Report on the Radio Testing

For

SmarDTV (UK) Limited

on

S55

Report no. TRA-031431-00-45-05A

20th April 2017

Report Number: TRA-031431-00-45-05A
Issue: A

REPORT ON THE RADIO TESTING OF A
SmarDTV (UK) Limited
S55
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247 & IC RSS-247

TEST DATE: 25th Apr - 26th Sep 2016

Tested by:	A Longley	A Longley – A Wong Radio Test Engineers
Written by:	D Winstanley	D Winstanley Senior Radio Test Engineer
Approved by:	 Digitally signed by John Charters DN: cn=John Charters, o=Element Materials Technology, ou, email=john.charters@element.com, c=GB Date: 2017.04.20 15:46:02 +01'00'	J Charters Department Manager- Radio
Date:	20th April 2017	

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

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	20th April 2017	Original

2 Summary

TEST REPORT NUMBER:	TRA-031431-00-45-05A
WORKS ORDER NUMBER	TRA-029575-02
PURPOSE OF TEST:	Certification.
TEST SPECIFICATION(S):	47CFR15.247 & RSS-247
EQUIPMENT UNDER TEST (EUT):	S55
FCC IDENTIFIER:	DKN-AVAD1
ISED IDENTIFER:	1707A-AVAD1
MANUFACTURER/AGENT:	SmarDTV (UK) Limited
ADDRESS:	Beckside Design Centre Millennium Business Park Station Rd Steeton Keighley West Yorkshire BD20 6QW United Kingdom
CLIENT CONTACT:	Chris Wordley ☎ 01535 659000 ✉ chris.wordley@smardtv.com
ORDER NUMBER:	POR01251
TEST DATE:	25th Apr - 26th Sep 2016
TESTED BY:	A Longley – A Wong 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	☐	*Note 2*
AC power line conducted emissions		Gen, 8.8	15.207	☐	*Note 1*
Occupied bandwidth		247, 5.2 (1)	15.247(a)(2)	☒	*Pass*
Conducted carrier power	Peak	247, 5.4 (4)	15.247(b)(3)	☒	*Pass*
	Max.			☐	
Conducted / radiated RF power out-of-band		247, 5.5	15.247(d)	☒	*Pass*
Power spectral density, conducted		247, 5.2 (2)	15.247(e)	☒	*Pass*
Calculation of duty correction		-	15.35(c)	☐	*N/A*

Notes:

1. Battery Powered Operation only with an internal fully charged Lithium-ion battery
2. See Test report TRA-031431-00-45-02A

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

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

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

3 Contents

4 Introduction

This report TRA-031431-00-45-05A presents the results of the Radio testing on a SmarDTV (UK) Limited, S55 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 SmarDTV (UK) Limited by Element, at the address(es) detailed below.

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

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

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

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

Throughout this report EUT denotes equipment under test.

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

IC Registration Number(s):

Element Hull	3483A
Element North West	3930B

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

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

5 Test Specifications

5.1 Normative References

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

5.2 Deviations from Test Standards

There were no deviations from the test standard.

6 Glossary of Terms

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

7 Equipment Under Test

7.1 EUT Identification

- Name: S55
- Serial Number: Sample S7
- Model Number: S55
- Software Revision: RF Test Software
- Build Level: Pre-production S55 sample S7

7.2 EUT Mode of Operation

7.2.1 Transmission

The mode of operation for transmitter tests was as follows…
EUT was operated on a single frequency, Top, Middle or Bottom, the EUT was modulated with GFSK or unmodulated as required

7.3 EUT Radio Parameters

7.3.1 General

Frequency of operation:	2400 – 2483.5 MHz
Modulation type(s):	GFSK
Occupied channel bandwidth(s):	1MHz
Channel spacing:	2MHz
ITU emission designator(s):	G1D
Declared output power(s):	<+10 dBm
Nominal Supply Voltage:	Lithium-ion Battery at 3.7 V d.c.

7.3.2 Product specific declarations

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

7.4 EUT Description

The EUT is a converter for HDMI video streams and then transmits then data over a WiFi network.

This report only covers Bluetooth Low Energy operation.

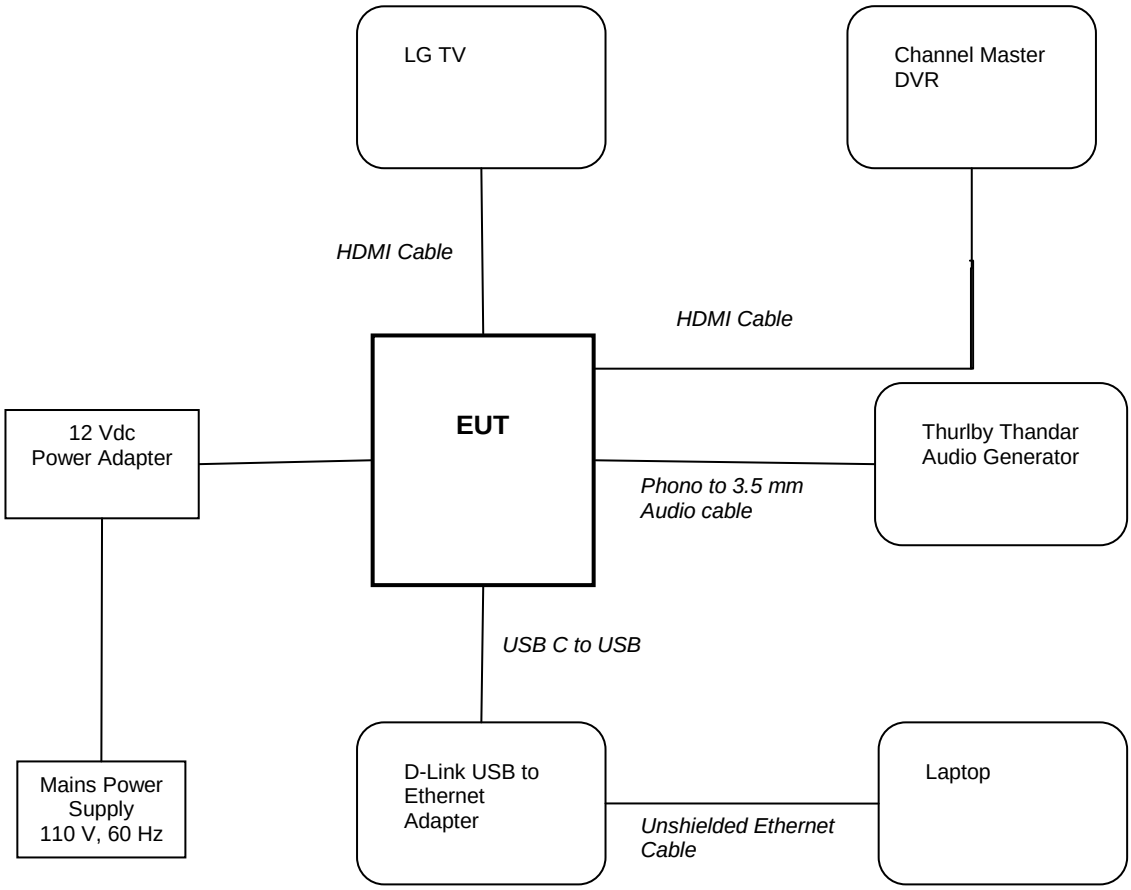
8 Modifications

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:



Conducted measurements were performed under with the module mounted in a N63 device.
Setup relates to the N63 device in which the module was mounted during conducted testing.
N63 information details.

- Serial Number: 1604210679 & 14604210698
- Model Number: TRA-029575 – S60

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.

Sample No.	***Description***	***Model No.***	***Serial No.***
TRA-029575 - S08	EUT 12 Vdc Power Adapter	EADP-40MB A	HBBD45F00A7
TRA-029575 - S11	Lenovo ThinkPad	E560	34546
TRA-029575 - S14	Thurlby Thandar Audio Generator	TF215	045441
TRA-029575 - S15	LG TV	M227WDL	002MAAK4P824
TRA-029575 - S17	Channel Master DVR	CM-7500TB1	R5YFKZ00228D
TRA-029575 - S27	Dlink USB to Ethernet adapter	DUB-E100	Q8041AA002873

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 to the N63 Host device was approx. 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:

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

11 Occupied Bandwidth

11.1 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.

11.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Lab4
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:	2 MHz
EUT Test Modulations:	BTLE
Deviations From Standard:	None
Measurement BW: (IC requirement: 1% to 5% OBW; FCC requirement: 100 kHz)	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300 kHz
Measurement Span: (requirement 2 to 5 times OBW)	3 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 40 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V ac	

11.3 Test Limit

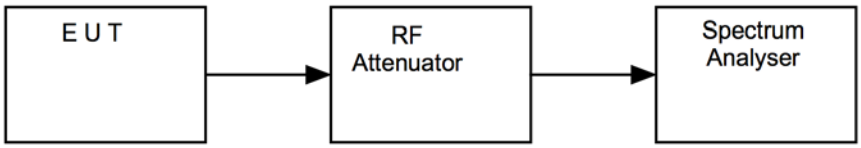
The minimum -6 dB bandwidth shall be at least 500 kHz.

