

RF Test Report

MIC Rule(s): Item 19 of Article 2 Paragraph 1

Applicant: Angry Miao Technology Co., Limited

Product Name: CYBERBOARD

Model: CB02

Report No.: ZKS210500170-1

Tested Date: 2021-05-28

Issued Date: 2021-06-01

Tested By : Lieber Ouyang (Engineer)

Approved By: Lahm Peng (Manager)

Prepared By:



Lieber Ouyang
Lahm Peng

Shenzhen ZRLK Testing Technology Co., Ltd.

Room 607, Floor 6, Building 2A, Chuangwei Innovation Valley, Tangtou
No.1 Road, Shiyan Street, Baoan District, Shenzhen, Guangdong, China

Tel.: +86-755-33019599 Fax.: +86-755-33019599 Website: www.zrklab.com

Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen ZRLK Testing Technology Co., Ltd.

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1. General Information

1.1 Product Information

Applicant and Manufacturer	
Applicant:	Angry Miao Technology Co., Limited
Address of Applicant:	2/F, No.5 of Nanteng Street, Qi'ao Industrial Zone, Tangjiawan Town (National Hi-Tech Industrial Development Zone), Xiangzhou District, Zhuhai, China.
Manufacturer:	Angry Miao Technology Co., Limited
Address of Manufacturer:	2/F, No.5 of Nanteng Street, Qi'ao Industrial Zone, Tangjiawan Town (National Hi-Tech Industrial Development Zone), Xiangzhou District, Zhuhai, China.

General Description of EUT	
Product Name:	CYBERBOARD
Model No.:	CB02
Trade Name:	Angry Miao
Adding Model(s):	--
Rated Voltage:	Input: DC 5V/2A, Output: DC 3.7V by Battery
Frequency Range:	2402~2480MHz
Modulation:	GFSK
Quantity of Channels	40CH
Channel Separation:	2MHz
Type of Antenna:	FPCB Antenna
Antenna Gain:	-0.23dBi
Hardware Version:	CB02_MainBoard_P4
Software Version:	AM_CB020.N40.r1.01.20
Note 1: The test data is gathered from a production sample, provided by the manufacturer.	

Center Frequency of Each of Channel (BLE):

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 01:	2402MHz	Channel 11:	2422MHz	Channel 21:	2442MHz	Channel 31:	2462MHz
Channel 02:	2404MHz	Channel 12:	2424MHz	Channel 22:	2444MHz	Channel 32:	2464MHz
Channel 03:	2406MHz	Channel 13:	2426MHz	Channel 23:	2446MHz	Channel 33:	2466MHz
Channel 04:	2408MHz	Channel 14:	2428MHz	Channel 24:	2448MHz	Channel 34:	2468MHz
Channel 05:	2410MHz	Channel 15:	2430MHz	Channel 25:	2450MHz	Channel 35:	2470MHz
Channel 06:	2412MHz	Channel 16:	2432MHz	Channel 26:	2452MHz	Channel 36:	2472MHz
Channel 07:	2414MHz	Channel 17:	2434MHz	Channel 27:	2454MHz	Channel 37:	2474MHz
Channel 08:	2416MHz	Channel 18:	2436MHz	Channel 28:	2456MHz	Channel 38:	2476MHz
Channel 09:	2418MHz	Channel 19:	2438MHz	Channel 29:	2458MHz	Channel 39:	2478MHz
Channel 10:	2420MHz	Channel 20:	2440MHz	Channel 30:	2460MHz	Channel 40:	2480MHz

1.2 Compliance Standards

Compliance Standards or Rules
Certification Ordinance, Art. 49.20, and MIC public notice 88:2004, annex 43
Item 19 of Article 2 Paragraph 1 of the MIC rules for 2.4GHz band wide-band low-power data communication system
ARIB STD-T66(V3.7)
The objective of the manufacturer or applicant is to demonstrate compliance with the above rules or standards.
According to standards for test methodology
MIC public notice 88:2004, annex 43
All measurements contained in this report were conducted with all above rules
Maintenance of compliance is the responsibility of the manufacturer or applicant. Any modification of the product, which result is lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Facilities

Testing Lab: Shenzhen ZRLK Testing Technology Co., Ltd.
All measurement facilities used to collect the measurement data are located at Room 607, Floor 6, Building 2A, Chuangwei Innovation Valley, Tangtou No.1 Road, Shiyan Street, Baoan District, Shenzhen, Guangdong, China

1.4 Test Setup Information

List of Test Modes			
Test Mode	Description	Remark	
TM1	Low/Middle/High	2402/2442/2480MHz	
List and Details of Auxiliary Equipment			
Description	Manufacturer	Model	Serial Number
--	--	--	--
The equipment under test (EUT) was configured to measure its highest possible emission and immunity level. The test modes were adapted according to the operation manual for use.			

1.5 Test Conditions

DC Input by Battery

Supply Voltage			
	DC Input Voltage V	DC Voltage V	Percent
Normal	3.7	3.3	
+10%	4.07	3.3	0%
-10%	3.33	3.3	0%

Note 1: When the input voltage is reduced or increased by 10%, the regulator voltage changes of less than 1%. So the following test items are conducted in the normal voltage.

Note 2: The regulator voltage is integral within IC U6(TPS22919DCKR).

Test Environment			
Temperature	21℃	Humidity	53%

1.6 Measurement Uncertainty

Parameter	Conditions	Uncertainty
RF Output Power	9kHz-6GHz	$\pm 0.56\text{dB}$
Frequency Tolerance	9kHz-6GHz	$\pm 1 \times 10^{-7}$
Occupied Bandwidth	9kHz-6GHz	$\pm 2.1\%$
Dwell Time	9kHz-6GHz	$\pm 1.0\%$
Transmitter Spurious Emissions	9kHz-25GHz	$\pm 0.70\text{dB}$
Receiver Spurious Emissions	9kHz-25GHz	$\pm 0.70\text{dB}$

1.7 List of Test and Measurement Instruments

Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Spectrum Analyzer	Agilent	E4407B	US40521006	2020-07-10	2021-07-09
Attenuator	SHX	DTS10-10dB-6G	16081801	2020-07-10	2021-07-09

All test equipments were calibrated by CTI METROLOGY TECHNOLOGY CO., LTD.

