TDFM-136A

VHF/FM DIGITAL AIRBORNE TRANSCEIVER

MODIFICATION GUIDE

Til Document No. 12RE463

Rev. NC

AUG 2012

Technisonic Industries Limited.

! WARNING !

For Approved Radio Shop Use ONLY.

The procedures described herein are to be performed by qualified personnel only, if you are an end user, please locate an approved maintenance facility to perform any of the described procedures for you.

This procedure assumes familiarity with the TDFM-136A, and access to all pertinent documentation.

CONTACT INFORMATION

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REVISIONS

Document Revision Table for 12RE4xx				
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SECTION 1 - INTRODUCTION

This guide provides information regarding the hardware modification of the TiL TDFM-136A as of the date indicated on the front of the document. As the product has been discontinued due to parts availability issues, this summary is considered complete at this time.

This guide assumes that the user is familiar with general electronics repair and handling procedures and practices, and that the user has access to appropriate tools and specific device documentation.

1.1 Scope

It is the intent of this document to provide the user the modification history of the transceiver, and the ECO (Engineering Change Orders) that describe those modifications. As well, this provides a one-stop location of all the necessary information including pictures that may not have been part of the original ECO documentation.

1.2 Modification Index

The modification index is given in table 1 below with reference to the appropriate TiL ECO's.

Table 1. TDFM-136A Modification Index

MOD #	Description	Apply to FDA	ECO
1	Restrict condition that may lead to high current draw that could damage Q1 on Power Switch board in Front Panel.	1427 & lower	10C881
2	Front Panel Board: Change R11 & C18 to pull Display reset low on power up. Replace R6 to reduce Vled. Add cross-linked diodes between Vled & Vlog on display board to keep voltage levels linked.	1475 & lower see “Mod 2” for details	10C876B 10C882B
3	Power Switch Board: replace MTD20P06HDL MOSFET with SUD50P06-GE3. The SUD part has a much lower Rds on, and thus runs much cooler.	1542 & lower	10C890B
4	Modified main Heatsink	As needed	10C922B
5	RF Amplifier Board: Add MMIC Amp a to improve receive sensitivity.	1616 & lower	11C931E
6	MCU Board: Permanently close Jumper J2 on MCU. Needed for Release 3 firmware.	1634 & lower	11C946A
7	D25 Mounting: Replace white thermally conductive paste with thermally conductive foam. Add spacers to stand-offs in housing for PCB mount.	1662 & lower	11C006B

1.3 Modification Recommendations

A recommendation for each modification is shown in table 2 below. These are expanded on in the body of this document at each modification entry.

Table 2. TDFM-136 Modification Recommendation		
MOD #	Description	Recommendation
1	RF Amplifier: Change resistor to remove possibility of high current condition.	Perform
2	Front Panel Board: Modify to pull display reset line low. Front Panel Board: Change R6 to reduce Vled. Front Panel Board: Back to back diodes across Vled/Vlog	Do not perform Do not perform Perform
3	Power Switch Board: Replace MOSFET.	Perform
4	Replace Main Heat sink.	Evaluate
5	RF Amplifier Board: Add MMIC Amp to receiver.	Perform
6	MCU: Close J2.	Perform
7	D25 Chassis: Replace paste with foam, add spacers.	Perform

Before starting be sure to read all the instructions completely, and have any necessary documentation and equipment available.

SECTION 2 - MODIFYING THE RADIO

This section contains a description of each of the modifications, the importance, the scope, and a recommendation of whether or not to perform it with reasons.

2.1 MOD 1 – Remove possibility of excessive current draw

In an early versions of the TDFM-136A, upon transmit it could happen that the RF module would demand excessive current for the RF power amplifier. In this case the transistor Q1 on the Power Switch board could overheat. This modification sets a current limit to remove the possibility of exceeding the safe level.

Importance: Critical – unmodified units can draw excessive current and burn Q1 on the Power switch board in the front panel.

Scope: This was performed in the factory upon discovery (from FDA1428). Given the severity of the problem a bulletin was released (SBFM 03.1-01) and a major effort was made to alert users. Any unit returned had this modification automatically applied.

Modification: Change R37 on RF Amplifier board from 5k to 20k ohm (0805, TiL# CRCW0805 203).
Reference ECO: 10C881.

Recommendation: Perform.

