Report on the Radio Testing

For

Widex A/S

on

TV Controller II

Report no. TRA-031974-47-01C

7th September 2016

Element Materials Technology Warwick Ltd.
Registered in England and Wales. Registered Office: 5 Fleet Place, London, EC4M 7RD
Company Reg No. 02536659

Report Number: TRA-031974-47-01C
Issue: C

REPORT ON THE RADIO TESTING OF A
Widex A/S
TV-DEX (TV-Controller II)
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247 & IC RSS-247

TEST DATE: 25-29th July 2016

Written by: S Hodgkinson

S Hodgkinson
Radio Test Engineer

Approved by: John Charters

Digitally signed by John Charters
DN: cn=John Charters, o=Element Materials Technology, ou, email=john.charters@element.com, c=GB
Date: 2016.09.09 14:38:06 +01'00'

J Charters
Department Manager - Radio

Date: 7th September 2016

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1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	23rd August 2016	Original
B	24th August 2016	Added model number to Name (TV-Controller II)
C	7th September 2016	Update typos

2 Summary

TEST REPORT NUMBER:	TRA-031974-47-01C
WORKS ORDER NUMBER	TRA-031974-00
PURPOSE OF TEST:	USA: Testing of radio frequency equipment per the relevant authorization procedure of chapter 47 of CFR (code of federal regulations) Part 2, subpart J. Canada: Testing of radio apparatus for TAC (technical acceptance certificate) per subsections 4(2) of the Radiocommunication Act and 21(1) of the Radiocommunication Regulations.
TEST SPECIFICATION(S):	47CFR15.247 & RSS-247
EQUIPMENT UNDER TEST (EUT):	TV-DEX (TV-Controller II)
FCC IDENTIFIER:	TTY-TVC2
IC IDENTIFIER	5676B-TVC2
EUT SERIAL NUMBER:	138235 118826
MANUFACTURER/AGENT:	Widex A/S
ADDRESS:	Nymoellevej 6 3540 Lynge Denmark
CLIENT CONTACT:	Hans-Otto Bindeballe ☎ +45 44355916 ✉ hob@widex.com
TEST DATE:	25-29th July 2016
TESTED BY:	S Hodgkinson Element

2.1 Test Summary

Test Method and Description		*Requirement Clause*		*Applicable to this equipment*	*Result / Note*
		RSS	*47CFR15*		
Radiated spurious emissions (restricted bands of operation and cabinet radiation)		Gen, 8.10	15.205	☒	*Pass*
AC power line conducted emissions		Gen, 8.8	15.207	☐	
Occupied bandwidth		247, 5.2 (1)	15.247(a)(2)	☒	*Pass*
Conducted carrier power	Peak	247, 5.4 (4)	15.247(b)(3)	☒	*Pass*
	Max.			☐	
Conducted / radiated RF power out-of-band		247, 5.5	15.247(d)	☒	*Pass*
Power spectral density, conducted		247, 5.2 (2)	15.247(e)	☒	*Pass*
Calculation of duty correction		-	15.35(c)	☐	

Notes:

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

3 Contents

4 Introduction

This report TRA-031974-47-01C presents the results of the Radio testing on a Widex A/S, TV-DEX (TV-Controller II)Controller II to specification 47CFR15 Radio Frequency Devices and RSS-247 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

The testing was carried out for Widex A/S by Element, at the address(es) detailed below.

☐ Element Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK

☒ Element Skelmersdale
Unit 1
Pendle Place
Skemersdale
West Lancashire
WN8 9PN
UK

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:
Element is accredited for the above sites under the US-EU MRA, Designation number UK0009.

IC Registration Number(s):

Element Hull	3483A
Element North West	3930B-4

The test site requirements of ANSI C63.4-2014 are met up to 1GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

5 Test Specifications

5.1 Normative References

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ANSI C63.4-2014 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- Industry Canada RSS-247, Issue 1, May 2015 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- Industry Canada RSS-Gen, Issue 4, November 2014 – General Requirements for Compliance of Radio Apparatus

5.2 Deviations from Test Standards

There were no deviations from the test standard.

6 Glossary of Terms

§	denotes a section reference from the standard, not this document
AC	Alternating Current
ANSI	American National Standards Institute
BW	bandwidth
C	Celsius
CFR	Code of Federal Regulations
CW	Continuous Wave
dB	decibel
dBm	dB relative to 1 milliwatt
DC	Direct Current
DSSS	Direct Sequence Spread Spectrum
EIRP	Equivalent Isotropically Radiated Power
ERP	Effective Radiated Power
EUT	Equipment Under Test
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
Hz	hertz
IC	Industry Canada
ITU	International Telecommunication Union
LBT	Listen Before Talk
m	metre
max	maximum
MIMO	Multiple Input and Multiple Output
min	minimum
MRA	Mutual Recognition Agreement
N/A	Not Applicable
PCB	Printed Circuit Board
PDF	Portable Document Format
Pt-mpt	Point-to-multipoint
Pt-pt	Point-to-point
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	receiver
s	second
SVSWR	Site Voltage Standing Wave Ratio
Tx	transmitter
UKAS	United Kingdom Accreditation Service
V	volt
W	watt
Ω	ohm

7 Equipment Under Test

7.1 EUT Identification

- Name: TV-DEX (TV-Controller II)
- Model Number / Type: TV-Controller II
- Serial Number: 118826
- Hardware: build 21062016Ver010019
- Software Revision: V01.00.1921.06.16GCC

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

Not Applicable – No support/monitoring equipment required.

7.2 EUT Mode of Operation

7.2.1 Transmission

The mode of operation for Tx tests was as follows…
The test frequency was controlled via button presses on the TV remote control

7.3 EUT Radio Parameters

7.3.1 General

Frequency of operation:	2.4GHz- 2.4835GHz
Modulation type(s):	GFSK
Occupied channel bandwidth(s):	777.243/833.333/929.487
ITU emission designator(s):	2M00D1DXT
Declared output power(s):	0dBm
Nominal Supply Voltage:	4.0Vdc
Duty cycle:	64%

7.3.2 Antennas

Type:	Integral
Gain:	0dBi

7.3.3 Product specific declarations

7.4 EUT Description

The device is a remote control for a TV or Audio system in conjunction with a hearing aid. the remote control makes use of two radios, 2.4GHz and 10.6MHz.

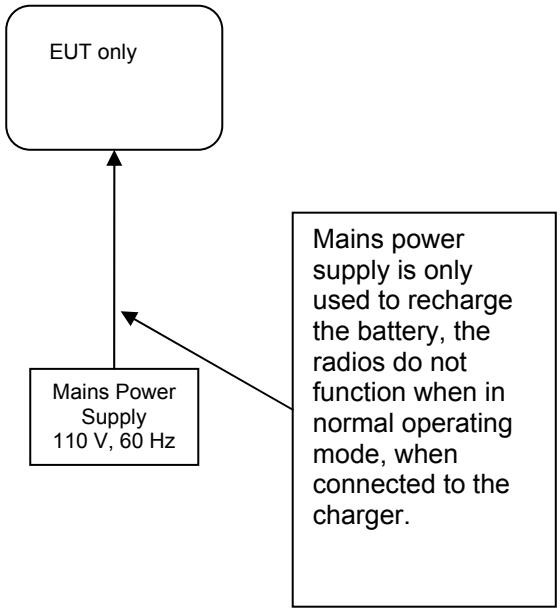
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

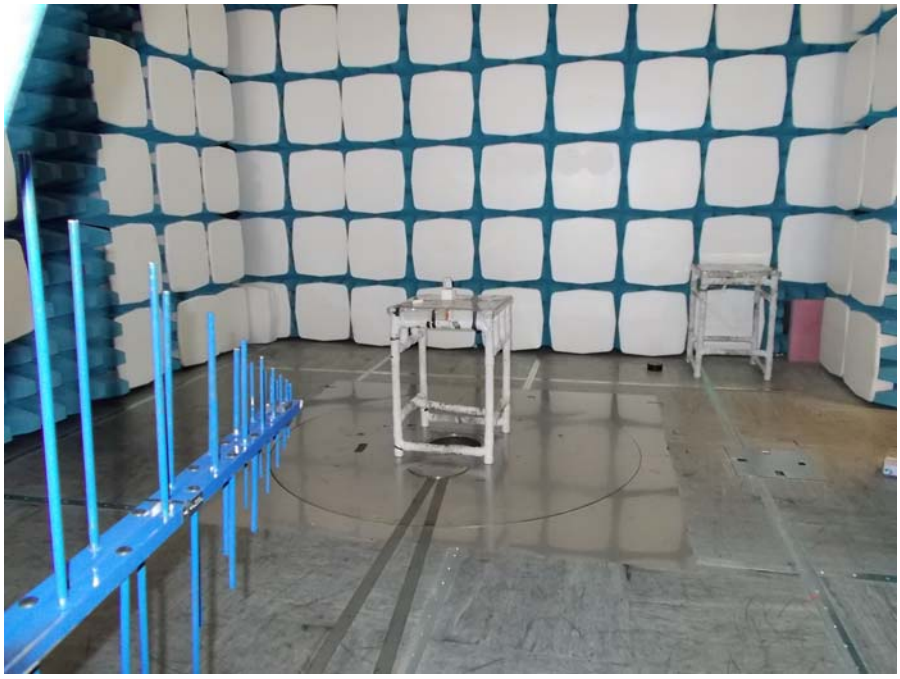
9.1 Block Diagram

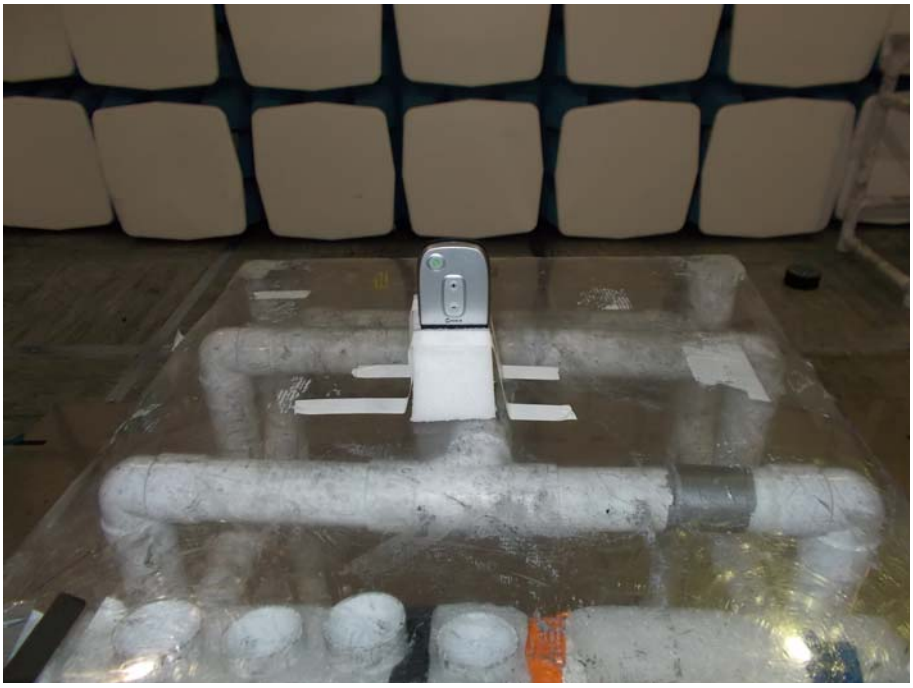
The following diagram shows basic EUT interconnections with cable type and cable lengths identified:



9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:





10 General Technical Parameters

10.1 Normal Conditions

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was approx. from batteries.

10.2 Varying Test Conditions

There are no specific frequency stability requirements for the type of device. The results contained in this report demonstrate that the occupied bandwidth is contained within the authorised band and the manufacturer has declared sufficient frequency stability (refer to section 7.4).