2. Summary of Test Results

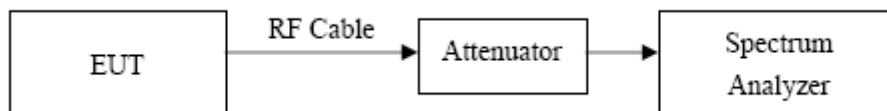
MIC Rules	Description of Test Items	Result
Item 19	RF Output Power	Passed
	Frequency Tolerance	Passed
	Occupied Bandwidth	Passed
	Spread Bandwidth and Spread Factor	Passed
	Holding Time of Hopping Frequency	N/A
	Transmitter Spurious Emissions	Passed
	Receiver Spurious Emissions	Passed
	Interference Prevention Function	Passed
<p>Passed: The EUT complies with the essential requirements in the standard</p> <p>Failed: The EUT does not comply with the essential requirements in the standard</p> <p>N/A: Not applicable</p>		

3. RF Output Power

3.1 Standard and Limit

According to Item 19 of Article 2 Paragraph 1, the maximum permit antenna power is 3mW/MHz, for DSSS the maximum permit antenna power is 10mW, and the maximum permit tolerance is +20% or -80%.

3.2 Test Setup Block Diagram



3.3 Test Procedure

A spectrum analyzer or similar device shall be used to observe a sample of the modulated transmitter's radio frequency power output.

- (a) A sample detector function must be used.
- (b) A measurement instrument with an integrated 1MHz power bandwidth function may be used to automate the test process.
- (c) Connect the EUT to the RF input of the spectrum analyzer via a 50ohm attenuator.
- (d) Set the RBW = 1MHz, VBW = 3MHz, center of frequency = operating frequency, Sweep = Auto.
- (e) 'Maximum Hold' mode may be used to accumulate the measurement result over several scans provided emission is repetitive in nature.
- (f) Repeat above procedures until all frequency measured was complete.

3.4 Test Data and Results

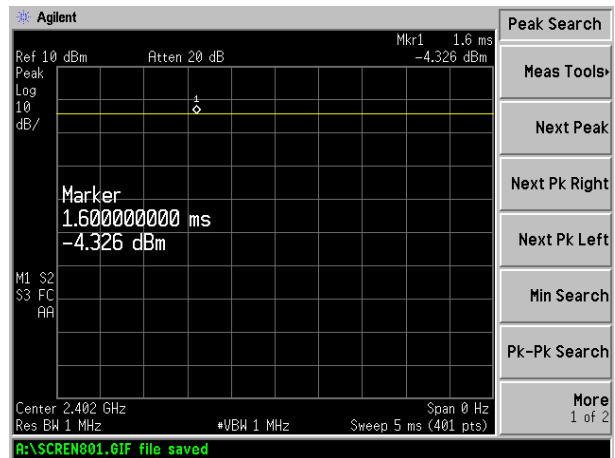
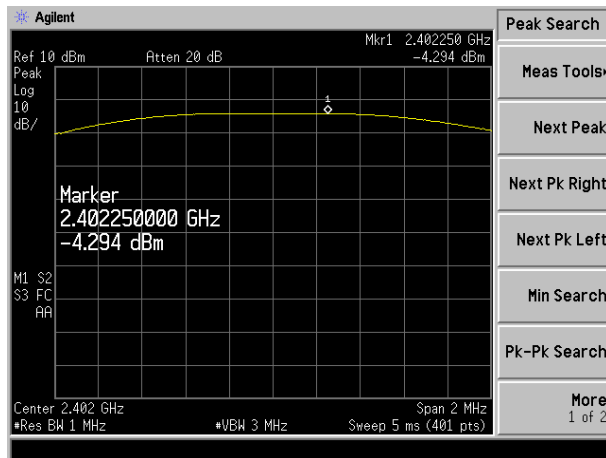
Frequency (MHz)	Measure Value (dBm)	Limit (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)
BLE_GFSK					
2402	-4.326	10	-0.23	-4.349	12.14
2442	-5.339	10	-0.23	-5.362	12.14
2480	-5.473	10	-0.23	-5.496	12.14

Frequency (MHz)	Output Power (mW)	Rated Output Power (mW)	Tolerance (%)	Limit (%)
BLE_GFSK				
2402	0.369	1	-63.10	+20% to -80%
2442	0.292	1	-70.80	+20% to -80%
2480	0.284	1	-71.60	+20% to -80%
Note: Tolerance = (Output Power – Rated Output Power) / Rated Output Power * 100%				

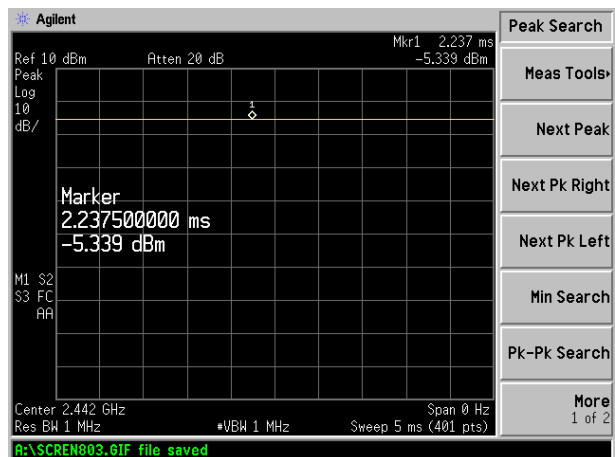
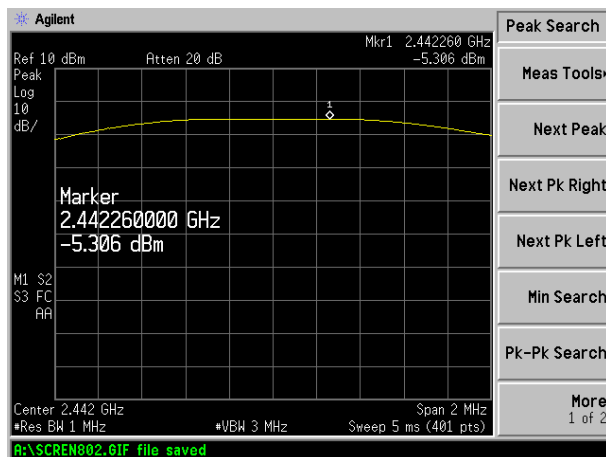
Please refer to the test plots

