TEST REPORT

Applicant:	Dragino Technology Co., Limited
Address of Applicant:	Room 202, Block B, BCT Incubation Bases (BaoChengTai), No.8 CaiYunRoad LongCheng Street, LongGang District ; Shenzhen 518116,China
Manufacturer:	Dragino Technology Co., Limited
Address of Manufacturer:	Room 202, Block B, BCT Incubation Bases (BaoChengTai), No.8 CaiYunRoad LongCheng Street, LongGang District ; Shenzhen 518116,China
Equipment Under Test (EUT)	
Product Name:	LoRaWAN Sensor Node
Model No.:	LSN50 v2
Trade Mark:	Dragino
Applicable standards:	ETSI EN 300 220-1 V3.1.1 (2017-02) ETSI EN 300 220-2 V3.2.1 (2018-06)
Date of sample receipt:	May 12, 2020
Date of Test:	May 13, 2020- May 29, 2020
Date of report issue:	May 31, 2020
Test Result :	PASS *

*In the configuration tested, the EUT complied with the standards specified above.

The CE mark as shown below can be used, under the responsibility of the manufacturer, after completion of an EC Declaration of Conformity and compliance with all relevant EC Directives. The protection requirements with respect to electromagnetic compatibility contained in Directive 2014/53/EU are considered.

Robinson Lo
Laboratory Manager

2 Version

Version No.	Date	Description
00	*May 31, 2020*	*Original*

Prepared By:		***Date:***	*May 31, 2020*
	Project Engineer		
Check By:		***Date:***	*May 31, 2020*
	Reviewer		

3 Contents

4 Test Summary

Radio Spectrum Matter (RSM) Part of Tx				
Test item	**Test Requirement**	**Test method**	**Limit/Severity**	**Result**
Operating frequency	ETSI EN 300 220-2	ETSI EN 300 220-1	Annexes B or C of EN 300 220-2	Pass
Effective Radiated Power	ETSI EN 300 220-2	ETSI EN 300 220-1	Annexes B or C of EN 300 220-2	Pass
Maximum e.r.p. Spectral Density	ETSI EN 300 220-2	ETSI EN 300 220-1	Annexes B or C of EN 300 220-2	N/A
Duty cycle	ETSI EN 300 220-2	ETSI EN 300 220-1	Annexes B or C of EN 300 220-2	Pass
Occupied Bandwidth	ETSI EN 300 220-2	ETSI EN 300 220-1	Annexes B or C of EN 300 220-2	Pass
Frequency Error	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.7	N/A
Tx Out of Band Emissions	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.8.2	Pass
Transmit Spurious Emmisions	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.9.2	Pass
Transient Power	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.10.2	Pass
Adjacent Channel Power	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.11.2	N/A
TX behaviour under Low Voltage Conditions	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.12.2	Pass
Adaptive Power Control	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.13.2	N/A
Short Term Behaviour	ETSI EN 300 220-2	N/A	annex C, table C.1	N/A
FHSS Equipment Requirements	ETSI EN 300 220-2	N/A	Clause 4.3.10.2	N/A
Radio Spectrum Matter (RSM) Part of Rx				
Test item	**Test Requirement**	**Test method**	**Limit/Severity**	**Result**
Receiver sensitivity	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.14.2	N/A
Adjacent channel selectivity	ETSI EN 300 220-1	ETSI EN 300 220-1	Clause 5.15.2	N/A
Receiver saturation at Adjacent Channel	ETSI EN 300 220-1	ETSI EN 300 220-1	Clause 5.16.2	N/A
Spurious response rejection	ETSI EN 300 220-1	ETSI EN 300 220-1	Clause 5.17.2	N/A
Blocking	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.18.2	Pass
Behaviour at high wanted signal level	ETSI EN 300 220-1	ETSI EN 300 220-1	Clause 5.19.2	N/A
Clear Channel Assessment threshold	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.21.2.2	N/A
Polite spectrum access timing parameters	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.21.3.1	N/A
Adaptive Frequency Agility	ETSI EN 300 220-2	N/A	N/A	N/A
Receive Spurious emmisions	ETSI EN 300 220-2	ETSI EN 300 220-1	Clause 5.9.2	Pass
Bi-Directional Operation Verification	ETSI EN 300 220-1	ETSI EN 300 220-1	Clause 5.22.2	N/A

Pass: The EUT complies with the essential requirements in the standard.

N/A: not applicable.

5 General Information

5.1 General Description of EUT

Product Name:	LoRaWAN Sensor Node
Model No.:	LSN50 v2
Operation Frequency:	863MHz-870MHz
Occupied bandwidth	200kHz
Number of Channels:	35
Modulation type:	External antenna
Antenna type:	FSK
Antenna Gain:	2.00dBi
Power supply:	DC 3.6V Lithium Battery

5.2 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode
Receiving mode	Keep the EUT in continuously receiving mode

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	**863.1MHz**	10	864.7MHz	19	866.7MHz	28	868.5MHz
2	863.3MHz	11	864.9MHz	20	866.9MHz	29	868.7MHz
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
8	864.5MHz	17	866.3MHz	26	868.1MHz	35	**869.9MHz**
9	864.7MHz	18	**866.5MHz**	27	868.3MHz		

Test Channel	Frequency(MHz)
Lowest channel	863.1
Middle channel	866.5
Highest channel	869.9

5.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

● **FCC —Registration No.: 381383**

Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383.

● **IC —Registration No.: 9079A**

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A

● **NVLAP (LAB CODE:600179-0)**

Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). LAB CODE:600179-0

5.4 Test Location

All tests were performed at:

Global United Technology Services Co., Ltd.
Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102
Tel: 0755-27798480
Fax: 0755-27798960

5.5 Description of Support Units

None

5.6 Deviation from Standards

None

5.7 Abnormalities from Standard Conditions

None

5.8 Other Information Requested by the Customer

None

6 Test Instruments list

Radiated Emission:

Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July. 03 2015	July. 02 2020
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June. 26 2019	June. 25 2020
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 26 2019	June. 25 2020
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 26 2019	June. 25 2020
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 26 2019	June. 25 2020
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 26 2019	June. 25 2020
9	Coaxial Cable	GTS	N/A	GTS211	June. 26 2019	June. 25 2020
10	Coaxial cable	GTS	N/A	GTS210	June. 26 2019	June. 25 2020
11	Coaxial Cable	GTS	N/A	GTS212	June. 26 2019	June. 25 2020
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 26 2019	June. 25 2020
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 26 2019	June. 25 2020
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 26 2019	June. 25 2020
15	Band filter	Amindeon	82346	GTS219	June. 26 2019	June. 25 2020
16	Power Meter	Anritsu	ML2495A	GTS540	June. 26 2019	June. 25 2020
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 26 2019	June. 25 2020
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 26 2019	June. 25 2020
19	Splitter	Agilent	11636B	GTS237	June. 26 2019	June. 25 2020
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 26 2019	June. 25 2020
21	Breitband hornantenne	SCHWARZBECK	BBHA 9170	GTS579	Oct. 19 2019	Oct. 18 2020
22	Amplifier	TDK	PA-02-02	GTS574	Oct. 19 2019	Oct. 18 2020
23	Amplifier	TDK	PA-02-03	GTS576	Oct. 19 2019	Oct. 18 2020
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	June. 26 2019	June. 25 2020

General used equipment:

Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Humidity/ Temperature Indicator	KTJ	TA328	GTS243	June. 26 2019	June. 25 2020
2	Barometer	ChangChun	DYM3	GTS255	June. 26 2019	June. 25 2020

RF Conducted:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	MXA Signal Analyzer	Agilent	N9020A	GTS566	June. 26 2019	June. 25 2020
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 26 2019	June. 25 2020
3	Spectrum Analyzer	Agilent	E4440A	GTS533	June. 26 2019	June. 25 2020
4	MXG vector Signal Generator	Agilent	N5182A	GTS567	June. 26 2019	June. 25 2020
5	ESG Analog Signal Generator	Agilent	E4428C	GTS568	June. 26 2019	June. 25 2020
6	USB RF Power Sensor	DARE	RPR3006W	GTS569	June. 26 2019	June. 25 2020
7	RF Switch Box	Shongyi	RFSW3003328	GTS571	June. 26 2019	June. 25 2020
8	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 26 2019	June. 25 2020
9	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	GTS572	June. 26 2019	June. 25 2020

7 Radio Technical Requirements Specification in ETSI EN 300 220-2

7.1 Test conditions

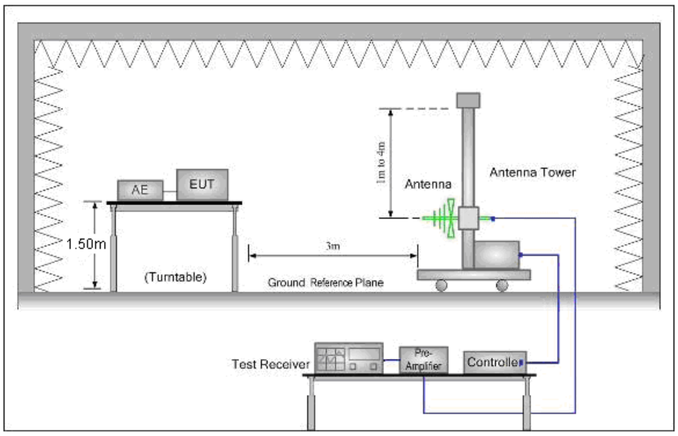
Normal conditions	Ambient:	Temperature.:	+15°C to +35°C
		relative humidity:	20 % to 75 %
	Power supply:	Battery:	Nominal
		AC mains source	Nominal
		Other power sources	Nominal
Extreme conditions	Ambient:	Temperature.:	-20°C to +55°C
	Power supply:	Battery:	0.9 and 1.3 mutiplied for lead-acid battery 0.85 and 1.15 mutiplied for"gel-cell" type batteries 0.85 and 0.9 mutiplied for lithium and nickel-cadmium type batteries For other types it may declared by manufacturer
		AC mains source	±10% of the norminal power source
		Other power sources	Declared by manufacturer

7.2 Transmitter Requirement

7.2.1 Operation Frequency

The Operational Frequency band was declared by the manufacturer which conforms annexes B, C or any NRI of ETSI EN 300220-2.

7.2.2 Effective Radiated Power

Test Requirement:	ETSI EN 300 220-2 clause 4.3.1
Test Method:	ETSI EN 300 220-1 clause 5.2.2
Test site:	Measurement Distance: 3m (Semi-Anechoic Chamber)
Receiver setup:	RBW=120kHz, VBW=300kHz, Detector= peak
Limit:	10mW=10dBm
Test setup:	
Test procedure:	Substitution method was performed to determine the actual ERP emission levels of the EUT. The following test procedure as below: 1. On the test site as test setup graph above,the EUT shall be placed at the 1.5m support on the turntable and in the position closest to normal use as declared by the provider. 2. The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.The output of the test antenna shall be connected to the measuring receiver. 3. The transmitter shall be switched on, if possible, without modulation and the measuring receiver shall be tuned to the frequency of the transmitter under test. 4. The test antenna shall be raised and lowered from 1m to 4m until a maximum signal level is detected by the measuring receiver. Then the turntable should be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver. 5. Repeat step 4 for test frequency with the test antenna polarized horizontally. 6. Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground. 7. Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends vertically polarized, and with the signal

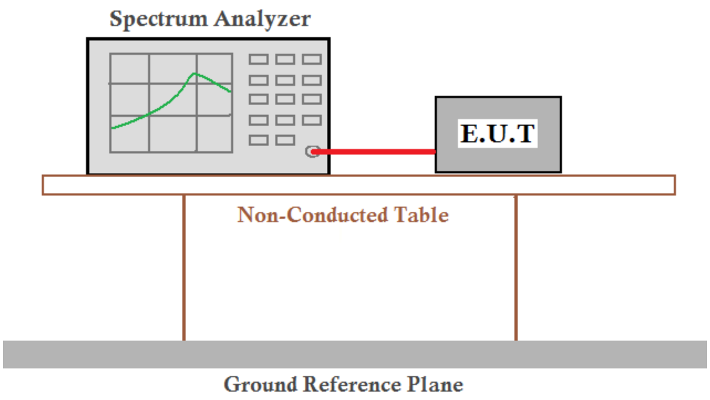
	generator tuned to a particular test frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output. 8. Repeat step 7 with both antennas horizontally polarized for each test frequency. 9. Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps 7 and 8 by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula: ERP(dBm) = Pg(dBm)) + antenna gain (dBd) where: Pg is the generator output power into the substitution antenna.
Measurement Record:	Uncertainty: 0.65dB
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

Channel	ERP Level (dBm)	Limit (dBm)	Result
Lowest	12.84	14.00	Pass
Middle	12.94		
Highest	12.82		

Remark:Peak value is applicable.

