Report No.: GTS201608000106E02

SPECTRUM REPORT

Applicant:	RADIOLINK ELECTRONIC LIMITED
Address of Applicant:	3/F,Building 2, Fuguo industrial park, Kaifeng Road, Meilin, Shenzhen, Guangdong China

Equipment Under Test (EUT)

Product Name:	Radio Control
Model No.:	AT9, AT9S
Trade Mark:	RadioLink
Applicable standards:	ETSI EN 300 328 V1.9.1 (2015-02)
Date of sample receipt:	September 01, 2016
Date of Test:	September 02-09, 2016
Date of report issue:	September 12, 2016
Test Result :	PASS *

* In the configuration tested, the EUT detailed in this report 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 1999/5/EC are considered.

Robinson Lo
Laboratory Manager

2 Version

Version No.	Date	Description
00	*September 12, 2016*	*Original*

Prepared By: *Yang Liu* ***Date:*** *September 12, 2016*

Project Engineer

Check By: *Andy Wu* ***Date:*** *September 12, 2016*

Reviewer

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4 Test Summary

Radio Spectrum Matter (RSM) Part of Tx					
Test	**Test Requirement**	**Test method**	**Limit/Severity**	**Uncertainty**	**Result**
RF Output Power	Clause 4.3.1.2	Clause 5.3.2.2	20dBm	±1.5dB	PASS
Duty cycle, Tx-Sequence, Tx-gap	Clause 4.3.1.3	Clause 5.3.2.2	Clause 4.3.1.3.3	±5 %	PASS
Accumulated Transmit time, Frequency occupation & Hopping Sequence	Clause 4.3.1.4	Clause 5.3.4.2	Clause 4.3.1.4.3	±5 %	PASS
Hopping Frequency Separation	Clause 4.3.1.5	Clause 5.3.5.2	Clause 4.3.1.5.3	±5 %	PASS
Medium Utilisation	Clause 4.3.1.6	Clause 5.3.2.2	Clause 4.3.1.6.3	--	PASS
Adaptivity	Clause 4.3.1.7	Clause 5.3.7.2	Clause 4.3.1.7.2.2 & Clause 4.3.1.7.3.2 & Clause 4.3.1.7.4.2	--	N/A
Occupied Channel Bandwidth	Clause 4.3.1.8	Clause 5.3.8.2	Clause 4.3.1.8.3	±5 %	PASS
Transmitter unwanted emissions in the OOB domain	Clause 4.3.1.9	Clause 5.3.9.2	Clause 4.3.1.9.3	±1.5dB	PASS
Transmitter unwanted emissions in the spurious domain	Clause 4.3.1.10	Clause 5.3.10.2	Clause 4.3.1.10.3	±6dB	PASS
Radio Spectrum Matter (RSM) Part of Rx					
Receiver spurious emissions	Clause 4.3.1.11	Clause 5.3.11.2	Clause 4.3.1.11.3	±6dB	PASS
Receiver Blocking	Clause 4.3.1.12	Clause 5.3.7.2	Clause 4.3.1.12.3	--	N/A
Geo-location capability	Clause 4.3.1.13	--	--	--	N/A

Remark:

Tx: In this whole report Tx (or tx) means Transmitter.

Rx: In this whole report Rx (or rx) means Receiver.

Temperature (Uncertainty): ±1°C Humidity(Uncertainty): ±5%

Uncertainty: ± 3%(for DC and low frequency voltages)

5 General Information

5.1 Client Information

Applicant:	RADIOLINK ELECTRONIC LIMITED
Address of Applicant:	3/F,Building 2, Fuguo industrial park, Kaifeng Road, Meilin, Shenzhen, Guangdong China
Manufacturer:	RADIOLINK ELECTRONIC LIMITED
Address of Manufacturer:	3/F,Building 2, Fuguo industrial park, Kaifeng Road, Meilin, Shenzhen, Guangdong China

5.2 General Description of EUT

Product Name:	Radio Control
Model No.:	AT9, AT9S
Operation Frequency:	2409MHz-2474MHz
Channel numbers:	32
Channel separation:	2MHz
Modulation technology:	QPSK
Antenna Type:	Integral Antenna
Antenna gain:	2.00dBi (declare by Applicant)
Power supply:	Tx: DC 12V (8*"AA" battery) Rx: DC 6V (4*"AA" battery)

Remark: The system works in the frequency range of 2409MHz to 2474MHz. This band has been divided to 32 independent channels. Each radio system uses 16 different channels, the minimum channel separation is ≥1MHz. By using various switch-on times, hopping scheme and channel frequencies, the system can guarantee a jamming free radio transmission. The channel list is below.

Operation Frequency each of channel							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2409.0MHz	9	2425.0MHz	17	2444.0MHz	25	2460.0MHz
2	2411.0MHz	10	2427.0MHz	18	2446.0MHz	26	2462.0MHz
3	2413.0MHz	11	2429.0MHz	19	2448.0MHz	27	2464.0MHz
4	2415.0MHz	12	2431.0MHz	20	2450.0MHz	28	2466.0MHz
5	2417.0MHz	13	2433.0MHz	21	2452.0MHz	29	2468.0MHz
6	2419.0MHz	14	2435.0MHz	22	2454.0MHz	30	2470.0MHz
7	2421.0MHz	15	2437.0MHz	23	2456.0MHz	31	2472.0MHz
8	2423.0MHz	16	2439.0MHz	24	2458.0MHz	32	2474.0MHz

The test frequency is below:

Test channel	Frequency (MHz)
Lowest channel	2409MHz
Middle channel	2444MHz
Highest channel	2474MHz

5.3 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode.

5.4 Test Facility

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

● **FCC —Registration No.: 600491**

Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fuly described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 600491, June 22, 2016.

● **Industry Canada (IC) —Registration No.: 9079A-2**

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-2, August 15, 2016.

5.5 Test Location

All tests were performed at:

Global United Technology Services Co., Ltd.
Address: No. 301-309, 3/F., Jinyuan Business Building, No.2, Laodong Industrrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China
Tel: 0755-27798480
Fax: 0755-27798960

5.6 Description of Support Units

The EUT has been tested as an independent unit.

5.7 Deviation from Standards

None.

5.8 Abnormalities from Standard Conditions

None.

5.9 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	9.0(L)*6.0(W)* 6.0(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	ESU EMI Test Receiver	R&S	ESU26	GTS203	June. 29 2016	June. 28 2017
4	BiConiLog Antenna	SCHWARZBECK	VULB9163	GTS214	June. 29 2016	June. 28 2017
5	Double-ridged horn antenna	SCHWARZBECK	9120D	GTS208	June. 29 2016	June. 28 2017
6	Horn Antenna	ETS-LINDGREN	3160-09	GTS218	June. 29 2016	June. 28 2017
7	RF Amplifier	HP	8347A	GTS204	June. 29 2016	June. 28 2017
8	RF Amplifier	HP	8349B	GTS206	June. 29 2016	June. 28 2017
9	Broadband Preamplifier	SCHWARZBECK	BBV9718	GTS535	June. 29 2016	June. 28 2017
10	PSA Series Spectrum Analyzer	Agilent	E4440A	GTS536	June. 29 2016	June. 28 2017
11	Universal Radio Communication tester	ROHDE&SCHWARZ	CMU 200	GTS538	June. 29 2016	June. 28 2017
12	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
13	Coaxial cable	GTS	N/A	GTS210	N/A	N/A
14	Coaxial Cable	GTS	N/A	GTS211	N/A	N/A
15	Thermo meter	N/A	N/A	GTS256	June. 29 2016	June. 28 2017

Conducted:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	Signal Analyzer	Agilent	N9010A	MY48030494	June. 29 2016	June. 28 2017
2	vector Signal Generator	Agilent	E4438C	MY49070163	June. 29 2016	June. 28 2017
3	splitter	Mini-Circuits	ZAP-50W	NN256400424	June. 29 2016	June. 28 2017
4	Directional Coupler	Agilent	87300C	MY44300299	June. 29 2016	June. 28 2017
5	vector Signal Generator	Agilent	E4438C	US44271917	June. 29 2016	June. 28 2017
6	X-series USB Peak and Average Power Sensor	Agilent	U2021XA	MY54080020	June. 29 2016	June. 28 2017
7	X-series USB Peak and Average Power Sensor	Agilent	U2021XA	MY54110001	June. 29 2016	June. 28 2017
8	X-series USB Peak and Average Power Sensor	Agilent	U2021XA	MY53480008	June. 29 2016	June. 28 2017
9	X-series USB Peak and Average Power Sensor	Agilent	U2021XA	MY54080019	June. 29 2016	June. 28 2017
10	4 Ch.Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	TW54063507	June. 29 2016	June. 28 2017
11	4 Ch.Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	TW54063513	June. 29 2016	June. 28 2017
12	splitter	Mini	PS3-7	4463	June. 29 2016	June. 28 2017

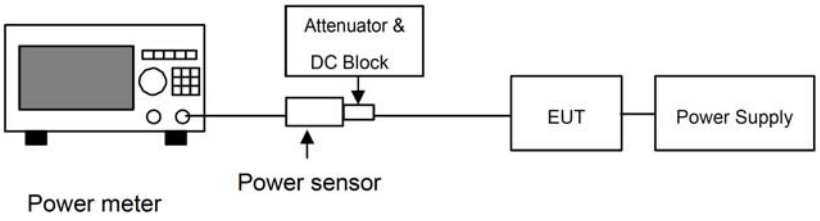
7 Radio Technical Specification in ETSI EN 300 328

7.1 Test Environment and Mode

Test mode:			
Transmitting mode:	Keep the EUT in transmitting mode with modulation.		
Receiving mode	Keep the EUT in receiving mode.		
Operating Environment:			
Item	**Normal condition**	**Extreme condition**	
		High Temp	Low Temp
Temperature	+25ºC	+55ºC	-20ºC
Humidity	20%-95%		
Atmospheric Pressure:	1008 mbar		

7.2 Transmitter Requirement

7.2.1 RF Output Power

Test Requirement:	ETSI EN 300 328 clause 4.3.1.2
Test Method:	ETSI EN 300 328 clause 5.3.2.2.1.2
Limit:	20dBm
Test setup:	
Test procedure:	**Step 1:** • Use a fast power sensor suitable for 2,4 GHz and capable of minimum 1 MS/s. • Use the following settings: - Sample speed 1 MS/s or faster. - The samples shall represent the RMS power of the signal. - Measurement duration: For non-adaptive equipment: equal to the observation period defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured. NOTE 1: For adaptive equipment, to increase the measurement accuracy, a higher number of bursts may be used. **Step 2:** • 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. • For conducted measurements on devices with multiple transmit chains: - Connect one power sensor to each transmit port for a synchronous measurement on all transmit 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 500 ns. - For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples in all following steps. **Step 3:** • Find the start and stop times of each burst in the stored measurement samples. The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples in step 2. NOTE 2: In case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.

