



MT-4E VHF & UHF RECEIVER & TRANSMITTER INSTRUCTION MANUAL

136–174 MHz / 380–406 MHz / 406–470 MHz /
470–520 MHz / 768–869 MHz / 896–960 MHz

Covers Models:

VR-4E150-00-000	UR-4E768-00-000
VR-4E150-A0-000	UR-4E800-00-000
UR-4E380-00-000	UR-4E850-00-000
UR-4E420-00-000	VT-4E150-00-800
UR-4E420-A0-000	UT-4E380-00-600
UR-4E440-00-000	UT-4E450-00-800
UR-4E460-00-000	UT-4E500-00-800
UR-4E460-A0-000	UT-4E850-00-300
UR-4E500-00-000	UT-4E900-00-300

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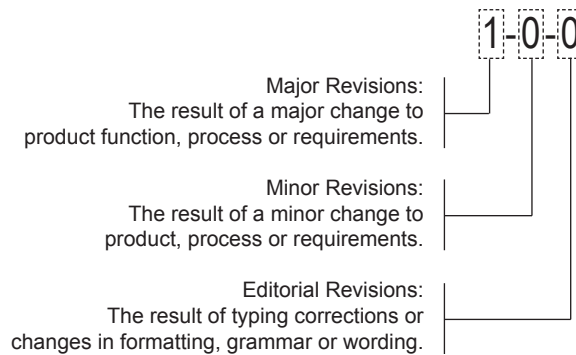
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DOCUMENT REVISION DEFINITION

Daniels Electronics Ltd. utilizes a three-level revision system. This system enables Daniels to identify the significance of a revision. Each element of the revision number signifies the scope of change as described in the diagram below.



Three-level revision numbers start at 1-0-0 for the first release. The appropriate element of the revision number is incremented by 1 for each subsequent revision, causing any digits to the right to be reset to 0.

For example:

If the current revision = 2-1-1 Then the next major revision = 3-0-0

If the current revision = 4-3-1 Then the next minor revision = 4-4-0

If the current revision = 3-2-2 Then the next editorial revision = 3-2-3

The complete revision history is provided at the back of the document.

NOTE

The user's authority to operate this equipment could be revoked through any changes or modifications not expressly approved by Daniels Electronics Ltd.

The design of this equipment is subject to change due to continuous development. This equipment may incorporate minor changes in detail from the information contained in this manual.

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

RF Exposure Warning

Exposure to radio frequency (RF) energy has been identified as a potential environmental factor that must be considered before a radio transmitter can be authorized or licensed. The FCC and IC have therefore developed maximum permissible exposure (MPE) limits for field strength and power density, listed in FCC 47 CFR 1.1310 and IC RSS-102 Issue 2 Sect 4. The FCC has furthermore determined that determination of compliance with these exposure limits, and preparation of an Environmental Assessment (EA) if the limits are exceeded, is necessary only for facilities, operations and transmitters that fall into certain risk categories, listed in FCC 47 CFR 1.1307 (b), Table 1. All other facilities, operations and transmitters are categorically excluded from making such studies or preparing an EA, except as indicated in FCC 47 CFR 1.1307 (c) and (d).

Revised FCC OET Bulletin 65 (Edition 97-01) and IC RSS-102 Issue 2 provide assistance in determining whether a proposed or existing transmitting facility, operation or device complies with RF exposure limits. In accordance with OET Bulletin 65, FCC 47 CFR 1.1307 (b) and RSS-102 Issue Sect 2.5, this Daniels Electronics Ltd. transmitter is categorically excluded from routine evaluation or preparing an EA for RF emissions and this exclusion is sufficient basis for assuming compliance with FCC/IC MPE limits. This exclusion is subject to the limits specified in FCC 47 CFR 1.1307 (b), 1.1310 and IC RSS-102 Issue 2 Sect 4. Daniels Electronics Ltd. has no reason to believe that this excluded transmitter encompasses exceptional characteristics that could cause non-compliance.

Notes:

- The FCC and IC's exposure guidelines constitute exposure limits, not emission limits. They are relevant to locations that are accessible to workers or members of the public. Such access can be restricted or controlled by appropriate means (i.e., fences, warning signs, etc.).
- The FCC and IC's limits apply cumulatively to all sources of RF emissions affecting a given site. Sites exceeding these limits are subject to an EA and must provide test reports indicating compliance.

RF Safety Guidelines and Information

Base and Repeater radio transmitters are designed to generate and radiate RF energy by means of an external antenna, typically mounted at a significant height above ground to provide adequate signal coverage. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication. The following antenna installation guidelines are extracted from Appendix A from OET Bulletin 65 and must be adhered to in order to ensure RF exposure compliance:

Non-building-mounted Antennas:

Height above ground level to lowest point of antenna ≥ 10 m or
Power ≤ 1000 W ERP (1640 W EIRP)

Building-mounted Antennas:

Power ≤ 1000 W ERP (1640 W EIRP)

The following RF Safety Guidelines should be observed when working in or around transmitter sites:

- Do not work on or around any transmitting antenna while RF power is applied.
- Before working on an antenna, disable the appropriate transmitter and ensure a "DO NOT USE" or similar sign is placed on or near the PTT or key-up control.
- Assume all antennas are active unless specifically indicated otherwise.
- Never operate a transmitter with the cover removed.
- Ensure all personnel entering a transmitter site have electromagnetic energy awareness training.

For more information on RF energy exposure and compliance, please refer to the following:

1. FCC Code of Regulations; 47 CFR 1.1307 and 1.1310.
2. FCC OET Bulletin 65, Edition 97-01, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields."
3. <http://www.fcc.gov/oet/rfsafety/>.
4. IC RSS-102 Issue 2, "Radio Frequency Exposure Compliance of Radio Communication Apparatus."

Contents

General Information	1
Introduction	1
Channel and Bank Selection.....	3
Radio Service Software Programming.....	5
Introduction	5
Radio System Configurations	7
Repeater	7
Analog Fixed (Base) Station Interface	8
Digital Fixed (Base) Station Interface	8
VHF & UHF Receivers and Transmitters	9
VHF & UHF Hardware Tuning and Troubleshooting	11
Repair Note.....	11
Recommended Test Equipment.....	12
Receiver Jumpers	13
Transmitter Jumpers	14
Front Panel RJ45 Jack Pinouts.....	14
Receiver Troubleshooting	15
Transmitter Troubleshooting	18
System Troubleshooting	20
48-Pin Motherboard Interface Connector.....	21
VHF and UHF Parts List	23
VHF / UHF Receiver Electrical Parts List.....	23
VHF / UHF Receiver Mechanical Parts List	24
VHF / UHF Receiver P25 Digital Firmware	24
VHF / UHF Receiver and Transmitter Encryption	24
VHF / UHF Receiver and Transmitter RSS.....	24
VHF / UHF Transmitter Electrical Parts List.....	25
VHF / UHF Transmitter Mechanical Parts List	25
VHF / UHF Transmitter P25 Digital Firmware	25
700 / 800 / 900 MHz Receivers and Transmitters.....	27
700 / 800 / 900 MHz Jumpers	29
Receiver Jumpers	29
Transmitter Jumpers	30

Contents continued next page

Contents (continued)

700 / 800 / 900 MHz Parts List.....	31
700 / 800 MHz Receiver Electrical Parts	31
700 / 800 MHz Receiver Mechanical Parts.....	31
700 / 800 MHz Receiver P25 Digital Firmware	32
700 / 800 / 900 MHz Receiver and Transmitter Encryption	32
700 / 800 / 900 MHz Receiver and Transmitter RSS	32
700 / 800 / 900 MHz Transmitter Electrical Parts.....	32
700 / 800 / 900 MHz Transmitter Mechanical Parts	33
700 / 800 / 900 MHz Transmitter P25 Digital Firmware	33
 Specification Data Sheets.....	 35
VHF and UHF Receiver Performance Specifications	37
380–406 MHz Receiver Performance Specifications.....	39
430–450 MHz Receiver Performance Specifications.....	41
VHF and UHF Transmitter Performance Specifications.....	43
VHF and UHF Physical Specifications	44
380–406 MHz Transmitter Performance Specifications	45
380–406 and 430–450 MHz Physical Specifications	46
700 / 800 MHz Receiver Performance Specifications.....	47
700 / 800 / 900 MHz Transmitter Performance Specifications.....	49
700 / 800 / 900 MHz Physical Specifications	50
 Glossary of Terms	 51



GENERAL INFORMATION

NOTE: The General Information and the Theory of Operation sections are common for all models of MT-4E Receivers and Transmitters. Information that is specific to individual models will be identified where relevant.

INTRODUCTION

The MT-4E Receiver and Transmitter are FM radio modules capable of analog operation in 12.5 kHz (narrow band) or 25 kHz (wide band) channels. A firmware upgrade may be purchased to allow P25 Digital operation. Modular design allows each of the receiver and transmitter's internal modules to be individually assembled and tested, which facilitates construction, tuning and general maintenance.

The MT-4E Receiver and Transmitter combine state of the art performance in a compact modular enclosure for applications ranging from remote mountain top repeaters to congested urban radio environments. Each module is characterized by dependable, low maintenance performance under the most severe environmental conditions.

The MT-4E Receiver and Transmitter are primarily software controlled radio modules, allowing tuning, programming and maintenance to be done via software service with few hardware adjustments required.

The MT-4E series is compatible with all Daniels' subrack and base station enclosures. It supports a basic analog interface and may be used in a mixed system with MT-3 and MT-4 series receivers and transmitters.

P25 Digital Mode

When the P25 firmware upgrade is purchased, the MT-4E family of receivers and transmitters may be configured for P25 Digital operation, or mixed mode operation. In a repeater configuration, the receiver passes the complete P25 Digital voice packet directly to the transmitter so no P25 Digital information is lost.

All P25 specifications, operational description and information contained in this instruction manual require the P25 firmware upgrade to function. If the MT-4E Receiver and Transmitter are purchased without the P25 firmware upgrade, the radio will program and operate in analog mode only.

NOTE: This equipment is not to be operated within the frequency band 406–406.1 MHz unless specifically authorized by the Federal Communications Commission or Industry Canada in conjunction with COSPAS / SARSAT.

Secure Communications

The receiver and transmitter are capable of decoding and encoding secure communications if a DES-OFB / AES Encryption Module is installed. To successfully decode or encode a transmission, the encryption module must be programmed with a valid encryption key using the Motorola KVL 3000 Plus Keyloader in conjunction with a Daniels Keyloader Cable. The Daniels Keyloader Cable plugs into the front panel RJ45 jack on the front of the receiver or transmitter module.

Consult Keyloader instructions for details on loading a key. A loaded key may be zeroized by pulling the CLEAR KEYS 1, then the CLEAR KEYS 2 inputs to ground 500 ms apart. Alternately, the CI-BC-4E Base Controller or Universal Interface Card (UIC) may be used to clear the keys for all modules in a system with a single key press of the switch marked ZEROIZE KEY. The CI-BC-4E Base Controller can also be used to control whether the transmitter outputs a secure or a clear signal.

