

FCC and IC Test Report for Parts 15.247, 15.207 and RSS-247, RSS Gen (DTS)

Product name : IQ2.0
Applicant : SALTO Systems, S.L.
FCC ID : UKCIQ2
ISED ID : 10088A-IQ2

Test report No. : 170600688 07 Ver 2.00

Laboratory information

Accreditation

Telefication is designated by the FCC as an Accredited Test Firm for compliance testing of equipment subject to Certification under Parts 15 & 18. The Designation number is: NL0001

The Industry Canada registration number for the 3 meter test chamber of Telefication is: 4173A-1.

Documentation

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2005. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

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Testing Location

Test Site	Telefication BV
Test Site location	Edisonstraat 12a 6902 PK Zevenaar The Netherlands Tel. +31889983600 Fax. +31316583189
Test Site FCC	NL0001

Revision History

Version	Date	Remarks	By
v0.50	9-10-2017	First draft	PS
v1.00	06-03-2018	Initial release	PS
v2.00	22-03-2018	Updated clause 1.6 with variant information. Changed KDB Publication No. 558074 D01DTS Meas. Guidance V0305 to v04	PS

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Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.247(a)	RSS-247 5.2 (1)	6dB Bandwidth	3.1	Pass
--	RSS-GEN 6.6	99% Bandwidth	3.2	Pass
15.247(b)	RSS-247 5.1 (2)	RF output power	3.3	Pass
15.247(e)	RSS-247 5.2 (2)	Power spectral density	3.4	Pass
15.247(d)	RSS-247 5.5	Band edge emissions	--	NA ^{*)}
15.209 (a)	RSS-247 5.4	Radiated Spurious emissions	3.5	Pass
15.205 (a)	RSS Gen 8.10	Spurious emissions in the restricted bands	3.5	Pass
15.207 (a)	RSS-Gen 8.8	Conducted spurious on AC mains	3.6, 3.7	Pass

^{*)} Not applicable, since the band edges of the lowest and highest channels are outside 2 MHz of the authorized band edges.

1 General Description

1.1 Applicant

Client name:	Salto systems, S.L.
Address	C/Arkotz 9 Pol. Lanbarren, Oiartzun
Zip code:	20180
Telephone:	+34 943344550
Contact name:	j.imedio@saltosystems.com
E-mail:	Mr. Juan Imedio

1.2 Manufacturer

Manufacturer name:	Salto systems, S.L.
Address:	C/Arkotz 9 Pol. Lanbarren, Oiartzun
Zip code:	20180
Contact name::	j.imedio@saltosystems.com
E-mail:	Mr. Juan Imedio

1.3 Tested Equipment Under Test (EUT)

Product name:	IQ2.0
Brand name:	SALTO
Product type:	Data transmission equipment operating in the 2.4 GHz band
FCC ID:	UKCIQ2
ISED ID	10088A-IQ2
Model(s):	IQ222, IQ223, IQ224
Software version:	--
Hardware version:	--
Date of receipt	07-08-2017
Tests started:	11-08-2017
Testing ended:	06-03-2018

1.4 Product specifications of Equipment under test

Tx Frequency range (MHz)	2405 - 2480
Rx frequency range (MHz)	2405 - 2480
Maximum output power to antenna (dBm)	5
Antenna type	chip
Antenna gain (dBi)	0.5
Type of modulation	O-QPSK, DSSS
Emission designator	G1D

1.5 Modification of the Equipment Under Test (EUT)

PoE version only

To minimise radiated emissions in the VHF band two capacitors (2x 4.7 nF) were added:
One between pins 3 and 7 of the PoE module, type Ag9905M, and the other between pins 3 and 5 of the same module.

1.6 Observations and remarks

The sample features a ZigBee (IEEE 802.15.4) embedded radio and two radio modules (WiFi and Bluetooth BLE). The product comes in three variants depending on the type of power supply:

IQ222: BLE + IEEE802.15.4 + Wifi (no PoE)

IQ223: BLE + IEEE802.15.4 (PoE)

IQ224: BLE + IEEE802.15.4 (no PoE)

This report contains the test results of the ZigBee radio part of the IQ2.0.

1.7 Environmental conditions

Test date	11-08-2017	16-08-2017
Ambient temperature	25 °C	26 °C
Humidity	49 %	49 %

1.8 Measurement Standards

- FCC KDB Publication No. 558074 D01DTS Meas. Guidance V04
- ANSI C63.10:2013

1.9 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247, §15.207
- RSS-247 Issue 2, RSS-GEN Issue 4

1.10 Conclusions

The sample of the product showed NO NON-COMPLIANCES to the specifications stated in paragraph 1.9 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Telefication accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.9 "*Applicable standards*".

All tests are performed by:

Name : ing. P.A. Suringa

Review of test methods and report by:

Name : ing R. van Barneveld

The above conclusions have been verified by the following signatory:

Date : 23-03-2018

Name : ing. K.A. Roes

Function : Coordinator Radio Laboratory

Signature :



2 Test configuration of the Equipment Under Test

2.1 Test mode

The applicant provided test mode firmware for the EUT, in which it was possible to configure the EUT into different test channels.

2.2 Tested channels and Data rates

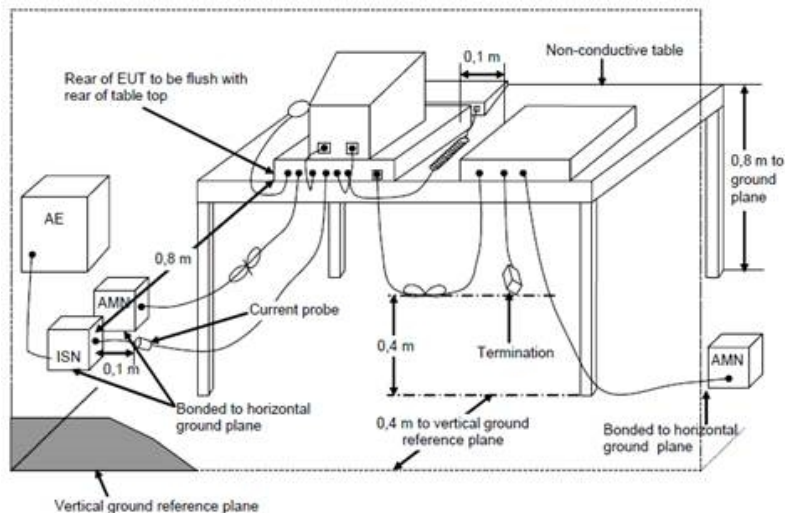
Technology	Channels	Data rate	Frequency (MHz)
ZigBee	11	250 kbps	2405
	19	250 kbps	2445
	26	250 kbps	2480

