

Report on the Radio Testing  
For  
Accesso Technology Group PLC  
on  
QBand+  
Report no. TRA-032154-45-00B  
11th January 2017

RF915 4.0

Report Number: TRA-032154-45-00B  
Issue: B

REPORT ON THE RADIO TESTING OF A  
Accesso Technology Group PLC  
QBand+  
WITH RESPECT TO SPECIFICATION  
FCC 47CFR 15.247 & IC RSS-247

TEST DATE: 07/12/2016 to 22/12/2016

Written by: A Longley

A Longley  
Radio Test Engineer

Approved by:

J Charters  
Department Manager - Radio

Date: 11th January 2017

Disclaimers:

- [1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE
- [2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

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RF915 4.0

## 1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	23 <sup>rd</sup> December 2016	Original
B	11 <sup>th</sup> January 2017	Add IEDS ID and update FCC id

## 2 Summary

TEST REPORT NUMBER: TRA-032154-45-00B

WORKS ORDER NUMBER: TRA-032154-00

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): QBand+

FCC IDENTIFIER: 2AKCMP2600-915

IC IDENTIFIER: 21963-P2600-915

EUT SERIAL NUMBER: PPT003

MANUFACTURER/AGENT: Accesso Technology Group PLC

ADDRESS: Unit 5 The Pavilions  
Ruscombe Park  
Twyford  
Berkshire  
RG10 9NN  
United Kingdom

CLIENT CONTACT: Tony Underwood  
☎ TPS01189 347446  
✉ tony.underwood@accesso.com

ORDER NUMBER: PO: 1213

TEST DATE: 07/12/2016 to 22/12/2016

TESTED BY: A Longley  
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	<input checked="" type="checkbox"/>	Pass
AC power line conducted emissions		Gen, 8.8	15.207	<input type="checkbox"/>	N/A
Occupied bandwidth		247, 5.2 (1)	15.247(a)(2)	<input checked="" type="checkbox"/>	Pass
Conducted carrier power	Peak	247, 5.4 (4)	15.247(b)(3)	<input checked="" type="checkbox"/>	Pass
	Max.			<input type="checkbox"/>	
Conducted / radiated RF power out-of-band		247, 5.5	15.247(d)	<input checked="" type="checkbox"/>	Pass
Power spectral density, conducted		247, 5.2 (2)	15.247(e)	<input checked="" type="checkbox"/>	Pass
Calculation of duty correction		-	15.35(c)	<input type="checkbox"/>	N/A

### 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).

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## 4 Introduction

This report TRA-032154-45-00B presents the results of the Radio testing on an Accesso Technology Group PLC, QBand+ 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 Accesso Technology Group PLC by Element, at the address(es) detailed below.

<input checked="" type="checkbox"/>	Element Hull Unit E South Orbital Trading Park Hedon Road Hull HU9 1NJ UK	<input type="checkbox"/>	Element Skelmersdale Unit 1 Pendle Place Skemersdale West Lancashire WN8 9PN UK
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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

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

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

## 7 Equipment Under Test

### 7.1 EUT Identification

- Name: QBand+
- Serial Number: PPT003
- Model Number: P2600-915
- Software Revision: Not Applicable
- Build Level / Revision Number: Pre-Production

### 7.2 System Equipment

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.*

### 7.3 EUT Mode of Operation

#### 7.3.1 Transmission

The mode of operation for Tx tests was as follows...

The EUT was placed into a continuous transmit mode on 2402, 2426 or 2480 MHz by means of running batch files on a laptop by means of an NFC connection. Copies of the batch files used to set the operating modes have been stored in the job folder on the Element network.

#### 7.3.2 Reception

The mode of operation for Rx tests was as follows...

The EUT was placed into a powered up state by means of running a batch file on a laptop by means of an NFC connection. A copy of the batch file used to set the operating mode has been stored in the job folder on the Element network.

## 7.4 EUT Radio Parameters

### 7.4.1 General

<b>Frequency of operation:</b>	2402 to 2480 MHz
<b>Modulation type(s):</b>	GFSK
<b>Occupied channel bandwidth(s):</b>	1 MHz
<b>Channel spacing:</b>	2 MHz
<b>ITU emission designator(s):</b>	G1D
<b>Warning against use of alternative antennas in user manual (yes/no):</b>	N/A fixed internal antenna
<b>Nominal Supply Voltage:</b>	3 Vdc (internal battery)
<b>Location of notice for license exempt use:</b>	Label / user manual / both.
<b>Method of prevention of use on non-US / non-Canadian frequencies:</b>	N/A

### 7.4.2 Antennas

<b>Type:</b>	Board mounted Chip antenna
<b>Frequency range:</b>	2.400 to 2.485 GHz
<b>Impedance:</b>	50 $\Omega$
<b>SWR:</b>	< 3
<b>Gain:</b>	1.72 dBi Typical
<b>Polarisation:</b>	Linear
<b>Connector type:</b>	N/A (Board mounted)
<b>Length:</b>	2 mm
<b>Environmental limits:</b>	-40°C to 105°C
<b>Mounting:</b>	Soldered directly to PCB

### 7.4.3 Product specific declarations

<b>Multiple antenna configuration(s), e.g. MIMO:</b>	N/A
<b>Fixed pt-pt operations (yes/no):</b>	No
<b>Installation manual advice on pt-pt operational restrictions (yes/no):</b>	N/A
<b>Fixed pt-mpt operations (yes/no):</b>	No
<b>Simultaneous tx (yes/no):</b>	N/A

### 7.5 EUT Description

The EUT was a wristband with a display panel, it contained a Bluetooth Low Energy transceiver (covered by this report), it also contained a 915 MHz "LoRa" transceiver which is not covered by this test report.

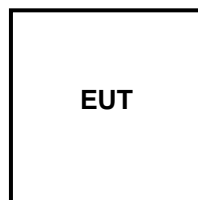
## **8 Modifications**

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 3V dc from CR3032 battery.

### 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:

	<b>Category</b>	<b>Nominal</b>	<b>Variation</b>
<input type="checkbox"/>	Mains	110 V ac +/-2 %	85 % and 115 %
<input checked="" type="checkbox"/>	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 Hull
Test Chamber:	Lab 16
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	1 MHz
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: 20 °C	+15 °C to +35 °C (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)
Supply: 3 V dc	

### 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

<i>Frequency (MHz)</i>	<i>Field Strength (µV/m at 3 m)</i>
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 dB $\mu$ V/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 dB $\mu$ V;

CL is the cable loss in dB;

AF is the test antenna factor in dB/m;

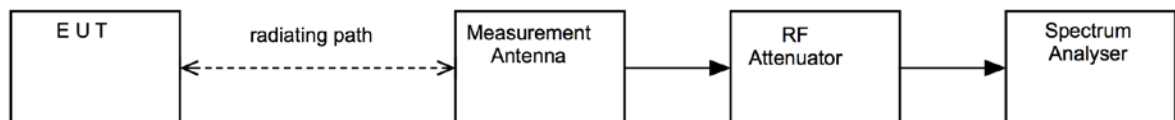
PA is the pre-amplifier gain in dB (where used);