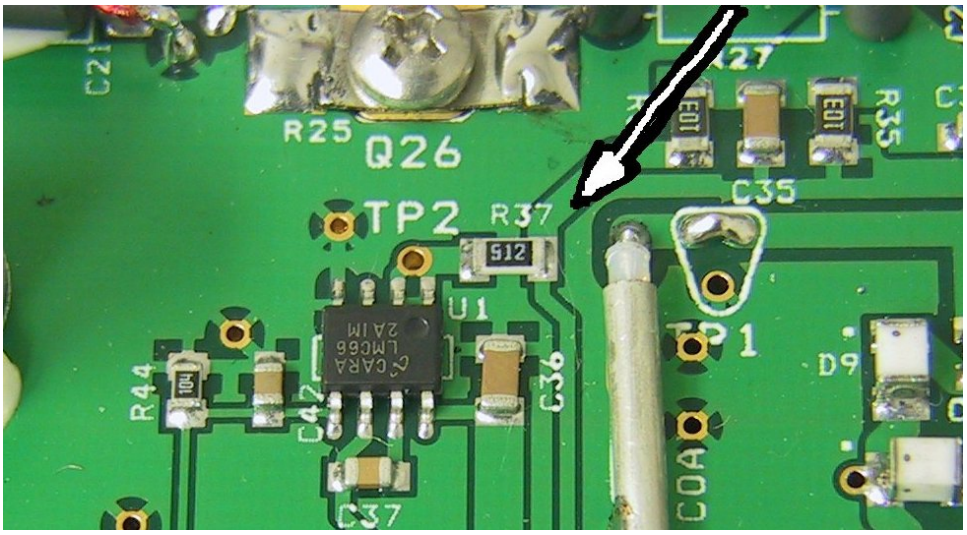

Figure 1. Location of R37 on Main RF Amplifier Module

Instructions:

1. Remove top cover, and locate R37 on the RF Amplifier Board (ASSY# 093764-1).
2. Replace R37 on Amplifier board.
3. Assume thermal stress to Q1 on Power Switch Board – perform MOD 3 below.

2.2 MOD 2 – Modifications to fix Display board failures

When we initially saw a series of display failures there was no positive identification of the failure mode, so three possibilities were addressed:

a) keep the display reset line low during boot.
b) adjust Vled such that it was better centered in the recommended range such that potential power surges stayed in the safe operating area.
c) lock the supply voltages such that they could not vary by more than a diode drop.

Item 1 was covered in 10C876, while items 2 & 3 were covered by 10C882. Some time after these were introduced we had verification that the solution was item 3.

Importance - Varies as follows:

a) The controlling MCU and the display share the same voltage supply, so practically speaking the reset line will never be high before power is applied.
b) While Vled was initially set in the higher end of the operating range, it was still well within specified range, there is no reason to believe that this contributed to a failure.
c) This is a verified failure mode and should be addressed.

Scope: These were all applied at the factory upon discovery of problems (from FDA1475 on), also we perform them on any units returned that note display problems.

Modification 2a: Remove R11. Remove C18, replace it with a 47k resistor (0805, TiL# CRCW0805 473).
Reference ECO: 10C876B

Recommendation: Do not Perform – The value gained is low and the difficulty due to location of the parts is high.

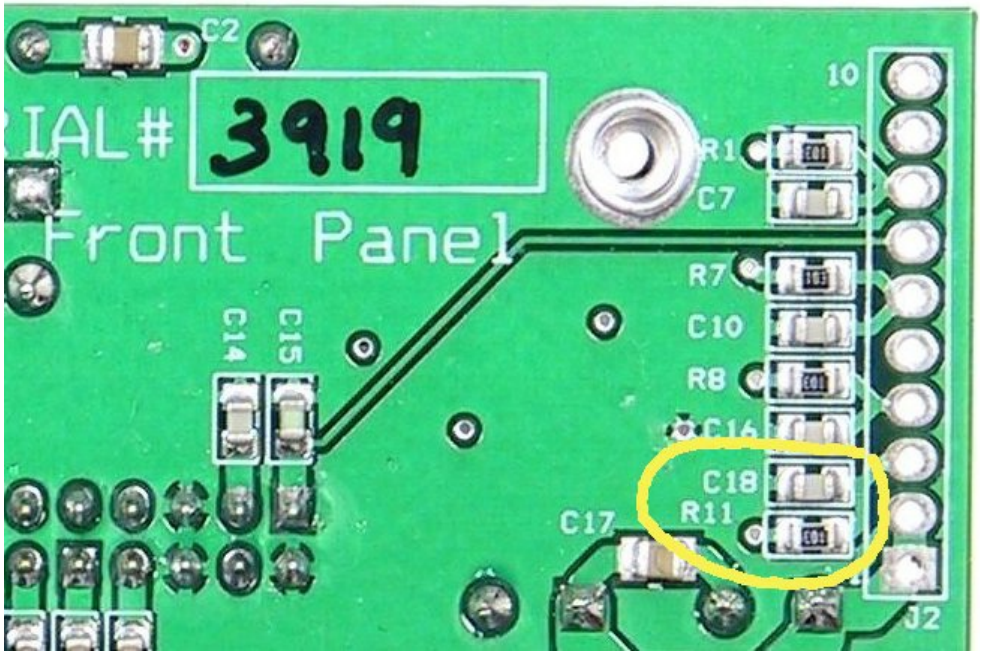

Figure 2. MOD 2a - Location of R11 and C18 on Front Panel Board.

Note: that if you *do* decide to remove the display board to perform this, then you should consider performing MOD 2b as well.

Instructions:

1. Remove the Front Panel Assembly from the radio, be sure not to damage the wires for the module keyloader connections.
2. Remove the Front Panel Interface Board (ASSY# 093762-1) from the Front Panel Assembly.
3. Remove the Display Board (983371-1) (this is difficult, be very careful not to damage the solder pads on the Front Panel Board.
4. On Front Panel Board (ASSY# 983367-2), remove R11, remove C18 and replace with 47k ohm resistor.
5. Replace the Display Board (unless performing MOD 2b also).
6. Re assemble Front Panel Assembly (unless performing MOD 2b also).

