not unsquelch (thump is heard in speaker at turn on). Squelch and monitor buttons pushed in.	1. Synthesizer unlocked. 2. Synthesizer PROM missing. 3. 9.6 V regulator failure. 4. Audio is being muted. 5. Loss of continuity to squelch switch. 6. Q2102 shorted emitter to collector. 7. 9.6 T present. 8. Detector U2 bad or choke L7 open. 9. Audio op amp (U50) failure. 10. I-F amp IC failure (U1) or choke L6 open. 11. Crystal filter Y2 open. 12. Loss of continuity in volume control. 13. Failure in *DVP* circuitry.	1,2 A logic high at P355-10 (TP49) indicates unlocked. Repair synthesizer or install PROM. 3. Check for 9.5 - 9.7 volts at TP36. 4. Check for logic high (mute) at TP9 (normal voltage when unmuted is 4.2 volts at TP9). 5. Short P355-3 (TP47) to chassis. 7. Transmit LED on if 9.6 T on 8. Verify 9.5 volts at U2-11, verify approximately 6 volts at TP6. 9. Verify 4.8 volts at U50-1 and -7. 10. Verify 9.5 volts at U1-10 and 7.8 volts at U1-5 (TP4). 11. Jumper across Y2A and then Y2B. 12. Jumper P355 pin 9 to pin 1 with Off-on/Volume control at mid-position. 13. Go to Table 10.
D. High distortion, gets worse at higher output levels.	1. Main board to heatsink screws loose. 2. Heatsink to casting screws loose. 3. Supply voltage too low. 4. Ground connection reversed at distortion analyzer input. 5. Ground loops in test setup.	1,2. Tighten screws. 3. Increase to 13.2 V. 5. Float ground on power supply and distortion analyzer.
E. High distortion, approx same at any output level	1. Signal generator off-frequency. 2. Excessive test deviation. 3. Q1 bad or L1 open. 4. L2 open. 5. Q2 bad, L3 or L4 open. 6. 11.7 volt supply low. 7. Bad crystal filters. 8. Reference oscillator off-frequency.	2. Reduce to 60% of full system deviation. 3. Verify 1.4 - 2.0 volts at TP2. 4. Normal voltage at Q1-D is 11.7 V, if L2 open will be 4 volts. 5. Verify 1.4 - 2.0 volts at TP3. 7. Test i-f gain; test for good ground between filter cans and main board ground.
F. Low audio output power	1. See Condition D, causes 1, 2, 3, and 4.	
G. Very low audio output power	1. Q54 or Q56 bad. 2. See condition D, cause 4.	
H. Poor sensitivity (quieting and SINAD)	1. 11.7 volt supply low. 2. See E,3;4;5;7. 3. Dirty or corroded connection to phono plugs from front end to jacks in chassis. 4. Failure in harmonic filter/ant switch 5. Q307 open. 6. Poor i-f sensitivity. 7. Low injection level from synthesizer.	4. Measure insertion loss between antenna connector and J356; 1 dB or less typical (or) measure sensitivity directly into front end ANTenna coaxial cable. 5. Verify 9.6 T less than 0.1 volt in receive mode. 6. Disconnect center lead from front end coaxial cable at TP1, meaure i-f sensitivity from 50-ohm generator at 21.4 MHz; 0.25 to 0.30 uV (20 dBq) typical, if bad, go to K. 7. Check for at least 3.0 volts at INJection meter point, or check for + 11 dBm or higher at J357.
I. Poor SINAD, good quieting sensitivity	1. See E,1;2;8. 2. See D,1;2;3;4;5. 3. See E,4;7	

Table 5. Receiver and Main Board Troubleshooting Procedures According to Symptom (Cont'd.)

Symptom	Possible Cause	Correction or Test
J. Poor quieting, good SINAD sensitivity	1. Using too high an audio level for 0 dBq reference.	1. Reduce noise output to 1.0 - 1.5 volts rms audio ouput with no input signal.
K. Poor i-f sensitivity	1. See E,3;4;5;6;7	1. If open crystals are suspected short across the outside pins of each crystal one at a time.
L. Weak level of unquieted noise with no input signal.	1. Edge of can over R8, R9, nearest to U1 shorting to pad on circuit board. 2. Crystal filter Y2 bad. 3. L5 (quad coil) detuned. 4. Self-quieting spur is present.	1. Bend can in to clear pad. 2. Perform i-f gain test or short across outside terminals of crystals. 4. Occurs only on certain channel(s), check screws securing synthesizer board and cover; check for broken shield on front end coaxial cables.
M. Same as L, but very tinny high-frequency sound.	1. Loss of continuity through Off-on/Volume control.	1. Jumper P355 pin 9 to pin 1 with Off-on/Volume control at mid-position.
N. I-F Instability	1. Shield over L5 or under U2 shorting to chassis. 2. Broken coaxial cable shield, front end output to i-f input. 3. Front end not tuned near operating frequency. 4. Spring fingers on i-f cans bent, corroded, or missing.	3. Retune front end to center of operating range; limit receive channel spacing to specified range of front end (up to 6 MHz for single front end).
O. Excessive i-f passband ripple	1. L2 open 2. See N,1;2;3;4 3. Defective i-f crystals 4. See E,7.	1. Verify 11.7 volts (not 4 volts) at Q1-D. 3. Sweep i-f at low (– 120 dBm) and high (0 dBm) levels (input to TP1, output at U2-1). Remove choke L7 when sweeping. Ripple only in out-of-limit sweep indicates bad Y1; ripple at all levels indicates bad Y2.
P. Some coils in single front end do not peak	1. (RF1 coil): Shorted or open ANTenna coax or P356. 2. (L01 coil): Shorted or open INJection coax or P357. 3. (RF4 or L02 coils): May be normal condition occassionally at band edges (146 or 174 MHz for Range II radios). 4. (RF1, RF2, RF5, L01, or L02) coil tap broken at weld. 5. (Any coil) broken coil lead.	4,5. Examine installation environment or methods for excessive vibration of radio when in use.
Q. Intermittent or abrupt changes in meter indications while tuning single front end.	1. See P,4;5	
R. Squelch closing time remains slow (200 msec) even for strong signals	1. Main board components in the area of R2118 and R2119 are shorting to pins of power connector on power board. 2. CR2106, Q2100, C2109.	1. Push components (including Q2102, Q2100, Q58) in toward capacitor C63. 2. Refer to squelch theory of operation.
S. Squelch chatter	1. C2107, C2109, R2117.	
T. Squelch exhibits high-frequency scratchy sound when closing or during fading	1. C2108 open.	
U. Squelch produces "ticks" when closing	1. C70 open. 2. C69 leaky or installed backwards. 3. Station being received is transmitting PL and receiver in question does not have PL filter in receiver audio path (part of PL/DPL option)	3. Normal operation under certain strong-signal conditions.
V. Radio does not unsquelch with squelch adjust potentiometer fully CCW and squelch button out.	1. Normal operation; minimum opening sensitivity is 3 dBq (typ).	
W. Transmitter over-deviates and splatters excessively.	1. Choke L325 open. 2. VCO MOD is set too high.	1. Verify normal dc resistance of L325 (35 ohms). 2. Refer to deviation adjustment procedure of service manual.
X. Poor adjacent channel selectivity of receiver and/or break-up of audio at high signal levels.	1. C300 in 11.7 volt supply open or Q305 shorted collector to emitter. 2. Main board-to-heat sink or heat sink-to-chassis screws loose. 3. Failure in VCO noise filter (part of synthesizer board) 4. Q300 in 9.6 V regulator shorted collector to emitter. 5. C304 open or missing.	1. Verify ac voltage at Q305-E much lower than at Q305-C at high audio output levels. 3. Refer to synthesizer troubleshooting procedures. 4. Verify 9.6 volts at TP36.

Table 6. Standard VCO and Synthesizer Troubleshooting Procedures, According to Symptom

Symptom	Possible Cause	Correction or Test
A. Synthesizer always out of lock.	1. No PROM. 2. No DC voltages. 3. Strobe control not working. 4. Reference oscillator not working. 5. Synthesizer rf feedback not working. 6. Board screws missing. 7. Wrong range VCO. 8. Open connectors. 9. U115 bad. 10. Bad frequency shift. 11. U350 bad.	1. Check or replace PROM. 2. Check 9.6 V regulator, 5 V regulator, and VCO noise filter. 3. Check pin 28 on U115 for logic low. 4. Check output of oscillator. 5. Check frequency at pin 9 on U115. 6. Insert replacement screws. 7. Check kit number. 8. Check connectors P353, J151, P374. 9. Check all outputs of U115. 10. Check inputs and outputs of U171 and Q172. 11. Check U350.
B. Synthesizer only out of lock on some channels.	1. Bad PROM. 2. Some frequency switches not working. 3. Synthesizer rf feedback not working. 4. Open connection between P353 and J353.	1. Check or replace PROM. 2. Check input and output of U177 and Q172. 3. Check frequency at pin 9 of U115. 4. Check P353 and J353 for continuity.
C. No out of lock signal.	1. Lock detector shorted or broken. 2. Open connection between P353 and J353. 3. U115 bad.	1. Check bias of Q154, Q155, and Q156. Check U350. 2. Check P353 and J353 for continuity. 3. Check operation at U115 pin 7.
D. Synthesizer does not change frequency.	1. Strobe control not working. 2. Bad PROM. 3. Open connection between P353 and J353.	1. Check operation of strobe control circuits, and U351. 2. Check or replace PROM. 3. Check P353 and J353 for continuity.
E. Low or no rf power.	1. Bad VCO. 2. Bad VCO buffer. 3. Injection switch not working. 4. Open connector between VCO and synthesizer circuit board or between synthesizer circuit board and synthesizer interconnect board. 5. Synthesizer interconnect board not connected to exciter or mixer.	1. Replace VCO. 2. Check bias on Q190. 3. Check bias of PIN switches CR190 and CR191. 4. Check connectors P374 and J1300. 5. Check continuity of circuit board.
F. Power in receive, but not transmit, or vice versa.	1. Injection switch not working. 2. Outputs shorted. 3. 9.6T not working. 4. Open connector between synthesizer circuit board and synthesizer interconnect board. 5. Synthesizer interconnect board not connected to exciter or mixer.	1. Check bias of PIN switches CR190 and 191. 2. Check outputs for shorts. 3. Trace 9.6T to Q191. 4. Check connector P374. 5. Check continuity of circuit board.
G. Poor hum and noise.	1. Bad VCO. 2. Bad or missing components in loop filter. 3. Missing grounds. 4. RF feedback power low to synthesizer IC. 5. Bad VCO AGC. 6. Bad VCO noise filter. 7. Bad 9.6 V dc regulator.	1. Replace VCO. 2. Check value of components. 3. Check screws for tightness. Check connectors. 4. Check Q192. 5. Check bias and operation of Q189 and Q188. 6. Check VCO noise filter bias and C142, C143. 7. Check ripple and voltage of regulator.
H. Poor reference spurs (spurious responses at regulator frequency intervals).	1. Missing grounds. 2. Bad VCO. 3. Bad or missing components in loop filter. 4. Strobe control malfunction.	1. Check screws and connectors. 2. Replace VCO. 3. Check values of components. 4. Check operation of strobe circuit.
I. Cannot warp oscillator.	1. Bad C101. 2. Bad crystal. 3. C101 shorted.	1. Check or replace C101. 2. Check or replace crystal. 3. Check for short circuit.
J. Oscillator drifts with time.	1. Bad crystal. 2. Bad tank capacitors.	1. Check or replace crystal. 2. Replace capacitor.
K. No modulation.	1. Bad VCO. 2. Bad or missing R180 or R181. 3. Connectors.	1. Replace VCO. 2. Check resistors. 3. Check connectors.

Table 7. Standard VCO and Synthesizer Troubleshooting Procedures, According to Circuit Block

Circuit	Symptom	Correction or Test
A. Reference oscillator.	1. Does not oscillate. 2. Level too low or too high. 3. Oscillator does not warp.	1. Check dc bias, crystal, tank capacitors. 2. Check AGC, dc bias. 3. Check C102; may be shorted or broken.
B. VCO noise filter.	1. No output. 2. No filter action.	1. Check for short circuits. Check Q140; may be open. Check drive from Q141; may be no drive. 2. Check all diodes, R142, C142, and all output capacitors.
C. Charge pump.	1. No current action.	1. Check bias on Q152 and Q153 and check for open circuits.
D. Loop filter.	1. No filter action. 2. Short circuit.	1. Check all capacitors for open circuits. Check all resistors for open circuits. 2. Check all capacitors. Check Q153.
E. Lock detector.	1. Always indicates lock. 2. Always indicates out of lock.	1. Check all dc bias. Check for open circuit between Q154 and pin 7 of U115. Check R159 and C156. Check U350. 2. Check all dc bias. Check for short circuit at base to supply and ground; transistors Q154, Q155, and Q156. Check U350.
F. PIN switching circuits.	1. Does not switch.	1. Check for output short circuits. Check for bad U170, or Q170 and Q171. Check for open circuits to U170, or Q170 and Q171.
G. VCO buffers.	1. No power or low power from main buffer. 2. No power or low power from feedback buffer. 3. Antenna switch not functioning.	1. Check bias of Q190. Check antenna switch. Check C192 for open circuit. 2. Check bias of Q192. Check R196 for open circuit. Check C190 for open circuit. 3. Check 9.6T for open circuits. Check diode bias. Check Q191 for bias.
H. AGC	1. No VCO output, AGC detect signal high. 2. No VCO output, AGC detect signal low.	1. Check R185 for short circuit. Check base of Q188 for short circuit to 8.9 V dc. Check collector of Q189 for open circuit. 2. Check for bad Q188. Check for open R188. Check for shorted Q189.
I. Strobe control circuit.	1. Flip-flop does not change state. 2. Flip-flop does not reset. 3. Does not enable strobe. 4. Does not disable strobe.	1. Check U351. Check capacitors C129 through C131 (if used) for open circuit. Check for short circuit in FC line. Check for no bias or bad bias at Q116 and Q117. Check for bad NOR gate (U116). 2. Check for open or short circuit at pin 1 of U116. Check for bad lock detector. Check for bad NOR gate inverters (U116). 3. Check for bad lock detector. Check for bad NOR gate inverters (U116). Check for bad Q120 or Q119. 4. Check pin 8 of U116; may be tied high. Check for short circuit at Q119 or Q120. Check for bad lock detector (Q154, Q156). Check for bad NOR gate inverters (U116).

Table 8. Fast-Lok VCO and Synthesizer Troubleshooting Procedures, According to Symptom

Symptom	Possible Cause	Correction or Test
A. Synthesizer always out of lock.	1. No PROM (or incorrect PROM). 2. No DC voltages. 3. Strobe control not working. 4. Reference oscillator not working. 5. Synthesizer rf feedback not working. 6. Board screws missing 7. Wrong range VCO. 8. Open connectors. 8. U115 bad. 10. Bad frequency shift. 11. No RF power. 12. Bad phase detector 13. Open circuitry in loop filter.	1. Check or replace PROM 2. Check 9.6 V regulator, 5 V regulator, and VCO noise filter. 3. Check pin 28 on U115 for logic low. 4. Check output of oscillator. 5. Check frequency at pin 25 on U115. 6. Insert replacement screws. 7. Check kit number. 8. Check connectors. 9. Check all outputs of U115. 10. Check inputs and outputs of U155 and Q156. 11. Check VCO output. 12. Check for proper inputs and output ramp. 13. Short circuit input-output of loop filter-see if synthesizer locks.
B. Synthesizer only out of lock on some channels.	1. Bad PROM 2. Some frequency switches not working. 3. Synthesizer rf feedback not working. 4. Open connection between P353 and J353. 5. Poor connection between J1300 and P1300. 6. Poor ground connections. 7. Open circuit at transmit or receive injection port. 8. Low driver level to divider (U115). 9. Bad phase detector (U140). 10. Synthesizer not changing channel.	1. Check or replace PROM. 2. Check input and output of U155 and Q156. 3. Check frequency at pin 25 of U155. 4. Check P353 and J353 for continuity. 5. Check for continuity. 6. Tighten all VCO & synthesizer screws. 7. Check connector J357-P357 for continuity and check coax from buffer amp to low level amplifier (LLA). 8. Check rf level at divider pin 25. 9. Check for proper inputs and output ramp. 10. Check frequency change (FC) pulse and strobe circuit.
C. No out of lock signal.	1. Lock detect switch shorted or broken. 2. Open connection between P353 and J353. 3. U140 bad (Phase detector).	1. Check bias of Q142 and Q143. 2. Check P353 and J353 for continuity. 3. Check operation at U140-10.
D. Synthesizer does not change frequency.	1. Strobe control not working. 2. Bad PROM 3. Open connection between P353 and J353. 4. Frequency switches not working. 5. Bad phase detector (U140).	1. Check operation of strobe control circuits (Q117, Q118). 2. Check or replace PROM. 3. Check P353 and J353 for continuity. 4. Check input and output of U155 and Q156. 5. Check operation of pin 10.
E. Low or no rf power.	1. Bad VCO. 2. Bad VCO rf amplifier. 3. Injection switch not working. 4. Open connector between VCO and synthesizer circuit board or between synthesizer circuit board and synthesizer board. 5. Synthesizer rf amplifier board not connected to exciter or mixer. 6. AGC circuit malfunction. 7. Poor ground connection. 8. Bad VCO 8.9 V supply.	1. Replace VCO. 2. Check bias on Q190. 3. Check bias of PIN switches CR190 and CR191. 4. Check connectors P190 and J1300 5. Check continuity of circuit board. 6. Short Q171 collector to GND to see if problem goes away. 7. Tighten all VCO/synthesizer screws. 8. Check output of Q180 for 8.9 volts
F. RF power in receive, but not transmit, or vice versa.	1. Injection switch not working. 2. Injection switch outputs short circuited. 3. 9.6T not working. 4. Open connector between synthesizer circuit board and synthesizer interconnect board. 5. Synthesizer rf amplifier board not connected to exciter or mixer.	1. Check bias of PIN switches CR109 and CR191. 2. Check outputs for short circuits. 3. Trace 9.6T to Q191. 4. Check connector P374. 5. Check continuity of rf amplifier circuit board and connectors.
G. Poor hum and noise. (Synthesizer and output noisy).	1. Bad VCO. 2. Bad or missing components in loop filter. 3. Poor ground connections. 4. RF feedback power low to synthesizer IC. 5. Bad VCO AGC. 6. Bad VCO noise filter. 7. Bad 9.6 V dc regulator. 8. Undesired modulation from main board. 9. Adapt line high. 10. Bad connector contacts.	1. Replace VCO. 2. Check value of components. 3. Check screws for tightness. Check connectors. 4. Check Q116. 5. Check bias and operation of Q170 and Q171. 6. Check VCO noise filter Q180 bias and C186, 185 and 184. 7. Check ripple and voltage of regulator. 8. Ground R175 to see if problem goes away. 9. See Symptom A above. 10. Check contacts between synthesizer and interconnect board (J353/P353), between VCO and synthesizer (J1300/P1300), and between main board and front panel interconnect board (J355/P355).

*Table 8. **Fast-Lok** VCO and Synthesizer Troubleshooting Procedures, According to Symptom (Cont'd.)*

Symptom	Possible Cause	Correction or Test
H. Poor reference spurs (spurious responses at regulator frequency intervals).	1. Poor ground connections. 2. Bad VCO. 3. Bad or missing components in loop filter. 4. Strobe control malfunction.	1. Check screws and connectors. 2. Replace VCO. 3. Check values of components. 4. Check operation of strobe circuit (Q118).
I. Cannot warp oscillator or oscillator drifts with time.	1. Bad reference oscillator.	1. Replace reference oscillator (channel) element (Y102).
J. No modulation.	1. Bad VCO. 2. Bad or missing R175 or R176. 3. Bad connector contacts.	1. Replace VCO. 2. Check resistors. 3. Check connector P353, J1300.

*Table 9. **Fast-Lok** VCO and Synthesizer Troubleshooting Procedures, According to Circuit Block*

Circuit	Possible Cause	Correction or Test
A. Output RF Amplifier	1. Power in receive but not in transmit, or vise versa. 2. No power in receive and transmit.	1. Check for proper bias on PIN injection switches CR190, CR191. Check outputs for short circuit. Check 9.6T at Q191 emitter in transmit. 2. Check operation of rf amplifier Q190. If no input present, perform VCO checks.
B. VCO	1. No output at any frequency. 2. Stable output present at incorrect frequency. 3. Output present but unstable. 4. Output present but low level. 5. Correct output level and frequency but excessive noise or spurious tones present (may effect hum and noise measurement, or may be heard in speaker while in receive).	1. Check VCO pin 2 for presence of 8.9 volt supply. Check all ground connections and tighten if necessary. Check AGC voltage at VCO pin 11. Replace VCO. 2. If ADAPT line is low, perform reference oscillator, and/or divider checks. If ADAPT line is high: check state of VCO PIN switches by monitoring pins 4, 6, 7, 8, 12, 13 (if bad, perform PIN driver checks). Check voltage at phase detector pin 15 for proper range (3-8 V dc - should change when channel changes) (Note 1). Check reference oscillator frequency. Check steering line voltage and compare to the voltage at phase detector pin 15. If different, perform loop filter tests. Perform PROM tests. 3. Check connections between synthesizer and VCO (J1300/P1300). Check and tighten grounds on VCO and synthesizer. If ADAPT line is high perform phase detector tests. Check for short or open circuit at receive/transmit injection ports. Check performance of VCO filter. Temporarily ground VCO MOD line. If condition disappears, check main board. Replace VCO. 4. Check all connections to VCO. Check and tighten all VCO ground connections. Perform AGC checks. Replace VCO. 5. Check and tighten all ground connections. Clean contacts between VCO and synthesizer (J1300). Perform VCO Filter tests. Perform Loop Filter tests. Temporarily ground VCO MOD line, if problem disappears check main board. If ADAPT line is high perform phase detector tests. Check AGC circuit for proper operation. Replace VCO.
C. Loop Filter	1. Output frequency unstable. 2. Noise or spurious tones present (may effect hum and noise measurement or may be heard in speaker while in receive mode). 3. Synthesizer out of lock.	1. If ADAPT line is high, perform phase detector tests. Check for intermittent contact in circuit elements of filter. Check operation of CMOS switches (U141). 2. Check ADAPT line and U141 pin 13. Replace Q143 if necessary. Check all components in loop filter for proper value. Check for short circuits between guard band and loop filter output. 3. Short circuit steering line to phase detector pin 15 (Note 2). If system locks up check all components in loop fitler for proper operation, otherwise, perform phase detector tests and/or VCO tests.

*Table 9. **Fast-Lok** VCO and Synthesizer Troubleshooting Procedures, According to Circuit Block (Cont'd.)*

Circuit	Possible Cause	Correction or Test
D. Phase Detector	1. Synthesizer does not lock on frequency. 2. Ramp voltage not present or unstable. 3. Incorrect PIN voltage at pin 6. 4. Synthesizer does not change frequency.	1. Check for stable ramp voltage at pin 24 of phase detector. If ramp is present with amplitude between 3 volts and 8 volts, check PIN drivers for correct range (perform PROM, divider or strobe checks of necessary). If ramp is present but no output voltage at pin 15, check C143, C144 and Q141. Replace phase detector. 2. Check for proper inputs from divider at pins 2 and 23 of phase detector. Perform divider checks if necessary. Check C143 and C144 for correct value and good connection. Check Q140 and C142 and replace if necessary. Monitor sample timing of U140 pin 22. Check C141 and C152 and replace if necessary. Replace phase detector (U140). 3. Check input at pin 11. If correct replace phase detector, otherwise check divider. 4. Check frequency, change pulse pin 5; if not present, troubleshoot connections from interconnect board (P353), otherwise check PROM and strobe circuits. Also, check divider. Replace phase detector.
E. Divider	1. 5 kHz reference pulse not present or unstable at pin 5 of divider. 2. Loop pulse not present at pin 9 of divider. 3. Loop pulse present but not at 5 kHz repitition rate. 4. Incorrect PIN voltage at pin 17, 19 or 20.	1. Check 14.4 MHz reference at pin 2; if present with correct level and frequency check PROM, divider and reference oscillator. 2. Check rf level at divider pin 25 if present with correct level, replace divider otherwise, check rf buffer (replace Q116 if necessary) and perform output rf amplifier tests. 3. Perform phase detector tests. Check PIN drivers for correct range. Check strobe circuit and PROM. Replace divider (U115). 4. Check strobe circuit and PROM. Replace divider (U115).
F. Pin Drivers	1. Incorrect PIN voltages at pins 4, 6, 7, 8, 12, 13 for channel selected.	1. Check PIN drives from divider (pin 19, 20 and phase detector (pin 6). Replace U155, Q156, Q155 where necessary.
G. Strobe circuit and PROM	1. Synthesizer always out of lock. 2. Synthesizer off frequency on some channels. 3. Radio does not change frequency when channel selector is rotated.	1. Check PROM socket connections. Check that PROM is installed correctly. Change PROM and recheck for lock. 2. Check that strobe circuit functions (see correction 3 below). Check or replace PROM. 3. Check for strobe pulses at PROM pin 16 when channel selector is rotated. Check components in strobe circuit (i.e. Q115, Q117, Q118) and replace if necessary. Check strobe output of divider. Check inputs A0 through A4 (pins 9 to 13 of P353). Verify that they represent binary number of the channel selected. Verify correct operation of 9.6T line (pin 14 of P353). Replace PROM.
H. Reference Oscillator.	1. Does not oscillate. 2. Does not warp. 3. Off frequency.	1. Check dc voltage supply to reference oscillator; if ok, replace reference oscillator. 2. Replace reference oscillator. 3. Adjust warp control.
I. VCO Noise Filter/8.9 V supply	1. Output voltage not present or wrong value. 2. No filter action. (causing noisy VCO output).	1. Check for short circuits. Check Q180 and Q181. 2. Check all associated capacitors for correct value and proper connection. Check all diodes.
J. AGC	1. No (or low) VCO output with AGC detector signal high. 2. No (or low) VCO output with AGC detector signal low.	1. Check R172 for short circuit. Check base of Q171 for short circuit to 8.9 V dc. Check collector of Q170 for open circuit. 2. Check Q171. Check R170 for open circuit. Check Q170 for shorted transistor.
K. Voltage Supplies	1. One or more supply voltages not present or incorrect value. 2. Supply voltage not present at input to one or more circuit blocks.	1. Check for presence of 9.6 volts at synthesizer board pin 3. Check for 5 V at output of U180; replace regulator if necessary. Check for 8.9 volts at collector of Q180, perform VCO noise filter tests if necessary. 2. Check for proper voltage at supply voltage pin of each IC on synthesizer board (refer to schematic diagram). Troubleshoot circuit board plating bypass capacitors and coupling resistors where necessary.

Notes:
1. Measurements on steering line (SL) must be made with a high-impedance (10 meg dc) voltmeter to avoid affecting circuit operation.
2. Loop filter may easily be short circuited by connecting guard band to loop filter output at J1300-10.

Table 10. DVP Troubleshooting Procedures, According to Symptom

Symptom	Possible Cause	Correction or Test
A. No verification tone when loading key.	1. Volume is turned too low on radio. 2. Code inserter not properly connected to radio. 3. Loss of continuity between *DVP* encryption board and code plug receptacle. 4. Encryption hybrid not in socket. 5. Code inserter malfunction.	1. Increase volume on radio. 2. Check connector cable from cable inserter to radio. 3. Check VLN4129A key loading cable kit. 4. Check *DVP* encryption hybrid TRN6777B. 5. See code inserter manual.
B. *DVP* front panel indicators or switches non-functional.	1. Loss of continuity between *DVP* front panel and *DVP* encryption board.	1. Check cable from *DVP* front panel to *DVP* encryption board.
C. Radio will not receive in clear or coded mode.	1. No filtered 9.6 V supply to *DVP* encryption board or *DVP* interface board. 2. No "Option Receive Audio" to *DVP* encryption board. 3. No "Switched Receive Audio" on *DVP* encryption board. 4. No "Switched Receive Audio" to radio main board or to radio option board.	1. Check voltage on R179 of *DVP* interface board. Check for shorts to filtered 9.6 V supply. 2. Check cable from main board to *DVP* interface board. 3. Check U105C and U107D. For receive coded mode U105 pin 11 should be logic high. For receive clear mode this pin should be logic low. 4. Check cable from radio main board or radio option board to *DVP* interface board.
D. Radio receives in clear mode but not in coded mode. Coded/clear indicator does not light.	1. No "Switched Receive Audio" from *DVP* encryption board in coded mode. 2. No "Option Receive Audio" to *DVP* encryption board equalizer. 3. Faulty equalizer circuit on *DVP* encryption board.	1. Check U105C and U107D. For receive coded mode pin 11 of U105 should be logic high. 2. Check C106. 3. Check equalizer filter circuit (includes U107B) on *DVP* encryption board.
E. Radio will receive in coded mode but not in clear mode.	1. No "Switched Receive Audio" from *DVP* encryption board in clear mode.	1. Check U105C and U107D. For receive clear mode pin 11 of U105 should be logic low.
F. Transmit coded/clear indicator does not go off and on when coded/clear button is depressed.	1. Lack of continuity from *DVP* front panel coded/clear switch to *DVP* encryption board. 2. No 5 V supply on *DVP* encryption board. 3. U110 not functioning. 4. U109 not functioning. 5. Q106 not functioning.	1. Check cable and connectors from *DVP* front panel to *DVP* encryption board. 2. Check 5 V regulator U101. Also check CR111A. Check for shorts on the 5 V supply. 3. Check pins 1,2,10,11,12, and 13 of U110. 4. Check pins 2,3, and 5 of U109. 5. Check Q106.
G. Transmit coded/clear indicator is functional but radio always transmits in the clear mode.	1. U105A and U105B not switching.	1. Check pins 9 and 10 of U105. Both pins should be logic high for transmit coded mode.
H. Transmit coded/clear indicator is functional but radio always transmits in the coded mode.	1. U105A and U105B not switching.	1. Check pins 9 and 10 of U105. Both pins should be logic low for transmit clear mode.

ALIGNMENT

1. INTRODUCTION

Alignment of the *DVP MCX100* radio consists of four procedures which should be performed in the following sequence:

- transmitter alignment
- oscillator frequency adjustment
- deviation adjustment
- receiver alignment.

2. RECOMMENDED TEST EQUIPMENT

Refer to Table 1 which lists the recommended test equipment which should be used for performing the alignment procedures presented in this section.

*Table 1. Recommended Test Equipment for **DVP MCX100** Radio Alignment*

General Type	Application	Recommended Model	Minimum Specifications
AC-DC VOM	DC voltage measurements, general	Motorola T1009	Measurement range: 0-15 V dc Sensitivity: 20,000 ohms/volt
DC Multimeter	DC voltage readings requiring a high input resistance meter	Motorola S1063	Measurement range: 0-15 V dc Input resistance: 11 megohms
AC Voltmeter	Audio voltage measurements	Motorola S1053	Measurement range: 0-10 V ac Input resistance: 10 megohms
RF Voltmeter	RF voltage measurements	Motorola S1339	Measurement range: 100 uV-3V from 1 MHz-512 MHz Inputs: 50-ohm and high impedance
Tuning Probe Adapter (Note 1)	Widespace Single and Dual Front End Alignment	Motorola TRN4778	
Oscilloscope	Waveform observation	Motorola R1004	Vertical sensitivity: 5 mV-10 V/division Horizontal time base: 0.2 usec. — 0.5 sec/division
RF Wattmeter	Transmitter output power measurement	Motorola S1350 with appropriate element and T1013 RF Dummy Load	Measurement range: 0-250 Watts
Frequency Meter	Transmitter frequency measurement	Model R1200 Service Monitor with high stability oscillator (X suffix) option. Frequency calibration recommended every 6 months or less.	Measurement range: 134-174 MHz Frequency resolution: 10 Hz
Deviation Meter	Transmitter modulation deviation measurement	Motorola R1200 Service Monitor with SLN6350 Deviation Meter and SLN6381 Audio Frequency Synthesizer *(audio synthesizer required only for DPL radios).*	Measurement range: 0-10 kHz deviation Frequency range: 134-174 MHz
RF Signal Generator	Receiver alignment and troubleshooting	Motorola R1200 Service Monitor with attenuator	Frequency range: 134-174 MHz Output Level: 0.1 uV-100,000 uV Must be capable of at least ± 3 kHz deviation when modulated by 1 kHz tone.
Audio Signal Generator	Audio circuit troubleshooting	Motorola S1067	Frequency range: 20 Hz-20 kHz Output level: 50 mV-1 V
PL Tone Generator (Note 2)	Tone-coded *Private-Line* decoder troubleshooting	Motorola S1333	Frequency range: 10 Hz-9999 Hz Output level: 0-3 V rms
DPL Test Set (Note 3)	*Digital Private-Line* encoder-decoder troubleshooting	Motorola SLN6413	
DVP Test Set	*DVP* Encoder-Decoder Troubleshooting	Motorola R1012	

Table 1. Recommended Test Equipment for DVP MCX100 Radio Alignment (Cont'd.)

General Type	Application	Recommended Model	Minimum Specifications
2-Ohm Speaker/ Audio Load	Receiver alignment and measurement	TSN6031A Speaker Kit with RPX4134A Modification Kit	
Tuning Tool Kit	Receiver and transmitter alignment	Motorola TRN4671A	
DC Power Supply	DC power for shop service	Motorola R1011	1-20 V dc 0-40 A
Front Panel Extender Cables	Troubleshooting	Motorola RTK4036A	
Metric Nutdriver Kit	Radio Assembly/Disassembly	RSX4048A	

NOTES:

1. Required for dual front end models only
2. Required for tone-coded *Private-Line* models only
3. Required for *Digital Private-Line* models only

NOTE

All test equipment, with the exception of the DPL test set, tuning tool kit, tuning probe adapter, *DVP* test set and dc power supply may be replaced by the Motorola R2001 System Analyzer.

3. TRANSMITTER ALIGNMENT

Refer to Figure 1 which shows the various test points which are to be referred to in the procedure. Also refer to the pertinent schematic diagrams and circuit board details located in this manual

3.1 POWER LEVEL ADJUSTMENT

NOTE

Key the radio only while making an adjustment. The adjustments should be done at the appropriate supply voltage level specified in Table 2.

Step 1. Preset R236 (voltage limit potentiometer) by turning it fully clockwise. Preset R245 (power adjust potentiometer) by turning it fully counterclockwise.

Step 2. Refer to Table 2 and find the power set level which corresponds to the power rating of the unit being adjusted.

Step 3. Select any transmit channel. Key the radio and adjust R245 (power adjust potentiometer) for the power set level determined in Step 2.

Step 4. Switch through all the transmit channels and record the channel which gives the MINIMUM power level, as specified in Table 2.

Table 2. Power Amplifier Adjustments

Power Rating (Watts)	Power Set Level (Watts)	Supply Voltage (Volts)
10	10.5 min.	13.8
30	31 min	13.6

Step 5. Switch through all the transmit channels while observing the dc voltage indication at TP27 (P351-2). Record the voltage level and channel for the channel that gives the highest voltage level. If this voltage level is greater than 10 V dc, proceed to Step 9, do not perform Steps 6, 7, and 8.

Step 6. On the channel with the highest voltage level found in Step 5, turn R245 clockwise until the dc voltage level increases approximately 3 volts, but do not exceed 12 volts.

NOTE

A 3 volt increase may not be possible on some 30 watt models. In this case, reduce the radio power supply voltage (not lower than 10.8 V dc) while monitoring TP27, until a voltage level approximately 3 volts higher than the voltage recorded in Step 5 is obtained.

Step 7. Adjust R236 for a dc voltage level that is 2 volts higher than the level recorded in Step 5.

Step 8. Reset power supply voltage to the appropriate value given in Table 2 (if necessary).

Step 9. Switch to the channel that was determined in Step 4 and repeat Step 3 on this channel.

Step 10. Verify that all the transmit channels now have the proper output power level.

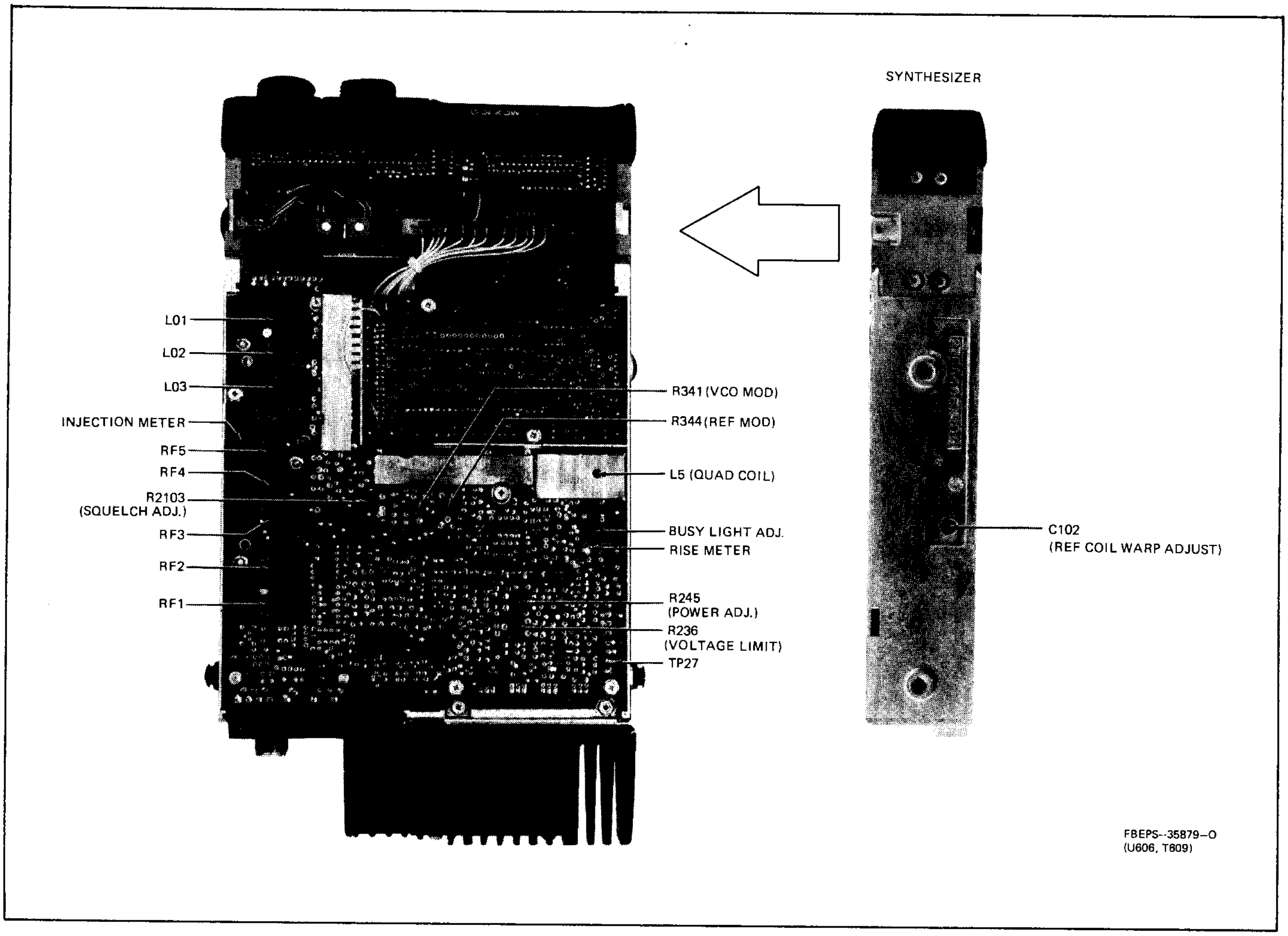


Figure 1. DVP MCX100 Radio Alignment Test Points

3.2 OSCILLATOR FREQUENCY ADJUSTMENT

Step 1. Set the channel selector switch to channel 1.

Step 2. (For PL/DPL units only.) Disconnect connector J377 from the PL/DPL board, to disable encoder modulation. Disconnect P101 from the *DVP* interface board, which enables a push-to-talk to occur. Key the transmitter to generate an unmodulated carrier.

Step 3. (For other units.) Set radio to standard transmit mode. Key the transmitter to transmit an unmodulated carrier.

Step 4. Adjust C102 (reference oscillator warp adjustment) until the proper frequency indication ± 100 Hz is obtained.

Step 5. Set the channel selector switch to channel 2 and check the transmit frequency.

Step 6. Repeat the procedure until all the channels have been checked.

Step 7. Once the oscillator frequency adjustment procedure has been completed, reconnect J377 and P101 if they were disconnected in Step 2.

3.3 DEVIATION ADJUSTMENT

NOTE

It is important that deviation be checked on all the transmit channels to ensure that no over-deviation occurs on any channel.

Step 1. Set the channel selector switch to any available channel on the radio set.

Step 2. Set radio to standard transmit mode.

Step 3. Turn R344 (REF MOD potentiometer) fully counterclockwise.

Step 4. Connect the audio oscillator output leads to the microphone audio input, as follows:

- hot lead to J350-12
- ground lead to J350-11.

Step 5. Set the audio oscillator to 1000 Hz and adjust its output level to 800 mV (RMS).

Step 6. Using the appropriate rf load, key the transmitter and observe the deviation level. Readjust audio oscillator level per Step 5 if necessary.

Step 7. Adjust R341 (VCO MOD potentiometer) until a 5 kHz deviation level is obtained.

Step 8. Set the radio set to the other transmit channels and observe the deviation level obtained on each. Make a note of the channel having the highest deviation level. If more than one channel produces the same maximum deviation level, note the channel with the highest frequency among those having the maximum deviation level. Use this channel for Steps 9 through 14.

Step 9. Adjust R341 (VCO MOD potentiometer) to obtain a deviation level of 4.6 kHz.

NOTE

Do not defeat the PL encoder on PL radio units. The procedure for DPL radio units is provided in Step 11. For radios equipped with selectable PL/DPL signaling, perform Steps 1 through 9 on any channel programmed to transmit PL signal, then perform Step 11 on the channel or channels programmed to transmit DPL signal.

Step 10. Turn R344 (REF MOD potentiometer) fully clockwise.

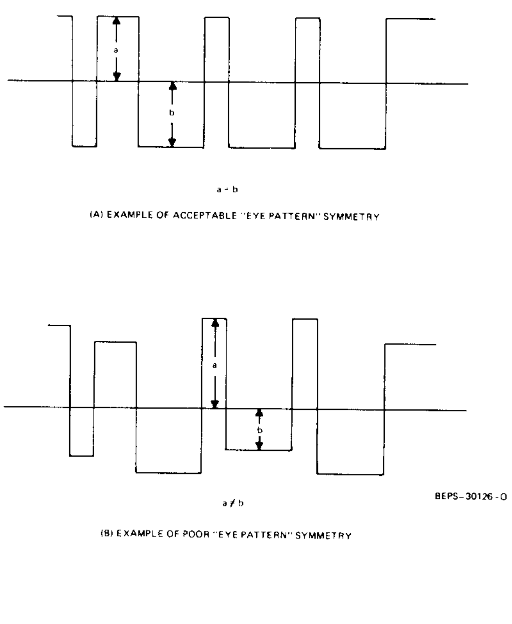


Figure 2. Examples of "Eye Pattern" Symmetry

Step 11. (For DPL radio sets only.) Connect the direct-coupled input lead of an oscilloscope to the digital output of a standard test receiver. Select the middle rf channel that transmits DPL. (For two- channel radio sets, select the channel having the lower transmit frequency.) Adjust the REF MOD potentiometer (R344) until the best eye pattern symmetry is obtained. Refer to Figure 2. Check all other channels equipped with DPL and verify that all the eye patterns are similar.

Step 12. Set the radio to private transmit mode and key the transmitter. Using an oscilloscope to monitor the voltage at P355-7, adjust the *DVP* REF MOD potentiometer (R161 on the *DVP* interface board) for an eye-pattern with a peak-to-peak voltage of 4 volts.

NOTE

In some DPL models a peak-to-peak voltage of 4 volts will not be obtainable. In this case R161 should be turned fully counterclockwise in order to obtain the maximum peak-to-peak voltage possible.

Step 13. Adjust the *DVP* VCO MOD potentiometer (R158 on the *DVP* interface board) for a deviation of 4 kHz.

Step 14. Check the deviation level on all the transmit channels and verify that it does not exceed 4.6 kHz in standard transmit mode, and does not exceed 4.0 kHz in private transmit mode.

4. RECEIVER ALIGNMENT

IMPORTANT

Proper receiver alignment first requires correct identification of the rf deck used in the radio.

- The single front end type employs a circuit board rf deck, with board mounted coils (in cans), only.
- The widespace single front end type employs a casted rf deck, with three integral coils (L707, 708, and 709).
- The widespace dual front end type employs a casted rf deck, with six integral coils (L704 thru L709).

After identifying the type of rf deck used in the radio, proceed to the appropriate rf deck alignment procedure paragraph in this section of this manual.

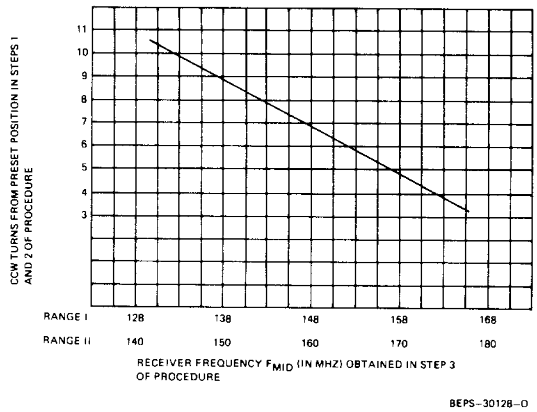


Figure 3. Coils Adjustment Graph

4.1 RF DECK ALIGNMENT PROCEDURE (SINGLE FRONT END TYPE)

Step 1. Turn the slugs of coils RF1, RF2, RF3, RF4, and RF5 clockwise until they reach the top of the coil forms.

Step 2. Carefully turn the slugs of coils L01, L02, and L03 clockwise until they touch the injection shield cover; then turn these slugs five full turns in a counterclockwise direction.

Step 3. Determine the tune-up frequency as follows:

- for single-channel sets, $F_{tune} = F_{receive}$
- for multi-channel sets, determine F_{mid} by using the following formula: $F_{mid} = (F_{high} + F_{low}) \div 2$.

NOTE

If there are channels within plus or minus 0.5 MHz of F_{mid}, the tune-up should be performed on the channel nearest to F_{mid}. If the two nearest channels are symmetrically located above and below F_{mid}, use the channel with the lower frequency. If there are no channels within plus or minus 0.5 MHz of F_{mid}, a tune-up PROM (programmable read-only memory) should be used on receive frequency F_{mid}. A procedure for tuning the receiver when a tune-up PROM is required, but is not available is provided at the end of this section. The widespace models do not require a tune-up PROM.

Step 4. Set the channel selector switch to the proper channel, as determined in the preceding step.

Step 5. Connect an ac voltmeter across the audio output of the radio set. The audio output must be terminated in either the recommended 2-ohm speaker/audio load (refer to test equipment list), or a 2-ohm resistor.

Step 6. Depress the squelch button and monitor button (if used), so that noise is heard in the speaker.

Step 7. Adjust the volume control until a comfortable noise level is obtained. If a 2-ohm load is used, adjust the volume control until an indication of approximately 1 volt is obtained across the load.

Step 8. Adjust L5 (quad coil) until maximum noise level is obtained from the speaker. Set the slugs of L01, L02, L03, RF1, RF2, RF3, RF4, and RF5 in accordance with the instructions provided in the graph of Figure 3.

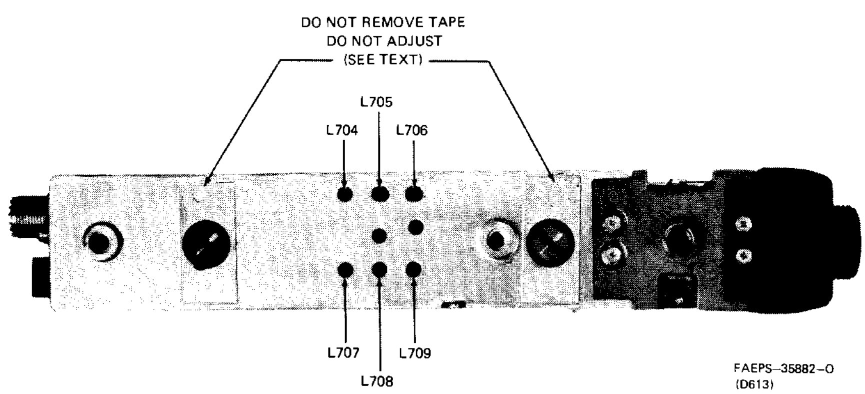


Figure 4. Widespace Single and Dual Front End Alignment Points

Step 9. Connect a high input-impedance dc voltmeter to the INJ METER point (Figure 1) and set it to a low dc voltage range. Adjust coils L02, L01, and L03 (in this order) until a maximum dc voltage level (typically between 2.1 and 3.5 V dc) is obtained. Repeat the step until no further increase in dc voltage level can be obtained.

Step 10. Connect a signal generator to the antenna connector of the receiver and adjust the generator so that it will provide an on-frequency, unmodulated signal that is sufficiently strong to quiet the receiver. Connect a dc voltmeter to the RISE MTR test point (Figure 1) and set it to a low dc voltage range. Adjust coils RF1, RF2, RF3, RF4, and RF5 (in this order) until a maximum dc voltage indication is obtained. Adjust the signal generator, as required, to maintain the dc voltage between 2.5 and 3.5 V dc during tune-up. Repeat the step until no further increase in dc voltage level can be obtained. Proceed to the Receiver Adjustments Procedure paragraph in this section of the manual.

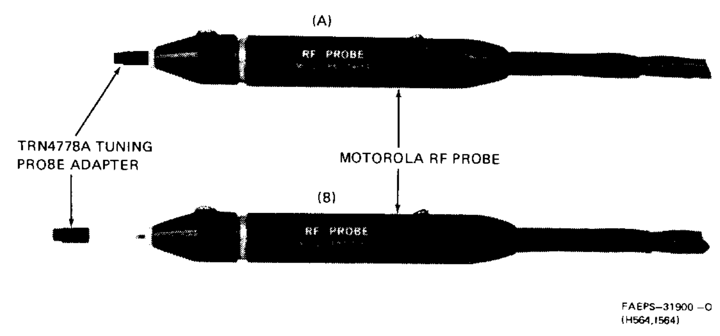


Figure 5. DVP MCX100 Alignment Probe
(A) RF Probe with Tuning Adapter in position
(B) RF Probe and Tuning Adapter separated

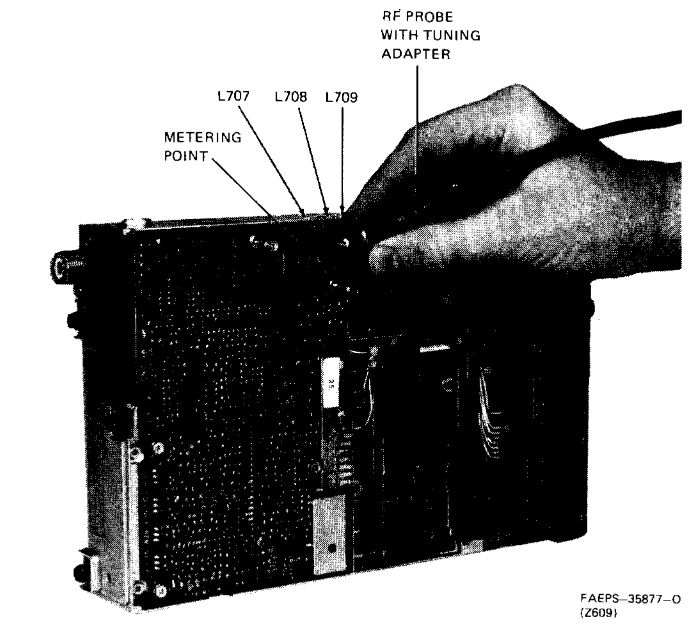


Figure 6. Main Board Side Tuning Probe Position (Widespace Single Front End and Widespace Dual Front End High Range)

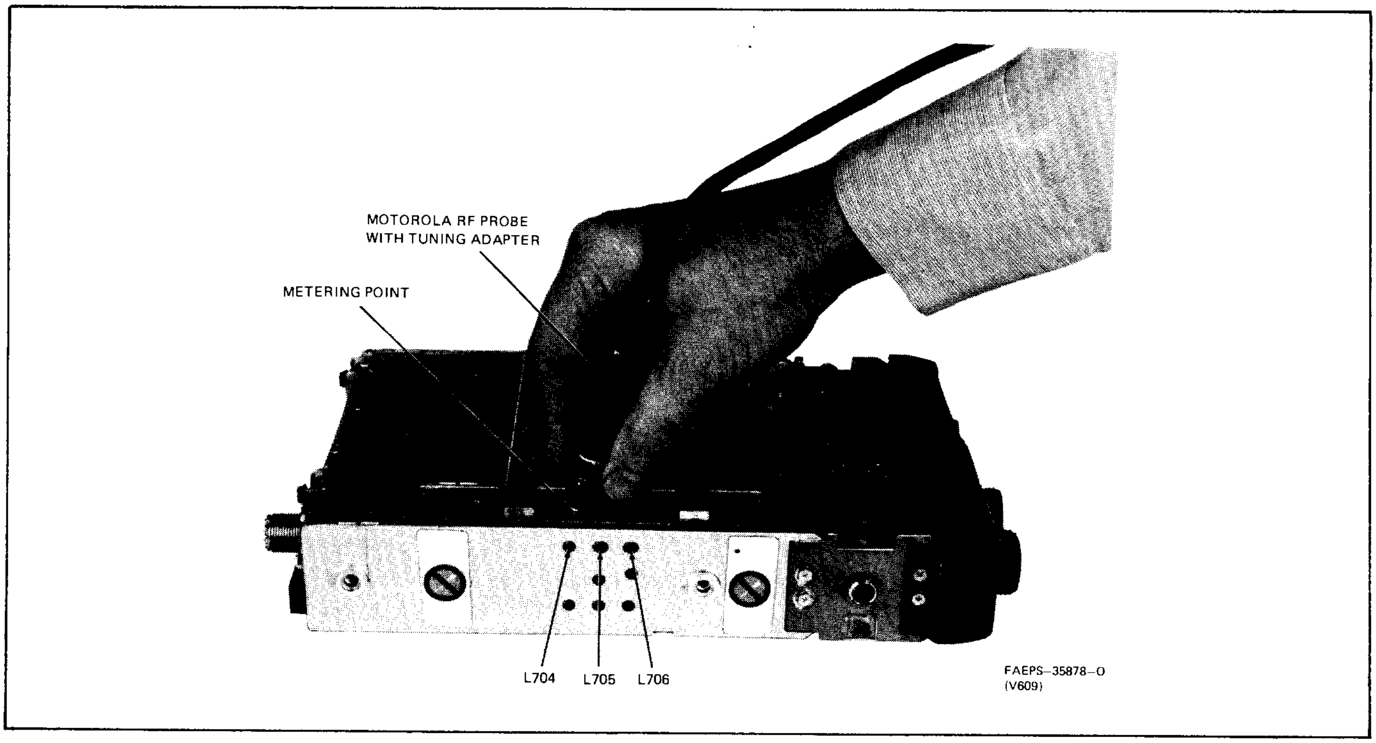


Figure 7. Synthesizer Side Tuning Probe Position (Widespace Dual Front End Low Range)

4.2 RF DECK ALIGNMENT PROCEDURE (WIDESPACE DUAL FRONT END TYPE)

In the following procedure, radios in the 136-to-162 MHz frequency range are referred to as Range 1 radio sets, and radios in the 146-to-174 MHz range are referred to as Range 2 radio sets. The terms high and low range refer to the ranges of the switched filters within the rf deck, the actual frequency ranges are determined by the requirements of the particular radio.

NOTE

The rf input coils (L701,L702,L703) of this type radio are covered with a strip of tape (refer to Figure 4). These coils are computer-set at the factory during assembly and **MUST NOT BE FIELD ADJUSTED**. If a replacement rf deck is purchased from Motorola, these coils will be preset by the factory. There should never be any reason to readjust these coils.

Step 1A. (Range 1 radios only) Carefully turn the slugs of coils L704, L705, L706, L707, L708, and L709 counterclockwise until the adjusting screws just protrude from the radio chassis wall.

Step 1B. (Range 2 radios only) Carefully turn the slugs of coils L704, L705, L706, L707, L708, and L709 clockwise until the adjusting screws are flush with the torque nut on the rf deck housing.

Step 2. Refer to label on the cover of the radio for tune-up frequencies for both high and low range switched filters. If the label is not supplied or is missing, contact your Motorola representative for information. The tune-up frequency is not necessarily the midpoint of the frequency range.

Step 3. Set the channel selector switch to any channel programmed into the radio.

Step 4. Connect an ac voltmeter across the audio output of the radio set. The audio output must be terminated in either the recommended 2-ohm speaker/audio load (refer to Table 1), or a 2-ohm resistor.

Step 5. Depress the squelch button and monitor button (if used), so that noise is heard in the speaker (if used).

Step 6. Adjust the volume control until a comfortable noise level is reached. If a 2-ohm load is used, adjust the volume control for an indication of approximately 1 volt across the load.

Step 7. Adjust L5 (quad coil) until maximum noise level is obtained from the speaker, or the highest reading on the voltmeter is obtained.

Step 8. Set the rf generator to the high range tune-up frequency, and set the channel selector to the *highest operating frequency*.

Step 9. Press the tuning probe adapter (Motorola No. TRN4778A) onto the probe of the rf voltmeter as shown in Figure 5.

Step 10. Place the radio into the position shown in Figure 6, and insert the test probe adapter tip through the HI RNG FLTR probe hole in the main board and into the tuning hole of the first cavity (L707) of the high range switched filter.

Step 11. Keep the probe in position, and turn L707 in (clockwise) for Range 1 radios or out (counterclockwise) for Range 2 radios until a peak in the voltmeter reading is obtained.

Step 12. Keep the probe in position, and turn L708 in the same direction (as in Step 11 for Range 1 or 2) until a dip in the voltmeter reading is obtained.

Step 13. Keep the probe in position, and turn L709 in the same direction (as in Step 11 for Range 1 or 2) until a peak in the voltmeter reading is obtained. The high range switched filter is now tuned.

Step 14. Set the signal generator to the low range tune-up frequency, and the channel selector switch to the *lowest operating frequency.*

Step 15. Place the radio in the position shown in Figure 7 and place the test probe adapter tip into the hole of the first cavity (L704) of the low range switched filter.

Step 16. Keep the probe in position and turn L704 in (clockwise) for Range 1 radios or out (counterclockwise) for Range 2 radios until a peak in the voltmeter reading is obtained.

Step 17. Keep the probe in position and turn L705 in the same direction (as in Step 16 for Range 1 or 2) until a dip in the voltmeter reading is obtained.

Step 18. Keep the probe in position, and turn L706 in the same direction (as in Step 16 for Range 1 or 2) until a peak in the voltmeter reading is obtained. Both switched filters are now tuned. Proceed to the Receiver Adjustments Procedure paragraph in this section of the manual.

4.3 RF DECK ALIGNMENT PROCEDURE (WIDESPACE SINGLE FRONT END TYPE)

Step 1. Carefully turn the slugs of coils L707, L708, and L709 clockwise until the adjusting screws are flush with the torque nut on the rf deck housing.

NOTE

The rf input coils (L701, L702, L703) and injection input coils (L710, L711, L712) of this type radio are covered with a strip of tape (refer to Figure 4). These coils are computer-set at the factory during assembly and **MUST NOT BE FIELD ADJUSTED**. If a replacement rf deck is purchased from Motorola, these coils will be preset by the factory. There should never be any reason to readjust these coils.

Step 2. Refer to label on the cover of the radio for tune-up frequency, If the label is not supplied or is missing, contact your Motorola representative for information. The tune-up frequency is not necessarily the midpoint of the frequency range.

Step 3. Set the channel selector switch to any channel programmed into the radio.

Step 4. Connect an ac voltmeter across the audio output of the radio set. The audio output must be terminated in either the recommended 2-ohm speaker/audio load (refer to Table 1), or a 2-ohm resistor.

Step 5. Depress the squelch button and monitor button (if used), so that noise is heard in the speaker (if used).

Step 6. Adjust the volume control until a comfortable noise level is reached. If a 2-ohm load is used, adjust the volume control for an indication of approximately 1 volt across the load.

Step 7. Adjust L5 (quad coil) until maximum noise level is obtained from the speaker, or the highest reading on the voltmeter is obtained.

Step 8. Set the rf generator to the tune-up frequency.

Step 9. Press the tuning probe adapter (Motorola No. TRN4778A) onto the probe of the rf voltmeter as shown in Figure 5.

Step 10. Place the radio into the position shown in Figure 6, and insert the test probe adapter tip through the HI RNG FLTR probe hole in the main board and into the tuning hole of the first cavity (L707) of the filter.

Step 11. Keep the probe in position and turn L707 in (clockwise) for Range 1 radios or out (counterclockwise) for Range 2 radios until a peak in the voltmeter reading is obtained.

Step 12. Keep the probe in position and turn L708 in the same direction (as in Step 11 for Range 1 or 2) until a dip in the voltmeter reading is obtained.

Step 13. Keep the probe in position and turn L709 in the same direction (as in Step 11 for Range 1 or 2) until a peak in the voltmeter reading is obtained. The filter is now tuned. Proceed to the Receiver Adjustments Procedure paragraph in this section of the manual.

4.4 RECEIVER ADJUSTMENTS PROCEDURE

NOTE

The following Receiver Adjustments Procedure is to be performed after the appropriate RF Deck Alignment Procedure is completed.

Step 1. Set the signal generator to provide an output of 1 mV at 1 kHz modulation at 3 kHz deviation. With the volume control set for a comfortable listening level, very slowly adjust L5 (quad coil) until a maximum tone level is obtained from the speaker (or a maximum indication across a 2-ohm load, if such a load is used).

Step 2. Set the generator to provide an unmodulated, on-frequency output signal that causes 10 dB of noise quieting.

Step 3. Turn R2103 (SQUELCH ADJ. potentiometer) fully counterclockwise and set the squelch pushbutton on the front panel to the OUT position.

Step 4. Turn R2103 clockwise until the speaker noise mutes; then *very slowly* turn it counterclockwise until the speaker noise just stays unmuted.

Step 5. Reduce the signal generator output level to zero and then *very slowly* increase it until the speaker unmutes. Verify that the noise quieting (at squelch opening) is between 9 and 11 dB.

Step 6. (For PL/DPL or *Select 5* radio sets only.) Using the signal generator, apply an on-frequency, unmodulated output signal that produces 23 dB of noise quieting. Adjust R1202 (BUSY LIGHT ADJ. potentiometer) until the busy light on the front panel just turns on.

Step 7. Check radio on all channels for 20 dB quieting sensitivity. The quieting level should not exceed 0.35 uV on any channel.

4.5 RECEIVER ALIGNMENT WITHOUT TUNE-UP PROM (SINGLE FRONT END MODELS ONLY)

NOTE

This receiver alignment procedure should be used if a tune-up PROM is required, but is not available.

Step 1. Turn the slugs of coils RF1, RF2, RF3, RF4, and RF5 clockwise until they reach the top of the coil forms.

Step 2. Carefully turn the slugs of coils L01, L02, and L03 clockwise until they touch the injection shield cover; then turn these slugs five full turns in a counterclockwise direction.

Step 3. Connect an ac voltmeter across the audio output of the radio set. The audio output must be terminated in either the recommended 2-ohm speaker/audio load (refer to test equipment list), or a 2-ohm resistor.

Step 4. Depress the squelch button and monitor button (if used), so that noise is heard in the speaker.

Step 5. Adjust the volume control until a comfortable noise level is obtained. If a 2-ohm load is used, adjust the volume control until an indication of approximately 1 volt is obtained across the load.

Step 6. Adjust L5 (quad coil) until maximum noise level is obtained from the speaker. Set the slugs of L01, L02, L03, RF1, RF2, RF3, RF4, and RF5 in accordance with the instructions provided in the graph of Figure 3.

Step 7. Select the receive channel with the lowest frequency with the channel selector switch.

Step 8. Connect a high input-impedance dc voltmeter to the INJ METER point (Figure 1) and set it to a low dc voltage range. Adjust coils L02, L01, and L03 (in this order) until a maximum dc voltage level (typically between 2.1 and 3.5 V dc) is obtained. Repeat the step until no further increase in dc voltage level can be obtained.

Step 9. Connect a signal generator to the antenna connector of the receiver and adjust the generator so that it will provide an on-frequency, unmodulated signal that is sufficiently strong to quiet the receiver. Connect a dc voltmeter to the RISE MTR test point (Figure 1) and set it to a low dc voltage range. Adjust coils RF1, RF2, RF3, RF4, and RF5 (in this order) until a maximum dc voltage indication is obtained. Adjust the signal generator, as required, to maintain the dc voltage between 2.5 and 3.5 V dc during tune-up. Repeat the step until no further increase in dc voltage level can be obtained.

Step 10. Select the receiver channel with the highest frequency. Connect a high-input-impedance dc voltmeter to the INJ METER point (Figure l) and set it to the appropriate low range. Noting the number of turns required, adjust L02, L01, and L03 in a clockwise direction (in this order) *only once* to obtain maximum dc voltage indication with each coil. (Some coils may not require any change.)

