

Prüfbericht-Nr.: <i>Test Report No.:</i>	19111401A.r01	Auftrags-Nr.: <i>Order No.:</i>	89003529	Seite 1 von 49 Page 1 of 49
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	1659792	Auftragsdatum: <i>Order date:</i>	23.03.2020	
Auftraggeber: <i>Client:</i>	Nedap N.V.			
Prüfgegenstand: <i>Test item:</i>	Digital Transmission System (DTS) Lamp driver 4kW, Radio interface			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	Lamp driver 4kW			
Auftrags-Inhalt: <i>Order content:</i>	Compliance with standard			
Prüfgrundlage: <i>Test specification:</i>	FCC 47 CFR Part 15, Subpart C, Section 15.247 (10-1-19 Edition) RSS-Gen (Issue 5, March 2019) and RSS-247 (Issue 2, February 2017) ANSI C63.10-2013 KDB 558074 D0115.247 Meas Guidance v05r02, April 2, 2019			

Wareneingangsdatum: <i>Date of receipt:</i>	23.04.2020	
Prüfmuster-Nr.: <i>Test sample No.:</i>	Sample 1 (radiated tests) Sample 3 (conducted tests)	
Prüfzeitraum: <i>Testing period:</i>	28.04.2020 – 13.05.2020	
Ort der Prüfung: <i>Place of testing:</i>	Leek	
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland Nederland B.V. Leek Laboratory	
Prüfergebnis*: <i>Test result*:</i>	PASS	

geprüft von / tested by:		Kontrolliert von / reviewed & approved by:			
8-Jun-20	Richard van der Meer/ Test Engineer	8-Jun-20	Erik van der Wal, Senior Expert Telecom		
Datum <i>Date</i>	Name / Stellung <i>Name / Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name / Stellung <i>Name / Position</i>	Unterschrift <i>Signature</i>

Sonstiges / Other: report issue date is equal to approved date.

Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery: 1</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>
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* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut Prüfgrundlage(n)	3 = befriedigend F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	4 = ausreichend N/A = nicht anwendbar	5 = mangelhaft N/T = nicht getestet
Legend:	1 = very good P(ass) = passed a.m. Test specification(s)	2 = good Test specification(s)	3 = satisfactory F(ail) a.m. test specification(s)	4 = sufficient N/A = not applicable	5 = poor N/T = not tested

This test report only relates to the a.m. testsample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This report does not entitle to carry any test mark.

TÜV Rheinland Nederland B.V. · Eiberkamp 10 · 9351 VT Leek · Tel: + 31 88 8887888
Mail: info@nl.tuv.com · Web: www.tuv.com

<i>EUT front view</i>	<i>EUT rear view</i>
	



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TEST SUMMARY

Test Specification Clause	Test Case	Pass	Fail	Not applicable	Not performed
§15.247(a2)	Spectrum Bandwidth of a DTS System / 6dB BW	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§ 15.247 (b) (3)	Maximum output power (conducted)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247 (e)	Peak power spectral density	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247 (d)	Band-edge compliance of conducted emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.205	Band-edge compliance of radiated emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247 (d)	Spurious Emission - conducted (Transmitter)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§ 15.209	Spurious Emission - radiated (Transmitter)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§ 15.207	AC Power Line Conducted Emissions <30 MHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Revisions Revisions

Revision Revision	Datum Date	Anmerkung Remark	Verfasser Author
-	08.06.2020	First release	R. van der Meer

Note: Latest revision report will replace all previous reports



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1. General Remarks

1.1.1 Complementary Materials

There is no attachment to this test report.

1.1.2 Special Accessories

None.

1.1.3 Equipment modifications

None

2. Test Sites

2.1 Test Facilities

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meters. The site is listed with the FCC and ISED and accredited by RvA (Cert #L484). The 3 meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meter

The Federal Communications Commission and Industry Canada has reviewed the technical characteristics of the test facilities at TÜV Rheinland Nederland B.V., located in Leek, 9351VT Eiberkamp 10, The Netherlands, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948.

The description of the test facilities has been filed at the Office of the Federal Communications Commission under Designation Number NL0005 (test site registration number: 786213). The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

The description of the test facilities has been filed to Industry Canada under CABID number NL0002 (test site registration number: 2932G-2). The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

Normal test conditions:

Temperature (*) : +15°C to +35°C
Relative humidity(*) : 20 % to 75 %
Supply voltage : 400 Vac.

()When it was impracticable to carry out the tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests are stated separately.*

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Inventory number	Calibration date (mm/yyyy)	Calibration due date (mm/yyyy)
For Antenna Port Conducted Emissions					
Temperature-Humiditymeter	Extech	SD500	2789213	06/2019	06/2020
Spectrum Analyzer	Rohde & Schwarz	FSV	2790260	07/2018	07/2020
Power supply 400Vac/60Hz	Chroma	61705	2790478	01/2020	01/2021
RF Cable	Rohde & Schwarz	WF	2789116 /A00347	07/2019	07/2020
For Radiated Emissions					
Measurement Receiver	Rohde & Schwarz	ERC7	2790497	07/2019	07/2020
RF Cable S-AR	Gigalink	APG0500	2789217	03/2020	03/2021
Controller	Maturo	SCU/088/8090811	A00450	N/A	N/A
Power supply 400Vac/60Hz	Chroma	61705	2790478	01/2020	01/2021
Test facility	Comtest	FCC listed: 786213 IC: 2932G-2	2789009	03/2020	03/2022
Spectrum Analyzer	Rohde & Schwarz	FSV	2790106	07/2018	07/2020
Antenna mast+control	Innco	CO3000	9002463	N/A	N/A
Temperature-Humiditymeter	Extech	SD500	2789214	06/2019	06/2020
Guidehorn 1-18 GHz	EMCO	3115	2788777	02/2019	02/2022
Guidehorn 18-26.5 GHz	ETS-Lindgren	3160-09	2788982	01/2018	01/2021
Amplifier 18-40 GHz			2789148/ 2790233	11/2019	11/2020
RF Cable 18-40 GHz	CentricRF	C6464-160-120	9001996	12/2019	12/2020
Biconilog Testantenna	Teseq	CBL 6111D	2789237	10/2019	10/2020
2.4 GHz bandreject filter	BSC	XN-1783	2788837	N/A	N/A
Bandpass filter 4-10 GHz	Reactel	7AS-7G-6G-511	2788904	N/A	N/A
Bandpass filter 10-26 GHz	Reactel	9HS-10G/26.5G-S11	2788924	N/A	N/A
Preamplifier 0.5 - 18 GHz	Miteq	AMF-5D-005180-28-13p	2789021	N/A	N/A
Filterbox	EMCS	RFS06S	2789029	11/2019	11/2020

Kind of Equipment	Manufacturer	Model Name	Inventory number	Calibration date (mm/yyyy)	Calibration due date (mm/yyyy)
For AC Powerline Conducted Emissions					
Pulse limiter	R&S	ESH3-Z2	2788823	09/2019	09/2020
Variac	RFT	LSS020	2788944	NA	NA
LISN	R&S	ESH2-Z5	2788791	06/2018	06/2020
Measurement Receiver	Rohde & Schwarz	ESCS30	2789421	11/2019	11/2020
Shielded room for Conducted emissions	--	--	2789207	NA	NA
Temperature-Humidity meter	Extech	SD500	2789213	06/2019	06/2020
Power supply 400Vac/60Hz	Chroma	61705	2790478	01/2020	01/2021

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing. NA= Not Applicable

Accreditation

The reported tests were performed under ISO17025:2005 accreditation, unless otherwise specified as 'not under Accreditation'

An overview of all TÜV Rheinland Nederland B.V. accreditations, notifications and designations, please visit our website www.tuv.com/nl. You can find the relevant declarations under the download link.

2.3 Measurement Uncertainty

Table 2: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Antenna Port Conducted Emission	< 1.3GHz	1.7dB
	1.3 - 40GHz	2.9 – 3.4dB
Radiated Emission	150kHz - 30MHz	±5.0dB
	30MHz - 1GHz	±5.0dB
	> 1GHz	±5.5dB
AC Power Line Conducted Emissions	150kHz - 30MHz	±3.5dB

3. General Product Information

The EUT is designed to operate in the 2.4 GHz ISM frequency band. The EUT utilizes communication Protocol based RF Interface:

Protocol: Bluetooth Low Energy (BLE)

The PCB implementation is based on a M41W9VT4 chipset. Bluetooth v4.2 Low Energy compliant 1 Mbps GFSK modulation. The EUT, has 1 antenna for transmitting and receiving.

Technical Specifications	Value
Operating Frequency band	2402 – 2480 MHz , Non Hopping
Modulation	GFSK 1Mbps
Antenna Gain	5.3 dBi

There are no interface ports present on the EUT.

3.1 Countermeasures to achieve compliance

No additional measures were employed to achieve compliance.

3.2 Operation Modes

Testing was performed at the lowest operating frequency (2402 MHz), at the operating frequency in the middle of the specified frequency band (2440 MHz) and at the highest operating frequency (2480 MHz). These operation modes were selected after review of the capabilities and characteristics of the EUT.

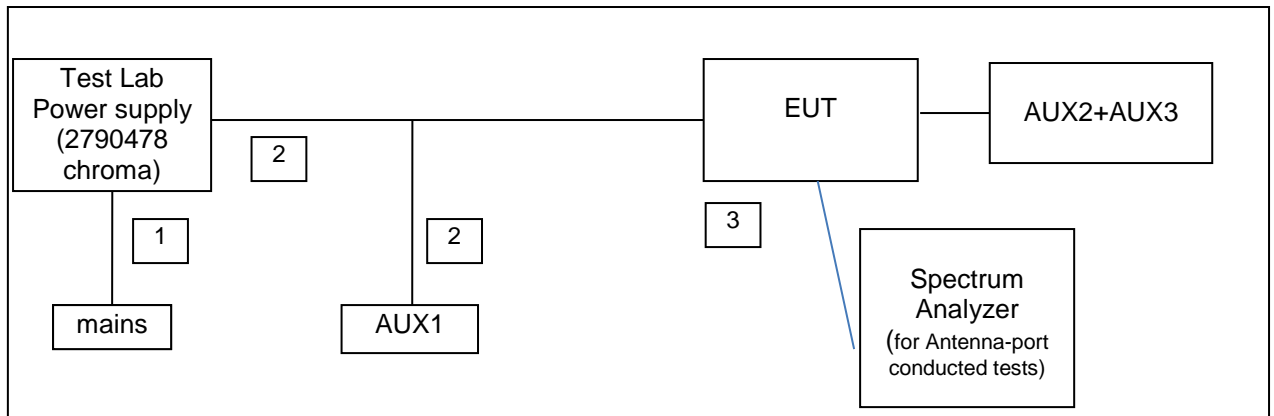
Modulation	Power level Setting	Test frequencies (MHz)		
		Lowest	Middle	Highest
BLE	31 (=Max)	2402	2440	2480

3.3 Physical Configuration for Testing

The EUT was tested on a stand-alone basis as per Figure 1 for the antenna port conducted tests and with lamp driver and motion detector.

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10-2013.

Figure 1: Test Setup Diagram – antenna port conducted tests and programming.



No.	Port	From	To	Remarks
1.	Mains	Mains	Power Supply	-
2.	AC Power	Power Supply	EUT+AUX1	-
3.	Antenna port	EUT	Spectrum analyzer	Conducted tests

For radiated tests:

EUT : Lamp driver 4kW
Manufacturer : Nedap NV
Brand : Nedap
Model : Lamp driver 4kW
Serial number : EMC Sample 1 (Radiated tests); EMC Sample 3 (Conducted tests)
Voltage input rating : 400 - 480Vrms / L1-L2 + PE, 48 – 63 Hz
Voltage output rating : 279 - 500V / 14.3 – 9.3A
Current input rating : 22A max.

AUX1 : Heater 400V
Manufacturer : Eurom Powerful Products
Brand : EUROM
Model : EK 15002
Serial number : AI0151

AUX2 : USB To RS232/422/485 Converter
Manufacturer : Trycom Technology Co Ltd
Brand : TRYCOM
Model : TRP-C08
Serial number : -

AUX3 : Laptop
Manufacturer : Hewlett Packard
Brand : Hewlett Packard
Model : EliteBook 820

