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The Netherlands
Chamber of Commerce
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ETSI Test Report for EN 300 328 v2.2.2

Product name : iotspot LTE-M

Applicant : iottum B.V.

Test report No. : 191200470 001 v1.00

Laboratory information

Accreditation

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).

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.

Telefication is a Wireless Device Testing laboratory recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.
The Industry Canada registration number for the 3 meter test chamber of Telefication is: 4173A-1.

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Documentation

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at Telefication Netherlands.

Testing Location

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

Revision History

Version	Date	Remarks	By
v0.5	02-03-2020	First draft version	RvB
v1.0	29-03-2020	Initial release version	RvB

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Summary of Test results

EN 300 328 v2.2.2	Description	Section in report	Verdict
4.3.2.1	RF output power	3.1	Pass
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4.3.2.3	Power spectral density	3.3	Pass
4.3.2.8	Out- of-Band Spurious emissions	3.4	Pass
4.3.2.9	TX spurious emissions	3.5	Pass
4.3.2.10	RX Spurious emissions	3.6	Pass
4.3.2.11	RX blocking	3.7	Pass

1 General Description

1.1 Applicant

Client name:	Iottum B.V.
Address	Parcivalring 161, S'-Hertogenbosch, The Netherlands
Zip code:	5221 LC
E-mail:	marnix@iotspot.co
Contact name:	Mr. M. Lankhorst

1.2 Manufacturer

Manufacturer name:	Iottum B.V.
Address:	Parcivalring 161, S'-Hertogenbosch, The Netherlands
Zip code:	5221 LC
E-mail:	marnix@iotspot.co
Contact name:	Mr. M. Lankhorst

1.3 Tested Equipment Under Test (EUT)

Product name:	iotspot LTE-M
Brand name:	iotspot
Product type:	iotspot LTE-M is an on-premise, low-voltage powered device that transmits and receives GSM and Bluetooth signals, transmits passive NFC signals and emits LED light
Variant model(s):	--
Software version:	--
Hardware version:	--
Date of receipt	27-01-2020
Tests started:	27-01-2020
Testing ended:	30-01-2020

1.4 Product specifications of Equipment under test

TX Frequency range (MHz):	2400 – 2483.5
RX frequency range (MHz):	2400 – 2483.5
Antenna type:	Chip Antenna
Antenna gain (dBi):	0.5
Type of modulation:	GFSK
Receiver category:	2

1.5 Observations and remarks

The manufacturer provided both a radiated sample and conducted sample for radio testing.

1.6 Environmental conditions

Test date	28-01-2020	29-01-2020	30-01-2020
Ambient temperature	20.6°C	20.7°C	21.8°C
Humidity	39.0%	35.0%	35.0%

1.7 Measurement standards

- EN 300 328 v2.2.2

1.8 Applicable standards

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

- EN 300 328 v2.2.2

1.9 Observation sand Remarks.

The EUT contains a BLE radio and LTE-M/GSM module. This report covers the BLE radio.

1.10 Conclusions

The sample of the product showed NO NON-COMPLIANCES to the specifications stated in paragraph 1.8 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 1.8 *"Applicable standards".*

All tests are performed by:

Name : ing R. Van Barneveld

Review of test methods and report by:

Name : ing P.A. Suringa

The above conclusions have been verified by the following signatory:

Date : 30-03-0-2020

Name : ing P.A. Suringa

Function : Senior test engineer

Signature :

2 Test configuration of the Equipment Under Test

2.1 Test mode

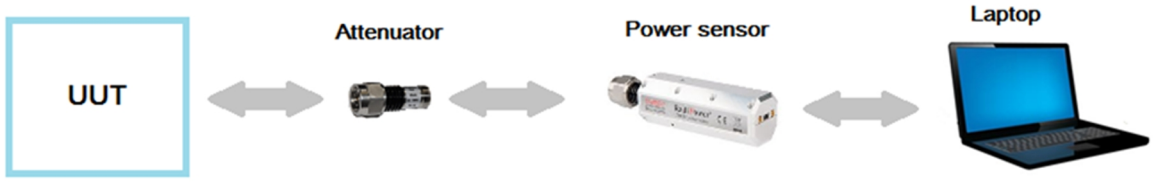
The applicant provided test mode firmware for the EUT, in which it was possible to configure the EUT into different test channels.

2.2 Tested channels and Data rates

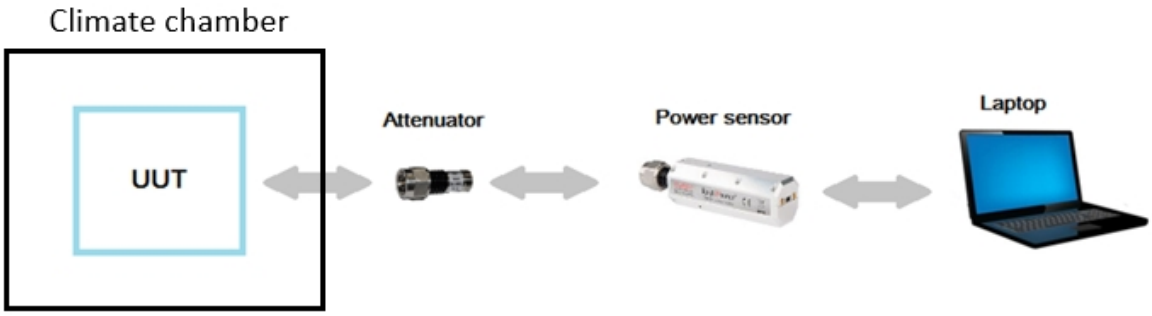
Technology	Channels	Data rate	Frequency (MHz)
Bluetooth Low energy	37 (Low)	1 Mbps	2402
	17 (Mid)	1 Mbps	2440
	39 (High)	1 Mbps	2480

2.3 Test setups

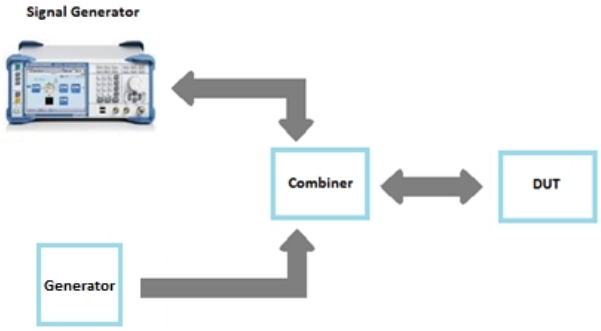
Test setup for E.I.R.P



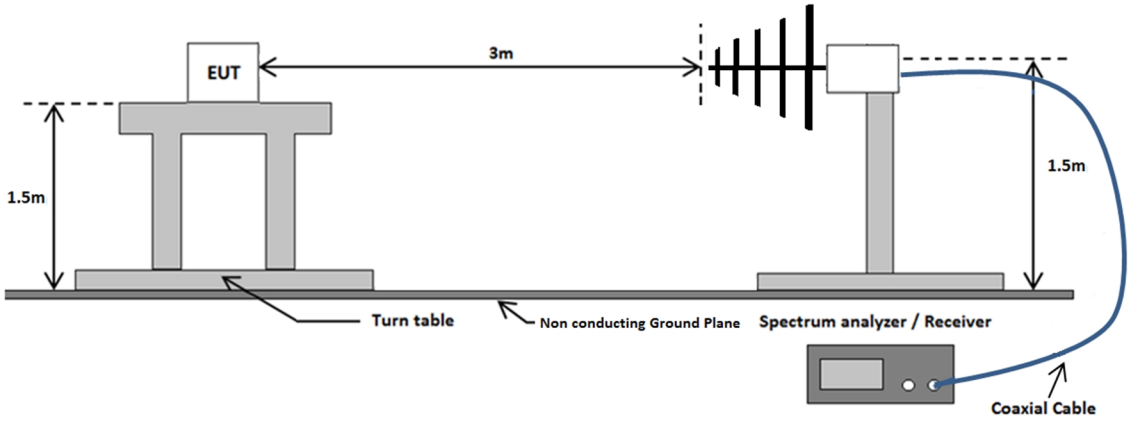
Test setup for E.I.R.P at extreme conditions