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**



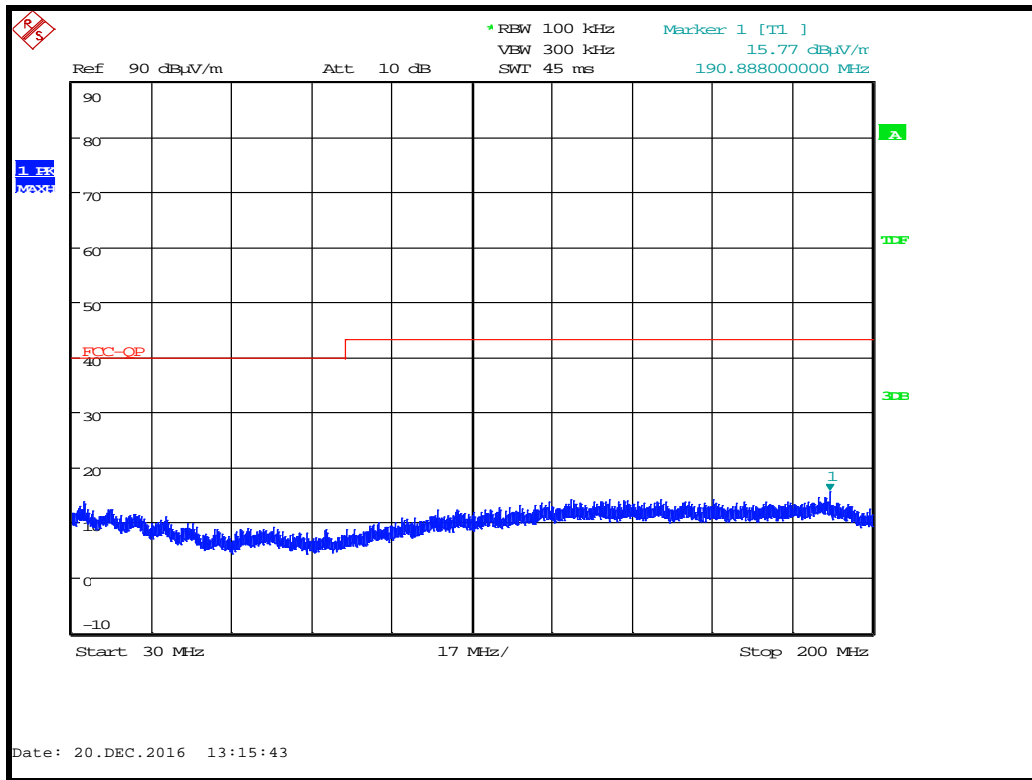
**11.5 Test Set-up Photograph**



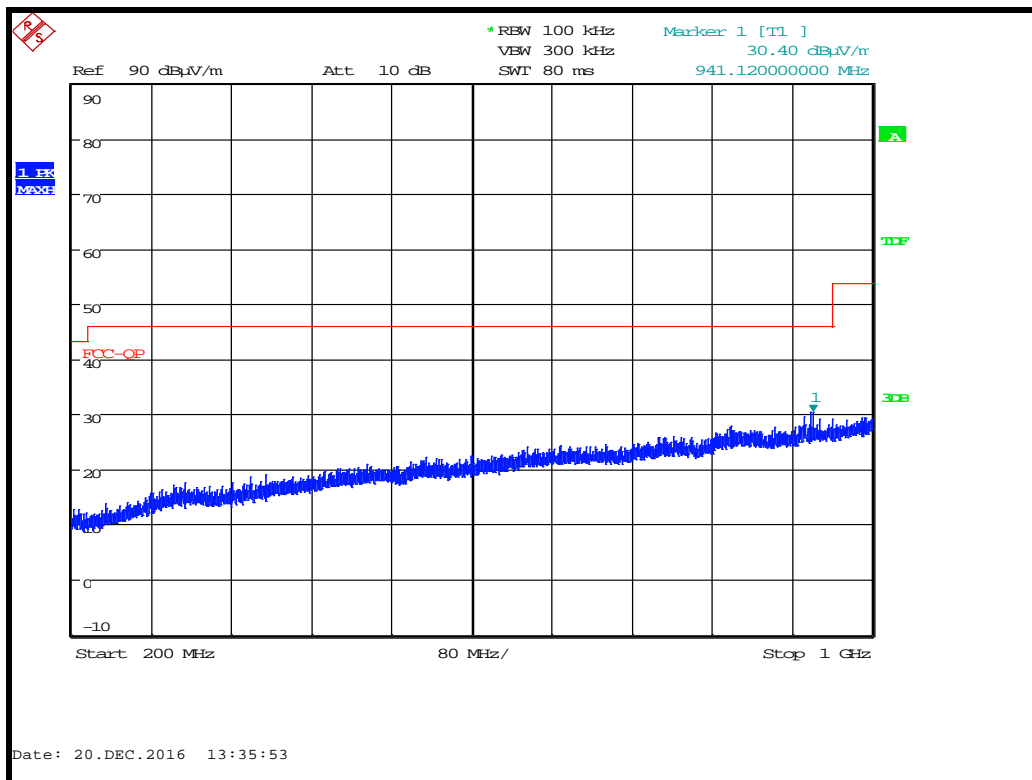
**11.6 Test Equipment**

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ATS	Rainford	Ferrite Lined Chamber	REF886	21/07/2017
FSU46	R&S	Spectrum Analyser	REF910	05/07/2017
310	Sonoma	Pre-Amp (9kHz – 1GHz)	REF927	30/06/2018
8449B	Agilent	Pre-Amp (1 – 26.5GHz)	REF913	02/02/2018
3109	EMCO	Biconical Antenna	RFG095	17/05/2019
3146	EMCO	Log Periodic Antenna	RFG191	17/05/2019
3115	EMCO	Horn Antenna	RFG129	09/02/2018
	Q-Par	Horn Antenna	RFG629	30/09/2017