Variation of supply voltage is required to ensure stability of the declared output power. During carrier power testing the following variations were made:

	Category	***Nominal***	***Variation***
☐	Mains	110 V ac +/-2 %	85 % and 115 %
☒	Battery	New battery	N/A

11 Radiated emissions

11.1 Definitions

Spurious emissions
Emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Restricted bands
A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	Low / Mid / High
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak Above 1 GHz: RMS average and Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 4.0 V dc	From batteries (as declared)

11.3 Test Limit

Unwanted emissions that fall within the restricted frequency bands shall comply with the limits specified:

General Field Strength Limits for License-Exempt Transmitters at Frequencies above 30 MHz

Frequency (MHz)	***Field Strength (µV/m at 3 m)***
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

11.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBµV/m at the regulatory distance, using:

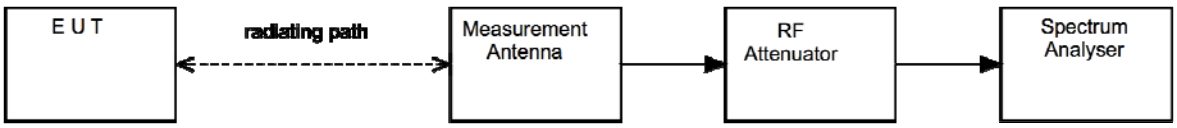
$$FS = PR + CL + AF – PA + DC – CF$$

Where,

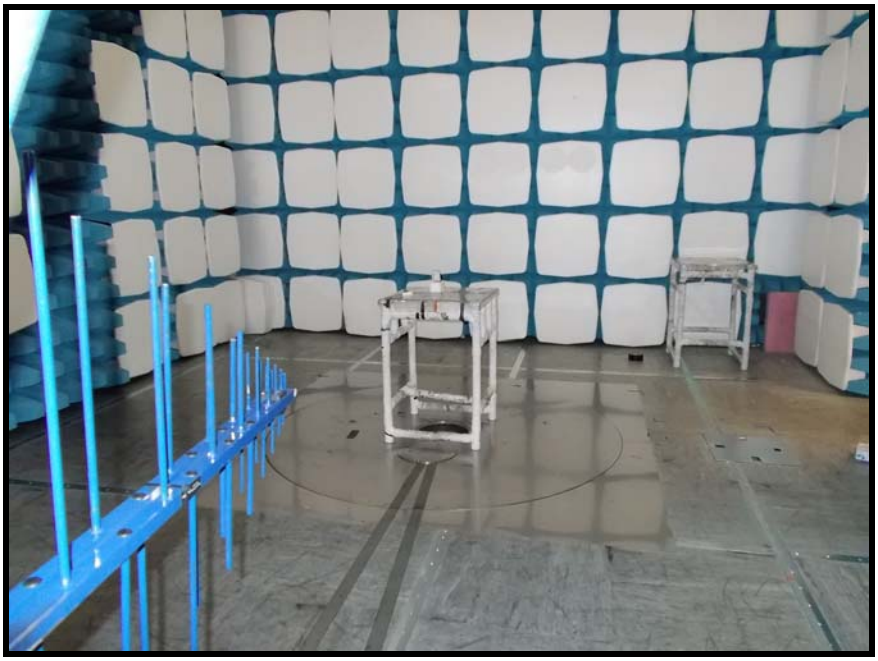
PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor in dB (where measurement distance different to limit distance);

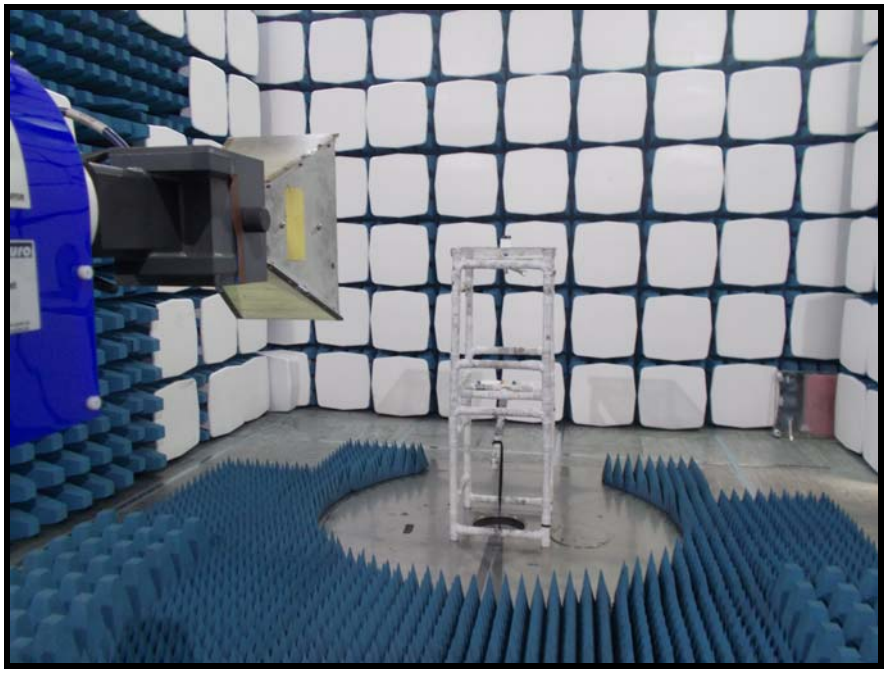
This field strength value is then compared with the regulatory limit.

Figure i Test Setup



11.5 Test Set-up Photograph



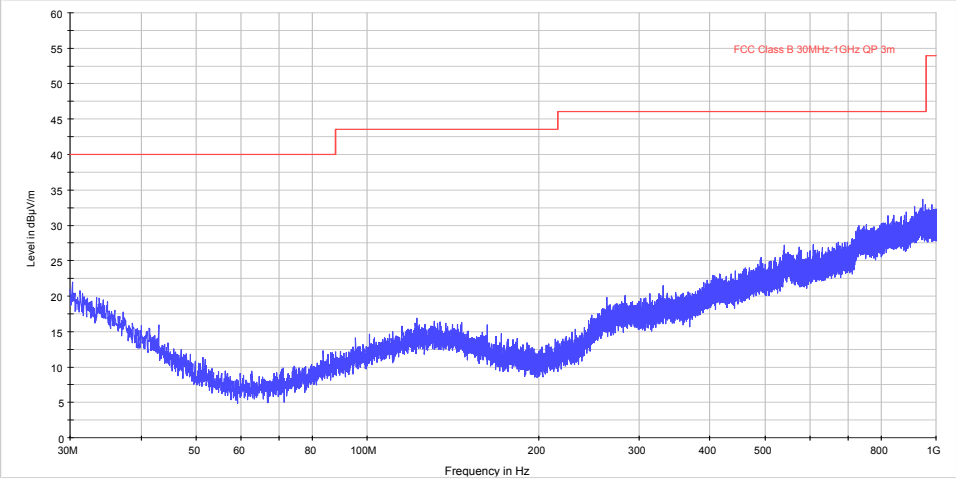


11.6 Test Equipment

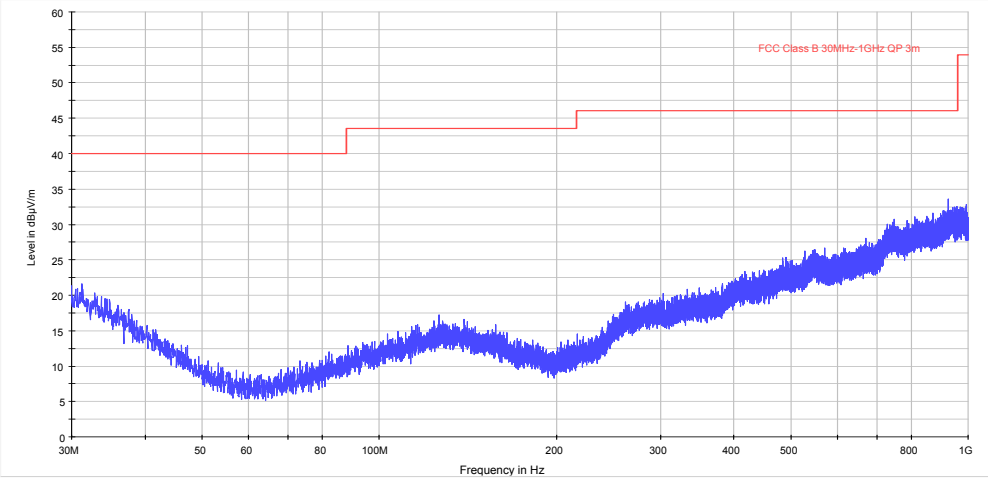
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
CBL611/A	Chase	Bilog	U191	26/02/2017
Radio Chamber - PP	Rainford EMC	ATS	REF940	08/09/2016
3115	EMCO	1-18GHz Horn	L139	25/09/2017
SH4141	BSC	High Pass Filter	REF977	25/02/2017
ESVS10	R&S	Receiver	U004	25/05/2017
FSU50	R&S	Spectrum Analyser	U544	16/03/2017
20240-20	Flann	Horn 18-26GHz (&U330)	L300	07/04/2018

11.7 Test Results

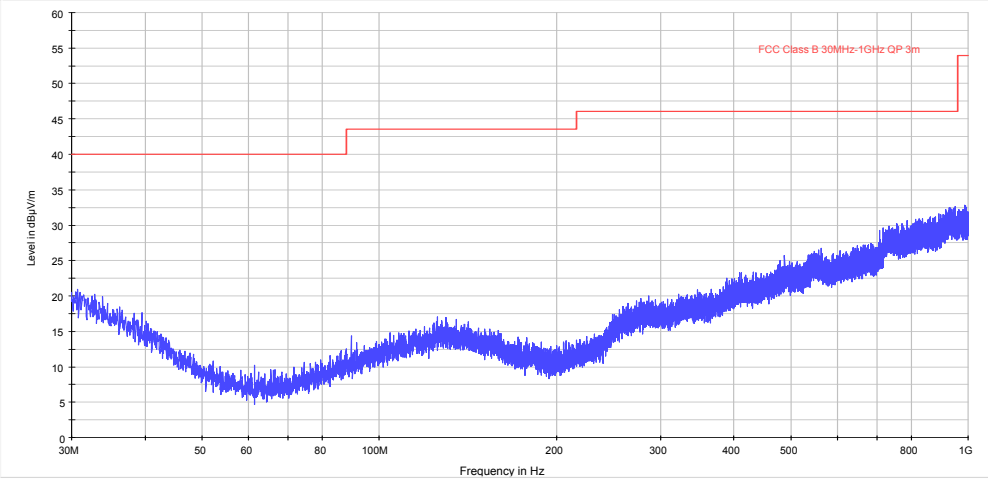
Tx bottom channel 30MHz – 1GHz



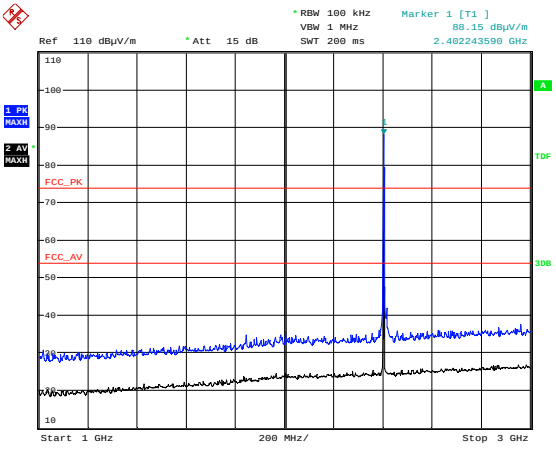
Tx Middle channel 30MHz – 1GHz



Tx Top channel 30MHz – 1GHz



Bottom Tx 1-3GHz



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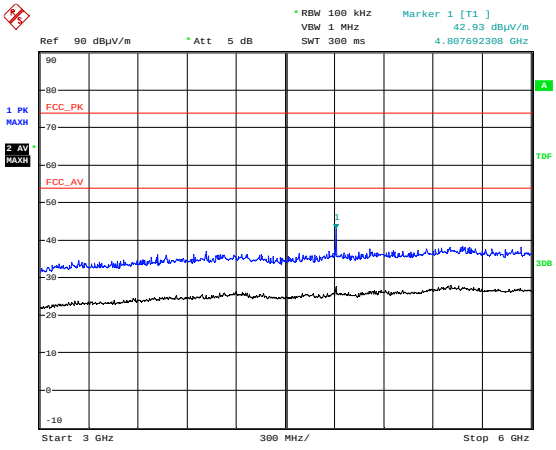
Bottom Tx 3-6GHz



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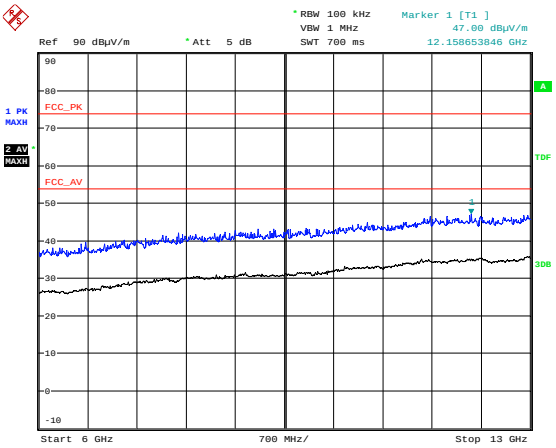
Bottom Tx 6-13GHz