Modification 2b: Replace R6 with a 13k resistor (0805, TiL# CRCW0805 133).
Reference ECO: 10C882B.

Recommendation: Do not Perform – The value gained is low and the difficulty due to location of the parts is high.

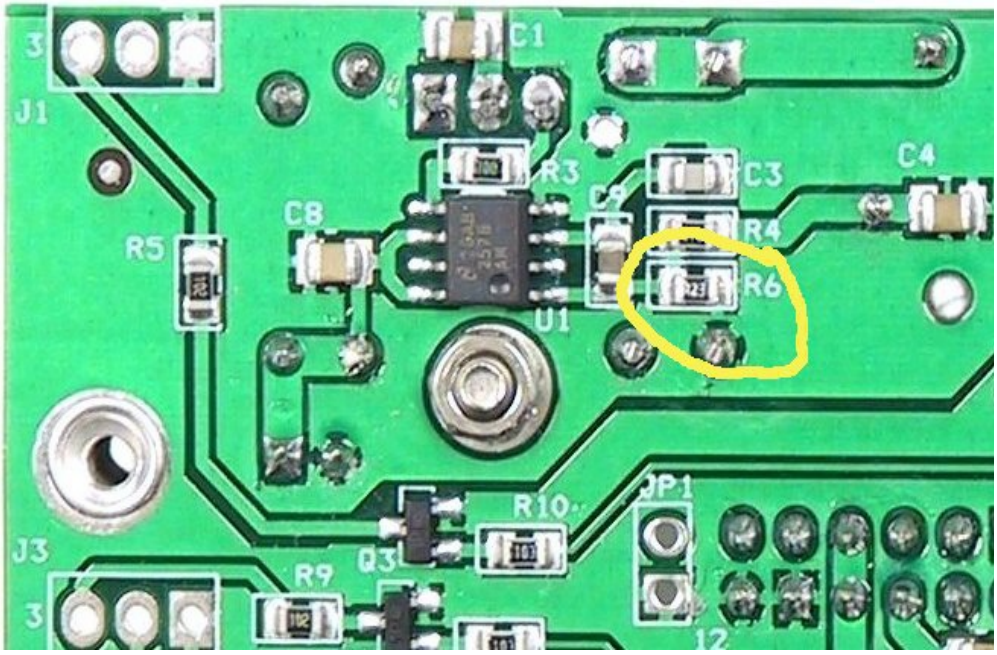

Figure 3. MOD 2b - Location of R6 on Front Panel Board.

Instructions:

1. As per 2a, above remove the Front Panel Assembly, the Front Panel Interface Board and the Display board from the radio.
2. Remove R6 and replace with 13k ohm resistor).
3. Replace the Display Board.
4. Perform 2c.

Modification 2c: Put back to back diodes across Vled and Vlog power pins to the display board. This keeps the two voltage rails within 0.7 volts of each other, which stops a short on Vlog from causing internal current flow from Vled which will damage the part.
Reference ECO: 10C882B

