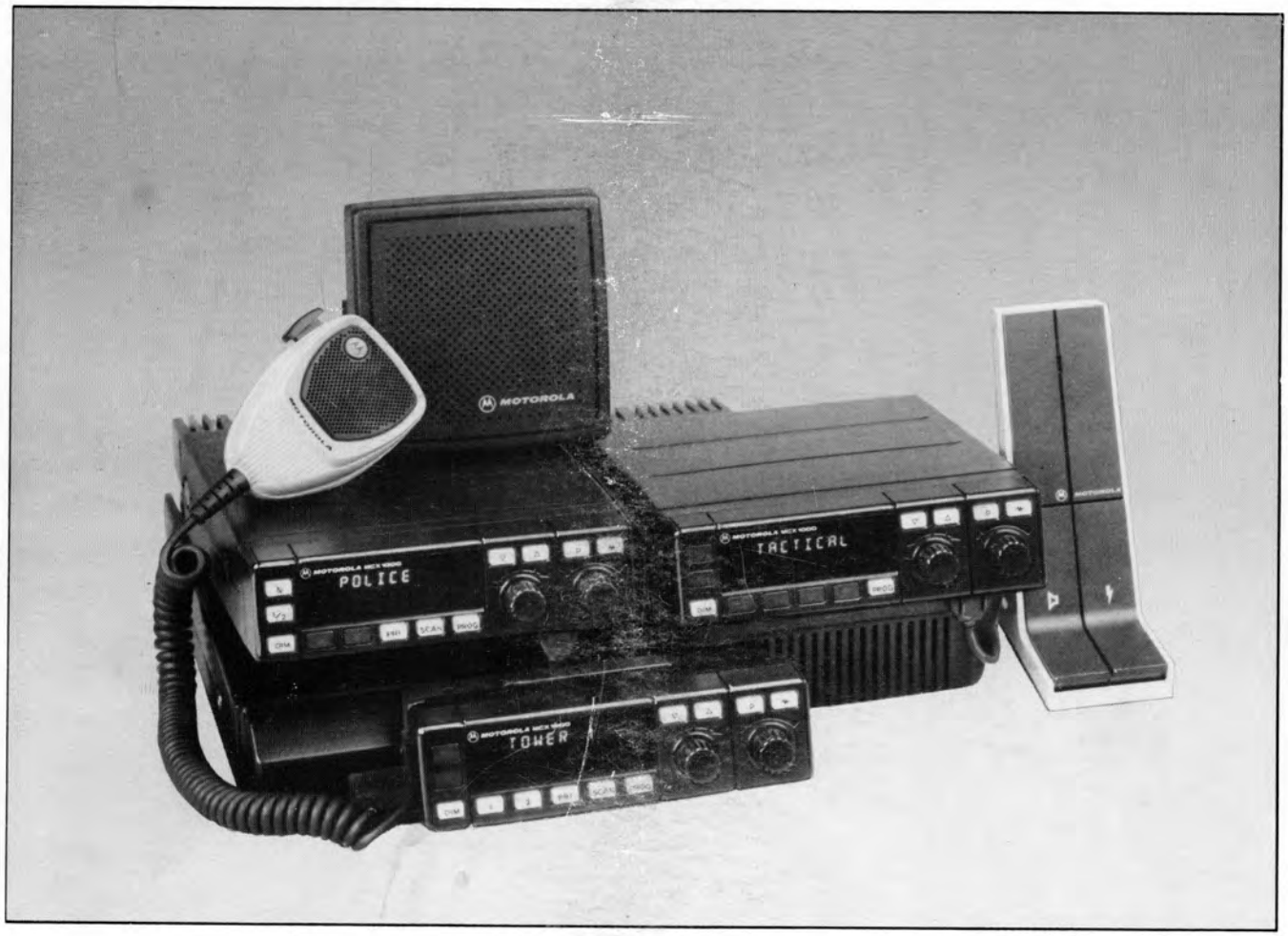
(MCX-1000 VHF Service Manual 68P02902A17-B)

MOTOROLA LIMITED
Communications Division

MCX1000™
DIGITAL-CAPABLE TWO-WAY FM RADIO
136-162, 146-174 MHz
30/40 WATTS RF POWER



THIS MANUAL HAS BEEN
DISCONTINUED

VHF Service Manual
for Digital Capable Radio
68P02902A17
Issue B

MCX1000™
DIGITAL CAPABLE TWO-WAY FM RADIO

136-162, 146-174 MHz
30/40 WATTS RF POWER

CONTENTS

FRONT MATTER

Title Page
Copyrights
Manual Ordering Information
General Safety Information i
Service iii
Replacement Parts Ordering v
Contents vii
List of Figures ix

1. INTRODUCTION

1.1 Scope of Manual 1-1
1.2 Radio Set Model Chart 1-1
1.3 Assembly Breakdown Chart 1-1
1.4 Performance Specifications 1-1
1.5 Metric Measure 1-1

2. INSTALLATION AND OPERATION OF THE RADIO

2.1 Overview of the Radio 2-1
2.2 Operating Instructions 2-5
2.3 Programming the Radio From the Front Panel 2-10
2.4 Installation Instructions 2-15
2.5 List of Accessories 2-18
2.6 Description of Radio Options 2-19
2.7 Options Unique to Digital Capable Radios 2-24
2.8 Option Compatibility Chart 2-26

NOTE: Pages i through vi have been omitted due to non-relevancy.

3. GENERAL MAINTENANCE AND ALIGNMENT PROCEDURES

3.1 Radio Description 3-1
3.2 Recommended Test Equipment for Maintenance and Alignment 3-4
3.3 Radio Service Programmer 3-4
3.4 Safe Handling of CMOS Integrated Circuit Devices
Removal / Replacement of Chip Components 3-6
3.5 Radio Set Disassembly / Assembly 3-9
3.6 Transmitter Alignment 3-17
3.7 Receiver Alignment 3-20

4. RADIO FUNCTIONAL BLOCK DIAGRAMS AND CABLE KITS

4.1 Radio Functional (Block) Diagram 4-1
4.2 Audio Block Diagrams 4-1
4.3 Cabling diagrams 4-1

5. CONTROL HEAD

5.1 Control Head 5-1
5.2 Control Head Display Board 5-1
5.3 Remote Mount Control Head Microcomputer Board 5-2
5.4 Dash Mount Control Head Microcomputer Board 5-3

6. RADIO MICROCOMPUTER SYSTEM

6.1 Radio Microcomputer System 6-1
6.2 Command Board 6-1
6.3 Analog Interface Board 6-2
6.4 Front Panel Interconnect Board 6-2
6.5 Remote Interface Board 6-2
6.6 MDC 600/1200 Signalling System 6-3

7. SYNTHESIZER AND VCO

7.1 Standard Lock Frequency Synthesizer 7-1
7.2 Fast-Lok Frequency Synthesizer 7-2
7.3 VCO (voltage controlled oscillator) Module 7-4

8. RECEIVER AND TRANSMITTER

8.1 General 8-1
8.2 Receiver Dual Front End Assembly 8-1
8.3 Main Board 8-1
8.4 Harmonic Filter Hybrid Assembly 8-4
8.5 Transmitter Low Level Amplifier Hybrid Assembly 8-4
8.6 Transmitter 10 Watt Amplifier Hybrid Assembly 8-4
8.7 Transmitter 30 Watt Amplifier Hybrid Assembly 8-4
8.8 Transmitter Power Amplifier Interconnect Board 8-4
8.9 Power Interconnect Board 8-5

9. ACCESSORY INFORMATION

9.1 General 9-1
9.2 Mobile Microphone 9-1
9.3 Base Microphone 9-1
9.4 Touch-Code Encoder Microphone 9-11
9.5 Mobile Speaker Illustrated Parts List 9-12
9.6 Base Station Mounting Tray and Speaker Illustrated Parts List 9-12
9.7 Base Station Power Supply 9-27

APPENDIX A ERROR MESSAGES

A.1 Power-Up Self Test A-1
A.2 Power-Up Error Messages A-1
A.3 Other Messages A-1

USER QUESTIONNAIRE ..... Back of Manual

AVAILABLE BACKGROUND REFERENCE PUBLICATIONS ..... Back of Manual

LIST OF FIGURES

FIGURE **TITLE** **PAGE**

SECTION 1. INTRODUCTION

1-1 Radio Set Model Chart 1-2
1-2 Tanapa Breakdown Chart 1-3
1-3 Performance Specifications for the MCX1000 Radio 1-4

SECTION 2. INSTALLATION AND OPERATION OF THE RADIO

2-1 Dash Mount MCX1000 Radio 2-2
2-2 Remote Mount MCX1000 Control Head 2-2

FIGURE	TITLE	PAGE
2-3	MCX1000 Base Station	2-4
2-4	Standard MCX1000 Radio Controls	2-4
2-5	MCX1000 Scan Radio	2-8
2-6	MCX1000 Radio with Two-Level Priority Scan	2-8
2-7	Mounting Trays and Floor Mounting Adapter	2-15
2-8	Power Lead Connections for Mobile Radios (Without the MBB113 Option)	2-16
2-9	Power Lead Connections for Mobile Radios with the MBB113 Option	2-16
2-10	Power Lead Connections for Remote Mount Radios (Without the MBB113 Option)	2-17
2-11	Power Lead Connections for Remote Mount Radios with the MBB113 Option	2-17
2-12	Power Lead Connections for Base Station Applications	2-18
2-13	MCX1000 Mobile Radio with DTMF Microphone	2-20
2-14	MCX1000 Radio with Singletone to follow Mode Selector Switch	2-21
2-15	MCX1000 Radio with Selectable Singletone	2-21
2-16	MCX1000 Radio with Dual Singletone	2-21
2-17	MCX1000 Radio with Selectable PL / DPL	2-21
2-18	MCX1000 Radio with MDC EmergencyAlert Activated by Pushbutton on Control Head	2-22
2-19	Option Compatibility Chart	2-26

SECTION 3. GENERAL MAINTENANCE AND ALIGNMENT PROCEDURES

3-1	MCX1000 Radio Bottom View with Cover Removed	3-2
3-2	MCX1000 Radio Top View with Cover Removed	3-3
3-3	Recommended Test Equipment for MCX1000 Radio Servicing	3-7
3-4	Recommended Test Equipment for Radio Specifications Verification	3-8
3-5	Screw Torque Specifications	3-9
3-6	MCX1000 Radio Alignment Test Points	3-17
3-7	Examples of "Eye Pattern" Symmetry	3-19
3-8	Widespace Dual Front End Alignment Points	3-20
3-9	MCX1000 Alignment Probe	3-21
3-10	Main Board Side Tuning Probe Position (High Range)	3-21
3-11	Synthesizer Side Tuning Probe Position (Low Range)	3-22
3-12	MCX1000 Radio Set Exploded View	3-27
3-13	MCX1000 Control Head Button Placement	3-29

SECTION 4. RADIO FUNCTIONAL BLOCK DIAGRAMS AND CABLE KITS

4-1	Radio Functional Block Diagram	4-3
4-2	Receiver Audio Block Diagram	4-7
4-3	Transmitter Audio Block Diagram	4-9
4-4	Remote Control Head Cable	4-11
4-5	Radio Set Internal Cable	4-12

FIGURE	TITLE	PAGE

SECTION 5. CONTROL HEAD

5-1	Control Head Block Diagram	5-5
5-2	Display Board-Board Details	5-7
5-3	Display Board Schematic Diagram	5-9
5-4	Display Board Parts List	5-10
5-5	Dash Mount Control Head Microcomputer Board-Board Details	5-11
5-6	Dash Mount Control Head Microcomputer Board Schematic Dia.	5-13
5-7	Dash Mount Control Head Microcomputer Board-Parts List	5-14
5-8	Remote Mount Control Head Microcomputer Board-Board Details	5-15
5-9	Remote Mount Control Head Microcomputer Board Schematic Dia.	5-17
5-10	Remote Mount Control Head Microcomputer Board Parts List	5-18

SECTION 6. RADIO MICROCOMPUTER SYSTEM

6-1	Radio Microcomputer System Functional Block Diagram	6-5
6-2	Command Board-Board Details	6-7
6-3	Command Board Schematic Diagram	6-9
6-4	Command Board Parts List	6-12
6-5	Analog Interface Board-Board Details	6-13
6-6	Analog Interface Board Schematic Diagram	6-15
6-7	Analog Interface Board Parts List	6-16
6-8	Front Panel Interconnect Board-Board Details	6-17
6-9	Front Panel Interconnect Board Schematic Diagram	6-19
6-10	Front Panel Interconnect Board Parts List	6-20
6-11	Remote Interface Board-Board Details	6-21
6-12	Remote Interface Board Schematic Diagram	6-23
6-13	Remote Interface Board Parts List	6-24
6-14	MDC600 Filter Board-Board Details	6-25
6-15	MDC600 Filter Board Schematic Diagram	6-27
6-16	MDC600 Filter Board Parts List	6-25

SECTION 7. SYNTHESIZER AND VCO

7-1	Standard Lock Frequency Synthesizer and VCO - Block Diagram	7-5
7-2	Standard Lock Frequency Synthesizer Board-Board Details	7-7
7-3	Standard Lock Frequency Synthesizer Board Schematic Diagram	7-9
7-4	Standard Lock Frequency Synthesizer Board Parts List	7-10
7-5	Fast-Lok Frequency Synthesizer andVCO Block Diagram	7-11
7-6	Fast-Lok Frequency Synthesizer Board-Board Details	7-13
7-7	Fast-Lok Frequency Synthesizer Board Schematic Diagram	7-15
7-8	Fast-Lok Frequency Synthesizer Board Parts List	7-16
7-9	2 PPM Channel Element Board & Synthesizer Interconnect Bd.	7-17
7-10	Synthesizer RF Amplifier Board-Board Details & Parts List	7-17
7-11	Voltage Controlled Oscillator Schematic Diagram	7-19

FIGURE	TITLE	PAGE

SECTION 8. RECEIVER AND TRANSMITTER

8-1	Widespace Dual Front End Boards-Board Details	8-7
8-2	Widespace Dual Front End Boards Schematic Diagram	8-9
8-3	Widespace Dual Front End Boards Parts List	8-10
8-4	Main Board-Board Details	8-11
8-5	Main Board Receiver Schematic	8-13
8-6	Main Board Parts List	8-16
8-7	Main Board / Transmitter Schematic Diagram	8-17
8-8	Harmonic Filter Hybrid Assembly-Board Details	8-19
8-9	30 Watt P. A. Interconnect Board	8-19
8-10	10 Watt Power Amplifier Hybrid-Board Details	8-21
8-11	Low Level Amplifier Hybrid-Board Details	8-21
8-12	30 Watt Power Amplifier Hybrid-Board Details	8-21
8-13	Power Amplifiers Schematic Diagram	8-23
8-14	Power Amplifiers Parts Lists	8-26
8-15	Power Interconnect Board Schematic Diagram & Parts List	8-27
8-16	Power Interconnect Board-Board Details	8-27

SECTION 9. ACCESSORIES

9-1	Mobile Microphone Exploded View	9-3
9-2	Mobile Microphone Board Schematic Diagram	9-5
9-3	Mobile Microphone Parts List	9-5
9-4	Mobile Microphone Board-Board Details	9-5
9-5	Base Microphone Exploded View	9-7
9-6	Base Microphone Parts List	9-9
9-7	Base Microphone Board-Board Details	9-9
9-8	Base Microphone Board Schematic Diagram	9-9
9-9	Touch-Code Encoder Microphone Functional Block Diagram	9-13
9-10	Touch-Code Encoder Microphone Exploded View	9-15
9-11	Touch-Code Mic. Tone / Logic Board - Board Details	9-17
9-12	Touch-Code Mic. Tone / Logic Board Parts List	9-17
9-13	Touch-Code Mic. Tone / Logic Board Schematic Diagram	9-19
9-14	Touch-Code Mic. Microphone / Beeper Board-Board Details	9-21
9-15	Touch-Code Mic. Microphone / Beeper Board Parts List	9-21
9-16	Touch-Code Mic. Microphone / Beeper Board Schematic Diagram	9-23
9-17	Mobile Speaker Illustrated Parts List	9-25
9-18	Base Station Speaker Tray Illustrated Parts List	9-26
9-19	Power Supply Regulator Board Parts List	9-29
9-20	Power Supply Regulator Board-Board Details	9-29
9-21	Power Supply Regulator Board Schematic Diagram	9-29
9-22	Power Supply Chassis Parts List	9-30
9-23	Base Station Cable Kit Details	9-30

SECTION 1. INTRODUCTION

1.1 SCOPE OF MANUAL

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains the required service information for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by Manual Revisions. Revisions reflecting the latest engineering changes in the equipment are inserted into the manual before shipment from Motorola.

1.2 RADIO SET MODEL CHART

The Radio Set Model Chart (Figure 1-1) gives a complete breakdown of each radio model. This model breakdown listing consists of tanapas and kits. (A tanapa contains a group of kits whereas a kit contains piece parts and groups of piece parts called assemblies.)

1.3 TANAPA BREAKDOWN CHART

The Tanapa Breakdown Chart (Figure 1-2) describes the kits which are contained in each tanapa used in the radio. The parts lists for kits are located with the appropriate schematic diagrams and board details or with the radio exploded view. See the List of Figures for a complete listing of all parts lists and drawings .

1.4 PERFORMANCE SPECIFICATIONS

The Performance Specifications Chart (Figure 1-3) describes the mechanical, electrical and electronic characteristics of the MCX1000 Radio Set.

1.5 METRIC MEASURE

Unless indicated otherwise, measurements given in this manual are in metric units, with imperial units following in brackets.

VHF MCX1000 DIGITAL CAPABLE RADIO SET MODEL BREAKDOWN

CODE :

- ● = ONE ITEM SUPPLIED WITH EACH RADIO
- O = ONE ITEM SUPPLIED DEPENDENT UPON FREQUENCY
- ▲ = ONE ITEM SUPPLIED AS SHOWN

ITEM	DESCRIPTION	MOUNT: DASH CHANNELS: 128 MODEL: MBD43UXA7H00AK	MOUNT: REMOTE CHANNELS: 128 MODEL: MBT43UXA7H00AK
6802901A91	OPERATOR INSTRUCTION MANUAL	●	●
MBTAD6113A	MOBILE ANTENNA 152-162 MHZ	●	●
MBTFD6431A	HARMONIC FILTER HYBRID 136-162 MHZ	O	O
MBTFD6432A	HARMONIC FILTER HYBRID 146-174 MHZ	O	O
MBTKN8158C(D)	POWER CABLE (DASH MOUNT RADIO)	●	
MBTLD9132A	LOW LEVEL AMPLIFIER HYBRID 136-174 MHZ	●	●
MBTLD9142A	10 W POWER AMPLIFIER HYBRID 136-162 MHZ	O	O
MBTLD9143A	10 W POWER AMPLIFIER HYBRID 146-174 MHZ	O	O
MBTLN2324B	CHASSIS 136-174 MHZ	●	●
MBTLN2334B	30 W POWER AMPLIFIER 136-174 MHZ	●	●
MBTRN4671A	TUNING TOOL (per 5 radios)	▲	▲
MBTRN4673A	TOP COVER	●	●
MBTRN4674A	BOTTOM COVER	●	●
MBTRN4675A	INSTALLATION KIT	●	●
MBTRN4696A	BOARD , POWER AMPLIFIER INTERCONNECT	●	●
MBTRN4778A	TUNING PROBE ADAPTER (per 5 radios)	▲	▲
MBTSN6032A	SPEAKER , MOBILE	●	●
VKN4140A	CABLE, 17 FT. CONTROL		●
VKN4147A	INTERNAL RADIO CABLE	●	●
VKN4151A	POWER CABLE, 18 FT.(REMOTE MOUNT RADIO)		●
VLD1051A	DUAL FRONT END 136-162 MHZ	O	O
VLD1052A	DUAL FRONT END 146-174 MHZ	O	O
VLD1081A	VCO ASSEMBLY, VHF 136-162 MHZ STD LOCK	O	O
VLD1082A	VCO ASSEMBLY, VHF 146-174 MHZ STD LOCK	O	O
VLN1108A	DASH CONTROL HEAD ASSEMBLY	●	
VLN1109A	REMOTE CONTROL HEAD ASSEMBLY		●
VLN4624A	BOARD, SYNTHESIZER INTERCONNECT	●	●
VLN4663A	BOARD, FRONT PANEL INTERCONNECT	●	●
VLN4664B	BOARD, ANALOG INTERFACE	●	●
VLN4665A	BOARD, REMOTE INTERFACE		●
VLN4672A	NAMEPLATE, VHF	●	●
VLN4695A	BOARD, STANDARD LOCK SYNTHESIZER, 5PPM VHF	●	●
VLN4707A	BOARD, MICROCOMPUTER 8K EE	●	●
VLN4720A	HARDWARE, REMOTE MARRY UP		●
VLN4770A	BOARD, MAIN, DIGITAL 25 : 30 KHz	●	●
VLN4845A	HARDWARE, VHF , MARRY UP	●	●
VLN4865A	BUTTON PLUG (6 used)	●	●
VLN4866A	MIC HANG-UP CLIP	●	●
VMN1016A	MICROPHONE	●	●
VLN4666A	BOARD, MICROCOMPUTER 2K EE - Option		
VLN4733A	MDC FILTER BOARD - Option		
Note: Option Compatibility Chart is located on page 2-26			

Figure 1-1 Radio Set Model Chart

TANAPA BREAKDOWN CHART

MBTLN2324B Chassis
Contains: -MBTRN4602A Tx Feed Through Plate -MBTRN4603A Chassis Hardware -MBTRN5365A Power Interconnect Board

MBTLN2334B 30 Watt Power Amplifier
Contains: -MBTLD9151A 30 W VHF P A Hybrid -MBTRN4905A 30 W Heat Sink Hardware

VLD1051A Dual Front End (Range 1) VLD1052A Dual Front End (Range 2)
Contains: -MBTRN5001A Dual Front End Hardware -VLN4553A Coils and Hardware -VLN4554A Housing Assembly

VLD1081A VCO
Contains: -VLD4081A Hybrid VCO Standard VHF R1 -VLN4628A VCO Hardware

VLD1082A VCO
Contains: -VLD4082A Hybrid VCO Standard VHF R2 -VLN4628A VCO Hardware

VLN1108A Control Head (dash mount models)
Contains: -VLN4667A Display Board -VLN4668B Dash Control Head Micro-computer Board -VLN4670A Dash Control Head Hardware

VLN1109A Control Head (remote mount models)
Contains: -VLN4667A Display Board -VLN4669A Remote Control Head Micro-computer Board -VLN4671A Remote Control Head Hardware

VMN1016A Mobile Microphone
Contains: -VLN4765A Microphone Board -VLN4712A Microphone Hardware

VMN1017A DTMF Microphone
Contains: -VLN4383A Logic Board -VLN4823A Beeper Board -VLN4386A Touch Tone Keypad -VLN4713A Hardware

VMN1018A Base Station Microphone
Contains: -VLN4824A Microphone Board -VLN4714A Microphone Hardware

Figure 1-2 Tanapa Breakdown Chart

GENERAL

No. of Modes/Zones:	56/8 or 128/24
Squelch Option:	Carrier Squelch, Private Line and Digital Private Line are standard and available in the same radio unit.
Primary Power:	13.6 V Nominal, Negative Ground
Channel Resolution:	Multiples of 5.0 KHz or 6.25 KHz
Frequency Range:	136-162, 146-174 MHz
RF Power Output:	40 Watts typical, for U. S. 30 Watts , Canada (EIA)
Receive Current at Rated Audio:	1.8 A
Transmit Current at Rated Power:	8 A (at 30 Watts)
Standby Current:	1 A

TRANSCEIVER DIMENSIONS AND WEIGHT

	Front Mount	Remote Mount
Length mm (inches)	291 (11.5)	295 (11.6)
Extended Length	338 (13.3)	340 (13.4)
Width mm (inches)	179 (7.0)	179 (7.0)
Height mm (inches)	51 (2.0)	51 (2.0)
Weight kg (lb)	3.7 (8.0)	4.0 (8.1)

CONTROL HEAD DIMENSIONS AND WEIGHT

Length (depth) mm (inches)	61.5 (2.4)
Width mm (inches)	179 (7.0)
Height mm (inches)	51 (2.0)
Weight (with microphone) kg (lb)	1.22 (2.9)
Speaker Weight kg (lb)	.77 (1.7)

TRANSMITTER (specifications at 30 Watts output)

Output Impedance:	50 ohms
Frequency Stability:	±0.0005%; optional ±0.0002% From -30 ° C to +60 ° C ambient (+25 ° C reference)
Spurious and Harmonics:	85 dB below carrier
Modulation:	(16F3) ± 5 KHz
Audio Sensitivity:	80 mV nominal for 60% system deviation
FM noise:	50 dB
Audio Response:	+1/-3 dB from 300 to 3000 Hz
Audio Distortion:	3% at 1000 Hz at 60% deviation
Frequency Separation:	26 or 28 MHz

VIBRATION AND SHOCK METHODS

TEST:	Vibration
Standard:	MIL810D
Method:	514.3
Procedure:	Curve NAVMAT P-9492
Radio Performance:	Meets or exceeds published specifications following vibration.
TEST:	Shock
Standard:	MIL810D
Method:	516.3
Procedure:	III
Radio Performance:	Meets or exceeds published specifications following shock.

RECEIVER

Audio Output:	EIA: 5 Watts at 3% distortion
Input Impedance:	50 ohms
EIA Modulation Acceptance:	± 7 KHz
Frequency Stability:	±0.0005%; optional ±0.0002% From -30 ° C to +60 ° C ambient (+25 ° C reference)
Receiver Channel Spacing:	30 KHz or 25 KHz (EIA)
Sensitivity EIA SINAD:	0.30 uV
Selectivity:	90 dB (30 KHz spacing) 85 dB (25 KHz spacing)
Intermodulation:	80 dB
Spurious and Image rejection:	85 dB
Squelch Sensitivity:	Carrier squelch (fixed): 10 dBQ Tone coded squelch (fixed): 6 dBQ Digital coded squelch (fixed): 6 dBQ
Frequency Separation:	12 MHz Note: Receiver separation of up to 20 MHz possible with some performance degradation.

Figure 1-3 Performance Specifications for the MCX1000 Radio

END OF SECTION 1

MOTOROLA LIMITED
Communications Division

SECTION 2. INSTALLATION AND OPERATION OF THE RADIO

2.1 OVERVIEW OF THE RADIO

2.1.1 GENERAL DESCRIPTION

The MCX1000 is a multiple frequency, multiple zone capable, synthesized FM mobile radio. It is a 30/40 watt radio, available in the VHF frequency range of 136 to 174 MHz and in the UHF frequency range of 403 to 430 MHz. and 440 to 470 MHz. MCX1000 is available in front mount (Figure 1), remote mount (Figure 2) or base station (Figure 3) configurations.

The radio has an eight character vacuum fluorescent alpha-numeric display. Modes*, zones*, codes and tones can be named with such titles as "FIRE", "POLICE", etc., or whatever best communicates to you the meaning of that mode.

The MCX1000 uses an EEPROM (Electrically Erasable Programmable Read Only Memory Device). This enables the personality of the radio to be changed in the field. For example, mode names may be redefined, frequencies added, deleted or changed, or other radio characteristics altered.

* In any discussion involving the MCX1000 Radio, the terms "mode" and "zone" are often used. Their definitions follow.

MODE- A mode consists of a Transmit or Receive frequency plus a collection of personality parameters; i.e. PL/DPL codes, slaved singletone, busy mode lockout, alphanumeric mode name. The word "channel" is often used synonymously with the word "mode" though the correct definition of "channel" is only a transmit and receive frequency that does not carry personality parameters.

ZONE- A zone is a collection of modes often used for geographical grouping.

2.1.2 ELECTRICAL CHARACTERISTICS

The MCX1000 radio has excellent transmitter and receiver performance specifications and a sophisticated channel scan monitoring system. Accelerated Life Testing (ALT) of radio sets in the design stage helps to ensure reliability.

The MCX1000 incorporates the latest in advanced surface mount microprocessor technology. The radio is capable of combining Private-Line, Digital Private-Line and Carrier Squelch modes all in one radio model. Digital capable models of the MCX1000 are available to provide a radio capable of handling Securenet voice encryption. The design of the radio is flexible enough to allow changes to its option package as your communication needs grow and evolve. Finally, the Digital MCX1000 is able to handle high speed data transmissions.

2.1.3 MECHANICAL CHARACTERISTICS

The radio has a die cast metal chassis. Top and bottom covers are constructed from aluminum. The control head is made of a polycarbonate compound able to withstand the toughest environments as well as temperature extremes. The radio has the ability to survive MIL Std 810C and 810D for shock and vibration.

The modular construction of the MCX1000, the simple mechanical design of its parts, and the ease with which the radio can be assembled translates into reduced down time and reduced servicing costs.

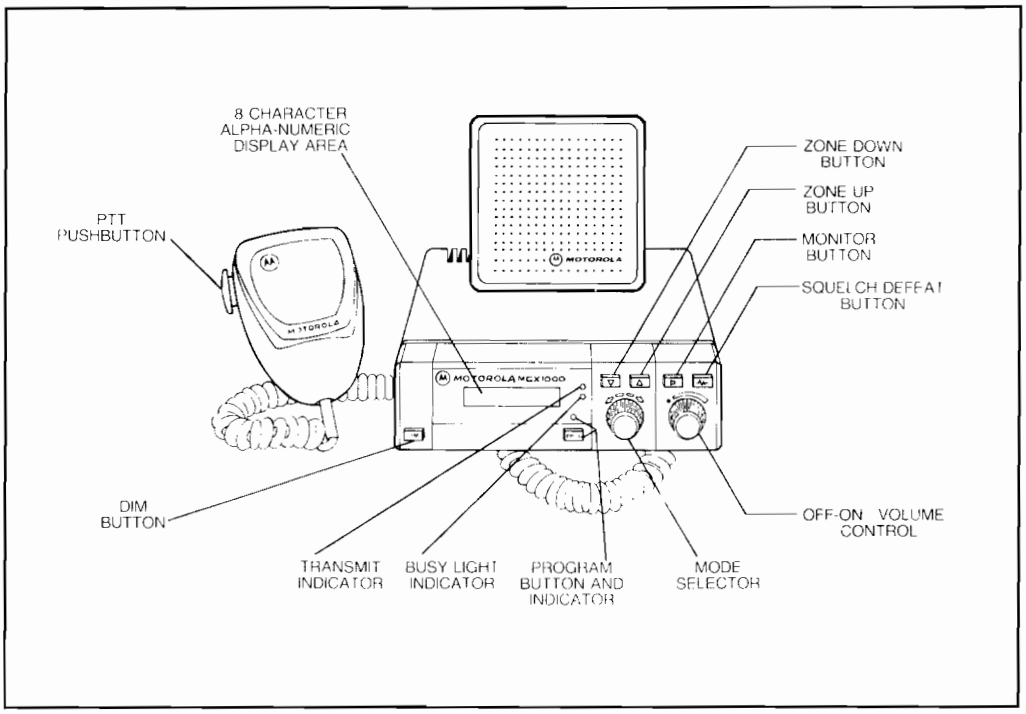


Figure 2-1 Front Mount MCX1000 Radio

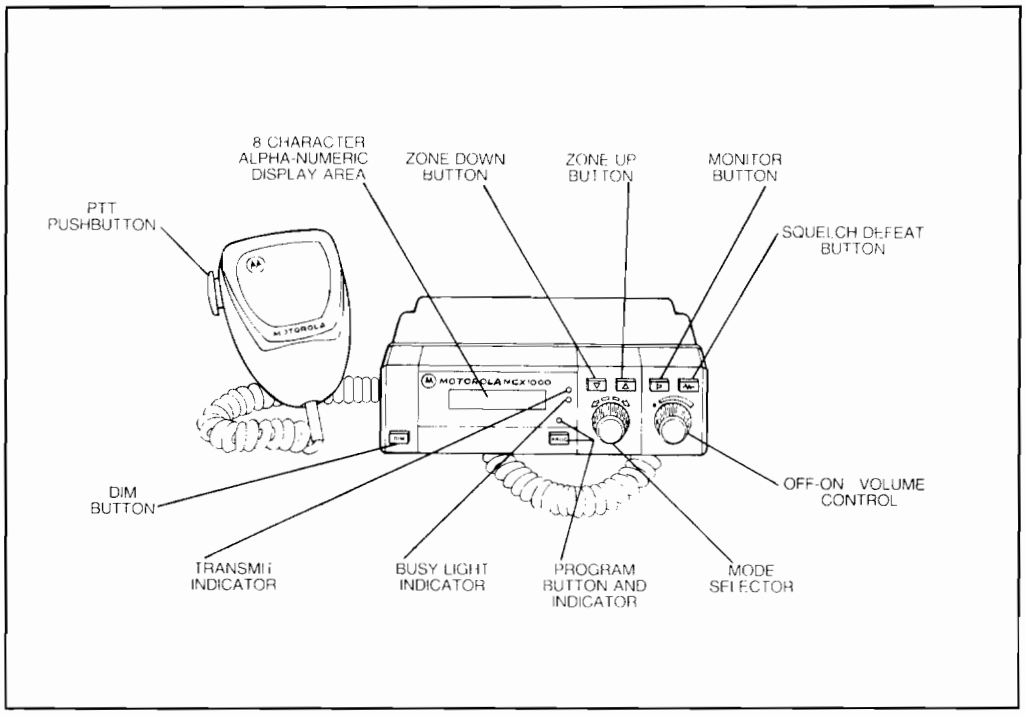


Figure 2-2 Remote Mount MCX1000 Control Head

2.1.4 MCX1000 STANDARD RADIO OFFERING

MCX1000 is available in the following model configurations:

- VHF or UHF
- Front Mount or Remote Mount
- 56 mode/8 zone or 128 mode/24 zone
- Non-Digital or Digital capable modulation

All Models

All MCX1000 mobile radio models come standard with the following:

- 8 character alph-numeric display
- Transmit indicator
- Busy Light Indicator
- Squelch Button
- Monitor Button
- Dim Button
- Rotary Volume and Mode Controls
- Zone Up and Down Buttons
- Program Button and Indicator
- 30/40 watts power output (UHF-30 watts)
- 56 mode/8 zone OR 128 mode/24 zone capability (depending on model ordered)
- Multiple coded squelch capability accomodating Carrier Squelch, PRIVATE-LINE and DIGITAL PRIVATE-LINE in one radio model
- 60 second duration Time-Out-Timer
- Broad transmit and receive bandwidths
- EEPROM field reprogramming capability
- Survives MIL Std 810C and MIL Std 810D for shock and vibration
- Operates from a 12 VDC negative ground
- User programmability from the front panel (Program Button)
- Microphone with hang-up clip
- Unity gain 1/4 wave antenna
- Mounting tray and hardware
- Owner's manual- English

Front Mount Models

- Speaker with 17 ft. (5.2 meter) cable
- 10 ft. (3.0 meter) negative ground cable kit

Remote Mount Models

- Control Head with 17 ft. (5.2 meter) plug in cable
- Speaker with 17 ft. (5.2 meter) cable
- 18 ft. (5.5 meter) negative ground cable kit

MCX1000 Options

Options are listed in point form below. For a description of these options, refer to Section 2.6 in this manual.

OPTIONS INTERNAL TO THE RADIO

- Omit user programming from the front panel of the radio
- 2 ppm stability
- Fast lok synthesizer
- Lower Range VHF, 136 to 162 MHz.
- Omit Time-Out-Timer
- Non-standard Time-Out-Timer
- Omit Alert Tone

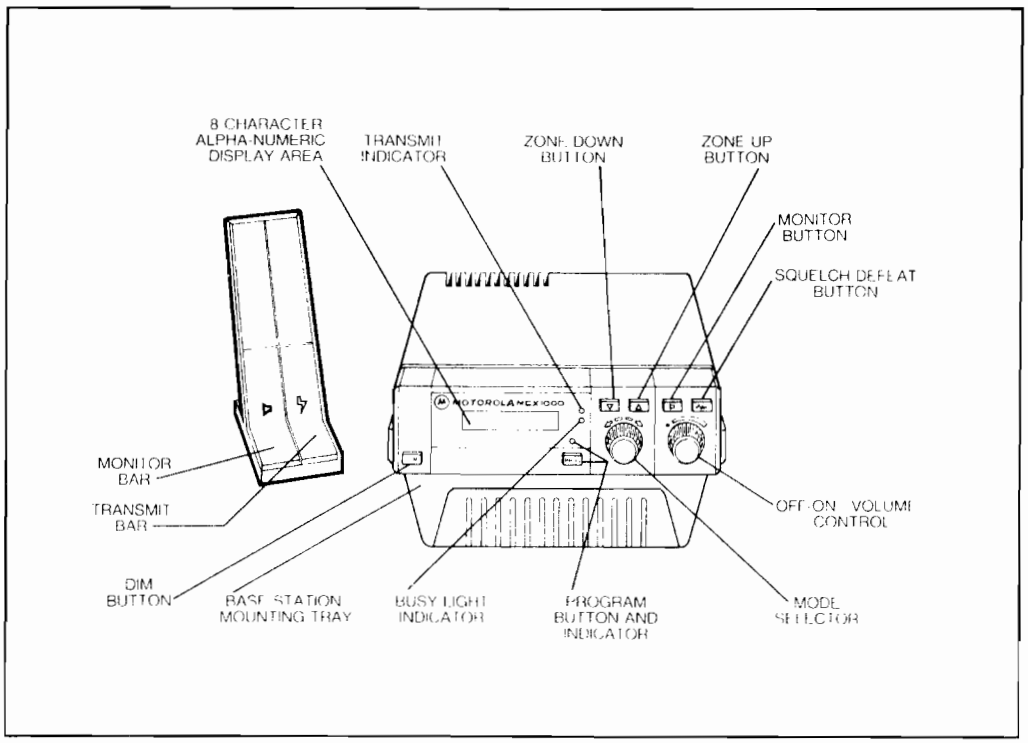


Figure 2-3 MCX1000 Base Station

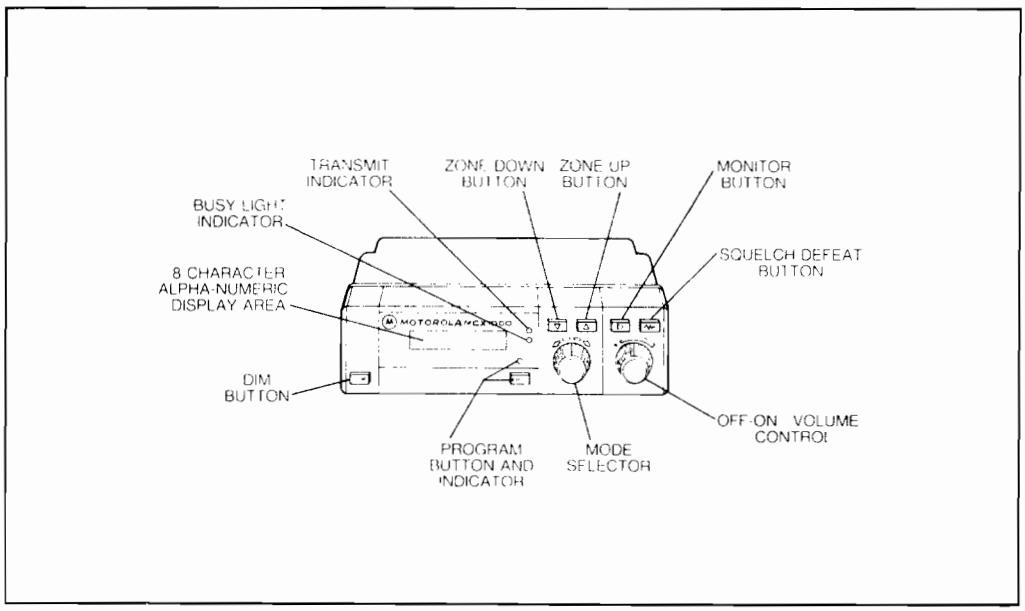


Figure 2-4 Standard MCX1000 Radio Controls

- Disable Lighting

Scan Options

- Operator selectable scan
- Add 2 level priority
- Priority to follow mode selector switch
- Omit spontaneous priority

Singletone Signalling

- Singletone to follow mode selector switch
- Selectable singletone
- Dual singletone
- Singletone with non-standard duration

PL/DPL Signalling

- Selectable PL/DPL
- Transmit Inhibit on Busy Mode

MDC Signalling

- Unit Identification and Emergency Alert (MDC1200 and MDC600)
- Emergency Alert activated by pushbutton on control head
- Emergency Alert activated by hidden pushbutton
- Emergency Alert activated by hidden footswitch

General

- 56 Mode Operation (UXA models only)
- Railroad Requirement (UXA models only)

Encryption

Voice encryption is available for the Digital MCX1000 Radio in several option configurations. Refer to Section 2.7 for a description of the encryption options.

OPTIONS AND ACCESSORIES EXTERNAL TO THE RADIO

- Base station operation
- Omit base station power supply and cables
- DTMF microphone
- Spare control head
- Omit antenna, cable and connectors
- Broadband antenna
- Omit mobile microphone
- Omit speaker
- Omit battery cable
- Omit mounting tray and installation kit
- Omit all accessories
- Mounting tray with right hand lock
- Hinged mounting bracket
- Security Housing
- Ignition switch transmitter control
- Remote mounting kit
- Service Manual

2.2 OPERATING INSTRUCTIONS

2.2.1 STANDARD MCX1000 CONTROLS

Figure 2-4 illustrates the controls that are standard on every MCX1000 Radio. A brief description of each of the standard controls is included below.

Alpha-Numeric Display Area

The alpha-numeric display is capable of displaying up to 8 characters, and will show all 26 letters (upper case only) and numbers (0-9 inclusive).

Busy Light Indicator

This indicator is lit whenever there is a carrier present on the selected mode.

Transmit Indicator

This indicator is lit whenever the transmitter is keyed.

Zone Select Buttons

The Zone Buttons are used to move radio operation from one zone to another. Initially the factory programs the radio so that the zone names displayed are ZONE A, ZONE B etc. The first time either of the zone buttons is pressed, the radio display changes from showing the name of the "mode" it is operating on to the name of the "zone" it is currently operating in. Pressing the Zone Up Button a second time within three seconds causes the radio to advance one zone and display the new zone name. (If the Zone Up Button is pressed and held, the radio and its display advance through zones at a rate of three zones per second.) The Zone Down Button works in the opposite manner. An audio tone will be heard as the radio changes from one zone to another. The zone name being displayed will revert back to the mode name in 3 seconds, or will revert immediately when the mode selector switch is rotated.

Monitor Button

Pushing the Monitor Button will cause the radio to show the status of the PL or DPL operation in the display. If PL or DPL is enabled, the display will show "MON OFF". If PL or DPL is disabled to monitor the channel activity, the display will show "MONITOR". Pressing the Monitor Button a second time within three seconds will change the PL or DPL status. In addition, an audio tone will be heard to acknowledge the change in PL or DPL status.

Squelch Defeat Button

If the radio is squelched, pushing the squelch button will cause the radio to become unsquelched. The radio audio will remain unsquelched until the squelch button is again pushed. This is useful for setting speaker volume.

Off/On Volume Rotary Control

This control is used to turn the radio on and off and to set the volume. Fully counter-clockwise is off; the volume is increased with clockwise rotation. Information which has been programmed from the front panel will be retained in the radio memory when the radio is turned off.

Mode Selector Rotary Control

Turning the Mode Selector Switch will cause the mode and the mode name in the radio display to change. Initially the factory programs the radio so that the mode names displayed are MODE 1, MODE 2 etc. The selector has no end stop, and an audio tone is heard when the last mode is passed and the rotary sequence is repeated.

Program Button

This button is used to place the radio in the program mode of operation; ie., when the radio is to be reconfigured from the front panel. The Program button is used to initiate the assignment of modes to zones and the configuring of scan lists within zones. (See Section 2.3 for further information.) It is also used to temporarily delete a mode from the scan list while the radio is scanning.

If the Omit User Programming From the Front Panel option is ordered, the Program button cannot be used as described above. Alternatively, Service Programming may limit the use of this button to either initiate the assignment of modes to zones or configure the scan lists within zones.

Program Indicator

This LED is lit whenever the radio is in the programming mode of operation.

Dim Button

This button is used to alter the light intensity of the display. Consecutive pushes of the DIM Button will step the display panel through three light intensities : BRIGHT, DIM and DIMMEST. The addition of a fourth light intensity (OFF position) is an option on the MCX1000. This OFF position turns off the display panel as well as the backlighting of all buttons on the radio.

The Disable Lighting option may be useful when the radio is being used in a surveillance application.

2.2.2 TO TURN THE RADIO ON

Turn the off-on/volume control clockwise until a click is heard. Depending on the installation, you may also be required to turn on the ignition switch of your vehicle.

2.2.3 TO RECEIVE

Use the following sequence to set the volume control of your radio to a comfortable listening level.

1. Turn the radio on.
2. If no audio is heard, press the squelch button.
3. Adjust the volume control to the desired level.
4. Press the squelch button again to again mute the audible background noise.

Note- For Digital MCX1000 Radios with Encryption: If the incoming message is 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, the noise will not be heard unless the microphone is off-hook or the Monitor function enabled.

2.2.4 TO TRANSMIT

NOTE

For mobiles equipped with the "Ignition Switch Transmitter Control" option, the transmitter cannot be operated unless the vehicle ignition switch is turned on.

Non-digital MCX1000 Radios

1. Before starting transmission, monitor all traffic on the selected mode to ensure that it is not in use. In order to monitor with a PL/DPL radio, remove the mobile microphone from its hang up clip or push the monitor button, or depress and hold the monitor bar on a base station microphone.

2. If the mode is clear, you may transmit your message. To do this, hold the microphone approximately 2 inches from your mouth, depress and hold the push-to-talk (PTT) button (or Transmit bar on base stations), and speak into the microphone. The Transmit Indicator lights. After finishing your message, release the PTT pushbutton to receive a reply.

3. After completing the call, place the mobile microphone in the microphone hangup clip. For base stations, depress the Monitor paddle.

Digital MCX1000 Radios with Encryption

CLEAR/CODED SELECT BUTTON SYMBOL 

1. Press the Clear/Coded Select Button to choose either clear voice or encrypted voice operation. The word "CLEAR" or "CODED" appears in the display. Also, the Clear/Coded Indicator lights when coded operation is selected. On models with the Dual Code option, select the desired code for transmitting by pressing the Code Select Button (1\2). The word "CODE 1" or "CODE 2" appears on the display for one second. The Code Select Indicator lights when you have selected code 2.

2. Before starting transmission, monitor all traffic on the selected mode to ensure that it is not in use. Remove the mobile microphone from its hangup clip or depress the Monitor bar on the base station microphone. If the mode is clear, you may transmit your message.

3. 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. On dual code radios, the selected code, "CODE 1" or "CODE 2", is displayed for one second when the transmitter is keyed. The transmitted audio is either encrypted or non-encrypted, depending upon the selected operation. If the transmitted audio of an encryption capable radio is non-encrypted, a short tone or beep is heard immediately after the microphone is keyed. After finishing your message, release the PTT pushbutton to receive a reply.

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

2.2.5 TO TURN RADIO SET OFF

Turn the off-on/volume control completely counterclockwise until a click is heard. (In mobile installations in which the green wire is connected to the accessory side of the ignition switch, the radio may also be turned off by turning off the vehicle ignition switch).

2.2.6 OPTIONAL MCX1000 CONTROLS

Scanning Controls

OPERATOR SELECTABLE SCAN (See Figure 2-5)

To Operate Scan Function.

If you are already operating in the zone you wish to scan:

1. Make sure that the microphone is in the hangup clip (on hook). Press the SCAN button. The word "SCANNING" will appear on the display, the Scan indicator will light, and the receiver will commence scanning all modes in the scan list of the zone.

2. When an active mode with the correct signalling code is detected, the scanner stops, the alpha-numeric display indicates this mode, and the operator hears the call. To respond to the call, lift the microphone off-hook during the call or within 2 seconds of the end of the call. If the microphone is not lifted off-hook within this time period, the radio resumes scanning.

3. With the microphone off-hook, converse in the normal manner. At the end of the conversation, place the microphone on-hook. The radio will resume scanning.

4. It is possible to temporarily delete a mode from the scan sequence because of annoying heavy traffic. While the scanner is on and stopped on the mode to be deleted (microphone on-hook), press the PROG (program) button . The scanner will now skip that mode until the scanner is turned off or the microphone is taken off-hook. Other modes may be deleted as required until there is only one mode remaining.

If you are not already in the zone you wish to scan:

Using the Zone Up or Zone Down buttons, move to the zone you wish to scan as indicated by the alpha-numeric display. The zone name will remain on the display for 3 seconds, and then the display will change to the last selected mode in the zone. Then perform steps 1, 2, 3 and 4 just discussed above.

TWO LEVEL PRIORITY SCAN (See Figure 2-6)

If your radio is equipped with priority scan and the scanner is turned on, a call on the first level priority mode overrides any other call that you are listening to, and a call on a second level priority mode overrides any call except a first level priority

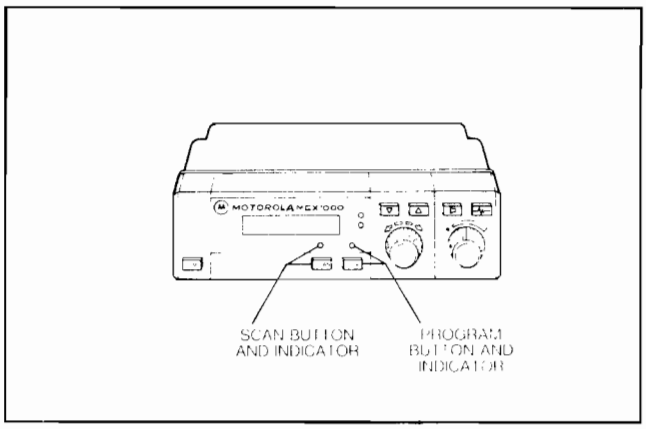


Figure 2-5 MCX1000 Scan Radio

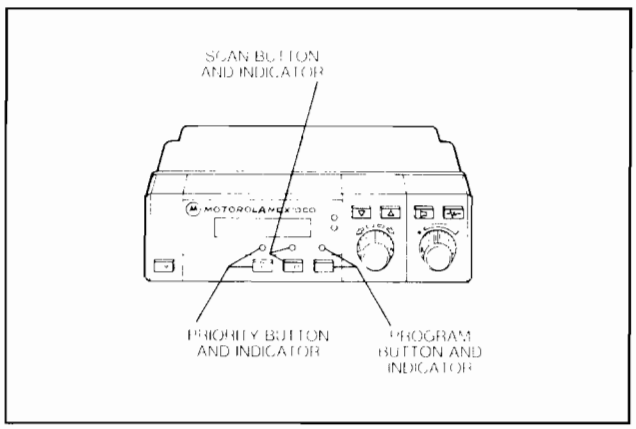


Figure 2-6 MCX1000 with Two-Level Priority Scan

call. When this occurs, the Priority indicator lights, the radio display shows the name of the priority mode, and an alert tone is heard in the speaker, followed by the verbal priority message. NOTE: The Priority indicator will flash if the message received is on the first level priority mode. If the message received is on the second level priority mode, the Priority LED will light continuously.

With priority scan (unless MBB316 "Omit Spontaneous Priority" has been ordered), the last mode transmitted on is temporarily assigned to the second level priority status. The reassignment lasts for a period of 60 seconds after the microphone is placed on hook. The reassignment period assures that the operator hears any follow-up messages.

Your radio can be routed to its first level priority mode within a zone quickly and easily when you are not scanning or when the microphone is "Off Hook". To access your first level priority mode, push the PRIORITY button. The radio and its display immediately moves to the first level priority mode and a tone is heard. If there is no first level priority mode, the radio moves to the second level priority mode, and a tone is heard.

2.2.7 SELECTABLE PL/DPL

Up to 16 (56 mode, 8 zone models) or 32 (128 mode, 24 zone models) PL/DPL codes may be selected on the MCX1000. To change the PL/DPL code of an MCX1000 radio, the shaded arrow buttons on the radio front panel are employed. (See Figure 2-17. Note that these button locations change when radios have the encryption option.) Use these buttons to call up the desired PL/DPL code. Codes will be shown on the alpha-numeric display of the radio. When at the desired code, simply wait 3 seconds for the radio display to revert back to showing the mode name. This 3 second wait can be avoided by turning the Mode Selector switch one notch in either direction so as to call up the mode name immediately. The radio now carries the new PL/DPL code.

2.2.8 SINGLETONE SIGNALLING

Singletone to Follow Mode Selector Switch
(See Figure 2-14)

A single one second encode tone is transmitted from the radio when the Singletone button (marked with a musical note) on the radio front panel is pushed. Holding the Singletone button depressed beyond the one second timed interval causes the radio to transmit the singletone for as long as the button is depressed.

Selectable singletone
(See Figure 2-15)

Up to 10 (56 mode, 8 zone models) or 32 (128, 24 zone models) encode tones may be selected for transmission on the MCX1000. A singletone is selected through a sequence of button pushes involving the Program button (see Selectable Singletone Programming instructions in this section). By depressing the Singletone button (marked with a musical note) on the radio front panel, the selected tone is transmitted. The standard transmission time is one second. Holding the Singletone button depressed beyond the one second timed interval causes the radio to transmit the singletone for as long as the button is depressed.

Dual Singletone (See Figure 2-16)

An MCX1000 Radio having the Dual Singletone option is capable of transmitting two independent encode tones by means of the "1" or "2" buttons on the radio front panel. To send a Singletone transmission, the desired tone button is pressed. The standard transmission time is one second. Holding a Dual Singletone button depressed beyond the 1 second timed interval causes the radio to transmit the Singletone for as long as the button is depressed.

2.2.9 MDC SIGNALLING

MDC1200 and MDC600 Signalling - Unit Identification

Each time the Push-to-talk button on the microphone is depressed, a specific pre-programmed burst of data is transmitted to the base station, identifying the radio unit.

MDC Signalling - Emergency Alert Activated by a Pushbutton on the Control Head
(See Figure 2-18)

Pressing the unlabeled "Emergency" button on the radio front panel sends a silent data burst

to the base station informing it of the identity and emergency status of the radio. The red emergency indicator and the PTT indicator are both illuminated to indicate that the message is being transmitted.

MDC Signalling - Emergency Alert Activated by a Hidden Pushbutton

Activating a hidden pushbutton sends a silent data burst to the base station informing it of the identity of the radio and emergency status. So that attention is not drawn to the radio, with this option the red emergency indicator and the PTT indicator are not illuminated while the emergency data signal is being transmitted.

MDC Signalling - Emergency Alert Activated by a Hidden Footswitch

Activating a hidden footswitch sends a silent data burst to the base station informing it of the identity of the radio and emergency status. So that attention is not drawn to the radio, with this option the red emergency indicator and the PTT indicator are not illuminated while the emergency data signal is being transmitted.

2.3 PROGRAMMING THE RADIO FROM THE FRONT PANEL

Programming the MCX1000 radio is initiated by pressing the "PROG" button on the radio front panel. (See Figure 2-4) In response, the PROG indicator will light. The next step involves pushing the function button you wish to program i.e., "Zone", "Scan" or "Singletone". The programming of each of these functions is described individually on the following pages.

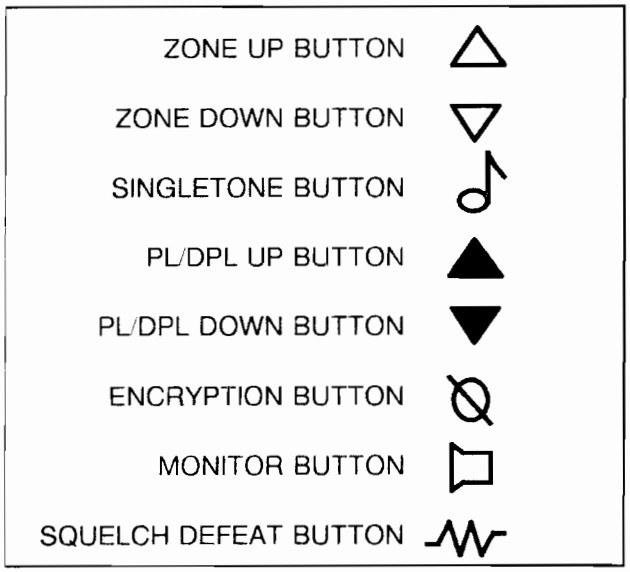
NOTES

1. **IF THE RADIO IS EQUIPPED WITH ENCRYPTION, ENSURE THAT IT IS NOT IN CODED MODE BEFORE PROCEEDING WITH FRONT PANEL PROGRAMMING.**

2. While being programmed, the radio will transmit or receive messages on the currently selected mode.

3. When in the normal mode of operation, only those zones which have mode content can be accessed. When in the programming mode, all of the zones can be accessed.

In the following programming procedures, reference is made to buttons on the radio front panel. Below is a summary of the front panel button symbols.



Front Panel Button Symbols

The charts on the following pages describe the three front panel programming procedures for the types of programming listed below :

- Zone Programming

Modes are grouped into Zones by following the Zone Programming Instructions. Zones may define geographical operating areas, or be used for grouping special types of modes such as those equipped for placing telephone calls. Each Zone can have a unique 8 digit alphanumeric name. Initially the Zone names are "ZONE A"., "ZONE B" etc.

- Scan Programming

Within the set of Modes which have been grouped into a Zone, specific Modes can be selected to be scanned. This selection is made by programming from the front panel by following the Scan Programming Instructions.

- Selectable Singletone Programming

ZONE PROGRAMMING INSTRUCTIONS

(FOR PROGRAMMING FROM THE RADIO FRONT PANEL)

	INSTRUCTION	RADIO'S RESPONSE
Step 1	Press the PROG button.	PROG indicator lights.
Step 2	Press the Zone Up or Zone Down button.	"PROGZONE" appears momentarily on the display followed by the zone name (appears flashing).
Step 3	Use the Zone Up or Zone Down button to access the zone you wish to program.	The name of the zone to be programmed appears flashing in the display. A tone is heard each time the zone is changed.
Step 4	Rotate the Mode Selector switch to select the mode to be programmed into the zone.	The mode appears flashing in the display if not currently in the zone; the mode will appear steady (not flashing) if currently in the zone.
Step 5	To add a mode which is currently not in the zone (i.e. the mode display is flashing), press either the Zone Up or the Zone Down button once. To remove a mode which is currently in the zone (i.e. the mode display is steady), press either the Zone Up or Zone Down button once. NOTE: Pushing the Scan or Priority button will add the mode to the Zone and Scan list simultaneously.	Mode name changes from flashing to steady and is added to the zone. Mode name changes from steady to flashing and is removed from the zone.
Step 6	Rotate the Mode Selector to select another mode to be added or removed from the zone and repeat Steps 5 and 6 until the zone has been programmed.	
Step 7	Once programming of the zone is complete, press PROG button to exit from programming.	PROG indicator will go off. The zone name will appear on the display for 3 seconds followed by the last selected mode name.
Step 8	Repeat Steps 1 through 7 to program additional zones if required.	

NOTE:
If all modes are removed from a zone, that particular zone cannot be selected with the Zone Up or Zone Down buttons except when programming the radio.

SCAN PROGRAMMING INSTRUCTIONS
(FOR PROGRAMMING FROM THE FRONT PANEL)

	INSTRUCTION	RADIO'S RESPONSE
Step 1	Turn the scanner off by pressing the SCAN button.	Scan indicator turns off.
Step 2	Use the Zone Up or Zone Down button to access the zone whose scan you wish to program.	The name of the zone whose scan list you wish to program appears in the display for 3 seconds followed by the currently selected mode.
Step 3	Press the PROG button followed immediately by the SCAN button.	"PROGSCAN" appears momentarily on the display followed by the zone name. The zone name appears for 1 second followed by the name of the last selected mode in the zone.
Step 4	Rotate the Mode Selector switch to select the mode which you plan to add or remove from the scanning sequence.	The Scan indicator will light if this mode is in the scan list; the Scan indicator will not light if this mode is not in the scan list. NOTE: For radios with MBB424 (Add 2 Level Priority) - if the mode is the first level priority mode, the Priority indicator will flash; if the mode is the second level priority mode, the Priority indicator will light continuously.
Step 5	The SCAN button is used to toggle the selected mode in or out of the scan list as indicated by the Scan indicator. If Scan indicator is off, press the SCAN button. If Scan indicator is on, press SCAN button. NOTE: If the radio is equipped with MBB424 "Add 2 Level Priority", the PRI button can be used to add a mode to the scan list as well as designate its priority status.	Scan indicator lights and the mode is added to scan list Scan indicator turns off and the mode is removed from scan list. **CONTINUED ON NEXT PAGE**

SCAN PROGRAMMING INSTRUCTIONS
(FOR PROGRAMMING FROM THE FRONT PANEL)

	INSTRUCTION	RADIO'S RESPONSE
Step 5. Continued	If Scan indicator is off, press PRI button once.	Scan indicator on and Priority indicator flashing, mode entered in scan list and designated Priority 2.
	If Scan indicator is off, press PRI button twice.	Scan indicator and Priority indicator on, mode entered in scan list and designated Priority 1.
	NOTE: The PRI button, when pressed, sequences the priority status of the selected mode through three states, Priority 1, Priority 2, and non-priority. There can only be one Priority 1 and one Priority 2 mode assigned in a zone.	If priority (first and second) is already assigned, pressing the PRI button will have no effect (but a tone will be heard). You must first remove the priority status on the other programmed mode before priority can be reassigned to a new mode. If only one level of priority has been assigned (first or second) to another mode, pressing the PRI button will alternate between two states; non-priority and the unassigned priority level only.
If more Scan Program changes are required:	Repeat Steps 4 and 5 until the scan list for the selected zone is complete.	
If Scan Programming is required in other zones:	Use the Zone Up or Zone Down button to select another Zone and repeat Steps 4. and 5. until the Scan list for the selected Zone is complete.	
To complete:	Once the scan list for the zone is complete, press the PROG button to exit from programming. NOTE: Scan lists and priority assignments can be programmed while programming a zone by performing Step 5 of these instructions immediately after Step 5 in "Programming a Zone"	Program indicator goes off; radio and display reverts back to last mode used.

SELECTABLE SINGLETONE PROGRAMMING INSTRUCTIONS

(FOR PROGRAMMING FROM THE FRONT PANEL)

	INSTRUCTION	RADIO'S RESPONSE
Step 1	Press the PROG button.	Program indicator lights.
Step 2	Press the SELECTABLE SINGLETONE button. (See Figure 2-15)	"PROGTONE" appears momentarily in the display followed by the name of the last singletone selected. If no singletone has been previously selected, the name of the first selectable singletone programmed into your radio will appear .
Step 3	Use the Mode Selector to select the singletone you wish to send.	The singletone name will appear in the display.
Step 4	Press the PROG button to exit from programming.	Program indicator turns off. Radio and display revert back to last mode used.
To Operate:	Press SELECTABLE SINGLETONE button to send singletone.	Singletone transmission is heard.

2.4 INSTALLATION

2.4.1 FRONT MOUNT RADIO SETS

1. Depending on the option ordered, front-mount radios may be mounted using either standard or optional trays alone or in conjunction with a floor mounting adaptor (refer to Figure 2-7).

2. If a tray is used alone, mount it securely by means of the four (10 X 3/4") screws provided.

3. If a tray is used with a mounting adaptor, first mount the adaptor, using the four (10 X 1-1/2") screws provided. After mounting the adaptor, adjust its angle as desired and then mount the tray on the floor mounting adaptor, using the studs to align the fixture; four mounting screws are provided.

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

2.4.2 REMOTE-MOUNT RADIO SETS

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

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

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

4. Route the cable assembly from the control head to the transceiver; insert the cable connector into its mate on the transceiver and secure the connector using the screws provided.

2.4.3 ALL MODELS

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

2. For mobile units, mount the microphone hangup clip at the selected position. (See Note following.) For base station applications, the base microphone should be directly connected to the front of the unit.

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

4. Install the dc power cable in accordance with the instructions provided in Figures 2-8 through 2-12. MBB113 is the "Ignition Control of PTT" option.

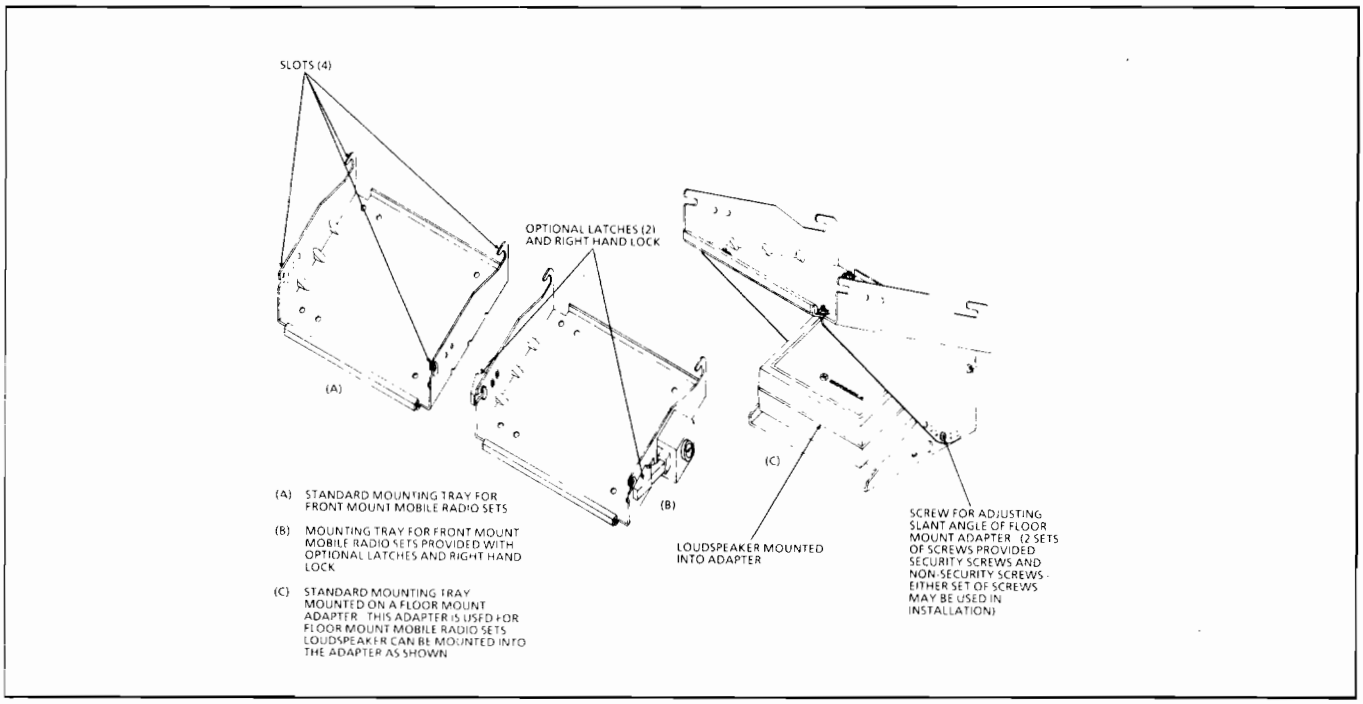


Figure 2-7. Mounting Trays and Floor Mounting Adapter

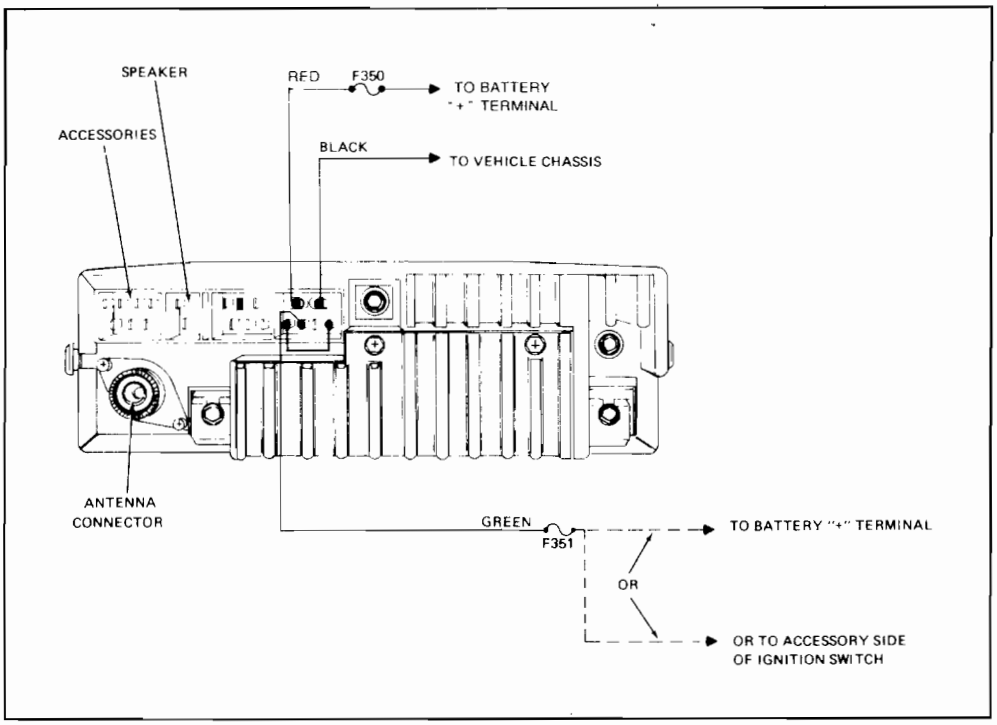


Figure 2-8 Power Lead Connections for Mobile Radios (Without the MBB113 Option-Ignition Switch Transmitter Control)

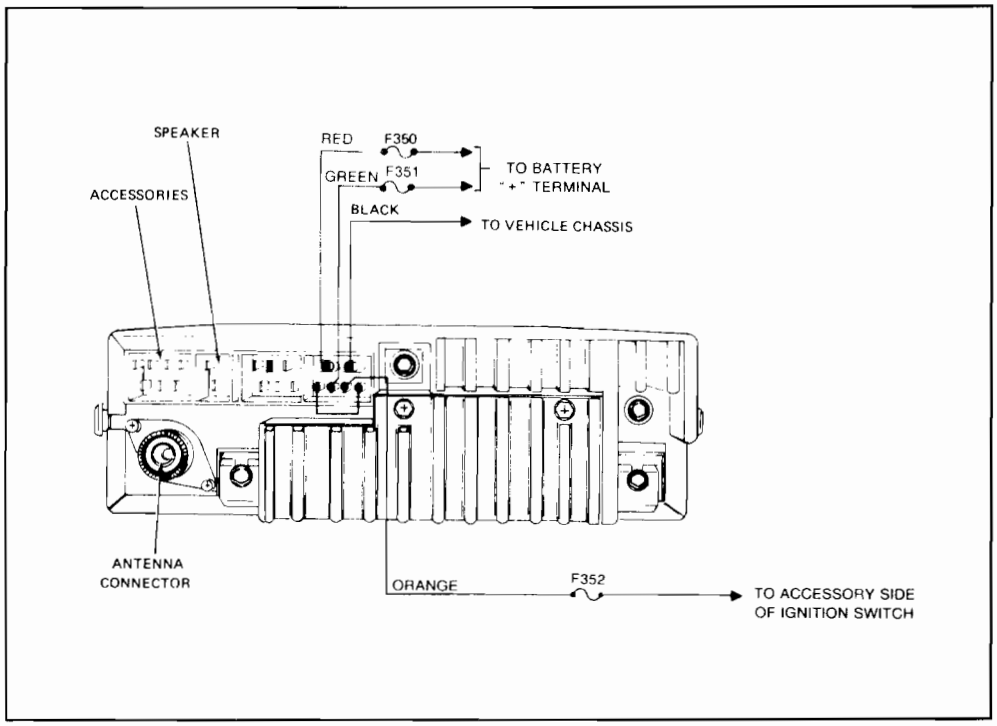


Figure 2-9 Power Lead Connections for Mobile Radios with the MBB113 Option-Ignition Switch Transmitter Control

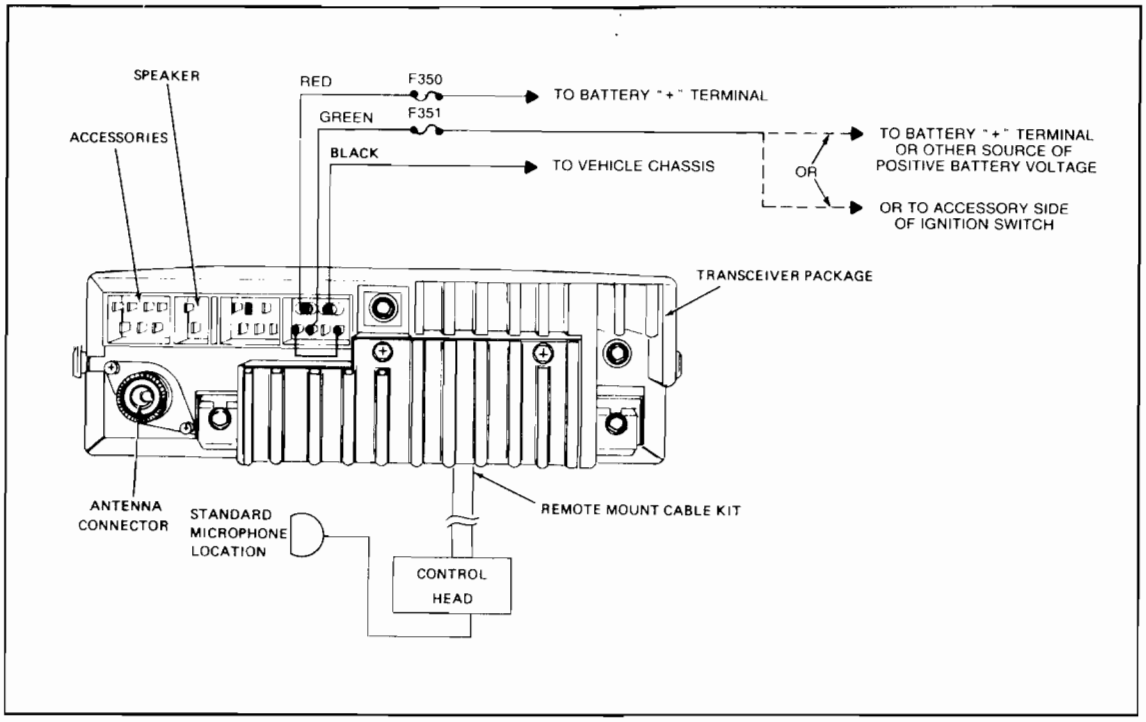


Figure 2-10 Power Lead Connections for Remote Mount Radios (Without the MBB113 Option-Ignition Switch Transmitter Control)

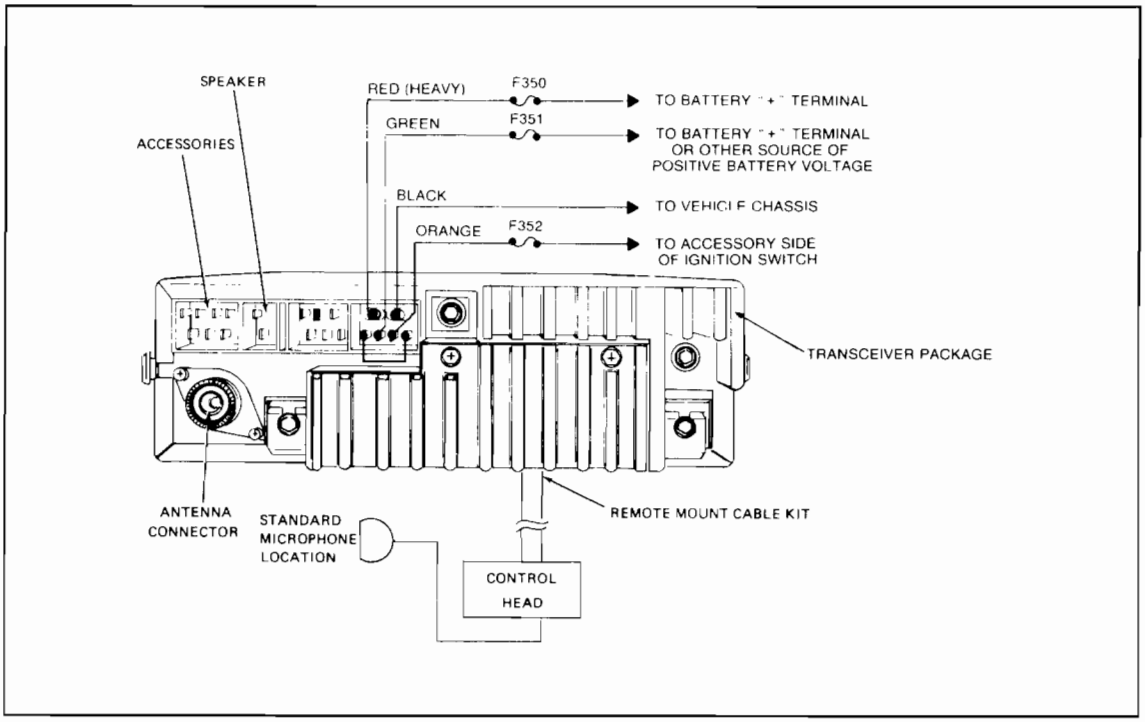


Figure 2-11 Power Lead Connections for Remote Mount Radios with the MBB113 Option-Ignition Switch Transmitter Control

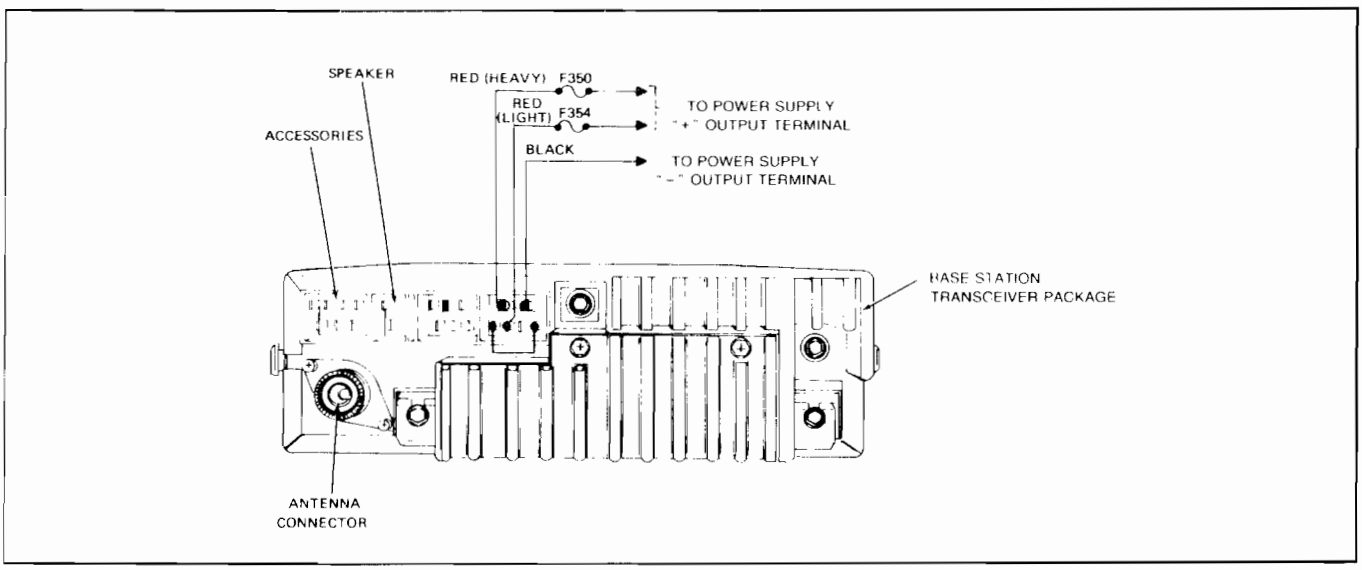


Figure 2-12 Power Lead Connections for Base Station Applications

NOTE:

If the hangup clip is not mounted on a grounded metal surface, connect the supplied wire from the hangup clip to a car chassis ground. **The hangup clip must be electrically grounded to operate the OFF-HOOK function of the microphone.**

2.5 LIST OF ACCESSORIES

MODEL #	DESCRIPTION
VMN1016	Standard palm microphone
VMN1017	DTMF microphone
VMN1018	Base station desk top microphone
MBTSN6032	Standard 5 Watt speaker with 17 ft cable
MBTRN4898	Mounting tray with built-in speaker
VPN1013	Power Supply, 120 V AC
VKN4139	Main radio cable 8 ft with connector (control head to radio)
VKN4140	Main radio cable 17 ft with connector
MBTKN8158	Mobile 10 ft power cable and fuses
VKN4151	Mobile 18 ft power cable and fuses
MBTKN8199	Base 10 ft power cable and fuses
MBTKN8160	Ignition switch transmitter control-Front mount
MBTKN8197	Ignition switch transmitter control-Remote mount
MBTRN4675	Standard mounting tray
MBTRN4679	Mounting tray with right hand lock
VLN4777	Hinged mounting bracket
V1022	Spare Control Head

MBTRN4671	Tuning Tool
MBTRN4778	Tuning Probe Adaptor

Field Retrofit Kits

Field retrofit kits are available from Motorola that allow digital versions of the MCX1000 Radio to be converted to voice encryption operation. For more information on the available encryption options, see Section 2.7 in this manual.

