FCC Test Report

Report No: FCS202202052W01

Issued for

Applicant:	DongGuan DeRuiChen Electronics Co., Ltd.
Address:	No.1 Wuxing Road, Changping Town, Dongguan City
Product Name:	FM TRANSMITTER
Brand Name:	N/A
Model Name:	C87B
Series Model:	N/A
FCC ID:	2A4Z2-C87B

Issued By: Flux Compliance Service Laboratory
Add: Room 105 Floor Bao hao Technology Building 1 NO.15 Gong ye West Road
Hi-Tech Industrial, Song shan lake Dongguan
Tel: 769-27280901 Fax:769-27280901 http://www.FCS-lab.com

TEST RESULT CERTIFICATION

Applicant's Name..... :	DongGuan DeRuiChen Electronics Co., Ltd.
Address..... :	No.1 Wuxing Road, Changping Town, Dongguan City
Manufacture's Name..... :	DongGuan DeRuiChen Electronics Co., Ltd.
Address..... :	No.1 Wuxing Road, Changping Town, Dongguan City

Product Description

Product Name..... :	FM TRANSMITTER
Model Name..... :	C87B
Series Model.....:	N/A
Test Standards..... :	FCC Rules and Regulations Part 15 Subpart C, Section 247
Test Procedure..... :	ANSI C63.10:2013

This device described above has been tested by Flux Compliance Service Laboratory, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
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Date of Test.....:	
Date (s) of performance of tests. :	20 Feb. 2022~26 Feb. 2022
Date of Issue.....:	26 Feb. 2022
Test Result.....:	Pass

Tested by : Scott shen
(Scott Shen)

Reviewed by : Duke Qian
(Duke Qian)

Approved by : Jack Wang
(Jack Wang)

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Revision History

Rev.	Issue Date	Effect Page	Contents
00	26 Feb. 2022	N/A	N/A

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 15.247 Meas Guidance v05r02

FCC Part 15.247,Subpart C			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	N/A	--
15.247(a)(1)	Hopping Channel Separation	PASS	--
15.247 (b)(2)	Output Power	PASS	--
15.209	Radiated Spurious Emission	PASS	--
15.247(d)	Conducted Spurious & Band Edge Emission	PASS	--
15.247(a)(1)(i)	Number of Hopping Frequency	PASS	--
15.247(a)(1)(i)	Dwell Time	PASS	--
15.247(a)(1)	20dB Bandwidth 99% Bandwidth	PASS	--
15.205	Restricted bands of operation	PASS	--
Part 15.247(d)/part 15.209(a)	Band Edge Emission	PASS	
15.203	Antenna Requirement	PASS	

NOTE:

(1)" N/A" denotes test is not applicable in this Test Report

(2) All tests are according to ANSI C63.10-2013

1.1 TEST FACTORY

Company Name:	Flux Compliance Service Laboratory
Address:	Room 105 Floor Bao hao Technology Building 1 NO.15 Gong ye West Road Hi-Tech Industrial, Song shan lake Dongguan
Telephone:	+86-769-27280901
Fax:	+86-769-27280901
FCC Test Firm Registration Number: 514908 Designation number: CN0127 A2LA accreditation number：5545.01	

1.2 MEASUREMENT UNCERTAINTY

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

No.	Item	Uncertainty
1	RF output power, conducted	±0.71dB
2	Unwanted Emissions, conducted	±2.988 dB
3	Conducted Emission (9KHz-150KHz)	±4.13 dB
4	Conducted Emission (150KHz-30MHz)	±4.74 dB
5	All emissions,radiated(<1G) 30MHz-1000MHz	±5.2 dB
6	All emissions,radiated 1GHz -18GHz	±4.66 dB
7	All emissions,radiated 18GHz -40GHz	±4.31 dB

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	FM TRANSMITTER
Trade Name	N/A
Model Name	C87B
Series Model	N/A
Model Difference	N/A
Channel List	Please refer to the Note 2.
Operation frequency	2402MHz-2480MHz
Modulation:	GFSK
Transmitter rate:	1MHz
Power supply	DC 12V-24V
Hardware version number	V1.0
Software version number	V1.0
Connecting I/O Port(s)	Please refer to the User's Manual

Note:

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

2.

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402MHz	21	2422MHz	41	2442MHz	61	2462MHz
2	2403MHz	22	2423MHz	42	2443MHz	62	2463MHz
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
19	2420MHz	39	2440MHz	59	2460MHz	79	2480MHz
20	2421MHz	40	2441MHz	60	2461MHz		

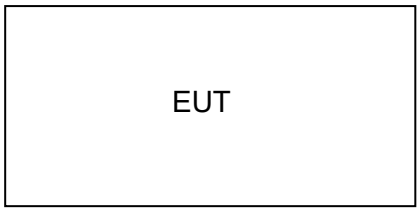
3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	NA	BHGC	PCB Antenna	N/A	1.0	Antenna

2.2 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Block diagram of EUT configuration for test



Test software: the FCC tool
The test softeware was used to control EUT work in continuous TX mode, and select test channel, Wireless mode as below table

No.	Test model descrption
1	Low channel GFSK
2	Middle channel GFSK
3	High channel GFSK
4	Hopping GFSK

Note:

1. All the test modes can be supply by battery, only the result of the worst case recorded in the report. GFSK mode is worst mode.
2. For radiated emission, 3 axis were chosen for testing for each applicable mode.
3. The EUT used fully charge battery when tested.
4. During the test, the dutycycle>98%, the test voltage was tuned from 85% to 115% of the Nominal rate supply votage, and found that the worst case was the nominal rated supply condition, So the report just shows that condition’s data

2.3 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

Item	Equipment	Mfr/Brand	Model/Type No.	Serial No.	Note

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Serial No.	Note

Note:

(1) The support equipment was authorized by Declaration of Confirmation.

(2) For detachable type I/O cable should be specified the length in cm in『Length』column.

(3) “YES” is means “shielded” “with core”; “NO” is means “unshielded” “without core”.

2.4 EQUIPMENTS LIST

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Company No.	Last calibration	Calibrated until
EMI Test Receiver	R&S	ESRP 3	FCS-E001	2022.02.10	2023.02.09
Signal Analyzer	R&S	FSV40-N	FCS-E012	2022.02.10	2023.02.09
Active loop Antenna	ZHINAN	ZN30900C	FCS-E013	2022.02.10	2023.02.09
Bilog Antenna	SCHWARZBECK	VULB 9168	FCS-E002	2022.02.10	2023.02.09
Horn Antenna	SCHWARZBECK	BBHA 9120D	FCS-E003	2022.02.10	2023.02.09
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	FCS-E018	2022.02.10	2023.02.09
Pre-Amplifier(0.1M-3GHz)	EMCI	EM330N	FCS-E004	2022.02.10	2023.02.09
Pre-Amplifier (1G-18GHz)	N/A	TSAMP-0518SE	FCS-E014	2022.02.10	2023.02.09
Pre-Amplifier (18G-40GHz)	TERA-MW	TRLA-0400	FCS-E019	2022.02.10	2023.02.09
Temperature & Humidity	HTC-1	victor	FCS-E005	2022.02.10	2023.02.09
Testing Software	EZ-EMC(Ver.STSLAB 03A1 RE)				

Conduction Test equipment

Kind of Equipment	Manufacturer	Type No.	Company No.	Last calibration	Calibrated until
EMI Test Receiver	R&S	ESPI	FCS-E020	2022.02.10	2023.02.09
LISN	R&S	ENV216	FCS-E007	2022.02.10	2023.02.09
LISN	ETS	3810/2NM	FCS-E009	2022.02.10	2023.02.09
Temperature & Humidity	HTC-1	victor	FCS-E008	2022.02.10	2023.02.09
Testing Software	EZ-EMC(Ver.EMC-CON 3A1.1)				

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Company No.	Last calibration	Calibrated until
MXA SIGNAL Analyzer	Keysight	N9020A	FCS-E015	2022.02.10	2023.02.09
Spectrum Analyzer	Agilent	E4447A	MY50180039	2022.02.10	2023.02.09
Spectrum Analyzer	R&S	FSV-40	101499	2022.02.10	2023.02.09
Power Sensor	Agilent	UX2021XA	FCS-E021	2022.02.10	2023.02.09
Testing Software	EZ-EMC(Ver.STSLAB 03A1 RE)				

3. 20DB BANDWIDTH

3.1 Limit

FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
15.247a(1)	20dB bandwidth	N/A	2400-2483.5

3.2 Test Procedure

(1) Connect EUT's antenna output to spectrum analyzer by RF cable.

