

Report on the Radio Testing

For

Pace plc

on

DOCSIS 3 HYBRID GATEWAY STB

Report no. TRA-028175-47-04A

2nd December 2015

RF916 2.0

Report Number: TRA-028175-47-04A  
Issue: A

REPORT ON THE RADIO TESTING OF A  
Pace plc  
DOCSIS 3 HYBRID GATEWAY STB  
WITH RESPECT TO SPECIFICATION  
FCC 47CFR 15.247 & IC RSS-210 Annex 8

TEST DATE: 1st October - 13th November 2015

Written by: D Winstanley

D Winstanley  
Radio Test Engineer

Approved by:

J Charters  
Department Manager - Radio

Date: 2nd December 2015

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

---

RF916 2.0

## 1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	2nd December 2015	Original

## 2 Summary

TEST REPORT NUMBER: TRA-028175-47-04A

WORKS ORDER NUMBER: TRA-028175-00

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.

TEST SPECIFICATION(S): 47CFR15.247

EQUIPMENT UNDER TEST (EUT): DOCSIS 3 HYBRID GATEWAY STB

FCC IDENTIFIER: NQ8ND7506

EUT SERIAL NUMBER: FN34A152840077

MANUFACTURER/AGENT: Pace plc

ADDRESS: Victoria Road  
Saltaire  
Shipley  
West Yorkshire  
BD18 3LF  
United Kingdom

CLIENT CONTACT: Robert Turner  
☎ 01274 537080  
✉ robert.turner@pace.com

ORDER NUMBER: Not Applicable

TEST DATE: 1st October - 13th November 2015

TESTED BY: D Winstanley  
Element

## 2.1 Test Summary

<b>Test Method and Description</b>	<b>Requirement Clause 47CFR15</b>	<b>Applicable to this equipment</b>	<b>Result / Note</b>
Radiated spurious emissions (restricted bands of operation and cabinet radiation)	15.205	<input checked="" type="checkbox"/>	Pass
AC power line conducted emissions	15.207	<input type="checkbox"/>	Note 1
Carrier frequency separation	15.247(a)(1)	<input checked="" type="checkbox"/>	Pass
Number of hopping channels	15.247(a)(1) (i), (ii) and (iii)	<input checked="" type="checkbox"/>	Pass
Average time of occupancy	15.247(a)(1) (i), (ii) and (iii)	<input checked="" type="checkbox"/>	Pass
Maximum peak conducted output power	15.247 (a)(1), (b)(1) and (b)(2)	<input checked="" type="checkbox"/>	Pass
20dB emission bandwidth	15.247(a)(1) (i) and (ii)	<input checked="" type="checkbox"/>	Pass
Out-of-band emissions	15.247(d)	<input checked="" type="checkbox"/>	Pass

### Notes:

1. See Test report TRA-028175-47-06A. AC Power line Conducted emissions were recorded with all radio devices active simultaneously

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

1	Revision Record.....	3
2	Summary.....	4
2.1	Test Summary.....	5
3	Contents.....	6
4	Introduction .....	8
5	Test Specifications .....	9
5.1	Normative References .....	9
5.2	Deviations from Test Standards .....	9
6	Glossary of Terms.....	10
7	Equipment Under Test .....	11
7.1	EUT Identification.....	11
7.2	System Equipment.....	11
7.3	EUT Mode of Operation .....	12
7.3.1	Transmission.....	12
7.3.2	Reception.....	12
7.4	EUT Radio Parameters .....	13
7.4.1	General .....	13
7.4.2	Antennas.....	13
7.4.3	Product specific declarations.....	14
7.5	EUT Description .....	14
8	Modifications .....	15
9	EUT Test Setup .....	16
9.1	Block Diagram.....	16
10	General Technical Parameters.....	17
10.1	Normal Conditions.....	17
10.2	Varying Test Conditions .....	17
11	Radiated emissions.....	18
11.1	Definitions .....	18
11.2	Test Parameters.....	18
11.3	Test Limit.....	18
11.4	Test Method .....	19
11.5	Test Equipment.....	20
11.6	Test Results .....	21
12	Carrier frequency separation.....	30
12.1	Definition .....	30
12.2	Test Parameters.....	30
12.3	Test Limit.....	30
12.4	Test Method .....	31
12.5	Test Equipment.....	31
12.6	Test Results .....	31
13	Number of hopping frequencies .....	33
13.1	Definition .....	33
13.2	Test Parameters.....	33
13.3	Test Limit.....	33
13.4	Test Method .....	34
13.5	Test Equipment.....	34
13.6	Test Results .....	35
14	Average channel occupancy .....	36
14.1	Definition .....	36
14.2	Test Parameters.....	36
14.3	Test Limit.....	36
14.4	Test Method .....	37
14.5	Test Equipment.....	37
14.6	Test Results .....	37
15	Maximum peak conducted output power.....	41
15.1	Definition .....	41
15.2	Test Parameters.....	41
15.3	Test Limit.....	41
15.4	Test Method .....	42
15.5	Test Equipment.....	42
15.6	Test Results .....	43
16	Occupied Bandwidth .....	44

16.1	Definition .....	44
16.2	Test Parameters.....	44
16.3	Test Limit.....	44
16.4	Test Method .....	45
16.5	Test Equipment.....	45
16.6	Test Results .....	46
17	Out-of-band and conducted spurious emissions .....	52
17.1	Definition .....	52
17.2	Test Parameters.....	52
17.3	Test Limits.....	52
17.4	Test Method .....	53
17.5	Test Equipment.....	53
17.6	Test Results .....	54
18	Measurement Uncertainty .....	60

## 4 Introduction

This report TRA-028175-47-04A presents the results of the Bluetooth Classic Radio testing on a Pace plc, DOCSIS 3 HYBRID GATEWAY STB to specification 47CFR15 Radio Frequency Devices

The testing was carried out for Pace plc by Element, at the address(es) detailed below.

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

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-210, Issue 8, December 2010 – Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
- 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: DOCSIS 3 HYBRID GATEWAY STB
- Serial Number: FN34A152840077
- Model Number: ND7506
- Build Revision
 

260-2251000	Layer 3 TV DDR3 Main Board Assembly
262-2227000	Layer 3 TV Server Front Panel assembly
260-2264000	PCA 2.4G WIFI MODULE
260-E397020	PCA 5G WIFI
- Software Version
 

Video Soc	
BootLoader: CBL v1.74	
Firmware version: v1.161	
Bluetooth Driver version: BCM20705B0_002.001.014.0590.0927	
CableModem	
CM Bootloader : v1.144	
CM App: v1.144-ltw	

### 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.

- Name: HDMI HDCP Ready Unit
- Sample Number: S03
- Serial Number: DP2012110417
- Model Number: None
- Name: Arris Cadant C3 CMTS
- Sample Number: S04
- Serial Number: 65000181-002109
- Model Number: None
- Name: PX031ECB Box
- Sample Number: S05
- Serial Number: PADA00015189
- Model Number: None
- Name: Dell Latitude Laptop
- Sample Number: S06
- Serial Number: SAL-17646
- Model Number: D430
- Name: Dell Latitude Laptop
- Sample Number: S07
- Serial Number: PACE0000019241
- Model Number: E6400
- Name: AOC 4K Television
- Sample Number: TRA-024769S07
- Serial Number: HCXE8JA002064
- Model Number: None

### **7.3 EUT Mode of Operation**

#### *7.3.1 Transmission*

The EUT was under the control of test software named 'digi debug' which when run exercised the EUT in its worst case configuration. While the test was running the EUT was decoding AV (audio visual) data from a MOCA (Multimedia over Coax Alliance) stream and then displaying it via HDMI at 2160p resolution. The EUT was connected to a DOCSIS head end. The HDD of the EUT was also active, with data being written to it and then read back. An internal SD card was inserted in order that the SD card TX and RX clock lines (50MHz) were active. A source playing HD AV was connected to the HDMI input of the EUT. Both USB ports were connected to USB 3.0 memory sticks. All other ports were terminated appropriately.

Bluetooth Classic transmitter control was either 'digi debug' or Blue tool software provided by the manufacturer of the Bluetooth hardware. The commands provided by the manufacturer setup the device into a permanent modulated transmit mode on the required channel.

#### *7.3.2 Reception*

This report covers transmitter operation only, results for unintentional emissions can be found in test report TRA-028175-44-00A

## 7.4 EUT Radio Parameters

### 7.4.1 General

<b>Frequency of operation:</b>	2400 – 2483.5 MHz
<b>Modulation type(s):</b>	GFSK, QPSK, 8PSK
<b>Occupied channel bandwidth(s):</b>	1 MHz
<b>Channel spacing:</b>	1 MHz
<b>Declared output power(s):</b>	10 mW (10 dBm)
<b>Warning against use of alternative antennas in user manual (yes/no):</b>	Not Applicable
<b>Nominal Supply Voltage:</b>	110 Vac
<b>Location of notice for license exempt use:</b>	Label / user manual / both.
<b>Duty cycle:</b>	Upto 100 %

### 7.4.2 Antennas

<b>Type:</b>	PCB style
<b>Frequency range:</b>	2400 – 2483.5 MHz
<b>Impedance:</b>	50 Ohms
<b>Gain:</b>	See Table
<b>Polarisation:</b>	Omni
<b>Beam width:</b>	Not Applicable
<b>Connector type:</b>	U-FL
<b>Mounting:</b>	Case Mounted

	Freq (MHz)	Peak Gain	Directivity	Efficiency
BT	2400	4.81	6.57	66.68 %
	2450	4.48	6.34	65.10 %
	2500	4.77	6.50	67.06 %
	Average			66.28 %

### 7.4.3 Product specific declarations

<b>Multiple antenna configuration(s), e.g. MIMO:</b>	Not Applicable
<b>Fixed pt-pt operations (yes/no):</b>	No
<b>Installation manual advice on pt-pt operational restrictions (yes/no):</b>	Not Applicable
<b>Fixed pt-mpt operations (yes/no):</b>	Not Applicable
<b>Simultaneous tx (yes/no):</b>	Yes

### 7.5 EUT Description

The EUT is a DOCSIS 3 Gateway, delivering broadband to the home via Ethernet or 2.4GHz Wi-Fi. The Gateway is capable of taking IP sourced video streams and displaying them on a TV via HDMI 2, Component and CVBS. It can connect to client boxes, routing video to up to three additional rooms within the home. Primary connection to the clients is via 5GHz Wi-Fi (802.11ac) but the client can also be connected via MOCA or Ethernet. Bluetooth is implemented on the Gateway to provide the option to connect to a smart remote control.

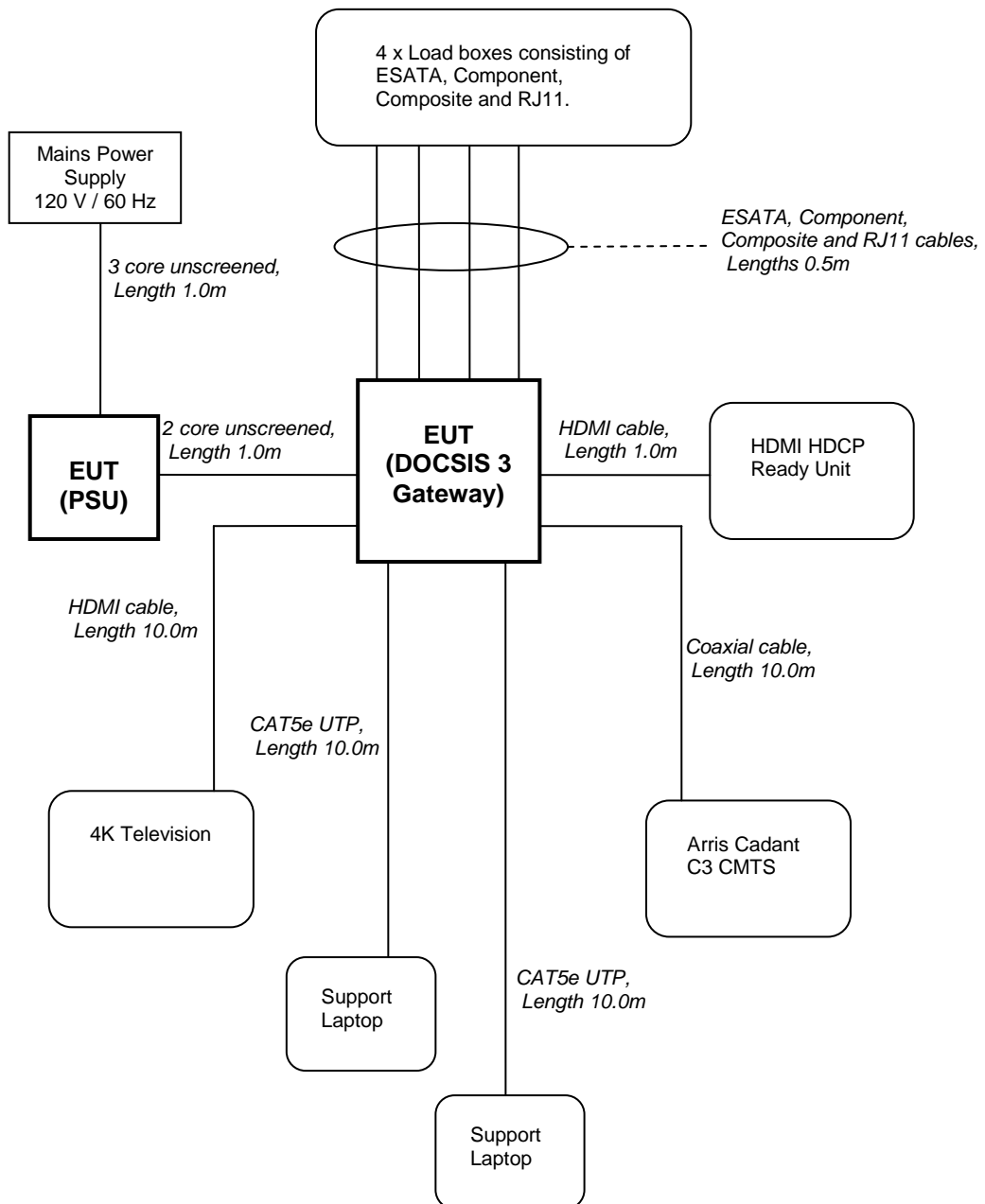
## **8 Modifications**

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:





## 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. 5 V dc from the adaptor / 3 V dc from alkaline batteries / 110 V ac, 60 Hz, from the mains.