Firmware Upgrades

Receiver and transmitter firmware upgrading is performed with the PC-based firmware flashing software. A USB Type A to 5-pin Mini-B cable is used to connect the USB port of an IBM-compatible computer to the USB port on the front panel of the receiver or transmitter module.

Firmware upgrades can be found on the Daniels Electronics Ltd. website at www.danelec.com.

MT-4E Receiver Family Models

Following are the models in the MT-4E Receiver family:

VR-4E150-00-000	UR-4E460-00-000
VR-4E150-A0-000	UR-4E460-A0-000
UR-4E380-00-000	UR-4E500-00-000
UR-4E420-00-000	UR-4E768-00-000
UR-4E420-A0-000	UR-4E800-00-000
UR-4E440-00-000	UR-4E850-00-000

MT-4E Transmitter Family Models

Following are the models in the MT-4E Transmitter family:

VT-4E150-00-800
UT-4E380-00-600
UT-4E450-00-800
UT-4E500-00-800
UT-4E850-00-300
UT-4E900-00-300

CHANNEL AND BANK SELECTION

Four channel select lines, CSEL 0 – CSEL 3, from the motherboard are brought into the receiver and transmitter modules by the 48-pin rear connector, allowing selection of 16 different channels. These signals are normally pulled low in the receiver and transmitter, but are typically set by jumpers on the motherboard to select Channel 1 by default. In addition, a bank select input is provided to switch between Bank A and B, each of which has 16 channels. The Bank select line normally floats high (+5 V), selecting Bank A, but may be pulled low or high externally to select Bank B.

Channel and Bank Select Line Mapping

The table below shows the relationship between the states of the bank and channel select lines. Note that the channel select lines follow a binary pattern, but that the binary “0” represents Channel 1. The Bank A/B select line normally floats high (+5 V), selecting Bank A, but may be pulled low or high externally via the Bank A/B select line.

BANK A/B	CSEL 3	CSEL 2	CSEL 1	CSEL 0	BANK SELECTED	CHANNEL SELECTED
HI	LO	LO	LO	LO	A	1
HI	LO	LO	LO	HI	A	2
HI	LO	LO	HI	LO	A	3
HI	LO	LO	HI	HI	A	4
HI	LO	HI	LO	LO	A	5
HI	LO	HI	LO	HI	A	6
HI	LO	HI	HI	LO	A	7
HI	LO	HI	HI	HI	A	8
HI	HI	LO	LO	LO	A	9
HI	HI	LO	LO	HI	A	10
HI	HI	LO	HI	LO	A	11
HI	HI	LO	HI	HI	A	12
HI	HI	HI	LO	LO	A	13
HI	HI	HI	LO	HI	A	14
HI	HI	HI	HI	LO	A	15
HI	HI	HI	HI	HI	A	16
LO	LO	LO	LO	LO	B	1
LO	LO	LO	LO	HI	B	2
LO	LO	LO	HI	LO	B	3
LO	LO	LO	HI	HI	B	4
LO	LO	HI	LO	LO	B	5
LO	LO	HI	LO	HI	B	6
LO	LO	HI	HI	LO	B	7
LO	LO	HI	HI	HI	B	8
LO	HI	LO	LO	LO	B	9
LO	HI	LO	LO	HI	B	10
LO	HI	LO	HI	LO	B	11
LO	HI	LO	HI	HI	B	12
LO	HI	HI	LO	LO	B	13
LO	HI	HI	LO	HI	B	14
LO	HI	HI	HI	LO	B	15
LO	HI	HI	HI	HI	B	16



RADIO SERVICE SOFTWARE PROGRAMMING

INTRODUCTION

NOTE: This manual contains general information about Radio Service Software (RSS). Software revisions occur regularly. For current RSS versions and instructions, refer to up-to-date help files on the Daniels Electronics website (www.danelec.com > Products > Software > Radio Service Software (RSS) > RSS Download Page). Once RSS is downloaded with either the full or demo version, click **Help** to access the help files.

Receiver and transmitter programming is performed with the PC-based RSS. A USB Type A to 5-pin Mini-B cable (included with the software) is used to connect the USB port of an IBM-compatible computer to the USB port on the front panel of the receiver or transmitter module.

The RSS allows the receiver or transmitter to be programmed for:

- operating frequencies
- CTCSS and DCS signaling
- P25 Digital settings, such as NAC and TGID
- modulation type
- many other parameters

System Recommendations:

- Microsoft Windows 2000
- Microsoft Windows XP

Recommended Minimum Specification:

- Pentium III Processor – 500 MHz
- 256 MB Memory (RAM)
- 1 GB Free Disk Space

Installation

The RSS should install automatically once the CD is inserted. If not, run SETUP.EXE, located on the CD.

NOTE: The receiver and transmitter must be programmed separately.

Once the connections are made, the RSS may be run on the computer and the radio switched on. The first time a receiver or transmitter is connected, the USB drivers will need to be installed from the CD using the Hardware Update Wizard.

To test the connection:

1. Choose the appropriate module from the Select Device drop-down list.
2. Click **Configure** on the main screen to open the Receiver or Transmitter Configuration window.
3. Click **Rx ID** (or **Tx ID**).
4. Click **Read**.

The serial number, model number, firmware version and last programmed date should appear in the appropriate fields.

RSS Programming Mode

Programming options are divided into two categories – Global Settings and Channel Settings. When the receiver or transmitter menu is selected from the main screen, both the global and channel settings for the current channel are displayed.

The RSS may be used to save a receiver or transmitter configuration to disk. This function allows the user to save a standard configuration and use it as a starting configuration for all modules. An archive of configurations from each radio system in operation may also be kept so that replacement radios can be programmed easily.

NOTE: If the MT-4E Receiver or Transmitter is purchased without the P25 Digital firmware upgrade, the P25 Digital options will not be available in the RSS.

RSS Service Mode

RSS Service Mode allows tuning, testing and setup of the receiver and transmitter modules. Analog and P25 Digital test modes, such as Bit Error Rate testing and Test Patterns generation can be selected by the RSS. Audio Levels, RF Power Output and Reference Oscillator adjustments can also be performed in RSS Service Mode.



RADIO SYSTEM CONFIGURATIONS

REPEATER

The MT-4E series receivers and transmitters may be configured in a repeater configuration. The standard way of setting up a repeater system is to connect the receiver to the transmitter through a Radio Interconnect Cable plugged into the RJ45 CNTL BUS connectors on the front panels of each radio module. This cable routes analog and digital COR / PTT signals and LVDS Serial Data from the receiver to the transmitter in both analog and P25 Digital mode. The Radio Interconnect Cable may be connected directly from the receiver to the transmitter, or may be routed through a Repeater Control Card.

A typical configuration is to set up the repeater to re-transmit an incoming signal in the same mode as it is received (i.e., normally, you would want a received analog signal to be repeated as analog and a received digital signal to be repeated as digital). This requires the receiver and transmitter modules to be programmed in Mixed Mode of operation through the RSS. The repeater may also be programmed to operate in analog or P25 Digital mode only.

Mixed Mode Repeat operation occurs as follows:

1. The receiver determines whether an incoming signal is analog or digital and asserts either the ANALOG COR or DIGITAL COR signal line on the front panel RJ45 CNTL BUS connector. LVDS Serial Data is sent to the RJ45 CNTL BUS connector as well.
2. The COR signal and LVDS Serial Data are transferred over the Radio Interconnect Cable directly to the transmitter or are routed through a Repeater Control Card.
3. The transmitter senses the incoming ANALOG PTT or DIGITAL PTT signal from the front panel RJ45 CNTL BUS connector and keys up in analog mode or P25 Digital mode. LVDS Serial Data is routed through the transmitter for transmission.

An alternate way of setting up a repeater system is to connect the receiver to the transmitter through an Audio Control Card or Base Controller. These control cards route analog audio and a single COR / PTT signal from the receiver to the transmitter. This configuration is recommended for analog repeater systems only.

The receiver and transmitter have no connection between them apart from the audio (Audio Control Card or Base Controller only), COR / PTT signals and LVDS Serial Data lines. The transmitter does not get any information from the receiver about which frequency or channel number to key up on. The receiver and transmitter channel is determined by the state of the channel select lines and bank select line.

ANALOG FIXED (BASE) STATION INTERFACE

The MT-4E series receivers and transmitters may be configured in a fixed (or base) station configuration with an analog interface. An Audio Control Card or Base Controller is added to the system for E&M control. For tone remote control of the system, a Tone Remote Adapter is added to the system along with the base controller. The audio control card or the base controller will also allow for repeat capability of the system using analog audio as the repeat path.

The base controller is used for system control of encryption and decryption of the P25 Digital voice messages. Optional decryption or encryption modules are required in the receiver and transmitter modules.

DIGITAL FIXED (BASE) STATION INTERFACE

The MT-4E series receivers and transmitters may be configured in a fixed (or base) station configuration with a digital interface. A universal interface card (UIC) is added to the system for Ethernet control.



VHF & UHF RECEIVERS AND TRANSMITTERS

The following section provides information that is primarily for VHF / UHF receiver and transmitter modules.

For specific information on 700 / 800 / 900 MHz receiver and transmitter modules, see the 700 / 800 / 900 MHz section in this manual.



VHF & UHF HARDWARE TUNING AND TROUBLESHOOTING

REPAIR NOTE

MT-4E Receivers and Transmitters employ a high percentage of surface mount components which should not be removed or replaced using an ordinary soldering iron. Removal and replacement of surface mount components should be performed only with specifically designed surface mount rework and repair stations complete with Electrostatic Discharge (ESD) protection.

When removing surface mount solder jumpers, it is recommended to use solder wick braid in place of vacuum-type de-soldering tools. This will help prevent damage to the circuit boards.

RECOMMENDED TEST EQUIPMENT

Alignment of the receiver and transmitter requires the following test equipment or its equivalent.

Power supply – Regulated +9.5 VDC at 2 A	Phillips PM 2811
Power Supply – Regulated +13.8 VDC at 2 A	Topward TPS-4000
Oscilloscope / Multimeter	Fluke 97 Scopemeter
Current Meter	Fluke 75 Multimeter
Communications Service Monitor (Analog)	Marconi Instruments 2965A or equivalent
Communications Service Monitor (P25 Digital and Analog)	IFR 2975
Alignment Tools	Daniels A-TK-04

It is recommended that the radio communications test set be frequency-locked to an external reference (WWVH, GPS, Loran C) so that the high-stability local oscillator may be accurately set.

Complete Receiver and Transmitter Alignment

A complete receiver and transmitter alignment is performed at the factory and should not be required under normal circumstances. A large change in receiver or transmitter operating frequency, as discussed in the next section, or a replacement of major receiver or transmitter sub-assembly modules, may require a complete realignment operation.