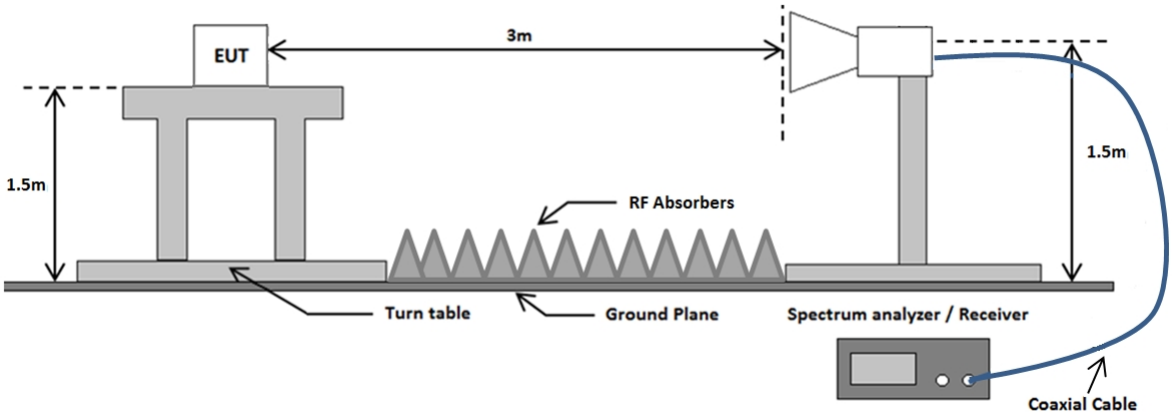
Test Setup for receiver tests: Receiver Blocking



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



2.4 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
Spectrum Analyzer	Rohde & Schwarz	FSV40	TE01269	3.2 -3.6
Signal Generator	Rohde & Schwarz	SMBV100a	TE01280	3.7
Power sensor	DARE	RPR3006W	TE11140	3.1
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	3.5, 3.6
Climate chamber	CTS	C-40/350	TE00741	3.1
High pass filter	Wainwright instruments	WHK10-2520-3000-18000	TE01146	3.5
Radimation software	DARE	2016.2.8	--	3.1
Pre amplifier	Hewlett Packard	8449B	TE00092	3.5, 3.6
Pre amplifier	Rohde & Schwarz	ESV-Z3	TE00098	3.5, 3.6
Anechoic Room	Euroshield	RFB-F-100	TE01064	3.5, 3.6
Directional coupler	Hewlett Packard	HP87300C	TE00505	3.7
6 dB attenuator	Hewlett Packard	8491A	TE00403	3.7

3 Test results

3.1 RF output power Measurement

3.1.1 Limit

The maximum RF output power = 20 dBm.

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 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

According to chapter 5.4.2 of EN 300 328 v2.2.2
IRN 014 – Method 3

3.1.5 Test Results of the RF output power Measurement

BLE

Test conditions	Frequency (MHz)	Data rate	Output power (dBm)
T_{min} 5°C	2402	1 Mbps	-5.0
T_{nom} 20°C			-5.1
T_{max} 35°C			-4.5
Uncertainty:	±0.986 dB		

Test conditions	Frequency (MHz)	Data rate	Output power (dBm)
T_{min} 5°C	2440	1 Mbps	-4.5
T_{nom} 20°C			-4.4
T_{max} 35°C			-4.6
Uncertainty:	±0.986 dB		

Test conditions	Frequency (MHz)	Data rate	Output power (dBm)
T_{min} 5°C	2480	1 Mbps	-4.6
T_{nom} 20°C			-4.3
T_{max} 35°C			-4.6
Uncertainty:	±0.986 dB		

3.2 99% Occupied Bandwidth

3.2.1 Limit

The occupied bandwidth shall completely inside the band 2400 – 2483.5 MHz.

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 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

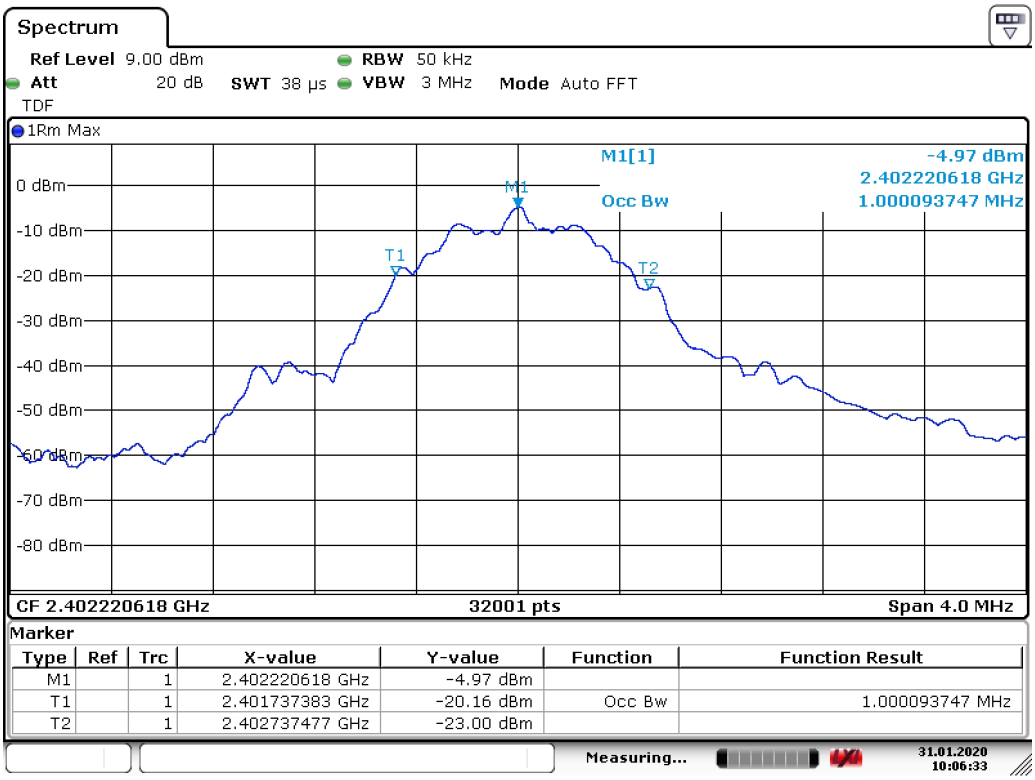
According to chapter 5.4.7 of EN 300 328 v2.2.2
IRN 017 – Method 1

3.2.5 Test results of the 99% Occupied Bandwidth Measurement

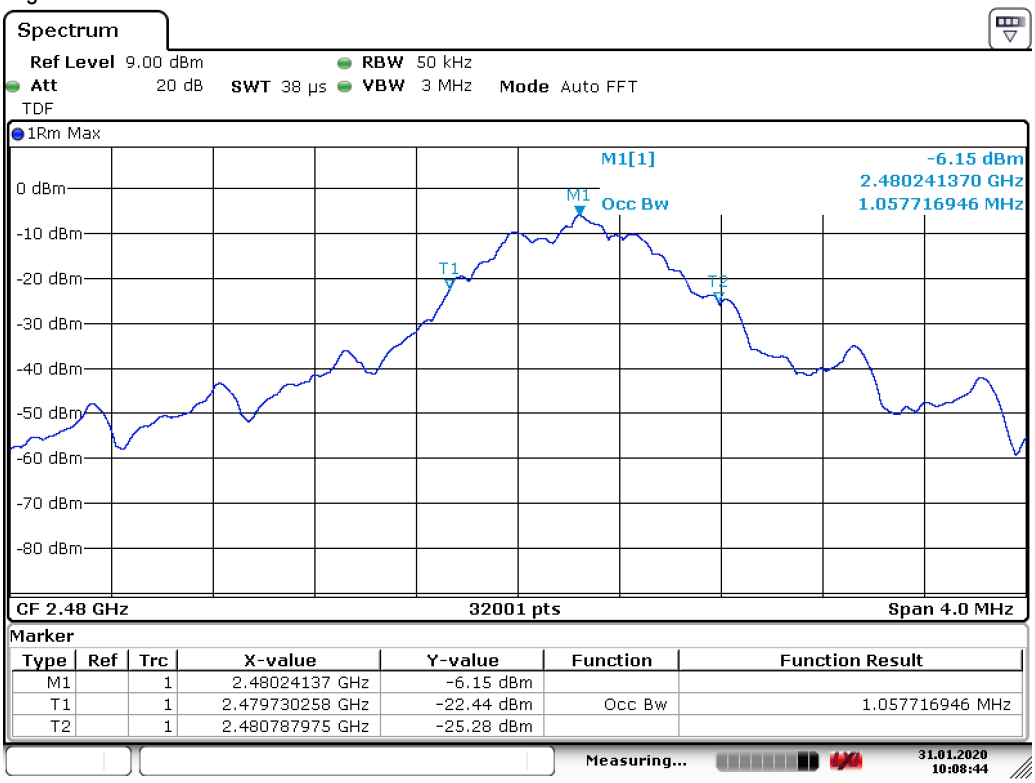
Technology Std.	Channel	Frequency (MHz)	Data rate	99% OBW (MHz)
Bluetooth Low energy	37 (Low)	2402	1 Mbps	1.00
	39 (High)	2480	1 Mbps	1.05
Uncertainty	± 12 kHz			

