Radio Test Report-2.4G BT

Report Reference No. ..... : AAEMT/EMC/201119-01-05

Applicant's name..... Netradyne Inc.

Address..... : 9191 Towne Centre Drive, Suite 200, San Diego, CA 92122

Manufacture's Name..... : Netradyne Inc.

Address..... : 9191 Towne Centre Drive, Suite 200, San Diego, CA 92122

Test item description:

Product name..... : Driveri

Trademark ..... : Netradyne

Model and/or type reference ..... : D-210

Serial Model: .....: D-210A, D-211

Testing Laboratory information:

Testing Laboratory Name ..... : AA Electro Magnetic Test Laboratory Private Limited

Address ..... : Plot No 174, Udyog Vihar-Phase4, Sector18, Gurgaon, Haryana, India

Standards ..... : ETSI EN 300 328 V2.2.2 (2019-07)

This device has been tested and found to comply with the stated standard(s), which is (are) required by the council directive of 2014/53/EU and indicated in the test report and are applicable only to the tested sample identified in the report.

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Testing .....:

Date of receipt of test item .....: Nov. 19, 2020

Date (s) of performance of tests .....: Nov. 19, 2020 ~ Jan. 11, 2021

Date of Issue.....: Jan. 12, 2021

Test Result.....: PASS

Declaration of Conformity: Declaration of conformity of the results is based as per the standard limits

Compiled by (+ signature) Abhinav Kumar: Abhinav Kumar

Authorized & Reviewed by (+ signature) Dr. Lenin Raja:

Issued by (+ signature) Bittu Kumar: Bittu Kumar

AA Electro Magnetic Test Laboratory Pvt. Ltd.

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1 Contents

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2 Test Summary

2.1 Compliance with ETSI EN 300 328 V2.2.2 (2019-07)

No.	Description of Test Item	Basic Standard	Results
Transmitter Parameters			
1	RF Output Power	EN300328 clause 4.3.1.2	**Pass**
2	Duty cycle, Tx-Sequence, Tx-gap	EN300328 clause 4.3.1.3	**N/A**
3	Dwell time	EN300328 clause 4.3.1.4	**Pass**
4	Minimum Frequency Occupation	EN300328 clause 4.3.1.4	**Pass**
5	Hopping Sequence	EN300328 clause 4.3.1.4	**Pass**
6	Hopping Frequency Separation	EN300328 clause 4.3.1.5	**Pass**
7	Medium Utilization (MU) factor	EN300328 clause 4.3.1.6	**N/A**
8	Adaptivity (Adaptive Frequency Hopping)	EN300328 clause 4.3.1.7	**N/A**
9	Occupied Channel Bandwidth	EN300328 clause 4.3.1.8	**Pass**
10	Transmitter unwanted emissions in the out-of-band domain	EN300328 clause 4.3.1.9	**Pass**
11	Transmitter unwanted emissions in the spurious domain	EN300328 clause 4.3.1.10	**Pass**
12	Geo-location capability	EN 300 328 Clause 4.3.2.12.2	**N/A**
Receiver Parameters			
13	Receiver spurious emissions	EN300328 clause 4.3.1.11	**Pass**
14	Receiver Blocking	EN300328 clause 4.3.1.12	**Pass**
N/A: not applicable. Refer to the relevant section for the details.			
EN 300 328: the detail version is ETSI EN 300 328 V2.2.2 (2019-07) in the whole report.			
Tx: In this whole report Tx (or tx) means Transmitter. Rx: In this whole report Rx (or rx) means Receiver. RF: In this whole report RF means Radio Frequency. The EUT belongs to the list of 'Class-1' equipment in accordance with the Commission Decision 2000/299/EC (6 April 2000). Temperature (Uncertainty): ±1°C Humidity (Uncertainty): ±5%			

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3 Test Facility

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

ILAC / NABL Accreditation No.: TC-8597

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by National Accreditation Board for Testing and Calibration Laboratories (NABL).

ILAC –A2LA Accreditation No.: 5593.01

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered American Association of Laboratory Accreditation (A2LA.)

FCC- Recognition No.: 137777

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Federal Communications Commission (FCC).

ISED Recognition No.: 26046

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Institute for Social and Economic Development.(ISED)

VCCI- Registration No: 4053

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Voluntary Control Council for Interference.(VCCI)

TEC Designation No.: IND063

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Telecommunication Engineering (TEC) Center.

BIS Recognition No: 816586

BIS recognized as per CRS scheme for IT electronics, LED control gears, Lamp, Inverter / UPS are recognized as per LRS 2020.

3.1 Deviation from Standard

None

3.2 Abnormalities from Standard Conditions

None

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4 General Information

4.1 General Description of EUT

Manufacturer:	Netradyne Inc.
Manufacturer Address:	9191 Towne Centre Drive, Suite 200, San Diego, CA 92122
EUT Name:	Driveri
Model No:	D-210
Serial Model:	D-210A, D-211
Brand Name:	Netradyne
Bluetooth version:	Bluetooth v5.0
Operation frequency:	2402 MHz to 2480 MHz
Channel Number:	79
Modulation Type:	GFSK, π/4-DQPSK, 8DPSK
Modulation Technology:	FHSS
Antenna Type:	Adaptive equipment
Antenna Gain:	3 dBi
H/W No.:	501-1-00908_B1
S/W No.:	2.4.9.rc.2
Adapter:	Input : 12VDC, 3A
Power Cord:	N/A
Note:	
1.	For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

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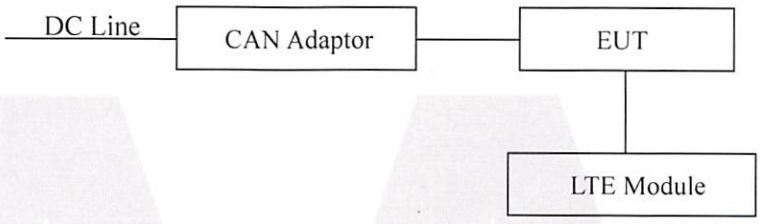
4.2 Description of Test setup

EUT was tested in normal configuration (Please See following Block diagrams)

1. Block diagram of EUT configuration (TX Mode)



4.3 EUT Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	Signal cord
1	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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4.4 Test Peripheral List

No.	Equipment	Manufacturer	FCC ID	Model No.	Serial No.	Power cord	signal cable
1	Driveri/DCM LTE Module	Netradyne Inc.	2AM8R-DC M-NA1-100	DriverI/DCM	N/A	N/A	N/A
2	CAN Adaptor Board	Netradyne Inc.	N/A	A1 version : D-210-AD1 A2 version : D-210-AD2 A3 version : D-210-AD3	N/A	N/A	N/A

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4.5 Equipments List for All Test Items

No	Test Equipment	Manufacturer	Model No	Serial No	Cal. Date	Cal. Due Date
1	EMI TEST Receiver	Rohde and schwarz	ESIB26	838786/010	2019/01/28	2020/01/27
2	Loop antenna	DA ZE Beijing	ZN30900C	18052	2019/01/29	2020/01/28
3	Hi power horn antenna	DA ZE Beijing	ZN30700	18012	2019/01/30	2020/01/29
4	Horn antenna	DA ZE Beijing	ZN30702	18006	2019/01/30	2020/01/29
5	Horn antenna	DA ZE Beijing	ZN30703	18005	2019/01/30	2020/01/29
6	Pre Amplifier	KELIANDA	LNA-0009295	-	2019/01/28	2020/01/29
7	Pre Amplifier	KELIANDA	CF-00218	-	2019/01/28	2020/01/27
8	Bi conical Antenna	DA ZE Beijing	ZN30505C	17038	2019/01/28	2020/01/29
9	EMI-RECEIVER	Schwarzbeck	FCKL	1528194	2019/01/28	2020/01/27
10	Spectrum Analyzer	ADVANTEST	R3361	-	2019/05/15	2020/05/14
11	LISN	Kyoritsu	KNW-407	8-1789-5	2019/01/28	2020/01/27
12	Network - LISN	SCHWAR ZBECK	NNBM8125	81251314	2019/01/28	2020/01/27
13	Network - LISN	SCHWAR ZBECK	NNBM8125	81251315	2019/01/28	2020/01/27
14	PULSE LIMITER	Rohde and schwarz	ESH3-Z2	100681	2019/05/13	2020/05/12
15	50Ω Coaxial Switch	DAIWA	1565157	-	2019/05/13	2020/05/12
16	50Ω Coaxial Switch	-	-	-	2019/05/13	2020/05/12
17	Wireless signal power meter	DARE!!	RPR3006W	RFSW190220	2019/01/29	2020/01/27
18	Signal Generator	KEYSIGHT	N5181A	512071	2019/01/29	2020/01/28
19	RF Vector Signal Generator	Keysight	N5182B	512094	2019/01/29	2020/01/28
20	Spectrum analyzer	R and S	FSV-40N	101385	2019/01/29	2020/01/28
21	Radio Communication Tester	R and S	CMW 500	124589	2019/5/15	2020/5/14

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22	Signal Generator	R and S	SMP 02	837017/004 836593/005	2019/5/15	2020/5/14
23	DC Power Supply	Guanker	JK15040K	TNC/ET/C/001/ 15	2019/2/2	2020/2/1
24	Pro.Temp&Humi. chamber	MENTEK	MHP-150-1C	MAA08112501	2019/2/2	2020/2/1
25	Attenuators	AGILENT	8494B		-	-
26	Attenuators	AGILENT	8495B		-	-

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4.6 Measurement Uncertainty

No.	Item	Uncertainty
1	Conducted Emission Test	2.78dB
2	Radiated Emission Test	2.82dB
3	RF power, conducted	2.62dB
4	RF power density, conducted	2.72dB
5	Spurious emissions, conducted	2.83dB
6	All emissions, radiated(<1G)	2.80dB
7	All emissions, radiated(>1G)	2.81dB

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5 Radio Technical Requirements Specification in EN 300 328

5.1 Transmitter Conditions

Item	EUT Type
1	stand-alone radio equipment with or without their own control provisions;
2	plug-in radio devices intended for use with or within a variety of host systems, e.g. personal computers, hand-held terminals, etc.;
3	plug-in radio devices intended for use within combined equipment, e.g. cable modems, set-top boxes, access points, etc.;
4	Combined equipment or a combination of a plug-in radio device and a specific type of host equipment.

Modulation
FHSS

EUT belongs to item 1 with FHSS modulation.

5.2 Test conditions

5.2.1 Normal conditions

Ambient:	Temperature:	+15°C to +35°C
	Relative humidity:	20% to 75%
	Press:	1010 mbar
Power supply:	AC	AC 230V for adapter
	DC	10.8Vto13.2V

5.2.2 Extreme conditions

Ambient:	Temperature:	-20 °C to +40 °C (Which declared by manufacture)
Power supply:	DC	10.8Vto13.2V

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5.3 Test frequencies

EUT channels and frequencies list:

Description of Channel:					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454	--	--
26	2428	53	2455	--	--

Test frequencies are the lowest channel: 0 channel(2402MHz), middle channel: 39 channel(2441 MHz) and highest channel: 78 channel(2480 MHz)

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6 Transmitter Requirements

6.1 RF Output Power

6.1.1 Limit(ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.2.3)

For non-adaptive frequency hopping systems

The maximum RF output power for non-adaptive Frequency Hopping equipment, shall be declared by the supplier. The maximum RF output power for this equipment shall be equal to or less than the value declared by the supplier. This declared value shall be equal to or less than 20dBm.

For adaptive frequency hopping systems

The maximum RF output power for adaptive Frequency Hopping equipment shall be equal to or less than 20dBm.

6.1.2 Test procedure

ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.2

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Use a fast power sensor suitable for 2, 4 GHz and capable of 1 MS/s.
3. Sample speed 1 MS/s or faster, and must represent the power of the signal.
4. For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured.
5. For conducted measurements on devices with one transmit chain:

   -Connect the power sensor to the transmit port, sample the transmit signal and store the raw data. use these stored samples in all following steps.
6. For conducted measurements on devices with multiple transmit chains:

   - Connect one power sensor to each transmit port for a synchronous measurement on all transmits ports.

   -Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than half the time between two samples.

   -For each instant in time, sum the power of the individual samples of all ports and store them. Use these stored samples in all following steps.
7. Find the start and stop times of each burst in the stored measurement samples.