(2) Set the spectrum analyzer as follows

RBW: 30kHz

VBW: 100kHz

Detector Mode: AVG

Sweep time: auto

Trace mode Max hold

(3) Allow the trace to stabilize, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

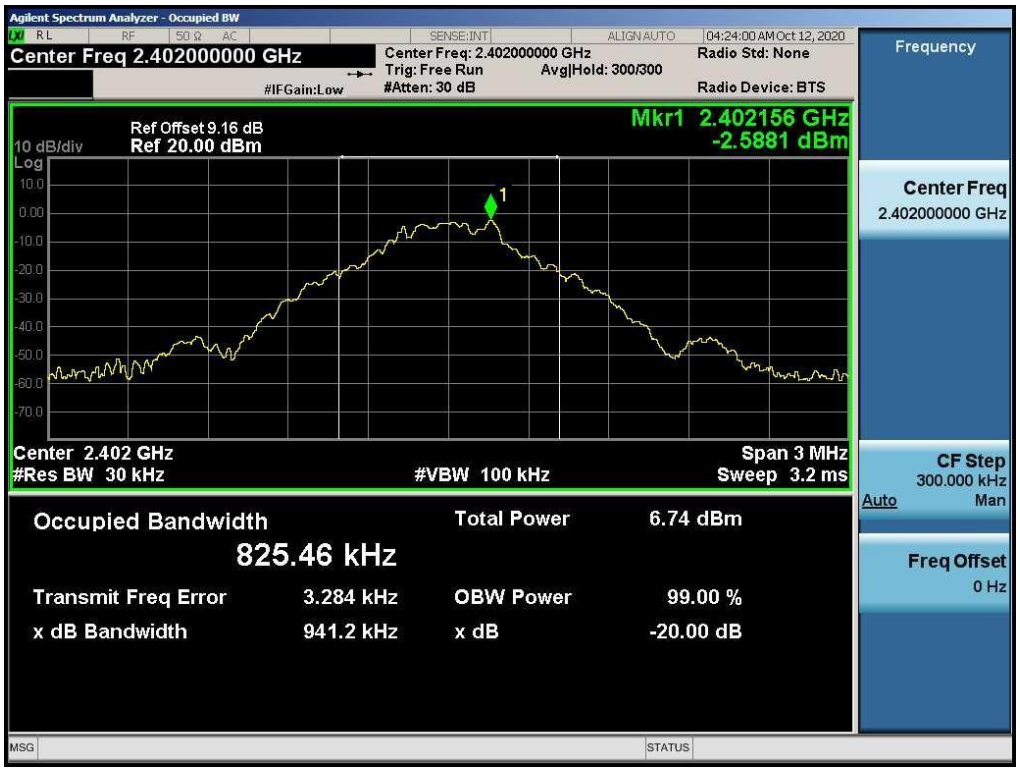
3.3 Test setup

3.4 Test results

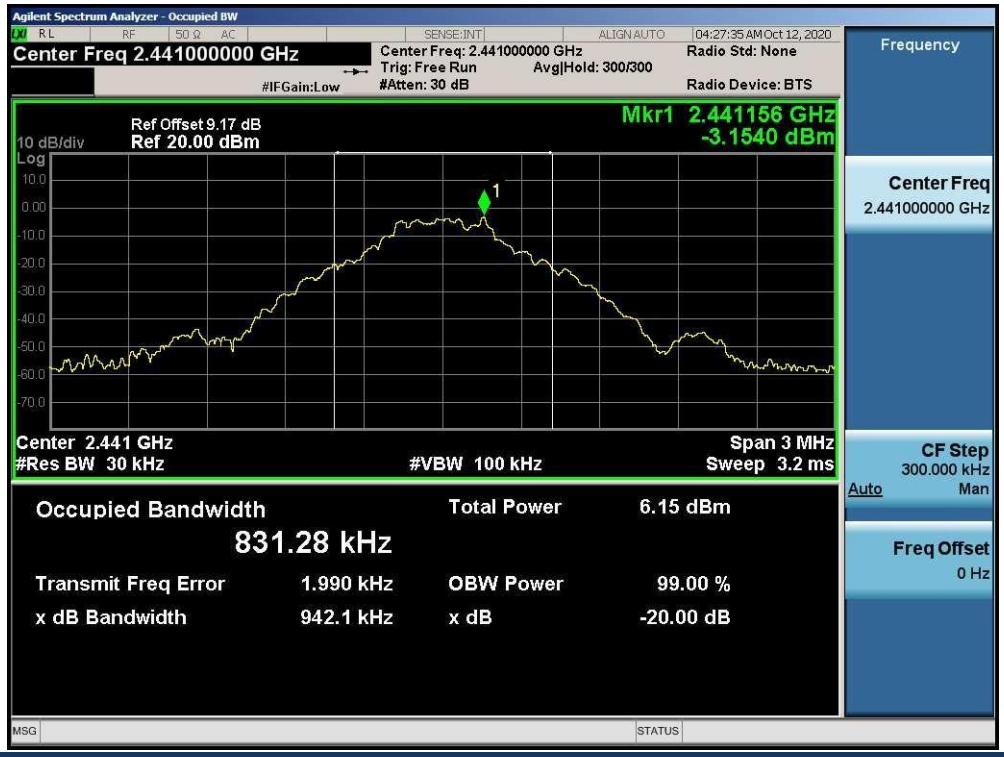
TestMode	Channel (MHz)	20dB Bandwidth (MHz)	Limit [MHz]	Verdict
Lowest	2402MHz	0.9412	0.5	Pass
Middle	2441MHz	0.9421	0.5	Pass
Highest	2480MHz	0.9359	0.5	Pass

3.5 Original Test Data

Low



Middle



High

Agilent Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
04:30:56 AM Oct 12, 2020
Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold: 300/300
#IFGain:Low
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Frequency
Ref Offset 9.17 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 2.480156 GHz
-3.8257 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center Freq
2.480000000 GHz
Center 2.48 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3 MHz
Sweep 3.2 ms
CF Step
300.000 kHz
Auto
Man
Occupied Bandwidth
826.82 kHz
Total Power
5.52 dBm
Transmit Freq Error
2.241 kHz
OBW Power
99.00 %
x dB Bandwidth
935.9 kHz
x dB
-20.00 dB
Freq Offset
0 Hz
MSG
STATUS

4 CONDUCTED OUTPUT POWER

4.1 LIMIT

FCC Part15 Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
15.247(b)(1)	Peak output power	Power<1W(30dBm)	2400-2483.5

4.2 TEST PROCEDURE

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
(2) Spectrum Setting:
RBW=1MHz, VBW=3MHz, Detector=Peak (If 20dB BW ≤1 MHz)
RBW=3MHz, VBW=8MHz, Detector=Peak (If 20dB BW > 1 MHz)
(3) The EUT was set to continuously transmitting in the max power during the test.

4.3 TEST SETUP

4.5 TEST RESULTS

TestMode	Channel (MHz)	Result（dBm）	Limit（dBm）	Verdict
Lowest	2402MHz	-0.546	30	Pass
Middle	2441MHz	-1.178	30	Pass
Highest	2480MHz	-1.789	30	Pass

Low

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.402000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 100/100
05:41:16 AM Oct 12, 2020
Ref Offset 9.16 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 2.401 985 GHz
-0.546 dBm
Center 2.402000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 5.000 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.402000000 GHz
Start Freq
2.399500000 GHz
Stop Freq
2.404500000 GHz
CF Step
500.000 kHz
Auto
Man
Freq Offset
0 Hz

Middle

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 100/100
05:41:34 AM Oct 12, 2020
Ref Offset 9.17 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 2.440 900 GHz
-1.178 dBm
Center 2.441000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 5.000 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.441000000 GHz
Start Freq
2.438500000 GHz
Stop Freq
2.443500000 GHz
CF Step
500.000 kHz
Auto
Man
Freq Offset
0 Hz

High

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
05:41:59 AM Oct 12, 2020
Center Freq 2.480000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Ref Offset 9.17 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 2.480 135 GHz
-1.789 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
1
Center 2.480000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 5.000 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.477500000 GHz
Stop Freq
2.482500000 GHz
CF Step
500.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

5 NUMBER OF HOPPING CHANNEL

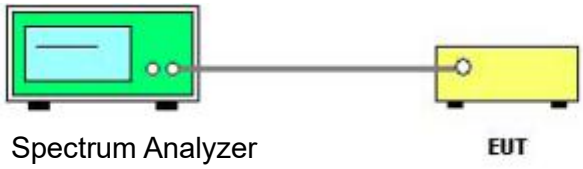
5.1 LIMIT

FCC Part 15.247,Subpart C RSS-247 Issue 2				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247 (a)(1)(iii) RSS-247	Number of Hopping Channel	>15	2400-2483.5	PASS

5.2 TEST PROCEDURE

a The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b Spectrum Setting: RBW= 300KHz, VBW=300KHz, Sweep time = Auto

5.3 TEST SETUP

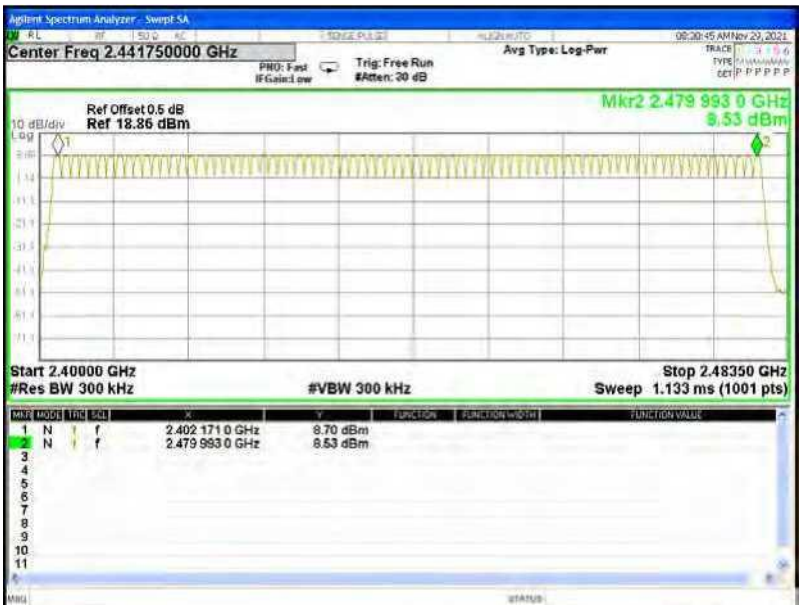


5.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

5.5 TEST RESULTS

Temperature:	25 °C	Relative Humidity:	60%
Test Mode:	Hopping Mode -GFSK Mode	Test Voltage:	DC 48V



6 BAND EDGE AND SPURIOUS(CONDUCTED)

6.1 LIMIT

In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 30dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

6.2 TEST PROCEDURE

(1) Connect EUT's antenna output to spectrum analyzer by RF cable.

