FCC 47 CFR PART 15 SUBPART C AND ANSI C63.10: 2013

TEST REPORT

For

ANALOG PLAYER

Model: TN-180BT

Brand Name: TEAC

Issued for

TEAC CORPORATION
1-47 Ochiai, Tama-shi, Tokyo 206-8530,Japan

Issued By

Compliance Certification Services Inc.

Tainan Laboratory

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Issued Date: May 07, 2018

Testing Laboratory
1109

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REVISION HISTORY

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	April 03, 2018	Initial Issue	ALL	Gina Lin
01	May 07, 2018	See the following note rev.01	Page20	Gina Lin

Note:

※ Rev.00 Issue Date： April 03, 2018 T180315N01-RC1
Original Report

※ Rev.01 Issue Date： May 07, 2018 T180315N01-RC1
Update the limit of MAXIMUM PEAK OUTPUT POWER on page20.

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1. TEST REPORT CERTIFICATION

Applicant	:	**TEAC CORPORATION**
Address	:	1-47 Ochiai, Tama-shi, Tokyo 206-8530,Japan
Manufacturer	:	**1.Ya Horng Electronic Co., Ltd.** **2.Atten Electronic (Dongguan) Co., Ltd.**
Address	:	1.No. 35, Shalun, Jon Sha Village, Anding Dist., Tainan City 745, Taiwan (R.O.C.) 2.No.34 Gao Yu Nan Road.188 Industrial District, Ping Shan Administrative District, Tang Xia Town, Dong Guan, Guangdong, 523728, China.
Equipment Under Test	:	ANALOG PLAYER
Model Number	:	TN-180BT
Brand Name	:	TEAC
Date of Test	:	March 15, 2018 ~ March 27, 2018

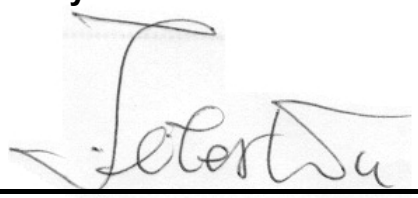
APPLICABLE STANDARD	
STANDARD	**TEST RESULT**
FCC Part 15 Subpart C: 2014 AND ANSI C63.10: 2013	PASS

We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in **ANSI C63.10: 2013** and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

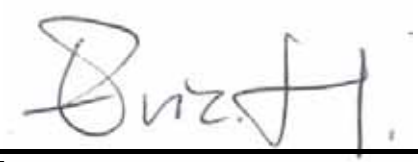
The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:



Jeter Wu
Assistant Manager

Reviewed by:



Eric Huang
Section Manager

2. EUT DESCRIPTION

2.1 DESCRIPTION OF EUT & POWER

Product	ANALOG PLAYER
Model Number	TN-180BT
Brand Name	TEAC
Identify Number	T180315N01
Received Date	March 15, 2018
Frequency Range	2402 ~ 2480 MHz
Transmit Peak Power	GFSK : 1.576dBm / 1.437mW 8DPSK: -0.72dBm / 0.847mW
Channel Spacing	1MHz
Transmit Data Rate	GFSK (1Mbps), π/4-DQPSK (2Mbps), 8-DPSK (3Mbps)
Modulation Technique	Frequency Hopping Spread Spectrum
Number of Channels	79 Channels
Power Supply	AC100-240V, 50/60Hz(Powered by Adapter)
Antenna Type	Type: PIFA Antenna Manufacturer: BRITO TECHNOLOGY Model: ANT-200 Gain: 2.04dBi
Hardware Version	V.0
Software Version	AT02BT_00

Power Adapter :

No.	Manufacturer	Model No.	Power Input	Power Output
1	GPE	GPE053A-V120050-Z	100-240Vac, 50/60Hz, 0.2A	12Vdc, 500mA, 6W

Remark:
1. The sample selected for test was production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for **FCC ID: XEG-TN180BT** filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.
3. For more details, please refer to the User's manual of the EUT.

3. DESCRIPTION OF TEST MODES

The EUT had been tested under operating condition.

There are three channels have been tested as following :

Channel	Frequency (MHz)
Low	2402
Middle	2441
High	2480

Radiated Emission Test (Below 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

Normal Operation

Radiated Emission Test (Above 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

Tested Channel	Modulation Technology	Modulation Type	Packet Type
Low, Mid, High	FHSS	GFSK	DH5
Low, Mid, High	FHSS	8-DPSK	3-DH5

Bandedge Measurement :

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

Tested Channel	Modulation Technology	Modulation Type	Packet Type
Low, High	FHSS	GFSK	DH5
Low, High	FHSS	8-DPSK	3-DH5

Antenna Port Conducted Measurement :

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

Tested Channel	Modulation Technology	Modulation Type	Packet Type
Low, Mid, High	FHSS	GFSK	DH5
Low, Mid, High	FHSS	8-DPSK	3-DH5

4. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10 : 2013 and FCC CFR 47 15.207, 15.209 and 15.247.

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

☒ No.8,Jiucengling, Xinhua Dist., Tainan City 712, Taiwan (R.O.C.)

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.
Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

5.3 LABORATORY ACCREDITATIONS LISTINGS

The test facilities used to perform radiated and conducted emissions tests are accredited by Taiwan Accreditation Foundation for the specific scope of accreditation under Lab Code: 1109 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by TAF or any agency of the Government. In addition, the test facilities are listed with Federal Communications Commission (registration no: TW-1037).

5.4 TABLE OF ACCREDITATIONS AND LISTINGS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

Taiwan	TAF

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

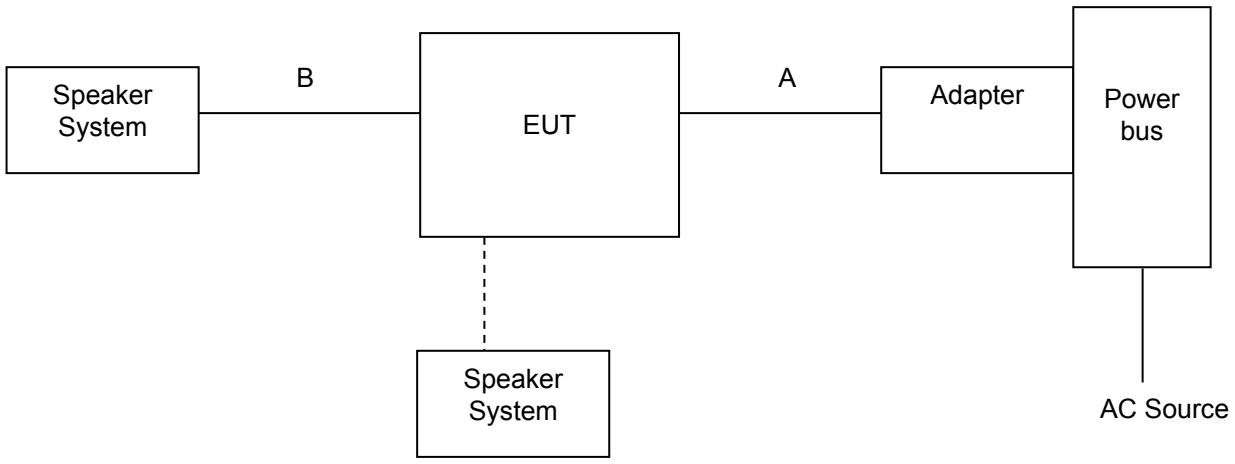
Canada	INDUSTRY CANADA
Germany	TUV NORD
Taiwan	BSMI
USA	FCC