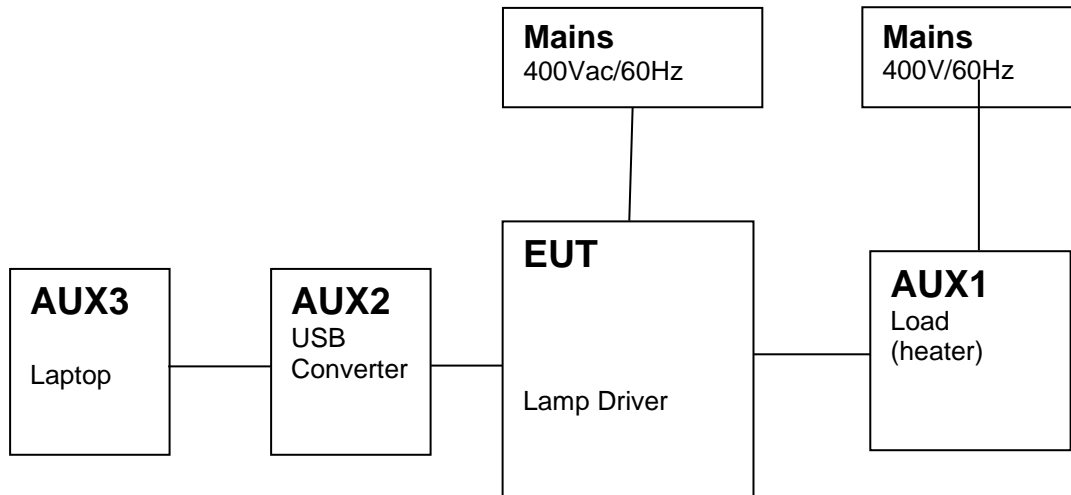


Fig. A: Test setup

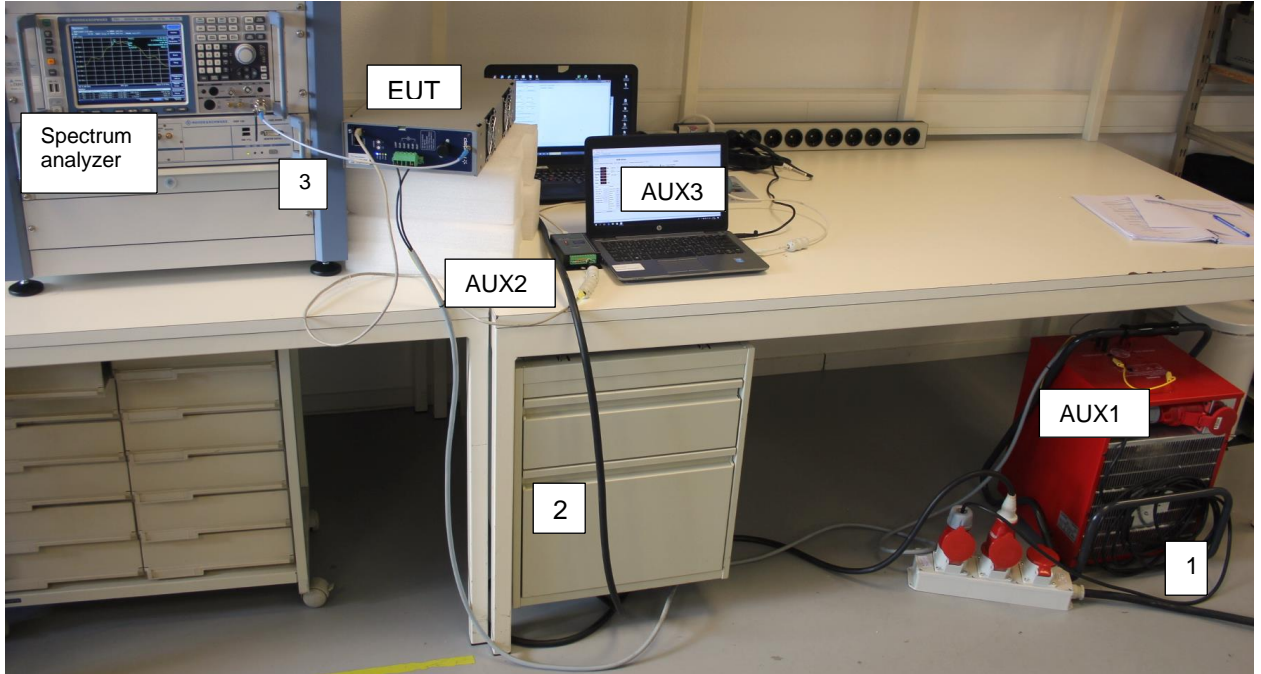


Figure 2: Test Setup Photos – conducted tests

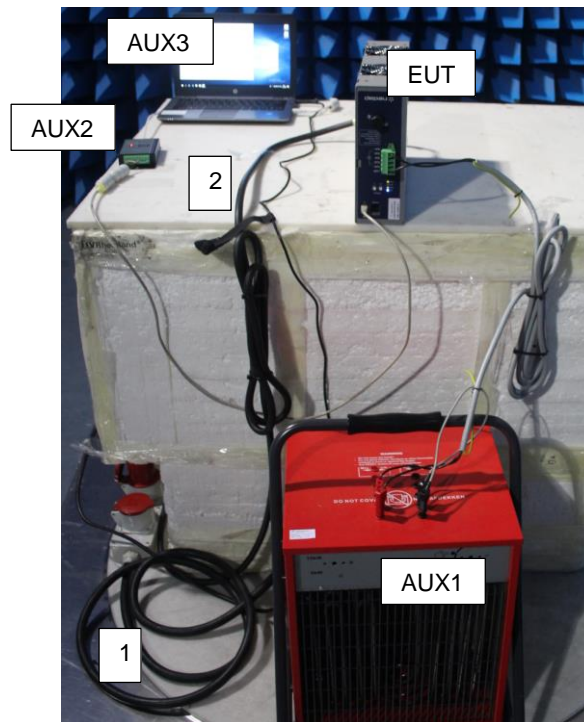


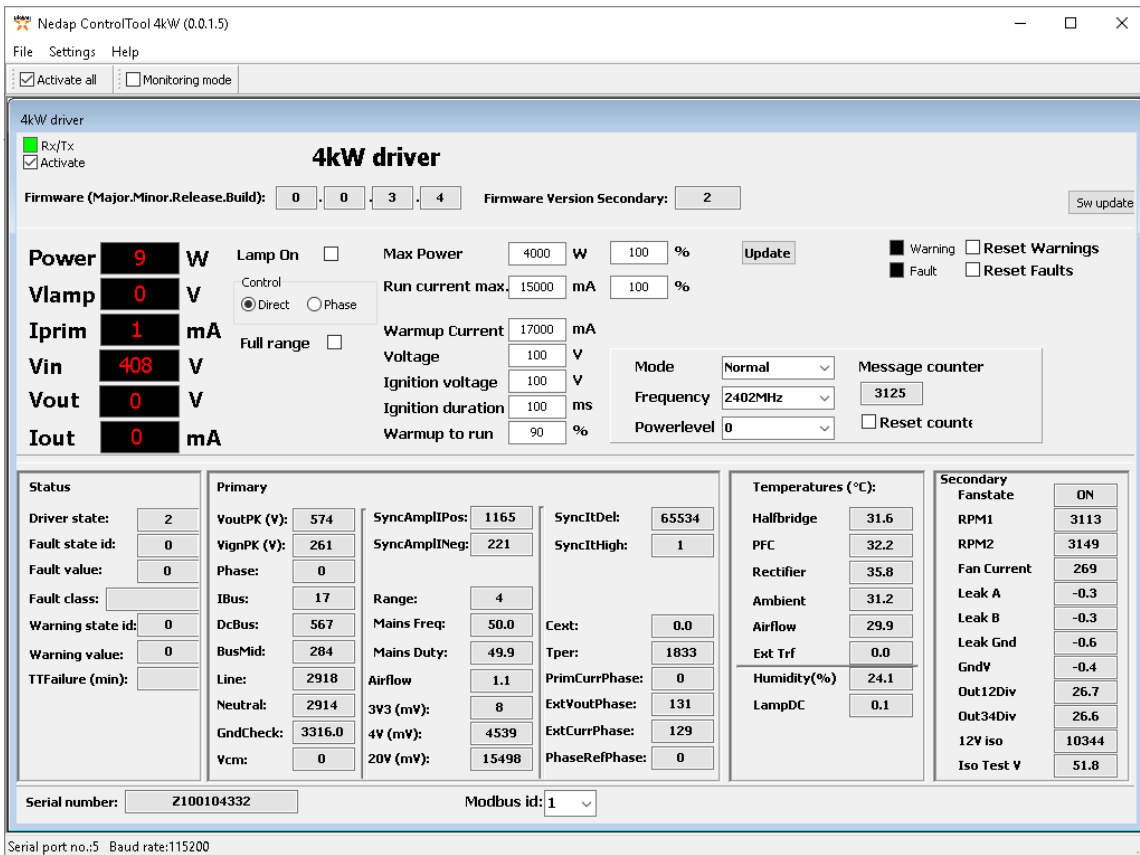
Figure 3: Test Setup Photos – radiated tests

3.4 Test Software

The test modes were set by using Windows program ControlTool4kW-FCC-1.5. This software was running on a laptop computer (AUX3). It was used to enable the test operation modes below, as appropriate.

Dedicated samples was provided by the applicant for conducted and radiated emissions tests.

Screenshot of the software:



3.5 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

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4. Test Results

4.1.1 DTS (6dB) and 99% Bandwidth

RESULT: Pass

Date of testing: 2020-05-06

Requirements:

FCC 15.247(a)(2) and RSS-247 Section 5.2(1)

For systems using digital modulation in the 2400-2483.5MHz band, the 6dB bandwidth shall be at least 500kHz.

For 99% Bandwidth: RSS-Gen Section 4.6.1: No requirement is given.

Test procedure 6dB bandwidth:

ANSI C63.10-2013 section 11.8.1 Option 1

A spectrum analyzer was connected to the antenna port of the EUT. The spectrum analyzer resolution bandwidth was set to 100kHz, video bandwidth to 300kHz and the span wide enough to capture the modulated carrier.

For 99% Bandwidth:

Test procedure: RSS-Gen.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

A spectrum analyzer was connected to the antenna port of the EUT. The spectrum analyzer resolution bandwidth was set to 1% of the selected span, Video bandwidth was set to 3 times the resolution bandwidth. The span was set to capture the whole modulation process. The Spectrum analyzers automated function for 99% BW was used.
Measurement uncertainty is +/-

Plots A1,B1 and C1 shown on the next pages are of the 6 dB bandwidth.

Plots A2,B2 and C2 shown on the next pages are of the 99% bandwidth

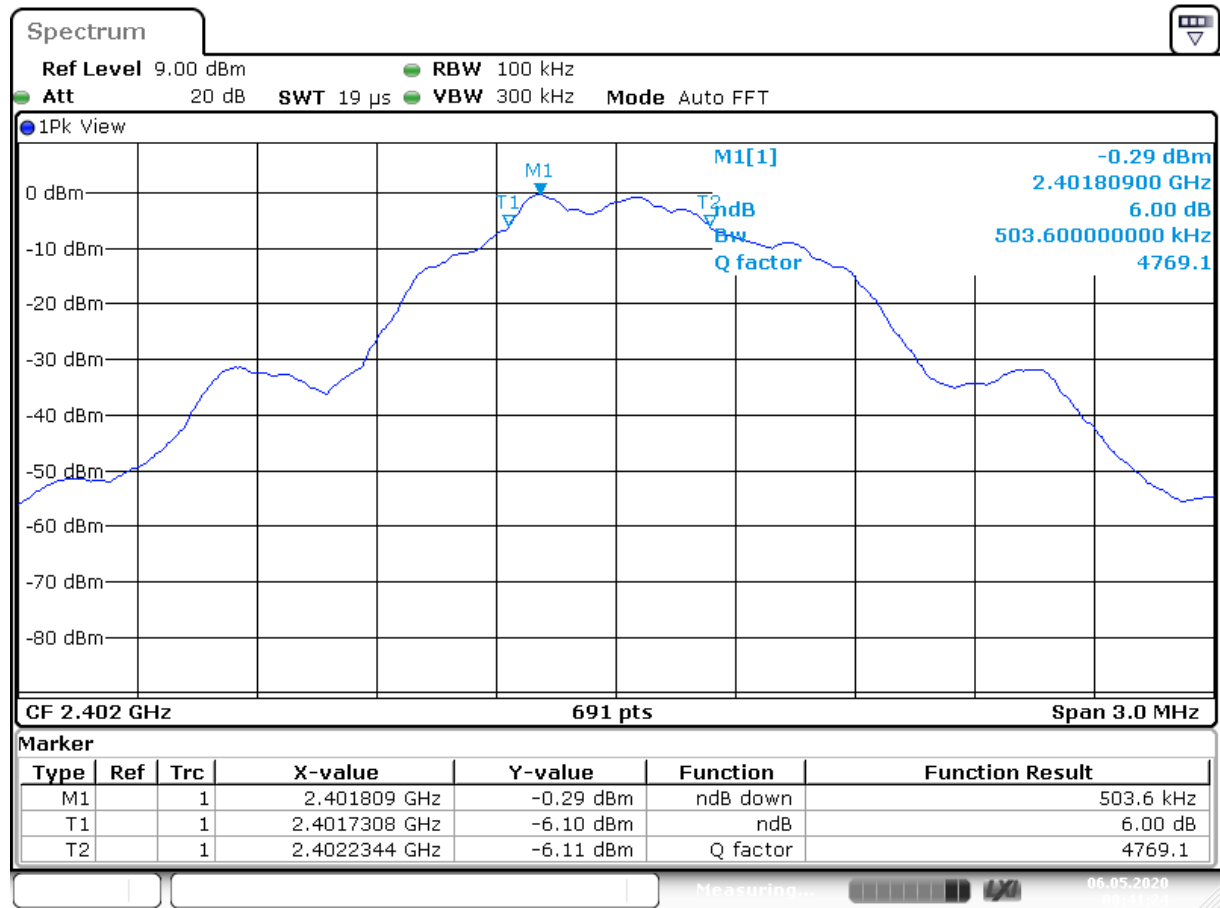
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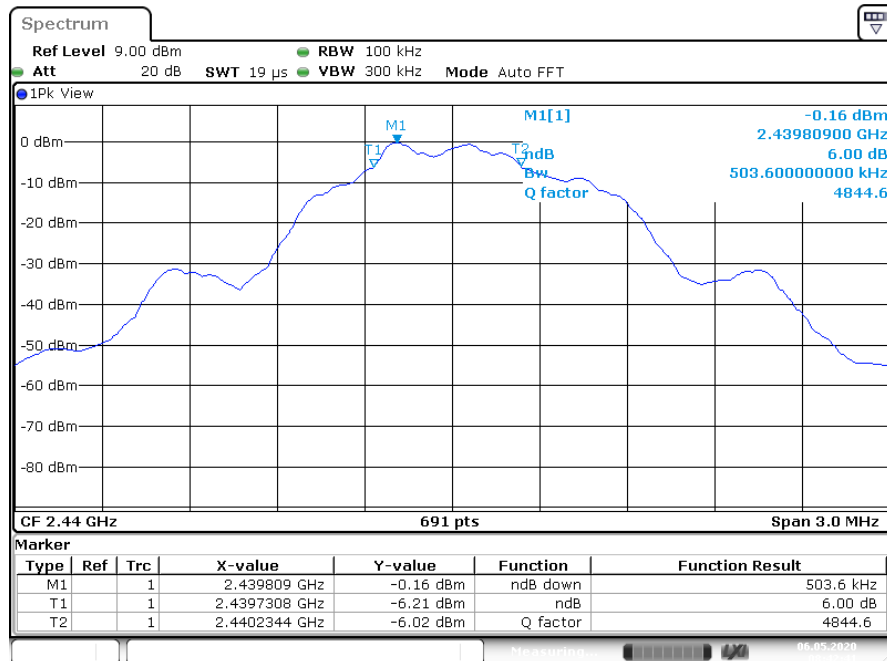
6dB and 99% Bandwidth

Operating Frequency [MHz]	99% Bandwidth [kHz]	6dB Bandwidth [kHz]	Limit [kHz]	Verdict [Pass/Fail]	Plot number
2402	1034	503.6	>500	Pass	A1/A2
2440	1034	503.6	>500	Pass	B1/B2
2480	1037	508.0	>500	Pass	C1/C2



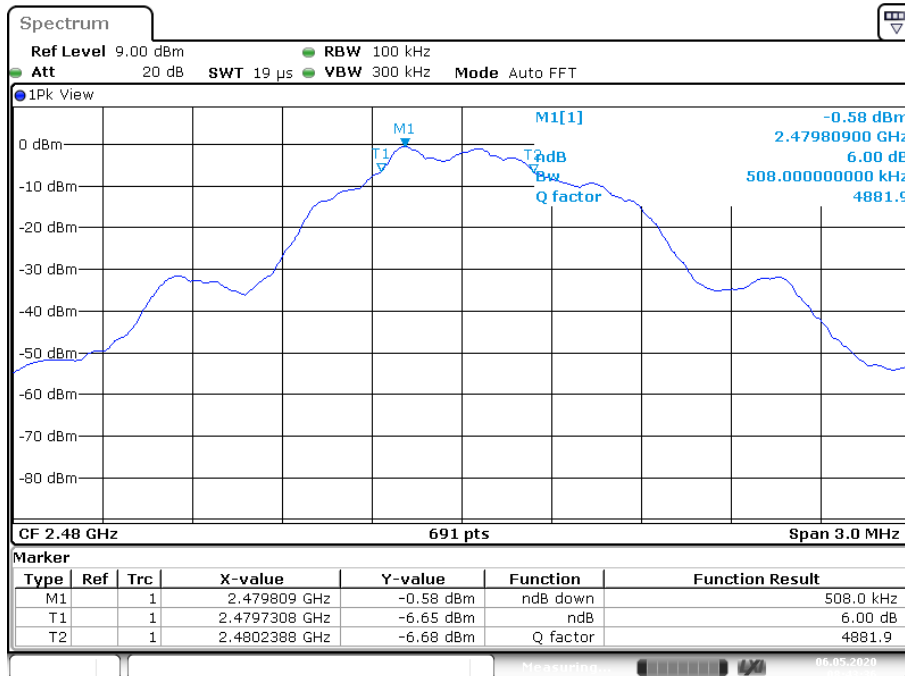
Date: 6 MAY 2020 08:41:24

Plot A1



Date: 6 MAY 2020 08:42:41

Plot B1



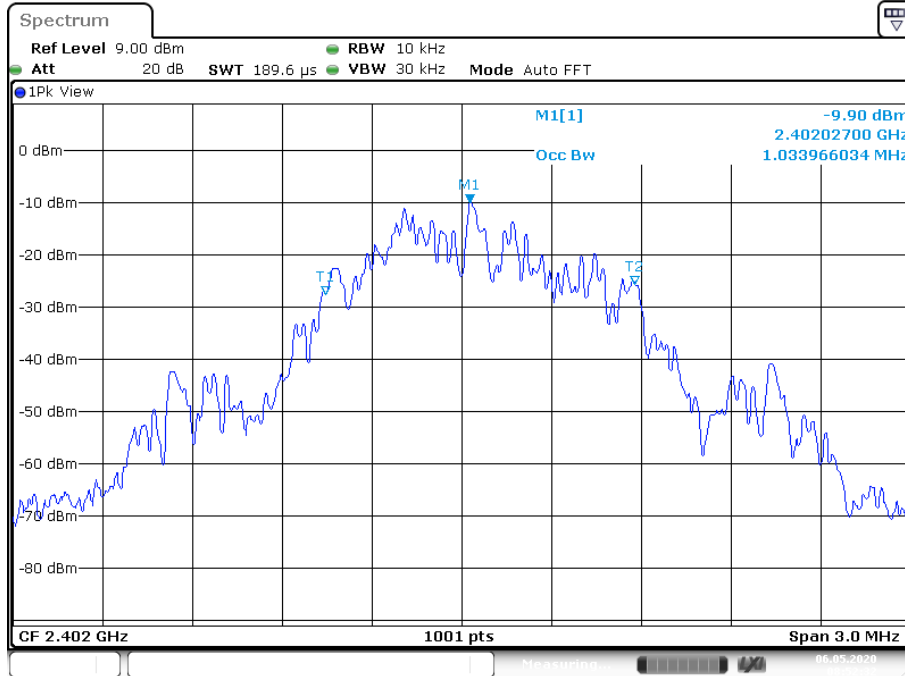
Date: 6 MAY 2020 08:43:36

Plot C1

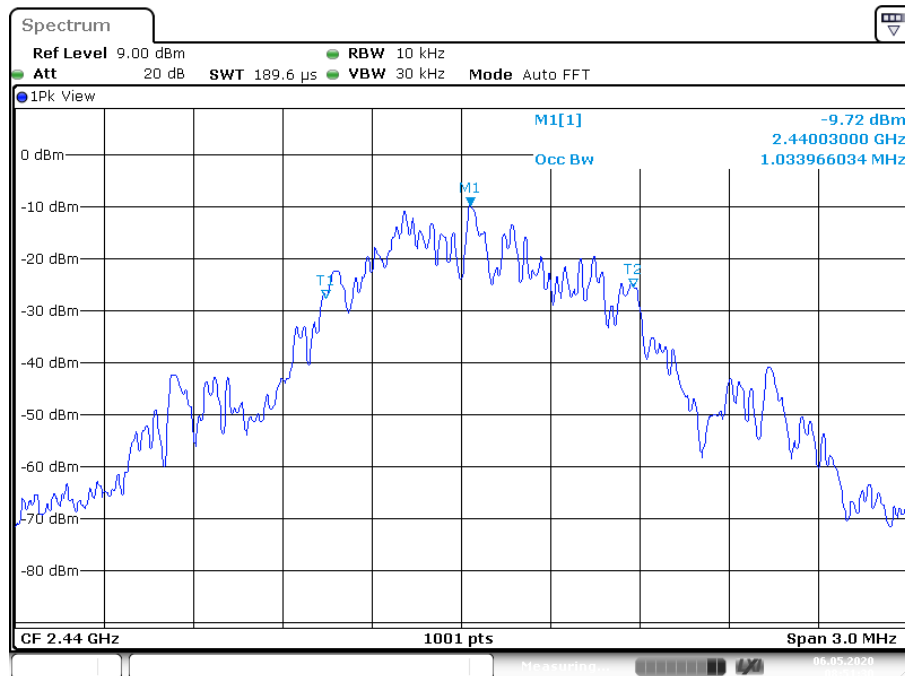
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Plot A2