Step 11. Connect a dc voltmeter to the RISE MTR point (Figure l). Using a signal generator, apply an on-frequency, unmodulated signal of sufficient strength to quiet the receiver. Recording the number of turns required, adjust coils RF1, RF2, RF3, RF4, and RF5 in a clockwise direction (in the order listed) *only once* to obtain a maximum dc voltage indication with each coil (typically between 2.5 and 3.5 V). (Some coils may not require any change.) While performing the step, adjust the generator, as required, to maintain the dc voltage at the specified level (i.e., between 2.5 and 3.5 V dc).

Step 12. For any coil whose position was changed while performing Steps 10 and 11, turn the coil in question counterclockwise, the number of turns being *half* of those recorded in Steps 10 and 11.

Step 13. Set the signal generator to provide an output of 1 mV at 1 kHz modulation at 3 kHz deviation. With the volume control set for a comfortable listening level, very slowly adjust L5 (quad coil) until a maximum tone level is obtained from the speaker (or a maximum indication across a 2-ohm load, if such a load is used).

Step 14. Set the generator to provide an unmodulated, on-frequency output signal that causes 10 dB of noise quieting.

Step 15. Turn R2103 (SQUELCH ADJ. potentiometer) fully counterclockwise and set the squelch pushbutton on the front panel to the OUT position.

Step 16. Turn R2103 clockwise until the speaker noise mutes; then *very slowly* turn it counterclockwise until the speaker noise just stays unmuted.

Step 17. Reduce the signal generator output level to zero and then *very slowly* increase it until the speaker unmutes. Verify that the noise quieting (at squelch opening) is between 9 and 11 dB.

Step 18. (For PL/DPL or *Select 5* radio sets only.) Using the signal generator, apply an on-frequency, unmodulated output signal that produces 23 dB of noise quieting. Adjust R1202 (BUSY LIGHT ADJ. potentiometer) until the busy light on the front panel just turns on.

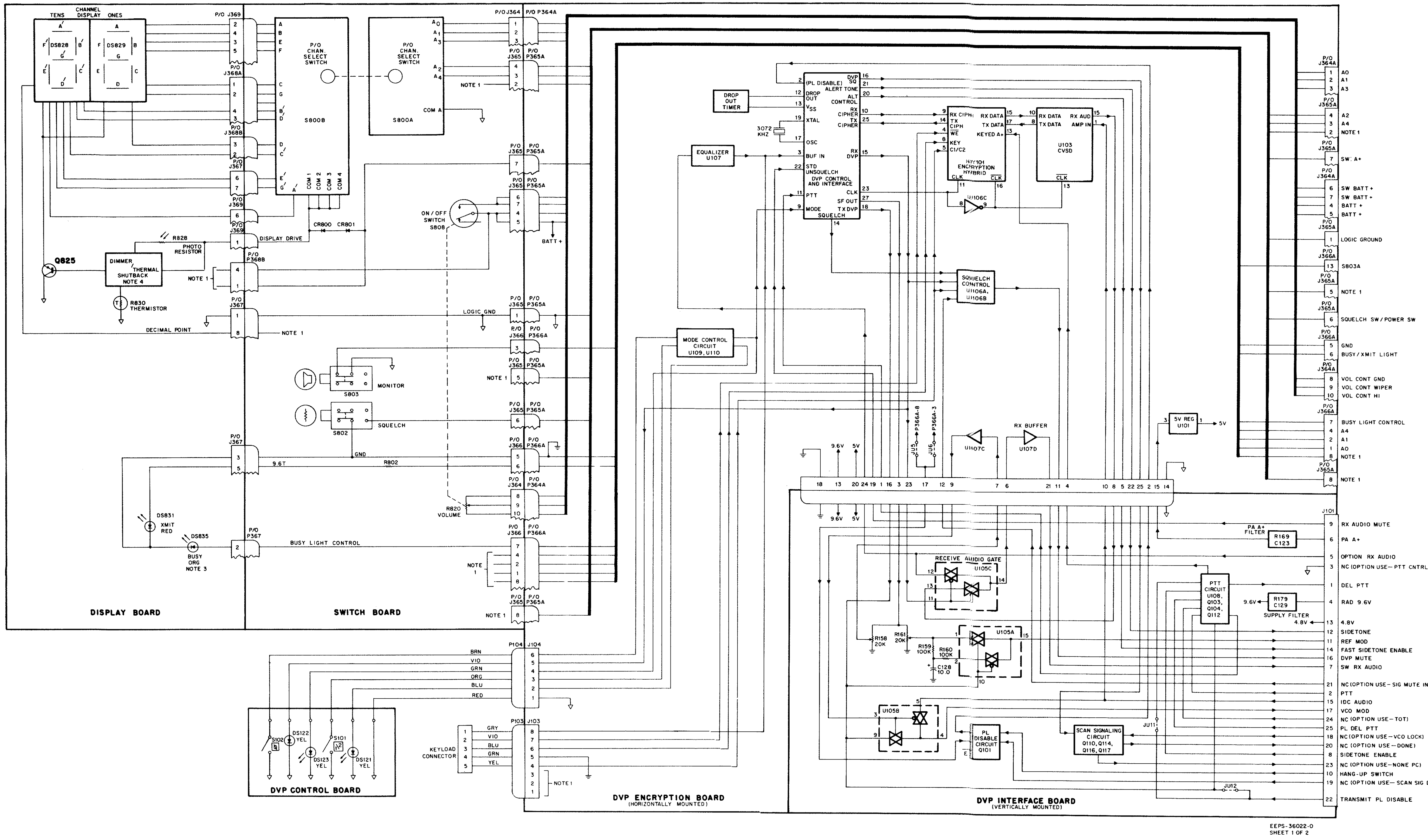
Step 19. Verify that 20 dB quieting is obtained on all the receive channels. *Slightly* adjust coils RF1, RF2, RF3, RF4, and RF5, if required, until all the receive channels are within the quieting sensitivity specification of 0.35 microvolts.

NOTE

Clockwise rotation of the coil slugs raises the tuning frequency, whereas a counterclockwise rotation lowers the tuning frequency.

DVP MCX100 FRONT MOUNT RADIO SET

FUNCTIONAL INTERCONNECT DIAGRAM



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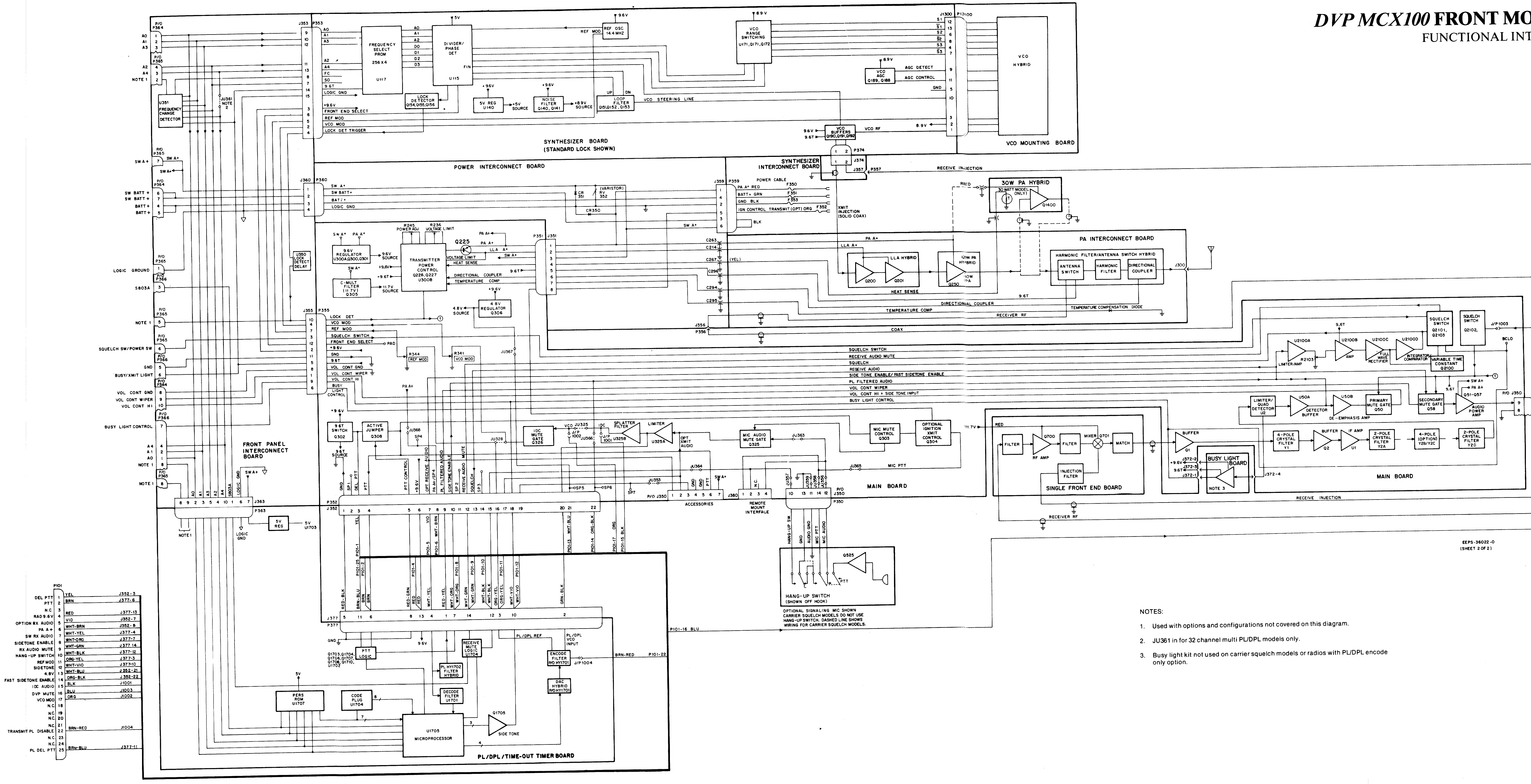
(Sheet 1 of 2)
3/15/83- *PHI*

DVP MCX100 FRONT MOUNT RADIO SET

FUNCTIONAL INTERCONNECT DIAGRAM



NOTES:

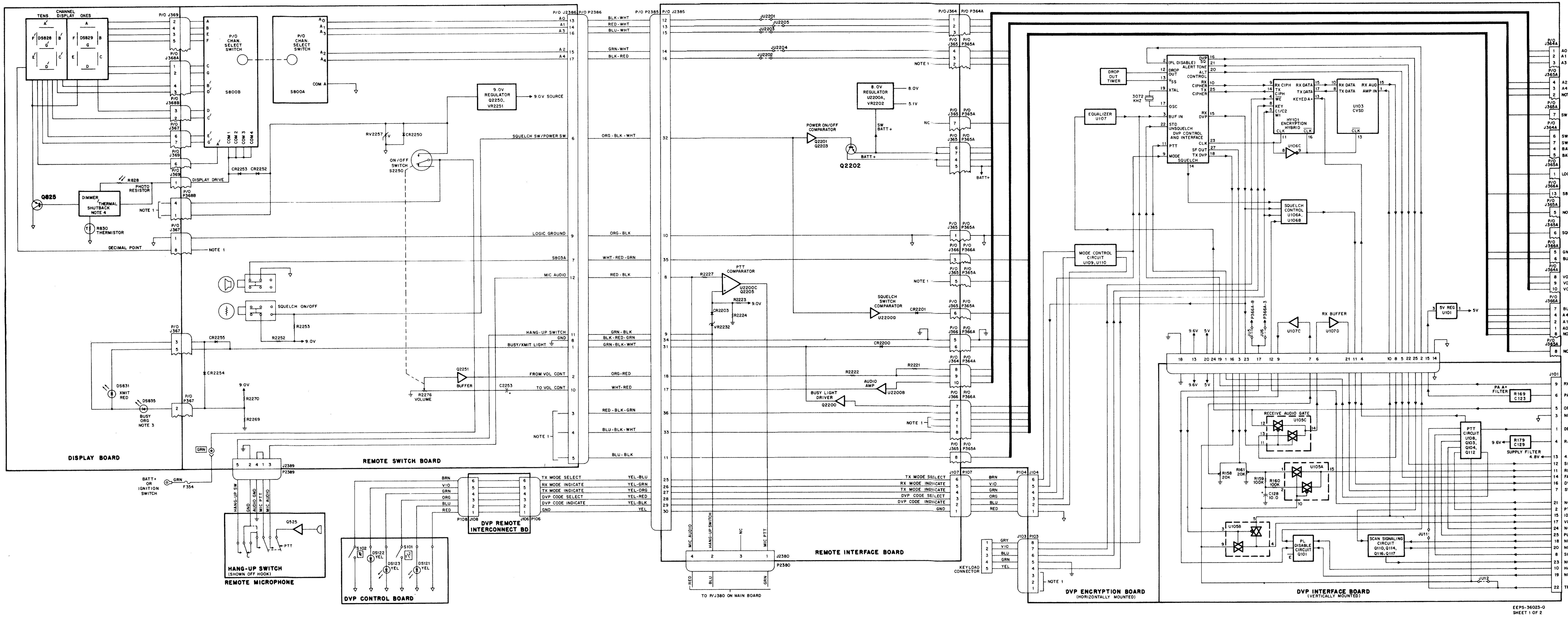
1. Used with options and configurations not covered on this diagram.
2. JU361 in for 32 channel multi PL/DPL models only.
3. Busy light kit not used on carrier squelch models or radios with PL/DPL encode only option.

DVP MCX100 FRONT MOUNT RADIO SET

68P81064E14-O
(Sheet 2 of 2)
3/15/83- *PHI*

DVP MCX100 REMOTE MOUNT RADIO SET

FUNCTIONAL INTERCONNECT DIAGRAM



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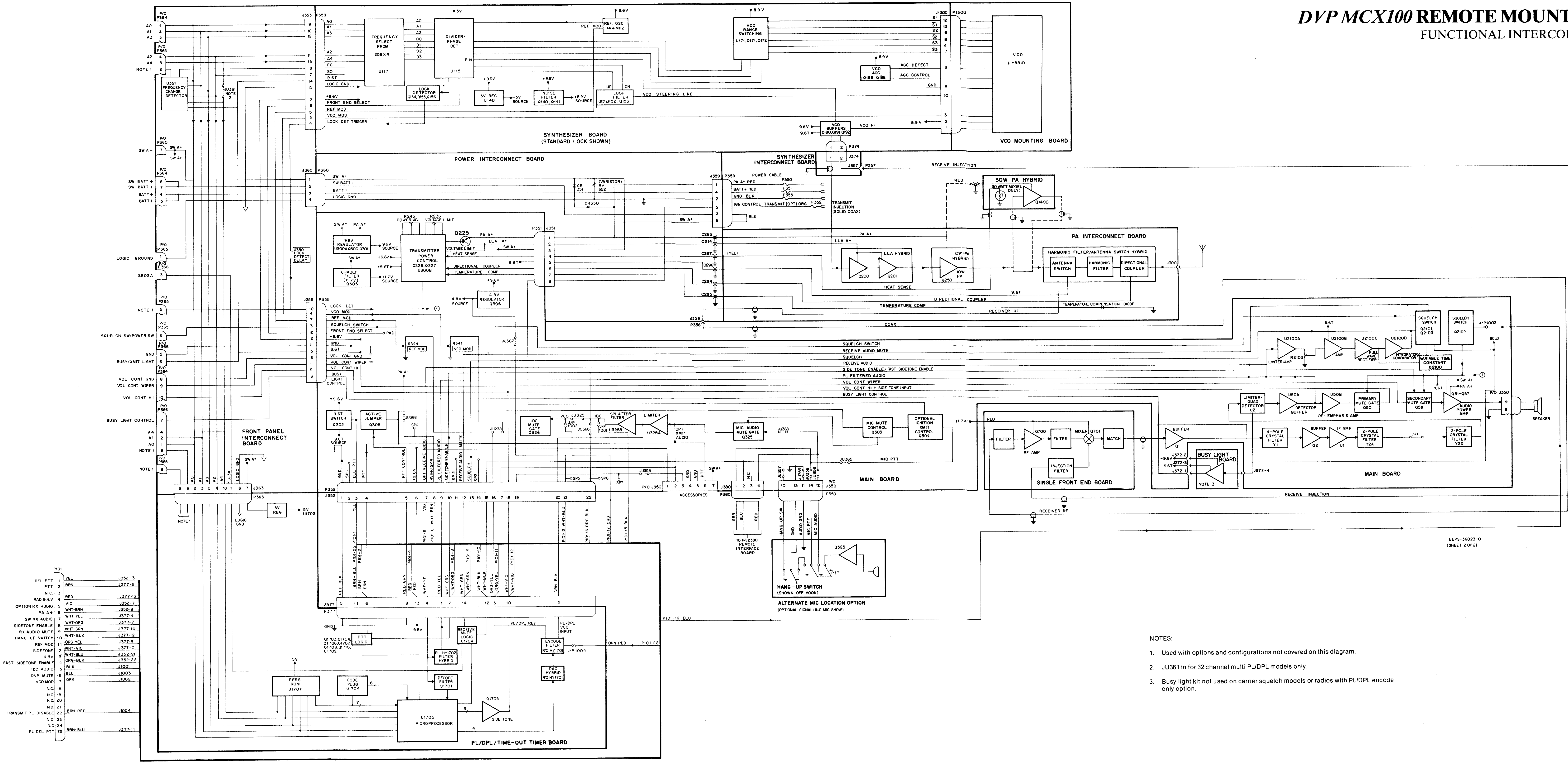
DVP MCX100 REMOTE MOUNT RADIO SET

FUNCTIONAL INTERCONNECT DIAGRAM



NOTES:

1. Used with options and configurations not covered on this diagram.
2. JU361 in for 32 channel multi PL/DPL models only.
3. Busy light kit not used on carrier squelch models or radios with PL/DPL encode only option.

68P81064E16-O
(Sheet 2 of 2)
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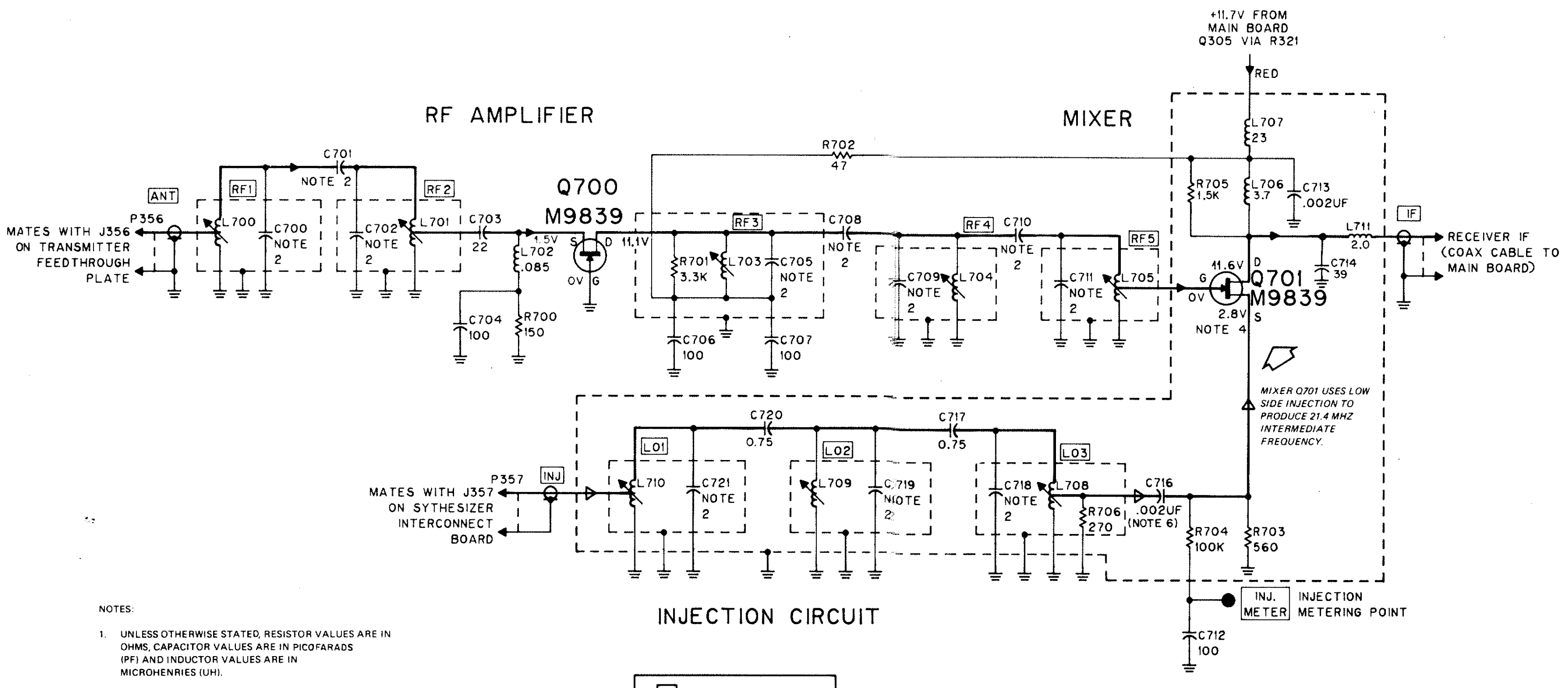
DVP MCX100 REMOTE MOUNT RADIO SET

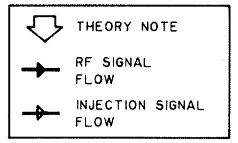
SINGLE FRONT END



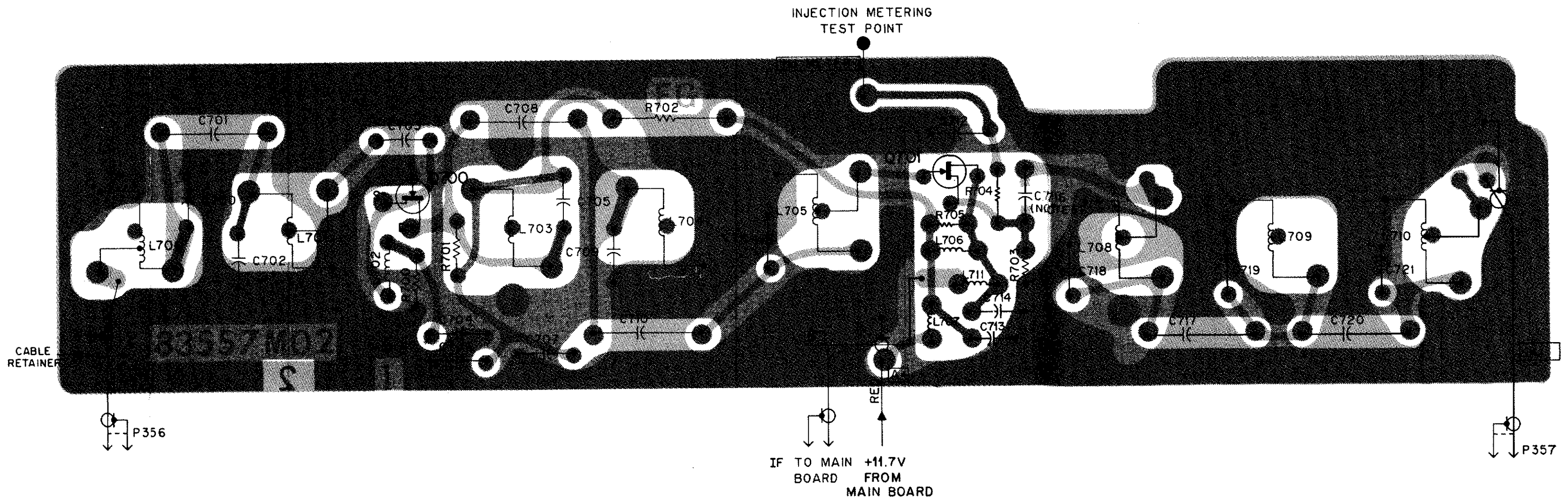
DEPS-30157-B

NOTES:

1. UNLESS OTHERWISE STATED, RESISTOR VALUES ARE IN OHMS, CAPACITOR VALUES ARE IN PICOFARADS (PF) AND INDUCTOR VALUES ARE IN MICROHENRIES (UH).
2. VALUE DEPENDENT ON FREQUENCY. REFER TO PARTS LIST FOR COMPONENT VALUE.
3. DOTTED LINES DENOTE SHIELDS.
4. MEASURED WITH INJECTION SIGNAL PRESENT. WITHOUT INJECTION 2.2V.
5. INDUCTOR LABELS SUCH AS [RF 1] ARE PRINTED ON THE SOLDER SIDE OF THE MAIN BOARD.
6. CAPACITOR C716 IS A CHIP TYPE COMPONENT LOCATED ON SOLDER SIDE OF CIRCUIT BOARD.

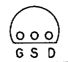


SINGLE FRONT END



SHOWN FROM SOLDER SIDE

OL-DEPS-30158-B
SOLDER SIDE BD-DEPS-30159-B
COMPONENT SIDE BD-DEPS-30160-A



TRANSISTOR BASE DETAIL

parts list

TRD6161B Single Front End, 136-162 MHz (L)
TRD6162B Single Front End, 146-174 MHz (H)

PL-7171-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ± 5%; 50 V: unless otherwise stated:
C700 (H)	21-11022H24	9 ± 0.5
C700 (L)	21-11022H28	11
C701 (L)	21-82450B47	1
C701 (H)	21-82450B48	0.75
C702 (H)	21-11022H24	9 ± 0.5
C702 (L)	21-11022H28	11
C703	21-11022G38	22
C704	21-11022M42	100
C705 (H)	21-11022H16	5.6 ± 0.5
C705 (L)	21-11022H19	6.8 ± 0.5
C706, 707	21-11022M42	100
C708 (H)	21-82450B33	0.56
C708 (L)	21-82450B48	0.75
C709 (H)	21-11022H20	7.0 ± 0.5
C709 (L)	21-11022H23	8.2 ± 0.5
C710 (H)	21-82450B33	0.56
C710 (L)	21-82450B48	0.75
C711 (H)	21-11022H16	5.6 ± 0.5
C711 (L)	21-11022H19	6.8 ± 0.5
C712	21-11022M42	100
C713	21-11021E25	.002 uF ± 10%
C714	21-11022H41	39
C715	NOT USED	
C716	21-84547A26	.0022 uF ± 10% (chip)
C717	21-82450B48	0.75
C718 (H)	21-11022H23	8.2 ± 0.5
C718 (L)	21-11022H27	10 ± 0.5
C719 (H)	21-11022H17	6 ± 0.5
C719 (L)	21-11022H23	8.2 ± 0.5
C720	21-82450B48	0.75
C721 (H)	21-11022H23	8.2 ± 0.5
C721 (L)	21-11022H27	10 ± 0.5
		coil, rf:
L700, 701	24-84972A34	3-1/2 turns; tapped (coded RED)
L702	24-82723H13	choke, 0.85 uH
L703, 704	24-84972A35	3-1/2 turns (coded ORG)
L705	24-84972A36	3-1/2 turns; tapped (coded GRN)
L706	24-82835G21	choke, 3.7 uH
L707	24-82723H35	choke, 23 uH
L708	24-84972A37	4-1/2 turns; tapped (coded YEL)
L709	24-84972A38	4-1/2 turns (coded WHT)
L710	24-84972A37	4-1/2 turns; tapped (coded YEL)
L711	24-82190C17	choke, 2 uH
		connector, plug:
P356,357	28-82365D03	male, single contact (antenna)
		transistor: (see note)
Q700, 701	48-869839	field-effect; M9839
		resistor, fixed: ± 5%; 1/4 W;
R700	6-11020A29	150
R701	6-11020A61	3.3k
R702	6-11009C17	47
R703	6-11020A43	560
R704	6-11020A97	100k
R705	6-11020A53	1.5k
R706	6-185A35	270, 1/8 W
R707	6-11020A17	47
	mechanical parts	
	3-84208M01	SCREW, machine; M3 x 0.5 x 8; 3 used
	14-84114M01	INSULATOR, (mixer shield)
	14-84155M01	INSULATOR, (rf shield)
	26-84115M01	SHIELD, mixer; component side
	26-84598A01	SHIELD, coil; 8 used
	26-84079N01	SHIELD, large; solder side
	26-84117M01	SHIELD, small solder side
	37-16754	GROMMET, rubber; 6 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

SINGLE FRONT END

MODELS TRD6161B (136-162 MHz)
AND TRD6162B (146-174 MHz)

FUNCTION

Provides receive rf amplification, injection, and output at i-f frequency.

SINGLE FRONT END

WIDESPACE SINGLE FRONT END

MODEL TLD2492B (146-174 MHz)

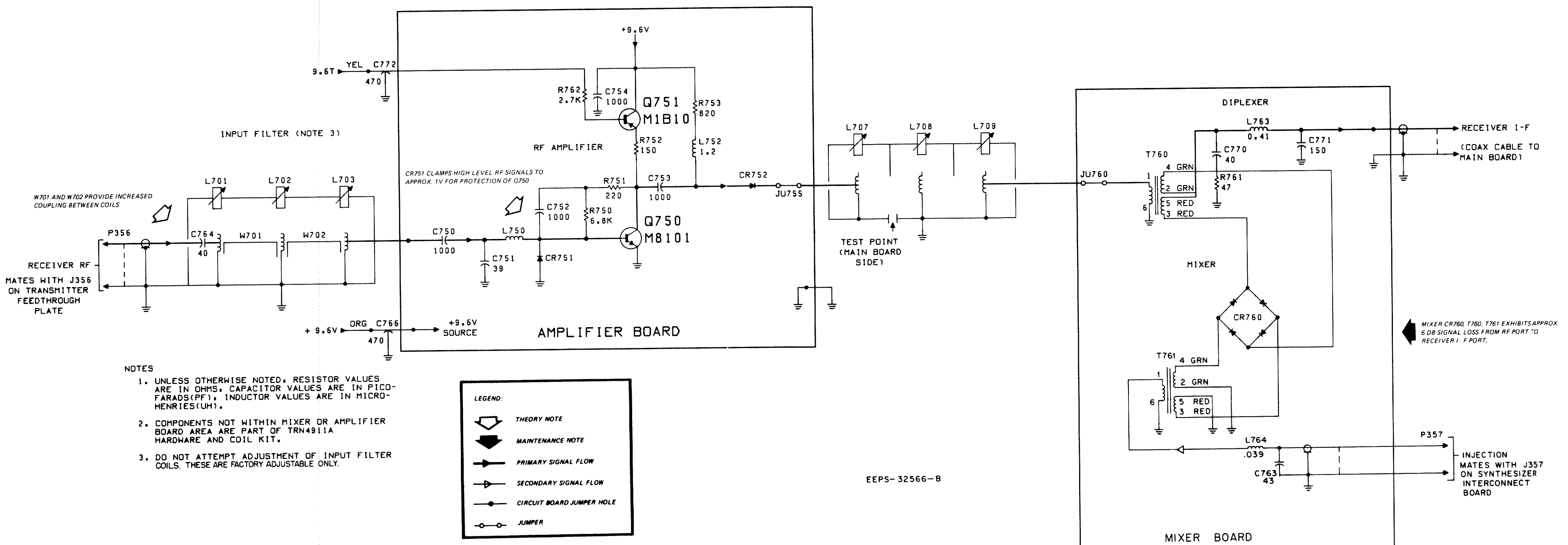
FUNCTION

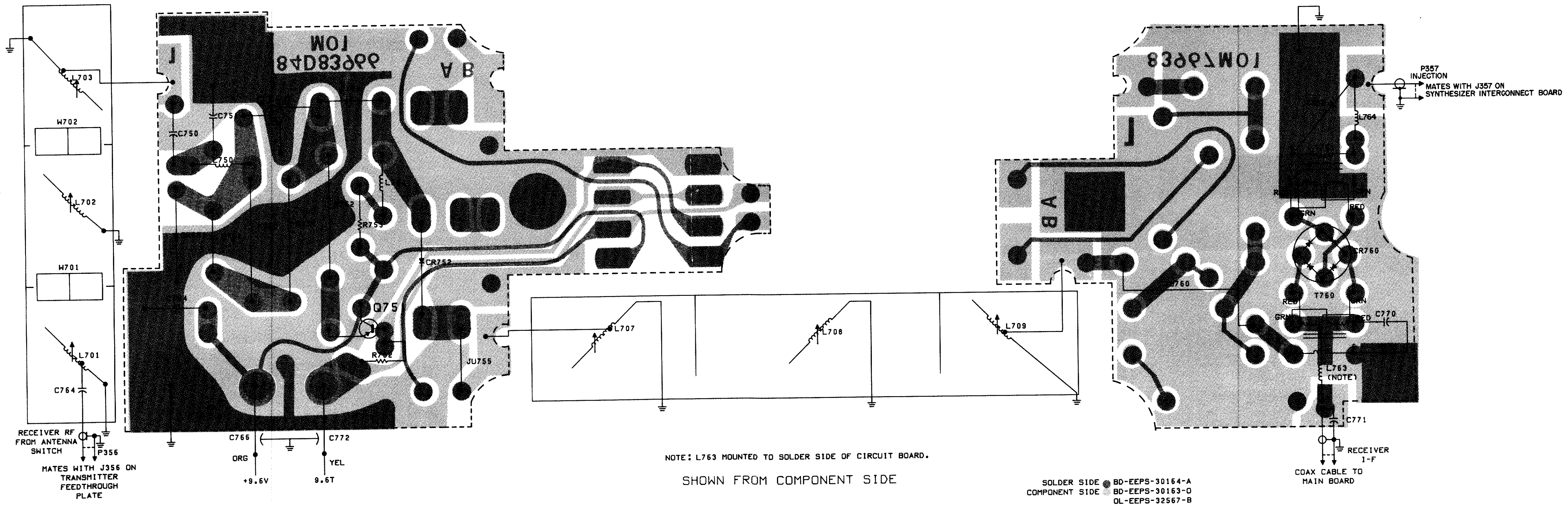
Provides receive rf amplication, injection, and output to receiver i-f amplifier.

Widespace Single Front End
Model Complement Chart

TLD2492B	Widespace Single Front End (146-174 MHz)
TRN4911B	Hardware and Coils (146-174 MHz)
TRN4952B	Housing Assembly
TRN5001A	Hardware

Provides receive rf amplication, injection, and output to receiver i-f amplifier.





parts list

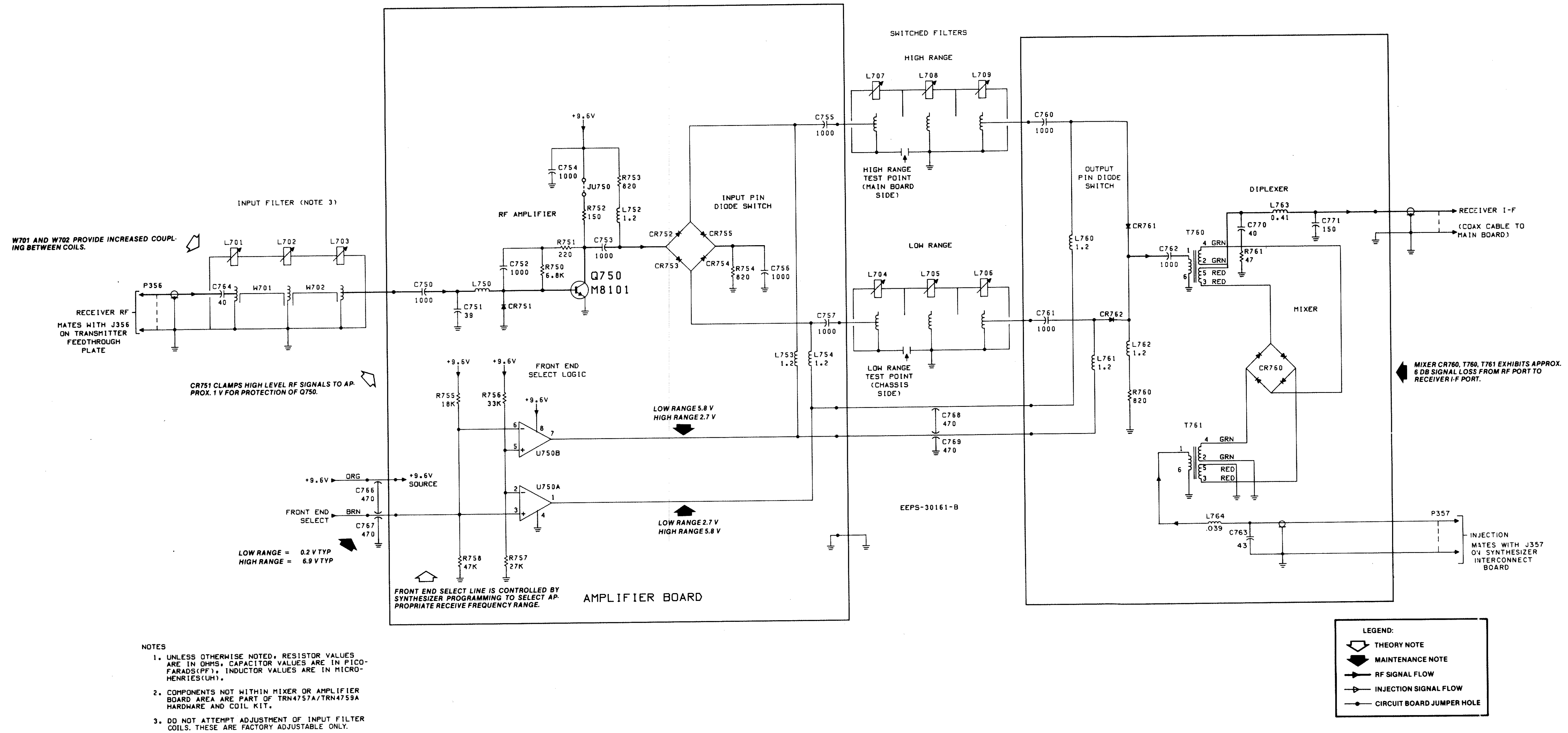
TRN4911B Hardware and Coil Kit (146-174 MHz) PL-7499-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C750	21-11021E13	1000 pF ± 10%; 50 V
C751	21-11028G44	39 pF ± 5%; 50 V
C752 thru 754	21-11021E13	1000 pF ± 10%; 50 V
C763	21-00020M27	43 pF ± 5%; 50 V
C764	21-82358G28	40 pF ± 5%; 100 V
C766	21-84874K01	470 pF ± 20%; 250 V (feed-thru)
C770	21-00020M28	40 pF ± 5%; 100 V
C771	21-00020M02	150 pF ± 5%; 75 V
C772	21-84874K01	470 pF ± 20%; 250 V (feed-thru)
		diode: (see note)
CR751	48-83654H01	silicon
CR752	48-00083M01	silicon, PIN
CR760	48-00085M01	quad
		connector, plug:
P356, P357	28-82365D03	male, single contact (phono)
		coil;
L701	24-00078M29	input, helical
L702	24-00078M22	input, helical
L703	24-00078M21	input, helical
L707	24-00078M23	helical high
L708	24-00078M24	helical high
L709	24-00078M25	helical high
L750	24-00080M01	air wound
L752	24-82723H01	choke; 1.2 uH
L763	24-82723H05	choke; 0.41 uH
L764	24-82723H25	choke; 0.039 uH
		transistor: (see note)
Q750	48-00081M01	NPN; type M8101
Q751.	48-02081B10	PNP; type M1810
		resistor, fixed ± 5%; 1/4 W
R750	6-11009C69	6.8k
R751	6-124A33	220
R752	6-124A29	150
R753	6-11020A47	820
R761	26-185A17	47, 1/8 W
R762	6-11020A59	2.7k
		transformer:
T760, 761	24-00079M01	balun
		mechanical parts
	3-84208M01	SCREW, machine; M3 x 0.5 x 8; 2 used
	3-84208M03	SCREW, machine; M2.2 x 0.45 x 6; 18 used
	15-84118M01	HOUSING, preselector base
W701,702	1-80734D23	COUPLING, insert; 2 used
	1-80732D79	INJECTION CABLE assembly; includes:
	30-83794C01	CABLE, coaxial; 8" used refer P356
	1-80732D80	ANTENNA CABLE assembly; includes:
	30-83361G01	CABLE, coaxial RG178 B/U; 4" used refer P357
	1-80732D81	OUTPUT CABLE assembly includes:
	30-83361G01	CABLE, coaxial RG178 B/U; 3" used

TRN5001A Hardware PL-7593-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-84208M03	SCREW, machine, M2.5 x 0.5 x 6; 12 used
	54-00056M01	LABEL warning; 2 used

68P81048E19-B
1/19/83- PHI



NOTES

1. UNLESS OTHERWISE NOTED, RESISTOR VALUES ARE IN OHMS. CAPACITOR VALUES ARE IN PICOFARADS(PF). INDUCTOR VALUES ARE IN MICROHENRIES(UH).
2. COMPONENTS NOT WITHIN MIXER OR AMPLIFIER BOARD AREA ARE PART OF TRN4757A/TRN4759A HARDWARE AND COIL KIT.
3. DO NOT ATTEMPT ADJUSTMENT OF INPUT FILTER COILS. THESE ARE FACTORY ADJUSTABLE ONLY.

parts list

TRN4757B Hardware and Coil Kit (136-162 MHz)
TRN4759B Hardware and Coil Kit (146-174 MHz) PL-7446-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C750	21-11021E13	1000 pF ± 10%; 50 V
C751	21-11026G44	39 pF ± 5%; 50 V
C752 thru 757	21-11021E13	1000 pF ± 10%; 50 V
C760, 761, 762	21-11021E13	100 pF ± 10%; 50 V
C763	21-00020M27	43 pF ± 5%; 50 V
C764	21-00030M28	40 pF ± 5%; 100 V
C766 thru C769	21-84874K01	470 pF ± 20%; 250 V (feed-thru)
C770	21-00020M28	40 pF ± 5%; 100 V
C771	21-00025M02	150 pF ± 5%; 75 V
		connector, plug:
P356, P357	28-82365D03	male, single contact (phono)
		coil;
L701	24-00078M19	input, helical (TRN4757A only)
	or 24-00078M29	input, helical (TRN4759A only)
L702	24-00078M12	input, helical TRN4757A only)
	or 24-00078M22	input, helical (TRN7459A only)
L703	24-00078M11	input, helical (TRN4757A only)
	or 24-00078M21	input, helical (TRN4759A only
L704	24-00078M13	switched, helical low
L705	24-00078M14	switched, helical low
L706	24-00078M15	switched, helical low
L707	24-00078M23	switched, helical high
L708	24-00078M24	switched, helical high
L709	24-00078M25	switched, helical high
L750	24-00080M01	air wound
L752 thru 754	24-82723H01	choke; 1.2 uH
L760, 761, 762	24-82723H01	choke; 1.2 uH
L763	24-82723H05	choke; 0.41 uH
L764	24-82723H25	choke; 0.039 uH
		diode: (see note)
CR751	48-83654H01	silicon
CR752, 753	48-00083M01	silicon, PIN
CR754, 755	48-00082M01	silicon, PIN
CR760	48-00085M01	quad
CR761, 762	48-00083M01	silicon Pin

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		resistor, fixed ± 5%; 1/4 W
R750	6-11009C69	6.8k
R751	6-124A33	220
R752	6-124A29	150
R753, 754	6-11020A47	820
R755	6-11009C79	18k
R756	6-11020A85	33k
R757	6-11020A83	27k
R758	6-11020A89	47k
R760	6-11009A47	820 ± 5%; 1/4 W
		transistor: (see note)
Q750	48-00081M01	NPN; type M8101
		transformer:
T760, 761	24-00079M01	balun
		integrated circuit: (see note)
U750	51-80067C03	type 67C03
		mechanical parts
	3-84208M01	SCREW, machine; M3 x 0. x 8; 2 used
	3-84208M03	SCREW, machine; M2.5 x 0.5 x 6; 6 used
	15-84118M01	HOUSING, preselector base
W701,702	1-80734D23	COUPLING, insert; 2 used
	1-80732D79	INJECTION CABLE assembly; includes:
	30-83794C01	CABLE, coaxial; 8" used refer P356
	1-80732D80	ANTENNA CABLE assembly; includes:
	30-83361G01	CABLE, coaxial RG178 B/U; 4" used refer P357
	1-80732D81	OUTPUT CABLE assembly includes:
	30-83361G01	CABLE, coaxial RG178 B/U; 3" used

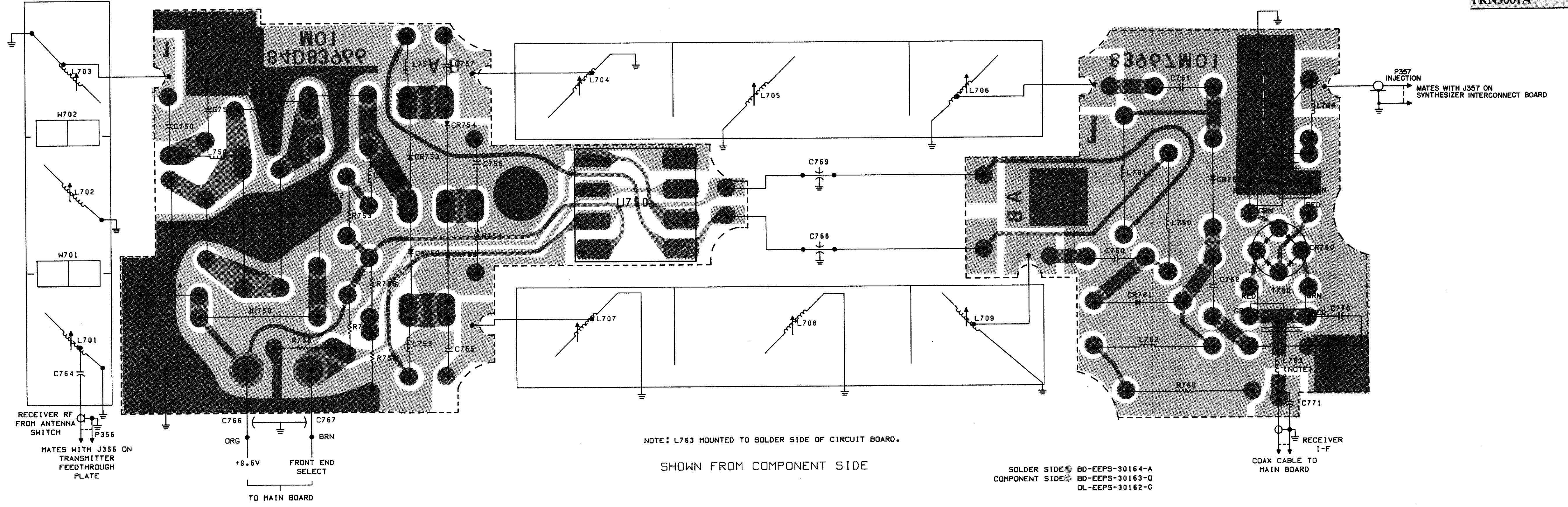
note: For optimum performancs, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN4760B Housing Assembly PL-7448-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2-84773E02	NUT, tension; 12 used
	3-84589G02	SCREW, set; 8-32 x 7/16"; 6 used
	3-84589G05	SCREW, 8-32 x 0.55"; 6 used
	15-84119M01	HOUSING, preselector

TRN5001A Hardware PL-7593-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-84208M03	SCREW, machine, M2.5 x 0.5 x 6; 12 used
	54-00056M01	LABEL, warning; 2 used



WIDESPACE DUAL FRONT END

MODELS TLD2461B (136-162 MHz) AND TLD2462B (146-174 MHz)

FUNCTION

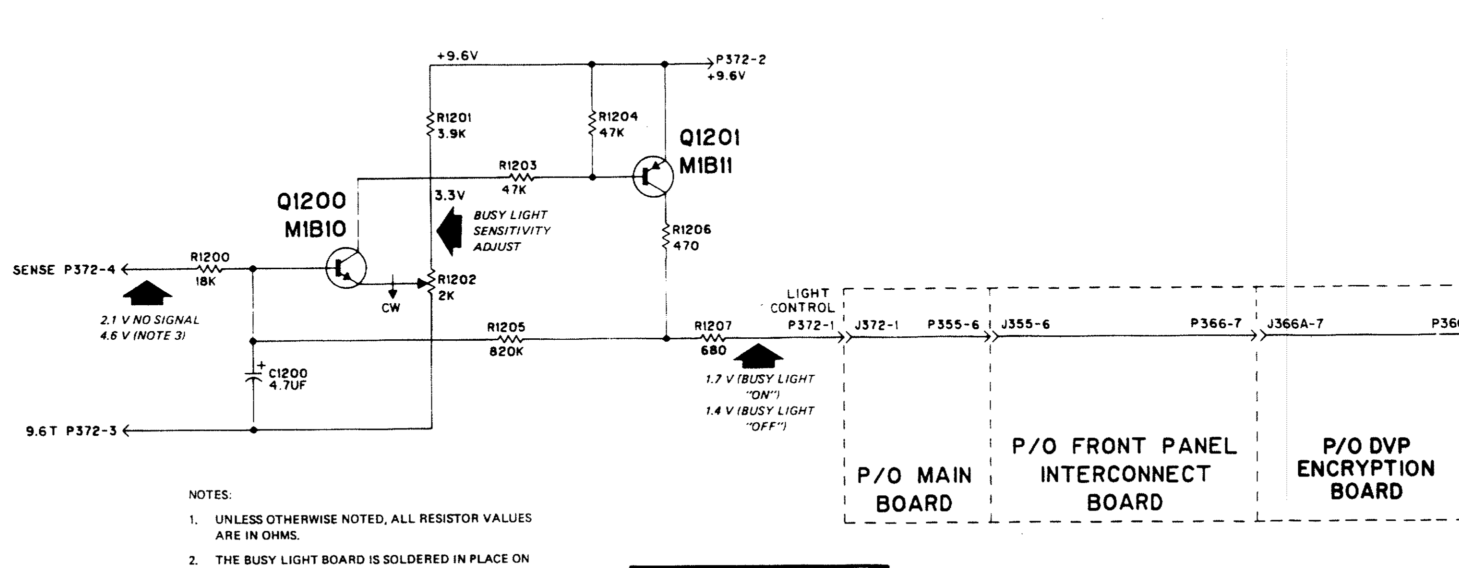
Provides extended frequency coverage by switching between two three-cell helical filters. The filters may be tuned independently within the operating frequency of the radio. Switching between the ranges is controlled by the Front End Select line from the synthesizer.

Output is at the receiver intermediate frequency (i-f).

Widespace Dual Front End Model Complement Chart

TLD2461B Dual Front-End (136-162 MHz)	
TRN4757B	Hardware and Coils (136-162 MHz)
TRN4760B	Housing
TRN5001A	Hardware
TLD2462B Dual Front End (146-174 MHz)	
TRN4759B	Hardware and Coils (146-174 MHz)
TRN4760B	Housing
TRN5001A	Hardware

BUSY LIGHT

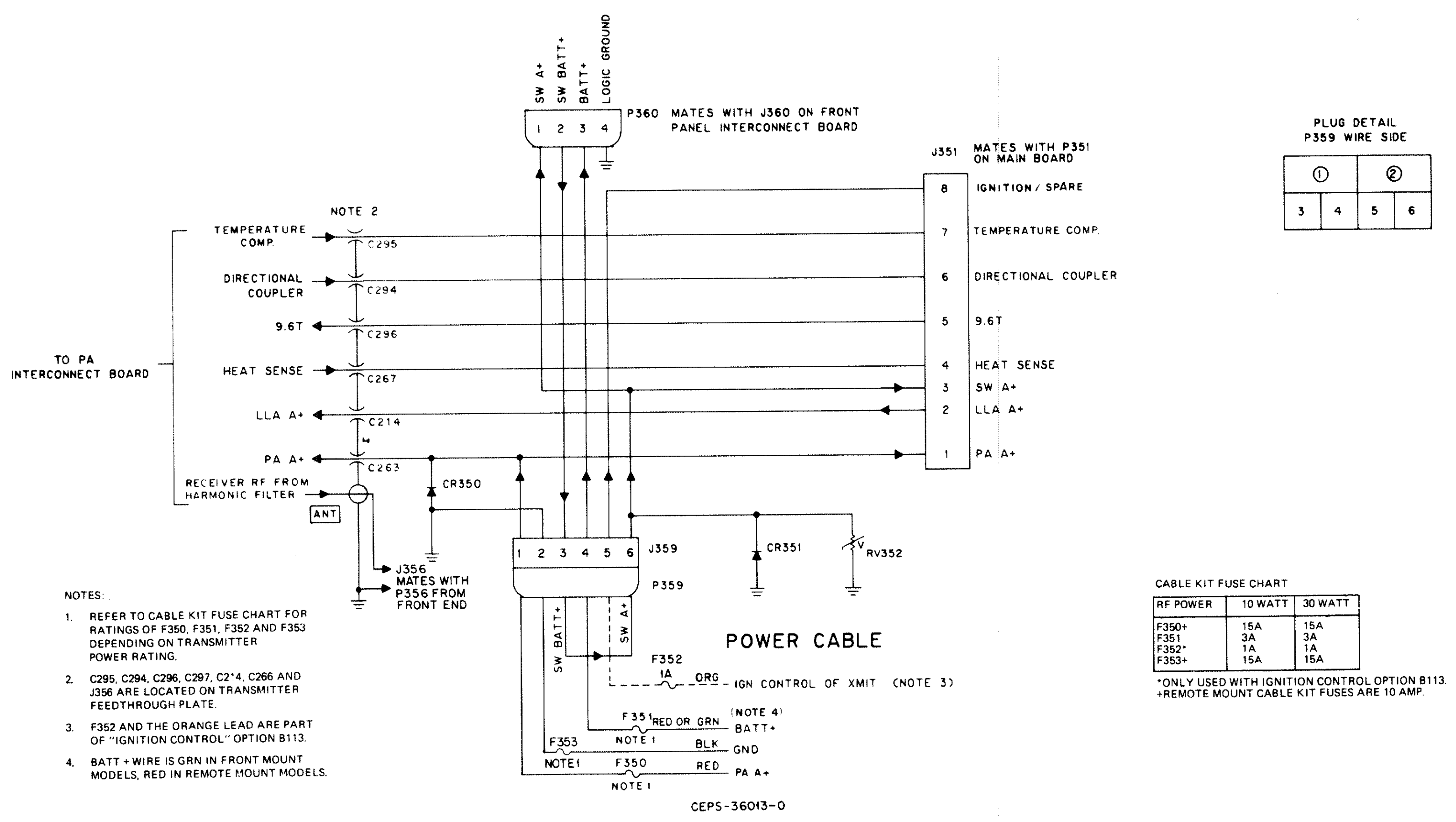


NOTES:

1. UNLESS OTHERWISE NOTED, ALL RESISTOR VALUES ARE IN OHMS.
2. THE BUSY LIGHT BOARD IS SOLDERED IN PLACE ON THE MAIN BOARD AT THE FOUR CONNECTION POINTS.
3. VOLTAGE MEASURED WITH -50 DBM ON-CHANNEL, UNMODULATED SIGNAL AT THE ANTENNA INPUT. VOLTAGES ARE TYPICAL.

LEGEND
➡ = MAINTENANCE DATA

POWER INTERCONNECT BOARD AND POWER CABLE



NOTES:

1. REFER TO CABLE KIT FUSE CHART FOR RATINGS OF F350, F351, F352 AND F353 DEPENDING ON TRANSMITTER POWER RATING.
2. C295, C294, C296, C267, C214, C266 AND C263 ARE LOCATED ON TRANSMITTER FEEDTHROUGH PLATE.
3. F352 AND THE ORANGE LEAD ARE PART OF "IGNITION CONTROL" OPTION B113.
4. BATT + WIRE IS GRN IN FRONT MOUNT MODELS, RED IN REMOTE MOUNT MODELS.

CABLE KIT FUSE CHART

RF POWER	10 WATT	30 WATT
F350•	15A	15A
F351	3A	3A
F352*	1A	1A
F353•	15A	15A

*ONLY USED WITH IGNITION CONTROL OPTION B113.
•REMOTE MOUNT CABLE KIT FUSES ARE 10 AMP.

parts list

VRN4000A Main Board, 25/30 kHz — PL-8364-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C1 thru 3	21-11021E25	.002
C4	21-11022G34	15 pF ± 5%
C5 thru 11	21-11021E25	.002
C12	21-11022G34	15 pF ± 5%
C13	21-11022G25	8 pF ± 0.5 pF
C14	21-11021E26	.005
C15	21-11021E25	.002
C16	21-82450B33	0.56 pF ± 5%; 500 V
C17	21-00020M26	150 pF ± 5%; 100 V
C18, 19	21-11021E25	.002
C21	21-11021E26	.005
C22	21-11021E25	.002
C23	21-11021E09	470 pF
C24, 25	21-82450B33	0.56 pF ± 5%; 500 V
C27, 28	21-11021E25	.002
C50, 51	23-11019A26	22 ± 20%; 16 V
C52		NOT USED
C53	21-11021E09	470 pF
C54	8-11023B09	.0047
C55	8-11023B03	.0015
C56	23-11019A09	1 ± 20%
C57, 58	23-11019A26	22 ± 20%; 16 V
C59	8-11023B17	.022
C60	23-11019A26	22 ± 20%; 16 V
C61, 62	21-11022M42	100 pF ± 5%
C63	23-83210A19	500 + 100-10%; 20 V
C64	8-11023B17	.022
C65	23-84613M02	22 ± 20%; 25 V
C66, 67	21-11022M42	100 pF ± 5%
C68	8-84637L22	0.22; 100 V
C69, 70	23-11019A26	22 ± 20%; 16 V
C225, 226	21-11022M42	100 pF ± 5%
C227	23-11019A26	22 ± 20%; 16 V
C228	8-11023B13	.01
C229	8-11023B23	.068
C230	8-11023B09	.0047
C300	23-11019A26	22 ± 20%
C301	21-11022M42	100 pF ± 5%
C302	21-11021E25	.002
C303	23-84613M02	22 ± 20%; 25 V
C304	8-11023B13	.01
C305	23-84613M03	47 ± 20%; 16 V
C306	21-11022M42	100 pF ± 5%
C307	23-84613M02	22 ± 20%; 25 V
C325	21-11022M42	100 pF ± 5%
C326	8-11023A11	.0068 ± 5%
C327	23-11019A09	1 ± 20%
C328	8-11023B01	.001
C329	8-11023B05	.0022
C330	21-11022G52	80 pF ± 5%
C331	23-11019A45	100 ± 20%; 16 V
C332	21-11022M42	100 pF ± 5%
C333	8-11023B18	.027
C334	21-11025A01	.01 ± 20%; 25 V
C335, 336	23-11019A26	22 ± 20%; 16 V
C2100	8-11023B21	.047
C2101	23-11019A09	1 ± 20%
C2102	8-11023B01	.001
C2103	8-11023B09	.0047
C2104, 2105	21-11022M42	100 pF ± 5%
C2106	23-11019A26	22 ± 20%; 16 V
C2107	8-11023B17	.022
C2108	23-11019A07	0.47
C2109	23-11019A09	1 ± 20%
C2110	8-11023B13	.01
		diode: (see note)
CR50, 51	48-84399M01	silicon
CR52, 53	48-83654H02	silicon
CR225 thru 229	48-84399M01	silicon
CR300	48-84399M01	silicon
CR301		NOT USED
CR302 thru 305	48-84399M01	silicon
CR325	48-84399M01	silicon
CR2102 thru 2106	48-84399M01	silicon
CR2107, 2108	48-83654H01	silicon
		connector, receptacle:
J350	1-80731D28	assembly, 14-contact
J380	28-84318M10	male; 4-contact
		coil, rf:
L1 thru 4	24-82723H35	choke; 23 uH
L5	24-84972A57	8-1/2 turns coded GRN
L6,7	24-82723H35	choke; 23 uH
L50	24-82190C15	choke; 1.2 uH
L325	24-82415N02	choke; 10 mH
		connector, plug:
P351	28-82647K03	male, 8-contact
P352	28-84318M01	male, 22-contact
P355	28-82502M04	male, 12-contact
		transistor: (see note)
Q1, 2	48-869839	field-effect, type M9839
Q50, 51, 52	48-02081B11	PNP; type M1B11
Q53	48-02081B10	NPN; type M1B10
Q54	48-869807	PNP; type M9807
Q55	48-02081B10	NPN; type M1B10
Q56	48-869806	NPN; type M9806
Q57	48-02081B11	PNP; type M1B11
Q58	48-02081B10	NPN; type M1B10
Q225	48-84411L10	PNP; type M1110
Q226	48-02081B10	NPN; type M1B10
Q227	48-02081B11	PNP; type M1B11
Q300	48-869807	PNP; type M9807
Q301	48-02081B10	NPN; type M1B10
Q302	48-869641	NPN; type M9641
Q303, 305 thru 308	48-02081B10	NPN; type M1B10
Q325	48-02081B11	PNP; type M1B11
Q326	48-02081B10	NPN; type M1B10
Q2100 thru 2103	48-02081B10	NPN; type M1B10
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11020A29	150
R2	6-11020A47	820
R3	6-11020A49	1k
R4	6-11020A29	150
R5	6-11020A35	270
R6,7	6-11020A47	820
R8	6-11020A43	560
R9	6-11020A35	270
R10	6-11020A85	33k
R11	6-11009C71	8.2k
R50	6-11020A65	4.7k
R51	6-11020A83	27k
R52	6-11020A75	12k
R53	6-11020A91	56k
R54	6-11020B02	150k
R55	6-11020B18	680k
R56	6-11020A71	8.2k
R57	6-11020B14	470k
R58, 59	6-11020A73	10k
R60	6-11020A43	560
R61, 62	6-11020A89	47k
R63	6-11020A87	39k
R64	6-11020A97	100k
R65	6-11020A81	22k
R66	6-11020A73	10k
R67	6-11020A61	3.3k
R68	6-11020A29	150
R69	6-11020A49	1k
R70, 71	6-11020A43	560
R72	6-11020A35	270
R73	6-11020A79	18k
R74	6-11020A29	150
R75	6-11020A91	56k
R76	6-11020A57	2.2k
R77	6-11020A65	4.7k
R78, 79	17-82036G59	0.18 ± 10%; 1 W
R225	6-11020A25	100
R226	6-11020A49	1k
R227	6-11020A25	100
R228	6-11020A65	4.7k
R229	6-11020A67	5.6k
R230	6-11020A61	3.3k
R231	6-11020A73	10k
R232	6-11020A47	820
R233	6-11020A59	2.7k
R234	6-11020A75	12k
R235	6-11020A71	8.2k
R236	18-84944C02	variable; 25k ± 20%
R237, 238	6-11020A77	15k
R239	6-11020A73	10k
R240	6-11020A85	33k
R241	6-11020A89	47k
R242	6-11020A63	3.9k
R243	6-11020A81	22k
R244	6-11020A75	12k
R245	18-84944C02	variable; 25k ± 20%
R246	6-11020A72	9.1k
R247	6-11020A57	2.2k
R300	6-11020A53	1.5k
R301	6-11020A37	330
R302	6-11020A45	680
R303	6-11020A75	12k
R304	6-11020A76	13k
R305	6-11020A51	1.2k
R306	6-11020A73	10k
R307	6-10621C87	9090 ± 1%
R308	6-10621C91	10.0k ± 1%
R309		NOT USED
R310	6-11020A27	120
R311	6-11020A43	560
R312	6-11020A89	47k
R314	6-11020A45	680
R315		NOT USED
R316	6-11020A65	4.7k
R317	6-11020A53	1.5k
R318	6-11020A77	15k
R319	6-11020A73	10k
R320, 321	6-11020A01	10
R325	6-11020A43	560
R326, 327	6-11020A73	10k
R328	6-11020A65	4.7k
R329	6-11020A86	36k
R330	6-11020B17	620k
R331	6-11020A65	4.7k
R332	6-11020A73	10k
R333	6-11020A73	10k
R334	6-11020A86	36k
R335	6-11020A98	110k
R336	6-11020A98	110k
R337	6-11020A57	2.2k
R338, 339	6-11020A97	100k
R340	6-11020A73	10k
R341	18-84944C03	variable, 10k ± 20%
R342	6-11020A59	2.7k
R343	6-11020A01	10
R344	18-84944C03	variable, 10k ± 20%
R345	6-11020A49	1k
R346	6-1102057	2.2k
R347	6-11020A25	100
R348	6-11020A73	10k
R349	6-11020A25	100
R2100, 2101	6-11009C57	2.2k
R2102	6-11009C85	33k
R2103	18-84944C01	variable, 2k ± 20%
R2104	6-11020A57	2.2k
R2105	6-11009C53	1.5k
R2106		NOT USED
R2107, 2108	6-11020A53	1.5k
R2109	6-11020A85	33k
R2110	6-11020A85	33k
R2111	6-11020A85	33k
R2112	6-11020A81	22k
R2113	6-11020A29	150
R2114	6-11020A55	1.8k
R2115	6-11020A85	33k
R2116	6-11020B02	150k
R2117	6-11020A73	10k
R2118	6-11020A55	1.8k
R2119	6-11020A47	820
R2120	6-11020A89	47k
R2121	6-11020A65	4.7k
R2122	6-11020A79	18k
R2123	6-11020A76	13k
R2124	6-11020A73	10k
R2125	6-11020A53	1.5k
		thermistor:
RT2106	6-82557J06	16k @ 25°C
		integrated circuit (see note)
U1	51-83629M47	wideband amplifier
U2	51-84561L84	limiter/detector
U50	51-82609M33	dual operational amplifier
U300, 325	51-82609M33	dual operational amplifier
U2100	51-83629M06	quad operational amplifier
		voltage regulator: (see note)
VR54	48-82256C15	Zener type; 5.1 V
VR225	48-82256C33	Zener type; 2.6 V
VR301	48-83461E40	Zener type; 5.1 v ± 1%
VR353	48-82256C11	Zener type; 10 V
VR354	48-82256C20	Zener type; 27 V
VR355	48-82256C11	Zener type; 10 V
VR2100, 2101	48-82256C33	Zener type; 2.6 V
		crystal: (see note)
Y1A, B	48-05535C05	filter matched pair: BLK-ORG
Y2A, B	48-05535C07	filter matched pair: BLU-VIO
		mechanical parts
	3-84208M03	SCREW, tapping: M2.5 x 0.45 x 6.0; 4 used
	3-84208M01	SCREW, tapping: M3 x 0.5 x 8.0; 2 used
	4-490124	WASHER, flat, 0.092 x .250"; 2 used
	4-84152B01	WASHER, shoulder, nylon; 4 used
	14-05160A01	INSULATOR,crystal; 4 used
	14-84123M01	INSULATOR, shield (for 26-84132M01)
	14-84124M01	INSULATOR, shield; 2 used (for 26-82437N01, and 2)
	14-84391F01	INSULATOR, transistor; 4 used
	1-80737D85	SHIELD, detector input with spring
	1-80737D84	SHIELD, first buffer (Q1) with spring
	1-80737D83	SHIELD, second buffer (Q2) with spring
	26-82437N01	SHIELD, solder side (Y1)
	26-82437N02	SHIELD, solder side (Y2)
	26-84130M01	SHIELD, coil (L5)
	26-84132M01	SHIELD, detector solder side
	26-84104M01	HEAT SINK, main board audio/regulator
	39-10184A10	CONTACT, pin (bubble); 3 used
	43-84136M01	SPACER, standoff; 3 used
	46-84135M01	GUIDE, circuit board

TKN8158B Power Cable (Front Mount CUA and EXA Models) — PL-7165-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F350	65-4165	15A
F351	65-20404	3A; 250 V
F353	65-4165	15A
		mechanical parts
P359	15-84192M01	HOUSING, connector; 6-contact
	14-82883A01	INSULATOR, fuseholer; 3 used
	42-82884A01	CLIP, fuseholder; 3 used
	1-80733D11	ASSEMBLY, black wire and terminal; includes:
	9-84151B03	TERMINAL, female (small); 2 used
	1-80733D12	ASSEMBLY, red wire and terminal (short) includes:
	42-82884A01	CLIP, fuse holder
	29-82607B03	LUG, ring
	14-82882A01	BODY, fuse holder
	41-82885A01	SPRING, fuse holder
	1-80733D13	ASSEMBLY, red wire and terminal (long) includes:
	29-84151L05	TERMINAL, female (large)
	1-80733D14	ASSEMBLY, green wire and terminal (short) includes:
	42-82884A01	CLIP, fuse holder
	29-865065	LUG, ring
	14-82882A01	BODY, fuse holder
	41-82885A01	SPRING, fuse holder
	1-80733D15	ASSEMBLY, green wire and terminal (long) includes:
	9-84151B03	TERMINAL, female (small)
	1-80733D16	ASSEMBLY, black wire and terminal (short) includes:
	42-82884A01	CLIP, fuse holder
	29-82607B03	LUG, ring
	14-82882A01	BODY, fuse holder
	41-82885A01	SPRING, fuse holder
	1-80733D17	ASSEMBLY, black wire and terminal (long) includes:
	29-84151L05	TERMINAL, female (large)

TRN4602A Transmitter Feedthrough Plate — PL-7166-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C214, 263, 267, 294, 295, 296	21-84874K01	470 pF ± 20%; 250 V; feed-thru
		connector, receptacle:
J356	9-83663C01	female; single contact
		mechanical parts
	3-84208M01	SCREW, machine: M3 x 0.5 x 8; feed-thru
	4-84207E02	SOLDER RING
	29-84322M01	TERMINAL, pin; feed-thru, 6 used
	64-84212M01	PLATE, feed-thru

TRN4604A Busy Light Board — PL-7170-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1200	23-84665F21	4.7 uF ± 10%; 50 V
		light emitting diode:
DS835	48-84404E10	orange
		connector, pin:
P372	28-84318M04	male; single contact; 4 used
		transistor: (see note)
Q1200	48-02081B10	NPN; type M1B10
Q1201	48-02081B11	PNP; type M1B11
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1200	6-11020A79	18k
R1201	6-11020A63	3.9k
R1202	18-84944C01	variable; 2k
R1203, 1204	6-11020A89	47k
R1205	6-11020B20	820k
R1206	6-11020A41	470
R1207	6-11020A45	680
		mechanical part
	43-84137M02	SPACER, LED

TKN8160A Ignition Control PTT (Front Mount CUA and EXA Models) — PL-7216-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F352	65-52281	1A
		transistor: (see note)
Q304	48-02081B10	NPN; type M1B10
		resistor, fixed:
R313	6-11020A73	10k ± 5%; 1/4 W
		mechanical parts
	1-80733D18	ASSEMBLY, orange wire and clip includes:
	42-82884A01	CLIP, fuse holder
	1-80733D19	ASSEMBLY, orange wire and terminal; includes:
	9-84151B03	TERMINAL
	14-82882A01	BODY, fuse holder
	14-82883A01	CAP, fuse holder
	41-82885A01	SPRING, fuse holder
	42-82884A01	CLIP, fuse holder
	42-10217A02	STRAP, cable harness

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN5365A Power Interconnect Board — PL-7167-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode: (see note)
CR350	48-82525G13	silicon
CR351	48-82525G19	silicon
RV352	6-84357M01	varistor, metal oxide
		connector, receptacle:
J351	9-83497F10	female; 8-contact
J359	—	includes: (see note 2)
	29-3053	LUG, solder; 2 used
	29-84134M01	TERMINAL, short; 4 used

notes:

1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.
2. For parts not listed in the above parts list refer to the radio set mechanical parts list section.