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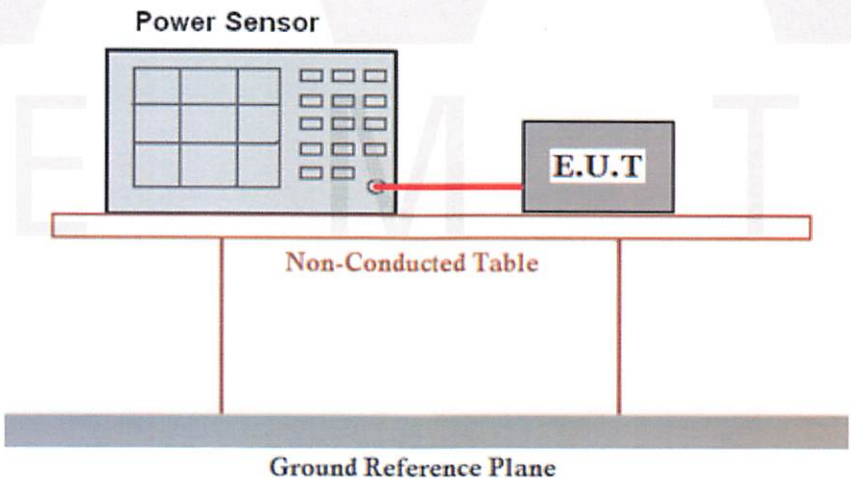
8. Between the start and stop times of each individual burst calculate the RMS power over the burst. Save these Pburst values, as well as the start and stop times for each burst.
9. The highest of all Pburst values (value "A" in dBm) will be used for maximum e.i.r.p. calculations.
10. Add the (stated) antenna assembly gain "G" in dBi of the individual antenna, If applicable, add the additional beam forming gain "Y" in dB.
11. If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used.
12. The RF Output Power (P) shall be calculated using the formula below: P = A + G + Y

Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

EUT Operation

Status: Enter test mode for the product, keep EUT in continuously transmitting status with hoping on mode.
Conducted measurement for this kind of products which be used for integral antenna equipment connect to the measuring equipment.
Test the EUT in normal mode and EDR mode.
Pre-test the EUT in AC mode and B/O mode, find worse case in B/O mode.

6.1.3 TEST SETUP



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6.1.4 Test record

Measurement Conditions (in Normal & Extreme)		Limit =20dBm		
Temperature (°C)	Voltage (V DC)	Test result (dBm)	Test Limit (dBm)	Pass/Fail
CH00 2402MHz				
T_{nom} = +25	V_{nom} = 12.0	8.07	20	Pass
T_{max} = +40	V_{max} = 13.2	7.44	20	Pass
	V_{min} = 10.8	7.69	20	Pass
T_{min} = -20	V_{max} = 13.2	7.99	20	Pass
	V_{min} = 10.8	8.04	20	Pass
CH39 2441MHz				
T_{nom} = +25	V_{nom} = 12.0	6.84	20	Pass
T_{max} = +40	V_{max} = 13.2	6.77	20	Pass
	V_{min} = 10.8	6.38	20	Pass
T_{min} = -20	V_{max} = 13.2	6.55	20	Pass
	V_{min} = 10.8	6.18	20	Pass
CH78 2480MHz				
T_{nom} = +25	V_{nom} = 12.0	4.36	20	Pass
T_{max} = +40	V_{max} = 13.2	4.23	20	Pass
	V_{min} = 10.8	3.99	20	Pass
T_{min} = -20	V_{max} = 13.2	4.32	20	Pass
	V_{min} = 10.8	4.29	20	Pass

Remark:

1) Test the RF output power in EUT continuously transmitting mode in normal conditions and read the relative value in extremely conditions.
2) Antenna gain(G): 3 dBi
   Cable loss: 1.0 dB
   RF output power =A (RMS power) + G + Cable loss.
3) The number of bursts measurement is 15.
4) EUT is tested in all modes (1M, 2M & 3M), worst data has been recorded.

TEST RESULTS: The unit does meet the requirements.

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6.2 Duty cycle, Tx-Sequence, Tx-gap

6.2.1 Limit(ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.3.3)

For non-adaptive FHSS equipment, the Duty Cycle shall be equal to or less than the maximum value declared by the supplier. In addition, the maximum Tx-sequence time shall be 5 ms while the minimum Tx-gap time shall be 5 ms.

6.2.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.2

6.2.3 TEST SETUP

6.2.4 Test result

Not applicable.

Refer to the EN 300 328 clause 4.3.1.3.1 section for the details.

These requirements apply to non-adaptive frequency hopping equipment or to adaptive frequency hopping equipment operating in a non-adaptive mode.

These requirements do not apply for equipment with a maximum declared RF Output power of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.

As the EUT belongs to Adaptive equipment type, so the test is not applicable and skipped.

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6.3 Dwell time, Minimum Frequency Occupation and Hopping Sequence

6.3.1 Limit(ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.4.3)

The maximum accumulated dwell time on any hopping frequency shall be 400 ms within any period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

6.3.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.2

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

The analyzer shall be set as follows:

- Centre Frequency: Equal to the hopping frequency being investigated
- Frequency Span: 0 Hz
- RBW: ~ 50 % of the Occupied Channel Bandwidth
- VBW: ≥ RBW
- Detector Mode: RMS
- Sweep time: Equal to the Dwell Time × Minimum number of hopping frequencies (N) (see clause 4.3.1.4.2)
- Number of sweep points: 30 000
- Trace mode: Clear / Write
- Trigger: Free Run

2. Save the trace data to a file for further analysis by a computing device using an appropriate software application or program.

3. Indentify the data points related to the frequency being investigated by applying a threshold. the data points resulting from transmissions on the hopping frequency being investigated are assumed to have much higher levels compared to data points resulting from transmissions on adjacent hopping frequencies. If a clear determination between these transmissions is not possible, the RBW in step 1 shall be further reduced. In addition, a channel filter may be used, Count the number of data points identified as resulting from transmissions on the frequency being investigated and multiply this number by the time difference between two consecutive data points.

4. The result in step 3 is the accumulated Dwell Time which shall comply with the limit provided in clauses 4.3.1.3.2.1 or 4.3.1.3.2.2 and which shall be recorded in the test report.

5. Make the following changes on the analyzer and repeat steps 2 and 3. Sweep time: 4 × Dwell Time × Actual number of hopping frequencies in use.

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The hopping frequencies occupied by the system without having transmissions during the dwell time (blacklisted frequencies) should be taken into account in the actual number of hopping frequencies in use. If this number can not be determined (number of blacklisted frequencies unknown) it shall be assumed that the equipment uses the minimum number of hopping frequencies as defined in clauses 4.3.1.4.2.1 or 4.3.1.4.2.2. The result shall be compared to the limit for the Minimum Frequency Occupation Time defined in clauses 4.3.1.3.2.1 or 4.3.1.3.2.2. This value shall be recorded in the test report.

6. Make the following changes on the analyzer:

- Start Frequency: 2 400 MHz
- Stop Frequency: 2 483,5 MHz
- RBW: ~ 50 % of the Occupied Channel Bandwidth (single hop)
- VBW: ≥ RBW
- Detector Mode: RMS
- Sweep time: Auto
- Trace Mode: Max Hold
- Trigger: Free Run

• When the trace has completed, indentify the number of hopping frequencies used by the hopping sequence.

• The result shall be compared to the limit (value N) defined in clauses 4.3.1.3.2.1 or 4.3.1.3.2.2. This value shall be recorded in the test report.

For equipment with blacklisted frequencies, it might not be possible to verify the number of hopping frequencies in use. However they shall comply with the requirement for accumulated Dwell time and Minimum Frequency Occupation Time assuming the minimum number of hopping frequencies defined in clauses 4.3.1.3.2.1 or 4.3.1.3.2.2 are in use.

7. For adaptive systems, using the lowest and highest -20 dB points from the total spectrum envelope obtained in step 6, it shall be verified whether the system uses 70 % of the band specified in clause 1. The result shall be recorded in the test report.

Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). Repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

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EUT Operation:

Test Status: Enter test mode for the product, keep EUT in continuously transmitting status with hoping on mode with different packages; find the worst case is GFSK & 8DPSK mode.

Pre-test the EUT in AC mode and B/O mode, find worse case in B/O mode.

6.3.3 TEST SETUP

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6.3.4 Test result

Measurement Data:

Dwell Time:

GFSK. Channel 00: 2.402GHz										
DH1 time slot	=	0.3829	(ms)	*	33	*	(31.6/3.16)	=	126.357	ms
DH3 time slot	=	1.6358	(ms)	*	15	*	(31.6/3.16)	=	245.370	ms
DH5 time slot	=	2.892	(ms)	*	11	*	(31.6/3.16)	=	318.120	ms

Note: Dwell time = (1600/(79*DHT))*79*0.4*Single hop time, where DHT=2/4/6 for DH1/DH3/DH5.

The results are not greater than 0.4 seconds.

Note: EUT is tested on Channel 00, 39 & 78 in all modes (1M, 2M & 3M) and worst data has been recorded.

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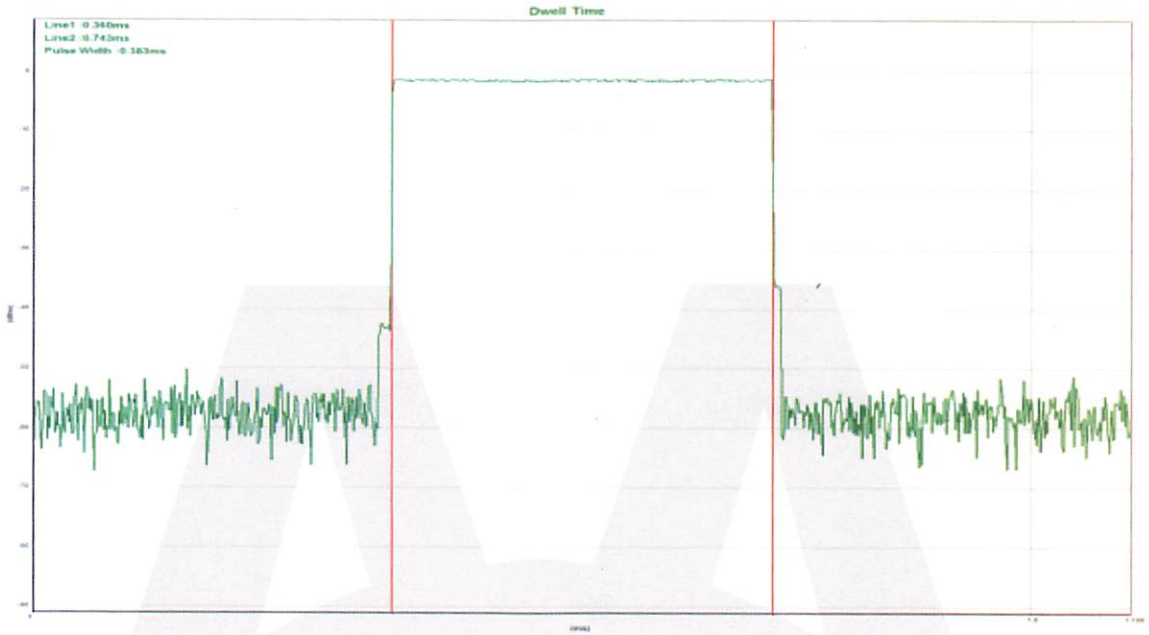
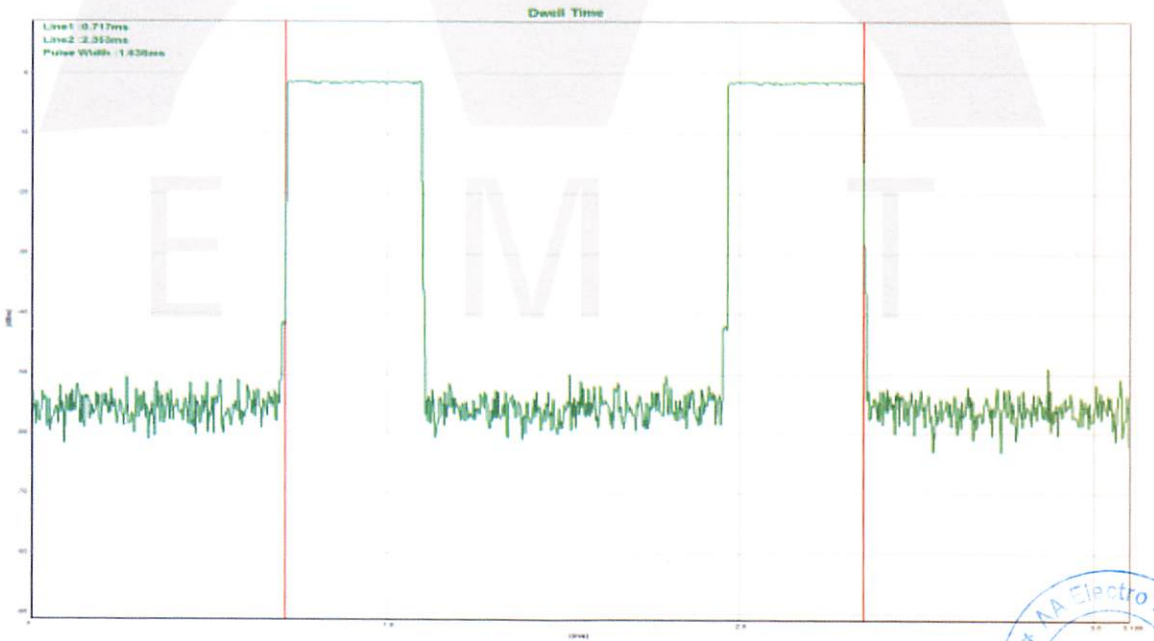
Test graph as below:

DH1



DH3



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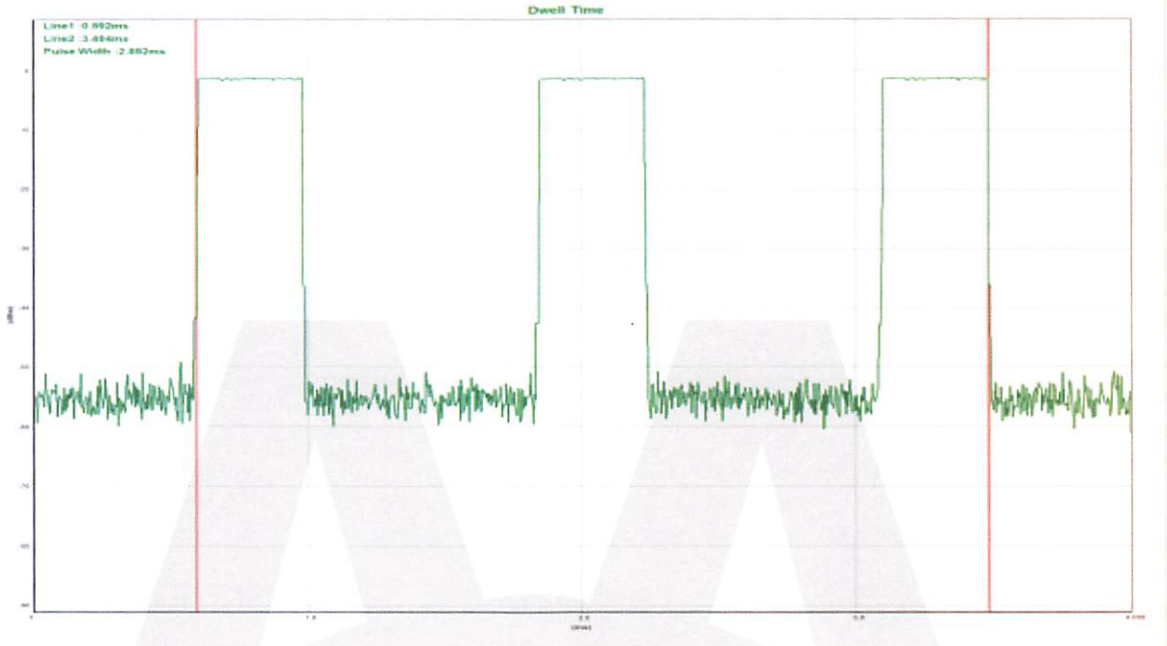
DH5



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6.4 Minimum Frequency Occupation

6.4.1 Limit(ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.4)

The Minimum Frequency Occupation Time shall be equal to one dwell time within a period not exceeding four times the product of the dwell time per hop and the number of hopping frequencies in use.

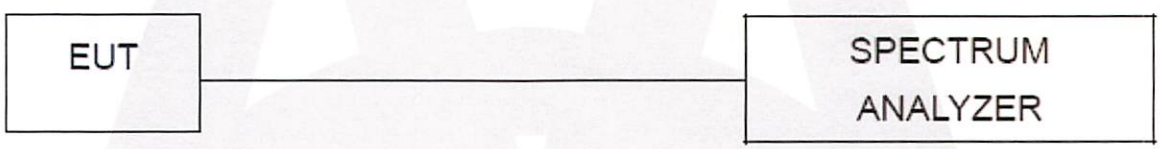
6.4.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.2.2

EUT Operation:

Test Status: Enter test mode for the product, keep EUT in continuously transmitting status with hoping on mode with different packages; find the worst case is 8DPSK mode. Pre-test the EUT in AC mode and B/O mode, find worse case in B/O mode.

6.4.3 TEST SETUP



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6.4.4 Test result

Channel (MHz)	Packages	Dwell Time per hop (ms)	Testing period (ms)	Frequency Occupation period	Limit Dwell Times No.	Result
2402.0	DH1	0.383	121.028	1	one dwell time	Pass
	DH3	1.635	516.660	2		Pass
	DH5	2.891	913.556	3		Pass

Testing period: 4 x Dwell time per hop x 79 Channels

Note: EUT is tested on Channel 00, 39 & 78 in all modes (1M, 2M & 3M) and worst data has been recorded.

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6.5 Hopping Sequence

6.5.1 Limit(ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.5.3)

The hopping sequence(s) shall contain at least N hopping frequencies at all times, where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

6.5.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.3.4

EUT Operation:

Test Status: Enter test mode for the product, keep EUT in continuously transmitting status with hoping on mode with different packages; find the worst case is 8DPSK mode. Pre-test the EUT in AC mode and B/O mode, find worse case in B/O mode.

6.5.3 TEST SETUP

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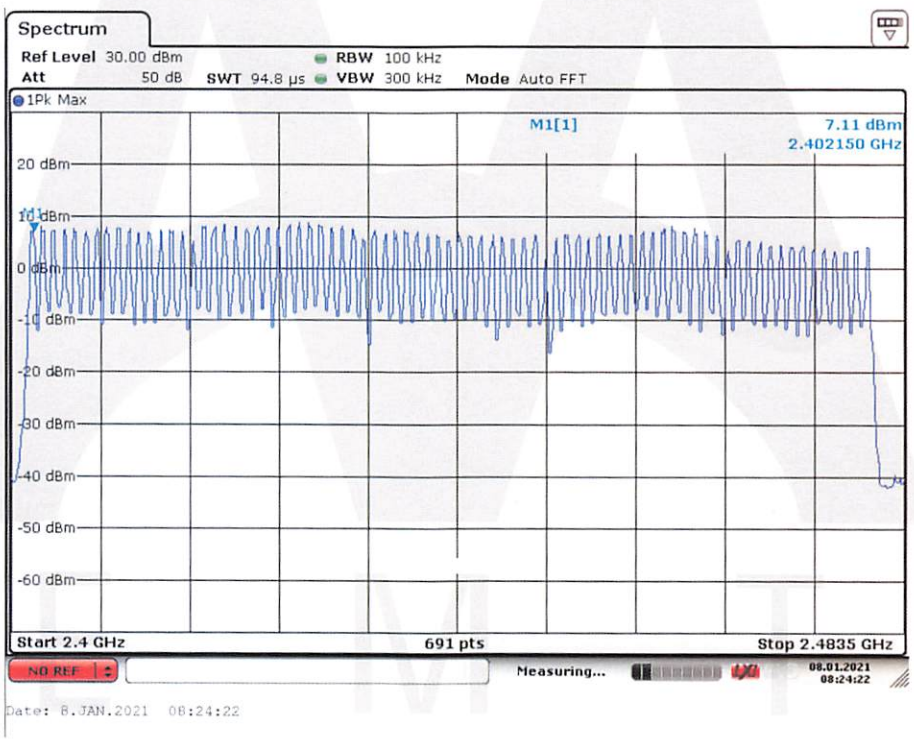
6.5.4 Test result

The unit does meet the requirements.

Hopping Sequence					
ISM band (MHz)	Operation band (MHz)	20dB Down Bandwidth (%)	Limit (%)	Channel number	Limit (N)
2400-2483.5	2402-2480	95.13	≥70%	79	≥15

Test graph as below:



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6.6 Hopping Frequency Separation

6.6.1 Limit(ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.5.3)

Non-adaptive frequency hopping systems

The minimum Hopping Frequency Separation shall be equal to Occupied Channel Bandwidth (see clause 4.3.1.7) of a single hop, with a minimum separation of 100 kHz.

Adaptive frequency hopping systems

The minimum Hopping Frequency Separation shall be 100 kHz.

6.6.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.5

Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

The analyzer shall be set as follows:

- Centre Frequency: Centre of the two adjacent hopping frequencies

-Frequency Span: Sufficient to see the complete power envelope of both hopping frequencies

- RBW: 1 % of the Span
- VBW: 3 × RBW
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep Time: Auto

• Allow the trace to stabilize.

•Use the marker-delta function to determine the Hopping Frequency Separation between the peaks of the two adjacent hopping frequencies. This value shall be compared with the limits defined in clause 4.3.1.5.3 and shall be recorded in the test report.

EUT Operation:

Test Status: Test the EUT in hopping mode.

Pre-test the EUT in AC mode and B/O mode, find worse case in B/O mode.

6.6.3 TEST SETUP

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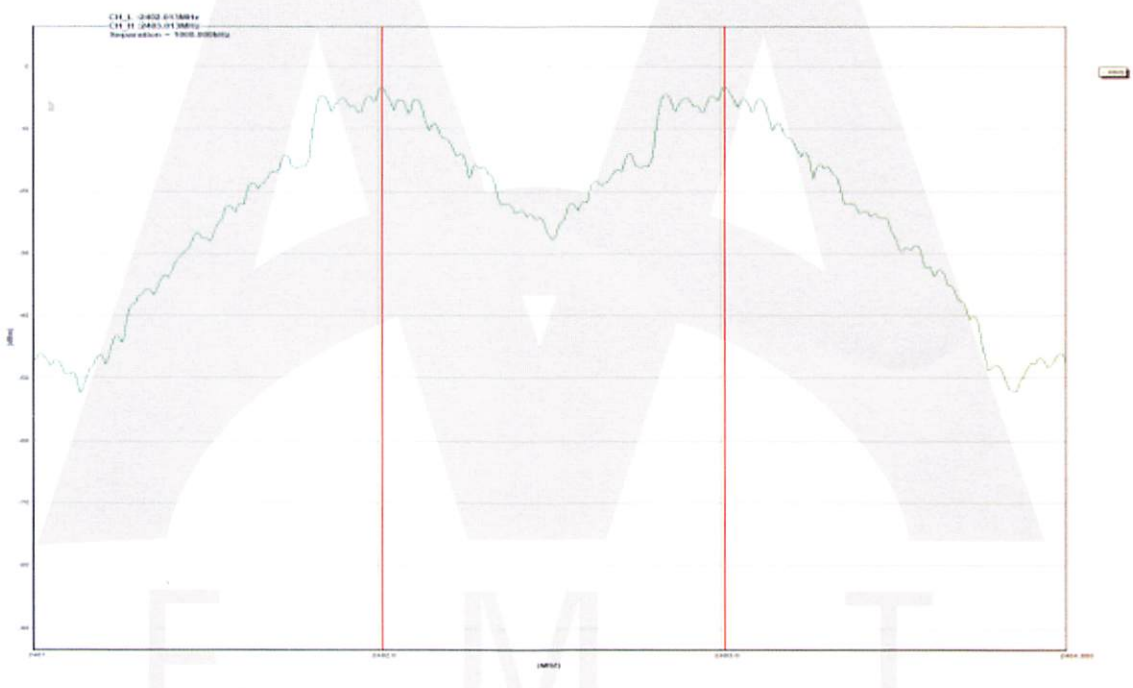
6.6.4 Test result

Test Channel	Carrier Frequencies Separated (MHz)	Pass/Fail (limit 100 KHz)
Lower Channels (channel 0 and channel 1)	1000.0000	Pass
Middle Channels (channel 39 and channel 40)	1000.0000	Pass
Upper Channels (channel 77 and channel 78)	1004.3000	Pass



