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Test Report No.:	**16071303.fcc01**	*Page 1 of 32*

Client:	**CowManager B.V.** PO Box 46, 3480DA Harmelen, Netherlands		
Test Item:	**Digital Transmission System (DTS)** **ZigBee**		
Identification:	**WIB910**	*Serial Number:*	**00 01EF**
Project No.:	**16071303**	*Date of Receipt:*	**December 13, 2016**
Testing Location:	**TÜV Rheinland Nederland B.V.** Eiberkamp 10 9351VT Leek		
Test Specification:	FCC 47 CFR Part 15, Subpart C, Section 15.247 (10-1-15 Edition) RSS-Gen (Issue 4, November 2014) and RSS-247 (Issue 2, February 2017) ANSI C63.10-2013		

Test Result:	*The test item **passed** the test specification(s).*
Testing Laboratory:	**TÜV Rheinland Nederland B.V.** Eiberkamp 10 9351 VT Leek

Tested by:			*Reviewed by:*		
2017-05-04	R. van der Meer / Inspector		2017-05-04	E. van der Wal / Reviewer	
Date	*Name/Position*	*Signature*	*Date*	*Name/Position*	*Signature*

Other Aspects:-.

Abbreviations:	***P(ass)***	***=***	***passed***
	F(ail)	***=***	***failed***
	N/A	***=***	***not applicable***
	N/T	***=***	***not tested***

TEST SUMMARY

5.1.1 CONDUCTED MEASUREMENTS AT ANTENNA PORT
RESULT: PASS

5.1.2 6DB BANDWIDTH
RESULT: PASS

5.1.3 PEAK POWER SPECTRAL DENSITY
RESULT: PASS

5.1.4 BAND EDGE CONDUCTED EMISSIONS
RESULT: Pass

5.1.5 RADIATED SPURIOUS EMISSIONS OF TRANSMITTER
RESULT: PASS

5.2.1 AC POWER LINE CONDUCTED EMISSION OF TRANSMITTER
RESULT: Pass

Contents

1 General Remarks

1.1 Complementary Materials

There is no attachment to this test report.

2. Test Sites

2.1 Test Facilities

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 registration number 90828. 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 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 (*) : +19°C to +25°C
Relative humidity(*) : 20 % to 75 %
Supply voltage : 5Vdc.

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	A00446	04/2016	04/2017
Spectrum Analyzer	Rohde & Schwarz	FSV	A01744	07/2016	07/2017
RF Cable	Huber + Suhner	Sucoflex 102	A00344	05/2016	05/2017
For Radiated Emissions					
Measurement Receiver	Rohde & Schwarz	ESCI	A00314	03/2016	03/2017
RF Cable S-AR	Gigalink	APG0500	A00447	01/2016	01/2017
Controller	Maturo	SCU/088/ 8090811	A00450	N/A	N/A
Controller	EMCS	DOC202	A00257	N/A	N/A
Test facility	Comtest	FCC listed: 90828 IC: 2932G-2	A00235	04/2014	04/2017
Spectrum Analyzer	Rohde & Schwarz	FSV	A00337	06/2016	06/2017
Antenna mast	EMCS	AP-4702C	A00258	N/A	N/A
Amplifier for A00209	EMCS	--	A00378	N/A	N/A
Temperature-Humiditymeter	Extech	SD500	A00444	04/2016	04/2017
Guidehorn 1-18 GHz	EMCO	3115	A00009	04/2016	04/2017
Guidehorn 18-26.5 GHz	EMCO	3160-09	A00209	04/2016	04/2017
Biconilog Testantenna	Teseq	CBL 6111D	A00466	06/2016	06/2017
2.4 GHz bandreject filter	BSC	XN-1783	A00065	N/A	N/A
Bandpass filter 4-10 GHz	Reactel	7AS-7G-6G-511	A00131	N/A	N/A
Bandpass filter 10-26 GHz	Reactel	9HS-10G/26.5G-S11	A00151	N/A	N/A
Preamplifier 0.5 - 18 GHz	Miteq	AMF-5D-005180-28-13p	A00247	N/A	N/A
Filterbox	EMCS	RFS06S	A00255	02/2016	02/2017

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	A00051	02/2016	02/2017
Variac	RFT	LSS020	A00171	NA	NA
LISN	EMCO	3625/2	A00022	01/2016	01/2018
Measurement Receiver	Rohde & Schwarz	ESCS30	A00726	10/2016	10/2017
Shielded room for Conducted emissions	--	--	A00437	NA	NA
Temperature-Humiditymeter	Extech	SD500	A00444/	04/2016	04/2017

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

2.3 Measurement Uncertainty

Table 2: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Antenna Port Conducted Emission	< 6GHz	±2.5dB
	> 6GHz	±2.7 to ± 4.2
Radiated Emission		
	30MHz - 1GHz	±5.22dB
	> 1GHz	±5.22dB
AC Power Line Conducted Emissions	150kHz - 30MHz	±3.5dB

3. General Product Information

3.1 Product Function and Intended Use

The brand CowManager B.V. model WIB910, hereafter referred to as EUT, is a ZigBee transceiver used to transmit data within a ZigBee network consisting of a SensOor, Router and Coordinator. ZigBee uses Offset Quadrature Phase-shift Keying (OQPSK) and Direct Sequence Spread Spectrum (DSSS) for modulating radio-signals in physical layer based on 802.15.4 protocols

The 802.15.4 (ZigBee) channel allocation consists of 16 channels numbered 11 to 26, starting at 2.405GHz (CH11) and ending at 2.480GHz (CH26), but will only be used on 2405MHz (CH11). Bandwidth is 2MHz per channel.

The EUT is a Zigbee module fitted with a reversed SMA connector for connection to an external antenna. All radiated testing was performed using the supplied antenna, the conducted tests were performed on the reversed SMA connector.

The content of this report and measurement results have not been changed other than the way of presenting the data.

3.2 System Details

Details and an overview of the system and all of its components, as it has been tested, may be found below.

EUT	:	Digital Transmission System (DTS)
Manufacturer	:	CowManager B.V.
Brand	:	CowManager
Model(s)	:	WIB910
Serial Number	:	00 01EF
Firmware version	:	5.25
Voltage input rating	:	-
Voltage output rating	:	5Vdc
Current input rating	:	--
Antenna	:	External
Antenna Gain	:	+ 5.0 dBi
Operating frequency	:	2405 MHz
Modulation	:	OQPSK
Data-rate	:	250 kbps
Remarks	:	n.a.

Table 3: Interfaces present on the EUT

There are no interface ports present on the EUT.

3.3 Countermeasures to achieve compliance

No additional measures were employed to achieve compliance.

4. Test Set-up and Operation Modes

4.1 Test Methodology

The test methodology used is based on the requirements of RSS-GEN, RSS-247, 47 CFR Part 15, Sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209, 15.247.

The test methods, which have been used, are based on ANSI C63.10-2013**.**

4.2 Operation Modes

Testing was performed at operating frequency (2405 MHz),the only available frequency in the EUT. These operation modes were selected after review of the capabilities and characteristics of the EUT. The test mode was pre-defined by the applicant..