3.2.6 Plots of the 99% Occupied Bandwidth Measurement

Low channel



High channel



3.3 Power Spectral Density

3.3.1 Limit

10 dBm per MHz.

3.3.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 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

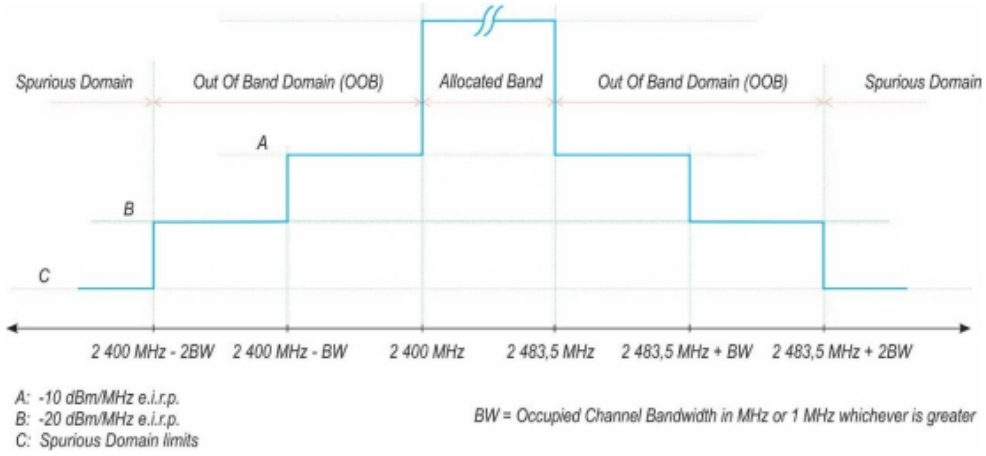
According to chapter 5.4.3 of EN 300 328 V2.2.2
IRN 030 – Method 4

3.3.5 Test results of Power Spectral Density Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	PSD (dBm /MHz)
Bluetooth Low energy	37 (Low)	2402	1 Mbps	-7.71
	17 (Mid)	2442		-7.3
	39 (High)	2480		-7.23
Uncertainty	±0.986 dB			

3.4 Out-of-Band Emissions

3.4.1 Limit



3.4.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.4.3 Test setup

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

3.4.4 Test procedure

According to chapter 5.4.8 of EN 300 328 v2.2.2
IRN 025 – Method 3

3.4.5 Test results of the OOB Measurements

BLE Out-of-band emissions
Low channel

Frequency (MHz)	Out of band level (dBm/MHz)
2398.5	-45.07
2399.5	-48.42
2400-2483.5	--
2484	-61.91
2485	-62.71
Uncertainty	± 1.4 dB

High channel

Frequency (MHz)	Out of band level (dBm/MHz)
2398.5	-63.02
2399.5	-62.98
2400-2483.5	--
2484	-49.13
2485	-51.26
Uncertainty	± 1.4 dB

3.5 TX Radiated Spurious Emissions Measurement

3.5.1 Limit

Frequency range	Power
30 – 47 MHz	-36 dBm
47 – 74 MHz	-54 dBm
74 – 87.5 MHz	-36 dBm
87.5 – 118 MHz	-54 dBm
118 – 174 MHz	-36 dBm
174 – 230 MHz	-54 dBm
230 – 470 MHz	-36 dBm
470 – 862 MHz	-54 dBm
862 – 1000 MHz	-36 dBm
1 – 12.75 GHz	-30 dBm

3.5.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.5.3 Test setup

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

3.5.4 Test procedure

According to chapter 5.4.9 of EN 300 328 v2.2.2
IRN 016 – Method 1

3.5.5 Test results of TX Radiated Spurious Emissions Measurement

See next page.

3.5.6 Measurement Uncertainty

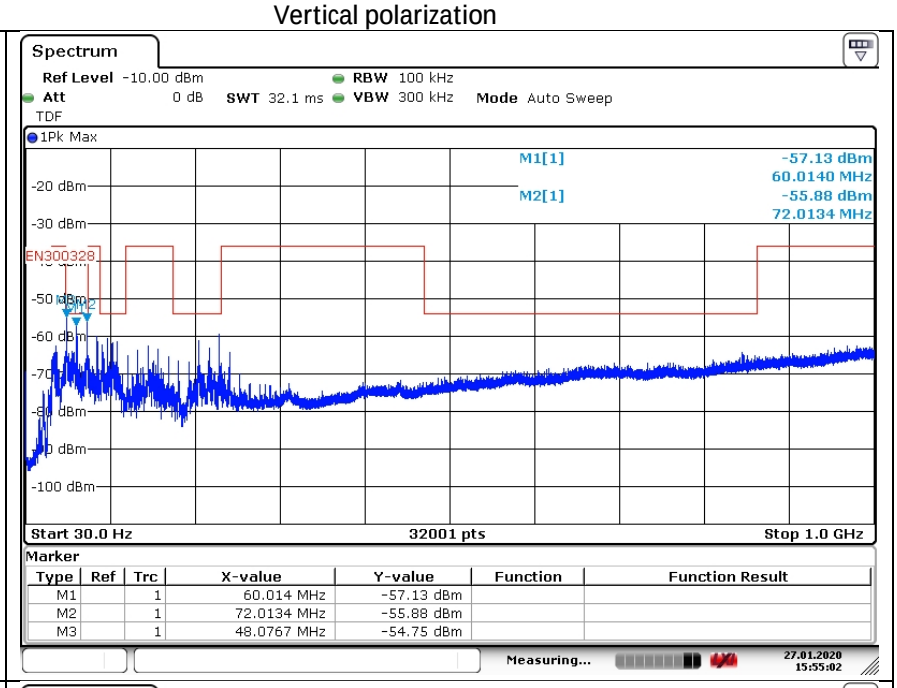
Frequency range	Measurement uncertainty
30 – 1000 MHz	±3.6
1 – 10 GHz	±3.5
10 – 18 GHz	±3.8

