Report on the Radio Testing

For

Rentokil Initial 1927 plc

on

Bed Bug Monitor

Report no. TRA-039992-45-00A

22 June 2018

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

Report Number: TRA-039992-45-00A
Issue: A

REPORT ON THE RADIO TESTING OF A
Rentokil Initial 1927 plc
Bed Bug Monitor
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247

TEST DATE: 2018-05-03 to 2018-05-22

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Date:	22 June 2018	

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1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	22 June 2018	Original

2 Summary

TEST REPORT NUMBER:	TRA-039992-45-00A
WORKS ORDER NUMBER:	TRA-039992-02
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):	Bed Bug Monitor
FCC IDENTIFIER:	2AK3PGSD-500349
EUT SERIAL NUMBER:	BLD2.1.6
MANUFACTURER/AGENT:	Rentokil Initial 1927 plc
ADDRESS:	Marketing and Innovation Riverbank Meadows Business Park Camberley GU17 9AB United Kingdom
CLIENT CONTACT:	Ning Pan ☎ 01276536676 ✉ ning.pan@rentokil-initial.com
ORDER NUMBER:	PO-G017689
TEST DATE:	2018-05-03 to 2018-05-22
TESTED BY:	A Longley Element

2.1 Test Summary

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

Notes:

Note 1: The results in this report cover radiated tests only and are intended to support the use of a previously tested module in a new product. See also Element test report TRA-033559-45-00B.

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-039992-45-00A presents the results of the Radio testing on a Rentokil Initial 1927 plc, Bed Bug Monitor to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Rentokil Initial 1927 plc by Element, at the address 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 UK0007.

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.

5.2 Deviations from Test Standards

There were no deviations from the test standard.

The results in this report cover radiated tests only and are intended to support the use of a previously tested module in a new product. See also Element test report TRA-033559-45-00B.

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: Bed Bug Monitor
- Serial Number: BLD2.1.6
- Model Number: GSD-801014
- Software Revision: Not Applicable
- Build Level / Revision Number: Not Applicable

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.

Laptop PC (required to change operating mode, not connected during testing).

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Transmitter tests was as follows:
Continuous transmit mode with modulation.

7.3.2 Reception

The mode of operation for Receiver tests was as follows:
No receiver testing is detailed in this report.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	915 MHz to 928 MHz
Modulation type(s):	FSK chirp (LoRa)
Occupied channel bandwidth(s):	200 kHz
Channel spacing:	200 kHz
ITU emission designator(s):	125K1DEX
Declared output power(s):	10 dBm
Warning against use of alternative antennas in user manual (yes/no):	Yes
Nominal Supply Voltage:	3 Vdc
Location of notice for license exempt use:	Label / user manual / both.
Method of prevention of use on non-US / non-Canadian frequencies:	Software Locked
Duty cycle:	< 10 % in normal operation

7.4.2 Antennas

Type:	PRO-OB-471
Frequency range:	902 MHz to 928 MHz
Impedance:	50 Ω
Return Loss:	-6 dB
Gain:	3 dBi
Polarisation:	Linear
Connector type:	Soldered to PCB
Length:	34 mm
Environmental limits:	-40 ˚C to +125 ˚C

7.4.3 Product specific declarations

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

7.5 EUT Description

The EUT is a bedbug detector containing a LoRa radio module.

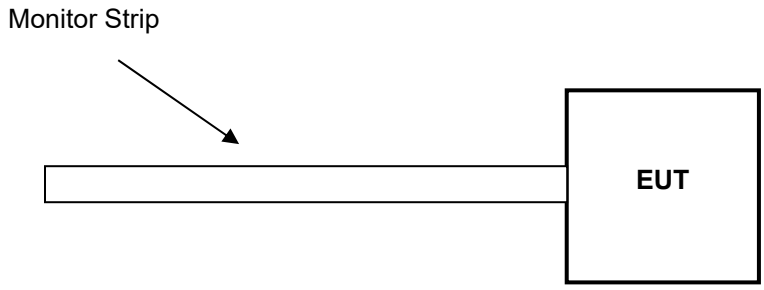
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

9.1 Block Diagram

The following diagram shows basic EUT setup, the EUT is battery powered standalone device:



9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:

10 General Technical Parameters

10.1 Normal Conditions

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 3 V dc from alkaline batteries.

11 Radiated emissions

11.1 Definitions

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

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

11.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Laboratory 2
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels Measured:	Low Channel 06 / Mid Channel 31 / High Channel 55
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: 24 °C	+15 ºC to +35 ºC (as declared)
Humidity: 19 % RH	20 % RH to 75 % RH (as declared)
Supply: 3 V dc	(as declared)

11.3 Test Limit

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

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

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

11.4 Test Method

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

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

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

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

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

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

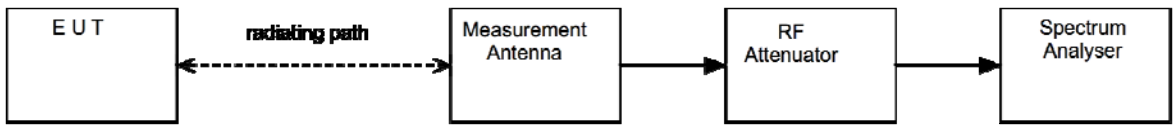
$$FS = PR + CL + AF – PA + DC – CF$$

Where,

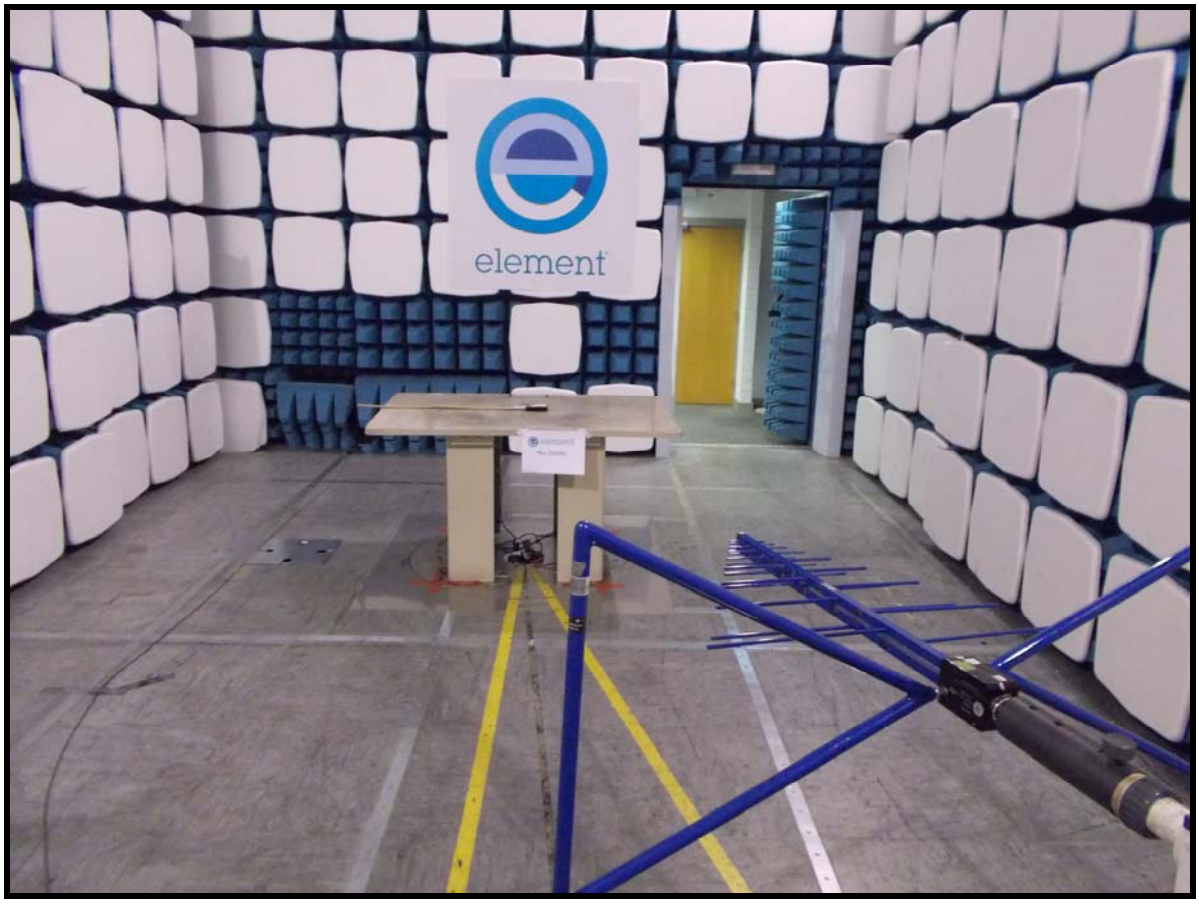
PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor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

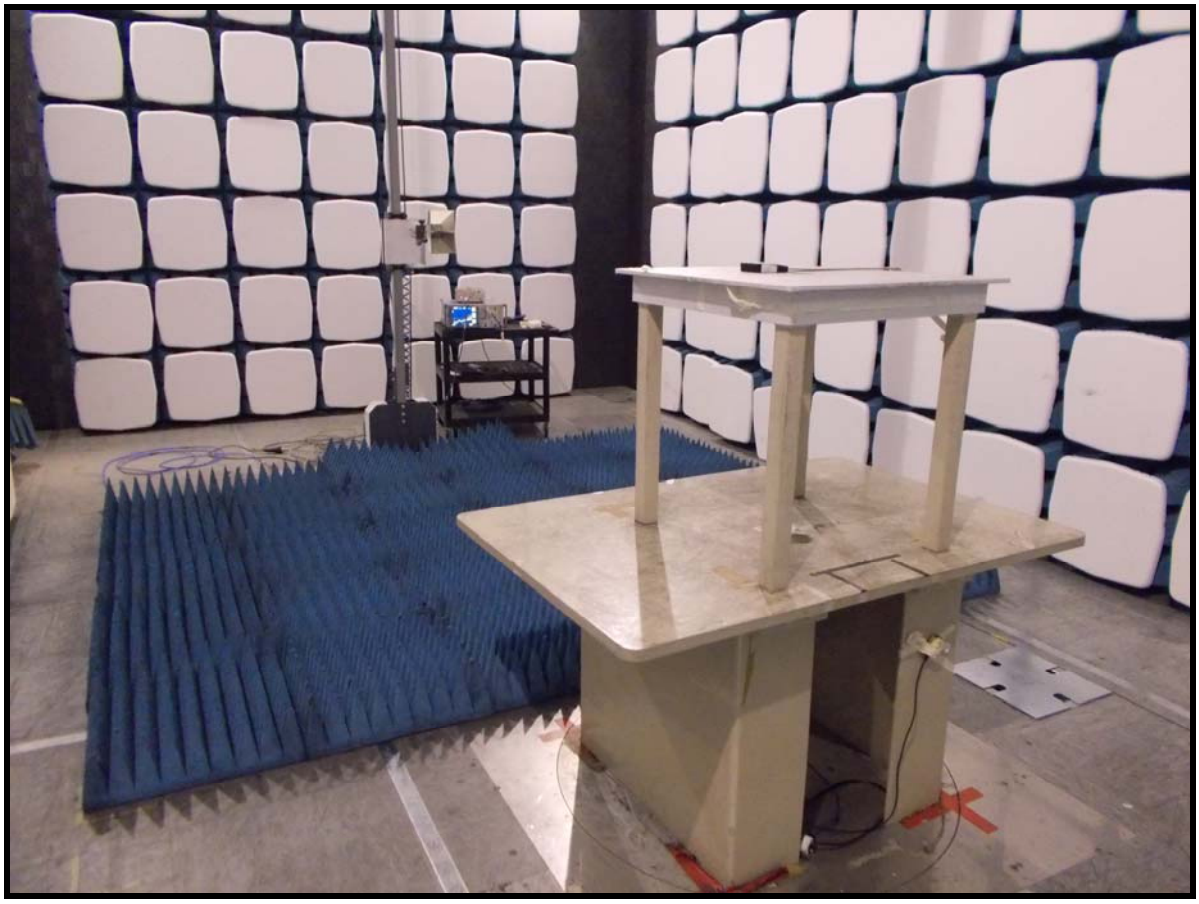
This field strength value is then compared with the regulatory limit.

