FCC TEST REPORT

Report No: STS1502002F02

Issued for

DOPPIO MOBILE INTERNATIONAL LIMITED

1011A, 10/F., Harbour Centre Tower 1, No.1 Hok Cheung St., Hung Hom, Kowloon, Hong Kong.

Product Name:	THUNDER PLUS
Brand Name:	doppio
Model No.:	DP5108
Series Model:	N/A
FCC ID:	N2GDP5108
Test Standard:	FCC Part 15.247

Shenzhen STS Test Services Co., Ltd.
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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Jan.30, 2015	Valid	Original Report

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1. VERIFICATION OF CONFORMITY

Applicant	DOPPIO MOBILE INTERNATIONAL LIMITED
Address	1011A, 10/F., Harbour Centre Tower 1, No.1 Hok Cheung St., Hung Hom, Kowloon, Hong Kong.
Manufacturer	DOPPIO MOBILE (SHENZHEN) LIMITED
Address	Room313, 3th Floor, Building 10 Jiale Building, NO.11 YanNan Road,Futian District, Shenzhen
Product Designation	THUNDER PLUS
Brand Name	doppio
Test Model	DP5108
Date of test	Jan.05, 2015 to Jan.30, 2015
Deviation	None
Condition of Test Sample	Normal
Report Template	STSRT-US-BR/RF

We hereby certify that:

The above equipment was tested by Shenzhen STS Test Services Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4 (2003) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC Rules Part 15.247

Testing Engineer : (Jin Ming)

Report writing : (Sunny zheng)

Authorized Signatory : (Bovey Yang)

2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

The EUT is “THUNDER PLUS” designed as a “Communication Device”. It is designed by way of utilizing the FHSS technology to achieve the system operation.

A major technical description of EUT is described as following

Operation Frequency	2.402 GHz to 2.480GHz
RF Output Power	1.93dBm(Max)
Bluetooth Version	V 3.0
Modulation	GFSK, π /4-DQPSK, 8DPSK
Number of channels	79
Hardware Version	P6120-02
Software Version	DP5108_DOPPIO_ONE
Antenna Designation	Integrated Antenna
Antenna Gain	0.8dBi
Power Supply	DC3.7V by Battery

2.2. TABLE OF CARRIER FREQUENCYS

Frequency Band	Channel Number	Frequency
2400~2483.5MHZ	0	2402MHZ
	1	2403MHZ
	:	:
	38	2440 MHZ
	39	2441 MHZ
	40	2442 MHZ
	:	:
	77	2479 MHZ
	78	2480 MHZ

2.3. RECEIVER INPUT BANDWIDTH

The input bandwidth of the receiver is 1.3MHZ,In every connection one Bluetooth device is the master and the other one is slave. The master determines the hopping sequence. The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally the type of connection(e.g. single of multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.

Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

2.4. EXAMPLE OF A HOPPING SEQUENCY IN DATA MODE

Example of a 79 hopping sequence in data mode:
40,21,44,23,42,53,46,55,48,33,52,35,50,65,54,67
56,37,60,39,58,69,62,71,64,25,68,27,66,57,70,59
72,29,76,31,74,61,78,63,01,41,05,43,03,73,07,75
09,45,13,47,11,77,15,00,64,49,66,53,68,02,70,06
01, 51, 03, 55, 05, 04

2.5. EQUALLY AVERAGE USE OF FREQUENCIES AND BEHAVIOUR

The generation of the hopping sequence in connection mode depends essentially on two input values:
1. LAP/UAP of the master of the connection.
2. Internal master clock

The LAP(lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP(upper address part) are the 24MSB's of the 48BD_ADDRESS

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For ehavior zation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5us.The clock has a cycle of about one day(23h30).In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire. LAP(24 bits),4LSB's(4bits)(Input 1) and the 27MSB's of the clock(Input 2) are used. With this input values different mathematical procedures(permutations, additions, XOR-operations)are performed to generate te Sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following□ehavior:

The first connection between the two devices is established, a hopping sequence was generated. For Transmitting the wanted data the complete hopping sequence was not used. The connection ended.

The second connection will be established. A new hopping sequence is generated. Due to the fact the Bluetooth clock has a different value, because the period between the two transmission is longer(and it Cannot be shorter) than the minimum resolution of the clock(312.5us).The hopping sequence will always Differ from the first one.

2.6. RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for **FCC ID: N2GDP5108** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.7. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in FCC DA 00-705. Radiated testing was performed at an antenna to EUT distance 3 meters.

2.8. SPECIAL ACCESSORIES

Refer to section 5.2.

2.9. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

3. MEASUREMENT UNCERTAINTY

Conducted measurement: +/- 2.75dB
Radiated measurement: +/- 3.2dB

4. DESCRIPTION OF TEST MODES

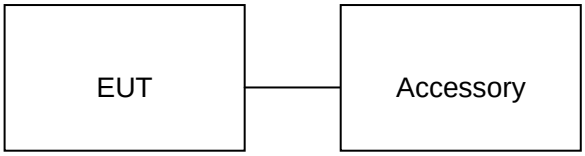
NO.	TEST MODE DESCRIPTION
1	Low channel GFSK
2	Middle channel GFSK
3	High channel GFSK
4	Low channel π /4-DQPSK
5	Middle channel π /4-DQPSK
6	High channel π /4-DQPSK
7	Low channel 8DPSK
8	Middle channel 8DPSK
9	High channel 8DPSK
10	Normal Hopping

Note:
1. All the test modes can be supply by Built-in Li-ion battery, only the result of the worst case was recorded in the report, if no other cases.
2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.

5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM

Configuration:



5.2. EQUIPMENT USED IN EUT SYSTEM

Item	Equipment	Model No.	ID or Specification	Remark
1	Mobile Phone	DP5108	FCCID:N2GDP5108	EUT
2	Adapter	DP5108	DC 5V/1A	Accessory
3	Battery	DP5108	DC 3.7V 4000mAh	Accessory
4	Earphone	DP5108	N/A	Accessory
5	USB Cable	DP5108	N/A	Accessory

5.3. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.247	Peak Output Power	Compliant
§15.247	20 dB Bandwidth	Compliant
§15.247	Spurious Emission	Compliant
§15.209	Radiated Emission	Compliant
§15.247	Band Edges	Compliant
§15.207	Conduction Emission	Compliant
§15.247	Number of Hopping Frequency	Compliant
§15.247	Time of Occupancy	Compliant
§15.247	Frequency Separation	Compliant
§15.203	Antenna Requirement	Compliant

6. TEST FACILITY

Site	Shenzhen STS Test Services Co., Ltd.
Location	1/F, Building 2, Zhuoke Science Park, Chongqing Road, Fuyong, Baoan District, Shenzhen, China
Description	The test site is constructed and calibrated to meet the FCC requirements in documents ANSI C63.4:2003.FCC Registration No.: 842334

ALL TEST EQUIPMENT LIST

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Spectrum Analyzer	Agilent	E4407B	MY50140340	2014.10.25	2015.10.24
Test Receiver	R&S	ESCI	101427	2014.10.25	2015.10.24
Bilog Antenna	TESEQ	CBL6111D	34678	2014.10.27	2015.10.26
50Ω Coaxial Switch	Anritsu	MP59B	6200264416	2014.06.06	2015.06.06
Horn Antenna	R&S	9120D	152265	2014.10.27	2015.10.26
Horn Ant	Schwarzbeck	BBHA 9170	9170-181	2014.07.06	2015.07.05
Amplifier	EM	EM-30180	060538	2014.12.22	2015.12.21
Loop Antenna	ARA	PLA-1030/B	1029	2014.06.08	2015.06.07
Power Meter	Anritsu	ML2495A	1204003	2014.10.25	2015.10.24
Power Sensor	Anritsu	MA2411B	100309	2014.10.25	2015.10.24

Conduction Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	102086	2014.10.25	2015.10.24	102086
LISN	R&S	ENV216	101242	2014.10.25	2015.10.24
LISN	EMCO	3810/2NM	000-23625	2014.10.25	2015.10.24
50Ω Coaxial Switch	Anritsu	MP59B	6200264417	2014.06.06	2015.06.06
Passive Voltage Probe	R&S	ESH2-Z3	100196	2014.06.06	2015.06.06
Absorbing clamp	R&S	MDS-21	100668	2014.10.27	2015.10.26

7. PEAK OUTPUT POWER

7.1. MEASUREMENT PROCEDURE

For peak power test:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, middle and the bottom operation frequency individually.
3. RBW > the 20 dB bandwidth of the emission being measured, VBW ≥ RBW.
4. Record the maximum power from the Spectrum Analyzer.

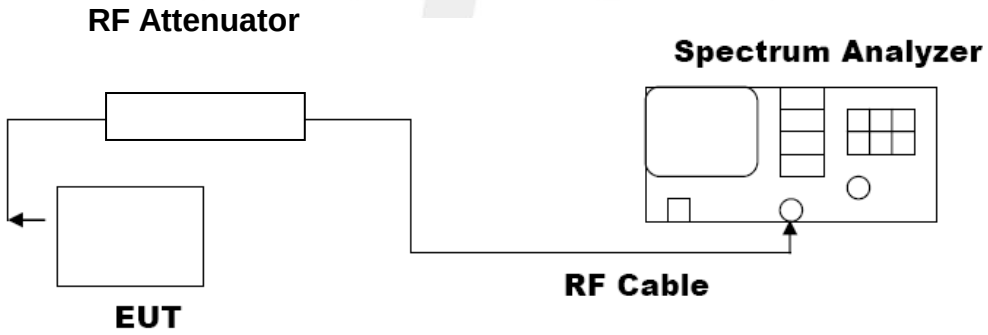
For average power test:

1. Connect EUT RF output port to power probe through an RF attenuator.
2. Connect the power probe to the PC.
3. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
4. Record the maximum power from the software.
5. The maximum peak power shall be less 1 W or 0.125W, if channel separation > 2/3 bandwidth provided the systems operate with an output power no greater than 125 mW(20.96dBm).

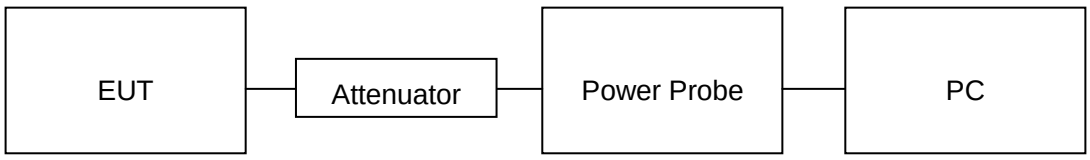
Note：The EUT was tested according to DA000705 for compliance to FCC 47CFR 15.247 requirements.

7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

PEAK POWER TEST SETUP



AVERAGE POWER SETUP



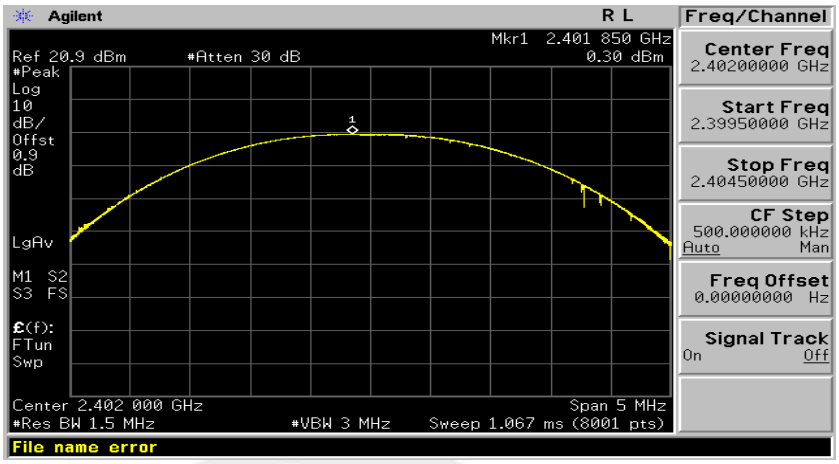
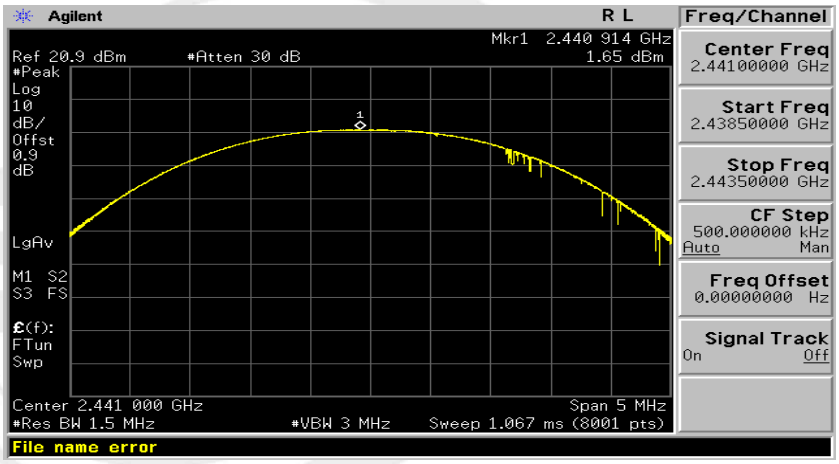
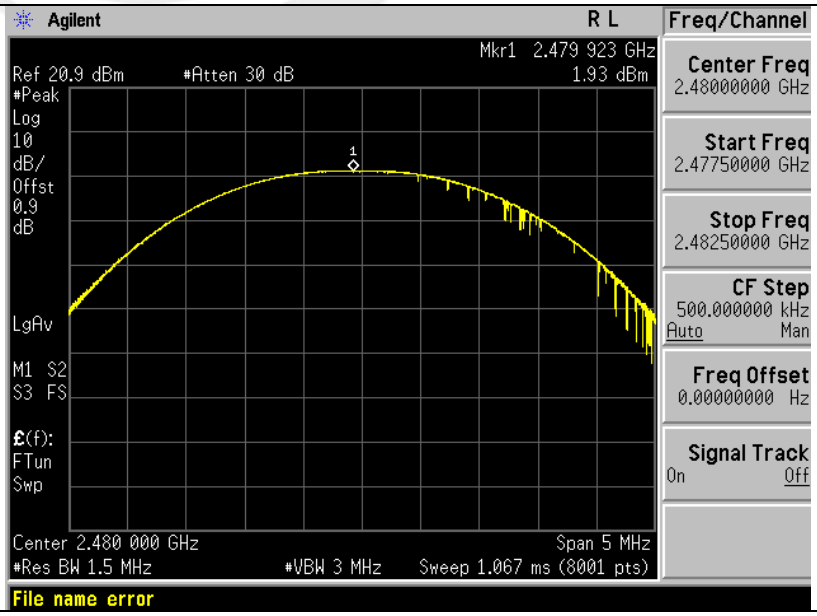
7.3. LIMITS AND MEASUREMENT RESULT

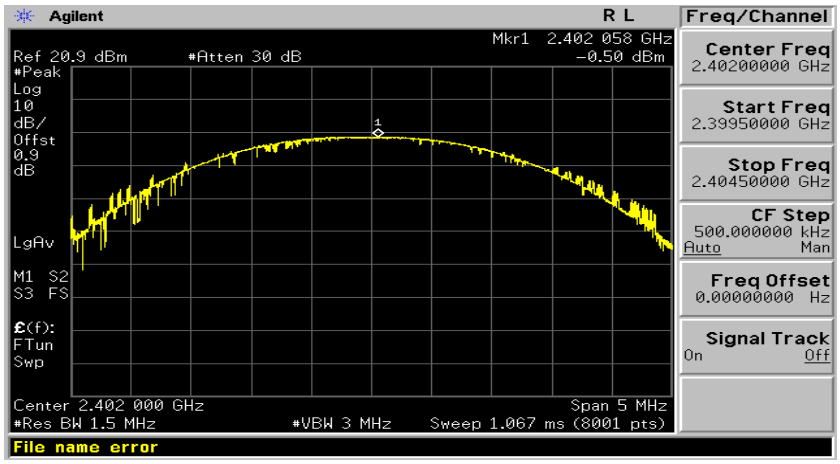
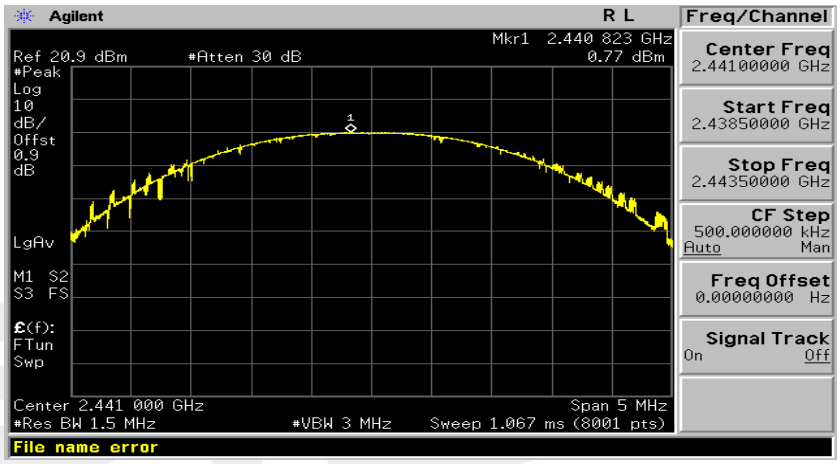
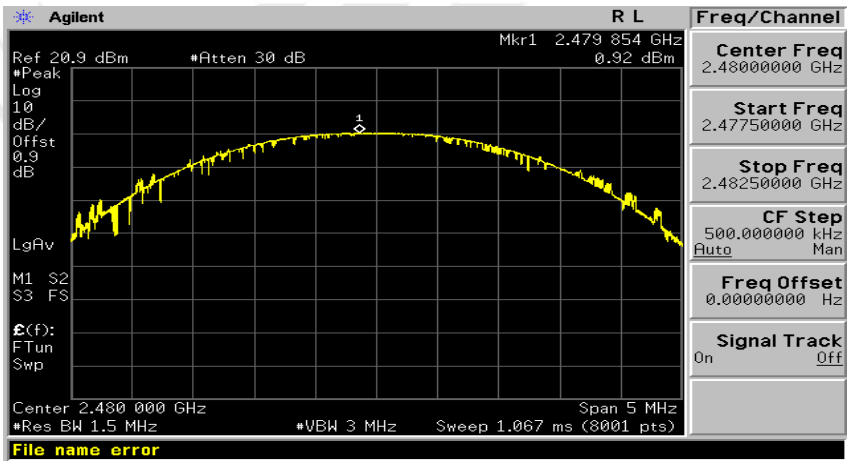
PEAK OUTPUT POWER MEASUREMENT RESULT FOR GFSK MOUDULATION				
Frequency (GHz)	Average Power (dBm)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
2.402	-1.71	0.30	30	Pass
2.441	-0.36	1.65	30	Pass
2.480	0.12	1.93	30	Pass

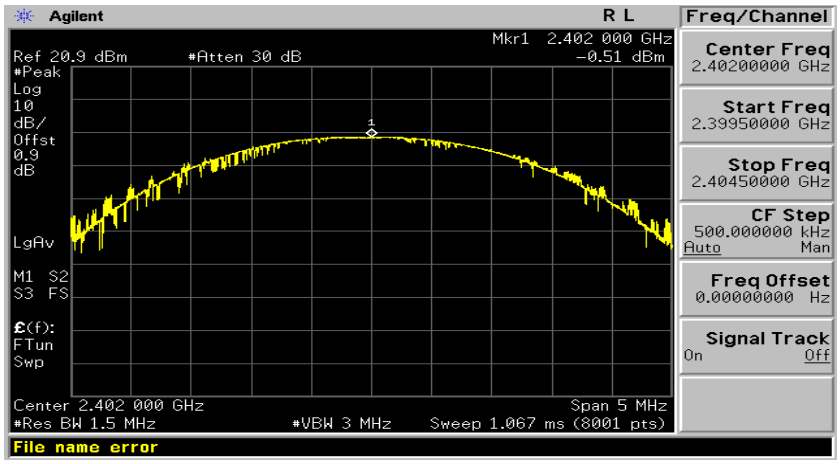
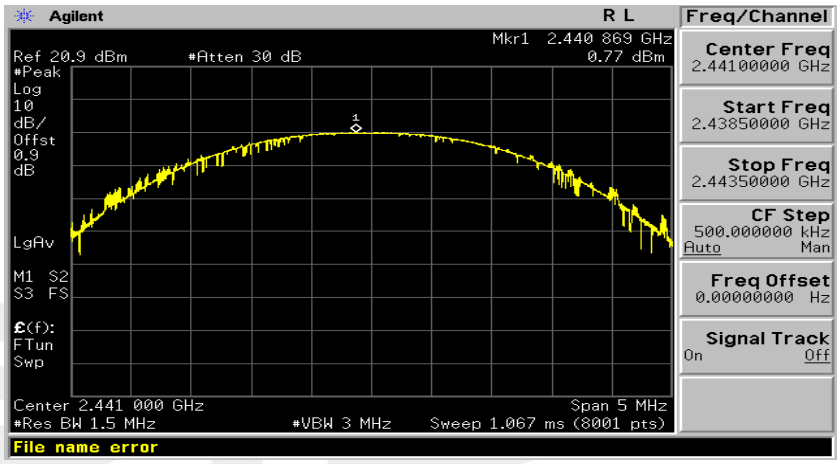
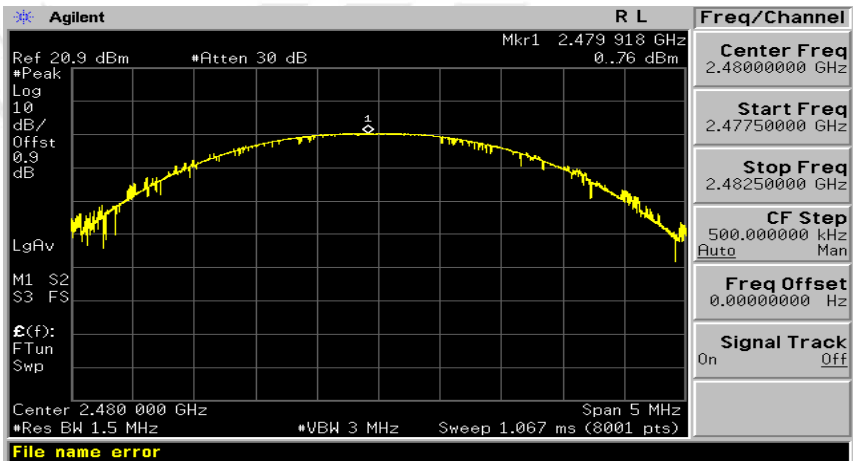
PEAK OUTPUT POWER MEASUREMENT RESULT FOR Ⅱ /4-DQPSK MODULATION				
Frequency (GHz)	Average Power (dBm)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
2.402	-2.51	-0.5	21	Pass
2.441	-1.24	0.77	21	Pass
2.480	-0.89	0.92	21	Pass

PEAK OUTPUT POWER MEASUREMENT RESULT FOR 8-DPSK MODULATION				
Frequency (GHz)	Average Power (dBm)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
2.402	-2.52	-0.51	21	Pass
2.441	-1.24	0.77	21	Pass
2.480	-0.85	0.76	21	Pass

Test Graph

Graphs	
GFSK/LCH	
GFSK/MCH	
GFSK/HCH	

π /4DQPSK/LCH	
π /4DQPSK/MCH	
π /4DQPSK/HCH	

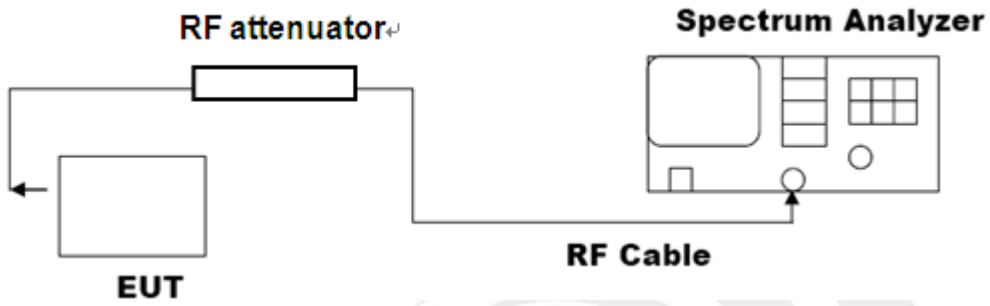
8DPSK/LCH	
8DPSK/MCH	
8DPSK/HCH	

8. 20DB BANDWIDTH

8.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2, Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hoping channel
   RBW ≥ 1% of the 20 dB bandwidth, VBW ≥ RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

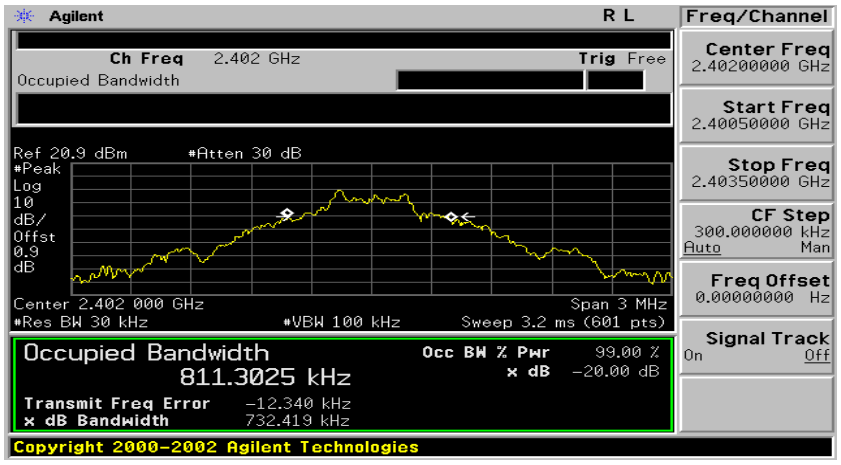
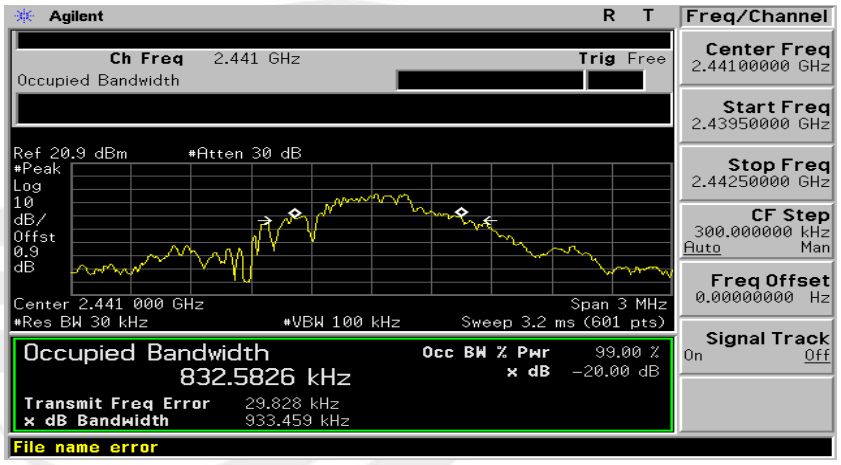
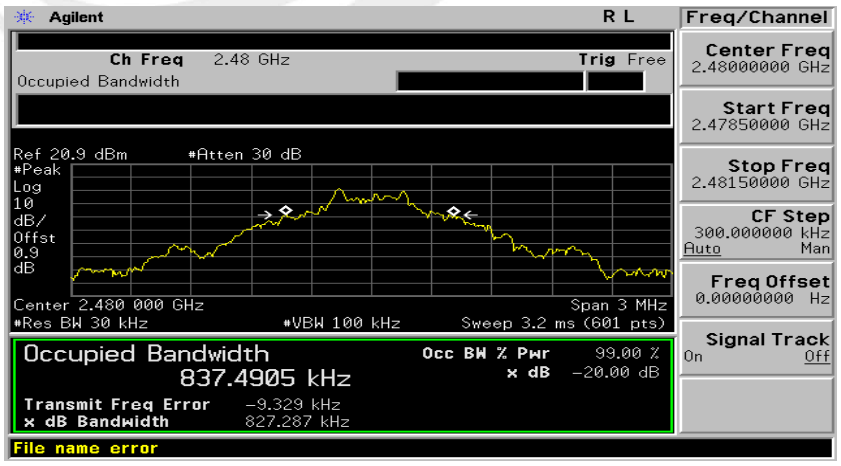
8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