2.3 Conducted Test setup

RF tests at antenna connector

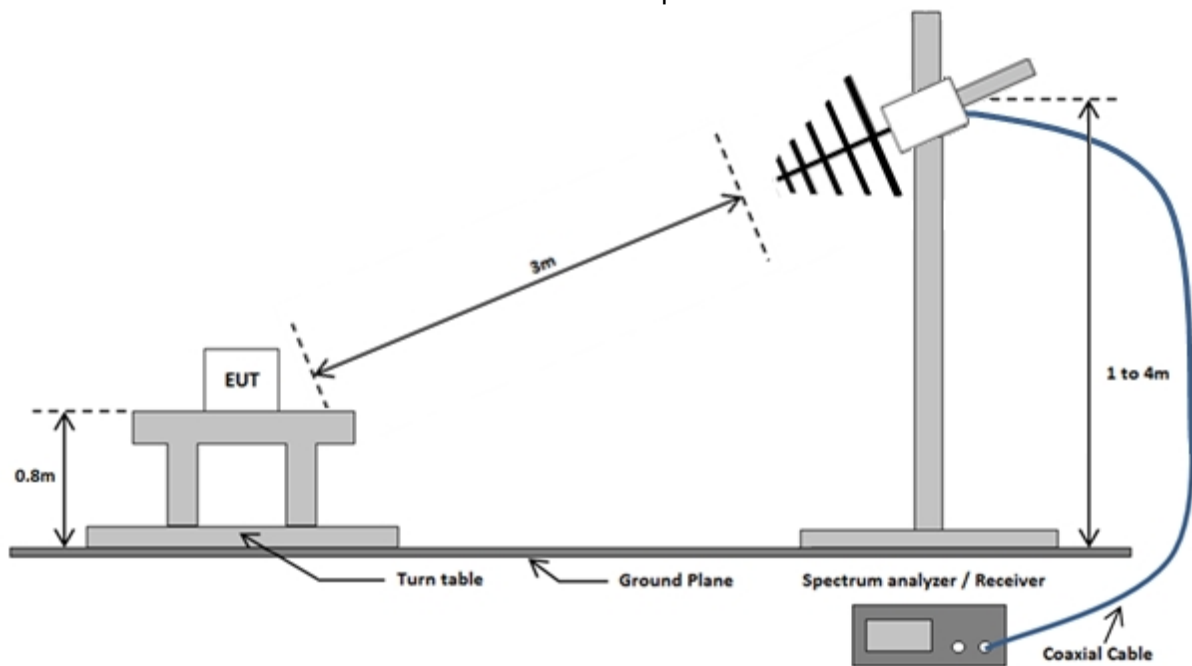


Emissions test at AC mains

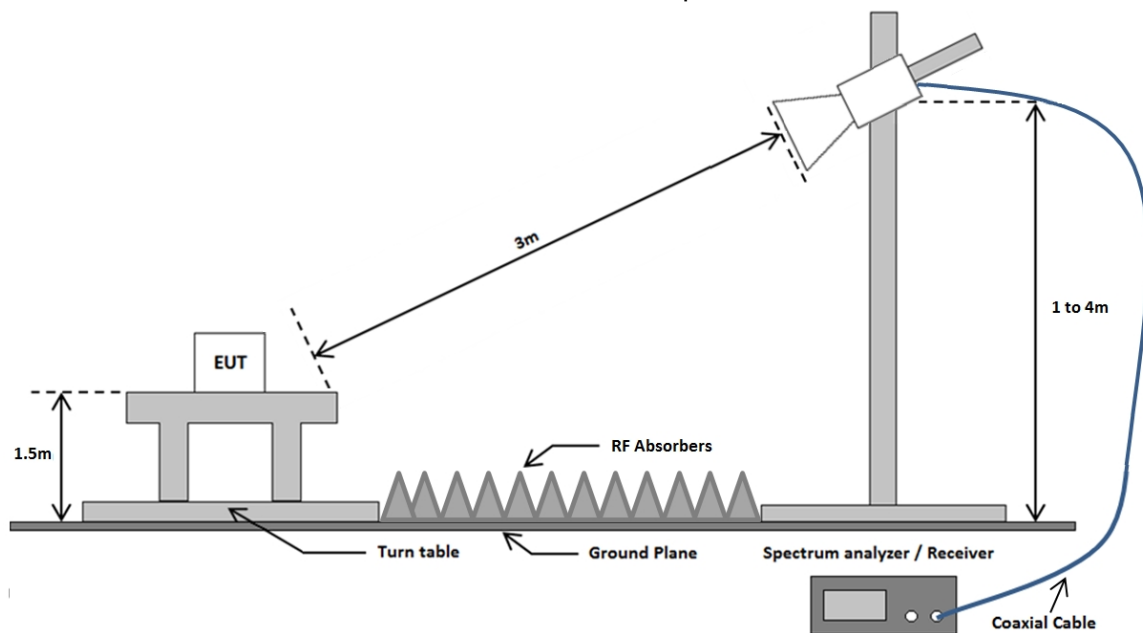


2.4 Radiated Test setup

Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



2.5 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
Spectrum Analyzer	Rohde & Schwarz	FSV	TE01269	3.1, 3.2, 3.3
Spectrum Analyzer	Rohde & Schwarz	FSP40	TE11125	3.5
Spectrum Analyzer	Rohde & Schwarz	ESCI	TE11128	3.2, 3.6
Spectrum Analyzer	Rohde & Schwarz	ESR7	TE01220	3.7
Biconilog Antenna	Chase	CBL6112A	TE00967	3.5
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	3.5
SAC Chamber	Comtest Engineering BV	-	TE00861	3.5
Measurement software	Dare	Radimation	2016.2.8	3.5, 3.6, 3.7
Artificial Mains Network (AMN)	Rohde & Schwarz	ESH3-Z5	TE00208	3.6, 3.7
Pulse limiter	Rohde & Schwarz	ESH3-Z2	TE00756	3.6, 3.7
High pass filter	Wainwright instruments	WHK3.0/18G-10EF	TE01140	3.5
Pre-amplifier	Hewlett Packard	8449B	TE00092	3.5

3 Test results

3.1 6dB bandwidth Measurement

3.1.1 Limit

The minimum 6 dB Bandwidth shall be at least 500 kHz.

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.1.4 Test procedure

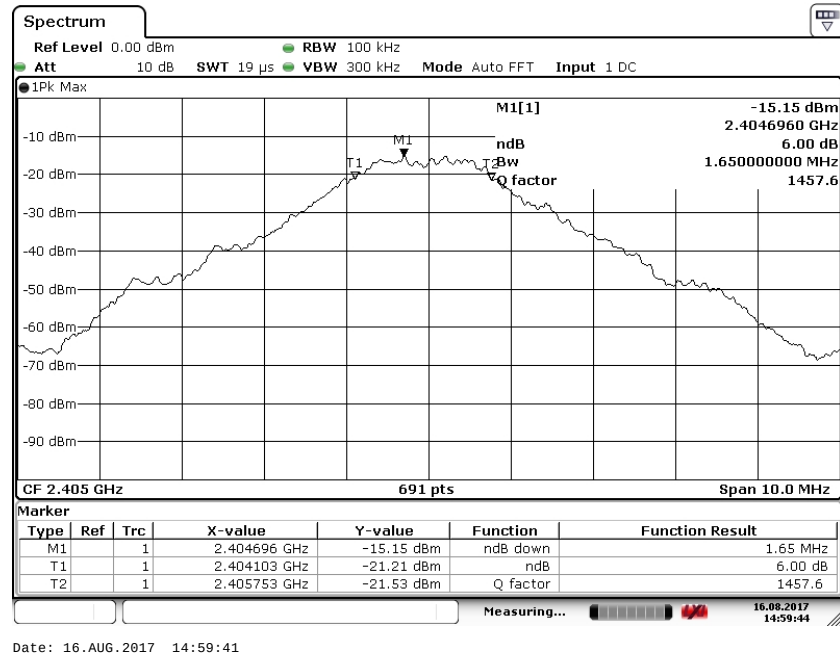
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.