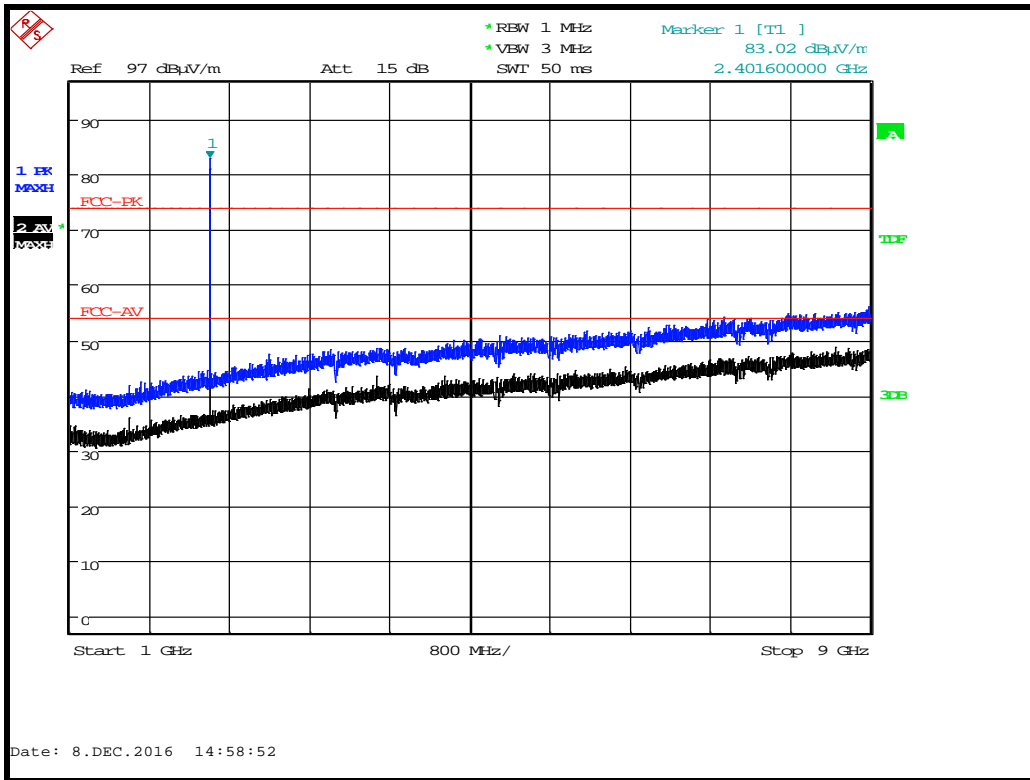
### 11.7 Test Results



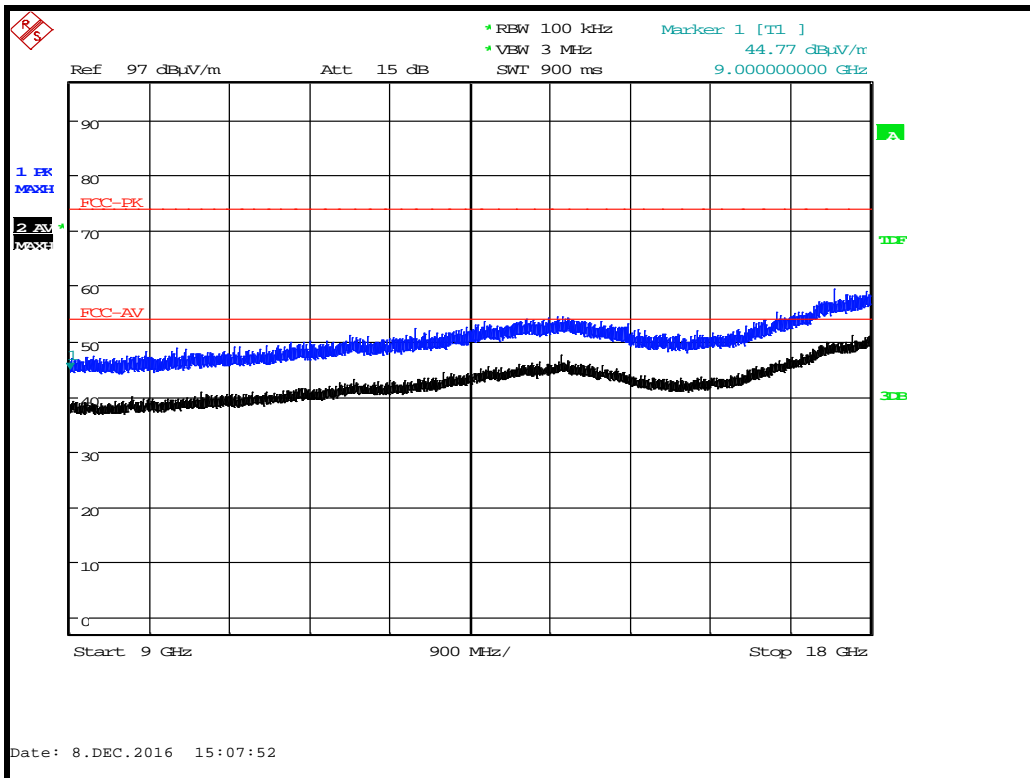
Bottom Channel : 30 to 200 MHz



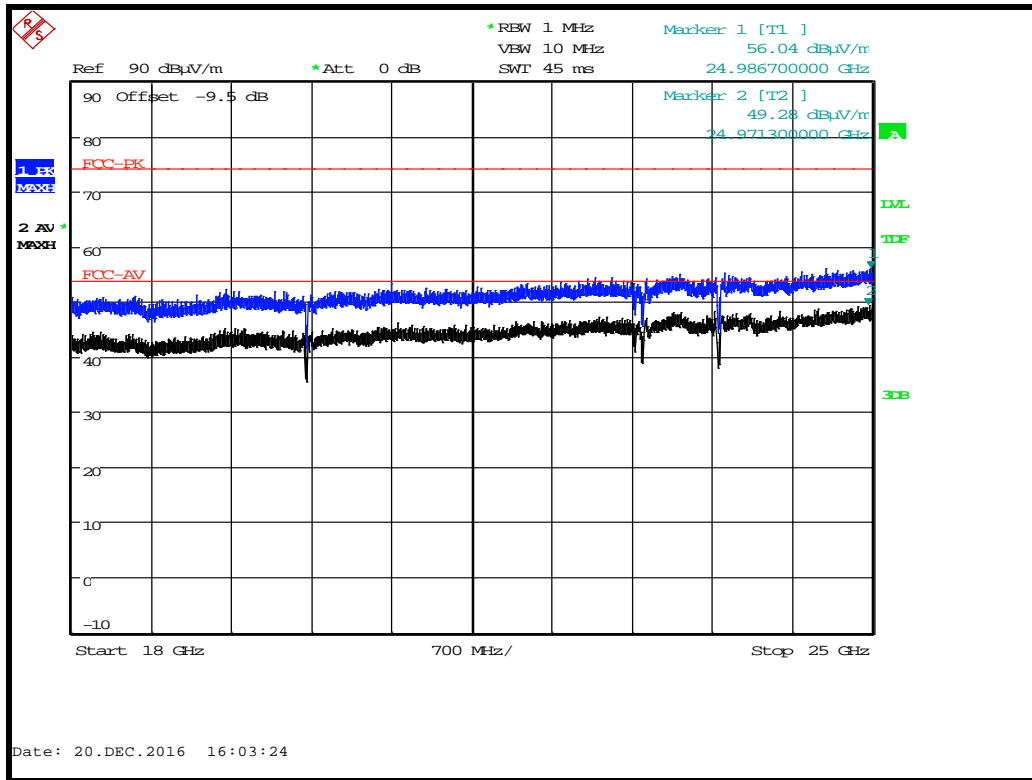
Bottom Channel : 200 to 1000 MHz



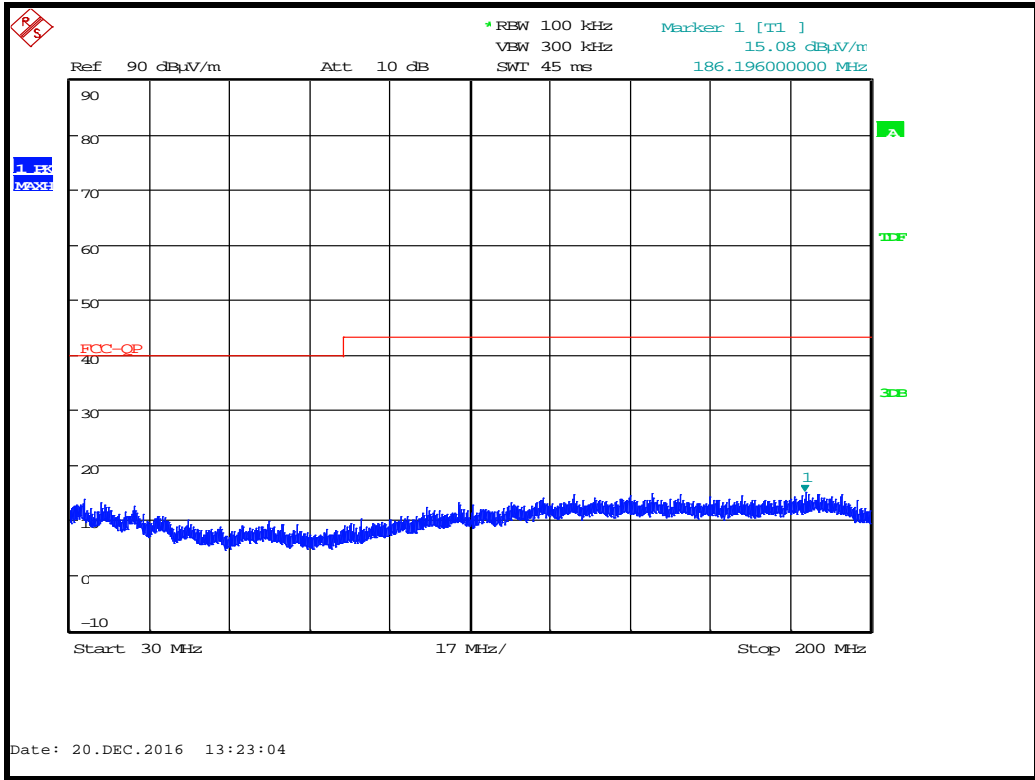
Bottom Channel : 1 to 9 GHz



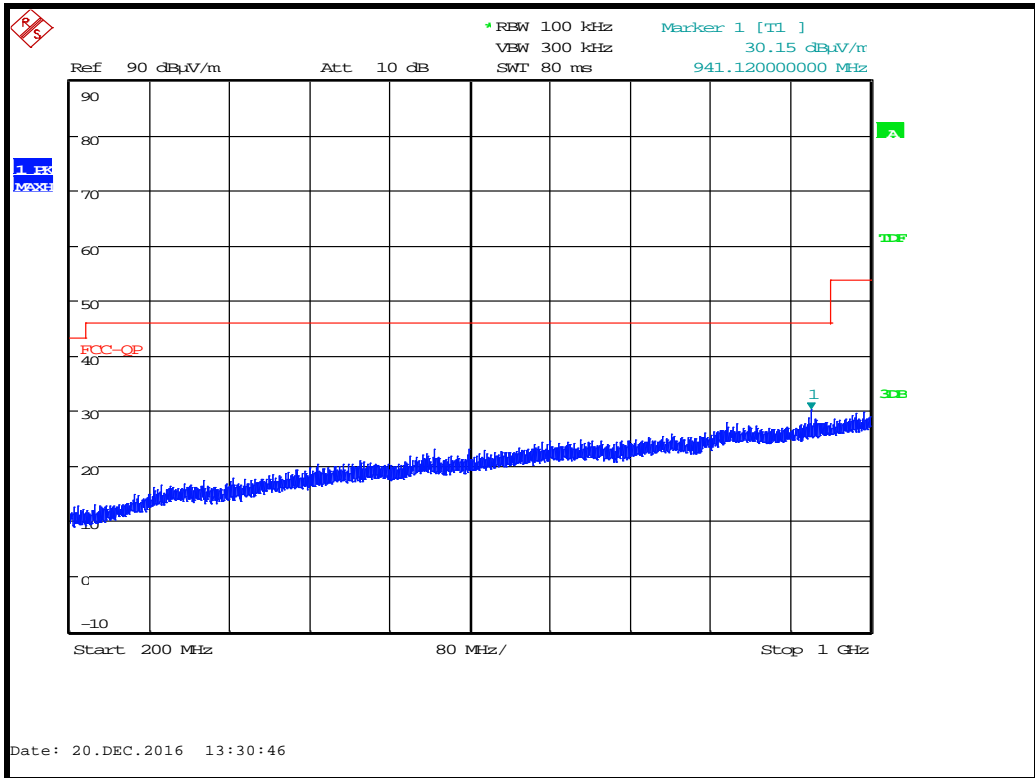
Bottom Channel : 9 to 18 GHz



Bottom Channel 18 to 25 GHz

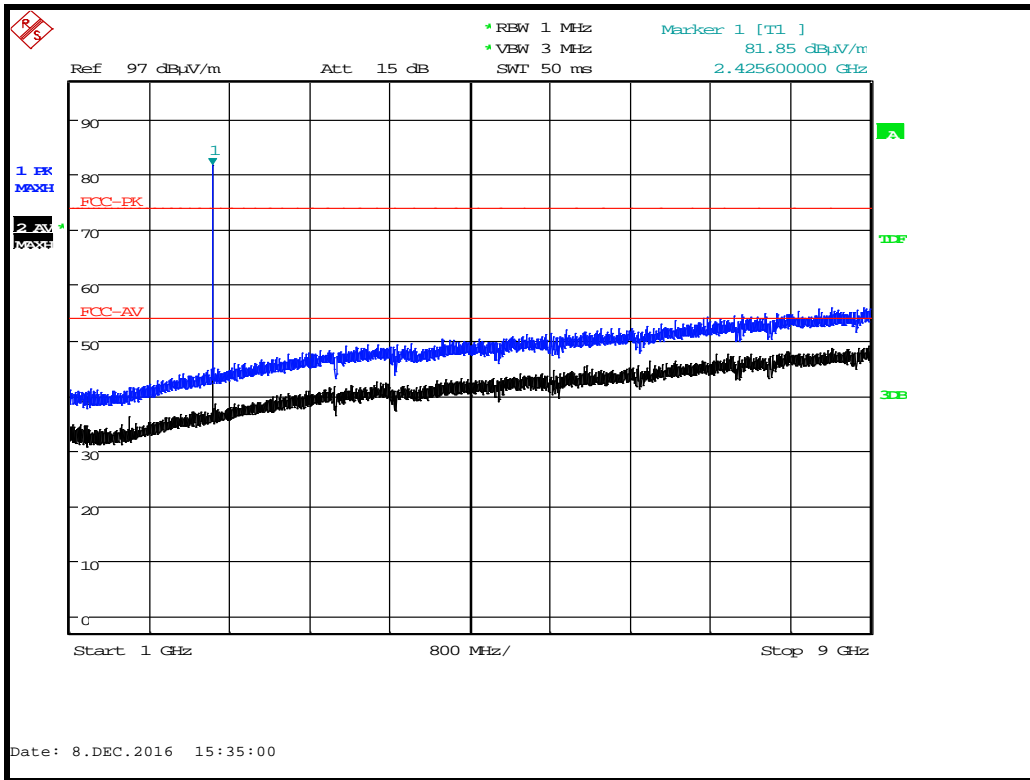