RECEIVER JUMPERS

VHF / UHF Receiver Mainboard

PCB 50164

Jumper	Default Position	Function / Description
JU1	IN	When installed enables Clear Keys 1 Input
JU2	IN	When installed enables Clear Keys 2 Input
JU3	IN	When installed enables power to Discriminator Output amplifier
JU4	OUT	RX Mode Pullup
JU5	OUT	When installed bypasses AC coupling on the Discriminator output
JU6	IN	RX Secure / Clear Pullup
JU7	OUT	When installed enables power to Disc LPF
JU8	OUT	COR Pullup
JU9	X	Balanced Audio Transformer (X: Active, Y: Bypass)
JU10	X	Balanced Audio Transformer (X: Active, Y: Bypass)
JU11	IN	When installed enables power to Balanced Audio Output Amplifier
JU12	OUT	Increase Balanced Audio Gain by 2.7 dB
JU13	OUT	Disable 600 Ω Audio Output; Enable Low Impedance Audio Output
JU14	X	Balanced Audio Transformer (X: Active, Y: Bypass)
JU15	OUT	For factory testing purposes only (power to coax for RF Preselector)
JU16	IN	Isolate IF Filter Stage
JU17	IN	For factory testing purposes only (RX Main to DSP on UDB)
JU18	IN	For factory testing purposes only (RX Main to DSP on UDB)
JU19	IN	For factory testing purposes only (RX Main to DSP on UDB)
JU20	OUT	For factory testing purposes only (RX Main to DSP on UDB)
JU21	IN	For factory testing purposes only (RX Main to DSP on UDB)
JU22	IN	For factory testing purposes only (RX Main to DSP on UDB)
JU23	IN	For factory testing purposes only (RX Main to DSP on UDB)
JU24	IN	For factory testing purposes only (supplies power to IF VREF)
JU25	X	Communications for ENCRYPT -MT4E-XX1
JU26	X	X: synchronous
JU27	X	Y: asynchronous
JU28	---	Does not exist
JU29	IN	UDB MCLR
JU30	IN	DSP GPIO5
JU31	IN	DSP GPIO6
JU32	Y	X: ENCRYPT-MT4E-XX Y: ENCRYPT-MT4E-XX1 Selects which UCM installed

TRANSMITTER JUMPERS

VHF / UHF Transmitter Mainboard

PCB 50156

Jumper	Default Position	Function / Description
JU1	X	X: A/D Front Panel Switch selects transmitter A/D mode Y: A/D External Input selects transmitter A/D mode
JU2	Y	X: MIC OUT connects to Microphone Audio Input Y: MIC IN connects to Microphone Audio input
JU3	X	X: 600 Ω Audio Transformer Y: Bypass Transformer
JU4	IN	When installed selects 600 Ω resistance to ground
JU5	OUT	When installed enables Clear Keys 1 Input*
JU6	OUT	When installed enables Clear Keys 2 Input*
JU7	X	X: 600 Ω Audio Transformer Y: Bypass Transformer
JU8	X	X: 600 Ω Audio Transformer Y: Bypass Transformer
JU9	OUT	When installed bypasses AC coupling on the Subtone / Direct Modulation input.
JU10	X	X: ENCRYPT-MT4E-XX Selects which UCM installed Y: ENCRYPT-MT4E-XX1
JU11	OUT	Changes gain for TCXO / MOD input to synthesizer
JU12	X	X: Direct MOD input Select source for the Spare input. Y: Spare
JU13	X	X: Spare Select source for the Spare input. Y: DSP Bypass
JU14	OUT	When installed disables AC coupling of direct MOD input.

*Installed only if encryption is enabled.

FRONT PANEL RJ45 JACK PINOUTS

A single, 8-position RJ45 jack is mounted on the front panel of the receiver and transmitter. The following are the connections on the RJ45 jack.

Pin	Signal
1	CRYPTO MODULE KEYLOAD
2	UNUSED SPARE
3	ANALOG COR / PTT
4	LVDS DATA A
5	LVDS DATA B
6	DIGITAL COR / PTT
7	NO CONNECTION
8	NO CONNECTION
Shield	GROUND

RECEIVER TROUBLESHOOTING

The receiver is composed of four main components; the receiver mainboard, the synthesizer module, the RF Preselector and the universal daughter board (UDB). An optional decryption module can be installed in the receiver.

The following steps will help you determine the most likely sub-assembly that contains a fault and may help you determine why the fault is occurring.

NOTE: The sub-assembly or the entire receiver can be sent back to Daniels Service section for repair. Contact Daniels Service section before returning any product.

Before testing, the receiver should be in the subrack or connected to the subrack by means of an Extender Card or kit. The main power to the system (+13.8 VDC) and the +9.5 VDC regulated supply should be checked via the front panel of the system regulator.

Testing the Receiver

1. Flip the receiver front panel ON/OFF switch from the OFF position to the NORM position.

2. Check that the two front panel LEDs both turn ON for less than five seconds and then turn OFF.

If this is not the case, the most likely fault is on the UDB, on the synthesizer, or on the receiver mainboard. Make sure that the UDB and the synthesizer module are properly seated on the receiver mainboard.

3. Connect the receiver to the PC with the USB cable and run the Radio Service Software (RSS).

4. Select [P25 or Analog] Receiver.

5. Click **Configure**.

6. Click **Read** to read the receiver configuration.

If the RSS returns "Device Not Responding," physically inspect the USB cable and connection, check the Daniels USB driver and check that the USB is recognized by the Device Manager. If the RSS still does not recognize the connection, the most likely fault is on the UDB.

7. Click **Rx ID**.

8. Click **Read** to read the Receiver ID.

Confirm that the Frequency Band in the Synthesizer ID Model Number matches the Frequency Band in the Receiver Global Settings. If the settings do not match, the synthesizer will require replacement or the programming will need to be changed to match the synthesizer hardware.

If the receiver is still not functioning properly, the module level check should be conducted in the following order.

Receiver Mainboard

Check the following test points on the receiver mainboard:

Test Point	Signal Monitored	Typical Voltage
TP1	Voltage from motherboard +13.8 VDC line	+13.8 VDC**
TP2	Regulated +9.5 VDC from motherboard	+9.5 VDC \pm 5 %
TP9	Switched +13.8 VDC line from front panel switch	+13.8 VDC**
TP37	+6.0 VDC supply	+6.0 VDC \pm 5 %
TP38	-6.0 VDC supply	-6.0 VDC \pm 5 %
TP54	+3.3 VDC supply	+3.3 VDC \pm 5 %
TP55	+1.2 VDC supply	+1.2 VDC \pm 5 %
TP56	+1.8 VDC supply	+1.8 VDC \pm 5 %
TP57	+2.5 VDC supply	+2.5 VDC \pm 5 %
TP58	+5.0 VDC supply	+5.0 VDC \pm 5 %

Test Points are shown on the VHF / UHF Receiver Jumper and Test Point Locator Illustrations.

If the test point voltages are within the specified range, the following tests further verify that the receiver mainboard may not be the source of problem.

Apply a -30 dBm IF signal of the frequency specified (see the VHF and UHF Receiver Performance Specifications data sheet) to the receiver mainboard IF Input SMB connector. If the signal is properly demodulated it proves that the receiver mainboard and UDB are in working condition. Proceed to troubleshooting the synthesizer and UDB module.

** Refer to the Specification Data Sheets (located in this manual) for the full Supply Voltage range.

Synthesizer and UDB Module

The Synthesizer Module and UDB are bound together through their communication link. At this level of fault diagnosis it is not feasible to isolate the problem between the two units.

If the receiver front panel ON/OFF switch is set from the OFF position to the NORM position and the two front panel LEDs stay on, check that the synthesizer and the UDB are properly seated on the receiver mainboard and check the following test points on the UDB. To access the UDB, the shield lid covering the UDB will need to be removed.

Test Point	Signal Monitored	Typical voltage
TP1	Ground	0 VDC
TP2	Logic power	+3.3 VDC \pm 5%
TP3	DSP core supply	+1.2 VDC \pm 5%
TP4	CPLD core supply	+1.8 VDC \pm 5%

If the UDB voltages are not within the specified tolerances, it is most likely that the receiver mainboard (which supplies these voltages to the UDB) is faulty or there is a short within the UDB.

If the UDB voltages are within the specified tolerances, inject a -70 dBm carrier on the receiver frequency into the RF input and check the RSSI meter reading in RSS Service mode. If the RSSI meter reading is low (< 30), perform the following test to verify that the synthesizer is locked on frequency:

Disconnect the LO output SMB connector from the synthesizer to the RF Preselector and connect the synthesizer LO output to a radio communication test set. Confirm that the synthesizer LO frequency matches the Target Synthesizer RF OUT found in the "Reference Oscillator" field of RSS Service mode. The LO output should be approximately +7 dBm.

The frequency of the synthesizer LO output will be above or below the receiver frequency by the IF frequency (see the VHF and UHF Receiver Performance Specifications data sheet). Check that this output is within the tolerance for the local oscillator frequency stability (see the VHF and UHF Receiver Performance Specifications data sheet). Also ensure that the RF frequency will change with programmed channel changes in the RSS.

Receiver RF Preselector

Check the +9.5 VDC power supply wire to the RF Preselector. The supply voltage should be +9.5 VDC \pm 5 %. Inject a -30 dBm carrier on the receiver frequency into the RF Input and check that the IF Output of the RF Preselector is equal to the specified IF frequency (see the VHF and UHF Receiver Performance Specifications data sheet) and the output can be demodulated through the communication test set. If this is not the case, the synthesizer or the RF Preselector, or both, are faulty.

To further isolate the fault, the LO output can be disconnected from the synthesizer and an LO input can be applied from an external source to the RF Preselector. The frequency of the external LO input should be the Target Synthesizer RF OUT found in the "Reference Oscillator" field of RSS Service mode. Check the 21.4 MHz output of the module using a communication test set.

TRANSMITTER TROUBLESHOOTING

The transmitter is composed of four main components: the transmitter mainboard, the synthesizer module, RF power amplifier and universal daughter board (UDB). An optional encryption module can also be installed in the transmitter.

The following steps will help you determine the most likely sub-assembly that contains a fault and may help you determine why the fault is occurring.

NOTE: The sub-assembly or the entire transmitter can be sent back to Daniels Service section for repair. Contact Daniels Service section before returning any product.

Before testing, the transmitter should be in the subrack or connected to the subrack by means of an extender card or kit, and the main power to the system (+13.8 VDC) and the +9.5 VDC regulated supply should be checked via the front panel of the system regulator. The transmitter RF output should be terminated with a 50 Ω load of appropriate wattage or communications test set.

Testing the Transmitter

-
1. Flip the transmitter front panel NORM/ OFF/ KEY TX switch from the OFF position to the NORM position
 2. Check that the two front panel LEDs both turn ON for less than two seconds and then turn OFF.

If this is not the case or the transmitter is not functioning properly, the following steps can be taken.

-
3. Connect the transmitter to the PC with the USB cable
 4. Run the Radio Service Software (RSS).
 5. Select [P25 or Analog] Transmitter.
 6. Click **Configure**.
 5. Click **Read** to read the transmitter configuration.

If the RSS returns "Device Not Responding," physically inspect the USB cable and connection, check the Daniels USB driver and check the connection through the Device Manager. If the RSS still does not recognize the connection, the most likely fault is on the UDB.

-
6. Click **Tx ID**.
 7. Click **Read** to read the transmitter ID.