MAIN BOARD AND POWER INTERCONNECT BOARD

POWER CABLES
BUSY LIGHT

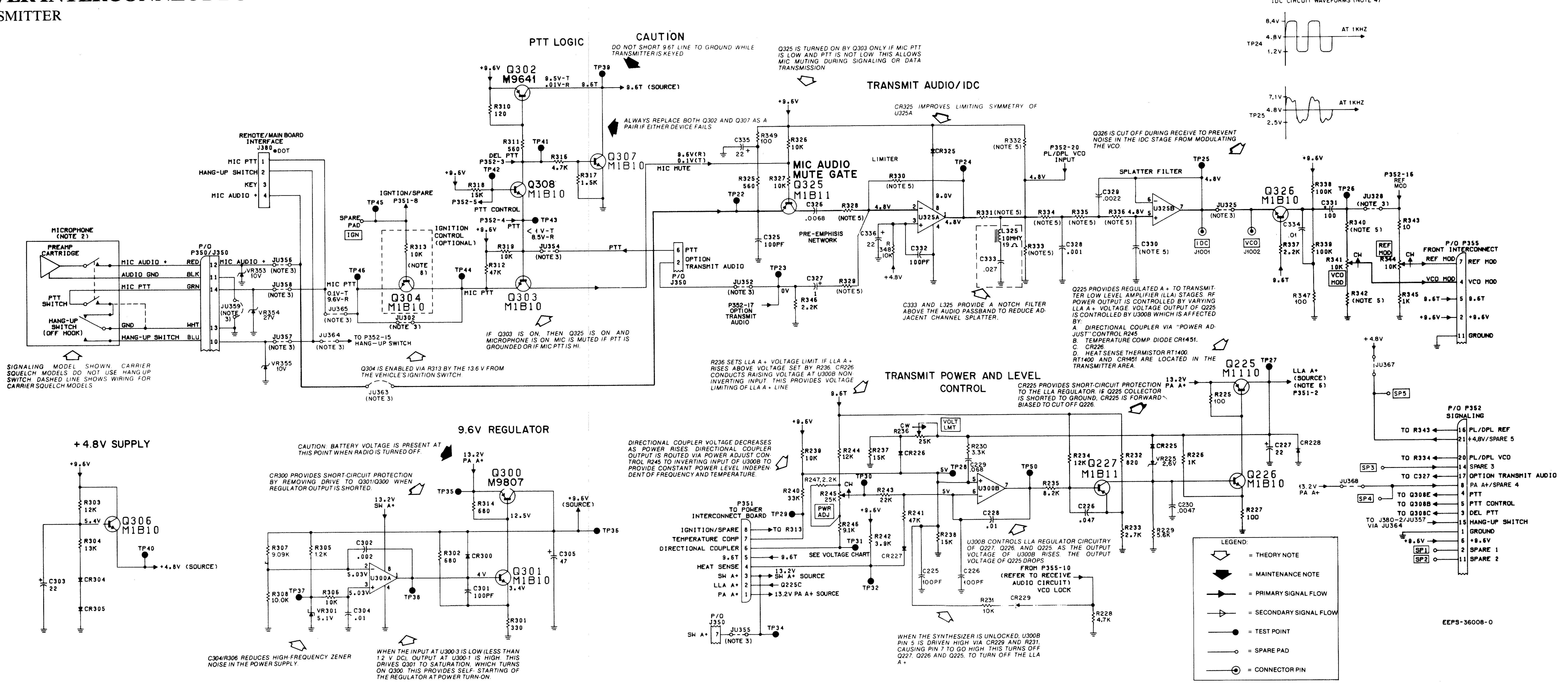
FUNCTION

The main board contains receiver circuitry, transmitter audio and power control circuitry, and voltage regulation for transmitter and receiver circuits. The power interconnect board provides power distribution for the radio set and feedthrough interconnect from the main to the power amplifier circuitry.

MAIN BOARD AND POWER INTERCONNECT BOARD

TRANSMITTER

TRANSMITTER



NOTES:

1. Unless otherwise noted, resistor values are in ohms, capacitor values in microfarads, inductor values are in microhenries.
2. Refer to Microphone instruction section for preamplifier information.
3. Refer to Jumper Table.
4. Measured with 800 millivolts rms, 1 kHz input to "MIC AUDIO +" input (J350-12) with "MIC PTT" (J350-14) grounded.
5. Refer to Parts List for component values.
6. LLA refers to low level rf amplifier stage.
7. Voltage notations:
   (T) = Transmitter Keyed
   (R) = Receive (Transmitter Unkeyed)
8. R313 and Q304 are part of "Ignition Control" Option B113.

Transmitter Jumper Table

Jumper	Function	Location
JU302	Cut For Ignition PTT Control Option B113	Q304
JU325	Always Out	U325B-7
JU328	Install For Special Applications Only	R340
JU352	Cut For Alternate Use of J350-2	J350-2
JU354	Cut For Alternate Use of J350-6	J350-6
JU355	Cut For Alternate Use of J350-7	J350-7
JU356	Cut For Alternate Use of J350-12	J350-12
JU357	Cut For Alternate Use of J350-10	J350-10
JU358	Cut For Alternate Use of J350-14	J350-14
JU359	Cut For Alternate Use of J350-11	J350-11
JU363	Cut For Alternate Use of J350-12 And J380-4 (MIC AUDIO +)	Q325-E
JU364	Cut For Alternate Use of J350-10 And J380-2 (Hang-Up Switch)	P352-15
JU365	Cut For Alternate Use of J350-14 And J380-1 (MIC PTT)	Q304-E
JU367	Cut For Alternate Use of P352-21	P352-21
JU368	Always In	P352-8

Component Designation Chart

Transmit Audio/IDC	325-349
9.6 V Regulator, 4.8 V Regulator and PTT Logic	300-324
Transmit Power & Level Control	225-249 and U300B

Integrated Circuit Chart

Reference Number	Type Number	V+ Pin	V− Pin	Description
U300, U325	0I9M33	8	4	Dual Op Amp

TP31 Voltage Chart

Output Power	TP31 Voltage
0 Watts	2.0 V
10 Watts	1.6 V
30 Watts	1.3 V

parts list

TKN8173B Power Cable Remote Mount (CUA and EXA Models) PL-7464-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F350	65-10266	10A; 32 V
F351	65-20404	3A; 250 V
F353	65-10266	10A; 32 V
		mechanical parts
P359	15-84192M01	HOUSING, connector; 6-contact
	14-82883A01	INSULATOR, fuseholder; 3 used
	42-82884A01	CLIP, fuseholder; 3 used
	1-80733D11	ASSEMBLY, black wire and terminal, includes:
	9-84151B03	TERMINAL, female (small); 2 used
	1-80734D03	ASSEMBLY, red wire (short remote) includes:
	14-82882A01	BODY, fuseholder
	29-832116	LUG, ring tongue (3/8" stud)
	41-82885A01	SPRING, fuseholder
	42-82884A01	CLIP, fuseholder
	1-80734D04	ASSEMBLY, red wire #18 (short remote) includes:
	14-82882A01	BODY, fuseholder
	29-865065	LUG, ring tongue (3/8" stud)
	41-82885A01	SPRING, fuseholder
	42-82884A01	CLIP, fuseholder
	1-80734D05	ASSEMBLY, black wire (short remote) includes:
	14-82882A01	BODY, fuseholder
	29-832116	LUG, ring tongue (3/8" stud)
	41-82884A01	CLIP, fuseholder
	41-82885A01	SPRING, fuseholder
	1-80734D06	ASSEMBLY, red wire (long remote) includes:
	29-84151L05	TERMINAL, female (large)
	1-80734D07	ASSEMBLY, red wire #18 (long remote) includes:
	9-84151B03	RECEPTACLE, female; single contact
	1-80734D08	ASSEMBLY, black wire (long remote) includes:
	29-84151L05	TERMINAL, female (large)
	14-82883A01	CAP, fuseholder; 3 used
	42-10217A02	STRAP, cable harness; 6 used
	42-10217A14	STRAP, tie; 0.140 x 5.50
	42-82884A01	CLIP, fuse; 3 used

TKN8197A Ignition Control PTT Remote (CUA and EXA Models) PL-7468-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F352	65-52281	1A
		transistor: (see note)
Q304	48-02081B10	NPN; type M1B10
		resistor:
R313	6-11020A73	10k ± 5%; 1/4 W
		mechanical parts
	1-80732D45	ASSEMBLY, org. wire and terminal (long) includes:
	9-84151B03	RECEPTACLE, contact; female
	1-80733D18	ASSEMBLY, org. wire and terminal (short) includes:
	42-82884A01	CLIP, fuseholder
	14-82882A01	BODY, fuseholder
	14-82883A01	CAP, fuseholder
	41-82885A01	SPRING, fuseholder
	42-10217A02	STRAP, cable harness
	42-82884A01	CLIP, fuseholder

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

MAIN BOARD AND POWER INTERCONNECT BOARD

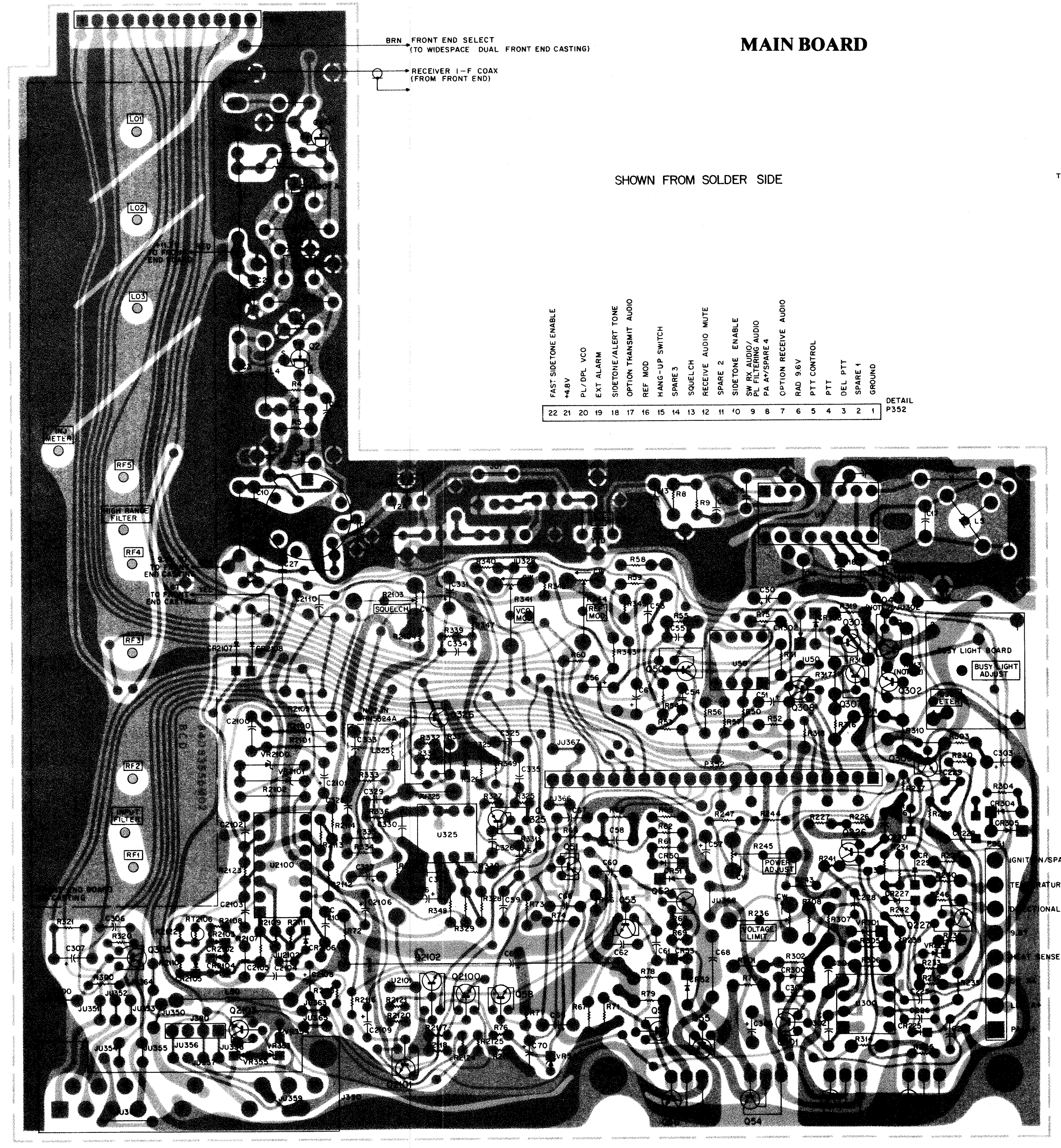
CIRCUIT BOARD DETAILS

MAIN BOARD

SHOWN FROM SOLDER SIDE

DETAIL P355

VOL CONT WIPER	1
+9.6V	2
SQUELCH SWITCH	3
VCO MOD	4
9.6T	5
BUSY LIGHT CONTROL	6
REF MOD	7
VOL CONT GROUND	8
VOL CONT HI	9
LOCK DET	10
GROUND	11
FRONT END SELECT	12



DETAIL P352

22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
FAST SIDETONE ENABLE	+4.8V	PL/DPL VCO	EXT ALARM	SIDETONE/ALERT TONE	OPTION TRANSMIT AUDIO	REF MOD	HANG-UP SWITCH	SPARE 3	SQUELCH	RECEIVE AUDIO MUTE	SPARE 2	SIDETONE ENABLE	SW RX AUDIO/ PL FILTERING AUDIO	PA A+/SPARE 4	OPTION RECEIVE AUDIO	RAD 9.6V	PTT CONTROL	PTT	DEL PTT	SPARE 1	GROUND

DETAIL J380

4	3	2	1
MIC AUDIO +	KEY	HANG-UP SWITCH	MIC PTT

DETAIL J350

OPTION RECEIVE AUDIO	1
OPTION TRANSMIT AUDIO	2
EXT ALARM	3
OPTION AUDIO GROUND	4
OPTION DC GROUND	5
PTT	6
SW A+	7
SPKR LO	8
SPKR HI	9
HANG UP SWITCH	10
AUDIO GROUND	11
MIC AUDIO +	12
GROUND	13
MIC PTT	14

TRANSISTOR DETAILS
(SHOWN FROM WIRE LEAD SIDE)

C B E
ALL PLASTIC ENCASED TRANSISTORS EXCEPT Q302, Q1, Q2

E B C
Q302

D S G
Q1, Q2

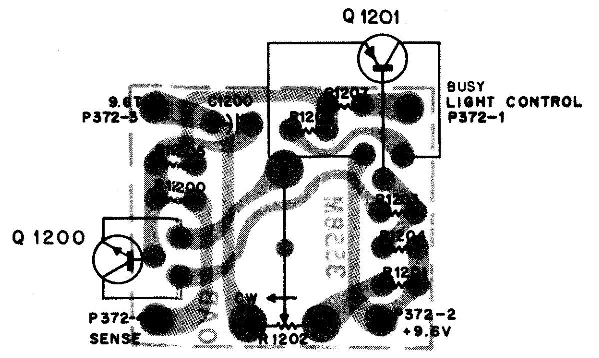
B C E
Q54, Q56, Q300, Q225

NOTES:

1. TEST POINTS AND SPARE PADS ARE IDENTIFIED ON CIRCUIT BOARD.
2. Q304 AND R313 ARE PART OF IGNITION CONTROL OPTION B113.
3. ALL JUMPERS EXCEPT JU328, JU368, AND JU2100 ARE PLATING CUT JUMPERS. TO REMOVE JUMPERS, CUT THE PLATING.
4. PIN "1" OF INTEGRATED CIRCUITS AND CONNECTORS AND "CATHODE" OF DIODES DESIGNATED BY SQUARE PADS.

SOLDER SIDE EEPS-34997-0
COMPONENT SIDE EEPS-34996-0
OL EEPS-36018-0

BUSY LIGHT BOARD

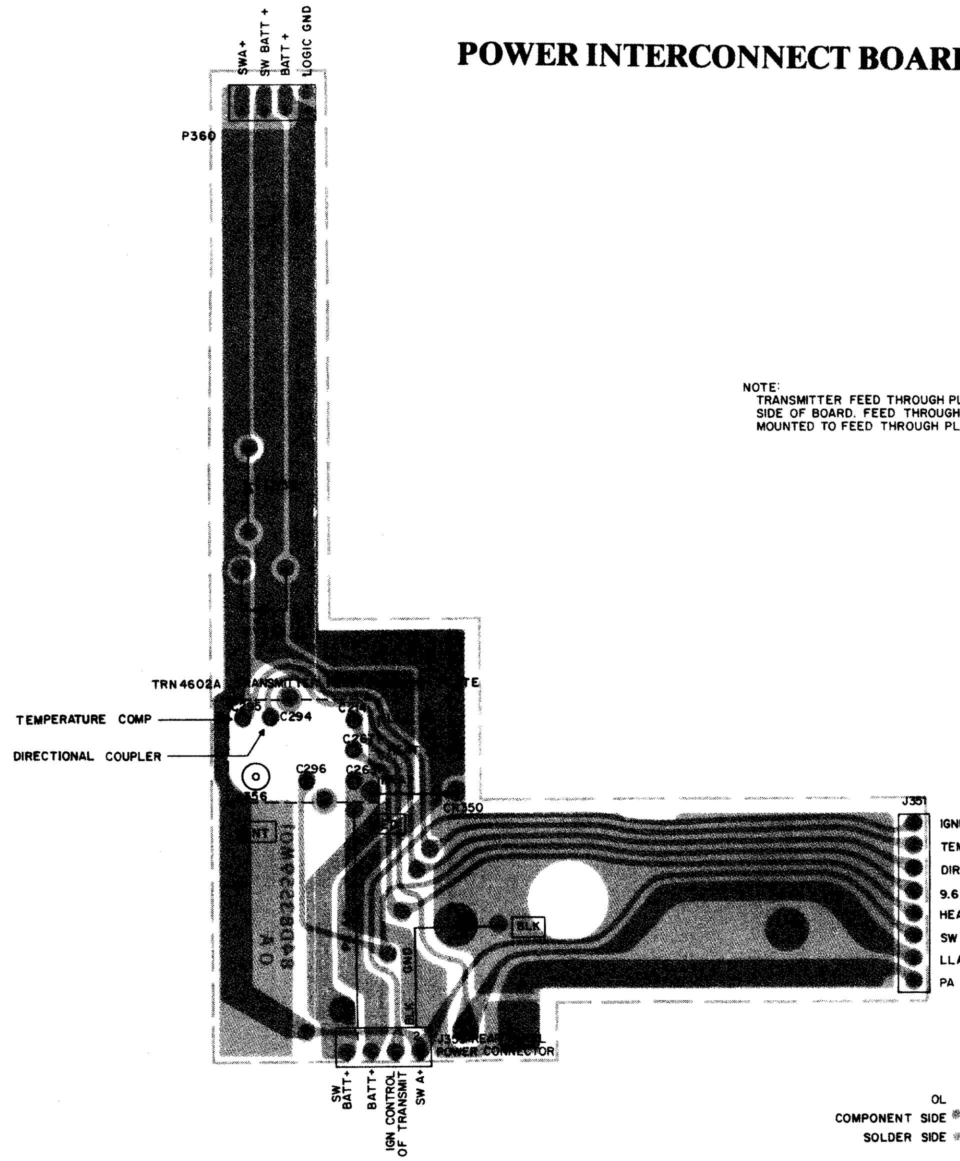


SHOWN FROM COMPONENT SIDE

SOLDER SIDE BEPS-30156-0
COMPONENT SIDE BEPS-30155-0
OL BEPS-30154-0

POWER INTERCONNECT BOARD

NOTE:
TRANSMITTER FEED THROUGH PLATE MOUNTED ON SOLDER SIDE OF BOARD. FEED THROUGH CAPACITORS AND J356 ARE MOUNTED TO FEED THROUGH PLATE.

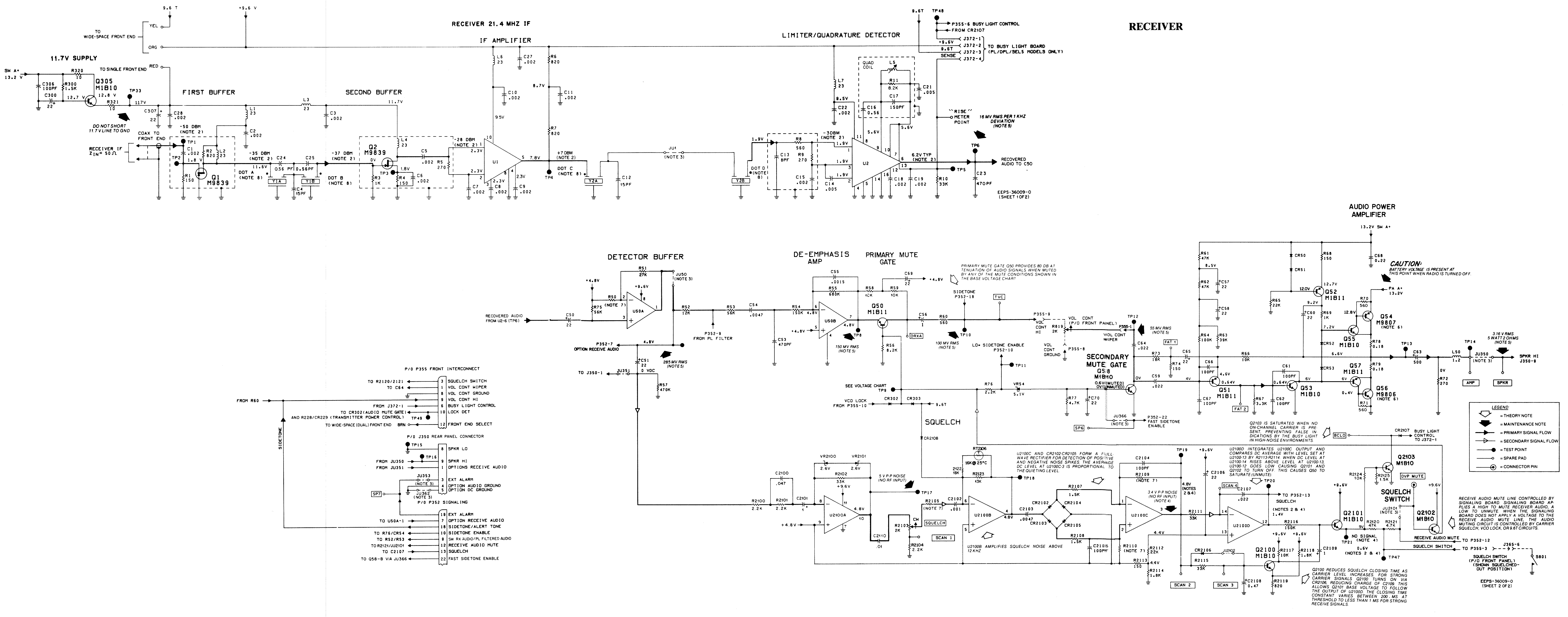


SHOWN FROM COMPONENT SIDE

OL DEPS-30138-A
COMPONENT SIDE DEPS-30139-0
SOLDER SIDE DEPS-30140-0

MAIN BOARD AND POWER INTERCONNECT BOARD

RECEIVER



NOTES:

1. Unless otherwise noted, resistor values are in ohms, capacitor values are in microfarads, inductor values are in microhenries.
2. Measured with -50 dBm 21.4 MHz unmodulated signal at i-f input or with an unmodulated on-channel signal at the antenna input at a level of -60 dBm (VHF radios without widespaced receive option) or -53 dBm (all UHF radios, or VHF radios with widespaced receive option).
3. Refer to Jumper Table.
4. Measured with squelch adjust control R2103 set for opening sensitivity of 10 dB quieting.
5. Measured with 1 mV on-channel signal at antenna input modulated with 1 kHz tone at 3 kHz deviation and volume control adjusted for 5 watt audio output.
6. Mounted on heat sink, must be insulated from ground.
7. Refer to parts list for component value.
8. Refer to Table 1 for crystal filter dot color coding.

Table 1. Crystal Filter Dot Color Coding

Kit No.	Channel Spacing	Dot Color A	Dot Color B	Dot Color C	Dot Color D
TRN5521A	25/30	BLK	ORG	BLU	VIO

Table 2. Receiver Jumper Table

Jumper	Function	Location
JU1	Always In	Y2
JU50	Cut For Special Applications Only	U50A
JU350	Cut For Special Applications Only	J350-9
JU351	Cut For Alternate Use of J350-1	J350-1
JU353	Cut For Alternate Use of J350-3	J350-3
JU362	Cut For Alternate Use of J350-5	J350-5
JU366	Cut For Alternate Use of P352-22	Q58-B
JU2101	Always Out	Q2102-B
JU2102	Always In	Q2100-B

Component Designations Chart

I-F	01-49
Receiver Audio	50-99
Squelch	2100-2149

TP9 Mute Voltage Chart

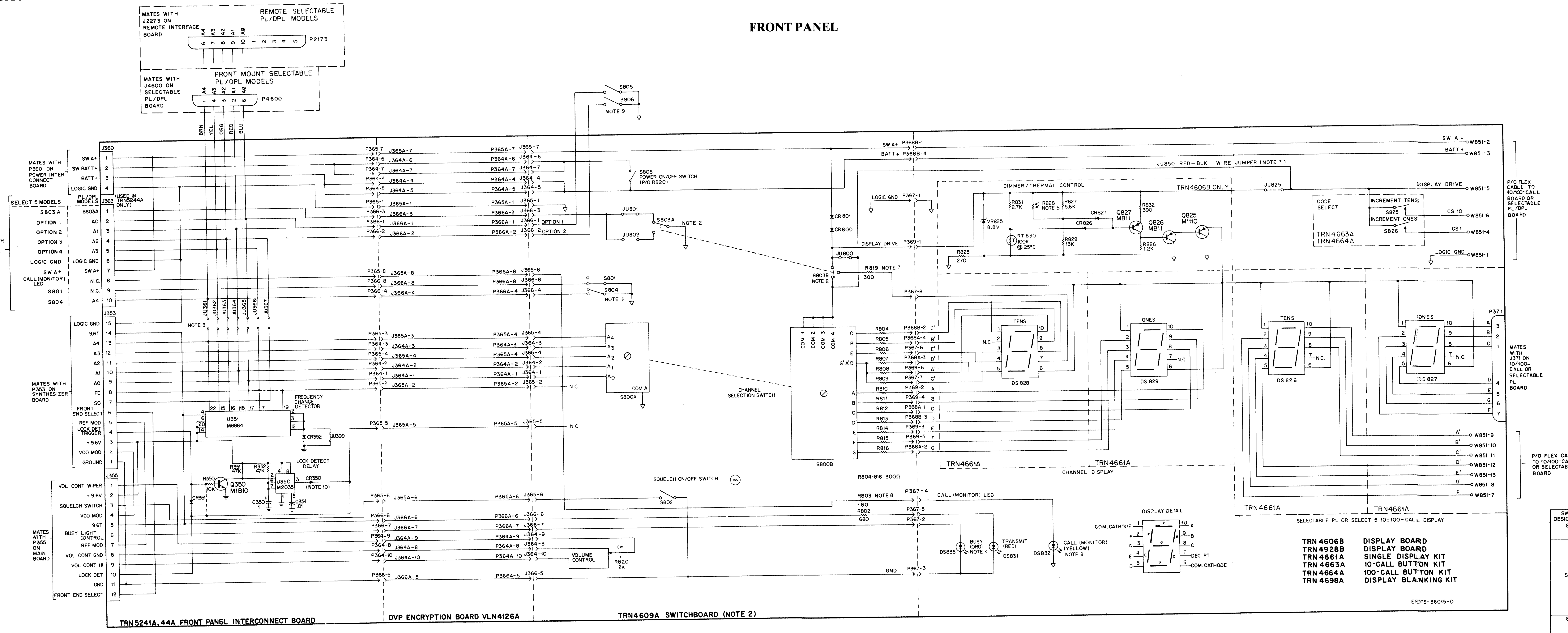
Condition	TP9 Volts DC
Unsquelched	4.2
Muted	9 V
Transmit	9
VCO Unlocked	9

MAIN BOARD AND POWER INTERCONNECT BOARD

FRONT PANEL BOARDS

SCHEMATIC DIAGRAM

FRONT PANEL



NOTES:

1. Resistor values given in ohms.
2. All pushbutton switches are shown in the "OUT" position. Function and position of switches designated S801, S803, and S804 change with option/model configuration. Refer to signaling switch chart.
3. Refer to jumper chart.
4. Busy light not used in carrier squelch or encode only models. DS835 is part of Busy Light Kit TRN4604A.
5. R828 value is greater than 200k when dark, nominal 30k at 1 footcandle.
6. DS826 and DS827 used in models with Select 5 signaling 100-call option or selectable PL/DPL squelch 30-code option. DS827 used in models with Select 5 signaling 10-call option or selectable PL/DPL squelch 10-code option.
7. For display blanking JU800 and JU825 are cut, and wire jumper JU850 is added between display board and switch board. Resistor R819 is added (p/o TRN4698A Display Blanking Kit).
8. Call light DS832 and resistor R803 are part of Select 5 and PL/DPL Scan Base option board kits. DS832 is referenced CALL for Select 5 and MONITOR for Scan Base.
9. S805 and S806 are mounted directly to front panel. Refer to thumbwheel switch manual section for kit and part numbers.
10. CR350 removed for use with FAST-LOK Synthesizer.

Jumper Chart

JU361	In for 17-32 channel, multi PL/DPL only
JU362	Cut for selectable PL/DPL squelch option
JU363	Cut for selectable PL/DPL squelch option
JU364	Cut for selectable PL/DPL squelch option
JU365	Cut for selectable PL/DPL squelch option
JU366	In for special applications
JU367	Cut for special applications
JU399	Cut for dash mount *Channel-Scan* radios
JU800	Cut for display blanking with TRN4698A Kit
JU825	Cut for display blanking with TRN4698A Kit
JU850	In for display blanking (p/o TRN4698A Kit)
JU801	In when S803 is latching switch
JU802	In when S803 is momentary contact switch

SIGNALING SWITCH CHART

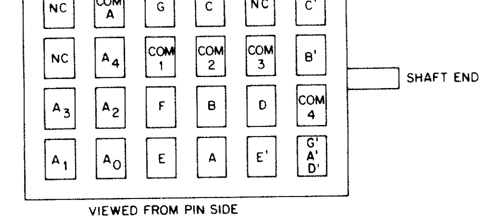
SWITCH DESIGNATION	SYMBOL	TYPE	BUTTON/SWITCH KIT	FUNCTION
S801		LATCHING	TRN4660A	SELECT 5 MONITOR
S803		LATCHING	TRN4660A	PL/DPL MONITOR
		LATCHING	TRN4656A	SECONDARY CALL/ EXTERNAL ALARM
		MOMENTARY	TRN4658A	SELECT 5 CALL
	(I)	MOMENTARY	TRN4657A	SINGLE TONE REPEATER
S804		MOMENTARY	TRN4658A	SELECT 5 CALL
	(GRAY)	MOMENTARY	TRN4659A	5-TONE REPEATER
S805	(I)	MOMENTARY	NOTE 9	SINGLE TONE REPEATER
S806	(II)	MOMENTARY	NOTE 9	2-SINGLE TONE REPEATER

SWITCH CONTACT TABLE

SWITCH POSITION	S800A SYNTHESIZER CODE A_0	A_1	A_2	A_3	A_4	S800B TENS DISPLAY G' A' D'	B'	C'	E'		ONES DISPLAY A	B	C	D	E	F	G
1		●	●	●	●							●	●				
2	●		●	●	●						●	●		●	●		●
3			●	●	●						●	●	●	●			●
4	●	●		●	●							●	●			●	●
5		●		●	●						●		●	●		●	●
6	●			●	●						●		●	●	●	●	●
7				●	●						●	●	●				
8	●	●	●		●						●	●	●	●	●	●	●
9		●	●		●						●	●	●	●		●	●
10	●		●		●		●	●			●	●	●	●	●	●	
11			●		●		●	●				●	●				
12	●	●			●		●	●			●	●		●	●		●
13		●			●		●	●			●	●	●	●			●
14	●				●		●	●				●	●			●	●
15					●		●	●			●		●	●		●	●
16	●	●	●	●			●	●			●		●	●	●	●	●
17		●	●	●			●	●			●	●	●				
18	●		●	●			●	●			●	●	●	●	●	●	●
19			●	●			●	●			●	●	●	●		●	●
20	●	●		●		●	●		●		●	●	●	●	●	●	
21		●		●		●	●		●			●	●				
22	●			●		●	●		●		●	●		●	●		●
23				●		●	●		●		●	●	●	●			●
24	●	●	●			●	●		●			●	●			●	●
25		●	●			●	●		●		●		●	●		●	●
26	●		●			●	●		●		●		●	●	●	●	●
27			●			●	●		●		●	●	●				
28	●	●				●	●		●		●	●	●	●	●	●	●
29		●				●	●		●		●	●	●	●		●	●
30	●					●	●	●			●	●	●	●	●	●	
31						●	●	●				●	●				
32	●	●	●	●	●	●	●	●			●	●		●	●		●

● DENOTES CONTACT CONNECTED TO COM LEAD(CLOSED).
SYNTHESIZER CODE PINS CONNECT TO COM A
DISPLAY PINS CONNECTED TO COM 1,2,3,4

SWITCH CONNECTION DETAIL

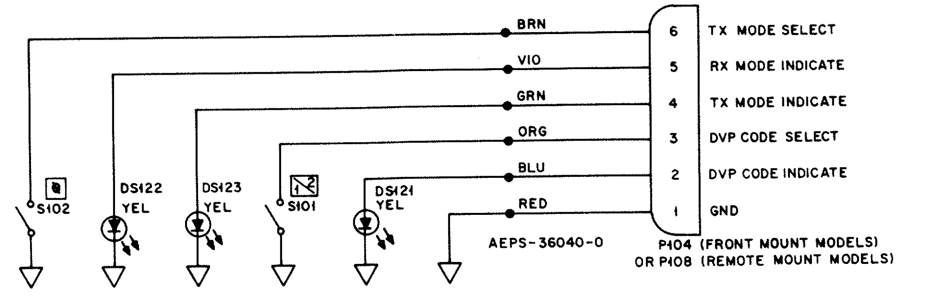


VIEWED FROM PIN SIDE

NOTE:
1. NC DENOTES NOT CONNECTED.

EEPS-36150-O

CONTROL BOARD



68P81064E18-O
(Sheet 1 of 2)
3/15/83- PHI

parts list

VLN4123A *DVP* Front Panel
VLN4124A Dual Code Front Panel — PL-8358-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		light emitting diode:
DS121	48-84404E14	yellow (VLN4124A only)
DS122, 123	48-84404E14	yellow
		connector:
P108	14-84277D29	housing, 6 contact
	9-84279D03	CONTACT; 6 used
		switch:
S101	40-84291N02	momentary; (code select - VLN4124A only)
S102	40-84291N02	momentary; (clear/coded)
		mechanical parts
	42-10217A02	STRAP, cable
	43-84962N01	SPACER, front panel
	61-82106N01	LENS, LED; 2 used
	61-84152M02	LENS, (photocell)
	61-82106N01	LENS, LED (VLN4124A only)
	64-84345N01	PANEL, front

VLN4147A Volume and Frequency Switch — PL-8354-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2-84218M01	NUT, volume switch
	2-84218M02	NUT, volume switch
	3-84208M03	SCREW, tapping M2.5 x 5 x 6
	3-84220M01	SCREW, set M3 x 0.5 x 6; 2 used
	4-84219M01	LOCKWASHER, #7 internal
	4-84219M02	LOCKWASHER, #9 internal
	36-84148M01	KNOB, off/volume
	36-84149M01	KNOB, select
	37-84215M01	BAND, channel select
	37-84215M02	BAND, volume knob
	46-84150M01	STOP, knob
	46-84150M02	STOP, knob

TRN4606B Display Board, 2-32F
TRN4928B Display Board, 2-32F w/Thumbwheel Switches — PL-7174-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode: (see note)
CR826, 827	48-84399M01	silicon
		light emitting diode:
DS831	48-84404E03	red (transmit indicator)
DS832	48-84404E05	yellow, (Select 5 & Channel Scan base models only)
		connector, receptacle:
J367	9-83880M02	female; 8-contact
J368A, 368B	9-83880M04	female; 4-contact
J369	9-83080M03	female; 6-contact
		transistor: (see note)
Q825	48-84411L10	PNP; type M1110
Q826, 827	48-02081B11	PNP; type MB11
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R825	6-11009C35	270
R826	6-11020A51	1.2k
R827	6-11020A67	5.6k
R828	6-84292M01	light dependent
R829	6-11009C76	13k
R831	6-11020A59	2.7k
R832	6-11020A39	390
		thermistor:
RT830	6-38600K05	100k @ 25°C
		voltage regulator:
VR825	48-82256C56	Zener type; 8.8 V
		mechanical parts
	43-84063M01	SPACER, wire (TRN4606B only)
	4-84345A15	WASHER, insulating
	43-84137M02	SPACER, LED

notes:
1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN4609A Front Mount Switch Board, 32 Channel — PL-8420-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode: (see note)
CR801, 802	48-82466H13	silicon
		connector, receptacle:
J364	9-83880M01	female; 10-contact
J365, 366	9-83880M02	female; 8-contact
		connector, plug:
P367	28-84528K15	male; 8-contact
P368A, 368B	28-84528K17	male; 4-contact
P369	28-84528K16	male; 6-contact
		resistor, fixed:
R802	6-11009C45	680 ± 5%; 1/4 W
R803	6-11009C31	180 ± 5%; 1/4 W (Select 5 & Channel Scan base models only)
R804, 805, 810 thru 816	6-11009C36	300 ± 5%; 1/4 W
R806 thru 809	6-11009C36	300 ± 5%; 1/4 W
R820	18-84075M01	variable; 2k ± 20%; .05 W; includes S808
		switch:
S800	40-82270M02	rotary; 32-position
S802	40-84330M02	spst, squelch

notes:

1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

2. For parts not listed in the above parts list refer to the radio set mechanical parts list section.

TRN4698A Display Blanking Kit — PL-7516-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		resistor, fixed:
R819	6-11020A36	300 ± 5%; 1/4 W
		jumper, wire:
JU850	30-10286B95	wire (3.25")

TRN5241A Front Panel Interconnect Board (Standard)
TRN5244A Front Panel Interconnect Board (Signaling) — PL-7809-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor:
C350	23-82397D36	1 uF ± 10%, 50 V
C351	21-11025A01	.01 uF ± 20%, 25 V
		diode: (see note)
CR350, 351	48-83654H01	silicon
CR352	48-82178A06	germanium
		connector, receptacle:
J353	1-80731D21	ASSEMBLY synthesizer connector includes:
	15-84164M01	HOUSING, socket
	30-84165M01	CABLE, 15 cond; flat with terminal
	39-84323M01	CONTACT, 15 used
J355	9-82846L03	female; 12-contact
J363	9-83880M01	female; 10-contact (TRN5244 only)
		connector, plug:
J360	28-83878M01	male; 4-contact
P364	28-84528K14	male; 10-contact
P365, 366	28-84528K15	male; 8-contact
		transistor: (see note)
Q350	48-2081B10	NPN; type M1B10
		resistor, fixed: ± 5%; 1/4 W:
R350	6-11009C73	10k
R351, 352	6-11009C89	47k
		integrated circuit: (see note)
U350	51-84561L23	type 61L23, timer
U351	51-84768F54	type 68F54, freq. change det.

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN4656A Secondary Call/External Alarm Switch w/Button
TRN4657A Single Tone Repeater Switch w/Button
TRN4658A *Select 5* Call Switch w/Button
TRN4659A 5-Tone Repeater Access Switch w/Button
TRN4660A Monitor Switch w/Button — PL-7200-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		switch:
S801 or 803	40-84330M02	dpdt, latching
S803, 804	40-84330M01	dpdt, momentary contact

note: Refer to exploded view details for button illustration and part numbers.

TRN4661A Single Display — PL-8421-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		light emitting diode:
DS828, 829	48-83477K04	7-segment

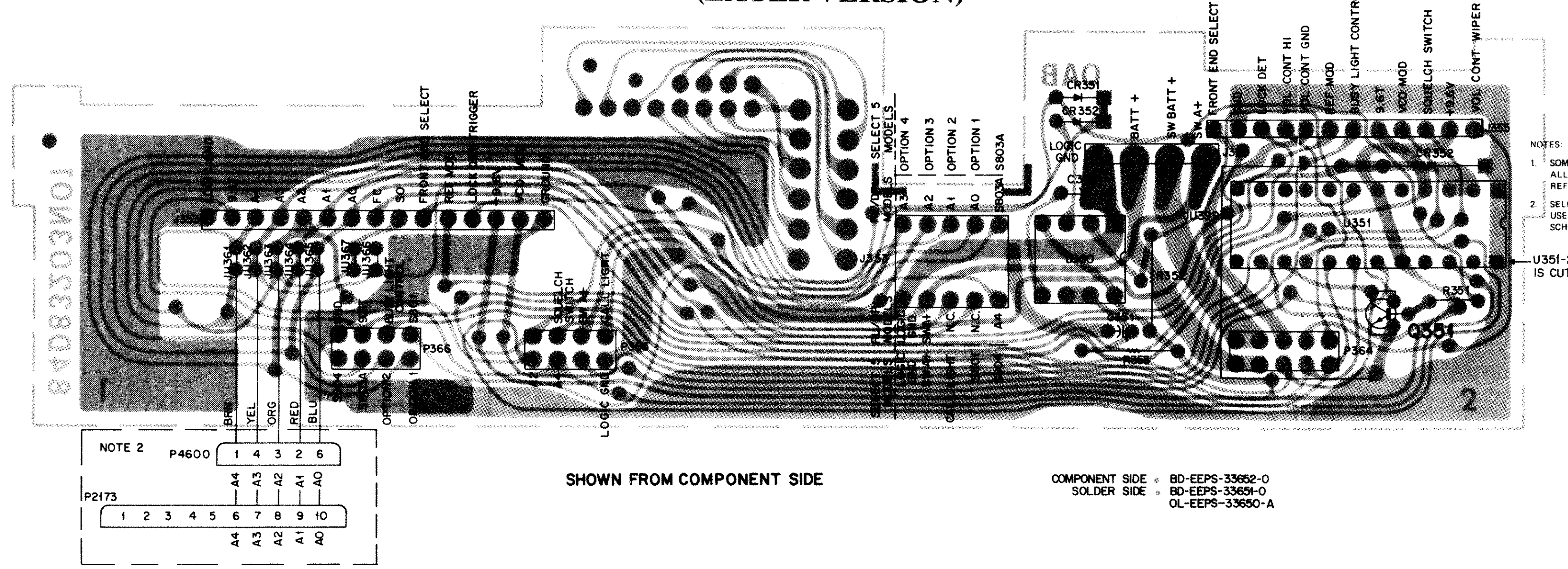
note: For parts not listed in the above parts list refer to the radio set mechanical parts list section.

TRN4663A 10-Call Button w/Switch
TRN4664A 100-Call Button w/Switch — PL-7515-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, plug:
P371	28-82502M03	male; 7-contact
		switch:
S805, 806	40-82473N01	dual spst; circuit board dome contact

note: Refer to *Select 5* signaling exploded view detail for mechanical parts.

TRN5241A/44A FRONT PANEL INTERCONNECT BOARD (LATER VERSION)



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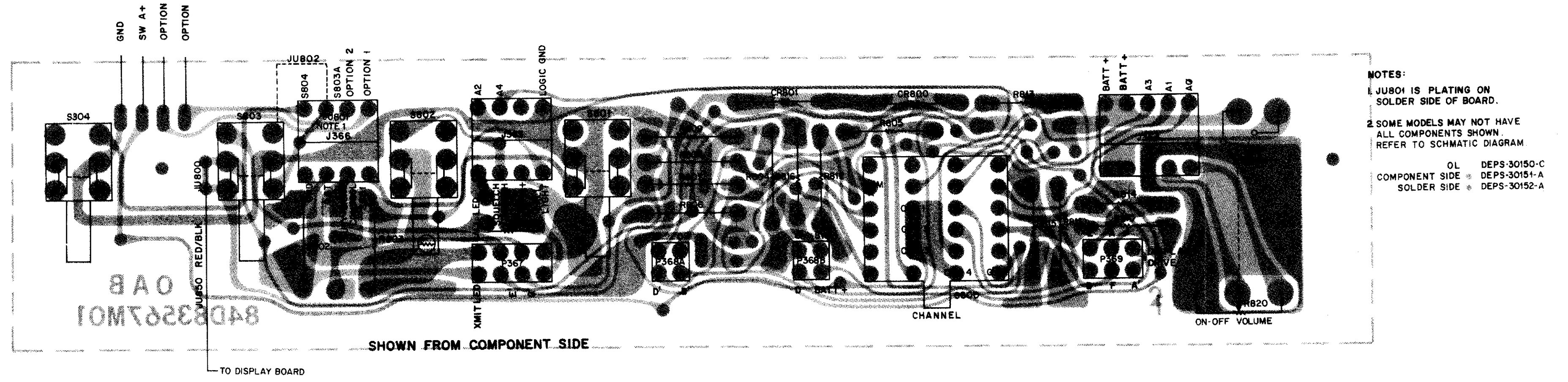
SWITCH BOARD



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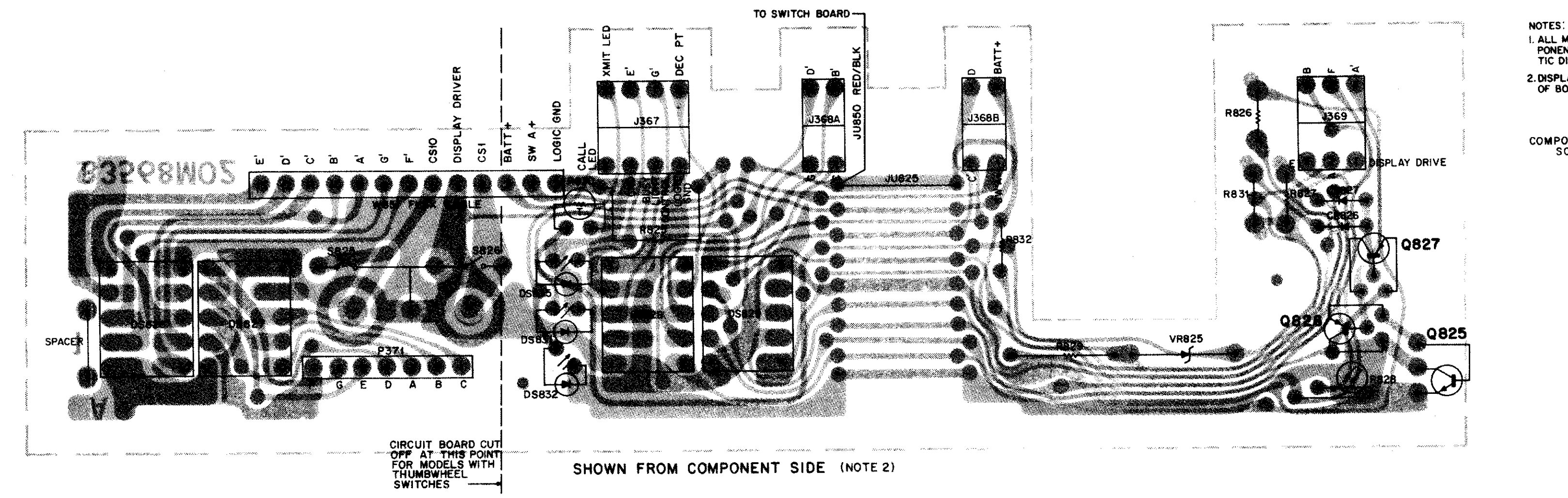
MULTI-CHANNEL DISPLAY BOARD



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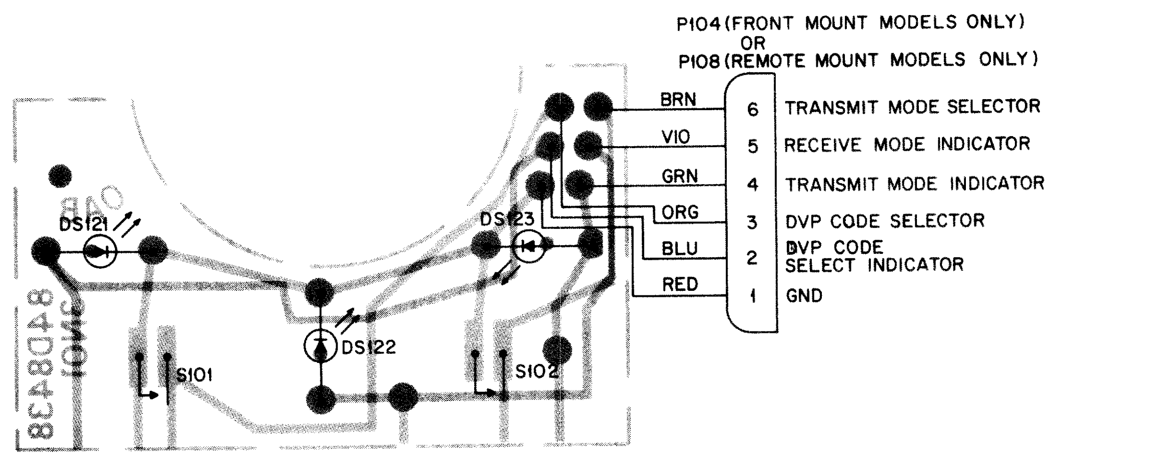
FRONT PANEL BOARDS

CIRCUIT BOARD DETAILS AND PARTS LISTS

FUNCTION

Provides channel selection and display, and all controls and indicators.

CONTROL BOARD



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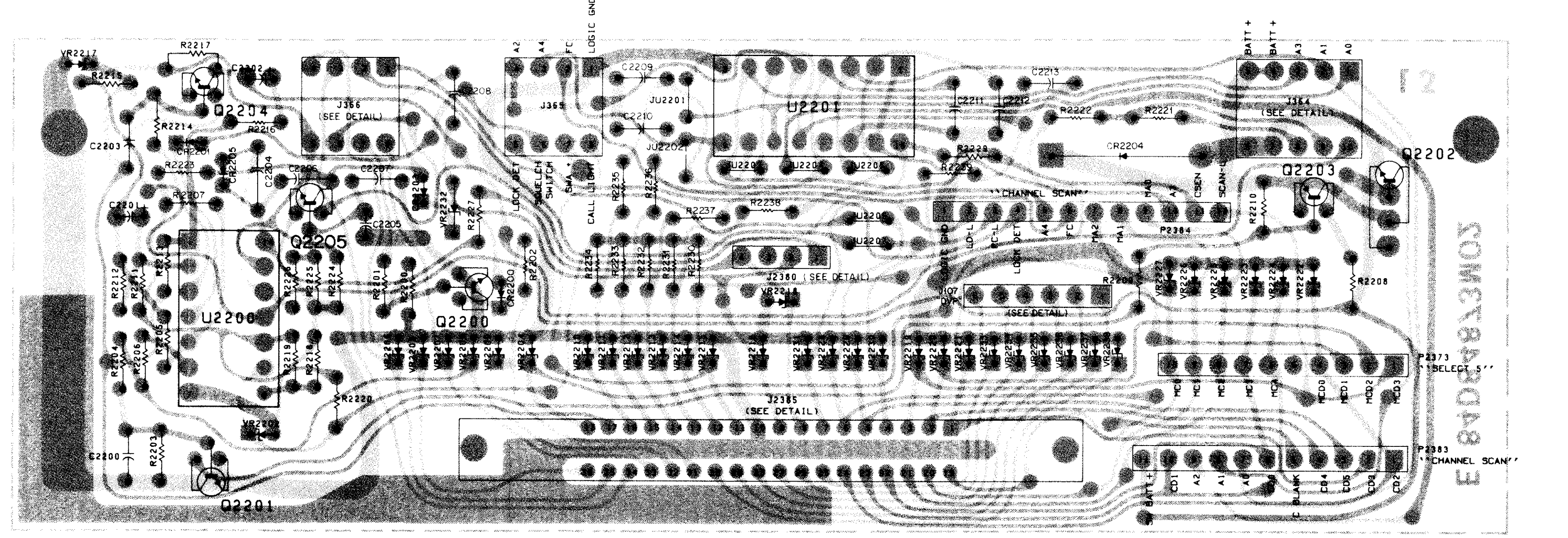
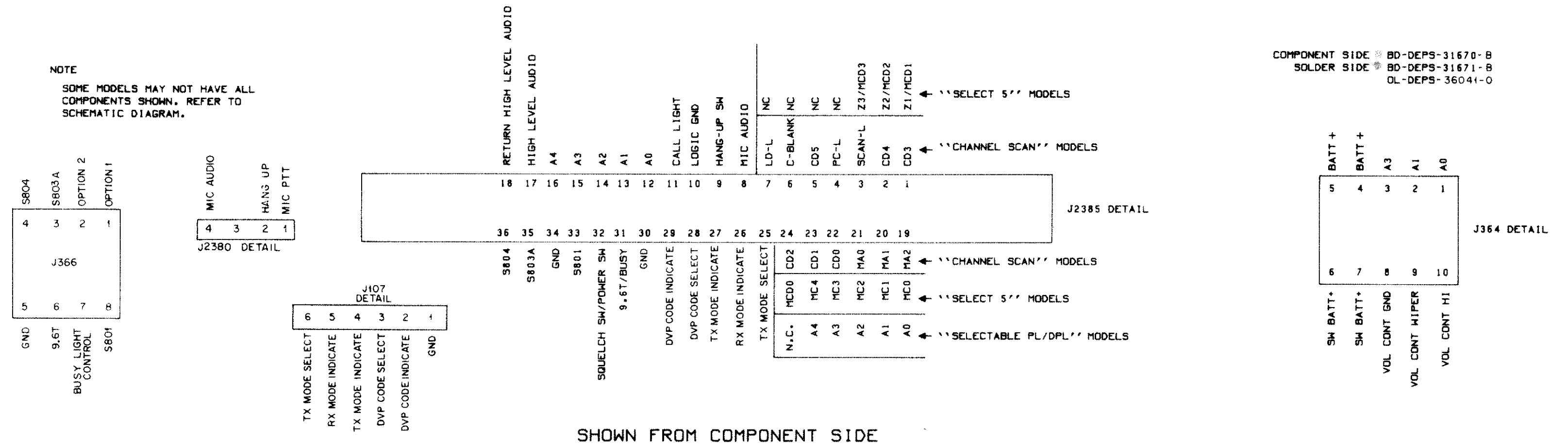
COMPONENT SIDE ● BD-BEPS-36019-0
SOLDER SIDE ● BD-BEPS-36020-0
OL-BEPS-36021-0

REMOTE FRONT PANEL BOARDS

CIRCUIT BOARD DETAILS
AND PARTS LISTS

REMOTE INTERFACE BOARD





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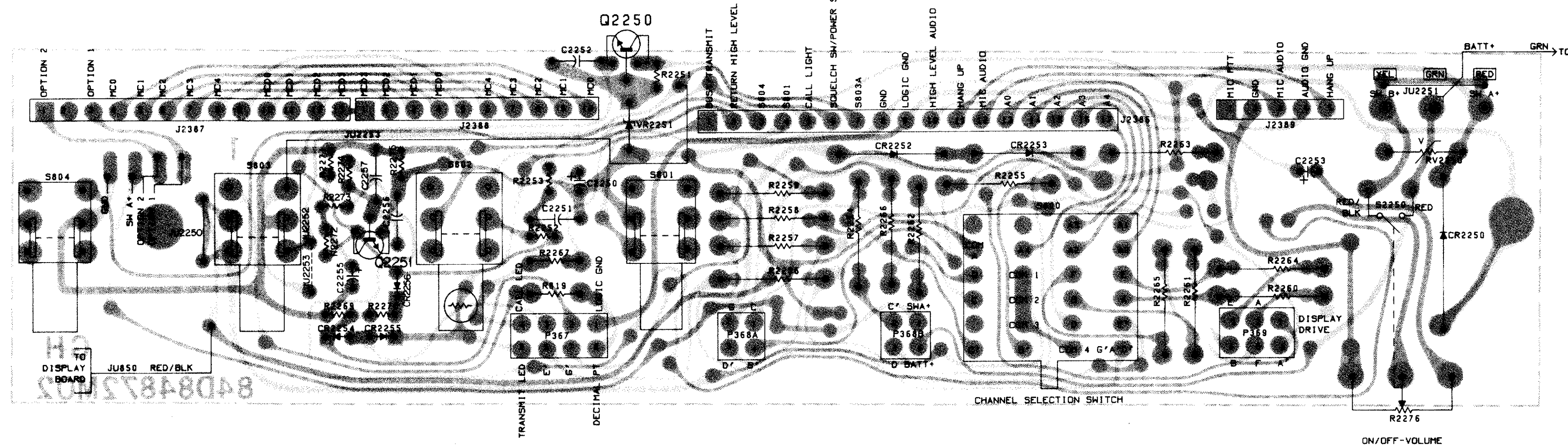
REMOTE SWITCH BOARD



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68P81064E19-O
(Sheet 1 of 4)
3/15/83-PHI

parts list

VKN4031A Remote Control Cable (8 ft.)
VKN4032A Remote Control Cable (17 ft.) — PL-8359-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, plug:
P106	14-84277D29	housing, 6 contact
	9-84279D03	CONTACT, receptacle; 6 used
P2385	28-82004N01	male, flat: 36 contact
	15-84994M01	PLUG, covers
P2386	9-84319M04	female, 17 contact
P2387	9-84319M05	female, 13 contact
		mechanical parts
	42-10217A02	STRAP, cable; 5 used
	42-84995M01	RETAINER, plug clip
	42-10217A14	STRAP, tie, .140 x 5.50 nylon (VKN4032A only)

TRN4767A Remote Switch Board, 32 Channel — PL-8422-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C2250	23-11037A27	22 uF ± 20%; 25 V
C2251	8-11017B08	.01 uF ± 10%; 50 V
C2252	21-11022M42	100 pF ± 5%; 50 V
C2253, 2254, 2255	23-11037A27	22 uF ± 20%; 25 V
C2256	21-11022M42	100 pF ± 5%; 50 V
C2257	21-11021E09	470 pF ± 10%; 50 V
		diode: (see note)
CR2250	48-82525G19	silicon
CR2252, 2253	48-82466H13	silicon
CR2254, 2255, 2256	48-84399M01	silicon
		connector, plug:
J2386	28-84318M13	male, 17-contact
J2387	28-84318M12	male, 13-contact
J2388	28-84318M03	male, 10-contact
J2389	28-84318M11	male, 5-contact
P367	28-84528K15	male, 8-contact
P368A, 368B	28-84528K17	male, 4-contact
P369	28-84528K16	male, 6-contact
		transistor: (see note)
Q2250	48-869648	NPN; type M9648
Q2251	48-02081B10	NPN; type M1B10
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R2251	6-11020A43	560
R2252	6-11020A49	1k
R2253	6-11020A73	10k
R2254, 2255	6-11009C36	300
R2256 thru 2259	6-11009C36	300
R2260 thru 2266	6-11009C36	300
R2267	6-11020A34	240
R2269, 2270	6-11020A37	330
R2271, 2272	6-11020A89	47k
R2273	6-11020A73	10k
R2274	6-11020A49	1k
R2275	6-11020A73	10k
R2276	18-84075M01	variable; 2k (includes switch S2250)
		varistor:
RV2250	6-84357M01	metal oxide
		switch:
S800	40-82270M02	32 position
S801	40-84330M02	latching
S2250	—	p/o R2276
		voltage regulator: (see note)
VR2251	48-82256C11	Zener type; 10 V
		mechanical part
	39-10184A10	PIN, bubble; 3 used

TKN8195A Cable Remote Multicall Interconnect — PL-7530-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
P2273, 2373	9-84319M02	female. 10-contact
		mechanical part
	42-10217A02	STRAP, cable harness WHT; 2 used

TKN8196A Cable, Remote *Channel Scan* Interconnect — PL-7541-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
P2283	9-84319M07	female; 11-contact
P2284	9-84319M08	female; 12-contact
P2383	9-84319M07	female; 11-contact
P2384	9-84319M08	female; 12-contact
		connector, plug
J2383	28-83186M04	male, right angle; 11-contact
J2384	28-83186M05	male, right angle; 12-contact
		non-referenced items
	1-80732D48	CABLE, remote *Channel Scan* interconnect 11-cond; includes ref. items: P2383, P2283, and
	42-10217A02	STRAP, cable harness WHT; 2 used
	1-80732D49	CABLE, remote *Channel Scan* interconnect 12-cond; includes ref. items P2384, P2284, and
	42-10217A02	STRAP, cable harness WHT; 2 used

VKN4030A Remote Interface Cable Kit — PL-8360-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
P104, 107	14-84277D29	housing, 6 contact
		mechanical parts
	9-84279D03	CONTACT, receptacle; 12 used
	42-10217A02	STRAP, cable

VLN4148A Remote Interconnect Board Kit — PL-8353-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, plug:
J106, 108	28-84528K48	male, 2 x 6 contact

TRN4763B Basic Remote Interface Board
TRN4764B Universal Remote Interface Board — PL-7462-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor:
C2200	21-11022M42	100 pF ± 5%; 50 V
C2201, 2202	23-11037A27	22 uF ± 20%; 25 V
C2203	21-11022M42	100 pF ± 5%; 50 V
C2204	8-11017B14	.047 uF 10%, 50 V
C2205	23-11037A27	22 uF ± 20%; 25 V
C2206-2208	21-11022M42	100 pF ± 5%; 50 V
C2209-2213	21-11025A01	.01 uF ± 20%; 25 V
		diode: (see note)
CR2200, 2201, 2203	48-84399M01	silicon
CR2204	48-82525G19	silicon
CR2205	48-84399M01	silicon
		connector, receptacle:
J364	9-83880M01	female; 10-contact
J365, 366	9-83880M02	female; 8-contact
J2273	28-84318M03	male; 10-contact (TRN4764B only)
J2283	28-84318M14	male; 11-contact (TRN4764B only)
J2284	28-84318M15	male; 12-contact (TRN4764B only)
J2380	28-84318M10	male; 4-contact
J2385	9-82003N01	female; 36-contact
		connector, plug:
P380, 2380	9-84319M06	female; 4-contact
		transistor: (see note)
Q2200, 2201	48-02081B10	NPN; type M1B10
Q2202	48-869806	NPN; type M9806
Q2203	48-02081B11	PNP; type M1B11
Q2204, 2205	48-02081B10	NPN; type M1B10
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R2200	6-11020A49	1k
R2201	6-11020A65	4.7k
R2202	6-11020A21	68
R2203	6-11020A65	4.7k
R2204	6-11020A73	10k
R2205	6-11020A75	12k
R2206	6-11020A73	10k
R2207	6-11020A61	3.3k
R2208	6-11020A45	680
R2209	6-11020A57	2.2k
R2210	6-11020A45	680
R2211, 2212	6-11020A73	10k
R2213	6-11020A75	12k
R2214	6-11020A49	1k
R2215	6-11020A43	560
R2216	6-11020A57	2.2k
R2217	6-11020A73	10k
R2218	6-11020A81	22k
R2219	6-11020A76	13k
R2220	6-11020A51	1.2k
R2221	6-11020A33	220
R2222	6-11020A51	1.2k
R2223	6-11020A61	3.3k
R2224	6-11020A83	27k
R2225	6-11020A45	680
R2226	6-11020A61	3.3k
R2227	6-11020A73	10k
R2229-2234	6-11020A89	47k (TRN4764B only)
R2235-2239	6-11020A25	100
		integrated circuit: (see note)
U2200	51-83629M06	type 29M06; quad op amp
U2201	51-83627M62	three-state buffer (TRN4764B only)
		voltage regulator: (see note)
VR2202	48-82256C15	Zener type; 5.1 V
VR2204-2218	48-82256C11	Zener type; 10 V
VR2219	48-82256C14	Zener type; 15 V (TRN4764B only)
VR2220-2231	48-82256C11	Zener type; 10 V (TRN4764B only)
VR2232	48-82256C26	Zener type; 3.3 V
		mechanical parts
	1-80732D47	ASSEMBLY INTERCONNECT CABLE; includes:
	42-10217A02	STRAP, cable harness; 3 used; includes reference items P380, P2380

TKN8175A Remote Control Head Power Cable (CUA and EXA Models) — PL-7466-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F351	65-52281	1A
		mechanical parts
	1-80733D14	ASSEMBLY, green wire and terminal (short) includes:
	14-82882A01	BODY, fuse holder
	29-865065	LUG, ring tongue (3/8" stud)
	41-82885A01	SPRING, fuse holder
	42-82884A01	CLIP, fuse holder
	1-80734D01	ASSEMBLY, green wire long remote; includes:
	29-82141N01	TERMINAL
	14-82883A01	CAP, fuse holder
	42-82884A01	CLIP, fuse holder

VLN4146A Remote Hardware Kit — PL-8362-O

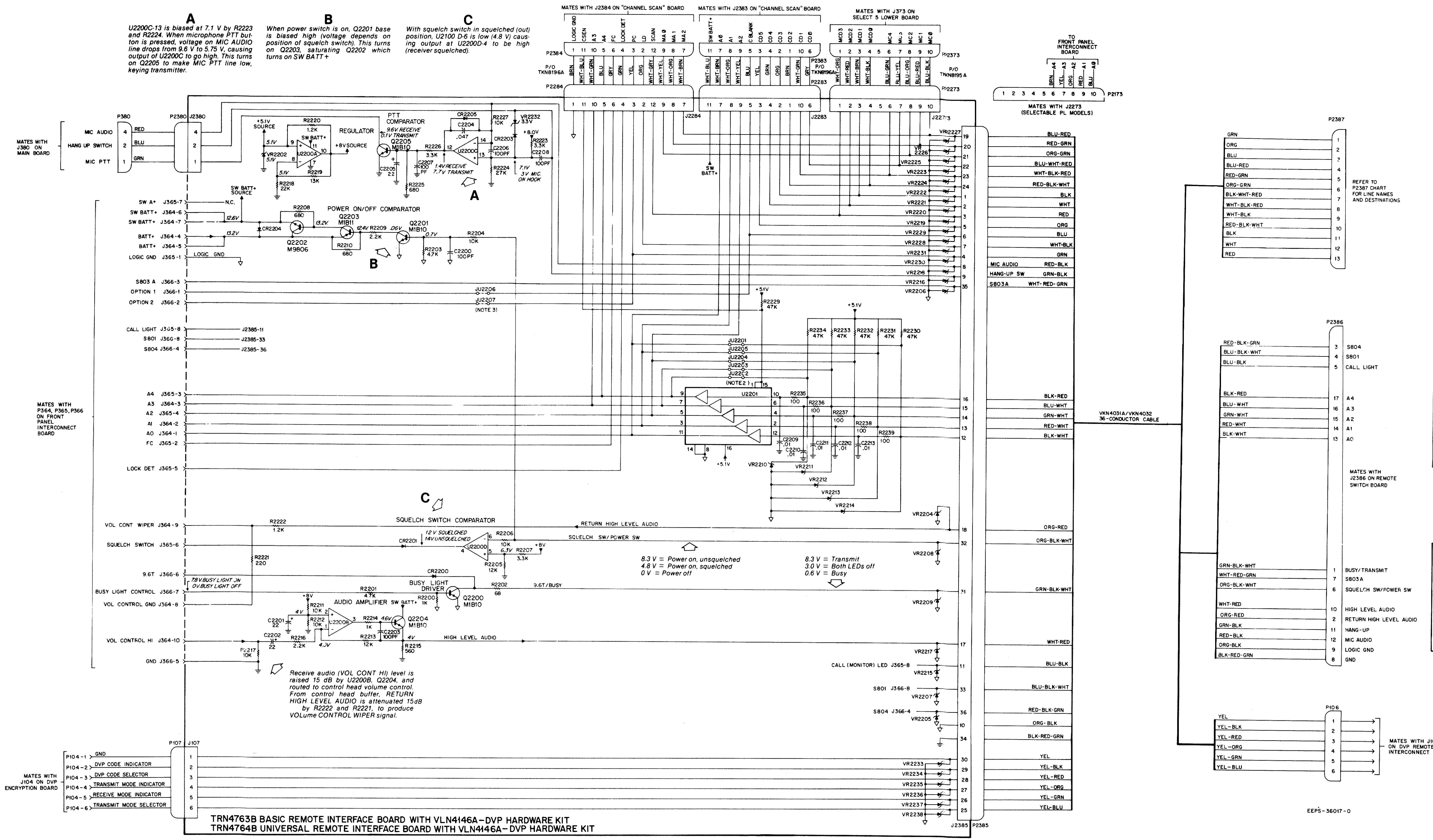
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
J107	28-84318M29	male; 6 contact
		voltage, regulator: (see note)
VR2233 thru 2238	48-82256C11	Zener type; 10 V

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

REMOTE FRONT PANEL BOARDS

REMOTE INTERFACE BOARD
MODELS VLN1011A and VLN1012A

REMOTE INTERFACE BOARD AND CABLE



NOTES:

1. Resistor values given in ohms, capacitor values given in microfarads (uF), unless otherwise stated.
2. JU2201-JU2205 cut for Channel Scan monitoring models only.
3. JU2206, JU2207 IN for special options only.