3.1.5 Test Results of the 6 dB bandwidth Measurement

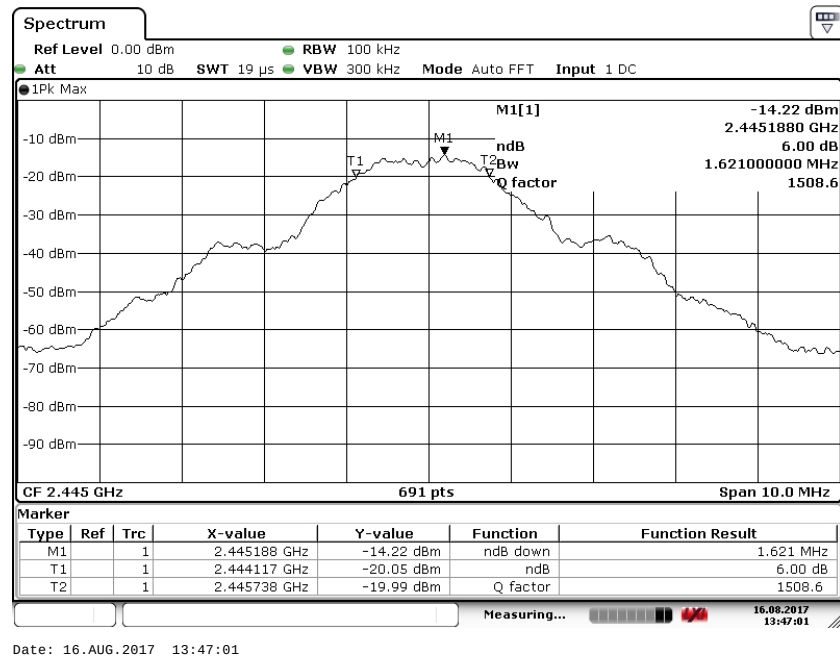
Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
ZigBee	11	2405	250 kbps	1650
	19	2445	250 kbps	1621
	26	2480	250 kbps	1664
Uncertainty	± 362 kHz			

3.1.6 Plots of the 6 dB bandwidth Measurement

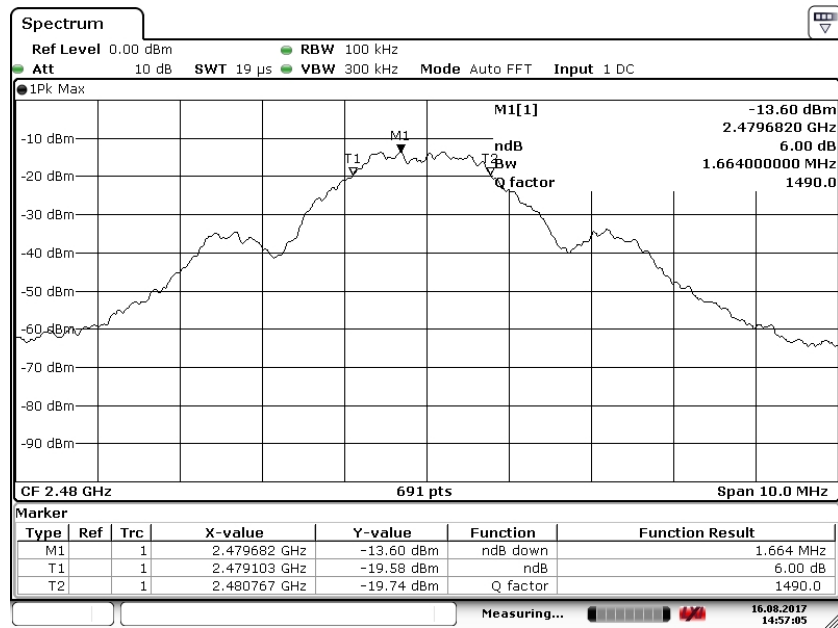
6dB Bandwidth (Channel 11)



6dB Bandwidth (Channel 19)



6dB Bandwidth (Channel 26)



Date: 16.AUG.2017 14:57:03

3.2 99% Occupied Bandwidth

3.2.1 Limit

According to RSS-Gen 6.6.

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.2.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.2.4 Test procedure

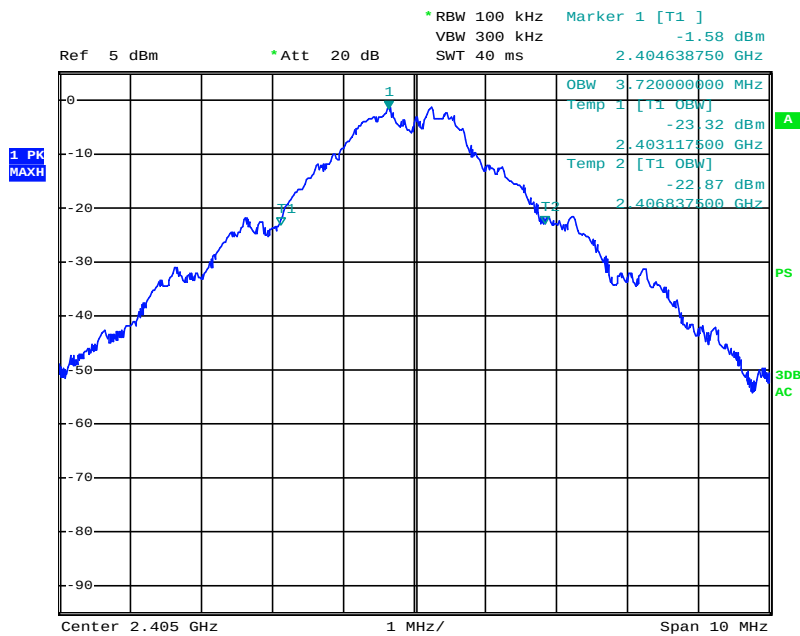
- 1 Set the centre frequency to the nominal EUT channel centre frequency.
- 2 Set span = 1.5 times to 0.5 times the Occupied Bandwidth.
- 3 Set VBW $\geq 3 \times$ RBW.
- 4 Video averaging is not permitted. Where practical detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode(until the trace stabilizes) shall be used.