Confirm that the frequency band in the Synthesizer ID Model Number matches the frequency band in the Transmitter Global Settings. If the settings do not match, the synthesizer will require replacement or the programming will need to be changed to match the synthesizer hardware.

If the transmitter is still not functioning properly, the module level check should be conducted in the following order.

Transmitter Mainboard

Check the following test points on the transmitter mainboard:

Test Point	Signal Monitored	Typical Voltage
TP1	Voltage from Motherboard +13.8 VDC Line	+13.8 VDC**
TP2	Regulated +9.5 VDC from Motherboard	+9.5 VDC \pm 5 %
TP3	USB Connector Power	+3.0 VDC or +5.0 VDC
TP4	Switched +13.8 VDC Line from Front Panel Switch	+13.8 VDC**

Test Points are shown on the VHF / UHF Transmitter Jumper and Test Point Locator Illustrations.

If the test point voltages are within the specified range, it is most likely that the transmitter mainboard is not the source of problem. Proceed to the following step.

Synthesizer and UDB Modules

The synthesizer module and UDB are bound together through their communication link. At this level of fault diagnosis it is not feasible to isolate the problem between two units.

If the transmitter front panel NORM/OFF/ KEY TX switch is set from the OFF position to the NORM position and the two front panel LEDs stay on, check that the synthesizer and the UDB are properly seated on the transmitter mainboard and check the following test points on the UDB. To access the UDB, the amplifier sub-assembly and the shield lid covering the UDB will need to be removed:

Test Point	Signal Monitored	Typical Voltage
TP1	Ground	0 VDC
TP2	Logic power	+3.3 VDC \pm 5 %
TP3	DSP core supply	+1.2 VDC \pm 5 %
TP4	CPLD core supply	+1.8 VDC \pm 5 %

Test Points are shown on the VHF / UHF Transmitter Jumper and Test Point Locator Illustrations.

If the UDB voltages are not within the specified tolerances, the transmitter mainboard (that supplies these voltages to the UDB) is most likely faulty. If the UDB voltages are within the specified tolerances, it is likely that the synthesizer or the UDB, or both, are faulty.

If the transmitter front panel NORM/OFF/ KEY TX switch is set from the OFF position to the NORM position; the two front panel LEDs both turn ON for less than two seconds and then turn OFF; and the RF output power control is set at its maximum in the "Power Levels" field of RSS Service mode, but the RF output power is considerably less than 8.0 W:

- Ensure that Synthesizer Reference is set to Internal in the "Jumper Settings" field of RSS Service mode.
- Ensure that the output of the synthesizer module on the RF cable is 0 dBm (\pm 2 dBm) and that the RF frequency will change with programmed channel changes in the RSS. If this is not the case, it is likely that the synthesizer or the UDB, or both, are faulty.

** Refer to the Specification Data Sheets (located in this manual) for the full Supply Voltage range.

Transmitter Amplifier

Set the front panel switch on the transmitter to KEY TX and check that the transmitter output power is approximately 0.5 to 8.0 W for VHF and UHF models.

Check the following pins on Connector J1 (while the transmitter is keyed):

Pin	Signal Monitored	Typical Voltage
1	RF Enable / Power Control (+0.5 to +3.0 VDC corresponds to 0.5 to 8.0 W RF Power Output)	+0.5 to +3.0 VDC
2	Regulated +9.5 VDC from motherboard	+9.5 VDC \pm 5%
3	Voltage from motherboard +13.8 VDC line	+13.8 VDC**

If Pin 1 is not within tolerance, the most likely fault is in the UDB or synthesizer module. If Pins 1, 2 and 3 are within the specified tolerances and there is no RF output power, the most likely fault is in the amplifier.

To test the RF power amplifier sub-assembly, set the output power to maximum using “Power Level Adjustments” in RSS Service mode, and drive the input of the amplifier with a 0 dBm RF signal. Check that the RF power output is 8.0 W when the front panel switch is set to KEY TX.

SYSTEM TROUBLESHOOTING

If the radio system is not receiving or transmitting on the right frequency, check the Channel and Bank Select lines of the receiver and transmitter modules. The motherboard has jumpers that allow one of 16 channels to be selected on a receiver or transmitter. The factory default is to have them all set to ground the channel select lines CSEL 0 through CSEL 3, forcing the radio to operate on Channel 1. On the receiver and transmitter there is also a Bank A/B line which usually floats high – selecting Bank A. The receiver and transmitter have separate control of their channel select lines, so changing receiver channels does not affect the transmitter channel.

If the Radio Service Software is failing partway through a read or write of the receiver, check that the receiver is not squelching and unsquelching repeatedly during the read or write operation. Disconnect the RF signal source from the receiver during the read or write operation.

** Refer to the Specification Data Sheets (located in this manual) for the full Supply Voltage range.

48-PIN MOTHERBOARD INTERFACE CONNECTOR

A 48-pin connector is used for interfacing the MT-4E Motherboard to the receiver and transmitter.

Receiver

Pin	Name	Pin	Name	Pin	Name
D2	Relay Normally Open 1 [O/P]	B2	+13.8 VDC [I/P]	Z2	+13.8 VDC [I/P]
D4	Relay Common 1 [O/P]	B4	Receive Secure / Clear* [O/P]	Z4	No Connect
D6	Relay Normally Closed 1 [O/P]	B6	+9.5 VDC [I/P]	Z6	+9.5 VDC [I/P]
D8	Relay Normally Closed 2 [O/P]	B8	No Connect	Z8	No Connect
D10	Relay Common 2 [O/P]	B10	Discriminator LPF [O/P]	Z10	No Connect
D12	Relay Normally Open 2 [O/P]	B12	COR* [O/P]	Z12	COR* [O/P]
D14	Clear Keys 1* [I/P]	B14	Discriminator [O/P]	Z14	Squelch Override* [I/P]
D16	Clear Keys 2* [I/P]	B16	No Connect	Z16	No Connect
D18	No Connect	B18	No Connect	Z18	Bank A/B* [I/P]
D20	Channel Select 0 (LSB) [I/P]	B20	SM-3 Speaker Audio [O/P]	Z20	No Connect
D22	Channel Select 1 [I/P]	B22	No Connect	Z22	No Connect
D24	Channel Select 2 [I/P]	B24	Signal Strength (RSSI) [O/P]	Z24	RX Mode [O/P]
D26	Channel Select 3 (MSB) [I/P]	B26	Balanced Audio 1 [O/P]	Z26	Balanced Audio 2 [O/P]
D28	No Connect	B28	Mute* [I/P]	Z28	No Connect
D30	No Connect	B30	Ground	Z30	Ground
D32	No Connect	B32	Ground	Z32	Ground

Transmitter

Pin	Name	Pin	Name	Pin	Name
D2	No Connect	B2	+13.8 VDC [I/P]	Z2	+13.8 VDC [I/P]
D4	No Connect	B4	Microphone Audio Output [O/P]	Z4	Microphone Audio Input [I/P]
D6	No Connect	B6	+9.5 VDC [I/P]	Z6	+9.5 VDC [I/P]
D8	No Connect	B8	Isolated Positive PTT [I/P]	Z8	Isolated Negative PTT [I/P]
D10	No Connect	B10	PTT* [I/P]	Z10	PTT* [I/P]
D12	No Connect	B12	Bank A/B* [I/P]	Z12	Bank A/B* [I/P]
D14	Clear Keys 1* [I/P]	B14	PTT* [I/P]	Z14	PTT* [I/P]
D16	Clear Keys 2* [I/P]	B16	No Connect	Z16	No Connect
D18	No Connect	B18	Balanced Audio 2 [I/P]	Z18	Balanced Audio 1 [I/P]
D20	Channel Select 0 (LSB) [I/P]	B20	SM-3 Speaker Audio [I/P]	Z20	No Connect
D22	Channel Select 1 [I/P]	B22	Subtone [I/P]	Z22	A*/D Mode Control [I/P]
D24	Channel Select 2 [I/P]	B24	PTT Output* [O/P]	Z24	Transmit Secure / Clear* [I/P]
D26	Channel Select 3 (MSB) [I/P]	B26	Forward Power Alarm* [O/P]	Z26	High VSWR Alarm* [O/P]
D28	No Connect	B28	No Connect	Z28	Direct Modulation
D30	No Connect	B30	Ground	Z30	Ground
D32	No Connect	B32	Ground	Z32	Ground

* Indicates an active low signal.



VHF AND UHF PARTS LIST

VHF / UHF RECEIVER ELECTRICAL PARTS LIST

Part Number	Description	Product	Qty
A11-RX4E-MAIN-01	RX MB,MT-4E 100-400MH INCL UDB	UHF and VHF	1
A11-UDB	UNIVERSAL DAUGHTER BOARD	ALL	1
A11-FE4-150	RF PRESELECTOR CLASS B,136-174	VHF CLASS B	1
A11-FE4A-150	RF PRESELECTOR CLASS A,136-174	VHF CLASS A	1
A13-FE4-380	PRESELECTOR/4E, 380-406 MHz	UHF (380-406)	1
A13-FE4-420	RF PRESELECTOR CLASS B,406-430	UHF (406-430) CLASS B	1
A13-FE4A-420	RF PRESELECTOR CLASS A,406-430	UHF (406-430) CLASS A	1
A13-FE4-440	PRESELECTOR/4E, 430-450 MHz	UHF (430-450)	1
A13-FE4-460	RF PRESELECTOR CLASS B,450-470	UHF (450-470) CLASS B	1
A13-FE4A-460	RF PRESELECTOR CLASS A,450-470	UHF (450-470) CLASS A	1
A13-FE4-500	RF PRESELECTOR CLASS B,470-520	UHF (470-520) CLASS B	1
A64-OR4-150	SYNTHESIZER, RX, VHF,136-174	VHF	1
A64-OR4-380	SYNTHESIZER, RX/4E,UHF,380-406	UHF (380-406,430-450)	1
A64-OR4-440	SYNTHESIZER, RX ,UHF,406-470	UHF (406-430,450-470)	1
A64-OR4-500	SYNTHESIZER, RX ,UHF,470-520	UHF (470-520)	1

