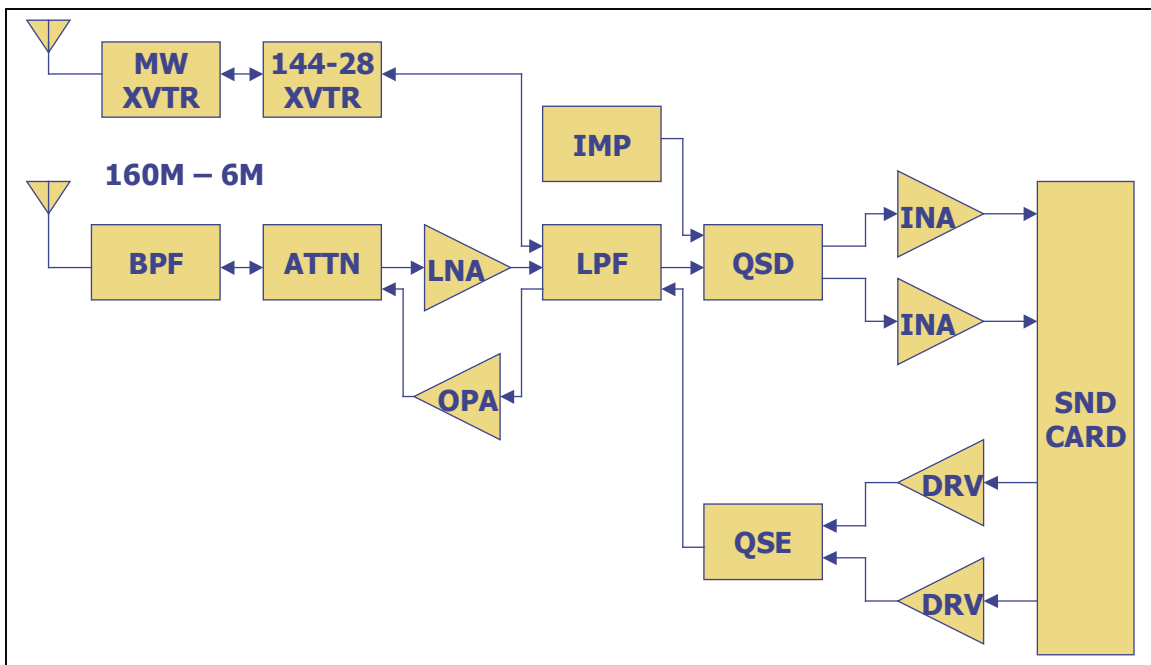


**RF Expansion (RFE) Board Installation Instructions**  
**Version 1.4**

**Introduction**

The RFE board is designed to sandwich between the SDR-1000 BPF and TRX boards. When installed, the RFE breaks the signal path between those boards to incorporate a low noise preamp, 5<sup>th</sup> order low pass filters, enhanced 1W PEP amplifier, and transverter control. As a result, the BPF board will provide front end filtering for the low noise preamplifier as well as harmonic suppression for the new 1W amplifier. The 1W amplifier on the BPF board is bypassed in this configuration. The block diagram below illustrates the complete radio with RFE and transverter options installed.



Installation involves:

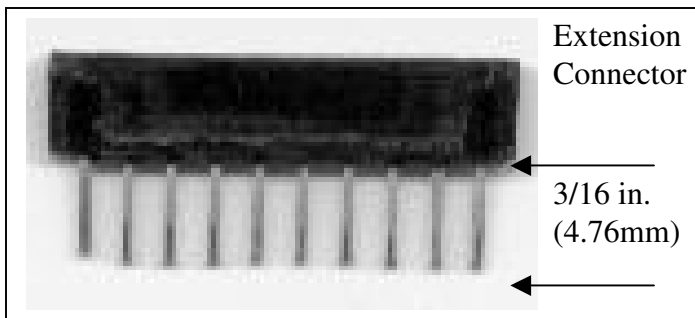
1. Partial disassembly of the existing board stack unless installed on a new radio
2. Trimming and refitting two connectors (reversing these changes will require refitting a connector on the BPF board)
3. Assembling and installing a small coax jumper
4. Enabling the RFE board in the SDRConsole software

**Installation**

[] If you are installing the RFE in an existing radio, remove the BPF board from the board stack, leaving the nylon spacers mounted on the TRX board as originally installed. Save the four #4 nuts for later.

