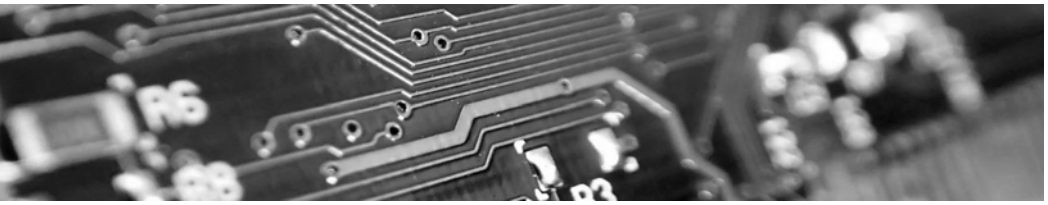
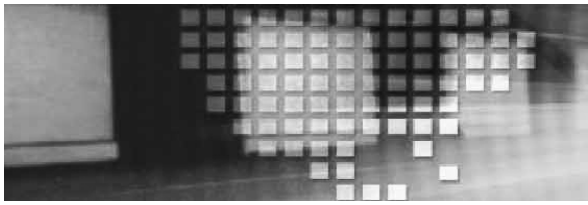
Xenotran Corporation
RF/IF PCA Board Quick Start Guide





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Introduction

Xenotran introduces a new test and development tool for CIB/IW waveform design. This RF/IF board is a wideband RF front-end, with full duplex transmit and receive capabilities. This tool supports COTS D/A and A/D development boards to facilitate RF waveform synthesis and receive RF signals in the UHF SATCOM band.

The transmitter chain takes a modulated I/Q (Q is optional) input signal at 0 dBm, amplifies and frequency shifts the signal to an output range from 290 MHz to 318 MHz. The input signal range from 7 to 35 MHz is readily producible for a majority of COTS D/A development boards. Xenotran has designed this support tool to work specifically with Hunt Engineering D/A modules and Xenotran's 181C modulator implementation.

The receive chain has an input RF bandwidth range from 240 to 268 MHz. The receiver provides about 72 dB of gain, and frequency shifts the incoming signal down to a range from 7 to 35 MHz, where it can be readily sampled by a COTS A/D development board. Xenotran has designed this tool to work specifically with Hunt Engineering A/D modules and Xenotran's 181C demodulator implementation.

The RF/IF board provides an extremely low phase noise OCXO reference clock and can take an external 10 MHz reference as test requirements warrant. Furthermore, a cross mix signal is provided that gives the test platform an RF loopback capability for UHF SATCOM RF testing without a satellite simulator.

Board Overview

Xenotran's RF2IF PCA Board is a wideband RF front-end, with full duplex transmit and receive capabilities, for use in CIB/IW waveform design and test. The RF2IF PCA Board supports COTS D/A and A/D development boards to facilitate RF waveform synthesis and to receive RF signals in the UHF SATCOM band.

Transmitter Specifications

- Input Signal (IF): I/Q (Q optional) at 0 dBm.
- Input Signal Range: 7 – 35 MHz
- Output Signal Range (RF): 290 – 318 MHz
- Output Signal Power: -7 dBm

Receiver Specifications

- Input Signal Range (RF): 240 – 268 MHz
- Receiver Gain: ~72 dB
- Output Signal Range (IF): 7 – 35 MHz
- Output Signal: I/Q

Additional Features

- Choice of internal or external 10 MHz reference.
- Cross mix signal for RF loopback
- Dual 96.768 MHz outputs to aid in using the RF2IF PCA board with Hunt Engineering A/D modules and Xenotran's 181C demodulator implementation.