BLE_GFSK

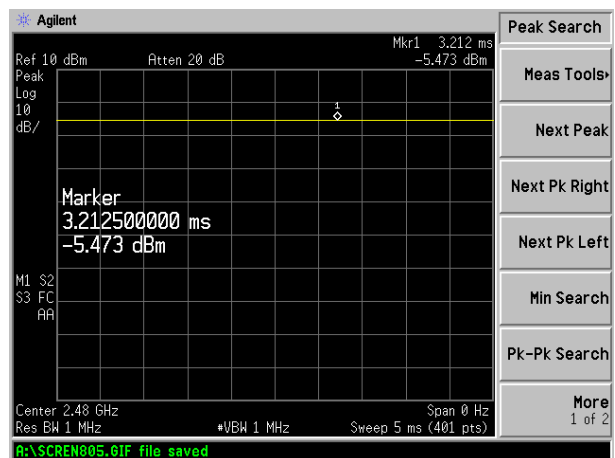
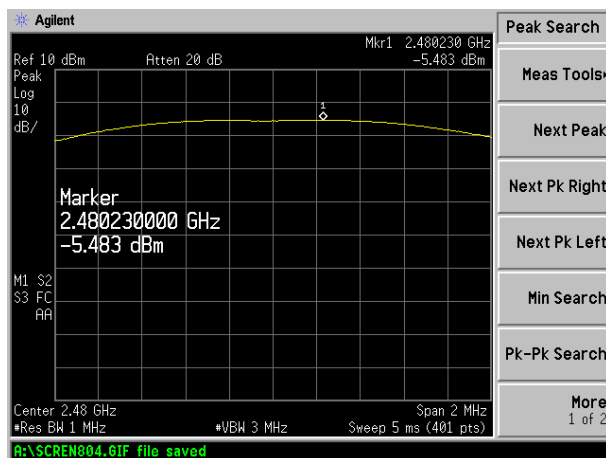
Low CH



Middle CH



High CH

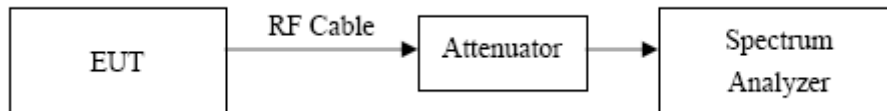


4. Frequency Tolerance

4.1 Standard and Limit

According to Item 19 of Article 2 Paragraph 1, the maximum permit tolerance of frequency is 50ppm.

4.2 Test Setup Block Diagram



4.3 Test Procedure

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set center frequency of spectrum analyzer = operating frequency.
3. Set the spectrum analyzer as RBW, VBW=10KHz, Span = 1MHz.
- 4 'Maximum Hold' mode may be used to accumulate the measurement result over several scans provided emission is repetitive in nature.
5. Repeat above procedures until all frequency measured was complete.

4.4 Test Data and Results

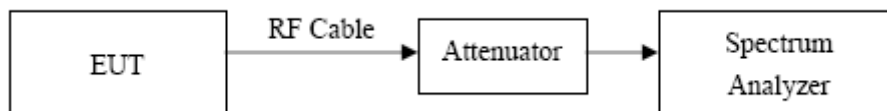
Power Supply	Test Frequency (MHz)	Reading Value (MHz)	Tolerance (ppm)	Limit (ppm)
DC 3.7V	2402	2402.0040	1.67	± 50
	2442	2442.0040	1.64	± 50
	2480	2480.0043	1.73	± 50

5. Occupied Bandwidth / Spread Bandwidth / Spread Factor

5.1 Standard and Limit

According to Item 19 of Article 2 Paragraph 1. The occupied bandwidth shall not exceed 26MHz, the spreading bandwidth no less than 500kHz, and the operating frequency range lies within the band 2400MHz to 2483.5 MHz.

5.2 Test Setup Block Diagram



5.3 Test Procedure

(1) Set up the spectrum analyzer as the follows:

Center frequency: Test frequency

Sweep bandwidth: 2 to 3.5 times of allowance

Resoluble bandwidth: less than 3% of allowance

Video bandwidth: Equivalent to resolvable bandwidth

Sweep time: Minimum time by which measuring accuracy is assured (In case of burst wave, 1 burst shall be contained per 1 sample)

Sampling points: More than 400 points

Sweep mode : Continuous sweeping

Detection mode: Positive peak

Display mode: Maximum holding

(2) Repeat the sweeping till no change was observed on the display and enter all values of data point to the computer as array variable.

(3) About all data, convert dB value to antilogarithm of electric power dimension.

(4) Add up the electric power of all data and record it as “Sum total of electric power”.

(5) Adding up data in order from the lowest frequency to upper frequencies, look for a limit point where the value reaches to 0.5% (5% in case of diffusion bandwidth) of “Sum total of electric power”. Convert the limit point to frequency and record as “Lowest limit frequency”.

(6) Adding up data in order from the highest frequency to lower frequencies, look for a limit point where the value reaches to 0.5% (5% in case of diffusion bandwidth) of “Sum total of electric power”. Convert the limit point to frequency and record as “Highest limit frequency”.

(7) Repeat above procedures until all frequency measured was complete.

5.4 Test Data and Results

Occupied Bandwidth (99% Emission Bandwidth)

Power Supply	Modulation	Test Frequency (MHz)	Reading Value	Limit
DC 3.7V	BLE_GFSK	2402	1.0953	<26MHz
		2442	1.0927	<26MHz
		2480	1.0932	<26MHz

Diffusion Bandwidth (90% Emission Bandwidth)

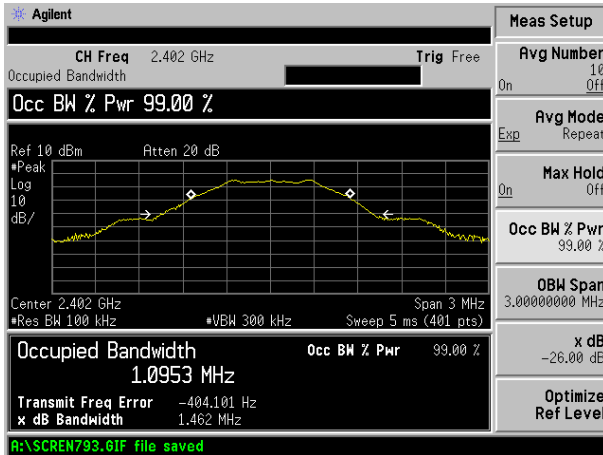
Power Supply	Modulation	Test Frequency (MHz)	Reading Value	Limit
DC 3.7V	BLE_GFSK	2402	719.5990	$\geq 500\text{kHz}$
		2442	723.1004	$\geq 500\text{kHz}$
		2480	725.4556	$\geq 500\text{kHz}$

