MAINTENANCE MANUAL
SERVICE SECTION
FOR
MDS VHF & UHF
CONVENTIONAL RADIO

TABLE OF CONTENTS

DESCRIPTION

This Service Section contains the information necessary for aligning and troubleshooting the MDS VHF & UHF Conventional mobile radios. In addition, information is provided for disassembling the radio and replacing chip components.

INITIAL ADJUSTMENTS

After the radio has been installed as described in the Installation Manual, the following adjustments should be made by a certified electronics technician.

TRANSMITTER ADJUSTMENT

The transmitter has been adjusted at the factory and should require no readjustment. However, the antenna length should be adjusted for optimum VSWR. The frequency and modulation should be measured and recorded for future reference. For the complete transmitter alignment, refer to the Alignment Procedure (see the Table of Contents).

RECEIVER ALIGNMENT

Receivers are aligned at the factory for operation. VHF radios are aligned at 150-168 MHz. Mid-split UHF radios are aligned at 450-462 MHz and high-split UHF radios are aligned at 470-482 MHz. No initial adjustments to the receiver are required in these ranges. Refer to the Table of Contents for the complete receiver alignment or for alignment of frequencies outside the factory aligned frequencies.

RE-INSTALL

The MDS Conventional mobile radios are designed to operate in 12 volt negative ground vehicles only. If the mobile radio is moved to a different vehicle, always check the battery polarity of the new vehicle system.

PREVENTIVE MAINTENANCE

To ensure high operating efficiency and to prevent mechanical and electrical failures from interrupting system operations, routine checks should be made of all mechanical and electrical parts at regular intervals. Preventive maintenance should include the following checks:

CONNECTIONS

Ground connections to the voltage source should be periodically checked for tightness. Loose or poor connections to the power source will cause excessive voltage drops and faulty operation. When ground connections are not made directly to the battery, the connection from the battery to vehicle chassis must be checked for low impedance. A high impedance may cause excessive voltage drops and alternator noise problems.

ELECTRICAL SYSTEM

Check the voltage regulator and alternator or generator periodically to keep the electrical system within safe and economical operation limits. Overvoltage is indicated when the battery loses water rapidly. Usage of 1 or 2 ounces of water per cell per week is acceptable for batteries in continuous operation. A weak battery will often cause excessive noise or faulty operation.

MECHANICAL INSPECTION

Since mobile units are subject to constant shock and vibration, check for loose plugs, nuts, screws and other parts to make sure that nothing is working loose.

ANTENNA

The antenna, antenna base and all contacts should be kept clean and free from corrosion. If the antenna or its base should become coated or poorly grounded, loss of radiation and a weak signal will result.

FREQUENCY CHECK

Check the transmitter frequency and deviation. Normally, these checks are made when the unit is first put into operation, after the first six months, and once a year thereafter.

DISASSEMBLY

TOP AND BOTTOM COVERS

1. Loosen the two M2.6-0.45 x 8 Phillips screws near the back of the radio that secure the top cover in place.
2. Remove the top cover from the radio.
3. Repeat steps (1) and (2) for the bottom cover.

FRONT PANEL ASSEMBLY

1. Remove the four M3-0.6 x 6 Phillips screws that secure the Front Panel assembly to the radio chassis.
2. Remove all the M2-0.4 screws that secure the two copper shielding plates.
3. Unplug the speaker cable (W5) from the Main Board.
4. Remove the M2.6-0.45 Phillips taptite screw that secures the grounding wire.
5. Carefully fold back the front cap to access the PWB for servicing.

Front Panel Printed Circuit Board

6. Remove the seven M2.6-0.45 Phillips taptite screws that secure the printed circuit board to the Front Panel.
7. Remove the Front Panel PCB.

The Speaker

8. Remove the four M2.6-0.45 Phillips taptite screws that secure the two speaker retainers to the Front Panel.
9. Remove the Speaker.

HEAT SINK ASSEMBLY

1. Unplug the two coaxial cables (W1) and (W2) from the Main Board.
2. Unplug the 2-way cable (W3) and (W4) from the pins that extend from the Heat Sink assembly.

NOTE

When reassembling, be sure to match the red wire with the red dot on the casting to properly orient the connectors.

3. Remove the two M4-0.7 X 30 hex head screws that secure the Heat Sink Assembly to the radio frame.
4. Remove the Heat Sink Assembly.

Power Amplifier Board

5. Remove the shield plate on the top of the Heat Sink by unsoldering the shield at the two feed thru capacitor locations.
6. Remove the eight M2.6-0.45 Phillips taptite screws that secure the PA Board to the Heat Sink.
7. Remove the three (four for UHF) M2.6-0.45 Phillips taptite screws that secure the PA transistors to the Heat Sink.
8. Unplug the four-way power cable on the PA Board.
9. Remove the power cord strain relief.
10. Unsolder the Heat Sink mounted TNC RF connector.
11. On VHF radios, unsolder the ground strap for Q1.
12. Remove the PA Board.

NOTE

If PA transistors are replaced, mount the PA Board to the Heat Sink, mount the PA transistors and then solder transistor leads to the PA Board.

MAIN BOARD

1. Remove the two clips that secure the regulators (U63) and (U22) to the radio frame.
2. Remove the two clips that secure the regulator (U30), and transistor (Q15) to the radio frame.
3. Remove the clip that secures the four-way cable (W4) to the radio frame.
4. Unplug the four-way cable (W4) from the audio part of the Main Board.
5. Remove the M2.6-0.45 Phillips screw, M2.6 plain washer, M2.6 spring washer and M2.6 nut that secure the audio PA (U79) to the radio frame.
6. Remove the fifteen M2.6-0.45 Phillips taptite screws from the Main Board.
7. Unsolder the ribbon cable going to the control panel.
8. Remove the Main Board.

COMPONENT REPLACEMENT

SURFACE MOUNT COMPONENTS

Surface mounted "Chip" components should always be replaced using a temperature controlled soldering system. The soldering tools may be either a temperature controlled soldering iron or a temperature controlled hot-air soldering station. A hot-air system is recommended for the removal of components on multilayered boards. With either soldering system, a temperature of 700°F (371°C) should be maintained.

The following procedures outline the removal and replacement of surface mounted "Chip" components. If a hot-air soldering system is employed, see the manufacture's operating instructions for detailed information on the use of your system.

CAUTION

Avoid applying heat to the body of any surface mount component using standard soldering methods. Heat should be applied only to the metallized terminals of the components. Hot-air systems do not damage the components since the heat is quickly and evenly distributed to the external surface of the component.

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering a CMOS device, the soldering equipment should have a known good earth ground.

