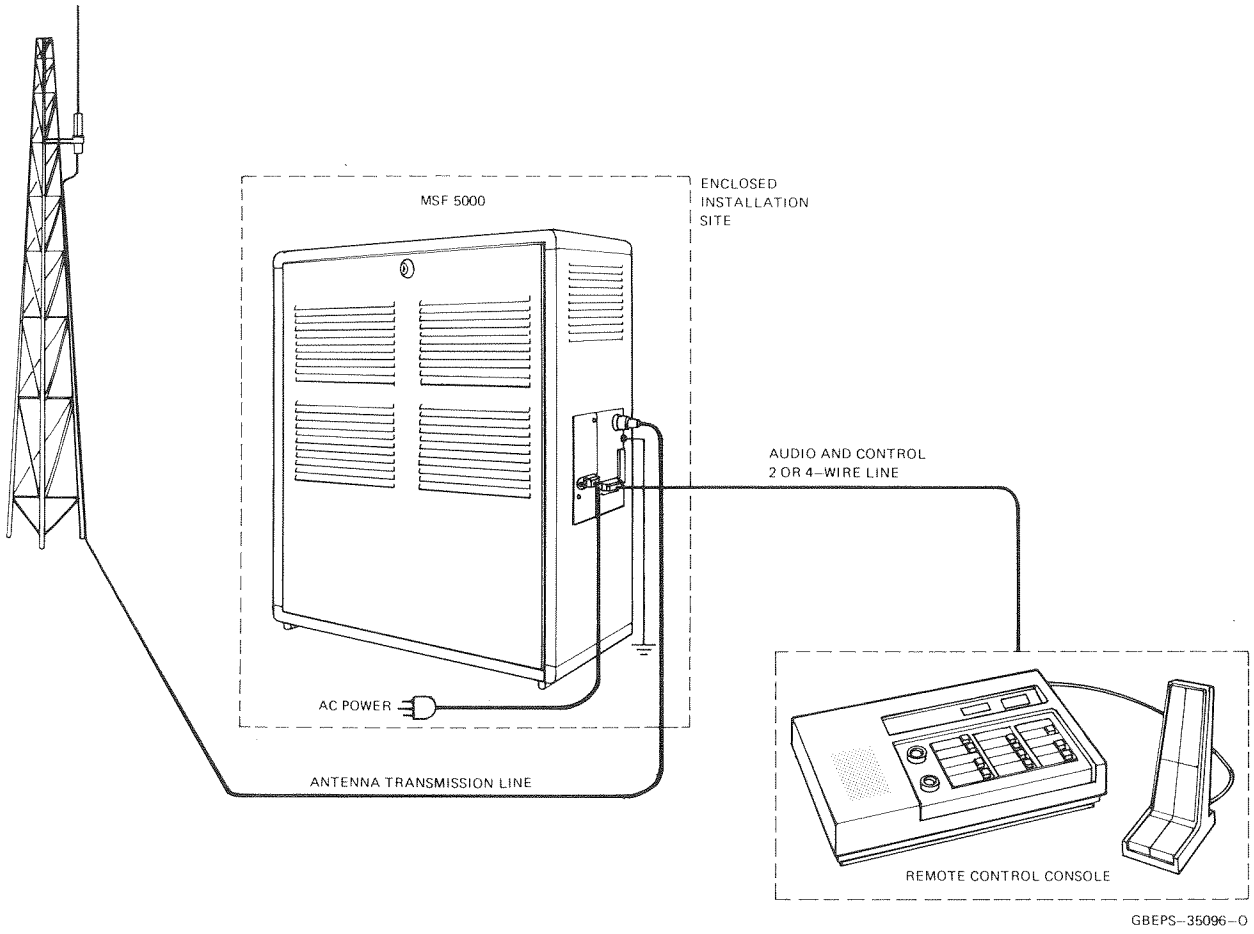


Figure 1. Typical System Configuration

1. INTRODUCTION

1.1 The Motorola *MSF 5000* UHF FM Base and Repeater (RT) Stations are microprocessor controlled two-way radio stations that use state-of-the-art fundamental carrier frequency synthesis to generate all required transmit and receive frequencies. Separate frequency synthesizer circuits are provided for transmit and receive signals. The circuits provide ±.0002% frequency stability.

1.2 Transmit and receive frequencies, as well as many other station parameters, are controlled by data stored in a code plug(s) in the station control circuits. A code plug can be replaced or the code plug's data altered when it is necessary to change station operating parameters or functions. The *MSF 5000* station is capable of *Private-Line* (PL), *Digital Private-Line* (DPL), and carrier squelch operation in the same radio unit. As a result, the Motorola *MSF 5000* stations offer Maximum Station Flexibility via a new conception of a communi-

cation channel, wherein most station operating parameters or functions are variable, on a per channel basis, in a single radio unit.

1.3 The station design includes rf shielding and filtering to meet domestic FCC Industrial Class A and international CEPT and FTZ specifications. Base stations include an antenna switch and repeater (RT) stations include either two antenna connectors, or one antenna connector along with built-in duplexer filtering options. The antenna connector(s) is(are) a type-N female receptacle(s), and is(are) supplied on all station models except for base stations with an antenna switch, which have a type-UHF female receptacle antenna connector.

1.4 The station cabinet is designed such that all assemblies may be serviced, removed, and/or replaced from the front of the housing. Cooling is provided by convective air flow through louvres in the cabinet door and the sides of the cabinet. No forced air cooling is required.

2. CAPABILITIES

All *MSF 5000* stations provide the following features:

- Microprocessor station control
- Broadband operation
- Frequency synthesis (separate for both transmit and receive)
- Wide operating temperature range — from -30 to +60°C (-22° to +140°F)
- Solid-state, easily serviceable, modular design
- Wireline control (dc or tone)
- PL/DPL coded squelch
- Variable communication channel parameters (on a per channel basis)
- Remote station alarm reporting
- Single stage circulator PA protection from transmitter intermodulation and antenna mismatch (VSWR)
- Automatic station identification

2.1 STATION CONTROL

2.1.1 Most station functional operations are controlled by an 8-bit microprocessor (uP), a read-only memory (ROM) containing the operating firmware, an eraseable re-programmable read-only memory (an EPROM code plug), and associated support and control circuits. The station control system programming is designed to simplify station set-up and operation.

2.1.2 Most unique user-specified operating parameters or station functions such as, but not limited to, transmit and receive frequency, transmit and receive squelch code (PL, DPL, or carrier), AND squelch, automatic station identification, etc., are contained in a code plug (EPROM) and may be varied in any combination on a per channel basis. This permits the station to be easily customized to meet specific user requirements. Operational modifications are implemented by simply reprogramming the existing code plug with data to accommodate changes in user requirements or operating parameters.

2.2 BROADBAND OPERATION

The *MSF 5000* station can operate as a base or repeater (RT) station on specific frequencies in the 435 to 475 MHz band. The *MSF 5000* station can be tuned anywhere within its 40 MHz operating band. It can transmit on frequencies separated by up to 6.1 MHz, and receive on frequencies separated by up to 2 MHz, without degradation of specifications. With built-in duplexer filtering options, the transmit frequency separation may be as much as 1 MHz.

