Qualification Report

OpenCellular - Connect1 Radio Frequency module with Software Defined Radio (RF-SDR)

Revision: 1.1

[13-FEB-2017]

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1. Purpose

The purpose of this document is to capture test data for Radio-Frequency module with Software-Defined-Radio (RF-SDR) as part of OpenCellular Base Transceiver Station (BTS). The document is intended to provide a formal report of measured and validated parameters to qualify RF-SDR module as part of design validation testing to ensure consistent and reliable operation across all supported operating and environmental conditions.

2. Scope

Scope of this document is to qualify different sections as mentioned below:

- 1. Power Source section which includes Volatge regulators, FPGA PMIC
- 2. Clock section which includes VCTCXO, PLL
- 3. FPGA and FX3 section
- 4. Transceiver Section (AD9361)
- 5. Transmitter and Receiver Sections

3. Device-Under-Test (DUT) Details

a. System : OpenCellular Connect -1

b. Sub-system : RF-SDR

c. Hardware version : Life - 1 & Life - 2

d. Software version : The git versions as follows

a. Openbsc : 5085e0bb. Osmo-trx : 2e5e2c5c. Uhd : f70dd85

e. Sample Count : 01

4. Qualification Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

5. Qualification Result Summary

Test ID	Sub-system	Function	Test cases/specification	Priority	Status
Pwr1.1		1. Conversion from	Voltage Accuracy	P0	Pass
Pwr1.2		12V input from GBC	Load regulation	P0	Pass
Pwr1.3		board to 5.7, 3.7, 1.8,	Line regulation	P0	Pass
Pwr1.4		1.2, 3.3,1 and 5.1V	Ripple Noise	P1	Pass
Pwr1.5		output using switching regulators.	Voltage Control	PO	Pass
Pwr1.6	Power	Converting and regulating from switching regulators out to voltages	Voltage Accuracy	PO	Pass
Pwr1.7		required by various devices on RF_SDR section using LDO's.	Voltage Control	PO	Pass
Pwr1.8		3. Read current flow via current sensor circuit.	Current consumption	PO	Pass
Clk 1.1		To synchronize with	Clock output level		Pass
Clk 1.2		the GBC system clock	Frequency		Pass
Clk 1.3		and generate clock	Frequency accuracy		Pass
Clk 1.4		frequency required	Phase noise		Fail
Clk 1.5		for transceiver IC	Lock time		Pass
Clk 1.6	Clock	To synchronize with the GBC system clock	Clock Duty Cycle	P1	Pass
Clk 1.7		and generate clock frequency required for codec FPGA	Jitter	P1	Pass
Clk 1.8		Clock from AD9361 out to FPGA and other	Clock Duty Cycle	P4	Pass
Clk 1.9		digital clocks	Jitter	P4	Pass
FPGA 1.1.1	FPGA	Artix-7	Boot configuration	P0	Pass
FPGA 1.1.2			Power sequence	PO	Pass
FPGA 1.2.1		FX3 - SPI	Electrical validation	PO	Pass
FPGA 1.2.2			Functional validation	P1	Pass

FPGA 1.3.1			Electrical validation	P0	Fail
FPGA		AD9361 - SPI	Functional validation	D1	Dace
1.3.2			Functional validation	P1	Pass
FPGA 1.4.1		540 0015 0	Electrical validation	PO	Pass
FPGA 1.4.2		FX3 - GPIF:Control	Functional validation	P1	Pass
FPGA 1.5.1			Electrical validation	PO	Pass
FPGA		FX3 - GPIF:Data	Functional validation	P1	Pass
1.5.2 FPGA			Electrical validation	P0	Pass
1.6.1 FPGA		AD9361 - Control	Functional validation	P1	Pass
1.6.2 FPGA			Electrical validation	P0	Fail
1.7.1 FPGA		AD9361 - Data	Functional validation	P1	Pass
1.7.2					
FX3 1.1		FX3	Configuration	P0	Pass
FX3 1.2.1		EEPROM-I2C	Electrical validation	P0	Pass
FX3 1.2.2			Functional validation	P0	Pass
FX3 1.3.1	FX3	Debug USB Switch - USB2.0	Functional validation	P0	Pass
FX3 1.4.1		Debug USB Switch - USB 3.0	Functional validation	P0	Pass
TRX 1.1			Maximum Output Power		Pass
TRX 1.2			Transmit power control- ATTENUATION RANGE		Pass
TRX 1.3			Modulation Accuracy	P2	Pass
TRX 1.4	DE /T.		Carrier Leakage	P2	Pass
TRX 1.5	RF/Transceiver (AD9361) -	AD9361(Transceiver	LO Lock Detect		Pass
TRX 1.6	(AD9361) - Pipe1	IC)is used to convert base band data to RF on transmit side and RF to base band on	Output RF spectrum i). Adjacent channel power ii). Spectrum due to switching	P2	Fail
TRX 1.7		receive side.	Receiver sensitivity	P1	Open
TRX 1.8			Maximum Input signal	P1	Open
TRX 2.1			Maximum Output Power		Pass
TRX 2.2	RF/Transceiver (AD9361) -		Transmit power control- ATTENUATION RANGE		Pass
TRX 2.3	Pipe2		Modulation Accuracy	P2	Pass

TRX 2.4			Carrier Leakage	P2	Pass
TRX 2.5			LO Lock Detect		Pass
TRX 2.6			Output RF spectrum i). Adjacent channel power ii). Spectrum due to switching	P2	Fail
TRX 2.7			Receiver sensitivity	P1	Open
TRX 2.8			Maximum Input signal	P1	Open
TX_P 1.1			Gain		Pass
TX_P 1.2			Attenuation (part of TIVA I2C testing)		Pass
TX_P 1.3	TX pipe - 1		Attenuation step (part of TIVA I2C testing)		Pass
TX_P 1.4		TV	Output Power		Pass
TX_P 1.5		TX pipe is used to amplify and control TX	RF power detection	P0	Pass
TX_P 2.1		signal	Gain		Pass
TX_P 2.2		,	Attenuation (part of TIVA I2C testing)		Pass
TX_P 2.3	TX pipe - 2		Attenuation step (part of TIVA I2C testing)		Pass
TX_P 2.4			Output Power		Pass
TX_P 2.5			RF power detection	P0	Pass
RX_P 1.1			Noise Figure	P0	Fail
RX_P 1.2			Gain		Fail
RX_P 1.3	RX pipe - 1		Attenuation (part of TIVA I2C testing)		Pass
RX_P 1.4		RX pipe is used to	Attenuation step (part of TIVA I2C testing)		Pass
RX_P 2.1		amplify and control RX signal	Noise Figure	P0	Fail
RX_P 2.2		Signal	Gain		Fail
RX_P 2.3	RX pipe -2		Attenuation (part of TIVA I2C testing)		Pass
RX_P 2.4			Attenuation step (part of TIVA I2C testing)		Pass
			TX Subsystem along with AD9361 with GBC		
TX_C 1.2	Transmitter	To transmit and receive GSM signals	i) Output Power and Tolerance ii) RF carrier power versus time	PO	Pass
TX_C 1.3	_Chain 1	with baseband data	Static Power Control	Р0	Pass
TX_C 1.4		from Linux PC.	Modulation accuracy	P2	Pass
TX_C 1.5			Output RF spectrum i). Adjacent channel power ii). Spectrum due to switching	P2	Fail

TX_C 1.6		Spurious Emissions i). Tx and Rx band spurious ii). Cross-band spurious iii). Out-of-band spurious	PO	Fail
		TX Subsystem along with AD9361 with GBC		
TX_C 2.2		i) Output Power and Tolerance ii) RF carrier power versus time	PO	Pass
TX_C 2.3		Static Power Control	P0	Pass
TX_C 2.4	Transmitter	Modulation accuracy	P2	Pass
TX_C 2.5	_Chain 2	Output RF spectrum i). Adjacent channel power ii). Spectrum due to switching	P2	Fail
TX_C 2.6		Spurious Emissions i). Tx and Rx band spurious ii). Cross-band spurious iii). Out-of-band spurious	PO	Fail
RX_C 1.1	Receiver Chain 1	Reference Sensitivity Level	P1	Open
RX_C 2.1	Receiver Chain 2	Reference Sensitivity Level	P1	Open

6. Tools and Test Equipment

Test (Sub- System)	Tools and Test Equipment	Model and Version Information			
	DC Power Supply	RIGOL DP832			
Power	Electronic Load	KMO64			
	Oscilloscope	MSO9404A			
	DC Power Supply	RIGOL DP832			
	PXIe chassis	M9381A			
	RF Cables	SMA Male to SMA Male			
Clock	Pig tail SMA Cables	One end SMA Female connector and another end open cable			
	Linux PC	TBD			
	Oscilloscope	MSO9404A			
	DC Power Supply	RIGOL DP832			
FPGA	Oscilloscope	MSO9404A			
	Linux PC	TBD			
	DC Power Supply	RIGOL DP832			
FX3	Oscilloscope	MSO9404A			
	Linux PC	TBD			
	DC Power Supply	RIGOL DP832			
	PXIe chassis	M9381A			
RF/Transceiver	RF Cables	SMA Male to SMA Male			
(AD9361) – Pipe1	Pig tail SMA Cables	One end SMA Female connector and another end open cable			
	Linux PC	TBD			
	Oscilloscope	MSO9404A			
	DC Power Supply	RIGOL DP832			
	PXIe chassis	M9381A			
RF/Transceiver	RF Cables	SMA Male to SMA Male			
(AD9361) – Pipe2	Pig tail SMA Cables	One end SMA Female connector and another end open cable			
	Oscilloscope	MSO9404A			
	Linux PC	TBD			
	DC Power Supply	RIGOL DP832			
	PXIe chassis	M9381A			
TX pipe – 1	RF Cables	SMA Male to SMA Male			
1 1	Pig tail SMA Cables	One end SMA Female connector and another end open cable			
	DC Power Supply	RIGOL DP832			
TX pipe – 2	PXIe chassis	M9381A			
	RF Cables	SMA Male to SMA Male			

	Pig tail SMA Cables	One end SMA Female connector and another end open cable		
	Noise Source	HP – 346B		
DV mino 1	Signal Analyzer	Keysight N9020A		
RX pipe – 1	RF Cables	SMA(F) to Switch type cable		
		BNC to BNC cable		
	Noise Source	HP – 346B		
RX pipe -2	Signal Analyzer	Keysight N9020A		
KA pipe -2	RF Cables	SMA(F) to Switch type cable		
		BNC to BNC cable		
	DC Power Supply	RIGOL DP832		
Transmitter	PXIe chassis	M9381A		
_Chain 1	RF Cables	SMA Male to SMA Male		
	Attenuator	30dB		
	DC Power Supply	RIGOL DP832		
Transmitter	PXIe chassis	M9381A		
_Chain 2	RF Cables	SMA Male to SMA Male		
	Attenuator	30dB		
Receiver Chain 1				
Receiver Chain 2				

8 Power

8.1 Voltage accuracy

8.1.1 Test ID

Pwr1.1

8.1.2 Purpose

The purpose of the test case is to measure the output voltage of switching regulators and to ensure that these voltages are in specified limits.

8.1.3 Test and Measurement Method

Refer to section 3.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

8.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Full

8.1.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0004

8.1.6 **Test** Results

The measured output voltage accuracy of switching regulators are within 2% of expected voltage

U3500 (12V to 5.7V):

	Voltage Accuracy for U3500													
Sl.	Test case No.	Voltage		Load Current	Output Current	Output Voltage	Specifica	ation(V)	Design margin	Result				
No.		(V)	(A)	(A)	(V)	Min	Max	(%)						
1	Pwr1.1	11.4	4	2.184	5.795	5.586	5.814	-0.326797386	PASS					
2	Pwr1.1	12	4	2.072	5.796	5.586	5.814	-0.309597523	PASS					
3	Pwr1.1	12.6	4	1.969	5.792	5.586	5.814	-0.378396973	PASS					

U3501 (12V to 5.7V):

	Voltage Accuracy for U3501													
Sl. Te	Test case Supply Voltage		1 est case Voltage Curr		Load Current	Output Current	- Specification v		ation(V)	Design margin	Result			
190.	No.	(V)	(A)	(A)	(V)	Min Max		(%)						
1	Pwr1.1	11.4	4	2.153	5.713	5.586	5.814	-1.737186103	PASS					
2	Pwr1.1	12	4	2.043	5.717	5.586	5.814	-1.668386653	PASS					
3	Pwr1.1	12.6	4	1.942	5.714	5.586	5.814	-1.71998624	PASS					

U4000 (12V to 3.7V):

	Voltage Accuracy for U4000													
Sl.	Test case Supply Voltage		Voltage Current		· · · · · · · · · · · · · · · · · ·		ation(V)	Design margin	Result					
No.	No.	(V)	(A)	(A)	(A) (V)		Max	(%)						
1	Pwr1.1	11.4	4	1.402	3.741	3.626	3.774	-0.874403816	PASS					
2	Pwr1.1	12	4	1.338	3.741	3.626	3.774	-0.874403816	PASS					
3	Pwr1.1	12.6	4	1.274	3.739	3.626	3.774	-0.927397986	PASS					

U3400 (3.7V to 1.8V):

	Voltage Accuracy for U3400													
Sl. No.	Test case No.	1 est case Voltage Current Current Vo		Output Voltage	Specification(V)		Design margin	Result						
190.		(V)	(A) (A)		(V)	Min	Max	(%)						
1	Pwr1.1	3.6	500	0.261	1.81	1.773	1.827	-0.930487137	PASS					
2	Pwr1.1	3.7	500	0.25	1.815	1.773	1.827	-0.65681445	PASS					
3	Pwr1.1	3.8	500	0.248	1.817	1.773	1.827	-0.547345375	PASS					

NOTE: Refer to section 8.4.7 for measurement logs of switching regulators for voltage accuracy.

8.2 Load Regulation

8.2.1 Test **ID**

Pwr1.2

8.2.2 Purpose

The purpose of this test case is to check the capability of switching regulators to maintain a constant output voltage over changes in the load.

8.2.3 Test and Measurement Method

Refer to section 3.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

8.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage -12V DC

System/Test Load: Min-Typical-Max

8.2.5 **DUT Sample Information**

RF-SDR Board Serial Number - WZ1630LIFE2SDR0004

8.2.6 Test Results

The output voltage accuracy of regulators are within 2% of expected voltage under various load conditions.

U3500 (12V to 5.7V):

	Load Regulation (Input Voltage – 12V) for U3500													
Sl. No.	Test case	Load Current	Output Current	Output Voltage	Specifica	ation(V)	Design margin	Result						
	No.	(A)	(A)	(V) (avg)	Min	Max	(%)	Tesure						
1	Pwr1.2	1	0.494	5.788	5.586	5.814	-0.447196422	PASS						
2	Pwr1.2	2	0.998	5.791	5.586	5.814	-0.395596835	PASS						
3	Pwr1.2	3	1.524	5.794	5.586	5.814	-0.343997248	PASS						
4	Pwr1.2	4	2.072	5.796	5.586	5.814	-0.309597523	PASS						

U3501 (12V to 5.7V):

	Load Regulation (Input Voltage – 12V) for U3501												
Sl. No.	Test case	Load Current	Output Current	Output Voltage	Specifica	ation(V)	Design margin	Result					
	No.	(A)	(A)	(V) (avg)	Min	Max	(%)	1100410					
1	Pwr1.2	1	0.486	5.76	5.586	5.814	-0.92879257	PASS					
2	Pwr1.2	2	0.983	5.758	5.586	5.814	-0.963192294	PASS					
3	Pwr1.2	3	1.501	5.743	5.586	5.814	-1.22119023	PASS					
4	Pwr1.2	4	2.043	5.717	5.586	5.814	-1.668386653	PASS					

U4000 (12V to 3.7V):

		Loa	d Regulation (Input Voltag	e – 12V) fo	or U4000			
Sl.	Test case	Load Current	Output Current	Output Voltage	Specifica	ation(V)	Design margin	Result	
No.	No.	(A)	(A)	(V) (avg)	Min	Max	(%)	resure	
1	Pwr1.2	1	0.325	3.737	3.626	3.774	-0.980392157	PASS	
2	Pwr1.2	2	0.646	3.741	3.626	3.774	-0.874403816	PASS	
3	Pwr1.2	3	0.983	3.739	3.626	3.774	-0.927397986	PASS	
4	Pwr1.2	4	1.338	3.741	3.626	3.774	-0.874403816	PASS	

U3400 (3.7V to 1.8V):

	Load Regulation (Input Voltage – 3.7V) for U3400										
Sl.	Test case No.	Load Current	Output Current	Output Voltage	Specifica	ation(V)	Design margin	Result			
No.		(A)	(A)	(V) (avg)	Min	Max	(%)				
1	Pwr1.2	300	0.15	1.82	1.773	1.827	-0.383141762	PASS			
2	Pwr1.2	400	0.202	1.816	1.773	1.827	-0.602079912	PASS			
3	Pwr1.2	500	0.25	1.815	1.773	1.827	-0.65681445	PASS			

NOTE: Refer to section 8.4.7 for measurement logs of switching regulators for Load regulation.

8.3 Line Regulation

8.3.1 Test ID

Pwr1.3

8.3.2 Purpose

The purpose of this test case is to check the ability of the switching regulators to maintain its specified output voltage over changes in the input line voltage.

8.3.3 Test and Measurement Method

Refer to section 3.1.3 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

8.3.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +11.4V DC to 12.6V DC

System/Test Load: Min-Typical-Max

8.3.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0004

8.3.6 **Test** Results

The output voltage accuracy of switching regulators are within 2% of expected voltage under various supply input and load conditions.