Recommendation: *Perform – This fixes a known vulnerability.*

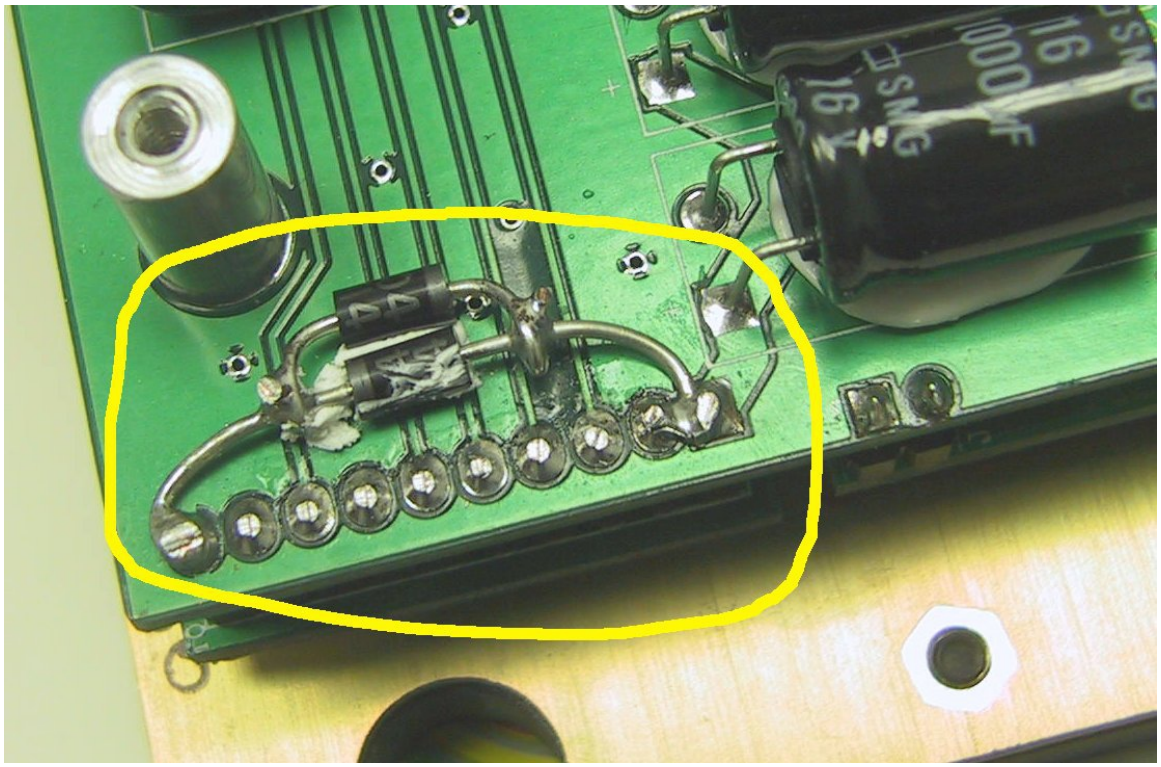

Figure 4. MOD 2c - Back-to-back diodes across Vled & Vlog.

Instructions:

1. As per 2a, above remove the Front Panel Assembly, and the Front Panel Interface Board from the radio. Do not remove the Display Board.
2. Remove the Front Panel Interface Board (ASSY# 093762-1) from the Front Panel Assembly.
3. Solder two diodes (1N4004) back to back
4. As shown in Figure 4: On the back of the Front Panel Board (ASSY# 983367-2) mount the diodes with a small dot of RTV, and then solder to Display Board Connector pins as shown in Figure 4.
5. Re-Assemble and replace the Front Panel Assembly in the radio chassis.

2.3 MOD 3 – Replace Power Switch Board MOSFET.

It was decided to upgrade the MOSFET used in a variety on applications with a device that had superior performance (lower Rds on and thus generating less heat).

Importance: Low – *providing MOD 1 has been performed* the current draw is low enough in the TDFM-136A that this part never gets hot. The part is now used everywhere to reduce inventory costs, the new part is better, but unnecessary in this application *providing MOD 1 has been performed*.

Scope: The new part is used in all current production and was introduced part way through production of the TDFM-136A (from FDA1543 on)

Modification: Replace MOSFET (Q1) on Power Switch Board.
Reference ECO: 10C890B.

Recommendation: If serial number is less than FDA1427 then device could have been subject to high current condition – replace. If serial number is higher, then the device would never have been subjected to high current condition – no need to replace.

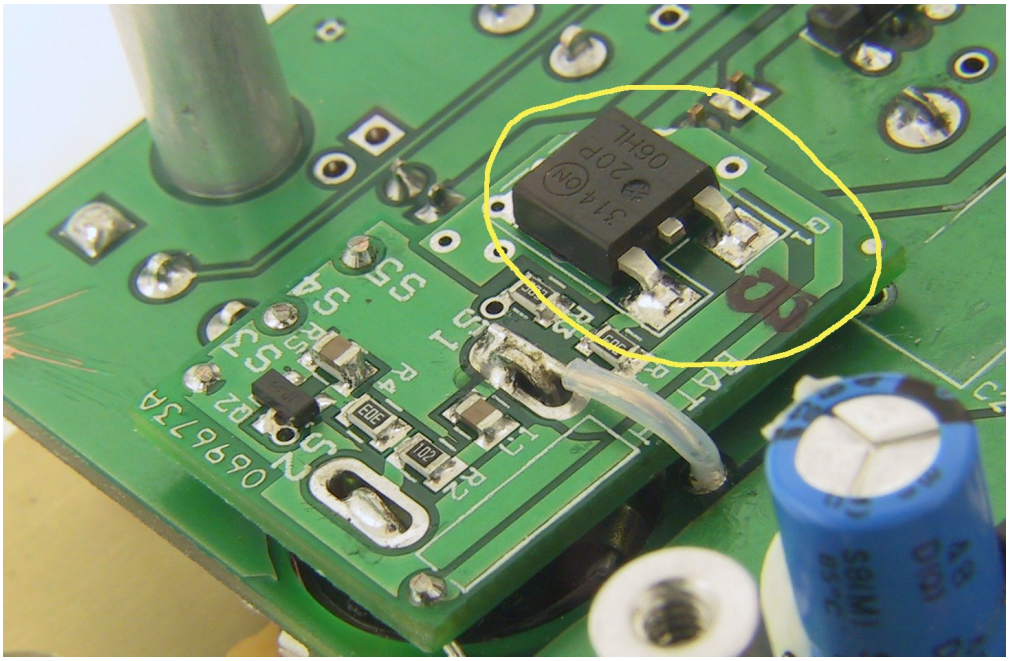

Figure 5. The location of Q1 on the Power Switch Board.

Instructions:

1. Remove the Front Panel Assembly from the radio, be sure not to damage the wires for the module keyloader connections.
2. Remove the Front Panel Interface Board (ASSY# 093762-1) from the Front Panel Assembly.
3. Remove the Q1 (MTD20P06HDL), from the Power Switch Board (ASSY# 063677)
4. Replace with MOSFET SUD50P06-15-GE3.
5. Re assemble the front panel.

