Testing the RF Transceiver Board

Servicing a SuperDARN Transceiver  
Step 11

Content

[1. Introduction 3](#_Toc95980833)

[2. Instructions 3](#_Toc95980834)

[3. Shortcut 5](#_Toc95980835)

[4. Conclusion 6](#_Toc95980836)

# Introduction

This document provides work instructions for testing the RF Transceiver Board in a SuperDARN transceiver box. Before attempting to implement these instructions, be sure to complete all the preceding steps in the procedure for Servicing a SuperDARN Transceiver.

# Instructions

Following are the step-by-step instructions for testing the RF Transceiver Board. In the case of unforeseen problems occurring, apply electronic fault-finding techniques.

1. Connect the transceiver test board to the transceiver board and power it with 15 V from a test bench power supply.
2. Verify that all 4 LEDs in the **PWR** LED bank on the transceiver test board are on.
3. Verify that test pin **P20** is at 10.5 V and **P19** at 3.3 V on the transceiver board.
4. Flip all the switches on the transceiver test board on, one by one and verify that their corresponding LEDs respond accordingly (switch on and off when the switches are flipped).
5. Switch on the AWG and set the frequency to 12.5 MHz and set the amplitude to 100 mVpp. Connect a BNC cable between the Output of the AWG and Channel 1 on the Agilent MSO6104A to view the waveform. Make sure to press “Output” on the front face to enable the waveform. Remember to set the impedance of the channel to 50 Ω and use a 50 Ω feed through connection on the oscilloscope channel being used. Check that the waveform displayed is correct.
6. Connect the output of the AWG to the **DAC2** port on the transceiver test board and Channel 1 on the Agilent MSO6104A to the **DAC2\_Out** port on the transceiver board.
7. Verify that the signal observed is the same 12.5 MHz, 100 mVpp signal with possible minor amplitude losses (3 mV).
8. Connect the output of the AWG to the **DAC1**(Tx) port on the transceiver test board and Channel 1 on the Agilent MSO6104A to the **TxOUT** port on the transceiver board.
9. Verify that the signal observed is a 12.5 MHz, 25 mVpp signal. This is due to the Tx attenuator being set to maximum attenuation by default.
10. Switch the LE (Latch Enable) of the Tx AGC bank on the transceiver test board on. This sets the Tx attenuator to minimum attenuation.
11. Verify that the signal observed is a 12.5 MHz, 1 Vpp signal (800 mV 1 Vpp).
12. Switch through the attenuation switches in the Tx AGC bank on the transceiver test board one by one, starting at 1 dB all the way through to 16 dB. Verify after flipping each switch that the signal’s peak-to-peak amplitude decreases more and more with an increasing value of attenuation.
13. Flip all the switches on the transceiver test board back to their original state (off).
14. Connect the output of the AWG to the Antenna port on the transceiver board and Channel 1 on the Agilent MSO6104A to the **MON2** port on the transceiver test board.
15. Verify that the signal observed is the same 12.5 MHz, 100 mVpp signal with possible minor amplitude losses (3 mV).
16. Connect the output of the AWG to the Current port and terminate the **Pwr\_Amp** port on the transceiver board and connect Channel 1 on the Agilent MSO6104A to the **MON1** port on the transceiver test board.
17. Verify that the signal observed is a 12.5 MHz, 70 mVpp signal with possible minor amplitude losses (3 mV).
18. Switch SWB on, on the transceiver test board.
19. Verify that the signal observed is a 12.5 MHz, 50 mVpp signal with possible minor amplitude losses (3 mV).
20. Switch the power off.
21. Connect the output of the AWG to the **Pwr\_Amp** port and terminate the Current port on the transceiver board and connect Channel 1 on the Agilent MSO6104A to the **MON1** port on the transceiver test board.
22. Switch the power on.
23. Verify that the signal observed is a 12.5 MHz, 50 mVpp signal with possible minor amplitude losses (3 mV).
24. Switch SWB off, on the transceiver test board.
25. Verify that no signal is measured at the **MON1** output port.
26. Change the amplitude on the AWG to 1 mVpp as the amplification on the Rx signal path is very large and one does not want the output of the receiver to be more than 1 Vpp.
27. Connect the output of the AWG to the **RFin** port on the transceiver board. Connect Channel 1 on the Agilent MSO6104A to the **ADC(Rx)** port and terminate the **DAC1(Tx)** port, on the transceiver test board.
28. Switch the **LE** (Latch Enable) of the Rx AGC bank on the transceiver test board on. This sets the Rx attenuator to minimum attenuation.
29. Verify that the signal observed is a 12.5 MHz, 1 Vpp signal (800 mVpp 1 Vpp).
30. Switch through the attenuation switches in the Rx AGC bank on the transceiver test board one by one, starting at 1 dB all the way through to 16 dB. Verify after flipping each switch that the signal’s pk-pk amplitude decreases more and more with an increasing value of attenuation.
31. Flip all the switches on the transceiver test board back to their original state (off).
32. Switch the power off.
33. Connect the output of the AWG to the **DAC1**(Tx) port and connect Channel 1 on the Agilent MSO6104A to the **ADC**(Rx) port on the transceiver test board and terminate the **RFin** port on the transceiver board.
34. Change the amplitude on the AWG to 50 mVpp.
35. Switch on the LE (Latch Enable) switches in the Tx AGC and Rx AGC banks on the transceiver test board.
36. Switch SWA on, on the transceiver test board.
37. Switch the power on.
38. Verify that the signal observed is a 12.5 MHz, 1 Vpp signal (800 mV - 1 Vpp).
39. Switch SWA off, on the transceiver test board.
40. Verify that no signal is measured at the **ADC(Rx)** port on the transceiver test board.