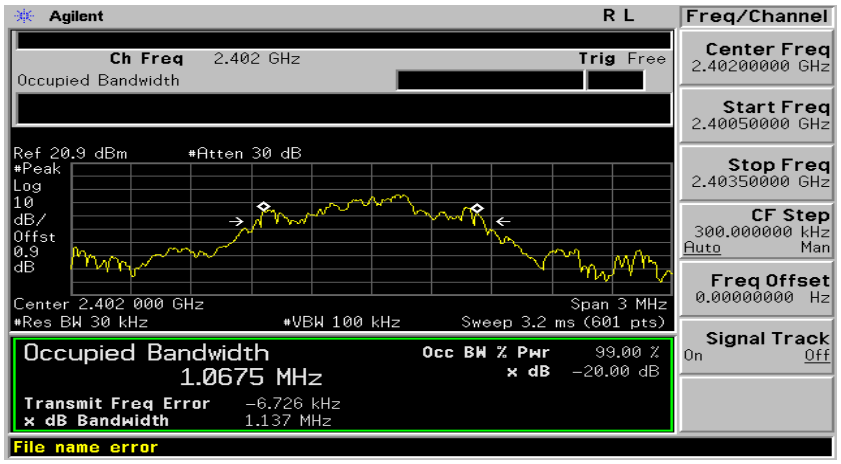
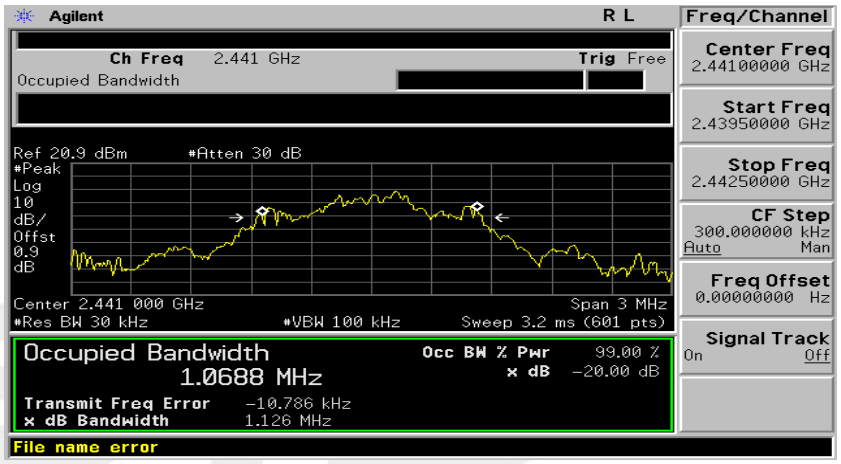
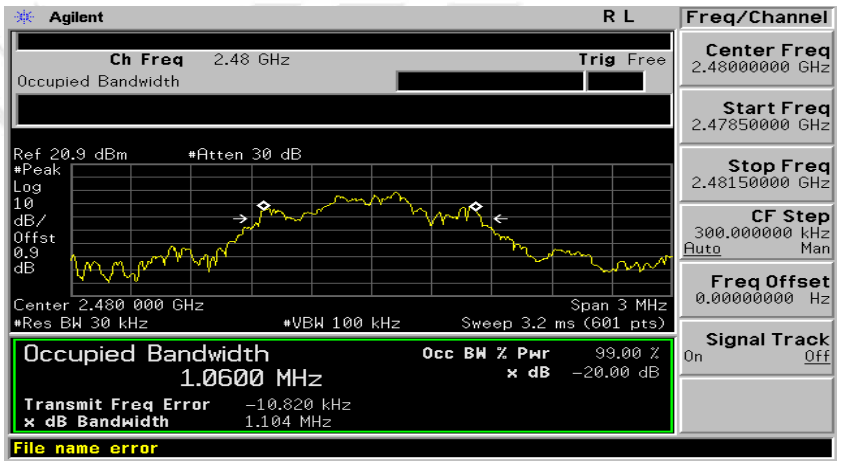


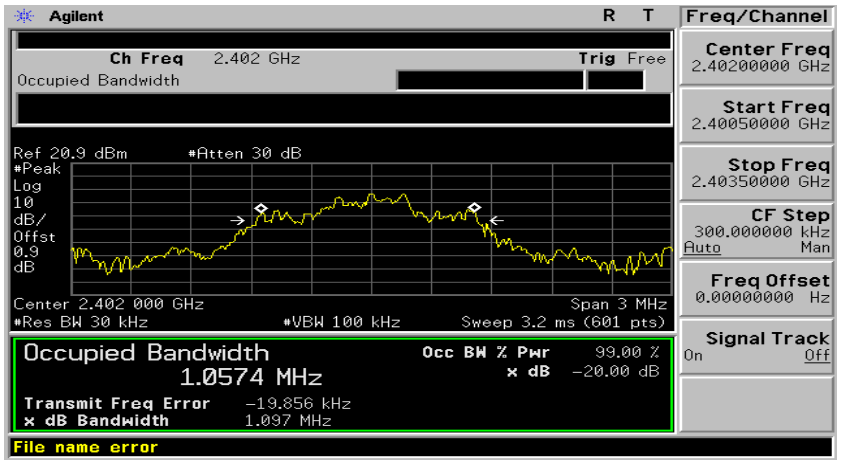
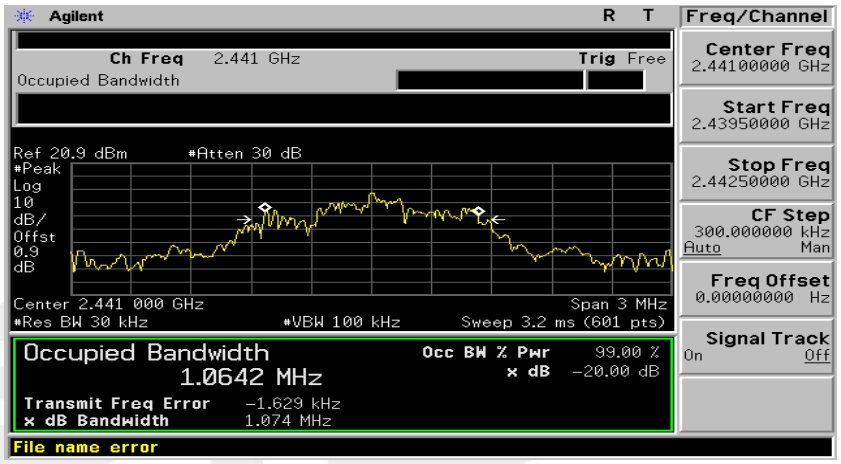
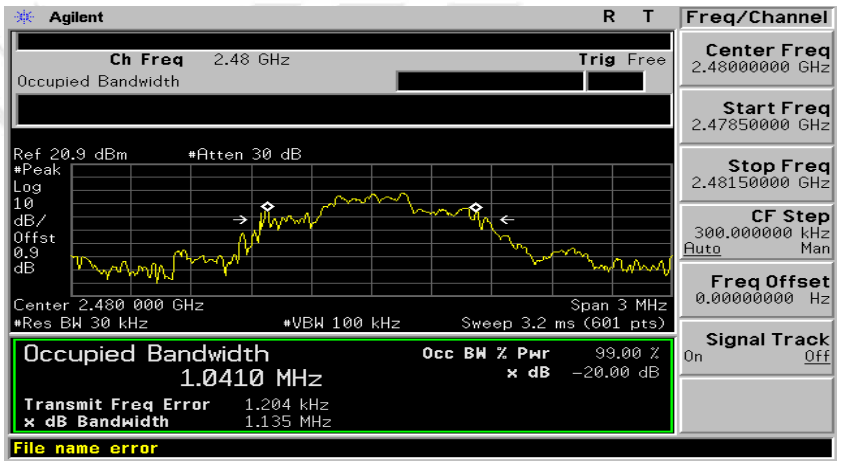
8.3. LIMITS AND MEASUREMENT RESULTS

Mode	Channel.	EBW [MHz]	OBW [MHz]	Verdict
GFSK	LCH	0.7324	0.8113	PASS
GFSK	MCH	0.9335	0.8326	PASS
GFSK	HCH	0.8273	0.8375	PASS
π/4DQPSK	LCH	1.1372	1.0675	PASS
π/4DQPSK	MCH	1.1260	1.0688	PASS
π/4DQPSK	HCH	1.1044	1.0600	PASS
8DPSK	LCH	1.0970	1.0574	PASS
8DPSK	MCH	1.0743	1.0642	PASS
8DPSK	HCH	1.1351	1.0410	PASS

Test Graph

Graphs	
GFSK/LCH	
GFSK/MCH	
GFSK/HCH	

π /4DQPSK/LCH	
π /4DQPSK/MCH	
π /4DQPSK/HCH	

8DPSK/LCH	
8DPSK/MCH	
8DPSK/HCH	

9. CONDUCTED SPURIOUS EMISSION

9.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the Middle and the bottom operation frequency individually.
3. Set the Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
   RBW = 100 kHz; VBW ≥ RBW; Sweep = auto; Detector function = peak.
4. Set SPA Trace 1 Max hold, then View.

Note: The EUT was tested according to DA000705 for compliance to FCC 47CFR 15.247 requirements. Owing to satisfy the requirements of the number of measurement points, we set the RBW=1MHz, VBW＞RBW, scan up through 10th harmonic, and consider the tested results as the worst case, if the tested results conform to the requirement, we can deem that the real tested results(set the RBW=100KHz, VBW＞RBW) are conform to the requirement.

9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 8.2

9.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6

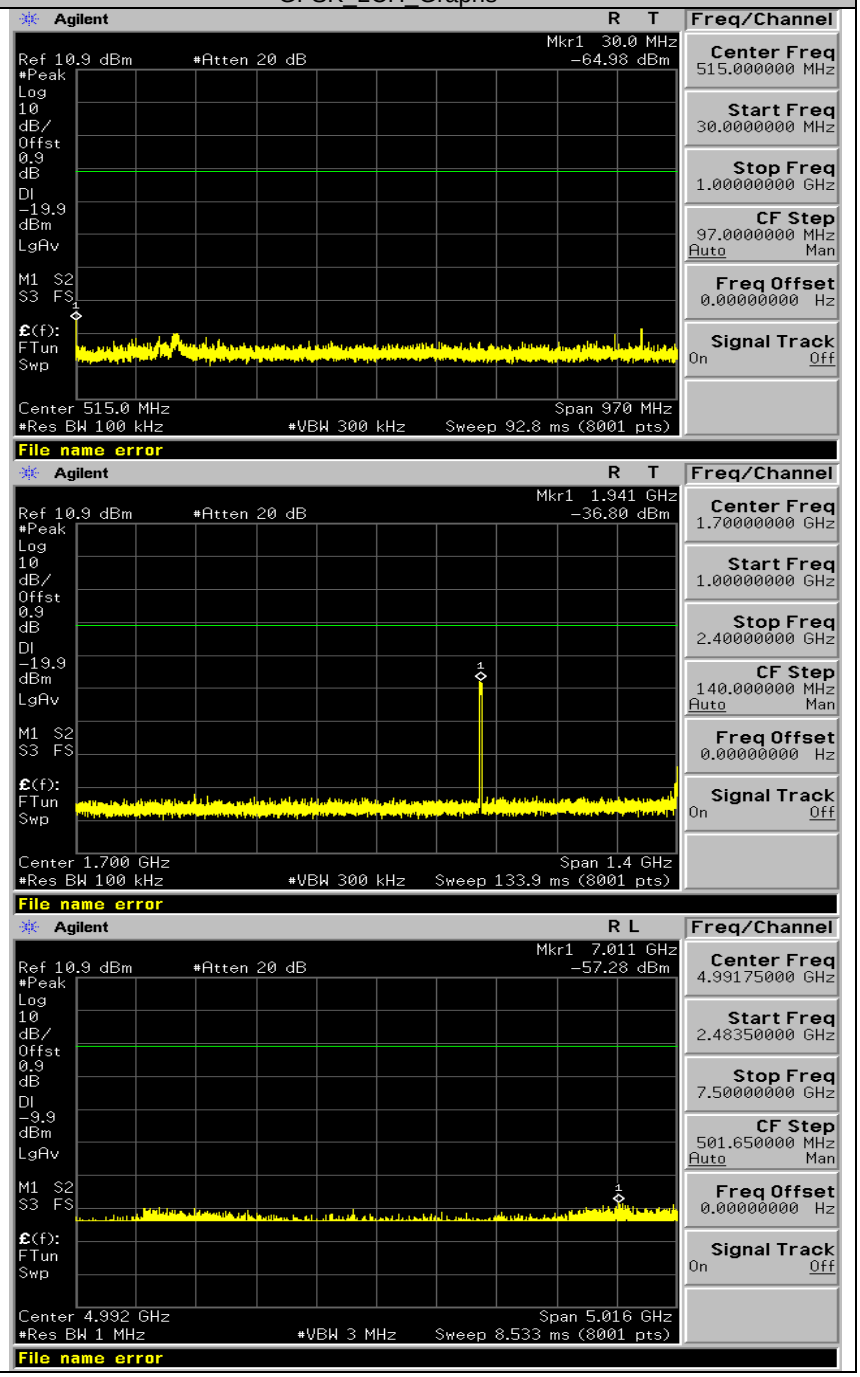
9.4. LIMITS AND MEASUREMENT RESULT

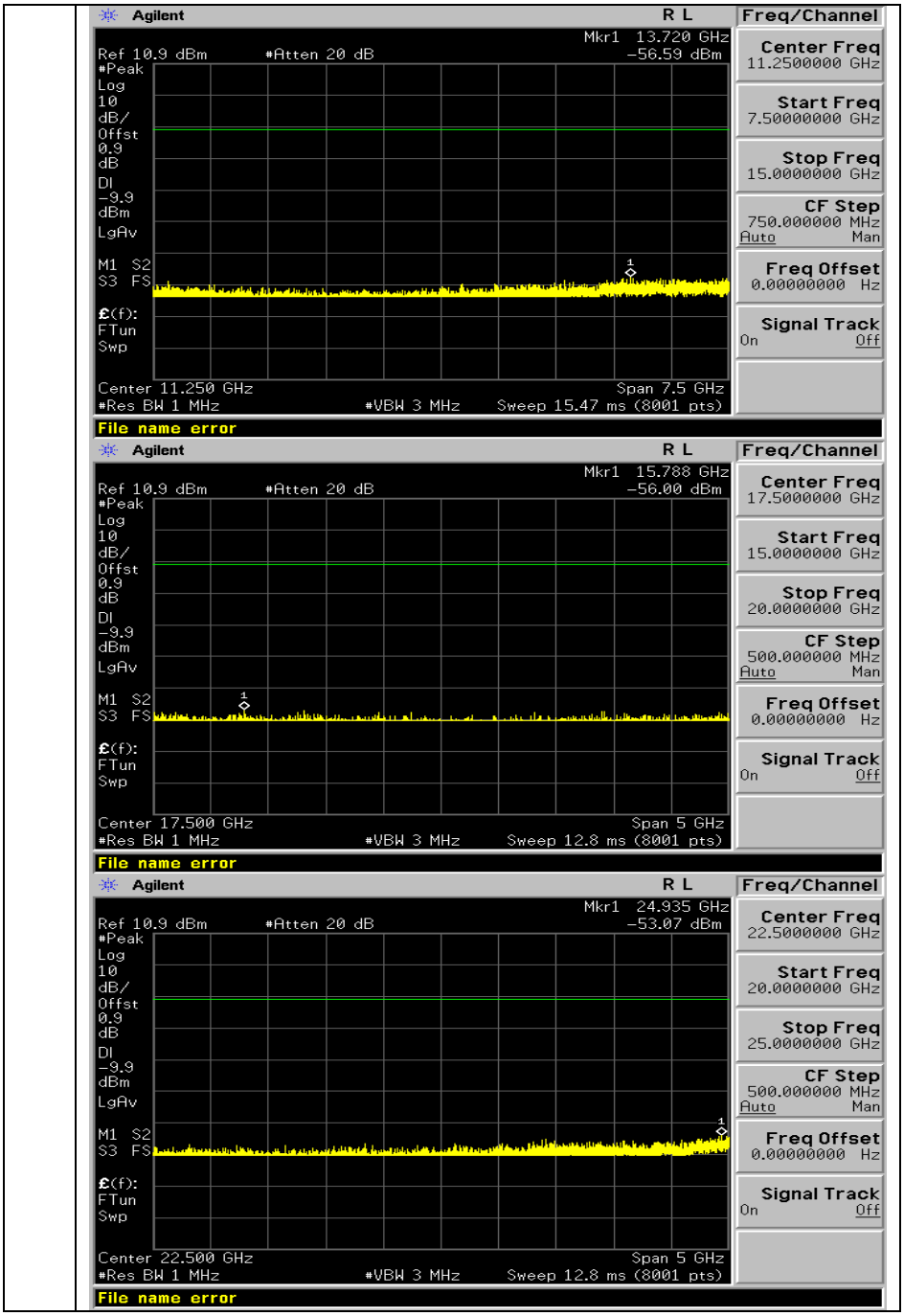
LIMITS AND MEASUREMENT RESULT		
Applicable Limits	**Measurement Result**	
	Test Data	**Criteria**
In any 100 KHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. In addition, radiation emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in§15.209(a))	At least -20dBc than the limit Specified on the BOTTOM Channel	PASS
	At least -20dBc than the limit Specified on the TOP Channel	PASS

