


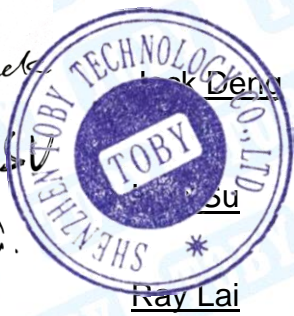


RF TEST REPORT

Certificate No. : TB200926511
Applicant : Heltec Automation Technology Co., Ltd
Equipment Under Test (EUT)
EUT Name : Heltec LoRa Gateway
Model No. : HT-M01
Serial Model No. : HT-M02, HT-M02S
Brand Name : ----
Receipt Date : 2020-09-13
Test Date : 2020-09-14 to 2020-10-16
Issue Date : 2020-10-17
Standards : ETSI EN 300 220-1 V3.1.1: 2017
ETSI EN 300 220-2 V3.2.1: 2018
Conclusions : **PASS**

In the configuration tested, the EUT complied with the standards specified above. The EUT technically complies with the Council Directive 2014/53/EU relating to radio equipment.

Test/Witness Engineer : 
Engineer Supervisor : 
Engineer Manager : 

Ray Lai



This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

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Revision History

Report No.	Version	Description	Issued Date
TB-RF175543	Rev.01	Initial issue of report	2020-10-17

1 General Information

1.1 Client Information

Applicant	:	Heltec Automation Technology Co., Ltd
Address	:	2-208, Block A, Yusha Building, 64 Hangtian Road, Longtan Industrial Park, Chenghua District, Chengdu, Sichuan, China
Manufacturer	:	Heltec Automation Technology Co., Ltd
Address	:	2-208, Block A, Yusha Building, 64 Hangtian Road, Longtan Industrial Park, Chenghua District, Chengdu, Sichuan, China

1.2 General Description of EUT (Equipment Under Test)

EUT Name	:	Heltec LoRa Gateway	
Model No.	:	HT-M01, HT-M02, HT-M02S	
Model Difference	:	The all model only difference of color.	
Product Description	:	Lora: 866.7-869.7MHz	
		Out Power(Max): 12.21dBm	
		Antenna Type:	External Antenna
		Antenna Gain:	3 dBi
		Receiver category:	2
		Modulation Type: LORA	
Power Rating	:	Input: DC 5V,2A	
Software Version	:	V1.0	
Hardware Version	:	V2	
Connecting I/O Port(S)	:	Please refer to the User's Manual	

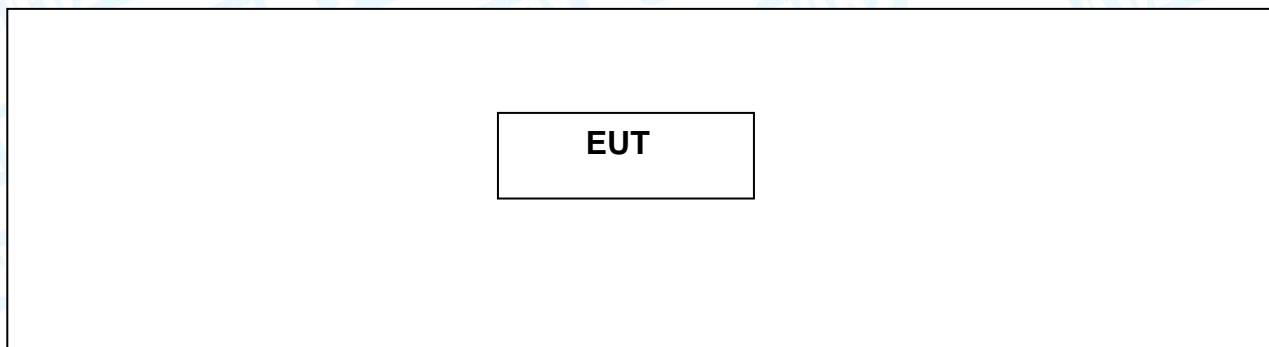
Note:

(1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

(2) Frequency List:

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
866.7	867.3	867.9	868.5	868.9	869.5
866.9	867.5	868.1	868.7	869.1	869.7
867.1	867.7	868.3	868.8	869.3	/

1.3 Block Diagram Showing the Configuration of System Tested



1.4 Description of Support Units

The EUT has been tested as an independent unit.

1.5 Description of Operating Mode

To investigate the maximum EMI emission characteristics generated from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Test Mode: Continuously transmitting		
	Frequency (MHz)	Test Frequency (MHz)
L	865MHZ-868MHZ	866.7
		867.9
M	868MHZ-878.6MHZ	868.5

Note:

- (1) The EUT is considered a portable unit, and it was pre-tested on the positioned of each 3 axis: X axis, Y axis and Z axis. The worst case was found positioned on Z-plane. There for only the test data of this Z-plane were used for radiated emission measurement test.

1.6 Description of Testing Condition

	Normal Test Conditions	Extreme Test Conditions
Temperature	15°C~35°C	-25°C~55°C
Humidity	20%~75%	N/A
Supply Voltage	DC 5.0V	DC 4.8V~DC 7.0V

Note :

- (1) For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in clause 4.3.4.1.2(EN 300 220-1), at the upper and lower temperatures of the range as follows:

General	-25°C to +55°C
Portable	-10°C to +55°C
Normal indoor use	+5°C to +35°C
Automotive	-40°C to +125°C

(2) **Mains voltage:**

The extreme test voltage for equipment to be connected to an AC mains source shall be the nominal mains voltage $\pm 10\%$.

Regulated lead-acid or gel-cell type batteries:

When the radio equipment is intended for operation from the usual type of regulated lead-acid battery power sources, the extreme test voltages shall be 1,3 and 0,9 multiplied by the nominal voltage of the battery (6 V, 12 V, etc.).

For float charge applications using "gel-cell" type batteries, the extreme test voltages shall be 1,15 and 0,85 multiplied by the nominal voltage of the declared battery voltage.

Power sources using other types of batteries:

The lower extreme test voltages for equipment with power sources using the following types of battery shall be:

- For the Leclanché or lithium type battery: 0,85 times the nominal voltage of the battery;
- For the nickel-cadmium type of battery: 0,9 times the nominal voltage of the battery. In both cases, the upper extreme test voltage shall be 1,15 times the nominal voltage of the battery.
- For other types of batteries, the lower extreme test voltage for the discharged condition shall be declared by the equipment provider.

The nominal voltage is considered to be the upper extreme test voltage in this case.

1.7 Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

Test Item	Expanded Uncertainty (U_{Lab})
Conducted Emission	± 3.10 dB
Radiated Emission (9kHz to 30 MHz)	± 4.60 dB
RF Power-Conducted	± 0.18 dB
RF level uncertainty for a given BER	± 1.5 dB
Radiated Emission (30MHz to 1000 MHz)	± 4.40 dB
Radiated Emission (Above 1000MHz)	± 4.20 dB
Temperature	$\pm 0.6^{\circ}\text{C}$
Humidity	$\pm 4\%$

1.8 Test Facility

The testing report were performed by the Shenzhen Toby Technology Co., Ltd., in their facilities located at 1A/F., Bldg.6, Yusheng Industrial Zone, The National Road No.107 Xixiang Section 467, Xixiang, Bao'an, Shenzhen, Guangdong, China. At the time of testing, the following bodies accredited the Laboratory:

CNAS (L5813)

The Laboratory has been accredited by CNAS to ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories for the competence in the field of testing. And the Registration No.: CNAS L5813.

A2LA Certificate No.: 4750.01

The laboratory has been accredited by American Association for Laboratory Accreditation(A2LA) to ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories for the technical competence in the field of Electrical Testing. And the A2LA Certificate No.: 4750.01.FCC Accredited Test Site Number: 854351.

IC Registration No.: (11950A)

The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing. The site registration: Site# 11950A.

2 Test Results Summary

Harmonised Standards EN 300 220-2					
Requirement			Requirement Conditionality		Result
No	Description	Reference: Clause No	U/C	Condition	-
1	Operating frequency	4.2.1	U	-	PASS
2	Unwanted emissions in the spurious domain	4.2.2	U	-	PASS
3	TX effective radiated power	4.3.1	U	-	PASS
4	TX Maximum e.r.p. spectral density	4.3.2	C	Applies to EUT using annex B bands I, L. Applies to EUT using DSSS or wideband techniques other than FHSS modulation, using annex C band X.	N/A
5	TX Duty cycle	4.3.3	C	Not applicable to EUT with polite spectrum access where permitted in annex B, table B.1 or annex C, table C.1 or any NRI.	PASS
6	TX Occupied bandwidth	4.3.4	U	-	PASS
7	TX out of band emissions	4.3.5	C	Applies to EUT with OCW > 25 kHz.	PASS
8	TX Transient Power	4.3.6	U	-	PASS
9	TX Adjacent channel power	4.3.7	C	Applies to EUT with OCW ≤ 25 kHz.	N/A
10	TX behaviour under low voltage conditions	4.3.8	C	Applies to battery powered EUT.	N/A
11	TX Adaptive power control	4.3.9	C	Applies to EUT with adaptive power control using annex C band AA.	N/A
12	TX FHSS	4.3.10	C	Applies to FHSS EUT.	N/A
13	TX Short term behaviour	4.3.11	C	Applies to EUT using annex C bands Y, Z, AA, AB, AC, AD.	N/A
14	RX sensitivity	4.4.1	C	Applies to EUT with polite spectrum access.	N/A
15	Clear channel assessment threshold	4.5.2	C	Applies to EUT with polite spectrum access.	N/A
16	Polite spectrum access timing parameters	4.5.3	C	Applies to EUT with polite spectrum access.	N/A
17	RX Blocking	4.4.2	U	-	PASS
18	Adaptive Frequency Agility	4.5.4	C	Applies to EUT with AFA.	N/A

Note:
 (1) "N/A" indicates test is not applicable in this Test Report.
 (2) "U/C": Indicates whether the requirement is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

