Report on the Radio Testing

For

AGD Systems Ltd

on

MC-138 Module

Report no. TRA-044143-45-01B

17 September 2019

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UKAS TESTING
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Report Number: TRA-044143-45-01B
Issue: B

REPORT ON THE RADIO TESTING OF A
AGD Systems Ltd
MC-138 Module
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.245

TEST DATE: 2019-02-11 to 2019-03-13

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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

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	5 April 2019	Original
B	17 September 2019	Updates due to review process

2 Summary

TEST REPORT NUMBER:	TRA-044143-45-01B
WORKS ORDER NUMBER:	TRA-044143-00
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):	47CFR15.245
EQUIPMENT UNDER TEST (EUT):	MC-138 Module
FCC IDENTIFIER:	WH3MC138
EUT SERIAL NUMBER:	Unknown
MANUFACTURER/AGENT:	AGD Systems Ltd
ADDRESS:	White Lion House Gloucester Road Staverton Cheltenham Gloucestershire GL51 0TF United Kingdom
CLIENT CONTACT:	Richard Ellis ☎ +44(0) 1452 854212 ✉ richard.ellis@agd-systems.com
TEST DATE:	2019-02-11 to 2019-03-13
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	15.245(b)	☒	*Pass*
AC power line conducted emissions	15.207	☒	*Pass*
Occupied bandwidth	15.215(c)	☒	*Pass*
Field strength of fundamental	15.245(b)	☒	*Pass*
Calculation of duty correction	15.35(c)	☐	*N/A*

Notes:

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

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

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

3 Contents

4 Introduction

This report TRA-044143-45-01B presents the results of the Radio testing on a AGD Systems Ltd, MC-138 Module to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for AGD Systems Ltd 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 UK0009.

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

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.

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: MC-138 Module
- Serial Number: Unknown
- Model Number: MC-138 (IVS-947) Module
- Software Revision: MI-197ver3
- Build Level / Revision Number: Prototype

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
Bench-top Power Supply

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for transmit tests was as follows:-
The EUT was placed in continuous transmit mode on the selected centre frequency and with the sweep direction noted in the results section.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	24.125 GHz
Modulation type(s):	FMCW
Occupied channel bandwidth(s):	21.4 MHz (302 mode); 24.1 MHz (306 mode)
Channel spacing:	Wideband
Declared output power(s):	Maximum EIRP 19 dBm
Nominal Supply Voltage:	12 Vdc
Duty cycle:	100%

7.5 EUT Description

The EUT is an FMCW radar module for use in traffic monitoring applications.

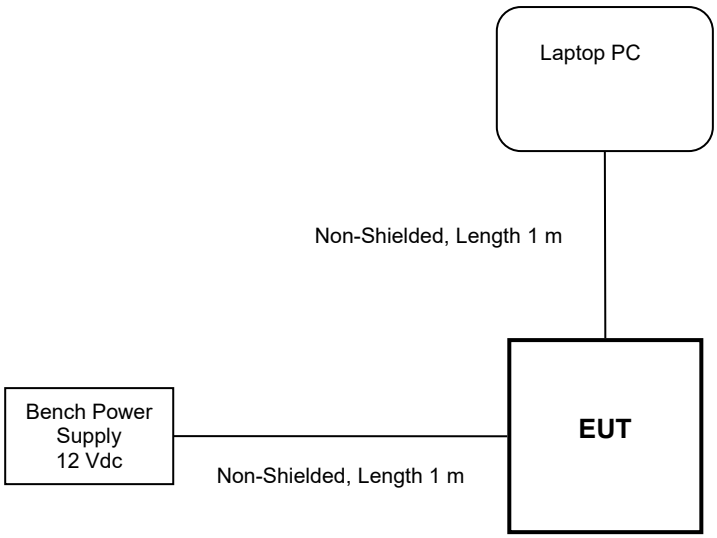
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

9.1 Block Diagram

The following diagram shows basic EUT interconnections:



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 12 V dc from a bench top power supply.

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***
☒	Power Supply	10.2 Vdc – 13.8 Vdc	85 % and 115 %

11 Radiated emissions

11.1 Definitions

Out-of-band emissions
Emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but exclude spurious emissions.

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 3
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequencies Measured:	24.125 GHz
EUT Channel Bandwidths:	24.1 MHz
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz; Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak; Above 1 GHz: RMS average and Peak

Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 ºC to +35 ºC (as declared)
Humidity: 34 % RH	20 % RH to 75 % RH (as declared)
Supply: 12 Vdc	

11.3 Test Limit

The average field strength of emissions measured at 3m shall not exceed:

(a) 2500 mV/m for fundamental emission; and

(b) 25 mV/m for harmonic emissions for devices operating in the 24.075-24.175 GHz band

Harmonic emissions falling into restricted bands n and which are below 17.7 GHz shall meet the general field strength limits.

Harmonic emissions falling into restricted bands which are at and above 17.7 GHz shall not exceed the following strength limits measured at a distance of 3 m:

(a) 25 mV/m for the second and third harmonic emissions of devices operating in the band 24.075-24.175 GHz; and

(b) 7.5 mV/m for all other devices.

Emissions radiated outside of these specified operating frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits specified, whichever is less stringent.

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

n.b. peak limit is 20 dB above average.

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:

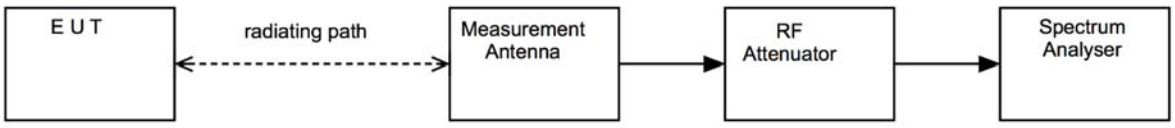
$$FS = PR + CL + AF – PA + DC – CF$$

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



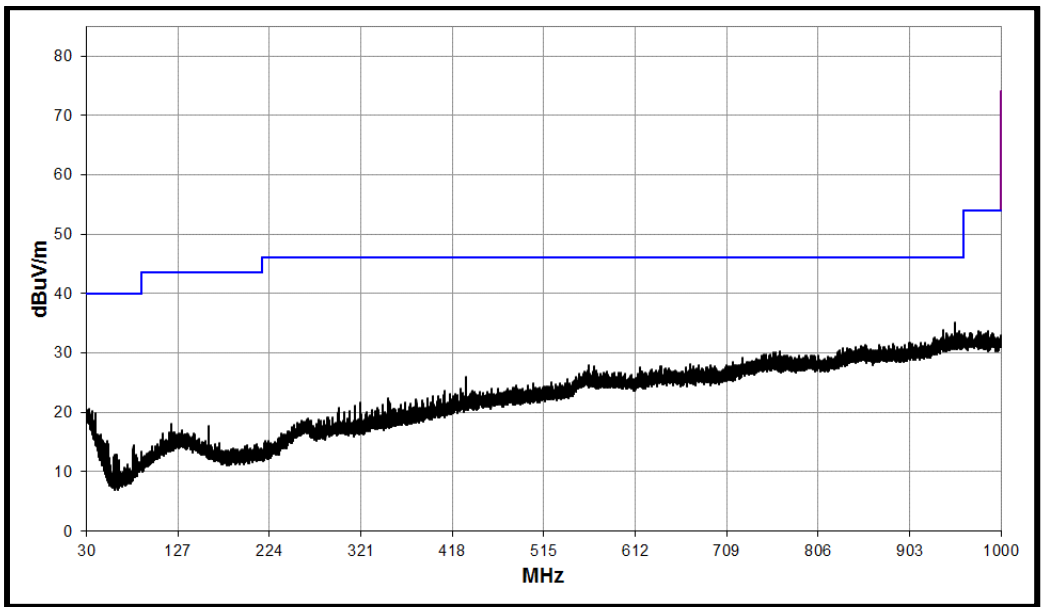
Test Set-up Photograph

11.5 Test Equipment

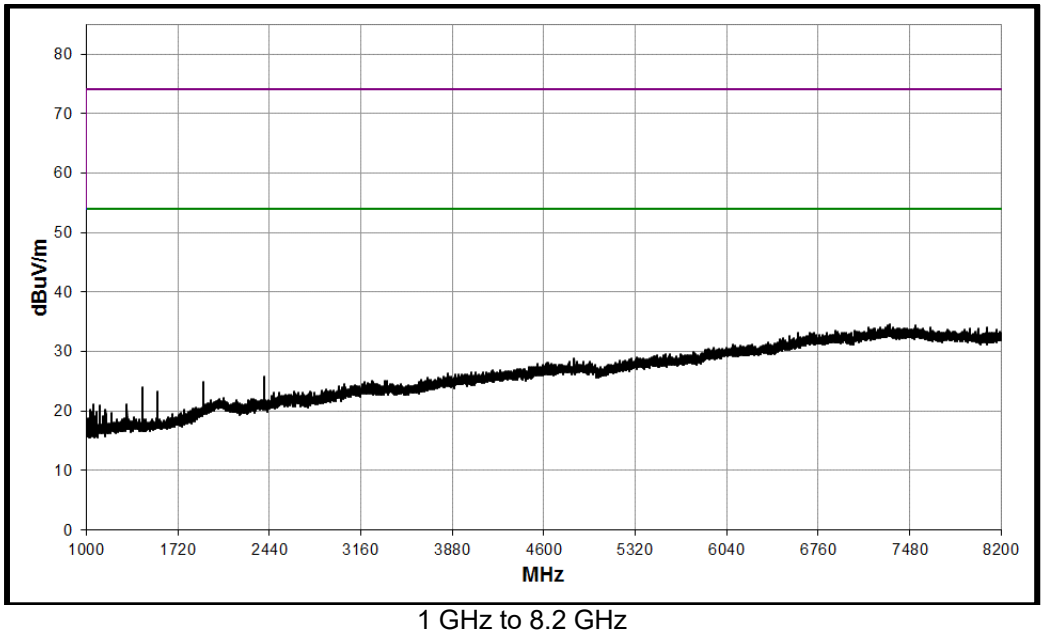
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
310	Sonoma	Pre-Amp (9kHz – 1GHz)	REF927	2019-05-22
3115	EMCO	Horn Antenna	RFG129	2020-02-12
LB-180400-25-C-KF	A Info Inc	Horn Antenna	REF2246	2020-07-25
LB-62-25-C-SF	A Info Inc	Horn Antenna	REF2244	2020-07-16
CBL6111B	Chase	Bilog Antenna	REF2233	2020-08-17
ATS	Rainford	Ferrite Lined Chamber	REF886	2020-07-29
ESU40	R&S	Receiver	RFG701	2019-12-18
ESW26	R&S	EMI Test Receiver	REF2235	2019-07-23
11970Q	Agilent	Harmonic Mixer (33-50)	U365	2019-05-05
11970V	Agilent	Harmonic Mixer (50-75)	U366	2019-05-04
11970W	Agilent	Harmonic Mixer (75-110)	U367	2019-05-17
25240-20	Flann	Standard Gain Horn (50-75)	U368	2019-05-05
27240-20	Flann	Standard Gain Horn (75-110)	U369	2019-05-04
23240-20	Flann	Standard Gain Horn (33-50)	L264A	2019-05-17
N9030A	Agilent	Spectrum Analyser	REF2167	2019-07-25