2.3 FREQUENCY SYNTHESIS

All *MSF 5000* radio frequencies are generated electronically by using fundamental carrier frequency synthesis, rather than individual crystal circuits or channel elements. Frequency synthesis simplifies multiple-frequency operation since frequencies can be changed, added, or deleted by reprogramming the code plug. In addition, frequency synthesis provides a significant reduction in transmitter sideband noise levels. Separate transmit and receive frequency synthesizer circuits and voltage-controlled oscillator (VCO) circuits are used to provide complete independent control of transmit and receive frequencies.

2.4 REMOTE STATION ALARM REPORTING VIA WIRELINE

This standard capability allows audible indications of both internal and external station alarms to be routed to the remote control console. If wireline control of the station is optionally deleted, remote station alarm reporting via wireline is automatically converted to over-the-air remote station alarm reporting.

NOTE
Alarm conditions are always available on the MUX bus of the expansion connector.

2.5 AUTOMATIC STATION IDENTIFICATION

This standard capability provides for a Morse code station identification to be transmitted over-the-air every 15 minutes during periods when there is no transmitter activity. The 15 minute timing period begins 5 seconds after the transmitter is dekeyed. The station Auto ID code may be specified by the user and is programmed into the code plug. If the station incorporates a multi-channel option, the Auto ID is transmitted on the currently selected channel.

3. EQUIPMENT

3.1 CABINET

3.1.1 The station cabinet consists of a standard 19-inch wide, rack-mount internal frame, a vinyl-covered steel wraparound side and back cover skin, top and bottom covers, and a front door, as shown in Figure 2. The cabinet is compact, designed for indoor installation, and may be stacked up to three high at site installations using Option TRN5757A Station Stackinng Hardware Kit, where space is a premium. The center bolts in the top and bottom covers are temporarily removed and then used to secure stacked cabinets together.

3.1.2 The overall cabinet demensions are 26-1/2 inches high, 20-3/4 inches wide, and 10 inches deep. When the front door is removed, all major modules are accessible from the front of the cabinet (see Figure 3) and either tilt outward, are secured to the cabinet frame, or are slide mounted to facilitate maintenance. Convection cooling is provided by air drawn through the front door of the cabinet and expelled through the sides of the wraparound cover skin.

3.2 JUNCTION BOX

3.2.1 A junction box, flush-mounted in the right side of the cabinet provides facilities for all external connections to the cabinet. These include power connections, antenna connections, and telephone line type audio and control wireline connections (where applicable). Optional external battery connections may also be provided through the junction box panel. No additional holes need be drilled or cut in the exterior surface of the cabinet for installation.

3.2.2 The fuse for the station ac power line and a convenience outlet for servicing purposes are accessible on the junction box from the inside of the cabinet. Line transient protection is provided on the wireline input connections to the junction box.

3.3 POWER AMPLIFIER DECK

3.3.1 The transmitter power amplifier (PA) deck is mounted in the upper half of the cabinet and is accessible when the cabinet door is removed. The PA deck can be tilted outward to one of two positions when screws securing it to the cabinet frame are removed. All PA