Surface Mount Removal

1. Grip the component with tweezers or small needlenose pliers.
2. Alternately heat the metallized terminal ends of the surface mount component with the soldering iron. If a hot-air system is used, direct the heat to the terminals of the component. Use extreme care with the soldering equipment to prevent damage to the printed wire board (PWB) and the surrounding components.
3. When the solder on all terminals is liquefied, gently remove the component. Excessive force may cause the PWB pads to separate from the board if all solder is not completely liquefied.
4. It may be necessary to remove excess solder using a vacuum de-soldering tool or Solderwick®. Again, use great care when de-soldering or soldering on the printed wire boards. It may also be necessary to remove the epoxy adhesive that was under the surface mount component and any flux on the printed wire board.

Surface Mount Component Replacement

1. "Tin" one terminal end of the new component and the corresponding pad of the PWB. Use as little solder as possible.

2. Place the component on the PWB pads, observing proper orientation for capacitors, diodes, transistors, etc.

3. Simultaneously touch the "tinned" terminal end and the "tinned" pad with the soldering iron. Slightly press the component down on the board as the solder liquefies. Solder all terminals, allowing the component time to cool between each application of heat. Do not apply heat for an excessive length of time and do not use excessive solder.

   With a hot-air system, apply hot air until all "tinned" areas are melted and the component is seated in place. It may be necessary to slightly press the component down on the board. Touch-up the soldered connections with a standard soldering iron if needed. Do not use excessive solder.

4. Allow the component and the board to cool and then remove all flux from the area using alcohol or another GE approved flux remover.

CAUTION

Some chemicals may damage the internal and external plastic parts of the MDS mobile radio.

SURFACE MOUNTED INTEGRATED CIRCUIT REPLACEMENT

Soldering and de-soldering techniques of the surface mounted IC's are similar to the above outlined procedures for the surface mounted chip components. Use extreme care and observe static precautions when removing or replacing the defective (or suspect) IC's. This will prevent any damage to the printed wire board or the surrounding circuitry.

The hot-air soldering system is the best method of replacing surface mount IC's. The IC's can easily be removed and installed using the hot-air system. See the manufacturers instructions for complete details on tip selection and other operating instructions unique to your system.

If a hot-air system is not available, the service technician may wish to clip the pins near the body of the defective IC and remove it. The pins can then be removed from the PWB with a standard soldering iron and tweezers, and the new IC installed following the Surface Mount Component Replacement procedures. It may not be necessary to "tin" all (or any) of the IC pins before the installation process.

MODULE REPLACEMENT

The modules in the MDS mobile radio are very reliable devices. Before replacing any of the modules, check the associated circuitry thoroughly to insure there is not a problem elsewhere. If replacement is necessary, follow the procedures below.

All of the component lead holes on the Main Board for the modules are plated through from the top to the bottom of the board. This allows for easy removal and replacement of the modules as long as appropriate soldering techniques are observed. Always observe static precautions when handling the board during module replacement.

To remove a module, position the board in a work vice (face down, chip components up) and remove the solder from the plated-through points at the appropriate pins. If a hot-air system is employed, use an appropriate tip that will localize the heat on the pins and not on surrounding chip components. Solderwick® or a vacuum de-soldering iron will also remove the solder if a hot-air station is not available. When all solder has been removed or liquefied, the module should drop out.

To install a module, clean any solder from the plated through holes and clean all flux from the board. Next, install the replacement module making sure that all pins align in the proper holes on the board. Re-solder the pins to the board. Clean the flux from the board using an approved solvent and clip any excess lead length.

TEST MODE

TEST PREPARATION

To test the MDS VHF & UHF Conventional radio it is necessary to be able to select the operating frequency and operating mode. This needs to be done without removing the circuit board from the radio, which would interrupt the signal flow. This can be done using the 19A705965P1 Handset with the MDS radio.

TEST MODE SELECTION

Built into the software of the MDS radio is a Test Operating Mode. This software is normally disabled before shipment to the customer. It is necessary to enable this Test Operating Mode by writing to the radio personality PROM from the PC programmer. This function is menu selectable.

OPERATION WITH HANDSET

The MDS radio may be operated in the test mode with the 19A705965P1 Handset and Cord 19D901619P2 (Handset and Cord may be ordered as SPK9024). Connect the radio and system for testing as shown in Figure 1. The following selections may now be made from the handset.

- TX Mode/RX Mode
- Open/Mute TX Audio Paths
- Open/Mute RX Audio Paths
- Modulate TX with Channel Guard Tones
- Test Microprocessor Ports

TESTS

The tests described in the following paragraphs are an integral part of the MDS Conventional radio operational software. The data link uses 11 bits ASCII (1 start, 8 data and 2 stop), no parity and operates at 300 baud.

The USER TESTS are enabled whenever power is applied to the unit.

The FIELD TEST sequence is entered in the following manner:

- Plug the handset in and then power the unit up. The display will display "TESTMODE".

Defining The Test Functions

The following is a description of the available test functions. Each function has a two-digit index number associated with it. This number will be in parenthesis next to the title of the function. The two-digit number preceded by "FCN" enables the function. Wait until the display is updated before pushing the next button (approximately 1/2 second).

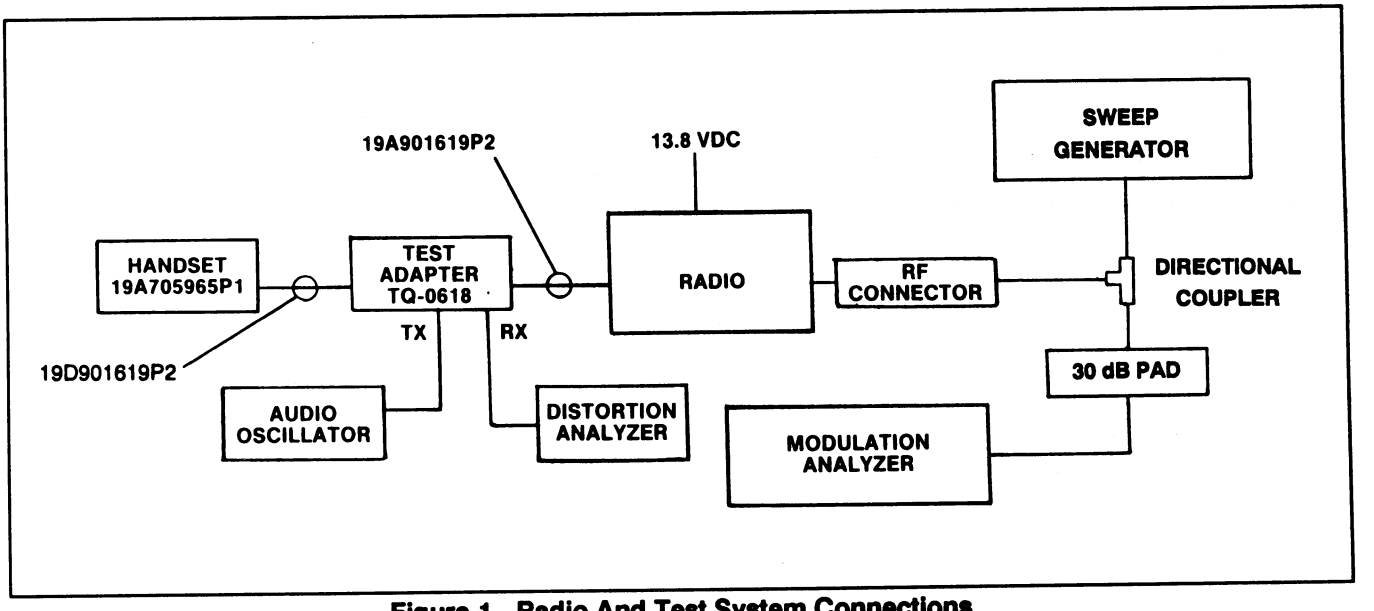

Figure 1 - Radio And Test System Connections

Default Conditions

The unit, upon entering the SERVICE SHOP TESTS, will revert to default conditions to avoid undefined states.

