

ATP For The RHU

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Description	Rev.	ECO	Name	Signature	Date
In ATP for RHU change Iden and SMR band to: Iden band: DL_851-869MHz , UL_806-824MHz SMR band: UL_896-901MHz	A02	C000739	Guy Becher		11/07/05

RHU TESTS

ATP - RF Test Procedure

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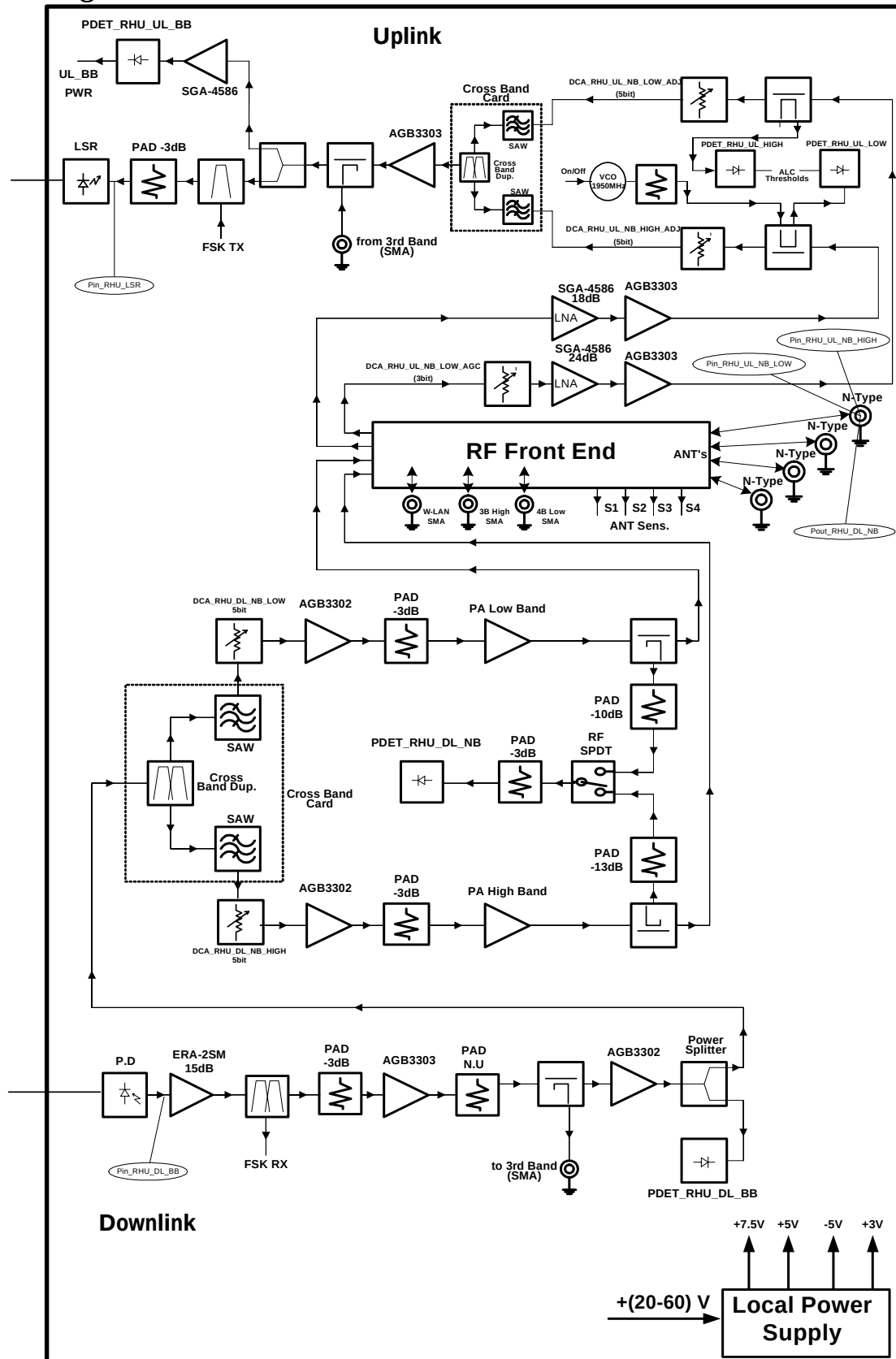
1. Scope

This document describes the ATP (Acceptance Test Procedure) to be performed for the RHU 1000 Dual Band

2. Required Equipment.

- 2.1. 1xHP8753C+ HP85046A Network Analyzer + S Parameters Set or equivalent.
- 2.2. 1xPower Supply.
- 2.3. 1xNetwork Printer/Plotter.
- 2.4. 2xHP8648B Signal Generator or equivalent.
- 2.5. 1xHP8594E Spectrum Analyzer or equivalent
- 2.6. 1x Multi-meter.
- 2.7. Terminators 50 Ω SMA
- 2.8. Terminators 50 Ω N-Type
- 2.9. Programming Plug
- 2.10. 2xFiber Optic cables
- 2.11. 1xLow noise amplifier (SMA)
- 2.12. 1xOptical Power Meter