11.6 Test Results

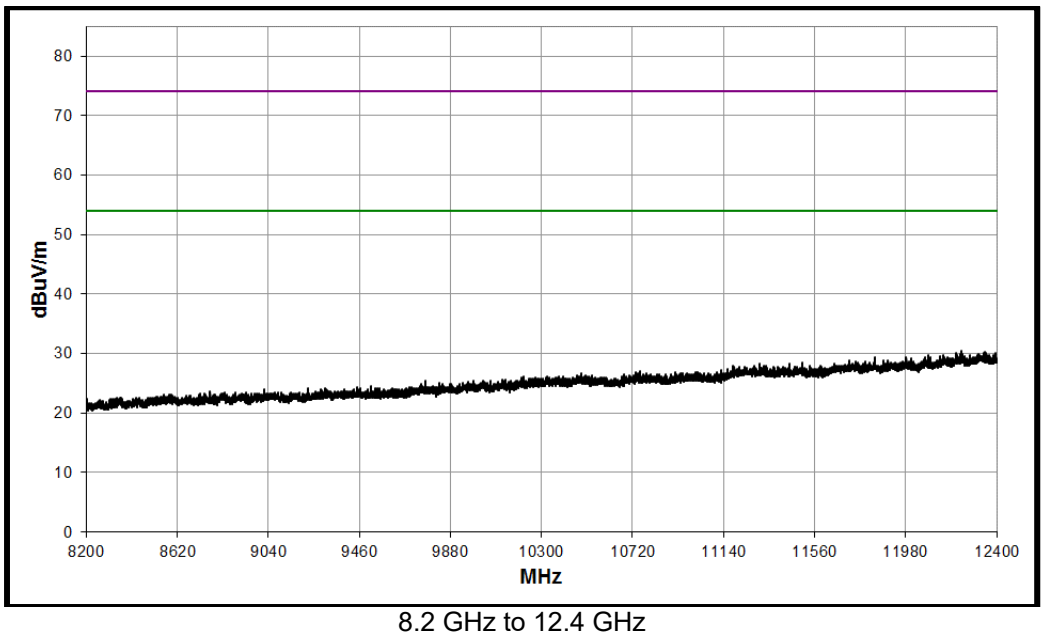
High Power Setting; Mode: 302; Frequency: 24.125 GHz							
Detector	***Frequency (MHz)***	***Amplitude (dBµV)***	***Factor (dB)***	***Distance Adjustment (dB)***	***Emission level (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
No Emissions within 20 dBs of the limit							



