

EMC Test Report

Project Number: 3811993

Report Number: 3811993EMC02 **Revision Level:** 0

Client: Continental Automotive Systems, Inc.

Equipment Under Test: Wireless Modem Module

Model: TVN

FCC Rule Parts: Part 2, Part 22(H), Part 24(E)

Industry Canada: RSS-GEN, Issue 4: 2014

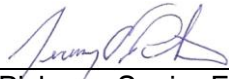
RSS-132, Issue 3: 2013

RSS-133 Issue 6: 2013

Report issued on: 23 September 2015

Test Result: Compliant

Tested by:



Jeremy O. Pickens, Senior EMC Engineer

Reviewed by:



David Schramm, EMC/RF/SAR/HAC Manager

Remarks:

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or Testing done by SGS International Electrical Approvals in connection with distribution or use of the product described in this report must be approved by SGS international Electrical Approvals in writing.

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1 Summary of Test Results

Reference Sections	Test Description	Test Limit	Test Condition	Test Result
Transmit Mode Testing				
2.1046 RSS-GEN (6.12)	Conducted Output Power	N/A	Conducted	Reported
24.232(d) RSS-132 5.4 RSS-133 6.4	Peak-to-Average Ratio	<13 dB		Pass
2.1049 22.917(a) 24.238(a) RSS-GEN(6.6)	Occupied Bandwidth	N/A		Reported
2.1051 22.917(a) 24.238(a)	Band Edge / Conducted Spurious Emissions	$< 43 + 10\log_{10}(P_{[Watts]})$ at band edge and for all out of band emissions		Pass
22.913(a)(2)	Effective Radiated Power	< 7 Watts max ERP		Pass
RSS-132 5.4	Effective Radiated Power	< 11.5 Watts max ERP		Pass
24.232(c) RSS-133 6.4	Effective Isotropic Radiated Power	< 2 Watts max EIRP		Pass
2.1053 22.917(a) 24.238(a) RSS-GEN (6.13) RSS-132 5.5 RSS-133 6.5	Radiated Spurious Emissions	$< 43 + 10\log_{10}(P_{[Watts]})$ at band edge and for all out of band emissions	Radiated	Pass
2.1055 22.917(a) 24.238(a) RSS-GEN (6.11) RSS-132 5.3 RSS-132 6.3	Frequency Stability	<2.5 ppm		Pass

1.1 Modifications Required to Compliance

None

2 General Information

2.1 Client Information

Name: Continental Automotive System, Inc..
Address: 21440 West Lake Cook Road
City, State, Zip, Country: Deer Park, IL 60010, USA

2.2 Test Laboratory

Name: SGS North America, Inc.
Address: 620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country: Suwanee, GA 30024, USA

2.3 General Information of EUT

Type of Product: Wireless Modem Module
Model Number: TVN
FCC ID: LHJ-TVN
IC ID: 2807E-TVN
IMEI Number: 352584070000267

Rated Voltage: 10.2 - 13.8 Vdc,
Test Voltage: 12 Vdc
Tx Frequency Range: 826.4– 846.6 MHz (WCDMA Band V)
1852.4– 1907.6 MHz (WCDMA Band II)

FCC Classification: PCS Licensed Transmitter PCB
Type: Pre Production

Sample Received Date: 28 July 2015
Dates of testing: 17 Aug - 22 Sept 2015

2.4 Operating Modes and Conditions

The EUT was exercised by connecting a CMW communications tester to the device. The CMW was used to control signaling and channel during testing.

3 RF Output Power

3.1 Test Result

Test Description	Basic Standards	Test Result
RF Output Power	FCC Part 2.1046 RSS-GEN (6.12)	Reported

3.2 Test Method

A radio link was established between EUT and Radio Communication Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester. The CMW500 was used to measure the output power.

The measurements were conducted at the low, middle, and high channel.

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.3 °C

Relative Humidity: 52.1%

Atmospheric Pressure: 98.2 kPa

3.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
CMW500 WIDEBAND RADIO COMMUNICATIONS TESTER	CMW500	ROHDE & SCHWARZ	B094874	6-Dec-2015
MULTIFLEX COAXIAL CABLE	141	HUBER&SUHNER	B095585	4-Aug-2016

- Unless otherwise noted, equipment is on a 1 year calibration cycle.
- Based on manufacturer's specifications, the CMW-500 is on a 3 year calibration cycle.

3.5 Test Data

Band	UpLink Channel	UL Frequency (MHz)	Subtest	Measured Power (dBm)	Cable Loss (dB)	Conducted Power (dBm)
2	9262	1852.4	Subtest1	23.64	0.53	24.17
2	9400	1880	Subtest1	23.8	0.53	24.33
2	9538	1907.6	Subtest1	23.6	0.54	24.14
5	4132	826.4	Subtest1	23.41	0.35	23.76
5	4175	835	Subtest1	23.5	0.35	23.85
5	4233	846.6	Subtest1	23.67	0.35	24.02
2	9262	1852.4	Subtest2	23.58	0.53	24.11
2	9400	1880	Subtest2	23.98	0.53	24.51
2	9538	1907.6	Subtest2	23.55	0.54	24.09
5	4132	826.4	Subtest2	23.32	0.35	23.67
5	4175	835	Subtest2	23.69	0.35	24.04
5	4233	846.6	Subtest2	23.75	0.35	24.1
2	9262	1852.4	Subtest3	23.1	0.53	23.63
2	9400	1880	Subtest3	23.43	0.53	23.96
2	9538	1907.6	Subtest3	23.23	0.54	23.77
5	4132	826.4	Subtest3	22.88	0.35	23.23
5	4175	835	Subtest3	23.17	0.35	23.52
5	4233	846.6	Subtest3	22.91	0.35	23.26
2	9262	1852.4	Subtest4	23.16	0.53	23.69
2	9400	1880	Subtest4	23.32	0.53	23.85
2	9538	1907.6	Subtest4	23.1	0.54	23.64
5	4132	826.4	Subtest4	22.8	0.35	23.15
5	4175	835	Subtest4	22.99	0.35	23.34
5	4233	846.6	Subtest4	23.35	0.35	23.7
2	9262	1852.4	Subtest5	23.68	0.53	24.21
2	9400	1880	Subtest5	23.63	0.53	24.16
2	9538	1907.6	Subtest5	23.52	0.54	24.06
5	4132	826.4	Subtest5	23.64	0.35	23.99
5	4175	835	Subtest5	23.56	0.35	23.91
5	4233	846.6	Subtest5	23.58	0.35	23.93

Band V Max: 24.51dBm (0.282W)

Band II Max: 24.1dBm (0.257W)

4 Occupied Bandwidth

4.1 Test Result

Test Description	Basic Standards	Test Result
Occupied Bandwidth	FCC Part 2.1049 FCC Part 22.917(a) FCC Part 24.238(a) RSS-GEN(6.6)	Reported

4.2 Test Method

The occupied bandwidth is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power by a given emission. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sample detector shall be used since a peak detector may produce a wider than actual bandwidth.

A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester. The occupied bandwidth was measured using spectrum analyzer's occupied bandwidth measurement. RBW was set to 30 kHz on spectrum analyzer.

The bandwidth of 99% power can be read on spectrum analyzer.

4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.3 °C
Relative Humidity: 52.1 %
Atmospheric Pressure: 98.2 kPa

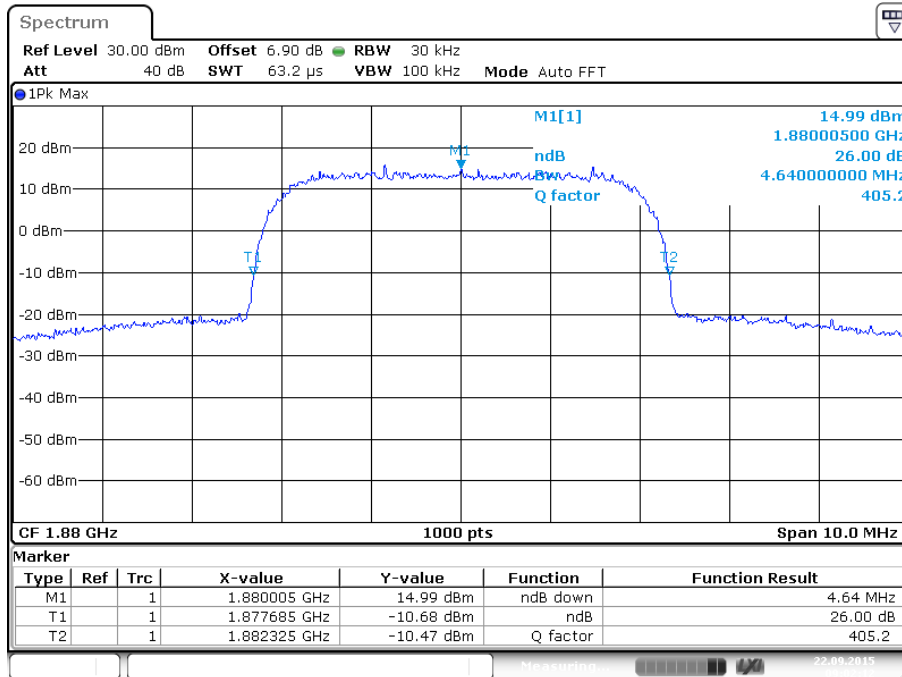
4.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	28-Aug-2015
CMW500 WIDEBAND RADIO COMMUNICATIONS TESTER	CMW500	ROHDE & SCHWARZ	B094874	6-Dec-2015
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	B101743	5-Aug-2016
COAXIAL CABLE	1134	GORE	B094785	4-Aug-2016

- Unless otherwise noted, equipment is on a 1 year calibration cycle.
- Based on manufacturer's specifications, the CMW-500 is on a 3 year calibration cycle.

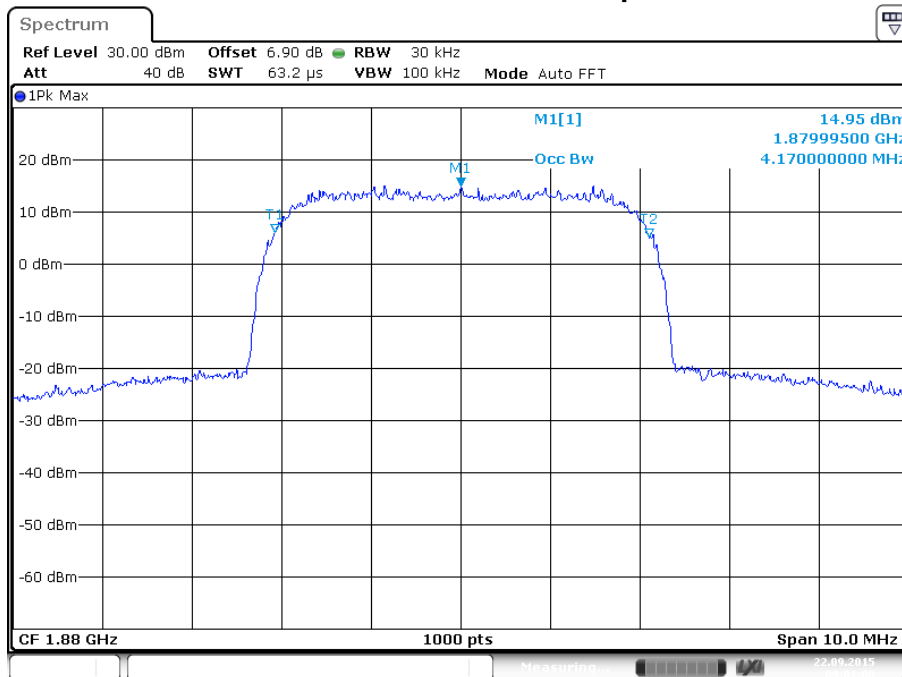
4.5 Test Data

WCDMA – Band II CH 9400 - 26dB Bandwidth



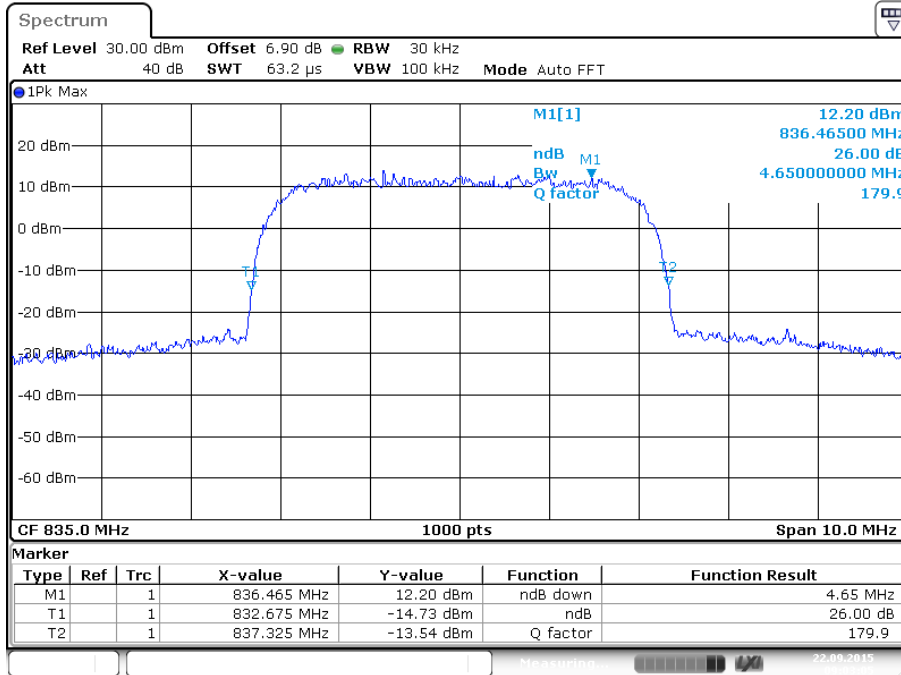
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WCDMA – Band II CH 9400 - 99% Occupied Bandwidth