3. Block Diagram



4. Setup

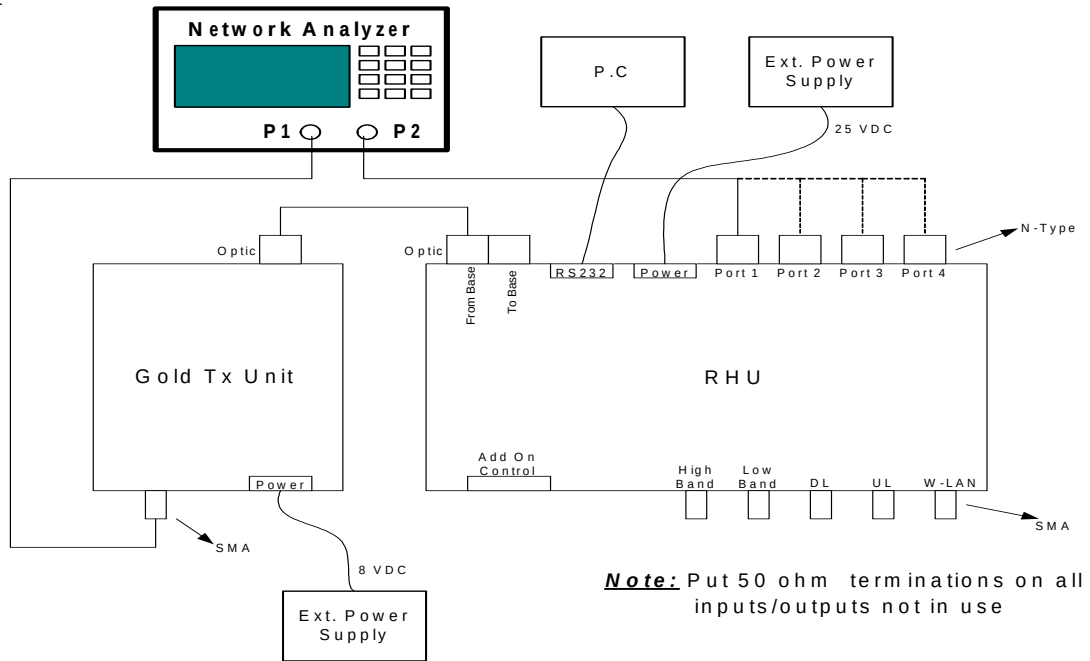


Figure 4.1: Network Analyzer DL

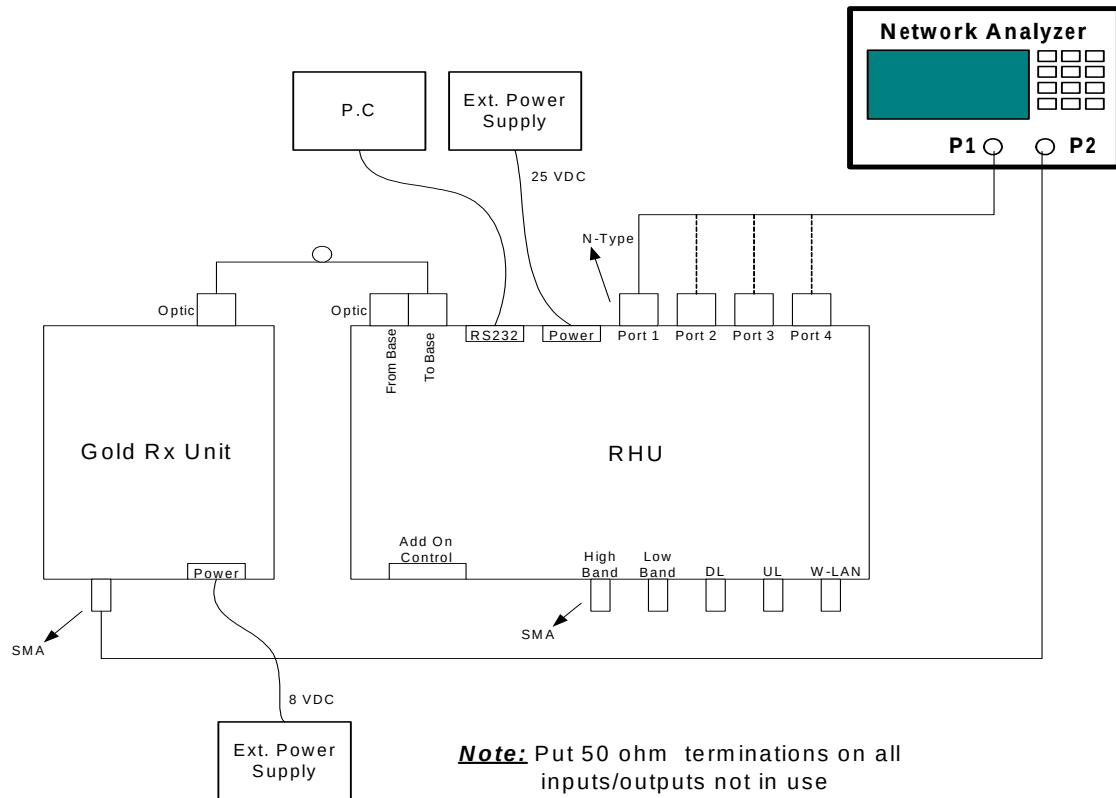


Figure 4.2: Network Analyzer UL

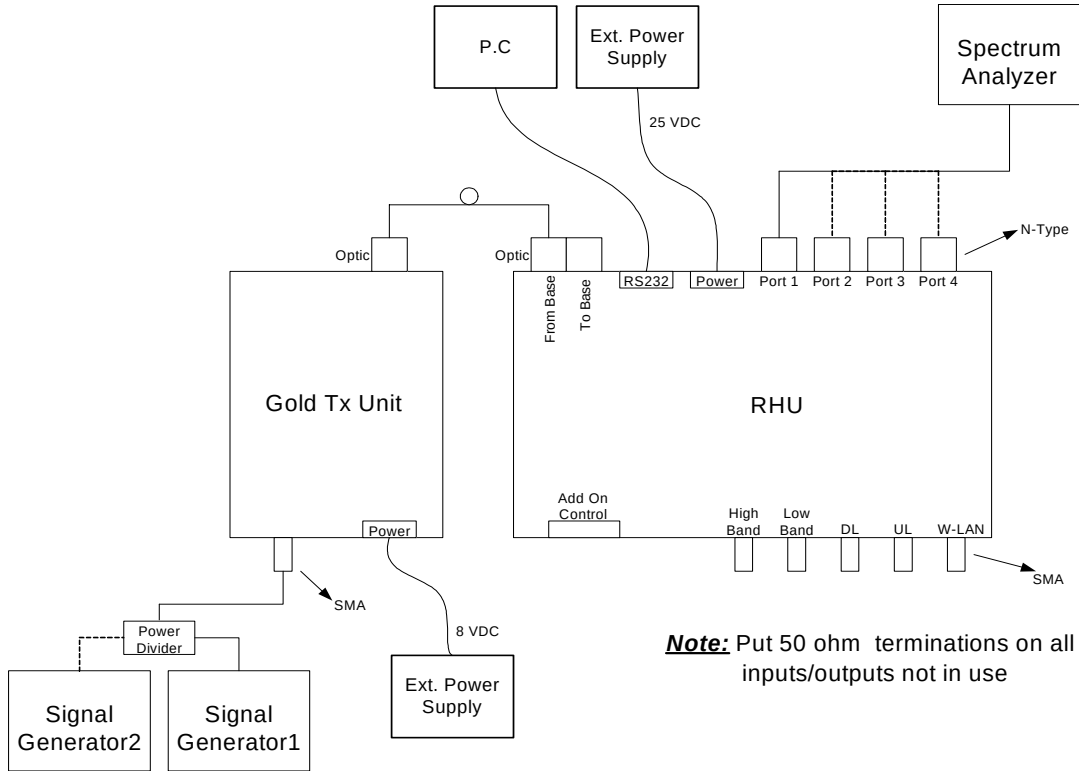


Figure 4.3: Signal Generator DL

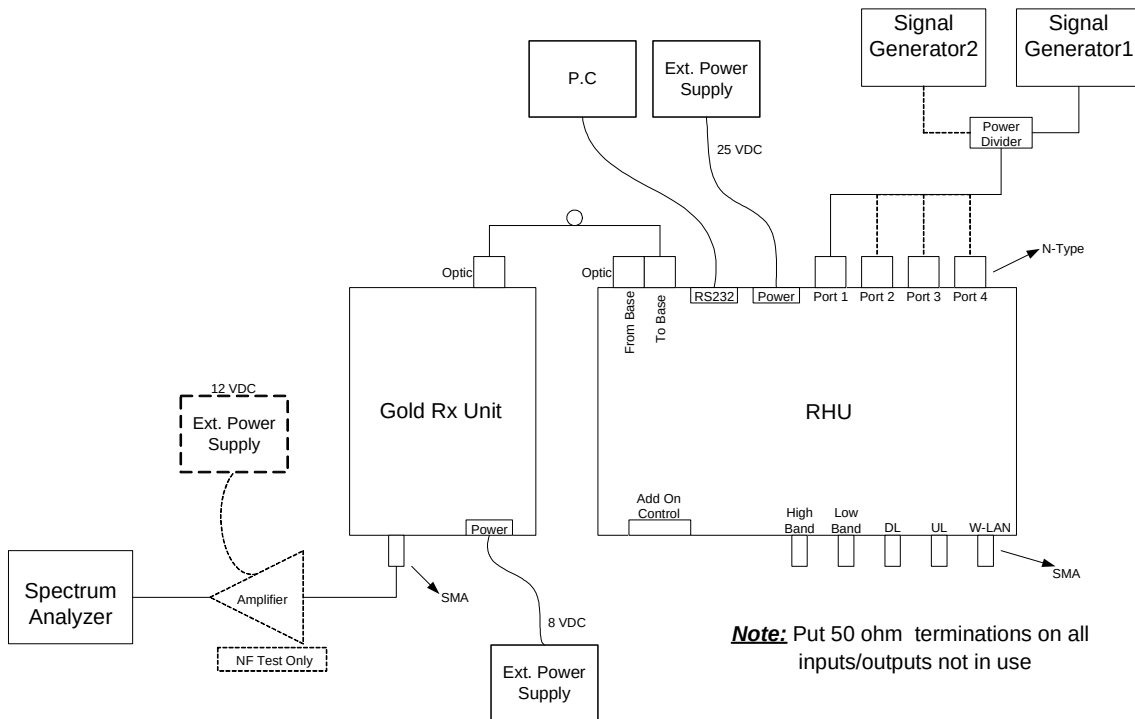


Figure 4.4: Signal Generator UL

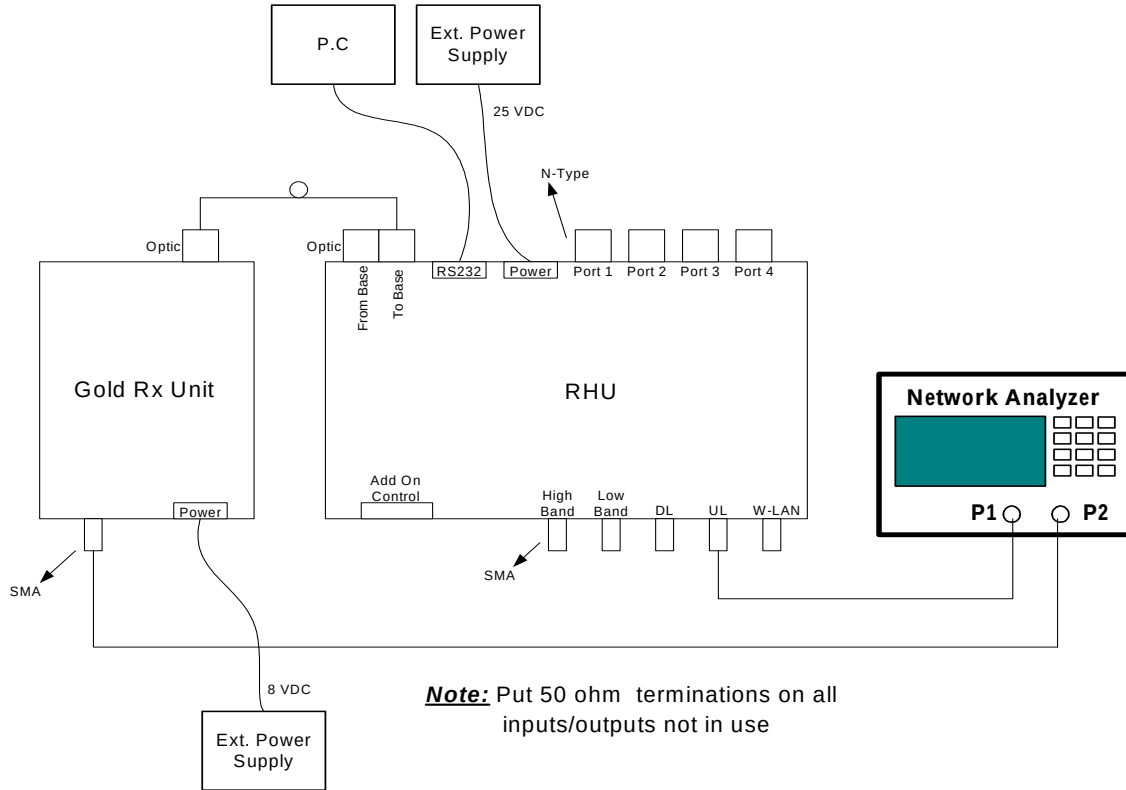


Figure 4.5: UL SMA Configuration

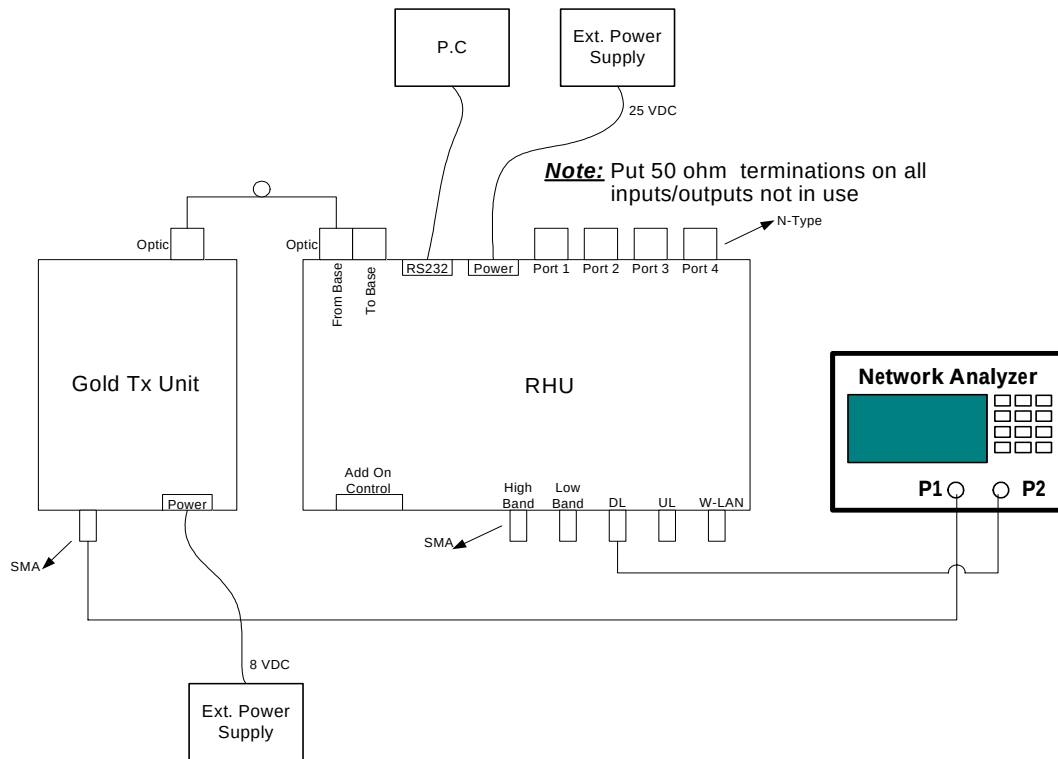


Figure 4.6: DL SMA Configuration

Note: Put 50 ohm terminations on all inputs/outputs not in use

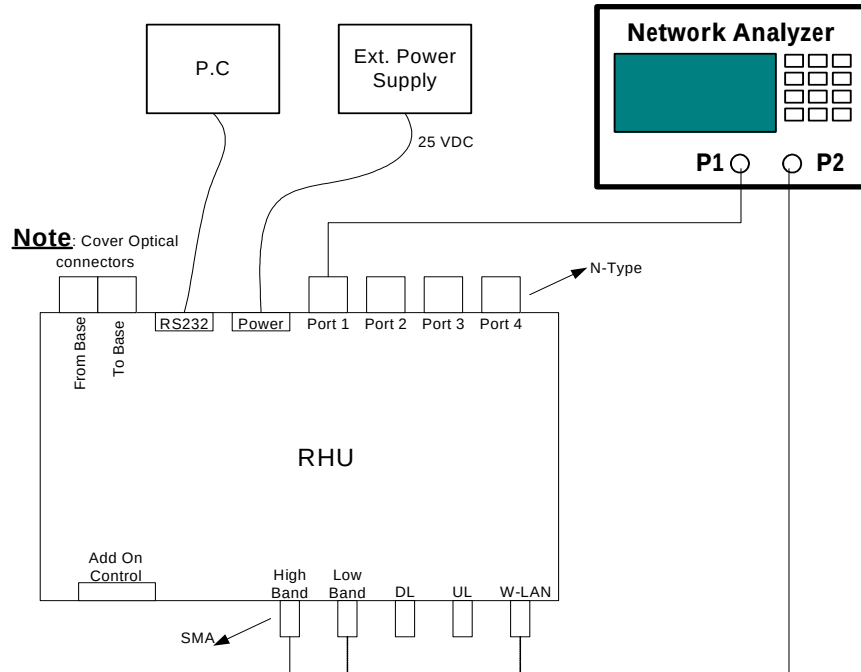


Figure 4.7 WLAN test configuration

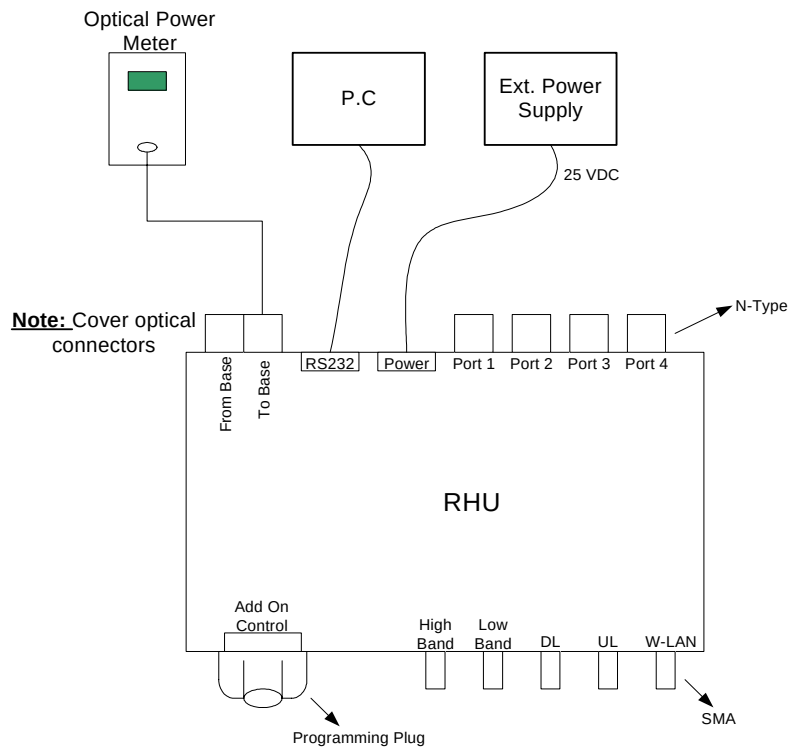