### 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 checked="" type="checkbox"/>	Mains	110 V ac +/-2 %	85 % and 115 %
<input 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 Skelmersdale
Test Chamber:	Radio Chamber (REF940)
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: 18 °C	+15 °C to +35 °C (as declared)
Humidity: 51 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V ac	230 V ac $\pm$ 10 % (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

<i>Frequency (MHz)</i>	<i>Field Strength (<math>\mu</math>V/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;

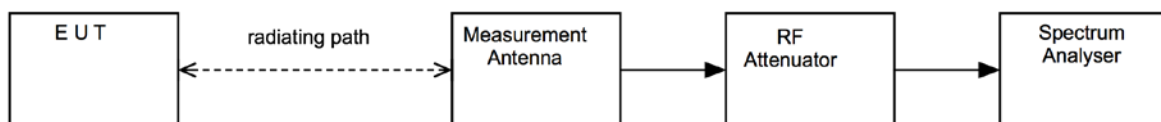
PA is the pre-amplifier gain in dB (where used);

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 Equipment

<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>
Bilog	Chase	CBL611/A	UH191	26/02/2017
ESVS10	R&S	ESVS10	L352	07/08/2016
Spectrum Analyser	R&S	FSU26	REF909	13/02/2016
Horn Antenna	EMCO	3115	L139	20/09/2015
Pre-Amplifier	Agilent	8449B	L572	10/02/2016
Horn Antenna	Flann	20240-20	L300	10/02/2016
Horn Antenna	Flann	22240-20	L301	Note 1
Filter	BSC	SN 4478	U543	23/08/2017

#### ANSI C63.10 - 4.4.3 a) Antenna calibration

Standard gain horns need not be periodically recalibrated, unless damage or deterioration is suspected or known to have occurred. If a standard gain horn is not periodically recalibrated, then its critical dimensions (see IEEE Std 1309-2005) shall be verified and documented on an annual basis

## 11.6 Test Results

Modulation: GFSK <sub>c</sub> - 2402 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dB $\mu$ V)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dB $\mu$ V/m)	Field Strength ( $\mu$ V/m)	Limit ( $\mu$ V/m)
No Significant Emissions in restricted bands within 20 dB of the Limit										

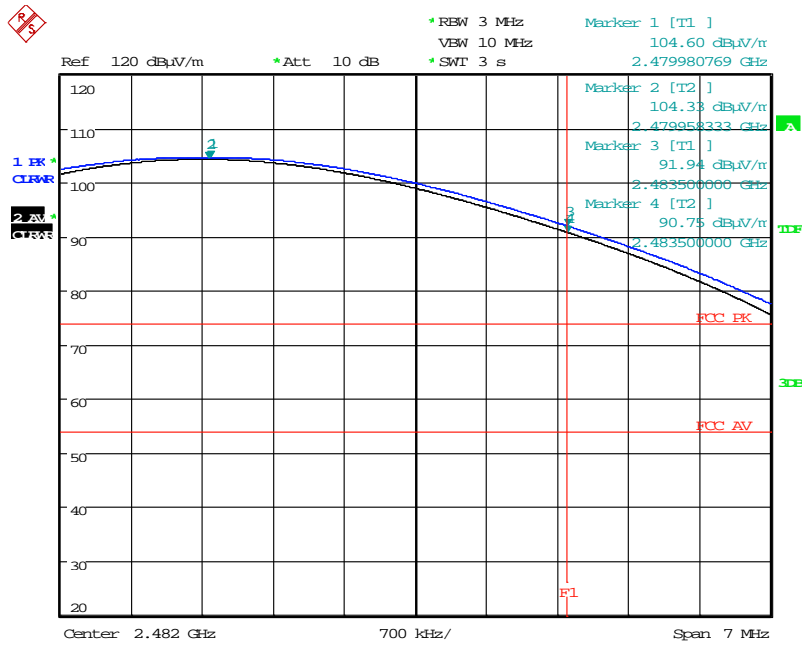
Modulation: GFSK <sub>c</sub> - 2440 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dB $\mu$ V)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dB $\mu$ V/m)	Field Strength ( $\mu$ V/m)	Limit ( $\mu$ V/m)
Pk	4879.97	51.41	5.20	33.30	35.90	0.00	0.00	54.01	501.76	5012
Av	4879.97	43.35	5.20	33.30	35.90	0.00	0.00	45.95	198.38	500
Pk	7319.97	48.49	6.00	36.40	36.61	0.00	0.00	54.28	517.61	5012
Av	7319.97	38.12	6.00	36.40	36.61	0.00	0.00	43.91	156.86	500

Modulation: GFSK <sub>c</sub> - 2480 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dB $\mu$ V)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dB $\mu$ V/m)	Field Strength ( $\mu$ V/m)	Limit ( $\mu$ V/m)
Pk	4959.95	51.02	5.10	33.50	35.89	0.00	0.00	53.73	485.85	5012
Av	4959.95	43.61	5.10	33.50	35.89	0.00	0.00	46.32	207.01	500
Pk	7439.95	47.93	6.10	36.70	36.64	0.00	0.00	54.09	506.41	5012
Av	7439.95	36.59	6.10	36.70	36.64	0.00	0.00	42.75	137.25	500

Upper bandedge measurements using marker delta method

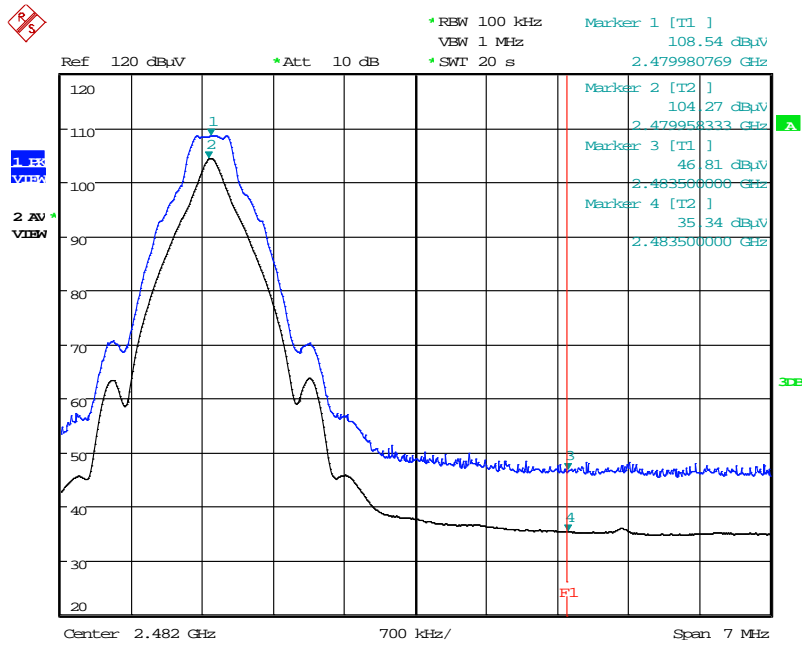
Modulation: GFSK <sub>c</sub> - 2480 MHz				
Measurement	Peak Detector		Average Detector	
Carrier power (3MHz RBW)	104.60	dB $\mu$ V/m	104.33	dB $\mu$ V/m
Peak Level in (100kHz RBW)	108.52	dB $\mu$ V	104.57	dB $\mu$ V
delta in 100kHz	-61.73	dB	-68.93	dB
Power At Bandedge	42.87	dB $\mu$ V/m	35.40	dB $\mu$ V/m
Limit	74.00	dB $\mu$ V/m	54.00	dB $\mu$ V/m
Margin	31.13	dB	18.60	dB

### Upper band edge compliance



Date: 9.NOV.2015 10:38:34

### Power in 3 MHz bandwidth



Date: 9.NOV.2015 10:40:20

### Power and Levels @ Bandedge in 100 kHz for delta levels

<b>Modulation: QPSK<sub>c</sub>- 2402 MHz</b>										
<b>Detector</b>	<b>Freq. (MHz)</b>	<b>Meas'd Emission (dBμV)</b>	<b>Cable Loss (dB)</b>	<b>Antenna Factor (dB/m)</b>	<b>Pre-amp Gain (dB)</b>	<b>Duty Cycle Corr'n (dB)</b>	<b>Distance Extrap'n Factor (dB)</b>	<b>Field Strength (dBμV/m)</b>	<b>Field Strength (μV/m)</b>	<b>Limit (μV/m)</b>
No Significant Emissions in restricted bands within 20 dB of the Limit										

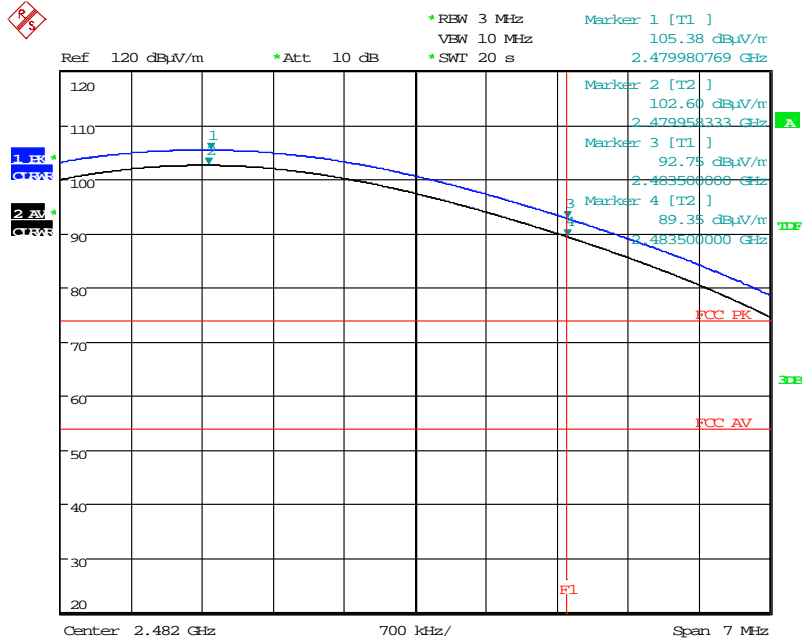
<b>Modulation: QPSK<sub>c</sub>- 2440 MHz</b>										
<b>Detector</b>	<b>Freq. (MHz)</b>	<b>Meas'd Emission (dBμV)</b>	<b>Cable Loss (dB)</b>	<b>Antenna Factor (dB/m)</b>	<b>Pre-amp Gain (dB)</b>	<b>Duty Cycle Corr'n (dB)</b>	<b>Distance Extrap'n Factor (dB)</b>	<b>Field Strength (dBμV/m)</b>	<b>Field Strength (μV/m)</b>	<b>Limit (μV/m)</b>
Pk	4879.97	51.50	5.20	33.30	35.90	0.00	0.00	54.10	506.99	5012
Av	4879.97	40.46	5.20	33.30	35.90	0.00	0.00	43.06	142.23	500
Pk	7319.97	48.32	6.00	36.40	36.61	0.00	0.00	54.11	507.57	5012
Av	7319.97	35.97	6.00	36.40	36.61	0.00	0.00	41.76	122.46	500

<b>Modulation: QPSK<sub>c</sub>- 2480 MHz</b>										
<b>Detector</b>	<b>Freq. (MHz)</b>	<b>Meas'd Emission (dBμV)</b>	<b>Cable Loss (dB)</b>	<b>Antenna Factor (dB/m)</b>	<b>Pre-amp Gain (dB)</b>	<b>Duty Cycle Corr'n (dB)</b>	<b>Distance Extrap'n Factor (dB)</b>	<b>Field Strength (dBμV/m)</b>	<b>Field Strength (μV/m)</b>	<b>Limit (μV/m)</b>
Pk	4959.95	50.44	5.10	33.50	35.89	0.00	0.00	53.15	454.46	5012
Av	4959.95	40.36	5.10	33.50	35.89	0.00	0.00	43.07	142.40	500
Pk	7439.95	47.52	6.10	36.70	36.64	0.00	0.00	53.68	483.06	5012
Av	7439.95	35.01	6.10	36.70	36.64	0.00	0.00	41.17	114.42	500

Upper bandedge measurements using marker delta method

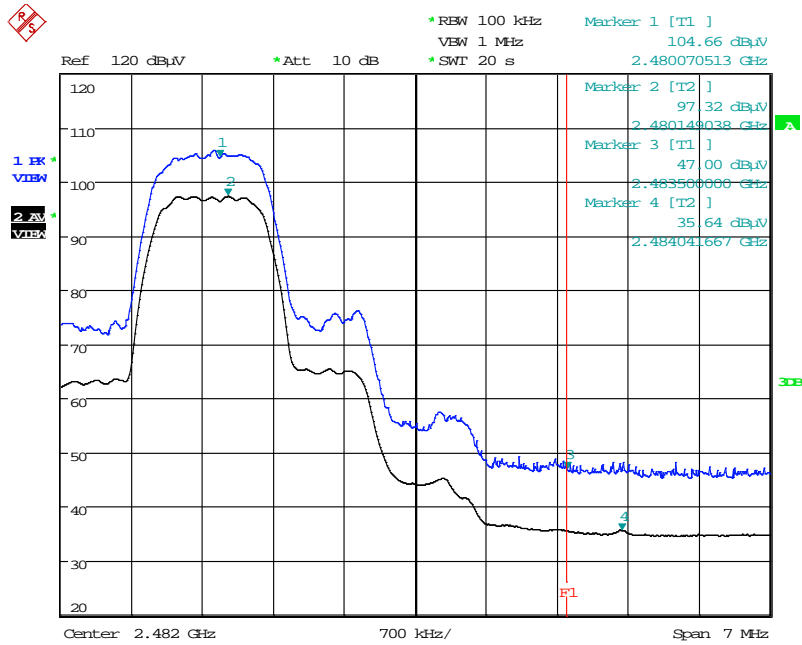
<b>Modulation: QPSK<sub>c</sub>- 2480 MHz</b>				
Measurement	Peak Detector		Average Detector	
	Carrier power (3MHz RBW)	105.38	dBuV/m	102.60
Peak Level in (100kHz RBW)	104.66	dBuV	97.32	dBuV
delta in 100kHz	-57.66	dB	-61.68	dB
Power At Bandedge	47.72	dBuV/m	40.92	dBuV/m
Limit	74.00	dBuV/m	54.00	dBuV/m
Margin	26.28	dB	13.08	dB

### Upper band edge compliance



Date: 9.NOV.2015 10:43:32

### Power in 3 MHz bandwidth



Date: 9.NOV.2015 10:52:48

### Power and Levels @ Bandedge in 100 kHz for delta levels



<b>Modulation: 8PSK;- 2402 MHz</b>										
<b>Detector</b>	<b>Freq. (MHz)</b>	<b>Meas'd Emission (dBµV)</b>	<b>Cable Loss (dB)</b>	<b>Antenna Factor (dB/m)</b>	<b>Pre-amp Gain (dB)</b>	<b>Duty Cycle Corr'n (dB)</b>	<b>Distance Extrap'n Factor (dB)</b>	<b>Field Strength (dBµV/m)</b>	<b>Field Strength (µV/m)</b>	<b>Limit (µV/m)</b>
No Significant Emissions in restricted bands within 20 dB of the Limit										