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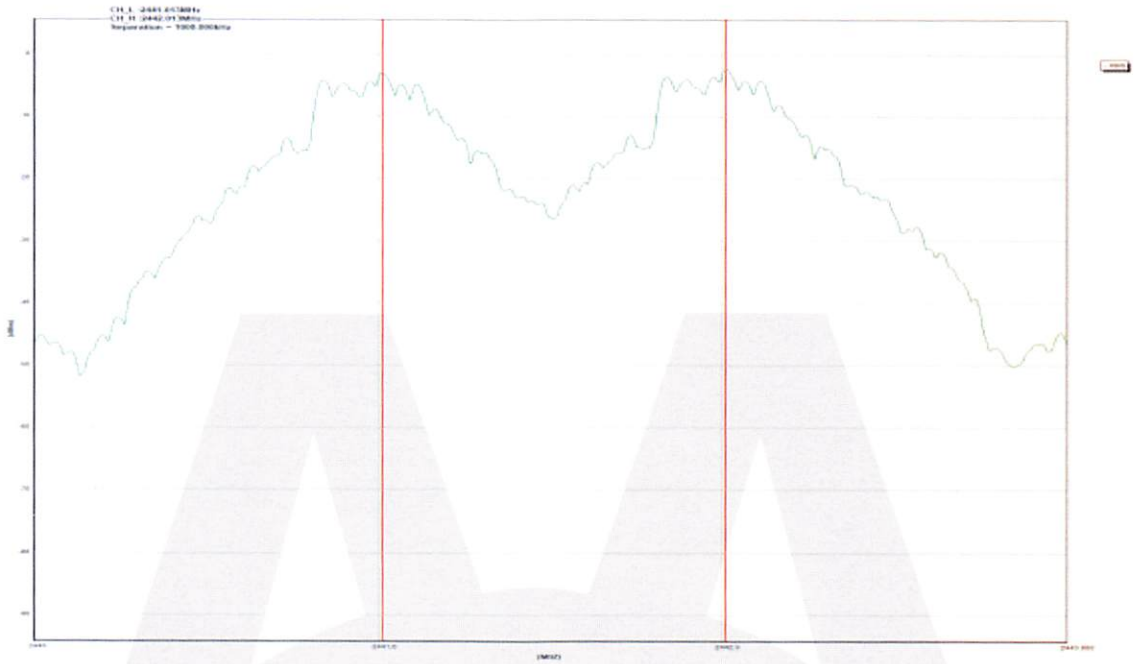

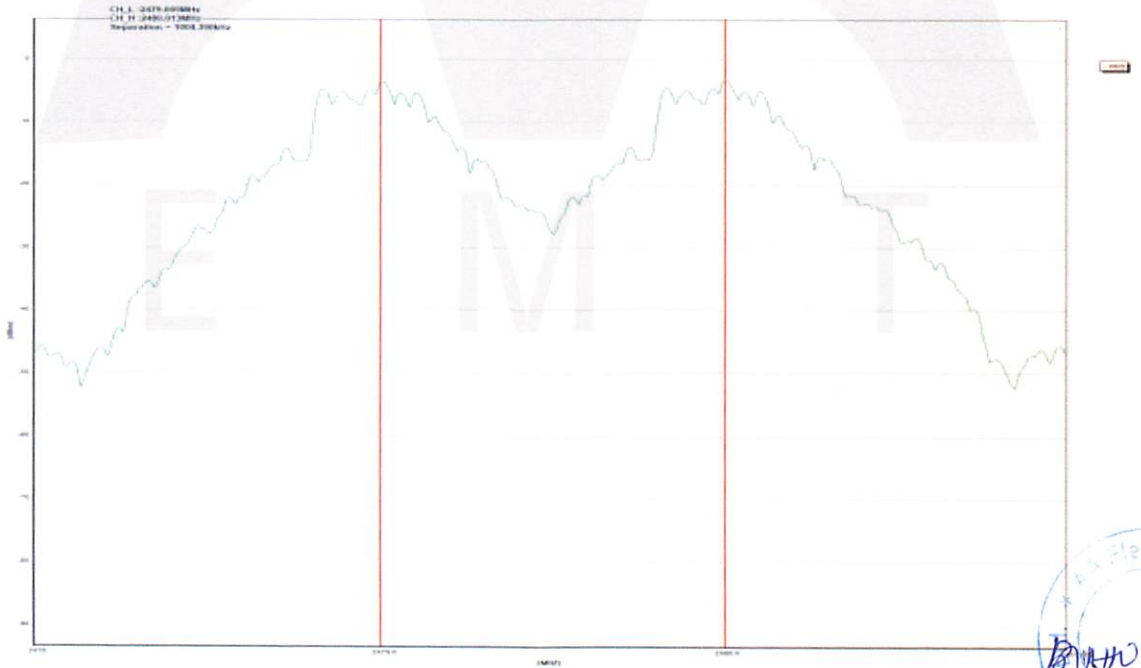

Note: EUT is tested on Channel 00, 39 & 78 in all modes (1M, 2M & 3M) and worst data has been recorded.

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6.7 Medium Utilization (MU) factor

6.7.1 Limit (ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.6.3)

For non-adaptive equipment

The maximum Medium Utilization factor for non-adaptive Frequency Hopping equipment shall be 10 %.

6.7.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07)

6.7.3 Test result

Not applicable.

This requirement does not apply to adaptive equipment unless operating in a non-adaptive Mode.

In addition, this requirement does not apply for equipment with a maximum declared RF Output Power level of less than 10dBm E.I.R.P. or for equipment when operating in a mode where the RF Output power is less than 10dBm E.I.R.P.

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6.8 Adaptivity (Adaptive Frequency Hopping)

6.8.1 Limit (ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.7.4.2)

Adaptivity Limit

Non-LBT based Detect and Avoid

- The channel shall remain unavailable for a minimum time equal to 1 s after which the channel may be considered again as an 'available' channel;
- COT ≤ 40 ms;
- Idle Period shall be minimum 5% of COT with a minimum of 100us;
- Detection threshold level = -70dBm/MHz + 20 – Pout E.I.R.P (Pout in dBm); LBT based Detect and Avoid(Frame Based Equipment)
- The CCA observation time shall be not less than 20 us;
- The CCA time used by the equipment shall be declared by the supplier;
- COT = 1-10 ms;
- Idle Period = 5% of COT;
- Detection threshold level = -70dBm/MHz + 20 – Pout E.I.R.P (Pout in dBm); LBT based Detect and Avoid(Load Based Equipment)
- The CCA observation time shall be not less than 20 us;
- The CCA time used by the equipment shall be declared by the supplier;
- COT ≤ (13 / 32) * q ms; q = [4~32]; 1.625ms~13ms;
- R = number of clear idle slots are randomly [1~q]. Every time an Extended CCA is required and the 'R' value stored in a counter.
- Detection threshold level = -70dBm/MHz + 20 – Pout E.I.R.P (Pout in dBm); Short Control Signalling Transmissions:
- Short Control Signalling Transmissions shall have a maximum duty cycle of 10% within an observation period of 50ms.

6.8.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.6

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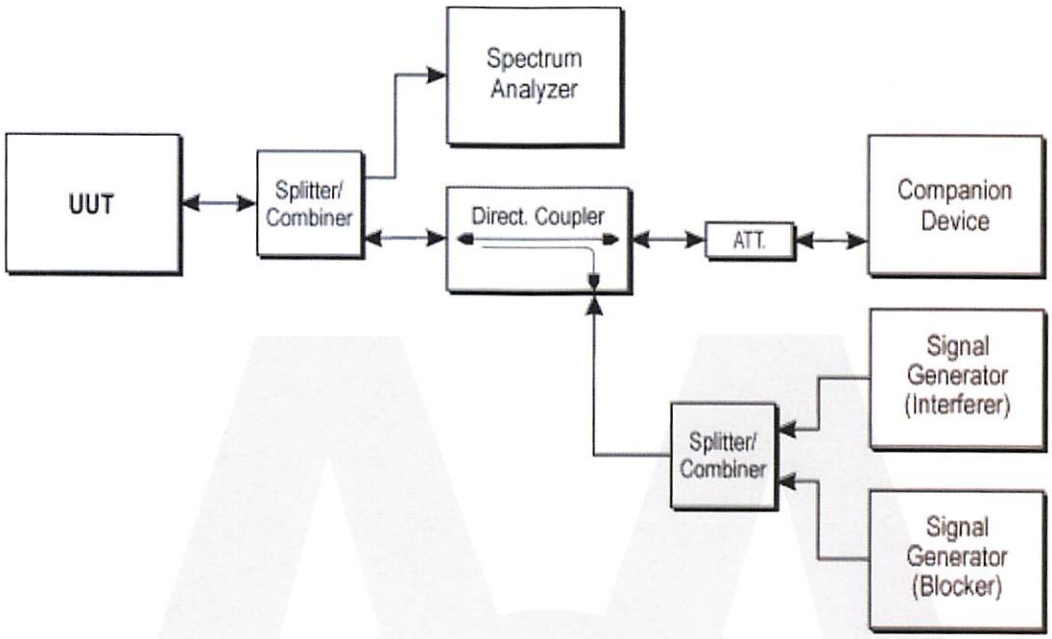
6.8.3 Test Setup



6.8.4 Test result

Not applicable.

Adaptivity (Adaptive Frequency Hopping)

This requirement does not apply to non-adaptive equipment or adaptive equipment operating in a non-adaptive mode providing the equipment complies with the requirements and/or restrictions applicable to non-adaptive equipment.

In addition, this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.

As the EUT about RF Output power level is less than 10 dBm e.i.r.p, so the test is not applicable and skipped.

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6.9 Occupied Channel Bandwidth

6.9.1 Limit (ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.8.3)

For non-adaptive Frequency Hopping equipment with E.I.R.P greater than 10dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the value declared by the supplier. This declared value shall not be greater than 5 MHz.

6.9.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.7

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum and use the following settings:
   - Centre Frequency: The centre frequency of the channel under test
   - Resolution BW: ~ 1 % of the span without going below 1 %
   - Video BW: 3 × RBW
   - Frequency Span: 2 × Occupied Channel Bandwidth (e.g. 40 MHz for a 20 MHz channel)
   - Detector Mode: RMS
   - Trace Mode: Max Hold
2. Wait until the trace is completed, Find the peak value of the trace and place the analyser marker on this peak.
3. Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT, this value shall be recorded.

NOTE: Make sure that the power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals left and right from the power envelope being taken into account by this measurement.

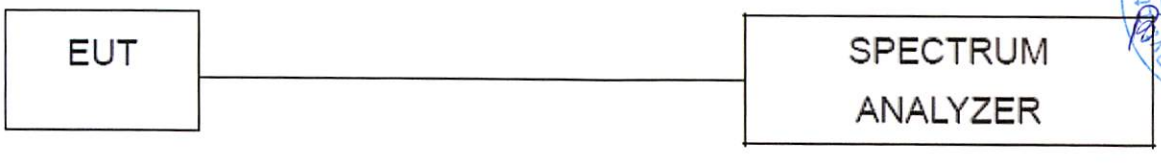
EUT Operation

Status: Enter test mode for the product. Test in Channel lowest (2402MHz), highest (2480MHz), keep in continuously transmitting status on a single Hopping Frequency.

Test the EUT in normal mode and EDR mode.

Pre-test the EUT in AC mode and B/O mode, find worse case in B/O mode.

6.9.3 Test Setup



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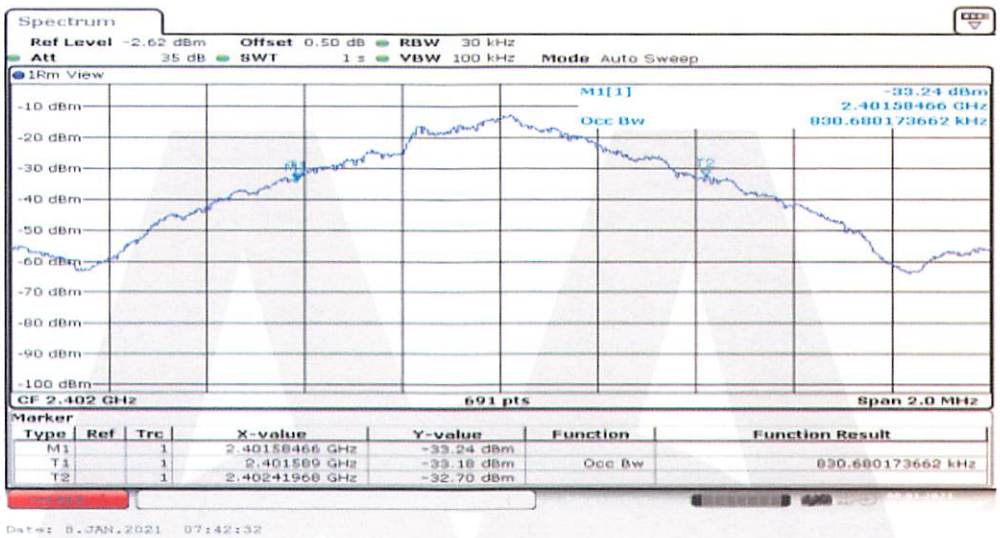
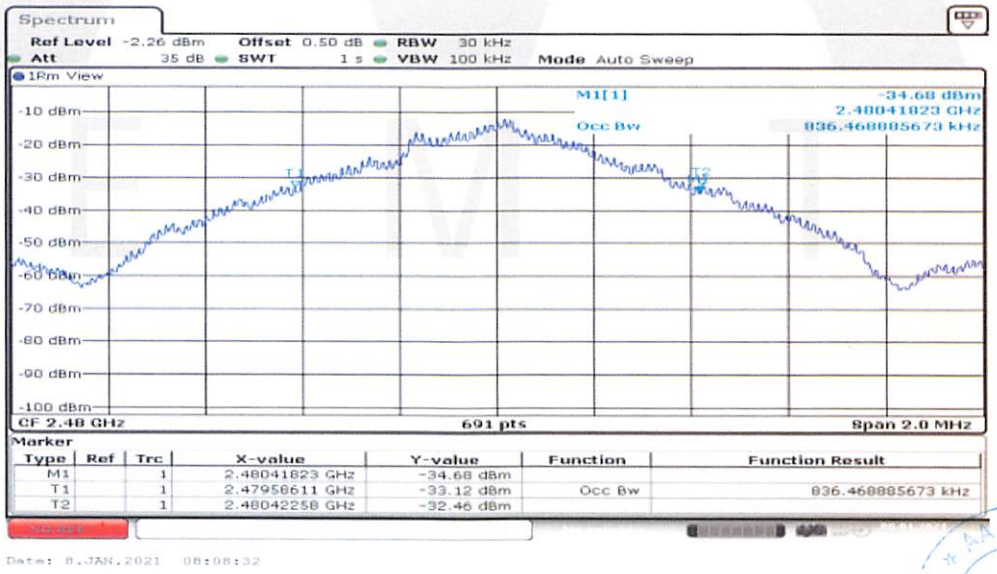
6.9.4 Test result

Remark: These measurements shall only be performed at normal test conditions.

