

TECHNISONIC

Communications

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TDFM-136B
ANALOG/DIGITAL
VHF/FM TRANSCEIVER

TDFM-136B

ANALOG/DIGITAL VHF/FM TRANSCEIVERS

The all new Technisonic TDFM-136B is a Project 25 U.S. Forest Service compliant airborne VHF/FM transceiver. Providing digital or conventional analog FM communications on every currently available channel from 136 to 174 MHz within the VHF/FM band. The new 136B has been designed from the ground up with your forestry mission in mind as a drop-in replacement for existing Technisonic and NPX radio sets.

- The TDFM-136B operates on the Common Air Interface and is capable of multimode operation at 12.5 kHz analog* and Project 25 12.5 kHz digital modulation on a channel-by-channel basis.
- The TDFM-136 transceiver features a Two Channel Synthesized Guard receiver.
- Allows up to 230 non-volatile memory positions (channels) via front panel 12 button key pad, or downloaded from a PC.
- Direct Entry or Simplex mode is accomplished by simply keying in the desired operating frequency.
- A 48-Character, 2 line LED matrix display, is available in green or optional NVG compatible.
- Support of unique CTCSS and DCS signaling for transmit and receive frequencies.
- New architecture is based on Digital Signal Processor (DSP) technology and does not depend on availability of proprietary chip sets from competitive vendors.
- Encryption support of DES single bit cypher feedback encryption to enable operation with existing systems and is upgradeable to Project 25 DES OFB or AES encryption standard.
- A USB upload/download function allows the operator to program all radios via a PC.
- Scan enabled across any or all of the channels stored in the preset memory positions.
- The TDFM-136B transceiver is panel-mounted (standard Dzus) and completely self-contained in a 3.0" (H), 5.75" (W) and 8.0" (D) chassis weighing just 3.5 pounds.
- Front panel controls are MAIN for main channel volume, GUARD for guard channel.



TDFM-136B GENERAL SPECIFICATIONS

Frequency Range:

136.000 MHz to 174.000 MHz

Operating Modes:

Project 25 CAI and conventional analog simplex or semi duplex

P25 Conventional Digital Mode

Channel Spacing: 12.5 /25 kHz * (230 Preset Channels)

Dimensions: 3.0" (H), 5.75" (W) and 8.0" (D)

Weight: 3.5 Lbs (1.6 Kg)

Temperature Range: -45°C to 70°C

Power Requirement: 28 V DC

Certification: FCC and DOC Type Approved

Guard receiver: 2 channel synthesized

CTCSS Squelch Capability:

Encodes/decodes all 64 available tones

DPL/DCS capability: All available digital squelch codes

DTMF Encoder: All standard DTMF tones supported

Audio Output: 500mW into 600 ohms

Speaker Output: 2.5 Watts into 4 ohms

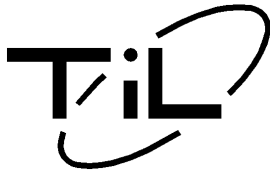
Backlighting: 28V DC or 5V DC, software selectable

* 25 kHz analog operation is only enabled where permitted by statute

MORE CAPABLE. LESS COST.

Corporate Headquarters

240 Traders Blvd.
Mississauga, ON Canada L4Z 1W7
905.890.2113



TDFM-136B

VHF/FM DIGITAL AIRBORNE TRANSCEIVER



INSTALLATION INSTRUCTIONS

TiL Document No. 08RE398

Revision B Issue 2

JANUARY 2013

Technisonic Industries Limited

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IMPORTANT INFORMATION

As of January 1st, 2013, the FCC will no longer allow transceivers to be delivered to the US that are capable of Wideband (25kHz) channel spacing in the commercial 2 way mobile / base sections of the VHF and UHF bands. Low band VHF and 700/800 MHz are not affected.

The TDFM-136B transceiver is affected by this new rule and has been modified to restrict Wideband operation on the above bands. When programming the radio from the front panel, if Wideband has been disabled then the Wideband ('w') Operating Mode will not be available as a selection. When using the TDP-136 programming software, a warning will be issued if the user attempts to load Wideband channels into a radio that has had Wideband disabled. If the user elects to ignore the warning and load the Wideband channels anyway, the transceiver will automatically set the channels to receive only.

! 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

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 1.0 meter 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 B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. 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. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- Re-orient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet or circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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

WARRANTY INFORMATION

The Model TDFM-136B VHF/FM Digital 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 Blvd.,
Mississauga, Ontario
L4Z 1W7

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

STC APPROVALS

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 (both US and Canadian) on its airborne FM products for many helicopters currently being delivered in the US and Canada as well as a number of single engine fixed wing aircraft. The DO-160C test data, referenced below, are 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 Industries Ltd. and require the written authority of Technisonic for their use. To assist Factory Authorized Technisonic Dealers in the certification process, we have placed copies of our Canadian and US STCs on our website along with a letter of authorization for their use. These documents may be downloaded and used as support for the technical submission to FAA or Transport Canada. Only factory authorized 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 website www.til.ca for the latest issue of available STCs and letter of authorization for use.

Document Revision Table for 08RE398				
Rev.	Page	Description	Date	Edited By
A	2-6 2-7	Added 2.7.10 to describe Power Jumper. Updated figure 2-4 to reflect new MCU board.	15-May-2012	F.M.
B	1-4 2-3	Corrected Table 1-6: DO-160G; Radio Frequency Susceptibility Category T. Updated figure 2-2 to add Memory Up / Down push buttons to parts list (Item 4).	02-Jan-2013	F.M.
B - 1	Inside Front Cover Back Page	Added information statement regarding new FCC Wideband restrictions. Added Warranty Information	11-Feb-2013	F.M.
B - 2	i-v iv 2-3 3-7 All	Corrected Page Numbers (Roman Numerals used to begin at iii). Corrected Table of Contents (Incorrect Page Numbers) Corrected Figure 2.2: Detailed Wiring Connections. - Added Optional High Pass Filter - Updated AC references under Notes Updated Procedure D to allow Flight Testing for Glide Slope Interference. Corrected Spelling & Grammar throughout document.	13-Jan-2014	A.L.