Middle Channel : 30 to 200 MHz

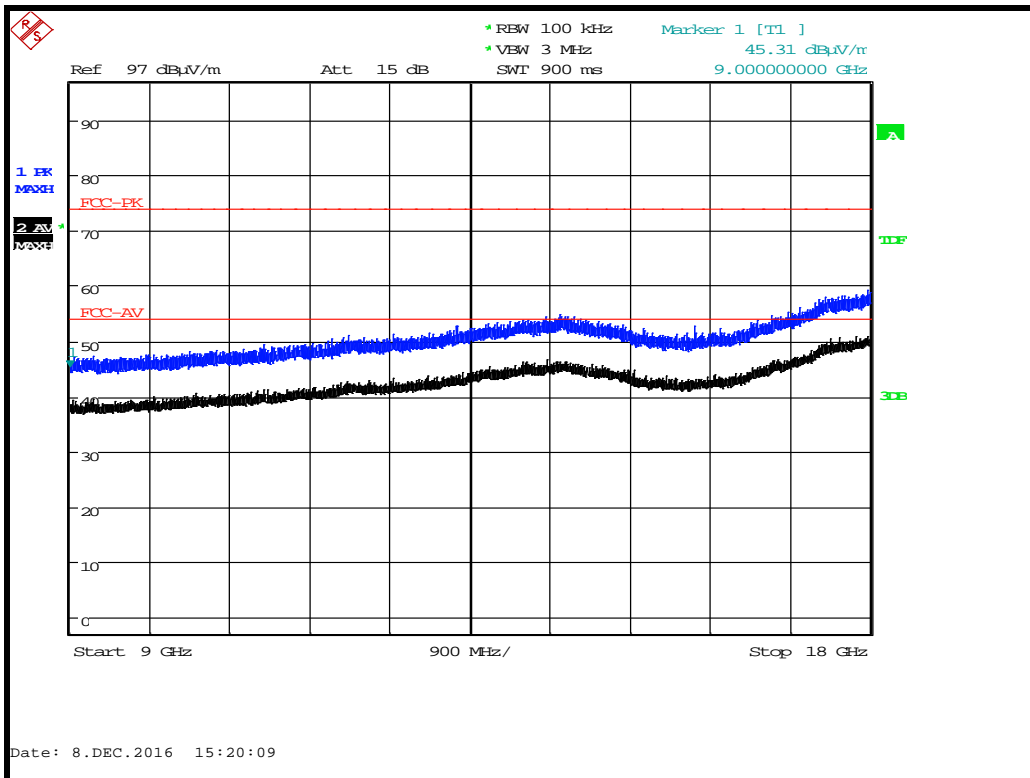


Middle Channel : 200 to 1000 MHz

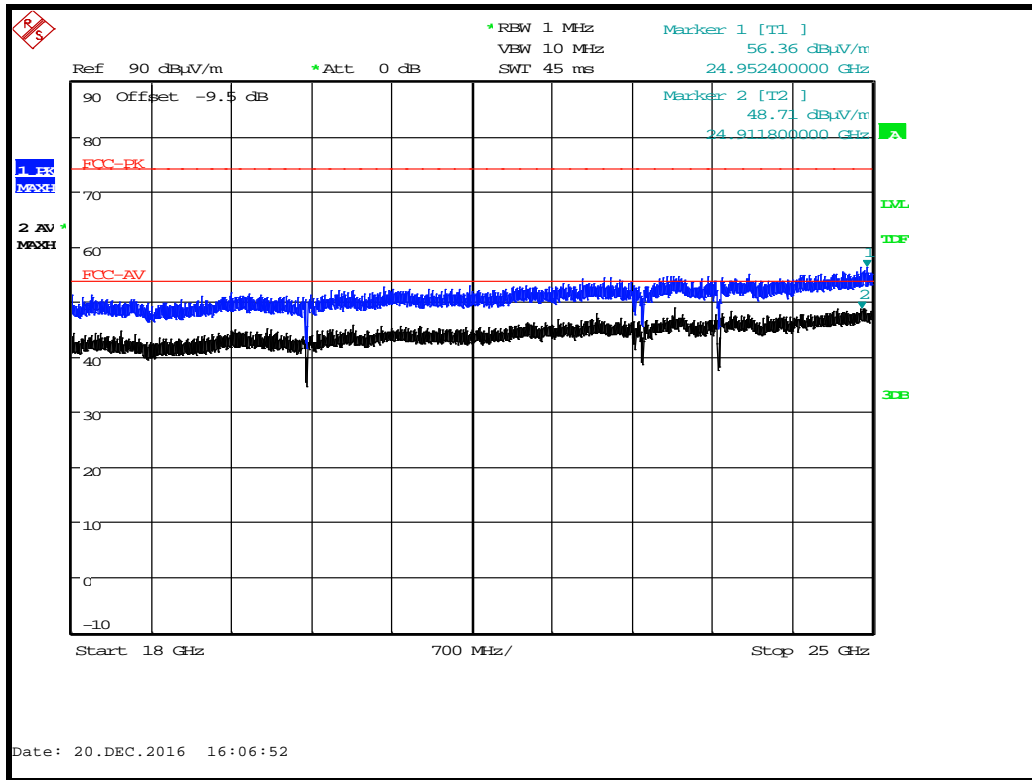




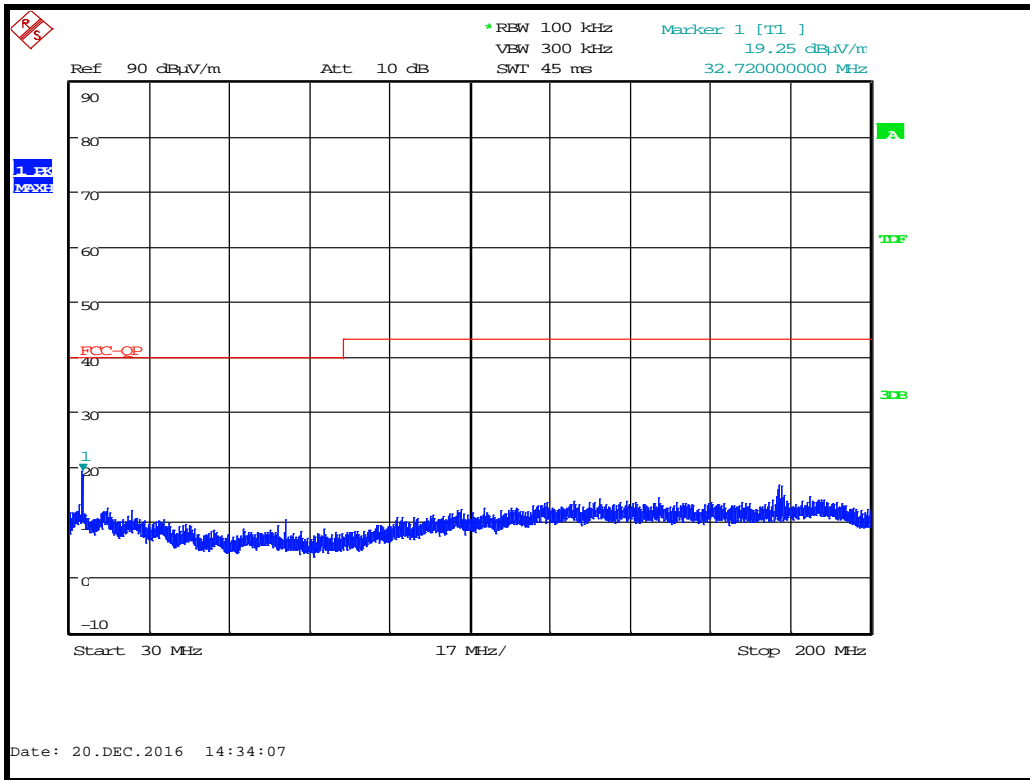
Middle Channel : 1 to 9 GHz



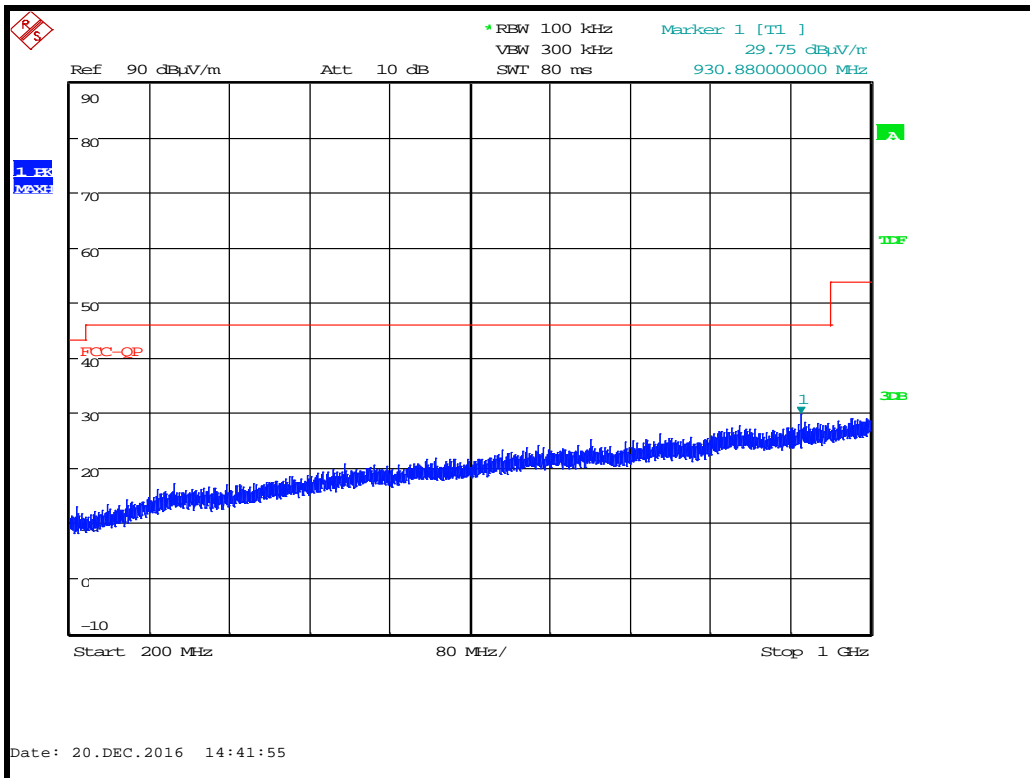
Middle Channel : 9 to 18 GHz



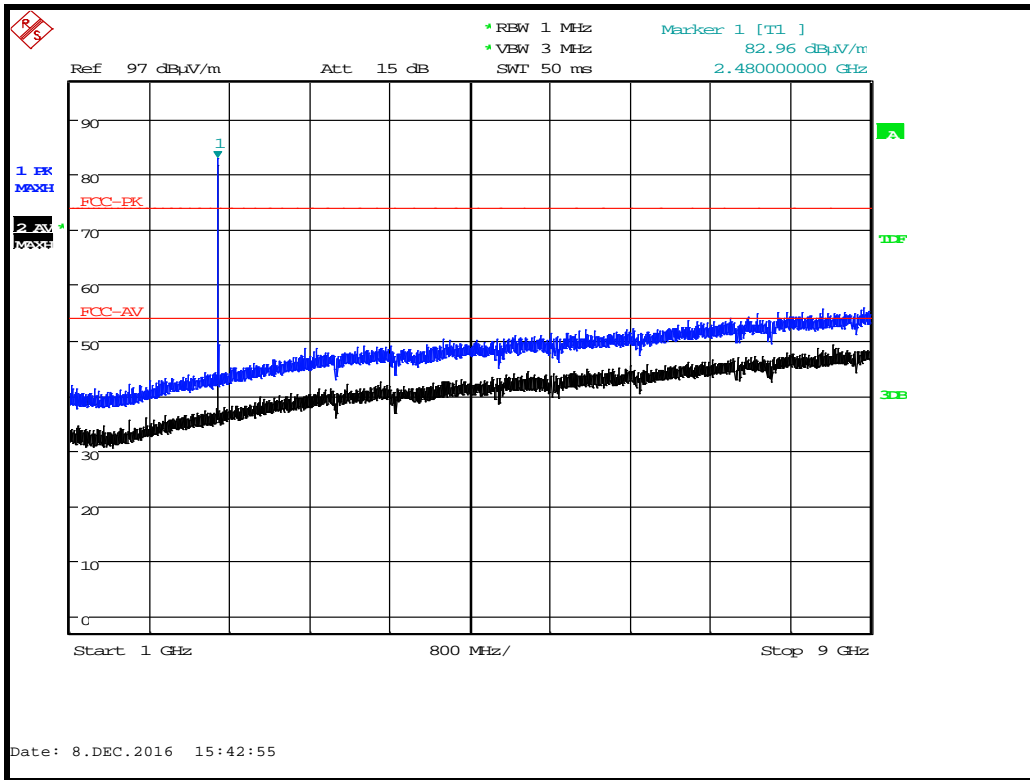
Middle Channel 18 to 25 GHz



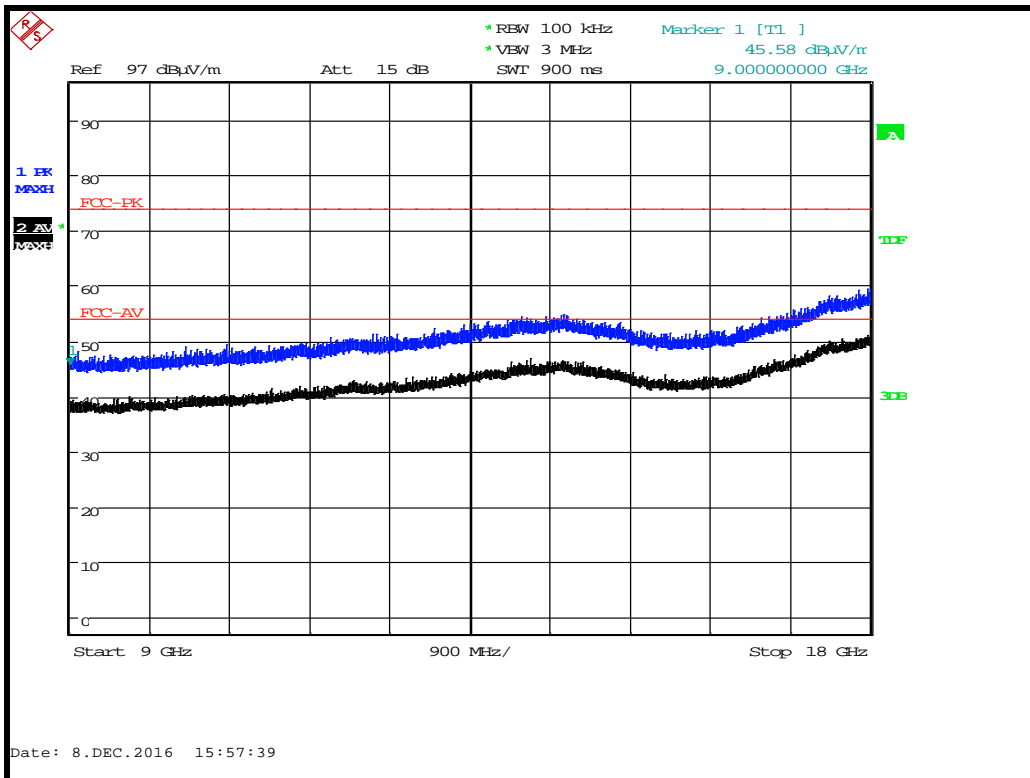
Top Channel : 30 to 200 MHz



