TECHNISONIC
Communications

# YOU DESIGN IT. WE BUILD IT.

## THE NEW P25 PHASE II COMPLIANT TDFM-9100


# TDFM-9100

**Multi-Band P25 PHASE II**
**Airborne FM Communications**

# TDFM-9100

## Multi-Band P25 PHASE II
## Airborne FM Communications

**The TDFM-9100 is the next evolution of the highly successful TDFM-6000 series.**

Newly designed and featuring both Project 25 Phase I and Phase II technology. The TDFM-9100 is specifically designed to meet the growing capabilities demanded by Airborne Law Enforcement and EMS operators across the country. Developed around a new two-module configuration, the 9100 can be configured to support the full P25 FM band spectrum, VHF, UHF-Lo, UHF-Hi and 7/800 MHz using available dual band modules. Fully customizable, the 9100 is the latest addition to the already successful Technisonic 9000 series product line.

### Key Features

- Each radio can be individually configured to support one or two, single or dual band, modules.
- Module supports Conventional Analog, Conventional P25 and optional Phase I (FDMA) and Phase II (TDMA) technologies for Trunked operation.
- Single Band or simultaneous Multi-Band
- Operation from multiple locations in aircraft (RC9100)
- Displays all active channels simultaneously
- Cross Band Repeat, Relay and Simulcast
- Programming via Motorola CPS software program
- Encryption with OTAR and or Multi-Key (optional)
- Supports SmartNet, SMARTZONE and P25 Trunking (optional)


*The TDFM-9100 is designed to meet the demands of Airborne Law Enforcement and EMS operators.*

- P25 capable Bandwidths VHF, UHF-Lo, UHF-Hi and 700/800 MHz Bands
- Supports P25 Digital/Analog Operation in Conventional or Trunked Modes
- Front Panel Connector for Module Programming via USB and Encryption Key loading
- Optional Encryption Protocols AES, DES, DES-XL, DES-OFB. ADP encryption is standard in all modules
- Each module supports 3000 channels/200 zones and can be programmed to operate in either a digital or analog mode on a channel by channel basis.
- Each module supports scan across its entire frequency spectrum even if dual band configured
- Built in audio switching allows RF modules to operate in either a single or combined transceiver configuration

MORE CAPABLE. LESS COST.

**New Customer Inquiries**
Jim Huddock
Minneapolis, MN
612.231.9020

**Corporate Headquarters**
240 Traders BLVD.
Mississauga, ON Canada L4Z 1W7
905.890.2113

# TDFM-9100

## MULTIBAND P25 AIRBORNE TRANSCEIVER


# Installation Instructions

**TiL Document No. 13RE483**
**Rev. A**

**NOVEMBER 2014**


**Technisonic Industries Limited**
**240 Traders Boulevard, Mississauga, Ontario L4Z 1W7**
**Tel: (905) 890-2113 Fax: (905) 890-5338**
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| REVISION HISTORY<br>[ 13RE483 ] | | | | |
|---|---|---|---|---|
| REV | SECTION<br>- PAGE - | DESCRIPTION | DATE | EDITED<br>BY |
| A | front | Added CI-295-300 antenna | 16/10/14 | SM |
| | | | | |

## NOTES

### ESD CAUTION

This unit contains static sensitive devices. Wear a grounded wrist strap and/or conductive gloves when handling printed circuit boards.

### FCC COMPLIANCE INFORMATION

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

**WARNING:** For compliance with FCC RF Exposure Requirements the mobile transmitter antenna installation shall comply with the following two conditions:

1. The transmitter antenna gain shall not exceed 3 dBi.
2. The transmitter antenna is required to be located outside of a vehicle and kept at a separation distance of 70 cm or more between the transmitter antenna of this device and persons during operation.

**NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his/her own expense.

### WARNING AND DISCLAIMER

Changes or modifications not expressly approved by Technisonic Industries could void the user's authority to operate the equipment.

This manual is designed to provide information about the TDFM-9100. Every effort has been made to make this manual as complete and accurate as possible.

### WARRANTY INFORMATION

The Model TDFM-9100 Transceiver is under warranty for one year from date of purchase. Failed units caused by defective parts, or workmanship should be returned to:

Technisonic Industries Limited
240 Traders Boulevard
Mississauga, Ontario L4Z 1W7

Tel: (905) 890-2113
Fax: (905) 890-5338

## SUMMARY OF DO-160G ENVIRONMENTAL TESTING

Summary of DO-160G Environmental Testing for Technisonic Model TDFM-9100 Transceiver:

| Conditions | Category |
|---|---|
| Temperature and Altitude | A2, B1, C4, D1 |
| Temperature Variation | B |
| Humidity | A |
| Operational shock and Crash Safety | A |
| Vibration | S, U |
| Magnetic Effect | Z |
| Power Input | B |
| Voltage Spike | B |
| Audio Frequency Susceptibility | B |
| Induced Signal Susceptibility | AC |
| Radio Frequency Susceptibility | T |
| Radio Frequency Emission | M |
| Electrostatic Discharge | A |

For more detailed information, see appendix A.

## INSTALLATION APPROVAL NOTE

Presently, no TSO standard exists for airborne FM transceivers. To make it easier for installation agencies to provide their customers with an approved installation supported by an effective Airworthiness Approval, Technisonic has secured Supplemental Type Certificate (STC) Approvals on its Airborne FM products for a limited number of airframes. The above referenced DO-160G test data is also on file and available from Technisonic to support approval requirements in airframes for which Technisonic does not possess an STC.

Approved aircraft types are listed in the attachments to the formal STC documents. These STCs are the exclusive property of Technisonic and require the written authority of Technisonic for their use. Letters of permissin are provided upon request. To assist Factory Authorized Technisonic Dealers in the certification process, we have placed copies of our STCs on our web site. These documents may be downloaded and used as support for the technical submission to FAA or Transport Canada. Only authorized factory dealers/installers are permitted to download and make use of these documents on behalf of their customers (end users) in support of regulatory agency approval. Please refer to the Technisonic web site www.til.ca for the latest issue of available STCs.

### Trademark Notices

TDFM-9100 Transceivers contain two-way radio protocols licensed from Motorola, Inc.

Motorola KVL 3000+® is a registered trademark of Motorola.

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# SECTION 1 - GENERAL DESCRIPTION

## 1.1 INTRODUCTION

This publication provides operating information on the TDFM-9100 airborne transceiver. The exact configuration depends on which and how many RF modules are installed.

## 1.2 DESCRIPTION

The TDFM-9100 transceiver is an airborne multi-band radio capable of operation in conventional, analog and P25 digital FM systems, SmartNet/SmartZone trunking systems and P25 9600 trunking systems. RF modules are available in single or dual bands that support VHF, UHF-LO, UHF-HI and 700-800 MHz bands. 1 or 2 single or dual band modules can be supported.

These optional additional features include P25 9600 trunking Phase 1 and 2 that may be combined with AES and/or DES-OFB encryption with OTAR in any of the available modules.

The TDFM-9100 is not normally frequency agile. In order to have the ability to change the frequencies at the front panel.

## 1.3 MODEL VARIATION

There are several variations of the Model TDFM-9100 Transceiver. Each variation offers different features and performance based on the type of RF modules and options installed.

The following is a breakdown of the TDFM-9100 model variations:

P/N 121270-D-91-TBB-P91XXX

(PRODUCT TYPE)-(D)-(91)-(Tray 1)-(Project)

PRODUCT TYPE: 121270 = TDFM-9100 series, 1 tray, 1 – 2 modules

D= Display type:

1) Standard Green LED
2) Night Vision Green LED

91 = TDFM-9100

Tray Breakdown: (TBB):

T = Module type: Always A in the TDFM-9100 for APX type modules

B = Band code for each module in the tray:

Band Codes

| | |
|---|---|
| 1 | VHF (136-174) |
| 2 | UHF LO (380-470) |
| 3 | UHF HI (450–520) |
| 4 | 700/800 (764-870) |
| A | VHF / 700 / 800 |
| B | VHF/ UHF LO |
| C | VHF / UHF HI |
| D | UHF LO / UHF HI |
| E | UHF LO / 700 / 800 |
| F | UHF HI / 700 / 800 |
| G* | 700 / 800 / VHF |
| H* | 700 / 800 / UHF LO |
| I* | 700 / 800 / UHF HI |

**Notes:** There is only one tray in the TDFM-9100. If only one module is supplied in the tray the second B digit will be a 0 in (TBB).
Module types C, D, E and G will only be available if OEM agreements can be made for their use.
Standard Band Codes will indicate dual band module order as shown in Band Codes A through F.

* Band codes with dual band module order as shown in G, H and I are only available by special order. The basic premise is that the lowest frequency range will always be specified first. This is to keep code plugs similar to Motorola convention and assure wide compatibility.

Project Number: P91XXX represents a 5 digit project number that identifies specific options that are contained in each module and describes the full TDFM-9100 configuration.

All model variations are capable of supporting both 28 Volt and 5 Volt AC or DC back lighting. The units are shipped set to operate on 28 Volt back lighting. Equipment can be set to operate on 5V back lighting by using the software based configuration menu. See Section 2.17 configuration menu. (Damage will not occur if the incorrect voltage is applied.)

## 1.4 TECHNICAL CHARACTERISTICS

| Specification | Characteristic |
|---|---|
| Model Designation: | TDFM-9100 |
| Physical Dimensions: | Approx. (L) 8.0" x (W) 5.75" x (H) 3.0" |
| Weight: | ~3.5 Lbs (1.6 Kg) |
| Operating Temperature Range: | -30° C to +60° C |
| Power Requirement: | |
| Voltage: | 28.0 VDC ± 15% |
| Current: | 500 mA minimum / 5A maximum |
| Audio Output Power (including sidetone): | 65 mW into 600 Ω |
| Microphone Inputs: | Carbon or Equivalent |
| Panel Back Lighting: | |
| Voltage: | 28 or 5 Volts AC or DC (selectable) |
| Current: | 61 mA max |

**RF Modules**

| Specification | Characteristic |
|---|---|
| RF Output Power: | 1 or 6 Watts (VHF)<br>1 or 5 Watts (UHF)<br>1 or 3 Watts (700/800) |
| Frequency Range | |
| VHF Band: | 136 to 174 MHz |
| UHF LO Band: | 380 to 470 MHz |
| UHF HI Band: | 450 to 520 MHz |
| 700 / 800 bands: | 764 to 870 MHz |
| No. of channels per band: | 2000 pre-programmable channels |

| **Transmitter section** | **VHF** | **UHF** | **800** |
|---|---|---|---|
| FM Hum and noise in dB (wideband): | -48 | -45 | -45 |
| Audio Distortion: | 1% | 1.0% | 1.0% |
| Frequency Stability in ppm: | ±1.0 | ±1.0 | ±1.5 |
| Modulation Limiting: | Wide band | | ±5kHz |
| | Narrow band | | ±2.5kHz |

| **Receiver section** | **VHF** | **UHF** | **800** |
|---|---|---|---|
| *Sensitivity* in uV: | | | |
| *Digital 1% BER (12.5kHz) | 0.29 | 0.32 | 0.40 |
| *Digital 5% BER (12.5kHz) | 0.21 | 0.28 | 0.30 |
| **Analog with 12dB SINAD | 0.25 | 0.25 | 0.25 |
| *Selectivity* in dB: | | | |
| 25 kHz Channel | -80 | -78 | -72 |
| 12.5 kHz Channel | -70 | -68 | -67 |
| Intermodulation * ** | -80 | -80 | -80 |

*Measured in digital mode per TIA / EIA IS 102.CAAA under nominal conditions.
** Measured in analog mode per TIA / EIA 603 under nominal conditions.