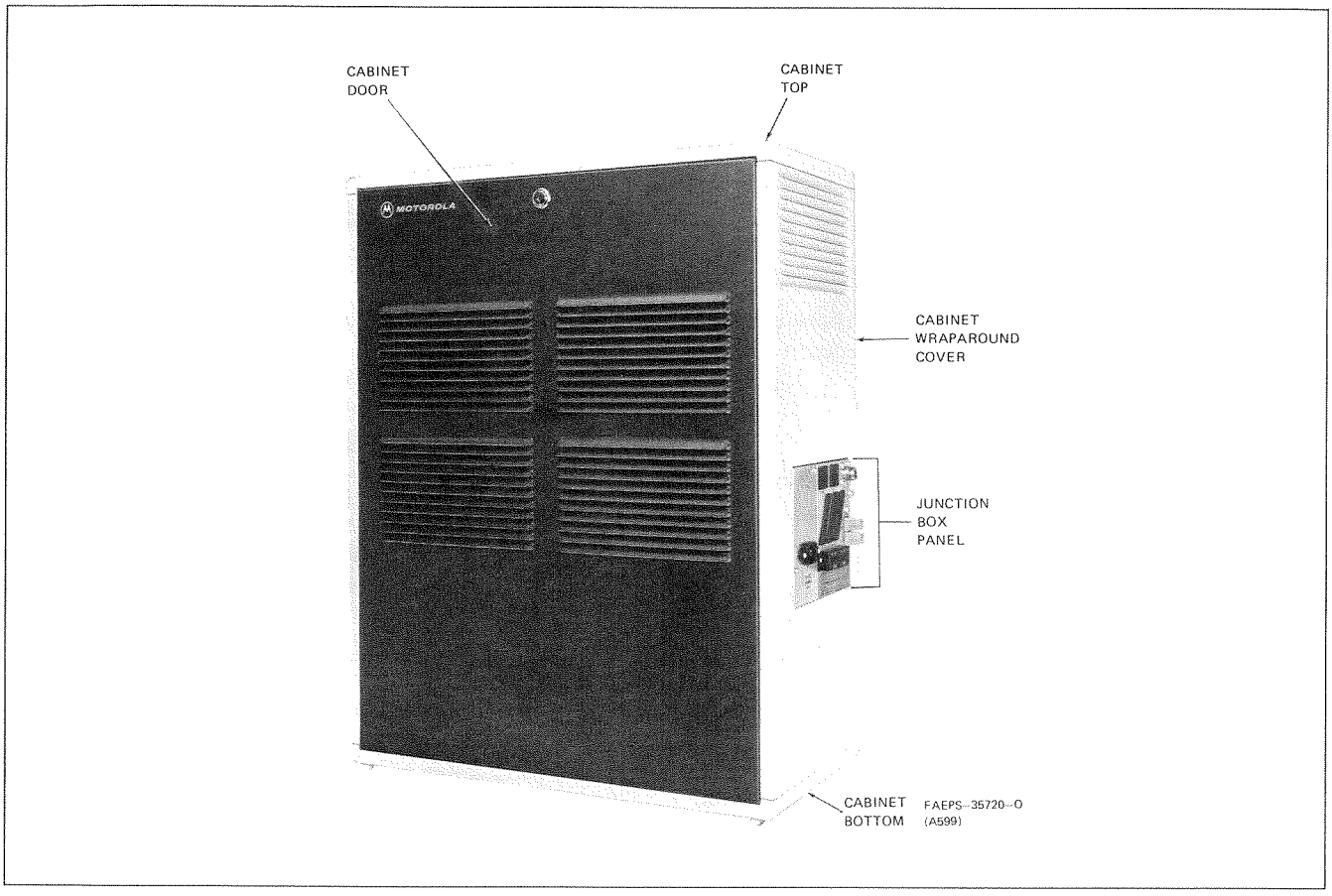


Figure 2. Typical MSF 5000 Station

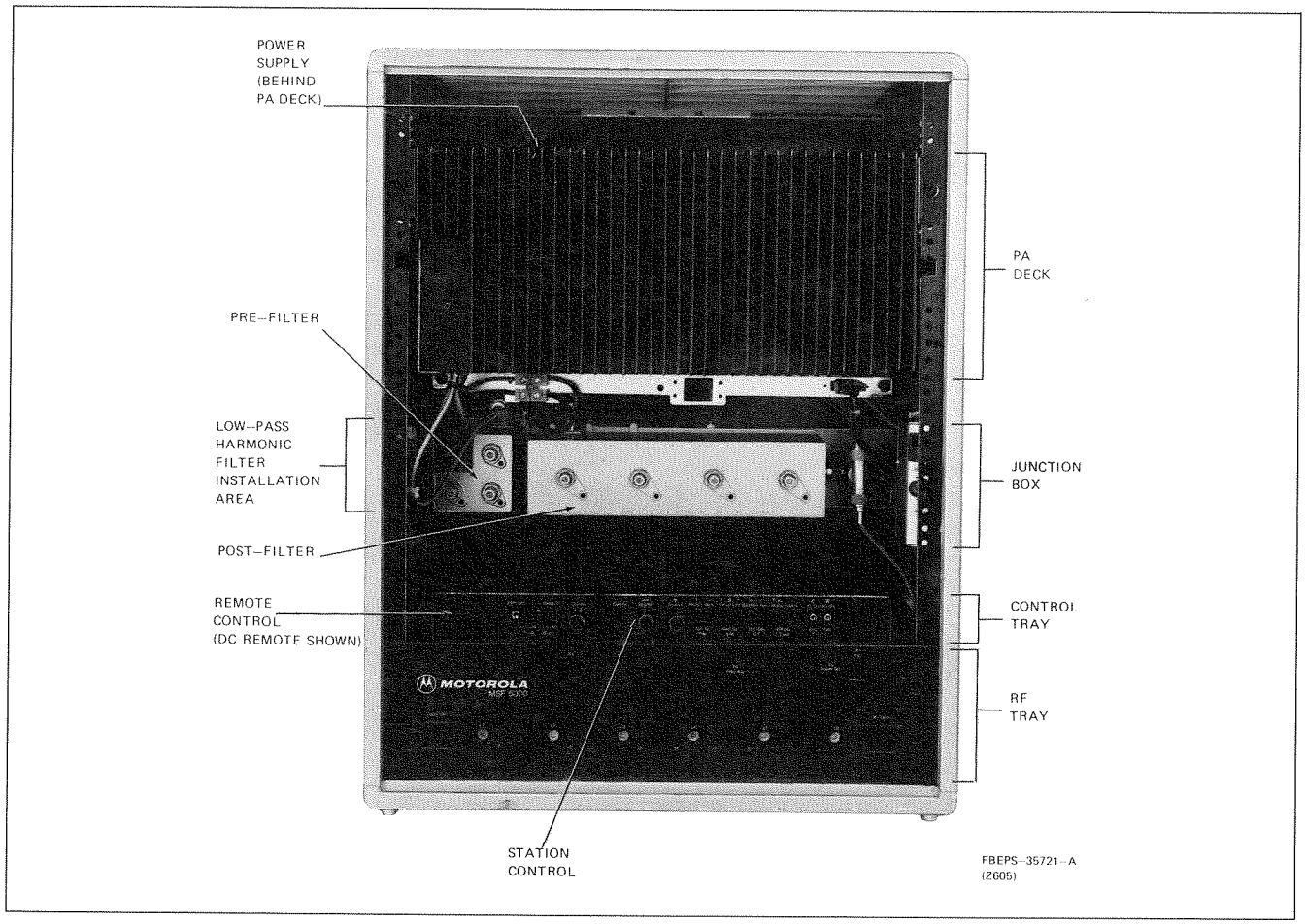


Figure 3. MSF 5000 Station Internal View

deck connections (rf, power, and control) are made at the left end of the PA deck heat sink, beneath a cover plate.

3.3.2 The power amplifier modules and internal circulator are mounted in the power amplifier heat sink casting. The PA consists of five rf modules, a power splitter, a power combiner, and a circulator stage. The rf modules comprise a predriver stage and four identical amplifier stages. One amplifier stage drives the three remaining final stages, that are connected in parallel. The PA is designed such that if one of the parallel-connected final stages should fail, the transmitter will continue to operate safely, but at a reduced power. The PA includes a metering plug that permits current draw measurements of each module for servicing purposes. The circulator protects the PA from transmitter intermodulation and antenna mismatch (VSWR). The PA stages and circulator are all broad-band devices and require no tuning. A low-pass filter, mounted beneath the power amplifier deck and connected between the power amplifier and the antenna connector, attenuates transmitter harmonics.

3.4 POWER SUPPLY

The station power supply is mounted in the upper half of the cabinet behind the transmitter power amplifier and is accessible when the amplifier is tilted forward. The power supply is a ferroresonant type designed to operate from a nominal 121 volt, single-phase, 60 Hz ac power source. It delivers up to 500 watts (13.8 volts dc). The power supply operates with line voltage variations of 96 to 132 volts ac and provides transient protection against line surges and lightning.

3.5 RF TRAY

3.5.1 The rf tray is mounted on slides in the bottom of the cabinet. Refer to Figure 4. Latches on the ends of the front panel secure the tray to the cabinet frame. The rf tray provides mounting for the receiver preselector filter and a compartmentalized casting that contains and provides shielding for the uniboard, receiver front end, injection amplifier, transmit and receive VCO's, and the intermediate power amplifier (IPA). An interconnect board, vertically mounted in a slot beneath the rf tray casting, provides connections between circuit boards

and assemblies mounted in the rf tray, power amplifier deck, power supply, and control tray. Feedthrough plate assemblies mounted in the rf tray provide isolation between the interconnect board, circuit boards, and assemblies contained in the rf tray casting. Additional shielding and isolation is provided by covers and plates over critical circuit board areas and compartments, by metal braid between compartments, and by the rf tray cover.

3.5.2 Access to the RX and TX metering jacks, 14.4 MHz reference oscillator adjustment control (F_o Freq Adj), power output adjust control (P_o Power Set), and preselector filter tuning screws and probe connectors (L1-L6, J1-J6) are provided through the front panel of the rf tray.

3.6 CONTROL TRAY

3.6.1 The control tray is mounted on top of the rf tray and provides mounting space for the station control board and dc or tone remote control board. The control tray is secured to the top of the rf tray on the left end and hinged on the right end. After sliding the rf tray from the cabinet, the snaplock securing the control tray to the rf tray can be released and the control tray tilted up to the right (refer to Figure 5). This exposes the station control and remote control boards for servicing. Controls and indicators for the station control board and the remote control board are accessible from the front of the control tray and are described in the Operation section of this manual.

3.6.2 A connector (J800) on top of the control tray provides electrical access to the control section for metering and expansion. This permits the addition of an expansion tray on top of the control tray and allows interconnection of and communication between the two trays. The expansion connector is described in the Station Control section of this manual.

4. CONTROL FACILITIES

4.1 GENERAL

Base station operation is wireline controlled via the dc or tone remote control board. Both dc and tone remote control boards receive transmit audio as well as commands from the wireline, and send receiver audio down the wireline. Repeater (RT) stations normally operate without wireline control, but may be configured for control through a remote control board.

4.2 DC REMOTE CONTROL

Under dc wireline control, a dc control current with either positive or negative polarity and selected amplitude is generated at a remote control location and applied to the line connected to the station. The current is detected by the remote control board, which produces a binary command that is then applied to the station control board. Table 1 defines the standard dc line current inputs to and resulting functions in the *MSF 5000* base or repeater (RT) stations.