U3500 (12V to 5.7V):

	Line regulation without electronic load for U3500											
SI.	Test case	Supply	Output	Output	Specific	ation(V)	Design					
No.	No.	Voltage (V)	Current (A)	Voltage (V)	Min	Max	margin (%)	Result				
1	Pwr1.3	11.4	0.01	5.79	5.586	5.814	-0.4128	PASS				
2	Pwr1.3	12	0.01	5.789	5.586	5.814	-0.43	PASS				
3	Pwr1.3	12.6	0.01	5.793	5.586	5.814	-0.3612	PASS				

			Line regul	ation with e	lectronic loa	d for U3500			
Sl.	Test case	Supply	Load	Output	Output	Specific	ation(V)	Design	
No.	No.	Voltage (V)	Current (A)	Current (A)	Voltage (V)	Min	Max	margin (%)	Result
1	Pwr1.3	11.4	1	0.519	5.791	5.586	5.814	-0.3956	PASS
2	Pwr1.3	11.4	2	1.047	5.79	5.586	5.814	-0.4128	PASS
3	Pwr1.3	11.4	3	1.6	5.795	5.586	5.814	-0.3268	PASS
4	Pwr1.3	11.4	4	2.184	5.795	5.586	5.814	-0.3268	PASS
5	Pwr1.3	12	1	0.494	5.788	5.586	5.814	-0.4472	PASS
6	Pwr1.3	12	2	0.998	5.791	5.586	5.814	-0.3956	PASS
7	Pwr1.3	12	3	1.524	5.794	5.586	5.814	-0.344	PASS
8	Pwr1.3	12	4	2.072	5.796	5.586	5.814	-0.3096	PASS
9	Pwr1.3	12.6	1	0.473	5.791	5.586	5.814	-0.3956	PASS
10	Pwr1.3	12.6	2	0.949	5.786	5.586	5.814	-0.4816	PASS
11	Pwr1.3	12.6	3	1.45	5.798	5.586	5.814	-0.2752	PASS
12	Pwr1.3	12.6	4	1.969	5.792	5.586	5.814	-0.3784	PASS

U3501 (12V to 5.7V):

	Line regulation without electronic load for U3501											
SI.	Test case	Supply	Output	Output	Specific	ation(V)	Design					
No.	No.	Voltage (V)	Current (A)	Voltage (V)	Min Max		margin (%)	Result				
1	Pwr1.3	11.4	0.009	5.781	5.586	5.814	-0.5676	PASS				
2	Pwr1.3	12	0.009	5.764	5.586	5.814	-0.85999	PASS				
3	Pwr1.3	12.6	0.009	5.779	5.586	5.814	-0.602	PASS				

			Line regul	lation with e	lectronic loa	d for U3501			
SI.	Test case	Supply	Load	Output	Output	Specific	ation(V)	Design	
No.	No.	Voltage (V)	Current (A)	Current (A)	Voltage (V)	Min	Max	margin (%)	Result
1	Pwr1.3	11.4	1	0.512	5.76	5.586	5.814	-0.92879	PASS
2	Pwr1.3	11.4	2	1.038	5.756	5.586	5.814	-0.99759	PASS
3	Pwr1.3	11.4	3	1.585	5.738	5.586	5.814	-1.30719	PASS
4	Pwr1.3	11.4	4	2.153	5.713	5.586	5.814	-1.73719	PASS
5	Pwr1.3	12	1	0.486	5.76	5.586	5.814	-0.92879	PASS
6	Pwr1.3	12	2	0.983	5.758	5.586	5.814	-0.96319	PASS
7	Pwr1.3	12	3	1.501	5.743	5.586	5.814	-1.22119	PASS
8	Pwr1.3	12	4	2.043	5.717	5.586	5.814	-1.66839	PASS
9	Pwr1.3	12.6	1	0.465	5.759	5.586	5.814	-0.94599	PASS
10	Pwr1.3	12.6	2	0.935	5.756	5.586	5.814	-0.99759	PASS
11	Pwr1.3	12.6	3	1.43	5.735	5.586	5.814	-1.35879	PASS
12	Pwr1.3	12.6	4	1.942	5.714	5.586	5.814	-1.71999	PASS

U4000 (12V to 3.7V):

	Line regulation without electronic load for U4000											
CI	Test case	Supply	Output	Output	Specific	ation(V)	Design					
Sl. No.	No.	Voltage (V)	Current (A)	Voltage (V)	Min Max		margin (%)	Result				
1	Pwr1.3	11.4	0.008	3.734	3.626	3.774	-1.05988	PASS				
2	Pwr1.3	12	0.008	3.739	3.626	3.774	-0.9274	PASS				
3	Pwr1.3	12.6	0.008	3.742	3.626	3.774	-0.84791	PASS				

			Line regul	ation with e	lectronic loa	d for U4000			
Sl.	Test case	Supply	Load	Output	Output	Specific	ation(V)	Design	
No.	No.	Voltage (V)	Current (A)	Current (A)	Voltage (V)	Min	Max	margin (%)	Result
1	Pwr1.3	11.4	1	0.339	3.737	3.626	3.774	-0.98039	PASS
2	Pwr1.3	11.4	2	0.681	3.739	3.626	3.774	-0.9274	PASS
3	Pwr1.3	11.4	3	1.035	3.738	3.626	3.774	-0.9539	PASS
4	Pwr1.3	11.4	4	1.402	3.741	3.626	3.774	-0.8744	PASS
5	Pwr1.3	12	1	0.325	3.737	3.626	3.774	-0.98039	PASS
6	Pwr1.3	12	2	0.646	3.741	3.626	3.774	-0.8744	PASS
7	Pwr1.3	12	3	0.983	3.739	3.626	3.774	-0.9274	PASS
8	Pwr1.3	12	4	1.338	3.741	3.626	3.774	-0.8744	PASS
9	Pwr1.3	12.6	1	0.309	3.741	3.626	3.774	-0.8744	PASS
10	Pwr1.3	12.6	2	0.618	3.737	3.626	3.774	-0.98039	PASS
11	Pwr1.3	12.6	3	0.936	3.737	3.626	3.774	-0.98039	PASS
12	Pwr1.3	12.6	4	1.274	3.739	3.626	3.774	-0.9274	PASS

U3400 (3.7V to 1.8V):

	Line regulation without electronic load for U3400											
Sl.	Test case	Supply	Output	Output	Specific	ation(V)	Design					
No.	No.	Voltage (V)	Current (A)	Voltage (V)	Min	Max margin (%)		Result				
1	Pwr1.3	3.6	0.04	1.82	1.773	1.827	-0.38314	PASS				
2	Pwr1.3	3.7	0.04	1.82	1.773	1.827	-0.38314	PASS				
3	Pwr1.3	3.8	0.04	1.82	1.773	1.827	-0.38314	PASS				

			Line regul	ation with e	lectronic loa	d for U3400			
Sl.	Test case	Supply	Load	Output	Output	Specific	ation(V)	Design	
No.	No.	Voltage (V)	Current (A)	Current (A)	Voltage (V)	Min	Max	margin (%)	Result
1	Pwr1.3	3.6	300	0.153	1.82	1.773	1.827	-0.38314	PASS
2	Pwr1.3	3.6	400	0.207	1.817	1.773	1.827	-0.54735	PASS
3	Pwr1.3	3.6	500	0.261	1.81	1.773	1.827	-0.93049	PASS
4	Pwr1.3	3.7	300	0.15	1.82	1.773	1.827	-0.38314	PASS
5	Pwr1.3	3.7	400	0.202	1.816	1.773	1.827	-0.60208	PASS
6	Pwr1.3	3.7	500	0.25	1.815	1.773	1.827	-0.65681	PASS
7	Pwr1.3	3.8	300	0.147	1.82	1.773	1.827	-0.38314	PASS
8	Pwr1.3	3.8	400	0.198	1.818	1.773	1.827	-0.49261	PASS
9	Pwr1.3	3.8	500	0.248	1.817	1.773	1.827	-0.54735	PASS

NOTE: Refer to section 8.4.7 for measurement logs of switching regulators for line regulation.

8.4 Ripple Noise

8.4.1 Test ID

Pwr1.4

8.4.2 Purpose

The purpose of this test case is to check the maximum peak-to-peak ripple voltage of switching regulators output under full load condition and typical input voltage.

8.4.3 Test and Measurement Method

Refer to section 3.1.4 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

8.4.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage -12V DC

System/Test Load: Full

8.4.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0004

8.4.6 Test Results

The maximum peak-to-peak ripple voltage measured is found to be less than 10% (as per the LT8640IUDC specification) of the output voltage.

U3500 (12V to 5.7V):

	Ripple Measurement for U3500										
C1	Test case	Supply	Load	Ripple	Specifica	tion(mV)	Design				
Sl. No.	No.	Voltage (V)	Current (A)	Voltage (mV)	Min	Max	Margin (%)	Result			
1	Pwr1.4	12	4	8.8	0	10	-12	PASS			

U3501 (12V to 5.7V):

	Ripple Measurement for U3501											
Sl. Test cas	Tost asso	Supply		Ripple	Specifica	tion(mV)	Design					
		Voltage (V)	Current (A)	Voltage (mV)	Min	Max	Margin (%)	Result				
1	Pwr1.4	12	4	2.4	0	10	-76	PASS				

U4000 (12V to 3.7V):

	Ripple Measurement for U4000											
Sl.	Test case	Supply	Load	Ripple	Specifica	tion(mV)	Design					
No	-	No.	Voltage (V)	Current (A)	Voltage (mV)	Min	Max	Margin (%)	Result			
1		Pwr1.4	12	4	9.6	0	10	-4	PASS			

U3400 (3.7V to 1.8V):

	Ripple Measurement for U3400											
Sl. No.	Test case	Supply	Load	Ripple	Specifica	tion(mV)	Design					
	No.	Voltage (V)	Current (A)	Voltage (mV)	Min	Max	Margin (%)	Result				
1	Pwr1.4	3.7	500	8.12	0	10	-18.8	PASS				

8.4.7 Measurement logs

The detailed analysis report with waveform captured for each of the Switching regulators function test cases executed is embed in the excel document attached herewith



8.5 Voltage Control

8.5.1 Test ID

Pwr1.5

8.5.2 Purpose

The purpose of this test case is to check the Voltage Output with respect to Enable on Switching Regulators.

8.5.3 Test and Measurement Method

Refer to section 3.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

8.5.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage -12V DC

System/Test Load: Full

8.5.5 **DUT Sample Information**

RF-SDR Board Serial Number - WZ1630LIFE2SDR0004

8.5.6 Test Results

PASS - Test case is replica of Voltage accuracy, refer to section 8.1.

8.6 Voltage accuracy

8.6.1 Test ID

Pwr1.6

8.6.2 Purpose

The purpose of the test case is to measure the Output voltage of all LDO's and to ensure that these voltages are in specified limits.

8.6.3 Test and Measurement Method

Refer to section 3.1.5 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

8.6.4 **Test** Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Full

8.6.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0010

8.6.6 **Test** Results

			Volta	ge Accuracy	for LDO's			
Sl. No.	Test case No.	LDO	Supply Voltage (V)	Output Voltage (V)	Expected Voltage (V)	Deviation (%)	Output voltage accuracy (%)	Pass/Fail
		U3700						
1		(TPS7A8300)	5.7	5.04	5	0.8	1	PASS
2		U3701 (TPS7A8300)	5.7	5.066	5	1.32	1	FAIL
		U3600						
3		(TPS7A8300)	5.7	5.077	5	1.54	1	FAIL
4		U3601 (TPS7A8300)	5.7	5.03	5	0.6	1	PASS
		U3900						
5		(TPS7A8300)	5.7	5.059	5	1.18	1	FAIL
6		U3901 (TPS7A8300)	5.7	5.04	5	0.8	1	PASS
7	Pwr1.6	U3800 (TPS7A8300)	5.7	5.082	5	1.64	1	FAIL
8		U4100 (TPS7A8300)	3.7	3.295	3.3	0.151515	1	PASS
9		U3801 (TPS7A8300)	5.7	5.076	5	1.52	1	FAIL
10		U3401 (ADP1755ACPZ- R7)	1.8	1.303	1.3	0.230769	2	PASS
11		U3402 (ADP1755ACPZ- R7)	1.8	1.301	1.3	0.076923	2	PASS
12		U4001 (TPS7A8001)	5.7	5.01	5	0.2	3	PASS

Resolution for failure:

Change the tolerance of feed back resistors of LDO's to 1%.

Results table after changing feedback resistors tolerance of LDO's to 1%

			Volta	ge Accuracy	for LDO's			
Sl. No.	Test case No.	LDO	Supply Voltage (V)	Output Voltage (V)	Expected Voltage (V)	Deviation (%)	Output voltage accuracy (%)	Result
		U3700		()		· /	, , ,	
1		(TPS7A8300)	5.7	5.04	5	0.8	1	PASS
		U3701						
2		(TPS7A8300)	5.7	4.97	5	0.87	1	PASS
		U3600						
3		(TPS7A8300)	5.7	4.97	5	0.87	1	PASS
		U3601						
4		(TPS7A8300)	5.7	5.03	5	0.6	1	PASS
		U3900						
5		(TPS7A8300)	5.7	4.96	5	0.87	1	PASS
		U3901						
6		(TPS7A8300)	5.7	5.04	5	0.8	1	PASS
	Pwr1.6	U3800						
7		(TPS7A8300)	5.7	4.99	5	0.87	1	PASS
		U4100					_	
8		(TPS7A8300)	3.7	3.295	3.3	0.151515	1	PASS
		U3801		4.00	_	0.07	4	D.4.6.6
9		(TPS7A8300)	5.7	4.96	5	0.87	1	PASS
		U3401						
10		(ADP1755ACPZ-	1.0	1 202	1.2	0.220760	2	DACC
10		R7) U3402	1.8	1.303	1.3	0.230769	<u> </u>	PASS
		(ADP1755ACPZ-						
11		R7)	1.8	1.301	1.3	0.076923	2	PASS
	-	U4001	1.0	1.501	1.5	0.070323		1 733
12		(TPS7A8001)	5.7	5.01	5	0.2	3	PASS

8.7 Voltage Control

8.7.1 Test ID

Pwr1.7

8.7.2 Purpose

The purpose of this test case is to check the Voltage Output with respect to Enable on LDO's.

8.7.3 Test and Measurement Method

Refer to section 3.1.5 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

8.7.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage -12V DC

System/Test Load: Full

8.7.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0004

8.7.6 Test Results

PASS - Test case is replica of Voltage accuracy ,refer to section 8.6.

8.8 Current consumption

8.8.1 Test ID

Pwr1.8

8.8.2 Purpose

The purpose of the test case is to measure the board current consumption through current sensing IC.

8.8.3 Test and Measurement Method

Refer to section 3.1.6 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

8.8.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Full

8.8.5 **DUT Sample Information**

RF-SDR Board Serial Number – WZ1630LIFE2SDR0011

8.8.6 Test Results

					RF IN	NA226 SEN	ISORS					
	FPC	GA			СН1				(CH2		
SPE C	BUS_VO LT	MAR GIN	CURR ENT	SPEC	VOLT	MARG IN	CURR ENT	SPEC	VOLT	MARG IN	CURR ENT	RESUL T
(mA)	(mV)	(mA)	(mA)	(mA)	(mV)	(mA)	(mA)	(mA)	(mV)	(mA)	(mA)	
<100	12006	15	85	<2000	5666	372	1628	<1800	5660	79	1721	PASS
<100	12008	15	85	<2000	5667	373	1627	<1800	5660	84	1716	PASS
<100	12006	15	85	<2000	5667	369	1631	<1800	5662	92	1708	PASS
<100	12007	15	85	<2000	5667	374	1626	<1800	5662	97	1703	PASS
<100	12010	14	86	<2000	5667	180	1820	<1800	5662	102	1698	PASS
<100	12007	12	88	<2000	5668	382	1618	<1800	5662	108	1692	PASS
<100	12010	10	90	<2000	5667	355	1645	<1800	5663	110	1690	PASS
<100	12003	13	87	<2000	5667	388	1612	<1800	5662	99	1701	PASS
<100	12011	12	88	<2000	5668	389	1611	<1800	5665	120	1680	PASS
<100	12011	12	88	<2000	5667	389	1611	<1800	5665	125	1675	PASS
<100	12012	10	90	<2000	5668	397	1603	<1800	5665	124	1676	PASS
<100	12015	12	88	<2000	5668	200	1800	<1800	5666	128	1672	PASS
<100	12015	10	90	<2000	5670	394	1606	<1800	5666	134	1666	PASS
<100	12013	12	88	<2000	5670	395	1605	<1800	5666	134	1666	PASS
<100	12012	10	90	<2000	5670	398	1602	<1800	5666	140	1660	PASS
<100	12013	10	90	<2000	5670	397	1603	<1800	5666	139	1661	PASS
<100	12012	10	90	<2000	5671	399	1601	<1800	5667	142	1658	PASS
<100	12015	12	88	<2000	5670	404	1596	<1800	5665	143	1657	PASS
<100	12015	13	87	<2000	5671	278	1722	<1800	5666	148	1652	PASS

9 Clock

9.1 Clock output level

9.1.1 Test ID

CLK 1.1

9.1.2 Purpose

The purpose of this test case is to verify if the PLL is locked and to check the Clock output level.

9.1.3 Test and Measurement Method

Refer to section 4.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

9.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Reference input-From signal generator (For system measurements reference input will be from GBC/Sync board)

9.1.5 **DUT Sample Information**

RF-SDR Board Serial Number - WZ1630LIFE2SDR0013

9.1.6 Test Results

Clock Amplitude								
Specification Result Margin Pass/Fail								
<1.3V(p-p)	1V(p-p)	0.3V	PASS					

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

9.2 Frequency and Frequency accuracy

9.2.1 Test ID

CLK 1.2 & 1.3

9.2.2 Purpose

The purpose of this test case is to verify if the frequency is within acceptable accuracy.

9.2.3 Test and Measurement Method

Refer to section 4.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

9.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

All measurements are done with reference from signal generator, loop filter values are updated on the board.

9.2.5 **DUT Sample Information**

RF-SDR Board Serial Number - WZ1630LIFE2SDR0013

9.2.6 Test Results

GSM system specification is $<\pm0.05$ ppm (±2 Hz), since the measurement is only for RF_SDR Board without Sync board, We have a tighter spec of $<\pm0.025$ ppm (±1 Hz),

Frequency Accuracy									
Specification Output Result(Hz) Margin Pass/Fail									
<±0.025ppm(±1Hz)	-0.084	0.916	PASS						

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

9.3 Phase noise

9.3.1 Test ID

CLK 1.4

9.3.2 Purpose

The purpose of this test case is to verify that the phase noise of the clock is within acceptable limits

9.3.3 Test and Measurement Method

Refer to section 4.1.3 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

9.3.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

All measurements are done with reference from signal generator, loop filter values are updated on the board.