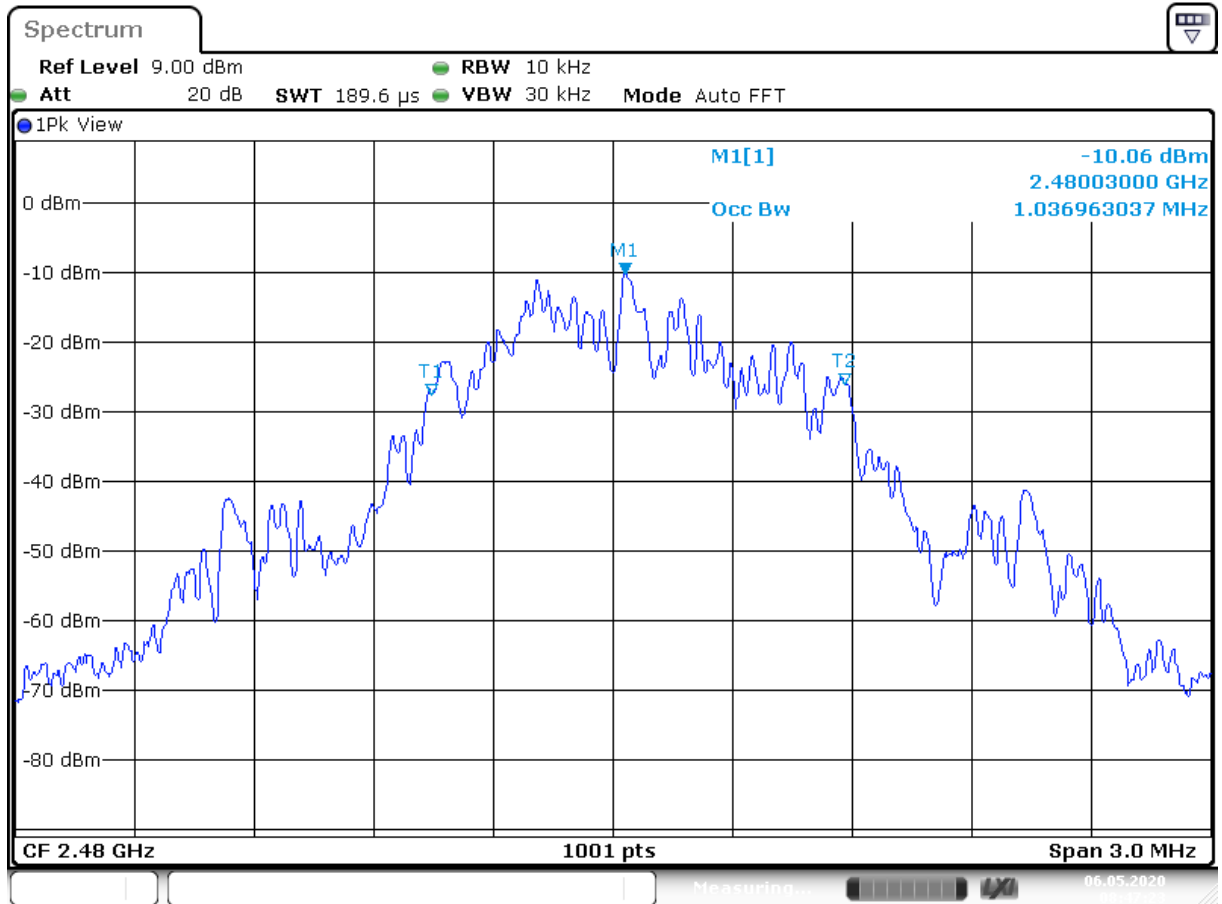


Plot B2

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Date: 6 MAY 2020 08:47:24

Plot C2

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4.1.2 Conducted Output Power

RESULT: Pass

Date of testing: 2020-05-06

Requirements:

FCC 15.247(b)(3)

For systems using digital modulation in the 2400-2483.5 MHz band, the maximum peak output power is 1W (+30dBm).

RSS-247 section 5.4(4): the e.i.r.p. shall not exceed 4 W (+36 dBm).

Test procedure:

The Peak Conducted Output Power was measured using the method according to section 11.9.1.1 in ANSI C63.10-2013.

The maximum peak output power (conducted) was measured at the antenna connector with a spectrum analyzer. The final measurement takes into account the loss generated by all the involved cables.

Measurement uncertainty is +/- 0.7 dB.

Notes: $mW = 10^{(dBm/10)}$
 $dBm = 10 \times \log(mW)$

plots : Peak power plots,

Figures 1a, 1b and 1c show plots of the Peak Power outputs, correction factors (= 0.01 dB Cable loss) included in the reading.



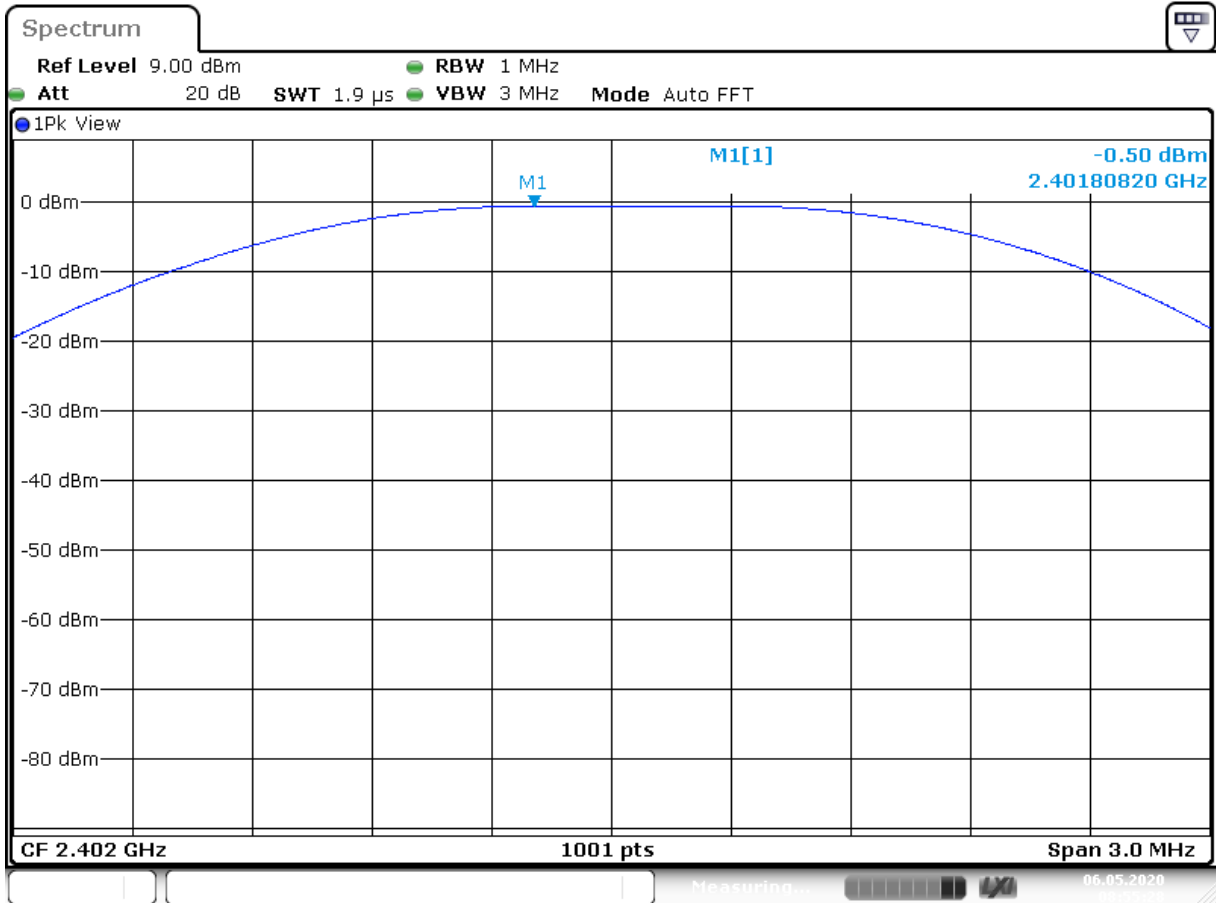
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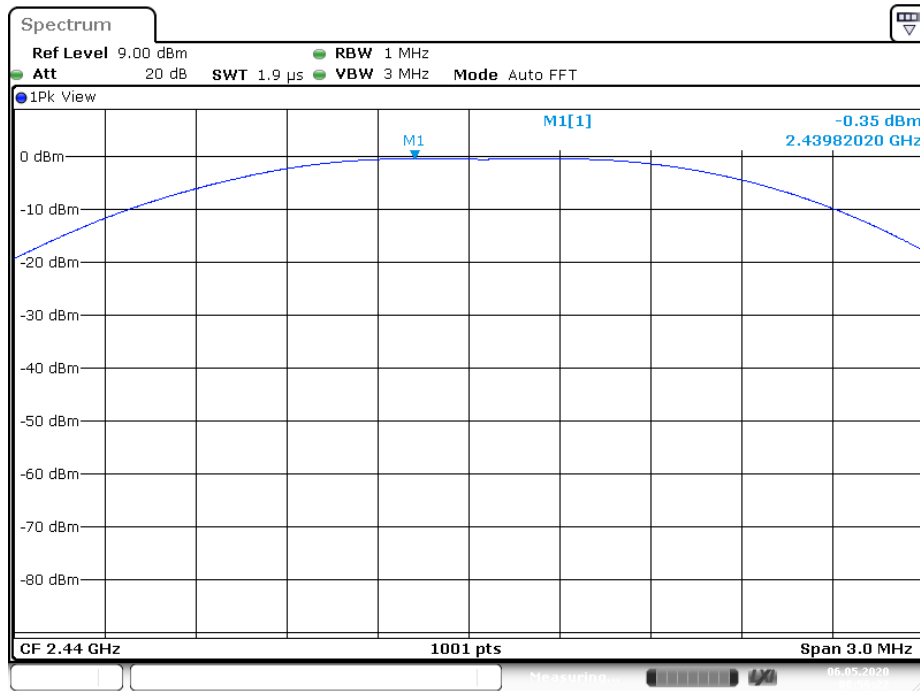
Conducted Output Power

Frequency [MHz]	Output Power [W]	Limit [W]	Verdict [Pass/Fail]	Plot number
2402	0.00089 (-0.50 dBm)	1 (+30 dBm)	Pass	1A
2440	0.00092 (-0.35 dBm)	1 (+30 dBm)	Pass	1B
2480	0.00083 (-0.82 dBm)	1 (+30 dBm)	Pass	1C

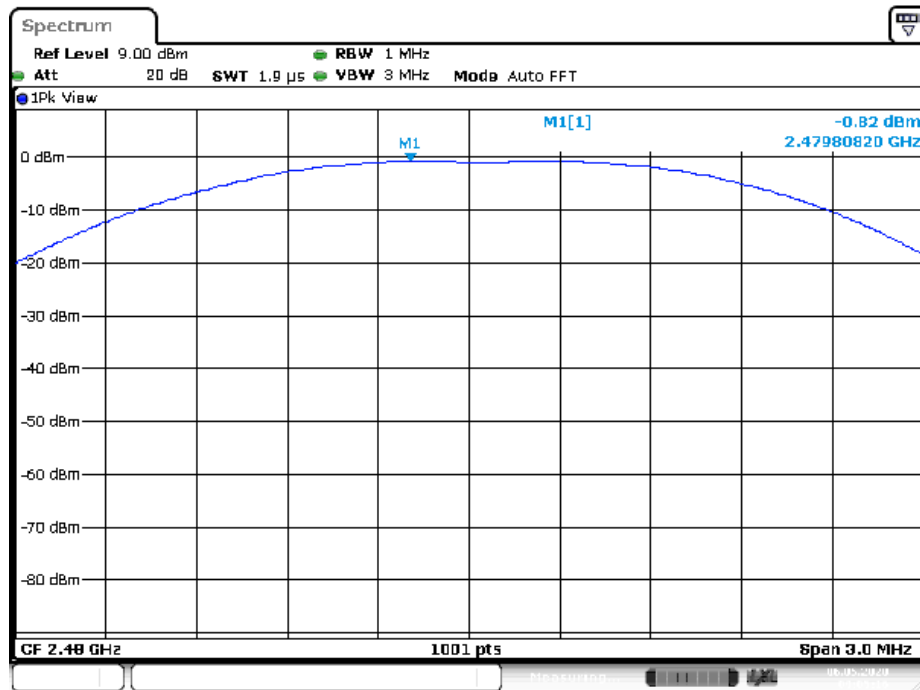


Date: 6 MAY 2020 08:55:27

Plot A



Plot B



Plot C

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4.1.3 Peak Power Spectral Density

RESULT: Pass

Date of testing: 2020-05-06

Requirements:

FCC 15.247(e) and RSS-247 section 5.2(2)

For digitally modulated systems, the power spectral density (PSD) conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

Test procedure:

ANSI C63.10-2013

The section 11.10.2 PKPSD peak PSD procedure was used. A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 3kHz and the video bandwidth was set to 10kHz. The sweep time was set to auto couple and the trace was allowed to stabilize before making the final measurement. By using the Peak marker function the maximum amplitude was determined. The final measurement takes into account the loss generated by all the involved cables.

Measurement uncertainty is +/- 0.7 dB.