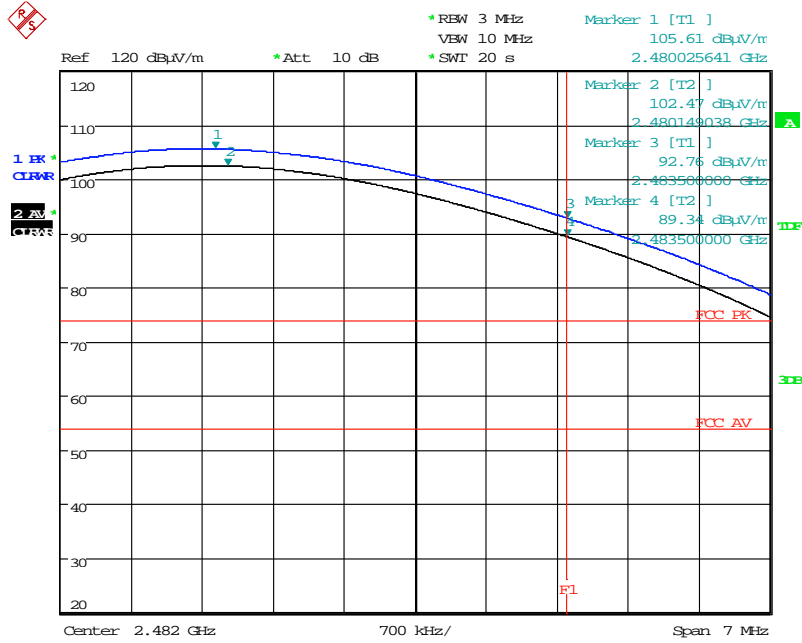
<b>Modulation: 8PSK;- 2440 MHz</b>										
<b>Detector</b>	<b>Freq. (MHz)</b>	<b>Meas'd Emission (dBµV)</b>	<b>Cable Loss (dB)</b>	<b>Antenna Factor (dB/m)</b>	<b>Pre-amp Gain (dB)</b>	<b>Duty Cycle Corr'n (dB)</b>	<b>Distance Extrap'n Factor (dB)</b>	<b>Field Strength (dBµV/m)</b>	<b>Field Strength (µV/m)</b>	<b>Limit (µV/m)</b>
Pk	4879.97	50.99	5.20	33.30	35.90	0.00	0.00	53.59	478.08	5012
Av	4879.97	40.37	5.20	33.30	35.90	0.00	0.00	42.97	140.77	500
Pk	7319.97	49.19	6.00	36.40	36.61	0.00	0.00	54.98	561.05	5012
Av	7319.97	35.90	6.00	36.40	36.61	0.00	0.00	41.69	121.48	500

<b>Modulation: 8PSK;- 2480 MHz</b>										
<b>Detector</b>	<b>Freq. (MHz)</b>	<b>Meas'd Emission (dBµV)</b>	<b>Cable Loss (dB)</b>	<b>Antenna Factor (dB/m)</b>	<b>Pre-amp Gain (dB)</b>	<b>Duty Cycle Corr'n (dB)</b>	<b>Distance Extrap'n Factor (dB)</b>	<b>Field Strength (dBµV/m)</b>	<b>Field Strength (µV/m)</b>	<b>Limit (µV/m)</b>
Pk	4959.95	50.05	5.10	33.50	35.89	0.00	0.00	52.76	434.51	5012
Av	4959.95	40.33	5.10	33.50	35.89	0.00	0.00	43.04	141.91	500
Pk	7439.95	47.92	6.10	36.70	36.64	0.00	0.00	54.08	505.82	5012
Av	7439.95	34.95	6.10	36.70	36.64	0.00	0.00	41.11	113.63	500

Upper bandedge measurements using marker delta method

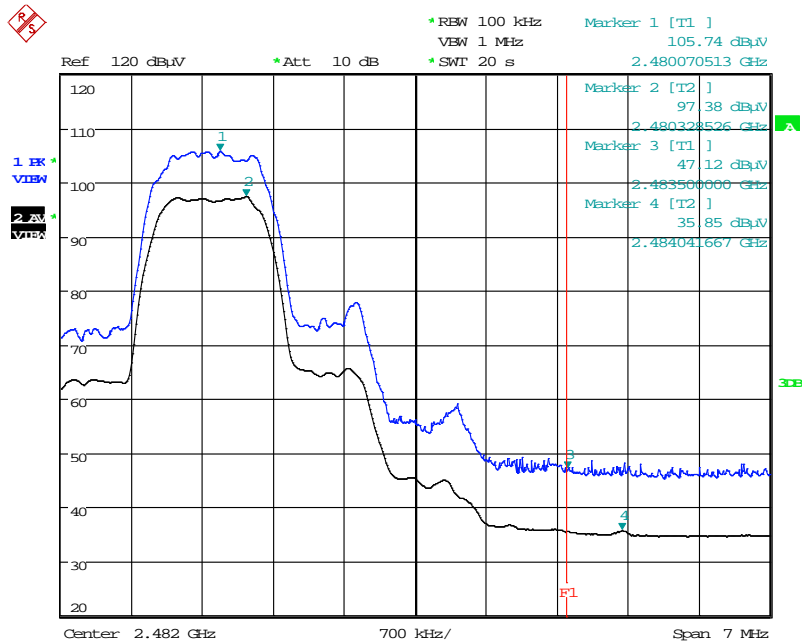
<b>Modulation: 8PSK;- 2480 MHz</b>					
Measurement		Peak Detector		Average Detector	
Carrier power (3MHz RBW)		105.61	dBuV/m	102.47	dBuV/m
Peak Level in (100kHz RBW)		105.74	dBuV	97.38	dBuV
delta in 100kHz		-58.62	dB	-61.53	dB
Power At Bandedge		46.99	dBuV/m	40.94	dBuV/m
Limit		74.00	dBuV/m	54.00	dBuV/m
Margin		27.01	dB	13.06	dB

### Upper band edge compliance



Date: 9.NOV.2015 10:49:05

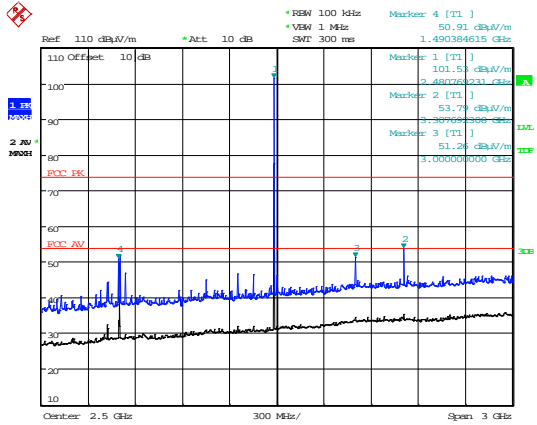
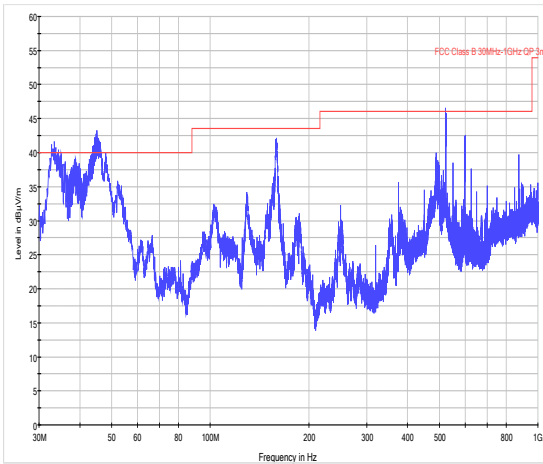
### Power in 3 MHz bandwidth



Date: 9.NOV.2015 10:51:45

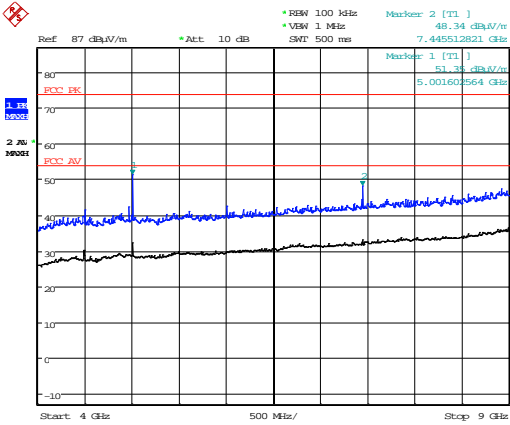
### Power and Levels @ Bandedge in 100 kHz for delta levels

### 2402 MHz



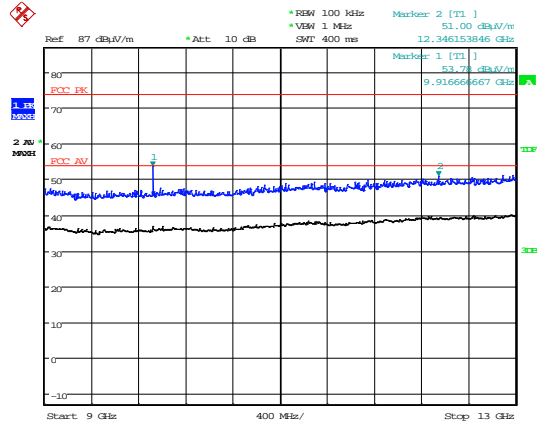
Date: 2.OCT.2015 13:45:12

### 30 MHz – 1 GHz



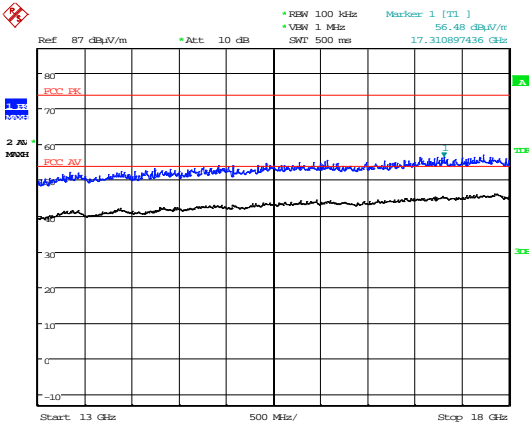
Date: 2.OCT.2015 13:35:31

### 1 GHz – 4 GHz



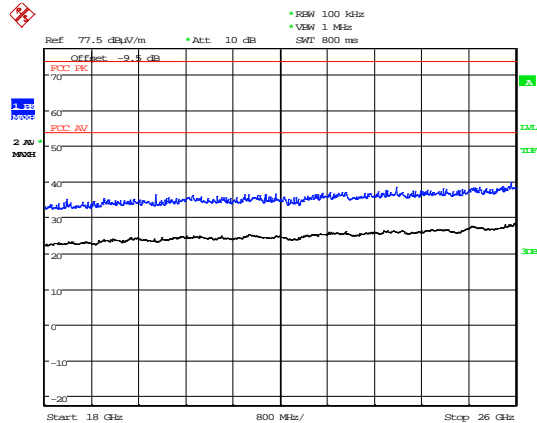
Date: 2.OCT.2015 12:28:47

### 4 GHz – 9 GHz



Date: 2.OCT.2015 12:24:01

### 9 GHz – 13 GHz

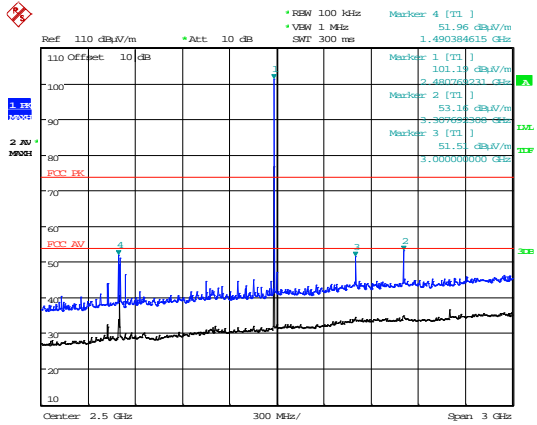
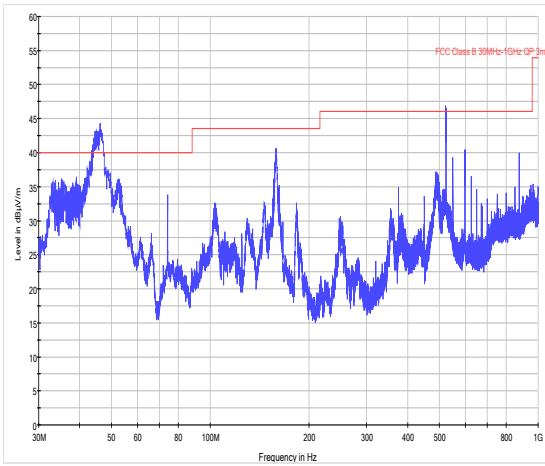


Date: 2.OCT.2015 11:47:09

### 13 GHz – 18 GHz

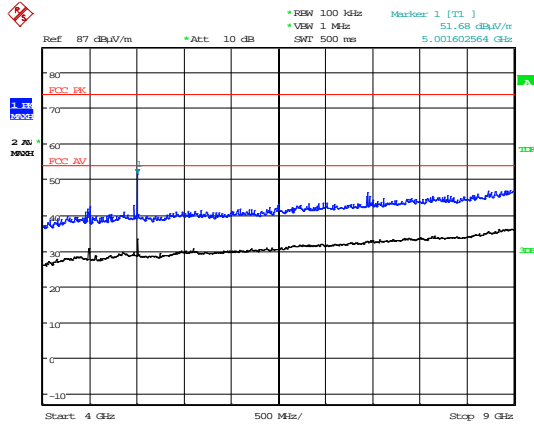
### 18 GHz – 25 GHz

### 2440 MHz



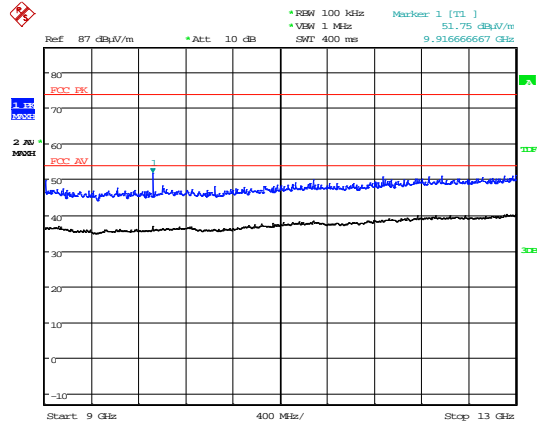
Date: 2.OCT.2015 13:46:24

### 30 MHz – 1 GHz



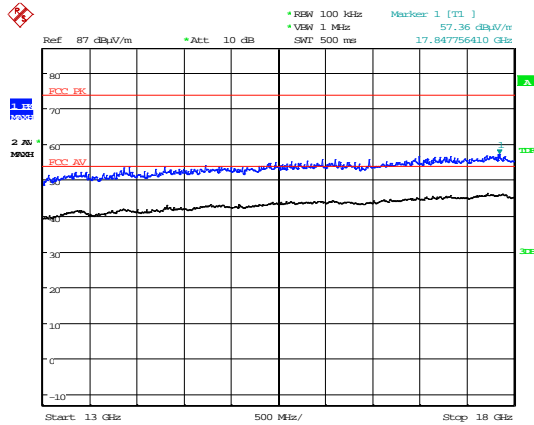
Date: 2.OCT.2015 13:34:29

### 1 GHz – 4 GHz



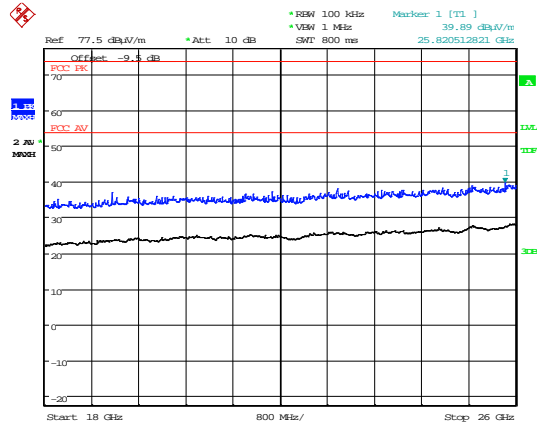
Date: 2.OCT.2015 12:30:05

### 4 GHz – 9 GHz



Date: 2.OCT.2015 12:17:56

### 9 GHz – 13 GHz

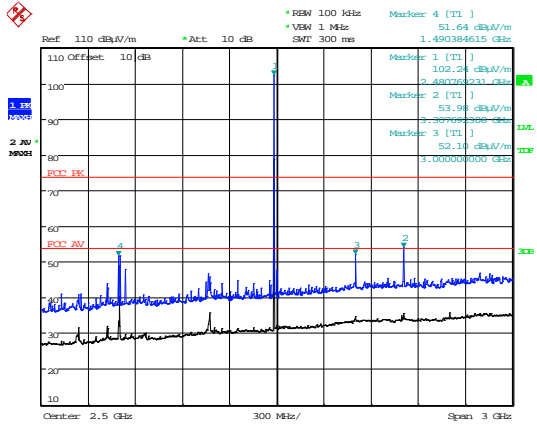
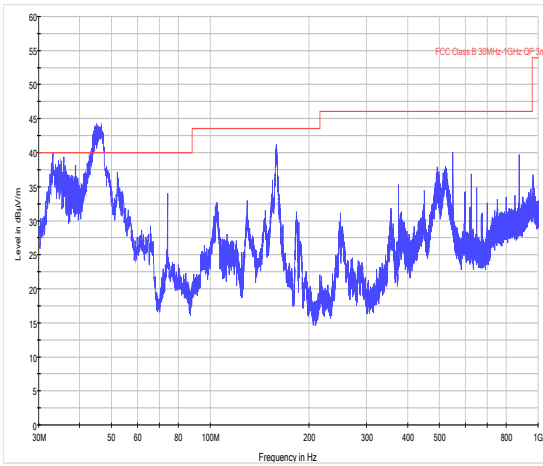