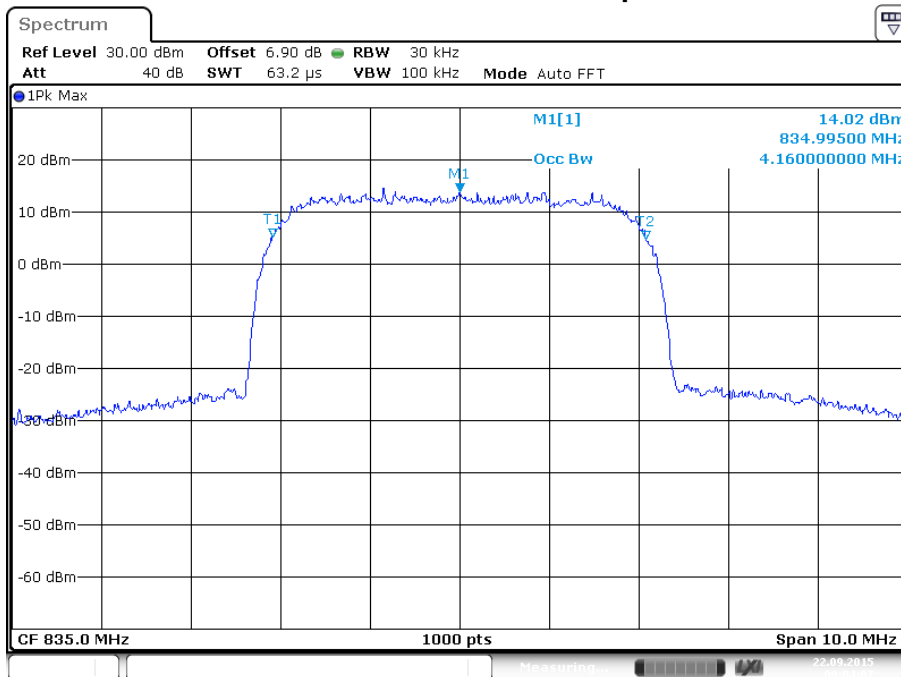
Date: 22.SEP.2015 09:01:08

WCDMA – Band V CH 4175 - 26dB Bandwidth



Date: 22.SEP.2015 09:03:05

WCDMA – Band V CH 4175 - 99% Occupied Bandwidth



Date: 22.SEP.2015 09:04:07

5 Band Edge and Conducted Spurious Emissions

5.1 Test Result

Test Description	Basic Standards	Test Result
Conducted spurious emissions and Band Edge	2.1051 22.917(a) 24.238(a)	Pass

5.2 Test Method

The levels of the carrier and the various conducted spurious and harmonics frequencies were measured by means of a calibrated spectrum analyzer. The emissions spectrum emanating from the EUT transmit antenna port were scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB. Compliance was based on the use of a spectrum analyzer employing a resolution bandwidth of 1 MHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of a least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emissions bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.1 °C

Relative Humidity: 53.2 %

Atmospheric Pressure: 98.1 kPa

5.4 Test Equipment

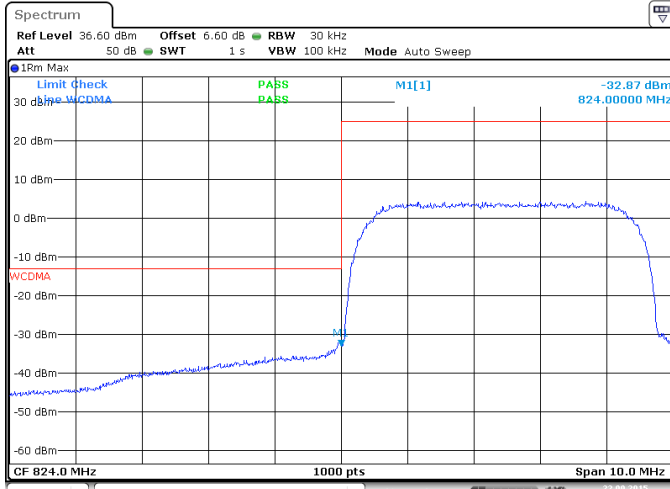
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	27-Sep-2015
CMW500 WIDEBAND RADIO COMMUNICATIONS TESTER	CMW500	ROHDE & SCHWARZ	B094874	6-Dec-2015
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	B101743	5-Aug-2016
COAXIAL CABLE	1134	GORE	B094785	4-Aug-2016

- Unless otherwise noted, equipment is on a 1 year calibration cycle.
- Based on manufacturer's specifications, the CMW-500 is on a 3 year calibration cycle.

5.5 Test Data

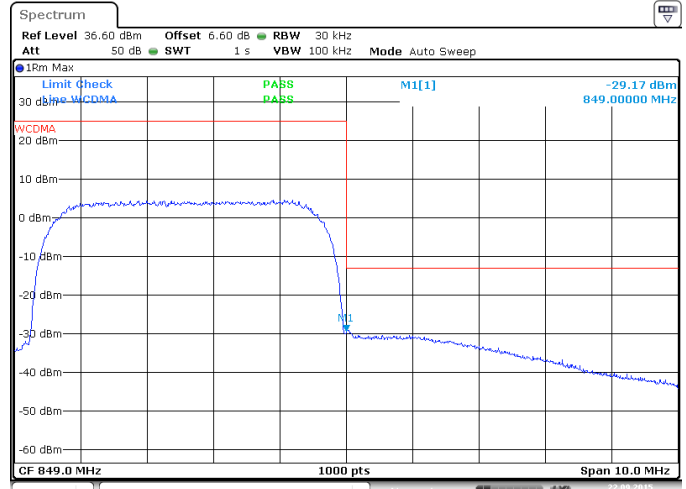
WCDMA, Band V

Lower Band Edge (Channel 4132, 826.4 MHz)



Date: 22.SEP.2015 08:31:11

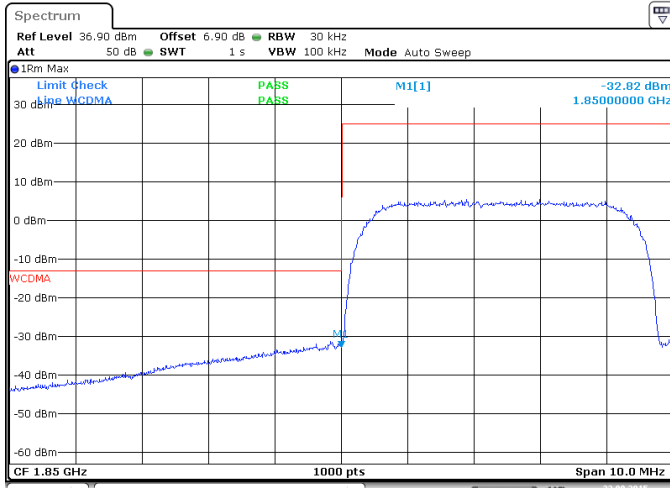
Upper Band Edge (Channel 4233, 846.6 MHz)



Date: 22.SEP.2015 08:44:00

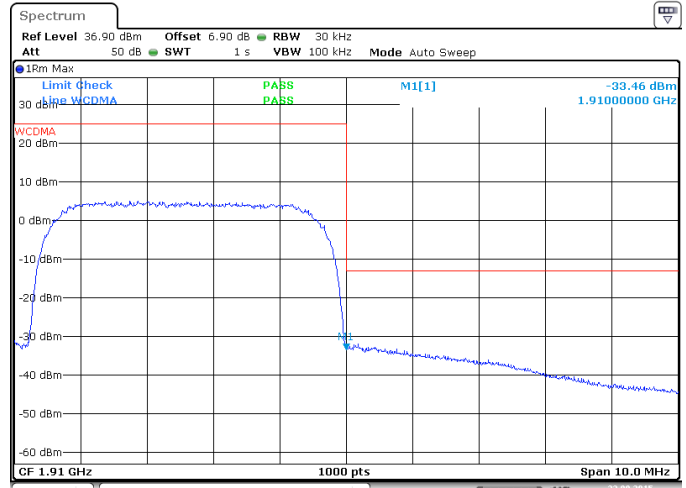
WCDMA, Band II

Lower Band Edge (Channel 9262, 1852.4 MHz)



Date: 22.SEP.2015 08:50:13

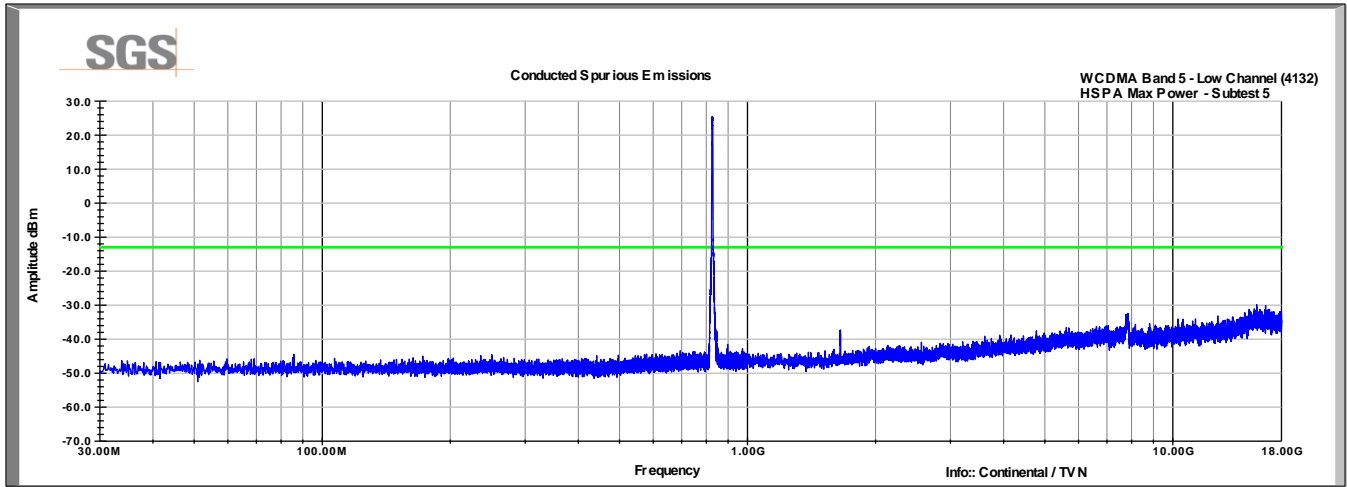
Upper Band Edge (Channel 9538, 1907.6 MHz)