The EUT has been tested in the modes as described in table below

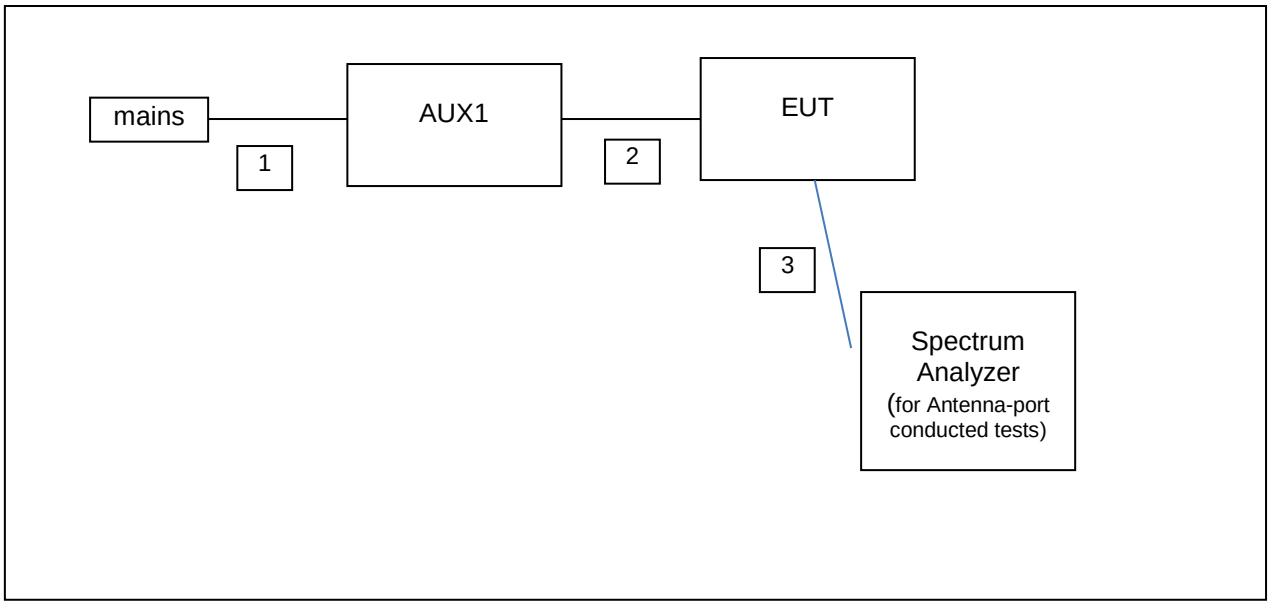
Operation Mode	EUT Status	Frequency (MHz)	TX power control setting
Continues Transmit (Tx)	On	2405 (Ch 11)	0x10

4.3 Physical Configuration for Testing

The EUT was pre-configured to continuously transmit at a specified output power and channel as specified in the test data. See section 4.5 for Auxiliary details.

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.



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

4.4 Test Software

No test software was used. The EUT was pre-configured by the applicant.

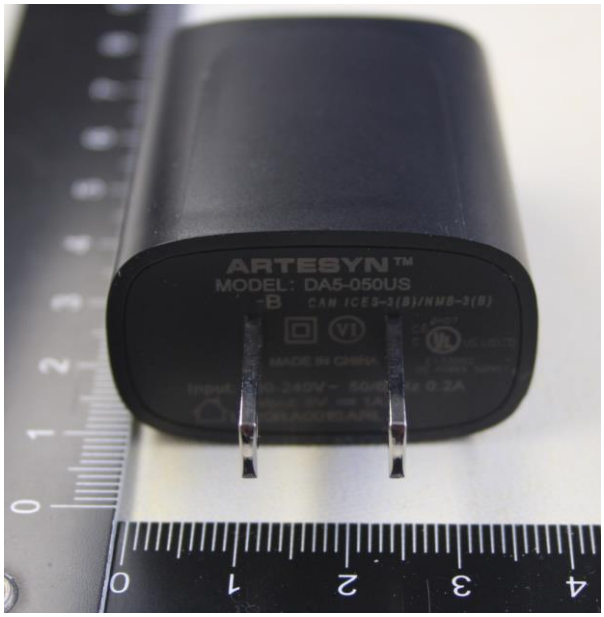
4.5 Special Accessories and Auxiliary Equipment

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

The auxiliary items were not used during testing, but instead are only used to make the required settings for testing. For setting the transmit frequency, enable modulation etc.

1. AUX1

Product:	Power supply
Brand:	ARTESYN
Model:	DA5-050US
Output voltage:	5Vdc
Remark:	-



5. Test Results

5.1 Conducted Measurements at Antenna Port

5.1.1 Conducted Output Power

RESULT: PASS

Date of testing: 2017-01-12

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.

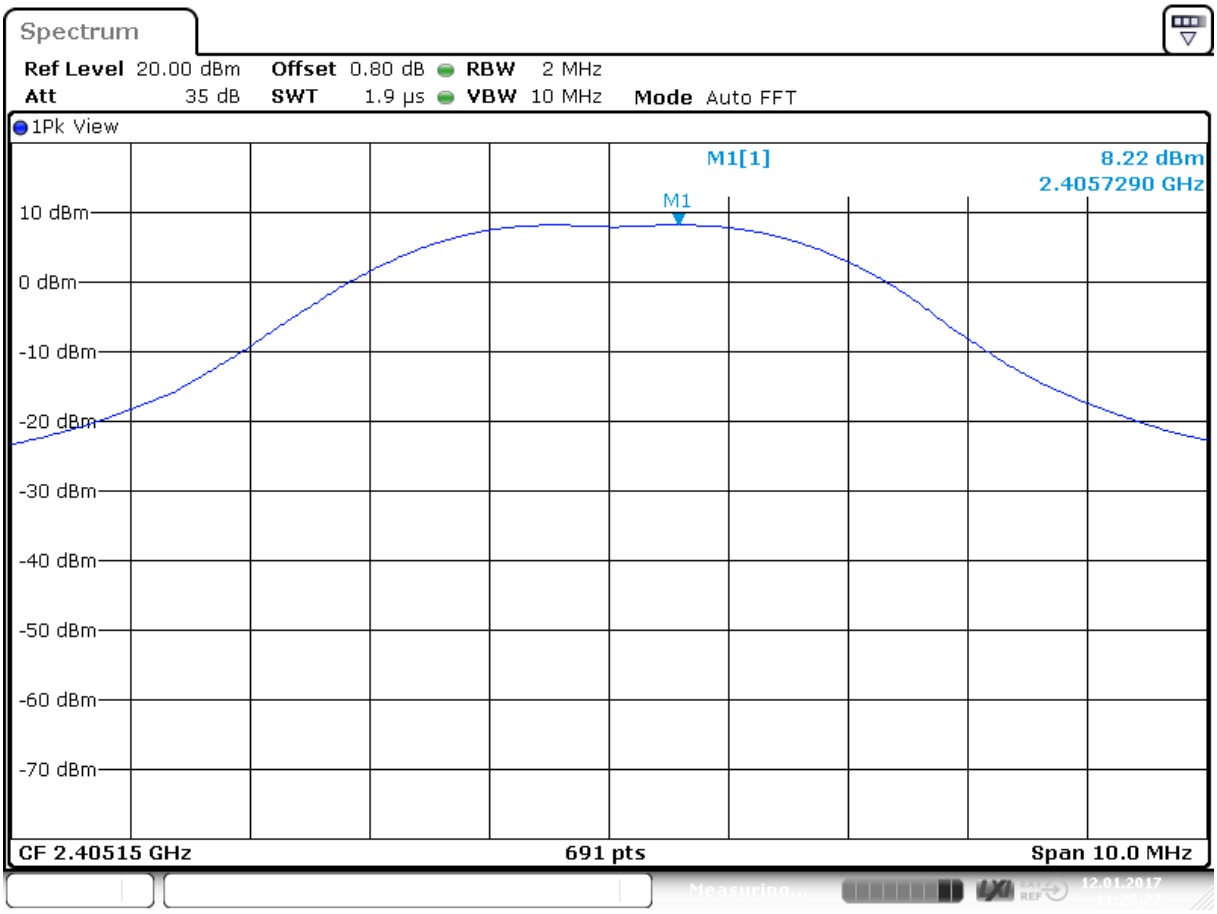
Measurement uncertainty is +/- 2.5 dB.

Notes: mW = 10 ^ (dBm/10)
dBm = 10 x log(mW)

plots : Peak power plots,
Figures 1a shows plot of the Peak Power output, correction factors (= 0.8dB Cableloss) included in the reading.