Normal mode: 1M

Test Channel	Bandwidth 99%(MHz)	FL (MHz) or FH (MHz)	Lower Limit (MHz)	Higher Limit (MHz)
Lowest	0.831	2401.585	> 2400.0	N/A
Highest	0.836	2480.418	N/A	< 2483.5





Note: EUT is tested on Channel 00, 39 & 78 in all modes (1M, 2M & 3M) and worst data has been recorded.

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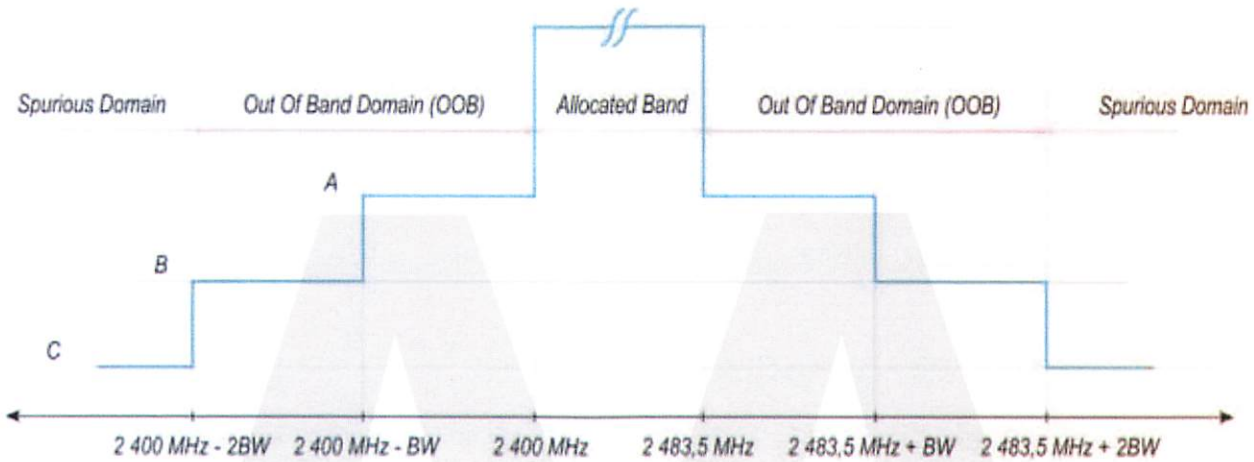
6.10 Transmitter unwanted emissions in the out-of-band domain

6.10.1 Limit(ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.9.3)

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask.



6.10.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.8

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum and use the following settings:
   - Centre Frequency: 2 484 MHz
   - Span: 0 Hz
   - Resolution BW: 1 MHz
   - Filter mode: Channel filter
   - Video BW: 3 MHz
   - Detector Mode: RMS
   - Trace Mode: Clear / Write
   - Sweep Mode: Continuous
   - Sweep Points: 5 000
   - Trigger Mode: Video trigger

   NOTE 1: In case video triggering is not possible, an external trigger source may be used.
   - Sweep Time: Suitable to capture one transmission burst
2. segment 2 483,5 MHz to 2 483,5 MHz + BW
   - Adjust the trigger level to select the transmissions with the highest power level.
   - For frequency hopping equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected.

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•Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS power shall be measured using the Time Domain Power function.

• Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask.

•Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

3. segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW

•Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz.

4. segment 2 400 MHz - BW to 2 400 MHz

•Change the centre frequency of the analyser to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz.

5. segment 2 400 MHz - 2BW to 2 400 MHz - BW

•Change the centre frequency of the analyser to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz.

6. In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain "G" in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figures 1 or 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered.

•In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements need to be repeated for each of the active transmit chains. The declared antenna assembly gain "G" in dBi for a single antenna shall be added to these results. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. Comparison with the applicable limits shall be done using any of the options given below:

- Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added. The additional beamforming gain "Y" in dB shall be added as well and the resulting values compared with the limits provided by the mask given in figures 1 or 3.
- Option 2: the limits provided by the mask given in figures 1 or 3 shall be reduced by 10 x log 10(Ach) and the additional beamforming gain "Y" in dB. The results for each of the transmit chains shall be individually compared with these reduced limits.

NOTE 2: Ach refers to the number of active transmit chains.

It shall be recorded whether the equipment complies with the mask provided in figures 1 or 3.

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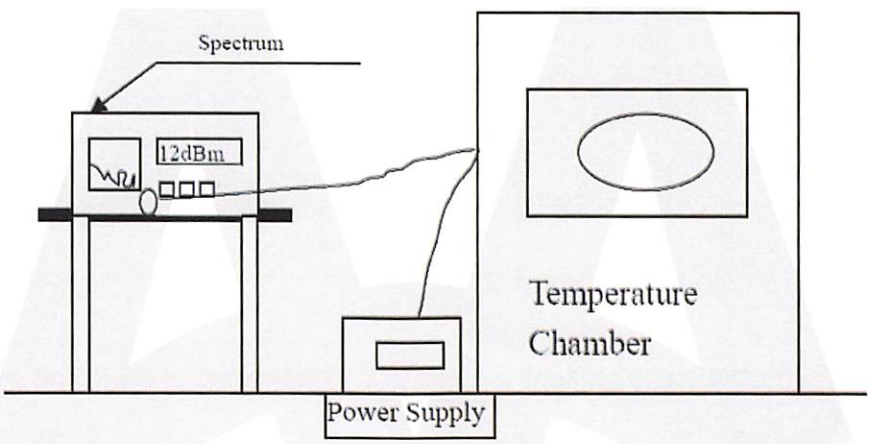
EUT Operation

Status: Enter test mode for the product, keep EUT in continuously transmitting status with hoping on mode with different packages; find the worst case is GFSK, 8DPSK mode.
Pre-test the EUT in AC mode and B/O mode, find worse case in B/O mode.

6.10.3 Test Setup

For Conducted Measurement



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6.10.4 Test result

Modulation Type	Test Condition	Test Channel	Frequency (MHz)	Level (dBm)	Limit (dBm)
GFSK	Normal	Lowest Channel	2399.62	-54.506	-10
			2398.68	-63.061	-20
		Highest Channel	2484.24	-63.376	-10
			2484.63	-64.878	-20
	NVLT	Lowest Channel	2400.32	-55.129	-10
			2399.33	-63.305	-20
		Highest Channel	2484.44	-54.767	-10
			2485.64	-63.042	-20
	NVHT	Lowest Channel	2399.44	-55.311	-10
			2398.77	-63.707	-20
		Highest Channel	2484.17	-54.87	-10
			2485.03	-63.721	-20
∏/4QPSK	Normal	Lowest Channel	2399.83	-55.284	-10
			2398.52	-62.701	-20
		Highest Channel	2484.52	-64.647	-10
			2484.25	-66.423	-20
	NVLT	Lowest Channel	2399.98	-52.687	-10
			2398.81	-63.562	-20
		Highest Channel	2483.65	-63.762	-10
			2485.62	-67.141	-20
	NVHT	Lowest Channel	2398.78	-53.968	-10
			2398.12	-63.242	-20
		Highest Channel	2484.95	-54.357	-10
			2485.15	-63.876	-20
8DPSK	Normal	Lowest Channel	2399.47	-55.046	-10
			2398.52	-62.524	-20
		Highest Channel	2484.14	-64.721	-10
			2485.22	-66.729	-20
	NVLT	Lowest Channel	2398.91	-53.056	-10
			2397.20	-64.318	-20
		Highest Channel	2483.58	-64.071	-10
			2485.43	-67.445	-20
	NVHT	Lowest Channel	2399.69	-52.823	-10
			2397.97	-69.135	-20
		Highest Channel	2483.46	-65.356	-10
			2485.58	-65.684	-20

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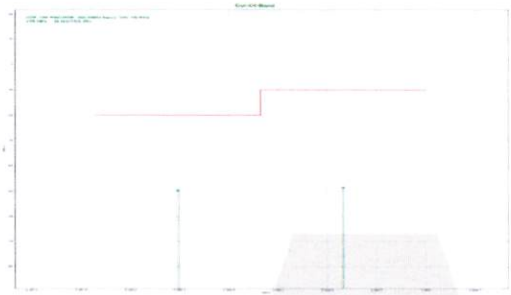
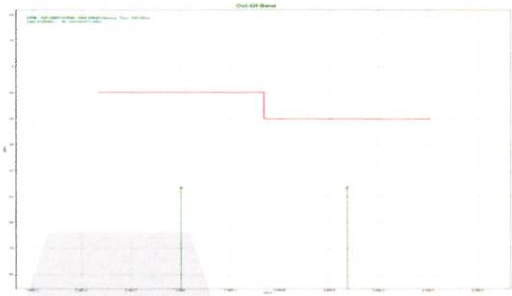
Test plots at normal condition:

Condition:	Normal

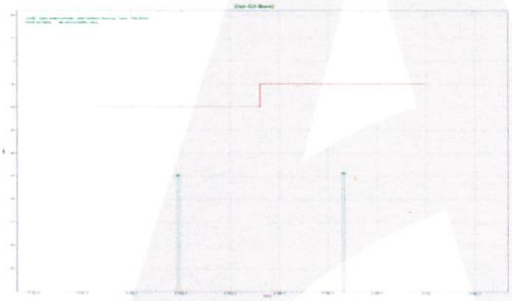
CH Low (Normal Temp) 1M



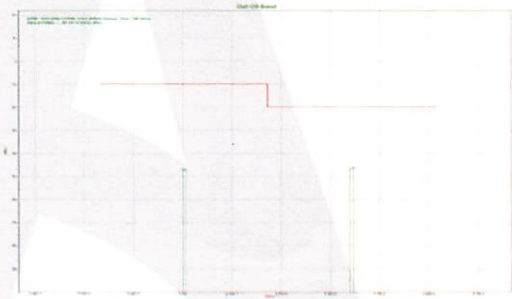
CH High (Normal Temp) 1M



CH Low (Normal Temp) 2M



CH High (Normal Temp) 2M



CH Low (Normal Temp) 3M

CH High (Normal Temp) 3M

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6.11 Transmitter unwanted emissions in the spurious domain

6.11.1 Limit(ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.10.3)

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 1.

Table 1: Transmitter limits for spurious emissions

Frequency range	Maximum power, e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	Bandwidth
30 MHz to 47 MHz	-36 dBm	100KHz
47 MHz to 74 MHz	-54 dBm	100KHz
74 MHz to 87,5 MHz	-36 dBm	100KHz
87,5 MHz to 118 MHz	-54 dBm	100KHz
118 MHz to 174 MHz	-36 dBm	100KHz
174 MHz to 230 MHz	-54 dBm	100KHz
230 MHz to 470 MHz	-36 dBm	100KHz
470 MHz to 862 MHz	-54 dBm	100KHz
862 MHz to 1 GHz	-36 dBm	100KHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

6.11.2Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.9

Substitution method was performed to determine the actual spurious emission levels of the EUT.
The following test procedure as below:
1)Below 1GHz test procedure:

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 test 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 test 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

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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.