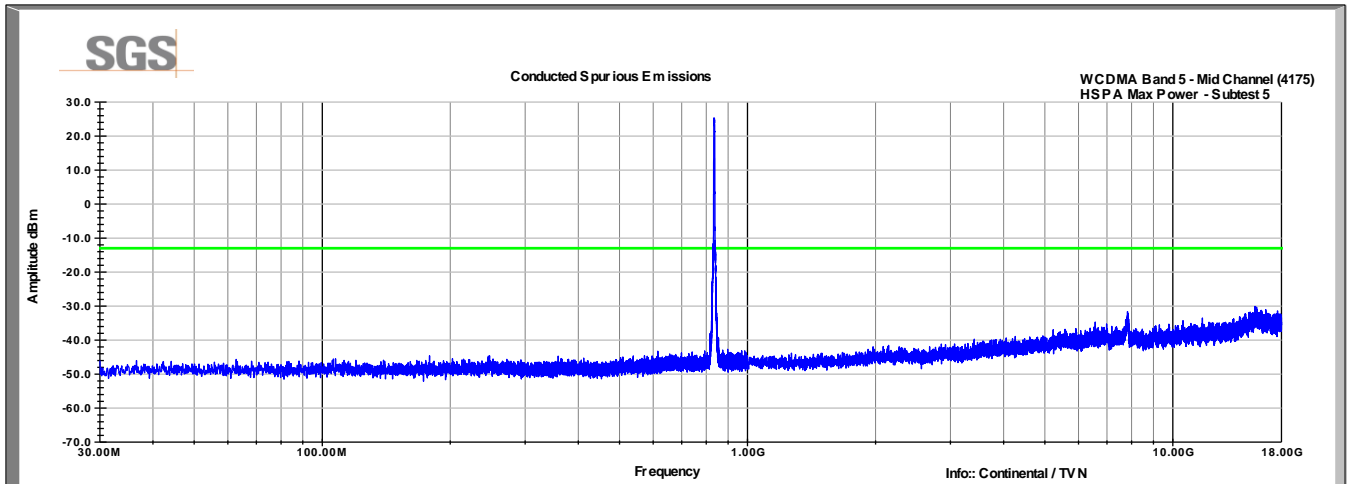
Date: 22.SEP.2015 08:49:05

5.6 Conducted Spurious Emissions Plot

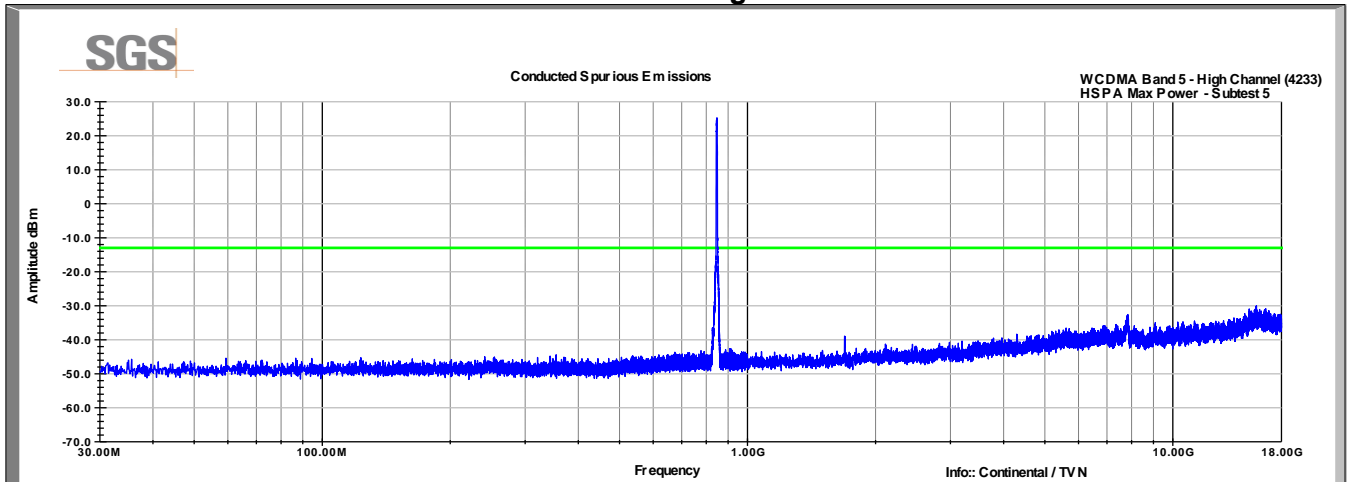
WCDMA Band V Low Channel



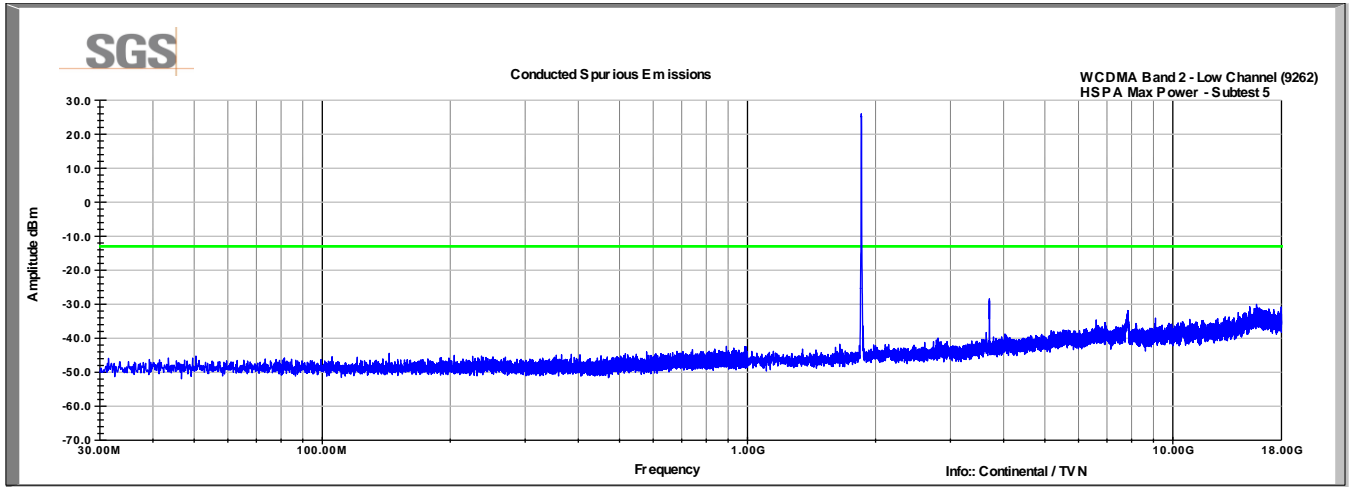
WCDMA Band V Mid Channel



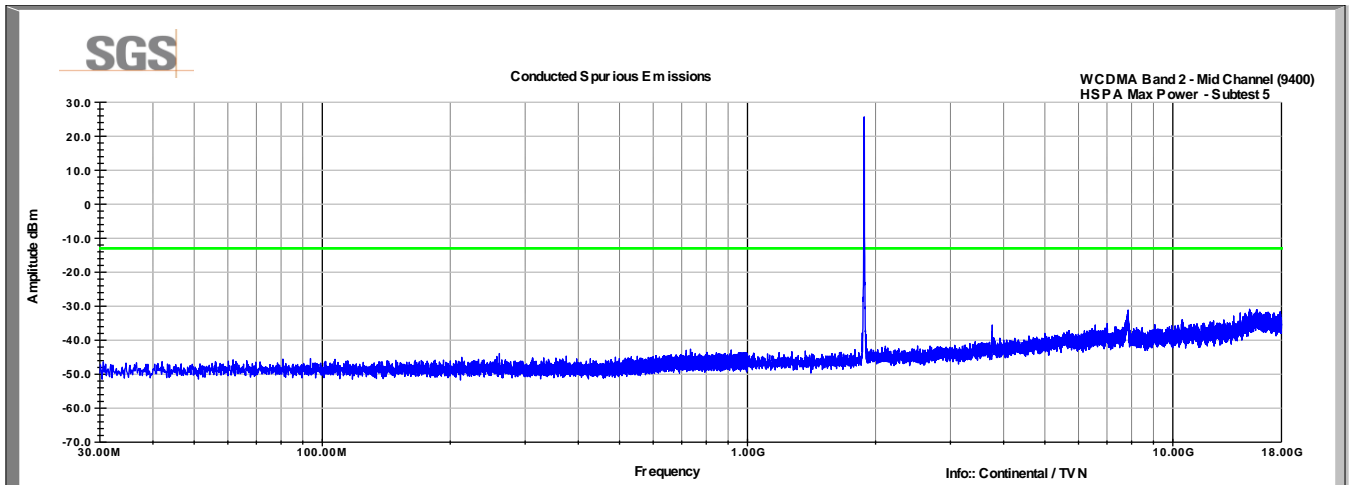
WCDMA Band V High Channel



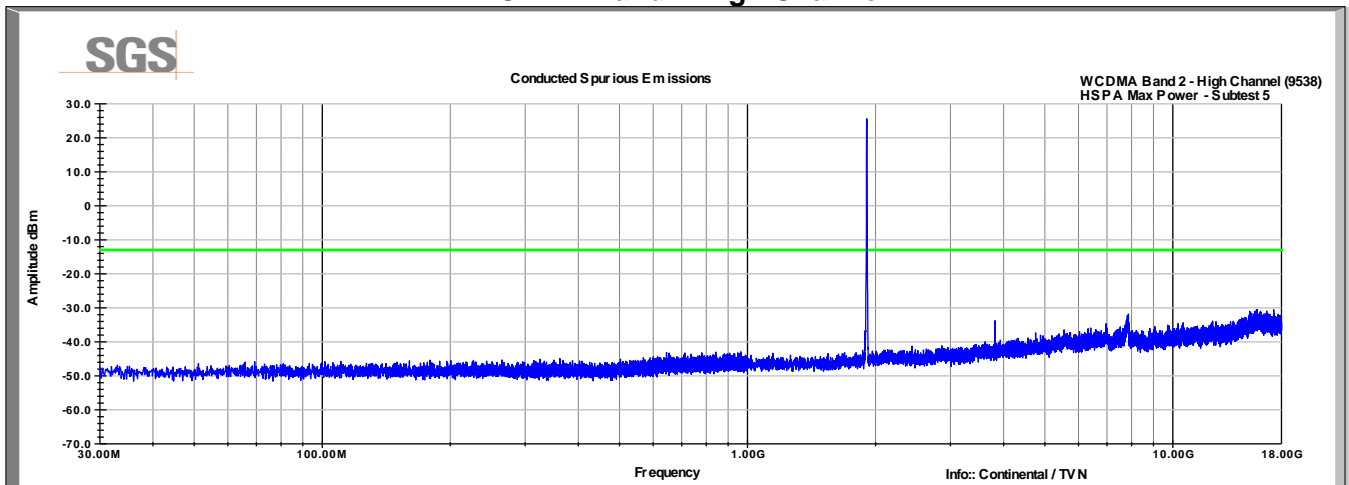
WCDMA Band II Low Channel



WCDMA Band II Mid Channel



WCDMA Band II High Channel



6 Effective Radiated Power

6.1.1 Test Result

Test Description	Basic Standards	Test Result
Effective Radiated Power	FCC Part 22.913(a)(2) RSS-132 5.4	Pass
Effective Isotropic Radiated Power	24.232(c) RSS-133 6.4	Pass

6.1.2 Test Method

Because the TVN device is not provided with an antenna, ERP/EIRP measurements were taken by measuring the conducted output power and defining the maximum gain antenna that may be used as specified by the manufacturer.

6.2 Test Site

SGS EMC Laboratory, Suwanee, GA

6.3 Test Equipment

None

6.4 Test Data

Band	Max Power dBm	Antenna Gain dBd/dBi	Cable Loss, dB	ERP/EIRP (dBm)	ERP/EIRP Limit, dBm		Result	
					FCC	IC	FCC	IC
					Band 5 / 824.7	23.99	6.1	1
Band 5 / 836.52	24.04	6.1	1	29.14	38.5	31.1	PASS	PASS
Band 5 / 848.31	24.1	6.1	1	29.2	38.5	31.2	PASS	PASS
Band 2 / 1851.25	24.21	6.1	1	29.31	33	33.5	PASS	PASS
Band 2 / 1880	24.51	6.1	1	29.61	33	33.5	PASS	PASS
Band 2 / 1908.75	24.14	6.1	1	29.24	33	33.6	PASS	PASS

Note: Antenna gain was determined from maximum gain while still meeting the RF exposure requirements for simultaneous transmissions.

7 Radiated Spurious Emissions

7.1 Test Result

Test Description	Basic Standards		Test Result
Radiated Spurious Emissions	FCC Part 2.1053 FCC Part 22.917(a) FCC Part 24.238(a) ANSI/TIA-603-C-2004	RSS-GEN (6.13) RSS-132 5.5 RSS-133 6.5	Pass

7.2 Test Method

The levels of the carrier and the various conducted spurious and harmonics frequencies are measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB. Compliance is based on the use of a spectrum analyzer employing a resolution bandwidth of 1 MHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of a least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emissions bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

The EUT was manipulated through each of its three orthogonal axes with the measurement oriented in both vertical and horizontal polarizations.

A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester. The measurements were conducted at the low, middle, and high channels in RC3/SO55 which was determined to be the worst case operating mode.