# SECTION 2 – INSTALLATION INSTRUCTIONS

## 2.1 GENERAL

This section contains information and instructions for the correct installation of the TDFM-9100 Transceiver.

## 2.2 EQUIPMENT PACKING LOG

Unpack the equipment and check for any damage that may have occurred during transit. Save the original shipping container for returns due to damage or warranty claims. Check that each item on the packing slip has been shipped in the container.

## 2.3 INSTALLATION

The TDFM-9100 Transceiver is designed to be Dzus mounted and should be installed in conjunction with an IN-9100 installation kit. See Figure 2.1 for an outline drawing of the unit with dimensions to facilitate the installation.

## 2.4 INSTALLATION KIT - CONTENTS

The IN-9100 installation kit (P/N 139463-1) consists of:

1. One 25 pin Cannon D mating connector (female) complete with crimp pins and hood.
2. 2 BNC connectors (male).

## 2.5 ANTENNA INSTALLATION

The type and number of antennas depends on the model of transceiver being installed. See a complete list in figure 2.7.
The antenna should be mounted on the bottom of the aircraft whenever possible. Consult with instructions provided with the antenna. Connect the RF cables to the back of the transceiver using the MALE BNC connectors provided in the installation kit. It is possible to use equivalent 50 ohm aviation antennas that cover the appropriate bandwidths. Also see section 2.21 Antenna Selection and Installation Considerations.

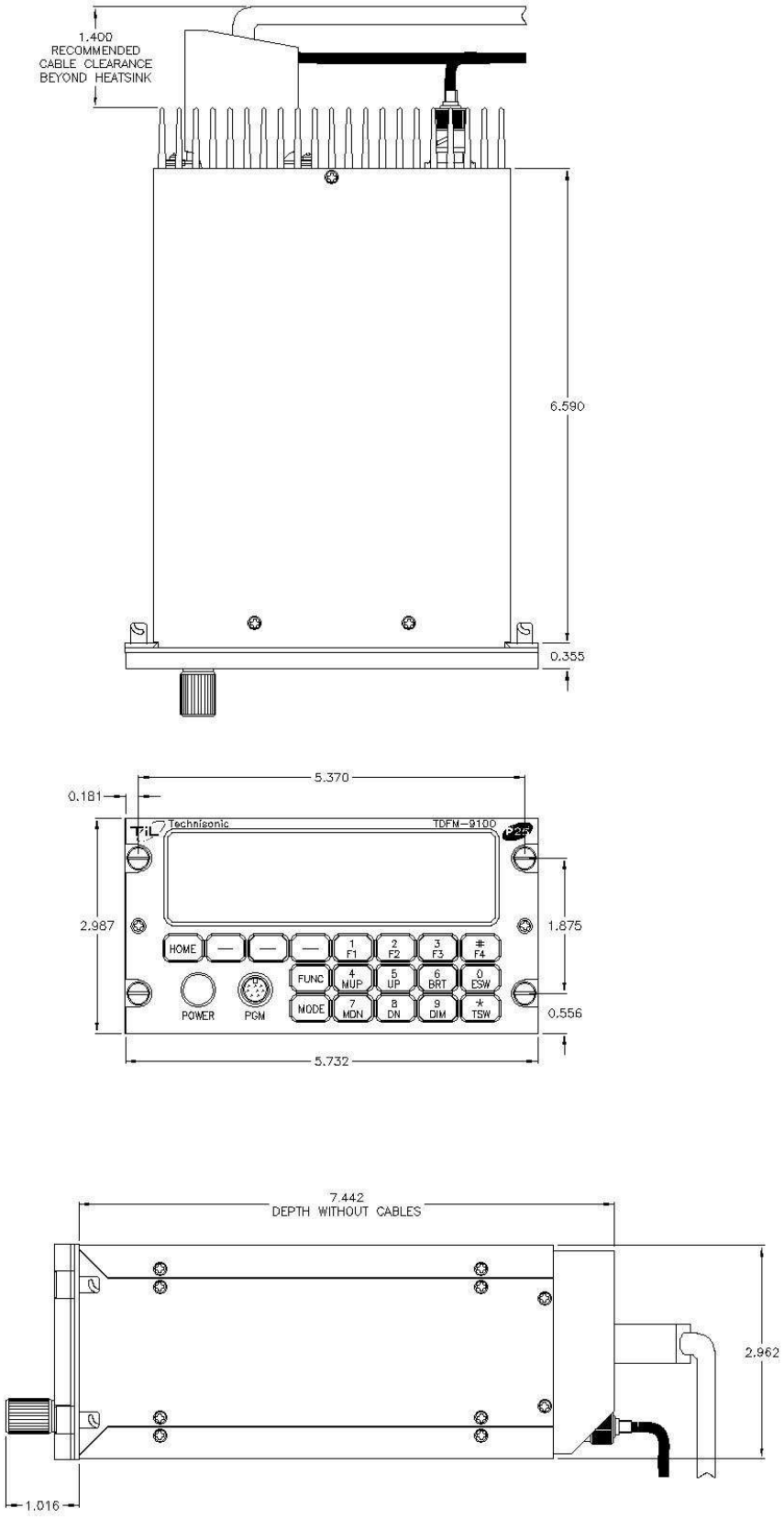


**FIGURE 2.1** Outline Drawing for Model TDFM-9100

## 2.6 INSTALLATION - PIN LOCATIONS AND CONNECTIONS

| J1 (25 Pin D Connections) - Use FEMALE Connector | |
|---|---|
| **Pin #** | **Description** |
| 1 | Ground |
| 2 | Main Power +28 VDC |
| 3 | Mic 1 |
| 4 | Audio 1 |
| 5 | PTT 1 |
| 6 | Mic 2 |
| 7 | Audio 2 |
| 8 | PTT 2 |
| 9 | Mic Combined |
| 10 | Audio Combined |
| 11 | PTT Combined |
| 12 | TX Data |
| 13 | RX Data |
| 14 | Ground |
| 15 | Main Power +28 VDC |
| 16 | Up |
| 17 | Down |
| 18 | Channel / Band |
| 19 | No Connection |
| 20 | No Connection |
| 21 | No Connection |
| 22 | No Connection |
| 23 | No Connection |
| 24 | No Connection |
| 25 | Panel Backlighting |

**TABLE 2.1** J1 (25 pin D) connections

## 2.7 INSTALLATION - WIRING INSTRUCTIONS

Figure 2-2(a, b and c) show all required connections and recommended wire sizes for the TDFM-9100 transceiver. There are receive audio, mic audio and PTT lines for each band as well as a set of lines combining both bands. The TDFM-9100 can be wired such that band selection can be made on the audio panel. Two positions need to be available on the audio panel. Otherwise the TDFM-9100 can be wired into one position of the audio panel where band selection and audio monitoring is done on the TDFM-9100 front panel. An installation can be wired in a combination of both methods as all inputs and outputs are always active.

## 2.8 MAIN GROUND – J1 PINS 1 AND 14

Both pins should be connected to power ground. These pins are internally connected to the chassis.

## 2.9 MAIN POWER + 28VDC – J1 PINS 2 AND 15

Both pins should be connected to +28 volts DC +/- 15%.

## 2.10 MIC 1 AND 2 – J1 PINS 3 AND 6

The microphone input signals shall be connected using shielded wire with the shield connected to ground (pin 1 or 14). It is recommended for best results to leave the other end of the shield floating to prevent ground currents unless you are connecting to an audio panel with floating hi and lo inputs (like the Technisonic A710, A711, A711L or TDAP-711) in which case the shield must be connected to the lo input. These are individual inputs for each band.

## 2.11 MIC COMBINED – J1 PIN 9

The combined mic inputs should be wired and shielded as the individual mic inputs above. This mic input can be used for either band. Band selection is made at the TDFM-9100 front panel.

## 2.12 AUDIO 1 AND 2 – J1 PINS 4 and 7

These are individual audio outputs from each band. All outputs are 600 ohms impedance. The output power is 600 mW maximum. Unused outputs do not have to be terminated and should be left unconnected. These outputs are also found on J5 along with their respective grounds such that a separate wire bundle can be run with only audio outputs, further reducing the possibility of cross talk.

## 2.13 AUDIO COMBINED – J1 PIN 10

This is combined audio output from either or both bands as selected from the front panel. The specifications are the same as the individual outputs above.

## 2.14 PTT 1 AND 2 – J1 PINS 5 AND 8

Individual PTT lines for each band. These lines should be floating when in receive and grounded for transmit. The input has a pull up resistor to 5 volts. Connecting an audio panel that wishes to see more, may result in no receive audio. Connect a 1N4006 diode in series with the cathode towards the audio panel in this case.

## 2.15 PTT COMBINED – J1 PIN 11

The combined PTT input to either or both bands as selected from the front panel. The specifications are the same as the individual inputs above.

## 2.16 TX DATA AND RX DATA – J1 PINS 12 AND 13

These pins provide RS-232 serial communications for use with the RC-9100 remote control head if installed. Consult the RC-9100 installation manual for details.

## 2.17 UP AND DOWN – J1 PINS 16 AND 17

These pins can be used to scroll up and down through the bands or channels for the band currently selected depending on the band input below. The inputs normally floating are grounded to activate. Two push buttons or a center off, SPDT, spring loaded toggle switch are typically used on these inputs.

## 2.18 CHANNEL/BAND – J1 pin 18

The Channel / Band input determines the function of the up down inputs above. If left unconnected, the up/down inputs are for channel selection. If grounded, the input is for band selection.

## 2.19 PANEL BACKLIGHTING – J1 PIN 25

Connect to aircraft panel dimming bus. The transceiver is capable of supporting 28 VAC/DC or 5 VAC/DC backlighting circuits. Select 28 volts or 5 volts via the configuration menu (see section 2.17). No damage will occur if the wrong setting is selected.