2.6 DESCRIPTION OF RADIO OPTIONS

2.6.1 GENERAL OPTIONS

MBB978 Omit User Programming From the Radio Front Panel

This option makes programming of the radio by its user from the radio front panel impossible. The user would be unable to change the modes included in a zone and the modes that are scanned. Should this option be ordered, a field programmer would be required to reprogram the radio. If selectable singletone is included in the radio, the program button can be used only to select singletone.

MBB460 2 PPM Stability

The MCX1000 comes standard with 5 ppm stability. This option changes radio hardware to improve the frequency accuracy of the radio, an option especially important when the radio is used as part of a data transmission system.

MBB462 Fast-Lok Synthesizer

The lock time of the standard synthesizer is 110 milliseconds. With this option, a new fast-lok synthesizer reduces lock time to less than 3 milliseconds. The faster lock speed is required for units with the Priority Scan option -MBB424 (and is included as part of MBB424) and is strongly recommended for systems where many channels are being scanned. It is also recommended for large mobile data systems where vehicles are polled and rapid receiver and transmitter turn on response is required.

MBB310 Lower Range VHF Option

The VHF MCX1000 Radio is available for operation in Range I (136-162 MHz) or Range II (146-174 MHz) bands. When all transmit and receive frequencies are in the same sub-band overlap area (146-162 MHz), Range II (146-174 MHz) boards will be supplied as standard.

This option (MBB310) should be used when all present frequencies are in the overlap area but future user applications require Range I (136-162 MHz) capability.

MBB75 Omit Time-Out-Timer

Deletes the 60 second timer that is standard on the radio.

MBB287 Non-Standard Time-Out-Timer

This option alters the time period from the standard 60 seconds to one of the following choices: 30, 90, 120, 150, 180, or 210 seconds.

MBB289 Omit Alert Tone

This option removes all the alert tones that are heard when zones are selected and when the mode selector is rotated past the last mode. Alert tones will still be heard while programming from the front panel.

MBB366 Disable Lighting

This option adds an OFF position to the DIM button function. The OFF position will turn off all lighting on the front panel of the control head including the backlighting of all buttons. There is no visible indication that the radio is operating when the dimmer is in the off position.

MBB20 DTMF Microphone (See Figure 2-13)

Deletes the regular mobile microphone and replaces it with a TOUCH-CODE encode microphone. The DTMF microphone allows the transmission of standard dual tone multi-frequency

(DTMF) signals, which are used for remote signalling applications and mobile telephone operations.

2.6.2 SCAN OPTIONS

MBB423 Operator Selectable Scan

This option provides the SCAN button on the radio front panel and the ability of the radio to perform the scan function within each of its zones. NOTE: Upon receipt of his radio, the user will have to select and program the modes to be scanned within each zone from the radio front panel (see Programming the Scan instructions). For diagram and instructions on how to operate the scan function, refer to section 2.2.5.

MBB424 Add 2 Level Priority

This option provides the PRIORITY button on the radio's front panel and the ability of the radio to perform the priority scan function within each of its zones. NOTE: Upon receipt of his radio, the user will have to select and program priority to the modes in the scan list within each zone from the radio front panel. For diagram and instructions on how to operate Two Level Priority Scan, refer to section 2.2.6.

MBB315 Priority to Follow Mode Selector Switch

This feature permits the user to manually select the desired first level priority mode by rotating the mode selector switch to the desired mode and then switching on the scanner.

MBB316 Omit Spontaneous Priority

Spontaneous Priority is standard on the MCX1000 radio. With Spontaneous Priority, the last mode transmitted on is assigned secondary priority status for 60 seconds once the microphone is placed on hook. This feature ensures that a delayed continuation of a conversation will be monitored and not missed. If another mode has previously been programmed with secondary priority status in the scan sequence, the radio will scan with two secondary priority modes for 60 seconds after the microphone is placed on hook. MBB316 "Omit Spontaneous Priority" deletes this feature.

2.6.3 SINGLETONE SIGNALLING OPTIONS

MBB312 Singletone to Follow Mode Selector Switch (See Figure 2-14)

A single one second encode tone is sent from the radio when the "Singletone" pushbutton (marked

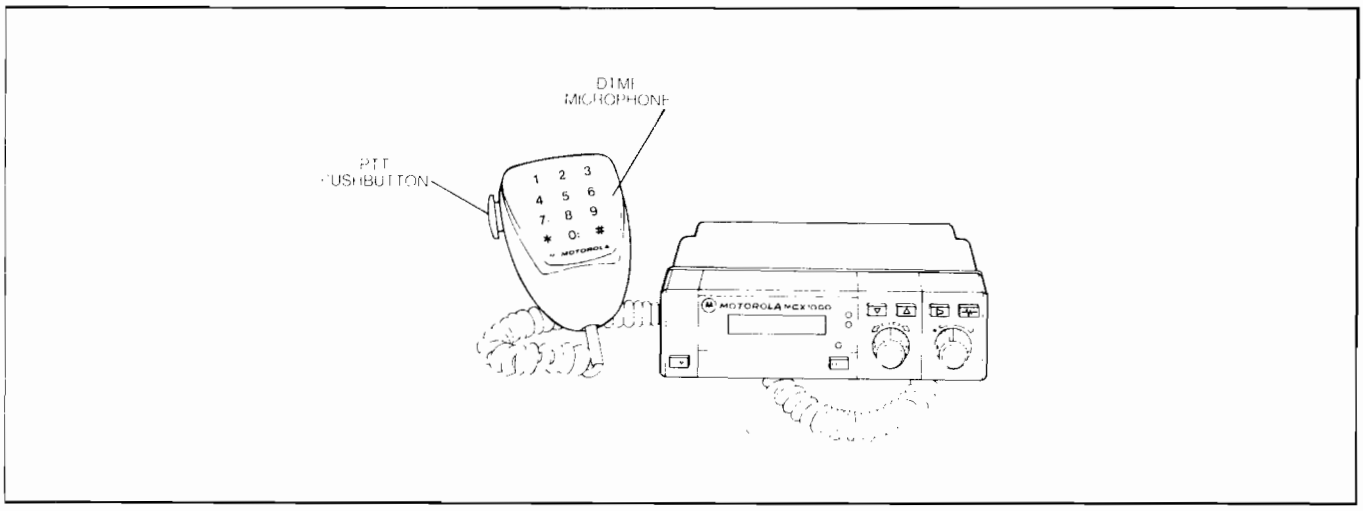


Figure 2-13 MCX1000 Mobile Radio with DTMF Microphone

with a musical note) on the radio front panel is pushed. Holding the Singletone pushbutton depressed beyond the 1 second timed interval causes the radio to transmit the singletone for as long as the button is depressed. The Singletone frequency is determined by the selected mode (the frequency having been previously programmed for the particular mode).

MBB313 Selectable Singletone (See Figure 2-15)

Up to 10 (56 mode, 8 zone models) or 32 (128 mode, 24 zone models) encode tones may be selected for transmission on the MCX1000. A singletone is selected through a sequence of button pushes involving the Program Button (see Programming Selectable Singletone). By depressing the Singletone button (marked with a musical note) on the radio front panel, the selected tone is transmitted. The standard transmission time is one second. Holding the Singletone button depressed beyond the 1 second timed interval causes the radio to transmit the singletone for as long as the button is depressed.

MBB487 Dual Singletone (See Figure 2-16)

Two independent encode tones can be sent from the radio by means of the "**1**" or "**2**" buttons on the radio front panel. The standard transmission time is one second. Holding a dual singletone button depressed beyond the 1 second timed interval causes the radio to transmit the singletone for as long as the button is depressed.

MBB801 Singletone With Non-Standard Duration

This option alters the standard singletone time duration from 1 second (MBB312, MBB313, or MBB487) to one of the following choices: 0.25, 0.5, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, or 5.0 seconds.

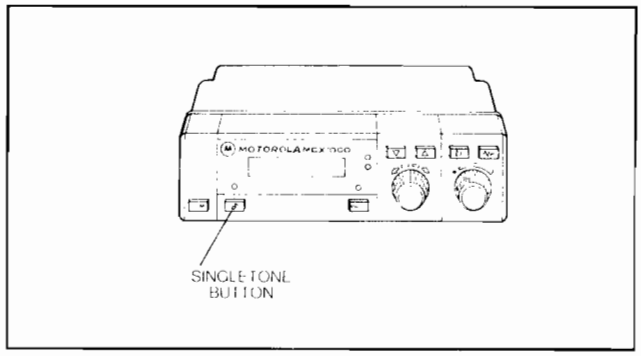


Figure 2-14 MCX1000 Radio with Singletone to Follow Mode Selector Switch

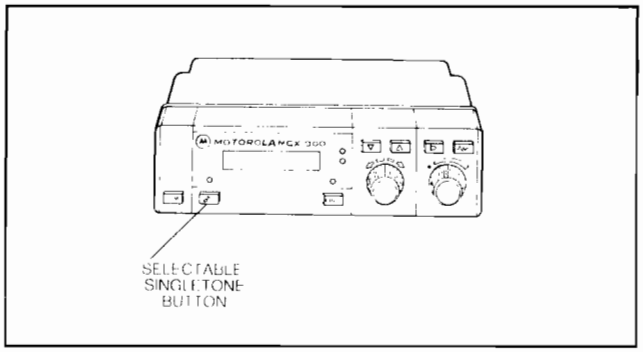


Figure 2-15 MCX1000 Radio with Selectable Singletone

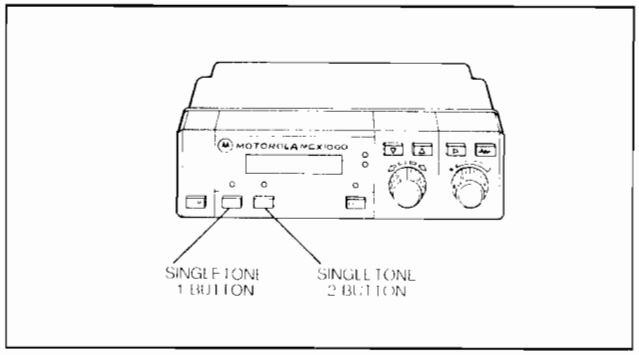


Figure 2-16 MCX1000 Radio with Dual Singletone

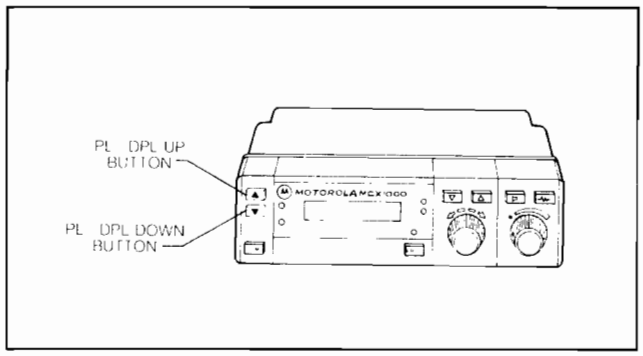


Figure 2-17MCX1000 Radio with Selectable PL / DPL

2.6.4 PRIVATE-LINE / DIGITAL PRIVATE LINE OPTIONS

MBB463 Selectable PL/DPL (See Figure 2-17)

(PL/DPL button positions change with encrypted radios)

Changing the radio PL/DPL code involves the use of the shaded arrow buttons on the front panel of the radio. Use the up or down buttons to call up the desired code. (Codes will be shown on the radio display). When you reach the code you desire, wait 3 seconds for the radio display to revert back to its mode name (this wait may be eliminated by turning the mode selector switch 1 click in either direction). The radio now carries the PL/DPL code you have just assigned. NOTE: This option may be desired if the radio is used on a shared community repeater.

MBB334 Transmit Inhibit on Busy Mode

This option prevents the radio transmitter from keying on an active mode when the wrong PL code is present on the carrier. When the mode is busy with the proper PL code, the Busy Indicator will light steadily. When the mode is busy with the wrong PL code, the Busy Indicator will flash, and if the transmitter PTT is operated, a tone will be heard indicating that the transmitter is inhibited at that time.

The monitor button is disabled with this option so that the receiver audio can be heard only when the proper PL code is present. The squelch button will produce an audible tone when pressed so that the volume level may be adjusted.

This option eliminates interference possible when radio users share the same repeater.

2.6.5 MDC SIGNALLING OPTIONS

MBB708 MDC-1200 Signalling- Unit Identification

Each time the push-to-talk button on the microphone is depressed, a specific pre-programmed burst of data is transmitted to identify the radio unit. During a short period of time, a tone can be heard from the speaker. When the tone ends, the voice message can begin.

MBB452 MDC600 Signalling-Unit Identification

Each time the push-to-talk button on the microphone is depressed, a specific pre-programmed burst of data is transmitted to identify the radio unit. During a short period of time, a tone can be heard from the speaker. When the tone ends, the voice message can begin.

MBB873 MDC Signalling- Emergency Alert Activated by Pushbutton on Control Head (See Figure 2-18)

Pressing the unlabeled "Emergency" pushbutton on the radio front panel sends a unique silent data transmission to the base station informing it of the radio identity and emergency status. Either MDC600 or MDC1200 signalling is used, depending on the MDC Unit Identification option ordered with the radio.

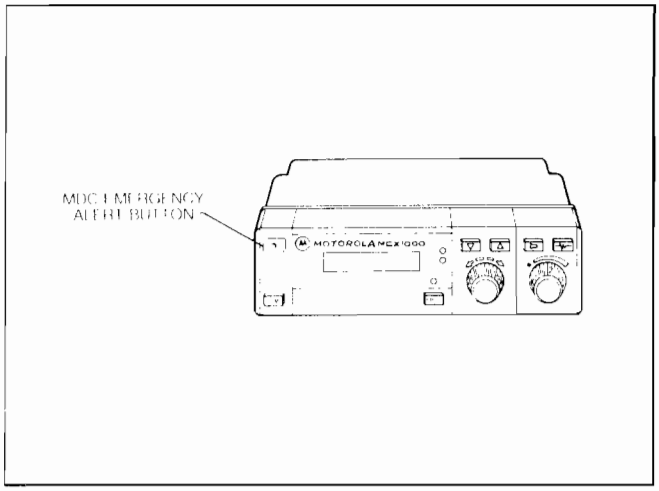


Figure 2-18 MCX1000 Radio with MDC Emergency Alert Activated by Pushbutton on Control Head

MBB688 MDC Signalling-Emergency Alert Activated by Hidden Pushbutton

Activating a hidden pushbutton sends a unique silent data transmission to the base station informing it of the radio identity and emergency status. Either MDC600 or MDC1200 signalling is used, depending on the MDC Unit Identification option ordered with the radio.

MBB470 MDC Signalling-Emergency Alert Activated by Hidden Footswitch

Activating a hidden footswitch sends a unique silent data transmission to the base station informing it of the radio identity and emergency status. Either MDC600 or MDC1200 signalling is used, depending on the MDC Unit Identification option ordered with the radio.

2.6.6 MANUAL OPTIONS

MBB292 French Instruction Manual (Canadian Option Only)

A French Instruction Manual is substituted for the English Instruction Manual that is normally shipped with every radio.

MBB206 Service Manual

This option adds a service manual (1 per every 10 radios ordered).

2.6.7 INSTALLATION OPTIONS

MBB665 Base Station Operation

This option converts the standard front mount mobile package model into a 12 Volt DC base station by omitting all the mobile accessories and adding a base station power supply, base station power cables and fuses, base station tray with built-in speaker, and base microphone.

MBB32 Omit Base Station Power Supply and Cables

The option deletes the base station power supply and cables that are part of MBB665.

V1022 Spare Control Head

This accessory consists of a kit composed of a universal remote mount control head and all possible buttons.

MBB70 Omit Antenna, Cable and Connectors

This option removes the antenna, cable and connectors from the MCX1000 radio package.

MBB652 Broadband Antenna

This option replaces the standard unity gain 1/4 wave antenna with a 1/4 wave broadband antenna. A broadband antenna is recommended if the range of transmit frequencies is beyond the span of 139 MHz to 153 MHz, below 146 MHz to above 161 MHz, or below 155 MHz to above 172 MHz.

MBB297 Mounting Tray With Right Hand Lock

This option replaces the standard mounting tray with a mounting tray that has 2 latches plus a right hand lock.

MBB475 Hinged Mounting Bracket

The hinged mounting bracket is recommended for floor-mount mobile radio sets. Two pairs of screws are provided with the hinged mounting bracket, namely security screws and non-security screws. Either set of screws may be used in the installation.

MBB113 Ignition Switch Transmitter Control

This option permits the transmitter to be controlled through the vehicle ignition switch, preventing unauthorized transmission in unattended vehicles.

MBB335 Remote Mounting Kit

This option shortens the length of the speaker and control head cables on remote mount models from 17 ft (5.2m) to 8 ft (2.4m).

MBB71 Omit Mobile Microphone

This option removes the standard palm microphone from the MCX1000 radio package.

MBB87 Omit Speaker

This option removes the mobile speaker and its cable from the MCX1000 radio package.

MBB161 Omit Battery Cable

This option removes the power cable from the remote mount MCX1000 radio package.

MBB65 Omit Mounting Tray and Installation Kit

This option removes the mounting tray and associated hardware from the MCX1000 radio package.

MBB90 Omit All Accessories

This option removes the antenna, cable and connectors, palm microphone, speaker, power cable, mounting tray and installation kit from the MCX1000 Radio package.

2.7 OPTIONS UNIQUE TO DIGITAL CAPABLE RADIOS (UXA MODELS)

MBB236 56 Mode Operation

This option changes the maximum number of operating modes in the radio from 128 to 56 and the number of zones from 24 to 8.

MBB981 Railroad Requirement

This option replaces the dual front end receiver with a single front end receiver (4MHz) and allows two independent encode tones to be sent from the radio by means of the "1" and "2" buttons on the radio front panel.

Factory Installed Encryption

This option adds hardware (extended chassis and boards) and a specific voice encryption module to the radio depending on the type of encryption ordered.

Dual Code Select

This option allows the user to select between two encryption codes for transmission. The dual code select option is available only with a specific type of voice encryption option.

Proper Code Detect

This option causes the radio to mute if the receiving signal has the wrong encryption code.

Spare Encryption Module

Ordering this option adds a spare encryption module to the package that ships with your radio. NOTE: LIMIT OF 1 KIT FOR EVERY RADIO ORDERED.

Field Installed Encryption

Ordering this option provides the hardware (extended chassis and boards) and a specific voice encryption module to the radio depending on the type of encryption ordered.

Security Housing Mounting Tray-Front Mount

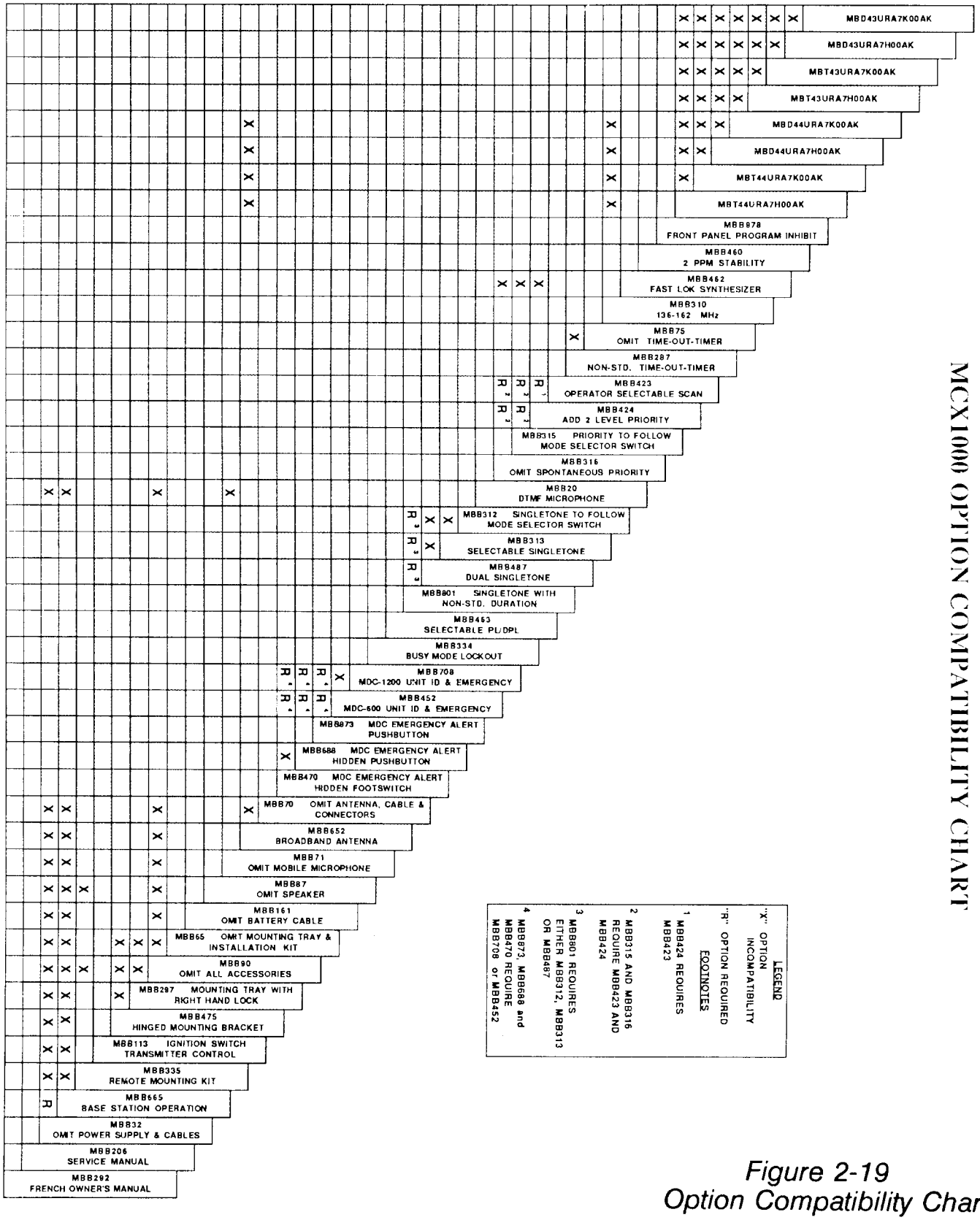
This option provides a lockable front mounting tray containing an anti-tamper switch. If any attempt is made to tamper with the radio, the electronic key is automatically erased.

Security Housing Mounting Tray-Trunk Mount

This option provides a lockable mounting tray containing an anti-tamper switch. If any attempt is made to tamper with the radio, the electronic key is automatically erased.

2.8 OPTION COMPATIBILITY CHART

Before ordering radio options, refer to Figure 2-19 to determine option compatibility. Also, Figure 2-19 indicates the options that must be ordered together.



MCX1000 OPTION COMPATIBILITY CHART

Figure 2-19
Option Compatibility Chart

END OF SECTION 2

MOTOROLA LIMITED
Communications Division

SECTION 3. MAINTENANCE AND ALIGNMENT

3.1 RADIO DESCRIPTION

3.1.1 GENERAL

The MCX1000 VHF Radio operates in the range of 136-162 or 146-174 MHz and has transmit capabilities of 30/40 Watts rf output. It is available in a dash mount, remote mount or base station configuration. The MCX1000 Radio receives all control signals from its own microcomputer board.

The radio chassis is constructed of rugged cast metal with separate top and bottom covers.The back of the chassis contains the connectors for external power, antenna, external option connections, and a heat sink for power transistor cooling.

The radio control head contains all controls and indicators as well as the microphone connector.

Compartments inside the chassis isolate the PA, receiver front end, frequency synthesizer, microcomputer / analog interface, 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.

The top and bottom cover are easily removed. Most of the internal 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 appropriate screws and pulling from the radio.

The chassis is designed so that most boards are readily accessible by removing the top cover, bottom cover, and PA shield. The main assemblies for the radio are listed below.

- power amplifier interconnect board
- 30 watt heat sink
- synthesizer board
- synthesizer interconnect board
- VCO hybrid assembly
- main board
- front panel interconnect board
- dual front end
- harmonic filter hybrid
- low level amplifier hybrid
- 10 watt power amplifier hybrid
- 30 watt power amplifier hybrid
- analog interface board
- remote interface board (remote mount models)
- command board (2K or 8K)
- display board
- dash or remote control head microcomputer board
- power interconnect board

See Figures 3-1 and 3-2 for the location of the board assemblies listed above. For boards not shown, refer to subsections 3.1.2 through 3.1.13 for board locations.

3.1.2 POWER AMPLIFIER (PA) INTERCONNECT BOARD

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

- low level amplifier hybrid
- 10 watt power amplifier hybrid
- harmonic filter / antenna switch hybrid

The PA interconnect board is located on the bottom of the chassis, adjacent to the rear wall. All transmitter circuits except push-to-talk (PTT) logic, transmit audio/instantaneous deviation control (IDC), and transmit power and level control are located on these hybrids.This board cannot be removed. Replacement of components on this board, if necessary, should be done from the exposed side of the board.

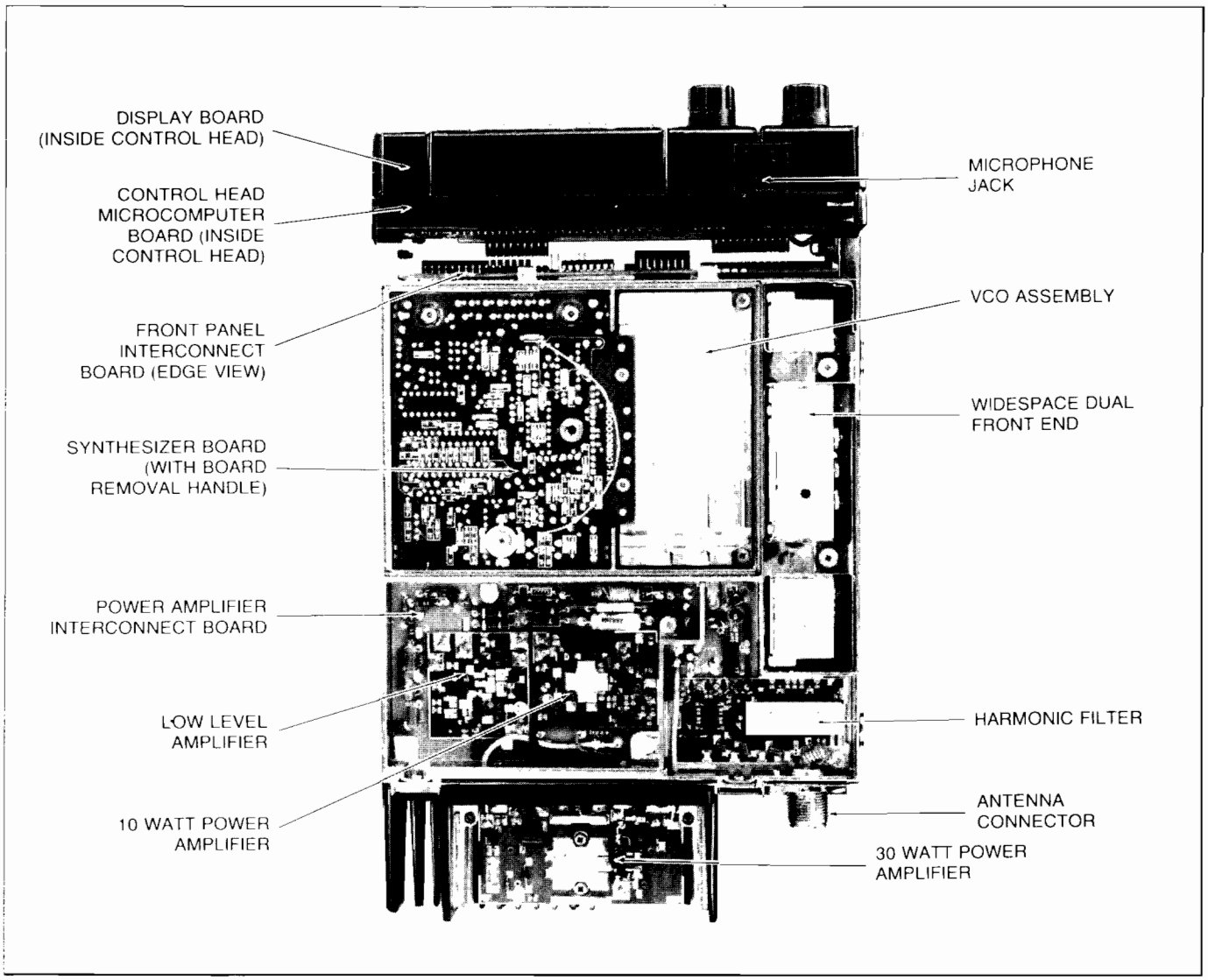


Figure 3-1 MCX1000 Radio Bottom View with Cover Removed

3.1.3 30 WATT HEAT SINK

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

3.1.4 30 WATT POWER AMPLIFIER

The power amplifier is mounted inside the external heat sink and is accessed by removing the bottom cover of the heat sink.

3.1.5 FREQUENCY SYNTHESIZER

The 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
- miscellaneous buffering, filtering, and control circuitry.

The VCO assembly contains :

- the voltage controlled oscillator circuit,
- buffer,
- range shift circuitry,

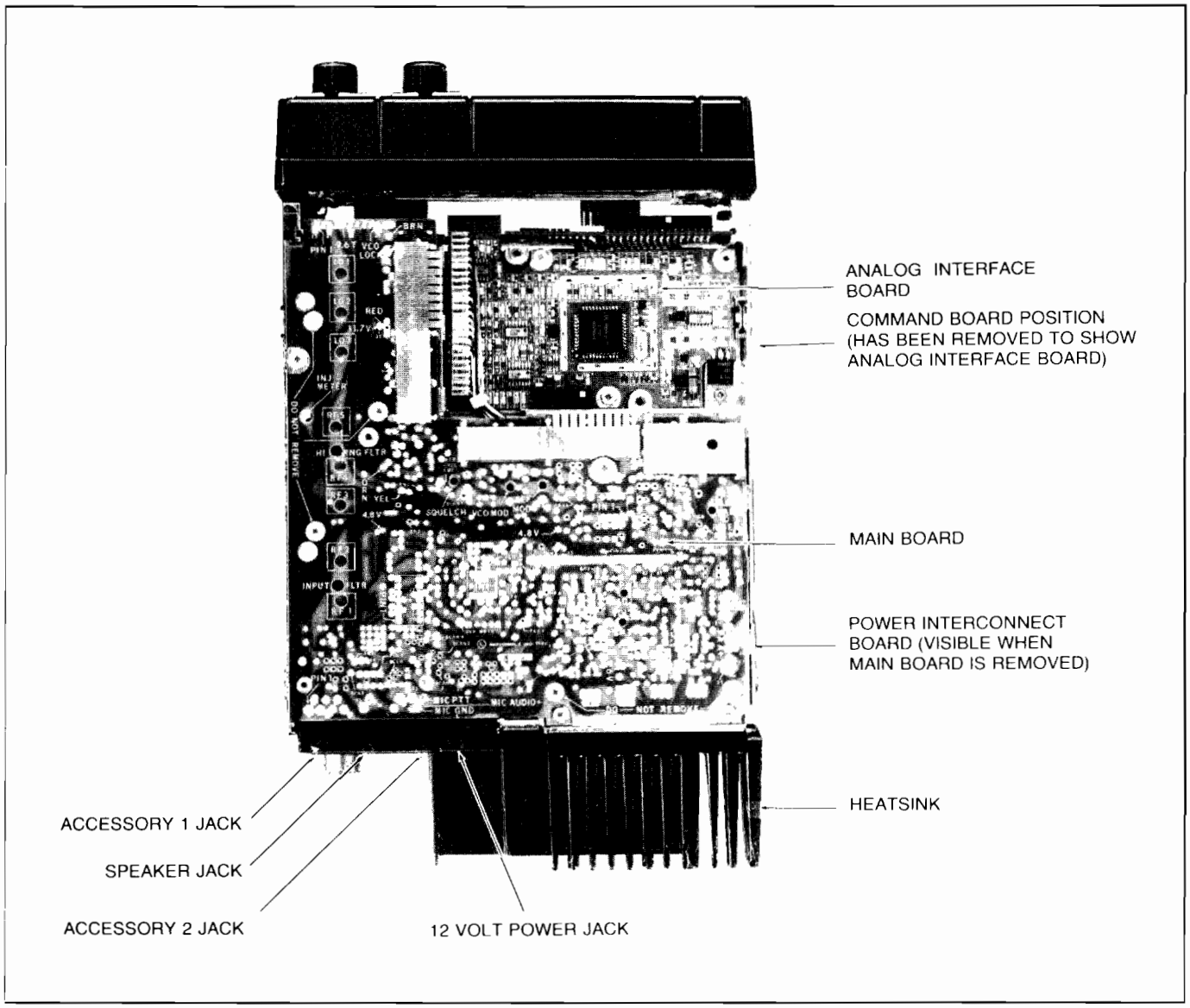


Figure 3-2 MCX1000 Radio Top View with Cover Removed

• varactor diodes, which produce frequency modulation of the VCO.

3.1.6 MAIN BOARD

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

- push-to-talk logic
- transmit audio / IDC
- transmit power and level control

3.1.7 FRONT PANEL INTERCONNECT BOARD

The front panel interconnect board provides for the connections between the front panel, power interconnect board, synthesizer board, main board, analog interface board and command board. The front panel interconnect board is located in a slot at the front of the radio chassis and is accessible by removing the radio control head (in dash mount models) or removing the radio remote transceiver front cover (in remote mount models).

3.1.8 POWER INTERCONNECT BOARD

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. The power interconnect board cannot be removed. Replacement of components on this board, if necessary, should be done from the exposed side of the board,

3.1.9 DUAL FRONT END

The front end contains the rf amplifier, mixer, and tuned filters which provide selectivity. The front end is attached to the main board. A dual front end board is standard in each radio model.

3.1.10 COMMAND BOARD

The command board is located on the top of the radio set at the front, in the space not taken by the main board. The command board is the main controller for the radio. Its memory contains the personality data for the radio and it controls the serial bus, synthesizer and volume control IC. It also controls the microcomputer on the analog interface board

3.1.11 REMOTE INTERFACE BOARD

The remote interface board allows the radio set to be mounted in a remote location such as under the seat or in the trunk, and be controlled from the vehicle dashboard.This board is located at the front of the radio chassis and is accessible by removing the radio remote transceiver front cover (in remote mount models).

3.1.12 ANALOG INTERFACE BOARD

The analog interface board is located underneath the command board. It is accessible after removal of the command board from the radio. A microcomputer on the analog interface board interfaces the main microcomputer (located on the command board) to the radio circuitry. The analog interface board also provides transmit PL and singletone, audio gating and filtering.

3.1.13 DISPLAY BOARD

The display board is mounted vertically in the control head and is located directly on the front panel. As its name implies, it holds all displays and display drivers. Also mounted on this board are all front panel pushbuttons and indicator LED's.

3.1.14 DASH / REMOTE CONTROL HEAD MICROCOMPUTER BOARD

Depending upon model, either a dash control head microcomputer board or a remote control head microcomputer board will be present in each radio. This board is mounted vertically in the control head directly behind the display board.The control head microcomputer controls the display board and interfaces to the radio. It scans the keyboard and sends information from the keyboard to the radio. As well, it receives data from the radio and places this information in the display. All front panel LED's are controlled from this board.

3.2 RECOMMENDED TEST EQUIPMENT FOR MAINTENANCE AND ALIGNMENT

Refer to Figure 3-3 for a listing of test equipment needed to perform maintenance and alignment to the MCX1000 Radio Set.

NOTE

All test equipment, with the exception of the DPL test set, tuning tool kit, tuning probe adapter, and dc power supply may be replaced by the Motorola R2001 System Analyzer.

Figure 3-4 contains a listing of additional equipment used to verify radio specifications. Note that the equipment listed in Figure 3-4 is <u>not</u> required for maintenance and alignment.

3.3 FIELD PROGRAMMING

The MCX1000 Radio uses an EEPROM (Electrically Erasable Programmable Read Only Memory) to store information on modes, zones, signalling codes and tones, signalling durations and Time-Out-Timer durations.

3.3.1 SERVICE PROGRAMMING WITH A RADIO SERVICE PROGRAMMER

The MCX1000's EEPROM can be reprogrammed in the field without ever removing the EEPROM from the radio. To program, an IBM PC, XT, AT or PC Convertible computer is connected through a Radio Interface Box ("RIB") to the microphone connector of the radio. Once the computer is connected to the radio, the prompts provided by the software guide the operator through all the steps required for programming.

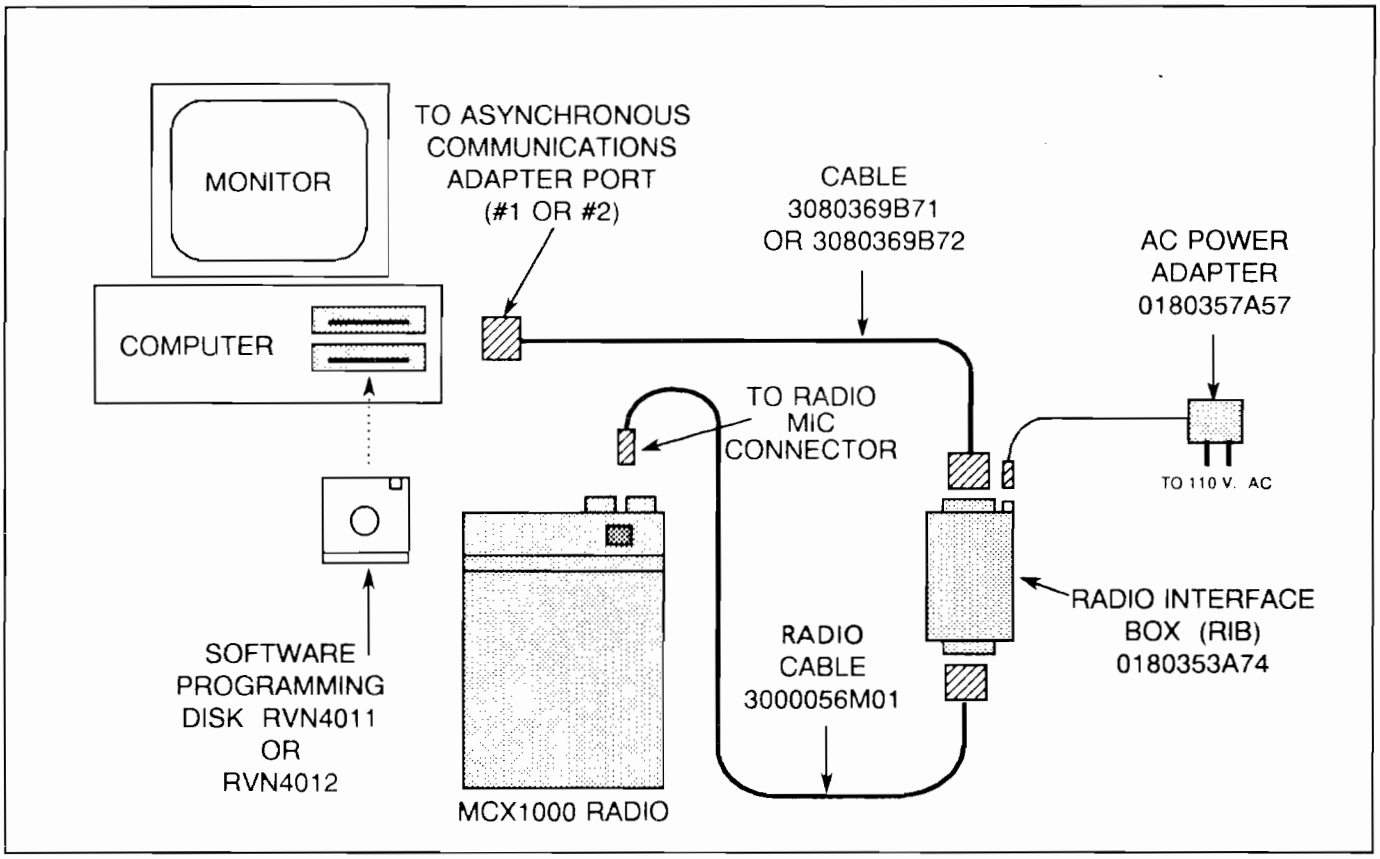
3.3.2 REQUIRED EQUIPMENT

The items in the table at right are required for reprogramming an MCX1000 Radio. All items except the computer are available through Motorola National Parts.

DESCRIPTION	PART NUMBER
Computer	IBM PC, XT , AT or PC Convertible with min. 512K RAM, IBM DOS 3.0 or higher, and an Asynchronous Communications Adapter
RIB (Radio Interface Box)	0180353A74
Computer Cable from RIB to :	
• IBM PC, XT or PC Convertible	3080369B71
• IBM AT	3080369B72
Radio Cable from RIB to MCX1000	3000056M01
Software Programming Disk	5 1/4" - RVN4011 3 1/2" - RVN4012
AC Power Adapter	0180357A57

3.3.3 FIELD PROGRAMMING CONNECTIONS

The diagram below shows the necessary connections to the computer, radio interface box and the MCX1000 Radio for radio programming.



Field Programming Connections Diagram

3.3.4 ELECTRONIC ENCRYPTION KEY TRANSFER

Instructions detailing the method of inserting an encryption key into a digital capable MCX1000 Radio with a Securenet voice encryption option are provided in separate manuals associated with the particular Key Code Inserter ordered for the MCX1000 Radio.

Information on the Securenet voice encryption circuitry and associated voice encryption options is provided in a manual supplement entitled Securenet Digital Voice Encryption MCX1000 Two-Way FM Radio (Motorola part # 68P02902A19).

3.4 SAFE HANDLING OF CMOS INTEGRATED CIRCUITS / REMOVAL AND REPLACEMENT OF CHIP COMPONENTS

The following precautions should be observed when handling, removing or replacing integrated circuits and chip components.

CAUTION 1.

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 IC's are vulnerable to damage from static charges. Motorola Publication Number 68P81106E84, "SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES" contains information pertinent to the safe handling of these devices. To obtain this publication, fill in and mail the self mailer titled Available Background Reference Publications at the back of this manual .

CAUTION 2.

DO NOT remove or insert any circuit boards or integrated circuits while power is applied.

CAUTION 3.

Connect a wrist-type grounding strap to the chassis before opening the chassis.

CAUTION 4.

Special techniques are used when installing or removing chip type components. If these techniques are not implemented correctly, serious damage may occur to the circuit and / or the performance of the circuitry associated with the chip components may be degraded. Motorola Publication Number 68P81113E77, "Removal and Replacement of Chip Components on Circuit Boards" contains detailed information on this subject. To obtain this publication, fill in and mail the self mailer titled Available Background Reference Publications at the back of this manual.

General Type	Application	Recommended Model	Minimum Specifications
AC-DC VOM	DC voltage measurements, general	Motorola T1009	Measurement range: 0-15 Vdc Sensitivity: 20,000 ohms / volt
DC Multimeter	DC voltage readings requiring a high input resistance meter	Motorola R1037 or R1038	Measurement range: 0-15 Vdc Input resistance: 11 megohms
AC Voltmeter	Audio voltage measurements	Motorola S1053	Measurement range: 0-10 Vac
RF Voltmeter	RF voltage measurements	Motorola S1339	Measurement range: 100 uV-3V from1 MHz-512 MHz Inputs: 50 ohm and high imp.
Tuning Probe Adapter	Dual Front End Alignment	Motorola MBTRN4778	
Oscilloscope	Waveform observation	Motorola R1028 or R1029	Vertical sensitivity:5 mV-10 V / division, Horizontal time base: 0.2 usec.-.5 sec / div.
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 R2001 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 R2001 Service Monitor with RTC4000 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 R2001 Service Monitor with attenuator	Frequency range:134-174 MHz Output Level:0.1uV-100,000uV 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-20kHz Output level: 50 mV-1 V
PL ToneGenerator (for PL models only)	Tone-coded Private-Line decoder troubleshooting	Motorola R1100	Frequency range: 10 Hz-9999Hz Output level: 0-3 V rms
DPL Test Set (for DPL models only)	Digital Private-Line encoder-decoder troubleshooting	Motorola SLN6413	

Sheet 1

Figure 3-3 Recommended Test Equipment for MCX1000 Radio Servicing (Sheet 1)

General Type	Application	RecommendedModel	Minimum Specifications
Speaker/Load	Receiver alignment and measurement	TSN6031A Speaker Kit with RPX4134A Modification Kit	
Tuning Tool Kit	Receiver and transmitter alignment	Motorola TRN 4671A	
DC Power Supply	DC power for shop service	Motorola R1011	1-20 Vdc, 0-40 A
Front Panel Extender Cables	Troubleshooting	Motorola RTK4036A	
Metric Nutdriver Kit	Radio Assembly / Disassembly	RSX4048A	

Sheet 2

Figure 3-3 Recommended Test Equipment for MCX1000 Radio Servicing (Sheet 2)

General Type	Application	RecommendedModel	Minimum Specifications
Distortion Analyzer	Distortion and SINAD measurements	Hewlett-Packard Model 331A	Average-responding detector
Low Noise RF signal generators (2 used)	Receiver Intermodulation and Adjacent-Channel Selectivity measurements	Hewlett-Packard Model 8640B with option H60, "Low Single Sideband Noise"	SSB noise >142 dB / √Hz below carrier (20 kHz offset 1 Hz bandwidth)
Broadband Signal Combiner, 50 ohms	Receiver Intermodulation and Adjacent-Channel Selectivity measurements	Anzac T-1000	25 dB minimum isolation
Three - port resistive combiner, 50 ohms	Three-generator Intermodulation measurements	Measurements M501 or equivalent	
Psophometer	CEPT method SINAD measurements	Hewlett-Packard Model 3556A	
Spectrum Analyzer	Transmitter spurs and harmonics	Hewlett-Packard Model 141T Mainframe with 8554L and 8552A Heads	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		
10 dB thruline pad, 50 ohms	Transmitter spurs and harmonics		
Tunable notch filter. 50 ohms	Transmitter spurs and harmonics		40 dB minimum notch depth, tunable 136-174 MHz

Figure 3-4 Recommended Test Equipment for Radio Specifications Verification

3.5 RADIO SET DISASSEMBLY / ASSEMBLY

3.5.1 GENERAL

CAUTION

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

The MCX1000 Exploded View and Mechanical Parts Lists (Figure 3-12) , MCX1000 Radio-Bottom View (Figure 3-1) and MCX1000 Radio-Top View (Figure 3-2) may be used as reference.

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 cannot 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 insertion 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.

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 MCX1000 radio are listed in Figure 3-5.

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.

Screw Size	Application	Maximum Torque
M2.5 x .45	30 Watt final transistor;main board heat sink devices	6 ±1 In-Lbs. (0.7 ±0.1 Nm)
M4.0 x .70 x 9.0	30 Watt heat sink to chassis mtg.; top and bottom cover screws	20 ±2 In-Lbs. (2.3 ± 0.2 Nm)
M3.0 x .50 x 10.0	Synthesizer cover	14 ± 2 In-Lbs. (1.6 ± 0.2 Nm)
M3.0 x .50 x 12.0	VCO assembly	12 ± 2 In-Lbs. (1.4 ± 0.1 Nm)
M3.0 x .50 x 8.0	All other applications not listed above	12 ± 2 In-Lbs. (1.4 ± 0.1 Nm)
	10 Watt RF final mtg. stud	5 ± 1 In-Lbs (0.6 ± 0.1 Nm)

Figure 3-5 Screw Torque Specifications

3.5.2 VCO ASSEMBLY REPLACEMENT

To replace the VCO Assembly, perform the following steps.

1. Remove three screws holding synthesizer board in casting.

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

3. Perform this step only if the radio is equipped with a fast-lok synthesizer.
   In preparation for removing the Synthesizer RF Amplifier Board, remove the one screw holding the VCO which is closest to the Synthesizer RF Amplifier Board (see the board details for this board, located in Section 7). Unsolder the following three points, being careful not to damage or tear the copper foil on the board:
   -RF input from VCO
   -Receive injection (J357)
   -Transmit injection
   Lift the Synthesizer RF Amplifier Board from the chassis.

4. Remove the four screws (or three remaining screws if step 3 was performed) holding the VCO in place. Lift VCO out of compartment.

5. Reverse the above steps to install a new VCO. The screws that secure the VCO and synthesizer must be tightened 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.

3.5.3 SYNTHESIZER BOARD REPLACEMENT

To replace the Synthesizer Board, perform the following steps.

1. Remove three screws (five screws in Fast-Lok version) holding synthesizer board in casting.

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

NOTE

Only the divider/phase detector IC U115 is socket mounted and therefore field replaceable. Replacement is described below.

3. Use an integrated circuit extraction tool to remove the IC U115 from its socket.

4. When replacing U115 with a new IC, note that the IC pins may have to be bent slightly to line up with the socket holes.

5. Replace the IC with firm pressure directed toward the centre of the IC . Be sure to observe correct orientation as indicated by the circuit board legend.

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

3.5.4 SYNTHESIZER RF AMPLIFIER BOARD (Used only with Fast-Lok Synthesizer)

To replace the Synthesizer RF Amplifier Board, perform the following steps.

1. Remove the Synthesizer Board as described above (section 3.5.3).

2. Remove the screw holding the RF Amplifier Board in position.

3. Unsolder the pin between the RF Amplifier Board and the VCO interconnect board. Unsolder at the RF Amplifier Board end. (See Section 7 for details of this board.)

4. Unsolder the connections to the RF Amplifier Board from J357 (receive injection) and the transmit injection coax. Take care not to damage the plated through holes into which these connections are soldered.

5. Lift the RF Amplifier Board straight up to remove it from the synthesizer compartment.

6. Reverse the above steps to replace the board. Screw should be tightened to 12±2 inch-pounds.

3.5.5 TRANSMITTER MODULE REPLACEMENT

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.

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.

Low Level Amplifier

To replace the Low Level Amplifier, perform the following steps.

1. Unsolder the six connection pins.
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.
3. Clean the six connection pins and circuit board pads of any excess solder and straighten the pins if necessary.
4. Place the new module over the pins to check for alignment.
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.
6. Bridge solder between the six connection pins and their associated hybrid pads so solder is wicked around 25% of the pins.

10 Watt Amplifier

To replace the 10 Watt Amplifier, perform the following steps.

1. Unsolder the five connection pins.
2. Remove the main board (see main board removal / replacement procedure).
3. Remove the transistor stud nut.
4. From the main board side, gently tap on the stud of the transistor to remove the module.
5. Clean the five connection pins and circuit board pads of any excess solder and straighten the pins if necessary.
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.
7. Replace the transistor stud nut and tighten to a torque of 5 $\pm$ 1 inch-pounds.
8. Bridge solder between the five connection pins and their associatedhybrid pads so solder is wicked around 25% of the pins.

30 Watt Amplifier

To replace the 30 Watt Amplifier, perform the following steps.

NOTE

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

1. Unsolder the input and output coaxial cables so they are clear of the hybrid.
2. Unsolder the jumper going to thermistor RT1400 at the hybrid end.
3. Unsolder the feed network L1403 at the hybrid end.
4. Unsolder the ground lug next to thermistor RT1400.
5. Remove the two screws holding transistor Q1400
6. Remove the module.
7. Put thermal compound on the flange of the new module device where it contacts the heat sink.

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

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

10. Reconnect all wires and coaxial cables.

Harmonic Filter

To replace the Harmonic Filter, perform the following steps.

1. Unsolder the centre 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 centre conductor hole.

2. Unsolder the five connector pins.

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

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

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

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

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

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

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

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.

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

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

3.5.6 MAIN BOARD REMOVAL / REPLACEMENT

Main Board Removal

To remove the Main Board, perform the following steps.

1. Remove radio top and bottom covers.

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 heat sink. These two screws are identified by the legend DO NOT REMOVE on the main board.

3. Remove the two screws on bottom of radio securing the front end to chassis crossbars.

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.

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

6. Remove 22-pin connector J352, by pulling straight out to avoid bending pins of P352.

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

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

9. Lift main board completely away from chassis.

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

Main Board Replacement

To replace the Main Board, perform the following steps.

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.

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.

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

5. Apply thermal grease to heatsink and chassis if it was wiped off during servicing.

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.

7. Install two screws securing heatsink 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.

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

9. Install two screws on bottom of chassis securing front end casting to chassis crossbars. Tighten to 12 ±2 inch-pounds.

8. Replace radio top and bottom covers. Tighten screws to 20 ± 2 inch-pounds.

Dual Front End

The Dual Front End Assembly is attached to the main board. See the Main Board removal / replacement procedures above if access to the Dual Front End is required.

3.5.7 CONTROL HEAD DISASSEMBLY / ASSEMBLY (REMOTE MOUNT MODELS)

Remote Mount Control Head Microcomputer Board

To replace the Remote Mount Control Head Microcomputer Board, perform the following steps.

1. Remove the two screws from the back of the control head. Also remove the two screws which pass through the back housing into the rear cable connector.

2. Carefully separate the front and back housing of the control head. Remove the four screws holding the control head microcomputer board in the back housing.

CAUTION

Use care when separating the front and back housing of the control head. The two halves are joined internally by means of short flex cables.

3. The flex connectors must be unsoldered from the control head microcomputer board if its replacement becomes necessary.

4. The control head microcomputer board is replaced by reversing the above steps.

Display board

To replace the Display Board, perform the following steps

1. Remove the volume and channel selector knobs using the following procedure.
   - Wrap each knob with foam to protect it.
   - A small vice should be used to firmly grip each knob (one at a time).
   - Pull firmly on the control head to separate the knob from its shaft.

2. Remove the nuts and knurled washers exposed by the removal of the two knobs mentioned above (on the front of the display panel).

3. Remove the two screws from the back of the control head.

4. Carefully separate the front and back housing of the control head.

5. Remove the five screws that hold the display board in the front housing.

CAUTION

Use care when separating the front and back housing of the control head. The two halves are joined internally by means of short flex cables.

NOTE

Hold the control head face down when removing the display board so that the front panel buttons won't fall out and get lost. Also, part of the button mechanism may stick to the display board. This part should be replaced in its proper position behind the light pipes in the control head.

CAUTION

Take care not to touch the black carbon pads behind the rubber membranes of the button mechanism. Also , do not touch the gold plated etching on the surface of the display board.

6. With the control head face down, the display board may be carefully removed from the front housing.

7. The display board is replaced by reversing the above steps.

3.5.8 CONTROL HEAD DISASSEMBLY / ASSEMBLY (DASH MOUNT MODELS)

The Control Head on a dash mount model radio contains both the Control Head Microcomputer board and the Display board.Steps for their removal and replacement are described below.

Dash Mount Control Head Microcomputer Board

To replace the Dash Mount Control Head Microcomputer Board, perform the following steps.

1. Remove the radio top and bottom covers.
2. Remove the four screws (two on each side of the radio) that fasten the control head to the main radio chassis.
3. Carefully pull the control head from the radio chassis.
4. Remove the screws holding the microcomputer board in place in the control head. Be sure to remove the screw fastening the regulator to the control head, as the regulator is soldered to the display board.
5. The microcomputer board may now be carefully pulled from the control head.

NOTE

The microcomputer board is attached to the display board by short flex cables. These are soldered in place.

6. For complete removal of the microcomputer board from the radio, the display board to which it is attached must also be removed. Instructions for display board removal follow in the next section.
7. Replace the microcomputer board by reversing the above steps.

Display Board

To replace the Display Board, perform the following replacement steps.

1. Remove the radio top and bottom covers.
2. Remove the four screws (two on each side of the radio) that fasten the control head to the main radio chassis.
3. Carefully pull the control head from the radio chassis.
4. Remove the volume and channel selector knobs using the following procedure.

   - Wrap each knob with foam to protect it.
   - A small vice should be used to firmly grip each knob (one at a time).
   - Pull firmly on the control head to separate the knob from its shaft.

5. Remove the nuts and knurled washers exposed by the removal of the two knobs mentioned above (on the front of the display panel).
6. The control head microcomputer board must now be removed. (This will allow access to the display board.) The previous section describes the required steps. Note that some of the steps have already been performed.
7. Microcomputer board removal exposes two screws that fasten the adapter sleeve to the control head. Remove these two screws.
8. Swing the adapter sleeve away from the control head so that it unlatches from its other two points of attachment.
9. The adapter sleeve may now be removed by moving the microcomputer board diagonally through the adapter sleeve opening.
10. Remove the five screws that hold the display board in the front housing.

NOTE

Hold the control head face down when removing the display board so that the front panel buttons won't fall out and get lost. Also, part of the button mechanism may stick to the display board. This part should be replaced in its proper position behind the light pipes in the control head.

11. With the control head face down, the display board may be carefully removed from the front housing.

CAUTION

Take care not to touch the black carbon pads behind the rubber membranes of the button mechanism. Also , do not touch the gold plated etching on the surface of the display board.

12. The display board is replaced by reversing the above steps.

3.5.9 COMMAND BOARD

To replace the Command Board, perform the following steps.

1. Remove the top cover and the two screws holding the command board in the casting.

2. Use the pull string to carefully lift the command board straight up from the casting. Care should be taken to avoid bending the connector pins of the two connectors mounted on this board.

3. To replace this board , reverse the above steps.

3.5.10 ANALOG INTERFACE BOARD

To replace the Analog Interface Board, perform the following steps.

1. Remove the command board first. See section preceeding.The analog interface board is located underneath the command board.

2. Remove the plug attached to the analog interface board.

3. Remove the four screws that hold the analog interface board in the casting.Note that one of these four screws passes through the 5 volt regulator.

4. The board may now be lifted from its position. Take care not to bend the pins of the connector that attaches this board to the front panel interconnect board.

5. This board is replaced by reversing the above steps.

3.5.11 REMOTE INTERFACE BOARD

To replace the Remote Interface Board, perform the following steps.

1. Remove the top and bottom covers.

2. Remove the four screws (two on each side) that attach the radio remote transciever front cover to the main chassis casting.

3. The remote transciever front cover (including the attached Remote Interface board) may now be pulled from the main chassis casting.

4. To remove the Remote Interface board from the front cover, the following six screws must be removed; two screws that fasten the Remote Interface board to the front cover, two screws holding the remote cable jack and two screws (inside the front cover) that fasten the two transistors to the front cover.

5. This board is replaced by reversing the above steps.

3.5.12 FRONT PANEL INTERCONNECT BOARD

This board is soldered to the power interconnect board and cannot be easily removed.

The following boards plug into the front panel interconnect board:

- Main board
- Command board
- analog interface board
- synthesizer board
- Remote interface board (on remote mount models)
- Dash mount control head microcomputer board (on dash mount models)

Removing the boards mentioned above will leave the Front Panel Interconnect board fully exposed within the main chassis casting.

3.6 TRANSMITTER ALIGNMENT

The transmitter of the MCX1000 Radio should be aligned before the receiver. The procedures below should be performed in the sequence shown.

- transmitter alignment
- oscillator frequency adjustment
- deviation adjustment

Refer to Figure 3-6 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.

3.6.1 POWER LEVEL ADJUSTMENT

NOTES

1. Key the radio only while making an adjustment.
2. The adjustments should be performed with a "receive" supply voltage of 13.8 volts and a "transmit" supply voltage of 13.6 volts.

1. Preset R236 (voltage limit potentiometer) by turning it fully clockwise. Preset R245 (power adjust potentiometer) by turning it fully counterclockwise.

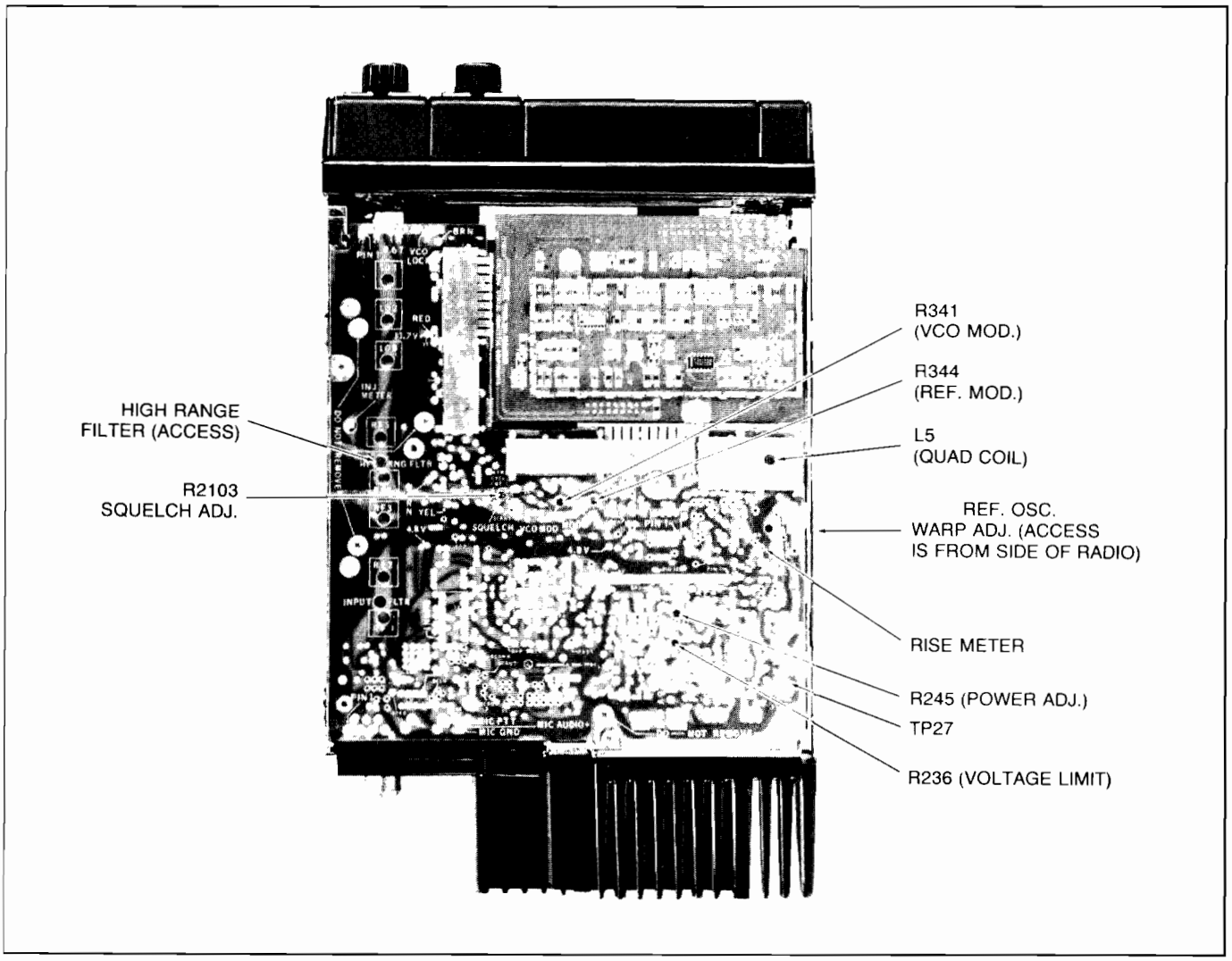


Figure 3-6 MCX1000 Radio Alignment Test Points

2. Select any transmit mode. Key the radio and adjust R245 (power adjust potentiometer) for a power level of 40 Watts (in Canada set power level at 31 Watts) at a voltage of 13.6 volts.

3. Switch through all the transmit modes and record the mode which gives the minimum power level.

4. Switch through all the transmit modes while observing the dc voltage indication at TP27 (P351-2). Record the voltage level and mode for the mode that gives the highest voltage level. If this voltage level is greater than 10 V dc, proceed to Step 8; do not perform Steps 5,6 and 7.

5. On the mode with the highest voltage level found in Step 4, 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 models. In this case , reduce the radio power supply voltage (not lower than 10.8 Vdc) while monitoring TP27, until a voltage level approximately 3 volts higher than the voltage recorded in Step 4 is obtained.

6. Adjust R236 for a dc voltage level that is 2 volts higher than the level recorded in Step 4.

7. Reset power supply voltage to 13.6 volts (if necessary).

8. Switch to the mode that was determined in Step 3. and repeat Step 2. on this mode.

9. Verify that all the transmit modes now have the proper output power level.

3.6.2 OSCILLATOR FREQUENCY ADJUSTMENT

CAUTION

Make sure the radio antenna connector (J300) is terminated into 50 ohms.

1. Insert a Diagnostic Test Plug (part # 0180358A54) into the microphone jack on the Control Head.

2. Enter the diagnostic mode by switching the radio from "off" to "on".

3. Press the DIM button repeatedly until the word "RADIOTST" shows in the Control Head display.

4. Remove the Diagnostic Test Plug and plug the microphone into the microphone jack.

5. Press the PROG (program) button once. The radio beeps to indicate it is in the Radio Diagnostic mode and the radio display shows (for a 3 second period) the current version number of the radio software.

6. Push the Monitor button repeatedly until the display shows the phrase "PL OFF"

7. Set the mode selector switch to channel 1 and key the transmitter to transmit an unmodulated carrier.

8. Adjust reference oscillator (channel element) warp adjustment (see Figure 3-6) until the proper frequency indication ± 100 Hz is obtained.

NOTE

If step 8. cannot be performed due to insufficient transmitter power output, perform steps 1 and 2 of section 3.6.1.

9. Set the mode selector switch to mode 2 and check the transmit frequency.

10. Repeat the procedure until all the modes have been checked.

11. Reset the radio by turning it off and then on again.

3.6.3 DEVIATION ADJUSTMENT

NOTE

It is important that deviation be checked on all the transmit modes to ensure that no over-deviation occurs on any mode.

If the radio to be adjusted has voice encryption capability, make sure that deviation adjustments are made in clear mode unless specified otherwise.

1. Set the mode selector switch to any available PL/DPL mode on the radio set. If the radio has selectable PL/DPL, select a PL/DPL code. If the radio has no PL/DPL programmed into it whatsoever, then select any mode.

2. Preset R344 (REF MOD potentiometer) to mid-position.

   Refer to Figure 3-6 for the location of adjustment points.

3. Connect the audio oscillator output leads to the microphone audio input, as explained below:
   -hot lead to J4200-6
   -ground lead to J4200-3

4. Set the audio oscillator to 1000 Hz and adjust its output level to 800 mVrms.

5. Using the appropriate rf load, key the transmitter and observe the deviation level. Readjust audio oscillator level per Step 4. if necessary.

6. Adjust R341 (VCO MOD potentiometer) until a 4.8 KHz deviation is obtained.

7. Set the radio set to the other transmit modes and record the deviation level obtained on each. Make a note of the mode having the highest deviation level. If more than one mode produces the same maximum deviation level, note the mode with the highest frequency among those having the maximum deviation level.

8. Set the radio to the mode noted in Step 7. Adjust R341 (VCO MOD potentiometer) to obtain a 4.8 KHz deviation.

9. Disconnect the audio oscillator. Proceed to Step 10.

10. Insert a Diagnostic Test Plug (part # 0180358A54) into the microphone jack on the control head.

11. Enter the diagnostic mode by switching the radio from off to on.

12. Press the DIM button repeatedly until the word "RADIOTST" shows in the control head display.

13. Remove the Diagnostic Test Plug and plug the microphone into the microphone jack.

14. Press the PROG (program) button once. The radio beeps to indicate it is in the Radio Diagnostic Mode and the radio display shows (for a 3 second period) the current version number of the radio software.

15. Push the monitor button repeatedly until the display shows the phrase "TX DPL"

16. Connect a direct-coupled input lead of an oscilloscope to the digital output of a standard test receiver. Adjust the REF MOD potentiometer (R344) until the best eye pattern symmetry is obtained. Refer to Figure 3-7. Check all other modes equipped with DPL and verify that all the eye patterns are similar.