Figure 4.8 SPI Lines Test

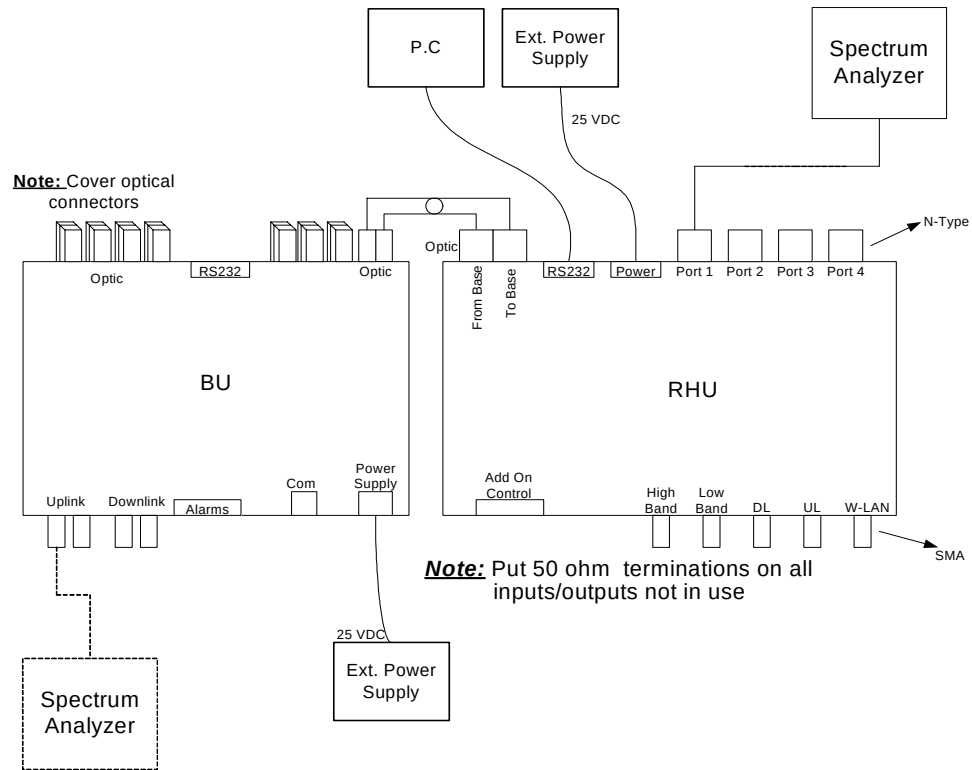


Figure 4.9 FSK Test

5. Mean Gain Target Values

Setup	Application	Target Downlink Mean Gain LB	Target Uplink Mean Gain LB	Target Downlink Mean Gain HB	Target Uplink Mean Gain HB
1	RHU 1K Cell_PCS	54 dB	34.7 dB	50.5dB	31.1dB
2	RHU 1K GSM_DCS	48 dB	33.4 dB	47.3 dB	29.6 dB
3	RHU 1K Iden_PCS	53.6 dB	33.4 dB	51.4 dB	29.5 dB
4	RHU 1K Iden_SMR	54.5 dB	34.9 dB	54.5 dB	44.3 dB
5	RHU 1K Orange_DCS	48.6 dB	34.8 dB	46.8 dB	30.7 dB
6	RHU 1K Cell_DCS	54.1 dB	34.9 dB	47.2 dB	30.4 dB
7	RHU 1K SMR_PCS	56.2 dB	36.1 dB	51.6 dB	30 dB

5.1. Network Analyzer Setup

Turn on Network Analyzer 30min, before start tests.