7.3 Test Equipment

Test Start Date: 21-Aug-2015

Test End Date: 24-Aug-2015

Tester: KS

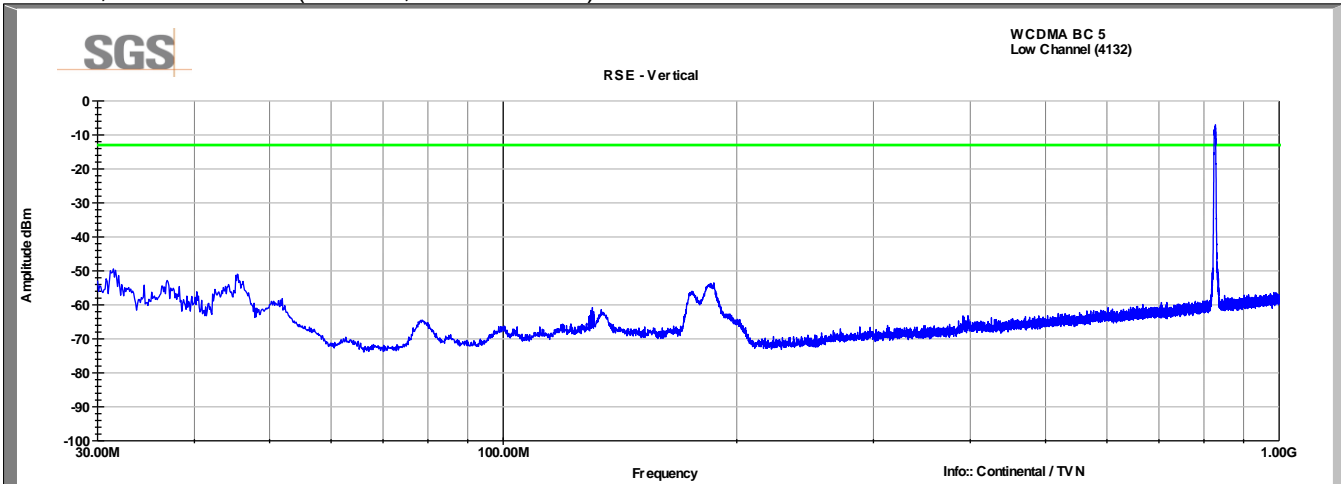
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	4-Aug-2016
ANTENNA, BILOG	JB6	SUNOL	B079689	3-Sep-2015
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079699	14-Apr-2016
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2016
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	4-Aug-2016
RF CABLE	SF106	HUBER&SUHNER	B085888	4-Aug-2016
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079716	4-Aug-2016

- Unless otherwise noted, equipment is on a 1 year calibration cycle.

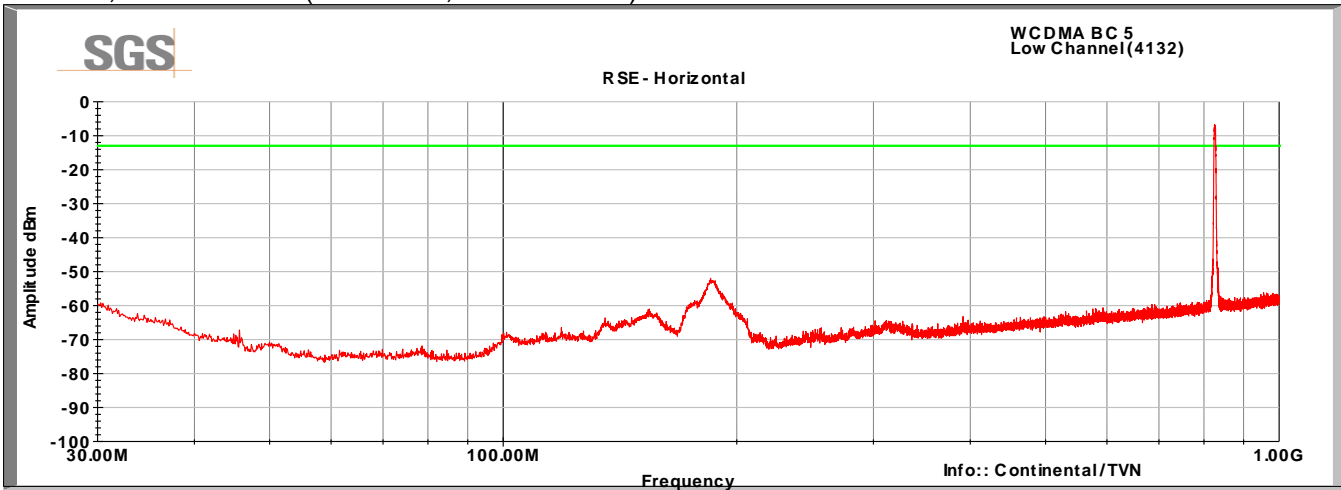
7.4 Test Data

Test Date(s): 21 - 24 August 2015

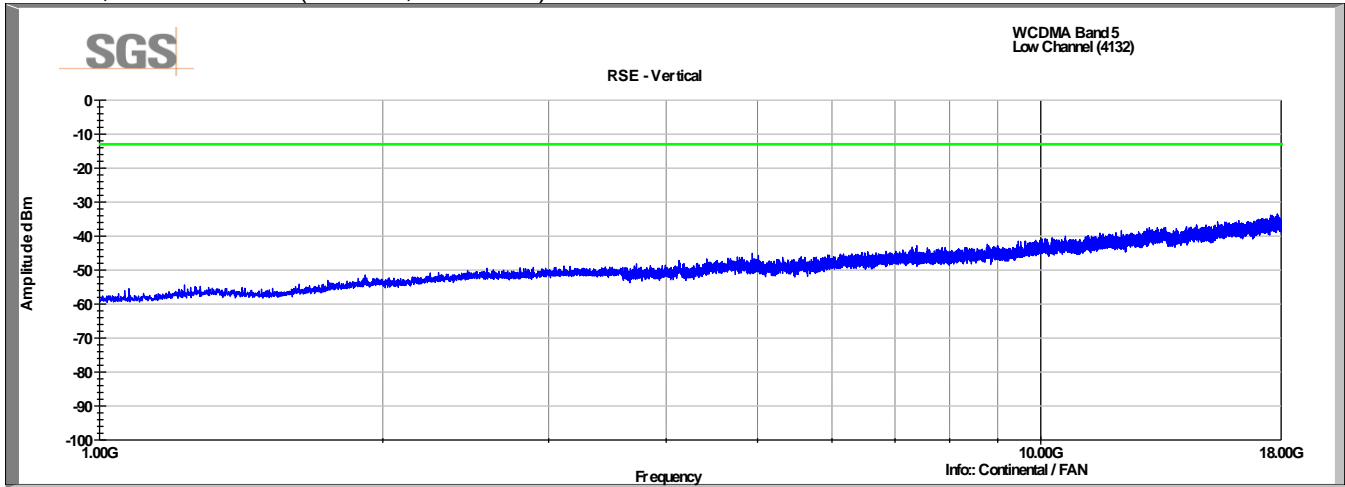
Band V, Low Channel (Vertical, 30-1000MHz)



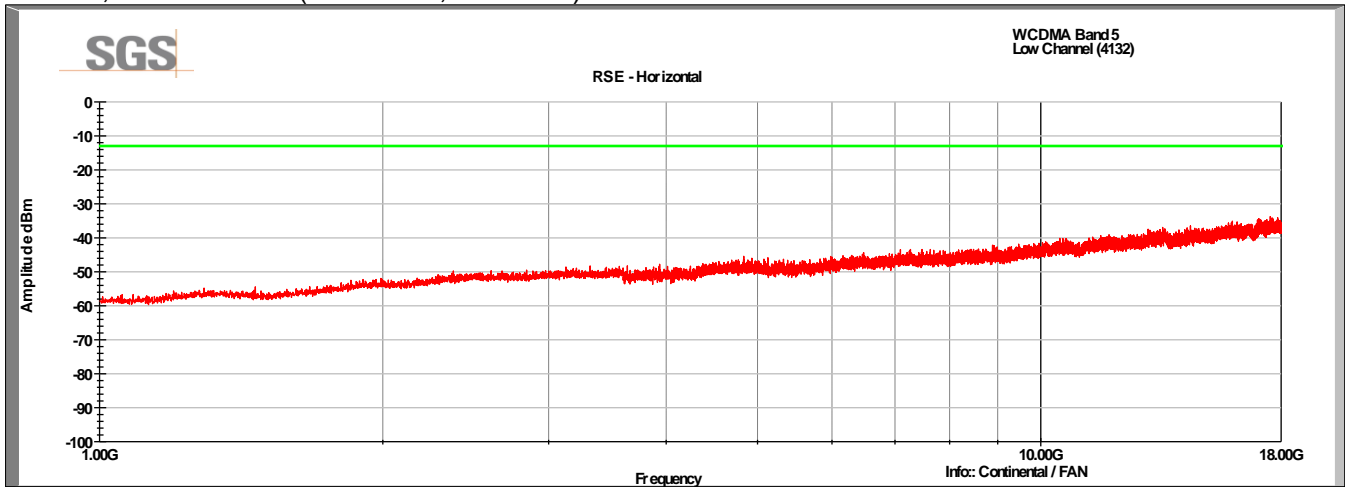
Band V, Low Channel (Horizontal, 30-1000MHz)



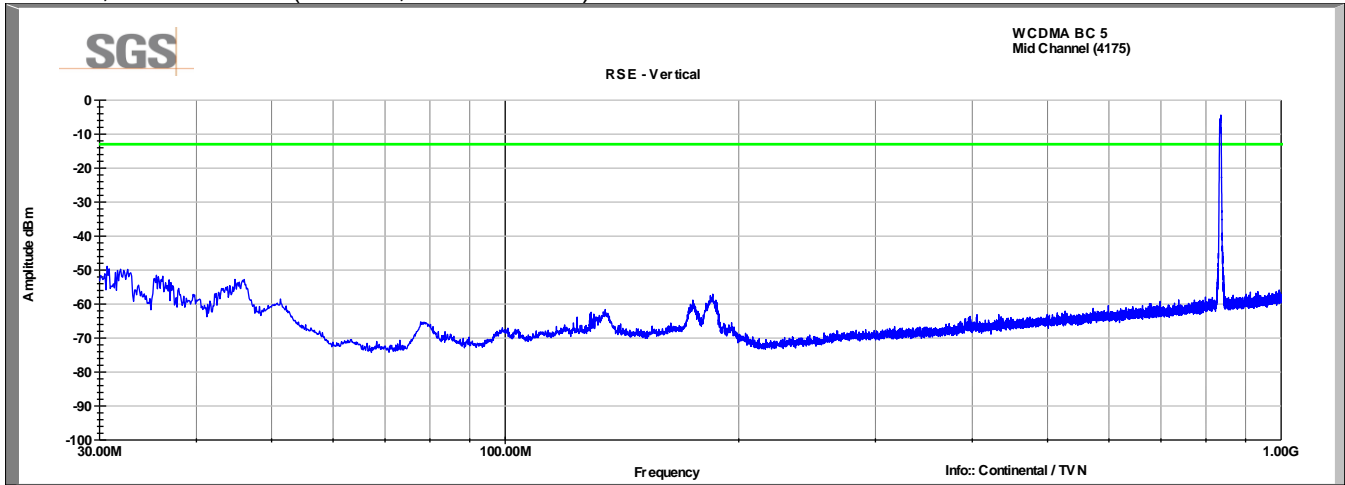
Band V, Low Channel (Vertical, 1-18GHz)



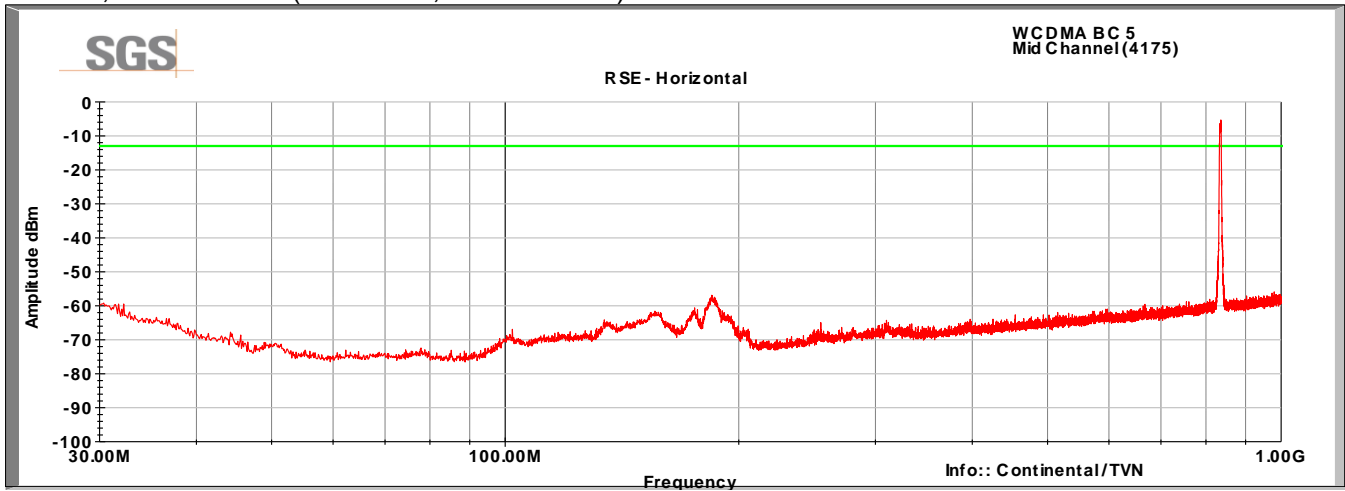
Band V, Low Channel (Horizontal, 1-18GHz)