CHANNEL 1: - - - - - - - - - - - - > Channel 1. The frequency for this channel must be previously programmed using the PC Programmer

VOLUME: - - - - - - - - - - - - - > SET AT 7 (RANGE 0-15)

LOW PASS FILTER: - - - - - - - - > OFF

Tx AUDIO: - - - - - - - - - - - - > OFF

Rx AUDIO: - - - - - - - - - - - - > Enabled when CAS is active

PTT: - - - - - - - - - - - - - - - - > Always Enabled

Special Keys (CLR, VOL, STO, END, RCL, SND)

The handset has 6 special keys. When in the test mode, their function is as follows:

CLR	- START AND END DELIMITER FOR CHANNEL NUMBER	CLR - 7FH
END	- TURNS THE TRANSMITTER OFF	END - 6FH
FCN	- INVOKE A NEW FUNCTION	FCN - 41H
SND	- STORE TRIM POT SETTINGS TO EEPROM	SND - 3DH
RCL	- RESET TO DEFAULT CONDITIONS	RCL - 5FH
STO	- EXIT TEST MODE	STO - 3CH
VOLUME	- RAMP VOLUME UP/DOWN	VOLUME UP - 3BH
		VOLUME DN - 3AH

Channel Select

Select a channel by entering "CLR" followed by a channel number (1-8) followed by the "CLR". This function automatically unkeys the transmitter. The channel frequency should be programmed by the PC Programming software TQ-3363.

Example for channel 2: [CLR] 2 [CLR]

Functions

KEY TRANSMITTER (01)

ON	(FCN 01)	(HEX 41 30 31)
OFF	(END)	

Carrier on/off at the specified frequency. This function overrides the PTT switch.

RECEIVE AUDIO ON (02)

(FCN 02) (HEX 41 30 32)

This test turns the receive audio (including speaker) ON. This test overides CAS.

RECEIVE AUDIO OFF (03)

(FCN 03) (HEX 41 30 33)

This test turns the receive audio (including speaker) OFF. After this function is used the radio will turn the Rx Audio ON when CAS is active.

MICROPHONE AUDIO ON (04)

(FCN 04) (HEX 41 30 34)

This test turns ON the mic mute gates.

MICROPHONE AUDIO OFF (05)

(FCN 05) (HEX 41 30 35)

This test turns OFF the mic mute gates.

TONE CHANNEL GUARD MOD TEST ON (06)

(FCN 06) (HEX 41 30 06)

This test will generate a 170 Hz sine wave using the DAC. The radio will generate the 170 Hz until FUNCTION 07 is used to stop it.

Example: To generate the 170.0 Hz sine wave, the following sequence must be entered:

[FCN] [06]

TONE CHANNEL GUARD MOT TEST OFF (07)

(FCN 07) (HEX 41 30 07)

This test will stop the 170 Hz sine wave turned ON by FUNCTION 06.

Example: To stop the 170.0 Hz sine wave, the following sequence must be entered:

[FCN] [07]

DIGITAL CHANNEL GUARD MOD TEST ON (08)

(FCN 08) (HEX 41 30 08)

This test will generate a 10 Hz sine wave using the DAC. The radio will generate the 10 Hz until FUNCTION 09 is used to stop it.

Example: To generate the 10 Hz sine wave, the following sequence must be entered:

[FCN] [08]

DIGITAL CHANNEL GUARD MOD TEST OFF (09)

(FCN 09) (HEX 41 30 09)

This test will stop the 10 Hz sine wave turned ON by FUNCTION 08.

Example: To stop the 10 Hz sine wave, the following sequence must be entered:

[FCN] [09]

NOTE

Functions (10) thru (14) are reserved and will display "INVALID" if selected.

ALERT BEEP (15)

(FCN 15) (HEX 41 31 35)

This function sounds a 1 sec beep cycle (500 msec ON - 500 msec OFF). This is the alert tone used for self test and Type 99 Tone Alert.

NOTE

Any key causes reset to default conditions.

NOTE

Function (16) is reserved and will display "INVALID" if selected.

RELAY SWITCH TOGGLE TEST ON (17)

(FCN 17) (HEX 41 31 37)

This function toggles the relay line at a 1000 Hz rate for board level testing. Use for Type 99 external alarm testing.

NOTE

Any key causes reset to default conditions.

RELAY SWITCH TOGGLE TEST OFF (18)

(FCN 18) (HEX 41 31 38)

This function turns OFF the relay toggle test.

NOTE

Any key causes reset to default conditions.

MICROPROCESSOR PORT PIN CHECK (19)

(FCN 19) (HEX 41 31 39)

This function is used at board level test to check the operation of the port pins. The port pins will toggle at the rate indicated in the following table.

PIN NUMBERS (80C535)				RATE	
P1	P3	P4	P5		
36		1	67	20	kHz
35	22	2	66	10	kHz
34	23	3	65	5	kHz
33	24	5	64	2.5	kHz
32	25	6	63	1250	Hz
31	26	7	62	625	Hz
30	27	8	61	312	Hz
29	28	9	60	156	Hz

NOTE

Any key causes reset to default conditions.

SOFTWARE REVISION (20)

(FCN 20) (HEX 41 32 30)

This test displays the software revision contained in the EPROM.

NOTE

Any key causes reset to default conditions.

NOTE

Function (21) is reserved and should not be used.

CHECKSUM TEST (22)

(FNC 22) (HEX 41 32 32)

This test performs a checksum test on the program memory.

If the test passes "PROM OK" is displayed.
If the test fails "BAD PROM" is displayed.

NOTE

Any key causes reset to default conditions.

DISPLAY TEST (23)

(FCN 23) (HEX 41 32 33)

This function is used to test all display possibilities. The display changes every 1/2 second and the order is as follows:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, L, H, A, P, -, , BSY on, BSY off, TX on, TX off, Decimal Point ON, Decimal Point OFF.

NOTE

Any key causes reset to default conditions.

NOTE

The binary search used in tests 24-29 works in the following manner:

* - sets mid level
0 - decrements value
1 - increments value

Once * is pressed the steps decremented are half of the previous value. i.e. 32 - first step, 16 second step, 8 third step, etc.