9.3.5 **DUT Sample Information**

RF-SDR Board Serial Number - WZ1630LIFE2SDR0013

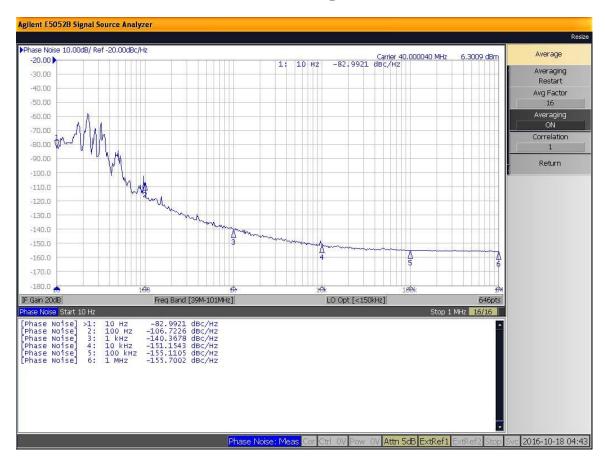
9.3.6 Test Results

		Phase N	oise Meas	urement	
	Phase Noise	dBc/Hz			Phase noise measurement
Frequency Offset			margin	Pass/Fail	dBc/Hz
10Hz	<-88	-73.08	-14.92	FAIL	-82.9921
100Hz	<-115	-93.28	-21.72	PASS	-115.5(Marker is on spurious)
1kHz	<-138	-104.89	-33.11	PASS	-140.3678
10kHz	<-145	-109.49	-35.51	PASS	-151.1543
100kHz	<-150	-118.03	-31.97	PASS	-155.1105
1MHz	<-152	-138.62	-13.38	PASS	-155.7002

Resolution for failure:

Measurements were taken with reference input from signal generator having accuracy of 5Hz. In actual scenario input reference is from SYNC board which is in lock with 1PPS GPS signal, with this input as per design we will meet requirements at 10Hz.

9.3.7 Test and Measurement Logs



9.4 Lock time

9.4.1 Test ID

CLK 1.5

9.4.2 Purpose

The purpose of the test is to verify the maximum time taken for the PLL to settle to certain frequency and accuracy.

9.4.3 Test and Measurement Method

Refer to section 4.1.4 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

9.4.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

9.4.5 **DUT Sample Information**

RF-SDR Board Serial Number – WZ1630LIFE2SDR0013

9.4.6 Test Results

Lock Time								
Specification Measured Margin Result								
2 ms	900.9 us	1099.1 us	PASS					

NOTE: specification is from GSM frequency hoping parameter

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

9.5 Clock Duty Cycle

9.5.1 Test ID

CLK 1.6

9.5.2 Purpose

The purpose of this test case is to verify whether the duty cycle of the clock signal satisfies the minimum required specifications

9.5.3 Test and Measurement Method

Refer to section 4.1.5 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

9.5.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Reference input-From signal generator (For system measurements reference input will be from GBC/Sync board)

9.5.5 **DUT Sample Information**

RF-SDR Board Serial Number – WZ1630LIFE2SDR0020

9.5.6 Test Results

Test	Measuring Point	Measuring Criteria	Observation Sp		fication	Design Margin (%)	Test result
				Min	Max		
		Clock Dut	y Cycle				
SIN_CLK_BUFF_OUT3	R22.2	Duty Cycle (%)	47.73	25	NA	-90.92	PASS

NOTE: The Max value of clock duty cycle is not mentioned in the FPGA datasheet. Hence, mentioned as NA.

9.5.7 Test and Measurement Logs



9.6 Jitter

9.6.1 Test ID

CLK 1.7

9.6.2 Purpose

The purpose of this test case is to verify if the period jitter of the clock signal is within the expected limit.

9.6.3 Test and Measurement Method

Refer to section 4.1.6 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

9.6.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Reference input-From signal generator (For system measurements reference input will be from GBC/Sync board)

9.6.5 **DUT Sample Information**

RF-SDR Board Serial Number - WZ1630LIFE2SDR0020

9.6.6 Test Results

Test	Measuring Point	Measuring Criteria	Observation	Specification Min Max		Design Margin (%)	Test result
		Cloc	ck Period Jitter				
SIN_CLK_BUFF_OUT3	R22.2	Period Jitter (ns)	0.075	NA	5	-98.50	PASS

NOTE: The Min. value of clock period jitter is not mentioned in FPGA datasheet. Hence, mentioned as NA.

9.6.7 Test and Measurement Logs



9.7 Clock Duty Cycle

9.7.1 Test ID

CLK 1.8

9.7.2 Purpose

The purpose of this test case is to verify whether the duty cycle of the clock signal satisfies the minimum required specifications

9.7.3 Test and Measurement Method

Refer to section 4.1.7 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

9.7.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Reference input-From signal generator (For system measurements reference input will be from GBC/Sync board)

9.7.5 **DUT Sample Information**

RF-SDR Board Serial Number – WZ1630LIFE2SDR0020

9.7.6 Test Results

Test	Measuring Point	Measuring Criteria	Observation	Specif	ication	Design Margin (%)	Test result
				Min	Max		
		Clock Du	ıty Cycle				
CAT_CLKOUT_FPGA	U9.B2	Duty Cycle (%)	48.47	25	NA	-93.88	PASS

NOTE: The Max value of clock duty cycle is not mentioned in the FPGA datasheet. Hence, mentioned as NA.

9.7.7 Test and Measurement Logs



9.8 Jitter

9.8.1 Test ID

CLK 1.9

9.8.2 Purpose

The purpose of this test case is to verify if the period jitter of the clock signal is within the expected limit.

9.8.3 Test and Measurement Method

Refer to section 4.1.8 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

9.8.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Reference input-From signal generator (For system measurements reference input will be from GBC/Sync board)

9.8.5 **DUT Sample Information**

RF-SDR Board Serial Number - WZ1630LIFE2SDR0020

9.8.6 Test Results

Test	Measuring Point	Measuring Criteria	Observation	Specification		Design Margin (%)	Test result	
				Min	Max			
Clock Period Jitter								
CAT_CLKOUT_FPGA	U9.B2	Period Jitter (ns)	0.175	NA	5	-96.50	PASS	

NOTE: The Min. value of clock period jitter is not mentioned in FPGA datasheet. Hence, mentioned as NA.

9.8.7 Test and Measurement Logs



10 FPGA

10.1 Artix - 7 -Boot configuration

10.1.1 Test ID

FPGA 1.1.1

10.1.2 Purpose

The purpose of the test case is to verify the boot configuration of Artix - 7 FPGA.

10.1.3 Test and Measurement Method

Refer to section 5.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

10.1.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.1.6 Test Results

Artix – 7 FPGA booted up successfully and was functioning as required.

10.1.7 Test and Measurement Logs

The snapshot of boot configuration of Artix - 7 FPGA is attached below.



Artix_7_Boot_Confi guration.PNG

NOTE: This test case is a functional test. Hence, no specification table.

10.2 Artix - 7 - Power sequence

10.2.1 Test ID

FPGA 1.1.2

10.2.2 Purpose

The purpose of this test case is to verify the power sequence of Artix - 7 FPGA.

10.2.3 Test and Measurement Method

Refer to section 5.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

10.2.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.2.6 Test Results

	Artix_7_Power_On_Sequence							
Sl.No	Specification (Expected sequence)	Logic analyzer bits	Measurement Points	Measured sequence	Design Margin	Pass/Fail		
1	1P8V_FX3	D0	C276	1P8V_FX3		DAGG		
2	1P2V _FX3	D6	C272	1P2V_FX3				
3	VCCINT+VCCBRAM	D4	C245	VCCINT+VCCBRAM	NA			
4	VCCAUX18	D1	C256	VCCAUX18		PASS		
5	1.8VD_FPGA	D2	C251	1.8VD_FPGA				
6	3.3VD_FPGA	D3	C255	3.3VD_FPGA				

10.2.7 Test and Measurement Logs



10.3 FX3 - SPI -Electrical validation

10.3.1 Test ID

FPGA 1.2.1

10.3.2 Purpose

The purpose of the test case is to verify the electrical characteristics of SPI interface of FX3.

10.3.3 Test and Measurement Method

Refer to section 5.1.3 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.3.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

10.3.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.3.6 Test Results

Tr. d	Measuring Point	Measuring Criteria	Observation	Specification		Design	T	
Test				Min	Max	Margin (%)	Test result	
FX3 – SPI								
FX3_SCLK	U9.V19	VIL (max) (V)	0.3	-0.3	0.63	200.00	PASS	
		VIH (min) (V)	1.5	1.17	2.1	-28.21	PASS	
		Minimum High time (ns)	22.6	2.5	NA	-804.00	PASS	
		Minimum Low time (ns)	23.1	2.5	NA	-824.00	PASS	
		Frequency (MHz)	20.16	0	100	-79.84	PASS	
FX3_MOSI	U9.R22	VIL (max) (V)	0	-0.3	0.63	100.00	PASS	
		VIH (min) (V)	1.8	1.17	2.1	-14.29	PASS	
		Minimum High time (ns)	47.8	2.5	NA	- 1812.00	PASS	
		Minimum Low time (ns)	97.2	2.5	NA	- 3788.00	PASS	

NOTE: The Max. value of Minimum High time and Minimum Low time is not mentioned in FPGA datasheet. Hence, mentioned as NA.

10.3.7 Test and Measurement Logs



10.4 FX3 - SPI -Functional validation

10.4.1 Test ID

FPGA 1.2.2

10.4.2 Purpose

The purpose of the test case is to validate the functioning of the SPI interface of FX3.

10.4.3 Test and Measurement Method

Refer to section 5.1.4 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.4.4 Test Condition

Ambient Temperature – 25°C Operating Voltage – 18V System load – Typical

10.4.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.4.6 Test Results

FX3 is able to read and write registers of FPGA and the functioning of the SPI interface is validated.

10.4.7 Test and Measurement Logs

The snapshot for the functional validation of FX3 – SPI signals is attached below.



FX3_SPI_Functional _Snapshot.PNG

10.5 AD9361 – SPI-Electrical validation/Signal integrity

10.5.1 Test ID

FPGA 1.3.1

10.5.2 Purpose

The purpose of the test case is to verify the electrical characteristics of SPI interface of AD9361 transceiver

10.5.3 Test and Measurement Method

Refer to section 5.1.5 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.5.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

10.5.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.5.6 Test Results

Test	Measuring Point	Measuring Criteria	Observation	Specification Min Max		Specification		Specification		Design Margin (%)	Test result
AD9361 – SPI (EV)											
CAT_SCLK		VIL (max) (V)	-0.02	0	0.36	- 105.56	FAIL				
	U9.C2	VIH (min) (V)	1.82	1.44	1.8	1.11	FAIL				
		Frequency (MHz)	1	0	50	-98.00	PASS				
CAT MOSI	U9.A1	VIL (max) (V)	0.02	0	0.36	-94.44	PASS				
CAT_WOSI	U9.A1	VIH (min) (V)	1.78	1.44	1.8	-1.11	PASS				
CAT MISO	U9.B1	VIL (max) (V)	-0.02	-0.3	0.63	93.33	PASS				
CAT_MISO		VIH (min) (V)	1.9	1.17	2.10	-9.52	PASS				

Resolution for failure:

The voltage levels of CAT_SCLK clock signal exceeds beyond the specified Min. and Max. values. A series resistor has been included in the path of the signal in Rev. C to resolve this issue.

10.5.7 Test and Measurement Logs



Signal Integrity

10.5.8 Purpose

The purpose of the test case is to verify the signal integrity characteristics of SPI interface of AD9361 transceiver.

10.5.9 Test and Measurement Method

Refer to section 5.1.5 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document.

10.5.10 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

10.5.11 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.5.12 Test Results

Test	Measuring Point	Measuring Criteria	Observation	Specification		Design Margin (%)	Test result
				Min	Max		
CAT_SCLK	U9.C2	Positive Overshoot (V)	0.645	0	0.18	258.33	FAIL
CAT_SOLK	09.02	Negative Overshoot (V)	0.528	0	0.18	193.33	FAIL
		Positive Overshoot (V)	0.388	0	0.18	115.56	FAIL
CAT_MOSI	U9.A1	Negative Overshoot (V)	0.511	0	0.18	183.89	FAIL
		Data Setup time (ns)	10	2	NA	-400.00	PASS
		Data Hold time (ns)	2000	1	1000	100.00	PASS
		Positive Overshoot (V)	0.36	0	0.18	100	FAIL
CAT_MISO	U9.B1	Negative Overshoot (V)	0.26	0	0.18	44.44	FAIL
		Data Setup time (ns)	984	2.44	NA	-40227.87	PASS
		Data Hold time (ns)	4	0.62	1000	-99.60	PASS

NOTE: The Max. value of Data Setup time and Data Hold time is not mentioned in the FPGA datasheet. Hence, mentioned as NA.

Resolution for failure:

The positive and negative overshoot of the signals, namely, CAT_SCLK, CAT_MOSI, and CAT_MISO exceed beyond the specified Max. value of overshoot. A series resistor has been included in the path of the signal in Rev. C to resolve this issue.

10.5.13 Test and Measurement Logs



10.6 AD9361 - SPI-Functional validation

10.6.1 Test ID

FPGA 1.3.2

10.6.2 Purpose

The purpose of the test case is to validate the functioning of the SPI interface of AD9361 transceiver

10.6.3 Test and Measurement Method

Refer to section 5.1.6 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document.

10.6.4 Test Condition

Ambient Temperature – 25°C Operating Voltage – 18V System load – Typical

10.6.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LJFE2SDR0022

10.6.6 Test Results

The functioning of the SPI interface between AD9361 transceiver and Artix – 7 FPGA has been validated.

10.6.7 Test and Measurement Logs

The snapshot for the functional validation of AD9361 - SPI signals is attached below.



AD9361_SPI_Functional_Validation_sna



AD9361_SPI_Functional_Snapshot.png

10.7 FX3 - GPIF Control - Electrical validation

10.7.1 Test ID

FPGA 1.4.1

10.7.2 Purpose

The purpose of the test case is to verify the electrical characteristics of control signals of FX3 – GPIF.

10.7.3 Test and Measurement Method

Refer to section 5.1.7 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.7.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

10.7.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.7.6 Test Results

Test	Measuring Point	Measuring Criteria	Observation	Specification		Design Margin (%)	Test				
				Min	Max		result				
	FX3 – GPIF (Control)										
		VIL (max) (V)	0	-0.3	0.63	100.00	PASS				
	U9.G15	VIH (min) (V)	1.8	1.17	2.1	-14.29	PASS				
GPIF_CTL3		Minimum High Time (ns)	18000	2.5	19750	-8.86	PASS				
		Minimum Low Time (ns)	1750	2.5	19750	-91.14	PASS				
		VIL (max) (V)	0	-0.3	0.63	100.00	PASS				
		VIH (min) (V)	1.8	1.17	2.1	-14.29	PASS				
GPIF_CTL12	U9.G13	Minimum High Time (ns)	200	2.5	1200	-83.33	PASS				
		Minimum Low Time (ns)	1000	2.5	1200	-16.67	PASS				

10.7.7 Test and Measurement Logs



10.8 FX3 - GPIF Control - Functional validation

10.8.1 Test ID

FPGA 1.4.2

10.8.2 Purpose

The purpose of the test case is to validate the functioning of the control signals of FX3-GPIF

10.8.3 Test and Measurement Method

Refer to section 5.1.8 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.8.4 Test Condition

Ambient Temperature – 25°C Operating Voltage – 18V

System load – Typical

10.8.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.8.6 Test Results

The functioning of the control signals from FX3 to Artix – 7 FPGA has been validated

10.8.7 Test and Measurement Logs

The snapshot for the functional validation of FX3 – GPIF control signals is attached below.





FX3_GPIF_Control_F FX3_GPIF_Function unctional_Snapshotal_Snapshot_0x01.pi

10.9 FX3 - GPIF Data - Electrical validation

10.9.1 Test ID

FPGA 1.5.1

10.9.2 Purpose

The purpose of the test case is to verify the electrical characteristics of data signals of FX3 – GPIF.

10.9.3 Test and Measurement Method

Refer to section 5.1.9 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.9.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

10.9.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.9.6 Test Results

Test	Measuring Point	Measuring Criteria	Observation	Specification		Design Margin (%)	Test result
				Min	Max		
		FX3 -	- GPIF (Data)		_	T	
		VIL (max) (V)	0	-0.3	0.63	100.00	PASS
0015 004	1101/04	VIH (min) (V)	1.88	1.17	2.1	-10.48	PASS
GPIF_D04	U9.K21	Minimum High Time (ns)	10	2.5	NA	-300.00	PASS
		Minimum Low Time (ns)	10	2.5	NA	-300.00	PASS
	U9.L18	VIL (max) (V)	0	-0.3	0.63	100.00	PASS
		VIH (min) (V)	1.8	1.17	2.1	-14.29	PASS
GPIF_D19		Minimum High Time (ns)	210	2.5	NA	-8300.00	PASS
		Minimum Low Time (ns)	45	2.5	NA	-1700.00	PASS
		VIL (max) (V)	0	-0.3	0.63	100.00	PASS
0015 000		VIH (min) (V)	1.84	1.17	2.1	-12.38	PASS
GPIF_D29	U9.J17	Minimum High Time (ns)	145	2.5	NA	-5700.00	PASS
		Minimum Low Time (ns)	95	2.5	NA	-3700.00	PASS
		VIL (max) (V)	0	-0.3	0.63	100.00	PASS
		VIH (min) (V)	1.8	1.17	2.1	-14.29	PASS
GPIF_D31	U9.L15	Minimum High Time (ns)	44	2.5	NA	-1660.00	PASS
		Minimum Low Time (ns)	44	2.5	NA	-1660.00	PASS

NOTE: The Max. value of Min. High time and Min. Low time is not mentioned in the FPGA datasheet. Hence, mentioned as NA.