3.5.7 Plots of the TX Radiated Spurious Emissions Measurement

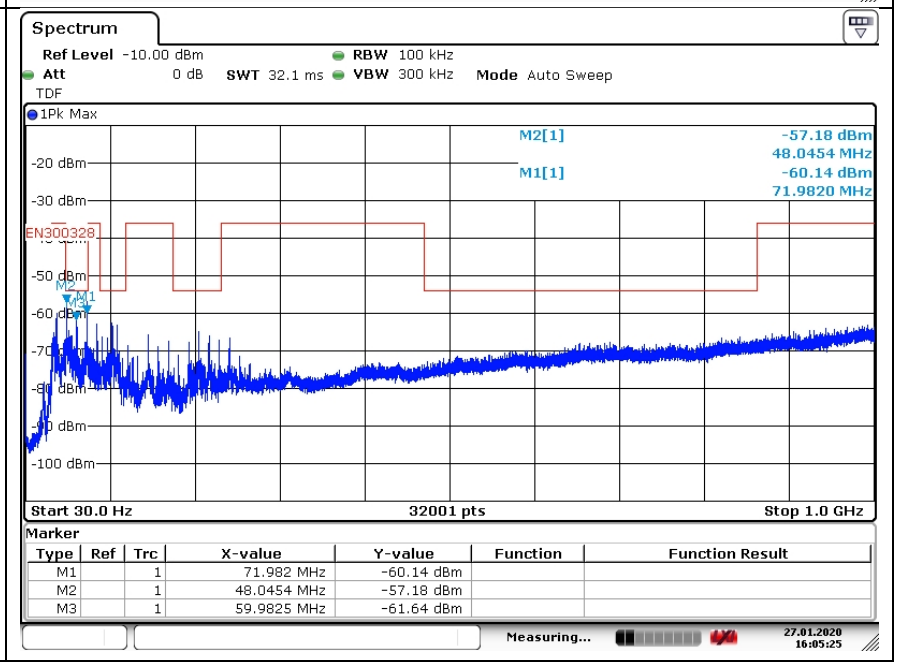
30 MHz to 1 GHz

Vertical polarization

Low ch



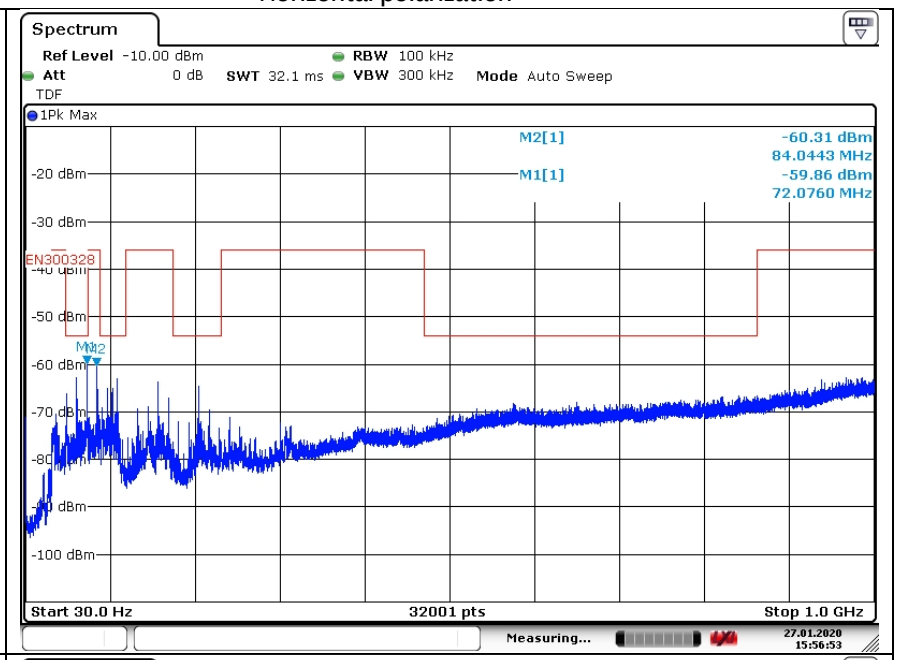
High ch



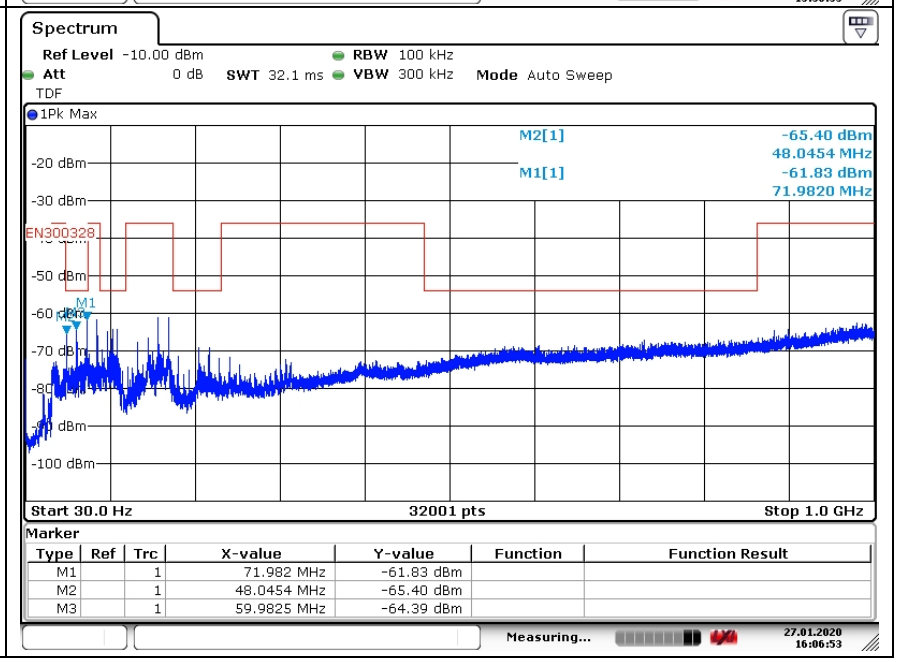
30 MHz to 1 GHz

Horizontal polarization

Low ch



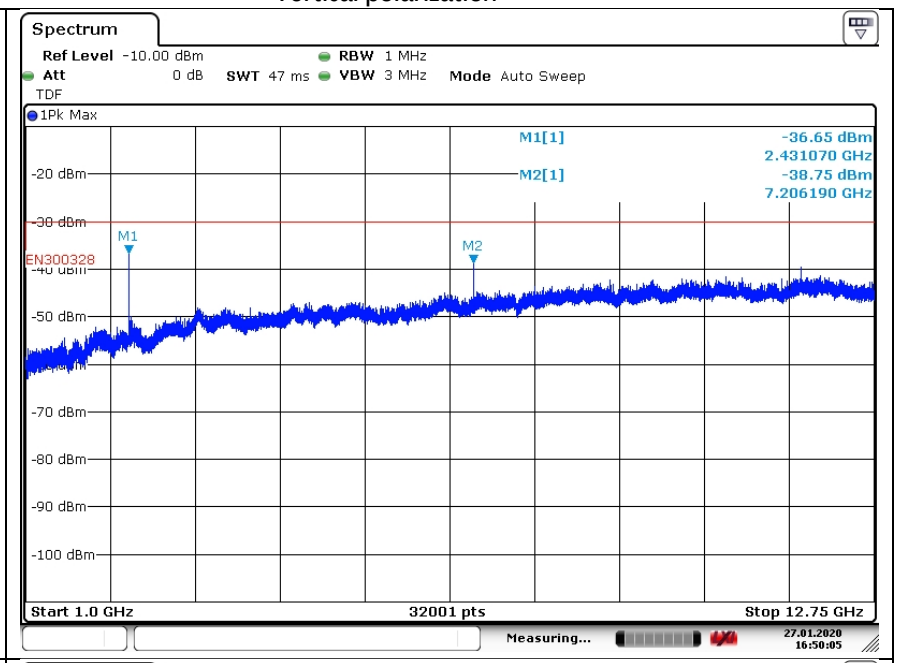
High ch



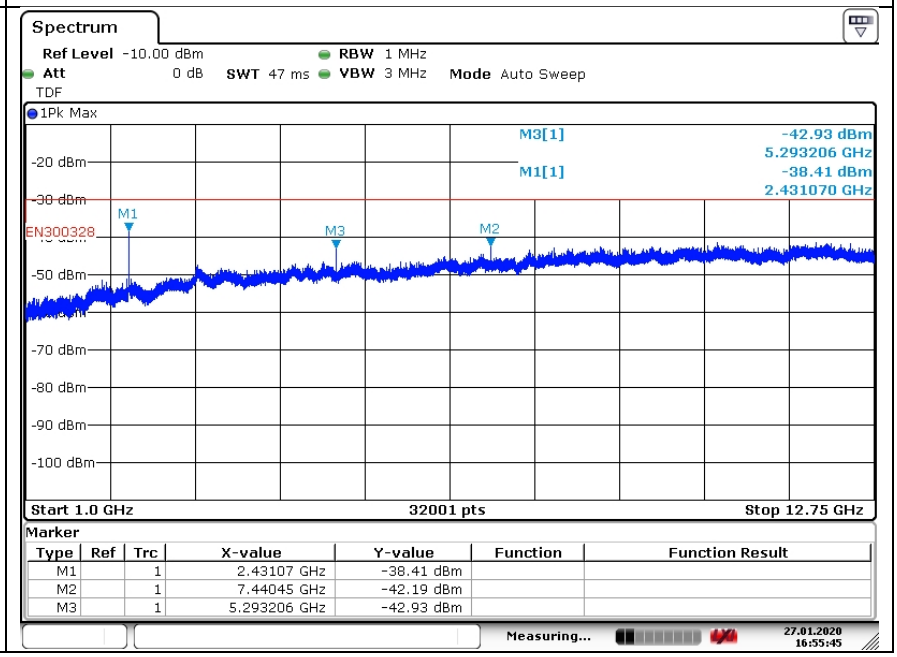
1 GHz to 12.75 GHz

Vertical polarization

Low ch



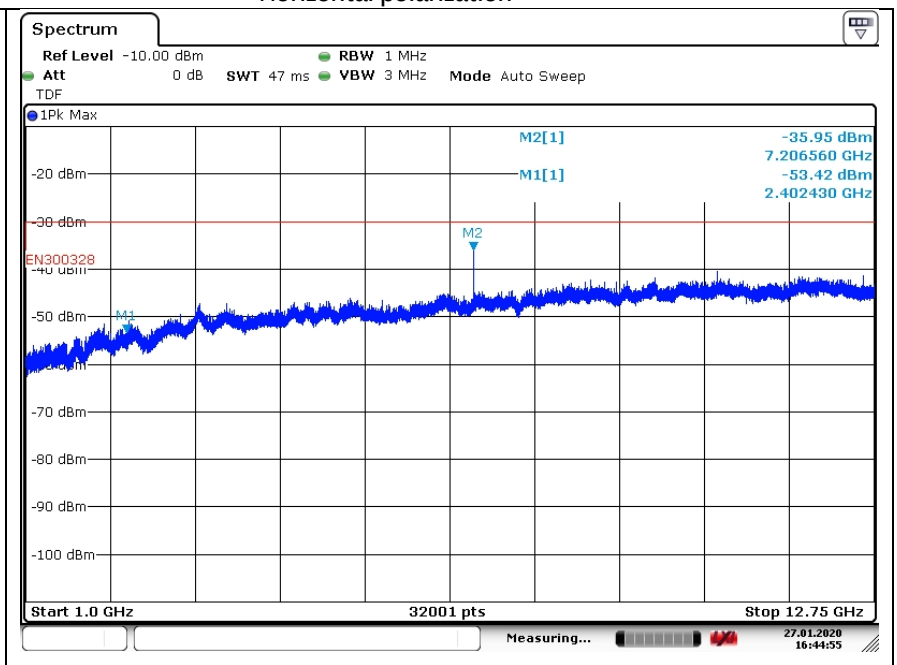
High ch



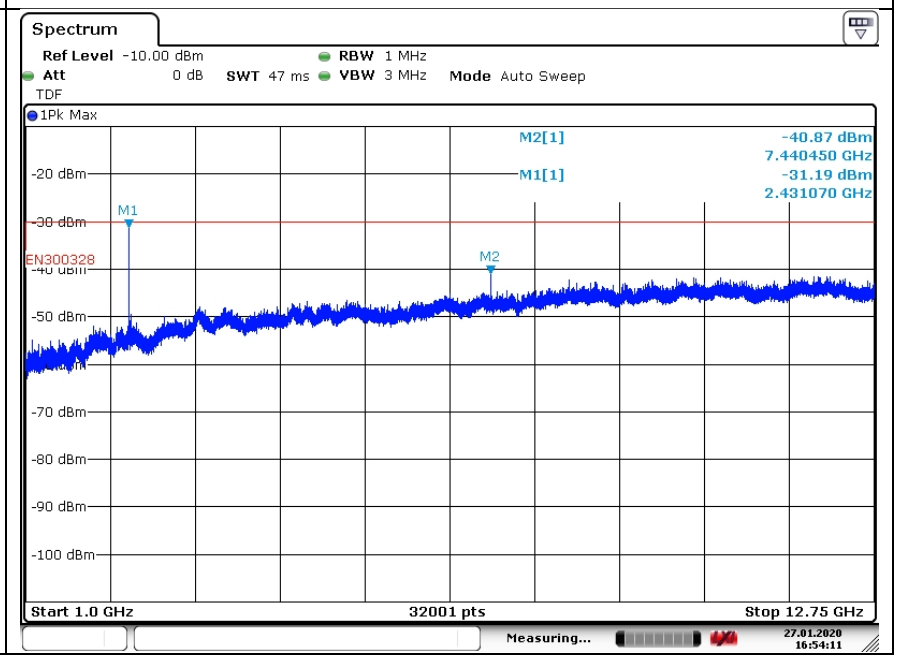
1 GHz to 12.75 GHz

Horizontal polarization

Low ch



High ch