Table 5.1: Downlink Network Analyzer Configurations

Setup	Application	Measure	Source Power	Start Freq.	Stop Freq.	MKR 1	MKR 2	Sweep Time	Scale/ Div
1	Downlink Cell Band	S21	-10 dBm	750 MHz	1000 MHz	869 MHz	894 MHz	Auto	2 dB
2	Downlink GSM Band	S21	-10 dBm	750 MHz	1000 MHz	935 MHz	960 MHz	Auto	2 dB
3	Downlink PAGE/SMR Band	S21	-10 dBm	750 MHz	1000 MHz	929 MHz	941 MHz	Auto	2 dB
4	Downlink iDEN Band	S21	-10 dBm	750 MHz	1000 MHz	851 MHz	869 MHz	Auto	2 dB
5	Downlink DCS Band	S21	-10 dBm	1700 MHz	2200 MHz	1805 MHz	1880 MHz	Auto	2 dB
6	Downlink PCS Band	S21	-10 dBm	1700 MHz	2200 MHz	1930 MHz	1990 MHz	Auto	2 dB
7	Downlink UMTS Band	S21	-10 dBm	1700 MHz	2200 MHz	2110 MHz	2170 MHz	Auto	2 dB

Table 5.2: Uplink Network Analyzer Configurations

Setup	Application	Measure	Source Power	Start Freq.	Stop Freq.	MKR 1	MKR 2	Sweep Time	Scale/ Div
1	Uplink Cell Band	S21	-40 dBm	750 MHz	1000 MHz	824 MHz	849 MHz	Auto	2 dB
2	Uplink GSM Band	S21	-40 dBm	750 MHz	1000 MHz	890 MHz	915 MHz	Auto	2 dB
3	Uplink PAGE/SMR Band	S21	-40 dBm	750 MHz	1000 MHz	896 MHz	901 MHz	Auto	2 dB
4	Uplink iDEN Band	S21	-40 dBm	750 MHz	1000 MHz	806 MHz	824 MHz	Auto	2 dB
5	Uplink DCS Band	S21	-40 dBm	1700 MHz	2200 MHz	1710 MHz	1785 MHz	Auto	2 dB
6	Uplink PCS Band	S21	-40 dBm	1700 MHz	2200 MHz	1850 MHz	1910 MHz	Auto	2 dB
7	Uplink UMTS Band	S21	-40 dBm	1700 MHz	2200 MHz	1920 MHz	1980 MHz	Auto	2 dB