[] Prepare the 10 pin extension connector for installation according to the photo below.

- With diagonal cutters, cut the pins on the 10-pin extension connector to 3/16 inches (4.76mm) in length. **Caution: if the pins are longer than 1/4 inch (6.35mm) they may short to the pins below and cause the board to malfunction. If the pins are cut too short, they may not make contact with the connector below. This can result in loss of sensitivity/transmit power on one or more bands.**
- With a sharp pointed instrument, such as a toothpick or small nail, spread the internal socket teeth apart so that they can accept the pins on J4 from the BPF board.
- Install the extension connector into J5 on the RFE board.



[] With diagonal cutters, carefully cut the pins on J4 on the underside of the BPF board to 1/8 inch (3.18mm) in length. Plug the Extension Connector on to J4 on the underside of the board. *Once this modification is made, the BPF board will no longer work without the RFE installed.*

[] Assemble the coax cable extension as shown in the photo below.



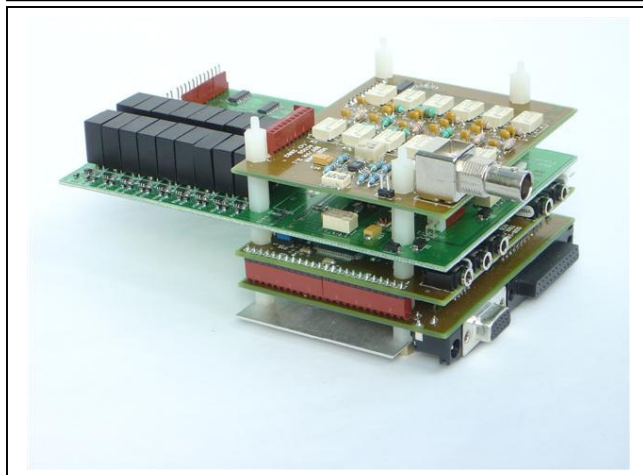
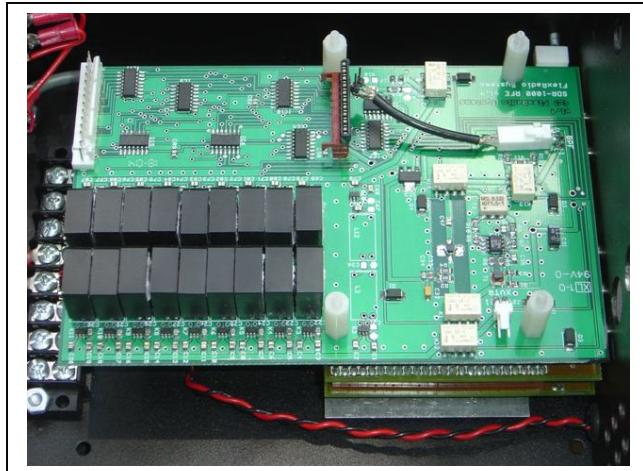
- Carefully remove 1/2 inch (12.7mm) of outside insulation from the RG174/U coax. Do not damage the braid.
- Separate the braid from the center conductor and twist the braid to form a ground lead on each end.
- On each end of the cable, strip approximately 1/8 inch (3.2mm) of insulation from the center conductor.
- Tin the braid and center conductor on each end, being careful not to heat longer than necessary to flow the solder.

- Crimp and solder the two connector pins provided to the center conductor and ground lead on one end of the cable. Make sure that the pins and cable leads are oriented as seen in the photo above. Note that the orientation tabs on the plastic connector are facing up and that the center conductor is reversed on each end of the cable.
- Insert the pins into the connector housing so that the center conductor of the coax will connect to pin 1 of J1 on the RFE board. Refer to the photo for pin 1 orientation. *Be sure to install the pins so that the spring side faces up with the connector's locator pins also facing up.*
- Solder the other two coax leads to the right angle header pins. *The center conductor of the coax must connect to pin 1 on the BPF board.*
- Inspect the cable ends to make sure that there are no stray strands from the shield to short to the center conductor.
- Wrap a short piece of electrical tape around each end over the exposed braid to prevent the braid from shorting to the PC board. **Shorting of the braid to the BPF board above can cause one of the filter banks to fail.**
- Plug the connector end of the cable into J1 on the RFE board.