VHF / UHF RECEIVER MECHANICAL PARTS LIST

Part Number	Description	Product	Qty
3702-62501010	CASE, 14HP RF PLUG-IN, MT-3 RX	ALL	1
3702-10000120	FASTENER, QUICK RELEASE, GRAY	ALL	4
5630-12023250	GASKET, BeCu,3FINGER,.71",CLIP	ALL	2
3702-10000614	HANDLE, FRONT PANEL, 14HP,GREY	ALL	1
3702-33160011	HOLDER, PCB/EXTRACTOR,DIE CAST	ALL	1
5671-250N062B	HOLE PLUG, .250" HOLE,NYL.,BLK	ALL	1
5783-15110977	INSULATOR,2.56" x 2.27",MYLAR	ALL	1
3536-10111405	LABEL/LEXAN, 14HP, VHF: RED	VHF	1
3536-10131410	LABEL/LEXAN,14HP,UHF/SM: BLACK	UHF	1
5814-3M0LK00S	LOCKWASHER, M3, SPLIT,A2 STEEL	ALL	4
3702-10001214	NAMEPLATE, BLANK, 14HP, ALUM.	ALL	1
5813-2M5SQ50S	NUT, M2.5, SQUARE-5mm, A2 S/S	ALL	2
3702-63001101	PANEL, REAR,POS.1,14HP EXTRSN.	ALL	1
3802-61001082	PANEL/FRONT,W/IDENT: MT-4E RX	ALL	1
5812-2M5PP12S	SCREW, M2.5 x 12 PAN/PHIL, A2	ALL	1
5812-2M5FP14S	SCREW, M2.5 x 14 FLAT/PHIL, A2	ALL	2
5812-2M5PP06S	SCREW, M2.5 X 6, PAN/PHIL., A2	ALL	4
5812-2M5VP08S	SCREW, M2.5x8,OVAL C/S/PHIL,A2	ALL	1
5812-3M0PP08T	SCREW, M3 x 8, PAN/PHIL, BLACK	ALL	4
5812-3M0VP08S	SCREW, M3 x 8,OVAL C/S/PHIL,A2	ALL	6

VHF / UHF RECEIVER P25 DIGITAL FIRMWARE

Part Number	Description	Product	Qty
APP-FIRM01-W-XX	DIGITAL UPGRADE FIRMWARE, MT-4E RX	ALL	1

VHF / UHF RECEIVER AND TRANSMITTER ENCRYPTION

Part Number	Description	Product	Qty
ENCRYPT-MT4E-XX	ENCRYPTION MODULE, MT-4E RX/TX	ALL	1

VHF / UHF RECEIVER AND TRANSMITTER RSS

Part Number	Description	Product	Qty
APP-RSS03-WC-XX	RADIO SERVICE SOFTWARE, MT-4E	ALL	1

VHF / UHF TRANSMITTER ELECTRICAL PARTS LIST

Part Number	Description	Product	Qty
A21-TX4E-MAIN-01	TX, MB ASSY, MT-4E, INCL UDB	ALL	1
A11-UDB	UNIVERSAL DAUGHTER BOARD	ALL	1
A21-VPA155-08	TX POWER AMP, VHF130-180 MHz	VHF	1
A23-UPA450-08	TX POWER AMP, UHF 380-512 MHz	UHF	1
A64-OT4-150	SYNTHESIZER, TX, VHF,136-174	VHF	1
A64-OT4-380	SYNTHESIZER, TX/4E,UHF,380-406	UHF (380-406)	1
A64-OT4-440	SYNTHESIZER, TX, UHF,406-470	UHF (406-470)	1
A64-OT4-500	SYNTHESIZER, TX, UHF,470-520	UHF (470-520)	1

VHF / UHF TRANSMITTER MECHANICAL PARTS LIST

Part Number	Description	Product	Qty
A89-MIC4-08	CABLE/CONN ASSY,MICROPHONE CON	ALL	1
7910-WP0WP011	CABLE,SMB PLUG-PLUG,RG316,11cm	ALL	1
3702-62502010	CASE, 14HP RF PLUG-IN, MT-3 TX	ALL	1
3702-10000120	FASTENER, QUICK RELEASE, GRAY	ALL	4
5630-12023250	GASKET, BeCu,3FINGER,.71",CLIP	ALL	2
3702-10000614	HANDLE, FRONT PANEL, 14HP,GREY	ALL	1
5671-250N062B	HOLE PLUG, .250" HOLE,NYL.,BLK	ALL	1
5783-15110977	INSULATOR,2.56" x 2.27",MYLAR	ALL	1
3536-10111405	LABEL/LEXAN, 14HP, VHF: RED	VHF	1
3536-10131410	LABEL/LEXAN,14HP,UHF/SM: BLACK	UHF	1
5814-3M0LK00S	LOCKWASHER, M3, SPLIT,A2 STEEL	ALL	4
3702-10001214	NAMEPLATE, BLANK, 14HP, ALUM.	ALL	1
5813-2M5SQ50S	NUT, M2.5, SQUARE-5mm, A2 S/S	ALL	2
3702-63002101	PANEL, REAR,POS.4,14HP EXTRSN.	ALL	1
3802-61002121	PANEL/FRONT, W/IDENT: MT-4E TX	ALL	1
5812-2M5PP12S	SCREW, M2.5 x 12 PAN/PHIL, A2	ALL	2
5812-2M5FP14S	SCREW, M2.5 x 14 FLAT/PHIL, A2	ALL	2
5812-2M5PP06S	SCREW, M2.5 X 6, PAN/PHIL., A2	ALL	4
5812-3M0PP06S	SCREW, M3 X 6, PAN/PHILLIPS,A2	ALL	2
5812-3M0PP08T	SCREW, M3 x 8, PAN/PHIL, BLACK	ALL	4
5812-3M0VP08S	SCREW, M3 x 8,OVAL C/S/PHIL,A2	ALL	6
5812-5M0FP08S	SCREW, M5 x 8, FLAT/PHIL., A2	ALL	4

VHF / UHF TRANSMITTER P25 DIGITAL FIRMWARE

Part Number	Description	Product	Qty
APP-FIRM02-W-XX	DIGITAL UPGRADE FIRMWARE, MT-4E TX	ALL	1



700 / 800 / 900 MHZ RECEIVERS AND TRANSMITTERS

The following section provides information that is primarily for 700 / 800 / 900 MHz receiver and transmitter modules.

For specific information on VHF and UHF receiver and transmitter modules, see the VHF and UHF section.



700 / 800 / 900 MHZ JUMPERS

RECEIVER JUMPERS

700 / 800 MHz Receiver Mainboard

PCB 50171

Jumper	Default Position	Function / Description
JU1	OUT	Enable Clear Keys 1
JU2	OUT	Enable Clear Keys 2
JU3	IN	Enable Power to Discriminator Circuit
JU4	OUT	Enable Pullup Resistor on RX_Mode
JU5	OUT	Bypass 330 nF Audio Cap
JU6	IN	Enable Pullup Resistor on RX_Sec / Clr
JU7	OUT	Enable Power to Discriminator LPF Circuit
JU8	OUT	Enable Pullup Resistor on COR
JU9	X	Balanced Audio Transformer (X=Active, Y=Bypass)
JU10	X	Balanced Audio Transformer (X=Active, Y=Bypass)
JU11	IN	Enable Power to Balanced Audio Amplifier
JU12	OUT	Increase Balanced Audio Gain by 2.7 dB
JU13	OUT	Disable 600 Ω Audio Output; Enable Low Impedance Audio Output
JU14	X	Balanced Audio Transformer (X=Active, Y=Bypass)
JU15	X	X: Synchronous Y: Asynchronous
JU16	X	X: Synchronous Y: Asynchronous
JU17	X	X: Synchronous Y: Asynchronous
JU18	IN	Synthesizer Programming
JU19	IN	Synthesizer Programming
JU20	IN	Synthesizer Programming
JU21	IN	Enable 3.3 V Power to IF VREF
JU22	IN	For factory testing purposes only (Isolate XTAL filter stage from circuit)

700 / 800 MHz Receiver Mainboard Jumpers (continued)

JU23	IN	Jumper for D&D Testing (Disconnect SSI Data Line)
JU24	IN	Jumper for D&D Testing (Disconnect SSI Data Line)
JU25	IN	Jumper for D&D Testing (Disconnect SSI Data Line)
JU26	OUT	Jumper for D&D Testing (Disconnect SPI Data Line)
JU27	IN	Jumper for D&D Testing (Disconnect SPI Data Line)
JU28	IN	Jumper for D&D Testing (Disconnect SPI Data Line)
JU29	IN	Jumper for D&D Testing (Disconnect SPI Data Line)
JU30	Y	X: ENCRYPT-MT4E-XX Selects which UCM installed Y: ENCRYPT-MT4E-XX1

TRANSMITTER JUMPERS

700 / 800 / 900 MHz Transmitter Mainboard

PCB 50156

Jumper	Default Position	Function / Description
JU1	X	X: A/D Front Panel Switch selects transmitter A/D mode Y: A/D External Input selects transmitter A/D mode
JU2	Y	X: MIC OUT connects to Microphone Audio Input Y: MIC IN connects to Microphone Audio input
JU3	X	X: 600 Ω Audio Transformer Y: Bypass Transformer
JU4	IN	When installed selects 600 Ω resistance to ground
JU5	OUT	When installed enables Clear Keys 1 Input
JU6	OUT	When installed enables Clear Keys 2 Input
JU7	X	X: 600 Ω Audio Transformer Y: Bypass Transformer
JU8	X	X: 600 Ω Audio Transformer Y: Bypass Transformer
JU9	OUT	When installed bypasses AC coupling on the Subtone / Direct Modulation input.
JU10	X	X: ENCRYPT-MT4E-XX Selects which UCM installed Y: ENCRYPT-MT4E-XX1
JU11	OUT	Changes gain for TCXO / MOD input to synthesizer
JU12	X	X: Direct MOD input Select source for the Spare input. Y: Spare
JU13	X	X: Spare Select source for the Spare input. Y: DSP Bypass
JU14	OUT	When installed disables AC coupling of direct MOD input.

*Installed only if encryption is enabled.



700 / 800 / 900 MHZ PARTS LIST

700 / 800 MHZ RECEIVER ELECTRICAL PARTS

Part Number	Description	Qty
A14-RX4E-MAIN-01	RX,MB,MT-4E 700-900MH INCL UDB	1
A11-UDB	UNIVERSAL DAUGHTER BOARD	1
A14-FE4-770	PRESELECTOR/4E,CLASS B,768-776	1
A15-FE4-800	PRESELECTOR/UR-4E, 799-824 MHz	1
A15-FE4-850	PRESELECTOR/UR-4E, 851-869 MHz	1
A64-OR4-800	SYNTHESIZER, RX/4E,UHF,764-960	1

700 / 800 MHZ RECEIVER MECHANICAL PARTS

Part Number	Description	Qty
3702-62501010	CASE, 14HP RF PLUG-IN, MT-3 RX	1
3702-10000120	FASTENER, QUICK RELEASE, GRAY	4
5630-12023250	GASKET, BeCu,3FINGER,.71",CLIP	2
3702-10000614	HANDLE, FRONT PANEL, 14HP,GREY	1
3702-33160011	HOLDER, PCB/EXTRACTOR,DIE CAST	1
5671-250N062B	HOLE PLUG, .250" HOLE,NYL.,BLK	1
5783-15110977	INSULATOR,2.56" x 2.27",MYLAR	1
3536-10151405	LABEL/LEXAN, 14HP, UHF: BLUE	1
5814-3M0LK00S	LOCKWASHER, M3, SPLIT,A2 STEEL	4
3702-10001214	NAMEPLATE, BLANK, 14HP, ALUM.	1
5813-2M5SQ50S	NUT, M2.5, SQUARE-5mm, A2 S/S	2
5833-T2M55615	NUT, PRESS,M2.5,5.6mmOD,PC MNT	2
3702-63001101	PANEL, REAR,POS.1,14HP EXTRSN.	1
3802-61001082	PANEL/FRONT,W/IDENT: MT-4E RX	1
5812-2M0PP06S	SCREW, M2 X 6, PAN/PHILLIPS,A2	4
5812-2M5PP12S	SCREW, M2.5 x 12 PAN/PHIL, A2	1
5812-2M5FP14S	SCREW, M2.5 x 14 FLAT/PHIL, A2	2