Table 5.3: General Network Tests

Setup	Application	Measure	Source Power	Start Freq.	Stop Freq.	MKR 1	MKR 2	Sweep Time	Scale/ Div
1	WLAN	S21	-35 dBm	1700 MHz	2500 MHz	2400 MHz	2483 MHz	Auto	2 dB
2	WLAN Low Band	S21	-35 dBm	1700 MHz	2500 MHz	1710 MHz	2170 MHz	Auto	2 dB
3	WLAN High Band	S21	-35 dBm	750 MHz	1000 MHz	806 MHz	960 MHz	Auto	2 dB
4	Downlink SMA Low Band	S21	-35 dBm	750 MHz	1000 MHz	800 MHz	960 MHz	Auto	2 dB
5	Downlink SMA High Band	S21	-35 dBm	1700 MHz	2200 MHz	1710 MHz	2170 MHz	Auto	2 dB
6	Uplink SMA Low Band	S21	-35 dBm	750 MHz	1000 MHz	800 MHz	960 MHz	Auto	2 dB
7	Uplink SMA High Band	S21	-35 dBm	1700 MHz	2200 MHz	1710 MHz	2170 MHz	Auto	2 dB

6. Spectrum Analyzer Setup

Table 6.1 – Signal Generator/Spectrum Analyzer - Power Detector Setup

Setup	Application	Signal Generator Frequency	SA Center Freq.	Span	Reference Level	RBW Hz	VBW Hz	Attn. dB
1	Downlink Cell Band	881 MHz	881 MHz	15MHz	20dBm	Auto	Auto	Auto
2	Orange 900	908 MHz	908 MHz	15MHz	20dBm	Auto	Auto	Auto
3	Downlink GSM Band	947 MHz	947 MHz	15MHz	20dBm	Auto	Auto	Auto
4	Downlink PAGE/SMR Band	935 MHz	935 MHz	15MHz	20dBm	Auto	Auto	Auto
5	Downlink iDEN Band	860 MHz	860 MHz	15MHz	20dBm	Auto	Auto	Auto
6	Downlink DCS Band	1842 MHz	1842 MHz	15MHz	20dBm	Auto	Auto	Auto
7	Downlink PCS Band	1960 MHz	1960 MHz	15MHz	20dBm	Auto	Auto	Auto
8	Downlink UMTS Band	2140 MHz	2140 MHz	15MHz	20dBm	Auto	Auto	Auto

Table 6.2 – Signal Generator/Spectrum Analyzer – Noise Figure setup

Setup	Application	Center Freq. 1	Center Freq. 2	Span	Reference Level	RBW Hz	VBW Hz	Attn. dB
1	Uplink Cell Band	836.5 MHz	849 MHz	1MHz	20dBm	Auto	Auto	Auto
2	Uplink Orange 900	908.5 MHz	915 MHz	1MHz	20dBm	Auto	Auto	Auto
3	Uplink GSM Band	902.5 MHz	915 MHz	1MHz	20dBm	Auto	Auto	Auto
4	Uplink PAGE/SMR Band	900 MHz	902 MHz	1MHz	20dBm	Auto	Auto	Auto
5	Uplink iDEN Band	815 MHz	821 MHz	1MHz	20dBm	Auto	Auto	Auto
6	Uplink DCS Band	1747.5 MHz	1785 MHz	1MHz	20dBm	Auto	Auto	Auto
7	Uplink PCS Band	1880 MHz	1910 MHz	1MHz	20dBm	Auto	Auto	Auto
8	Uplink UMTS Band	1950 MHz	1980 MHz	1MHz	20dBm	Auto	Auto	Auto

Table 6.3 –Spectrum Analyzer – Marker Noise Setup

Attn dB	RBW Hz	VBW Hz	Reference Level dBm
0	Auto	300	-80

Table 6.4 – Signal Generator –IIP3

Setup	Application	Signal Generator 1	Signal Generator 2	UL Pout / Tone
1	Uplink Cell Band	835.5 MHz	837.5 MHz	-35dBm
2	Uplink Orange 900	907.5 MHz	909.5 MHz	-35dBm
3	Uplink GSM Band	901.5 MHz	903.5MHz	-35dBm
4	Uplink PAGE/SMR Band	899 MHz	901MHz	-35dBm
5	Uplink iDEN Band	814 MHz	816MHz	-35dBm
6	Uplink DCS Band	1746.5 MHz	1748.5 MHz	-35dBm
7	Uplink PCS Band	1879 MHz	1881 MHz	-35dBm
8	Uplink UMTS Band	1949 MHz	1951 MHz	-35dBm

Table 6.5 – Spectrum Analyzer –IIP3

Setup	Application	Left IMD3	Right IMD3	Output Signal	Reference Level	Span	Reference Level	RBW/VBW Hz
1	Downlink Cell Band	833.5 MHz	839.5 MHz	835.5 MHz	-60dBm	15MHz	20dBm	Auto
2	Downlink Orange 900	905.5 MHz	911.5 MHz	907.5 MHz	-60dBm	15MHz	20dBm	Auto
3	Downlink GSM Band	899.5 MHz	905.5MHz	901.5 MHz	-60dBm	15MHz	20dBm	Auto
4	Downlink PAGE/SMR Band	897 MHz	903 MHz	899 MHz	-60dBm	15MHz	20dBm	Auto
5	Downlink iDEN Band	812 MHz	818 MHz	814 MHz	-60dBm	15MHz	20dBm	Auto
6	Downlink DCS Band	1744.5 MHz	1750.5 MHz	1746.5 MHz	-60dBm	15MHz	20dBm	Auto
7	Downlink PCS Band	1877 MHz	1883 MHz	1879 MHz	-60dBm	15MHz	20dBm	Auto
8	Downlink UMTS Band	1947 MHz	1953 MHz	1949 MHz	-60dBm	15MHz	20dBm	Auto

Table 6.6 – Signal Generator –IMD3

Setup	Application	Signal Generator 1	Signal Generator 2	DL Pout / Tone
1	Downlink Cell Band	880.5 MHz	882.5 MHz	-35dBm
2	Downlink Orange 900	946.5 MHz	948.5 MHz	-35dBm
3	Downlink GSM Band	929.5 MHz	931.5MHz	-35dBm
4	Downlink PAGE/SMR Band	859 MHz	861MHz	-35dBm
5	Downlink iDEN Band	937 MHz	939MHz	-35dBm
6	Downlink DCS Band	1841.5 MHz	1843.5 MHz	-35dBm
7	Downlink PCS Band	1959 MHz	1961 MHz	-35dBm
8	Downlink UMTS Band	2139 MHz	2141 MHz	-35dBm