(2) Establish a reference level by using the following procedure:

Center frequency	DTS Channel center frequency
RBW:	100kHz
VBW:	300kHz
Span	1.5times the DTS bandwidth
Detector Mode:	Pake
Sweep time:	auto
Trace mode	Max hold

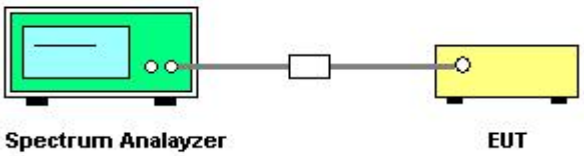
(3) Establish Allow the trace to stabilize, use the peak marker function to determine the maximum peak power level to establish the reference level.

(4) Set the spectrum analyzer as follows:

RBW:	100kHz
VBW:	300kHz
Span	Encompass frequency range to be measured
Number of measurement points	≥span/RBW
Detector Mode:	Pake
Sweep time:	auto
Trace mode	Max hold

(5) Allow the trace to stabilize, use the peak marker function to determine the maximum amplitude of all unwanted emissions outside of the authorized frequency band

6.3 TEST SETUP

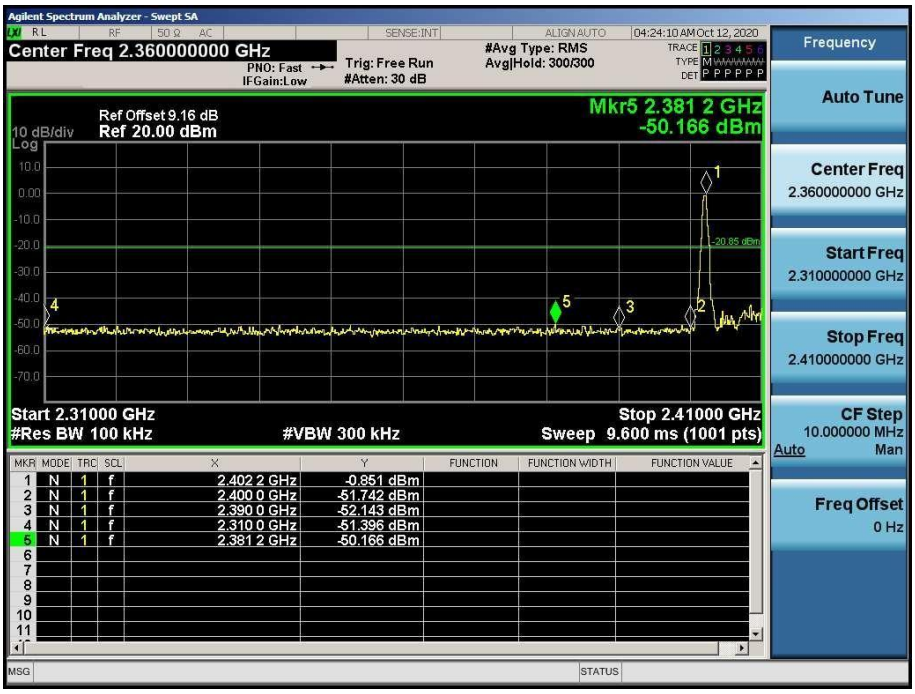


6.4 TEST RESULTS

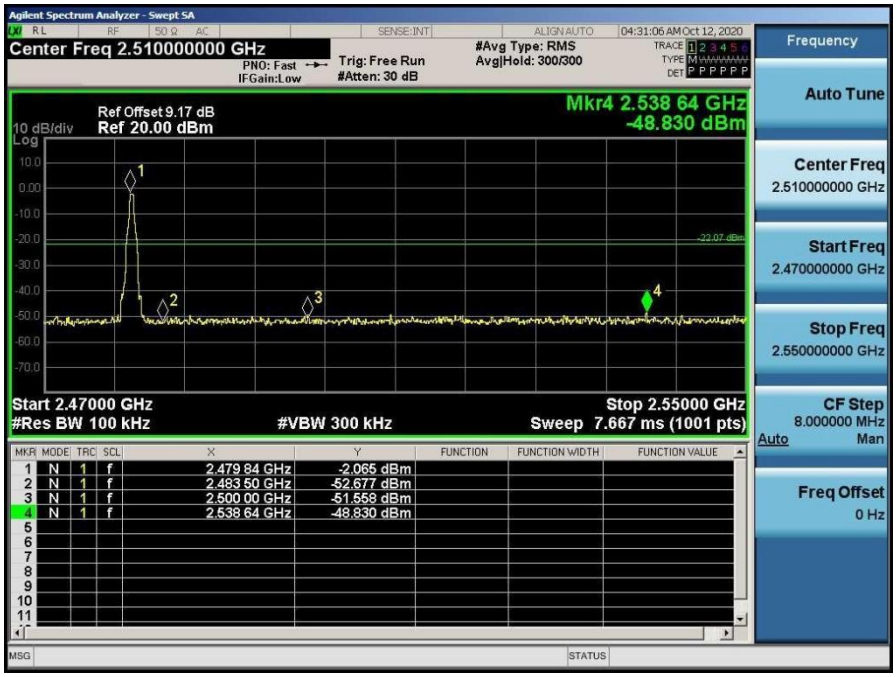
Eut set mode	CH or Frequency	Result
GFSK	CH1	Pass
	CH79	Pass