700 / 800 MHz Receiver Mechanical Parts (continued)

Part Number	Description	Qty
5812-2M5PP06S	SCREW, M2.5 X 6, PAN/PHIL., A2	4
5812-2M5VP08S	SCREW, M2.5x8, OVAL C/S/PHIL, A2	1
5812-3M0PP08T	SCREW, M3 x 8, PAN/PHIL, BLACK	4
5812-3M0VP08S	SCREW, M3 x 8, OVAL C/S/PHIL, A2	6
5917-7B4BM30T	STANDOFF, 7/32OD, 1/4L, M3, SWAGE	2
5927-5SF25T	STANDOFF, 5.5mm OD, 4.5mm L, M2.5	3

700 / 800 MHz RECEIVER P25 DIGITAL FIRMWARE

Part Number	Description	Product	Qty
APP-FIRM01-W-XX	DIGITAL UPGRADE FIRMWARE, MT-4E RX	ALL	1

700 / 800 / 900 MHz RECEIVER AND TRANSMITTER ENCRYPTION

Part Number	Description	Product	Qty
ENCRYPT-MT4E-XX	ENCRYPTION MODULE, MT-4E RX/TX	ALL	1

700 / 800 / 900 MHz RECEIVER AND TRANSMITTER RSS

Part Number	Description	Product	Qty
APP-RSS03-WC-XX	RADIO SERVICE SOFTWARE, MT-4E	ALL	1

700 / 800 / 900 MHz TRANSMITTER ELECTRICAL PARTS

Part Number	Description	Qty
A21-TX4E-MAIN-01	TX, MB ASSY, MT-4E, INCL UDB	1
A11-UDB	UNIVERSAL DAUGHTER BOARD	1
A25-UPA835-03	POWER AMP, TX, 3W, 768-869 MHz	1
A64-OT4-800	SYNTHESIZER, TX/4E, UHF, 760-960	1

700 / 800 / 900 MHZ TRANSMITTER MECHANICAL PARTS

Part Number	Description	Qty
A89-MIC4-08	CABLE/CONN ASSY,MICROPHONE CON	1
7910-WP0WP011	CABLE,SMB PLUG-PLUG,RG316,11cm	1
3702-62502010	CASE, 14HP RF PLUG-IN, MT-3 TX	1
3702-10000120	FASTENER, QUICK RELEASE, GRAY	4
5630-12023250	GASKET, BeCu,3FINGER,,71",CLIP	2
3702-10000614	HANDLE, FRONT PANEL, 14HP,GREY	1
5671-250N062B	HOLE PLUG, .250" HOLE,NYL.,BLK	1
5783-15110977	INSULATOR,2.56" x 2.27",MYLAR	1
3536-10151405	LABEL/LEXAN, 14HP, UHF: BLUE	1
5814-3M0LK00S	LOCKWASHER, M3, SPLIT,A2 STEEL	4
3702-10001214	NAMEPLATE, BLANK, 14HP, ALUM.	1
5813-2M5SQ50S	NUT, M2.5, SQUARE-5mm, A2 S/S	2
3702-63002101	PANEL, REAR,POS.4,14HP EXTRSN.	1
3802-61002121	PANEL/FRONT, W/IDENT: MT-4E TX	1
3702-64202050	PLATE ASSEMBLY, 8W AMP, ALUM.	1
5812-2M5PP12S	SCREW, M2.5 x 12 PAN/PHIL, A2	2
5812-2M5FP14S	SCREW, M2.5 x 14 FLAT/PHIL, A2	2
5812-2M5PP06S	SCREW, M2.5 X 6, PAN/PHIL., A2	4
5812-3M0FP06S	SCREW, M3 X 6, FLAT/PHIL., A2	2
5812-3M0PP06S	SCREW, M3 X 6, PAN/PHILLIPS,A2	2
5812-3M0PP06S	SCREW, M3 X 6, PAN/PHILLIPS,A2	5
5812-3M0PP08T	SCREW, M3 x 8, PAN/PHIL, BLACK	4
5812-3M0VP08S	SCREW, M3 x 8,OVAL C/S/PHIL,A2	6
5812-5M0FP08S	SCREW, M5 x 8, FLAT/PHIL., A2	4

700 / 800 / 900 MHZ TRANSMITTER
P25 DIGITAL FIRMWARE

Part Number	Description	Product	Qty
APP-FIRM02-W-XX	DIGITAL UPGRADE FIRMWARE, MT-4E TX	ALL	1



SPECIFICATION DATA SHEETS

This section contains detailed specifications for RF modules within the scope of this manual.

To verify performance and set-up test procedures, please refer to these data sheets when performing technical operations on the equipment.

VHF AND UHF RECEIVER PERFORMANCE SPECIFICATIONS

NOTE: 380–406 MHz and 430–450 MHz Receiver specifications are not included in these VHF / UHF receiver specifications; see the separate 380–406 MHz and 430–450 MHz receiver specifications following.

General

Frequency Range:	136–174 MHz (VHF) / 406–430 MHz, 450–470 MHz, 470–520 MHz (UHF)
Channel Spacing:	12.5, 15, 25 and 30 kHz
Channel Selection:	VHF: 2.5 kHz, 5.0 kHz and 6.25 kHz UHF: 6.25 kHz
Number of Channels:	Preset capability for 2 banks of 16 channels
Channel Switching Range:	± 2.0 MHz
Compatibility:	MT-3 and MT-4 Series Radio Systems; P25 interoperable*
System Impedance:	50 Ω (Type-N connector)
Frequency Generation:	Internal Synthesizer
Reference Sensitivity:	≤ -118 dBm (0.28uV) for 12 dB SINAD / ≤ -118 dBm (0.28uV) for 5% BER*
Local Oscillator Frequency Stability:	± 1.0 ppm (VHF) / ± 0.5 ppm (UHF)
Adjacent Channel Rejection (Selectivity):	Class A: ≥ 45 dB; Narrow band Analog ≥ 75 dB; Wide band Analog ≥ 60 dB; Digital* Class B: ≥ 40 dB; Narrow band Analog ≥ 70 dB; Wide band Analog ≥ 60 dB; Digital*
Intermodulation Rejection:	Class A: ≥ 75 dB; Narrow band and Wide band Analog ≥ 80 dB; Digital* Class B: ≥ 70 dB; Narrow band and Wide band Analog ≥ 70 dB; Digital*
Spurious Response Rejection:	Class A: ≥ 75 dB; Narrow band Analog ≥ 85 dB; Wide band Analog ≥ 90 dB; Digital* Class B: ≥ 70 dB; Narrow band and Wide band Analog ≥ 70 dB; Digital*
Conducted Spurious Output Power:	≤ -95 dBm
Hum and Noise Ratio:	≥ 31 dB; Narrow band Analog ≥ 37 dB; Wide band Analog

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

VHF and UHF Receiver Performance Specifications (continued)

Audio Output:	600 Ω balanced line output (configurable for unbalanced line); De-emphasis or Flat output, +3 dBm maximum level
Audio Distortion:	Analog: $\leq 2.0\%$ (25°C); $\leq 3.0\%$ (-30°C to +60°C) Digital as per TIA / EIA 102.CAAB*
Front Panel Controls:	Receiver Power On (Norm) / Off Squelch Disable (Push button) Analog and Digital Receive LED indicators
COR Interface:	150 mA, 50V open drain power MOSFET
Supply Voltage:	+13.8 VDC Nominal (range +10 to +17 VDC) † +9.5 VDC Regulated
Supply Current:	Class A: < 250 mA; with no encryption module installed < 280 mA; with encryption module installed Class B: < 115 mA; with no encryption module installed < 145 mA; with encryption module installed
Operating Temperature Range:	-30°C to +60°C
Operating Humidity:	95% RH (non-condensing) at +25°C
CTCSS Decode:	Programmable to any of 42 CTCSS tones
DCS Decode:	Programmable to any of 83 DCS sequences. Normal or inverted DCS can be selected.
IC Certification No.:	142A-VR4E150A (VHF Class A) 142A-UR4E420A (UHF Low band Class A) 142A-UR4E460A (UHF High band Class A) 142A-VR4E150 (VHF Class B) 142A-UR4E420 (UHF Low band Class B) 142A-UR4E460 (UHF High band Class B) 142A-UR4E500 (UHF T-Band Class B)
FCC ID:	n/a – Declaration of Conformity (DOC)

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

380–406 MHZ RECEIVER

PERFORMANCE SPECIFICATIONS

General

Frequency Range:	380–406 MHz
Channel Spacing:	12.5, 15, 25 and 30 kHz
Channel Selection:	6.25 kHz
Number of Channels:	Preset capability for 2 banks of 16 channels
Channel Switching Range:	± 2.0 MHz
Compatibility:	MT-3 and MT-4 Series Radio Systems; P25 interoperable*
System Impedance:	50 Ω (Type-N connector)
Frequency Generation:	Internal Synthesizer
Reference Sensitivity:	≤ -116 dBm (0.35uV) for 12 dB SINAD ≤ -116 dBm (0.35uV) for 5% BER
Local Oscillator Frequency Stability:	± 0.5 ppm
Adjacent Channel Rejection (Selectivity):	≥ 45 dB; Narrow Band Analog ≥ 75 dB; Wide Band Analog ≥ 60 dB; Digital*
Intermodulation Rejection:	≥ 75 dB; Narrow Band and Wide Band Analog ≥ 80 dB; Digital*
Spurious Response Rejection:	≥ 75 dB; Narrow Band and Wide Band Analog ≥ 90 dB; Digital*
Conducted Spurious Output Power:	≤ -95 dBm
Hum and Noise Ratio:	≥ 34 dB; Narrow Band Analog ≥ 40 dB; Wide Band Analog
Audio Output:	600 Ω balanced line output (configurable for unbalanced line); De-emphasis or Flat output, +3 dBm maximum level
Audio Distortion:	Analog: ≤ 2.0% (25°C); ≤ 3.0% (-30°C to +60°C) Digital as per TIA / EIA 102.CAAB*
Front Panel Controls:	Receiver Power On (Norm) / Off Squelch Disable (Push button) Analog and Digital Receive LED indicators
COR Interface:	150 mA, 50V open drain power MOSFET
Supply Voltage:	+13.8 VDC Nominal (range +10 to +17 VDC) † +9.5 VDC Regulated
Supply Current:	< 270 mA; with no encryption module installed < 300 mA; with encryption module installed
Operating Temperature Range:	-30°C to +60°C
Operating Humidity:	95% RH (non-condensing) at +25°C
CTCSS Decode:	Programmable to any of 42 CTCSS tones
DCS Decode:	Programmable to any of 83 DCS sequences. Normal or inverted DCS can be selected.
IC Certification No.:	n/a
FCC ID:	n/a