P2387 Line Name Chart

	Option Configuration			
Pin No.	Select 5 With Thumbwheel Switch Options	Select 5 With 10/100-Call	Selectable PL/DPL	Channel Scan Monitoring
1	N.C.	N.C.	N.C.	PC
2	N.C.	N.C.	N.C.	CD5
3	N.C.	N.C.	N.C.	C BLANK
4	MC0	N.C.	A0	MA2
5	MC1	N.C.	A1	MA1
6	MC2	N.C.	A2	MA0
7	MC3	MC3	A3	CD0
8	MC4	MC4	A4	CD1
9	N.C.	N.C.	N.C.	LD
10	MCD0	MCD0	N.C.	CD2
11	MCD1	MCD1	N.C.	CD3
12	MCD2	MCD2	N.C.	CD4
13	MCD3	MCD3	N.C.	SCAN
Mating Connector and Destination	J2387 Remote Switch Board	J1387 Remote 10/100 Call Board	J3387 Remote Selectable PL/DPL Board	J4387 Remote Display Buffer Board

LEGEND:
- THEORY NOTE
- SIGNAL FLOW
- PIN AND SLEEVE CONNECTION
- GROUND
- LOGIC GROUND
- CIRCUIT BOARD SOLDER CONNECTION

EEPS-36017-O

FUNCTION

Allows radio set to be mounted in remote location such as under seat or in trunk, and be controlled from the vehicle dashboard.

Refer to Front Panel Boards section for information on Front Panel Interconnect Board and Display Boards. These are the same in Remote Mount radios as those used in Front Mount Radios.

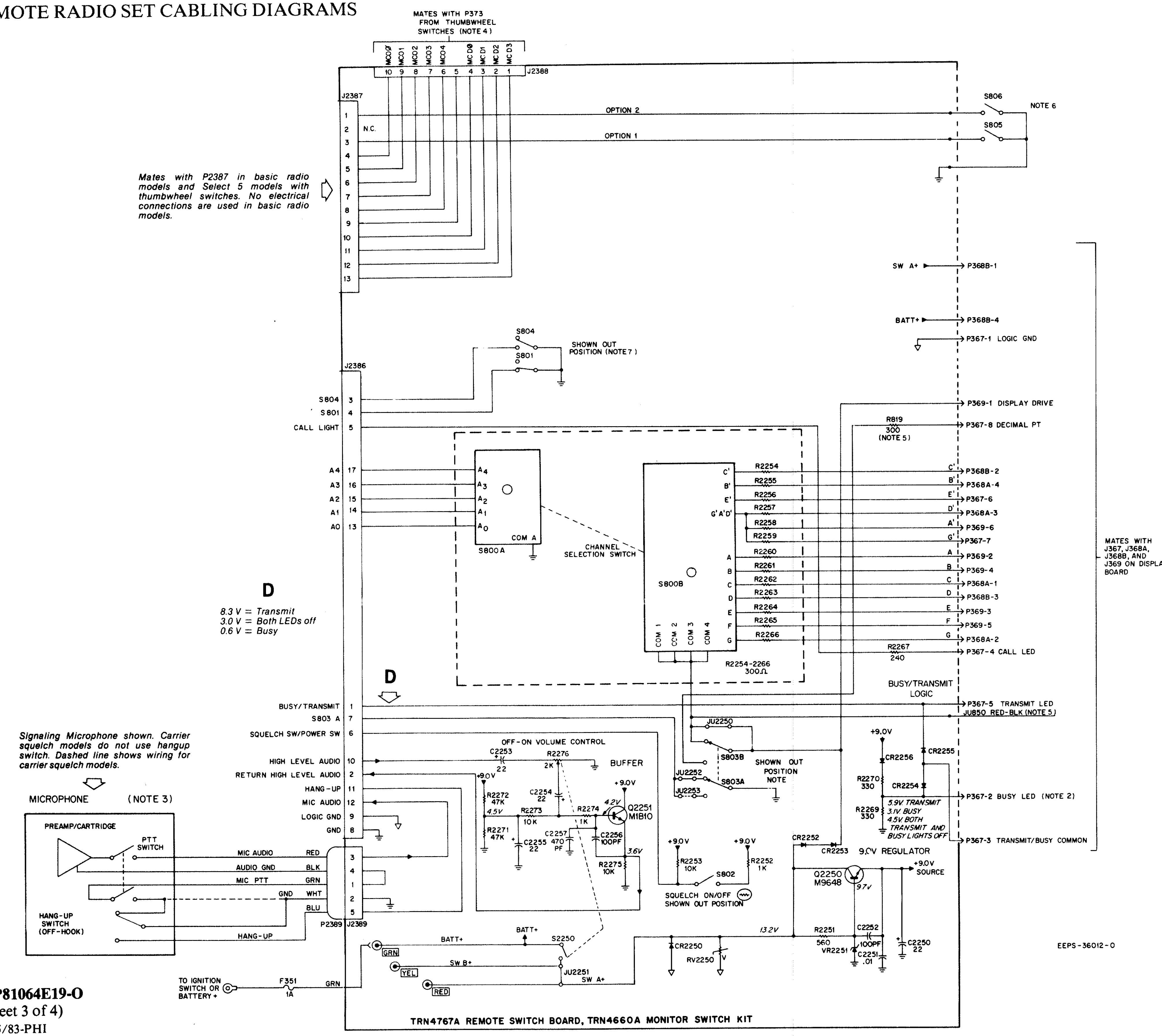
Model Complement Chart

VLN1011A	*DVP* Basic Remote Interface Board
TRN4763B	Basic Remote Interface Board
VLN4146A	*DVP* Remote Hardware Kit
VLN1021A	*DVP* Universal Remote Interface Board
TRN4764B	Universal Remote Interface Board
VLN4146A	*DVP* Remote Hardware Kit

REMOTE FRONT PANEL BOARDS

REMOTE SWITCH BOARD AND
REMOTE RADIO SET CABLING DIAGRAMS

REMOTE SWITCH BOARD



NOTES:

1. Resistor values given in ohms, capacitor values given in microfarads (uF), unless otherwise stated.
2. Busy light not used in carrier squelch or PL squelch with encode only models.
3. Refer to Microphone instruction section for parts list and information.
4. J2388 used in "Select 5" signaling models with thumbwheel switch options only.
5. For display blanking option JU2250 and JU825 (display board) are cut, and wire jumper JU850 is added between display board and switch board. R819 is added (part of TRN4698A Display Blanking Kit).
6. S805 and S806 are mounted directly to front panel. Refer to signaling switch chart for function and kits.
7. Function and position of switches designated S801, S803, and S804 change with option or model configuration. Refer to Signaling Switch Chart.

SIGNALING SWITCH CHART

Switch Desig.	Symbol	Type	Button/Switch Kit	Function
S801		Latching	TRN4660A	Select 5 Monitor
S803		Latching	TRN4660A	PL/DPL Monitor
		Latching	TRN4656A	Secondary Call/ External Alarm
		Momentary	TRN4658A	Select 5 Call
	I	Momentary	TRN4657A	Single Tone Repeater
S804		Momentary	TRN4658A	Select 5 Call
	(GRAY)	Momentary	TRN4659A	5-Tone Repeater
S805	I	Momentary	TRN4994A & THN6468A	Single Tone Repeater
S806	II	Momentary	TRN4994A & THN6469A	2-Single Tone Repeater

JUMPER CHART

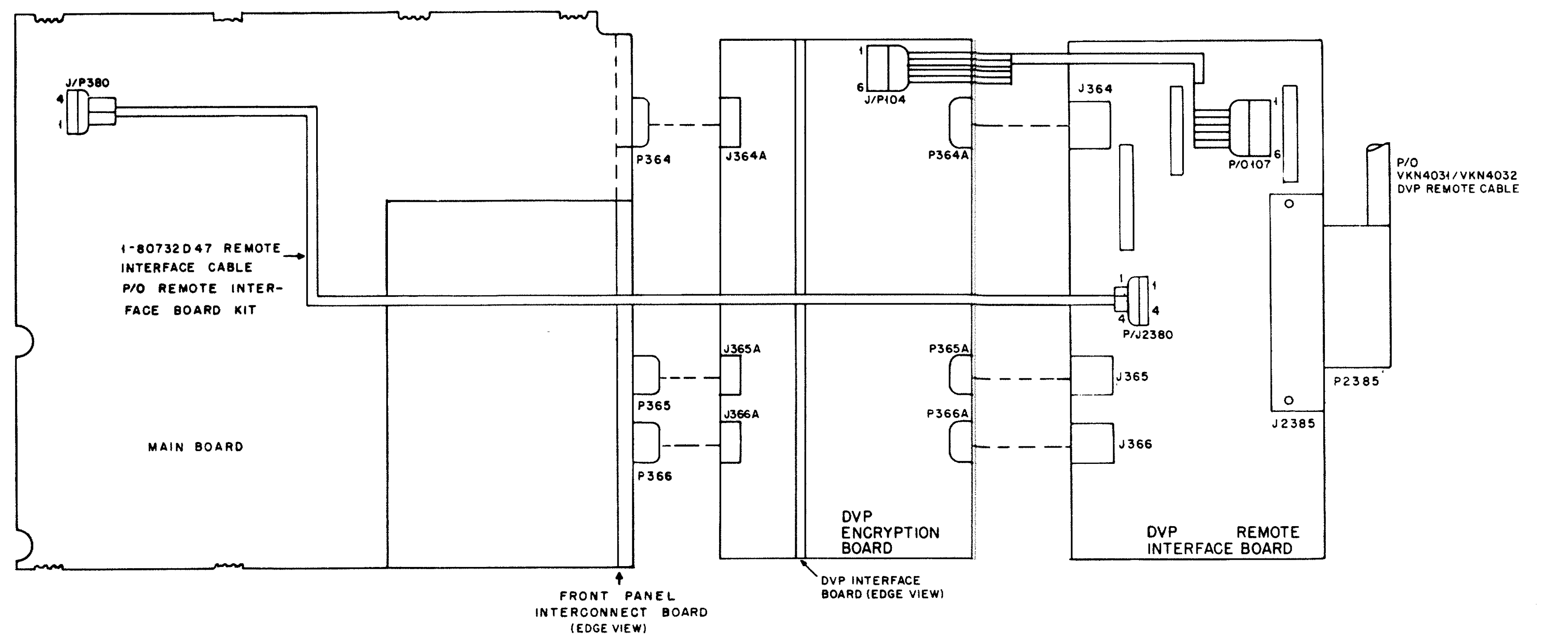
JU2250	Cut For Display Blanking Option
JU2251	Cut For Option
JU2252	IN When S803 Is Latching Switch
JU2253	IN When S803 Is Momentary Contact Switch

LEGEND:

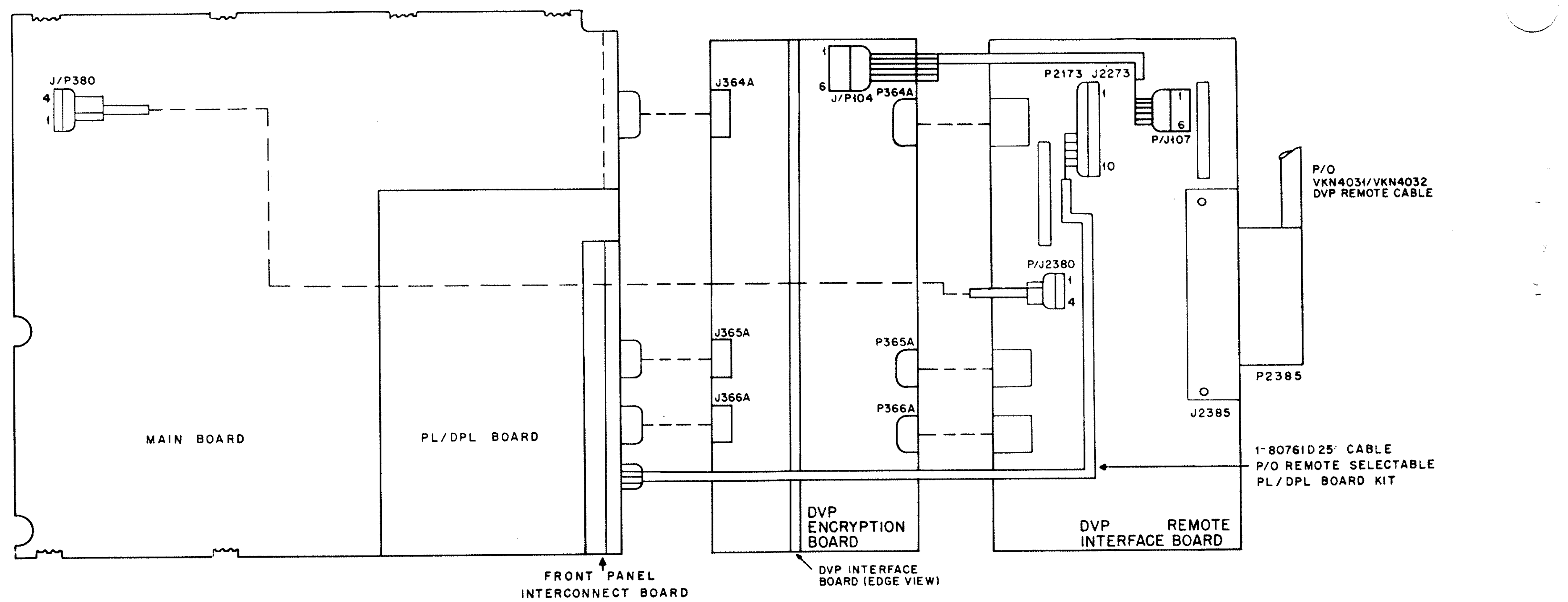
- THEORY NOTE
- SIGNAL FLOW
- PIN AND SLEEVE CONNECTION
- LOGIC GROUND
- GROUND
- CIRCUIT BOARD SOLDER CONNECTION
- WIRE JUMPER
- PLATED JUMPER

REMOTE RADIO SET CABLING

1. ALL REMOTE RADIOS



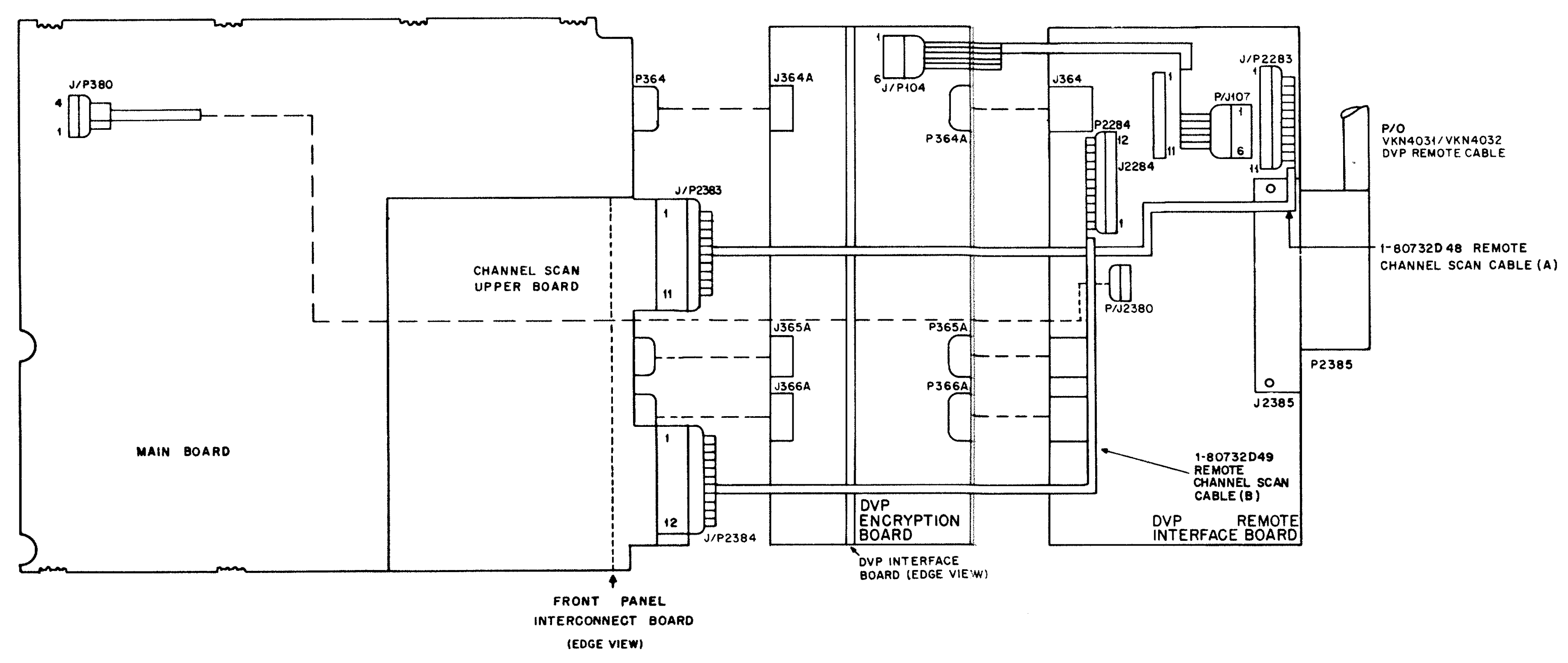
2. REMOTE SELECTABLE PL/DPL SQUELCH



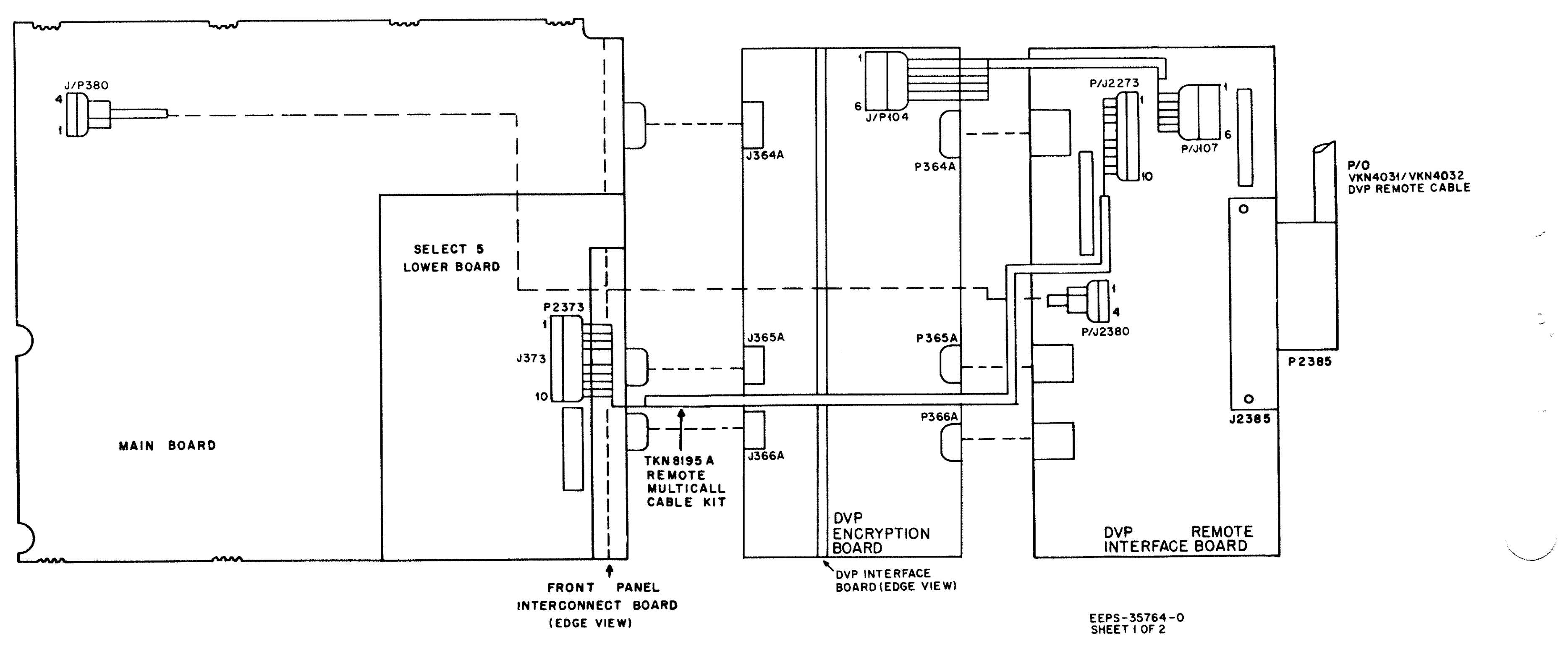
NOTES:

1. REFER TO APPROPRIATE SCHEMATIC DIAGRAMS FOR CABLE WIRE COLORS, SIGNAL NAMES, AND PARTS LISTS.
2. THIS DRAWING ILLUSTRATES REMOTE RADIO INTERCABLING AND INTERCONNECTION. NON-RELATED CONNECTIONS NOT SHOWN. PARTS SHOWN ARE FOR ORIENTATION.

3. REMOTE CHANNEL SCAN MONITOR



4. REMOTE SELECT 5 SIGNALING WITH MULTICALL



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SHEET 1 OF 2

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(Sheet 3 of 4)
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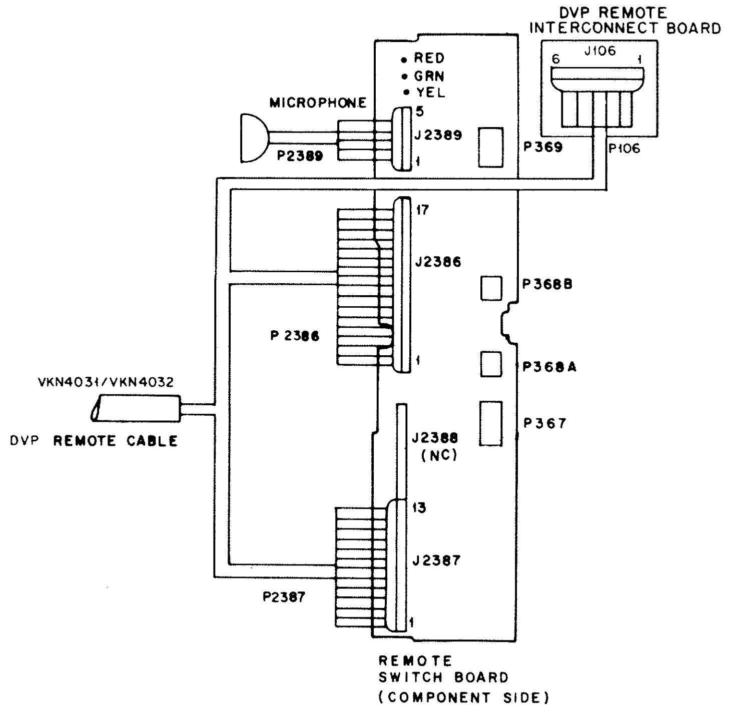
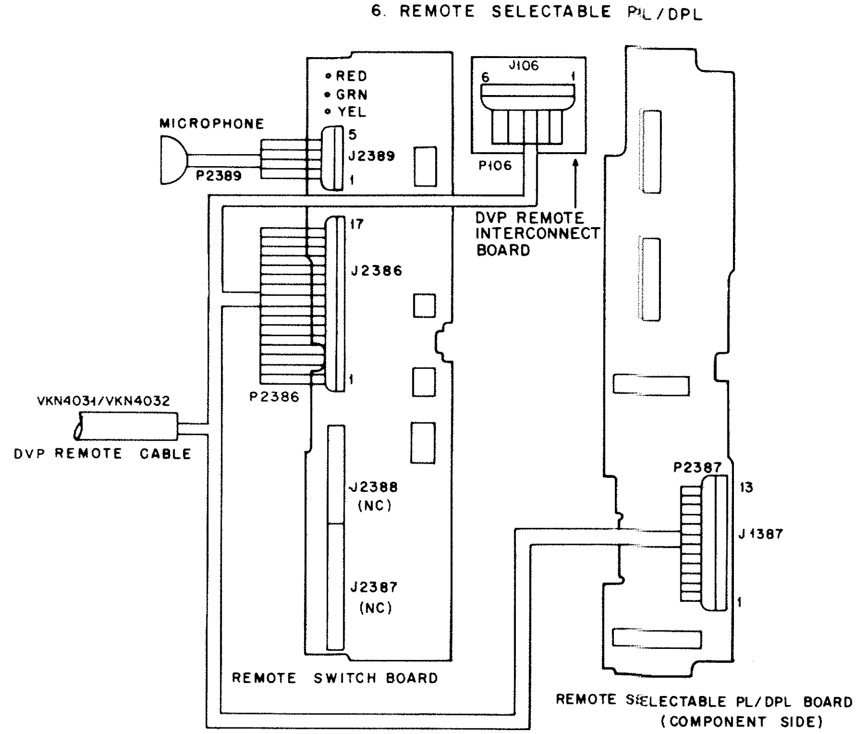
REMOTE CONTROL HEAD CABLING

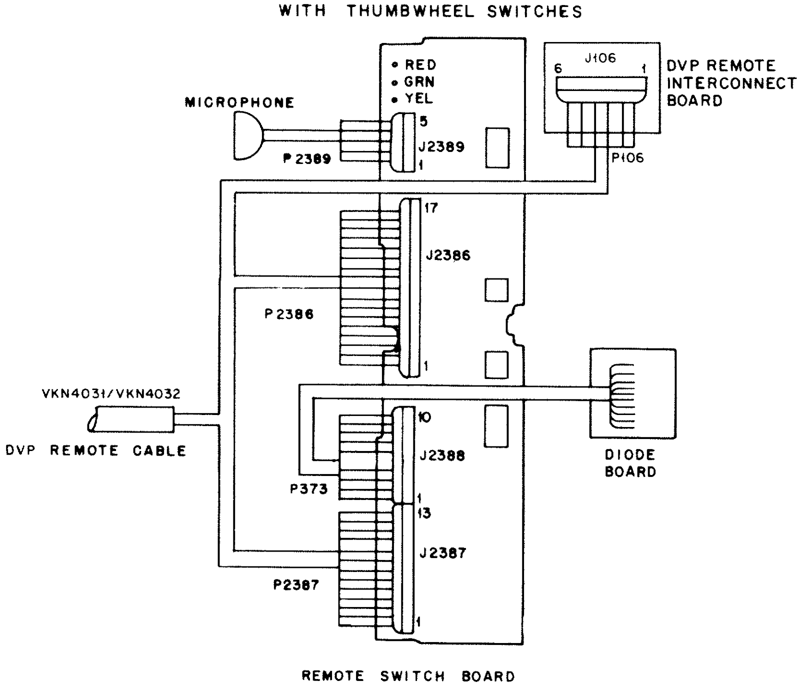
5. BASIC REMOTE CONTROL HEAD



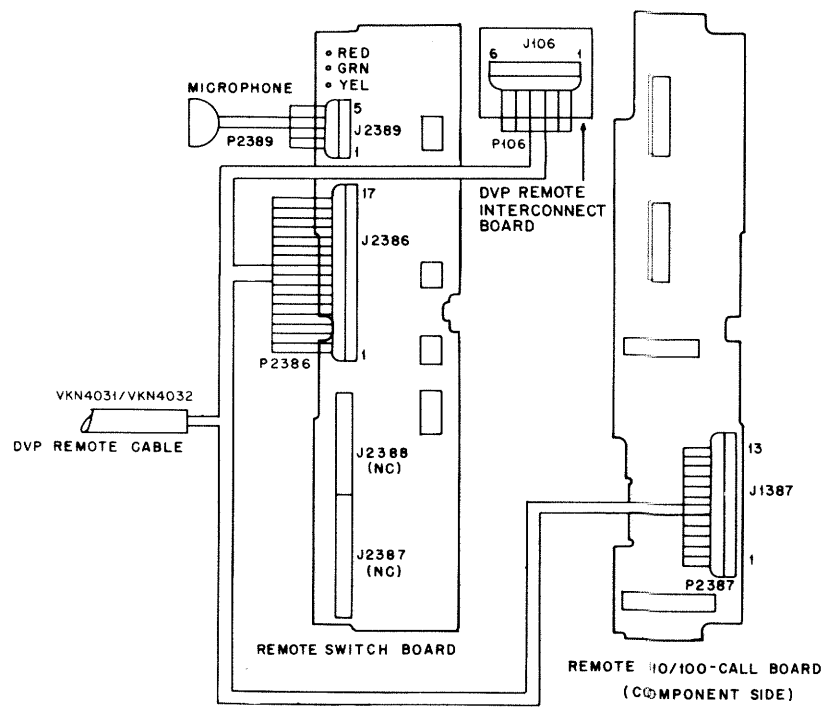
6. REMOTE SELECTABLE PL/DPL



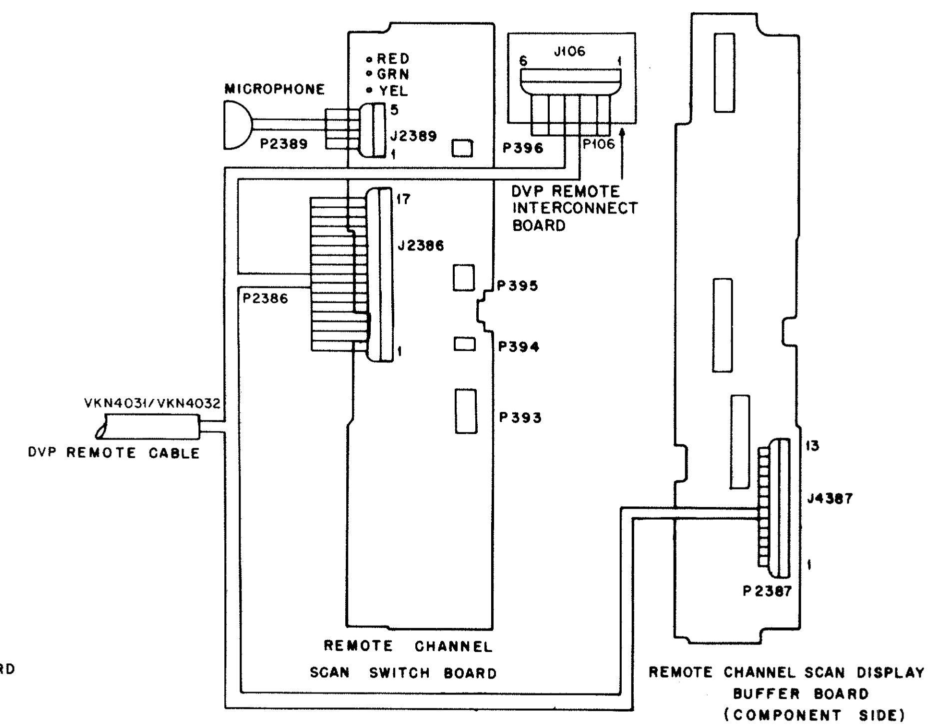
7. REMOTE SELECT 5 WITH THUMBWHEEL SWITCHES



8. REMOTE SELECT 5 WITH 10/100-CALL

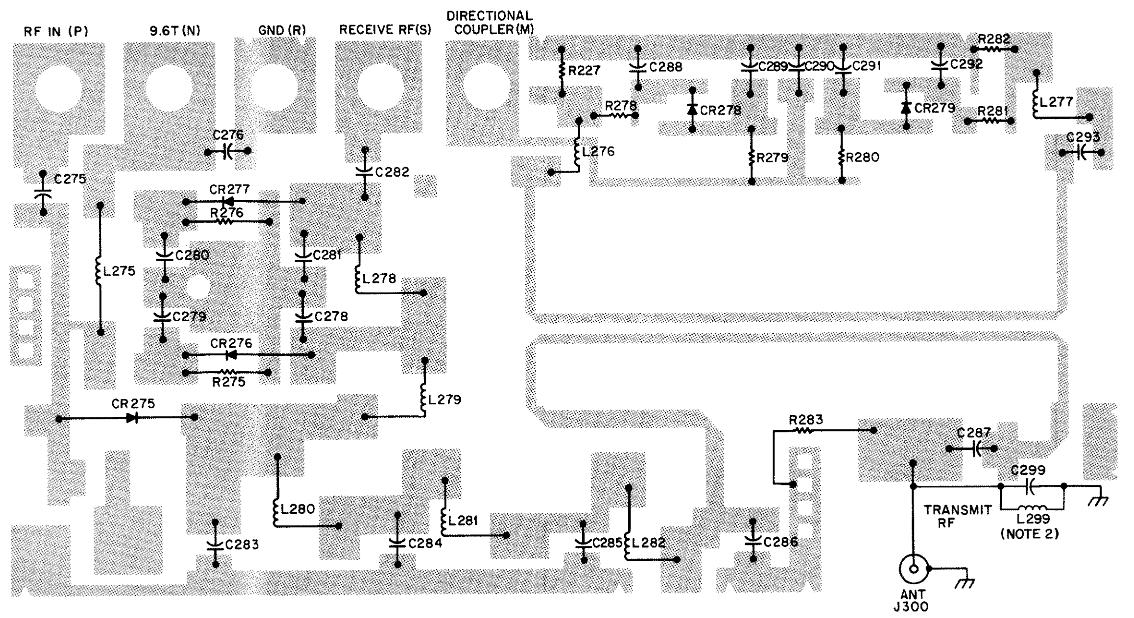


9. REMOTE CHANNEL SCAN



EEPS-35764-0
SHEET 2 OF 2

HARMONIC FILTER



SHOWN FROM COMPONENT SIDE

BD-CEPS-30185-O
OL-CEPS-30184-A

1. ALL RESISTORS SHOWN ON THIS BOARD ARE SCREENED ON THE SUBSTRATE, CONSEQUENTLY THEY CANNOT BE SERVICED.
2. C299 AND L299 ARE MOUNTED TO ANTENNA CONNECTOR J300, REFER TO SCHEMATIC DIAGRAM.

parts list

TRN4905A Heat Sink, 30 Watt PA (136-174 MHz) — PL-8423-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1415	21-82812H03	1000 pF +100-0%; 500 V; feed-thru
C1416	21-821474	470 pF ±20%; 500 V; feed-thru
		coil, rf:
L1403	24-82190C15	1.2 uH (wound on R1401)
		resistor, fixed:
R1401	6-125B82	4.7 ohm, 1/2 W, 5%
		mechanical part
	29-84775M01	LUG, soldering

note: For parts not listed in the above parts list, refer to the exploded view mechanical parts list.

TLD9142A Power Amplifier, 10 Watt, 136-162 MHz (L)
TLD9143A Power Amplifier, 10 Watt, 146-174 MHz (H) — PL-8424-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ±5%; 50 V; unless otherwise stated:
C250 (L)	21-84873H80	60 ±2%
C250 (H)	21-84873H85	56
C251	21-84873H59	100
C252	21-84873H68	200
C253	21-84547A22	47 nF ±10%; 25 V
C254 (L), 255 (L)	21-84873H50	33
C254 (H), 255 (H)	21-84873H57	27
C256 (L), 257 (L)	21-84873H91	50
C256 (H), 257 (H)	21-84873H88	43
C258 (L), 259 (L)	21-84873H85	56
C258 (H), 259 (H)	21-84873H91	50
C260 (L)	21-84873H89	20 ±2%
C260 (H)	21-84873H86	18 ±2%
C261	21-84873H61	22
C262	21-84873H98	330 ±10%
C263	21-84547A23	.018 uF ±20%
C264, 266	21-84873H98	330 ±10%
		diode: (see note)
CR250	48-83654H01	silicon
		coil, rf:
L250	24-84331M16	14 nH
L254	24-84331M17	34 nH
L255	24-84331M18	27 nH
L256	24-84331M22	6 nH
L257 (L)	24-84331M05	10 nH
L257 (H)	21-84331M13	12 nH
L258	24-84331M10	13 nH
L259	24-82723H11	200 nH
		transistor: (see note)
Q250	48-84411L90	NPN; type M1190

TLD9132A Low Level Amplifier — PL-7179-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ±5%; 50 V: unless otherwise stated
C200	21-84873H98	330 ±10%
C201, 202	21-84873H58	51
C203	21-84873H68	200
C204	21-84873H77	12; 25 V
C205	21-84873H68	200
C206	21-84873H80	60 ±2%
C207	21-84873H81	110
C208	21-84873H98	330 ±10%
C209	21-84547A22	47 nF ±10%; 25 V
C210	21-84873H89	20
C211	21-84873H23	27
C212	21-84873H84	160
C213	21-84547A24	0.1 uF ±20%; 25 V
		diode: (see note)
CR200	48-83654H01	silicon
		coil, rf:
L200	24-84331M11	13 nH
L201	24-82723H27	1.2 uH
L202	24-84331M12	29 nH
L203	24-84331M13	12 nH
L205	1-80702T04	assembly bead
L206	24-84331M14	58 nH
L207	24-84331M12	29 nH
L208	24-84331M15	20 nH
		transistor: (see note)
Q200	48-869657	NPN; type M9657
Q201	48-869859	NPN; type M9859

TFD6431A Harmonic Filter, Range 1 (136-162 MHz) (L))
TFD6432A Harmonic Filter, Range 2 (146-174 MHz) (H) — PL-7180-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ±10%; 50 V; unless otherwise stated:
C275, 276	21-84873H98	330
C278 (L)	21-84873H94	24 (TFD6431A)
C278 (H)	21-84873H89	20 (TFD6432A)
C279, 280	21-84873H98	330
C281	21-84873H76	10
C282	21-84873H98	330
C283 (H)	21-84736E35	20
C283 (L)	21-84736E37	24
C284 (H)	21-84736E10	25.5
C284 (L)	21-84736E32	27
C285 (H)	21-84736E10	25.5
C285 (L)	21-84736E32	27
C286	21-84736E29	7.5
C287	21-84873H98	330
C288	21-84873H76	10
C289, 290, 291	21-84873H98	330
C292	21-84873H76	10
C293	21-84547A11	.01 uF
		diode: (see note)
CR275, 276, 277	48-83510F04	silicon
CR278, 279	48-84939C35	silicon
		coil, rf:
L275	24-82723H27	choke; 1.2 uH
L276, 277	24-84331M05	10 nH
L278 (L)	24-84331M41	55 nH
L278 (H)	24-84331M32	51 nH
L279 (H)	24-84331M30	46 nH
L279 (L)	24-84331M29	45 nH
L280 (H)	24-84331M35	63 nH
L280 (L)	21-84331M34	64 nH
L281 (H)	21-84331M27	78 nH
L281 (L)	21-84331M25	80 nH
L282 (H)	24-84331M37	55 nH
L282 (L)	24-84331M36	56 nH

note: L299 and C299 are part of TRN4672A. Refer to Radio Set Hardware Kit Parts List

TLD9151A Power Amplifier, 30 Watt (136-174 MHz) — PL-8425-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ±5%; 50 V; unless otherwise stated:
C1400	21-84873H51	180
C1401	21-84873H86	18 ±2%
C1402	21-84873H73	75
C1403, 1404	21-84736E21	100
C1405	21-84547A23	.018 uF ±20%
C1406	21-84873H74	300
C1410, 1411	21-84736E41	140
C1412	21-84736E21	100
C1413	21-84736E10	25.5
C1414	21-84773H52	470
		diode: (see note)
CR1400	48-83654H01	silicon
		ferrite bead:
E1400	1-80739D84	rf
		coil, rf:
L1400	24-84331M02	22 nH
L1401	24-84331M42	240 nH
L1402	24-84331M03	33 nH
L1404	24-84331M43	28 nH
		transistor: (see note)
Q1400	48-84411L56	NPN; type M1156
		resistor, fixed:
R1400	6-185B81	1.5k ±10%; 1/8 W
		thermistor:
RT1400	6-867628	195k @ 25°C
		mechanical part
	64-82287N01	PLATE, strap ground; 2 used

TRN4695A Power Amplifier Interconnect Board, Low Power 6/10 W
TRN4696A Power Amplifier Interconnect Board, High Power 25/30 W — PL-7181-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1417	23-83908L02	15 uF ±20%; 100 V
C1451	21-11022G35	16 pF ±5%; 50 V
C1452	21-84511B06	5.1 pF ±5%; 50 V
C1453	21-84736E21	100 pF ±5%; 50 V
C1454	8-82317B01	0.1 uF ±10%; 100 V (TRN4696A)
		diode: (see note)
CR1451	48-83654H01	silicon
		bead:
E1450, 1451, 1452, 1453, 1454	76-83960B01	ferrite, short
		coil, rf:
L1451, 1452	24-83884G04	70 nH
L1453, 1454	24-82723H11	200 nH
L1455	24-84346A02	170 nH (TRN4696A)
		resistor, fixed:
R1451, 1452	6-124B67	8.2 ±5%; 1/4 W
R1453	6-11009C29	150 ±5%; 1/4 W
R1454, 1455	6-125A48	910 ±5%; 1/2 W (TRN4696A)
R1454, 1455		NOT USED (TRN4695A)
R1456, 1457	6-125A01	10 ±5%; 1/2 W (TRN4696A)
R1456, 1457	6-125A12	30 ±5%; 1/2 W (TRN4695A)
		mechanical part
	29-84322M02	TERMINAL, pin; 22 used (TRN4696A) 16 used (TRN4695A)

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

POWER AMPLIFIERS

FUNCTION

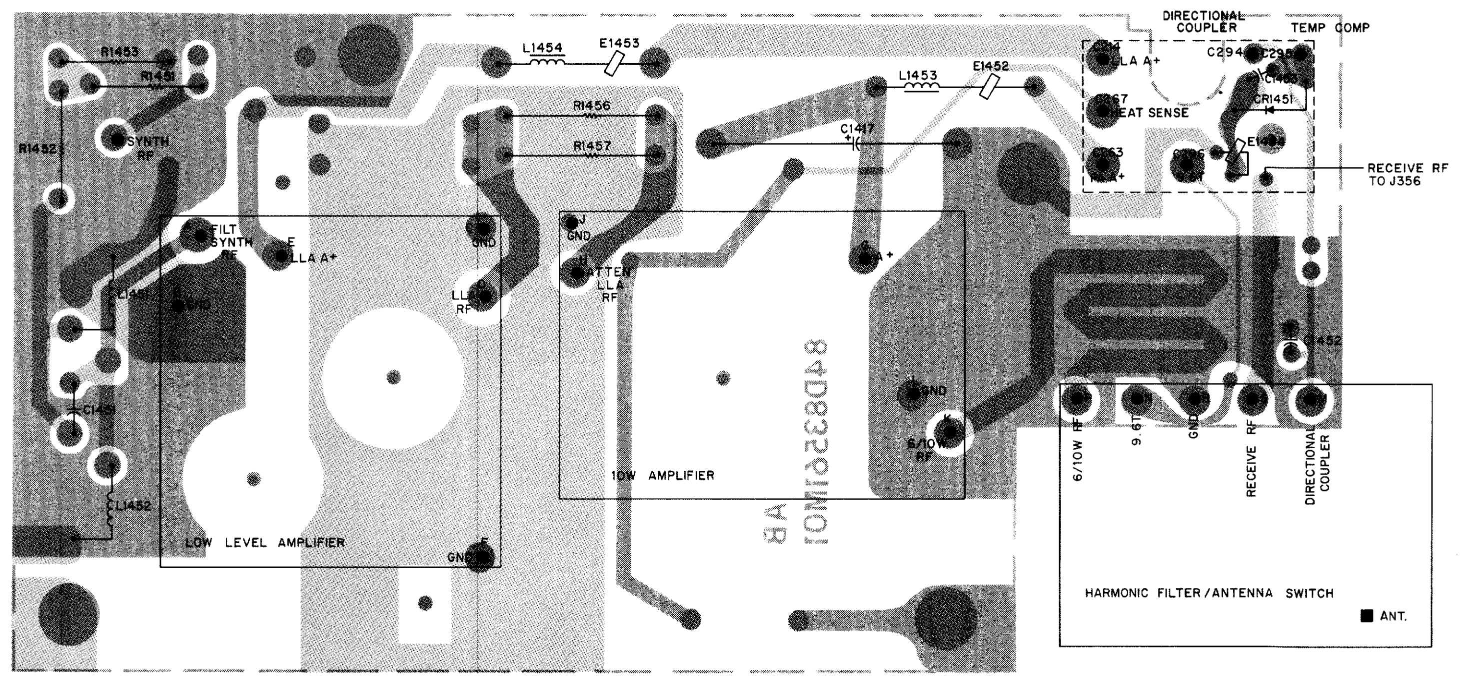
Power amplifier hybrids, except the 30 W PA are mounted to PA interconnect board. Low level amplifier provides amplification at synthesizer output, and power regulation as controlled by main board power circuitry. Harmonic Filter/Antenna Switch attenuates harmonics and switches antenna between transmitter and receiver.

30 Watt Power Amplifier Model Complement Chart

TLN2334B	30 W Power Amplifier Assembly
TLD9151A	30 W PA Hybrid
TRN4905A	30 W PA Heat Sink & Hardware

POWER AMPLIFIERS

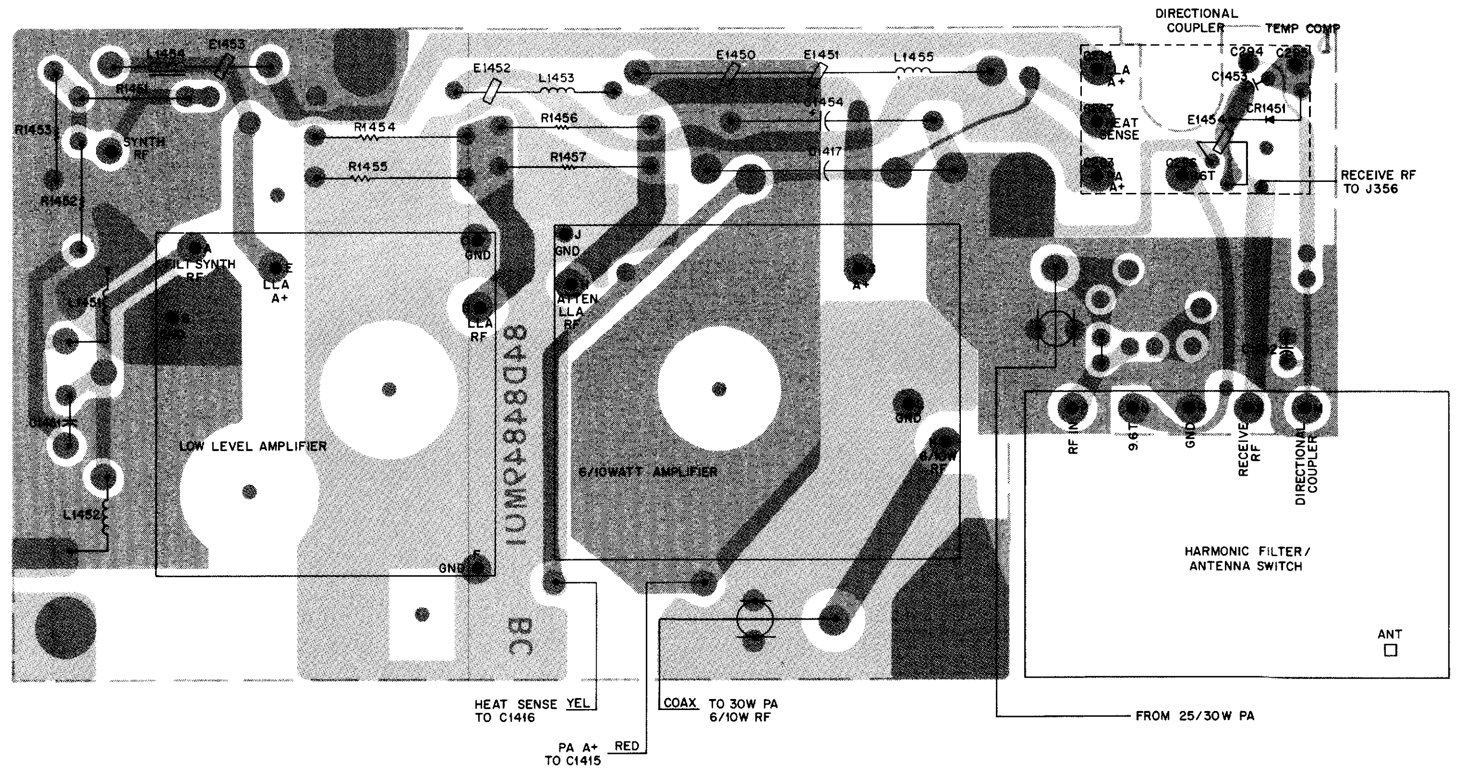
10 WATT PA INTERCONNECT BOARD



SHOWN FROM COMPONENT SIDE

COMPONENT SIDE = DEPS-30190-A
SOLDER SIDE = DEPS-30189-A
OL DEPS-30188-A

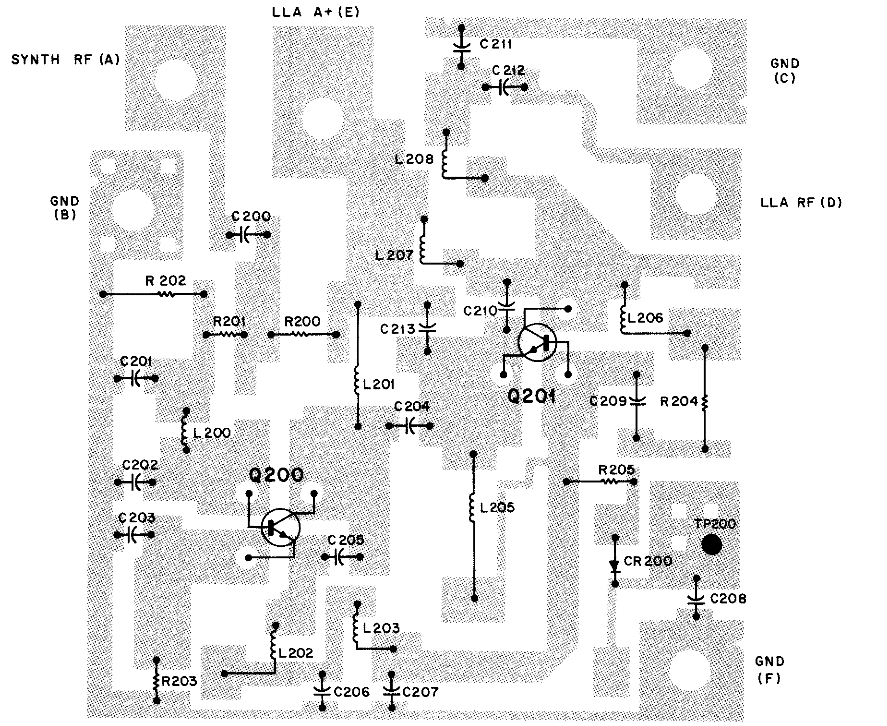
30 WATT PA INTERCONNECT BOARD



SHOWN FROM COMPONENT SIDE

SOLDER SIDE = BD — DEPS-30202-A
COMPONENT SIDE = BD — DEPS-30201-A
OL = BD — DEPS-30200-A

LOW LEVEL AMPLIFIER

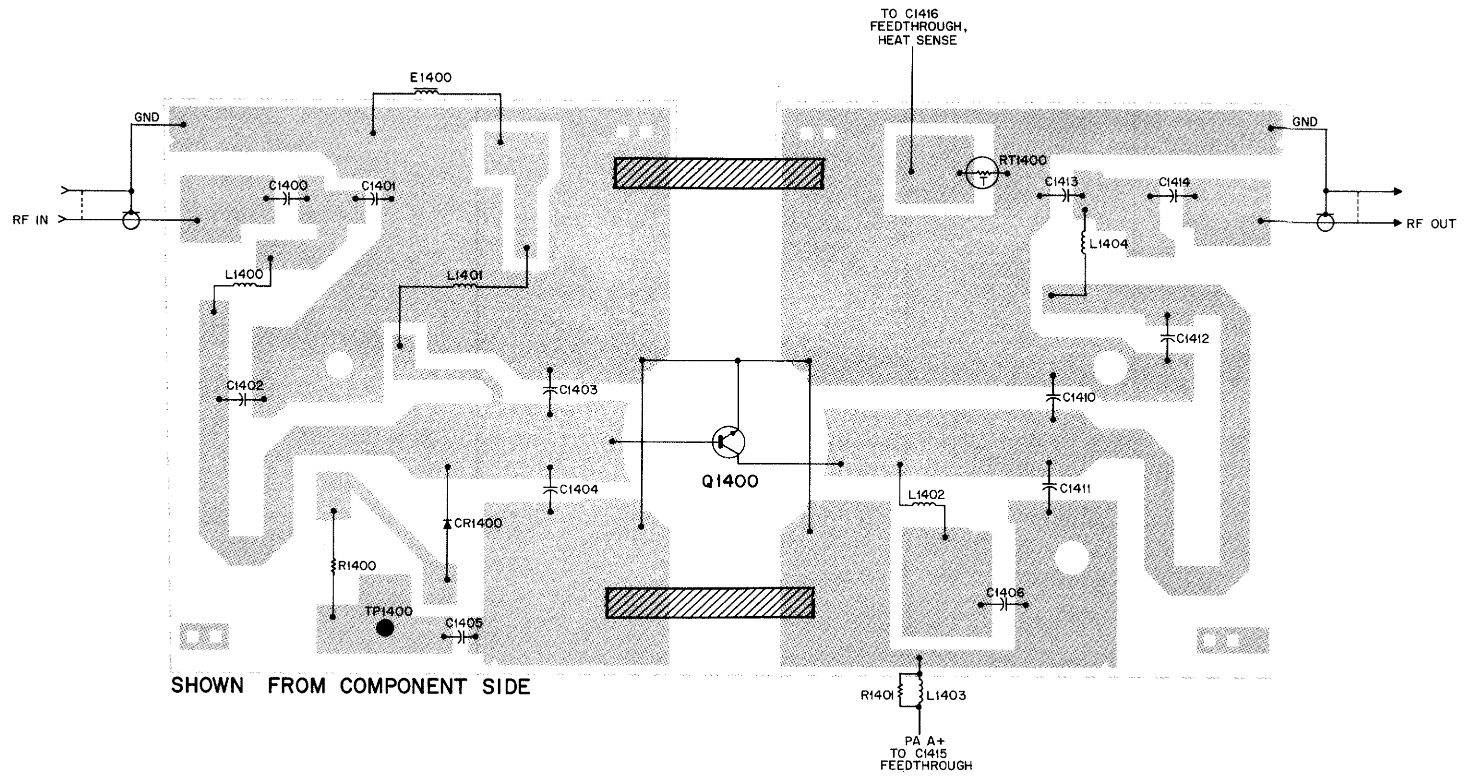


SHOWN FROM COMPONENT SIDE

OL-CEPS-30177-O
CEPS-30178-O

NOTE:
ALL RESISTORS SHOWN ON THIS BOARD ARE SCREENED ON THE SUBSTRATE, HENCE THEY ARE NOT SERVICEABLE

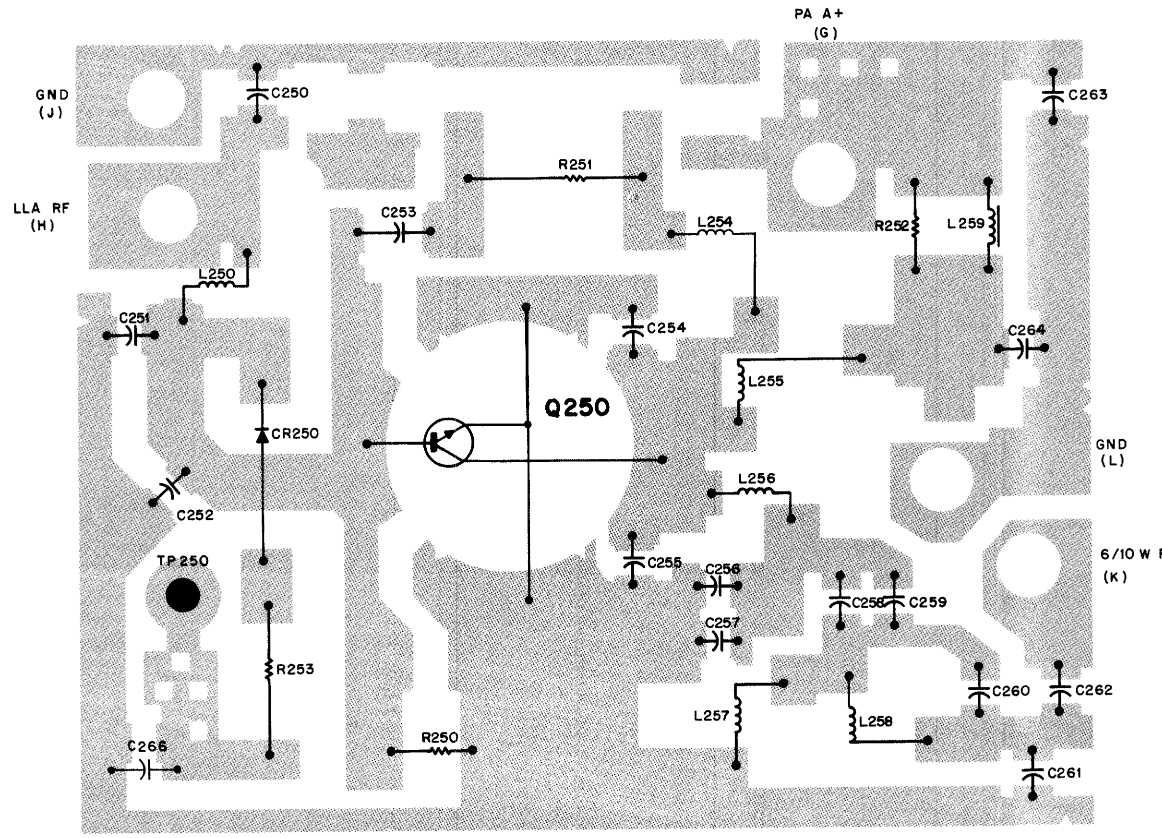
TLD9151A 30 WATT POWER AMPLIFIER



SHOWN FROM COMPONENT SIDE

BD DEPS-32880-O
OL DEPS-32882-A

10 WATT POWER AMPLIFIER



NOTE
ALL RESISTORS SHOWN ON THIS BOARD ARE SCREENED ON SUBSTRATE; THEY ARE NOT SERVICEABLE.