10.9.7 Test and Measurement Logs



10.10 FX3 - GPIF Data - Functional validation

10.10.1 Test ID

FPGA 1.5.2

10.10.2 Purpose

The purpose of the test case is to validate the functioning of the data signals of FX3 – GPIF

10.10.3 Test and Measurement Method

Refer to section 5.1.10 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.10.4 Test Condition

Ambient Temperature – 25°C Operating Voltage – 18V System load – Typical

10.10.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.10.6 Test Results

FX3 is able to send data to FPGA and the functioning of the data signals has been validated.

10.10.7 Test and Measurement Logs

The snapshot for the functional validation of FX3-GPIF data signals is attached below.





FX3_GPIF_Data_Fun FX3_GPIF_Function ctional_Snapshot.PNal_Snapshot_0x01.pi

10.11 AD9361 - Control- Electrical validation

10.11.1 Test ID

FPGA 1.6.1

10.11.2 Purpose

The purpose of the test case is to validate the electrical characteristics of the control signals of AD9361 transceiver.

10.11.3 Test and Measurement Method

Refer to section 5.1.11 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document.

10.11.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage – 18V

System load – Typical

10.11.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.11.6 Test Results

Test	Measuring Point	Measuring Criteria	Observation	Specification		vation Specification Design Margin (%)		Margin	Test result
				Min	Max				
AD9361 (Control)									
CODEC CTRL OUT2	U9.U21	VIL (max) (V)	-0.04	-0.3	0.63	86.67	PASS		
CODEC_CTRL_OUT2		VIH (min) (V)	1.8	1.17	2.1	-14.29	PASS		
CODEC CTRL OUT3	U9.P19	VIL (max) (V)	-0.04	-0.3	0.63	86.67	PASS		
CODEC_CTRL_OUTS	09.619	VIH (min) (V)	1.8	1.17	2.1	-14.29	PASS		

10.11.7 Test and Measurement Logs



10.12 AD9361 - Control- Functional validation

10.12.1 Test ID

FPGA 1.6.2

10.12.2 Purpose

The purpose of the test case is to validate the functioning of AD9361 control signals.

10.12.3 Test and Measurement Method

Refer to section 5.1.12 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.12.4 Test Condition

Ambient Temperature – 25°C Operating Voltage – 18V System load – Typical

10.12.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.12.6 Test Results

The functioning of the control signals from AD9361 Transceiver to Artix – 7 FPGA has been validated.

10.12.7 Test and Measurement Logs

The snapshot for the functional validation of AD9361 control signals is attached below.



AD9361_Control_Functional_Snapshot.r

10.13 AD9361 - Data- Electrical validation

10.13.1 Test ID

FPGA 1.7.1

10.13.2 Purpose

The purpose of the test case is to verify the electrical characteristics of data signals of AD9361 transceiver.

10.13.3 Test and Measurement Method

Refer to section 5.1.13 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.13.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

10.13.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.13.6 Test Results

Test	Measuring Point	Measuring Criteria	Observation	Specification		Design Margin (%)	Test
	100			Min	Max	g (,v)	result
			AD9361 (Da	ta)	•		
		VIL (max) (V)	0.01	0	0.36	-97.22	PASS
		VIH (min) (V)	1.73	1.44	1.8	-3.89	PASS
CODEC_D1	U9.AB12	Rx Data Delay (DATA_CLK to Data Outputs) (ns)	10.4	0	1.5	593.33	FAIL
		Rx Data Delay (DATA_CLK to Rx_FRAME) (ns)	7.6	0	1	660.00	FAIL
		VIL (max) (V)	0	0	0.36	-100.00	PASS
	U9.W12	VIH (min) (V)	1.74	1.44	1.8	-3.33	PASS
CODEC_D10		Rx Data Delay (DATA_CLK to Data Outputs) (ns)	11	0	1.5	633.33	FAIL
		Rx Data Delay (DATA_CLK to Rx_FRAME) (ns)	6.8	0	1	580.00	FAIL
		VIL (max) (V)	-0.01	0	0.36	-102.78	PASS
		VIH (min) (V)	1.79	1.44	1.8	-0.56	PASS
CODEC_D18	U9.AA15	Tx Data Setup Time (ns)	5.9	0	1.5	293.33	FAIL
		Tx Data Hold Time (ns)	9.3	0	1	830.00	FAIL
		VIL (max) (V)	-0.02	0	0.36	-105.56	PASS
		VIH (min) (V)	1.8	1.44	1.8	0.00	PASS
CODEC_D20	U9.Y13	Tx Data Setup Time (ns)	7.8	0	1.5	420.00	FAIL
		Tx Data Hold Time (ns)	8	0	1	700.00	FAIL

Resolution for failure:

The Rx data delay (DATA_CLK to Data Outputs), Rx Data delay (DATA_CLK to Rx Frame), Tx Data Setup time, and Tx Data Hold time exceed beyond the specified Max. value.

Series resistors are included in the path of the signal and all the data lines are length matched in Rev. C.

10.13.7 Test and Measurement Logs



10.14 AD9361 - Data- Functional validation

10.14.1 Test ID

FPGA 1.7.2

10.14.2 Purpose

The purpose of the test case is to validate the functioning of AD9361 data signals.

10.14.3 Test and Measurement Method

Refer to section 5.1.14 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

10.14.4 Test Condition

Ambient Temperature – 25°C Operating Voltage – 18V System load – Typical

10.14.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

10.14.6 Test Results

AD9361 was able to send and receive data from FPGA and the functioning of the data signals has been validated.

10.14.7 Test and Measurement Logs

The snapshot for the functional validation of AD9361 data signals is attached below.



11 FX3

11.1 FX3 (CYUSB3014)-Configuration

11.1.1 Test ID

FX3 1.1

11.1.2 Purpose

The purpose of this test case is to verify the configuration of FX3.

11.1.3 Test and Measurement Method

Refer to section 6.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

11.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

11.1.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

11.1.6 Test Results

The snapshot for FX3 configuration is attached below.





FX3_Configuration_ Operating_over_US Snapshot.PNG B_3.0.png

11.2 EEPROM (24LC256) - I2C -Electrical validation

11.2.1 Test ID

FX3 1.2.1

11.2.2 Purpose

The purpose of the test case is to verify the electrical characteristics of I2C interface of the serial EEPROM.

11.2.3 Test and Measurement Method

Refer to section 6.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

11.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

11.2.5 **DUT Sample Information**

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

11.2.6 Test Results

Test	Measuring Point	Measuring Criteria	Observation	Specification Min Max		Design Margin (%)	Test result				
EEPROM – I2C											
		VIL (max) (V)	-0.06	-0.5	0.36	88.00	PASS				
	R61.2	VIH (min) (V)	1.8	1.26	2.3	-21.74	PASS				
FX3_SCL		Rise time (ns)	132	20	1000	-86.80	PASS				
		Fall time (ns)	32	6.54	300	-89.33	PASS				
		Frequency (KHz)	371.7	0	400	-7.08	PASS				
		VIL (max) (V)	-0.06	-0.5	0.36	88.00	PASS				
EV3 CD4	R60.2	VIH (min) (V)	1.8	1.26	2.3	-21.74	PASS				
FX3_SDA	R00.2	Rise time (ns)	100	20	1000	-90.00	PASS				
		Fall time (ns)	33	6.54	300	-89.00	PASS				

11.2.7 Test and Measurement Logs



11.3 EEPROM (24LC256) - I2C -Functional validation

11.3.1 Test ID

FX3 1.2.2

11.3.2 Purpose

The purpose of the test case is to validate the functioning of I2C interface of the serial EEPROM

11.3.3 Test and Measurement Method

Refer to section 6.1.3 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

11.3.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage – 18V

System load - Typical

11.3.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0022

11.3.6 Test Results

FX3 was able to read /write data from EEPROM and the functioning of the I2C interface has been validated.

11.3.7 Test and Measurement Logs

The snapshot for the functional validation of EEPROM – I2C signals is attached below.



EEPROM_I2C_Functional_Snapshot.PNG

11.4 Functional validation of Debug USB Switch – USB2.0 from FX3

11.4.1 Test ID

FX3 1.3.1

11.4.2 Purpose

The purpose of the test case is to validate USB 2.0 through Debug USB Switch.

11.4.3 Test and Measurement Method

Refer to section 6.1.4 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

11.4.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

11.4.5 DUT Sample Information

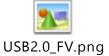
RF-SDR Board Serial Number – WZ1630LIFE2SDR0010

11.4.6 Test Results

The functional validation of USB 2.0 through Debug USB Switch is verified.

11.4.7 Test and Measurement Logs

The snapshot of functional validation of USB 2.0 in Debug USB Switch are attached.



11.5 Functional validation of Debug USB Switch – USB3.0 from FX3

11.5.1 Test ID

FX3 1.4.1

11.5.2 Purpose

The purpose of the test case is to validate USB 3.0 through Debug USB Switch.

11.5.3 Test and Measurement Method

Refer to section 6.1.5 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

11.5.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

11.5.5 **DUT Sample Information**

RF-SDR Board Serial Number – WZ1630LJFE2SDR0010

11.5.6 Test Results

The functional validation of USB 3.0 through Debug USB Switch is verified.

11.5.7 Test and Measurement Logs

The snapshot of functional validation of USB 3.0 in Debug USB Switch are attached here.



usb3.0_FV.png

12 RF/Transceiver (AD9361) - Pipe1

12.1 Maximum Output Power from AD9361- Pipe 1

12.1.1 Test ID

TRX 1.1

12.1.2 Purpose

The purpose of this test case is to check maximum power that is possible from AD9361 transceiver.

12.1.3 Test and Measurement Method

Refer to section 7.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

12.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

12.1.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1622LIFE1SDR0003

12.1.6 Test Results

Attenuation			imum Ou Balun (dl	tput Power Bm)				
setting from UHD code for AD9361	Specification	GSM-900			Min(dBm)	Max(dBm)	Margin (dBm)	Result
(dB)		В	M	T				
0	>-5dBm	-1.7	-1.7	-1.8	-1.8	-1.7	3.2	PASS

Attenuation setting		CH1 Maximum Output Power at Balun (dBm)							
from UHD code for AD9361 (dB)	Specification	DCS-1800			Min(dBm)	Max (dBm)	Margin in(dBm)	Result	
		В	M	T					
0	>-5dBm	-3.1	-3.1	-3.2	-3.2	-3.1	1.8	PASS	

NOTE: Pig tail cable losses are taken into account during setup calibration.

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

12.2 Transmit Power Control from AD9361-Pipe1

12.2.1 Test ID

TRX 1.2

12.2.2 Purpose

The purpose of this test case is to control Transmit power from AD9361 transceiver.

12.2.3 Test and Measurement Method

Refer to section 7.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

12.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

12.2.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1622LIFE1SDR0003

12.2.6 Test Results

	CH1 OUTPUT	r POWER	CONTR	OL				
ATTENUATION SETTING FROM UHD			GSM-900)	MIN	MAX	MARGIN	
CODE FOR AD9361	SPECIFICATION	В	M	T	1/221 (IN (dBm)	RESULT
Output power level in dBm with 0dB attenuation	>-5dBm	-1.7	-1.7	-1.8	-1.8	-1.7	3.2	PASS
Output power level in dBm with 10dB attenuation	>-15dBm	-11.5	-11	-11.5	-11.5	-11	3.5	PASS
Attenuation in dB with 10dB atten setting in AD9361	10dB(+/- 2dB)	9.8	9.3	9.7	9.3	9.8	1.3	PASS
Output power level in dBm with 20dB attenuation	>-25dBm	-21.4	-21	-21.3	-21.4	-21	3.6	PASS
Attenuation in dB with 20dB atten setting in AD9361	20dB(+/- 2dB)	19.7	19.3	19.5	19.3	19.7	0.8	PASS

ATTENUATION	CH1 OUTPUT	POWER	CONTRO	L				
SETTING FROM			DCS-1800		MIN	MAX	MARGIN	DEGIN E
UHD CODE FOR AD9361	SPECIFICATION	В	M	Т			IN (dBm)	RESULT
Output power level in dBm with 0dB attenuation	>-5dBm	-3.1	-3.1	-3.2	-3.2	-3.1	1.8	PASS
Output power level in dBm with 10dB attenuation	>-15dBm	-12.4	-12.5	-12.7	-12.7	-12.4	2.6	PASS
Attenuation in dB with 10dB atten setting in AD9361	10dB(+/- 2dB) 12dB< Atten>8dB	9.3	9.4	9.5	9.3	9.5	1.3	PASS
Output power level in dBm with 20dB attenuation	>-25dBm	-21.9	-22.1	-22.2	-22.2	-21.9	2.8	PASS
Attenuation in dB with 20dB atten setting in AD9361	20dB(+/- 2dB) 22dB< Atten>18dB	18.8	19	19	18.8	19	0.8	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

12.3 Modulation Accuracy -TRx - Pipe 1

12.3.1 Test ID

TRX 1.3

12.3.2 Purpose

The purpose of this test case is, Phase error and EVM are fundamental parameters used in GSM to characterize modulation accuracy. These measurements reveal much about a transmitter's performance. Poor phase error or EVM indicates a problem with the I/Q baseband generator, filters, modulator or amplifier in the transmitter circuitry.

12.3.3 Test and Measurement Method

Refer to section 7.1.3 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document.

12.3.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

12.3.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1622LIFE1SDR0003

12.3.6 Test Results

CH1_Phase Error											
26.11.4	Specificatio	Specificatio	Specificatio GSM 900								
Modulatio n	n (R&D)	n (Normal)	RMS(deg)		Min	Max	Margin	Result			
	RMS(deg)	RMS(deg)	В	M	T	(deg)	(deg)	(deg)			
GMSK	<3.6	<5	0.3	0.	0.4 4	0.39	0.44	3.16	PASS		

CH1_Phase Error											
	Specification Specification GSM 900										
Modulation	(R&D)	(Normal)	PF	PEAK(deg)			Max	Margin	Result		
	< PEAK(deg)	< PEAK(deg)	В	M	T	(deg)	(deg)	(deg)			
GMSK	<14.2	<20	1.02	1.02 0.98 1.23 0.98 1.23 12.97					PASS		

	СН	1_Mean Frequency Error							
Modulation	Specification(R&D)	Specification(normal)	G	SSM 900		Min	Max	Margin	
1120441402011	ppm / Hz	ppm / Hz	B(Hz)	M(Hz)	T(Hz)	(Hz)	(Hz)	(Hz)	Result
GMSK	< 0.03/±27Hz	< 0.05/±45Hz	0.12	-0.48	-0.45	-0.48	0.12	26.52	PASS

CH1_Phase Error										
	Specificatio	Specificatio			D 1					
Modulatio n	n (R&D)	n (Normal)	RMS(deg)			Min	Max	Margin	Result	
	< RMS(deg)	< RMS(deg)	В	M	T	(deg)	(deg)	(deg)		
GMSK	<3.6	<5	0. 4	0.4 7	0.4 4	0.4	0.47	3.13	PASS	

CH1_Phase Error											
	Specification	Specification									
Modulation	(R&D)	(Normal)	PF	PEAK(deg)			Max	Margin	Result		
	< PEAK(deg)	< PEAK(deg)	В	B M T		(deg)	(deg)	(deg)			
GMSK	<14.2 <20 1.08 1.38 1.44 1.08 1.44		1.08 1.38 1.44 1.08 1				12.76	PASS			

	Cl								
Modulation	Specification(R&D)	Specification(normal)		DCS 1800		Min	Max	Margin	
Modulation	ppm / Hz	ppm / Hz	B(Hz)	M(Hz)	T(Hz)	(Hz)	(Hz)	(Hz)	Result
GMSK	< 0.03/±54Hz	< 0.05/±90Hz	-0.44	-0.43	-0.18	-0.44	-0.18	53.56	PASS

12.3.7 Test and Measurement Logs



12.4 Output RF Spectrum- i) Adjacent channel power-TRx Pipe 1

12.4.1 Test ID

TRX 16

12.4.2 Purpose

The purpose of this test case is measure adjacent channel power, the modulation process in a transmitter causes the continuous wave (CW) Carrier to spread spectrally. The "spectrum due to modulation and wideband noise" measurement is used to ensure that modulation process does not cause excessive spectral spread. If it did, other users who are operating on different frequencies would experience interference. The measurement of spectrum due to modulation and wideband noise can be thought of as an adjacent channel power (ACP).

12.4.3 Test and Measurement Method

Refer to section 7.1.4 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

12.4.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Signal output level: 0dBm

12.4.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1622LIFE1SDR0003

12.4.6 Test Results

CH1_spectrum due to modulation												
Spec	ification		GSM 900 Result									
			B(d	B(dBc) M(dBc) T(dBc) Min Max Margin								
offset frequency	< dBc	RBW KHz	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	in (dB)	
100KHz	0.5	30	-9.15	-9.67	-8.61	-9.06	-9.14	-9.66	-9.67	-8.61	8.11	PASS
200KHz	-30	30	-38.66	-37.65	-38.08	-37.04	-38.58	-37.59	-38.66	-37.04	7.04	PASS
250KHz	-33	30	-40.28	-41.5	-40.68	-42.1	-40.72	-41.7	-42.1	-40.28	7.28	PASS
400KHz	-60	30	-63.69	-63.18	-62.71	-63.11	-62.85	-62.31	-63.69	-62.31	2.31	PASS
600KHz to 1200KHz	-60	30	-70.97	-71.06	-69.82	-69.89	-69.61	-69.69	-71.06	-69.61	9.61	PASS
1200KHz to 1800KHz	-63	30	-75.15	-75.66	-74.35	-74.28	-74.15	-75.11	-75.66	-74.15	11.15	PASS
1800KHz to 6000KHz	-65	100	-74.52	-74.08	-71.13	-73.91	-74.05	-74.49	-74.52	-71.13	6.13	PASS

				CH1_spe	ctrum du	e to modu	lation						
Spec	ification			DCS 1800 Result									
			B(d	B(dBc) M(dBc) T(dBc) Min Max Margin									
offset frequency	< dBc	RBW KHz	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	in (dB)		
100KHz	0.5	30	-11.61	-4.54	-9.12	-9.62	-9.13	-9.63	-11.61	-4.54	4.04	PASS	
200KHz	-30	30	-35	-36.31	-38.49	-37.6	-38.57	-37.5	-38.57	-35	5	PASS	
250KHz	-33	30	-38.88	-40.6	-40.66	-42.34	-39.72	-41.54	-42.34	-38.88	5.88	PASS	
400KHz	-60	30	-55.98	-56.19	-59.67	-59.56	-58.75	-59.81	-59.81	-55.98	-4.02	FAIL	
600KHz to 1200KHz	-60	30	-60.32	-60.78	-64.26	-64.6	-64.39	-63.6	-64.6	-60.32	4.32	PASS	
1200KHz to 1800KHz	-63	30	-65.73	-66.77	-69.97	-69.75	-69.8	-70.19	-70.19	-65.73	2.73	PASS	
1800KHz to 6000KHz	-65	100	-67.46	-67.61	-71.65	-71.49	-72.48	-72.23	-72.48	-67.46	2.46	PASS	

Resolution for failure:

We are meeting spectrum due to modulation requirements with only one chain at AD9361 active. When two chains of AD9361 are active the output of one chain is not stable (not all time slots are ON only burst broadcast channel is seen).