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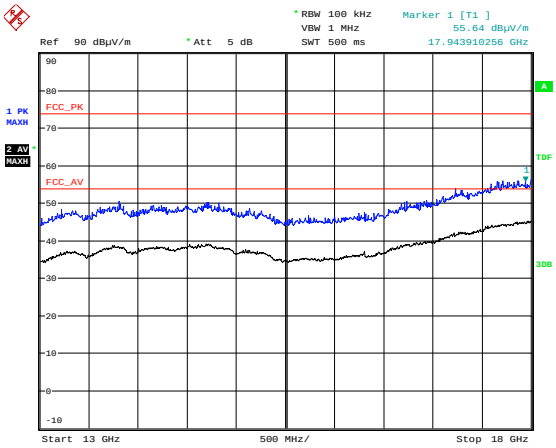
Bottom Tx 13-18GHz



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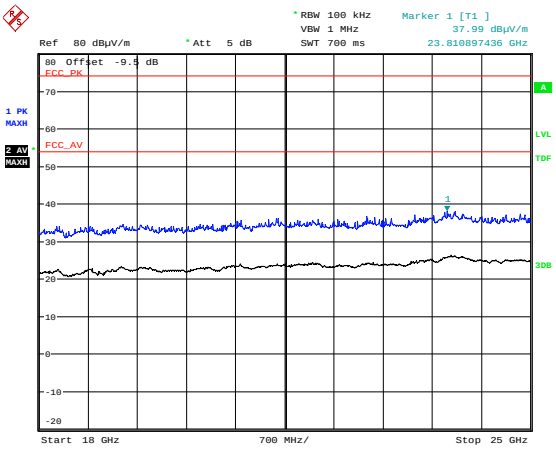
Bottom Tx 18-25GHz



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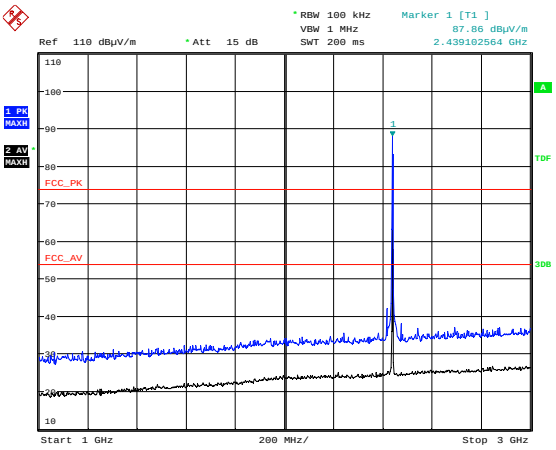
Middle Tx 1-3GHz



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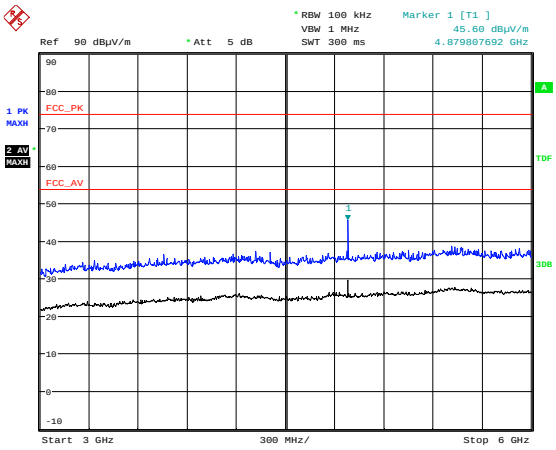
Middle Tx 3-6GHz



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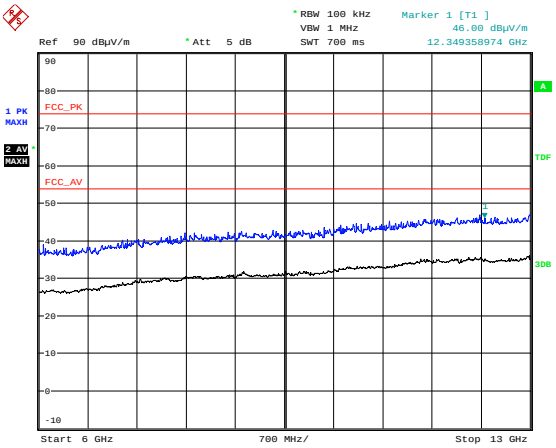
Middle Tx 6-13GHz



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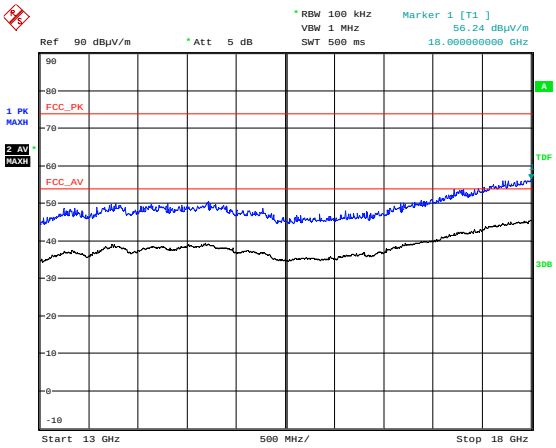
Middle Tx 13-18GHz



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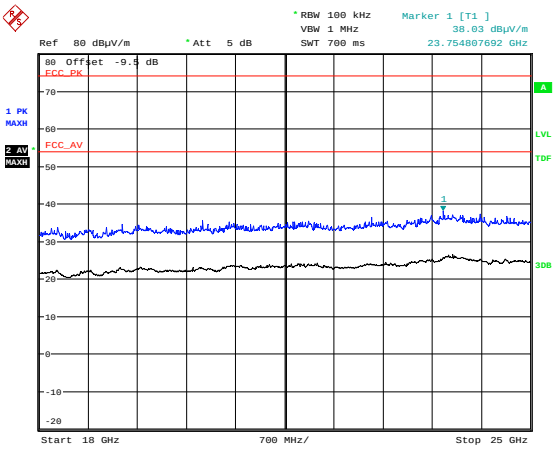
Middle Tx 18-25GHz



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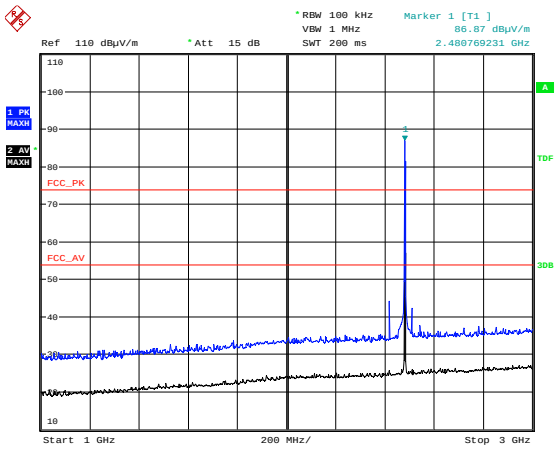
Top Tx 1-3GHz



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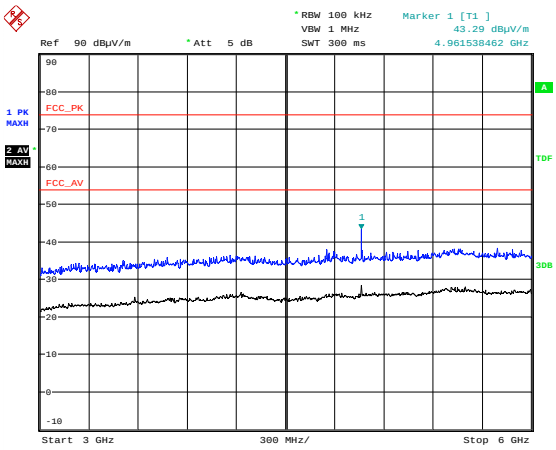
Top Tx 3-6GHz



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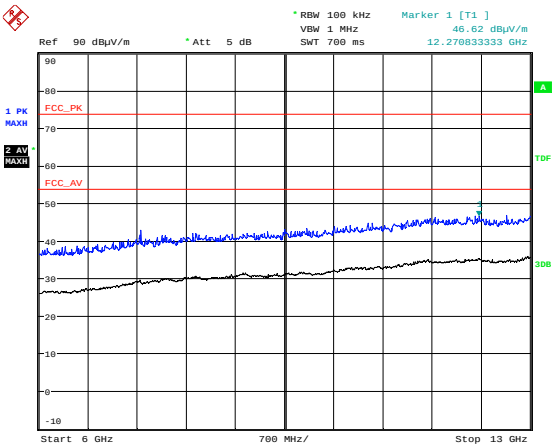
Top Tx 6-13GHz



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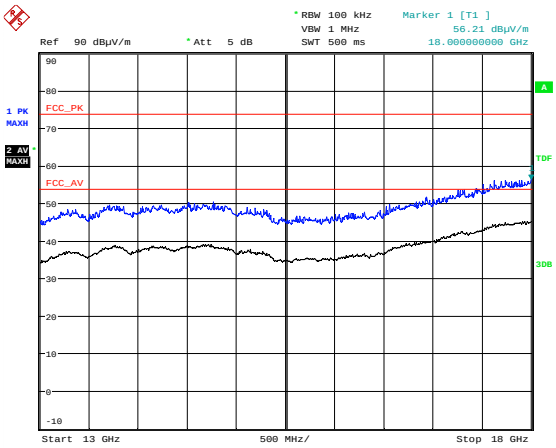
Top Tx 13-18GHz



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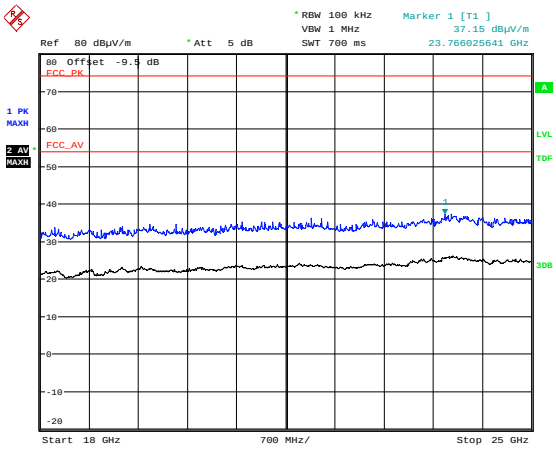
Top Tx 18-25GHz



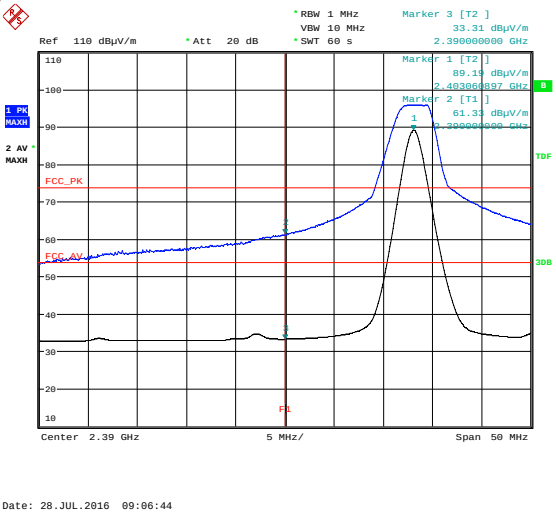
Date: 2.AUG.2016 09:37:03

High Power; Channel: low										
Detector	**Freq. (MHz)**	**Meas'd Emission (dBµV)**	**Cable Loss (dB)**	**Antenna Factor (dB/m)**	**Pre-amp Gain (dB)**	**Duty Cycle Corr'n (dB)**	**Distance Extrap'n Factor (dB)**	**Field Strength (dBµV/m)**	**Field Strength (µV/m)**	**Limit (µV/m)**
Pk	4806.13	56.63	4.2	33.1	35.2	-	-	58.71	862.	5011
Av	4806.13	45.36	4.2	33.1	35.2	-	-	47.44	235.5	500

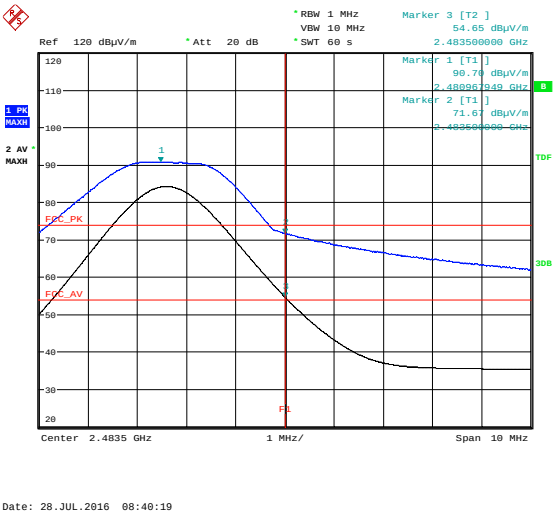
High Power; Channel: mid										
Detector	**Freq. (MHz)**	**Meas'd Emission (dBµV)**	**Cable Loss (dB)**	**Antenna Factor (dB/m)**	**Pre-amp Gain (dB)**	**Duty Cycle Corr'n (dB)**	**Distance Extrap'n Factor (dB)**	**Field Strength (dBµV/m)**	**Field Strength (µV/m)**	**Limit (µV/m)**
Pk	4878.13	54.97	4.2	33.3	35.2	-	-	57.27	730.3	5011
Av	4878.13	43.86	4.2	33.3	35.2	-	-	46.16	203.2	500