3.2.5 Test results of the 99% Occupied Bandwidth Measurement

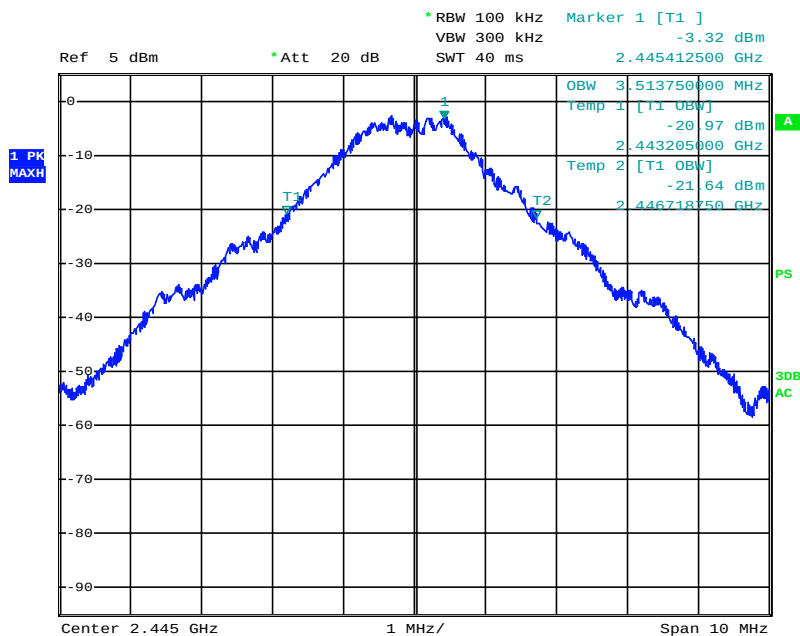
Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
ZigBee	11	2405	250 kbps	3720
	19	2445	250 kbps	3514
	26	2480	250 kbps	3395
Uncertainty	± 362 kHz			

3.2.6 Plots of the 99% Occupied Bandwidth Measurement

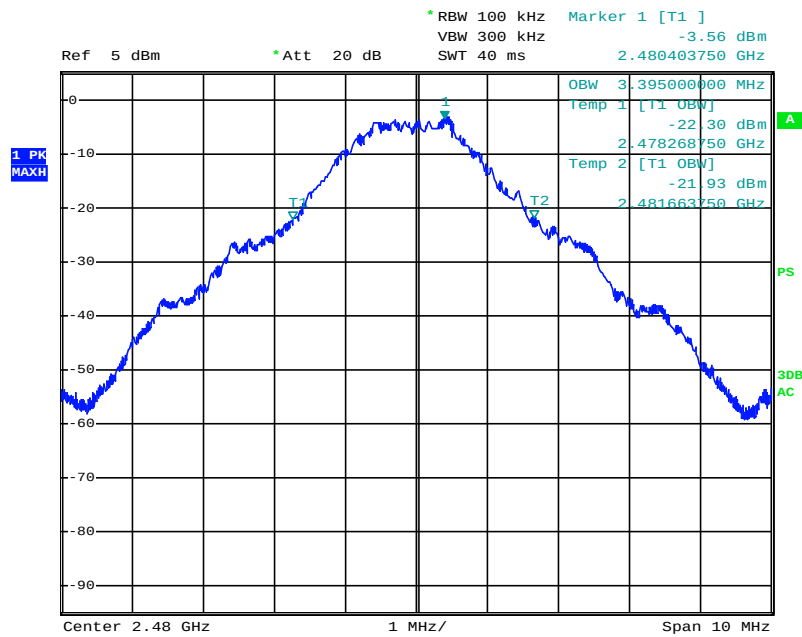
99% Occupied Bandwidth (Channel 11)



99% Occupied Bandwidth (Channel 19)



99% Occupied Bandwidth (Channel 26)



3.3 Output Power Measurement

3.3.1 Limit

For systems using digital modulation in the 2400-2483.5 MHz, the limit for the peak output power is 30 dBm. If transmitting antenna of directional gain greater than 6 dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point to point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

3.3.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.3.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.3.4 Test procedure

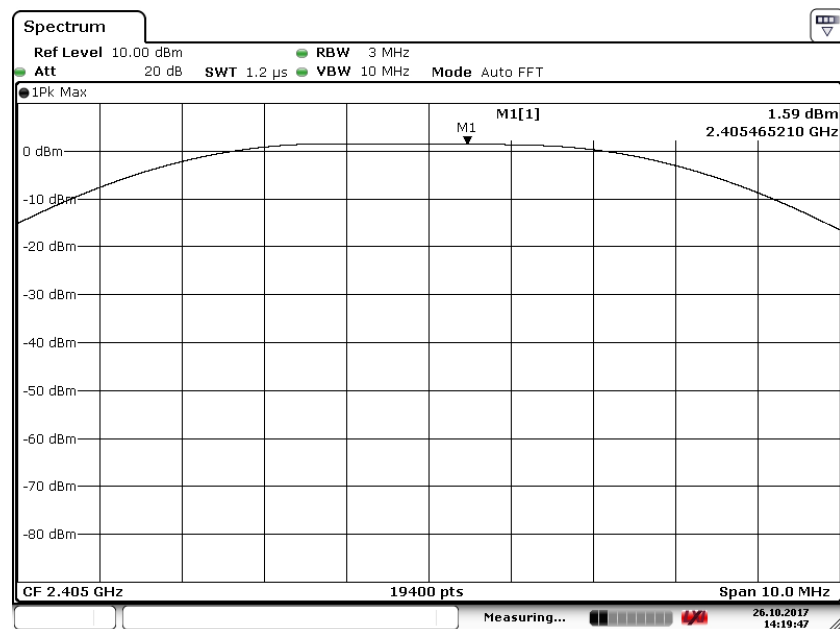
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.

3.3.5 Test results of Output Power Measurement

Technology Std.	Channel	Peak method			Peak output power (dBm eirp)
		Frequency (MHz)	Data rate		
ZigBee	11	2405	250 kbps		2.09
	19	2445	250 kbps		1.61
	26	2480	250 kbps		1.06
Uncertainty	±0.63 dB				

3.3.6 Plots of Output Power Measurement

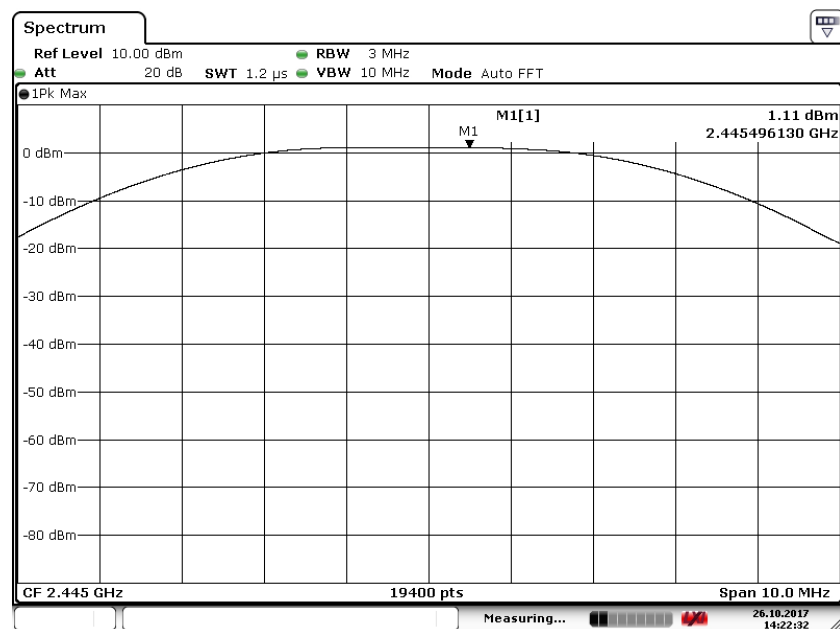
Peak Output Power (Channel 11)