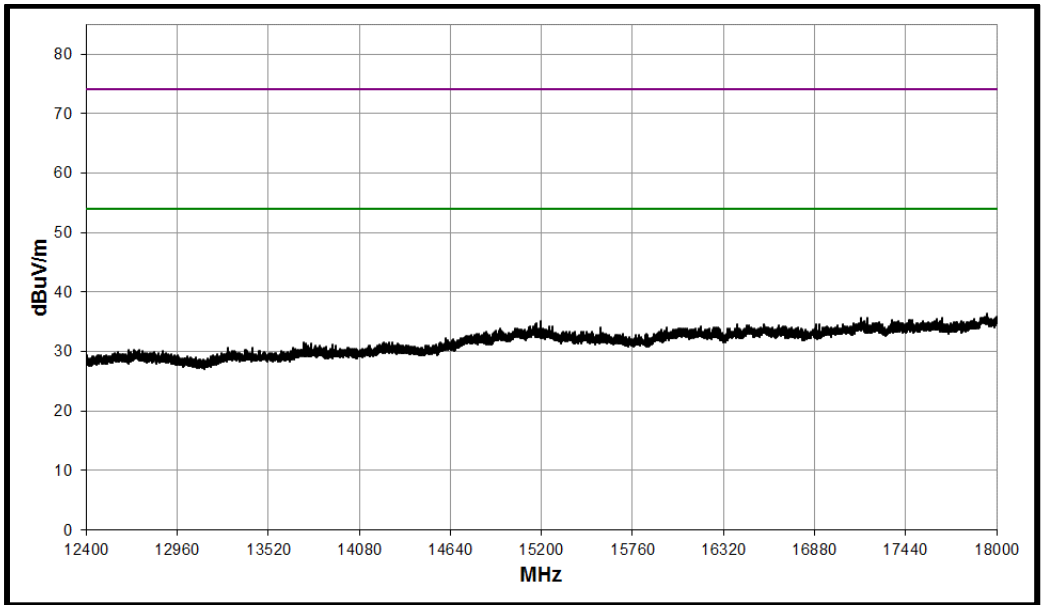
30 MHz to 1 GHz



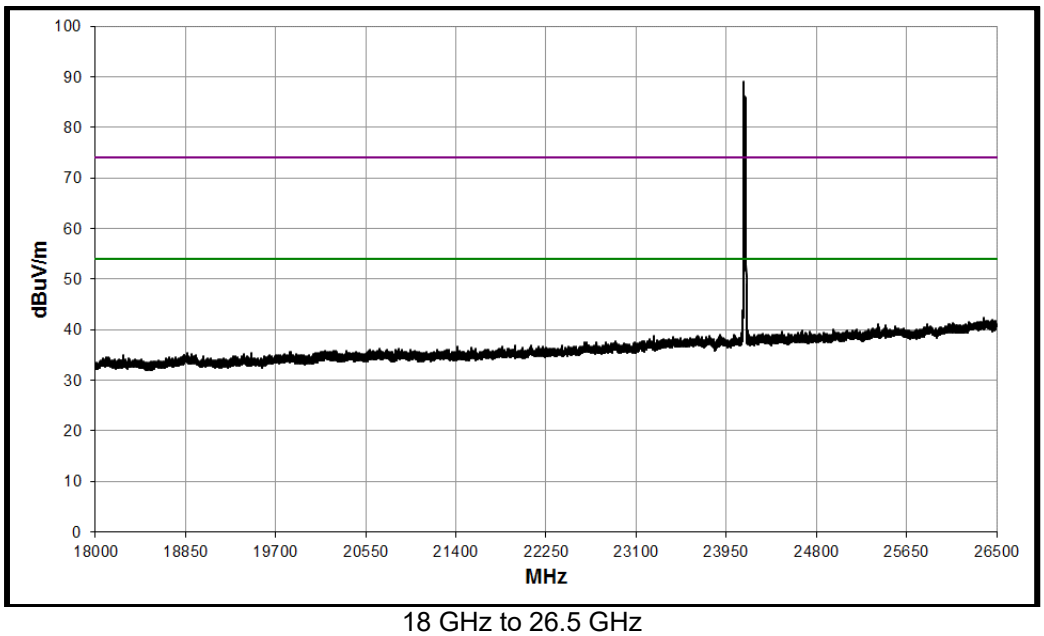
1 GHz to 8.2 GHz



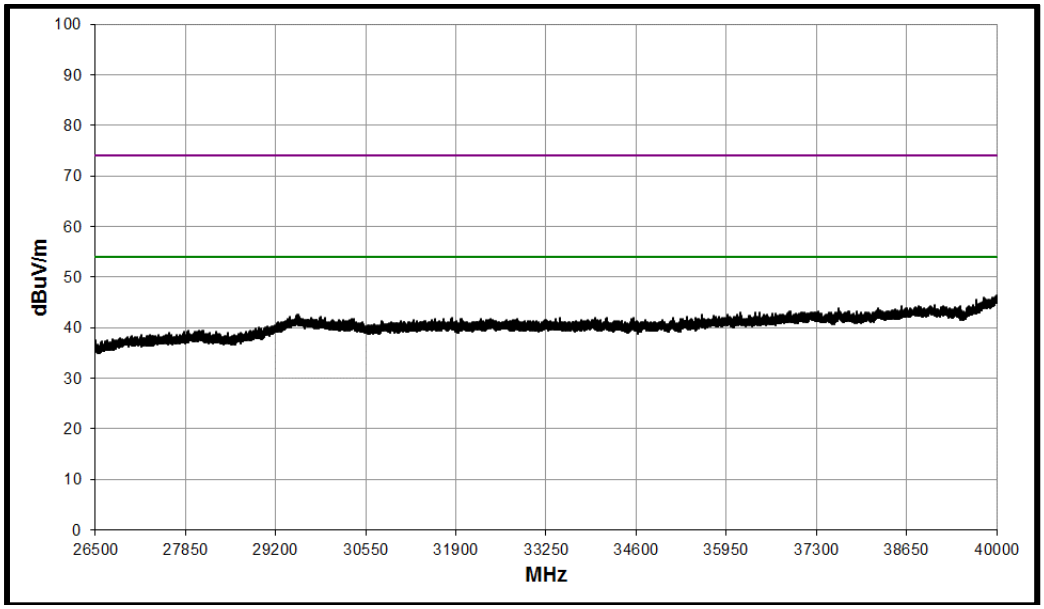
8.2 GHz to 12.4 GHz



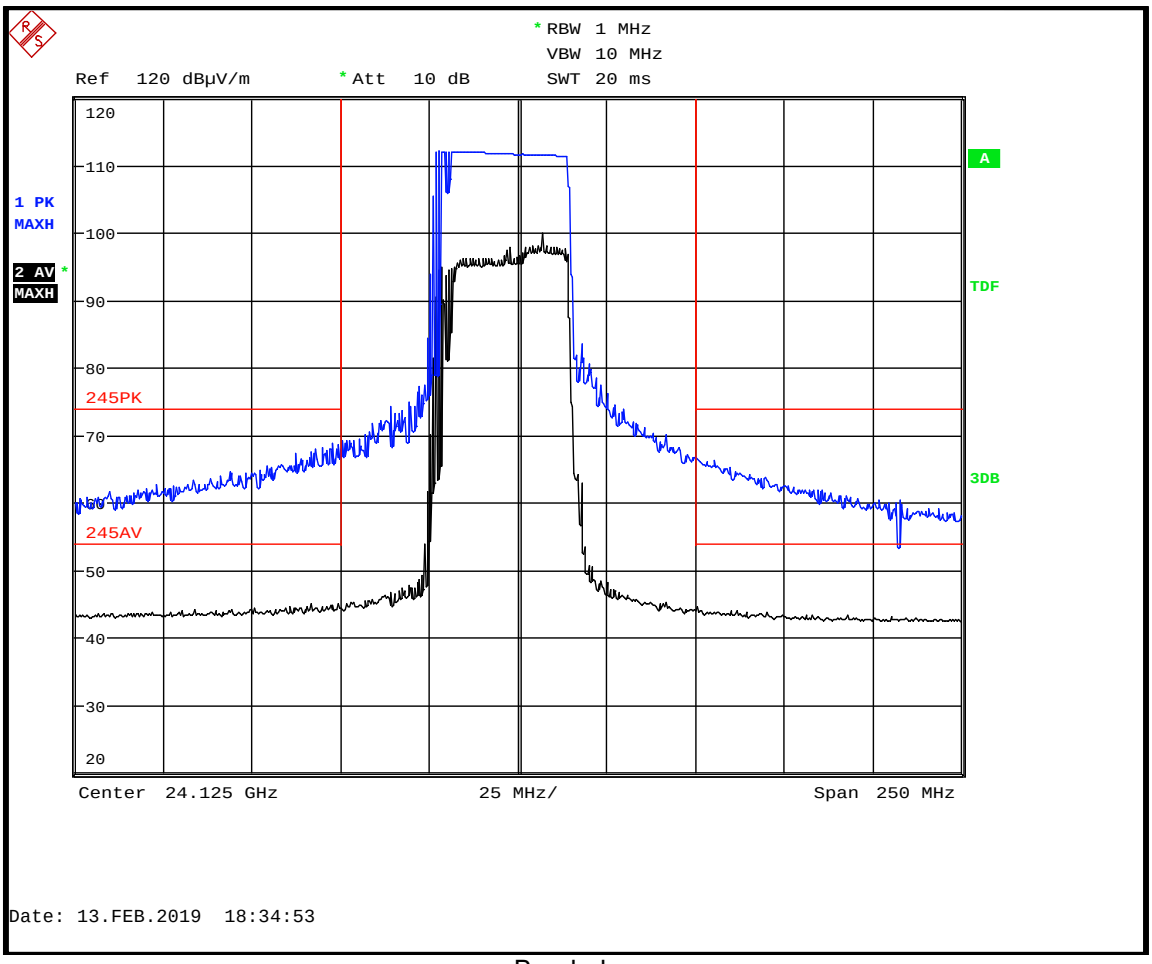
12.4 GHz to 18 GHz



18 GHz to 26.5 GHz



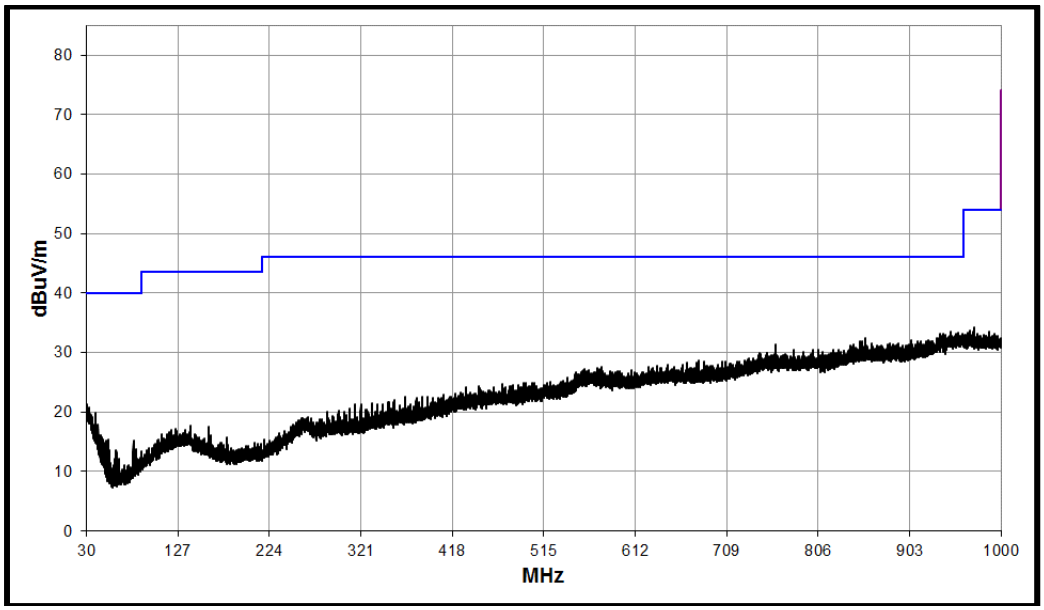
26.5 GHz to 40 GHz



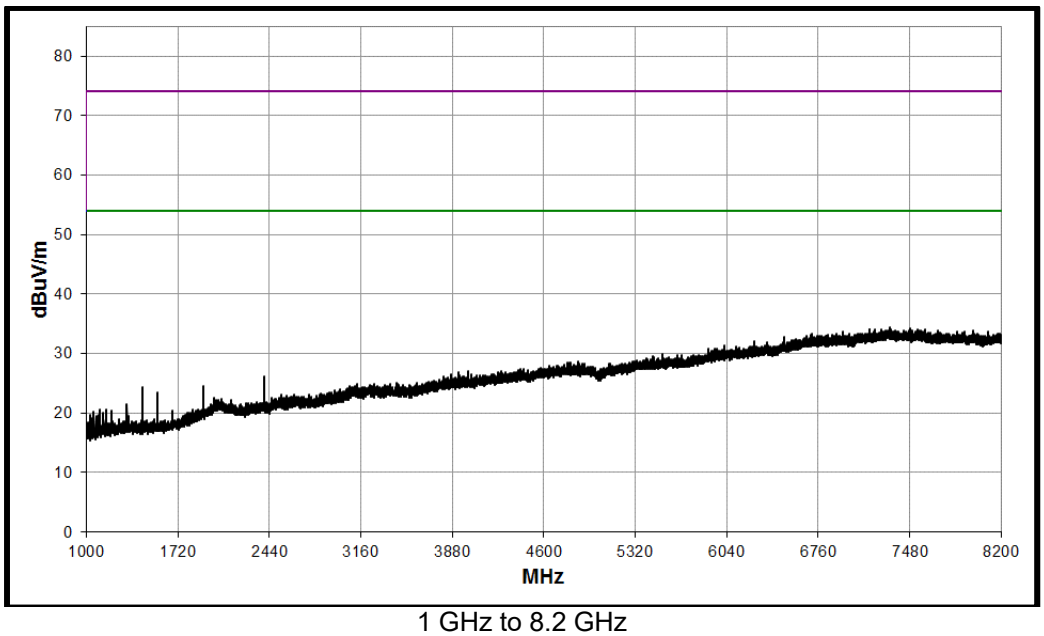
Bandedge

The frequency range 40 GHz to 110 GHz was investigated, no emissions were found above the instrument noise floor.

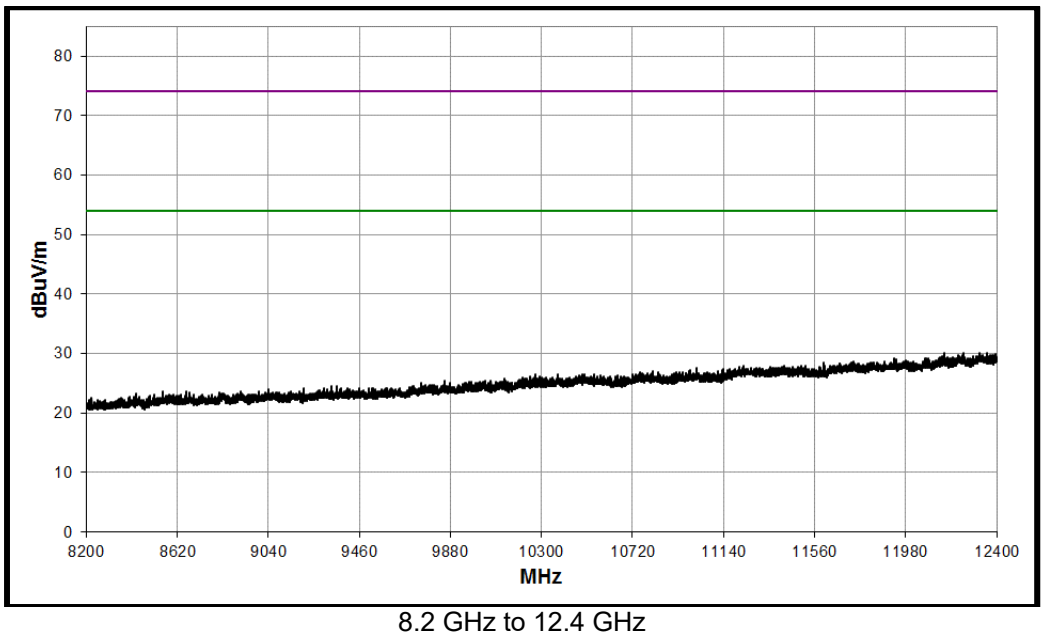
High Power Setting; Mode: 306 C1; Frequency: 24.125 GHz							
Detector	***Frequency (MHz)***	***Amplitude (dBµV)***	***Factor (dB)***	***Distance Adjustment (dB)***	***Emission level (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
No Emissions within 20 dBs of the limit							