3 Test Equipment

Used Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	144382	Sep. 11, 2020	Sep. 10, 2021
MXA Signal Analyzer	Agilent	N9020A	MY49100060	Sep. 11, 2020	Sep. 10, 2021
Vector Signal Generator	Agilent	N5182A	MY50141294	Sep. 11, 2020	Sep. 10, 2021
Analog Signal Generator	Agilent	N5181A	MY50141953	Sep. 11, 2020	Sep. 10, 2021
RF Power Sensor	DARE!! Instruments	RadiPowerRP R3006W	17I00015SNO26	Sep. 11, 2020	Sep. 10, 2021
	DARE!! Instruments	RadiPowerRP R3006W	17I00015SNO29	Sep. 11, 2020	Sep. 10, 2021
	DARE!! Instruments	RadiPowerRP R3006W	17I00015SNO31	Sep. 11, 2020	Sep. 10, 2021
	DARE!! Instruments	RadiPowerRP R3006W	17I00015SNO33	Sep. 11, 2020	Sep. 10, 2021
Spectrum Analyzer	Agilent	E4407B	MY45106456	Jul. 06, 2020	Jul. 05, 2021
EMI Test Receiver	Rohde & Schwarz	ESPI	100010/007	Jul. 06, 2020	Jul. 05, 2021
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar.01, 2020	Feb. 28, 2022
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar.01, 2020	Feb. 28, 2022
Pre-amplifier	Sonoma	310N	185903	Mar.01, 2020	Feb. 28, 2021
Pre-amplifier	HP	8447B	3008A00849	Mar.01, 2020	Feb. 28, 2021
Cable	HUBER+SUHNER	100	SUCOFLEX	Mar.01, 2020	Feb. 28, 2021
Positioning Controller	ETS-LINDGREN	2090	N/A	Mar.01, 2020	Feb. 28, 2021
Temp. & Humidity Chamber	ZHONG ZHI	CZ-A-225D	HW08053	N/A	N/A
DC Power Supply	MATRIX	MPS-3005L-3	D806050W	Jul. 06, 2020	Jul. 05, 2021
AC Power Supply	HengJie	HPC-1110	2010007	Jul. 06, 2020	Jul. 05, 2021

4 Unwanted Emissions In the Spurious Domain

4.1 Test Standard and Limit

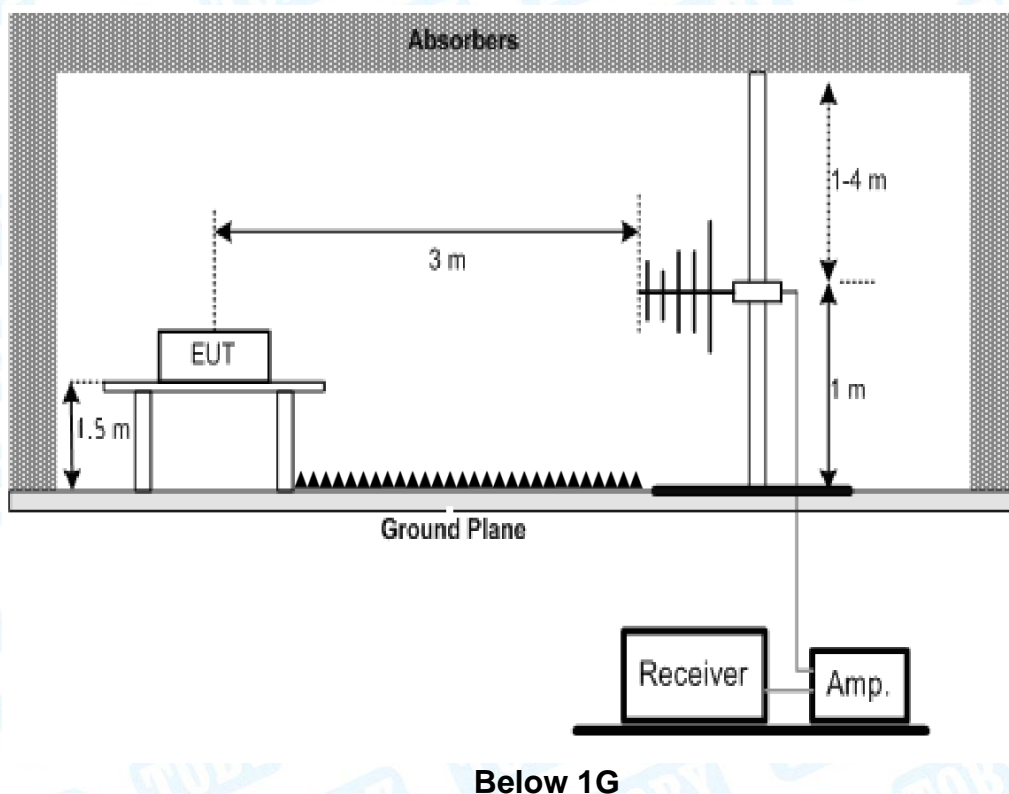
4.1.1 Test Standard

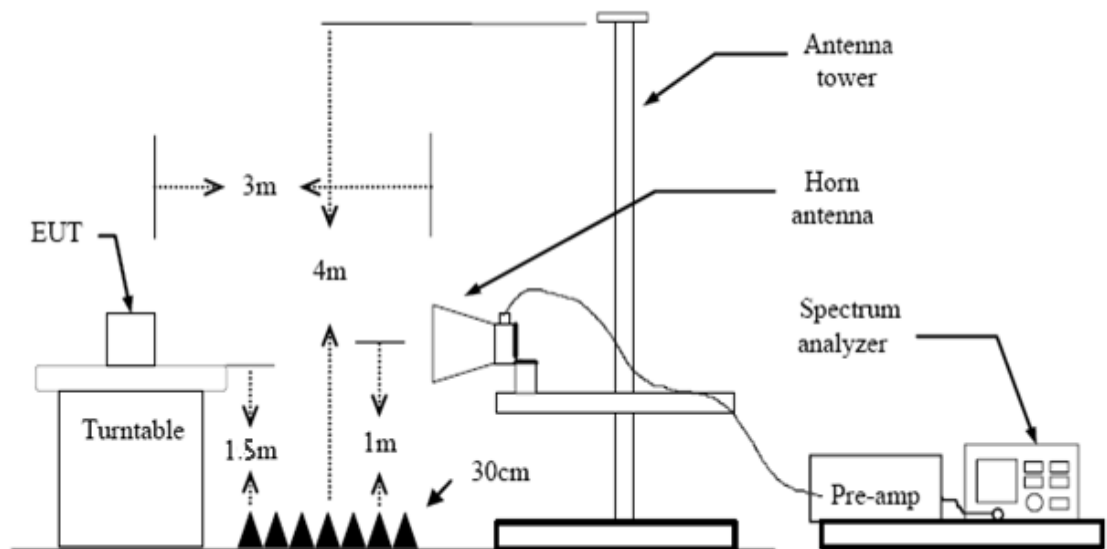
ETSI EN 300 220-1 V3.1.1:2017 clause 5.9
ETSI EN 300 220-2 V3.2.1:2018 clause 4.2.2

4.1.2 Test Limit

Spurious domain emission limits			
Frequency	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
State			
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

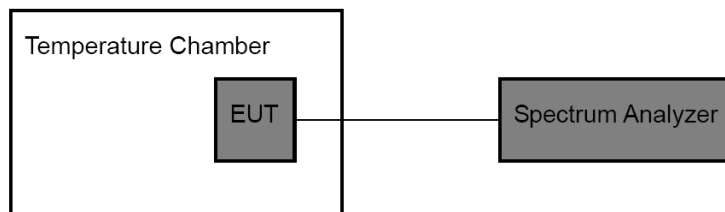
4.2 Test Setup





Above 1G

Extreme Condition:



4.3 Test Procedure

The conducted measurement procedure in clause 5.9.3.3.1 of ETSI EN 300 220-1 V3.1.1. The radiated measurement procedure in clause 5.9.3.3.2 of ETSI EN 300 220-1 V3.1.1, with the antenna port terminated in a dummy load.

4.4 EUT Operation During Test

The measurements shall be performed during continuously transmitting.

4.5 Deviation From Test Standard

No deviation

4.6 Test Data

Please refer to the Attachment A.

5 Effective Radiated Power

5.1 Test Standard and Limit

5.1.1 Test Standard

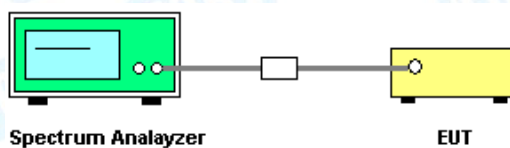
ETSI EN 300 220-1 V3.1.1:2017 clause 5.2
ETSI EN 300 220-2 V3.2.1:2018 clause 4.3.1

5.1.2 Limits

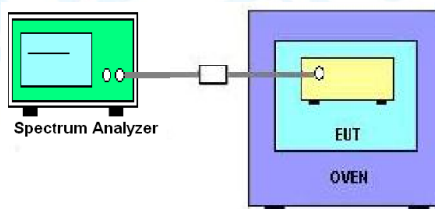
	Operational Frequency Band	Maximum effective radiated power, e.r.p.	Maximum occupied bandwidth	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)
L	865 MHz to 868MHz	25 mW e.r.p.	The whole band	$\leq 1\%$ duty cycle or polite spectrum access
M	868MHz to 878.6MHz	25 mW e.r.p.	The whole band	$\leq 1\%$ duty cycle or polite spectrum access

5.2 Test Setup

Normal Condition



Extreme Condition



5.3 Test Procedure

The conducted measurement procedure in clause 5.2.2.1 of ETSI EN 300 220-1 V3.1.1.

5.4 EUT Operation During Test

The measurements shall be performed during continuously transmitting.

5.5 Deviation From Test Standard

No deviation

5.6 Test Data

Please refer to the Attachment B.

6 Duty cycle

6.1 Test Standard and Limit

6.1.1 Test Standard

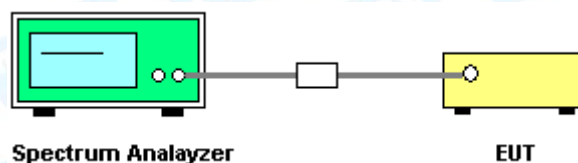
ETSI EN 300 220-1 V3.1.1:2017 clause 5.4
ETSI EN 300 220-2 V3.2.1:2018 Annex B& C

6.1.2 Limits

Operational Frequency Band		Maximum effective radiated power, e.r.p.	Maximum occupied bandwidth	Channel access and occupation rules (e.g. Duty cycle or LBT + AFA)
L	865 MHz to 868MHz	25 mW e.r.p.	The whole band	≤ 1 % duty cycle or polite spectrum access
M	868MHz to 878.6MHz	25 mW e.r.p.	The whole band	≤ 1 % duty cycle or polite spectrum access

6.2 Test Setup

Normal Condition



6.3 Test Procedure

The conducted measurement procedure in clause 5.4 of ETSI EN 300 220-1 V3.1.1.

6.4 EUT Operation During Test

The measurements shall be performed during continuously transmitting.

6.5 Deviation From Test Standard

No deviation

6.6 Test Data

Please refer to the Attachment C.

7 Occupied Bandwidth

7.1 Test Standard and Limit

7.1.1 Test Standard

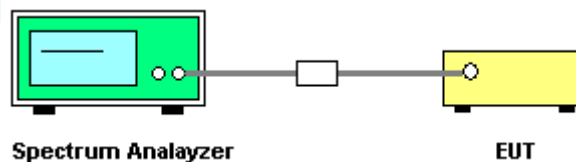
ETSI EN 300 220-1 V3.1.1:2017 clause 5.6
ETSI EN 300 220-2 V3.2.1:2018 clause 3.1.1

7.1.2 Limits

The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band.