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

† For GSA BPA Contract: GSC-TFMG-BPA-09-002 the following specifications apply:
Supply Voltage range: +10 to +18 VDC

430–450 MHZ RECEIVER PERFORMANCE SPECIFICATIONS

General

Frequency Range:	430–450 MHz
Channel Spacing:	12.5, 15, 25 and 30 kHz
Channel Selection:	6.25 kHz
Number of Channels:	Preset capability for 2 banks of 16 channels
Channel Switching Range:	± 2.0 MHz
Compatibility:	MT-3 and MT-4 Series Radio Systems; P25 interoperable*
System Impedance:	50 Ω (Type-N connector)
Frequency Generation:	Internal Synthesizer
Reference Sensitivity:	≤ -116 dBm (0.35uV) for 12 dB SINAD ≤ -116 dBm (0.35uV) for 5% BER
Local Oscillator Frequency Stability:	± 0.5 ppm
Adjacent Channel Rejection (Selectivity):	≥ 45 dB; Narrow Band Analog ≥ 75 dB; Wide Band Analog ≥ 60 dB; Digital*
Intermodulation Rejection:	≥ 75 dB; Narrow Band and Wide Band Analog ≥ 80 dB; Digital*
Spurious Response Rejection:	≥ 75 dB; Narrow Band and Wide Band Analog ≥ 90 dB; Digital*
Conducted Spurious Output Power:	≤ -95 dBm
Hum and Noise Ratio:	≥ 34 dB; Narrow Band Analog ≥ 40 dB; Wide Band Analog
Audio Output:	600 Ω balanced line output (configurable for unbalanced line); De-emphasis or Flat output, +3 dBm maximum level
Audio Distortion:	Analog: ≤ 2.0% (25°C); ≤ 3.0% (-30°C to +60°C) Digital as per TIA / EIA 102.CAAB*
Front Panel Controls:	Receiver Power On (Norm) / Off Squelch Disable (Push button) Analog and Digital Receive LED indicators
COR Interface:	150 mA, 50V open drain power MOSFET
Supply Voltage:	+13.8 VDC Nominal (range +10 to +17 VDC) † +9.5 VDC Regulated
Supply Current:	< 270 mA; with no encryption module installed < 300 mA; with encryption module installed
Operating Temperature Range:	-30°C to +60°C
Operating Humidity:	95% RH (non-condensing) at +25°C
CTCSS Decode:	Programmable to any of 42 CTCSS tones
DCS Decode:	Programmable to any of 83 DCS sequences. Normal or inverted DCS can be selected.
IC Certification No.:	n/a
FCC ID:	n/a - Declaration of Conformity (DOC)

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

† For GSA BPA Contract: GSC-TFMG-BPA-09-002 the following specifications apply:
Supply Voltage range: +10 to +18 VDC

VHF AND UHF TRANSMITTER PERFORMANCE SPECIFICATIONS

NOTE: 380–406 MHz Transmitter specifications are not included in these VHF / UHF transmitter specifications; see the separate 380–406 MHz transmitter specifications following.

General

Frequency Range:	136–174 MHz, 406–470 MHz, 470–520 MHz
Carrier Frequency Stability:	± 1.0 ppm (VHF) / ± 0.5 ppm (UHF)
Channel Spacing:	12.5, 15, 25 and 30 kHz
Channel Selection:	VHF: 2.5 kHz, 5.0 kHz and 6.25 kHz UHF: 6.25 kHz
Number of Channels:	Preset capability for 2 banks of 16 channels
Compatibility:	MT-3 and MT-4 Series Radio Systems; P25 interoperable*
RF Output Power:	0.5 to 8.0W Continuous
Emission Designators:	Analog: 11K0F3E (Narrow band); 16K0F3E (Wide band) Digital Paging: 9K2F1D P25 Digital: 8K10F1E (Digital Voice); 8K10F1D (Digital Data)*
System Impedance:	50 Ω; Type-N connector
Duty Cycle:	100%; Continuous operation
Undesired Emissions: (Adjacent Channel Power Ratio)	< -70 dBc, Analog < -70 dBc, Digital*
Undesired Emissions: (Conducted Spurious)	< -70 dBc @ 8.0 W RF Output
Intermodulation Attenuation:	≥ 45 dB Analog ≥ 45 dB Digital*
VSWR Protection:	< 20:1 VSWR at all phase angles
Operating Temperature Range:	-30°C to +60°C
Operating Humidity:	95% RH (non-condensing) at +25°C
Operating Voltage:	+13.8 VDC Nominal (range +10 to +17 VDC) † +9.5 VDC Regulated
Transmit Current:	< 1.7A @ 2.0 W RF Output < 2.8A @ 8.0 W RF Output
Stand By Current:	<50 mA (no encryption installed) <80 mA (with encryption modules installed)
Front Panel Controls:	Transmitter Power On (Norm) / Off / Key Tx Mic Mode: Analog / Digital Analog and Digital Transmit LED indicators
PTT Time-Out-Timer:	Programmable from 15 to 465 sec. (in increments of 15 sec., ± 5 sec.) or infinity (default 300 sec.) using Radio Service Software.
Audio Input:	600 Ω balanced or unbalanced input (600 Ω or 15k Ω selectable input impedance)
Audio Frequency Response:	Pre-emphasis; +1, -3 dB (300 to 3000 Hz)

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

† For GSA BPA Contract: GSC-TFMG-BPA-09-002 the following specifications apply:
Supply Voltage range: +10 to +18 VDC

VHF and UHF Transmitter Performance Specifications (continued)

Audio Deviation Limiting:	± 2.5 kHz Narrow band, ± 5.0 kHz Wide band
Audio Distortion:	< 3% THD; 1 kHz tone at 1.5 kHz or 3 kHz deviation
FM Hum and Noise Ratio:	≥ 40 dB (0.3 to 3.4 kHz De-emphasis off)
CTCSS Decode / Encode:	Programmable to any of 42 CTCSS tones.
DCS Decode / Encode:	Programmable to any of 83 DCS sequences. Normal or inverted DCS can be selected. Turn-Off code optional.
IC Certification No.:	142A-VT4E150 (VHF) 142A-UT4E450 (UHF 406–470 MHz only)
FCC ID:	H4JVT-4E150 (VHF) H4JUT-4E450 (UHF)

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

VHF AND UHF PHYSICAL SPECIFICATIONS

Physical Dimensions:	Width: 7.1 cm (2.8 in)	Height: 12.8 cm (5.05 in)	Depth: 19 cm (7.5 in)
Module Weight:	Receiver: 1.2 kg (2.5 lbs.) Transmitter: 1.4 kg (3.0 lbs.)		
Corrosion Prevention:	<ul style="list-style-type: none"> • Anodized aluminum construction • Stainless steel hardware • Gold-plated module connectors 		
Module Design:	<ul style="list-style-type: none"> • Compact Eurostandard modular design • Plug-in modules mate with the Daniels standard MT-4E repeater subrack • Subracks / modules comply with IEEE 1101, DIN 41494 and IEC 297-3 (mechanical size / modular arrangement) 		
External Connections:	RF Connection: Type-N connector located on the module front panel. Digital I/O interface is made via RJ45 modular jack located on the front panel. Programming interface is made via Mini-B USB 1.1 jack located on the front panel. Motherboard connections (Audio, Power, and Control) are made through a 48-pin, gold-plated, Type-F connector on the rear of the module. User connection made through mated motherboard assembly of the radio subrack. Type-F connector complies with DIN 41612 Level 2 (200 mating cycles, 4-day 10 ppm SO ₂ gas test with no functional impairment and no change in contact resistance).		
Handle Text Colour:	Red (VHF) / Black (UHF)		

380–406 MHZ TRANSMITTER PERFORMANCE SPECIFICATIONS

General

Frequency Range:	380–406 MHz
Carrier Frequency Stability:	± 0.5 ppm
Channel Spacing:	12.5, 15, 25 and 30 kHz
Channel Selection:	6.25 kHz
Number of Channels:	Preset capability for 2 banks of 16 channels
Compatibility:	MT-3 and MT-4 Series Radio Systems; P25 interoperable*
RF Output Power:	0.5 to 6.0W Continuous
Emission Designators:	n/a
System Impedance:	50 Ω; Type-N connector
Duty Cycle:	100%; Continuous operation
Undesired Emissions: (Adjacent Channel Power Ratio)	< -70 dBc, Wide Band Analog < -60 dBc Narrow Band Analog < -67 dBc, Digital*
Undesired Emissions: (Conducted Spurious)	< -70 dBc @ 6.0W RF Output
Intermodulation Attenuation:	≥ 40 dB Analog ≥ 40 dB Digital*
VSWR Protection:	< 20:1 VSWR at all phase angles
Operating Temperature Range:	-30°C to +60°C
Operating Humidity:	95% RH (non-condensing) at +25°C
Operating Voltage:	+13.8 VDC Nominal (range +10 to +17 VDC) † +9.5 VDC Regulated
Transmit Current:	< 1.7A @ 2.0W RF Output < 2.8A @ 6.0W RF Output
Stand By Current:	<50 mA (no encryption installed) <80 mA (with encryption modules installed)
Front Panel Controls:	Transmitter Power On (Norm) / Off / Key Tx Mic Mode: Analog / Digital Analog and Digital Transmit LED indicators
PTT Time-Out-Timer:	Programmable from 15 to 465 sec. (in increments of 15 sec., ± 5 sec.) or infinity (default 300 sec.) using Radio Service Software.
Audio Input:	600 Ω balanced or unbalanced input (600 Ω or 15k Ω selectable input impedance)
Audio Frequency Response:	Pre-emphasis; +1, -3 dB (300 to 3000 Hz)
Audio Deviation Limiting:	± 2.5 kHz Narrow band, ± 5.0 kHz Wide band
Audio Distortion:	< 2% THD; 1 kHz tone at 1.5 kHz or 3 kHz deviation
FM Hum and Noise Ratio:	≥ 40 dB Wide Band Analog (0.3 to 3.4 kHz De-emphasis off) ≥ 34 dB Narrow Band Analog (0.3 to 3.4 kHz De-emphasis off)
CTCSS Decode / Encode:	Programmable to any of 42 CTCSS tones.