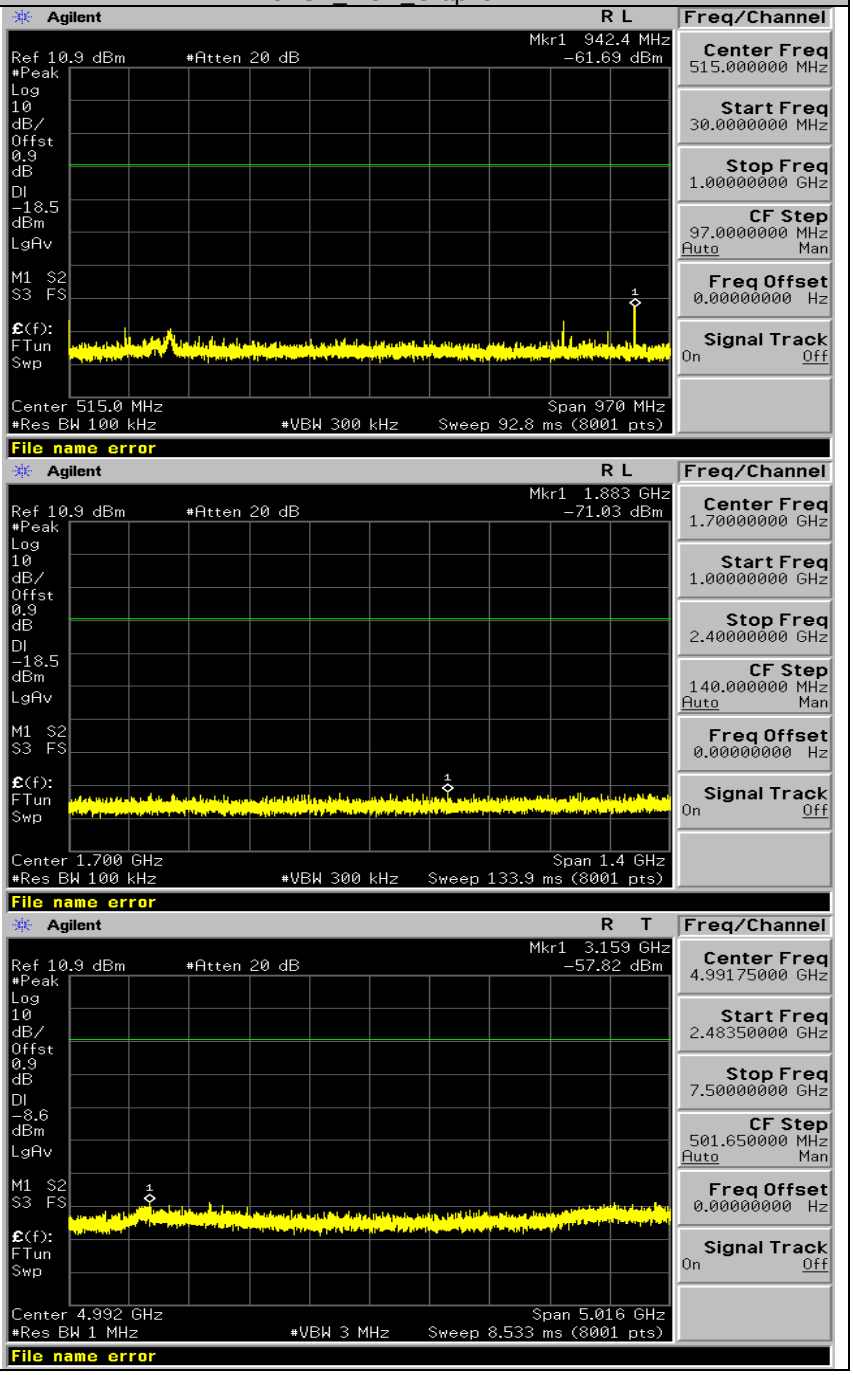
Test Graph

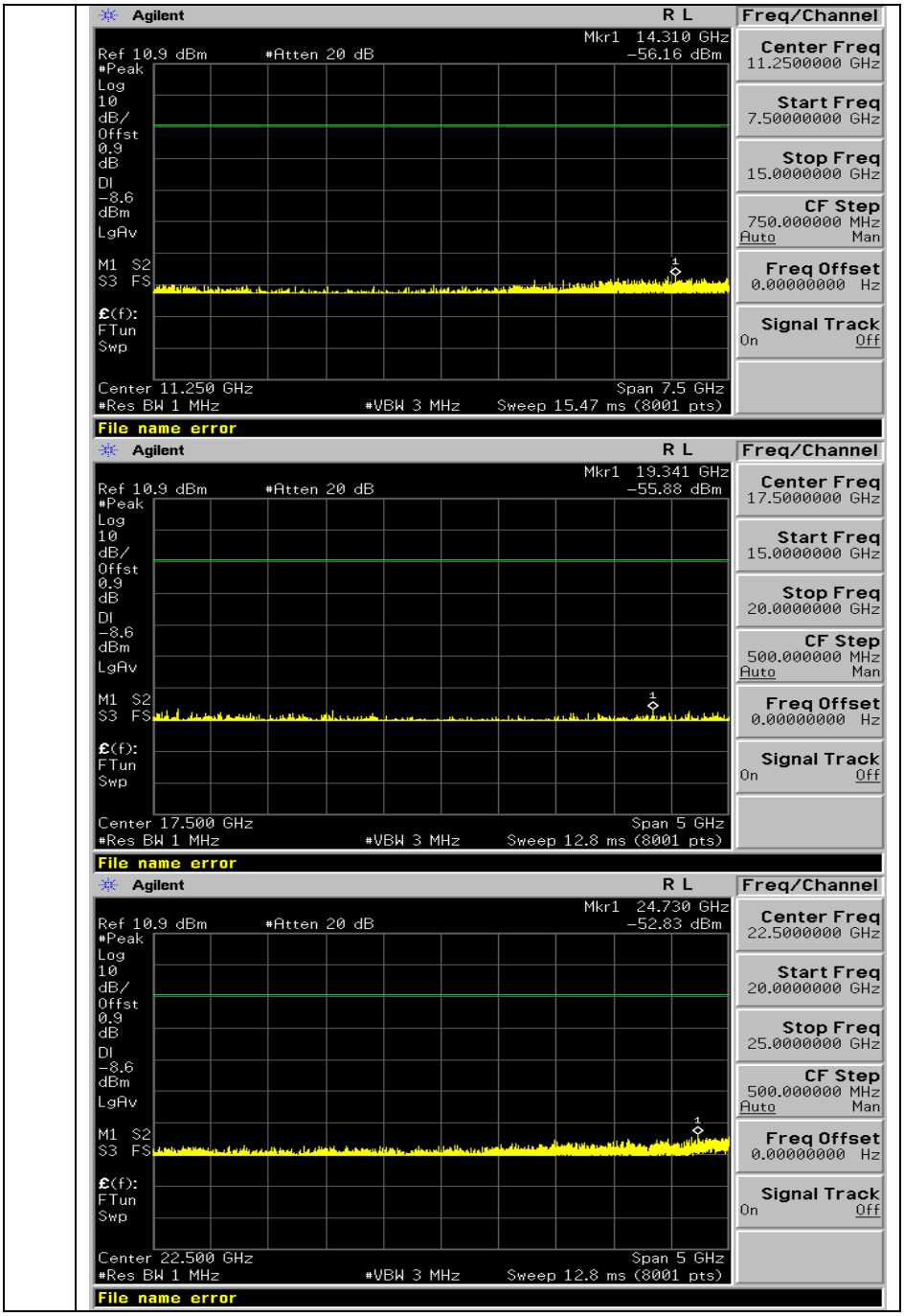
GFSK_LCH_Graphs

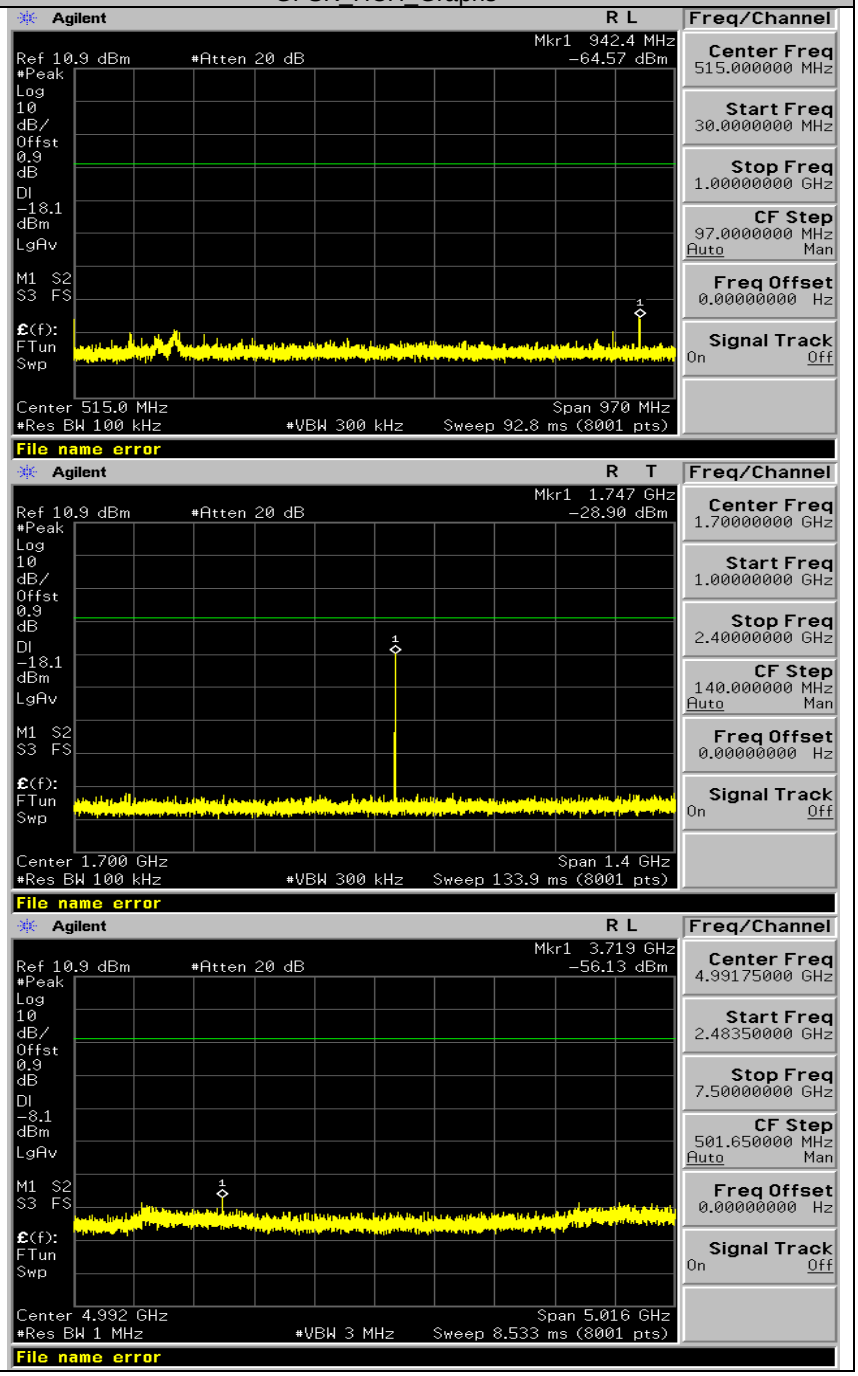
Puw

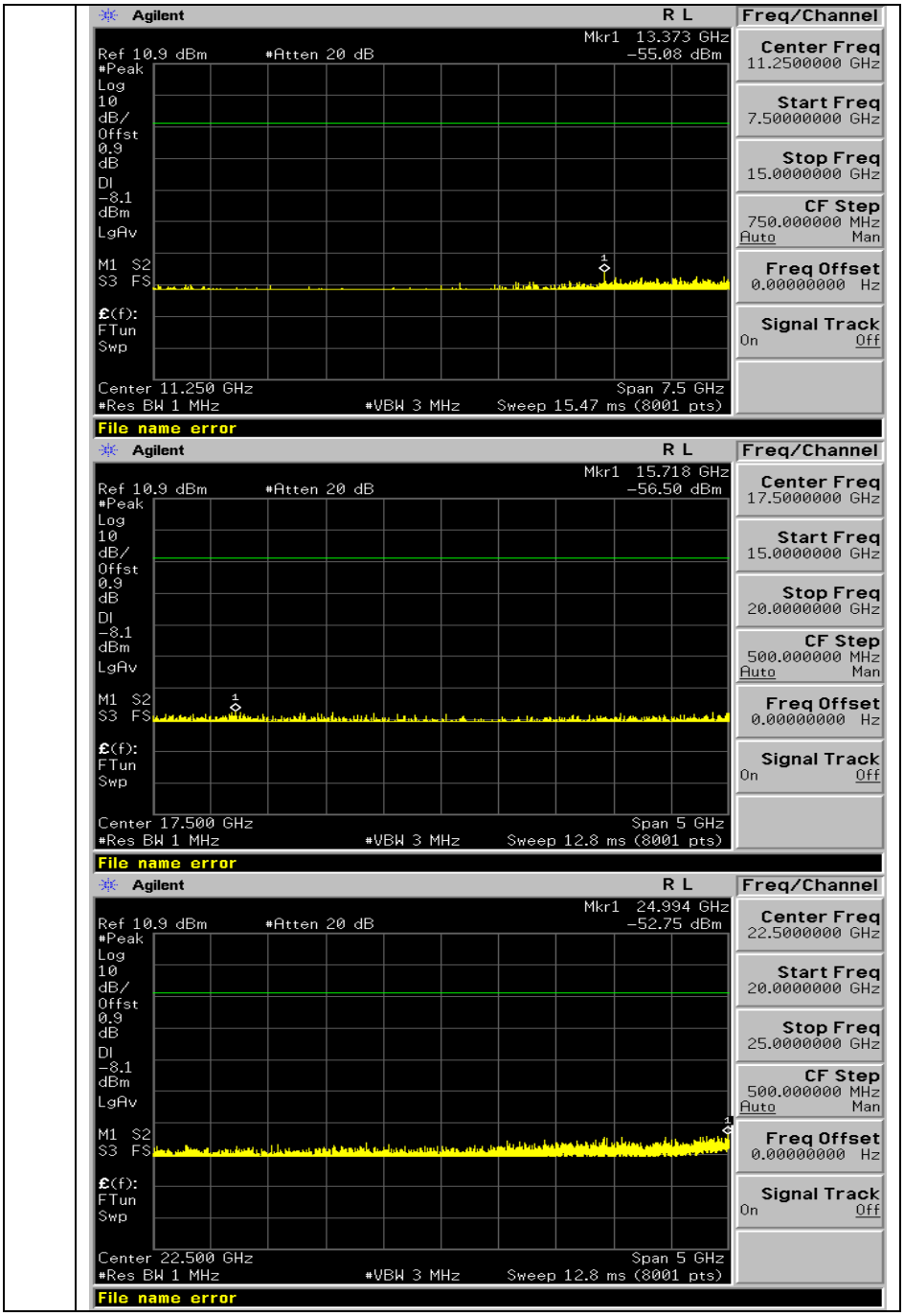


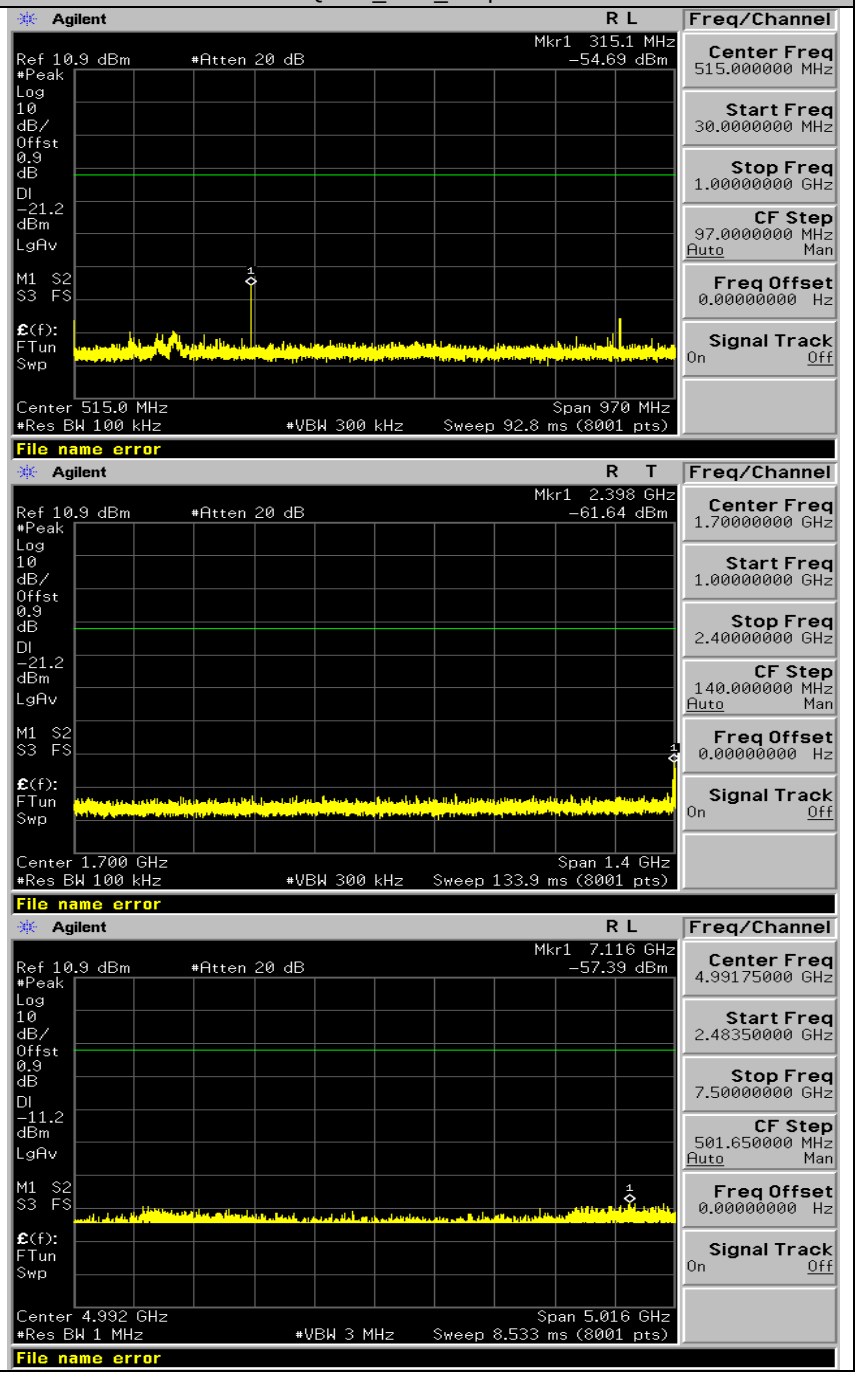

Agilent
R L
Freq/Channel
Mkr1 13.720 GHz
Ref 10.9 dBm
#Atten 20 dB
-56.59 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.9
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
11.2500000 GHz
Start Freq
7.50000000 GHz
Stop Freq
15.0000000 GHz
CF Step
750.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 11.250 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 7.5 GHz
Sweep 15.47 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 15.788 GHz
Ref 10.9 dBm
#Atten 20 dB
-56.00 dBm
Center Freq
17.5000000 GHz
Start Freq
15.0000000 GHz
Stop Freq
20.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 17.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 24.935 GHz
Ref 10.9 dBm
#Atten 20 dB
-53.07 dBm
Center Freq
22.5000000 GHz
Start Freq
20.0000000 GHz
Stop Freq
25.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 22.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error

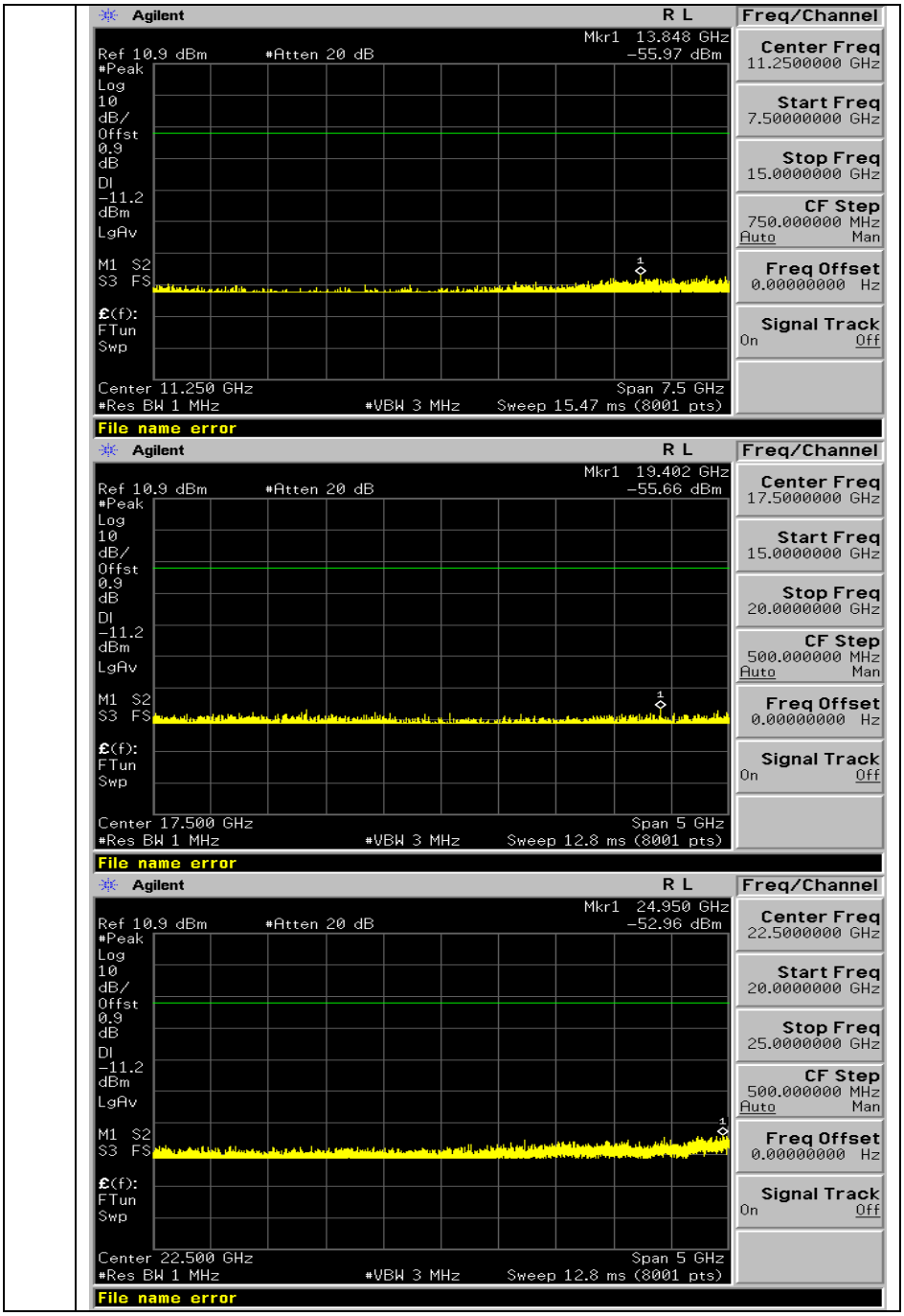
GFSK_MCH_Graphs	
Puw	

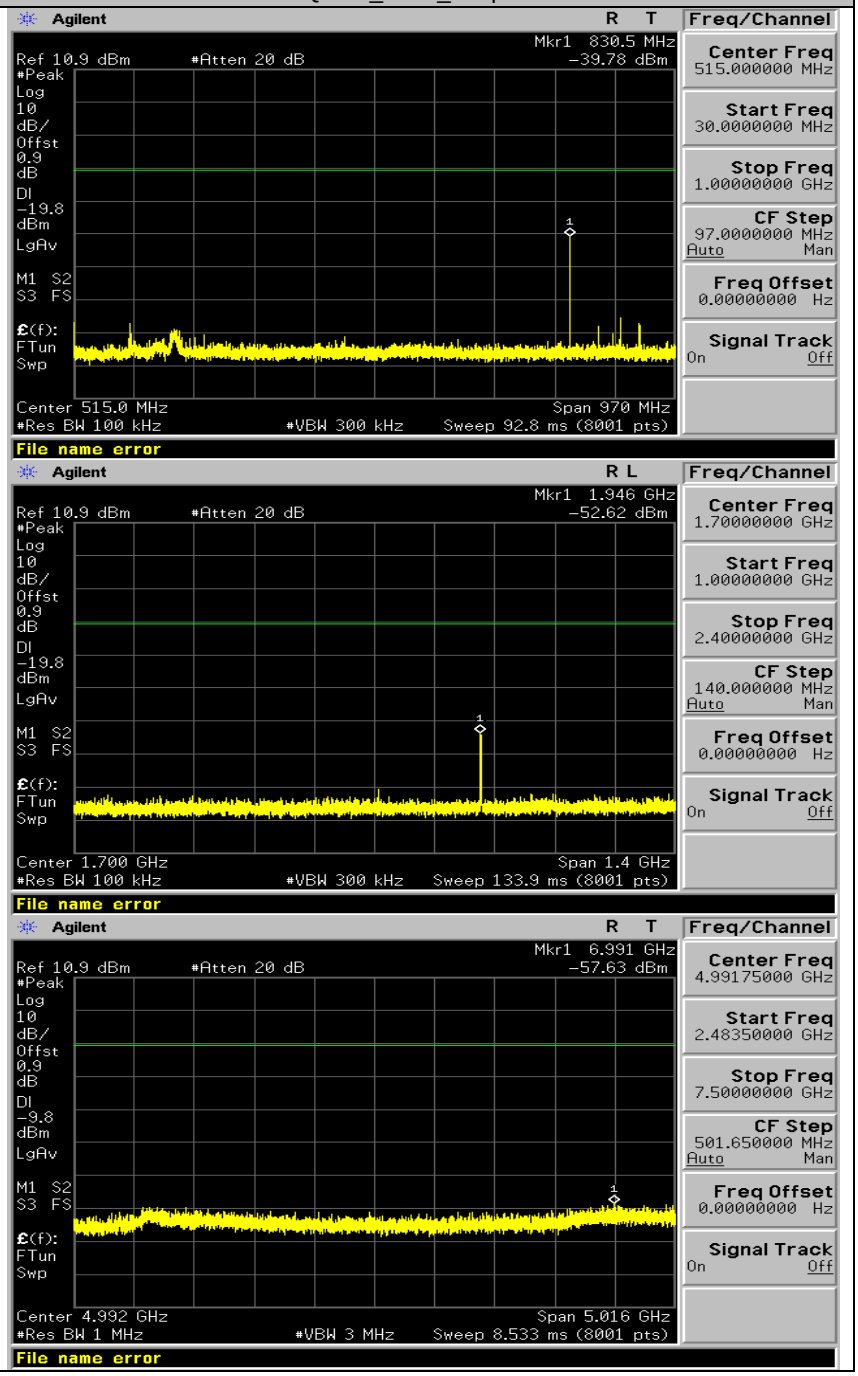

Agilent
R L
Freq/Channel
Mkr1 14.310 GHz
Ref 10.9 dBm
#Atten 20 dB
-56.16 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-8.6
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
11.2500000 GHz
Start Freq
7.50000000 GHz
Stop Freq
15.0000000 GHz
CF Step
750.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 11.250 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 7.5 GHz
Sweep 15.47 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 19.341 GHz
Ref 10.9 dBm
#Atten 20 dB
-55.88 dBm
Center Freq
17.5000000 GHz
Start Freq
15.0000000 GHz
Stop Freq
20.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 17.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 24.730 GHz
Ref 10.9 dBm
#Atten 20 dB
-52.83 dBm
Center Freq
22.5000000 GHz
Start Freq
20.0000000 GHz
Stop Freq
25.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 22.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error

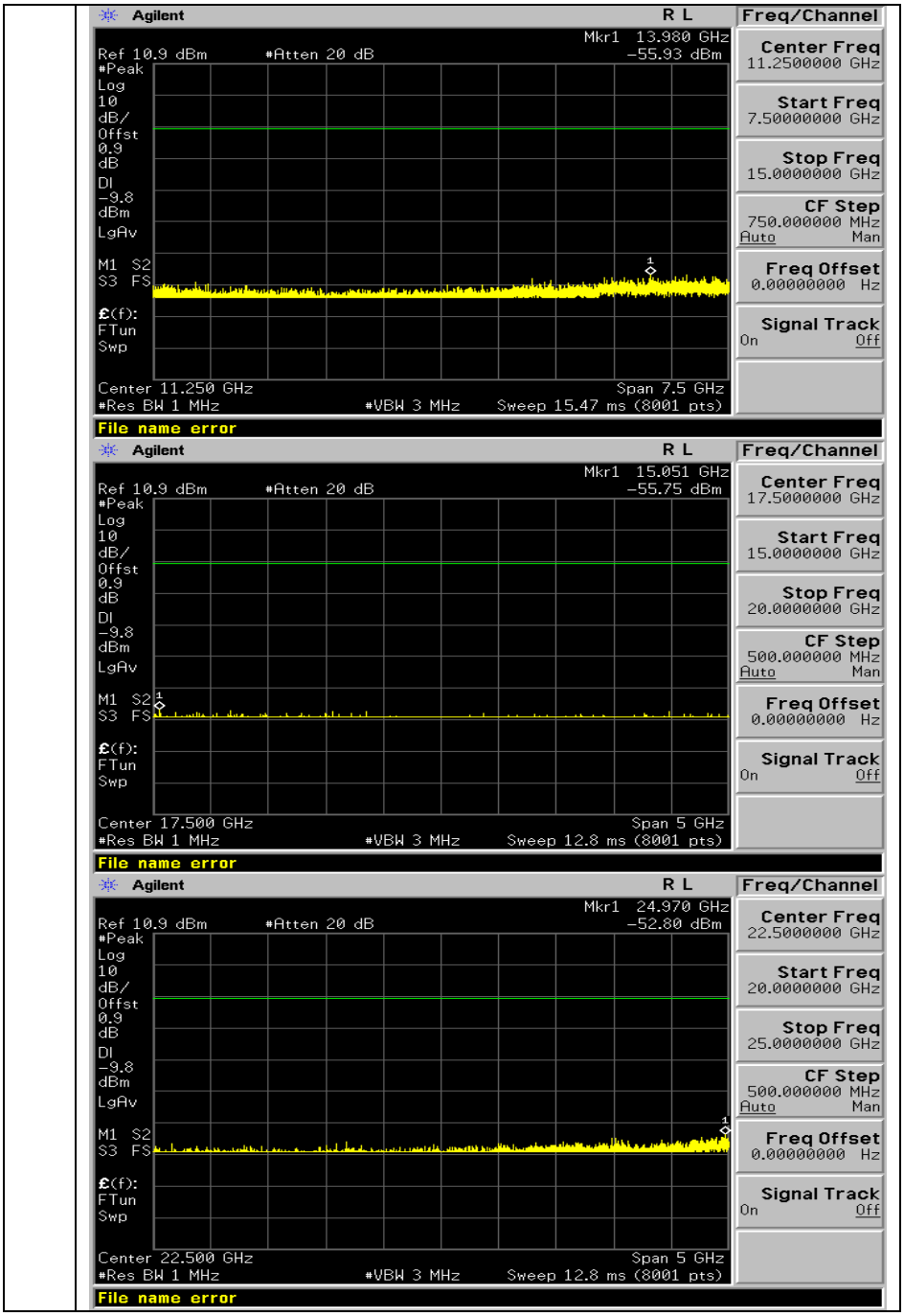
GFSK_HCH_Graphs	
Puw	

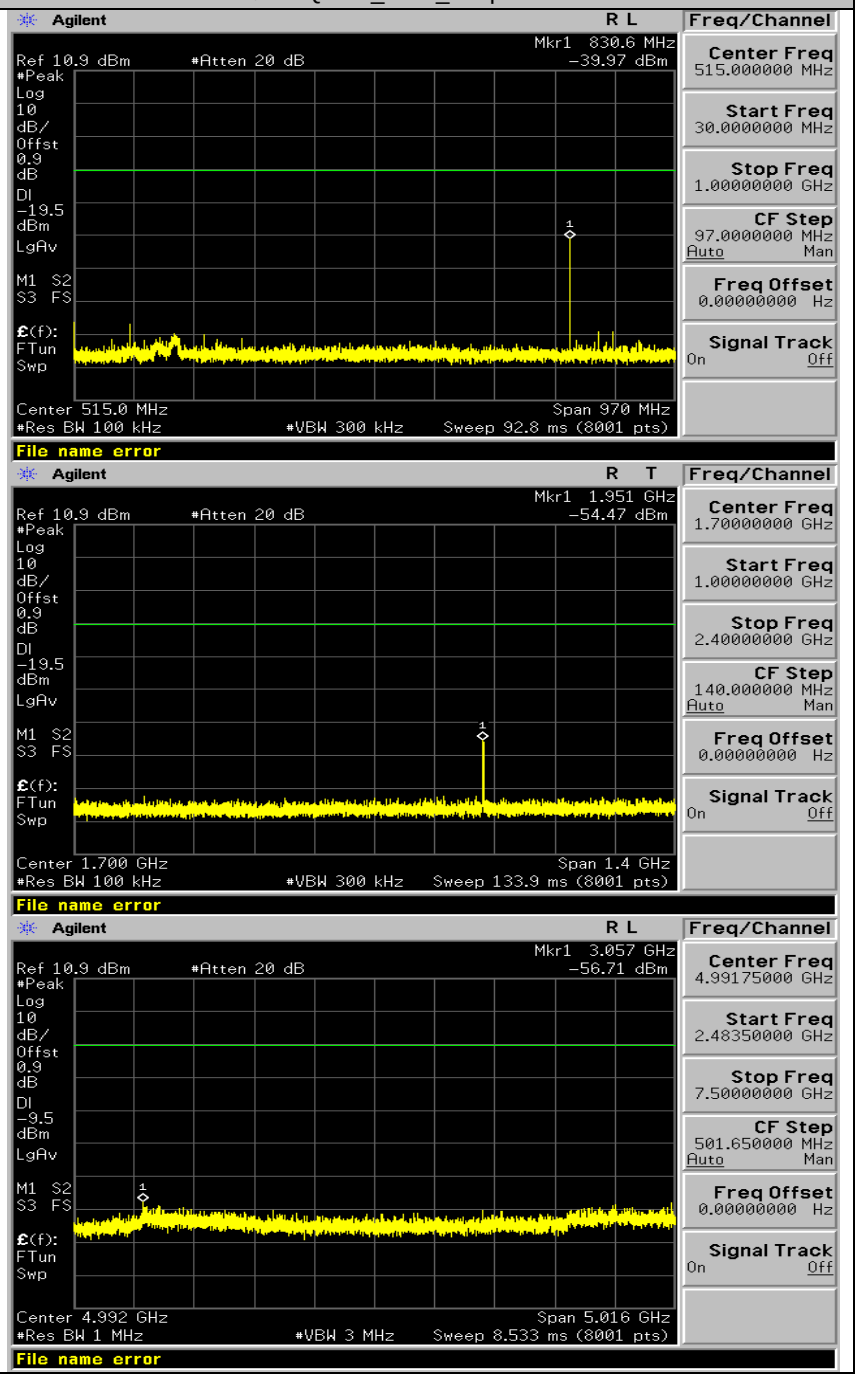

Agilent
R L
Freq/Channel
Mkr1 13.373 GHz
Ref 10.9 dBm
#Atten 20 dB
-55.08 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-8.1
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
11.2500000 GHz
Start Freq
7.50000000 GHz
Stop Freq
15.0000000 GHz
CF Step
750.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 11.250 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 7.5 GHz
Sweep 15.47 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 15.718 GHz
Ref 10.9 dBm
#Atten 20 dB
-56.50 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-8.1
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
17.5000000 GHz
Start Freq
15.0000000 GHz
Stop Freq
20.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 17.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 24.994 GHz
Ref 10.9 dBm
#Atten 20 dB
-52.75 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-8.1
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
22.5000000 GHz
Start Freq
20.0000000 GHz
Stop Freq
25.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 22.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error