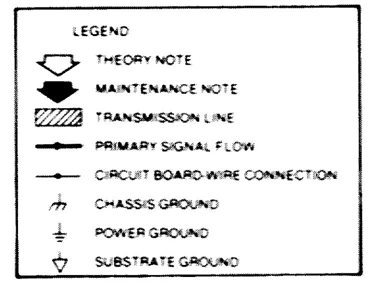
BD-CEPS-30180-O
OL-CEPS-30181-A

SHOWN FROM COMPONENT SIDE

POWER AMPLIFIER

NOTES

1. UNLESS OTHERWISE STATED, RESISTOR VALUES ARE GIVEN IN OHMS. CAPACITOR VALUES ARE GIVEN IN PICOFARADS (PF) AND INDUCTOR VALUES ARE GIVEN IN TURNS (T) OR MICROHENRIES (UH)
2. FEEDTHROUGH CAPACITORS C1415 AND C1416 ARE MOUNTED ON POWER AMPLIFIER HEATSINK
3. ALL RESISTORS DENOTED WITH (*) ARE SCREENED ON SUBSTRATE AND ARE THEREFORE NON-SERVICEABLE
4. C1417 IS CONNECTED TO L260 IN 10 WATT MODELS ONLY, TO L1405 IN 30 WATT MODELS ONLY
5. NOT USED
6. L299 AND C299 ARE MOUNTED FROM CENTER PIN OF ANTENNA JACK J300 TO A CHASSIS LUG. REFER TO RADIO SET HARDWARE KIT PARTS LIST IN MECHANICAL PARTS SECTION OF THIS MANUAL
7. REFER TO PARTS LIST FOR COMPONENT VALUE

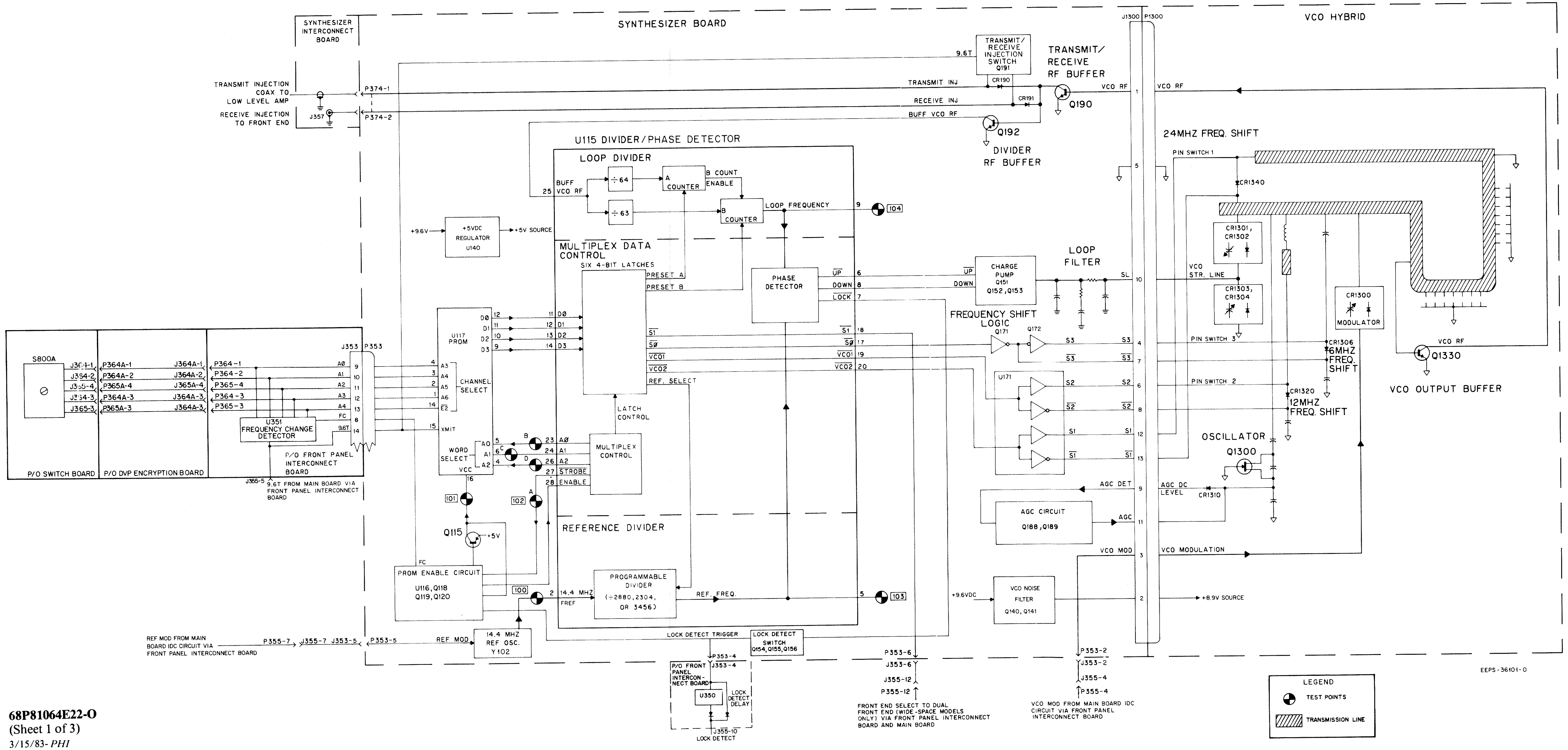


EEPS-36029-0

STANDARD LOCK FREQUENCY SYNTHESIZER

FUNCTIONAL INTERCONNECT DIAGRAM AND PARTS LIST

SYNTHESIZER FUNCTIONAL INTERCONNECT DIAGRAM



68P81064E22-O
(Sheet 1 of 3)
3/15/83- *PHI*

parts list

TRN5243A Synthesizer — PL-8414-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 20%; 25 V; unless otherwise stated:
C100	21-11026F42	100 pF ± 5%; 50 V
C101		NOT USED
C102		NOT USED
C103, 104		NOT USED
C106, 107	21-11025A01	.01
C108	21-82610C87	47 pF ± 5%; 200 V
C110	21-11025A01	.01
C111	23-84665F20	1
C112	21-11025A01	.01
C113	21-11025A01	.01
C114	21-11026F42	100 pF ± 5%; 50 V
C115	21-11025A01	.01; 50 V
C116	21-868829	220 pF ± 5%; 50 V
C117	21-11025A01	.01
C118	21-868829	220 pF ± 5%; 50 V
C119	21-11025A01	.01
C121	21-11026F42	100 pF ± 5%; 50 V
C123	23-84538G13	22; 25 V
C124, 126	21-11025A01	.01
C127	21-868829	220 pF ± 5%; 50 V
C128	21-84393M03	1500 pF
C140	21-11025A01	.01
C141	21-11026F42	100 pF ± 5%; 50 V
C142	23-11019A27	22; 16 V
C143	23-84538G13	22; 25 V
C144	21-11025A01	.01
C145	21-11026F42	100 pF ± 5%; 50 V
C146	21-11025A01	.01
C147	23-84538G03	.01 ± 10%; 16 V
C150	23-84538G22	6.8 ± 10%; 16 V
C151	8-84637L21	0.15 ± 10%; 100 V
C152	8-11023A17	.022 ± 5%; 50 V
C153	8-11017B01	.001 ± 10%; 50 V
C154	21-11025A01	.01
C155	23-11019A27	22; 16 V
C156	8-11023A17	.022 ± 5%; 50 V
C157, 158	21-11026F42	100 pF ± 5%; 50 V
C171 - 184	21-84874K01	470 pF; 250 V
C187	23-84665F20	1; 50 V
C188	21-11025A01	.01
C190, 191	21-11026F42	100 pF ± 5%; 50 V
C192	21-11025A01	.01
C193	21-84511B01	100 pF ± 10%; 50 V
C194	21-11025A01	.01
C195, 196, 197	21-11026F42	100 pF ± 5%; 50 V
C199	21-11026F42	100 pF ± 5%; 50 V
C200	21-11022G17	4.7 pF ± .25 pF; 50 V
		diode: (see note)
CR100, 101		NOT USED
CR140, 141, 142, 143, 151, 152	48-84399M01	silicon
CR190, 191	48-83510F03	silicon
		connector, receptacle:
J1300	9-84321M01	female: 13-contact
		coil, rf:
L100	24-82723H27	choke: 1.2 uH
L101	24-82723H39	choke: 2.6 uH
L102	24-82723H27	choke: 1.2 uH
L116	24-82549D41	choke: 100 uH
L117 - 127	24-82723H27	choke: 1.2 uH
L150	24-82549D41	choke: 100 uH
L190, 191	24-82723H39	choke; 2.6 uH
L192 - 193	24-82723H27	choke: 1.2 uH
L194	24-82723H13	85 nH, air
		connector, plug:
P353	1-80731D23	assembly, feed-thru plate includes: C171 thru 185
	29-84322M01	TERMINAL, post: 14 used
	84-83566M01	BOARD, feed-thru
P374	28-82040K03	male: 2-contact
P379	28-83186M02	male: 4-contact adapter
		transistor: (see note)
Q100		NOT USED
Q101		NOT USED
Q102		NOT USED
Q115	48-869681	PNP; type M9681
Q118 - 120	48-02081B10	NPN; type M1B10
Q140	48-869681	PNP; type M9681
Q14, 151	48-02081B10	NPN; type M1B10
Q152	48-02081B11	PNP; type M1B11
Q153, 154, 155	48-02081B10	NPN; type M1B10
Q156	48-02081B11	PNP; type M1B11
Q171	48-02081B10	NPN; type M1B10
Q172	48-02081B11	PNP; type M1B11
Q188, 189	48-02081B10	NPN; type M1B10
Q190	48-869932	NPN; type M9932
Q191	48-02081B11	PNP; type M1B11
Q192	48-869932	NPN; type M9932
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated:
R100		NOT USED
R101		NOT USED
R102		NOT USED
R103		NOT USED
R107		NOT USED
R109		NOT USED
R115 - 117	6-11020A73	10k
R118 - 122	6-11020A79	18k
R123	6-11020A57	2.2k
R124	6-11020A49	1k
R125	6-11020A45	680
R126	6-11020A41	470
R127	6-11020A49	1k
R128	6-11020A65	4.7k
R129	6-11020A31	180
R130	6-11020A81	22k
R133	6-11020A85	33k
R134	6-11020A89	47k
R135, 136	6-11020A73	10k
R138	6-11020A73	10k
R140	6-11020A45	680
R141	6-11020A35	270
R142	6-11020A73	10k
R143	6-11020A71	8.2k
R144	6-11020A57	2.2k
R150	6-11020A53	1.5k
R151	6-11020A61	3.3k
R152, 153	6-11020A25	100
R154	6-11020A53	1.5k
R155	6-11020A71	8.2k
R156	6-11020A45	680
R157	6-11020A77	15k
R158	6-11020A85	33k
R159	6-11020A23	82
R160	6-11020A87	39k
R161	6-11020A59	2.7k
R162	6-11020A13	3.9k
R163	6-11020A40	680
R164	6-11020A59	2.7k
R165	6-11020A53	1.5k
R166	6-11020A47	820
R167	6-11020A39	390
R168	6-11020A87	3.9k
R172	6-11020A73	10k
R173, 174	6-11020A89	47k
R175	6-11020A49	1k
R176, 178	6-11020A65	4.7k
R179	6-11020A49	1k
R180, 181	6-11020A89	47k
R184	6-11020A61	3.3k
R185	6-11020A29	150
R186	6-11020A73	10k
R187	6-11020A11	27
R188	6-11020A61	3.3k
R191	6-11020A39	390
R192	6-11020A19	56
R193	6-11020A49	1k
R194	6-11020A65	4.7k
R196, 197	6-11020A73	10k
R189	6-11020A45	680
R199, 200	6-11020A39	390
		integrated circuit: (see note)
U115	TRN4669A	Divider
U116	51-82884C03	type M8403 (Quad NOR)
	or 51-82884C04	type M8404 (Quad NOR)
U117	TRN4670A	PROM, up to 32 channel
U140	41-84621K96	type 7805 (regulator)
U171	51-83627M53	type M2753 (line driver)
		crystal: (see note)
Y102	51-80291B02	channel element KXN1096
		mechanical parts
	3-84208M03	SCREW, machine (M2.2 x 0.45 x 6)
	7-84109M01	BRACKET, synthesizer mounting
	9-80269B01	SOCKET, PROM
	9-80269B03	SOCKET, divider
	14-05160A01	INSULATOR, crystal
	42-10219A17	RETAINER: 3 used
	75-84112M01	PAD, channel element (2 used)
	11-00008853	TWINE, lagging
	64-84111M01	PLATE, feed-thru
	3-84208M01	SCREW, machine (M3 x 0.5 x 8") 3 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN4670A PROM Kit, 32-Channel — PL-7787-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U117	51-80070C03	32-channel PROM (standard lock)
U116	51-80070C03	32-channel PROM (fast-lock)

note: This is part number of non-programmed PROM module. Order programmed PROM modules from factory on *MCX100* Supplementary Order Form.

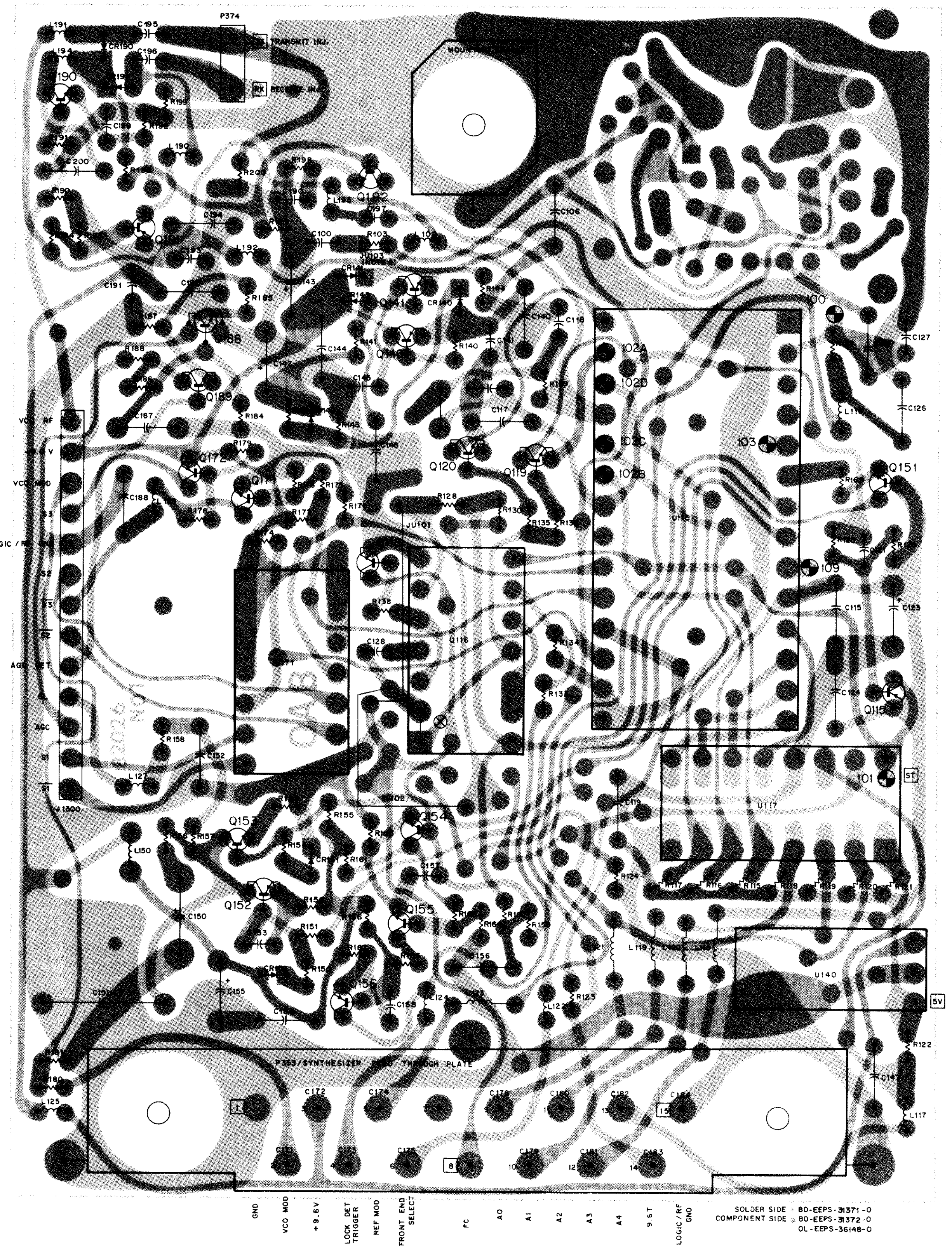
TRN4601A Synthesizer Interconnect Board — PL-7193-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
J374	29-10134A29	female; 2 used

STANDARD LOCK FREQUENCY SYNTHESIZER

CIRCUIT BOARD DETAILS

TRN5243A SYNTHESIZER BOARD

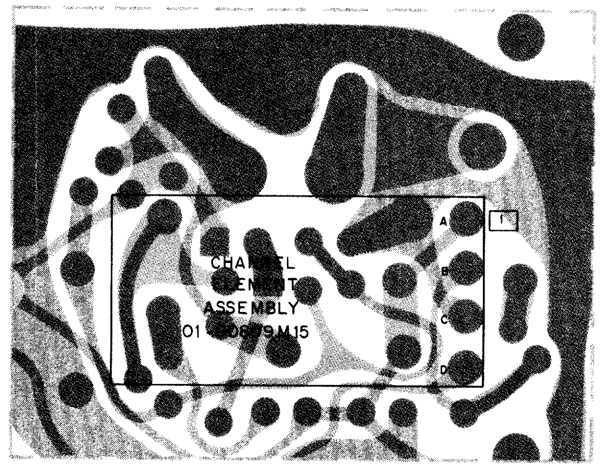


SHOWN FROM SOLDER SIDE

NOTES:
1. REFER TO SCHEMATIC DIAGRAM FOR USAGE OF RH03/JU103.

LEGEND:
- TEST POINTS
- PLATING CUT

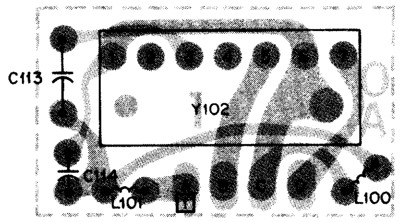
SYNTHESIZER BOARD DETAIL



SHOWN FROM SOLDER SIDE

SOLDER SIDE BD-BEPS-30205-O
COMPONENT SIDE BD-BEPS-30204-O
OL-BEPS-36149-O

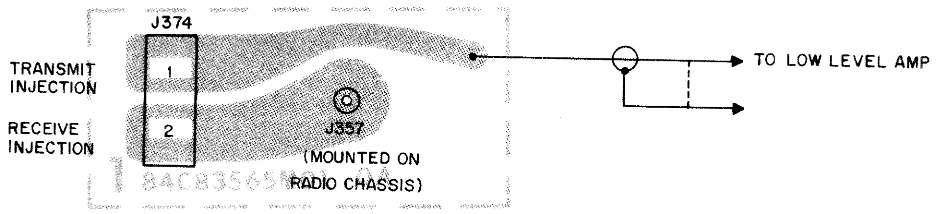
CHANNEL ELEMENT BOARD



SHOWN FROM COMPONENT SIDE

SOLDER SIDE AEPS-30208-O
COMPONENT SIDE AEPS-30207-O
OL AEPS-30206-A

SYNTHESIZER INTERCONNECT BOARD

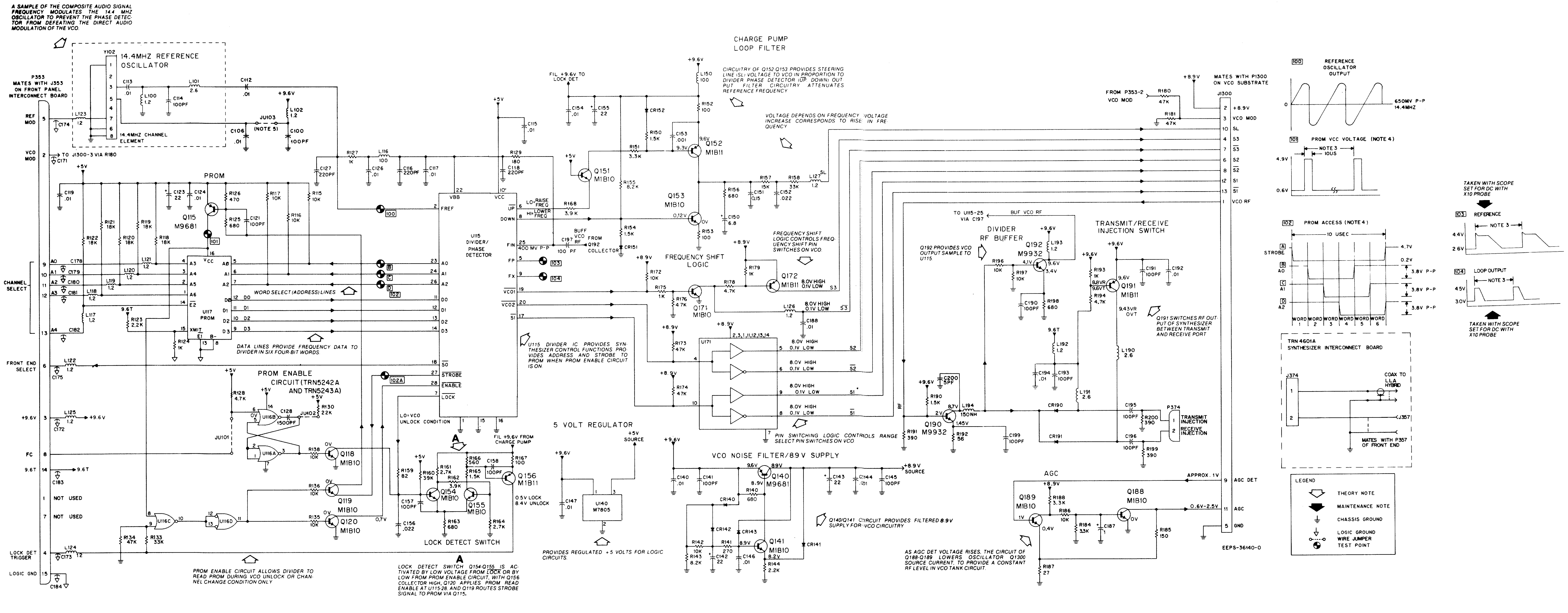


OL -BEPS-30209-O
SOLDER SIDE -BEPS-30211 -O

STANDARD LOCK FREQUENCY SYNTHESIZER

SYNTHESIZER BOARD
SCHEMATIC DIAGRAM

SYNTHESIZER BOARD



NOTES:

1. UNLESS OTHERWISE NOTED, RESISTOR VALUES ARE IN OHMS, CAPACITORS VALUES ARE MICROFARADS, INDUCATOR VALUES ARE IN MICROHENRIES.
2. VOLTAGE DESIGNATION:
   T = TRANSMIT
   R = RECEIVE
3. PERIOD FOR WAVEFORMS AT TEST POINTS 101, 103 and 104 ARE AS FOLLOWS:

   160 USEC AT 6.25 KHZ CHANNEL SPACING
   200 USEC AT 5 KHZ CHANNEL SPACING
   240 USEC AT 4.166 KHZ CHANNEL SPACING
4. WAVEFORM AT 101 AND 102 PRESENT DURING OUT-OF-LOCK OR CHANNEL CHANGE CONDITION.
5. JU103 ALWAYS IN.

FUNCTION

Generates mixer injection signal in receive mode, and low level modulated rf in transmit mode.

68P81064E22-O
(Sheet 3 of 3)
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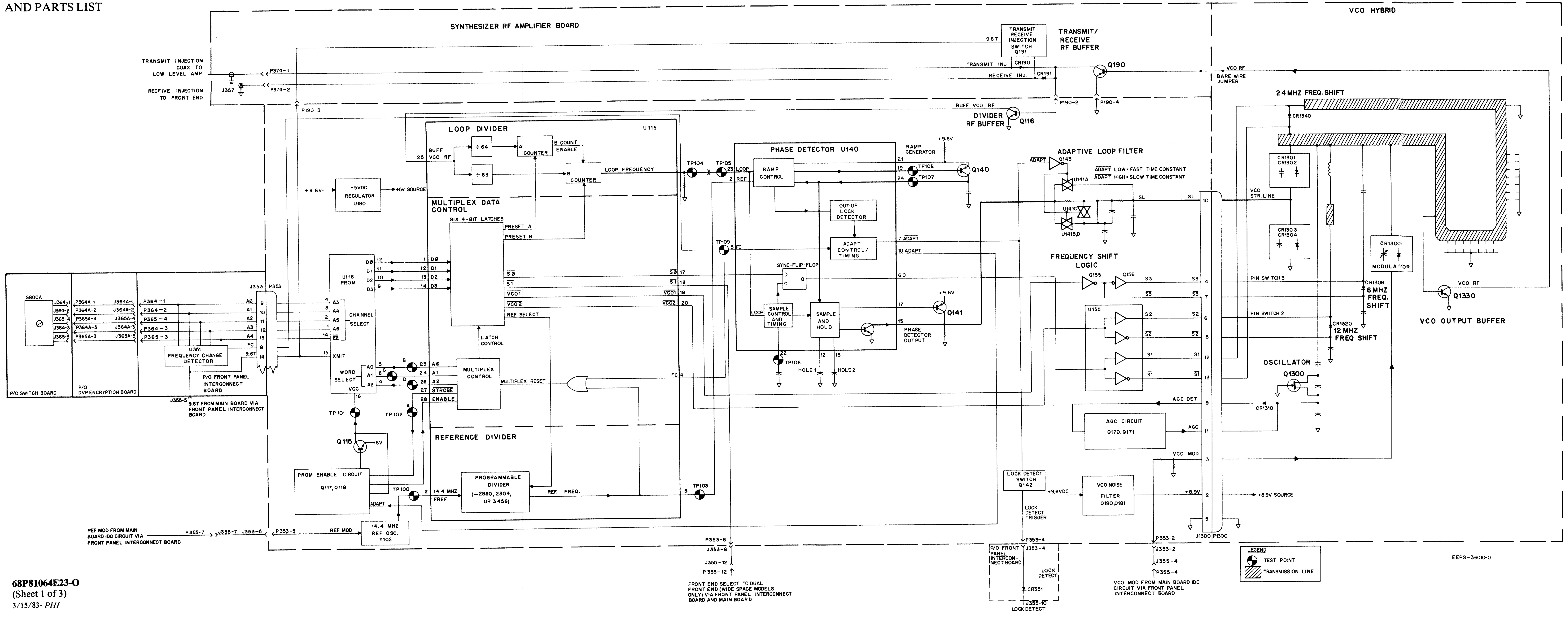
FAST—LOK FREQUENCY SYNTHESIZER

FUNCTIONAL INTERCONNECT DIAGRAM AND PARTS LIST

SYNTHESIZER FUNCTIONAL INTERCONNECT DIAGRAM



68P81064E23-O
(Sheet 1 of 3)
3/15/83- *PHI*

parts list

TRN5129A Synthesizer *Fast-Lok* Board — PL-7858-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: ± 10%; 50 V: unless otherwise stated
C101	21-11025A01	.01 uF ± 20%; 25 V
C103	21-11026F42	100 pF ± 5%
C104	21-11032A21	.01 uF (chip)
C115	21-11032A21	.01 uF (chip)
C116	21-11031A39	100 pF ± 5% (chip)
C118	21-11032A21	.01 uF (chip)
C119, 120, 121	21-11031A51	330 pF ± 5% (chip)
C122, 123, 124	21-11032A21	.01 uF (chip)
C125	21-11031A39	100 pF ± 5% (chip)
C126, 127, 128	21-11031A51	330 pF ± 5% (chip)
C140	21-11032A21	.01 uF (chip)
C141	8-11017B07	.0068 uF
C142	8-80027B02	.0082 uF ± 5%; 100 V
C143	8-11017A01	.001 uF ± 5%
C144	8-80027B02	.0047 uF ± 5%; 100 V
C145	23-84538G03	0.1 uF ± 20%; 35 V
C146	8-00012M01	1 uF; 100 V
C147	8-00013M01	.033 uF; 100 V
C148	23-11013C56	22 uF ± 20%; 15 V
C149	21-11032A21	.01 uF (chip)
C150	23-11019A27	22 uF ± 20%; 25 V
C151	21-00026M37	220 pF (chip)
C152, 153	21-11031A51	330 ± 5% (chip)
C161 thru 174	21-84874K01	470 pF; feed-thru
C176	23-11013G01	0.1 uF (chip)
C180	21-11032A21	.01 uF (chip)
C181	21-11031A51	330 pF ± 5% (chip)
C182	23-11019A27	22 uF ± 20%; 25 V
C183	21-11032A21	.01 uF (chip)
C184	23-11013C56	22 uF ± 20%; 25 V
C185	21-11032A25	.022 uF (chip)
C186	21-11031A51	330 pF ± 5% (chip)
C187, 188	23-11013C56	22 uF ± 20%; 15 V
C189	21-11032A21	.01 uF (chip)
C190	23-11019A27	22 uF ± 20%; 15 V
		diode: (see note)
CR115, 116	48-84399M01	silicon
CR140	48-84399M01	silicon
CR180 thru 183	48-83654H01	silicon
		connector, receptacle:
J1300	9-84321M01	female; 13-contact
		coil, rf:
L100	24-82723H27	choke; 1.2 uH
L101	24-82723H39	choke; 2.6 uH
L102	NOT USED	
L103	24-82723H27	choke; 1.2 uH
L116 thru 124	24-82723H27	choke; 1.2 uH
L140	24-82549D41	choke; 100 uH
L141, 142, 143	24-82723H27	choke; 1.2 uH
L180	24-82723H27	choke; 1.2 uH
L181	24-82549D41	choke; 100 uH
		connector, plug:
P190	28-82040K04	PLUG, 4-contact
P353	29-84322M01	TERMINAL, feed-thru; 15 used
		transistor: (see note)
Q115	48-869681	PNP; type M9681
Q116	48-869932	NPN; type M9932
Q117, 118	48-869642	NPN; type M9642
Q140	48-869548	PNP; type M9548
Q141, 142, 143	48-869643	PNP; type M9643
Q155	48-869642	NPN; type M9642
Q156	48-869643	PNP; type M9643
Q170, 171	48-869642	NPN; type M9642
Q180	48-869681	PNP; type M9681
Q181	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/8 W (chip type): unless otherwise stated
R115, 116, 117	6-11024A65	4.7k
R118 thru 122	6-11024A73	10k
R123	6-11024A57	2.2k
R124, 125	6-11024A49	1k
R126	6-11024A31	180
R127	6-11024A65	4.7k
R128	6-11024A69	6.8k
R129	6-11024A41	470
R130	6-11024A47	820
R131	6-11024A45	680
R132	6-11024A57	2.2k
R133	6-11024A65	4.7k
R134	6-11024A73	10k
R135	6-11024A65	4.7k
R136, 137, 138	6-11024A73	10k
R139	6-11024A57	2.2k
R140	6-11024A29	150
R141	6-11024A35	270
R142	6-11024A36	300
R143	6-11024A11	27
R144	6-11024A65	4.7k
R145	6-11024A73	10k
R146	6-11024A81	22k
R147	6-11020B10	330k (carbon film)
R148	6-11024A73	10k
R149	6-11020A57	2.2k (carbon film)
R150	6-11024A73	10k
R151	6-11024A77	15k
R152	6-11024A65	4.7k
R153	6-11024A81	22k
R154	6-11024A65	4.7k
R156	6-11024A73	10k
R157	6-11024A49	1k
R158, 159	6-11024A65	4.7k
R160	6-11024A49	1k
R161, 162	6-11024A81	22k
R163	6-11024A73	10k
R170	6-11024A61	3.3k
R171	6-11024A11	27
R172	6-11024A29	150
R173	6-11024A73	10k
R174	6-11024A61	3.3k
R175, 176	6-11024A81	22k
R177	6-11024A73	10k
R178	6-11024A65	4.7k
R179	6-11024A89	47k
R180	6-11024A71	8.2k
R181	6-11024A73	10k
R182	6-11024A35	270
R183	6-11024A57	2.2k
R184	6-11024A45	680
		thermistor:
RT140	6-83600K02	1k @ 25°C
		integrated circuit: (see note)
U115	51-84768F63	divider
U116	TRN4666A or	PROM; 1-16 channel
	TRN4670A	PROM; up to 32 channel
U140	51-83977M23	phase detector
U141	51-80073C02	quad analog switch
U155	51-83627M53	line driver
U180	51-83629M17	5 V regulator
		crystal: (see note)
Y102	51-80291B02	oscillator 14.4 MHz
		mechanical parts
	7-83091N01	BRACKET, synthesizer rear
	64-84111M01	PLATE, feed-thru
	75-84112M01	PAD, channel element; 2 used
	3-84208M01	SCREW, feed-thru plate; 4 used
	3-84208M03	SCREW, M2.5
	9-80269B01	IC SOCKET; PROM
	9-82071K09	IC SOCKET; 14-pin (2 used),divider

TRN5218A Synthesizer RF Amplifier/Wall — PL-7857-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: ± 10%; 75 V: unless otherwise stated
C190	21-00026M37	220 pF
C191	21-84511B75	5.6 pF ± 0.25 pF; 200 V
C192, 193	21-00026M24	100 pF
C194	21-00021M01	.01 uF; 50 V
C195	21-00026M37	220 pF
C196	21-00021M01	.01 uF; 50 V
C197	21-00026M37	220 pF
		diode: (see note)
CR190, 191	48-83510F03	silicon
		connector:
J190	29-10134A29	female: single contact; 4 used
		coil, rf:
L190	24-82723H22	150 nH
L191, 192	24-82723H19	choke; 2.6 uH
L193, 194	24-82723H27	choke; 1.2 uH
		transistor: (see note)
Q190	48-869932	NPN; type M9932
Q191	48-02081B11	PNP; type M1B11
		resistor, fixed: ± 5%; 1/8 W: unless otherwise stated
R190	6-185A53	1.5k
R191	6-185A39	390
R192	6-185A19	56
R193		NOT USED
R194	6-185A49	1k
R195	6-185A65	4.7k
R196, 197	6-185A39	390
R198	6-185A83	27k
		mechanical parts
	7-83090N01	BRACKET, mounting
	14-83099N01	INSULATOR, rf buffer; side
	14-83099N02	INSULATOR, rf buffer; top
	26-83092N01	SHIELD, can
	26-82845M01	SHIELD, fast lock

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

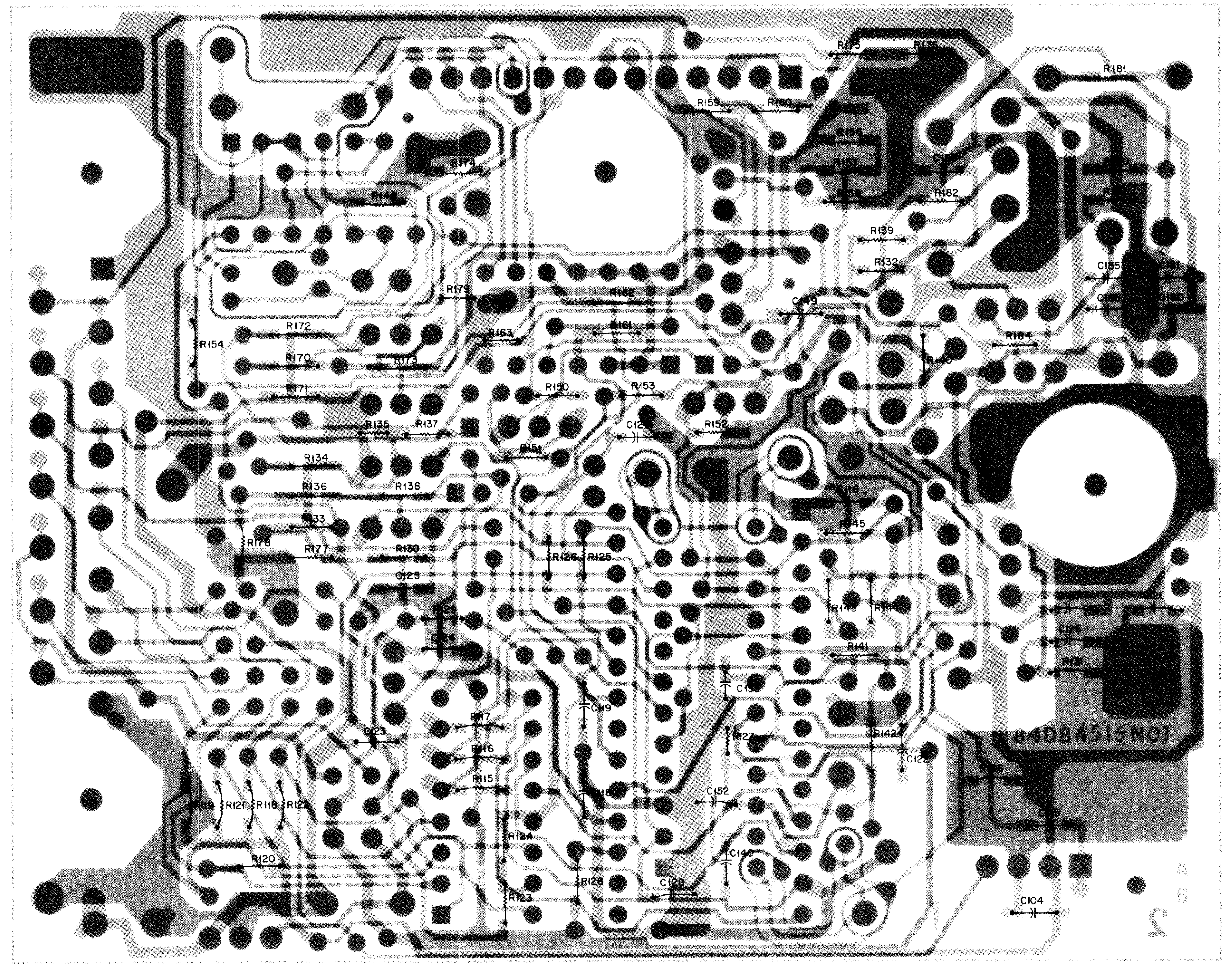
TRN4670A PROM Kit, 32-Channel — PL-7787-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U117	51-80070C03	32-channel PROM (standard lock)
U116	51-80070C03	32-channel PROM (fast-lock)

note: This is part number of non-programmed PROM module. Order programmed PROM modules from factory on *MCX100* Supplementary Order Form.

FAST—LOK
FREQUENCY SYNTHESIZER
CIRCUIT BOARD DETAILS

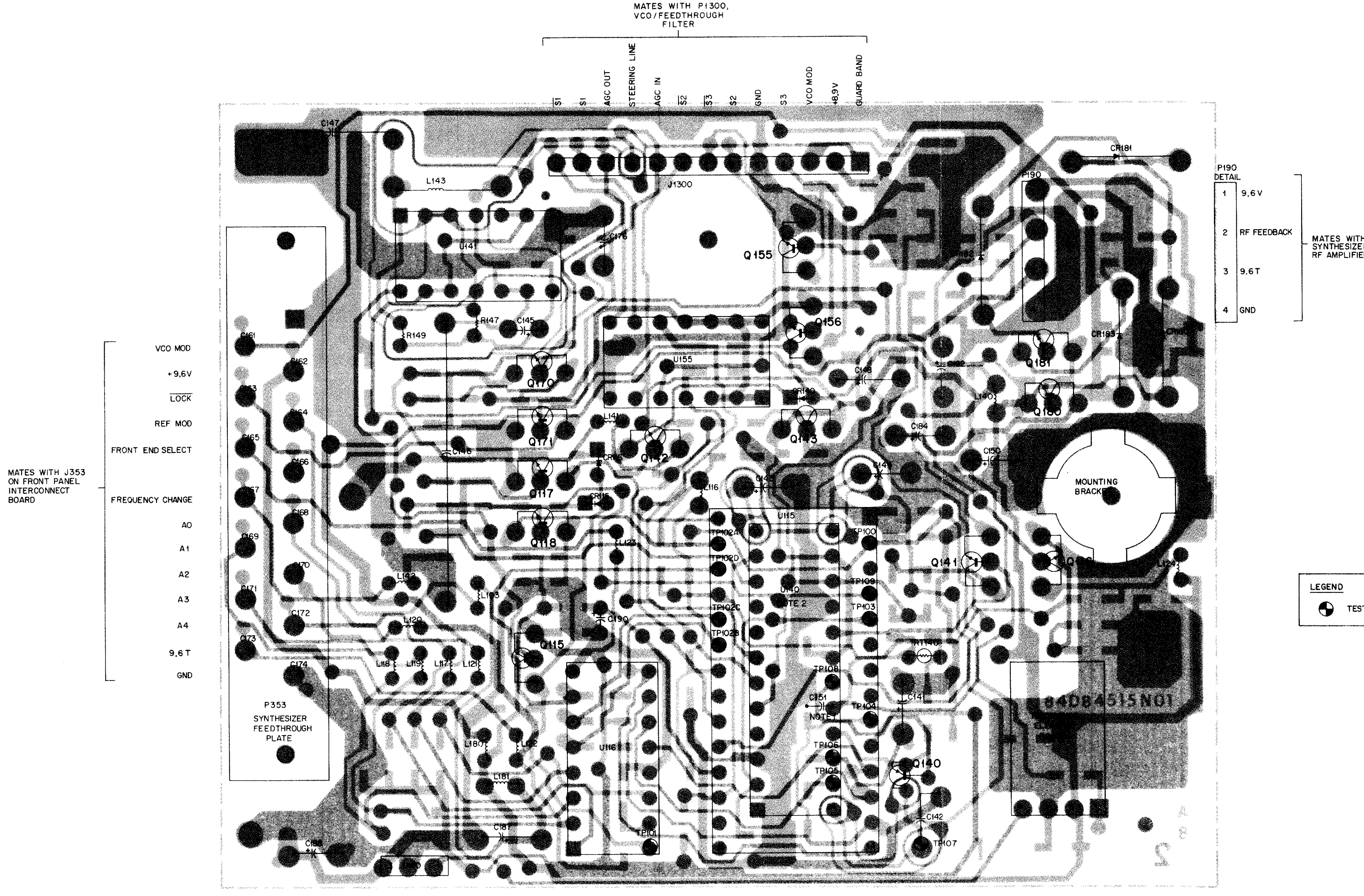
SYNTHESIZER BOARD — SOLDER SIDE CHIP COMPONENTS



SHOWN FROM SOLDER SIDE

OL EEPS-33751-A
SOLDER SIDE BD EEPS-33749-A
COMPONENT SIDE BD EEPS-33750-A

SYNTHESIZER BOARD — COMPONENT SIDE COMPONENTS



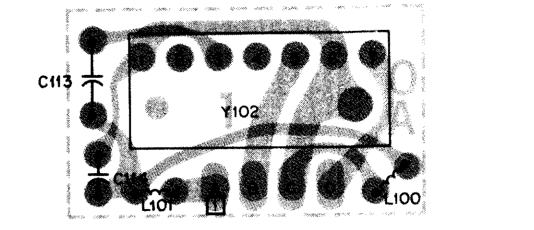
SHOWN FROM SOLDER SIDE

OL EEPS-33748-A
SOLDER SIDE BD EEPS-33749-A
COMPONENT SIDE BD EEPS-33750-A

NOTES:
1. C151 IS MOUNTED ON SOLDER SIDE OF BOARD.
2. U140 IS MOUNTED BELOW U115 ON COMPONENT SIDE OF BOARD.

LEGEND
TEST POINT

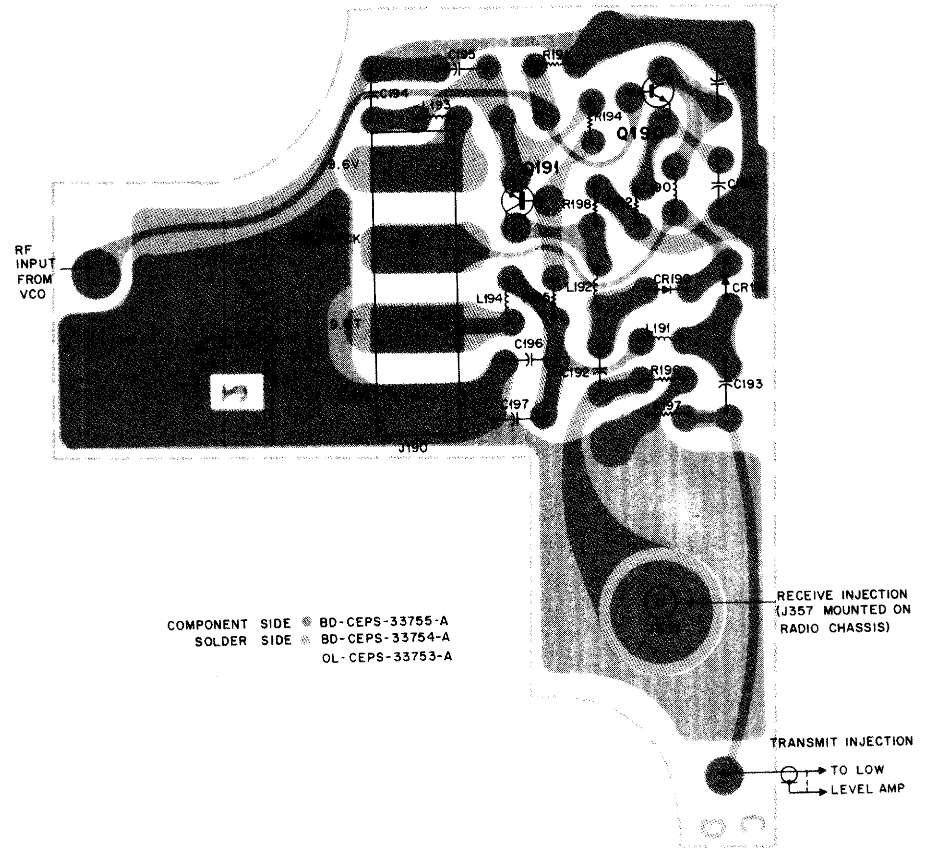
CHANNEL ELEMENT BOARD



SHOWN FROM COMPONENT SIDE

SOLDER SIDE AEPS-30208-O
COMPONENT SIDE AEPS-30207-O
OL AEPS-30206-A

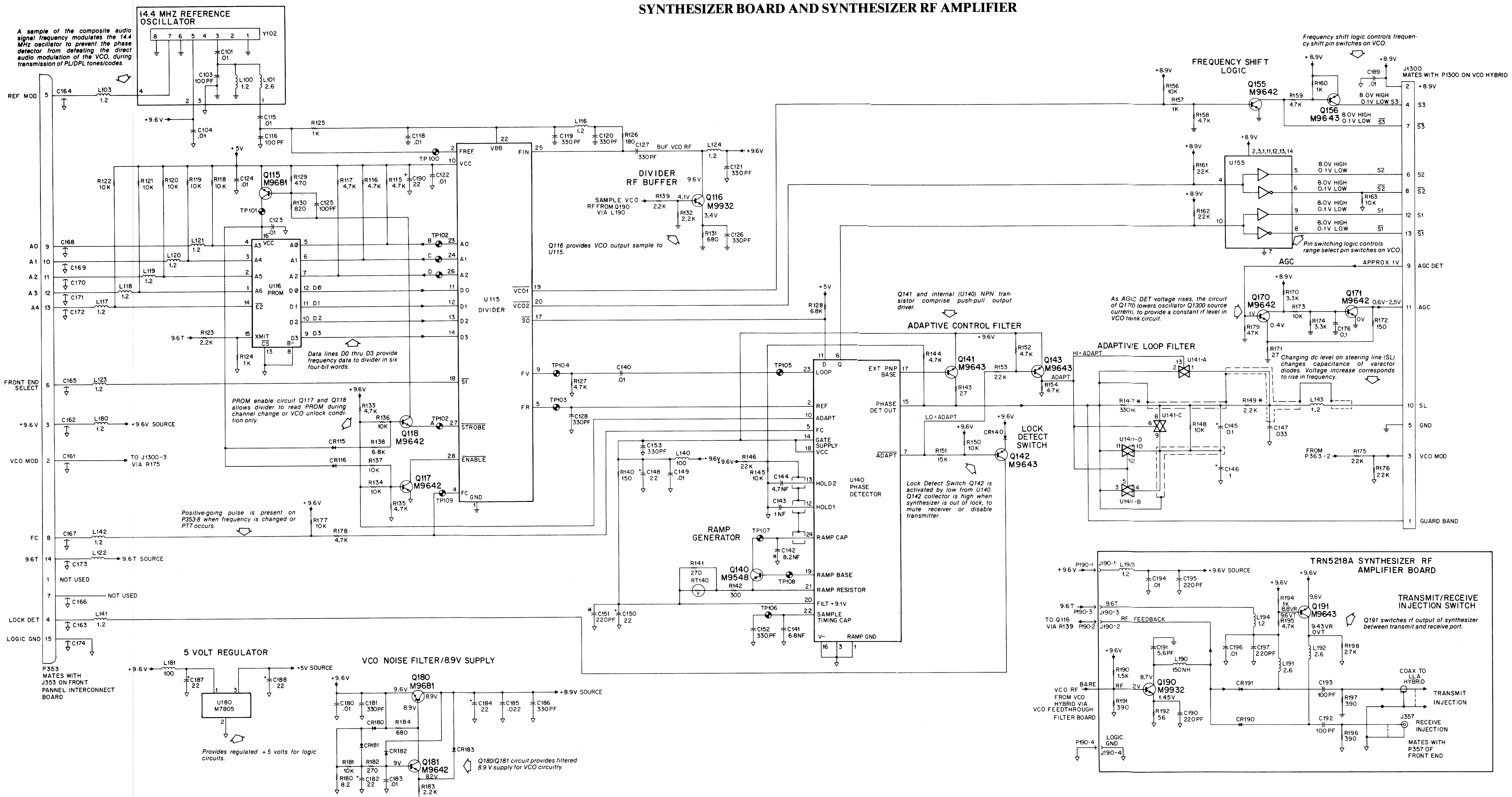
SYNTHESIZER RF AMPLIFIER BOARD

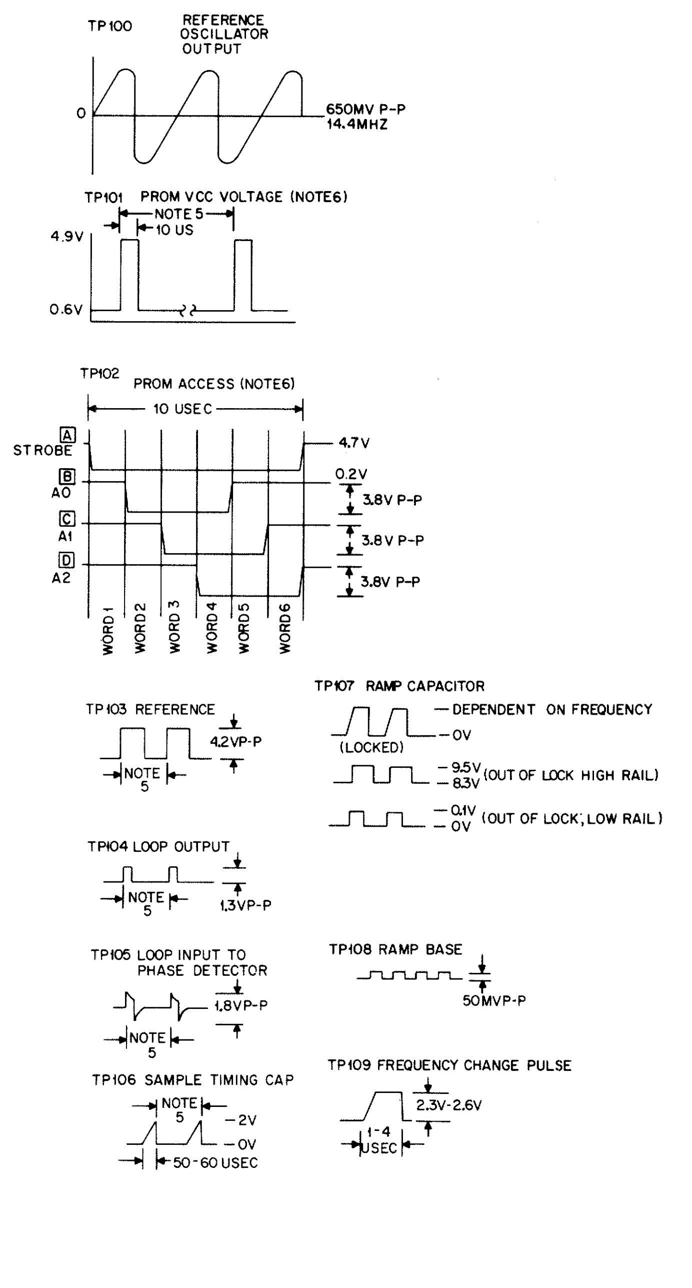


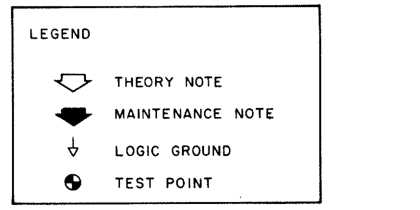
COMPONENT SIDE BD-CEPS-33755-A
SOLDER SIDE BD-CEPS-33754-A
OL-CEPS-33753-A

SHOWN FROM SOLDER SIDE

SYNTHESIZER BOARD AND SYNTHESIZER RF AMPLIFIER







FAST—LOK FREQUENCY SYNTHESIZER

SYNTHESIZER BOARD
SCHEMATIC DIAGRAM

FUNCTION

Controls voltage controlled oscillator (VCO) to generate mixer injection signal in receive mode, and low level modulated rf in transmit mode.

Fast-Lok Synthesizer Option
Model Complement Chart

TRN5129A	*Fast-Lok Synthesizer Board*
TRN5218A	*Synthesizer RF Amplifier/Wall*

Note: Refer to VCO Instruction Section for VCO models.

NOTES:

1. Unless otherwise noted, resistor values are in ohms, capacitor values are in microfarads, inductor values are in microhenries.
2. All resistors, except those marked with an asterisk (*) are chip components mounted to solder side of circuit board.
3. All capacitors are chip components mounted to solder side of circuit board, except electrolytic (polarized) capacitors, and those marked with an asterisk (*).
4. Voltage designations:
   T = Transmit
   R = Receive
5. Period for waveforms at test points 101, 103, 104, 105, and 106 are as follows:
   160 usec at 6.25 kHz channel spacing
   200 usec at 5 kHz channel spacing
   240 usec at 4.166 kHz channel spacing
6. Waveform at TP101 and 102 present during out-of-lock or channel change condition.
7. Dashed lines denote "guard band" shields, which consist of plating around portions of circuitry.

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(Sheet 3 of 3)
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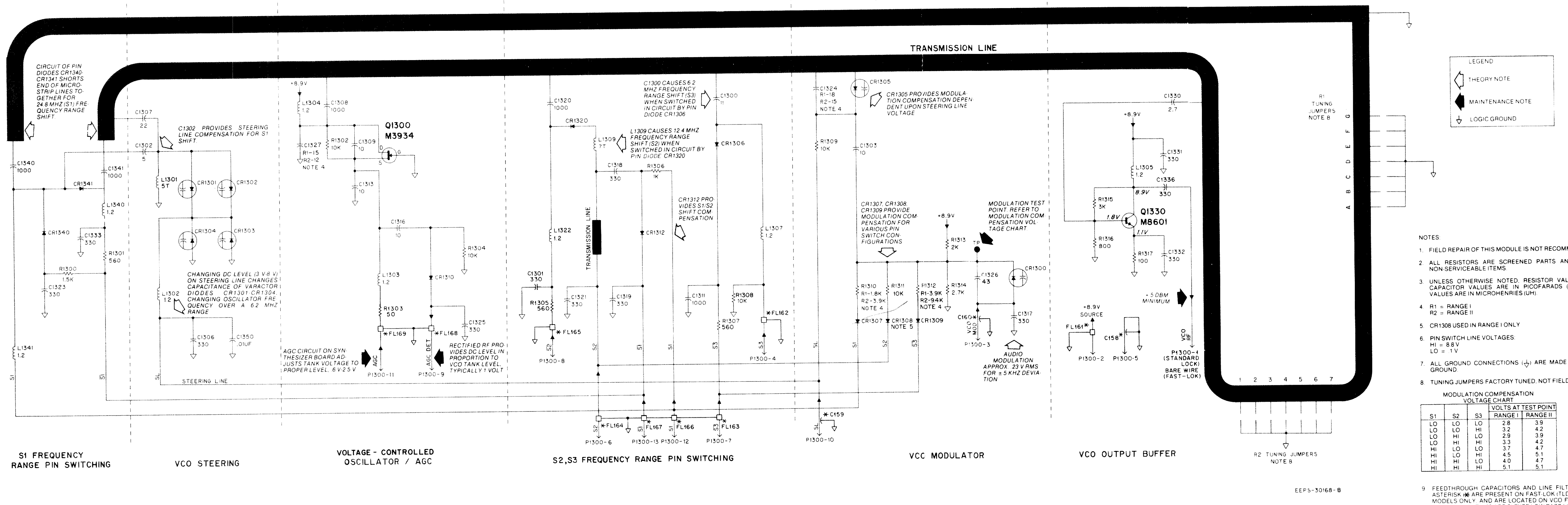
FAST—LOK FREQUENCY SYNTHESIZER/VOLTAGE CONTROLLED OSCILLATOR

VOLTAGE CONTROLLED OSCILLATOR

MODELS TLD2441A/TLD2442A STANDARD LOCK
AND TLD2541A/TLD2542A *FAST—LOK*

VCO SCHEMATIC



NOTES:

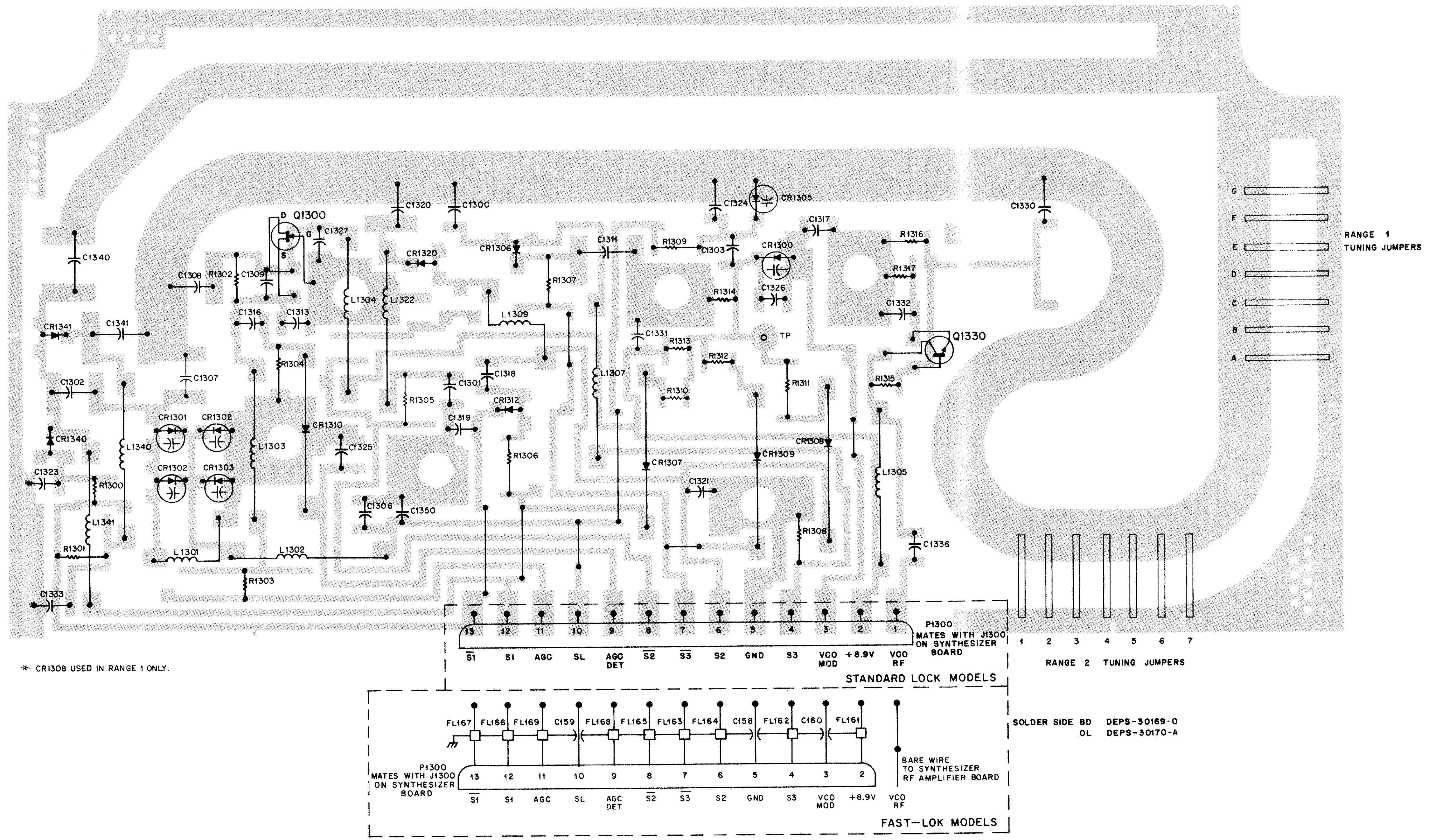
1. FIELD REPAIR OF THIS MODULE IS NOT RECOMMENDED.
2. ALL RESISTORS ARE SCREENED PARTS AND ARE THEREFORE NON-SERVICEABLE ITEMS.
3. UNLESS OTHERWISE NOTED, RESISTOR VALUES ARE IN OHMS, CAPACITOR VALUES ARE IN PICOFARADS (PF) AND INDUCTOR VALUES ARE IN MICROHENRIES (UH).
4. R1 = RANGE I
   R2 = RANGE II
5. CR1308 USED IN RANGE I ONLY
6. PIN SWITCH LINE VOLTAGES:
   HI = 8.8 V
   LO = .1 V
7. ALL GROUND CONNECTIONS (⏚) ARE MADE TO RADIO LOGIC/RF GROUND.
8. TUNING JUMPERS FACTORY TUNED, NOT FIELD ADJUSTABLE.

MODULATION COMPENSATION VOLTAGE CHART

S1	S2	S3	VOLTS AT TEST POINT RANGE I	VOLTS AT TEST POINT RANGE II
LO	LO	LO	2.8	3.9
LO	LO	HI	3.2	4.2
LO	HI	LO	2.9	3.9
LO	HI	HI	3.3	4.2
HI	LO	LO	3.7	4.7
HI	LO	HI	4.5	5.1
HI	HI	LO	4.0	4.7
HI	HI	HI	5.1	5.1

9. FEEDTHROUGH CAPACITORS AND LINE FILTERS DESIGNATED BY ASTERISK (✱) ARE PRESENT ON FAST-LOK (TLD2541A AND TLD2542A) MODELS ONLY, AND ARE LOCATED ON VCO FEEDTHROUGH FILTER BOARD. FL161-FL169 ARE PI-TYPE LOW PASS LINE FILTERS.