SET VCO REFERENCE (24)

(FCN 24) (HEX 41 32 34) TCXO = xx (*, 0, 1) (HEX 3E, 30, 31)

This test allows the user to set the reference oscillator on frequency. When started, the current level is displayed from (00 to 63). When the proper level is reached , SND exits the test and writes the new value to EEPROM to be remembered permanently.

SET PA POWER LEVEL (25)

(FCN 25) (HEX 41 32 35) PAVAL = xx (*, 0, 1) (HEX 3E, 30, 31)

This test allows the user to set the RF power amp power control level. When started, the current level is displayed (from 00 to 63). When the proper level is reached, SND exits the test and writes the new value to EEPROM to be remembered permanently.

SET GAIN OF THE MODULATION PATH TO THE REF OSC (26)

(FCN 26) (HEX 41 32 36) LFMOD = xx (*, 0, 1) (HEX 3E, 30, 31)

This test allows the user to set the gain of the path that feeds low frequency (Digital Channel Guard) audio to the reference oscillator. When started the current level is displayed (from 00 to 63). When the proper level is reached SND exits the test and writes the new value to the EEPROM to be remembered permanently.

SET GAIN OF THE MODULATION PATH TO THE VCO (27)

(FCN 27) (HEX 41 32 37) CGMOD = xx (*, 0, 1) (HEX 3E, 30, 31)

This test allows the user to set the gain of the path that feeds audio to the voltage controlled oscillator. When started, the current level is displayed (from 00 to 63). When the proper level is reached, SND exits the test and writes the new value to the EEPROM to be remembered permanently.

SET GAIN OF THE MIC AUDIO PATH (28)

(FCN 28) (HEX 41 32 38) MICGN = xx (*, 0, 1) (HEX 3E, 30, 31)

This test allows the user to set the mic gain value to compensate for differences in microphones (±3dB). When started the current level is displayed (from 00 to 63). When the proper level is reached SND exits the test and writes the new value to EEPROM to be remembered permanently.

SET SQUELCH LEVEL (29)

(FCN 29) (HEX 41 32 39) SQLCH = xx (*, 0, 1) (HEX 3E, 30, 31)

This test allows the user to set the squelch for proper operation in Conventional operation. When started, the current level is displayed (from 00 to 63). When the proper level is reached SND exits the test and writes the new value to EEPROM to be remembered permanently.

KEYPAD TEST (30)

(FCN 30) (HEX 41 33 30)

This test allows the user to test the keypad for sticky or non-operating keys. Key names will be displayed in the handset display until another key is pressed. Any and all keys that are pressed or sticking will be displayed.

NOTE

Any key causes reset to default conditions.

CHANNEL GUARD LOW PASS FILTER ON (31)

(FCN 31) (HEX 41 33 31)

This test allows the user to check tone limiter operation by turning the Low Pass filter ON.

NOTE

Any key causes reset to default conditions, which will also bypass this Low Pass filter.

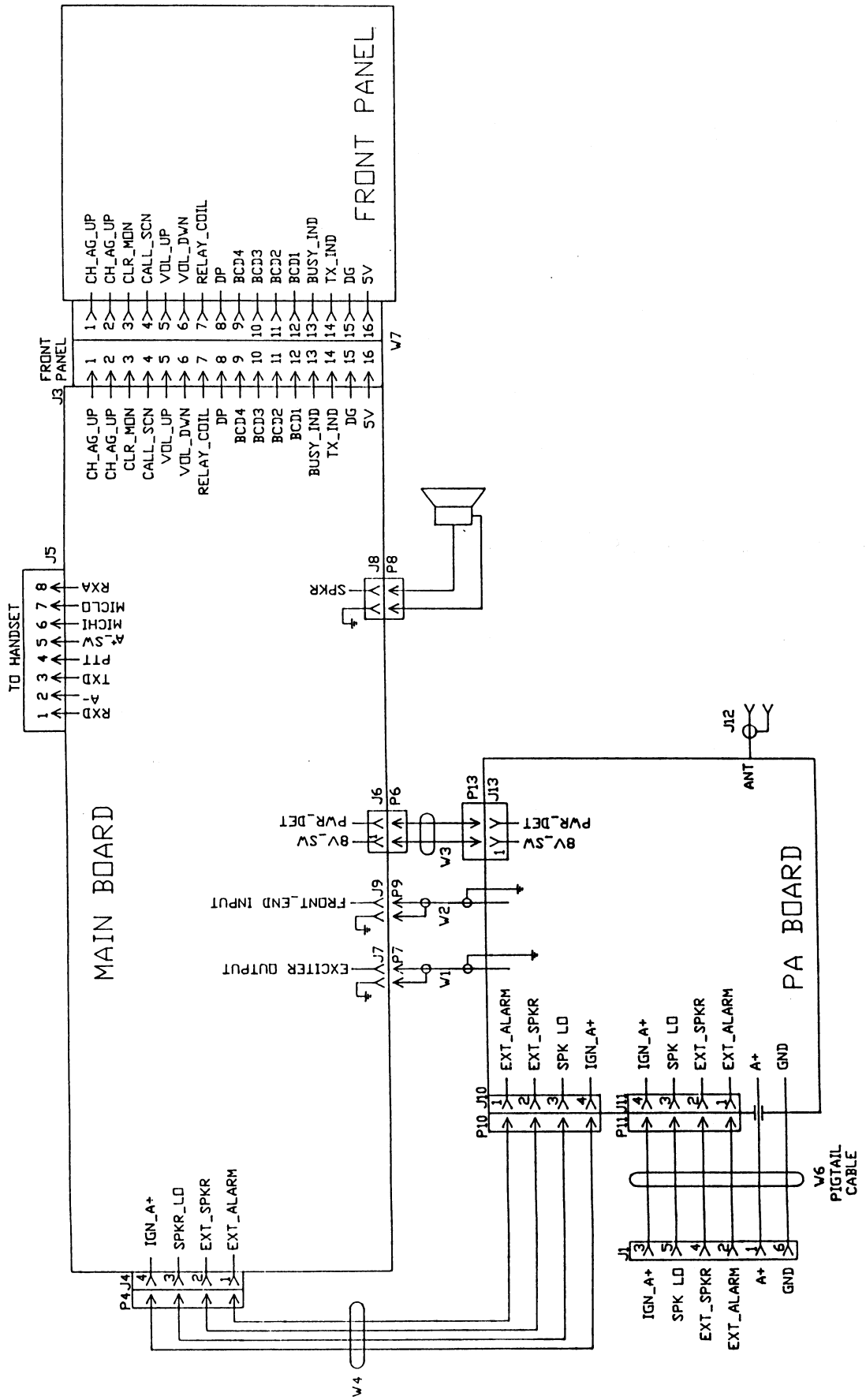

Figure 2 - System Interconnection Diagram

TROUBLESHOOTING PROCEDURE

This section should help isolate a problem to a particular board or circuit. Troubleshooting charts and block diagrams for power distribution and signal flow are given. Figure 2 provides A System Interconnection Diagram. Refer to the appropriate maintenance manual on the suspected board for additional troubleshooting and circuit information.