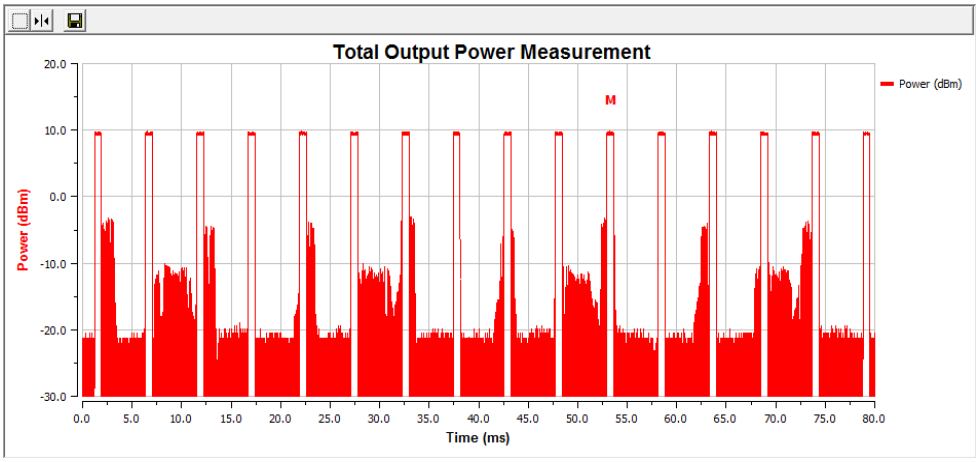
	Step 4: • Between the start and stop times of each individual burst calculate the RMS power over the burst using the formula below. Save these Pburst values, as well as the start and stop times for each burst. $P_{burst} = \frac{1}{k}\sum_{n=1}^{k} P_{sample}(n)$ with 'k' being the total number of samples and 'n' the actual sample number **Step 5:** • The highest of all Pburst values (value "A" in dBm) will be used for maximum e.i.r.p. calculations. **Step 6:** • Add the (stated) antenna assembly gain "G" in dBi of the individual antenna. • If applicable, add the additional beamforming gain "Y" in dB. • If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used. • The RF Output Power (P) shall be calculated using the formula below: P = A + G + Y • This value, which shall comply with the limit given in clause 4.3.1.2.3 or clause 4.3.2.2.3, shall be recorded in the test report.
Measurement Record:	Uncertainty: ± 1.5dB
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data

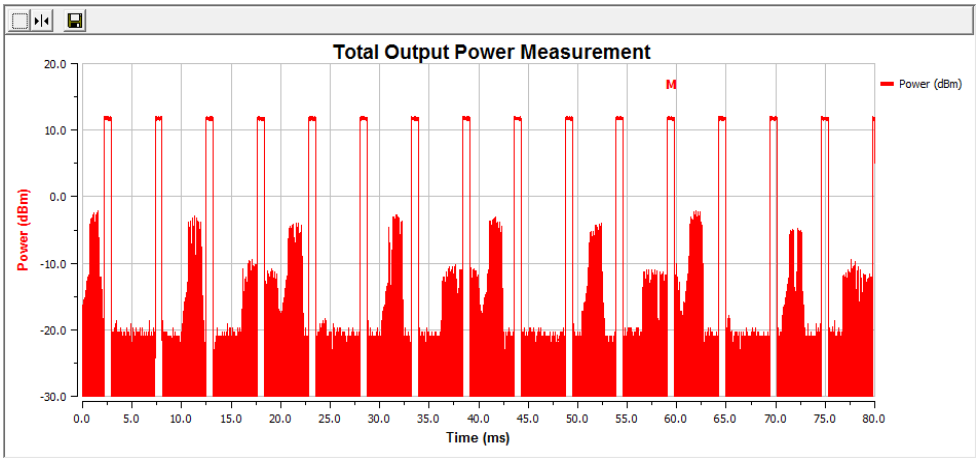
Test conditions	Channel	Read Level (dBm)	Antenna Gain(dBi)	Calculated Power (dBm)	Limit (dBm)	Result
Normal	Lowest	9.51	2.00	11.51	20	Pass
	Middle	11.83	2.00	13.83		
	Highest	13.14	2.00	15.14		
NVHT	Lowest	9.44	2.00	11.44		
	Middle	11.73	2.00	13.73		
	Highest	13.04	2.00	15.04		
NVLT	Lowest	9.49	2.00	11.49		
	Middle	11.81	2.00	13.81		
	Highest	13.12	2.00	15.12		

Remark:
1>. Volt= Voltage, Temp= Temparature
2>. Antenna Gain=2.0dBi

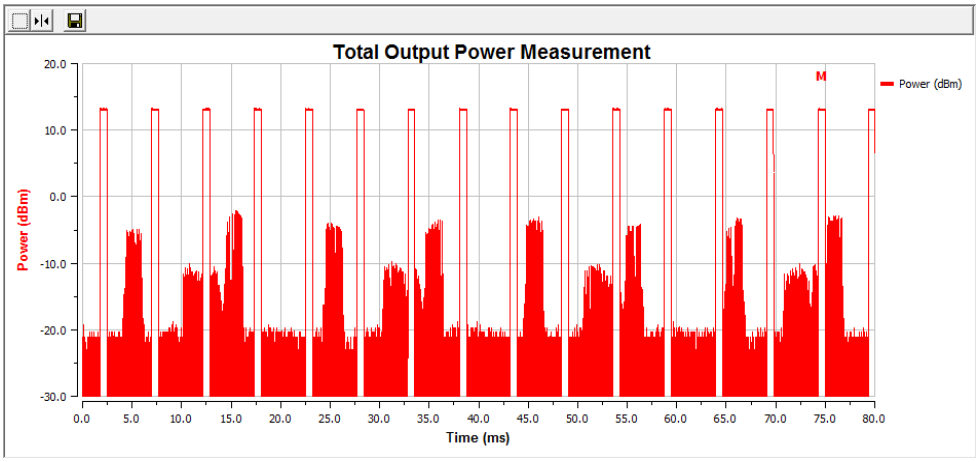
The test plot of normal condition is below:



Lowest Channel

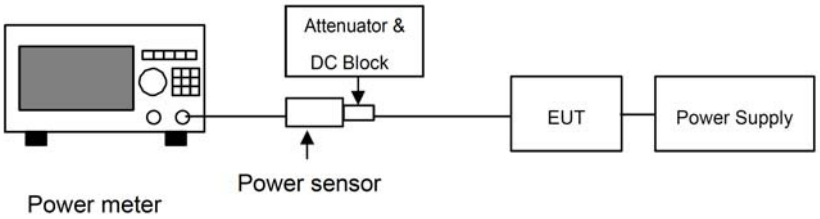


Middle Channel



Highest Channel

7.2.2 Duty Cycle, Tx-sequence, Tx-gap

Test Requirement:	ETSI EN 300 328 clause 4.3.1.3
Test Method:	ETSI EN 300 328 clause 5.3.2.2.1.2
Limit:	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.
Test setup:	
Test procedure:	Refer to clause 5.3.2.2.1.2
Measurement Record:	Uncertainty: ±5 %
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data

Duty Cycle:

Dwell Time (ms)	Observation period (Dwell time * 100) (ms)	Duty Cycle	Declared Duty Cycle	Result
2.13	213	7.81%	10%	Pass

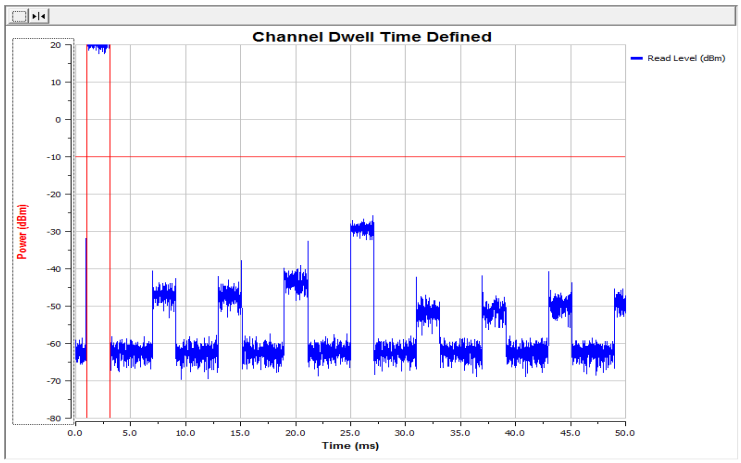
Tx-sequence:

Tx-sequence (ms)	Limit (ms)	Result
2.13	≤ 5	Pass

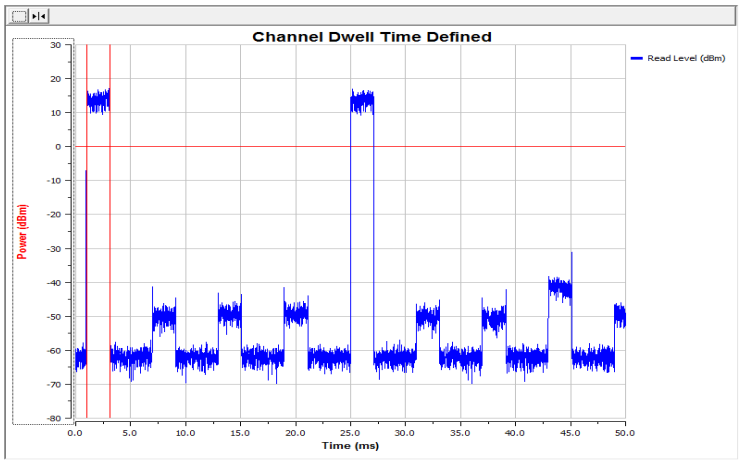
Tx-gap:

Tx-gap (ms)	Limit (ms)	Result
25.15	≥ 5	Pass

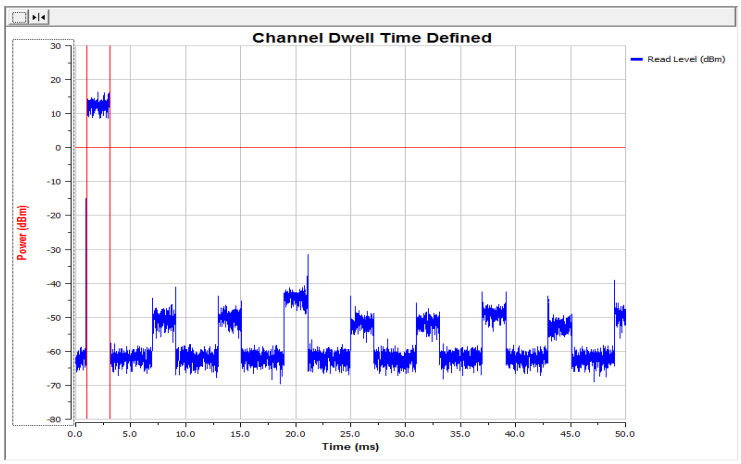
Modulation Type:	GFSK	Test Channel:	Lowest Channel