6.5 Original test data

CH1 2402MHZ



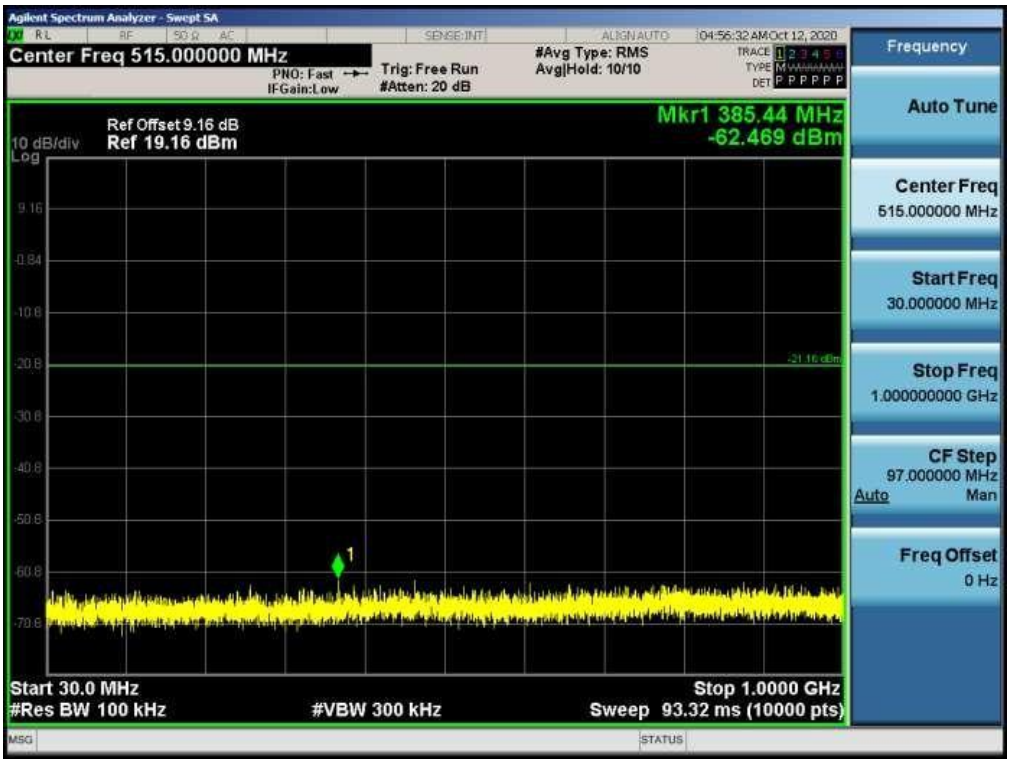
CH79 2480MHZ



Spurious emissions

Low 2402MHz

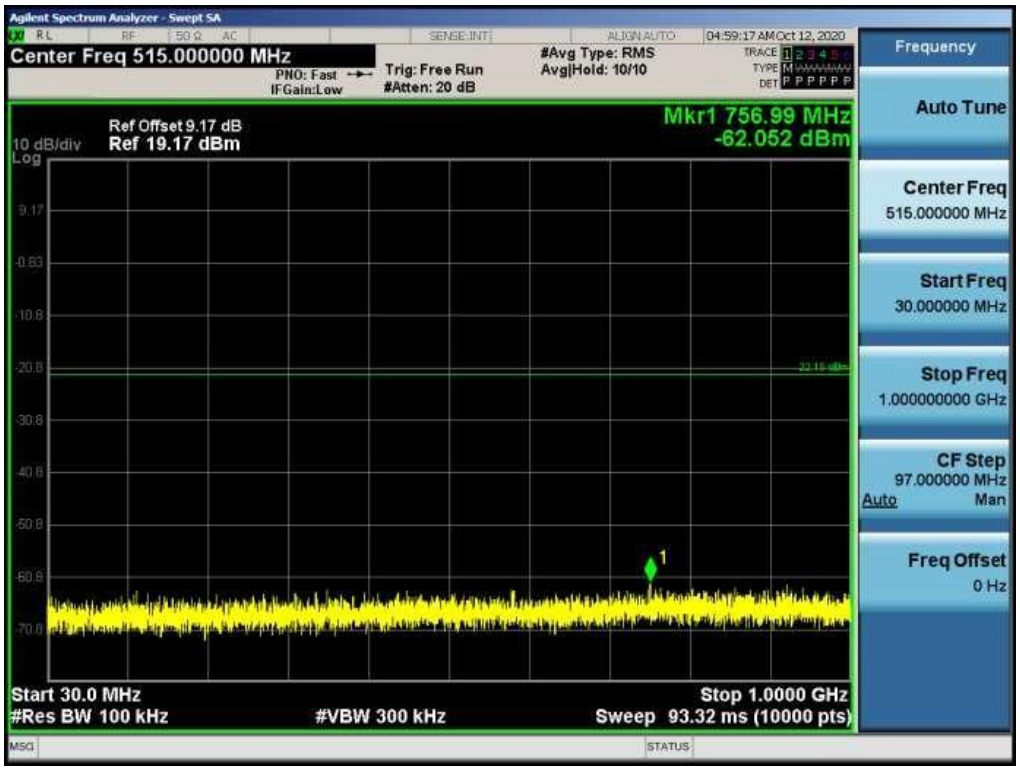
30MHz-1000MHz



1GHz-26.5GHz

Middle 2441MHz

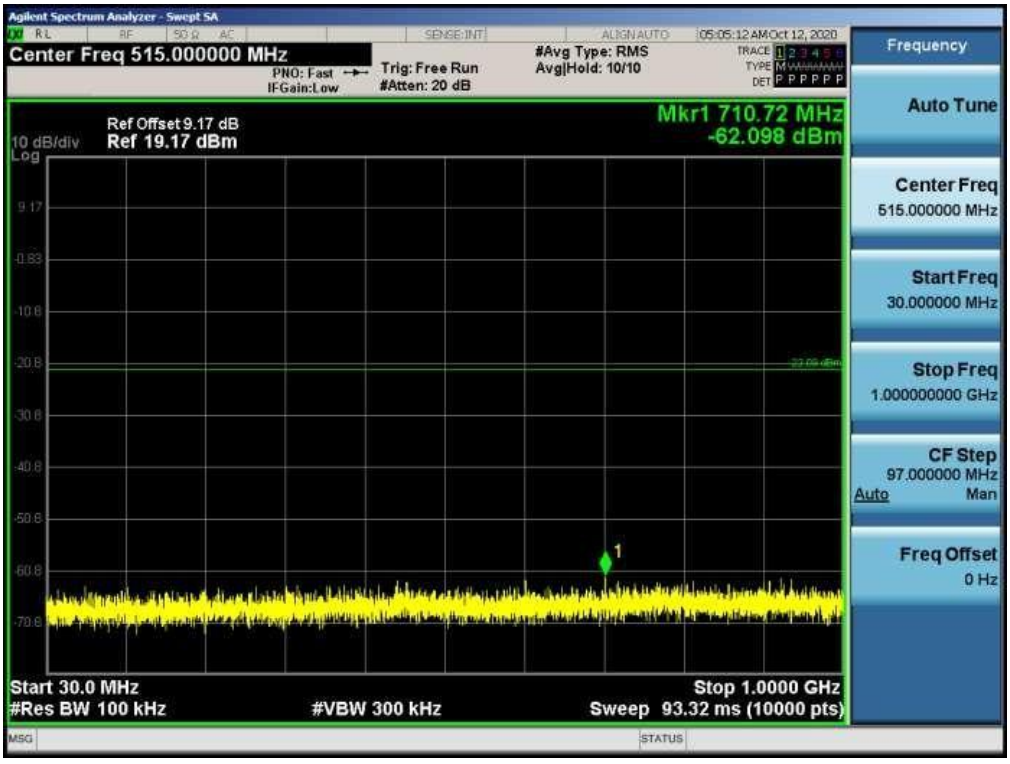
30MHz-1000MHz



1GHz-26.5GHz

High 2480MHz

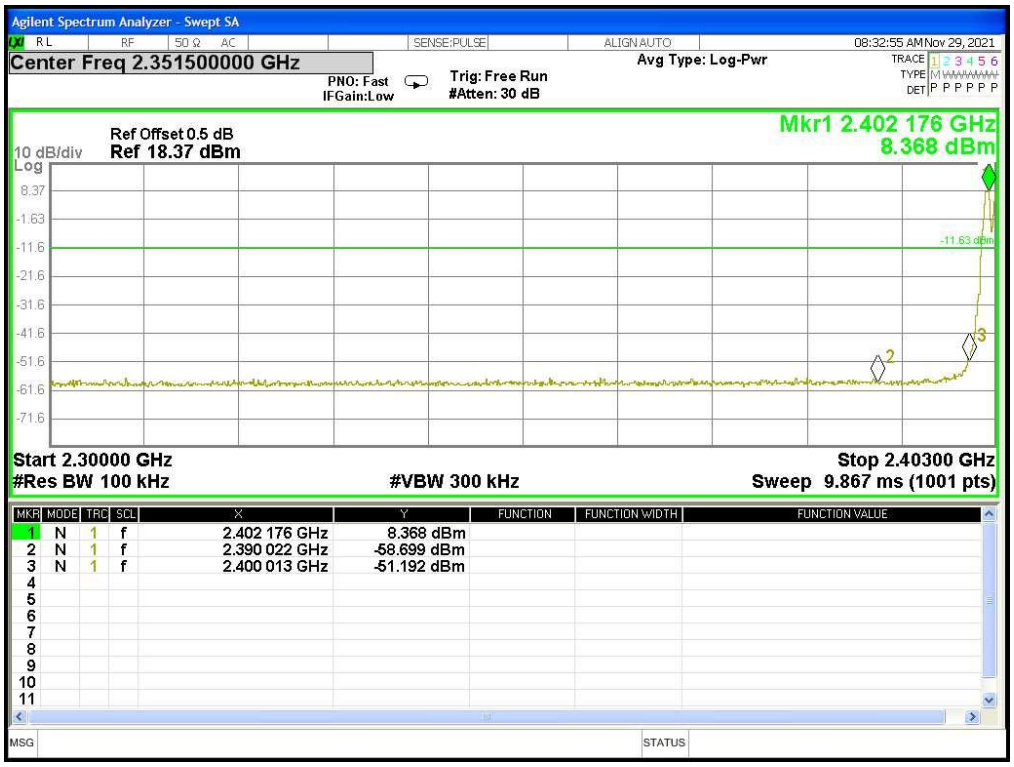
30MHz-1000MHz

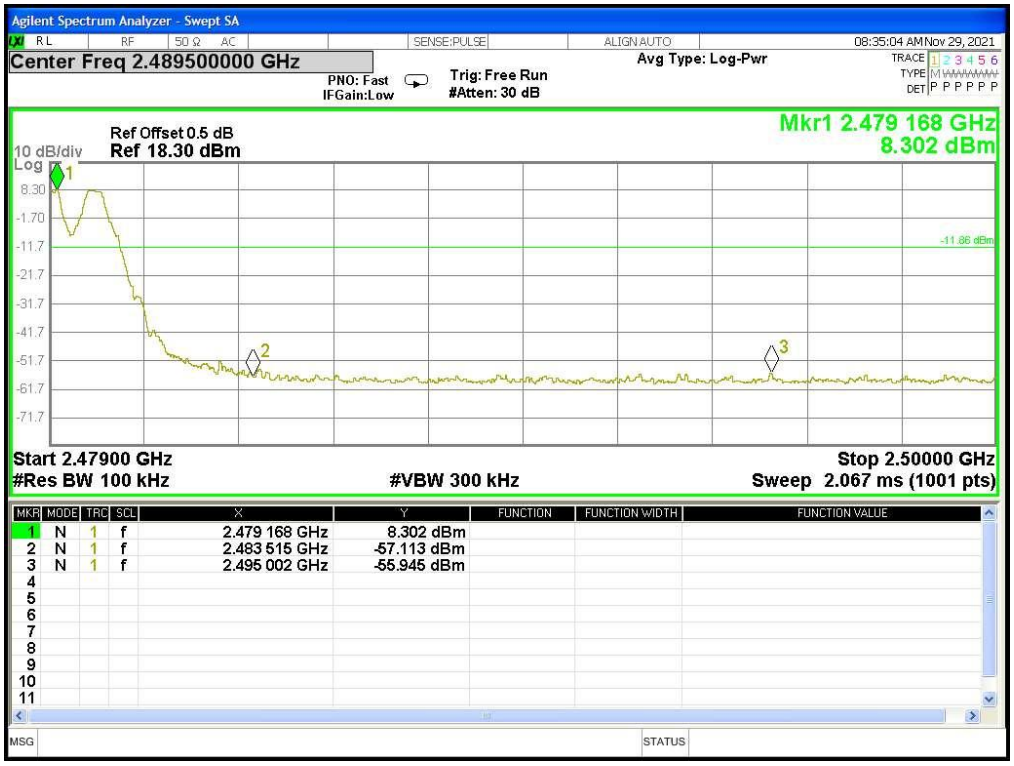


1GHz-26.5GHz

Agilent Spectrum Analyzer - Swept SA
Center Freq 13.750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 10/10
05:05:45 AM Oct 12, 2020
Ref Offset 9.17 dB
10 dB/div
Log
Ref 19.17 dBm
Mkr1 1.747 2 GHz
-43.496 dBm
Start 1.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.437 s (10000 pts)
Frequency
Auto Tune
Center Freq
13.750000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
26.500000000 GHz
CF Step
2.550000000 GHz
Auto
Man
Freq Offset
0 Hz

For Hopping Band edge





7 RADIATED EMISSION MEASUREMENT

7.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205(a)&209(a) limit in the table and according to ANSI C63.10-2013 below has to be followed

LIMITS OF RADIATED EMISSION MEASUREMENT (0.009MHz - 1000MHz)

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (1GHz-25 GHz)

FREQUENCY (MHz)	(dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

For Radiated Emission

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/AV
Start Frequency	1000 MHz(Peak/AV)
Stop Frequency	10th carrier hamonic(Peak/AV)
RB / VB (emission in restricted band)	PK=1MHz / 1MHz, AV=1 MHz /10 Hz