POWER ON CHECKS

The radio provides several self-diagnostic checks when power is applied and informs the user of a possible problem within the radio. These tests provide the following error messages on the handset display.

ERROR 1 No personality. The radio has not been programmed with customer information.

ERROR 2 Not used.

ERROR 3 Synthesizer unlocked. The Synthesizer is tested to verify that it will lock in the proper amount of time at various frequencies across the bands.

ERROR 4 EPROM program memory checksum error. If the microprocessor uses external memory, the EPROM has been corrupted or is malfunctioning.

TROUBLESHOOTING CHART

SYMPTOMS	CHECKS
Low, distorted or no RX audio	Check the receiver **RX_AUDIO_TONES** output. If audio is improper, the problem is most likely in the RX Circuit. If Synthesizer load commands are incorrect, the problem may be in the Logic Circuit. If the audio is correct at **RX_AUDIO_TONES,** check the Audio Circuit at the speaker output. If improper, check for proper unmute commands from the Logic Circuit. Proper commands indicate an Audio Circuit problem.
No RX Alert Tones (Radio OK otherwise)	Check the Signalling Tone output from the Logic Circuit. Operate the volume controls. If tones are not present, a problem in the Logic Circuit is indicated. If tones are present, the problem is most likely in the Audio Circuit.
Poor RX Sensitivity	The problem is most likely in the RX Circuit. Refer to the Main Board Maintenance Manual for additional service notes on the RX Circuit.
No TX Power	Check the **NEG_DPTT** level (active low) to the TX Circuit. If present, then the problem is most likely on the TX Circuit. If the **NEG_DPTT** is not low, the problem is most likely in the Logic Circuit.
Low TX Power	Check the TX frequency. If the TX frequency is out of band, check the Synthesizer Circuit on the Main Board. Check the synthesizer load commands from the Logic Circuit. If the commands are not present, a problem on the Logic Circuit is likely. If the TX frequency is correct, refer to the Main Board and Power Amplifier Board Maintenance Manuals and troubleshoot the transmitter.

TROUBLESHOOTING CHART (CONT)

SYMPTOMS	CHECKS
Distorted TX Audio	Check for good grounding of the Main Board to the casting. Check the MOD input to the Synthesizer Circuit. If distorted, a problem in the Audio Circuit is likely. Check the mute switch DSW2-E. If incorrect, a difficulty in the Logic Circuit is indicated. If only the tones are distorted, a Logic Circuit problem is likely (faulty tone generation).
TX Off Frequency	This is most likely a problem in the Synthesizer Circuit. Refer to the frequency set instruction in the transmitter alignment section in this manual. Check the synthesizer load commands. If the load command is improper, a Logic Circuit problem is likely.
No TX Modulation	Check the **MOD** input to the VCO. If present, the problem is most likely in the synthesizer. If not present, determine what is missing: Channel Guard tones, voice or both.
Missing Tone	Look at **STD_TONE_BIAS** input to the Audio Circuit. If the tones are not present, the problem is most likely in the Logic Circuit. Otherwise the problem is in the Audio Circuit.
Voice Signal Missing	Check the mute command to analog switch DSW2-E from the Logic Circuit. Check also the **MICHI_IN** input to the Audio Circuit. If all signals are correct, the problem is in the Audio Circuit.

POWER DISTRIBUTION

Figure 3 provides a Block Diagram of the DC Power Distribution for **A+**, **IGN_A+**, **A+_SW** and the regulated voltages throughout the radio.

A+

A+ powers the 40 watt PA transistors on the Power Amplifier Board in the Power Amplifier Assembly. D1 provides reverse voltage protection.

A+_SW

IGN_A+ originates from the vehicle ignition switch and feeds the Main Boards through J4. **IGN_A+** is filtered by Q24 to form **A+_SW** which then supplies power to two 8 volt regulators and three 5 volt regulators.

Regulated Voltages

A+_SW is the source power for all voltage regulators. One 2 volt regulator receives power from a 5 volt regulator to allow for less power dissipation in the 2 volt regulator.

RF Circuit

The receiver front end module, most of the circuitry in the synthesizer, exciter and the transmitter power control circuit are powered by an 8 volt regulator U30. The output of U30 is switched before going to the exciter supply input. The VCO is powered by another 8 volt regulator U58. A 5 volt regulator U60 supplies power to the IF module, reference oscillator and the prescaler.

Logic Circuit

A single 5 volt regulator U63 is used to power the Logic Circuit. The input voltage is **A+_SW**. The power on reset circuitry for the microprocessor is part of regulator U63. This reset signal prevents scrambled operation due to low voltage transients during automobile starting.

Audio Circuit

A 5 volt regulator U22 provides power to the Audio Circuit except U79 which is powered by **A+_SW**. **A+_SW** provides the input voltage to U22. A 2 volt regulator U83 provides the bias reference for the operational amplifiers.

AUDIO SIGNAL FLOW

Figure 4 provides a Block Diagram of the Audio Signal Flow throughout the radio. Audio levels at important points are also shown. Refer to the block diagrams in the Main Board Maintenance Manual for other audio levels.

Transmitter Audio

TX audio from the microphone is controlled by the Logic Circuit. After processing Channel Guard tones, the audio **(MOD)** is fed to the Synthesizer Circuit. **MOD** is adjusted by deviation adjust trimpot DSW2-A before feeding the modulation input of the VCO.

Receiver Audio

Discriminator audio is buffered by Q23 in the Audio Circuit. On the Main Board, **RX_AUDIO_TONES** feeds two paths. The tone path (not shown on the block diagram) processes tones for decoding by the Logic Circuit microprocessor; the RX audio path is filtered to eliminate the 3 kHz busy tones, muted by the logic Circuit and amplified to a level capable of driving an external 4 ohm speaker at 4 watts. The **RX AUDIO** output is also routed to the handset connector.

LOGIC SIGNAL FLOW

Microprocessor U77 provides synthesizer data to the Synthesizer Circuit, control signals to the switches in the Audio Circuit, and displays serial data to the handset. U77 also accepts tone data from the Audio Circuit, PTT data from the handset and keypad signals from the front panel control. All logic lines should have 4 to 5 volts for a logic high and less than 0.5 volt for a logic low. Figure 5 provides a Block Diagram of the Logic Signal Flow.