Note: the fundamental frequency at 2480 MHz is not subject to the limit.

3.6 Radiated RX Spurious Emissions Measurement

3.6.1 Limit

Frequency range	Power
30 – 1000 MHz	-57 dBm
1 – 12.75 GHz	-47 dBm

3.6.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.6.3 Test setup

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

3.6.4 Test procedure

According to chapter 5.4.10 of EN 300 328 v2.2.2
IRN 016 – Method 1

3.6.5 Test results of RX Radiated Spurious Emissions Measurement

See next page.

3.6.6 Measurement Uncertainty

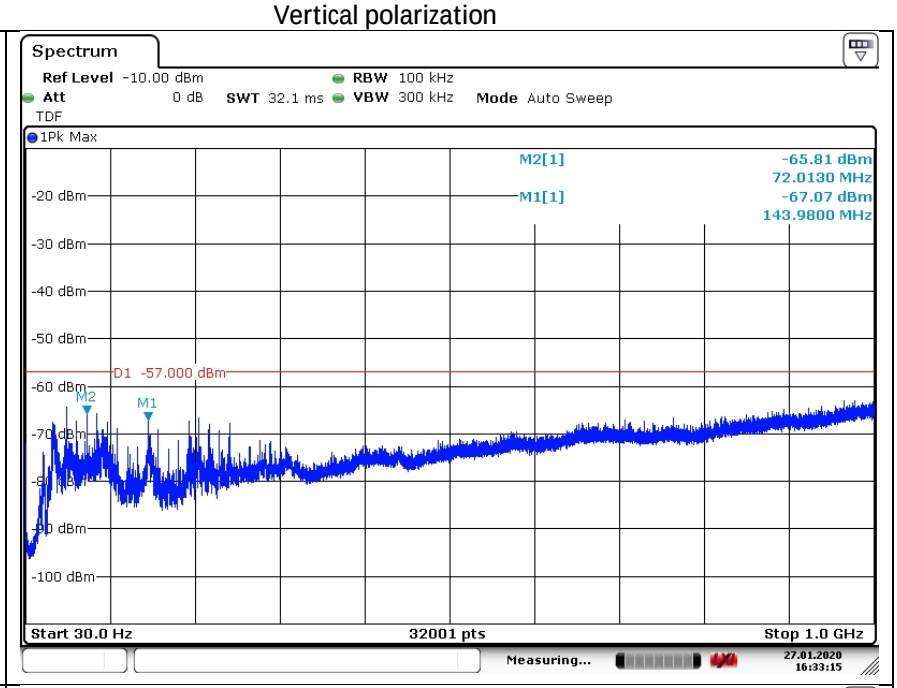
Frequency range	Measurement uncertainty
30 – 1000 MHz	±3.6
1 – 10 GHz	±3.5
10 – 18 GHz	±3.8