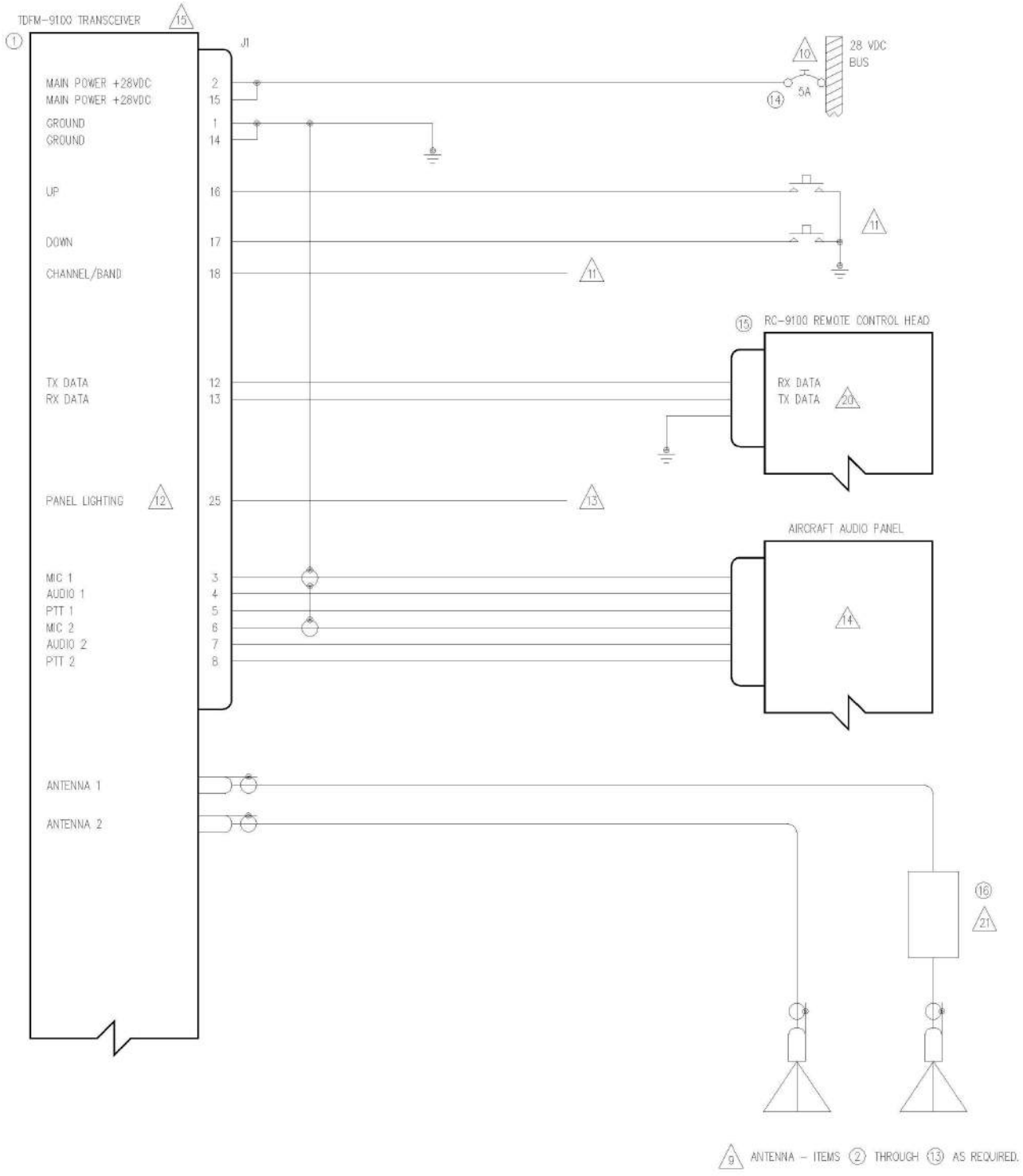


**FIGURE 2.3** Wiring connections for separate band control.

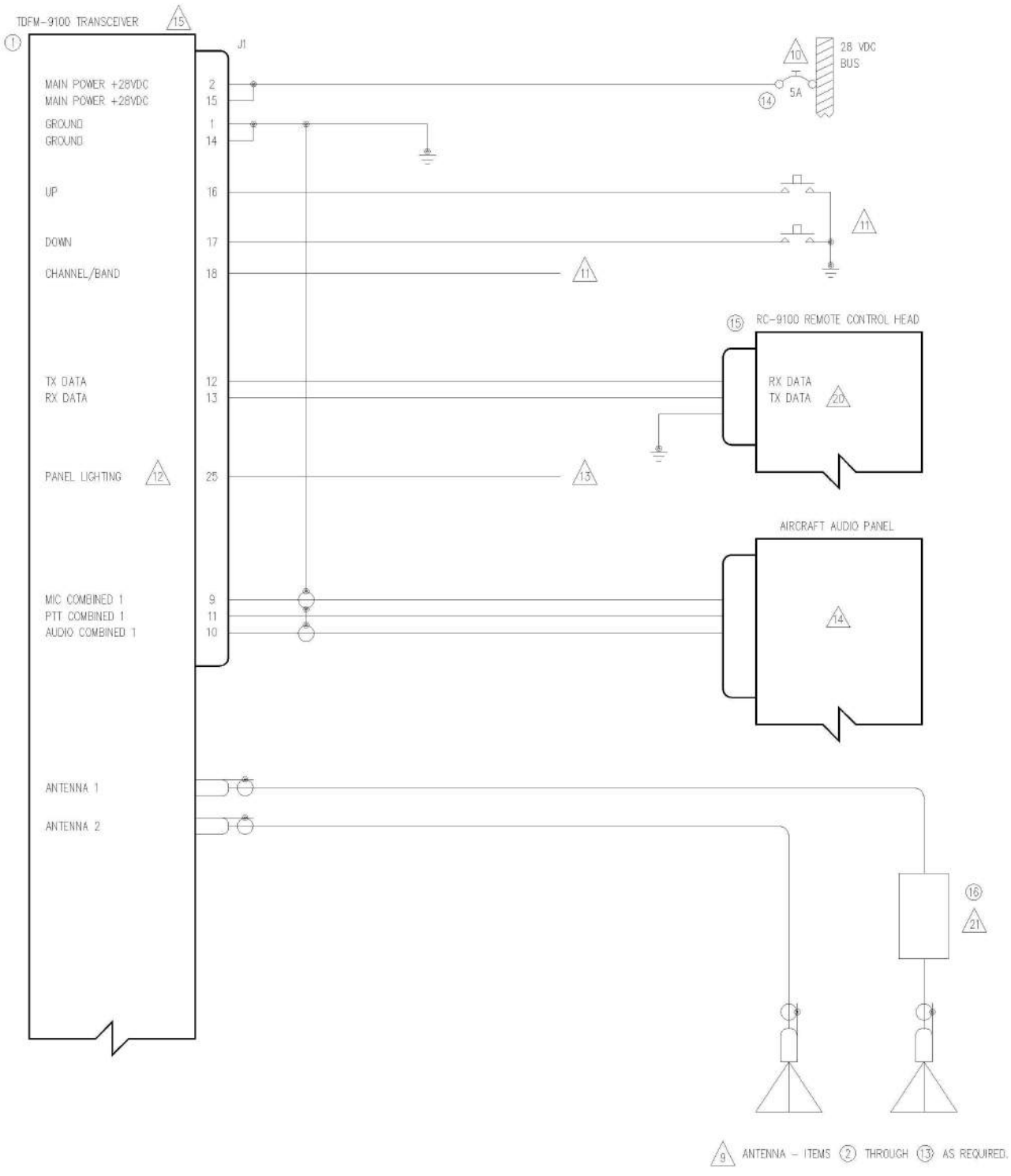


**FIGURE 2.5** Wiring connections for Combined band control.

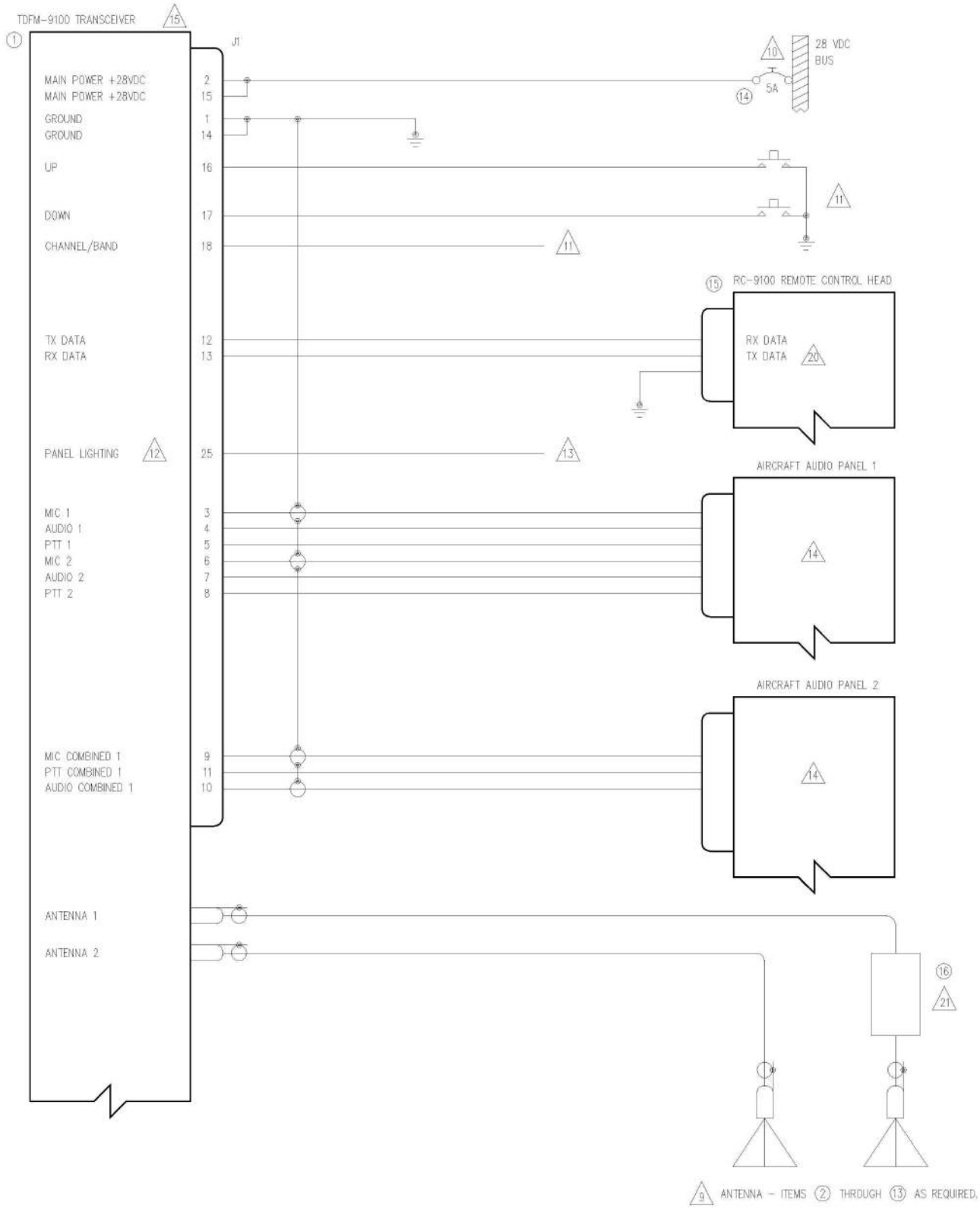


**FIGURE 2.6** Wiring connections for Separate and Combined band control.

| QTY | ITEM | PART NUMBER | DESCRIPTION | MANUFACTURER | MATERIAL |
|---|---|---|---|---|---|
| 1 | 1 | TDFM-9100 | MULTIBAND FM COMMUNICATIONS TRANSCEIVER. | TECHNISONIC INDUSTRIES LIMITED | |
| A/R | 2 | CI-292-3 | VHF ANTENNA, 138 TO 174 MHz | COMANT INDUSTRIES | |
| A/R | 3 | CI-292-4 | VHF ANTENNA, 136 TO 174 MHz | COMANT INDUSTRIES | |
| A/R | 4 | CI-275 | UHFLO ANTENNA, 403 TO 470 MHz | COMANT INDUSTRIES | |
| A/R | 5 | CI-275 | UHFHI ANTENNA, 450 TO 512 MHz | COMANT INDUSTRIES | |
| A/R | 6 | CI-285 | UHFHI (II) ANTENNA, 450 TO 520 MHz | COMANT INDUSTRIES | |
| A/R | 7 | CI-306 | 800 ANTENNA, 806 TO 870 MHz | COMANT INDUSTRIES | |
| A/R | 8 | CI-285 | 800/700 (II) ANTENNA, 700 TO 870 MHz | COMANT INDUSTRIES | |
| A/R | 9 | CI-295-200 | VHF/UHF ANTENNA, 136 TO 174 / 380 TO 520 MHz | COMANT INDUSTRIES | |
| A/R | 10 | CI-295-250 | VHF/700/800 ANTENNA, 136 TO 174 / 764 TO 870 MHz | COMANT INDUSTRIES | |
| A/R | 11 | 21-50-45 | VHF/UHF/700/800 ANTENNA, 136 TO 174 / 380 TO 870 MHz | COOPER ANTENNAS | |
| A/R | 12 | AV-925 | VHF/UHF/700/800 ANTENNA, 136 TO 174 / 380 TO 520 / 760 TO 870 MHz | RAMI ANTENNAS | |
| A/R | 13 | CI-925-300 | VHF/UHF/700/800 ANTENNA, 136 TO 174 / 380 TO 520 / 764 TO 870 MHz | COMANT INDUSTRIES | |
| 1 | 14 | 7274-11-5 | CIRCUIT BREAKER, 5 AMPS | KLIXON | |
| 1 | 15 | RC-9100 | REMOTE CONTROL HEAD | TECHNISONIC INDUSTRIES LIMITED | |
| 1 | 16 | SRA-6000 | SWITCHED RECEIVE ATTENUATOR | TECHNISONIC INDUSTRIES LIMITED | |

NOTES:

1) ALL WIRE IAW MIL-W-22759 UNLESS OTHERWISE SPECIFIED.
2) ALL CABLE IAW MIL-C-27500 UNLESS OTHERWISE SPECIFIED.
3) COAXIAL CABLE IAW MIL-C-17 UNLESS OTHERWISE SPECIFIED. DO NOT USE COAX WITH PVC INSULATION.
4) FABRICATION & INSTALLATION OF WIRING HARNESS IAW AC 43.13-1B CHAPTER 11.
5) GROUNDING AND BONDING IAW AC 43.13-1B CHAPTER 11, SECTION 15.
6) ALL SINGLE WIRE TO BE #22 AWG MINIMUM AND ALL SHIELDED WIRE TO BE #24 AWG MINIMUM, UNLESS OTHERWISE SPECIFIED.
7) POWER AND GROUND WIRES TO BE #20 AWG.
8) ANTENNA COAX TO BE RG-142/U OR EQUIVALENT.

9 INSTALLATION OF ANTENNA IAW AC 43.13-1B CHAPTER 4, SECTION 4, CHAPTERS 6 & 7, AND AC 43.13-2A CHAPTER 3. IF POSSIBLE, THE ANTENNA SHOULD BE LOCATED A MINIMUM OF 12 FT FROM AIRCRAFT NAVIGATION RECEIVER ANTENNAS AND A MINIMUM OF 4 FEET FROM AIRCRAFT COMMUNICATIONS AND ELT ANTENNAS. BE CAREFUL NOT TO CHOOSE SEPARATIONS THAT CLOSELY APROXIMATE 1/4 OR 1/2 OR WHOLE NUMBER MULTIPLES OF THE NAVIGATION OR COMMUNICATIONS WAVELENGTH.

10 AN EQUIVALENT CIRCUIT BREAKER OR FUSE MAY BE USED.

11 THE CHANNEL/BAND UP/DOWN PUSH BUTTONS ARE OPTIONAL. GROUND CHANNEL/BAND INPUT FOR BAND CONTROL, LEAVE UNCONNECTED FOR CHANNEL CONTROL.

12 THIS INPUT IS FOR BOTH 28 VDC AND 5 VAC PANEL LIGHTING. SELECT THE APPROPRIATE VOLTAGE IN THE CONFIGURATION MENU.

13 CONNECT TO THE APPROPRIATE AIRCRAFT DIMMING BUSS.

14 CONNECT TO THE AIRCRAFT AUDIO SYSTEM OR STAND-ALONE HEADSET JACKS.

15 INSTALLATION OF TRANSCEIVER IAW AC 43.13-1B CHAPTER 4, SECTION 4 AND AC 43.13-2A, CHAPTER 2. PR3 1/2 DZUS RAIL OR EQUIVALENT MAY BE USED.

16) TEST THE SYSTEM IN ACCORDANCE WITH THE POST-INSTALLATION TEST PROCEDURE IN THE INSTALLATION AND OPERATING INSTRUCTIONS MANUAL.

17) REFER TO THE AIRCRAFT STRUCTURAL REPAIR MANUAL AND THE MAINTENANCE MANUAL FOR INSTRUCTIONS AND INFORMATION PERTINENT TO THIS INSTALLATION.

18) THE USE OF RED DISPLAYS SHOULD BE MINIMIZED OR AVOIDED SO AS NOT TO DETRACT FROM THE ATTENTION GETTING CHARACTERISTICS NEEDED IN WARNING AND CAUTION ANNUNCIATORS. RED SHOULD BE USED TO ANNUNCIATE EMERGENCY CONDITIONS REQUIRING IMMEDIATE RESPONSE BY THE FLIGHT CREW. UNITS WITH RED DISPLAYS SHOULD NOT BE LOCATED IN CLOSE PROXIMITY TO WARNING AND CAUTION ANNUNCIATORS. THE INSTALLATION OF UNITS WITH RED DISPLAYS MUST BE EVALUATED ON A CASE BY CASE BASIS TO ENSURE THAT THE EFFECTIVENESS OF THE WARNING AND CAUTION ANNUNCIATORS IS NOT ADVERSELY AFFECTED.

19 NOT NORMALLY USED IN AIRCRAFT.

20 CONNECTION TO AN OPTIONAL RC-9100 SLAVE CONTROL HEAD.

21 CONNECTION TO AN OPTIONAL SRA-6000 SWITCHED RECEIVE ATTENUATOR.