High Power; Channel: high										
Detector	**Freq. (MHz)**	**Meas'd Emission (dBµV)**	**Cable Loss (dB)**	**Antenna Factor (dB/m)**	**Pre-amp Gain (dB)**	**Duty Cycle Corr'n (dB)**	**Distance Extrap'n Factor (dB)**	**Field Strength (dBµV/m)**	**Field Strength (µV/m)**	**Limit (µV/m)**
Pk	4962.13	55.73	4.2	33.5	35.2	-	-	58.25	817.5	5011
Av	4962.13	44.49	4.2	33.5	35.2	-	-	47.01	224.1	500

Lower radiated Bandedge

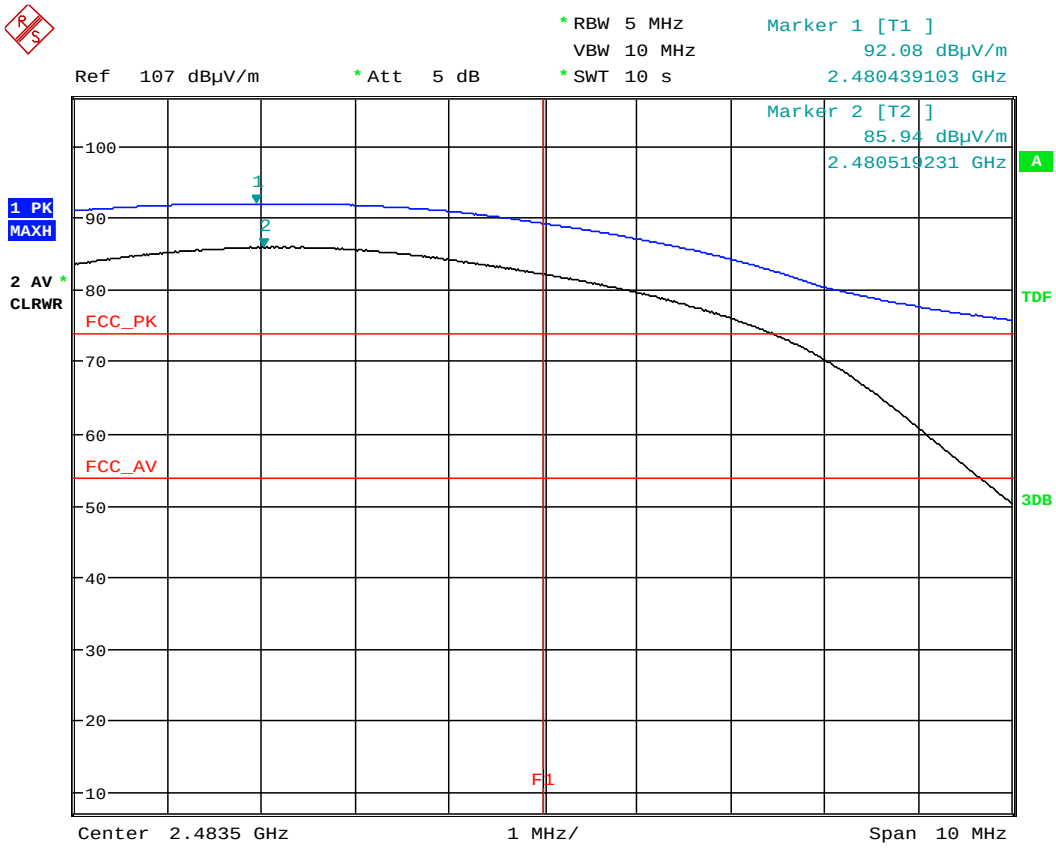


Upper radiated bandedge



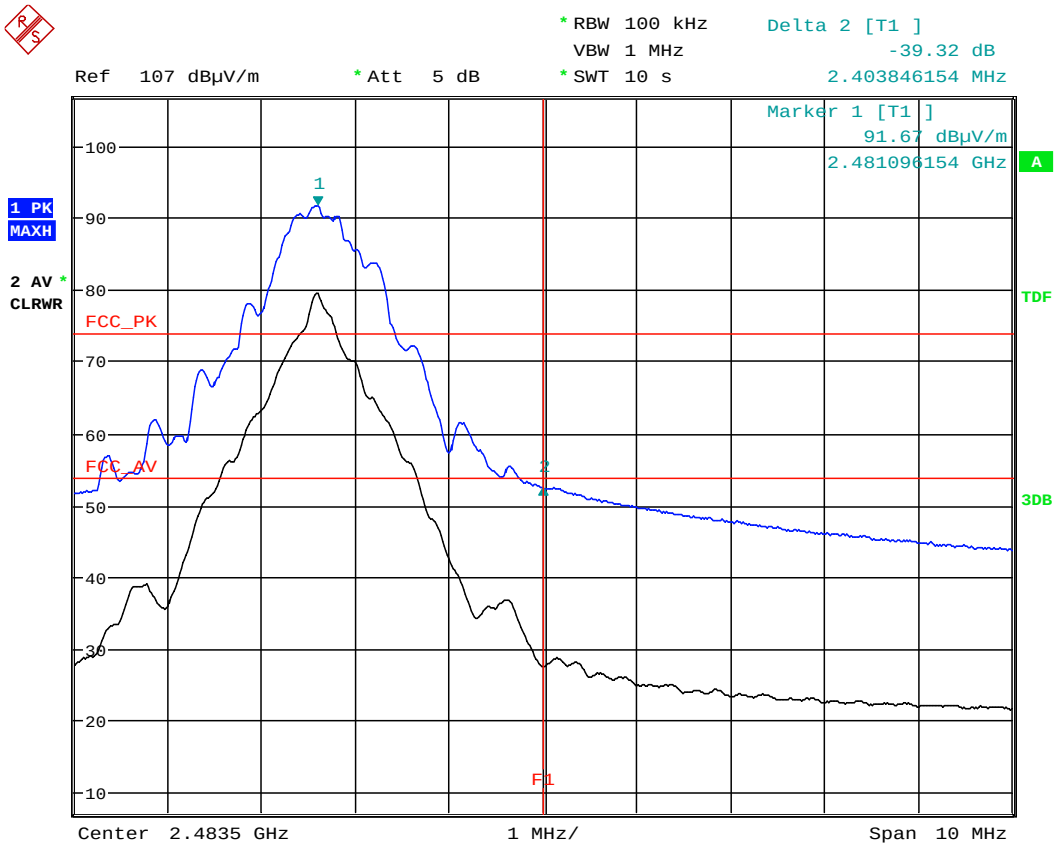
As can be seen on the above plot using a 1MHz RBW, the bandage plots shows the Average Value to be over the limit.
Therefore delta Mkr method used to show compliance with the limits

FCC Bandedge Delta Mkr method
5MHz RBW Ref level



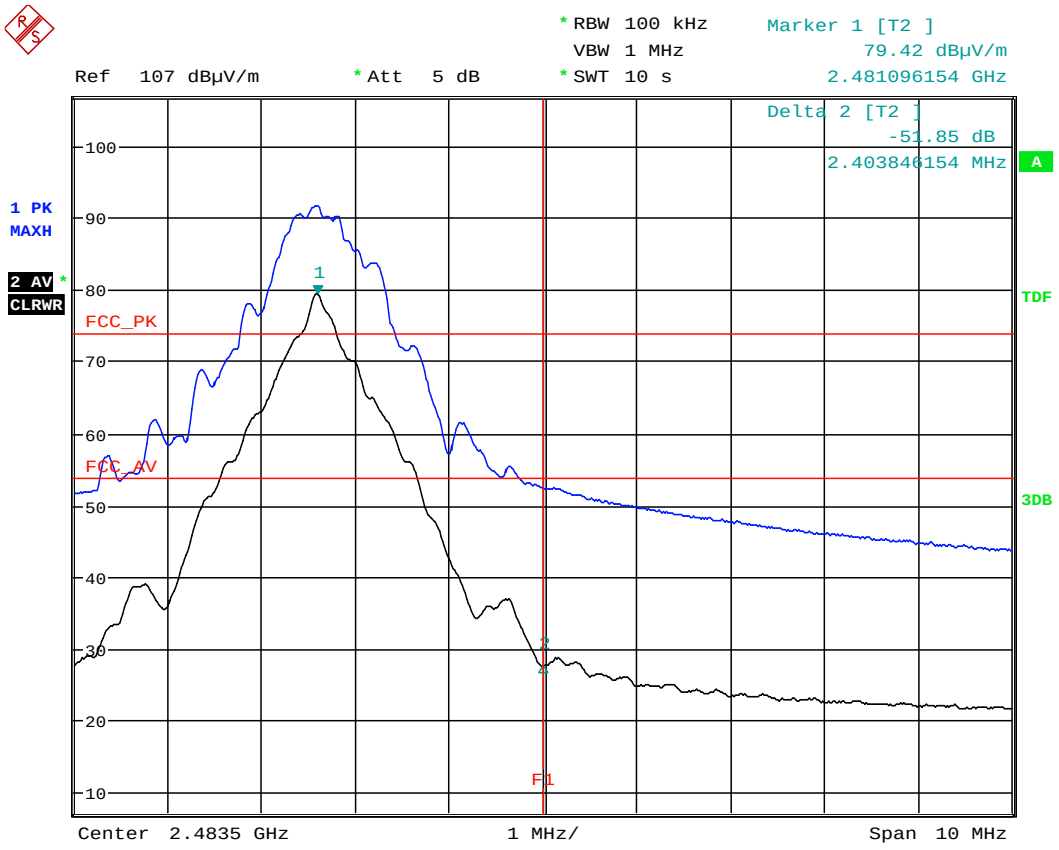
Date: 29.JUL.2016 13:23:18

Pk Levels 100kHz RBW



Date: 29.JUL.2016 13:22:00

▲ Average Levels 100kHz



Date: 29.JUL.2016 13:17:08

Bandedge result

Pk Max level = 92.08dBµV/m

Av Max level = 85.98dBµV/m

Pk ▲ = 39.32dBc

Therefore 92.08dBµV/m - 39.32dBc = 52.76dBµV/m = Pass

Av ▲ = 51.85dBc

Therefore 85.98dBµV/m – 51.85dBc = 34.13dBµV/m = Pass

12 Occupied Bandwidth

12.1 Definition

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	IC: ANSI C63.10-2013, Clause 6.9 FCC: ANSI C63.10-2013, Clause 11.8
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths(kHz)	777.243/833.333/929.487
EUT Test Modulations:	GFSK
Deviations From Standard:	None
Measurement BW: requirement: 100 kHz)	100kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300kHz
Measurement Span:	5MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 26 °C	+15 ºC to +35 ºC (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 4.0 V dc	From batteries (as declared)

12.3 Test Limit

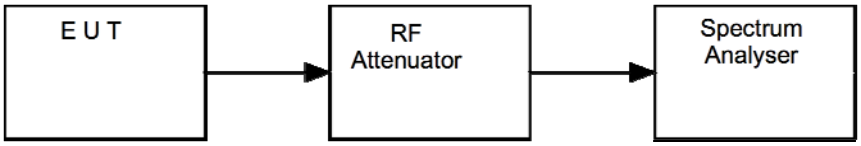
The minimum -6 dB bandwidth shall be at least 500 kHz.