7.2.3 Duty Cycle

Test Requirement:	ETSI EN 300 220-2 clause 4.3.3
Test Method:	ETSI EN 300 220-1 clause 5.4
Limit:	According to ETSI EN 300 220-2 table B.1 band K to Q, the minimum dutycycle is 0.1%.
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

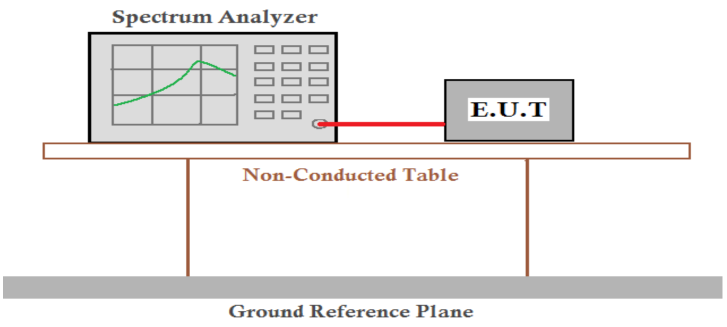
Measurement Data

Channel	Ton time(ms)	Tcycle time(s)	Dutycycle	Limit	Result
Lowest	1490.00	1800.00	0.083%	0.1%	Pass
Middle	1490.00	1800.00	0.083%	0.1%	Pass
Highest	1490.00	1800.00	0.083%	0.1%	Pass

7.2.4 Occupied Bandwidth

Test Requirement:	ETSI EN 300 220-2 clause 4.3.4
Test Method:	ETSI EN 300 220-1 clause 5.6
Receive setup:	**Table 12: Test Parameters for Max Occupied Bandwidth Measurement**

Setting	Value	Notes
Centre frequency	The nominal Operating Frequency	The highest or lowest Operating Frequency as declared by the manufacturer
RBW	1 % to 3 % of OCW without being below 100 Hz	
VBW	3 x RBW	Nearest available analyser setting to 3 x RBW
Span	At least 2 x Operating Channel width	Span should be large enough to include all major components of the signal and its side bands
Detector Mode	RMS	
Trace	Max hold	

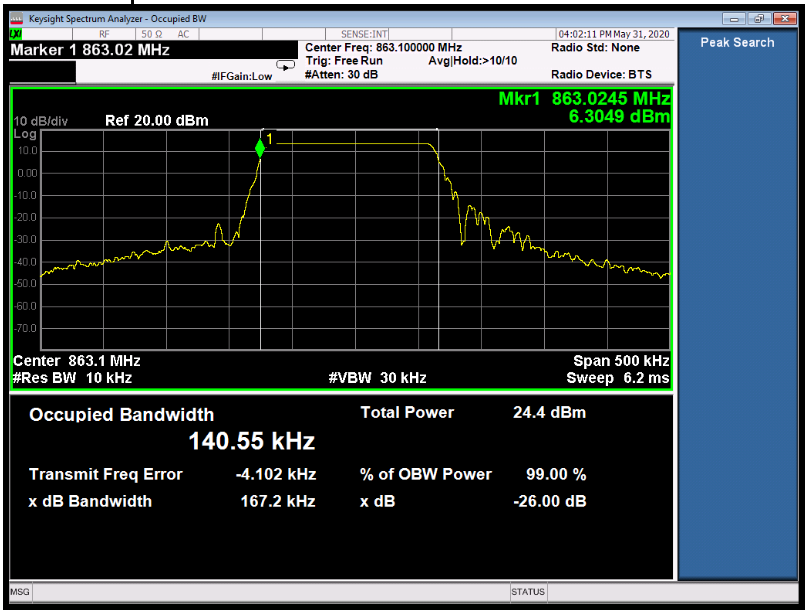
Limit:	The Operating Channel shall be declared and shall reside entirely within the Operational Frequency Band. The Maximum Occupied Bandwidth at 99 % shall reside entirely within the Operating Channel defined by F_{low} and F_{high}. Note: For 865 MHz to 868 MHz FHSS equipment.The Maximum occupied bandwidth per hopping channel shell less or equal to 50kHz. For 863 MHz to 870 MHz FHSS equipment.The Maximum occupied bandwidth per hopping channel shell less or equal to 100kHz.
Test setup:	

Test Procedure:	**Step 1:** Operation of the EUT shall be started, on the highest operating frequency as declared by the manufacturer, with the appropriate test signal. The signal attenuation shall be adjusted to ensure that the signal power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals on either side of the power envelope being included in the measurement. **Step 2:** When the trace is completed the peak value of the trace shall be located and the analyser marker placed on this peak. **Step 3:** The 99 % occupied bandwidth function of the spectrum analyser shall be used to measure the occupied bandwidth of the signal.
Measurement Record:	Uncertainty: ±5%
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

Test condition	Channel	99% Occupied Bandwidth(kHz)	F_L(MHz)	F_H(MHz)	Limit	Result
NTNV	Lowest	140.55	863.0245	-	Occupied Bandwidth limited to 300KHz, F_{low} and F_{high} shall reside entirely within the operating band	Pass
	Highest	138.29	-	869.9650		
LTHV	Lowest	139.37	863.0241	-		
	Highest	137.68	-	869.9672		
LTLV	Lowest	140.56	863.0238	-		
	Highest	139.47	-	869.9638		
HTLV	Lowest	141.53	863.0248	-		
	Highest	139.44	-	869.9648		
HTHV	Lowest	139.58	863.0286	-		
	Highest	140.46	-	869.9631		

The normal condition test plot:



7.2.5 TX Out Of Band Emissions

Test Requirement:	ETSI EN 300 220-2 clause 4.3.5
Test Method:	ETSI EN 300 220-1 clause 5.8.3

Receive setup:

Table 16: Test Parameters for Out Of Band for Operating Channel Measurement

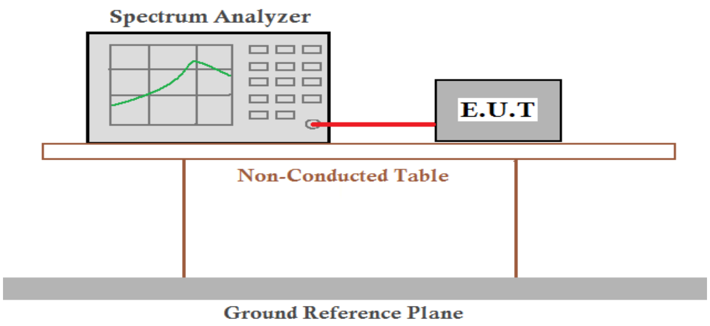
Spectrum Analyser Setting	Value	Notes
Centre frequency	Operating Frequency	
Span	6 x Operating Channel width	
RBW	1 kHz (see note)	Resolution bandwidth for Out Of Band domain measurements
Detector Function	RMS	
Trace Mode	Linear AVG	Applies only for EUT generating D-M2 test signal. An appropriate number of samples should be averaged to give a stable reading
	Max Hold	Applies only for EUT generating D-M2a or D-M3 test signal.
NOTE: If the value of RBW used is different from RBW_{REF} in clause 5.8.2, use the bandwidth correction in clause 4.3.10.1.		