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GENERAL DESCRIPTION

1.1 Introduction

This publication provides operating and installation information for the TDFM-136B Digital Transceiver manufactured by Technisonic Industries Limited. The TDFM-136B is Project 25 (P25), Phase 1 compliant. The unit offers digital or conventional analog FM communications over an extended frequency range with selectable channel spacing and is intended for use (in the U.S.) only by government agencies or contractors thereto who have obtained licensing for operation in the 136-150 MHz portion of the band. If the TDFM-136B transceiver is used in CANADA, operation is restricted to the following sub bands: 138-144, 148-148.99, 149.005-150.005, and 150.05-174 MHz. Furthermore, the frequency agile transceiver is restricted to airborne use and must not be operated as a base station in Canada.

1.2 Description

The TDFM-136B Transceiver is a frequency agile, fully synthesized airborne transceiver capable of operating in the 136.000 MHz to 174.000 MHz frequency range in 2.5kHz increments (with either 25 kHz analog, 12.5 kHz analog channel spacing, and P25 12.5 kHz digital modulation on a channel by channel basis. The Transceiver can operate without restriction on any split frequency pair in the band and also incorporates a two channel synthesized guard receiver.

The TDFM-136B Transceiver provides 230 operator accessible memory positions. Each of which is capable of storing Scan List membership information, up to eight (8) character alphanumeric identifiers, and Operating Mode information. In addition, each memory position contains information for both transmit and receive including: frequency, CTCSS tone, DCS (DPL) code, P25 TalkGroup, and P25 Network Access Code (NAC) information.

Channel operating parameters, including frequency and other related data, are presented on a 48 character, two line LED matrix display. Data entry and function control takes place via a 12 button keypad.

1.3 Purpose of Equipment

The TDFM-136B Digital VHF/FM Transceiver is designed to provide secondary airborne communications to facilitate operations which are typically performed in a low altitude environment. The transmitter section of this unit has a minimum of 8 watts and does not exceed 10 watts output power (which may be reduced by a front panel switch to 1 watt in order to reduce interference to land based systems).

1.4 Model Variation

The base Part Number for the Model TDFM-136B is 081252. There are three parameters that affect model variation: display lighting, number of antennae, and encryption operation. The combinations result in 12 possible extensions to the base part number and are shown in Table 1-1 below.

Table 1-1. TDFM-136B - Model Variation			
Parameter			Part Number
Display Lighting	Antennae	Encryption Capable	
Green	Single	No	081252-1-10
Green	Single	Yes	081252-1-11
Green	Dual	No	081252-1-20
Green	Dual	Yes	081252-1-21
Red	Single	No	081252-2-10
Red	Single	Yes	081252-2-11
Red	Dual	No	081252-2-20
Red	Dual	Yes	081252-2-21
N/V	Single	No	081252-3-10
N/V	Single	Yes	081252-3-11
N/V	Dual	No	081252-3-20
N/V	Dual	Yes	081252-3-21

1.5 Technical Characteristics

The tables below provide the technical characteristics for the Technisonic Industries Ltd. Model TDFM-136B.

Table 1-2. TDFM-136B - General Characteristics	
Characteristic	Specification
Dimensions (including heat sink)	Approx. 8.0" X 3.0" X 5.75"
Weight	Approx. 3.5 Lbs (1.6 Kg)
Mounting	Panel Mount via DZUS fasteners
Power Requirement: Voltage Current	28.0 VDC, $\pm 15\%$ Receive - 0.7 A Max. Transmit Low Power (1W) - 1.3 A Max. Transmit High Power (8-10W) - 2.0 A Max.
Audio Output Power: Headset Speaker Output	0.5 Watts into 600 ohms 2.5 Watts min. into 4 ohms
Back Lighting	28 Volts / 5 Volts
Display Colour	Green (standard) Red (specify) NVG (specify)
Temperature Range: Operating Storage	-45°C to +70°C -55°C to +85°C
Altitude	50,000 feet

Table 1-3. TDFM-136B - Operational Characteristics	
Characteristic	Specification
Frequency Range	136.000 to 174.000 MHz
Operating Modes	Conventional Analog: 12.5 / 25 kHz. P25 CAI: 12 KBPS FSK, 9.6 KBPS C4FM
Channel Spacing:	25 kHz. or 12.5 kHz
Programmable Memories:	230 memories
Scan Lists	15 scan lists
Description	Up to 8 characters, alpha-numeric
Operating Modes	Analog Wide, Analog Narrow, P25 Digital
Frequency	Rx/Tx (Simplex/Duplex), 136.0000 – 174.0000
Squelch Modes	Rx/Tx (Simplex/Duplex), CTCSS Tones, DCS Codes, P25 TalkGroup, P25 NAC
Guard Receiver:	2 channels programmed with:
Description	Up to 8 characters, alpha-numeric
Operating Modes	Analog Wide, Analog Narrow, Digital
Frequency	Rx/Tx (Simplex/Duplex), 136.0000 – 174.0000 MHz.
Squelch Modes	Rx/Tx (Simplex/Duplex), CTCSS Tones, DCS Codes, P25 TalkGroup, P25 NAC
CTCSS Tones	42 CTCSS tones, including all standard tones.
DCS Codes	All standard DCS (DPL*) codes
P25 TalkGroup	\$0000 to \$FFFF (0 to 65535)
P25 Network Access Code (NAC)	\$000 to \$FFF (0 to 4095)