Date: 2.OCT.2015 11:48:26

### 13 GHz – 18 GHz

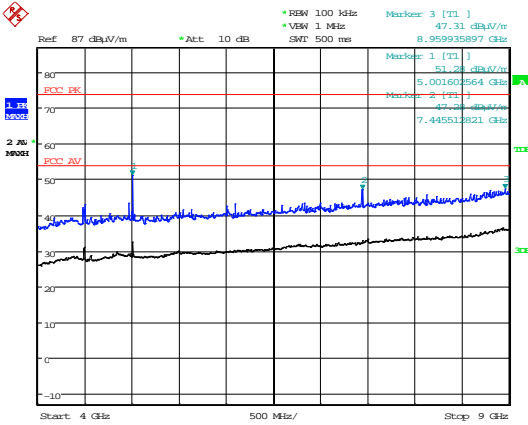
### 18 GHz – 25 GHz

### 2480 MHz



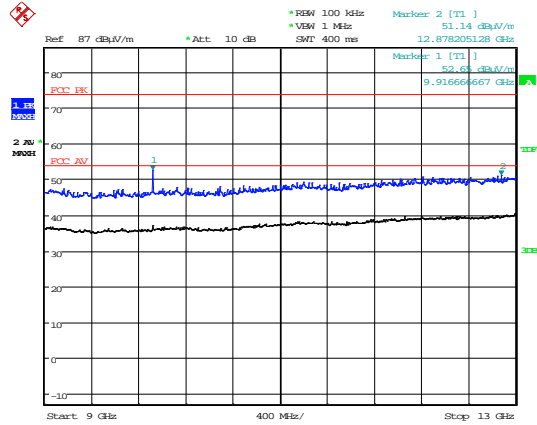
Date: 2.OCT.2015 13:49:46

### 30 MHz – 1 GHz



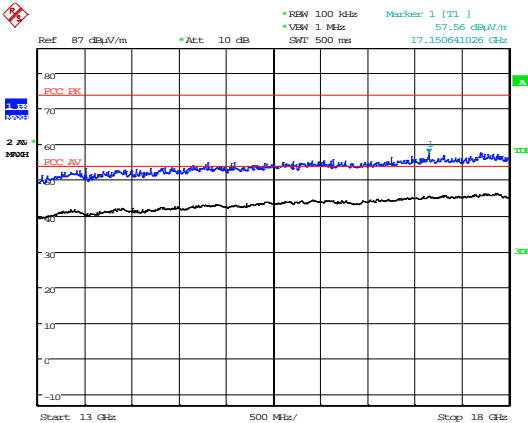
Date: 2.OCT.2015 12:36:17

### 1 GHz – 4 GHz



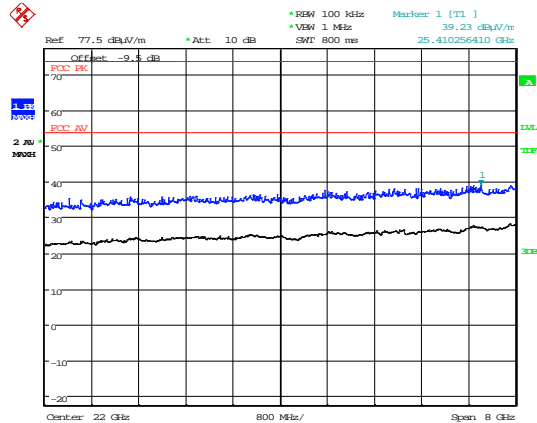
Date: 2.OCT.2015 12:34:41

### 4 GHz – 9 GHz



Date: 2.OCT.2015 12:13:36

### 9 GHz – 13 GHz



Date: 2.OCT.2015 11:52:01

### 13 GHz – 18 GHz

### 18 GHz – 25 GHz

## 12 Carrier frequency separation

### 12.1 Definition

The carrier frequency separation is the frequency separation between two adjacent hopping frequencies.

### 12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.2
EUT Channels / Frequencies Measured:	All; 2405 to 2480 MHz
EUT Test Modulations:	Internal pattern generation – hopping enabled
Deviations From Standard:	None
Measurement BW:	100 kHz
Measurement Detector:	Peak

### Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V acc	230 V ac $\pm$ 10 % (as declared)

### 12.3 Test Limit

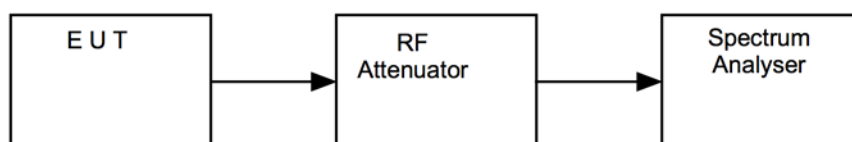
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the band 2400 to 2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the -20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

## 12.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iii, the emissions of 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 nominal bandwidth.

**Figure iii Test Setup**

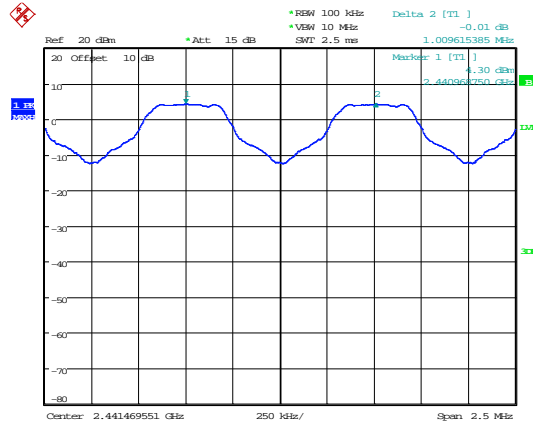


## 12.5 Test Equipment

Type of Equipment	Maker/Supplier	Model Number	Element Number	Calibration Due Date
Spectrum Analyser	R&S	FSU26	REF909	13/02/2016
Spectrum Analyser	R&S	FSU26	UH405	11/05/2016
10 dB Attenuator	Radiall	R411820121	N/A	In Use

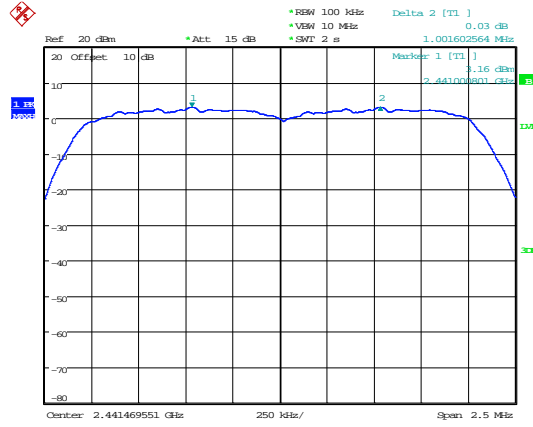
## 12.6 Test Results

Modulation	$F_{1c}$ (MHz)	$F_{2c}$ (MHz)	Channel Separation, $F_{2c} - F_{1c}$ (kHz)	Result
GFSK	2440	2441	1009.615	PASS
QPSK	2440	2441	1001.602	PASS
8 PSK	2440	2441	991.987	PASS



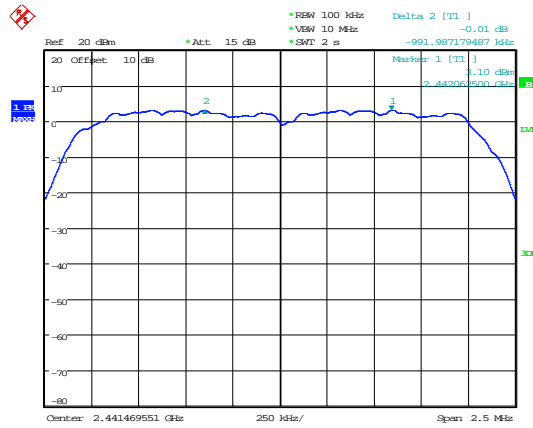
Date: 29.OCT.2015 11:00:53

### GFSK



Date: 29.OCT.2015 11:04:01

### QPSK



Date: 29.OCT.2015 11:06:24

### 8PSK



## 13 Number of hopping frequencies

### 13.1 Definition

The total number of hopping frequencies (the centre frequencies defined within the hopping sequence of a FHSS equipment) which are randomly sequenced in order to spread the transmission.

### 13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.3
EUT Channels / Frequencies Measured:	All; 2405 – 2480 MHz
EUT Test Modulations:	Internal pattern generation – hopping enabled
Deviations From Standard:	None
Measurement BW:	100 kHz
Measurement Detector:	Peak

### Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V ac	230 V ac $\pm$ 10 % (as declared)

### 13.3 Test Limit

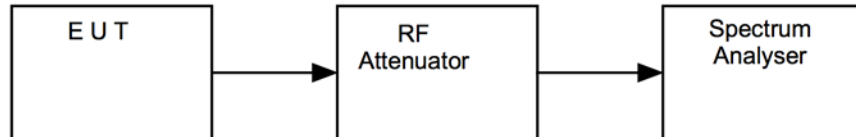
- For frequency hopping systems in the band 902 to 928 MHz: if the -20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels; If the -20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels;
- Frequency hopping systems operating in the band 2400 to 2483.5 MHz shall use at least 15 hopping channels;
- Frequency hopping systems operating in the band 5725 to 5850 MHz shall use at least 75 hopping channels.

### 13.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the emissions of 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 nominal bandwidth.

**Figure iv Test Setup**

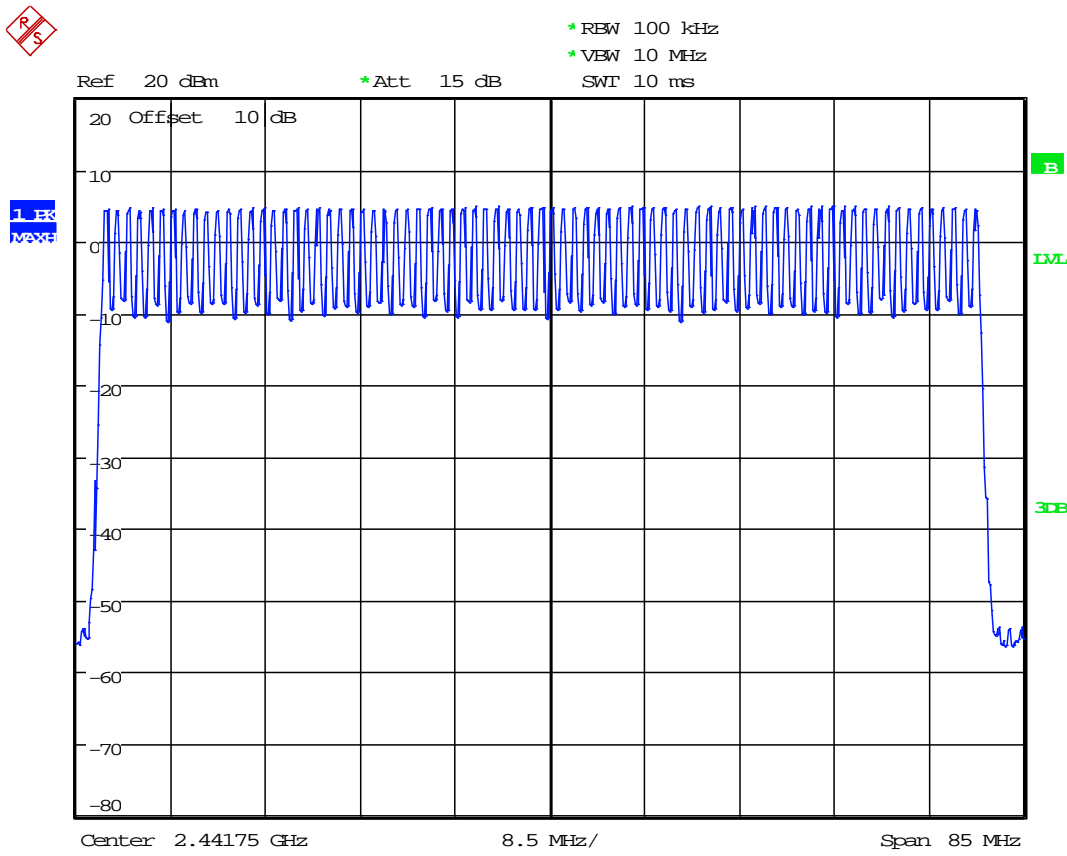


### 13.5 Test Equipment

<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>
Spectrum Analyser	R&S	FSU26	REF909	13/02/2016
Spectrum Analyser	R&S	FSU26	UH405	11/05/2016
10 dB Attenuator	Radiall	R411820121	N/A	In Use

13.6 Test Results

Modulation: ; Power setting: .				
Data Rate	Lowest channel, $F_{CL}$ (MHz)	Highest channel, $F_{CH}$ (MHz)	Number of channels observed	Result
GFSK	2402	2480	79	PASS
QPSK	2402	2480	79	PASS
8 PSK	2402	2480	79	PASS



Date: 29.OCT.2015 10:37:37

## 14 Average channel occupancy

### 14.1 Definition

The channel occupancy is the total of the transmitter 'on' times, during an observation period, on a particular hopping frequency.