Limit:

Table 15: Emission limits in the Out Of Band domains

Domain	Frequency Range	RBW_{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 6)	$f \le f_{low\_OFB}$ - 400 kHz	10 kHz	-36 dBm
	F_{low_OFB} - 400 kHz $\le f \le f_{low\_OFB}$ - 200 kHz	1 kHz	-36 dBm
	f_{low} - 200 kHz $\le f < f_{low\_OFB}$	1 kHz	See Figure 6
	$f = f_{low\_OFB}$	1 kHz	0 dBm
	$f = f_{high\_OFB}$	1 kHz	0 dBm
	$F_{high\_OFB} < f \le f_{high\_OFB}$ + 200 kHz	1 kHz	See Figure 6
	F_{high_OFB} + 200 kHz $\le f \le f_{high\_OFB}$ + 400 kHz	1 kHz	-36 dBm
	F_{high_OFB} + 400 kHz $\le f$	10 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 5)	$f = f_c$- 2.5 x OCW	1 kHz	-36 dBm
	f_c - 2,5 x OCW $\le f \le f_c$ - 0,5 x OCW	1 kHz	See Figure 5
	$f = f_c$ - 0,5 x OCW	1 kHz	0 dBm
	$f = f_c$ + 0,5 x OCW	1 kHz	0 dBm
	f_c + 0,5 x OCW $\le f \le f_c$ + 2,5 x OCW	1 kHz	See Figure 5
	$f = f_c$+ 2,5 x OCW	1 kHz	-36 dBm
NOTE: f is the measurement frequency. f_c is the Operating Frequency. F_{low_OFB} is the lower edge of the Operational Frequency Band. F_{high_OFB} is the upper edge of the Operational Frequency Band. OCW is the operating channel bandwidth.			

Test setup:



Test Procedure:	Refer to clause 5.8.3.4 of ETSI EN300220-1
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

Domain	Frequency Range	Result
OOB limits applicable to Operational Frequency Band	$f \leq f_{low\_OFB}$ - 400 kHz	Pass
	F_{low_OFB} - 400 kHz $\leq f \leq f_{low\_OFB}$ - 200 kHz	Pass
	f_{low} - 200 kHz $\leq f < f_{low\_OFB}$	Pass
	$f = f_{low\_OFB}$	Pass
	$f = f_{high\_OFB}$	Pass
	$F_{high\_OFB} < f \leq f_{high\_OFB}$ + 200 kHz	Pass
	F_{high_OFB} + 200 kHz $\leq f \leq f_{high\_OFB}$ + 400 kHz	Pass
	F_{high_OFB} + 400 kHz $\leq f$	Pass
OOB limits applicable to Operating Channel	$f = f_c$- 2.5 x OCW	Pass
	f_c - 2,5 x OCW $\leq f \leq f_c$ - 0,5 x OCW	Pass
	$f = f_c$ - 0,5 x OCW	Pass
	$f = f_c$ + 0,5 x OCW	Pass
	f_c + 0,5 x OCW $\leq f \leq f_c$ + 2,5 x OCW	Pass
	$f = f_c$+ 2,5 x OCW	Pass

7.2.6 Transient power

Test Requirement:	ETSI EN 300 220-2 Clause 4.3.6
Test Method:	ETSI EN 300 220-1 Clause 5.10.3
Limit:	**Table 23: Transmitter Transient Power limits** 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
Test procedure:	The output of the EUT shall be connected to a spectrum analyser or equivalent measuring equipment. The measurement shall be undertaken in zero span mode. The analyser's centre frequency shall be set to an offset from the operating centre frequency. These offset values and their corresponding RBW configurations are listed in Table 24.

Table 24: RBW for Transient Measurement

Measurement points: offset from centre frequency	Analyser RBW	RBW_{REF}
-0,5 x OCW - 3 kHz 0,5 x OCW + 3 kHz Not applicable for OCW < 25 kHz	1 kHz	1kHz
±12,5 kHz or ±OCW whichever is the greater	Max (RBW pattern 1, 3, 10 kHz) ≤ Offset frequency/6 (see note)	1 kHz
-0,5 x OCW - 400 kHz 0,5 x OCW + 400 kHz	100 kHz	1 kHz
-0,5 x OCW -1 200 kHz 0,5 x OCW + 1 200 kHz	300 kHz	1 kHz

NOTE: Max (RBW pattern 1, 3, 10 kHz) means the maximum bandwidth that falls into the commonly implemented 1, 3, 10 kHz RBW filter bandwidth incremental pattern of spectrum analysers.
EXAMPLE: If OCW is 25 kHz then the RBW value corresponding to one OCW offset frequency is 3 kHz. The rest of the analyser settings are listed in Table 25, and if OCW is 250 kHz then the RBW value corresponding to one OCW offset frequency is 30 kHz.

Table 25: Parameters for Transient Measurement

Spectrum Analyser Setting	Value	Notes
VBW/RBW	10	At higher RBW values VBW may be clipped to its maximum value
Sweep time	500 ms	
RBW filter	Gaussian	
Trace Detector Function	RMS	
Trace Mode	Max hold	
Sweep points	501	
Measurement mode	Continuous sweep	

NOTE: The ratio between the number of sweep points and the sweep time shall be the same ratio as above if different number of sweep points is used.

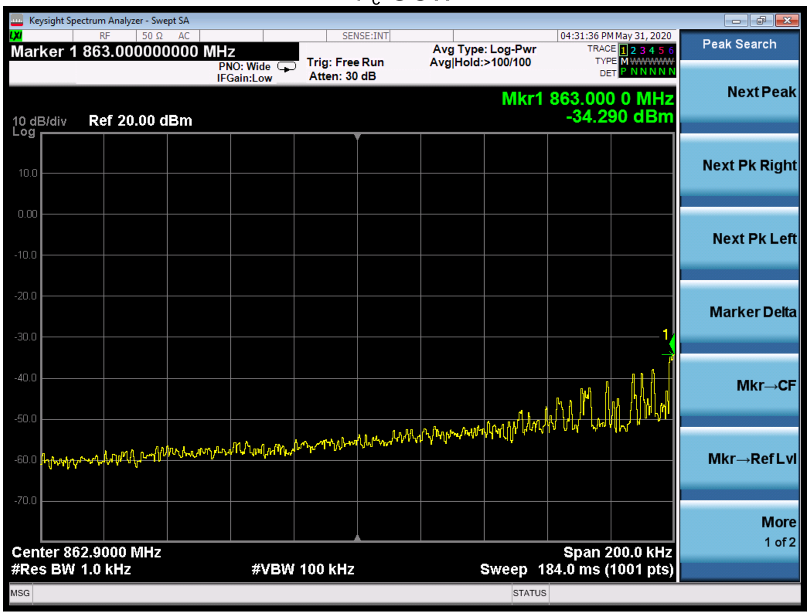
The used modulation shall be D-M3. The analyser shall be set to the settings of Table 25 and a measurement shall be started for each offset frequency. The EUT shall transmit at least five D-M3 test signal. The peak value shall be recorded and the measurement shall be repeated at each offset frequency mentioned in Table 24.
The recorded power values shall be converted to power values measured in RBWREF by the formula in clause 4.3.10.1.