Copies of granted accreditation certificates are available for downloading from our web site, http:///www.ccsrf.com

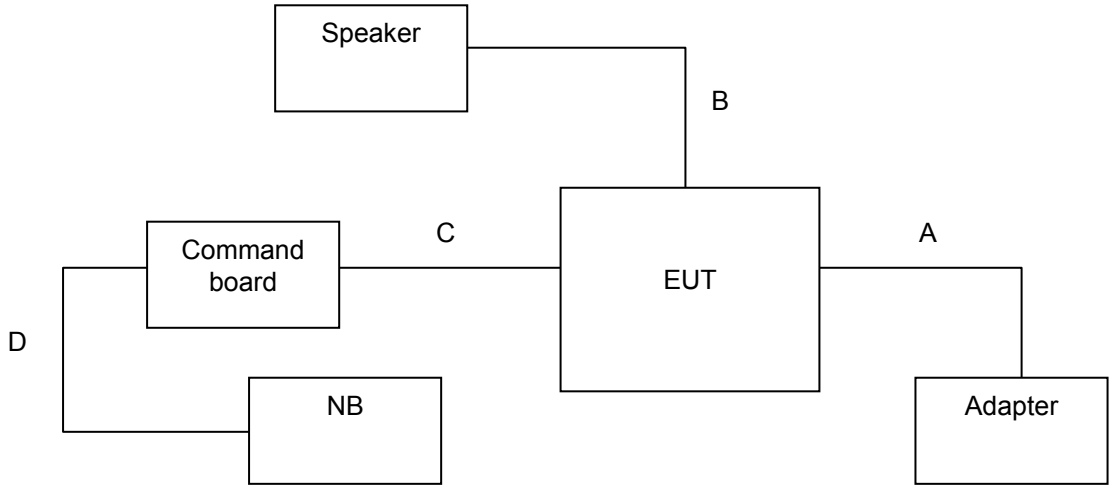
6. SETUP OF EQUIPMENT UNDER TEST

6.1 SETUP CONFIGURATION OF EUT

EMI



RF



6.2 SUPPORT EQUIPMENT

For EMI test

No.	Product	Manufacturer	Model No.	Certify No.	Signal cable
1	Speaker System	ECHO	LA-227	DOC	Audio cable, unshd, 1.6m
2	Speaker System	KINYO	BTS-672	DOC	N/A

No.	Signal cable description	
A	DC Power	Unshielded, 1.5m, 1 pcs.
B	Audio	Unshielded, 0.9m, 1 pcs.

For RF test

No.	Product	Manufacturer	Model No.	Certify No.	Signal cable
1	Notebook	Acer	AS 3830TG	DOC	Power cable, unshd, 1.6m
2	Speaker system	ECHO	LA-227	DOC	Audio cable, unshd, 1.6m

No.	Signal cable description	
A	Power	Unshielded, 1.5m, 1pcs
B	Audio	Unshielded, 1.0m, 1pcs
C	Command	Unshielded, 1.0m, 1pcs
D	USB	Shielded, 1.0m, 1pcs. with one core

Remark: *Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*

*shd=shielded, unshd=unshielded

EUT OPERATING CONDITION

RF Setup

1. Set up all computers like the setup diagram.
2. The “ISRT_V1.0.37.2841” software was used for testing
3. Choose Chip Number “IS1621S_393_SRC_V3.1”, COM “COM44” and BAUDRATE”115200”.

TX Mode:

GFSK(DH1):

Packet Type > DH1

BDR MAX > 0x36

GFSK(DH3):

BDR MAX > 0x36

GFSK(DH5):

Packet Type > DH5

BDR MAX > 0x36

8-DPSK(3DH1):

Packet Type > 3DH1

BDR MAX > 0x2e

8-DPSK(3DH3):

Packet Type > 3DH3

EDR MAX > 0x2e

8-DPSK(3DH5):

Packet Type > 3DH5

EDR MAX > 0x2e

RX Mode:

RX

3. All of the function are under run.
4. Start test.

7. APPLICABLE LIMITS AND TEST RESULTS

7.1 20dB BANDWIDTH FOR HOPPING

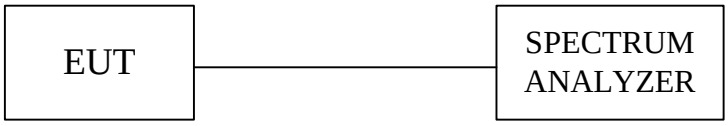
LIMIT

None; for reporting purposes only.

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	05/08/2018

TEST SETUP



TEST PROCEDURE

The 20dB band width was measured with a spectrum analyzer connected to RF antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer. Display Line and Marker Delta functions, the 20dB band width of the emission was determined.

TEST RESULTS

Model Name	TN-180BT	Test By	Ted Huang
Temp & Humidity	24.5°C, 52%	Test Date	2018/3/26