Figure i Test Setup



11.5 Test Set-up Photograph


element

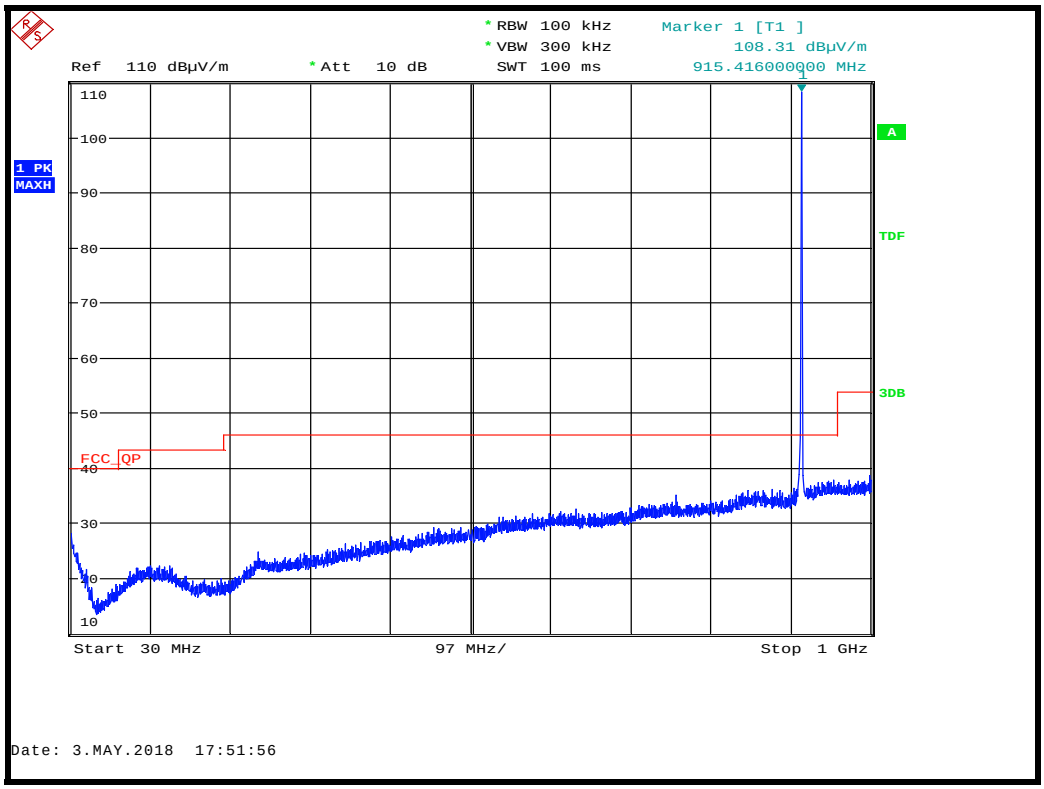


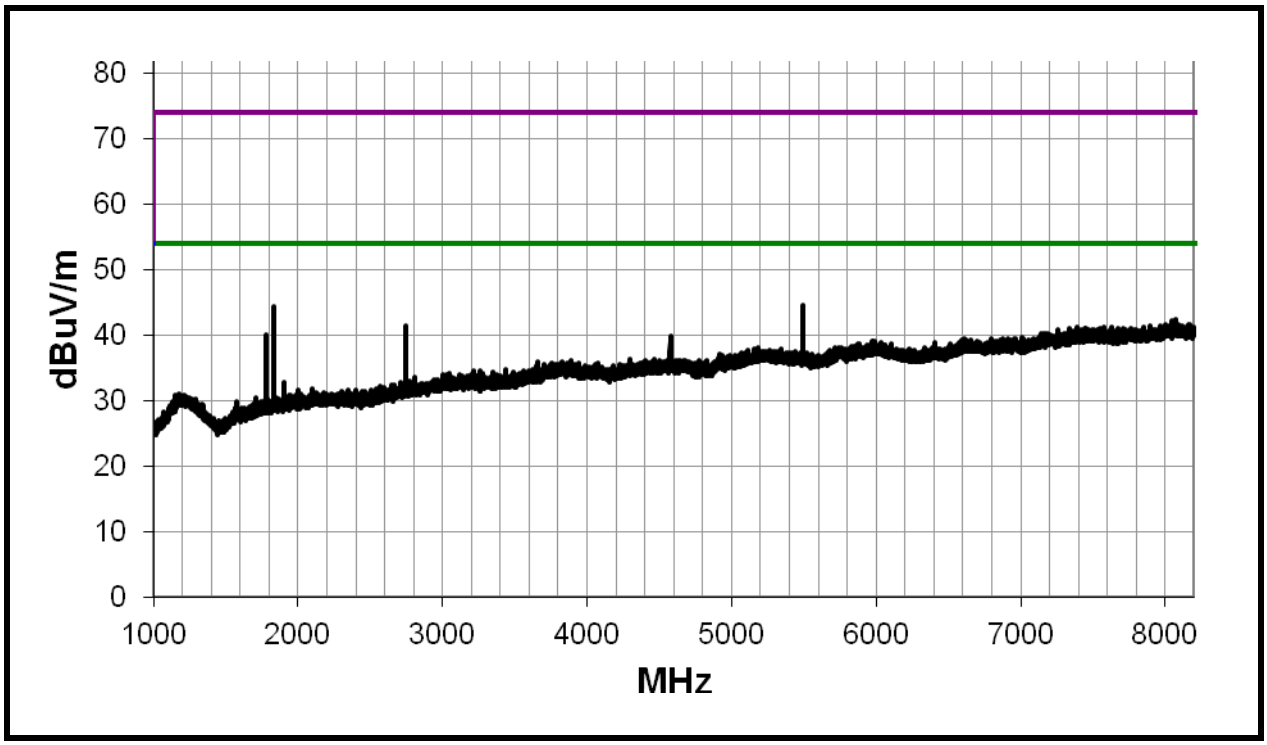
11.6 Test Equipment

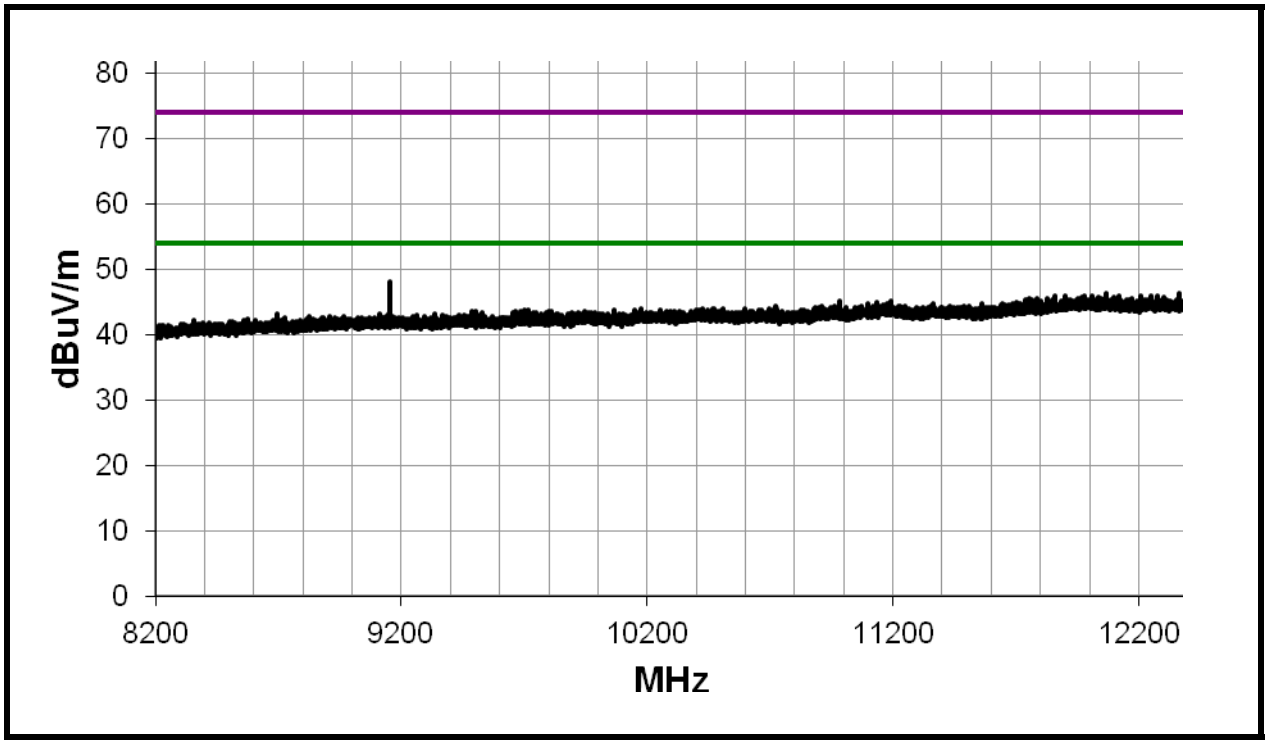
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ATS	Rainford	Ferrite Lined Chamber	REF886	2018-07-24
FSU46	R&S	Spectrum Analyser	U281	2018-06-19
CBL6111B	Chase	Bilog Antenna	REF2218	2019-11-06
VUBA9117	Schwarzbeck	Biconical Antenna	REF859	2018-09-14
310	Sonoma	Pre-Amp (9kHz – 1GHz)	REF927	2018-06-30
8449B	Agilent	Pre-Amp (1 – 26.5GHz)	REF913	2019-02-07
3115	EMCO	Horn Antenna	RFG129	2020-02-12
3TNF-500/1000-N/N	K & L	Tuneable Notch Filter	REF827	Cal in use
VHF-1300+	Mini Circuits	High Pass Filter	REF2227	2019-02-27
VHF-3100+	Mini Circuits	High Pass Filter	REF688	2019-02-27

11.7 Test Results

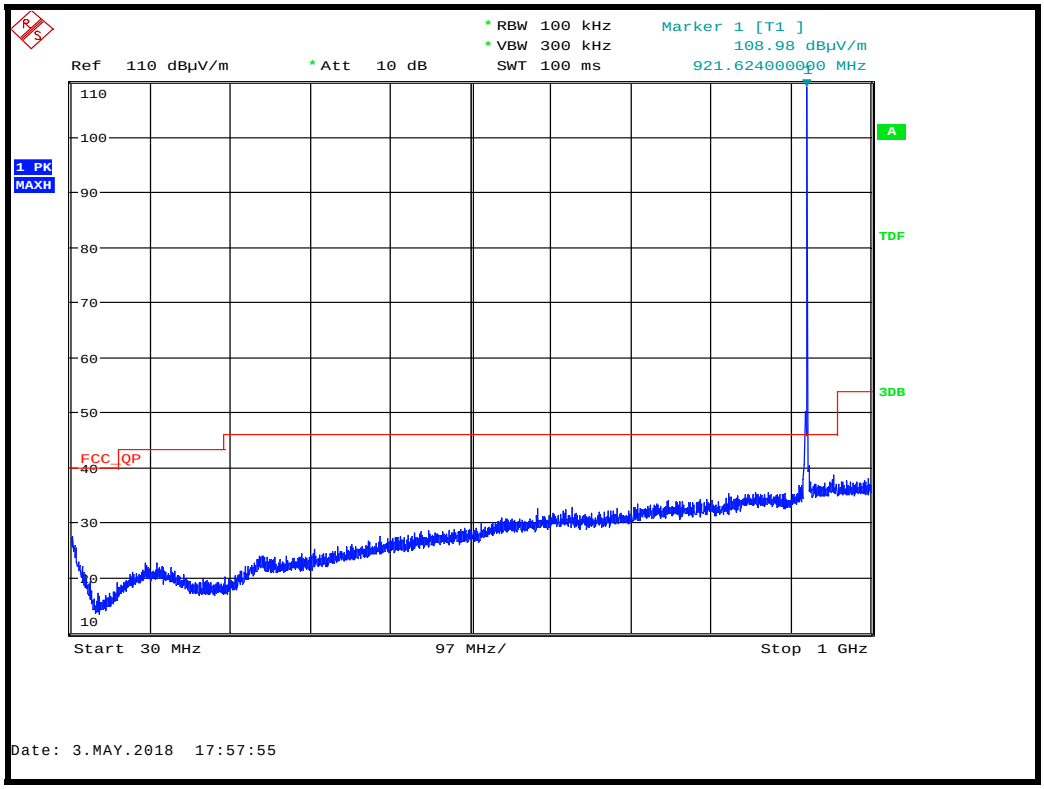
Channel 6 (Bottom Channel)