11.4 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

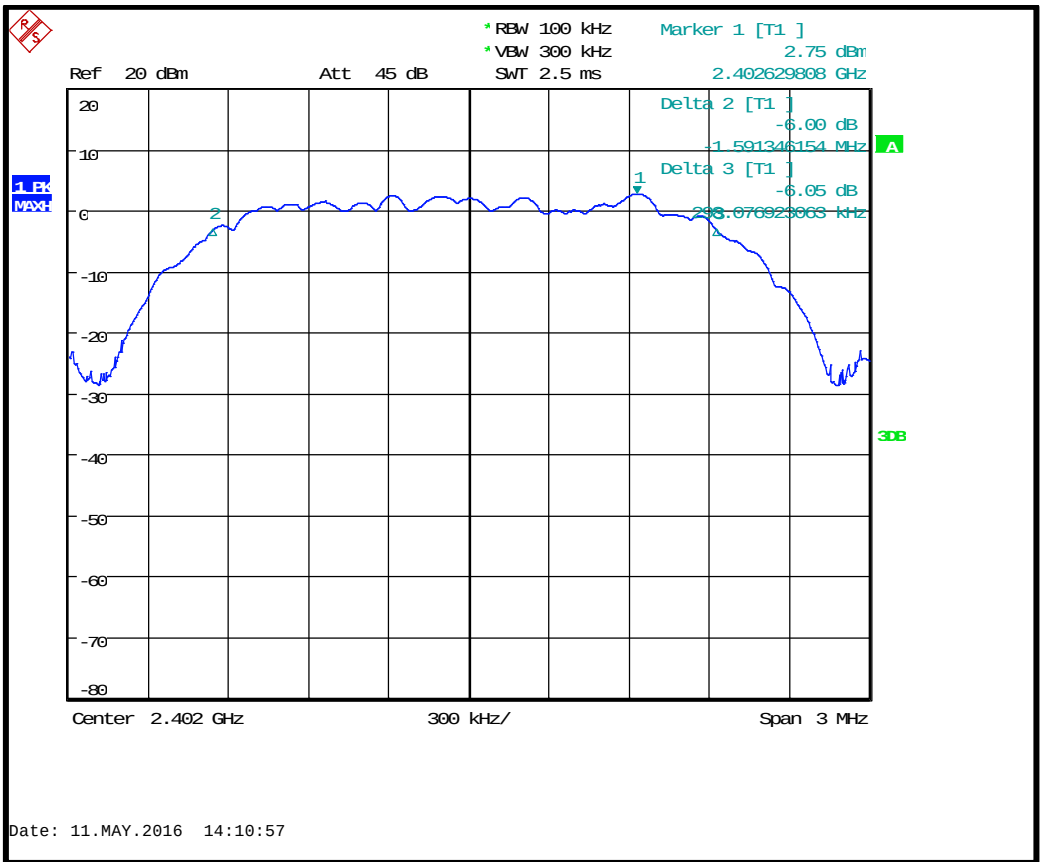


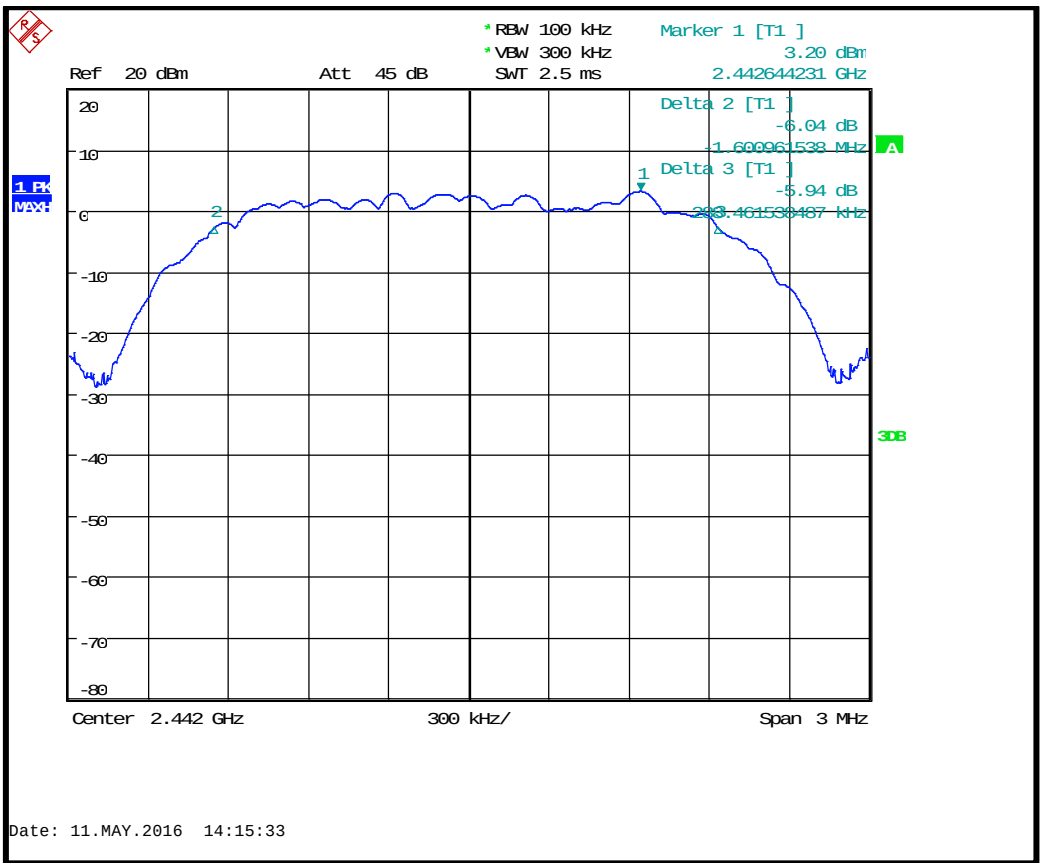
11.5 Test Equipment

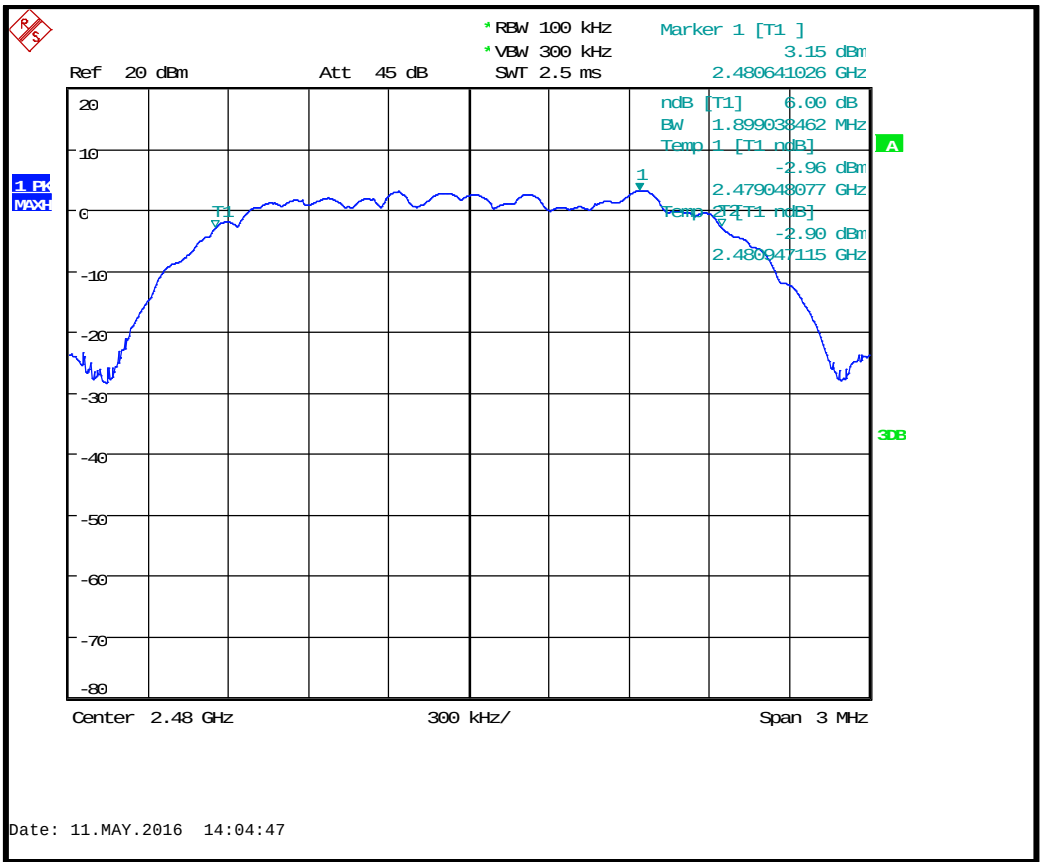
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU26	R&S	Spectrum Analyser	U405	11/05/2016

11.6 Test Results

Modulation: GFSK; Data rate: BTLE; Power setting: 0dBm				
Channel Frequency (MHz)	**F_L (MHz)**	**F_H (MHz)**	**6dB Bandwidth (kHz)**	**Result**
2402	2401.038462	2402.887885	1849.423	PASS
2442	2440.841348	2442.730772	1889.424	PASS
2480	2479.048077	2480.947115	1899.039	PASS




RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 1 [T1]
3.20 dBm
2.442644231 GHz
Ref 20 dBm
Att 45 dB
Delta 2 [T1]
-6.04 dB
1.600961538 MHz
Delta 3 [T1]
-5.94 dB
2.461538487 kHz
1 PK MAXH
A
3DB
Center 2.442 GHz
300 kHz/
Span 3 MHz
Date: 11.MAY.2016 14:15:33


RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 1 [T1]
3.15 dBm
2.480641026 GHz
Ref 20 dBm
Att 45 dB
ndB [T1] 6.00 dB
BW 1.899038462 MHz
Temp 1 [T1 ndB]
-2.96 dBm
2.479048077 GHz
Temp 2 [T1 ndB]
-2.90 dBm
2.480947115 GHz
1 PK MAXH
A
3DB
Center 2.48 GHz
300 kHz/
Span 3 MHz
Date: 11.MAY.2016 14:04:47

12 Maximum peak conducted output power

12.1 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.

12.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Lab4
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	2 MHz
Deviations From Standard:	None
Measurement BW:	N/A (Power Meter)
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	N/A (Power Meter)
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: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 35 % RH	20 % RH to 75 % RH (as declared)

12.3 Test Limit

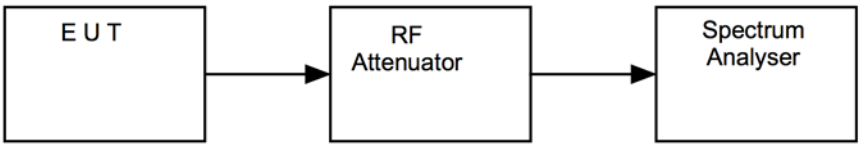
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

12.4 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



12.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
RPR3006W	Dare	Power Meter	REF2112	22/03/2017

12.6 Test Results

Modulation: GFSK; PRBS9; Data rate: BTLE; Power setting: 0dBm				
Channel Frequency (MHz)	***Level (dBm)***	***Cable loss (dB)***	***Power (mW)***	***Result***
2402	7.2	0	5.25	PASS
2442	7.6	0	5.75	PASS
2480	7.2	0	5.25	PASS

13 Out-of-band and conducted spurious emissions

13.1 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.

13.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Lab 4
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.11
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	2 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: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 36 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V ac	

13.3 Test Limit

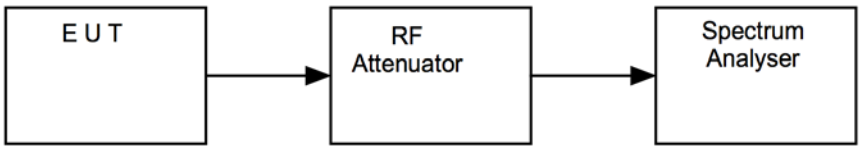
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either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

13.4 Test Method

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

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

Figure v Test Setup

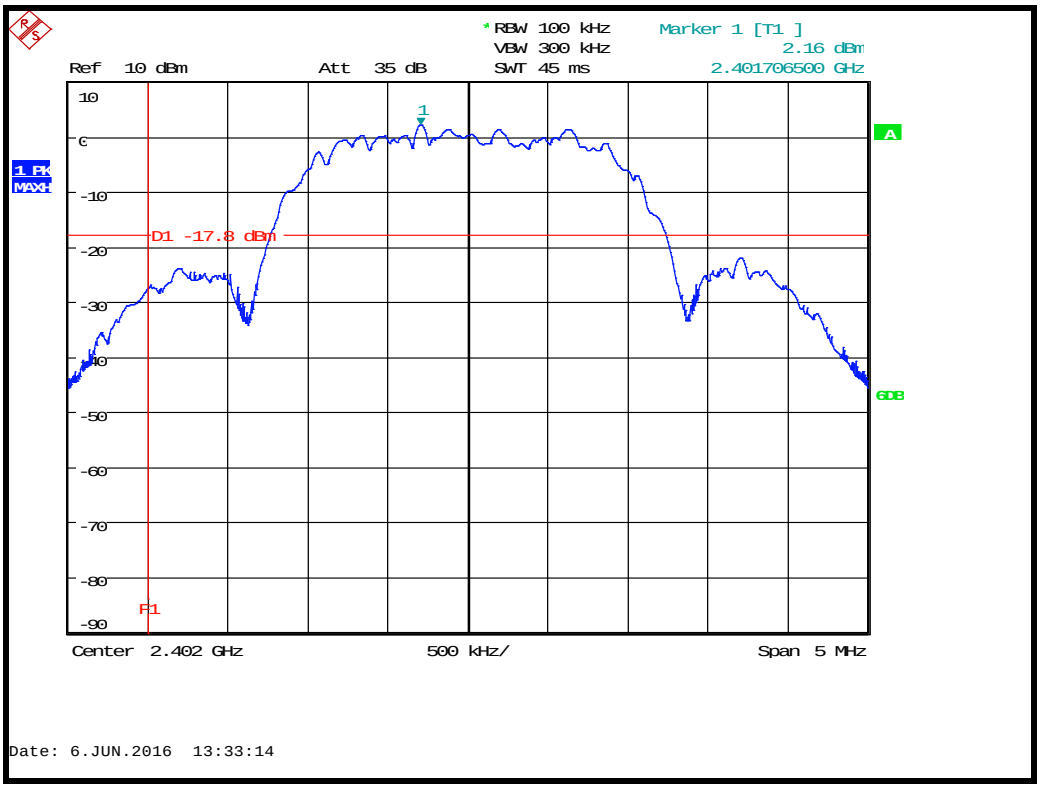


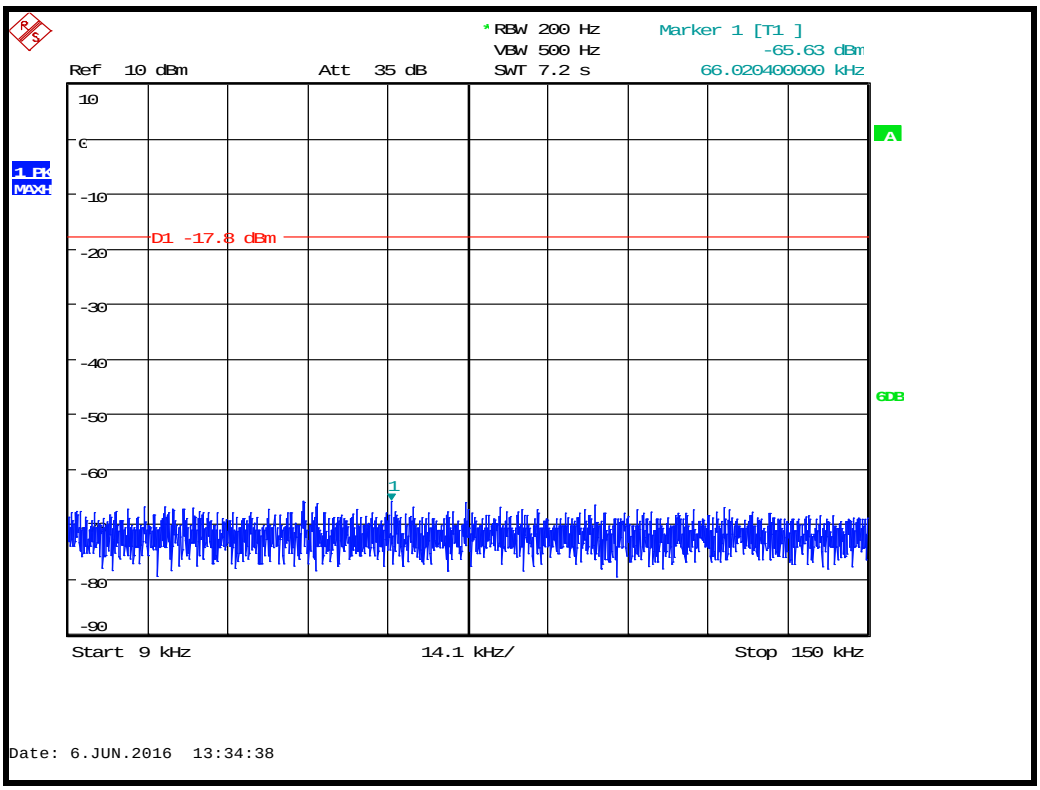
13.5 Test Equipment

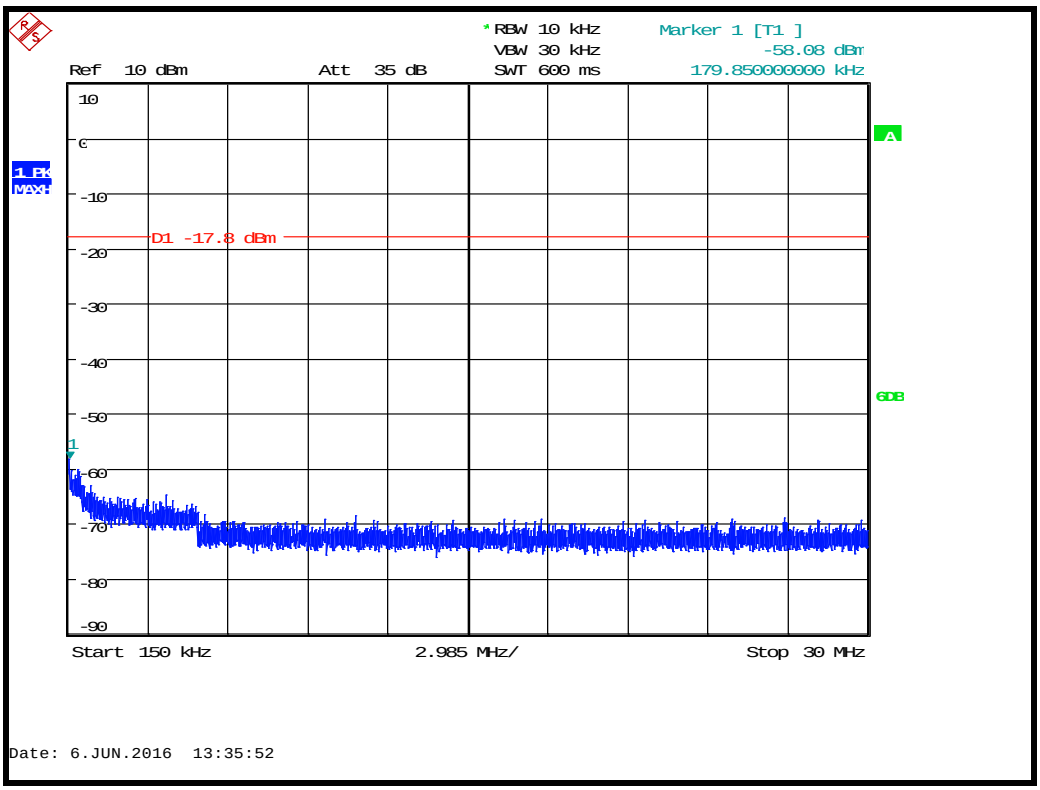
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU26	R&S	Spectrum Analyser	REF909	26/04/2017