2) above 1GHz test procedure:

1.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.

EUT Operation:

Status: Enter test mode for the product. Test in Channel lowest (2402MHz) and highest (2480MHz); keep in continuously transmitting mode on a single Hopping Frequency.

Pretest the EUT in normal mode and EDR mode, the worse case is EDR mode, compliance the worse case and reported it.

Pre-test the EUT in AC mode and B/O mode, find worse case in B/O mode.

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6.11.3 Test Setup

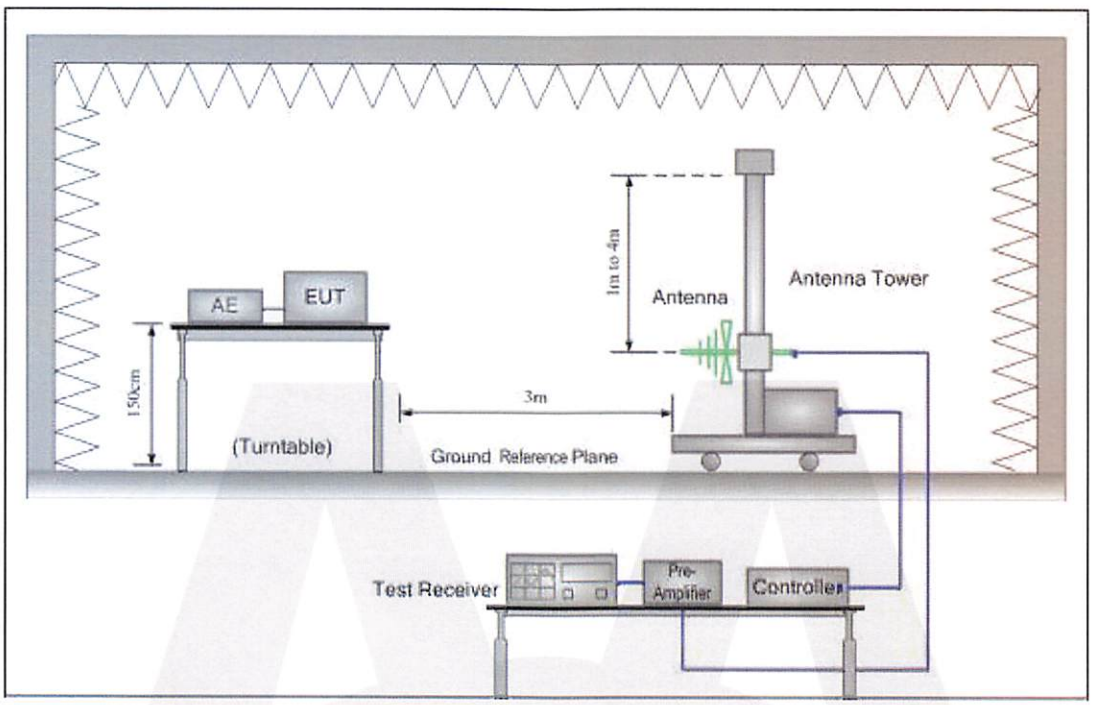

Figure 1. 30MHz to 1GHz

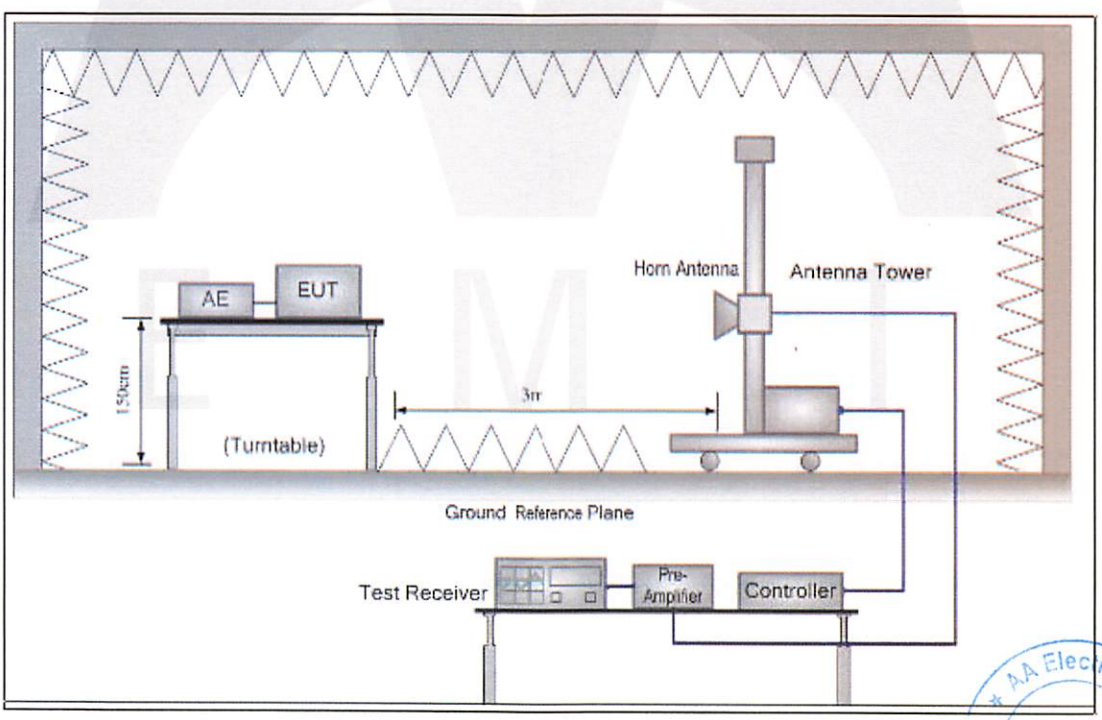

Figure 2. Above 1GHz

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6.11.4 Radiated Test result

For BR Model: 1M

1.Test in Channel lowest (2402 MHz)

below 1 GHz				
Maximum Frequency	Spurious Emission polarization and Level		Limit	Over Limit
MHz	polarization	dBm	dBm	dB
111.86	Vertical	-65.20	-54	-11.20
238.52	Vertical	-52.72	-36	-16.72
482.56	Vertical	-57.09	-54	-3.09
115.31	Horizontal	-62.15	-54	-8.15
238.77	Horizontal	-61.88	-36	-25.88
804.29	Horizontal	-56.95	-54	-2.95
Above 1 GHz				
Maximum Frequency	Spurious Emission polarization and Level		Limit	Over Limit
MHz	polarization	dBm	dBm	dB
4804.32	Vertical	-42.12	-30	-12.12
7205.40	Vertical	-44.42	-30	-14.42
7205.31	Vertical	-43.04	-30	-13.04
9608.78	Horizontal	-44.42	-30	-14.42

2. Test in Channel highest (2480 MHz)

below 1 GHz				
Maximum Frequency	Spurious Emission polarization and Level		Limit	Over Limit
MHz	polarization	dBm	dBm	dB
65.54	Vertical	-73.52	-54	-19.52
198.96	Vertical	-61.75	-54	-7.75
295.71	Vertical	-52.53	-36	-16.53
44.11	Horizontal	-71.25	-36	-35.25
122.54	Horizontal	-65.22	-36	-29.22
285.73	Horizontal	-62.35	-36	-26.35
Above 1 GHz				
Maximum Frequency	Spurious Emission polarization and Level		Limit	Over Limit
MHz	polarization	dBm	dBm	dB
4959.60	Vertical	-42.04	-30	-12.04
7440.01	Vertical	-41.77	-30	-11.77
4960.16	Vertical	-41.70	-30	-11.70
7440.75	Horizontal	-45.39	-30	-15.39

Note: **Others emission at least have 20dBm margin. No recording in the test report.**

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For EDR Model: 3M

Test in Channel lowest (2402 MHz)

below 1 GHz				
Maximum Frequency	**Spurious Emission polarization and Level**		**Limit**	**Over Limit**
MHz	**polarization**	**dBm**	**dBm**	**dB**
107.65	Vertical	-60.29	-54	-6.29
166.36	Vertical	-69.14	-36	-33.14
507.39	Vertical	-64.90	-54	-10.90
102.58	Horizontal	-60.70	-54	-6.70
186.51	Horizontal	-68.90	-54	-14.90
540.32	Horizontal	-64.49	-54	-10.49
Above 1 GHz				
Maximum Frequency	**Spurious Emission polarization and Level**		**Limit**	**Over Limit**
MHz	**polarization**	**dBm**	**dBm**	**dB**
4803.78	Vertical	-41.89	-30	-11.89
7205.72	Vertical	-45.59	-30	-15.59
4804.21	Vertical	-42.36	-30	-12.36
7205.50	Horizontal	-44.18	-30	-14.18

2. Test in Channel highest (2480 MHz)

below 1 GHz				
Maximum Frequency	**Spurious Emission polarization and Level**		**Limit**	**Over Limit**
MHz	**polarization**	**dBm**	**dBm**	**dB**
64.87	Vertical	-67.22	-54	-13.22
273.35	Vertical	-65.93	-36	-29.93
664.98	Vertical	-63.46	-54	-9.46
77.80	Horizontal	-65.48	-36	-29.48
412.24	Horizontal	-61.43	-36	-25.43
478.95	Horizontal	-66.67	-54	-12.67
Above 1 GHz				
Maximum Frequency	Spurious Emission polarization and Level		Limit	Over Limit
MHz	polarization	dBm	dBm	dB
4960.45	Vertical	-42.72	-30	-12.72
7440.10	Vertical	-43.14	-30	-13.14
4959.95	Vertical	-41.59	-30	-11.59
7439.84	Horizontal	-44.52	-30	-14.52

Note: **Others emission at least have 20dBm margin. No recording in the test report.**

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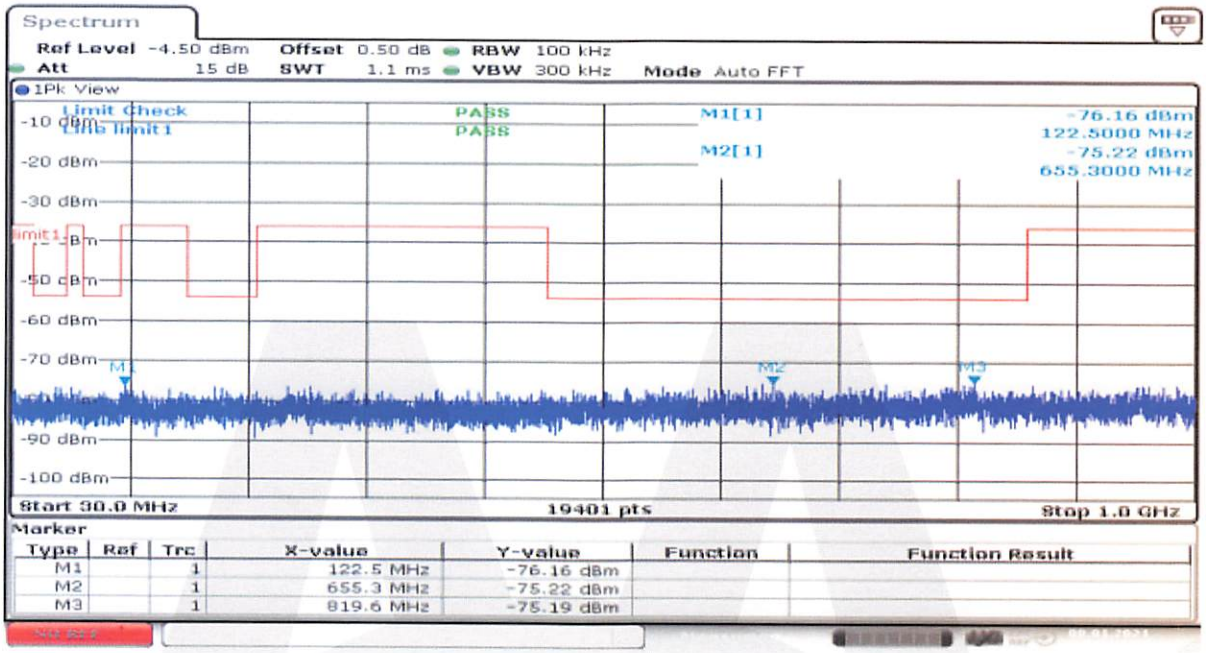
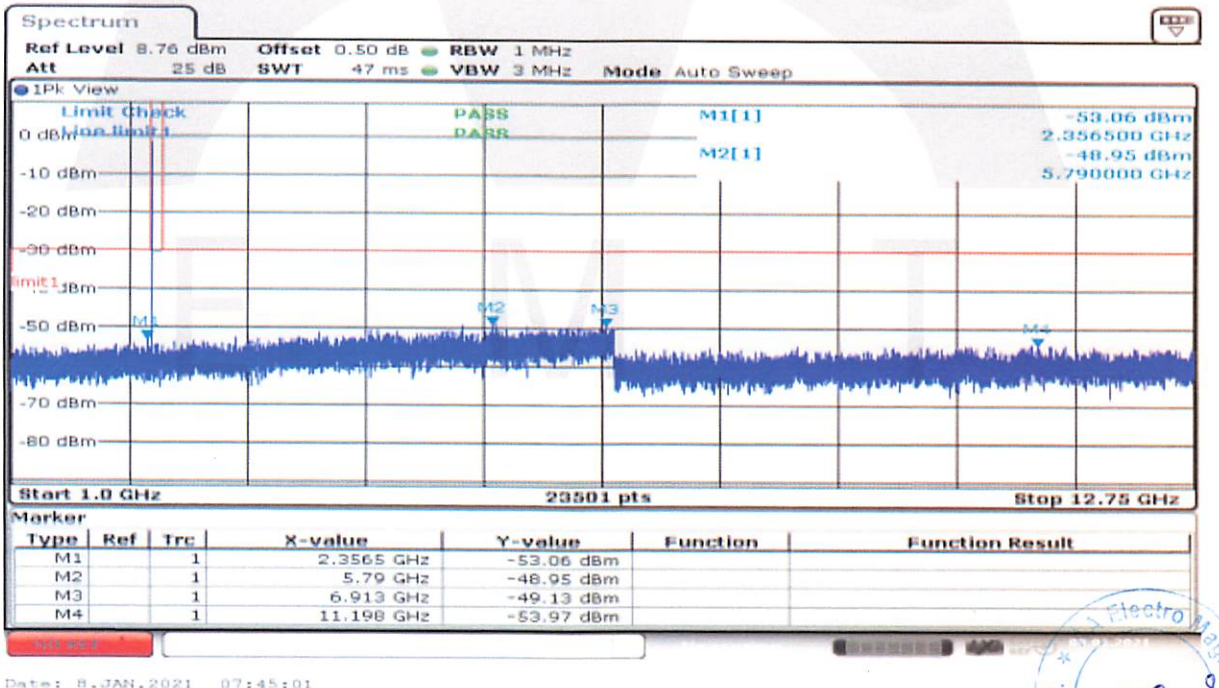
Test Result (Conducted measurement)