Please refer to the following test plots

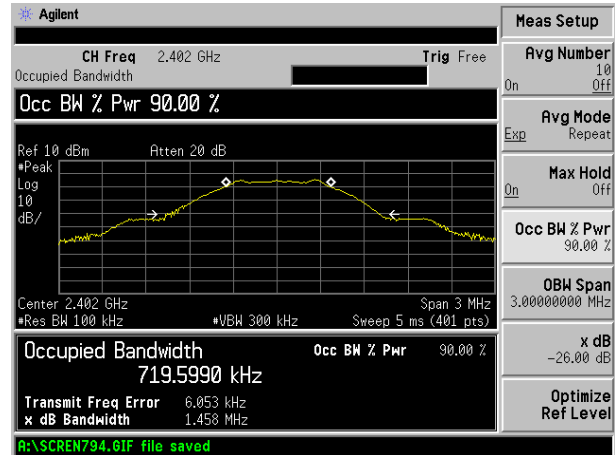
BLE_GFSK

Low CH

99% Occupied Bandwidth

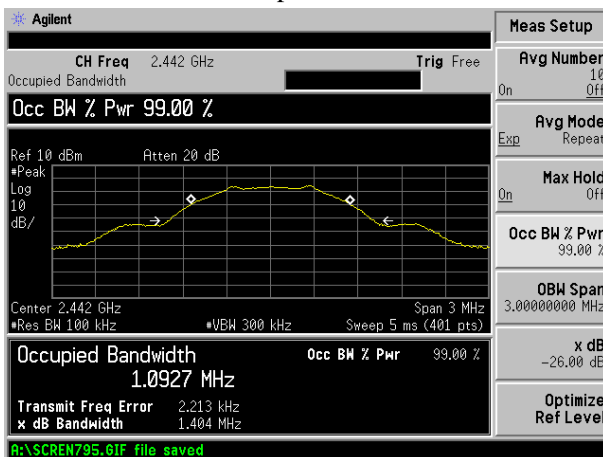


90% Diffusion Bandwidth

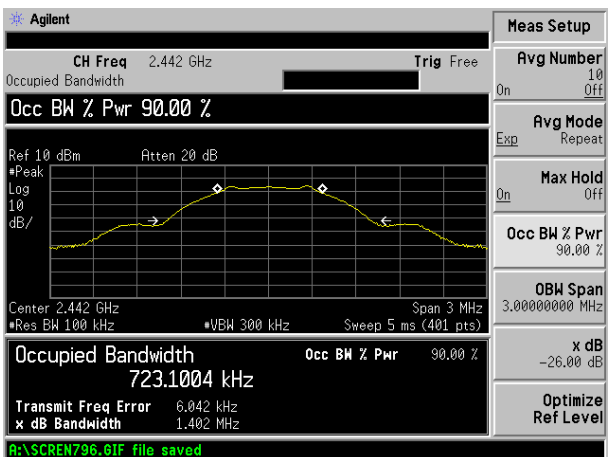


Middle CH

99% Occupied Bandwidth

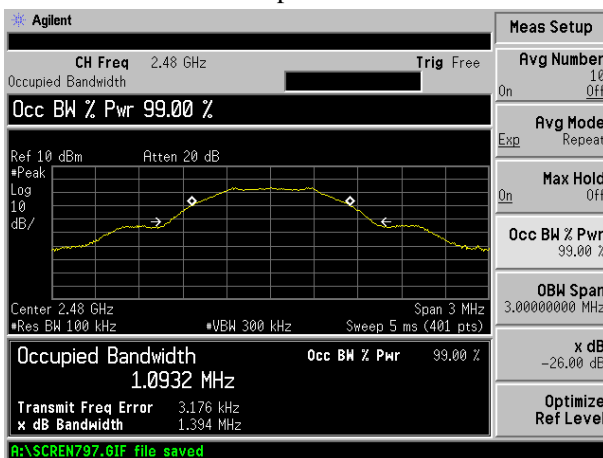


90% Diffusion Bandwidth

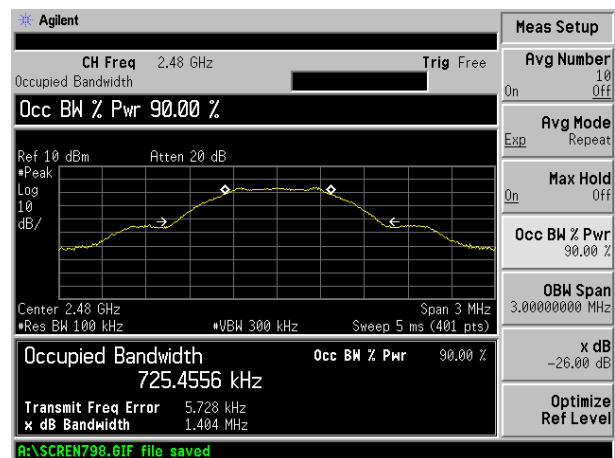


High CH

99% Occupied Bandwidth



90% Diffusion Bandwidth



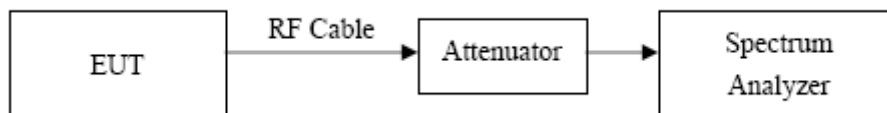
6. Transmitter Spurious Emissions

6.1 Standard and Limit

According to Item 19 of Article 2 Paragraph 1. The transmitter spurious emissions shall not exceed the following limit:

- (1) Below 2387MHz : 2.5 μ W/MHz
- (2) 2387 to 2400MHz : 25 μ W/MHz
- (3) 2483.5 through 2496.5MHz : 25 μ W/MHz
- (4) Over 2496.5MHz : 2.5 μ W/MHz

6.2 Test Setup Block Diagram



6.3 Test Procedure

- (1) A spectrumIn case of conducted measurements, the radio device shall be connected to the measuring equipment via a suitable attenuator.
- (2) The measurement equipment shall be set for peak hold mode of operation.
- (3) the transmitter shall be operated at the highest output power, or, in the case of equipment able to operate at more than one power level, at the lowest and highest output powers;
- (4) The resolution bandwidth shall be set to 100kHz from 10MHz to 1GHz, the resolution bandwidth shall be set to 1MHz above 1GHz , and the sweep time shall be set to auto mode, to ensure all major modulation products are captured.
- (5) When the searched result is less than the specified limit, the maximum one shall be recorded, when the result is more than the specified limit, all measured values shall be recorded.
- (5) This measurement shall be repeated with the transmitter in standby mode where applicable.
- (6) Repeat above procedures until all frequency measured was complete.