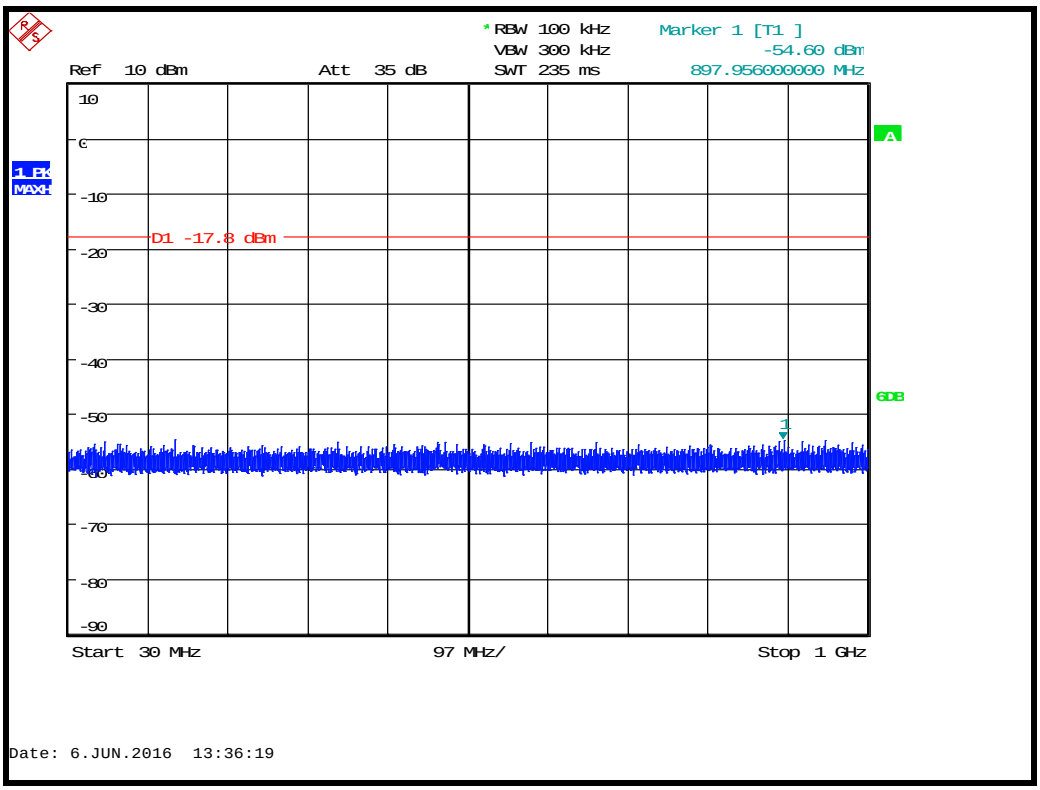
13.6 Test Results

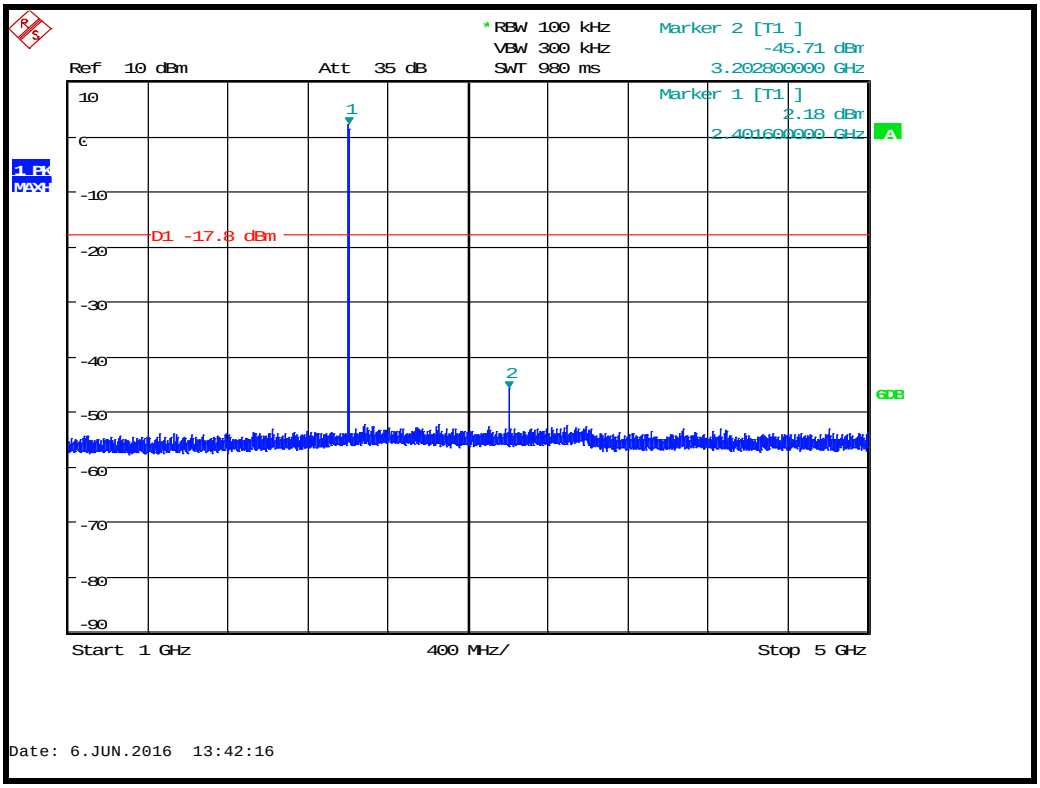
Modulation: BTLE; Data rate: BTLE; Power setting: Full						
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Analyzer Level (dBm)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
2402	2401.707	2.16	2.16	-17.8	ref	PASS
There were no emissions detected within 20 dB of the limit.						PASS

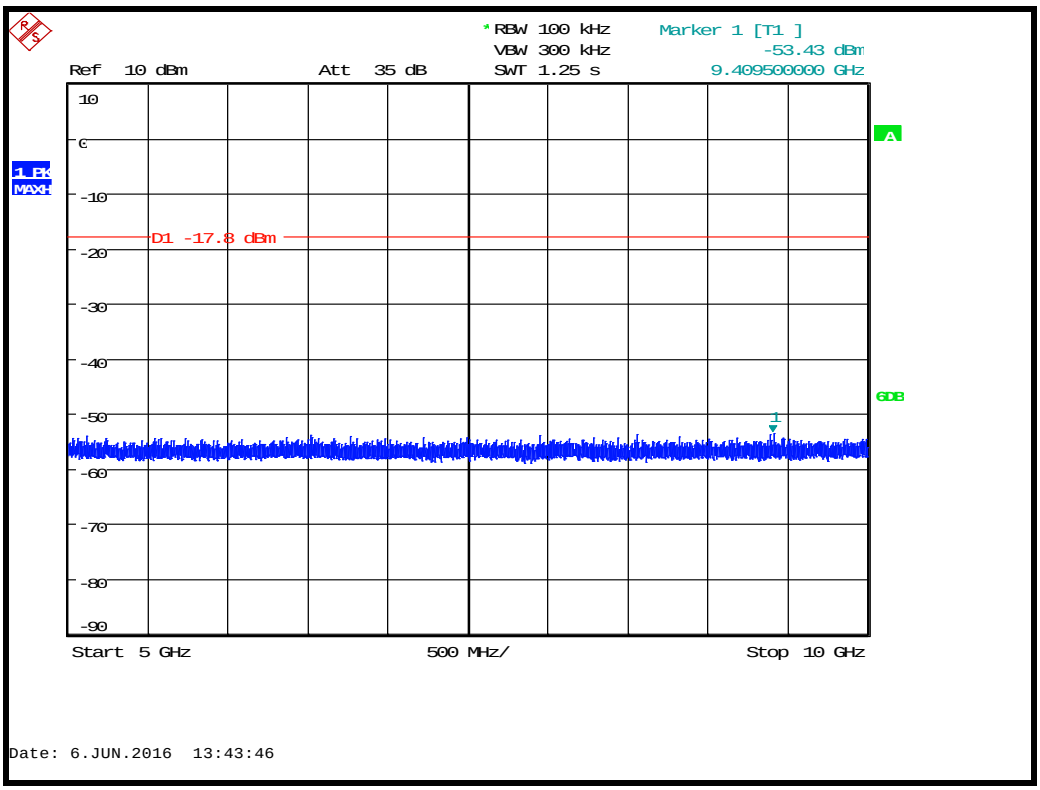


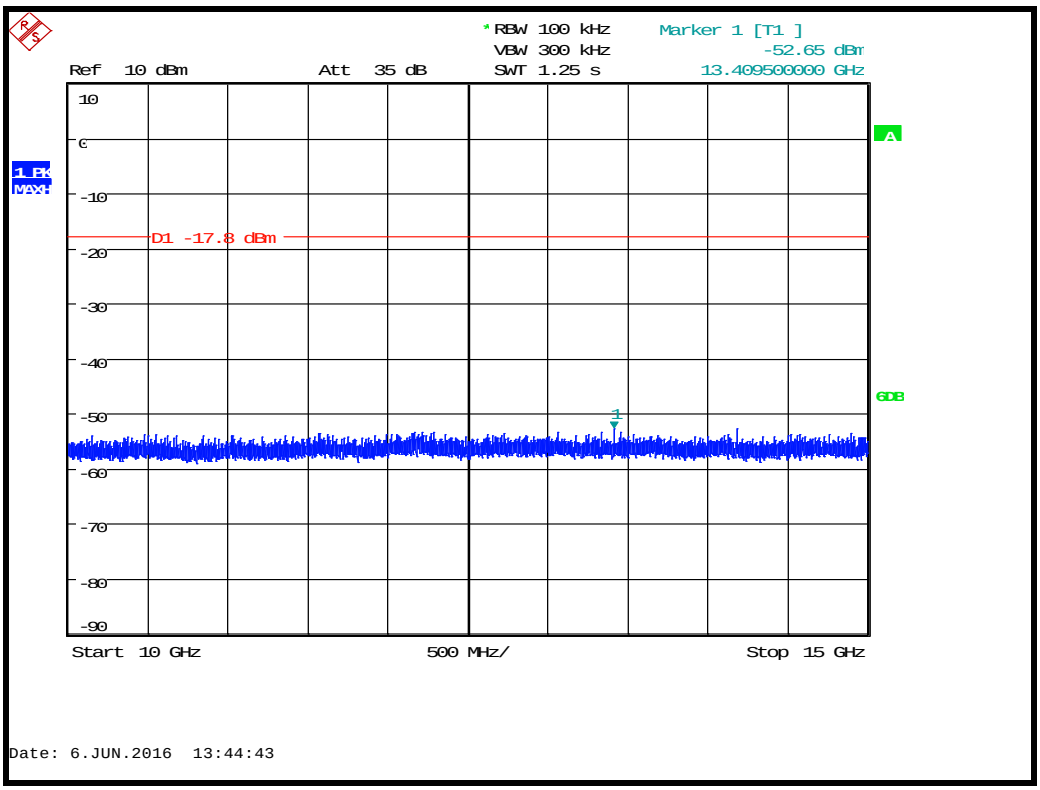

RBW 200 Hz
VBW 500 Hz
SWT 7.2 s
Marker 1 [T1]
-65.63 dBm
66.020400000 kHz
Ref 10 dBm
Att 35 dB
D1 -17.8 dBm
Start 9 kHz
14.1 kHz/
Stop 150 kHz
Date: 6.JUN.2016 13:34:38