### 14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.4
EUT Channels / Frequencies Measured:	Mid
EUT Number of hopping channels:	79
EUT Test Modulations:	Internal pattern generation – hopping enabled
Deviations From Standard:	None
Measurement BW:	1 MHz
Measurement Detector:	Peak

### Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V ac	230 V ac $\pm$ 10 % (as declared)

### 14.3 Test Limit

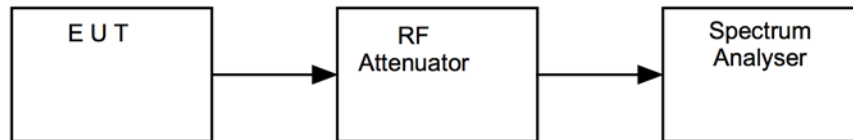
- For frequency hopping systems in the band 902 to 928 MHz: if the -20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20 second period;  
If the -20 dB bandwidth of the hopping channel is 250 kHz or greater, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10 second period;
- Frequency hopping systems operating in the band 2400 to 2483.5 MHz: The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed;
- Frequency hopping systems operating in the band 5725 to 5850 MHz: The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

#### 14.4 Test Method

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

The measurements were performed with EUT set at its maximum duty. A number of hops were observed to confirm consistency of the dwell time / observe the worst case. All modulation schemes, data rates and power settings were used to observe the worst-case configuration.

**Figure v Test Setup**



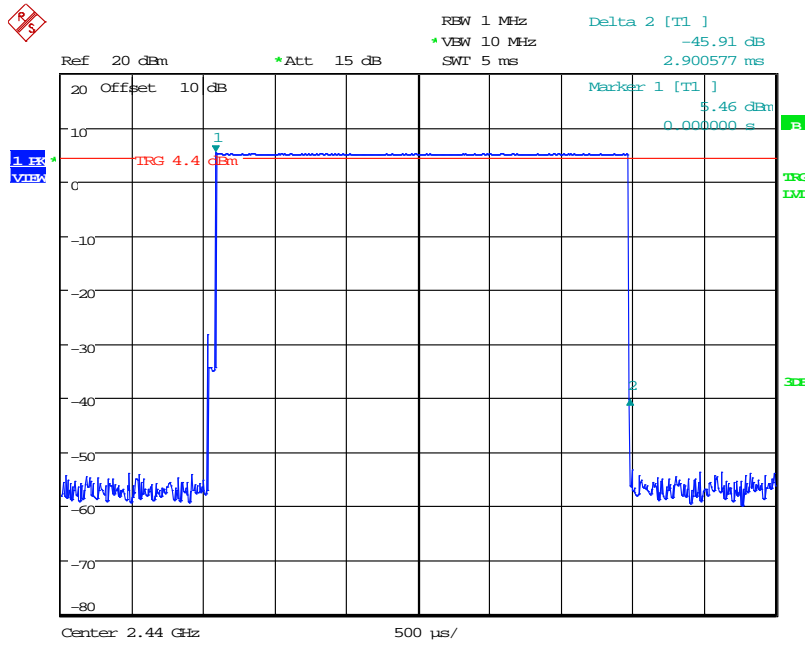
#### 14.5 Test Equipment

<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>
Spectrum Analyser	R&S	FSU26	REF909	13/02/2016
Spectrum Analyser	R&S	FSU26	UH405	11/05/2016
10 dB Attenuator	Radiall	R411820121	N/A	In Use

#### 14.6 Test Results

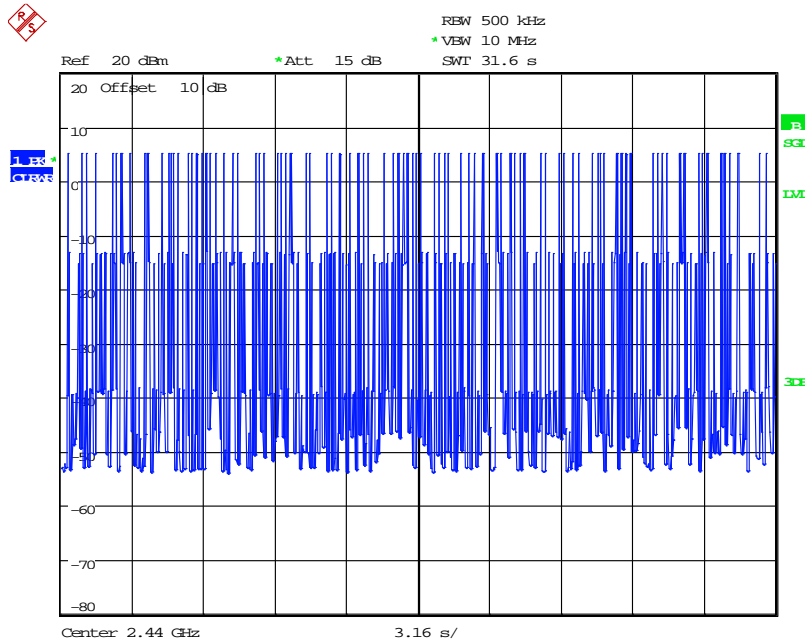
<i>Modulation: ; Power setting: .</i>					
<i>Data Rate</i>	<i>Individual occupancy time (ms)</i>	<i>Observation period (s)</i>	<i>Number of hops observed</i>	<i>Average time of occupancy (s)</i>	<i>Result</i>
GFSK	2.900	31.6	92	0.267	PASS
QPSK	2.901	31.6	91	0.264	PASS
8PSK	2.901	31.6	97	0.281	PASS

### GFSK Modulation



Date: 29.OCT.2015 10:41:06

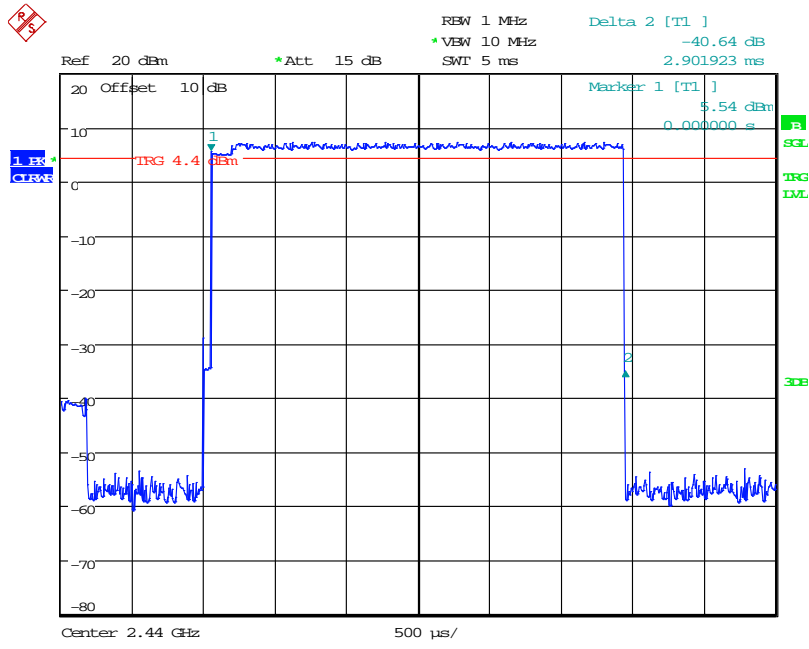
### Individual Occupancy Time



Date: 29.OCT.2015 10:45:38

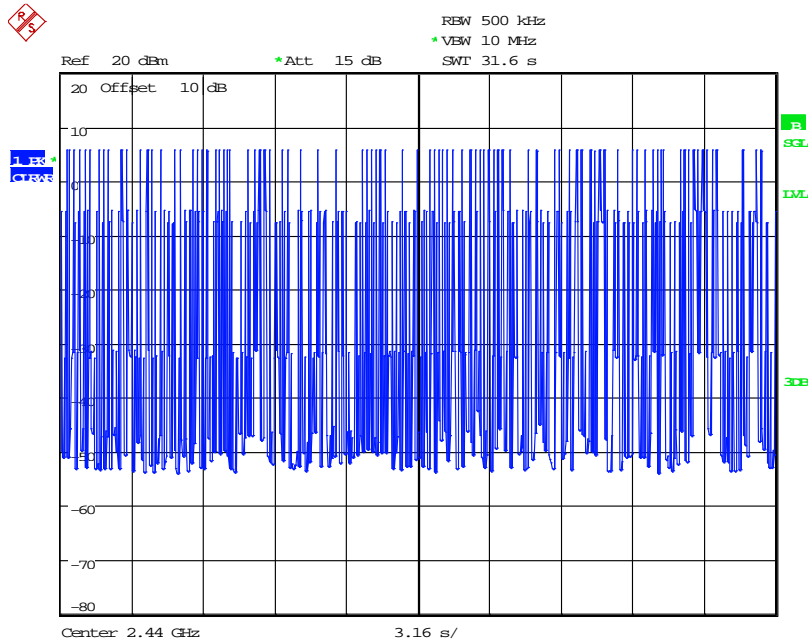
### Number of Hops Observed

### QPSK Modulation



Date: 29.OCT.2015 10:56:32

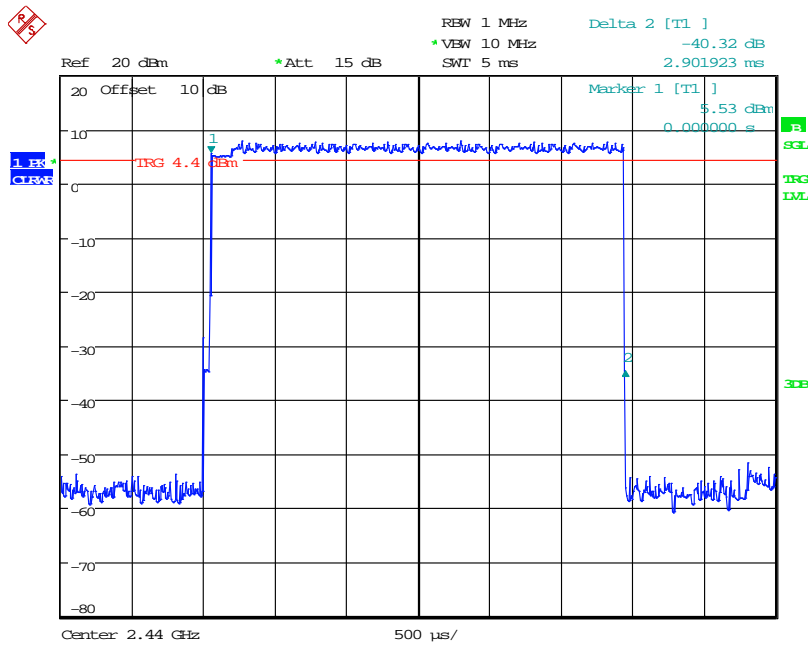
### Individual Occupancy Time



Date: 29.OCT.2015 10:50:43

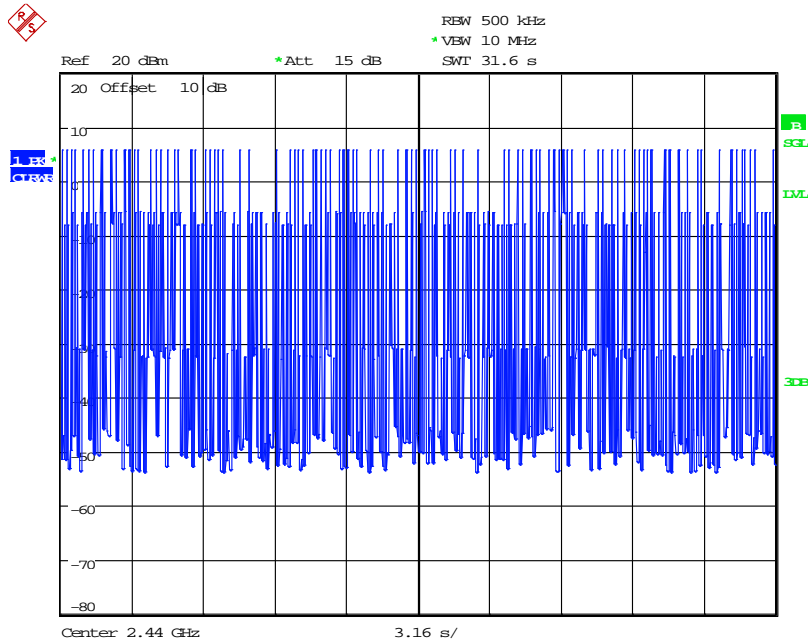
### Number of Hops Observed

### 8PSK Modulation



Date: 29.OCT.2015 10:55:20

### Individual Occupancy Time



Date: 29.OCT.2015 10:53:06

### Number of Hops Observed



## 15 Maximum peak conducted output power

### 15.1 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.

### 15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.5
EUT Channels / Frequencies Measured:	2402 MHz / 2440 MHz / 2480 MHz – hopping disabled.
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None
Measurement BW:	3 MHz
Spectrum Analyzer Video BW:	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: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)

### 15.3 Test Limit

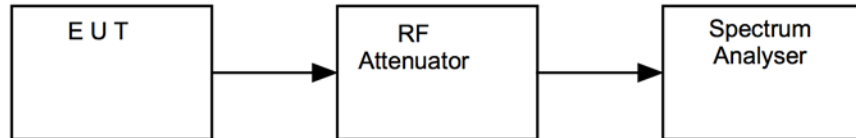
- For frequency hopping systems operating in the band 902 to 928 MHz, the maximum peak conducted output power shall not exceed 1 W, and the e.i.r.p. shall not exceed 4 W, if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W, and the e.i.r.p. shall not exceed 1 W, if the hopset uses less than 50 hopping channels.
- For frequency hopping systems operating in the band 2400 to 2483.5 MHz and employing at least 15 channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W. The e.i.r.p. shall not exceed 4 W.
- For frequency hopping systems operating in the band 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W.
- Point-to-point systems in the bands 2400-2483.5 MHz and 5725 to 5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers.