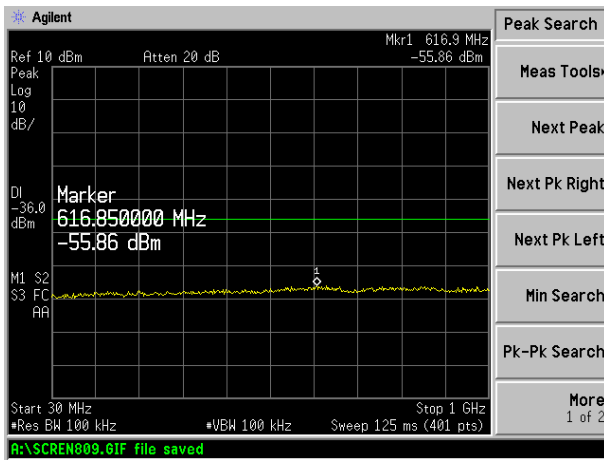
6.4 Test Data and Results

Frequency Range (MHz)	Maximum Spurious Emission Value (dBm)	Limit (dBm)
Low Channel (2402MHz)		
30-1000	-55.86	-36
1000-2387	-48.57	-26 (2.5uW)
2387-2400	-26.19	-16 (25uW)
2483.5-2496.5	-48.74	-16 (25uW)
2496.5-12750	-46.69	-26 (2.5uW)
Middle Channel (2442MHz)		
30-1000	-56.16	-36
1000-2387	-48.57	-26 (2.5uW)
2387-2400	-49.68	-16 (25uW)
2483.5-2496.5	-49.37	-16 (25uW)
2496.5-12750	-41.40	-26 (2.5uW)
High Channel (2480MHz)		
30-1000	-55.31	-36
1000-2387	-48.59	-26 (2.5uW)
2387-2400	-49.64	-16 (25uW)
2483.5-2496.5	-33.77	-16 (25uW)
2496.5-12750	-46.55	-26 (2.5uW)

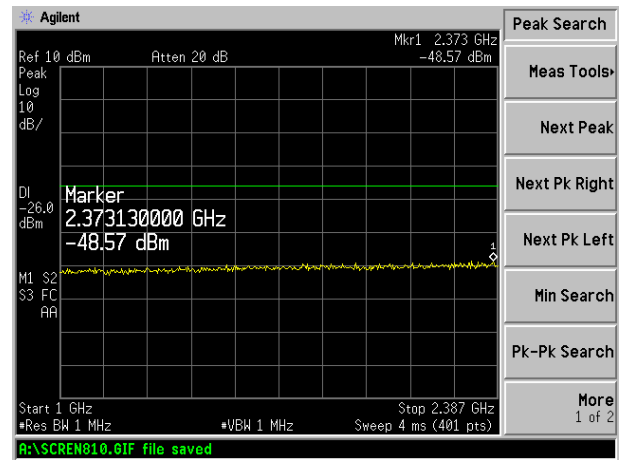
Please refer to the following test plots

Low Channel (2402MHz)