**FIGURE 2.7** Wiring connection notes for the TDFM-9100 Transceiver

## 2.20 ANTENNA SELECTION AND INSTALLATION CONSIDERATIONS

Antenna installations will vary according to the number / type of bands installed in the TDFM-9100, types of antennas selected and space available on the aircraft. The materials list above contains many but not all antennas available. If dual band RF modules are installed in the TDFM-9100, it is suggested to use a single connector, multiband antenna for each of the RF modules installed. When single band modules are installed, a single band antenna should be used. If the TDFM-9100 has more than one single band module installed that are on different frequency bands, a single multiband antenna with separate connectors or a multiband antenna with a coupler can be used if the frequencies in use are not multiples of each other. For example, transmitting near 150 MHz on VHF may interfere with frequencies near 450 MHz on the UHF band. Antennas should be spaced as far as possible from each other with the Comm antennas on the opposite side (top or bottom) from the FM antennas.

## 2.22 POST INSTALLATION EMI TEST

### PURPOSE

The purpose of this test is to identify any interference that the TDFM-9100 transceiver may cause with existing aircraft systems.

### TEST CONDITIONS

The TDFM-9100 transceiver should be installed and function tested. The antenna VSWR should be checked. A forward/reverse power check with an in-line wattmeter should show no more than 10% reflected power. For the following tests, insure that the output power is set to high.

### METHODOLOGY

Most of the EMI tests can be accomplished on the ground. In some cases flight testing is required or is easier. If the aircraft is approved for IFR operations, then it is mandatory that interference between the TDFM-9100 transceiver and the approach aids be checked in flight.

The GPS should be operational and navigating with at least the minimum compliment of satellites. The VHF comm should be set to the frequencies indicated with the squelch open. VOR/DME receivers should be set to the frequencies indicated and selected for display. If possible, set up a DME ramp test set on the frequencies indicated and adjust the output until the flags are out of view. The transponder and encoder should be monitored with ramp test equipment. Set the output of the transponder test set to 3db above the output necessary to achieve 90% reply. If possible set the ADF to a nearby navigation station.

Modulate the TDFM-9100 transmitter on the indicated frequencies for at least 20 seconds.

Observe the GPS for any degradation in satellite status or availability or flags. Listen for any noise or detected audio signals on the VHF comm(s). Listen for any noise or detected audio signals on the VOR/LOC receiver audio; look for any moment of flags or needles on the VOR/LOC/GS navigation display(s). Observe the transponder for any loss of reply or spurious reply.

List the power plant, fuel and other electric instruments in the chart provided and note any anomalies that occur while transmitting. Assess the results.

If the aircraft is equipped with an autopilot or a stability augmentation system, then test fly the aircraft and verify that operation of the TDFM-9100 transceiver does not have adverse effects on these systems. After checking for gross effects at a safe altitude, fly an approach with each of the different navigation systems coupled to the autopilot (ILS, GPS ETC.) and look for any anomalies.

**RESULTS**

If the installed system passes all of the applicable EMI tests, then no further action is required. If interference is observed then the interference must be assessed against the appropriate standards of airworthiness for the system in question. For example it is permissible for a VFR certified GPS to lose navigation capability while the TDFM-9100 unit is transmitting, providing that it recovers properly and promptly, but it is not permissible for an IFR Approach certified GPS to be affected in the same way. A complete discussion of all the standards of airworthiness to be applied in assessing EMI effects is beyond the scope of this document.

**PROCEDURE**

**A.** Operate the TDFM-9100 transmitter on the following frequency for at least 20 seconds. Observe the GPS for any degradation in satellite status or availability or flags.

| **FREQUENCIES** | **GPS #1** | | **GPS #2** | |
|---|---|---|---|---|
| **TDFM-9100** | **PASS** | **FAIL** | **PASS** | **FAIL** |
| 143.2125 MHz | | | | |
| 143.2250 MHz | | | | |
| 157.5375 MHz | | | | |
| 157.5500 MHz | | | | |
| 512.0000 MHz | | | | |

**NOTES:**

**B.** Determine if the image frequency for the VHF Comm falls within the range of the TDFM-9100. If so, select a set of frequencies that will cause the TDFM-9100 to be set as close as possible to the image frequency. Any one of the many possible sets will suffice. Record those values in the spaces provided in the following chart. Modulate the TDFM-9100 transmitter on the following frequencies for at least 20 seconds. Listen for any noise or detected audio signals on the VHF comm.