Table 6.7 – Spectrum Analyzer –IMD3

Setup	Application	F1	F2	Reference Level	Span	Reference Level	RBW Hz	VBW Hz
1	Downlink Cell Band	878.5 MHz	884.5 MHz	-60dBm	15MHz	20dBm	Auto	Auto
2	Downlink Orange 900	944.5 MHz	950.5 MHz	-60dBm	15MHz	20dBm	Auto	Auto
3	Downlink GSM Band	927.5 MHz	933.5MHz	-60dBm	15MHz	20dBm	Auto	Auto
4	Downlink PAGE/SMR Band	857 MHz	863 MHz	-60dBm	15MHz	20dBm	Auto	Auto
5	Downlink iDEN Band	935 MHz	941 MHz	-60dBm	15MHz	20dBm	Auto	Auto
6	Downlink DCS Band	1839.5 MHz	1845.5 MHz	-60dBm	15MHz	20dBm	Auto	Auto
7	Downlink PCS Band	1957 MHz	1963 MHz	-60dBm	15MHz	20dBm	Auto	Auto
8	Downlink UMTS Band	2137 MHz	2143 MHz	-60dBm	15MHz	20dBm	Auto	Auto

7. FSK Setup Table

	Downlink Rejection	Uplink Carrier	RHU Tx	BU Tx
Harmonic 1	399.04 MHz	793.92 MHz	-20 dBm	-20 dBm
Harmonic 2	798.07 MHz	1984.8 MHz	-20 dBm	-20 dBm
Harmonic 3	1995.18 MHz	2381.76 MHz	-20 dBm	-20 dBm
Harmonic 4	2394.22 MHz		-20 dBm	-20 dBm

8. Laser Current Calibration

- 8.1. Connect the RHU according to setup 4.8.
- 8.2. Run the RHU GUI software.
- 8.3. Write down the laser slope efficiency (SE) from the laser manufacturer data sheet.
- 8.4. Write down the laser current threshold (I_{th}) from the laser manufacturer data sheet.
- 8.5. Change the “LASER” value in the RHU GUI software until “**I_{bias}**” matches to **I_{th}+25mA**.
- 8.6. Record “I_{bias}” to ATR.
- 8.7. Record “LASER” to ATR.
- 8.8. Record “I_{th}” to ATR.
- 8.9. Record Slope efficiency to ATR.

9. Optical Power PDI

- 9.1. Connect the RHU according to setup 4.8.
- 9.2. Measure the laser power with the optical power meter.
- 9.3. Record result to ATR.
- 9.4. Run the RHU GUI software and read the “PDI Mon” value.
- 9.5. Convert the “PDI Mon” Value to Volts according to the following expression:

$$(V = \frac{PDI_Mon \times 5}{255})$$

- 9.6. Record result to ATR.

10. Antenna Connection

- 10.1. Connect the RHU according to setup 4.8.
- 10.2. Run the RHU GUI software.
- 10.3. Connect 50Ω N-type termination on antenna port1 and verify that the antenna indicator in the GUI software is green.
- 10.4. Remove the 50Ω termination from antenna port1 and verify that the antenna indicator in the GUI software is red.
- 10.5. Record results to ATR.
- 10.6. Repeat the steps 10.3 to 10.5 for antenna ports 2 to 4.

11. SPI Lines Test

- 11.1. Connect the RHU according to setup 4.8.
- 11.2. Open the Hyper Terminal program.
- 11.3. Select “Disconnect” then “File” → “Properties”.
- 11.4. Select “Connect using : COM1”.
- 11.5. In the “Configure” menu select the following Parameters:
Bits Per Second: 19200, Data bits: 8, Parity: None, Stop bit: 1, Flow control: Hardware.
- 11.6. Select “Connect” and Activate CAPS LOCK on the keyboard.
- 11.7. Type “[FF FF FF FF D0 ZZ]” and press Enter.
- 11.8. The following reply will appear “[Serial Number 50 Code ZZ]” where “Code” defines the SPI lines status according to the following table:

<u>Status</u>	<u>Code</u>
“OK”	0
General Error	1
Clock Line Error	2,3
D out Lines Error	4,5
Chip Select Error	6,7
D in Lines Error	8

12. Software verification

- 12.1. Connect the RHU and Tx Gold unit according to setup 4.1.
- 12.2. Run the RHU GUI program.
- 12.3. Click “Connect” button and verify there is no error message.
- 12.4. Record the version number indicated as “FW” to ATR.
- 12.5. Record the Serial number indicated as “S/N” to ATR.
- 12.6. Record “Downlink V” and “Uplink V” to ATR.

13. LED Test

- 13.1. After programming process, turn on the RHU GUI program.
- 13.2. Verify that all three LEDs are lighting immediately after turn on the power and after a while just the RUN LED is flickering and the rest are darks.
- 13.3. Record result to ATR
- 13.4.

14. Current Test

- 14.1. Measure the current to the RHU.
- 14.2. Record result to ATR.

15. General Network Tests

15.1. WLAN SMA Port Test

- 15.1.1. Connect the RHU unit according to setup 4.7.
- 15.1.2. Set the Network Analyzer according to the RHU band, Based on table 5.4, S21 and ripple measurement.
- 15.1.3. Repeat the measurement for SMA ports “Low Band” and “High Band”.
- 15.1.4. Record the results to the ATR.

15.2. Downlink SMA Port

- 15.2.1. Connect the RHU unit according to setup 4.6.
- 15.2.2. Set the Network Analyzer according to the RHU band, Based on table 5.4, S21 and ripple Measurement.
- 15.2.3. Repeat the measurement for low band and high band.
- 15.2.4. Record the results to the ATR.

15.3. Uplink SMA Port

- 15.3.1. Connect the RHU unit according to setup 4.5.
- 15.3.2. Set the Network Analyzer according to the RHU band, Based on table 5.4, S21 and ripple Measurement.
- 15.3.3. Repeat the measurement for low band and high band.
- 15.3.4. Record the results to the ATR.

16. Downlink Mean Gain Adjustment Test

- 16.1. Connect the RHU and Tx Gold unit according to setup 4.1.
- 16.2. Set the Network Analyzer according to the RHU band, base on Table 5.2, S21 measurement.
- 16.3. Adjust the downlink DCA using the “RHU” SW until S21 comply with the target Mean gain value according to table 5.1.
- 16.4. Record the Mean Gain to ATR.
- 16.5. Record the Ripple To ATR.
- 16.6. Record DCA value to ATR.