Measurement Record:	Uncertainty: ± 1.5dB
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

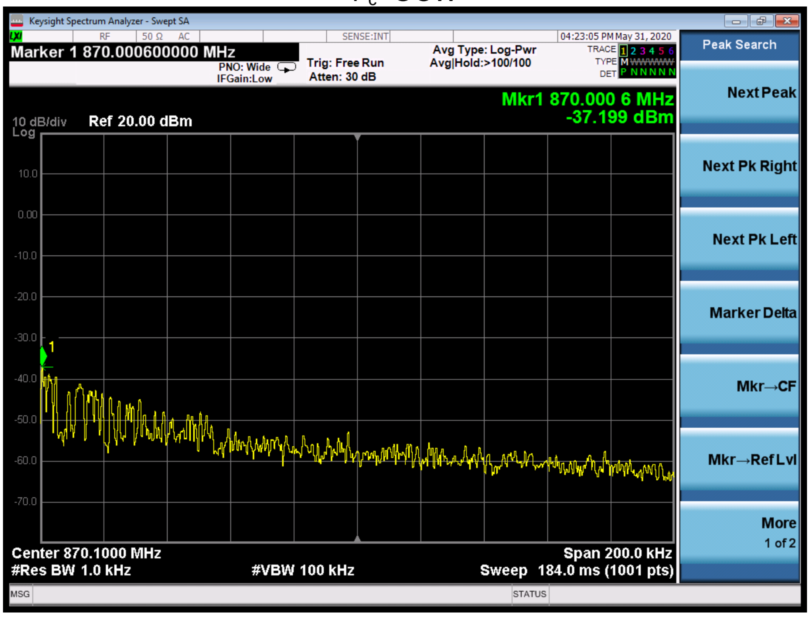
Measurement Data

Frequency offset	Peak Power level (dBm)	Limit (dBm)	Result
F_c-0.5*OCW-1200kHz	-44.99	-27	Pass
F_c-0.5*OCW-400kHz	-41.62	-27	
F_c-OCW	-34.29	0	
F_c+OCW	-37.20	0	
F_c+0.5*OCW+400kHz	-42.20	-27	
F_C+0.5*OCW+1200kHz	-42.83	-27	

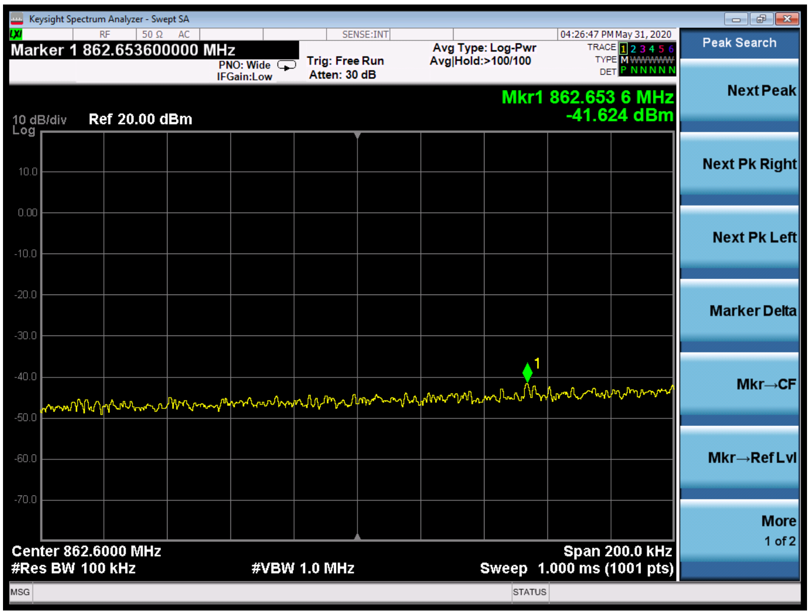
F_c-OCW


Keysight Spectrum Analyzer - Swept SA
Marker 1 863.000000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
04:31:36 PM May 31, 2020
Mkr1 863.000 0 MHz
-34.290 dBm
10 dB/div
Log
Ref 20.00 dBm
Center 862.9000 MHz
#Res BW 1.0 kHz
#VBW 100 kHz
Span 200.0 kHz
Sweep 184.0 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→RefLvl
More
1 of 2

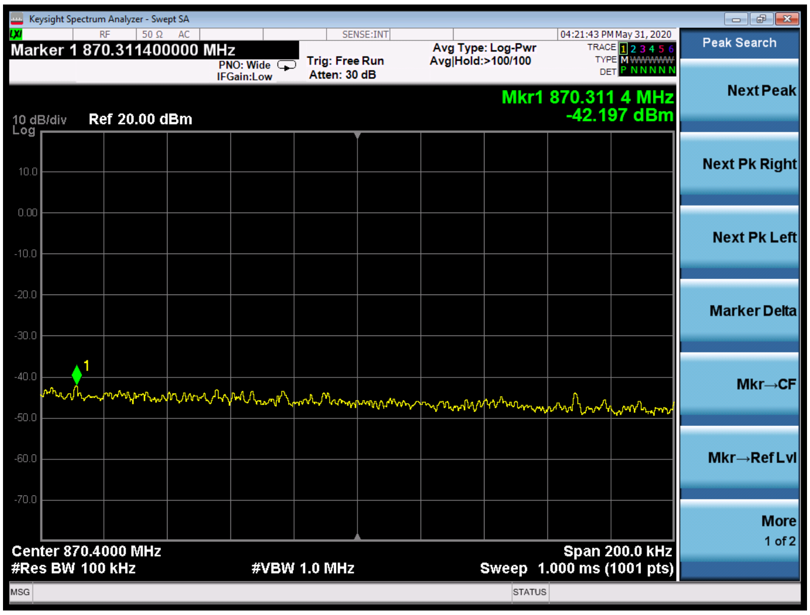
F_c+OCW


Keysight Spectrum Analyzer - Swept SA
Marker 1 870.000600000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
04:23:05 PM May 31, 2020
Mkr1 870.000 6 MHz
-37.199 dBm
10 dB/div
Log
Ref 20.00 dBm
Center 870.1000 MHz
#Res BW 1.0 kHz
#VBW 100 kHz
Span 200.0 kHz
Sweep 184.0 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→RefLvl
More
1 of 2