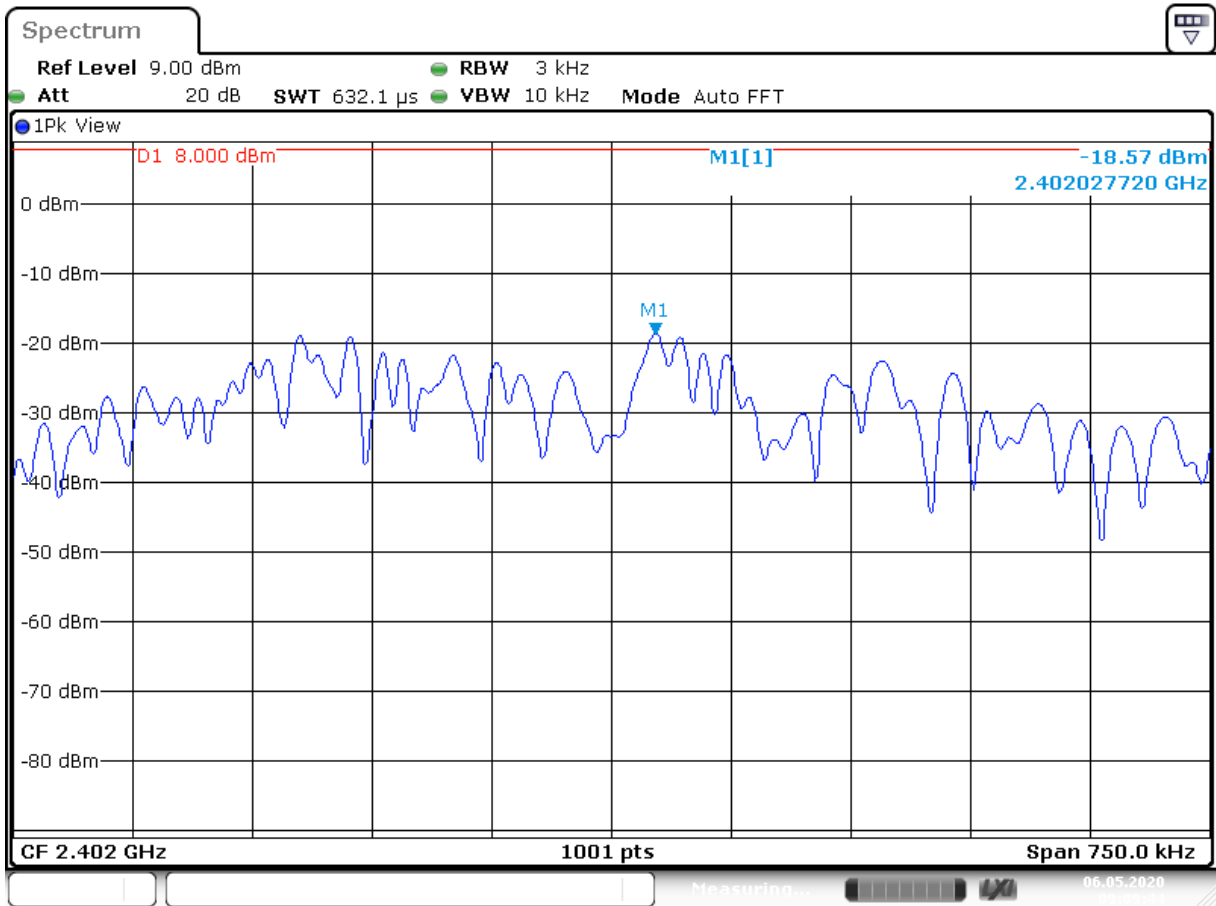
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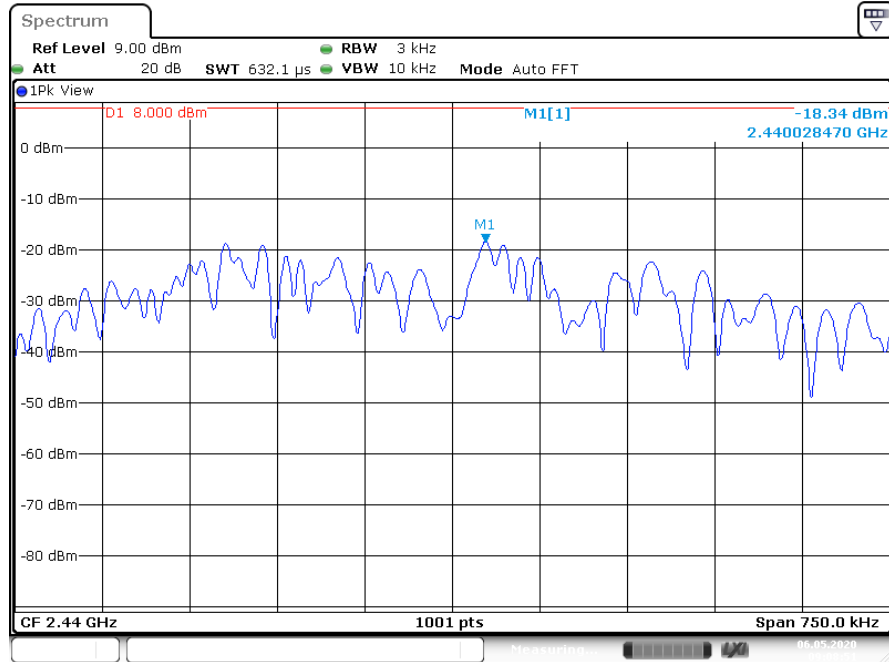
Peak Power Spectral Density

Operating Frequency [MHz]	Max PSD [dBm]	Limit [dBm]	Verdict [Pass/Fail]	Plot
2402	-18.6	8	Pass	A
2440	-18.3	8	Pass	B
2480	-18.8	8	Pass	C

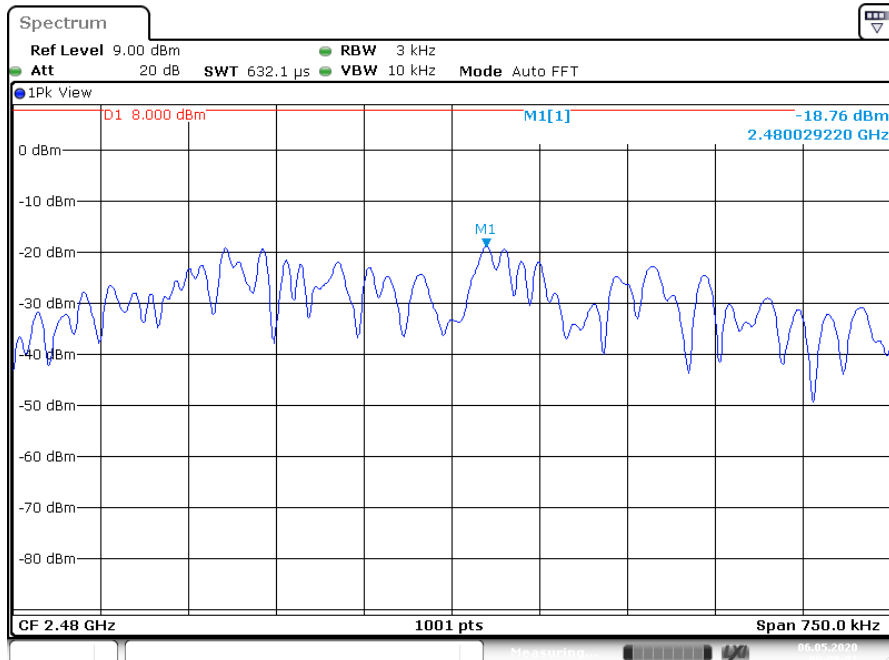


Date: 6 MAY 2020 09:09:45

Plot A



Plot B



Plot C

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4.1.4 Band Edge Conducted Emissions

RESULT: Pass

Date of testing:

2020-05-06

Requirements:

FCC 15.205, FCC 15.209, FCC 15.247(d) and RSS-247 section 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 the transmitter demonstrates compliance with the peak conducted power limits.

Test procedure:

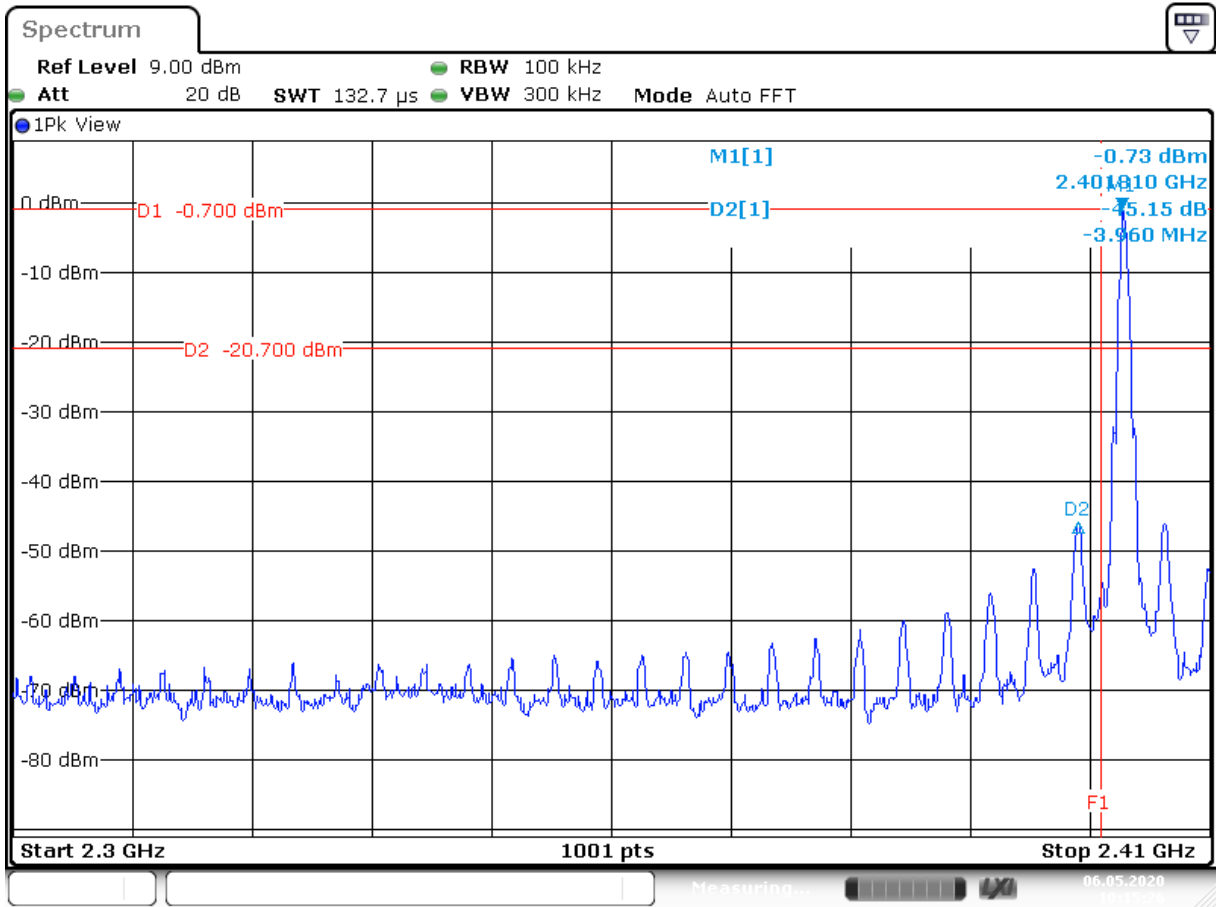
The marker-delta method, as described in ANSI C63.10 was used.

Antenna port conducted measurements were performed using a spectrum analyzer with a suitable span to encompass the peak of the fundamental and using the following settings: RBW = 100kHz, VBW = 300kHz.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Measurement uncertainty is +/- 0.7 dB.

Results: All out of band spurious emissions are more than 20 dB below the fundamental. See the figures on the following pages.

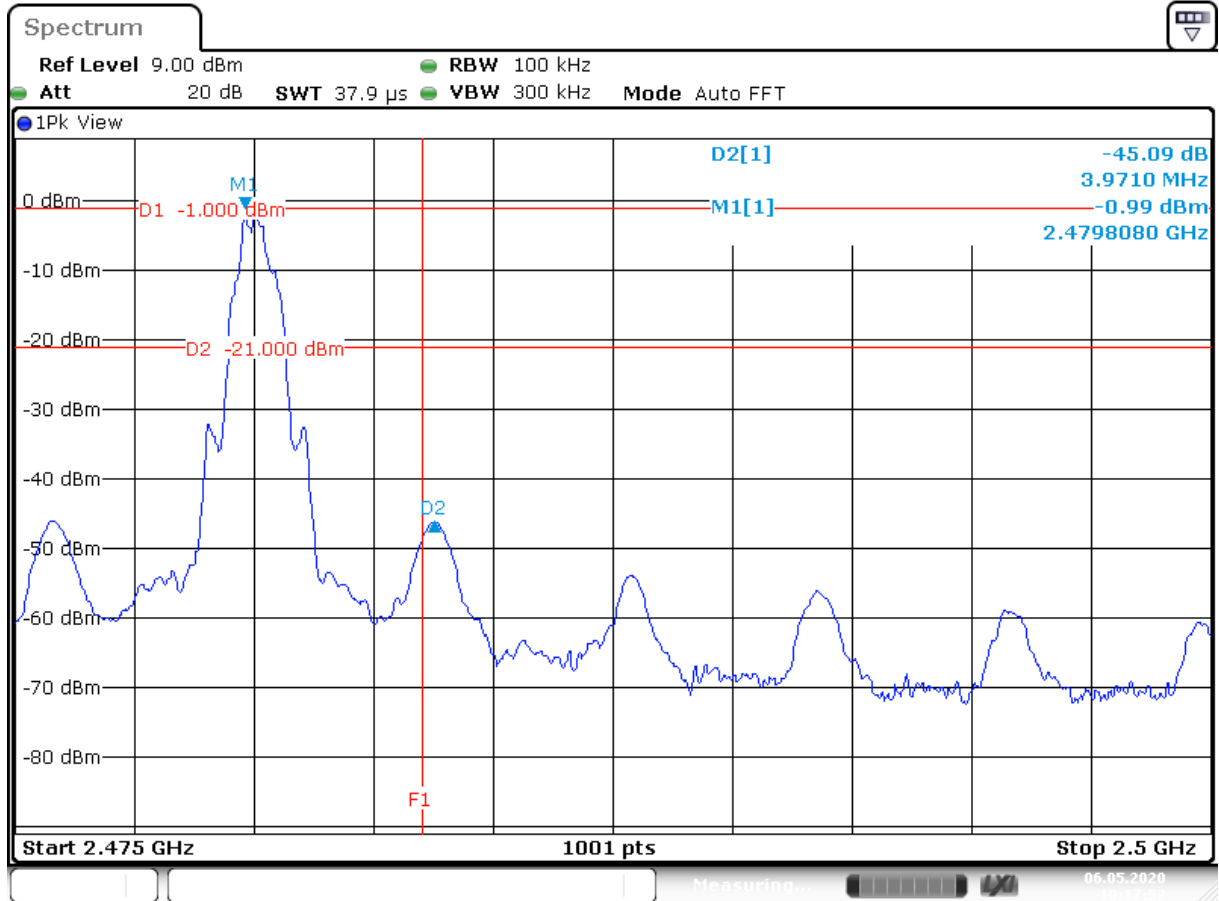


Date: 6 MAY 2020 10:15:26

Plot: Band Edge Conducted Emission, Spectral Diagram, 2402 MHz

Plot showing more than 20 dB band edge attenuation.

F1 shows the band edge frequency of 2400 MHz.



Date: 6 MAY 2020 10:17:52

Plot: Band Edge Conducted Emission, Spectral Diagram, 2480 MHz.
Plot showing more than 20 dB band edge attenuation.
F1 shows the band edge frequency of 2483.5 MHz.

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4.1.5 Radiated Spurious Emissions of Transmitter

RESULT: Pass

Date of testing: 2020-05-12 & 13

Frequency range: 30MHz - 25GHz

Requirements:

FCC 15.209 and FCC 15.247(d) and RSS-Gen

Radiated emissions which fall outside the operation frequency band and outside restricted bands shall either meet the limit specified in FCC 15.209(a) or be attenuated at least 20dB below the power level in the 100kHz bandwidth within the band that contains the highest level of the desired power (the less severe limit applies).

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) and RSS-Gen Table 6, must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen Table 4.

Test procedure:

ANSI C63.10-2013

Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 30MHz to the 10th harmonic of the highest fundamental transmitter frequency (25GHz). Final radiated emission measurements were made at 3m distance.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs. At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit. Where Peak (Pk) values were at least 6 dB under the Average (Av) limits, Av value was not tested. Where Average values were tested, Average values were measured using a reduced Video Bandwidth, with a minimum of 10 kHz.

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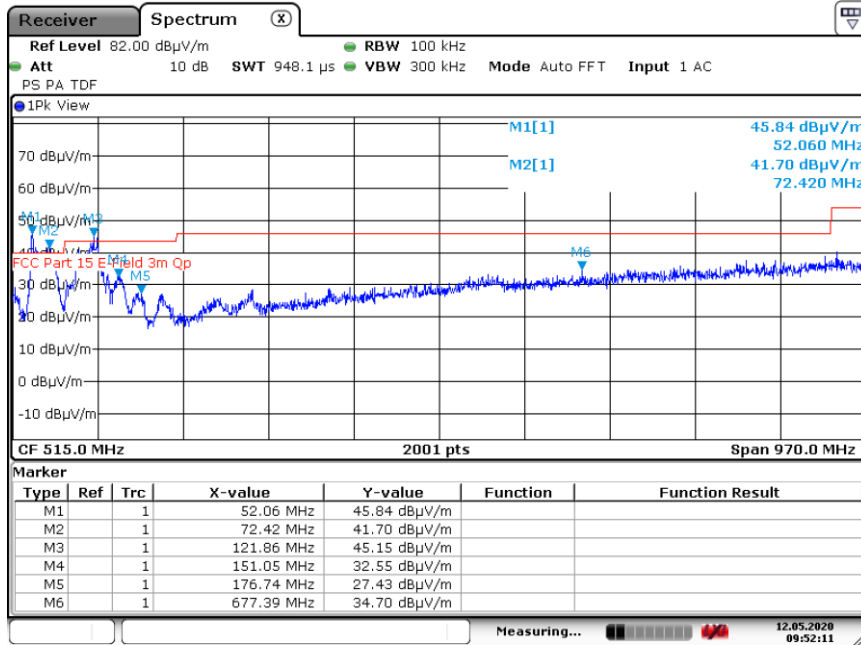
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Radiated Emissions, 30MHz - 1GHz

Frequency [MHz]	EUT Orientation	Antenna Orientation	Level QP [dBµV/m]	Limit QP [dBµV/m]	Verdict [Pass/Fail]
52.0	Vertical	Vertical	37.1	40.0	Pass
58.8	Side	Vertical	32.0	40.0	Pass
103.4	Side	Vertical	33.5	43.5	Pass
117.5	Side	Vertical	35.1	43.5	Pass
121.9	Vertical	Vertical	36.0	43.5	Pass
667.4 noise	-	Vertical	23.5	46.0	Pass