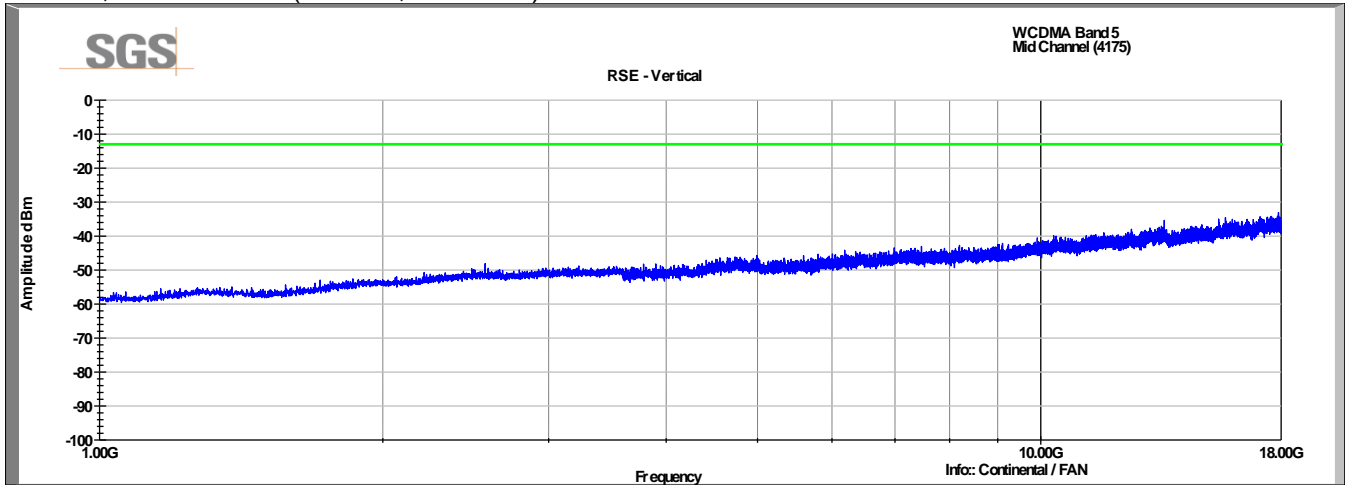
Band V, Mid Channel (Vertical, 30-1000MHz)



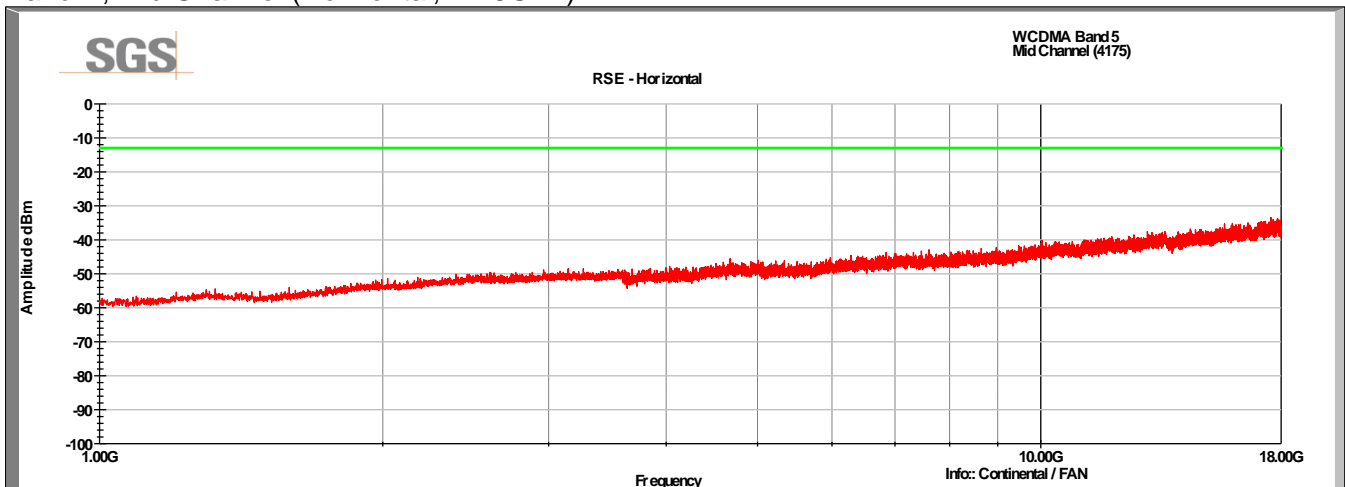
Band V, Mid Channel (Horizontal, 30-1000MHz)



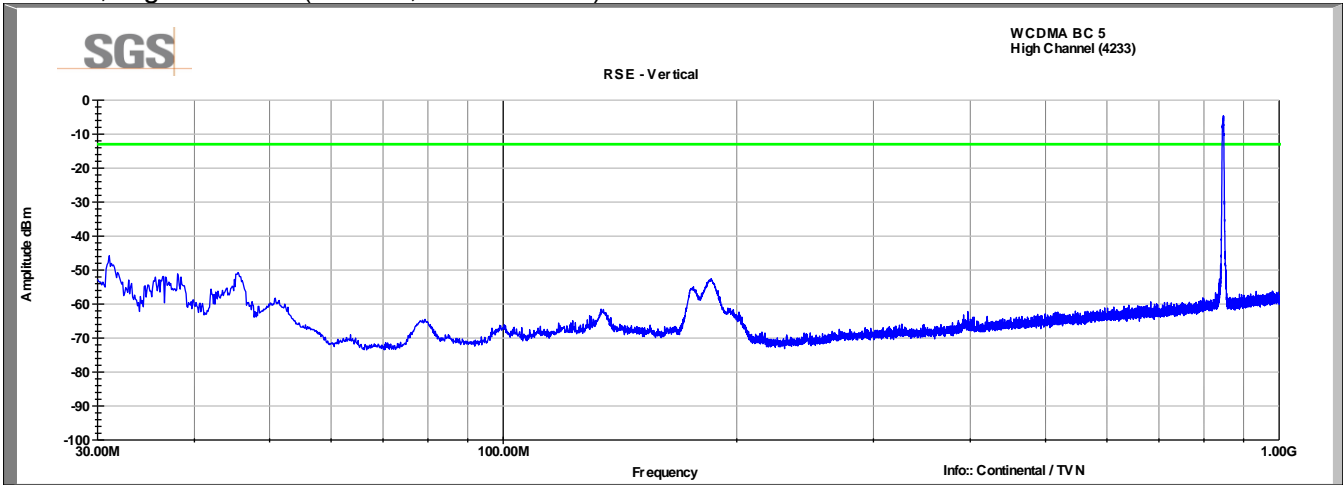
Band V, Mid Channel (Vertical, 1-18GHz)



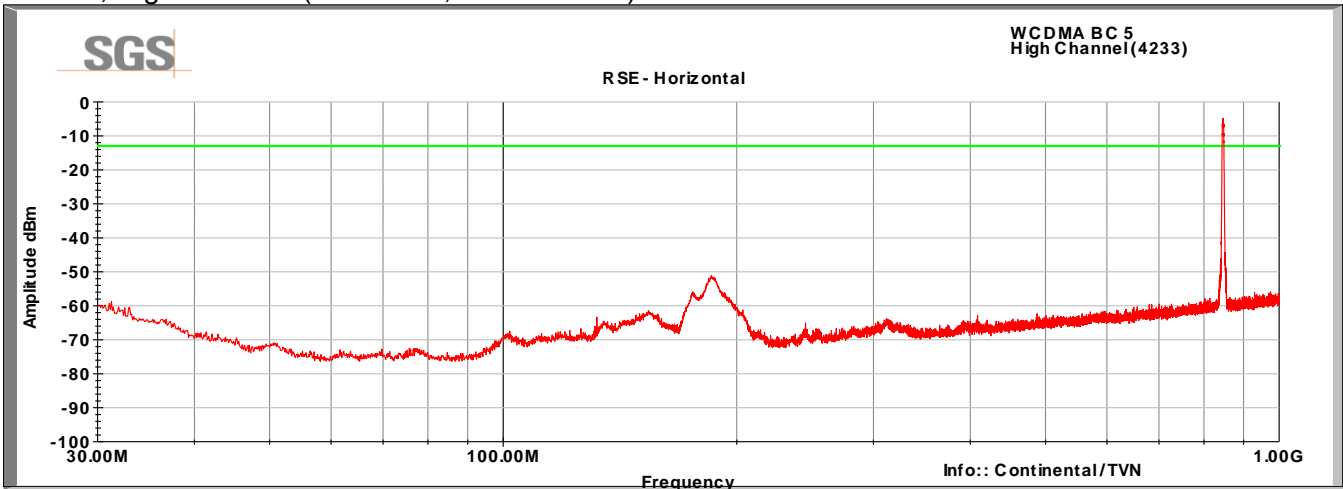
Band V, Mid Channel (Horizontal, 1-18GHz)



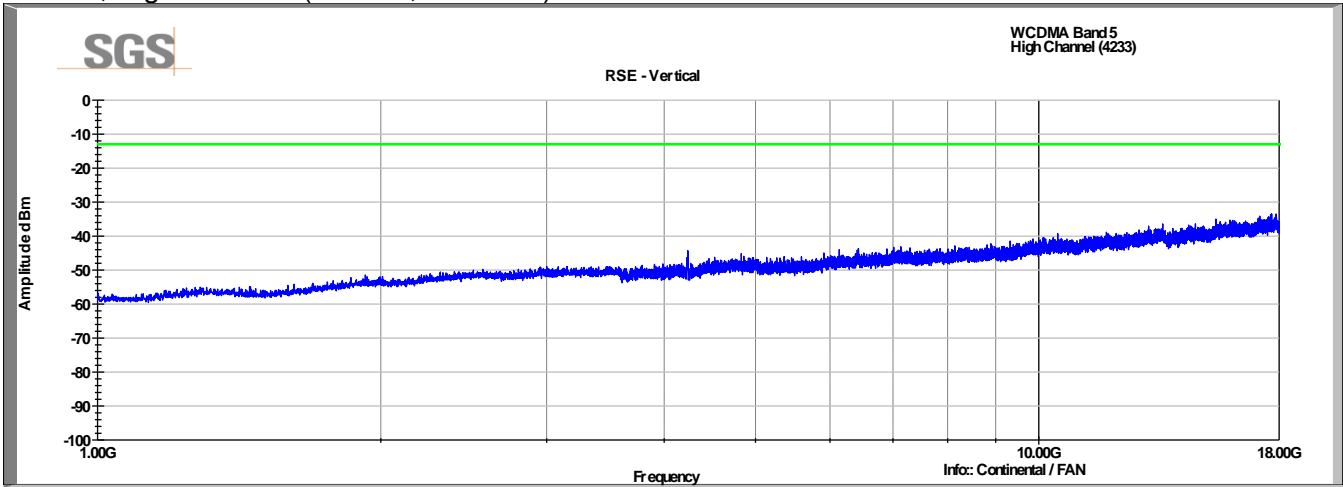
Band V, High Channel (Vertical, 30-1000MHz)



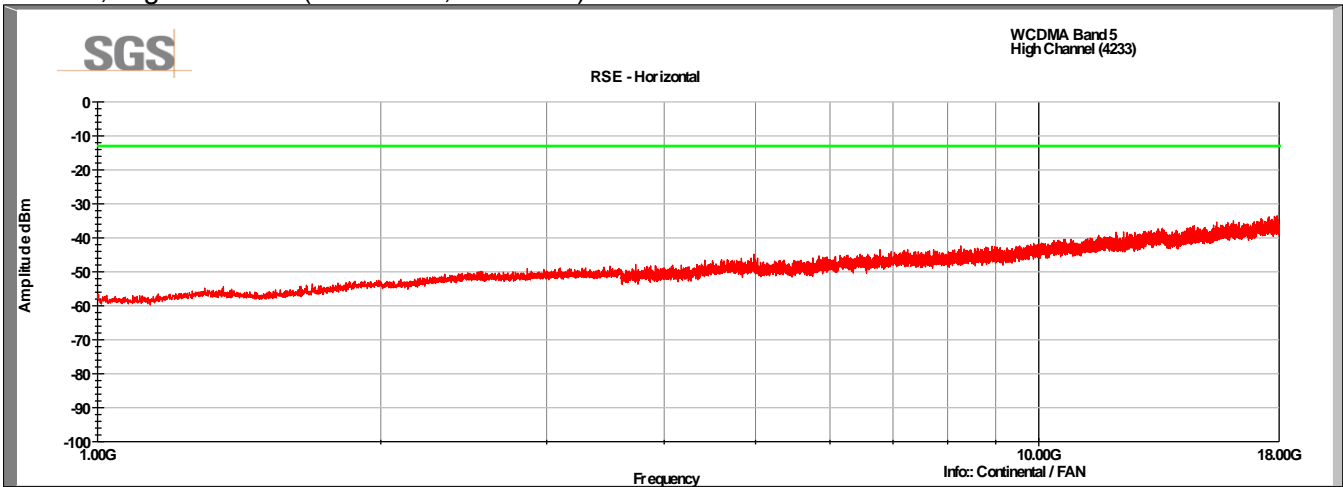
Band V, High Channel (Horizontal, 30-1000MHz)