2.4 MOD 4 – Modified Heatsink.

When the TDFM-136 was modified to TDFM-136A, a change to the amplifier board caused changes to the main heatsink profile. These changes caused some interference fit issues in certain airframes depending on the position of the radio in the stack.

While the antenna position was not changed to the original position, the heatsink profile was changed to match, or be within, the original TDFM-136 heatsink profile.

Importance: This depends entirely on your airframe and radio location. If there is a fit problem, then you need the new heatsink. As of this writing the only known interference problem

Scope: The new part is 098812C introduced part way through production of the TDFM-136A, from SN FDA1698.

Modification: Replace main heatsink.
Reference ECO: 10C992B.

Recommendation: See importance. If you do not need it, do not bother; the original heat sink works as well or better. *This is an issue of fit for a particular installation, not an issue of performance.*

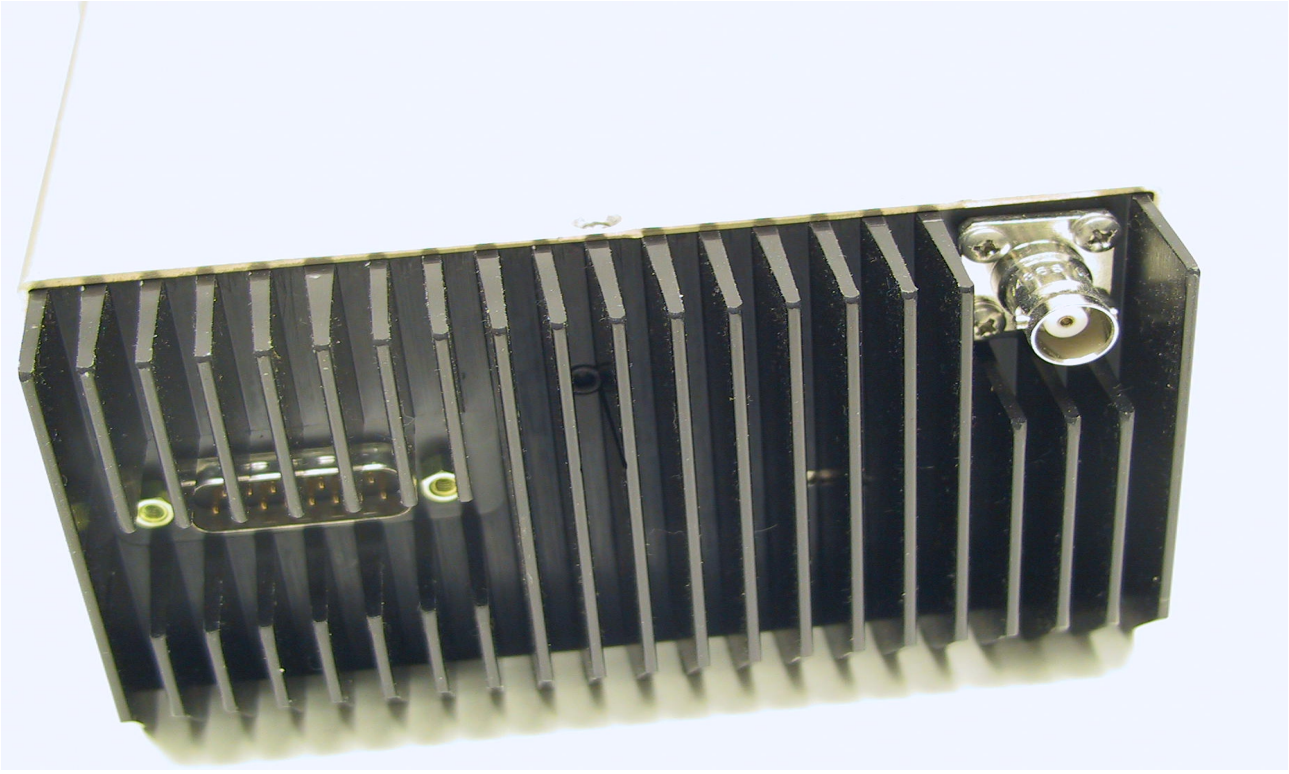

Figure 6. The Original main heat sink on the TDFM-136A.