Example - Bendix/King KY 196A:
The first IF frequency is 11.4 MHz. The L.O. is above the received frequency (high side injection), therefore the image frequency is 22.8 MHz above the selected frequency. Set the KY 196A to 120.000 MHz and the TDFM-9000 to 142.8000 MHz.

| **FREQUENCIES** | | **RESULTS** | |
|---|---|---|---|
| **VHF #1** | **TDFM-9100** | **PASS** | **FAIL** |
| 135.975 | 136.0000 | | |
| 121.150 | 157.5000 | | |
| 131.250 | 157.5000 | | |
| **Image:** | | | |
| | | | |
| | | | |

| **FREQUENCIES** | | **RESULTS** | |
|---|---|---|---|
| **VHF #2** | **TDFM-9100** | **PASS** | **FAIL** |
| 135.975 | 136.0000 | | |
| 121.150 | 157.5000 | | |
| 131.250 | 157.5000 | | |
| **Image:** | | | |
| | | | |
| | | | |

**NOTES:**

**C.** Determine if the image frequency for the VOR/ILS Nav falls within the range of the TDFM-9100. If so, select two sets of frequencies that will cause the TDFM-9100 to be set as close as possible to the image frequency. Choose one set in the localizer frequency range and one in the VOR frequency range. Record those values in the spaces provided in the following chart. Modulate the TDFM-9100 transmitter on the following frequencies for at least 20 seconds. Listen for any noise or detected audio signals on the receiver audio; look for any moment of flags or needles on the navigation display.

| **FREQUENCIES** | | **RESULTS** | |
|---|---|---|---|
| **VOR/ILS #1** | **TDFM-9100** | **PASS** | **FAIL** |
| 108.000 | 162.0000 | | |
| 108.100 | 162.1500 | | |
| **Image:** | | | |
| | | | |
| | | | |

| **FREQUENCIES** | | **RESULTS** | |
|---|---|---|---|
| **VOR/ILS #2** | **TDFM-9100** | **PASS** | **FAIL** |
| 108.000 | 162.0000 | | |
| 108.100 | 162.1500 | | |
| **Image:** | | | |
| | | | |
| | | | |

**NOTES:**

**D.** The following procedure checks for second harmonic interference to the glide slope receiver from the TDFM-9100. All transceivers produce harmonics (multiples of the wanted frequency) and while the TDFM-9100 far exceeds FCC requirements, interference can still be experienced depending upon antenna position and separation. Furthermore, harmonics can be generated by other equipment in the aircraft and the structure of the aircraft where dissimilar metals make contact or where grounds are isolated, etc. This is also true of aircraft hangars, therefore testing should be done outside away from any structures where possible.

With a portable glide slope generator, provide enough signal to firmly activate the indicator needle and hide all flags. Increase the signal level by 3 dB. Modulate the TDFM-9100 transmitter on the following frequencies for at least 20 seconds. Observe the Glide Slope displays. Look for any movement of flags or needles on the navigation display. If an interference condition is detected, then the installation will have to be flight tested according to the following procedure. Using the table below, determine the glide slope frequency based on the localizer frequency of the ILS to be used. Divide the glide slope frequency by 2 and program into the TDFM-9100. Fly the aircraft to intercept the localizer and glide slope (both needles centered) at 26 nm from the runway. Transmit on the TDFM-9100 for 10 seconds and watch for any deflections or flags. Repeat the test every 2 nm until the indicators are not affected. If the distance is greater than 18 nm then a pass shall be recorded. Otherwise the TDFM-9100 shall be placarded “Do not transmit while on ILS approach”.

| Localizer | Glide slope | Localizer | Glide slope |
|---|---|---|---|
| 108.10 | 334.70 | 110.10 | 334.40 |
| 108.15 | 334.55 | 110.15 | 334.25 |
| 108.30 | 334.10 | 110.30 | 335.00 |
| 108.35 | 333.95 | 110.35 | 334.85 |
| 108.50 | 329.90 | 110.50 | 329.60 |
| 108.55 | 329.75 | 110.55 | 329.45 |
| 108.70 | 330.50 | 110.70 | 330.20 |
| 108.75 | 330.35 | 110.75 | 330.05 |
| 108.90 | 329.30 | 110.90 | 330.80 |
| 108.95 | 329.15 | 110.95 | 330.65 |
| 109.10 | 331.40 | 111.10 | 331.70 |
| 109.15 | 331.25 | 111.15 | 331.55 |
| 109.30 | 332.00 | 111.30 | 332.30 |
| 109.35 | 331.85 | 111.35 | 332.15 |
| 109.50 | 332.60 | 111.50 | 332.90 |
| 109.55 | 332.35 | 111.55 | 332.75 |
| 109.70 | 333.20 | 111.70 | 333.50 |
| 109.75 | 333.05 | 111.75 | 333.35 |
| 109.90 | 333.80 | 111.90 | 331.10 |
| 109.95 | 333.65 | 111.95 | 330.95 |

| FREQUENCIES | | RESULTS | |
|---|---|---|---|
| **G/S #1** | **TDFM-9100** | **PASS** | **FAIL** |
| 334.7 (108.1) | 167.35 | | |
| | | | |

| FREQUENCIES | | RESULTS | |
|---|---|---|---|
| **G/S #2** | **TDFM-9100** | **PASS** | **FAIL** |
| 334.7 (108.1) | 167.35 | | |
| | | | |

**NOTES:**

**E.** Operate the TDFM-9100 transmitter on the following frequency for at least 20 seconds. Observe the Transponder for any spurious replies or loss of reply to test set.

| FREQUENCIES | TRANSPONDER #1 | | TRANSPONDER #2 | |
|---|---|---|---|---|
| **TDFM-9100** | **PASS** | **FAIL** | **PASS** | **FAIL** |
| 512 MHz | | | | |

**NOTES:**

**F.** Modulate the TDFM-9100 transmitter on the following frequencies for at least 20 seconds. Observe the DME displays. Look for loss of distance information on the display.

| **FREQUENCIES** | | **RESULTS** | |
|---|---|---|---|
| **DME 1** | **TDFM-9100** | **PASS** | **FAIL** |
| 978 (108.0) | 489 | | |
| 1020 (112.1) | 510 | | |
| | | | |

| **FREQUENCIES** | | **RESULTS** | |
|---|---|---|---|
| **DME 2** | **TDFM-9100** | **PASS** | **FAIL** |
| 978 (108.0) | 489 | | |
| 1020 (112.1) | 510 | | |
| | | | |

**NOTES:**

**G.** **NOTE:** For the following tests, select a frequency at the top, middle and bottom of each band of the TDFM-9100 transceiver.

| | 136 to 174 MHz Band | 403 to 470 MHz Band | 450 to 512 MHz Band | 806 to 870 MHz Band |
|---|---|---|---|---|
| Frequency #1 | | | | |
| Frequency #2 | | | | |
| Frequency #3 | | | | |

**H.** At a safe altitude engage the autopilot or stability augmentation system. Modulate the TDFM-9100 transmitter on the above frequencies for at least 20 seconds. Observe any effect on the autopilot or stability augmentation system.

Observations:

**I.** Perform a coupled ILS approach to the aircraft's certified limits. Modulate the TDFM-9100 transmitter on the above frequencies for at least 20 seconds. Observe any effect on the autopilot. Repeat for second flight director/autopilot if equipped.

Observations:

**J.** List the power plant, fuel and other electric instruments in the chart provided and note any anomalies that occur while transmitting. Assess the results.

| STEP | SYSTEM | PASS | FAIL | NOTES |
|---|---|---|---|---|
| 1 | Com 1&2<br>(UHF Lo, UHF Hi, and 800 MHz) | | | |
| 2 | Transponder & Encoder<br>(VHF, UHF Lo, and 800 MHz) | | | |
| 3 | ADF 1 & 2 | | | |
| 4 | VG | | | |
| 5 | Glideslope 1&2<br>(UHF Lo, UHF Hi, and 800 MHz) | | | |
| 6 | VOR/LOC 1&2<br>(UHF Lo, UHF Hi, and 800 MHz) | | | |
| 7 | Compass | | | |
| 8 | Directional Gyro | | | |
| 9 | Fuel Pressure | | | |
| 10 | Oil Temp | | | |
| 11 | Amps | | | |
| 12 | Bus Voltage | | | |

| | | | | |
|---|---|---|---|---|
| 13 | Fuel % | | | |
| 14 | Ng | | | |
| 15 | TOT | | | |
| 16 | Torque % | | | |
| 17 | Annunciators | | | |
| 18 | Digital Clock | | | |
| 19 | Oil Pressure | | | |
| 20 | DME 1&2<br>(VHF, UHF Lo, and 800 MHz) | | | |
| 21 | GPS 1&2<br>(UHF Lo and 800 MHz) | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| STEP | SYSTEM | PASS | FAIL | NOTES |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**NOTES:**

# APPENDIX A

## SUPPORT NOTES

- For the latest Service Bulletin(s) refer to the Publication Index list under the section for this model (*login required*).
- For the latest Technical Information Bulletins refer to the Publication Index list under the section for this model (*login required*).
- For the latest Software Release(s) refer to the Publication Index list under the section for this model's software/firmware history index (*login required*).

## ENVIRONMENTAL QUALIFICATION FORM

Model No: TDFM-9100
Part No: 121270-2-91-AAB/91000
Description: Airborne Transceiver

Manufacturer: Technisonic Industries Limited
240 Traders Blvd.,
Mississauga, Ontario
Canada
L4Z 1W7

Tel: 905-890-2113
Fax: 905-890-5338

Tested to: RTCA / DO-160G (December 8, 2010)

Date Tested: Feb xx, 2014 – March xx, 2014

Test Report No: 14RExxx

| CONDITIONS | SECTION | CATEGORY | COMMENTS |
|---|---|---|---|
| Temperature and Altitude | 4.0 | A2, B1, C4, D1 | |
| Low Temperature – Survival | 4.5.1 | | – 55 degrees C |
| Low Temperature – Short Time Operating | 4.5.1 | | – 40 degrees C |
| Low Temperature – Operating | 4.5.2 | | – 30 degrees C |
| High Temperature – Survival | 4.5.3 | | + 85 degrees C |
| High Temperature – Short Time Operating | 4.5.3 | | + 70 degrees C |
| High Temperature – Operating | 4.5.4 | | + 70 degrees C |
| In-Flight Loss of Cooling | 4.5.5 | | not applicable |
| Altitude | 4.6.1 | | 50,000 feet |

| CONDITIONS | SECTION | CATEGORY | COMMENTS |
|---|---|---|---|
| Decompression | 4.6.2 | | 50,000 feet |
| Overpressure | 4.6.3 | | – 15,000 feet |
| Temperature Variation | 5.0 | B | +/– 5 degrees C per minute |
| Humidity | 6.0 | A | Standard Humidity Environment |
| Operational Shock and Crash Safety | 7.0 | A | Standard Operational Shocks |
| Vibration | 8.0 | S | Sinusoidal Vibration – curve M |
| | | S | Random Vibration – curve B |
| | | U | Sine-On-Random Vibration – curve G |
| Explosive Atmosphere | 9.0 | X | not tested |
| Waterproofness | 10.0 | X | not tested |
| Fluids Susceptibility | 11.0 | X | not tested |
| Sand and Dust | 12.0 | X | not tested |
| Fungus | 13.0 | X | not tested |
| Salt Fog Test | 14.0 | X | not tested |
| Magnetic Effect | 15.0 | Z | distance result was 0.21 meters |
| Power Input | 16.0 | B | see NOTE-2 |
| Voltage Spike | 17.0 | B | |
| Audio Frequency Susceptibility | 18.0 | B | |
| Induced Signal Susceptibility | 19.0 | AC | |
| Radio Frequency Susceptibility | 20.0 | T | see NOTE-1 |
| Radio Frequency Emission | 21.0 | M | see NOTE-1 |
| Lightning Induced Transient Susceptibility | 22.0 | X | not tested |
| Lightning Direct Effects | 23.0 | X | not tested |
| Icing | 24.0 | X | not tested |
| Electrostatic Discharge | 25.0 | A | 10 discharge locations were used |
| Fire, Flammability | 26.0 | X | not tested |
| Other Tests | | | |

**Remarks:**

All testing was performed at Technisonic Industries unless otherwise indicated.