17. Port Unbalance

- 17.1. Connect the RHU and Tx Gold unit according to setup 4.1.
- 17.2. Measure S21 on the antenna ports 1 to 4 according to the frequency bands detailed in table 5.2.
- 17.3. Record results to the ATR.

18. Uplink Mean Gain Adjustment Test

- 18.1. Connect the RHU and Tx Gold unit according to setup 4.2.
- 18.2. Set the Network Analyzer according to the RHU band, base on Table 5.3, S21 measurement.
- 18.3. Adjust the downlink DCA using the “RHU” SW until S21 comply with the target Mean gain value according to table 5.1.
- 18.4. Record the Mean Gain to ATR.
- 18.5. Record the Ripple To ATR.
- 18.6. Record DCA value to ATR

19. Uplink AGC Test

- 19.1. Connect the RHU and Rx Gold unit according to setup 4.4.
- 19.2. Set the signal generator frequency to the center frequency of the RHU Uplink Band.
- 19.3. Set the signal generator power to -35dBm .
- 19.4. Set the spectrum analyzer to the center frequency of the RHU Uplink Band.
- 19.5. Calculate the gain.
- 19.6. Record result to the ATR.
- 19.7. Set the signal generator power to -20dBm .
- 19.8. Calculate the gain.
- 19.9. Record result to the ATR.

20. Down link Power Detector

20.1. Power Detector Low Band

- 20.1.1. Connect the RHU and Tx Gold unit according to setup 4.3.
- 20.1.2. Set Spectrum Analyzer according to the RHU band, based on Table 6.1.
- 20.1.3. Set Signal Generator Frequency according to the RHU band, based on Table 6.1.
- 20.1.4. Adjust the signal generator output power to get $+1\text{dBm}$ on the spectrum analyzer.
- 20.1.5. Measure the Output Signal on the Spectrum analyzer and read the A/D value on the “RHU” SW.
- 20.1.6. Record result to ATR.
- 20.1.7. Increase the Power Level of the Signal Generator by 1 dB.
- 20.1.8. Measure the Output Signal on the Spectrum and read the A/D value on the “RHU” SW.
- 20.1.9. Record result to ATR.
- 20.1.10. Repeat stages 19.1.6 to 19.1.9 22 times.

20.2. Power Detector High Band

- 20.2.1. Connect the RHU and Tx Gold unit according to setup 4.3.
- 20.2.2. Set Spectrum Analyzer according to the RHU band, based on Table 6.1.
Set Signal Generator Frequency according to the RHU band, based on Table 6.1.
- 20.2.3. Adjust the signal generator output power to get -1dBm on the spectrum analyzer.
- 20.2.4. Measure the Output Signal on the Spectrum analyzer and read the A/D value on the “RHU” SW.
- 20.2.5. Record result to ATR.
- 20.2.6. Increase the Power Level of the Signal Generator by 1 dB.
- 20.2.7. Measure the Output Signal on the Spectrum and read the A/D value on the “RHU” SW.
- 20.2.8. Record result to ATR.
- 20.2.9. Repeat stages 19.1.16 to 19.1.18 22 times.

21. NF Test

The noise figure test is performed on 2 frequencies of the band: the center frequency (center frequency 1 in table 6.2) and the right edge frequency of the band (center frequency 2 in table 6.2).

- 21.1. Connect the RHU and Rx Gold unit according to setup 4.4.
- 21.2. Set Spectrum Analyzer and Signal Generator Frequencies according to the RHU band to center frequency 1, based on Table 6.2.
- 21.3. Measure the composite input power to the Rx gold unit.
- 21.4. Measure the output signal on antenna Port 1 with the spectrum analyzer.
- 21.5. Press the “RF OFF” button on the signal generator.
- 21.6. Set up the spectrum analyzer to marker noise measurement according to table 6.3.
- 21.7. Measure the noise floor at the center frequency based on table 6.3.
- 21.8. Calculate the noise figure using the following expression:

$$Gain = (Output Power) - (Input Power)$$

$$NF = -174 - NFL - Gain.$$

- 21.9. Record the result to the ATR.
- 21.10. Repeat steps 16.2 to 16.9 for center frequency 2.

22. IMD3 test

- 22.1. Connect the RHU and Tx Gold unit according to setup 4.3.
- 22.2. Set Signal generators according to the RHU band, based on table 6.6.
- 22.3. Measure the IMD3 products at the RHU output with the spectrum analyzer according to the table 6.7.

Note: there are two IMD3 products on either side of the output signals ($2f_1 - f_2, 2f_2 - f_1$)

- 22.4. Record the worst result to the ATR.

23. IIP3 test

- 23.1. Connect the RHU and Rx Gold Unit according to setup 4.4.
- 23.2. Set signal generators according to the RHU band, based on table 6.4.
- 23.3. Measure the IMD3 and output signals on the spectrum analyzer according to table 6.5.
- 23.4. Calculate the IIP3 value according to the following expression:

$$IIP3 = 2 \times P_{OUT} - Gain - P_{IMD3}$$

$$Gain = P_{Out} - P_{in}$$

- 23.5. Record the result to ATR.

24. FSK Downlink Rejection

- 24.1. Connect the RHU and BU according to setup 4.9.
- 24.2. Run the RHU and BU GUI software.
- 24.3. Set the BU and RHU FSK Tx power according to table 7.
- 24.4. Set the spectrum analyzer to the Downlink Rejection frequencies according to table 7.
- 24.5. Measure the Downlink rejection signal.
- 24.6. Record the results to ATR.

25. FSK Uplink Carrier

- 25.1. Connect the RHU and BU according to setup 4.9.
- 25.2. Run the RHU and BU GUI software.
- 25.3. Set the BU and RHU FSK Tx power according to table 7.
- 25.4. Set the spectrum analyzer to the Uplink carrier frequencies according to table 7.
- 25.5. Measure the Uplink carrier signal.
- 25.6. Record the results to ATR.

26. FSK MODEM

- 26.1. Connect RHU and BU according to setup 4.9.
- 26.2. Remove RS232 cable and let the link run for 2 minuets.
- 26.3. Plug RS232 plug and run the RHU GUI software.
- 26.4. Read FSK counter on the RHU GUI software.
- 26.5. Record result to ATR.