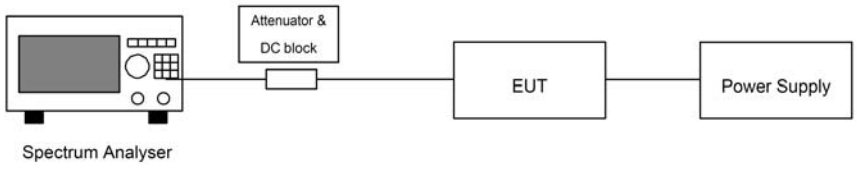
Modulation Type:	GFSK	Test Channel:	Middle Channel



Modulation Type:	GFSK	Test Channel:	Highest Channel



7.2.3 Accumulated Transmit Time, Frequency occupation & Hopping Sequence

Test Requirement:	ETSI EN 300 328 clause 4.3.1.4
Test Method:	ETSI EN 300 328 clause 5.3.4.2
Limit:	**1) Non-adaptive frequency hopping systems** The accumulated Dwell Time on any hopping frequency shall not be greater than 15 ms within any period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used. Non-adaptive medical devices requiring reverse compatibility with other medical devices placed on the market when earlier versions of the present document were harmonised, are allowed to have an operating mode in which the maximum dwell time is 400 ms. The hopping sequence(s) shall contain at least N hopping frequencies where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater. 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. **2) Adaptive frequency hopping systems** Adaptive Frequency Hopping systems shall be capable of operating over a minimum of 70 % of the band specified in clause 1. 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. 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. 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.
Test setup:	
Test procedure:	Refer to clause 5.3.4.2.1
Measurement Record:	Uncertainty: ±5 %
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data

Accumulated Transmit Time:

Channel	Dwell time per hop (ms)	Minimum number of hop frequency	15ms* minimum number of hopping frequencies (s)	Maximum accumulated dwell time (ms)	Limit (ms)	Result
Lowest	2.13	15	0.225	4.26	≤15	Pass
Middle	2.12	15	0.225	2.12		Pass
Highest	2.12	15	0.225	2.12		Pass

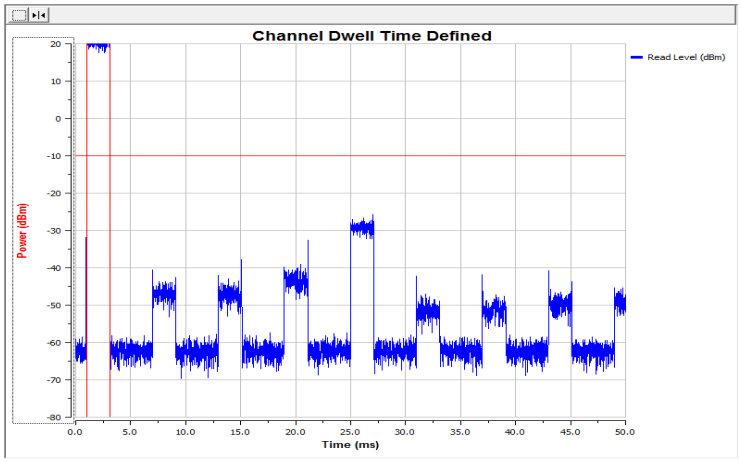
Frequency Occupation:

Channel	Dwell time per hop (ms)	Number of hop frequency	Number of hop in [4*Dwell time per hop*N]	[4*Dwell time per hop*N] (ms)	Dwell Time in [[4*Dwell time per hop*N]] (ms)	Result
Lowest	2.13	16	1	136.32	2.13	Pass
Middle	2.12	16	1	135.68	2.12	Pass
Highest	2.12	16	1	135.68	2.12	Pass

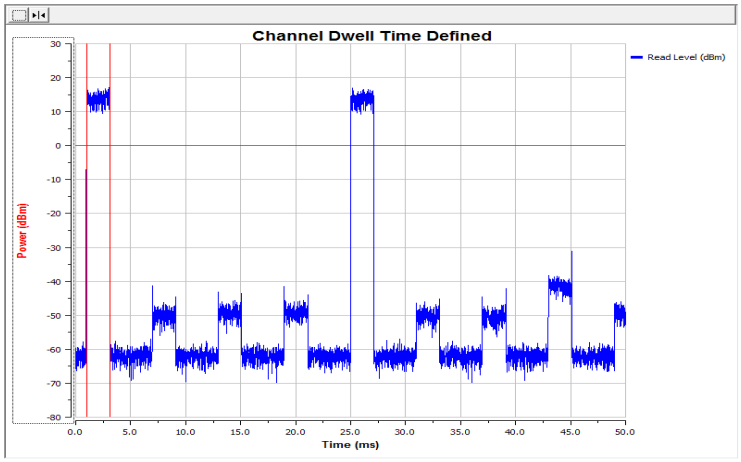
Hopping Sequence:

Number of hopping frequencies	Limit	Result
16	≥15	Pass

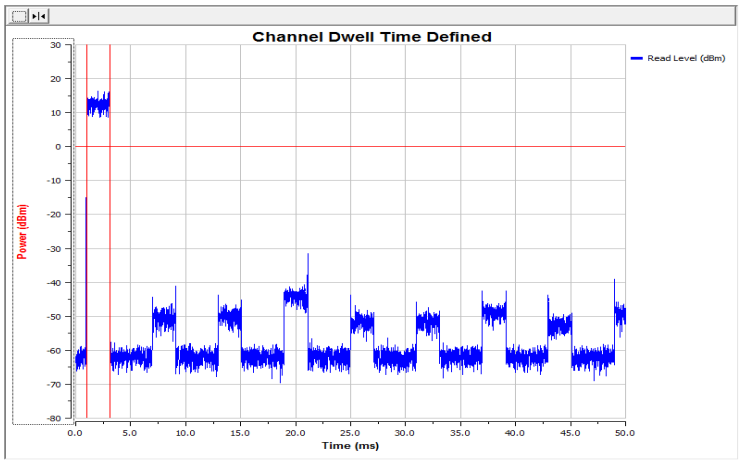
Modulation Type:	GFSK	Test Channel:	Lowest Channel



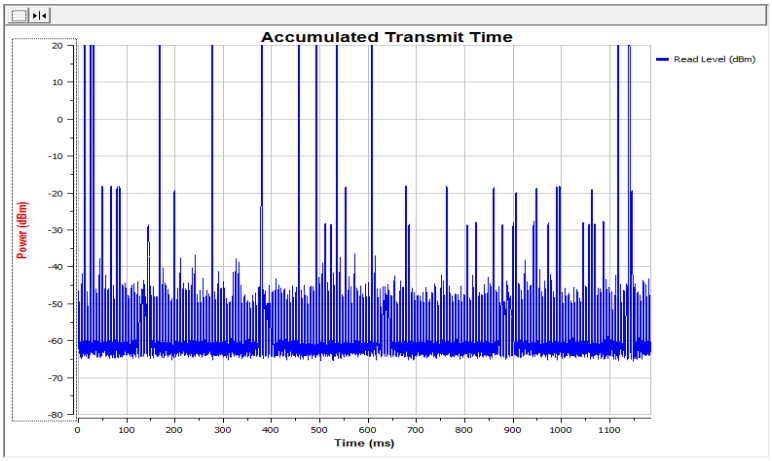
Modulation Type:	GFSK	Test Channel:	Middle Channel



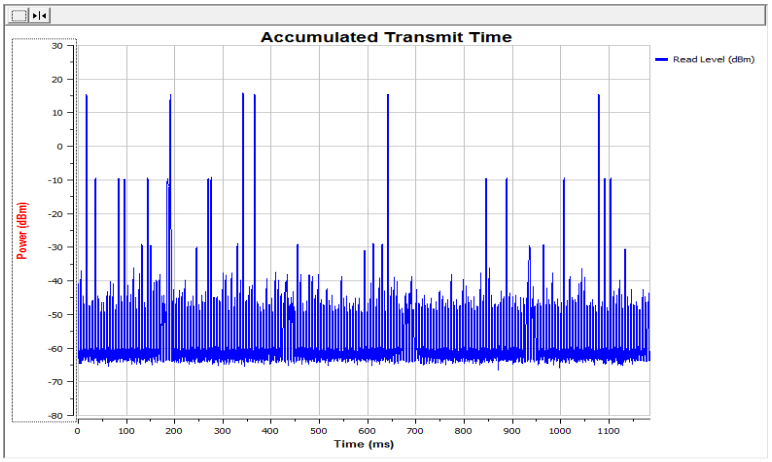
Modulation Type:	GFSK	Test Channel:	Highest Channel



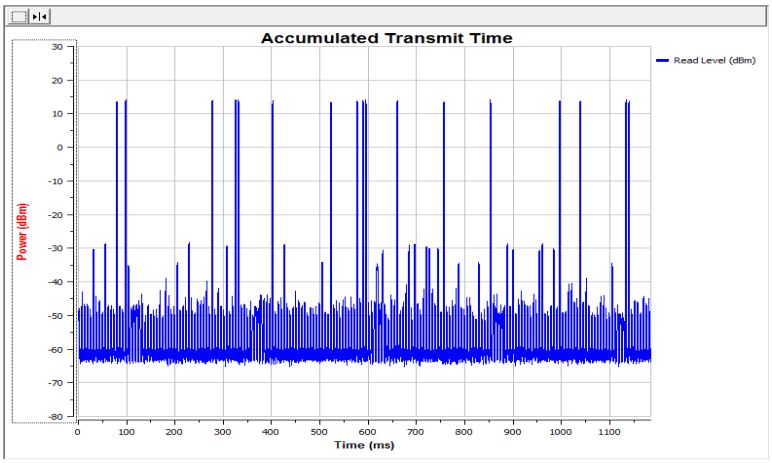
Modulation Type:	GFSK	Test Channel:	Lowest Channel



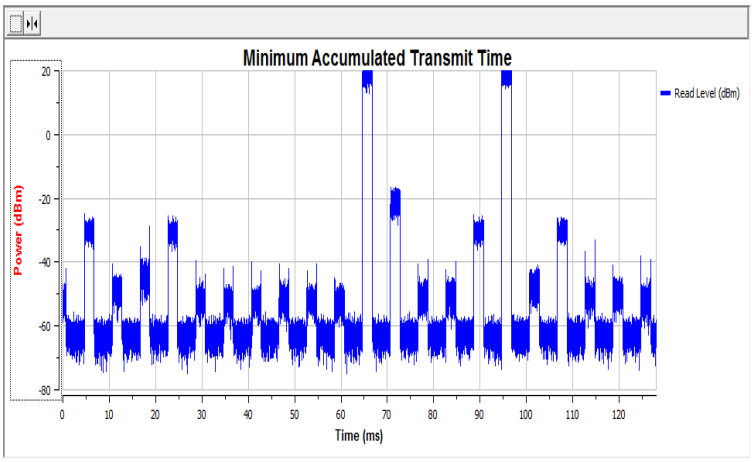
Modulation Type:	GFSK	Test Channel:	Middle Channel