For Band edge

Spectrum Parameter	Setting
Detector	Peak/AV
Start/Stop Frequency	Lower Band Edge: 2300 to 2403 MHz Upper Band Edge: 2479 to 2500 MHz
RB / VB (emission in restricted band)	PK=1MHz / 1MHz, AV=1 MHz / 10 Hz

Receiver Parameter	**Setting**
Attenuation	Auto
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

7.2 TEST PROCEDURE

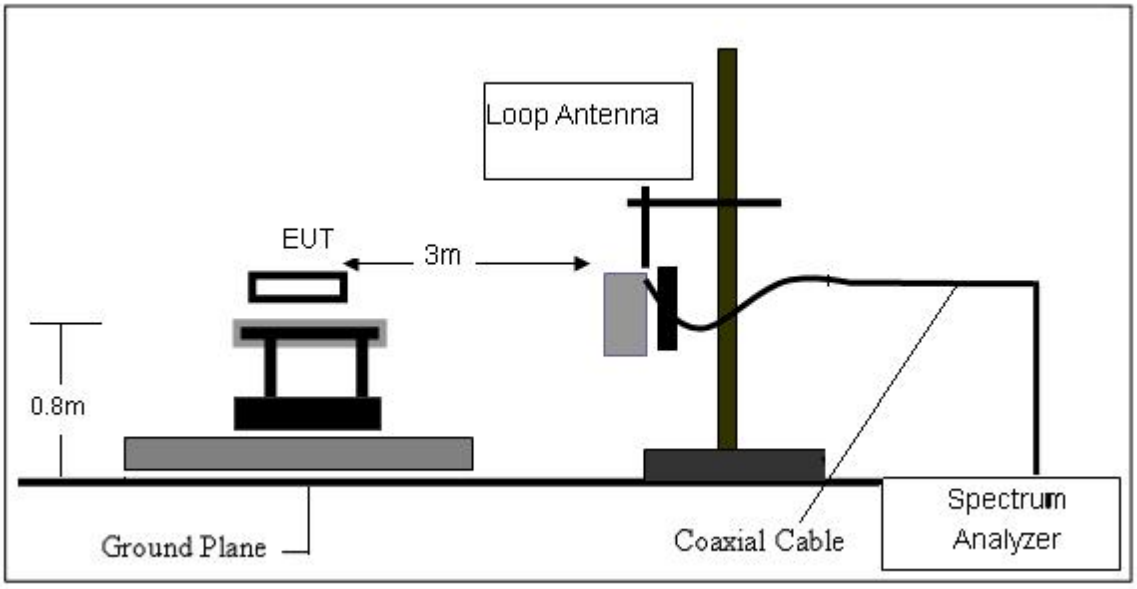
a. The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz,and above 1GHz.
b. The EUT was placed on the top of a rotating table 0.8 meters (above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The height of the equipment shall be 0.8 m(above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. horizontal and vertical polarizations of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then QuasiPeak detector mode re-measured.
e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

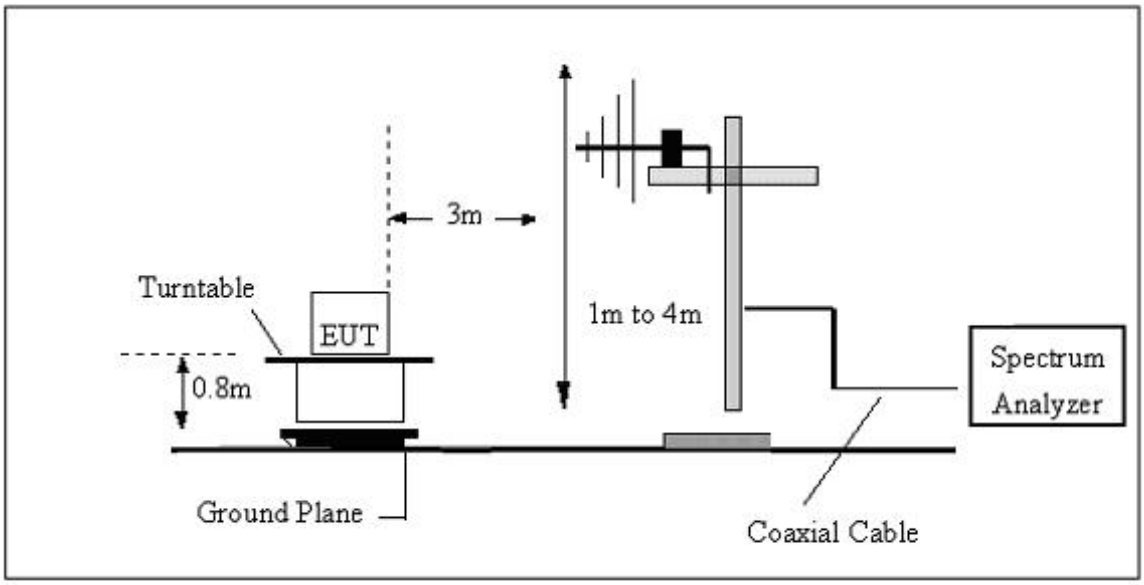
Both horizontal and vertical antenna polarities were tested
and performed pretest to three orthogonal axis. The worst case emissions were reported

7.3 TESTSETUP

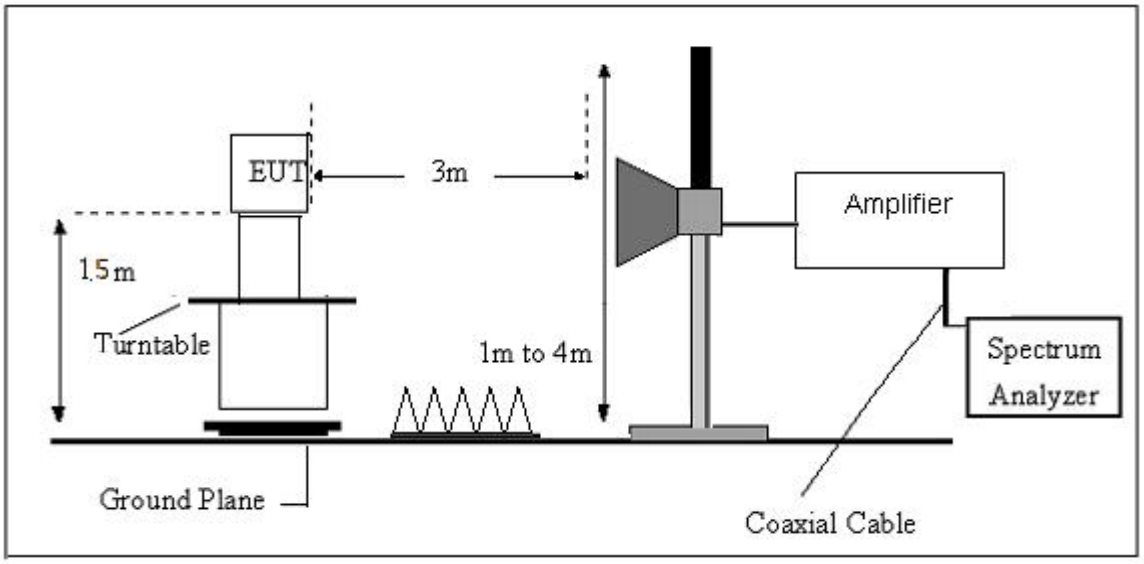
（A）Radiated Emission Test-Up Frequency Below 30MHz



（B）Radiated Emission Test-Up Frequency 30MHz~1GHz



（C）Radiated Emission Test-Up Frequency Above 1GHz



7.4. TEST RESULTS

(9KHz-30MHz)

Temperature:	22.7℃	Relative Humidity:	61%
Test Voltage:	DC 12V	Test Mode:	GFSK

Freq.	Reading	Limit	Margin	State	Test Result
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F	
--	--	--	--	--	PASS
--	--	--	--	--	PASS

Note:

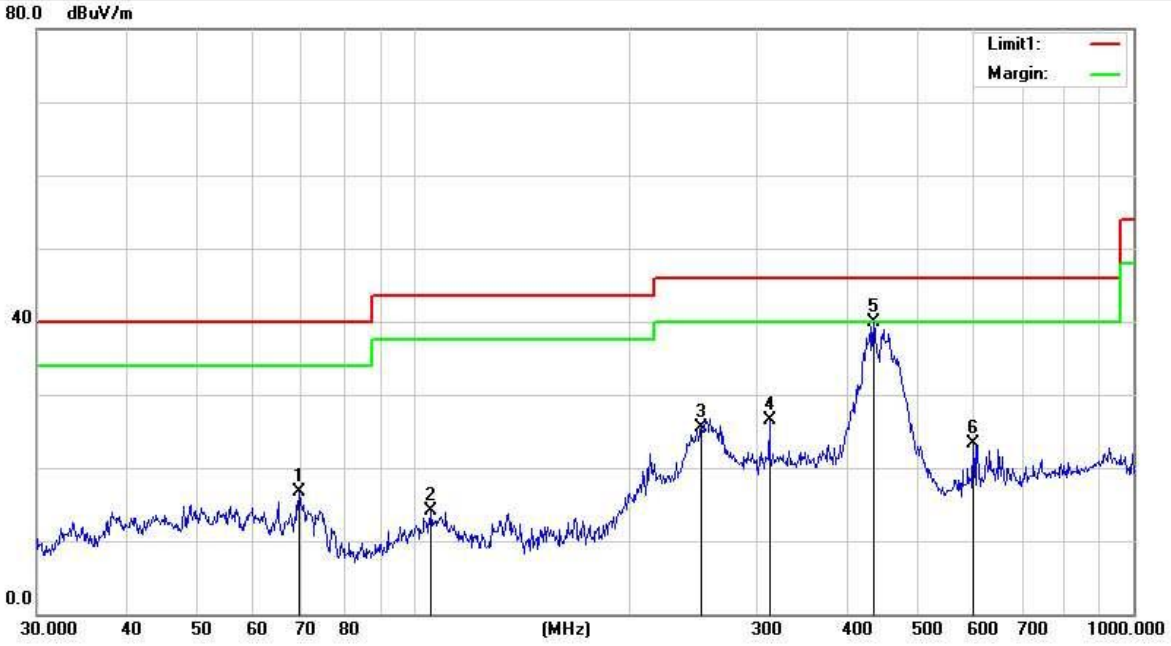
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =40 log (specific distance/test distance)(dB);

Limit line = specific limits (dBuv) + distance extrapolation factor.