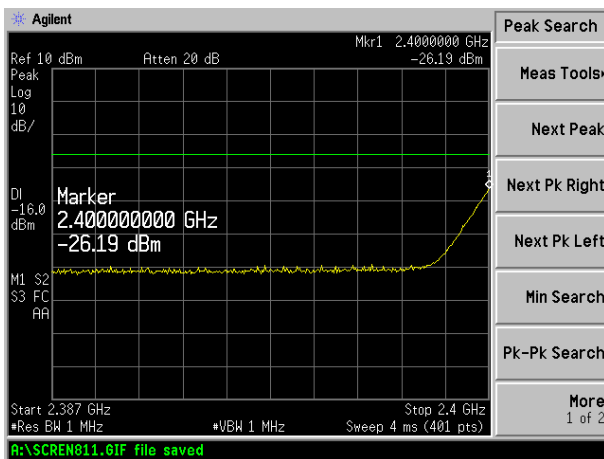
30MHz-1000MHz



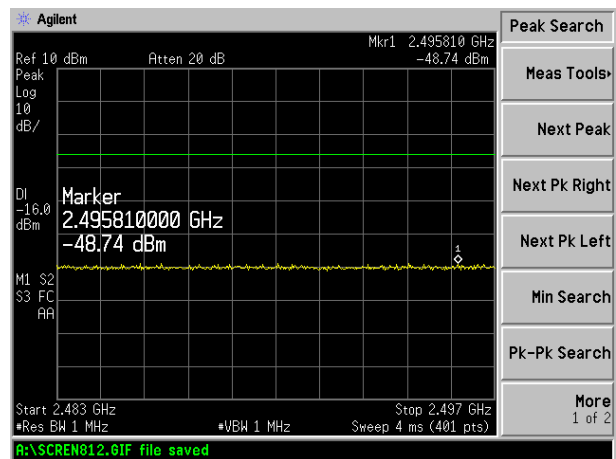
1000MHz-2387MHz



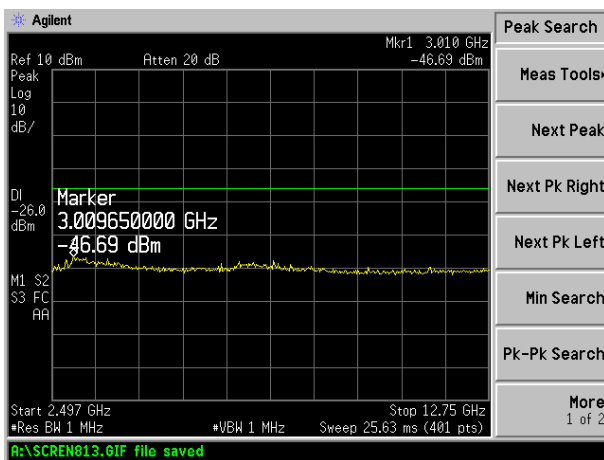
2387MHz-2400MHz



2483.5MHz-2496.5MHz

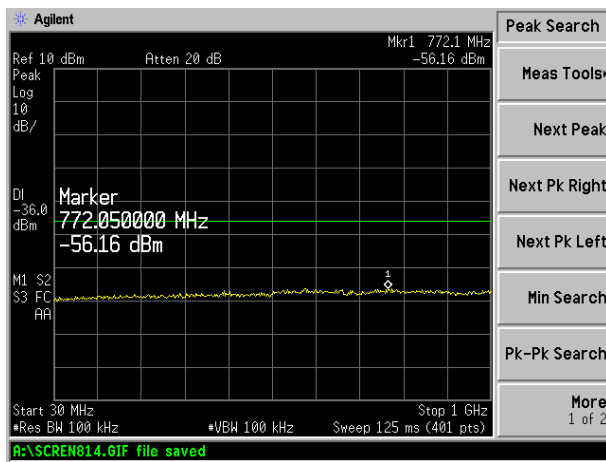


2496.5MHz-12750MHz

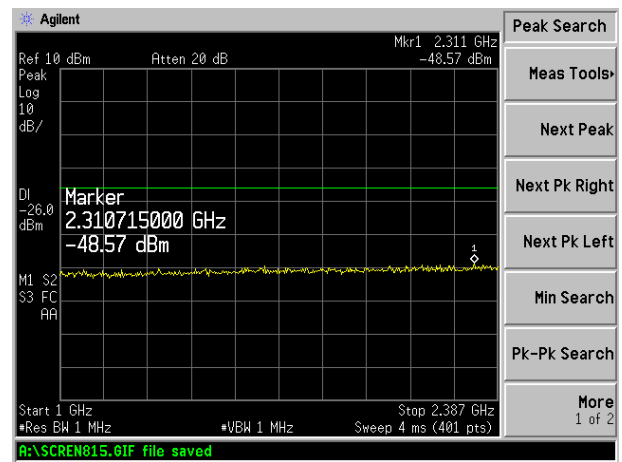


Middle Channel (2442MHz)

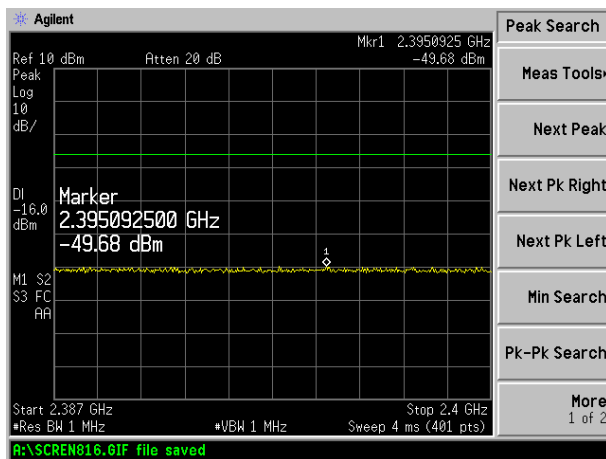
30MHz-1000MHz



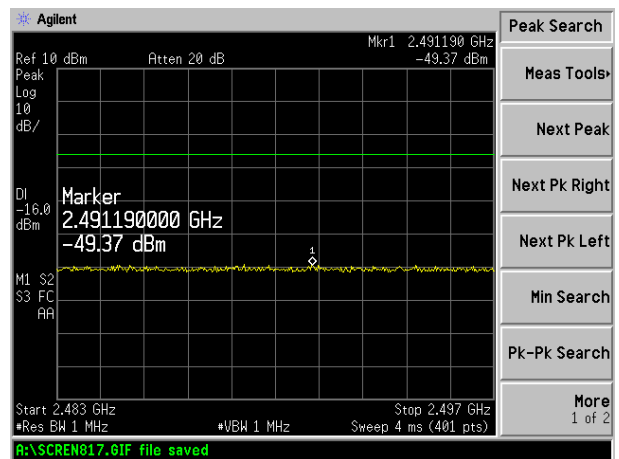
1000MHz-2387MHz



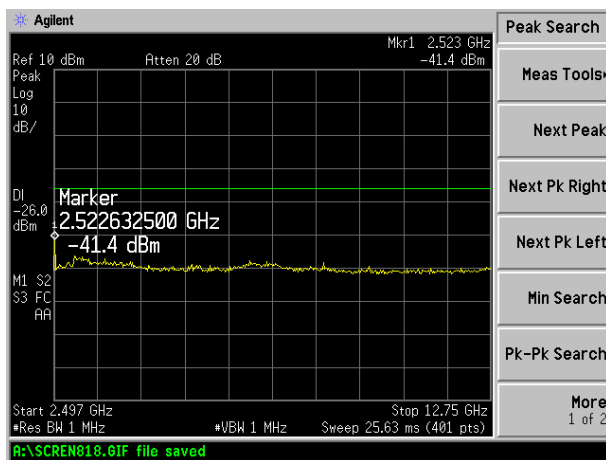
2387MHz-2400MHz



2483.5MHz-2496.5MHz

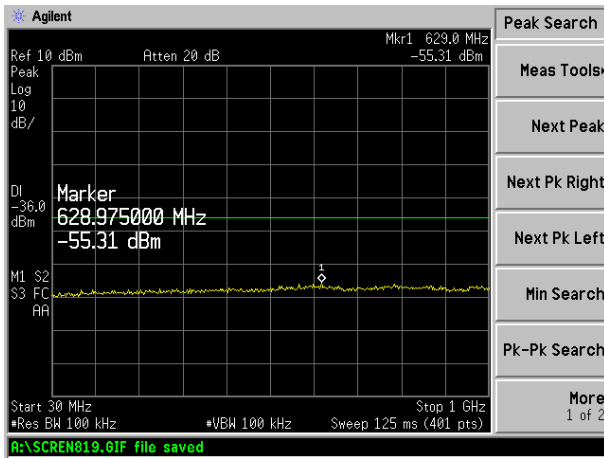


2496.5MHz-12750MHz

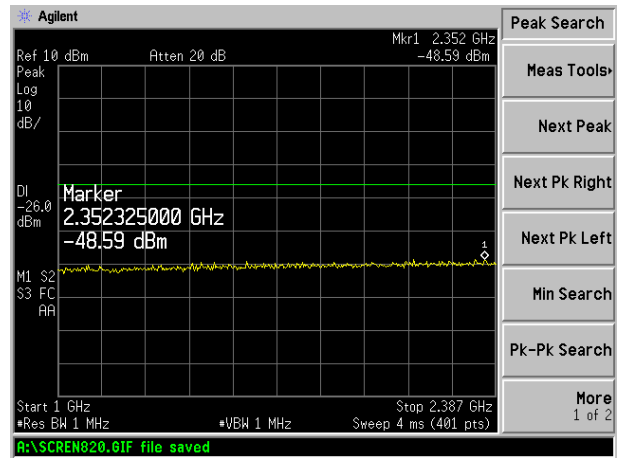


High Channel (2480MHz)