VCO HYBRID



VOLTAGE CONTROLLED OSCILLATOR

MODELS TLD2441A/TLD2442A STANDARD LOCK
TLD2541A/TLD2542A *FAST—LOK*

parts list

TRN5217A VCO Filter Kit — PL-7856-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C158, 159, 160	21-80234C01	470 pF; feed-thru
		filter:
FL161 thru 169	91-87511C02	feed-thru
		connector, plug:
P1300	28-84318M15	male; 12-contact
	mechanical parts	
	22-83317N01	PIN, feed-thru; 13 used
	29-84322M04	TERMINAL
	64-83093N01	PLATE, feed-thru

TLD9122A VCO Kit, Range 1
TLD9123A VCO Kit, Range 2
TLD9301A VCO, *Fast-Lok* Range 1
TLD9302A VCO, *Fast-Lok* Range 2 — PL-7168-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ± 5%; 50 V; unless otherwise stated:
C1300	21-84296M01	11
C1301	21-84873H98	330 ± 10%
C1302	21-84736E07	5.1 ± 0.25 pF
C1303	21-84873H76	10
C1306	21-84873H98	330 ± 10%
C1307	21-84736E13	22
C1308	21-84873H13	1000
C1309	21-84736E30	10 ± 0.5 pF
C1311	21-84873H13	1000
C1313, 1316	21-84873H76	10
C1317, 1318, 1319	21-84873H98	330 ± 10%
C1320	21-84873H13	1000
C1321, 1323	21-84873H98	330 ± 10%
C1324 (R1)	21-84873H86	18 ± 2%
C1324 (R2)	21-84873H97	15
C1325	21-84873H98	330 ± 10%
C1326	21-84873H88	43
C1327 (R1)	21-84873H97	15
C1327 (R2)	21-84873H77	12
C1330	21-84873H60	2.7 ± .25 pF
C1331, 1332, 1333, 1336	21-84873H98	330 ± 10%
C1340, 1341	21-84873H13	1000
C1350	21-84547A11	.01 uF
		diode: (see note)
CR1300 - 1305	48-82190H57	varactor
CR1306	48-84622E02	silicon
CR1307, 1308, 1309	48-83654H01	silicon
CR1310	48-84616A01	hot carrier
CR1312, 1320, 1340, 1341	48-84622E02	silicon
		coil, rf:
L1301	24-84331M39	5 turns
L1302 - 1305, 1307	24-82723H27	choke; 1.2 uH
L1309	24-84331M40	7 turns
L1322, 1340, 1341	24-82723H27	choke; 1.2 uH
		connector:
P1300	31-84107M01	terminal, header
		transistor: (see note)
Q1300	48-84939C34	field-effect; type M3934
Q1330	48-84086J01	NPN; type M8601
	mechanical parts	
	42-83894N01	CLIP; 2 used
	31-83318N01	TERMINAL STRIP (TLD9301A, TLD9302A only)

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

FUNCTION

Generates mixer injection signal in receive mode, and low level modulated rf in transmit mode. Controlled by synthesizer board.

Standard Lock VCO Model Complement Chart

TLD2441A VCO Assembly RI	
TLD9122A	VCO Hybrid
TRN4703A	Carrier Plate
TLD2442A VCO Assembly RII	
TLD9123A	VCO Hybrid
TRN4703A	VCO Carrier Plate

Note: When replacing VCO hybrid, order VCO Assembly for applicable range (TLD2441A or TLD2442A)

Fast—Lok VCO Model Complement Chart

TLD2541A VCO/Feed-thru Filter RI	
TLD9311A	VCO/Carrier RI
TRN5217A	VCO Filter
TLD2542A VCO/Feed-thru Filter RII	
TLD9312A	VCO/Carrier RII
TRN5217A	VCO Filter
TLD9311A VCO/Carrier RI	
TLD9301A	VCO RI
64-83089N01	Carrier Plate
TLD9312 VCO/Carrier RII	
TLD9302A	VCO RII
64-83089N01	Carrier Plate

Note: When replacing VCO hybrid, order VCO/Carrier Kit for applicable range (TLD9311A or TLD9312A).

DIGITAL VOICE PROTECTION (*DVP*)

CIRCUIT MODULE
MODEL VLN1009A

parts list

VLN4127A Interface Board — PL-8350-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C101	23-82397D25	0.27 uF ± 10%; 20 V
C106	23-82397D52	1.0 uF ± 20%; 20 V
C108	23-82397D03	10 uF ± 20%; 6 V
C112	21-84547A13	0.1 uF ± 10%; 50 V
C119	23-82397D52	1.0 uF ± 20%; 20 V
C120	23-82397D16	22 uF ± 20%; 15 V
C121	21-11032A09	1000 pF ± 10%; 50 V (chip)
C123	23-84538G14	1 uF ± 10%; 35 V
C128	23-82397D15	10 uF ± 20%; 20 V
C129	23-82397D16	22 uF ± 20%; 15 V
C130	21-11032A09	1000 pF ± 10%; 50 V (chip)
C139	21-11032A09	1000 pF ± 10%; 50 V (chip)
		diode: (see note)
CR101, 102, 103	48-84939C33	silicon
CR113	48-84939C33	silicon
CR117	48-84939C35	hot carrier
CR119, 120	48-84939C33	silicon
CR124	48-84939C33	silicon
		connector:
J101	28-82288N03	male; 25 contact
P105	9-83880M13	female; 26 contact
		transistor: (see note)$
Q101, 102, 103, 104	48-05148G06	NPN; (chip)
Q105	48-05448G05	PNP; (chip)
Q110, 111	48-05148G06	NPN; (chip)
Q112	48-05148G05	PNP; (chip)
Q114	48-05148G06	NPN; (chip)
Q116, 117	48-05148G06	NPN; (chip)
		resistor, fixed: ± 5%; 1/8 W: unless otherwise stated
R101, 102	6-11024A89	47k (chip)
R103, 104, 105	6-11024A97	100k (chip)
R107	6-11024A81	22k (chip)
R108	6-11024A73	10k (chip)
R109	6-11029A89	47k (chip)
R110, 111	6-11024A73	10k (chip)
R112	6-11024A89	47k (chip)
R127	6-11024A97	100k (chip)
R128	6-11024A93	68k (chip)
R141	6-11024A89	47k (chip)
R145, 146	6-11024A65	4.7k (chip)
R147	6-11024A89	47k (chip)
R148	6-11024A81	22k (chip)
R149	6-11024A97	100k (chip)
R157	6-11024A97	100k (chip)
R158	18-83452F33	variable; 25k
R159, 160	6-11024A97	100k (chip)
R161	18-83452F33	variable; 25 V
R164	6-11024A97	100k (chip)
R167	6-11024A89	47k (chip)
R169	6-11024A22	82 (chip)
R170	6-11024A97	100k (chip)
R177	6-11024A97	100k (chip)
R179	6-11024A03	12 (chip)
R181	6-11024A97	100k (chip)
R183	6-11024A87	39k
R185	6-11024A73	10k (chip)
		integrated circuit: (see note)
U105	51-82884L65	analog switch
U108	51-82884L61	hex mutli-function

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

VKN4020A Carrier Squelch Cable Kit — PL-8363-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
J352	9-82301N01	female; 22 contact
P101	9-84319M18	female; 25 contact
P101 thru 1004	39-10184A73	contact, receptacle
		mechanical part
	42-10217A02	STRAP, cable; 5 used

68P81064E24-O
(Sheet 1 of 2)
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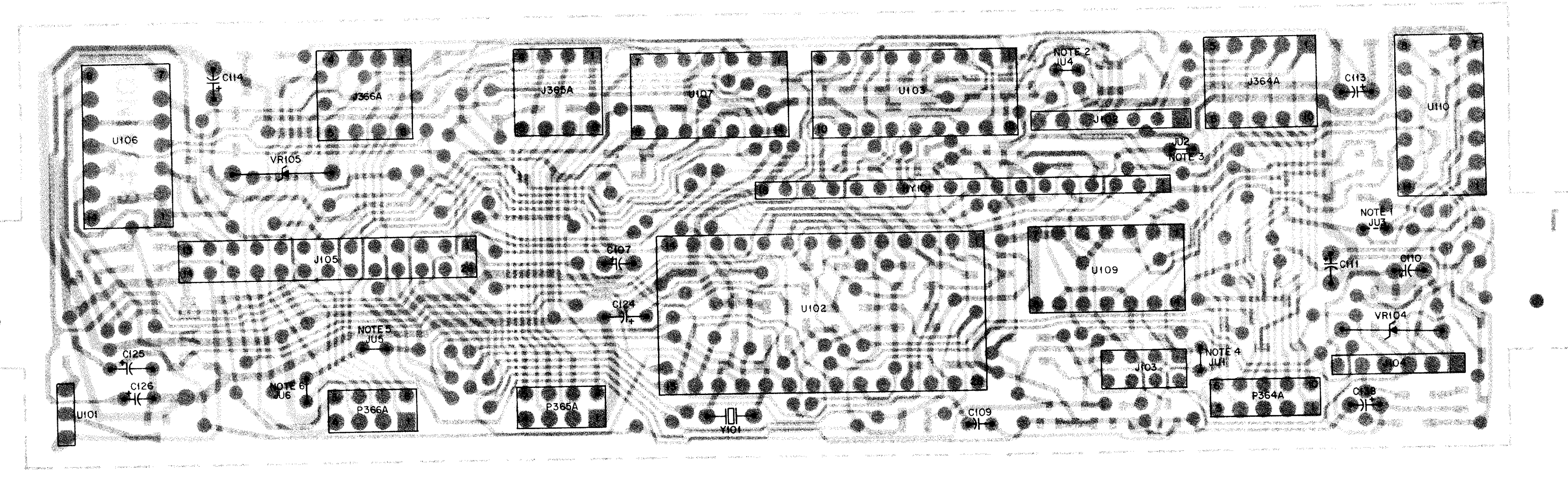
ENCRYPTION BOARD



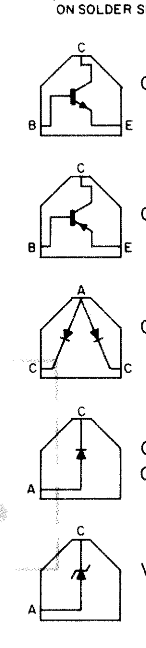
SHOWN FROM COMPONENT SIDE

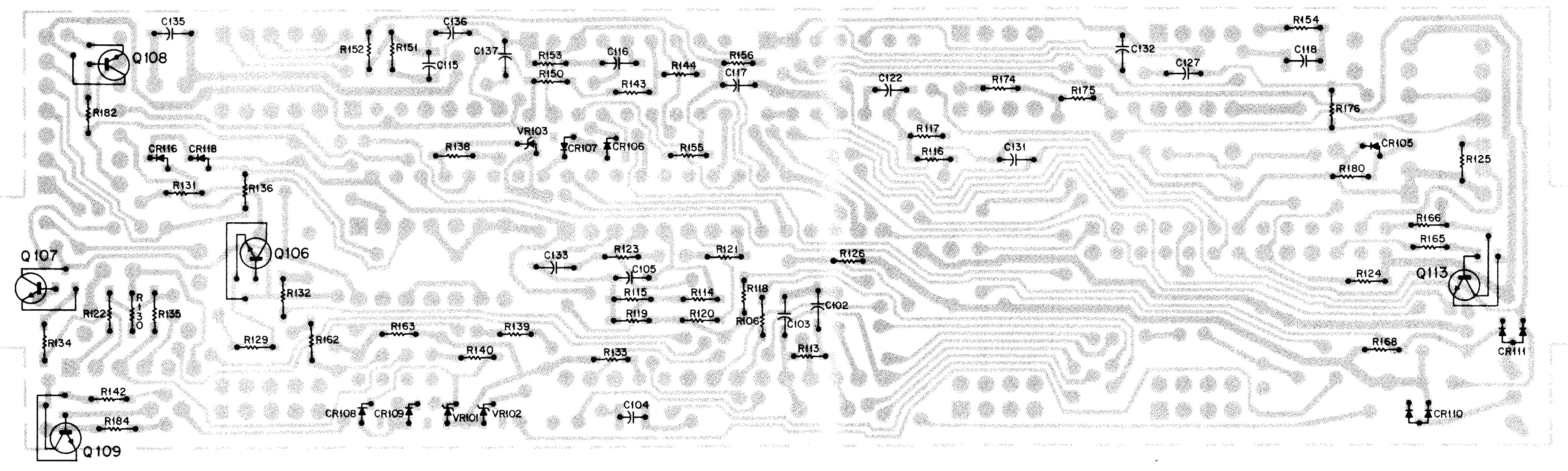
COMPONENT SIDE - DEPS-35908-O
SOLDER SIDE - DEPS-35909-O
OL - DEPS-35910-O

NOTES:

1. JU3 jumper is always removed.
2. JU4 jumper is always installed.
3. JU2 jumper is removed for dual code option.
4. JU1 jumper is always installed.
5. JU5 jumper is always installed.
6. JU6 jumper is removed for Single Tone and Select 5 models only.

TRANSISTOR/DIODE DETAILS
(AS VIEWED FROM TOP OF COMPONENTS ON SOLDER SIDE OF BOARD)

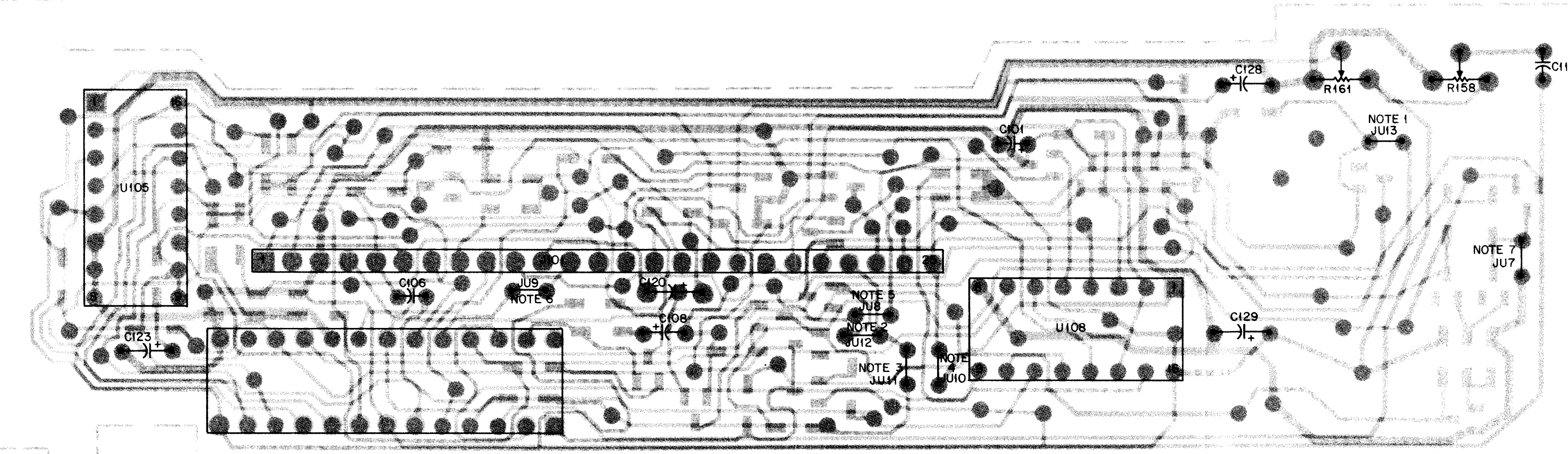




SHOWN FROM SOLDER SIDE

SOLDER SIDE : DEPS-35926-O
SSOL : DEPS-35911-O

INTERFACE BOARD



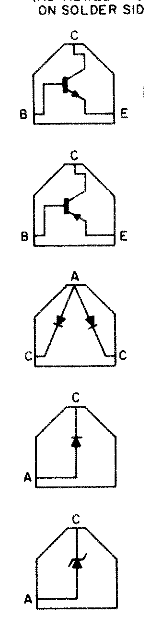
SHOWN FROM COMPONENT SIDE

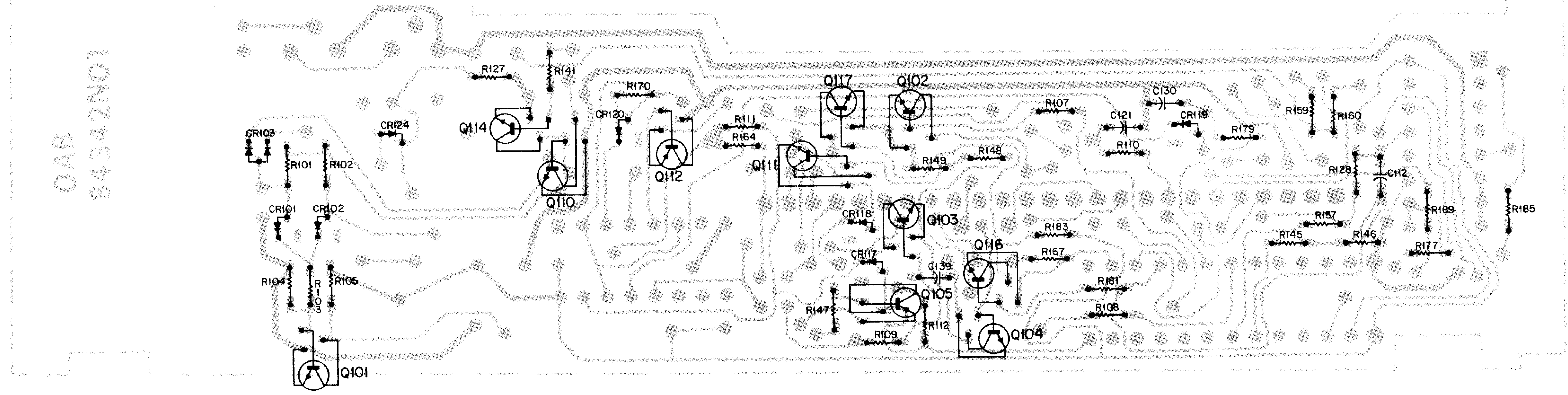
COMPONENT SIDE : BD-DEPS-35912-O
SOLDER SIDE : BD-DEPS-35913-O
OL- DEPS-35914-O

NOTES:

1. JU13 jumper is installed in Select 5 models only.
2. JU12 jumper is removed for Select 5 models only.
3. JU11 jumper is installed in Select 5 models only.
4. JU10 jumper is removed in PL and single tone models only.
5. JU8 jumper is installed in radios with proper code or carrier squelch.
6. JU9 jumper is removed when alert tone is not desired.
7. JU7 jumper is installed for special applications only.

TRANSISTOR/DIODE DETAILS
(AS VIEWED FROM TOP OF COMPONENTS ON SOLDER SIDE OF BOARDS)





SHOWN FROM SOLDER SIDE

SOLDER SIDE : BD-DEPS-35927-O
SSOL : OL-DEPS-35915-O

parts list

VLN4126A Encryption Board — PL-8349-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C102, 103	21-11031B26	30 pF ± 6%; 50 V (chip)
C104	21-84296M08	0033 uF ± 5%; 50 V (chip)
C105	21-11031D53	390 pF ± 0.5 pF; 50 V (chip)
C107	23-84538G14	1 uF ± 10%; 35 V
C109	23-82397D52	1 uF ± 20%; 20 V
C110, 111	23-84538G14	1 uF ± 10%; 35 V
C113, 114	23-84538G14	1 uF ± 10%; 35 V
C115	21-84296M07	.0022 uF ± 5%; 50 V (chip)
C116, 117	21-11032A23	.015 uF ± 10%; 50 V (chip)
C118	21-84547A13	0.1 uF ± 10%; 50 V (chip)
C122	21-11031A34	62 pF ± 5%; 50 V (chip)
C124	23-82397D15	10 uF ± 20%; 20 V
C125	23-82397D16	22 uF ± 20%; 15 V
C126	23-84538G14	1 uF ± 10%; 35 V
C127	21-11031A34	62 pF ± 50%; 50 V (chip)
C131, 132, 133	21-11031A34	62 pF ± 5%; 50 V (chip)
C135, 136, 137	21-11031A34	62 pF ± 5%; 50 V (chip)
C138	23-84538G14	1 uF ± 10%; 35 V
		diode: (see note)
CR105 thru 109	48-84939C35	hot carrier
CR110, 111	48-84939C33	silicon
CR116	48-84939C35	hot carrier
CR118	48-8439C35	hot carrier
		connector:
J103	28-84528K20	male; 8 contact
J104	28-84318M29	male; 6 contact
J105	28-84528K47	male; 26 contact
J364A	9-83880M01	female; 10 contact
J365A, 366A	9-83880M02	female; 8 contact
P364A	28-83186M14	male; 10 contact
P365A, 366A	28-83186M13	male; 8 contact
		transistor: (see note)
Q106, 107	48-05148G06	NPN (chip)
Q108	48-05148G05	PNP (chip)
Q109	48-05148G06	NPN (chip)
Q113	48-05148G06	NPN (chip)
		resistor fixed: ± 5%; 1/8 W: unless otherwise stated
R106	6-11024A97	100k (chip)
R113	6-11024B22	1 meg. (chip)
R114	6-11024A93	68k (chip)
R115	6-11024A69	6.8k (chip)
R116	6-11024A93	68k (chip)
R117	6-11024B06	220k (chip)
R118	6-11024A93	68k (chip)
R119	6-11024A49	1k (chip)
R120	6-11024B22	1 meg. (chip)
R121	6-11024A65	4.7k (chip)
R122	6-11024A49	1k (chip)
R123	6-11024A73	10k (chip)
R124	6-11024A89	47k (chip)
R125	6-11024A89	47k (chip)
R126	6-11024A97	100k (chip)
R129	6-11024A32	200 (chip)
R130	6-11024A87	39k (chip)
R131	6-11024A93	68k (chip)
R132, 133	6-11024A97	100k (chip)
R134	6-11024A32	200 (chip)
R135	6-11024A87	39k (chip)
R136	6-11024A93	68k (chip)
R138, 139, 140	6-11024A47	820 (chip)
R142	6-11024A41	470 (chip)
R143	6-11024A97	100k (chip)
R144	6-11024A69	6.8k (chip)
R150	6-11024A97	100k (chip)
R151	6-11024B14	470k (chip)
R152	6-11024B06	220k (chip)
R153	6-11024A87	39k (chip)
R154	6-11024A69	6.8k (chip)
R155, 156	6-11024B14	470k (chip)
R162, 163	6-11024A57	2.2k (chip)
R165	6-11024A89	47k (chip)
R166	6-11024A73	10k (chip)
R168	6-11024B14	470k (chip)
R174, 175	6-11024A89	47k (chip)
R176	6-11024B14	470k (chip)
R180	6-11024B06	220k (chip)
R182	6-11024A41	470 (chip)
R184	6-11024A89	47k (chip)
		integrated circuit: (see note)
U101	51-84561L86	5V-regulator
U102	51-83977M38	control and interface
U103	51-83977M33	CVSD and detector
U106	51-82884L06	3-input NAND gate:
U107	51-84561L75	Quad operational amplifier
U109	51-82884L13	D-flip-flop
U110	51-82884L63	hex inverting

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		voltage regulator: (see note)
VR101, 102, 103	48-84904N01	Zener type; 10 V (chip)
VR104, 105	48-82297D16	Zener type; 13 V
		crystal: (see note)
Y101	48-82611M12	3072 kHz
		mechanical part
	14-05160A01	INSULATOR

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

VLN4128A *DVP* Extension Hardware — PL-8351-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-84208M01	SCREW, tapping M3 x 0.5 x 8; 2 used
	15-84663N02	CASTING, chassis extension
	2-84334M01	NUT, M3
	3-84208M01	SCREW, tapping 3-0.5 x 8; 5 used
	42-84940N01	CLIP, bracket

VLN4129A Key Loading Kit — PL-8352-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
P103	14-84277D17	housing, 8 contact
		mechanical parts
	15-84663N01	CASTING, chassis extension
	9-84279D03	CONTACT, female; 5 used
	9-80263D01	KEY, plug receptacle

NOTES:

1. Unless otherwise indicated: resistor values are in ohms, and capacitor values are in mmicrofarads.
2. This diagram shows positive logic:

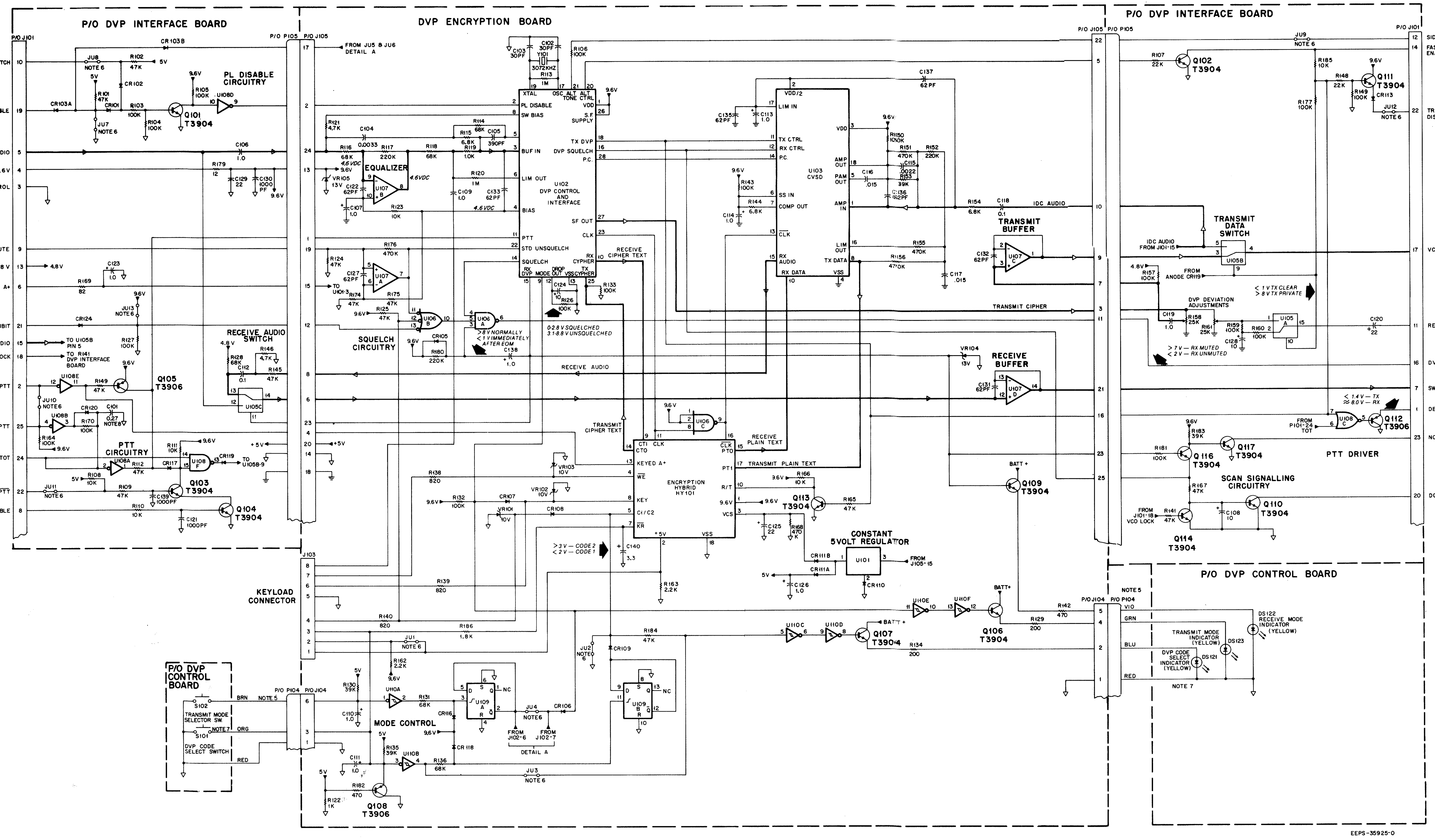
   Logic "1" greater than 70% of supply voltage
   Logic "0" less than 30% of supply voltage
3. Integrated circuits on this board are CMOS devices.
4. IC types and connections for this board are as follows:

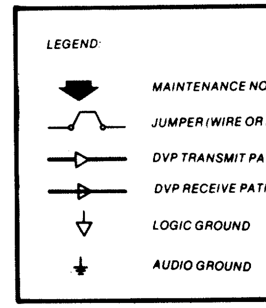
Reference Designation	Manufacturer's Description	Vcc	Gnd
U101	5 V Regulator	1	2
U102	Control and Interface	1	13
U103	CVSD	3	4
U104	Not Used		
U105	Quad Analog Switch	16	8
U106	3-Input NAND Gate	14	7
U107	Quad Op Amp	11	4
U108	Hex Multifunction Gate	16	8
U109	D Flip-Flop	14	7
U110	Hex Inverter	14	7

5. Cabling and connectors from J104 on DVP Encryption Board to the DVP Control Board are shown for dash mount radios only. For remote mount radio cabling, refer to "Remote Radio Set Cabling" diagram.
6.

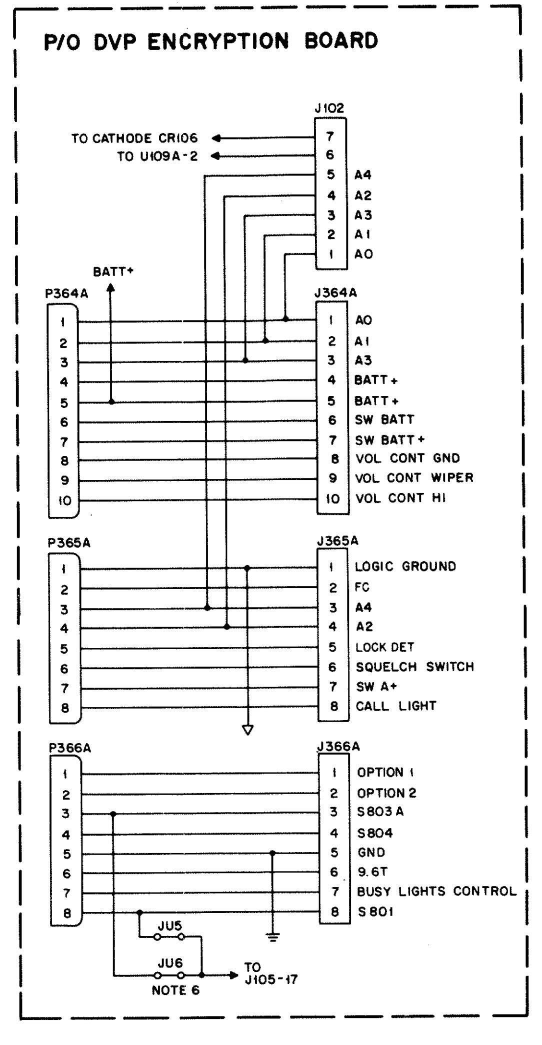
Jumper	Usage Description
JU1	Always In
JU2	Out for Dual Code Option
JU3	Always Out
JU4	Always In
JU5	Always In
JU6	Out for Single Tone and Select 5 Models Only
JU7	In for Special Applications Only
JU8	In for Radios With Proper Code or Carrier Squelch
JU9	Out if Alert Tone Not Wanted
JU10	Out for PL and Single Tone Models Only
JU11	In for Select 5 Models
JU12	Out for Select 5 Models Only
JU13	In for Select 5 Radios Only

7. Used only in radios equipped with dual code.
8. C101 is in for Single Tone and Select 5 models only.





DETAIL A



DIGITAL VOICE PROTECTION (*DVP*)

CIRCUIT MODULE
MODEL VLN1009A

FUNCTION

These boards contain the circuitry necessary to perform all the *DVP* functions. Audio conversion and reconstruction, plain text encryption and cipher text decryption, as well as the generation of necessary *DVP* control signals are done on the Encryption board. Most of the circuitry required to interface with the rest of the radio circuitry is on the Interface board.

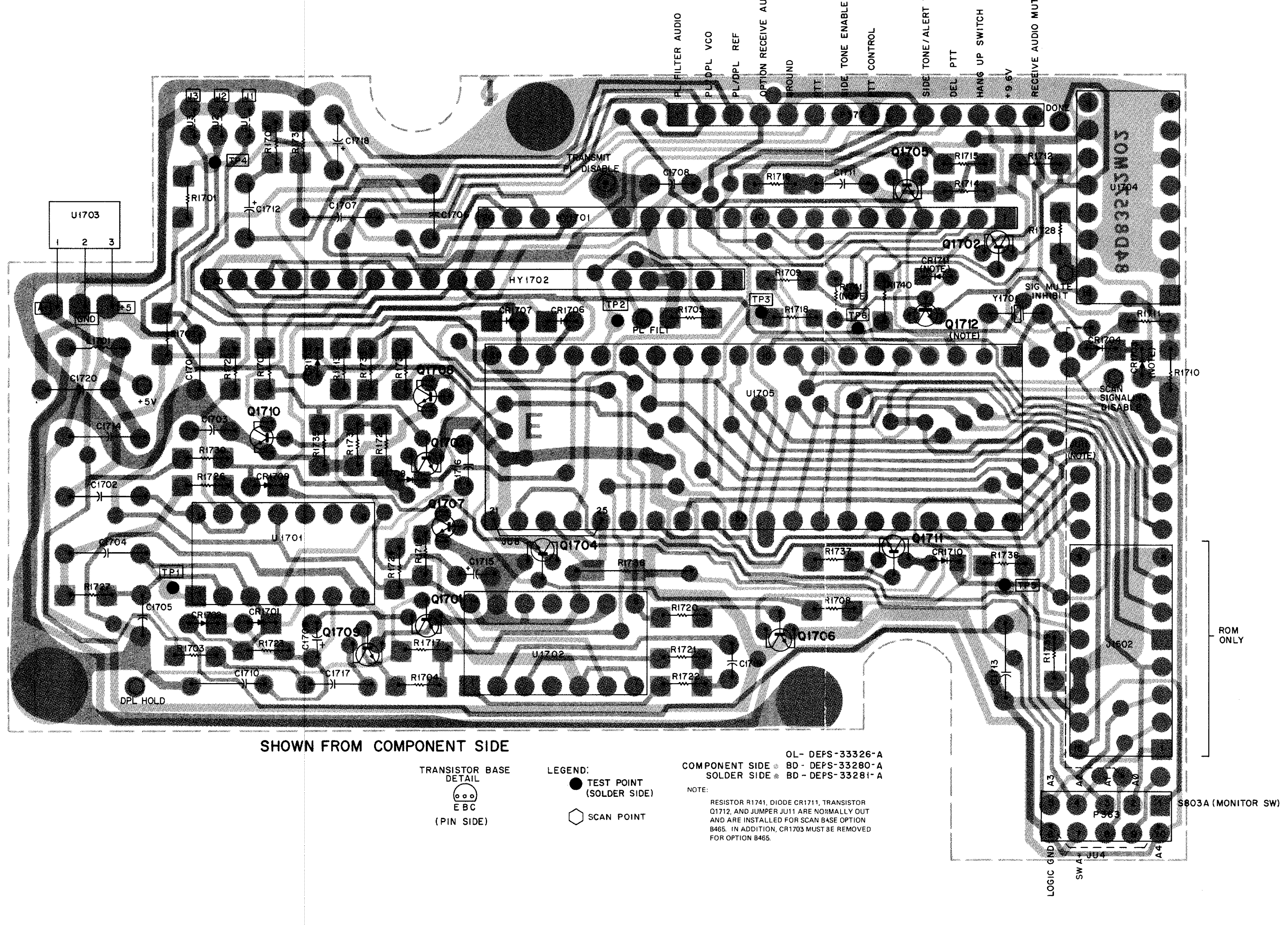
Model Complement

VLN1009A	*DVP* Circuit Module
VLN4126A	Encryption Board
VLN4127A	Interface Board
VLN4128A	Extension Hardware

TONE *PRIVATE-LINE* AND *DIGITAL PRIVATE-LINE* ENCODER/DECODER

MODEL VLN1024A

PL/DPL CIRCUIT BOARD



parts list

TRN4667C PL/DPL Board — PL-8416-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 5%; 50 V: unless otherwise stated
C1701	8-11023A20	.039
C1702	8-11023A25	0.1
C1703	8-11023A35	.003
C1704	8-11023A25	0.1
C1705	8-11023A02	.0012
C1706	8-11023A20	.039
C1707	8-11023A25	0.1
C1708	8-11023A10	.0056
C1709	23-84538G01	1 ± 20%
C1710	8-11023A22	.056
C1711	8-11023A20	.039
C1712	23-84665F25	47 ± 20%; 10 V
	or 23-11019A38	47 ± 20%; 10 V
C1713, 1714	8-11023A25	0.1
C1715	23-84538G01	1 ± 20%
C1716	8-11023A04	.0018
C1717	8-11023A06	.0027
C1718	23-84665F25	47 ± 20%; 10 V
	or 23-11019A38	47 ± 20%; 10 V
C1719	8-11023A01	.001
C1720	21-82428B07	.01 ± 20%; 100 V
		diode: (see note)
CR1701 - 1710	48-84399M01	silicon
CR1711	48-84399M01	silicon (*Channel Scan* base models only)
		connector, receptacle:
J1502	9-80269B01	SOCKET, 16-contact
J1004	39-10184A10	TERMINAL, pin
		coil, rf:
L1701	24-83451F02	choke: 47 uH
		connector, plug:
P363	28-84528K14	male: 10-contact
P377	28-84318M02	male: 14-contact
		transistor: (see note)
Q1701 - 1711	48-02081B10	NPN; type M1B10
Q1712	48-02081B10	NPN; type M1B10 (Channel Scan base models only)
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1701	6-10621D70	64.9k ± 1%
R1702	6-10621D62	53.6k ± 1%
R1703	6-11020B16	560k
R1704, 1705	6-11020A89	47k (note 3)
R1706	6-11020A75	12k
R1707	6-11020A97	100k
R1708	6-11020A73	10k
R1709	6-11020A89	47k
R1710, 1711	6-11020A73	10k
R1712	6-11020A81	22k
R1713	6-11020A85	33k
R1714	6-11020A57	2.2k
R1715, 1716	6-11020A79	18k
R1717	6-11020A89	47k
R1718	6-11020A73	10k
R1719	6-11020A57	2.2k
R1720	6-11020A89	47k
R1721	6-11020A99	120k
R1722	6-11020A91	56k
R1723	6-11020A97	100k
R1724	6-11020A91	56k
R1725	6-10621D70	64.9k ± 1%
R1726	6-10621D82	86.6k ± 1%
R1727	6-10621D62	53.6k ± 1%
R1728	6-11020A97	100k
R1729	6-11020A87	39k
R1730	6-11020A75	12k
R1731	6-11020A81	22k
R1732	6-11020A79	18k
R1733	6-11020A89	47k
R1734	6-11020A93	68k
R1735	6-11020A97	100k
R1736	6-11009C73	10k
R1737	6-11020A89	47k
R1738, 1739	6-11020A73	10k
R1740	6-11020A49	1k
R1741	6-11020A65	4.7k (Channel Scan base models only)
		integrated circuit: (see note)
U1701	51-83629M06	type M2906
U1702	51-82884L57	type 84L57
U1703	51-83629M17	type 29M17
U1704	51-83627M62	type 27M62
U1705	51-83625M72	type 25M72

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		crystal:
Y1701	48-82611M06	4 MHz
		mechanical parts
	9-80269B04	SOCKET, 40-contact (U1705)
	14-05160A01	INSULATOR, crystal
	TRN4666A	ROM, personality

notes:

1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.
2. For parts not listed in the above parts list refer to the radio set mechanical parts list section.
3. Value of R1705 may be varied at time of production. Replace with value originally supplied.

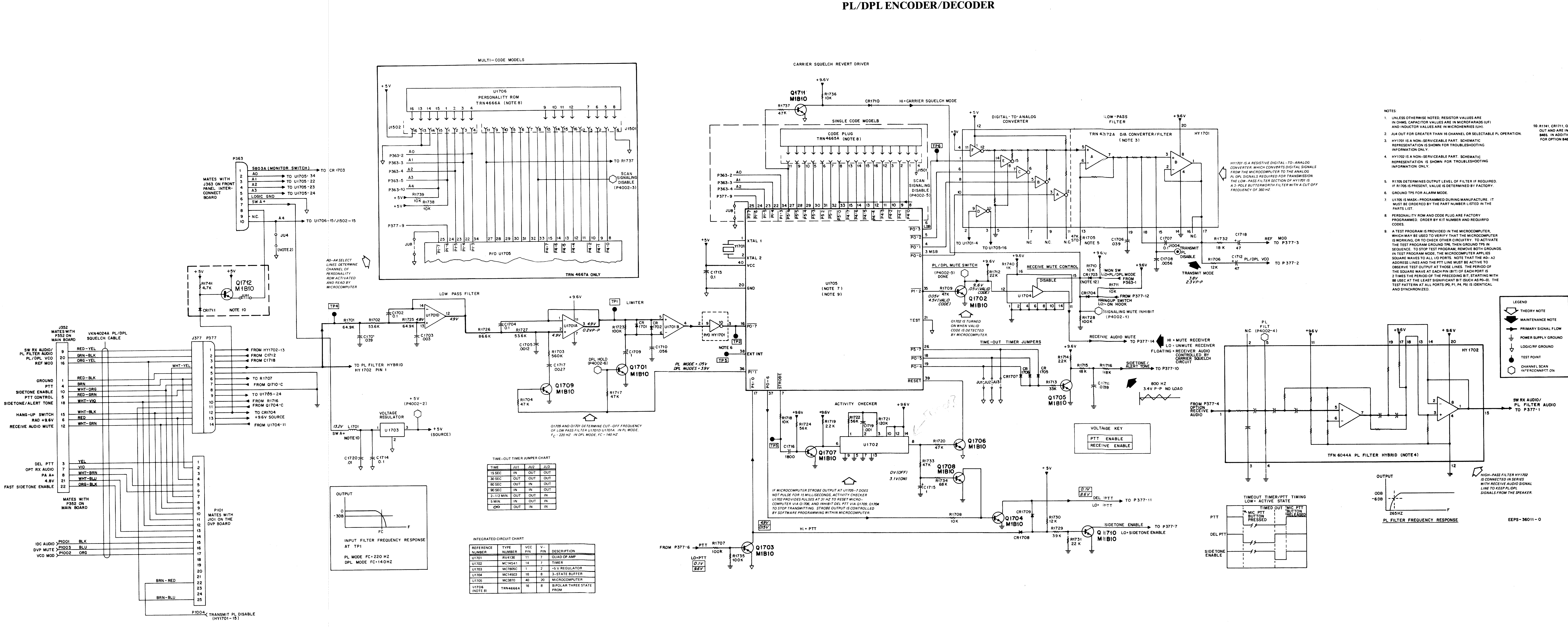
VKN4024A PL Cable Kit — PL-8361-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
J352	9-82301N01	female; 22 contact
J377	9-82301N04	female; 14 contact
P101	9-84319M18	female; 25 contact
P1001 thru 1004	39-10184A73	contact, receptacle
		mechanical part
	42-10217A02	STRAP, cable; 5 used

68P81064E26-O
(Sheet 1 of 2)
3/15/83- *PHI*

TONE *PRIVATE-LINE* AND *DIGITAL PRIVATE-LINE* ENCODER/DECODER

MODEL VLN1024A



NOTES:

1. UNLESS OTHERWISE NOTED, RESISTOR VALUES ARE IN OHMS, CAPACITOR VALUES ARE IN MICROFARADS (UF) AND INDUCTOR VALUES ARE IN MICROHENRIES (UH).
2. JU4 OUT FOR GREATER THAN 16 CHANNEL OR SELECTABLE PL OPERATION.
3. HY1701 IS A NON-SERVICEABLE PART. SCHEMATIC REPRESENTATION IS SHOWN FOR TROUBLESHOOTING INFORMATION ONLY.
4. HY1702 IS A NON-SERVICEABLE PART. SCHEMATIC REPRESENTATION IS SHOWN FOR TROUBLESHOOTING INFORMATION ONLY.
5. R1705 DETERMINES OUTPUT LEVEL OF FILTER IF REQUIRED. IF R1705 IS PRESENT, VALUE IS DETERMINED BY FACTORY.
6. GROUND TP5 FOR ALARM MODE.
7. U1705 IS MASK-PROGRAMMED DURING MANUFACTURE. IT MUST BE ORDERED BY THE PART NUMBER LISTED IN THE PARTS LIST.
8. PERSONALITY ROM AND CODE PLUG ARE FACTORY PROGRAMMED. ORDER BY KIT NUMBER AND REQUIRFD CODES.
9. A TEST PROGRAM IS PROVIDED IN THE MICROCOMPUTER, WHICH MAY BE USED TO VERIFY THAT THE MICROCOMPUTER IS WORKING, OR TO CHECK OTHER CIRCUITRY. TO ACTIVATE THE TEST PROGRAM GROUND TP6, THEN GROUND TP5 IN SEQUENCE. TO STOP TEST PROGRAM, REMOVE BOTH GROUNDS. IN TEST PROGRAM MODE, THE MICROCOMPUTER APPLIES SQUARE WAVES TO ALL I/O PORTS. NOTE THAT THE A0–A2 ADDRESS LINES AND THE PTT LINE MUST BE ACTIVE TO OBSERVE TEST OUTPUT AT THOSE LINES. THE PERIOD OF THE SQUARE WAVE AT EACH PIN (BIT) OF EACH PORT IS 2 TIMES THE PERIOD OF THE PRECEDING BIT, STARTING WITH 88 USEC AT THE LEAST SIGNIFICANT BIT (SUCH AS P0–0). THE TEST PATTERN AT ALL PORTS (P0, P1, P4, P5) IS IDENTICAL AND SYNCHRONIZED.
10. R1741, CR1711, Q1712, AND JU11 ARE NORMALLY OUT AND ARE INSTALLED FOR SCAN BASE OPTION B465. IN ADDITION, CR1703 MUST BE REMOVED FOR OPTION B465.

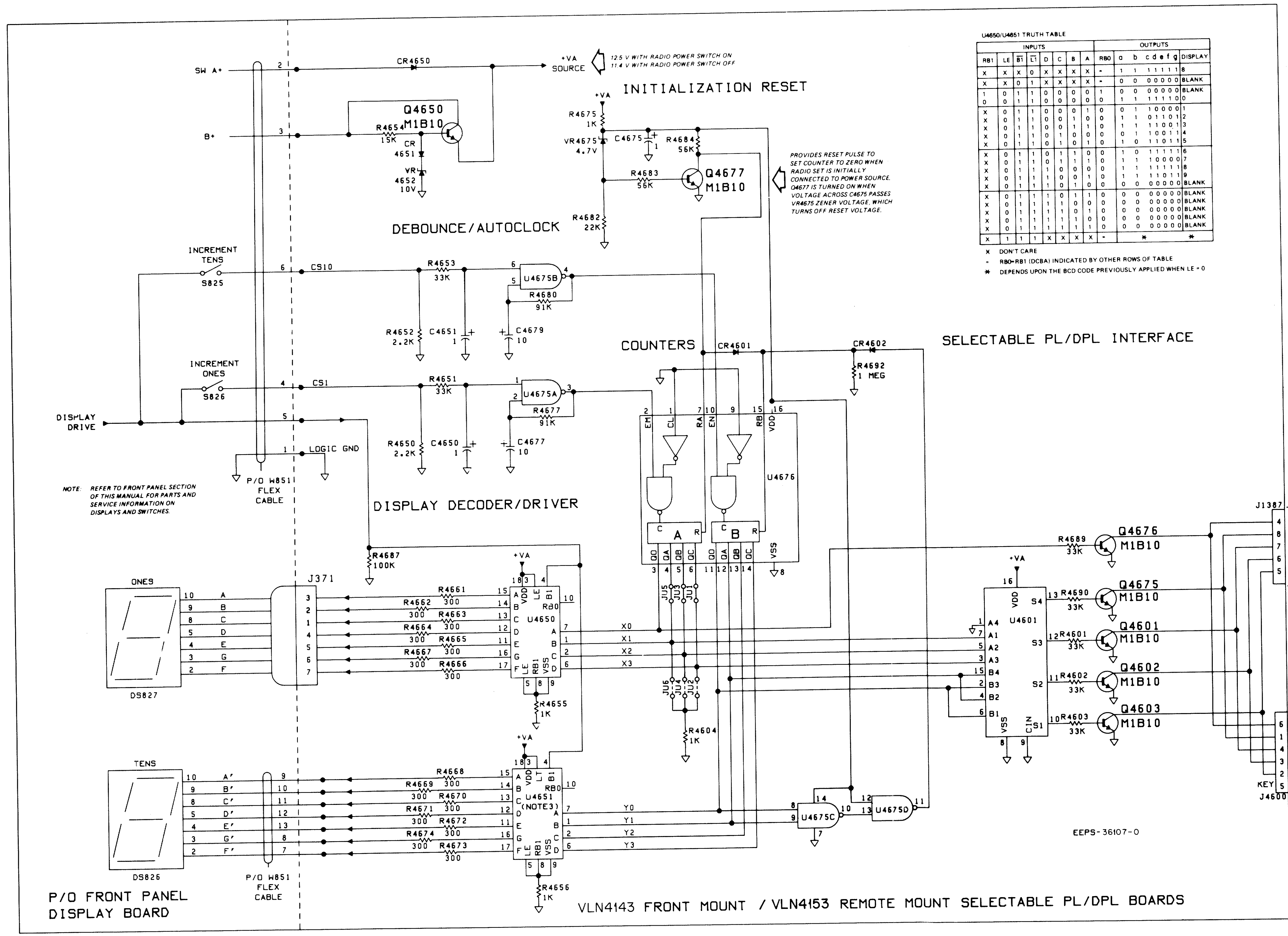
FUNCTION

Encodes and decodes tone *Private-Line* and *Digital Private-Line* coded squelch signals to enable and be enabled by compatibly equipped radios. Also provides time-out timer function to de-key transmitter after a predetermined amount of time. Time-out timer may be reset by momentarily releasing microphone push-to-talk button.

Model Complement Chart

VLN1024A Multi-Code PL/DPL Assembly
TFN6044A PL Filter, CEPT
TRN4372A D-A Hybrid
TRN4667C Multi-PL/DPL Board

SELECTABLE PL/DPL ENCODER



U4650/U4651 TRUTH TABLE

INPUTS								OUTPUTS								
RB1	LE	$\overline{BI}$	$\overline{LI}$	D	C	B	A	RBO	a	b	c	d	e	f	g	DISPLAY
X	X	X	0	X	X	X	X	=	1	1	1	1	1	1	1	8
X	X	0	1	X	X	X	X	=	0	0	0	0	0	0	0	BLANK
1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	BLANK
0	0	1	1	0	0	0	0	0	1	1	1	1	1	1	0	0
X	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	1
X	0	1	1	0	0	1	0	0	1	1	0	1	1	0	1	2
X	0	1	1	0	0	1	1	0	1	1	1	1	0	0	1	3
X	0	1	1	0	1	0	0	0	0	1	1	0	0	1	1	4
X	0	1	1	0	1	0	1	0	1	0	1	1	0	1	1	5
X	0	1	1	0	1	1	0	0	1	0	1	1	1	1	1	6
X	0	1	1	0	1	1	1	0	1	1	1	0	0	0	0	7
X	0	1	1	1	0	0	0	0	1	1	1	1	1	1	1	8
X	0	1	1	1	0	0	1	0	1	1	1	1	0	1	1	9
X	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	BLANK
X	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	BLANK
X	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	BLANK
X	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	BLANK
X	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	BLANK
X	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	BLANK
X	1	1	1	X	X	X	X	=	*							*

X DON'T CARE
= RBO=RB1 (DCBA) INDICATED BY OTHER ROWS OF TABLE
* DEPENDS UPON THE BCD CODE PREVIOUSLY APPLIED WHEN LE = 0

NOTES:

1. UNLESS OTHERWISE STATED, RESISTOR VALUES ARE GIVEN IN OHMS, CAPACITOR VALUES ARE GIVEN IN MICROFARADS (UF).
2. J4600 IS USED IN FRONT MOUNT (VLN4143) MODELS. J1387 IS USED IN REMOTE MOUNT (VLN4153) MODELS.
3. U4651 IS CONTAINED IN TRN4689A DISPLAY BUFFER SECOND DIGIT KIT.

INTEGRATED CIRCUIT CHART

REF	VDD PIN	VSS PIN	DESCRIPTION	TYPE
U4650	18	9	DISPLAY DECODER/DRIVER	84L76
U4651	18	9	DISPLAY DECODER/DRIVER	84L76
U4675	14	7	QUAD NAND	84L66
U4676	16	8	DUAL 4-BIT UP COUNTER	84L12
U4601	16	8	4-BIT FULL ADDER	84L23

U4676 TRUTH TABLE

CLOCK	ENABLE	RESET	ACTION
↑	1	0	INCREMENT COUNTER
0	↓	0	INCREMENT COUNTER
↓	X	0	NO CHANGE
X	↑	0	NO CHANGE
↑	0	0	NO CHANGE
1	↓	0	NO CHANGE
X	X	1	Q0 THRU Q3 = 0

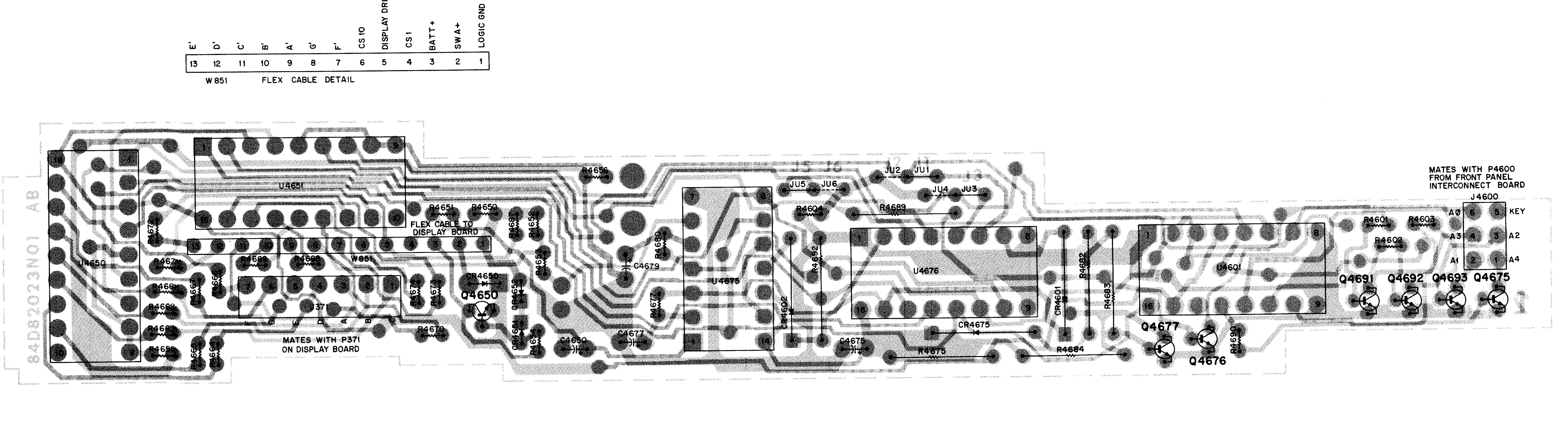
X = DON'T CARE

U4601 TRUTH TABLE (ONE STAGE)

C_{IN}	B	A	C_{OUT}	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

LEGEND
THEORY NOTE
LOGIC GROUND
SIGNAL FLOW

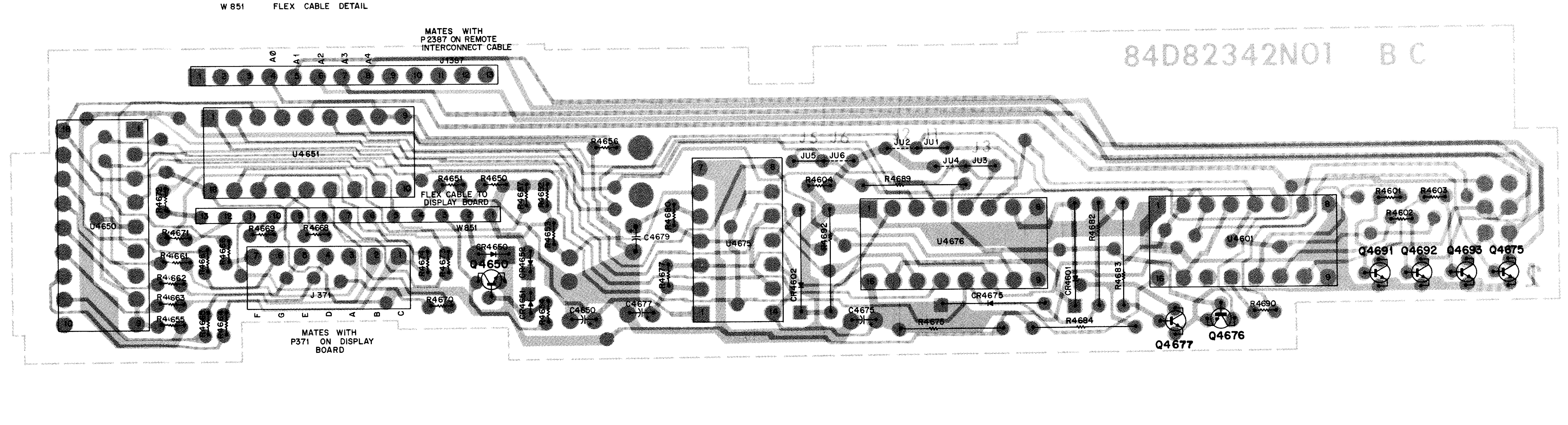
FRONT MOUNT SELECTABLE PL/DPL BOARD



SHOWN FROM SOLDER SIDE

OL-EEPS-33045-0
COMPONENT SIDE: BD-EEPS-33046-0
SOLDER SIDE: BD-EEPS-33047-0

REMOTE MOUNT SELECTABLE PL/DPL BOARD



SHOWN FROM SOLDER SIDE

OL-EEPS-33073-A
COMPONENT SIDE: BD-EEPS-33074-A
SOLDER SIDE: BD-EEPS-33075-A

parts list

VLN4143A Selectable PL/DPL Board (Front Mount)
VLN4153A Selectable PL/DPL Board (Remote Mount) — PL-8415-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 20%; 25 V
C4650, 4651	23-11037H09	1.0
C4675	23-11037A09	1.0
C4677	23-11037A20	1.0
C4679	23-11037A20	1.0
		diode: (see note)
CR4601, 4602	48-83654H01	silicon
CR4650	48-82466H13	silicon
CR4651	48-84399M01	silicon
		connector, receptacle:
J371	9-82846L04	female, 7-contact
		connector, plug:
J4600	28-84528K16	male, 6-contact (VLN4143A only)
		transistor: (see note)
Q4601, 4602, 4603	42-2081B10	NPN; type M1B10
Q4650	48-2081B10	NPN; type M1B10
Q4675, 4676, 4677	48-2081B10	NPN; type M1B10
		resistor, fixed: ± 5%; 1/4 W
R4601, 4602, 4603	6-11020A85	33k
R4604	6-11020A49	1k
R4650	6-11020A57	2.2k
R4651	6-11020A85	33k
R4652	6-11020A57	2.2k
R4653	6-11020A85	33k
R4653	26-11020A77	15k
R4655, 4656	6-11020A49	1k
R4687	6-11020A97	100k
R4661 thru 4674	6-11020A36	300
R4675	6-11009C49	1k
R4677, 4680	6-11020A96	91k
R4682	6-11009C81	22k
R4683, 4684	6-11009C91	56k
R4689	6-11009C85	33k
R4690	6-11020A85	33k
R4692	6-11009D22	1.0 meg
		integrated circuit: (see note)
U4601	51-82884L23	4-bit full added
U4650	51-82884L76	decoder/driver; type 84L23
U4675	51-82884L66	quad NAND; type 84L66
U4676	51-82884L12	dual 4-bit up-counter; type 84L12
		cable, flat:
W851	30-82906L08	13-conductor
		voltage regulator: (see note)
VR4652	48-82256C11	Zener; 10 V
VR4675	48-82256C03	Zener; 4.7 V
	mechanical parts	
	42-84064M01	CLIP, board retainer (VLN4143A)
	46-82377N01	GUIDE, circuit board; 2 used (VLN4153A)

notes:

1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.
2. For component not listed in the above parts list, refer to the exploded view/mechanical parts list section.

VKN4034A *DVP* Selectable PL/DPL Cable (Remote Mount) — PL-8427-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J1387	9-84319M02	female, 10 contact
	mechanical parts	
	42-10217A02	STRAP, cable harness; 2 used

VKN4028A *DVP* Selectable PL/DPL Cable (Front Mount) — PL-8426-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
P4600	9-84279D02	TERMINAL, female; 5 used
	14-84277D21	6 pin receptacle
	22-84835F01	PLUG, polarizing key
	mechanical parts	
	42-10217A02	STRAP, cable harness

TRN4689A Second Digit Display Buffer — PL-7644-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U4651	51-82884L76	decoder/driver: type 84L76

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

SELECTABLE PL/DPL ENCODER/DECODER

MODELS VLN1013A AND VLN1014A

FUNCTION

Allows operator to select PL/DPL squelch codes encoded and decoded by the PL/DPL encoder/decoder. Replaces the channel selector switch input to the PL/DPL board with input corresponding to operator-selected code displayed on front panel.

Model Complement Chart

VLN1013A	*DVP* Selectable PL/DPL (Dash)
VLN4143A	*DVP* Selectable PL/DPL Kit
VKN4028A	*DVP* Selectable Pl/DPL Cbl. Kit
VLN1014A	*DVP* Selectable PL/DPL (Remote)
VLN4153A	*DVP* Selectable PL/DPL Kit
VKN4034	*DVP* Selectable PL/DPL Cbl. Kit

parts list

TRN5042B Single Tone Board — PL-8428-O

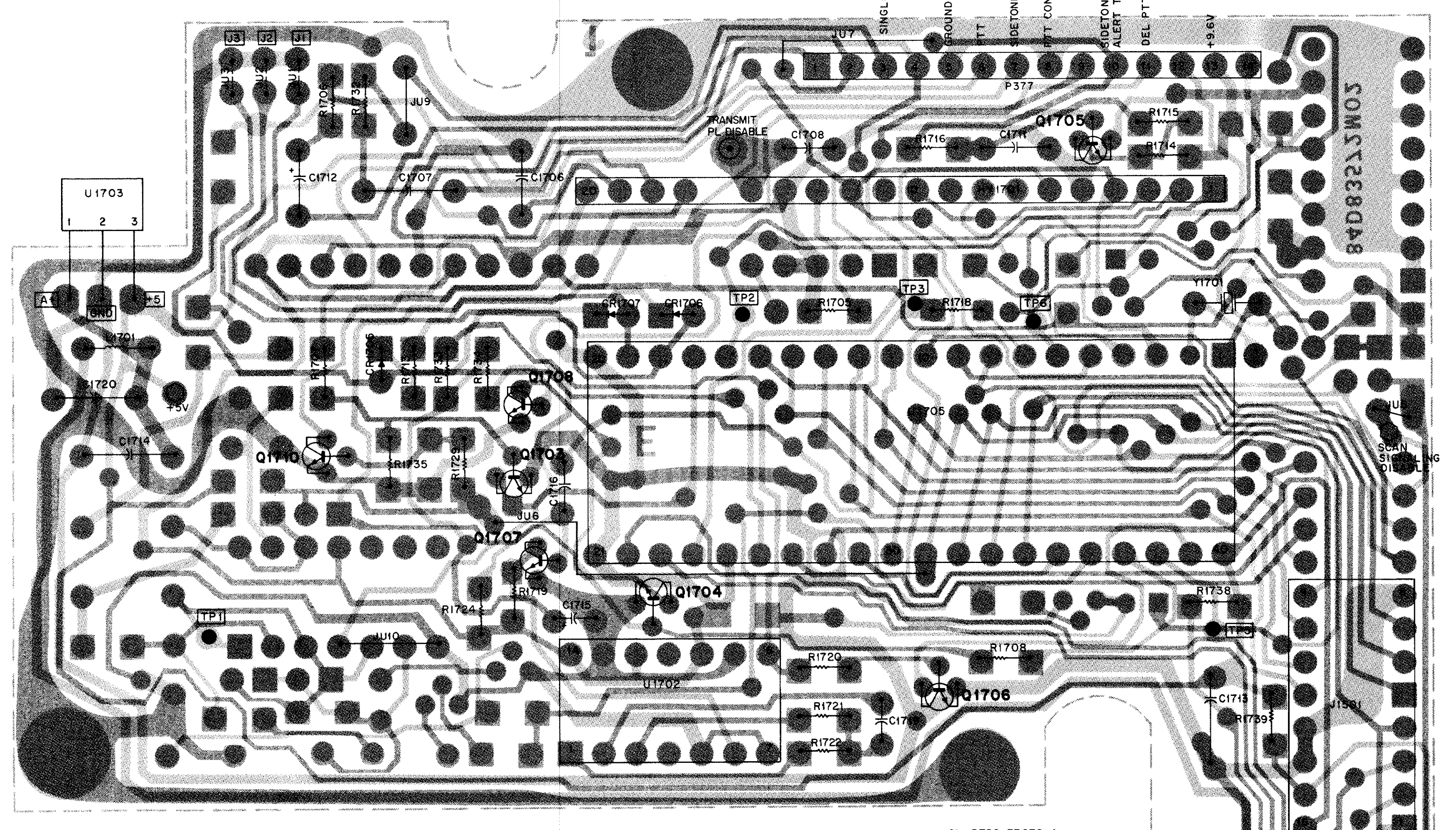
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 5%; 50 V: unless otherwise stated
C1706	8-11023A08	.0039
C1707	8-11023A13	.01
C1708	21-82428B45	820 pF
C1711	8-11023A20	.039
C1712	23-84665F25	47 ± 20%; 10 V
	or 23-11019A38	47 ± 20%; 10 V
C1713, 1714	8-11023A25	0.1
C1715	23-84538G01	1 ± 20%
C1716	8-11023A04	.0018
C1719	8-11023A01	.001
C1720	21-82428B07	.01 ± 20%; 100 V
		diode: (see note)
CR1705 - 1707	48-84399M01	silicon
		connector, receptacle:
J1501	9-80269B01	SOCKET, 16-contact
		coil, rf:
L1701	24-83451F02	choke: 47 uH
		connector, plug:
P363	28-84528K14	male: 10-contact
P377	28-84318M02	male: 14-contact
		transistor: (see note)
Q1703 - 1708, 1710	48-02081B10	NPN; type M1B10
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1705	6-11020A89	47k (note 3)
R1706	6-11020A75	12k
R1707	6-11020A97	100k
R1708	6-11020A73	10k
R1713	6-11020A85	33k
R1714	6-11020A57	2.2k
R1715, 1716	6-11020A79	18k
R1718	6-11020A73	10k
R1719	6-11020A57	2.2k
R1720	6-11020A89	47k
R1721	6-11020A99	120k
R1722	6-11020A91	56k
R1724	6-11020A91	56k
R1725	6-10621D70	64.9k ± 1%
R1726	6-10621D82	86.6k ± 1%
R1727	6-10621D62	53.6k ± 1%
R1728	6-11020A97	100k
R1729	6-11020A87	39k
R1730	6-11020A75	12k
R1731	6-11020A81	22k
R1732	6-11020A79	18k
R1733	6-11020A89	47k
R1734	6-11020A93	68k
R1735	6-11020A97	100k
R1738, 1739	6-11020A73	10k
		integrated circuit: (see note)
U1702	51-82884L57	type 84L57
U1703	51-83629M17	type 29M17
U1705	51-83625M39	type 25M39
		crystal:
Y1701	48-82611M06	4 MHz
		mechanical parts
	9-80269B04	SOCKET, 40-contact (U1705)
	14-05160A01	INSULATOR, crystal
	TRN4666A	ROM, personality
	39-10184A10	TERMINAL, pin

notes:

1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.
2. For parts not listed in the above parts list refer to the radio set mechanical parts list section.
3. Value of R1705 may be varied at time of production. Replace with value originally supplied.