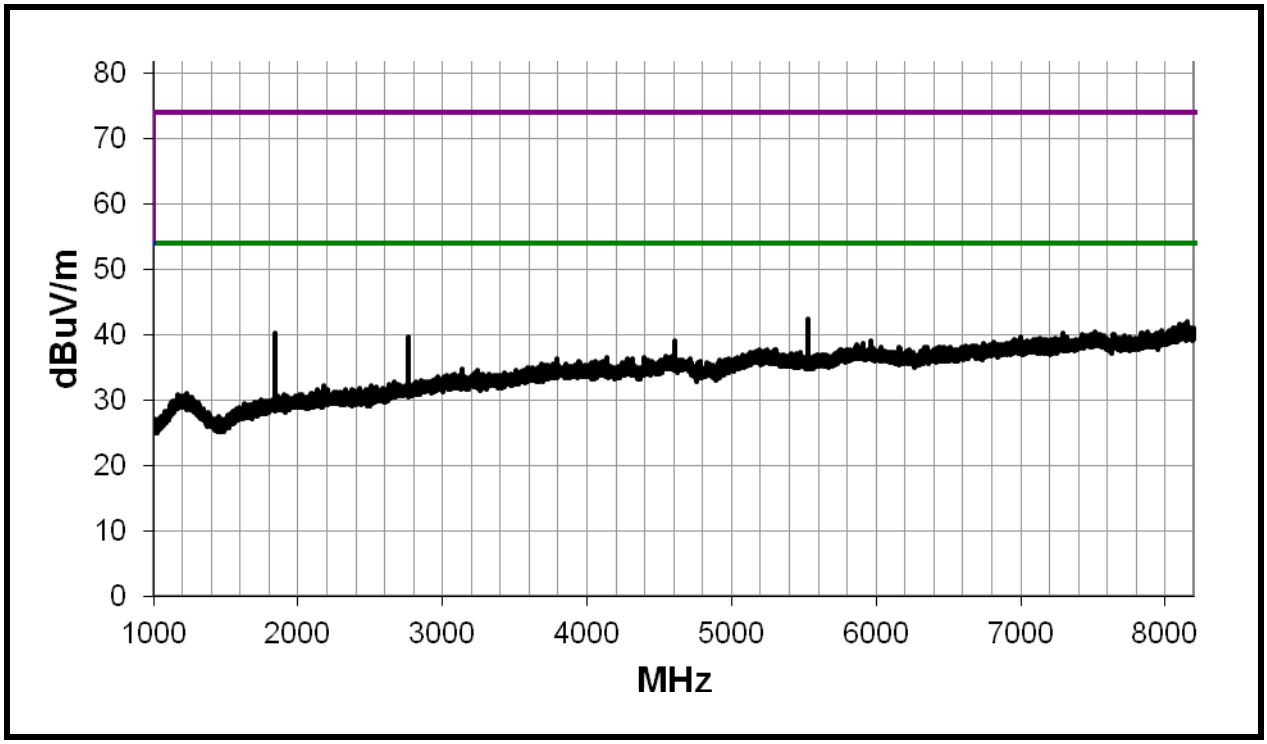


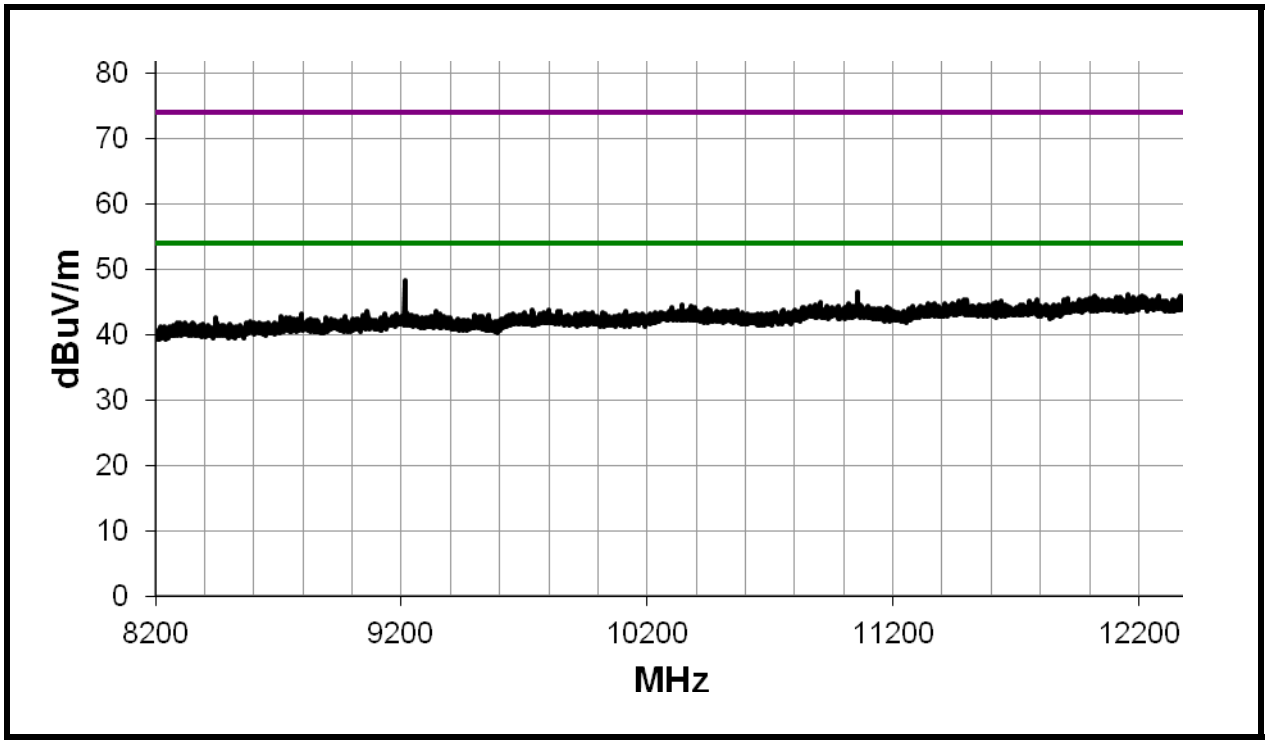



80
70
60
50
40
30
20
10
0
dBuV/m
8200
9200
10200
11200
12200
MHz

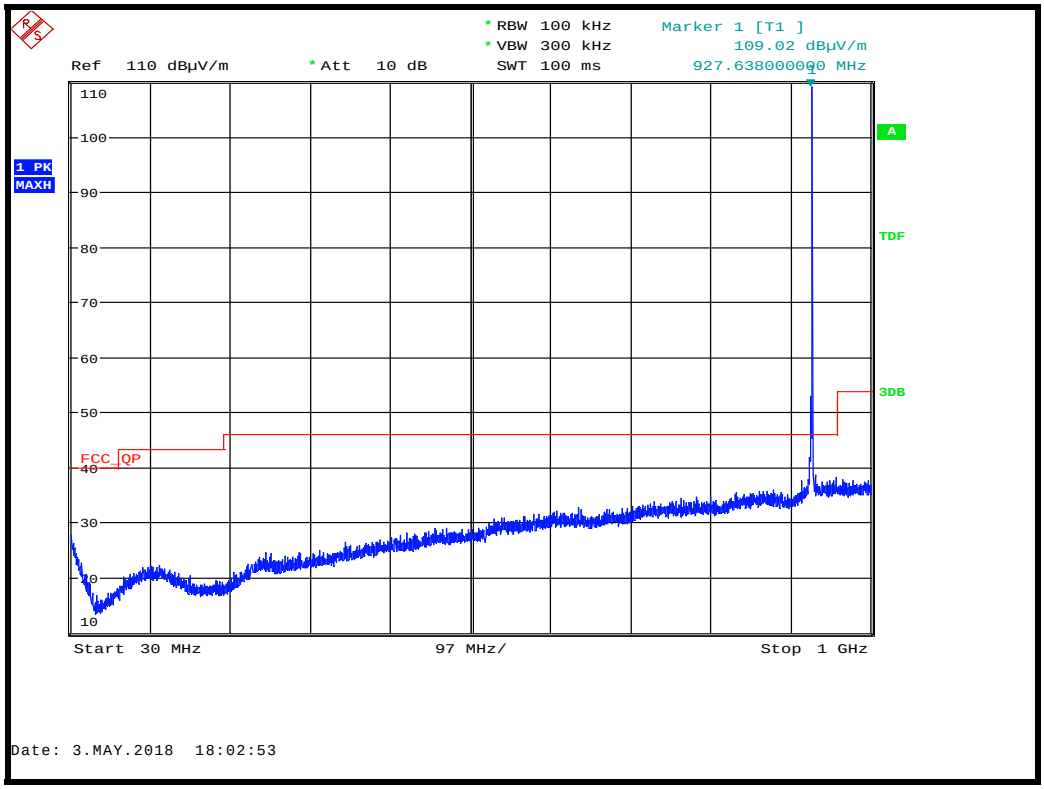
Channel 31 (Middle Channel)