Modulation Type: GFSK / DH5

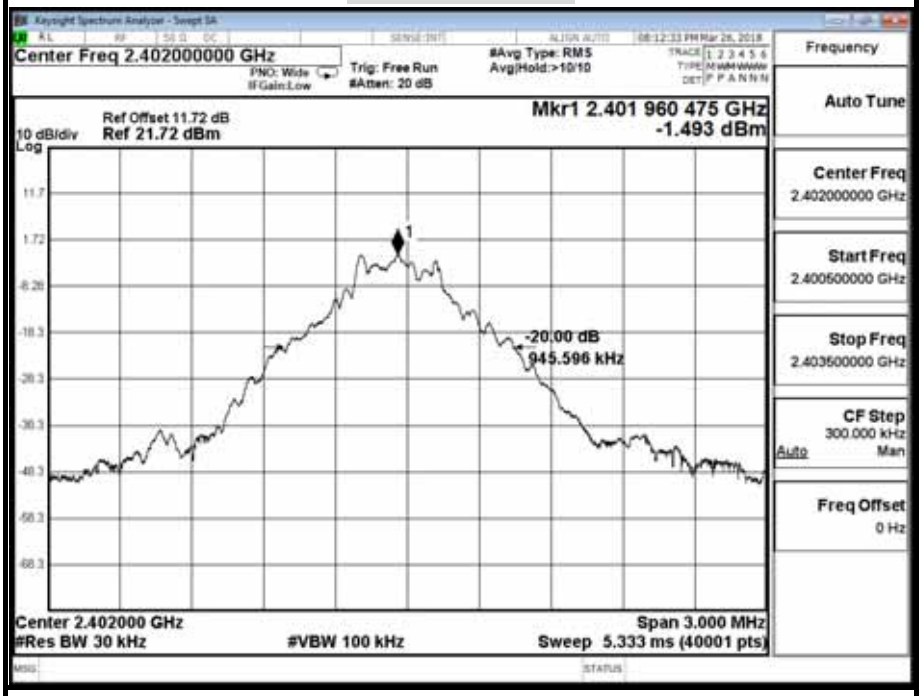
Channel	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Pass / Fail
Low	2402	945.60	N/A
Middle	2441	943.14	N/A
High	2480	944.38	N/A

Modulation Type: 8-DPSK / 3-DH5

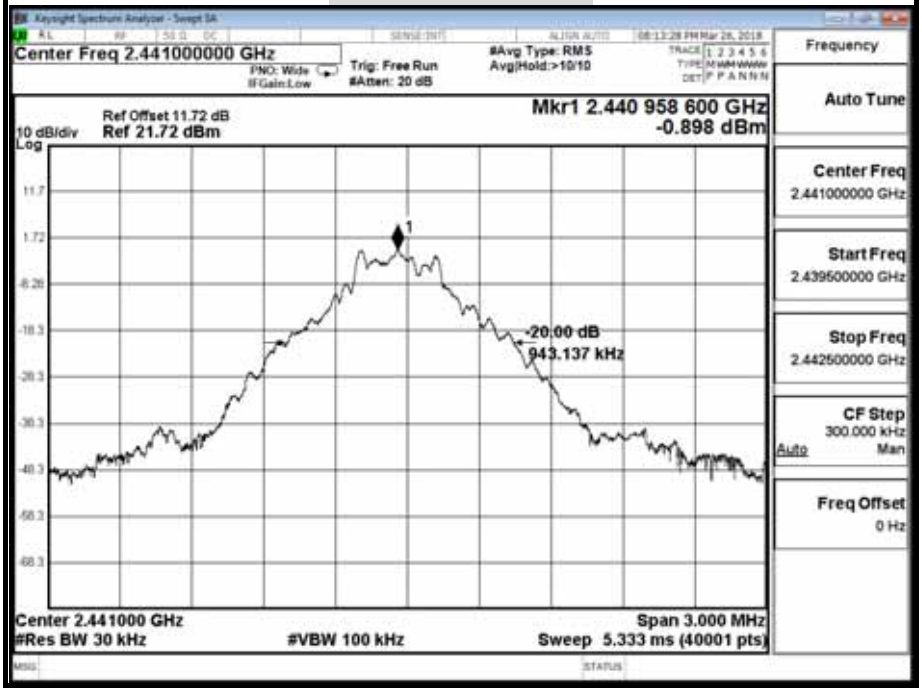
Channel	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Pass / Fail
Low	2402	1287.00	N/A
Middle	2441	1300.00	N/A
High	2480	1282.00	N/A