Conducted Output Power

Frequency [MHz]	Output Power [dBm]	Limit [dBm]	Verdict [Pass/Fail]	Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	Plot number
2405	8.22 (6.64 mW)	+30	Pass	5.0	13.22	21.0	1A



Date: 12.JAN.2017 11:25:26

Plot A

5.1.2 DTS Bandwidth

RESULT: PASS

Date of testing: 2017-01-12

Requirements:

FCC 15.247(a)(2)
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

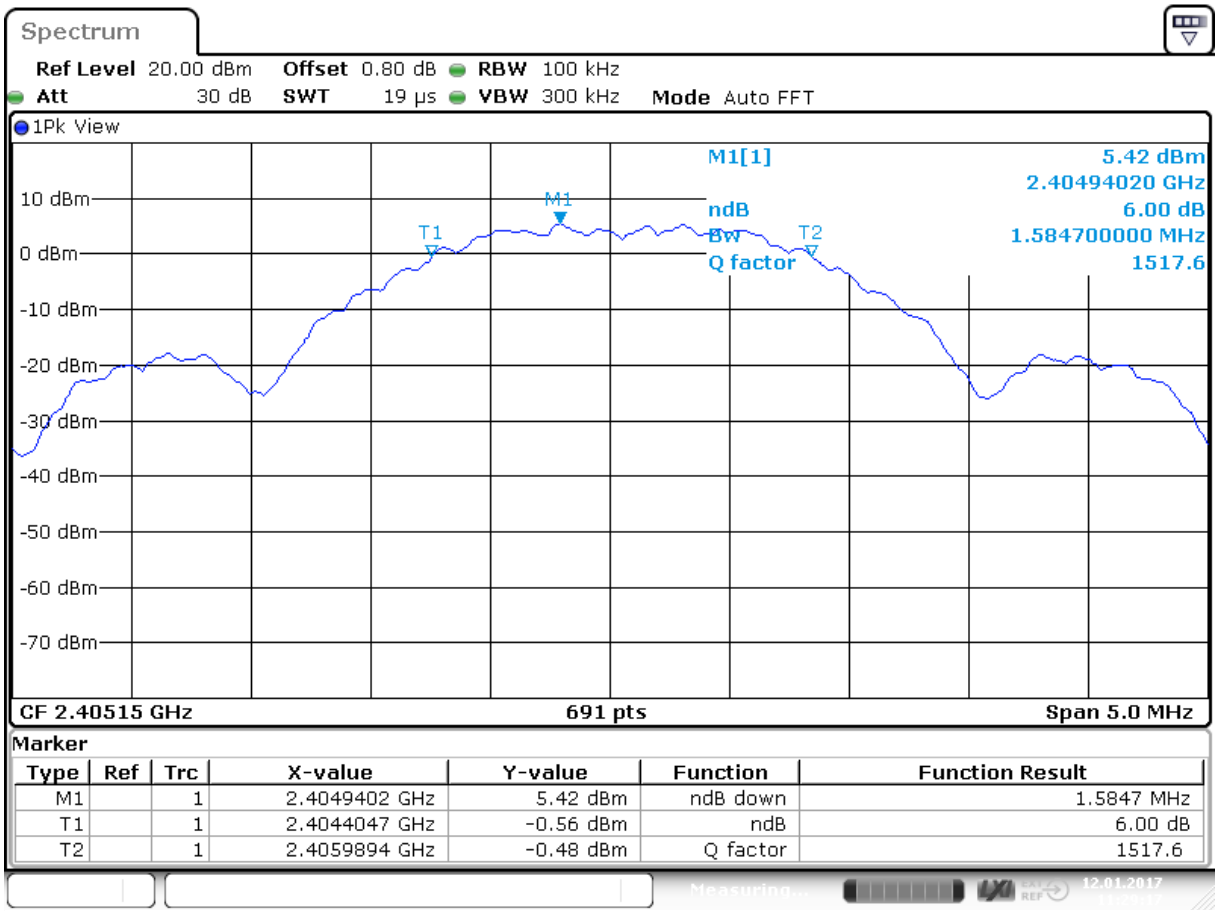
The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission sideskirts. The resolution bandwidth shall be set as close to 1% of the selected span as 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 x BW was used.
Measurement uncertainty is +/- 26kHz.

Plot A1 shown on the next page is of the 6 dB bandwidth.
Plot A2 shown on the next pages is of the 99% bandwidth.

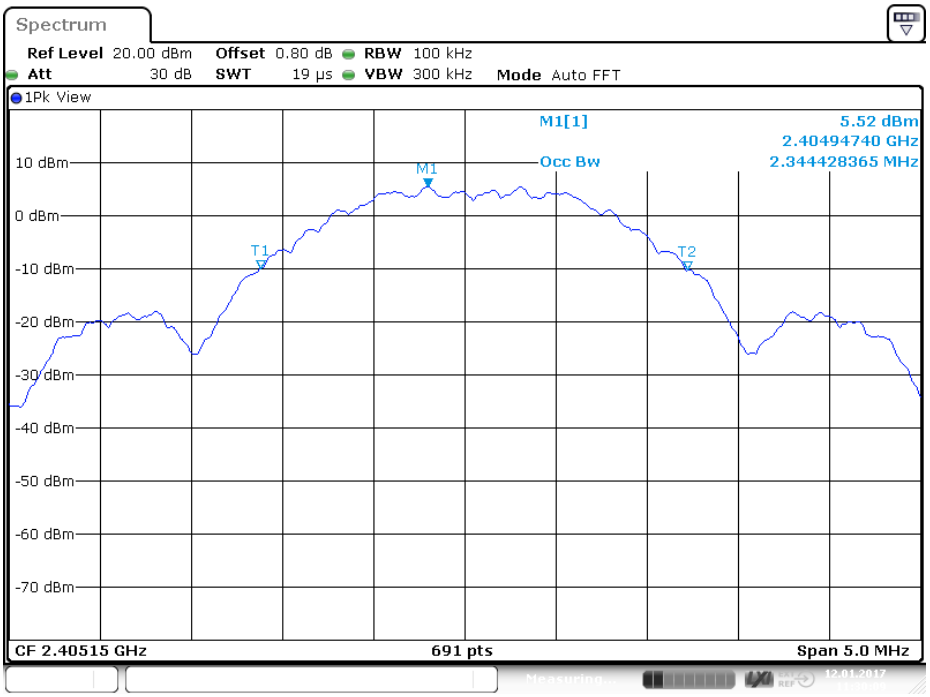
6dB and 99% Bandwidth

Operating Frequency [MHz]	99% Bandwidth [kHz]	6dB Bandwidth [kHz]	Limit [kHz]	Verdict [Pass/Fail]	Plot number
2405	2344	1585	>500	Pass	A1/A2



Date: 12.JAN.2017 11:29:17

Plot A1



Date: 12.JAN.2017 11:30:09

Plot A2 99% BW

5.1.3 Peak Power Spectral Density

RESULT: PASS

Date of testing: 2017-01-12

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:

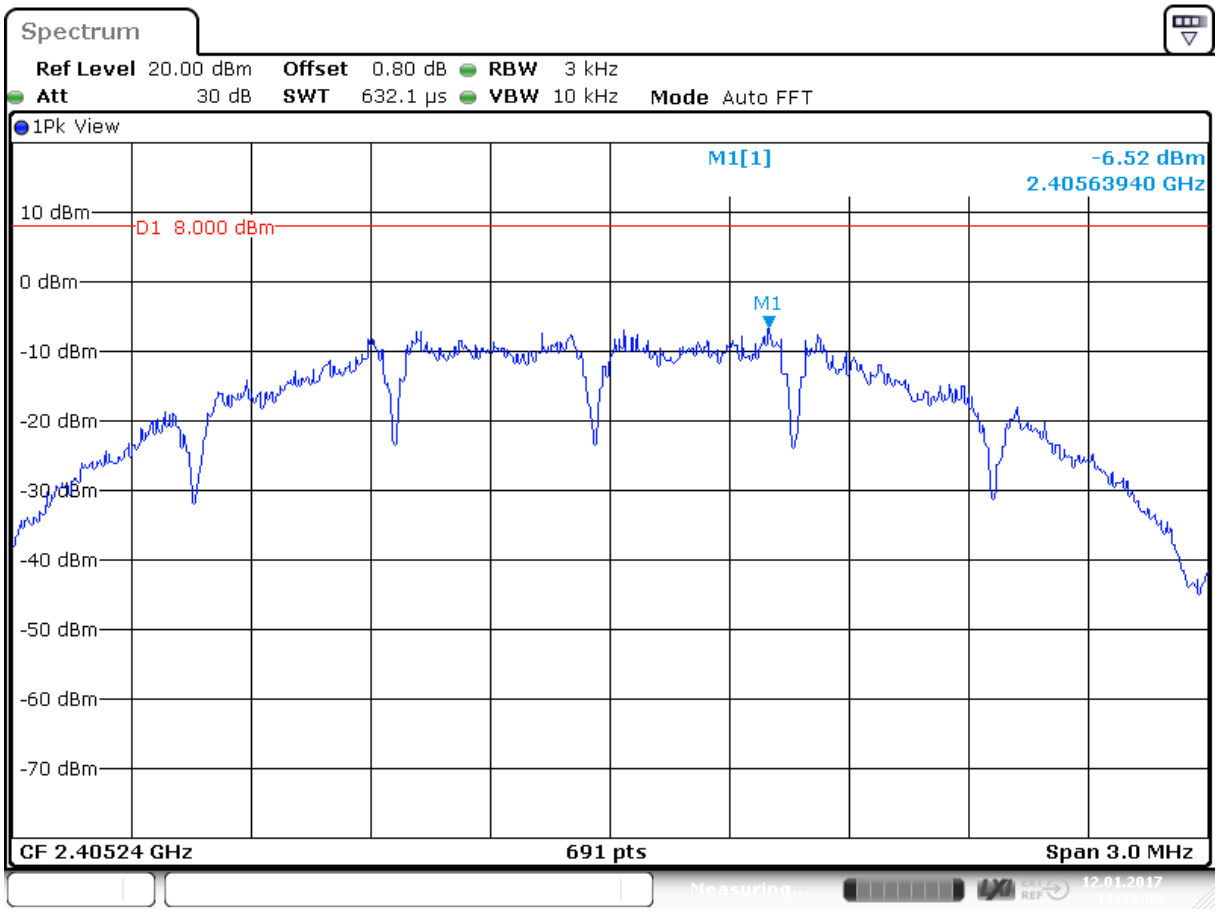
ANSI C63.10-2013

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 (0.8 dB).

Measurement uncertainty is +/- 1.1 dB.

Peak Power Spectral Density

Operating Frequency [MHz]	Max PSD [dBm]	Limit [dBm]	Verdict [Pass/Fail]	Plot
2405	-6.52	8	Pass	A



Date: 12.JAN.2017 11:38:07

Plot A

5.1.4 Band Edge Conducted Emissions

RESULT: Pass

Date of testing: 2017-01-12

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:

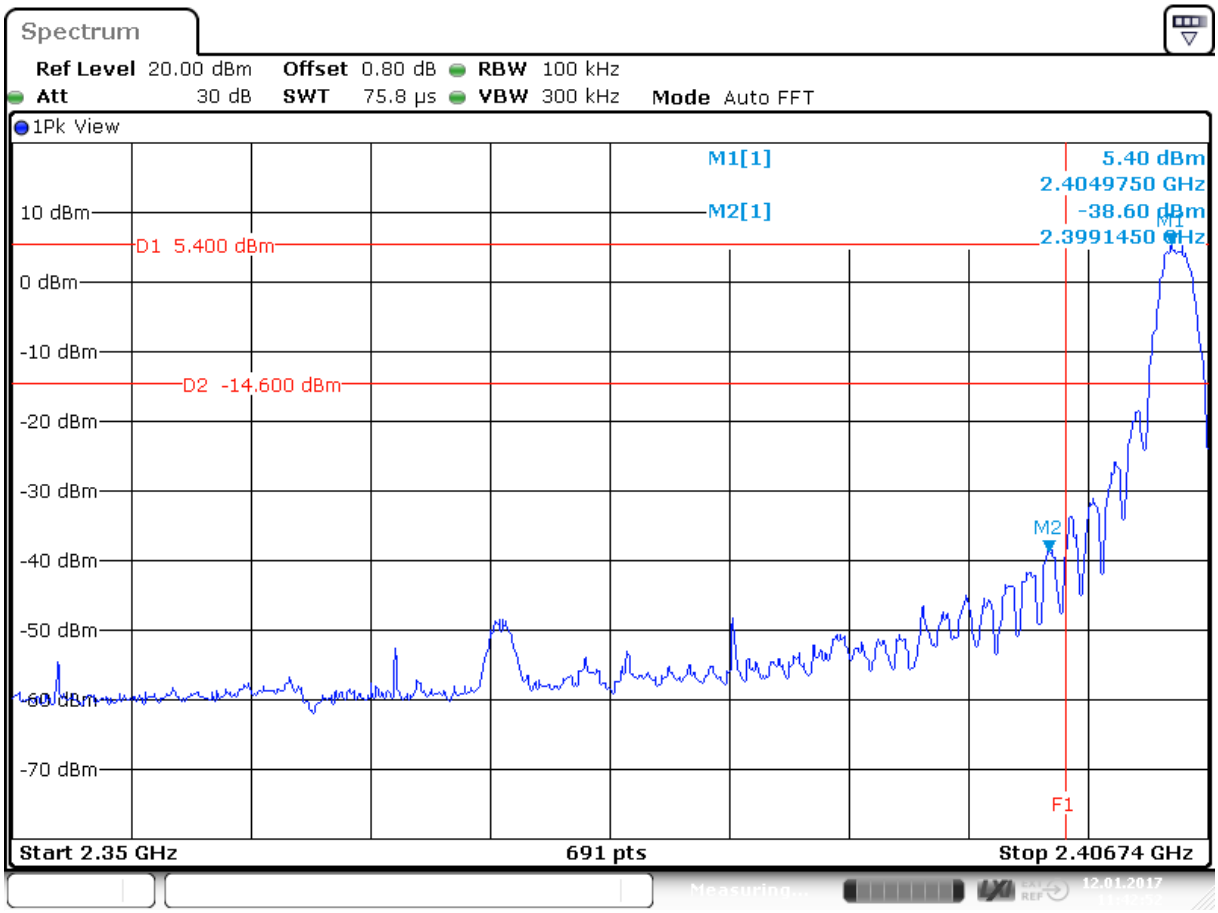
ANSI C63.10-2013
Section 11.13

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

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 +/- 2.5 dB.

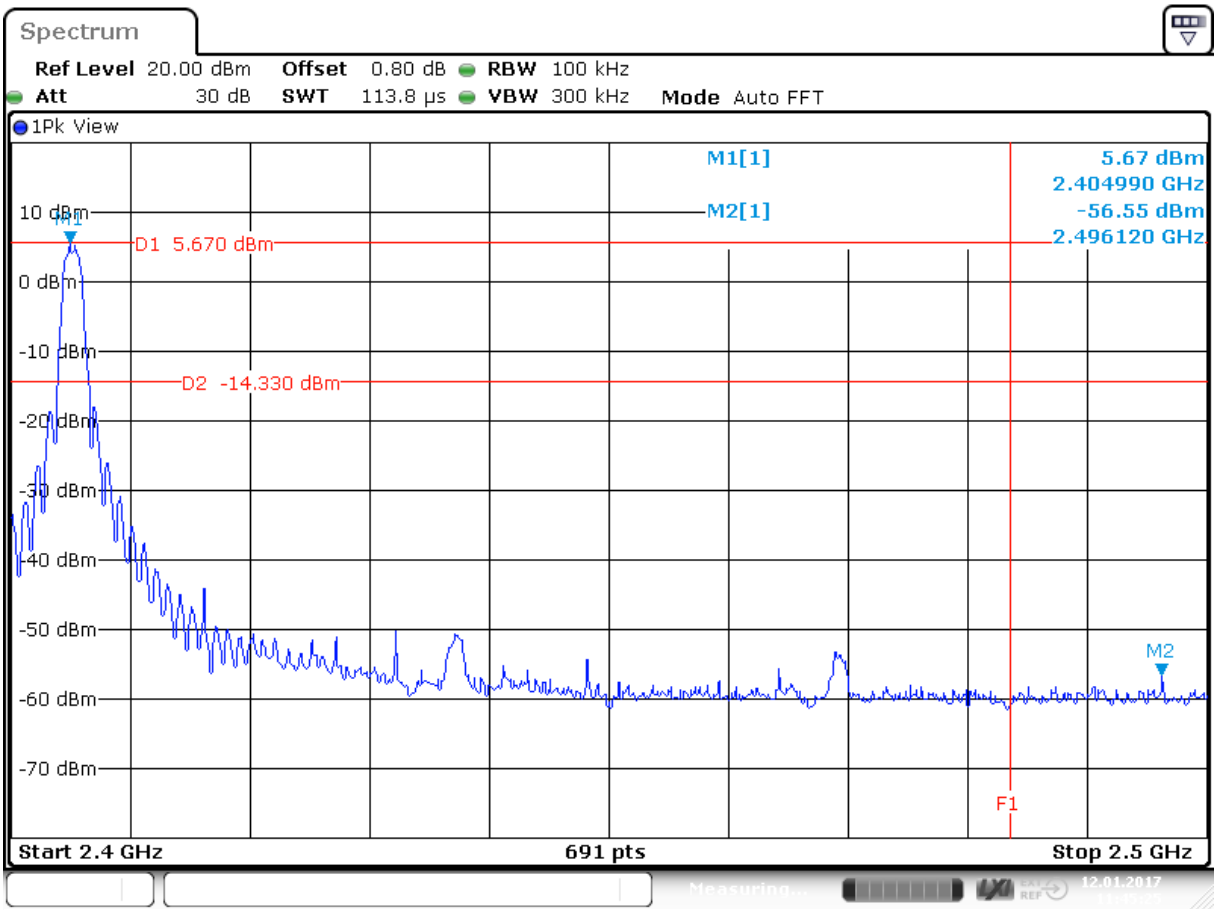
Results: All out of band spurious emissions are more than 20 dB below the fundamental.
See the figures on the following pages.