Bt, channel: 78 : Measure RX Spurious Emission 1 - 12.5 GHz

Date: 26.OCT.2017 14:19:48

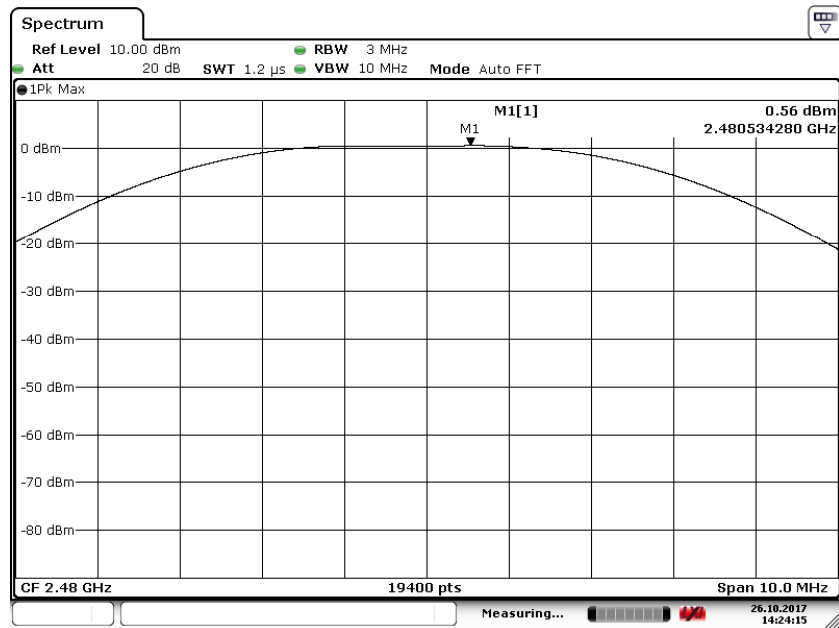
Peak Output Power (Channel 19)



Bt, channel: 78 : Measure RX Spurious Emission 1 - 12.5 GHz

Date: 26.OCT.2017 14:22:33

Peak Output Power (Channel 26)



Bt, channel: 78 : Measure RX Spurious Emission 1 - 12.5 GHz
Date: 26.OCT.2017 14:24:15

3.4 Power Spectral Density

3.4.1 Limit

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

3.4.2 Measurement instruments

Not applicable.

3.4.3 Test setup

Not applicable.

3.4.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.

3.4.5 Test results of Power Spectral Density Measurement

Since the peak output power values are well below 8 dBm/3 kHz, the power spectral density limit is considered to be met.

3.5 Radiated spurious emissions measurement (incl. restricted band spurious emissions)

3.5.1 Limits

In any 100 kHz bandwidth outside the operating frequency band, the RF power 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 a RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Attenuation below the general limits specified in §15.209 (a) is not required.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the limits specified in §15.209(a) (see below).

Frequency (MHz)	Field strength ($\mu\text{V/m}$)	Measurement distance(m)
0.009 – 0.490	$2400/F(\text{kHz})$	300
0.490 – 1.705	$24000/F(\text{kHz})$	30
1.705 - 30	30	30
30 -88	100	3
88 - 216	150	3
216-960	200	3
Above 960	500	3

3.5.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.5.3 Test setup

The test setup is as shown in chapter 2.4 of this report.

3.5.4 Test procedure

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz.

Radiated emission limits in these three bands are based on measurements employing an average detector.

Other details are according to KDB Publication 558074 V04, sections 11.3 and 12.1.

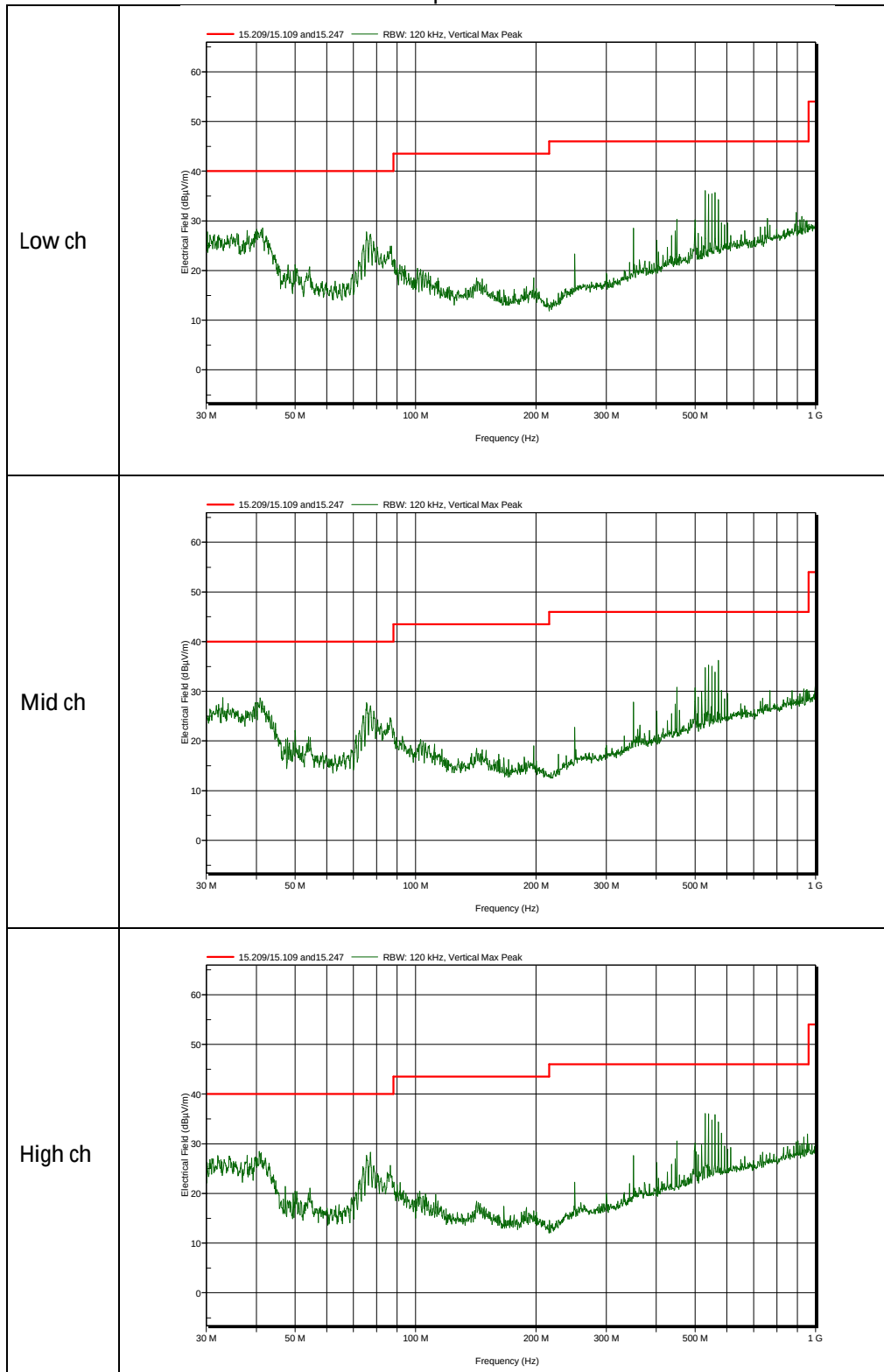
3.5.5 Note

- In the frequency range of 1 – 18 GHz the green trace is measured using a peak detector and the red trace is measured using an average detector. The top limit line represent the peak limit and the bottom limit represents the average limit.