20dB BANDWIDTH

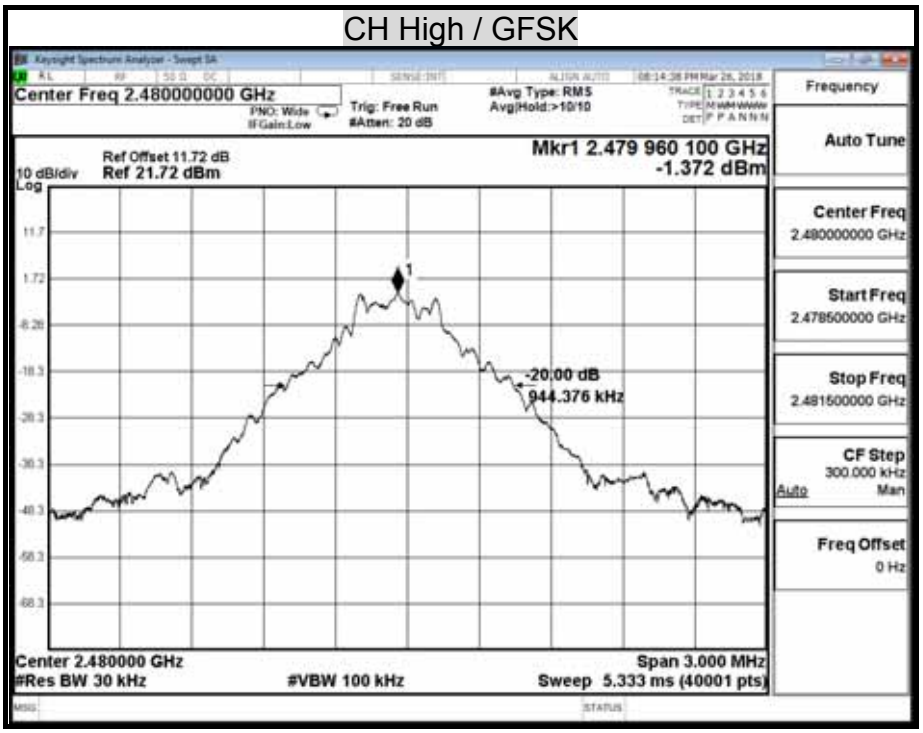
CH Low / GFSK



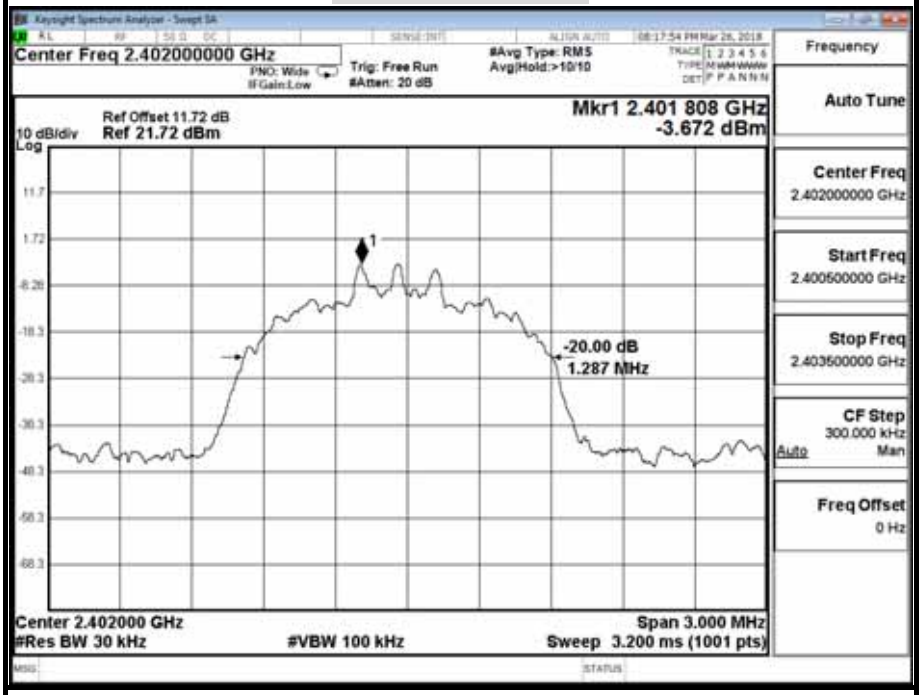
CH Middle / GFSK



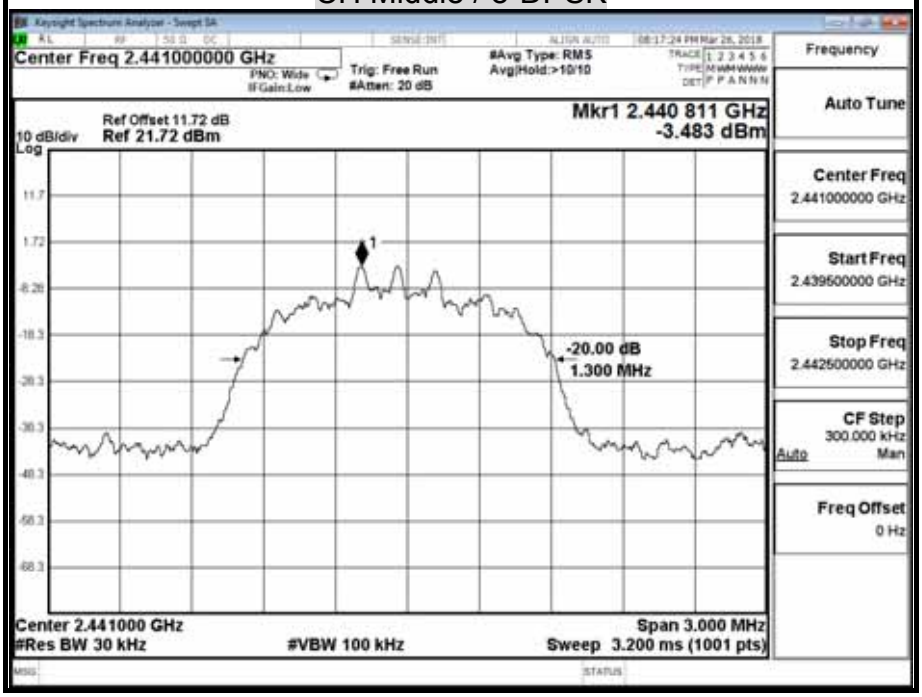
CH High / GFSK


Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>10/10
Frequency
Auto Tune
Ref Offset 11.72 dB
10 dB/div
Ref 21.72 dBm
Log
Mkr1 2.479 960 100 GHz
-1.372 dBm
-20.00 dB
944.376 kHz
Center Freq
2.480000000 GHz
Start Freq
2.478500000 GHz
Stop Freq
2.481500000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
Center 2.480000 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3.000 MHz
Sweep 5.333 ms (40001 pts)

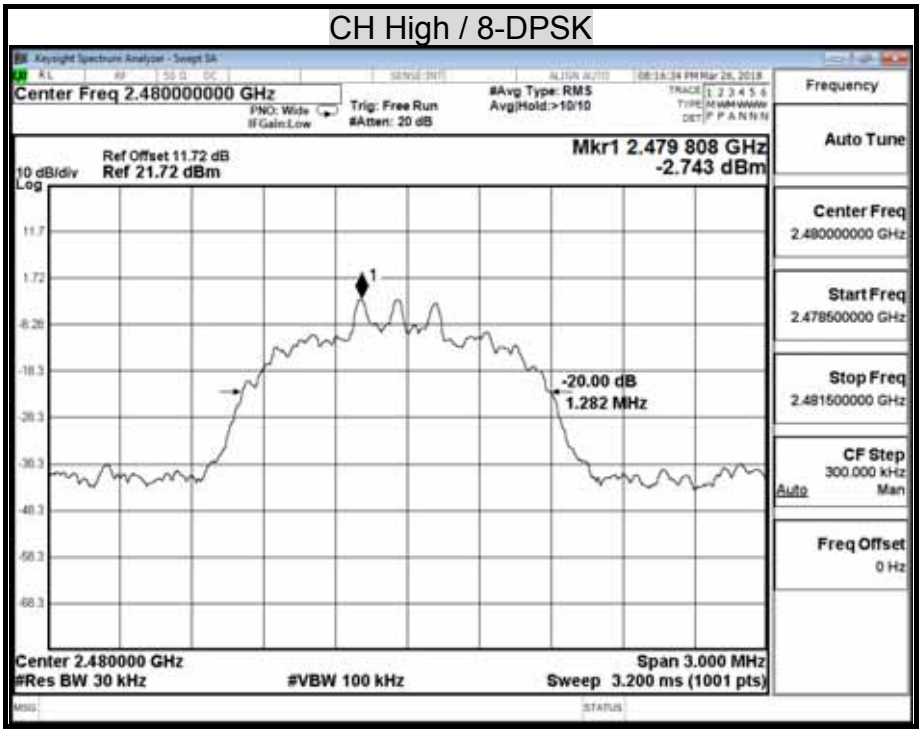
CH Low / 8-DPSK



CH Middle / 8-DPSK



CH High / 8-DPSK



7.2 MAXIMUM PEAK OUTPUT POWER

LIMIT

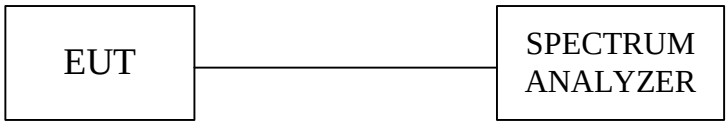
§15.247(b)(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	05/08/2018

.

Test Configuration



TEST PROCEDURE

The RF power output was measured with a Spectrum Analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A power meter was used to record the shape of the transmit signal.