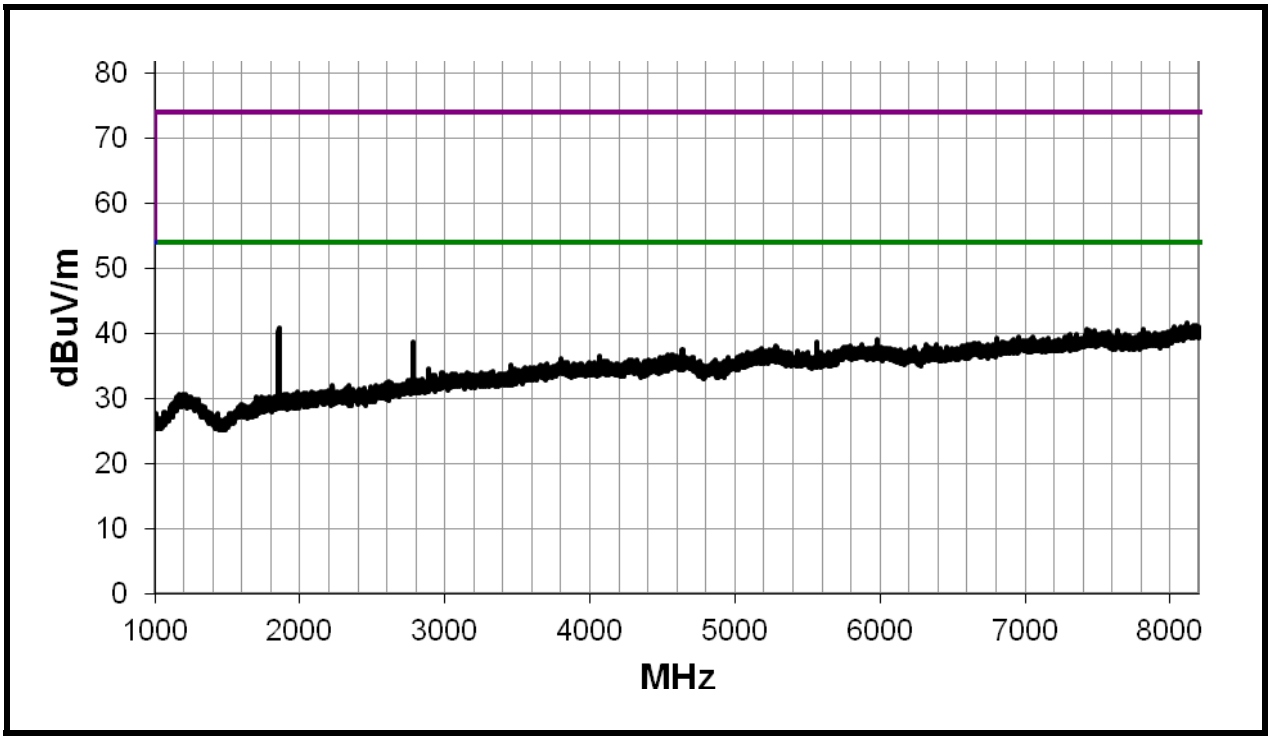


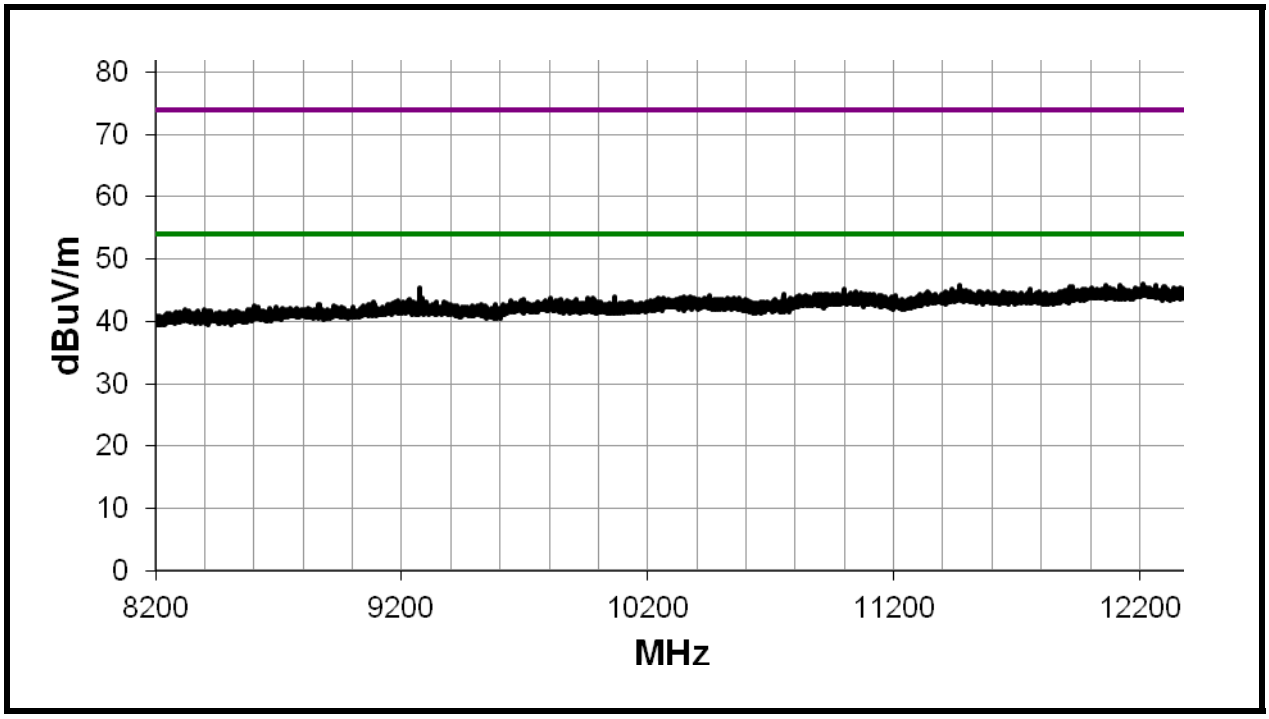



80
70
60
50
40
30
20
10
0
dBuV/m
8200
9200
10200
11200
12200
MHz

Channel 55 (Top Channel)






80
70
60
50
40
30
20
10
0
dBuV/m
8200
9200
10200
11200
12200
MHz

Power 0x06; Channel: 06										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Filter Loss (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
P	5491.50	45.7	4.9	34.2	35.6	0.4	0.0	49.6	303.0	5000.0
A	5491.50	37.7	4.9	34.2	35.6	0.4	0.0	41.6	120.6	500.0
P	9152.00	50.27	6.4	37.8	36.2	1.1	0.0	59.3	925.8	5000.0
A	9152.00	44.85	6.4	37.8	36.2	1.1	0.0	53.9	496.0	500.0

Power 0x06; Channel: 31										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Filter Loss (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
P	9215.00	43.61	6.4	37.9	36.3	1.1	0.0	52.7	433.5	5000.0
A	9215.00	33.21	6.4	37.9	36.3	1.1	0.0	42.3	130.9	500.0
P	11058.32	45.4	7.1	38.5	35.8	0	0.0	55.2	575.4	5000.0
A	11058.32	34.0	7.1	38.5	35.8	0	0.0	43.8	154.9	500.0

Power 0x06; Channel: 55										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Filter Loss (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
P	9275.00	47.47	6.4	37.9	36.3	1.1	0.0	56.6	674.5	5000.0
A	9725.00	40.16	6.4	37.9	36.3	1.1	0.0	49.3	290.7	500.0

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:	Lab 16
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.5
EUT Channels Measured:	Low Channel 06 / Mid Channel 29 / High Channel 55 - Hopping disabled
EUT Channel Bandwidths:	200 kHz
Deviations From Standard:	None
Measurement BW:	3 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10 kHz
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Battery Power = new battery.

Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 ºC to +35 ºC (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)

12.3 Test Limit

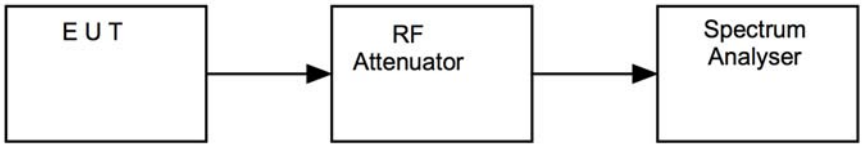
- For frequency hopping systems operating in the band 902 to 928 MHz, the maximum peak conducted output power shall not exceed 1 W, and the e.i.r.p. shall not exceed 4 W, if the hopset uses 50 or more hopping channels;
  the maximum peak conducted output power shall not exceed 0.25 W, and the e.i.r.p. 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 75 hopping 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.

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

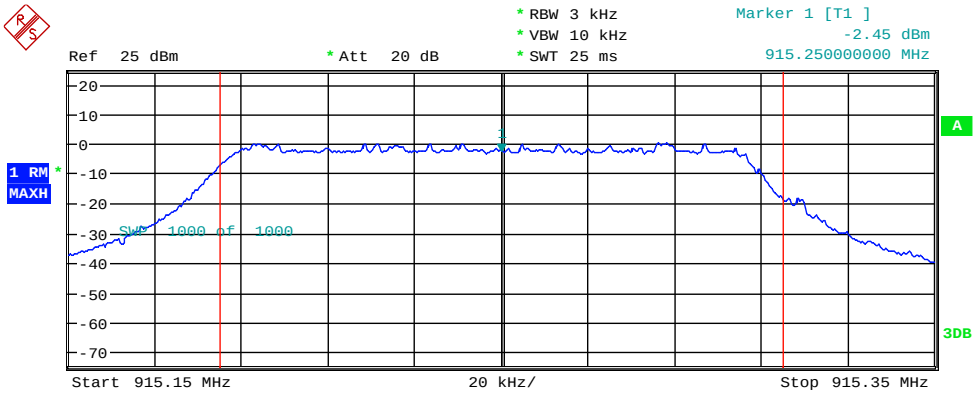
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	2018-06-19

12.6 Test Results

Power setting: 0x06				
Channel Frequency (MHz)	***Analyzer Level (dBm)***	***Cable loss (dB)***	***Power (mW)***	***Result***
915.25	13.73	0	23.60	PASS
921.50	13.40	0	21.88	PASS
927.50	12.96	0	19.77	PASS

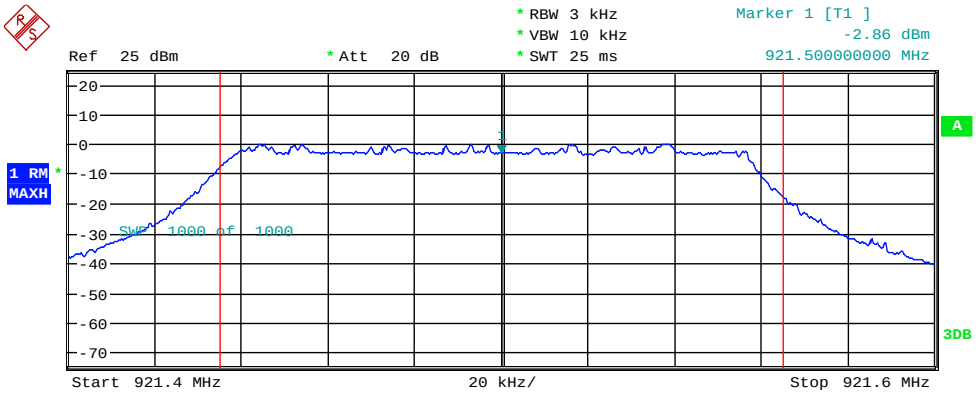
Antennas used by all three products covered by this report were < 6 dBi gain, 6 dBi was used as a worst case to cover all products.

Measurements were made using the AVGSA-1 method detailed in 558074 D01 DTS Meas Guidance v04



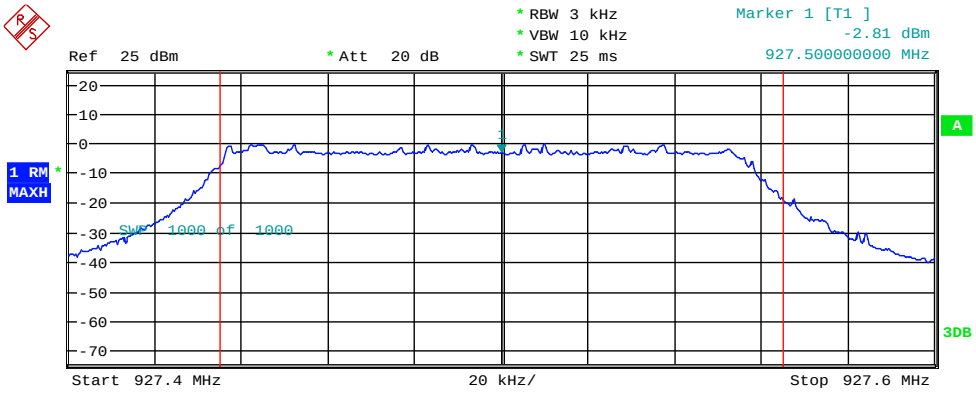
Tx Channel

Bandwidth	130 kHz	Power	13.73 dBm



Tx Channel

Bandwidth	130 kHz	Power	13.40 dBm



Tx Channel

Bandwidth	130 kHz	Power	12.96 dBm

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:	Wireless Laboratory 2
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.11
EUT Channels / Frequencies Measured:	Low Channel 06 / Mid Channel 31 / High Channel 55
EUT Channel Bandwidths:	200 kHz
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 10 GHz

Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 ºC to +35 ºC (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 3 Vdc	(as declared)

13.3 Test Limit

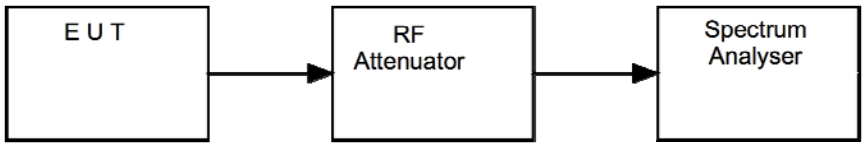
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either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