3.6.7 Plots of the RX Radiated Spurious Emissions Measurement

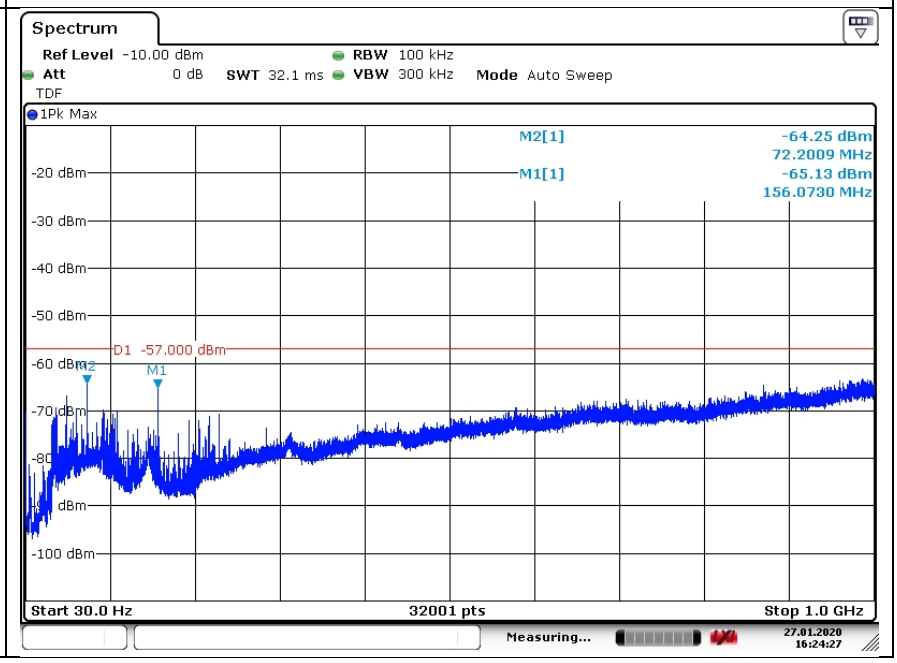
30 MHz to 1 GHz

Vertical polarization

Low ch

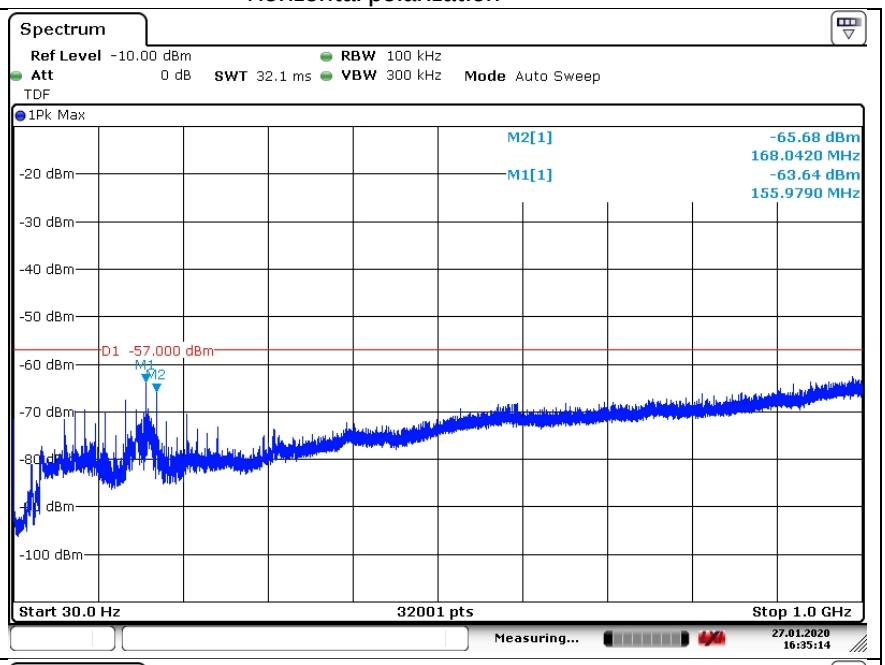
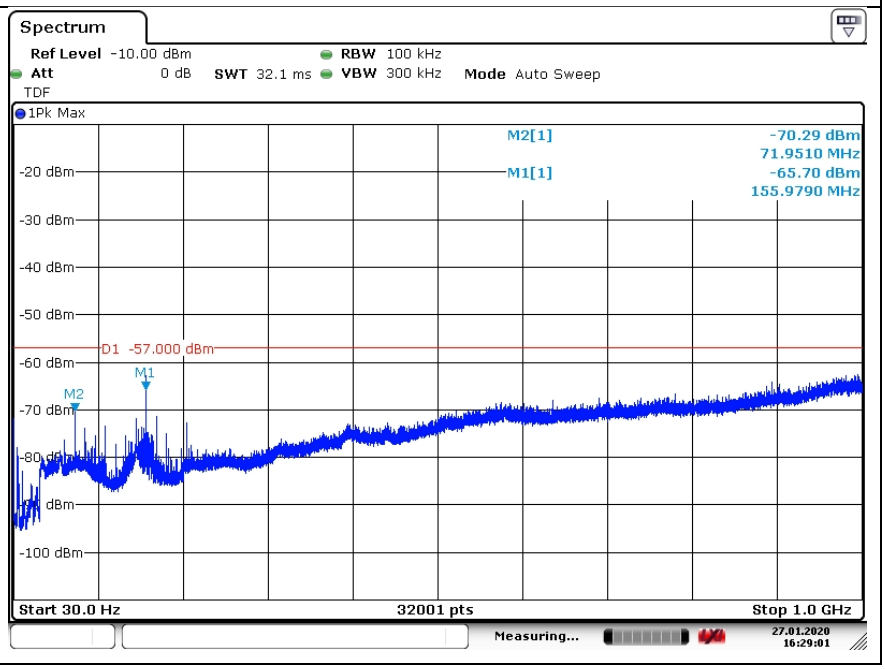


High ch



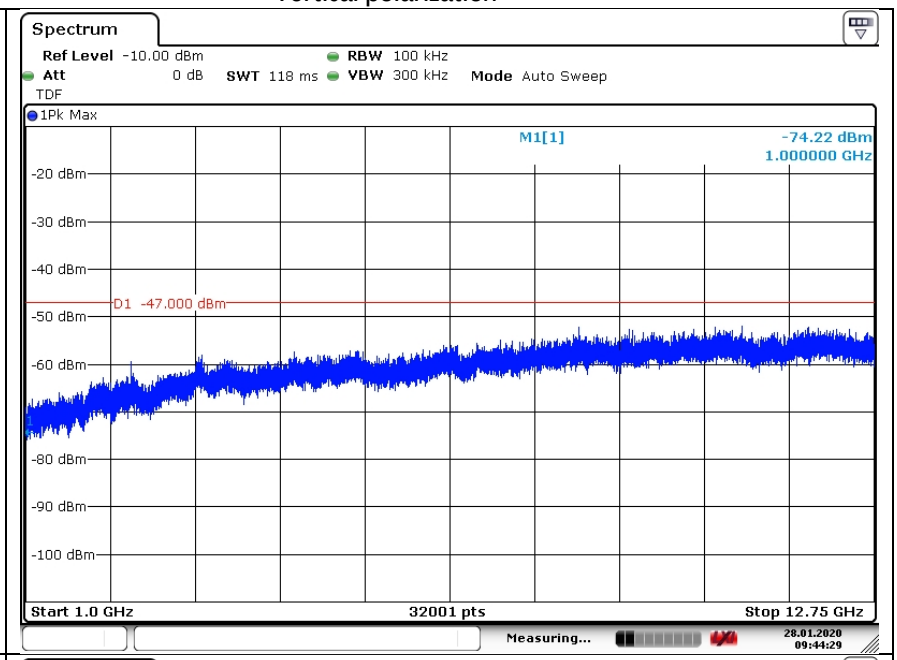
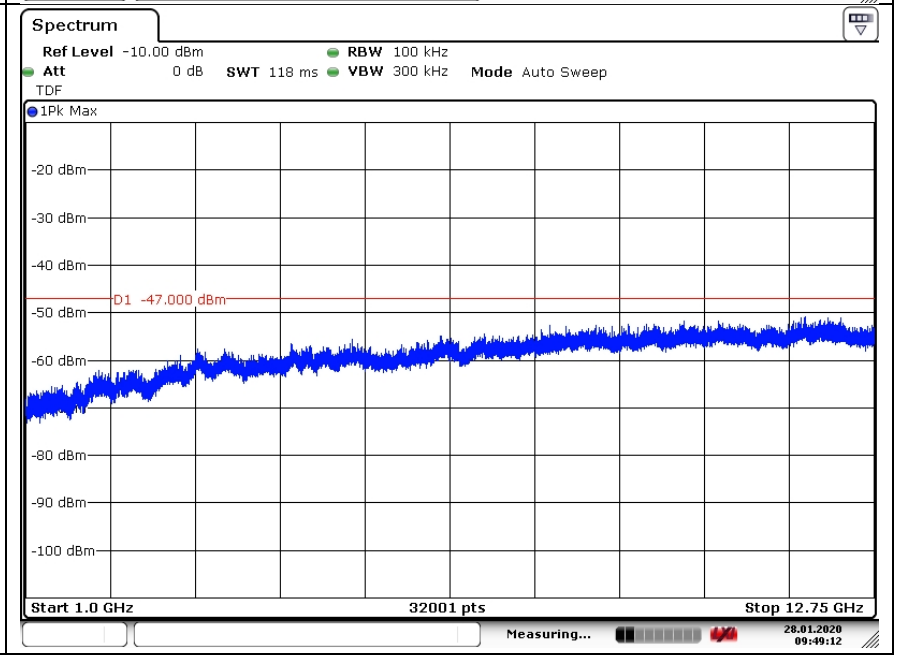
30 MHz to 1 GHz