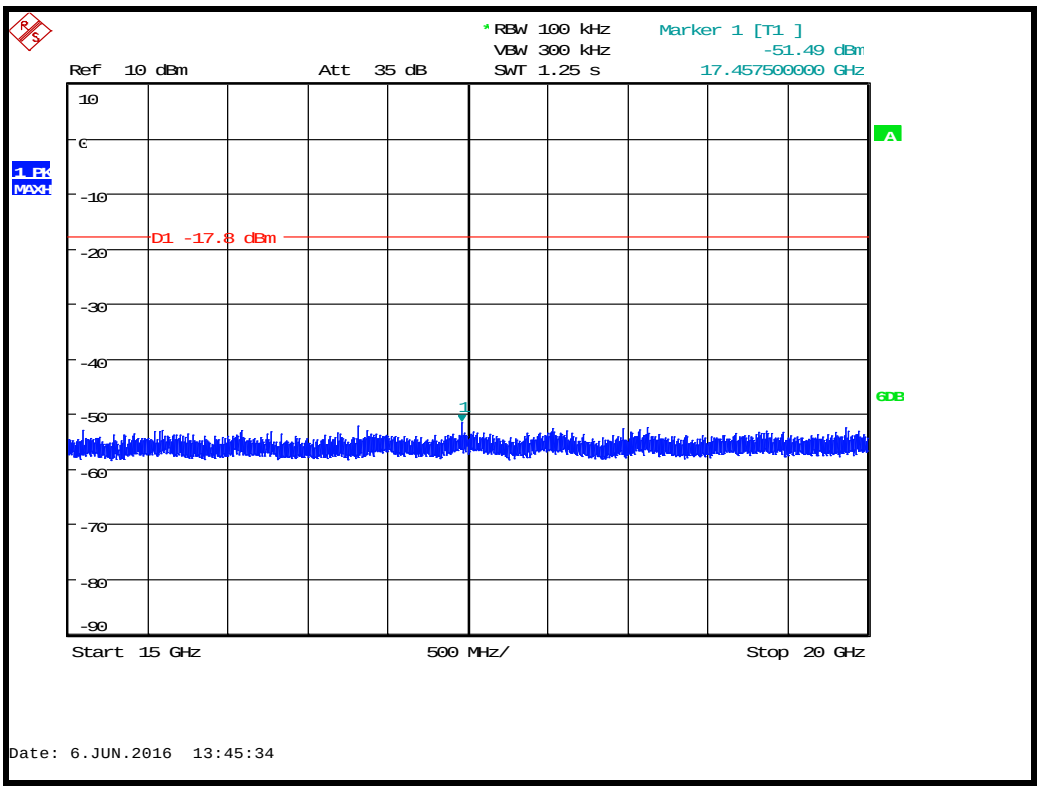

RBW 10 kHz
VBW 30 kHz
SWT 600 ms
Marker 1 [T1]
-58.08 dBm
179.850000000 kHz
Ref 10 dBm
Att 35 dB
D1 -17.8 dBm
Start 150 kHz
2.985 MHz/
Stop 30 MHz
Date: 6.JUN.2016 13:35:52

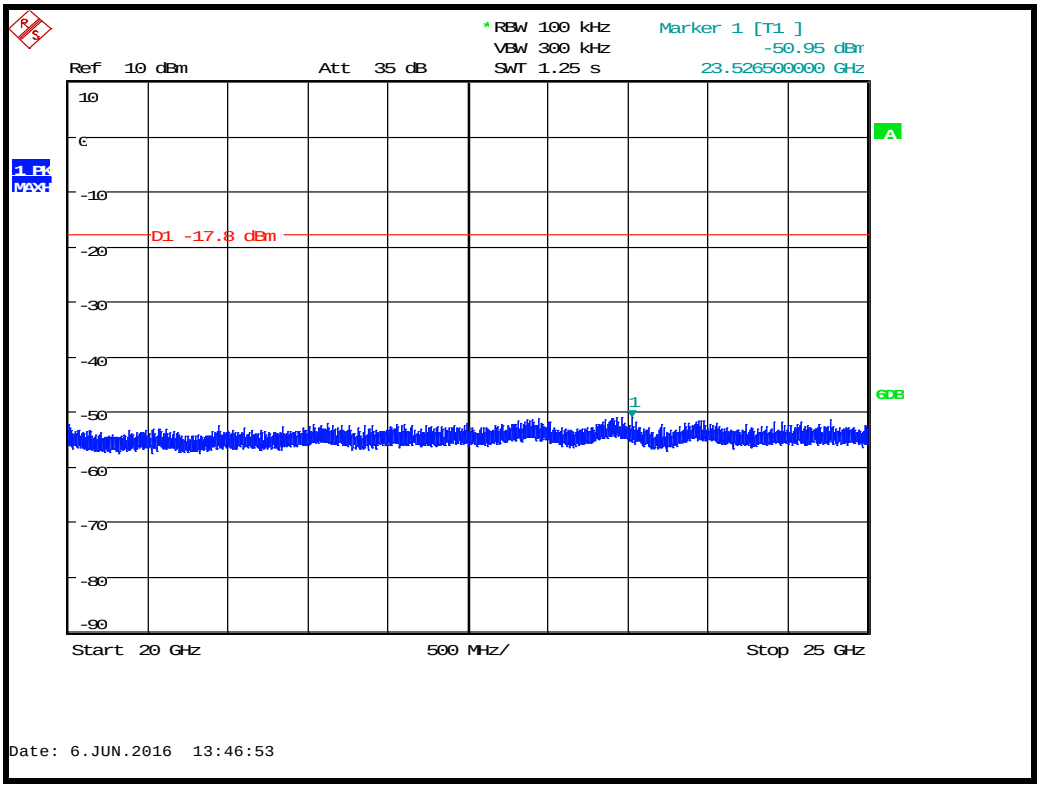

RBW 100 kHz
VBW 300 kHz
SWT 235 ms
Marker 1 [T1]
-54.60 dBm
897.956000000 MHz
Ref 10 dBm
Att 35 dB
D1 -17.8 dBm
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 6.JUN.2016 13:36:19


RBW 100 kHz
VBW 300 kHz
SWT 980 ms
Marker 2 [T1]
-45.71 dBm
3.202800000 GHz
Marker 1 [T1]
2.18 dBm
2.401600000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.8 dBm
Start 1 GHz
400 MHz/
Stop 5 GHz
Date: 6.JUN.2016 13:42:16

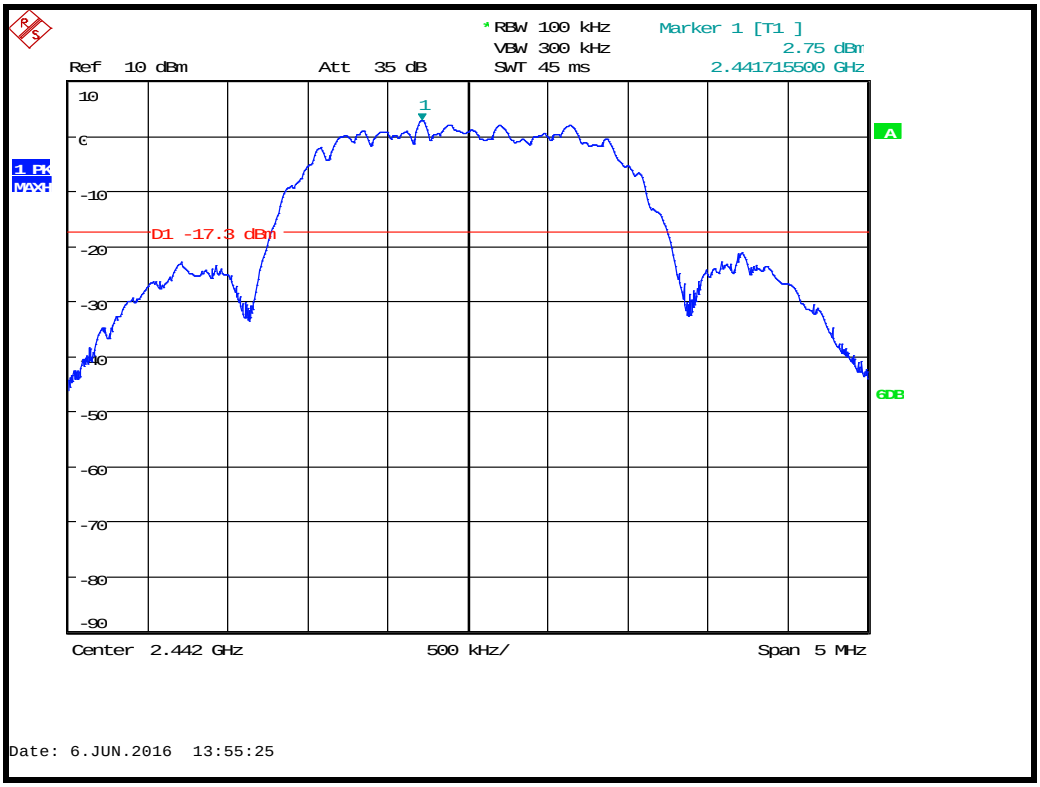

RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-53.43 dBm
9.409500000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.8 dBm
Start 5 GHz
500 MHz/
Stop 10 GHz
Date: 6.JUN.2016 13:43:46

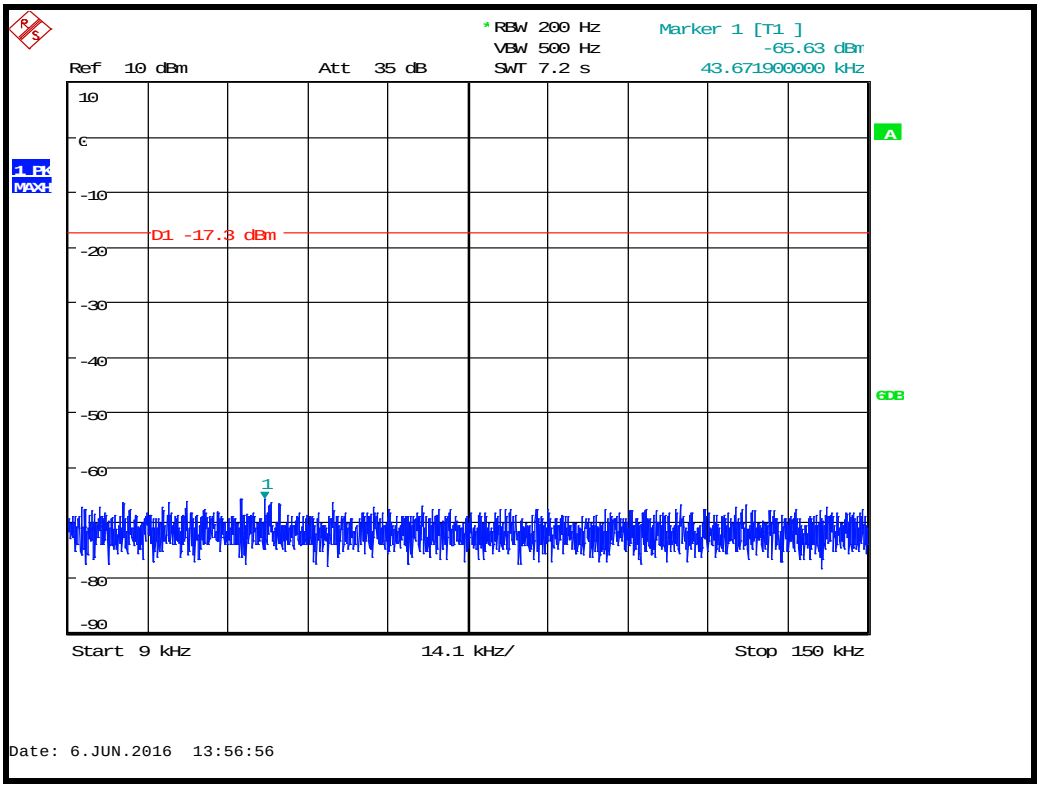

RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-52.65 dBm
13.409500000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.8 dBm
Start 10 GHz
500 MHz/
Stop 15 GHz
Date: 6.JUN.2016 13:44:43

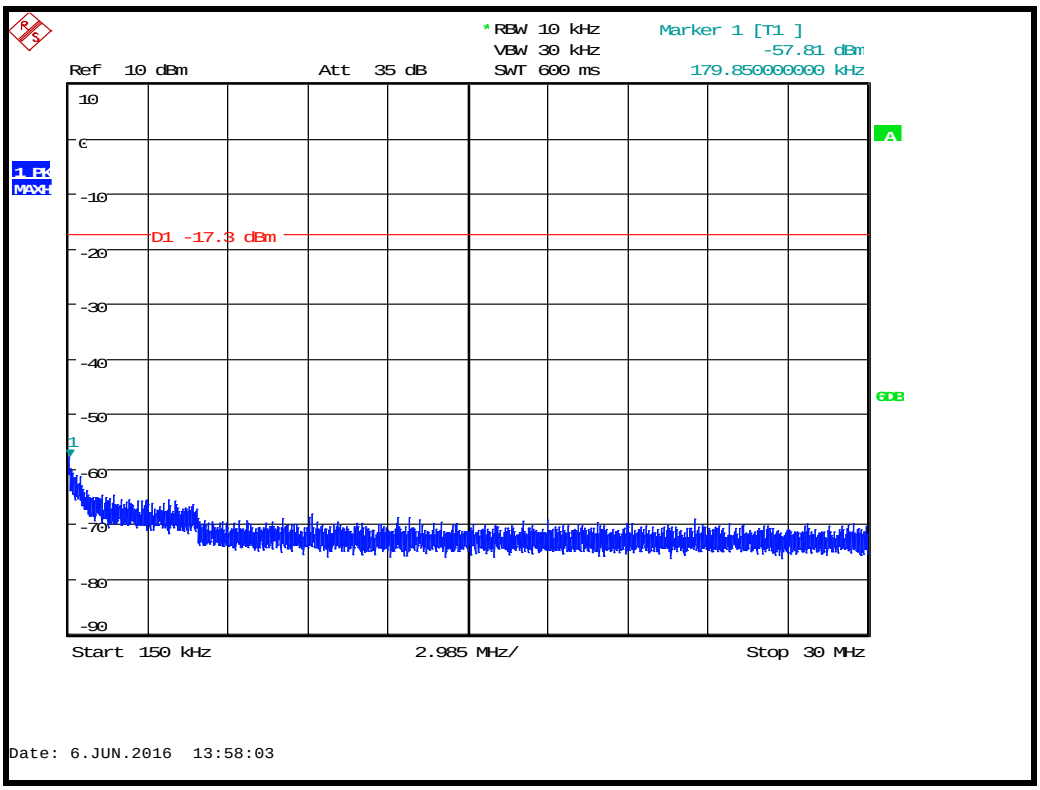

RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-51.49 dBm
17.457500000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.8 dBm
Start 15 GHz
500 MHz/
Stop 20 GHz
Date: 6.JUN.2016 13:45:34