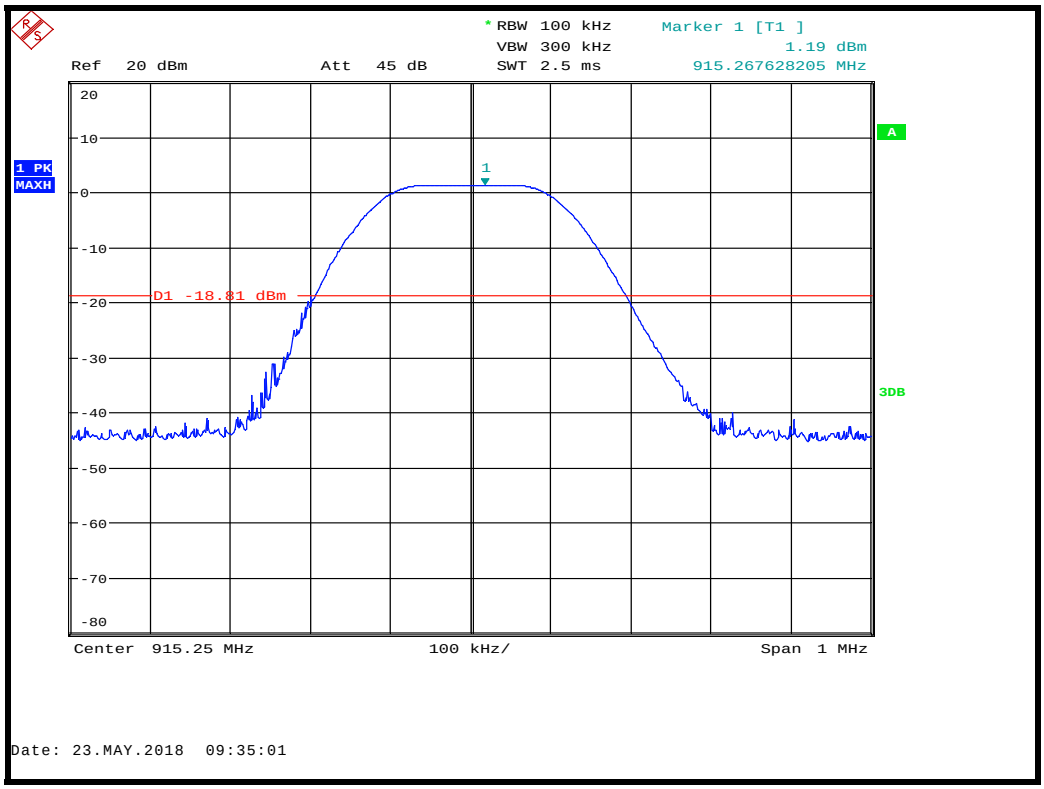


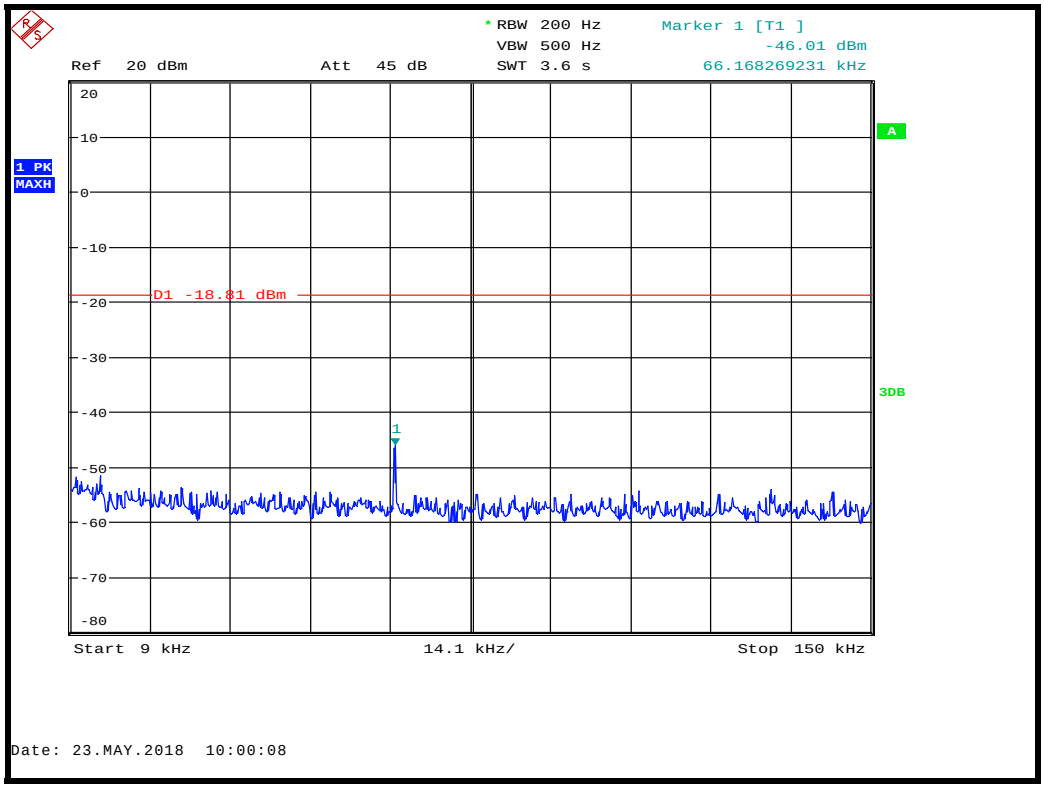
13.5 Test Equipment

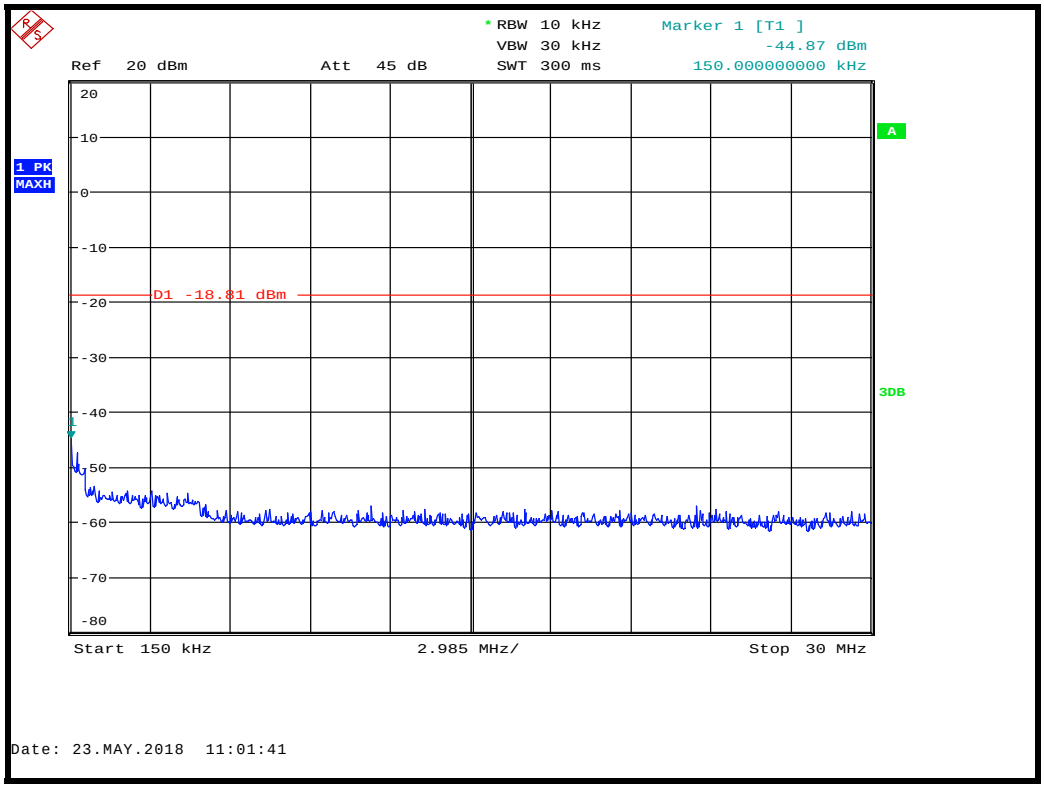
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	2018-06-19

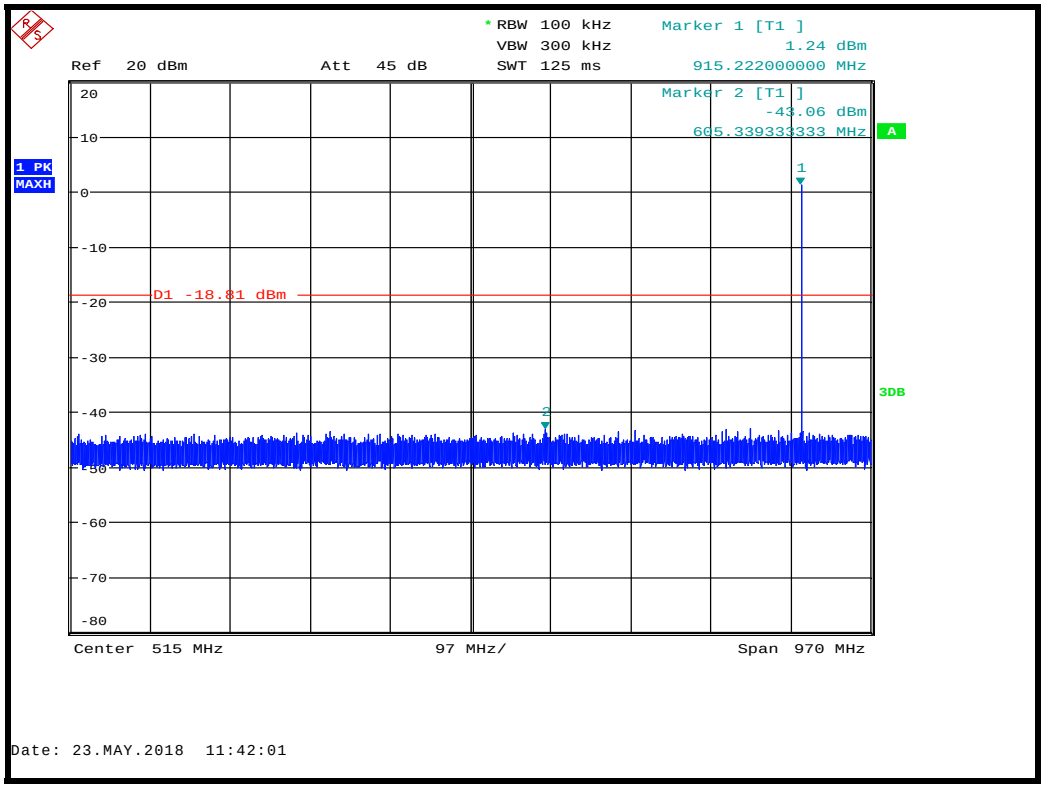
13.6 Test Results

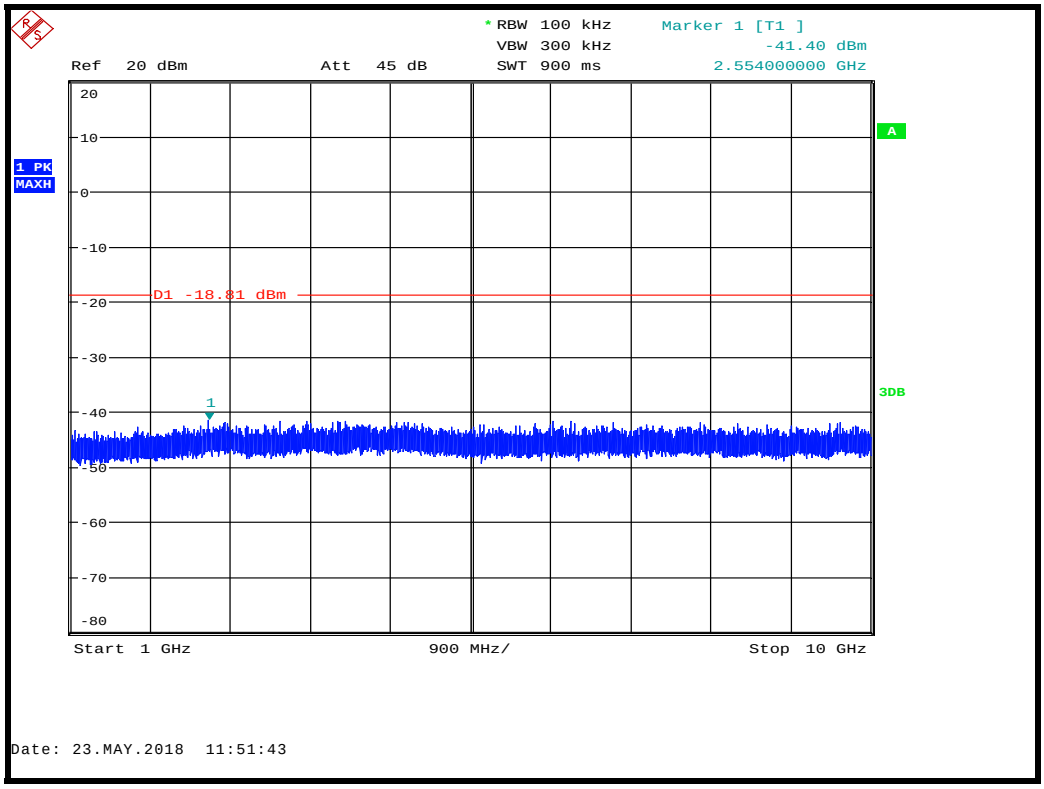
Power setting: 0x06						
Channel Frequency (MHz)	**Emission Frequency (MHz)**	**Analyzer Level (dBm)**	**Emission Level (dBm)**	**Limit (dBm)**	**Margin (dB)**	**Result**
Low	915.25	1.19	1.19	N/A	N/A	PASS
	0.0662	-46.01	-46.01	-18.81	-27.20	PASS
	0.1500	-44.87	-44.87	-18.81	-26.06	PASS
	605.3393	-43.06	-43.06	-18.81	-24.25	PASS
	2554.0000	-41.40	-41.40	-18.81	-22.59	PASS