* DPL is a trademark of Motorola Corporation

Table 1-4. TDFM-136B - Receiver Characteristics - Main and Guard	
Characteristic	Specification
Sensitivity at 12 dB SINAD	-116dBm
Adjacent Channel Selectivity	-60dB (25 or 12.5 kHz)
Spurious Attenuation	-70 dB
Third Order Intermodulation	-70 dB
Image Attenuation	-80 dB
FM Acceptance	± 6 kHz
Hum and Noise	Better than 45dB
Audio Distortion	Less than 5%
Antenna Conducted Emission	Less than -57dBm

Table 1-5. TDFM-136B - Transmitter Characteristics	
Characteristic	Specification
RF Output Power: Low High	1 watt 10 watts
Output Impedance	50 ohms
Maximum Deviation: Wide (25 kHz) Narrow (12.5 kHz)	± 5 kHz ± 2.5 kHz
Maximum Deviation – Narrow	± 2.5 kHz (12.5 kHz mode)
Spurious Attenuation	-90 dB below carrier level
Frequency Stability	± 2.5 ppm
Microphone Circuit	Carbon or equivalent
Side-tone Output	0.5W (max) into 600ohms
Harmonic Attenuation	-65 dB below carrier level
FM Hum And Noise	-40 dB
Audio Input	50 mV at 2.5 into 200 Ω input circuit for ± 3.5 deviation, adjust.
Audio Distortion	Less than 5%

1.6 Certification Summary

The following table gives a summary of DO-160G Environmental Testing for Technisonic Model TDFM-136B VHF Digital Transceiver.

Table 1-6. TDFM-136B - Environmental Testing Summary		
Conditions	Section	Conducted Test
Temperature and Altitude	4.0	Equipment tested to Categories B2 and D1.
Temperature Variation	5.0	Category B.
Humidity	6.0	Category A.
Operational Shock and Crash Safety	7.0	Category A.
Vibration	8.0	Equipment is tested without shock mounts to categories S and U.
Magnetic Effect	15.0	Equipment is class A.
Power Input	16.0	Category B.
Voltage Spike	17.0	Category B.
Audio Frequency Susceptibility	18.0	Category B.
Induced Signal Susceptibility	19.0	Category A.
Radio Frequency Susceptibility	20.0	Category T.
RF Emission (DO-160D)	21.0	Category B.
RF Emission (DO-160C)	21.0	Category Z.
Electrostatic Discharge	25.0	Category A.

SECTION 2

INSTALLATION INSTRUCTIONS

This section contains information and instructions for the correct installation of the TDFM-136B VHF/FM Digital Transceiver.

Prior to installation, make certain that the correct frequencies are pre-programmed in accordance with the equipment user's valid FCC operator's license.

2.1 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. Verify that the equipment display and back-lighting configuration are the same as those ordered.

2.2 Transceiver Installation

The TDFM-136B Transceivers are designed to be Dzus mounted and should be installed in conjunction with a IN-150 installation kit. See Figure 2-3 for an outline drawing of the unit with dimensions to facilitate the installation.

2.3 Installation Kit - Contents

The IN-150 installation kit consists of:

1. One 15 pin Cannon D mating connector (female) complete with crimp pins and hood.
2. One BNC antenna mating RF connector (male) and hood.

2.4 Antenna Installation

Antenna, P/N CI-292 or a suitable equivalent, may be used with the TDFM-136B transceivers. The antenna should be mounted on the bottom of the aircraft whenever possible and must be located at least 1.0 meter (40 inches) from any occupant in the airframe. Consult the instructions provided with the antenna. Connect RF cable from antenna to the back of the TDFM-136B unit by utilizing the BNC mating connector provided in the installation kit.

2.5 Installation - Pin Locations and Connections

A single 15 pin DSUB connector, mounted on the rear of the unit, provides the means to connect all power, control, and audio signals between the TDFM-136B and the airframe. The pin numbers and locations for the 15 pin DSUB connector are shown in Figure 2-1 below. The view shown is of the connector mounted in the unit. Select the appropriate mating connector.