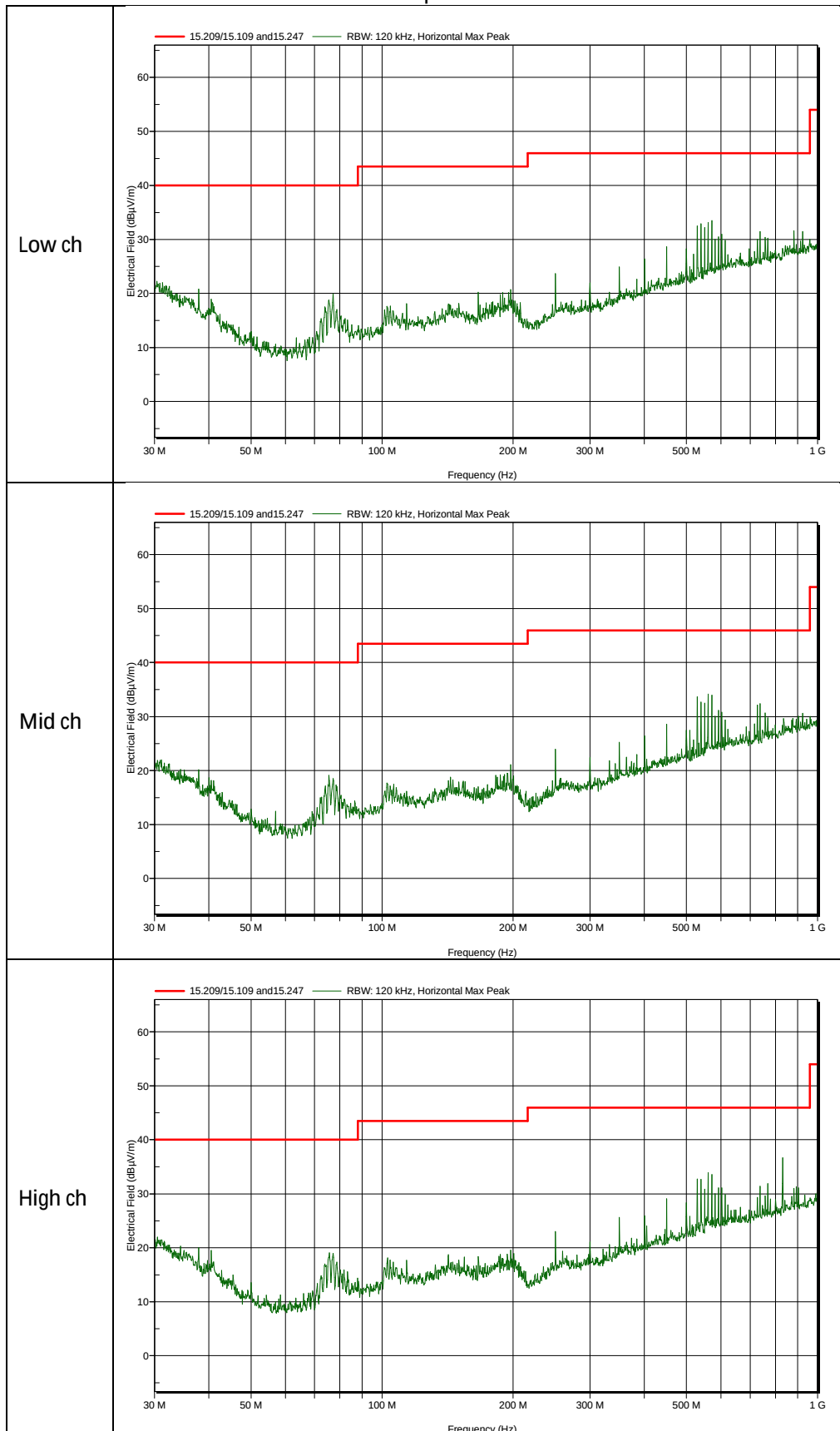
3.5.6 Plots of the Radiated Spurious Emissions Measurement