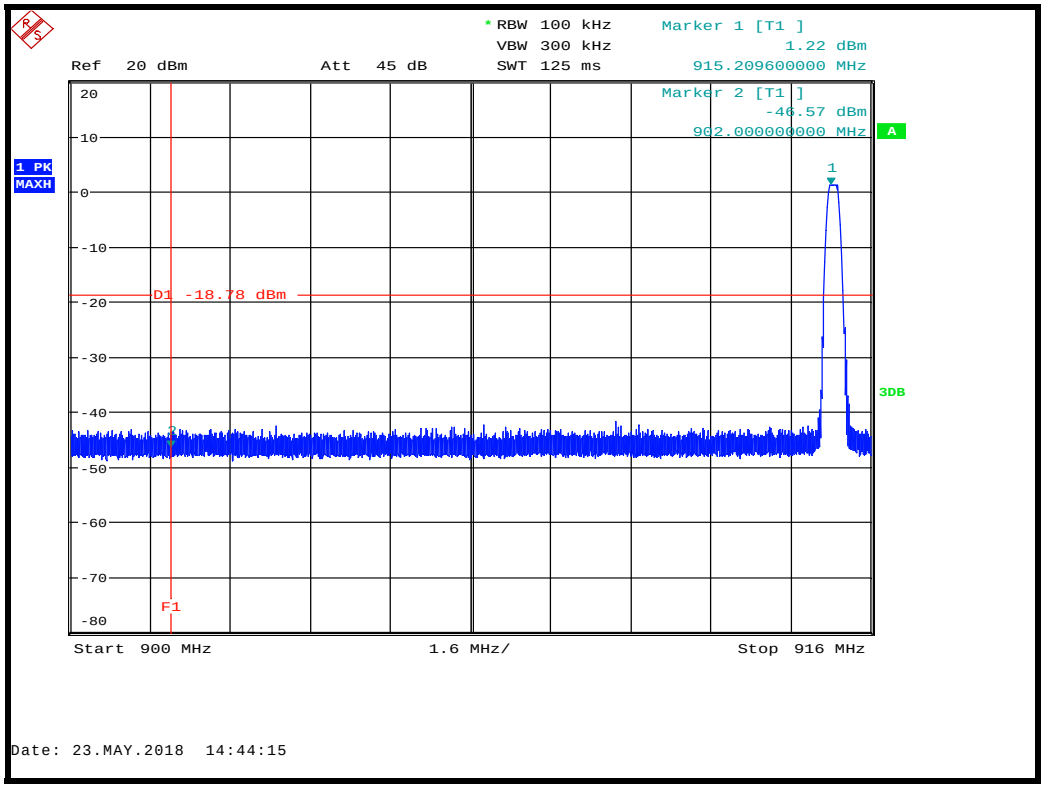



RBW 200 Hz
VBW 500 Hz
SWT 3.6 s
Marker 1 [T1]
-46.01 dBm
66.168269231 kHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -18.81 dBm
Start 9 kHz
14.1 kHz/
Stop 150 kHz
Date: 23.MAY.2018 10:00:08

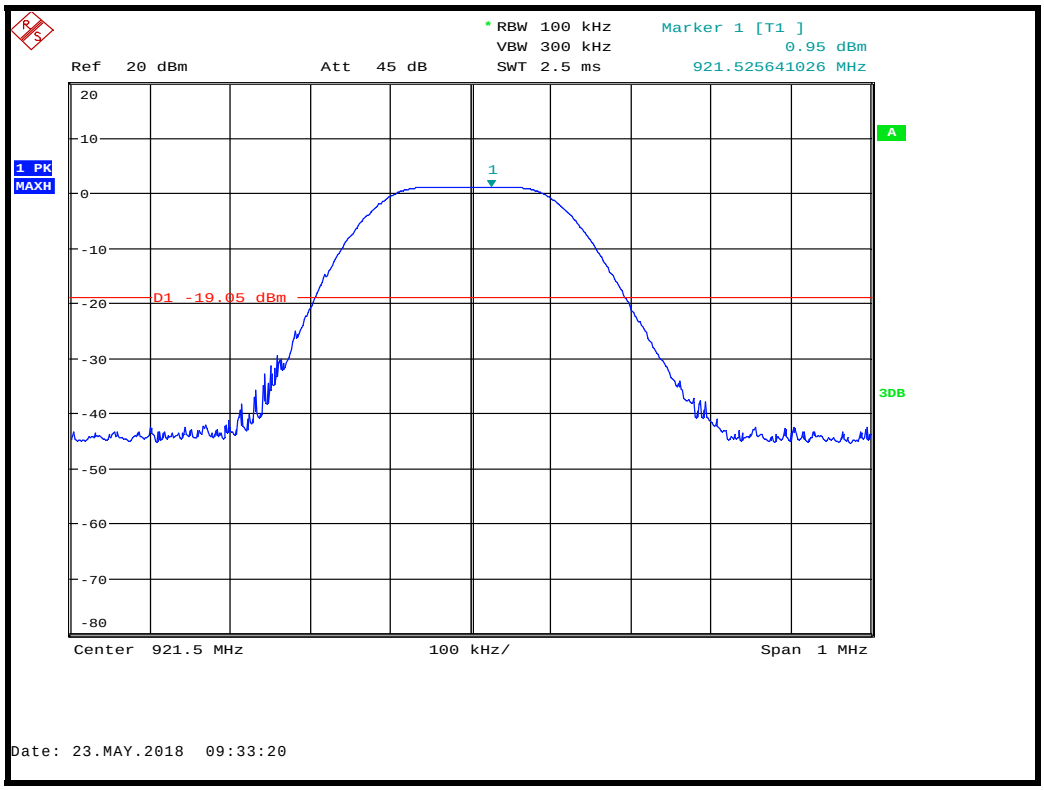

RBW 10 kHz
VBW 30 kHz
SWT 300 ms
Marker 1 [T1]
-44.87 dBm
150.000000000 kHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -18.81 dBm
Start 150 kHz
2.985 MHz/
Stop 30 MHz
Date: 23.MAY.2018 11:01:41

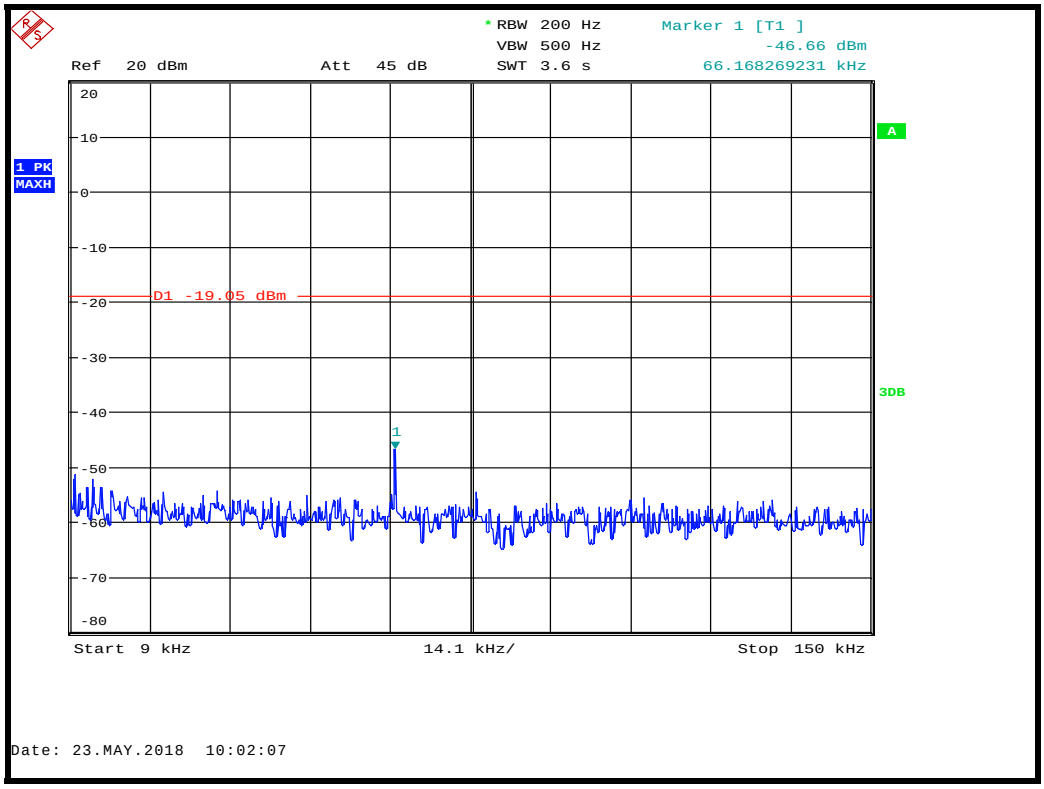

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
1.24 dBm
915.222000000 MHz
Marker 2 [T1]
-43.06 dBm
605.339333333 MHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -18.81 dBm
Center 515 MHz
97 MHz/
Span 970 MHz
Date: 23.MAY.2018 11:42:01

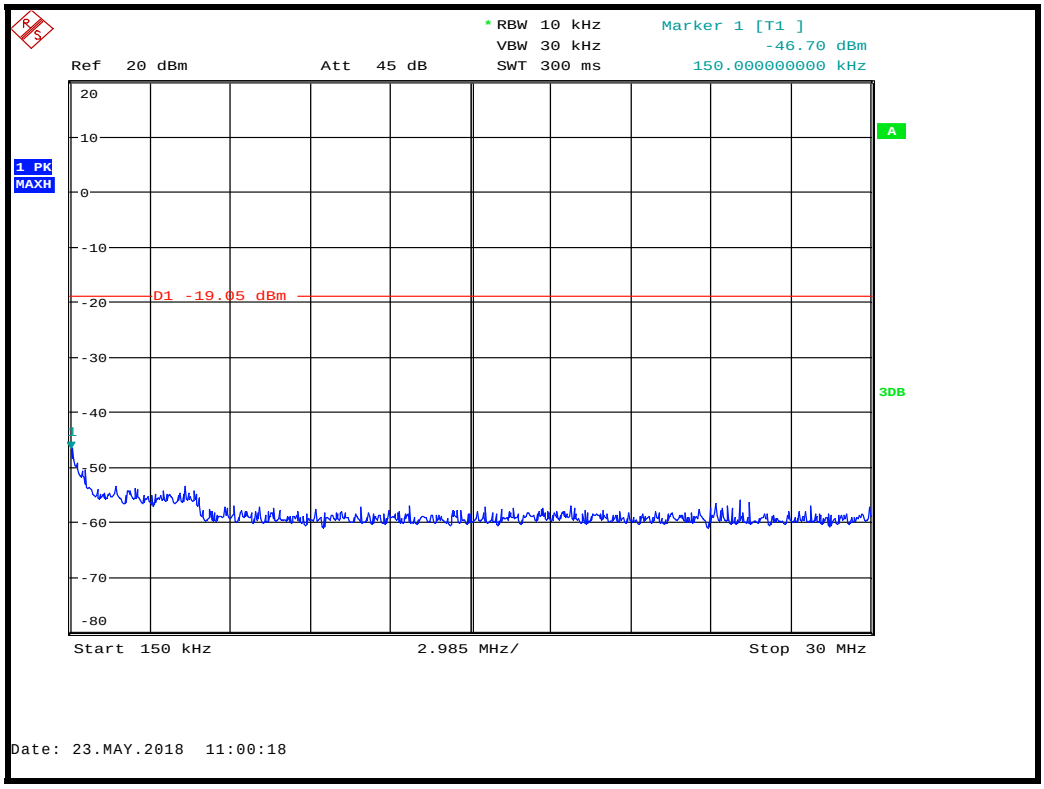

RBW 100 kHz
VBW 300 kHz
SWT 900 ms
Marker 1 [T1]
-41.40 dBm
2.554000000 GHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -18.81 dBm
Start 1 GHz
900 MHz/
Stop 10 GHz
Date: 23.MAY.2018 11:51:43