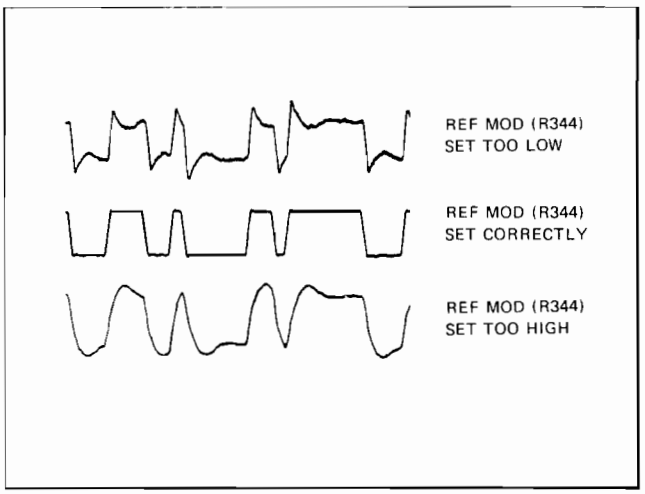


Figure 3-7 Examples of "Eye Pattern" Symmetry

17. Reset the radio by turning it off and then on again.

18. Repeat Step 3. and Steps 8. through 17.

19 Check the deviation level on all transmit modes and verify that it does not exceed 5.0 KHz.

3.6.4 ADDITIONAL DEVIATION ADJUSTMENT FOR ENCRYPTED RADIOS

The following procedure applies to digital radios equipped for voice encryption operation.

Perform the following deviation adjustment steps only after the deviation adjustment steps of the previous section (Section 3.6.3) have been completed.

1. Set the radio to the mode that has the highest deviation in clear mode operation. Use the mode noted in Step 7. of the previous section.

2. Press the Clear/Coded Select Button to place the radio into the encrypted mode of operation (the Clear/Coded Indicator LED lights).

3. Press the PTT button on the mic, while monitoring the deviation.

4. Adjust resistor R6109 on the Securenet Option Board for 4.0 kHz deviation. This resistor is accessed by removing the top cover of the radio. It is mounted at the upper edge of the Securenet Option Board.

5. Check the deviation level on all transmit modes and verify that it is between 3.4 and 4.4 kHz. Readjust R6109 if required.

3.7 RECEIVER ALIGNMENT

Receiver alignment should be performed after transmitter alignment is complete.

Several different RF front ends are available for the MCX1000 Radio, depending on the frequency of the radio and the type of front end used in the radio (dual front end or single front end). Section 3.7.1 describes the dual front end alignment procedures while Sections 3.7.2 and 3.7.3 describe the single front end alignment procedures.

3.7.1 WIDESPACE DUAL FRONT END ALIGNMENT

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) are covered with a strip of tape (refer to figure 3-8.). These coils are set at the factory during assembly and **MUST NOT BE FIELD ADJUSTED**. If a replace-ment rf deck is purchased from Motorola,

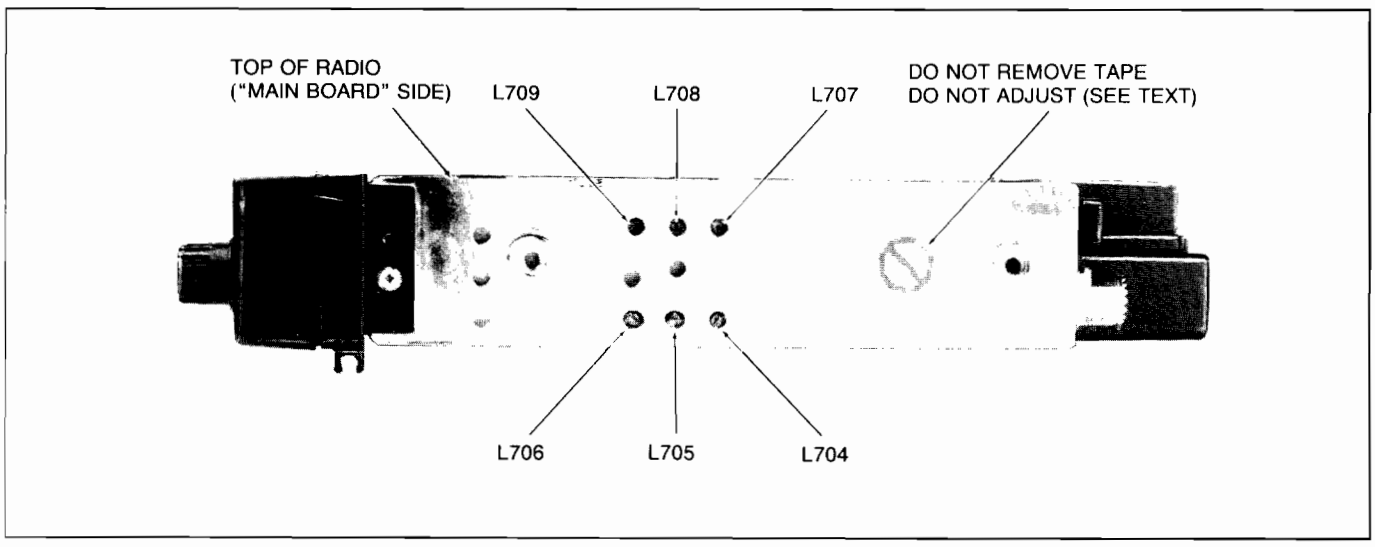


Figure 3-8 Widespace Dual Front End Alignment Points

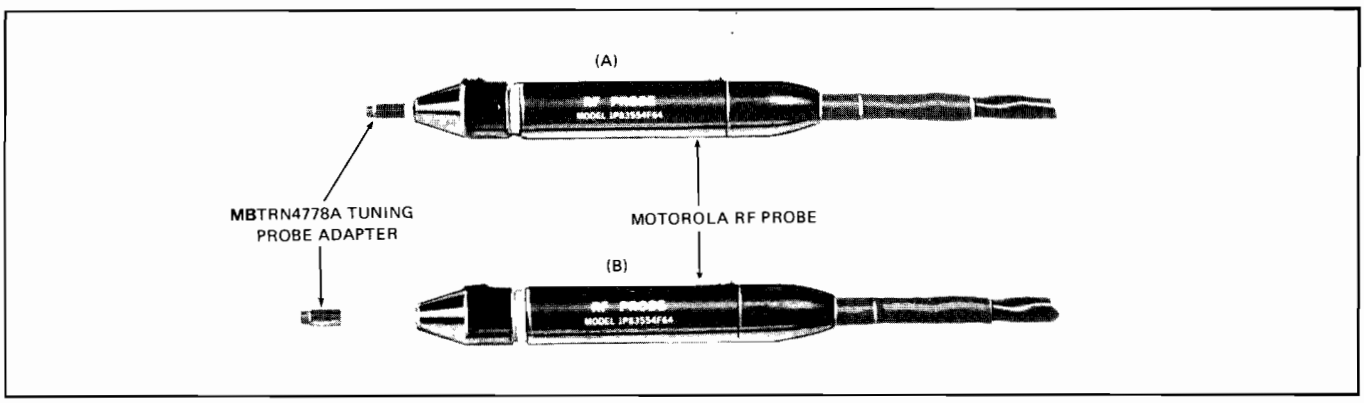


Figure 3-9 MCX1000 Alignment Probe
(A) RF Probe with Tuning Adapter in Position
(B) RF Probe and Tuning Adapter Separated

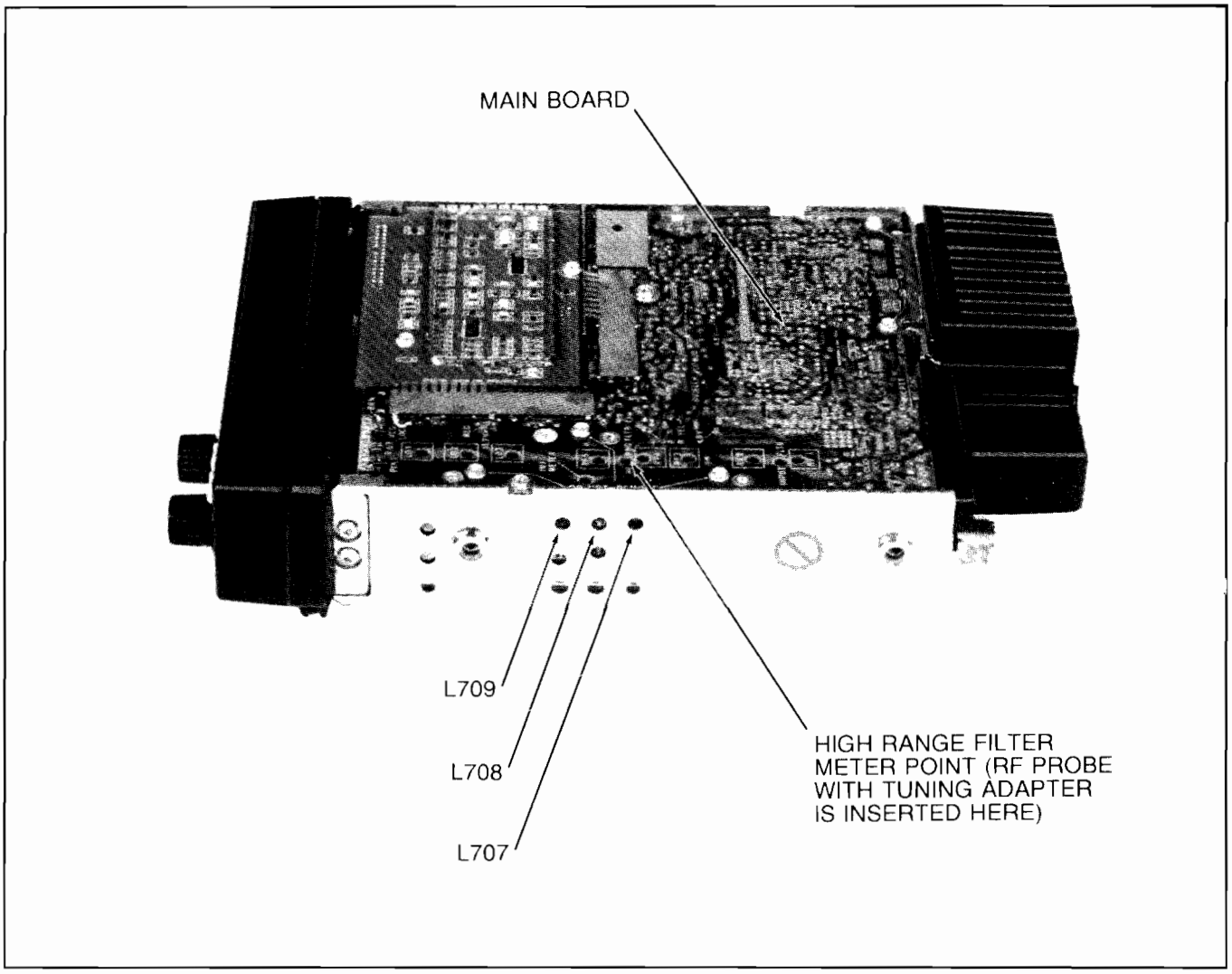


Figure 3-10 Main Board Side Tuning Probe Position (High Range)

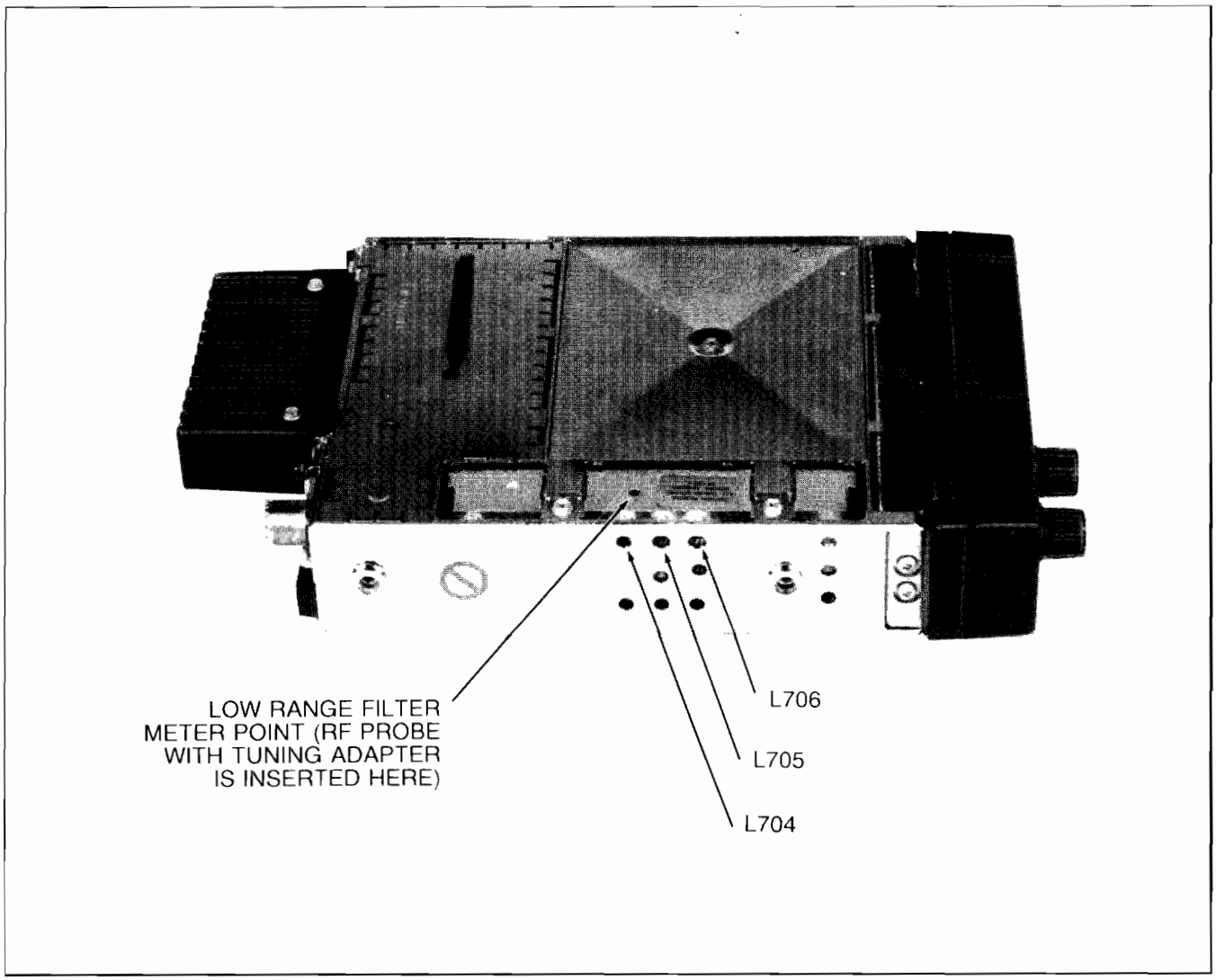


Figure 3-11 Synthesizer Side Tuning Probe Position (Low Range)

these coils will be preset by the factory. There should never be any reason to readjust these coils.

1A. (Range 1 radios only) Carefully turn the slugs of coils L704, L705, L706, L707, L708 and L709 (Figure 3-8) counterclockwise until the adjusting screws just protrude from the radio chassis wall.

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.

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. Tune-up frequencies may also be determined by using the Radio Service Programmer.

3. Set the mode selector switch to any mode programmed into the radio.

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 test equipment list), or a 2-ohm resister.

5. Depress the squelch button and the monitor button (if used) so that noise is heard in the

speaker (if one is used).

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.

7. Adjust L5 (quad coil) (Figure 3-6) until a maximum noise level is obtained from the speaker, or the highest reading is obtained on the voltmeter.

8. To tune the high filter: Set the rf generator to the high range tune-up frequency at an rf level of -20 dBm, and set the mode selector of the radio to the *highest receive operating frequency*.

9. Press the tuning probe adapter (Motorola # MBTRN4778) onto the probe of the rf voltmeter as shown in Figure 3-9.

10. Place the radio into the position shown in Figure 3-10. and insert the test probe adapter tip through the hole in the main board and into the tuning hole of the first cavity (L707) of the high range switched filter.

11. Hold 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.

12. Hold the probe in position and turn L708 in the same direction (turned in Step 11) until a dip in the voltmeter reading is obtained.

13. Hold the probe in position and turn L709 in the same direction (turned in Step 11) until a peak in the voltmeter reading is obtained. The high range switched filter is now tuned.

14. To tune the low filter: Set the signal generator to the low range tune-up frequency at an rf level of -20 dBm, and the mode selector switch to the *lowest receive operating frequency*.

15. Place the radio in the position shown in Figure 3-11 and place the test probe adapter tip into the hole of the first cavity (L704) of the low range switched filter.

16. Hold 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.

17. Hold the probe in position and turn L705 in the same direction (turned in Step 16) until a dip in the voltmeter reading is obtained.

18. Hold the probe in position and turn L706 in the same direction (turned in Step 16) until a peak in the voltmeter reading is obtained. Both switched filters are now tuned. Continue with the Receiver Adjustment in Section 3.7.4.

3.7.2 SINGLE FRONT END ALIGNMENT

This procedure is to be used when maximum receive frequency separation does not exceed 4 MHz. (See Section 3.7.3 for alternate tuning procedures.)

1. Preset the tuning slugs of coils RF1, RF2, RF3, RF4 and RF5 clockwise until they reach the top of the coil forms. (See Figure 3-12 for coil positions.)

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.

3. Determine the tuneup frequency as follows:
-for single mode radios; $F_{tune} = F_{receive}$
-for multi-mode radios; determine F_{mid} by using the formula $F_{mid} = (F_{max} + F_{min})/2$.

NOTE

If there are receive frequencies within plus or minus 0.5 MHz of F_{mid}, the tuneup should be performed on the receive frequency closest to F_{mid}. If the two nearest frequencies are symetrically located above and below F_{mid}, use the lower frequency. If there are no frequencies within plus or minus 0.5 MHz of F_{mid}, check the frequency separation. If separation does not exceed 2 MHz, F_{tune} is the closest frequency above F_{mid}. If separation exceeds 2 MHz, the alternate tuneup procedure described in Section 3.7.3 must be used.

4. Set the mode selector switch to the proper frequency as determined in the preceding step.

5. Connect a 2 ohm, 5 watt load to the radio speaker output terminals, and connect an AC voltmeter across this load. Polarity is important: J350-9 is hot, J350-8 is ground.

6. Depress the squelch button to disable the carrier squelch feature of the radio.

7. With no rf input to the radio, adjust the volume control for 1.0 volt rms of noise across the load.

8. Adjust L5 (quad coil) for maximum noise level, readjusting the volume control as required to maintain 1.0 volt rms of noise. This adjustment is not critical at this time as the quad coil will be repeaked later.

9. Set the slugs of L01, L02, L03, RF1, RF2, RF3, RF4 and RF5 in accordance with the instructions provided in Figure 3-13, Coil Adjustment Chart.

10. Connect a high input impedance DC voltmeter to the INJ METER point (see Figure 3-12 for location) 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 VDC) is obtained. Repeat the step until no further increase in DC voltage level can be obtained.

11. 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 point (see Figure 3-12) 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 below saturation level of the rise meter during tuneup (typical 2.5 - 3.5 V). Repeat the step until no further increase in DC voltage level can be obtained.

12. Set the signal generator to provide a 1 mV rf output modulated with a 1 KHz sine wave set to produce 60% of full system deviation (60% of 5 KHz = 3 KHz). With the volume control set for 1 V rms across the 2 ohm load, very slowly tune L5 (quad coil) for maximum audio output. This adjustment completes the rf deck alignment. Continue with the adjustments in Section 3.7.4.

3.7.3 SINGLE FRONT END ALIGNMENT (ALTERNATE PROCEDURE)

This procedure is to be used when there are no receive frequencies within plus or minus 0.5 MHz of F_{mid} (where $F_{mid} = (F_{max} + F_{min})/2$) and channel separation ($F_{max} - F_{min}$) exceeds 2 MHz but not 4 MHz.

1. Preset the tuning slugs of coils RF1, RF2, RF3, RF4 and RF5 clockwise until they reach the top of the coil forms. (See Figure 3-12 for coil positions.)

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.

3. Connect a 2 ohm, 5 watt load to the radio speaker output terminals, and connect an AC voltmeter across this load. Polarity is important: J350-9 is hot, J350-8 is ground.

4. Depress the squelch button to disable the carrier squelch feature of the radio.

5. With no rf input to the radio, adjust the volume control for 1.0 volt rms of noise across the load.

6. Adjust L5 (quad coil) for maximum noise level, readjusting the volume control as required to maintain 1.0 volt rms of noise. This adjustment is not critical at this time as the quad coil will be repeaked later.

7. Set the slugs of L01, L02, L03, RF1, RF2, RF3, RF4 and RF5 in accordance with the instructions provided in Figure 3-13, Coil Adjustment Chart.

8. Select the mode with the lowest receive frequency.

9. Connect a high input impedance DC voltmeter to the INJ METER point (see Figure 3-12 for location) and set it to a low DC voltage range.

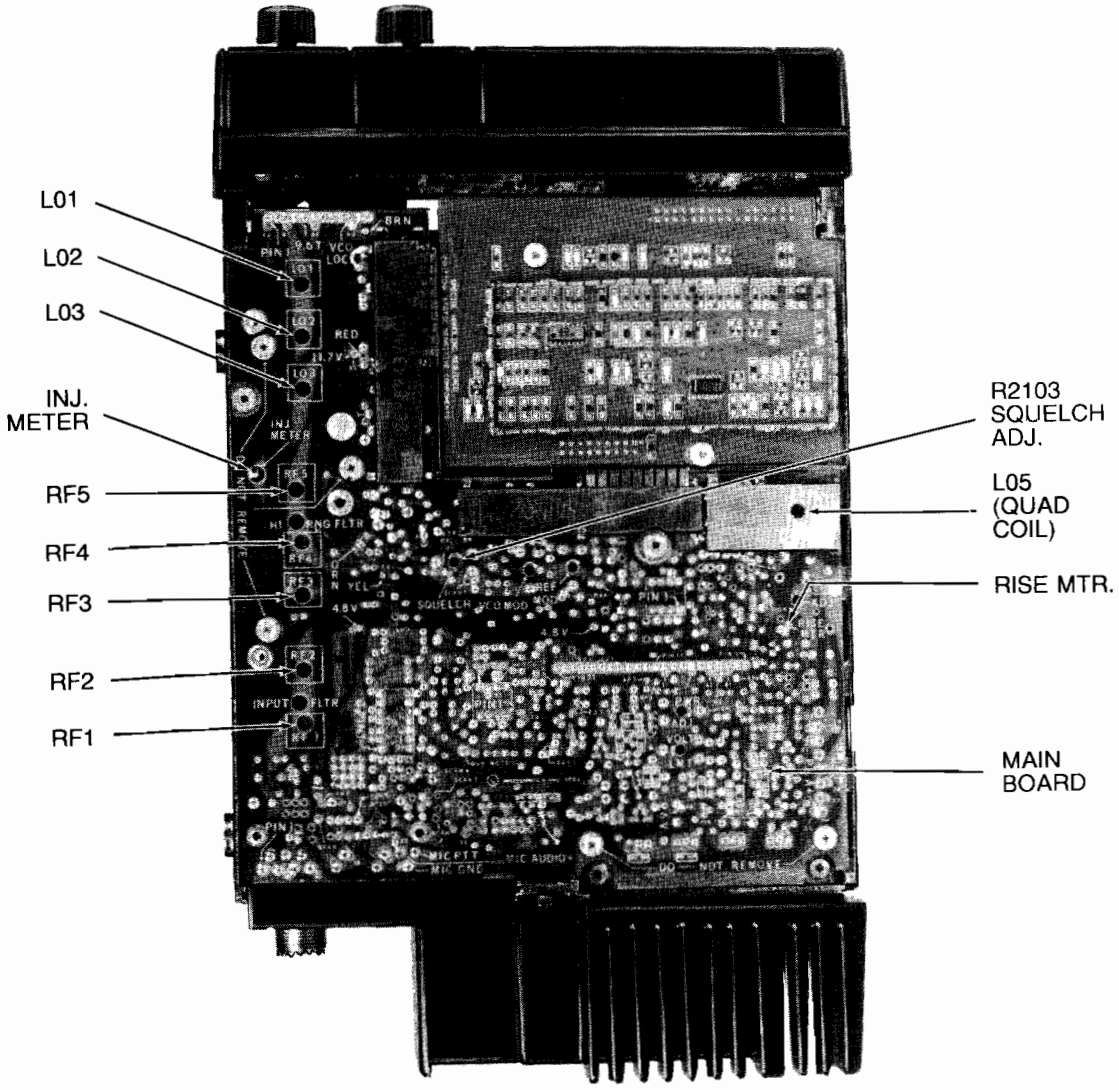


Figure 3-12 MCX1000 Single Front End Alignment Points

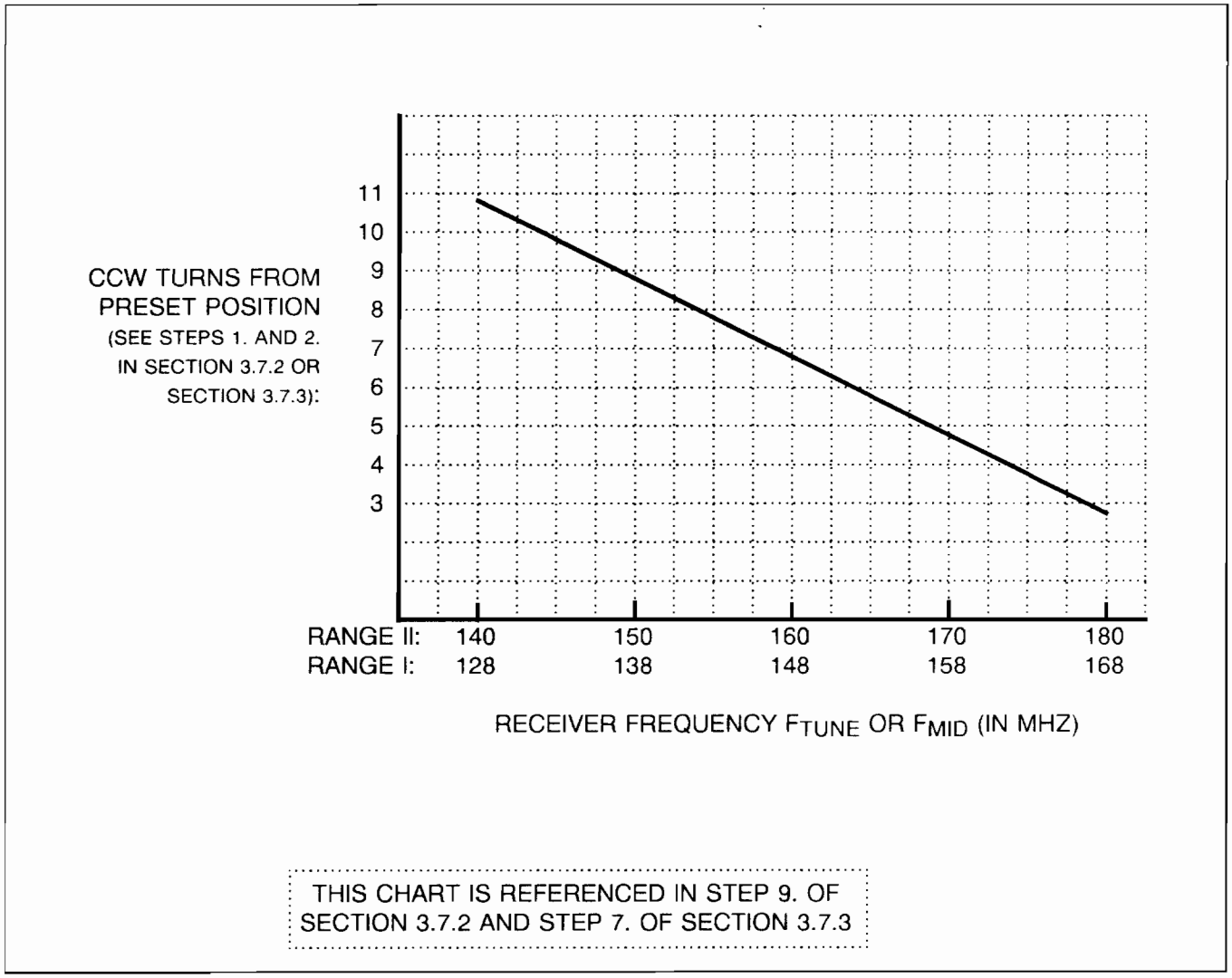


Figure 3-13 MCX1000 Single Front End Coil Adjustment Chart

Adjust coils L02, L01 and L03 (in this order) until a maximum DC voltage level (typically between 2.1 and 3.5 VDC) is obtained. Repeat the step until no further increase in DC voltage level can be obtained.

10. Connect a signal generator to the antenna connector of the receiver and adjust the generator so that it will provide an on channel frequency (the lowest receive frequency of the radio) unmodulated signal that is sufficiently strong to quiet the receiver. Connect a DC voltmeter to the RISE MTR point (see Figure 3-12 for position) 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 below saturation level of the rise meter during tuneup (typical 2.5-3.5 V). Repeat the step until no further increase in DC voltage level can be obtained.

11. Select the mode with the highest receive frequency. Connect a DC voltmeter to the INJ METER point (see Figure 3-12 for location) and set it to a low DC voltage range. Noting the number of turns required, adjust L02, L01

and L03 in a clockwise direction (in this order) only once to obtain a maximum DC voltage indication with each coil. (Some coils may not require any change.)

12. Connect a DC voltmeter to the RISE MTR point. Connect a signal generator to the receiver and apply an on channel frequency (the highest receive frequency of the radio) unmodulated signal of sufficient strength to quiet the receiver. Noting the number of turns required, adjust coils RF1, RF2, RF3, RF4 and RF5 in a clockwise direction (in this order) only once to obtain a maximum DC voltage indication with each coil (typically between 2.5 and 3.5 VDC). (Some coils may not require change.) While performing the step, adjust the generator, as required, to maintain the DC voltage at the specified level (between 2.5 and 3.5 VDC).

13. For any coil whose position was changed while performing steps 11. and 12. , turn the coil in question counterclockwise half the number of turns recorded in steps 11. and 12.

14. Set the signal generator to provide a 1 mV RF output modulated with a 1 KHz sine wave set to produce 60% of full system deviation (60% of 5 KHz = 3 KHz). With the volume control set for 1 volt rms across the 2 ohm load, very slowly tune L5 (quad coil) for maximum audio output. This adjustment completes the rf deck alignment. Continue with the adjustments in Section 3.7.4.

3.7.4 RECEIVER ADJUSTMENT (SQUELCH)

The receiver adjustment is made after RF deck alignment is complete.

1. With no rf input, press the squelch/unsquelch button to squelch the radio.

2. Adjust the squelch trimmer R2103 fully counterclockwise (see Figure 3-12 for location).

3. Apply an on-frequency, 1 mv rf signal, modulated with 1 kHz at 3 kHz deviation.

4. Adjust the audio volume control for 5 watts (3.16 Vrms on a 2 ohm load).

5. Reduce the rf level until 10 db SINAD is obtained.

6. Adjust squelch trimmer R2103 so that the radio just stays unmuted.

7. Verify that the radio unsquelches on all modes within the limits of 9 db SINAD minimum and 11 db SINAD maximum.

NOTE: J352, J380, P356, P357
MUST BE ORIENTED AS SHOWN.

NOTE FOR PART NUMBER 40 ON THIS DIAGRAM,
TWO DIFFERENT ACCESSORY PLUGS ARE AVAILABLE
1. 7 PIN ACCESSORY PLUG (P350)
HOUSING: 1584193M01 (1 USED)
PIN: 0984151B03 (7 USED)
2. 5 PIN ACCESSORY PLUG
HOUSING: 1484590B01 (1 USED)
PIN: 0984151B03 (5 USED)

Figure 3-12
Radio Set
Exploded View
(Sheet 1)

parts list

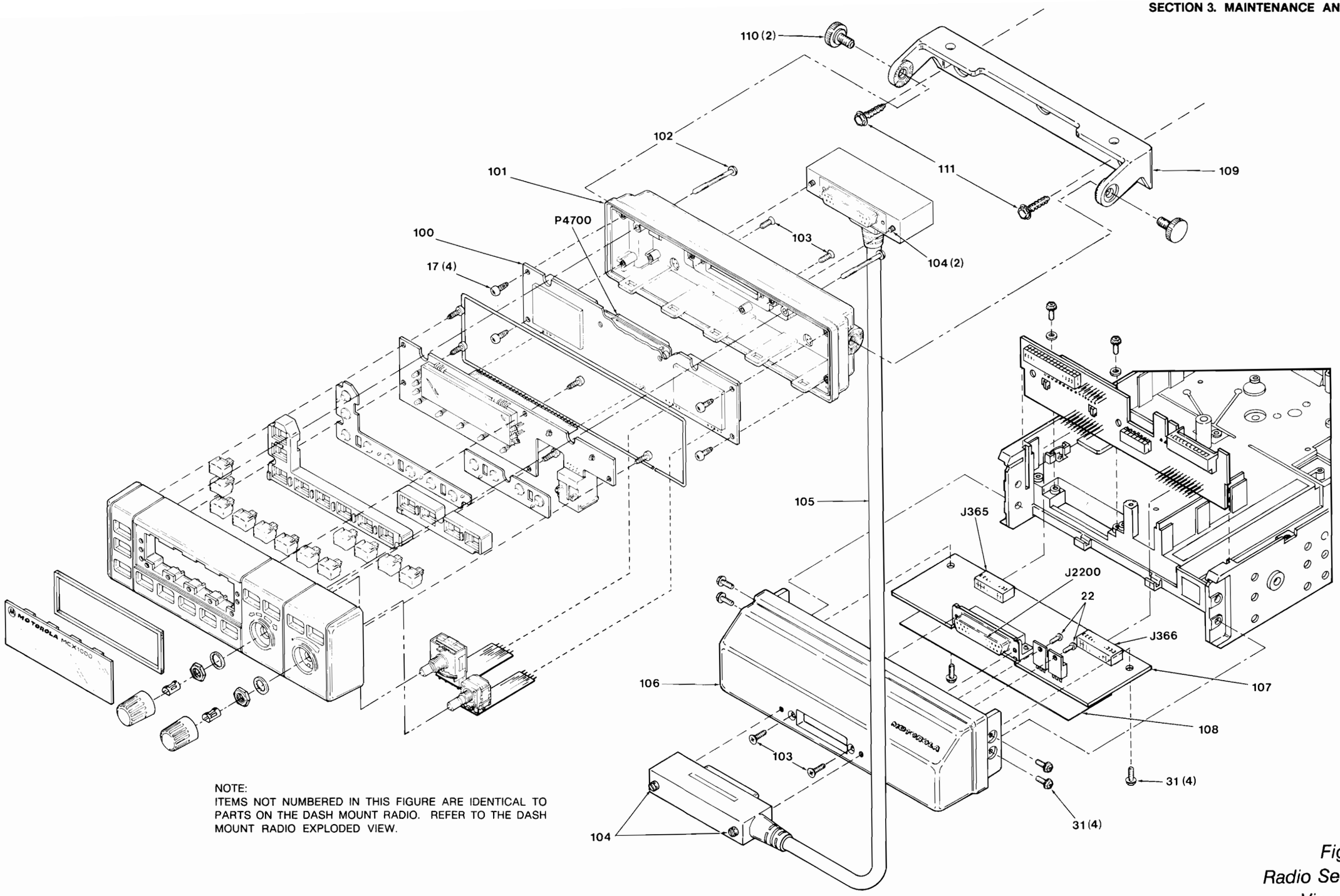
RADIO SET MECHNICAL PARTS (DASH MOUNT VERSION)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	6100018M01	LENS C/H B
2	3200044M01	GASKET LENS
3	3600017M01	KNOB VOLUME/CHANNEL SW (2 used)
3A		SPRING CLIP (P/O 3600017M01) (2 used)
4	284218M02	NUT, M9 X 0.75
5	484219M02	LOCKWASHER, #9 internal
6	284218M01	NUT, M7 X 0.75
7	484219M01	LOCKWASHER, #7 internal
8	1500331M01	PLASTIC HOUSING C/H FRONT
9	4000100M02	ROTARY SW 24 POS, 1 OF 3
10	1800028M01	POT, 2K-20-.05W linear
11		SEE FIGURE 3-13 (SHEET 2) FOR BUTTON PART NUMBERS
12	6100017M01	LIGHT PIPE "L" SHAPE
13	6100017M02	LIGHT PIPE STRAIGHT
14	7500029M01	SILICON KEYPAD L SHAPED
15	7500029M02	SILICON KEYPAD STRAIGHT
16		DISPLAY BOARD
17	0310945A11	SCRTPG P3.12X1.27X8 STARSLTPAN (5 used)
18	3280058H03	GASKET HOUSING
19	4300069M01	SLEEVE , DASH
20	0310907A20	SCRMCH M3X0.5X10 INTSTAR PAN (2 used)
21		DASH MOUNT C / H MICRO. BOARD
22	0310943J03	SCR M2.5X0.45X6 STL
	0400009761	WSHRLCK 4 INT STL CAD (2 used)
25	3084177M01	CABLE, solid coaxial
	and 2910208A08	EYELET, 2 used
26		BOARD, front panel interconnect
27	1484184M01	INSULATOR, option area
28		ANALOG INTERFACE BOARD
29	0482318N01	WASHER, flat synthesizer connector
30	384208M03	SCREW, M2.2 X 0.45 X 6.0
31	0310943J10	SCREW T.T M3.0-0.5X8
32		CABLE, assembly (refer to associated circuit board parts list)
33	0310943J10	SCREW, washer, M3 X 0.5 X 8.0
34	1484173M01	INSULATOR, top cover
35	1584175M01	COVER, top
36	0384208M12	SCREW, Phillips M4 X 0.7 X 9.0
37	4684135M01	GUIDE, printed circuit
38		BOARD, main
39	2684104M01	HEATSINK
40		J350 (refer to main board parts list)
41,42	0310943J10	SCREW, washer M3 X 0.5 X 8.0
43		BOARD, dual front end
44	1584143M01	HOUSING connector base dc
45	2984167M01	TERMINAL, round
45A	0284334M01	NUT, terminal M3
46	1584144M01	HOUSING, connector cover dc
47		BOARD, power interconnect
48	0310943J10	SCREW, washer M3 X 0.5 X 8.0
49	0384208M12	SCREW, Phillips M4 X 0.7 X 9.0
50	0310943J10	SCREW, washer M3 X 0.5 X 8.0
51	6484188M01	PLATE, feed-thru
52	2684142M01	HEATSINK (30 W)
53	0310943J10	SCREW, washer M3 X 0.5 X 8.0
54		HYBRID, 30 W PA
55	0310943J10	SCREW, washer M3X 0.5 X 8.0
56	0384208M04	SCREW, washer M2.5 X 0.45 X 8.0
57	1584141M01	COVER, heatsink
58	0982442E09	J300 CONNECTOR, antenna
59	2784061M01	CHASSIS
60	0310943J10	SCREW, washer M3 X 0.5 X 8.0
61		BOARD PA interconnect
62	2684102M01	SHIELD, wall transmitter
63	0310943J10	SCREW, washer M3 X 0.5 X 8.0
64	0384208M12	SCREW, Phillips M4 X 0.7 X 9.0
65	1584174M01	COVER, bottom
66		HYBRID, harmonic filter
67	2684176M01	SHIELD, PA
68	5584300B01	HANDLE
69		HYBRID, 10 W PA
70		HYBRID, low level amplifier
71	0310943J10	SCREW, washer M3 X 0.5 X 8.0
72		HYBRID, VCO
73	3284178M01	GASKET, rf (19 inches)
74	0310943J10	SCREW, washer M3 X 0.5 X 8.0
75	0384208M11	SCREW, washer M3.5 X 0.6 X 14.0
76	2684103M01	SHIELD, synthesizer (std lock models)
77	1584147M01	COVER, synthesizer
78	0310943J10	SCREW, washer M3 X 0.5 X 8.0
79		BOARD, synthesizer VHF
80	0310943J10	SCREW, washer M3 X 0.5 X 8.0
81	1484170M01	INSULATOR, synthesizer cover
82	4383779N01	INSERT, chassis plug
83	027003	NUT, 8-32 X 5/16 X 1/8"
84	7582200H03	PAD, 2 used
85	1484172M01	INSULATOR, power board
86	6484169M01	PLATE NUT, cover side; 4 used
87	6484168M01	PLATE NUT, cover rear; 3 used
88	4282604H01	CLIP, transistor
89	1484171M01	INSULATOR
90	1582221N01	COVER, connector (microphone)
91	1582222N01	COVER, connector (accessory)
92	3284178M01	GASKET, rf (11.6 inches)
93	3284178M01	GASKET; rf (8.3 inches)
94		BOARD, synthesizer rf amplifier (Fast-Lok models)
95		MDC600/1200 FILTER BOARD
96	4300070M01	STANDOFF , PLASTIC (2 used)
97		COMMAND BOARD
98	7582200H01/03	PAD, FOIL
99	0310943J03	SCREW T.T M2.5-0.45X6.0

RADIO SET MECHNICAL PARTS (REMOTE MOUNT VERSION)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
17	0310945A11	SCR TPG P3.12X1.27X8 STAR SLT PAN
22	0310943J03	SCR M2.5X0.45X6 STL
31	0310943J10	SCREW TT M3.0-0.5X8
100		REMOTE MOUNT C / H MICRO. BOARD
101	1500332M01	PLASTIC HOUSING C / H BACK
102	0300039M01	SCREW, CAPTIVE (2 used)
103	0300140295	
	or 0300140143	SCR MCH 4-40X1/2 STARFLT STL (2 used)
104	0300038M01	CAPTIVE SCREW (2 used)
105	3000053M01	17 FT. REM. CONTROL CABLE
106	6400247M01	REMOTE RADIO FRONT COVER
107		REMOTE INTERFACE BOARD
108	1482125N02	FRONT PANEL INSULATOR
109	0784891M01	BRACKET, TRUNNION
110	180761D701	CONTROL HEAD MOUNTING KNOB
111	03140147 or	SCREW, TPG 10-32 X 3/4
	03140148	SCREW, TPG 10-32 X 1-1/2

Figure 3-12
Radio Set Exploded View
(Sheet 2)



NOTE:
ITEMS NOT NUMBERED IN THIS FIGURE ARE IDENTICAL TO PARTS ON THE DASH MOUNT RADIO. REFER TO THE DASH MOUNT RADIO EXPLODED VIEW.

Figure 3-12
Radio Set Exploded View (Sheet 3)

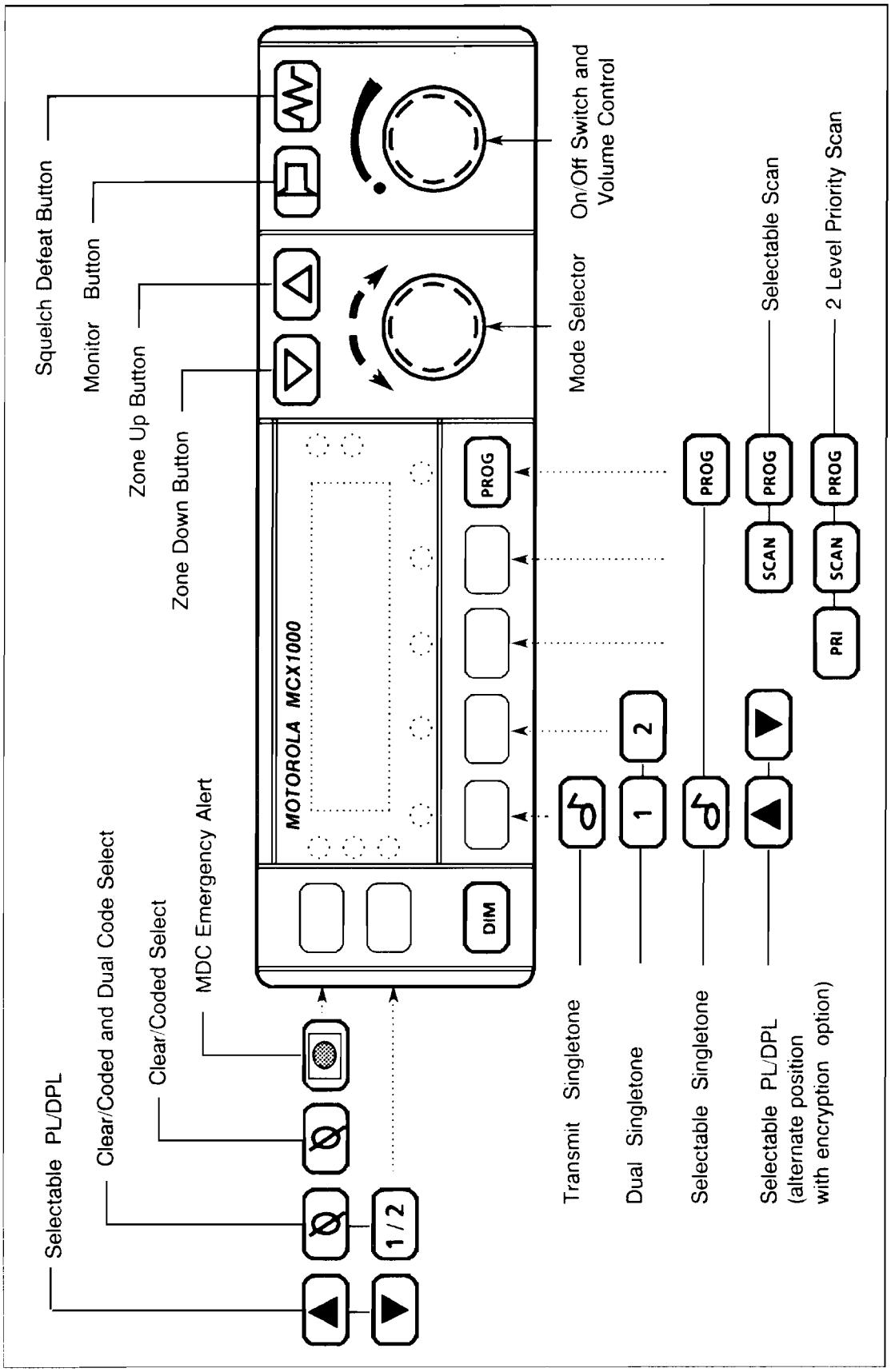


Figure 3-13 MCX1000 Control Head Button Placement (Sheet 1)

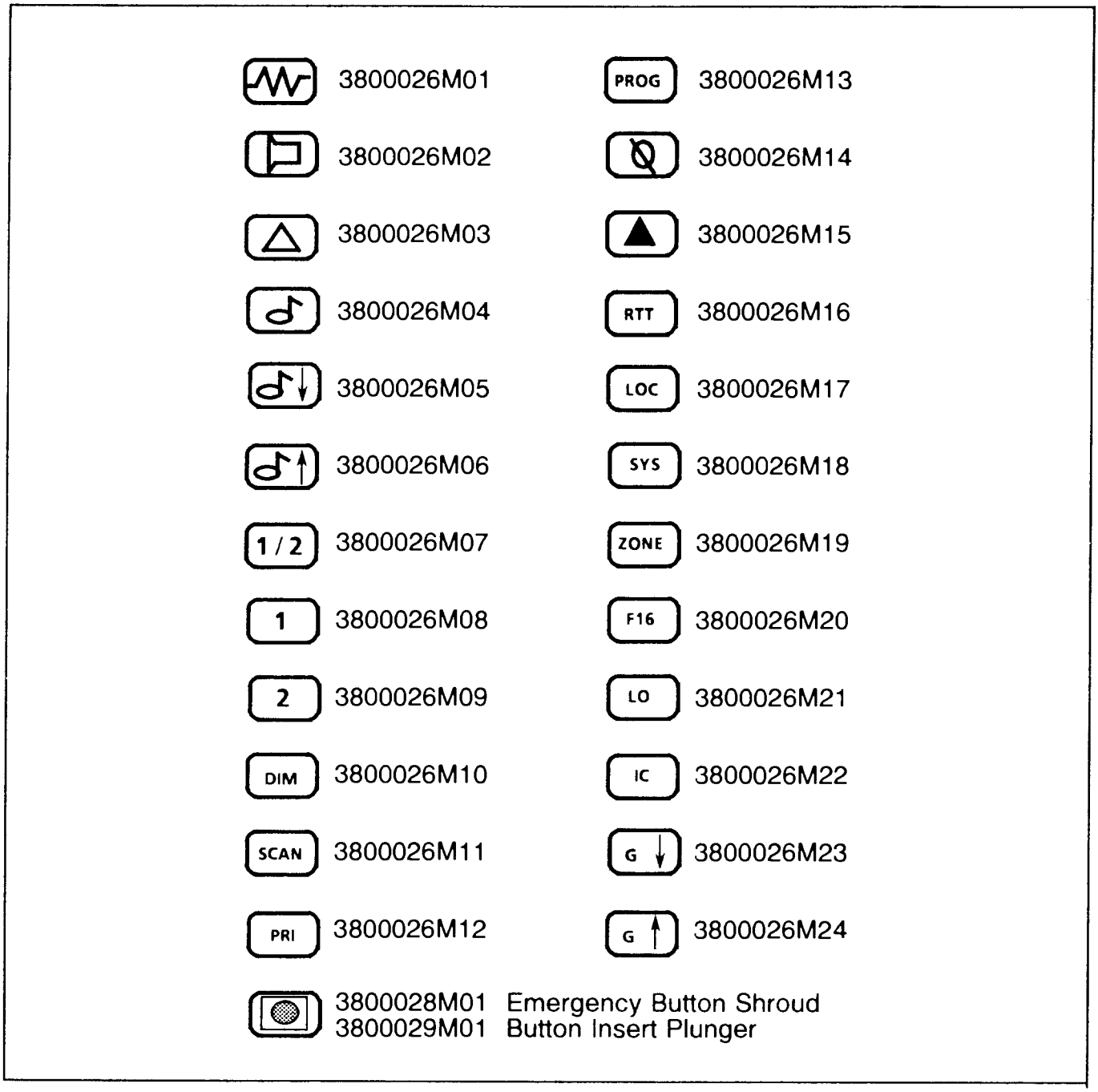


Figure 3-13 MCX1000 Control Head Button Placement (Sheet 2)

END OF SECTION 3

MOTOROLA LIMITED
Communications Division

SECTION 4. RADIO FUNCTIONAL BLOCK DIAGRAMS AND CABLE KITS

4.1 RADIO FUNCTIONAL BLOCK DIAGRAM

The overall radio functional block diagram is shown in Figure 4-1. Note that the following blocks are detailed in other sections of this manual :

- Section 5. Control Head

In Section 5 of this manual, the Control Head Functional Block Diagram contains information on the boards listed below.

-Display Board
-Dash or Remote Mount Microcomputer Board

- Section 6. Radio Microcomputer System

In Section 6 of this manual, the Radio Microcomputer System Functional Block Diagram contains information on the boards listed below.

-Command Board
-Analog Interface Board
-Front Panel Interconnect Board
-Remote Mount Interface Board (remote mount models only)
-MDC600 / 1200 Filter Board (used only with MDC600 / 1200 Signalling option)

- Section 7. Synthesizer and VCO

In Section 7 of this manual, the two Synthesizer and VCO Functional Block Diagrams (for standard and Fast-Lok synthesizers) contain information on the boards listed below.

-Synthesizer Board
-VCO Assembly (sealed unit, not field repairable)

4.2 AUDIO BLOCK DIAGRAMS

Receiver Audio Block Diagram

Figure 4-2 Receiver Audio Block Diagram indicates the audio path (both voice and data information) for the MCX1000 Radio Set in receive mode.

Transmitter Audio Block Diagram

Figure 4-3 Transmitter Audio Block Diagram indicates the audio path (both voice and data information) for the MCX1000 Radio Set in transmit mode.

4.3 CABLING DIAGRAMS

Remote Control Head Cable

Figure 4-4 shows the schematic diagram of the MCX1000 Radio Set Remote Control Head Cable (used only in the remote mount radio) to connect the Control Head to the main radio chassis.

Radio Internal Cable

Figure 4-5 shows the schematic diagram of the MCX1000 Radio Set Internal Cable.

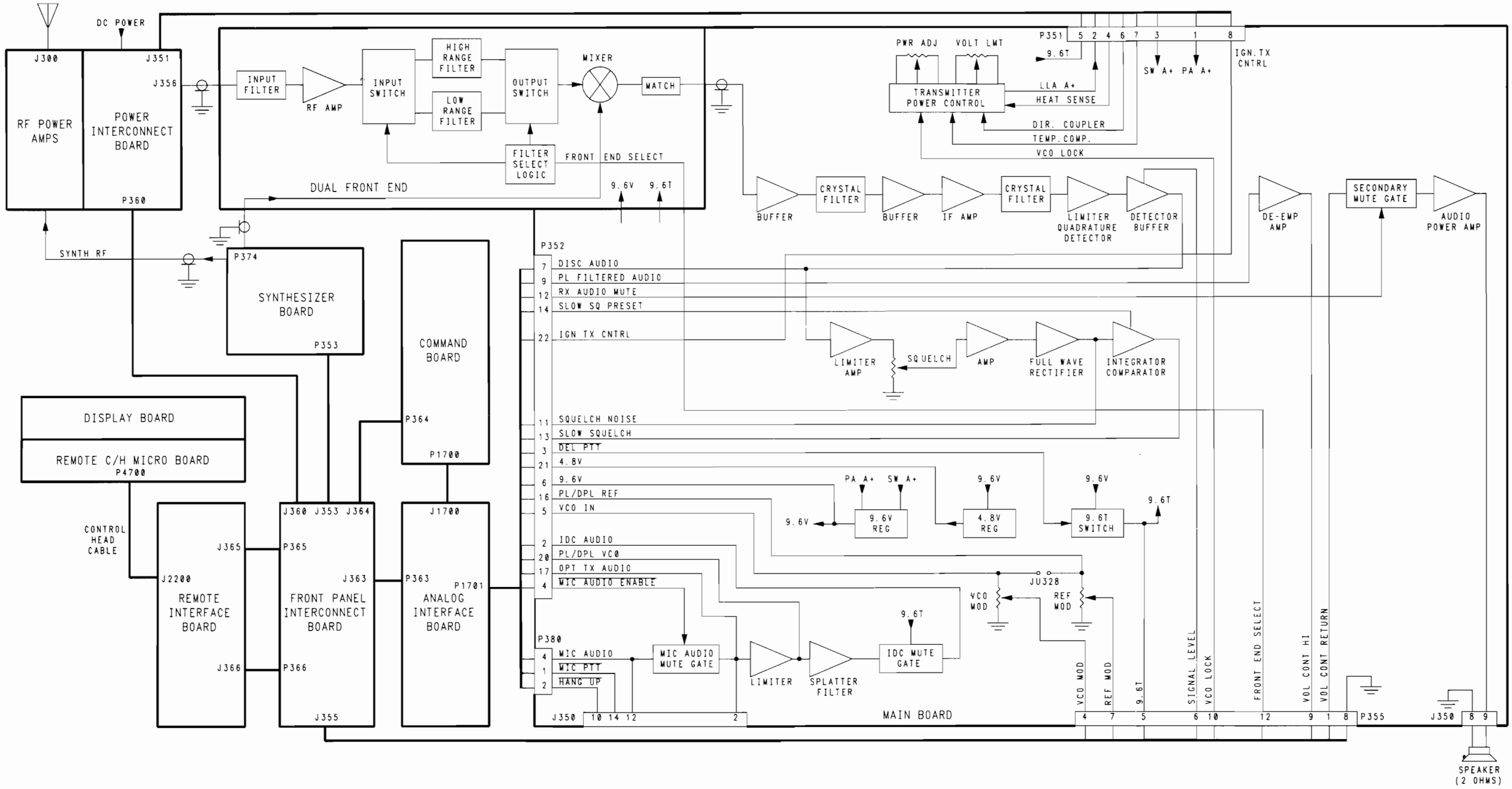


Figure 4-1
Radio Functional Block Diagram (Sheet 1.)

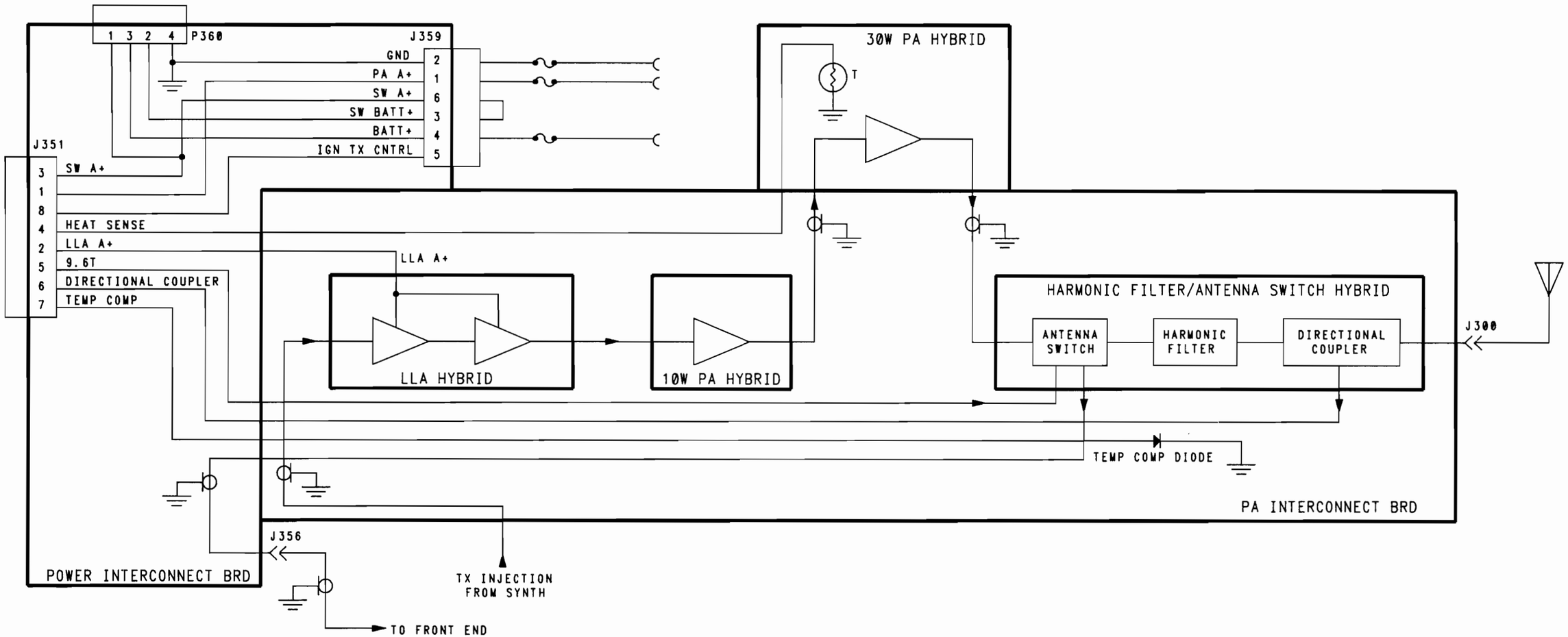


Figure 4-1
Radio Functional Block Diagram (Sheet 2.)
(Power Amplifier Section)

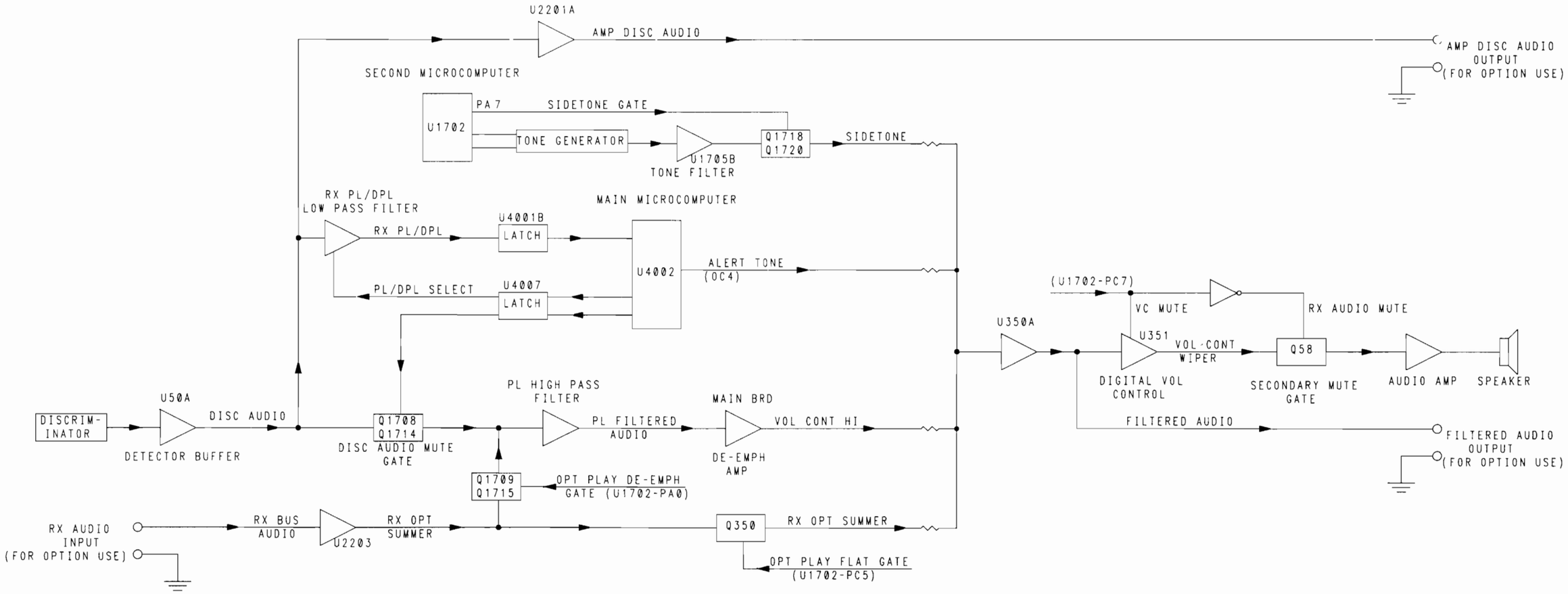


Figure 4-2
Receiver Audio Block Diagram

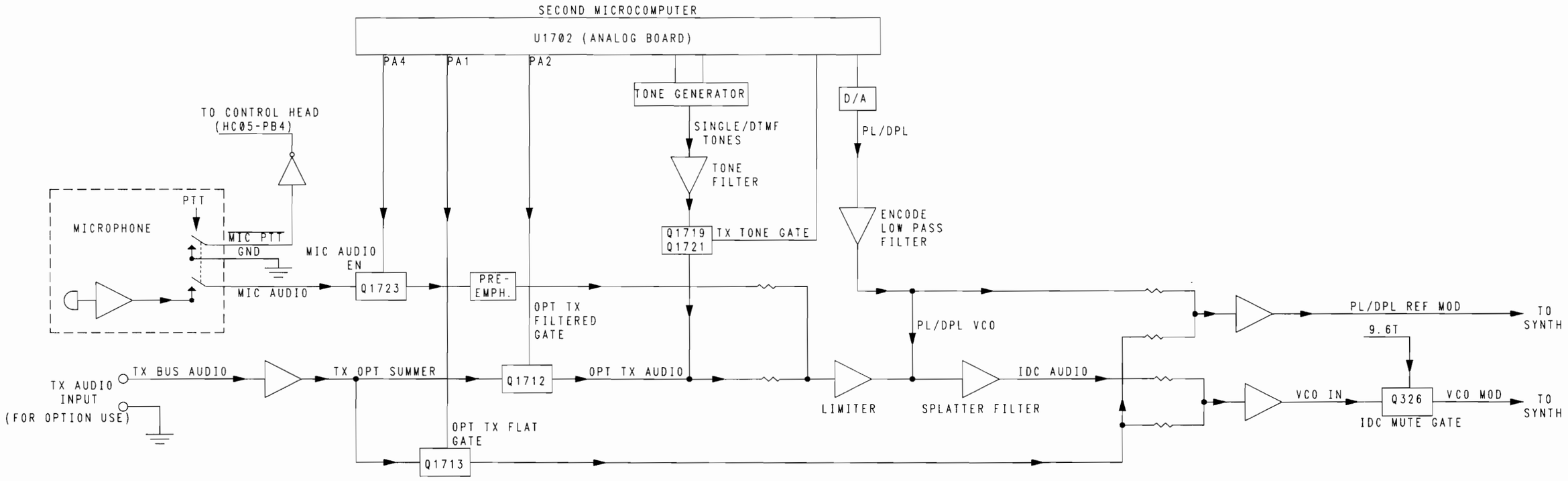
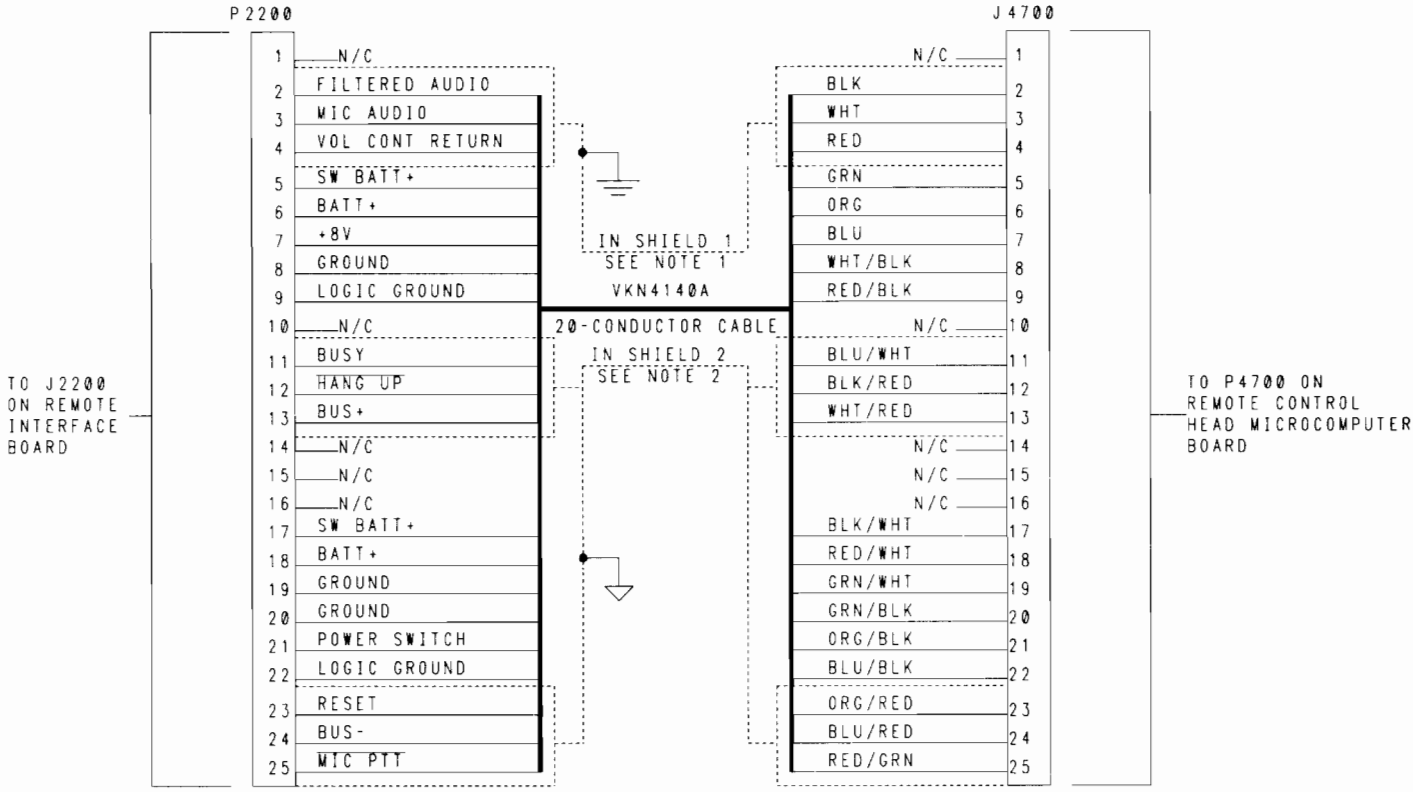


Figure 4-3
Transmitter Audio Block Diagram



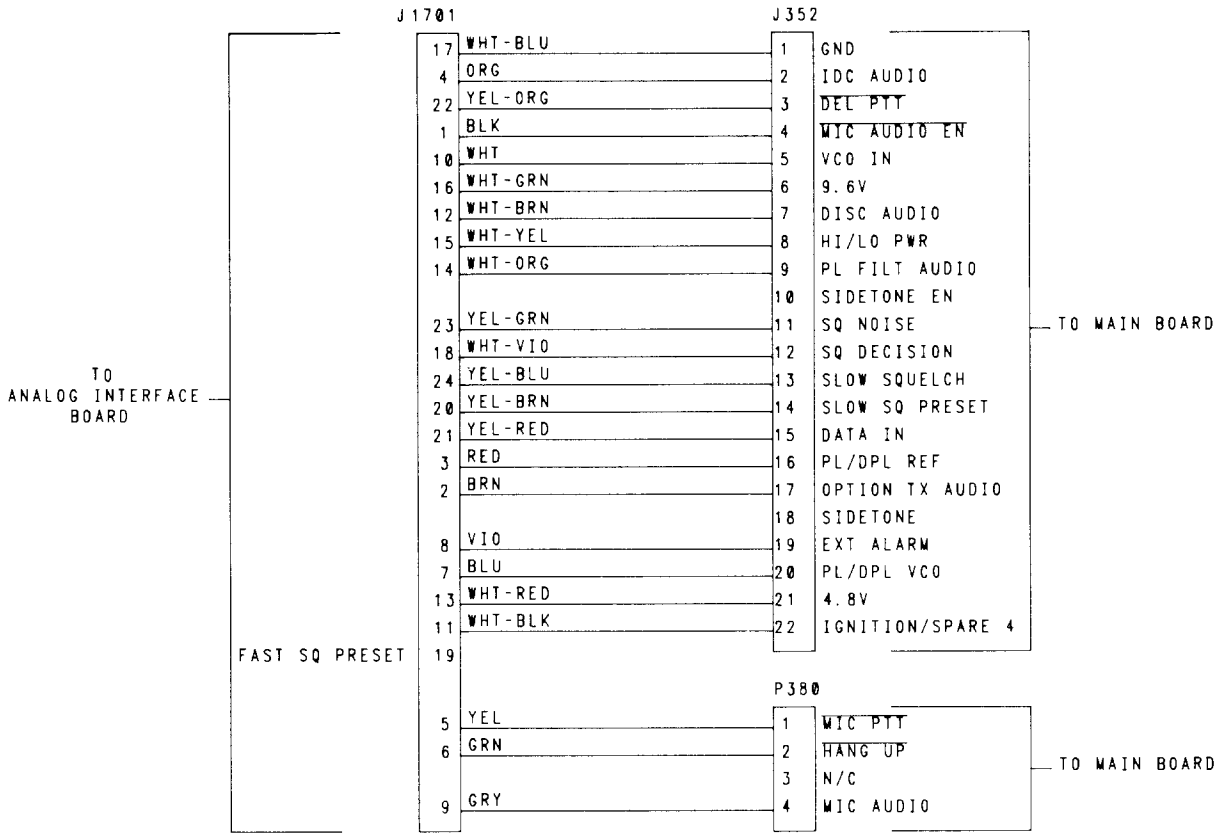
NOTES:
1. SHIELD 1 IS CONNECTED TO PIN 19 (GROUND)
2. SHIELD 2 IS CONNECTED TO PIN 22 (LOGIC GND)

parts list

VKN4140A 17 FT REMOTE CONTROL CABLE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3000053M02	17 FT REMOTE CTRL CBL

Figure 4-4
Remote Control Head Cable



parts list

VKN4147A INTERNAL RADIO CABLE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION	80113
	0900075M03	FEM CONNECTOR IDC 6 PIN	
	0900075M10	CONNECTOR FEM IDC 24 PIN (2)	
	2284835F01	KEYING PIN WHITE (4 used)	
		Wire, PVC	
	3010286M10	#26 STR WHITE	
	3010286L62	#26 STR WHITE	
	3010286L83	#26 WHT-ORG	
	3010286L75	#26 STR YEL-BLK	
	3010286L61	#26 STR YEL	
	3010286L69	#26 STR VIO	
	3010286L68	#26 STR BLU	
	3010286L77	#26 STR YEL-GRN	
	3010286L81	# 26 WHT-BLK	
	3010286L99	# 26 WHT-VIO	
	3010286L64	# 26 STR WHT-RED	
	3010286L86	# 26 STR WHT-BLU	
	3010286L85	# 26 STR WHT-GRN	
	3010286L84	# 26 STR WHT-YEL	
	3010286M11	# 26 STR RED	
	3010286L60	# 26 STR ORG	
	3010286L67	# 26 STR BLK	
	3010286L66	# 26 STR BRN	
	3010286L92	# 26 STR YEL-ORG	
	3010286L93	# 26 STR YEL-BLU	
	3010286L70	#26 STR GRY	
	3010286L82	#26 STR WHT-BRN	
	3010286L76	#26 STR YEL-RED	

Figure 4-5
Radio Set Internal Cable

END OF SECTION 4

MOTOROLA LIMITED
Communications Division

SECTION 5. CONTROL HEAD

5.1 CONTROL HEAD

The Control Head contains two boards; the Control Head Display Board and the Control Head Microcomputer Board.

The main functional blocks of the Control Head are highlighted in Figure 5-1.

Schematics which support the discussion below are inserted at the end of this section.

5.2 CONTROL HEAD DISPLAY BOARD

(Figures 5-2, 5-3 and 5-4)

The Display Board contains the following major blocks;

- LED indicators
- Vacuum Florescent Display (VFD)
- Keypad

Voltage requirements for the display board are +5V, +8V and +42V. These three voltages are obtained from the Control Head Microcomputer Board.

The microphone connector (J4200) contains all needed microphone connections as well as serial bus lines BUS+ , BUS- and the BUSY line from the control head microcomputer. These latter lines allow the radio EEPROM to be reprogrammed without opening the radio. In addition, the control head and / or radio can be system tested with an external serial bus controller.