12.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iii, the bandwidth of the EUT was measured on a spectrum analyser.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Figure iii Test Setup

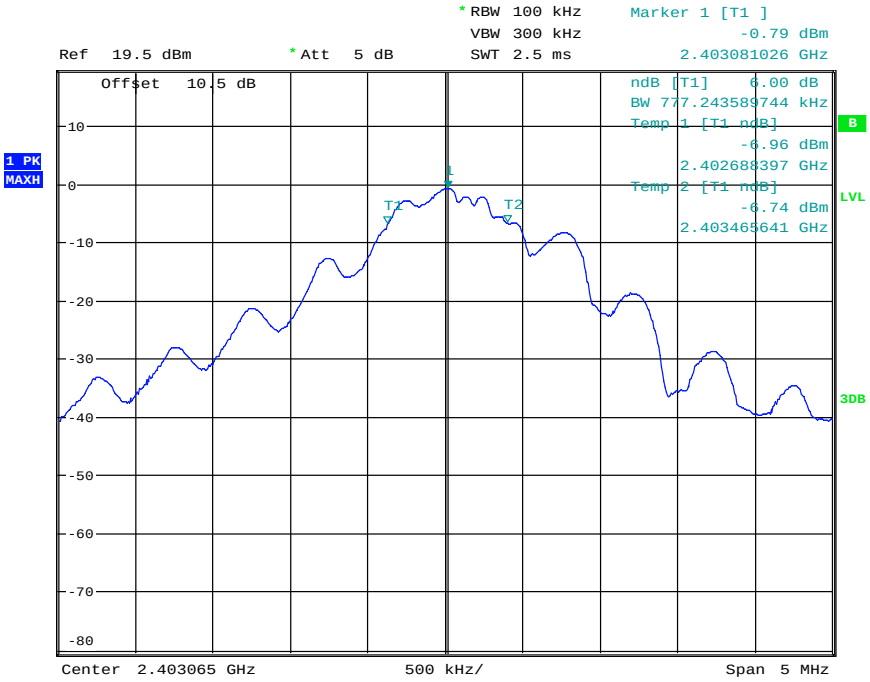


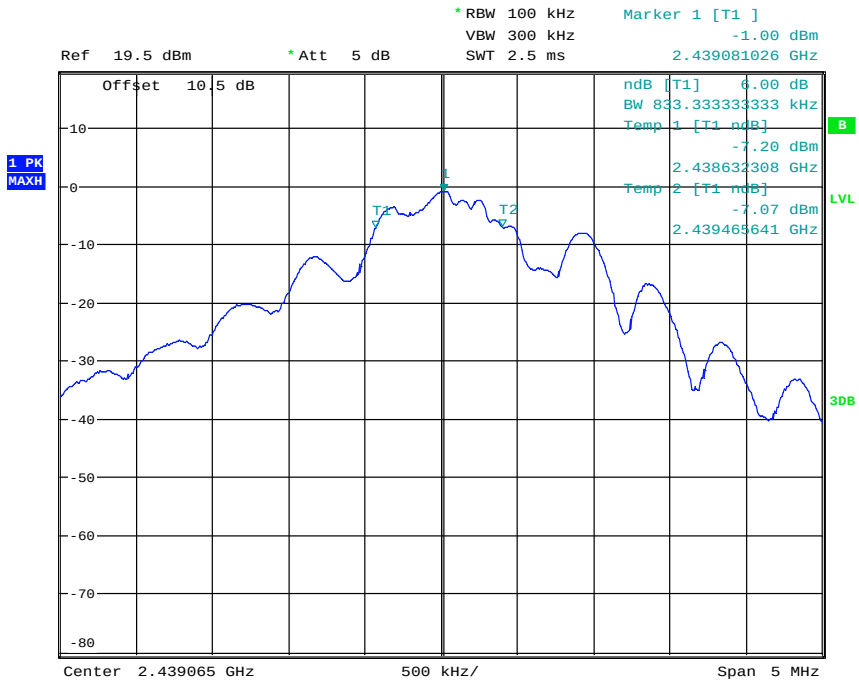
12.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU	R&S	Spectrum Analyser	UH405	02/06/2017

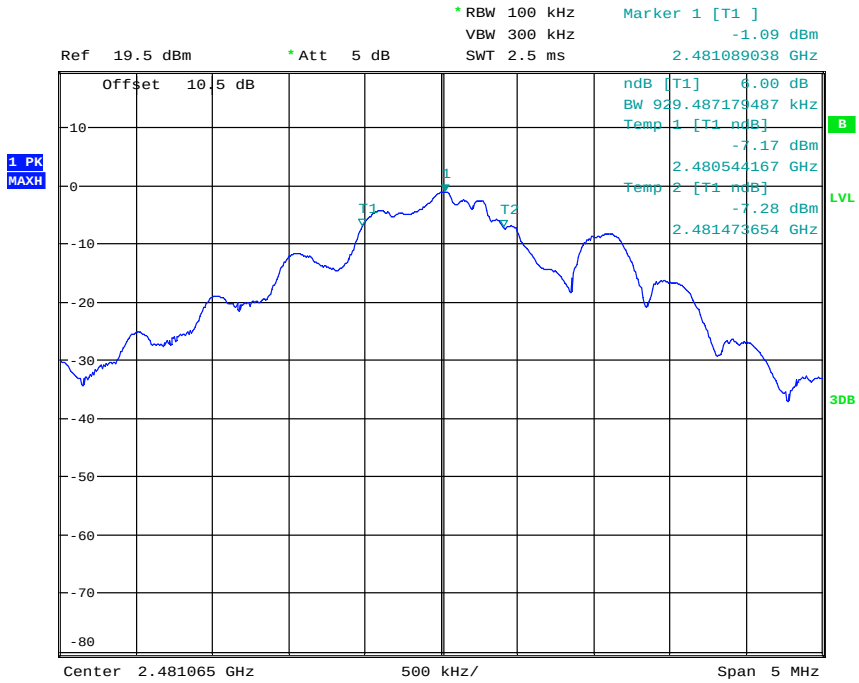
12.6 Test Results

RSS-247 FCC 15.247. Max power				
Channel Frequency (MHz)	**F_L (MHz)**	**F_H (MHz)**	**6dB Bandwidth (kHz)**	**Result**
2403.065	2402.688397	2403.465641	777.243	PASS
2439.065	2438.632308	2439.465641	833.333	PASS
2481.065	2480.544167	2481.473654	929.487	PASS



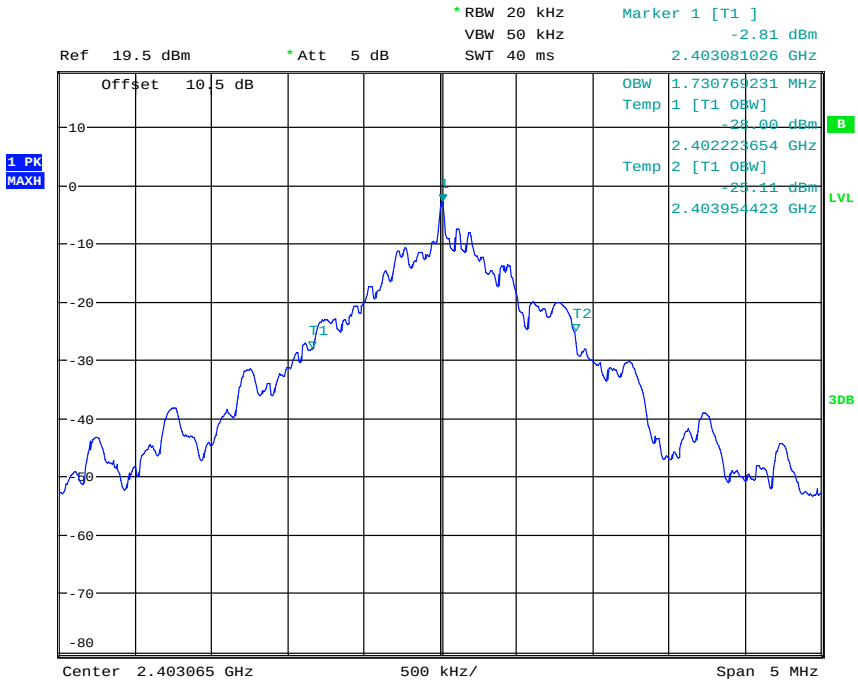


Date: 25.JUL.2016 10:41:07



Date: 25.JUL.2016 10:42:38

RSS-247 99% bandwidth. Modulation: Max power				
Channel Frequency (MHz)	***F_L (MHz)***	***F_H (MHz)***	***99% Bandwidth (MHz)***	***Result***
2403.065	2402.223654	2403.954423	1.73	PASS
2439.065	2438.151538	2440.138718	1.98	PASS
2481.065	2479.738077	2482.545769	2.80	PASS



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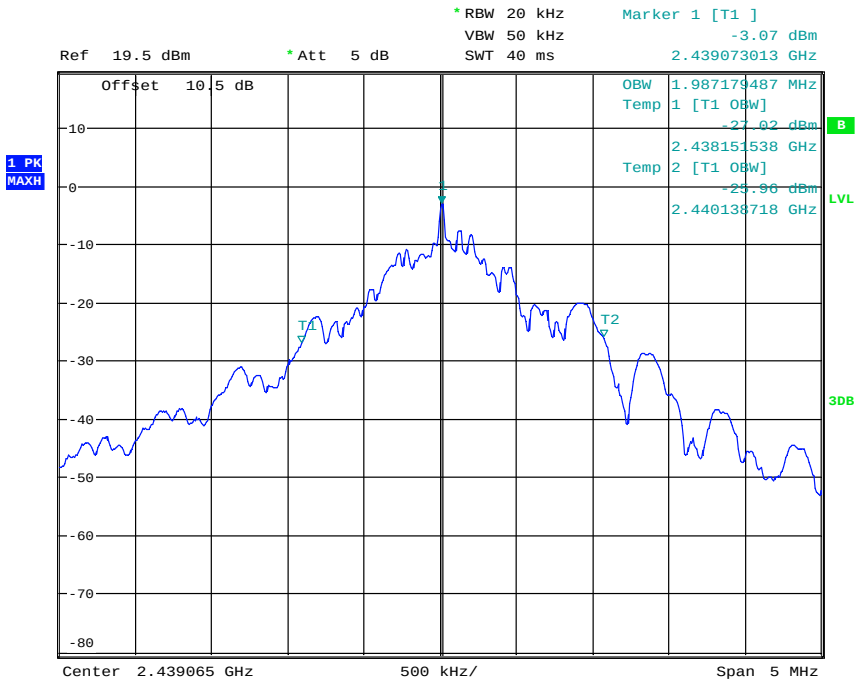

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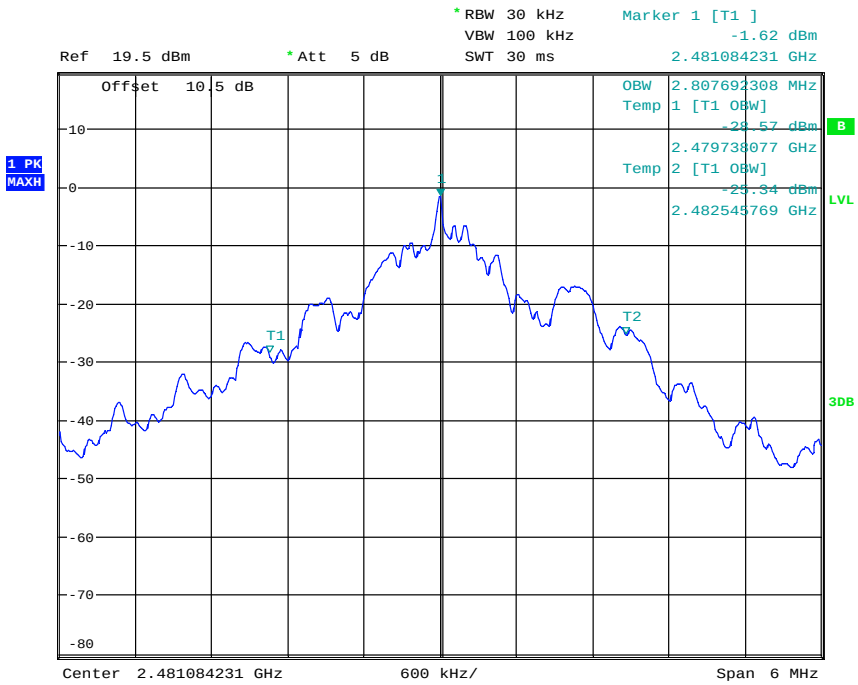


Date: 27.JUL.2016 11:21:50

13 Maximum peak conducted output power

13.1 Definition

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth.

The maximum conducted output power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	777.243/833.333/929.487
Deviations From Standard:	None
Measurement BW:	1MHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	3MHz
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Mains Power = 85 % and 115 % of Nominal (FCC only requirement); Battery Power = new battery.

Environmental Conditions (Normal Environment)

Temperature: 26 °C	+15 ºC to +35 ºC (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)

13.3 Test Limit

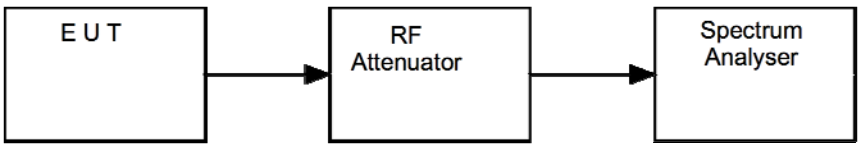
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1W.