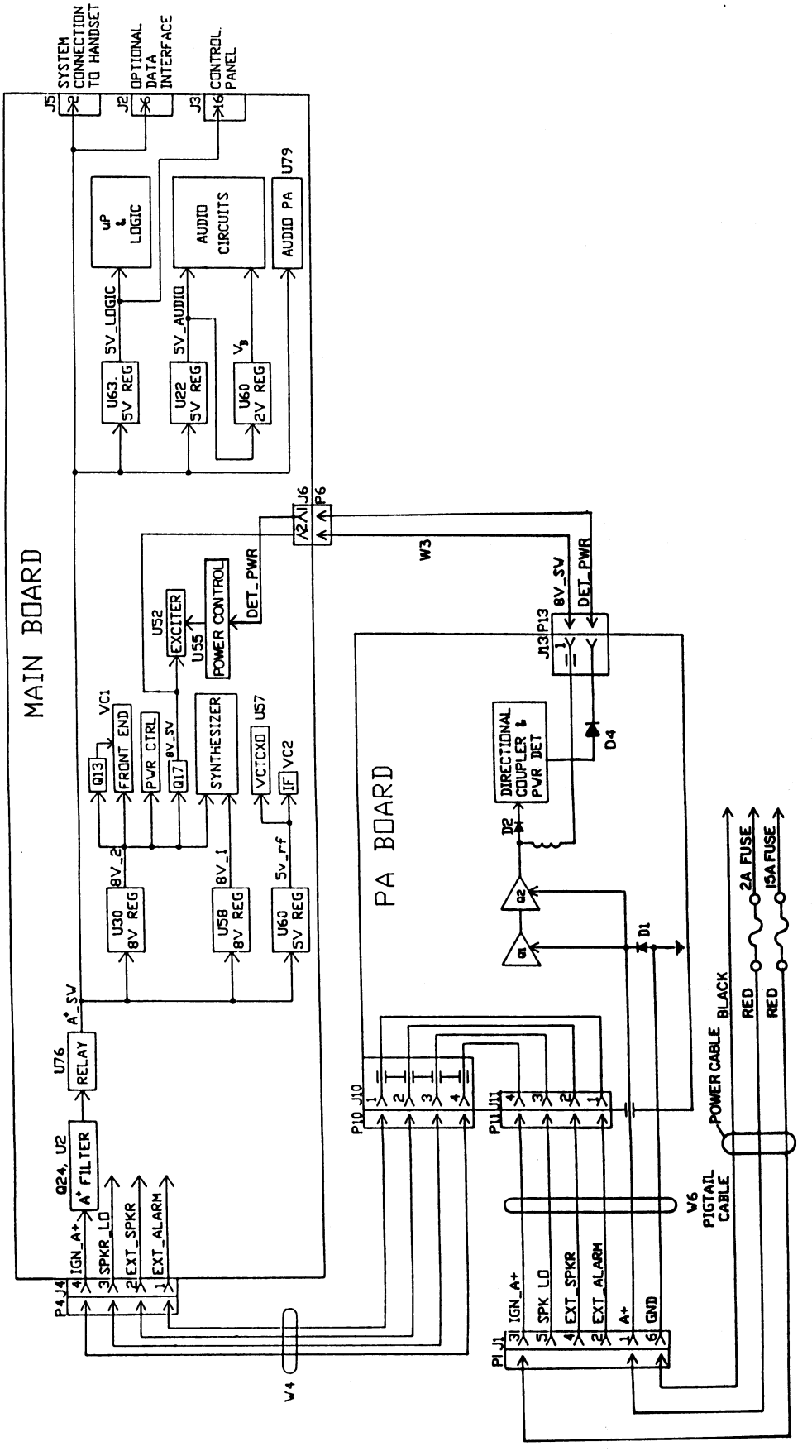

Figure 3 - DC Power Distribution Block Diagram

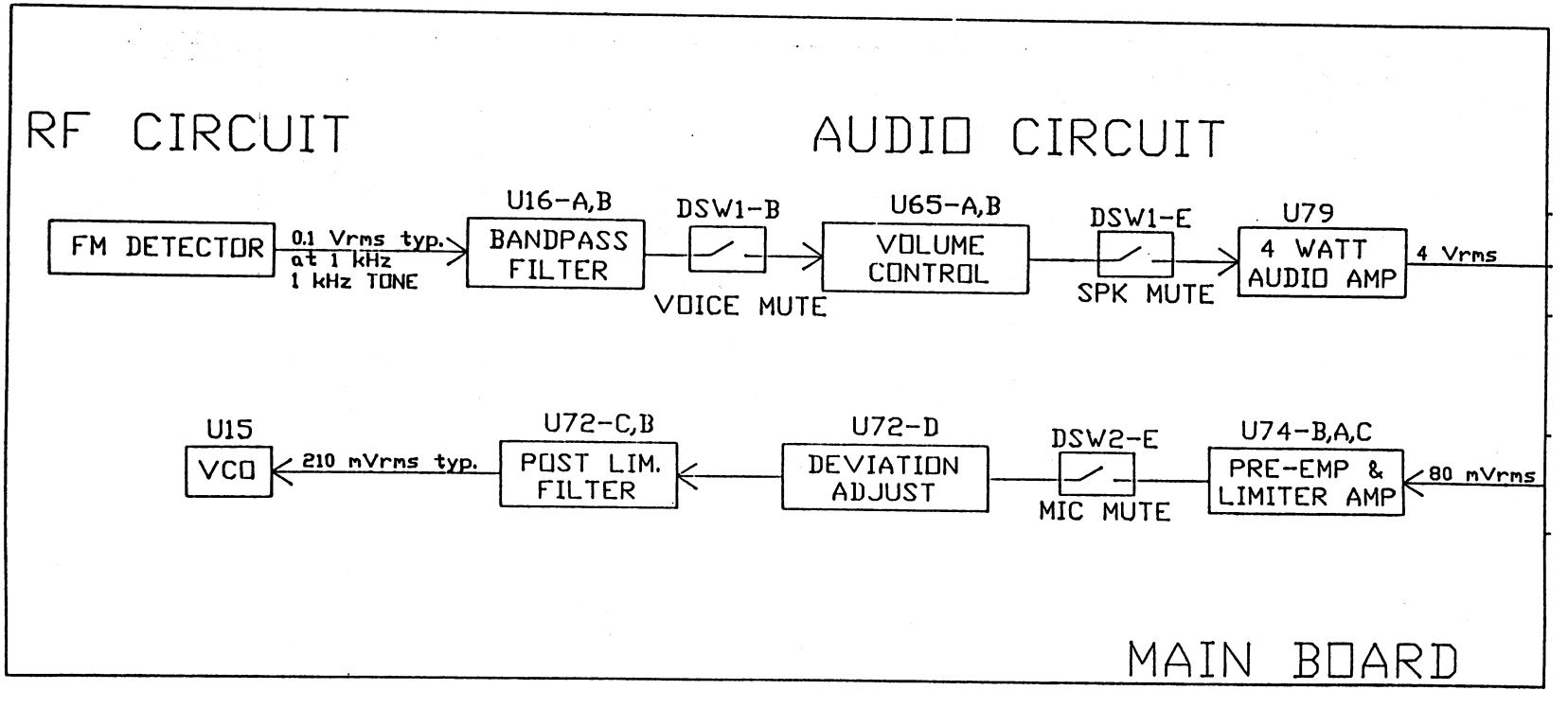

Figure 4 - Audio Signal Flow Block Diagram

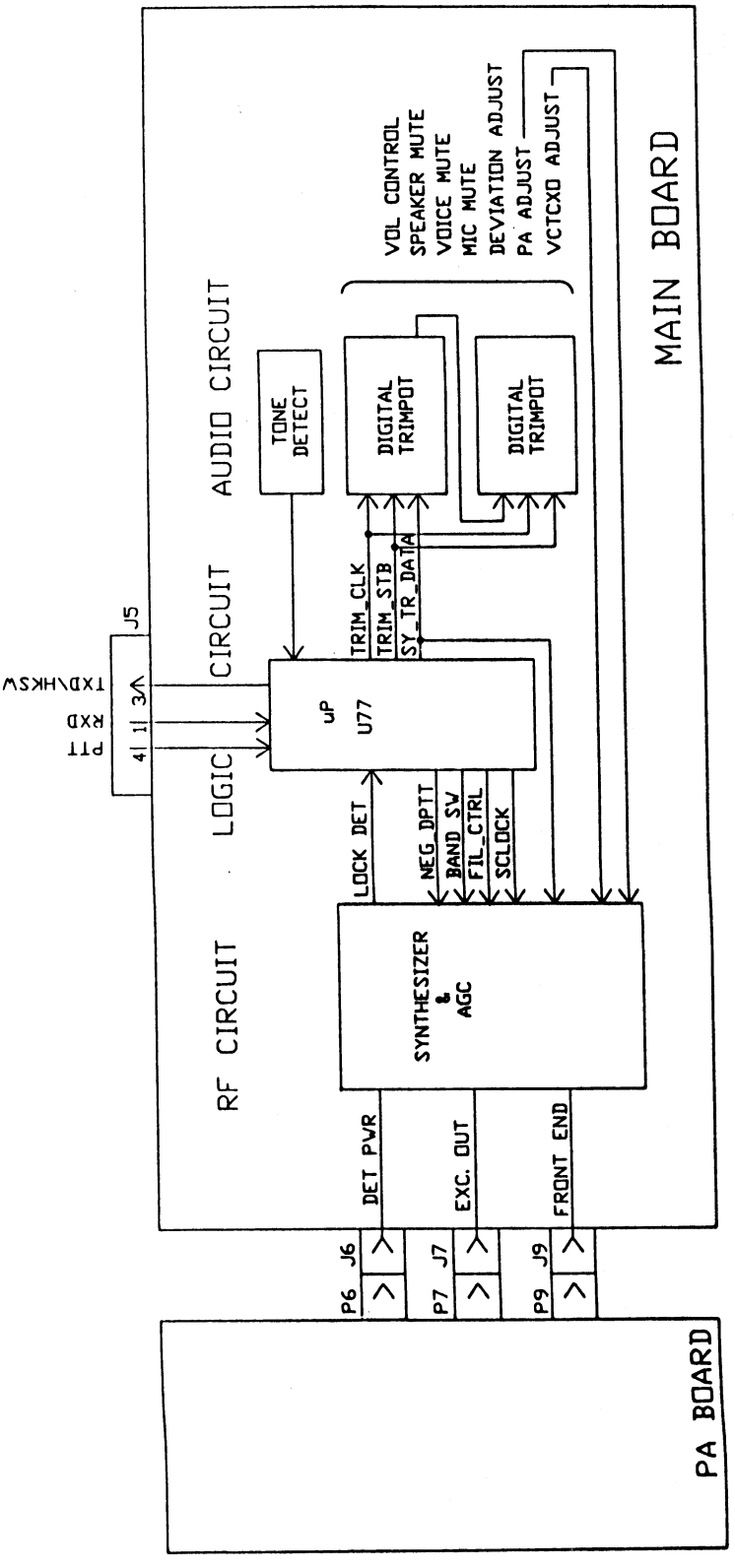

Figure 5 - Logic Signal Flow Block Diagram

RADIO ALIGNMENT PROCEDURE

To align the radio, test mode operation must be used as described in the Test Preparation section.

TRANSMITTER ALIGNMENT

Frequency Set

In test mode, key the transmitter **(FCN01)** and measure the transmit frequency. The frequency should be within ±100 Hz of the test mode channel frequency (default is channel 1). If not, adjust the reference oscillator by entering **FCN24** and step through the values until the frequency is within ±100 Hz. Press **SND** to store the setting. Turn off the transmitter by keying **END**.

NOTE

The ambient temperature should be 25 ±5°C. Ensure that the frequency counter calibration is better than ±0.1 PPM.

Modulation Set

1. Apply a 1 kHz 800 mVrms signal to the MICHI input at J5-6. Note that the MICHI input has a DC voltage present with an input impedance of 560 ohms.

2. Select channel **(CLR X CLR)**. Turn on mic audio path **(FCN04)** and key the transmitter **(FCN01)**. Adjust mic audio path gain to maximum **(FCN28)** and then change to **FCN27** to adjust the modulation setting for 3.7 ±0.1 kHz deviation. Store the setting by pressing **SND.**

3. Turn on the Channel Guard **(FCN06** or **FCN08)** and key the transmitter **(FCN01)**. Check that the deviation is less than 4.5 kHz.

Mic Audio Path Gain Set

1. Apply a 1 kHz 80 mVrms signal to the MICHI input at J5-6.