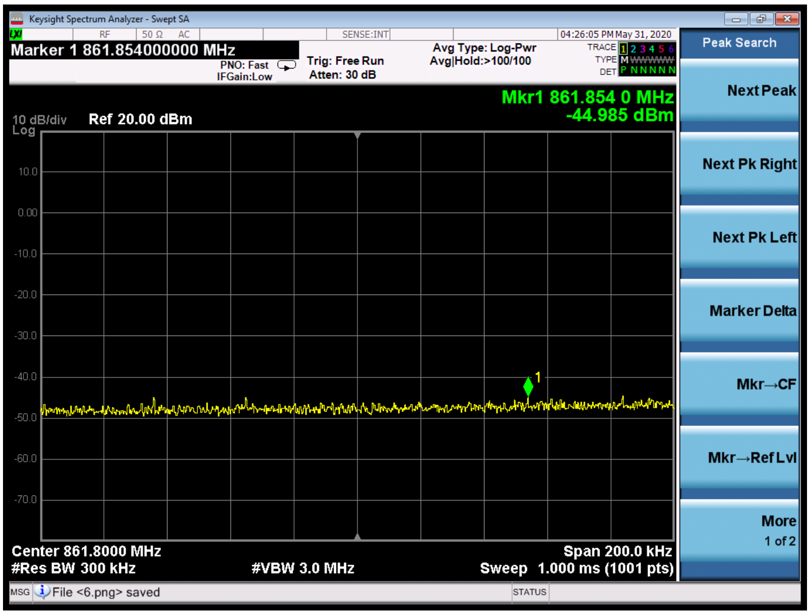
Fc-0.5*OCW-400kHz



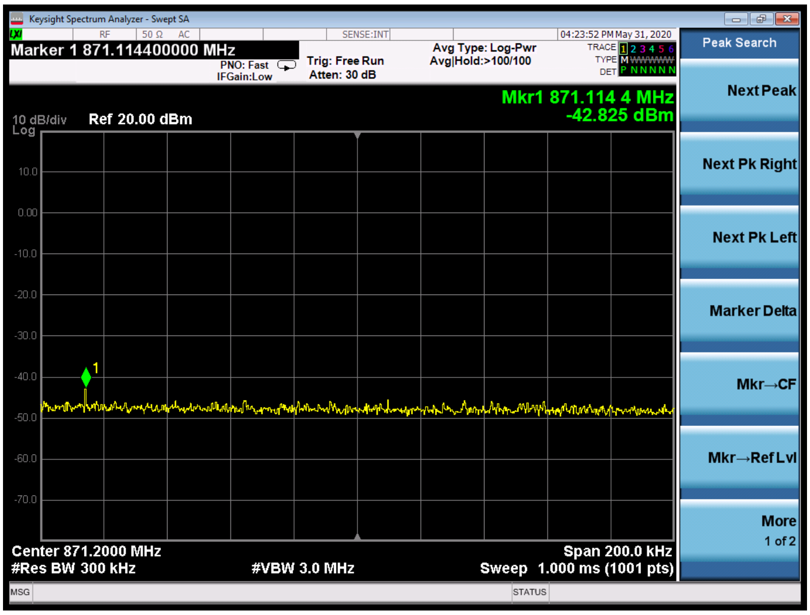
Fc-0.5*OCW+400kHz



Fc-0.5*OCW-1200kHz



Fc-0.5*OCW+1200kHz



7.2.7 Adaptive Power Control

This product not support this function.

7.2.8 Transmit spurious emissions

Test Requirement:	ETSI EN 300 220-2 Clause 4.2.2
Test Method:	ETSI EN 300 220-1 Clause 5.9.1.2

Receiver setup:

Table 20: Parameters for TX Spurious Radiations Measurement

Operating Mode	Frequency Range	RBW_{REF} (see note 2)
Transmit mode	9 kHz ≤ f < 150 kHz	1 kHz
	150 kHz ≤ f < 30 MHz	10 kHz
	30 MHz ≤ f < f_c - m	100 kHz
	f_c - m ≤ f < f_c - n	10 kHz
	f_c - n ≤ f < f_c - p	1 kHz
	f_c + p < f ≤ f_c + n	1 kHz
	f_c + n < f ≤ f_c + m	10 kHz
	f_c + m < f ≤ 1 GHz	100 kHz
	1 GHz < f ≤ 6 GHz	1 MHz

NOTE 1: f is the measurement frequency.
f_c is the Operating Frequency.
m is 10 x OCW or 500 kHz, whichever is the greater.
n is 4 x OCW or 100 kHz, whichever is the greater.
p is 2,5 x OCW.

NOTE 2: If the value of RBW used for measurement is different from RBW_{REF}, use bandwidth correction from clause 4.3.10.1.

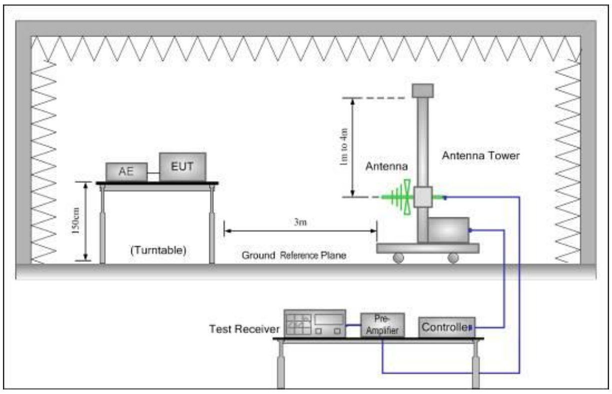
Test Frequency range:	25MHz to 6GHz

Limit:

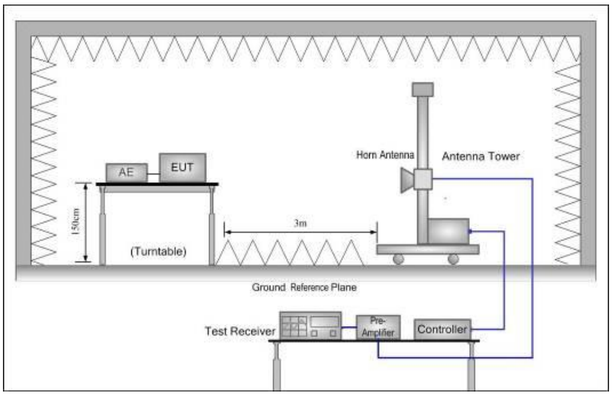
Frequency	Limit(operation)	Limit(standby)
47 MHz to 74 MHz 87.5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	4nW(-54dBm)	2nW(-57dBm)
Other frequencies below 1000 MHz	250nW(-36dBm)	2nW(-57dBm)
Above 1000 MHz	1uW(-30dBm)	20nW(-47dBm)

Test setup:

Below 1GHz



Above 1GHz

	
Test procedure:	Substitution method was performed to determine the actual ERP emission levels of the EUT. The following test procedure as below: **Below 1GHz:** 1. On the test site as test setup graph above,the EUT shall be placed at the 1.5m support on the turntable and in the position closest to normal use as declared by the provider. 2. The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.The output of the test antenna shall be connected to the measuring receiver. 3. The transmitter shall be switched on, if possible, without modulation and the measuring receiver shall be tuned to the frequency of the transmitter under test. 4. The test antenna shall be raised and lowered from 1m to 4m until a maximum signal level is detected by the measuring receiver. Then the turntable should be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver. 5. Repeat step 4 for test frequency with the test antenna polarized horizontally. 6. Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground. 7. Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends vertically polarized, and with the signal generator tuned to a particular test frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output. 8. Repeat step 7 with both antennas horizontally polarized for each test frequency. 9. Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps 7 and 8 by the power loss in

	the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula: ERP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBi) where: Pg is the generator output power into the substitution antenna. **Above 1GHz:** Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber, and the test antenna do not need to raise from 1 to 4m, just test in 1.5m height.
Measurement Record:	Uncertainty: 4.64dB
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

Middle Channel

Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	Polarization	Level(dBm)		
62.56	Vertical	-69.23	Section 7.2.8	Pass
548.63	V	-65.30		
1437.00	V	-50.05		
2756.00	V	-45.38		
3548.00	V	-41.83		
5110.00	V	-42.22		
48.39	Horizontal	-66.44		
838.70	H	-67.52		
1804.00	H	-49.69		
2426.00	H	-45.94		
3458.00	H	-41.68		
5310.00	H	-43.91		

7.3 Receiver Requirements

Receiver Classification, Table 1 of ETSI EN 300 220-1.

Rx Class	Risk assessment of Rx performance
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.
NOTE: The receiver category should be stated in both the test report and in the user's manual for the equipment. Receiver category 3 will be withdrawn after December 31st, 2018.	

The EUT (Receiver part) belong to Category 2 with no Polite spectrum access function.

7.3.1 Receiver sensitivity

Not applicable, since the test applied to Polite spectrum access equipment.

7.3.2 Clear Channel Assessment threshold

Not applicable, since the test applied to Polite spectrum access equipment.

7.3.3 Polite spectrum access timing parameters

Not applicable, since the test applied to Polite spectrum access equipment.

7.3.4 Adaptive Frequency Agility

Not applicable, since the test applied to AFA quipment.

7.3.5 Adjacent channel selectivity

Not applicable, since the test applied to Category 1 equipment.

7.3.6 Receiver saturation at Adjacent Channel

Not applicable, since the test applied to Category 1 equipment.

7.3.7 Spurious response rejection

Not applicable, since the test applied to Category 1 equipment.

7.3.8 Behaviour at high wanted signal level

Not applicable, since the test applied to Category 1 equipment.

7.3.9 Bi-Directional Operation Verification

Not applicable, since this product is not support Bi-Directional operation function.

7.3.10 Blocking

Test Requirement:	ETSI EN 300 220-2 Clause 4.4.2
Test Method:	ETSI EN 300 220-1 clause 5.18

Limit:

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 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 41: Blocking level parameters for RX category 2

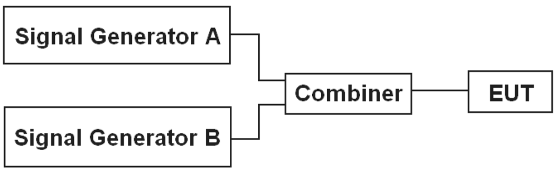
Requirement	Limits
	Receiver category 2
Blocking at ±2 MHz from OC edge f_{high} and f_{low}	≥ -69 dBm
Blocking at ±10 MHz from OC edge f_{high} and f_{low}	≥ -44 dBm
Blocking at ±5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -44 dBm

Table 40: Blocking level parameters for RX category 3

Requirement	Limits
	Receiver category 3
Blocking at ±2 MHz from OC edge f_{high} and f_{low}	≥ -80 dBm
Blocking at ±10 MHz from OC edge f_{high} and f_{low}	≥ -60 dBm
Blocking at ±5 % of Centre Frequency or 15 MHz, whichever is the greater	≥ -60 dBm

A = 10 log (BW_{kHz} / 16 kHz) BW is the receiver bandwidth

Test setup:



Test procedure:

1. Two signal generators A and B shall be connected to the receiver via a combining network to the receiver antennaconnector.
2. Signal generator A shall be at the nominal frequency of the receiver, with normal modulation of the wanted signal. Signal generator B shall be unmodulated.
3. Measurements shall be carried out at frequencies of the unwanted signal at approximately ±2 MHz and ±10 MHz, avoiding those frequencies at which spurious responses occur.
4. Initially signal generator B shall be switched off and using signal generator A the level which still gives sufficient response shall be established, however, the level at the receiver input shall not be adjusted below the sensitivity limit given in clause 8.1.4. The output level of generator A shall then be increased by 3 dB.
5. Signal generator B is then switched on and adjusted until the wanted criteria (see clause 8.1.1) is just exceeded. With signal generator B settings unchanged the power into the receiver is measured by replacing the receiver with a power meter or spectrum analyzer. This level shall be recorded. Alternatively, equipment having a dedicated or

	integral antenna may use a radiated measurement setup. For this, a test site from clause A.1 shall be selected and the requirements from clauses A.2 and A.3 apply. 6. Signal generators A and B together with a combiner shall be placed outside the anechoic chamber and a TX test antenna shall be placed with the EUT's antenna polarisation. The EUT shall be placed at the location of the turntable at the orientation of the most sensitive position. Generator A shall be set in order to reach the EUT sensitivity limit +3 dB. 7. The procedure shall be the same as for the conducted measurement. Bloking is the difference between signal generator B and signal generator A levels.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