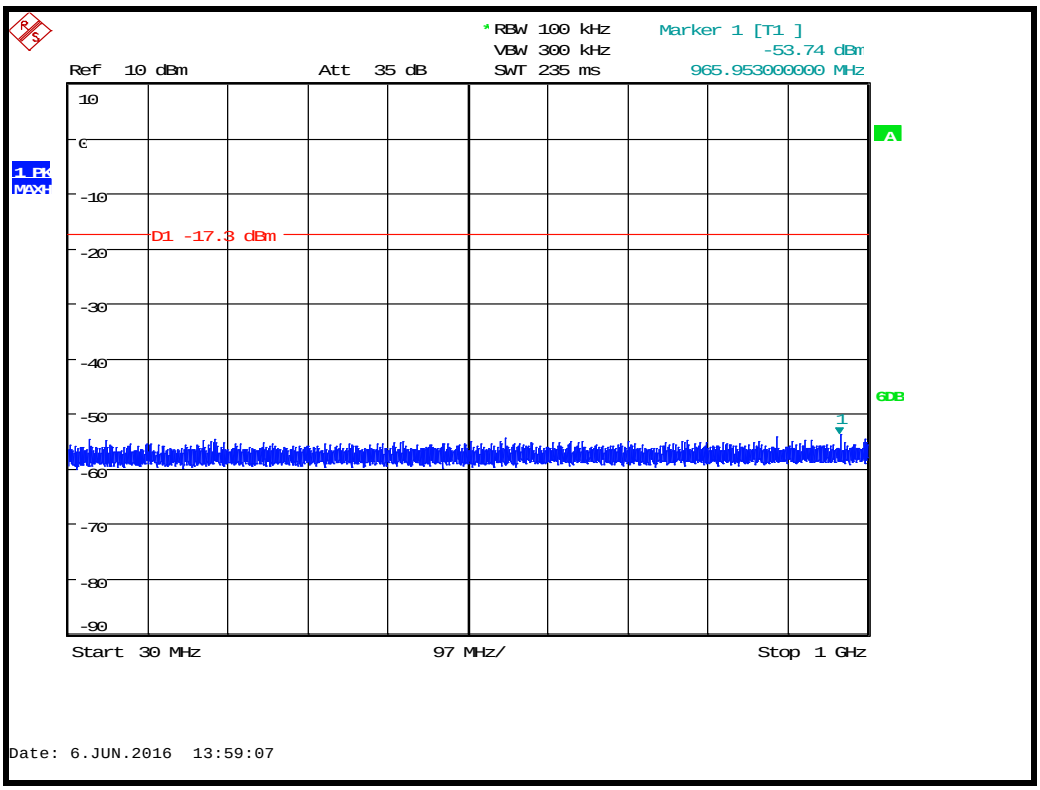

RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-50.95 dBm
23.526500000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.8 dBm
Start 20 GHz
500 MHz/
Stop 25 GHz
Date: 6.JUN.2016 13:46:53

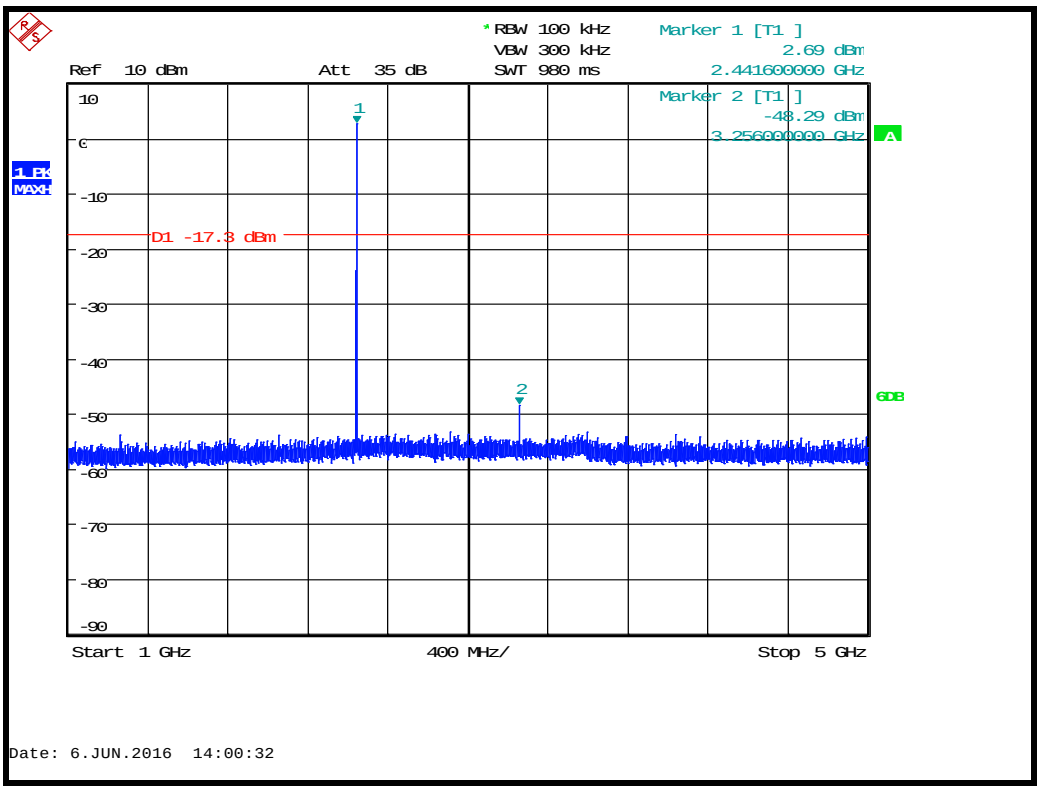
Modulation: GFSK; Data rate: BTLE; Power setting: Full						
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Analyzer Level (dBm)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
2442	2441.716	2.75	2.75	-17.3	ref	PASS
There were no emissions detected within 20 dB of the limit.						PASS

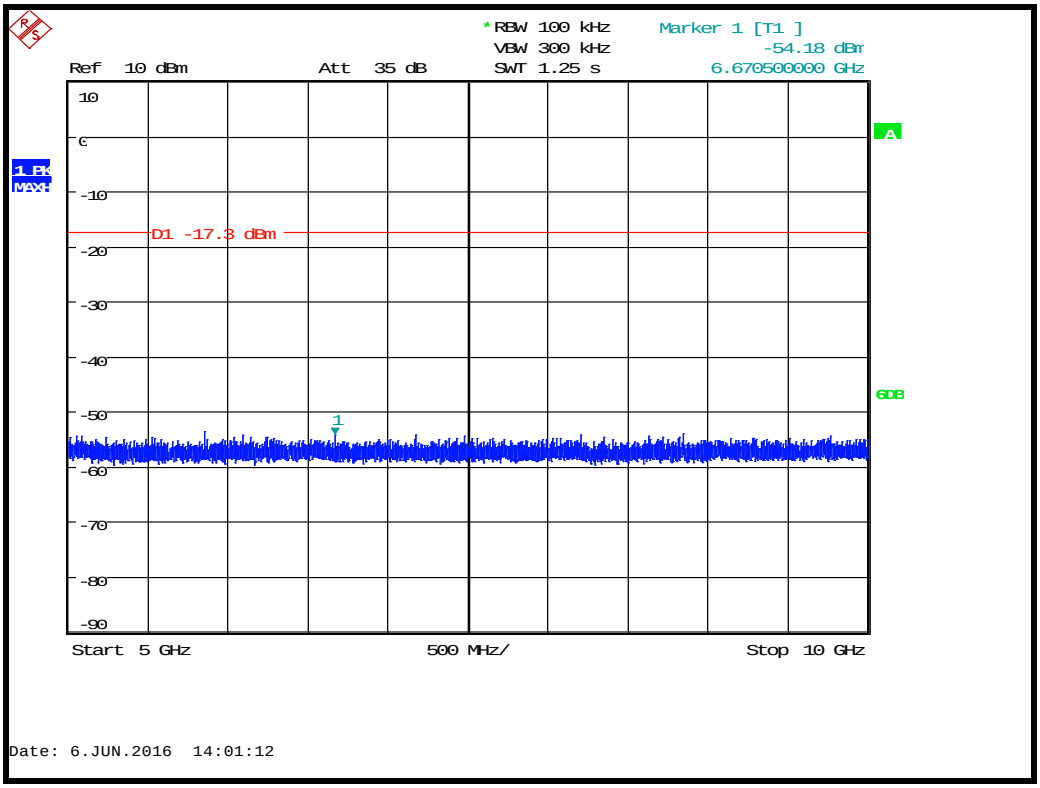


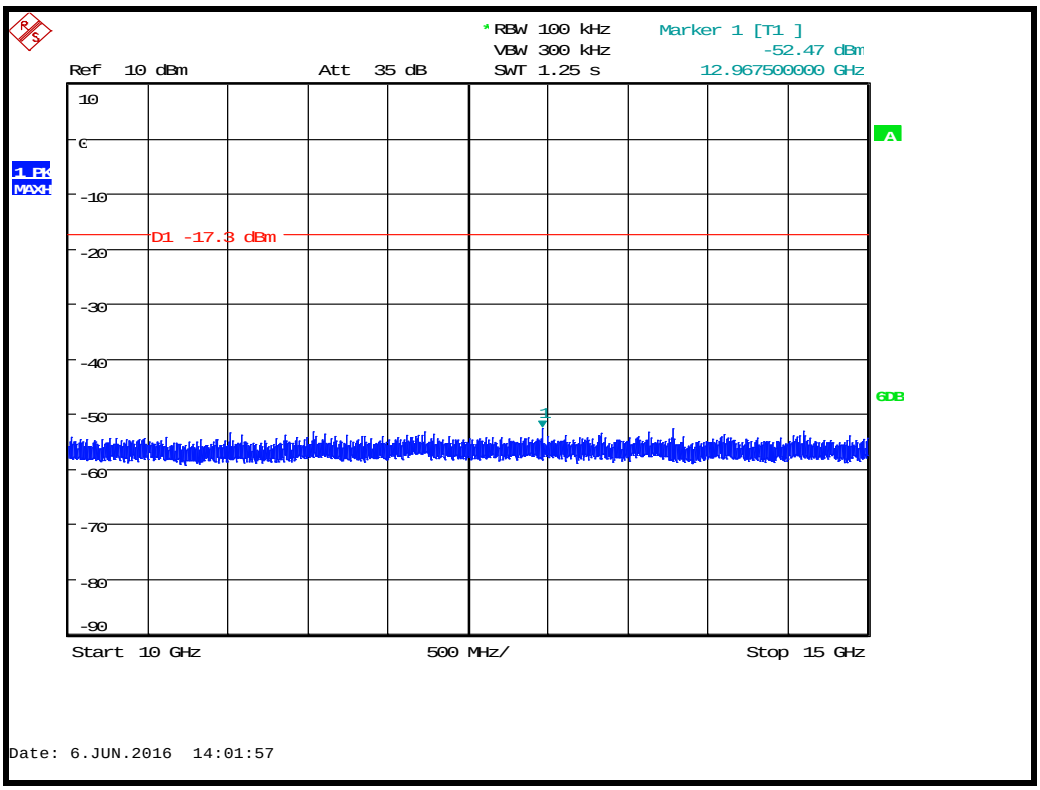


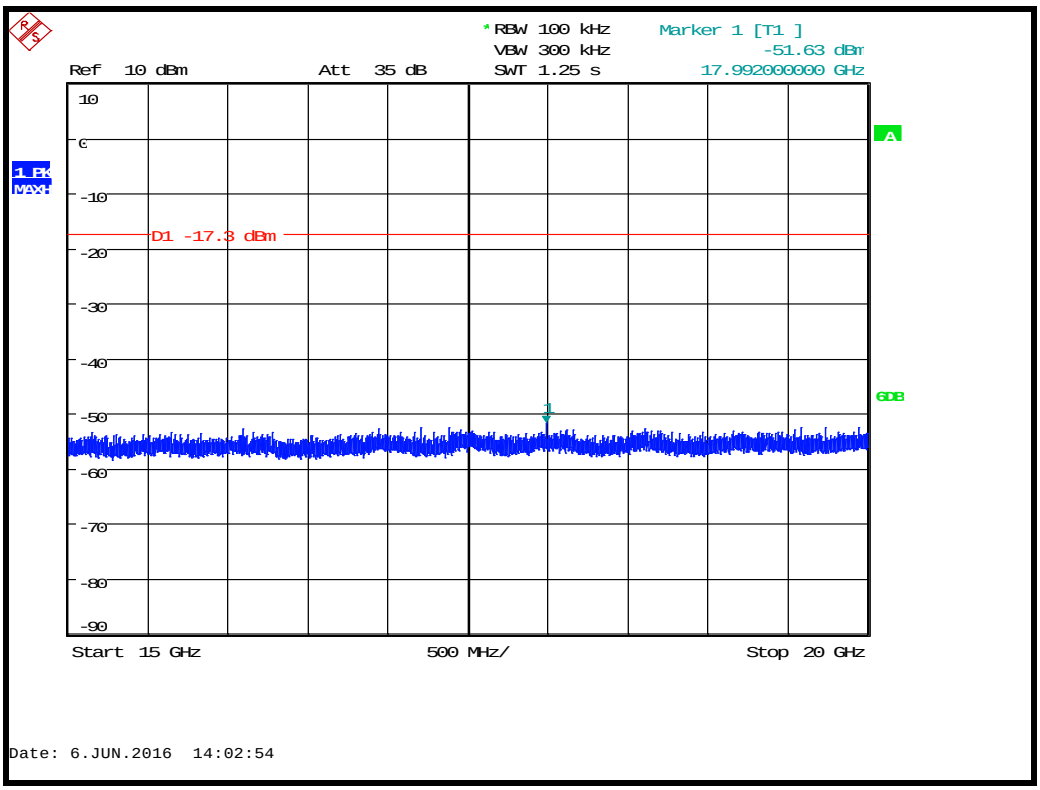

RBW 10 kHz
VBW 30 kHz
SWT 600 ms
Marker 1 [T1]
-57.81 dBm
179.850000000 kHz
Ref 10 dBm
Att 35 dB
D1 -17.3 dBm
Start 150 kHz
2.985 MHz/
Stop 30 MHz
Date: 6.JUN.2016 13:58:03