2. Select channel **(CLR X CLR)**. Turn on mic audio **(FCN04)** and key the transmitter **(FCN01).**

3. Adjust the mic audio path gain **(FCN28)** for a deviation of 2.2 kHz. Press **SND** to store the setting. Turn off transmitter **(FCN01).**

Transmitter Power Set

1. Select channel frequency that gives lowest PA power. Key the transmitter **(FCN01)** and adjust the PA power level **(FCN25)** for 40 watts. Press **SND** to store the setting.

2. Press **END** to unkey the transmitter.

RECEIVER ALIGNMENT

Front End Tuning (VHF)

See Fig. 1 for test configuration. The receiver RF filter F1 is fixed tuned for the full bandwidth. The tunable inductors L1 and L2 form a coupled-tuned bandpass filter with 18 MHz bandwidth and is aligned at the factory to cover the most commonly used segment of the split. Factory tuning is set for 150-168 MHz (VHF). Tuning will be required if the inductor is replaced. If it is necessary to move the passband to another 18 MHz segment within the split, tuning is also required. If all the receiver channels are within the preset 18 MHz bandwidth, skip the rest of this section since no front end tuning is required.

1. Connect a sweep generator (or equivalent equipment) with markers set at the desired 18 MHz bandwidth to the antenna jack as shown. RF output of sweep generator should not exceed -10 dBm to avoid saturating the RF amplifier Q1.

2. Open the cover of the front end module VC1 and measure the RF signal at TP2 with a high impedance RF probe. Connect the RF sweep generator and display (or equivalent equipment) to the RF probe.