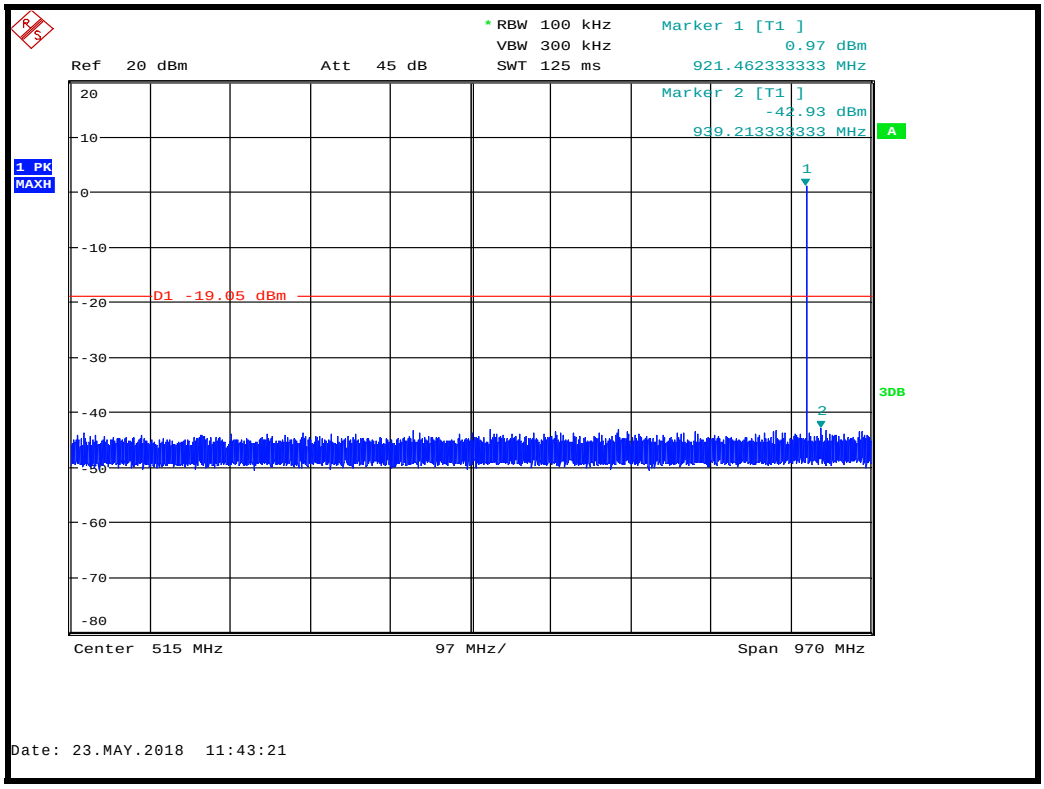

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
1.22 dBm
915.209600000 MHz
Marker 2 [T1]
-46.57 dBm
902.000000000 MHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -18.78 dBm
F1
Start 900 MHz
1.6 MHz/
Stop 916 MHz
Date: 23.MAY.2018 14:44:15

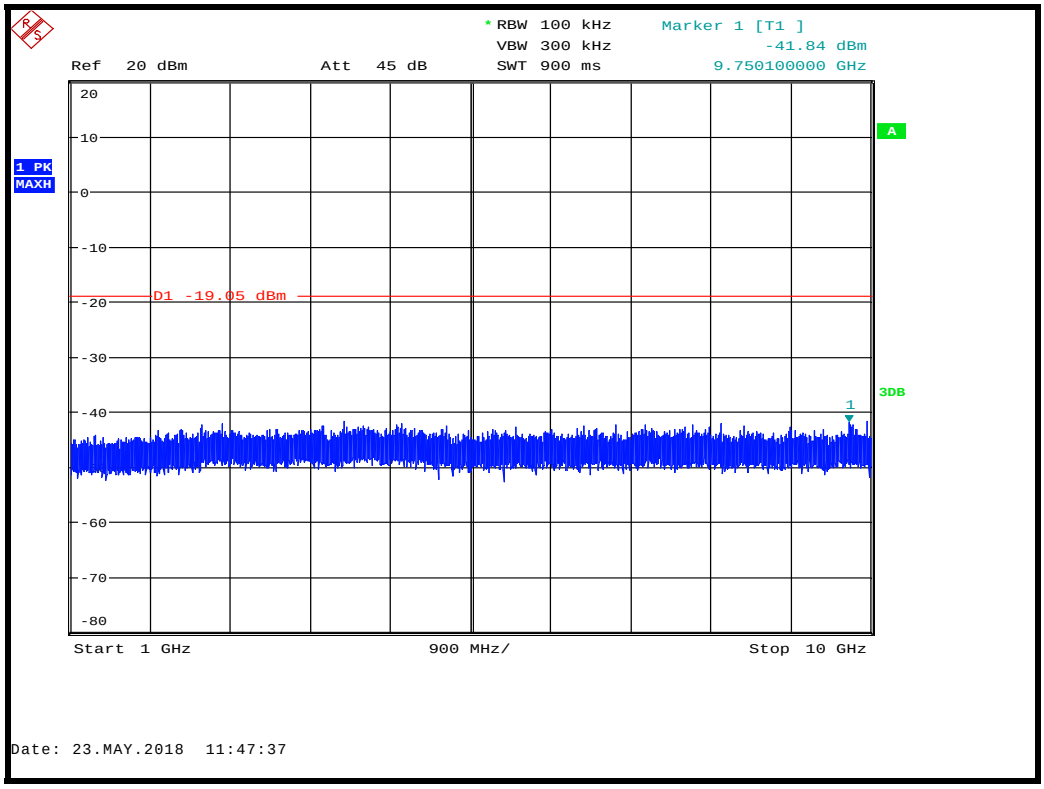
Power setting: 0x06						
Channel Frequency (MHz)	**Emission Frequency (MHz)**	**Analyzer Level (dBm)**	**Emission Level (dBm)**	**Limit (dBm)**	**Margin (dB)**	**Result**
Mid	921.5	0.95	0.95	N/A	N/A	PASS
	0.0662	-46.66	-46.66	-19.05	-27.61	PASS
	0.1500	-46.70	-46.70	-19.05	-27.65	PASS
	939.2133	-42.93	-42.93	-19.05	-23.88	PASS
	9750.1000	-41.84	-41.84	-19.05	-22.79	PASS



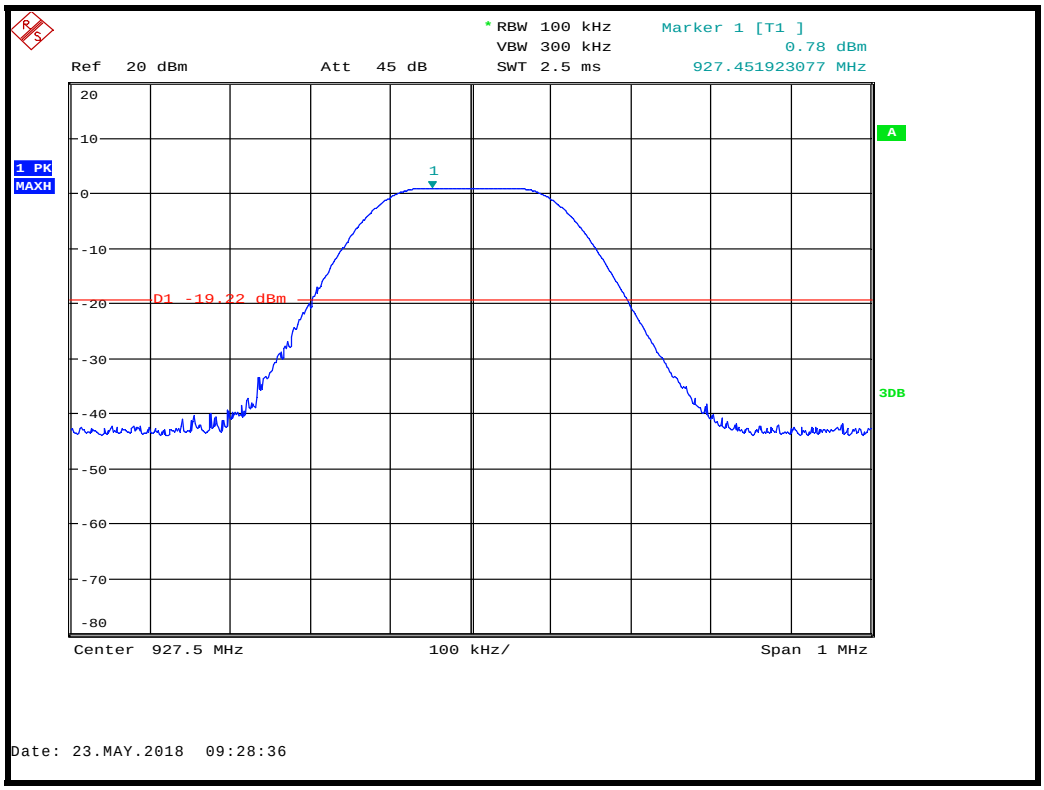

RBW 200 Hz
VBW 500 Hz
SWT 3.6 s
Marker 1 [T1]
-46.66 dBm
66.168269231 kHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -19.05 dBm
Start 9 kHz
14.1 kHz/
Stop 150 kHz
Date: 23.MAY.2018 10:02:07

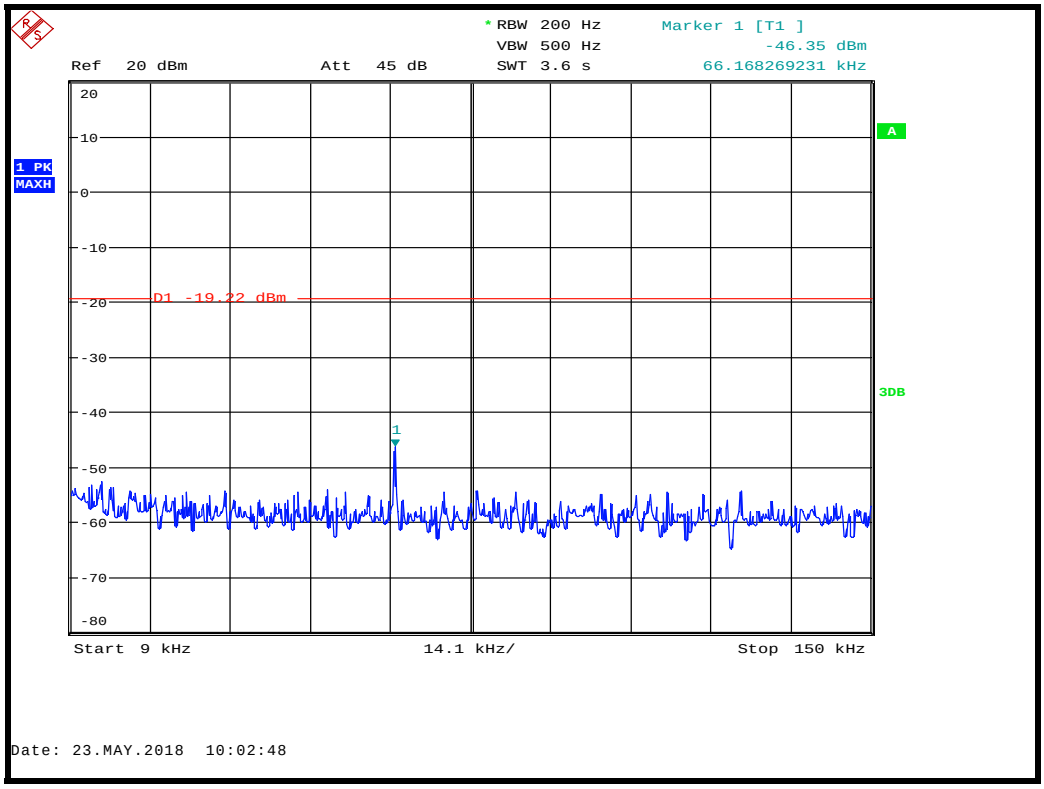

RBW 10 kHz
VBW 30 kHz
SWT 300 ms
Marker 1 [T1]
-46.70 dBm
150.000000000 kHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -19.05 dBm
Start 150 kHz
2.985 MHz/
Stop 30 MHz
Date: 23.MAY.2018 11:00:18

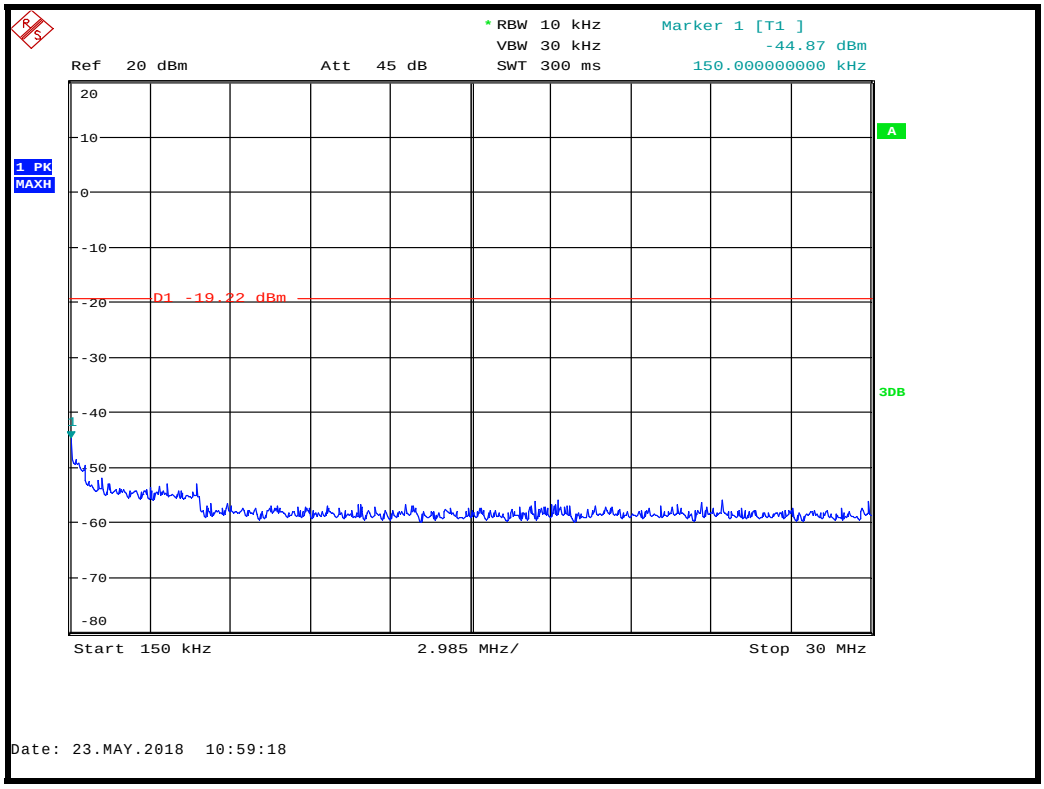

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
0.97 dBm
921.462333333 MHz
Marker 2 [T1]
-42.93 dBm
939.213333333 MHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -19.05 dBm
Center 515 MHz
97 MHz/
Span 970 MHz
Date: 23.MAY.2018 11:43:21