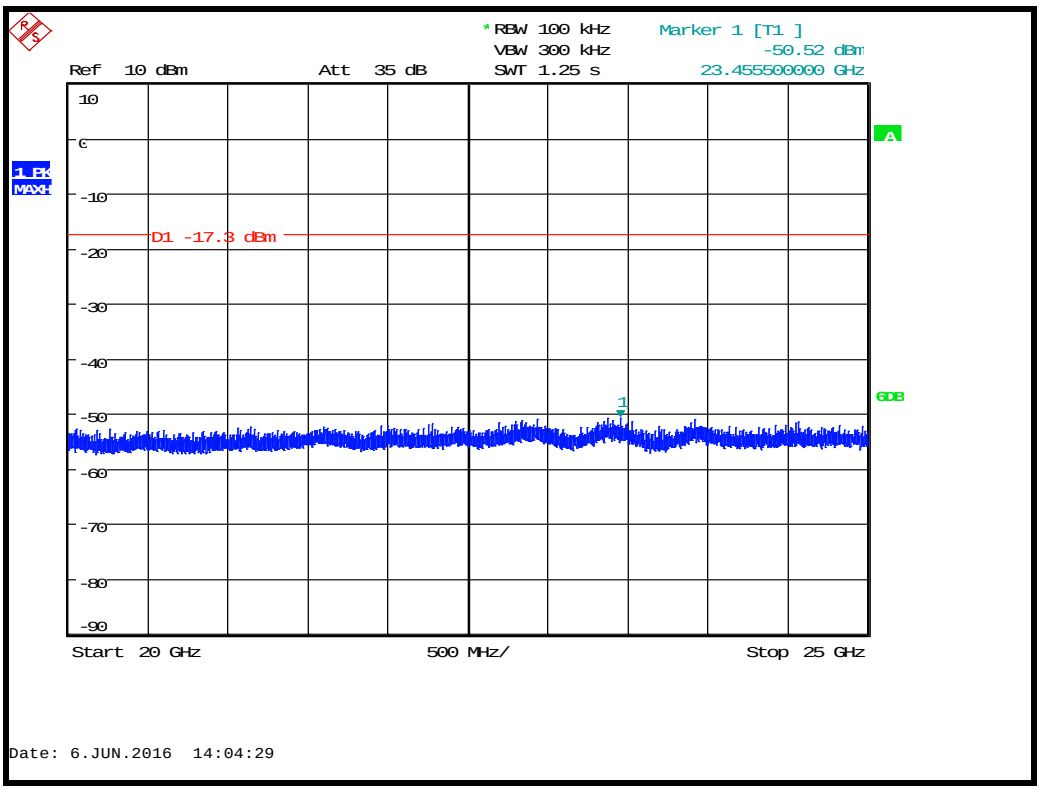

RBW 100 kHz
VBW 300 kHz
SWT 235 ms
Marker 1 [T1]
-53.74 dBm
965.953000000 MHz
Ref 10 dBm
Att 35 dB
D1 -17.3 dBm
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 6.JUN.2016 13:59:07


RBW 100 kHz
VBW 300 kHz
SWT 980 ms
Marker 1 [T1]
2.69 dBm
2.441600000 GHz
Marker 2 [T1]
-48.29 dBm
3.256000000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.3 dBm
Start 1 GHz
400 MHz/
Stop 5 GHz
Date: 6.JUN.2016 14:00:32

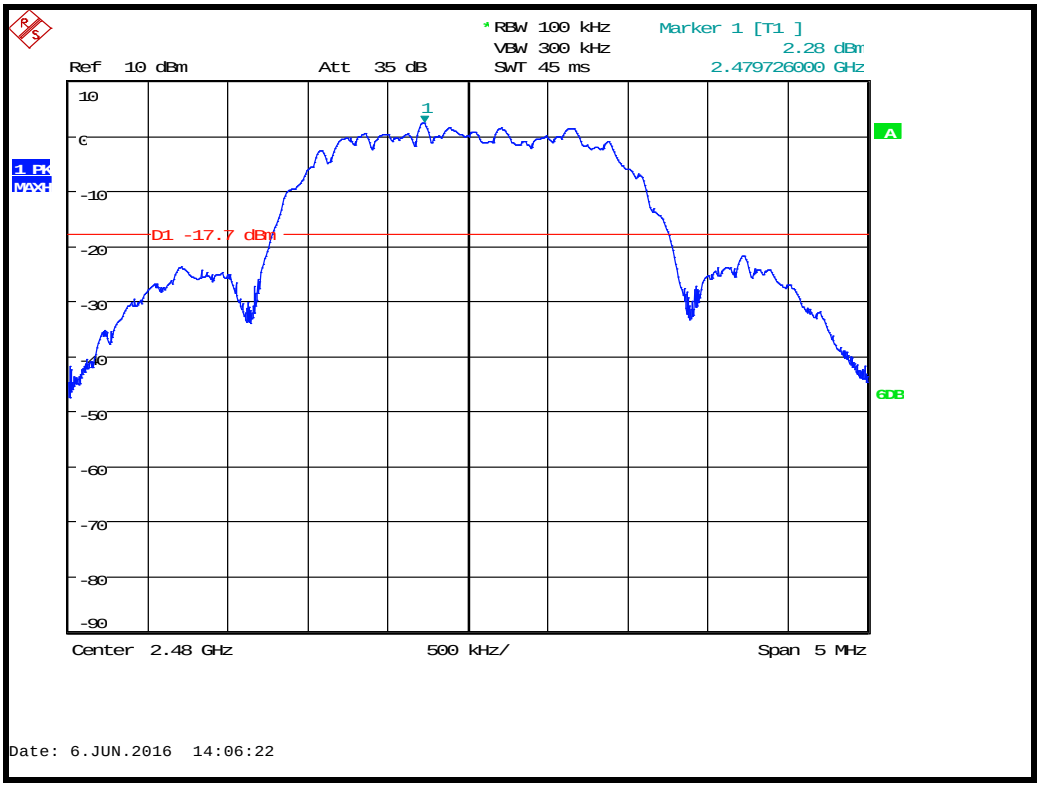

RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-54.18 dBm
6.670500000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.3 dBm
Start 5 GHz
500 MHz/
Stop 10 GHz
Date: 6.JUN.2016 14:01:12

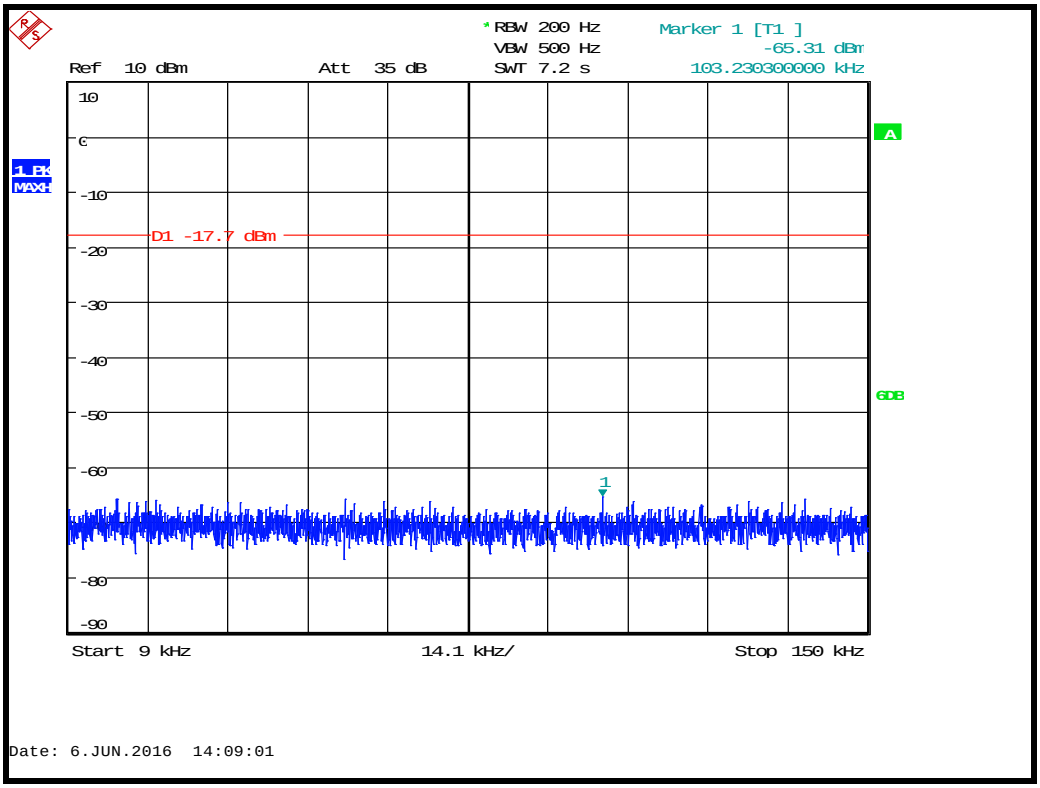

RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-52.47 dBm
12.967500000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.8 dBm
Start 10 GHz
500 MHz/
Stop 15 GHz
Date: 6.JUN.2016 14:01:57

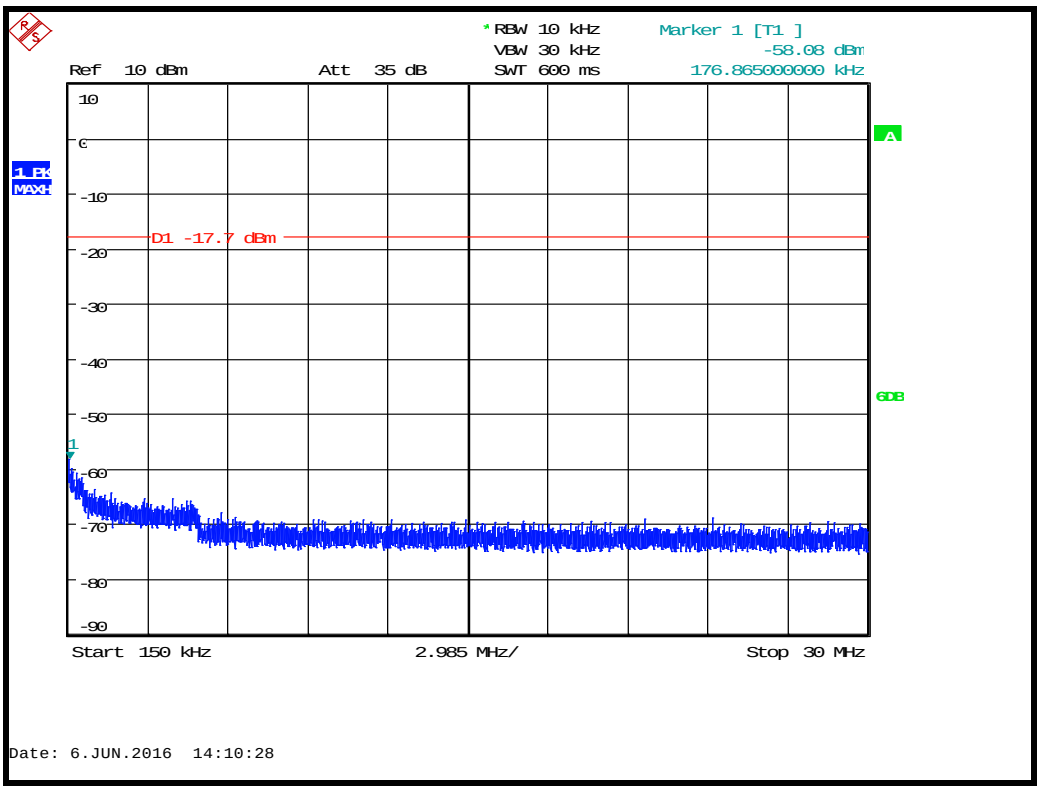

RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-51.63 dBm
17.992000000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.8 dBm
Start 15 GHz
500 MHz/
Stop 20 GHz
Date: 6.JUN.2016 14:02:54