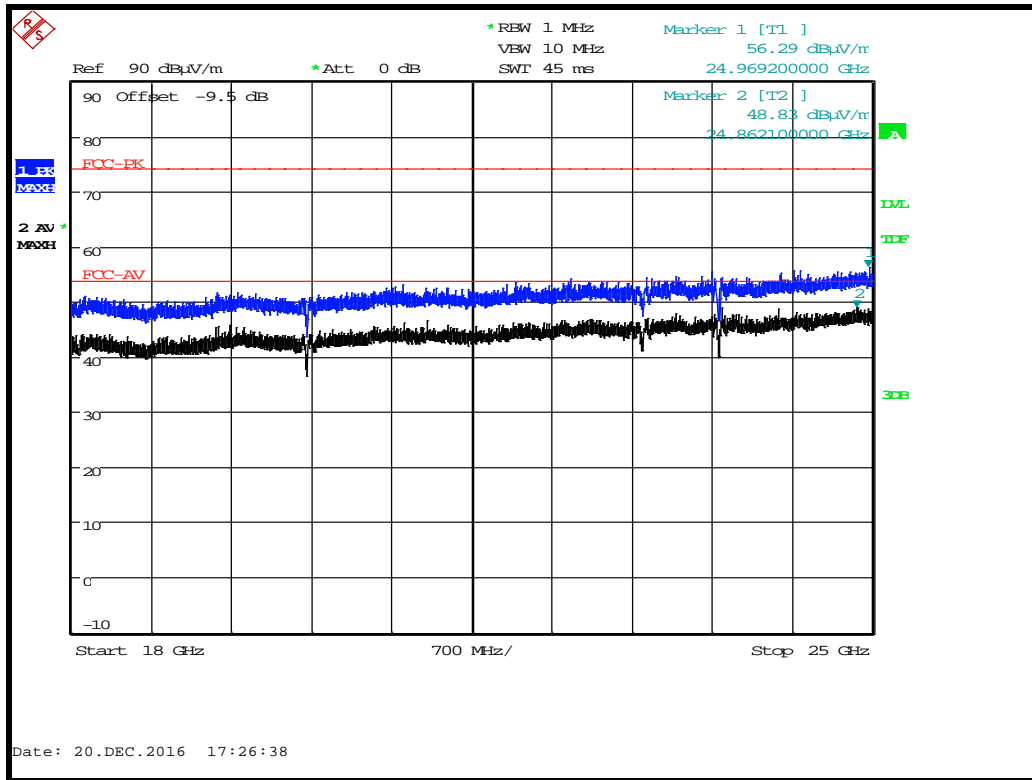
Top Channel : 200 to 1000 MHz



Top Channel : 1 to 9 GHz

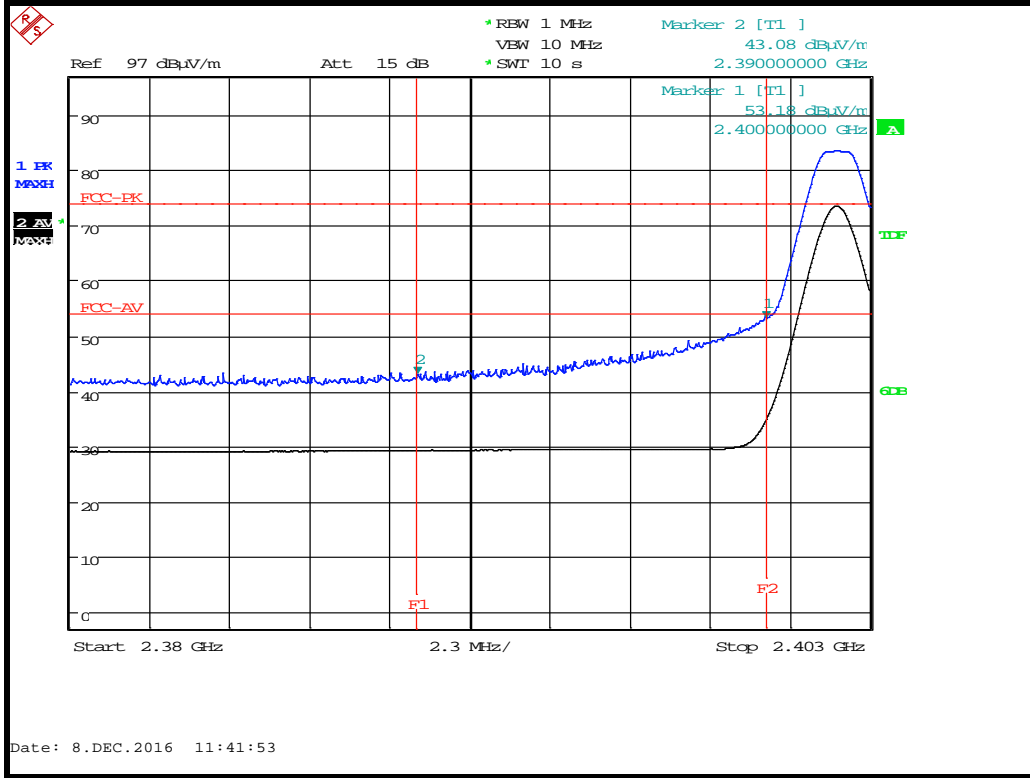


Top Channel : 9 to 18 GHz



Top Channel 18 to 25 GHz

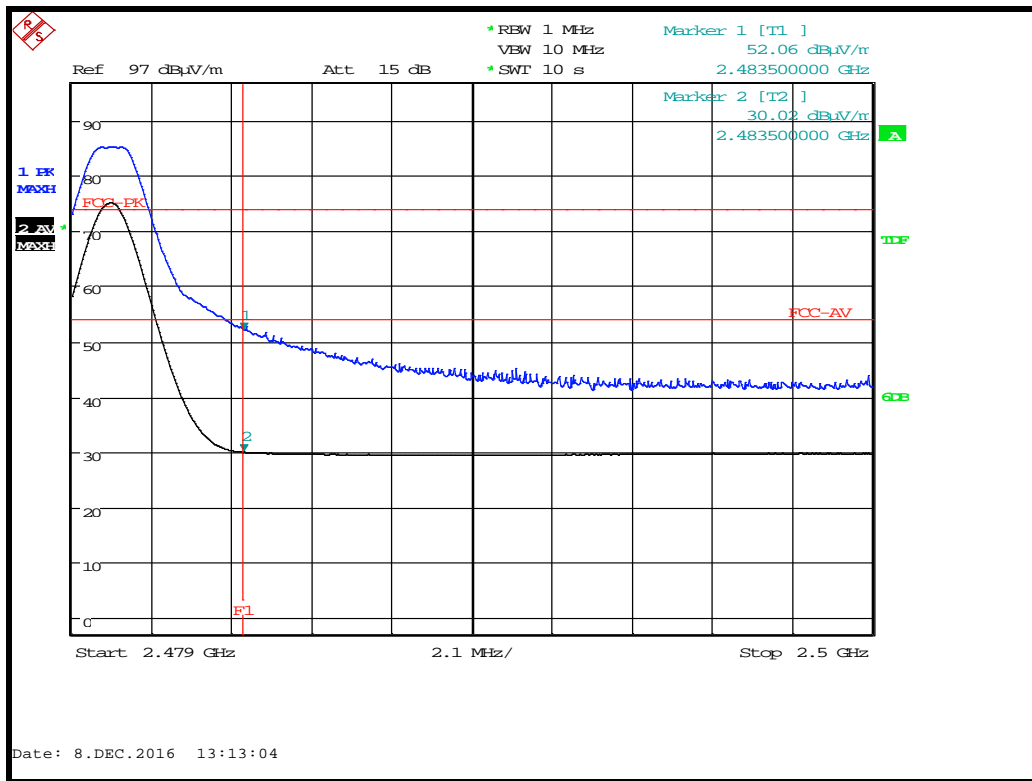
High Power; Channel: 2402 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dBμV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
No significant spurious emissions were detected.										