The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high} .

7.2 Test Setup



7.3 Test Procedure

The conducted measurement procedure in clause 5.6.3.4 of ETSI EN 300 220-1 V3.1.1.

7.4 EUT Operation During Test

The measurements shall be performed during continuously transmitting.

7.5 Deviation From Test Standard

No deviation

7.6 Test Data

Please refer to the Attachment D.

8 Tx Out of Band Emissions

8.1 Test Standard and Limit

8.1.1 Test Standard

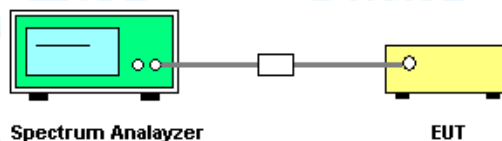
ETSI EN 300 220-1 V3.1.1:2017 clause 5.8

ETSI EN 300 220-2 V3.2.1:2018 clause 4.3.5

8.1.2 Limits

Tx Out of Band Emissions			
Domain	Frequency Range	RBW _{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \leq f_{\text{low_OFB}} - 400 \text{ kHz}$	10 kHz	-36 dBm
	$F_{\text{low_OFB}} - 400 \text{ kHz} \leq f \leq f_{\text{low_OFB}} - 200 \text{ kHz}$	1 kHz	-36 dBm
	$f_{\text{low}} - 200 \text{ kHz} \leq f < f_{\text{low_OFB}}$	1 kHz	See Figure 6
	$f = f_{\text{low_OFB}}$	1 kHz	0 dBm
	$f = f_{\text{high_OFB}}$	1 kHz	0 dBm
	$F_{\text{high_OFB}} < f \leq f_{\text{high_OFB}} + 200 \text{ kHz}$	1 kHz	See Figure 6
	$F_{\text{high_OFB}} + 200 \text{ kHz} \leq f \leq f_{\text{high_OFB}} + 400 \text{ kHz}$	1 kHz	-36 dBm
	$F_{\text{high_OFB}} + 400 \text{ kHz} \leq f$	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c - 2.5 \times \text{OCW}$	1 kHz	-36 dBm
	$f_c - 2.5 \times \text{OCW} \leq f \leq f_c - 0.5 \times \text{OCW}$	1 kHz	See Figure 5
	$f = f_c - 0.5 \times \text{OCW}$	1 kHz	0 dBm
	$f = f_c + 0.5 \times \text{OCW}$	1 kHz	0 dBm
	$f_c + 0.5 \times \text{OCW} \leq f \leq f_c + 2.5 \times \text{OCW}$	1 kHz	See Figure 5
	$f = f_c + 2.5 \times \text{OCW}$	1 kHz	-36 dBm
NOTE: f is the measurement frequency. f_c is the Operating Frequency. $F_{\text{low_OFB}}$ is the lower edge of the Operational Frequency Band. $F_{\text{high_OFB}}$ is the upper edge of the Operational Frequency Band. OCW is the operating channel bandwidth.			

8.2 Test Setup



8.3 Test Procedure

Please refer to chapter 5.8.3.3 of ETSI EN 300 220-1 V3.1.1

8.4 EUT Operation During Test

The measurements shall be performed during continuously transmitting.

8.5 Deviation From Test Standard

No deviation

8.6 Test Data

Please refer to the Attachment E.

9 Transient Power

9.1 Test Standard and Limit

9.1.1 Test Standard

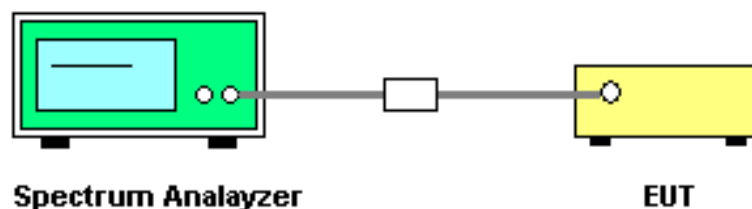
ETSI EN 300 220-1 V3.1.1:2017 clause 5.10

ETSI EN 300 220-2 V3.2.1:2018 clause 4.3.6

9.1.2 Limit

Transient power		
Absolute offset from centre frequency	RBW _{REF}	Peak power limit applicable at measurement points
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

9.2 Test Setup



9.3 Test Procedure

Please refer to chapter 5.10.3.2 of ETSI EN 300 220-1 V3.1.1

9.4 EUT Operating Condition

The EUT was programmed to be in transmitting mode.

9.5 Deviation From Test Standard

No deviation

9.6 Test Data

Please refer to the Attachment F.

10 Adjacent Channel Power

10.1 Test Standard and Limit

10.1.1 Test Standard

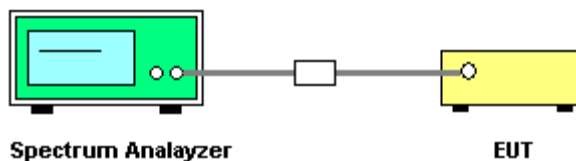
ETSI EN 300 220-1 V3.1.1:2017 clause 5.11
ETSI EN 300 220-2 V3.2.1:2018 clause 4.3.7

10.1.2 Limits

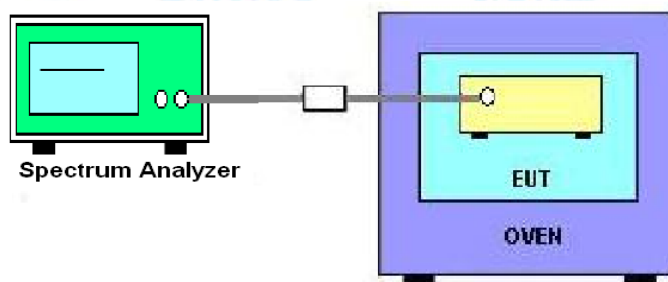
Adjacent Channel Power			
		Adjacent Channel power integrated over 0,7 x OCW	Alternate Adjacent Channel power integrated over 0,7 x OCW
OCW < 20 kHz	Normal test conditions	-20 dBm	-20 dBm
	Extreme test conditions	-15 dBm	-20 dBm
OCW ≥ 20 kHz	Normal test conditions	-37 dBm	-40 dBm
	Extreme test conditions	-32 dBm	-37 dBm

10.2 Test Setup

Normal Condition



Extreme Condition



10.3 Test Procedure

Please refer to chapter 5.11.3.4 of ETSI EN 300 220-1 V3.1.1

10.4 EUT Operating Condition

The EUT was programmed to be in transmitting mode.

10.5 Test Data

No requirement for this test item

11 Tx Behaviour Under Low Voltage Conditions

11.1 Test Standard and Limit

11.1.1 Test Standard

ETSI EN 300 220-1 V3.1.1:2017 clause 5.12
ETSI EN 300 220-2 V3.2.1:2018 clause 4.3.8

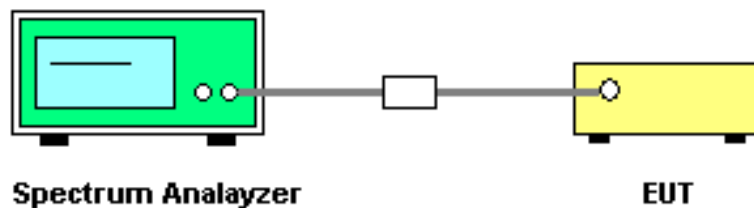
11.1.2 Limits

TX behaviour under Low Voltage Conditions

The equipment shall either:

- a) remain in the Operating Channel OC without exceeding any applicable limits (e.g. Duty Cycle); or
- b) reduce its effective radiated power below the Spurious Emission limits without exceeding any applicable limits (e.g. Duty Cycle); or
- c) shut down, (ceasing function); as the voltage falls below the manufacturers declared operating voltage.

11.2 Test Setup



11.3 Test Procedure

Please refer to chapter 5.12.3.2 of ETSI EN 300 220-1 V3.1.1

11.4 EUT Operating Condition

The EUT was programmed to be in transmitting mode.

11.5 Deviation From Test Standard

No deviation

11.6 Test Data

The equipment is not battery-powered, so the test item is not require.

12 Blocking

12.1 Test Standard and Limit

12.1.1 Test Standard

ETSI EN 300 220-1 V3.1.1:2017 clause 5.18

ETSI EN 300 220-2 V3.2.1:2018 clause 4.4.2

12.1.2 Limits

The blocking level shall not be less than the values given in below table, except at frequencies on which spurious responses are found.

Limits for receiver blocking

Table 41: Blocking level parameters for RX category 2

Requirement	Limits
	Receiver category 2
Blocking at ± 2 MHz from OC edge f_{high} and f_{low}	≥ -69 dBm
Blocking at ± 10 MHz from OC edge f_{high} and f_{low}	≥ -44 dBm
Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -44 dBm

Table 42: Blocking level parameters for RX category 1.5

Requirement	Limits
	Receiver category 1.5
Blocking at ± 2 MHz from OC edge f_{high} and f_{low}	≥ -43 dBm
Blocking at ± 10 MHz from OC edge f_{high} and f_{low}	≥ -33 dBm
Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -33 dBm

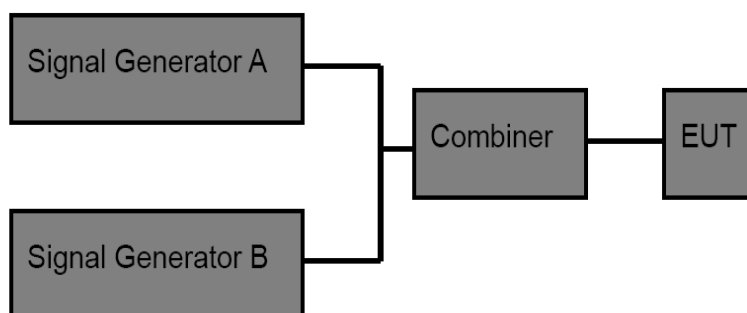
Table 43: Blocking level parameters for RX category 1

Requirement	Limits
	Receiver category 1
Blocking at ± 2 MHz from Centre Frequency	≥ -20 dBm
Blocking at ± 10 MHz from Centre Frequency	≥ -20 dBm
Blocking at ± 5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -20 dBm

Table 1: Receiver categories

Receiver category	Description
1	Category 1 is a high performance level of receiver. In particular to be used where the operation of a SRD may have inherent safety of human life implications.
1.5	Category 1.5 is an improved performance level of receiver category 2.
2	Category 2 is standard performance level of receiver.
3	Category 3 is a low performance level of receiver. Manufacturers have to be aware that category 3 receivers are not able to work properly in case of coexistence with some services such as a mobile radio service in adjacent bands. The manufacturer shall provide another mean to overcome the weakness of the radio link or accept the failure.