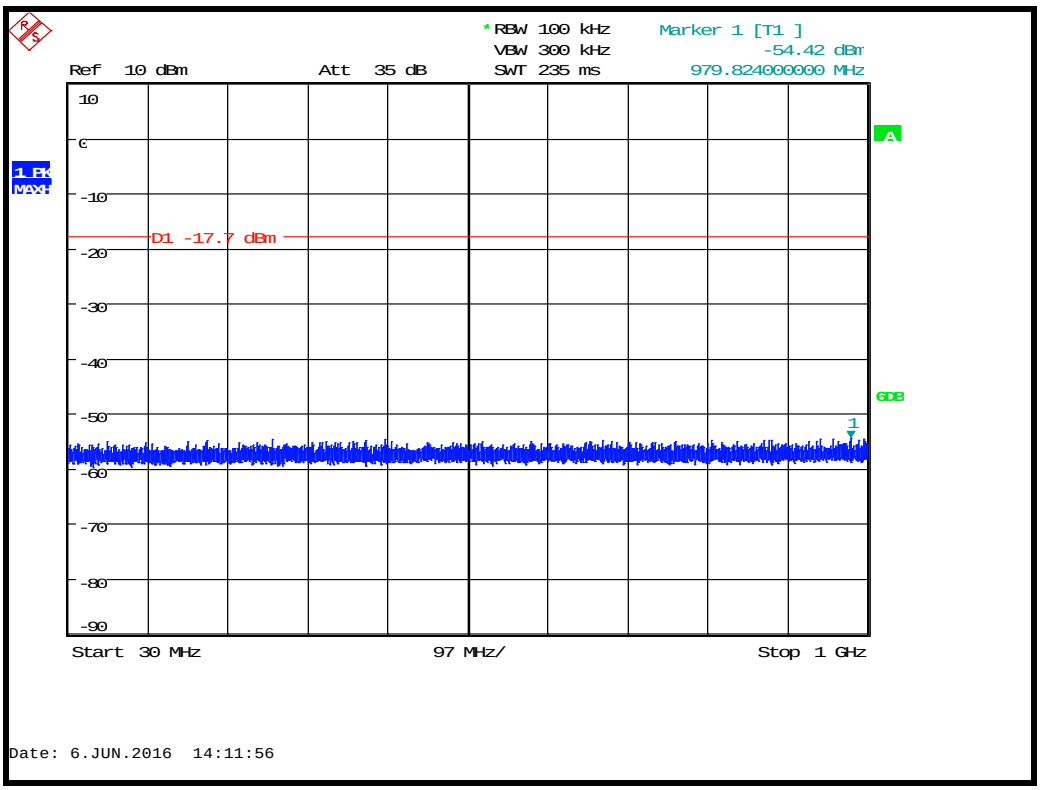

RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-50.52 dBm
23.455500000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.3 dBm
Start 20 GHz
500 MHz/
Stop 25 GHz
Date: 6.JUN.2016 14:04:29

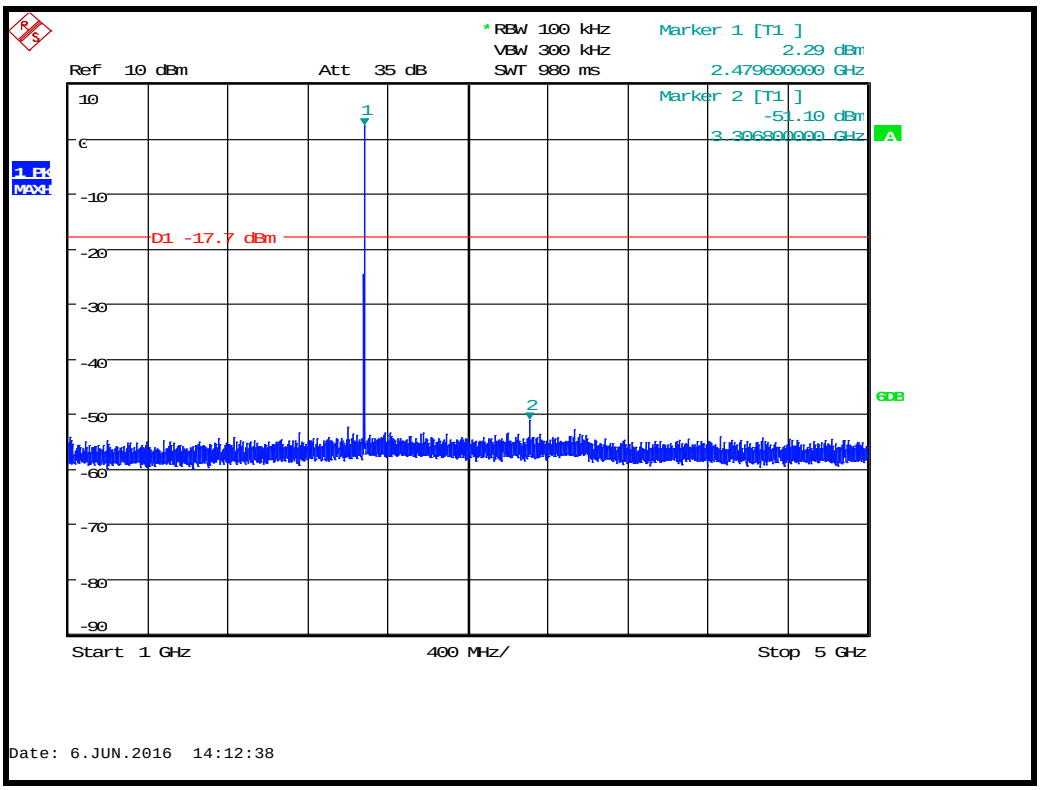
Modulation: GFSK; Data rate: BTLE; Power setting: Full						
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Analyzer Level (dBm)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
2480	2479.726	2.28	2.28	-17.7	ref	PASS
There were no emissions detected within 20 dB of the limit.						PASS

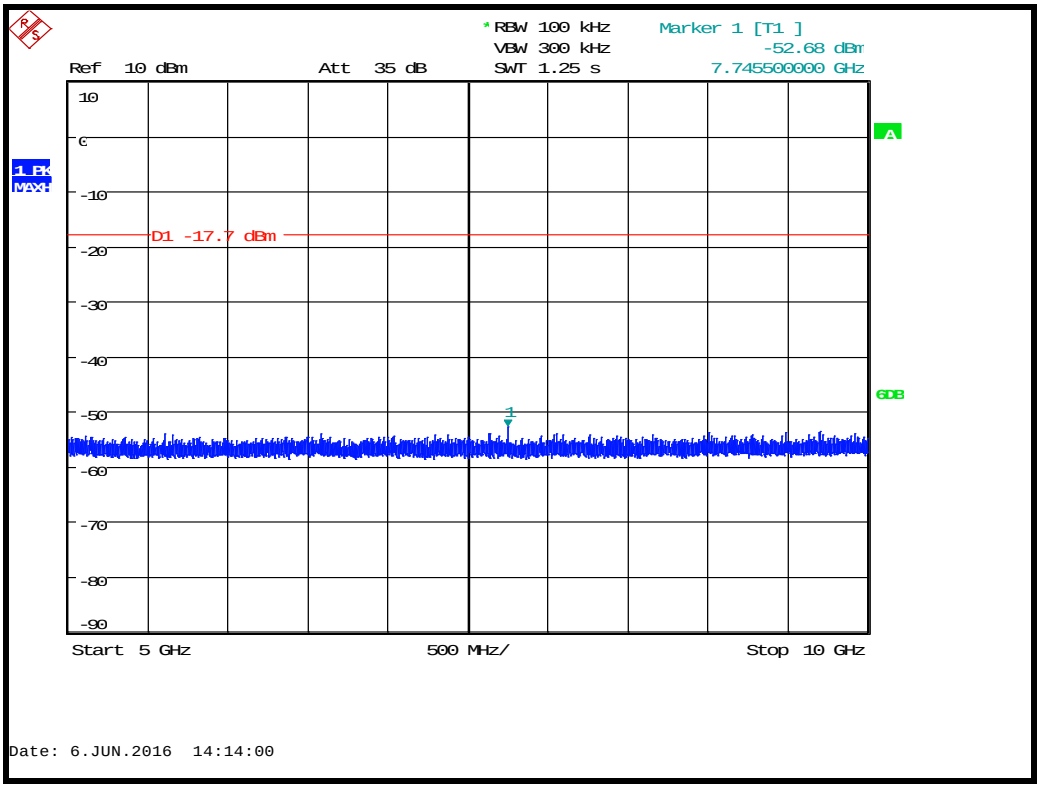


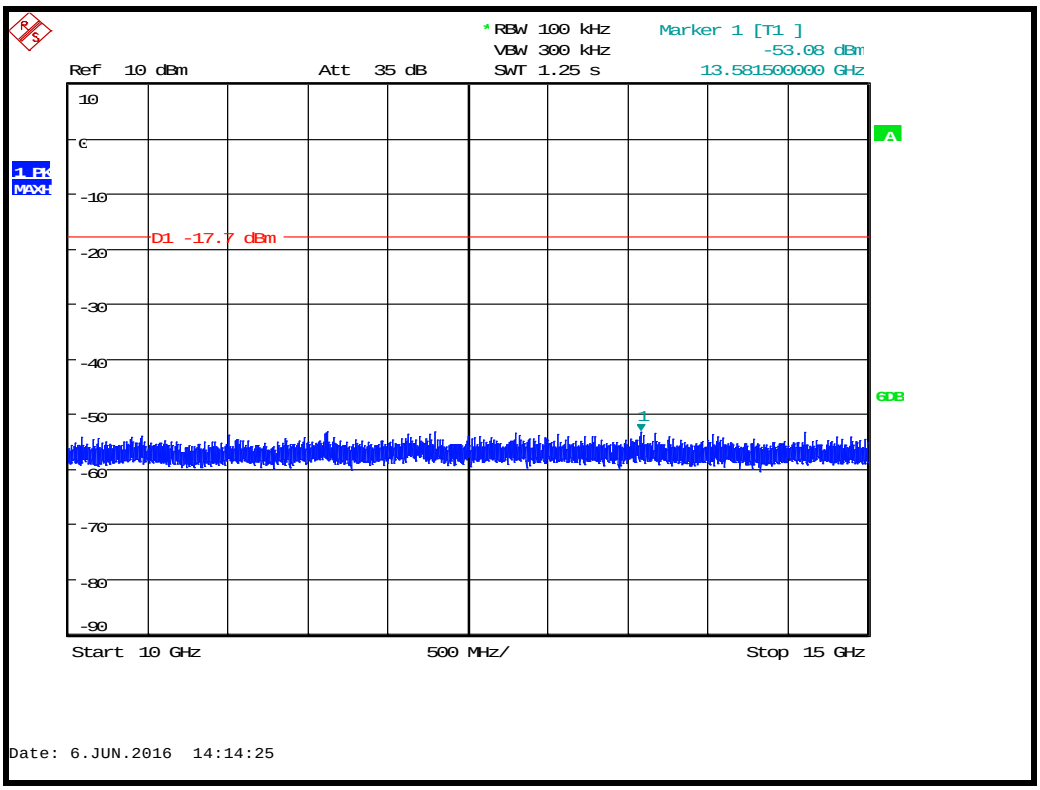


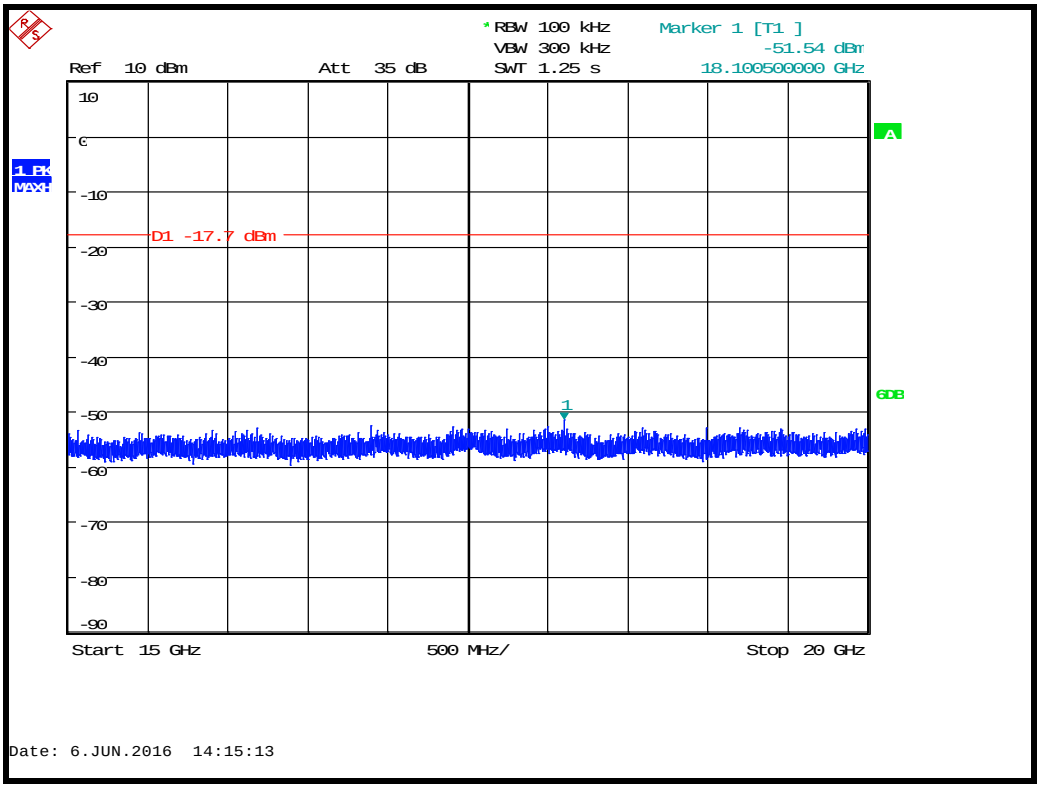

RBW 10 kHz
VBW 30 kHz
SWT 600 ms
Marker 1 [T1]
-58.08 dBm
176.865000000 kHz
Ref 10 dBm
Att 35 dB
D1 -17.7 dBm
Start 150 kHz
2.985 MHz/
Stop 30 MHz
Date: 6.JUN.2016 14:10:28