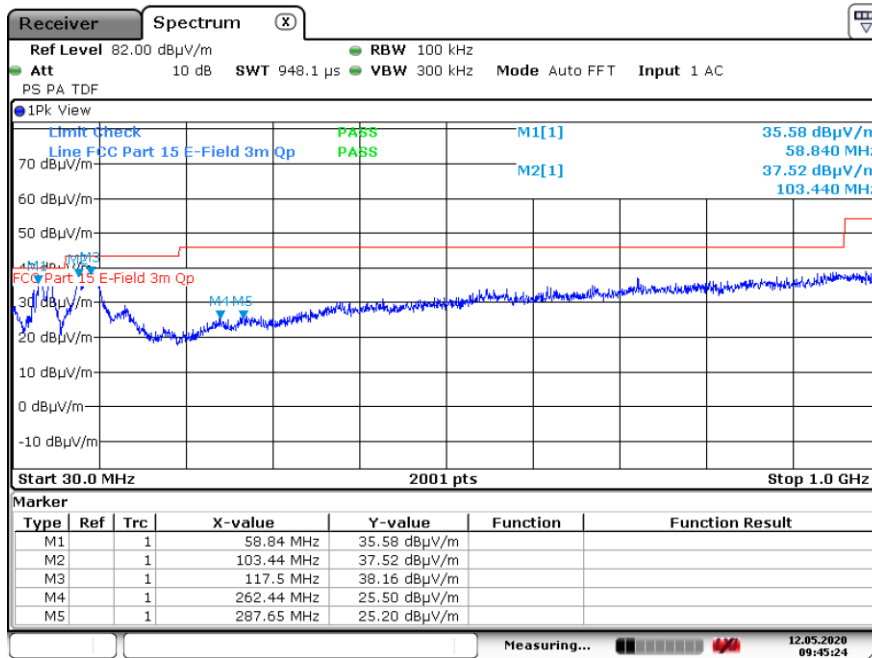
- Note:
- Level QP = Reading QP + Factor
 - Tested in modes as described in section 3.2, the 6 highest values noted.
- Preliminary measurements indicated that the radiated emissions from EUT were not affected by the EUT's operating mode or frequency.
- *^R refers to a frequency in a restricted band, *^H refers to a harmonic of the fundamental
 - Quasi Peak detector used with a bandwidth of 120 kHz..
 - Measurement uncertainty is +/- 5.0 dB.
 - a selection of plots are provided on the next pages

Plot of the emissions in the range 30 -1000 MHz



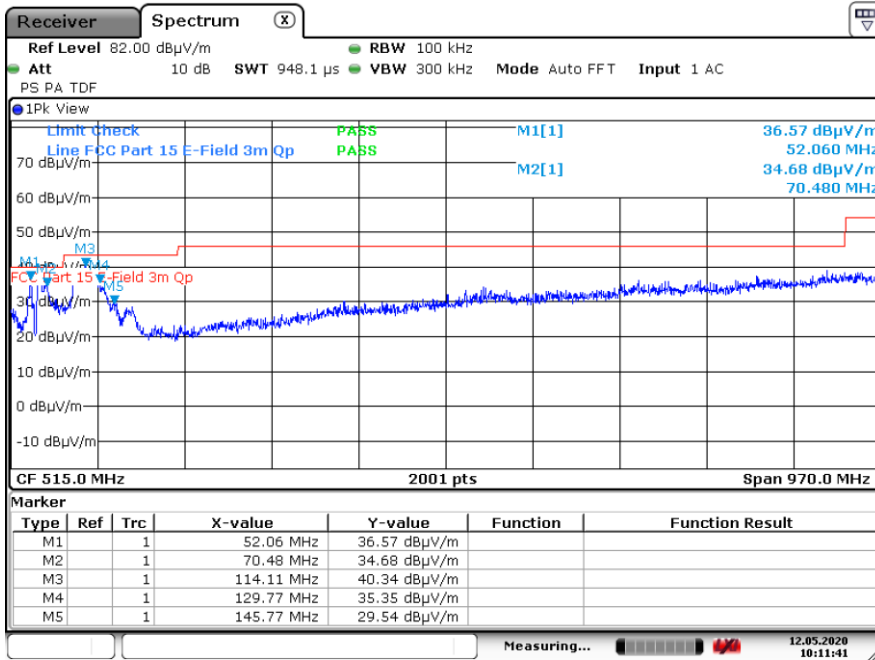
Date: 12.MAY.2020 09:52:11

Plot of the emissions in the range 30 – 1000 MHz (Peak detector values shown), EUT Vertical, Normal mode



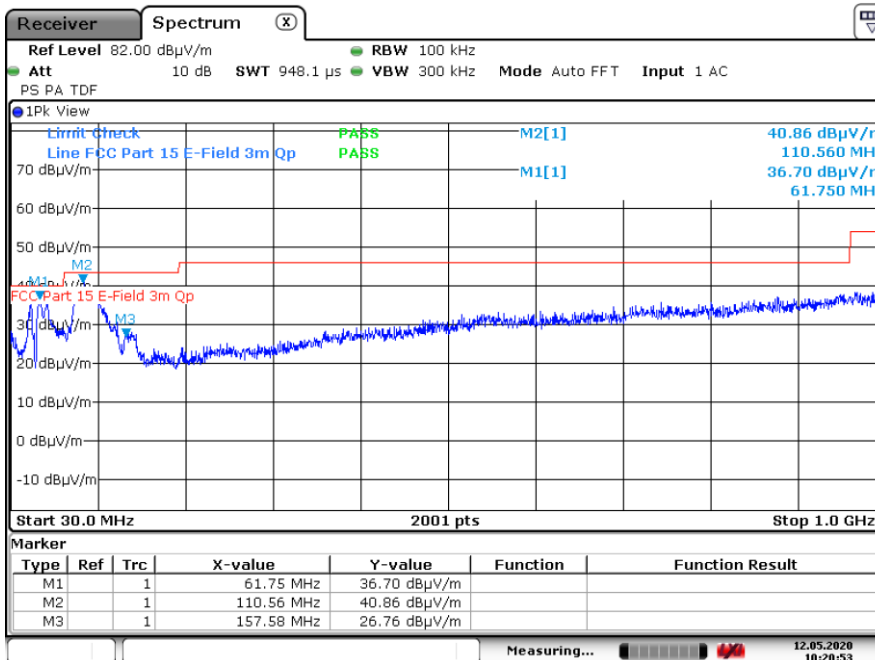
Date: 12.MAY.2020 09:45:25

Plot of the emissions in the range 30 – 1000 MHz (Peak detector values shown). EUT Sideways, Normal mode



Date: 12.MAY.2020 10:11:41

Plot of the emissions in the range 30 – 1000 MHz (Peak detector values shown), EUT Horizontal, 2402 MHz



Date: 12.MAY.2020 10:20:53

Plot of the emissions in the range 30 – 1000 MHz (Peak detector values shown). EUT Vertical, 2480 MHz

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Radiated Emissions, 1 - 25GHz, 2402 MHz.

Frequency [MHz]	EUT Orientation	Antenna Orientation	Detector	Level [dBµV/m]	Limit [dBµV/m]	Result
1198* ^R	Horizontal	Vertical	Pk	49.2	74 Pk 54 Av	Pass
1800	Horizontal	Vertical	Pk	46.5	74 Pk 54 Av	Pass
1994	Horizontal	Vertical	Pk	48.6	74 Pk 54 Av	Pass
6000	Side	Vertical	Pk	49.7	74 Pk 54 Av	Pass
7206* ^H	Side	Vertical	Pk	56.0 Pk 50.9 Av	74 Pk 54 Av	Pass
9609* ^H	Side	Vertical	Pk	55.3 Pk 50.5 Av	74 Pk 54 Av	Pass
13.57	Horizontal	Vertical	Pk	59.0 Pk 47.6 Av	74 Pk 54 Av	Pass

Radiated Emissions, 1 - 25GHz, 2440 MHz.

Frequency [MHz]	EUT Orientation	Antenna Orientation	Detector	Level [dBµV/m]	Limit [dBµV/m]	Result
1195	Horizontal	Vertical	Pk	51.5	74 Pk 54 Av	Pass
1994	Horizontal	Vertical	Pk	47.6	74 Pk 54 Av	Pass
6000	Horizontal	Vertical	Pk	51.5	74 Pk 54 Av	Pass
7321* ^{HR}	Horizontal	Vertical	Pk	55.9 Pk 50.1 Av	74 Pk 54 Av	Pass
9759* ^H	Horizontal	Vertical	Pk	53.8 Pk 48.8 Av	74 Pk 54 Av	Pass
12201* ^R	Side	Vertical	Pk	57.7 Pk 50.0 Av	74 Pk 54 Av	Pass

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Radiated Emissions, 1 - 25GHz, 2480 MHz.

Frequency [MHz]	EUT Orientation	Antenna Orientation	Detector	Level [dBµV/m]	Limit [dBµV/m]	Result
1199* ^R	Vertical	Horizontal	Pk	51.5	74 Pk 54 Av	Pass
6000	Side	Vertical	Pk	52.8	74 Pk 54 Av	Pass
7440* ^H * ^R	Side	Vertical	Pk	55.0 Pk 51.5 Av	74 Pk 54 Av	Pass
11500 -12400* ^R	Side	Vertical	Pk	56.8 Pk 52.5 Av	74 Pk 54 Av	Pass

Radiated Emissions, 1 - 25GHz, Normal Mode.

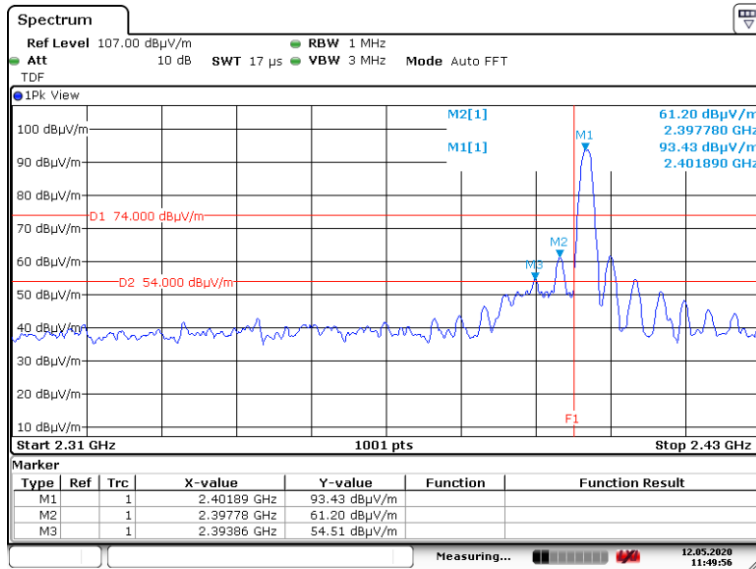
Frequency [MHz]	EUT Orientation	Antenna Orientation	Detector	Level [dBµV/m]	Limit [dBµV/m]	Result
1195* ^R	Horizontal	Vertical	Pk	51.6	74 Pk 54 Av	Pass
7859* ^H * ^R	Vertical	Horizontal	Pk	52.3	74 Pk 54 Av	Pass
9920* ^H * ^R	Vertical	Horizontal	Pk	53.5	74 Pk 54 Av	Pass
11000 -12000* ^R noise	-	Vertical	Pk	60.2 Pk 52.9 Av	74 Pk 54 Av	Pass

Emissions in restricted bands (Band Edges, radiated-worst case)

Frequency [MHz]	EUT Frequency [MHz] & Orientation	Antenna Orientation	Detector	Level [dBµV/m]	Limit [dBµV/m]	Result
2397.8	2402 Horizontal	Horizontal	Pk	61.2 Pk 42.3 Av	74 Pk 54 Av	Pass
2483.7	2480 Horizontal	Vertical	Pk	55.2 Pk 33.8 Av	74 Pk 54 Av	Pass

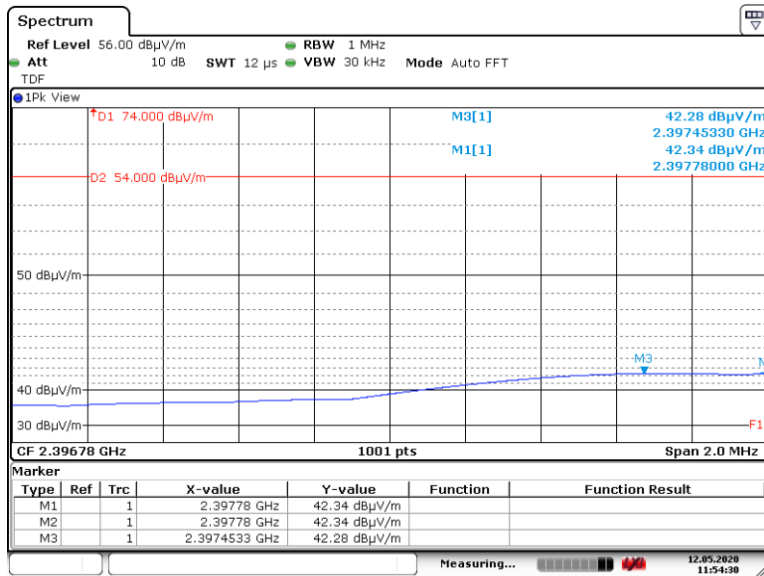
- Notes:
- *R refers to a frequency in a restricted band,
 - *H refers to a frequency which is a harmonic of the fundamental.
 - 1 MHz residual bandwidth filter setting used.
 - Field strength values of radiated emissions not listed in the tables above are more than 20 dB below the applicable limit.
 - Measurement uncertainty is +/- 5.5 dB
 - No emissions within 20dB of the applicable limit were observed above 18GHz
 - a selection of plots are provided on the next pages.

Plots of the radiated unwanted emissions 1 – 25 GHz,



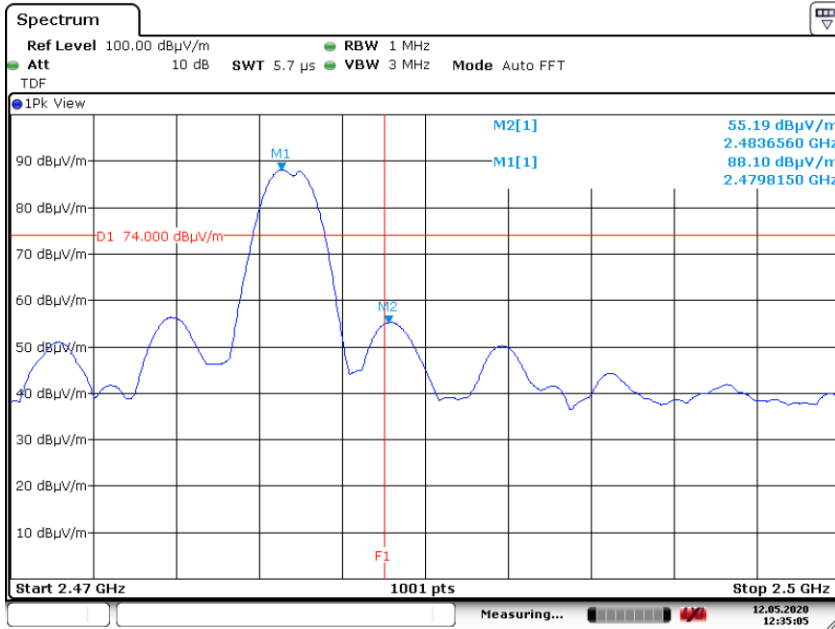
Date: 12.MAY.2020 11:49:56

Low Band Edge, Plot of the emissions in the restricted band 2.31 -2.39GHz at 2402 MHz, EUT Horizontal, Antenna Vertical polarization, Peak values shown



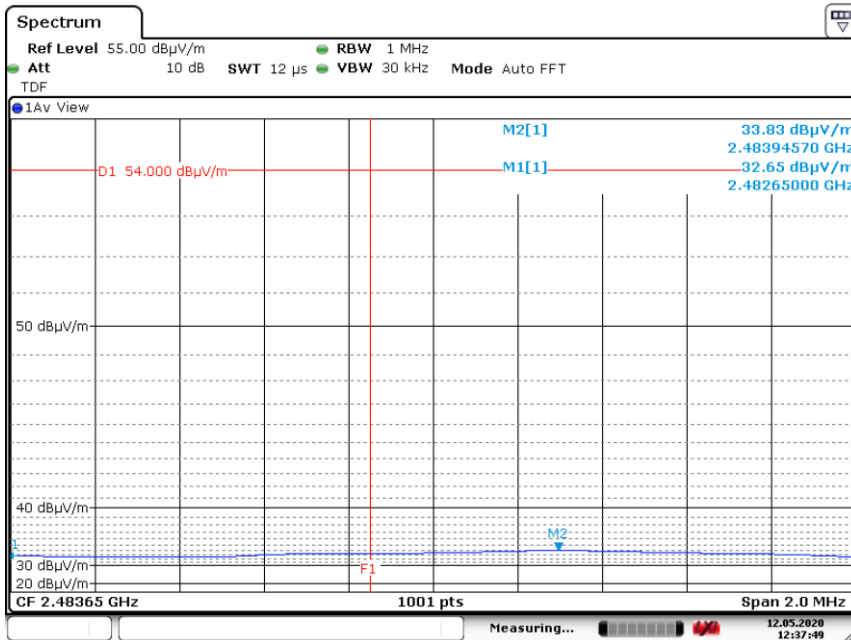
Date: 12.MAY.2020 11:54:29

Low Band Edge, Plot of the emissions in the restricted band 2.31 -2.39GHz at 2402 MHz, EUT Horizontal, Antenna Vertical polarization, Average value shown