12.4.7 Test and Measurement Logs



CH1_RF_SDR_modulation.zip

ii) Spectrum due to switching- TRx Pipe 1

12.4.8 Test ID

TRX 1.6

12.4.9 Purpose

The purpose of this test case is the GSM/EDGE transmitter's ramp RF power rapidly. The "transmitted RF carrier power versus time" measurement is used to ensure that this process happens at the correct times and happens fast enough. However, if RF power is ramped too quickly, undesirable spectral components exist in the transmission. This measurement is used to ensure that these components are below the acceptable level.

12.4.10 Test and Measurement Method

Refer to section 7.1.5 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

12.4.11 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

12.4.12 DUT Sample Information

RF-SDR Board Serial Number - WZ1622LIFE1SDR0003

12.4.13 Test Results

				CH1_spe	ectrum du	ie to switc	hing				Result
Specificat	ion				(GSM 900	Result				Result
Specificat	1011	B(d)	Bc)	M(d)	Bc)	T(d	Bc)	Min	Max	Margin in	
offset frequency	< dBc	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	(dB)	
400 KHz	-57	-57.48	-58.23	-57.77	-57.99	-57.2	-59.51	-59.51	-57.2	0.2	PASS
600 KHz	-67	-64.65	-64.87	-64.99	-65.32	-64.89	-63.72	-65.32	-63.72	3.28	PASS
1200 KHz	-74	-67.98	-68.43	-66.45	-67.34	-67.77	-67.3	-68.43	-66.45	-7.55	FAIL
1800 KHz	-74	-73.11	-74.64	-70.86	-73.6	-74.31	-73.71	-74.64	-70.86	-3.14	FAIL

			(CH1_spect	trum due	to switchi	ng				Result
Specificat	tion				DO	CS 1800 R	esult				Result
Specifical	uon	B(d	Bc)	M(d	M(dBc) T(dBc) Min Max Margin						
offset frequency	< dBc	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	(dB)	
400 KHz	-50	-54.16	-55.6	-53.11	-52.7	-54.78	-54.16	-55.6	-52.7	2.7	PASS
600 KHz	-58	-58.53	-58.74	-58.35	-58.71	-57.92	-57.85	-58.74	-57.85	-0.15	FAIL
1200 KHz	-66	-64.02	-63.74	-63.7	-62.66	-62.9	-62.3	-64.02	-62.3	-3.7	FAIL
1800 KHz	-66	-72.21	-71.88	-72.02	-71.54	-72.86	-70.69	-72.86	-70.69	4.69	PASS

Resolution for failure:

We are meeting spectrum due to switching requirements with only one chain at AD9361 active. When two chains of AD9361 are active the output of one chain is not stable (not all time slots are ON only burst broadcast channel is seen).

12.4.14 Test and Measurement Logs



CH1_RF_SDR_switching.zip

12.5 Carrier leakage - Pipe1

12.5.1 Test ID

TRX 1.4

12.5.2 Purpose

The purpose of this test case is to check carrier leakage that is possible from AD9361 transceiver LO.

12.5.3 Test and Measurement Method

Refer to section 7.1.6 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

12.5.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

12.5.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0010

12.5.6 Test Results

Carrier Leakage at 0dB attenuation	Spec in dBc	Carri	ier leakage	in dBc	Margin from Spec in dB	Result
		В	M	T		PASS
Chain1	-50	-55.7	-55.1	-55.8	5.1	rass

			Chain1						
	Wanted	signal powe	r in dBm	Bm Carrier leakage including 2 cable loss in dBm					
Band	В	M	T	В	M	T			
900	-1.7	-1.7	-1.8	-57.4	-56.8	-57.6			
1800	-3.1	-3.1	-3.2	-54.7	-53.78	-55.3			

12.5.7 Test and Measurement Logs



CH1_LO_Leakage.zip

13 RF/Transceiver (AD9361) - Pipe2 13.1 Maximum Output Power from AD9361-Pipe2

13.1.1 Test ID

TRX 2.1

13.1.2 Purpose

The purpose of this test case is to check maximum power that is possible from AD9361 transceiver.

13.1.3 Test and Measurement Method

Refer to section 8.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

13.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

13.1.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1622LIFE1SDR0003

13.1.6 Test Results

	Attenuation		CH2 Max Power at		-				
	setting from UHD code for AD9361	Specification	GSM-900			Min(dBm)	Max(dBm)	Margin in (dBm)	Result
l	(dB)		В	M	T				
ſ	0	>-5dBm	-1.5	-1.4	-1.6	-1.6	-1.4	3.4	PASS

Attenuation setting from UHD code for AD9361	etting from UHD		imum O Balun (c CS-1800	-	Min(dBm)	Max(dBm)	Margin in (dBm)	Result
(dB)		В	M	T			(ubiii)	
0	>-5dBm	-2.7	-3.1	-3.1	-3.1	-2.7	1.9	PASS

NOTE: Pig tail cable losses are taken into account during setup calibration.

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

13.2 Transmit Power Control from AD9361-Pipe2

13.2.1 Test ID

TRX 2.2

13.2.2 Purpose

The purpose of this test case is to control Transmit power from AD9361 transceiver.

13.2.3 Test and Measurement Method

Refer to section 8.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

13.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

13.2.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1622LIFE1SDR0003

13.2.6 Test Results

	CH2 OUTPUT	POWER	CONTRO	L				
ATTENUATION CETTING FROM 141D			GSM-900		NAINI	MAX	MADGIN	
SETTING FROM UHD CODE FOR AD9361	SPECIFICATION	В	M	Т	MIN		MARGIN IN (dBm)	RESULT
Output power level in dBm with 0dB attenuation	>-5dBm	-1.5	-1.4	-1.6	-1.6	-1.4	3.4	PASS
Output power level in dBm with 10dB attenuation	>-15dBm	-11.4	-11	-11.5	-11.5	-11	3.5	PASS
Attenuation in dB with 10dB atten setting in AD9361	10dB(+/- 2dB) 12dB< Atten>8dB	9.9	9.6	9.9	9.6	9.9	1.4	PASS
Output power level in dBm with 20dB attenuation	>-25dBm	-20.5	-21	-21.1	-21.1	-20.5	3.9	PASS
Attenuation in dB with 20dB atten setting in AD9361	20dB(+/- 2dB) 12dB< Atten>8dB	19	19.6	19.5	19	19.6	0.8	PASS

	CH2 Outp	ut Power (Control					
Attenuation setting from			DCS-1800)	NATNI	MAX	MADGIN	
UHD code for AD9361	Specification	В	M	Т	MIN		MARGIN IN (dBm)	RESULT
Output power level in dBm with 0dB attenuation	>-5dBm	-2.7	-3.1	-3.1	-3.1	-2.7	1.9	PASS
Output power level in dBm with 10dB attenuation	>-15dBm	-12.2	-12.5	-12.5	-12.5	-12.2	2.5	PASS
Attenuation in dB with 10dB atten setting in AD9361	10dB(+/- 2dB)	9.5	9.4	9.4	9.4	9.5	1.4	PASS
Output power level in dBm with 20dB attenuation	>-25dBm	-21.7	-21.9	-22.1	-22.1	-21.7	2.9	PASS
Attenuation in dB with 20dB atten setting in AD9361	20dB(+/- 2dB)	19	18.8	19	18.8	19	0.8	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

13.3 Modulation Accuracy -TRx - Pipe 2

13.3.1 Test ID

TRX 2.3

13.3.2 Purpose

The purpose of this test case is, Phase error and EVM are fundamental parameters used in GSM to characterize modulation accuracy. These measurements reveal much about a transmitter's performance. Poor phase error or EVM indicates a problem with the I/Q baseband generator, filters, modulator or amplifier in the transmitter circuitry.

13.3.3 Test and Measurement Method

Refer to section 8.1.3 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

13.3.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

13.3.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1622LIFE1SDR0003

13.3.6 Test Results

		CH2_1	Phase I	Error					
36 1 1 4	Specificatio	Specificatio				GSM 9	000		Result
Modulatio n	n (R&D)	n (Normal)	RMS(deg)			Min	Max	Margin in	Result
	< RMS(deg)	< RMS(deg)	В	M	T	(deg)	(deg)	(deg)	
GMSK	3.6	5	0.4	0.4	0. 4	0.4	0.42	3.18	PASS

		CH2_Phase E	rror						
	Specification	Specification							
Modulation	(R&D)	(Normal)	PEAK(deg)			Min	Max	Margin	Result
	< PEAK(deg)	< PEAK(deg)	В	M	T	(deg)	(deg)	in (deg)	
GMSK	14.2	20	1.01	1.12	0.96	0.96	1.12	13.08	PASS

	CH2_M	lean Frequency Error							
Modulation	Specification(R&D)	Specification(normal)		GSM 900		Min	Max	Margin	
Modulation	ppm / Hz	ppm / Hz	B(Hz)	M(Hz)	T(Hz)	(Hz)	(Hz)	in (Hz)	Result
GMSK	< 0.03/±27Hz	< 0.05/±45Hz	-0.31	-0.49	0.31	-0.49	0.31	26.51	PASS

		CH2_1	Phase	Error						
36 1 1 4	Specificatio	Specificatio				DCS 18	300		Result	
Modulatio n	n (R&D)	n (Normal)	F	RMS(de	eg)	Min	Max	Margin in	Kesuit	
	< RMS(deg)	< RMS(deg)	В	M	T	(deg)	(deg)	(deg)		
GMSK	3.6	5	0. 4	0.4 4	0.4 7	0.4	0.47	3.13	PASS	

		CH2_F	Phase E	Error						
	Specification	Specification				DCS 18	00			
Modulatio (R&D)		(Normal)	PF	EAK(d	eg)	Min	Max	Margin in	Result	
n	< PEAK(deg)	< PEAK(deg)	В	M	T	(deg)	(deg)	(deg)		
GMSK	14.2	20	0.9 7	1.1 7	1.2	0.97	1.24	12.96	PASS	

	CH2_M	Iean Frequency Error							
Modulation	Specification(R&D)	Specification(normal)]	DCS 1800)	Min	Mov	Margin	
Modulation	ppm / Hz	ppm / Hz	B(Hz)	M(Hz)	T(Hz)	(Hz)	(Hz)	in (Hz)	Result
GMSK	< 0.03/±54Hz	< 0.05/±90Hz	0.01	-0.35	-0.9	-0.9	0.01	53.1	PASS

13.3.7 Test and Measurement Logs



13.4 AD9361 Local Oscillator lock detect- Pipe 1&2

13.4.1 Test ID

TRX 1.5 and TRX 2.5.

13.4.2 Purpose

The purpose of this test case is to verify whether AD9361 Local oscillator is locked or not.

13.4.3 Test and Measurement Method

Refer to section 8.1.4 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

13.4.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

13.4.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0013

13.4.6 Test Results

Pass, All lock detects from AD9361 GPIO out pins are high. (>1.8V)

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

13.5 Output RF Spectrum- i) Adjacent channel power-TRx Pipe 2

13.5.1 Test ID

TRX 2.6

13.5.2 Purpose

The purpose of this test case is the modulation process in a transmitter causes the continuous wave (CW) Carrier to spread spectrally. The "spectrum due to modulation and wideband noise" measurement is used to ensure that modulation process does not cause excessive spectral spread. If it did, other users who are operating on different frequencies would experience interference. The measurement of spectrum due to modulation and wideband noise can be thought of as an adjacent channel power (ACP).

13.5.3 Test and Measurement Method

Refer to section 8.1.5 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

13.5.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Signal output level: 0dBm

13.5.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1622LIFE1SDR0003

13.5.6 Test Results

				CH2_spec	trum due	to modul	ation						
Spec	ification			GSM 900 Result									
			B(d	Bc)	M(d	lBc)	T(d	lBc)	Min	Max	Margin		
offset frequency	< dBc	RBW KHz	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	in (dB)		
100KHz	0.5	30	-10.11	-8.02	-9.87	-7.77	-9.13	-9.64	-10.11	-7.77	7.27	PASS	
200KHz	-30	30	-37.79	-37.52	-37.37	-37.24	-38.58	-37.59	-38.58	-37.24	7.24	PASS	
250KHz	-33	30	-40.37	-41.74	-40.31	-41.62	-40.68	-41.72	-41.74	-40.31	7.31	PASS	
400KHz	-60	30	-61.45	-62.07	-61.78	-61.51	-63.74	-63.83	-63.83	-61.45	1.45	PASS	
600KHz to 1200KHz	-60	30	-69.26	-68.86	-69.07	-68.46	-70.02	-69.7	-70.02	-68.46	8.46	PASS	
1200KHz to 1800KHz	-63	30	-73.06	-73.15	-72.71	-72.72	-73.99	-74.2	-74.2	-72.71	9.71	PASS	
1800KHz to 6000KHz	-65	100	-73	-72.7	-72.74	-72.67	-73.92	-73.9	-73.92	-72.67	7.67	PASS	

				CH2_spec	trum due	to modul	ation					
Spec	Specification			DCS 1800 Result								Result
				Bc)	M(d	lBc)	T(d	Bc)	Min	Max	Margin	
offset frequency	< dBc	RBW KHz	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	in (dB)	
100KHz	0.5	30	-8.9	-9.19	-8.81	-9.35	-8.88	-9.42	-9.42	-8.81	8.31	PASS
200KHz	-30	30	-38.17	-37.32	-38.03	-37.43	-38.26	-37.44	-38.26	-37.32	7.32	PASS
250KHz	-33	30	-40.32	-41.28	-40.11	-41.41	-40.17	-41.65	-41.65	-40.11	7.11	PASS
400KHz	-60	30	-62.39	-62.7	-59.63	-60.08	-59.74	-60.56	-62.7	-59.63	-0.37	FAIL
600KHz to 1200KHz	-60	30	-69.3	-68.79	-64.37	-64.66	-64.6	-64.27	-69.3	-64.27	8.27	PASS
1200KHz to 1800KHz	-63	30	-73.7	-73.86	-69.99	-69.62	-69.79	-70.33	-73.86	-69.62	6.62	PASS
1800KHz to 6000KHz	-65	100	-73.2	-74	-71.2	-71.27	-71.8	-71.88	-74	-71.2	6.2	PASS

Resolution for failure:

We are meeting spectrum due to modulation requirements with only one chain at AD9361 active. When two chains of AD9361 are active the output of one chain is not stable (not all time slots are ON only burst broadcast channel is seen).

13.5.7 Test and Measurement Logs



CH2_RF_SDR_modulation.zip

ii) Spectrum due to switching- TRx Pipe 2

13.5.8 Test ID

TRX 2.6

13.5.9 Purpose

The purpose of this test case is the GSM/EDGE transmitter's ramp RF power rapidly. The "transmitted RF carrier power versus time" measurement is used to ensure that this process happens at the correct times and happens fast enough. However, if RF power is ramped too quickly, undesirable spectral components exist in the transmission. This measurement is used to ensure that these components are below the acceptable level.

13.5.10 Test and Measurement Method

Refer to section 8.1.6 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

13.5.11 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

13.5.12 DUT Sample Information

RF-SDR Board Serial Number – WZ1622LIFE1SDR0003

13.5.13 Test Results

				CH2_spec	etrum due	to switchin	ng				Result
Specificat	ion				G	SM 900 Re	esult				Result
Specification		B(dBc)		M(d	Bc)	T(dl	Bc)	Min	Max	Margin	
offset frequency	< dBc	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	in (dB)	
400 KHz	-57	-58.24	-59.04	-56.22	-58.85	-57.55	-58.91	-59.04	-56.22	-0.78	FAIL
600 KHz	-67	-64.35	-64.37	-64.43	-64.76	-64.27	-63.8	-64.76	-63.8	-3.2	FAIL
1200 KHz	-74	-68.15	-67.14	-68	-65.92	-68.31	-66.22	-68.31	-65.92	-8.08	FAIL
1800 KHz	-74	-74.46	-74.66	-73.96	-74.75	-74.24	-74.22	-74.75	-73.96	-0.04	FAIL

			C	H2_spect	rum due t	o switchin	g				Result	
Smaaifiaati			DCS 1800 Result									
Specification		B(dBc)		M(c	dBc)	T(d	Bc)	Min	Max	Margin		
offset frequency	< dBc	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	in (dB)		
400 KHz	-50	-58.29	-58.52	-53.43	-55.64	-54.44	-54.8	-58.52	-53.43	3.43	PASS	
600 KHz	-58	-63.57	-62.41	-59.54	-57.52	-59.44	-59.61	-63.57	-57.52	-0.48	FAIL	
1200 KHz	-66	-67.84	-66.74	-63.55	-62.83	-63.37	-62.63	-67.84	-62.63	-3.37	FAIL	
1800 KHz	-66	-73.34	-74.05	-71.72	-70.45	-71.39	-71.88	-74.05	-70.45	4.45	PASS	

Resolution for failure:

We are meeting spectrum due to switching requirements with only one chain at AD9361 active. When two chains of AD9361 are active the output of one chain is not stable (not all time slots are ON only burst broadcast channel is seen).

13.5.14 Test and Measurement Logs



CH2_RF_SDR_switching.zip

13.6 Carrier leakage - Pipe2

13.6.1 Test ID

TRX 2.4

13.6.2 Purpose

The purpose of this test case is to check carrier leakage that is possible from AD9361 transceiver LO.