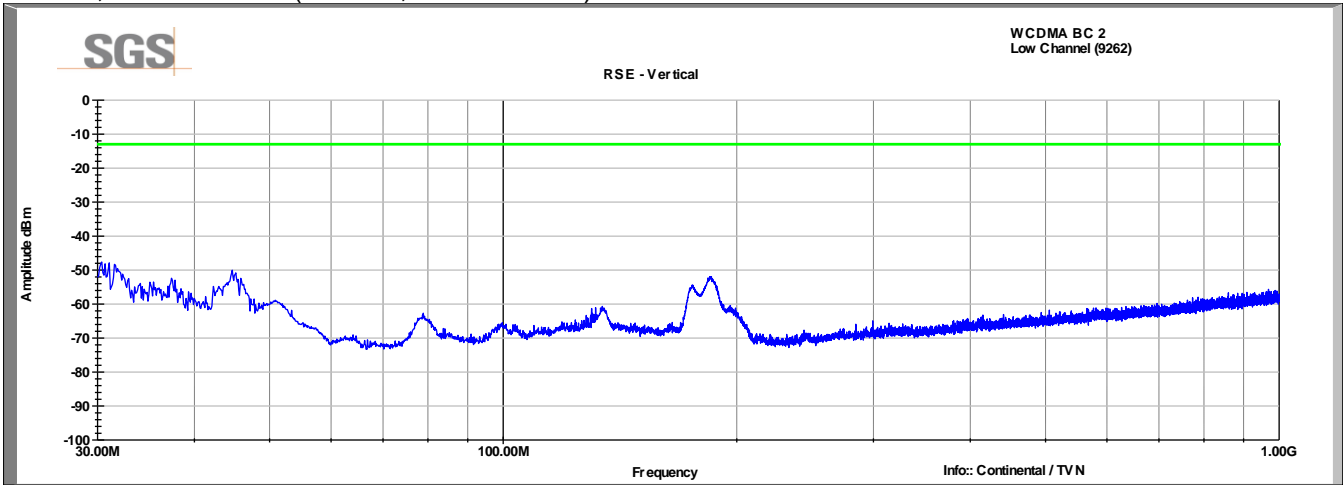
Band V, High Channel (Vertical, 1-18GHz)



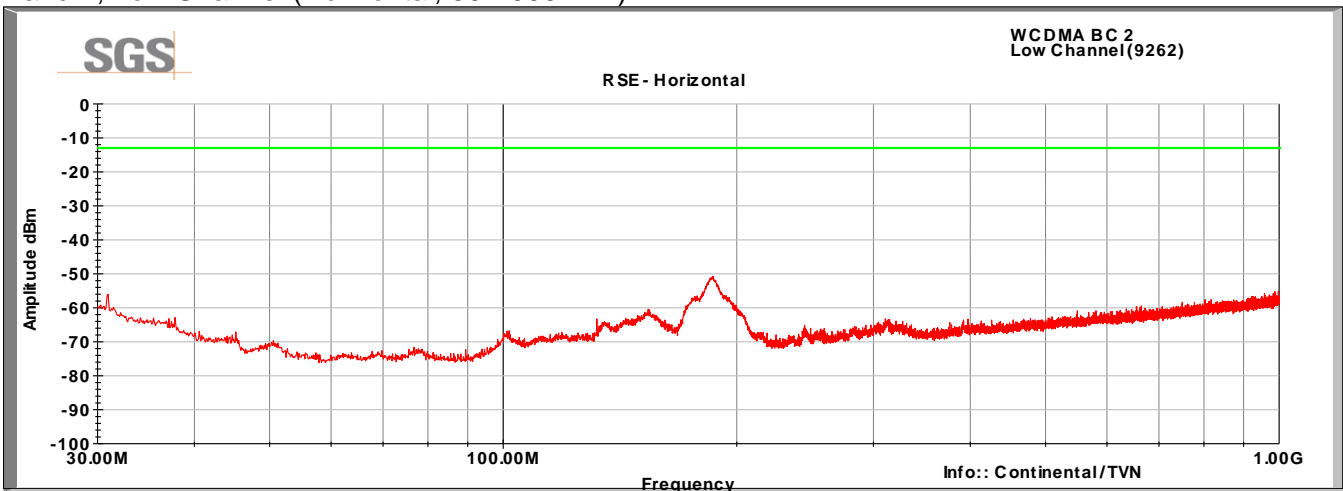
Band V, High Channel (Horizontal, 1-18GHz)



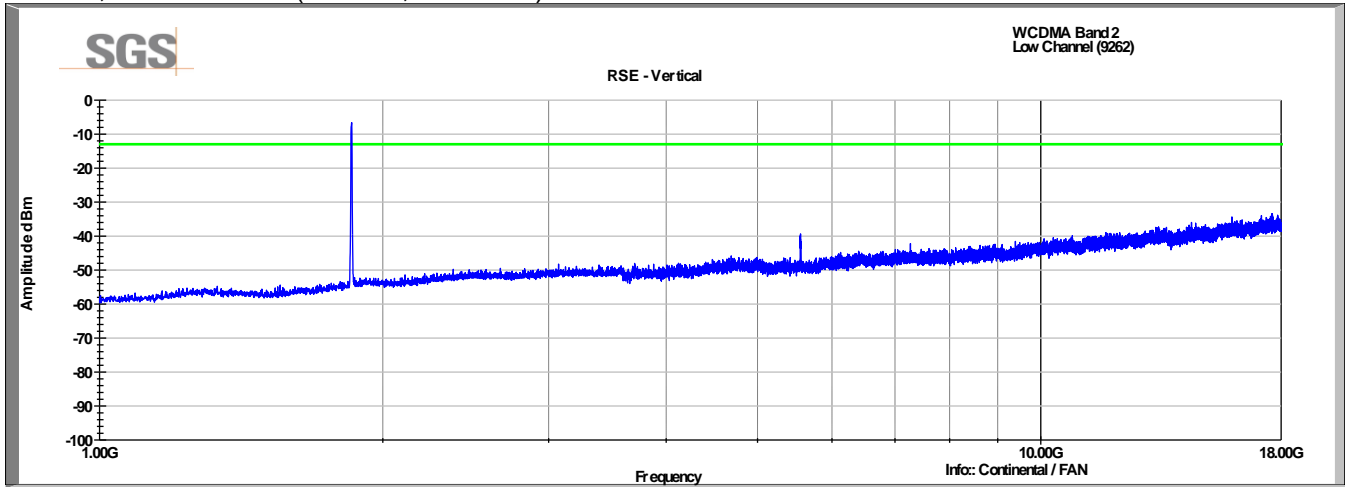
Band II, Low Channel (Vertical, 30-1000MHz)



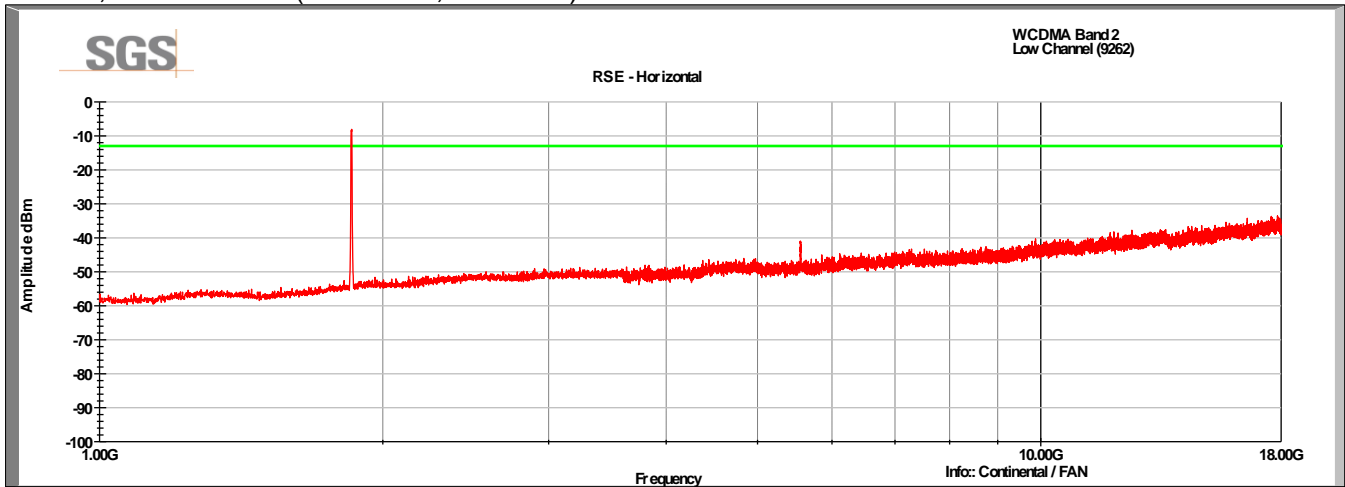
Band II, Low Channel (Horizontal, 30-1000MHz)



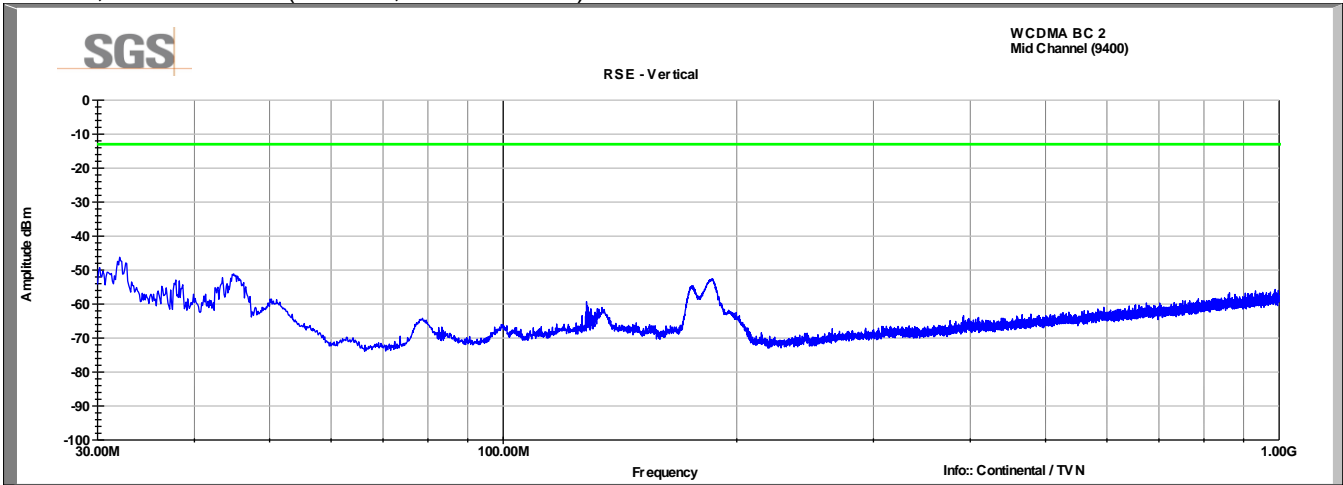
Band II, Low Channel (Vertical, 1-18GHz)



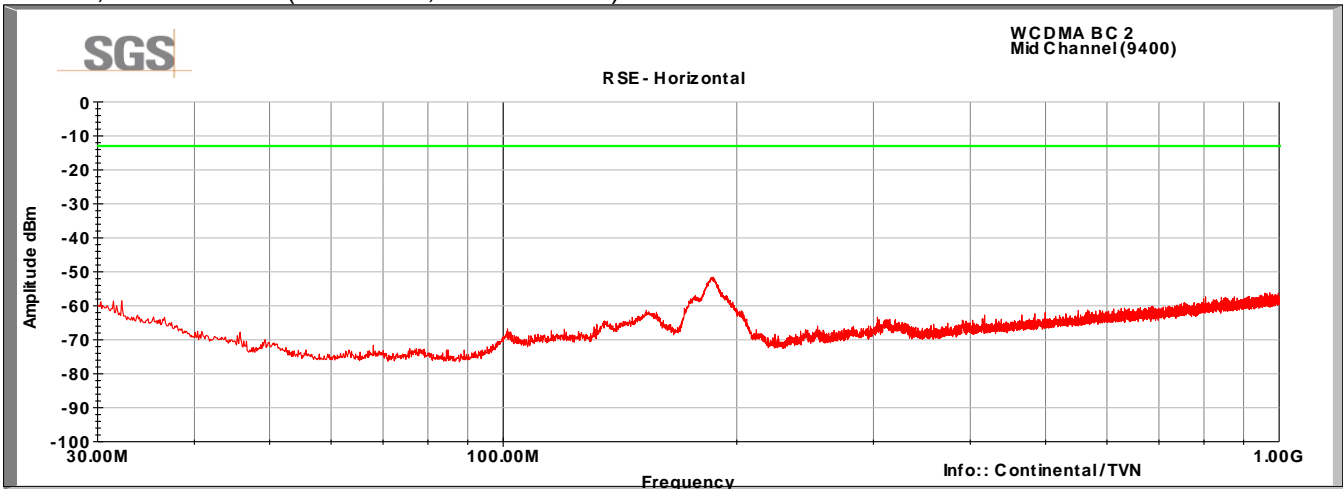
Band II, Low Channel (Horizontal, 1-18GHz)