30 – 1000 MHz

Vertical polarization

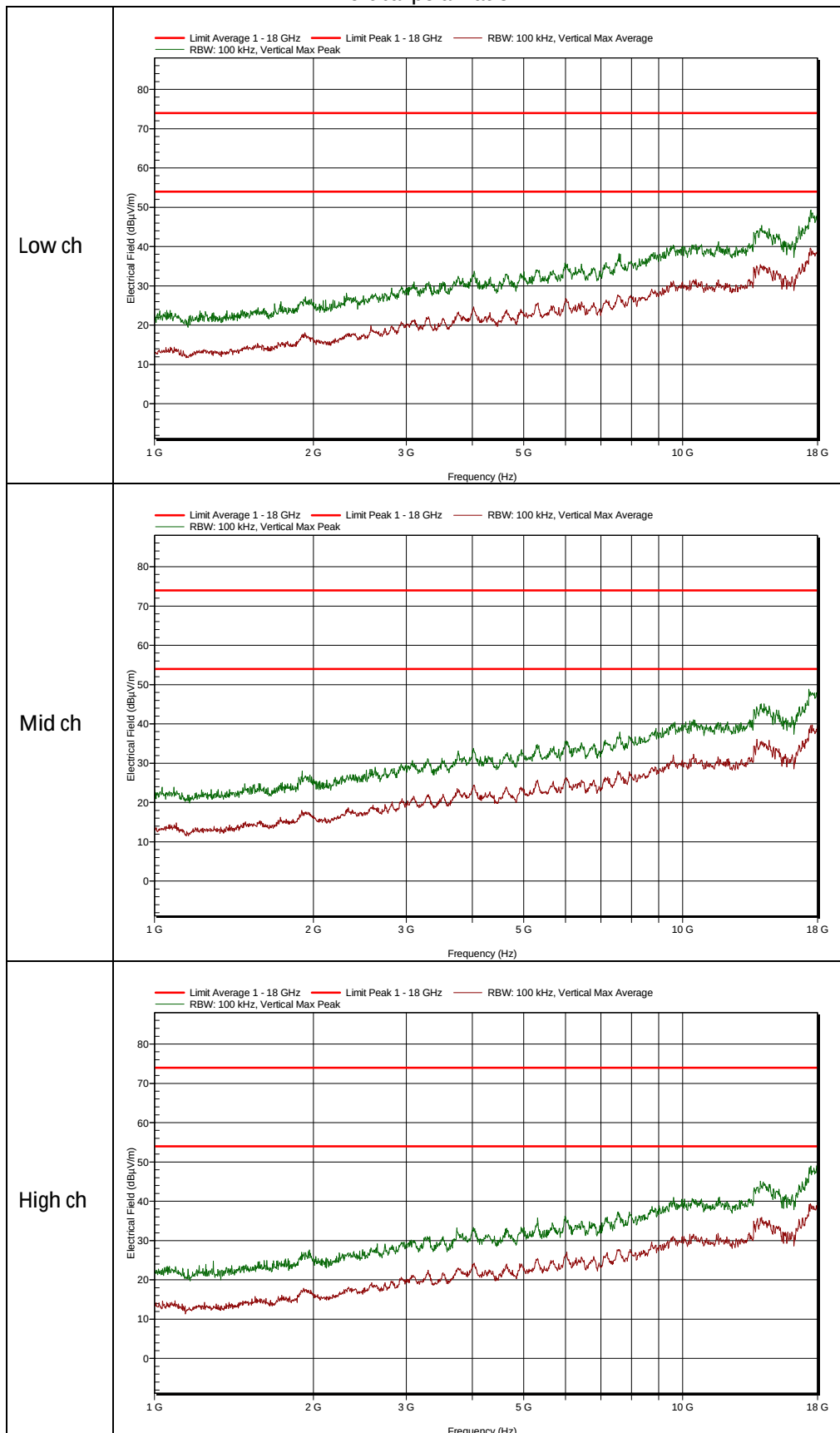


Horizontal polarization

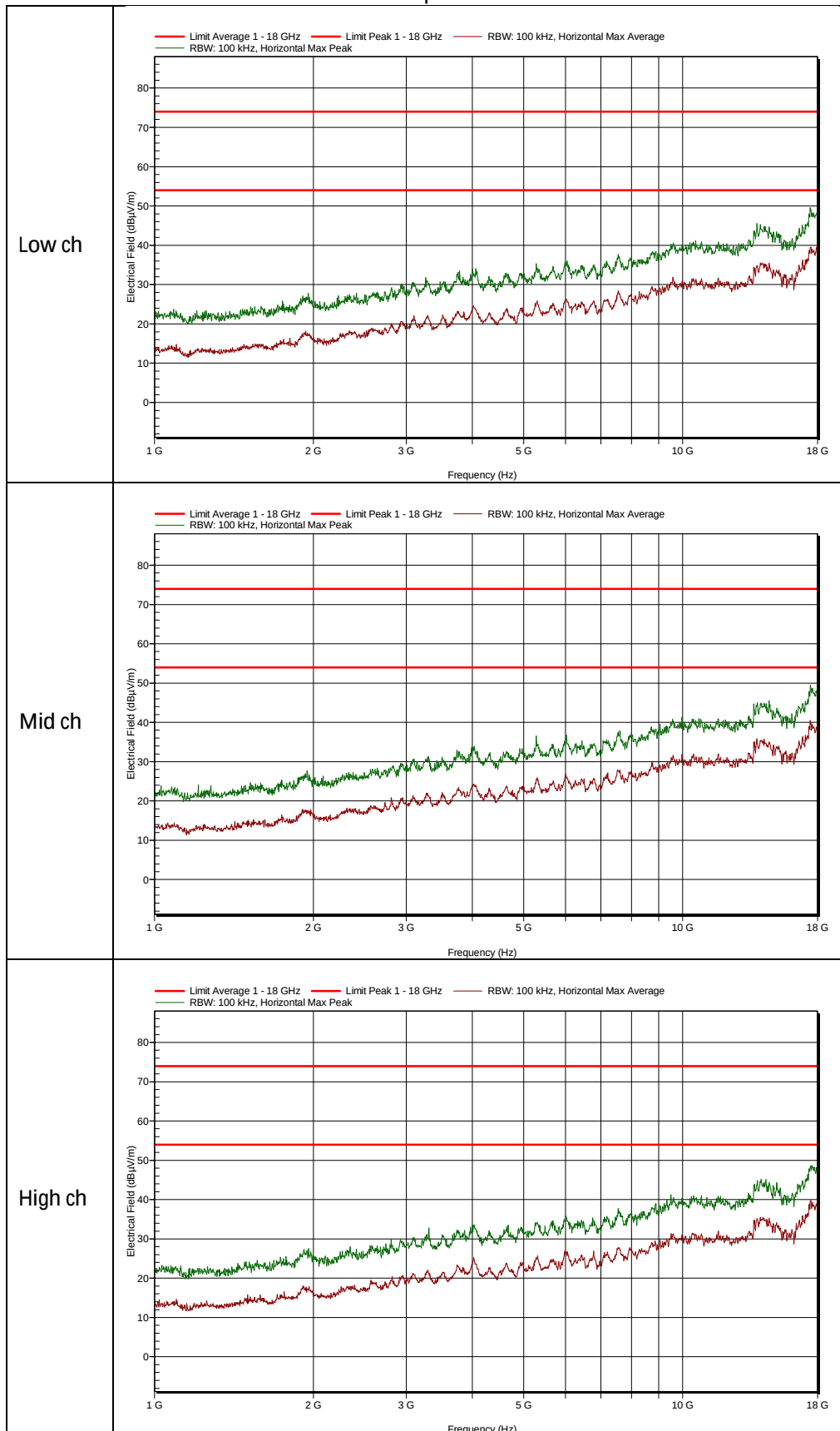


1 – 18 GHz

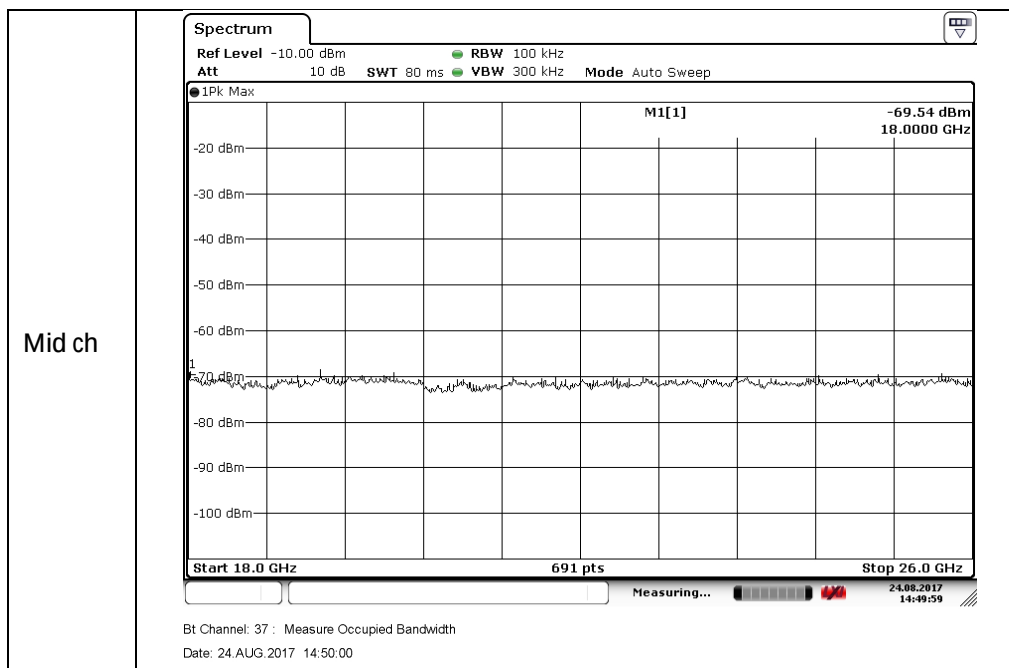
Vertical polarization



Horizontal polarization



18 GHz to 26.5 GHz



Note: The measurement above is performed as a pre-scan (middle channel only) on the temporary antenna connector. As no spurious emissions above the test system noise floor are observed, the radiated measurement is omitted.