13.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the resolution bandwidth of the spectrum analyser was increased above the EUT occupied bandwidth and the peak emission data noted.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Figure iv Test Setup



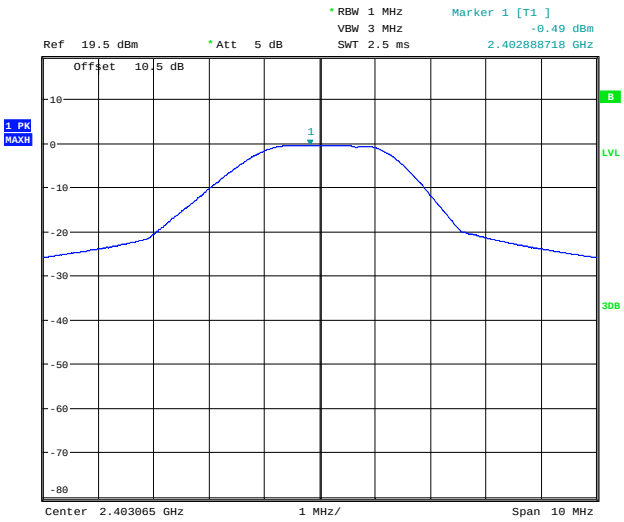
13.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU	R&S	Spectrum Analyser	UH405	02/06/2017

13.6 Test Results

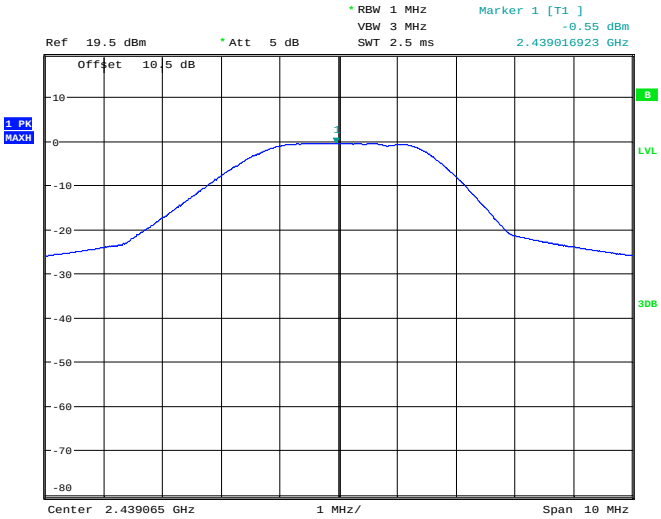
Channel Frequency (MHz)	*Analyzer Level (dBm)*	*Power (mW)*	*Result*
2403.065	-0.49	0.893	PASS
2439.065	-0.55	0.881	PASS
2481.065	-0.75	0.841	PASS

Tx Bottom channel



Date: 25.JUL.2016 11:21:18

Tx Middle channel



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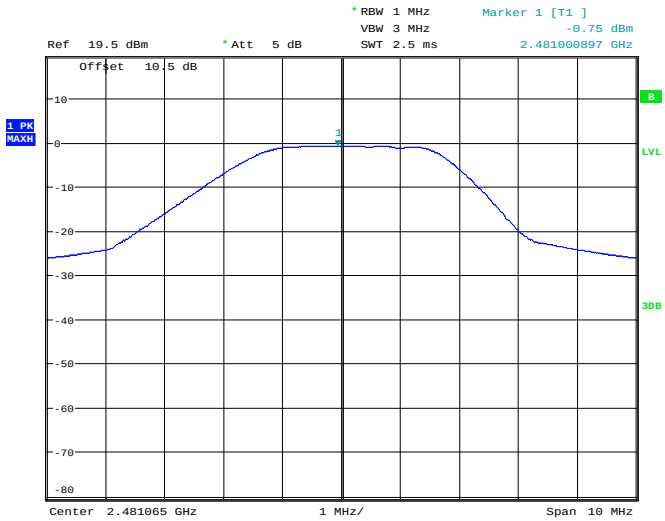
Tx Top channel



Date: 25.JUL.2016 11:23:39

14 Out-of-band and conducted spurious emissions

14.1 Definition

Out-of-band emission.
Emission on a frequency or frequencies immediately outside the necessary bandwidth that results from the modulation process but excluding spurious emissions.

Spurious emission.
Emission on a frequency or frequencies that are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products, and frequency conversion products, but exclude out-of-band emissions.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.11
EUT Channels / Frequencies Measured:	Low / Mid / High
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300 kHz
Measurement Detector:	Peak
Measurement Range:	30 MHz to 25 GHz

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 4.00V/dc	Battery powered % (as declared)

14.3 Test Limit

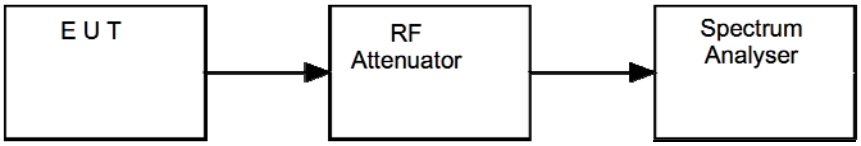
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in FCC 47CFR15.209(a) / RSS-Gen is not required.

14.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, the emissions from the EUT were measured on a spectrum analyser.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst case configuration in each bandwidth.

Figure v Test Setup



14.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU	R&S	Spectrum Analyser	UH405	02/06/2017

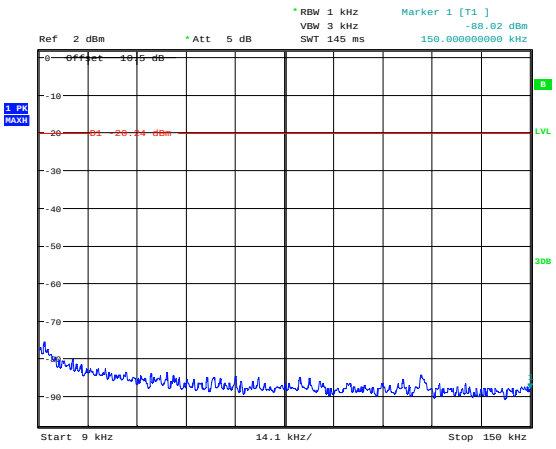
14.6 Test Results

Power setting: Maximum						
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Analyzer Level (dBm)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
2403.065	4807.692	-0.29	-39.90	-20.29	19.61	PASS
No further emissions within 20dBm of the limit						

Power setting: Maximum						
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Analyzer Level (dBm)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
2439.065	4884.615	-0.35	-40.10	-20.35	19.75	PASS
No further emissions within 20dBm of the limit						

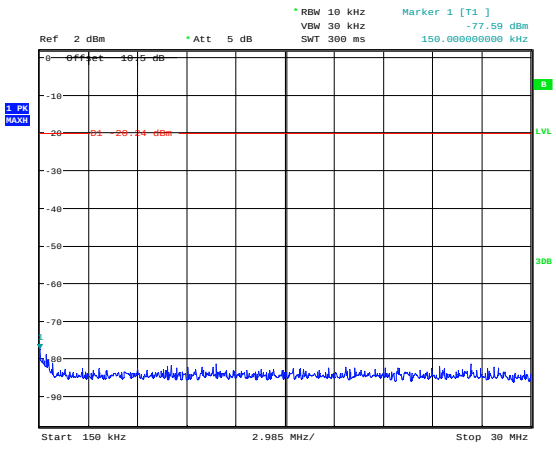
Power setting: Maximum						
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Analyzer Level (dBm)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
No emissions within 20dBm of the limit						

Tx Bottom Channel 9-150kHz



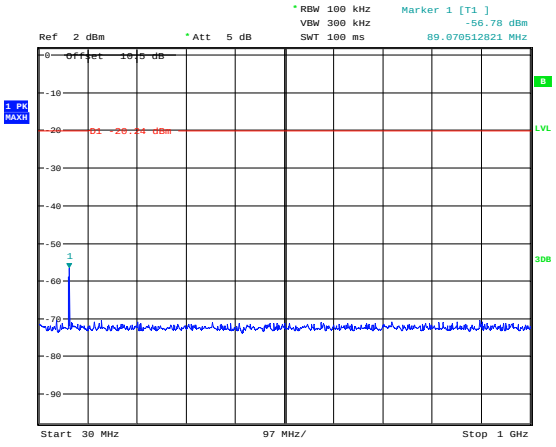
Date: 25.JUL.2016 11:45:21

Tx Bottom Channel 150-30MHz



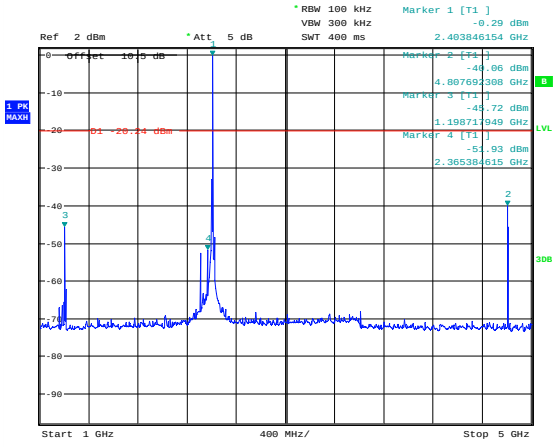
Date: 25.JUL.2016 11:45:51

Tx Bottom Channel 30MHz-1GHz



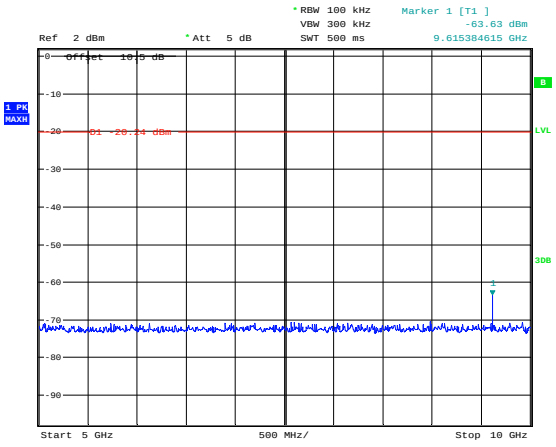
Date: 25.JUL.2016 11:46:40

Tx Bottom Channel 1GHz-5GHz



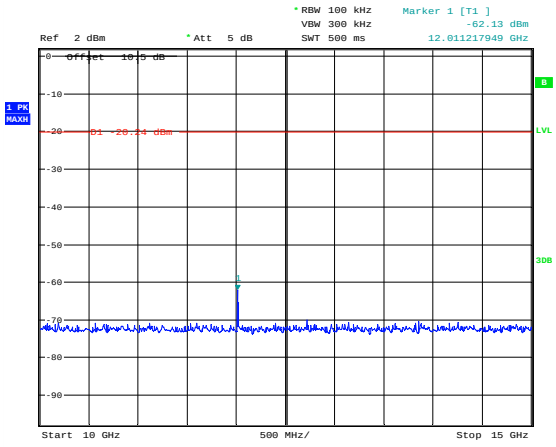
Date: 25.JUL.2016 11:47:37

Tx Bottom Channel 5GHz-10GHz



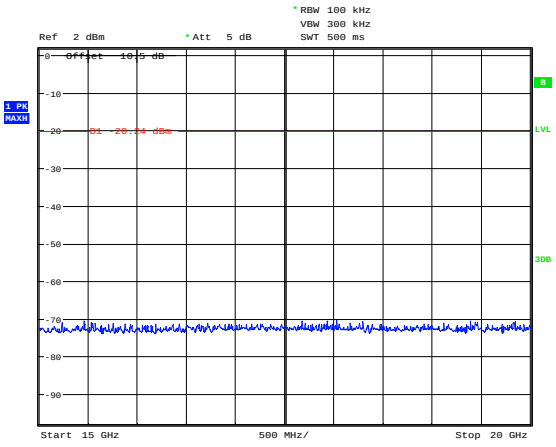
Date: 25.JUL.2016 11:48:15

Tx Bottom Channel 10GHz-15GHz



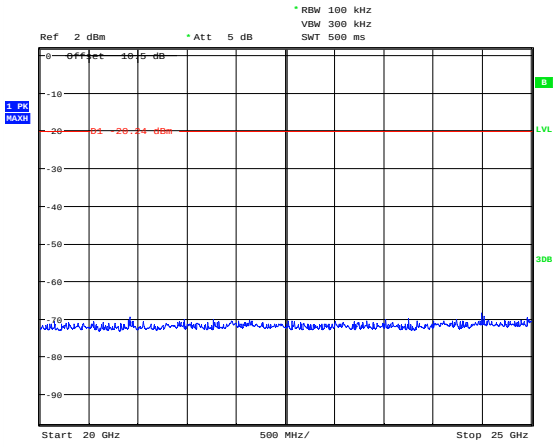
Date: 25.JUL.2016 11:48:46

Tx Bottom Channel 15GHz-20GHz



Date: 25.JUL.2016 11:49:10

Tx Bottom Channel 20GHz-25GHz



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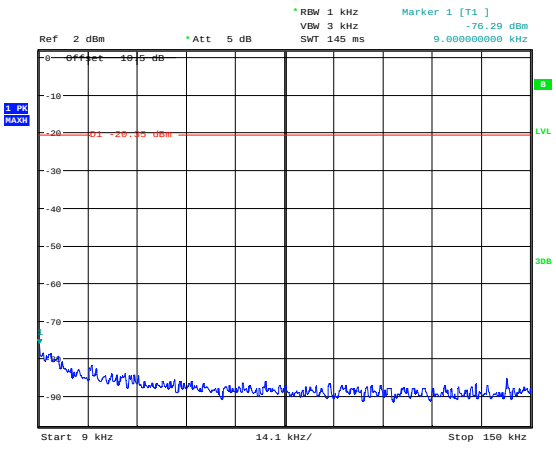
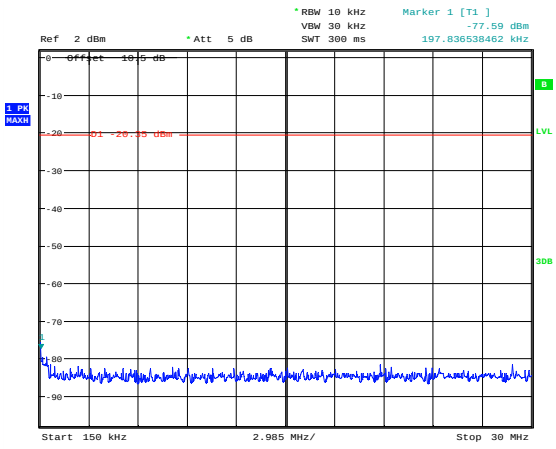
Tx Middle Channel 9-150kHz