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

380–406 MHz Transmitter Performance Specifications (continued)

DCS Decode / Encode:	Programmable to any of 83 DCS sequences. Normal or inverted DCS can be selected. Turn-Off code optional.
IC Certification No.:	n/a
FCC ID:	n/a

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

380–406 AND 430–450 MHZ PHYSICAL SPECIFICATIONS

Physical Dimensions:	Width: 7.1 cm (2.8 in)	Height: 12.8 cm (5.05 in)	Depth: 19 cm (7.5 in)
Module Weight:	Receiver: 1.2 kg (2.5 lbs.) Transmitter: 1.4 kg (3.0 lbs.)		
Corrosion Prevention:	<ul style="list-style-type: none"> • Anodized aluminum construction • Stainless steel hardware • Gold-plated module connectors 		
Module Design:	<ul style="list-style-type: none"> • Compact Eurostandard modular design • Plug-in modules mate with the Daniels standard MT-4E repeater subrack • Subracks / modules comply with IEEE 1101, DIN 41494 and IEC 297-3 (mechanical size / modular arrangement) 		
External Connections:	RF Connection: Type-N connector located on the module front panel. Digital I/O interface is made via RJ45 modular jack located on the front panel. Programming interface is made via Mini-B USB 1.1 jack located on the front panel. Motherboard connections (Audio, Power, and Control) are made through a 48-pin, gold-plated, Type-F connector on the rear of the module. User connection made through mated motherboard assembly of the radio subrack. Type-F connector complies with DIN 41612 Level 2 (200 mating cycles, 4-day 10 ppm SO ₂ gas test with no functional impairment and no change in contact resistance).		
Handle Text Colour:	Black		

700 / 800 MHZ RECEIVER PERFORMANCE SPECIFICATIONS

General

Frequency Range:	768–776 MHz, 798–824 MHz, 851–869 MHz
Channel Spacing:	12.5 and 25 kHz
Channel Selection:	6.25 kHz
Number of Channels:	Preset capability for 2 banks of 16 channels
Channel Switching Range:	unlimited
Compatibility:	MT-3 and MT-4 Series Radio Systems; P25 interoperable*
System Impedance:	50 Ω (Type-N connector)
Frequency Generation:	Internal Synthesizer
IF Frequency	73.35 MHz
Reference Sensitivity:	≤ -116 dBm (0.35 μ V) for 12 dB SINAD ≤ -116 dBm (0.35 μ V) for 5 % BER*
Local Oscillator Frequency Stability:	± 0.15 ppm
Adjacent Channel Rejection (Selectivity): Class B:	≥ 40 dB; Narrow Band Analog ≥ 70 dB; Wide Band Analog ≥ 60 dB; Digital*
Intermodulation Rejection:	Class B: ≥ 70 dB; Narrow Band and Wide Band Analog ≥ 70 dB; Digital*
Spurious Response Rejection:	Class B: ≥ 70 dB; Narrow Band and Wide Band Analog ≥ 70 dB; Digital*
Conducted Spurious Output Power:	≥ 80 dBm
Hum and Noise Ratio:	≥ 31 dB; Narrow Band Analog ≥ 37 dB; Wide Band Analog
Audio Output:	600 Ω balanced line output (configurable for unbalanced line); De-emphasis or Flat output, +3 dBm maximum level
Audio Distortion:	$\leq 3.0\%$ (25°C); $\leq 5.0\%$ (-30°C to +60°C)
Front Panel Controls:	Receiver Power On (Norm) / Off Squelch Disable (Push button) Analog and Digital Receive LED indicators
COR Interface:	150 mA, 50 V open drain power MOSFET
Supply Voltage:	+13.8 VDC Nominal (range +10 to +17 VDC) † +9.5 VDC Regulated
Supply Current:	Class B: < 200 mA
Operating Temperature Range:	-30°C to +60°C
Operating Humidity:	95% RH (non-condensing) at +25°C
CTCSS Decode:	Programmable to any of 42 CTCSS tones

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

† For GSA BPA Contract: GSC-TFMG-BPA-09-002 the following specifications apply:
Supply Voltage range: +10 to +18 VDC

700 / 800 MHz Receiver Performance Specifications (continued)

DCS Decode:	Programmable to any of 83 DCS sequences. Normal or inverted DCS can be selected.
IC Certification No.:	142A-UR4E768 142A-UR4E800 142A-UR4E850
FCC ID:	n/a – Declaration of Conformity (DOC)

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

700 / 800 / 900 MHZ TRANSMITTER PERFORMANCE SPECIFICATIONS

General

Frequency Range:	768–869 MHz, 896–960 MHz
Carrier Frequency Stability:	± 0.1 ppm
Channel Spacing:	12.5 and 25 kHz
Channel Selection:	6.25 kHz
Number of Channels:	Preset capability for 2 banks of 16 channels
Compatibility:	MT-3 and MT-4 Series Radio Systems; P25 interoperable*
RF Output Power:	0.5 to 3.0W Continuous
Emission Designators:	Analog: 11K0F3E (Narrow Band); 16K0F3E (Wide Band) Digital Paging: 9K2F1D P25 Digital: 8K10F1E (Digital Voice); 8K10F1D (Digital Data)*
System Impedance:	50 Ω; Type-N connector
Duty Cycle:	100%; Continuous operation
Undesired Emissions: (Adjacent Channel Power Ratio)	< -50 dBc, Narrow Band < -60 dBc, Wide Band < -67 dBc, Digital*
Undesired Emissions: (Conducted Spurious)	< -80 dBc @ 3.0 W RF Output
VSWR Protection:	< 20:1 VSWR at all phase angles
Operating Temperature Range:	-30°C to +60°C
Operating Humidity:	95% RH (non-condensing) at +25°C
Operating Voltage:	+13.8 VDC Nominal (range +10 to +17 VDC) † +9.5 VDC Regulated
Transmit Current:	< 1.8A @ 3.0W RF Output
Stand By Current:	< 115 mA (no encryption modules installed) < 145 mA (with encryption modules installed)
Front Panel Controls:	Transmitter Power On (Norm) / Off / Key Tx Mic Mode: Analog / Digital Analog and Digital Transmit LED indicators
PTT Time-Out-Timer:	Programmable from 15 to 465 sec. (in increments of 15 sec., ± 5 sec.) or infinity (default 300 sec.) using Radio Service Software.
Audio Input:	600 Ω balanced or unbalanced input (600 Ω or 15 k Ω selectable input impedance)
Audio Frequency Response:	Pre-emphasis; +1, -3 dB (300 to 3000 Hz)
Audio Deviation Limiting:	± 2.5 kHz Narrow band, ± 5.0 kHz Wide band
Audio Distortion:	< 3% THD; 1 kHz tone at 1.5 kHz or 3 kHz deviation
FM Hum and Noise Ratio:	≥ 31 dB; Narrow Band Analog ≥ 37 dB; Wide Band Analog
CTCSS Decode / Encode:	Programmable to any of 42 CTCSS tones.

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

† For GSA BPA Contract: GSC-TFMG-BPA-09-002 the following specifications apply:
Supply Voltage range: +10 to +18 VDC

700 / 800 / 900 MHz Transmitter Performance Specifications (continued)

DCS Decode / Encode:	Programmable to any of 83 DCS sequences. Normal or inverted DCS can be selected. Turn-Off code optional.
IC Certification No.:	142A-UT4E850 (768–869 MHz) 142A-UT4E900 (896–960 MHz)
FCC ID:	H4JUT-4E850 (768-869 MHz) H4JUT-4E900 (896–960 MHz)

* P25 Digital specifications are applicable only for modules with the P25 Digital firmware upgrade.

700 / 800 / 900 MHz PHYSICAL SPECIFICATIONS

Physical Dimensions:	Width: 7.1 cm (2.8 in)	Height: 12.8 cm (5.05 in)	Depth: 19 cm (7.5 in)
Module Weight:	Receiver: 1.2 kg (2.5 lbs.) Transmitter: 1.4 kg (3.0 lbs.)		
Corrosion Prevention:	<ul style="list-style-type: none"> • Anodized aluminum construction • Stainless steel hardware • Gold-plated module connectors 		
Module Design:	<ul style="list-style-type: none"> • Compact Eurostandard modular design • Plug-in modules mate with the Daniels standard MT-4E repeater subrack • Subracks / modules comply with IEEE 1101, DIN 41494 and IEC 297-3 (mechanical size / modular arrangement) 		
External Connections:	RF Connection: Type-N connector located on the module front panel. Digital I/O interface is made via RJ45 modular jack located on the front panel. Programming interface is made via Mini-B USB 1.1 jack located on the front panel. Motherboard connections (Audio, Power and Control) are made through a 48-pin, gold-plated, Type-F connector on the rear of the module. User connection is made through mated motherboard assembly of the radio subrack. Type-F connector complies with DIN 41612 Level 2 (200 mating cycles, 4-day 10 ppm SO ₂ gas test with no functional impairment and no change in contact resistance).		
Handle Text Colour:	Blue (768–869 MHz, 896–960 MHz)		



GLOSSARY OF TERMS

Bandwidth

The difference between the limiting frequencies of a continuous frequency band. Typically measured in kilohertz. May be considered the amount in kilohertz required for a single communications channel.

BER

BIT Error Rate.

BPS

BITs Per Second – a data rate measure.

C4FM

Constant Envelope 4-Level Frequency Modulation – an FM transmitter which uses Quadrature Phase Shift Keying (QPSK) modulation to work with a compatible frequency discriminator detection (CFDD) receiver.

Channel

A single unidirectional or bidirectional path for transmitting or receiving, or both, of electrical or electromagnetic signals.

Channel Spacing

Typically measured in kilohertz from the center of one channel to the center of the next-adjacent channel. May, or may not, be identical to bandwidth.

Common Air Interface (CAI)

A radio-to-radio signal path defined in terms of Access Method, Modulation Scheme, Vocoding Method, Channel Data Rate and Channel Data Format.

CTCSS

Abbreviation for “Continuous Tone-Controlled Squelch System.”

DCS

Digital Coded Squelch.

DSP

Digital Signal Processor – a specialized microprocessor.

DTMF

Dual-Tone Multi-Frequency – a signaling scheme used by the telephone system in which two voice band tones are generated for each keypad key press.

Encryption

A coding of plain text (or clear voice) into unintelligible forms for secure transmission.

Error Correction

Digital coding technique for detecting and correcting information transmission errors.

FCC

Federal Communications Commission.

Firmware

Software that is permanently stored in a hardware device, and allows reading and executing, but not writing or modifying the software.

I/O

Input / Output

ISO

International Standards Organization

LSB

Least Significant BIT.

Modulation

A controlled variation of any property of a carrier wave for the purpose of transferring information.

MSB

Most Significant BIT.

NAC

Network Access Code. A 12-bit field identifying the network of the radio message. Typically used to steer repeater functions.

PTT

Push-to-Talk – the switch on a subscriber unit which, when pressed, causes the subscriber unit to transmit.

QPSK

Quadrature Phase Shift Keying – modulation technique. PSK using four-phase states.

RF

Radio Frequency.

Signal

The detectable transmitted energy which carries information from a transmitter to a receiver.

SINAD

Signal-plus-Noise-and-Distortion to noise-and-distortion ratio.

Squelch

A radio circuit that eliminates noise from the speaker when no transmitted signal is present.

Subscriber Unit

A mobile or portable radio unit used in a radio system.

TGID

Talk Group Identifier. A 16-bit field identifying the talk group of the radio message.

TIA

Telecommunications Industry Association.

Time-Out Timer

A function that limits the transmission period to a pre-defined time. The user will automatically stop transmitting when the timer goes off after the pre-defined time.

Trunked (System)

Systems with full-feature sets in which all aspects of radio operation—including RF channel selection and access—are centrally managed.

UCM

Universal Cryptographic Module

UDB

Universal Daughter Board

VOCODER (Voice-Coder)

A type of voice coder. Usually consisting of a speech analyzer and a speech synthesizer which convert analog speech into digital signals for transmission and digital signals back into artificial speech sounds for reception.