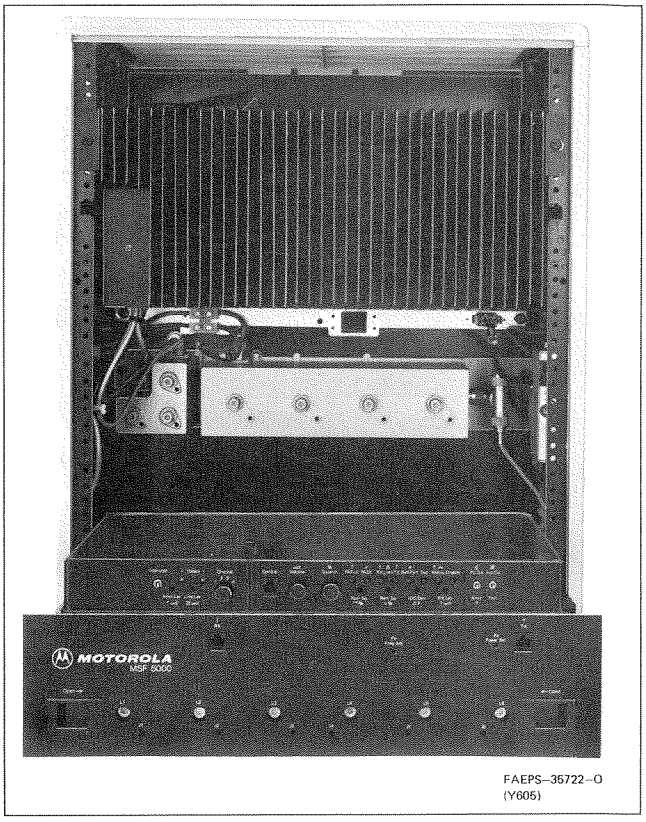


Figure 4. MSF 5000 Station Showing RF Tray Extended

NOTE

A binary command can be generated for either the detection or un-detection of any particular current, via code plug programming.

4.3 TONE REMOTE CONTROL

In a tone remote control system, the station responds to a sequence of audio command tones, generated by a remote control console, which are applied to the station's wireline input terminals (L1 on junction box panel). The tones are decoded by the tone remote control board and the resultant commands are applied to the station through the digital MUXBUS lines. DC continuity of the wireline is not required in tone remote control systems.

5. OPTIONS

5.1 EQUIPMENT OPTIONS

Station options are available to enhance operation in high-level rf environments, to permit single antenna duplexer operation, to provide charging current for external standby batteries, and to permit use of a 13.8 to 16.3 volt dc source to power the station.

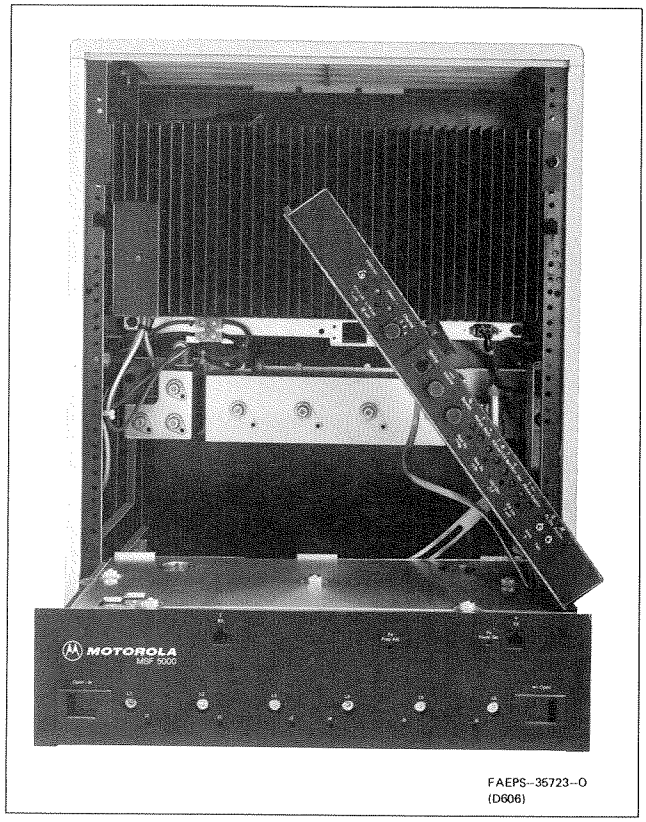


Figure 5. MSF 5000 Station With Control Tray Raised

Table 1. DC Wireline Control Currents

Current (mA)	Condition	Functions
0	Null	None
+5.5	Detected	Transmitter Keyed; Receiver Muted (Coded Squelch)
	Undetected	Transmitter Standby; Receiver Operative (Coded Squelch)
-2.5	Detected	Transmitter Standby; MONITOR Function — Receiver Operative (Carrier Squelch)
	Undetected	None

IMPORTANT

In some cases, addition of optional equipment may require changes in code plug programming.

5.1.1 Triple-Stage Circulator PA Deck (Option C676)

The triple-stage circulator option replaces the single-stage circulator PA deck with a PA deck containing a three-section circulator. The three-section circulator provides -70 dBc of transmitter intermodulation protection for the power amplifier in high-level rf environments. This option reduces station output power to 90 watts.

5.1.2 Transmitter Filtering (Options C597 and C675)

Option C675 is normally added to a station to provide the additional filtering required for single antenna duplexer applications. This option consists of two filters: a prefilter and a postfilter (together designated FL500). The prefilter replaces the straight adapter and is connected between the IPA and the PA Deck. The postfilter replaces the low-pass harmonic filter and is connected between the PA Deck and a combining TEE duplexer. Addition of filter FL500 alone reduces station output power to 80-watts.

For T/R spacings less than 5 MHz, Option C597 also changes the RF Tray, which further reduces station output power to 60-watt.

5.1.3 Triple-Stage Circulator PA Deck Plus Transmitter Filtering (Options C598 and C677)

Options C677 combines the triple-stage circulator and transmitter filtering options to provide -70 dBc of transmitter intermodulation protection for the power amplifier. The protection also provides the additional filtering required for single antenna duplexer applications. Addition of this option reduces station output power to 55-watts.

For T/R spacings less than 5 MHz, Option C598 also changes the RF Tray, which further reduces the station output power to 45-watts.

5.1.4 Battery Charger Power Supply (Option C28AP)

The battery charger power supply option is a factory installed option that replaces the station power supply with one that also provides charging current to external standby batteries. The battery charger power supply charging output can be set from 13.2 to 15.2 volts dc and will provide 1-1/2% regulation of the set voltage. Either float or equalize charging is switch selectable in the power supply. Lead-calcium or nickel-cadmimum batteries are recommended for use with this option.

5.1.5 Battery Charger Conversion Kit (Option TLN2566)

The battery charger conversion kit option is a field installed option that adds battery charging capability to the station power supply. This permits addition of standby batteries to power the station in case of a primary ac power loss. The battery charger conversion kit option adds the same features to the station power supply as those described for the battery charger power supply option C28AP.

5.1.6 DC Only Input Filter (Option C32)

The dc only input filter option deletes the power supply from the station and adds a filter chassis. The filter chassis permits operation of the station from a 13.8 to 16.3 volt dc power source.