13.6.3 Test and Measurement Method

Refer to section 8.1.7 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

13.6.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

13.6.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0010

13.6.6 Test Results

Carrier Leakage at 0dB attenuation	Spec in dBc	Carri	er leakage i	n dBc	Margin from Spec in dB	Result
		В	M	T		DAGG
Chain2	-50	-51.6	-50.68	-52.1	0.68	PASS

	Chain2								
	Wanted signal power in dBm Carrier leakage including 2d cable loss in dBm								
Band	В	М	Т	В	М	Т			
900	-1.5	-1.4	-1.6	-56.15	-56	-55.67			
1800	-2.7	-3.1	-3.1	-57.32	-52.7	-53.4			

13.6.7 Test and Measurement Logs



CH2_LO_Leakage.zip

Test Result for TRX 1.7, 1.8, 2.7 and 2.8 are missing

14 TX pipe - 114.1 Gain-Pipe1

14.1.1 Test ID

TX P 1.1

14.1.2 Purpose

The purpose of this test case is to verify and validate TX – Pipe1 gain (excluding AD9361 transceiver).

14.1.3 Test and Measurement Method

Refer to section 9.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

14.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

14.1.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1622LIFE1SDR0003

14.1.6 Test Results (Rev-A)

Band	Gain Specific	Input Signal		ured O wer (dB	-	Ov	erall G (dB)	ain	Margin	RESULT
Danu	ation (dB)	(dBm)	В	M	Т	В	M	T	in (dB)	RESULT
E-GSM-900	43	-24	29.1	30.8	30.6	49.1	50.8	50.6	6.1	PASS
GSM-850	43	-24	30.6	31.2	30.1	50.6	51.2	50.1	7.1	PASS
DCS-1800	43	-16	26	27.9	29	46	47.9	49	3	PASS
DCS-1900	43	-16	24.5	25.4	26	44.5	45.4	46	1.5	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

14.2 Attenuation and Attenuation step- TX Pipe1

14.2.1 Test ID

TX_P 1.2 and TX_P 1.3

14.2.2 Purpose

The purpose of this test case is to verify TX – Pipe1 digital attenuator attenuation and attenuation step (excluding Transceiver AD9361).

14.2.3 Test and Measurement Method

Refer to section 9.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

14.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

14.2.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0008

14.2.6 Test Results

Band	I/P Power (dBm)	Attenuation (dB)	Overall power after attenuation (dBm) 945.2(MHz)	Gain (dB) 945.2(MHz)	Spec (dB) 945.2(MHz)	Margin (dB) 945.2(MHz)	Result
		0	29.5	51.5	≥ 4 3	8.5	
		0.5	28.9	50.9	≥ 42.5	8.4	
E CCM		1	28.4	50.4	≥ 42	8.4	
E-GSM-	-22	2	27.5	49.5	≥ 41	8.5	PASS
900	- -	4	25.5	47.5	≥ 39	8.5	17100
		8	21.6	43.6	≥ 35	8.6	
		15.5	14.3	36.3	≥ 27.5	8.8	

Band	I/P Power (dBm)	Attenuation (dB)	Overall power after attenuation (dBm)	Gain (dB)	Spec (dB)	Margin (dB)	Result
		0	31.7	45.7	≥ 43	2.7	
		0.5	31.3	45.3	≥ 42.5	2.8	
Dag		1	30.8	44.8	≥ 42	2.8	
DCS- 1800	-14	2	29.7	43.7	≥ 41	2.7	PASS
1800		4	27.8	41.8	≥ 39	2.8	TASS
		8	24	38	≥ 35	3	
		15.5	16.6	30.6	≥ 27.5	3.1	

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	0	51.5	0	NA	NA	PASS
	0.5	50.9	0.6	0.35-0.65	0.05	PASS
E-	1	50.4	1.1	0.85-1.15	0.05	PASS
GSM -	2	49.5	2	1.75-2.25	0.25	PASS
900	4	47.5	4	3.75-4.25	0.25	PASS
-	8 43.6 7.9		7.5-8.5	0.4	PASS	
	15.5	36.3	15.2	15-16	0.2	PASS

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB) 1842.4(MHz)	Result
	0	45.7	0	NA	NA	PASS
	0.5	45.3	0.4	0.35-0.65	0.05	PASS
DCC	1	44.8	0.9	0.85-1.15	0.05	PASS
DCS- 1800	2	43.7	2	1.75-2.25	0.25	PASS
1800	4	41.8	3.9	3.75-4.25	0.15	PASS
	8	38	7.7	7.5-8.5	0.2	PASS
	15.5	30.6	15.1	15-16	0.1	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

14.3 Output Power- TX Pipe 1

14.3.1 Test ID

TX P 1.4

14.3.2 Purpose

The purpose of this test case is to verify TX – Pipe1 output power at antenna port (excluding Transceiver AD9361).

14.3.3 Test and Measurement Method

Refer to section 9.1.3 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

14.3.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

14.3.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0008

14.3.6 Test Results

Band	Output power Specification	Input Signal	Measured Output Power (dBm)		Output power	RESULT	
Danu	(dB)	(dBm)	В	M	T	Margin (dB)	RESCET
E-GSM-900	33 ± 2	-24	31.1	31.8	31.6	0.1	PASS
DCS-1800	33 ± 2	-16	31.8	32.2	32.1	0.8	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

14.4 RF power detection - TX Pipe1

14.4.1 Test ID

TX P 1.5

14.4.2 Purpose

The purpose of this test case is to verify TX – Pipe1 RF Power detection at antenna port (excluding Transceiver AD9361).

14.4.3 Test and Measurement Method

Refer to section 9.1.4 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

14.4.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

14.4.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0008

14.4.6 Test Results

Power at Antenna Port (dBm)	Power at Input of Power Detector (dBm)	ADC Decimal Value	ADC Binary Value	RESULT
945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)
29.5	-7.5	24	00011000	PASS
28.9	-8.1	23	00010111	PASS
28.4	-8.6	21	00010101	PASS
27.5	-9.5	19	00010011	PASS
25.5	-11.5	14	00001110	PASS
21.6	-15.4	9	00001001	PASS
14.3	-22.7	5	00000101	PASS

Power at Antenna Port (dBm)	Power at Input of Power Detector (dBm)	ADC Decimal Value	ADC Binary Value	RESULT
1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)
31.7	-5.3	30	00011110	PASS
31.3	-5.7	28	00011100	PASS
30.8	-6.2	28	00011100	PASS
29.7	-7.3	23	00010111	PASS
27.8	-9.2	19	00010011	PASS
24	-13	11	00001011	PASS
16.6	-20.4	4	00000100	PASS

15 TX pipe - 2

15.1 Gain-Pipe2

15.1.1 Test ID

TX P 2.1

15.1.2 Purpose

The purpose of this test case is to verify TX – Pipe2 gain (excluding Transceiver AD9361).

15.1.3 Test and Measurement Method

Refer to section 10.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

15.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

15.1.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1622LIFE1SDR0003

15.1.6 Test Results (Rev-A)

Band	Gain Specification	Input Signal	Measured Output Power (dBm)		Overall Gain (dB)			Min Gain Margin in	RESULT	
	(dB)	(dBm)	В	M	T	В	M	T	(dB)	
E-GSM- 900	43	-24	30.1	31.8	31.6	50.1	51.8	51.6	7.1	PASS
GSM-850	43	-24	31.6	32.2	31.2	51.6	52.2	51.2	8.2	PASS
DCS- 1800	43	-16	26.8	28.4	31.2	46.8	48.4	51.2	3.8	PASS
PCS-1900	43	-16	24.5	25.8	26.1	44.5	45.8	46.1	1.5	
										PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

15.2 Attenuation and Attenuation step- TX Pipe2

15.2.1 Test ID

TX P 2.2 and TX P 2.3

15.2.2 Purpose

The purpose of this test case is to verify TX – Pipe2 digital attenuator attenuation and attenuation step (excluding Transceiver AD9361).

15.2.3 Test and Measurement Method

Refer to section 10.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

15.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

15.2.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0008

15.2.6 Test Results

Band	I/P Power (dBm)	Attenuation (dB)	Overall power after attenuation (dBm)	Gain(dB) 945.2(MHz)	Spec (dB) 945.2(MHz)	Margin(dB) 945.2(MHz)	Result	
		0	29.7	51.7	≥ 43	8.7		
	-22	0.5	29.1	51.1	≥ 42.5	8.6	PASS	
		1	28.6	50.6	≥ 4 2	8.6		
E-GSM-900		2	27.6	49.6	≥ 41	8.6		
		4	25.6	47.6	≥ 39	8.6		
		8	21.6	43.6	≥ 35	8.6		
		15.5	14.3	36.3	≥ 27.5	8.8		

Band	I/P Power (dBm)	Attenuation (dB)	Overall power after attenuation (dBm)	Gain(dB) 1842.4(MHz)	Spec (dB) 1842.4(MHz)	Margin(dB)	Result		
		0	32.7	46.7	≥ 43	3.7			
		0.5	32.3	46.3	≥ 42.5	3.8			
		1	31.9	45.9	≥ 42	3.9			
DCS-1800	-14	2	30.9	44.9	≥ 41	3.9	PASS		
		4	28.9	42.9	≥ 39	3.9	TASS		
		8	25.1	39.1	≥ 35	4.1			
		15.5	17.9	31.6	≥ 27.5	4.4			

Band	Attenuation Step (dB) 945.2(MHz)	Gain measured (dB) 945.2(MHz)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	0	51.7	0	NA	NA	PASS
	0.5	51.1	0.6	0.35-0.65	0.05	PASS
E-	1	50.6	1.1	0.85-1.15	0.15	PASS
GSM -	2	49.6	2.1	1.75-2.25	0.15	PASS
900	4	47.6	4.1	3.75-4.25	0.15	PASS
	8	43.6	8.1	7.5-8.5	0.4	PASS
	15.5	36.3	15.4	15-16	0.4	PASS

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	D + GG
	0	46.7	0	NA	NA	PASS
	0.5	46.3	0.4	0.35-0.65	0.05	PASS
DCC	1	45.9	0.8	0.85-1.15	0.05	PASS
DCS- 1800	2	44.9	1.8	1.75-2.25	0.05	PASS
1000	4	42.9	3.8	3.75-4.25	0.05	PASS
	8	39.1	7.6	7.5-8.5	0.1	PASS
	15.5	31.6	15.1	15-16	0.1	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

15.3 Output Power- TX Pipe 2

15.3.1 Test ID

TX P 2.4

15.3.2 Purpose

The purpose of this test case is to verify TX – Pipe2 output power at antenna port (excluding Transceiver AD9361).

15.3.3 Test and Measurement Method

Refer to section 10.1.3 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

15.3.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

15.3.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0008

15.3.6 Test Results

Band	Output power Input Band Specification Signal			red Output (dBm)	Power	Output power	RESULT
Danu	(dB)	(dBm)	В	M	T	Margin in (dBm)	RESULT
E-GSM-900	33 ± 2	-24	31	31.329	31.2	0	PASS
DCS-1800	33 ± 2	-16	31.560	32.690	32.393	0.5	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV C boards.

15.4 RF power detection - Tx Pipe 2

15.4.1 Test ID

TX P 2.5

15.4.2 Purpose

The purpose of this test case is to verify TX – Pipe 2 RF Power detection at antenna port (excluding Transceiver AD9361).

15.4.3 Test and Measurement Method

Refer to section 10.1.4 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

15.4.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

15.4.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0008

15.4.6 Test Results

Power at Antenna port (dBm)	Power at Input of Power Detector (dBm)	ADC Decimal Value	ADC Binary Value	RESULT
945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)
29.7	-7.3	24	00011000	PASS
29.1	-7.9	23	00010111	PASS
28.6	-8.4	22	00010110	PASS
27.6	-9.4	19	00010011	PASS
25.6	-11.4	15	00001111	PASS
21.6	-15.4	9	00001001	PASS
14.3	-22.7	2	00000010	PASS

Power at Antenna port (dBm)	Power at Input of Power Detector (dBm)	ADC Decimal ADC Binary Value Value		RESULT
1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)
32.7	-4.3	33	00100001	PASS
32.3	-4.7	33	00100001	PASS
31.9	-5.1	30	00011110	PASS
30.9	-6.1	27	00011011	PASS
28.9	-8.1	22	00010110	PASS
25.1	-11.9	14	00001110	PASS
17.9	-19.1	5	00000101	PASS

16 RX pipe – 1

16.1 Noise Figure and Gain – Rx Pipe-1

16.1.1 Test ID

RX_P 1.1 and RX_P 1.2

16.1.2 Purpose

The purpose of this test case is to verify Rx Pipe -1 Noise Figure and Gain for all four bands at antenna port (excluding Transceiver AD9361).

16.1.3 Test and Measurement Method

Refer to section 11.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

16.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

16.1.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0020

16.1.6 Test Results for Noise Figure

Band	Noise Figure specification	I/P Signal from Noise Source	Measure	ed Noise Fi	gure (dB)	Margin(dB)	Result	
	(dB)	ENR in dB	В	M	T			
E-GSM-900	< 7	15.20	6.9942	4.6031	9.7379	2.7379	FAIL	
GSM-850	< 7	15.20	5.6602	6.8264	8.6216	1.6216	FAIL	
DCS-1800	< 7	15.20	5.0506	4.8100	7.0427	1.0427	FAIL	
PCS-1900	< 7	15.20	6.4666	5.074	8.0144	1.0144	FAIL	

16.1.7 Test Results for Gain

Band	Gain specification	I/P Signal from Noise	Meas	ured Gain	(dB)	Margin	RESULT	
Danu	(dB)	Source ENR in dB	В	M	T	in (dB)	RESCET	
E-GSM-900	≥ 5	15.20	8.924	10.736	7.130	2.130	PASS	
GSM-850	≥ 5	15.20	11.117	10.621	7.787	2.787	PASS	
DCS-1800	≥ 5	15.20	6.542	6.124	3.995	-1.005	FAIL	
PCS-1900	≥ 5	15.20	5.563	4.770	1.582	-3.418	FAIL	

Resolution for failure:

We have removed switches and changed low noise amplifier part which is having high gain in REV_C design, through which we can improve noise figure and gain at band edges for 1800 and 1900 bands.

16.1.8 Test and Measurement Logs



RX Pipe -1_NF_Gain.zip

16.2 Attenuation and Attenuation step- Rx Pipe1

16.2.1 Test ID

RX_P 1.3 and RX_P 1.4

16.2.2 Purpose

The purpose of this test case is to verify RX – Pipe1 digital attenuator attenuation and attenuation step (excluding Transceiver AD9361).

16.2.3 Test and Measurement Method

Refer to section 11.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

16.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

16.2.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

16.2.6 Test Results

Band	Input Power (dBm)	Attenuation (dB)	Overall Power after Attenuation (dBm) 902(MHz)	Gain(dB)	Spec (dB) 902(MHz)	Margin(dB)	Result
		0	-21.2	8.8	≥ 5	3.8	PASS
		0.5	-21.7	8.3	≥ 4.5	3.8	PASS
E-		1	-22.2	7.8	≥ 4	3.8	PASS
GSM-	-30	2	-23.2	6.8	≥ 3	3.8	PASS
900		4	-25.2	4.8	≥1	3.8	PASS
		8	-29.2	0.8	≥ -3	3.8	PASS
		15.5	-36.6	-6.6	≥ -10.5	3.9	PASS

Band	Input Power (dBm)	Attenuation (dB)	Overall Power after Attenuation (dBm) 1747(MHz)	Gain(dB)	Spec (dB)	Margin(dB)	Result
		0	-24.4	5.6	≥ 5	1.6	PASS
		0.5	-25	5	≥ 4.5	0.5	PASS
D. G.G.		1	-25.5	4.5	≥ 4	0.5	PASS
DCS- 1800	-30	2	-26.6	3.4	≥ 3	0.4	PASS
1000		4	-28.6	1.4	≥1	0.4	PASS
		8	-32.8	-2.8	≥ -3	0.2	PASS
		15.5	-40.4	-10.4	≥ -10.5	0.1	PASS

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)	
	0	8.8	0	NA	NA	PASS
	0.5	8.3	0.5	0.35-0.65	0.15	PASS
E-	1	7.8	1	0.85-1.15	0.15	PASS
GSM -	2	6.8	2	1.75-2.25	0.25	PASS
900	4	4.8	4	3.75-4.25	0.25	PASS
	8	0.8	8	7.5-8.5	0.5	PASS
	15.5	-6.6	15.4	15-16	0.4	PASS

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	
	0	5.6	0	NA	NA	PASS
	0.5	5	0.6	0.35-0.65	0.05	PASS
Dag	1	4.5	1.1	0.85-1.15	0.05	PASS
DCS- 1800	2	3.4	2.2	1.75-2.25	0.05	PASS
1000	4	1.4	4.2	3.75-4.25	0.05	PASS
	8	-2.8	8.4	7.5-8.5	0.1	PASS
	15.5	-10.4	16	15-16	0	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

17 RX pipe -2

17.1 Noise Figure and Gain – Rx Pipe-2

17.1.1 Test ID

RX_P 2.1 and RX_P 2.2

17.1.2 Purpose

The purpose of this test case is to verify Rx Pipe -2 Noise Figure and Gain for all four bands at antenna port (excluding Transceiver AD9361).

17.1.3 Test and Measurement Method

Refer to section 12.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

17.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

17.1.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0020

17.1.6 Test Results for Noise Figure

	Noise	I/P Signal	Measu	red Noise Fig	gure (dB)		
Band	Figure specificat ion (dB)	from Noise Source ENR in dB	В	М	T	Margin(dB)	RESULT
E-GSM-900	< 7	15.20	6.2058	4.4882	8.6773	1.6773	FAIL
GSM-850	< 7	15.20	6.1122	10.3793	8.1498	1.1498	FAIL
DCS-1800	< 7	15.20	4.7813	4.6170	11.4487	4.4487	FAIL
PCS-1900	< 7	15.20	5.7172	5.1511	7.8780	0.878	FAIL

17.1.7 Test Results for Gain

Band	Gain specific	I/P Signal from Noise	Me	asured Gair	Margin in	RESUL	
Dallu	ation (dB)	Source ENR in dB	В	M	T	(dB)	T
E-GSM- 900	≥ 5	15.20	9.784	11.113	7.367	2.367	PASS
GSM- 850	≥ 5	15.20	11.044	11.338	8.588	3.588	PASS
DCS- 1800	≥ 5	15.20	6.981	6.187	-2.27	-7.27	FAIL
PCS- 1900	≥ 5	15.20	6.086	4.946	1.695	-3.305	FAIL

Resolution for failure:

We have removed switches and changed low noise amplifier part which is having high gain in REV_C design, through which we can improve noise figure and gain at band edges for 1800 and 1900 bands.