5.2.1 LED Indicators

Indicator LED's DS4201 to DS4209 and DS4216 are controlled by commands on the serial bus from the radio microcomputer. The LED's are not controlled directly by the keys beside them on the control panel. Dimming is accomplished by software pulse width modulation of the LED driver transistors. Four dimming levels are selectable by using the dim key : full on, dim 1, dim 2, full off.

5.2.2 VFD

The 8 character VFD (vacuum florescent display) is multiplexed such that only one character is selected at any given time. The characters are refreshed at 250 Hz. The display driver IC's U4200 and U4201 are simple serial to parallel converters with a high voltage output stage. This high voltage (42 volts) comes from the high voltage switching generator residing on the control head microcomputer board.

A typical display cycle for the VFD is :

1. The control head microcomputer disables the VFD driver by making W4200-20 (strobe) high, thus turning off the display.

2. The microcomputer loads serial data into the display drivers (U4200, U4201) utilizing W4200-22 (clock) and W4200-21 (data).

3. The microcomputer then enables the new data to be displayed by making W4200-20 (strobe) low. Dimming is accomplished by software pulse width modulation of the W4200-20 (strobe) line.

Backlight LED's DS4210 to DS4215 provide illumination for the keys in dim light. The backlights are not dimmed but are on at all times except at the full off dimming level.

5.2.3 Keypad

The control head keys each send a signal to the control head microcomputer by grounding two unique lines of the six available (W4200-27 to 32). The microcomputer debounces and decodes a keypush and sends this information to the radio via the serial bus.

5.3 CONTROL HEAD MICROCOMPUTER BOARD (REMOTE MOUNT VERSION)

(Figures 5-8 to 5-10)

The Dash Mount and the Remote Mount Control Head Microcomputer Boards are similar. They contain the following major circuits:

- Volume control
- On-off switch
- Mode (channel) selector switch
- Microcomputer
- Bus interface
- Watchdog timer
- High voltage supply

5.3.1 On-Off, Volume

The on-off volume switch controls a power transistor in the main radio chassis which provides power to the radio. The radio then generates the +8 volts required by the control head. The volume control pot supplies a 0 - 5 volt DC signal to pin 4 of plug P4700 which is then digitized by the radio and used to operate a digital volume control IC.

5.3.2 Mode Selector Switch

The rotary mode selector switch is connected to the control head microcomputer via pins 19, 20 and 21 on U4700. The microcomputer determines the rotation direction (up or down) and sends this information to the radio via the serial bus.

The +5 volt source is provided by U4701 pin 1, SOIC 5 V regulator.

5.3.3 High Voltage Supply

The 42 volts required by the VFD is generated by the high voltage switching generator. The 555 timer (U4704) along with transistors Q4712 and Q4713 form a chopper which feeds step-up transformer T4700. The diode bridge consisting of CR4704 to CR4707, rectifies the output and provides approximately +42 V. This generator also produces a filament voltage of 2.3 Vac biased at 5.6 V by zener VR4710. To light a particular segment, the anode and grid of the VFD are made 36 volts higher (42 V - 5.6 V) than the filament.

5.3.4 Watchdog Timer

The power up/watchdog reset circuit comprises comparator U4702A, SCR Q4701 and associated circuitry. Upon power up the output of the comparator goes low and then high, thereby resetting the microcomputer (U4700). Thereafter, under normal circumstances, this circuit must be constantly "tickled" by the microcomputer to keep the comparator output high so that the microcomputer is not reset again.

5.3.5 Bus Interface

The Bus+ and Bus- lines comprise the serial bus. These two lines along with the BUSY line control all comunication between the control head, the radio and any other microprocessor controlled option which might be added. The Bus+ and Bus- lines form a differential pair with 5 volts between them (when one is high the other is low). These two lines form a bidirectional data path between the control head, radio and other options. The BUSY line is idle (U4700 pins 39 and 41 are high) when the control head is not sending a message. When a message is to be sent, the microcomputer causes BUSY to go high (U4700 pin 25 pulls low).

When trouble shooting a microcomputer board for a suspected serial bus fault, BUS+,BUS- and BUSY may be easily tested. Directions for this test are located on the schematic diagram of the Control Head Microcomputer Board. (both the dash and remote mount versions)

5.3.6 Other Information

The Microphone PTT and HANGUP lines are read, the information encoded and sent as a serial bus message to the radio.

5.4 CONTROL HEAD MICRO-COMPUTER BOARD (DASH MOUNT VERSION)

(Figures 5-5 to 5-7)

The Dash Mount Control Head Microcomputer Board is similar to the Remote Mount Control Head Microcomputer Board. The differences are described below.

1. The bus interface circuit for the Dash Mount Control Head Microcomputer Board becomes Rx DATA and Tx DATA instead of BUS+ and BUS-.

2. The Dash Mount Control Head Microcomputer Board does not contain a 5 V regulator.

3. The Dash Mount Control Head Microcomputer Board does contain an 8 V regulator (U4405).

The 8 V regulator for the Remote Mount Control Head Microcomputer Board resides on the Remote Interface Board.

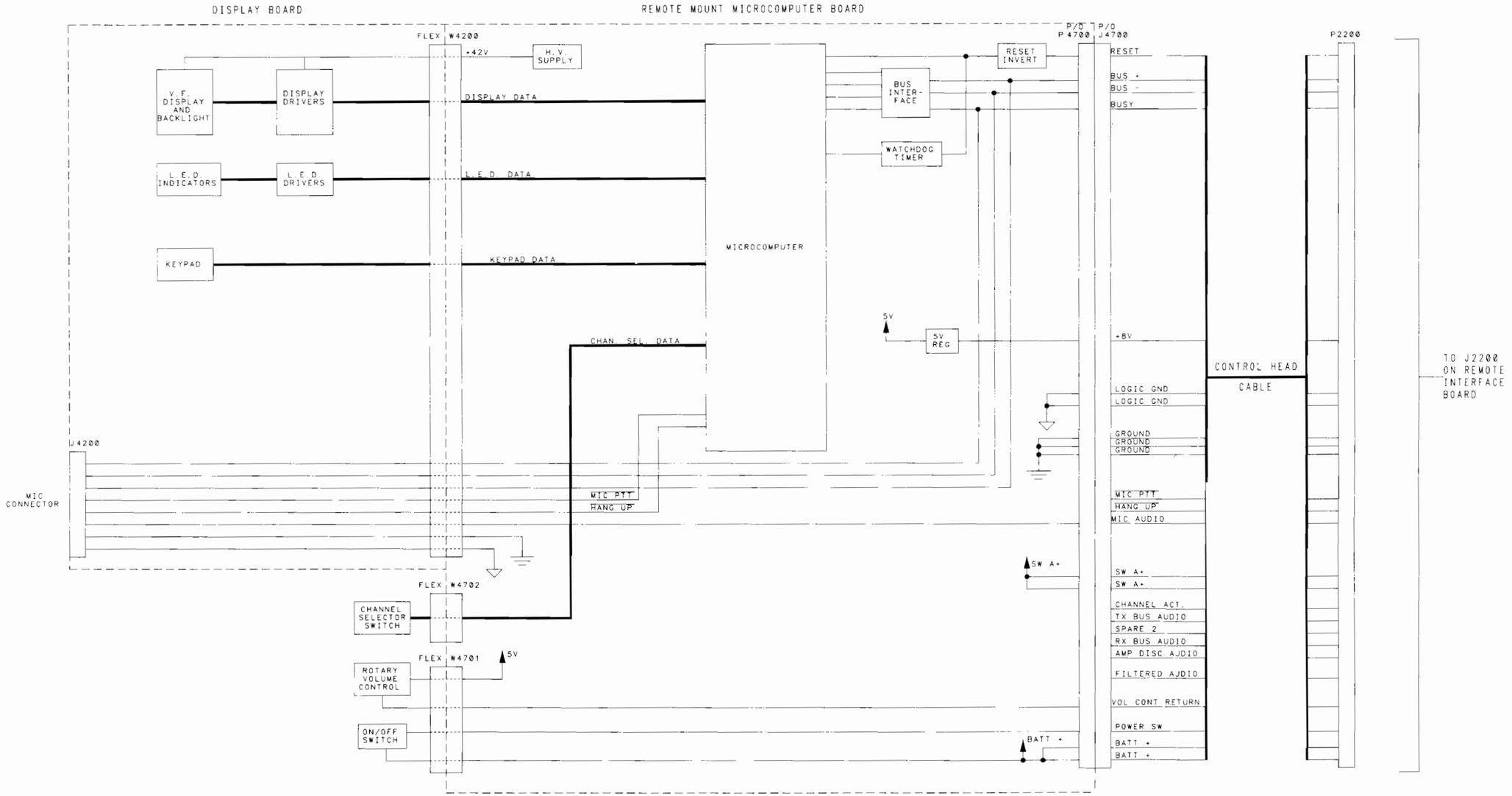
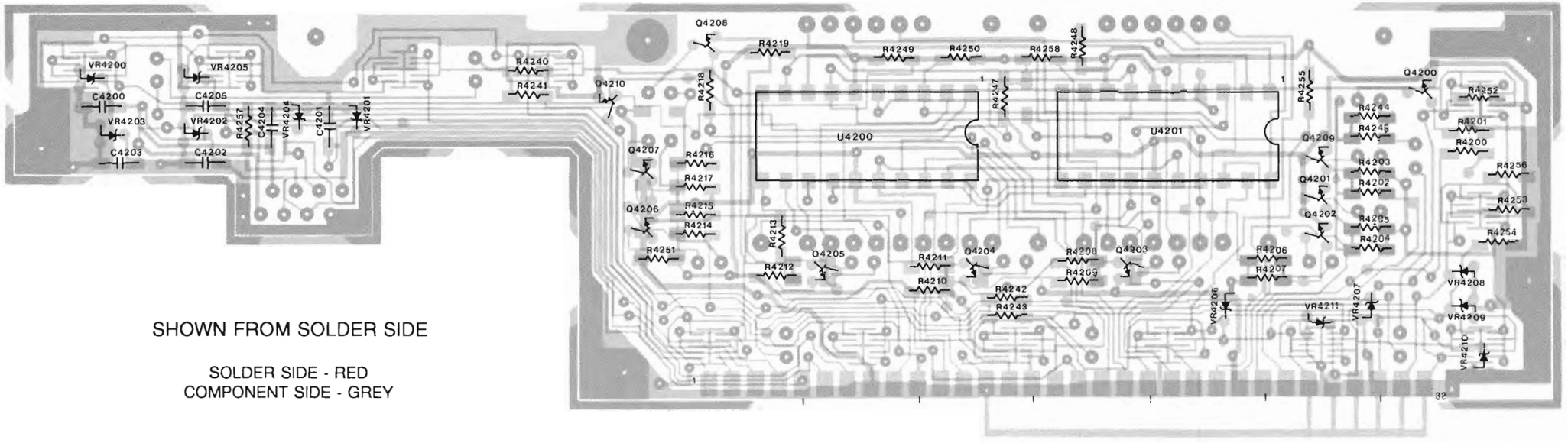
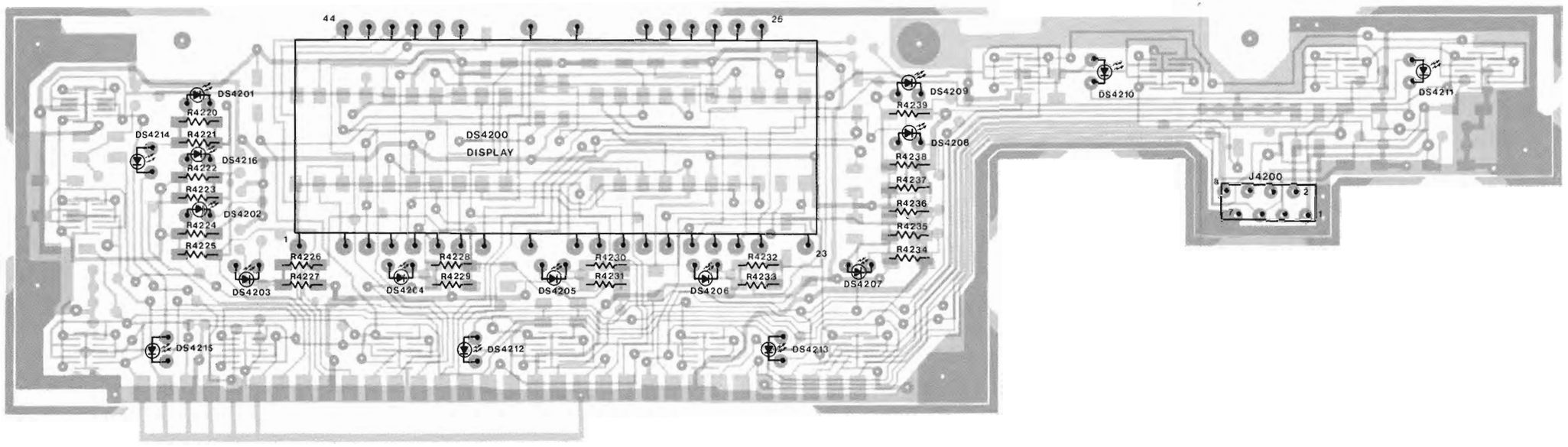


Figure 5-1
Control Head Block Diagram



SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY



SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00193M-O

Figure 5-2
Display Board - Board Details

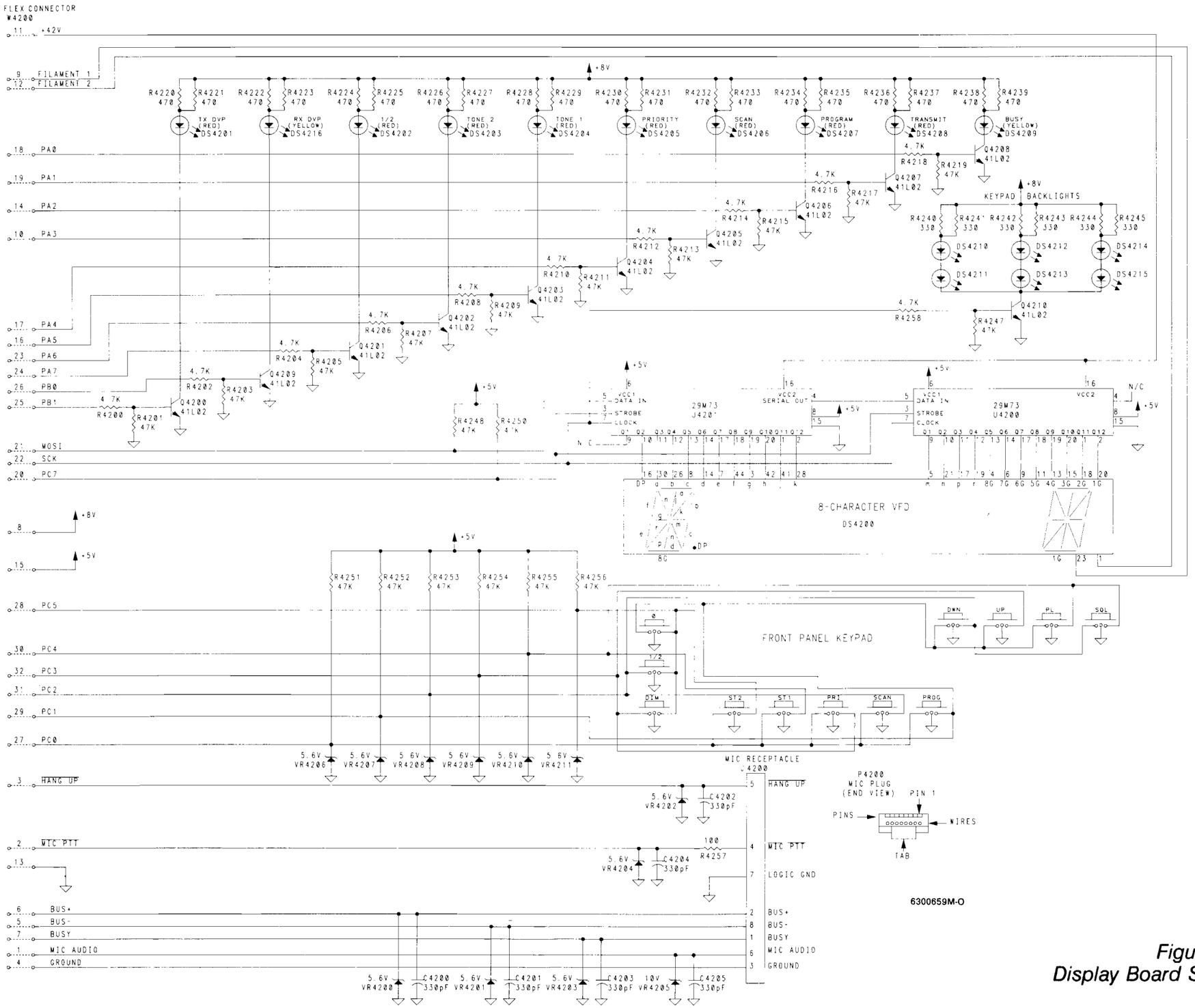


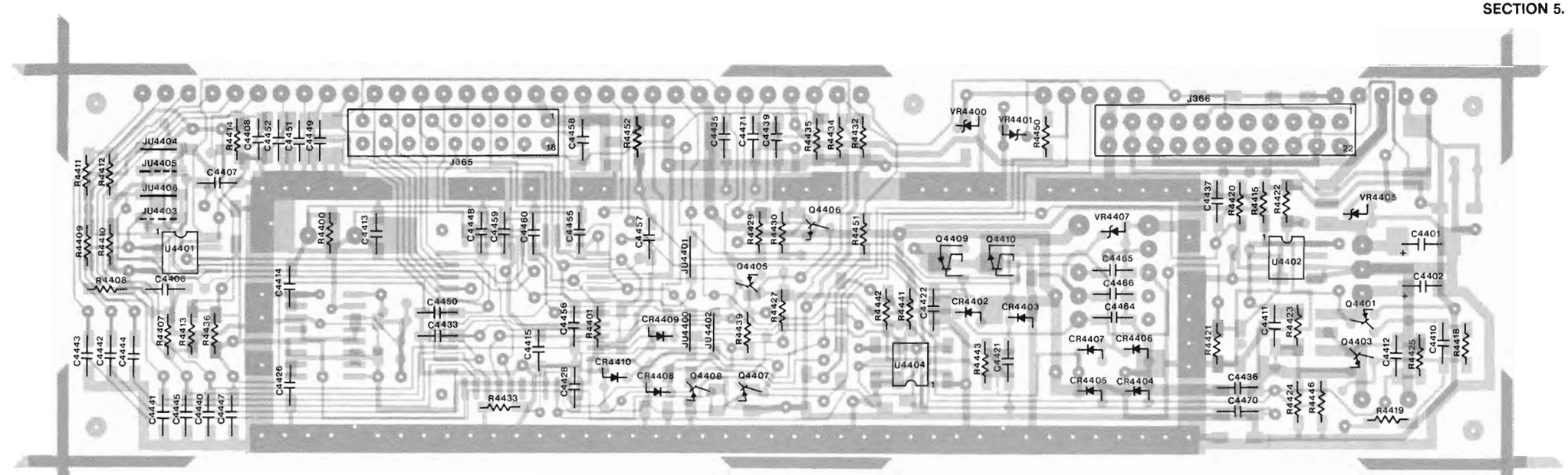
Figure 5-3
Display Board Schematic Diagram

parts list

VLN4667A DISPLAY BOARD

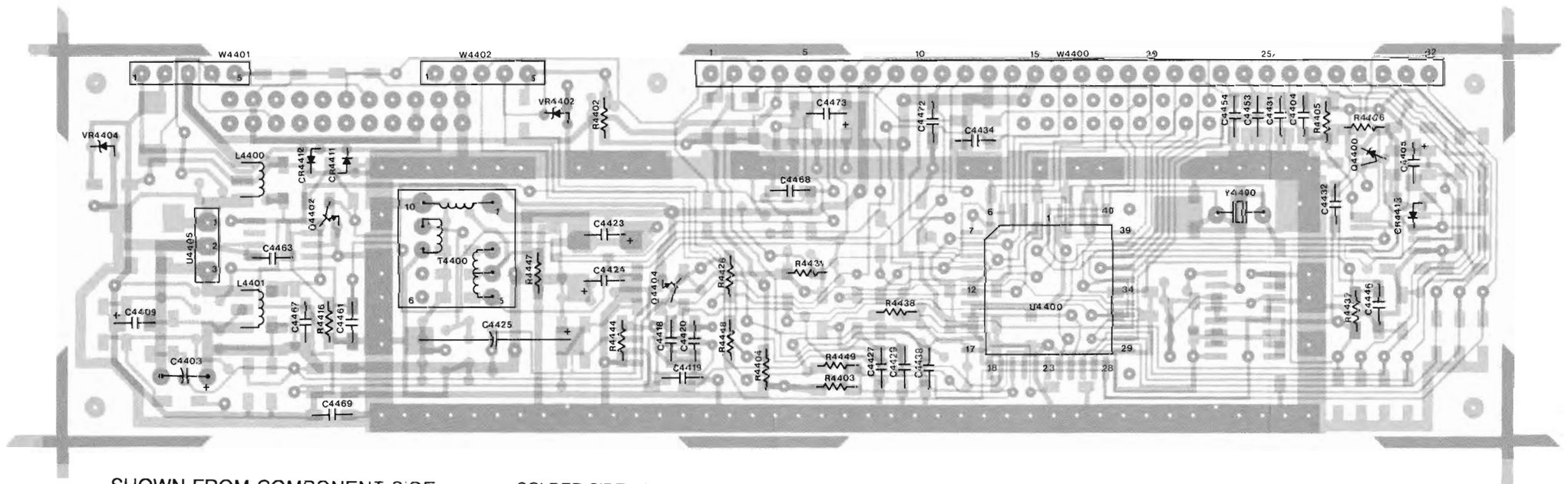
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, chip, pf
C4200	2111031A51	330-5-NP0-50V
C4201	2111031A51	330-5-NP0-50V
C4202	2111031A51	330-5-NP0-50V
C4203	2111031A51	330-5-NP0-50V
C4204	2111031A51	330-5-NP0-50V
C4205	2111031A51	330-5-NP0-50V
		LED
DS4200	7200004M01	VFD 8 CHARACTER
DS4201	4808111B09	RED
DS4202	4808111B09	RED
DS4203	4808111B09	RED
DS4204	4808111B09	RED
DS4205	4808111B09	RED
DS4206	4808111B09	RED
DS4207	4808111B09	RED
DS4208	4808111B09	RED
DS4209	4808111B10	YELLOW
DS4210	4880246K04	GREEN
DS4211	4880246K04	GREEN
DS4212	4880246K04	GREEN
DS4213	4880246K04	GREEN
DS4214	4880246K04	GREEN
DS4215	4880246K04	GREEN
DS4216	4808111B10	YELLOW
		Receptacle
J4200	0900078M01	8PIN (MICROPHONE)
		Transistor
Q4200	4880141L02	NPN SOT-23 MMBT3904
Q4201	4880141L02	NPN SOT-23 MMBT3904
Q4202	4880141L02	NPN SOT-23 MMBT3904
Q4203	4880141L02	NPN SOT-23 MMBT3904
Q4204	4880141L02	NPN SOT-23 MMBT3904
Q4205	4880141L02	NPN SOT-23 MMBT3904
Q4206	4880141L02	NPN SOT-23 MMBT3904
Q4207	4880141L02	NPN SOT-23 MMBT3904
Q4208	4880141L02	NPN SOT-23 MMBT3904
Q4209	4880141L02	NPN SOT-23 MMBT3904
Q4210	4880141L02	NPN SOT-23 MMBT3904
		Resistor, chip, 5%, 1/8 W
R4200	0600015M65	4.7K
R4201	0600015M89	47K
R4202	0600015M65	4.7K
R4203	0600015M89	47K
R4204	0600015M65	4.7K
R4205	0600015M89	47K
R4206	0600015M65	4.7K
R4207	0600015M89	47K
R4208	0600015M65	4.7K
R4209	0600015M89	47K
R4210	0600015M65	4.7K
R4211	0600015M89	47K
R4212	0600015M65	4.7K
R4213	0600015M89	47K
R4214	0600015M65	4.7K
R4215	0600015M89	47K
R4216	0600015M65	4.7K
R4217	0600015M89	47K
R4218	0600015M65	4.7K
R4219	0600015M89	47K
R4220	0600015M41	470
R4221	0600015M41	470
R4222	0600015M41	470
R4223	0600015M41	470
R4224	0600015M41	470
R4225	0600015M41	470
R4226	0600015M41	470
R4227	0600015M41	470
R4228	0600015M41	470
R4229	0600015M41	470
R4230	0600015M41	470
R4231	0600015M41	470
R4232	0600015M41	470
R4233	0600015M41	470
R4234	0600015M41	470
R4235	0600015M41	470
R4236	0600015M41	470
R4237	0600015M41	470
R4238	0600015M41	470
R4239	0600015M41	470
R4240	0600015M37	330
R4241	0600015M37	330
R4242	0600015M37	330
R4243	0600015M37	330
R4244	0600015M37	330
R4245	0600015M37	330
R4247	0600015M89	47K
R4248	0600015M89	47K
R4250	0600015M89	47K
R4251	0600015M89	47K
R4252	0600015M89	47K
R4253	0600015M89	47K
R4254	0600015M89	47K
R4255	0600015M89	47K
R4256	0600015M89	47K
R4257	0600015M49	1K
		Integrated Circuit
U4200	5183629M73	VFD DRIVER SN75512A
U4201	5183629M73	VFD DRIVER SN75512A
		Zener Diode
VR4200	4880140L07	CHIP 5.6V MMBZ5232
VR4201	4880140L07	CHIP 5.6V MMBZ5232
VR4202	4880140L07	CHIP 5.6V MMBZ5232
VR4203	4880140L07	CHIP 5.6V MMBZ5232
VR4204	4880140L07	CHIP 5.6V MMBZ5232
VR4205	4880140L15	SOT-23 MMBZ5240 10V
VR4206	4880140L07	CHIP 5.6V MMBZ5232
VR4207	4880140L07	CHIP 5.6V MMBZ5232
VR4208	4880140L07	CHIP 5.6V MMBZ5232
VR4209	4880140L07	CHIP 5.6V MMBZ5232
VR4210	4880140L07	SOT 5.6V
		Jumper
W4200	3000051M01	FLEX, 32 PIN
		Non-referenced item
	7500030M01	VFD PAD

Figure 5-4
Display Board Parts List



SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED

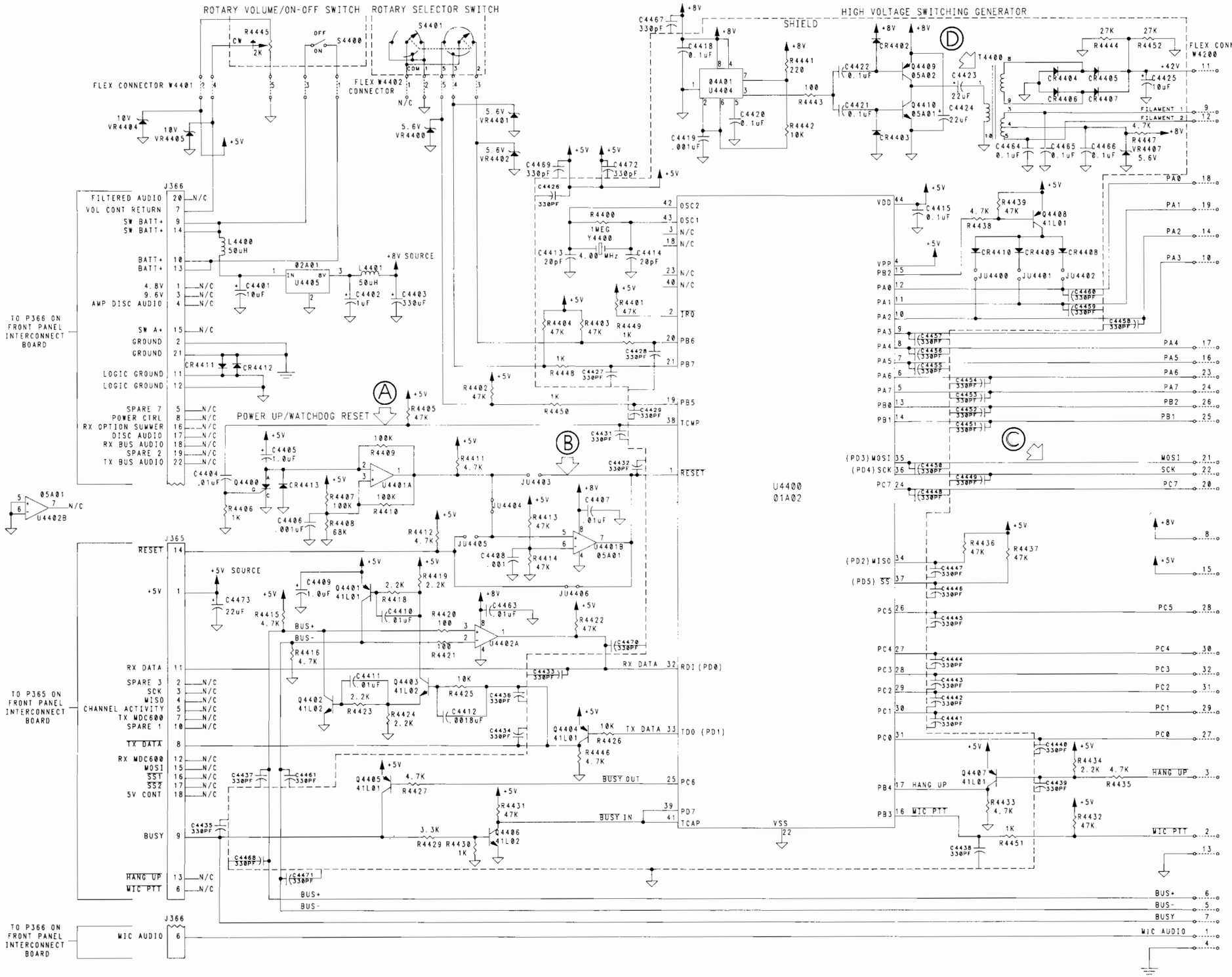


SHOWN FROM COMPONENT SIDE

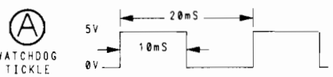
SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00203M-O

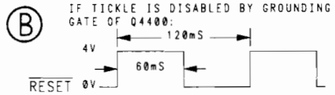
Figure 5-5
Dash Mount Control Head
Microcomputer Board
-Board Details



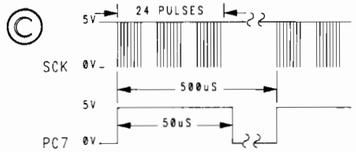
A WATCHDOG TICKLE



B IF TICKLE IS DISABLED BY GROUNDING GATE OF Q4400:

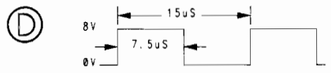


C



DATA (MOSI) IS VALID ON EDGE OF SCK

D



SEE FIGURE 5-6 (SHEET 2) FOR SERIAL BUS FAULT TEST

Figure 5-6
Dash Mount Control Head Microcomputer Board Schematic Diagram (Sheet 1)

parts list

VLN4668A DASH MOUNT CONTROL HEAD MICROCOMPUTER BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2600088M01	EMI SHIELD C/H MICRO TOP
	2600089M01	EMI SHIELD C/H MICRO BOTTOM
	2600093M01	SHIELD
		Capacitor, chip, pf (unless stated otherwise)
C4401	2362998D32	TANT 10uf -20-25V
C4402	2362998D09	1uf -20-35V
C4403	2302000A01	ALU LYTIC 330uf -20-16V
C4404	2111032A21	.01uf -10-X7R-50V
C4405	2362998D09	TANT 1.0uf -20-35V
C4406	2111032A09	0.001MF
C4407	2111032A21	.01uf -10-X7R-50V
C4408	2111032A09	0.001MF
C4409	2362998D09	CAP TANT CHIP 1.0uf -20-35V
C4410	2111032A21	.01uf -10-X7R-50V
C4411	2111032A21	.01uf -10-X7R-50V
C4412	2111032A12	.0018uf -10-X7R-50V
C4413	2111031A22	20PF-5-NPO-50V
C4414	2111031A22	20PF-5-NPO-50V
C4415	2160521F37	.1uf -20-X7R-25V
C4418	2160521F37	.1uf -20-X7R-25V
C4419	2111032A09	0.001MF
C4420	2160521F37	.1uf -20-X7R-25V
C4421	2160521F37	.1uf -20-X7R-25V
C4422	2160521F37	.1uf -20-X7R-25V
C4423	2362998D38	22uf -20-16V
C4424	2362998D38	22uf -20-16V
C4425	2300017M08	CAP ALU LYTIC 10MF-20-63V
C4426	2111031A51	330-5-NP0-50V
C4427	2111031A51	330-5-NP0-50V
C4428	2111031A51	330-5-NP0-50V
C4429	2111031A51	330-5-NP0-50V
C4431	2111031A51	330-5-NP0-50V
C4432	2111031A51	330-5-NP0-50V
C4433	2111031A51	330-5-NP0-50V
C4434	2111031A51	330-5-NP0-50V
C4435	2111031A51	330-5-NP0-50V
C4436	2111031A51	330-5-NP0-50V
C4437	2111031A51	330-5-NP0-50V
C4438	2111031A51	330-5-NP0-50V
C4439	2111031A51	330-5-NP0-50V
C4440	2111031A51	330-5-NP0-50V
C4441	2111031A51	330-5-NP0-50V
C4442	2111031A51	330-5-NP0-50V
C4443	2111031A51	330-5-NP0-50V
C4444	2111031A51	330-5-NP0-50V
C4445	2111031A51	330-5-NP0-50V
C4446	2111031A51	330-5-NP0-50V
C4447	2111031A51	330-5-NP0-50V
C4448	2111031A51	330-5-NP0-50V
C4449	2111031A51	330-5-NP0-50V
C4450	2111031A51	330-5-NP0-50V
C4451	2111031A51	330-5-NP0-50V
C4452	2111031A51	330-5-NP0-50V
C4453	2111031A51	330-5-NP0-50V
C4454	2111031A51	330-5-NP0-50V
C4455	2111031A51	330-5-NP0-50V
C4456	2111031A51	330-5-NP0-50V
C4457	2111031A51	330-5-NP0-50V
C4458	2111031A51	330-5-NP0-50V
C4459	2111031A51	330-5-NP0-50V
C4460	2111031A51	330-5-NP0-50V
C4461	2111031A51	330-5-NP0-50V
C4463	2111032A21	.01uf -10-X7R-50V
C4464	2160521F37	.1 uf-20-X7R-25V
C4465	2160521F37	.1 uf-20-X7R-25V
C4466	2160521F37	.1 uf-20-X7R-25V
C4467	2111031A51	330-5-NPO-50V
C4468	2111031A51	330-5-NPO-50V
C4469	2111031A51	330-5-NPO-50V
C4470	2111031A51	330-5-NPO-50V
C4471	2111031A51	330-5-NPO-50V
C4472	2111031A51	330-5-NPO-50V
C4473	2362998D38	TANT 22uf -20-16V
		Diode
CR4402	4802003A01	SOT-23 SIGNAL MMBD914
CR4403	4802003A01	SOT-23 SIGNAL MMBD914
CR4404	4802003A01	SOT-23 SIGNAL MMBD914
CR4405	4802003A01	SOT-23 SIGNAL MMBD914
CR4406	4802003A01	SOT-23 SIGNAL MMBD914
CR4407	4802003A01	SOT-23 SIGNAL MMBD914
CR4408	4802003A01	SOT-23 SIGNAL MMBD914
CR4409	4802003A01	SOT-23 SIGNAL MMBD914
CR4410	4802003A01	SOT-23 SIGNAL MMBD914
CR4411	4802003A01	SOT-23 SIGNAL MMBD914
CR4412	4802003A01	SOT-23 SIGNAL MMBD914
CR4413	4802003A01	SOT-23 SIGNAL MMBD914
		Connector
J365	0900076M10	FEM 18 PIN
J366	0900076M09	FEM 22 PIN
		Jumper Chip
JU4404	0600016M23	ZERO OHM
JU4406	0600016M23	ZERO OHM
		Coil
L4400	2402000A02	CHOKE 50 uH
L4401	2402000A02	CHOKE 50 uH
		Transistor
Q4400	4802000A01	SCR SOT-23 MMBS5060
Q4401	4880141L01	PNP SOT-23 MMBT3906
Q4402	4880141L02	NPN SOT-23 MMBT3904
Q4403	4880141L02	NPN SOT-23 MMBT3904
Q4404	4880141L01	PNP SOT-23 MMBT3906
Q4405	4880141L01	PNP SOT-23 MMBT3906
Q4406	4880141L02	NPN SOT-23 MMBT3904
Q4407	4880141L01	PNP SOT-23 MMBT3906
Q4408	4880141L01	PNP SOT-23 MMBT3906
Q4409	4802005A02	PNP SOT89 BCX69
Q4410	4802005A01	NPN SOT89 BCX68
		Resistor, chip
R4400	0600016M22	1M-5-1/8W
R4401	0600015M89	47K-5-1/8W
R4402	0600015M89	47K-5-1/8W
R4403	0600015M89	47K-5-1/8W
R4404	0600015M89	47K-5-1/8W
R4405	0600015M89	47K-5-1/8W
R4406	0600015M49	1K-5-1/8W
R4407	0600015M97	100K-5-1/8W
R4408	0600015M93	68K-5-1/8W
R4409	0600015M97	100K-5-1/8W
R4410	0600015M97	100K-5-1/8W
R4411	0600015M65	4.7K-5-1/8W
R4412	0600015M65	4.7K-5-1/8W
R4413	0600015M89	47K-5-1/8W
R4414	0600015M89	47K-5-1/8W
R4415	0600015M65	4.7K-5-1/8W
R4416	0600015M65	4.7K-5-1/8W
R4418	0600015M57	2.2K-5-1/8W
R4419	0600015M57	2.2K-5-1/8W
R4420	0600015M25	100-5-1/8W
R4421	0600015M25	100-5-1/8W
R4422	0600015M89	47K-5-1/8W
R4423	0600015M57	2.2K-5-1/8W
R4424	0600015M57	2.2K-5-1/8W
R4425	0600015M73	10K-5-1/8W
R4426	0600015M73	10K-5-1/8W
R4427	0600015M65	4.7K-5-1/8W
R4429	0600015M61	3.3K -5-1/8W
R4430	0600015M49	1K-5-1/8W
R4431	0600015M89	47K-5-1/8W
R4432	0600015M89	47K-5-1/8W
R4433	0600015M65	4.7K-5-1/8W
R4434	0600015M89	47K-5-1/8W
R4435	0600015M89	47K-5-1/8W
R4436	0600015M89	47K-5-1/8W
R4437	0600015M89	47K-5-1/8W
R4438	0600015M65	4.7K-5-1/8W
R4439	0600015M89	47K-5-1/8W
R4441	0600015M33	220-5-1/8W
R4442	0600015M73	10K-5-1/8W
R4443	0600015M25	100-5-1/8W
R4444	0600015M83	27K-5-1/8W
R4445	1800028M01	POT. 2K-20-.05W linear (not chip type)
R4446	0600015M65	4.7K-5-1/8W
R4447	0600015M65	4.7K-5-1/8W
R4448	0600015M49	1K-5-1/8 W
R4449	0600015M49	1K-5-1/8 W
R4450	0600015M49	1K-5-1/8 W
R4451	0600015M49	1K-5-1/8 W
R4452	0600015M83	27K-5-1/8W
		Switch
S4401	4000100M02	SW ROT 24POS 1 OF 3
		Transformer
T4400	2500060M01	VFD
		Inregrated Circuit
U4400	5102001A02	MICRO C/H MC68HC05C4FN
U4401	5102005A01	Dual comparator LM2903 S01C
U4402	5102005A01	Dual comparator LM2903 S01C
U4404	5102004A01	TIMER IC 555
U4405	5102002A01	REG 8V 3A TO220 78T08
		Diode, zener
VR4400	4880140L07	CHIP 5.6V
VR4401	4880140L07	CHIP 5.6V
VR4402	4880140L07	CHIP 5.6V
VR4404	4880140L15	SOT-23 MMBZ5240 10V
VR4405	4880140L15	SOT-23 MMBZ5240 10V
VR4407	4880140L07	CHIP 5.6V
		Conductor
W4400	3000051M01	FLEXIBLE JUMPER 16PIN
W4401	3000052M01	FLEXIBLE CIRCUIT CHAN SW
W4401	3000052M02	FLEXIBLE CIRCUIT VOL SW
		Crystal
Y4400	4802001A02	4MHZ LOW PROFILE
		Non-referenced item
	1405160A01	INSULATOR, CRYSTAL

Figure 5-7
Dash Mount Control Head
Microcomputer Board Parts List

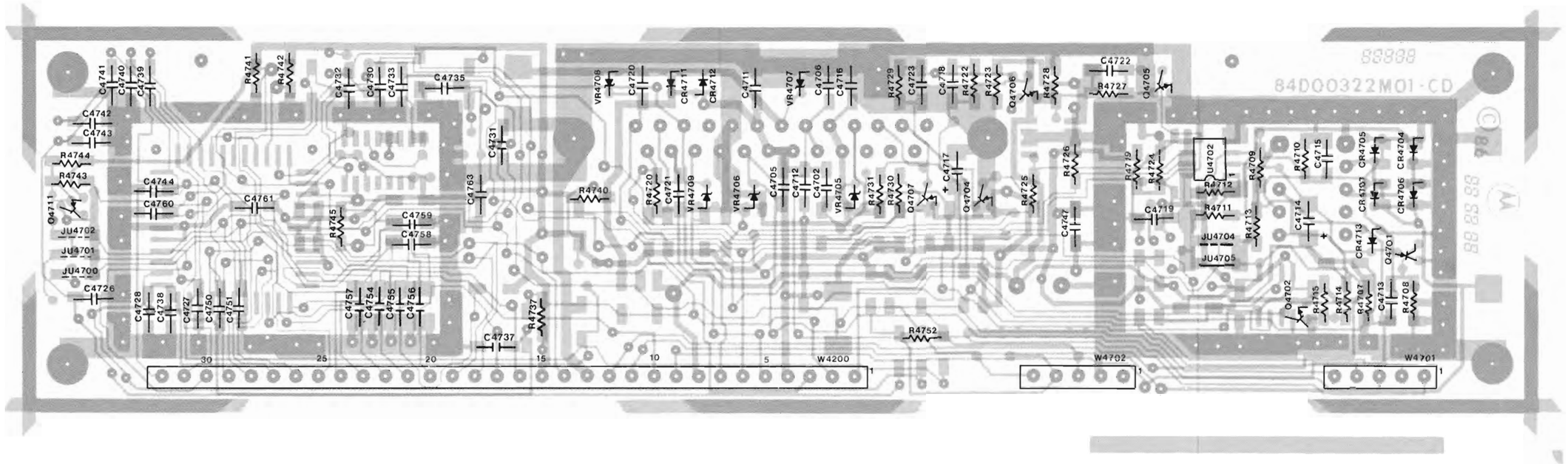
SERIAL BUS FAULT TEST

Disconnect the control head from the radio, place the microcomputer in a reset state (ground U4400-1) and power the control head by applying +5V to J365-1, +12 to +16V to J366-10, 13 and ground to J366-11, 12 (Extender Cables between the Front Panel Interconnect Board and the Dashmount Control Head Microcomputer Board may be used). With the microcomputer reset, all its I/O pins revert to the high impedance state and can be safely grounded or placed at 5 Vdc during the test.

Serial Bus Fault Test

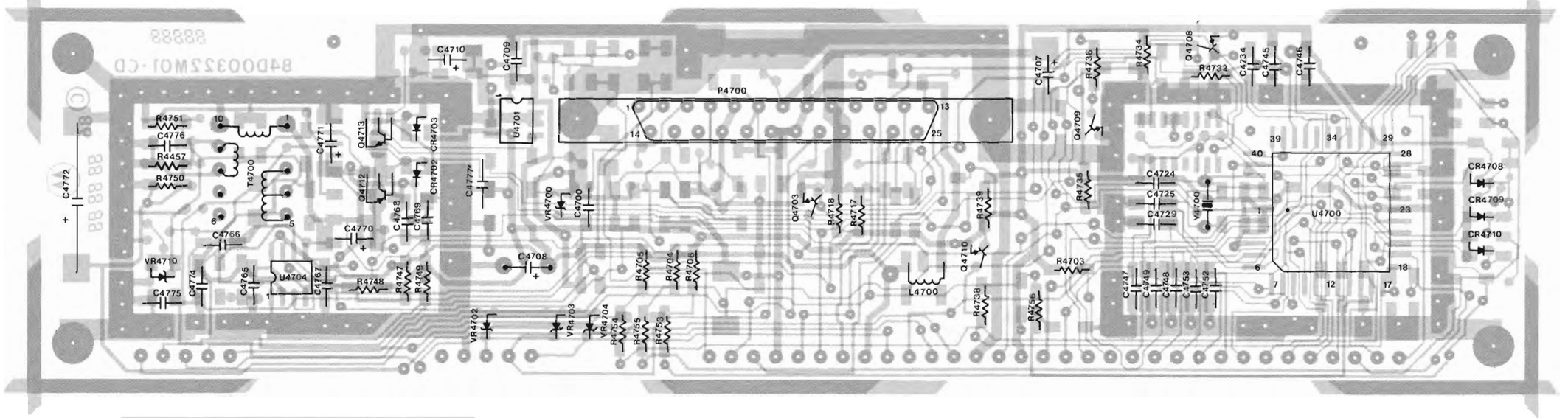
Test	Normal Indication
BUS + and BUS- test Apply 5 Vdc to U4400 -33 (TX DATA).	High at U4400 -32 (RX DATA) Low at J365-8 (TX DATA) High at J365-11 (RX DATA) High at J4200-2 (BUS +) Low at J4200-8 (BUS -)
Ground pin 33	Above indications reversed.
BUSY line test Apply 5 Vdc to U4400 -25 (BUSY out)	High at U4400 -39 and 41 (BUSY in) Low at J365-9
Ground pin 25	Above indications reversed.

Figure 5-6
Dash Mount Control Head
Microcomputer Board
Schematic Diagram (Sheet 2)



SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY



SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00194M-O

Figure 5-8
Remote Mount Control Head
Microcomputer Board
- Board Details

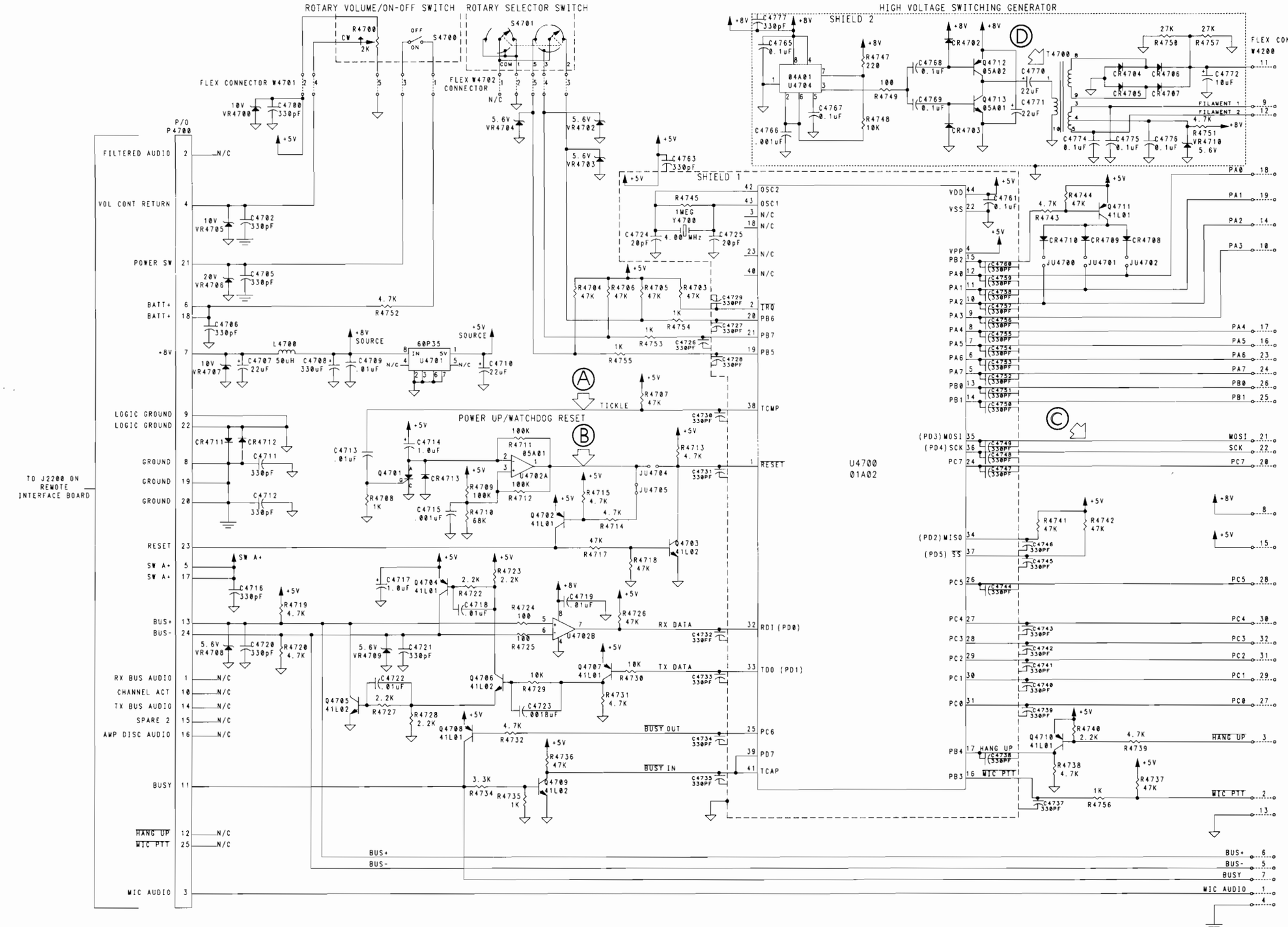


Figure 5-9
Remote Mount Control Head Microcomputer Board Schematic Diagram (Sheet 1)

parts list

VLN4669A REMOTE MOUNT CONTROL HEAD MICROCOMPUTER BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2600084M01	EMI SHIELD C/H MICRO TOP (2 USED)
	2600085M01	EMI SHIELD C/H MICRO BOTTOM (2)
	2600092M01	SHIELD
		Capacitor, chip, pf (unless stated otherwise)
C4700	2111031A51	330-5-NP0-50V
C4702	2111031A51	330-5-NP0-50V
C4705	2111031A51	330-5-NP0-50V
C4706	2111031A51	330-5-NP0-50V
C4707	2362998D38	TANT 22uf -20-16V
C4708	2302000A01	CAP ALU LYTIC 470MF-20-16V
C4709	2111032A21	.01uf -10-X7R-50V
C4710	2362998D38	22uf -20-16V
C4711	2111031A51	330-5-NP0-50V
C4712	2111031A51	330-5-NP0-50V
C4713	2111032A21	.01uf -10-X7F-50V
C4714	2362998D09	CAP TANT CHIP 1.0uf -20-35V
C4715	2111032A09	0.001MF
C4716	2111031A51	330-5-NP0-50V
C4717	2362998D09	CAP TANT CHIP 1.0uf -20-35V
C4718	2111032A21	.01uf -10-X7R-50V
C4719	2111032A21	.01uf -10-X7R-50V
C4720	2111031A51	330-5-NP0-50V
C4721	2111031A51	330-5-NP0-50V
C4722	2111032A21	.01uf -10-X7R-50V
C4723	2111032A12	.0018uf -10-X7R-50V
C4724	2111031A22	20PF-5-NPO-50V
C4725	2111031A22	20PF-5-NPO-50V
C4726	2111031A51	330-5-NP0-50V
C4727	2111031A51	330-5-NP0-50V
C4728	2111031A51	330-5-NP0-50V
C4729	2111031A51	330-5-NP0-50V
C4730	2111031A51	330-5-NP0-50V
C4731	2111031A51	330-5-NP0-50V
C4732	2111031A51	330-5-NP0-50V
C4733	2111031A51	330-5-NP0-50V
C4734	2111031A51	330-5-NP0-50V
C4735	2111031A51	330-5-NP0-50V
C4737	2111031A51	330-5-NP0-50V
C4738	2111031A51	330-5-NP0-50V
C4739	2111031A51	330-5-NP0-50V
C4740	2111031A51	330-5-NP0-50V
C4741	2111031A51	330-5-NP0-50V
C4742	2111031A51	330-5-NP0-50V
C4743	2111031A51	330-5-NP0-50V
C4744	2111031A51	330-5-NP0-50V
C4745	2111031A51	330-5-NP0-50V
C4746	2111031A51	330-5-NP0-50V
C4747	2111031A51	330-5-NP0-50V
C4748	2111031A51	330-5-NP0-50V
C4749	2111031A51	330-5-NP0-50V
C4750	2111031A51	330-5-NP0-50V
C4751	2111031A51	330-5-NP0-50V
C4752	2111031A51	330-5-NP0-50V
C4753	2111031A51	330-5-NP0-50V
C4754	2111031A51	330-5-NP0-50V
C4755	2111031A51	330-5-NP0-50V
C4756	2111031A51	330-5-NP0-50V
C4757	2111031A51	330-5-NP0-50V
C4758	2111031A51	330-5-NP0-50V
C4759	2111031A51	330-5-NP0-50V
C4760	2111031A51	330-5-NP0-50V
C4761	2160521F37	.1uf -20-X7R-25V
C4763	2111031A51	330-5-NP0-50V
C4765	2160521F37	.1uf -20-X7R-25V
C4766	2111032A09	0.001MF
C4767	2160521F37	.1uf -20-X7R-25V
C4768	2160521F37	.1uf -20-X7R-25V
C4769	2160521F37	.1uf -20-X7R-25V
C4770	2362998D38	22uf -20-16V
C4771	2362998D38	22uf -20-16V
C4772	2300017M08	CAP ALU LYTIC 10MF-20-63V
C4774	2160521F37	.1uf -20-X7R-25V
C4775	2160521F37	.1uf -20-X7R-25V
C4776	2160521F37	.1uf -20-X7R-25V
C4777	2111031A51	330-5-NPO-50V
		Diode
CR4702	4802003A01	SOT-23 SIGNAL MMBD914
CR4703	4802003A01	SOT-23 SIGNAL MMBD914
CR4704	4802003A01	SOT-23 SIGNAL MMBD914
CR4705	4802003A01	SOT-23 SIGNAL MMBD914
CR4706	4802003A01	SOT-23 SIGNAL MMBD914
CR4707	4802003A01	SOT-23 SIGNAL MMBD914
CR4708	4802003A01	SOT-23 SIGNAL MMBD914
CR4709	4802003A01	SOT-23 SIGNAL MMBD914
CR4710	4802003A01	SOT-23 SIGNAL MMBD914
CR4711	4802003A01	SOT-23 SIGNAL MMBD914
CR4712	4802003A01	SOT-23 SIGNAL MMBD914
CR4713	4802003A01	SOT-23 SIGNAL MMBD914
		Jumper Chip
JU4705	0600016M23	ZERO OHM
		Chake
L4700	2402000A02	50 uH
		Connector
P4700	2800044M01	CON 25PIN D-SUB STRAIGHT
		Transistor
Q4701	4802000A01	SCR SOT-23 MMBS5060
Q4702	4880141L01	PNP SOT-23 MMBT3906
Q4703	4880141L02	NPN SOT-23 MMBT3904
Q4704	4880141L01	PNP SOT-23 MMBT3906
Q4705	4880141L02	NPN SOT-23 MMBT3904
Q4706	4880141L02	NPN SOT-23 MMBT3904
Q4707	4880141L01	PNP SOT-23 MMBT3906
Q4708	4880141L01	PNP SOT-23 MMBT3906
Q4709	4880141L02	NPN SOT-23 MMBT3904
Q4710	4880141L01	PNP SOT-23 MMBT3906
Q4711	4880141L01	PNP SOT-23 MMBT3906
Q4712	4802005A02	PNP SOT89 BCX69
Q4713	4802005A01	NPN SOT89 BCX68
		Resistor, chip (unsess stated otherwuse)
R4700	1800028M01	pot w / switch vol. 2K linear
R4703	0600015M89	47K-5-1/8W
R4704	0600015M89	47K-5-1/8W
R4705	0600015M89	47K-5-1/8W
R4706	0600015M89	47K-5-1/8W
R4707	0600015M89	47K-5-1/8W
R4708	0600015M49	1K-5-1/8W
R4709	0600015M97	100K-5-1/8W
R4710	0600015M93	68K-5-1/8W
R4711	0600015M97	100K-5-1/8W
R4712	0600015M97	100K-5-1/8W
R4713	0600015M65	4.7K-5-1/8W
R4714	0600015M65	4.7K-5-1/8W
R4715	0600015M65	4.7K-5-1/8W
R4717	0600015M89	47K-5-1/8W
R4718	0600015M89	47K-5-1/8W
R4719	0600015M65	4.7K-5-1/8W
R4720	0600015M65	4.7K-5-1/8W
R4722	0600015M57	2.2K-5-1/8W
R4723	0600015M57	2.2K-5-1/8W
R4724	0600015M25	100-5-1/8W
R4725	0600015M25	100-5-1/8W
R4726	0600015M89	47K-5-1/8W
R4727	0600015M57	2.2K-5-1/8W
R4728	0600015M57	2.2K-5-1/8W
R4729	0600015M73	10K-5-1/8W
R4730	0600015M73	10K-5-1/8W
R4731	0600015M65	4.7K-5-1/8W
R4732	0600015M65	4.7K-5-1/8W
R4734	0600015M61	3.3K -5-1/8W
R4735	0600015M49	1K-5-1/8W
R4736	0600015M89	47K-5-1/8W
R4737	0600015M89	47K-5-1/8W
R4738	0600015M65	4.7K-5-1/8W
R4739	0600015M89	47K-5-1/8W
R4740	0600015M89	47K-5-1/8W
R4741	0600015M89	47K-5-1/8W
R4742	0600015M89	47K-5-1/8W
R4743	0600015M65	4.7K-5-1/8W
R4744	0600015M89	47K-5-1/8W
R4745	0600016M22	1M-5-1/8W
R4747	0600015M33	220-5-1/8W
R4748	0600015M73	10K-5-1/8W
R4749	0600015M25	100-5-1/8W
R4750	0600015M83	27K-5-1/8W
R4751	0600015M65	4.7K-5-1/8W
R4752	0600015M65	4.7K-5-1/8W
R4753	0600015M49	1K-5-1/8 W
R4754	0600015M49	1K-5-1/8 W
R4755	0600015M49	1K-5-1/8 W
R4756	0600015M49	1K-5-1/8 W
R4757	0600015M83	27K-5-1/8W
		Switch
S4701	4000100M02	SW ROT 24POS 1 OF 3
		Transformer
T4700	2500060M01	VFD
		Integrated Circuit
U4700	5102001A02	MICRO C/H MC68HC05C4FN
U4701	5182760P35	volt reg. 5V 76R13
U4702	5102005A01	Dual comparator LM2903 S01C
U4704	5102004A01	Timer IC 555
		Diode , zener
VR4700	4880140L07	CHIP 5.6V SOT
VR4702	4880140L07	CHIP 5.6V SOT
VR4703	4880140L07	CHIP 5.6V SOT
VR4704	4880140L07	CHIP 5.6V SOT
VR4705	4880140L15	SOT 23 MMBZ5240 10V
VR4706	4880140L25	20V SOT
VR4707	4880140L15	SOT 23 MMBZ5240 10V
VR4708	4880140L07	CHIP 5.6V SOT
VR4709	4880140L07	CHIP 5.6V SOT
VR4710	4880140L07	CHIP 5.6V SOT
		Jumper
W4200	3000051M01	flexible 16 pin
		Circuit
W4701	3000052M01	flexible vol. control
W4702	3000052M02	flexible chan. sw.
		Crystal
Y4700	4802001A02	4 MHz low profile
		Non-referenced Item
	1405160A01	INSULATOR, CRYSTAL

Figure 5-10
Remote Mount Control Head
Microcomputer Board Parts List

SERIAL BUS FAULT TEST

Disconnect the control head from the radio, place the microcomputer in a reset state (ground U4700-1) and power the control head by applying +8 V to P4700-7 and ground to P4700-9 and 22. With the microcomputer reset, all its I/O pins revert to the high impedance state and can be safely grounded or placed at 5 Vdc during the test.

Serial Bus Fault Test

Test	Normal Indication
BUS + and BUS- test Apply 5 Vdc to U4700 -33 (TX DATA).	High at U4700 -32 (RX DATA) High at P4700 -13 (BUS +) Low at P4700 -24 (BUS -)
Ground pin 33	Above indications reversed.
BUSY line test Apply 5 Vdc to U4700 -25 (BUSY out)	High at U4700 -39 and 41 (BUSY in) Low at P4700 -11
Ground pin 25	Above indications reversed.

Figure 5-9
Remote Mount Control Head
Microcomputer Board
Schematic Diagram (Sheet 2)

END OF SECTION 5

MOTOROLA LIMITED
Communications Division

SECTION 6. RADIO MICRO-COMPUTER SYSTEM

6.1 RADIO MICROCOMPUTER SYSTEM

The radio microcomputer system consists of the Command Board and the Analog Interface Board. The MDC600/1200 Signalling Filter Board is included if this option is ordered. Connections between the radio microcomputer system and the rest of the radio are provided by the Front Panel Interconnect Board (Figures 6-8, 6-9, 6-10) and the Remote Interface Board used on remote mount radios (Figures 6-11, 6-12, 6-13).

The main functional blocks of the radio microcomputer system are highlighted in Figure 6-1.

Schematics which support the discussion below are inserted at the end of this section.

6.2 COMMAND BOARD

(Figures 6-2, 6-3, 6-4)

Software which is used in the microcomputer U4002 resides in the PROM IC U4004 (programmable read only memory). Operational data (such as frequencies , PL codes, scan lists, zone lists, singletones, MDC signalling information and other user modifiable parameters) resides in EEPROM U4005 and the EEPROM within microcomputer U4002 itself.

User settings are contained in the 2K RAM IC U4006.

There are three latches on this board. Their functions are :

1. Latch U4010 passes frequency information to the synthesizer.

2. Latch U4007 passes control signals to circuitry on the Analog Interface Board.

3. Latch U4003 is used to latch address information from microcomputer U4002. The microcomputer U4002 data bus is multiplexed with the eight least significant address bits (AD0-AD7). The lower order address bits pass through latch U4003 while at the same time the higher order address bits pass directly to memory IC's U4004, U4005 and U4006. After the address is latched , the address bus becomes a data bus. Now data either passes out of the microcomputer U4002 or out of the memory IC's depending on whether a read or write cycle is in progress.

The address decoding for the latches and memory devices is accomplished by the bipolar PROM U4009.

The reset circuit is contained in quad comparator U4000 and resets the microcomputer if either the 13.8 Vdc, 5 Vdc or 5 Vdc continuous supply voltages drop below optimum levels.

The serial bus (which terminates at pins 20 and 21 on microcomputer U4002) is the prime means of communication with the control head and with radio options.

Transmit data (exiting by the TX DATA line) is brought back into microcomputer U4002 on the RX DATA line by means of a bus transceiver (located on the remote interface board of a remote mount radio and on the Control Head Microcomputer Board of a dash mount radio). Microcomputer U4002 then compares the incoming data with the outgoing data to make sure it matches.

The volume control return line will carry a 0-5 volt DC signal depending on the volume control setting. This voltage is converted in microcomputer U4002 to a digital signal which is then sent to the digital volume control IC located on the Front Panel Interconnect Board. The serial peripheral interface lines (MISO (master in , slave out), MOSI (master out, slave in), SCK (serial clock), and SS (slave select)) are used to carry the volume control information.

6.3 ANALOG INTERFACE BOARD

(see Figures 6-5, 6-6, 6-7)

Microcomputer U1702 on the Analog Interface Board communicates with microcomputer U4002 by means of the serial peripheral interface lines mentioned above. Microcomputer U1702 acts as a slave to the main microcomputer U4002 . It drives such hardware lines as the secondary mute (primary mute gate is on the main microcomputer board), and lines which control the audio gates in the receive and transmit path. Also contained are control lines for squelch and external alarm. Most audio shaping is done on this board.

Microcomputer U1702 drives two Digital to Analog converters. One is for the singletone path which is brought out on pins 17, 19, 20 and 21 of U1702 and applied to a five pole filter (part of U1705) and through two audio gates (Q1718, Q1719); one for sidetone and the other for transmit audio. The other Digital to Analog converter is for PL , the path being from pins 13, 14, 15 and 16 on U1702 through another three pole filter (part of U1705) and on to the VCO.

IC U1703 is the receive PL high pass filter and the receive PL low pass filter for the PL decoder.

Two comparators are utilized for the squelch; U1701A for channel activity and U1701B for squelch noise.

U1704A and B perform the transmit audio summing for the VCO.

6.4 FRONT PANEL INTERCONNECT BOARD

(see Figures 6-8, 6-9, 6-10)

The Front Panel Interconnect Board provides for connections among the following :

- Power Interconnect Board
- Synthesizer Board
- Main Board
- Command Board
- Analog Interface Board
- Dash Mount Control Head Microcomputer Board (on dash mount models only)
- Remote Interface Board (on remote mount models only)
- MDC600/1200 Filter Board (if the MDC Signalling option is ordered)

In addition, this board contains a 5 V regulator which provides a 5 V continuous supply when the radio is switched off. This voltage is used to power the random access memory IC (U4006) and the internal RAM of microcomputer U4002 on the Command Board.

Also the digital volume control IC (U351) is located on this board. This IC receives volume level information via a digital signal from microcomputer U4002 on the Command Board (through lines MISO, MOSI, SCK and SS) and sets the volume level accordingly on pin 1 of J 355 (volume control wiper).

6.5 REMOTE INTERFACE BOARD

(see Figures 6-11, 6-12, 6-13)

Most of the Control Head functions in the remote mount models operate in the same manner as the Control Head functions in front mount models. The only difference is that these functions are performed through the Remote Control Head Cable.

Several functions, however, require processing by the Remote Interface Board.

1. A bidirectional invertor (transistors Q2200 to Q2204) carries the reset signal between the microcomputers on the Command Board and the Remote Control Head Microcomputer Board.

2. The RX (receive) DATA and TX (transmit) DATA lines (pins 8 and 11, J365 on Remote Interface Board) are processed by the bus driver circuit (U2200, Q2206, Q2207 and Q2208) to become the Bus + and Bus- lines (pins 13 and 24, J2200). The Bus + and Bus- lines then proceed to

the Remote Mount Control Head Microcomputer Board.

3. Dual op amp U2201 acts as an audio buffer for audio signals on both the FILTERED AUDIO (pin 20, J366) and the DISC AUDIO (pin 17, J366) lines. U2203 acts as an audio buffer for audio signals on the RX BUS AUDIO (pin 1 J2200) line.

4. The power to the radio chassis is controlled by transistor Q2209 which is mounted on the Remote Interface Board. This transistor and associated circuitry is driven via the on-off switch mounted on the Control Head.

5. Regulated 8 volts to power circuitry in the control head is obtained from U2202.

6.6 MDC 600 / 1200 SIGNALLING SYSTEM

(Figures 6-10 and 6-11)

The MDC-600/1200 Signalling System is an option which may be ordered for the MCX1000 radio.

This system is a general purpose data control and information system specifically designed for land mobile operations. It identifies transmitters automatically, and has Emergency Alert capability. A typical system consists of a base station console (with a video display terminal) and several mobile units installed in vehicles. Information needed to operate the system is programmed into each radio and the base station console.

The signalling system uses PSK modulation and demodulation at 600 bps on a 1500 Hz carrier (MDC600 Signalling), or MSK modulation and demodulation at 1200 bps (MDC1200 Signalling). Data is transferred in short bursts or "packets". The sensitivity of the system is better than or equal to the sensitivity required for the reception of intelligible voice.

This system requires the addition of a filter board in the MCX1000 mobile radio. The microcomputer in the MCX1000 mobile performs all of the data modulation, demodulation, encoding, and decoding, and as well, contains the control logic and management functions.

The system can address up to 9,999 unique unit identification codes, 100 group codes, and 10 fleet codes. Each mobile is programmed with a unique unit number, group number, and fleet number. These numbers are used to identify and address the mobile units. All data packets contain the unit number or a combination of group and fleet numbers.

As an option, MDC-600/1200 signalling units may have a special detection algorithm to mute the audio during any data reception. This feature makes the data nearly transparent to listeners of radios equipped with MDC-600/1200 signalling.

Acknowledgement and re-transmission logic makes the basic functions reliable and automatic. The receiving unit acknowledges certain commands issued from the mobile or base unit automatically. The sending unit re-transmits automatically if it does not receive an acknowledgment.

Every mobile MDC-600/1200 unit can have an optional emergency alert switch added. This feature incorporates multiple transmission with acknowledge.

6.6.1 PROGRAMMING THE SYSTEM

All the features and parameters of the system that are utilized by the mobile radio are programmed into the radio microcomputer. This programming may be accomplished using the Field Programmer, which is available as an accessory. With it the customer may program his own mobile ID codes as well as other parameters of the system. The Field Programmer is discussed in section 3.4 of this manual.

6.6.2 SYSTEM FUNCTIONS

Automatic Unit Identification

There are no switches associated with this function. Each unit sends out a unique unit identification code at the beginning of every voice transmission. The microphone PTT switch triggers the transmission of the ID data packet at key-up. This data packet makes the base station console display the transmitting unit's unique

identification number. An option is available to trigger the transmission of the ID data packet on de-key as well.

Sidetone

This feature permits the operator to hear a continuous tone as data is being sent The operator can then adjust to any long system delay to prevent the loss of the first part of the voice transmission. This function is easily disabled once the operator has become accustomed to operating with such a delay.

Radio Check

This feature checks the complete RF link to and from a selected mobile. The console sends a command that causes the mobile to return a "handshake" signal back to the console. This requires no action from the mobile operator.

Emergency Alert

Emergency Alert is an optional feature activated by an external switch. It has absolute priority over any other radio functions currently in progress. In this mode, the mobile unit sends up to 20 data packets. Once a sequence is in progress, only two things can halt it; an acknowledge from the base or removal of power from the mobile unit. During an emergency sequence, the mobile unit gives no visible or audible evidence of transmission.