5.1.7 4-Wire Half Duplex Remote Control (Option C144)

The 4-wire remote control option provides 4-wire audio and control connections from the remote control console. Transmit audio and control signal inputs from the console to the station are provided on Line 1. Receive audio from the station to the remote control console is provided on line 2. This option allows half duplex audio communication between the remote control console and a mobile (a line push-to-talk mutes the receiver audio on line 2).

5.1.8 4-Wire Full Duplex Remote Control (Option C332)

Option C332 is the same as option C144, except that a line push-to-talk does not mute receiver audio. This option allows full duplex audio communication between a mobile and the remote control console through the base station, provided the two wirelines are kept electrically isolated.

5.2 CODE PLUG OPTIONS

5.2.1 Remote Squelch Control (Option C13)

5.2.1.1 This option allows Receiver 1 squelch to be tightened or loosened on command from the remote console via wireline. If this option is chosen, the station normally powers-up in the looser squelch setting, and must be changed to the tighter squelch setting by wireline command from the remote control console. It may be necessary to defeat this power-up function during servicing. Refer to the Installation section in this manual for details.

5.2.1.2 The tighter setting is determined by the station control front panel SQUELCH control. The looser setting is determined by both the SQUELCH control and the recessed (in the station control module's front panel) REMOTE SQUELCH control.

5.2.1.3 If this option is not chosen, Receiver 1 squelch defaults to the setting made via the station control front panel SQUELCH control.

5.2.2 Receive PL On/Off (Option C14)

5.2.2.1 This option allows the station to be switched from PL or DPL coded squelch to carrier squelch operation via wireline command from the remote control console.

5.2.2.2 If this option is not chosen, the station cannot be switched to carrier squelch operation from the console, except via the MONITOR function.

5.2.3 Transmit PL On/Off (Option C63)

5.2.3.1 This option pertains to single-channel stations only and permits muting of PL or DPL codes on the transmitted carrier.

5.2.3.2 If this option is not chosen, PL or DPL codes will be transmitted when the station transmitter is keyed.

5.2.4 Multi-Channel Station Operation

5.2.4.1 If multi-channel station operation is not chosen, the number of station channels default to one.

5.2.4.2 4-CHANNEL STATION OPERATION (OPTION C66)

This option permits multichannel (4-channel) station operation. Examples of channel-variable station parameters that may be selected are transmit and receive frequencies, transmit and receive PL and/or DPL codes, push-to-talk (PTT) priority, time-out times, and repeater drop-out delay times.

5.2.4.3 8-CHANNEL (OPTION C680 or C600)

Option C680 or C600 permits 8-channel station operation. Available on tone remote control stations only.

5.2.5 Omit Wireline

— DC Remote Control (Option C86)
— Tone Remote Control (Option C84)

All station models come with wireline control. This option deletes wireline control. Either option is compatible only with wireline control station models. If chosen, remote station alarm reporting, via wireline, is automatically converted to over-the-air remote station alarm reporting.

5.2.6 Remote Repeater Control (Option C143)

5.2.6.1 This option permits the repeater to be remotely set-up and knocked-down (from the remote control console).

5.2.6.2 If this option is not chosen, the repeater will be set-up at all times.

5.2.7 Delete Coded Squelch (Option C268)

This option causes the entire station to operate carrier squelch only. Neither PL nor DPL coded squelch is transmitted or used to open Receiver 1 squelch.

5.2.8 Add Automatic Station Identification (Option C345)

This option adds the automatic station identification function to the present station programming.

5.2.9 Variable Time-Out Timer (Option C395)

5.2.9.1 A time-out timer automatically turns the transmitter off when the transmission time exceeds a predetermined and programmed time period. Wireline, repeater, and local transmission times are each separately programmable on a per-channel basis from 15 to 465 seconds. Also, chosen time-out timers may be disabled (no time-out of transmission). It may be necessary to defeat this function during servicing. Refer to the Installation section in this manual for details.

5.2.9.2 If this option is not chosen, the time-out timer values default to: 2 minutes for wireline transmission; 1 minute for repeater transmission; and disabled (no time-out of transmission) when the transmitter is locally keyed (at the station).

5.2.10 Over-The-Air Remote Alarm Reporting (Option C578)

5.2.10.1 This option allows audible indications oof both internal and external station alarms to be transmitted over-the-air during any PTT.

5.2.10.2 If this option is not chosen, no alarms will be transmitted over-the-air.

NOTE
Alarm conditions are always available on the MUX bus of the expansion connector.

5.2.11 Delete Station Alarm Reporting (Option C669)

This option deletes either the wireline or the over-the-air (or both) remote station alarm reporting function(s), as required, by the present station programming.

5.2.12 Variable Repeater Drop-Out Delay (Option C671)

5.2.12.1 During a mobile transmission fade, or after the mobile operator releases his PTT button, the repeater remains keyed for a period of time known as the drop-out delay time period. The drop-out delay time period is programmable on a per-channel basis from 0 seconds (no delay) to 7 seconds, in 1 second increments.

5.2.12.2 If this option is not chosen, all drop-out delay time period values default to 2 seconds.

5.2.13 Variable Push-to-Talk Priority (Option C672)

5.2.13.1 Push-to-talk priorities determine whether a wireline, repeater, or local PTT signal will key the station in the event of simultaneous inputs (PTT "collisions"). Any priority sequence, including disallowing one or more PTT inputs (priority zero), can be programmed on a per-channel basis.

5.2.13.2 If this option is not chosen, the PTT priority defaults to: wireline-over-repeater-over-local (WRL). Refer to the station control section of this manual for further explanation of push-to-talk priority.

5.2.14 Variable Repeater Control (Option C673)

5.2.14.1 Receiver generated signals, such as carrier and coded squelch activity, can determine whether or not to initiate and maintain repeater keying. This option specifies which signals actually control repeater keying on a per-channel basis. The choices are any combination (AND'ed) of the following: (repeater) carrier squelch, coded squelch, and auxiliary detect.

5.2.14.2 If this option is not chosen, the default control of repeater keying varies depending upon the type of repeater. A coded squelch repeater defaults to: (repeater) carrier squelch AND coded squelch for repeater initiation, and coded squelch only to maintain repeater keying. A carrier squelch repeater defaults to: (repeater) carrier squelch only, both to initiate and maintain repeater keying.

5.2.15 Variable Receiver Audio Control (Option C674)

5.2.15.1 Receiver generated signals such as carrier and coded squelch activity can determine whether or not receiver audio is muted. This option specifies which signals actually control receiver audio muting on a per-channel basis. The choices are any combination (AND'ed) of the following: Receiver 1 squelch, coded squelch, and auxiliary detect.

5.2.15.2 If this option is not chosen, the default control of receiver audio muting varies depending upon the type of station. A coded squelch station defaults to coded squelch only. A carrier squelch station defaults to Receiver 1 squelch only.

5.2.16 Multiple-Input Transmit Control (Option C678)

5.2.16.1 Wireline, repeater, or local audio can be muted or mixed with transmit data audio, during a PTT when the external data detect bit on the MUX bus is active.

5.2.16.2 If this option is not chosen, wireline, repeater, and local audios will be muted when the external data detect bit on the MUX bus is active.