17.1.8 Test and Measurement Logs



17.2 Attenuation and Attenuation step- Rx Pipe2

17.2.1 Test ID

RX_P 2.3 and RX_P 2.4

17.2.2 Purpose

The purpose of this test case is to verify RX – Pipe2 digital attenuator attenuation and attenuation step (excluding Transceiver AD9361).

17.2.3 Test and Measurement Method

Refer to section 12.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

17.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

17.2.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

17.2.6 Test Results

Band	Input Power (dBm)	Attenuation (dB)	Overall Power after Attenuation (dBm) 902(MHz)	Gain(dB)	Spec (dB) 902(MHz)	Margin(dB)	Result
		0	-21.2	8.8	≥ 5	3.8	PASS
	-30	0.5	-21.7	8.3	≥ 4.5	3.8	PASS
E-		1	-22.2	7.8	≥ 4	3.8	PASS
GSM-		2	-23.1	6.9	≥ 3	3.9	PASS
900		4	-25.2	4.8	≥1	3.8	PASS
		8	-29.1	0.9	≥ -3	3.9	PASS
		15.5	-36.5	-6.5	≥ -10.5	4	PASS

Band	Input Power (dBm)	Attenuation (dB)	Overall Power after Attenuation (dBm) 1747(MHz)	Gain(dB)	Spec (dB) 1747(MHz)	Margin(dB)	Result
	-30	0	-24	6	≥ 5	1.6	PASS
		0.5	-24.7	5.3	≥ 4.5	0.8	PASS
DCC		1	-25.3	4.7	≥ 4	0.7	PASS
DCS- 1800		2	-26.4	3.6	≥ 3	0.6	PASS
1800		4	-28.5	1.5	≥1	0.5	PASS
		8	-32.6	-2.6	≥ -3	0.4	PASS
		15.5	-40.3	-10.3	≥ -10.5	0.2	PASS

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)	
	0	8.8	0	NA	NA	PASS
	0.5	8.3	0.5	0.35-0.65	0.15	PASS
E-	1	7.8	1	0.85-1.15	0.15	PASS
GSM -	2	6.9	1.9	1.75-2.25	0.15	PASS
900	4	4.8	4	3.75-4.25	0.25	PASS
	8	0.9	7.9	7.5-8.5	0.4	PASS
	15.5	-6.5	15.3	15-16	0.3	PASS

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	
	0	6	-0.4	NA	NA	PASS
	0.5	5.3	0.3	0.35-0.65	0.05	PASS
DCC	1	4.7	0.9	0.85-1.15	0.05	PASS
DCS- 1800	2	3.6	2	1.75-2.25	0.25	PASS
1000	4	1.5	4.1	3.75-4.25	0.15	PASS
	8	-2.6	8.2	7.5-8.5	0.3	PASS
	15.5	-10.3	15.9	15-16	0.1	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

18 Transmitter _Chain 1 18.1 i) Output Power- TX Chain 1

18.1.1 Test ID

TX C 1.2

18.1.2 Purpose

The purpose of this test case is to verify TX – Chain 1 output power at antenna port.

18.1.3 Test and Measurement Method

Refer to section 13.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

18.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

18.1.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0010

18.1.6 Test Results

Output power Band Specification		Input Signal	Measured Output Power (dBm)			Output power	RESULT
Danu	(dB)	(dBm)	В	M	T	Margin in (dBm)	RESULT
E-GSM- 900	33 ± 2	-22	32.1	32.6	32.4	1.1	PASS
DCS-1800	33 ± 2	-14	31.5	32	31.6	0.5	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV C boards.

ii) Power Vs Time – TX Chain 1

18.1.7 Test ID

TX C 1.2

18.1.8 Purpose

The purpose of this test case is to verify TX – Chain 1 Power Vs Time at antenna port.

18.1.9 Test and Measurement Method

Refer to section 13.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

18.1.10 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

18.1.11 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0010

18.1.12 Test Results

PASS

18.1.13 Test and Measurement Logs



CH1_Power vs Time.zip

18.2 Static power control - TX chain1

18.2.1 Test ID

TX C 1.3

18.2.2 Purpose

The purpose of this test case is to verify static power control for chain1.

18.2.3 Test and Measurement Method

Refer to section 13.1.3 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

18.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

18.2.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

18.2.6 Test Results

Band	Input Power (dBm)	Attenuation (dB)	Overall Power after Attenuation (dBm) 902(MHz)	Gain(dB)	Spec (≥ dB) 902(MHz)	Margin(dB)	Result
	-22	0	29.5	51.5	43	8.5	PASS
		0.5	28.9	50.9	42.5	8.4	PASS
E-		1	28.4	50.4	42	8.4	PASS
GSM-		2	27.5	49.5	41	8.5	PASS
900		4	25.5	47.5	39	8.5	PASS
		8	21.6	43.6	35	8.6	PASS
		15.5	14.3	36.3	27.5	8.8	PASS

Band	Input Power (dBm)	Attenuation (dB)	Overall Power after Attenuation (dBm)	Gain(dB)	Spec (≥ dB)	Margin(dB)	Result
		1747(MHz)	1747(MHz)	1747(MHz)	1747(MHz)	1747(MHz)	
		0	31.7	45.7	43	2.7	PASS
	-14	0.5	31.3	45.3	42.5	2.8	PASS
DCC		1	30.8	44.8	42	2.8	PASS
DCS- 1800		2	29.7	43.7	41	2.7	PASS
1800		4	27.8	41.8	39	2.8	PASS
		8	24	38	35	3	PASS
		15.5	16.6	30.6	27.5	3.1	PASS

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)	
	0	51.5	0	NA	NA	PASS
	0.5	50.9	0.6	0.35-0.65	0.05	PASS
E-	1	50.4	1.1	0.85-1.15	0.05	PASS
GSM -	2	49.5	2	1.75-2.25	0.25	PASS
900	4	47.5	4	3.75-4.25	0.25	PASS
	8	43.6	7.9	7.5-8.5	0.4	PASS
	15.5	36.3	15.2	15-16	0.2	PASS

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	
	0	45.7	0	NA	NA	PASS
	0.5	45.3	0.4	0.35-0.65	0.05	PASS
DOG	1	44.8	0.9	0.85-1.15	0.05	PASS
DCS- 1800	2	43.7	2	1.75-2.25	0.25	PASS
1000	4	41.8	3.9	3.75-4.25	0.15	PASS
	8	38	7.7	7.5-8.5	0.2	PASS
	15.5	30.6	15.1	15-16	0.1	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

18.3 Modulation Accuracy for TX - Chain 1

18.3.1 Test ID

TX_C_1.4

18.3.2 Purpose

The purpose of this test case is, Phase error and EVM are fundamental parameters used in GSM to characterize modulation accuracy. These measurements reveal much about a transmitter's performance. Poor phase error or EVM indicates a problem with the I/Q baseband generator, filters, modulator or amplifier in the transmitter circuitry.

18.3.3 Test and Measurement Method

Refer to section 13.1.4 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document.

18.3.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

18.3.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0010

18.3.6 Test Results

CH1_Phase Error											
Modulatio Specificatio Specificatio GSM 900											
Modulatio n (R&D)		n (Normal)	R	MS(de	g)	Min	Max	Margin	Result		
	RMS(deg)	RMS(deg)	В	M	T	(deg)	(deg)	(deg)			
GMSK	<3.6	<5	0.6 4	0.6 4	0.6 4	0.64	0.64	2.96	PASS		

		CH1_1	Phase I	Error							
Specification Specification GSM 900											
Modulatio	(R&D)	(Normal)	PE	CAK(de	eg)	Min	Max	Margin in	Result		
n	< PEAK(deg)	< PEAK(deg)	В	M	Т	(deg)	(deg)	(deg)			
GMSK	<14.2	<20	1.5 5	1.7 2	1.7 1	1.55	1.72	12.48	PASS		

	СН	1_Mean Frequency Error							
Modulation	Specification(R&D)	Specification(normal)	G	SSM 900		Min	Max	Margin	
1,104414101	ppm / Hz	ppm / Hz	B(Hz)	M(Hz)	T(Hz)	(Hz)	(Hz)	in (Hz)	Result
GMSK	< 0.03/±27Hz	< 0.05/±45Hz	-1.8	-2.1	-5.85	-5.85	-1.8	21.15	PASS

		CH1_	Phase	Error							
Specificatio Specificatio DCS 1800											
Modulatio n	n (R&D)	n (Normal)	R	MS(de	g)	Min	Max	Margin in	Result		
	< RMS(deg)	< RMS(deg)	В	M	T	(deg)	(deg)	(deg)			
GMSK	<3.6	<5	0.5	0.5 6	0.6	0.53	0.62	2.98	PASS		

		CH1_P	hase E	Crror								
	Specification Specification DCS 1800											
Modulatio n	(R&D)	(Normal)	PI	EAK(d	eg)	Min	Max	Margin in	Result			
11	< PEAK(deg)	< PEAK(deg)	В	M	T	(deg)	(deg)	(deg)				
GMSK	<14.2	<20	1.3	1.8 4	1.6 8	1.33	1.84	12.36	PASS			

	Cl	H1_Mean Frequency Error							
Modulation	Specification(R&D)	Specification(normal)		DCS 1800		Min	Max	Margin	
Modulation	ppm / Hz	ppm / Hz	B(Hz)	M(Hz)	T(Hz)	(Hz)	(Hz)	(Hz)	Result
GMSK	< 0.03/±54Hz	< 0.05/±90Hz	-1.22	0.38	-1.95	-1.95	0.38	52.05	PASS

18.3.7 Test and Measurement Logs



CH1_RF_SDR_TX_PORT_EVM.zip

18.4 Output RF Spectrum- i) Adjacent channel power-TX Chain 1

18.4.1 Test ID

TX C 1.5

18.4.2 Purpose

The purpose of this test case is measure adjacent channel power, the modulation process in a transmitter causes the continuous wave (CW) Carrier to spread spectrally. The "spectrum due to modulation and wideband noise" measurement is used to ensure that modulation process does not cause excessive spectral spread. If it did, other users who are operating on different frequencies would experience interference. The measurement of spectrum due to modulation and wideband noise can be thought of as an adjacent channel power (ACP).

18.4.3 Test and Measurement Method

Refer to section 13.1.5 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

18.4.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

18.4.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0010

18.4.6 Test Results

				CH1_spec	trum due	to modul	ation						
Spec	ification				GSM 900 Result								
			B(d	Bc)	M(dBc) T			lBc)	Min	Max	Margin		
offset frequency	< dBc	RBW KHz	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	(dB)		
100KHz	0.5	30	-8.94	-9.25	-10.39	-6.23	-8.89	-8.7	-10.39	-6.23	6.73	PASS	
200KHz	-30	30	-38.26	-37.31	-36.55	-36.35	-37.8	-37.11	-38.26	-36.35	6.35	PASS	
250KHz	-33	30	-40.37	-41.43	-39.51	-40.27	-40.42	-41.38	-41.43	-39.51	6.51	PASS	
400KHz	-60	30	-57.79	-57.48	-54.77	-54.88	-57.55	-58.41	-58.41	-54.77	-5.23	FAIL	
600KHz to 1200KHz	-60	30	-61.96	-62.15	-59.46	-59.14	-62.2	-62.21	-62.21	-59.14	-0.86	FAIL	
1200KHz to 1800KHz	-63	30	-72.28	-72.24	-69.32	-69.39	-72.02	-71.79	-72.28	-69.32	6.32	PASS	
1800KHz to 6000KHz	-65	100	-71.97	-72.21	-68.79	-69.37	-71.43	-71.44	-72.21	-68.79	3.79	PASS	

				CH1_spec	trum due	to modul	ation						
Spec	ification					DC	'S 1800 R	esult				Result	
			B(d	B(dBc) M(dBc) T(dBc) Min Max Margi									
offset frequency	< dBc	RBW KHz	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	n(dB)		
100KHz	0.5	30	-9.01	-9.25	-8.75	-9.34	-8.78	-9.23	-9.34	-8.75	9.25	PASS	
200KHz	-30	30	-38.32	-37.57	-38.31	-37.13	-37.85	-37.06	-38.32	-37.13	7.13	PASS	
250KHz	-33	30	-40.36	-41.42	-40.2	-41.7	-40.79	-42.09	-42.09	-40.2	7.2	PASS	
400KHz	-60	30	-57.82	-57.48	-57.47	-58.28	-57.88	-56.97	-58.28	-57.47	-2.53	FAIL	
600KHz to 1200KHz	-60	30	-63	-63.09	-62.61	-63.44	-62	-62.58	-63.44	-62	2	PASS	
1200KHz to 1800KHz	-63	30	-71.69	-71.21	-69.17	-68.03	-72.33	-70.31	-72.33	-68.03	5.03	PASS	
1800KHz to 6000KHz	-65	100	-72.58	-71.82	-71.28	-71.76	-71.41	-71.73	-72.58	-71.28	6.28	PASS	

Resolution for failure:

We have seen improvement in spectrum due to modulation by changing charge pump current value in AD9361 transceiver.

18.4.7 Test and Measurement Logs



 $CH1_RF_SDR_TX_PORT_modulation.zip$

ii) Spectrum due to switching- TX Chain 1

18.4.8 Test ID

TX_C 1.5

18.4.9 Purpose

The purpose of this test case is the GSM/EDGE transmitter's ramp RF power rapidly. The "transmitted RF carrier power versus time" measurement is used to ensure that this process happens at the correct times and happens fast enough. However, if RF power is ramped too quickly, undesirable spectral components exist in the transmission. This measurement is used to ensure that these components are below the acceptable level.

18.4.10 Test and Measurement Method

Refer to section 13.1.6 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

18.4.11 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

18.4.12 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0010

18.4.13 Test Results

				CH1_spe	ectrum du	e to switc	hing				Result			
Specificat	Specification GSM 900 Result													
Specificat	B(dBc) M(dBc) T(dBc) Min May													
offset frequency	< dBc	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	Margin(dB)				
400 KHz	-57	-53.19	-53.79	-53.63	-52.89	-54.56	-53.65	-54.56	-52.89	-4.11	FAIL			
600 KHz	-67	-55.75	-58.02	-57.94	-56.34	-57.11	-57.66	-58.02	-55.75	-11.25	FAIL			
1200 KHz	-74	-66.55	-66.29	-67.42	-67.43	-66.14	-66.93	-67.43	-66.14	-7.86	FAIL			
1800 KHz	-74	-72.32	-72.52	-73.24	-73.17	-73.44	-72.68	-73.44	-72.32	-1.68	FAIL			

			(CH1_spect	rum due	to switchi	ng				Result
Specificat	tion				DC	CS 1800 R	esult				Result
Specifical	поп	B(d)	Bc)	M(d	Bc)	T(dBc)		Min	Max	Margin	
offset frequency	< dBc	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	(dB)	
400 KHz	-50	-54.88	-54.33	-54.56	-53.23	-53.09	-52.56	-54.88	-53.09	3.09	PASS
600 KHz	-58	-58.79	-58.53	-58.51	-54.96	-58.36	-56.38	-58.79	-54.96	-3.04	FAIL
1200 KHz	-66	-67.14	-65.35	-66.51	-64.9	-65.24	-66.35	-67.14	-64.9	-1.1	FAIL
1800 KHz	-66	-74.49	-71.99	-73.47	-72.76	-72.5	-73.01	-74.49	-71.99	5.99	PASS

Resolution for failure:

Need software support to change raise time/fall time of each time slot.

18.4.14 Test and Measurement Logs



CH1_RF_SDR_TX_PORT_switching.zip

18.5 Spurious Emissions - TX chain1

18.5.1 Test ID

TX C 1.6

18.5.2 Purpose

The purpose of this test case is to ensure GSM transmitters do not put energy into the wrong parts of the spectrum, as this would cause interference to other users of the spectrum.

18.5.3 Test and Measurement Method

Refer to section 13.1.7 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

18.5.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

18.5.5 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0010

18.5.6 Test Results

				CH1_	900MHZ					
Start	Start	Spec	RBW	VBW	An	nplitude(dB	m)	Max	Margin	D 14
Frequency (MHz)	Frequency (MHz)	(dBm)	(KHz)	(KHz)	В	M	T	(dBm)	(dB)	Result
0.1	50	-36	10	30	no spur	no spur	no spur	0	36	PASS
50	880	-36	3000	9000	-65.14	-64.25	-64.21	-64.21	28.21	PASS
880	915	-98	100	100	-80.89	-80.18	-79.93	-79.93	-18.07	FAIL
915	920	-36	100	300	-81.44	-80.2	-82.25	-80.2	44.2	PASS
920	923	-36	30	90	-74.5	-77.5	-83.02	-74.5	38.5	PASS
925	960									
962	965	-36	30	90	-77.86	-71.84	-67.02	-67.02	31.02	PASS
965	970	-36	100	300	-76.35	-70.3	-67.58	-67.58	31.58	PASS
970	980	-36	300	900	-73.31	-72.32	-66.38	-66.38	30.38	PASS
989	990	-36	1000	3000	-71.22	-68.24	-69.14	-68.24	32.24	PASS
990	1000	-36	3000	9000	-65.22	-64.11	-64.17	-64.11	28.11	PASS
1000	12750	-30	3000	9000	-45.99	-45	-53	-45	15	PASS

CH1_1800MHZ										
Start	uency Frequency	Spec (dBm)	RBW (KHz)	VBW (KHz)	Amplitude(dBm)			Max	Margin	D
Frequency (MHz)					В	M	T	(dBm)	(dB)	Result
0.1	50	-36	10	30	no spur	no spur	no spur	0	36	PASS
50	1000	-36	3000	9000	-66.3	-66.4	-65.99	-65.99	29.99	PASS
1000	1710	-30	3000	9000	-65	-64.8	-63	-63	33	PASS
1710	1785	-98	100	100	-80.14	-79.95	-80.2	-79.95	-18.05	FAIL
1785	1795	-30	300	900	-75.9	-76.25	-76	-75.9	45.9	PASS
1795	1800	-30	100	300	-74	-79	-78	-74	44	PASS
1800	1803	-30	30	90	-69	-80	-82	-69	39	PASS
1805	1880									
1882	1885	-30	30	90	-82	-73.42	-63.51	-63.51	33.51	PASS
1887	1890	-30	100	300	-76.8	-77.3	-65.2	-65.2	35.2	PASS
1890	1900	-30	300	900	-74	-73.63	-60	-60	30	PASS
1900	1910	-30	1000	3000	-68	-68.28	-62	-62	32	PASS
1910	12750	-30	3000	9000	-56.76	-65	-61	-56.76	26.76	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

Resolution for failure:

We have added band pass filter in REV_C design on TX side for better rejections in self RX band.