RADIO B BLOCK DIAGRAM

TO SYNTHESIZER BOARD

REMOTE INTERFACE BOARD

FRONT PANEL INTERCONNECT BOARD

MICROCOMPUTER BOARD

MAIN BOARD

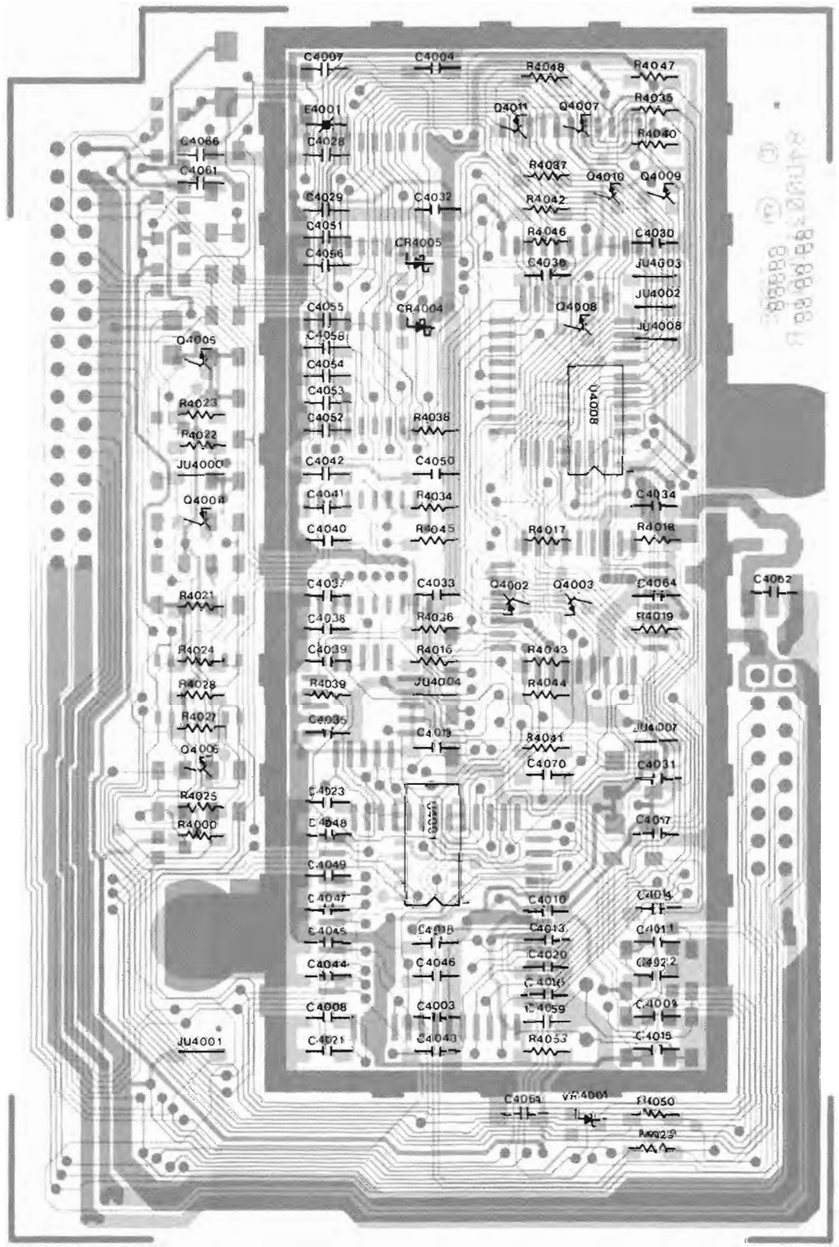
ANALOG INTERFACE BOARD

TO CONTROL HEAD VIA CABLE

TO POWER INTERCONNECT BOARD

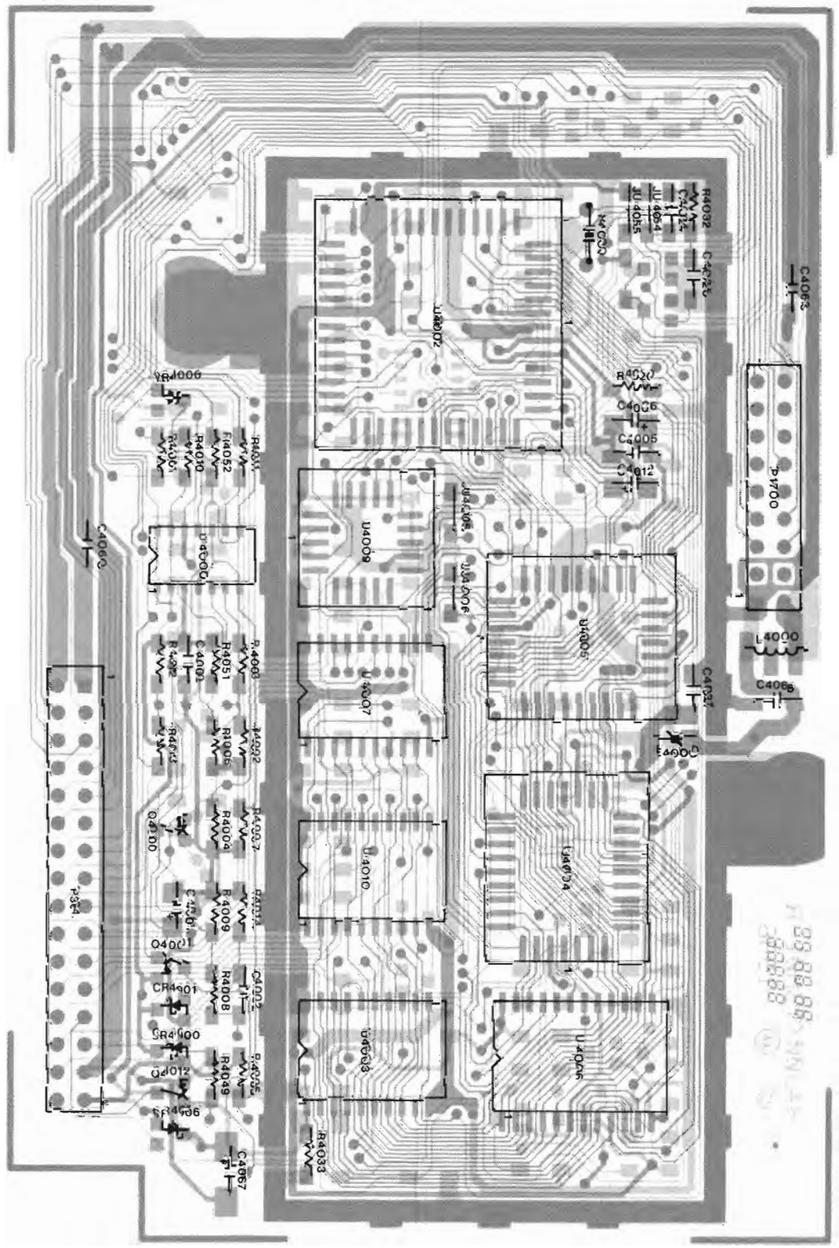
RADIO INTERNAL CABLE

Figure 6-1
Radio Microcomputer System
Functional Block Diagram



SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY



SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00187M-O

Figure 6-2
Command Board
- Board Details

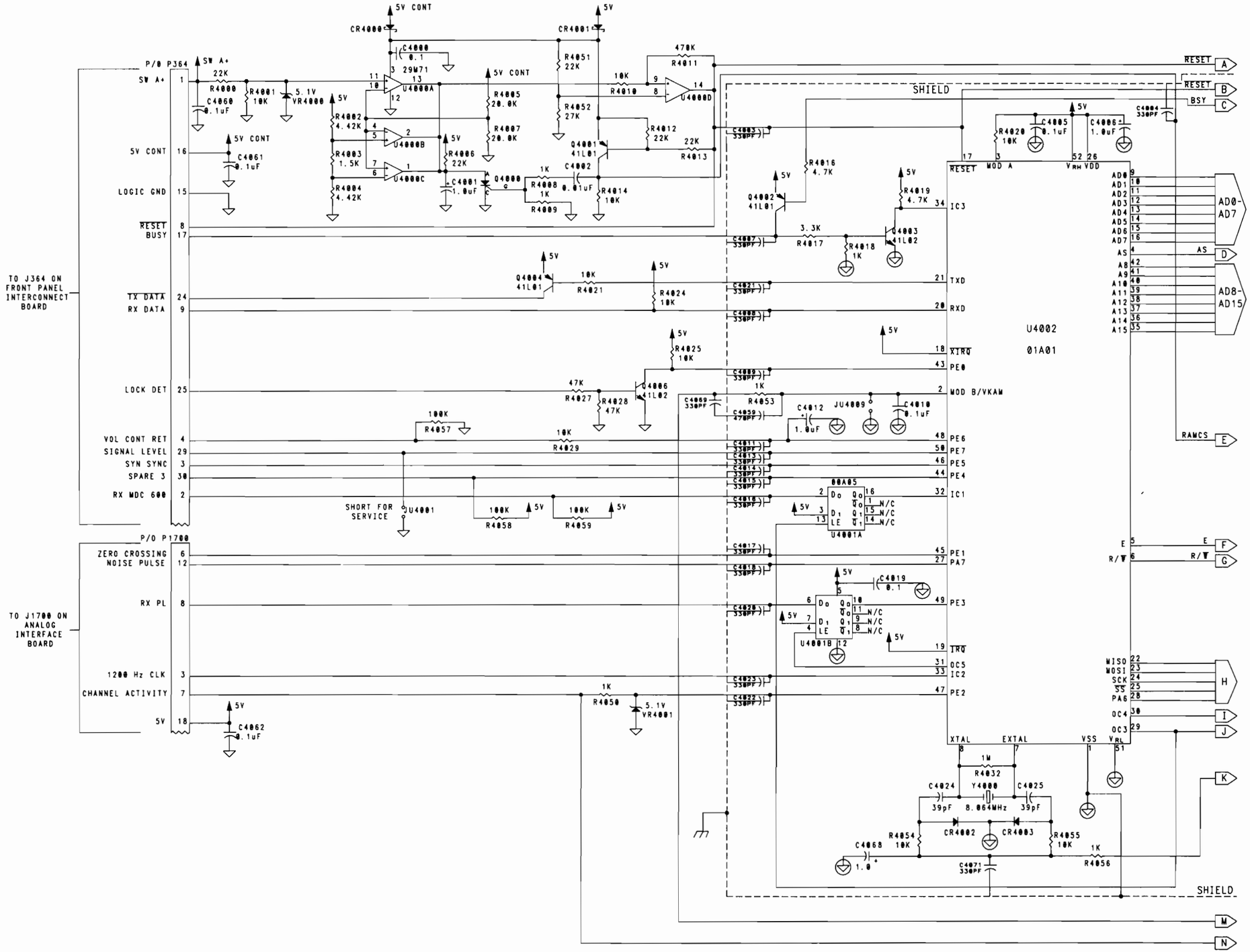
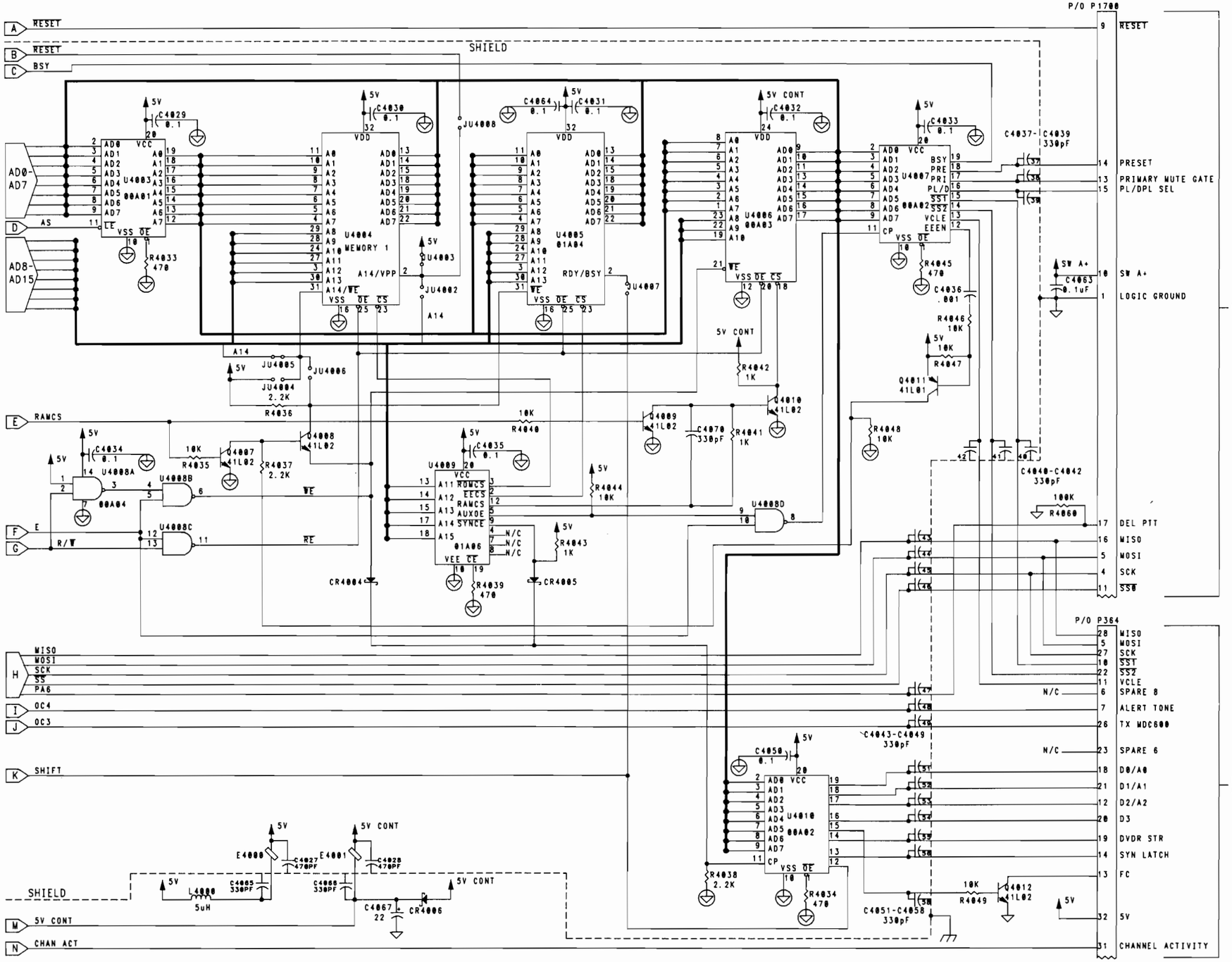


Figure 6-3
Command Board
Schematic Diagram
(Sheet 1)



JUMPER TABLE

JUMPER	PURPOSE
JU4001	IN FOR SERVICE MODE
JU4002	IN FOR 32K EEPROM ONLY
JU4003	IN FOR EPROMS ONLY
JU4004	IN FOR EEPROM WRITE INHIBIT
JU4005	IN FOR 32K EPROM ONLY
JU4006	IN FOR WRITABLE EEPROM
JU4007	OUT FOR EEPROM WITH RDY/BSY PIN
JU4008	IN FOR PAGE MODE EPROM
JU4009	IN TO CONFIGURE MICROCOMPUTER

Figure 6-3 Command Board Schematic Diagram (Sheet 2)

parts list

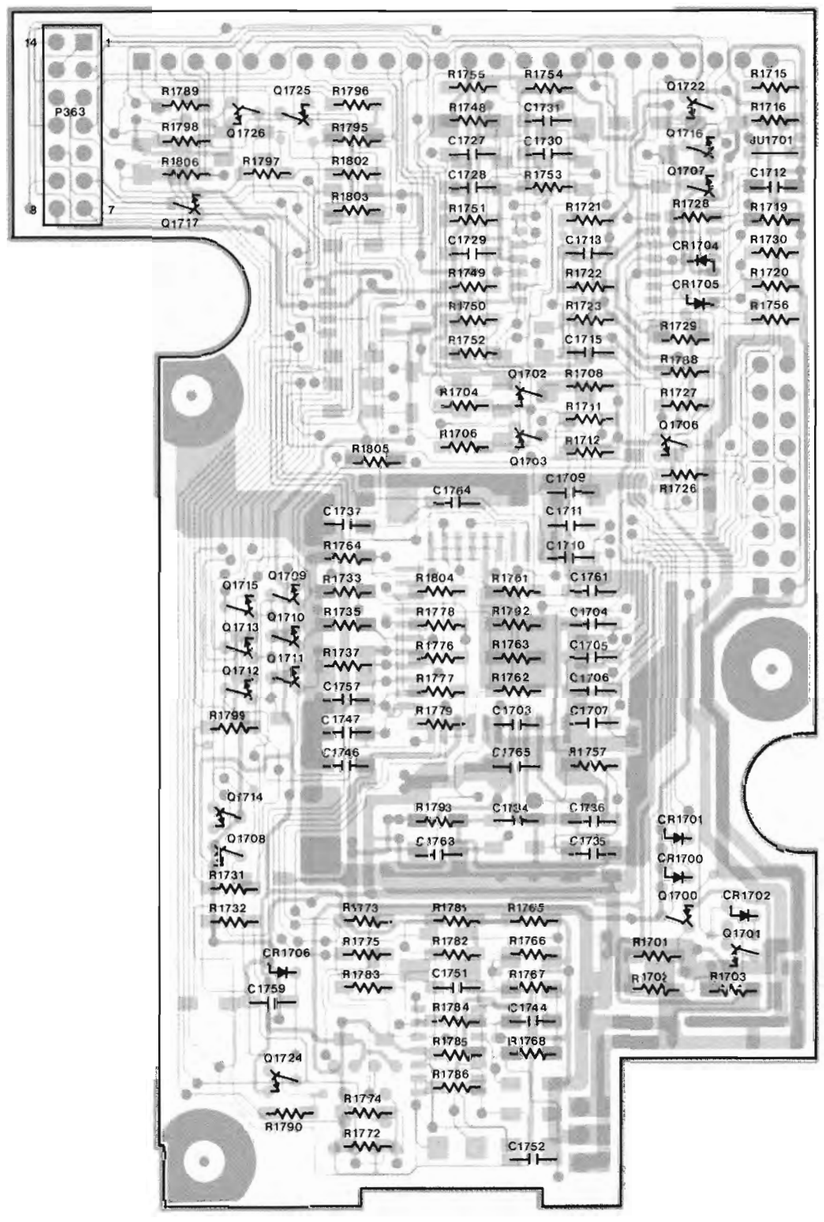
VLN4666A COMMAND BOARD 2K EE
VLN4707A COMMAND BOARD 8K EE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION 80126
	1405160A01	TEFLON INSULATOR
	2600080M01	SHIELD TOP MICROCOMPUTER
	2600081M01	SHIELD BOTTOM MICROCOMPUTER
	2600094M01	SHIELD
		Capacitor, chip, pf (unless stated otherwise)
C4000	2160521F37	.1uf -20-X7R-25V
C4001	2362998D09	CAP TANT CHIP 1.0uf -20-35V
C4002	2111032A21	.01uf -10-X7R-50V
C4003	2111031A51	330-5-NP0-50V
C4004	2111031A51	330-5-NP0-50V
C4005	2160521F37	.1uf -20-X7R-25V
C4006	2362998D09	CAP TANT CHIP 1.0uf -20-35V
C4007	2111031A51	330-5-NP0-50V
C4008	2111031A51	330-5-NP0-50V
C4009	2111031A51	330-5-NP0-50V
C4010	2160521F37	.1uf -20-X7R-25V
C4011	2111031A51	330-5-NP0-50V
C4012	2362998D09	CAP TANT CHIP 1.0uf -20-35V
C4013	2111031A51	330-5-NP0-50V
C4014	2111031A51	330-5-NP0-50V
C4015	2111031A51	330-5-NP0-50V
C4016	2111031A51	330-5-NP0-50V
C4017	2111031A51	330-5-NP0-50V
C4018	2111031A51	330-5-NP0-50V
C4019	2160521F37	.1uf -20-X7R-25V
C4020	2111031A51	330-5-NP0-50V
C4021	2111031A51	330-5-NP0-50V
C4022	2111031A51	330-5-NP0-50V
C4023	2111031A51	330-5-NP0-50V
C4024	2111031A26	30PF-5-NP0-50V
C4025	2111031A26	30PF-5-NP0-50V
C4027	2111059D52	470-5-NPO-50V
C4028	2111059D52	470-5-NPO-50V
C4029	2160521F37	.1uf -20-X7R-25V
C4030	2160521F37	.1uf -20-X7R-25V
C4031	2160521F37	.1uf -20-X7R-25V
C4032	2160521F37	.1uf -20-X7R-25V
C4033	2160521F37	.1uf -20-X7R-25V
C4034	2160521F37	.1uf -20-X7R-25V
C4035	2160521F37	.1uf -20-X7R-25V
C4036	2111032A09	.001uf -10-X7R-50V
C4037	2111031A51	330-5-NP0-50V
C4038	2111031A51	330-5-NP0-50V
C4039	2111031A51	330-5-NP0-50V
C4040	2111031A51	330-5-NP0-50V
C4041	2111031A51	330-5-NP0-50V
C4042	2111031A51	330-5-NP0-50V
C4043	2111031A51	330-5-NP0-50V
C4044	2111031A51	330-5-NP0-50V
C4045	2111031A51	330-5-NP0-50V
C4046	2111031A51	330-5-NP0-50V
C4047	2111031A51	330-5-NP0-50V
C4048	2111031A51	330-5-NP0-50V
C4049	2111031A51	330-5-NP0-50V
C4050	2160521F37	.1uf -20-X7R-25V
C4051	2111031A51	330-5-NP0-50V
C4052	2111031A51	330-5-NP0-50V
C4053	2111031A51	330-5-NP0-50V
C4054	2111031A51	330-5-NP0-50V
C4055	2111031A51	330-5-NP0-50V
C4056	2111031A51	330-5-NP0-50V
C4058	2111031A51	330-5-NP0-50V
C4059	2111059D52	470-5-NPO-50V
C4060	2160521F37	.1uf -20-X7R-25V
C4061	2160521F37	.1uf -20-X7R-25V
C4062	2160521F37	.1uf -20-X7R-25V
C4063	2160521F37	.1uf -20-X7R-25V
C4064	2160521F37	.1uf -10-X7R-50V
C4065	2111031A51	330-5-NPO-50V
C4066	2111031A51	330-5-NPO-50V
C4067	2362998D40	22-20-6.3V
C4069	2111031A51	330-5-NPO-50V
C4070	2111031A51	330-5-NPO-50V

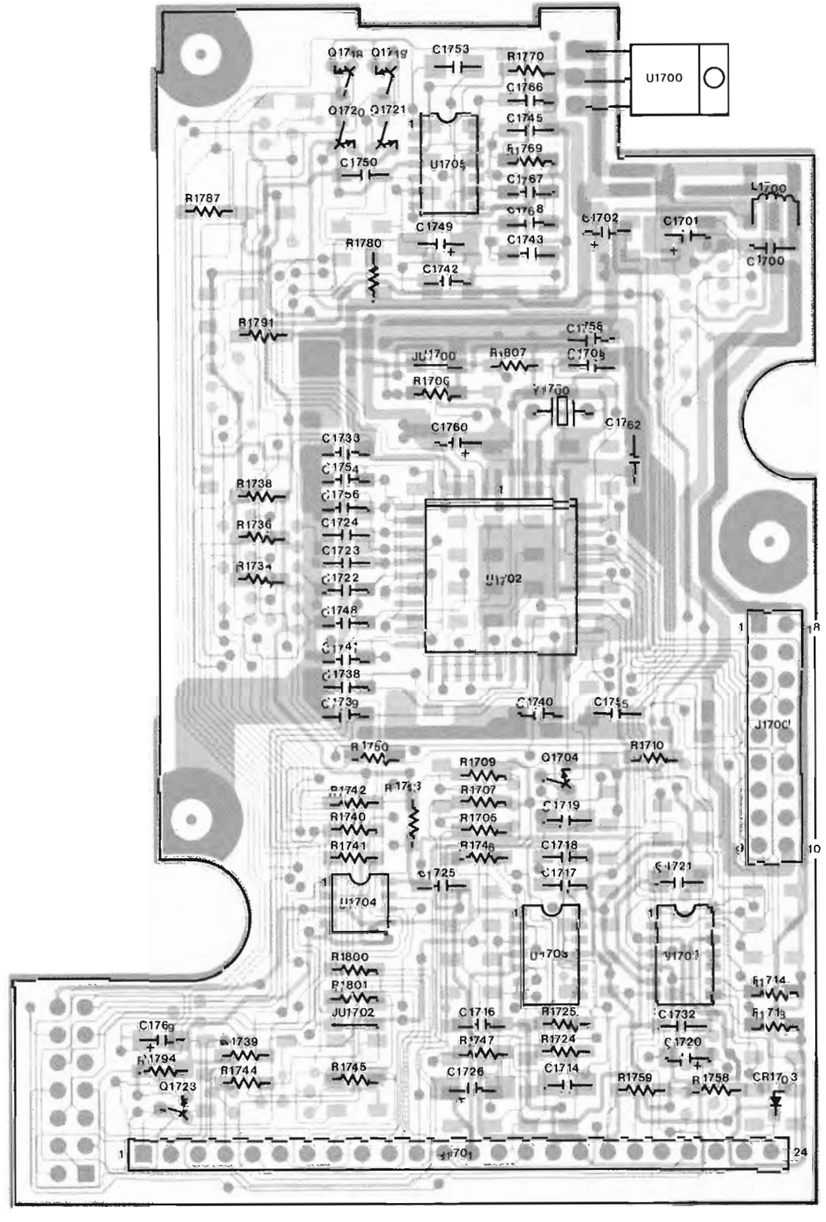
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Ferrite Bead Chip
E4000	7602000A02	55 OHM
E4001	7602000A02	55 OHM
		Diode
CR4000	4802003A02	HC SOT-23
CR4001	4802003A02	HC SOT-23
CR4004	4802003A02	HC SOT-23
CR4005	4802003A02	HC SOT-23
CR4006	4802003A02	HC SOT-23
		Jumper
JU4003	0600016M23	CHIP ZERO OHM
JU4005	0600016M23	CHIP ZERO OHM
JU4054	0600016M23	CHIP ZERO OHM
JU4055	0600016M23	CHIP ZERO OHM
		Coil
L4000	2402001A01	5.5 UH 1A. S.M. CHOKE
		Connector
P1700	2900026M07	STAKE PINS LONG
P364	2900026M01	STAKE PINS
		Transistor
Q4000	4802000A01	SCR SOT-23
Q4001	4880141L01	PNP SOT-23
Q4002	4880141L01	PNP SOT-23
Q4003	4880141L02	NPN SOT-23
Q4004	4880141L01	PNP SOT-23
Q4006	4880141L02	NPN SOT-23
Q4007	4880141L02	NPN SOT-23
Q4008	4880141L02	NPN SOT-23
Q4009	4880141L02	NPN SOT-23
Q4010	4880141L02	NPN SOT-23
Q4011	4880141L01	PNP SOT-23
Q4012	4880141L02	NPN SOT-23
		Resistor, chip
R4000	0600015M81	22K-5-1/8W
R4001	0600015M73	10K-5-1/8W
R4002	0602002A57	4.42K-1-1/8W
R4003	0600015M53	1.5K-5-1/8W
R4004	0602002A57	4.42K-1-1/8W
R4005	0602003A21	20.0K-1-1/8W
R4006	0600015M81	22K-5-1/8W
R4007	0602003A21	20.0K-1-1/8W
R4008	0600015M49	1K-5-1/8W
R4009	0600015M49	1K-5-1/8W
R4010	0600015M73	10K-5-1/8W
R4011	0600016M14	470K-5-1/8W
R4012	0600015M81	22K-5-1/8W
R4013	0600015M81	22K-5-1/8W
R4014	0600015M73	10K-5-1/8W
R4016	0600015M65	4.7K-5-1/8W
R4017	0600015M61	3.3K -5-1/8W
R4018	0600015M49	1K-5-1/8W
R4019	0600015M65	4.7K-5-1/8W
R4020	0600015M73	10K-5-1/8W
R4021	0600015M73	10K-5-1/8W
R4024	0600015M73	10K-5-1/8W
R4025	0600015M73	10K-5-1/8W
R4027	0600015M89	47K-5-1/8W
R4028	0600015M89	47K-5-1/8W
R4029	0600015M73	10K-5-1/8W
R4032	0600016M22	1M-5-1/8W
R4033	0600015M41	470-5-1/8W
R4034	0600015M41	470-5-1/8W
R4035	0600015M73	10K-5-1/8W

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R4036	0600015M57	2.2K-5-1/8W
R4037	0600015M57	2.2K-5-1/8W
R4038	0600015M57	2.2K-5-1/8W
R4039	0600015M41	470-5-1/8W
R4040	0600015M73	10K-5-1/8W
R4041	0600015M49	1K-5-1/8W
R4042	0600015M49	1K-5-1/8W
R4043	0600015M49	1K-5-1/8W
R4044	0600015M73	10K-5-1/8W
R4045	0600015M41	470-5-1/8W
R4046	0600015M73	10K-5-1/8W
R4047	0600015M73	10K-5-1/8W
R4048	0600015M73	10K-5-1/8W
R4049	0600015M73	10K-5-1/8W
R4050	0600015M49	1K-5-1/8W
R4051	0600015M81	22K-5-1/8W
R4052	0600015M83	27K-5-1/8W
R4053	0600015M49	1000-5-1/8W
		Integrated Circuit
U4000	5183629M71	QUAD COMP 29M71 SOIC
U4001	5102000A05	DUAL LATCH 00A05 SOIC
U4002	5102001A01	MICRO P 01A01 PLCC
U4003	5102000A01	OCTAL LATCH 00A01 SOIC
U4004	0102700A59	EPROM 0TP 32KX8 00A55 PLCC
U4005	5167403B01	EEPROM 2KX8 03B01 PLCC (VLN4666A only)
	5162500B01	EEPROM 8K X 8 00B01 PLCC (VLN4707A only)
U4006	5102000A03	CMOS RAM FLAT PACK 00A03
U4007	5102000A02	OCTAL D F/F 00A02 SOIC
U4008	5102000A04	QUAD NAND 00A04 SOIC
U4009	0102700A52	BI PROM 32X8 00A52 PLCC
U4010	5102000A02	OCTAL D F/F 00A02 SOIC
		Diode, zener
VR4000	4880140L06	SOT23 5.1V
VR4001	4880140L06	SOT23 5.1V
		Crystal
Y4000	4802001A01	8.0640 MHZ LOW PROFILE

Figure 6-4
Command Board Parts List



SHOWN FROM SOLDER SIDE



SHOWN FROM COMPONENT SIDE

31H00188M-A

SOLDER SIDE - RED
COMPONENT SIDE - GREY

SOLDER SIDE - RED
COMPONENT SIDE - GREY

Figure 6-5
Analog Interface Board
- Board Details

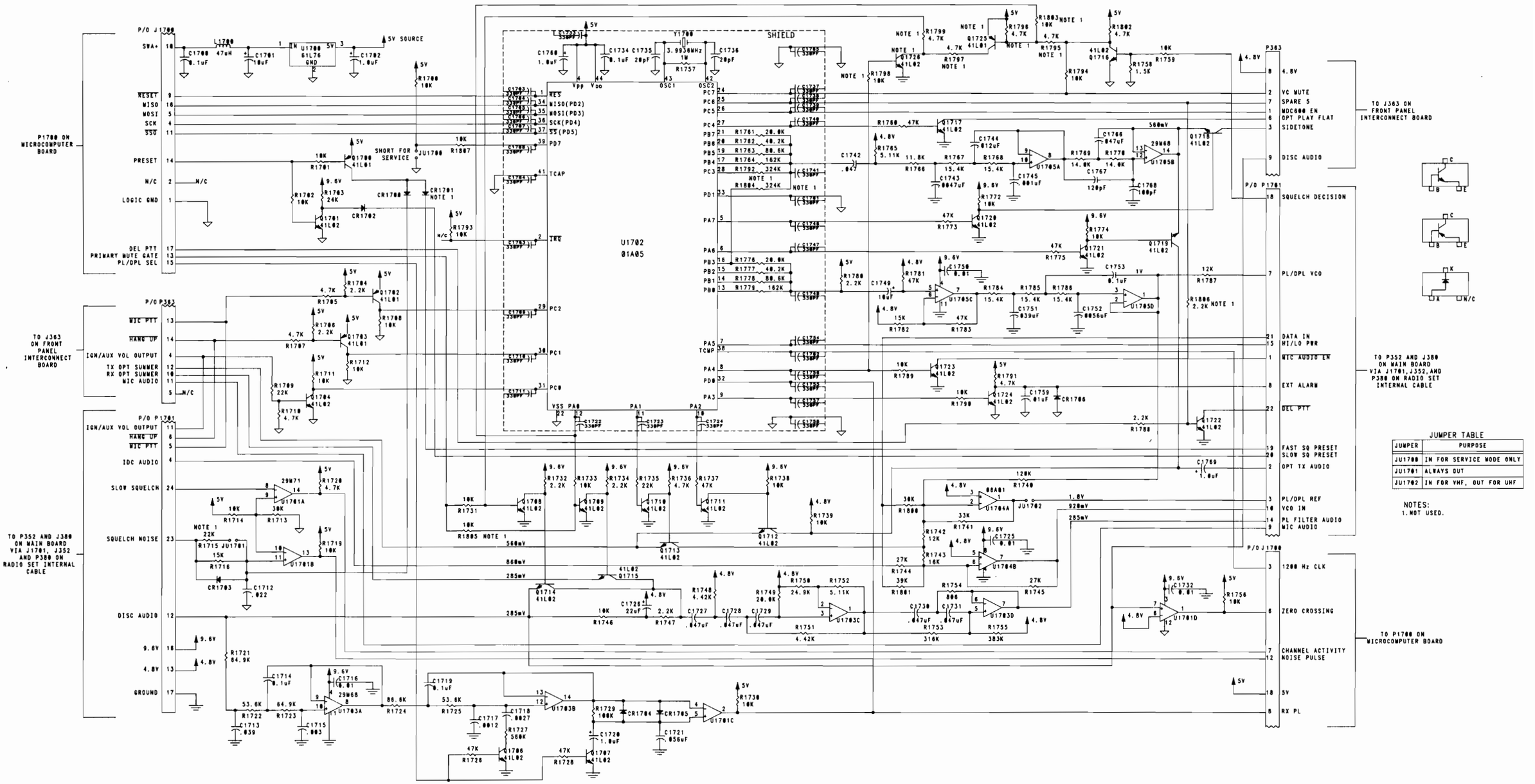


Figure 6-6
Analog Interface Board
Schematic Diagram

6300654M-B

parts list

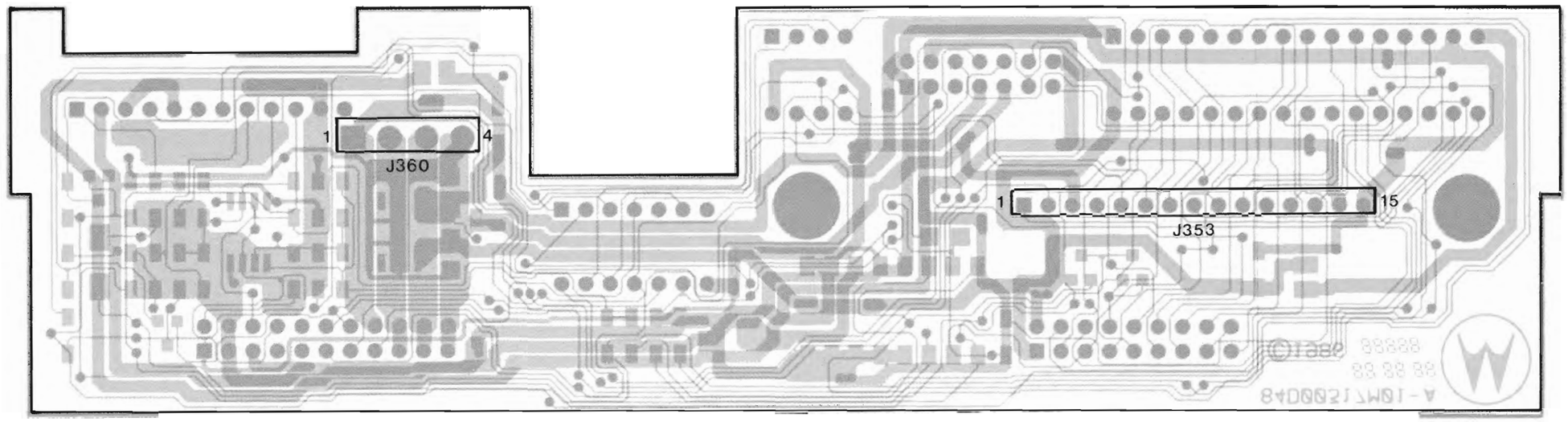
VLN4664B ANALOG INTERFACE BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION 80113
		Capacitor, chip, pf (unless stated otherwise)
C1700	2160521F37	0.1 uf-20-X7R-25V
C1701	2362998D32	TANT 10uf -20-25V
C1702	2362998D09	TANT 1.0uf -20-35V
C1703	2111031A51	330-5-NP0-50V
C1704	2111031A51	330-5-NP0-50V
C1705	2111031A51	330-5-NP0-50V
C1706	2111031A51	330-5-NP0-50V
C1707	2111031A51	330-5-NP0-50V
C1708	2111031A51	330-5-NP0-50V
C1709	2111031A51	330-5-NP0-50V
C1710	2111031A51	330-5-NP0-50V
C1711	2111031A51	330-5-NP0-50V
C1712	2111032A25	.022 uf- 10-X7R-50V
C1713	2102000A55	.039uf -5-X7F-50V
C1714	2102000A65	.1uf -5-X7F-50V
C1715	2102000A28	.003uf -5-X7F-50V
C1716	2111032A21	.01uf -10-X7R-50V
C1717	2102000A19	.0012uf -5-X7F-50V
C1718	2102000A27	.0027uf -5-X7F-50V
C1719	2102000A65	.1uf -5-X7F-50V
C1720	2362998D09	TANT 1.0uf -20-35V
C1721	2102000A59	.056uf -5-X7F-50V
C1722	2111031A51	330-5-NP0-50V
C1723	2111031A51	330-5-NP0-50V
C1724	2111031A51	330-5-NP0-50V
C1725	2111032A21	.01uf -10-X7R-50V
C1726	2362998D40	TANT 22uf -20-6.3V
C1727	2102000A57	.047uf -5-X7F-50V
C1728	2102000A57	.047uf -5-X7F-50V
C1729	2102000A57	.047uf -5-X7F-50V
C1730	2102000A57	.047uf -5-X7F-50V
C1731	2102000A57	.047uf -5-X7F-50V
C1732	2111032A21	.01uf -10-X7R-50V
C1733	2111031A51	330-5-NP0-50V
C1734	2160521F37	0.1 uf-20-X7R-25V
C1735	2111031A22	20PF-5-NPO-50V
C1736	2111031A22	20PF-5-NPO-50V
C1737	2111031A51	330-5-NP0-50V
C1738	2111031A51	330-5-NP0-50V
C1739	2111031A51	330-5-NP0-50V
C1740	2111031A51	330-5-NP0-50V
C1741	2111031A51	330-5-NP0-50V
C1742	2102000A57	.047uf-5-50V
C1743	2102000A33	.0047uf-5-50V
C1744	2102000A43	.012uf-5-X7F-50V
C1745	2102000A17	.001uf-5-50V
C1746	2111031A51	330-5-NP0-50V
C1747	2111031A51	330-5-NP0-50V
C1748	2111031A51	330-5-NP0-50V
C1749	2362998D33	TANT 10uf -20-16V
C1750	2111032A21	.01uf -10-X7R-50V
C1751	2102000A55	.039uf -5-X7F-50V
C1752	2102000A35	.0056uf -5-X7F-50V
C1753	2102000A65	.1uf -5-X7F-50V
C1754	2111031A51	330-5-NP0-50V
C1755	2111031A51	330-5-NP0-50V
C1756	2111031A51	330-5-NP0-50V
C1757	2111031A51	330-5-NP0-50V
C1758	2111031A51	330-5-NP0-50V
C1759	2111032A21	.01uf -10-X7R-50V
C1760	2362998D09	TANT 1.0uf -20-35V
C1761	2111031A51	330-5-NP0-50V
C1762	2111031A51	330-5-NP0-50V
C1763	2111031A51	330-5-NP0-50V
C1764	2111031A51	330-5-NP0-50V
C1765	2111031A51	330-5-NP0-50V
C1766	2102000A57	.047uf-5-50V
C1767	2111031A41	120-5-NPO-50V
C1768	2111031A39	100-5-NPO-50V
C1769	2362998D09	TANT-1.0uf-20-35V

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Diode
CR1700	4802003A01	MMBD914
CR1702	4802003A01	MMBD914
CR1703	4802003A01	MMBD914
CR1704	4802003A01	MMBD914
CR1705	4802003A01	MMBD914
CR1706	4802003A01	MMBD914
		Jumper
J1700	0900076M10	CONNECTOR FEM 18 PIN
JU1702	0600016M23	JUMPER CHIP ZERO OHM
		Coil
L1700	2402000A01	CHOKE 50 UH
		Connector
P1701	2900026M01	STAKE PINS (23 used)
P363	2800043M08	CONN MALE 14 POS 2X7 VERT
		Transistor, SOT-23 MMBT3904 (unless stated otherwise)
Q1700	4880141L01	PNP SOT-23 MMBT3906
Q1701	4880141L02	NPN
Q1702	4880141L01	PNP SOT-23 MMBT3906
Q1703	4880141L01	PNP SOT-23 MMBT3906
Q1704	4880141L02	NPN
Q1706	4880141L02	NPN
Q1707	4880141L02	NPN
Q1708	4880141L02	NPN
Q1709	4880141L02	NPN
Q1710	4880141L02	NPN
Q1711	4880141L02	NPN
Q1712	4880141L02	NPN
Q1713	4880141L02	NPN
Q1714	4880141L02	NPN
Q1715	4880141L02	NPN
Q1716	4880141L02	NPN
Q1717	4880141L02	NPN
Q1718	4880141L02	NPN
Q1719	4880141L02	NPN
Q1720	4880141L02	NPN
Q1721	4880141L02	NPN
Q1722	4880141L02	NPN
Q1723	4880141L02	NPN
Q1724	4880141L02	NPN
		Resistor, chip, 5%, 1/8 W (unless stated otherwise)
R1700	0600015M73	10K
R1701	0600015M73	10K
R1702	0600015M73	10K
R1703	0600015M82	24K
R1704	0600015M57	2.2K
R1705	0600015M65	4.7K
R1706	0600015M57	2.2K
R1707	0600015M65	4.7K
R1708	0600015M73	10K
R1709	0600015M81	22K
R1710	0600015M65	4.7K
R1711	0600015M73	10K
R1712	0600015M73	10K
R1713	0600015M84	30K
R1714	0600015M73	10K
R1716	0600015M77	15K
R1719	0600015M73	10K
R1720	0600015M65	4.7K
R1721	0602003A70	64.9K-1

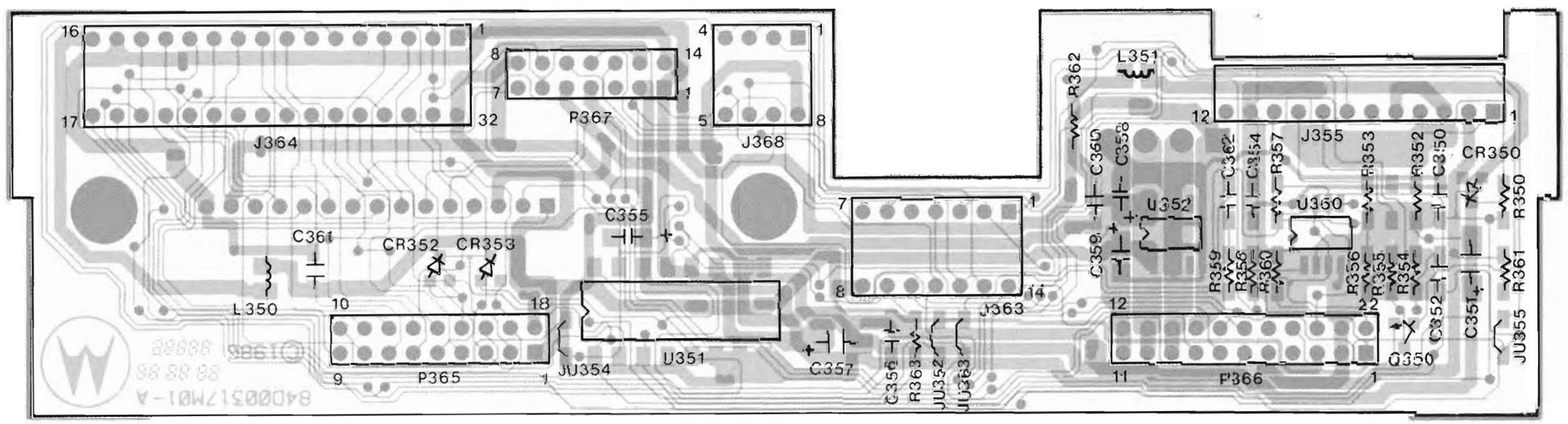
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION 71126
R1722	0602003A62	53.6K-1
R1723	0602003A70	64.9K-1
R1724	0602003A82	86.6K-1
R1725	0602003A62	53.6K-1
R1726	0600015M89	47K
R1727	0600016M16	560K
R1728	0600015M89	47K
R1729	0600015M97	100K
R1730	0600015M73	10K
R1731	0600015M73	10K
R1732	0600015M57	2.2K
R1733	0600015M73	10K
R1734	0600015M57	2.2K
R1735	0600015M81	22K
R1736	0600015M65	4.7K
R1737	0600015M89	47K
R1738	0600015M73	10K
R1739	0600015M73	10K
R1740	0600015M99	120K
R1741	0600015M85	33K
R1742	0600015M75	12K
R1743	0600015M78	16K
R1744	0600015M83	27K
R1745	0600015M83	27K
R1746	0600015M73	10K
R1747	0600015M57	2.2K
R1748	0602002A57	4.42K-1
R1749	0602003A21	20.0K-1
R1750	0602003A30	24.9K-1
R1751	0602002A57	4.42K-1
R1752	0602002A63	5.11K-1
R1753	0602004A37	316K-1
R1754	0602001A85	806-1
R1755	0602004A45	383K-1
R1756	0600015M73	10K
R1757	0600016M22	1M
R1758	0600015M53	1.5K
R1759	0600015M73	10K
R1760	0600015M89	47K
R1761	0602003A21	20.0K-1
R1762	0602003A50	40.2K-1
R1763	0602003A79	80.6K-1
R1764	0602004A09	162K-1
R1765	0602002A63	5.11K-1-1/8W
R1766	0602002A98	11.8K-1-1/8W
R1767	0602003A10	15.4K-1-1/8W
R1768	0602003A10	15.4K-1-1/8W
R1769	0602003A06	14.0K-1-1/8W
R1770	0602003A06	14.0K-1-1/8W
R1772	0600015M73	10K
R1773	0600015M89	47K
R1774	0600015M73	10K
R1775	0600015M89	47K
R1776	0602003A21	20.0K-1-1/8W
R1777	0602003A50	40.2K-1-1/8W
R1778	0602003A79	80.6K-1-1/8W
R1779	0602004A09	162K-1-1/8W
R1780	0600015M57	2.2K
R1781	0600015M89	47K
R1782	0600015M77	15K
R1783	0600015M89	47K
R1784	0602003A10	15.4K-1-1/8W
R1785	0602003A10	15.4K-1-1/8W
R1786	0602003A10	15.4K-1-1/8W
R1787	0600015M75	12K
R1788	0600015M57	2.2K
R1789	0600015M73	10K
R1790	0600015M73	10K
R1793	0600015M73	10K
R1794	0600015M65	4.7K
R1800	0600015M84	30K
R1801	0600015M87	39K
R1802	0600015M57	2.2K
R1807	0600015M73	10K
R1808	0660075A65	4.7K-F.C.
		Integrated Circuit
U1700	5184561L76	REG 5V 1A TO220 7805
U1701	5183629M71	QUAD COMP LM339D SOIC
U1702	5102001A05	U.P MC68HC05C4CFN SERIAL PIA
U1703	5183629M68	QUAD OP-AMP MC3403D SOIC
U1704	5102006A01	DUAL OP AMP MC1458 SOIC
U1705	5183629M68	QUAD OP-AMP MC3403D SOIC
Y1700	4802001A03	CRYSTAL 3.9936 MHZ LOW PROFILE
		Non-referenced items
	1405160A01	TEFLON INSULATOR (5 used)

Figure 6-7
Analog Interface Board Parts List



SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

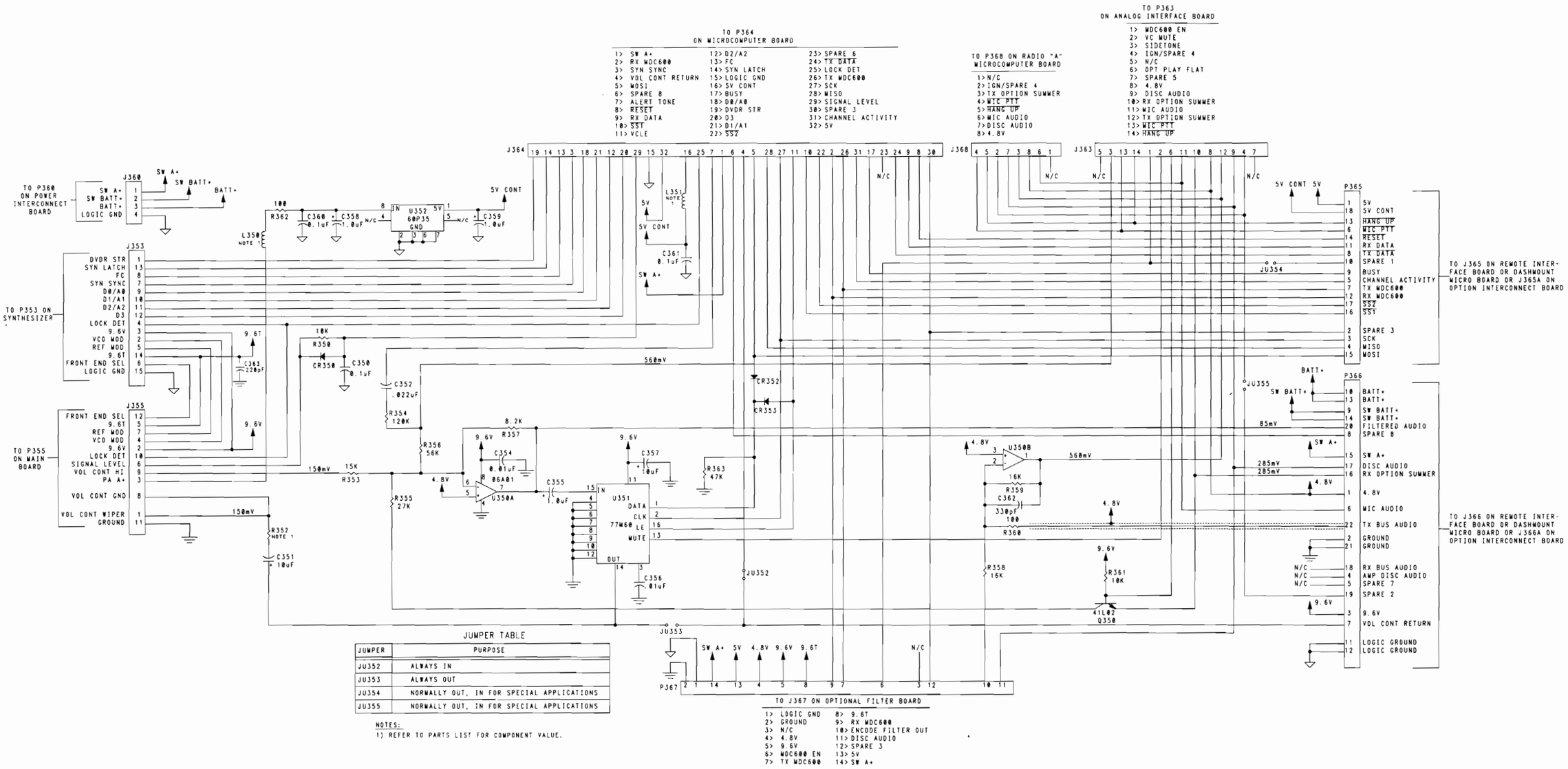


SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00189M-O

Figure 6-8
Front Panel Interconnect Board
- Board Details



JUMPER TABLE

JUMPER	PURPOSE
JU352	ALWAYS IN
JU353	ALWAYS OUT
JU354	NORMALLY OUT, IN FOR SPECIAL APPLICATIONS
JU355	NORMALLY OUT, IN FOR SPECIAL APPLICATIONS

NOTES:
1) REFER TO PARTS LIST FOR COMPONENT VALUE.

6300655M-O

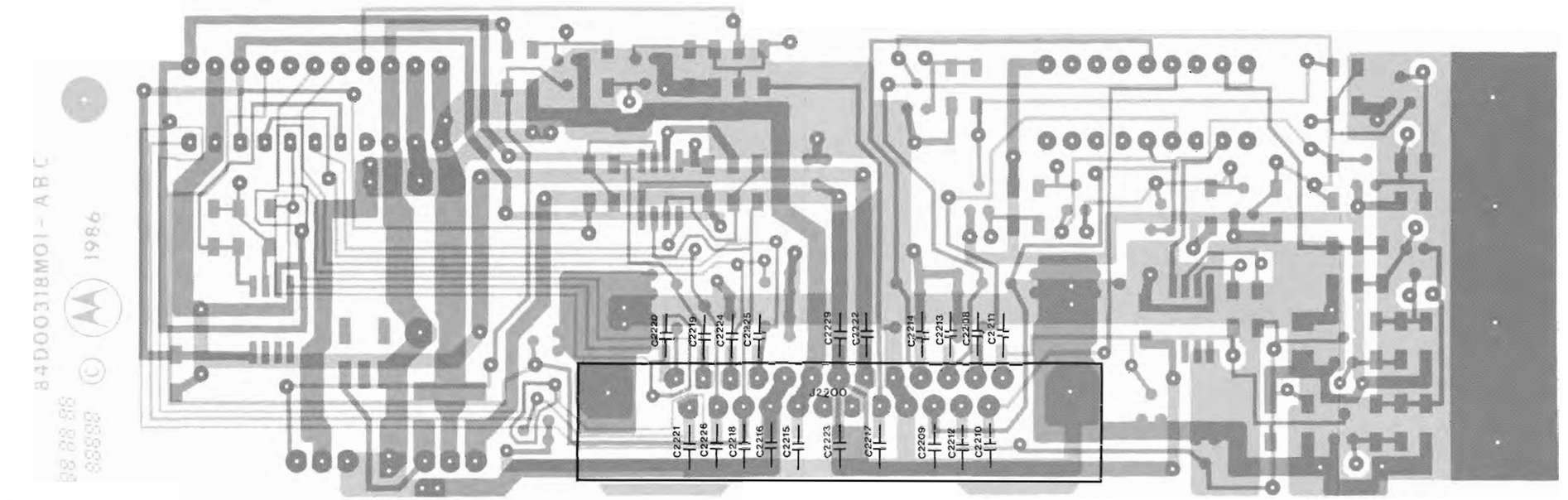
Figure 6-9
Front Panel Interconnect Board Schematic Diagram

parts list

VLN4663A FRONT PANEL INTERCONNECT BOARD

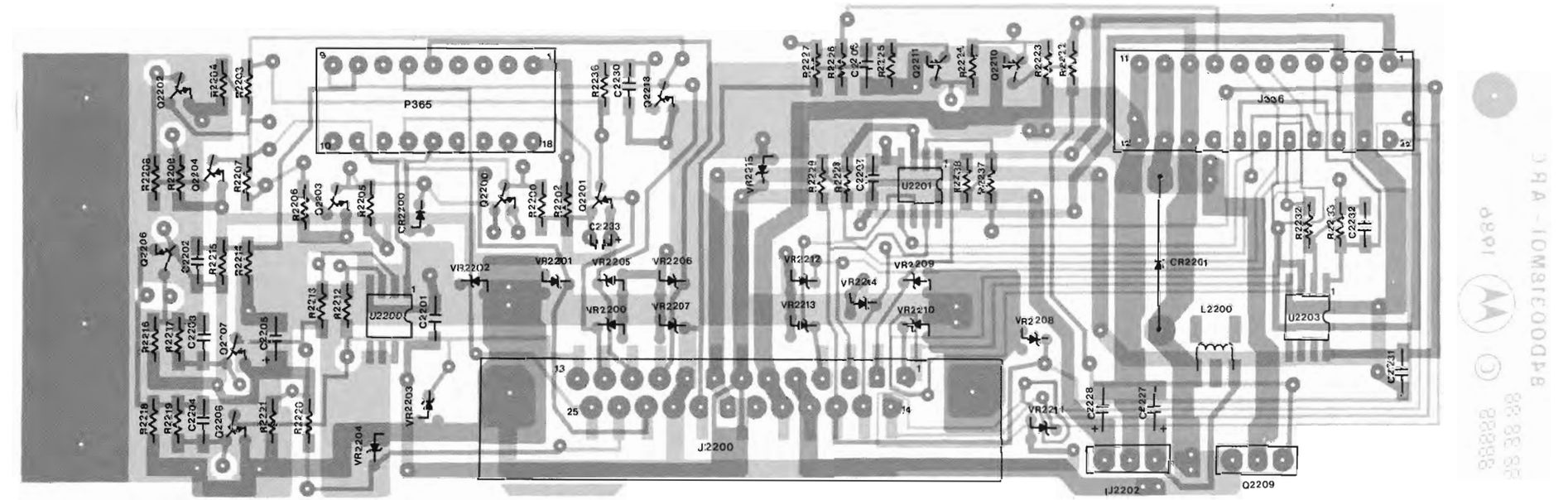
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor ,chip, uf (unless stated otherwise)
C350	2160521F37	0.1 -20-X7R-25V
C351	2362998D33	tant 10-20-16V
C352	2111032A25	.022-10-X7R-50V
C354	2111032A21	.01-10-X7R-50V
C355	2362998D09	tant 1.0-20-35V
C356	2111032A21	.01-10-X7R-50V
C357	2362998D33	tant 10-20-16V
C358	2362998D09	tant 1.0-20-35V
C359	2362998D09	tant 1.0-20-35V
C360	2160521F37	0.1 -20-X7R-25V
C361	2160521F37	0.1 -20-X7R-25V
C362	2111031A51	330 pf -5-NPO-50V
C263	2111022M50	CER DISC 220pf -5-P350-N1000
		Hot diode
CR350	4802003A01	MMBD914
CR352	4802003A01	MMBD914
CR353	4802003A01	MMBD914
		Connector
J353	0102700A29	synthesizer
J355	0982846L03	12 pin fem right angle
J360	2883878M01	4 pin male right angle
J363	0900076M03	14POS 2X7 HORIZ
J364	0900076M08	FEM 32POS 2X16 horiz
		Jumper chip
JU352	0600016M23	zero ohm
L350	0600016M23	zero ohm
L351	0600016M23	zero ohm
		Stake pins
P365	2900026M07	long
P366	2900026M07	long
P367	2900026M01	
		Transistor
Q350	4880141L02	NPN SOT-23 MMBT3904
		Resistor (chip type) ±5% 1/8 W
R350	0600015M73	10K
R351		NOT USED
R352	0600016M23	zero ohm
R353	0600015M77	15K
R354	0600015M99	120K
R355	0600015M83	27K
R356	0600015M91	56K
R357	0600015M71	8.2K
R358	0600015M78	16K
R359	0600015M78	16K
R360	0600015M25	100
R361	0600015M73	10K
R362	0600015M25	100
R363	0600015M89	47K
		Integrated circuit
U350	5102006A01	dual op amp MC1458 SOIC
U351	5183977M60	digital volume control SC7760PH
U352	5182760P35	volt reg. 5V 76R13

Figure 6-10
Front Panel Interconnect Board
Parts List



SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

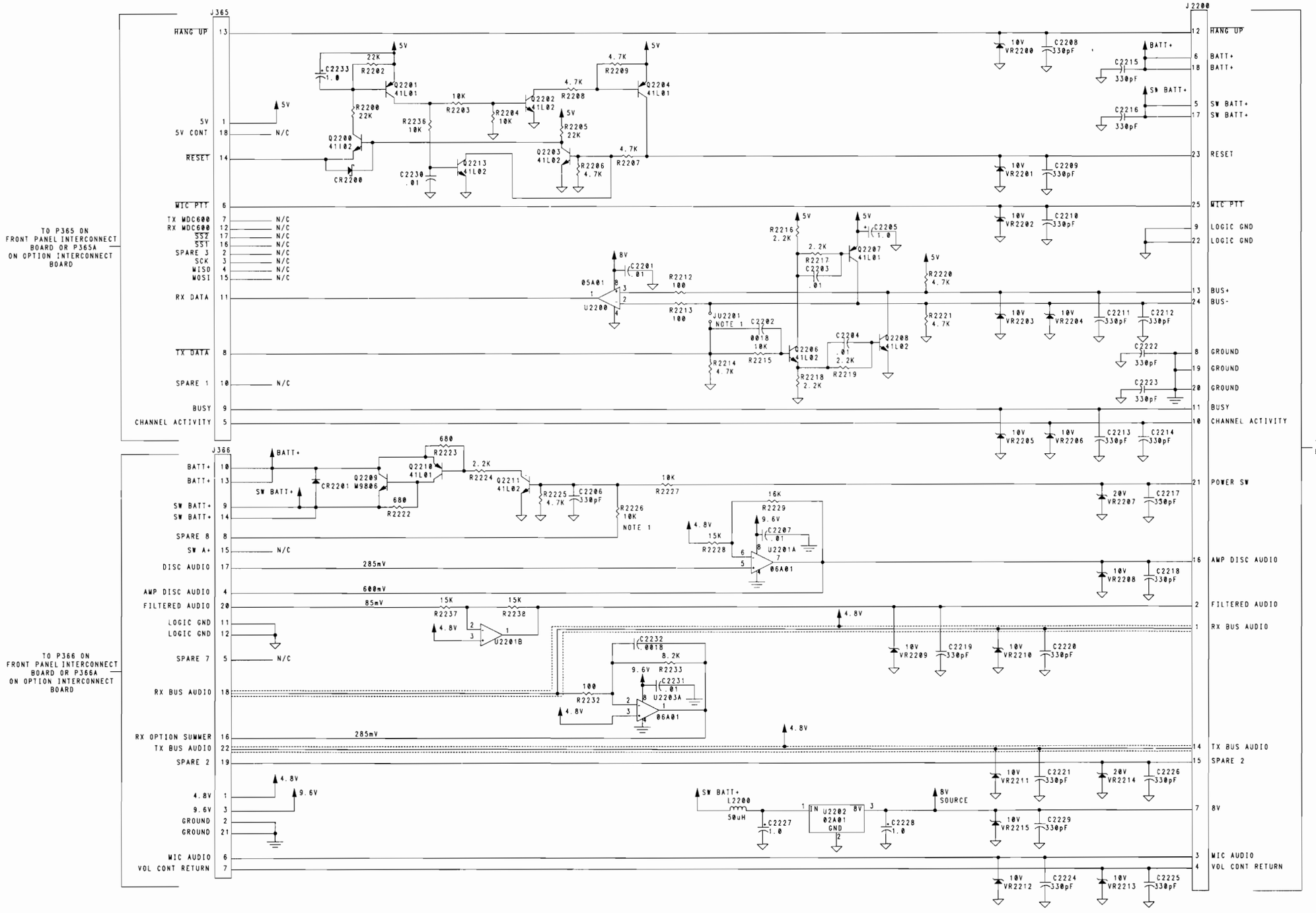


SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00190M-O

Figure 6-11
Remote Interface Board
- Board Details



6300656M-O

Figure 6-12
Remote Interface Board
Schematic Diagram

parts list

VLN4665A REMOTE INTERFACE BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, chip, pf, 5%, NPO,50V (unless stated otherwise)
C2201	2111032A21	.01uf-10-X7R-50V
C2202	2111032A12	.0018uf-10-X7R-50V
C2203	2111032A21	.01uf-10-X7R-50V
C2204	2111032A21	.01uf-10-X7R-50V
C2205	2362998D09	CAP TANT CHIP 1.0uf-20-35V
C2206	2111031A51	330
C2207	2111032A21	.01uf-10-X7R-50V
C2208	2111031A51	330
C2209	2111031A51	330
C2210	2111031A51	330
C2211	2111031A51	330
C2212	2111031A51	330
C2213	2111031A51	330
C2214	2111031A51	330
C2215	2111031A51	330
C2216	2111031A51	330
C2217	2111031A51	330
C2218	2111031A51	330
C2219	2111031A51	330
C2220	2111031A51	330
C2221	2111031A51	330
C2222	2111031A51	330
C2223	2111031A51	330
C2224	2111031A51	330
C2225	2111031A51	330
C2226	2111031A51	330
C2227	2362998D09	CAP TANT CHIP 1.0uf-20-35V
C2228	2362998D09	CAP TANT CHIP 1.0uf-20-35V
C2229	2111031A51	330
C2230	2111032A21	.01uf-10-X7F-50V
C2231	2111032A21	.01uf-10-X7F-50V
C2233	2384538G01	SOL TANT 1.0-20-35V
		Diode
CR2200	4802003A02	HC SOT-23
CR2201	4882525G19	SLCN 25G19 100V
		Connectors
J2200	0900077M01	25PIN PLASTIC D-SUB
J365	0900076M01	18PIN FEM BERG#65000-209
J366	0900076M07	FEM 22PIN BERG#65000-211
		Choke
L2200	2402000A02	50 uH
		Transistor
Q2200	4880141L02	NPN SOT-23 MMBT3904
Q2201	4880141L01	PNP SOT-23 MMBT3906
Q2202	4880141L02	NPN SOT-23 MMBT3904
Q2203	4880141L02	NPN SOT-23 MMBT3904
Q2204	4880141L01	PNP SOT-23 MMBT3906
Q2206	4880141L02	NPN SOT-23 MMBT3904
Q2207	4880141L01	PNP SOT-23 MMBT3906
Q2208	4880141L02	NPN SOT-23 MMBT3904
Q2209	4800869806	M9806
Q2210	4880141L01	PNP SOT-23 MMBT3906
Q2211	4880141L02	NPN SOT-23 MMBT3904
Q2213	4880141L02	NPN SOT-23 MMBT3904
		Resistor, chip (unless stated otherwise)
R2200	0600015M81	22K-5-1/8W
R2202	0600015M81	22K-5-1/8W
R2203	0600015M73	10K-5-1/8W
R2204	0600015M73	10K-5-1/8W
R2205	0600015M81	22K-5-1/8W
R2206	0600015M65	4.7K-5-1/8W
R2207	0600015M65	4.7K-5-1/8W
R2208	0600015M65	4.7K-5-1/8W
R2209	0600015M65	4.7K-5-1/8W
R2212	0600015M25	100-5-1/8W
R2213	0600015M25	100-5-1/8W
R2214	0600015M65	4.7K-5-1/8W
R2215	0600015M73	10K-5-1/8W
R2216	0600015M57	2.2K-5-1/8W
R2217	0600015M57	2.2K-5-1/8W
R2218	0600015M57	2.2K-5-1/8W
R2219	0600015M57	2.2K-5-1/8W
R2220	0600015M65	4.7K-5-1/8W
R2221	0600015M65	4.7K-5-1/8W
R2222	0600015M45	680 OHMS-5-1/8W
R2223	0600015M45	680 OHMS-5-1/8W
R2224	0600015M57	2.2K-5-1/8W
R2225	0600015M65	4.7K-5-1/8W
R2227	0600015M73	10K-5-1/8W
R2228	0600015M77	15K-5-1/8W
R2229	0600015M78	RES 16K CHIP 5-1/8W
R2232	0600015M25	100-5-1/8W
R2233	0600015M71	8.2K-5-1/8W
R2236	0600015M73	10K-5-1/8W
R2237	0600015M77	15K-5-1/8W
R2238	0600015M77	15K-5-1/8W
		Integrated Circuit
U2200	5102005A01	DUAL COMPARATOR S01C
U2201	5102006A01	DUAL OP AMP S0IC
U2202	5102002A01	REG 8V 3A TO220
U2203	5102006A01	DUAL OP AMP S0IC
		Diode, zener
VR2200	4811058B02	SOT-23 MMBZ5240 10V
VR2201	4811058B02	SOT-23 MMBZ5240 10V
VR2202	4811058B02	SOT-23 MMBZ5240 10V
VR2203	4811058B02	SOT-23 MMBZ5240 10V
VR2204	4811058B02	SOT-23 MMBZ5240 10V
VR2205	4811058B02	SOT-23 MMBZ5240 10V
VR2206	4811058B02	SOT-23 MMBZ5240 10V
VR2207	4880140L25	20.0 VOLT
VR2208	4811058B02	SOT-23 MMBZ5240 10V
VR2209	4811058B02	SOT-23 MMBZ5240 10V
VR2210	4811058B02	SOT-23 MMBZ5240 10V
VR2211	4811058B02	SOT-23 MMBZ5240 10V
VR2212	4811058B02	SOT-23 MMBZ5240 10V
VR2213	4811058B02	SOT-23 MMBZ5240 10V
VR2214	4880140L25	20.0 VOLT MMBZ5250
VR2215	4811058B02	SOT-23 MMBZ5240 10V

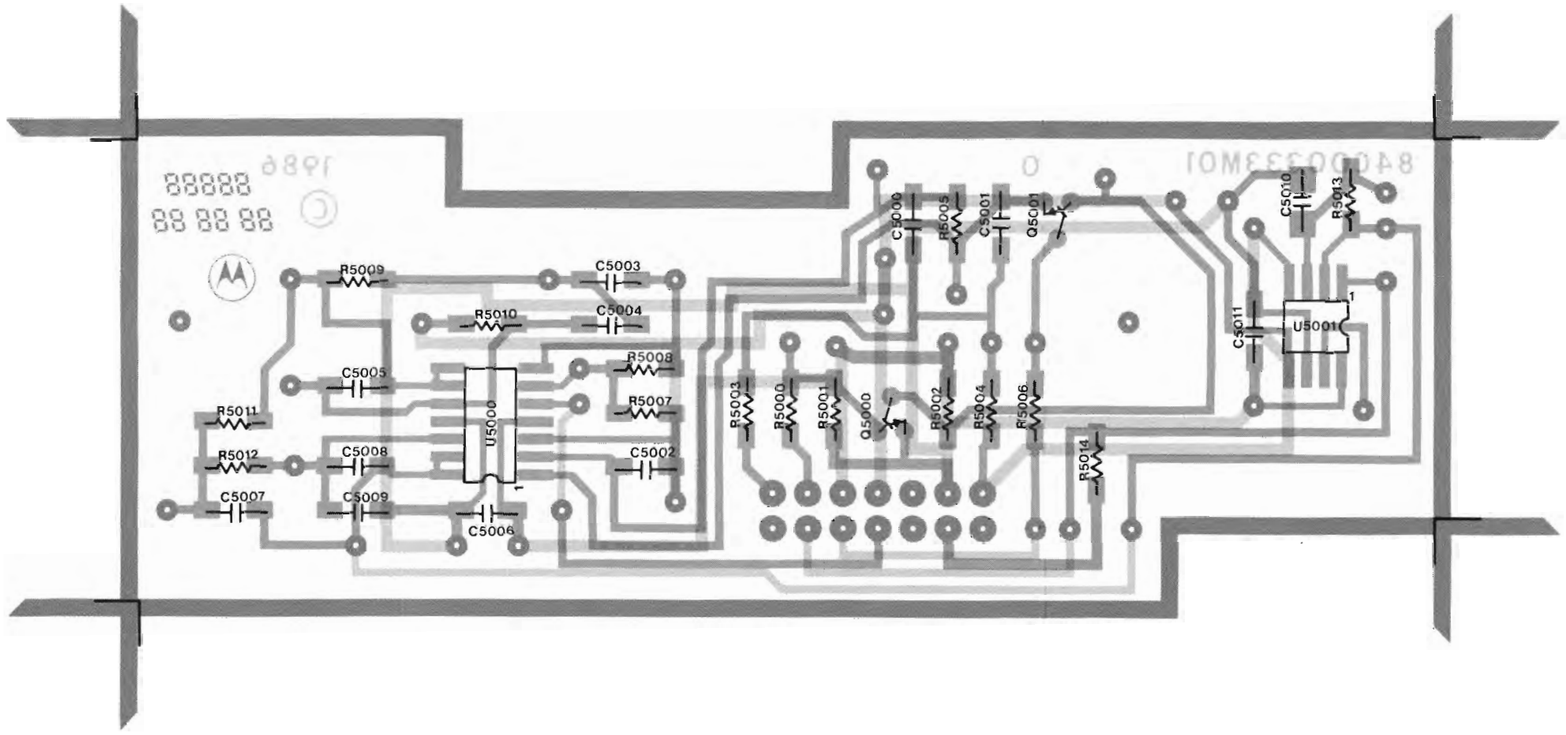
Figure 6-13
Remote Interface Board Parts List

parts list

VLN4733A MDC600 / 1200 FILTER BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, chip, uf (unless stated otherwise)
C5000	2102000A31	.0039-5-10V-X7F
C5001	2102000A31	.0039-5-10V-X7F
C5002	2111031A47	220pf-5-50V
C5005	2111031A47	220pf-5-50V
C5003	2102000A43	.012-5-X7F-50V
C5004	2102000A43	.012-5-X7F-50V
C5006	2111032A21	.01-10-X7R-50V
C5007	2102000A47	.018-5-X7R-50V
C5008	2111031A47	220pf-5-50V
C5009	2102000A27	.0027-5-X7R-50V
C5010	2362998D09	1.0-20-35V
C5011	2111032A21	.01-10-X7R-50V
		Resistor, chip, 5%, 1/8 W
R5000	0600015M73	10K
R5001	0600015M73	10K
R5002	0600015M73	10K
R5003	0600015M89	47K
R5003	0600015M76	13K
R5005	0600015M91	56K
R5006	0600015M25	100
R5007	0600015M81	22K
R5008	0600015M81	22K
R5009	0600015M75	12K
R5010	0600015M82	24K
R5011	0600015M76	13K
R5012	0600015M76	13K
R5013	0600015M81	22K
R5014	0600015M73	10K
		Transistor
Q5000	4880141L02	NPN, 503-23 MMBT390
Q5001	4880141L02	NPN, 503-23 MMBT390
		Quad op-amp
U5000	5183629M68	MC3403D
		Dual comparator
U5001	5102005A01	LM2903D
		Connector
J367	0900076M11	female, 14 pin
		Standoff
	4300070M01	9MM x 6.3 MM

Figure 6-16
MDC600 Filter Board Parts List

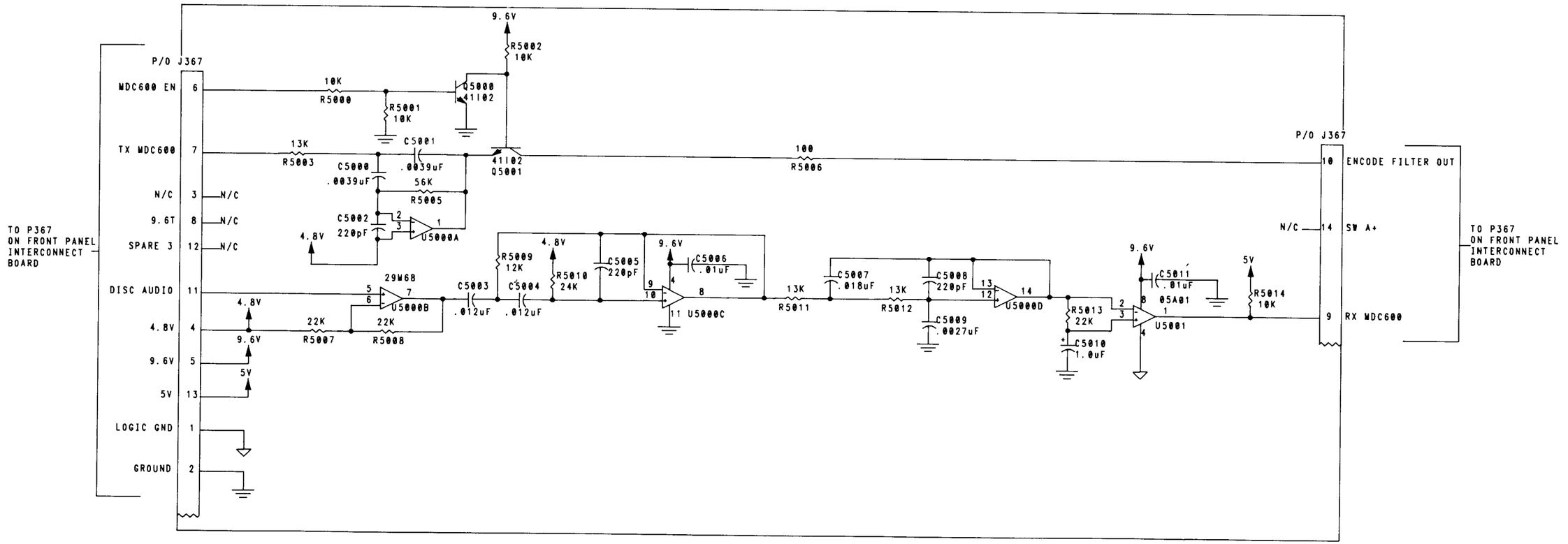


SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00204M-O

Figure 6-14
MDC600 Filter Board
- Board Details



6300669M-O

Figure 6-15
MDC 600 / 1200 Filter Board
Schematic Diagram

END OF SECTION 6

MOTOROLA LIMITED
Communications Division

SECTION 7. FREQUENCY SYNTHESIZER AND VCO

7.1 STANDARD LOCK FREQUENCY SYNTHESIZER

The main functional blocks of the Frequency Synthesizer and VCO are highlighted in Figure 7-1.

Schematics and board details which support the discussion below are inserted at the end of this section. (Figures 7-2 and 7-3)

The Synthesizer Board circuit may be broken up into eight functional blocks as follows :

- 14.4 MHz reference oscillator
- latch circuit
- divider / phase detector (U115)
- lock detect switch circuit
- charge pump and loop filter circuit
- frequency shift logic circuit
- VCO buffers and transmit / receive injection switch
- VCO AGC (automatic gain control)

The Voltage Controlled Oscillator Assembly (VCO) is a sealed unit and field servicing is not recommended. However, a brief description of its operation is included.