(30MHz-1000MHz)

Temperature:	24.7℃	Relative Humidity:	61%
Test Voltage:	DC 12V	Phase:	Horizontal
Test Mode:	GFSK		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	69.3568	36.91	-20.21	16.70	40.00	-23.30	QP
2	105.6414	31.99	-17.98	14.01	43.50	-29.49	QP
3	251.1802	43.20	-17.70	25.50	46.00	-20.50	QP
4	312.1792	42.33	-15.77	26.56	46.00	-19.44	QP
5	435.5898	54.31	-14.44	39.87	46.00	-6.13	QP
6	599.3211	34.68	-11.36	23.32	46.00	-22.68	QP

Note: 1. Margin = Result (Result =Reading + Factor)–Limit

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

Temperature:	22.7℃	Relative Humidity:	61%
Test Voltage:	DC 12V	Phase:	Vertical
Test Mode:	GFSK		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	51.3005	68.52	-40.24	28.28	40.00	-11.72	QP
2	74.1351	59.79	-40.24	19.55	40.00	-20.45	QP
3	109.4116	58.68	-40.24	18.44	43.50	-25.06	QP
4	134.5592	60.70	-40.24	20.46	43.50	-23.04	QP
5	242.5252	66.08	-40.24	25.84	46.00	-20.16	QP
6	435.5898	82.33	-40.24	42.09	46.00	-3.91	QP

Note: 1. Margin = Result (Result =Reading + Factor)–Limit

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

■ Above 1GHz

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4804.00	36.21	31.78	8.6	32.09	44.5	74.00	-29.5	Vertical
7206.00	31.24	36.15	11.65	32	47.04	74.00	-26.96	Vertical
9608.00	31.22	37.95	14.14	31.62	51.69	74.00	-22.31	Vertical
12010.00	*							Vertical
14412.00	*							Vertical
4804.00	39.67	31.78	8.6	32.09	47.96	74.00	-26.04	Horizontal
7206.00	33.01	36.15	11.65	32	48.81	74.00	-25.19	Horizontal
9608.00	29.54	37.95	14.14	31.62	50.01	74.00	-23.99	Horizontal
12010.00	*					74.00		Horizontal
14412.00	*					74.00		Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4804.00	25.12	31.78	8.6	32.09	33.41	54.00	-20.59	Vertical
7206.00	20.06	36.15	11.65	32	35.86	54.00	-18.14	Vertical
9608.00	19.23	37.95	14.14	31.62	39.7	54.00	-14.30	Vertical
12010.00	*					54.00		Vertical
14412.00	*					54.00		Vertical
4804.00	29.01	31.78	8.6	32.09	37.3	54.00	-16.70	Horizontal
7206.00	22.23	36.15	11.65	32	38.03	54.00	-15.97	Horizontal
9608.00	18.15	37.95	14.14	31.62	38.62	54.00	-15.38	Horizontal
12010.00	*					54.00		Horizontal
14412.00	*					54.00		Horizontal

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4882.00	39.06	31.85	8.67	32.12	47.46	74.00	-26.54	Vertical
7323.00	32.99	36.37	11.72	31.89	49.19	74.00	-24.81	Vertical
9764.00	32.50	38.35	14.25	31.62	53.48	74.00	-20.52	Vertical
12205.00	*					74.00		Vertical
14646.00	*					74.00		Vertical
4882.00	43.70	31.85	8.67	32.12	52.10	74.00	-21.90	Horizontal
7323.00	34.90	36.37	11.72	31.89	51.10	74.00	-22.90	Horizontal
9764.00	32.09	38.35	14.25	31.62	53.07	74.00	-20.93	Horizontal
12205.00	*					74.00		Horizontal
14646.00	*					74.00		Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4882.00	27.56	31.85	8.67	32.12	35.96	54.00	-18.04	Vertical
7323.00	21.49	36.37	11.72	31.89	37.69	54.00	-16.31	Vertical
9764.00	20.46	38.35	14.25	31.62	41.44	54.00	-12.56	Vertical
12205.00	*					54.00		Vertical
14646.00	*					54.00		Vertical
4882.00	31.98	31.85	8.67	32.12	40.38	54.00	-13.62	Horizontal
7323.00	23.78	36.37	11.72	31.89	39.98	54.00	-14.02	Horizontal
9764.00	20.34	38.35	14.25	31.62	41.32	54.00	-12.68	Horizontal
12205.00	*					54.00		Horizontal
14646.00	*					54.00		Horizontal

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4960.00	35.86	31.93	8.73	32.16	44.36	74.00	-29.64	Vertical
7440.00	31.05	36.59	11.79	31.78	47.65	74.00	-26.35	Vertical
9920.00	31.26	38.81	14.38	31.88	52.57	74.00	-21.43	Vertical
12400.00	*					74.00		Vertical
14880.00	*					74.00		Vertical
4960.00	39.54	31.93	8.73	32.16	48.04	74.00	-25.96	Horizontal
7440.00	32.99	36.59	11.79	31.78	49.59	74.00	-24.41	Horizontal
9920.00	29.62	38.81	14.38	31.88	50.93	74.00	-23.07	Horizontal
12400.00	*					74.00		Horizontal
14880.00	*					74.00		Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4960.00	25.16	31.93	8.73	32.16	33.66	54.00	-20.34	Vertical
7440.00	20.03	36.59	11.79	31.78	36.63	54.00	-17.37	Vertical
9920.00	19.65	38.81	14.38	31.88	40.96	54.00	-13.04	Vertical
12400.00						54.00		Vertical
14880.00						54.00		Vertical
4960.00	29.02	31.93	8.73	32.16	37.52	54.00	-16.48	Horizontal
7440.00	22.45	36.59	11.79	31.78	39.05	54.00	-14.95	Horizontal
9920.00	18.35	38.81	14.38	31.88	39.66	54.00	-14.34	Horizontal
12400.00	*					54.00		Horizontal
14880.00	*					54.00		Horizontal

Remarks:

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *"*", means this data is the too weak instrument of signal is unable to test.*
3. *The emission levels of other frequencies are very lower than the limit and not show in test report.*

Radiated Band Edge data

Remark: All restriction band have been tested, and only the worst case is shown in report

Low CH (GFSK)

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2390.00	39.19	27.59	5.38	30.18	41.98	74.00	-32.02	Horizontal
2400.00	55.45	27.58	5.39	30.18	58.24	74.00	-15.76	Horizontal
2390.00	39.38	27.59	5.38	30.18	42.17	74.00	-31.83	Vertical
2400.00	57.09	27.58	5.39	30.18	59.88	74.00	-14.12	Vertical

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2390.00	30.57	27.59	5.38	30.18	33.36	54.00	-20.64	Horizontal
2400.00	41.59	27.58	5.39	30.18	44.38	54.00	-9.62	Horizontal
2390.00	30.25	27.59	5.38	30.18	33.04	54.00	-20.96	Vertical
2400.00	42.89	27.58	5.39	30.18	45.68	54.00	-8.32	Vertical

High CH(GFSK)

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.50	46.43	27.53	5.47	24.80	54.63	74.00	-19.37	Horizontal
2500.00	45.73	27.55	5.49	24.86	53.91	74.00	-20.09	Horizontal
2483.50	47.43	27.53	5.47	24.80	55.63	74.00	-18.37	Vertical
2500.00	46.89	27.55	5.49	24.86	55.07	74.00	-18.93	Vertical

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.50	35.58	27.53	5.47	24.80	43.78	54.00	-10.22	Horizontal
2500.00	35.59	27.55	5.49	24.86	43.77	54.00	-10.23	Horizontal
2483.50	36.31	27.53	5.47	24.80	44.51	54.00	-9.49	Vertical
2500.00	35.41	27.55	5.49	24.86	43.59	54.00	-10.41	Vertical

Remarks:

1. Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

8 AVERAGE TIME OF OCCUPANCY

8.1 LIMIT

FCC Parti 5 (15.247), Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
15.247(a)(1)	Average Time of Occupancy	0.4 sec	2400-2483.5

8.2 TEST PROCEDURE

a. The transmitter output (antenna port) was connected to the spectrum analyzer.

b. Set RBW =1MHz/VBW =3MHz.
c. Use a video trigger with the trigger level set to enable triggering only on full pulses.
d. Sweep Time is more than once pulse time.
e. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
f. Measure the maximum time duration of one single pulse.
g. Set the EUT for DH5, DH3 and DH1 packet transmitting.
h. Measure the maximum time duration of one single pulse.
i. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is 3.37x31.6 = 106.6.
j. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is 5.06x31.6 = 160.
k. DH1 Packet permit maximum 1600 / 79 / 2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is 10.12x31.6 = 320.