[] *NOTE: Radios shipped after July 11, 2004 do not require the following modification.* On the TRX board, cut one lead on R20 and R21 respectively, to remove them from the circuit. This will convert the 40dB INA gain setting to 0dB. The 26dB setting is unchanged. This is necessary because the RFE board provides gain in front of the TRX board.

[] *NOTE: Radios shipped after July 12, 2004 do not require the following modification.*

OPTIONAL: Remove the surface mount resistors, R10 and R11 on the TRX board. Replace each with a jumper wire or zero ohm resistors (yes they exist). The simplest way to remove the old resistors is to use two soldering irons to simultaneously touch each end. When the solder melts on both ends, you can easily flip the resistor off the board. *If you are uncomfortable making this modification, then don't.* The modification is helpful but not essential. These resistors are no longer needed to swamp variations in antenna impedance since the preamp on the RFE now sets the impedance. These resistors cause a



slight signal loss on the higher bands.

[] Mount the RFE board on the four nylon spacers located on the TRX board. *Make sure that the pins on J2 and J5 of the RFE mate correctly with the respective connectors on the TRX board.*

[] Install the four #4 provided nylon washers on the threaded studs that now protrude through the top of the RFE board.

[] Install the four 5/8 inch (15.88mm) nylon spacers on the threaded studs.

[] **Starting from the bottom of the stack, the boards and hardware should be assembled in the following order (female end of spacers face down toward the chassis): 3/16 in. (9.25mm) metal spacers, heat sink plate, 3/8 in. nylon spacers, PIO board bottom up, 3/8 in. nylon spacers, nylon washers, TRX board, 3/8 in. nylon spacers, nylon washers, RFE board, 5/8 in. (15.88mm) nylon spacers, nylon washers, BPF board, 4-40 nuts.**

[] If the Down East Microwave DEMI144-28-FRS transverter is to be installed, you will need to install its coax cable to J2 before proceeding. Instructions for transverter installation are provided with the DEMI kit.

[] Plug the right angle header end of the coax cable to J2 on the under side of the BPF board so that the center conductor connects to pin 1.

[] Install the BPF board on the four nylon spacers using the four #4 nuts removed earlier. Note: the photo on the right shows nylon spacers above the BPF for mounting the DEMI transverter kit, which are not required for the basic radio. Instructions for DEMI144-28FRSK installation are provided with the kit from Down East Microwave.

[] Install SDRConsole v1.5.3 or later on the computer and check the RFE Enabled checkbox on the Setup Options>General tab. If you are installing the DEMI144-28FRSK at the same time, you will need to check the Transverter Enabled checkbox.

## **Operation**

The RFE board adds approximately 28dB of gain in front of the QSD on the TRX board. This provides several key benefits:

1. Low noise figure
2. Reduce DDS spur amplification
3. Improved filter performance
4. Reduced LO radiation

**Because of the increased front-end gain, in most cases you will want to use lower gain settings for bands below 21MHz.** The following table illustrates the sensitivity and dynamic range results for various settings of the INA gain and front-end 10dB attenuator.

These measurements were made with a M-Audio Audiophile USB sound card in 16-bit mode. Results will vary by sound card. The Audiophile does not have an input mixer so there is no way to reduce the sound card's analog input gain. Therefore, the maximum signal input to the radio before distortion will be dictated by the sound card in most cases.

Setting	Gain Setting	MDS	SFDR
A	0dB ATTN, 26dB INA	-141dBm	90dB
B	10dB ATTN, 26dB INA	-130dBm	89dB
C	0dB ATTN, 0dB INA	-127dBm	88dB
D	10dB ATTN, 0dB INA	-118dBm	89dB

For most sound cards, highest dynamic range will usually be achieved by setting the IF control (line-in) on the SDRConsole to the minimum possible level before the noise floor rises on the display. This raises the maximum signal handling capability without significantly increasing the noise figure of the radio. Settings B-D above will typically provide the best dynamic range for frequencies below approximately 22MHz. For higher frequencies, setting A may provide the best performance.

**Revision History:**

V1.3 8/16/04 Beginning 7/11/04, modifications to TRX board no longer required  
V1.4 12/14/04 Added electrical tape to cover coax braid on each end