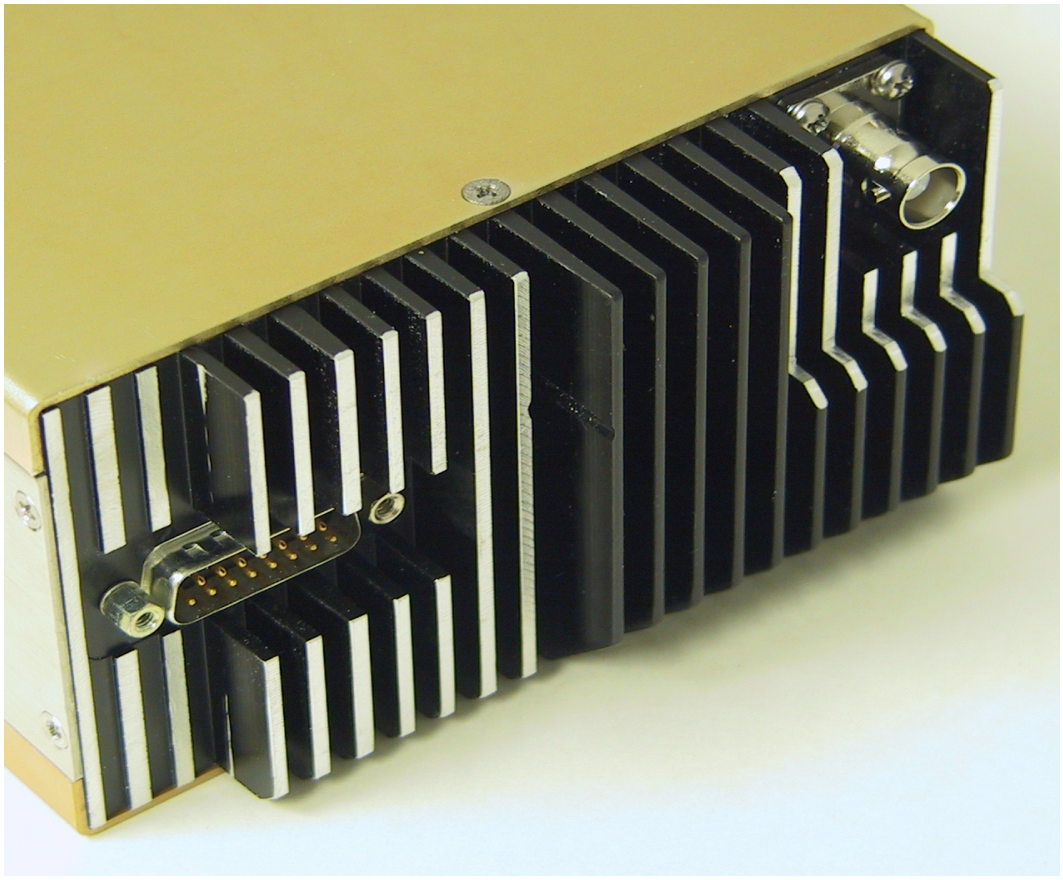

Figure 7. The Modified heat sink on the TDFM-136A.

Instructions:

1. Remove the top and bottom covers.
2. Remove the Front Panel Assembly (taking care not to damage the wire bundles going to the RF modules – disconnect these from the Front Panel Assembly.
3. Remove the blue wires from the RF modules, in the bottom tray, and then remove the tray with those modules.
4. On the MCU board, remove the three screws from the audio amplifier into the main heatsink, remove the spacer block as well.
5. Remove fasteners from DB-15 connector and hex nut from internal RF amplifier heatsink block (between fins in roughly the center of the heatsink about 2/3 up). The heatsink can now be removed from the unit.
6. Desolder and remove the small interface board (PCB#019238A) that is mounted to the BNC connector.
7. Remove the BNC connector.
8. Get new heatsink, and re-assemble following items 7 to 1.

2.5 MOD 5 – Add MMIC to receive line on RF Amplifier board

We began to notice that some of the units had a hard time meeting the receiver specification, after some investigation it was determined that some of the RF modules had a hard time meeting spec with the loss introduced by the antenna switching design.

Importance: Medium – If the unit shipped it should have met the specifications, however the unit may drop out of spec if the RF module changes because of a failure.

Scope: This was performed in the factory as soon as the modification was ready, from FDA1617 up. Also, we perform it on any units returned.

Modification: Add mmic daughter board (TiL #: 103811-1) to RF amplifier board.
Reference ECO: 11C931E.

Recommendation: Perform – The modification is reasonably simple and the install point is readily accessible.

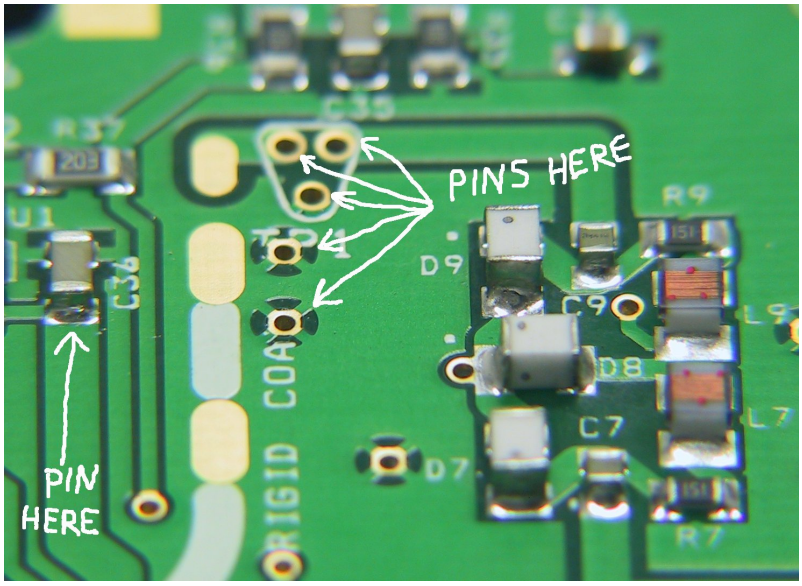

Figure 8. Pin locations for mmic daughter board.