7.1.1 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. Low frequency audio signals from the transmit audio circuit are applied to the reference modulation input. Note that a 2 PPM Reference Oscillator is optional.

7.1.2 LATCH CIRCUIT

The latch transfers data regarding receive and transmit frequencies from the main radio microcomputer to the divider / phase detector U115.

7.1.3 DIVIDER / PHASE DETECTOR

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 divider divides the 14.4 MHz reference oscillator signal and applies it as the reference frequency input to the phase detector. The loop divider divides the negative feedback input, which is the buffered VCO rf signal. This signal is applied as the loop frequency input to the phase detector. The phase detector calculates the phase difference of the two frequencies and generates error pulses on the UP and DOWN output lines that are proportional to this phase difference. The 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.

The divider/phase detector also supplies a data output to the frequency shift logic circuit, which in turn controls the VCO sub-range frequency required by the selected mode (channel).

A signal is also sent to the dual front end by the divider/phase detector so that the correct frequency range filter is selected.

7.1.4 LOCK DETECT SWITCH CIRCUIT

The lock detect switch circuit (Q154. Q155 and Q156) generates a lock detect 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.

7.1.5 CHARGE PUMP AND LOOP FILTER

The circuit (Q151, Q152 and Q153) changes the UP or DOWN error pulses from divider / phase detector U115 to a corresponding DC voltage. The DC voltage is filtered to become the VCO steering line voltage.

7.1.6 FREQUENCY SHIFT LOGIC CIRCUIT

The frequency shift logic circuit (Q171,Q172 and U171) controls the switching of the VCO to the sub-range frequencies at which it operates for a selected mode (channel).

7.1.7 VCO BUFFERS AND TRANSMIT / RECEIVE INJECTION SWITCH

The buffers (Q190 and Q192) 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.

7.1.8 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.

7.2 FAST-LOK FREQUENCY SYNTHESIZER (Optional)

The main functional blocks of the Fast-Lok Frequency Synthesizer and VCO are highlighted in Figure 7-4.

Schematics and board details which support the discussion below are inserted at the end of this section (Figures 7-5 to 7-8.

The Fast-Lok Frequency Synthesizer circuit may be broken up into nine functional blocks as follows:

- 14.4 MHz reference oscillator
- latch circuit
- divider
- phase detector
- adaptive loop filter
- frequency shift logic circuit
- VCO AGC
- synthesizer RF (buffer) amplifier (separate circuit board)
- lock detect switch

The VCO for the Fast-Lok Synthesizer is also a sealed unit. It operates in the same manner as the VCO for the Standard Lock Synthesizer.

7.2.1 14.4 MHz REFERENCE OSCILLATOR

The 14.4 MHz reference oscillator is a 5 PPM, high accuracy, 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. Low frequency audio signals from the transmit audio circuit are applied to the reference modulation input. Note that a 2 PPM Reference Oscillator is optional.

7.2.2 LATCH CIRCUIT

The latch transfers data regarding receive and transmit frequencies from the main radio microcomputer to the divider IC U115.

7.2.3 DIVIDER

Divider U115 contains the negative feedback, phase-locked-loop circuitry that controls the VCO frequency. The divider contains a reference divider and a loop divider. The reference divider divides the 14.4 MHz reference oscillator signal and applies it as the reference frequency input to the phase detector. The loop divider divides the negative feedback input, which is the buffered VCO rf signal.

This signal is applied as the loop frequency input to the phase detector.

The divider also supplies a data output to the frequency shift logic circuit, which in turn controls the VCO sub-range frequency required by the selected mode (channel).

A signal is also sent to the dual front end by the divider so that the correct frequency range filter is selected.

7.2.4 PHASE DETECTOR

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

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 and the lock detect switch.

The phase detector also generates a control signal (sync.) which ensures that the frequency reference data transferred to the synthesizer is synchronized with the reference frequency output of the divider IC.

7.2.5 ADAPTIVE LOOP FILTER

The adaptive loop filter, which is connected to the phase detector output line (U140-15), 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.

The adaptive loop filter is controlled by the phase detector to operate in either of two modes, either the Adapt or the Receive / Transmit mode. The Adapt mode is entered during any period when the synthesizer changes frequency. In this mode the filter response is removed to allow the synthesizer loop to change to new frequencies quickly.

The Receive/Transmit mode is entered when the synthesizer is locked on frequency.

7.2.6 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 mode (channel).

7.2.7 LOCK DETECT SWITCH CIRCUIT

The lock detect switch circuit (Q142) generates a lock detect 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.

7.2.8 VCO AGC CIRCUIT

The VCO AGC circuit consists of transistors Q170 and Q171. The circuit stabilizes the VCO gain by maintaining a constant rf level in the VCO tank circuit.

7.2.9 SYNTHESIZER RF AMPLIFIER BOARD

RF buffer Q190 amplifies the VCO rf output supplying 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. Signal transmission through either injection port is controlled by the 9.6T keying voltage applied to Q191. A high 9.6T keying voltage (transmit mode) turns off transistor Q191, forward biasing CR191 and routing the VCO rf to the transmit injection port at connector P374-1. From this 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) turns on transistor Q191, forward biasing CR190, routing the VCO rf to the receive injection port at connector J357. From this port, the

signal is fed as the receiver injection signal to the mixer in the receiver dual front end.

7.3 VOLTAGE CONTROLLED OSCILLATOR

(Figure 7-9)

The VCO Assembly circuit may be broken up into four functional blocks as follows :

- VCO steering line
- PIN (diode) switches
- VCO modulator
- VCO

7.3.1 VCO STEERING LINE

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 dc voltage is applied to the network of varactor diodes that control the frequency of the VCO.

The varactor diode network consists of CR1301 through CR1304. The dc voltage level present on the VCO steering line determines the capacitance of the varactor diodes. The capacitance of the varactor diodes determines the reactance of the VCO tank circuit, and therefore the operating frequency. Capacitor C1307 couples the varactor diode network to the VCO tank circuit, via the VCO transmission line.

7.3.2 PIN (DIODE) SWITCHES

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.

7.3.3 VCO MODULATOR

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.

To compensate for any drift in VCO frequency and to maintain a constant modulation level, a second varactor diode (CR1305) is used. This varactor diode is connected in series with varactor diode CR1300 and in parallel with the varactor diode network CR1301 to CR1304.

To compensate for frequency shifts, the dc bias on varactor diode 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 S3 frequency range shift signals.

7.3.4 VCO

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.

Transistor Q1300 is the amplifying element of a grounded-gate oscillator which operates at the desired injection frequency.

The VCO tank circuit consists 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 VCO rf output signal from the tank circuit is coupled through capacitor C1308 to the transmission line and then to the VCO output buffer Q1330. The output buffer feeds the VCO rf signal to the transmit/receive rf buffer on the synthesizer board.

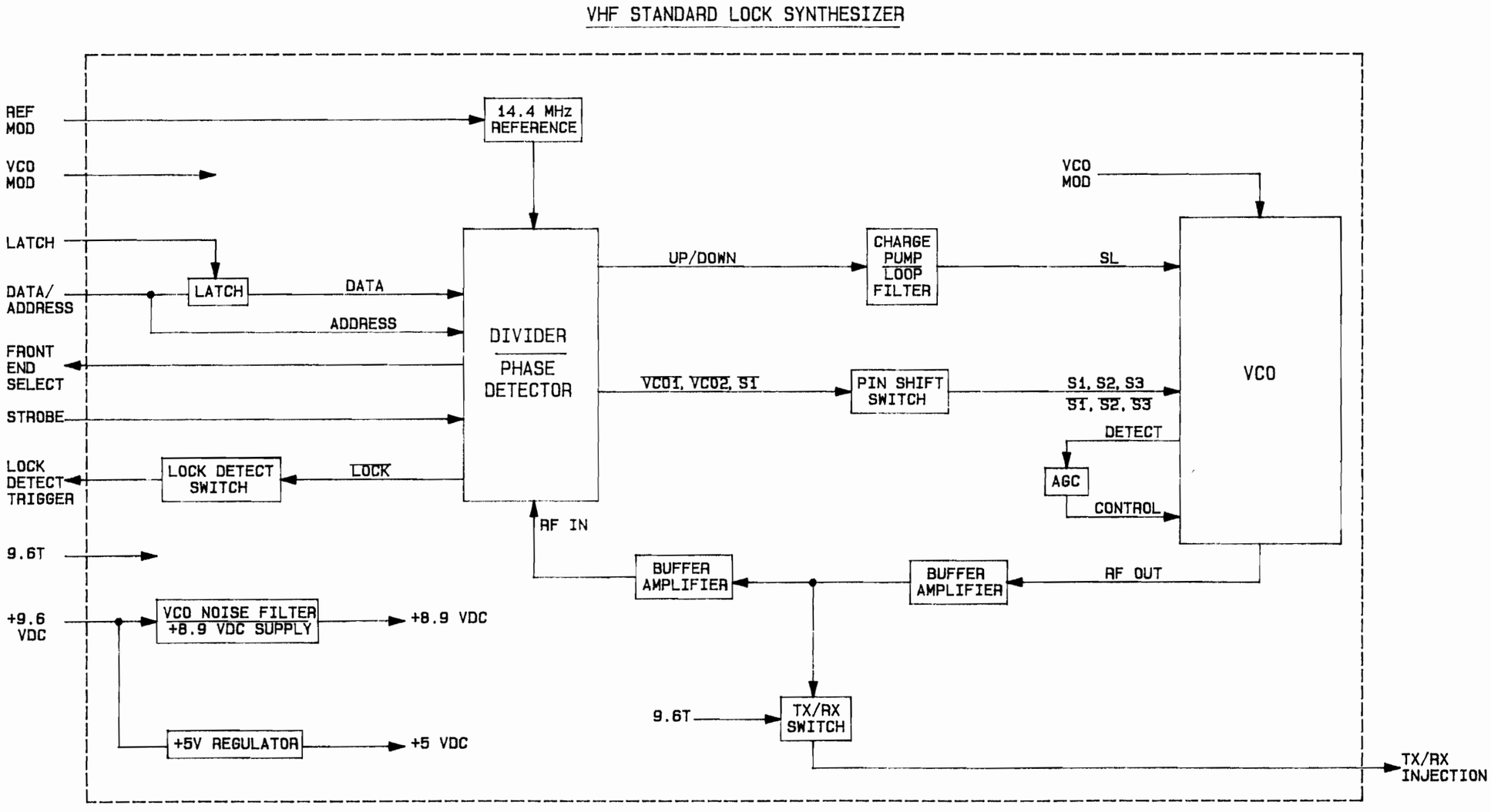
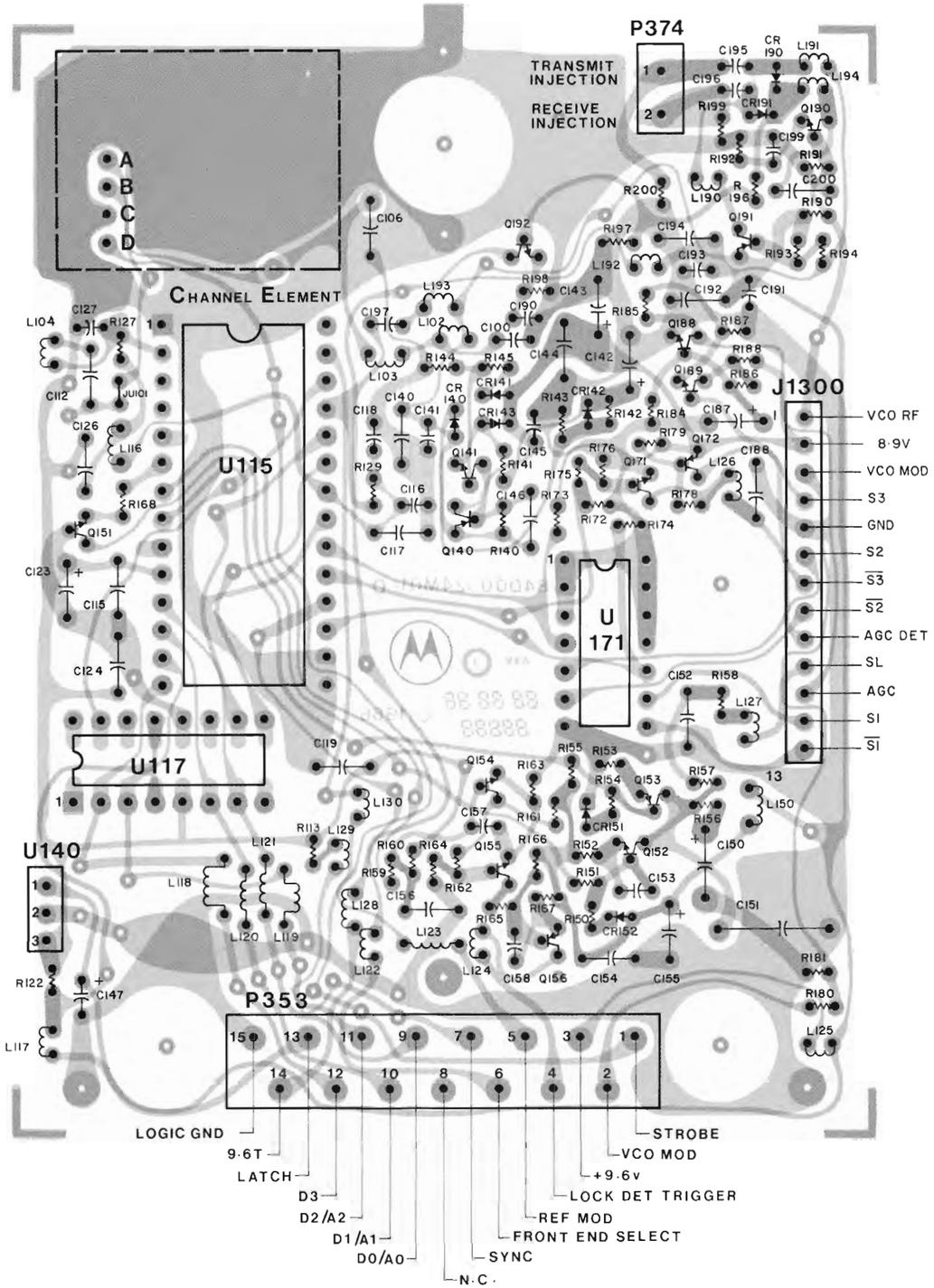


Figure 7-1
Standard Lock Frequency Synthesizer and V.C.O. - Block Diagram

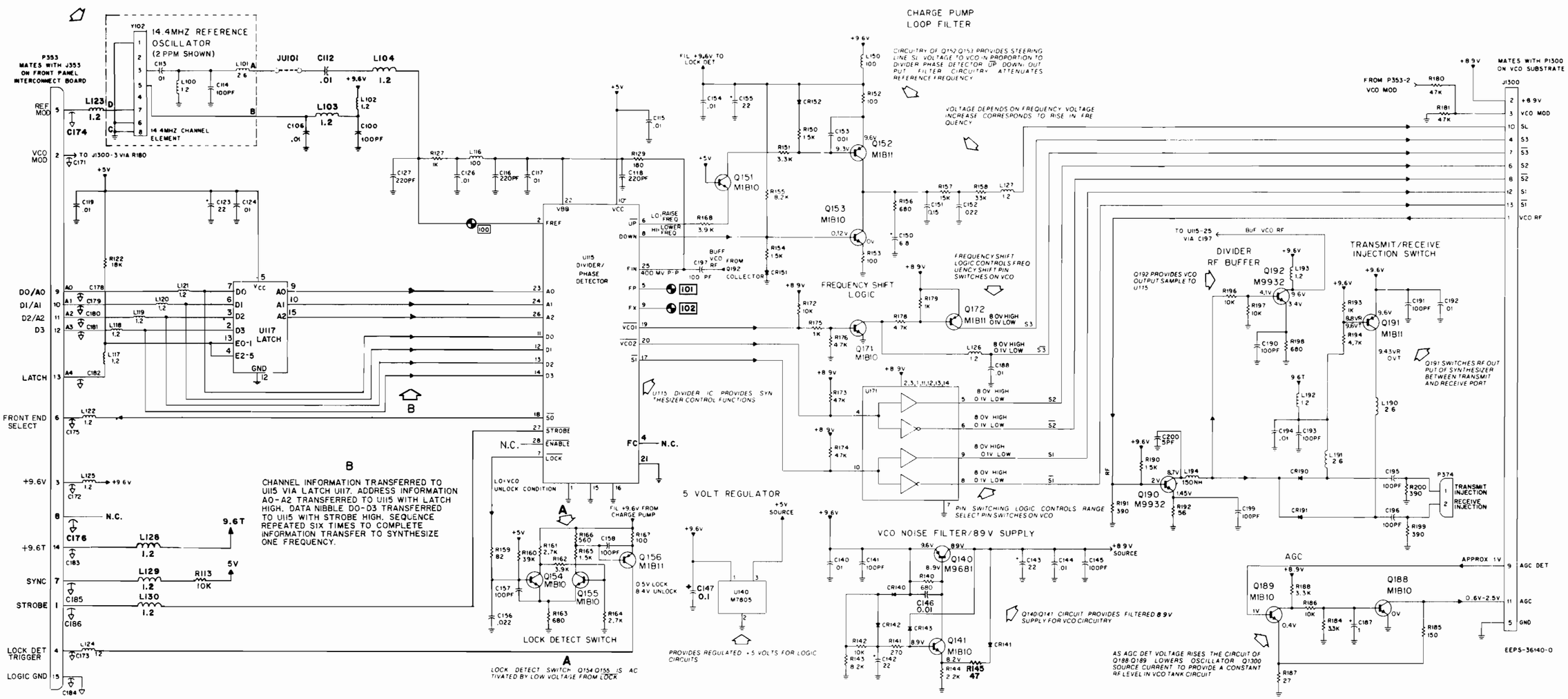
SHOWN FROM COMPONENT SIDE

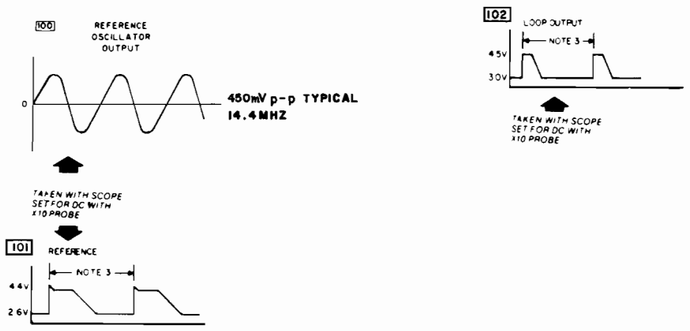
SOLDER SIDE - RED
COMPONENT SIDE - GREY

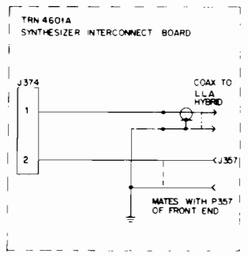


31H00199M-O

Figure 7-2
Standard Lock Frequency Synthesizer Board - Board Details



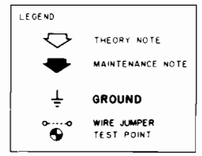




NOTES:

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 AND 102 IS AS** FOLLOWS:

   160 USEC AT 6.25 KHZ CHANNEL SPACING
   200 USECT AT 5 KHZ CHANNEL SPACING
   240 USEC AT 4.166 KHZ CHANNEL SPACING



6300650M-O

Figure 7-3
Standard Lock Frequency Synthesizer Board Schematic Diagram (Sheet 1)

parts list

VLN4695A STANDARD LOCK SYNTHESIZER VHF 5 PPM
VLN4696A STANDARD LOCK SYNTHESIZER VHF 2 PPM

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, uf (unless otherwise stated)
C100	2111026F42	CER DISC 100pf-5-P350-N1000
C106	2111025A01	CER DISC .01-20-25V
C112	2111025A01	CER DISC .01-20-25V
C115	2111025A01	CER DISC .01-20-25V
C116	2100026M37	CER PLT 220pf-10
C117	2111025A01	CER DISC .01-20-25V
C118	2100026M37	CER PLT 220pf-10
C119	2111025A01	CER DISC .01-20-25V
C121	2111026F42	CER DISC 100pf-5-P350-N1000
C123	2384538G13	TANT 22-20-20V
C124	2111025A01	CER DISC .01-20-25V
C127	2100026M37	CER PLT 220pf-10
C126	2111025A01	CER DISC .01-20-25V
C140	2111025A01	CER DISC .01-20-25V
C141	2111026F42	CER DISC 100pf-5-P350-N1000
C142	2311019A27	ALU 22-20-25V
C143	2311019A27	ALU 22-20-25V
C144	2111025A01	CER DISC .01-20-25V
C145	2111026F42	CER DISC 100pf-5-P350-N1000
C146	2111025A01	CER DISC .01-20-25V
C147	2384538G03	TANT .1-20-35V
C150	2384538G22	TANT 6.8-10-20V
C151	0884637L21	MTLZ POLYEST .15-10-100V
C152	0811023A17	POLYEST .022-5-50V
C153	0811017B01	POLYEST .001-10-50V
C154	2111025A01	CER DISC .01-20-25V
C155	2311019A27	ALU 22-20-25V
C156	0811023A17	POLYEST .022-5-50V
C157	2111026F42	CER DISC 100pf-5-P350-N1000
C158	2111026F42	CER DISC 100pf-5-P350-N1000
C187	2311019A09	ALU 1.0-20-50V
C188	2111025A01	CER DISC .01-20-25V
C190	2111026F42	CER DISC 100pf-5-P350-N1000
C191	2111026F42	CER DISC 100pf-5-P350-N1000
C192	2111025A01	CER DISC .01-20-25V
C193	2111026F42	CER DISC 100pf-5-P350-N1000
C194	2111025A01	CER DISC .01-20-25V
C195	2111026F42	CER DISC 100pf-5-P350-N1000
C196	2111026F42	CER DISC 100pf-5-P350-N1000
C197	2111026F42	CER DISC 100pf-5-P350-N1000
C199	2111026F42	CER DISC 100pf-5-P350-N1000
C200	2111022G17	CER DISC 4.7-25-NPO-50V
		Diode
CR140	4884399M01	SLCN
CR141	4884399M01	SLCN
CR142	4884399M01	SLCN
CR143	4884399M01	SLCN
CR151	4884399M01	SLCN
CR152	4884399M01	SLCN
CR190	4883510F06	10F06
CR191	4883510F06	10F06
		Connector
J116	0980269B03	SKT DUAL IN LINE IC
J1300	0984321M01	RECP CKT BD MTG
		Coil
L102	2482723H27	RF 1.2 UH
L103	2482723H27	RF 1.2 UH
L104	2482723H27	RF 1.2 UH
L116	2482549D37	CHK RF
L117	2482723H27	RF 1.2 UH
L118	2482723H27	RF 1.2 UH
L119	2482723H27	RF 1.2 UH
L120	2482723H27	RF 1.2 UH
L121	2482723H27	RF 1.2 UH
L122	2482723H27	RF 1.2 UH
L123	2482723H27	RF 1.2 UH
L124	2482723H27	RF 1.2 UH
L125	2482723H27	RF 1.2 UH
L126	2482723H27	RF 1.2 U
L127	2482723H27	RF 1.2 UH
L128	2482723H27	RF 1.2 UH
L129	2482723H27	RF 1.2 UH
L130	2482723H27	RF 1.2 UH
L150	2482549D37	CHK RF
L190	2482723H39	RF 2.6 UH
L191	2482723H39	RF 2.6 UH
L192	2482723H27	RF 1.2 UH
L193	2482723H27	RF 1.2 UH
L194	2482723H22	RF .15 UH
		Plug
P374	2882040K03	2 PIN
		Crystal Oscillator
PS* *(VLN4695A)	4882230P01	30P01
		Channel element board
PS* *(VLN4696A)	0180731D24	BD CHAN ELE 2 PPM
		Miscellaneous items
PS	0783091N01	BRKT SYNZR REAR MTG
PS	1000801234	FLAT WIRE
PS	1482299P01	INS
		Transistor
Q140	4811043A10	48R00869681
Q141	4802081B10	M1B10
Q151	4802081B10	M1B10
Q152	4802081B11	M1B11
Q153	4802081B10	M1B10
Q154	4802081B10	M1B10
Q155	4802081B10	M1B10
Q156	4802081B11	M1B11
Q171	4802081B10	M1B10
Q172	4802081B11	M1B11
Q188	4802081B10	M1B10
Q189	4802081B10	M1B10
Q191	4802081B11	M1B11
Q190	4811043A16	48R00869932
Q192	4811043A16	48R00869932
		Resistor,FCF ±5%, ¼W
R113	0611020A73	10K
R122	0611020A79	18K
R127	0611020A49	1000
R129	0611020A31	180
R130	0611020A81	22K
R140	0611020A45	680
R141	0611020A35	270
R142	0611020A73	10K
R143	0611020A71	8200
R144	0611020A57	2200
R145	0611020A17	47
R150	0611020A53	1500
R151	0611020A61	3300
R152	0611020A25	100
R153	0611020A25	100
R154	0611020A53	1500
R155	0611020A71	8200
R156	0611020A45	680
R157	0611020A77	15K
R158	0611020A85	33K
R159	0611020A23	82
R160	0611020A87	39K
R161	0611020A59	2700
R162	0611020A63	3900
R163	0611020A45	680
R164	0611020A59	2700
R165	0611020A53	1500
R166	0611020A43	560
R167	0611020A25	100
R168	0611020A63	3900
R172	0611020A73	10K
R173	0611020A89	47K
R174	0611020A89	47K
R175	0611020A49	1000
R176	0611020A65	4700
R178	0611020A65	4700
R179	0611020A49	1000
R180	0611020A89	47K
R181	0611020A89	47K
R184	0611020A61	3300
R185	0611020A29	150
R186	0611020A73	10K
R187	0611020A11	27
R188	0611020A61	3300
R190	0611020A53	1500
R191	0611020A39	390
R192	0611020A19	56
R193	0611020A49	1000
R194	0611020A65	4700
R196	0611020A73	10K
R197	0611020A73	10K
R198	0611020A45	680
R199	0611020A39	390
R200	0611020A39	390
		Integrated circuit
U117	5100073M01	LATCH
U171	5183627M53	BI
U140	5183629M17	BI
U115	5184768F63	MONO 68F63 SYNZR

Figure 7-4
Standard Lock Frequency Synthesizer Board Parts List

Frequency Shifting of VCO Sub-Range Frequencies (Range 1 VHF)

Frequency Range Select Signals			VCO Sub-Range (Range 1 VHF)
S1 VCO Pin 12	S2 VCO Pin 6	S3 VCO Pin 4	
0	0	1	114.6-120.599
0	0	0	120.6-126.599
0	1	1	126.6-132.499
0	1	0	132.5-138.399
1	0	1	138.4-144.299
1	0	0	144.3-150.199
1	1	1	150.2-156.099
1	1	0	156.1-162.0

Frequency Shifting of VCO Sub-Range Frequencies (Range 2 VHF)

Frequency Range Select Signals			VCO Sub-Range (Range 2 VHF)
S1 VCO Pin 12	S2 VCO Pin 6	S3 VCO Pin 4	
0	0	1	124.6-130.599
0	0	0	130.6-136.799
0	1	1	136.8-142.999
0	1	0	143.0-149.199
1	0	1	149.2-155.399
1	0	0	155.4-161.599
1	1	1	161.6-167.799
1	1	0	167.8-174.0

Figure 7-3
Standard Lock Frequency Synthesizer Board Schematic Diagram (Sheet 2)

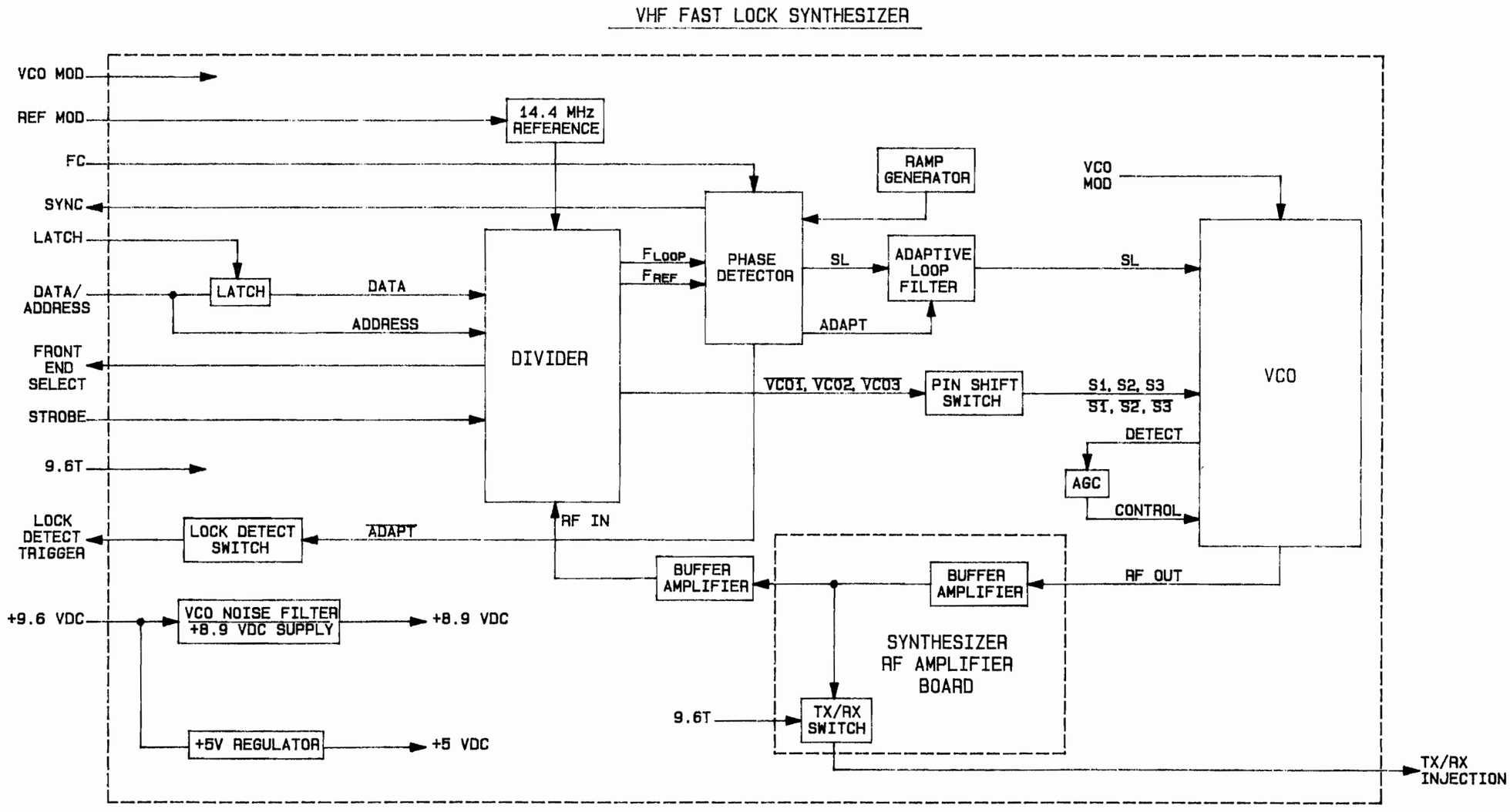
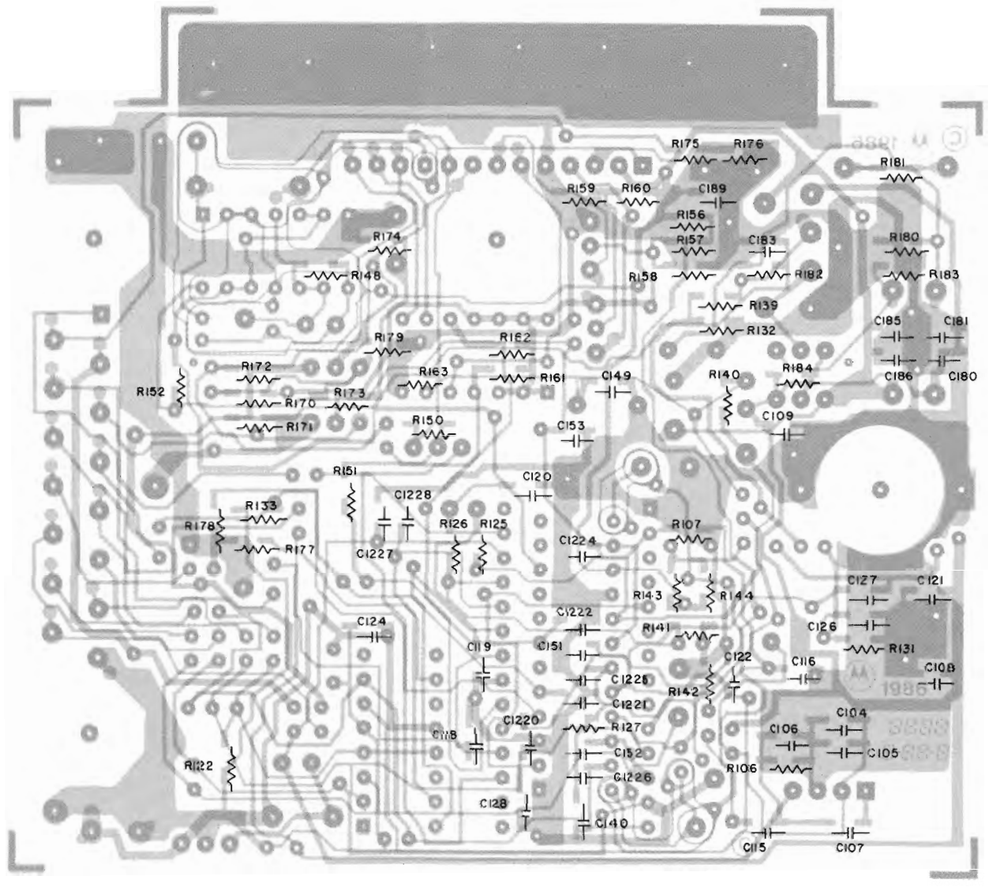
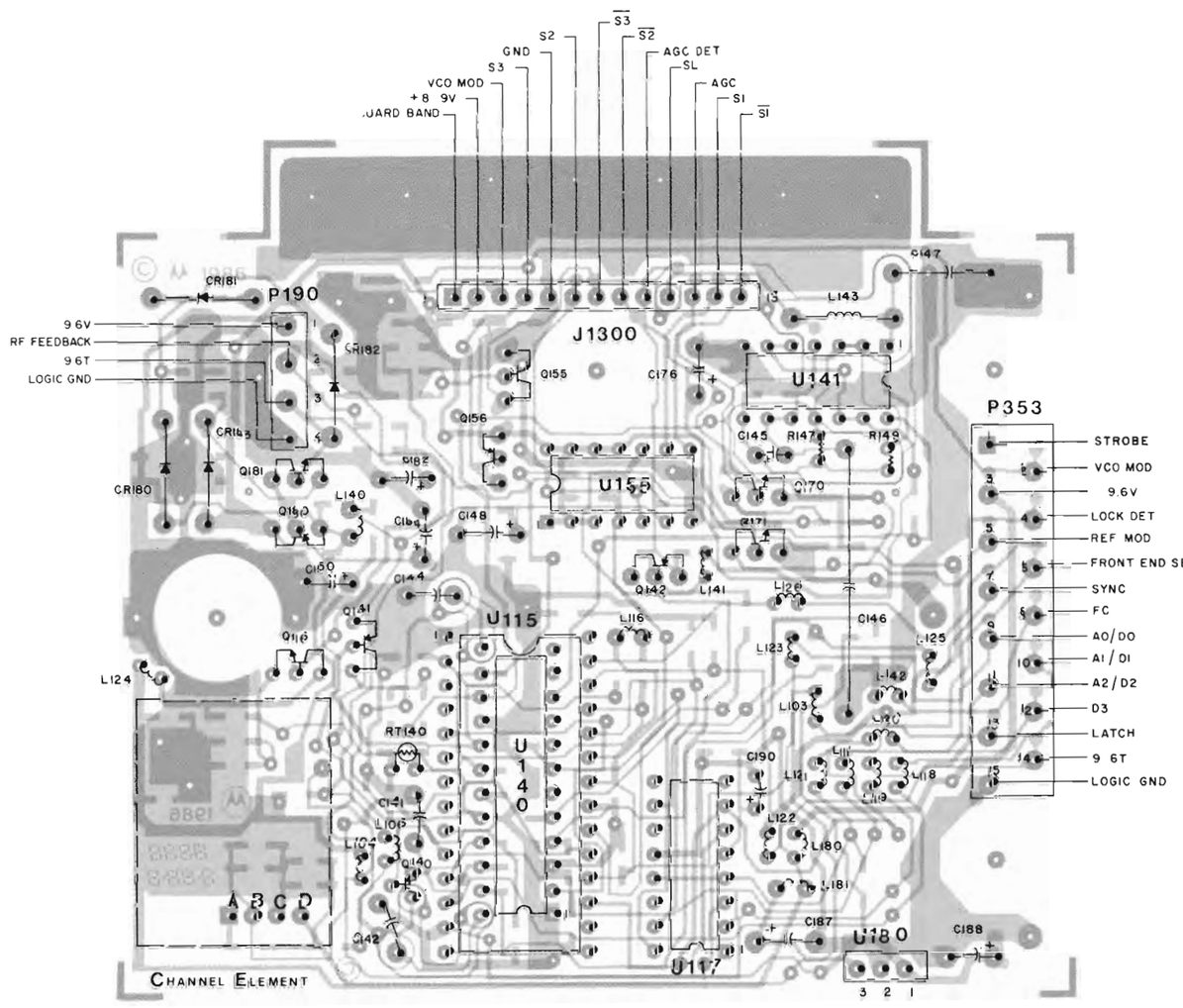


Figure 7-5
Fast-Lok Frequency Synthesizer and V.C.O. - Block Diagram



SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

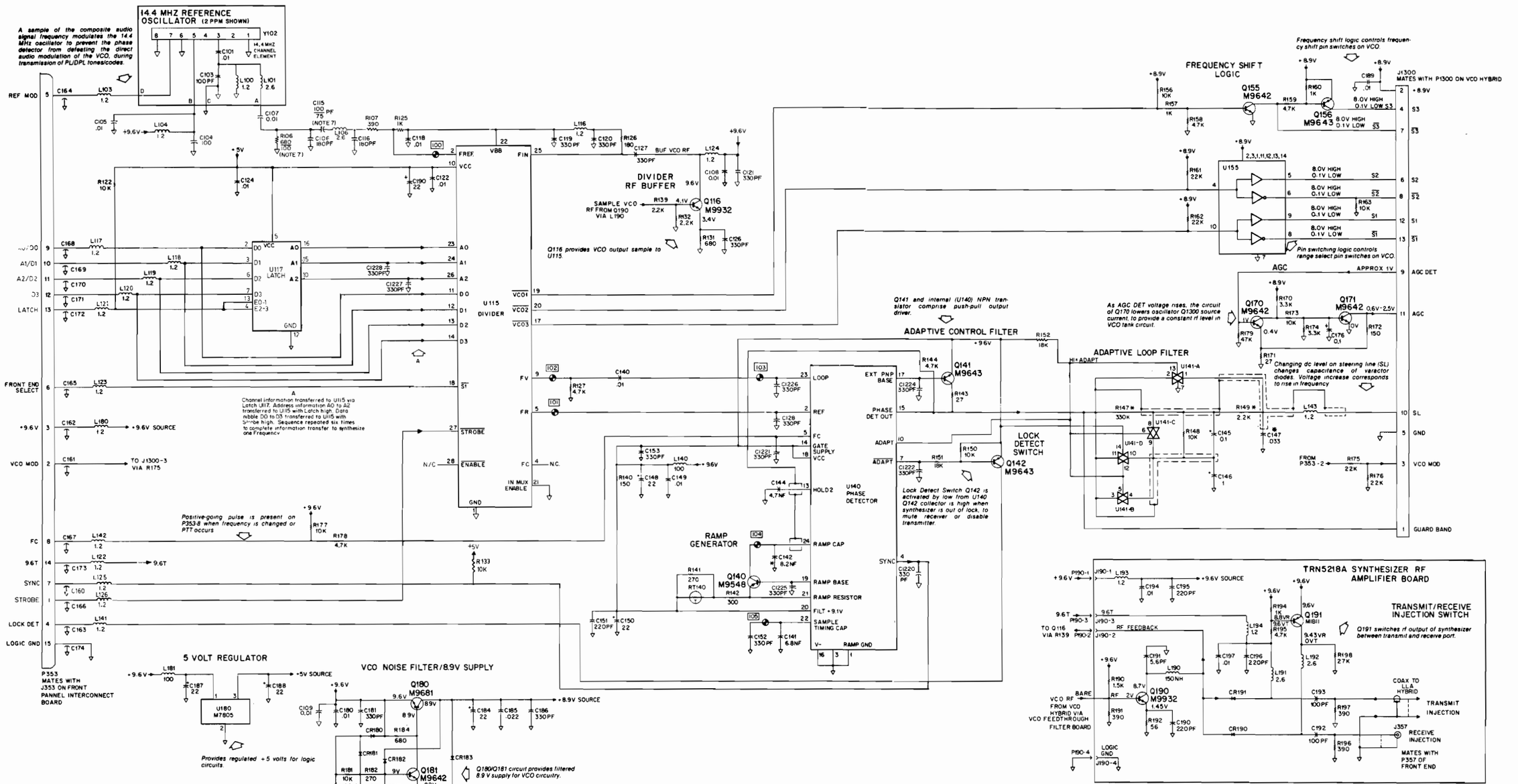


SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00156M-O

Figure 7-6
Fast-Lok Frequency Synthesizer Board - Board Details



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, 102, 103, and 105 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. Dashed lines denote guard band shields, which consist of plating around portions of circuitry.
7. This component is sensitive to the reference oscillator used. The format is $\frac{2PPM}{5PPM}$

100 REFERENCE OSCILLATOR OUTPUT — 1.0V P-P @ 14.4MHz

101 REFERENCE — 4.2VP-P — NOTE 5

102 LOOP OUTPUT — 4.2V / 2.5V — NOTE 5

103 LOOP INPUT TO PHASE DETECTOR — 2.5V / 0.7V — NOTE 5

104 RAMP CAPACITOR — DEPENDENT ON FREQUENCY
(LOCKED) — 0V
9.5V (OUT OF LOCK HIGH RAIL)
8.3V
0.1V (OUT OF LOCK LOW RAIL)
0V

105 SAMPLE TIMING CAP — NOTE 5 — 2V / 0V — 50-60 USEC

LEGEND
- THEORY NOTE
- MAINTENANCE NOTE
- GROUND
- TEST POINT

6300625M-O

Figure 7-7
Fast-Lok Frequency Synthesizer Board Schematic Diagram

parts list

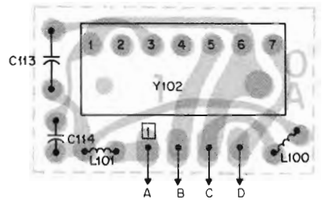
VLN4699A FAST-LOK SYNTHESIZER 5 PPM
VLN4700A FAST-LOK SYNTHESIZER 2 PPM

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, pf (unless stated otherwise)
C104	2111031A39	100-5-NPO-50V
C105	2111032A21	.01uf-10-X7R-50V
C106	2111031A45	180-5-NPO-50V
C107	2111032A21	.01uf-10-X7R-50V
C108	2111032A21	.01uf-10-X7R-50V
C109	2111032A21	.01uf-10-X7R-50V
C115	2111031A39	100-5-NPO-50V (VLN4700A only)
C115	2111031A45	180-5-NPO-50V (VLN4699A only)
C116	2111031A45	180-5-NPO-50V
C118	2111032A21	.01uf-10-X7R-50V
C119	2111031A51	330-5-NPO-50V
C120	2111031A51	330-5-NPO-50V
C121	2111031A51	330-5-NPO-50V
C122	2111032A21	.01uf-10-X7R-50V
C124	2111032A21	.01uf-10-X7R-50V
C126	2111031A51	330-5-NPO-50V
C127	2111031A51	330-5-NPO-50V
C128	2111031A51	330-5-NPO-50V
C140	2111032A21	.01uf-10-X7R-50V
C141	0811023B11	POLYEST .0068uf-10-50V
C142	0880027B03	POLYP 8200-5-100V
C144	0880027B02	POLYP 4700-5-100V
C145	2384538G03	.1uf-20-35V TANT
C146	0883862M05	MTLZ POLYP 1uf-10-100V
C147	0883765N01	MTLZ POLYP .033uf-10-125V
C148	2311013C56	22uf-20-15V TANT
C149	2111032A21	.01uf-10-X7R-50V
C150	2311019A27	22uf-20-25V ALU
C151	2111031A47	220-5-NPO-50V
C152	2111031A51	330-5-NPO-50V
C153	2111031A51	330-5-NPO-50V
C176	2384538G03	.1uf-20-35V TANT
C180	2111032A21	.01uf-10-X7R-50V
C181	2111031A51	330-5-NPO-50V
C182	2311019A27	22uf-20-25V ALU
C183	2111032A21	.01uf-10-X7R-50V
C184	2311013C56	22uf-20-15V TANT
C185	2111032A25	.022uf-10-X7R-50V
C186	2111031A51	330-5-NPO-50V
C187	2311013C56	22uf-20-15V TANT
C188	2311013C56	22uf-20-15V TANT
C189	2111032A21	.01uf-10-X7R-50V
C190	2311037A27	22uf-20-25V ALU
C1220	2111031A51	330-5-NPO-50V
C1221	2111031A51	330-5-NPO-50V
C1222	2111031A51	330-5-NPO-50V
C1224	2111031A51	330-5-NPO-50V
C1225	2111031A51	330-5-NPO-50V
C1226	2111031A51	330-5-NPO-50V
C1227	2111031A51	330-5-NPO-50V
C1228	2111031A51	330-5-NPO-50V
		Diode
CR180	4883654H01	SLCN
CR181	4883654H01	SLCN
CR182	4883654H01	SLCN
CR183	4883654H01	SLCN
		Coil
L103	2482723H27	RF 1.2UH
L104	2482723H27	RF 1.2UH
L106	2482723H39	RF 2.6UH
L116	2482723H27	RF 1.2UH
L117	2482723H27	RF 1.2UH
L118	2482723H27	RF 1.2UH
L119	2482723H27	RF 1.2UH
L120	2482723H27	RF 1.2UH
L121	2482723H27	RF 1.2UH
L122	2482723H27	RF 1.2UH
L123	2482723H27	RF 1.2UH
L124	2482723H27	RF 1.2UH
L125	2482723H27	RF 1.2UH
L126	2482723H27	RF 1.2UH
L140	2482549D37	RF 100UH
L141	2482723H27	RF 1.2UH
L142	2482723H27	RF 1.2UH
L143	2482723H27	RF 1.2UH
L180	2482723H27	RF 1.2UH
L181	2482549D37	RF 100UH
		Connector
J1300	0984321M01	CKT BD MTG RECP (13 CONT) (VLN4699A only)
P353	0100955M02	ASSEM FEED THRU PLTE
P190	2882040K04	4 PIN PLUG
U115	0982071K09	RECP 14 CONT
U115	0982071K09	RECP 14 CONT
		Transistor
Q116	4800869932	M9932
Q140	4800869548	M9548
Q141	4800869643	M9643
Q142	4800869643	M9643
Q155	4800869642	M9642
Q156	4800869643	M9643
Q170	4800869642	M9642
Q171	4800869642	M9642
Q180	4800869681	M9681
Q181	4800869642	M9642
		Resistor, chip, 5%, 1/8W (unless stated otherwise)
R106	0600015M45	680 (VLN4700A only)
R106	0600015M25	100 (VLN4699A only)
R107	0600015M39	390
R122	0600015M73	10K
R125	0600015M49	1000
R126	0600015M31	180
R127	0600015M65	4700
R131	0600015M45	680
R132	0600015M57	2200
R133	0600015M73	10K
R139	0600015M57	2200
R140	0600015M29	150
R141	0600015M35	270
R142	0600015M3[illegible]	300
R143	0600015M11	27
R144	0600015M65	4700
R147	0611020B10	330K -1/4W FCF
R148	0600015M73	10K
R149	0611020A57	2200 -1/4W FCF
R150	0600015M73	10K
R151	0600015M79	18K
R152	0600015M79	18K
R156	0600015M73	10K
R157	0600015M49	1000
R158	0600015M65	4700
R159	0600015M65	4700
R160	0600015M49	1000
R161	0600015M81	22K
R162	0600015M81	22K
R163	0600015M73	10K
R170	0600015M61	3300
R171	0600015M11	27
R172	0600015M29	150
R173	0600015M73	10K
R174	0600015M61	3300
R175	0600015M81	22K
R176	0600015M81	22K
R177	0600015M73	10K
R178	0600015M65	4700
R179	0600015M89	47K
R180	0600015M71	8200
R181	0600015M73	10K
R182	0600015M35	270
R183	0600015M57	2200
R184	0600015M45	680

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Thermister
RT140	0683600K02	1K
		Integrated Circuit
U115	5183977M37	77M37
U117	5100073A01	LATCH
U140	5183977M46	
U141	5180073C02	QUAD CMOS BILATERAL SW
U155	5183627M53	BI
		Non-referenced Items
	0783091N01	REAR MTG SYNZR BRKT
	2900026M02	TERM POST (15 used)
	0180731D24	CHAN ELE BD 2 PPM (VLN4700A only)
	4882230P01	XTAL OSC 30P01 (VLN4699A only)

Figure 7-8
Fast-Lok Frequency Synthesizer Board
Parts List

2 PPM CHANNEL ELEMENT BOARD

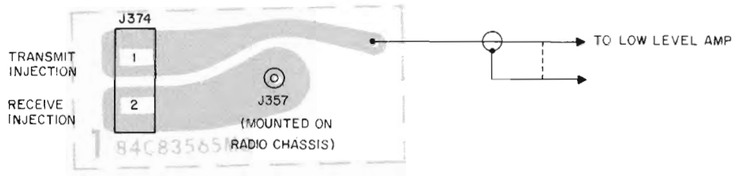


SHOWN FROM COMPONENT SIDE

31H00208M-O

SOLDER SIDE - RED
COMPONENT SIDE - GREY

SYNTHESIZER INTERCONNECT BOARD



SHOWN FROM SOLDER SIDE

31H00209M-O

SOLDER SIDE - RED
COMPONENT SIDE - GREY

parts list

0180731D24 2 PPM CHANNEL ELEMENT BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor
C113	2111025A01	CER DISC .01uf-20-25V
C114	2184511B01	CER PLT 100PF-10-N750
		Coil
L100	2482723H27	RF 1.2 UH
L101	2482723H39	RF 2.6 UH
		Reference oscillator
	5180291B02	KXN1096A
		Pad
	7584112M01	CHANNEL ELEMENT (2 used)

VLN4624A SYNTHESIZER INTERCONNECT BD VHF STD LOCK

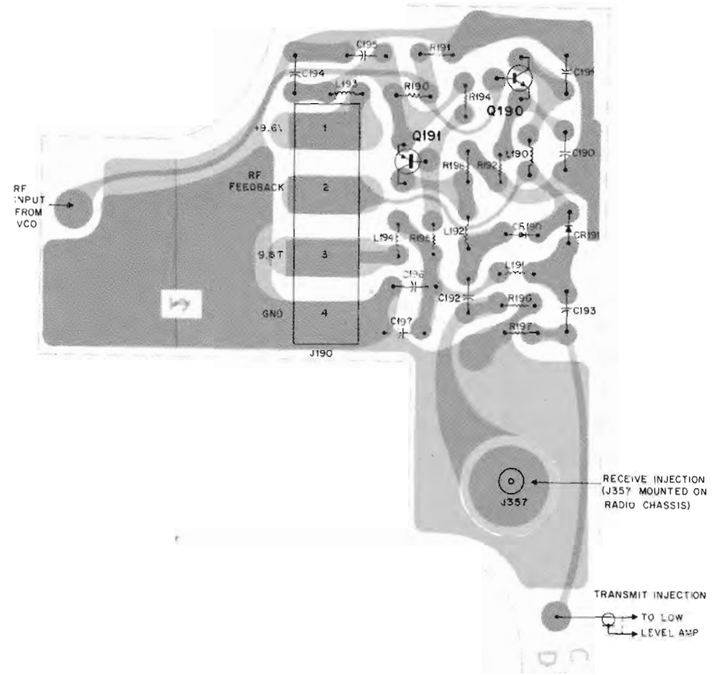
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2910134A29	LUG CONNECTOR (2 USED)

Figure 7-9
2 PPM Channel Element Board &
Synthesizer Interconnect Board
- Board Details & Parts Lists

VLN4633A SYNTHESIZER RF BUFFER BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor
C190	2100026M37	CER PLT 220pf-10
C191	2184511B75	CER 5.6pf-.25-N750
C192	2100026M24	CER PLT 100pf-10-N2200
C193	2100026M24	CER PLT 100pf-10-N2200
C194	2100021M01	CER DISC .01uf-10-50V
C195	2100026M37	CER PLT 220pf-10
C196	2100021M01	CER DISC .01uf-10-50V
C197	2100026M37	CER PLT 220pf-10
		Diode
CR190	4883510F06	10F06 0.7 OHM AT 3 MA
CR191	0180766D70	DIODE & SLEEVE ASSEM
		Connector
J190	2910134A29	LUG (4 USED)
		Coil
L190	2482723H22	.150UH
L191	2482723H39	2.6UH
L192	2482723H39	2.6UH
L193	2482723H27	1.2UH
L194	2482723H27	1.2UH
		Transistor
Q190	4800869932	M9932
Q191	4802081B11	M1B11
		Resistor
R190	0660075A53	150Ω
R191	0180766D67	390 RESISTOR & SLEEVE ASSEM.
R192	0180766D68	56 RESISTOR & SLEEVE ASSEM.
R194	0180766D69	1000 RESISTOR & SLEEVE ASSEM.
R195	0660075A65	470Ω
R196	0660075A39	39Ω
R197	0180766D67	390 RESISTOR & SLEEVE ASSEM.
R198	0660075A83	27K
		Mechanical Parts
	0783090N01	BRACKET, MOUNTING
	1483099N01	INSULATOR, RF BUFFER , SIDE
	1483099N02	INSULATOR, RF BUFFER ,TOP
	2683092N01	SHIELD, CAN
	2682845M01	SHIELD, FAST LOCK
	0102700A14	BOARD ASSEMBLY includes: BOARD, LUG,CONN (2910134A29)
	0700305M01	LUG MTG BRACKET

SYNTHESIZER RF AMPLIFIER BOARD

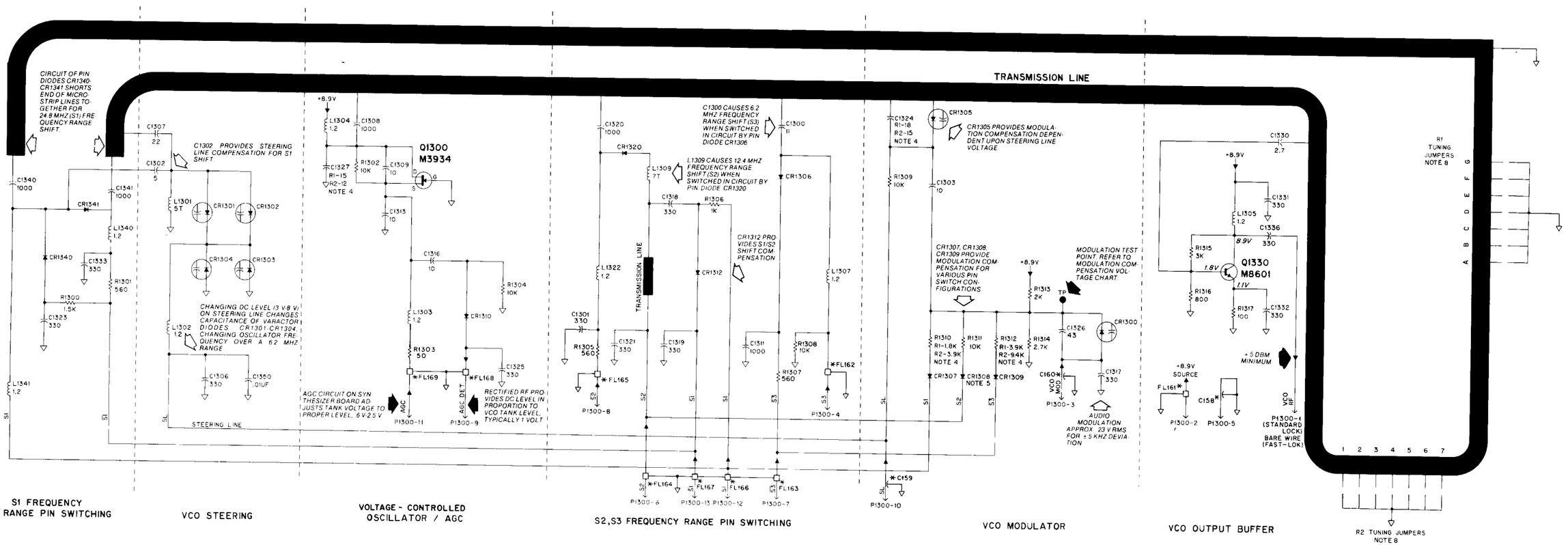


SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00210M-O

Figure 7-10
Synthesizer RF Amplifier Board
- Board Details & Parts list



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 I (TLD2541A AND TLD2542A MODELS ONLY) AND ARE LOCATED ON VCO FEEDTHROUGH FILTER BOARD. FL161-FL169 ARE PI-TYPE LOW PASS LINE FILTERS.

LEGEND
- THEORY NOTE
- MAINTENANCE NOTE
- LOGIC GROUND

6300681M-O

Figure 7-11
Voltage Controlled Oscillator Board Schematic Diagram

END OF SECTION 7

MOTOROLA LIMITED
Communications Division

SECTION 8. RECEIVER AND TRANSMITTER

8.1 GENERAL

This section contains schematic diagrams, board details and parts lists for the boards listed below.

- Receiver Widespaced Dual Front End Assembly Figures 8-1 to 8-3
- Main Board Figures8-4 to 8-7
- Harmonic Filter Hybrid Assembly Figures 8-8, 8-13 and 8-14
- Transmitter Low Level Amplifier Hybrid Assembly Figures 8-11, 8-13 and 8-14
- Transmitter 10 Watt Amplifier Hybrid Assembly Figures 8-10, 8-13 and 8-14
- Transmitter 30 Watt Amplifier Hybrid Assembly Figures 8-12, 8-13 and 8-14
- Transmitter Power Amplifier Interconnect Board Figures 8-9, 8-13 and 8-14
- Power Interconnect Board Figures 8-15 and 8-16

8.2 WIDESPACED DUAL FRONT END

(Figures 8-1 to 8-3)

The 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 (D.F.E.) provides coverage by switching between two, 6MHz 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 is controlled by the front end select signal supplied by the frequency synthesizer circuit. The D.F.E. 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 circuit. 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. (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.)

The amplified rf signal will pass through either the low or high range filter before proceeding to the mixer. Also applied to the mixer 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.

8.3 MAIN BOARD

The Main Board circuits are described in two parts ; receiver circuits and transmitter circuits.

8.3.1 MAIN BOARD RECEIVER CIRCUITS

(Figures 8-4, 8-5 and 8-6)

The Main Board contains the following receiver circuits:

- i-f
- limiter / quadrature detector
- low level audio
- audio power amplifier
- squelch

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 D.F.E. 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.

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.

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 to the PL / DPL circuits. 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.

Audio Muting Circuit

Primary mute gate Q1714 (on the Analog Interface Board) and a secondary mute gate in the volume control IC form the audio muting circuit.

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

- high lock detector (VCO lock) signal from the frequency synthesizer;
- the 9.6T keying voltage from the transmitter PTT logic circuit;
- the sidetone enable signal from the PL / DPL or time-out timer;
- the receive audio mute signal from the PL / DPL circuits;
- or the squelch mute signal developed by the receiver squelch circuit.

To allow the sidetone / alert tone to be inserted into the audio path when the recovered audio is muted, it is injected after the de-emphasis amplifier.

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.

Squelch Circuit

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 U100B 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. At this point the squelch signal is output to the Analog Interface Board using the SCAN 4 line (to pin 14 , P352; Slow Sq. Preset) and the SCAN 2 line (to pin 11, P352; Sq. Noise). After processing by the Analog Interface Board circuitry, the appropriate signal is applied to pin 12, P352. A high signal turns Q2102 on, muting the receiver audio.

Q2102 is also controlled by the receive audio mute signal supplied by the PL / DPL circuits. When a valid PL / DPL code is detected, the PL / DPL circuits provide an active low. This prevents Q2102 from muting the receive audio.

8.3.2 MAIN BOARD TRANSMITTER CIRCUITS

(Figures 8-4, 8-6 and 8-7)

The transmitter circuits are mounted on the Main Board and the PA Interconnect Board.

The Main Board contains the following circuits :

- transmit audio / IDC (instantaneous deviation control)
- transmit power level and control
- Part of PTT circuit

Transmit Audio / IDC

The transmit audio / IDC circuit processes the microphone audio to ensure that the proper level of audio drive is supplied to the VCO Assembly in the frequency synthesizer circuits. The low frequency PL / DPL encode signal is combined with the microphone audio and is routed, via IDC deviation control and compensation circuits, to the VCO Assembly. A second VCO reference modulation signal is routed to the 14.4 MHz reference oscillator in the frequency synthesizer circuits (DPL radios only).

Microphone audio is applied to mic mute gate Q325 , via connector J380-4. 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.

The output from the splatter filter is applied to the IDC mute gate Q326, which is open in the receive mode. The IDC audio , which carries information above 50 Hz, is routed to the frequency synthesizer circuits to drive the VCO hybrid.

The signal source used to modulate the 14.4 MHz reference oscillator is the PL / DPL reference modulation signal generated in the PL/DPL circuits. This signal, carrying information below 50 Hz, is routed to the reference oscillator.

Transmit Power and Level Control Circuit

The control circuit provides power leveling and protection from excessive temperature or excessive reflected rf power for the final power amplifier circuits. This is accomplished by reducing the gain of the low level amplifier. The circuit also disables the rf drive (by removing the LLA A+ voltage) if the frequency synthesizer goes out of lock.

The transmit power and level control circuit consists of transistors Q225, Q226, Q227, Q228 and differential amplifier U300B. A temperature compensation monitoring signal is developed by negative coefficient diode CR1451, mounted near the directional coupler. A heat sense signal is developed by a thermistor located in the 30 watt power amplifier. 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.

PTT

Part of the PTT circuit resides on the Main Board. When a request to transmit is made, the DEL PTT (delayed push to talk) line (on P352-3) goes low to turn on Q302 which then provides the 9.6T voltage required by the transmitter circuits. Q307 is turned off at this time. Under receive conditions , the DEL PTT line is high, thus turning on Q307 and turning off Q302.

8.4 HARMONIC FILTER / ANTENNA SWITCH

(Figures 8-8 , 8-13 and 8-14)

The harmonic filter / antenna switch attenuates harmonics of the transmitter during transmit mode and attenuates higher frequency spurious responses of the receiver during receive mode. It also switches the antenna between the transmit signal path and receive signal path.

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.

8.5 TRANSMITTER LOW LEVEL AMPLIFIER HYBRID ASSEMBLY

(Figures 8-11 , 8-13 and 8-14)

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 this amplifier is the 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 this amplifier is controlled by the LLA A+ operating voltage supplied by the transmit power level and control circuit.

8.6 TRANSMITTER 10 WATT AMPLIFIER HYBRID ASSEMBLY

(Figures 8-10, 8-13 and 8-14)

The 10 watt power amplifier consists of a single, non-linear stage Q250 that supplies the rf drive signal to the 30 watt amplifier. Operating power is supplied by the PA A+ voltage.

8.7 TRANSMITTER 30 WATT AMPLIFIER HYBRID ASSEMBLY

(Figures 8-12, 8-13 and 8-14)

The 30 watt amplifier consists of a single, non-linear stage, Q1400. Operating power is supplied by the PA A+ voltage. Temperature protection is provided by a thermistor located near the amplifier. The final rf output from the amplifier is applied to the harmonic filter / antenna switch.

8.8 TRANSMITTER POWER AMPLIFIER INTERCONNECT BOARD

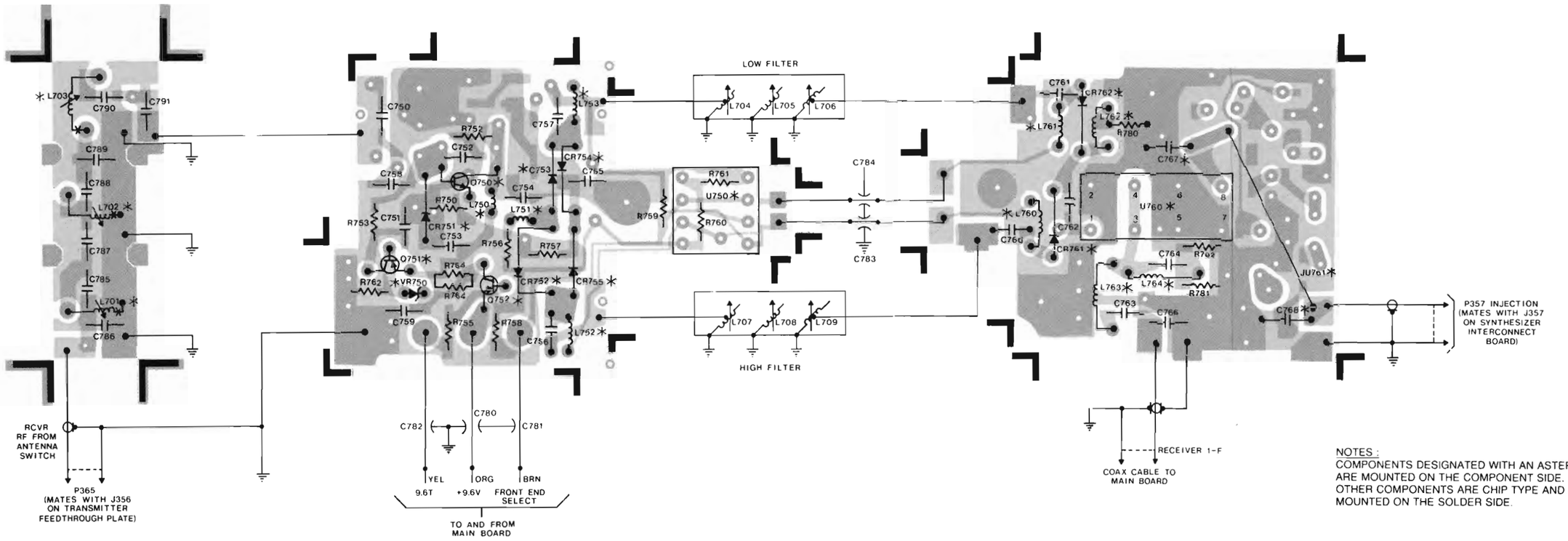
(Figures 8-9, 8-13 and 8-14)

The Transmitter Power Amplifier Interconnect Board contains and connects the low level amplifier hybrid, the 10 watt amplifier hybrid and the harmonic filter hybrid. The rf output from the 10 watt amplifier drives the 30 watt amplifier, which is mounted in the external heatsink.

8.9 POWER INTERCONNECT BOARD

(Figures 8-15 and 8-16)

The Power Interconnect Board provides power distribution for the radio set and feedthrough interconnect from the Main Board to the power amplifier circuitry.



'X' DENOTES LONG LEAD OF COILS. (TOP END)

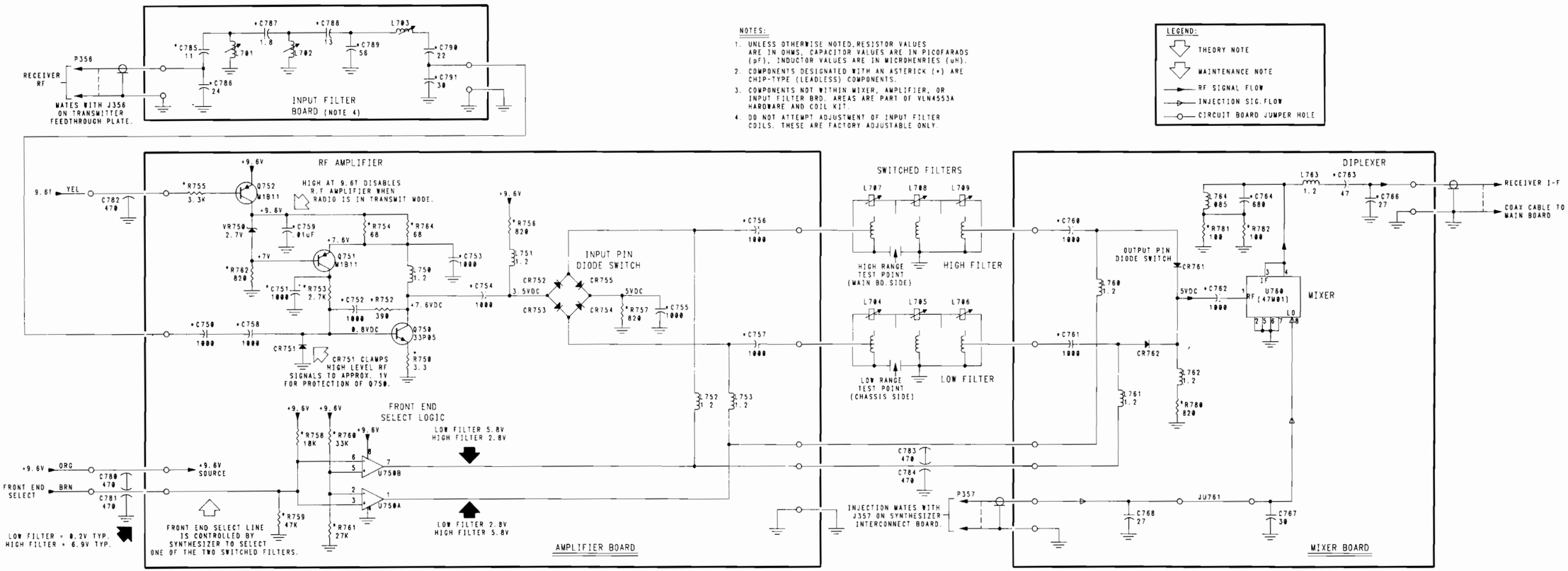
NOTES:
COMPONENTS DESIGNATED WITH AN ASTERISK (*) ARE MOUNTED ON THE COMPONENT SIDE. ALL OTHER COMPONENTS ARE CHIP TYPE AND ARE MOUNTED ON THE SOLDER SIDE.

SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00169M-O

Figure 8-1
Widespace Dual Front End Boards - Board Details



6300643M-O

Figure 8-2
Widespace Dual Front End Boards
Schematic Diagram

parts list

VLN4553A DUAL FRONT END HARDWARE AND COIL KIT

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor , (chip type) pF (unless stated otherwise)
C750 thru		
C758	2111032A09	.001uF - 50V
C759	2111032A21	.01uF -10-50V
C760 thru		
C762	2111032A09	.001uF-50V
C763	2111031B31	47-5-N150-50V
C764	2111031F59	680-5-N750-50V
C766	2111031A25	27-5-NPO-50V
C767	2111022H38	CER DISC 30-5-N150-50V
C768	2111022H37	CER DISC 27-5-N150-50V
C780 thru		
C784	2184874K01	470-20-250V feed-thru
C785	2111031A16	11-5-NPO-50V
C786	2111031A24	24-5-NPO-50V
C787	2111031A04	1.8 ± .25pF-NPO-50V
C788	2111031A18	13-5-NPO-50V
C789	2111031A33	56-5-NPO-50V
C790	2111031A23	22-5-NPO-50V
C791	2111031A26	30-5-NPO-50V
		Diode.silicon
CR751	4883654H01	
CR752,753	4800083M01	PIN
CR754,755	4800082M01	PIN
CR761,762	4800083M01	PIN
		Coil
L701 thru		
L703	2400083M01	INPUT FILTER
L704	2400078M13	SWITCHED, HELICAL LOW
L705	2400078M14	SWITCHED, HELICAL LOW
L706	2400078M15	SWITCHED, HELICAL LOW
L707	2400078M23	SWITCHED, HELICAL HIGH
L708	2400078M24	SWITCHED, HELICAL HIGH
L709	2400078M25	SWITCHED, HELICAL HIGH
L750 thru		
L753	2482723H01	CHOKE 1.2 UH
L760 thru		
L763	2482723H01	CHOKE 1.2 UH
L764	2482723H13	CHOKE .085 UH
		Connector, plug
P356,357	2882365D03	MALE, SINGLE CONTACT (phono)
		Transistor
Q750	4882233P05	NPN, TYPE 33P05
Q751,752	4802081B11	PNP, TYPE M1B11
		Resistor (chip type) ±5%,1/8 W
R750	0600016M13	3.3
R752	0600015M39	390
R754,764	0600015M21	68
R755	0600015M61	3.3K
R756,757	0600015M47	820
R758	0600015M79	18K
R759	0600015M89	47K
R753	0600015M59	2.7K
R760	0600015M85	33K
R761	0600015M83	27K
R762	0600015M47	820
R780	0600015M47	820
R781,782	0600015M25	100
		Integrated Circuit
U750	5180067C03	DUAL OP AMP
U760	5100047N01	MIXER HIGH BARRIER, TYPEM4701
		Voltage regulator
VR750	4882256C33	DIODE, SILICON ZENER,2.7V
		Mechanical parts
	0384208M01	SCREW, MACHINE, M3x0.5x8 (2 used)
	0384208M03	SCREW, MACHINE, M2.5x0.5x6 (6 used)
	1584118M01	HOUSING, PRESELECTOR BASE
	0180768D81	INJECTION CABLE ASSEMBLY INCLUDES
	30859004	CABLE, COAXIAL, 9" USED REFER P356
	0180732D80	ANTENNA CABLE ASSEMBLY INCLUDES
	3083361G01	CABLE, COAXIAL RG178B/U 6" USED . REFER P357
	0180768D82	OUTPUT CABLE ASSEMBLY INCLUDES
	3083361G01	CABLE, COAXIAL RG178B/U 3.5" USED

VLN4554A HOUSING ASSEMBLY (DUAL FRONT END)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	02844773E02	NUT,TENSION (6 used)
	0384589G05	SCREW, 8-32x0.55 (6 used)
	1584119M03	PRESELECTOR HOUSING

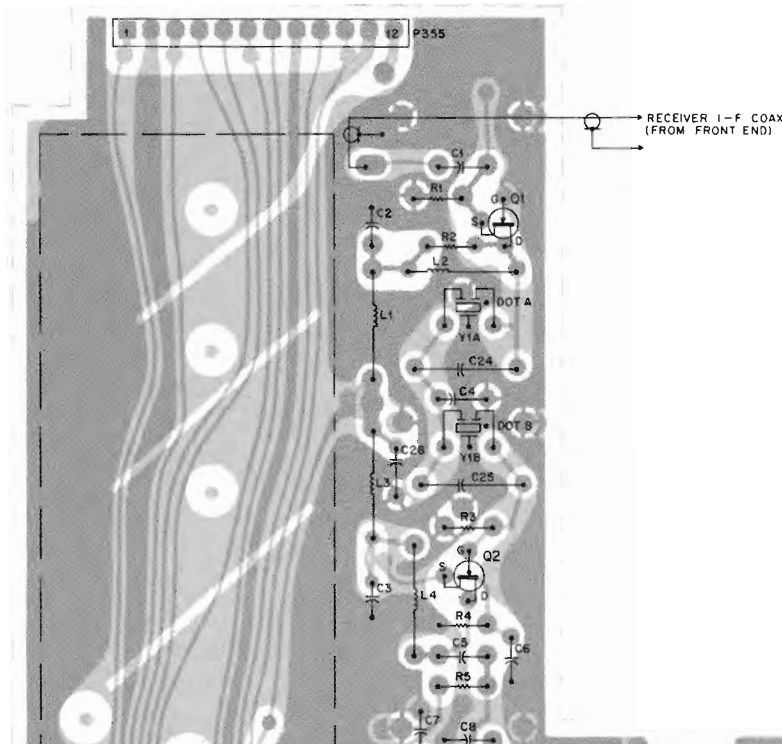
MBTRN5001A HARDWARE (DUAL FRONT END)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0384208M03	SCREW, MACHINE, M2.5x0.5x6 (11 used)
	5400056M01	WARNING LABEL

Figure 8-3
Widespace Dual Front End Boards
Parts lists

DETAIL P355

VOL CONT WIPER	1
+9.6V	2
PA A+	3
VCO MOD	4
9.6T	5
SIGNAL LEVEL	6
REF MOD	7
VOL CONT GROUND	8
VOL CONT HI	9
LOCK DET	10
GROUND	11
FRONT END SELECT	12



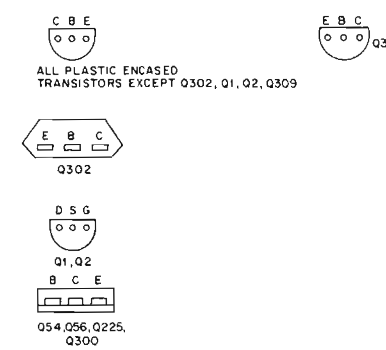
SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

DETAIL P352

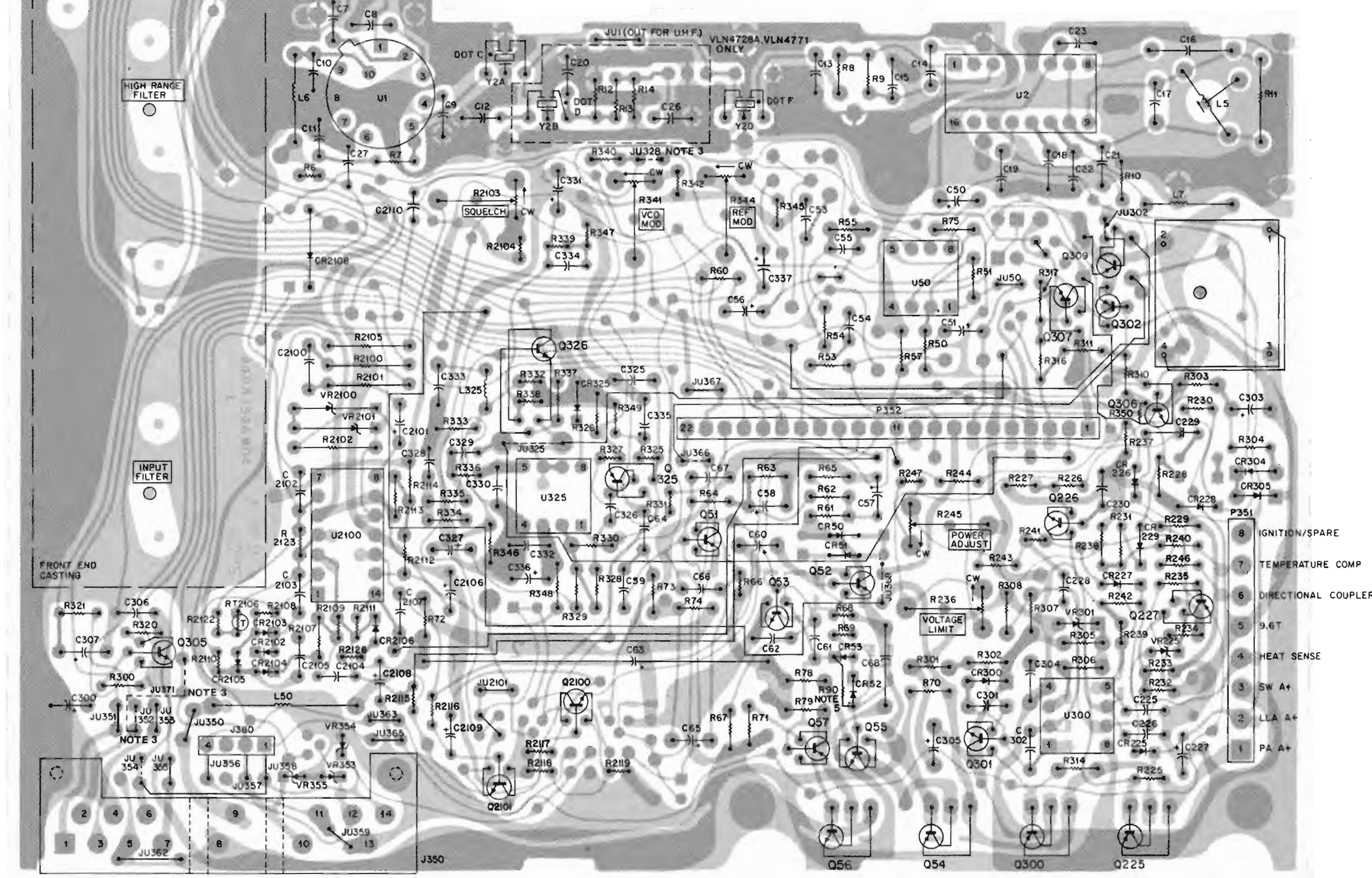
22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
IGNITION/SPARE 4	+4.8V	PL/DPL VCO	EXT ALARM	SIDETONE/ALERT TONE	OPTION TRANSMIT AUDIO	PL/DPL REF	N.C.	SLOW SQ. PRESET	SLOW SQUELCH	RECEIVE AUDIO MUTE	SQ NOISE	SIDETONE ENABLE	PL FILTERED AUDIO	HI/LO PWR	DISC. AUDIO	+9.6V	VCO IN	MIC AUDIO EN.	DEL PTT	IDC AUDIO	GROUND

TRANSISTOR DETAILS
(SHOWN FROM WIRE LEAD SIDE)



DETAIL J380

4	3	2	1
MIC AUDIO +	KEY	HANG-UP	MIC PTT



DETAIL J350

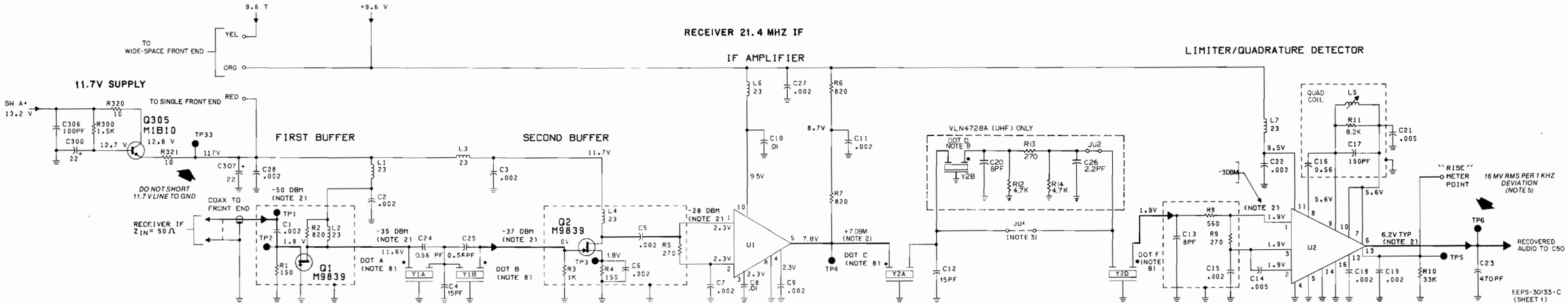
J350A	OPTION RECEIVE AUDIO	1
	OPTION TRANSMIT AUDIO	2
	EXT ALARM	3
	OPTION AUDIO GROUND	4
	OPTION DC GROUND	5
	PTT	6
	SW A+	7
J350B	SPKR LO	8
	SPKR HI	9
J350C		10
	AUDIO GROUND	11
	MIC AUDIO +	12
	GROUND	13
	PTT	14

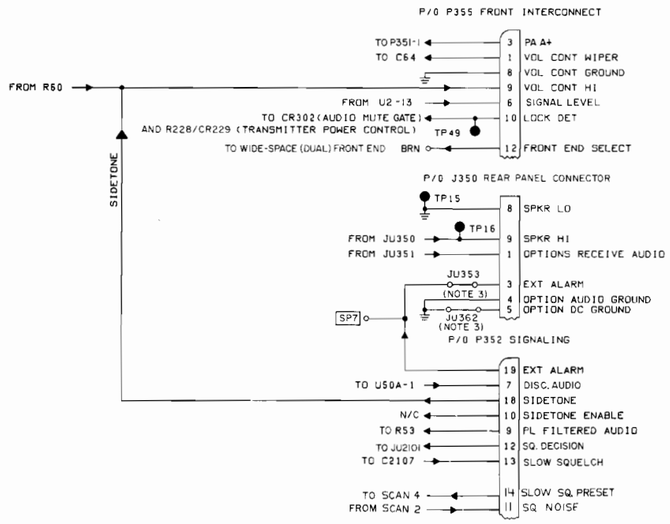
NOTES:

1. TEST POINTS AND SPARE PADS ARE IDENTIFIED ON CIRCUIT BOARD.
2. NOT USED.
3. SEE JUMPER TABLES ON MAIN BOARD SCHEMATIC DIAGRAMS TO DETERMINE WHETHER JUMPERS ARE IN OR OUT. TO REMOVE JUMPERS, PLATING IS CUT.
4. PIN 1 OF INTEGRATED CIRCUITS AND CONNECTORS AND CATHODE OF DIODES DESIGNATED BY SQUARE PADS.
5. R90 IS LOCATED ON THE SOLDER SIDE.

31H00212M-B

Figure 8-4
Main Board - Board Details





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 -53 dBm.
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.
6. Mounted on heat sink, must be insulated from ground.
7. Note 7. is omitted.
8. Crystal filter coding-- VHF and UHF RADIOS
   DOT A is BLACK,
   DOT B is ORANGE

   VHF RADIO DOT C is BLUE,
   DOT F IS VIOLET

   UHF RADIO DOT C is BLUE,
   DOT D is VIOLET.
   DOT F is BLUE.

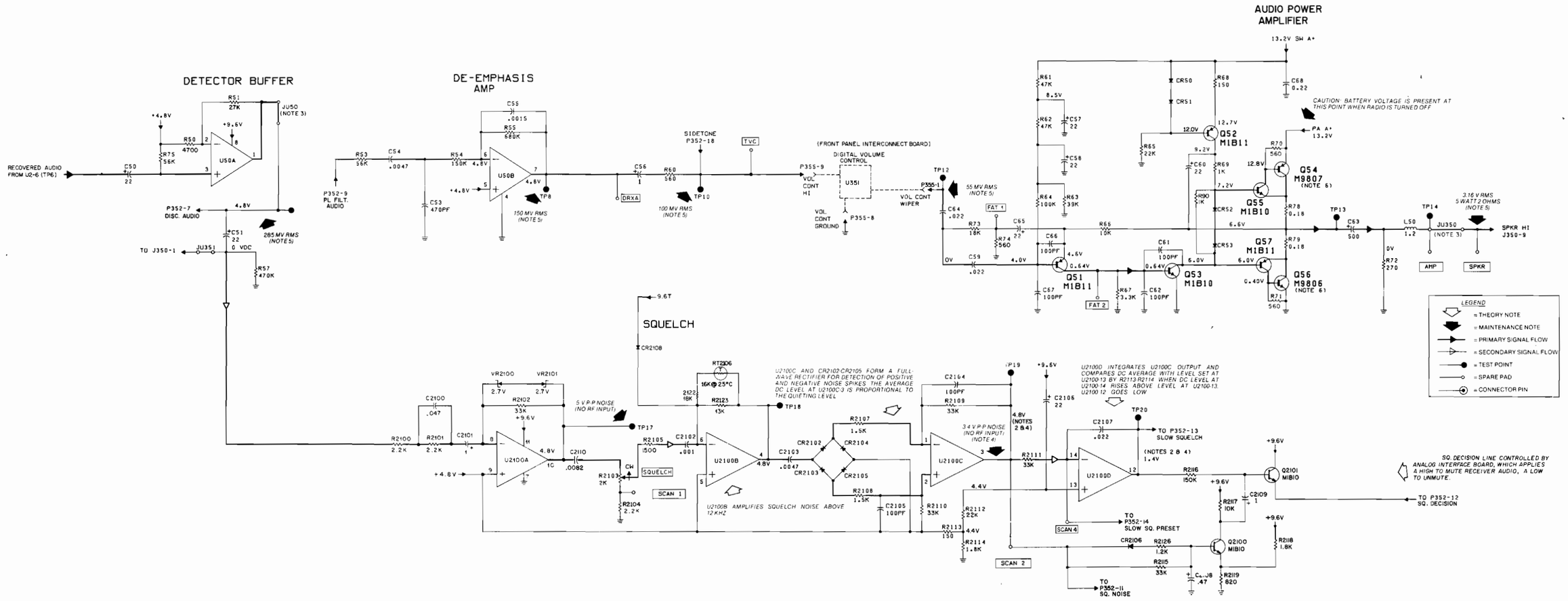
INTEGRATED CIRCUIT CHART

REFERENCE NUMBER	TYPE NUMBER	V-PIN	V + PIN	DESCRIPTION
U1	29M47	8	10	Wideband Amp
U2	M6184	4 / 14	11	Limiter/Quadrature Detector
U50	09M33	4	8	Dual Op Amp
U2100	29M06	7	11	Quad Op Amp

RECEIVER JUMPER TABLE

JUMPER	FUNCTION	LOCATION
UU1	IN (FOR VHF) OUT (FOR UHF)	Y2
JU2	IN (FOR UHF) NOT APPLIC. (VHF)	Y2
JU50	IN	U50A
JU350	IN	J350-9
JU351	IN	J350-1
JU353	IN	J350-3
JU362	IN	J350-5
JU366	OUT	Q58-B
JU2101	IN	Q2102-B

Figure 8-5
Main Board / Receiver
Schematic Diagram
(Sheet 1)



6300674M-B

Figure 8-5
Main Board / Receiver
Schematic Diagram
(Sheet 2)

parts list

VLN4770A MAIN BOARD DIGITAL 25 / 30 KHZ

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, Polyester, uF. 10% 50V (unless stated otherwise)
C1	2111021E25	CER DISC 2000pf-B
C2	2111021E25	CER DISC 2000pf-B
C3	2111021E25	CER DISC 2000pf-B
C4	2111022G34	CER DISC 15pf-5-NPO
C5	2111021E25	CER DISC 2000pf-B
C6	2111021E25	CER DISC 2000pf-B
C7	2111021E25	CER DISC 2000pf-B
C8	2111025A01	CER DISC .01-20-25V
C9	2111021E25	CER DISC 2000pf-B
C10	2111025A01	CER DISC .01-20-25V
C11	2111021E25	CER DISC 2000pf-B
C12	2111022G34	CER DISC 15pf-5-NPO
C13	2111022G25	CER DISC 8-.5-NPO
C14	2111021E26	CER DISC 5000pf-B
C15	2111021E25	CER DISC 2000pf-B
C16	2182450B33	FC .56-5-500V
C17	2100020M26	CER 150-5-NPO
C18	2111021E25	CER DISC 2000pf-B
C19	2111021E25	CER DISC 2000pf-B
C21	2111021E26	CER DISC 5000pf-B
C22	2111021E25	CER DISC 2000pf-B
C23	2111021E09	CER DISC 470pf-B
C24	2182450B33	FC .56-5-500V
C25	2182450B33	FC .56-5-500V
C27	2111021E25	CER DISC 2000pf-B
C28	2111021E25	CER DISC 2000pf-B
C50	2311019A26	ALU 22-20-16V
C51	2311019A26	ALU 22-20-16V
C53	2111021E09	CER DISC 470pf-B
C54	0811023B09	.0047
C55	0811023B03	.0015
C56	2311019A09	ALU 1.0-20
C57	2311019A26	ALU 22-20-16V
C58	2311019A26	ALU 22-20-16V
C59	0811023B17	.022
C60	2311019A26	ALU 22-20-16V
C61	2111022M42	CER DISC 100pf-5-P350-N1000
C62	2111022M42	CER DISC 100pf-5-P350-N1000
C63	2383210A19	ALU 500-10 + 100, 20V
C64	0811023B17	.022
C65	2384613M02	ALU 22-20-25V
C66	2111022M42	CER DISC 100pf-5-P350-N1000
C67	2111022M42	CER DISC 100pf-5-P350-N1000
C68	0884637L22	METALIZED .22-100V
C225	2111022M42	CER DISC 100pf-5-P350-N1000
C226	2111022M42	CER DISC 100pf-5-P350-N1000
C227	2311019A26	ALU 22-20-16V
C228	0811023B13	.010
C229	0811023B23	.068
C230	0811023B09	.0047
C300	2311019A26	ALU 22-20-16V
C301	2111022M42	CER DISC 100pf-5-P350-N1000
C302	2111021E25	CER DISC 2000pf-B
C303	2384613M02	ALU 22-20-25V
C304	0811023B13	.010
C305	2384613M03	ALU 47-20-16V
C306	2111022M42	CER DISC 100pf-5-P350-N1000
C307	2384613M02	ALU 22-20-25V
C325	2111022M42	CER DISC 100pf-5-P350-N1000
C326	0811023A11	.0068-5%
C327	2311019A09	1.0 20-50V ALU
C328	0811023B01	.0010
C329	0811023B05	.0022
C330	2111022G52	CER DISC 80-5-NPO
C331	2311019A45	ALU 100-20-16V
C332	2111022M42	CER DISC 100pf-5-P350-N1000
C333	0811023B18	.027
C334	2111025A01	CER DISC .01-20-25V
C335	2311019A26	ALU 22-20-16V
C336	2311019A26	ALU 22-20-16V
C337	2311019A45	ALU 100-20-16V
C2100	0811023B21	.047
C2101	2311019A09	ALU 1.0-20
C2102	0811023B01	.0010
C2103	0811023B09	.0047
C2104	2111022M42	CER DISC 100pf-5-P350-N1000
C2105	2111022M42	CER DISC 100pf -5-P350-N1000
C2106	2311019A26	ALU 22-20-16V
C2107	0811023B17	.022
C2108	2311019A07	0.47 20-50V
C2109	2311019A09	1.0 20-50V ALU
C2110	0811023A12	.0082
		Diode, Silicon (unless stated otherwise)
CR50	4883654H01	
CR51	4883654H01	
CR52	4883654H02	
CR53	4883654H02	
CR225	4884399M01	99M01
CR226	4884399M01	99M01
CR227	4884399M01	99M01
CR228	4884399M01	99M01
CR229	4884399M01	99M01
CR300	4884399M01	99M01
CR304	4884399M01	99M01
CR305	4884399M01	99M01
CR325	4884399M01	99M01
CR2102	4884399M01	99M01
CR2103	4884399M01	99M01
CR2104	4884399M01	99M01
CR2105	4884399M01	99M01
CR2106	4884399M01	99M01
CR2108	4883654H01	
VR225	4882256C33	ZENER 56C33 2.7V
VR301	4800104M01	ZENER 6.2V
VR353	4882256C11	ZENER 56C11 10V
VR354	4882256C11	ZENER 56C11 10V
VR355	4882256C11	ZENER 56C11 10V
VR2100	4882256C33	ZENER 56C33 2.7V
VR2101	4882256C33	ZENER 56C33 2.7V
		Coil
L1	2482723H35	RF 23 UH
L2	2482723H35	RF 23 UH
L3	2482723H35	RF 23 UH
L4	2482723H35	RF 23 UH
L5	2484972A57	QUAD COIL
L6	2482723H35	RF 23 UH
L7	2482723H35	RF 23 UH
L50	2482190C15	RF CHOKE 1.2 UH
L325	2482415N02	RF CHOKE 10 MH-10
		Mechanical Parts
P351	2882647K03	8 PIN PLUG
P355	2882502M04	12 CONT CONN PLUG
	1484123M01	INS. SHIELD
	1484124M01	INS. SHIELD (2 used)
J350	0180731D28	14 PIN CONN
	0180737D83	SHIELD & FINGERS (over Q2)
	0180737D84	SHIELD & FINGERS BUFFER over Q1)
	0180737D85	SHIELD & FINGERS DET. INPUT (over R8,9)
	0384208M01	SCR M3 X 0.5 X 8 STL (2 used)
	0500004M01	RIV HD STL ZINC PLT (2 used)
	1405160A01	INSUL. (4 used)
	2682437N01	SHLD RF
	2682437N02	SHLD RF
	2684130M01	SHLD COIL
	2684132M01	SHLD DET
		Transistor
Q1	4800869839	M9839
Q2	4800869839	M9839
Q51	4802081B11	M1B11
Q52	4802081B11	M1B11
Q53	4802081B10	M1B10
Q54	4800869807	M9807 (P/O 0180766D71)
Q55	4802081B10	M1B10
Q56	4800869806	M9806 (P/O 0180766D71)
Q57	4802081B11	M1B11
Q225	4884411L10	M1110 (P/O 0180766D71)
Q226	4802081B10	M1B10
Q227	4802081B11	M1B11
Q300	4800869807	M9807 (P/O 0180766D71)
Q301	4802081B10	M1B10
Q302	0180771D44	TRANSISTOR & HT SHRINK TUBING
Q305	4802081B10	M1B10
Q306	4802081B10	M1B10 (P/O 0102700A20)
Q307	4802081B10	M1B10
Q309	4800869707	M9707
Q325	4802081B11	M1B11
Q326	4802081B10	M1B10
Q2100	4802081B10	M1B10
Q2101	4802081B10	M1B10
		Resistor, FCF 5% 1/4 W. (unless stated otherwise)
R1	0611020A29	150
R2	0611020A47	820
R3	0611020A49	1000
R4	0611020A29	150
R5	0611020A35	270
R6	0611020A47	820
R7	0611020A47	820
R8	0611020A43	560
R9	0611020A35	270
R10	0611020A85	33K
R11	0611009C71	8200
R50	0611020A65	4700
R51	0611020A83	27K
R53	0611020A91	56K
R54	0611020B02	150K
R55	0611020B18	680K
R57	0611020B14	470K
R60	0611020A43	560
R61	0611020A89	47K
R62	0611020A89	47K
R63	0611020A87	39K
R64	0611020A97	100K
R65	0611020A81	22K
R66	0611020A73	10K
R67	0611020A61	3300
R68	0611020A29	150
R69	0611020A49	30
R70	0611020A43	560
R71	0611020A43	560
R72	0611020A35	270
R73	0611020A79	18K
R74	0611020A43	560
R75	0611020A91	56K
R78	1782036G59	FWW .18-10%-1W
R79	1782036G59	FWW .18-10%-1W
R225	0611020A25	100
R226	0611020A49	1000
R227	0611020A25	100
R228	0611020A65	4700
R229	0611020A67	5600
R230	0611020A61	3300
R231	0611020A73	10K
R232	0611020A47	820
R233	0611020A59	2700
R234	0611020A75	12K
R235	0611020A71	8200
R237	0611020A77	15K
R238	0611020A77	15K
R239	0611020A73	10K
R240	0611020A85	33K
R241	0611020A89	47K
R242	0611020A63	3900
R243	0611020A81	22K
R244	0611020A75	12K
R246	0611020A72	9100
R247	0611020A57	2200
R300	0611020A53	1500
R301	0611020A37	330
R302	0611020A45	680
R303	0611020A76	13K
R304	0611020A76	13K
R305	0611020A41	470
R306	0611020A73	10K
R307	0610621C66	RES FMF 5490-1-1/4
R308	0610621C91	RES FMF 10K-1-1/4
R310	0611020A27	120
R311	0611020A43	560
R314	0611020A45	680
R316	0611020A65	4700
R317	0611020A53	1500
R320	0611020A01	10
R321	0611020A01	10
R325	0611020A43	560
R326	0611020A73	10K
R327	0611020A73	10K
R328	0611020A65	4700
R329	0611020B02	150K
R330	0611020B17	620K
R331	0611020A65	4700
R332	0611020A73	10K
R333	0611020A73	10K
R334	0611020A86	36K
R335	0611020A98	110K
R336	0611020A98	110K
R337	0611020A57	2200
R338	0611020A97	100K
R339	0611020A97	100K
R340	0611020A73	10K
R342	0611020A59	2700
R345	0611020A49	1000
R346	0611020B14	470K
R347	0611020A25	100
R348	0611020A73	10K
R349	0611020A25	100
R350	0611009C81	22K (P/O 0102700A20 ASSY)
R2100	0611009C57	2200
R2101	0611009C57	2200
R2102	0611009C85	33K
R2104	0611020A57	2200
R2105	0611009C53	1500
R2107	0611020A53	1500
R2108	0611020A53	1500
R2109	0611020A85	33K
R2110	0611020A85	33K
R2111	0611020A85	33K
R2112	0611020A81	22K
R2113	0611020A29	150
R2114	0611020A55	1800
R2115	0611020A85	33K
R2116	0611020B02	150K
R2117	0611020A73	10K
R2118	0611020A55	1800
R2119	0611020A47	820
R2122	0611020A79	18K
R2123	0611020A76	13K
R2126	0611020A51	1200
		Variable resistor, 20% .1W
R336	1884944C02	25K
R341	1884944C03	10K
R344	1884944C03	10K
R245	1884944C02	25K
R2103	1884944C01	2000
		Thermistor
RT2106	0682557J06	16K
		Integrated Circuit
U1	5183629M47	3 STAGE DIFF. AMP
U2	5184561L84	IF-QUAD PHASE DET AMP
U50	5182609M33	09M33 MC4558
U300	5182609M33	09M33 MC4558
U325	5182609M33	09M33 MC4558
U2100	5183629M06	QUAD OP AMP
		Filter
Y1A,B	4805535C05	XTAL (matched pair)
Y2A,D	4805535C07	XTAL (matched pair)

Figure 8-6
Main Board Parts List

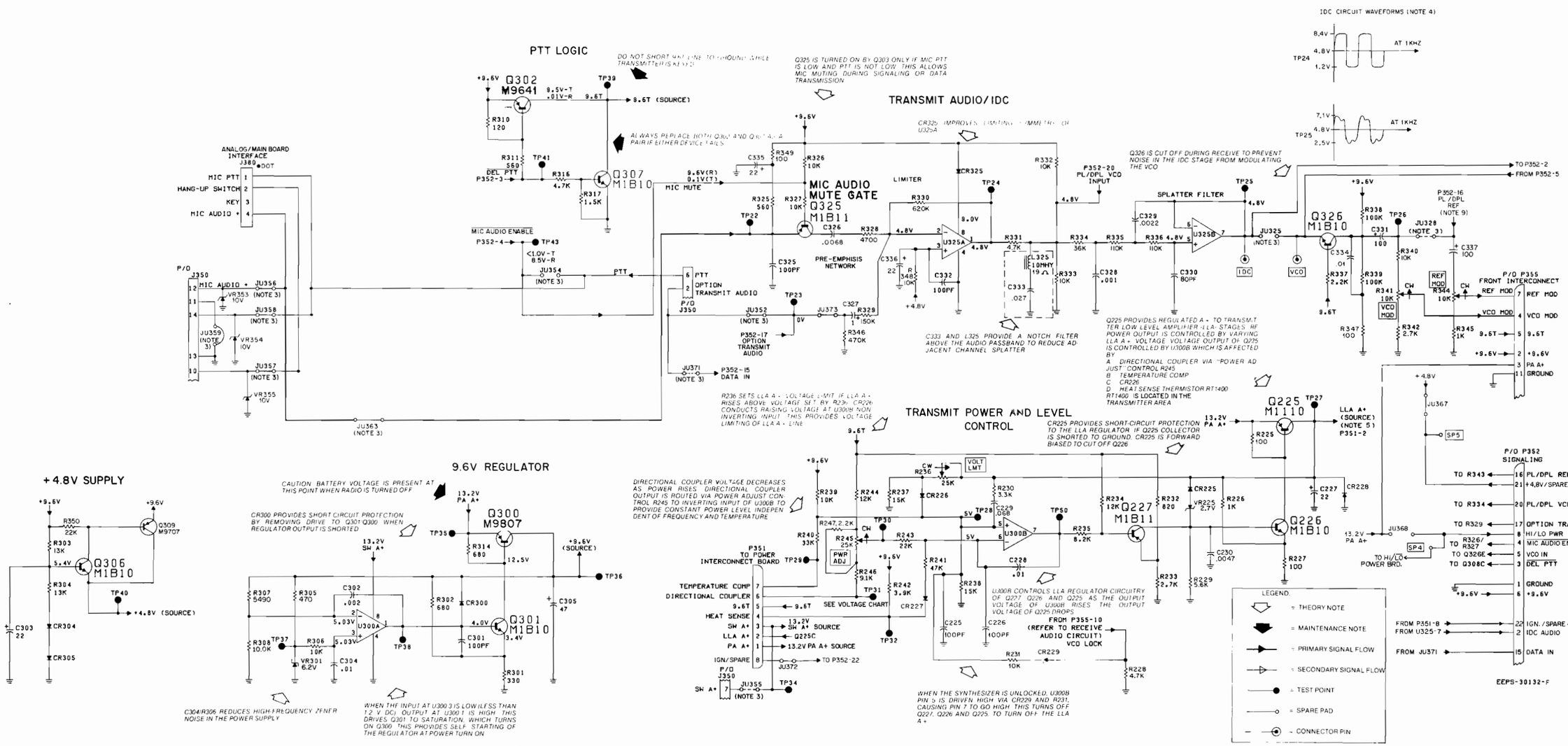


Figure 8-7
Main Board / Transmitter
Schematic Diagram
(Sheet 1)

6300675M-B

NOTES :

1. Unless otherwise noted, resistor values are in ohms, capacitor values in microfarads, inductor values are in microhenries.
2. Note 2. is omitted.
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. LLA refers to low level rf amplifier stage.
6. Voltage notations : (T) = Transmitter Keyed
   (R) = Receive (Transmitter unkeyed)

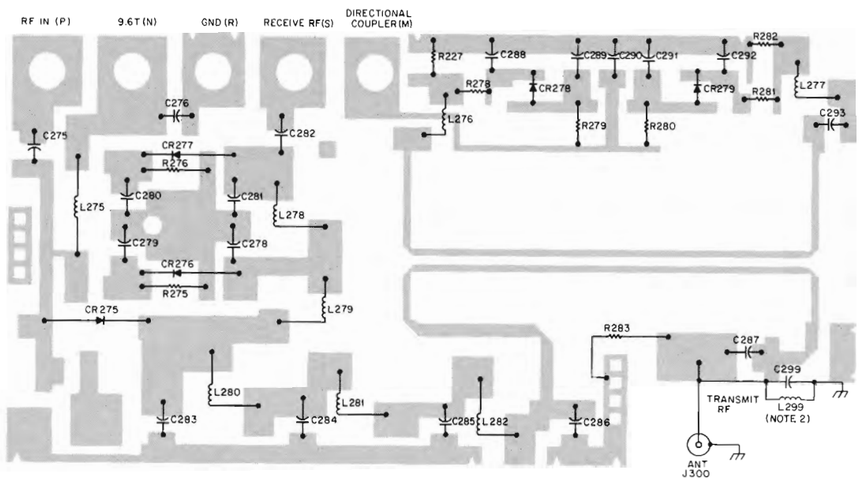
TRANSMITTER JUMPER TABLE

JUMPER	FUNCTION	LOCATION
JU302	OUT	Q309
JU325	OUT	U325B-7
JU328	OUT (FOR VHF) IN (FOR UHF)	R340
JU352	IN (FOR NON-DIGITAL) OUT (FOR DIGITAL RADIO)	J350-2
JU354	OUT	J350-6
JU355	IN	J350-7
JU356	IN	J350-12
JU357	IN	J350-10
JU358	IN	J350-14
JU359	IN	J350-11
JU363	IN	Q325-E
JU365	IN	J380-1
JU367	IN	P352-21
JU368	OUT	P352-8
JU371	OUT (FOR NON-DIGITAL) IN (FOR DIGITAL RADIO)	TP23

TP31 VOLTAGE CHART

OUTPUT POWER	TP31 VOLTAGE
0 Watts	2.0 V
30 Watts	1.3 V

Figure 8-7
Main Board / Transmitter
Schematic Diagram
(Sheet 2)

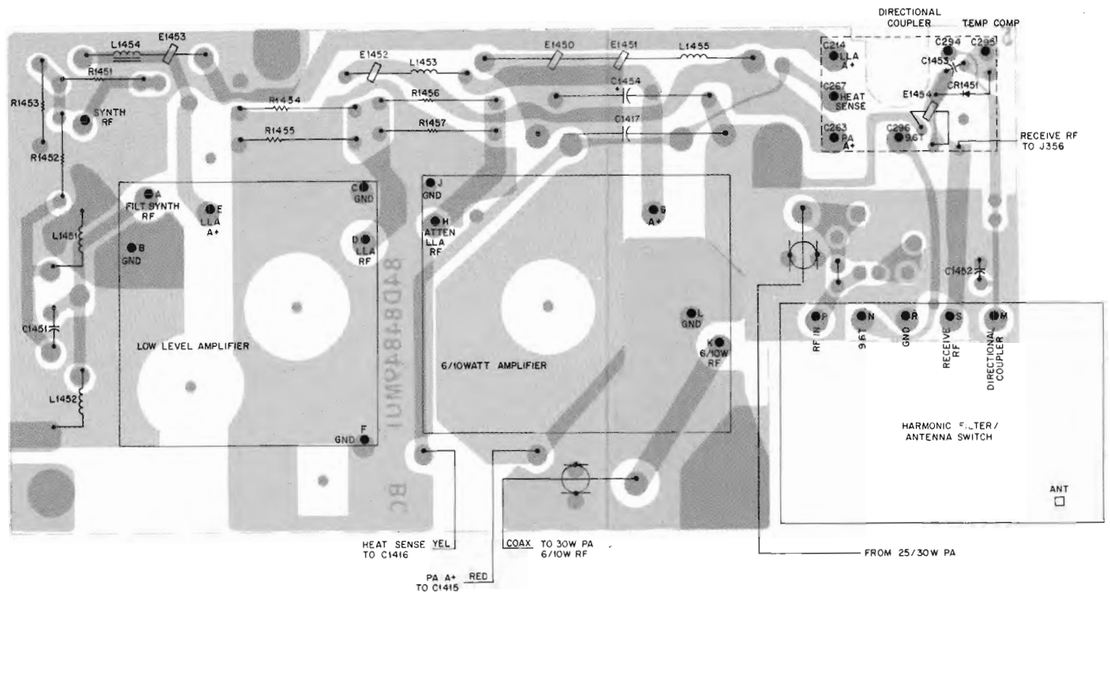


SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00213M-O

Figure 8-8
Harmonic Filter Hybrid Assembly
- Board Details

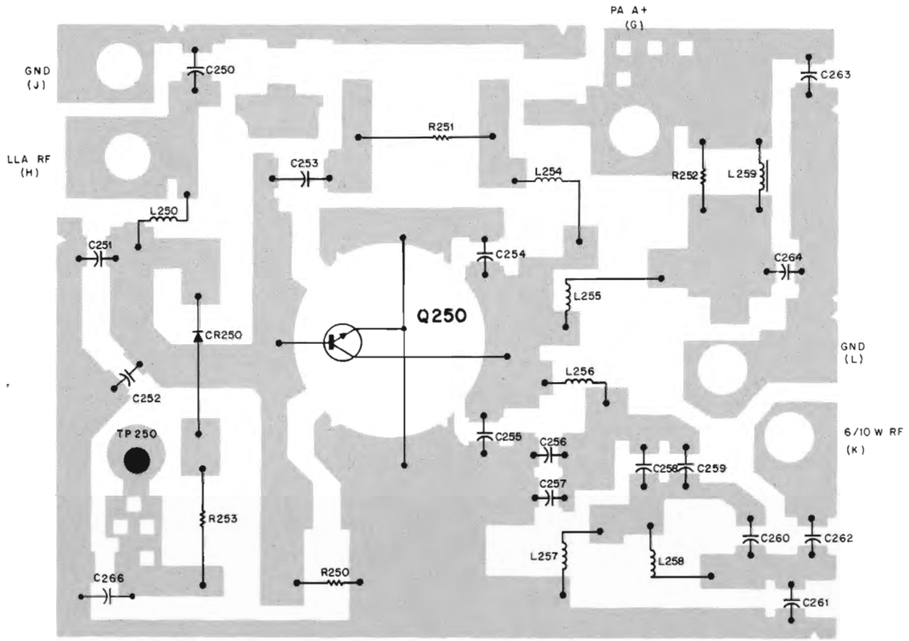


SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00214M-O

Figure 8-9
30 Watt P A Interconnect Board
- Board Details



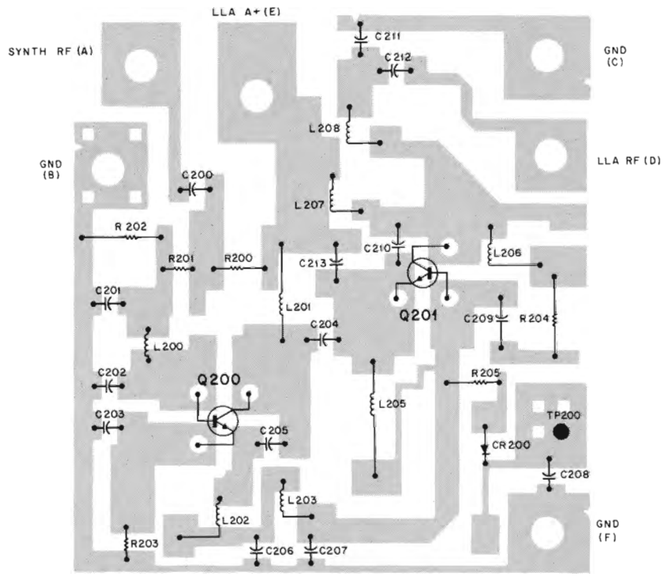
NOTE
ALL RESISTORS SHOWN ON THIS BOARD ARE SCREENED ON SUBSTRATE; THEY ARE NOT SERVICEABLE.

SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00215M-O

Figure 8-10
10 Watt Power Amplifier Hybrid
- Board Details



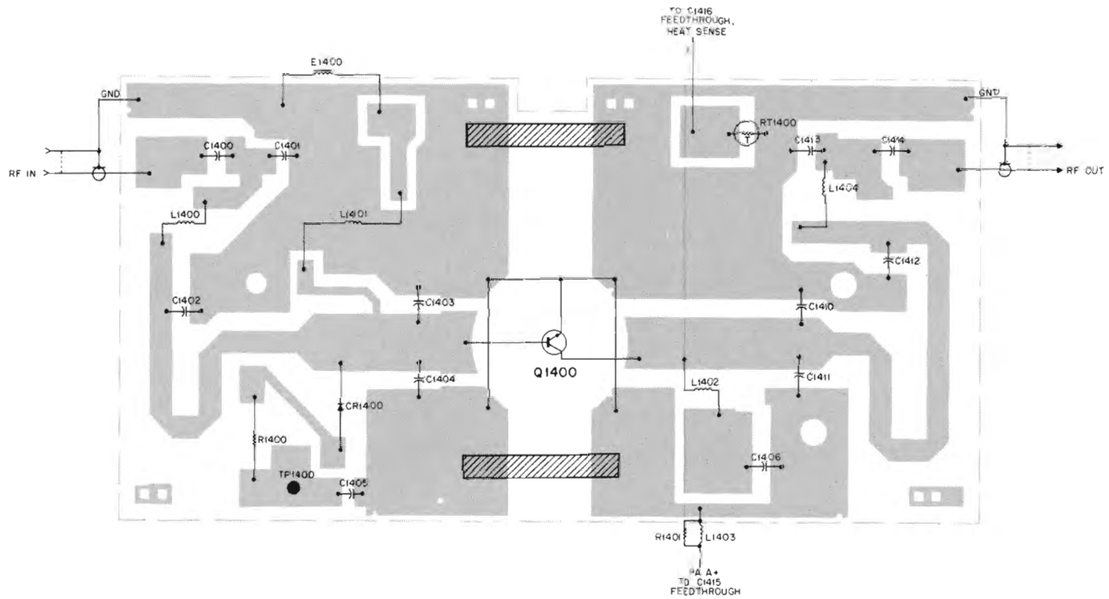
SHOWN FROM COMPONENT. SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

NOTE:
ALL RESISTORS SHOWN ON THIS BOARD ARE SCREENED ON THE SUBSTRATE, HENCE THEY ARE NOT SERVICEABLE.

31H00216M-O

Figure 8-11
Low Level Amplifier Hybrid
- Board Details



SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00217M-O

Figure 8-12
30 Watt Power Amplifier Hybrid
- Board Details

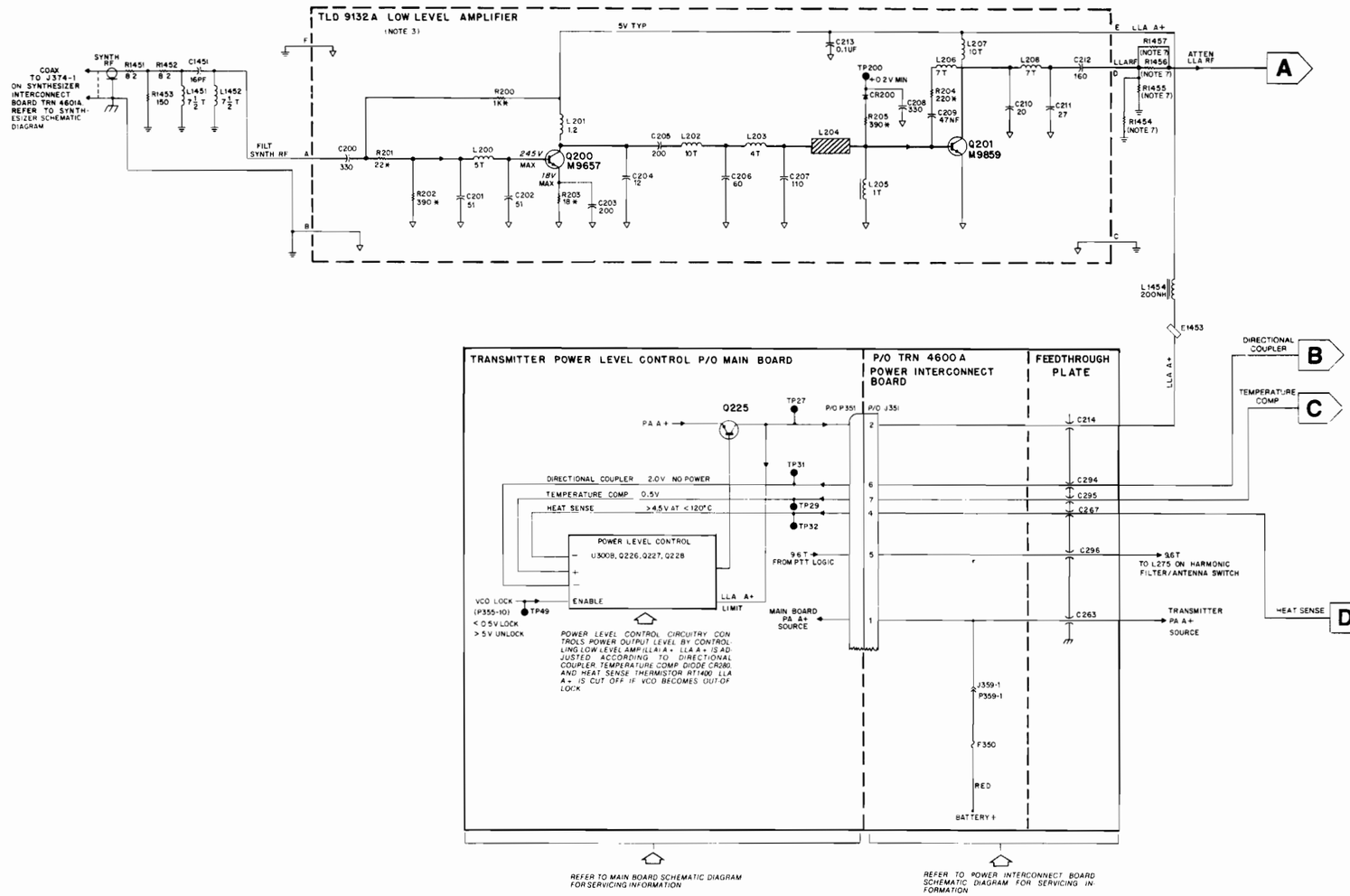
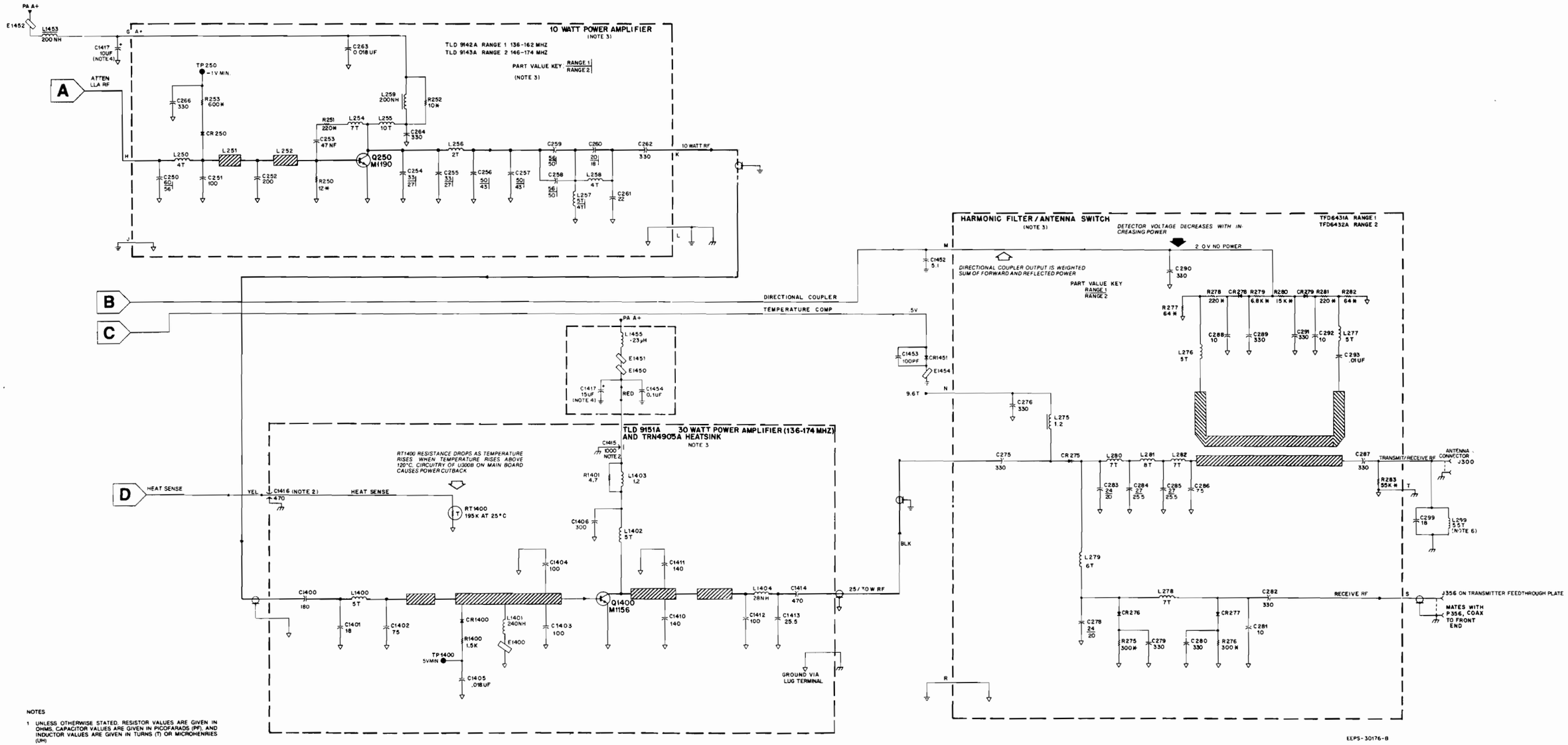


Figure 8-13
Power Amplifier
Schematic Diagram
(sheet 1)



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 6/10 WATT MODELS ONLY. TO L1405 IN 25/30 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.

LEGEND:
- THEORY NOTE
- MAINTENANCE NOTE
- TRANSMISSION LINE
- PRIMARY SIGNAL FLOW
- CIRCUIT BOARD-WIRE CONNECTION
- CHASSIS GROUND
- POWER GROUND
- SUBSTRATE GROUND

6300677M-O

Figure 8-13
Power Amplifier
Schematic Diagram
(sheet 2)

parts list

MBTLD9151A P.A. HYBRID 30 W. VHF

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, pf
C1400	2111059D51	CHIP 180-5-NPO-50V
C1401	2111059D86	CHIP 18-2-NPO 50V
C1402	2111059D73	CHIP 75-5-NPO-50V
C1403	2111059C21	CHIP 100-5-50V
C1404	2111059C21	CHIP 100-5-50V
C1405	2184547A23	CER CHIP 18,000-20-X7R-50V
C1406	2111059D74	CHIP 300-5-NPO-50V
C1410	2111059C41	140-5-50V
C1411	2111059C41	140-5-50V
C1412	2111059C21	CHIP 100-5-50V
C1413	2111059C10	CHIP 25.5-5-50V
C1414	2111059D52	CHIP 470-5-NPO-50V
		Diode
CR1400	4883654H01	SLCN
		Ferrite Bead
E1400	0180739D84	FLT FT
		Coil, Air
L1400	2484331M02	22 AWG 5 TNS
L1401	2484331M42	22 AWG 11 TNS
L1402	2484331M03	22 AWG 5 TNS
L1404	2484331M43	20 AWG 4 TNS
		Transistor
Q1400	4884411L56	NPN 11L56
		Resistor
R1400	0660075A53	1500-5-1/8
		Thermistor
RT1400	0600867628	TMTR

MBTRN4905A 30W HEAT SINK HARDWARE KIT

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor (both capacitors below are located on feedthru plate 0180731D25)
C1415	2182812H03	CER FEEDTHRU 1000 pf- + 100-0
C1416	2184874K01	CER FEEDTHRU
		Coil (both coil and resistor below are contained in assembly 0180760D55)
L1403	2482190C15	RF 1.2UH (wound on R1401)
		Resistor
R1401	0600125B61	FC 4.7-5-1/2
		Miscellaneous parts
	0180731D44	30W PA LUG & COAXIAL CABLE
	0180734D15	3" COAX INPUT ASSEMBLY
	1584141M01	HEAT SINK COVER
	0310943J03	SCR M2.5 X 0.45 X 6 STL

MBTFD 6431A HARMONIC FILTER HYBRID 30 W R1 VHF
MBTFD 6432A HARMONIC FILTER HYBRID 30 W R2 VHF

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, Chip type.pf
C275	2111059D98	330-10-NPO-50V
C276	2111059D98	330-10-NPO-50V
C278 (R2)	2111059D89	20-2-NPO-50V
C278 (R1)	2111059D94	24-5-NPO-50V
C279	2111059D98	330-10-NPO-50V
C280	2111059D98	330-10-NPO-50V
C281	2111059D76	10-5-NPO-50V
C282	2111059D98	330-10-NPO-50V
C283 (R2)	2111078B21	20-5-NPO-100V
C283 (R1)	2111078B23	24-5-NPO-100V
C284 (R2)	2111078B24	25-5-NPO-100V
C284 (R1)	2111078B25	27-5-NPO-100V
C285 (R2)	2111078B24	25-5-NPO-100V
C285 (R1)	2111078B25	27-5-NPO-100V
C286	2111078B10	7.5-25-NPO-100V
C287	2111059D98	330-10-NPO-50V
C288	2111059D76	10-5-NPO-50V
C289	2111059D98	330-10-NPO-50V
C290	2111059D98	330-10-NPO-50V
C291	2111059D98	330-10-NPO-50V
C292	2111059D76	10-5-NPO-50V
C293	2111059B11	10,000-20-X7R-50V
		Diode
CR275	4883510F04	10F04 1 OHM AT 50 MA
CR276	4883510F04	10F04 1 OHM AT 50 MA
CR277	4883510F04	10F04 1 OHM AT 50 MA
CR278 (R2)	48R02006A01	HOT CAR 39C35 4V
CR278 (R1)	48R02006A01	HOT CAR 06A01 4V LOW PRO
CR279 (R2)	48R02006A01	HOT CAR 39C35 4V
CR279 (R1)	48R02006A01	HOT CAR 06A01 4V LOW PRO
		Coil
L275 (R2)	2482723H49	RF 1.2 UH
L275 (R1)	2482723H49	RF 1.2 UH BLUBLK
L276	2484331M05	AIR 24AWG 5 TNS
L277	2484331M05	AIR 24AWG 5 TNS
L281 (R2)	2484331M27	AIR 24AWG 8 TNS
L281 (R1)	2484331M25	AIR 24AWG 8 TNS
L279 (R2)	2484331M30	AIR 24AWG 6 TNS
L279 (R1)	2484331M29	AIR 24AWG 6 TNS
L278 (R2)	2484331M32	AIR 24AWG 7 TNS
L278 (R1)	2484331M41	AIR 24AWG 7 TNS
L280 (R2)	2484331M35	AIR 24AWG 7 TNS
L280 (R1)	2484331M34	AIR 24AWG 7 TNS
L282 (R2)	2484331M37	AIR 24AWG 7 TNS
L282 (R1)	2484331M36	AIR 24AWG 7 TNS

MBTLD9142A 10 WATT PA HYBRID R1 VHF
MBTLD9143A 10 WATT PA HYBRID R2 VHF

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, chip, pf, 5%, NPO, 50V (unless stated otherwise)
C250 (R2)	2111059D85	56
C250 (R1)	2111059D80	60-2-NPO-50V
C251	2111059D59	100
C252	2111059D68	200
C253	2184547A22	47000 - 10 -X7R -25V
C254 (R2)	2111059D57	27
C254 (R1)	2111059D50	33.0
C255 (R2)	2111059D57	27
C255 (R1)	2111059D50	33.0
C256 (R2)	2111059D88	43
C256 (R1)	2111059D91	50
C257 (R2)	2111059D88	43
C257 (R1)	2111059D91	50
C258 (R2)	2111059D91	50
C258 (R1)	2111059D85	56
C259 (R2)	2111059D91	50
C259 (R1)	2111059D85	56
C260 (R2)	2111059D86	18 - 2%
C260 (R1)	2111059D89	20-2-NPO-50V
C261	2111059D61	22
C262	2111059D98	330 - 10%
C263	2184547A23	18000 -20 -X7R -50V
C264	2111059D98	330 - 10%
C266	2111059D98	330 - 10%
		Coil
L250	2484331M16	air 22AWG 4 turns
L254	2484331M17	air 24AWG 7 turns
L255	2484331M18	air 24AWG 10 turns
L256	2484331M22	air 24AWG 2 turns
L257 (R2)	2484331M13	air 22AWG 4 turns
L257 (R1)	2484331M05	air 24AWG 5 tns
L258	2484331M10	air 22AWG 4 turns
L259	2482723H46	RF .2 UH
		Diode
CR250	4883654H01	silicon
		Transistor
Q250	4884411L90	NPN 11L90

MBTLD9132A LL AMPLIFIER HYBRID VHF

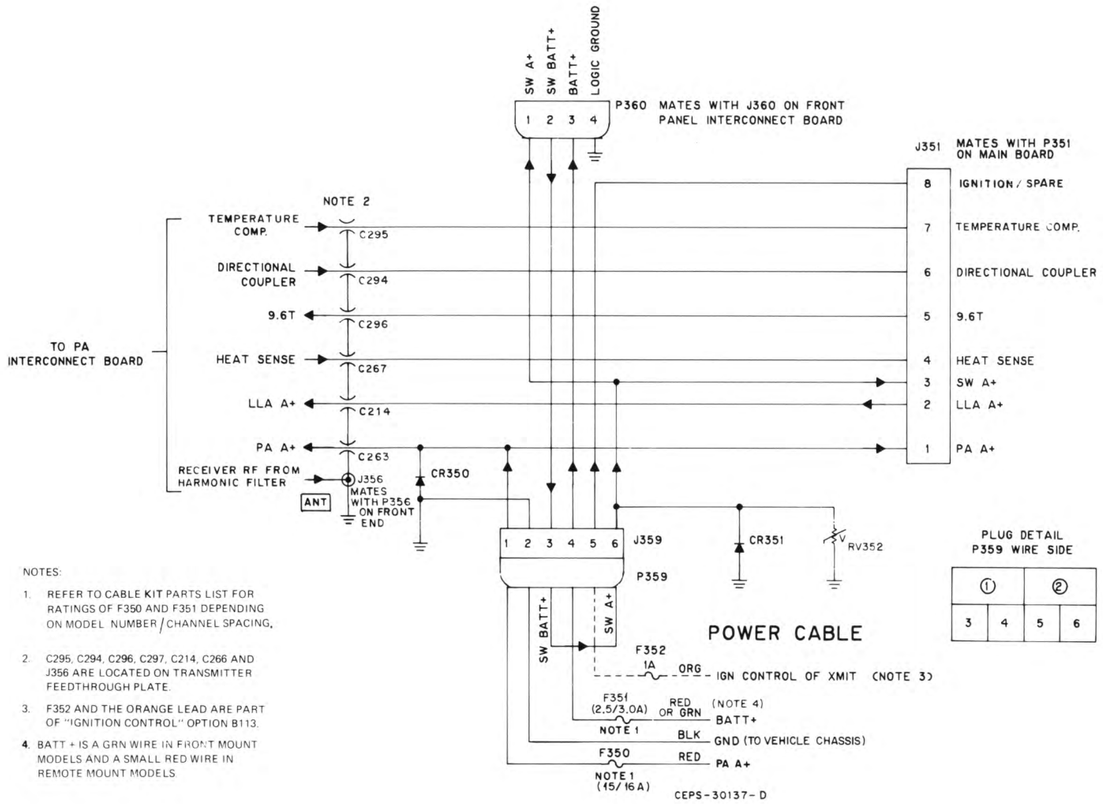
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, chip, pf, 5%, NPO, 50V (unless stated otherwise)
C200	2111059D98	330, 10%
C201	2111059D58	51
C202	2111059D58	51
C203	2111059D68	200
C204	2111059D77	12
C205	2111059D68	200
C206	2111059D80	60 , 2%
C207	2111059D81	110
C208	2111059D98	330, 10%
C209	2184547A22	47000 -10 -X7R -25V
C210	2111059D89	20, 2%
C211	2184873H23	27, MONO
C212	2111059D84	160
C213	2111059B24	.1uf -20% -X7R -25V
		Coil
L200	2484331M11	air 28 AWG 5 turns
L201	2482723H49	1.2 UH RF
L202	2484331M12	air 28 AWG 10 turns
L203	2484331M13	air 22 AWG 4 turns
L205	0180702T04	formed wire and bead
L206	2484331M14	air 24 AWG 7 turns
L207	2484331M12	air 28 AWG 10 turns
L208	2484331M15	air 28 AWG 7 turns
		Transistor
Q200	4800869657	M9657
Q201	4800869859	NPN 69859
		Diode
CR200	4883654H01	silicon

MBTRN4696A P.A. INTERCONNECT BOARD , HI POWER

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capicator, pf (unless otherwise stated)
C1417	2383908L02	CAP ALU 15 -10 + 75 25V
C 451	2111022G35	CAP CER DISC 16-5-NPO-50V
C1452	2184511B06	CAP CER PLT 5.1-5-NPO
C1453	2184511B01	CAP CER PLT 100-10-N750
C1454	0882317B01	CAP POLYEST .1uf-10-100V
		Diode
CR1451	4883654H01	SLCN
		Coil
E1454	7683960B01	CORE FERRITE
L1451	2483884G04	COIL
L1452	2483884G04	COIL
L1453	2482723H11	COIL RF .2UH
L1454	2482723H11	COIL RF .2UH
L1455	2484346A02	CHK RF .23UH
		Resistor
R1451	06124B67HB	8.2-5-1/4
R1452	06124B67HB	8.2-5-1/4
R1453	0611009C29HB	FCF 150-5-1/4
R1454	0600125A48	FC 910-5-1/2
R1455	0600125A48	FC 910-5-1/2
R1456	0600125A01	FC 10-5-1/2
R1457	0600125A01	FC 10-5-1/2

Figure 8-14

Power Amplifiers Parts Lists



NOTES:

1. REFER TO CABLE KIT PARTS LIST FOR RATINGS OF F350 AND F351 DEPENDING ON MODEL NUMBER / CHANNEL SPACING.
2. C295, C294, C296, C297, C214, C266 AND J356 ARE LOCATED ON TRANSMITTER FEEDTHROUGH PLATE.
3. F352 AND THE ORANGE LEAD ARE PART OF "IGNITION CONTROL" OPTION B113.
4. BATT + IS A GRN WIRE IN FRONT MOUNT MODELS AND A SMALL RED WIRE IN REMOTE MOUNT MODELS.

PLUG DETAIL
P359 WIRE SIDE

①		②	
3	4	5	6

parts list

MBTKN8158C POWER CABLE (DASH MOUNT RADIO)

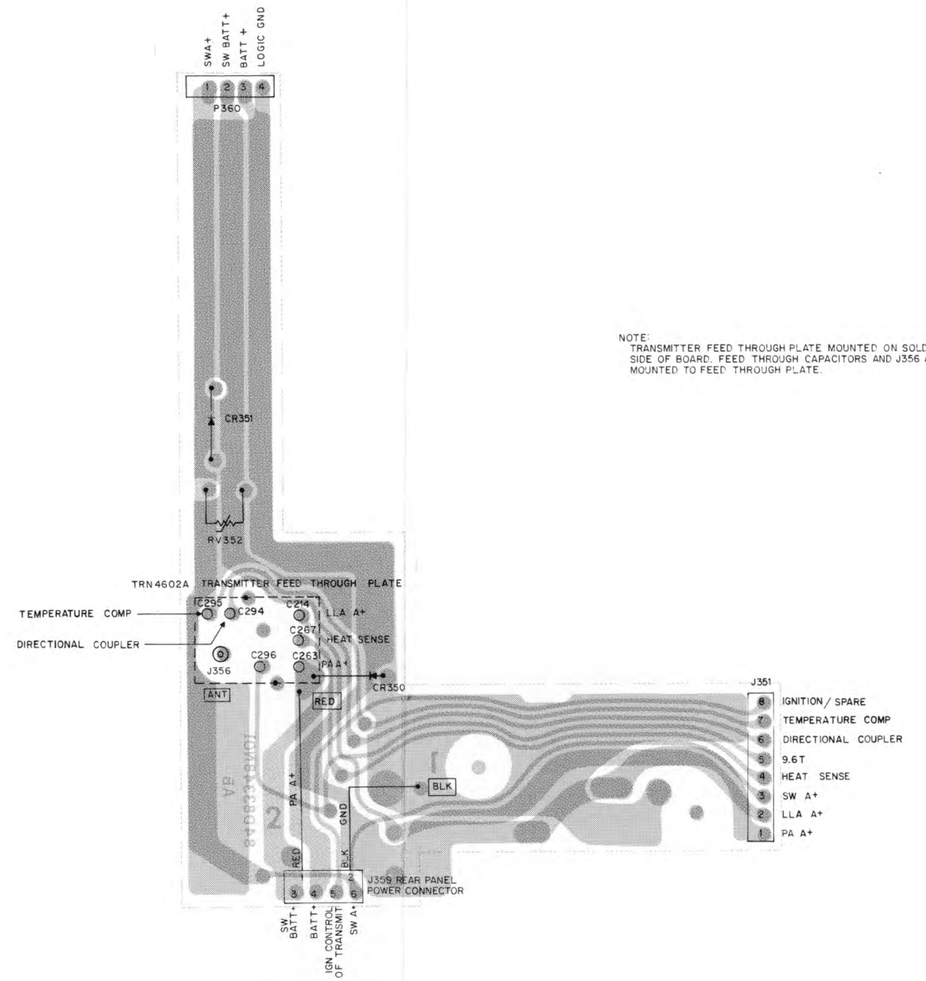
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F350	65-4165	15A
F351	65-20404	3A; 250 V
		mechanical parts
P359	15-84192M01	HOUSING, connector; 6-contact
	14-82883A01	INSULATOR, fuseholer; 2 used
	42-82884A01	CLIP, fuseholder; 2 used
	1-80733D11	ASSEMBLY, black wire and terminal; includes:
	9-84151B03	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)
	1-80733D17	ASSEMBLY, black wire and terminal (long) includes:
	29-84151L05	TERMINAL, female (large)

MBTRN5365A POWER INTERCONNECT BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Diode, Silicon
CR350	4882525G13	25G13 100V
CR351	4882525G19	25G19 100V
		Varistor
RV352	0600017M01	

6300678M-O

Figure 8-15
Power Interconnect Board
Schematic Diagram / Parts List



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

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00218M-O

Figure 8-16
Power Interconnect Board
- Board Details

END OF SECTION 8

MOTOROLA LIMITED
Communications Division

SECTION 9. ACCESSORY INFORMATION

9.1 GENERAL

This section provides information on the common accessories used with the MCX1000 Radio Set. These are:

- Mobile Microphone
- Base Microphone
- Touch-Code Encoder Microphone
- Mobile Speaker
- Base Station Mounting Tray and Speaker
- Base Station Power Supply

9.2 MOBILE MICROPHONE

The Mobile Microphone, model VMN1016A, includes:

- VLN4765A Microphone Board
- VLN4712A Microphone Hardware

An exploded view, schematic diagram, board details and parts list for the VMN1016A Mobile Microphone may be found in Figures 9-1 to 9-4.

The VMN1016A Mobile Microphone comes as standard equipment with each MCX1000 Mobile Radio Set.

9.3 BASE MICROPHONE

An exploded view, schematic diagram, board details and parts list for the VMN1018A Base microphone may be found in Figures 9-5 to 9-8.

9.3.1 DESCRIPTION

The VMN1018A Base Microphone permits convenient operation of the MCX1000 Radio Set when it is used as a base station. The monitor switch on the microphone performs the same function as the monitor button which is removed from the radio front panel when the radio is used with this microphone. In addition, the monitor switch performs the on/off hook function in carrier squelch scan systems. The push-to-talk switch on the microphone performs the same function as the push-to-talk button on the mobile microphone.

The base microphone contains a microphone and preamplifier circuit board, and a dual-action "transmit" switch.

All electrical components are mounted vertically in the housing with the microphone cartridge at the top and the switches at the bottom.

9.3.2 OPERATION

When operating the Base Microphone, it is important to monitor the mode (channel) to be used before transmitting. Monitoring is performed by pressing the monitor switch to stop the scanner and/or disable PL/DPL squelch, and listening for mode (channel) activity before pressing the PTT switch.

NOTE
If the PTT switch is pressed before the monitor switch, the radio automatically reverts to the off-hook mode and remains there until the monitor switch is pressed.

9.3.3 THEORY OF OPERATION

PL/DPL Squelch Scan

Pressing the monitor switch triggers U5021, a flip-flop in the microphone, to toggle the hang-up switch line. This function is equivalent to taking a mobile microphone off hook or replacing it on hook. When the scan switch is on, the monitor switch on the microphone performs the scan off-hook function (the scanner stops and reverts to the off-hook mode). The conversation then takes place in the carrier squelch mode. if the scan switch on the radio is switched off, the monitor switch performs the coded squelch/carrier squelch function.

Carrier Squelch Scan

Pressing the monitor switch on the microphone triggers U5021, a flip-flop in the microphone, to toggle the hang-up switch line. This function is equivalent to taking a mobile microphone off hook or replacing it on hook.

9.3.4 MAINTENANCE

Disassembly / Assembly

1. At the rear of the microphone, remove the four screws that secure the front cover to the housing; then remove the front cover.

2. On the bottom of the microphone, remove the four screws that secure the baseplate to the housing; then remove the baseplate.

3. Located on the underside of the dual action transmit switch is the pivot shaft. Remove the shaft retainer clip from the pivot shaft.

4. Remove the microphone cord from the U shaped slot at the rear of the base of the microphone.

5. Slide both halves of the pivot shaft toward the centre, releasing the shaft from the retaining holes in the housing.

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.

7. To assemble, reverse the order of the above steps.

9.3.5 TESTING

Test equipment required:

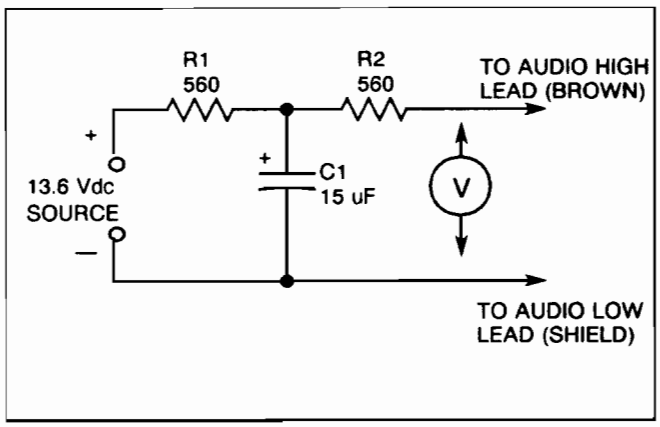
- S-1063 Motorola Solid State DC Multimeter or equivalent.
- S-1053 Motorola Solid State AC Voltmeter or equivalent.

- R-1004 Motorola General Purpose Dual Trace 15 MHz Oscilloscope.

Test Procedure:

NOTE
Potentiometer R5021 is factory set and field adjustment is not required.

The audio portion of the microphone can be tested either while connected to its associated equipment or to the test setup as shown in the diagram below.