Lower Band Edge Plot

High Power; Channel: 2426 MHz										
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)
No significant spurious emissions were detected.										

High Power; Channel: 2480 MHz										
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)
No significant spurious emissions were detected.										



Upper Band Edge Plot

## 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 Hull
Test Chamber:	Lab 16
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:	1 MHz
EUT Test Modulations:	As BTLE
Deviations From Standard:	None
Measurement BW:	100 kHz (10 kHz IC)
(IC requirement: 1% to 5% OBW; FCC requirement: 100 kHz)	
Spectrum Analyzer Video BW:	300 kHz (30 kHz IC)
(requirement at least 3x RBW)	
Measurement Span:	5 MHz
(requirement 2 to 5 times OBW)	
Measurement Detector:	Peak

### Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 °C to +35 °C (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)
Supply: 3 V dc	

### 12.3 Test Limit

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

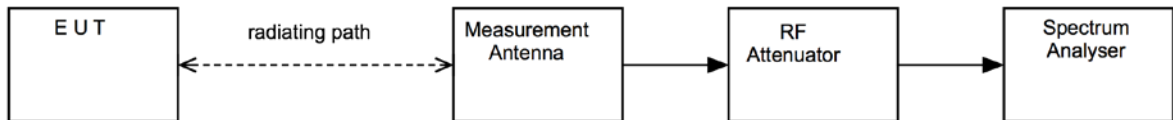


## 12.4 Test Method

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**

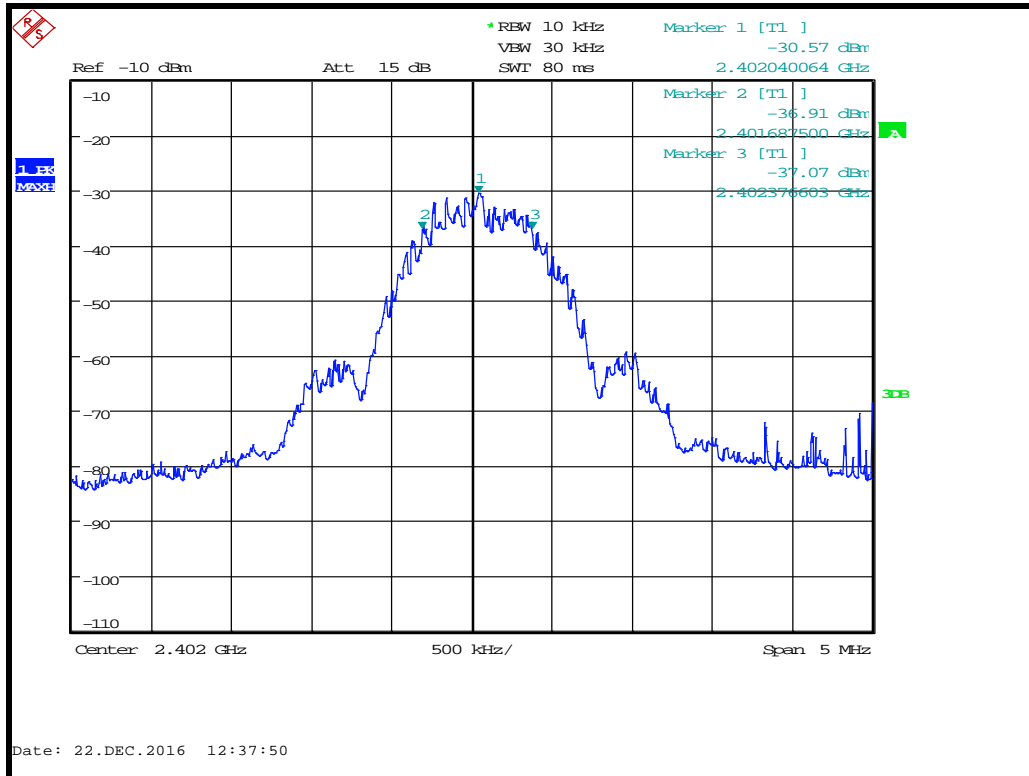


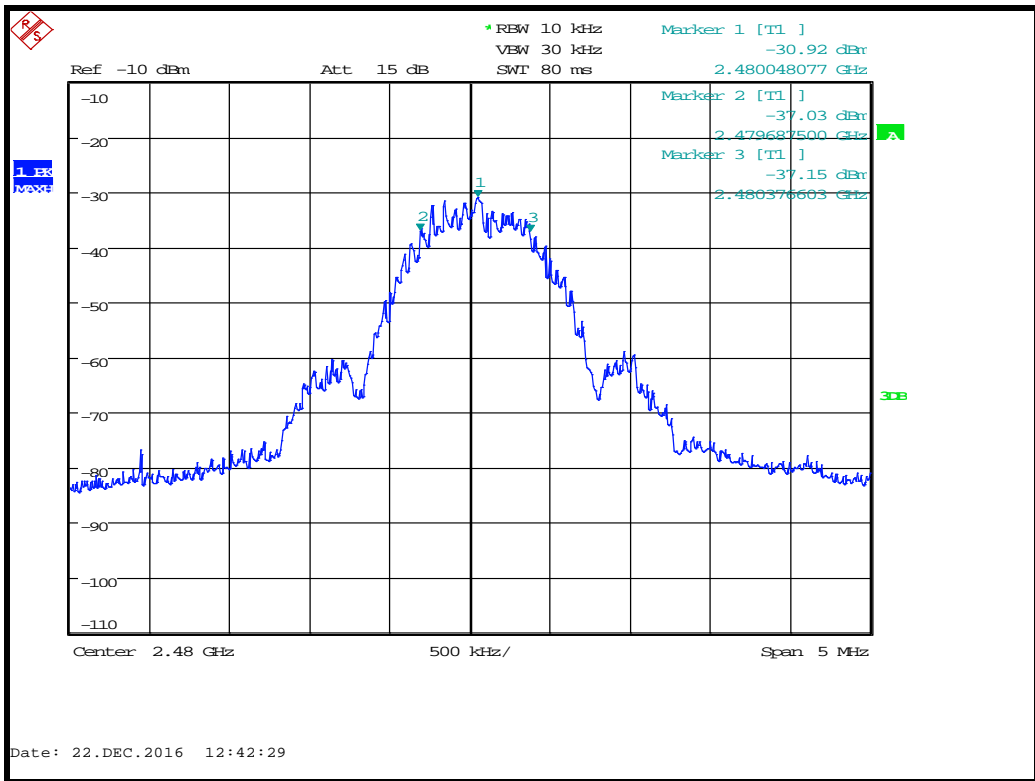
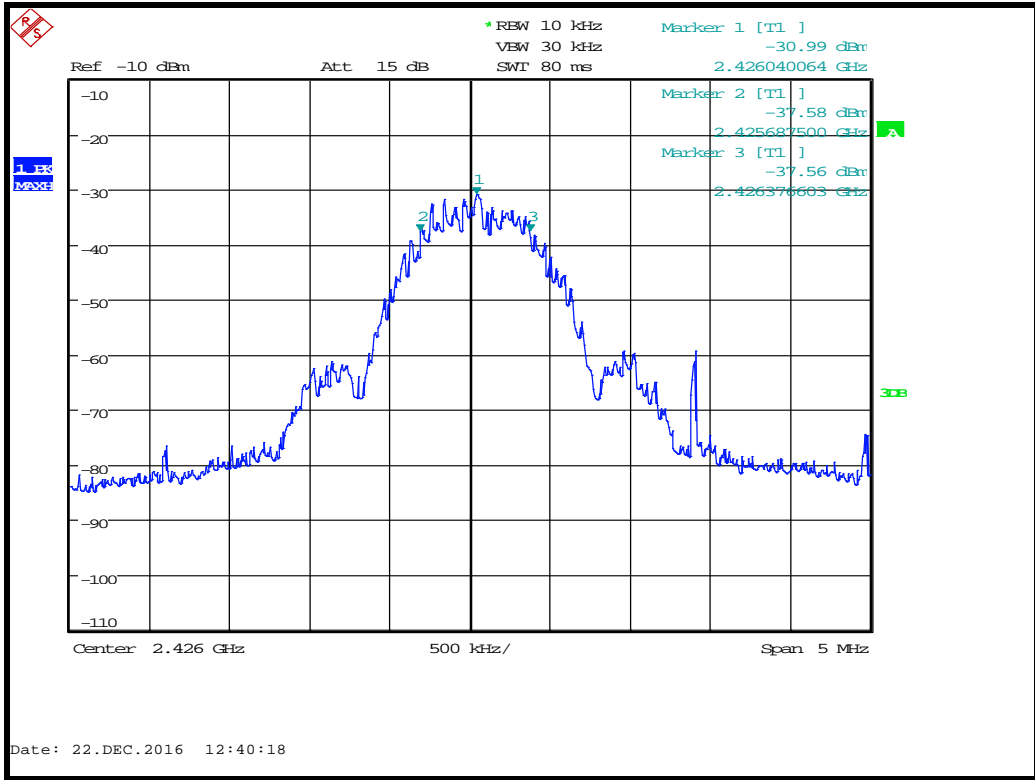
## 12.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	REF910	05/07/2017
8449B	Agilent	Pre-Amp (1 – 26.5GHz)	REF913	02/02/2018
3115	EMCO	Horn Antenna	RFG129	09/02/2018