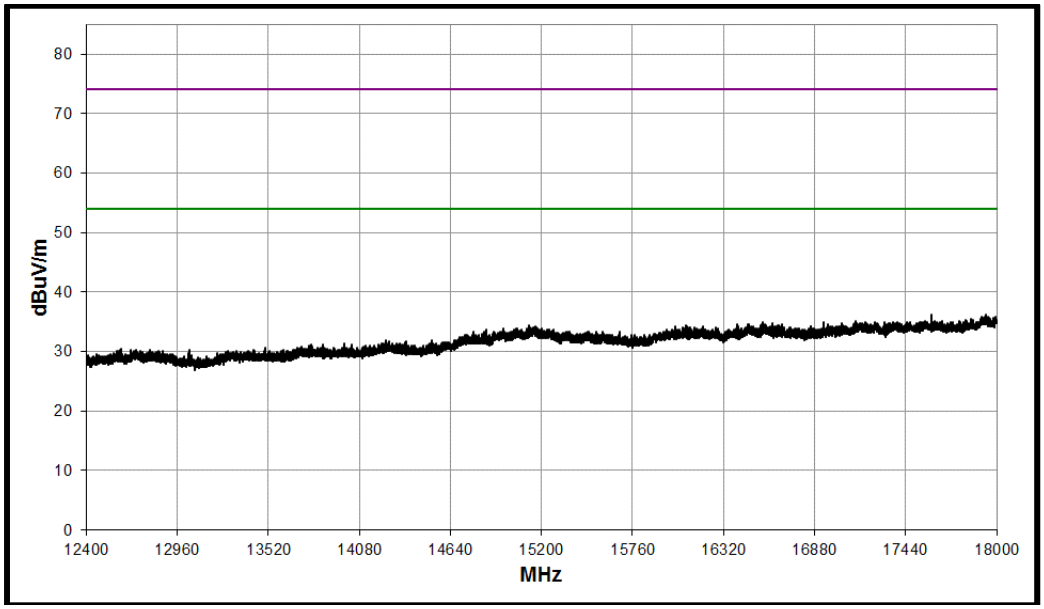
30 MHz to 1 GHz



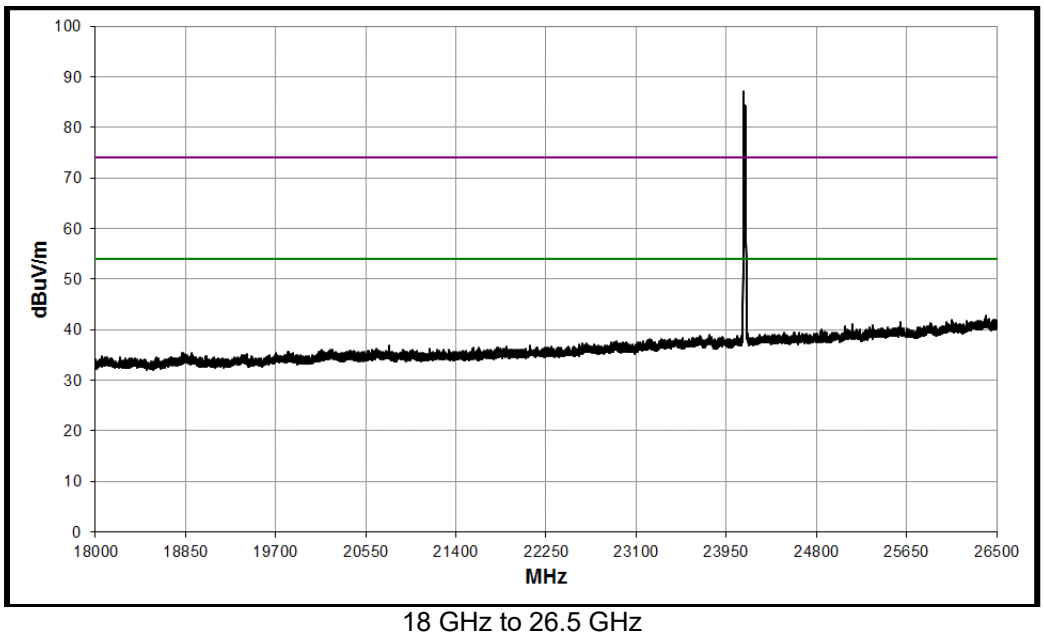
1 GHz to 8.2 GHz



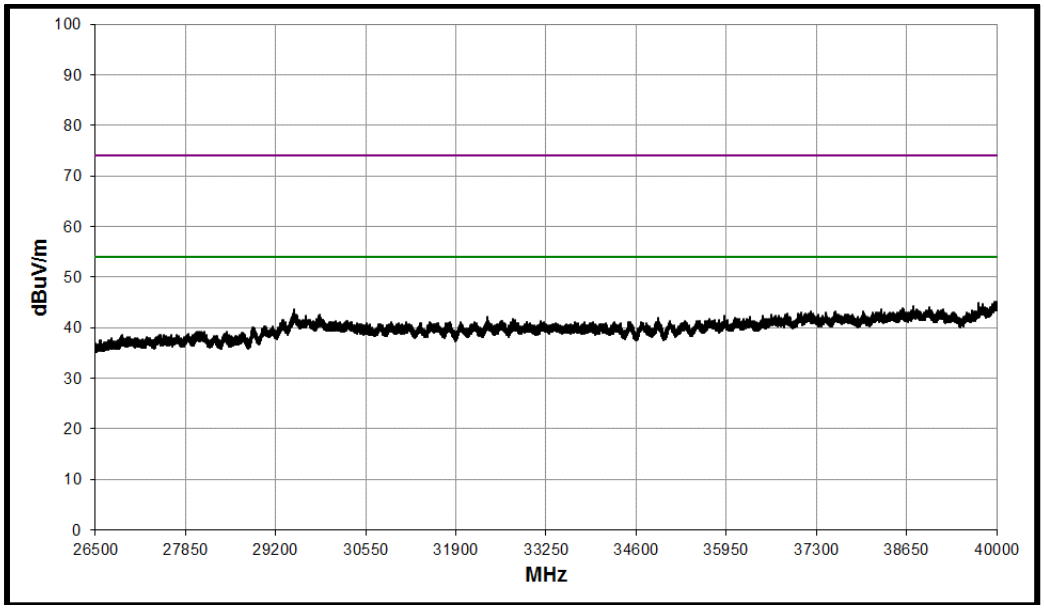
8.2 GHz to 12.4 GHz



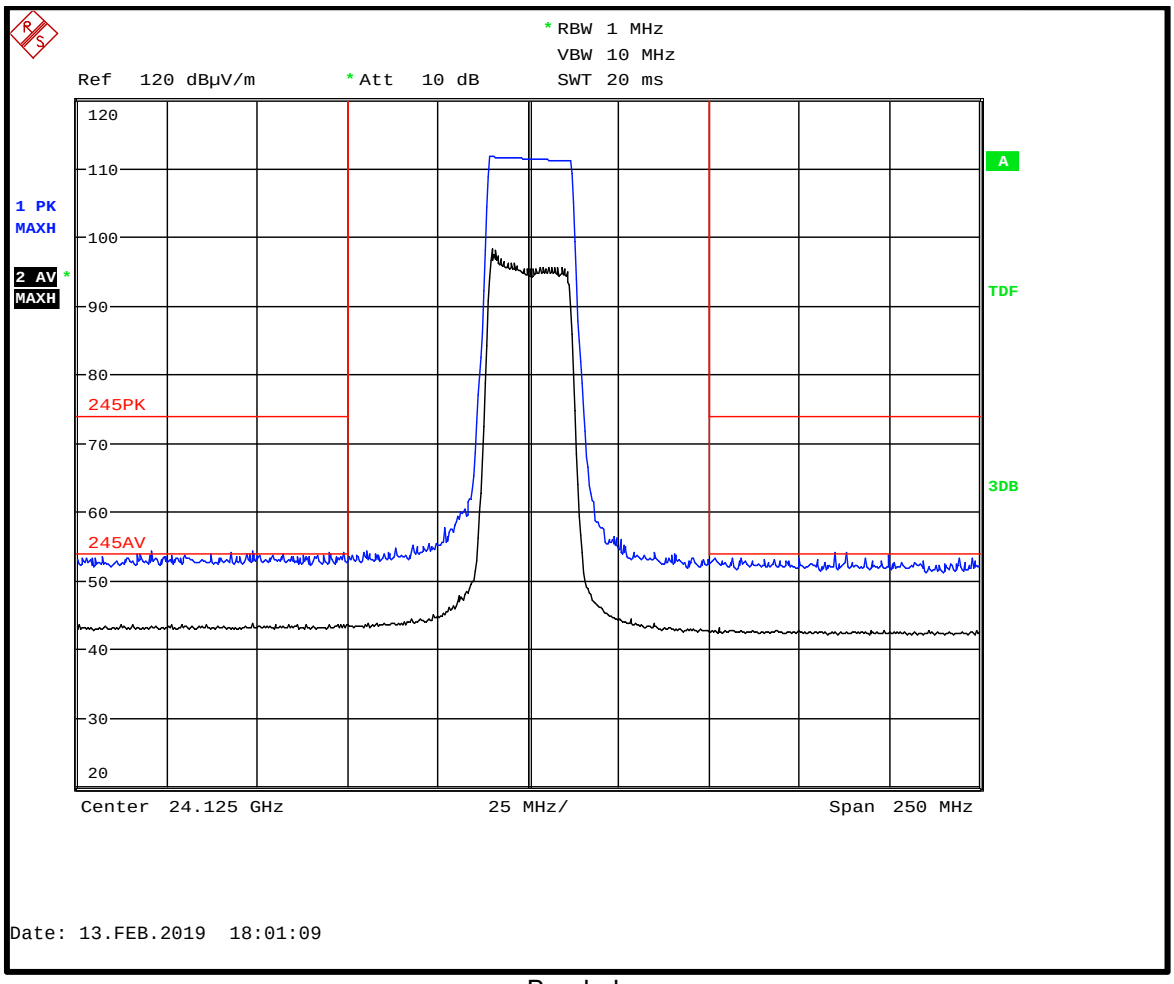
12.4 GHz to 18 GHz



18 GHz to 26.5 GHz



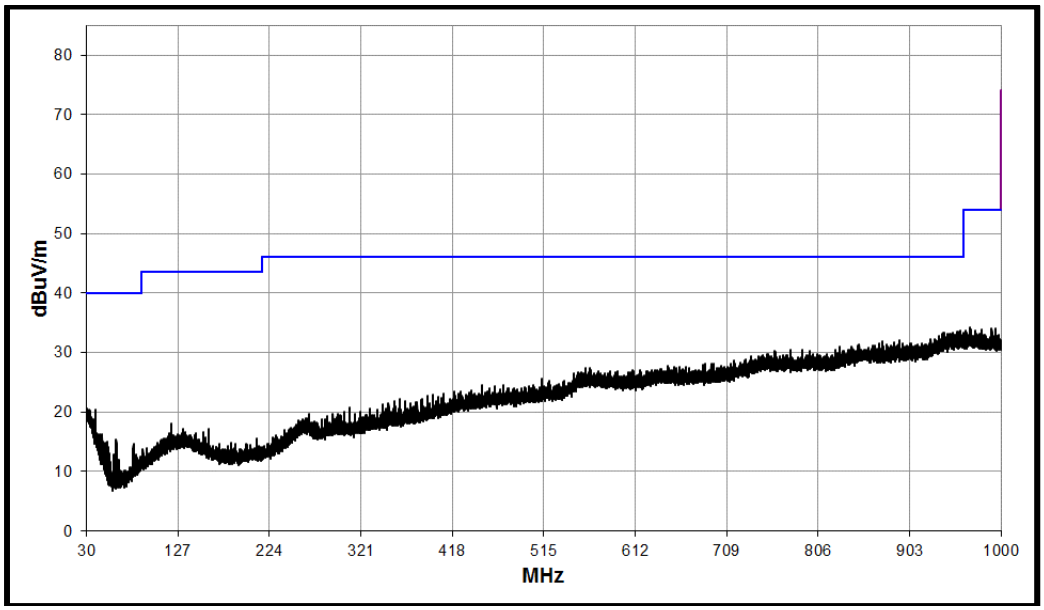
26.5 GHz to 40 GHz



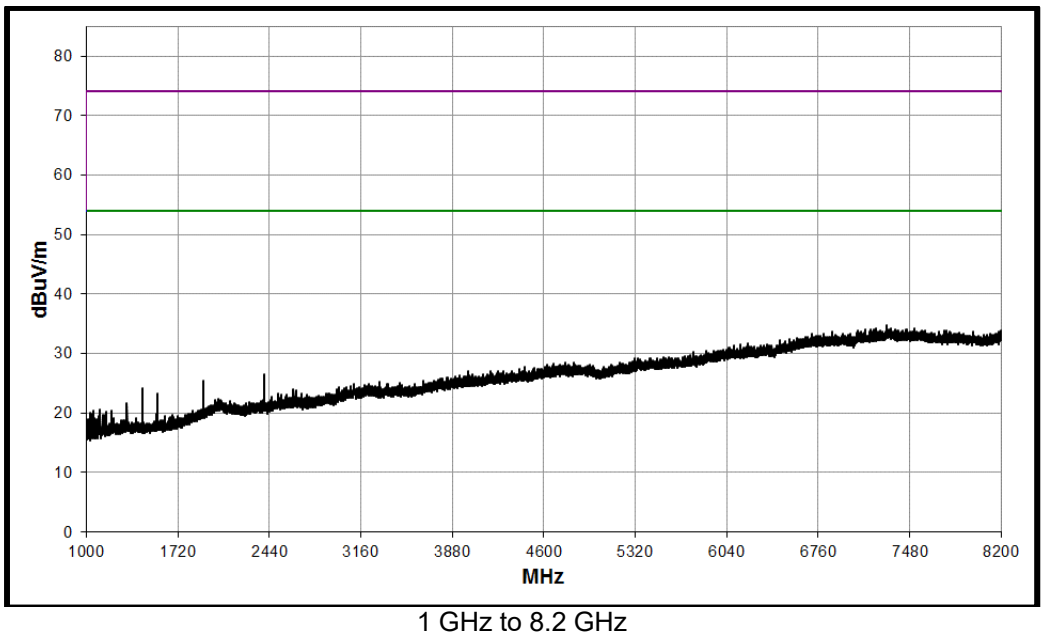
Bandedge