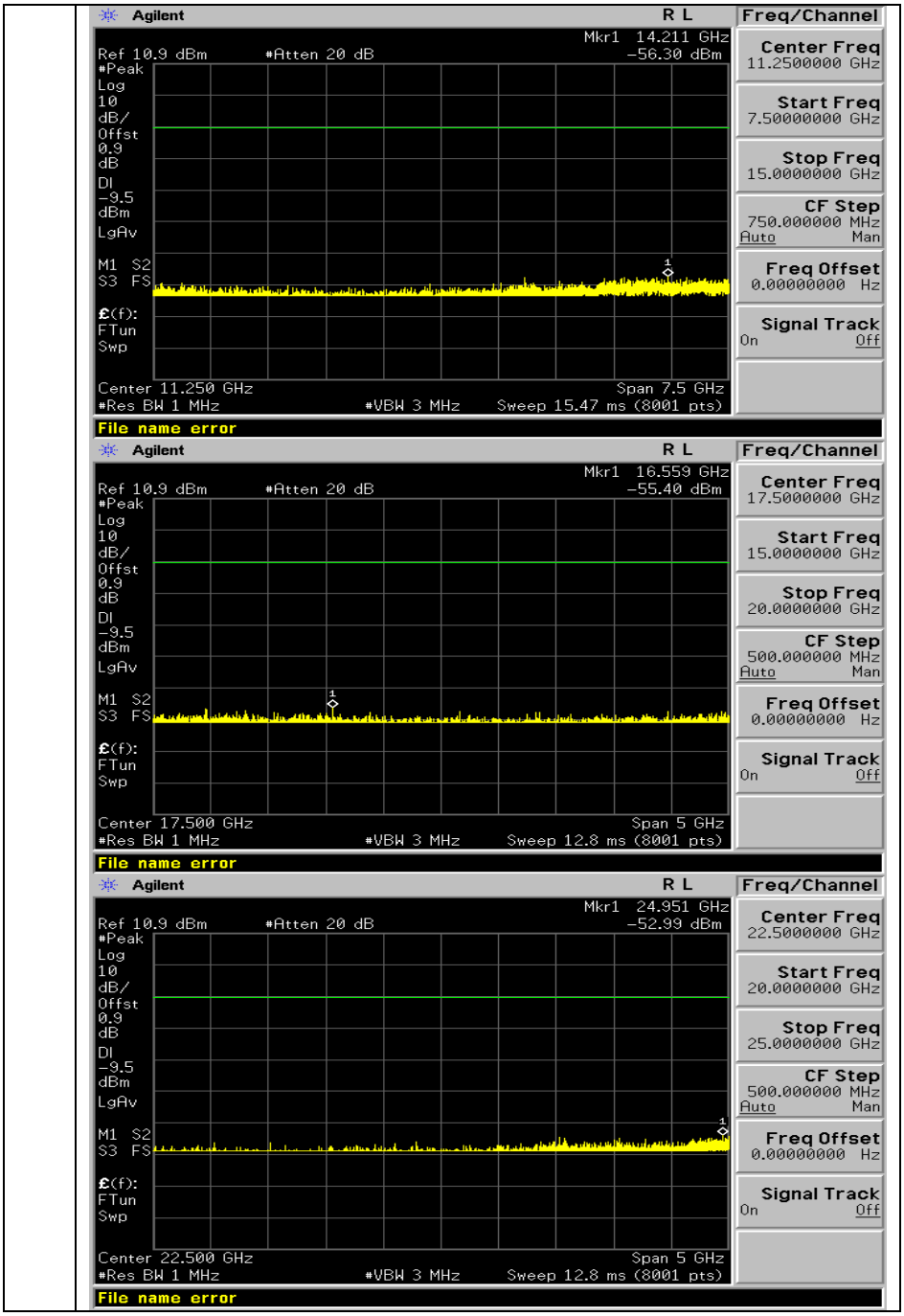
π/4DQPSK_LCH_Graphs	
Puw	

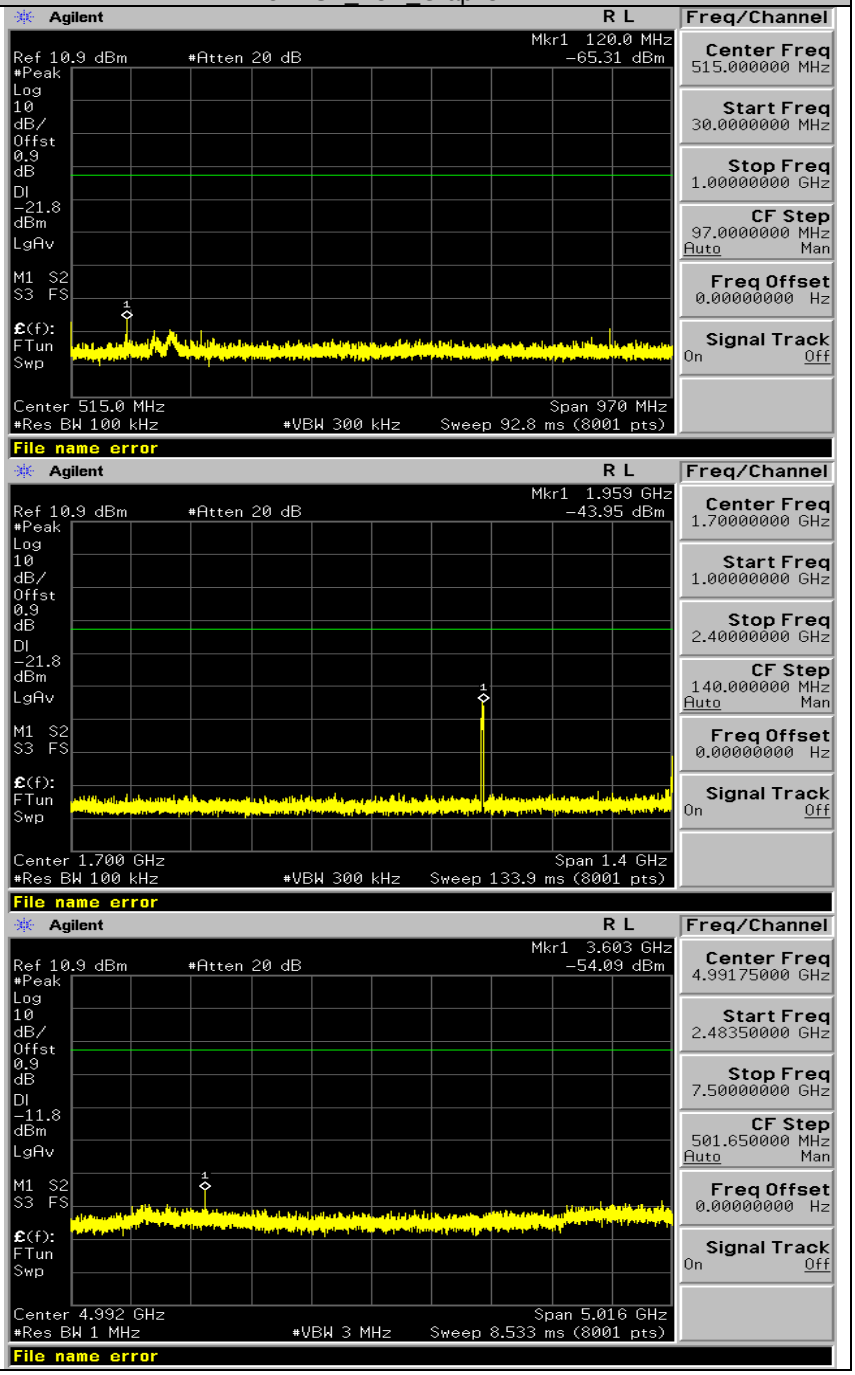

Agilent
R L
Freq/Channel
Mkr1 13.848 GHz
Ref 10.9 dBm
#Atten 20 dB
-55.97 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-11.2
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
11.2500000 GHz
Start Freq
7.50000000 GHz
Stop Freq
15.0000000 GHz
CF Step
750.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 11.250 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 7.5 GHz
Sweep 15.47 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 19.402 GHz
Ref 10.9 dBm
#Atten 20 dB
-55.66 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-11.2
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
17.5000000 GHz
Start Freq
15.0000000 GHz
Stop Freq
20.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 17.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 24.950 GHz
Ref 10.9 dBm
#Atten 20 dB
-52.96 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-11.2
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
22.5000000 GHz
Start Freq
20.0000000 GHz
Stop Freq
25.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 22.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error

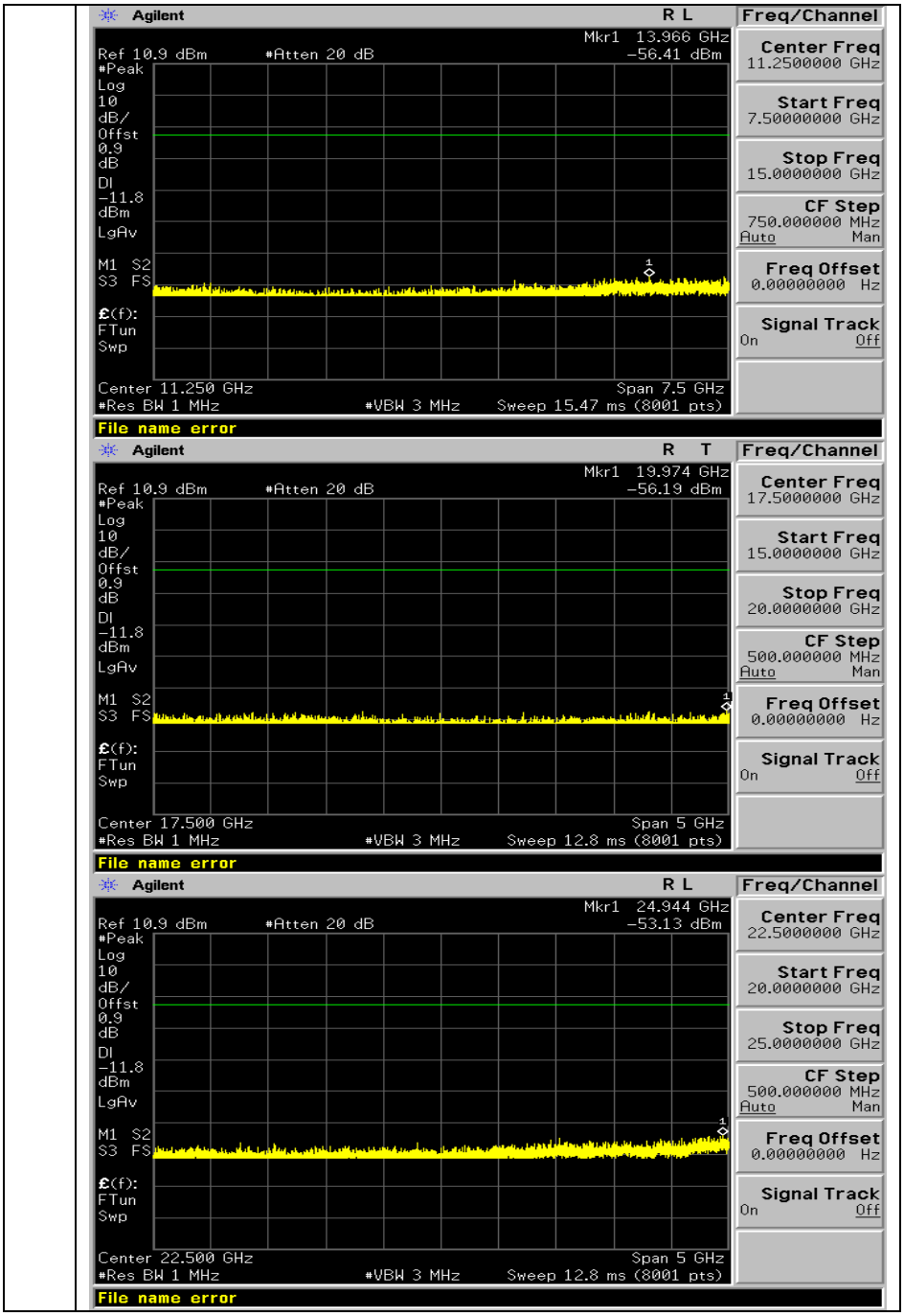
π/4DQPSK_MCH_Graphs	
Puw	

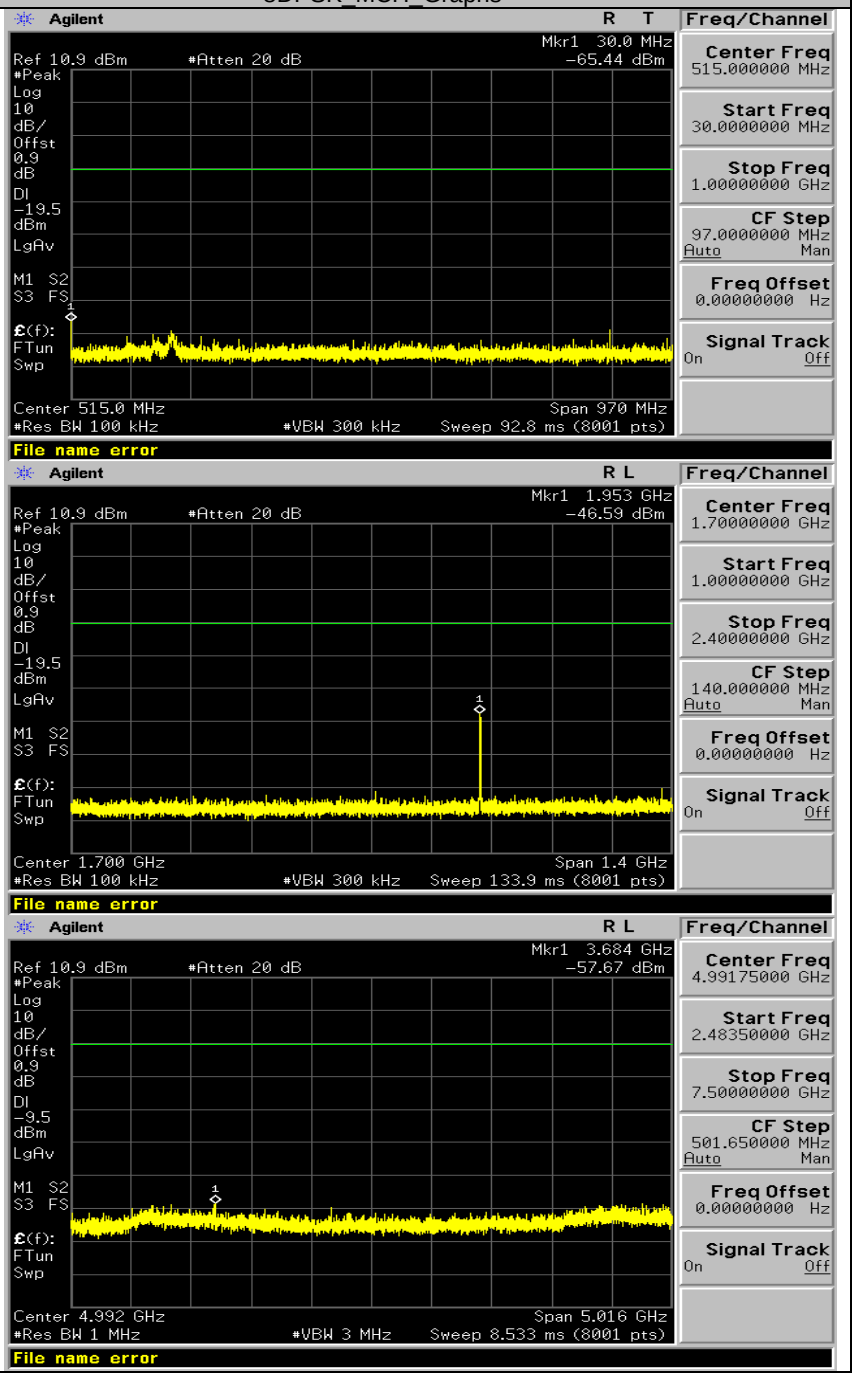

Agilent
R L
Freq/Channel
Mkr1 13.980 GHz
Ref 10.9 dBm
#Atten 20 dB
-55.93 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.8
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
11.2500000 GHz
Start Freq
7.50000000 GHz
Stop Freq
15.0000000 GHz
CF Step
750.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 11.250 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 7.5 GHz
Sweep 15.47 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 15.051 GHz
Ref 10.9 dBm
#Atten 20 dB
-55.75 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.8
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
17.5000000 GHz
Start Freq
15.0000000 GHz
Stop Freq
20.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 17.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 24.970 GHz
Ref 10.9 dBm
#Atten 20 dB
-52.80 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.8
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
22.5000000 GHz
Start Freq
20.0000000 GHz
Stop Freq
25.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 22.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error

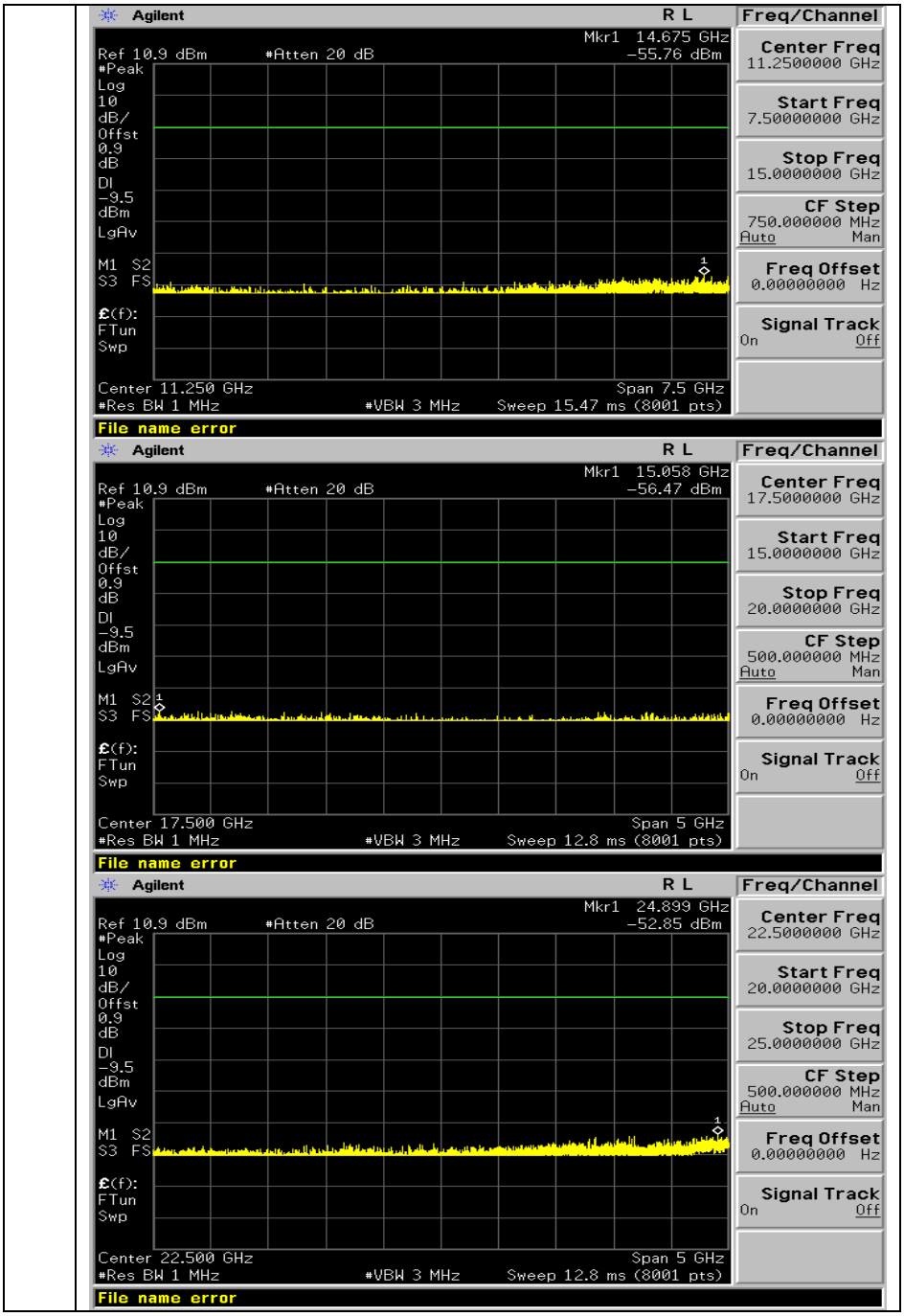
π/4DQPSK_HCH_Graphs	
Puw	

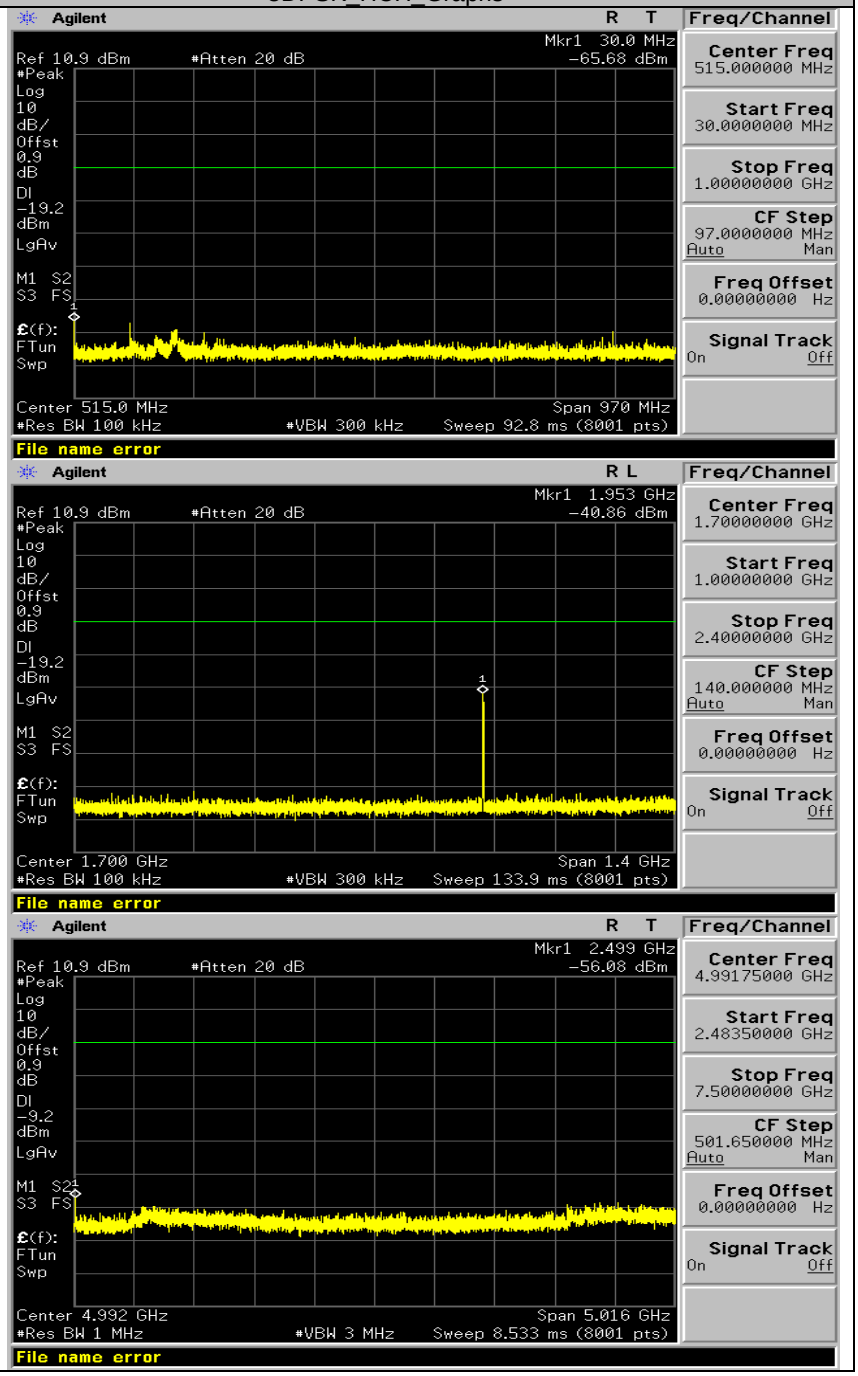

Agilent
R L
Freq/Channel
Mkr1 14.211 GHz
Ref 10.9 dBm
#Atten 20 dB
-56.30 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.5
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
11.2500000 GHz
Start Freq
7.50000000 GHz
Stop Freq
15.0000000 GHz
CF Step
750.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 11.250 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 7.5 GHz
Sweep 15.47 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 16.559 GHz
Ref 10.9 dBm
#Atten 20 dB
-55.40 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.5
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
17.5000000 GHz
Start Freq
15.0000000 GHz
Stop Freq
20.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 17.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 24.951 GHz
Ref 10.9 dBm
#Atten 20 dB
-52.99 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.5
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
22.5000000 GHz
Start Freq
20.0000000 GHz
Stop Freq
25.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 22.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error