### 15.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vi, 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 vi Test Setup**



### 15.5 Test Equipment

<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>
Spectrum Analyser	R&S	FSU26	REF909	13/02/2016
Spectrum Analyser	R&S	FSU26	UH405	11/05/2016
10 dB Attenuator	Radiall	R411820121	N/A	In Use

## 15.6 Test Results

<b>Modulation: GFSK; Power setting: 10 dBm</b>					
<b>Channel Frequency (MHz)</b>	<b>Analyzer Level (dBm)</b>	<b>Cable loss (dB)</b>	<b>Maximum peak conducted output power (dBm)</b>	<b>Maximum peak conducted output power (mW)</b>	<b>Result</b>
2402	-1.69	10	8.31	6.78	PASS
2441	-1.64	10	8.36	6.85	PASS
2480	-1.74	10	8.26	6.70	PASS

<b>Modulation: QPSK; Power setting: 10 dBm</b>					
<b>Channel Frequency (MHz)</b>	<b>Analyzer Level (dBm)</b>	<b>Cable loss (dB)</b>	<b>Maximum peak conducted output power (dBm)</b>	<b>Maximum peak conducted output power (mW)</b>	<b>Result</b>
2402	-0.91	10	9.09	8.11	PASS
2441	-0.92	10	9.08	8.09	PASS
2480	-0.95	10	9.05	8.04	PASS

<b>Modulation: 8PSK; Power setting: 10 dBm</b>					
<b>Channel Frequency (MHz)</b>	<b>Analyzer Level (dBm)</b>	<b>Cable loss (dB)</b>	<b>Maximum peak conducted output power (dBm)</b>	<b>Maximum peak conducted output power (mW)</b>	<b>Result</b>
2402	-0.61	10	9.39	8.69	PASS
2441	-0.60	10	9.40	8.71	PASS
2480	-0.65	10	9.35	8.61	PASS

## 16 Occupied Bandwidth

### 16.1 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.

### 16.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Channels / Frequencies Measured:	2402 MHz / 2440 MHz / 2480 MHz – hopping disabled.
EUT Channel Bandwidths:	1 MHz
EUT Test Modulations:	GFSK / QPSK / 8PSK
Deviations From Standard:	None
Measurement BW: (requirement: 1 % to 5 % OBW)	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10 MHz
Measurement Span: (requirement 2 to 5 times OBW)	3MHz
Measurement Detector:	Peak

### Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V ac	230 V ac $\pm$ 10 % (as declared)

### 16.3 Test Limit

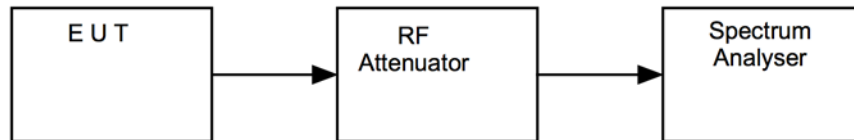
- For frequency hopping systems in the band 902 to 928 MHz: The maximum allowed -20 dB bandwidth of the hopping channel is 500 kHz.
- Frequency hopping systems operating in the band 5725 to 5850 MHz: The maximum -20 dB bandwidth of the hopping channel shall be 1 MHz

### 16.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vii, 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 vii Test Setup**



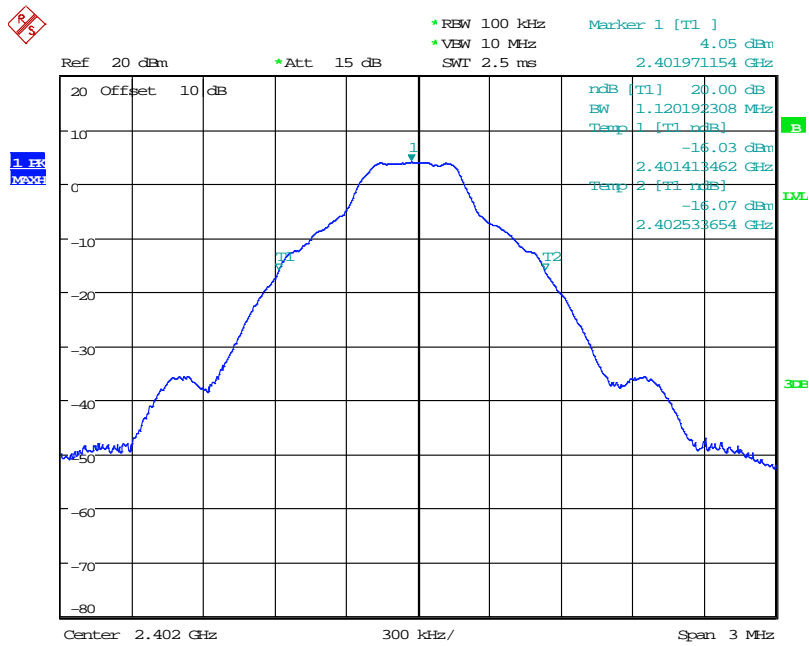
### 16.5 Test Equipment

<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>
Spectrum Analyser	R&S	FSU26	REF909	13/02/2016
Spectrum Analyser	R&S	FSU26	UH405	11/05/2016
10 dB Attenuator	Radiall	R411820121	N/A	In Use

16.6 Test Results

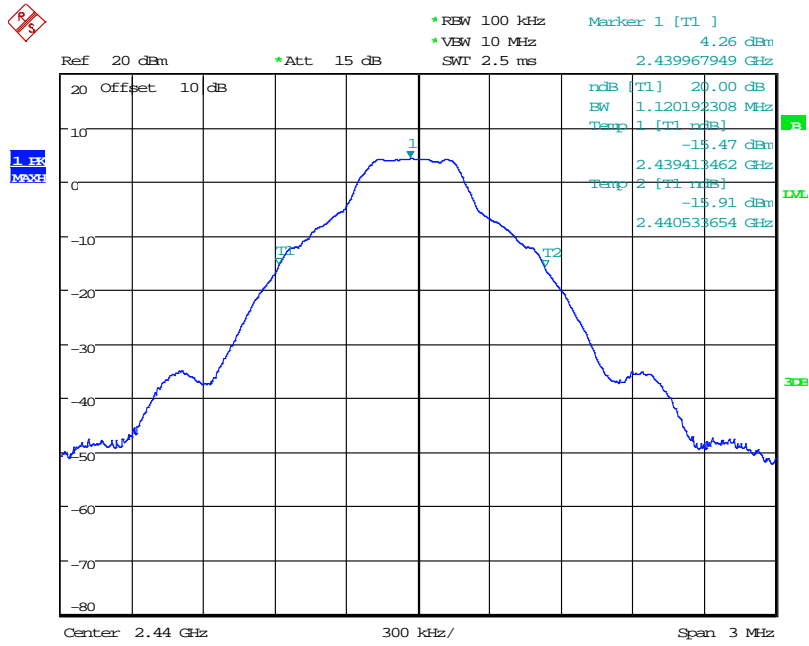
Modulation: GFSK; Power setting: 10 dBm				
Channel Frequency (MHz)	F <sub>L</sub> (MHz)	F <sub>H</sub> (MHz)	20dB Bandwidth (kHz)	Result
2402	2401.413462	2402.533654	1120.192	PASS
2440	2439.413462	2440.533654	1120.192	PASS
2480	2479.413462	2480.533654	1120.192	PASS

Operating Frequency - 2402 MHz



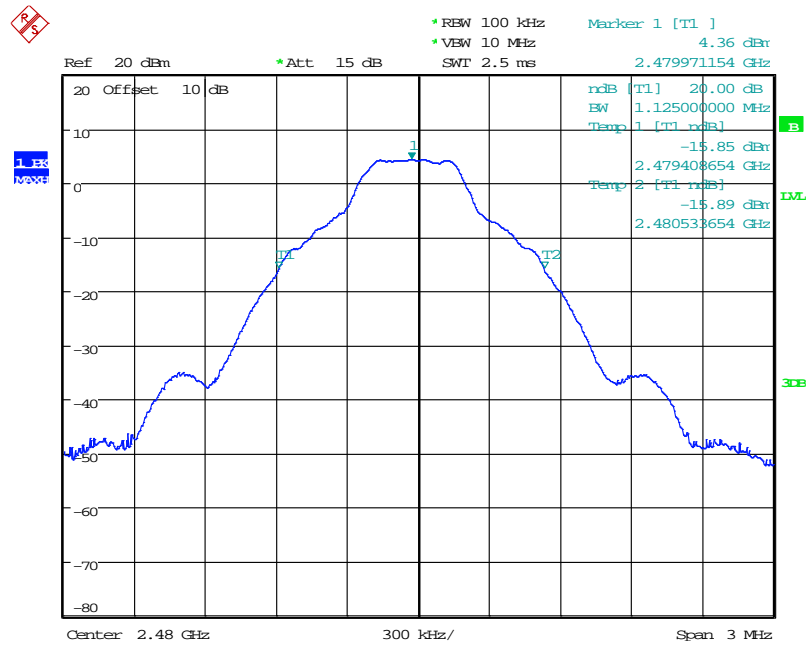
Date: 29.OCT.2015 11:12:09

### Operating Frequency - 2440 MHz



Date: 29.OCT.2015 11:10:51

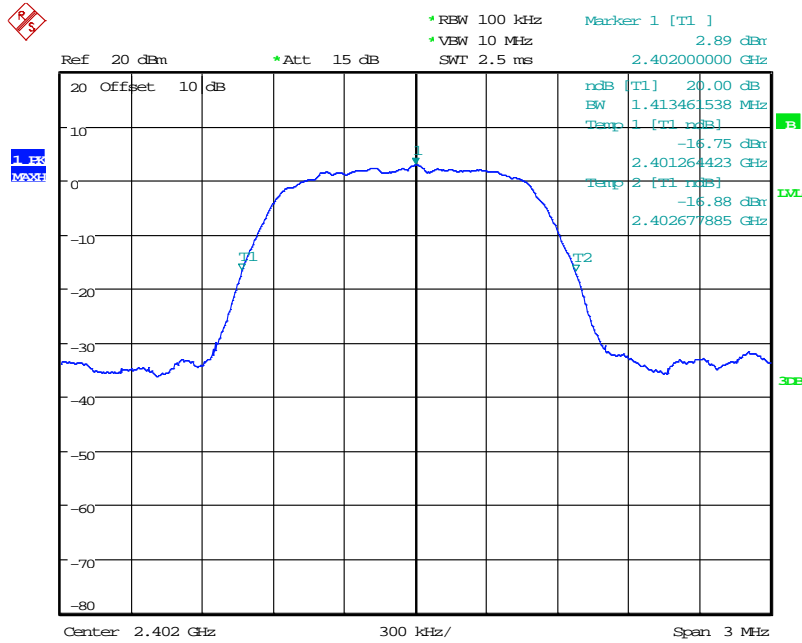
### Operating Frequency - 2480 MHz



Date: 29.OCT.2015 11:13:05

Modulation: QPSK; Power setting: 10 dBm				
Channel Frequency (MHz)	F <sub>L</sub> (MHz)	F <sub>H</sub> (MHz)	20dB Bandwidth (kHz)	Result
2402	2401.264423	2402.677885	1413.462	PASS
2440	2439.259615	2440.677885	1418.270	PASS
2480	2479.259615	2480.677885	1418.270	PASS