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

TEST RESULTS

Modulation Type: GFSK / DH5

Model Name	TN-180BT	Test By	Ted Huang
Temp & Humidity	24.5℃, 52%	Test Date	2018/3/26

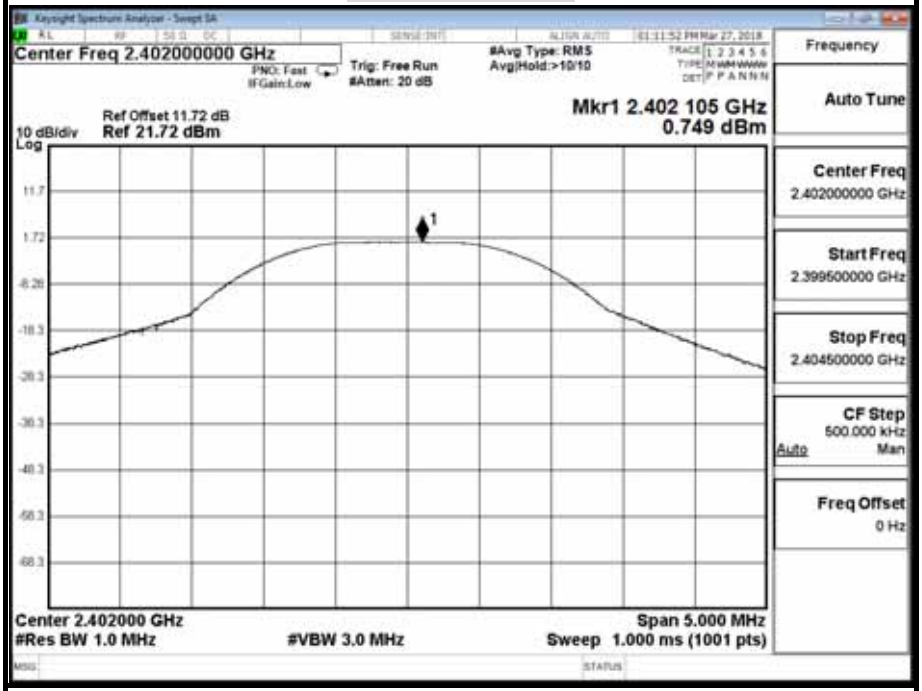
Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Output (mW)	Limit (mW)	Result
Low	2402	0.75	1.18823	1000	PASS
Mid	2441	1.32	1.35613		PASS
High	2480	1.58	1.43747		PASS

Modulation Type: 8-DPSK / 3-DH5

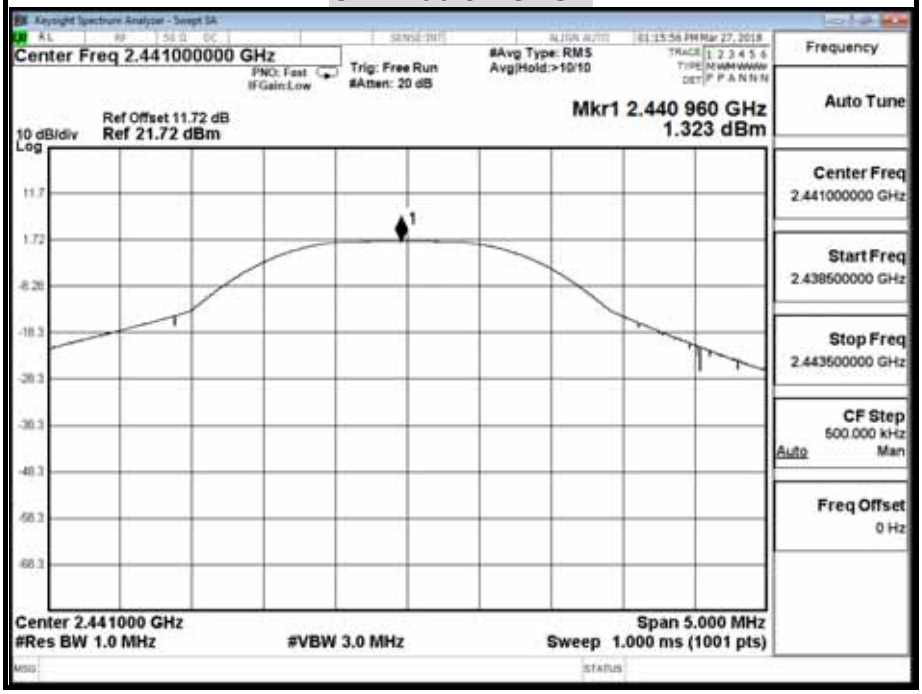
Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Output (mW)	Limit (mW)	Result
Low	2402	-1.02	0.79141	125	PASS
Mid	2441	-0.72	0.84723		PASS
High	2480	-0.77	0.83753		PASS