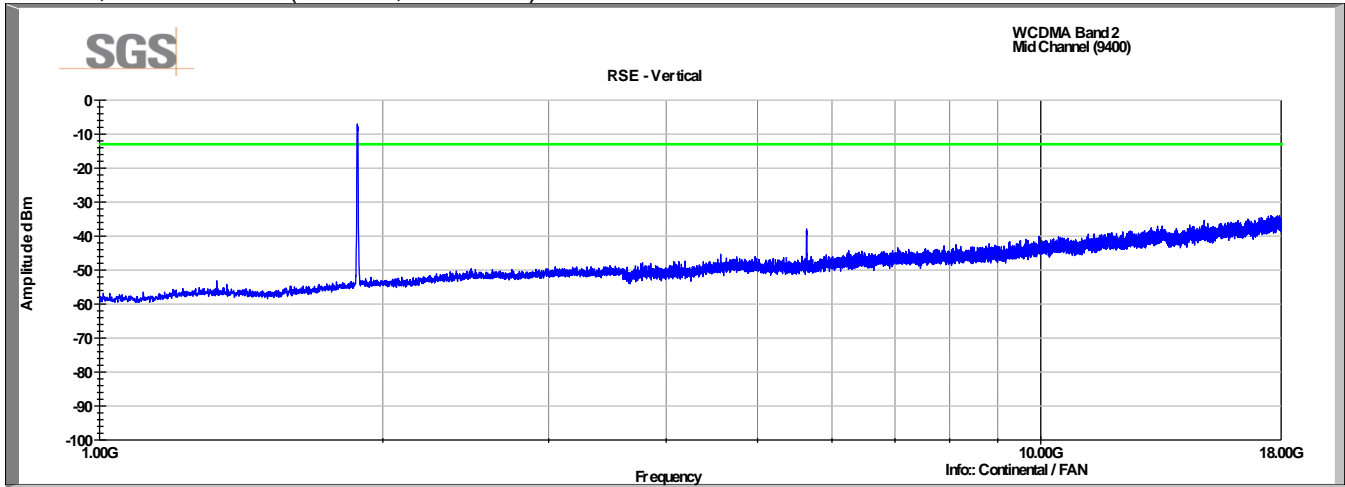
Band II, Mid Channel (Vertical, 30-1000MHz)



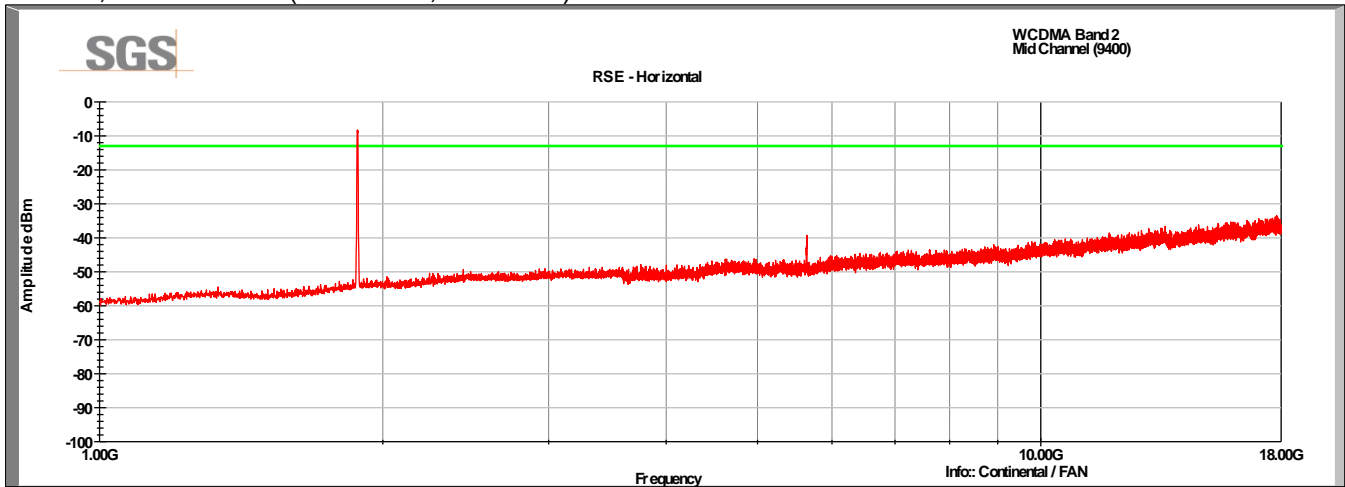
Band II, Mid Channel (Horizontal, 30-1000MHz)



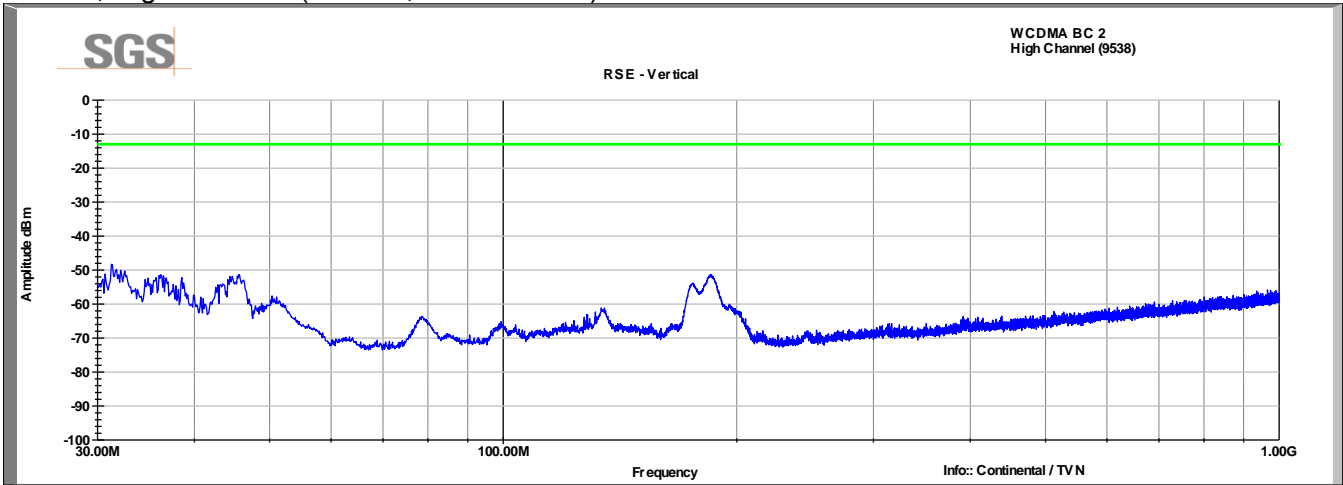
Band II, Mid Channel (Vertical, 1-18GHz)



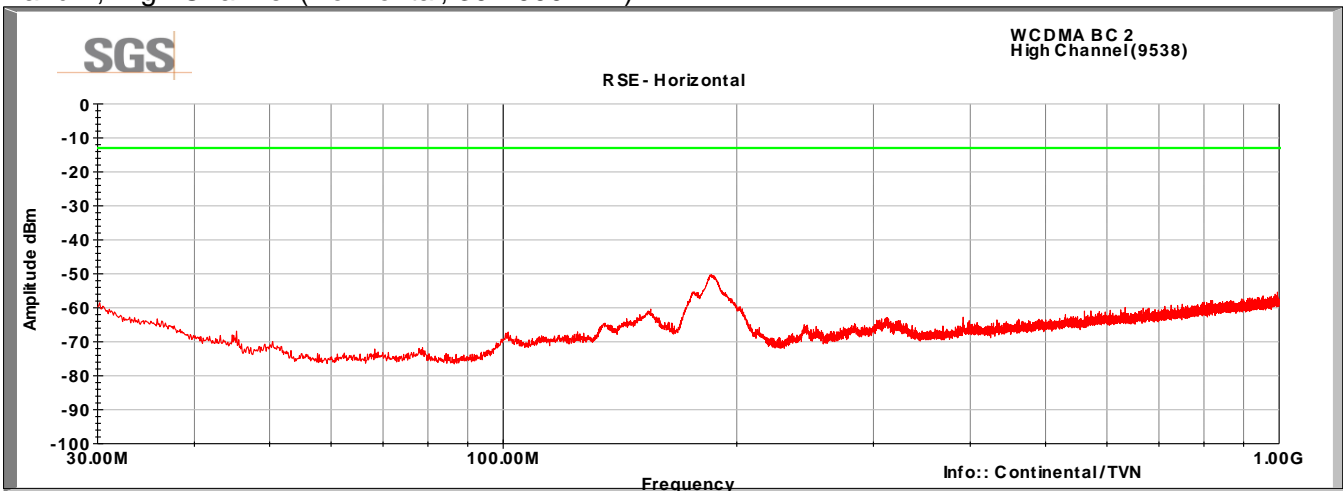
Band II, Mid Channel (Horizontal, 1-18GHz)



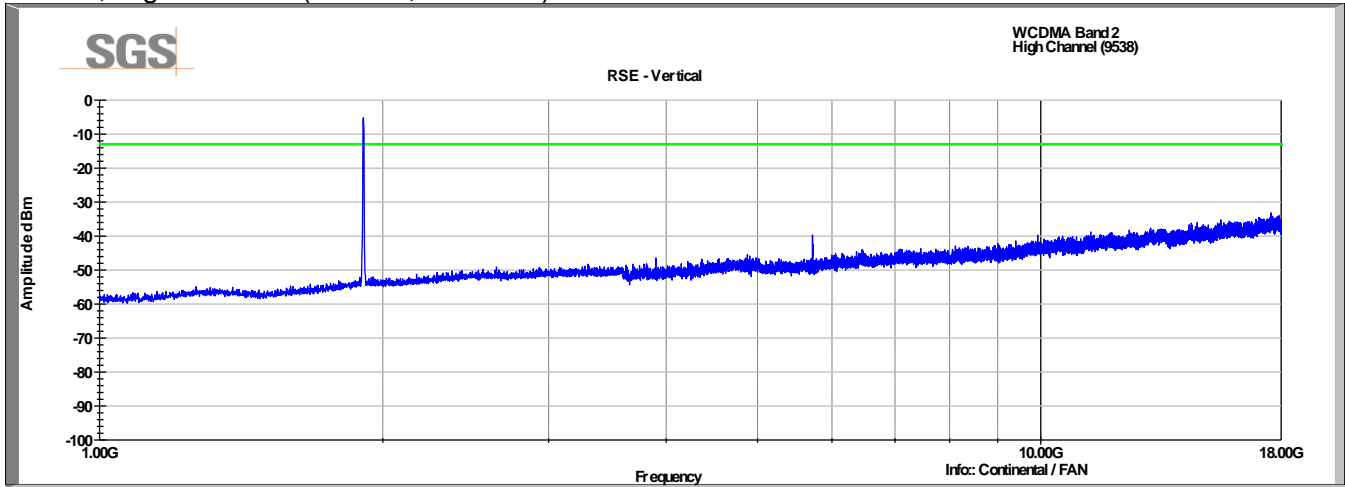
Band II, High Channel (Vertical, 30-1000MHz)



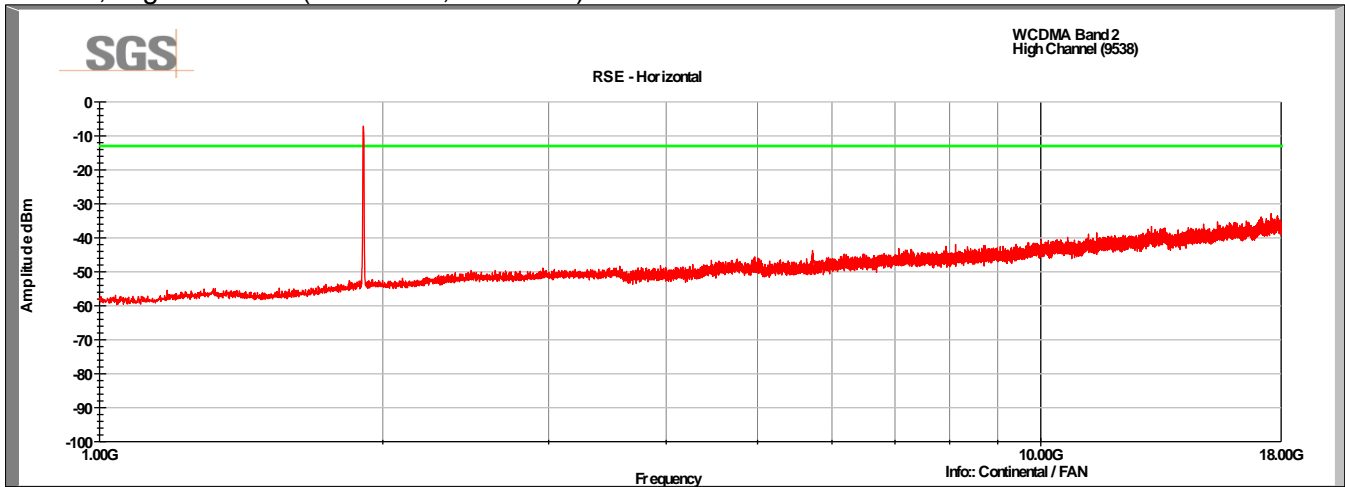
Band II, High Channel (Horizontal, 30-1000MHz)



Band II, High Channel (Vertical, 1-18GHz)



Band II, High Channel (Horizontal, 1-18GHz)



8 Frequency Stability

8.1 Test Result

Test Description	Basic Standards	Test Result
Frequency Stability	FCC Part 2.1055 FCC Part 22.917(a) FCC Part 24.238(a) RSS-GEN (6.11) RSS-132 5.3 RSS-132 6.3	Pass

8.2 Test Method

The EUT was placed inside the Environmental Chamber and was left inside chamber to stabilize to set temperature for minimum of thirty minutes before any measurements were made. The EUT was tested at BC0 channel 283 and BC1 channel 150.