### 12.6 Test Results

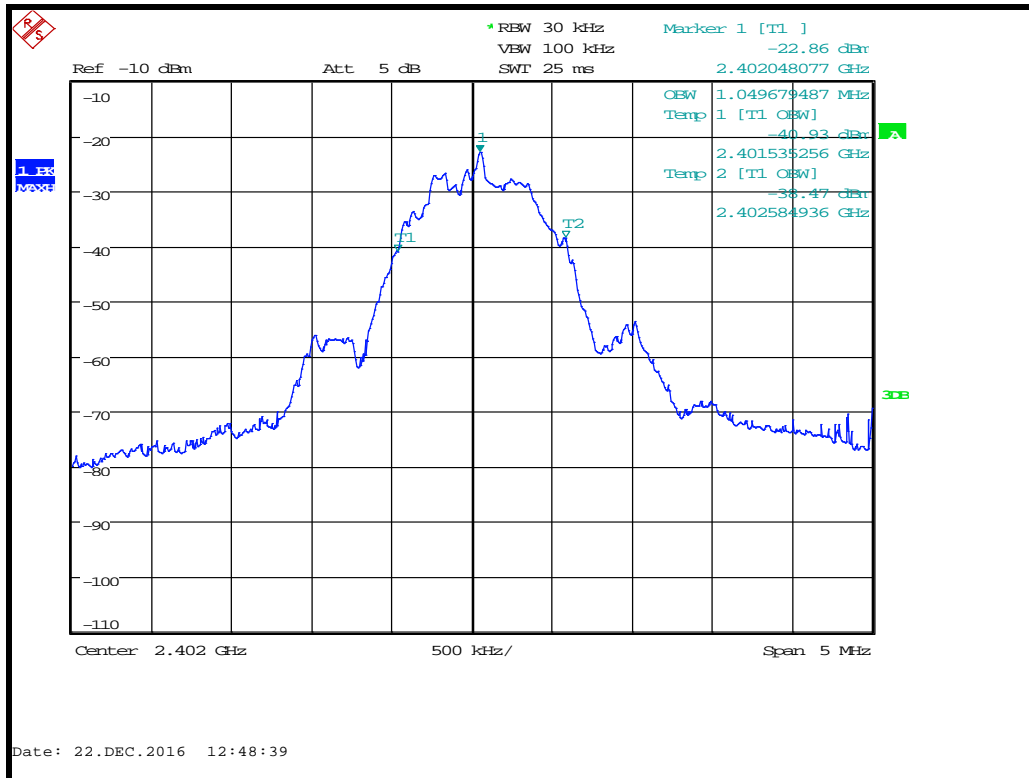
RSS-210. Modulation: as BTLE; Data rate: as BTLE; Power setting: Default				
Channel Frequency (MHz)	$F_L$ (MHz)	$F_H$ (MHz)	6dB Bandwidth (kHz)	Result
2402	2401.687500	2402.376603	689.103	PASS
2426	2425.687500	2426.376603	689.103	PASS
2480	2479.687500	2480.376603	689.103	PASS

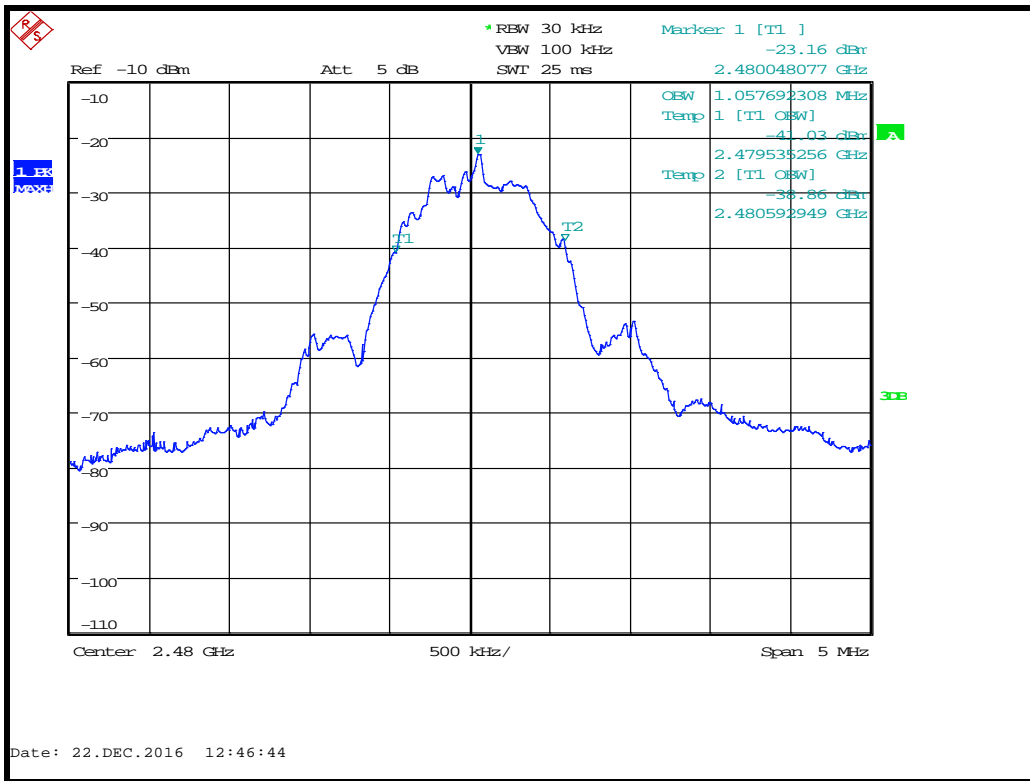




**RSS-210. Modulation: as BTLE; Data rate: as BTLE; Power setting: Default**

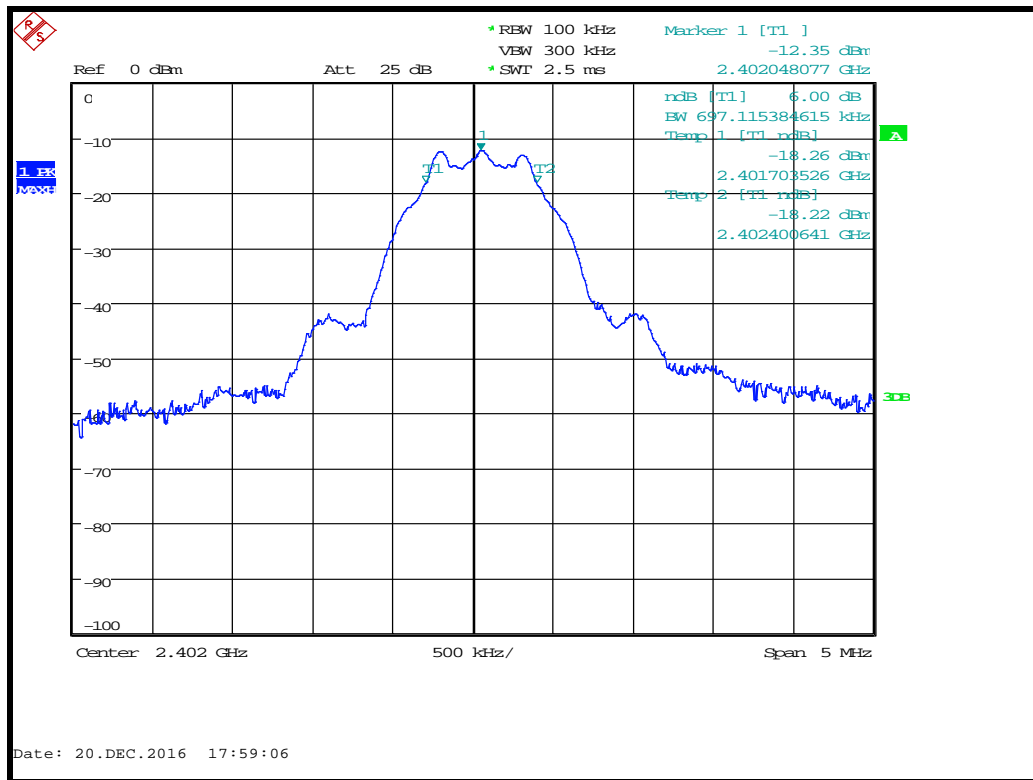
Channel Frequency (MHz)	$F_L$ (MHz)	$F_H$ (MHz)	99% Bandwidth (kHz)	Result
2402	2401.535256	2402.584936	1049.679487	PASS
2426	2425.535256	2426.592949	1057.692308	PASS
2480	2479.535256	2480.592949	1057.692308	PASS