# Shortcut

Once you are comfortable with what needs to be terminated when, where and why you can use the following shortcut test sequence for the transceiver board. Make sure that the oscilloscope is setup to trigger on the channel being used to measure and test on! And ZOOM in on the oscilloscope as the signals being measured in this test are mostly all very small.

1. Disconnect the transceiver board from the FPGA and unmount from the chassis.
2. Connect the transceiver board to the “RF Transceiver Test Board Ver 1.2” and power this setup with an external 15 V from a bench power supply.
3. Switch the power on and make sure all 4 power LEDs on the tester board light up; and that each LED corresponding to a DIP switch, switches on when the switch is turned on.
4. Switch all switches off again.
5. Switch on the AWG and set the frequency to 12.5 MHz and set the amplitude to 100 mVpp.
6. Connect the output of the AWG to the **DAC2** port and observe the same signal as output on **DAC2\_OUT**.
7. Connect the output of the AWG to the **DAC1(Tx)** port and observe a signal with an amplitude of ±25 mVpp on **Tx\_OUT**.
8. Flip the **TxAGC (LE)** switch on and observe a signal with an amplitude of ±800 mVpp on **Tx\_OUT**.
9. Flip the other **TxAGC** (1 dB – 16 dB) switches on one by one and observe an increasing attenuation of the signal on **Tx\_OUT**, corresponding to flipping the switches of increasing dBs.
10. Connect the output of the AWG to the Antenna port and observe the same signal as output on **MON2**.
11. Connect the output of the AWG to the Current port and terminate the **PwrAmp** port; observe a signal with an amplitude of ±70 mVpp on **MON1**.
12. Flip SWB switch on and observe the signal on **MON1** drop in amplitude to ±50 mVpp.
13. Switch the power off and swap the inputs to the Current and **Pwr\_Amp** ports
14. Switch the power back on and verify once more a signal with an amplitude of ±50 mVpp on **MON1**.
15. Flip SWB switch off and observe the signal on MON1 disappear. Flip SWB switch on and back off again, watching the signal with an amplitude ±50 mVpp re-appear and disappear again on **MON1**.
16. Power off and change the AWG output from 100 mVpp to 1 mVpp.
17. Connect the output of the AWG to the **RFin** port and terminate the **DAC1(Tx)** port; observe the same signal output on **ADC(Rx)**.
18. Flip the **RxAGC (LE)** switch on.
19. Power up the tester board and output the AWG; observe a signal with an amplitude of ±800 mVpp on **ADC(Rx)**.
20. Flip the other **RxAGC** (1 dB – 16 dB) switches on one by one and observe an increasing attenuation of the signal on **ADC(Rx)**, corresponding to flipping the switches of increasing dBs.

# Conclusion

This concludes the work instructions for testing the RF Transceiver Board of a SuperDARN transceiver box. The next step in the procedure for Servicing a SuperDARN Transceiver is to test the fully assembled Transceiver.