Figure 1 RF/IF PCA Board

Board Components

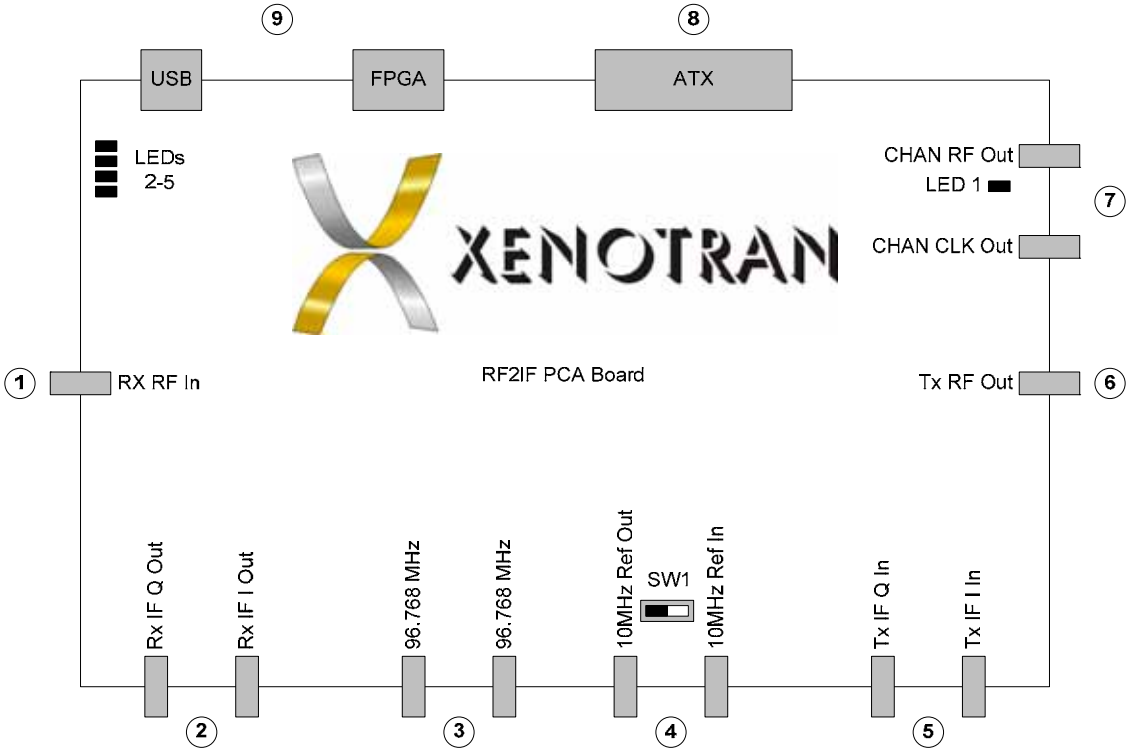

Figure 2 Board Diagram

Table 1 Board Components

Label	Component
1	Rx RF Input From SATSIM Output
2	Rx IF I and Q Outputs To Modem Demodulator
3	96.768 MHz Output To Hunt Module Clock Input
4	10 MHz Reference Output and Input
5	TX IF I and Q Inputs From Modem Modulator
6	Tx RF Output to SATSIM Input
7	Cross Mix Signal for RF Loop Back
8	ATX Power Supply Connector
9	USB/FPGA Connectors for Programming and Debug
SW1	Reference Source Select
LED1	Channel PLL Locked Indicator
LED2	Board Heartbeat
LED3	USB
LED4	Access
LED5	Error

Board Instructions

Powering Up

- Uses a standard ATX power supply
- To power up the board plug the motherboard power cable from the ATX power supply into board's ATX connector (Component 8).
- Once the ATX power supply is turned on, the board should power up and the Board Heartbeat indication (LED 2) should be blinking.

10 MHz Reference Select

- Board defaults to use an internal 10 MHz low phase OCXO reference clock.
- Changing between the external and internal reference sources is done using the Reference Select Switch (SW1).
- NOTE: On RFIF_001.X1 revision of the board, the switch silk screen on the board was reversed. To use the internal reference source, the switch should be set to "EXT_REF" and vice-versa.

RF Connections to SATSIM

- The Transmit RF output (component 6) should be connected to the SATSIM RF IN.
- The output power of the Transmit RF Out signal is about -7 dBm.
- The SATSIM RF OUT should be connected to the Receive RF In (component 1) connector.
- To avoid clipping Xenotran recommends that the power of the input RF signal not exceed the clipping point of -88 dBm.