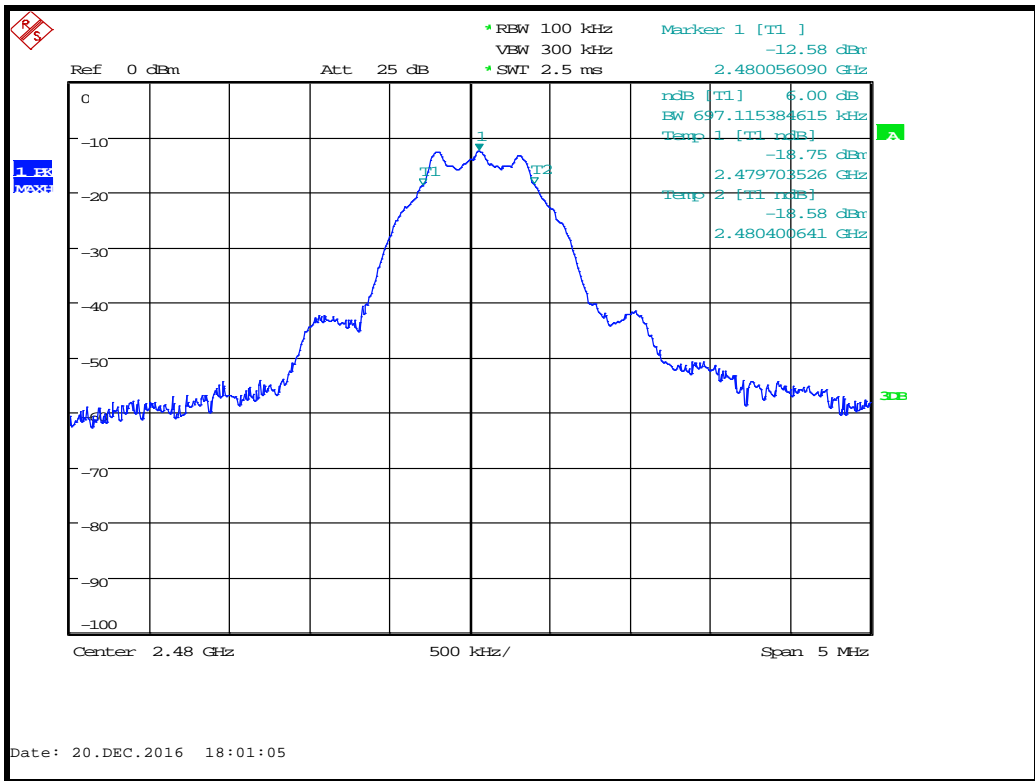
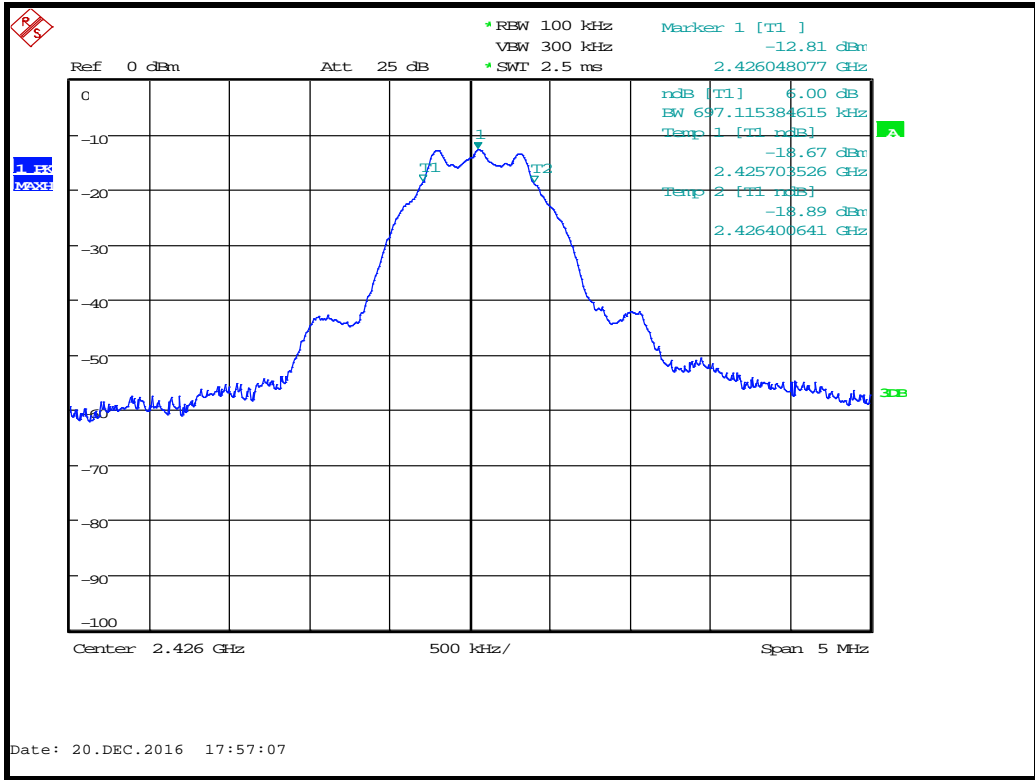




**FCC 15.247. Modulation: as BTLE; Data rate: as BTLE; Power setting: Default**

Channel Frequency (MHz)	$F_L$ (MHz)	$F_H$ (MHz)	6dB Bandwidth (kHz)	Result
2402	2401.703526	2402.400641	697.115	PASS
2426	2425.703526	2426.400641	697.115	PASS
2480	2479.703526	2480.400641	697.115	PASS





## 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 Hull
Test Chamber:	Lab 16
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None
Measurement BW:	3 MHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10 MHz
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: 20 °C	+15 °C to +35 °C (as declared)
Humidity: 45 % 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 1 W.

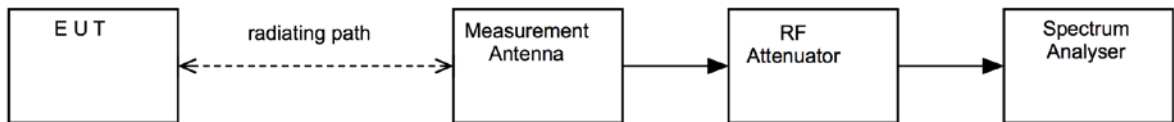


**13.4 Test Method**

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
FSU46	R&S	Spectrum Analyser	REF910	05/07/2017
8449B	Agilent	Pre-Amp (1 – 26.5GHz)	REF913	02/02/2018
3115	EMCO	Horn Antenna	RF9129	09/02/2018

**13.6 Test Results**

<i>Modulation: as BTLE; Data rate: as BTLE; Power setting: Default</i>					
<i>Channel Frequency (MHz)</i>	<i>Peak Radiated Power (dBm)</i>	<i>Distance (m)</i>	<i>Antenna Gain (dBi)</i>	<i>Max. Power (W)</i>	<i>Result</i>
2402	-10.6	3	1.72	0.059	PASS
2426	-11.1	3	1.72	0.052	PASS
2480	-9.0	3	1.72	0.085	PASS

## 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 Hull
Test Chamber:	N/A
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.11
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None

### Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 °C to +35 °C (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)
Supply: 3 Vdc	

### 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

All radiated spurious emissions results were below the general field strength limits specified in FCC 47CFR15.209(a) / RSS-Gen, testing to this section was not required.

## 15 Power spectral density

### 15.1 Definition

The power per unit bandwidth.

### 15.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Lab 16
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.10
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None
Measurement BW:	3 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10 kHz
Measurement Span: (requirement 1.5 times Channel BW)	1.1 MHz
Measurement Detector:	Peak

### Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 °C to +35 °C (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)
Supply: 3 V dc	

### 15.3 Test Limit

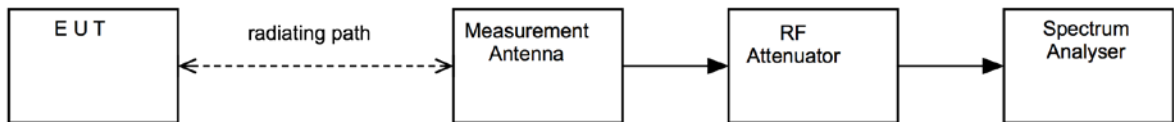
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

**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
FSU46	R&S	Spectrum Analyser	REF910	05/07/2017
8449B	Agilent	Pre-Amp (1 – 26.5GHz)	REF913	02/02/2018
3115	EMCO	Horn Antenna	RF9129	09/02/2018

## 15.6 Test Results

PSD measurements were made by taking a measurement with a 3 MHz RBW (as used for carrier power measurements) and using the Ref Level Offset function of the Spectrum Analyser to adjust the measured level to match the measured Carrier Power. Once this level setting had been made the RBW was changed to 3 kHz to take the peak PSD measurement.

<b>Modulation: as BTLE; Data rate: as BTLE; Power setting: Default</b>		
<b>Channel Frequency (MHz)</b>	<b>Power Spectral Density (dBm)</b>	<b>Result</b>
2402	-26.76	PASS
2426	-26.86	PASS
2480	-25.24	PASS

## 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

### KDB 447498

#### Section 4.3 General SAR test reduction and exclusion guidance

For Standalone SAR exclusion consideration, when SAR Exclusion Threshold requirement in KDB 447498 is satisfied, standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

In the frequency range below 100 MHz to 6 GHz and test separation distance of 50mm, the SAR Test Exclusion Threshold for operation in the 2400 – 2483.5 MHz band will be determined as follows

#### SAR Exclusion Threshold

$$NT = \{ [(MP/TSD) * \sqrt{fGHz}] + (TSD - 50mm) * 10 \}$$

Where:

NT	=	Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)
MP	=	Max Power of channel (mW) (inc tune up)
TSD	=	Min Test separation Distance (mm) = 50
fGHz	=	Transmit frequency (or 100MHz if lower)

We can transpose this formula to allow us to find the maximum power of a channel allowed and compare this to the measured maximum power.

$$MP = \{ [(NT * TSD) / \sqrt{fGHz}] + (TSD - 50) * 10 \}$$

#### Operating Frequency 2.402 GHz

$$MP = \{ [(3.0 * 50) / \sqrt{2.402}] + (50 - 50) * 10 \}$$

$$MP = \{ [150 / 1.55] + (0 * 10) \}$$

$$MP = 96.77mW$$

#### Operating Frequency 2.440 GHz

$$MP = \{ [(3.0 * 50) / \sqrt{2.426}] + (50 - 50) * 10 \}$$

$$MP = \{ [150 / 1.56] + (0 * 10) \}$$

$$MP = 96.15mW$$

#### Operating Frequency 2.480 GHz

$$MP = \{ [(3.0 * 50) / \sqrt{2.480}] + (50 - 50) * 10 \}$$

$$MP = \{ [150 / 1.57] + (0 * 10) \}$$

$$MP = 95.54mW$$

Channel Frequency (MHz)	EIRP (mW)	SAR Exclusion Threshold	SAR Evaluation
2402	59	96.77	Not Required
2426	52	96.15	Not Required
2480	85	95.54	Not Required

Therefore standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.