Instructions:

1. Remove top cover or radio.
2. Remove blue co-axial wires from connectors (marking as necessary for re-assembly)
3. Remove all mounting screws and remove the board.
4. Locate the mod5 mmic daughter board site on the RF amplifier board, and place the mmic daughter board (note the pin placement with C36)
5. Solder in place.
6. Cut pins as necessary.
7. Re-assemble the unit.

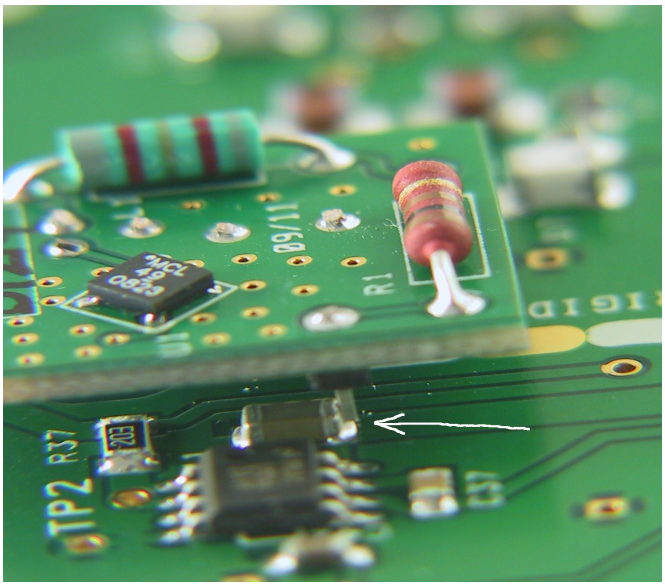

Figure 9. MMIC board mounted showing pin location at C36.

2.6 MOD 6 – Mod for Firmware release 3 and higher.

While the radio is easy to remove for work on the bench, a firmware upgrade requires that you break the factory seals. Among other things Release 3 firmware (3.x.x) adds a function that allows the user to access the higher programming levels via a password rather than having to break the factory seals and setting jumpers. However one of the jumpers that was set (J2 on the MCU) must be permanently closed for all this to work.

Importance: Varies – if, in the future, you wish to perform upgrades and do not want to open the unit then this must be done.

Scope: Once we had Firmware Release 3 ready, all units were modified in the factory to this configuration, starting at FDA1634.

Modification: Leave a shunt on jumper J2 at all times, or squeeze pins of J2 together and solder.
Reference ECO: 11C946.

Recommendation: Perform – it is necessary to run any Release 3 or higher code and is easy to perform.

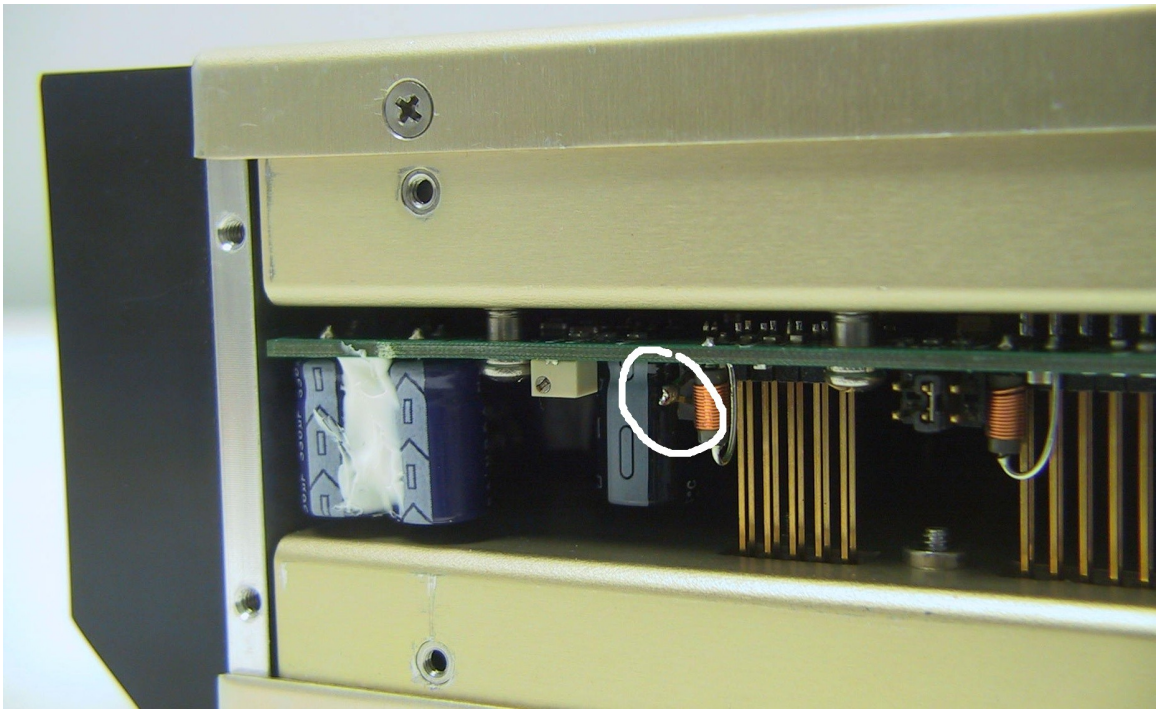

Figure 10. The Jumper J2 on MCU – closed and soldered.