MAXIMUM PEAK OUTPUT POWER

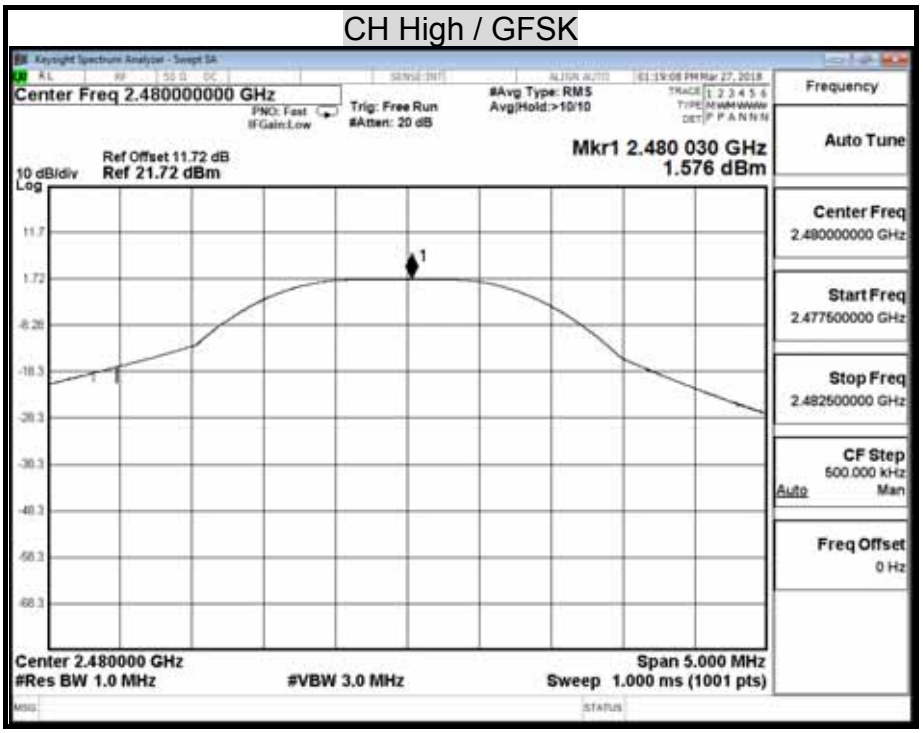
CH Low / GFSK



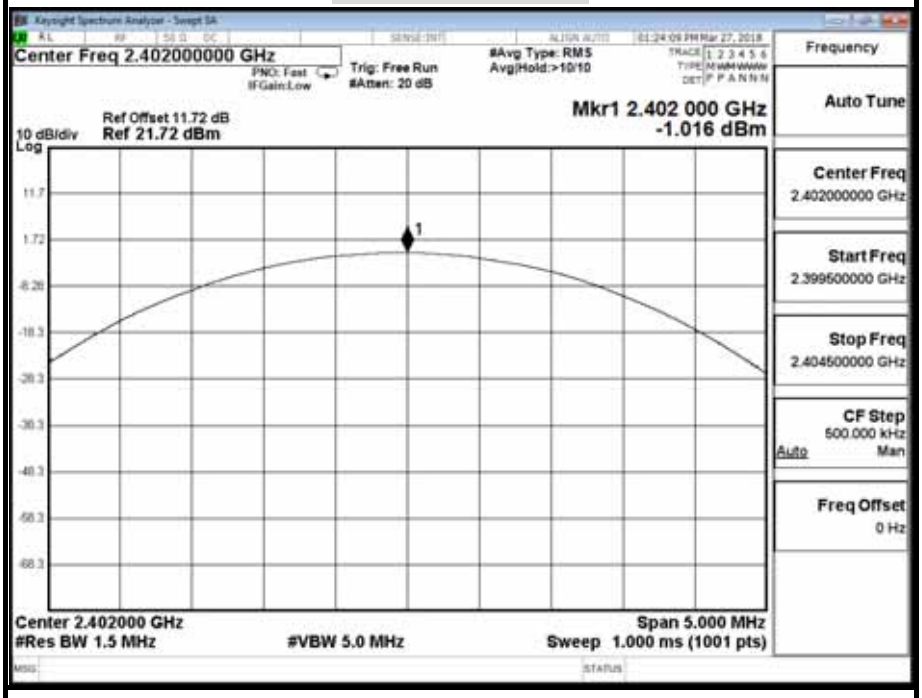
CH Middle / GFSK



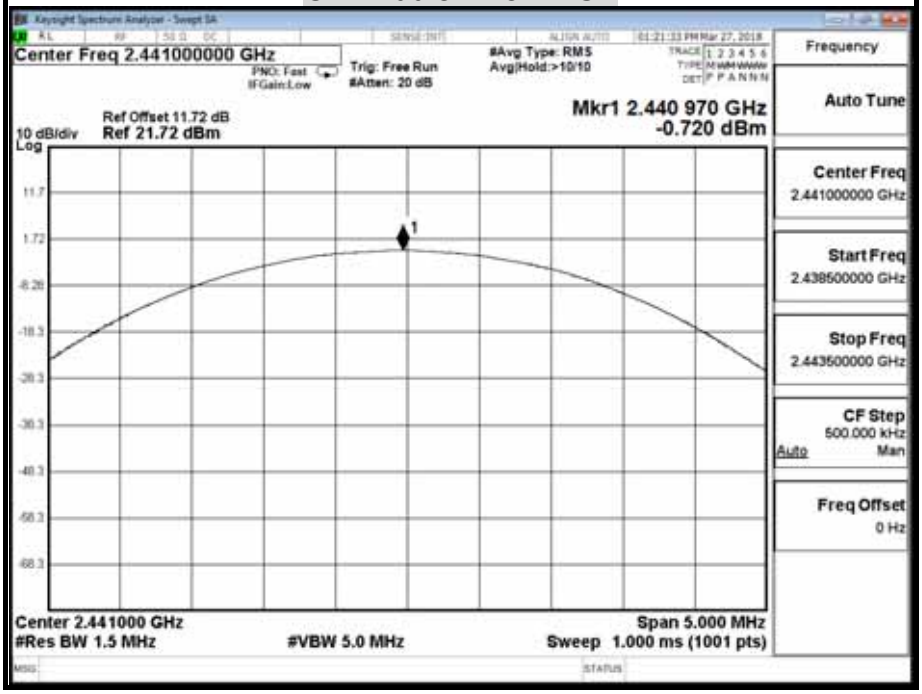
CH High / GFSK


Center Freq 2.480000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>10/10
Mkr1 2.480 030 GHz
1.576 dBm
Ref Offset 11.72 dB
10 dB/div
Ref 21.72 dBm
Log
11.7
1.72
-8.28
-18.3
-28.3
-38.3
-48.3
-58.3
-68.3
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

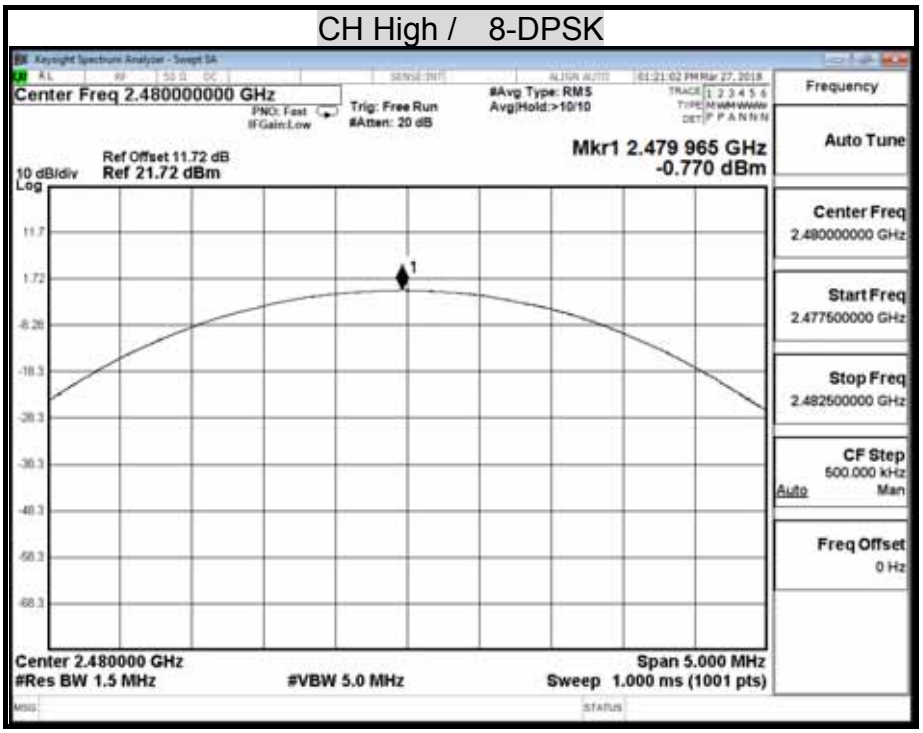
CH Low / 8-DPSK



CH Middle / 8-DPSK



CH High / 8-DPSK



7.3 HOPPING CHANNEL SEPARATION

LIMIT

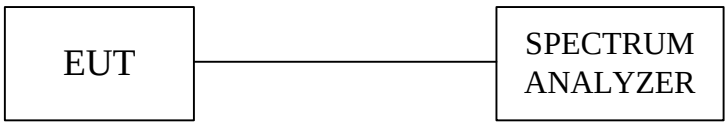
§15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo andomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	05/08/2018

.