19 Transmitter _Chain 2

19.1 i) Output Power- TX Chain 2

19.1.1 Test ID

TX C 2.2

19.1.2 Purpose

The purpose of this test case is to verify TX – Chain 2 output power at antenna port.

19.1.3 Test and Measurement Method

Refer to section 14.1.1 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

19.1.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

19.1.5 DUT Sample Information

RF-SDR Board Serial Number – WZ1630LIFE2SDR0010

19.1.6 Test Results

Band	Output power Specification	Input Signal	Measur	red Output 1 (dBm)	Power	Output power	RESULT
Danu	(dB)	(dBm)	В	M	Т	Margin (dBm)	RESCET
E-GSM-900	33 ± 2	-22	32.7	33.5	33.4	1.7	PASS
DCS-1800	33 ± 2	-14	31.5	32.6	32.3	0.5	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV C boards.

ii) Power Vs Time - TX Chain 2

19.1.7 Test ID

TX C 2.2

19.1.8 Purpose

The purpose of this test case is to verify TX – Chain 2 Power Vs Time at antenna port.

19.1.9 Test and Measurement Method

Refer to section 14.1.2 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

19.1.10 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

19.1.11 DUT Sample Information

RF-SDR Board Serial Number - WZ1630LIFE2SDR0010

19.1.12 Test Results

PASS

19.1.13 Test and Measurement Logs



19.2 Static power control - TX chain2

19.2.1 Test ID

TX C 2.3

19.2.2 Purpose

The purpose of this test case is to verify static power control for chain2.

19.2.3 Test and Measurement Method

Refer to section 14.1.3 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

19.2.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

19.2.5 DUT Sample Information

19.2.6 Test Results

Band	Input Power (dBm)	Attenuation (dB)	Overall Power after Attenuation (dBm) 902(MHz)	Gain(dB)	Spec (≥ dB) 902(MHz)	Margin(dB)	Result
		0	29.7	51.7	43	8.7	PASS
		0.5	29.1	51.1	42.5	8.6	PASS
E-		1	28.6	50.6	42	8.6	PASS
GSM-	-22	2	27.6	49.6	41	8.6	PASS
900		4	25.6	47.6	39	8.6	PASS
		8	21.6	43.6	35	8.6	PASS
		15.5	14.3	36.3	27.5	8.8	PASS

Band	Input Power (dBm)	Attenuation (dB)	Overall Power after Attenuation (dBm) 1747(MHz)	Gain(dB)	Spec (≥ dB) 1747(MHz)	Margin(dB)	Result
		()	32.7	46.7	43	3.7	PASS
		0.5	32.7	46.3	42.5	3.8	PASS
		1	31.9	45.9	42	3.9	PASS
DCS-	-14	2	30.9	44.9	41	3.9	PASS
1800		4	28.9	42.9	39	3.9	PASS
		8	25.1	39.1	35	4.1	PASS
		15.5	17.7	31.7	27.5	4.2	PASS

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)	945.2(MHz)	
	0	51.7	0	NA	NA	PASS
	0.5	51.1	0.6	0.35-0.65	0.05	PASS
E-	1	50.6	1.1	0.85-1.15	0.05	PASS
GSM -	2	49.6	2.1	1.75-2.25	0.05	PASS
900	4	47.6	4.1	3.75-4.25	0.15	PASS
	8	43.6	8.1	7.5-8.5	0.4	PASS
	15.5	36.3	15.4	15-16	0.4	PASS

Band	Attenuation Step (dB)	Gain measured (dB)	Measured Attenuation Step (dB)	Spec from datasheet (dB)	Margin (dB)	Result
	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	1842.4(MHz)	
	0	46.7	0	NA	NA	PASS
	0.5	46.3	0.4	0.35-0.65	0.05	PASS
DCC	1	45.9	0.8	0.85-1.15	0.05	PASS
DCS- 1800	2	44.9	1.8	1.75-2.25	0.05	PASS
1000	4	42.9	3.8	3.75-4.25	0.05	PASS
	8	39.1	7.6	7.5-8.5	0.4	PASS
	15.5	31.7	15	15-16	0	PASS

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

19.3 Modulation Accuracy for TX - Chain 2

19.3.1 Test ID

 $TX_C_2.4$

19.3.2 Purpose

The purpose of this test case is, Phase error and EVM are fundamental parameters used in GSM to characterize modulation accuracy. These measurements reveal much about a transmitter's performance. Poor phase error or EVM indicates a problem with the I/Q baseband generator, filters, modulator or amplifier in the transmitter circuitry.

19.3.3 Test and Measurement Method

Refer to section 14.1.4 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

19.3.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

Digital Attenuator: Minimum attenuation (0dB)

19.3.5 DUT Sample Information

19.3.6 Test Results

		CH2_Pha	se Erro	or					
	Specification	Specification			G	SM 900			D 14
Modulation	(R&D)	(Normal)	R	MS(de	g)	Min	Max	Margin	Result
	< RMS(deg)	< RMS(deg)	В	M	T	(deg)	(deg)	(deg)	
GMSK	3.6	5	0.64	0.64	0.65	0.64	0.65	2.95	PASS

		CH2_Phase E	rror						
	Specification	Specification			Dogult				
Modulation	(R&D)	(Normal)	PEAK(deg)			Min	Max	Margin	Result
	< PEAK(deg)	< PEAK(deg)	В	M	T	(deg)	(deg)	(deg)	
GMSK	14.2	20	1.67	1.51	1.67	1.51	1.67	12.53	PASS

	CH2_M								
Madulation	Specification(R&D)	&D) Specification(normal) GSM 900						Margin	
Modulation ppm / Hz		ppm / Hz	B(Hz)	M(Hz)	T(Hz)	(Hz)	(Hz)	(Hz)	Result
GMSK	< 0.03/±27Hz	< 0.05/±45Hz	2.66	-0.74	-0.41	-0.74	2.66	24.34	PASS

		CH2_Pha	se Erro	or					
	Specification	Specification			Result				
Modulation	(R&D)	(Normal)	R	MS(de	g)	Min	Max	Margin	Kesuit
	< RMS(deg)	< RMS(deg)	В	M	T	(deg)	(deg)	(deg)	
GMSK	3.6	5	0.51	0.54	0.54	0.51	0.54	3.06	PASS

		CH2_Pha	se Erro	or					
	Specification Specification				Result				
Modulation	(R&D)	(Normal)	PF	EAK(de	eg)	Min	Max	Margin	Result
	< PEAK(deg)	< PEAK(deg)	В	M	T	(deg)	(deg)	(deg)	
GMSK	14.2	20	1.32	1.46	1.65	1.32	1.65	12.55	PASS

	CH2_M	Iean Frequency Error							
Modulation	Specification(R&D)	Specification(normal)	Min	Mov	Margin				
Wiodulation	ppm / Hz	ppm / Hz	B(Hz)	M(Hz)	T(Hz)		(Hz)	(Hz)	Result
GMSK	< 0.03/±54Hz	< 0.05/±90Hz	-0.12	-0.92	0.22	-0.92	0.22	53.08	PASS

19.3.7 Test and Measurement Logs



CH2_RF_SDR_TX_PORT_EVM.zip

19.4 Output RF Spectrum- i) Adjacent channel power-Tx Chain 2

19.4.1 Test ID

TX C 2.5

19.4.2 Purpose

The purpose of this test case is the modulation process in a transmitter causes the continuous wave (CW) Carrier to spread spectrally. The "spectrum due to modulation and wideband noise" measurement is used to ensure that modulation process does not cause excessive spectral spread. If it did, other users who are operating on different frequencies would experience interference. The measurement of spectrum due to modulation and wideband noise can be thought of as an adjacent channel power (ACP).

19.4.3 Test and Measurement Method

Refer to section 14.1.5 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

19.4.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

19.4.5 DUT Sample Information

19.4.6 Test Results

			(CH2_spec	trum due	to modul	ation					
Spec	ification		GSM 900 Result									Result
			B(d	B(dBc) M(dBc) T(dBc) Min Max Margin								
offset frequency	< dBc	RBW KHz	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	(dB)	
100KHz	0.5	30	-9.88	-7.5	-9.1	-9.45	-9.1	-9.33	-9.88	-7.5	8	PASS
200KHz	-30	30	-37.48	-36.83	-38.47	-37.43	-38.32	-37.34	-38.47	-36.83	6.83	PASS
250KHz	-33	30	-39.95	-40.77	-40.38	-41.53	-40.64	-41.33	-41.53	-39.95	6.95	PASS
400KHz	-60	30	-56.79	-56.16	-57.79	-58.33	-57.11	-57.03	-58.33	-56.16	-3.84	FAIL
600KHz to 1200KHz	-60	30	-59.84	-60.85	-61.86	-63.03	-61.64	-62.42	-63.03	-59.84	-0.16	FAIL
1200KHz to 1800KHz	-63	30	-70.83	-70.51	-72.94	-73.19	-72.1	-71.64	-73.19	-70.51	7.51	PASS
1800KHz to 6000KHz	-65	100	-70.38	-70.34	-72.25	-72.17	-71.11	-71.35	-72.25	-70.34	5.34	PASS

CH2_spectrum due to modulation												
Specification			DCS 1800 Result									
				Bc)	M(c	M(dBc)		T(dBc)		Max	Margin	
offset frequency	< dBc	RBW KHz	Lower	Upper	Lower	Upper	Lower	Upper	Min (dBc)	(dBc)	(dB)	
100KHz	0.5	30	-8.84	-9.07	-9.94	-7.9	-9.19	-9.53	-9.94	-7.9	8.4	PASS
200KHz	-30	30	-38.18	-37.07	-37.61	-37.23	-38.36	-36.86	-38.36	-37.07	7.07	PASS
250KHz	-33	30	-40.53	-41.69	-39.93	-41.28	-40.22	-41.62	-41.69	-39.93	6.93	PASS
400KHz	-60	30	-58.2	-57.68	-57.84	-57.53	-58.15	-57.86	-58.2	-57.53	-2.47	FAIL
600KHz to 1200KHz	-60	30	-63.22	-63.21	-62.06	-62.14	-63.02	-63.62	-63.62	-62.06	2.06	PASS
1200KHz to 1800KHz	-63	30	-73	-72.15	-71.81	-71.12	-72.7	-72.44	-73	-71.12	8.12	PASS
1800KHz to 6000KHz	-65	100	-72.53	-71.36	-70.96	-70.79	-71.59	-71.97	-72.53	-70.79	5.79	PASS

Resolution for failure:

We have seen improvement in spectrum due to modulation by changing charge pump current value in AD9361 transceiver.

19.4.7 Test and Measurement Logs



CH2_RF_SDR_TX_PORT_modulation.zip

ii) Spectrum due to switching- TX Chain 2

19.4.8 Test ID

TX_C 2.5

19.4.9 Purpose

The purpose of this test case is the GSM/EDGE transmitter's ramp RF power rapidly. The "transmitted RF carrier power versus time" measurement is used to ensure that this process happens at the correct times and happens fast enough. However, if RF power is ramped too quickly, undesirable spectral components exist in the transmission. This measurement is used to ensure that these components are below the acceptable level.

19.4.10 Test and Measurement Method

Refer to section 14.1.6 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

19.4.11 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

19.4.12 DUT Sample Information

19.4.13 Test Results

	CH2_spectrum due to switching										Result
Specificat	S :				Result						
Specificat	1011	B(d)	Bc)	M(dBc)		T(dBc)		Min	Max	Margin	
offset frequency	< dBc	Lower	Upper	Lower	Upper	Lower	Upper	(dBc)	(dBc)	(dB)	
400 KHz	-57	-53.56	-52.57	-52.52	-53.17	-53.37	-51.34	-53.56	-52.52	-4.48	FAIL
600 KHz	-67	-56.65	-58.21	-56.82	-56.69	-57.26	-56.43	-58.21	-56.65	-10.35	FAIL
1200 KHz	-74	-66.25	-67.5	-68.89	-68.5	-67.17	-66.97	-68.89	-66.25	-7.75	FAIL
1800 KHz	-74	-73.34	-73.77	-72.28	-72.1	-72.81	-72.37	-73.77	-72.1	-1.9	FAIL

CH2_spectrum due to switching											Result		
Specifica	tion				DCS 1800 Result								
Specifica	tion	B(d	B(dBc)		M(dBc)		T(dBc)		Max	Margin			
offset frequency	< dBc	Lower	Upper	Lower	Upper	Lower	Upper	Min (dBc)	(dBc)	(dB)			
400 KHz	-50	-55.79	-54.2	-55.35	-55.44	-53.76	-54.47	-55.79	-53.76	3.76	PASS		
600 KHz	-58	-58.92	-57.96	-58.23	-59.22	-59.4	-58.06	-59.4	-57.96	-0.04	FAIL		
1200 KHz	-66	-69.7	-68.22	-68.84	-68.98	-67.95	-67.36	-69.7	-67.95	1.95	PASS		
1800 KHz	-66	-73.79	-72.92	-73.6	-74.11	-72.52	-73.49	-74.11	-72.52	6.52	PASS		

Resolution for failure:

Need software support to change raise time/fall time of each time slot.

19.4.14 Test and Measurement Logs



CH2_RF_SDR_TX_PORT_switching.zip

19.5 Spurious Emissions - TX chain2

19.5.1 Test ID

TX C 2.6

19.5.2 Purpose

The purpose of this test case is to ensure GSM transmitters do not put energy into the wrong parts of the spectrum, as this would cause interference to other users of the spectrum.

19.5.3 Test and Measurement Method

Refer to section 14.1.7 of OpenCellular – Connect1 Radio Frequency module with Software Defined Radio Test Specification document

19.5.4 Test Condition

Ambient Temperature – 25°C

Operating Voltage - +12V DC

System/Test Load: Typical

19.5.5 DUT Sample Information

19.5.6 Test Results

	CH2_900MHZ											
Start Frequency	Start Frequency	Spec (dBm)			An	nplitude(dB	m)	Max (dBm)	Margin (dB)	Result		
(MHz)	(MHz)	(4211)	(12112)	(KHz)	В	M	T	(4211)	(ub)			
0.1	50	-36	10	30	no spur	no spur	no spur	0	36	PASS		
50	880	-36	3000	9000	-66	-64.5	-65	-64.5	28.5	PASS		
880	915	-98	100	100	-80.98	-80.4	-79.12	-79.12	-18.88	FAIL		
915	920	-36	100	300	-78.6	-79.8	-80.28	-78.6	42.6	PASS		
920	923	-36	30	90	-73.4	-78.6	no spur	-73.4	37.4	PASS		
925	960											
962	965	-36	30	90	-80.46	-70	-66.25	-66.25	30.25	PASS		
965	970	-36	100	300	-74.41	-67.27	-66.6	-66.6	30.6	PASS		
970	980	-36	300	900	-75.7	-72.6	-67.63	-67.63	31.63	PASS		
989	990	-36	1000	3000	-71.3	-68.99	-69.25	-68.99	32.99	PASS		
990	1000	-36	3000	9000	-64.85	-64.5	-63.22	-63.22	27.22	PASS		
1000	12750	-30	3000	9000	-47.13	-45.02	-53.2	-45.02	15.02	PASS		

	CH2_1800MHZ										
Start Frequency	Start Frequency	Spec RBW (KHz)		VBW (KHz)	An	nplitude(dB	m)	Max (dBm)	Margin (dB)	Result	
(MHz)	(MHz)	(ubiii)	(IIIIZ)	(IIIIZ)	В	M	T	(ubiii)	(ub)		
0.1	50	-36	10	30	no spur	no spur	no spur	0	36	PASS	
50	1000	-36	3000	9000	-66.6	-65	-65.14	-65	29	PASS	
1000	1710	-30	3000	9000	-65.2	-63	-63.44	-63	33	PASS	
1710	1785	-98	100	100	-79.93	-79.5	-78.87	-78.87	-19.13	FAIL	
1785	1795	-30	300	900	-74.4	-74.33	-73.9	-73.9	43.9	PASS	
1795	1800	-30	100	300	-73	-78	-77	-73	43	PASS	
1800	1803	-30	30	90	-69.35	-77.95	-83	-69.35	39.35	PASS	
1805	1880										
1882	1885	-30	30	90	-82	-73	-64	-64	34	PASS	
1887	1890	-30	100	300	-76.8	-76	-62.22	-62.22	32.22	PASS	
1890	1900	-30	300	900	-73	-70	-56	-56	26	PASS	
1900	1910	-30	1000	3000	-69.47	-67	-60	-60	30	PASS	
1910	12750	-30	3000	9000	-57.45	-60	-57	-57	27	PASS	

NOTE: Screen shots were not captured, if required we make sure that we are capturing screen shots for REV_C boards.

Resolution for failure:

We have added band pass filter in REV_C design on TX side for better rejections in self RX band.

20 Revision History

SL.no	Date	Version	Author	Comments
1	February 9 th , 2017	1.0	OpenCellular Team	First Release
2	February 13 th 2017	1.1	OpenCellular Team	Incorporated comments on the 1st and 2 nd Page