8.3 TEST SETUP

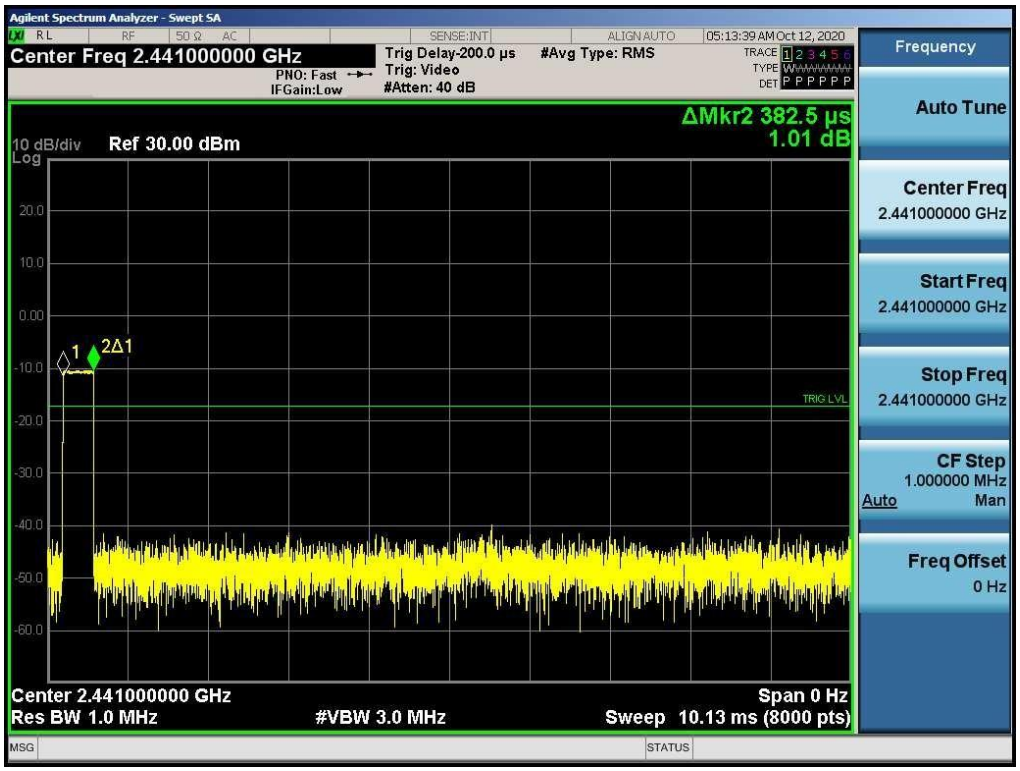
8.4 TEST RESULTS

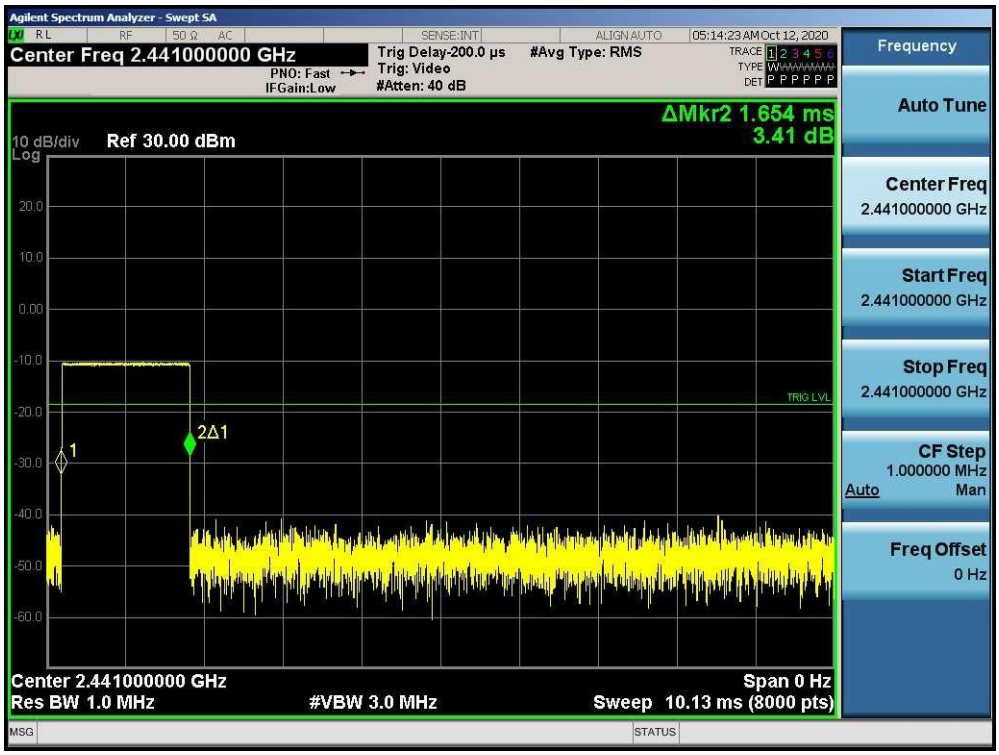
Mode	Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (ms)	Limit(s)	Conclusion
GFSK	DH1	2441	0.3825	122.40	<0.4	Pass
	DH3	2441	1.654	264.64	<0.4	Pass
	DH5	2441	2.898	309.12	<0.4	Pass

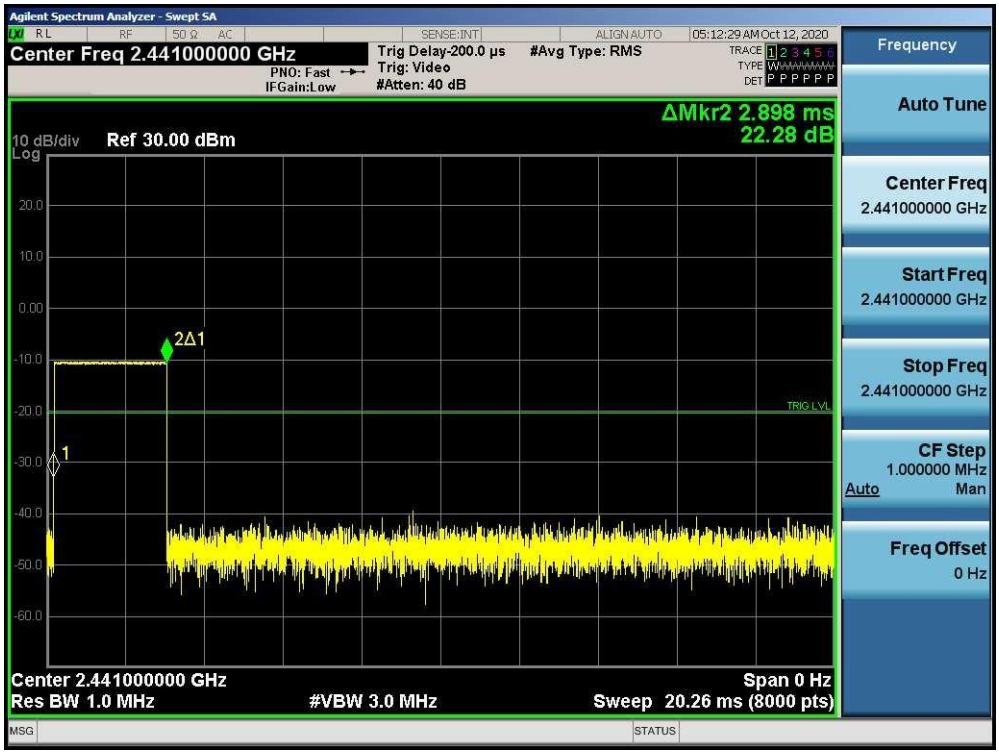
Notel: A period time = 0.4 (s) * 79 =31.6
Note2:
DH1 time slot = Pulse Duration * (1600/(2*79)) * Aperiod time
DH3 time slot = Pulse Duration * (1600/(4*79)) * Aperiod time
DH5 time slot = Pulse Duration * (1600/(6*79)) * Aperiod time

Note3: For GFSK :The test period: T= 0.4 Second/Channel x 79 Channel=31.6 s

8.5 ORIGINAL TEST DATA




Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
PNO: Fast
IFGain:Low
Trig Delay-200.0 µs
Trig: Video
#Atten: 40 dB
#Avg Type: RMS
05:14:23 AM Oct 12, 2020
ΔMkr2 1.654 ms
3.41 dB
10 dB/div
Log
Ref 30.00 dBm
TRIG LVL
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 10.13 ms (8000 pts)
Frequency
Auto Tune
Center Freq
2.441000000 GHz
Start Freq
2.441000000 GHz
Stop Freq
2.441000000 GHz
CF Step
1.000000 MHz
Auto
Man
Freq Offset
0 Hz


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
PNO: Fast
IFGain:Low
Trig Delay-200.0 µs
Trig: Video
#Atten: 40 dB
#Avg Type: RMS
05:12:29 AM Oct 12, 2020
ΔMkr2 2.898 ms
22.28 dB
10 dB/div
Log
Ref 30.00 dBm
TRIG LVL
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 20.26 ms (8000 pts)
Frequency
Auto Tune
Center Freq
2.441000000 GHz
Start Freq
2.441000000 GHz
Stop Freq
2.441000000 GHz
CF Step
1.000000 MHz
Auto
Man
Freq Offset
0 Hz

9 HOPPING CHANNEL SEPARATION MEASUREMEN

9.1 LIMIT

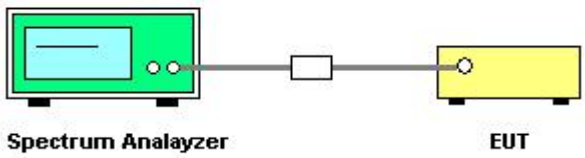
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> 20 dB Bandwidth or Channel Separation
RB	30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)
VB	100 kHz (20dB Bandwidth) /100 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

9.2 TEST PROCEDURE

a. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
b. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for 20 dB bandwidth measurement.
c. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for channel separation measurement