The frequency range 40 GHz to 110 GHz was investigated, no emissions were found above the instrument noise floor.

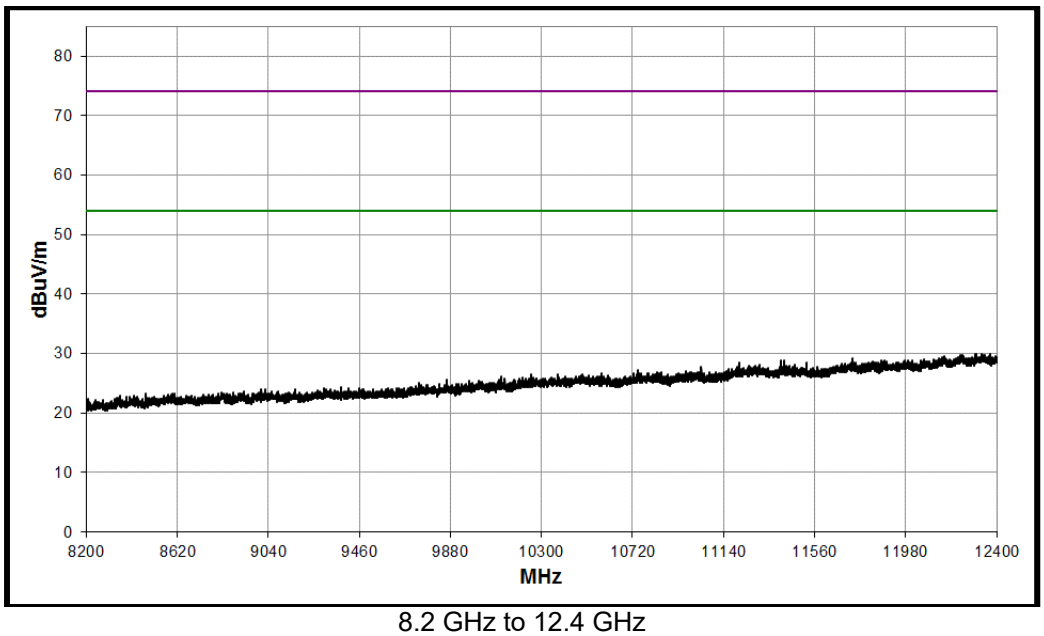
High Power Setting; Mode: 306 C2; Frequency: 24.125 GHz							
Detector	***Frequency (MHz)***	***Amplitude (dBµV)***	***Factor (dB)***	***Distance Adjustment (dB)***	***Emission level (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
No Emissions within 20 dBs of the limit							