12.2 Test Setup



12.3 Test Procedure

Please refer to chapter 5.18.6.4 of ETSI EN 300 220-1 V3.1.1

12.4 Deviation From Test Standard

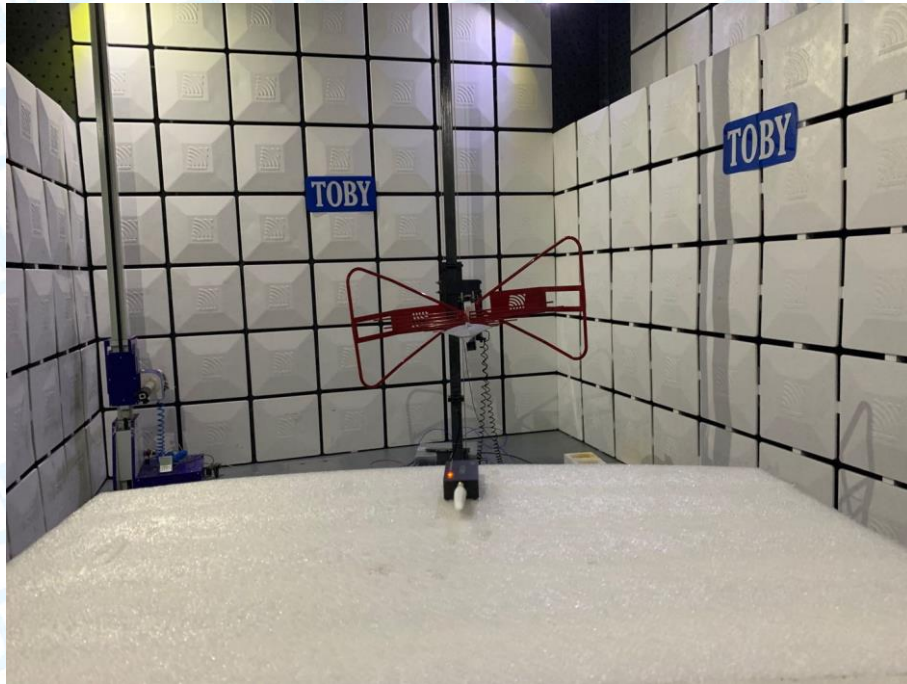
No deviation

12.5 Test Data

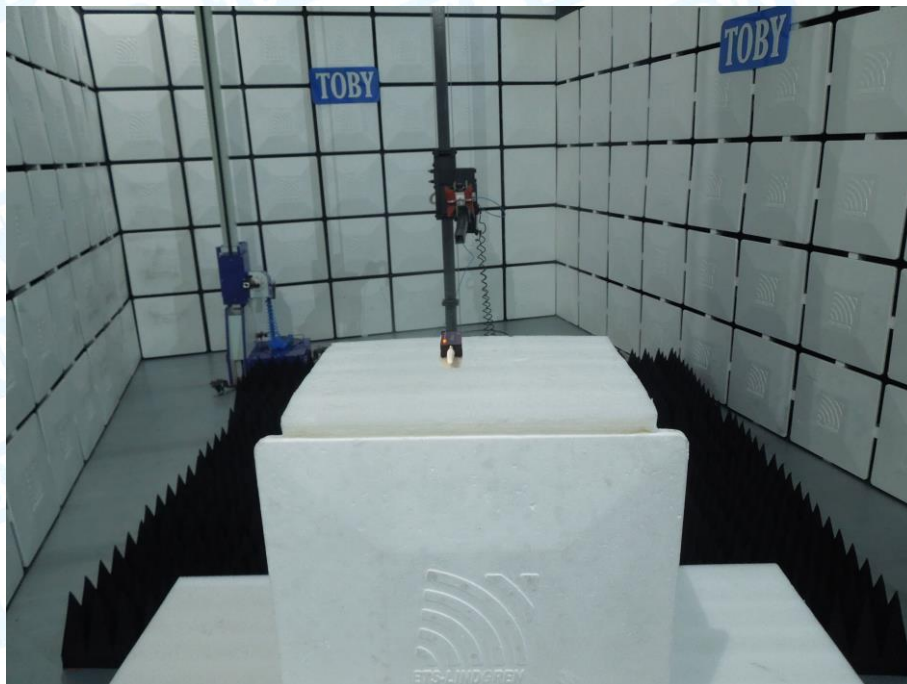
Please refer to the Attachment G.

13 Photographs – Test Setup

Radiated Spurious Emission (Below 1 GHz)



Radiated Spurious Emission (Above 1 GHz)



Attachment A-- Unwanted Emissions In the Spurious Domain

Test Mode :		TX Mode 866.7MHz	
Unwanted Emissions in the Spurious Domain with reference BW=125kHz			
Frequency Range	RBW	Limit	Results
	(kHz)	(dBm)	(P/F)
$F_c-4 \times \text{OCW}<f< F_c-2,5 \times \text{OCW}$	1kHz	-36 dBm	PASS
$F_c-\text{Max}(10\times\text{OCW}, 500\text{kHz})<f<F_c-4 \times \text{OCW}$	10kHz	-36 dBm	PASS
$F_c+2,5 \times \text{OCW}<f< F_c+4 \times \text{OCW}$	1kHz	-36 dBm	PASS
$F_c+4 \times \text{OCW}<f< F_c+\text{Max}(10\times\text{OCW}, 500\text{kHz})$	10kHz	-36 dBm	PASS
NOTE: Only showed test data of the worst mode			

Below 1G

Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Horizontal		
Test Mode:	TX Mode (866.7MHz)		
Remark:	No report for the emission which more than 10 dB below the prescribed limit. Only showed test data of the worst mode		

No.	Mk.	Freq. MHz	Reading Level dBm	Correct Factor dB	Measure- ment dBm	Limit dBm	Over dB	Detector
1		35.0048	-63.40	-1.08	-64.48	-36.00	-28.48	peak
2		41.4215	-56.13	-4.20	-60.33	-36.00	-24.33	peak
3		251.1802	-74.76	4.73	-70.03	-36.00	-34.03	peak
4		446.4141	-73.11	2.35	-70.76	-36.00	-34.76	peak
5		625.0778	-74.42	7.53	-66.89	-54.00	-12.89	peak
6	*	833.3170	-64.82	7.76	-57.06	-54.00	-3.06	peak

Emission Level= Read Level+ Correct Factor

Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Vertical		
Test Mode:	TX Mode (866.7MHz)		
Remark:	No report for the emission which more than 10 dB below the prescribed limit. Only showed test data of the worst mode		

No.	Mk.	Freq. MHz	Reading Level dBm	Correct Factor dB	Measure- ment dBm	Limit dBm	Over dB	Detector
1		33.5623	-58.02	-8.82	-66.84	-36.00	-30.84	peak
2		40.5591	-56.65	-13.16	-69.81	-36.00	-33.81	peak
3		249.4250	-64.02	-7.29	-71.31	-36.00	-35.31	peak
4		410.3824	-71.82	-1.86	-73.68	-36.00	-37.68	peak
5		472.1759	-71.33	-1.94	-73.27	-54.00	-19.27	peak
6	*	629.4772	-68.53	1.75	-66.78	-54.00	-12.78	peak

Emission Level= Read Level+ Correct Factor

Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Horizontal		
Test Mode:	RX Mode (866.7MHz)		
Remark:	No report for the emission which more than 10 dB below the prescribed limit. Only showed test data of the worst mode		

No.	Mk.	Freq. MHz	Reading Level dBm	Correct Factor dB	Measure- ment dBm	Limit dBm	Over dB	Detector
1		32.8637	-69.66	-0.18	-69.84	-57.00	-12.84	peak
2		35.7490	-68.51	-1.40	-69.91	-57.00	-12.91	peak
3		54.8348	-66.86	-9.09	-75.95	-57.00	-18.95	peak
4		71.5806	-55.45	-11.35	-66.80	-57.00	-9.80	peak
5	*	168.4138	-54.37	-10.72	-65.09	-57.00	-8.09	peak
6		239.1473	-68.16	2.45	-65.71	-57.00	-8.71	peak

Emission Level= Read Level+ Correct Factor

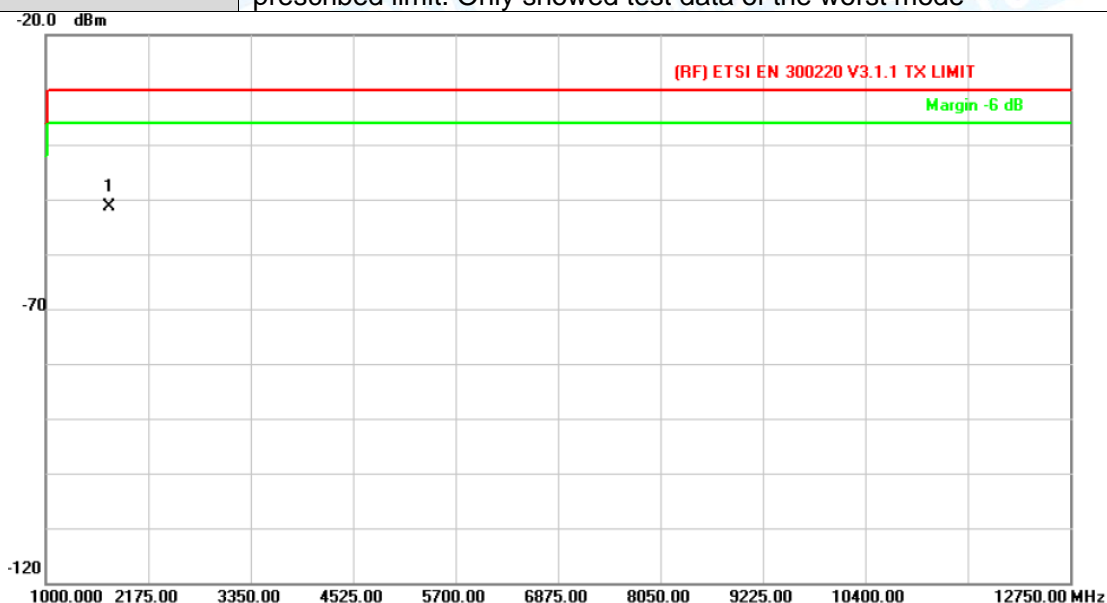
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Vertical		
Test Mode:	RX Mode (866.7MHz)		
Remark:	No report for the emission which more than 10 dB below the prescribed limit. Only showed test data of the worst mode		