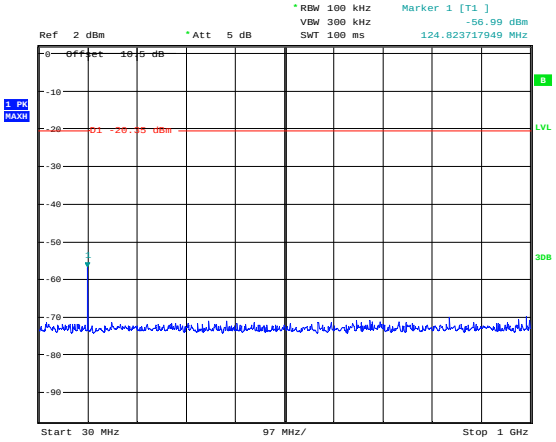
Date: 25.JUL.2016 12:02:01

Tx Middle Channel 150-30MHz



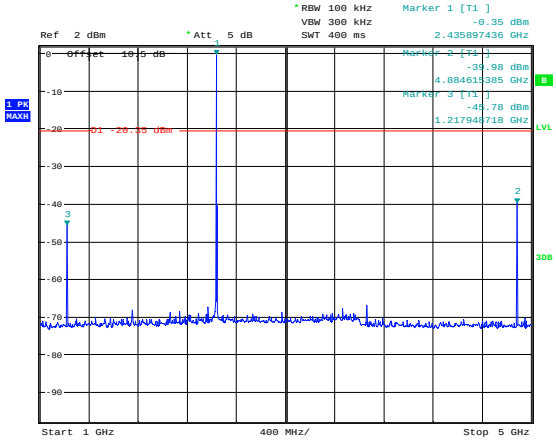
Date: 25.JUL.2016 12:02:21

Tx Middle Channel 30MHz-1GHz



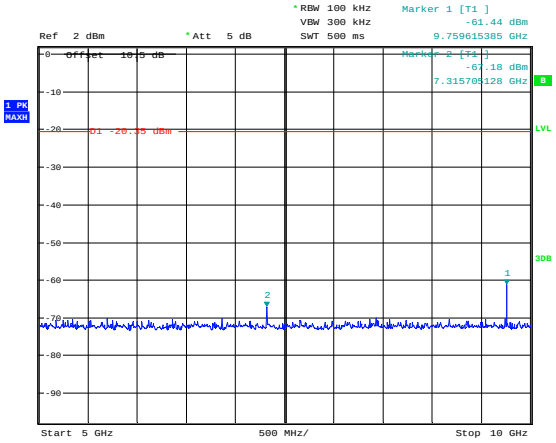
Date: 25.JUL.2016 12:02:52

Tx Middle Channel 1GHz-5GHz



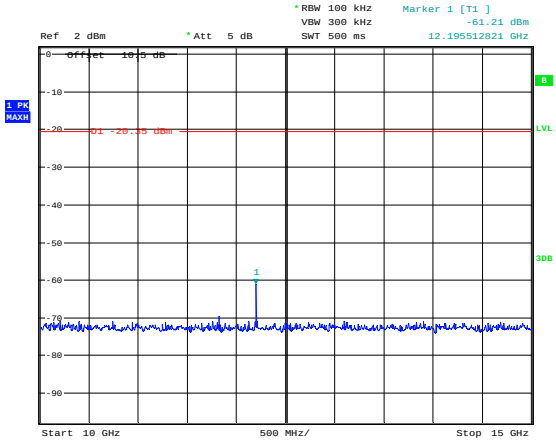
Date: 25.JUL.2016 12:01:39

Tx Middle Channel 5GHz-10GHz



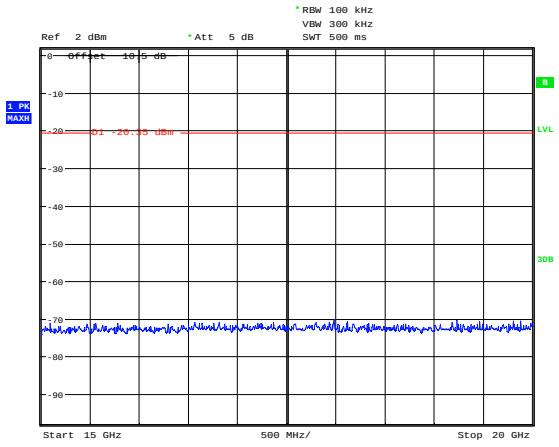
Date: 25.JUL.2016 12:03:38

Tx Middle Channel 10GHz-15GHz



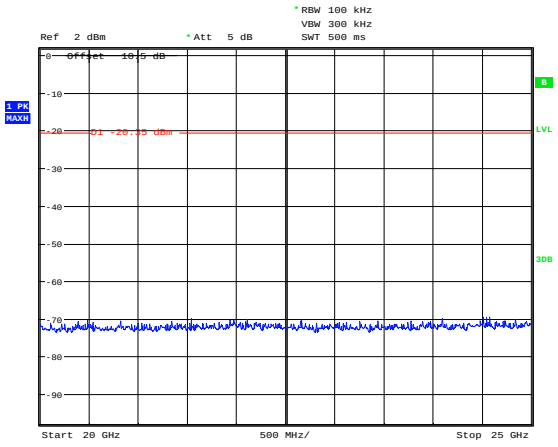
Date: 25.JUL.2016 12:04:03

Tx Middle Channel 15GHz-20GHz



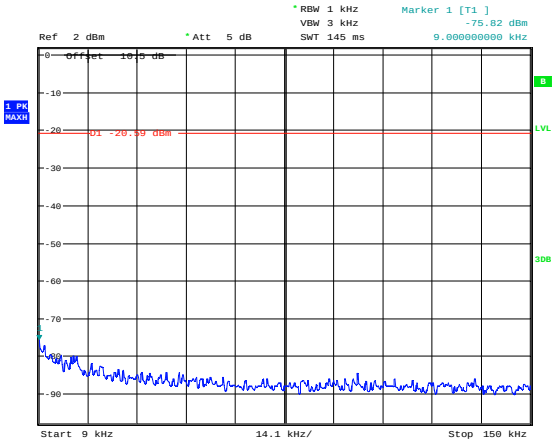
Date: 25.JUL.2016 12:04:24

Tx Middle Channel 20GHz-25GHz



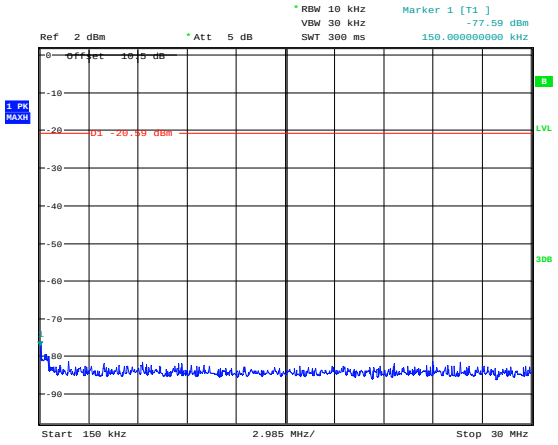
Date: 25.JUL.2016 12:04:43

Tx Top Channel 9-150kHz



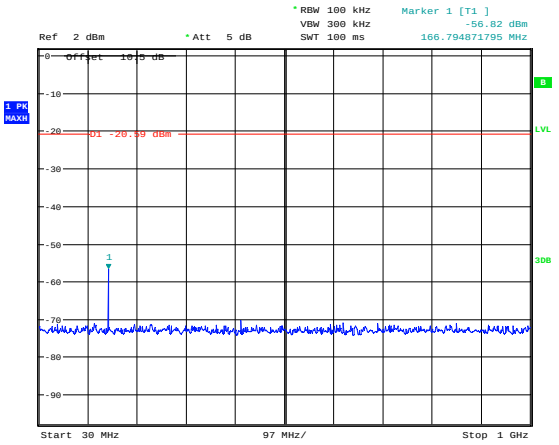
Date: 25.JUL.2016 12:07:12

Tx Top Channel 150-30MHz



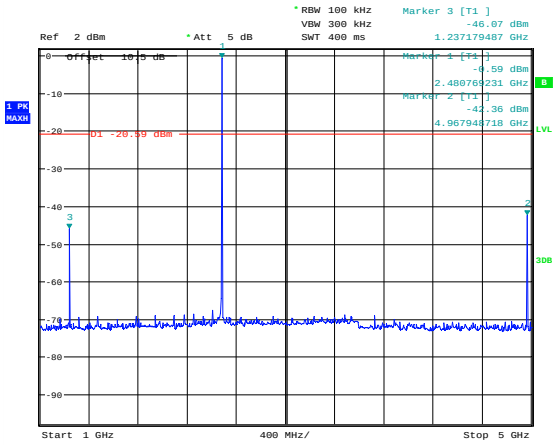
Date: 25.JUL.2016 12:07:41

Tx Top Channel 30MHz-1GHz



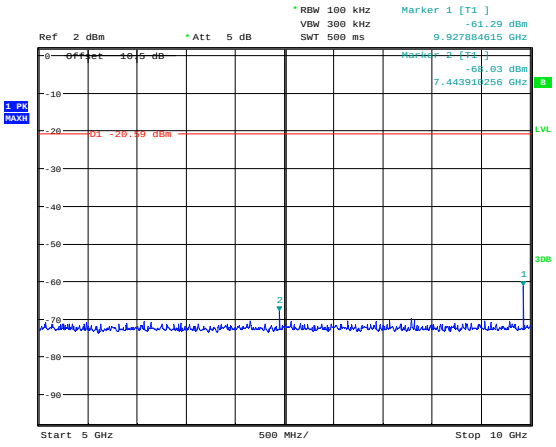
Date: 25.JUL.2016 12:08:04

Tx Top Channel 1GHz-5GHz



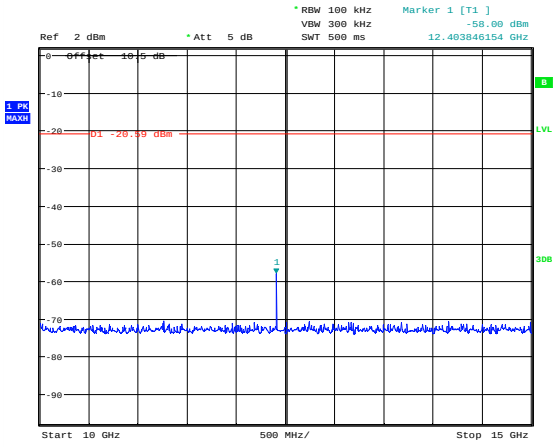
Date: 25.JUL.2016 12:06:42

Tx Top Channel 5GHz-10GHz



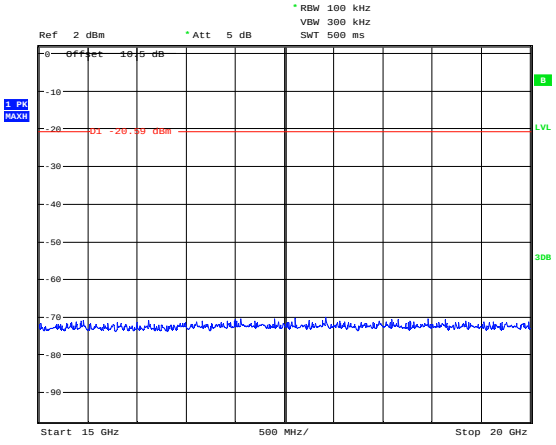
Date: 25.JUL.2016 12:08:37

Tx Top Channel 10GHz-15GHz



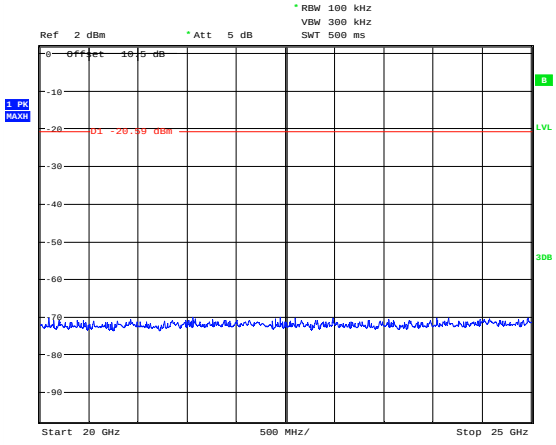
Date: 25.JUL.2016 12:08:57

Tx Top Channel 15GHz-20GHz



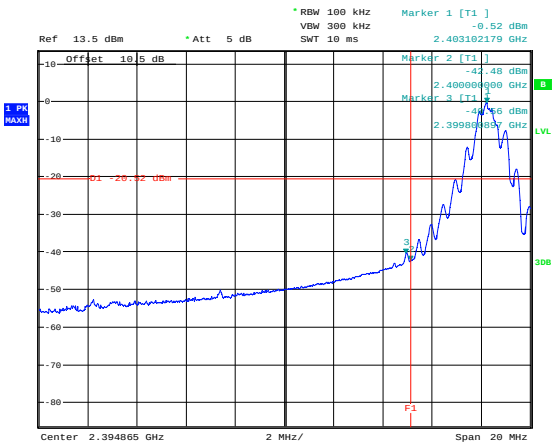
Date: 25.JUL.2016 12:09:19

Tx Top Channel 20GHz-25GHz

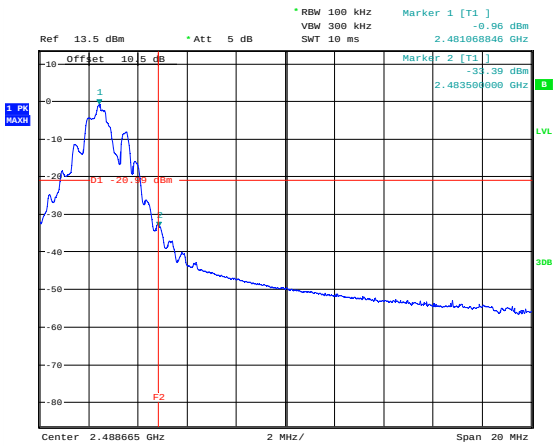


Date: 25.JUL.2016 12:09:39

Conducted Bandedge



Date: 25.JUL.2016 13:10:24



Date: 25.JUL.2016 13:06:33

15 Power spectral density

15.1 Definition

The power per unit bandwidth.

15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.10
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	777.243/833.333/929.487
Deviations From Standard:	None
Measurement BW:	3 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10.0kHz
Measurement Span: (requirement 1.5 times Channel BW)	2MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 ºC to +35 ºC (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 4V /dc	Powered by batteries (as declared)

15.3 Test Limit

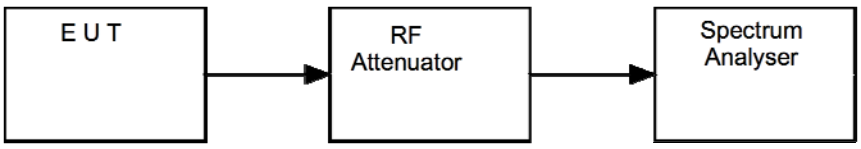
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

15.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vi, the peak emission of the EUT was measured on a spectrum analyser, with path losses taken into account.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst case configuration in each bandwidth.

Figure vi Test Setup

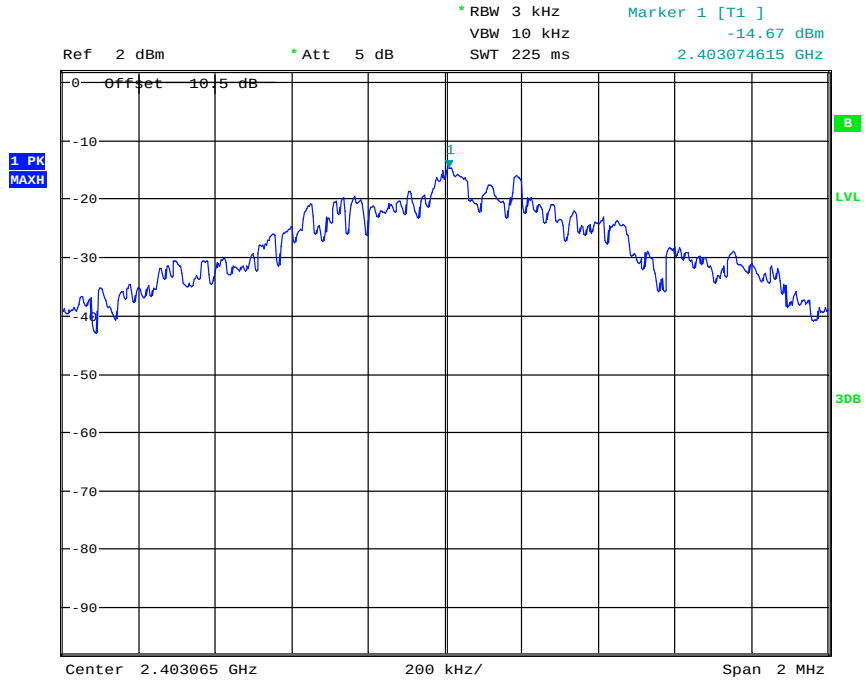


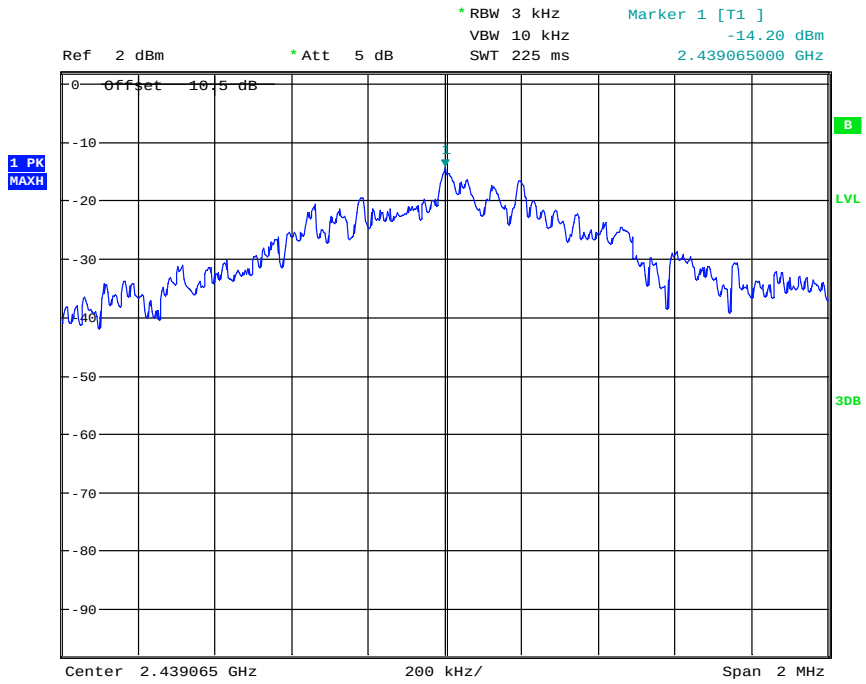
15.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU	R&S	Spectrum Analyser	UH405	02/06/2017

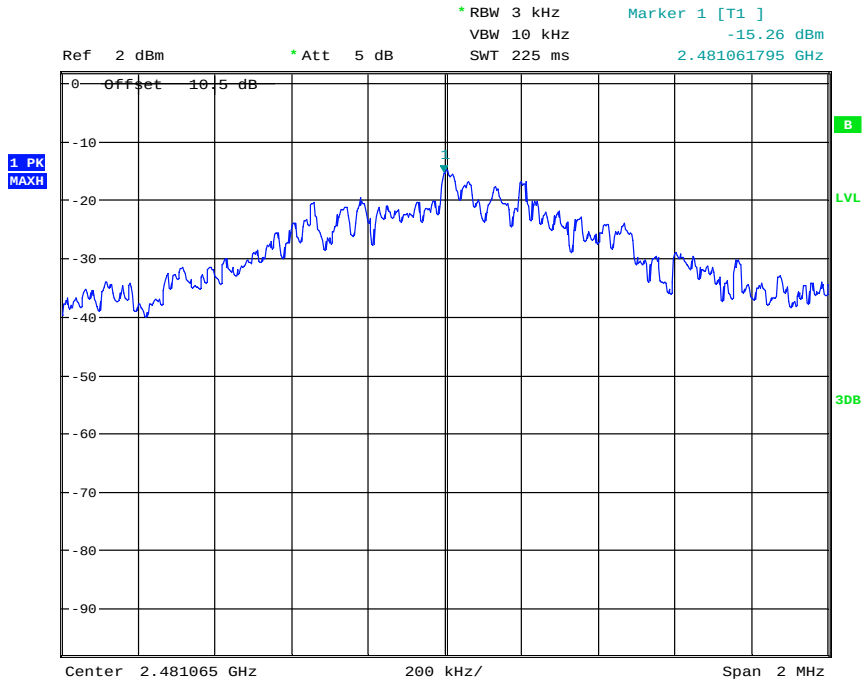
15.6 Test Results