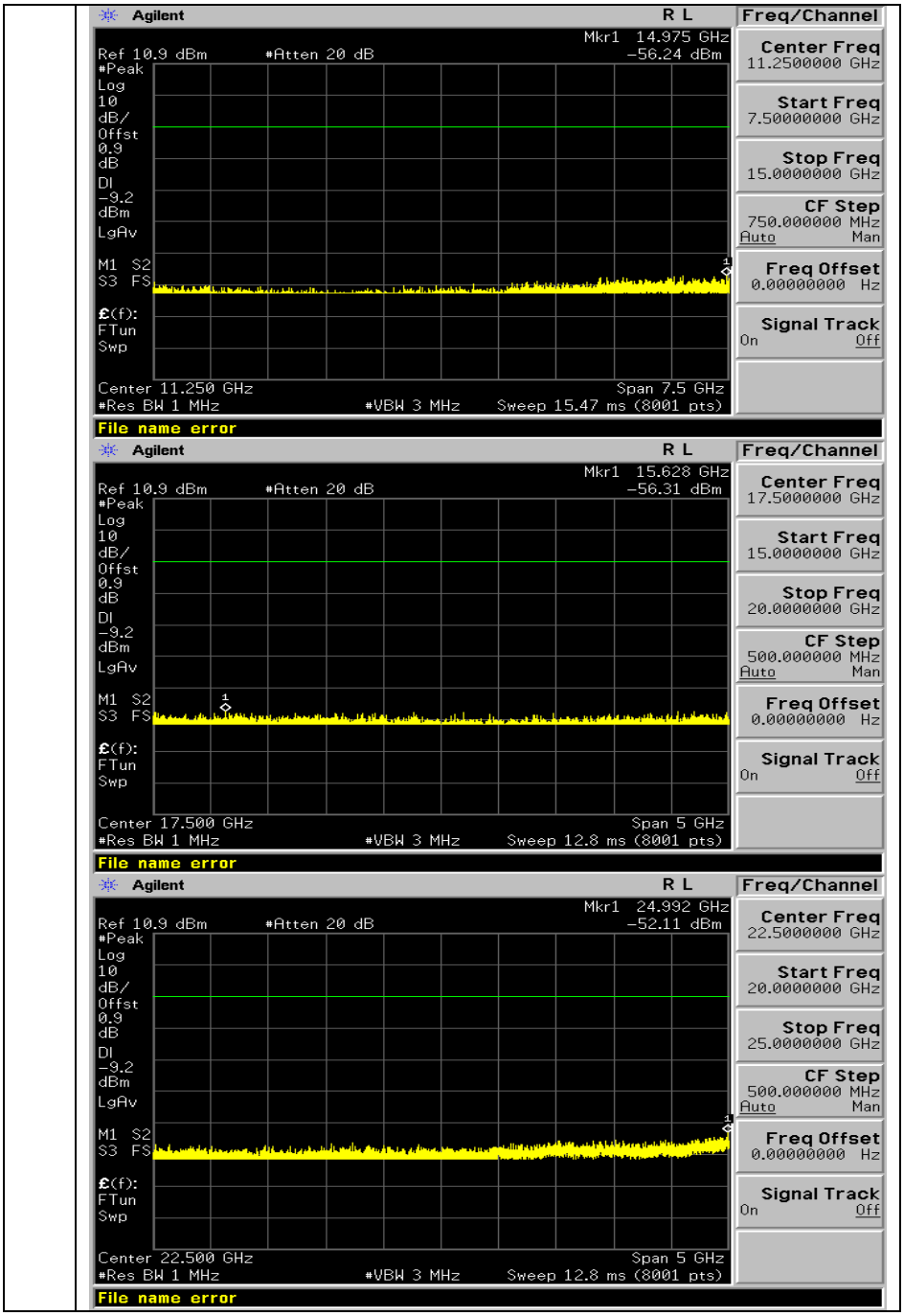
8DPSK_LCH_Graphs	
Puw	


Agilent
R L
Freq/Channel
Mkr1 13.966 GHz
Ref 10.9 dBm
#Atten 20 dB
-56.41 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-11.8
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
11.2500000 GHz
Start Freq
7.50000000 GHz
Stop Freq
15.0000000 GHz
CF Step
750.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 11.250 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 7.5 GHz
Sweep 15.47 ms (8001 pts)
File name error
Agilent
R T
Freq/Channel
Mkr1 19.974 GHz
Ref 10.9 dBm
#Atten 20 dB
-56.19 dBm
Center Freq
17.5000000 GHz
Start Freq
15.0000000 GHz
Stop Freq
20.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 17.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 24.944 GHz
Ref 10.9 dBm
#Atten 20 dB
-53.13 dBm
Center Freq
22.5000000 GHz
Start Freq
20.0000000 GHz
Stop Freq
25.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 22.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error

8DPSK_MCH_Graphs	
Puw	


Agilent
R L
Freq/Channel
Mkr1 14.675 GHz
Ref 10.9 dBm
#Atten 20 dB
-55.76 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.5
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
11.2500000 GHz
Start Freq
7.50000000 GHz
Stop Freq
15.0000000 GHz
CF Step
750.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 11.250 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 7.5 GHz
Sweep 15.47 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 15.058 GHz
Ref 10.9 dBm
#Atten 20 dB
-56.47 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.5
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
17.5000000 GHz
Start Freq
15.0000000 GHz
Stop Freq
20.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 17.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 24.899 GHz
Ref 10.9 dBm
#Atten 20 dB
-52.85 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.5
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
22.5000000 GHz
Start Freq
20.0000000 GHz
Stop Freq
25.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 22.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error

8DPSK_HCH_Graphs	
Puw	


Agilent
R L
Freq/Channel
Mkr1 14.975 GHz
Ref 10.9 dBm
#Atten 20 dB
-56.24 dBm
#Peak
Log
10
dB/
Offst
0.9
dB
Dl
-9.2
dBm
LgAv
M1 S2
S3 FS
£(f):
FTun
Swp
Center Freq
11.2500000 GHz
Start Freq
7.50000000 GHz
Stop Freq
15.0000000 GHz
CF Step
750.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 11.250 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 7.5 GHz
Sweep 15.47 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 15.628 GHz
Ref 10.9 dBm
#Atten 20 dB
-56.31 dBm
Center Freq
17.5000000 GHz
Start Freq
15.0000000 GHz
Stop Freq
20.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 17.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error
Agilent
R L
Freq/Channel
Mkr1 24.992 GHz
Ref 10.9 dBm
#Atten 20 dB
-52.11 dBm
Center Freq
22.5000000 GHz
Start Freq
20.0000000 GHz
Stop Freq
25.0000000 GHz
CF Step
500.000000 MHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Center 22.500 GHz
#Res BW 1 MHz
#VBW 3 MHz
Span 5 GHz
Sweep 12.8 ms (8001 pts)
File name error

10. RADIATED EMISSION

10.1. MEASUREMENT PROCEDURE

1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

The following table is the setting of spectrum analyzer and receiver.

in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on Part 15.247&205(a), then the Part15.247&209(a) limit in the table below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (Frequency Range 9kHz-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 (Above 1000MHz)

FREQUENCY (MHz)	Class B (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.

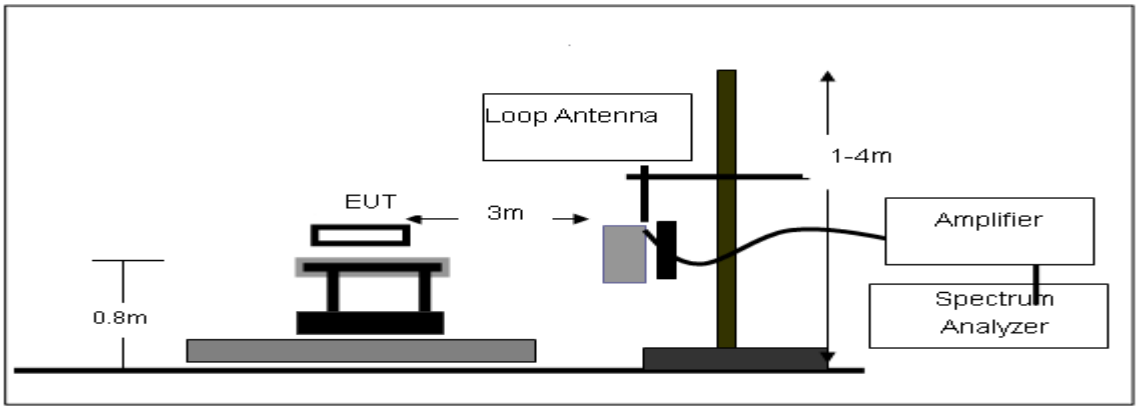
(3) Emission level (dBuV/m)=20log Emission level (uV/m).

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

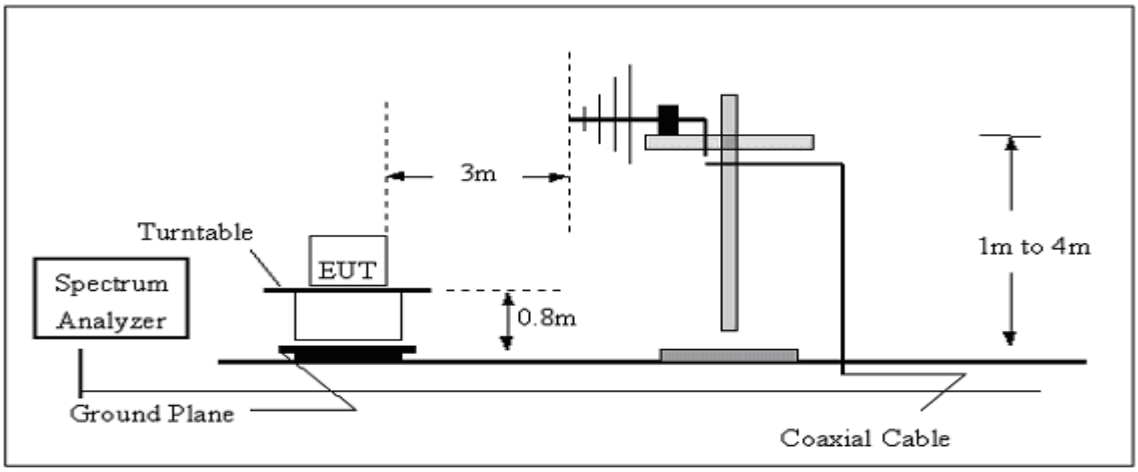
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

TEST SETUP

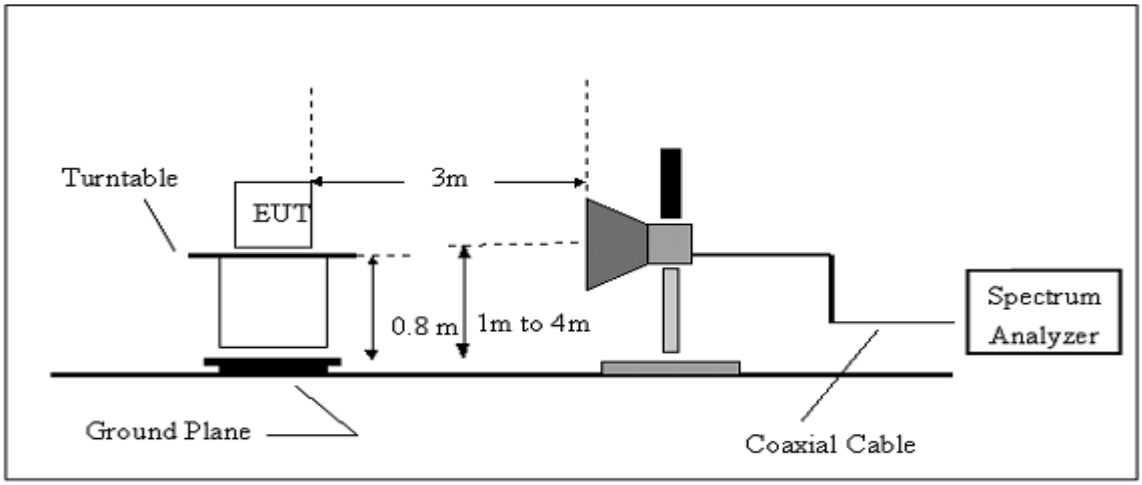
（A）Radiated Emission Test-Up Frequency Below 30MHz



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



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



TEST RESULT

RADIATED EMISSION BELOW 30MHZ

Between 9KHz – 30 MHz)

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

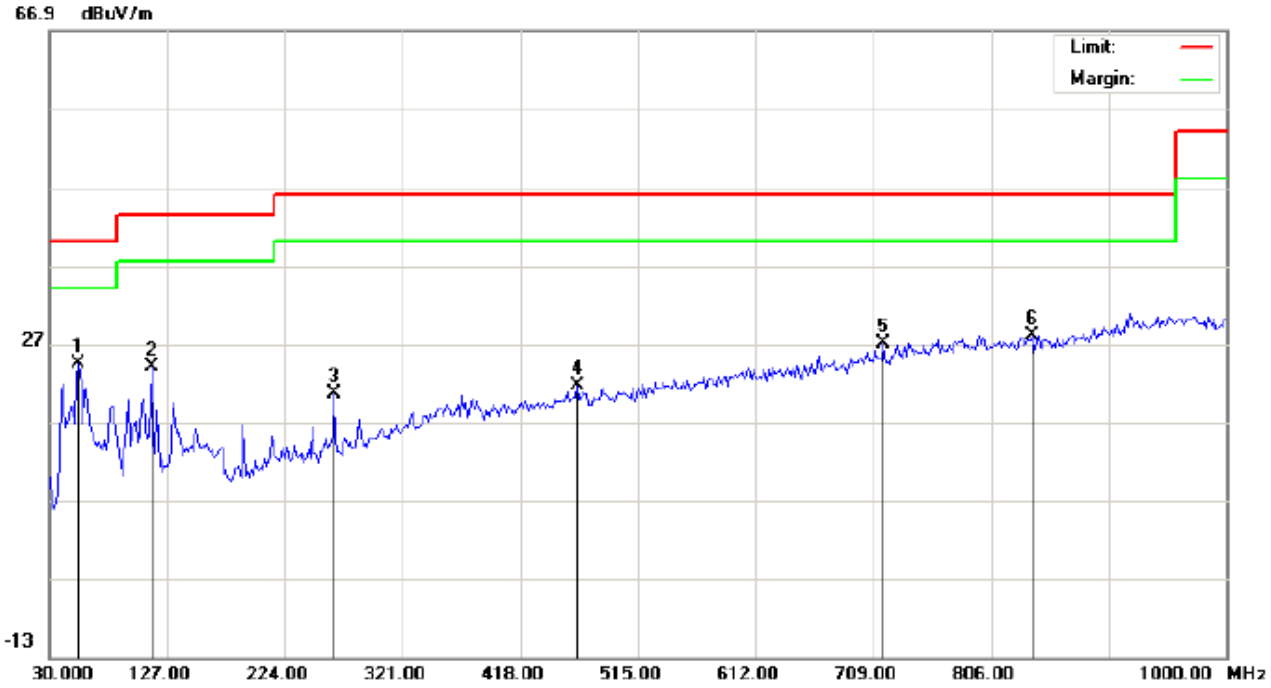
Note:

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.

RADIATED EMISSION BELOW 1GHZ-Horizontal



Site: site #1
Limit: FCC Class B 3M Radiation
EUT: THUNDER PLUS
M/N: DP5108
Mode: High Channel GFSK
Note:

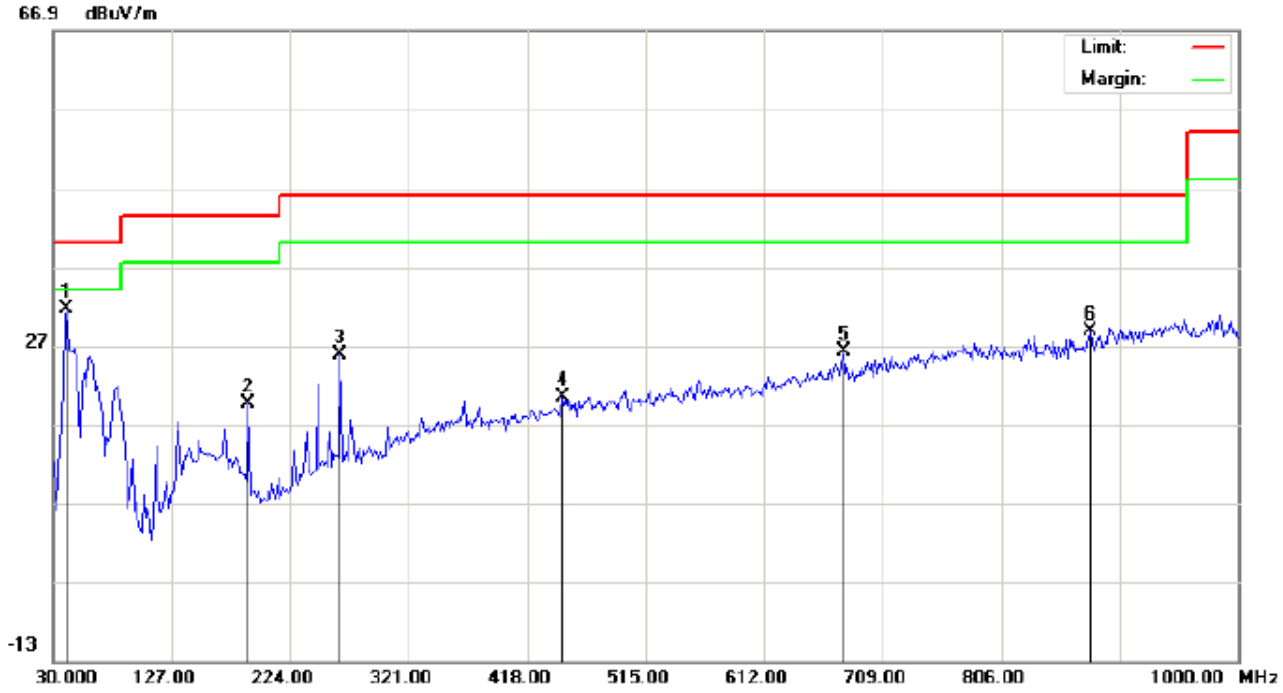
Polarization: *Horizontal*
Power: AC 120V/60Hz
Distance: 3m

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	54.2500	13.17	11.20	24.37	40.00	-15.63	peak			
2		114.0667	12.50	11.45	23.95	43.50	-19.55	peak			
3		264.4167	6.17	14.34	20.51	46.00	-25.49	peak			
4		464.8833	0.94	20.75	21.69	46.00	-24.31	peak			
5		717.0833	1.34	25.68	27.02	46.00	-18.98	peak			
6		839.9500	0.75	27.31	28.06	46.00	-17.94	peak			

RESULT: PASS

RADIATED EMISSION BELOW 1GHZ-Vertical



Site: site #1
Limit: FCC Class B 3M Radiation
EUT: THUNDER PLUS
M/N: DP5108
Mode: High Channel GFSK
Note:

Polarization: *Vertical*
Power: AC 120V/60Hz
Distance: 3m

Temperature: 26
Humidity: 60 %

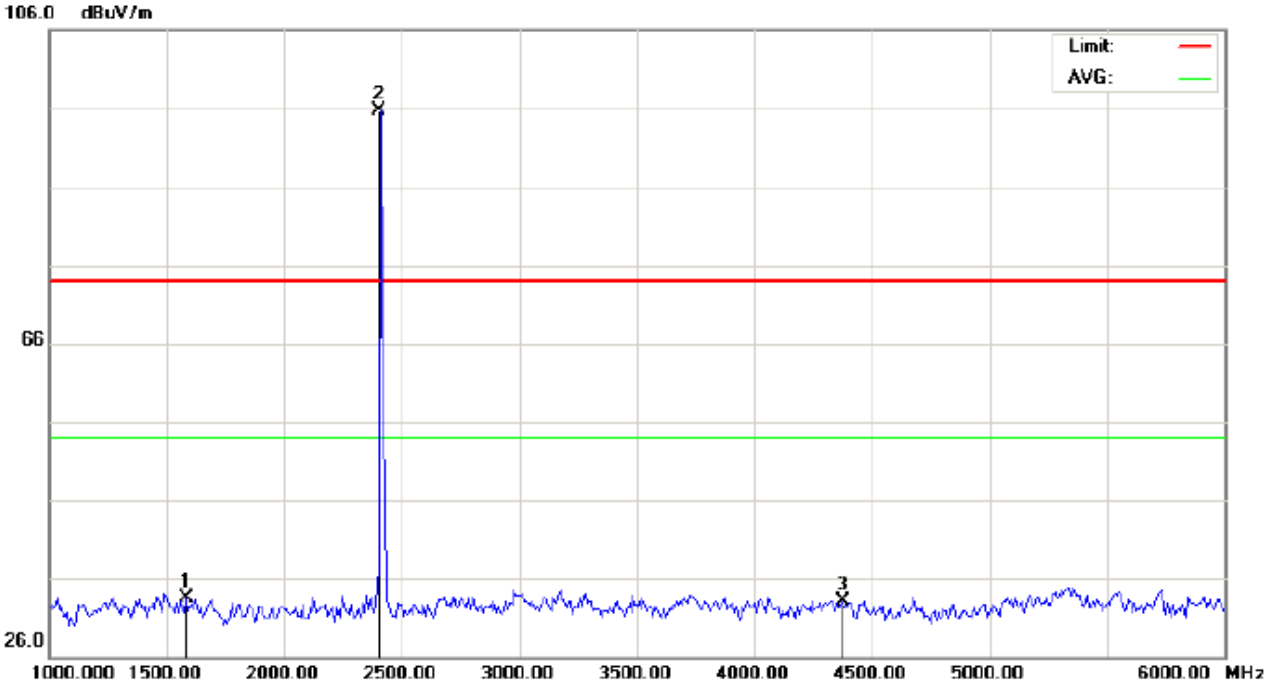
No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	41.3167	22.75	8.81	31.56	40.00	-8.44	peak			
2		190.0500	8.18	11.52	19.70	43.50	-23.80	peak			
3		264.4167	11.41	14.34	25.75	46.00	-20.25	peak			
4		447.1000	-0.07	20.50	20.43	46.00	-25.57	peak			
5		676.6667	1.57	24.56	26.13	46.00	-19.87	peak			
6		878.7500	0.65	28.06	28.71	46.00	-17.29	peak			

RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. The “Factor” value can be calculated automatically by software of measurement system.

RADIATED EMISSION TEST- (ABOVE 1GHZ)-LOW CHANNEL-HORIZONTAL



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: THUNDER PLUS
M/N: DP5108
Mode: Low Channel GFSK
Note:

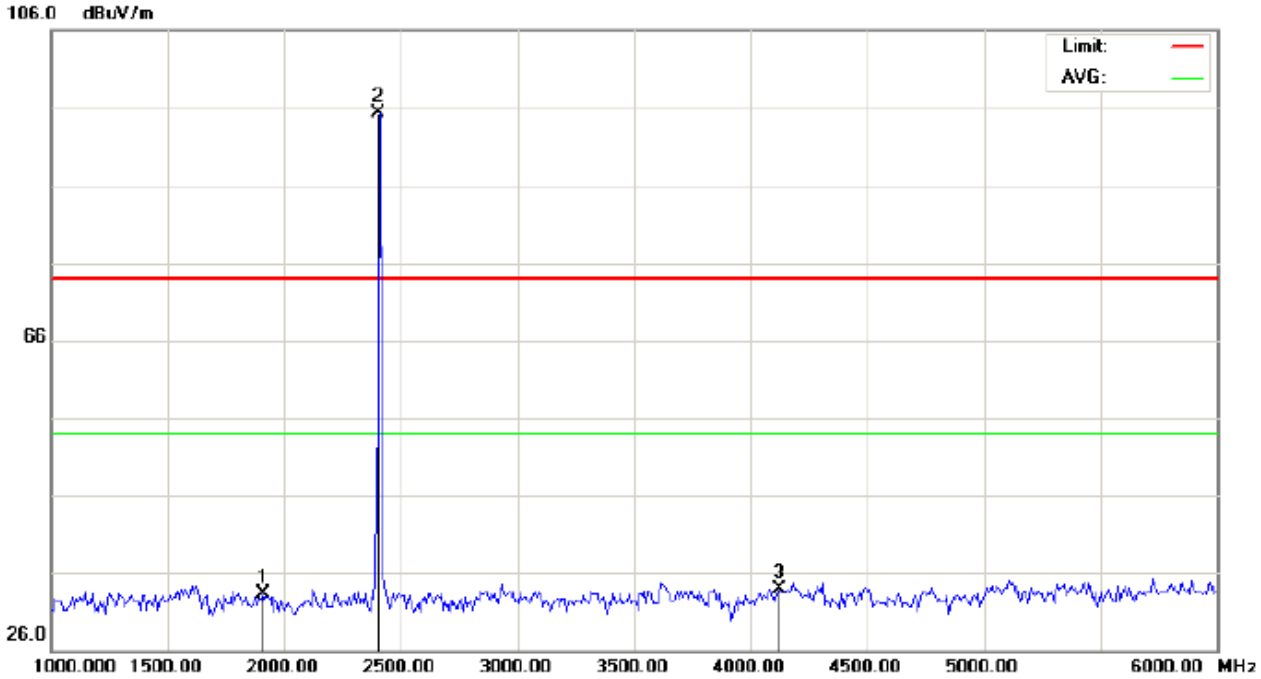
Polarization: *Horizontal*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		1583.333	48.05	-14.50	33.55	74.00	-40.45	peak			
2	*	2402.000	105.33	-9.68	95.65	74.00	21.65	peak			
3		4375.000	36.66	-3.53	33.13	74.00	-40.87	peak			

RESULT: PASS

RADIATED EMISSION TEST- (ABOVE 1GHZ)-LOW CHANNEL- VERTICAL



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: THUNDER PLUS
M/N: DP5108
Mode: Low Channel GFSK
Note:

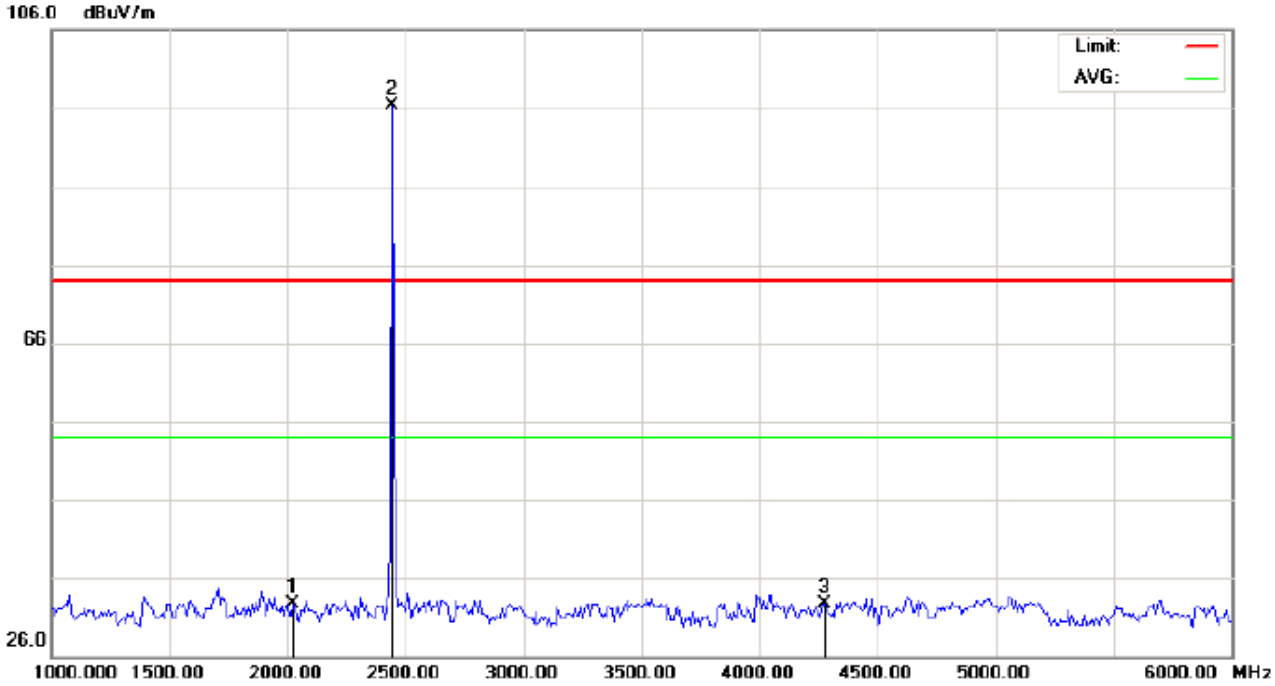
Polarization: *Vertical*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		1908.333	44.46	-11.08	33.38	74.00	-40.62	peak			
2	*	2402.000	105.08	-9.68	95.40	74.00	21.40	peak			
3		4125.000	38.22	-4.38	33.84	74.00	-40.16	peak			

RESULT: PASS

RADIATED EMISSION TEST- (ABOVE 1GHZ)-MIDDLE CHANNEL-HORIZONTAL



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: THUNDER PLUS
M/N: DP5108
Mode: Middle Channel GFSK
Note:

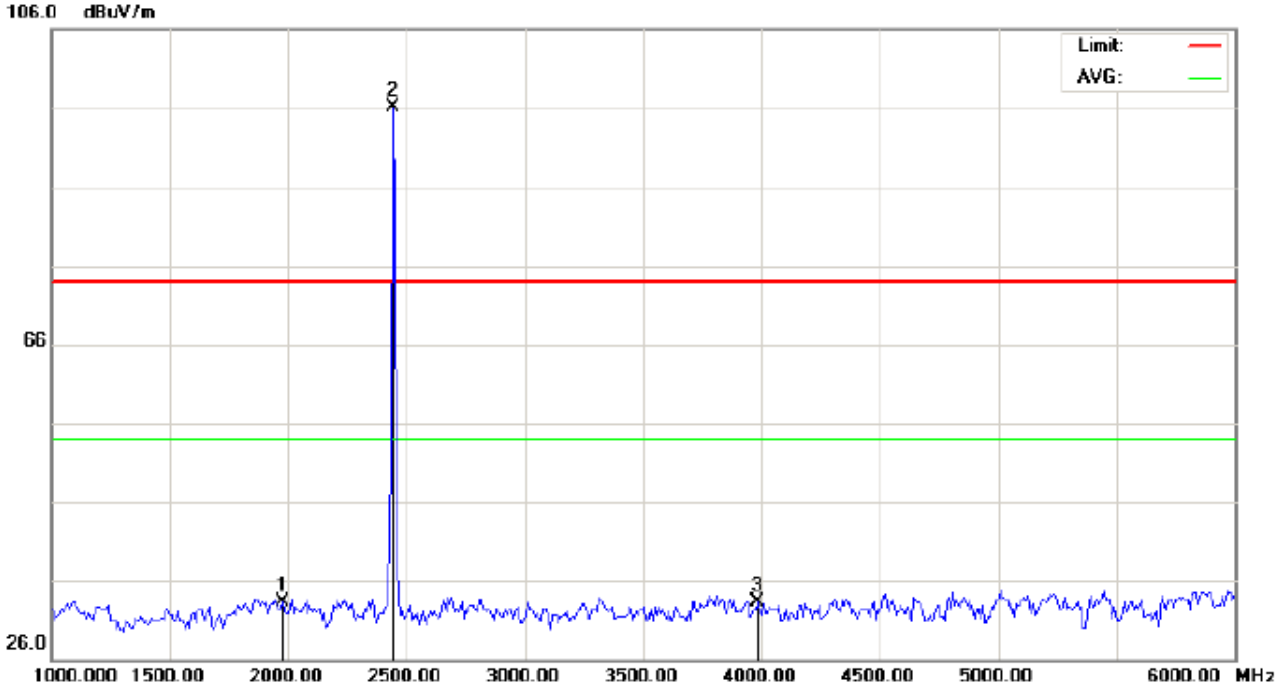
Polarization: *Horizontal*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	-	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		2025.000	42.76	-10.09	32.67	74.00	-41.33	peak			
2	*	2441.000	105.87	-9.63	96.24	74.00	22.24	peak			
3		4275.000	36.58	-3.87	32.71	74.00	-41.29	peak			

RESULT: PASS

RADIATED EMISSION TEST- (ABOVE 1GHZ)-MIDDLE CHANNEL- VERTICAL



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: THUNDER PLUS
M/N: DP5108
Mode: Middle Channel GFSK
Note:

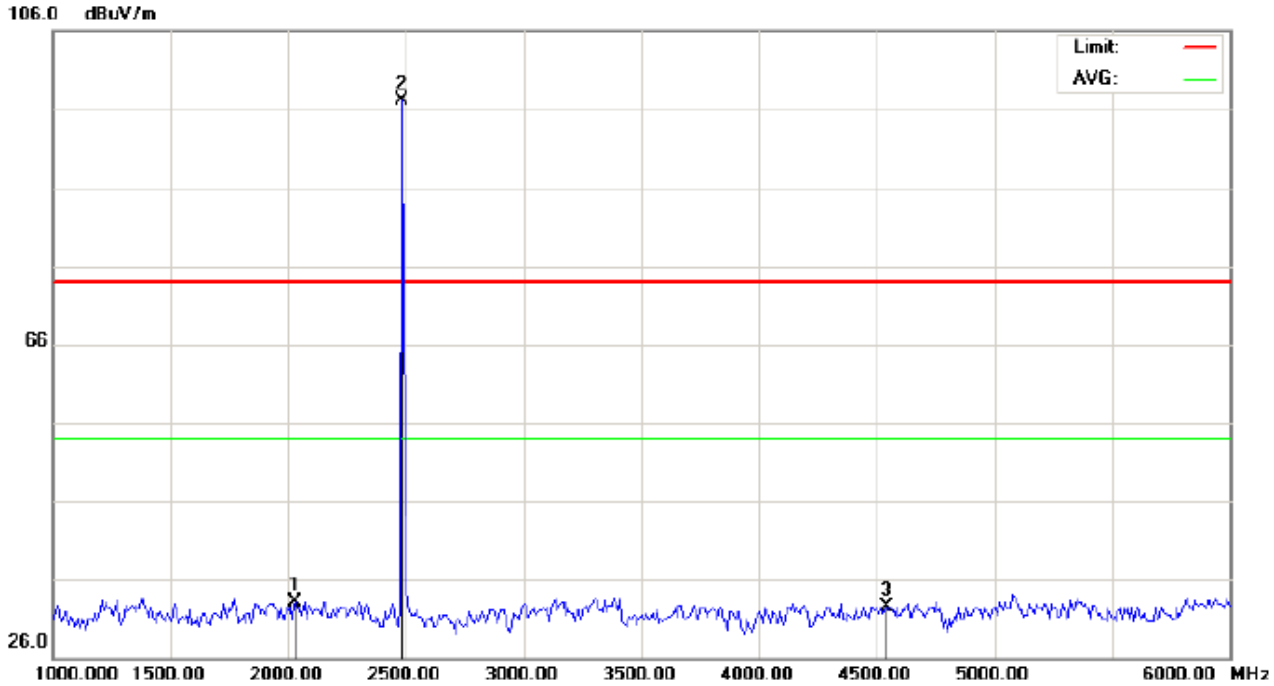
Polarization: *Vertical*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		1975.000	43.62	-10.38	33.24	74.00	-40.76	peak			
2	*	2441.000	105.80	-9.63	96.17	74.00	22.17	peak			
3		3983.333	38.14	-4.91	33.23	74.00	-40.77	peak			

RESULT: PASS

RADIATED EMISSION TEST- (ABOVE 1GHZ)-HIGH CHANNEL-HORIZONTAL



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: THUNDER PLUS
M/N: DP5108
Mode: High Channel GFSK
Note:

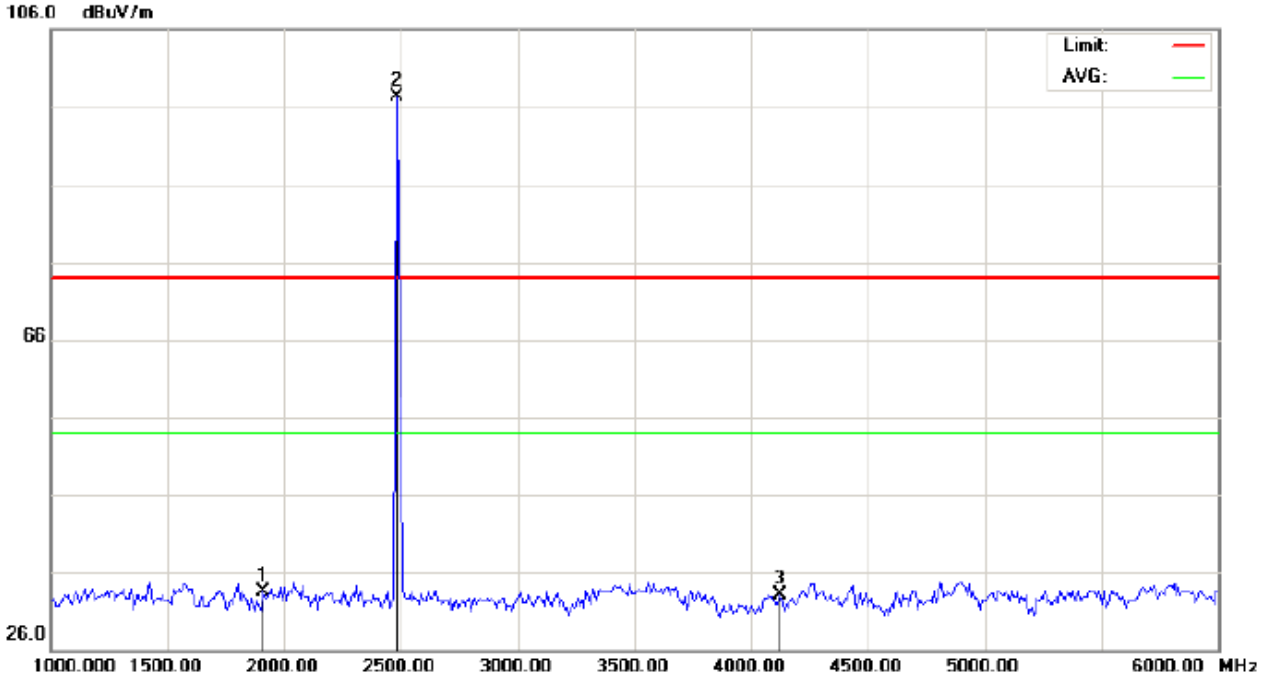
Polarization: *Horizontal*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		2033.333	43.26	-10.08	33.18	74.00	-40.82	peak			
2	*	2480.000	106.67	-9.59	97.08	74.00	23.08	peak			
3		4541.667	35.53	-3.00	32.53	74.00	-41.47	peak			

RESULT: PASS

RADIATED EMISSION TEST- (ABOVE 1GHZ)-HIGH CHANNEL- VERTICAL



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: THUNDER PLUS
M/N: DP5108
Mode: High Channel GFSK
Note:

Polarization: *Vertical*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		1908.333	44.68	-11.08	33.60	74.00	-40.40	peak			
2	*	2480.000	106.88	-9.59	97.29	74.00	23.29	peak			
3		4125.000	37.41	-4.38	33.03	74.00	-40.97	peak			

RESULT: PASS

Note: 6~25GHz at least have 20dB margin. No recording in the test report.

Factor=Antenna Factor + Cable loss - Amplifier gain, Margin=Measurement-Limit.

The “Factor” value can be calculated automatically by software of measurement system.

11. BAND EDGE EMISSION

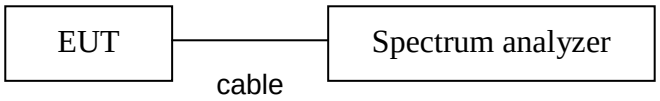
11.1. MEASUREMENT PROCEDURE

1. The transmitter output is connected to a spectrum analyzer.The resolution bandwidth is set to 100kHz.The video bandwidth is set to 300kHz.
2. Transmitter set to the normal hopping mode at 2.4 and 2.4835 GHz.

11.2. TEST SET-UP

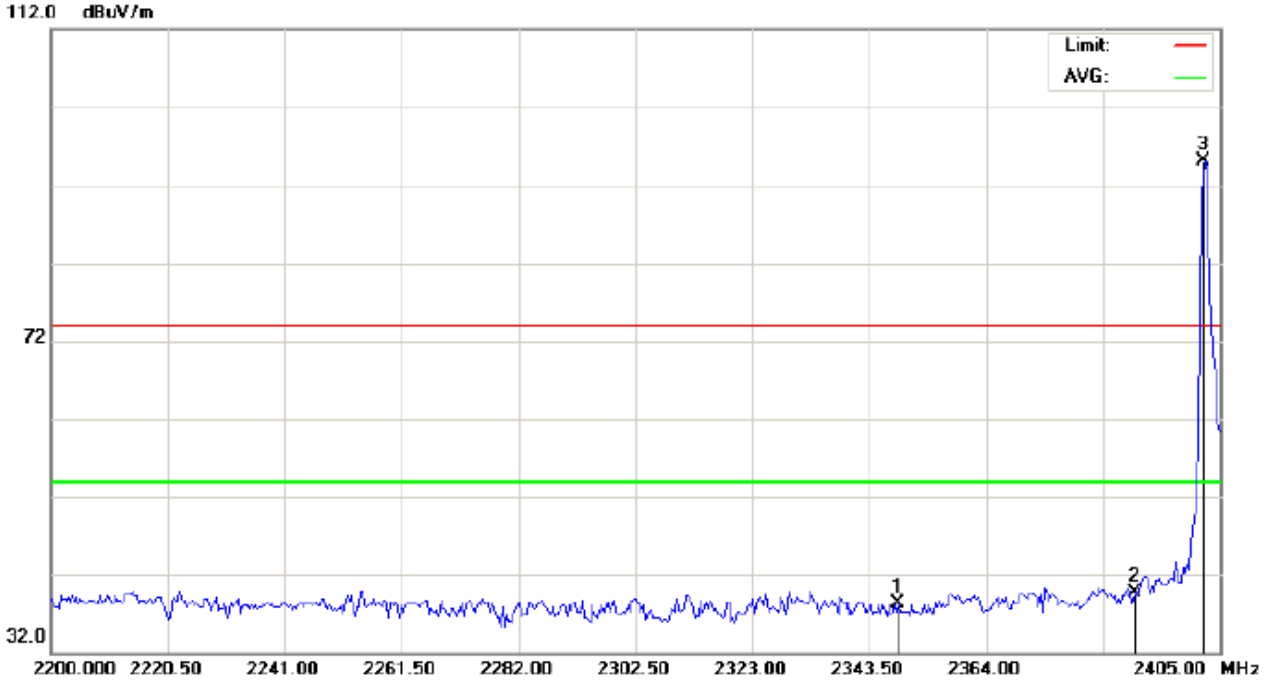
Radiated same as 10.2

Conducted set up



11.3. Radiated TEST RESULT

TEST PLOT OF BAND EDGE FOR LOW CHANNEL (3Mbps)-Horizontal



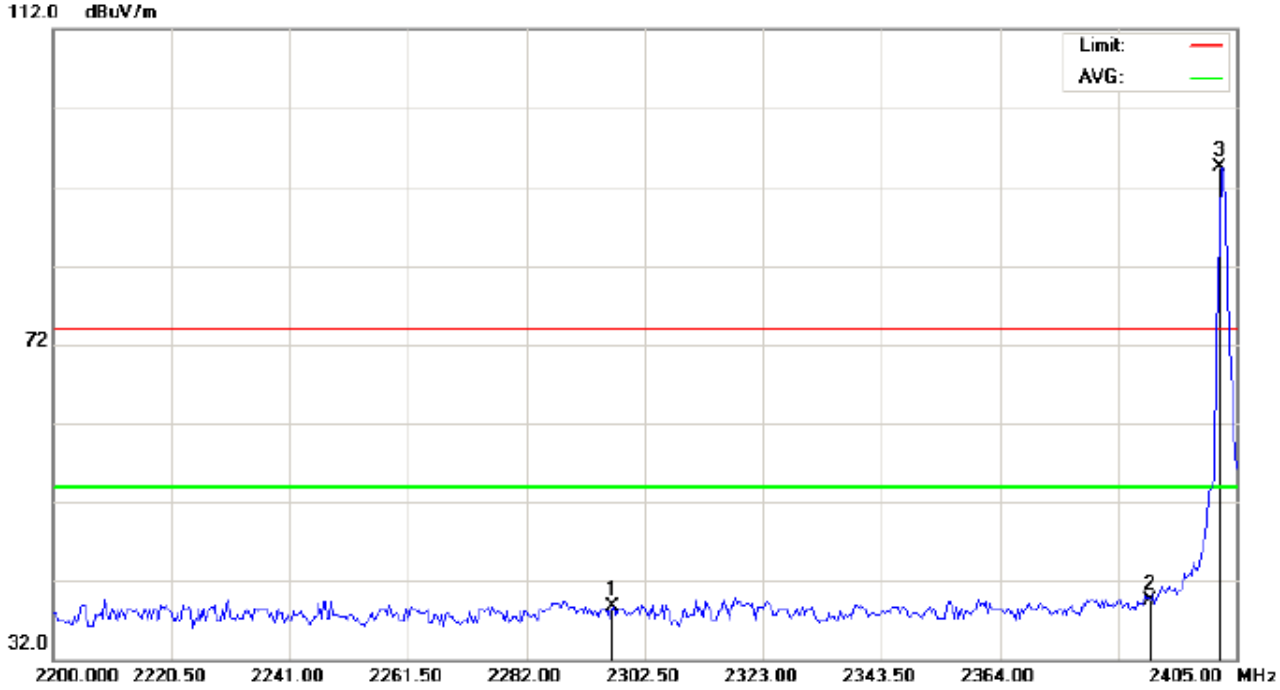
Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: THUNDER PLUS
M/N: DP5108
Mode: Low Channel TX
Note:

Polarization: *Horizontal*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		2348.625	47.97	-9.74	38.23	74.00	-35.77	peak			
2		2390.000	49.44	-9.69	39.75	74.00	-34.25	peak			
3	*	2402.000	104.73	-9.68	95.05	74.00	21.05	peak			

TEST PLOT OF BAND EDGE FOR LOW CHANNEL (3Mbps)-Vertical



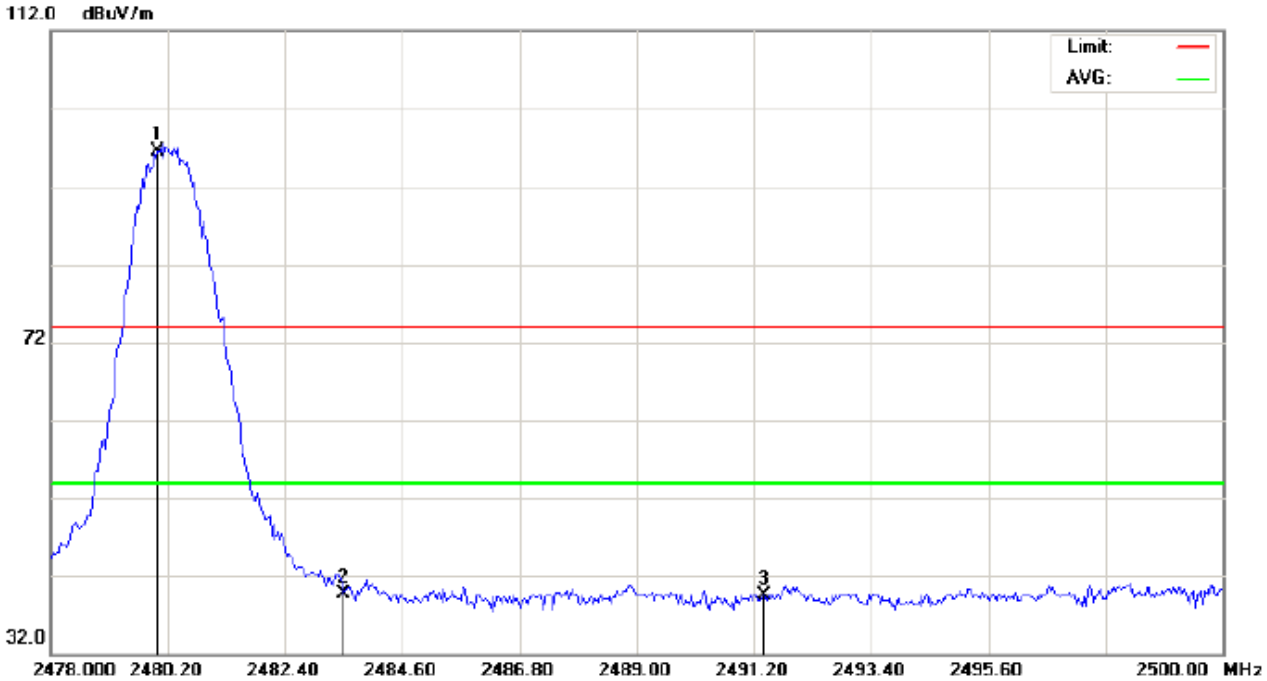
Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: THUNDER PLUS
M/N: DP5108
Mode: Low Channel TX
Note:

Polarization: *Vertical*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		2297.033	48.42	-9.79	38.63	74.00	-35.37	peak			
2		2390.000	49.15	-9.69	39.46	74.00	-34.54	peak			
3	*	2402.000	104.09	-9.68	94.41	74.00	20.41	peak			

TEST PLOT OF BAND EDGE FOR HIGH CHANNEL (3Mbps)-Horizontal



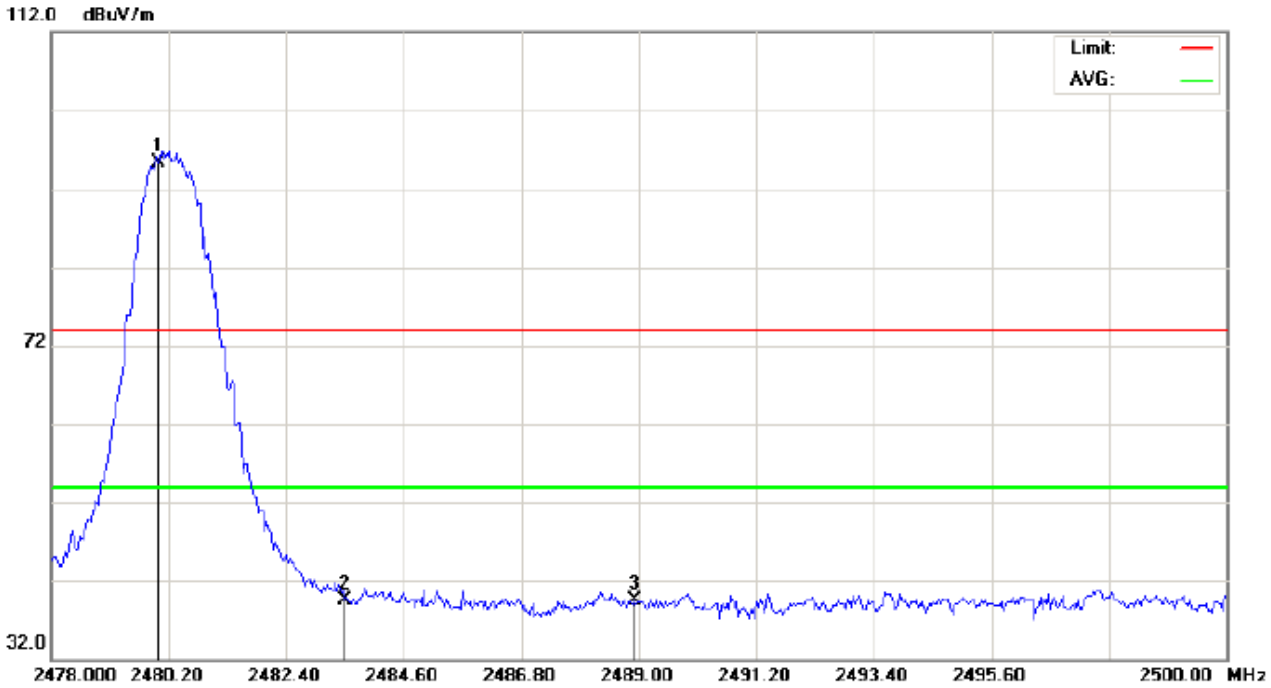
Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: THUNDER PLUS
M/N: DP5108
Mode: High Channel TX
Note:

Polarization: *Horizontal*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	-	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	2480.000	106.05	-9.59	96.46	74.00	22.46	peak			
2		2483.500	49.38	-9.59	39.79	74.00	-34.21	peak			
3		2491.383	49.14	-9.58	39.56	74.00	-34.44	peak			

TEST PLOT OF BAND EDGE FOR HIGH CHANNEL (3Mbps)-Vertical



Site: site #1
Limit: FCC Class B 3M Radiation above 1GHZ(PK)
EUT: THUNDER PLUS
M/N: DP5108
Mode: High Channel TX
Note:

Polarization: *Vertical*
Power:
Distance:

Temperature: 26
Humidity: 60 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	-	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	*	2480.000	104.95	-9.59	95.36	74.00	21.36	peak			
2		2483.500	49.19	-9.59	39.60	74.00	-34.40	peak			
3		2488.927	48.99	-9.58	39.41	74.00	-34.59	peak			

RESULT: PASS

Note: The other modes radiation emission have enough 20dB margin.

Factor=Antenna Factor + Cable loss - Amplifier gain, Over=Measure-Limit.

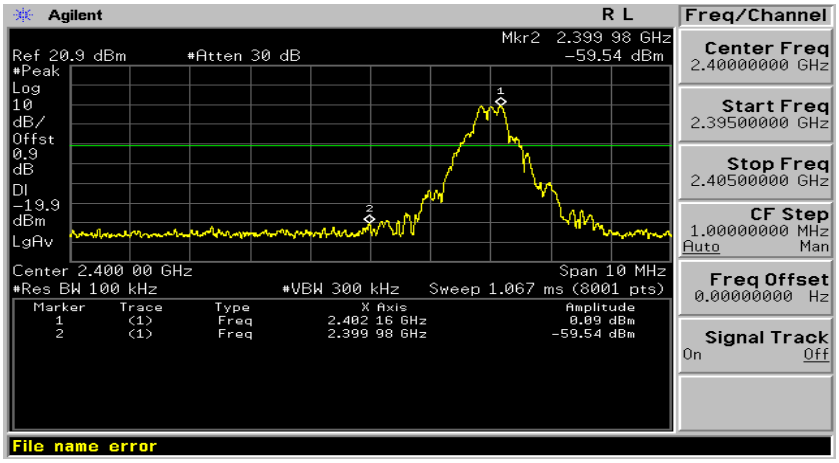
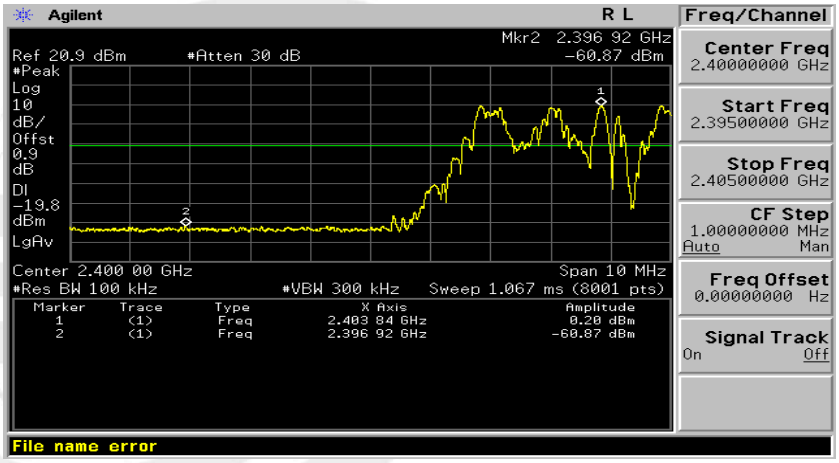
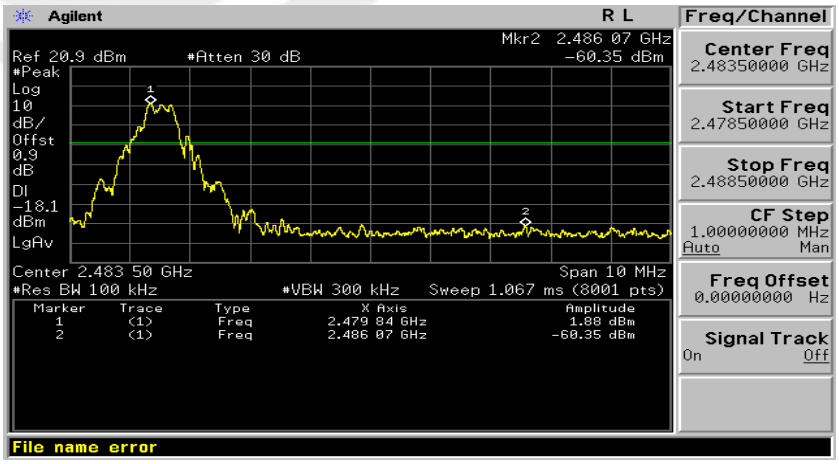
The “Factor” value can be calculated automatically by software of measurement system.