Note: EUT is tested on Channel 00, 39 & 78 in all modes (1M, 2M & 3M) and worst data has been recorded.

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6.12 Receiver spurious emissions

6.12.1 Limit(ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.11.3)

The spurious emissions of the receiver shall not exceed the values given in table 2.

Spurious emission limits for receivers

Frequency range	Maximum power, e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	Bandwidth
30 MHz to 1 GHz	-57 dBm	100KHz
1 GHz to 12,75 GHz	-47 dBm	1MHz

6.12.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.10

EUT Operation:

Status: Enter test mode for the product, Test in Channel lowest (2402MHz) and highest (2480MHz), keep in continuously receiving status.

Pre-test the EUT in AC mode and B/O mode, find worse case in B/O mode.

6.12.3 Test Setup

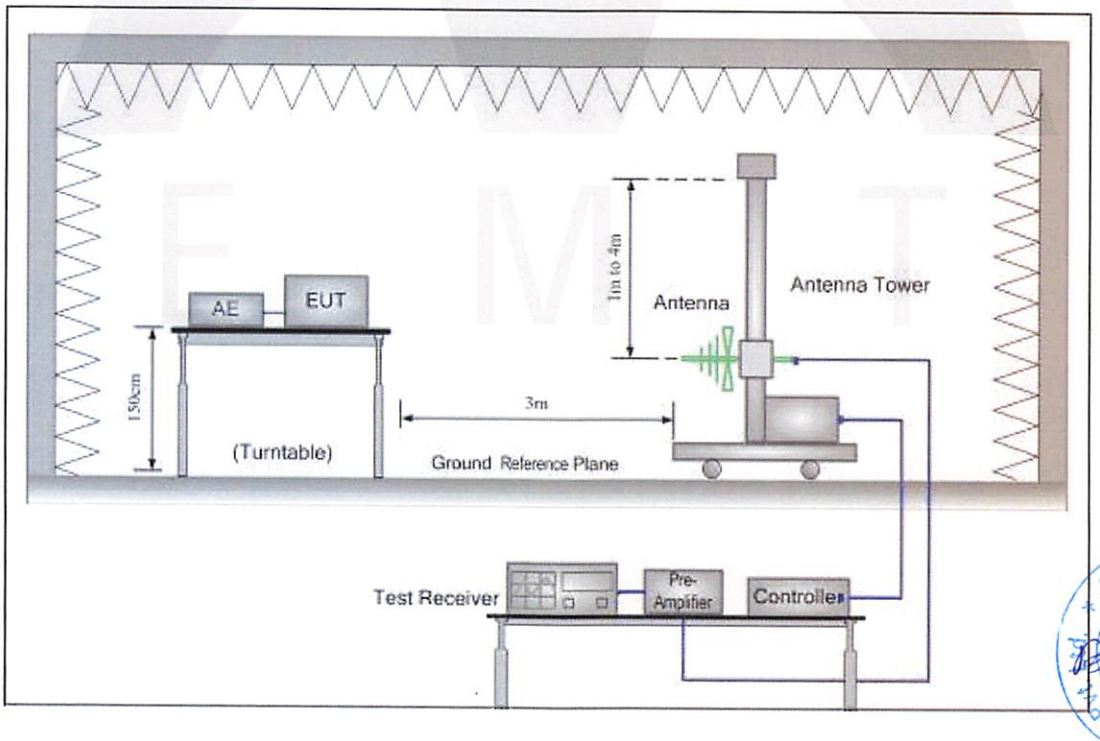

Figure 1. 30MHz to 1GHz

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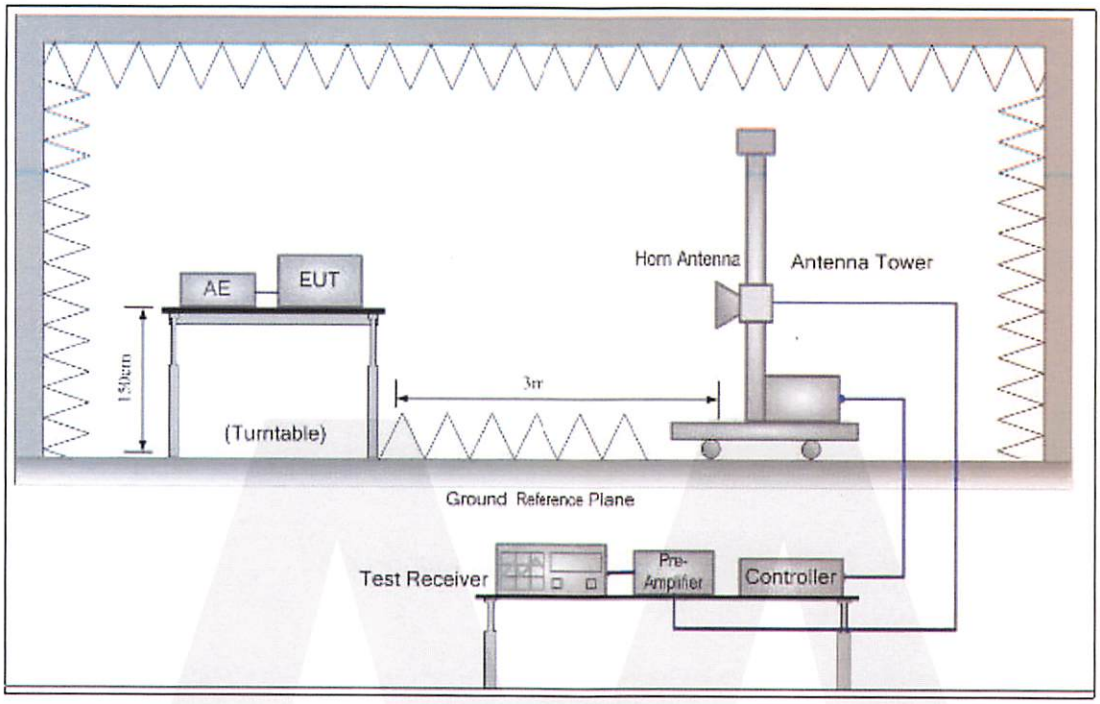

Figure 2. Above 1GHz

Test procedure:

Substitution method was performed to determine the actual spurious emission levels of the EUT.
The following test procedure as below:
1)Below 1GHz test procedure:

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 test 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 test 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.

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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:

$$ERP(dBm) = Pg(dBm) - \text{cable loss (dB)} + \text{antenna gain (dBd)}$$

where:

Pg is the generator output power into the substitution antenna.

2) above 1GHz test procedure:

1. 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.

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6.12.4 Test result

1M CH00 2402MHz

below 1 GHz				
Maximum Frequency	Spurious Emission polarization and Level		Limit	Over Limit
MHz	polarization	dBm	dBm	dB
79.19	Vertical	-71.01	-57	-14.01
183.78	Vertical	-69.97	-57	-12.97
436.41	Vertical	-67.88	-57	-10.88
116.44	Horizontal	-70.19	-57	-13.19
188.37	Horizontal	-71.57	-57	-14.57
434.63	Horizontal	-67.25	-57	-10.25
Above 1 GHz				
Maximum Frequency	Spurious Emission polarization and Level		Limit	Over Limit
MHz	polarization	dBm	dBm	dB
1712.88	Vertical	-57.08	-47	-10.08
2977.60	Vertical	-55.89	-47	-8.89
4957.49	Vertical	-56.93	-47	-9.93
1018.53	Horizontal	-60.38	-47	-13.38
3036.00	Horizontal	-54.74	-47	-7.74
5155.70	Horizontal	-52.62	-47	-5.62