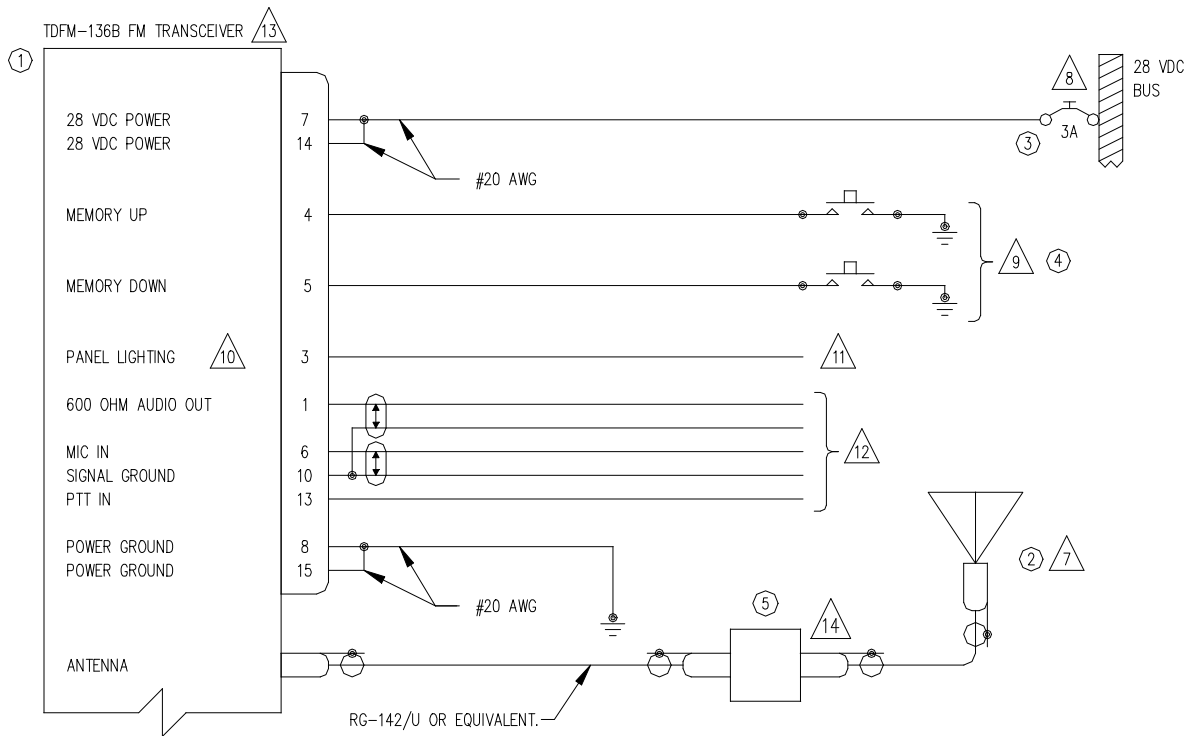


Figure 2-1. Transceiver Mounted View of the 15 Pin Connector

The description of the pin connections for the transceiver are provided in TABLE 3-1.

Pin #	Description	Notes
1	Audio - Headset	Output – 600 ohm
2	Serial Data Out	Output – RS232
3	Power - Panel Lighting	28VDC standard, 5VDC option
4	Signal - Memory Up	Input – Active Low
5	Signal - Memory Down	Input – Active Low
6	Audio - Microphone	Input
7, 14	Power - Main +28VDC	Power
8, 15	Power - Main Ground	Power
9	Audio - Speaker	Output – 4 ohm
10	Signal Ground	
11	Serial Data In	Input – RS232
13	Signal – PTT	Input – Active Low

Detailed wiring information is supplied in Figure 2-2 below.



QTY	ITEM	PART NUMBER	DESCRIPTION	SPEC	MATERIAL
1	1	TDFM-136B	VHF/FM COMMUNICATIONS TRANSCEIVER.	TECHNISONIC INDUSTRIES LIMITED	
1	2	CI-292-3	ANTENNA	COMANT	
1	3	7274-11-3	CIRCUIT BREAKER, 3 AMPS	KLIXON	
2	4	B9001BB	PUSH BUTTON	EATON	
1	5	133956-1	OPTIONAL HIGH PASS FILTER	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, SECTIONS 8-18.
- 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) INSTALLATION OF ANTENNA IAW AC 43.13-1B CHAPTER 2, 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 APPROXIMATE 1/4 OR 1/2 OR WHOLE NUMBER MULTIPLES OF THE NAVIGATION OR COMMUNICATIONS SYSTEM WAVELENGTH.
- 8) AN EQUIVALENT CIRCUIT BREAKER OR FUSE MAY BE USED.
- 9) THE MEMORY UP/DOWN PUSH BUTTONS ARE OPTIONAL.
- 10) THE TDFM-136B IS AVAILABLE WITH 28V OR 5V PANEL LIGHTING. CHECK THE CONFIGURATION CONTROL LABEL FOR THE CORRECT VOLTAGE.
- 11) CONNECT TO THE APPROPRIATE AIRCRAFT DIMMING BUSS.
- 12) CONNECT TO THE AIRCRAFT AUDIO SYSTEM OR STAND-ALONE HEADSET JACKS.
- 13) INSTALLATION OF TRANSCEIVER IAW AC 43.13-1B CHAPTER 2, SECTION 4 AND AC 43.13-2A, CHAPTER 2. PR 3 1/2 DZUS RAIL OR EQUIVALENT MAY BE USED.
- 14) OPTIONAL HIGH PASS FILTER, PART NUMBER 133956-1, TO REDUCE INTERFERENCE TO AM COM RADIO.
- 15) TEST THE SYSTEM IN ACCORDANCE WITH THE POST-INSTALLATION TEST PROCEDURE IN THE INSTALLATION AND OPERATING INSTRUCTIONS MANUAL.
- 16) REFER TO THE AIRCRAFT STRUCTURAL REPAIR MANUAL AND THE MAINTENANCE MANUAL FOR INSTRUCTIONS AND INFORMATION PERTINENT TO THIS INSTALLATION.
- 17) 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.

Figure 2-2. Detailed Wiring Connections for TDFM-136B Transceiver

2.6 Physical Dimensions

Figure 2-3 below shows the physical dimensions of the unit.