5.2.17 2-Channel Station Operation (Option C679)

5.2.17.1 This option permits multichannel (2-channel) station operation. Examples of channel-variable station parameters that may be selected are transmit and receive frequencies, transmit and receive PL and/or DPL codes, push-to-talk (PTT) priority, time-out times, and repeater drop-out delay times.

5.2.17.2 If this option is not chosen, the number of station channels default to one.

5.2.18 Expanded Remote Control (Option C683)

Any custom function definition of dc or tone control signals and/or MUX bus bit manipulation is accomplished via this option.

5.2.19 Guard Tone Keying (Option C170)

Available on tone remote control stations only, this option causes the transmitter to key up rapidly upon receipt of a single tone (the "guard tone"). This option will not allow *any* remote control function except a line push-to-talk.

5.2.20 Phone Line Integrity Test (Option C670)

This option uses the ability of the tone remote control board to generate as well as decode tones. In response to a function tone command from the remote console, the tone remote control board in the base station will return a 6.8 second burst of 1004 Hz tone on the phone line to the remote console (on L1 in 2-wire stations, L2 in 4-wire stations). The level of this tone will be approximately –13 dB from the level of a 5 kHz deviation 1 kHz receive audio tone. This option can be used to verify telephone line operation from the remote control location. The test can be interrupted by any valid wireline command from the remote console (such as line push-to-talk). This option is available only on tone remote control models.

6. FUNCTIONAL DESCRIPTION

6.1 The *MSF 5000* Station can be functionally divided into four parts:

- control circuits
- receiver
- transmitter
- power supply.

6.2 The station control circuits include a station control module (containing microprocessor, code plug, audio and squelch circuits, etc.), and a remote control board. Refer to the simplified functional block diagram at the end of this section. Both the station control and dc or tone remote control boards are located in the control tray. The uniboard is located in a compartment of the rf tray.

6.3 The receiver consists of the preselector filter, receive frequency synthesizer, receive VCO, injection amplifier, front-end (preamplifier-mixer), and i-f amplifier. The i-f amplifier includes limiter-detector and buffer stages. All of the above are located either in compartments of the rf tray casting or are affixed to the front panel. The receive synthesizer and i-f amplifier circuits are located on the uniboard.

6.4 The transmitter comprises the transmit frequency synthesizer, transmit VCO, intermediate power amplifier, power amplifier deck, low-pass filter, and power control circuits. Some stations, depending upon site requirements, are provided with additional filtering in the transmitter. Components of the transmitter frequency synthesizer and power control circuits are mounted on the uniboard. The uniboard, transmit VCO, and IPA are located in compartments in the rf tray casting. The PA deck is mounted in front of the station power supply in the upper part of the cabinet. The transmitter low-pass filter is mounted below the power amplifier deck. Both the transmit and receive frequency synthesizers are driven by a 14.4 MHz reference oscillator on the uniboard.

6.5 CONTROL CIRCUITS

6.5.1 The station control module provides such functions as control and monitoring of the transmitter, routing and muting of receiver audio, programming of receive and transmit frequency synthesizers, encoding and decoding of coded squelch signals, transmit instantaneous deviation control (IDC), and local amplification of station audio for maintenance purposes. Many station operating parameters are controlled by programmed data contained in a code plug (EPROM) on the station control module. The code plug can be exchanged or erased and reprogrammed if necessary to accommodate station expansion and/or changes in function. Any of the following parameters may be varied, in any combination, on a per-channel basis.

- Transmit frequency
- Receive frequency
- Transmit PL/DPL squelch code
- Receive PL/DPL squelch code
- Wireline (remote) PTT time-out time
- Repeater PTT time-out time
- Local (service) PTT time-out time
- Repeater drop-out delay time
- PTT priority
- Squelch conditions required to initially key transmitter or to hold it keyed (repeaters only)
- Squelch conditions required to unmute the receiver
- Transmitter audio mixing in certain systems
- Automatic station identification.

6.5.2 PTT time outs may be programmed from 15 to 465 seconds in 15 second increments or the time-out timer may be disabled. Repeater drop-out delay may be

programmed to be 0 to 7 seconds, adjustable in 1-second increments.

6.5.3 Automatic station identification can also be programmed into the code plug. In repeater applications, station control also performs the function of stripping PL and DPL codes from received audio signals. Necessary codes are regenerated or changed and added to the audio for transmission. This provides flexibility in cross coding and permits coding to be changed from PL to DPL, DPL to PL, or eliminated.

6.5.4 The dc remote control board provides the telephone line audio and dc control interface to the station via the station control module. Controls and amplifiers on the board provide level control and signal conditioning of audio signals both to and from the line. Circuits on the board are capable of detecting six line current signals, three positive and three negative. Positive or negative current detection is indicated by the - and + DETECT front panel LED indicators. Actual line connections from a remote control console to the station are made via the station's junction box, which provides line transient protection.

6.5.5 The tone remote control board, like station control, also contains a microprocessor and a code plug. It provides the telephone line audio interface to the station. It also detects tone commands and executes them by writing to the station MUXBUS lines. It has the ability to generate tones and send them down the wireline (for example, Phone Line Integrity Test, option C670). Up to 15 different function tone commands may be used, and any number of multiple function tones may be stacked sequentially. The front panel TONE DETECT LED lights momentarily after high level guard tone is detected and remains on while function tones are being decoded. If the function tone is a line push-to-talk, the LINE PTT LED remains on for the duration of the transmission. The TONE SEND LED indicates that the tone remote control board is generating a tone and sending it down the phone line. As with station control, the tone remote control code plug can be exchanged or erased and reprogrammed if desired to change functions.

6.5.6 The power control circuit controls the operation of and rf power output from the station transmitter. Keying inputs from the station control module switch the transmitter on and off by application of biasing signals to the intermediate power amplifier (IPA). Sensors in the PA deck provide the control circuit with inputs that permit precise control of rf power output to the antenna. Sensor inputs also permit the power control circuit to detect abnormal operating conditions in the PA deck and either cut back or completely cut off rf power output from the transmitter.

6.6 RECEIVER

6.6.1 The receiver is a super-heterodyne, single-conversion receiver designed for use in either base or repeater (RT) station (half- or full-duplex) applications. Functionally, the receiver consists of seven blocks. These include a preselector filter, the receiver front end (preamplifier-mixer), receive frequency synthesizer (which contains a synthesizer loop and a VCO), injection amplifier, injection filter, image filter, i-f amplifier, and squelch circuits. The synthesizer and injection amplifier circuits are mounted in compartments in the rf tray. The filters and receiver front end are mounted beneath the rf tray casting behind the front panel. The squelch circuitry is on the station control board, mounted in the control tray.

6.6.2 The rf input to the receiver is provided via the junction box either through an antenna switch (base station configuration), through a combining TEE connector (in-cabinet duplexer configuration), or directly from an individual junction box panel connector (other configurations). The preselector filter provides receiver input selectivity suitable for either half- or full-duplex station operation. The rf input from the preselectorr is applied to the receiver front end, which contains a preamplifier and mixer. The preamplifier output is routed through an image filter and applied to the mixer.