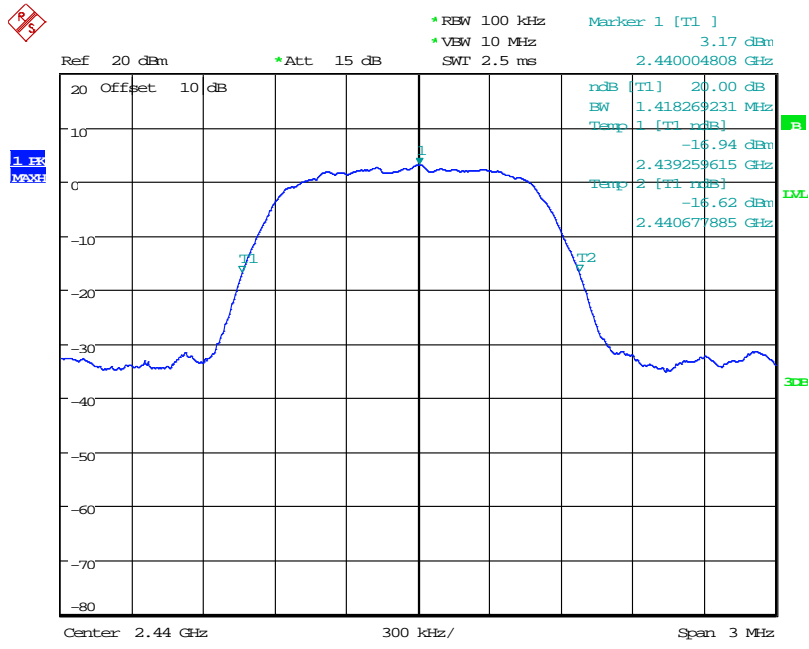
Operating Frequency - 2402 MHz



Date: 29.OCT.2015 11:19:09

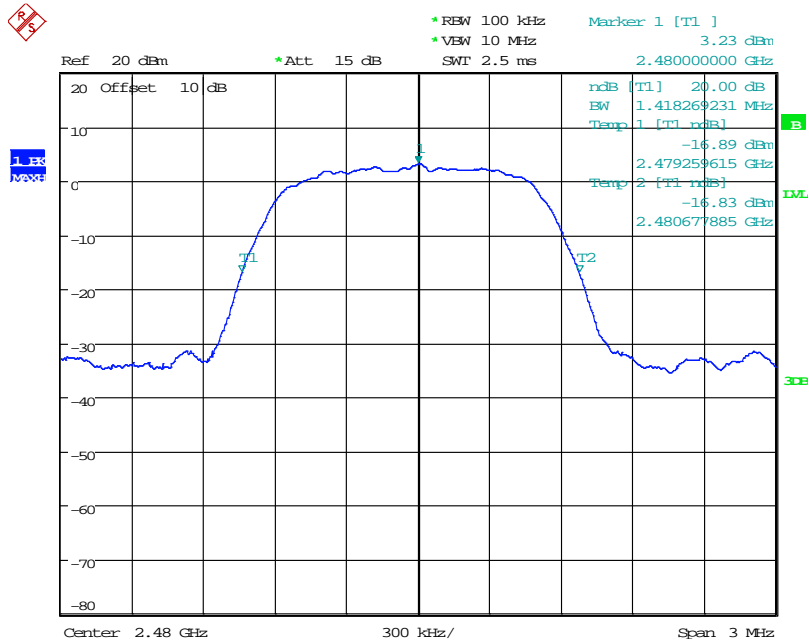


### Operating Frequency - 2440 MHz



Date: 29.OCT.2015 11:16:39

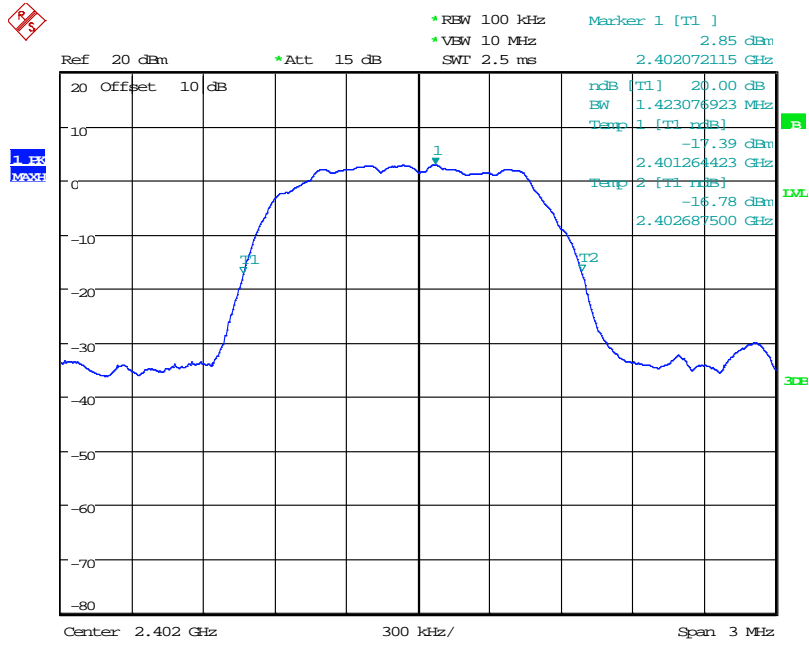
### Operating Frequency - 2480 MHz



Date: 29.OCT.2015 11:17:47

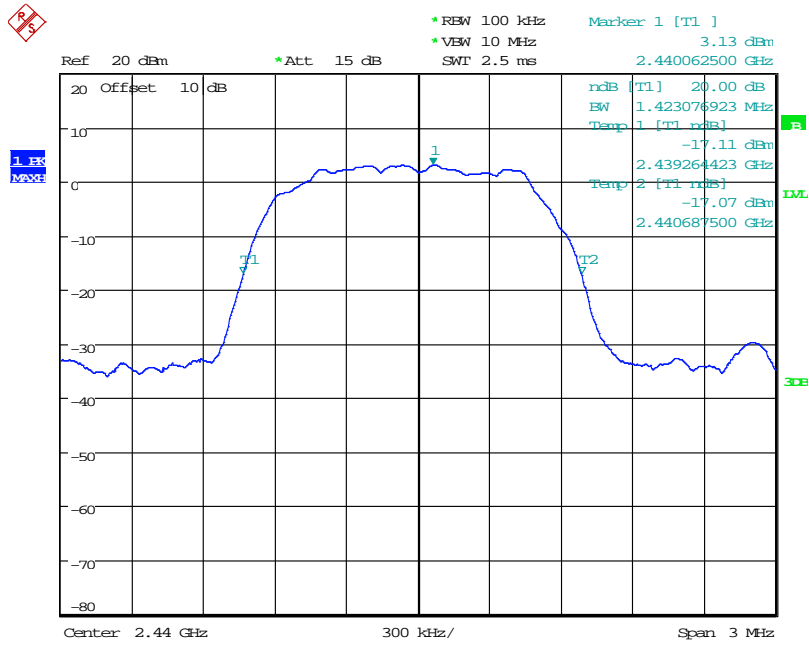
Modulation: 8PSK; Power setting: 10 dBm				
Channel Frequency (MHz)	F <sub>L</sub> (MHz)	F <sub>H</sub> (MHz)	20dB Bandwidth (kHz)	Result
2402	2401.264423	2402.687500	1423.077	PASS
2440	2439.264423	2440.687500	1423.077	PASS
2480	2479.264423	2480.682692	1418.269	PASS

Operating Frequency - 2402 MHz



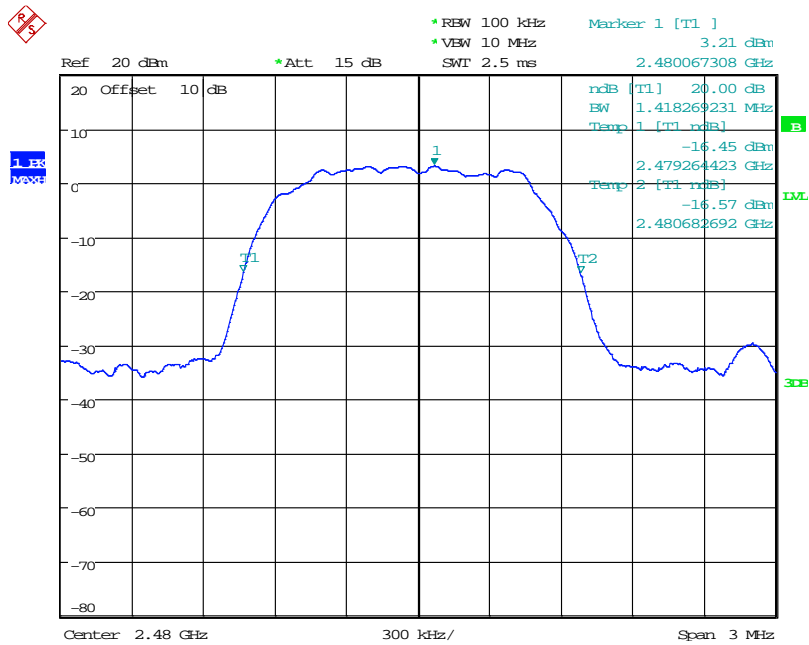
Date: 29.OCT.2015 11:23:51

### Operating Frequency - 2440 MHz



Date: 29.OCT.2015 11:25:00

### Operating Frequency - 2480 MHz



Date: 29.OCT.2015 11:26:23

## 17 Out-of-band and conducted spurious emissions

### 17.1 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.

### 17.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.8
EUT Channels / Frequencies Measured:	2402 MHz / 2440 MHz / 2480 MHz – hopping disabled.
EUT Channel Bandwidths:	1 MHz
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 26.5 GHz

### Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V ac	230 V ac ±10 % (as declared)

### 17.3 Test Limits

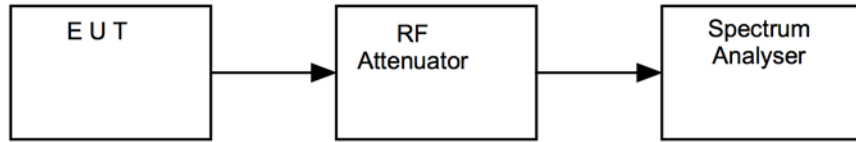
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either 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.

**17.4 Test Method**

With the EUT setup as per section 9 of this report and connected as per Figure viii, 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 viii Test Setup**



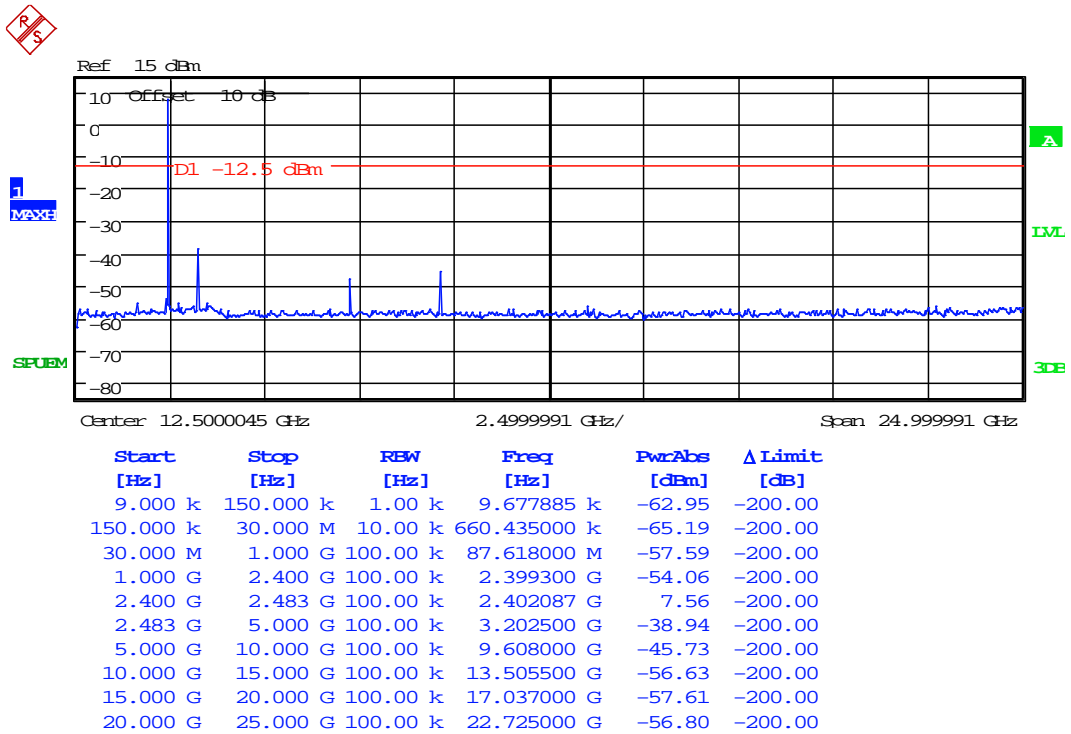
**17.5 Test Equipment**

<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>
Spectrum Analyser	R&S	FSU26	REF909	13/02/2016
Spectrum Analyser	R&S	FSU26	UH405	11/05/2016
10 dB Attenuator	Radiall	R411820121	N/A	In Use

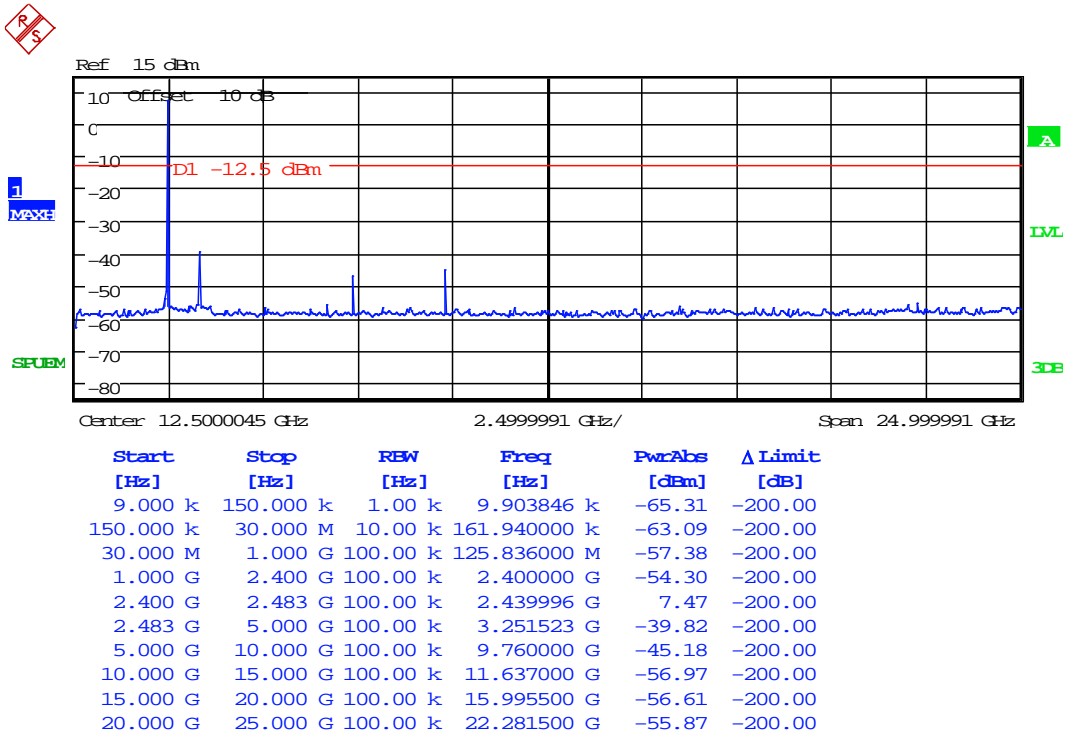
17.6 Test Results

Modulation: GFSK; Power setting: 10 dBm						
Channel Frequency (MHz)	Emission Frequency (MHz)	Analyzer Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2402		No significant emissions Within 10 dB of limit				PASS
2440		No significant emissions Within 10 dB of limit				PASS
2480		No significant emissions Within 10 dB of limit				PASS