9.3 TEST SETUP



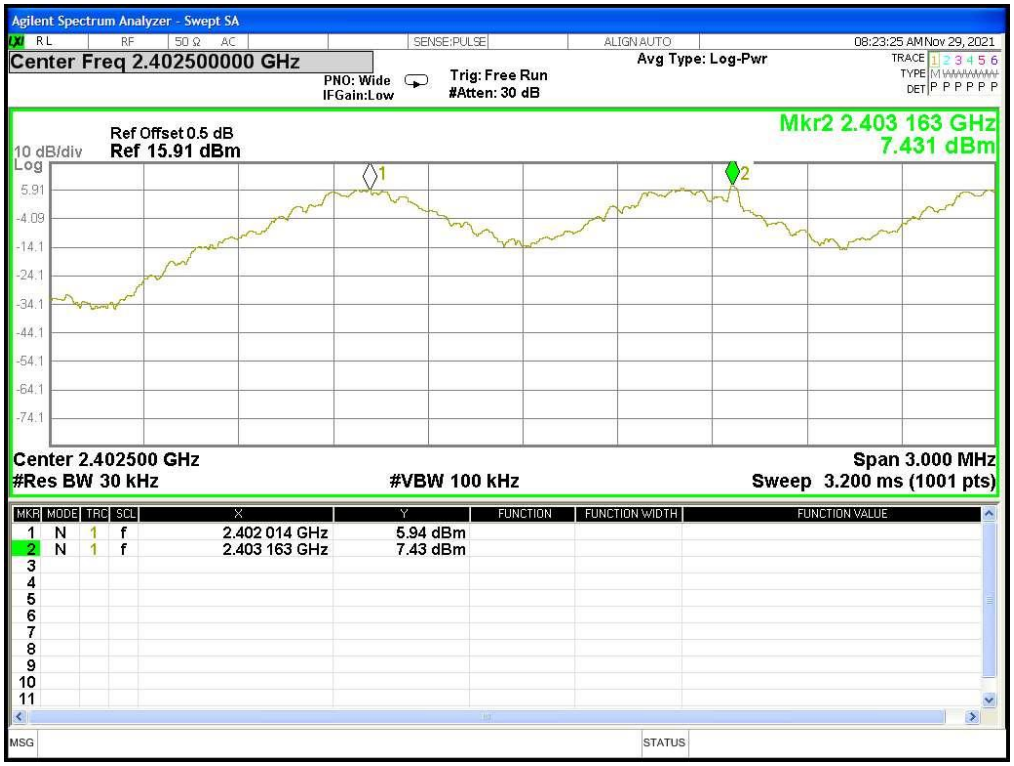
9.4 EUT OPERATION CONDITIONS

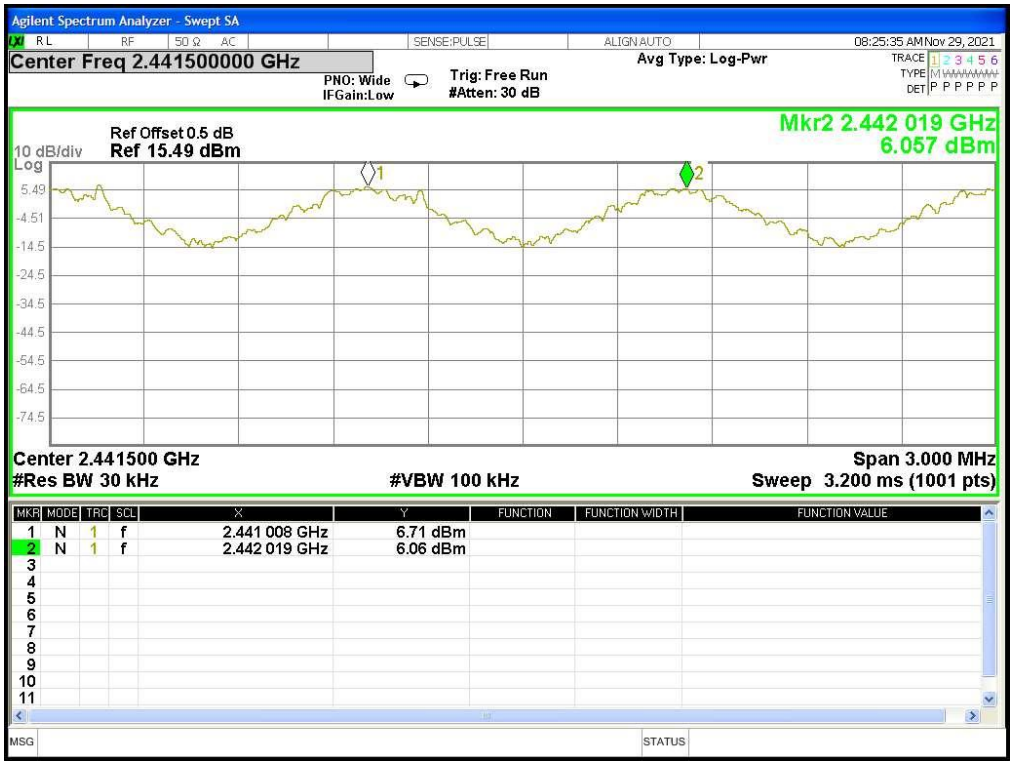
The EUT was programmed to be in continuously transmitting mode.

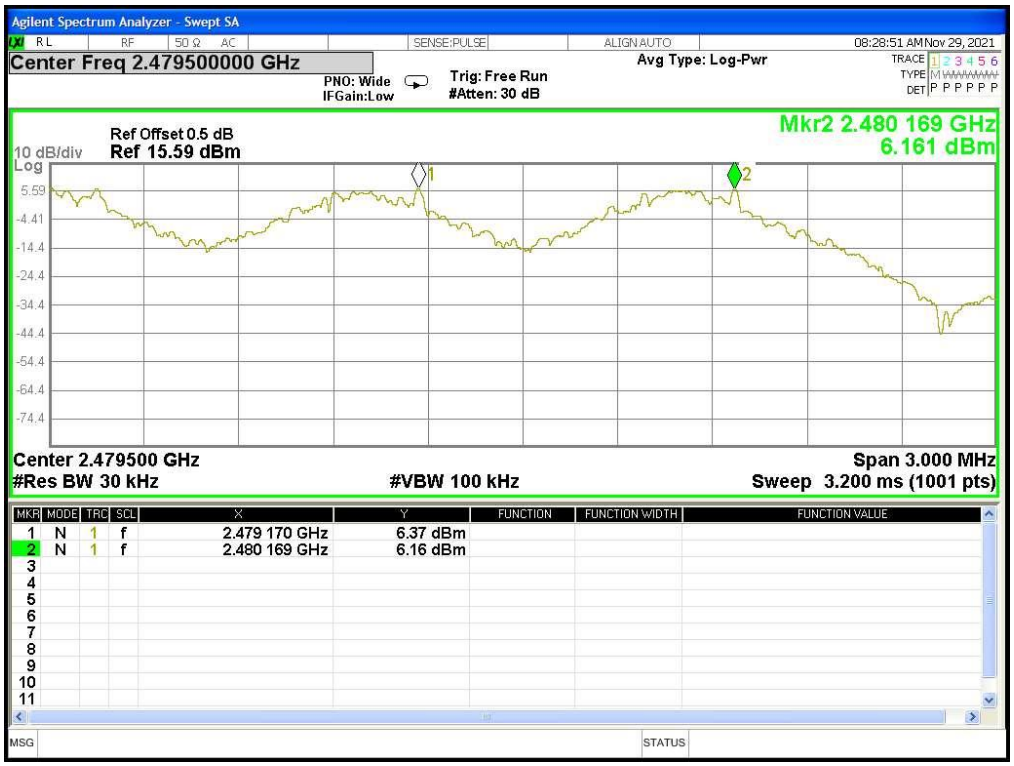
9.5 TEST RESULTS

Temperature:	25 °C	Relative Humidity:	60%
Test Mode:	GFSK Mode	Test Voltage:	DC 12V

Modulation	Frequency (MHz)	MarkI Frequency (MHz)	Mark2 Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)	Result
GFSK	2402	2402.014	2403.163	1.149	0.953	Pass
	2441	2441.008	2442.019	1.011	0.953	Pass
	2480	2479.170	2480.169	0.999	0.951	Pass




Agilent Spectrum Analyzer - Swept SA
RL RF 50 Ω AC SENSE:PULSE ALIGN AUTO 08:25:35 AM Nov 29, 2021
Center Freq 2.441500000 GHz
PNO: Wide IFGain:Low
Trig: Free Run #Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6 TYPE M DET P P P P P P
Ref Offset 0.5 dB
10 dB/div Ref 15.49 dBm
Log
Mkr2 2.442 019 GHz
6.057 dBm
5.49
-4.51
-14.5
-24.5
-34.5
-44.5
-54.5
-64.5
-74.5
Center 2.441500 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3.000 MHz
Sweep 3.200 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.441 008 GHz 6.71 dBm
2 N 1 f 2.442 019 GHz 6.06 dBm
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RL RF 50 Ω AC SENSE:PULSE ALIGN AUTO 08:28:51 AM Nov 29, 2021
Center Freq 2.479500000 GHz
PNO: Wide IFGain:Low
Trig: Free Run #Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6 TYPE M DET P P P P P P
Ref Offset 0.5 dB
10 dB/div Ref 15.59 dBm
Log
Mkr2 2.480 169 GHz
6.161 dBm
5.59
-4.41
-14.4
-24.4
-34.4
-44.4
-54.4
-64.4
-74.4
Center 2.479500 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3.000 MHz
Sweep 3.200 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.479 170 GHz 6.37 dBm
2 N 1 f 2.480 169 GHz 6.16 dBm
MSG
STATUS

10 ANTENNA REQUIREMENT

10.1 STANDARD REQUIREMENT

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

10.2 RESULT

The antennas used for this product are PCB antenna and no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is 1.0dBi.

※※※※※END OF THE REPORT※※※※※