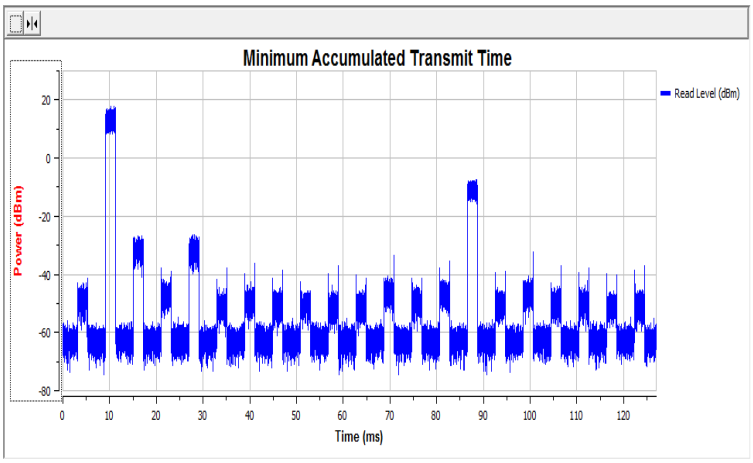
Modulation Type:	GFSK	Test Channel:	Highest Channel



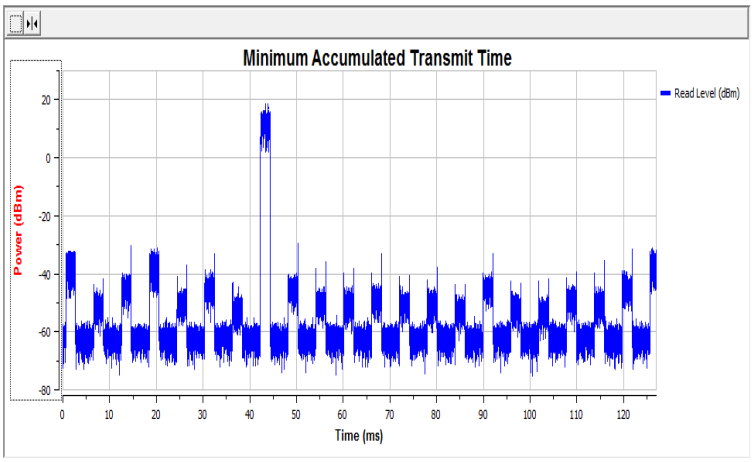
Modulation Type:	GFSK	Test Channel:	Lowest Channel



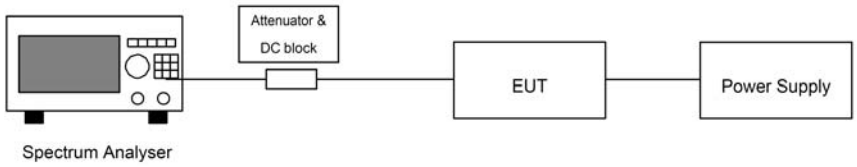
Modulation Type:	GFSK	Test Channel:	Middle Channel



Modulation Type:	GFSK	Test Channel:	Highest Channel



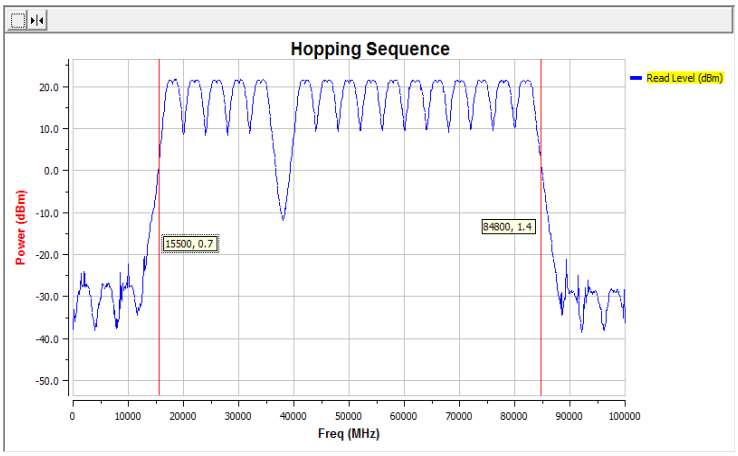
7.2.4 Hopping Frequency Separation

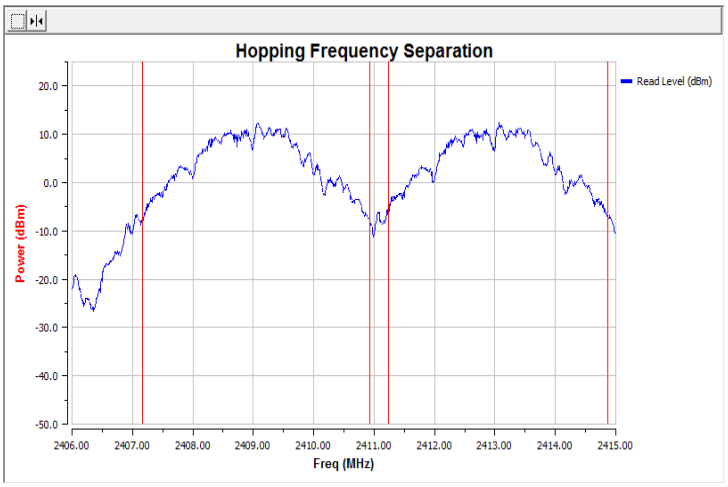
Test Requirement:	ETSI EN 300 328 clause 4.3.1.5
Test Method:	ETSI EN 300 328 clause 5.3.5.2.1
Limit:	a) For non-adaptive frequency hopping equipment. The Hopping Frequency Separation shall be equal or greater than the Occupied Channel Bandwidth (see clause 4.3.1.8), with a minimum separation of 100 kHz. For equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for non-adaptive Frequency Hopping equipment operating in a mode where the RF Output power is less than 10 dBm e.i.r.p. only the minimum Hopping Frequency Separation of 100 kHz applies. b) Adaptive frequency hopping equipment, The minimum Hopping Frequency Separation shall be 100 kHz. Adaptive Frequency Hopping equipment, which for one or more hopping frequencies, has switched to a non-adaptive mode because interference was detected on all these hopping positions with a level above the threshold level defined in clause 4.3.1.7.2.2 or clause 4.3.1.7.3.2, is allowed to continue to operate with a minimum Hopping Frequency Separation of 100 kHz on these hopping frequencies as long as the interference is present on these frequencies. The equipment shall continue to operate in an adaptive mode on other hopping frequencies. Adaptive Frequency Hopping equipment which decided to operate in a non-adaptive mode on one or more hopping frequencies without the presence of interference, shall comply with the limit in clause 4.3.1.5.3.1 for these hopping frequencies as well as with all other requirements applicable to non-adaptive frequency hopping equipment.
Test setup:	
Test procedure:	Clause 5.3.5.2.1
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data:

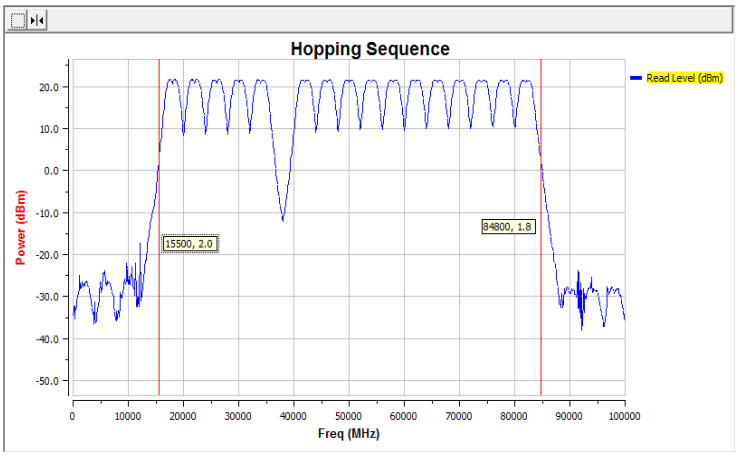
Channel	Hopping Frequency Separation (MHz)	Limit (kHz)	Result
Lowest	4.01	100	Pass
Middle	4.00		Pass
Highest	4.00		Pass

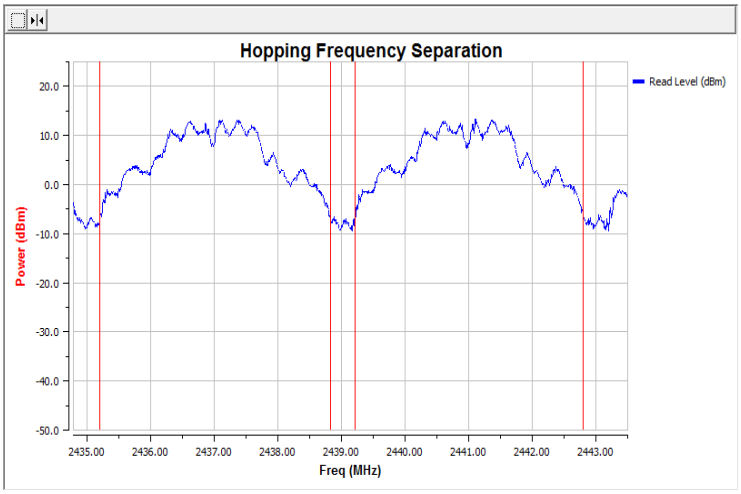
The test plot of normal condition is below:



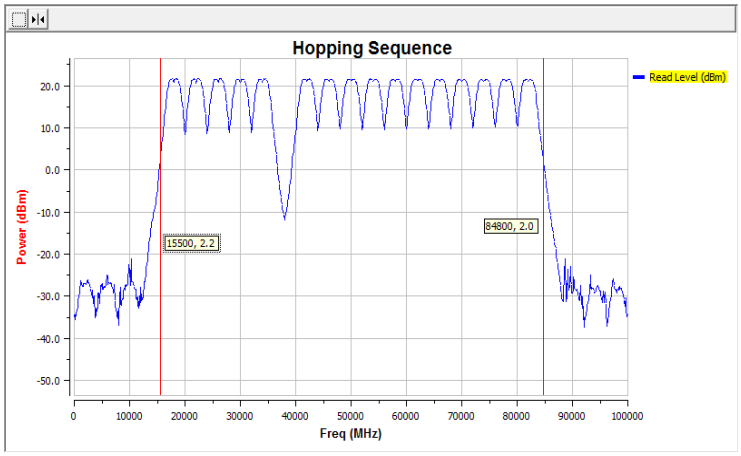


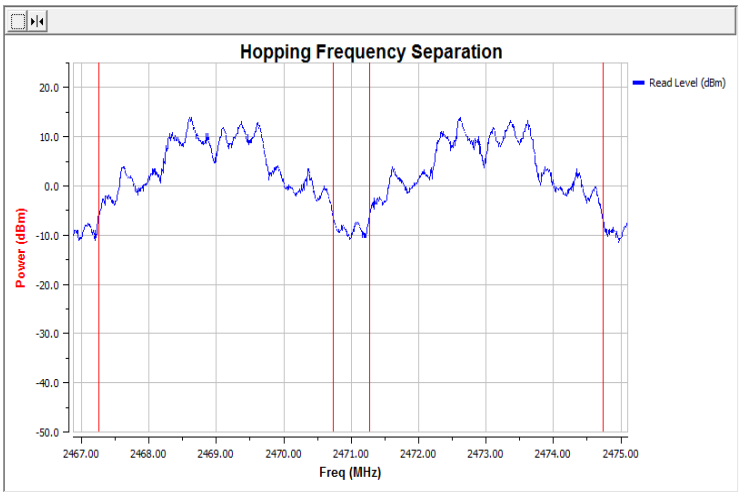
Lowest Channel





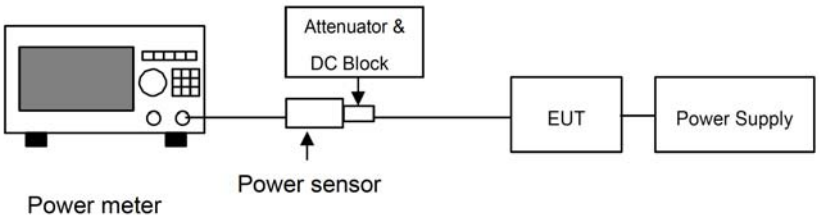
Middle Channel





Highest Channel

7.2.5 Medium Utilisation (MU) factor

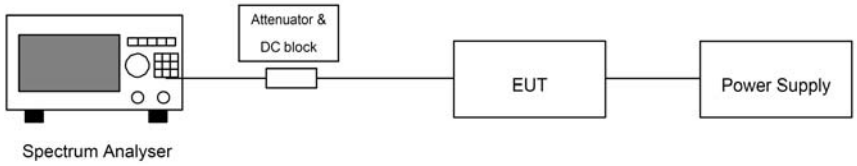
Test Requirement:	ETSI EN 300 328 clause 4.3.1.6
Test Method:	ETSI EN 300 328 clause 5.3.2.2.1.4
Limit:	The maximum Medium Utilisation factor for non-adaptive Frequency Hopping equipment shall be 10 %
Test setup:	
Test procedure:	Clause 5.3.2.2.1.4
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data:

Medium Utilisation (MU) factor	Limit (ms)	Result
2.55%	≤ 10%	Pass

MU=(P/100mW)*DC=(15.14dBm/100mW)*7.81%=(32.66mW/100mW)*7.81%=2.55%

7.2.6 Occupied Channel Bandwidth

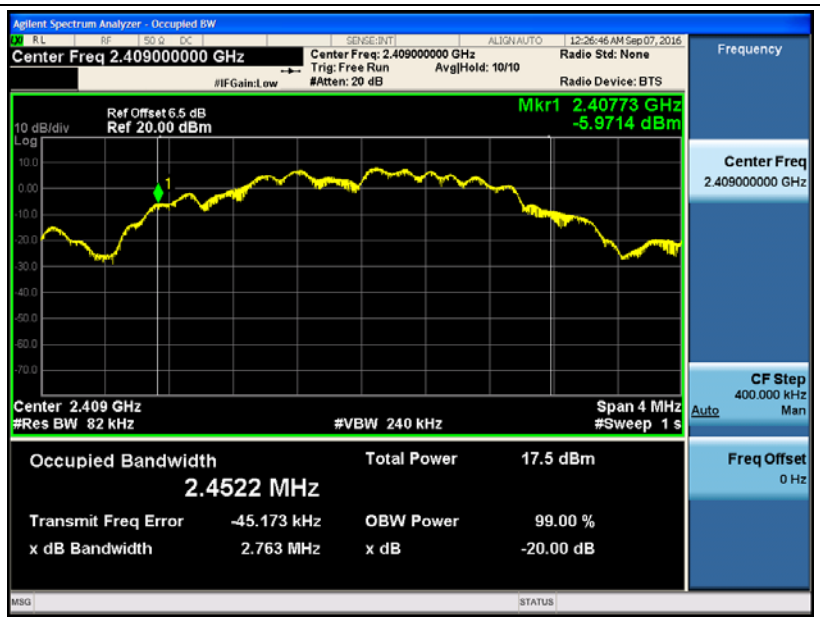
Test Requirement:	ETSI EN 300 328 clause 4.3.1.8
Limit:	The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band given in clause 1. For non-adaptive Frequency Hopping equipment with e.i.r.p greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the Nominal Channel Bandwidth declared by the supplier. See clause 5.3.1 j). This declared value shall not be greater than 5 MHz.
Test setup:	
Test Precedure:	Clause 5.3.8.2.1
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data:

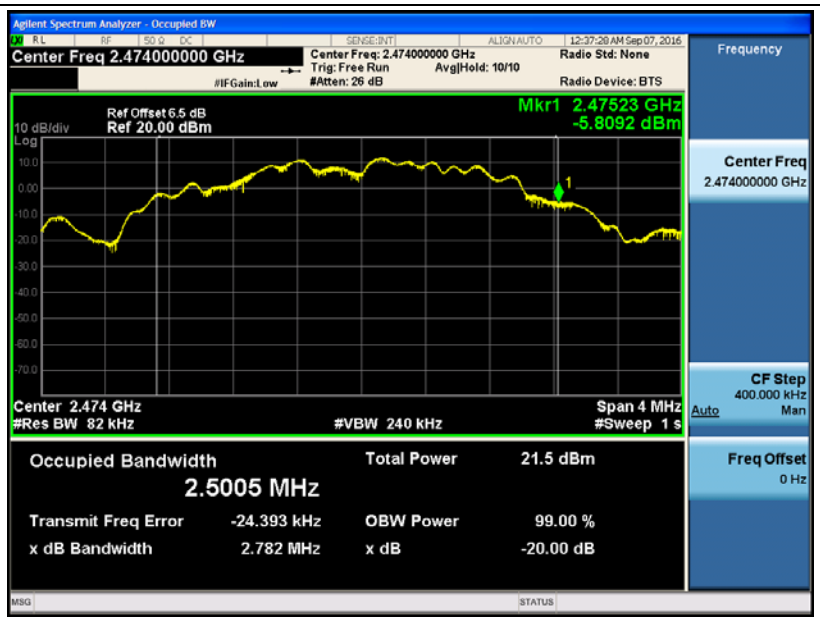
Test Channel	99% Bandwidth (MHz)	Declared Bandwidth (MHz)	F_L/F_H (MHz)	Limit	Result
Lowest	2.4522	5.000	2407.73	2400MHz ~ 2483.5MHz	Pass
Highest	2.5005	5.000	2475.23		Pass

The test plot of normal condition is below:

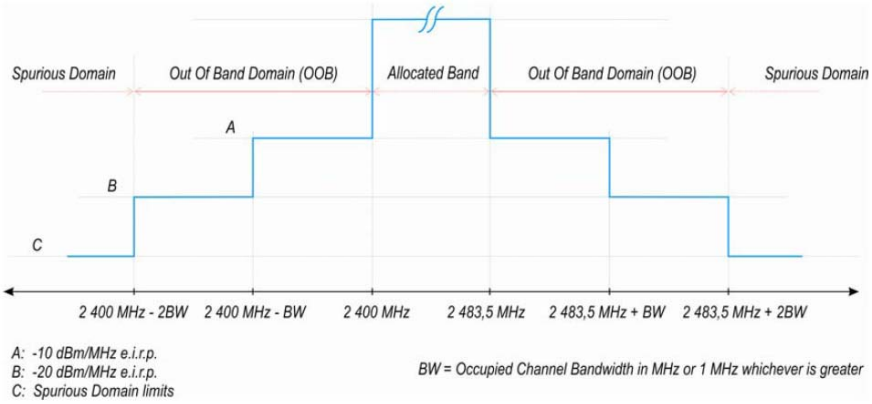
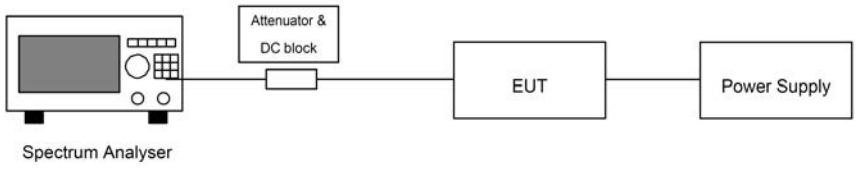
Channel:	Lowest



Channel:	Highest



7.2.7 Transmitter unwanted emissions in the OOB domain

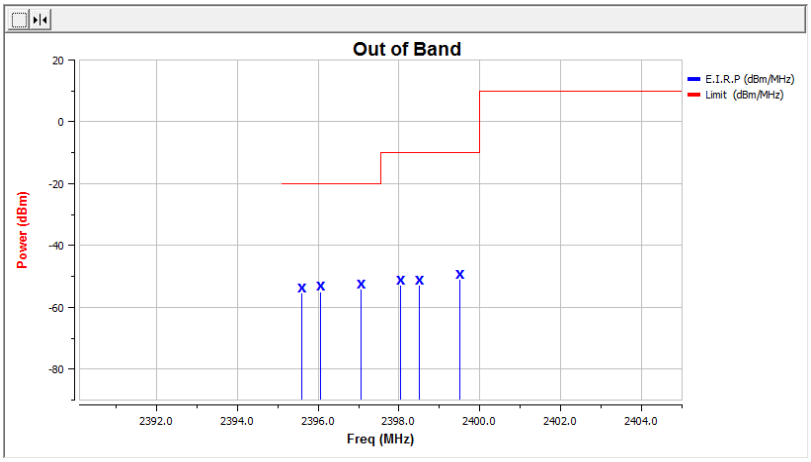
Test Requirement:	ETSI EN 300 328 clause 4.3.1.9
Test Method:	ETSI EN 300 328 clause 5.3.9.2
Limit:	The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 1.  **Figure 1: Transmit mask**
Test setup:	
Test procedure:	Clause 5.3.9.2.1
Measurement Record:	Uncertainty: ± 1.5dB
Test Instruments:	See section 6.0
Test mode:	Transmitting mode(GFSK modulatioin)