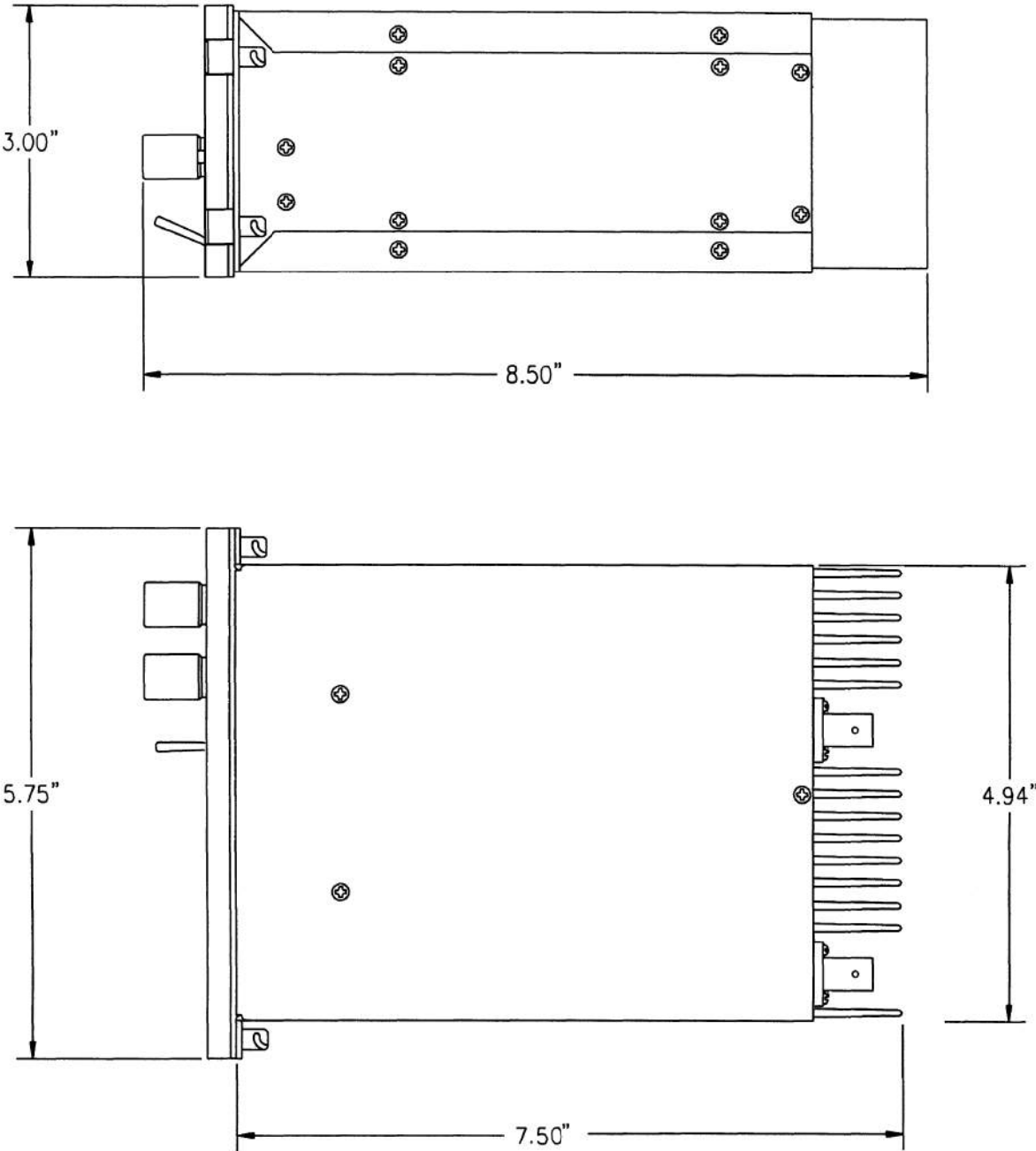


Figure 2-3. Outline Drawing for TDFM-136B Transceiver

2.7 Wiring Instructions

Figure 2-2 shows all required connections and recommended wire sizes for the TDFM-136B Transceiver operation in the airframe.

2.7.1 Main Power +28VDC

The main power +28VDC ($\pm 15\%$) is connected to pins 7 and 14 of the transceiver. Both pins should be connected.

2.7.2 Main Ground

Ground connections for the transceiver are made on pins 8 and 15. Both pins should be connected.

2.7.3 PTT (Ground Keying)

The PTT line is connected to pin 13 and should be floating when the transceiver is in receive mode and grounded during transmit mode.

2.7.4 Front Panel Back Lighting

Front panel back lighting connection should be made on pin 3 of the transceiver. The opposite end of this lead should be connected to the panel lighting system of the aircraft. Before connecting, verify the required panel lighting voltage. The unit is compatible with both 28V and 5V lighting bus voltages.

2.7.5 Audio Outputs (600 ohms and 4 Ohms)

The audio output from pin 9 can be used to drive a 4 ohm speaker up to 2.5 watts. Audio output from pin 1 is 600 ohms with a maximum of 0.5 watts.

2.7.6 Audio Output Ground

Pin 10 is the ground for both the 4 ohm and 600 ohm audio output signals on pins 9 and 1.

2.7.7 Mic Signal Input

The microphone input signal is to be provided on pin 6, utilising shielded wire with the shield grounded to pin 10.

2.7.8 Memory Up/Memory Down

Remote scrolling through the memory positions can be achieved by providing a ground to pins 4 (up) and 5 (down) through a momentary contact cyclic switch.

2.7.9 Data Input/Output

Channel data may be transferred to and from the unit using RS-232 communications protocol via pins 2 and 11.

2.7.10 Power Jumper

The radio must be turned on manually each time the avionics bus is switched on. If it is desired that the radio comes on with the radio master in the aircraft, remove the right side panel from the radio and install the supplied 0.1" jumper across JP1 (two pins) near the rear of the radio on the right side of the MCU board. The radio is shipped with the jumper on only one of the two pins. If you attempt to turn off the radio with the jumper installed, it will come back on again in 5 seconds. Turning the avionics bus or battery master switch off will be required to de-energize the radio.

2.8 Transmitter Side Tone Level Adjustment

The side tone level is set at the factory and there is no hardware adjustment. However, this level can be altered, via the radio software, to suit local conditions as follows:

1. Set the transceiver operating frequency to 155.0000 MHz and connect an appropriate test receiver to the RF output connector. Ensure that the output of the transceiver is terminated into a proper dummy load.
2. Key the transmitter and input a 1 kHz audio signal @ -10 dBm (0.25 VRMS) into the microphone input.
3. Select the Side-Tone Adjust command, and then adjust the side-tone level using the up/down arrows (keys 2 & 8) to produce a +3.0 dBm (1.0 VRMS) at the 600 ohm audio output (headset output).