3. Tune the slugs of L1 and L2 for the required 18 MHz bandwidth at -1 dB point. Ripple will be typically 0.5 - 1 dB.

CAUTION

A sweep tuning procedure is necessary to adjust the coupled-tuned bandpass filter for another 18 MHz segment of the split. Do not adjust L1 or L2 without sweep equipment or the receiver performance will be adversely affected.

Front End Tuning (UHF)

See Fig. 1 for test configuration. The receiver RF filters F1and F2 are fixed tuned for the most commonly used 12 MHz segment of the split. The filters do not require tuning even if they are replaced. The purpose of the tuning is to move the 12 MHz passband to another position of the split. The receiver is factory tuned to 450-462 MHz and 470-482 MHz for the UHF splits. If all the receiver channels are within the preset 12 MHz bandwidth, skip the rest of this section since no front end tuning is required.

1. Connect a sweep generator (or equivalent equipment) with markers set at the desired 12 MHz bandwidth to the antenna jack as shown. RF output of sweep generator should not exceed -10 dBm to avoid saturating the RF amplifier Q3.

2. Open the cover of the front end module VC1 and measure the RF signal at TP2 with a high impedance RF probe. Connect the RF sweep generator and display (or equivalent equipment) to the RF probe.

3. Tune the slugs of F1 and F2 for the required 12 MHz bandwidth at -1 dB point. Ripple will be typically 0.5 - 1 dB.

CAUTION

A sweep tuning procedure is necessary to adjust the RF filters for another 12 MHz segment of the split. Do not adjust F1 or F2 without sweep equipment or the receiver performance will be adversely affected.

IF TUNING

The crystal filter in the IF module is pretuned at the factory. Adjustment is not recommended during servicing. If an alignment problem is suspected, first check to see if the transmitter is on frequency. If problem still persists, replace the IF module.

Squelch Threshold Set

1. While on default channel, apply an RF signal modulated with a 1 kHz tone at 3 kHz deviation to the antenna jack.

2. Using a voltmeter or scope, monitor the CAS signal voltage at U67 pin 7. 0 Vdc indicates the squelch is closed, and +5 Vdc indicates the squelch is open.

3. Turn on the RX audio **(FCN02)** and monitor the SINAD of the audio at the external speaker output J1-4 of the pigtail cable.

4. Using test mode **FCN29,** set the squelch level to step 1. Adjust signal generator level for 10 dB SINAD. The CAS signal should be a logic low at 0 Vdc (squelch closed).

5. Increase the squelch level setting until the CAS signal switches to +5 Vdc. Store this setting by pressing **SND.**

TRANSMITTER VERIFICATION

Place the transmitter in the test mode operation for the following tests.

Transmitter Frequency

Key the transmitter **(FCN01)** and measure the transmit frequency (default test mode is channel 1). The measured frequency should be within ±100 Hz. Press **END** to turn off the transmitter.

Transmitter Power

Select a channel and key the transmitter. Power should be at least 40 watts. Press **END** to unkey the transmitter.

Modulation Limiting

1. Apply a 1 kHz tone at 800 mVrms to the MICHI input J5-6.
2. Select a channel at the lower limit of band. Turn on TX audio **(FCN04).** Turn on Channel Guard tone **(FCN06** or **FCN08)** and key the transmitter **(FCN01).**
3. The measured deviation should be less than 4.5 kHz. Press **END** to unkey the transmitter.

RECEIVER VERIFICATION

SINAD

1. Connect an RF signal generator set at 450 MHz modulated with a 1 kHz tone at 3 kHz deviation to the antenna jack. Set RF level to -50 dBm.
2. Connect a 4 ohm resistive load at speaker output J8. Select channel and turn receive audio on **(FCN02).** Adjust VOLUME UP/DOWN buttons until 4 Vrms is achieved across the load.
3. Change RF level on signal generator to -117.5 dBm and check for greater than 12 dB SINAD.
4. Repeat the test for lowest, middle and highest programmed frequencies.

Audio Distortion

1. Apply a strong (-50 dBm) on channel signal modulated with a 1 kHz tone at 3 kHz deviation.
2. With a 4 ohm load connected to the speaker output J8, adjust VOLUME UP/DOWN buttons unit the output level reaches 4 Vrms. The audio distortion should be less than 10%.

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This addendum provides new text for page 6 of LBI-38759. The text on page 6, sections **TEST MODE SELECTION, OPERATION WITH HANDSET, TESTS** and **Defining The Test Funtions**, should be replaced by the following:

TEST MODE SELECTION

Built into the software of the MDS radio is a Test Operating Mode. The radio may be operated in the test mode using the Test Handset 19A705965P1 and Cord 19D901619P2 (Handset and Cord may be ordered as SPK9102). This software is enabled using the following procedure:

1. Using the Power Switch on the front of the radio, turn the radio OFF.
2. Unplug the microphone.
3. Plug the Test Handset into the microphone jack, or connect the radio and system for testing as shown in Figure 1.
4. Power the unit up and the handset will display "TESTMODE".

The following selections may now be made from the handset:

- TX Mode/RX Mode
- Open/Mute TX Audio Paths
- Open/Mute RX Audio Paths
- Modulate TX with Channel Guard Tones
- Test Microprocessor Ports

TESTS

The tests described in the following paragraphs are an integral part of the MDS Conventional radio operational software. The data link uses 11 bits ASCII (1 start, 8 data and 2 stop), no parity and operates at 300 baud.

The USER TESTS are enabled whenever power is applied to the unit. The FIELD TEST are enabled as desribed in the previous section.

Defining The Test Functions

The following is a description of the available test functions. Each function has a two-digit index number associated with it. This number will be in parenthesis next to the title of the function. The two-digit number preceded by "FCN" enables the function. Wait untile the display is updated before pushing the next button (approximately 1/2 second).

ADDENDUM NO. 2 TO LBI-38759

This addendum provides a correction to the Test Functions on page 11 and a correction to the Transmitter Alignment Procedure on page 19.

ON PAGE 11

CHANNEL GUARD LOW PASS FILTER ON (31), should be replaced with the following:

CHANNEL GUARD LOW PASS FILTER OFF (31)

(FCN 31) (HEX 41 33 31)

This test allows the user to check wide band tone passage for T99 operation by turning the Low Pass filter OFF.

CHANNEL GUARD LOW PASS FILTER ON (32)

(FCN 32) (HEX 41 33 32)

This test allows the user to check tone limiter operation by turning the Low Pass filter ON.

ON PAGE 19

Under **Modulation Set**, step 3 should be replaced with the following:

3. Turn on the 170 Hz sine wave by pressing **(FCN 06)**, then press **(FCN 01)** to key the transmitter. Record the deviation of the 170 Hz tone. Next, key the transmitter **(FCN 01)** and press **(FCN 08)** to observe the low frequency (10 Hz) level. The deviation of this 10 Hz tone should be the same as the level recorded previously at 170 Hz. If the levels are not equal, press **(FCN 26)** and adjust this level by repeatedly pressing 1 or 0 to bring this deviation level equal to the 170 Hz level. Store the setting by pressing **SND.**