Instructions:

1. Remove the left hand side panel of the radio.
2. Locate jumper J2 (2 pins only toward back of unit)
3. Squeeze pins together and solder.
4. Reassemble the unit.

2.7 MOD 7 – Modification to RF Module chassis.

The Datron D25 RF modules come to us in a metal chassis that forms part of the RF shielding and supports the RF PCB. Some work to add shielding mesh was done at Datron after the chassis mold was completed. As a result the boards are subject to some flex that can cause cracks particularly in the receiver section. Additionally, the RF power amplifier is coated with white thermal paste, but is often not in contact with the heatsink itself. The modifications described here address these issues.

Importance: High – Datron has identified a known problem with receiver operation (cracked solder joint between Y1 oscillator module and PCB) that this can help to avoid.

Scope: These modifications were performed on all units with serial numbers FDA1662 and higher at the factory, and on all repairs.

Modification: Remove RF modules, clean off white thermal paste, replace with thermally conductive foam. Add spacers to housing PCB mounting as needed.
Reference ECO: 10C006B.

Recommendation: Perform.

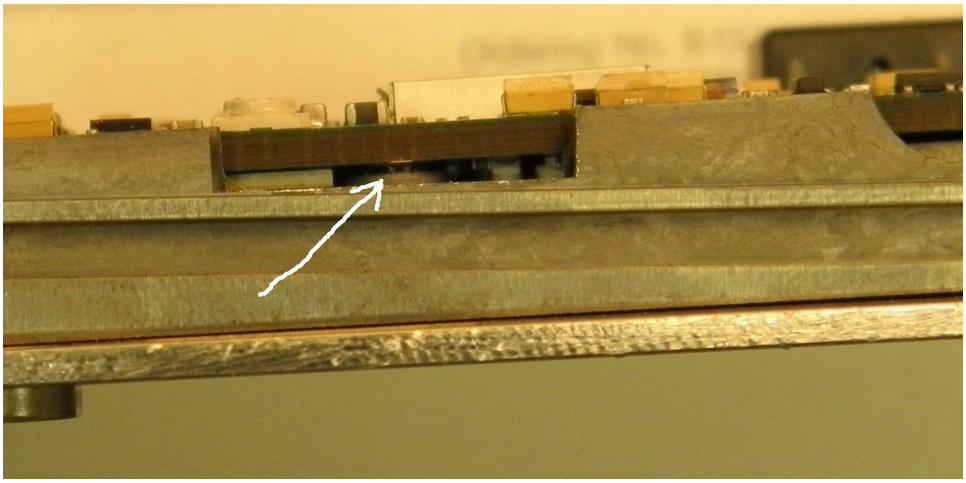

Figure 11. Cutaway showing the gap between housing mount and PCB.

Instructions - Access the modules:

1. Remove the Front Panel Assembly from the radio, be sure not to damage the wires for the module keyloader connections.
2. Remove the bottom cover of the radio.
3. Remove the two blue coaxial wires (on from each RF module), and mark so that you can return them to the correct position.
4. Remove bottom tray from radio.
5. Remove nuts, washers, and screw that hold TDFM-136A Module Interconnect board (ASSY: 093763-1) in place.
6. Remove spacers from screws that held Interface Board.
7. On bottom of tray, loosen those same screws such that the RF Module PCB may be removed.
8. Remove all the screws used to hold the RF Modules in place. Note that there is a small screw in the PCB towards the middle, see 'D' in figure 12.

Instructions - Modify the modules:

9. Remove the RF modules, take care to follow correct static handling procedures, note that RF module PA & module case may have white thermal paste on heatsink. (see 'A' in figure 12.) be sure to completely clean it off both the chassis and the RF PA on the PCB.
10. Put a 0.01” washer at 'B'. Place the PCB back into the chassis being careful not to dislodge the washer, insert the 2-56 screw at that location and gently tighten. The PCB should seat into the chassis without visible deformation around the screw location.
11. Add a screw through the PCB at 'C' and see if the board deforms in that location as you tighten it, if so, add a washer there and re-try the test. Once you are happy that the board will not be subject to substantial deformation by screws tightened at 'B' and 'C' then remove the board again.
12. Place a piece of thermally conductive foam on the heat sink surface of either the PA amp on the PCB or on the chassis at 'A'.
13. Add a lock-washer to each of the screws used to secure the PA AMP on the PA heatsink tabs at the screw locations.

14. Reassemble the unit.

Figure 12. D25 Chassis showing the points of interest.

The Parts used are:

Flat Washer: 2-56x3/16”x0.010 or OWSA02
Thermally Conductive Foam: 50G-D 1/4”x3/4”
Lock Washer: INT LWSS 002