Date: 12.MAY.2020 12:35:05

High Band Edge, Plot of the emissions in the restricted band 2.4835-2.5GHz at 2480 MHz, EUT Horizontal, Antenna Vertical polarization, Peak values shown



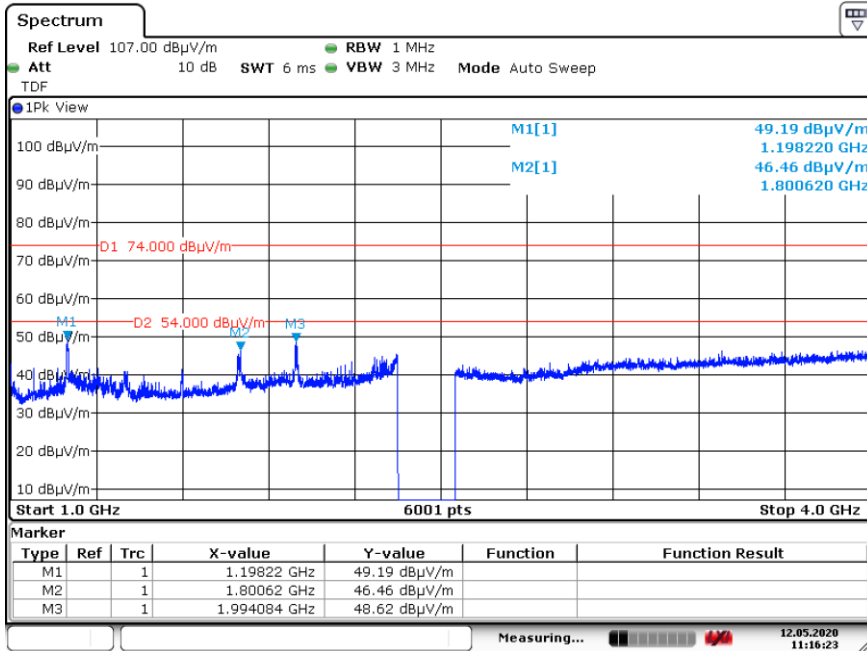
Date: 12.MAY.2020 12:37:49

High Band Edge, Plot of the emissions in the restricted band 2.4835-2.5GHz at 2480 MHz, EUT Horizontal, Antenna Vertical polarization, Average value shown

Test Report No.:

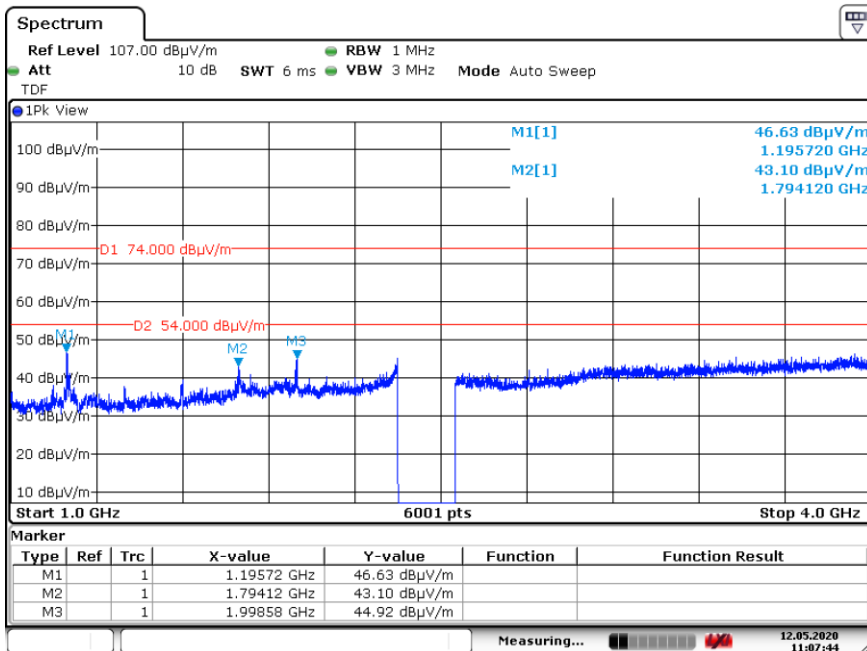
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Date: 12.MAY.2020 11:16:23

Plot Radiated unwanted emissions in the range 1 – 4 GHz in at 2402 MHz, EUT Horizontal (Peak values, Antenna Vertical position shown- gap is by the 2.4G Notch filter).



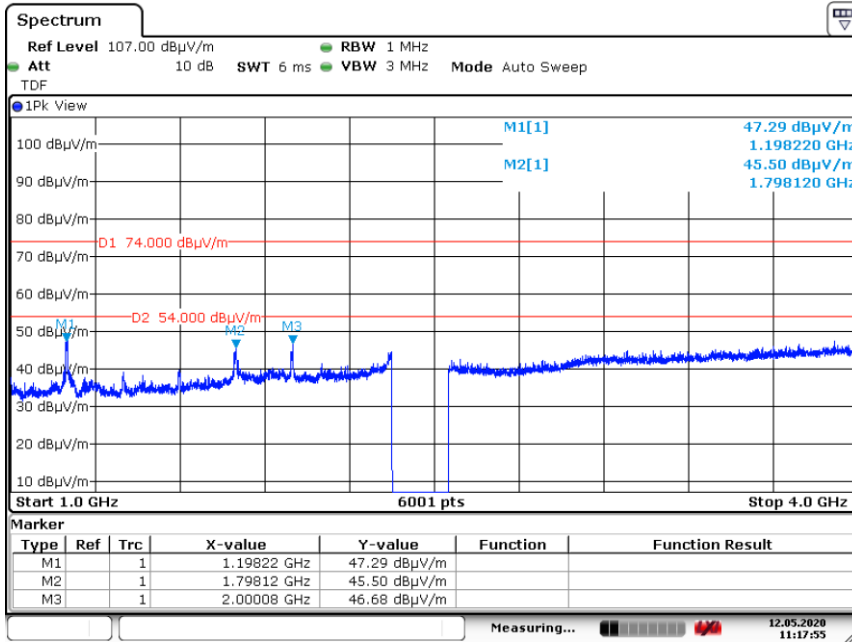
Date: 12.MAY.2020 11:07:45

Plot Radiated unwanted emissions in the range 1 – 4 GHz in at 2402 MHz, EUT Vertical (Peak values, Antenna Vertical position shown- gap is by the 2.4G Notch filter)

Test Report No.:

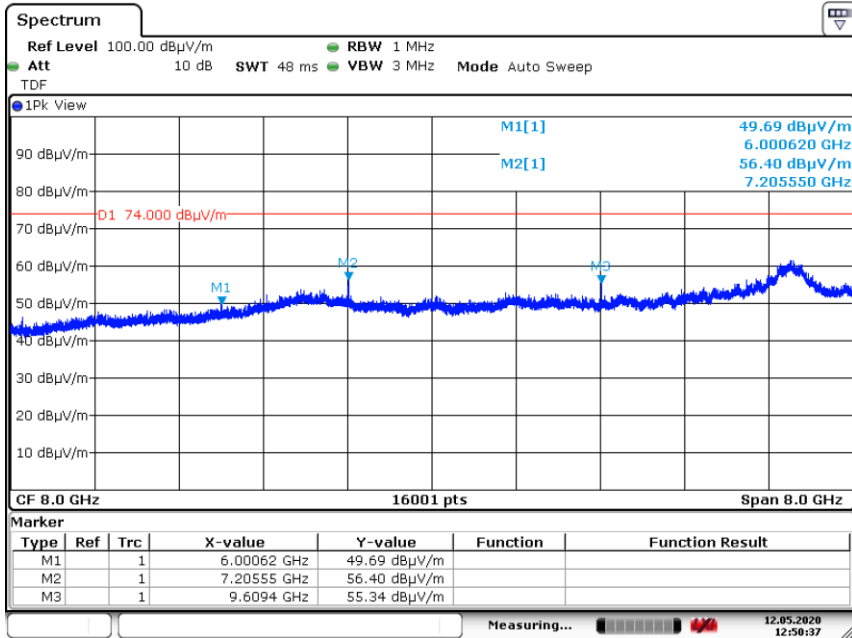
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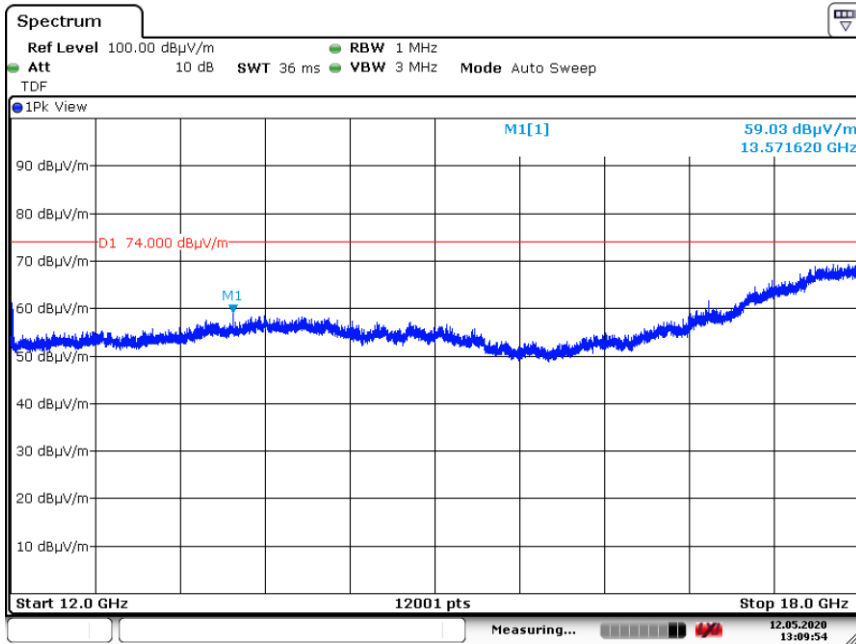
Date: 12.MAY.2020 11:17:55

Radiated unwanted emissions in the range 1 – 4 GHz at 2402 MHz
 (Peak values, EUT Sideways, Antenna vertical position shown, gap is by the 2.4G Notch filter).



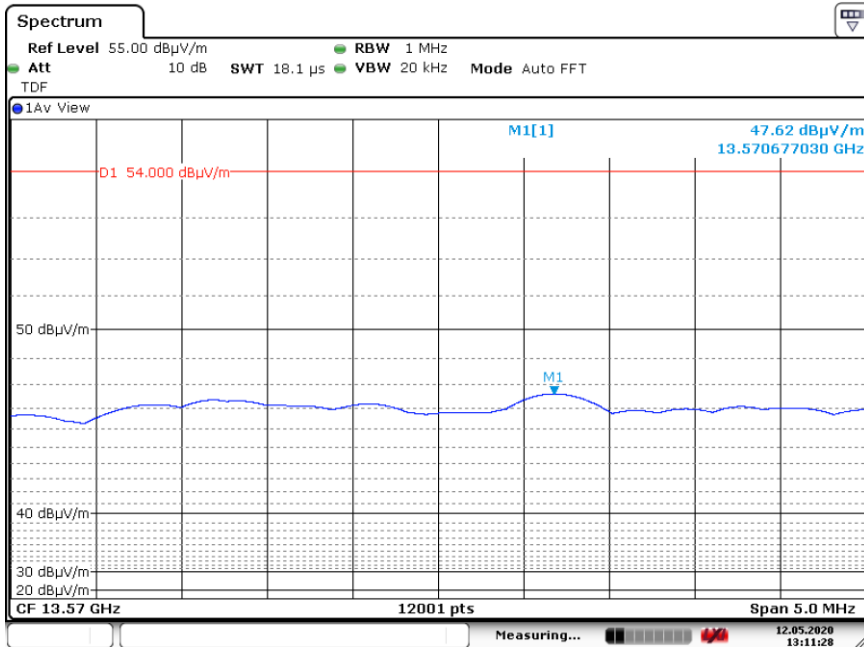
Date: 12.MAY.2020 12:50:37

Radiated unwanted emissions in the range 4 – 12 GHz at 2402 MHz
 (Peak values, EUT side ways, Antenna vertical position shown)



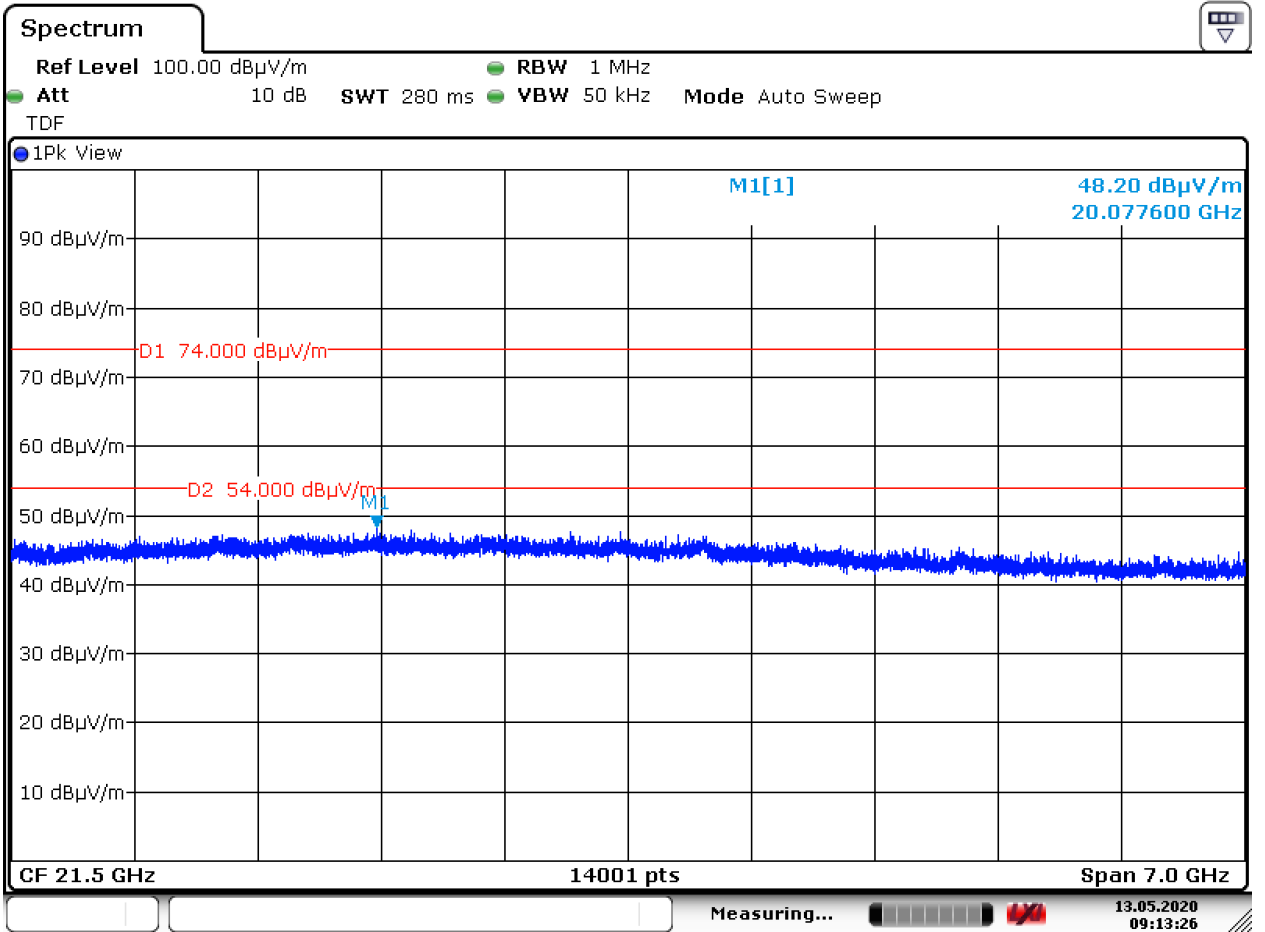
Date: 12.MAY.2020 13:09:54

Radiated unwanted emissions 12 to 18 GHz, at 2402 MHz
(Peak vales, EUT horizontal, Antenna vertical position shown)