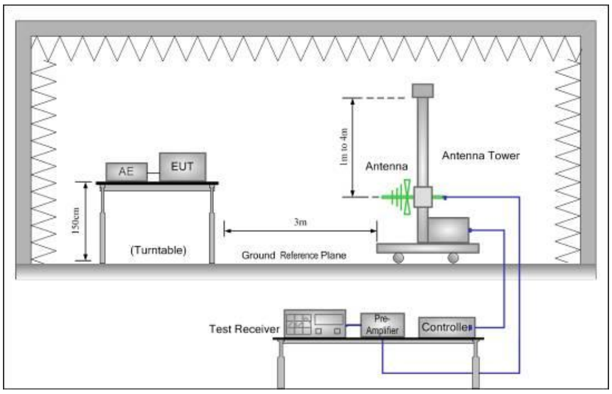
Measurement data:

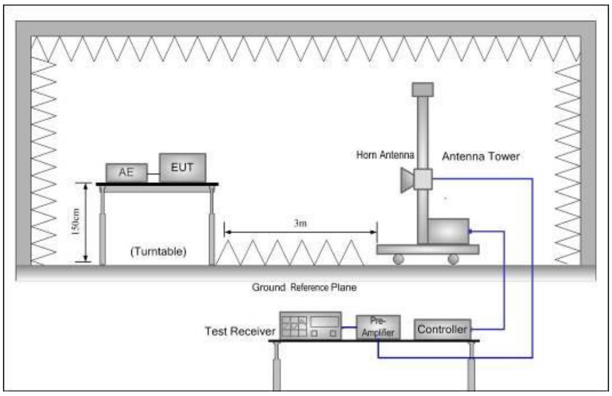
Middle channel

Receiver Category	**Frequency Offset**	**Value(dBm)**	**Limit(dBm)**	**Result**
2	Flow-5% of Fc	-40	-44.00	Pass
2	Flow-10MHz	-41	-44.00	Pass
2	Flow-2MHz	-58	-69.00	Pass
2	FHigh+2MHz	-56	-69.00	Pass
2	FHigh+10MHz	-42	-44.00	Pass
2	FHigh+5% of Fc	-40	-44.00	Pass

Remark: The provider declared that the receiver bandwidth is 200kHz.

7.3.11 Spurious emissions

<table>
<tr><td>Test Requirement:</td><td>ETSI EN 300 220-2 Clause 4.2.2</td></tr>
<tr><td>Test Method:</td><td>ETSI EN 300 220-1 Clause 5.9.1.2</td></tr>
<tr><td>Receiver setup:</td><td>
Table 20: Parameters for TX Spurious Radiations Measurement
<table>
<tr><th>Operating Mode</th><th>Frequency Range</th><th>RBW_{REF} (see note 2)</th></tr>
<tr><td rowspan="9">Transmit mode</td><td>9 kHz ≤ f < 150 kHz</td><td>1 kHz</td></tr>
<tr><td>150 kHz ≤ f < 30 MHz</td><td>10 kHz</td></tr>
<tr><td>30 MHz ≤ f < f_c - m</td><td>100 kHz</td></tr>
<tr><td>f_c - m ≤ f < f_c - n</td><td>10 kHz</td></tr>
<tr><td>f_c - n ≤ f < f_c - p</td><td>1 kHz</td></tr>
<tr><td>f_c + p < f ≤ f_c + n</td><td>1 kHz</td></tr>
<tr><td>f_c + n < f ≤ f_c + m</td><td>10 kHz</td></tr>
<tr><td>f_c + m < f ≤ 1 GHz</td><td>100 kHz</td></tr>
<tr><td>1 GHz < f ≤ 6 GHz</td><td>1 MHz</td></tr>
<tr><td colspan="3">NOTE 1: f is the measurement frequency.
f_c is the Operating Frequency.
m is 10 x OCW or 500 kHz, whichever is the greater.
n is 4 x OCW or 100 kHz, whichever is the greater.
p is 2,5 x OCW.
NOTE 2: If the value of RBW used for measurement is different from RBW_{REF}, use bandwidth correction from clause 4.3.10.1.</td></tr>
</table>
</td></tr>
<tr><td>Test Frequency range:</td><td>25MHz to 6GHz</td></tr>
<tr><td>Limit:</td><td>
<table>
<tr><th>Frequency</th><th>Limit</th></tr>
<tr><td>Other frequencies below 1000 MHz</td><td>2nW(-57dBm)</td></tr>
<tr><td>Above 1000 MHz</td><td>20nW(-47dBm)</td></tr>
</table>
</td></tr>
<tr><td>Test setup:</td><td>
Below 1GHz


Above 1GHz


</td></tr>
<tr><td>Test procedure:</td><td>Substitution method was performed to determine the actual ERP emission</td></tr>
</table>

	levels of the EUT. The following test procedure as below: **Below 1GHz:** 1. On the test site as test setup graph above,the EUT shall be placed at the 1.5m support on the turntable and in the position closest to normal use as declared by the provider. 2. The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.The output of the test antenna shall be connected to the measuring receiver. 3. The transmitter shall be switched on, if possible, without modulation and the measuring receiver shall be tuned to the frequency of the transmitter under test. 4. The test antenna shall be raised and lowered from 1m to 4m until a maximum signal level is detected by the measuring receiver. Then the turntable should be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver. 5. Repeat step 4 for test frequency with the test antenna polarized horizontally. 6. Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground. 7. Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends vertically polarized, and with the signal generator tuned to a particular test frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output. 8. Repeat step 7 with both antennas horizontally polarized for each test frequency. 9. Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps 7 and 8 by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula: ERP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBd) where: Pg is the generator output power into the substitution antenna. **Above 1GHz:** Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber, and the test antenna do not need to raise from 1 to 4m, just test in 1.5m height.
Measurement Record:	Uncertainty: 4.64dB
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details

Test results:	Pass

Measurement Data

Middle channel:

Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	Polarization	Level(dBm)		
48.01	Vertical	-68.91	2nW/ -57dBm below 1GHz, 20nW/ -47dBm above 1GHz.	Pass
513.55	V	-68.29		
4804.00	V	-60.52		
7206.00	V	-56.63		
9608.00	V	-51.71		
12010.00	V	-53.59		
34.67	Horizontal	-69.14		
818.68	H	-68.26		
4804.00	H	-63.18		
7206.00	H	-57.56		
9608.00	H	-53.13		
12010.00	H	-54.76		

8 Test Setup Photo

Reference to the **appendix I** for details.

9 EUT Constructional Details

Reference to the **appendix II** for details.

------End------