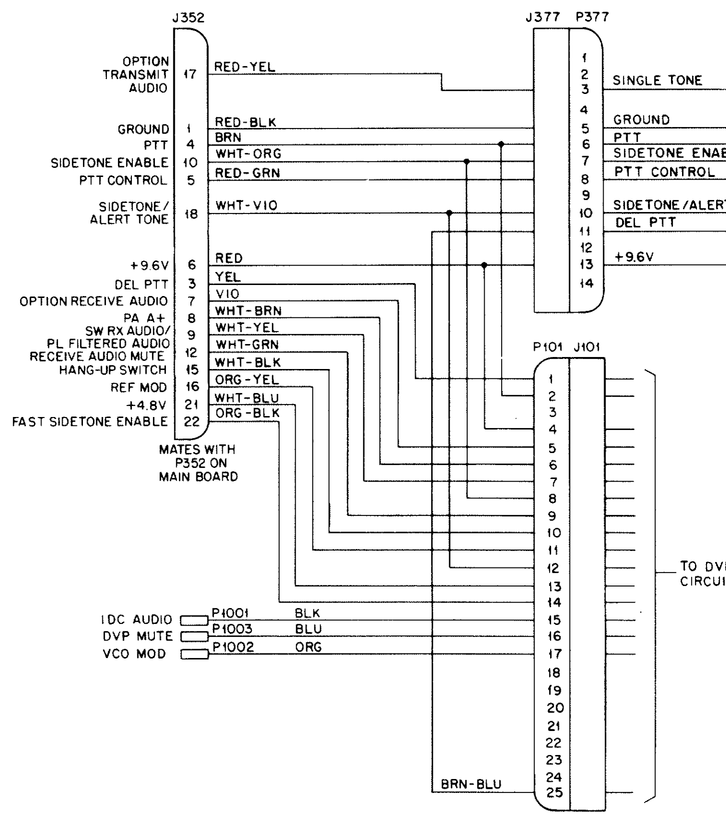
VKN4026A Singletone Cable Kit — PL-8408-O

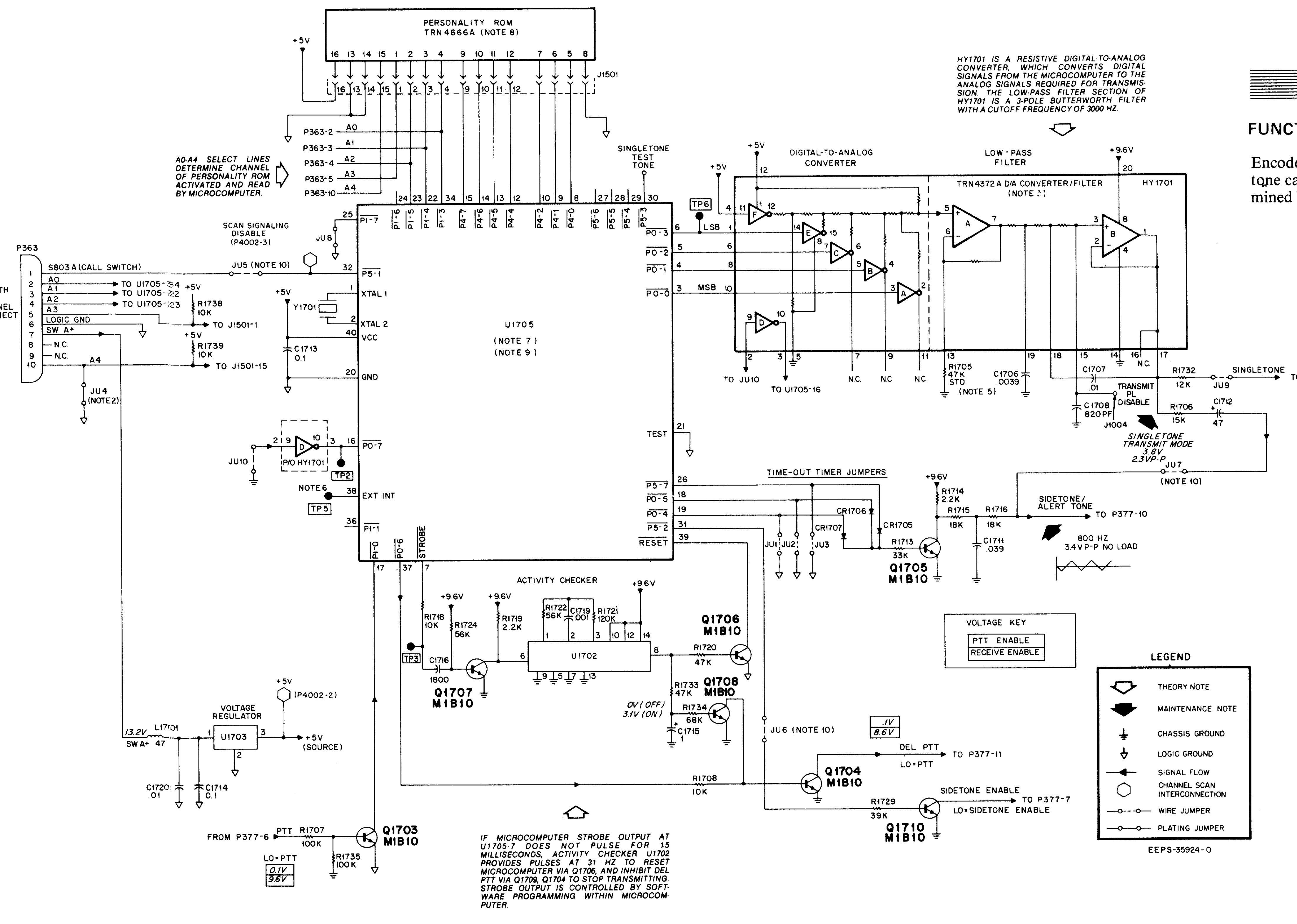
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector; receptacle:
J352	9-82301N01	female; 22-contact
J377	9-82301N04	female; 14-contact
P101	9-84319M18	female; 25-contact
		mechanical parts
	42-10217A02	STRAP, cable; 5 used



NOTES:

1. Unless otherwise noted, resistor values are in ohms, capacitor values are in microfarads (uF) and inductor values are in microhenries (uH).
2. JU4 is always out
3. HY1701 is a non-serviceable part. Schematic representation is shown for troubleshooting information only.
4. Not used.
5. R1705 determines output level of filter if required. If R1705 is present, value is determined by factory.
6. Ground TP5 for alarm mode.
7. U1705 is mask-programmed during manufacture. It must be ordered by the part number listed in the parts list.
8. Personality ROM is factory programmed. Order by kit number and required codes.
9. A test program is provided in the microcomputer, which may be used to verify that the microcomputer is working, or to check other circuitry. To activate the test program ground TP6, then ground TP5 in sequence. To stop test program, remove both grounds. In test program mode, the microcomputer applies square waves to all I/O ports. Note that the A0-A4 address lines and the PTT line must be active to observe test output at those lines. The period of the square wave at each pin (bit) of each port is 2 times the period of the preceding bit, starting with 88 usec at the least significant bit (such as P0-0). The test pattern at all ports (P0, P1, P4, P5) is identical and synchronized.
10. JU5, JU6, JU7, JU8, JU9 are always in.





SINGLE TONE ENCODER

MODEL TLN2394B

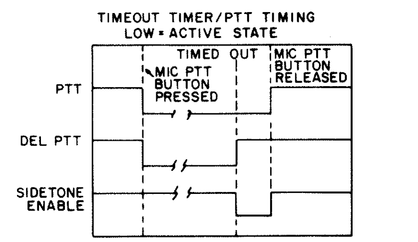
FUNCTION

Encodes single tone when operator presses front panel tone call button. Tone frequency and duration is determined by Personality ROM.

Model Complement Chart

TLN2394B Single Tone Encoder
TRN5042B Single Tone Board TRN4372A D-A Hybrid

TIMEOUT TIMER/PTT TIMING
LOW = ACTIVE STATE



TIME-OUT TIMER JUMPER CHART

TIME	JU1	JU2	JU3
15 SEC	IN	OUT	OUT
30 SEC	OUT	OUT	OUT
60 SEC	OUT	IN	OUT
90 SEC	IN	IN	OUT
2-1/2 MIN	OUT	OUT	IN
5 MIN.	IN	OUT	IN
∞	OUT	IN	IN

INTEGRATED CIRCUIT CHART

REFERENCE NUMBER	TYPE NUMBER	VCC PIN	V- PIN	DESCRIPTION
U1702	MC14541	14	7	TIMER
U1703	MC7805C	1	2	+ 5V REGULATOR
U1705	MC3870	40	20	MICROCOMPUTER
TRN 4666A (NOTE 8)	74S287	16	8	BIPOLAR THREE STATE PROM

SINGLETONE ENCODER

TIME-OUT TIMER

MODEL TRN5666A

parts list

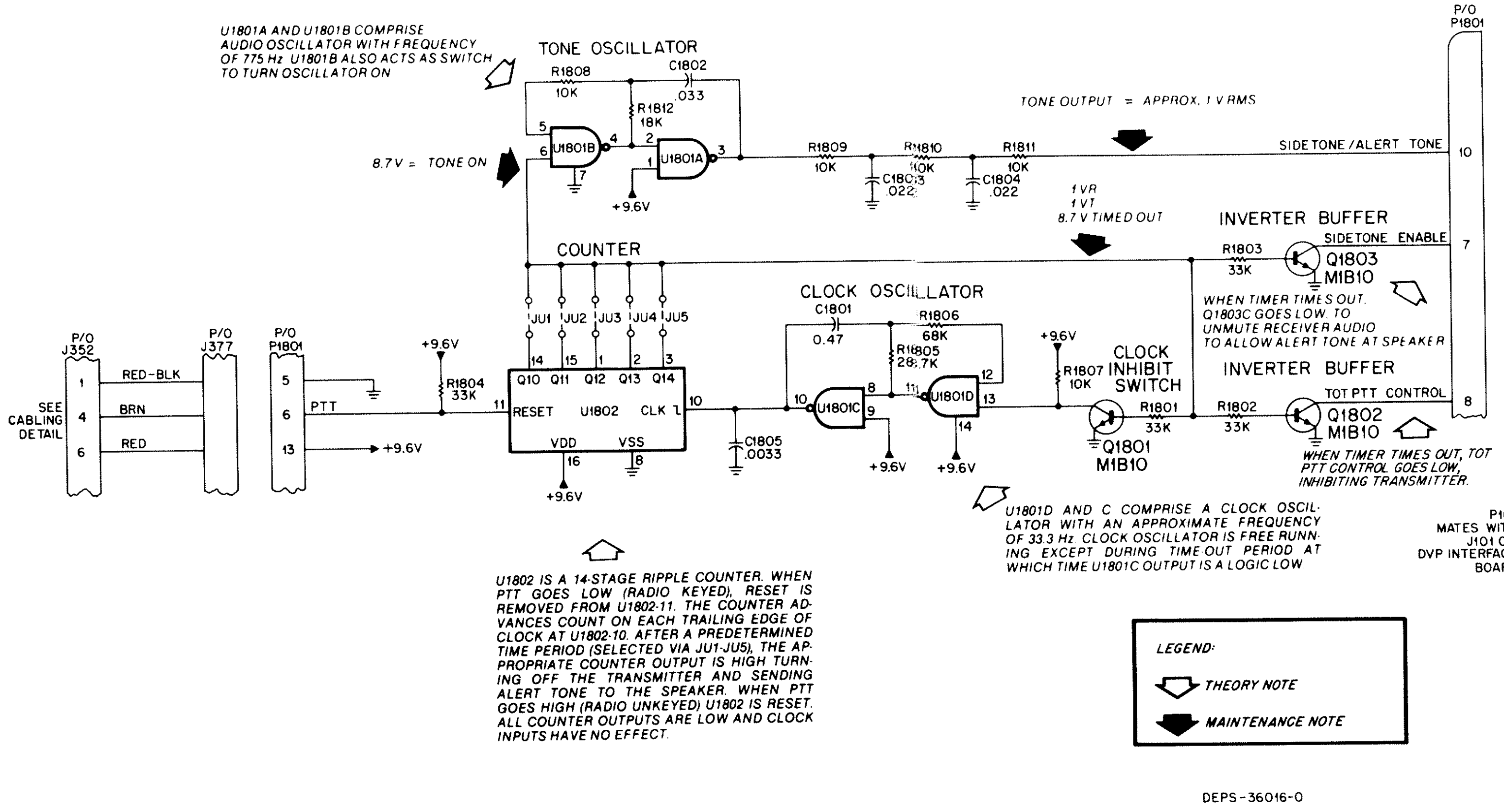
TRN5666A Time-Out Timer — PL-8429-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V; unless otherwise stated
C1801	8-84637L42	.47; 100 V
C1802	8-11023B19	.033
C1803, 1804	8-11023B17	.022
C1805	8-11023B07	.0033
		connector, receptacle:
P1801	28-84318M02	male; 14-contact
		transistor: (see note)
Q1801, 1802, 1803	48-02081B10	NPN; type M1B10
		resistor, fixed ± 5%; 1/4 W; unless otherwise stated
R1801, 1802, 1803, 1804	6-11020A85	33k
R1805	6-10621D36	28.7k; 1%, 1/8 W
R1806	6-11020A93	68k
R1807, 1808, 1809, 1810, 1811	6-11020A73	10k
R1812	6-11020A79	18k
		integrated circuit: (see note)
U1801	51-82884L05	Quad NAND gate
U1802	51-82884L42	14-bit Binary Counter

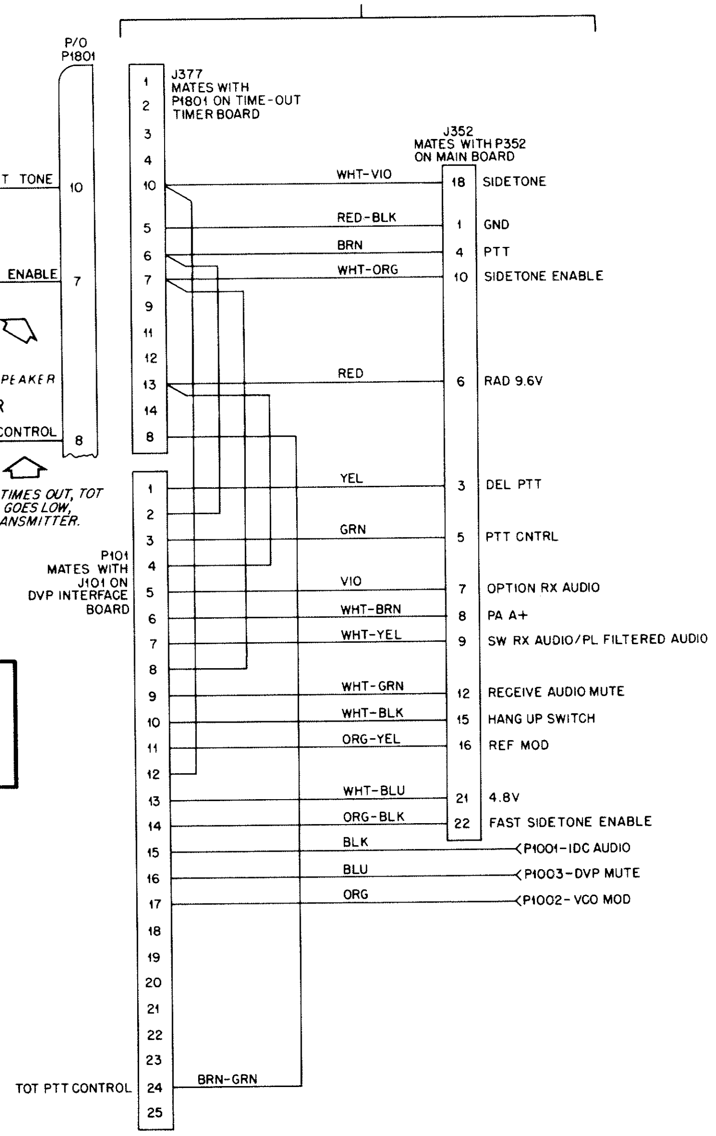
VKN4021A Time-Out Timer Cable Kit — PL-8409-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector; receptacle:
J352	9-82301N01	female; 22-contact
J377	9-82301N04	female; 14-contact
P101	9-84319M18	female; 25-contact
P1001 thru 1003	39-10184A73	CONTACT; receptacle
		mechanical parts
	42-10217A02	STRAP, cable; 5 used

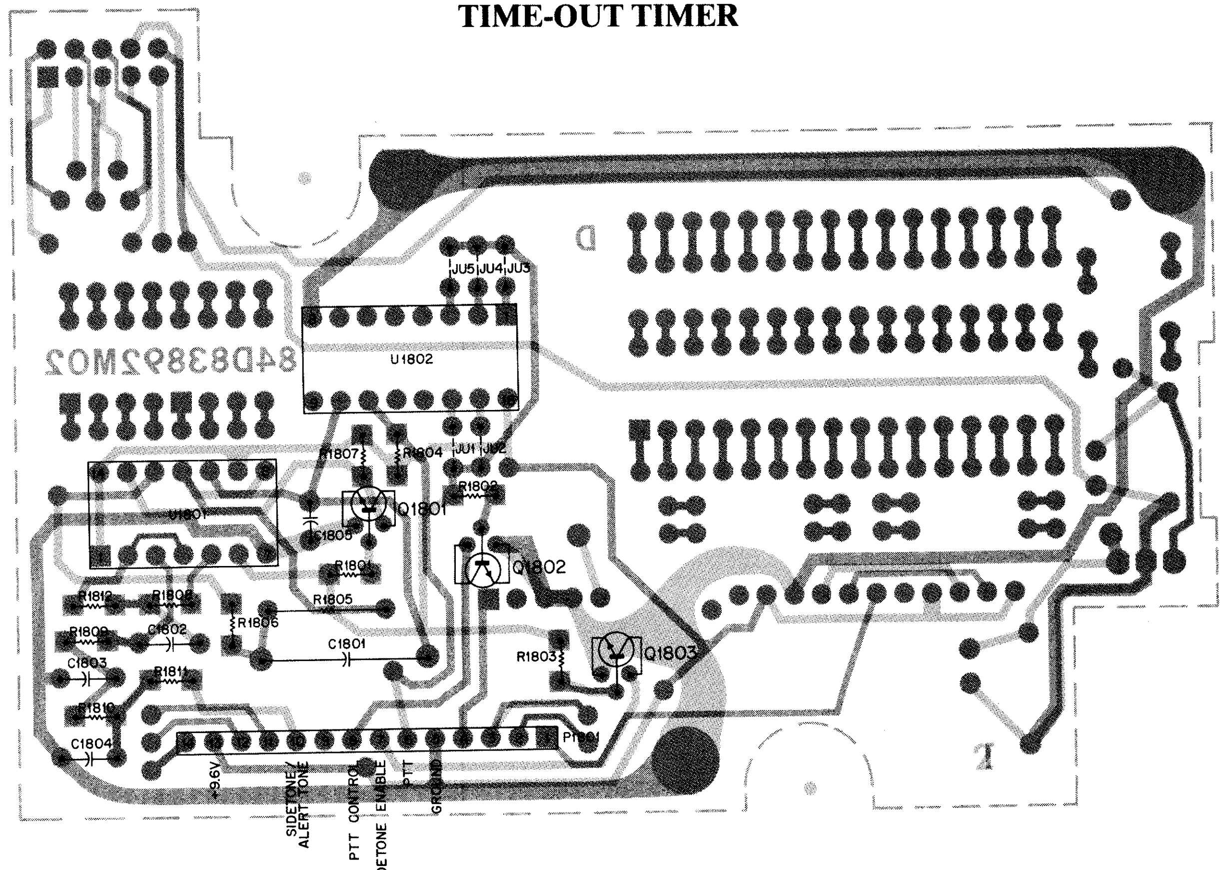
TIME-OUT TIMER



VKN4021A TIME-OUT TIMER CABLING DETAIL



TIME-OUT TIMER



SHOWN FROM COMPONENT SIDE

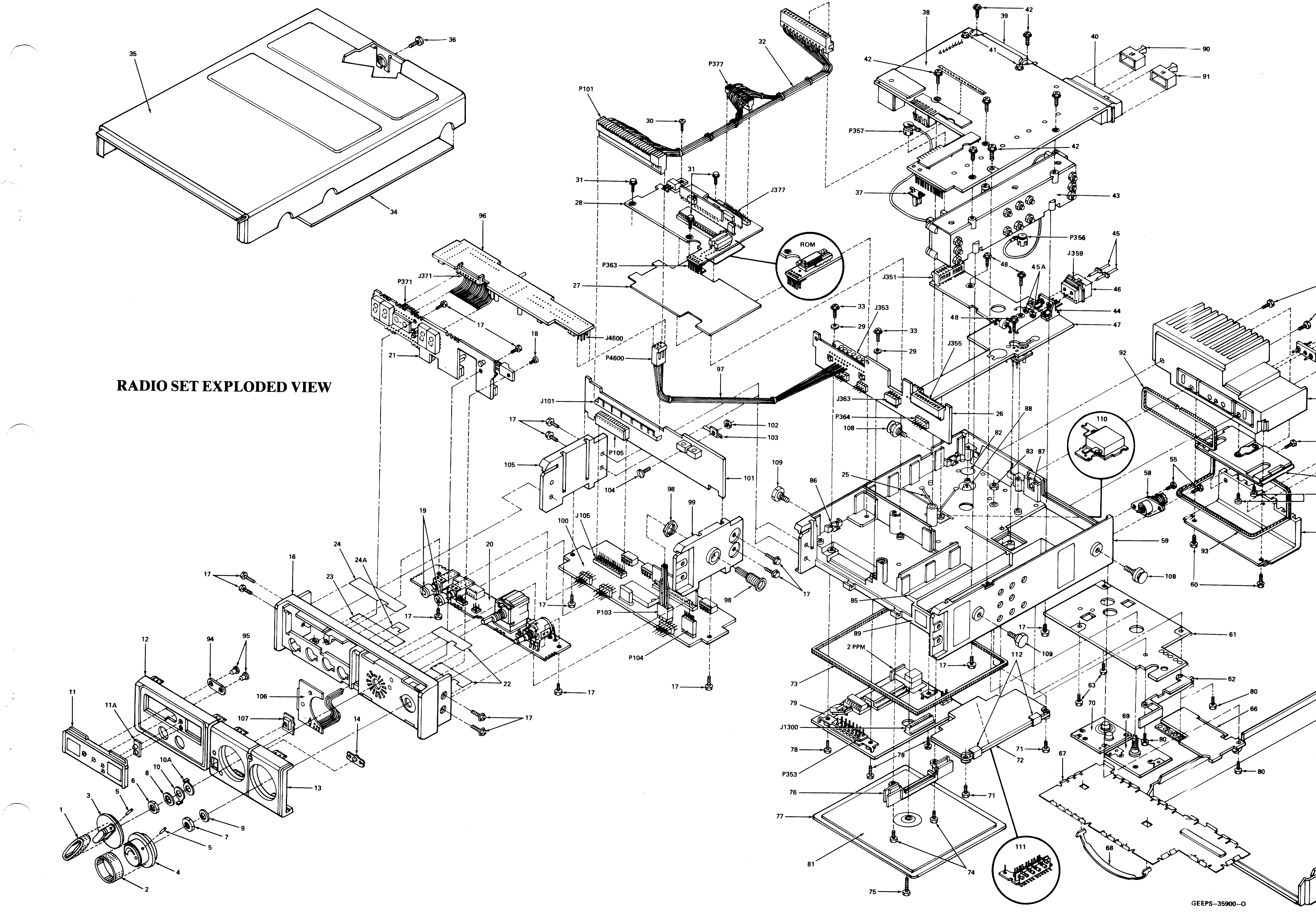
SOLDER SIDE ● DEPS-35742-O
COMPONENT SIDE ● DEPS-35743-O
OL DEPS-35744-O

FUNCTION

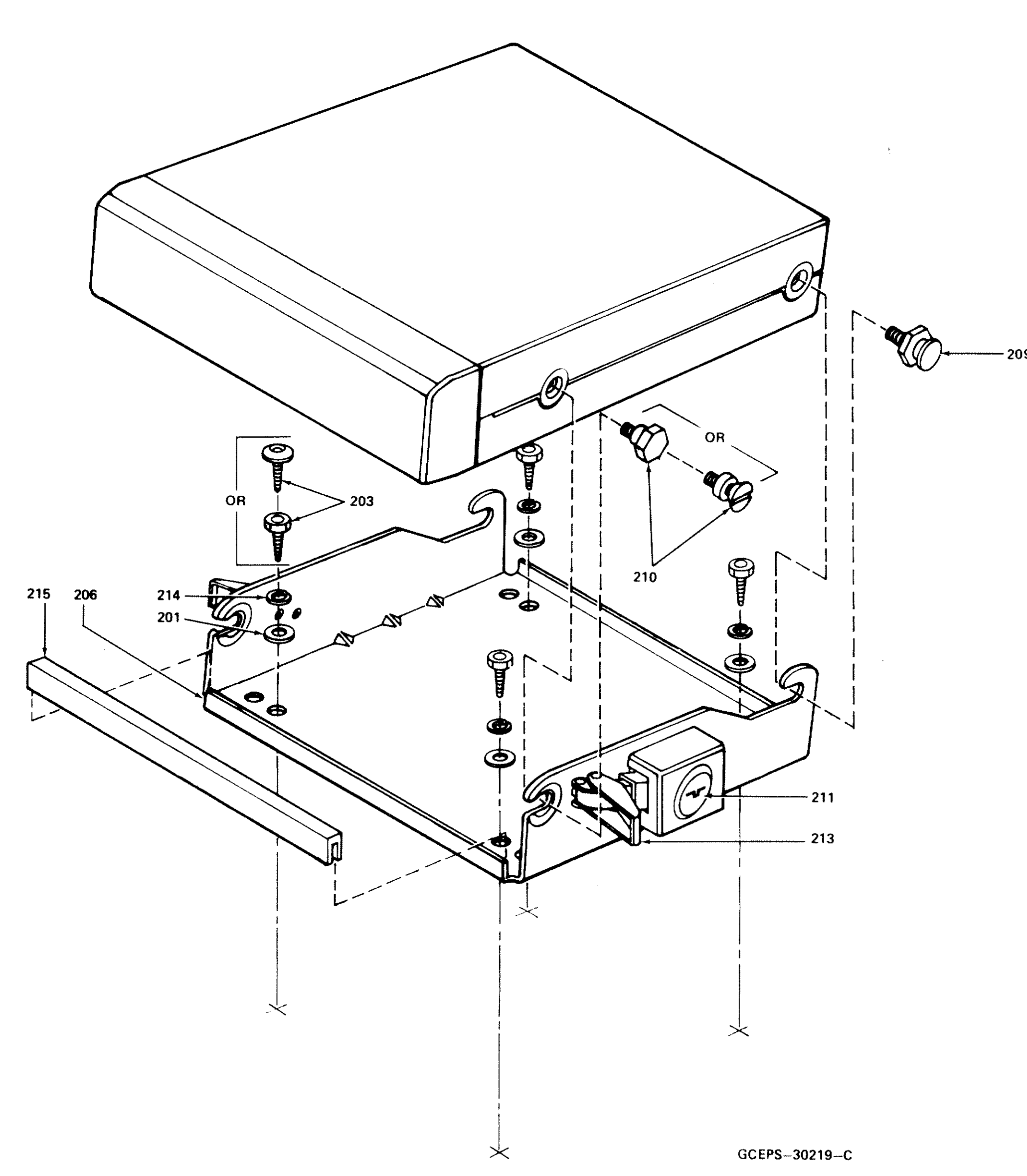
Dekeys transmitter after a predetermined period of time, such as 60 seconds. May be reset by momentarily releasing microphone push-to-talk button. Available on carrier squelch models only.

DVP MCX100 RADIO EXPLODED VIEWS AND MECHANICAL PARTS LISTS

RADIO SET EXPLODED VIEW



MOUNTING HARDWARE



parts list

Radio Set Mechanical Parts — PL-8400-O

ITEM	MOTOROLA PART NO.	DESCRIPTION
1	37-84215M01	BAND KNOB (channel select)
2	37-84215M02	BAND KNOB (volume control)
3	36-84149M01	KNOB (channel select)
4	36-84148M01	KNOB (volume on/off)
5	3-84220M01	SCREW, set, M3 x 0.5 x 5; 2 used
6	2-84218M02	NUT, M9 x 0.75
7	2-84218M01	NUT, M7 x 0.75
8	4-84219M02	LOCK WASHER #9 internal
9	4-84219M01	LOCK WASHER, #7 internal
10	46-84150M02	STOP KNOB
10A	46-84150M01	STOP KNOB
11	61-84153M01	LENS (TRN4638A)
	or 61-84153M02	LENS (TRN4639A)
	or 61-84153M11	LENS (TRN4644A)
	or 61-84153M12	LENS (TRN4645A)
11A	61-82106N01	LENS, display LED
12	64-84145M01	PANEL, button (TRN4623A)
	or 64-84145M02	PANEL, button (TRN4624A)
13	64-84345N01	*DVP*, front panel (VLN4123A)
	or 64-84345N02	*DVP*, dual code panel (VLN4124A)
14	61-84152M02	LENS, photocell
15		NOT USED
16	64-84046M01	PANEL, frame front (TRN4620A)
17	3-84208M01	SCREW, taptite; M3 x 0.5 x 8
18	3-84208M03	SCREW, taptite; M2.2 x 0.45 x 6
19	38-84139M01	BUTTON, push (squelch) TRN4608A
	and	TRN4609A, TRN4607A
	38-84139M03	BUTTON, push (monitor) TRN4660A
20	—	BOARD, switch
21	—	BOARD, display
22	14-84183M01	INSULATOR, front panel
23	14-84183M02	INSULATOR, front panel
24	14-84183M03	INSULATOR, front panel
24A	14-84183M05	INSULATOR, front panel center
25	30-84177M01	CABLE, solid coaxial
	& 29-10208A08	EYELET, 2 used
26	—	BOARD, front panel interconnect
27	14-84184M01	INSULATOR, option area
28	—	BOARD, PL/DPL
29	4-82318N01	WASHER, flat synthesizer connector
30	3-84208M03	SCREW, M2.2 x 0.45 x 6.0
31	3-84208M01	SCREW, washer; M3 x 0.5 x 8.0
32	—	CABLE, assembly (refer to associated circuit board parts list)
33	3-84208M01	SCREW, washer; M3 x 0.5 x 8.0
34	14-84173M01	INSULATOR, top cover
35	15-84175M01	COVER, top
36	3-84208M12	SCREW, Phillips M4 x 0.7 x 9.0
37	46-84135M01	GUIDE, printed circuit
38	—	BOARD, main
39	26-84104M01	HEATSINK
40	—	J350 (refer to main board parts list)
41, 42	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
43	—	Dual front end assembly
44	15-84143M01	HOUSING connector base dc
45	29-84167M01	TERMINAL, round
45A	2-84334M01	NUT, terminal M3
46	15-84144M01	HOUSING, connector cover dc
47	—	BOARD, power interconnnect
48	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
49	3-84208M12	SCREW, Phillips M4 x 0.7 x 9.0
50	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
51	64-84188M01	PLATE, feed-thru
52	26-84142M01	HEATSINK (30 W)
53	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
54	—	HYBRID, 30 W PA
55	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
56	3-84208M04	SCREW, washer M2.5 x 0.45 x 8.0
57	15-84141M01	COVER, heat sink
58	9-82442E09	J300 CONNECTOR, antenna
59	27-84061M01	CHASSIS
60	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
61	—	BOARD PA interconnect
62	26-84102M01	SHIELD, wall transmitter
63	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
64	3-84208M12	SCREW, Phillips M4 x 0.7 x 9.0
65	15-84174M01	COVER, bottom
66	—	HYBRID, harmonic filter
67	26-84176M01	SHIELD, PA
68	55-84300B01	HANDLE
69	—	HYBRID, 10 W PA
70	—	HYBRID, low level amplifier
71	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
72	—	HYBRID, VCO
73	32-84178M01	GASKET, rf (19 inches)
74	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
75	3-84208M11	SCREW, washer M3.5 x 0.6 x 14.0
76	26-84103M01	SHIELD, synthesizer (std lock models)
77	15-84147M01	COVER, synthesizer
78	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
79	—	BOARD, synthesizer VHF
80	3-84208M01	SCREW, washer M3 x 0.5 x 8.0
81	14-84170M01	INSULATOR, synthesizer cover
82	43-83779N01	INSERT, chassis plug
83	2-7003	NUT, 8-32 x 5/16 x 1/8"
84	75-82200H03	PAD, 2 used
85	14-84172M01	INSULATOR, power board
86	64-84169M01	PLATE NUT, cover side; 4 used
87	64-84168M01	PLATE NUT, cover rear; 3 used
88	42-82604H01	CLIP, transistor
89	14-84171M01	INSULATOR
90	15-82221N01	COVER, connector (microphone)
91	15-82222N01	COVER, connector (accessory)
92	32-84178M01	GASKET, rf (11.6 inches)
93	32-84178M01	GASKET, rf (8.3 inches)
94	75-84198M01	PAD, button
95	38-84113M01	BUTTON, PL/DPL code select
96	—	SELECTABLE PL/DPL board
97	—	CABLE, selecable PL/DPL (refer to front panel parts list)
98	•	J109 KEY PLUG, receptacle
99	15-84663N01	CHASSIS, extension casting
100	—	*DVP* encryption board
101	—	*DVP* interface board
102	2-84334M01	NUT, M3 x 0.5
103	42-84940N01	BRACKET, hybrid
104	3-84208M01	SCREW, machine; M3 x 0.5 x 8
105	15-84663N02	CHASSIS, extension casting
106	—	*DVP* control board
107	—	S102 transmit mode selector switch
108	3-84195M01	SCREW, mounting; M5 x 0.8 x 6
109	3-84867M01	SCREW, mounting tray (front)
110	—	Board, synthesizer RF amplifier (*Fast-Lok* models only)
111	—	Assembly, VCO feed-thru
112	42-83694N01	Clip, ground (2 used)

TRN4678A Tray with Latch, Mounting — PL-7254-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
201	4-8285	WASHER, flat; 4 used
203	3-138021	SCREW, tapping; 10-16 x 3/4"; 4 used
203	3-139926	SCREW, tapping; 10-16 x 1-1/2"; 4 used
206	7-84196M01	BRACKET mounting tray
209	3-84195M01	SCREW mounting rear; 2 used
210	3-84194M01	SCREW, mounting front; 2 used
213	55-84201M01	LATCH; 2 used
214	4-119332	WASHER, lock #10 split; 4 used
215	46-82540N01	CHANNEL, rubber

TRN4679A Tray, Mounting with Lock, Right-Hand — PL-7255-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
203	3-138021	SCREW, tapping; 10-16 x 3/4"; 4 used
203	3-139926	SCREW, tapping; 10-16 x 1-1/2"; 4 used
206	7-84196M02	BRACKET, mounting tray, right hand lock
209	3-84195M01	SCREW, mounting rear; 2 used
210	3-84194M01	SCREW, mounting front; 2 used
211	55-84224M01	LOCK
213	55-84201M01	LATCH; 2 used
	45-84200M01	CAM
215	46-82540N01	CHANNEL, rubber

VLN4130A Top Cover Kit — PL-8357-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	14-84173M01	INSULATOR, top cover
	15-84289N01	COVER, top
	75-82200H01	PAD
	75-82200H03	PAD, oscillator

VLN4131A Bottom Cover Kit — PL-8356-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	15-84288N01	COVER, bottom
	75-82200H03	PAD, oscillator; 2 used

TRN4603A Chassis Hardware Kit — PL-7248-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
J357	9-84135B02	female, single contact (phono)
		mechanical parts
	3-84208M01	SCREW, tapping, M3 x 0.5 x 8; 2 used
	29-10208A08	TERMINAL; 2 used

TRN4671A Tuning Tool Kit — PL-7249-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	66-83395A01	TOOL, align
	66-84974L01	TOOL, tuning

TRN4675A Standard Mounting Hardware — PL-7272-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
201	4-8285	WASHER, flat; 4 used
203	3-138021	SCREW, tapping; 10-16 x 3/4"; 4 used
203	3-139926	SCREW, tapping; 10-16 x 1-1/2"; 4 used
206	7-84196M01	BRACKET, mounting tray
209	3-84195M01	SCREW, mounting rear; 2 used
210	3-84867M01	SCREW, mounting front; 2 used
214	4-119332	WASHER, lock #10 split; 4 used
215	46-82540N01	CHANNEL, rubber

TRN4672B Radio Set Hardware Kit — PL-7537-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor:
C299	21-11022G36	18 pF ± 5%; 50 V
		coil, rf:
L299	24-83884G08	5.5 turns, ORG
		mechanical part
	29-5369	LUG

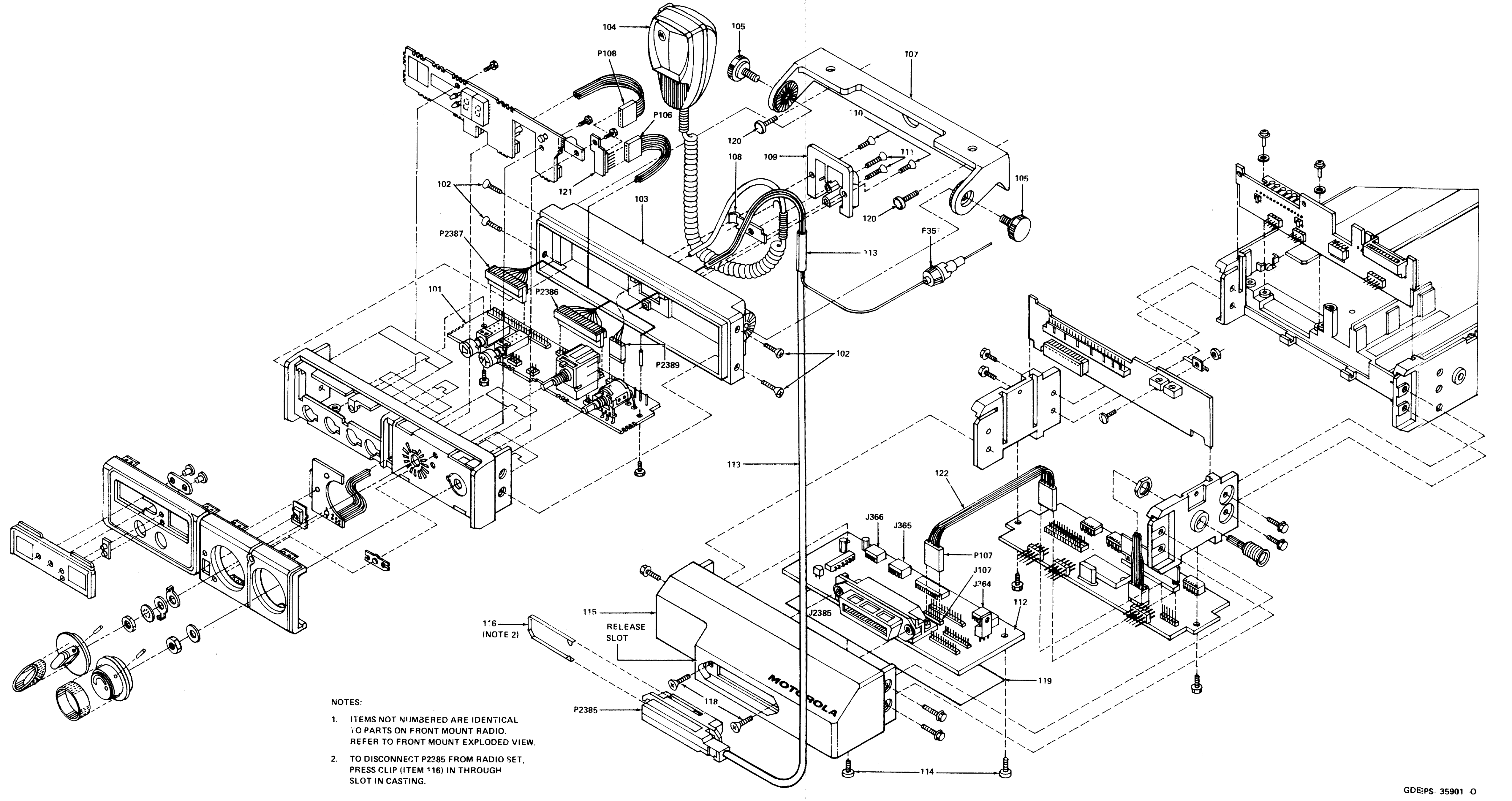
TRN4778A Tuning Probe Adaptor — PL-8330-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	43-00055M01	SLEEVE, tuning adjustment
	81-82603N01	TESTER, magnetic field probe

note: For parts not listed in the above parts list refer to the radio set mechanical parts list.

DVP MCX100 RADIO EXPLODED VIEWS AND MECHANICAL PARTS LISTS

REMOTE MOUNT RADIO SET WITH CONTROL HEAD



NOTES:

1. ITEMS NOT NUMBERED ARE IDENTICAL TO PARTS ON FRONT MOUNT RADIO. REFER TO FRONT MOUNT EXPLODED VIEW.
2. TO DISCONNECT P2385 FROM RADIO SET, PRESS CLIP (ITEM 116) IN THROUGH SLOT IN CASTING.

GDEPS-35901-O

parts list

Radio Set Mechanical Parts — PL-8401-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
101	—	BOARD, remote switch
102	3-84208M07	SCREW, M3 x 0.5 x 8, cover; 4 used
103	15-84877M01	COVER, control head
104	—	MICROPHONE (refer to Microphone section)
105	1-80761D701	KNOB, control head mounting; 2 used
106		NOT USED
107	7-84891M01	BRACKET, trunnion
108	7-84899M01	BRACKET, strain relief
109	15-84881M01	STRAIN RELIEF
110	3-84208M07	SCREW, M3 x 0.5 x 8; 2 used
111	3-84208M08	SCREW, M3 x 0.5 x 20; 2 used
112	—	BOARD, remote interface
113	—	CABLE, remote (VKN4031A or VKN4032A)
114	3-84208M01	SCREW, mounting; M3 x 0.5 x 8
115	64-84876M01	COVER, remote transceiver (front)
116	—	CLIP, plug retainer (VKN4031A or VKN4032A)
118	3-141143	SCREW, 4-40; 2 used
119	14-82125N01	INSULATOR, front panel
120	3-140147	SCREW, tapping; 10-32 x 3/4"; 3 used
	or 3-140148	SCREW, tapping; 10-32 x 1-1/2"; 3 used
121	—	*DVP*, interconnect board
122	—	*DVP*, remote interface cable kit

FRONT PANEL LENS DETAILS

MCX 100 FRONT PANEL LENSES

TYPE "A" LENSES–BASIC RADIO MODELS

REFERENCE ITEM 1	2	3	4	LENS KIT NUMBER	LENS PART NUMBER
				TRN4638A	61–84153M01
		●		TRN4639A	61–84153M02
	●	●		TRN4640A	61–84153M03
●				TRN4644A	61–84153M11
●		●		TRN4645A	61–84153M12
●	●	●		TRN4646A	61–84153M14

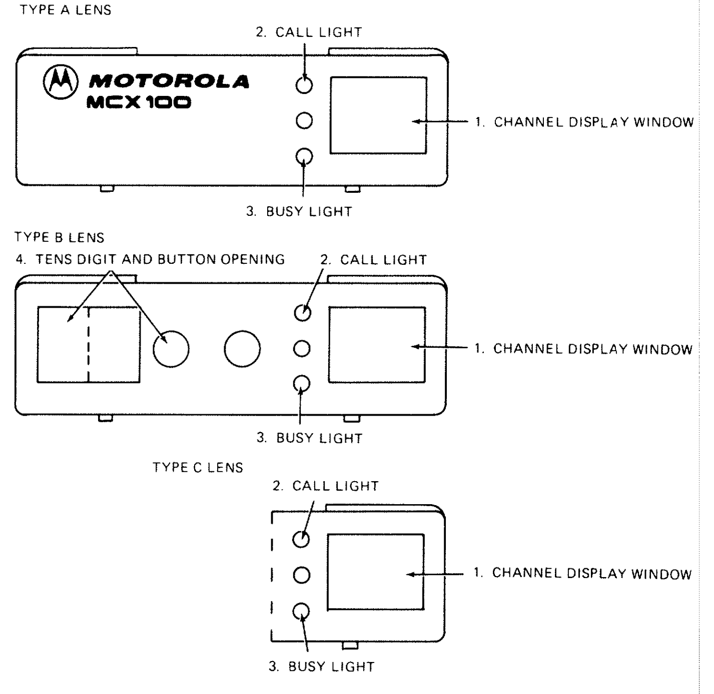
TYPE "B" LENSES–SELECT 5 WITH 10/100–CALL OPTIONS OR PL/DPL WITH SELECTABLE CODE OPTIONS

REFERENCE ITEM 1	2	3	4	LENS KIT NUMBER	LENS PART NUMBER
				TRN4652A	61–84153M01
		●		TRN4801A	61–84153M28
	●	●		TRN4641A	61–84153M06
			●	TRN4653A	61–84153M25
		●	●	TRN4800A	61–84153M27
	●	●	●	TRN4642A	61–84153M08
●				TRN4654A	61–84153M24
●		●		TRN4802A	61–84153M29
●	●	●		TRN4647A	61–84153M16
●			●	TRN4655A	61–84153M26
●		●	●	TRN4803A	61–84153M30
●	●	●	●	TRN4648A	61–84153M18

TYPE "C" LENSES–SELECT 5 MODELS WITH OPTIONS REQUIRING THUMBWHEEL SWITCHES

REFERENCE ITEM 1	2	3	4	LENS KIT NUMBER	LENS PART NUMBER
				TRN4804A	61–84153M31
	●	●		TRN4643A	61–84153M10
●				TRN4650A	61–84153M21
●		●		TRN4651A	61–84153M22
●	●	●		TRN4649A	61–84153M20

● DENOTES ITEM PRESENT IN LENS



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BUTTON PANEL DETAILS

MCX 100 FRONT PANEL BUTTON PANELS

TYPE I OPENING WITHOUT "MOTOROLA" EMBLEM

REFERENCE ITEM 1	2	3	BUTTON PANEL KIT NUMBER	BUTTON PANEL PART NUMBER
			TRN4623A	64–84145M01
●			TRN4635A	64–84145M15
	●		TRN4624A	64–84145M02
		●	TRN4636A	64–84145M16
●	●		TRN4807A	64–84145M18
●		●	TRN4625A	64–84145M03
	●	●	TRN4637A	64–84145M17
●	●	●	TRN4626A	64–84145M04

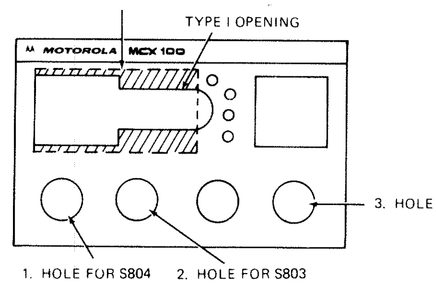
TYPE I OPENING WITH "MOTOROLA" EMBLEM

REFERENCE ITEM 1	2	3	BUTTON PANEL KIT NUMBER	BUTTON PANEL PART NUMBER
			TRN4805A	64–84145M05
●			TRN4634A	64–84145M14
	●		TRN4806A	64–84145M06
●	●		TRN4808A	64–84145M19
●		●	TRN4629A	64–84145M07
●	●	●	TRN4630A	64–84145M08

TYPE II OPENING WITH "MOTOROLA" EMBLEM

REFERENCE ITEM 1	2	3	BUTTON PANEL KIT NUMBER	BUTTON PANEL PART NUMBER
			TRN4627A	64–84145M09
●			TRN4633A	64–84145M13
	●		TRN4628A	64–84145M10
		●	TRN4982A	64–84145M22
●	●		TRN4809A	64–84145M20
●		●	TRN4631A	64–84145M11
	●	●	TRN4983A	64–84145M21
●	●	●	TRN4632A	64–84145M12

● DENOTES HOLE PRESENT IN BUTTON PANEL



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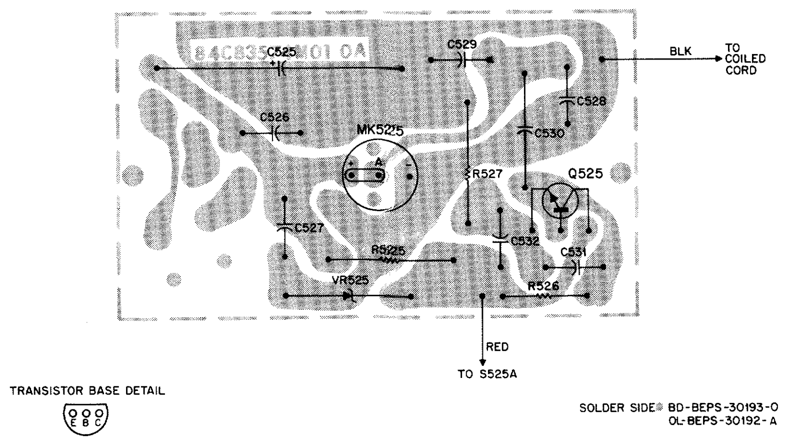
MCX100 SPEAKER

MODEL TSN6031A

MCX100 MOBILE MICROPHONES

MODELS TMN1024A, TMN1025A
TMN1026A, AND TMN1027A

MICROPHONE CIRCUIT BOARD



SHOWN FROM SOLDER SIDE

parts list

TRN4700A Microphone Hardware, Standard
TRN4701A Microphone Hardware, Signaling — PL-7182-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	3-135102	SCREW, tapping, 4-40 x 1/4"; 2 used
2	3-139999	SCREW, tapping, 6-19 x 3/8"; 3 used
3	3-140000	SCREW, tapping, 6-19 x 3/4"; 3 used
5	1-80731D39	HOUSING, riveted; microphone rear (TRN4701A) includes:
	41-84190M01	SPRING, plunger
	42-10219A52	C-RING, retainer
	45-82336M01	PLUNGER, actuator
	or 1-80709B93	HOUSING, riveted, microphone rear (TRN4700A)
6	15-82662M23	HOUSING, microphone flat
7	15-82896M01	HOUSING, microphone adapter
8	30-83385L01	CABLE (TRN4701A), with connector and strain relief, 5-conductor (W526)
	or 30-83731M03	CABLE (TRN4700A), with connector and strain relief, 4-conductor (W525)
9	32-82703B01	GASKET, microphone
10	37-12706	GROMMET; 2 used
11	38-84559B03	BUTTON, microphone
12	40-82263G02	S525, switch, push-to-talk
13	1-80762D02	S526 switch assembly, hang-up (TRN4701A)
14	42-852710	STRAP
15	—	part of ref. item 8
16	35-82652K01	BAFFLE, microphone
		non-referenced items
	13-84599B02	EMBLEM
	33-82102N01	NAMEPLATE (TMN1024A)
	33-82102N02	NAMEPLATE (TMN1025A)
	1-851093	CLIP, hang-up; includes:
	3-122830	SCREW, hang-up clip mounting, 8-15 x 1/2" tapping; 2 used
	38-84383D01	CAP, protective; 2 used
	1-80731D40	ASSEMBLY lead and terminal, red includes:
	29-82713M01	TERMINAL, single contact
	1-80731D38	ASSEMBLY wire and terminal wht-blu (TRN4701A) includes:
	29-82713M01	TERMINAL, single contact

TSN6031A Mobile Speaker (8-foot cable)
TSN6032A Mobile Speaker (17-foot cable) — PL-7186-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	15-84981B10	COVER, rear
2	7-84568B02	BRACKET, trunnion
3	3-136756	SCREW, tapping: 10-16 x 5/8"; 3 used
4	3-84244C03	SCREW, wing: 2 used
5	50-84561B07	SPEAKER, dynamic: 5"; 2 ohm
6	32-84564B01	GASKET, speaker
7	13-82671M05	BEZEL, speaker
8	14-84566B01	HOUSING, connector: 2 position
9	42-82018H05	RETAINER, cable
10	1-80731D32	ASSEMBLY, cable (TSN6031A); includes
	9-84151B03	CONTACT, receptacle: female; 2 used
	30-83155H01	CABLE, 2-conductor; 8 feet
	or 1-80734D90	ASSEMBLY, cable (TSN6032A); includes
	9-84151B03	CONTACT, receptacle; female; 2 used
	30-83155H01	CABLE, 2-conductor; 17 feet
11	3-140001	SCREW, tapping: 10-16 x 5/8"; 4 used
		non-referenced items
	33-83102N03	NAMEPLATE (TSN6031A)
	33-82102N06	NAMEPLATE (TSN6032A)

TRN4699A Microphone Board — PL-7183-A

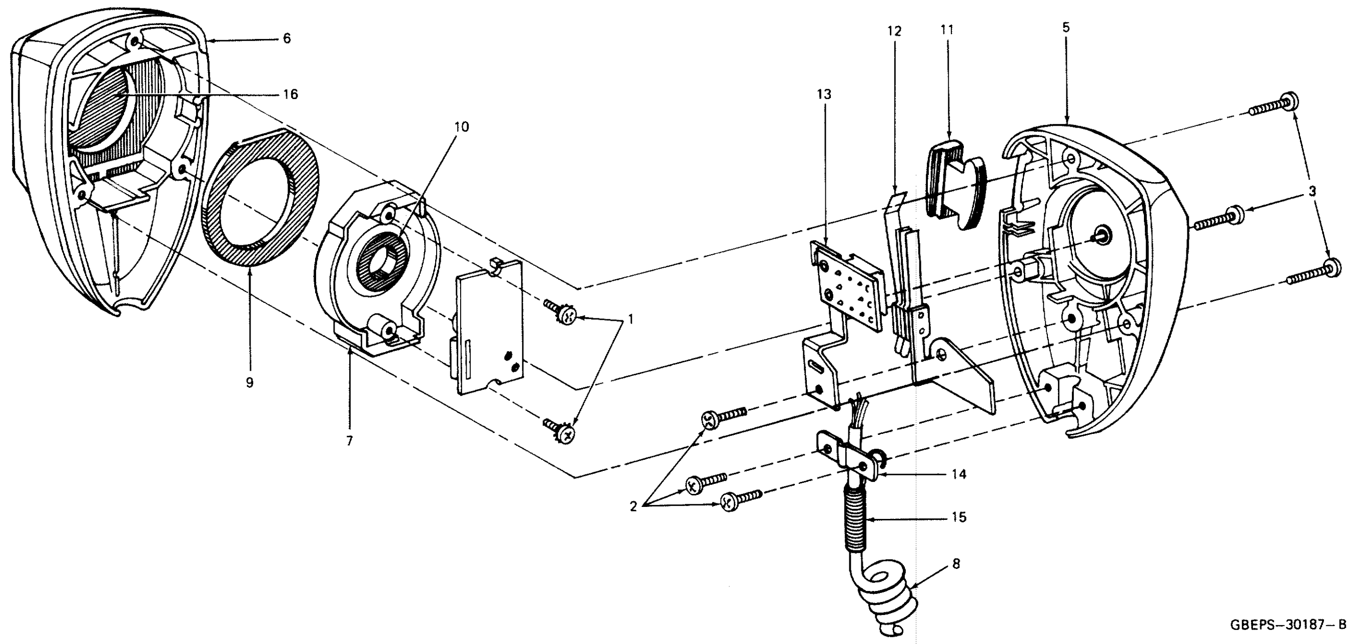
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 5%; 50 V; unless otherwise stated:
C525	23-84669A24	1 + 150-10%; 25 V
C526	21-11021E13	.001
C527	21-11022M29	30 pF
C528	21-11021E13	.001
C529	21-11022M29	30 pF
C530	8-84637L12	.047 ± 10%; 250 V
C531	21-11022M50	220 pF
C532	21-11021E13	.001
		cartridge:
MK525	50-82825M01	electret
		transistor: (see note)
Q525	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W;
R525	6-11009C57	2.2k
R526	6-11009C97	100k
R527	6-11009C19	56
		switch:
S525	—	dpst, refer to mechanical parts list
		voltage regulator: (see note)
VR525	48-82256C54	Zener type: 12 V

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

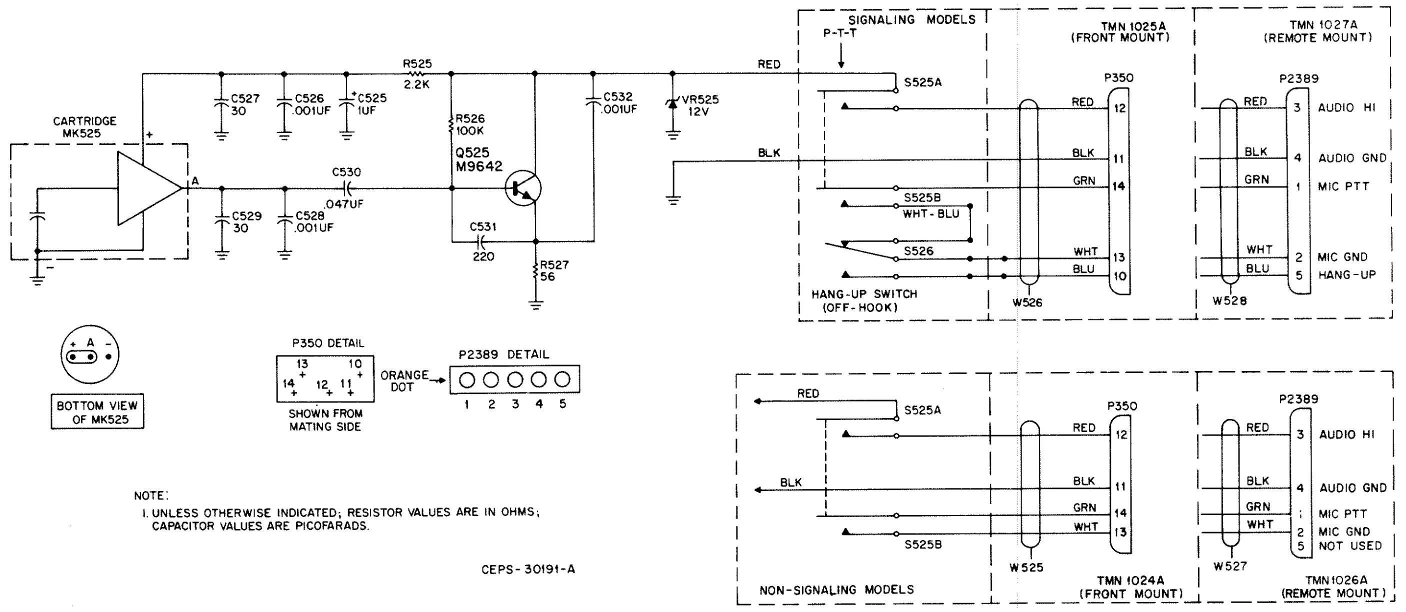
TRN4810A Microphone Hardware Standard Remote
TRN4811A Microphone Hardware Signaling Remote — PL-7471-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	3-135102	SCREW, tapping; 4-40 x 1/4"; 2 used
2	3-139999	SCREW, tapping; 6-19 x 3/8"; 3 used
3	3-140000	SCREW, tapping; 6-19 x 3/4"; 3 used
5	1-80731D39	HOUSING, microphone rear TRN8411A, includes:
	41-84190M01	SPRING, plunger
	45-82336N01	PLUNGER, actuator
	or 1-80709B93	HOUSING, microphone rear TRN8410A, includes:
	4-82705B01	WASHER, backup
	4-82707B01	WASHER, flat
	5-855939	RIVET, shoulder
	15-82662M13	HOUSING, microphone rear
6	15-82662M23	HOUSING, microphone flat
7	15-82896M01	HOUSING, microphone adapter
8	1-80734D76	ASSEMBLY coil cord; 4 wire (TRN4810A) includes:
	14-84277D26	P2389 RECEPTACLE, housing
	9-84279D02	PIN, terminal, female; 4 used
	29-83277G01	LUG, piercing; 4 used
	41-852707	SPRING, strain relief; 2 used
	30-82565B37	CABLE, coil cord (W528)
	or 1-80734D77	ASSEMBLY coil cord; 5 wire (TRN4811A) includes:
	14-84277D26	P2389 RECEPTACLE, housing
	9-84279D02	PIN, terminal, female; 5 used
	29-83277G01	LUG, piercing; 5 used
	41-852707	SPRING, strain relief; 2 used
	30-82565B38	CABLE, coil cord (W527)
9	32-82703B01	GASKET, microphone
10	37-12706	GROMMET; 2 used
11	38-84559B03	BUTTON, microphone
12	40-82263G02	S525, switch, push-to-talk
13	1-80762D02	S526, switch assembly, hang-up (TRN4811A)
14	42-852710	STRAP, plate
15	—	part of ref. item 8
16	35-82652K01	BAFFLE, microphone
		non-referenced items
	13-84599B02	EMBLEM
	33-82102N04	NAMEPLATE (TMN1026A)
	33-82102N05	NAMEPLATE (TMN1027A)
	1-851093	CLIP, hangup; includes:
	3-122830	SCREW, hang-up clip mounting, 8-15 x 1/2" tapping; 2 used
	38-84383D01	CAP, protective; 2 used
	1-80731D40	ASSEMBLY lead and terminal, red includes:
	29-82713M01	TERMINAL, single contact
	1-80731D38	ASSEMBLY wire and terminal wht-blu (TRN4811A) includes:
	29-82713M01	TERMINAL, single contact

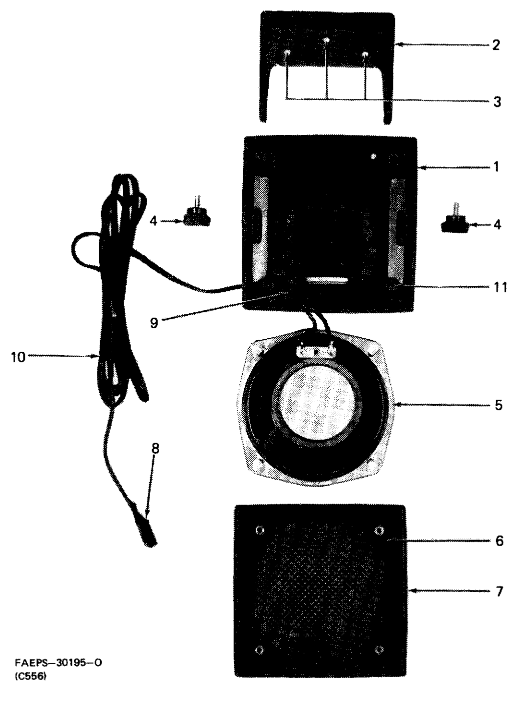
MICROPHONE EXPLODED VIEW



MICROPHONE SCHEMATIC DIAGRAM



SPEAKER PARTS



Microphone Model Complement

TMN1024A Microphone, Standard Front Mount
TRN4699A Board TRN4700A Mic Hardware, Standard Front
TMN1025A Microphone, Signaling Front Mount
TRN4699A Board TRN4701A Mic Hardware, Signaling Front
TMN1026A Microphone, Standard Remote Mount
TRN4699A Board TRN4810A Mic Hardware, Standard Remote
TMN1027A Microphone, Signaling Remote Mount
TRN4699A Board TRN4811A Mic Hardware, Signaling Remote

68P81045E94-C
1/19/83- PHI

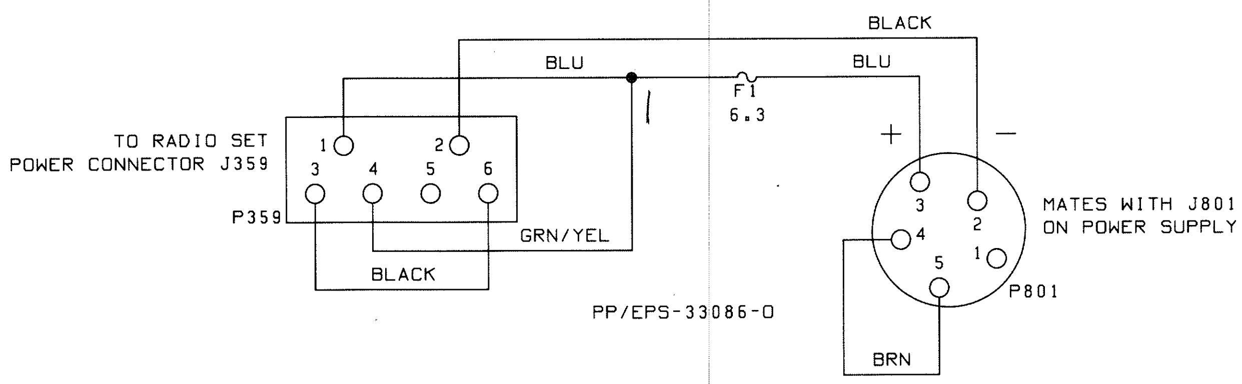
BASE STATION POWER CABLE AND SPEAKER TRAY

FUNCTION

Provides interconnection between GPN6101A Power Supply and *MCX100* Radio set.