Test Setup

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.

parts list

VLN4712A MICROPHONE HARDWARE KIT

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	1580137D05	HOUSING, MICROPHONE FRONT
2	3880144D03	BUTTON, MICROPHONE
3	8400337M01	MICROPHONE BOARD
4	3000054M01	CABLE , MICROPHONE
5	NOT USED	
6	0310943J10	SCR M3 x 0.5 x 8 STL
7	NOT USED	
8	NOT USED	
9	NOT USED	
11	NOT USED	
12	0102700A27	HOUSING, MICROPHONE REAR
10		ASSEMBLY NOT FIELD
13		REPAIRABLE. INCLUDES
14		PARTS WITH REFERENCE SYMBOL #'S 10, 13, 14
15	NOT USED	
16	NOT USED	
17	0300140001	SCREW, TPG, 6-19X7/8 PHLPAN STL (3 USED)
18	NOT USED	
19	0580148D01	MIC CTRG GROMMET
20	3580089D01	MIC BAFFLE
		Non-referenced item
	3910184A10	PLUG, CONTACT (4 used for connections to PC board)

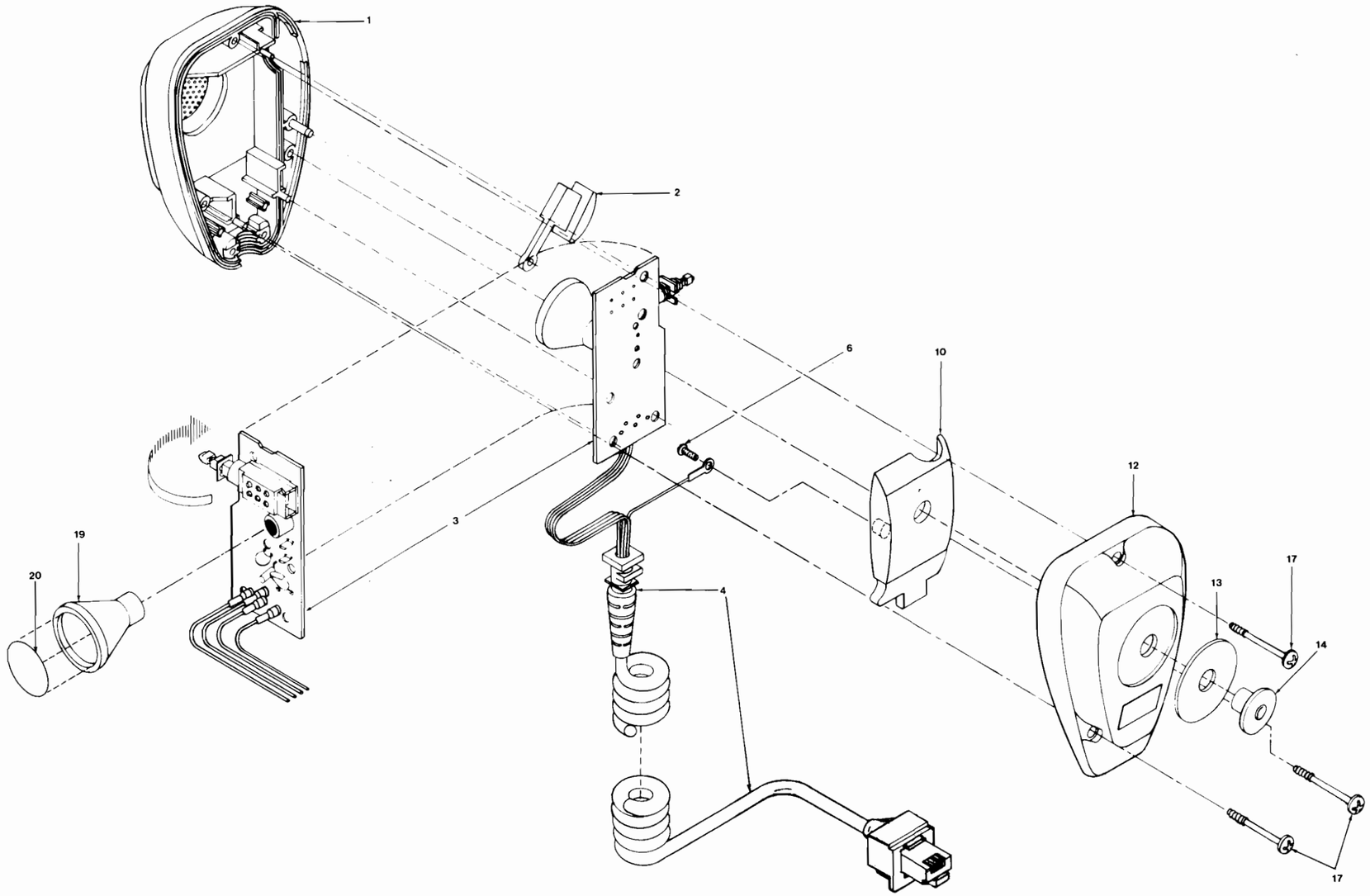


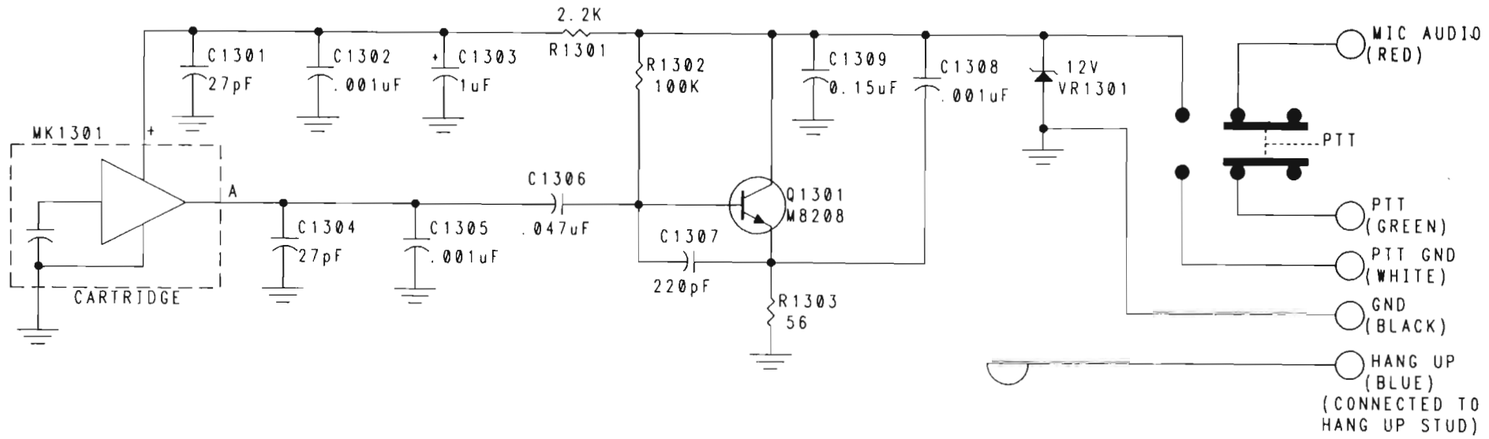
Figure 9-1
Mobile Microphone Exploded View

parts list

VLN4765A MICROPHONE BOARD

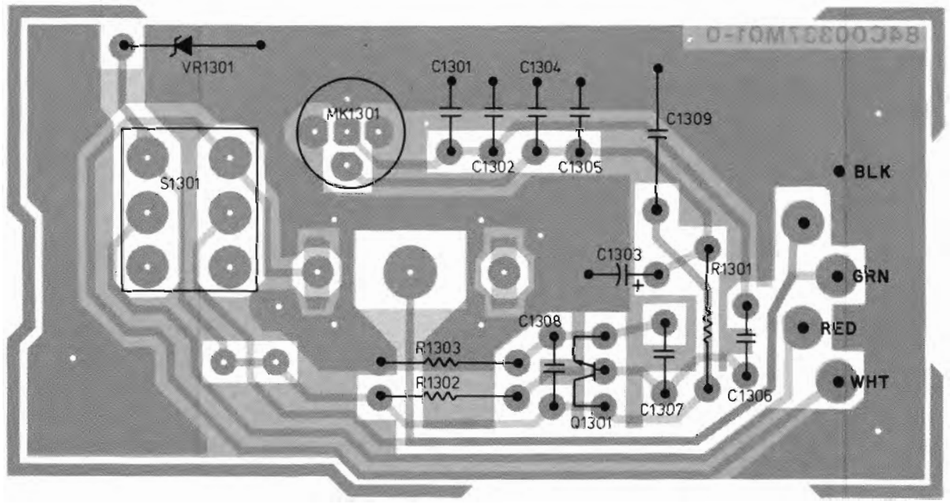
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor. uF ± 5% , 50 V (unless otherwise stated)
C1301	2111038H35	27 pF
C1302	2111039B13	1000 pF ± 10 %
C1303	2311019A09	1 ± 20%
C1304	2111038H35	27 pF
C1305	2111039B13	1000 pF ± 10 %
C1306	0811017A14	.047
C1307	2111038P50	220 pF
C1308	2111039B13	1000 pF ± 10 %
C1309	0884637L21	.15 ± 10 % 100 V
		Diode
CR1301	4880007E02	ZENER 12 V ± 5%
		Cartridge
MK1301	5080088E01	MICROPHONE , ELECTRET
		Transistor
Q1301	4800869642	M9642
		Resistor , fixed ± 5% 1/4 W
R1301	0611009C57HB	2200
R1302	0611009C97HB	100K
R1303	0611009C19HB	56
		Switch
S1301	4080065E02	MOMENTARY , PUSHBUTTON TYPE
	3910184A10	CONT PLUG (4)
		Non-referenced Items
	0580148D01	GROMMET, MICROPHONE CARTRIDGE
	1484360C01	INSULATOR, SWITCH

Figure 9-3
Mobile Microphone Parts List



6300673M-O

Figure 9-2
Mobile Microphone Schematic Diagram



SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

3100207M-O

Figure 9-4
Mobile Microphone Board - Board Details

parts list

VLN4714A BASE STATION MICROPHONE HARDWARE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	0210101A69	NUT SPR STL CAD
2	0300138809	SCR MCH 4-40X5/16 PHLBIN STL
3	0300140047	SCR TPG 4-20X5/8 PHLPAN STL
4	0410058B10	WSHR TEF
5	1500325M02	HSNG
6	1582976M05	COV FRONT
7	1582978M05	COV REAR
8	3884184E09	BTN RELEASE (left)
9	3884192E07	BTN RELEASE (right)
10	4284725E01	CLIP RETAINER
11	4784193E01	SHAFT
12	4784194E01	SHAFT EXTENSION
13	6482977M01	PLT BASE
	7584722E01	PAD BASE PLT
		Non-referenced items
	0300135676	SCR TPG 4-40X1/4 PHLHEX SST
	3000055M01	CORD MIC W/CONN
	3782633B13	GROM RBR
	4084711E03	SW LEAF
	4282143C05	CLP CBL

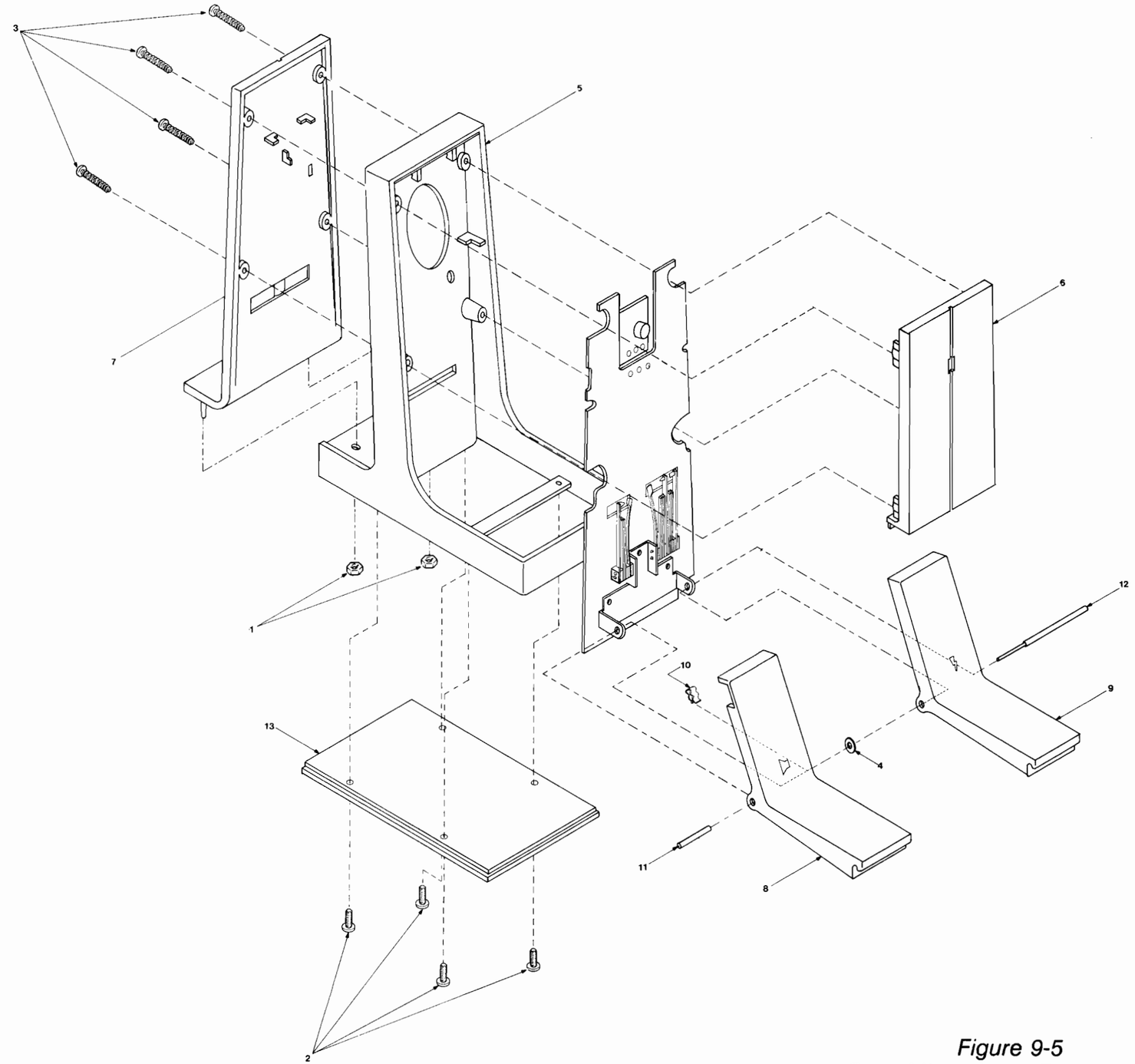


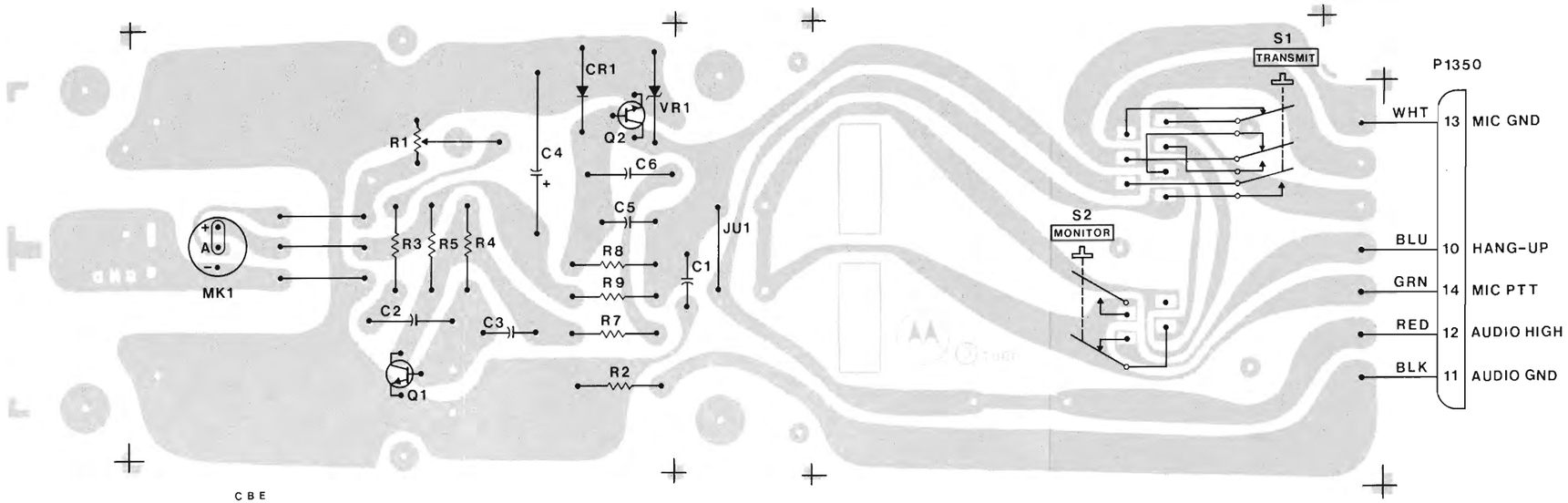
Figure 9-5
Base Microphone Exploded View

parts list

VLN4824A BASE STATION MICROPHONE BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, uf (unless stated otherwise)
C1	2182187B45	CER DISC 470pf-10-500V
C2	0884637L08	MTLZ POLYEST .015-10-400V
C3	2182187B44	CER DISC 1000-10-100V
C4	2384665F09	ALU 15 -10 + 150 25V
C5	2182187B06	CER DISC 560-10-X5F-500V
C6	0884637L12	MTLZ POLYEST .047-10-250V
		Diode
CR1	4883654H01	SLCN
		Microphone Cartridge
MK1	5082825M02	
		Transistor
Q1	4800869594	NPN 69594
Q2	4800869594	NPN 69594
		Resistor ,FCF, 5%, 1/4W unless stated otherwise)
R1	1884944C02	VAR 25K-20-.10W
R2	0611009C25HB	100
R3	0611009C77HB	15K
R4	0611009D14HB	470K
R5	0611009C73HB	10K
R7	0611009C59HB	2700
R8	0611009D08HB	270K
R9	0611009C55HB	1800
		Zener
VR1	4882256C38	56C38 9.1V
		Non-referenced Item
	3910184A10	PLUG CONNECTOR (5 used)

Figure 9-6
Base Microphone Parts List

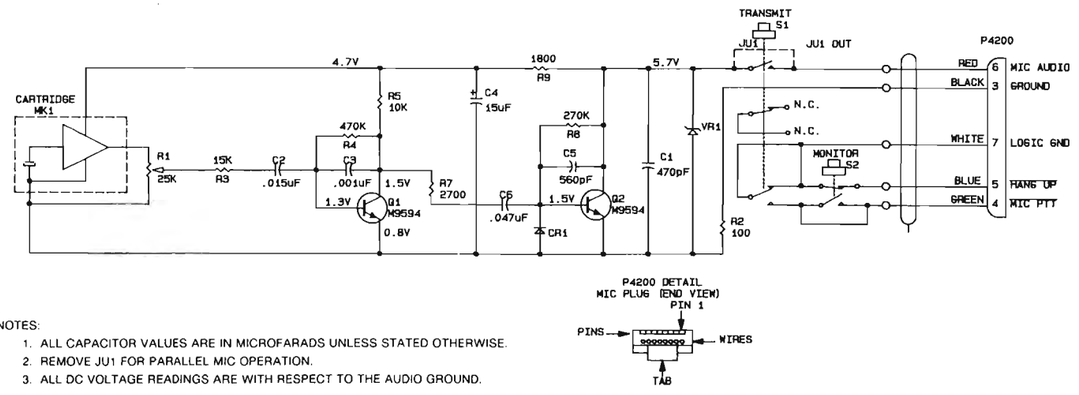


SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31H00219M-O

Figure 9-7
Base Microphone Board - Board Details



NOTES:

1. ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS STATED OTHERWISE.
2. REMOVE JU1 FOR PARALLEL MIC OPERATION.
3. ALL DC VOLTAGE READINGS ARE WITH RESPECT TO THE AUDIO GROUND.

6300687M-O

Figure 9-8
Base Microphone Board
Schematic Diagram

9.4 TOUCH-CODE ENCODER PALM MICROPHONE

The Touch-Code Encoder Palm Microphone, model VMN1017A, includes :

- VLN4383A Logic Board
- VLN4384A Beeper Board
- VLN4386A TT Keypad
- VLN4713A Hardware

The main functional blocks of the Touch-Code Encoder Microphone are highlighted in Figure 9-9

The exploded view, schematics and board details for the Logic and Beeper Boards are found in Figures 9-10 to 9-17.

9.4.1 DESCRIPTION

The model VMN1017A Touch-Code Encoder Microphone for use in the MCX1000 Radio allows the transmission of dual-tone, multi-frequency (DTMF) signals, used for remote signaling applications and mobile telephone operations. This microphone is used in place of the standard palm microphone. No modifications to the radio set are required.

Normal voice transmission is accomplished by pressing the push-to-talk (PTT) button and speaking directly towards the small opening in the keypad. Pressing any keypad button generates either continuous or timed (jumper selectable) DTMF tones. At the same time a keypad button is pressed , the automatic push-to-talk circuitry in the microphone is enabled which keys the radio set transmitter. A single frequency beep tone (sidetone) is also generated. This tone provides feedback to the operator indicating the required time a keypad button must be held down for proper system timing when the microphone is operated in the timed DTMF mode.

During DTMF tone transmission, the microphone is disabled to eliminate background noise from interfering with the signaling tones.

9.4.2 INSTALLATION

The Touch-Code Encoder Palm Microphone is a direct replacement for the MCX1000 radio set palm microphone. The microphone plugs into the mating receptacle on the radio set or on the control head in the normal manner.

The Touch-Code encoder deviation (preset at the factory), should be checked during installation. Refer to the maintenance section following for details.

9.4.3 OPERATION

Microphone Mode

The microphone is operated in the normal manner. Lift and hold the microphone about two inches from the lips. Press the PTT button and speak clearly into the opening on the keypad. Release the PTT button to listen.

Touch-Code Mode

Timed Tones Operation
(JU3 installed in Position B)

The digits of the operator's selected DTMF signal are entered through the keypad by firmly pressing a finger on one keypad button at a time. In this mode, the operator must hold the keypad button down for the first digit of the DTMF signal (and for each successive digit) until the sidetone beep stops. Holding the keypad button down for a longer time does not increase the DTMF tone duration. Releasing the keypad button before the sidetone beep stops produces a shortened DTMF signal and may prevent proper digit recognition by the system decoder.

NOTE

DO NOT press the microphone PTT button since the auto push-to-talk circuitry within the microphone is enabled whenever a keypad button is pressed. Pressing the microphone PTT button and a keypad button at the same time will prevent DTMF tone generation.

Continuous Tones Operation
(JU3 installed in Position A)

Use of the keypad and auto push-to-talk functions are the same as mentioned in the previous paragraph. In this manner of operation, the DTMF signal and sidetone beep are generated continuously (as long as the keypad button is held

down) and for as long as the auto push-to-talk timer in the microphone is active. The minimum time a keypad button must be held down depends upon the decoder or telephone interconnect used at the receiving end of the system. Once the auto push-to-talk timer times out, the radio set transmitter dekeys and continued attempts to generate the remaining DTMF signal tones are meaningless.

9.4.4 DEVIATION ADJUSTMENT

The Touch-Code feature of the microphone has been factory adjusted to provide proper deviation. Readjustment may be required if either the radio set transmitter or the microphone are serviced. The radio set must be adjusted for proper Instantaneous Deviation Control (IDC) prior to checking Touch-Code deviation.

1. Adjust a service monitor (Motorola R-1200A or equivalent) to the radio set transmitter frequency.

2. Prior to checking Touch-Code deviation, disable all other sources of modulation such as Private-Line, Digital Private-Line, or low speed data.

3. Press the # button on the keypad and observe the Touch-Code deviation on the service monitor. Correct deviation is 3 kHz.

4. A hole which allows access to tone deviation potentiometer R32 is located on the rear housing to the right of the nameplate. A long tuning tool, Motorola Part No. 66-84974L01, is required.

5. Adjust tone deviation potentiometer R32 for 3 kHz deviation of the DTMF signal (if required).

6. When setting deviation, it is important to set the level during the 1.2 seconds immediately following actuation of the # button. This is necessary since accurate setting of deviation can only be achieved if the automatic push-to-talk feature is enabled when the deviation level is set.

9.4.5 TIPS FOR USING THE ENCODER MICROPHONE

DTMF signaling was originally developed for telephone signaling on telephone lines and there are certain constraints on its adaptability to mobile radio. However, improved reliability will result if the simple precautions below are followed.

1. Limit placing your calls whenever possible to areas of optimum system coverage (full quieting). Calls made in noisy (fringe) areas may not be reliably placed.

2. Whenever possible, initiate your calls when the vehicle is not moving. Dialing when the vehicle is moving may not only be distracting for the driver, but reduces the reliability of the signaling due to weak signal (dead spot) or noise interference encountered with two-way radios in moving vehicles.

9.5 MOBILE SPEAKER ILLUSTRATED PARTS LIST

Two mobile speaker kits are available. They are :

- MBTSN6031A Speaker (Dash Mt. Radio)
- MBTSN6032A Speaker (Remote Mt. Radio)

Figure 9-18 contains the Illustrated Parts List for the Mobile Speaker. A mobile speaker is included with every mobile radio.

9.6 BASE STATION MOUNTING TRAY AND SPEAKER ILLUSTRATED PARTS LIST

- MBTRN4898A Base Station Speaker Tray

Figure 9-19 contains the Illustrated Parts List for the Base Station Mounting Tray and Speaker. The MCX1000 Radio mounts conveniently on top of this tray for ease of operation during base station use. This tray and speaker is included when the base station option is ordered. Option information is contained in Section 2 of this manual.

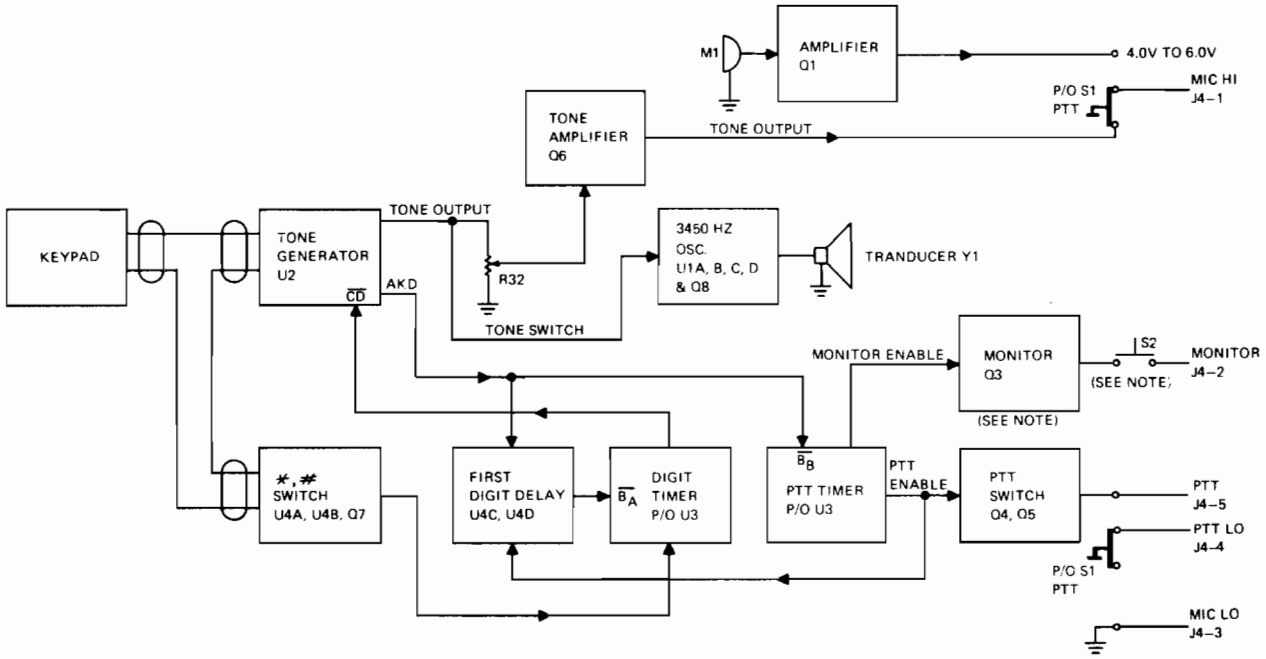


Figure 9-9
Touch-Code Encoder Microphone
Functional Block Diagram

parts list

VLN4386A DTMF MICROPHONE TOUCH TONE KEYPAD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
3	0780188F02	FRM KEY PAD
5	2880085E09	CONN MALE HEADER (2)
4	4580192F01	ACTR KEY PAD
6	8400288M01	BD KEY PAD

VLN4713A DTMF MICROPHONE HARDWARE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	1580185F01	HSNG MIC FRONT
2	3880144D03	BTN MIC
6A		LOGIC BOARD
7	3000057M01	CBL MIC
8	4280188G01	RETNR 0 RING (4)
9	4380187F01	SPACER PC BD MIC (4)
10		TRANSDUCER ASSY P/O VLN4384A
11		GASKET P/O VLN4384A, 0180725T82
12		SPACER P/O VLN4384A, 0180725T82
MK1		CONDENSER P/O VLN4384A, (ASSEMBLY # 0180725T82)
13		S2 SWITCH, P/O VLN4384A
14		CONTACT BTN P/O VLN4384A, 4080252E02
15		S1 SWITCH P/O VLN4384A
16		P3, P/O VLN4384A, 0980237F01
17		BEEPER BOARD
18	0180730T59	REAR HSNG ASSEMBLY
19		ABOVE ASSEMBLY NOT FIELD
20		REPAIRABLE. CONSISTS OF
21		PARTS WITH REFERENCE
23		SYMBOL #'S 18, 19, 20, 21,
24		23, 24, 25
25		
22		P1, P2, P/O VLN4383A
26	3280253E02	GSKT SW PL
27		J3, P/O VLN4383A
28	0380076E05	SCR METRIC HI LO (3)
29	0300140085	SCR TPG 4-20X3/8 PHLPAN STL (4)
30		J4, P/O VLN4384A
		Non-referenced items
	3300201M04	NAMEPLATE
	3580089D02	BAFFLE FELT MIC
	0100851093	MIC MOUNTING

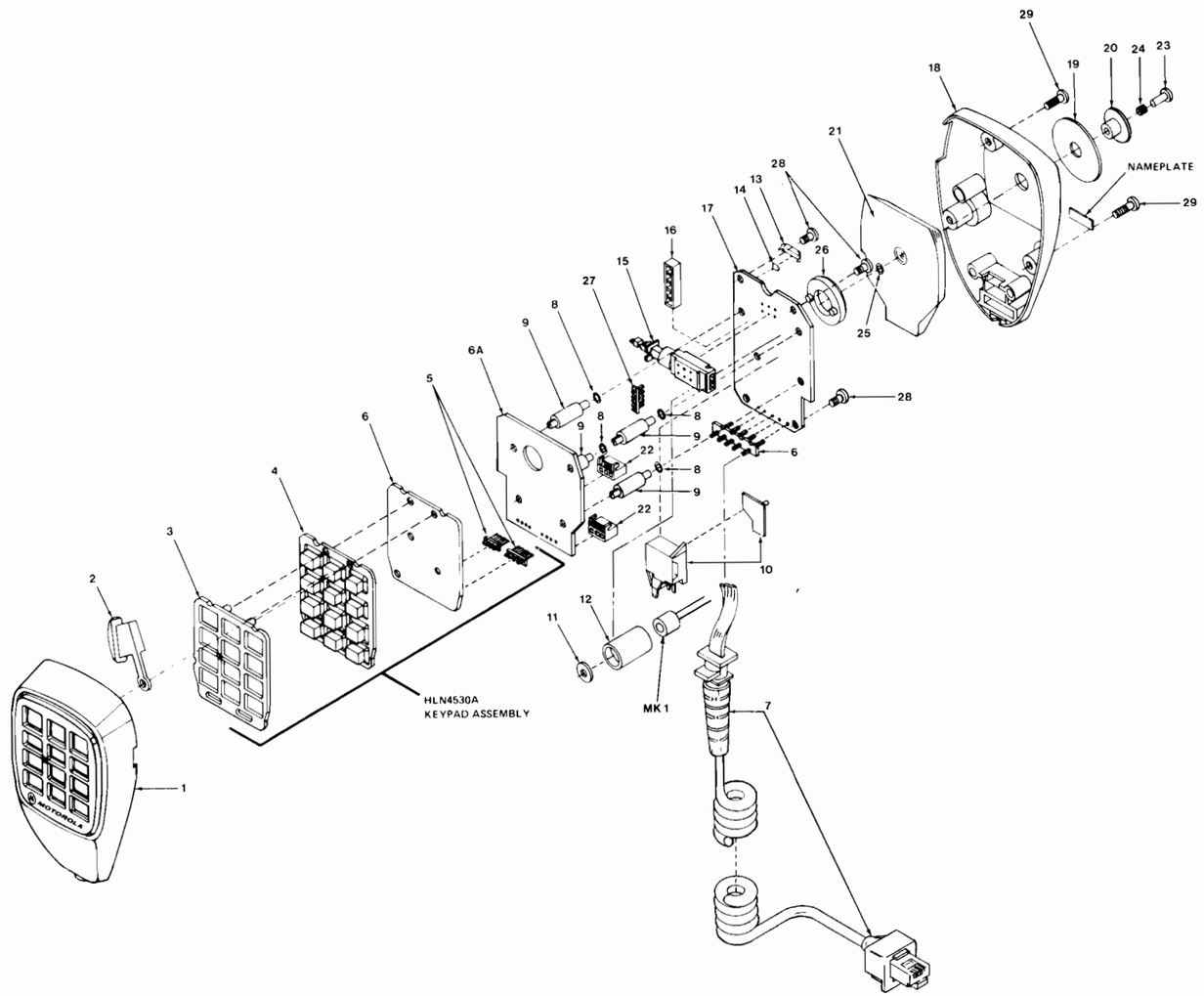


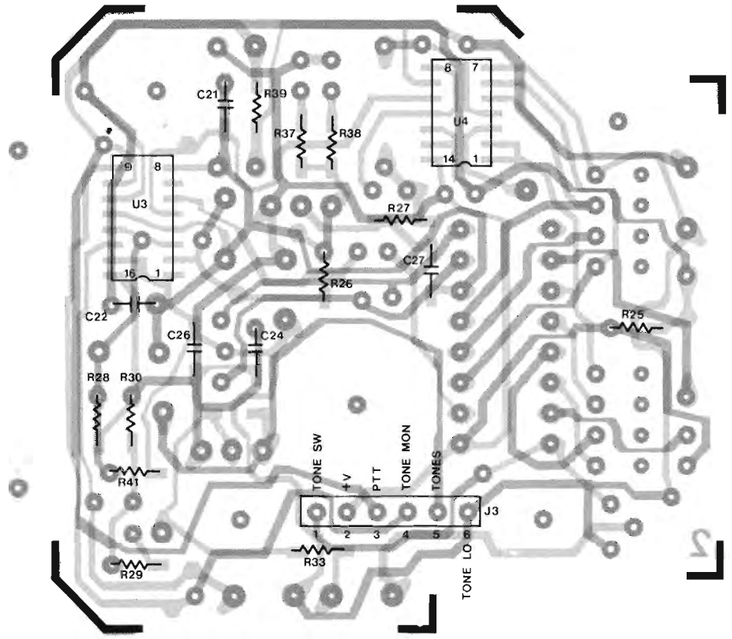
Figure 9-10
Touch-Code Encoder Microphone
Exploded View

parts list

VLN4383A DTMF MICROPHONE LOGIC BOARD

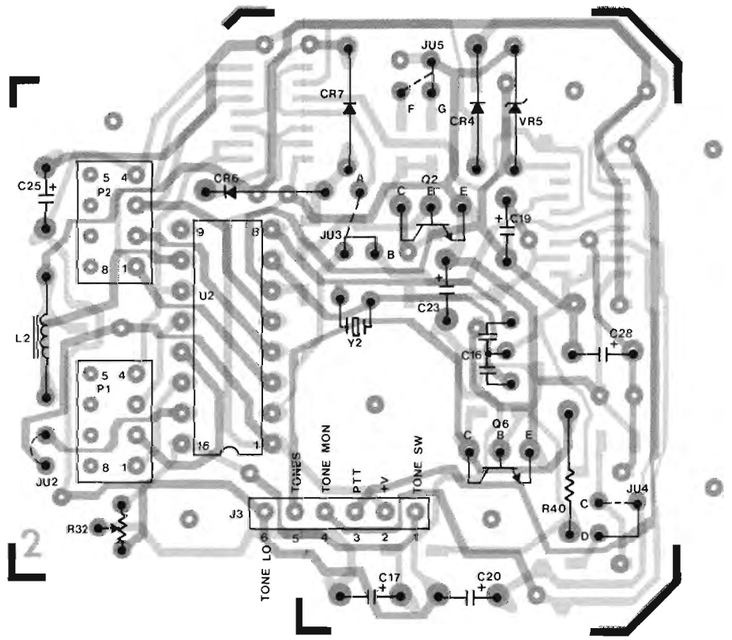
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Resistor, chip, 5% 1/8W. (unless stated otherwise)
R25	0600015M97	100K
R26	0600015M89	47K
R27	0600015M97	100K
R28	0600016M02	150K
R29	0600016M14	470K
R30	0600016M16	560K
R32	1805501C03	POT CKT BD
R33	0600015M63	3900
R37	0600016M15	510K
R38	0600016M04	180K
R39	0600016M08	270K
R40	0611009A65HB	FCF 4.7K 1/4W
R41	0600016M20	820K 1/4 W.
		Capacitor, chip, uf (unless stated otherwise)
C17	2311013F57	TANT 1 20 35V
C18	2111032A21	CHIP .01 10 X7R 50V
C19	2311013D05	TANT 2.2 10 20V
C20	2311013D05	TANT 2.2 10 20V
C21	2111032A09	CHIP .001 10 X7R 50V
C22	2111032A09	CHIP .001 10 X7R 50V
C23	2311013D15	TANT 15 10 20V
C24	2111032A09	CHIP .001 10 X7R 50V
C25	2311013D05	TANT 2.2 10 20V
C26	2111032A09	CHIP .001 10 X7R 50V
C27	2111032A09	CHIP .001 10 X7R 50V
C28	2311013F57	TANT 1 20 35V
		Connector
J3	2880085E08	CONN MALE HEADER
P1	0980238F01	RECP 4 PIN CKT BD MTNG
P2	0980238F01	RECP 4 PIN CKT BD MTNG
		Coil
L2	2482723H27	RF 1.2uH GRN
		Transistor
Q6	4800869642	M9642
Q7	4800869643	M9643
		Resonator
C16Y2	4800112M01	CERAMIC
		Diode
CR4	4883654H01	SLCN
CR6	4883654H01	SLCN
CR7	4883654H01	SLCN
VR5	4882256C03	ZENER 4.70V
		Integrated Circuit
U2	5180065C11	TN GENR
U3	5180073C09	CMOS DUAL MONOSTABLE
U4	5180073C08	CMOS QUAD NAND GATE SOIC

Figure 9-12
Touch-Code Encoder Microphone Tone / Logic Board Parts List



SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

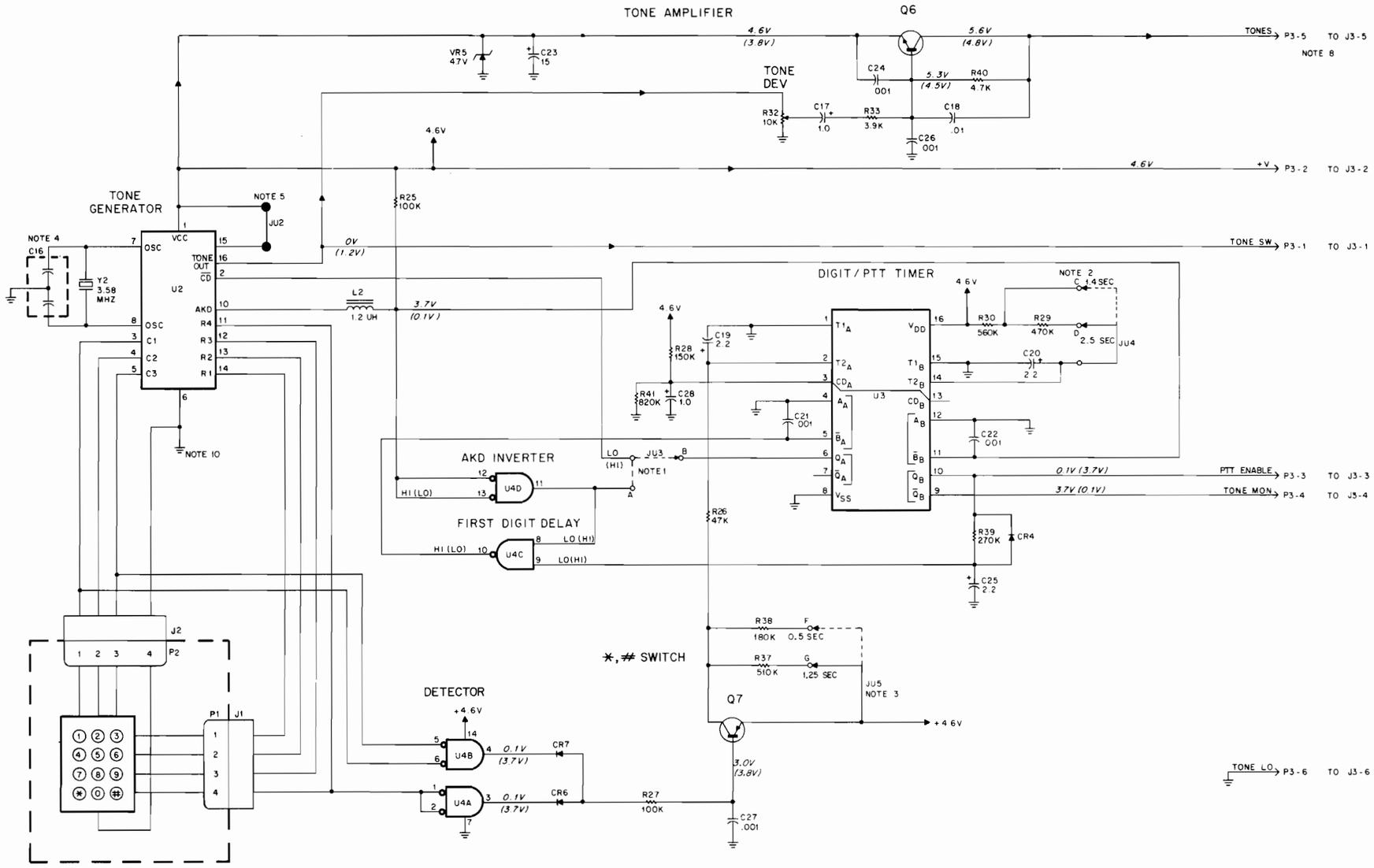


SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31D00130M-O

Figure 9-11
Touch-Code Encoder Microphone Tone / Logic Board- Board Details



NOTES:

1. Placing JU3 in Position A defeats timed tone operation. In Position A, tone duration lasts as long as touch-pad key is pressed. In Position B, tone duration is controlled by timer U3.
2. Placing JU4 in Position C selects a PTT hold time of 1.4 seconds. Placing JU4 in Position D selects a PTT hold time of 2.5 seconds.
3. Placing JU5 in Position F selects a *, # time of .5 second. Placing JU5 in Position G selects a *, # time of 1.25 seconds.
4. Y2 and C16 are a matched set and must be replaced as a pair. See parts list.
5. Pressing two keypad buttons in the same row or column will generate the single tone for that row or column. Removing jumper JU2 will inhibit any tone generation if more than one keypad button is pressed.
6. Voltages indicated as (0.1V) are active voltages (when either PTT or keypad buttons are depressed). Standby voltages are shown without parenthesis.
8. P3 connects to J3 on Mic / Beeper Board
9. Unless otherwise indicated, resistor values are in ohms, and capacitor values are in microfarads.
10. The ground symbol on this diagram is actually referenced to mic lo, not radio set ground.

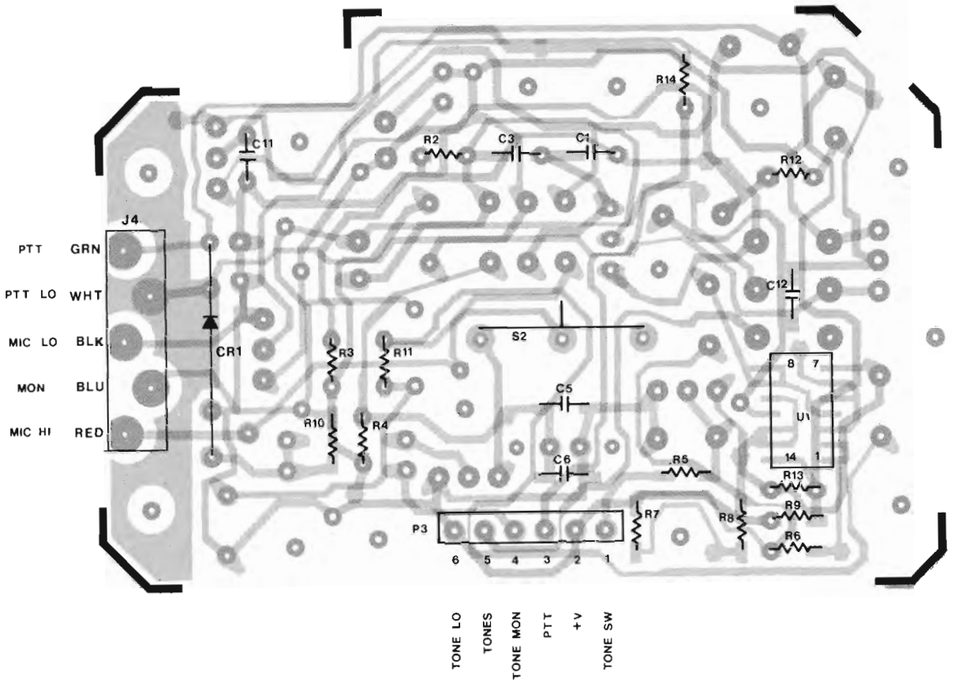
6300679M-O

Figure 9-13
Touch-Code Encoder Microphone
Tone / Logic Board Schematic Diagram

parts list

VLN4823A DTMF MICROPHONE BEEPER BOARD

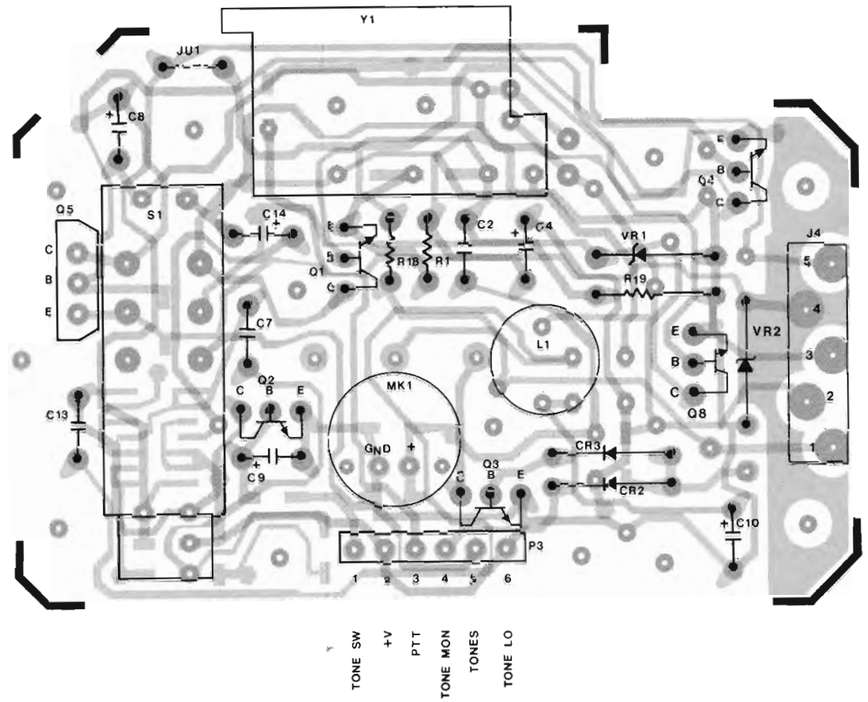
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, uf (unless stated otherwise)
C1	2111032A09	CHIP .001 .10 X7R 50V
C2	0811051A07	MTLZ POLYEST .01 5 63V
C3	2111031A47	CHIP 220 pf 5 NPO 50V
C4	2311013D13	TANT 10 10 20V
C5	2111032A09	CHIP .001 .10 X7R 50V
C6	2111031A25	CHIP 27 pf 5 NPO 50V
C7	0811051A05	MTLZ POLYEST .0047 5 63V
C8	2311013D13	TANT 10 10 20V
C9	2311013F57	TANT 1 20 35V
C10	2311013C12	TANT 27 10 15V
C11	2111032A09	CHIP .001 .10 X7R 50V
C12	2111032A21	CHIP .01 10 X7R 50V
C13	0811051A11	MTLZ POLYEST .047 5 63V
C14	2311013F57	TANT 1 20 35V
		Diode
CR2	4883654H01	SLCN
CR3	4883654H01	SLCN
CR9	4883654H01	SLCN
VR1	4882256C54	ZENER 12V
VR2	4882256C54	ZENER 12V
		Connector
J4	3910184A10	PLUG (5 used)
P3	0980237F01	RECP 6 PIN CKT BD MTNG
		Coil
L1	2480108G02	CHK AUDIO 110MH
		Transistor
Q1	4800869594	NPN 69594
Q2	4800869642	M9642
Q3	4800869642	M9642
Q4	4800869642	M9642
Q5	4800869640	M9640
Q8	4800869642	M9642
		Resistor, chip, 5%, 1/8 W (unless stated otherwise)
R1	0611020A19	FCF 56 1/4 W
R2	0600016M10	330K
R3	0600015M49	1000
R4	0600015M57	2200
R5	0600015M85	33K
R6	0600015M77	15K
R7	0600015M51	1200
R8	0600015M83	27K
R9	0600015M33	220
R10	0600015M85	33K
R11	0600015M61	3300
R12	0600015M77	15K
R13	0600016M14	470K
R14	0600015M77	15K
R18	0611020A46	FCF 750 1/4 W.
		Switch
S1	4080065E02	MOMENTARY
	4080252E01	CONT
S2	4080252E02	SW CONT BTN
		Non-referenced items
	5087188C01	TRANSDUCER ASSEMBLY
	0180725T82	MIC CET
		Integrated Circuit
U1	5180073C08	IC CMOS QUAD NAND GATE SOIC



SHOWN FROM SOLDER SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

Figure 9-15
Touch-Code Encoder Microphone
Microphone / Beeper Board Parts List

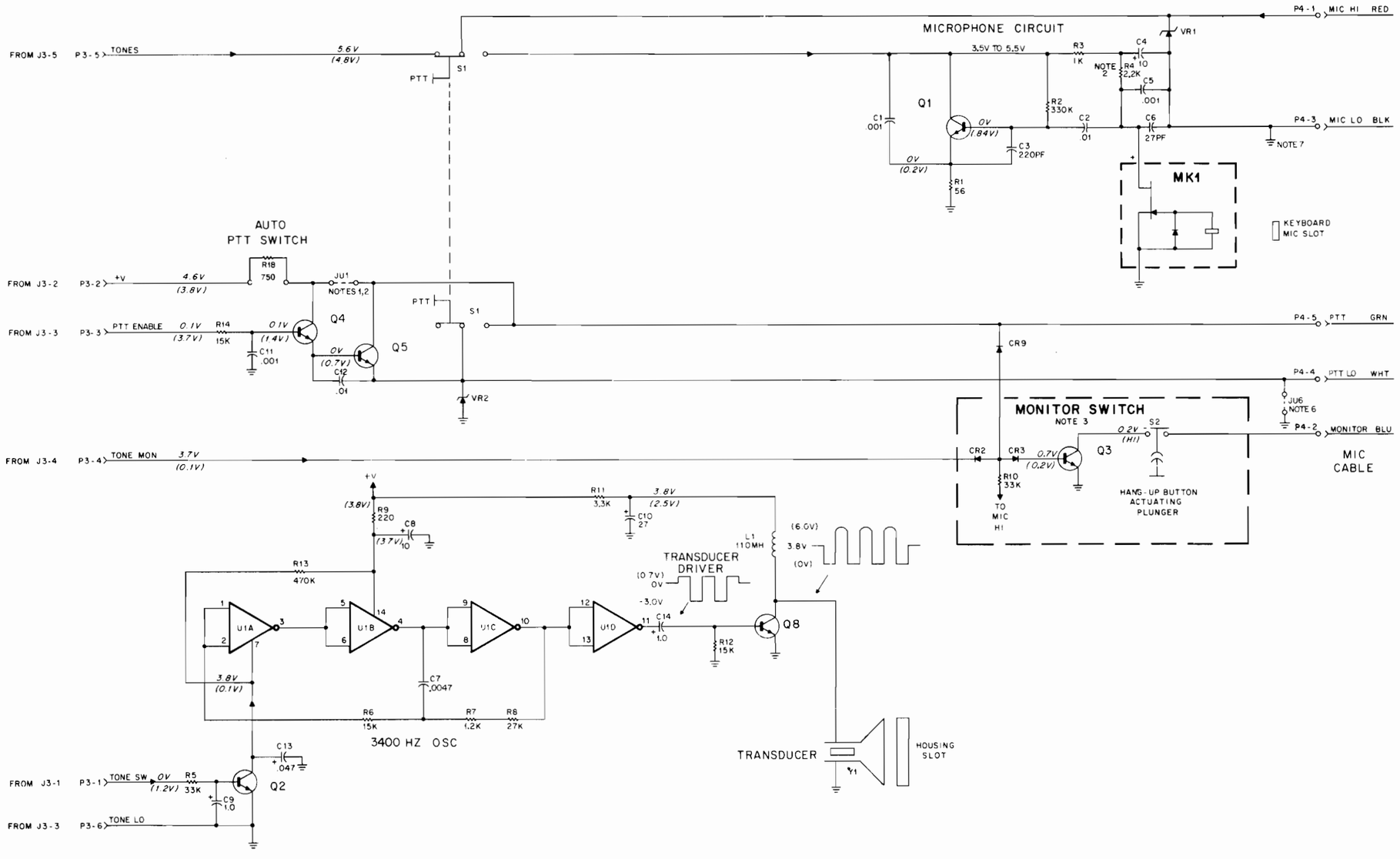


SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

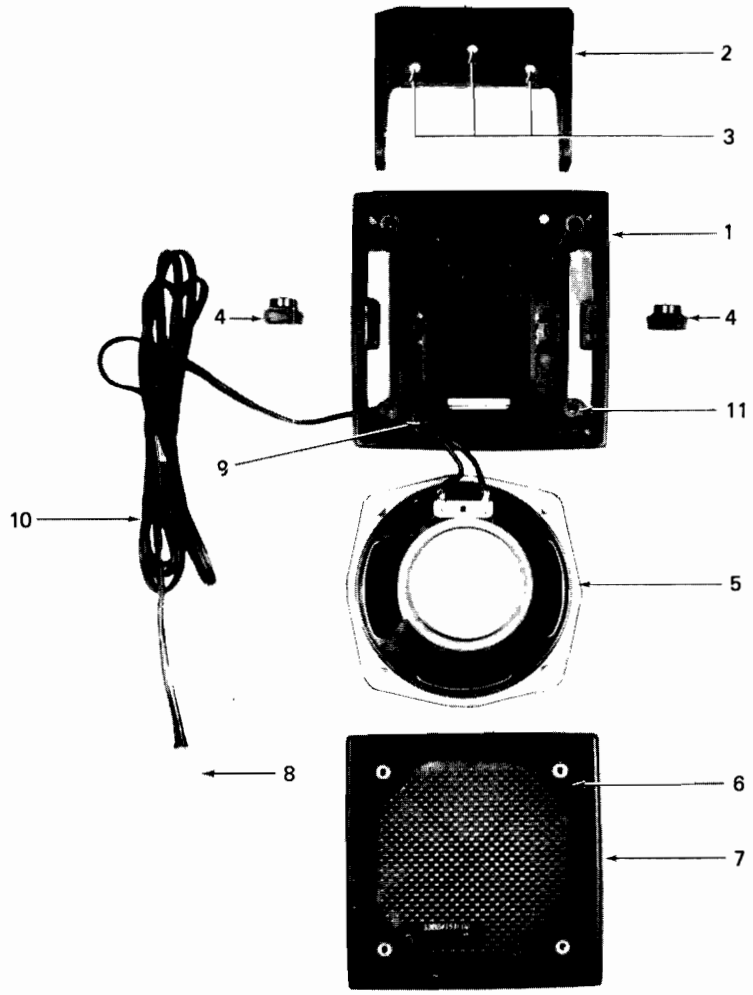
Figure 9-14
Touch-Code Encoder Microphone
Microphone / Beeper Board - Board Details

31D00131M-O



6300686M-O

Figure 9-16
Touch-Code Encoder Microphone
Microphone / Beeper Board
Schematic Diagram

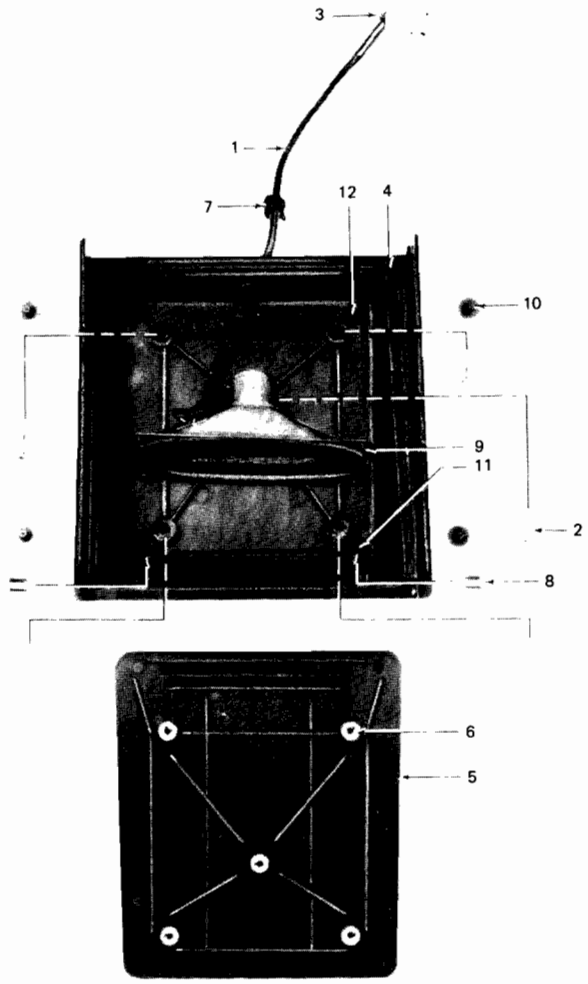


parts list

MBTSN6032A MOBILE SPEAKER

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	5000009M01	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 MB(TSN6031A); includes
	9-84151B03	CONTACT, receptacle: female; 2 used
	30-83155H01	CABLE, 2-conductor; 8 feet
	or 1-80734D90	ASSEMBLY, cable(MBTSN6032A); 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)
	33-83102N03	NAMEPLATE (MBTSN6031A)
	33-82102N06	NAMEPLATE (MBTSN6032A)

Figure 9-17
Mobile Speaker Illustrated Parts List



parts list

MBTRN4898A BASE STATION SPEAKER TRAY

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	180735D98	cable with connector pins
2	0300122916	screw (5 req'd)
3	1484566B01	cable connector housing
4	1582086N01	housing
5	1582087N01	cover
6	3882132N01	clamp on nut (5 req'd)
7	4282018H18	cable grommet
8	4282105N01	speaker clip (2 req'd)
9	5084401D01	speaker
10	5582104N01	detent button (4 req'd)
11	7582172N01	speaker pad (2 req'd)
12	7583951F01	bumper foot (4 req'd)
	3382102N07	nameplate

Figure 9-18
Base Station Speaker Tray
Illustrated Parts List

9.7 BASE STATION POWER SUPPLY

The Base Station Power Supply, model VPN1013A, includes:

- VLN4581A Regulator board
- ACHLN4662A Power Supply Chassis

9.7.1 DESCRIPTION

Motorola Model VPN1013A Base Station Power Supply is a 120 / 220 / 240 VAC regulated power source providing a nominal DC output of 13.8 volts at 12 amperes mazimum (intermittent duty service). This power supply is intended for the MCX1000 Radio in fixed station applications.

This compact power supply may be mounted on a desk or table top. The enclosure is a vented steel housing painted to match the associated radio equipment. An AC power ON-OFF switch and fuse are located on the front panel. A 6-pin receptacle is provided for 13.8 VDC power output connections. Note that a cable kit for DC power connection to the radio equipment is not provided with the power supply but must be ordered separately.

The power supply circuitry includes a power transformer, bridge rectifier assembly, capacitive filter, and series transistor regulator. The two regulator power transistors are mounted on an efficient heat radiator to ensure a safe operating temperature. Overload protection for the primary circuit is provided by the fuse on the front panel. Fuse rating depends on the primary voltage used. Refer to the notes on the accompanying schematic diagram for details. A three - conductor line cord provides 120 volt ac primary power connections to the power supply. The line cord plug must be removed and a proper connection made to the power source for 220 or 240 volt ac operation.

9.7.2 PRE-OPERATIONAL CONNECTIONS AND ADJUSTMENTS

Transformer Tap Connections

Refer to the power supply schematic diagram and verify proper connections at terminal block TB2 located on top of the power supply on the regulator board mounting bracket. The terminals of terminal block TB2 are numbered on the protective fibre cover for the terminal block. Refer to the table below.

POWER SOURCE	JU1	BLK-WHT WIRE
120 VAC	Between TB2-1 and TB2-4	To TB2-3
220 VAC	Not used	To TB2-2
240 VAC	Not used	To TB2-1

Transformer Tap Connections

Voltage Adjustment Procedure

1. Check that the power transformer tap connections are correct for the specific power source voltage being used. See chart above.

2. Connect a Motorola solid-state dc multimeter (or equivalent) between floating ground and terminal 8 of TB1 (junction of RED-GRN wires).Terminal strip TB1 is located on the regulator board mounting bracket.

3. Connect the Motorola radio equipment to the power supply and turn both units "on". During "transmit" conditions the volt-meter should read 13.8 volts.

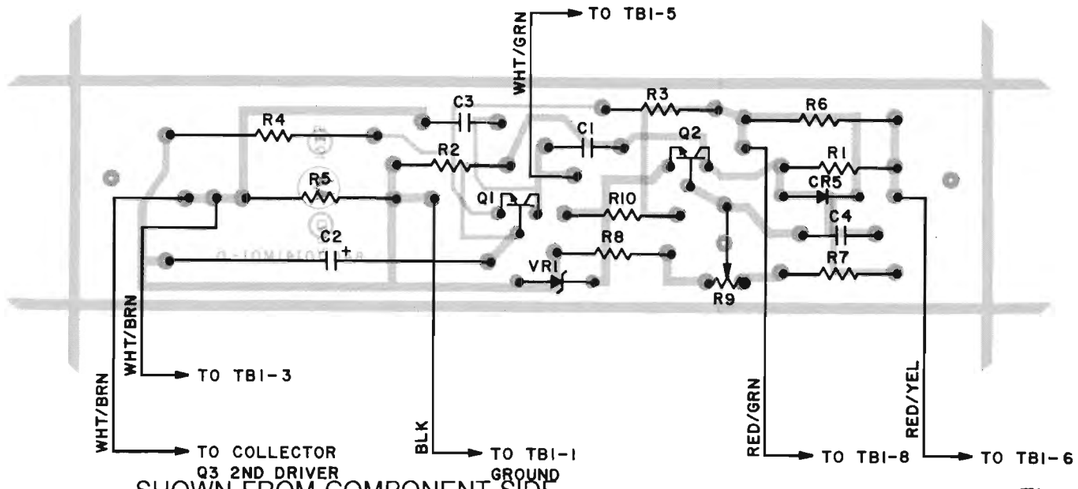
4. If the A+ voltage is not 13.8 volts, adjust control R9 for a voltmeter reading of 13.8 volts. This control is accessible through the hole in the regulator circuit board.

parts list

VLN4581A REGULATOR BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, uf 10% 50V
C1	882905G02	.022
C2	2383210A08	100 + 150-10%,25V.
C3,4	882905G02	.022
		Diode
CR5	4882392B03	silicon
		Transistor
Q1,2	48869642	NPN, type M9642
		Resistor 5% 1/2 W (unless stated otherwise)
R1	6125A41	470
R2	6125A53	1.5K
R3	6125A13	33
R4	1782177B40	200, 5W
R5,6	6126C41	470 10% , 1W
R7,8	6125A49	1K
R9	1884944C04	variable, 500 ohms
R10	6125C51	1.2K, 10%
		Zener diode
VR1	4883696E01	silicon,6.8V , 5%

Figure 9-19
Power Supply
Regulator Board Parts List

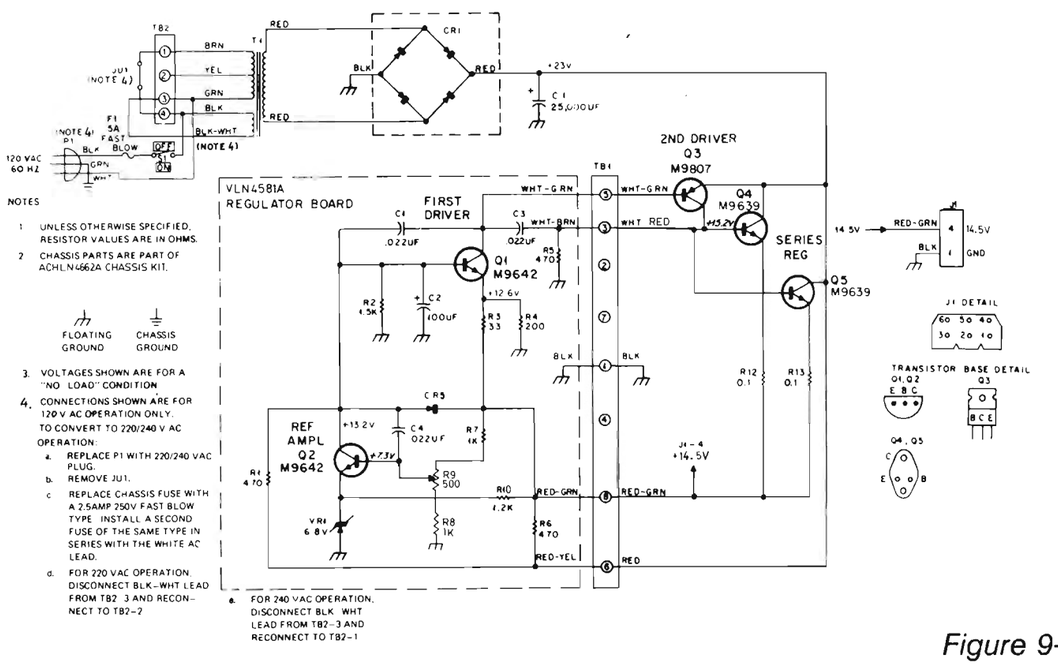


SHOWN FROM COMPONENT SIDE

SOLDER SIDE - RED
COMPONENT SIDE - GREY

31B00172M-O

Figure 9-20
Power Supply Regulator
Board - Board Details



6300437M-O

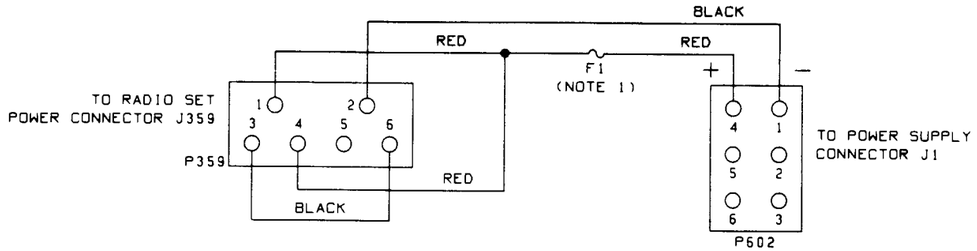
Figure 9-21
Power Supply Regulator
Board Schematic Diagram

parts list

ACHLN4662A POWER SUPPLY CHASSIS

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor
C1	2382464C10	25,000 uF, +75 -10%, 40V
		Diode
CR1	4884751H02	Silicon bridge rectifier assembly
		Connector
J1		receptacle includes: 1510183A53 insulator, 6 -contact 2982336A01 contact, female, 2 req'd
		Fuse
F1	6552293	cartridge, fast- blow type, 5 A
		Line cord
P1	3083212F01	includes ac plug
		Transistor
Q3	48869807	PNP, M9807
Q4, 5	48869639	NPN, M9639
		Switch
S1	4084241G04	slide, DPST
		Resistor, fixed
R12, 13	1782177B50	0.1, 10%, 7 W
		Transformer
T1	2584638C02	power,pri: res 4.9 ohms 240 volt configuration sec: res 0.035 ohms
		Terminal strip
TB1	3100202M01	8 terminals; no. 2 & 7 mtg.
TB2	3100173M01	4 terminals; screw
		Fuseholder
XF1	982083C01	extracter post type
		Non-referenced Items
	37134371	tubing, heatshrink:1" length 2 used
	100719M03	heat sink assembly
	29824456	lug, ring tongue
	4474216	washer, insulator, 2 req'd
	14865854	insulator, transistor
	2984489B01	lug, transistor, 2 req'd (used with Q4, Q5)
	27005	nut, hex; 6-32 x 1/4 x 3/32 (10 req'd)
	32977	screw, machine; 6-32 x 1- 1/8" 4 req'd
	47569	washer, flat;.145x.312x.027" 2 req'd
	47650	washer, lock; #6 (split) 2 req'd
	484496C01	washer, shoulder; 4 req'd
	2684923B06	heat sink
	295248	lug soldering: #6; 2 req'd
	31490181	terminal strip: #1 mtg; 2 req'd
	100719M02	diode bracket assembly includes 29824456 lug, ring tongue 29812979 lug, crimp terminal

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2121841	nut, hex: 6-32x5/16x7/64" 2 req'd
	3134168	screw, tapping 4-40x1/4" 2 req'd
	3134268	screw, tapping 4-40x7/16"; 2 req'd
	3138341	screw, machine 6-32x5/8"; 2 req'd
	4114057	washer, flat: .125x.312x .032"
	4821633	washer, shoulder
	783095F02	circuit board bracket
	1483275L01	insulator, prot.
	1484268A01	transistor insulator
	1484525G01	transistor insulator, TO66 Base
	295261	soldering lug; 2 req'd
	295369	soldering lug
	1500333M03	housing cover
	100719M04	chassis assembly, includes
	2982336A01	female terminal
	910454A04	connector
	2982336A01	female terminal
	29812979	crimp terminal lug
	27009	nut,10-32x3/8"
	29627	hex nut (2req'd) 4-40x3/16x3/32"
	3135031	machine screw,10-32x3/4"
	32979	machine screw, 6-32x3/8" (3req'd)
	37346	machine screw,6-32x3/4"
	3136143	tapping screw 8-32x1/4" (4 req'd)
	3139085	machine screw, 4-40x5/16" (2 req'd)
	3490773	machine screw, 6-32x9/16" (4 req'd)
	42645	lock washer,#6 split (4 req'd)
	47657	lock washer,#8 split (4 req'd)
	4114583	lock washer,#4 split (2 req'd)
	482418B88	insulator washer
	783158L01	bracket
	1384639D05	escutcheon
	2783252N01	chassis
	4282018H01	cable retainer
	7584215A02	recessed bumper
	32979	machine screw,6-32x3/8" (4 req'd)
	3139854	tapping screw 6-32x3/8" (8 req'd)
	3134168	tapping screw 4-40x1/4" (2 req'd)
	3138216	tapping screw 10-32x3/8" (3 req'd)
	42645	lock washer #6 split (4 req'd)
	4210217A02	cable harmess strap (3 req'd)
	3136139	lock screw 6-32x5/8" (2 req'd)
	37467	tapping screw 8-18x3/8" (4 req'd)
	47652	lock washer #10 ext. tooth



NOTES :

1. F1 IS 10 AMPS
2. CONNECTORS SHOWN FROM WIRE SIDE

Figure 9-22
Power Supply Chassis
Parts List

parts list

MBTKN8199A BASE STATION POWER CABLE KIT

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

Figure 9-23
Base Station
Cable Kit Details

END OF SECTION 9

MOTOROLA LIMITED
Communications Division

APPENDIX A ERROR MESSAGES

A.1 POWER-UP SELF TEST

At power-up the radio executes a self test routine. This routine tests radio hardware and firmware and external hardware such as control-heads, guard receiver, etc. During this test, two types of errors can occur:

1. A "fatal" error occurs when hardware or firmware necessary for normal operation fails. The firmware attempts to display a message and shut down the system. If hardware or firmware associated with the display fails, this attempt may be unsuccessful. The only radio operation allowed is programming with the service programmer.

2. A "non-fatal" error occurs when hardware or firmware not necessary for normal radio operation fails. The firmware attempts to display a message and then allows normal radio operation to continue.

NOTE

IN ORDER TO AVOID THE UNNECESSARY REPLACEMENT OF HARDWARE AND FIRMWARE AS SPECIFIED IN TABLE A.1 UNDER "POSSIBLE SOLUTIONS", FIRST PERFORM THE FOLLOWING STEPS:

1. **Ensure that solder joints, connectors and cabling to the failure location are intact and making proper contact.**

2. **Ensure that the serial bus (BUS +, BUS -, BUSY, Rx DATA, and Tx DATA) lines are functional.**

A.2 POWER-UP ERROR MESSAGES

Upon completion of the power-up self test routine, the radio attempts to display an error message if a problem has been encountered. This error message is displayed only for several seconds immediately after the self test routine is completed. Table A.1 on the following pages contains a listing of possible power-up error messages and information about these messages.

A.3 OTHER MESSAGES

Table A.2 contains other messages which may be displayed during normal use of the radio.

TABLE A.1
POWER-UP ERROR MESSAGES

(SEE NOTE ON THE PREVIOUS PAGE.)

MESSAGE DISPLAYED	ERROR LOCATION	ERROR TYPE	POSSIBLE SOLUTION
FL 05/81	Control Head	Fatal, ROM Failure	Replace control head microcomputer U4700 (remote mount) or U4400 (dash mount).
FL 05/88	Control Head	Fatal, RAM Failure	Replace control head microcomputer U4700 (remote mount) or U4400 (dash mount).
FL 05/90	Control Head	Fatal, Hardware Failure	Control head is not installed properly or has failed. Verify installation and cabling and troubleshoot as required.
ER 05/10	Control Head	Hardware Failure	Radio is programmed for dual control head operation. One control head is not installed properly or has failed. Verify installation and cabling and troubleshoot as required.
FL 01/81	Command Board	Fatal, ROM Failure	Replace PROM U4004
FL 01/82	Command Board	Fatal, EEPROM Failure	Replace command board microcomputer U4002 and/or EEPROM U4005.
FL 01/84	Command Board	Fatal, EEPROM Blank	Reprogram radio
FL 01/88	Command Board	Fatal, RAM Failure	Replace RAM U4006
FL 09/81	Securenet Board	Fatal, ROM Failure	Replace Securenet microcomputer U6101
FL 09/88	Securenet Board	Fatal, RAM Failure	Replace Securenet microcomputer U6101
FL 09/90	Securenet Board	Fatal, Hardware Failure	Radio is programmed for Securenet. Securenet Board is not installed properly or has failed. Verify installation and troubleshoot as required.

TABLE A.1 (CONTINUED)
POWER-UP ERROR MESSAGES

MESSAGE DISPLAYED	ERROR LOCATION	ERROR TYPE	POSSIBLE SOLUTION
ER 0C/01	Guard Receiver	ROM Failure	Replace guard receiver command board PROM U4004
ER 0C/10	Guard Receiver	Hardware Failure	Radio is programmed for a guard receiver. The guard receiver is not installed properly or has failed. Verify installation and cabling and troubleshoot as required.
FL SYN	Synthesizer	Not locked	Verify installation of synthesizer and troubleshoot as required.
WRNG SYN	Synthesizer	Wrong type fast-lock/ standard lock	Verify installation of synthesizer type for which the radio is programmed. NOTE: certain options such as priority scan (MBB424) require fast- lock.
WRNG BND	Synthesizer	Wrong Band VHF vs. UHF	Verify installation of synthesizer of band for which radio is programmed.
WRNG RNG	Synthesizer	Wrong Range Range 1 vs. 2 or 3	Verify installation of synthesizer of range of frequencies for which the radio is programmed.
FL EMG S	External Emergency Switch	Failed open	Radio is programmed for emergency switch option but switch is not installed or is open. Caution: Radio transmits emergency message every 5 minutes. This RF power can damage receiver test equipment.
FAILURE		Fatal	One or more of the fatal error messages has been displayed. Turn radio off, then on to redisplay the error messages.

TABLE A.2
OTHER DISPLAY MESSAGES

(MAY BE DISPLAYED DURING NORMAL RADIO USE)

MESSAGE DISPLAYED	EXPLANATION	SOLUTION
BLK LIST	The radio scanner has been turned on but no modes are programmed for scan.	Program desired modes for scan.
NO KEY	The radio encryption key has not been loaded. Coded voice transmission is not allowed.	Load encryption key with proper key loader.

END OF APPENDIX A