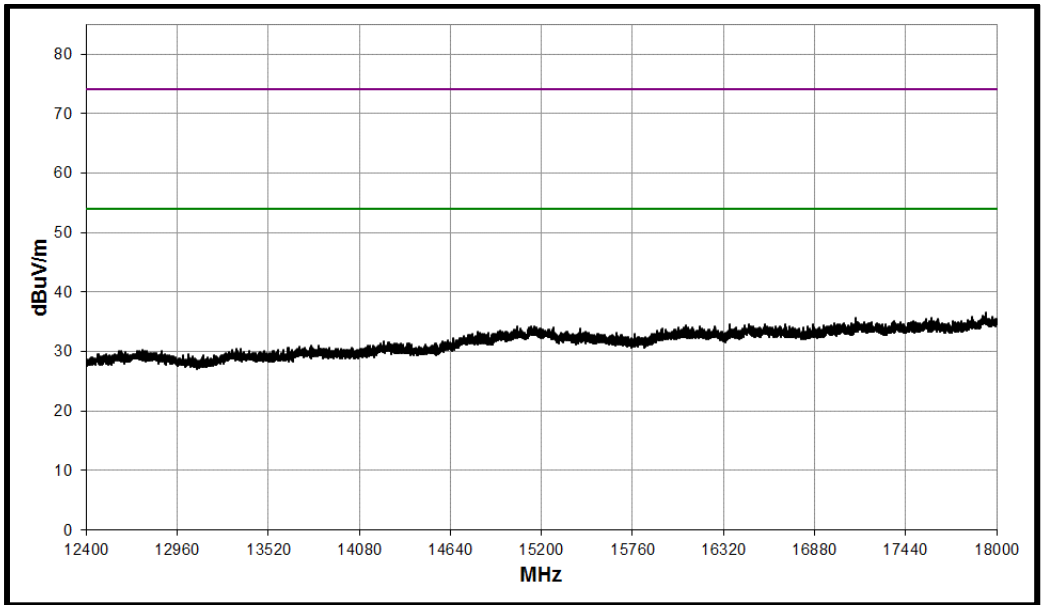
30 MHz to 1 GHz



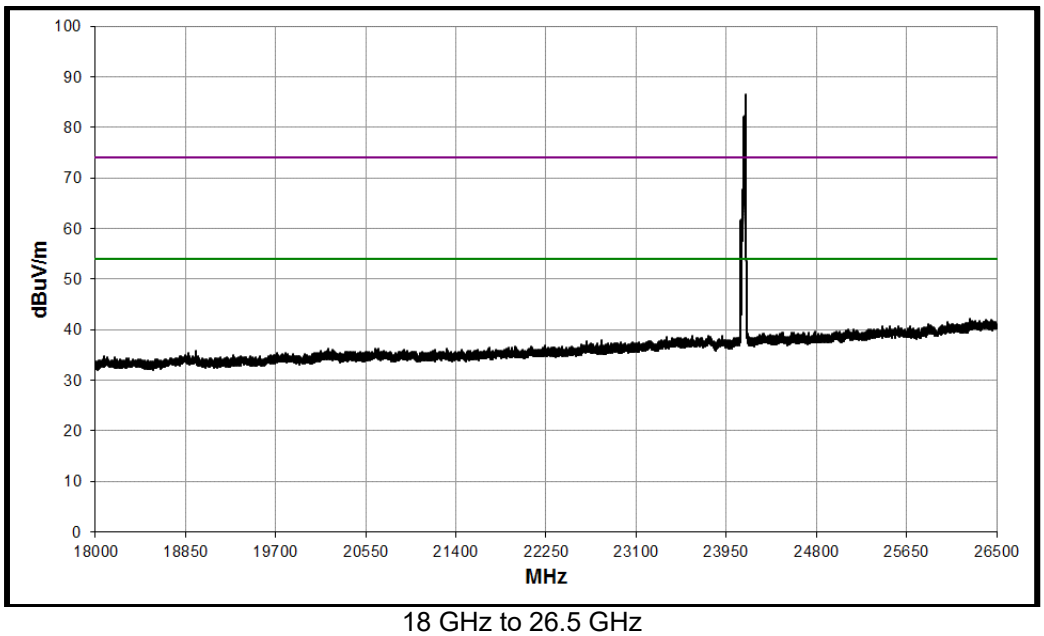
1 GHz to 8.2 GHz



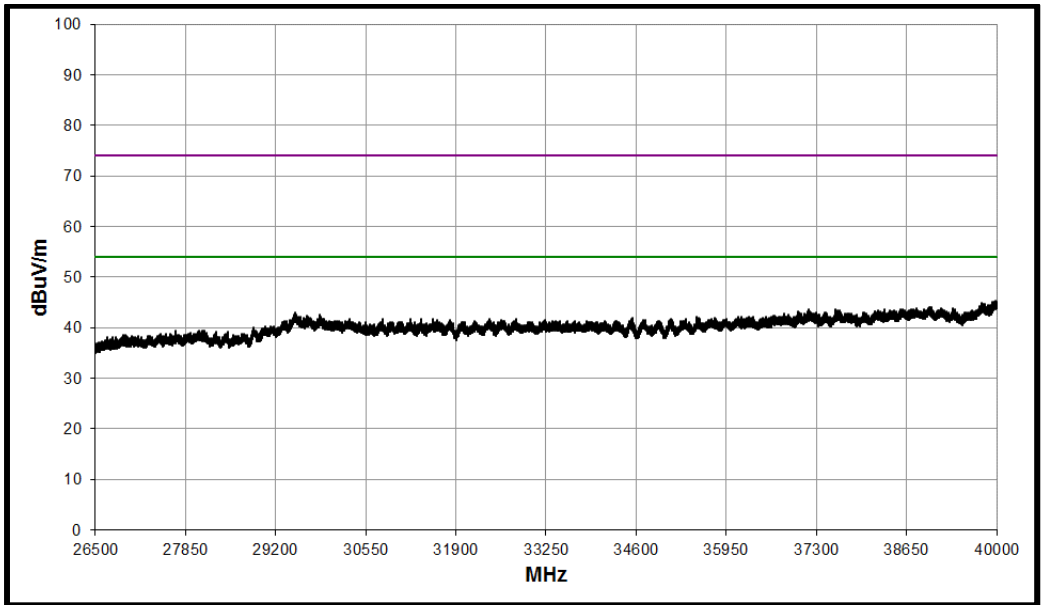
8.2 GHz to 12.4 GHz



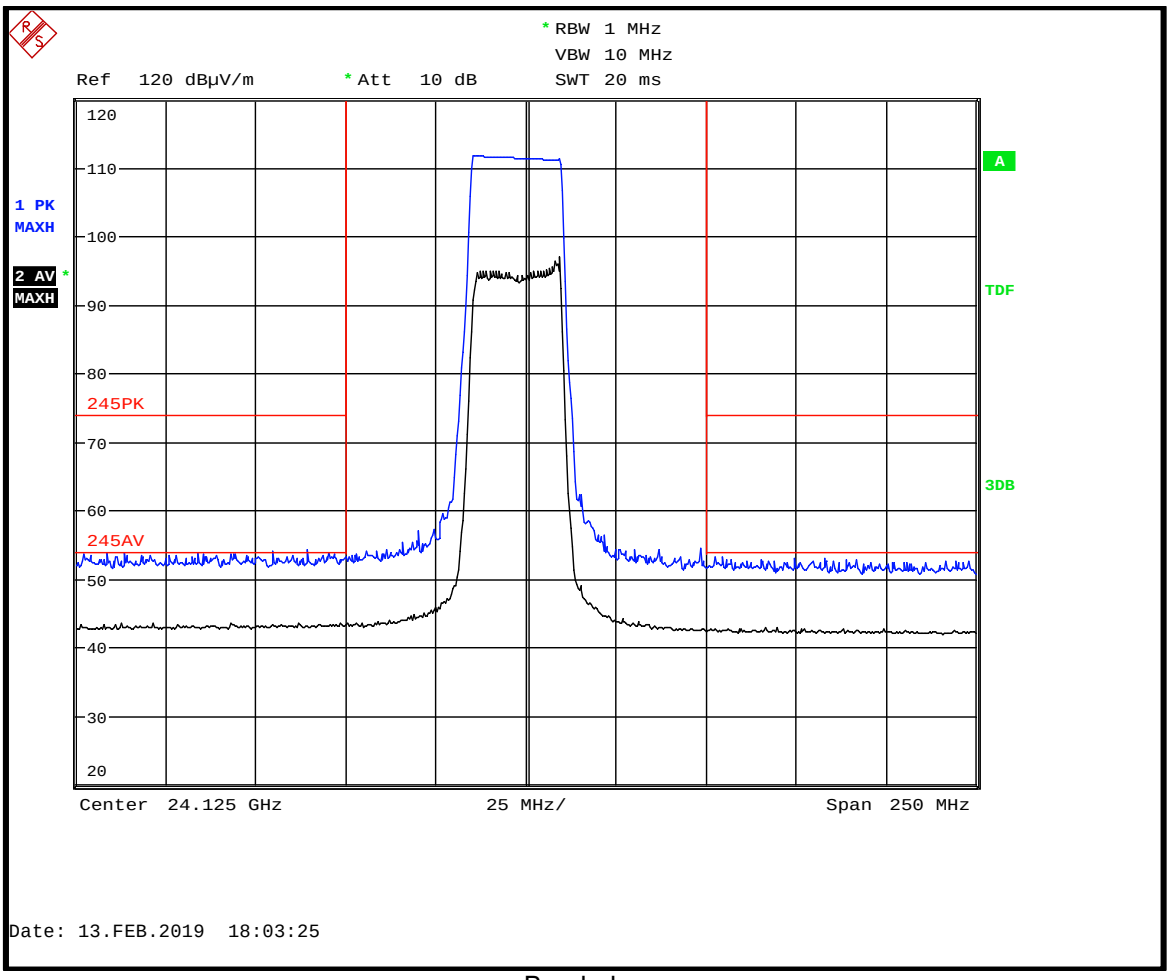
12.4 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz



Bandedge

The frequency range 40 GHz to 110 GHz was investigated, no emissions were found above the instrument noise floor.

12 AC power-line conducted emissions

12.1 Definition

Line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network.

12.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Screen Room 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.2
EUT Frequency Measured:	24.125 GHz
Deviations From Standard:	None
Measurement Detectors:	Quasi-Peak and Average

Environmental Conditions (Normal Environment)

Temperature: 19 °C	+15 ºC to +35 ºC (as declared)
Humidity: 38 % RH	20 % RH to 75 % RH (as declared)

12.3 Test Limit

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in Table 3.

Table 3 – AC Power Line Conducted Emission Limits

Frequency (MHz)	***Conducted limit (dBµV)***	
	Quasi-Peak	***Average****
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*The level decreases linearly with the logarithm of the frequency.
**A linear average detector is required.

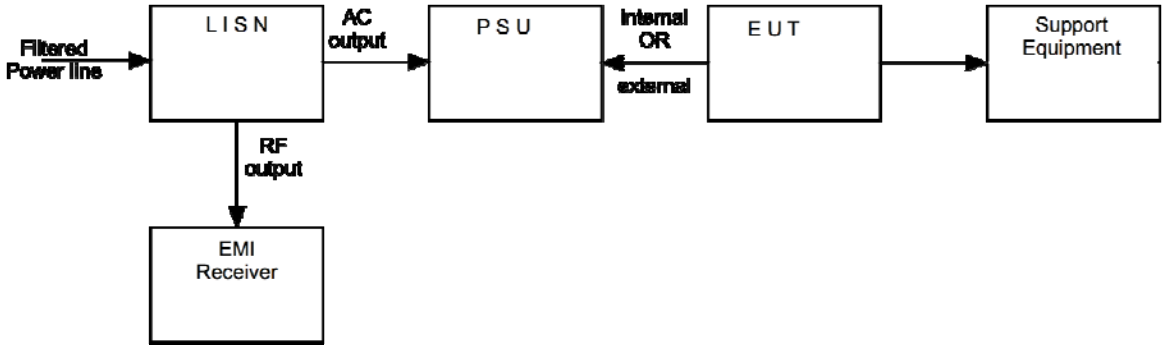
12.4 Test Method

With the EUT setup in a screened room, and connected as per Figure ii, the power line emissions were measured on a spectrum analyzer / EMI receiver.