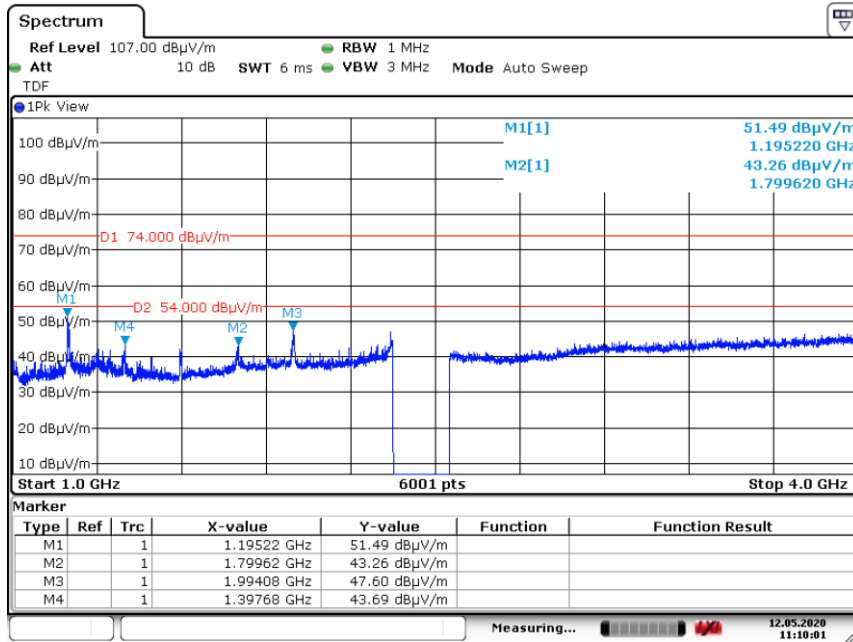
Date: 12.MAY.2020 13:11:28

Radiated unwanted emissions in the range 12 – 18 GHz at 2402 MHz
(Average value, EUT horizontal, Antenna vertical position)



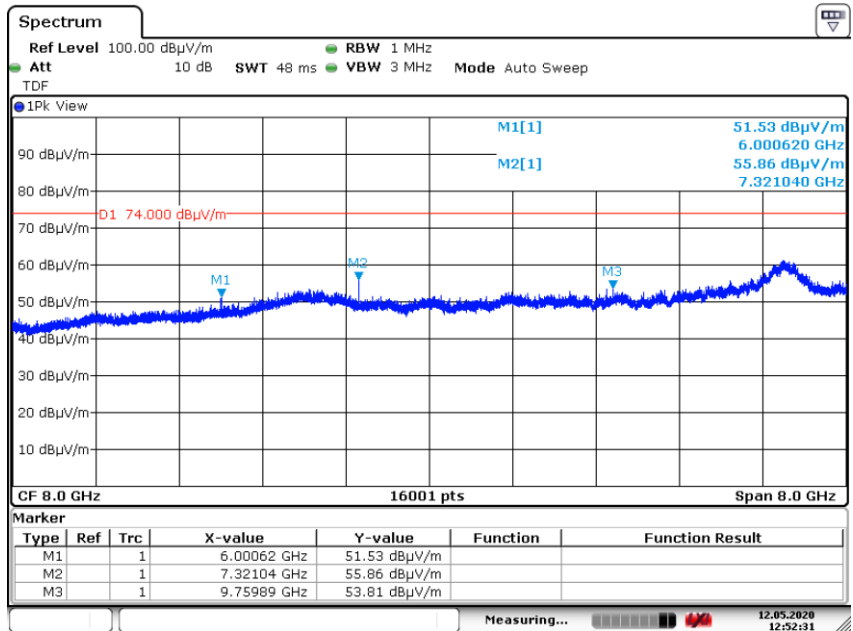
Date: 13.MAY.2020 09:13:26

Radiated unwanted emissions in the range 18 – 25 GHz at 2402 MHz
(Peak values, EUT horizontal, Antenna vertical position shown)



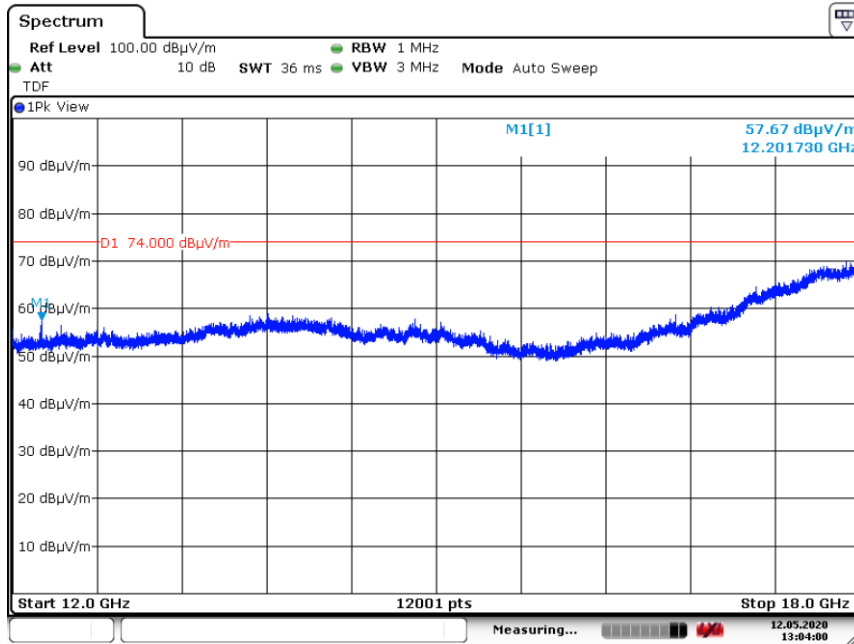
Date: 12.MAY.2020 11:10:01

Radiated unwanted emissions in the range 1 – 4 GHz at 2440 MHz
 (Peak values, EUT horizontal, Antenna vertical position shown, gap is by the 2.4G Notch filter)



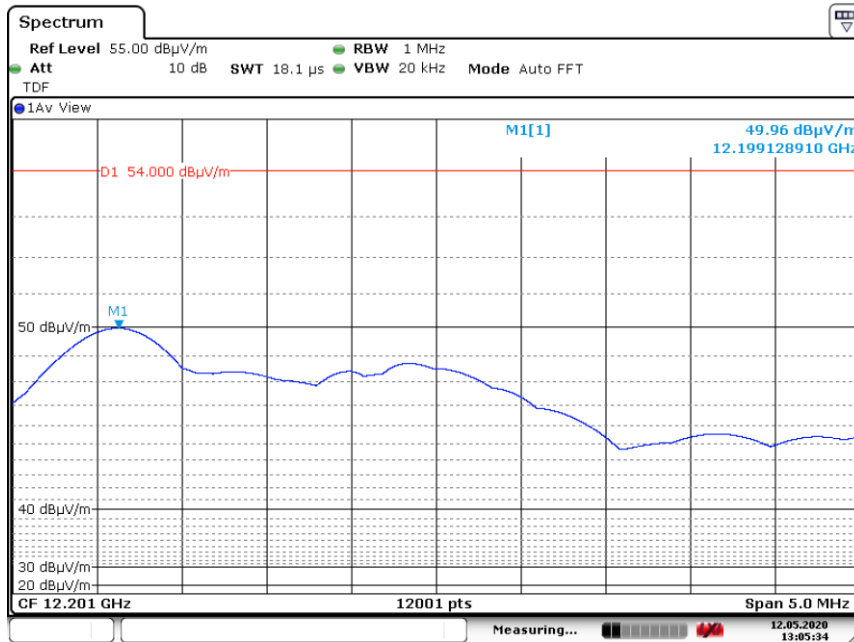
Date: 12.MAY.2020 12:52:31

Radiated unwanted emissions in the range 4 – 12 GHz at 2440 MHz
 (Peak values, EUT side ways, Antenna vertical position shown)



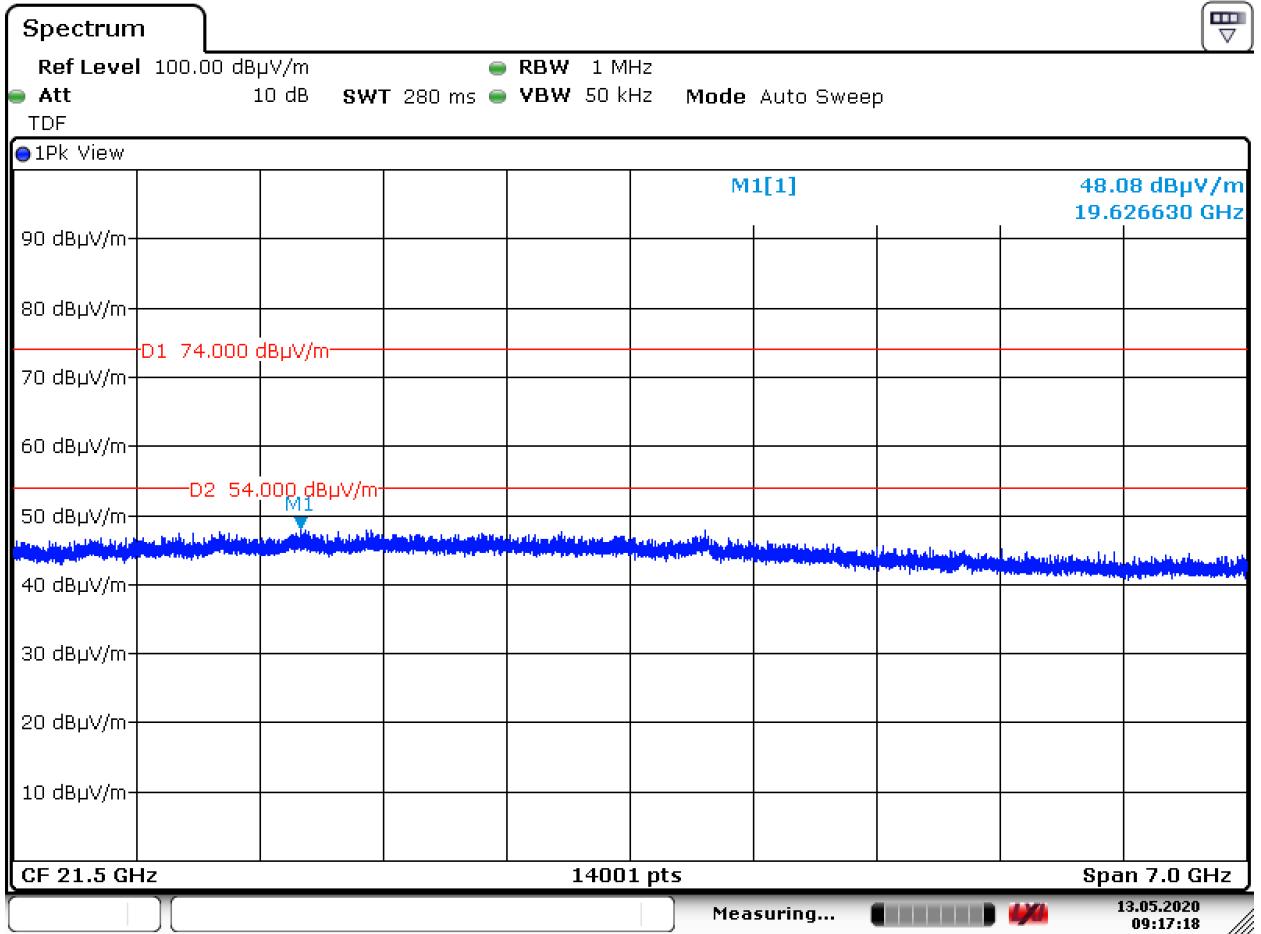
Date: 12.MAY.2020 13:04:00

Radiated unwanted emissions in the range 12 – 18 GHz at 2440 MHz
(Peak values, EUT Side, Antenna vertical position shown)



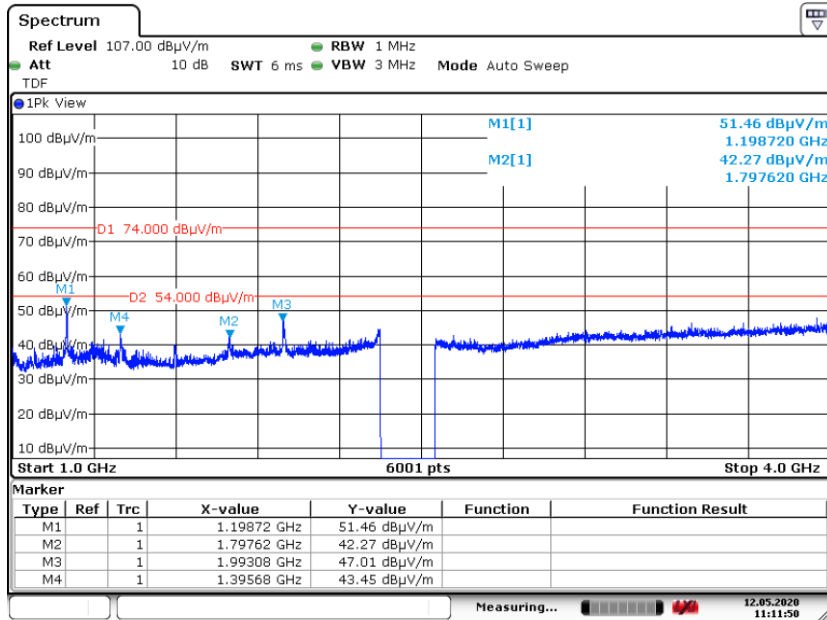
Date: 12.MAY.2020 13:05:34

Radiated unwanted emissions in the range 12 – 18 GHz at 2440 MHz
(Average values, EUT Side, Antenna vertical position shown)



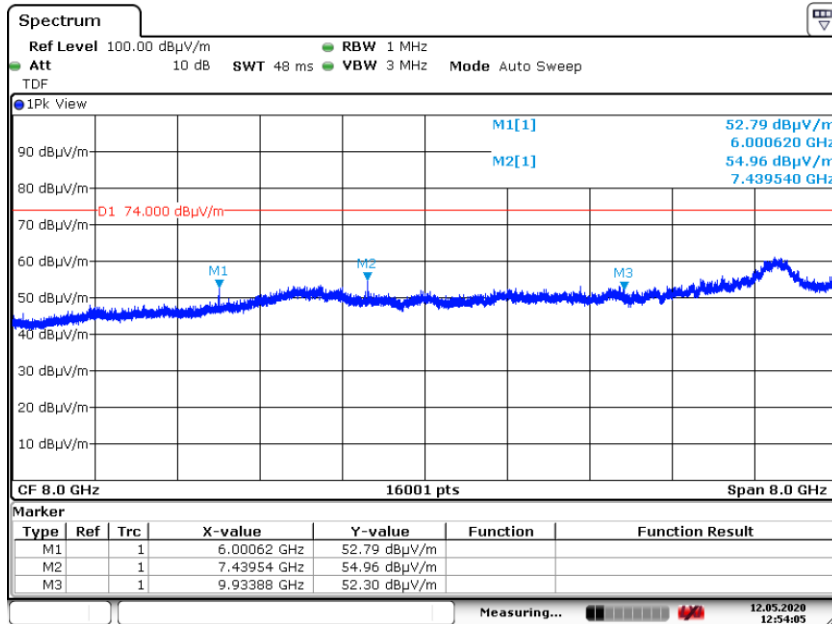
Date: 13.MAY.2020 09:17:18

Radiated unwanted emissions in the range 18 – 25 GHz at 2440 MHz
(Peak values, EUT horizontal ways, Antenna vertical position shown)



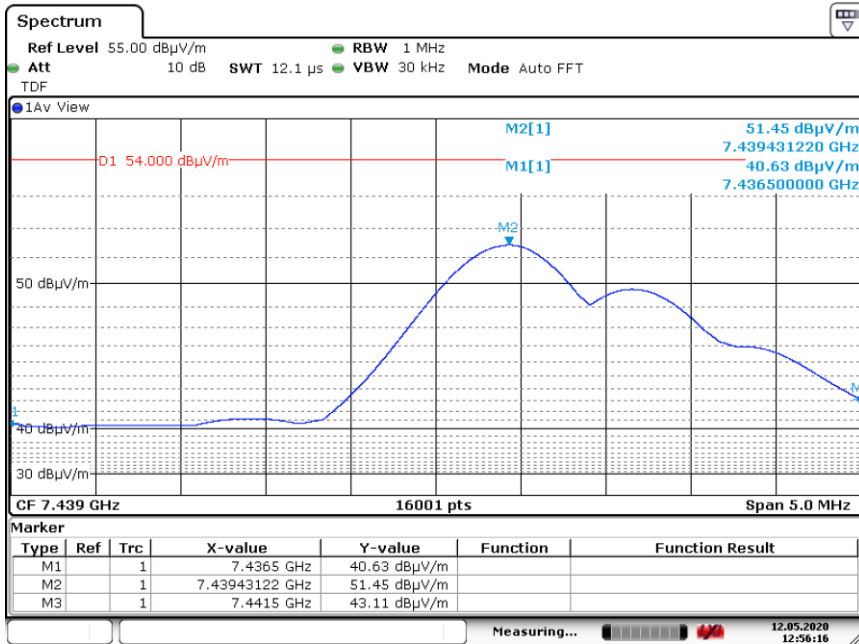
Date: 12.MAY.2020 11:11:50

Radiated unwanted emissions in the range 1 – 4 GHz at 2480 MHz
 (Peak values, EUT Vertical, Antenna horizontal position shown, gap is by the 2.4G Notch filter)