NOTE-1 Indicated test was performed by ULTRATECH LABS.

NOTE-2 Testing included subparagraph 16.6.1.3b: Requirement for Equipment with Digital Circuits.

**NOTES**

**Technisonic Industries Limited**
240 Traders Blvd., Mississauga, ON Canada L4Z 1W7
Tel: (905) 890-2113 Fax: (905) 890-5338

## IMPORTANT
## WARRANTY

All communication equipment manufactured by Technisonic Industries Limited is warranted to be free of defects in Material or Workmanship under normal use for a period of one year from Date of Purchase by the end user.

Warranty will only apply to equipment installed by a factory approved and/or authorized facility in accordance with Technisonic published installation instructions. Equipment falling under the following is not covered by warranty:

- equipment that has been repaired or altered in any way as to affect performance,
- equipment that has been subject to improper installation,
- equipment that has been used for purposes other than intended,
- equipment that has been involved in any accident, fire, flood, immersion or subject to any other abuse.

Expressly excluded from this warranty are changes or charges relating to the removal and re-installation of equipment from the aircraft. Technisonic will repair or replace (at Technisonic's discretion) any defective transceiver (or part thereof) found to be faulty during the Warranty Period.

Faulty equipment must be returned to Technisonic (or its authorized Warranty Depot) with transportation charges prepaid. Repaired (or replacement) equipment will be returned to the customer with collect freight charges. If the failure of a transceiver occurs within the first 30 days of service, Technisonic will return the repaired or replacement equipment prepaid.

Technisonic reserves the right to make changes in design, or additions to, or improvements in its products without obligation to install such additions and improvements in equipment previously manufactured. This Warranty is in lieu of any and all other warranties express or implied, including any warranty of merchantability or fitness, and of all other obligations or liabilities on the part of Technisonic.

This Warranty shall not be transferable or assignable to any other persons, firms or corporations.

**For warranty registration please complete the on-line Warranty Registration Form found at www.til.ca.**

# TDFM-9100

## MULTIBAND P25 AIRBORNE TRANSCEIVER


# Operating Instructions

**TiL Document No. 13RE482**
**Rev. N/C**

**November 2014**


**Technisonic Industries Limited**
**240 Traders Boulevard, Mississauga, Ontario L4Z 1W7**
**Tel: (905) 890-2113 Fax: (905) 890-5338**
**www.til.ca**

| REVISION HISTORY<br>[ 13RE482 ] | | | | |
|---|---|---|---|---|
| REV | SECTION<br>- PAGE - | DESCRIPTION | DATE | Edited by |
| | | | | |

## NOTES

**CAUTION STATIC SENSITIVE !**

This unit contains static sensitive devices. Wear a grounded wrist strap and/or conductive gloves when handling printed circuit boards.

**FCC COMPLIANCE INFORMATION**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

**WARNING:** For compliance with FCC RF Exposure Requirements the mobile transmitter antenna installation shall comply with the following two conditions:

1. The transmitter antenna gain shall not exceed 3 dBi.
2. The transmitter antennas shall be located outside of a vehicle and must not be co-located (kept at a separation distance of more than 20cm from each other when installed). Also they must be installed in such a way that they always maintain a separation distance of more than 90cm from any person during operation.

**NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his/her own expense.

**WARNING AND DISCLAIMER**

Changes or modifications not expressly approved by Technisonic Industries could void the user's authority to operate the equipment.

This manual is designed to provide information about the TDFM-9100. Every effort has been made to make this manual as complete and accurate as possible.

**WARRANTY INFORMATION**

The Model TDFM-9000 Transceiver is under warranty for one year from date of purchase.
Failed units caused by defective parts, or workmanship should be returned to:

Technisonic Industries Limited
240 Traders Boulevard
Mississauga, Ontario L4Z 1W7

Tel: (905) 890-2113
Fax: (905) 890-5338

SUMMARY OF DO-160G ENVIRONMENTAL TESTING
Summary of DO-160G Environmental Testing for Technisonic Model TDFM-9100 Transceiver:

| **Conditions** | **Category** |
|---|---|
| Temperature and Altitude | A2, B1, C4, D1 |
| Temperature Variation | B |
| Humidity | A |
| Operational shock and Crash Safety | A |
| Vibration | S, U |
| Magnetic Effect | Z |
| Power Input | B |
| Voltage Spike | B |
| Audio Frequency Susceptibility | B |
| Induced Signal Susceptibility | AC |
| Radio Frequency Susceptibility | T |
| Radio Frequency Emission | M |
| Electrostatic Discharge | A |

**STC APPROVAL NOTE**

Presently, no TSO standard exists for airborne FM transceivers. To make it easier for installation agencies to provide their customers with an approved installation supported by an effective Airworthiness Approval, Technisonic has secured Supplemental Type Certificate (STC) Approvals on its Airborne FM products for a limited number of airframes. The above referenced DO-160G test data is also on file and available from Technisonic to support approval requirements in airframes for which Technisonic does not possess an STC.

Approved aircraft types are listed in the attachments to the formal STC documents. These STCs are the exclusive property of Technisonic and require the written authority of Technisonic for their use. Letters of permissin are provided upon request. To assist Factory Authorized Technisonic Dealers in the certification process, we have placed copies of our STCs on our web site. These documents may be downloaded and used as support for the technical submission to FAA or Transport Canada. Only authorized factory dealers/installers are permitted to download and make use of these documents on behalf of their customers (end users) in support of regulatory agency approval. Please refer to the Technisonic web site www.til.ca for the latest issue of available STCs.

**WARNING AND DISCLAIMER**

This manual is designed to provide information about the TDFM-9100. Every effort has been made to make this manual as complete and accurate as possible.

**TRADEMARK NOTICES**

TDFM-9100 Transceivers contain two-way radio protocols licensed from Motorola, Inc.

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# SECTION 1 - GENERAL DESCRIPTION

## 1.1 INTRODUCTION

This publication provides operating information on the TDFM-9100 airborne transceiver. The exact configuration depends on which and how many RF modules are installed.

## 1.2 DESCRIPTION

The TDFM-9100 transceiver is an airborne multi-band radio capable of operation in conventional, analog, P25 and P25 phase II digital FM systems, SmartNet/SmartZone trunking systems and P25 9600 trunking systems. RF modules are available in single or dual bands that support VHF, UHF-LO, UHF-HI and 700-800 MHz bands. Up to 2 single or dual band modules can be supported.

These optional additional features include P25 9600 trunking Phase 1 and 2 that may be combined with AES and/or DES-OFB encryption with OTAR in any of the available modules.

The TDFM-9100 is not normally frequency agile. In order to have the ability to change the frequencies at the front panel, the FPP (front panel programming) option must be ordered for each band.

## 1.3 MODEL VARIATION

There are several variations of the Model TDFM-9100 Transceiver. Each variation offers different features and performance based on the type of RF modules and options installed.

The following is a breakdown of the TDFM-9000 model variations:

P/N 121270-D-91-TBB-P91XXX

(PRODUCT TYPE)-(D)-(91)-(Tray 1)-(Project)

PRODUCT TYPE: 121270 = TDFM 9100, 1 tray, 1 – 2 modules

D= Display type:

1) Standard Green
2) Night Vision Green

91 = TDFM 9100

Tray Breakdown: (TBB):

T = Module type: Always A in the TDFM-9100 for APX type modules

B = Band code for each module in the tray:

Band Codes

| | |
|---|---|
| 1 | VHF (136-174) |
| 2 | UHF LO (380-470) |
| 3 | UHF HI (450–520) |
| 4 | 700/800 (764-870) |
| A | VHF / 700 / 800 |
| B | VHF/ UHF LO |
| C | VHF / UHF HI |
| D | UHF LO / UHF HI |
| E | UHF LO / 700 / 800 |
| F | UHF HI / 700 / 800 |
| G* | 700 / 800 / VHF |
| H* | 700 / 800 / UHF LO |
| I* | 700 / 800 / UHF HI |

**Notes:** There is only one tray in the TDFM-9100. If only one module is supplied in the tray the second B digit will be a 0 in (TBB).
Module types C, D, E and G will only be available if OEM agreements can be made for their use.
Standard Band Codes will indicate dual band module order as shown in Band Codes A through F.

* Band codes with dual band module order as shown in G, H and I are only available by special order. The basic premise is that the lowest frequency range will always be specified first. This is to keep code plugs similar to Motorola convention and assure wide compatibility.

Project Number: P91XXX represents a 5 digit project number that identifies specific options that are contained in each module and describes the full TDFM-9100 configuration.

All model variations are capable of supporting both 28 Volt and 5 Volt AC or DC back lighting. The units are shipped set to operate on 28 Volt back lighting. Equipment can be set to operate on 5V back lighting by using the software based configuration menu. See Section 2.17 configuration menu. (Damage will not occur if the incorrect voltage is applied.)

## 1.4 TECHNICAL CHARACTERISTICS

| Specification | Characteristic |
|---|---|
| Model Designation: | TDFM-9100 |
| Physical Dimensions: | Approx. (L) 8.0" x (W) 5.75" x (H) 3.0" |
| Weight: | ~3.5 Lbs (1.6 Kg) |
| Operating Temperature Range: | -30° C to +60° C |
| Power Requirement: | |
| Voltage: | 28.0 VDC ± 15% |
| Current: | 500 mA minimum / 5A maximum |
| Audio Output Power (including sidetone): | 65 mW into 600 Ω |
| Microphone Inputs: | Carbon or Equivalent |
| Panel Back Lighting: | |
| Voltage: | 28 or 5 Volts AC or DC (selectable) |
| Current: | 61mA max |

**RF Modules**

| Specification | Characteristic |
|---|---|
| RF Output Power: | 1 or 6 Watts (VHF)<br>1 or 5 Watts (UHF)<br>1 or 3 Watts (700/800) |
| Frequency Range | |
| VHF Band: | 136 to 174 MHz |
| UHF LO Band: | 380 to 470 MHz |
| UHF HI Band: | 450 to 520 MHz |
| 700 / 800 bands: | 764 to 870 MHz |
| No. of channels per band: | 2000 pre-programmable channels |

| **Transmitter section** | **VHF** | **UHF** | **800** |
|---|---|---|---|
| FM Hum and noise in dB (wideband): | -48 | -45 | -45 |
| Audio Distortion: | 1% | 1.0% | 1.0% |
| Frequency Stability in ppm: | ±1.0 | ±1.0 | ±1.5 |
| Modulation Limiting: | Wide band | | ±5kHz |
| | Narrow band | | ±2.5kHz |

| **Receiver section** | **VHF** | **UHF** | **800** |
|---|---|---|---|
| *Sensitivity* in uV: | | | |
| *Digital 1% BER (12.5kHz) | 0.29 | 0.32 | 0.40 |
| *Digital 5% BER (12.5kHz) | 0.21 | 0.28 | 0.30 |
| **Analog with 12dB SINAD | 0.25 | 0.25 | 0.25 |
| *Selectivity* in dB: | | | |
| 25 kHz Channel | -80 | -78 | -72 |
| 12.5 kHz Channel | -70 | -68 | -67 |
| Intermodulation * ** | -80 | -80 | -80 |

*Measured in digital mode per TIA / EIA IS 102.CAAA under nominal conditions.
** Measured in analog mode per TIA / EIA 603 under nominal conditions.