AC power line conducted emissions from the EUT are checked first by preview scans with peak and average detectors covering both live and neutral lines. A spectrum analyzer is used to determine if any periodic emissions are present.

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans. Final measurements were performed with EUT set at its maximum duty in transmit and receive modes.

Figure ii Test Setup



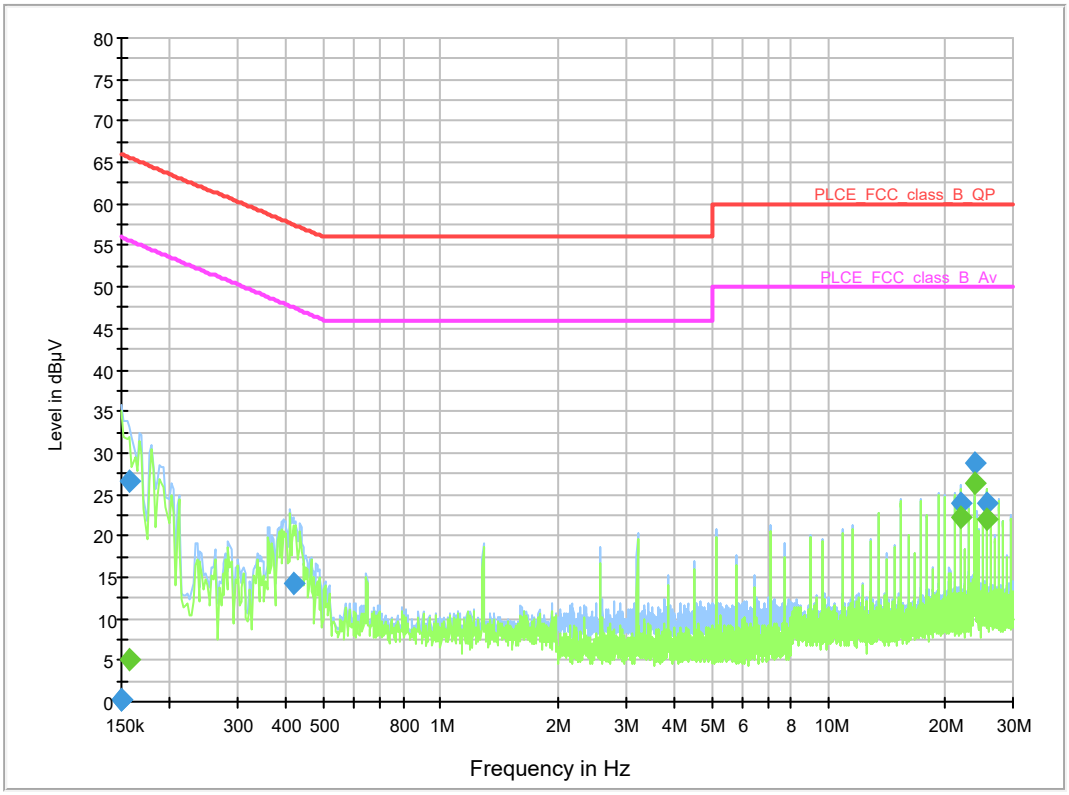
12.5 Test Set-up Photograph

12.6 Test Equipment

Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Receiver	R&S	ESHS10	RFG715	2019-11-16
Lisn	R&S	ESH3-Z5.831.5	RFG189	2019-04-06
Pulse Limiter	R&S	ESH3-Z2	RFG674	2019-07-31

12.7 Test Results

AC power-line conducted emissions, Transmit mode						
Results measured using the average detector						
Reference Number	**Frequency (MHz)**	**Conductor**	**Result (dBuV)**	**Specification Limit (dBuV)**	**Margin (dB)**	**Result Summary**
1	**0.156600**	**N**	**5.2**	**55.6**	**50.4**	PASS
2	**0.418975**	**N**	**-0.3**	**47.5**	**47.8**	PASS
3	**21.910500**	**N**	**22.3**	**50.0**	**27.7**	PASS
4	**24.000000**	**N**	**26.4**	**50.0**	**23.6**	PASS
5	**25.774000**	**N**	**21.9**	**50.0**	**28.1**	PASS
Results measured using the quasi-peak detector						
Reference Number	**Frequency (MHz)**	**Conductor**	**Result (dBuV)**	**Specification Limit (dBuV)**	**Margin (dB)**	**Result Summary**
1	**0.156600**	**N**	**26.7**	**65.6**	**38.9**	PASS
2	**0.418975**	**N**	**14.2**	**57.5**	**43.3**	PASS
3	**21.910500**	**N**	**24.0**	**60.0**	**36.0**	PASS
4	**24.000000**	**N**	**28.7**	**60.0**	**31.3**	PASS
5	**25.774000**	**N**	**24.0**	**60.0**	**36.0**	PASS



13 Occupied Bandwidth

13.1 Definitions

Occupied bandwidth
The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 % of the emitted power. This is also known as the *99 % emission bandwidth*. For transmitters in which there are multiple carriers, contiguous or non-contiguous in frequency, the occupied bandwidth is to be the sum of the occupied bandwidths of the individual carriers.

20 dB / 40 dB bandwidth
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.

13.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Laboratory 2 / Environmental Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
Deviations From Standard:	None
Measurement BW:	300 kHz
Spectrum Analyzer Video BW:	1 MHz
Measurement Span:	50 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 38 % RH	20 % RH to 75 % RH (as declared)
Supply: 12 Vdc	As declared

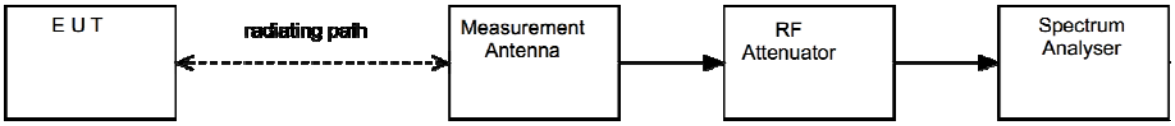
13.3 Test Limit

FCC:
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

13.4 Test Method

With the EUT connected as per Figure iii, the bandwidth of the EUT was measured on a spectrum analyser.