No.	Mk.	Freq. MHz	Reading Level dBm	Correct Factor dB	Measure- ment dBm	Limit dBm	Over dB	Detector
1		70.0902	-51.86	-12.67	-64.53	-57.00	-7.53	peak
2		115.3204	-61.28	-3.75	-65.03	-57.00	-8.03	peak
3		173.2050	-61.37	-6.71	-68.08	-57.00	-11.08	peak
4		337.2155	-65.92	-2.04	-67.96	-57.00	-10.96	peak
5		506.4791	-66.65	1.48	-65.17	-57.00	-8.17	peak
6	*	642.8613	-65.74	1.84	-63.90	-57.00	-6.90	peak

Emission Level= Read Level+ Correct Factor

Above 1G

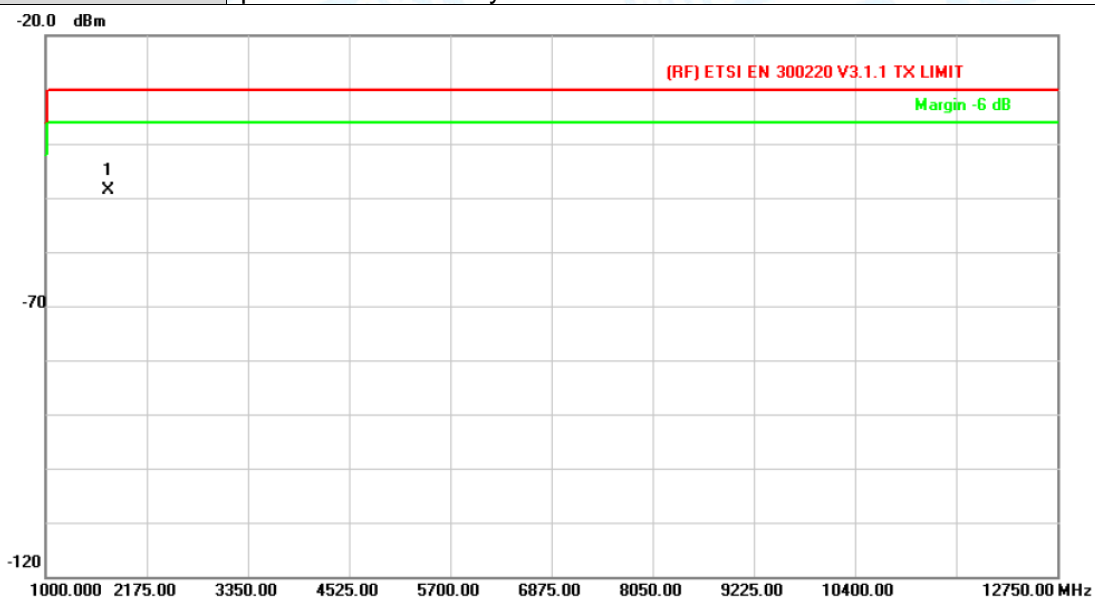
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Horizontal		
Test Mode:	TX Mode (866.7MHz)		
Remark:	No report for the emission which more than 20 dB below the prescribed limit. Only showed test data of the worst mode		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBm	dB	dBm	dBm	dB	Detector
1	*	1732.570	-62.50	11.03	-51.47	-30.00	-21.47	peak

Emission Level= Read Level+ Correct Factor

Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Vertical		
Test Mode:	TX Mode (866.7MHz)		
Remark:	No report for the emission which more than 20 dB below the prescribed limit. Only showed test data of the worst mode		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBm	dB	dBm	dBm	dB	Detector
1	*	1732.740	-57.96	9.33	-48.63	-30.00	-18.63	peak

Emission Level= Read Level+ Correct Factor

Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Horizontal		
Test Mode:	RX Mode (866.7MHz)		
Remark:	No report for the emission which more than 20 dB below the prescribed limit. Only showed test data of the worst mode		

-20.0 dBm



Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Horizontal		
Test Mode:	TX Mode (867.9MHz)		
Remark:	No report for the emission which more than 20 dB below the prescribed limit. Only showed test data of the worst mode		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBm	dB	dBm	dBm	dB	Detector
1	*	1735.740	-59.85	11.18	-48.67	-30.00	-18.67	peak

Emission Level= Read Level+ Correct Factor

Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Vertical		
Test Mode:	TX Mode (867.9MHz)		
Remark:	No report for the emission which more than 20 dB below the prescribed limit. Only showed test data of the worst mode		

The spectrum plot displays the emission level in dBm across a frequency range from 1000.000 MHz to 12750.00 MHz. A red horizontal line indicates the (RF) ETSI EN 300220 V3.1.1 TX LIMIT at approximately -30.00 dBm. A green horizontal line indicates the Margin -6 dB at approximately -36.00 dBm. A single data point, labeled '1 X', is plotted at 1735.890 MHz with a reading level of -55.15 dBm.

No.	Mk.	Freq. MHz	Reading Level dBm	Correct Factor dB	Measure- ment dBm	Limit dBm	Over dB	Detector
1	*	1735.890	-55.15	9.40	-45.75	-30.00	-15.75	peak

Emission Level= Read Level+ Correct Factor

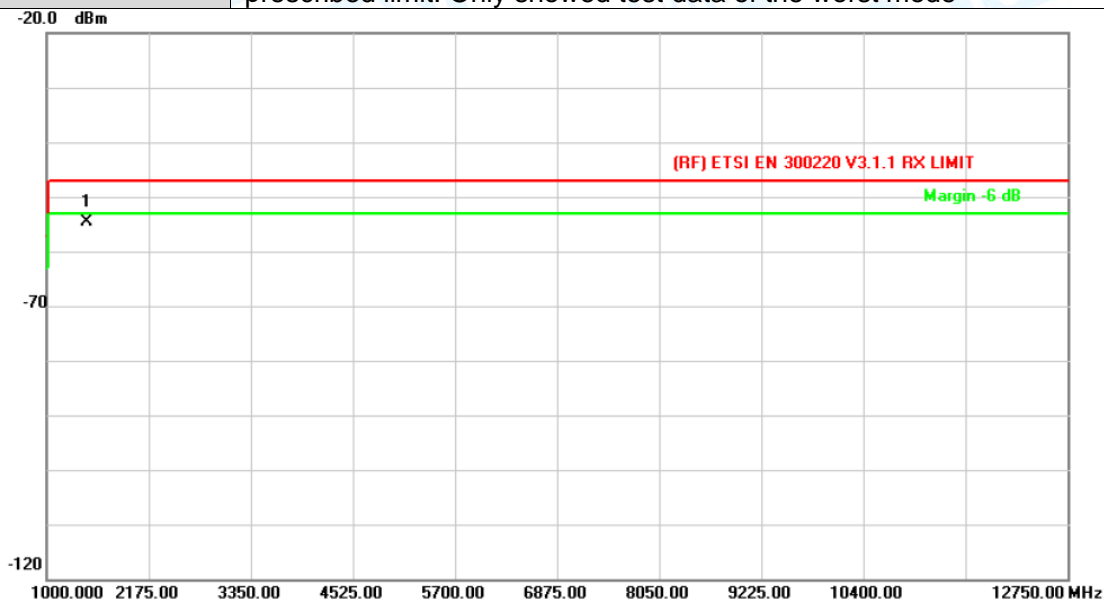
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Horizontal		
Test Mode:	RX Mode (867.9MHz)		
Remark:	No report for the emission which more than 20 dB below the prescribed limit. Only showed test data of the worst mode		

The spectrum plot displays the emission level in dBm across a frequency range from 1000.00 MHz to 12750.00 MHz. A red horizontal line indicates the (RF) ETSI EN 300220 V3.1.1 RX LIMIT at approximately -47.00 dBm. A green horizontal line indicates the Margin -6 dB at approximately -53.56 dBm. A single data point '1' is marked at 1464.670 MHz with a reading level of -62.42 dBm.

No.	Mk.	Freq. MHz	Reading Level dBm	Correct Factor dB	Measure- ment dBm	Limit dBm	Over dB	Detector
1	*	1464.670	-62.42	8.86	-53.56	-47.00	-6.56	peak

Emission Level= Read Level+ Correct Factor

Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Vertical		
Test Mode:	RX Mode (867.9MHz)		
Remark:	No report for the emission which more than 20 dB below the prescribed limit. Only showed test data of the worst mode		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over
		MHz	dBm	dB	dBm	dBm	dB
1	*	1467.560	-62.53	7.86	-54.67	-47.00	-7.67
							peak

Emission Level= Read Level+ Correct Factor

Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Horizontal		
Test Mode:	TX Mode (868.5MHz)		
Remark:	No report for the emission which more than 20 dB below the prescribed limit. Only showed test data of the worst mode		

The spectrum plot displays the emission level in dBm across a frequency range from 1000.000 MHz to 12750.00 MHz. A red horizontal line indicates the (RF) ETSI EN 300220 V3.1.1 TX LIMIT, and a green horizontal line indicates the Margin -6 dB. A single data point is visible at 1737.450 MHz with a reading level of -57.95 dBm.

No.	Mk.	Freq. MHz	Reading Level dBm	Correct Factor dB	Measure- ment dBm	Limit dBm	Over dB	Detector
1	*	1737.450	-57.95	9.42	-48.53	-30.00	-18.53	peak

Emission Level= Read Level+ Correct Factor

Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Vertical		
Test Mode:	TX Mode (868.5MHz)		
Remark:	No report for the emission which more than 20 dB below the prescribed limit. Only showed test data of the worst mode		

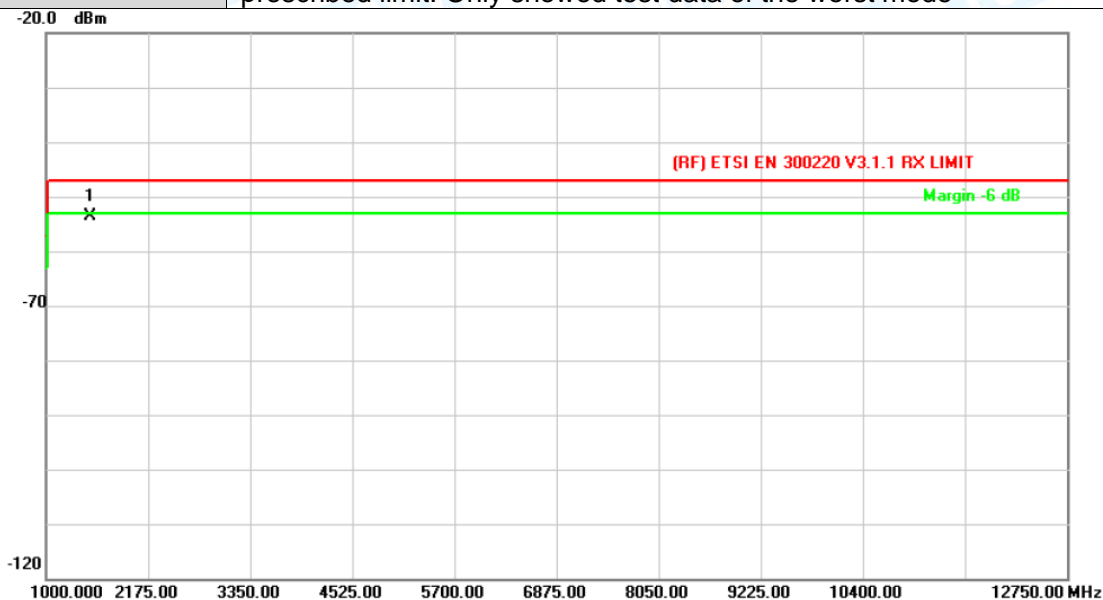
The spectrum plot displays the emission level in dBm across a frequency range from 1000.00 MHz to 12750.00 MHz. A red horizontal line indicates the (RF) ETSI EN 300220 V3.1.1 TX LIMIT, and a green horizontal line indicates the Margin -6 dB. A single data point, labeled '1 X', is plotted at 1737.580 MHz with a reading level of -58.10 dBm.