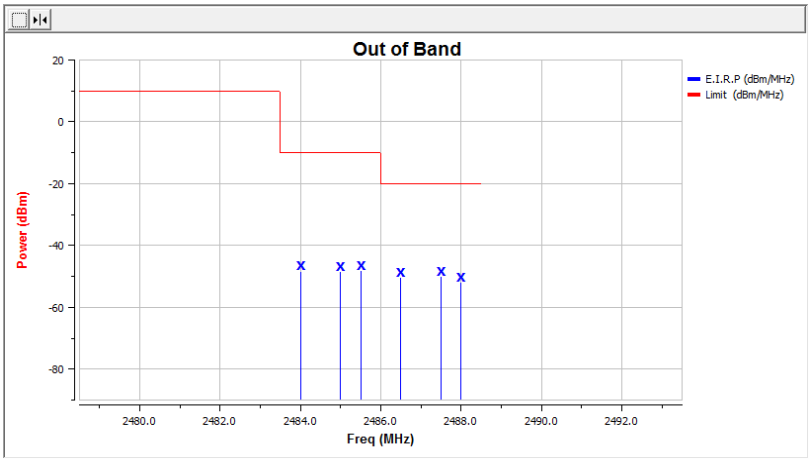
Measurement Data:

Modulation Type	Test Condition	Test Channel	Frequency (MHz)	Level (dBm)	Limit (dBm)
QPSK	Normal	Lowest Channel	2399.50	-51.35	-10
			2398.50	-53.11	-10
			2398.05	-53.17	-10
			2397.04	-54.34	-20
			2396.05	-55.26	-20
			2395.60	-55.65	-20
		Highest Channel	2484.00	-48.60	-10
			2485.00	-48.84	-10
			2485.51	-48.45	-10
			2486.50	-50.70	-20
			2487.50	-50.38	-20
			2488.06	-51.21	-20
	NVLT	Lowest Channel	2399.43	-50.26	-10
			2397.37	-51.69	-10
			2396.58	-48.10	-10
			2395.33	-50.25	-20
			2394.36	-51.75	-20
			2392.42	-49.34	-20
		Highest Channel	2484.06	-51.41	-10
			2486.05	-52.99	-10
			2487.13	-51.16	-10
			2488.18	-50.38	-20
			2490.01	-49.24	-20
			2491.06	-49.31	-20

Modulation Type	Test Condition	Test Channel	Frequency (MHz)	Level (dBm)	Limit (dBm)
QPSK	NVHT	Lowest Channel	2399.42	-47.53	-10
			2398.47	-49.86	-10
			2397.39	-50.01	-10
			2395.53	-51.68	-20
			2394.37	-52.79	-20
			2392.51	-49.32	-20
		Highest Channel	2484.02	-48.43	-10
			2485.10	-50.72	-10
			2486.09	-49.98	-10
			2488.05	-50.38	-20
			2489.06	-53.51	-20
			2491.09	-49.03	-20

The test plot of normal condition is below:





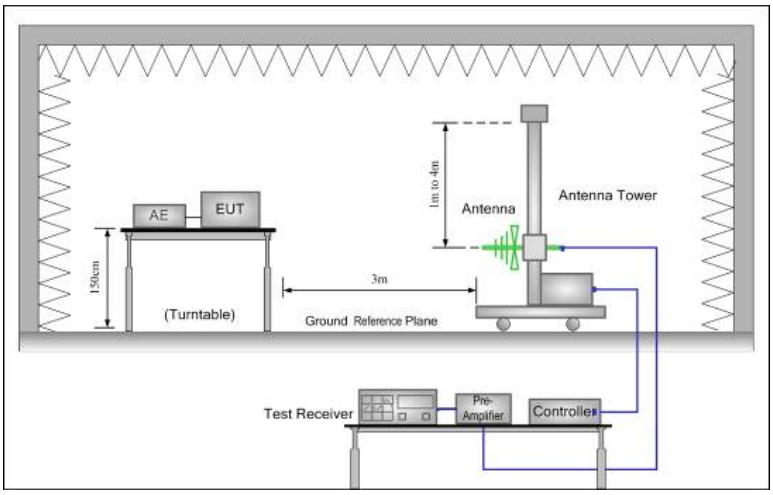
7.2.8 Transmitter unwanted emissions in the spurious domain

Test Requirement:	ETSI EN 300 328 clause 4.3.1.10
Test Method:	ETSI EN 300 328 clause 5.3.10.2
Receiver setup:	RBW=100KHz, VBW=30KHz, Detector= peak

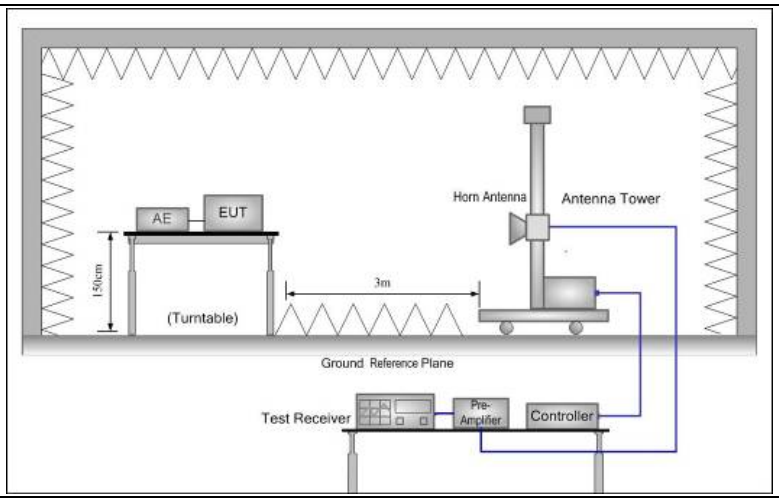
Limit:

Frequency Range	Maximum power e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87.5 MHz	-36 dBm	100 kHz
87.5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12.75 GHz	-30 dBm	1 MHz

Test Frequency range:	30MHz to 12.75GHz
Test setup:	Below 1GHz



Above 1GHz

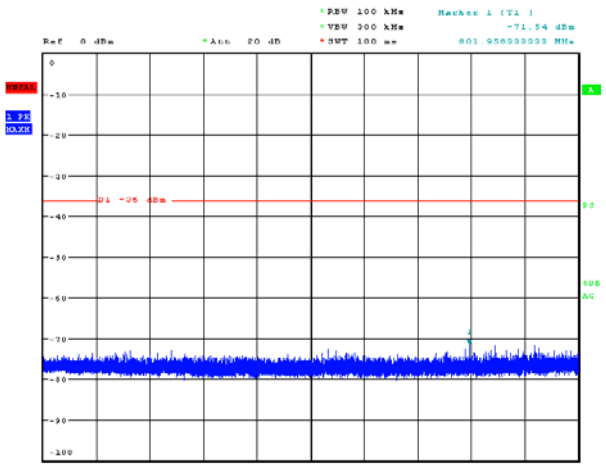
	
Test procedure:	The measurements were performed from 30 MHz to 12.75 GHz. The emissions over the range 30 MHz to 1 000 MHz shall be identified. Spectrum analyzer settings: Resolution bandwidth: 100 kHz Video bandwidth: 300 kHz Filter type: 3 dB (Gaussian) Detector mode: Peak Trace Mode: Max Hold Sweep Points: ≥ 19400 NOTE 1: For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented. Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel. For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies. NOTE 2: The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used. The emissions over the range 1 GHz to 12.75 GHz shall be identified. Spectrum analyzer settings: Resolution bandwidth: 1 MHz Video bandwidth: 3 MHz Filter type: 3 dB (Gaussian) Detector mode: Peak Trace Mode: Max Hold Sweep Points: ≥ 23500 NOTE 3: For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented. Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 1 MHz frequency step, the measurement time is greater than two transmissions

	of the UUT, on any channel. For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies. The signal is maximized through rotation and placement in the three orthogonal axes. NOTE 4: The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used. The EUT and its peripherals are placed on a turn table which is 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum spurious emission level. The EUT was positional such that the distance from antenna to the EUT was 1 meter for frequency above 1GHz and the distance from antenna to the EUT was 3 meters for frequency up to 1 GHz. The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level. Both horizontal and vertical polarizations of the antenna are set on measurement.
Measurement Record:	Uncertainty: ± 6dB
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

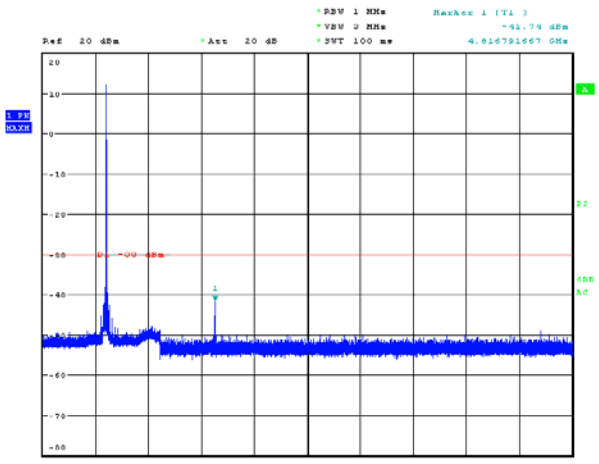
Measurement Data

The lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
39.85	Vertical	-75.71	-36.00	Pass
552.88	V	-65.28	-54.00	
4818.00	V	-40.08	-30.00	
7227.00	V	-33.62	-30.00	
9636.00	V	-33.76	-30.00	
12045.00	V	-40.01	-30.00	
90.22	Horizontal	-74.98	-36.00	
654.23	H	-63.16	-54.00	
4818.00	H	-41.35	-30.00	
7227.00	H	-34.43	-30.00	
9636.00	H	-34.55	-30.00	
12045.00	H	-41.27	-30.00	
The highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
56.84	Vertical	-71.05	-36.00	Pass
809.57	V	-67.46	-54.00	
4948.00	V	-41.11	-30.00	
7422.00	V	-36.25	-30.00	
9896.00	V	-34.36	-30.00	
12370.00	V	-40.12	-30.00	
40.96	Horizontal	-70.01	-36.00	
781.29	H	-68.12	-54.00	
4948.00	H	-42.27	-30.00	
7422.00	H	-37.43	-30.00	
9896.00	H	-35.56	-30.00	
12370.00	H	-41.69	-30.00	