Date: 12.JAN.2017 11:42:53

Plot: Band Edge Conducted Emission, Spectral Diagram, 2405 MHz

Plot showing more than 20 dB band edge attenuation.
F1 shows the band edge frequency of 2400 MHz.



Date: 12.JAN.2017 11:45:26

Plot: Band Edge Conducted Emission, Spectral Diagram, 2405 MHz.
Plot showing more than 20 dB band edge attenuation.
F1 shows the band edge frequency of 2483.5 MHz.

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5.1.5 Radiated Spurious Emissions of Transmitter

RESULT: PASS

Date of testing: 2016-12-13 & 14

Frequency range: 30 MHz - 25GHz

Requirements:

FCC 15.209, 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) 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

The EUT was placed on the top of a rotating non-conductive table 1.5 meters above the ground in a semi-anechoic chamber. 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 and 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.

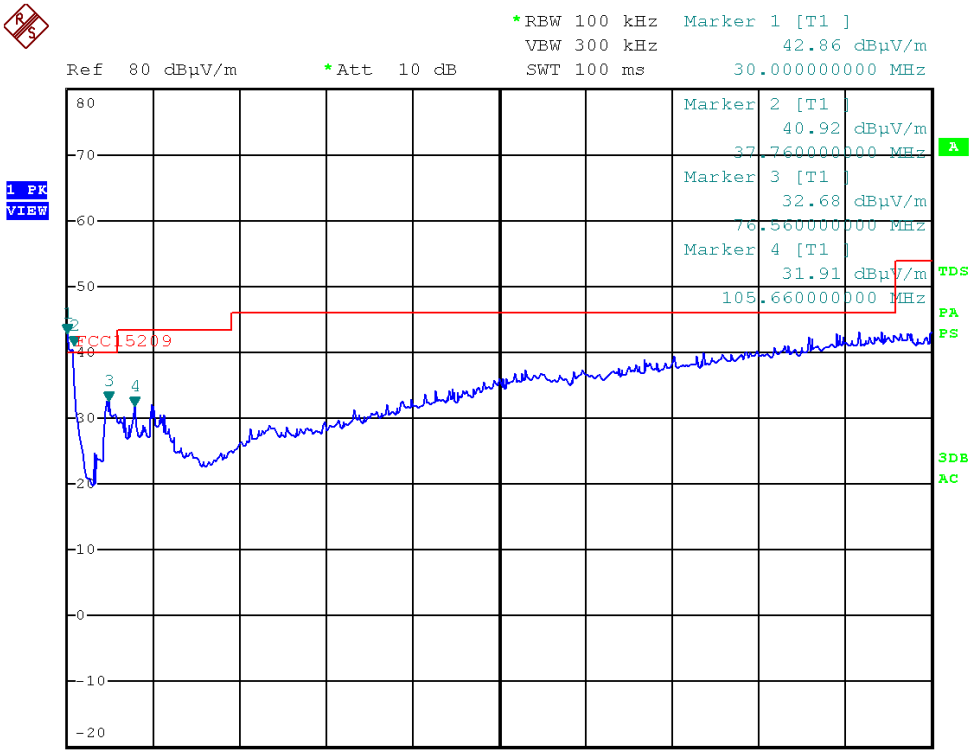
At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

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. The levels are expressed in dBm which are derived from dBm = E(dBµV/m) – 95.2dB. Where Peak (Pk) values where at least 6 dB under the Average (Av) limits, Av value was not tested. Where applicable Average values were obtained by using the duty cycle correction factor.

Radiated Emissions, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations

Frequency [MHz]	EUT Orientation	Antenna Orientation	Level QP [dBµV/m]	Limit QP [dBµV/m]	Verdict [Pass/Fail]
30.00	Vertical	Vertical	32.4	40.0	Pass
38.28	Vertical	Vertical	36.3	40.0	Pass
76.56	Vertical	Vertical	26.9	40.0	Pass
105.66	Vertical	Vertical	24.6	43.5	Pass
125.06	Vertical	Vertical	22.0	43.5	Pass
960 (noise)	Vertical	Vertical	35.5	46.0	Pass

Notes:
- Level QP = Reading QP + Factor
- Tested in modes as described in section 4.2, the 6 highest values noted.
- *R refers to a frequency in a restricted band
- Quasi Peak detector used with a bandwidth of 120 kHz.
- Measurement uncertainty is +/- 5.22 dB.



Plot of the emissions (Peak detector values shown)

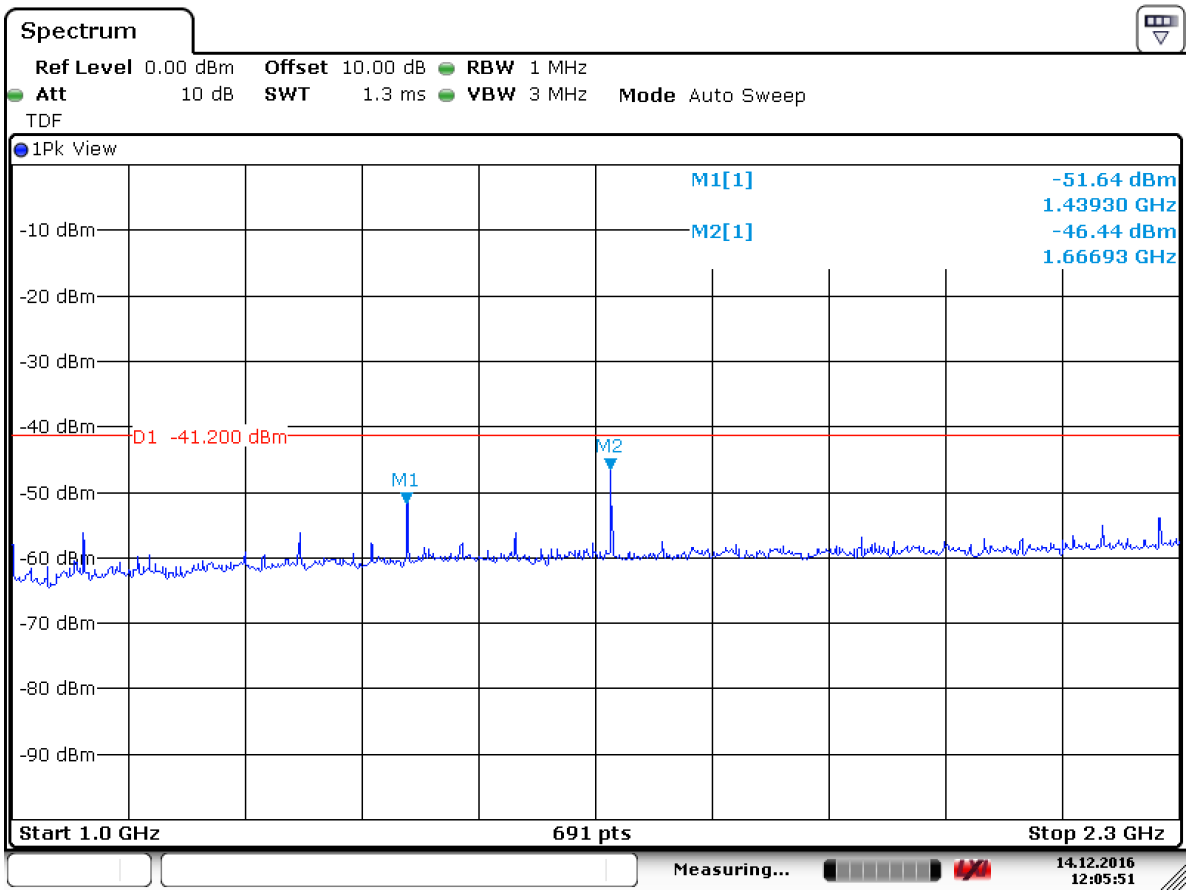
Radiated Emissions, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, 2405 MHz.