No.	Mk.	Freq. MHz	Reading Level dBm	Correct Factor dB	Measure- ment dBm	Limit dBm	Over dB	Detector
1	*	1737.580	-58.10	9.42	-48.68	-30.00	-18.68	peak

Emission Level= Read Level+ Correct Factor



Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 5.0V		
Ant. Pol.	Vertical		
Test Mode:	RX Mode (868.5MHz)		
Remark:	No report for the emission which more than 20 dB below the prescribed limit. Only showed test data of the worst mode		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBm	dB	dBm	dBm	dB	Detector
1	*	1503.570	-62.78	9.23	-53.55	-47.00	-6.55	peak

Emission Level= Read Level+ Correct Factor

Attachment B-- Effective Radiated Power

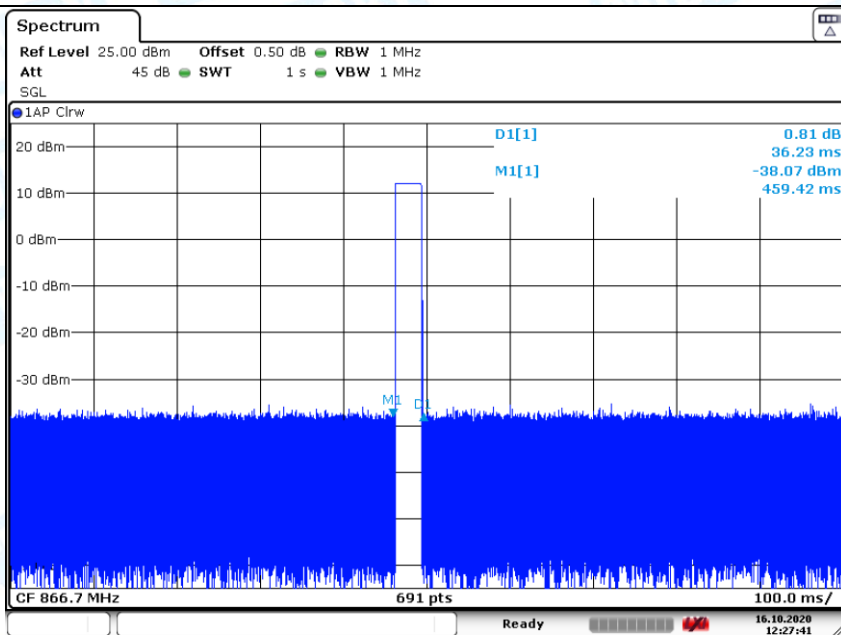
Test Mode :		TX Mode 866.7MHz			
Test Conditions				ERP Power (dBm)	
N nom	(°C)	25.0	V nom	(V)	5.0
				12.21	
Limits				25mW(14dBm)	
Result				PASS	

Test Mode :		TX Mode 867.9MHz			
Test Conditions				ERP Power (dBm)	
N nom	(°C)	25.0	V nom	(V)	5.0
				12.20	
Limits				25mW(14dBm)	
Result				PASS	

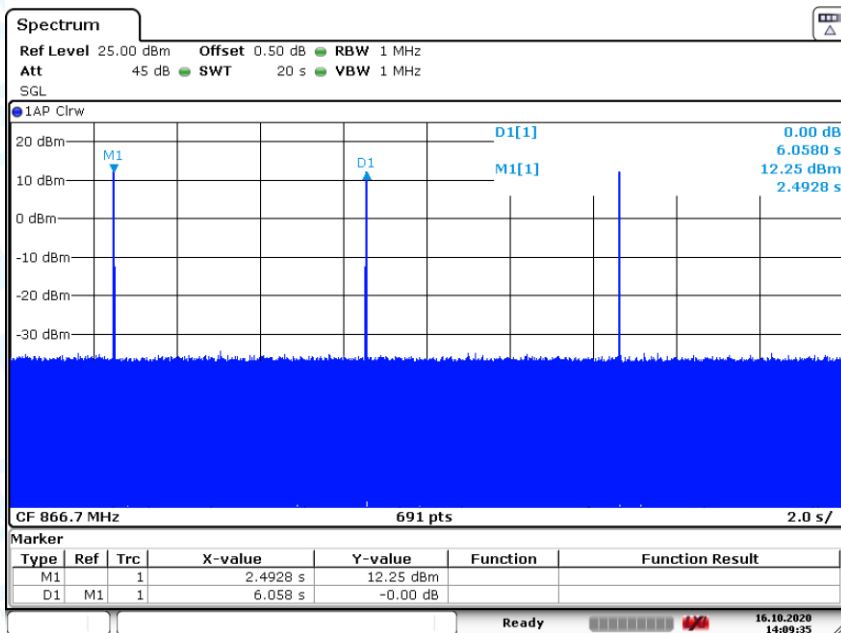
Test Mode :		TX Mode 868.5MHz				
Test Conditions				ERP Power (dBm)		
N nom	(°C)	25.0	V nom	(V)	5.0	12.20
Limits				25mW(14dBm)		
Result				PASS		

Attachment C—Duty Cycle

Temperature :	26°C	Relative Humidity :	60%	
Pressure :	1010 hPa	Test Voltage :	DC 5V	
Test Mode :	TX Mode			
Blocking Signal Test(Category 2)				
Frequency	Transmit On Time	Duty Cycle	Limit (dB)	Result
866.7 MHz	34.23ms	0.568 %	1%	Pass
867.9 MHz	34.78ms	0.577 %	1%	Pass
868.5 MHz	33.33ms	0.550 %	1%	Pass
Test Plot				



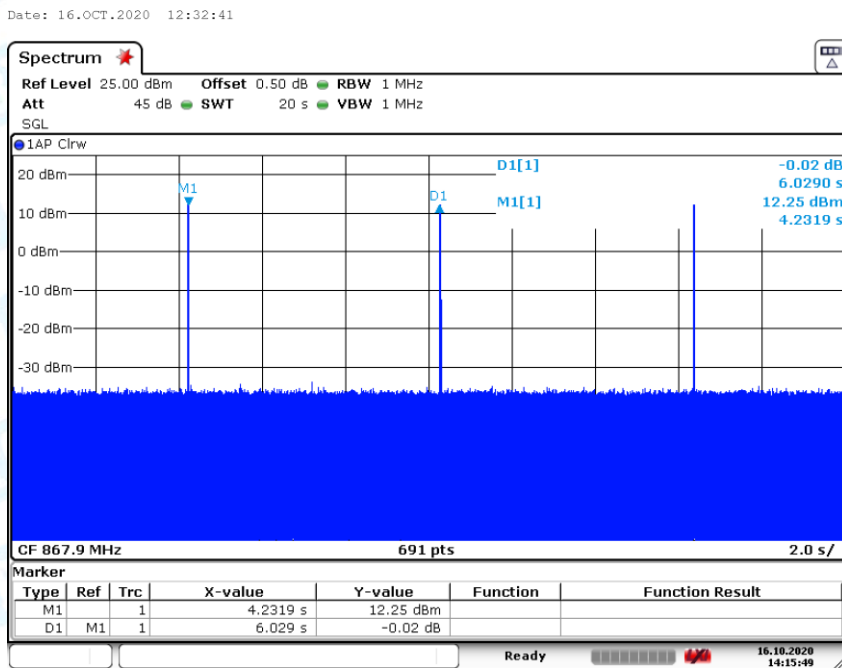
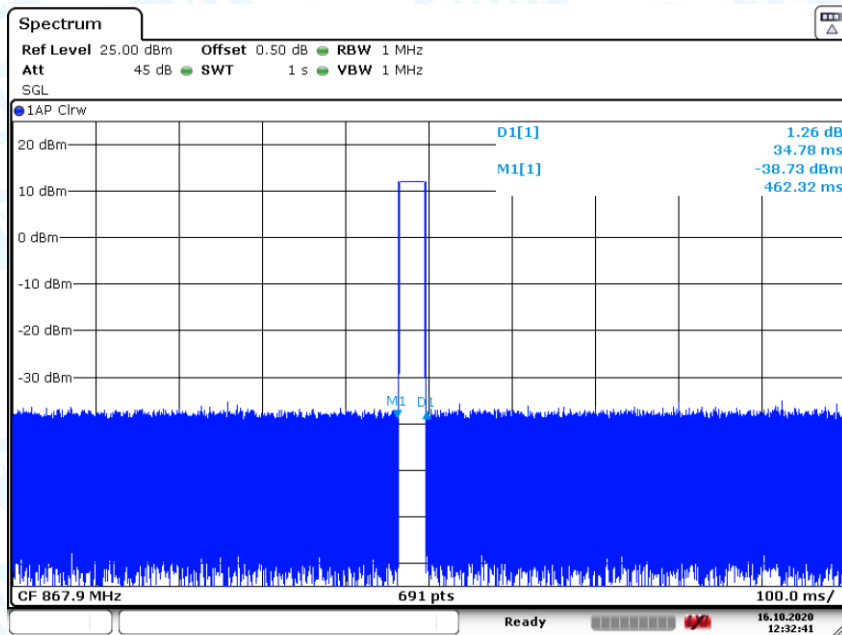
Date: 16.OCT.2020 12:27:41