2.9 Main and Guard Noise Squelch Adjustment

The squelch on both the main and guard receivers is factory set to open at approximately 0.5 microvolts; there is no hardware adjustment. However, this value can be altered, via the radio software, to suit local conditions as follows:

1. Set the main receiver of the transceiver to 155.000 MHz. Connect a signal generator to the antenna input of the transceiver.
2. Set the signal generator to produce a ± 3 deviation with a 1 kHz tone on 156.0000 MHz. Increase the signal generator RF level from 0.1 μ V until the squelch indicator LED is on. Verify the receiver SINAD ratio is between 12 and 14 dB.
3. If not, re-adjust main receiver squelch via the Edit Squelch software command.
4. Repeat the above procedure to adjust the guard receiver squelch setting using guard receiver squelch adjustment software command.

2.10 Reference Layouts

The reference layout, in Figure 2-4 below, shows the position of jumper control points for the MCU board.

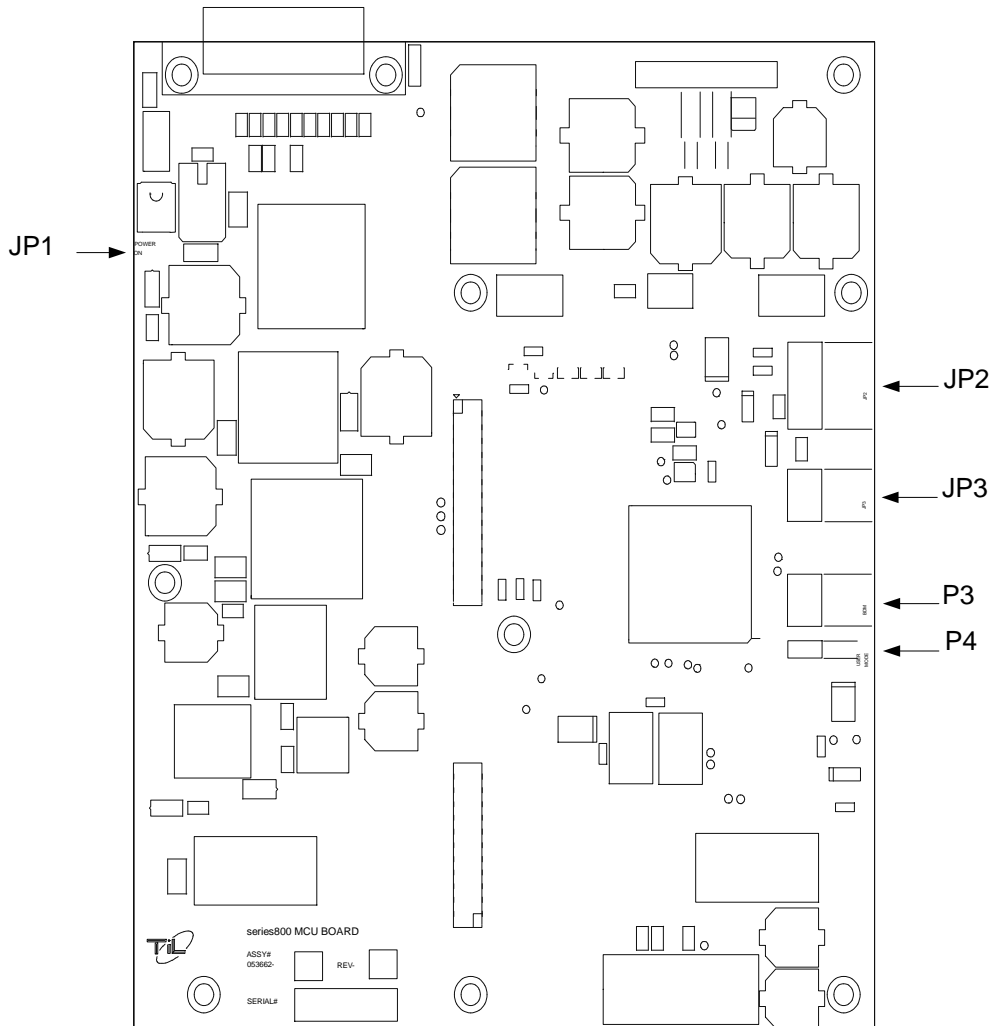


Figure 2-4. Control points for the TDFM-136B MCU Board

- JP1: Power jumper (see text). Not installed by default.
- JP2: Rear panel serial communications protocol select jumper:
1-3 & 2-4: RS-232 - default
All other combinations are invalid.
- JP3: Front panel serial communications protocol select jumper:
1-3 & 2-4: RS-485 - default
All other combinations are invalid.
- P3: Factory use only.
- P4: Maintenance mode enable. Not installed by default
(for bench use only; see Maintenance manual).

SECTION 3

Appendices

3.1 Appendix A CTCSS TONE TABLES and DCS CODE TABLES

Available CTCSS Tones
Tone
67.0
69.3
71.9
74.4
77.0
79.7
82.5
85.4
88.5
91.5
94.8
97.4
100.0
103.5
107.2
110.9
114.8
118.8
123.0
127.3
131.8
136.5
141.3
146.2
151.4
156.7
162.2
167.9
173.8
179.9
186.2
192.8
203.5
206.5
210.7
218.1
225.7
229.1
233.6
241.8
250.3
254.8

Available DCS Codes	
Code	Code
23	315
25	331
26	343
31	346
32	351
43	364
47	365
51	371
54	411
65	412
71	413
72	423
73	431
74	432
114	445
115	464
116	465
125	466
131	503
132	506
134	516
143	532
152	546
155	565
156	606
162	612
165	624
172	627
174	631
205	632
223	654
226	662
243	664
244	703
245	712
251	723
261	731
263	732
265	734
271	743
306	754
311	

3.2 Appendix B - POST INSTALLATION EMI TEST INSTRUCTIONS

3.2.1 PURPOSE

The purpose of these tests is to identify any interference that the TDFM-136B may cause with existing aircraft systems.