8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

8.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
CMW500 WIDEBAND RADIO COMMUNICATIONS TESTER	CMW500	ROHDE & SCHWARZ	B094874	6-Dec-2015
ENVIRONMENTAL CHAMBER	T2RC	TENNEY	B094877	CNR
HANDHELD MULTIMETER	87V	FLUKE	B079676	4-Aug-2016

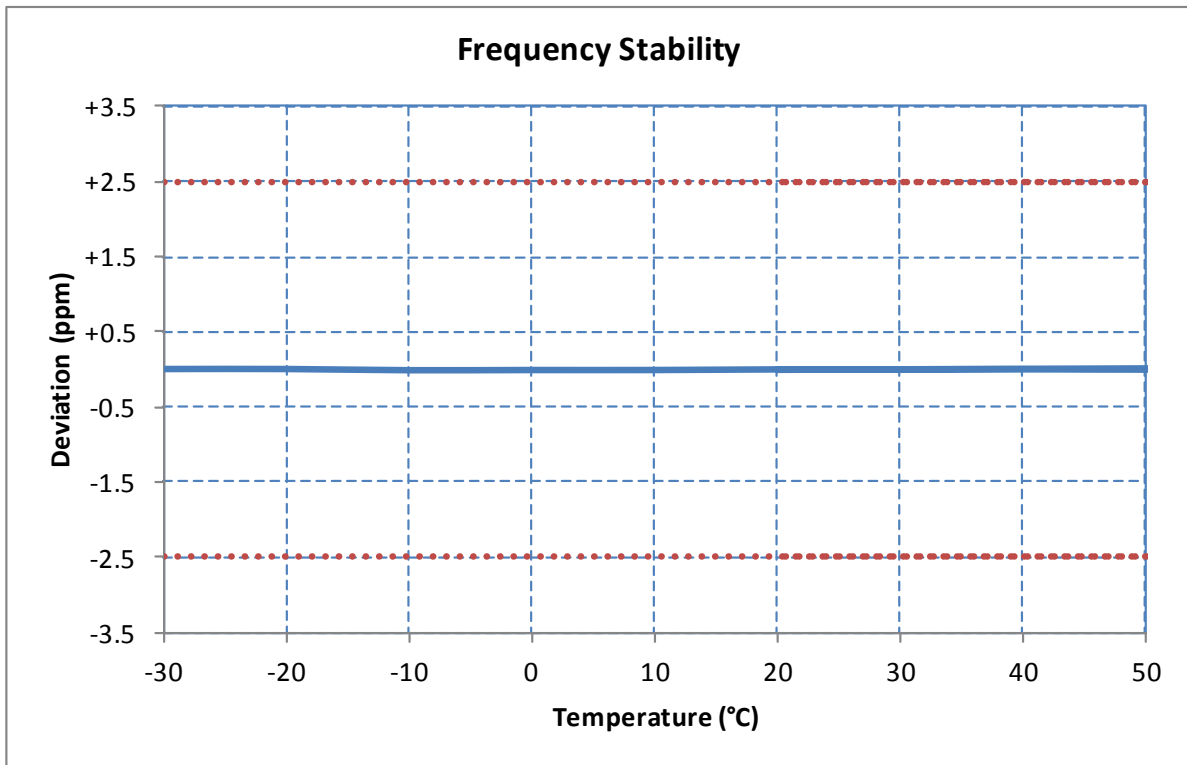
- Unless otherwise noted, equipment is on a 1 year calibration cycle.
- Based on manufacturer's specifications, the CMW-500 is on a 3 year calibration cycle.

8.5 Test Data

Test Date: 31 August 2015

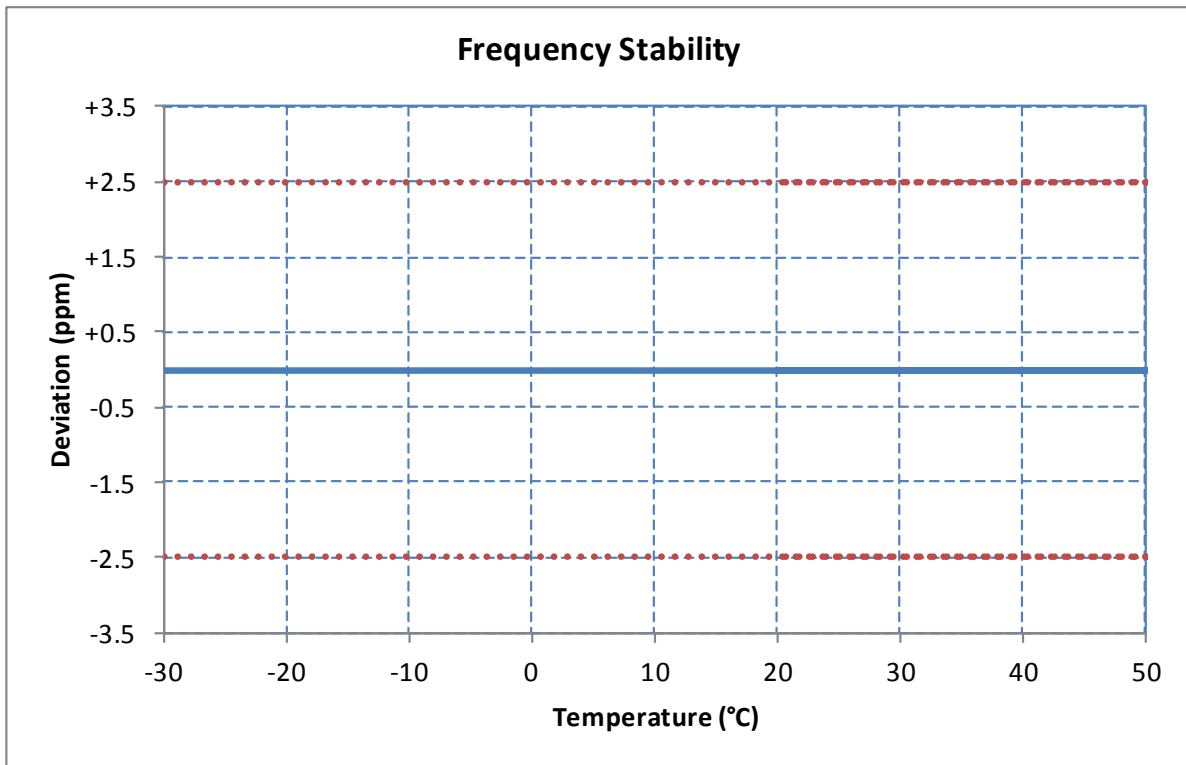
WCDMA, Band 5, Channel 4175 (835MHz)

Voltage %	Power V _{DC}	Temp °C	Frequency Hz	Freq Dev Hz	Freq Dev ppm	Deviation %
100%	12.00	+20 (Ref)	835,000,000	-0.3	-0.00	-0.000000
100%	12.00	-30	835,000,000	-0.1	-0.00	-0.000000
100%	12.00	-20	835,000,000	-0.1	-0.00	-0.000000
100%	12.00	-10	834,999,999	-0.7	-0.00	-0.000000
100%	12.00	0	834,999,999	-0.6	-0.00	-0.000000
100%	12.00	+10	834,999,999	-0.6	-0.00	-0.000000
100%	12.00	+20	835,000,000	-0.3	-0.00	-0.000000
100%	12.00	+30	835,000,000	-0.3	-0.00	-0.000000
100%	12.00	+40	835,000,000	-0.2	-0.00	-0.000000
100%	12.00	+50	835,000,000	-0.4	-0.00	-0.000000
100%	12.00	+55	835,000,000	+0.3	+0.00	+0.000000
115%	13.80	+20	835,000,000	-0.5	-0.00	-0.000000
85%	10.20	+20	835,000,000	-0.3	-0.00	-0.000000



WCDMA Band 2, Channel 9400 (1880MHz)

Voltage %	Power V _{DC}	Temp °C	Frequency Hz	Freq Dev Hz	Freq Dev ppm	Deviation %
100%	12.00	+20 (Ref)	1,879,999,994	-6.5	-0.00	-0.000000
100%	12.00	-30	1,879,999,993	-6.7	-0.00	-0.000000
100%	12.00	-20	1,879,999,994	-6.2	-0.00	-0.000000
100%	12.00	-10	1,879,999,993	-7.0	-0.00	-0.000000
100%	12.00	0	1,879,999,994	-6.5	-0.00	-0.000000
100%	12.00	+10	1,879,999,993	-6.9	-0.00	-0.000000
100%	12.00	+20	1,879,999,993	-7.1	-0.00	-0.000000
100%	12.00	+30	1,879,999,993	-7.1	-0.00	-0.000000
100%	12.00	+40	1,879,999,993	-7.0	-0.00	-0.000000
100%	12.00	+50	1,879,999,993	-6.8	-0.00	-0.000000
100%	12.00	+55	1,879,999,993	-6.8	-0.00	-0.000000
115%	13.80	+20	1,879,999,994	-6.5	-0.00	-0.000000
85%	10.20	+20	1,879,999,993	-6.6	-0.00	-0.000000



9 Peak to Average Ratio

9.1 Test Result

Test Description	Basic Standards	Test Result
Peak to Average Ratio	FCC Part 24.232(d) RSS-132 5.4 RSS-133 6.4	Pass

9.2 Test Method

KDB document 971168 D01 Power Meas License Digital Systems v02r01 was used to determine peak-to-average ratio. For the WCDMA measurement, Clause 5.7.1 was used which defined the measurement method using the CCDF function of the spectrum analyzer.

9.3 Test Site

SGS EMC Laboratory, Suwanee, GA

9.4 Test Equipment

Test Date: 22 Sept 2015

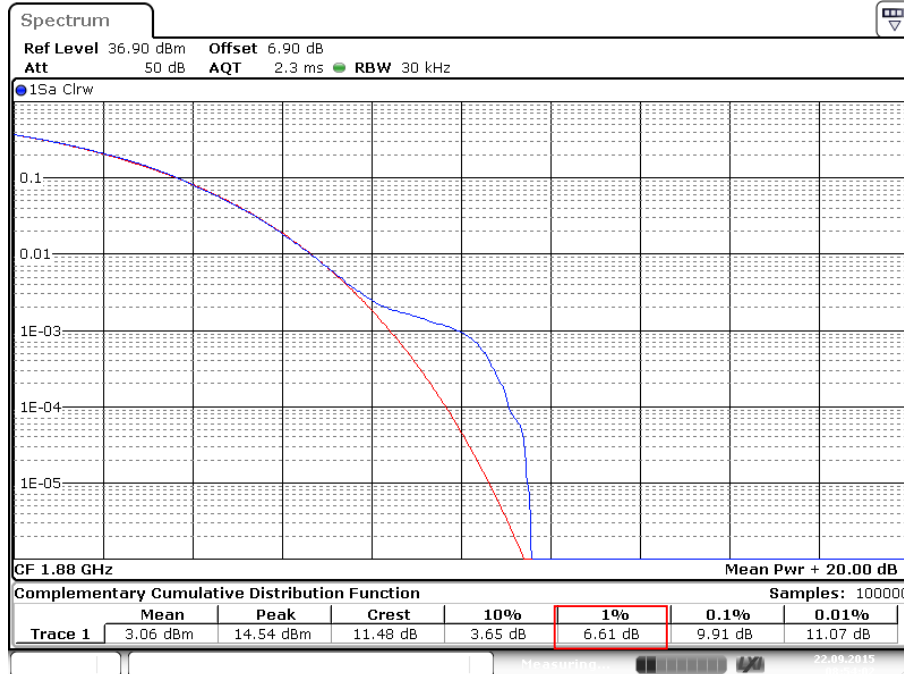
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
CMW500 WIDEBAND RADIO COMMUNICATIONS TESTER	CMW500	ROHDE & SCHWARZ	B094874	6-Dec-2015
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	28-Aug-2015
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	B101743	5-Aug-2016
COAXIAL CABLE	1134	GORE	B094785	4-Aug-2016

- Unless otherwise noted, equipment is on a 1 year calibration cycle.
- Based on manufacturer's specifications, the CMW-500 is on a 3 year calibration cycle.

9.5 Test Data

Test Date: 22 Sept 2015

WCDMA Band II



Date: 22.SEP.2015 08:54:03

10 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	23 September 2015
	-	