TEST SETUP



TEST PROCEDURE

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the MaxHold function record the separation of adjacent channels.
4. Measure the frequency difference of these two adjacent channels by spectrum analyzer MARK function. And then plot the result on spectrum analyzer screen.
5. Repeat above procedures until all frequencies measured were complete.

TEST RESULTS

Refer to section 8.1, 20dB bandwidth measurement, the measured channel separation should be greater than two-third of 20dB bandwidth or Minimum bandwidth.

Modulation Type: GFSK / DH5

Model Name	TN-180BT	Test By	Ted Huang
Temp & Humidity	24.5°C, 52%	Test Date	2018/3/26

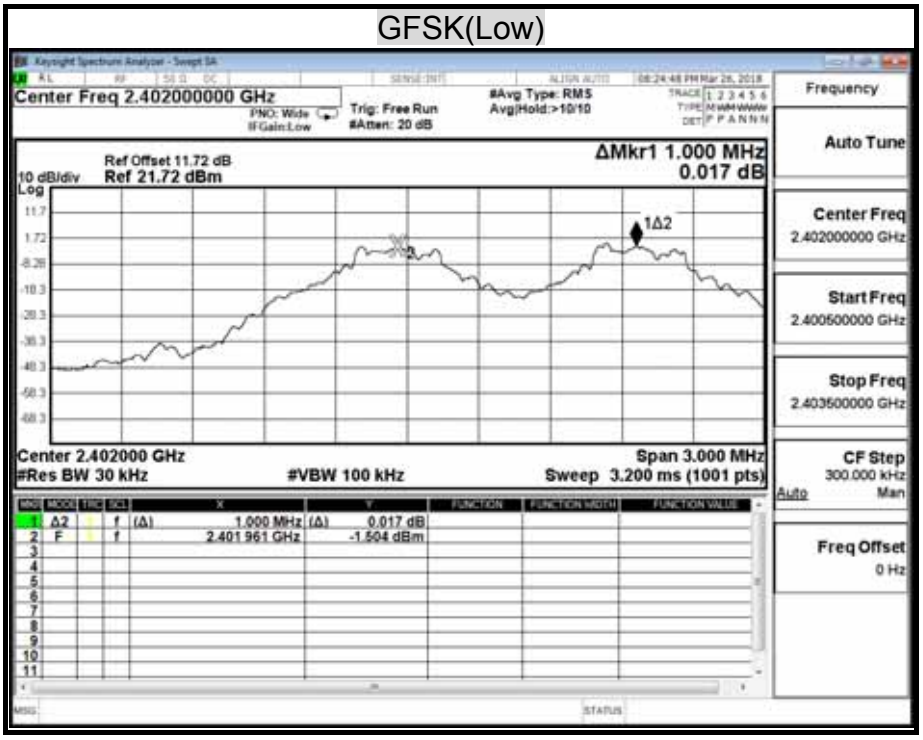
Channel	Adjacent Hopping Channel Separation (MHz)	Two –third of 20dB bandwidth (MHz)	Minimum Bandwidth (kHz)	Result
2402MHz	1.00	0.63	25 KHz	PASS
2441MHz	1.00	0.63	25 KHz	PASS
2480MHz	1.00	0.63	25 KHz	PASS

Modulation Type: 8-DPSK / 3-DH5

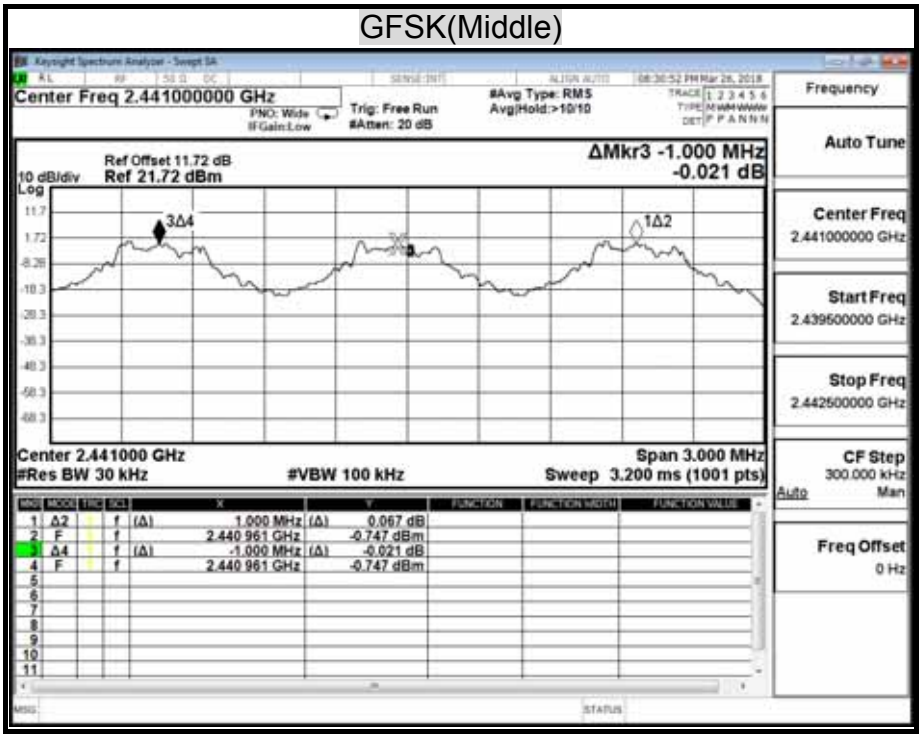
Channel	Adjacent Hopping Channel Separation (kHz)	Two –third of 20dB bandwidth (kHz)	Minimum Bandwidth (kHz)	Result
2402MHz	1.00	0.86	25 KHz	PASS
2441MHz	1.01	0.87	25 KHz	PASS
2480MHz	1.00	0.85	25 KHz	PASS