NOTE

Refer to Power Supply section of this manual for information on cables used with TPN series power supplies.



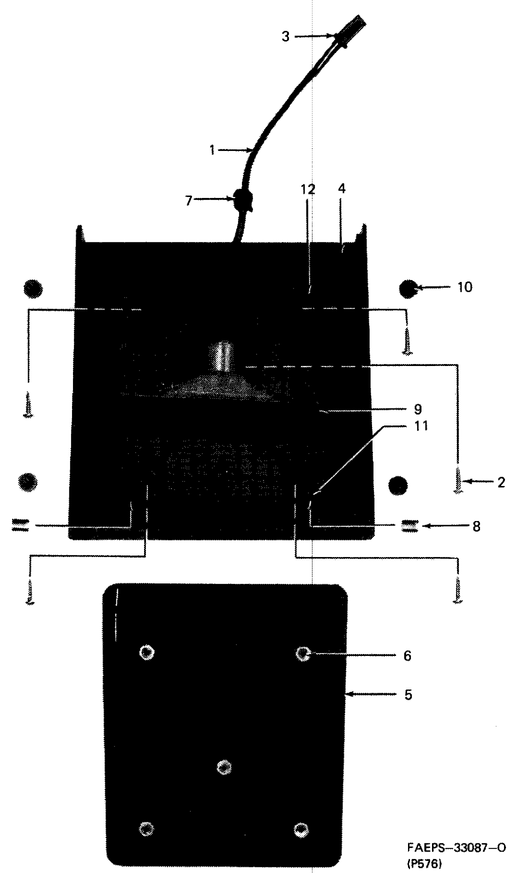
NOTE: CONNECTORS SHOWN FROM WIRE SIDE.

parts list

TKN8208A Low Power Cable Kit — PL-7637-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F1	65-84711C04	6.3 amp
		connector, plug:
P359	15-84192M01	HOUSING, 6-contact
P801	23-84749B01	male, 5-contact
		mechanical parts
	1-80733D11	assembly, jumper and terminal; includes:
	9-84151B05	TERMINAL; 2 used
	1-80737D34	assembly power cable; includes:
	29-84151L05	TERMINAL; 2 used
	9-84151B03	CONTACT, receptacle
	37-135566	TUBING, 1/4" heatshrink
	1-80737D35	assembly blue wires includes:
	5-82050	EYELET
	14-84710C01	BODY, fuseholder
	41-84707C01	SPRING
	42-84754B01	CLAMP
	2-84745B01	NUT
	15-84746B02	SHELL
	3-84747B01	SCREW, set

BASE STATION SPEAKER TRAY



TRN4898A Base Station Mounting Tray — PL-7633-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	1-80735D98	CABLE, with connector pins
2	3-122916	SCREW
3	14-84566B01	HOUSING, cable connector
4	15-82086N01	HOUSING
5	15-82087N01	COVER
6	38-82132N01	NUT, clamp-on
7	42-82018H18	GROMMET, cable
8	42-82105N01	CLIP, speaker
9	50-84401D01	SPEAKER
10	55-82104N01	BUTTON, detent
11	75-82172N01	PAD, speaker
12	75-83951F01	FOOT, bumper
		non-referenced item
	33-82102N07	NAMEPLATE

DESK MICROPHONES

MODELS TMN1028A AND TMN1029A

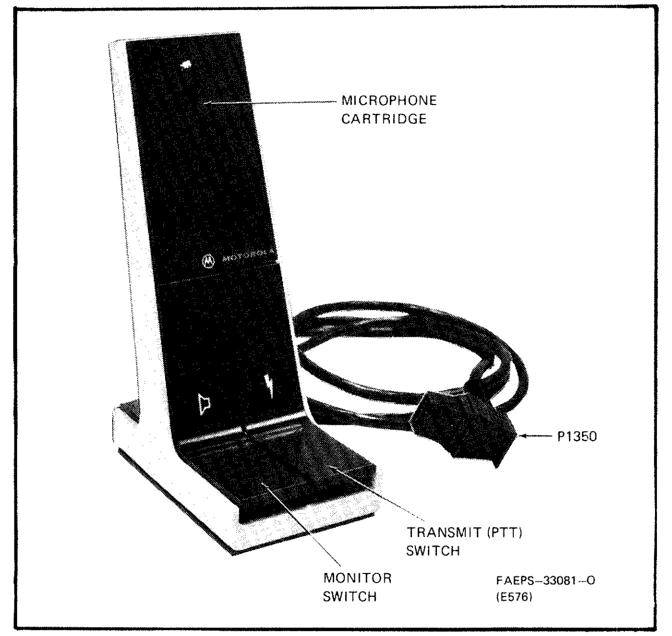


Figure 1. Microphone Controls

1. DESCRIPTION

1.1 The TMN1028A Desk Microphone contains a microphone and preamplifier circuit board, and a dual-action "Transmit" switch which allows easy operation for either hand-held or desk-top use in carrier squelch applications. The TMN1029A Desk Microphone is the same as the TMN1028A except that it contains an additional dual action "Monitor" switch for use in coded squelch applications.

1.2 All electrical components are mounted vertically in the housing with the microphone cartridge at the top and the switches at the bottom. A stranded cord with connector is routed out through the back at the base of the housing.

2. INSTALLATION

Before connecting the desk microphone to the radio set, verify that printed circuit board jumpers JU1 and JU2 are configured correctly for the system application. Microphones are shipped from the factory with both jumpers installed. Jumper JU2 (Model TMN1029A only) is removed when it is necessary to prevent an operator from transmitting without first monitoring a channel to verify it is clear. With JU2 removed, both the MONITOR and TRANSMIT switches must be activated before transmitting.

Refer to paragraph 4.1 for front cover removal to gain access to the jumpers when it is necessary to change the microphone jumper configuration.

3. OPERATION

3.1 GENERAL MICROPHONE PROCEDURE

To assure good audio transmission quality, observe the following general microphone practices.

- Keep microphone approximately 8 inches away from the mouth. The distance may vary depending on the user's tone of voice.
- Speak clearly and directly into the microphone at a normal conversational level.

3.2 TRANSMIT SWITCH

When pressed and held, the dual- action TRANSMIT switch causes the associated transmitter to be keyed.

3.3 MONITOR SWITCH

The MONITOR switch is a dual-action switch which operates in the same manner as the TRANSMIT switch.

The MONITOR switch (Model TMN1029A only) when activated, allows the operator to monitor a channel to be sure it is clear before transmitting. In systems using coded squelch, this feature is an FCC requirement. If jumper JU2 is removed, the operator must press and hold both the MONITOR and TRANSMIT switches before he can transmit. Releasing either switch ends the transmission.

4. MAINTENANCE

4.1 DISASSEMBLY

Step 1. At the rear of the microphone, remove the four screws that secure the front cover to the housing; then remove the front cover.

Step 2. On the bottom of the microphone, remove the four screws that secure the baseplate to the housing then remove the baseplate.

Step 3. Remove the shaft retainer clip from the pivot shaft (see Figure 2).

Step 4. Remove the cord grommet from the U- shaped slot. (See Figure 3).

Step 5. Slide both halves of the pivot shaft toward the center releasing the shaft from the retaining holes in the housing.

Step 6. Swing the lower edge of the printed circuit board (including switches) forward to disengage the upper portion of the circuit board from the housing. Remove the circuit board.

4.2 ASSEMBLY

Assembly is essentially the reverse order of disassembly.

4.3 TESTING

4.3.1 Test Equipment Required

- S-1063 Motorola Solid-State DC Multimeter or equivalent
- S-1053 Motorola Solid-State AC Voltmeter or equivalent
- R-1004 Motorola General Purpose Dual Trace 15 MHz Oscilloscope.

4.3.2 Test Procedure

NOTE

Potentiometer R1 is factory set and field adjustment is not required.

The microphone can be tested either while connected to its associated equipment or to the test setup as shown in Figure 4. Basic testing consists of checking resistances and dc voltages against the schematic diagram. Dynamic testing can be accomplished by speaking into the microphone and using an oscilloscope or ac voltmeter to monitor the amplification (gain) of the various stages. However, since a known dynamic input signal for field testing is not practicable, gain measurements are to be used only as indications of proper stage functioning. For that reason, no ac voltages are provided on the schematic.

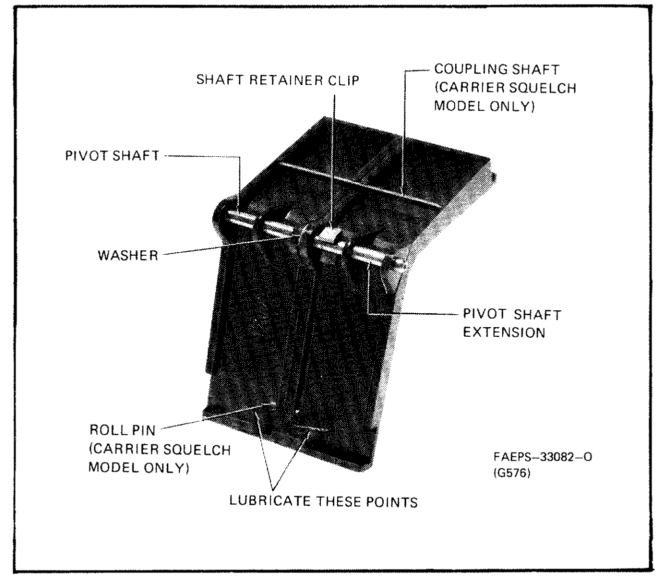


Figure 2. Pivot Shaft Detail

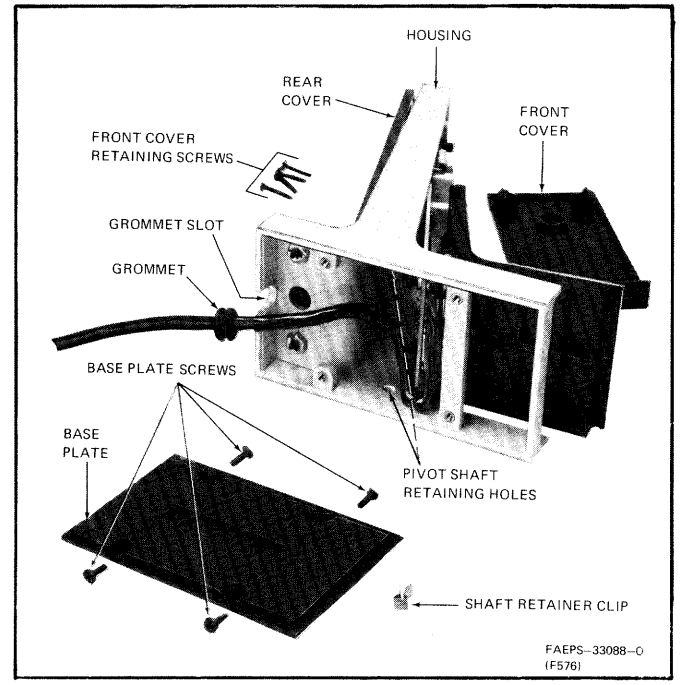


Figure 3. Microphone Assembly Detail

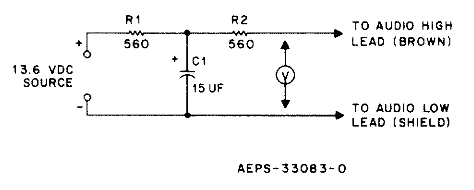


Figure 4. Test Setup

TMN1028A Model Complement

Item	Description	Ver
TRN4861A	Mic Circuit Board	0
TRN4820A	Mic Housing and Hardware	0

TMN1029A Model Complement

Item	Description	Ver
TRN4861A	Mic Circuit Board	0
TRN4821A	Mic Housing and Hardware	0

parts list

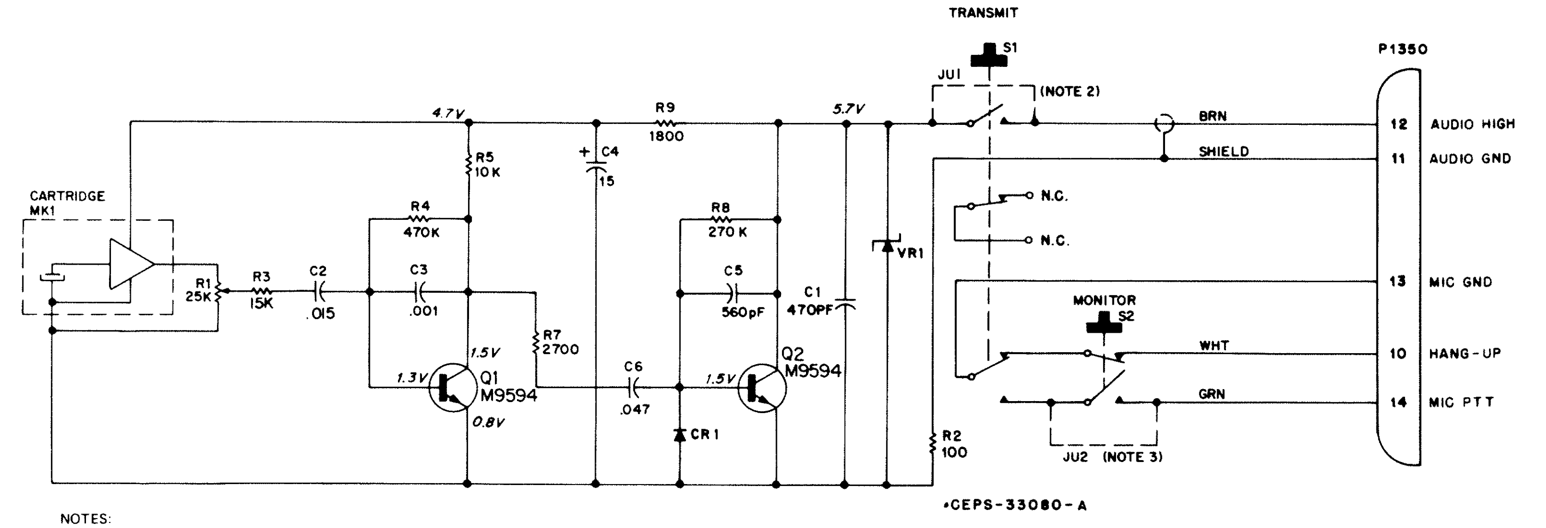
TRN4861A Microphone Circuit Board PL-7604-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; unless otherwise stated
C1	21-82187B45	470 pF; 500 V
C2	8-84637L08	.015; 400 V
C3	21-82187B44	.001; 100 V
C4	23-84665F09	15 + 150 -10%; 25 V
C5	21-82187B06	560 pF; 500 V
C6	8-84637L12	.047; 250 V
		diode:
CR1	48-83654H01	Silicon
		cartridge, microphone:
MK1	50-82825M01	miniature
		transistor: (see note)
Q1,2	48-869594	NPN; type M9594
		resistor, fixed ± 5%; 1/4 W; unless otherwise stated
R1	18-84944C02	variable; 25k
R2	6-11009C25	100
R3	6-11009C77	15k
R4	6-11009D14	470k
R5	6-11009C73	10k
R7	6-11009C59	2.7k
R8	6-11009D08	270k
R9	6-11009C55	l.8k
		voltage regulator:
VR1	48-82256C38	Zener; 9.1 V

TRN4820A & TRN4821A Microphone Housing & Hardware Kit PL-7605-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		switch, leaf:
S1,2	40-84711E02	2 section, multiple nonlocking contacts (TRN4820A)
	40-84711E03	2 section multiple nonlocking contacts (TRN4821A)
		mechanical parts
	2-10101A69	NUT, spring steel; 2 used
	3-135676	SCREW, tapping:4-40 x 1/4 "; 3 used (switch)
	3-138809	SCREW, machine: 4-40 x 5/16"; 4 used (baseplate)
	3-140047	SCREW, tapping: 4-40 x 5/8"; 4 used (front cover)
	4-10058B10	WASHER, ("TEFLON") THN4820A
	15-82976M03	COVER, front
	15-82978M01	COVER, rear
	15-84191E02	HOUSING
	22-82591C05	PIN, roll (TRN4820A)
	38-84184E06	BUTTON, left hand (TRN4820A)
	38-84184E03	BUTTON, left hand (TRN4821A) (monitor)
	38-84192E02	BUTTON, right hand (transmit)
	42-82143C05	CLAMP, cable
	42-84725E01	CLIP,retainer
	47-84193E01	SHAFT, button mounting pivot
	47-84194E01	SHAFT, extension
	47-84723E01	SHAFT, coupling (TRN4820A)
	64-82977M01	PLATE, base
	75-84722E01	PAD, base plate
	42-82143C05	CLAMP, cable
	30-82247N01	CABLE, 5-conductor
	37-82633B13	GROMMET

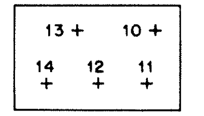
note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



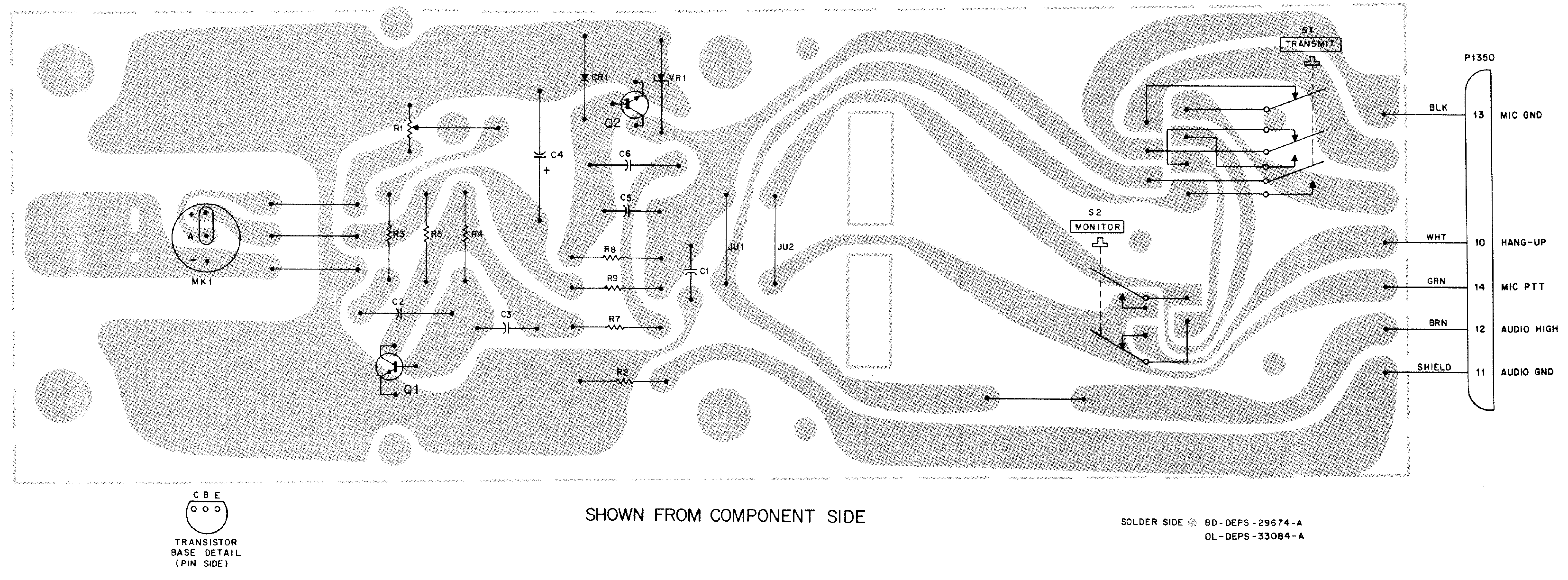
NOTES:

1. UNLESS OTHERWISE STATED: ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. REMOVE JU1 FOR PARALLEL MIC OPERATION.
3. REMOVE JU2 TO MONITOR BEFORE TRANSMIT.
4. ALL DC VOLTAGE READINGS ARE IN RESPECT TO THE **AUDIO GND**.
5. MONITOR SWITCH S2 IS PRESENT IN MODEL TMN1029A ONLY.

P1350 DETAIL



SHOWN FROM MATING SIDE



SHOWN FROM COMPONENT SIDE

DESK MICROPHONE

parts list

TKN6948A Power Cable Kit — PL-6084-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse, cartridge:
F602	65-86099	7.5 amp; 32 V; type 3AG; fast-blow
		connector, plug:
P601		includes:
	15-83293K01	INSULATOR, connector; 15-circuit
	29-84706E05	TERMINAL, pin; male; 4 used
	30-10286A21	WIRE, jumper; BLK
P602		includes:
	15-10183A52	INSULATOR, connector; 6-circuit
	29-82335A01	TERMINAL, pin; male; 4 used
		cable, power:
W601	30-84396L01	2-conductor; (18 ga.); 120" used
		fuseholder, in-line:
XF602		includes:
	14-82882A01	BODY, fuseholder
	14-82883A01	CAP, fuseholder
	41-82885A01	SPRING, compression
	42-82884A01	CLIP, fuseholder; 2 used
		non-referenced part
	37-134371	TUBING, heatsink (BLK) 1" length; 2 used

TKN6949A Power Cable Kit — PL-6085-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse, cartridge:
F603	65-4165	15 amp; 35 V; fast-blow type
		connector, plug:
P601		includes:
	15-83958L01	INSULATOR, connector; 17-circuit
	29-82335A01	TERMINAL, pin; male; (large) 2 used
	29-84706E05	TERMINAL, pin; male; (small) 6 used
	30-10286A21	WIRE, jumper; BLK
P602		includes:
	15-10183A52	INSULATOR, connector; 6-circuit
	29-82335A01	TERMINAL, pin; male; 4 used
		cable, power:
W601	30-84396L02	2-conductor; (14 ga.); 120" used
		fuseholder, in-line:
XF603		includes:
	14-82882A01	BODY, fuseholder
	14-82883A01	CAP, fuseholder
	41-82885A01	SPRING, compression
	42-82884A01	CLIP, fuseholder; 2 used
		non-referenced part
	37-134371	TUBING, heatsink (BLK) 1" length; 2 used

TLN5274B Regulator Board — PL-5361-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed; uF: ± 10%; 50 V: unless otherwise stated
C1	8-82905G02	.022
C2	23-83908L01	100 + 75-10%; 25 V
C3, 4	8-82905G02	.022
		semiconductor device, diode: (see note)
CR5	48-82392B03	silicon
		transistor: (see note)
Q1, 2	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/2 W: unless otherwise stated
R1	6-125A41	470
R2	6-125A53	1.5k
R3	6-125A13	33
R4	17-82177B40	200; 5 W
R5, 6	6-126C41	470 ± 10%; 1 W
R7, 8	6-125A49	1k
R9, 10	6-125C73	10k ± 10% (note: Use is optional, determined at factory)
R11	6-125C51	1.2k ± 10%
		semiconductor device, diode: (see note)
VR1	48-83696E01	silicon; Zener type: 6.8 V ± 5%

note: Replacement diodes and transistors must be ordered by listed part number only for optimum performance.

parts list

TRN6282A Power Supply Chassis — PL-3349-I

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1	23-82464C08	11,000 uF + 75-10%; 35 V
		semiconductor device, diode: (see note)
CR1	48-84571H02	Bridge Rectifier Assembly; silicon
		connector, receptacle:
J1		includes:
	15-10183A53	INSULATOR, 6-contact
	29-82336A01	CONTACT, female; 4-req'd. (p/o Model TLN5219A)
		fuse, cartridge:
F1	65-42092	fast-blow type; 2A
		line cord:
P1	30-83212F01	includes: ac plug
		transistor: (see note)
Q3	48-869807	PNP; type M9807
Q4	48-869639	NPN; type M9639
		switch, slide:
S1	40-84241G04	dpst
		transformer, power:
T1	25-83594E02	pri: res, 2.75 ohms sec: res 0.11 ohm
		terminal strip:
TB1	31-121700	8-terminals: no. 2 & 7 mtg.
		fuseholder:
XF1	9-82083C01	extractor post type
		non-referenced items
	1-80745B56	WIRE & LUG ASSEMBLY, includes:
	29-824456	LUG, ring tongue
	3-2977	SCREW, machine: 6-32 x 1-1/8"; 4 req'd.
	4-7569	WASHER, flat: .145 x .312 x .027"; 4 req'd.
	4-7650	WASHER, lock: #6 (split); 2 req'd.
	4-84496C01	WASHER, shoulder; 4 req'd.
	26-84923B06	HEATSINK
	29-5248	LUG, soldering: #6; 2 req'd.
	1-80745B57	DIODE BRACKET ASSEMBLY includes:
	1-80745B56	WIRE & LUG ASSEMBLY includes:
	29-824456	LUG, ring tongue
	1-80745B58	WIRE & LUG ASSEMBLY, includes:
	29-824456	LUG, ring tongue
	1-80745B60	WIRE & LUG ASSEMBLY, includes:
	29-824456	LUG, ring tongue
	1-80745B61	WIRE & LUG ASSEMBLY, includes:
	29-824456	LUG, ring tongue
	3-134168	SCREW, tapping: 4-40 x 1/4"; 2 req'd.
	3-134268	SCREW, tapping: 4-40 x 7/16"; 2 req'd.
	4-114057	WASHER, flat: .125 x .312 x .032"
	7-83095F02	BRACKET, circuit board
	14-84268A01	INSULATOR, transistor: 520 x .660"
	14-84525G01	INSULATOR, transistor (T066 base)
	29-5261	LUG, soldering: #6; 2 req'd.
	29-5369	LUG, soldering: #4
	1-80745B88	HOUSING ASSEMBLY, includes:
	13-868710	DECAL, patent
	15-83096F02	HOUSING
	1-80778B37	CHASSIS ASSEMBLY, includes:
	1-80747B60	WIRE & LUG ASSEMBLY, includes:
	29-82336A01	CONTACT, female
	1-80747B61	WIRE & LUG ASSEMBLY, includes:
	29-82336A01	CONTACT, female
	1-80747B62	WIRE & LUG ASSEMBLY, includes:
	29-82336A01	CONTACT, female
	1-80747B63	WIRE & LUG ASSEMBLY, includes:
	29-82336A01	CONTACT, female
	2-1355	NUT, hex: 8-32 x 5/16 x 1/8"; 4 req'd.
	2-7005	NUT, hex: 6-32 x 1/4 x 3/32"; 14 req'd.
	2-9627	NUT, hex: 4-40 x 3/16 x 3/32"; 2 req'd.
	2-119913	NUT, 8-32 x 11/32"
	3-2979	SCREW, machine: 6-32 x 3/8"; 7 req'd.
	3-7312	SCREW, machine: 8-32 x 3/4"
	3-7346	SCREW, machine: 6-32 x 3/4"
	3-139085	SCREW, machine: 4-40 x 5/16"; 2 req'd.
	3-490773	SCREW, machine: 6-32 x 9/16"; 4 req'd.
	4-2645	WASHER, lock: #6 (split); 12 req'd.
	4-9746	WASHER, lock: #8 (split); 4 req'd.
	4-114583	WASHER, lock: #4 (split); 2 req'd.
	4-82418B88	WASHER, insulator: .125 x .250 x .010"; 2 req'd.
	13-84639D04	ESCUTCHEON
	27-83252N01	CHASSIS
	42-82018H01	RETAINER, cable
	42-83415C01	CLIP, capacitor mounting
	43-82599M01	SPACER, 4 req'd.
	75-84215A02	BUMPER, recessed: 4 req'd.
	3-139854	SCREW, tapping: 6-32 x 3/8"; 6 req'd.
	3-134168	SCREW, tapping: 4-40 x 1/4"; 2 req'd.
	3-139138	SCREW, tapping: 10-32 x 3/8"; 3 req'd.
	33-84035E05	NAMEPLATE, model number
	42-10217A02	STRAP, cable harness; 3 req'd.
	54-84347M01	LABEL, warning
	9-10454A04	CONN. (YELLOW)

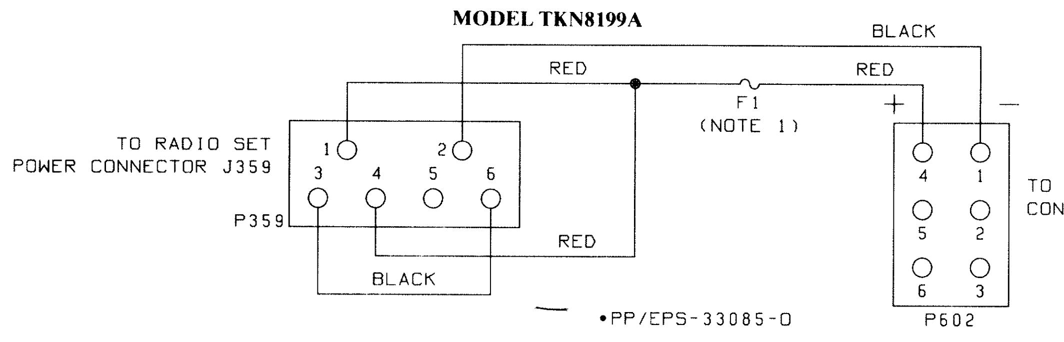
note: Replacement diodes and transistors must be ordered by listed part number only for optimum performance.

TKN8199A Power Cable Kit — PL-7636-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F1	65-10266	10 amp
	or 65-15270	6 amp
		connector, plug:
P359	15-84192M01	HOUSING, 6-contact
P602	15-10183A52	HOUSING, 6-contact
		mechanical parts
	1-80737D31	assembly power cable; includes:
	14-82883A01	CAP, fuse holder
	42-82884A01	CLIP, fuse
	29-82335A01	TERMINAL, male
	30-84396L02	CABLE, 2-conductor
	37-134370	TUBING, heatshrink; 3/4" (BLK)
	37-134371	TUBING, heatshrink; 3/8" (BLK)
	9-82845L01	CRIMP, connector
	1-80737D32	ASSEMBLY, red wire and lug; includes:
	9-84151B03	RECEPTACLE, single contact
	1-80737D33	ASSEMBLY, red wire and lug; includes:
	14-82882A01	BODY, fuseholder
	29-82335A01	TERMINAL, male
	41-82885A01	TERMINAL, fuseholder
	42-82884A01	CLIP, fuseholder

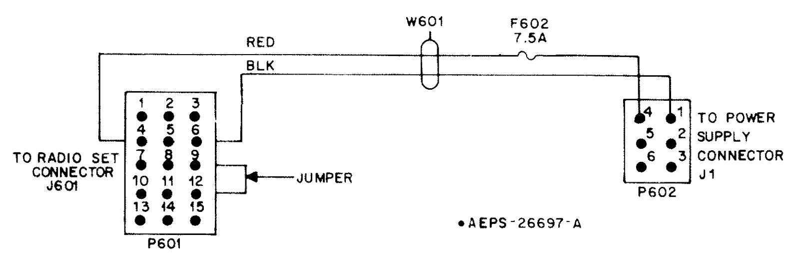
CABLE DETAILS

MODEL TKN8199A

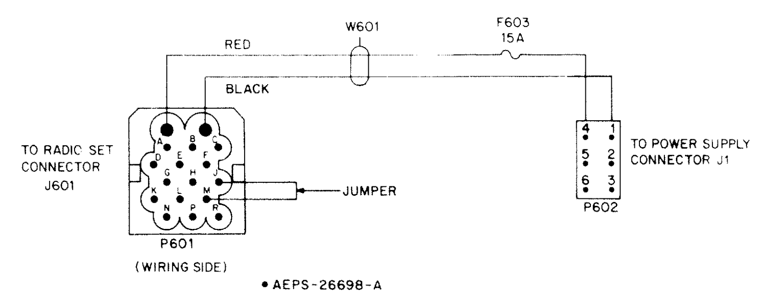


NOTES
1. F1 IS 6A IN 6/10W MODELS. 10A IN 25/30W MODELS.
2. CONNECTORS SHOWN FROM WIRE SIDE.

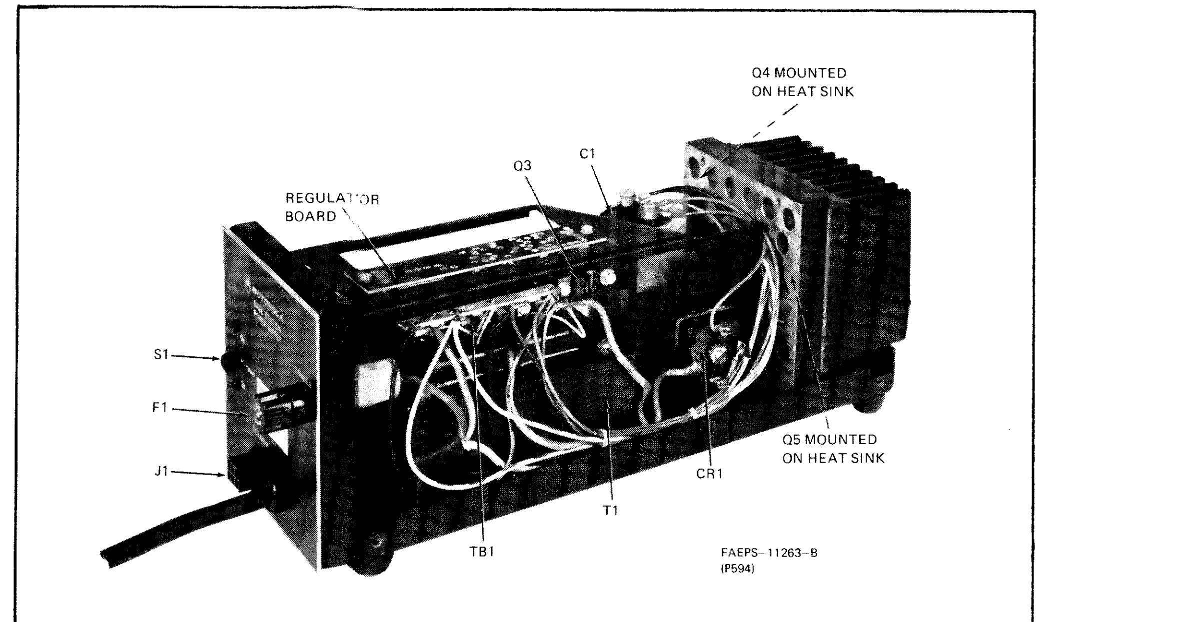
MODEL TKN6948A



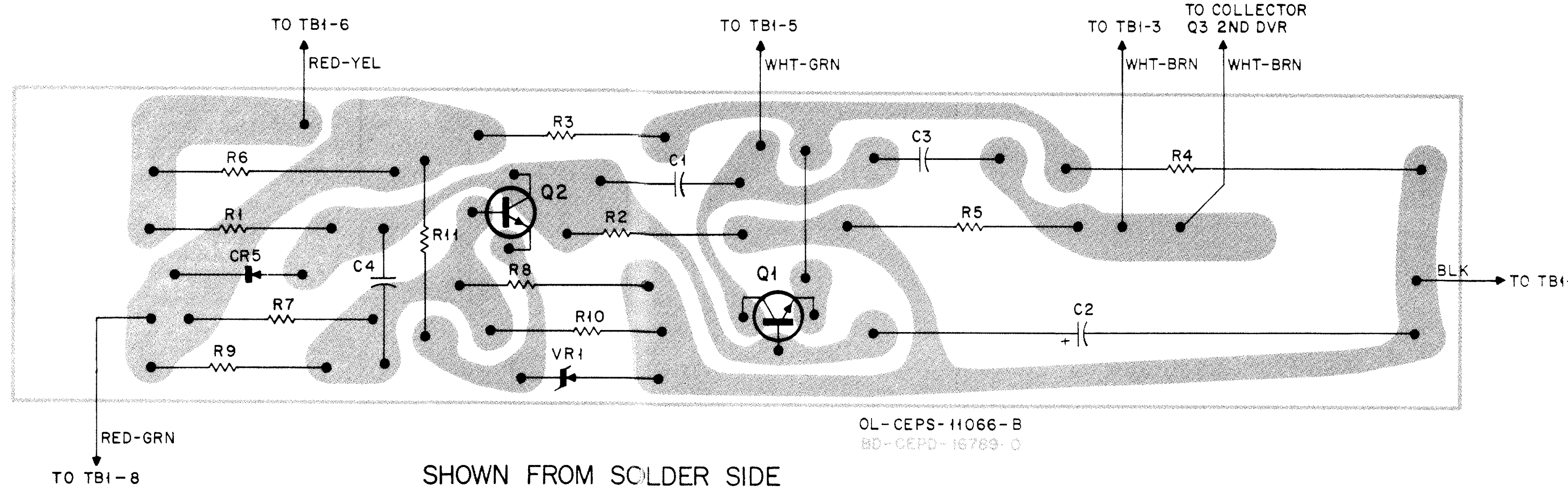
MODEL TKN6949A



PARTS LOCATION



REGULATOR BOARD DETAIL



SHOWN FROM SOLDER SIDE

BASE STATION POWER SUPPLY

MODEL TPN1136A

POWER CABLES

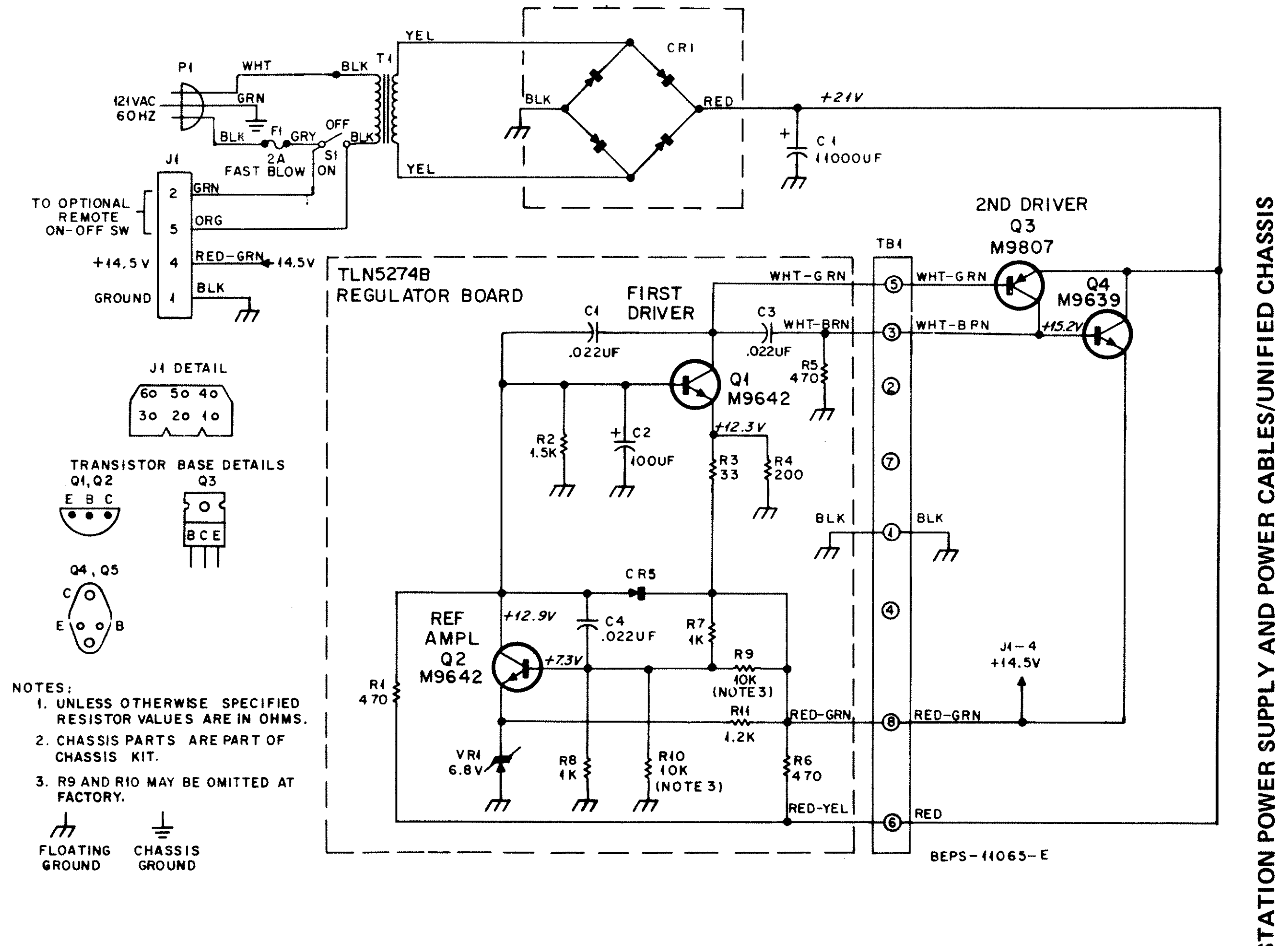
MODELS TKN6948A, TKN6949A, AND TKN8199A

MODEL TABLE

Model	Sub-Model	Description
TPN1136A	TLN5274B	Regulator Board
	TRN6282A	Power Supply Chassis
TKN6948A		Power Cable (*Maxar*)
TKN6949A		Power Cable (*Maxar-80*)
TKN8199A		Power Cable (*MCX100* or *DVP MCX100*)

FUNCTION

Provides the entire radio with regulated +14.5 V dc when used in a 120 V ac primary power fixed installation.



BASE STATION POWER SUPPLY AND POWER CABLES/UNIFIED CHASSIS

BASE STATION POWER SUPPLY

MODEL TPN1154A

POWER CABLE

MODELS TKN6948A, TKN6949A AND TKN8199A

parts list

TKN8199A Power Cable Kit — PL-7636-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F1	65-10266 or 65-15270	10 amp 6 amp
		connector, plug:
P359	15-84192M01	HOUSING, 6-contact
P602	15-10183A52	HOUSING, 6-contact
		mechanical parts
	1-80737D31	assembly power cable; includes:
	14-82883A01	CAP, fuse holder
	42-82884A01	CLIP, fuse
	29-82335A01	TERMINAL, male
	30-84396L02	CABLE, 2-conductor
	37-134370	TUBING, heatshrink; 3/4" (BLK)
	37-134371	TUBING, heatshrink; 3/8" (BLK)
	9-82845L01	CRIMP, connector
	1-80737D32	ASSEMBLY, red wire and lug; includes:
	9-84151B03	RECEPTACLE, single contact
	1-80737D33	ASSEMBLY, red wire and lug; includes:
	14-82882A01	BODY, fuseholder
	29-82335A01	TERMINAL, male
	41-82885A01	TERMINAL, fuseholder
	42-82884A01	CLIP, fuseholder

TKN6948A Power Cable Kit — PL-6084-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse, cartridge:
F602	65-86099	7.5 amp; 32 V; type 3AG; fast-blow
		connector, plug:
P601		includes:
	15-83293K01	INSULATOR, connector; 15-circuit
	29-84706E05	TERMINAL, pin; male; 4 used
	30-10286A21	WIRE, jumper; BLK
P602		includes:
	15-10183A52	INSULATOR, connector; 6-circuit
	29-82335A01	TERMINAL, pin; male; 4 used
		cable, power:
W601	30-84396L01	2-conductor; (18 ga.); 120" used
		fuseholder, in-line:
XF602		includes:
	14-82882A01	BODY, fuseholder
	14-82883A01	CAP, fuseholder
	41-82885A01	SPRING, compression
	42-82884A01	CLIP, fuseholder; 2 used
		non-referenced part
	37-134371	TUBING, heatsink (BLK) 1" length; 2 used

TKN6949A Power Cable Kit — PL-6085-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse, cartridge:
F603	65-4165	15 amp; 35 V; fast-blow type
		connector, plug:
P601		includes:
	15-83958L01	INSULATOR, connector; 17-circuit
	29-82335A01	TERMINAL, pin; male; (large) 2 used
	29-84706E05	TERMINAL, pin; male; (small) 6 used
	30-10286A21	WIRE, jumper; BLK
P602		includes:
	15-10183A52	INSULATOR, connector; 6-circuit
	29-82335A01	TERMINAL, pin; male; 4 used
		cable, power:
W601	30-84396L02	2-conductor; (14 ga.); 120" used
		fuseholder, in-line:
XF603		includes:
	14-82882A01	BODY, fuseholder
	14-82883A01	CAP, fuseholder
	41-82885A01	SPRING, compression
	42-82884A01	CLIP, fuseholder; 2 used
		non-referenced part
	37-134371	TUBING, heatsink (BLK) 1" length; 2 used

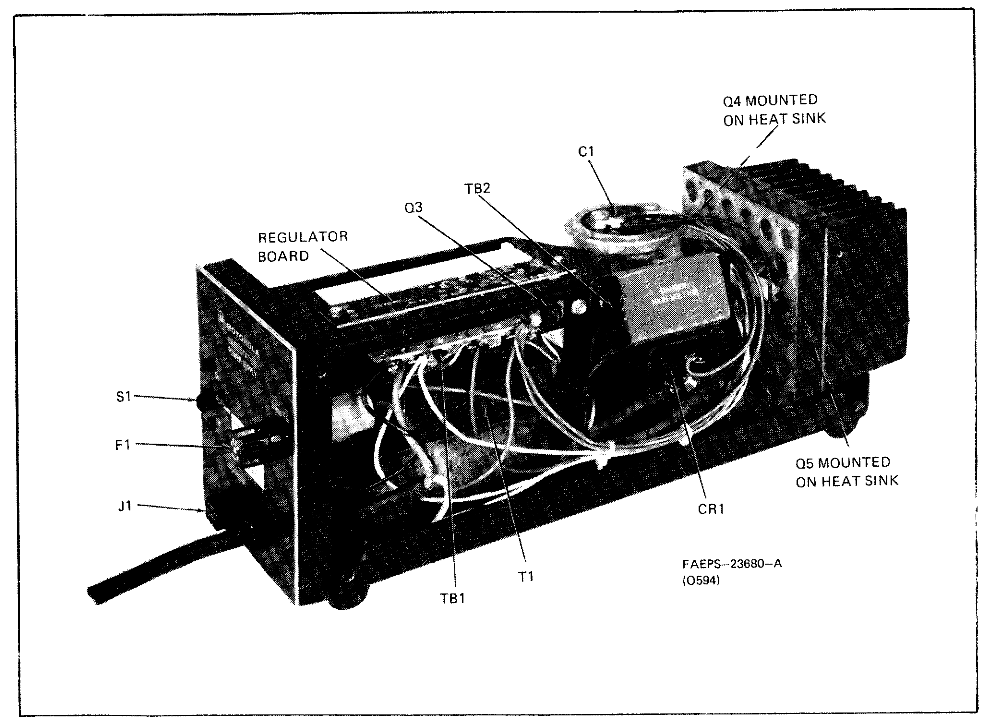
TRN6561A Power Supply Chassis — PL-5362-G

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1	23-82464C10	25,000 uF + 75-10%; 40 V
		semiconductor device; diode: (see note)
CR1	48-84571H02	Bridge Rectifier Assembly, silicon
		connector, receptacle:
J1		includes:
		15-10183A53 INSULATOR, 6-contact
		29-82336A01 CONTACT, female; 2 req'd.
		fuse, cartridge:
F1	65-52293	fast-blow type; 5 A
		line cord:
P1	30-83212F01	includes: ac plug
		transistor: (see note)
Q3	48-869807	PNP; type M9807
Q4, 5	48-869639	NPN; type M9639
		switch, slide:
S1	40-84241G04	DPST
		resistor, fixed:
R12, 13	17-82177B50	0.1 ± 10%; 7 W
		transformer, power:
T1	25-84638C02	pri: res. 4.9 ohms (240 volt configuration) sec: res. 0.035 ohms
		terminal strip:
TB1	31-121700	8 terminals; No. 2 & 7 mtg.
TB2	31-898341	4-terminals, screw
		fuseholder:
XF1	9-82083C01	extracter post type
		non-referenced items
	37-134371	TUBING, heatshrink: BLK 1" length; 2 used
	1-80794B62	HEAT SINK ASSEMBLY:
	1-80745B56	WIRE & LUG ASSEMBLY, includes:
	29-824456	LUG, ring tongue
	1-80794B63	TRANSISTOR & LUG ASSEMBLY: 2 req'd. includes:
	4-474216	WASHER, insulator; 2 req'd.
	14-865854	INSULATOR, transistor
	29-84489B01	LUG, transistor; 2 req'd. (used with Q4 & Q5)
	2-7005	NUT, hex: 6-32 x 1/4 x 3/32"; 10 req'd.
	3-2977	SCREW, machine: 6-32 x 1 1/8"; 4 req'd.
	4-7569	WASHER, flat: .145 x .312 x .027"; 2 req'd.
	4-7650	WASHER, lock: #6 (split); 2 req'd.
	4-84496C01	WASHER, shoulder; 4 req'd.
	26-84923B06	HEAT SINK
	29-5248	LUG, soldering: #6; 2 req'd.
	31-490181	TERMINAL STRIP: #1 mtg; 2 req'd.
	1-80794B64	DIODE BRACKET ASSEMBLY, includes:
	1-80745B56	WIRE & LUG ASSEMBLY, includes:
	29-824456	LUG, ring tongue
	1-80745B58	WIRE & LUG ASSEMBLY, includes:
	29-824456	LUG, ring tongue
	1-80745B60	WIRE & LUG ASSEMBLY, includes:
	29-824456	LUG, ring tongue
	1-80745B61	WIRE & LUG ASSEMBLY, includes:
	29-824456	LUG, ring
	1-80795B10	WIRE & LUG ASSEMBLY, includes:
	29-812979	LUG, crimp terminal
	2-121841	NUT, hex: 6-32 x 5/16 x 7/64"; 2 req'd.
	3-134168	SCREW, tapping 4-40 x 1/4"; 2 req'd.
	3-134268	SCREW, tapping 4-40 x 7/16"; 2 req'd.
	3-138341	SCREW, machine: 6-32 x 5/8"; 2 req'd.
	4-114057	WASHER, flat: .125 x .312 x .032"
	4-821633	WASHER, shoulder
	7-83095F02	BRACKET, circuit board
	14-83275L01	INSULATOR, prot
	14-84268A01	INSULATOR,transistor
	14-84525G01	INSULATOR, transistor (T066 Base)
	29-5261	LUG, soldering; 2 req'd.
	29-5369	LUG, soldering
	1-80794B65	HOUSING ASSEMBLY,includes:
	15-83296L02	HOUSING COVER
	1-80794B66	CHASSIS ASSEMBLY, includes:
	1-80747B60	WIRE & LUG ASSEMBLY, includes:
	29-82336A01	TERMINAL, female
	9-10454A04	connector
	1-80747B61	WIRE & LUG ASSEMBLY, includes:
	29-82336A01	TERMINAL, female
	1-80794B67	TRANSFORMER & LUG ASSEMBLY, includes
	29-812979	LUG, crimp terminal
	2-119913	NUT, 8-32 x 11/32"
	2-9627	NUT, hex: 4-40 x 3/16 x 3/32"; 2 req'd.
	3-7312	SCREW, machine; 8-32 x 3/4"
	3-2979	SCREW, machine: 6-32 x 3/8"; 3 req'd
	3-7346	SCREW, machine: 6-32 x 3/4";
	3-136143	SCREW, tapping: 8-32 x 1/4"; 4 req'd.
	3-139085	SCREW, machine: 4-40 x 5/16"; 2 req'd
	3-490773	SCREW, machine: 6-32 x 9/16"; 4 req'd
	4-2645	WASHER, lock: #6 (split); 4 req'd.
	4-7657	WASHER, lock: #8 (split); 4 req'd.
	4-114583	WASHER, lock: #4 (split); 2 req'd.
	4-82418B88	WASHER, insulator
	7-83158L01	BRACKET
	13-84639D05	ESCUTCHEON
	27-83252N01	CHASSIS
	42-82018H01	RETAINER, cable
	75-84215A02	BUMPER, recessed
	3-2979	SCREW, machine: 6-32 x 3/8"; 4 req'd
	3-139854	SCREW, tapping: 6-32 x 3/8"; 8 req'd
	3-134168	SCREW, tapping: 4-40 x 1/4"; 2 req'd
	3-139138	SCREW, tapping: 10-32 x 3/3"; 3 req'd.
	4-2645	WASHER, lock #6 (split); 4 req'd.
	42-10217A02	STRAP, cable harness; 3 req'd.

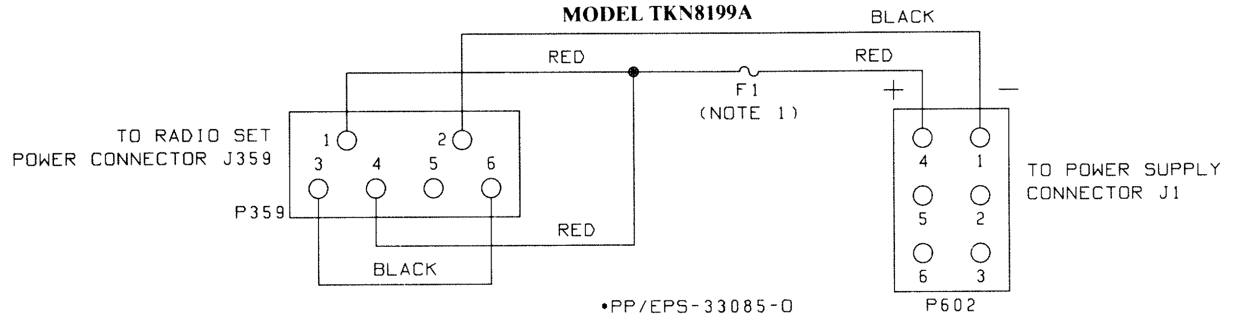
TLN5274B Regulator Board — PL-5361-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed; uF: ± 10%; 50 V: unless otherwise stated
C1	8-82905G02	.022
C2	23-83908L01	100 + 75-10%; 25 V
C3, 4	8-82905G02	.022
		semiconductor device, diode: (see note)
CR5	48-82392B03	silicon
		transistor: (see note)
Q1, 2	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/2 W: unless otherwise stated
R1	6-125A41	470
R2	6-125A53	1.5k
R3	6-125A13	33
R4	17-82177B40	200; 5 W
R5, 6	6-126C41	470 ± 10%; 1 W
R7, 8	6-125A49	1k
R9, 10	6-125C73	10k ± 10% (note: Use is optional, determined at factory)
R11	6-125C51	1.2k ± 10%
		semiconductor device, diode: (see note)
VR1	48-83696E01	silicon; Zener type: 6.8 V ± 5%

note: Replacement diodes and transistors must be ordered by listed part number only for optimum performance.

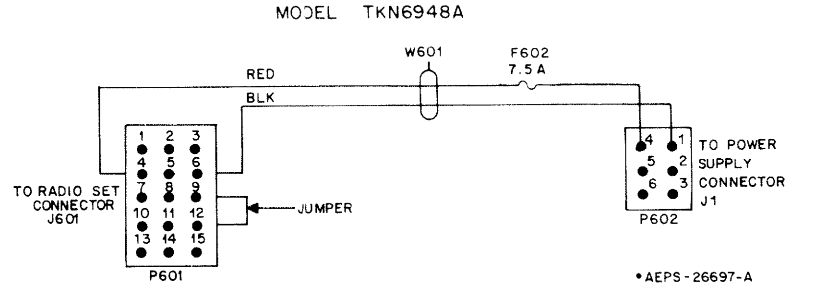


CABLE DETAILS
MODEL TKN8199A

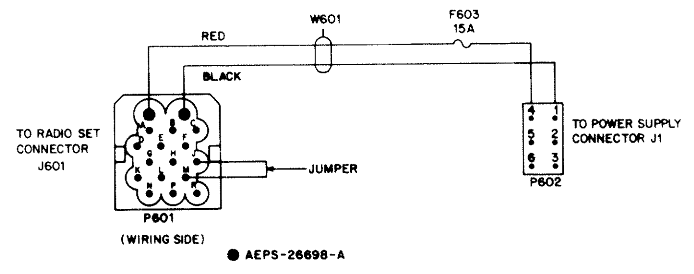


NOTES
1. F1 IS 6A IN 6/10W MODELS. 10A IN 25/30W MODELS.
2. CONNECTORS SHOWN FROM WIRE SIDE.

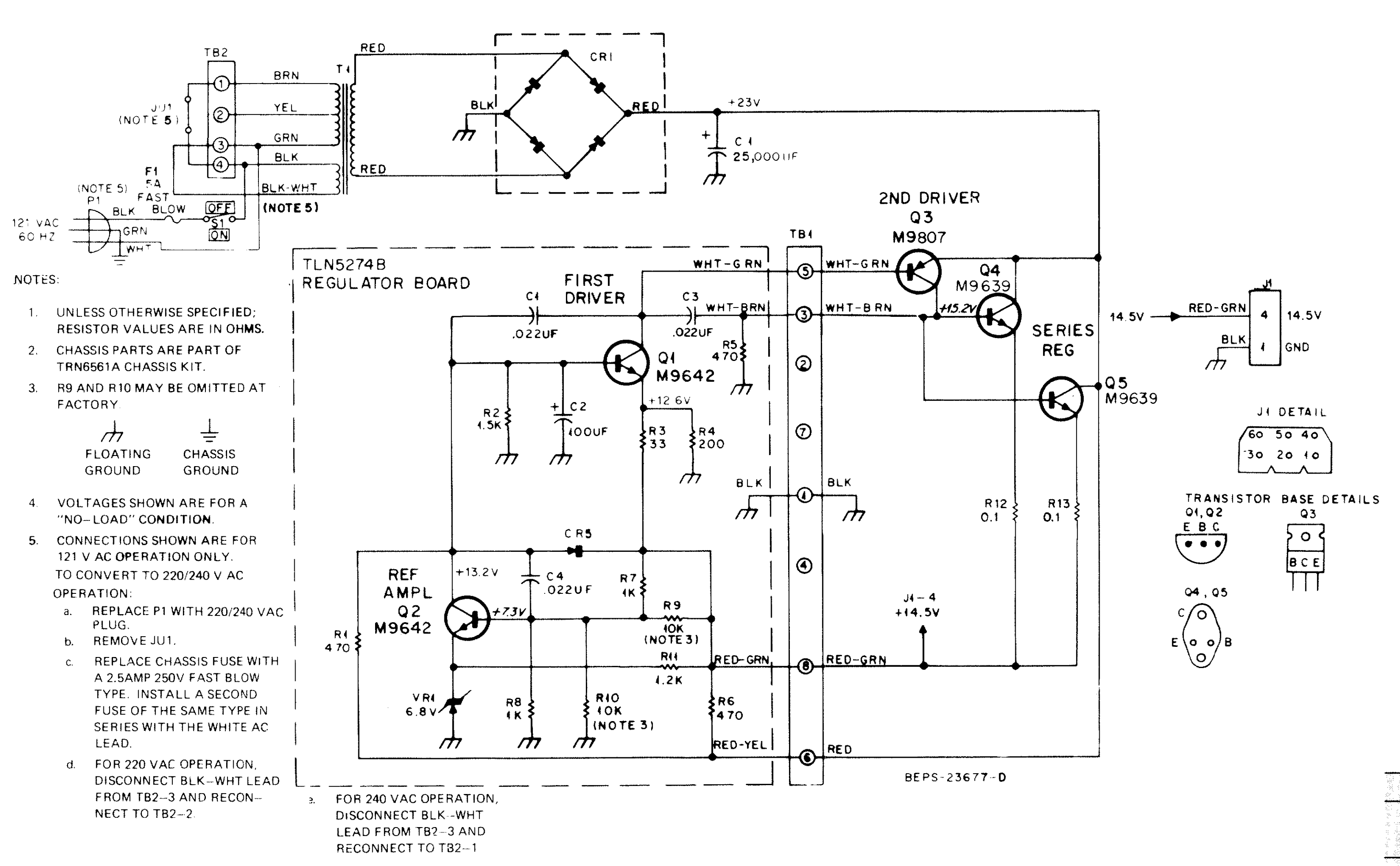
MODEL TKN6948A



MODEL TKN6949A

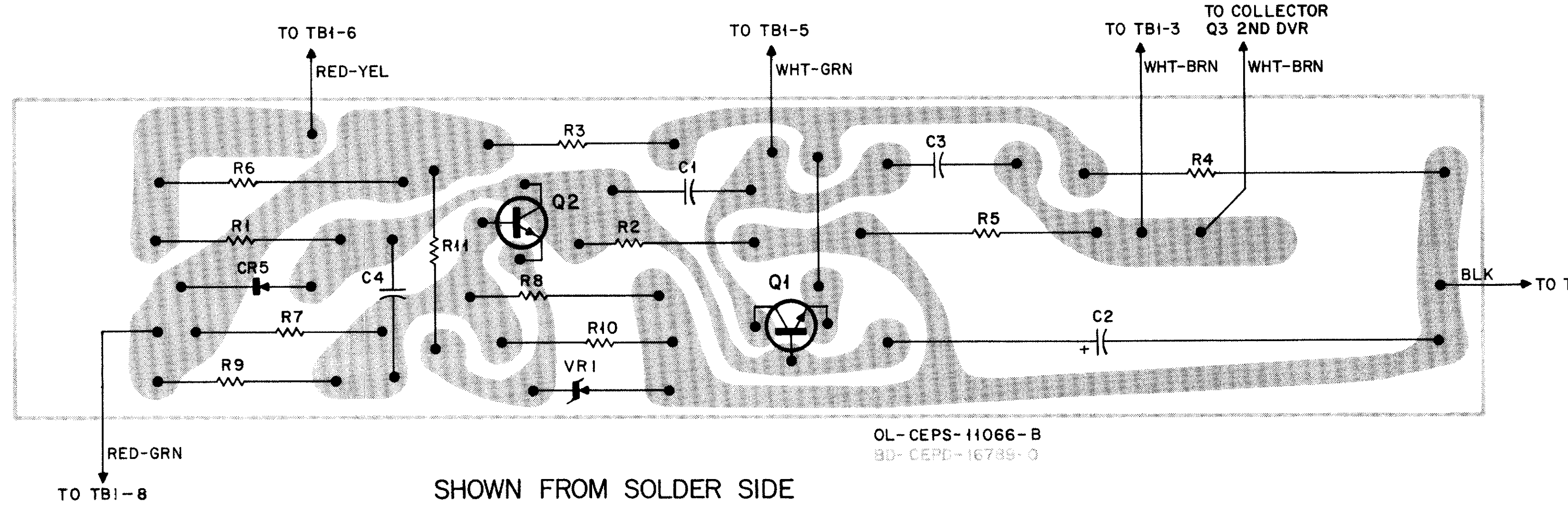


TPN1154A POWER SUPPLY SCHEMATIC DIAGRAM



NOTES:
1. UNLESS OTHERWISE SPECIFIED: RESISTOR VALUES ARE IN OHMS.
2. CHASSIS PARTS ARE PART OF TRN6561A CHASSIS KIT.
3. R9 AND R10 MAY BE OMITTED AT FACTORY.
4. VOLTAGES SHOWN ARE FOR A "NO-LOAD" CONDITION.
5. CONNECTIONS SHOWN ARE FOR 121 V AC OPERATION ONLY. TO CONVERT TO 220/240 V AC OPERATION:
a. REPLACE F1 WITH 220/240 VAC PLUG.
b. REMOVE JU1.
c. REPLACE CHASSIS FUSE WITH A 2.5AMP 250V FAST BLOW TYPE. INSTALL A SECOND FUSE OF THE SAME TYPE IN SERIES WITH THE WHITE AC LEAD.
d. FOR 220 VAC OPERATION, DISCONNECT BLK-WHT LEAD FROM TB2-3 AND RECONNECT TO TB2-2.
e. FOR 240 VAC OPERATION, DISCONNECT BLK-WHT LEAD FROM TB7-3 AND RECONNECT TO TB2-1.

TLN5274B REGULATOR CIRCUIT BOARD DETAIL



SHOWN FROM SOLDER SIDE

FUNCTION

Provides the entire radio with regulated +14.5 V dc when used in a 121 V ac primary power fixed installation.

MODEL TABLE

MODEL	SUB-MODEL	DESCRIPTION
TPN1154A	TLN5274B	REGULATOR BOARD
	TRN6561A	POWER SUPPLY CHASSIS
TKN6949A		POWER CABLE (*MAXAR* 80)
TKN8199A		POWER CABLE (*MCX100* or *DVP MCX100*)
TKN6948A		POWER CABLE (*MAXAR*)