The lowest channel

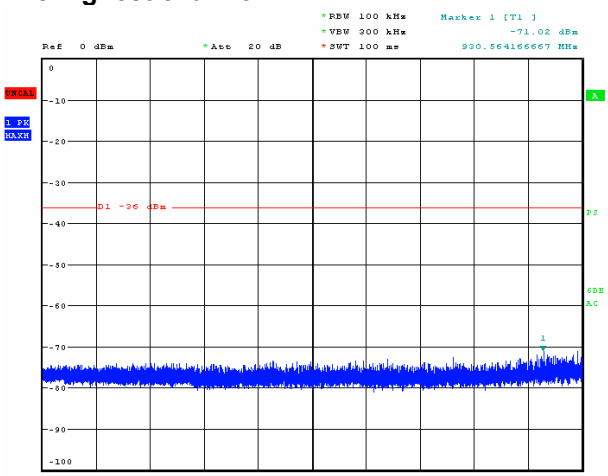


30M-1G

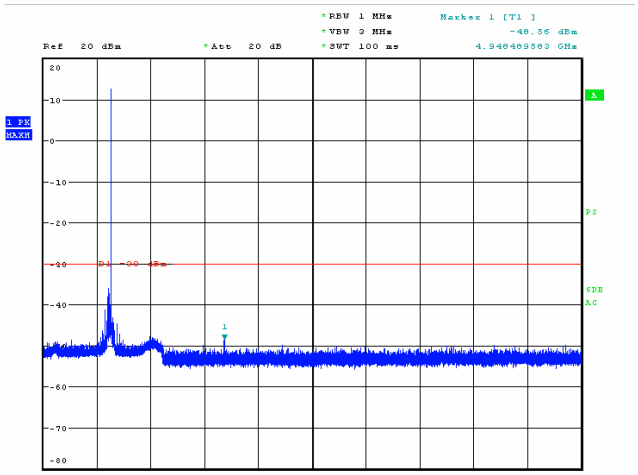


1G-12.75G

The highest channel



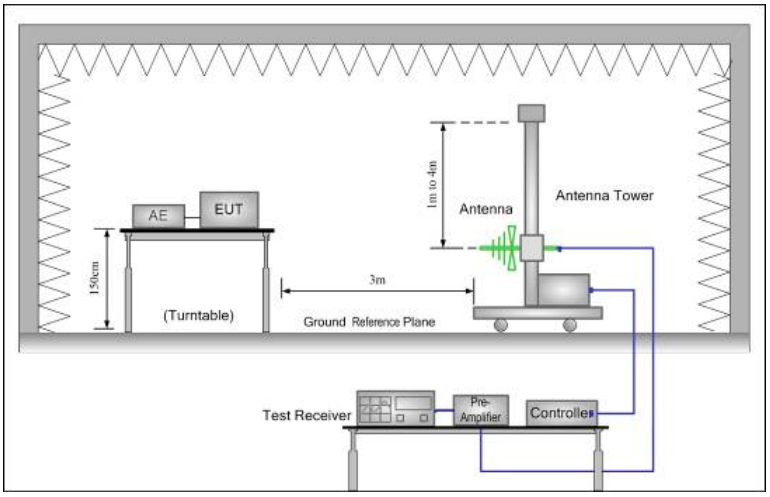
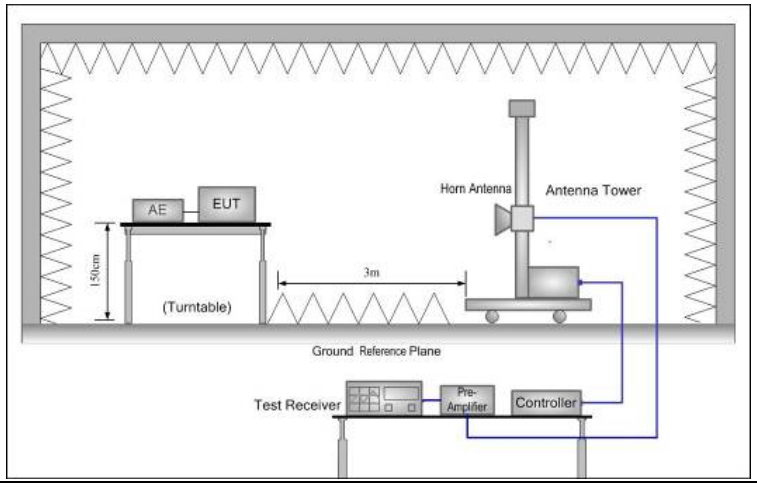
30M-1G



1G-12.75G

7.3 Receiver Requirement

7.3.1 Spurious Emissions

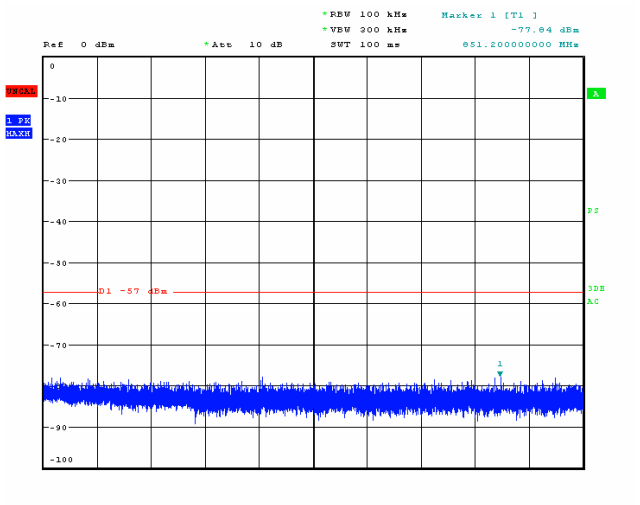
Test Requirement:	ETSI EN 300 328 clause 4.3.1.11
Test Method:	ETSI EN 300 328 clause 5.3.11.2
Limit:	Frequency / Limit(narrowband) / Limit(wideband) 30MHz to 1000 MHz / 2nW(-57dBm) / -107dBm/Hz 1GHz to 12.75GHz / 20nW(-47dBm) / -97dBm/Hz
Test Frequency range:	30MHz to 12.75GHz
Test setup:	Below 1GHz  Above 1GHz 

Test procedure:	The measurements were performed from 30 MHz to 12.75 GHz. The emissions over the range 30 MHz to 1 000 MHz shall be identified. Spectrum analyzer settings: Resolution bandwidth: 100 kHz Video bandwidth: 300 kHz Filter type: 3 dB (Gaussian) Detector mode: Peak Trace Mode: Max Hold Sweep Points: ≥ 19400 Sweep time: Auto The emissions over the range 1 GHz to 12.75 GHz shall be identified. Spectrum analyzer settings: Resolution bandwidth: 1 MHz Video bandwidth: 3 MHz Filter type: 3 dB (Gaussian) Detector mode: Peak Trace Mode: Max Hold Sweep Points: ≥ 23500 Sweep time: Auto The signal is maximized through rotation and placement in the three orthogonal axes. The EUT and its peripherals are placed on a turn table which is 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum spurious emission level. The EUT was positional such that the distance from antenna to the EUT was 1 meter for frequency above 1GHz and the distance from antenna to the EUT was 3 meters for frequency up to 1 GHz. The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level. Both horizontal and vertical polarizations of the antenna are set on measurement.
Measurement Record:	Uncertainty: ± 6dB
Test mode:	Kept Rx in receiving mode
Test Instruments:	See section 6.0

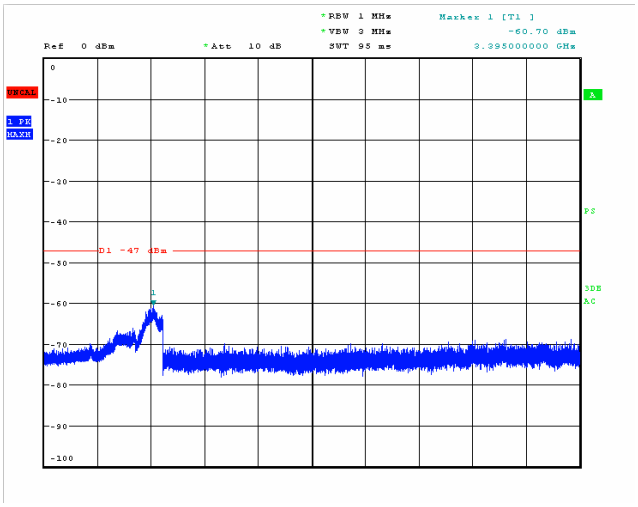
Measurement Data:

The lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
52.98	Vertical	-67.08	2nW/ -57dBm below 1GHz, 20nW/ -47dBm above 1GHz.	Pass
695.64	V	-66.23		
4818.00	V	-60.23		
7227.00	V	-59.17		
9636.00	V	-57.28		
12045.00	V	-57.54		
35.29	Horizontal	-68.66		
785.61	H	-67.08		
4818.00	H	-60.19		
7227.00	H	-63.58		
9636.00	H	-57.37		
12045.00	H	-59.64		
The highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
55.8	Vertical	-67.01	2nW/ -57dBm below 1GHz, 20nW/ -47dBm above 1GHz.	Pass
813.46	V	-68.26		
4948.00	V	-59.52		
7422.00	V	-62.07		
9896.00	V	-56.93		
12370.00	V	-61.02		
40.75	Horizontal	-66.52		
623.84	H	-67.37		
4948.00	H	-59.35		
7422.00	H	-62.22		
9896.00	H	-58.43		
12370.00	H	-60.08		