Date: 16.OCT.2020 14:09:35

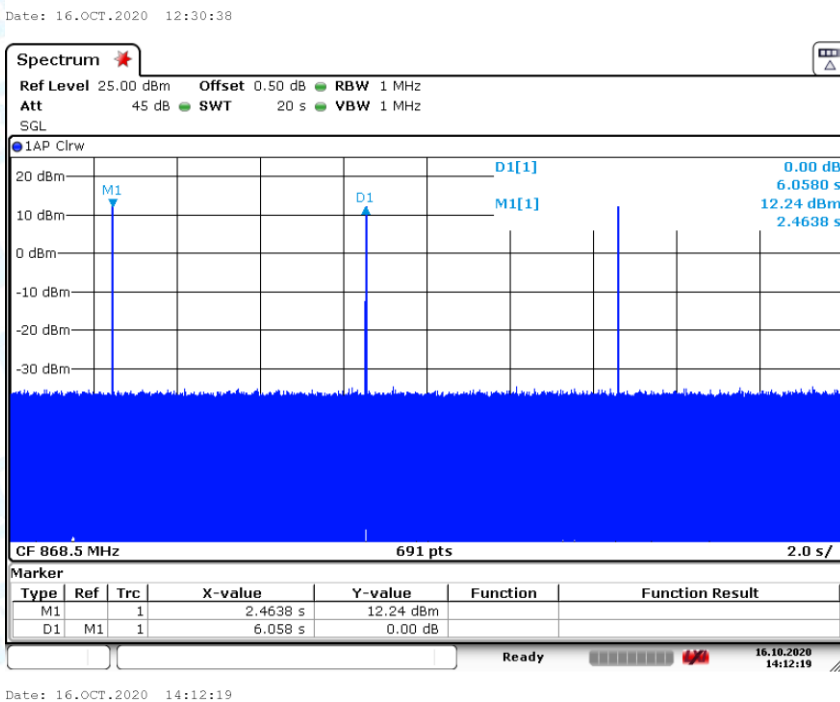
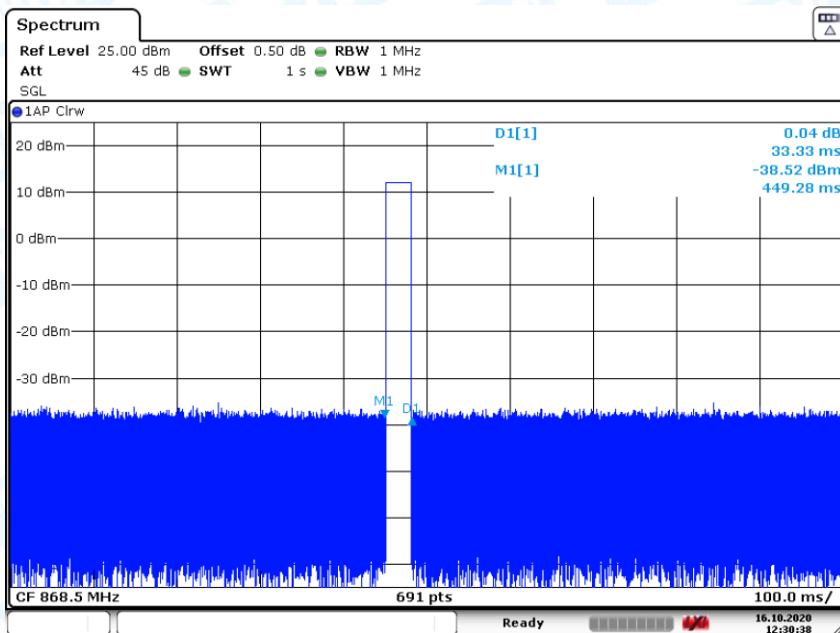
Note: The duty cycle is calculated as follow:

Duty cycle= Transmit On time (ms)/6.058(s)=Duty Cycle.



Note: The duty cycle is calculated as follow:

Duty cycle= Transmit On time (ms)/6.029(s)=Duty Cycle.

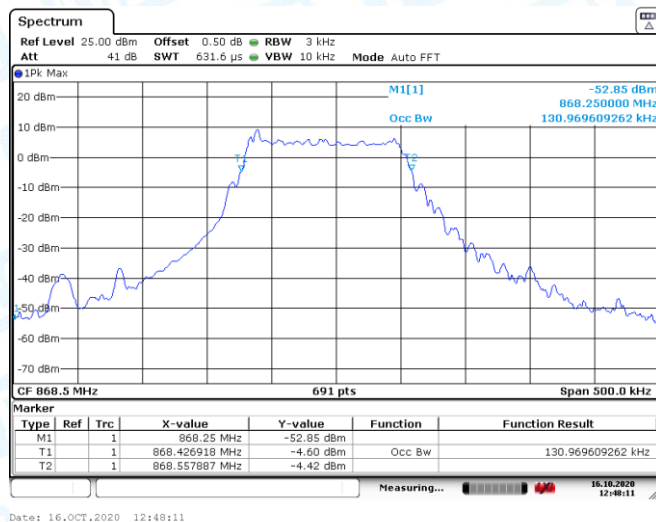
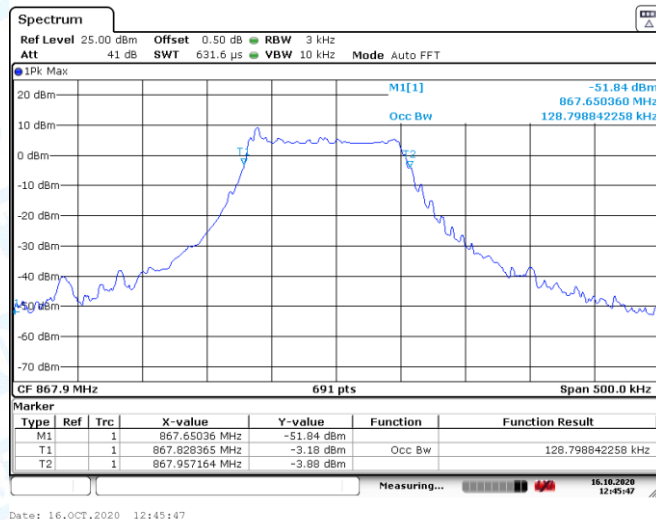
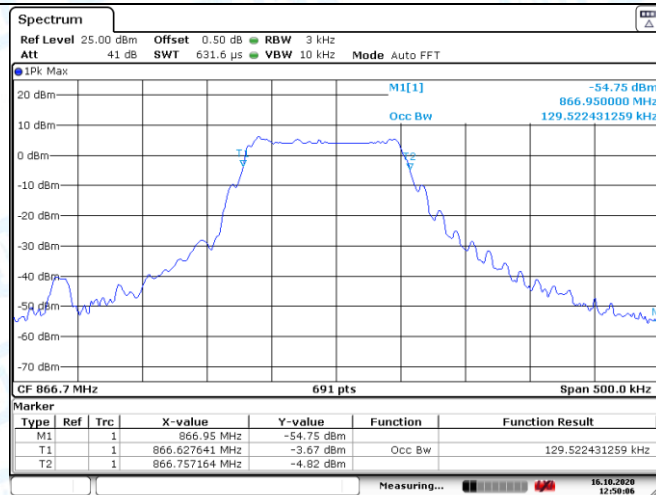


Note: The duty cycle is calculated as follow:

Duty cycle= Transmit On time (ms)/6.058(s)=Duty Cycle.

Attachment D-- Occupied Bandwidth

Modulated Signal Test			
Centre Frequency (MHz)	Occupied Channel Bandwidth (KHz)	Maximum Occupied Bandwidth (KHz)	Result
866.7	128.522	/	Pass
867.9	127.799	/	Pass
868.5	130.970	/	Pass



Remark: the plot only show the worst case.

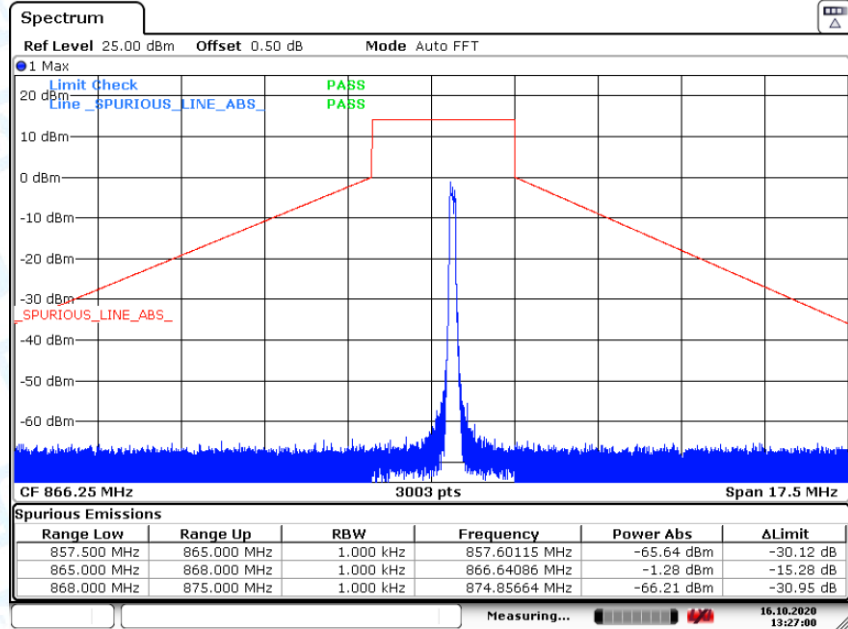
Attachment E--Tx Out of Band Emissions

Test Mode : TX Mode 866.7MHz

Note: All test modes were carried out for all operation modes, the worst test data(TN TN) is record the report