Frequency [MHz]	EUT Orientation	Antenna Orientation	Detector	Bandwidth (MHz)	Level [dBm]	Limit [dBm]	Result
1439.30*R	Vertical	Vertical	Pk	1	-51.6	--41.2 (Av) -21.2 (Pk)	Pass
1666.93*R	Vertical	Vertical	Pk	1	-46.4	--41.2 (Av) -21.2 (Pk)	Pass
2310-2390*R	Vertical	Vertical	Pk	1	-21.3	-41.2 (Av) -21.2 (Pk)	Pass
2310-2390*R	Vertical	Vertical	Av	Dcf=-38.7	-60.0	-41.2 (Av)	Pass
14171.88	Vertical	Vertical	Pk	1	-44.0	-21.2 (Pk)	Pass
14171.88	Vertical	Vertical	Av	Dcf=-38.7	-82.7	-41.2 (Av)	Pass
16568.12	Vertical	Horizontal	Pk	1	-42.5	-21.2 (Pk)	Pass
16568.12	Vertical	Horizontal	Av	Dcf=-38.7	-81.2	-41.2 (Av)	Pass
22079.90*R	Vertical	Horizontal	Pk	1	-46.2	-21.2 (Pk)	Pass
22079.90*R	Vertical	Horizontal	Av	Dcf=-38.7	-84.9	-41.2 (Av)	Pass

Notes:

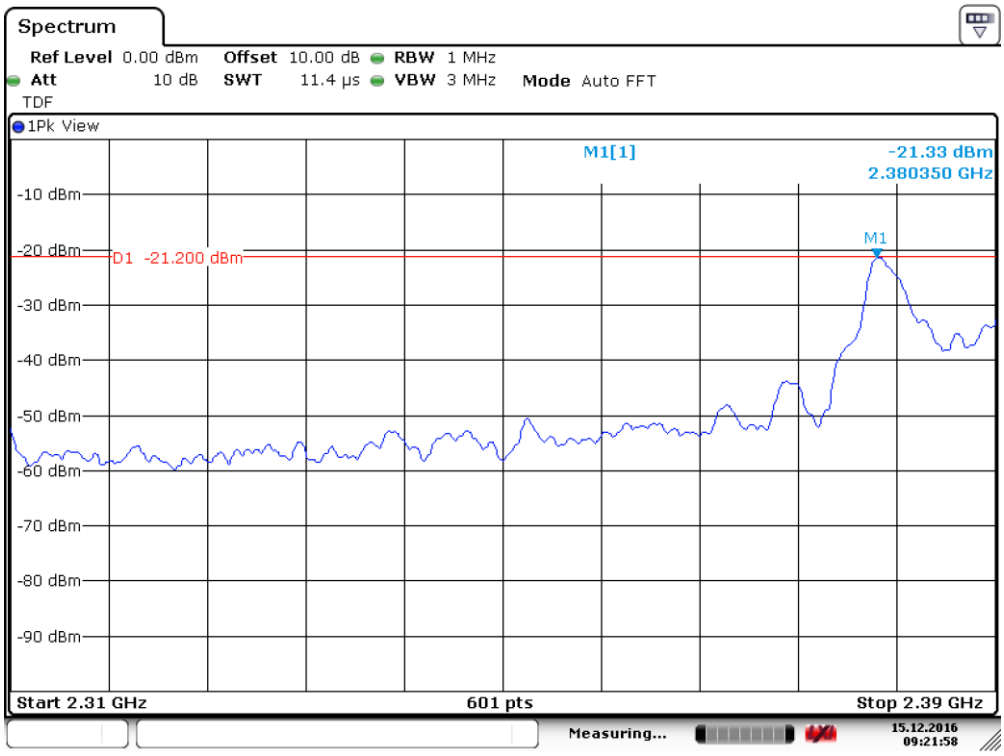
- *R refers to a frequency in a restricted band,
- *H refers to a frequency which is a harmonic of the fundamental.
- Dcf= -38.7 dB refers to a duty cycle correction factor, see section 6 for details
- From pre-test it was shown that the EUT in vertical position, was the worst case situation
- Measurement uncertainty is +/- 5.5 dB.
- a selection of plots is provided on the next pages

Plots of the radiated emissions



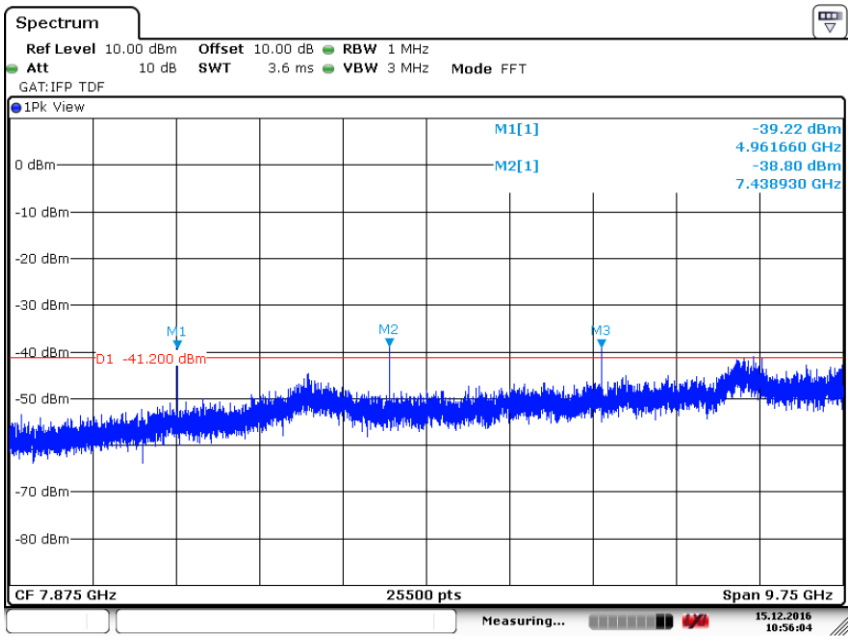
Date: 14.DEC.2016 12:05:50

Plot of the emissions at 2405 MHz, vertical polarization, Peak values shown



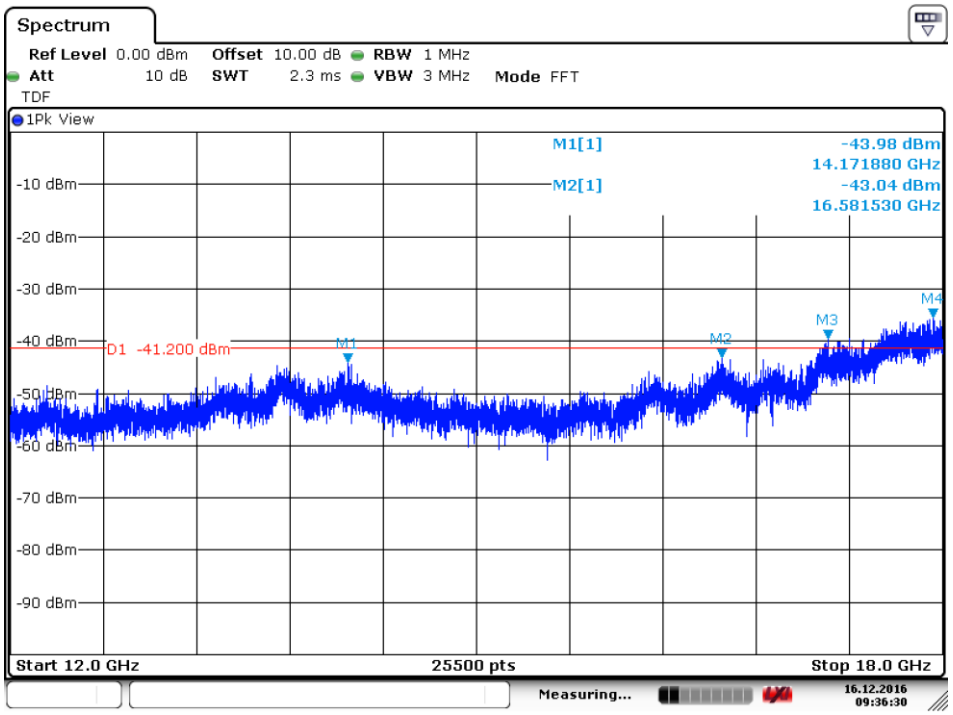
Date: 15.DEC.2016 09:21:57

Plot of the emissions in the restricted band 2.31-2.39GHz at 2405 MHz, Horizontal polarization, Peak values shown