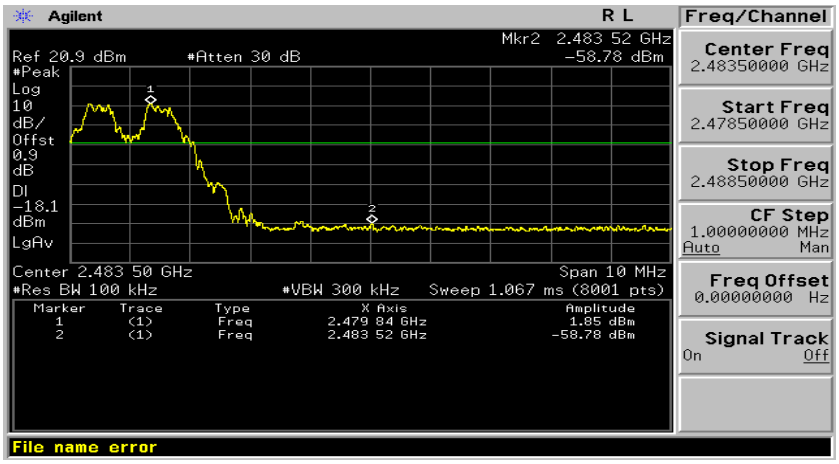
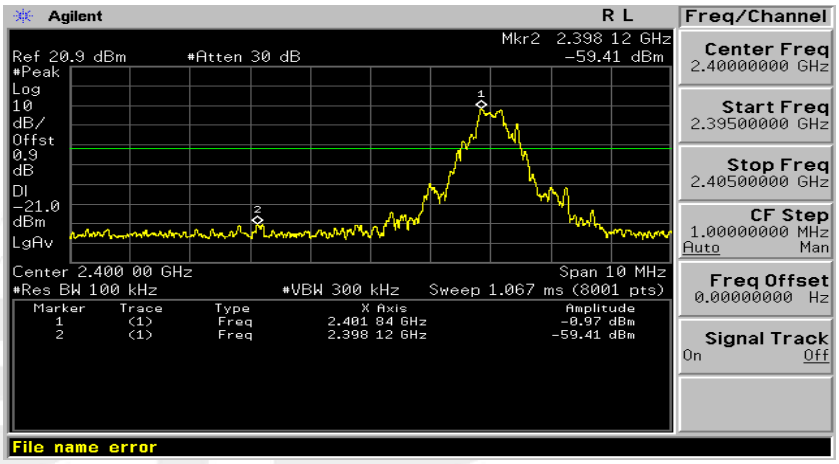
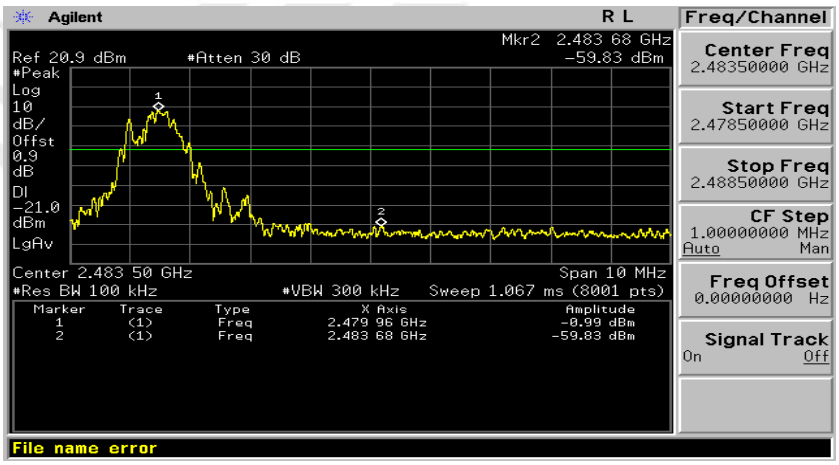
11.4 Conducted TEST RESULT

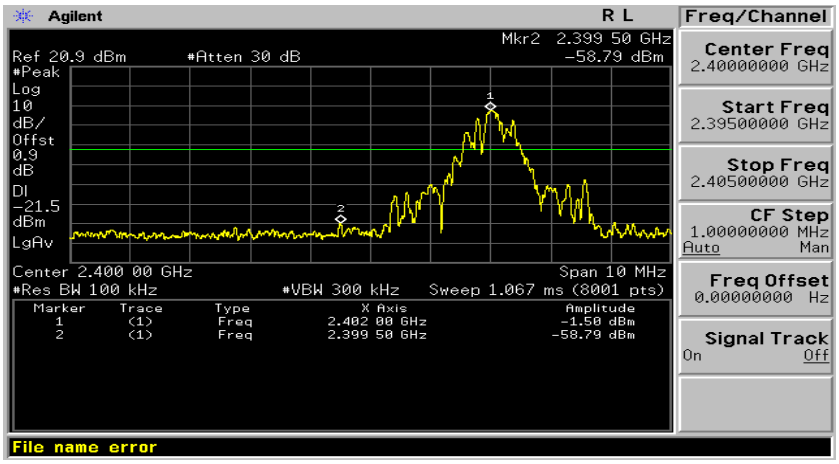
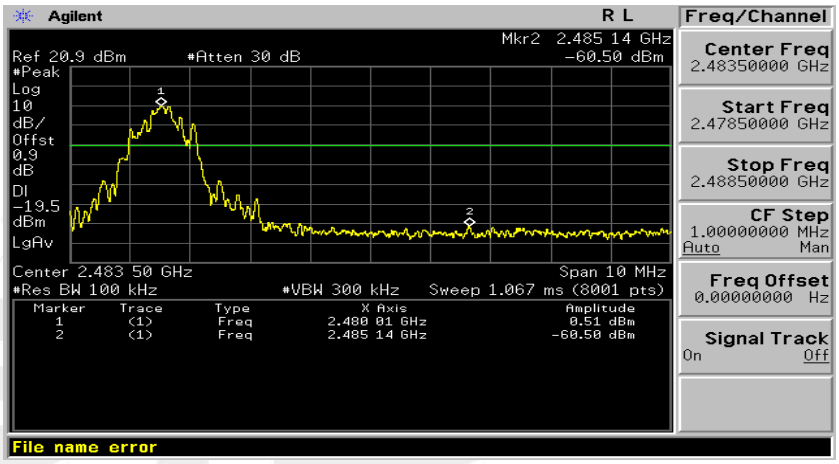
Mode	Channel	Carrier Frequency [MHz]	Frequency Hopping	Max Spurious Level [dBm]	Verdict
GFSK	LCH	2402	Off	-59.539	PASS
			On	-60.867	PASS
GFSK	HCH	2480	Off	-60.355	PASS
			On	-58.784	PASS
π/4DQPSK	LCH	2402	Off	-59.41	PASS
π/4DQPSK	HCH	2480	Off	-59.829	PASS
8DPSK	LCH	2402	Off	-58.795	PASS
8DPSK	HCH	2480	Off	-60.501	PASS

Note: All modes were tested, only the worst case record in the report.

Test Graph

Graphs	
GFSK/LCH/No Hop	
GFSK/LCH/Hop	
GFSK/HCH/No Hop	

GFSK/HCH/Hop	
π /4DQPSK/LCH/No Hop	
π /4DQPSK/HCH/No Hop	

8DPSK/LCH/No Hop	
8DPSK/HCH/No Hop	

12. NUMBER OF HOPPING FREQUENCY

12.1. MEASUREMENT PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer Start = 2.4GHz Stop = 2.4835GHz
4. Set the Spectrum Analyzer as RBW>=1%span, VBW>=RBW.

12.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

12.3. MEASUREMENT EQUIPMENT USED

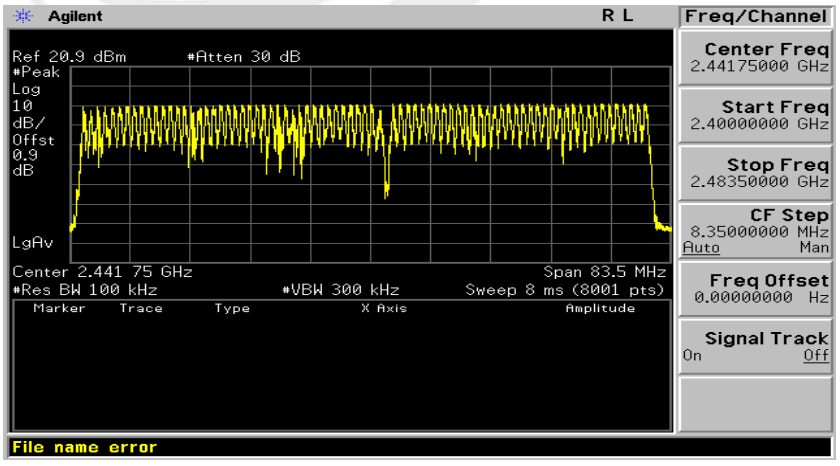
The same as described in section 6

12.4. LIMITS AND MEASUREMENT RESULT

Mode	Channel.	Number of Hopping Channel	Verdict
GFSK	Hop	79	PASS

Note: All modes were tested, only the worst case record in the report.

Test Graph

Graphs	
GFSK/Hop	

13. TIME OF OCCUPANCY (DWELL TIME)

13.1. MEASUREMENT PROCEDURE

1. Place the EUT on the table and set it in transmitting mode
2. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer.
3. Set Span = zero span, centered on a hoping channel
4. Set the spectrum analyzer as RBW=1MHz, VBW>=RBW, Span = 0 Hz

13.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

13.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6

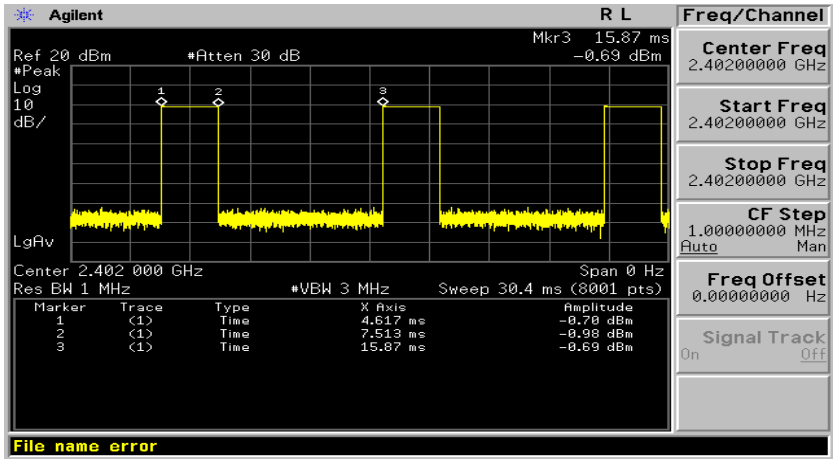
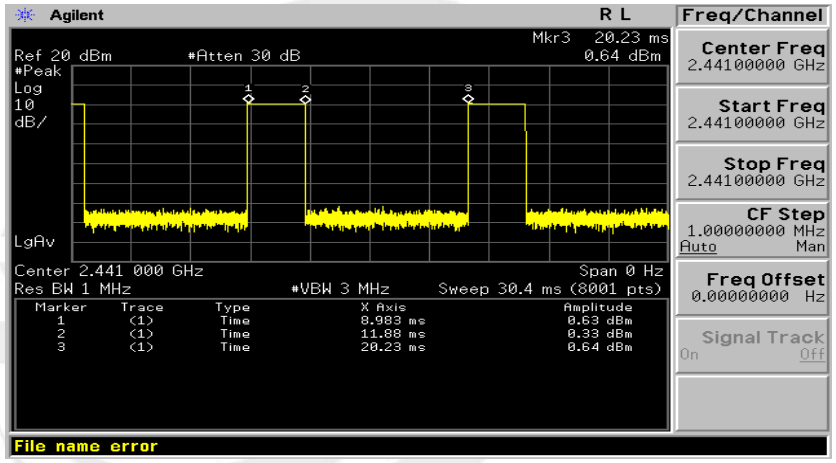
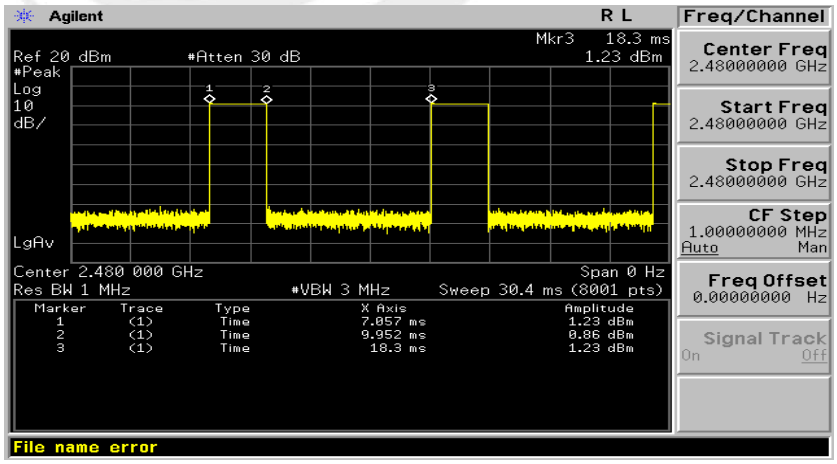
13.4. LIMITS AND MEASUREMENT RESULT

The Dwell Time=Burst Width*Total Hops. The detailed calculations are showed as follows:

- The duration for dwell time calculation:0.4[s]*hopping number=0.4[s]*79[ch]=31.6[s*ch];
- The burst width [ms/hop/ch], which is directly measured, refers to the duration on one channel hop.
- The hops per second for all channels: The selected EUT Conf uses a slot type of 5-Tx&1-Rx and a hopping rate of 1600 [ch*hop/s] for all channels. So the final hopping rate for all channels is 1600/6=266.67 [ch*hop/s]
- The hops per second on one channel: 266.67 [ch*hops/s]/79 [ch]=3.38 [hop/s];
- The total hops for all channels within the dwell time calculation duration:3.38 [hop/s]*31.6[s*ch]=106.67 [hop*ch];
- The dwell time for all channels hopping: 106.67 [hop*ch]*Burst Width [ms/hop/ch].

Mode	Channel.	Burst Width [ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[ms]	Verdict	Limit (ms)
GFSK	LCH	2.896	106.67	309.872	PASS	400
GFSK	MCH	2.896	106.67	309.872	PASS	400
GFSK	HCH	2.896	106.67	309.872	PASS	400

Test Graph

Graphs	
GFSK/LCH	
GFSK/MCH	
GFSK/HCH	

14. FREQUENCY SEPARATION

14.1. MEASUREMENT PROCEDURE

1. Place the EUT on the table and set it in transmitting mode
2. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer
3. Set Span = wide enough to capture the peaks of two adjacent channels Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span Video (or Average) Bandwidth (VBW) ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold

14.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 6.2

14.3. MEASUREMENT EQUIPMENT USED

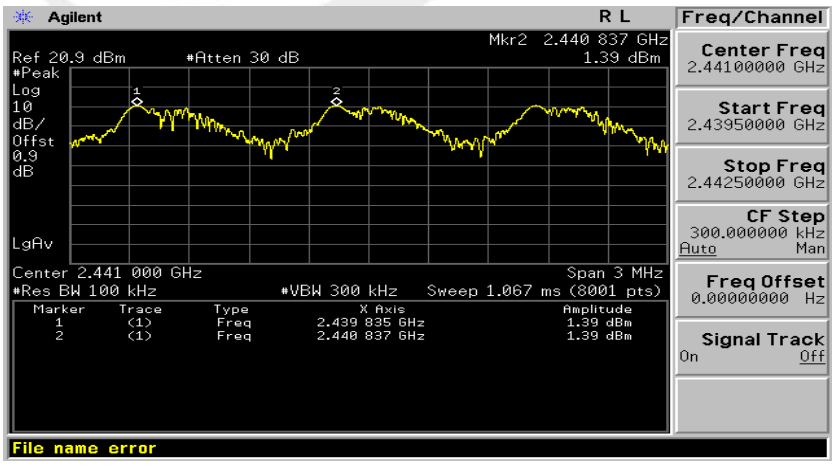
The same as described in section 6.3

14.4. LIMITS AND MEASUREMENT RESULT

Mode	Channel.	Carrier Frequency Separation [MHz]	Verdict
8DPSK	Hop	1.002	PASS

Note: All modes were tested, only the worst case record in the report.

Test Graph

Graphs	
8DPSK/Hop	

15. FCC LINE CONDUCTED EMISSION TEST

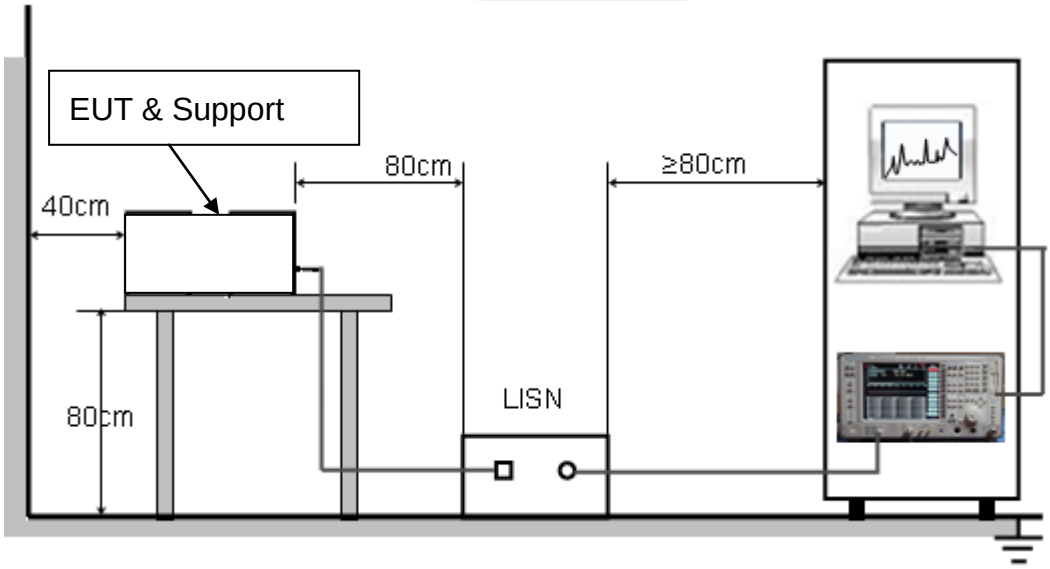
15.1. LIMITS OF LINE CONDUCTED EMISSION TEST

Frequency	Maximum RF Line Voltage	
	Q.P.(dBuV)	Average(dBuV)
150kHz~500kHz	66-56	56-46
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Note:

1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

15.2. BLOCK DIAGRAM OF LINE CONDUCTED EMISSION TEST



15.3. PRELIMINARY PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.4 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
2. Support equipment, if needed, was placed as per ANSI C63.4.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.4.
4. All support equipments received AC120V/60Hz power from a LISN, if any.
5. The EUT received DC charging voltage by adapter which received 120V/60Hzpower by a LISN..
6. The test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.
9. The test mode(s) were scanned during the preliminary test.

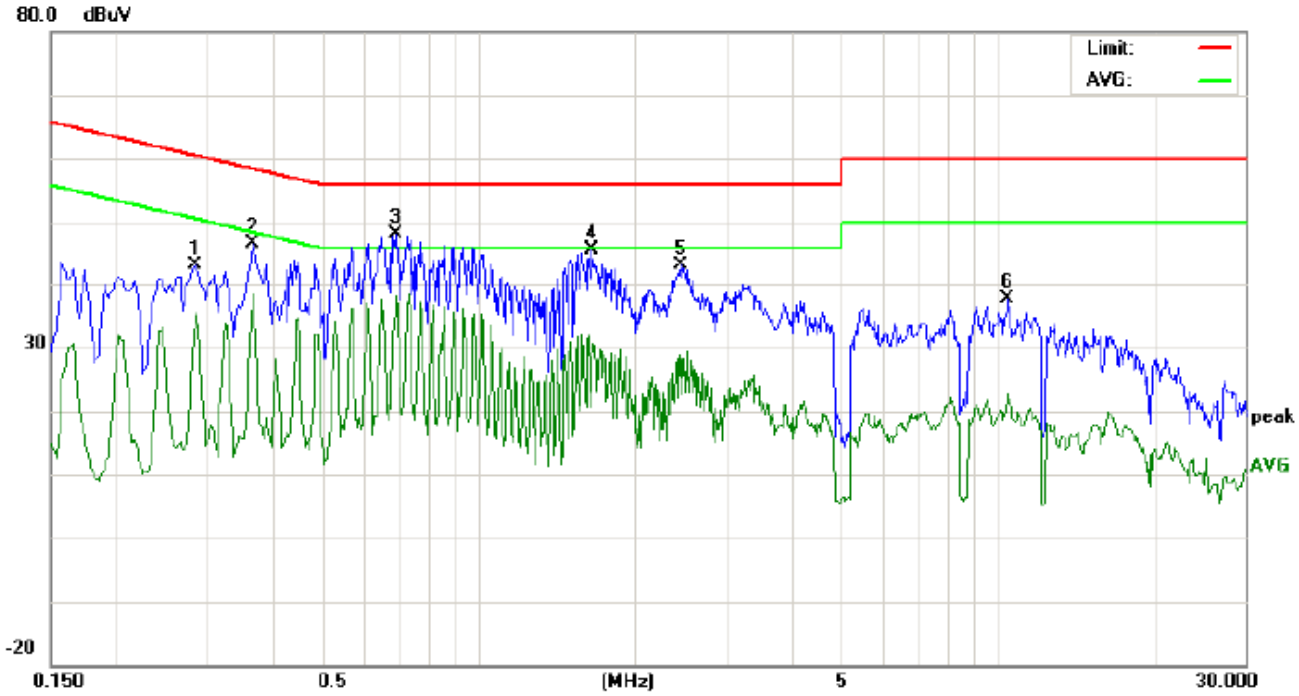
Then, the EUT configuration and cable configuration of the above highest emission level were recorded for reference of final testing.

15.4. FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less –2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
3. The test data of the worst case condition(s) was reported on the Summary Data page.

15.5. TEST RESULT OF LINE CONDUCTED EMISSION TEST

Line Conducted Emission Test Line 1-L



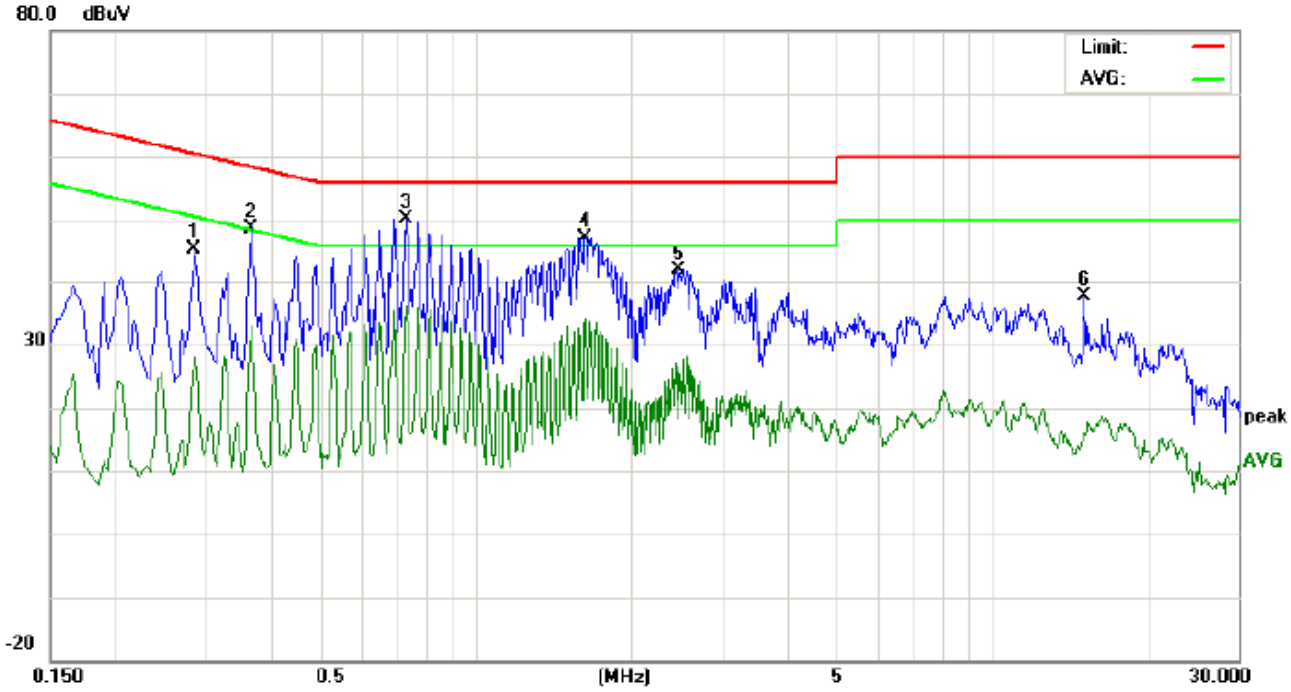
Site: Conduction
Limit: FCC Class B Conduction(QP)
EUT: THUNDER PLUS
M/N: DP5108
Mode: High Channel GFSK
Note:

Phase: *L1*
Power: AC 120V/60Hz

Temperature: 26
Humidity: 60 %

No.	Freq. (MHz)	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)		P/F	Comment
		Peak	QP	AVG	dB	Peak	QP	AVG	QP	AVG	QP	AVG		
1	0.2819	32.58		21.99	10.28	42.86		32.27	60.76	50.76	-17.90	-18.49	P	
2	0.3660	36.35		27.97	10.32	46.67		38.29	58.59	48.59	-11.92	-10.30	P	
3	0.6940	37.66		27.74	10.35	48.01		38.09	56.00	46.00	-7.99	-7.91	P	
4	1.6620	35.21		17.32	10.33	45.54		27.65	56.00	46.00	-10.46	-18.35	P	
5	2.4500	32.61		17.53	10.41	43.02		27.94	56.00	46.00	-12.98	-18.06	P	
6	10.4900	27.43		12.57	10.09	37.52		22.66	60.00	50.00	-22.48	-27.34	P	

Line Conducted Emission Test Line 2-N



Site: Conduction
Limit: FCC Class B Conduction(QP)
EUT: THUNDER PLUS
M/N: DP5108
Mode: High Channel GFSK
Note:

Phase: *N*
Power: AC 120V/60Hz

Temperature: 26
Humidity: 60 %

No.	Freq. (MHz)	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)		P/F	Comment
		Peak	QP	AVG	dB	Peak	QP	AVG	QP	AVG	QP	AVG		
1	0.2860	34.98		17.91	10.28	45.26		28.19	60.64	50.64	-15.38	-22.45	P	
2	0.3660	38.33		22.59	10.32	48.65		32.91	58.59	48.59	-9.94	-15.68	P	
3	0.7340	39.71		25.69	10.33	50.04		36.02	56.00	46.00	-5.96	-9.98	P	
4	1.6300	36.87		23.79	10.34	47.21		34.13	56.00	46.00	-8.79	-11.87	P	
5	2.4860	31.56		16.28	10.42	41.98		26.70	56.00	46.00	-14.02	-19.30	P	
6	15.1420	27.48		5.99	10.12	37.60		16.11	60.00	50.00	-22.40	-33.89	P	

16. ANTENNA REQUIREMENT

16.1 STANDARD REQUIREMENT
15.203 requirement: For intentional device, according to 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.