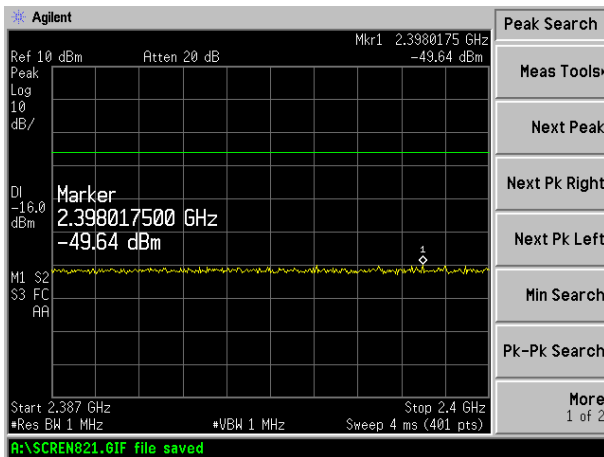
30MHz-1000MHz



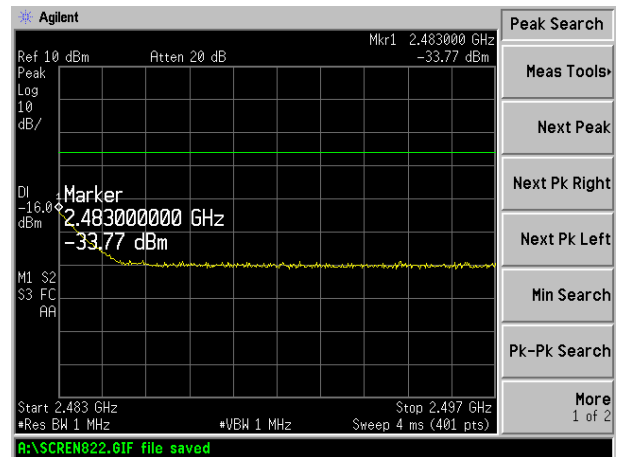
1000MHz-2387MHz



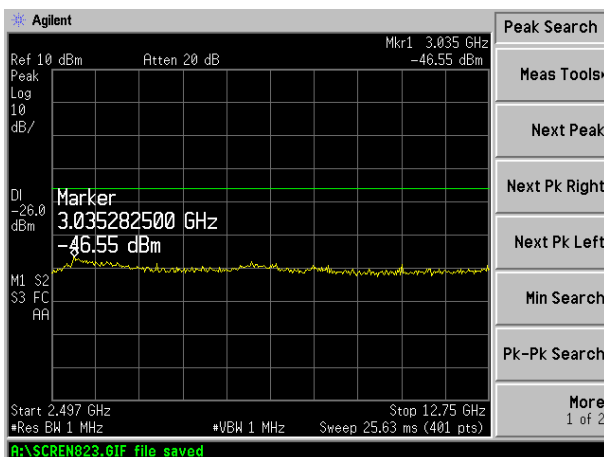
2387MHz-2400MHz



2483.5MHz-2496.5MHz



2496.5MHz-12750MHz



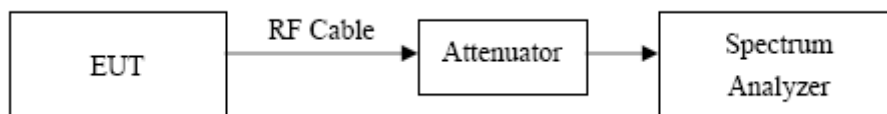
7. Receiver Spurious Emissions

7.1 Standard and Limit

According to Item 19 of Article 2 Paragraph 1. The receiver spurious emissions shall not exceeded the following limit:

- (1) Below 1GHz : 4nW
- (2) 1GHz or higher : 20nW

7.2 Test Setup Block Diagram



7.3 Test Procedure

- (1) A spectrumIn case of conducted measurements, the radio device shall be connected to the measuring equipment via a suitable attenuator.
- (2) The measurement equipment shall be set for peak hold mode of operation.
- (3) the transmitter shall be operated at the receiving mode.
- (4) The resolution bandwidth shall be set to 100kHz from 10MHz to 1GHz, the resolution bandwidth shall be set to 1MHz above 1GHz , and the sweep time shall be set to auto mode, to ensure all major modulation products are captured.
- (5) When the searched result is less than the specified limit, the maximum one shall be recorded, when the result is more than the specified limit, all measured values shall be recorded.
- (5) This measurement shall be repeated with the transmitter in standby mode where applicable.
- (6) Repeat above procedures until all frequency measured was complete.

7.4 Test Data and Results

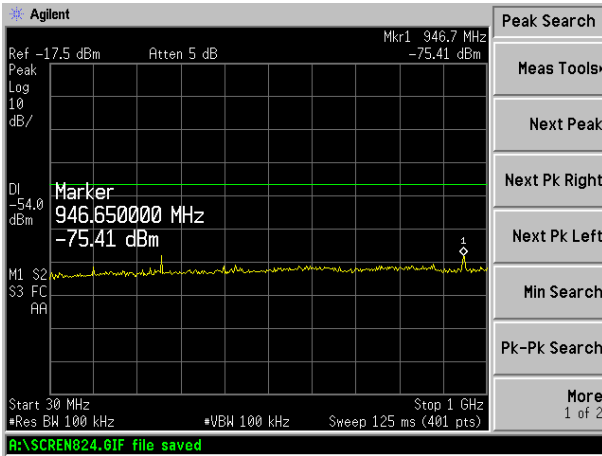
BLE_GFSK

Frequency Range (MHz)	Maximum Spurious Emission Value (dBm)	Limit (dBm)
Low Channel (2402MHz)		
30-1000	-75.41	-54 (4nW)
1000-12750	-57.24	-47 (20nW)
Middle Channel (2442MHz)		
30-1000	-74.61	-54 (4nW)
1000-12750	-62.13	-47 (20nW)
High Channel (2480MHz)		
30-1000	-75.71	-54 (4nW)
1000-12750	-63.04	-47 (20nW)