Horizontal polarization

Low ch	
High ch	

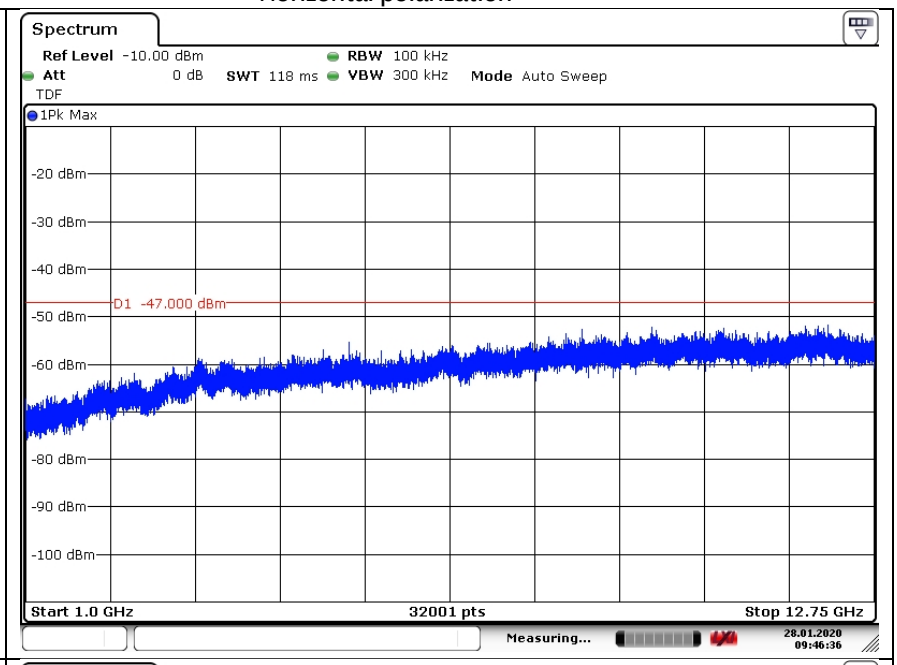
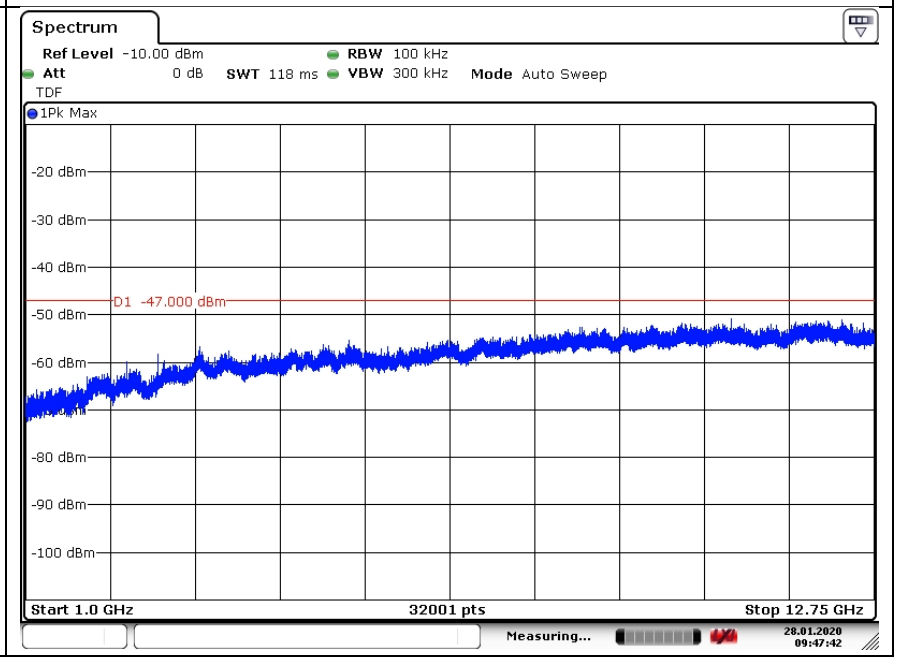
1 GHz to 12.75 GHz

Vertical polarization

Low ch	
High ch	

1 GHz to 12.75 GHz

Horizontal polarization

Low ch	
High ch	

3.7 Receiver blocking measurement

3.7.1 Limit

10% Packet Error Rate at the blocking levels stated in EN 300 328 v2.2.2, chapter 4.3.2.11

3.7.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.7.3 Test setup

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

3.7.4 Test procedure

See EN 300 328 v2.2.2, clause 5.4.11
IRN 021 – Method 1

3.7.5 Test results of the Receiver Blocking measurement

Low channel

Receiver category	Frequency of unwanted signal (MHz)	Minimum blocking level (dBm)	Per (%)
2	2300	-34	2
	2380	-34	2
	2504	-34	1
	2584	-34	1
Uncertainty:		+ 2.509/ -2.480 dB	

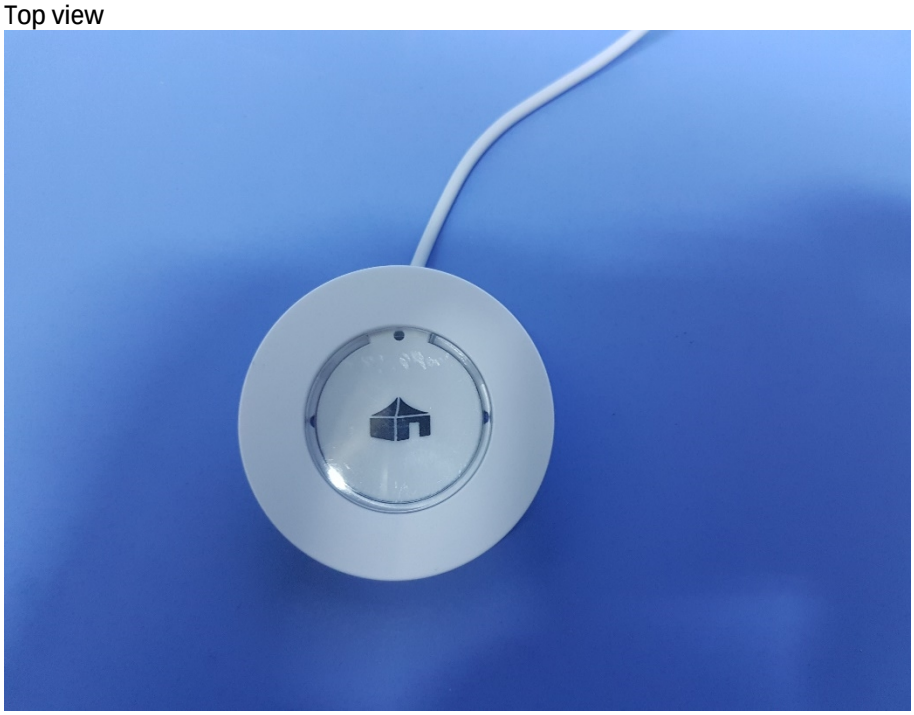
High channel

Receiver category	Frequency of unwanted signal (MHz)	Minimum blocking level (dBm)	Per (%)
2	2300	-34	2
	2380	-34	1
	2504	-34	0
	2584	-34	1
Uncertainty:		+ 2.509/ -2.480 dB	