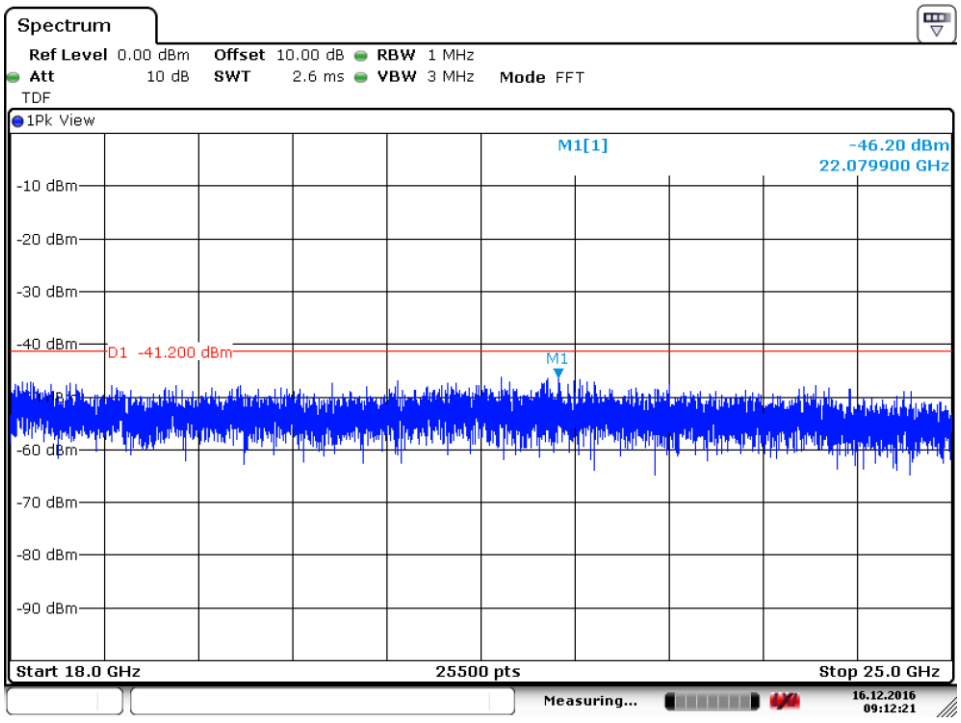
Date: 15.DEC.2016 10:56:04

Plot of the emissions in the band 3 – 12 GHz at 2480 MHz, EUT vertical Antenna Vertical polarization, Peak values shown



Date: 16.DEC.2016 09:36:30

Plot Radiated unwanted emissions in the range 12 – 18 GHz in Normal operation mode
(Peak values, Antenna Vertical position shown).



Date: 16.DEC.2016 09:12:20

Plot Radiated unwanted emissions in the range 18 – 25 GHz in Normal operation mode
(Peak values, Antenna Vertical position shown).

5.2 AC Power Line Conducted Measurements

RESULT: Pass.

Date of testing: 2017-01-30

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 µH/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 (dBµV) Quasi-Peak	Conducted Limit (dBµV) 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 µH / 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 is considered a floor-standing device. The EUT is placed on a non-conductive plate of 5mm thick above the ground plane, so to isolate it from the ground plane because the EUT normally does not make electrical contact with a ground plane. The EUT was positioned at least 80cm from the LISN. The power cable was routed over the non-conductive plate to the LISN.

5.2.1 Test results AC Power Line Conducted Emission of Transmitter

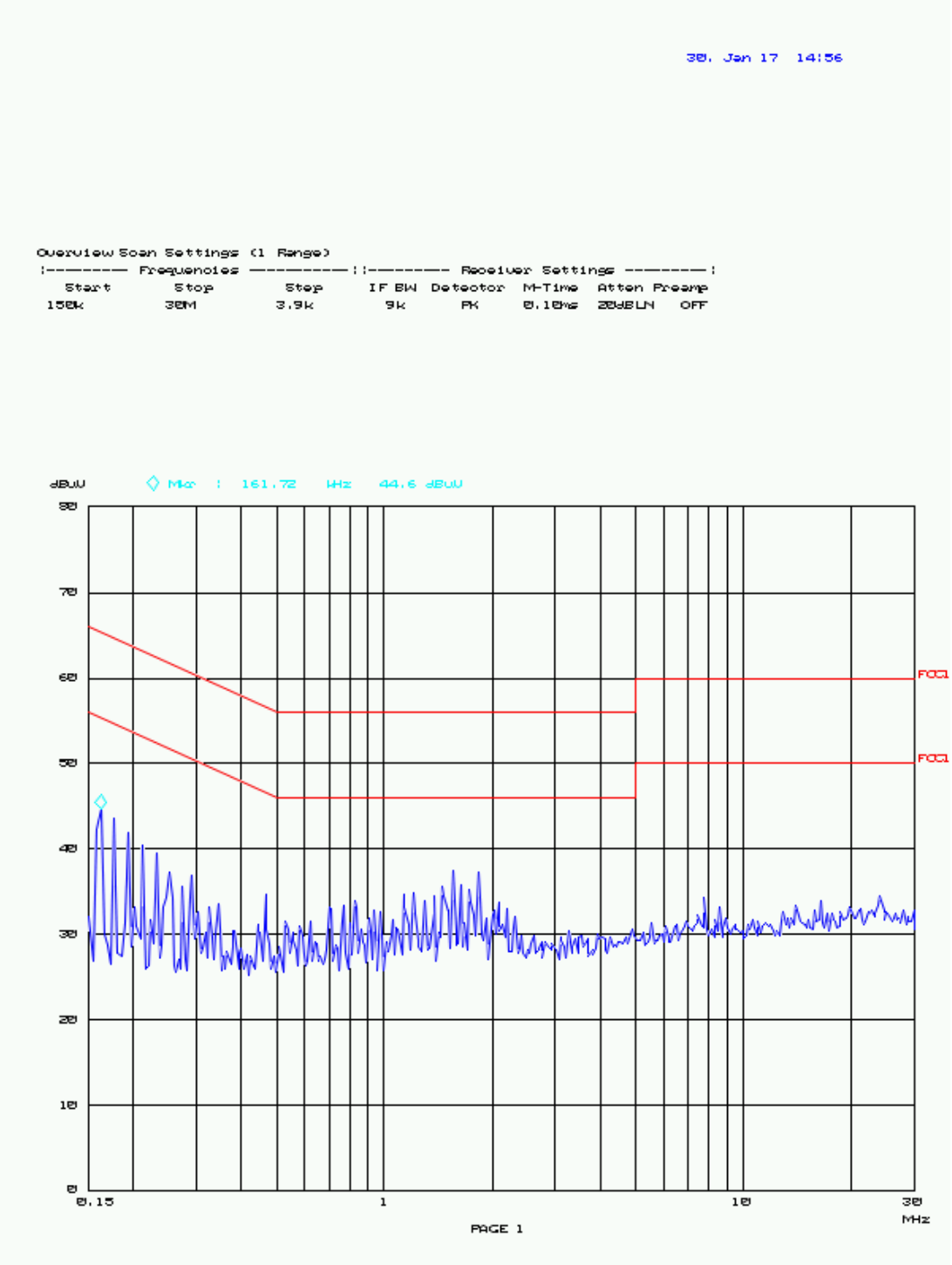
Frequency (MHz)	Measurement results (dBµV) L1		Measurement results (dBµV) L2/Neutral		Limits (dBµV)		Verdict (Pass/Fail)
	QP	AV	QP	AV	QP	AV	
0.15000	44.3	*3	43.5	*3	66.0	56.0	Pass
0.15781	42.0	*3	43.7	*3	65.5	55.5	Pass
0.16172	45.8	*3	43.0	*3	65.5	55.5	Pass
0.18125	43.7	*3	41.7	*3	64.5	54.5	Pass
0.19688	44.5	*3	39.3	*3	63.6	53.6	Pass
0.21250	39.8	*3	38.9	*3	63.2	53.2	Pass
0.23203	38.5	*3	37.2	*3	62.4	52.4	Pass

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 AUX1 that connects to the EUT, are depicted in the table above.