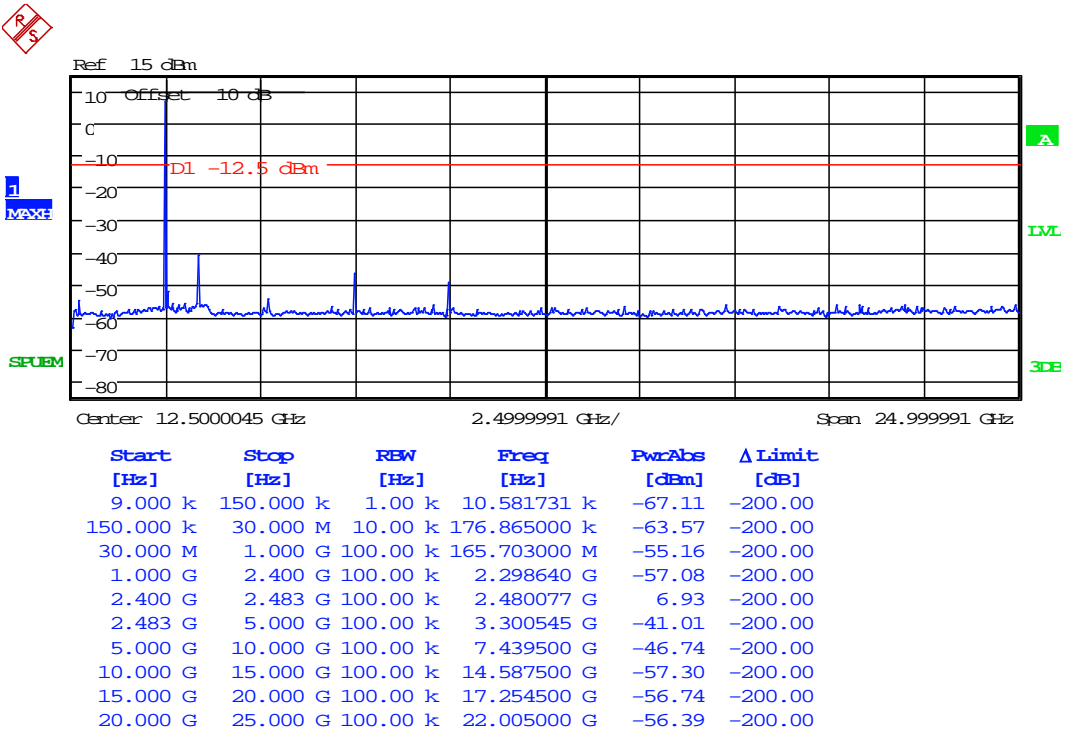
Operating Frequency - 2402 MHz



### Operating Frequency - 2440 MHz

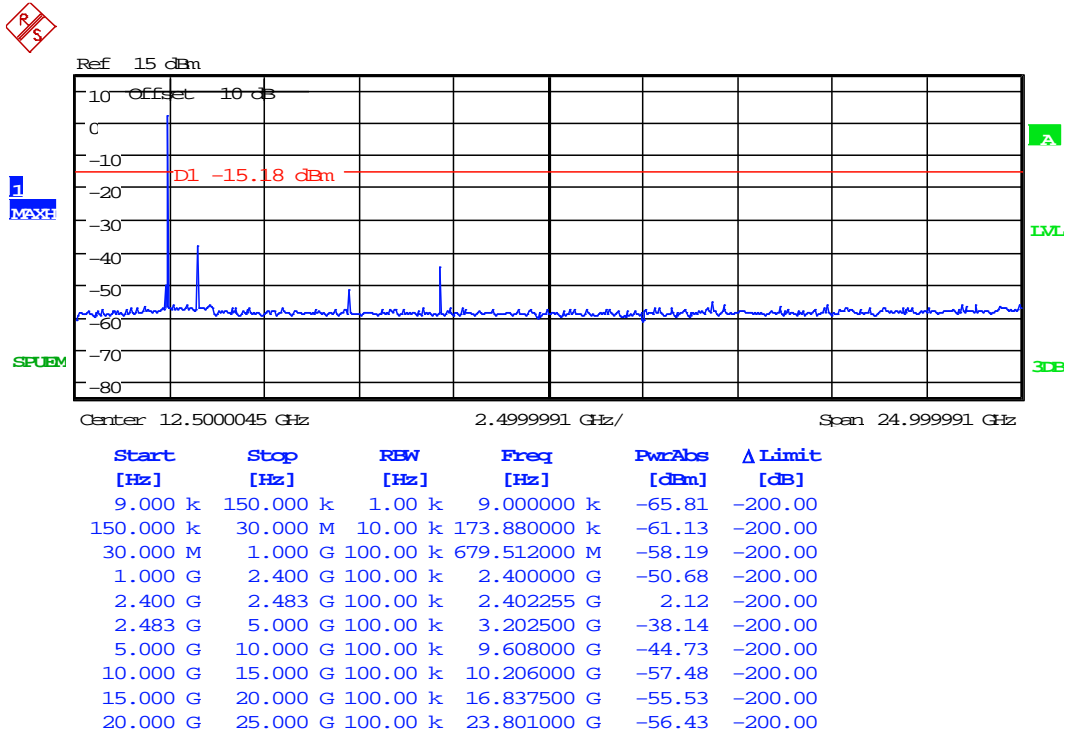


### Operating Frequency - 2480 MHz



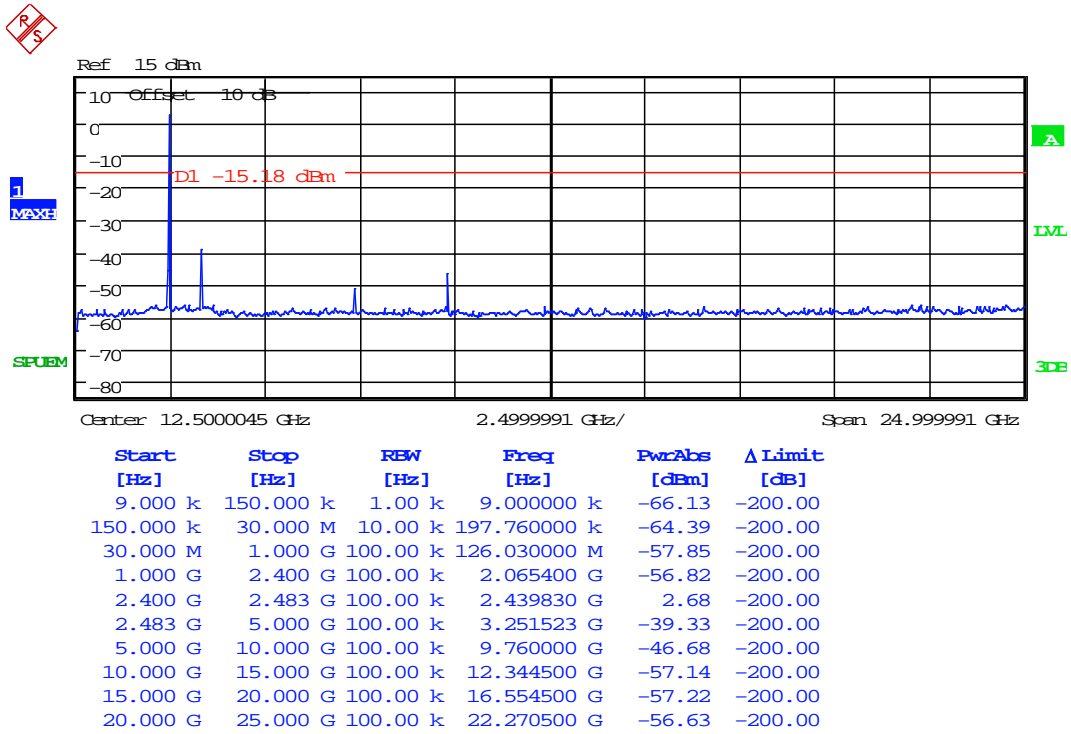
Modulation: QPSK; Power setting: 10 dBm						
Channel Frequency (MHz)	Emission Frequency (MHz)	Analyzer Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2402		No significant emissions Within 10 dB of limit				PASS
2440		No significant emissions Within 10 dB of limit				PASS
2480		No significant emissions Within 10 dB of limit				PASS

Operating Frequency - 2402 MHz

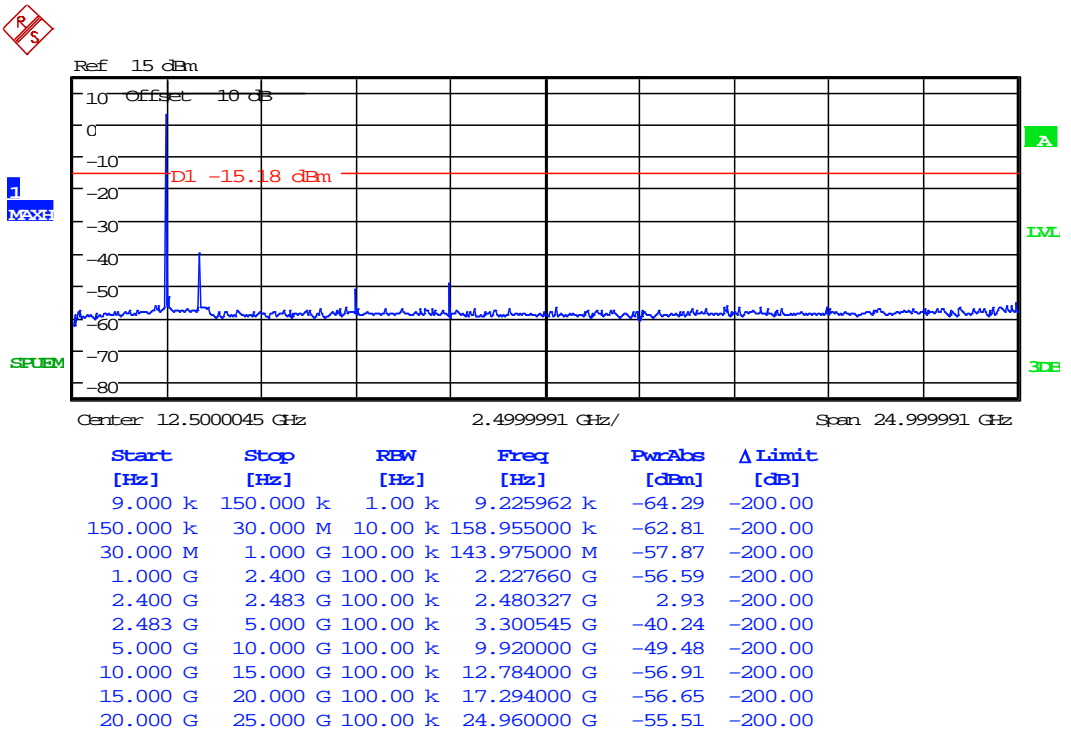




### Operating Frequency - 2440 MHz

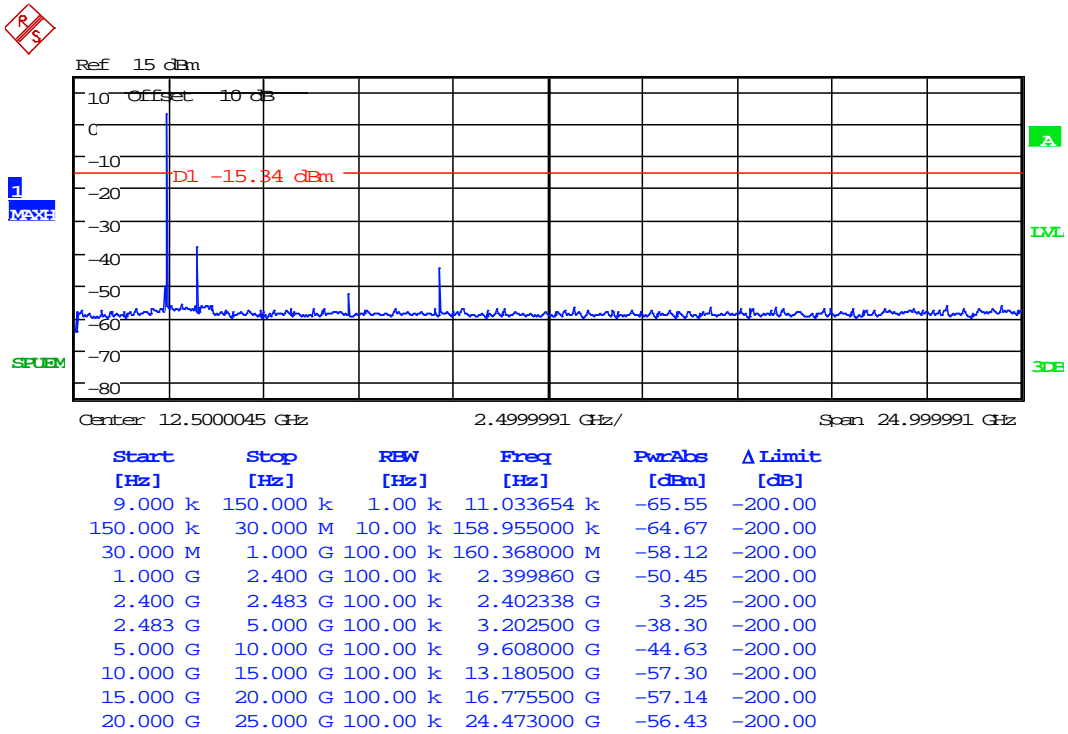


### Operating Frequency - 2480 MHz

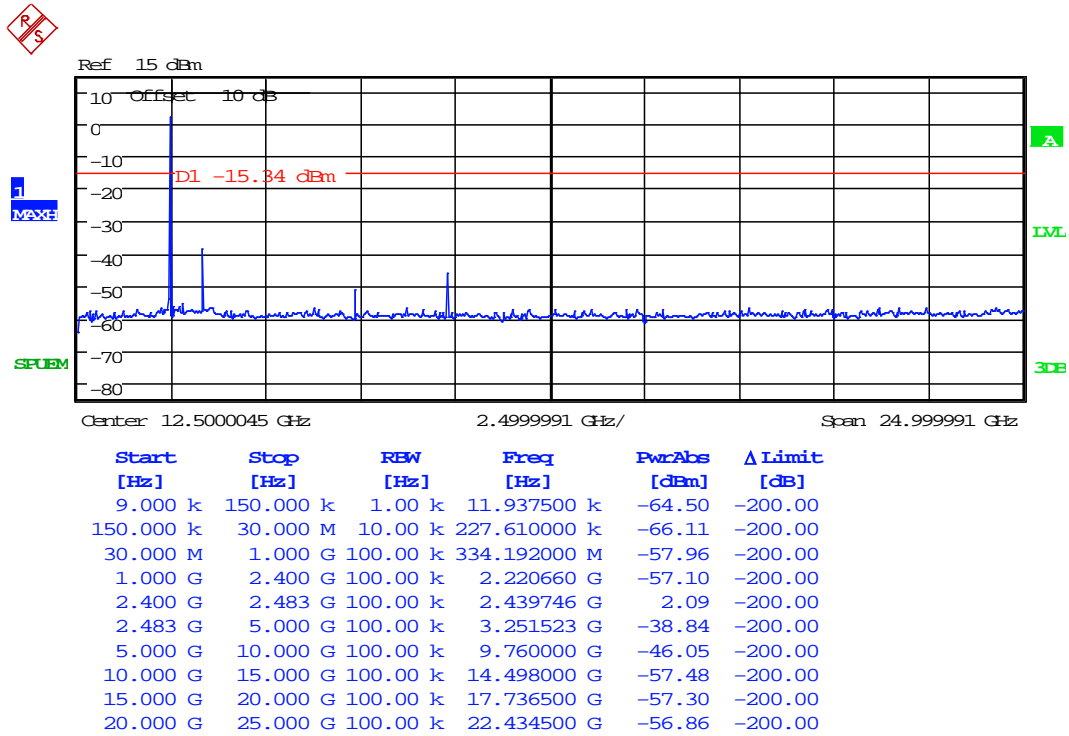


Modulation: 8PSK; Power setting: 10 dBm						
Channel Frequency (MHz)	Emission Frequency (MHz)	Analyzer Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2402		No significant emissions Within 10 dB of limit				PASS
2440		No significant emissions Within 10 dB of limit				PASS
2480		No significant emissions Within 10 dB of limit				PASS

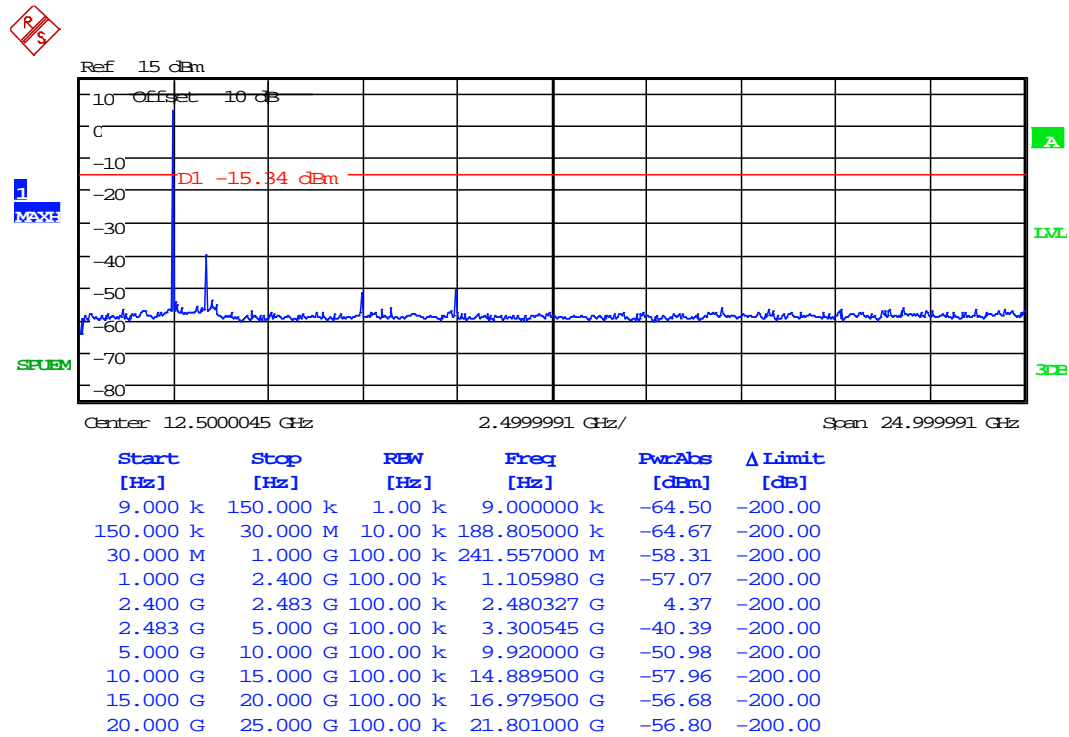
Operating Frequency - 2402 MHz



### Operating Frequency - 2440 MHz



### Operating Frequency - 2480 MHz



## 18 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] Frequency separation

Uncertainty in test result (Spectrum Analyser) = **3.6 kHz**

#### [7] Accumulated channel occupancy time

Uncertainty in test result = **7.98 %**