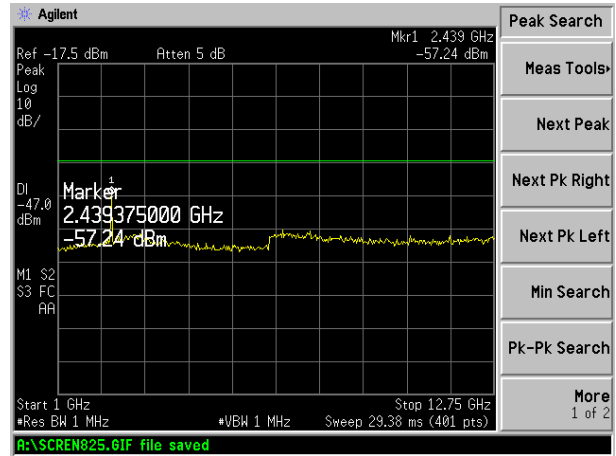
Please refer to the following test plots

Low Channel (2402MHz)

30MHz-1000MHz

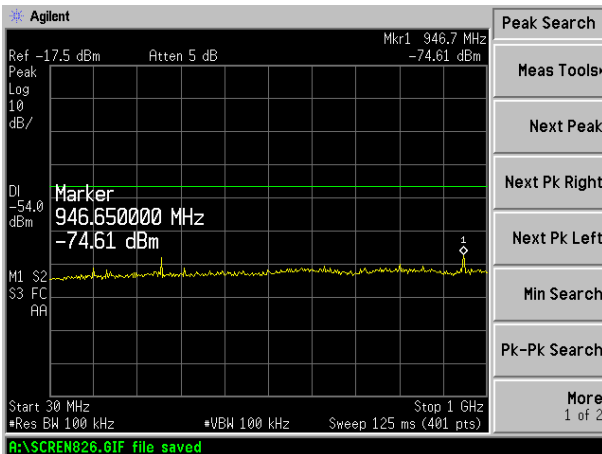


1GHz-12.75GHz

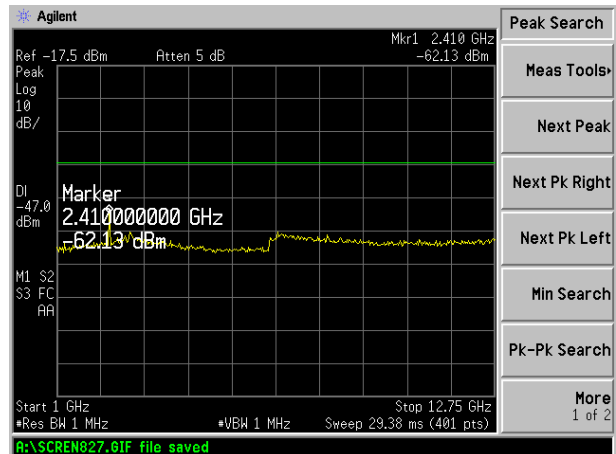


Middle Channel (2442MHz)

30MHz-1000MHz

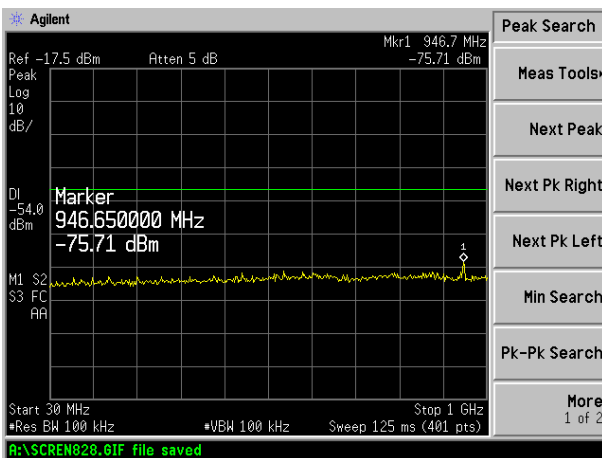


1GHz-12.75GHz

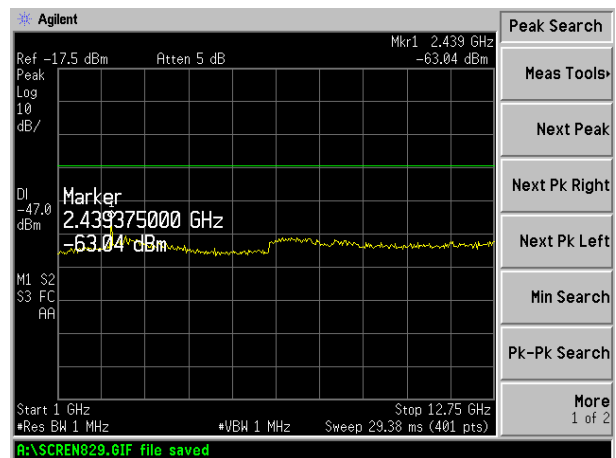


High Channel (2480MHz)

30MHz-1000MHz



1GHz-12.75GHz

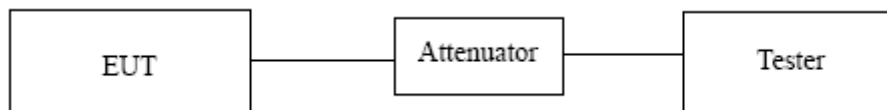


8. Interference Prevention Function

8.1 Standard and Limit

According to Item 19 of Article 2 Paragraph 1, the device shall have the function of automatic transmission or reception of identification code.

8.2 Test Setup Block Diagram



8.3 Test Procedure

1. Set the EUT in the usual operation condition.
2. The radio equipment with automatic transmitting function of identification code.
 - a. Transmit the assigned identification code from the radio equipment.
 - b. Confirm the identification code received by the demodulator.
3. The radio equipment with automatic receiving function of identification code.
 - a. Transmit the assigned identification code from the opposite equipment.
 - b. Confirm that the usual communication is available.
 - c. Transmit the identification code distinct from the assigned one from the opposite equipment.
 - d. Confirm that the radio equipment is stopped or an indication is displayed as the identification code is different.
4. The identification function shall be recorded.

8.4 Test Data and Results

Power Supply	Test Items	Test Result
DC 3.7V	Transmitting Function of Identification Code	>48 bits
	Receiving Function of Identification Code	>48 bits

MAC address: 00:00:00:00:3a:34

***** END OF REPORT *****