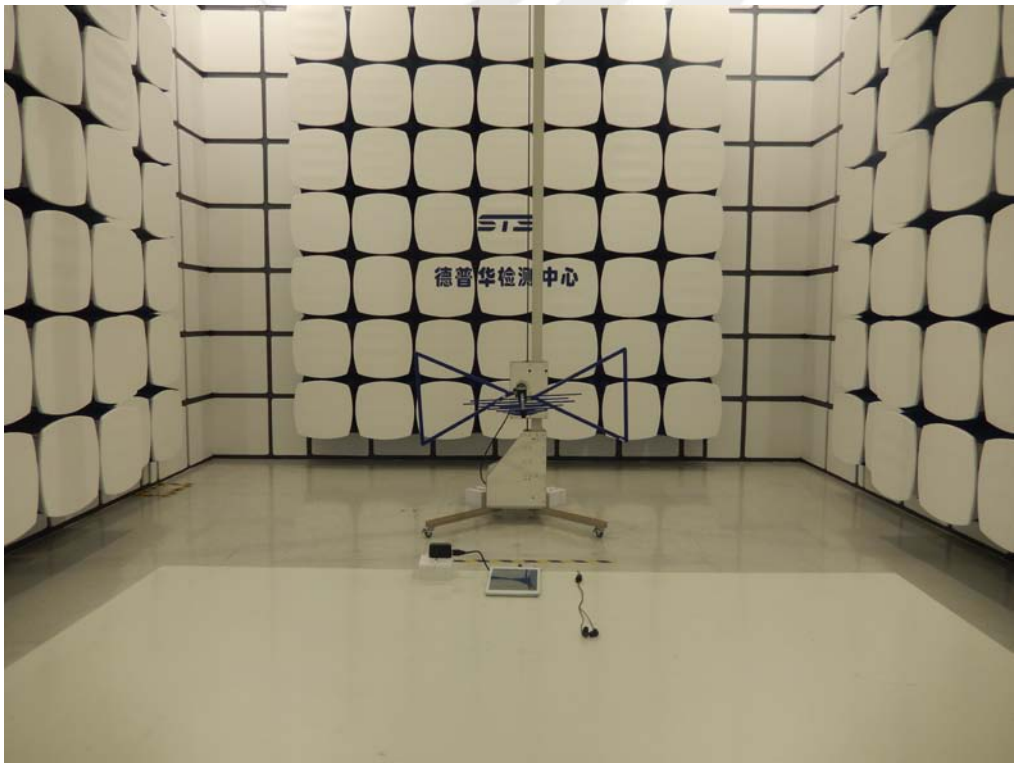
16.2 EUT ANTENNA
The EUT antenna is unique Antenna. It comply with the standard requirement.

APPENDIX A: PHOTOGRAPHS OF TEST SETUP

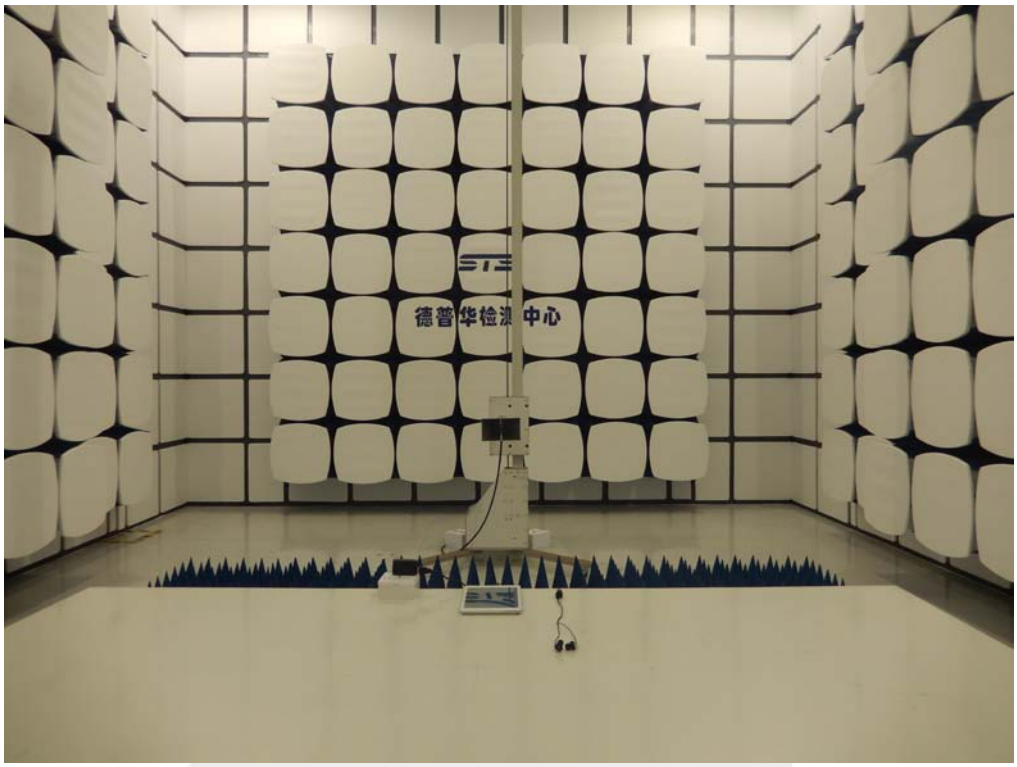
FCC LINE CONDUCTED EMISSION TEST SETUP

FCC RADIATED EMISSION TEST SETUP

radiation L



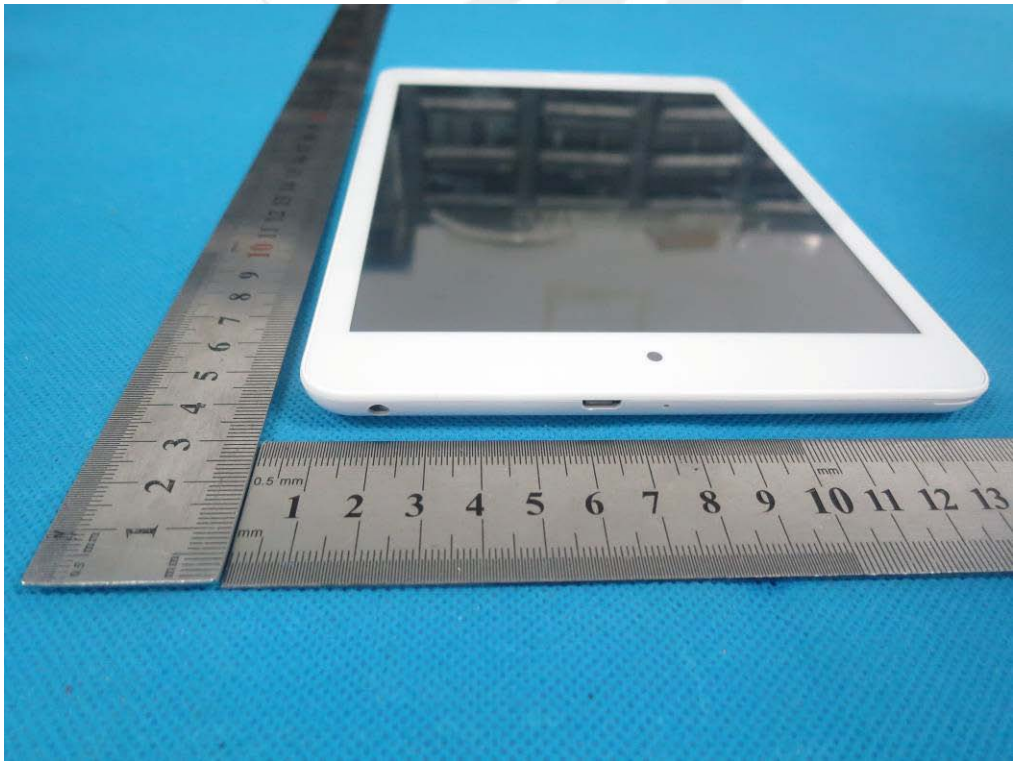
Adiation H



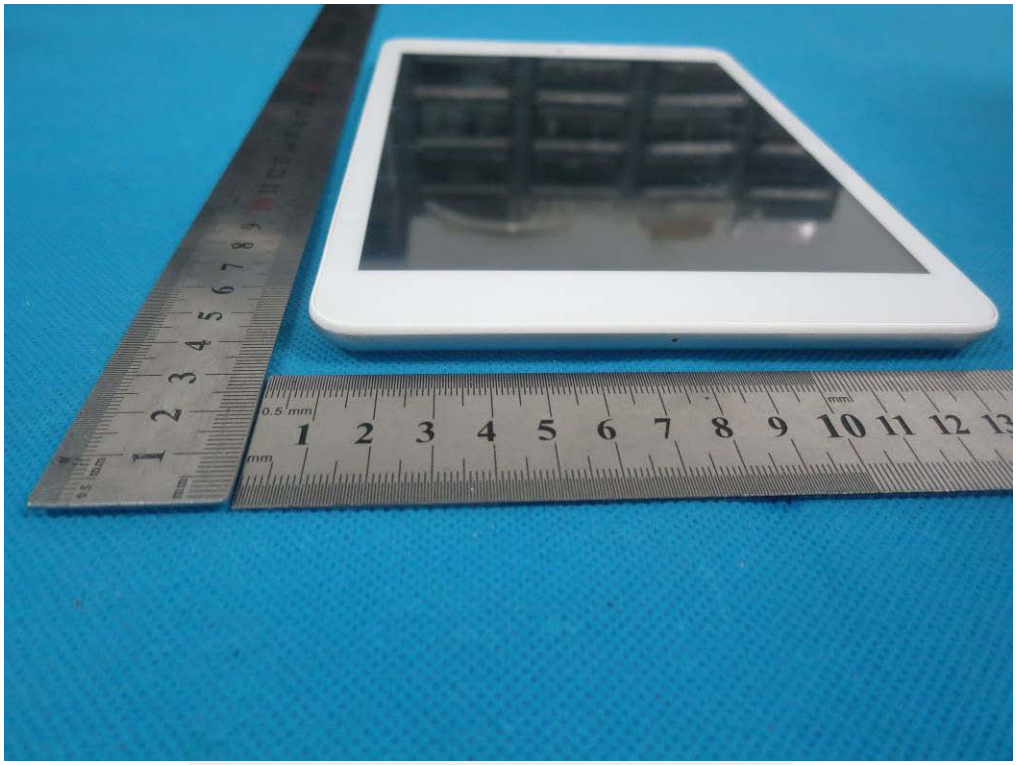
APPENDIX B: PHOTOGRAPHS OF EUT

TOTAL VIEW OF EUT

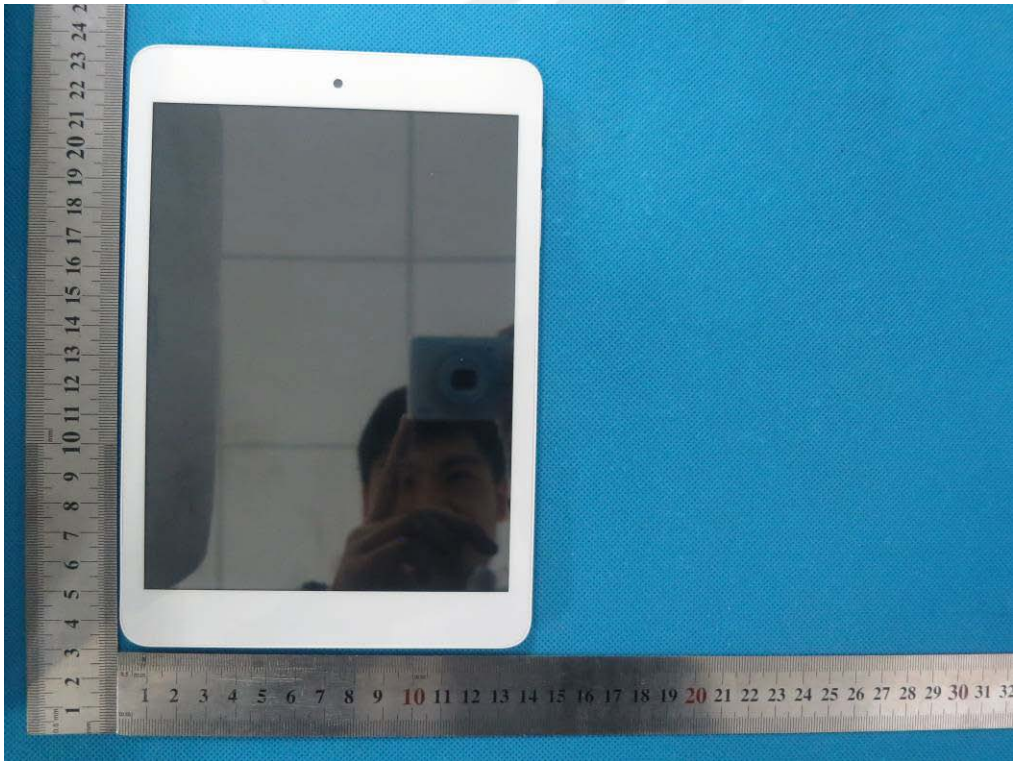
TOP VIEW OF EUT



BOTTOM VIEW OF EUT

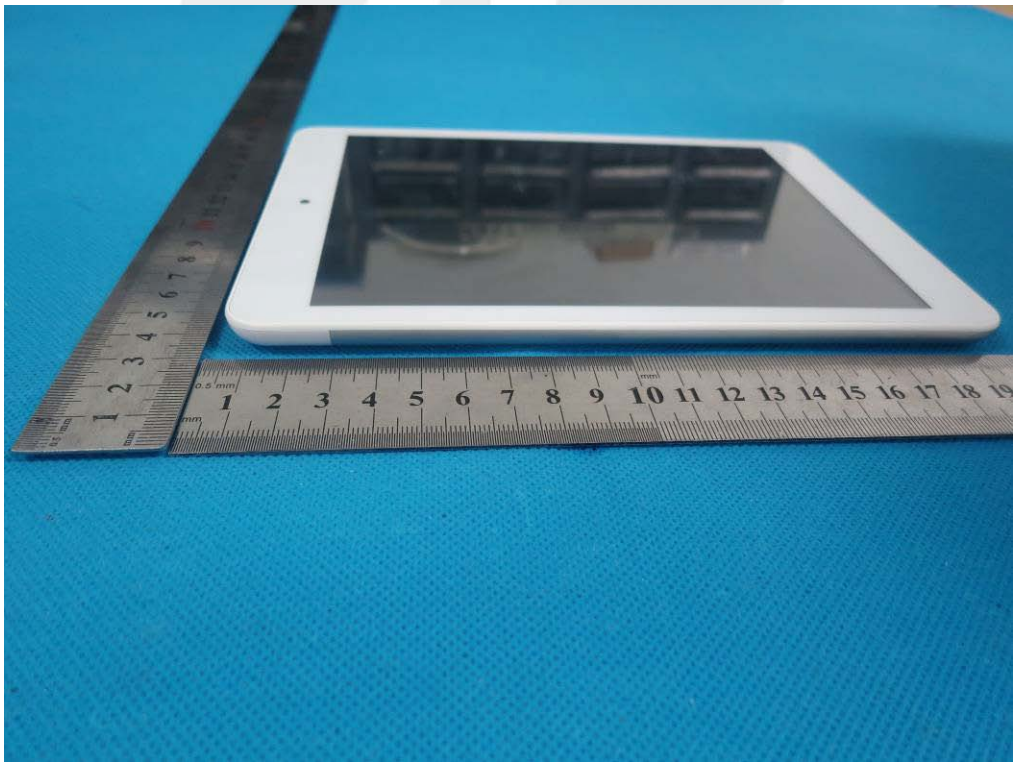


FRONT VIEW OF EUT

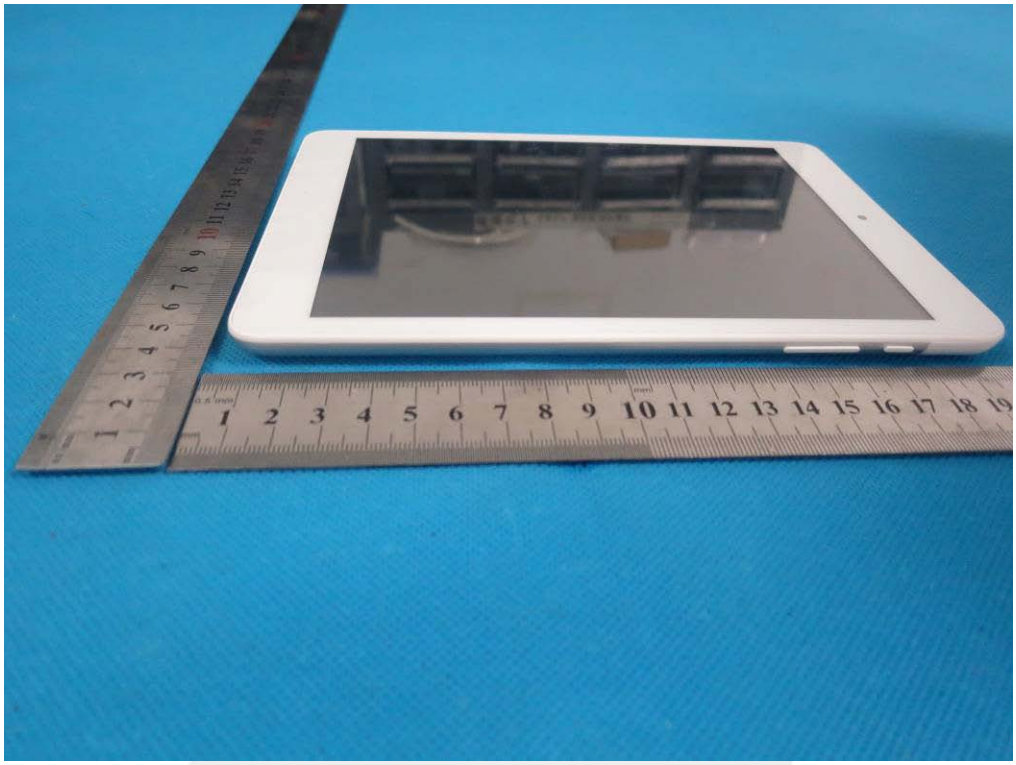


BACK VIEW OF EUT

LEFT VIEW OF EUT

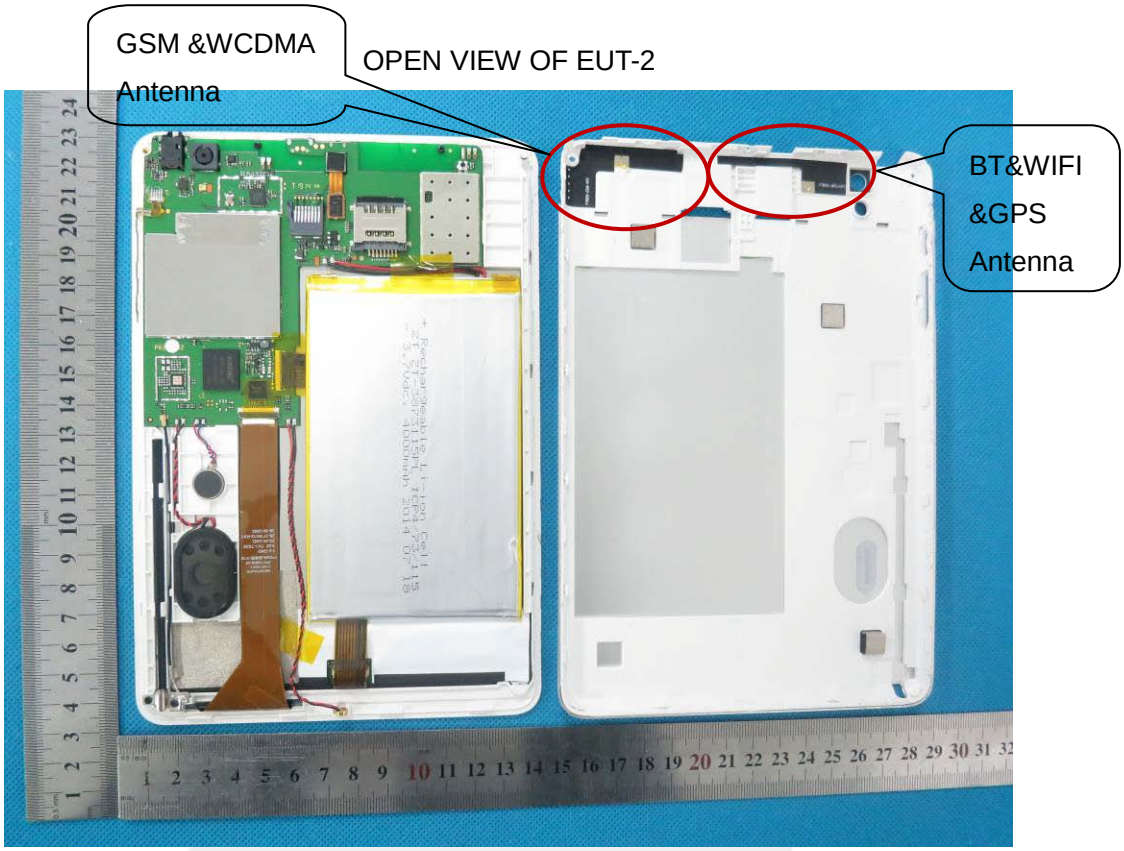


RIGHT VIEW OF EUT

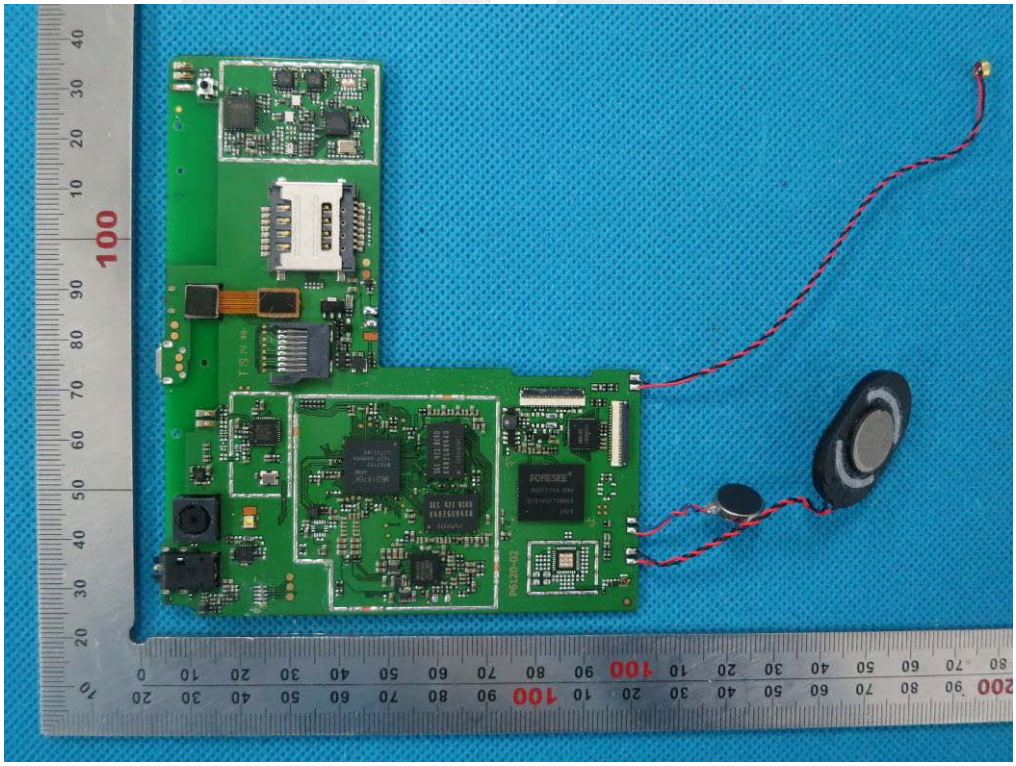


OPEN VIEW OF EUT-1

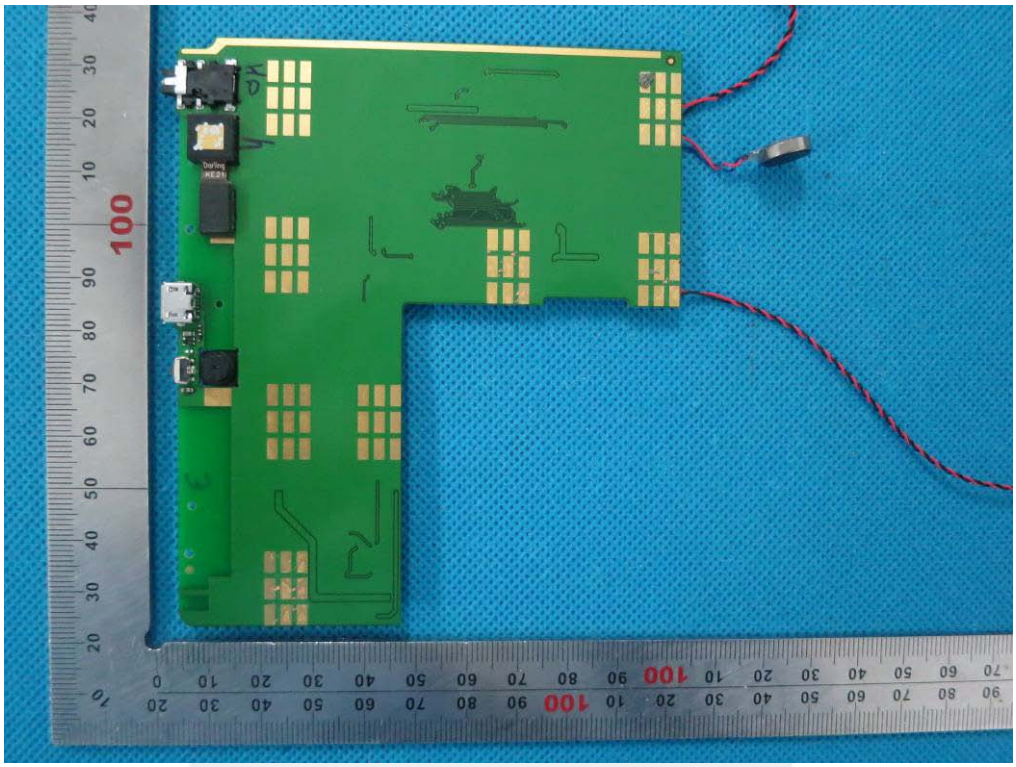
OPEN VIEW OF EUT-2



INTERNAL VIEW OF EUT-1



INTERNAL VIEW OF EUT-2



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