6.6.3 The injection (local oscillator) frequency input to the mixer is generated by the receive VCO under control of a steering voltage produced by the receive frequency synthesizer loop. This voltage locks the VCO on a frequency that is 10.7 MHz below the received frequency. The receive frequency synthesizer employs a phase-locked loop (PLL) to generate the steering line voltage and maintain precise control of the injection frequency. Inputs to the receive frequency synthesizer include frequency select (data) inputs from station control module, a 14.4 MHz input from the crystal-controlled reference oscillator, and the injection frequency output of the VCO that is fed back to the synthesizer before application to the input of the injection amplifier.

6.6.4 The receive synthesizer output frequency represents the desired receive operating frequency minus 10.7 MHz, the operating frequency of the i-f amplifier. The synthesizer output is applied to the injection amplifier input. The amplified rf signal is then fed to the front end mixer circuit, through a three-section injection filter. The incoming receive signal passes through the preselector bandpass filter and is amplified by the preamplifier. The signal is filtered in the image filter to reduce the image noise produced by the preamplifier stage. The signal is then fed into the mixer.

6.6.5 The mixer generates an i-f signal of 10.7 MHz. The i-f signal is routed through a bandpass crystal filter, amplified, routed through a four-pole crystal filter, am-

plified, and routed through a four-pole crystal filter to the limiter-quadrature detector stage.

6.6.6 The crystal filters substantially attenuate signals outside the predetermined receiver bandpass range. Detected audio is buffered and fed through the receive synthesizer to the station control module for processing and routing. Routing depends upon the station configuration and function. If the station is configured as a base station, audio is amplified and routed to a remote control console. If the station is configured as a repeater, audio is routed to the transmitter for retransmission.

6.7 TRANSMITTER

6.7.1 The transmitter consists of six major functional blocks comprising the transmit frequency synthesizer (which contains a synthesizer loop and a VCO), IPA, PA deck, power control circuits, and a low-pass harmonic filter. The transmit frequency synthesizer and power control circuits (located on the uniboard), transmitter VCO, and IPA are contained in the rf tray. The power amplifier deck is mounted in the upper half of the cabinet and the low-pass harmonic filter is secured to the cabinet frame directly beneath the PA deck.

6.7.2 Transmitter frequency is controlled by the steering line voltage generated in the transmit frequency synthesizer and applied to the transmitter low-noise VCO. The amplitude of the steering line voltage directly controls the output frequency of the transmitter VCO. The steering line voltage is developed in the transmit frequency synthesizer from frequency select (data) inputs from the station control module, the 14.4 MHz input from the crystal controlled reference oscillator, and a feedback of the modulated rf carrier signal (XMTR VCO) from the transmitter VCO. When the transmitter is keyed, the transmit frequency synthesizer locks the VCO frequency to the frequency represented by digital data from the station control module. The synthesizer employs a PLL to generate the steering line voltage that controls the frequency of the transmitter VCO. The modulated rf output generated by the transmitter VCO is applied to the input of the IPA in the rf tray via the transmit frequency synthesizer.

6.7.3 The four stages in the IPA provide complete control of the rf input to (and ultimately the output from) the PA deck. These stages receive transmit enable and control voltage signals from the power control circuit. The transmit enable signal originates from keying inputs received from the station control module. The variable control voltage signal is developed from the power output setting in the power control circuit, compared to the actual power output sensed in the PA deck. Overtemperature conditions sensed in the PA deck are also processed in the power control circuit to regulate rf power output. The controlled output of the IPA is applied to the power amplifier through a straight adapter (or an optional prefilter depending upon station configuration).

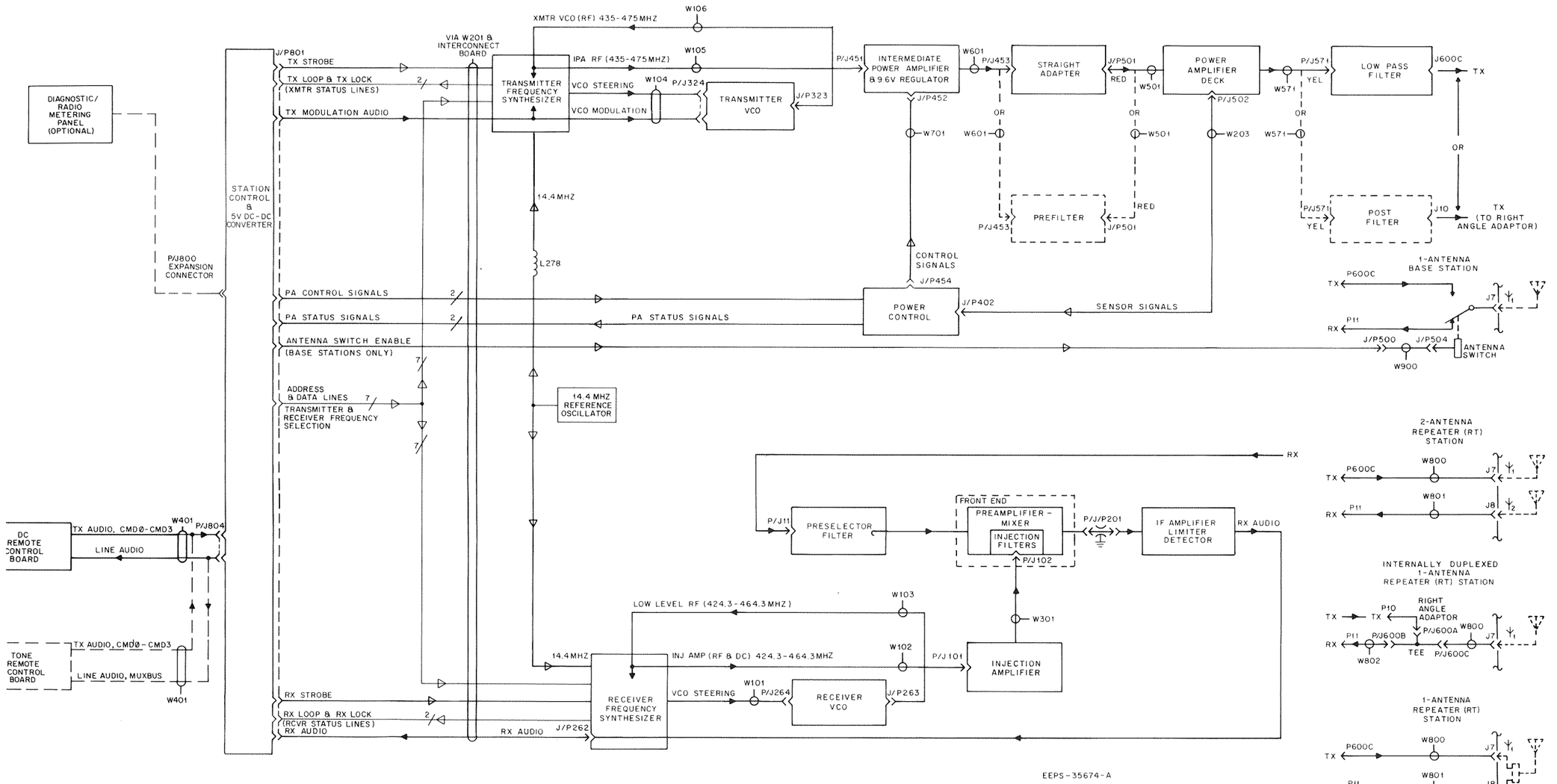
6.7.4 The PA deck consists of five stages comprising a predriver, driver, three parallel-connected final amplifiers, and a single- or triple-stage circulator. The routing of rf energy from the PA deck to the antenna is dependent upon station configuration and options. In base station applications, the power amplifier output is routed through the low-pass harmonic filter (or postfilter) to the antenna switch and, subsequently, to the antenna. Where the station is configured for repeater operation, the rf output from the low-pass harmonic filter (or postfilter) may be connected through a combining TEE connector to a common antenna connector or, alternately, the transmitter and receiver may have separate antenna connectors.