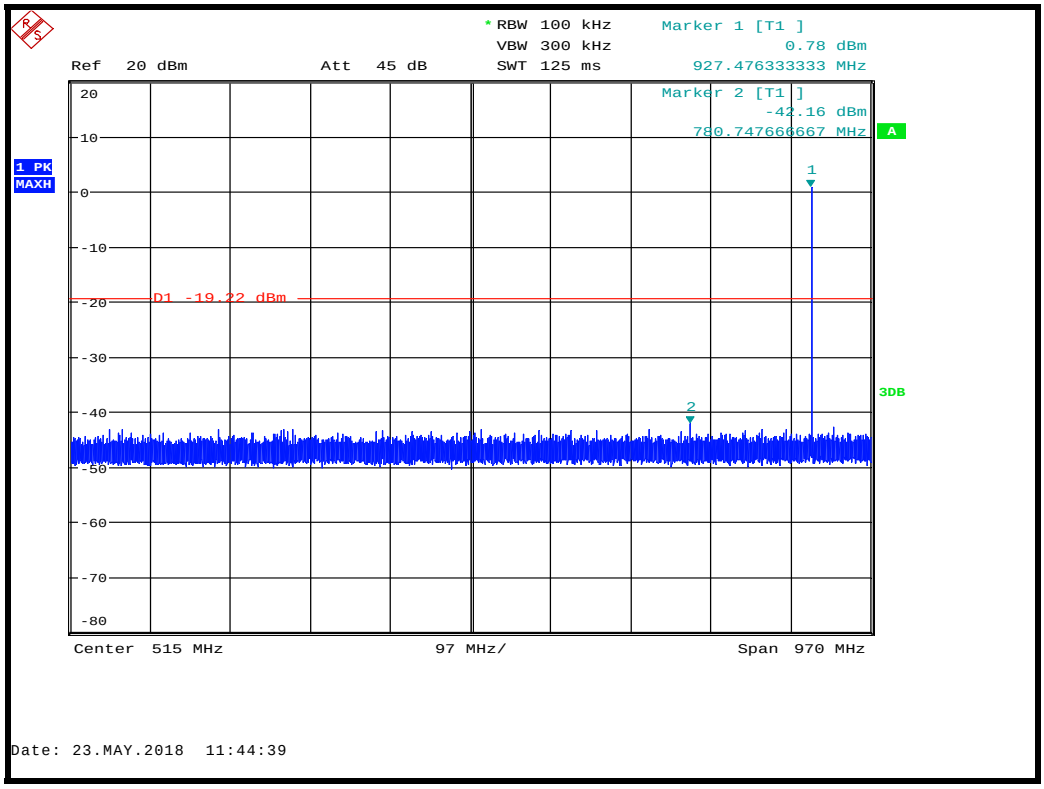

RBW 100 kHz
VBW 300 kHz
SWT 900 ms
Marker 1 [T1]
-41.84 dBm
9.750100000 GHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -19.05 dBm
Start 1 GHz
900 MHz/
Stop 10 GHz
Date: 23.MAY.2018 11:47:37

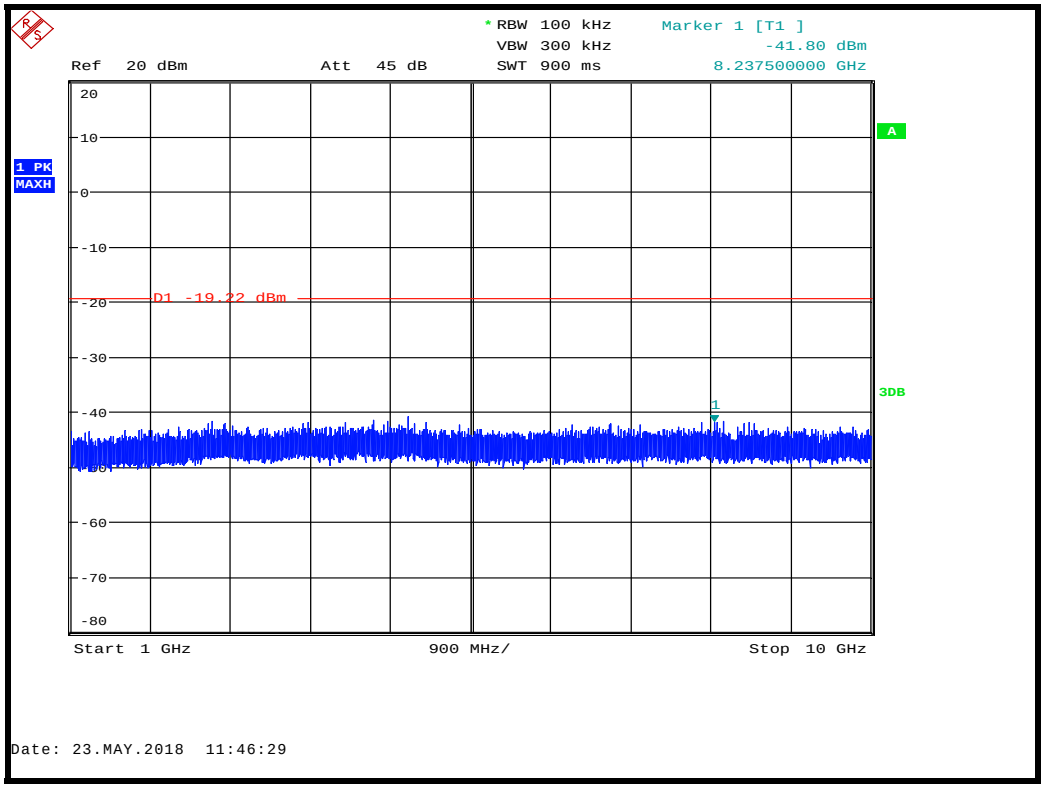
Power setting: 0x06						
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Analyzer Level (dBm)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
High	927.5	0.78	0.78	N/A	N/A	PASS
	0.062	-46.35	-46.35	-19.22	-27.13	PASS
	0.1500	-44.87	-44.87	-19.22	-25.65	PASS
	780.7477	-42.16	-42.16	-19.22	-22.94	PASS
	8237.5000	-41.80	-41.80	-19.22	-22.58	PASS

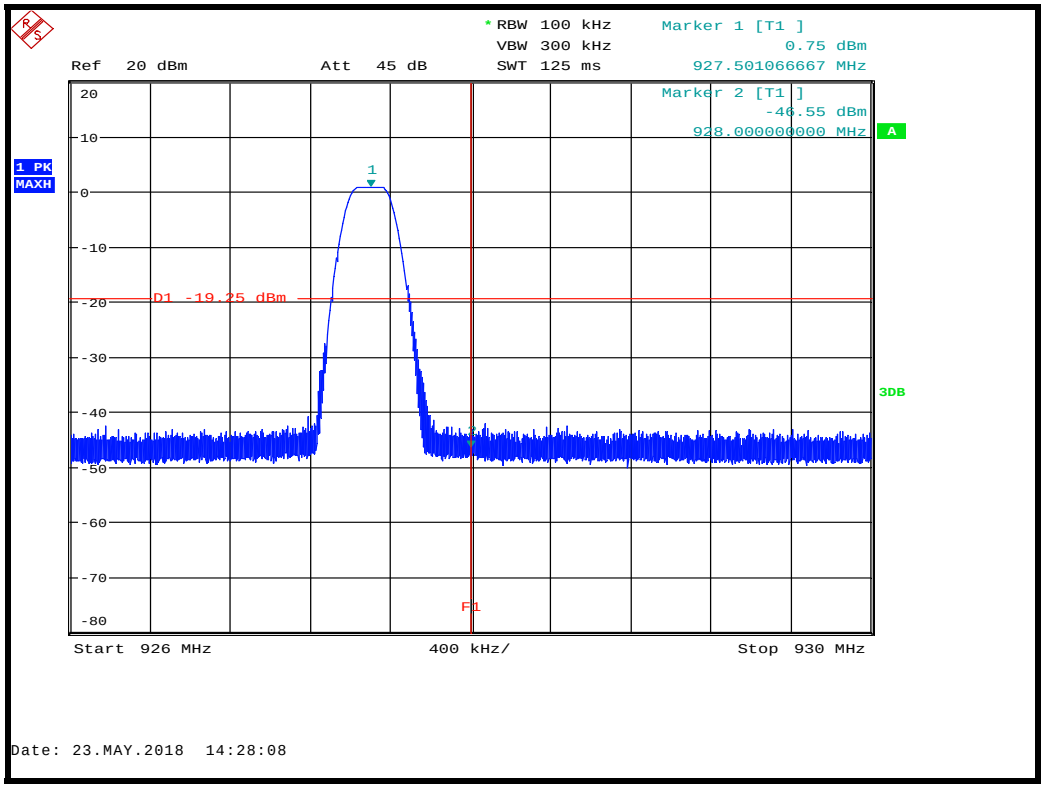



RBW 200 Hz
VBW 500 Hz
SWT 3.6 s
Marker 1 [T1]
-46.35 dBm
66.168269231 kHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -19.22 dBm
Start 9 kHz
14.1 kHz/
Stop 150 kHz
Date: 23.MAY.2018 10:02:48


RBW 10 kHz
VBW 30 kHz
SWT 300 ms
Marker 1 [T1]
-44.87 dBm
150.000000000 kHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -19.22 dBm
Start 150 kHz
2.985 MHz/
Stop 30 MHz
Date: 23.MAY.2018 10:59:18


RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
0.78 dBm
927.476333333 MHz
Marker 2 [T1]
-42.16 dBm
780.747666667 MHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -19.22 dBm
Center 515 MHz
97 MHz/
Span 970 MHz
Date: 23.MAY.2018 11:44:39


RBW 100 kHz
VBW 300 kHz
SWT 900 ms
Marker 1 [T1]
-41.80 dBm
8.237500000 GHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -19.22 dBm
Start 1 GHz
900 MHz/
Stop 10 GHz
Date: 23.MAY.2018 11:46:29


RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
0.75 dBm
927.501066667 MHz
Marker 2 [T1]
-46.55 dBm
928.000000000 MHz
Ref 20 dBm
Att 45 dB
1 PK
MAXH
A
3DB
D1 -19.25 dBm
F1
Start 926 MHz
400 kHz/
Stop 930 MHz
Date: 23.MAY.2018 14:28:08

14 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**

15 RF Exposure

MPE Calculation

As per KDB 447498

47 CFR §§1.1307 and 2.1091

2.1091 Radio frequency radiation exposure evaluation: Portable devices.

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimetres is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20cm separation specified under FCC rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 0.6mW/cm^2 power density limit, as required under FCC rules

Prediction of MPE limit at a given distance

Equation from KDB 447498 D01

$$S = \frac{1.64 \ ERP}{4\pi R^2} \quad \text{re - arranged} \qquad R = \sqrt{\frac{1.64 \ ERP}{S \ 4\pi}}$$

where:

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

Result:

Prediction Frequency (MHz)	Maximum ERP (mW)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 0.6mW/cm^2 (cm)
915.25	57.28	0.6	3.53

Prediction Frequency (MHz)	Maximum Conducted power (mW)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 0.6mW/cm^2 (cm)
915.25	23.60	0.6	2.27