# SECTION 2 – OPERATING INSTRUCTIONS

## 2.1 GENERAL

An LED display, a keypad and a rotary knob provide the operator control of the 1 or 2 RF modules installed in the unit. The display shows the activity of both modules as well as the soft key menu of the active band. The active module is selected by pressing the BAND key. The knob has multiple functions including volume, channel and zone. The microphone, key line and headphone audio can be wired separately for each module therefore switching from band to band is performed at an audio panel such as the Technisonic A71X series. This allows for separate and simultaneous operation on each of the bands just like having 2 separate radios. The transceiver can also be connected so that both bands are available on one combined output. It is possible to connect the transceiver such that both methods are used simultaneously.

## 2.2 FRONT PANEL

Refer to the diagram below:


**FIGURE 2-1** Front Panel Controls – TDFM-9100 Transceiver

## 2.3 POWER SWITCH

To switch the transceiver on, press and hold the knob until the radio powers up. The display will show TECHNISONIC and the software version installed followed by the model number along with which RF modules are installed. The display will then show the normal display. To switch off the transceiver at any time, press and hold the knob for 2 seconds until the display shows OFF then release. If it is desired that the radio powers up with the radio master in the aircraft, an 'always on' mode can be set in the configuration menu.

## 2.4 KNOB

The knob is a rotary encoder, which turns endlessly. The knob also has a push button incorporated so you can press the knob as well. Pressing the knob will toggle through the following possible knob modes:

Volume
Channel
Zone
Numlock

The current function of the knob is shown at the bottom right of the display. Some of these modes can be enabled or disabled in the configuration menu. The knob is only active for the band that is selected.

## 2.5 SOFT KEYS AND HOME

The 3 soft keys below the display assume the function shown on the menu above them. The functions displayed depend on how the module was programmed with the customer programming software (APX CPS)™. These menu items can be different on a channel by channel basis. Typical menu items may include but are not limited to:

**ZONE** - Pressing this function will prompt you for a new zone number which can be entered directly (if the keypad is in numlock mode) or scrolled using the UP(5) and DN(8) keys.

**MUTE** - Selecting this function will prompt you for an on or off entry using the soft keys to mute the tones. Tones refer to the beeps heard when pressing buttons.

**PWR** - Selecting PWR will allow the power output of the radio to be set to high or low.

**PROG** - Selecting PROG brings you to user programmable features of the radio such as telephone numbers or scan lists. The ability for the user to program phone numbers, scan lists, etc can be enabled or disabled by the CPS™.

**VIEW** - The view function is used to view lists. Lists can include scan lists, phone numbers, call lists and or paging.

**FPP** - Front Panel Programming mode allows you to program at the front panel without the customer programming software. This option is available on all standard modules.

At any time while in one of these functions, you can escape back to the normal mode by pressing the HOME key. When programming the modules with the APX CPS™, it is suggested not to double up functions. For example, programming a soft key to CHAN would be redundant since there is already a channel function using the knob.

## 2.6 BAND KEY

This button selects band 1 or band 2. An arrow points at the active band. The active band will also be highlighted for a few seconds while changing bands.

## 2.7 FUNC KEY

Pressing the FUNC key will bring up the following menu:


**FIGURE 2-2** TDFM-9100 Function Menu

You can select the desired function by rotating and pressing the knob or by using the Sel and Enter soft keys.

***Cross Band Repeat*** Invokes the cross band repeat menu. Enabling cross band repeat allows received audio from band to be automatically retransmitted on the other and visa versa but only in one direction at a time.

***Configuration*** Invokes the configuration menu (see 2.17 configuration menu). Various functions can be enabled or disabled to suit the operation.

***Simulcast*** Invokes the simulcast menu. You can select both bands to transmit simultaneously. Simulcast is only available when using the combined input/output. Simulcast can be used in conjunction with the cross band repeat mode.

***Maintenance*** Invokes the maintenance menu (see 2.18 maintenance menu). Allows setting of TX, RX audio levels and supervisory permissions for various functions.

Pressing the HOME key at any time will return the radio to normal operating mode without making any further changes.

## 2.8 F1 to F4 KEYS

Four function keys at the top of the keypad provide the same functions as the three side buttons and the top button found on the APX-7000 portable. They are as follows:

**F1** – Top-side-button (purple button) on the portable.

**F2** – Centre-side-button (with one dot) on the portable.

**F3** – Bottom-side button (with two dots) on the portable.

**F4** - Top button (orange button) on the portable.

**TDFM-9100 Transceiver Recommended Keypad Menu Defaults:**

| TDFM-9100 Transceiver ITEM | Portable ITEM | Conventional Operation | SmartNet / SmartZone Operation |
|---|---|---|---|
| F1 Key | Upper Side Button 1 | Monitor | Unprogrammed |
| F2 Key | Middle Side Button 2 | Nuisance Delete | Unprogrammed |
| F3 Key | Bottom Side Button 3 | Talkaround/ Direct | Unprogrammed |
| F4 Key | Top Button | Volume Set Tone | Volume Set Tone |
| MUP and MDN keys | 16-Position Rotary Knob | Channel Select | Talkgroup Select |
| ESW Key | Two-Position Concentric or Ergo Switch | Unprogrammed A (∅)<br>Unprogrammed B (O) | Unprogrammed A (∅)<br>Unprogrammed B (O) |
| TSW Key | Three-Position Toggle Switch | Blank (A)<br>PL Disable (B)<br>Scan (C) | Blank (A)<br>PL Disable (B)<br>Scan (C) |

**NOTE:** It is possible to use Motorola's Customer Programming Software (APX CPS™) to alter the default keypad settings of the TDFM-9100 radio. However if custom key settings are chosen it will not be possible for Technisonic to help the Pilot or other Radio User through operational difficulties. These questions will have to be referred to the Radio System Administrator responsible for customising the settings. Technisonic recommends that the default key settings stay in place until all airframe installation and operational issues have been overcome.

Module 1 and 2 of the TDFM-9100 Transceiver are programmable by Motorola APX CPS™ software. The following settings may be programmed for each Conventional Channel in a module:

| | |
|---|---|
| Tx Frequency | Zone |
| Tx PL/DPL Code | Channel |
| Rx Frequency | Name |
| Rx PL/DPL Code | RX Signal Voice Type |
| Time-Out Timer | TX Signal Voice Type |
| Scan List | Network Access Code |
| Phone Numbers | Tx Power |
| Talkgroup IDs | Private Call Type |
| Encryption Key Assignment | |

The following settings can be programmed for each mode in a P25 Trunked and/or SmartNet/SMART ZONE equipped radio:

| | |
|---|---|
| System Type | TG Strapping |
| System ID (NAC) | Zone |
| Individual ID (UID) | Scan List |
| Coverage Type | Scan Type |
| Affiliation Type | Interconnect |
| Control Channel (s) | Phone Display Format |
| Talkgroups | Private Call Operation |
| Status | Site Alias |
| Encryption Key Assignment | |

The function keys along with the rest of the keypad, revert to normal number keys during transmit and when NUM LOCK is selected by pressing the rotary knob.

## 2.9 MUP(4) AND MDN(7) KEYS (Memory Up and Down Keys)

These keys provide the same function as the rotary knob does when it is set to CHAN. These keys can be used to scroll through the channels. A single press will step the channel by one, but a push and hold will scroll to a desired channel number. The function of the rotary knob is temporarily set to CHAN when either of these keys is pressed.

## 2.10 UP(5) AND DN(8) KEYS

The keys provide the same function as the left and right arrow keys on the portable. The UP key equates to the right arrow key and the DN is the left. These keys are used for a variety of functions but in the normal operating mode, they are used to scroll through the soft key menus.

## 2.11 BRT(6) AND DIM(9) KEYS

Use these keys to dim or brighten the display. The radio powers up at full brightness for normal use but can be dimmed for night operations.

## 2.12 ESW(0) KEY (Ergo Switch Key)

The ESW key provides the function of the concentric or 'ergo' switch on the portable. The switch has two conditions which are represented by 'O' and '∅'. Pressing the ESW key toggles the condition back and forth. The condition is displayed at the right hand side of the display line, second character from the right. The ergo switch condition is saved when the unit is turned off. There are separate conditions for each band installed. The ESW key can be programmed with the APX CPS™ to a variety of functions such as low power, scan and secure or encrypted mode.

## 2.13 TSW(*) KEY (Toggle Switch Key)

The TSW key provides the function of the toggle switch on the portable. The switch has three conditions which are represented by 'A', 'B' and 'C'. Pressing the TSW key toggles the condition A,B,C,A,B, etc. The condition is displayed at the far right hand side of the display line, last character on the right. The toggle switch condition is saved when the unit is turned off. There are separate conditions for each band installed. The TSW key can be programmed with the APX CPS™ to a variety of functions such as low power, scan, zone select, or pl disabled mode.

## 2.14 DISPLAY

The transceiver has a three line 72 character LED display. The zone name, channel name, condition symbols (scan, direct, call, secure, monitor, etc) and switch settings will be displayed for each module. The active band is indicated by a pointer on the left side of the display. The bottom line displays the menu items associated with the module selected and the mode of the knob.

## 2.15 GENERAL OPERATION

Switch on the transceiver by pressing the knob. Select the desired band by pressing the BAND key. Select the TDFM-9100 on the aircraft audio panel. Press the knob again so that CHAN shows up on the bottom right of the display. Rotate the knob until the desired channel or talk group is selected. Press the knob until VOL is again shown on the display. You can adjust the volume by waiting until a signal is received or by pressing F1 (factory programmed for monitor function) and adjusting the rotary knob. The radio is ready to use. If the radio is installed in separate mode, remember that the band selected by the soft keys is what menu is displayed on the screen but the band selected by the audio panel is the band that you are transmitting and receiving on. To use the DTMF keypad while transmitting, the band you are using must be selected on the display.

## 2.16 APX CUSTOMER PROGRAMMING SOFTWARE (APX CPS™)

Programming the Bands in the TDFM-9100 is usually done with the use of third party programming software. Customer programming software, or "APX CPS," must be supplied by Motorola. However, conventional analog or P25 channels can be programmed at the front panel if each module is fitted with the Front Panel Programming option (FPP). See Section 2.19 for details.