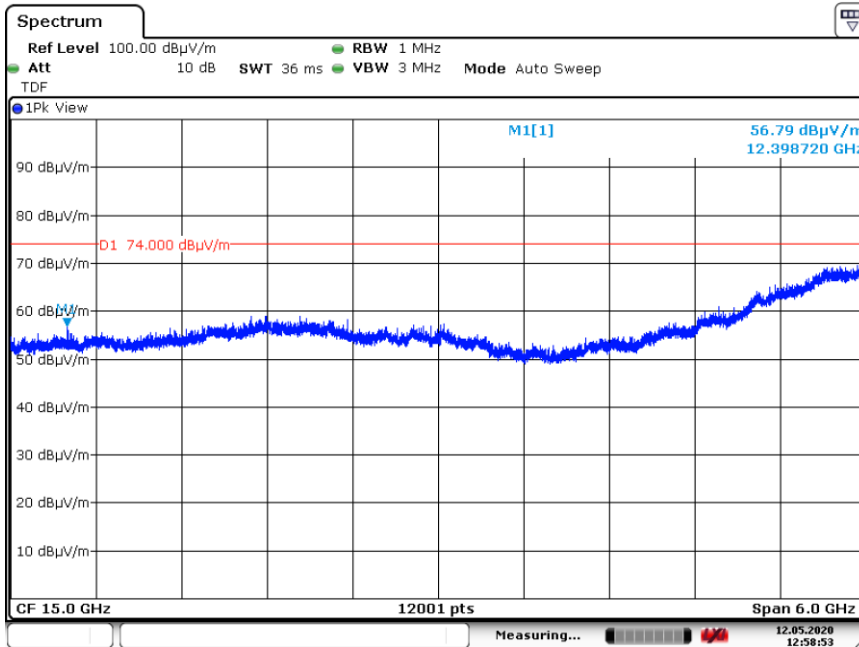


Date: 12.MAY.2020 12:54:05

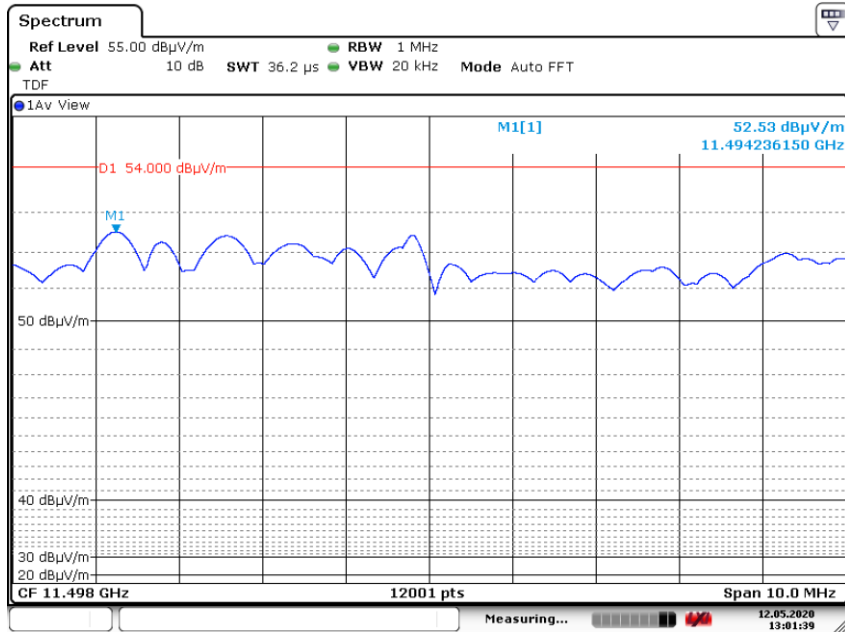
Radiated unwanted emissions in the range 4 – 12 GHz at 2480 MHz
 (Peak values, EUT Sideways, Antenna vertical position shown)



Radiated unwanted emissions at 7.4 GHz, harmonic of 2480 MHz
 (Average value, EUT Side ways, Antenna vertical position shown)

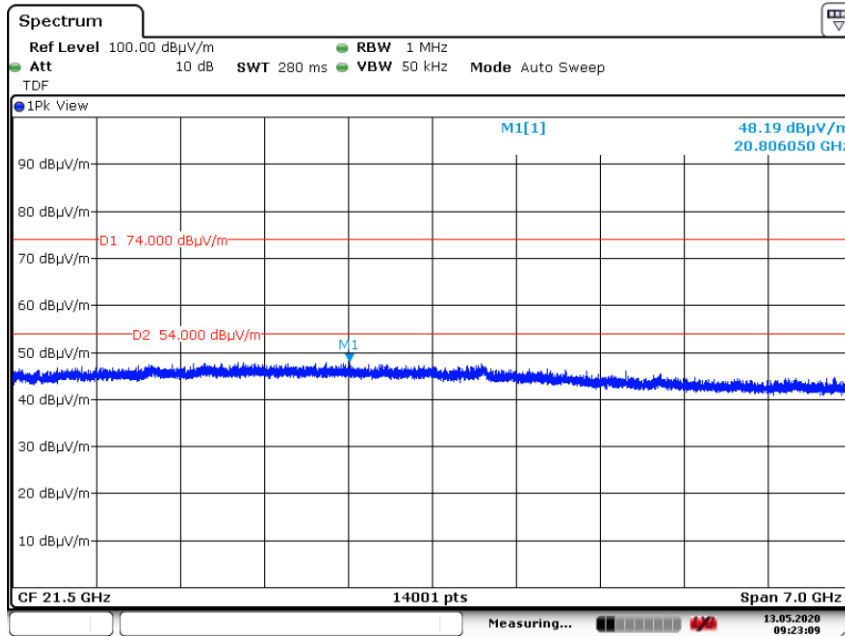


Radiated unwanted emissions in the range 12 – 18 GHz at 2480 MHz
 (Peak values reduced VBW, EUT Side ways, Antenna vertical position shown)



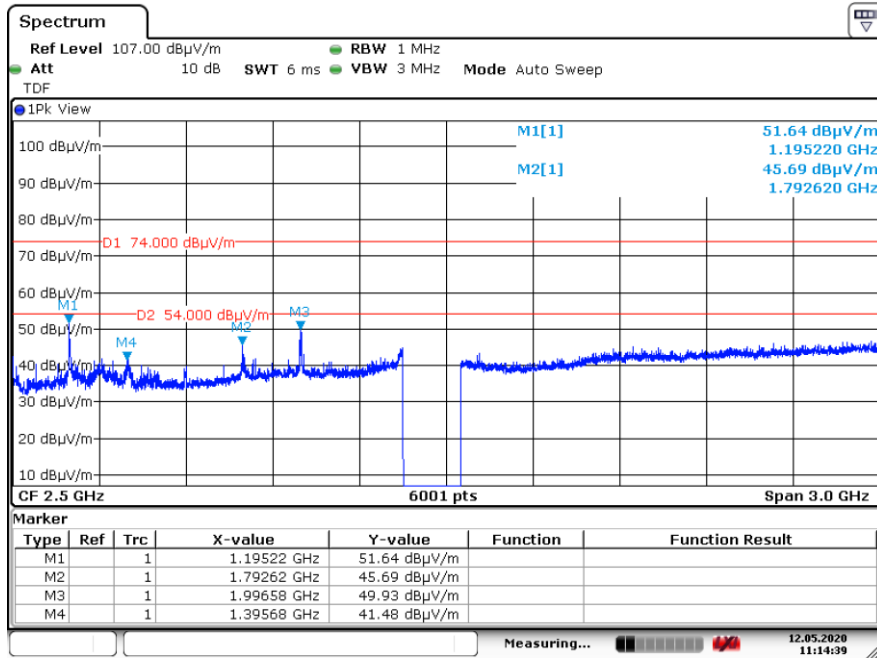
Date: 12.MAY.2020 13:01:39

Radiated unwanted emissions at 11.5 GHz @ 2480 MHz
(Average value, EUT vertical, Antenna vertical position shown)



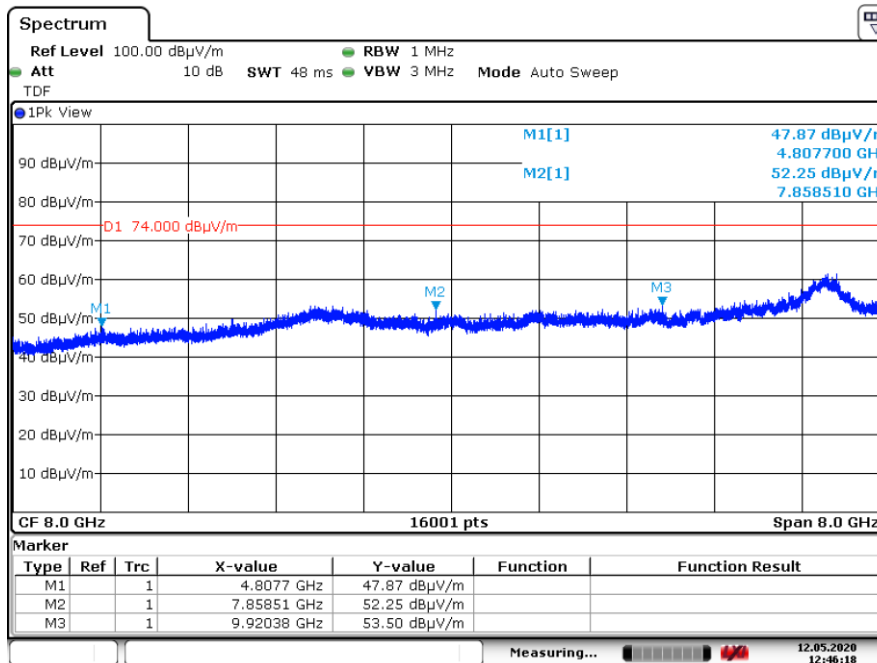
Date: 13.MAY.2020 09:23:09

Radiated unwanted emissions in the range 18 – 25 GHz at 2480 MHz
(Peak values, reduced VBW, EUT horizontal, Antenna Vertical position shown)



Date: 12.MAY.2020 11:14:39

Radiated unwanted emissions in the range 1 – 4 GHz , Normal Mode
 (Peak values, EUT horizontal, Antenna vertical position shown, gap is by the 2.4G Notch filter)



Date: 12.MAY.2020 12:46:18

Radiated unwanted emissions in the range 4 – 12 GHz Normal mode
 (Peak values, EUT Vertical, Antenna horizontal position shown)

4.2 AC Power Line Conducted Measurements

RESULT: Pass.

Date of testing: 2019-12-09
Tested by: Willem Brouwer

Requirements: for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that 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 the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency of Emission (MHz)	Conducted Limit (dB μ V) Quasi-Peak	Conducted Limit (dB μ V) Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 - 30	46	50

*Decreases with the logarithm of the frequency.

Test procedure:
ANSI C63.10-2013.

Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a 50 μ H / 50 Ω LISN. The frequency range from 150kHz to 30MHz was searched. The six highest EUT emissions relative to the limit were noted. The EUT was positioned at least 80cm from the LISN. The power cable was routed over the non-conductive plate to the LISN.

4.2.1 AC Power Line Conducted Emission of Transmitter

Results and limits L1						
Frequency (MHz)	Quasi peak detector			Average detector		
	Result	Limit	Margin	Result	Limit	Margin
0.16	61.3	65.5	4.1	40.0	55.5	15.5
0.17	62.2	65.0	2.7	45.5	55.0	9.5
0.19	58.0	64.0	6.1	39.9	54.0	14.1
0.20	58.3	63.6	5.3	38.4	53.6	15.3
0.25	47.9	61.8	13.8	30.0	51.8	21.7
3.13	48.4	56.0	7.6	36.4	46.0	9.6
9.96	39.6	60.0	20.4	32.2	50.0	17.8

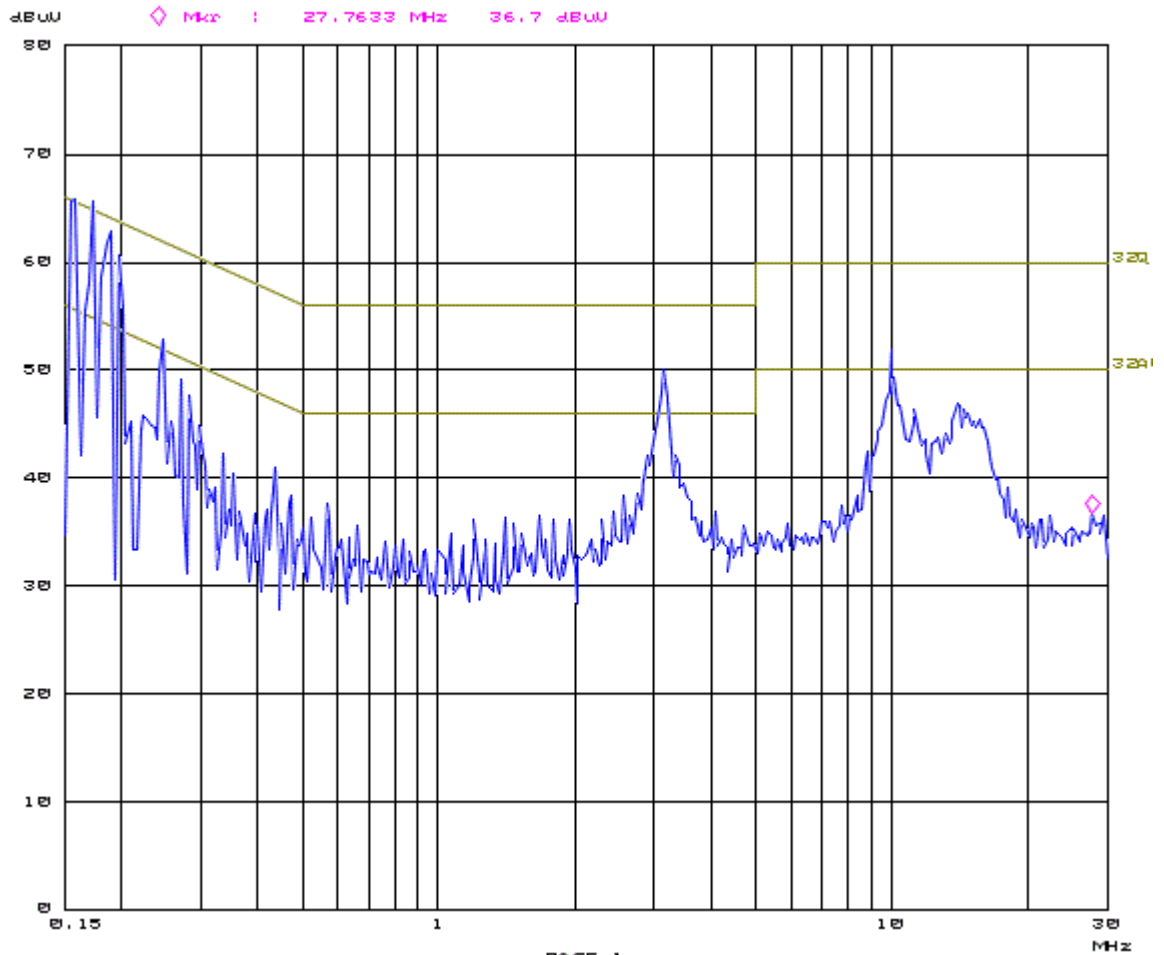
Results and limits L2						
Frequency (MHz)	Quasi peak detector			Average detector		
	Result	Limit	Margin	Result	Limit	Margin
0.16	61.8	65.5	3.7	40.3	55.5	15.1
0.17	62.7	65.0	2.2	45.8	55.0	9.2
0.19	58.6	64.0	5.5	40.4	54.0	13.7
0.20	59.0	63.6	4.6	38.9	53.6	14.7
0.25	48.9	61.8	12.8	30.8	51.8	20.9
3.13	48.6	56.0	7.4	36.3	46.0	9.7
9.96	44.8	60.0	15.2	36.4	50.0	13.6

The results of the AC power line conducted emission tests, carried out in accordance with 47 CFR Part 15 section 15.207(a) and RSS-Gen section 8.8, at the 120 Volts/ 60 Hz AC mains connection terminals of the EUT, are depicted in the table above.

Notes:

1. The resolution bandwidth used was 9 kHz.
2. From pre-test the worst case configuration proved to be the normal operation mode
 Worst case values noted.
3. Measurement uncertainty is +/- 3.5 dB.
4. Plots are provided on the next pages.

Plots of the AC Power-line Conducted Emissions



Pre-scan plot with peak detector of the AC Power-line Conducted emissions

End of report