4 Photo Module

4.1 External Photos

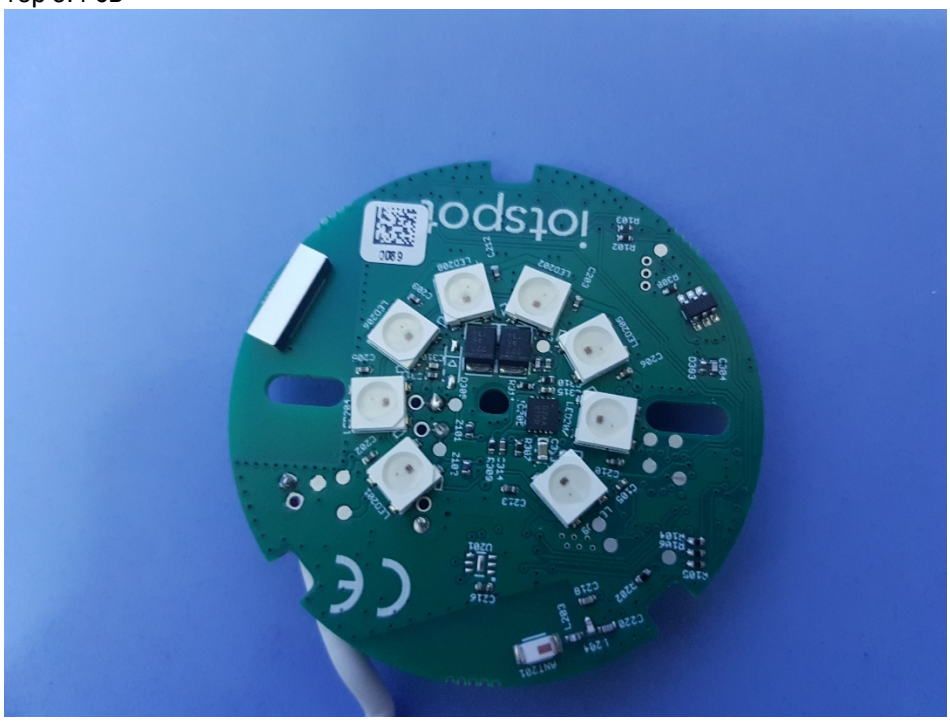
Top view



Bottom view

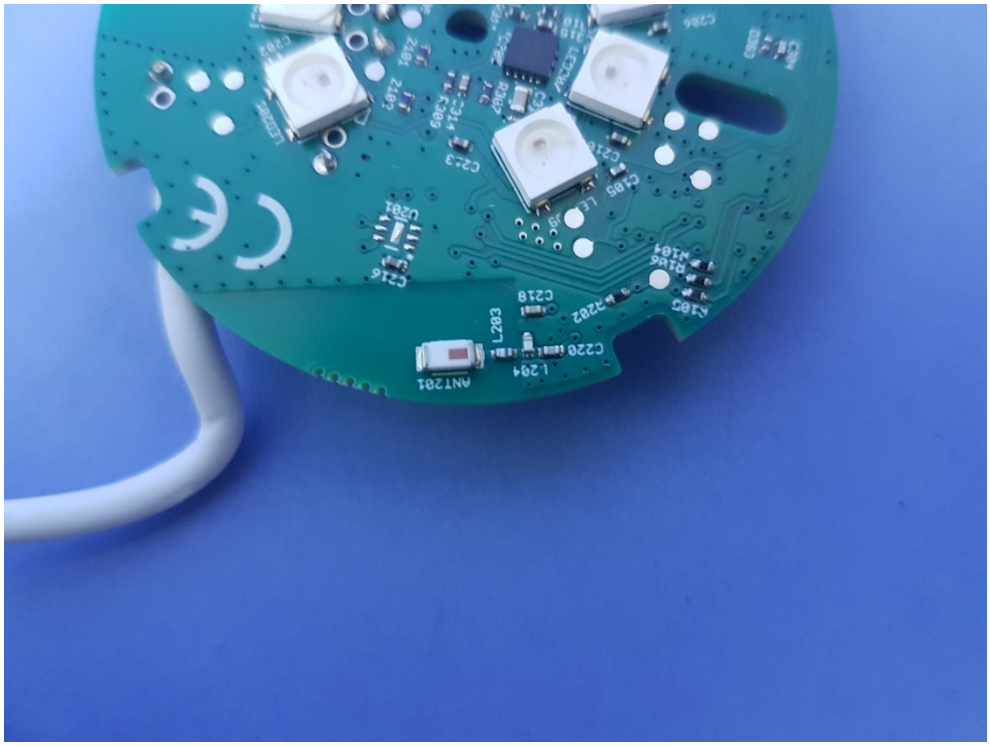
4.2 Internal Photos

Top of PCB

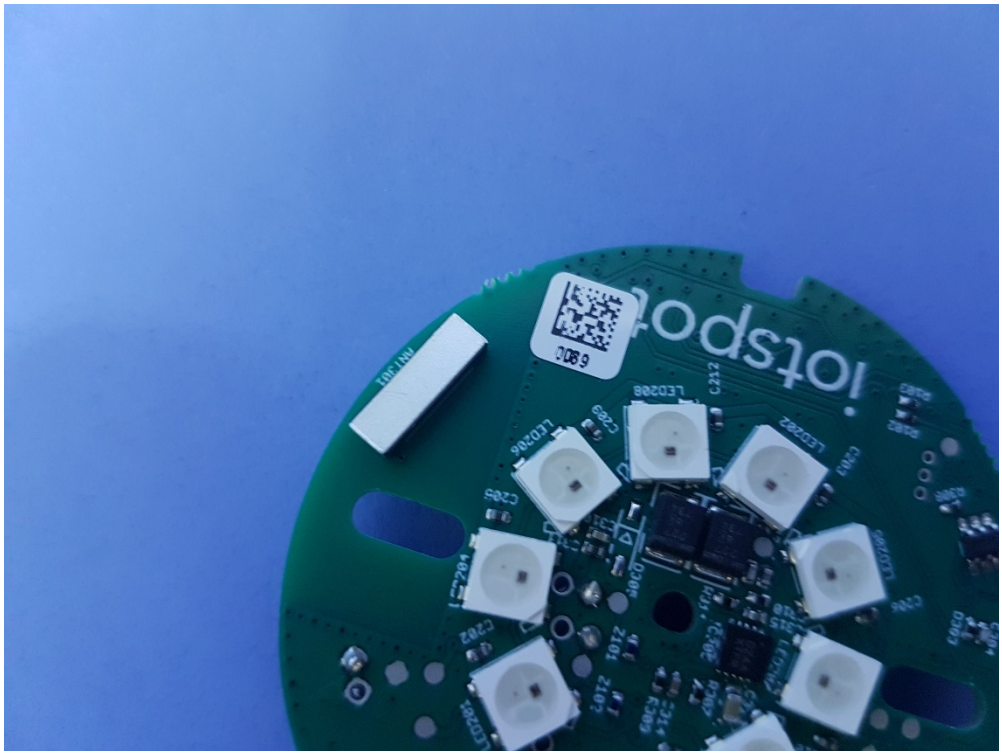


Top of PCB

BLE Antenna



LTE Antenna



4.3 Test setup Photos

Radiated emission 30 - 1000 MHz

Radiated emission 1 - 12.75 GHz