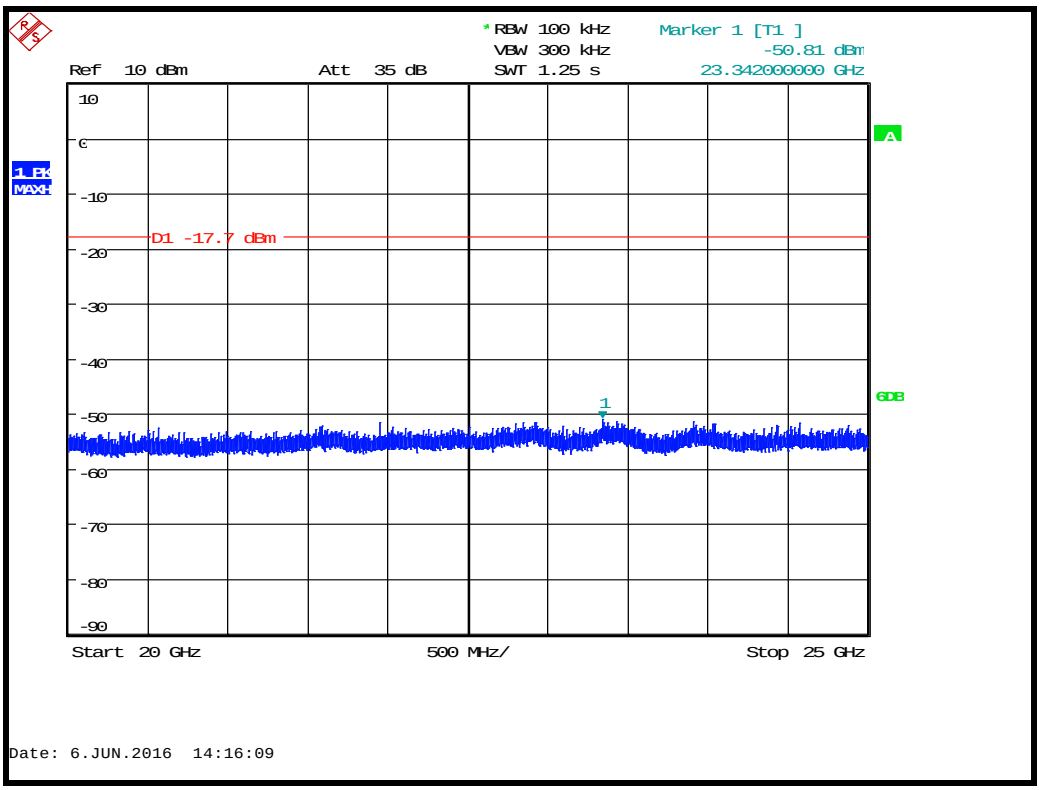

RBW 100 kHz
VBW 300 kHz
SWT 235 ms
Marker 1 [T1]
-54.42 dBm
979.824000000 MHz
Ref 10 dBm
Att 35 dB
D1 -17.7 dBm
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 6.JUN.2016 14:11:56


RBW 100 kHz
VBW 300 kHz
SWT 980 ms
Marker 1 [T1]
2.29 dBm
2.479600000 GHz
Marker 2 [T1]
-51.10 dBm
3.306800000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.7 dBm
Start 1 GHz
400 MHz/
Stop 5 GHz
Date: 6.JUN.2016 14:12:38


RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-52.68 dBm
7.745500000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.7 dBm
Start 5 GHz
500 MHz/
Stop 10 GHz
Date: 6.JUN.2016 14:14:00


RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-53.08 dBm
13.581500000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.7 dBm
Start 10 GHz
500 MHz/
Stop 15 GHz
Date: 6.JUN.2016 14:14:25


RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-51.54 dBm
18.100500000 GHz
Ref 10 dBm
Att 35 dB
D1 -17.7 dBm
Start 15 GHz
500 MHz/
Stop 20 GHz
Date: 6.JUN.2016 14:15:13


RBW 100 kHz
VBW 300 kHz
SWT 1.25 s
Marker 1 [T1]
-50.81 dBm
23.342000000 GHz
Ref 10 dBm
Att 35 dB
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
D1 -17.7 dBm
1
A
6DB
Start 20 GHz
500 MHz/
Stop 25 GHz
Date: 6.JUN.2016 14:16:09

14 Power spectral density

14.1 Definition

The power per unit bandwidth.

14.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Lab 4
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.10
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	2 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)	3 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 36 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V ac	

14.3 Test Limit

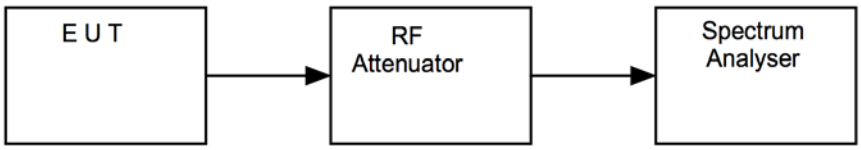
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

14.4 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

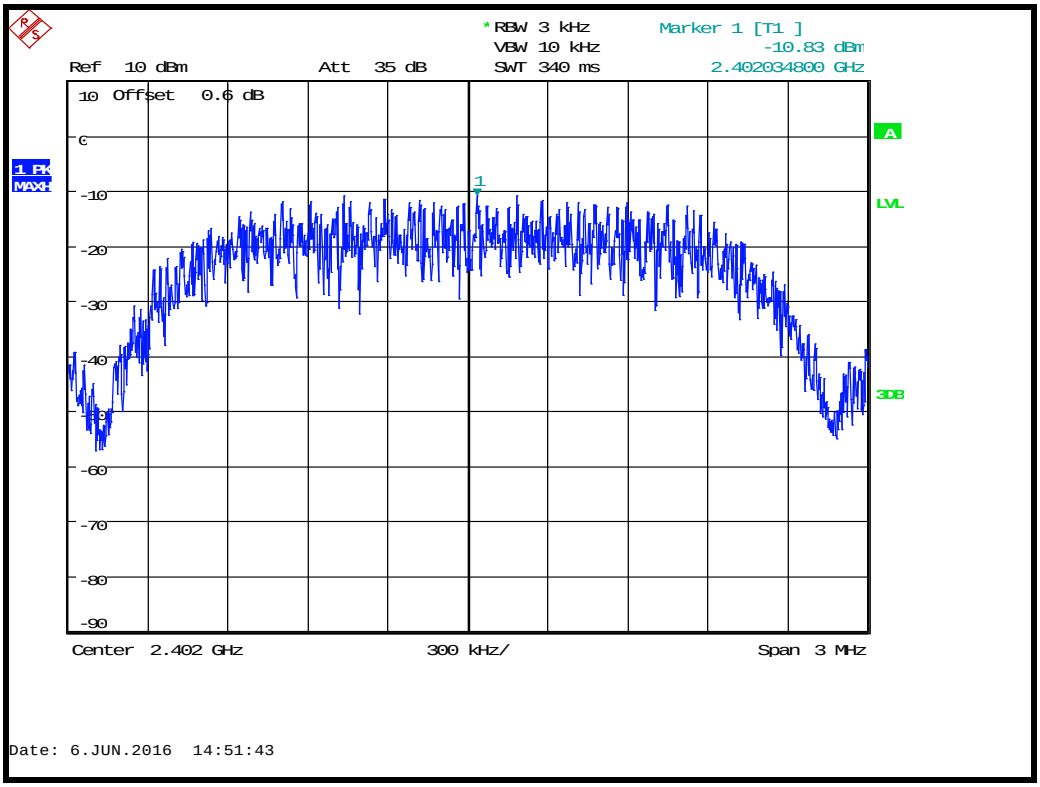


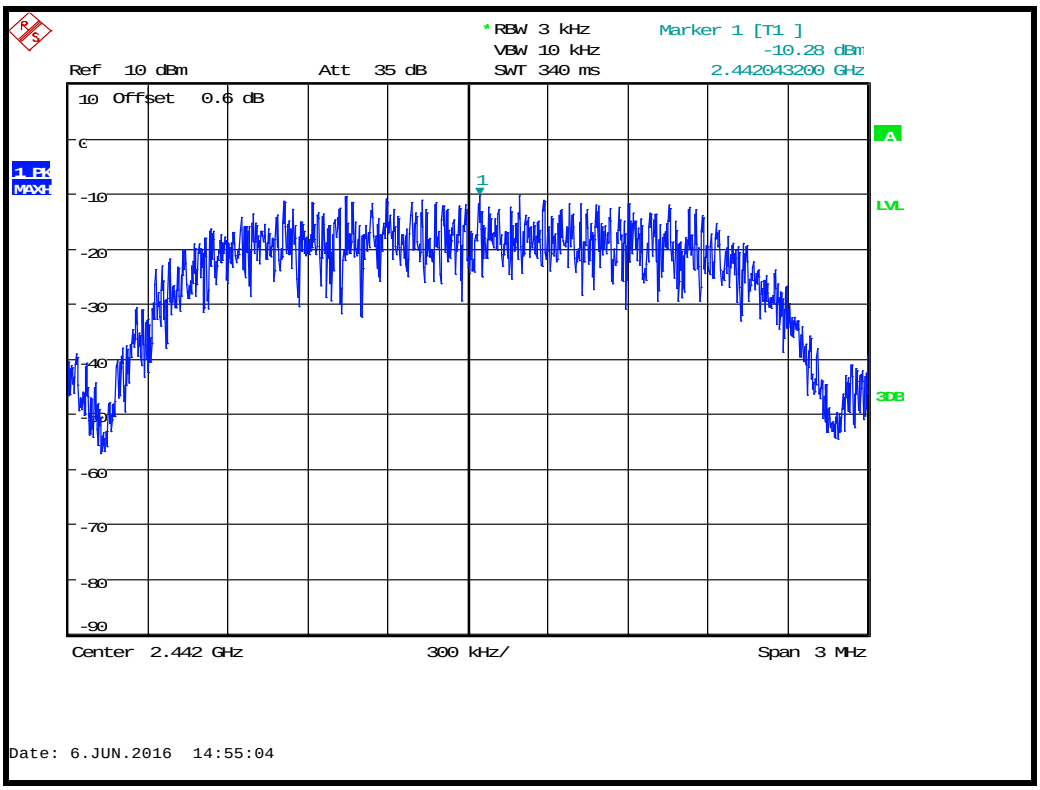
14.5 Test Equipment

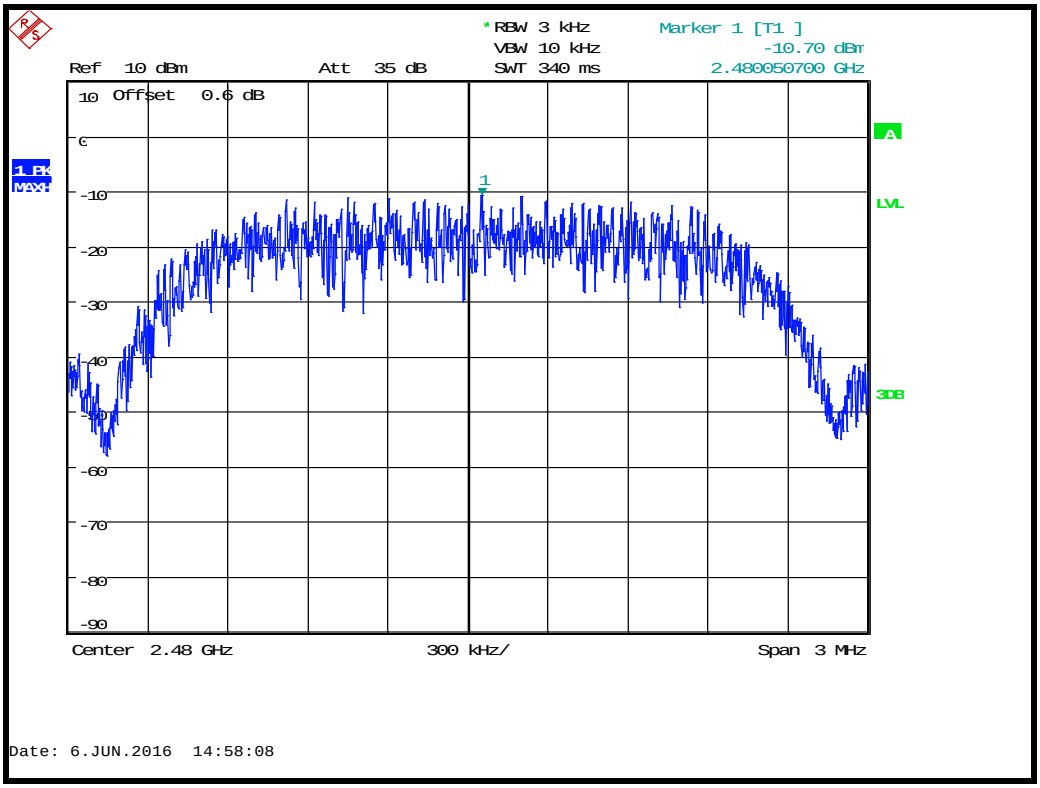
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU26	R&S	Spectrum Analyser	REF909	26/04/2017

14.6 Test Results

Modulation: GFSK; Data rate: BTLE; Power setting: Full				
Channel Frequency (MHz)	***Analyzer Level (dBm)***	***Cable loss (dB)***	***Power (dBm)***	***Result***
2402	-10.83	0	-10.83	PASS
2442	-10.28	0	-10.28	PASS
2480	-10.70	0	-10.70	PASS




RBW 3 kHz
VBW 10 kHz
SWT 340 ms
Marker 1 [T1]
-10.28 dBm
2.442043200 GHz
Ref 10 dBm
Att 35 dB
Offset 0.6 dB
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
1
A
LVL
3DB
Center 2.442 GHz
300 kHz/
Span 3 MHz
Date: 6.JUN.2016 14:55:04


RBW 3 kHz
VBW 10 kHz
SWT 340 ms
Marker 1 [T1]
-10.70 dBm
2.480050700 GHz
Ref 10 dBm
Att 35 dB
Offset 0.6 dB
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
1
A
LVL
3DB
Center 2.48 GHz
300 kHz/
Span 3 MHz
Date: 6.JUN.2016 14:58:08

15 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**