Figure iii Test Setup

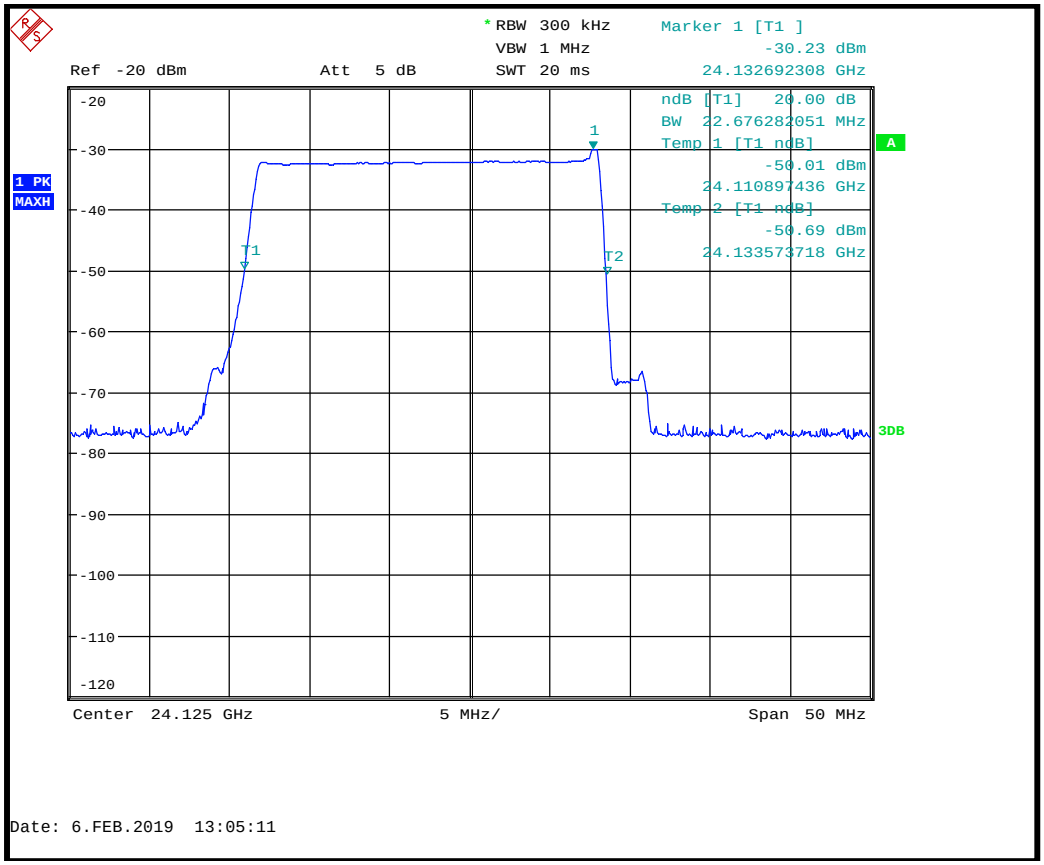


13.5 Test Equipment

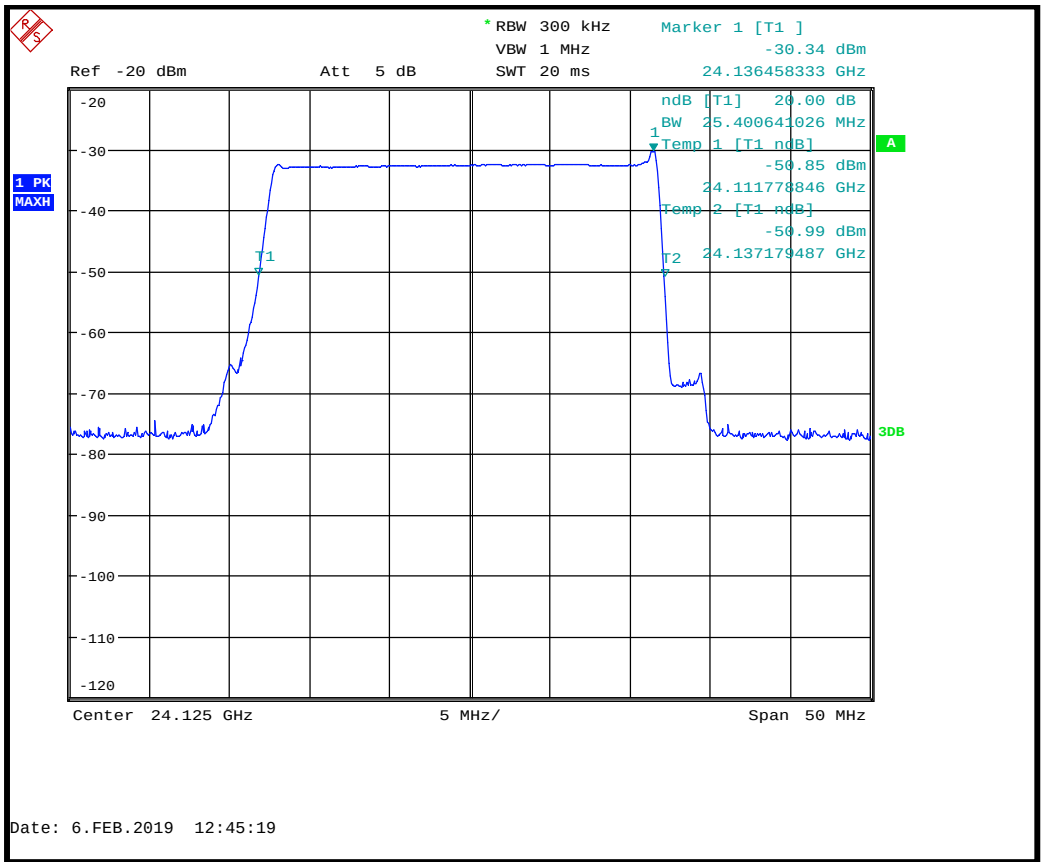
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	2019-11-20
QSH20S20S	Q-Par	Horn Antenna	RFG629	2019-09-26

13.6 Test Results

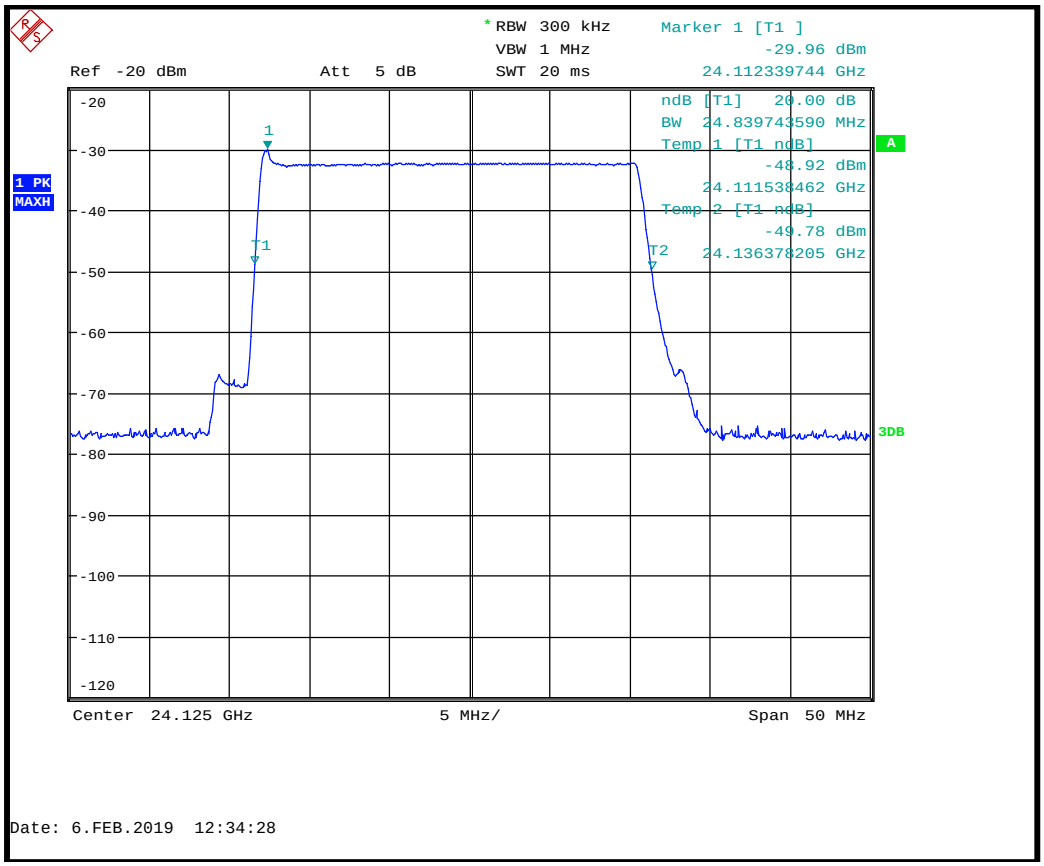
20 dB Bandwidth; 302 mode UP ramp				
Channel Frequency (MHz)	***F_L (MHz)***	***F_H (MHz)***	***20 dB Bandwidth (MHz)***	***Result***
24125	24110.897436	24133.573718	22.676282051	PASS



20 dB Bandwidth; 306 mode UP ramp				
Channel Frequency (MHz)	**F_L (MHz)**	**F_H (MHz)**	**20 dB Bandwidth (MHz)**	**Result**
24125	24111.778846	24137.179487	25.400641026	PASS



20 dB Bandwidth; 306 mode DOWN ramp				
Channel Frequency (MHz)	**F_L (MHz)**	**F_H (MHz)**	**20 dB Bandwidth (MHz)**	**Result**
24125	24111.538462	24136.378205	24.839743590	PASS



14 Transmitter output power (fundamental radiated emission)

14.1 Definition

The RF power dissipated in the standard output termination when operating under the rated duty cycle selected by the applicant for approval.

14.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Laboratory 3
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 / 6.6
EUT Frequency Measured:	24.125 GHz
Deviations From Standard:	None

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 37 % RH	20 % RH to 75 % RH (as declared)

14.3 Test Limit

The field strength measured at 3 meters shall not exceed the limits in the following table:

Field Strength Limits for License-Exempt Transmitters for Any Application

Fundamental frequency (GHz)	*Field strength (mV/m at 3 m)*	*Detector*
24.075 to 24.175	2500	Average, RMS

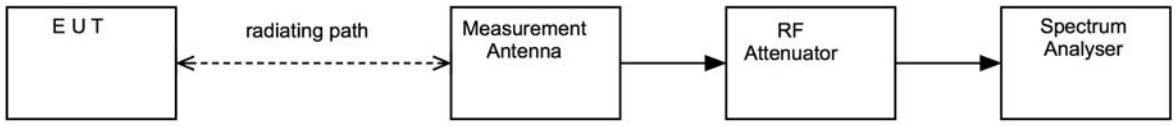
The peak limit is 20 dB above average.

14.4 Test Method

With the EUT 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



14.5 Test Equipment

Type of Equipment	*Maker/Supplier*	*Model Number*	*Element Number*	*Calibration Due Date*
Ferrite Lined Chamber	Rainford	-	REF2259	2020-08-03
Spectrum Analyser	R&S	FSU26	U405	2019-09-21
Horn Antenna	A Info Inc	LB-180400-25-C-KF	REF2246	2020-07-25

14.6 Test Results

Note: Channel 1 means upward sweep, while channel 2 means downward sweep

Mode: 302-100-000 Channel 1							
Channel Frequency (GHz)	*Meas'd Emission (dBµV)*	*Cable Loss (dB)*	*Antenna Factor (dB/m)*	*Pre-amp Gain (dB)*	*Field Strength (dBµV/m)*	*Distance Extrap'n Factor (dB)*	*Field Strength (mV/m)*
24.125	76.2	12.7	34.0	0.0	122.9	-9.54	465.46

Mode: 306-100-000 Channel 1							
Channel Frequency (GHz)	*Meas'd Emission (dBµV)*	*Cable Loss (dB)*	*Antenna Factor (dB/m)*	*Pre-amp Gain (dB)*	*Field Strength (dBµV/m)*	*Distance Extrap'n Factor (dB)*	*Field Strength (mV/m)*
24.125	76.2	12.7	34.0	0.0	122.9	-9.54	465.46

Mode: 306-100-000 Channel 2							
Channel Frequency (GHz)	*Meas'd Emission (dBµV)*	*Cable Loss (dB)*	*Antenna Factor (dB/m)*	*Pre-amp Gain (dB)*	*Field Strength (dBµV/m)*	*Distance Extrap'n Factor (dB)*	*Field Strength (mV/m)*
24.125	76.2	12.7	34.0	0.0	122.9	-9.54	465.46

The field strength in the tables above is for Peak carrier power.

The measurements in the tables above were made at a measurement distance of 1 m and extrapolated to 3 m for comparison with the limits.

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] Carrier power

Uncertainty in test result (Power Meter) = **1.08 dB**
Uncertainty in test result (Spectrum Analyser) = **2.48 dB**

[2] 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**

[3] AC power line conducted emissions

Uncertainty in test result = **3.4 dB**

[4] Occupied bandwidth

Uncertainty in test result = **15.5 %**

[5] Maximum frequency error

Uncertainty in test result (Power Meter) = **0.113 ppm**
Uncertainty in test result (Spectrum Analyser) = **0.265 ppm**

[6] Duty cycle

Uncertainty in test result = **7.98 %**

16 RF Exposure

KDB 447498 MPE Calculation

Prediction of MPE limit at a given distance

Equation from IEEE C95.1

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

where:

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

Note:

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

OR

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

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

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

Result

Prediction Frequency (MHz)	Field Strength (dBuV/m)	Maximum EIRP (mW)	Minimum Distance (cm)	Power density at distance (mW/cm^2)	Power density limit (S) (mW/cm^2)
24125	113.36	65.0	2.5	0.83	1