3.5.7 Measurement Uncertainty

Measurement uncertainty Radiated emissions below 1 GHz

Horizontal polarization	
30 – 200 MHz	4.5 dB
200 – 1000 MHz	3.6 dB
Vertical polarization	
30 – 200 MHz	5.4 dB
200 – 1000 MHz	4.6 dB

Measurement uncertainty Radiated emissions above 1 GHz

1000- 18000 MHZ	5.7 dB
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Measurement uncertainty Conducted emissions above 1 GHz

18000- 26500 MHZ	Not applicable
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3.6 AC mains conducted emissions measurement (non-PoE version)

3.6.1 Limit

According to 15.207 (a)

an intentional radiator 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.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

3.6.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.6.3 Test setup

The test setup is as shown in chapter 2.4 of this report.

3.6.4 Test procedure

According to ANSI C63.10: 2013, section 6.2.

3.6.5 Test results and plots of the AC mains conducted measurement

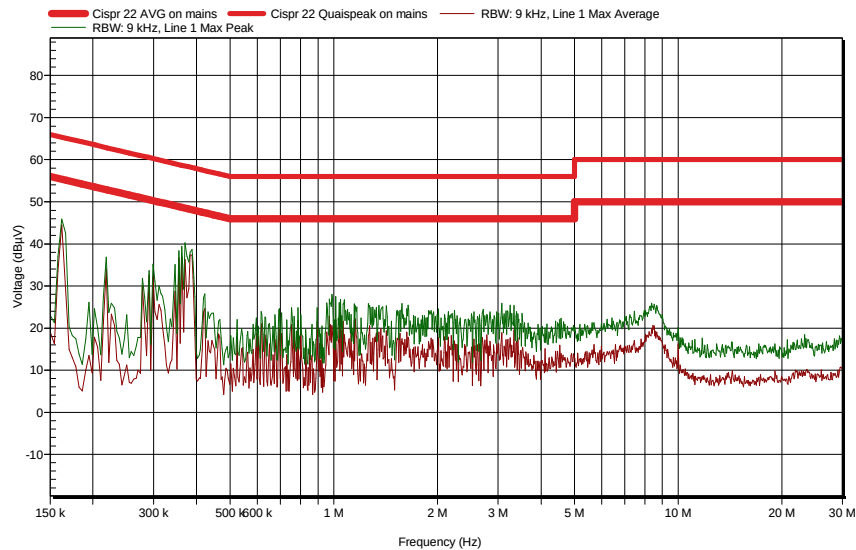
See next page.

3.6.6 Measurement uncertainty

+/- 3.6 dB

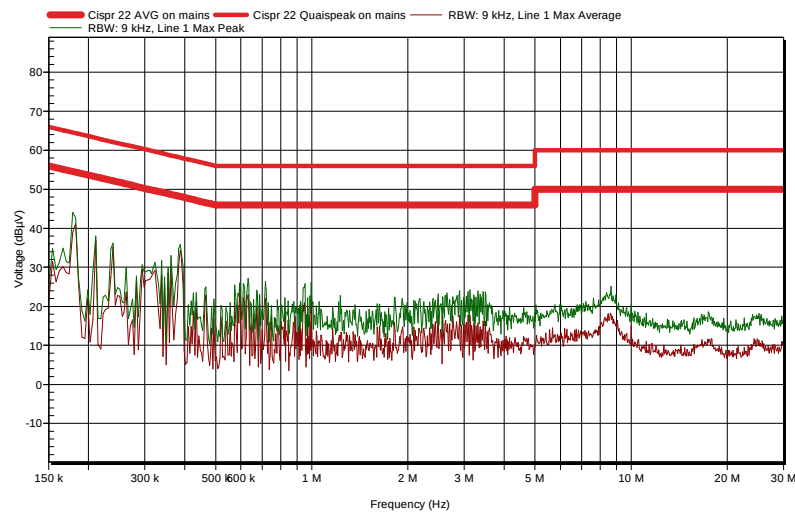
3.6.7 Plots of the AC mains conducted spurious measurement

Phase



Note: Peak value is already below the Quasi peak limit so no quasi peak measurement was performed

Neutral



Note: Peak value is already below the Quasi peak limit so no quasi peak measurement was performed

3.7 AC mains conducted emissions measurement (PoE version)

3.7.1 Limit

According to 15.207 (a)

An intentional radiator 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.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

3.7.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.7.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.7.4 Test procedure

According to ANSI C63.10: 2013, section 6.2.

The sample is power supplied by the PoE (power over Ethernet) injector.

The test is performed on the AC terminals of the PoE injector, while a ping test is running on the Ethernet connection.

3.7.5 Test results and plots of the AC mains conducted emissions measurement

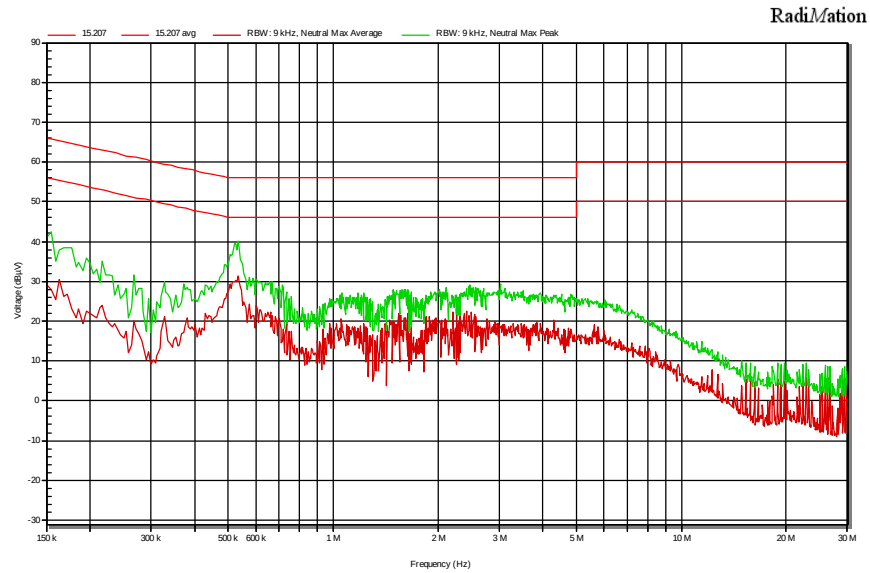
See next page.

3.7.6 Measurement uncertainty

+/- 3.6 dB

3.7.7 Plots of the AC mains conducted emissions measurement

Phase 110 Vac 60 Hz



Neutral 110 Vac 60 Hz