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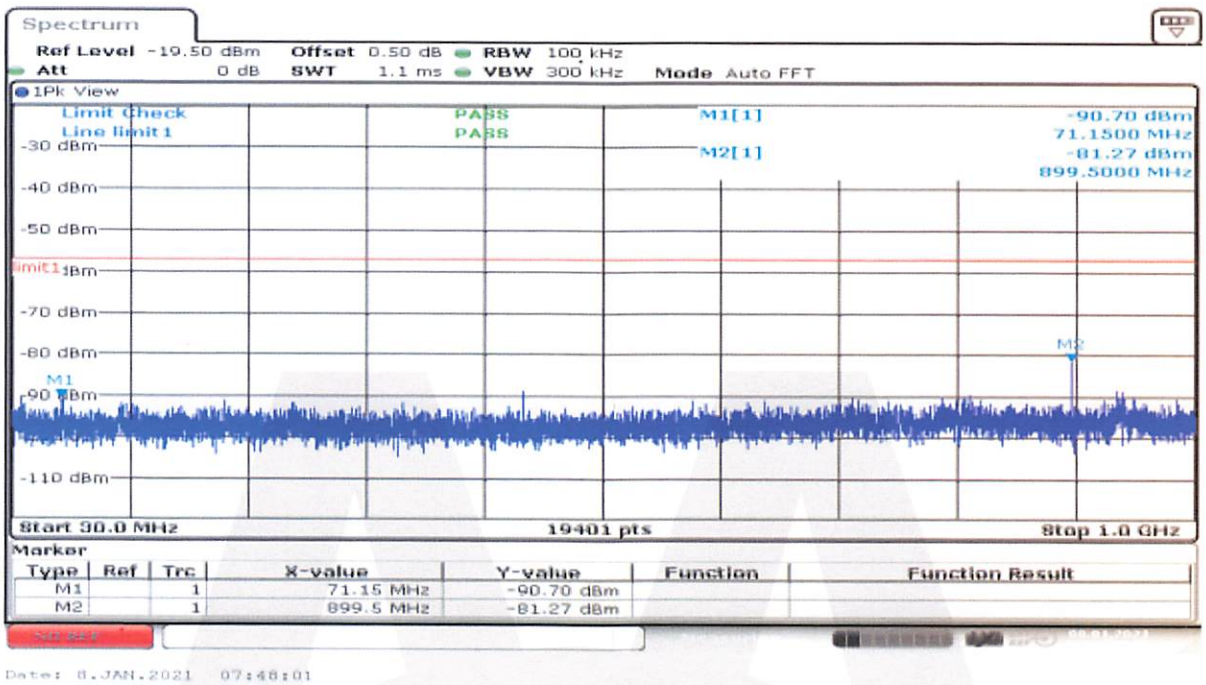
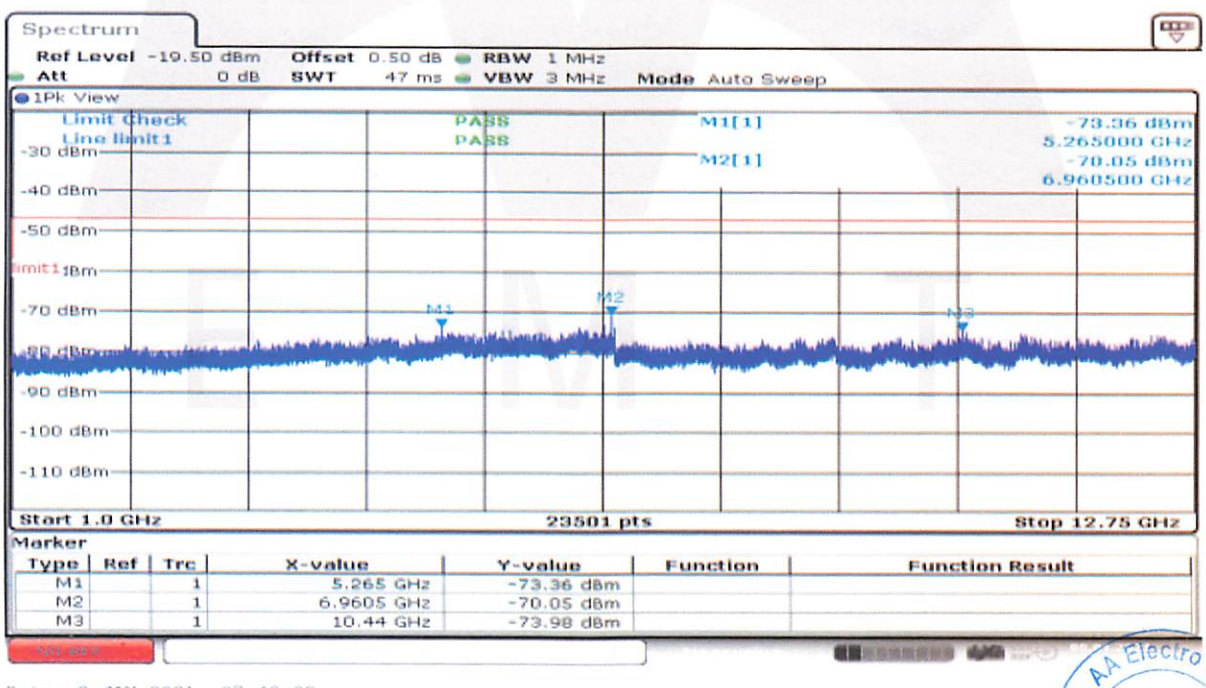
Test result(Conducted measurement) - CH00 2402MHz





Note: EUT is tested on Channel 00, 39 & 78 in all modes (1M, 2M & 3M) and worst data has been recorded.

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6.13 Receiver Blocking

6.13.1 Limit(ETSI EN 300 328 V2.2.2 (2019-07) Clause 4.3.1.12.4)

Receiver Category 2: Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of 10 dBm e.i.r.p. shall be considered as receiver category 2 equipment.

Table 1: Receiver Blocking Parameters for Raceiver Category 1 Equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P min + 6 dB	2 380 2 503,5	-53	CW
P min + 6 dB	2 300 2 330 2 360	-47	CW
P min + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW

NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal.
NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.

Table 2: Receiver Blocking Parameters for Raceiver Category 2 Equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P min + 6 dB	2 380 2 503,5	-57	CW
P min + 6 dB	2 300 2 583,5	-47	CW

NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal.
NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.

Table 3: Receiver Blocking Parameters for Raceiver Category 3 Equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P min + 12 dB	2 380 2 503,5	-57	CW
P min + 12 dB	2 300 2 583,5	-47	CW

NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal.
NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.

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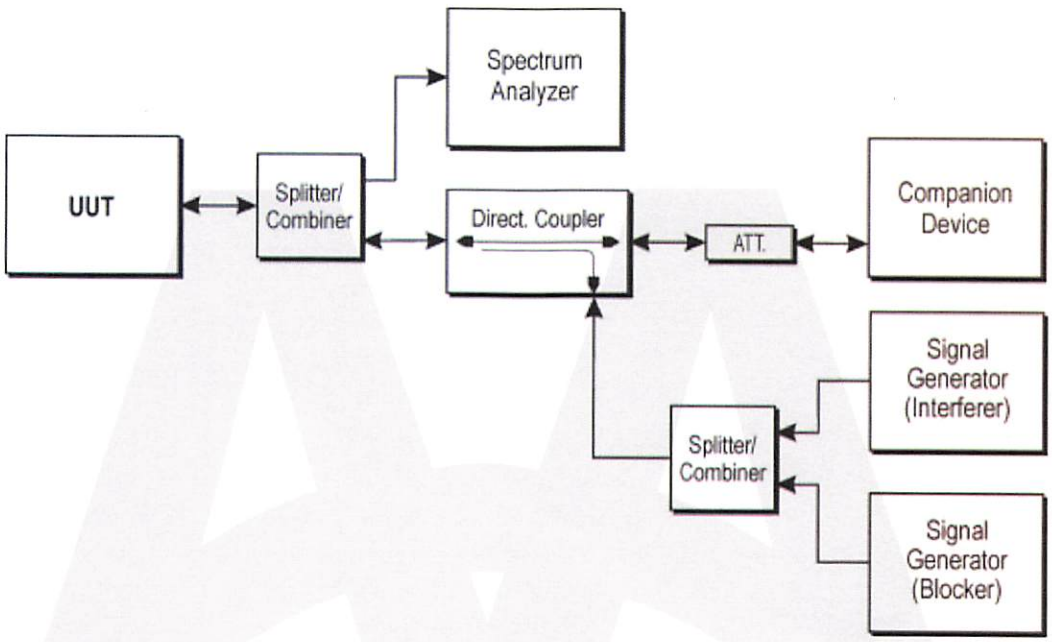
6.13.2 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.11

6.13.3 Test Setup

Conducted measurements



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6.13.4Test result

Receiver Blocking Result							
Modulation Mode	Operation Frequency (MHz)	Wanted Signal Mean Power from Companion Device (dBm) Pmin + 6 dB	Receiver Blocking Power (dBm)	Blocking Signal Frequency (MHz)	Type of Blocking Signal	PER(%)	Test Result
GFSK	Full channel	-74	-57	2380	CW	1.03	Pass
	Full channel	-74	-57	2503.5	CW	1.36	Pass
	Full channel	-74	-47	2380	CW	1.65	Pass
	Full channel	-74	-47	2503.5	CW	1.98	Pass
Test value	P_{min}= -80 dBm						
Limit	PER(Packet Error Rate) ≦ 10%						
Result	Complied						

Receiver Blocking Result							
Modulation Mode	Operation Frequency (MHz)	Wanted Signal Mean Power from Companion Device (dBm) Pmin + 6 dB	Receiver Blocking Power (dBm)	Blocking Signal Frequency (MHz)	Type of Blocking Signal	PER(%)	Test Result
Pi/4-DQPSK	Full channel	-74	-57	2380	CW	1.86	Pass
	Full channel	-74	-57	2503.5	CW	1.21	Pass
	Full channel	-74	-47	2380	CW	0.58	Pass
	Full channel	-74	-47	2503.5	CW	1.24	Pass
Test value	P_{min}= -80 dBm						
Limit	PER(Packet Error Rate) ≦ 10%						
Result	Complied						

Receiver Blocking Result							
Modulation Mode	Operation Frequency (MHz)	Wanted Signal Mean Power from Companion Device (dBm) Pmin + 6 dB	Receiver Blocking Power (dBm)	Blocking Signal Frequency (MHz)	Type of Blocking Signal	PER(%)	Test Result
8-DFSK	Full channel	-74	-57	2380	CW	1.10	Pass
	Full channel	-74	-57	2503.5	CW	0.49	Pass
	Full channel	-74	-47	2380	CW	1.07	Pass
	Full channel	-74	-47	2503.5	CW	1.49	Pass
Test value	P_{min}= -80 dBm						
Limit	PER(Packet Error Rate) ≦ 10%						
Result	Complied						

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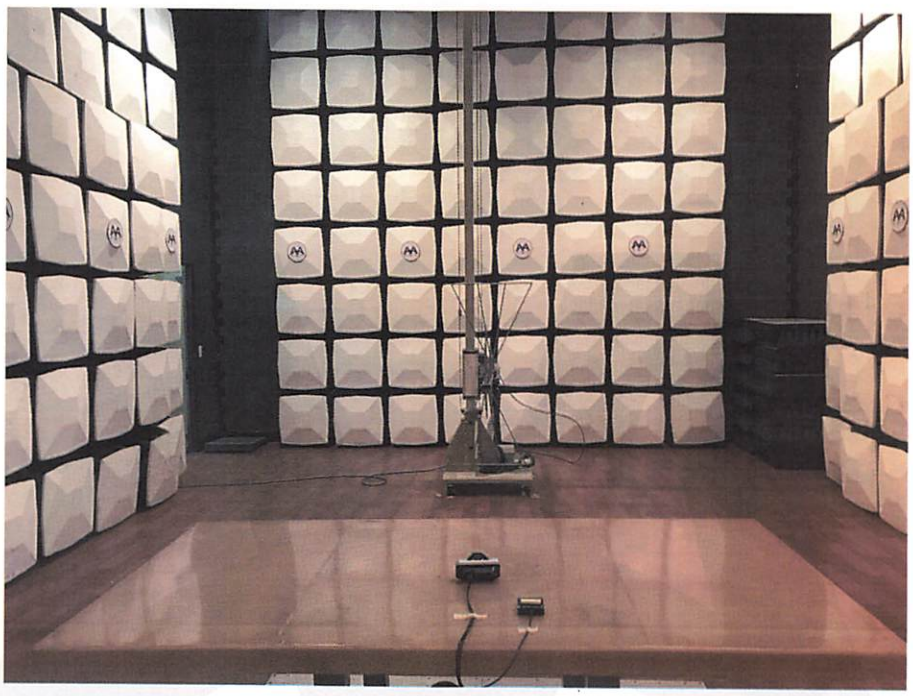
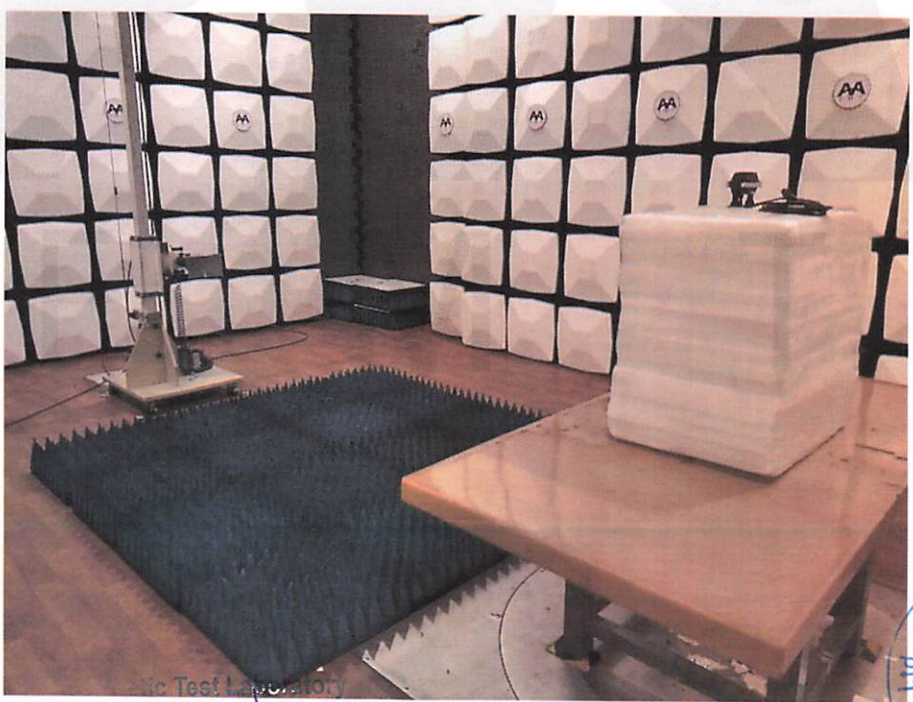
7 Test Setup Photograph





For AA Electro Magnetic Test Laboratory

Authorised Signatory

End of Report

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