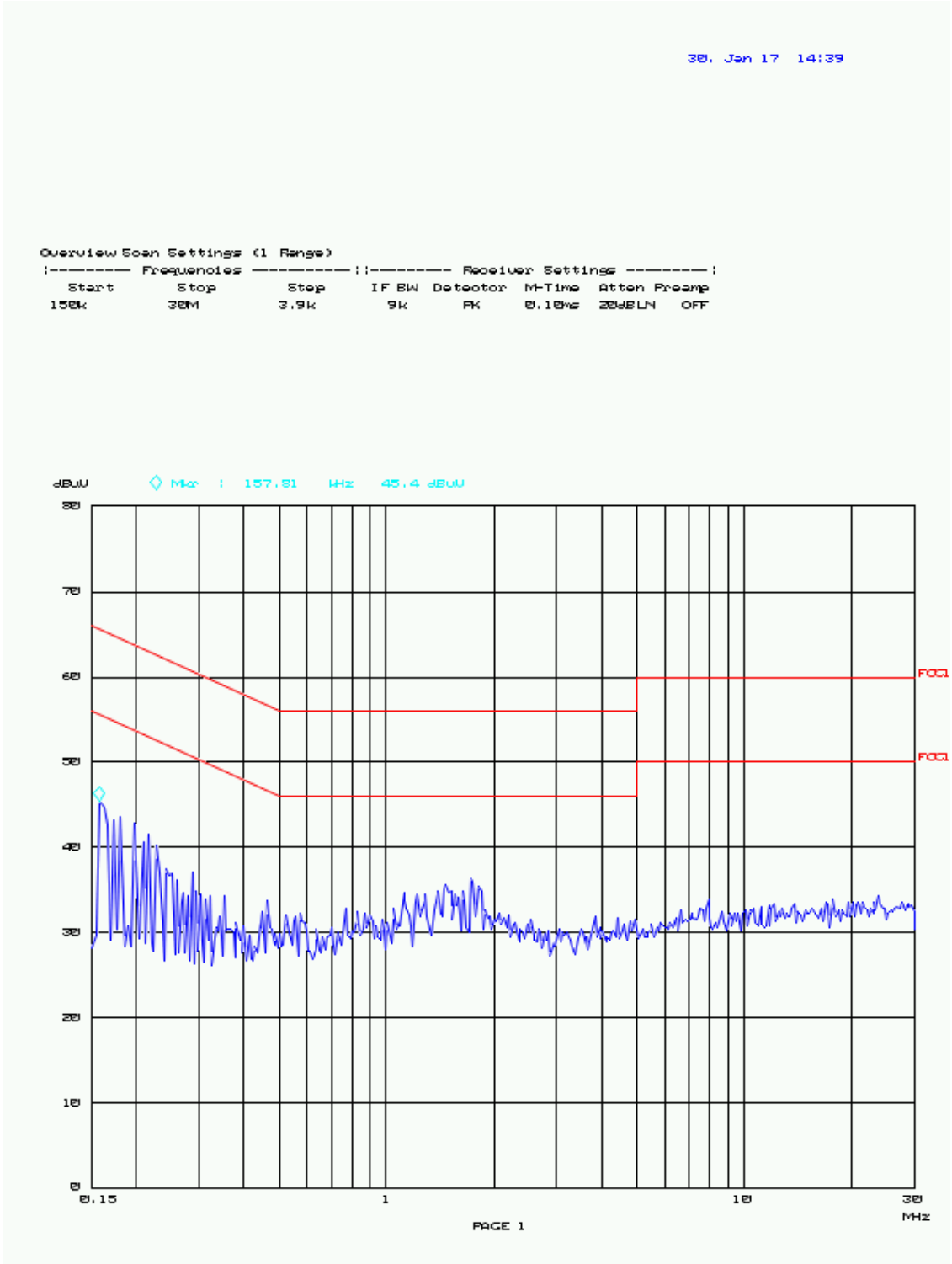
Notes:

1. The resolution bandwidth used was 9 kHz.
2. The 6 Worst case values noted.
3. Qp values were already within Av limits, therefor Av not tested.
4. Plots are provided on the next pages.

5.2.2 Plots of the AC Power-line Conducted Emissions



Plot of the AC Power-line Conducted emissions on L1

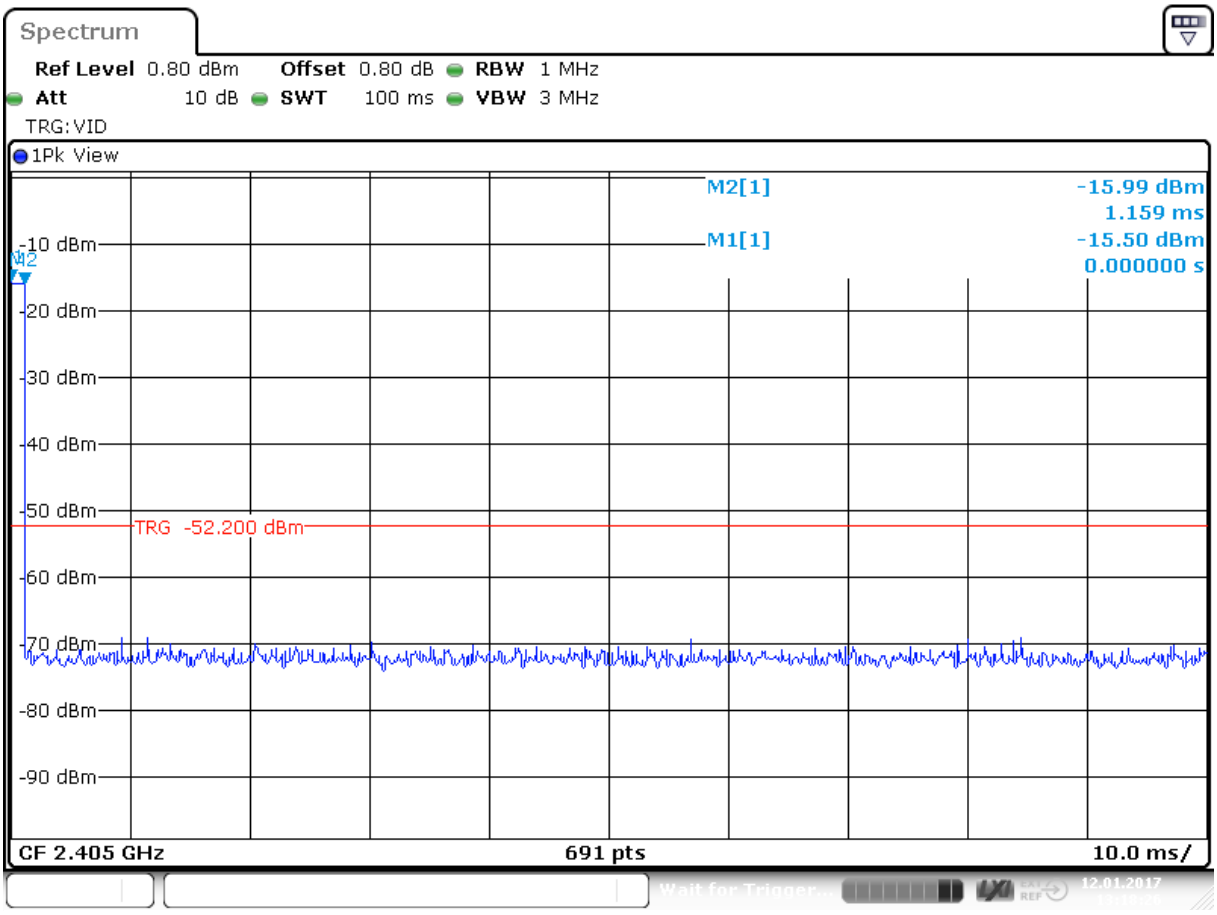


Plot of the AC Power-line Conducted emissions on L2

6 Duty cycle correction

The Dwell Time of the EUT, see plot below, is less than 100 ms and the measured value with Average detector may be adjusted with a ‘’duty cycle correction factor”, derived from 20 log (dwell time/100ms). In this case:

Duty Cycle Correction factor = 20 log (1.159ms/100ms) = -38.7 dB.



Plot Dwell time of the emissions in a 100ms period

End of report