The lowest channel

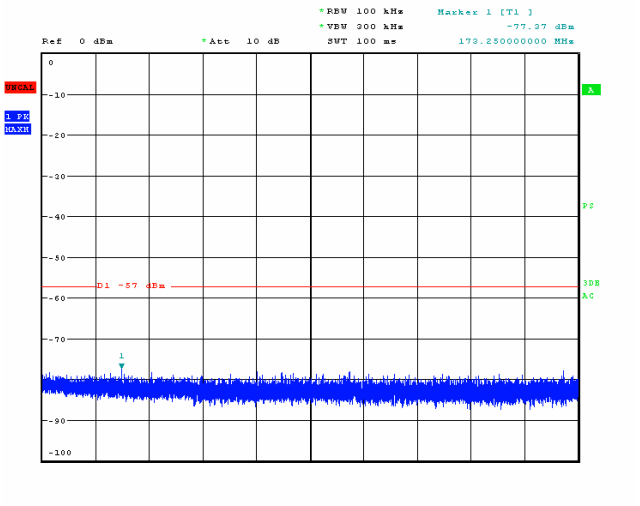


30M-1G

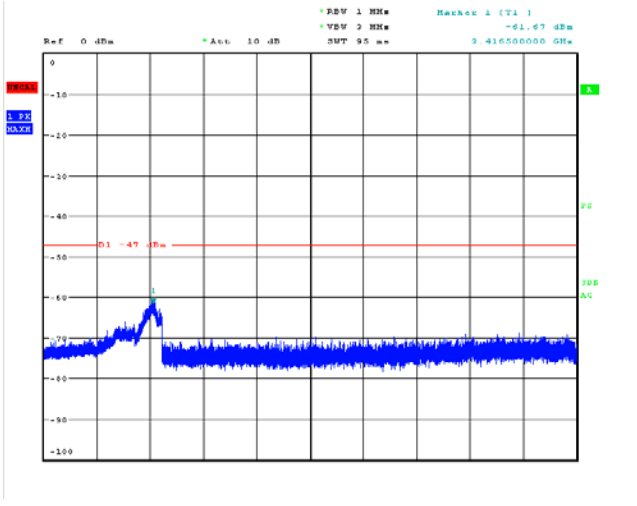


1G-12.75G

The highest channel



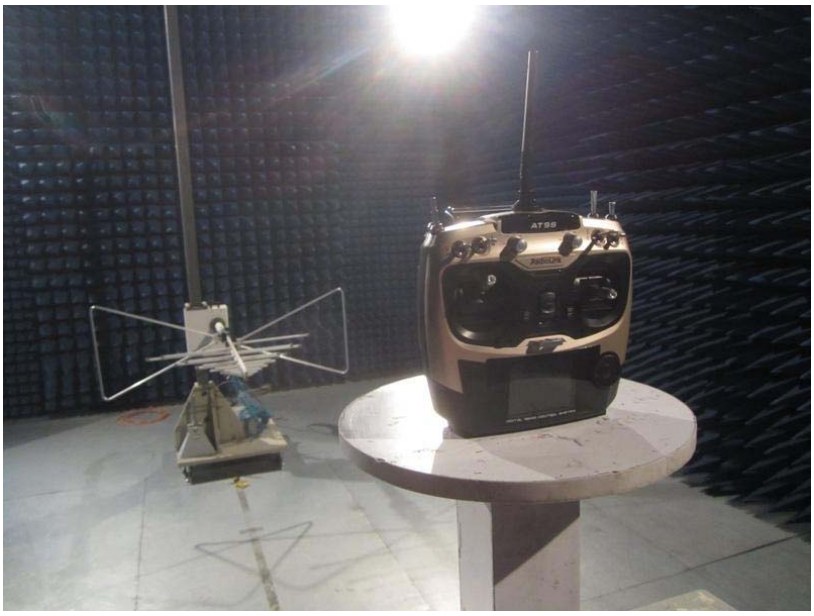
30M-1G



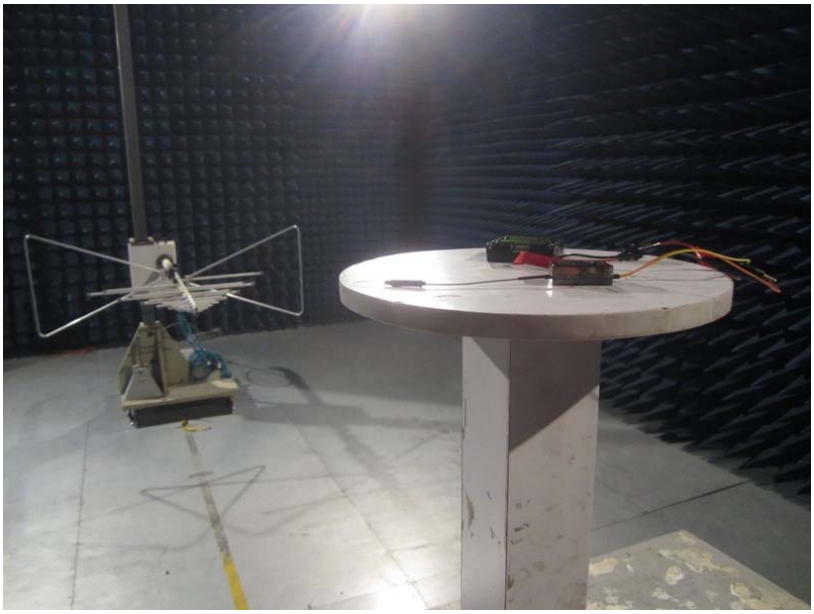
1G-12.75G

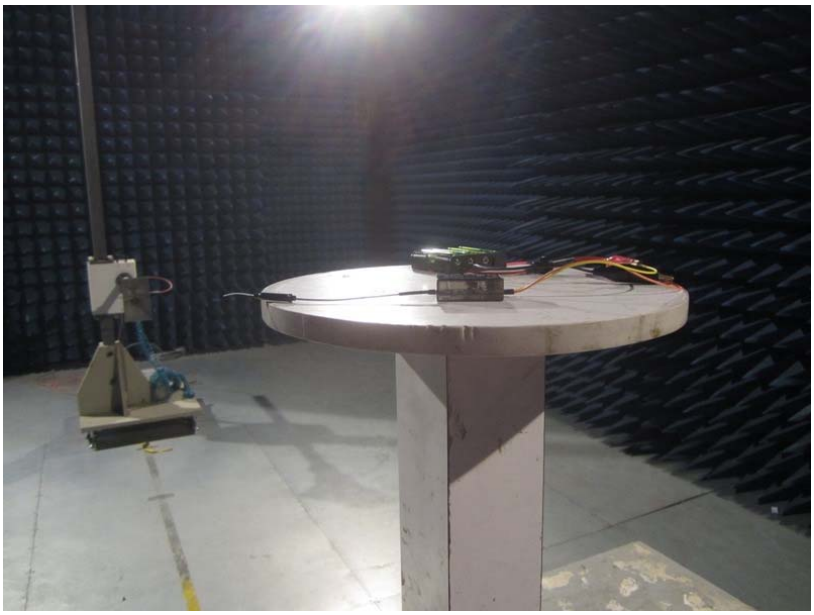
8 Test setup photo

TX:



Rx





9 EUT Constructional Details

Reference to the test report No. : GTS201608000108E01

ANNEX E

E.1 Information as required by EN 300 328 V1.9.1, clause 5.3.1

In accordance with EN 300 328, clause 5.3.1, the following information is provided by the supplier.

a) The type of modulation used by the equipment:

☒FHSS

☒Other forms of modulation

b) In case of FHSS modulation:

In case of non-Adaptive Frequency Hopping equipment:

The number of Hopping Frequencies: 16

In case of Adaptive Frequency Hopping Equipment: _____

The maximum number of Hopping Frequencies: _____

The minimum number of Hopping Frequencies: _____

The(Average) Dwell Time: _____

c) Adaptive / non-adaptive equipment:

☒Non-adaptive Equipment

☐Adaptive Equipment without the possibility to switch to a non-adaptive mode

☐Adaptive Equipment which can also operate in a non-adaptive mode

d) In case of adaptive equipment:

The maximum Channel Occupancy Time implemented by the equipment: _____ ms

In case of equipment using modulation different from FHSS:

☐The equipment is Frame Based equipment

☐The equipment is Load Based equipment

☐The equipment can switch dynamically between Frame Based and Load Based equipment

The CCA time implemented by the equipment: _____ µs

☐The equipment has implemented an non-LBT based DAA mechanism

☐The equipment can operate in more than one adaptive mode

e) In case of non-adaptive Equipment:

The maximum RF Output Power (e.i.r.p.): 15.14dBm dBm

The maximum (corresponding) Duty Cycle: 15.99 %

Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared): _____

f) The worst case operational mode for each of the following tests:

RF Output Power: _____

Power Spectral Density: _____

Duty cycle, Tx-Sequence, Tx-gap: N/A

Accumulated Transmit time, Frequency Occupation & Hopping Sequence (only for FHSS equipment) : N/A

Hopping Frequency Separation (only for FHSS equipment) : N/A

Medium Utilisation: N/A

Adaptivity & Receiver Blocking: _____

Nominal Channel Bandwidth: _____

Transmitter unwanted emissions in the OOB domain: _____

Transmitter unwanted emissions in the spurious domain: _____

Receiver spurious emissions: _____

g) The different transmit operating modes (tick all that apply):

☒Operating mode 1: Single Antenna Equipment

☒Equipment with only one antenna

☐Equipment with two diversity antennas but only one antenna active at any moment in time

☐Smart Antenna Systems with two or more antennas, but operating in a (legacy) mode where only one antenna is used. (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems)

☐Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming

☐Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode)

☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1

☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2

NOTE: Add more lines if more channel bandwidths are supported.

☐Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming

☐Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode)

☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1

☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2

NOTE: Add more lines if more channel bandwidths are supported.

h) In case of Smart Antenna Systems:

The number of Receive chains: _____

The number of Transmit chains: _____

☐Symmetrical power distribution

☐Asymmetrical power distribution

In case of beam forming, the maximum (additional)beam forming gain: _____

NOTE: The addirinal beam forming gain does not include the basic gain of a single antenna.

i) Operating Frequency Range(s) of the equipment:

Operating Frequency Range 1: 2409 MHz to 2474 MHz

Operating Frequency Range 2: _____ MHz to _____ MHz

NOTE: Add more lines if more Frequency Ranges are supported.

j) Occupied Channel Bandwidth(s):

Occupied Channel Bandwidth 1: 2.5005 MHz

Occupied Channel Bandwidth 2: _____ MHz

NOTE: Add more lines if more channel bandwidths are supported.

k) Type of Equipment (stand-alone, combined, plug-in radio device, etc.):

☒Stand-alone

☐Combined Equipment (Equipment where the radio part is fully integrated within another type of

equipment)

☐Plug-in radio device (Equipment intended for a variety of host systems)

☐Other _____

l) The extreme operating conditions that apply to the equipment:

Operating temperature range: -20 ° C to 55 ° C

Details provided are for the: ☒stand-alone equipment

☐Combined (or host) equipment

☐Test jig

m) The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels:

Antenna Type:

☒Integral Antenna

Antenna Gain: 2 dBi

If applicable, additional beamforming gain (excluding basic antenna gain): _____ dB

☐Temporary RF connector provided

☐No temporary RF connector provided

☐Dedicated Antennas (equipment with antenna connector)

☐Single power level with corresponding antenna(s)

☐Multiple power settings and corresponding antenna(s)

Number of different Power Levels:

Power Level 1:		dBm
Power Level 2:		dBm
Power Level 3:		dBm

NOTE 1: Add more lines in case the equipment has more power levels.

NOTE 2: These power levels are conducted power levels (at antenna connector).

For each of the Power Levels, provide the intended antenna assemblies, their corresponding gains (G) and the resulting e.i.r.p. levels also taking into account the beamforming gain (Y) if applicable

_____ dBm

Number of antenna assemblies provided for this power level: _____

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

_____ dBm

Number of antenna assemblies provided for this power level: _____

Assembly	Gain	e.i.r.p.	Part number or

#	(dBi)	(dBm)	model name
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

_____ dBm

Number of antenna assemblies provided for this power level: _____

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

n) The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:

Details provided are for the: ☒stand-alone equipment
☐combined (or host) equipment
☐test jig

Supply Voltage ☐AC mains State AC voltage _____ V
☒DC State DC voltage 12V for TX, 6V for RX V

In case of DC, indicate the type of power source
☐Internal Power Supply
☐External Power Supply or AC/DC adapter
☒Battery
☐Other: _____

o) Describe the test modes available which can facilitate testing:

AT9, AT9S

p) The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.):

proprietary

q) If applicable, the statistical analysis referred to in clause 5.3.1 q)

(to be provided as separate attachment)

r) If applicable, the statistical analysis referred to in clause 5.3.1 r)

(to be provided as separate attachment)

s) Geo-location capability supported by the equipment:

☐Yes

☐The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user

☐No

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