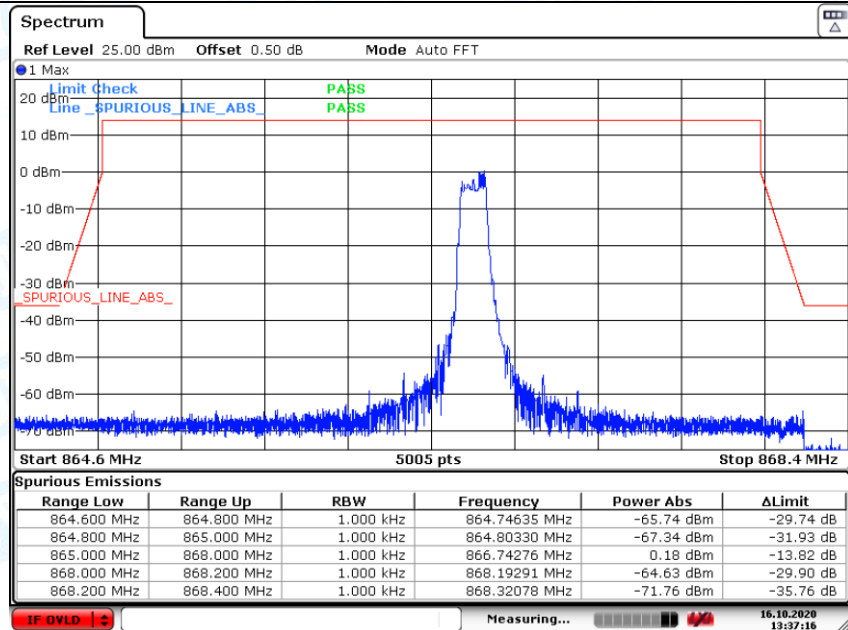
Operating Channel with reference BW

Tnom, Vnom



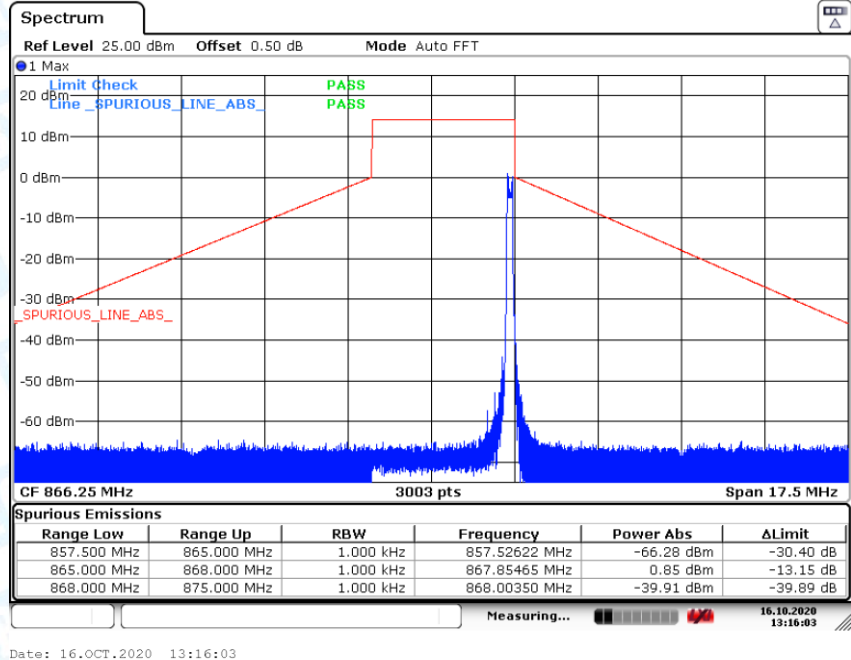
Operational Frequency Band with reference BW

Tnom, Vnom

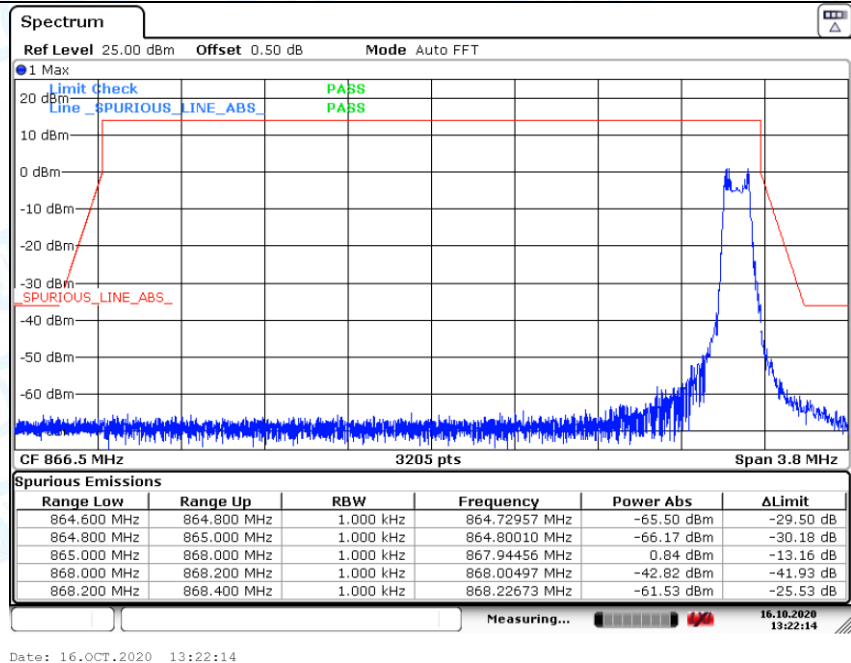


Test Mode : TX Mode 867.9MHz**Note:** All test modes were carried out for all operation modes, the worst test data(TN TN) is record the report**Operating Channel with reference BW**

Tnom, Vnom

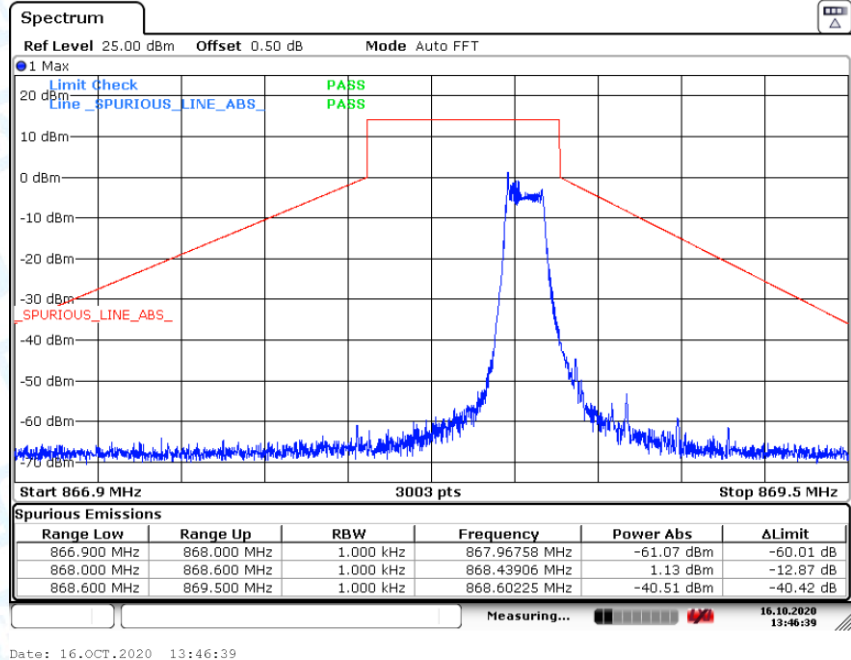
**Operational Frequency Band with reference BW**

Tnom, Vnom

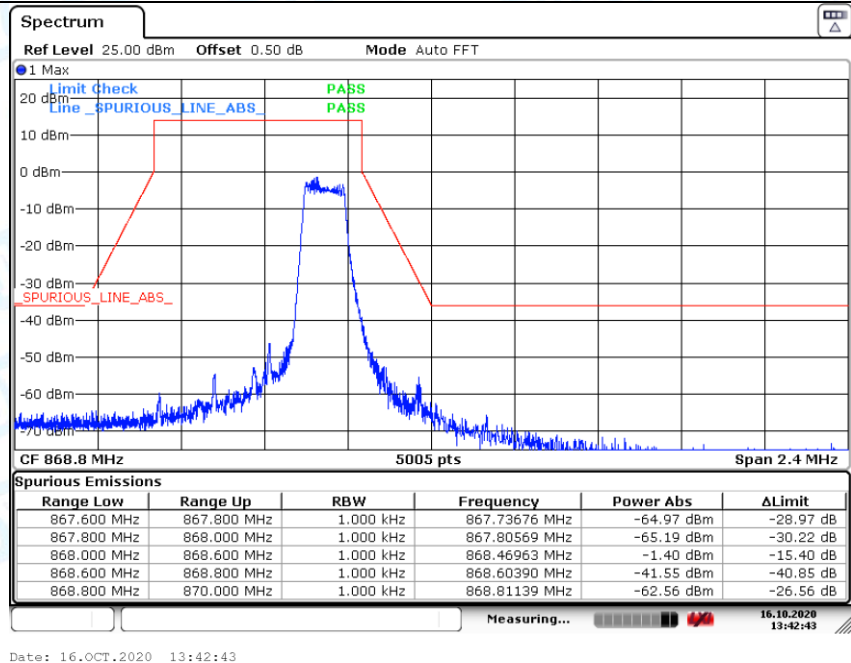


Test Mode : TX Mode 868.5MHz**Note:** All test modes were carried out for all operation modes, the worst test data(TN TN) is record the report**Operating Channel with reference BW**

Tnom, Vnom

**Operational Frequency Band with reference BW**

Tnom, Vnom



Attachment F--Transient Power

Test Mode :	Transmitting			
Test Channel (MHz)	Transient power (dBm)		Transient power (dBm)	
Absolute offset from centre frequency	≤ 400 kHz	> 400 kHz	≤ 400 kHz	> 400 kHz
866.7	-46.89	-46.56	0	-27
867.9	-46.36	-45.74	0	-27
868.5	-47.35	-46.23	0	-27
Text result (pass/fail)	Pass			

Attachment G-- Blocking

Temperature :	26°C	Relative Humidity :	60%
Pressure :	1010 hPa	Test Voltage :	DC 5V
Test Mode :	Receive Mode (866.7MHZ)		
Blocking Signal Test(Category 2)			
Frequency offset	Blocking Signal B-A (dB)	Limit (dB)	Result
+2 MHz	-60.67	≥-69	Pass
-2 MHz	-61.58	≥-69	Pass
+10 MHz	-30.44	≥-44	Pass
-10 MHz	-31.57	≥-44	Pass
+46 MHz	-24.63	≥-44	Pass
-46 MHz	-25.53	≥-44	Pass

Temperature :	26°C	Relative Humidity :	60%
Pressure :	1010 hPa	Test Voltage :	DC 5V
Test Mode :	Receive Mode (867.9MHZ)		
Blocking Signal Test(Category 2)			
Frequency offset	Blocking Signal B-A (dB)	Limit (dB)	Result
+2 MHz	-61.57	≥-69	Pass
-2 MHz	-62.63	≥-69	Pass
+10 MHz	-30.28	≥-44	Pass
-10 MHz	-31.35	≥-44	Pass
+46 MHz	-23.75	≥-44	Pass
-46 MHz	-26.46	≥-44	Pass

Temperature :	26°C	Relative Humidity :	60%
Pressure :	1010 hPa	Test Voltage :	DC 5V
Test Mode :	Receive Mode (868.5MHZ)		
Blocking Signal Test(Category 2)			
Frequency offset	Blocking Signal B-A (dB)	Limit (dB)	Result
+2 MHz	-61.64	≥-69	Pass
-2 MHz	-60.57	≥-69	Pass
+10 MHz	-30.57	≥-44	Pass
-10 MHz	-31.46	≥-44	Pass
+46 MHz	-25.65	≥-44	Pass
-46 MHz	-24.35	≥-44	Pass

-----END OF REPORT-----