Channel Frequency (MHz)	*Power (dBm)*	*Result*
2403.065	-14.67	PASS
2438.065	-14.20	PASS
2403.065	-15.26	PASS





Date: 25.JUL.2016 11:36:02



Date: 25.JUL.2016 11:37:08

16 Measurement Uncertainty

Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95 % confidence:

[1] Radiated spurious emissions

Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**
Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

[2] AC power line conducted emissions

Uncertainty in test result = **3.4 dB**

[3] Occupied bandwidth

Uncertainty in test result = **15.5 %**

[4] Conducted carrier power

Uncertainty in test result (Power Meter) = **1.08 dB**

[5] Conducted / radiated RF power out-of-band

Uncertainty in test result – up to 8.1 GHz = **3.31 dB**
Uncertainty in test result – 8.1 GHz to 15.3 GHz = **4.43 dB**
Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**
Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

[6] Power spectral density

Uncertainty in test result (Spectrum Analyser) = **2.48 dB**

17 RF exposure

RF Exposure **MPE Calculation**

KDB 447498

Prediction of MPE limit at a given distance

Equation from IEEE C95.1

$$S = \frac{EIRP}{4\pi R^2} \quad \text{re - arranged} \quad R = \sqrt{\frac{EIRP}{S\ 4\pi}}$$

where:

S = power density
R = distance to the centre of radiation of the antenna
EIRP = EUT Maximum power

Note:

The EIRP was calculated by addition of the maximum conducted carrier power plus the antenna gain.

OR

The following formula may be used to convert field strength (FS) in volts/metre to transmitter output power (TP) in watts:

$$TP = (FS \times D)^2 / (30 \times G)$$

where D is the distance in metres between the two antennas and G is the antenna numerical gain referenced to isotropic gain.

Result

Prediction Frequency (MHz)	Maximum Conducted Power (dBm)	Antenna Gain (dBi)	Maximum EIRP (mW)	Minimum Distance (cm)	Power density at distance (mW/cm^2)	Power density limit (S) (mW/cm^2)
2403.0	-0.49	0	0.893	0.27	0.974	1
2439.0	-0.55	0	0.881	0.27	0.961	1
2481.0	-0.75	0	0.841	0.26	0.990	1

RADIO FREQUENCY RADIATION EXPOSURE

RSS-102 issue 5

Exemption Limits for Routine Evaluation
Exemption Limits for Routine Evaluation
All transmitters are exempt from routine SAR and RF exposure evaluations provided that they comply with the requirements of sections RSS-102 Issue 5 sections 2.5.1 or 2.5.2
If the EUT does not meet the appropriate exemption limit, a complete SAR or RF exposure evaluation shall be performed. However, the power exemption limits in RSS-102 Issue 5 Table 1 can be applied to reduce the number of test configurations (e.g. testing of a tablet edge).
RSS-102 Issue 5 sections 2.5.1 limits:

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

RSS-102 i5	
Frequency	2403MHz
Section 2.5 Exemption limit	4mW
Max. conducted power	-0.49dBm
Antenna gain	0dBi
EIRP	0.893mW
Result	Exempt