3.2.2 TEST CONDITIONS

The TDFM-136B 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, ensure that the power switch is in the high position.

3.2.3 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-136B Airborne FM 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-136B 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 movement 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 auto-pilot or a stability augmentation system, then test fly the aircraft and verify that operation of the TDFM-136B 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 auto-pilot (ILS, GPS, etc.) and look for any anomalies.

3.2.4 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-136B is transmitting providing that it recovers properly and promptly but 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. The TDFM-136B surpasses Industry Canada and FCC specifications for spurious output including harmonics of the transmitted frequency. However, with the close proximity of antennas and the high sensitivity of modern avionics, there may still be undesired interference. When undesired interference is detected, the following action should be taken:

Move the VHF FM antenna further away from the antenna connected to the system being interfered with.

Harmonics can also be generated by the aircraft itself where dissimilar metals meet or in other avionics systems.

If the interference is not rectified, the unit shall be placarded to avoid use during the appropriate phase of flight. For example, if the unit causes undesired operation of the ILS, then the TDFM-136B should be placarded, "Not to be used during an IFR ILS approach."

3.2.5 PROCEDURE

- A. Operate the TDFM-136B 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	
	Pass	Fail	Pass	Fail
143.1800 MHz				
143.1825 MHz				
157.5000 MHz				
157.5425 MHz				

NOTES:

- B. Determine if the image frequency for the VHF Comm falls within the range of the TDFM-136B. If so, select a set of frequencies that will cause the TDFM-136B 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-136B 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 receive 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-136B to 142.8000 MHz.

Frequencies		Results	
VHF #1	TDFM-136B	Pass	Fail
135.975 MHz	138.0000 MHz		
121.150 MHz	157.5000 MHz		
131.250 MHz	157.5000 MHz		
Image			

Frequencies		Results	
VHF #2	TDFM-136B	Pass	Fail
135.975 MHz	138.0000 MHz		
121.150 MHz	157.5000 MHz		
131.250 MHz	157.5000 MHz		
Image			

NOTES:

- C. Determine if the image frequency for the VOR/ILS Nav falls within the range of the TDFM-136B. If so, select two sets of frequencies that will cause the TDFM-136B 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-136B 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-136B	Pass	Fail
108.000 MHz	162.0000 MHz		
108.100 MHz	162.1500 MHz		
Image			
Image			

Frequencies		Results	
VOR / ILS #2	TDFM-136B	Pass	Fail
108.000 MHz	162.0000 MHz		
108.100 MHz	161.1500 MHz		
Image			
Image			

NOTES:

- D. The following procedure checks for second harmonic interference to the glide slope receiver from the TDFM-136B. All transceivers produce harmonics (multiples of the wanted frequency) and while the TDFM-136B far exceeds FCC requirements, interference can still be experienced depending upon antenna position and separation. Furthermore, other equipment in the aircraft and the structure of the aircraft can generate harmonics where dissimilar metals make contact or where grounds are isolated, etc. This is also true of aircraft hangers; 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-136B 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-136B. Fly the aircraft to intercept the localizer and glide slope (both needles centered) at 26 nm from the runway. Transmit on the TDFM-136B 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-136B shall be placarded, "Do not transmit while on ILS approach."

<u>Localizer</u>	<u>Glide slope</u>	<u>Localizer</u>	<u>Glide slope</u>
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	
Glide Slope #1	TDFM-136B	Pass	Fail
334.7 (108.1)	167.3500 MHz		

Frequencies		Results	
Glide Slope #2	TDFM-136B	Pass	Fail
334.7 (108.1)	167.3500 MHz		

NOTES:

For the following tests (E & F), select a frequency at the top, middle, and bottom of the band of the TDFM-136B Transceiver.

VHF Band (138 to 174 Mhz)	
Frequency No. 1	
Frequency No. 2	
Frequency No. 3	

- E. At a safe altitude, engage the autopilot or stability augmentation system. Modulate the TDFM-136B on the above frequencies for at least 20 seconds. Observe any effect on the autopilot or stability augmentation system.

Observations:

- F. Perform a coupled ILS approach to the aircraft's certified limits. Modulate the TDFM-136B transmitter on the above frequencies for at least 20 seconds. Observe any effect on the autopilot. Repeat for second flight director/autopilot if so equipped.

Observations:

- G. 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	Comm 1 and Comm 2			
2	Transponder and Encoder			
3	ADF 1 and 2			
4	Vertical Gyro			
5	Glide slope 1 and 2			
6	VOR/LOC 1 and 2			
7	Directional Gyro			
8	Compass			
9	Fuel Pressure			
10	Oil Temperature			
11	Ammeter			
12	Bus Voltage			
13	Fuel			
14	Nt			
15	TOT			
16	% Torque			
17	Digital Clock			
18	Oil Pressure			
19	Annunciators			

Step	System	Pass	Fail	Notes
20				
21				
22				
23				
24				
25				
26				
27				

NOTES:

3.3 Appendix C – WARRANTY INFORMATION

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.**

MODEL TDFM-136B

Airborne Digital/Analog VHF FM Transceiver



Technisonic Analog/Digital VHF FM Transceiver

The Technisonic TDFM-136B Project 25 (Phase I) compliant airborne VHF transceiver provides digital or conventional analog FM communications on every currently available channel (from 136 to 174 MHz) within the General Radio Service VHF/FM High Band. The TDFM-136B operate on the Common Air Interface defined in TIA/TSB102 and is capable of multi-mode operation for 25 KHz analog*, 12.5 KHz analog, and Project 25, 12.5 KHz digital modulation on a channel by channel basis. Operational data can be entered into 230 non volatile memory positions(channels) via a front panel 12 button keypad, or downloaded from a PC via either a Serial or USB programming cable. Mode select and function control are also via the keypad. Operating frequencies, alpha numeric identifiers and other related data are presented on a 48 character, two line LED Matrix display, with NVG compatibility offered as an option. The analog modes include unique CTCSS and DCS signalling for transmit and receive frequencies, while the digital channels include both NAC and Talk Group as defined in the Project 25 SOR. This multi-mode capability enables the TFM-136B to operate within a system where both conventional analog and P25 digital systems are in use. The TDFM-136B architecture is based on Digital Signal Processor (DSP) technology and does not depend on availability of proprietary chip sets from competitive vendors.

The TDFM-136B can be operated in the Direct Entry mode by simply keying in the desired operating frequency. It can also function without restriction on any split frequency pair within the band. This radio features 230 preset memory positions, each capable of storing a receive frequency, a transmit frequency, and alpha numeric identifier for each channel, as well as DPL or DCS coded squelch information for each channel. Conventional or digital mode is selected while programming each individual channel. An upload/download function allows the operator to download channel information from a PC, or upload stored data from the transceiver to a PC using the proprietary software provided with each transceiver. Information stored in the transceiver's memory is available for instant recall by keypad entry, or by pressing the UP or DOWN buttons which will allow the operator to scroll through all preset channels. The TDFM-136B transceiver features a two channel synthesized guard receiver, a DTMF encoder for signalling during transmit and a scan function which will scan up to sixteen of the preset channels at once.

The TDFM-136B transceiver is panel mounted (standard Dzus) and completely self contained in a 8.0 x 3.0 x 5.75 inch chassis weighing just 3.5 pounds. Front panel controls are MAIN for main channel volume, GUARD for guard channel volume, a MN/GD switch for main or guard transmit select, and a G1/G2 switch which allows for selection of Guard 1 or Guard 2. Hi power is 10 Watts RF output. Lo power is 1 Watt. This transceiver offers 28 volt or 5 volt DC backlighting (software selectable), which is controlled from the aircraft dimmer bus, while display brightness is controlled from the aircraft dimmer bus with override from the front panel keypad. Mic gain and sidetone level can be adjusted in software for easy installation and set up for optimum performance. The Technisonic TDFM-136B transceiver is compliant with RTCA DO 160G categories relating to electrostatic discharge, vibration, overpressure, humidity, temperature and altitude, magnetic effect, power input, RF susceptibility, voltage spike, operational shock and crash safety, decompression, and RF emissions.

* - 25 KHz analog operation is only enabled where permitted by statute.

TDFM-136B General Specifications

Frequency Range	136.000 to 174.000 MHz
Operating Modes	Project 25 conventional analog simplex or semi-duplex mode. Project 25 conventional digital mode. Conventional analog mode restricted to 12.5 KHz for use in the US.
Channel Spacing	6.25 / 12.5 / 25 KHz (230 Preset channels) *
Dimensions	Approx 8.0 x 3.0 x 5.75 inches
Weight	3.5 Pounds (1.6 Kg)
Temperature range	-45 deg C to +70 deg C
Power requirement	28VDC, Receive – 500 mA, 1 Watt transmit – 900 mA, 10 Watts Transmit – 1.7 Amps
Functionality	Clear analog voice – P25 non trunked modes in accordance with P25 CAI (IS 102BAAA) Clear digital voice (DVS1 IMBE Vocoder).
Certification	FCC and Industry Canada Type Approved
Environmental Cat	Meets or exceeds the Minimum Operational Performance Standards for the following RTCA/DO-160G environmental test categories

Category	Test Section
A2, B2, D1	Temperature and Altitude
B	Temperature Variation
A	Humidity
A	Operational Shock and Crash Safety
S, U	Vibration
Z	Magnetic Effect
B	Power Input
B	Voltage Spike
B	Audio Frequency Susceptability
AC	Induced Signal Susceptability
T	Radio Frequency Susceptability
M	Radio frequency Emission
A	Electrostatic Discharge

Guard receiver	2 channel synthesized, Project 25 (Phase I) compliant
CTCSS squelch	Encodes/decodes all 64 available tones
DCS capability	Supports all available digital squelch codes
DTMF encoder	Supports all standard DTMF tones
Audio Output	500 mw into 600 ohms
Speaker Output	2.5 Watts into 4 ohms
Backlighting	25VDC or 5VDC, software selectable
Display	48 character, two line LED matrix

* - 25 KHz analog operation is only enabled where permitted by statute.

Minimum Performance Specifications

Main Receiver

Sensitivity	-116dBm
Adjacent Channel	-60dB for both analog and digital channels
Spurious response	-70dB
Third order intermod	-70dB
Image attenuation	-80dB
FM acceptance	+6KHz
Hum and noise	45dB 25 KHz, 40 dB 12.5 KHz
Audio distortion	less than 5%
Antenna emissions	less than -57dBm

Main Transmitter

RF power output	Lo power – 1 Watt, Hi power – 10 Watts
Output impedance	50 Ohms
Maximum deviation	Limited to 2.5 KHz for 12.5 KHz channels and 5 KHz for 25 KHz channels
Spurious attenuation	-90 dB below carrier level
Frequency Stability	+ 0.00025%
Microphone Circuit	Carbon or equivalent
Sidetone Output	500 mw (max) into 600 ohms
Harmonic attenuation	-65dB below carrier level
FM hum and noise	-40 dB
Audio input	-20dBm to 0dBm for full deviation

Guard Transceiver

All specifications identical to Main transceiver