6.8 POWER SUPPLY

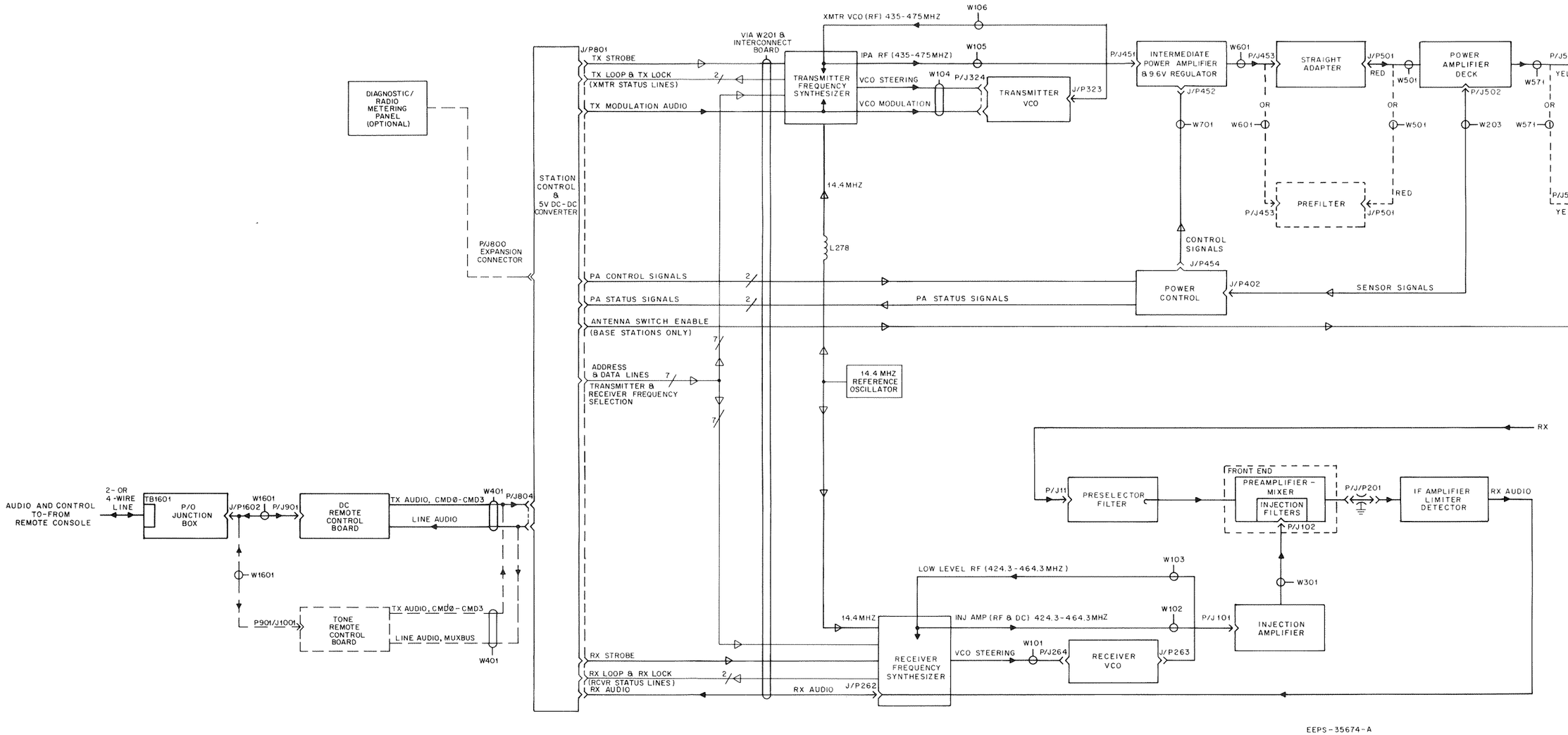
The station power supply is a ferro-resonant type design that operates from a nominal 121 volt ac, single-phase, 60 Hz power source. The power supply provides a nominal 13.8 volt dc output and sufficient power (500 W) to drive a fully optioned station. Various power supply options are available.

BLOCK DIAGRAM

MODEL *MSF 5000*



EEPS-35674-A


DIAGNOSTIC/ RADIO METERING PANEL (OPTIONAL)
P/J800 EXPANSION CONNECTOR
STATION CONTROL & 5V DC-DC CONVERTER
J/P801
TX STROBE
TX LOOP & TX LOCK (XMTR STATUS LINES)
TX MODULATION AUDIO
VIA W201 & INTERCONNECT BOARD
XMTR VCO (RF) 435-475MHZ
W106
W105
W104
IPA RF (435-475MHZ)
VCO STEERING
VCO MODULATION
TRANSMITTER FREQUENCY SYNTHESIZER
P/J324
TRANSMITTER VCO
J/P323
P/J451
INTERMEDIATE POWER AMPLIFIER & 9.6V REGULATOR
J/P452
W601
P/J453
STRAIGHT ADAPTER
J/P501
RED
W501
POWER AMPLIFIER DECK
P/J502
W203
W571
P/J571
YEL
OR
W701
PREFILTER
CONTROL SIGNALS
J/P454
14.4MHZ
L278
PA CONTROL SIGNALS
PA STATUS SIGNALS
ANTENNA SWITCH ENABLE (BASE STATIONS ONLY)
POWER CONTROL
J/P402
SENSOR SIGNALS
ADDRESS & DATA LINES
TRANSMITTER & RECEIVER FREQUENCY SELECTION
14.4 MHZ REFERENCE OSCILLATOR
RX
FRONT END
PREAMPLIFIER - MIXER
INJECTION FILTERS
P/J/P201
IF AMPLIFIER LIMITER DETECTOR
RX AUDIO
P/J11
PRESELECTOR FILTER
P/J102
W301
INJECTION AMPLIFIER
LOW LEVEL RF (424.3-464.3MHZ)
W103
W102
INJ AMP (RF & DC) 424.3-464.3MHZ
P/J101
W101
VCO STEERING
P/J264
RECEIVER VCO
J/P263
RX STROBE
RX LOOP & RX LOCK (RCVR STATUS LINES)
RX AUDIO
J/P262
RECEIVER FREQUENCY SYNTHESIZER
AUDIO AND CONTROL TO-FROM REMOTE CONSOLE
2- OR 4-WIRE LINE
TB1601
P/O JUNCTION BOX
W1601
J/P1602
P/J901
DC REMOTE CONTROL BOARD
TX AUDIO, CMD0-CMD3
LINE AUDIO
W401
P/J804
P901/J1001
TONE REMOTE CONTROL BOARD
TX AUDIO, MUXBUS
LINE AUDIO, MUXBUS
TX
RX
P11
P60
EEPS-35674-A