RF Loopback

- Xenotran's RF2IF PCA board can be used in conjunction with a frequency mixer to implement an RF loopback for testing without the use of a SATSIM.
- Xenotran recommends Mini-Circuits ZX05-1MHW-S as a Mixer for this test configuration.
- The Tx RF Out signal (component 6) should be attenuated by 21 dB and connected to the RF input of the Frequency Mixer.
- The Channel Clock Out signal (component 7) should be attenuated by 1 dB and connected to the LO input of the Frequency Mixer.
- The IF output of the Frequency mixer can then be connected to the Rx RF input of the board, through a 40 dB attenuator, to complete the RF loop.

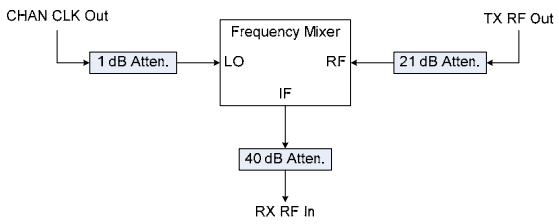

Figure 3 Frequency Mixer Connections

Interfacing to Hunt Engineering A/D and D/A Modules

The RF2IF PCA Board is designed to work seamlessly with the Hunt Engineering A/D, D/A modules and Xenotran's 181C waveform implementation.

Transmit Connections

- The OP/A output from the Hunt module should be connected to the TX IF I Input (Component 5)
- The OP/B output from the Hunt module should be connected to the TX IF Q Input (Component 5). This connection is optional but recommended for transmit side image rejection.

Receive Connections

- The Rx IF I output (Component 2) should be connected to the IP/A input of the Hunt module.
- The RX IF Q output (Component 2) should be connected to the IP/B input of the Hunt module.
- The power of the receive RF signal should be in the range of -88 dBm to -127 dBm.

Clock Connections

- If necessary, connect one of the 96.768 MHz outputs (Component 3) to the clock input of the Hunt module.

RF/IF X1 Errata and Notes

- Three VCO footprints are incorrect, requiring the VCO's be soldered at a slight angle, with short jumper wires used to connect three of the signals.
- Switching noise from the ATX power supply causes spurs at +/-36 and +/-73kHz on LO signals used in the receive and transmit mixers. On the receive mixer, the highest spurs are at -40dBc. The largest transmitter spurs are at -36dBc.
- At SW1, the EXT_REF and INT_REF silkscreen labels are reversed. To use the internal 10MHz reference, the switch must be set to EXT_REF.
- The VCO's used to generate the Rx and Tx LO signals produce slight second and third harmonic outputs. The third harmonic of the transmit VCO, 849MHz, creates mixing products that appear at the output between 859MHz and 876MHz.
- Due to an impedance mismatch between the low noise amplifier at U7 and the band pass filter at FL1, the receiver gain over the area of interest, 243 to 270MHz, varies by up to 10dB.
- The coax A/D inputs to the Hunt Heron-IO2 PCA treat the signal and shield of the coax cables as a differential input. The coax shields are not grounded on the HeronIO2. The default configuration of the RF2IF PCA does not ground the shields at J5 and J6 receiver outputs either. Because the shields are not grounded, care must be taken to ensure that any exposed SMA to BNC connectors on these cables do not short against other metal objects. This 'short' will not cause any damage, but could affect the A/D performance. The shields can be grounded at the RF2IF PCA by installing zero ohm resistors at R46-R49 and R60-R63.
- Because the receiver uses a mix down circuit with the LO frequency lower than the received signal range, the I and Q outputs at J5 and J6 will appear to be swapped because the signal on Q always leads the signal on I.
- The 33.6MHz signal available on J14 for simulating the satellite frequency shift is generated using a divide by 2 of the 67.2MHz signal output on J13. The 33.6MHz signal at J14 uses a CMOS output and contains significant odd harmonics, and slight even harmonics. Most of the harmonic products are removed out by band pass filters in the receiver. If required, an external low pass filter on the 33.6MHz signal can be used to reduce the harmonics.

Board Support

If you have questions please contact Alvin Clark at aclark@xenotran.com or 619-295-3000 x303.