A Programming cable "PC-9000" is required to connect the computer to the TDFM-9100. Bands 1 and 2 in the TDFM-9100 are considered an APX-7000 portable by the APX CPS™ software. To program a band in the transceiver, it must be selected by pressing the appropriate band select key before running the APX CPS™. Follow the instructions supplied with the APX CPS™.

The APX CPS Programming software (P/N RVN5224) must be purchased from Motorola On Line (MOL).

For instructions on ordering Motorola parts and APX CPS software see Technical Information Bulletin TIBFM 17-01.

This document is available on the Technisonic website at www.til.ca. On the main page, hover the cursor over "Project 25 Airborne FM." A pull-down menu should appear. Click the TDFM-9100 link to go directly to the TDFM-9100 page and click the link for "APX CPS Programming Software/Cables Ordering Guide." Refer to the section for Type "A" modules.

If encryption keys need to be loaded via a KVL-3000+, keyloader cable P/N 127500 may be also be obtained from Technisonic. This keyloader cable will plug into the front mini DIN connector of the TDFM-9100 transceiver.

The following cables for support of the TDFM-9100 can be purchased from Technisonic:

P/N 127499 Download/Programming Cable (See Figure 2.2).

P/N 127500 Encryption Keyload Cable (See Figure 2.3).

**FIGURE 2.3** Programming Cable: "PC-9000" P/N 127499

**FIGURE 2.4** Encryption Keyloading Cable: “KVL-9000” P/N 127500

## 2.17 CONFIGURATION MENU:

Some features of the TDFM-9100 transceiver can be configured to the user’s preference. The following menu items can be changed or modified. Rotate the knob to select the desired condition and press the knob to continue to the next configuration item:

| | |
|---|---|
| ***Knob Volume*** | Can be Enabled or Disabled. If Enabled, Volume will be one of the available modes the knob can assume during normal operation. |
| ***Knob Channel*** | Can be Enabled or Disabled. If Enabled, Channel will be one of the available modes the knob can assume during normal operation. |
| ***Knob Zone*** | Can be Enabled or Disabled. If Enabled, Zone will be one of the available modes the knob can assume during normal operation. |
| ***Knob Numlock*** | Can be Enabled or Disabled. . When this knob mode is selected by pressing the knob in the normal operating mode, the keyboard will act as a numeric entry rather than the usual functions. The knob itself has no function in this mode. Numlock mode can be used, for example, to select quick channel presets previously programmed in using the APX CPS software. Numlock mode will time out after 3 seconds at which time the knob will revert back to the default mode (see below). |
| ***Knob Default*** | Can be set to Volume or Channel. This is the mode the knob will assume when the TDFM-9100 is switched on or when the Numlock mode times out. |
| ***Backlighting*** | Can be set to 5 or 28 volts. This sets the operating range of the dimming input to the radio. The dimming input only controls the brightness of the keyboard and panel markings. The display brightness is controlled separately. No damage will occur to the TDFM-9100 if the wrong voltage is selected. |
| ***Always On*** | When enabled, the radio turns on and off with the aircraft radio master. When disabled, the knob must be used to switch on the radio. |
| ***Sidetone*** | The sidetone (transmit audio sent to the headset while transmitting) can be adjusted to a comfortable level while in this mode. |

Press the knob to accept the setting. The radio will then return to normal operating mode. The radio will keep these settings until they are changed again.

## 2.18 MAINTENANCE MENU

Some technical specifications of the TDFM-9100 transceiver can be configured to suit the installation. ***The settings in this menu should only be adjusted by maintenance or technical personnel as incorrect settings can result in undesired operation.*** The following menu items can be changed or modified. Rotate the knob to select the desired condition and press the knob to continue to the next configuration item:

| | |
|---|---|
| ***Mic 1 Level*** | Turning the knob will adjust the microphone input level for band 1 transmit. The level is displayed as a hexadecimal number and is adjustable between 00 and FF. |
| ***Mic 2 Level*** | Turning the knob will adjust the microphone input level for band 2 transmit. The level is displayed as a hexadecimal number and is adjustable between 00 and FF. |
| ***Mic C Level*** | Turning the knob will adjust the combined microphone input level for band 1 and 2. The level is displayed as a hexadecimal number and is adjustable between 00 and FF. |
| ***Band 1 RX Audio*** | Adjusts the audio output of the band 1 RF module to the audio amplifiers in the TDFM-9100. This level is set at the factory for maximum undistorted audio at full volume. |
| ***Band 2 RX Audio*** | Adjusts the audio output of the band 2 RF module to the audio amplifiers in the TDFM-9100. This level is set at the factory for maximum undistorted audio at full volume. |

Press the knob to accept the setting. The radio will then return to normal operating mode. The radio will keep these settings until they are changed again.

## 2.19 FRONT PANEL PROGRAMMING (FPP) MODE

All modules have the capability to program channel information such as frequencies, PL tones, modulation types, etc from the front panel provided the modules were ordered with the FPP option. FPP also must be activated in the APX CPS software for 'FPP' to appear in the soft menu.

Note: Individual zones must be activated for FPP in order to allow editing of channel information. For zones that have FPP disabled, the FPP menu will still function but no changes can be made to the channels in that zone. FPP can only be used on zones containing conventional analog or P25 channels. Zones with P25 Trunking or Motorola Trunking channels can only be programmed via APX CPS software.

Pressing FPP will initiate the following process:

***RX Frequency*** The receive frequency of the current channel will be displayed with the first digit blinking. Type in the desired frequency or just press the 'Next' menu key for no changes. Pressing 'Exit' menu key or the HOME key at any time will escape the programming process and bring the radio back into normal operating mode. If a invalid frequency is entered, the radio will revert back to the previously programmed frequency.

***TX Frequency*** The transmit frequency can be edited in the same fashion as the RX frequency.

***RX Mode*** The receive mode will be displayed. The mode can be Analog, Digital (P25) or Mixed (both). Press the knob or the 'Next' menu key.

***TX Mode*** The transmit mode will be displayed. Transmit mode can only be Analog or Digital and can only be changed if the receive mode was Mixed.

***RX CTCSS*** Receive CTCSS tone (also known as a PL or TPL tone) will be displayed. Rotate the knob for the desired tone or 'OFF'. Press the knob or 'Next' menu key.

***RX DCS*** RX DCS will only appear if the RX CTCSS was set to 'OFF'. The receive DCS code (also known as a DPL code) will be displayed. Rotate the knob to the desired code or 'OFF'. Selecting off will set the channel to carrier squelch only. Press the knob or 'Next' menu key.

***TX CTCSS*** Transmit CTCSS tone will be displayed. Rotate the knob for the desired tone or 'OFF'. Press the knob or 'Next' menu key.

***TX DCS*** TX DCS will only appear if the TX CTCSS was set to 'OFF'. The transmit DCS code will be displayed. Rotate the knob to the desired code or 'OFF'. Selecting off will set the channel to carrier only. Press the knob or 'Next' menu key.

***RX NAC*** The receive network access code will be displayed. The NAC is a 3 digit hexadecimal number which can include digits 0-9 and letters A-F. The keypad will act as numbers or letters. '123' or 'ABC' will be displayed on the bottom right corner of the display to indicate the mode which can be changed by rotating the knob. Press the knob or 'Next' menu key when the desired NAC is entered.

***TX NAC*** Enter the TX NAC as described above.

***Zone Name*** The Zone name will be displayed. The first letter will be flashing. Rotating the knob will scroll through the available letters, numbers and symbols. Press the knob to move to the next letter. Press 'Next' when done editing.

***Channel Name*** The Channel name will be displayed. Edit the channel name as described above.

***Talkgroup ID*** The Talkgroup ID will be displayed. This is a 4 digit hexadecimal number that can be edited as described under RX NAC above. Press 'Next' when done editing.

The radio will return to normal operating mode.

The following is a list of supported CTCSS/PL/TPL tones with the corresponding Motorola PL codes:

| PL(Hz) | MCODE | PL(Hz) | MCODE | PL(Hz) | MCODE | PL(Hz) | MCODE |
|---|---|---|---|---|---|---|---|
| 67.0 | XZ | 97.4 | ZB | 141.3 | 4A | 206.5 | 8Z |
| 69.3 | WZ | 100.0 | 1Z | 146.2 | 4B | 210.7 | M2 |
| 71.9 | XA | 103.5 | 1A | 151.4 | 5Z | 218.1 | M3 |
| 74.4 | WA | 107.2 | 1B | 156.7 | 5A | 225.7 | M4 |
| 77.0 | XB | 110.9 | 2Z | 162.2 | 5B | 229.1 | 9Z |
| 79.7 | WB | 114.8 | 2A | 167.9 | 6Z | 233.6 | M5 |
| 82.5 | YZ | 118.8 | 2B | 173.8 | 6A | 241.8 | M6 |
| 85.4 | YA | 123.0 | 3Z | 179.9 | 6B | 250.3 | M7 |
| 88.5 | YB | 127.3 | 3A | 186.2 | 7Z | 254.1 | OZ |
| 91.5 | ZZ | 131.8 | 3B | 192.8 | 7A | CSQ | CSQ |
| 94.8 | ZA | 136.5 | 4Z | 203.5 | M1 | | |

**TABLE 2.1** TDFM-9100 CTCSS/PL/TPL tones vs Motorola PL Codes

The following is a list of TDFM-9100 supported DCS/DPL CODES:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 023 | 072 | 152 | 244 | 343 | 432 | 606 | 723 |
| 025 | 073 | 155 | 245 | 346 | 445 | 612 | 731 |
| 026 | 074 | 156 | 251 | 351 | 464 | 624 | 732 |
| 031 | 114 | 162 | 261 | 364 | 465 | 627 | 734 |
| 032 | 115 | 165 | 263 | 365 | 466 | 631 | 743 |
| 043 | 116 | 172 | 265 | 371 | 503 | 632 | 754 |
| 047 | 125 | 174 | 271 | 411 | 506 | 654 | |
| 051 | 131 | 205 | 306 | 412 | 516 | 662 | |
| 054 | 132 | 223 | 311 | 413 | 532 | 664 | |
| 065 | 134 | 226 | 315 | 423 | 546 | 703 | |
| 071 | 143 | 243 | 331 | 431 | 565 | 712 | |

**TABLE 2.2** TDFM-9100 DCS/DPL Codes

## 2.20 PROGRAMMING CONSIDERATIONS

Every attempt has been made to allow the RF modules to behave as the Motorola APX-7000 portable. In most cases, an existing code plug can be loaded into one of the TDFM-9100 RF modules and it will operate normally. However there are some situations that must be considered when programming the TDFM-9100 through APX CPS software or FPP at the front panel:

Zone/Channel Name - Although both zone and channel names can contain as many as 14 characters each, there are only 14 character spaces on the display available in total. It is suggested the zone name be no longer than 5 characters and the channel name no longer than 9 characters to be displayed properly. Longer names will be cut off at the end.

Menu items - As mentioned before, programming CHAN or ZONE into the soft menu would be redundant and confusing as the TDFM-9100 already has the knob performing these functions. Other soft menu items such as INFO or CLOCK are not supported due to insufficient display space.