HOPPING CHANNEL SEPARATION

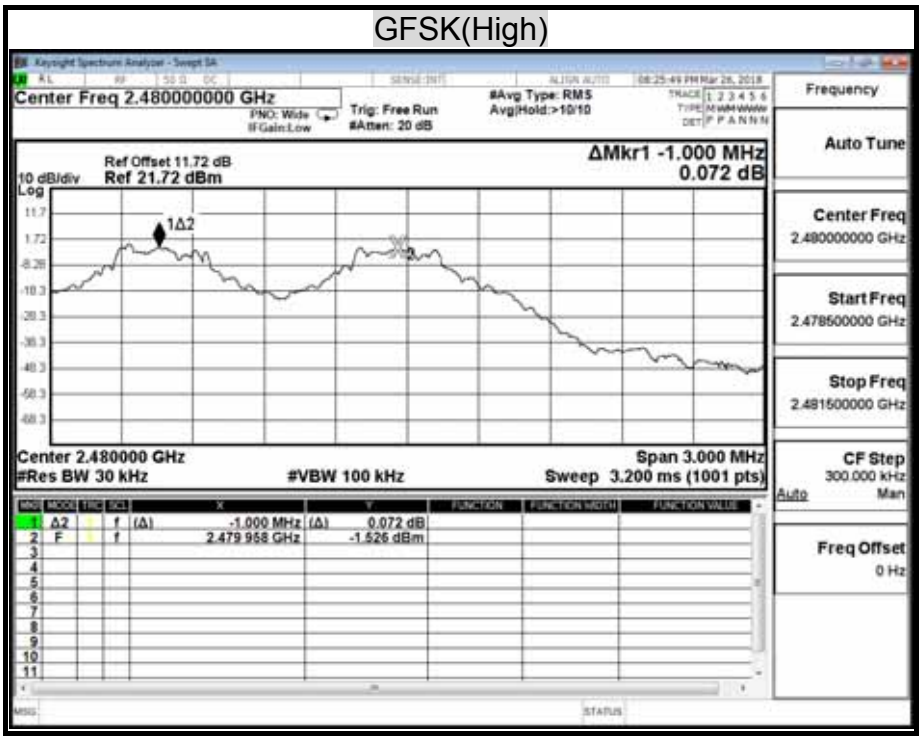
GFSK(Low)



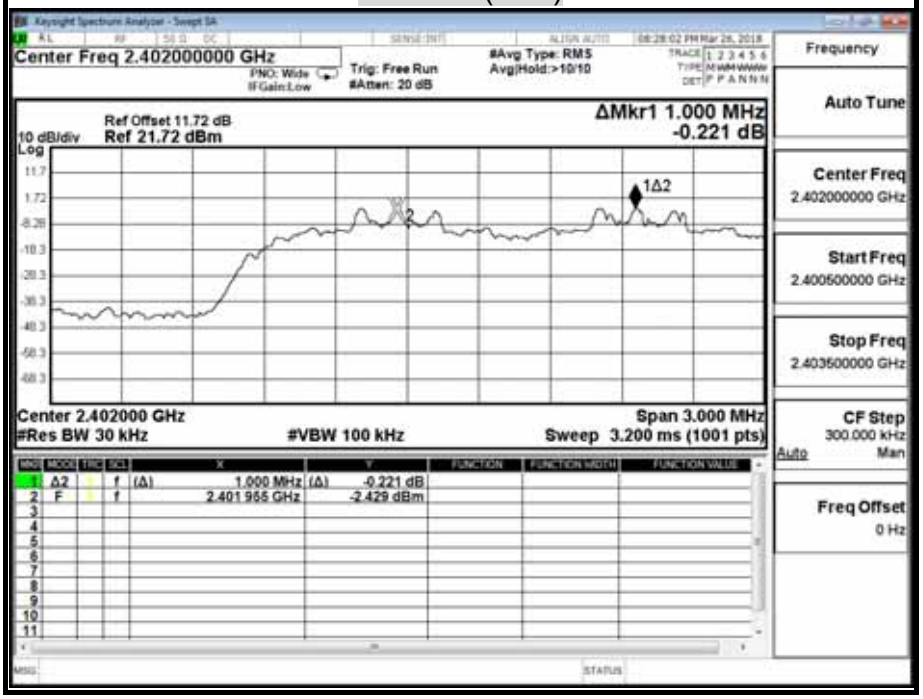
GFSK(Middle)



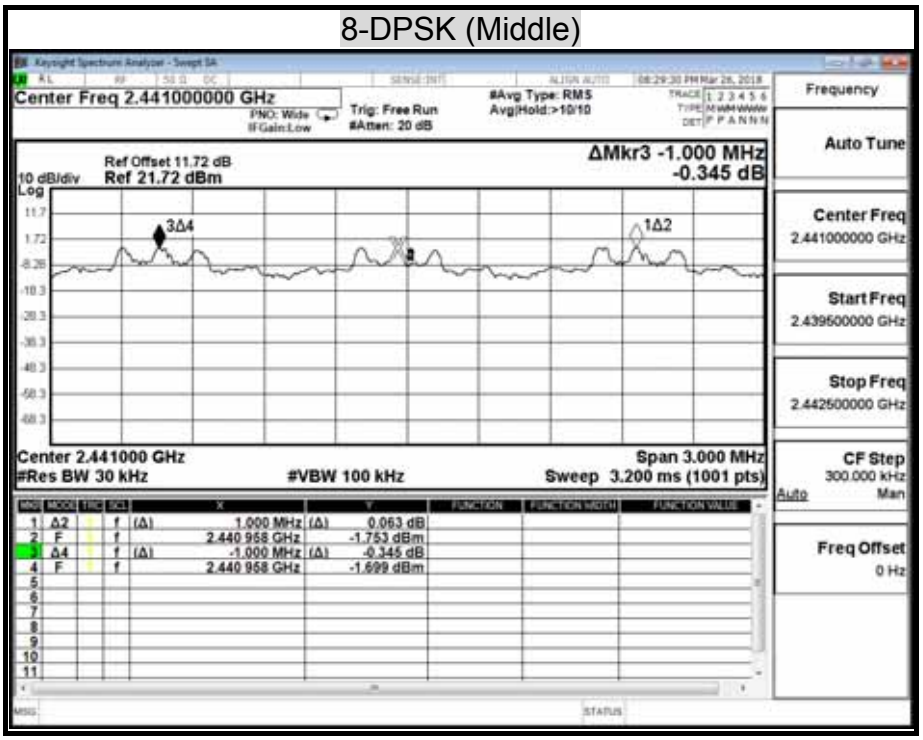
GFSK(High)



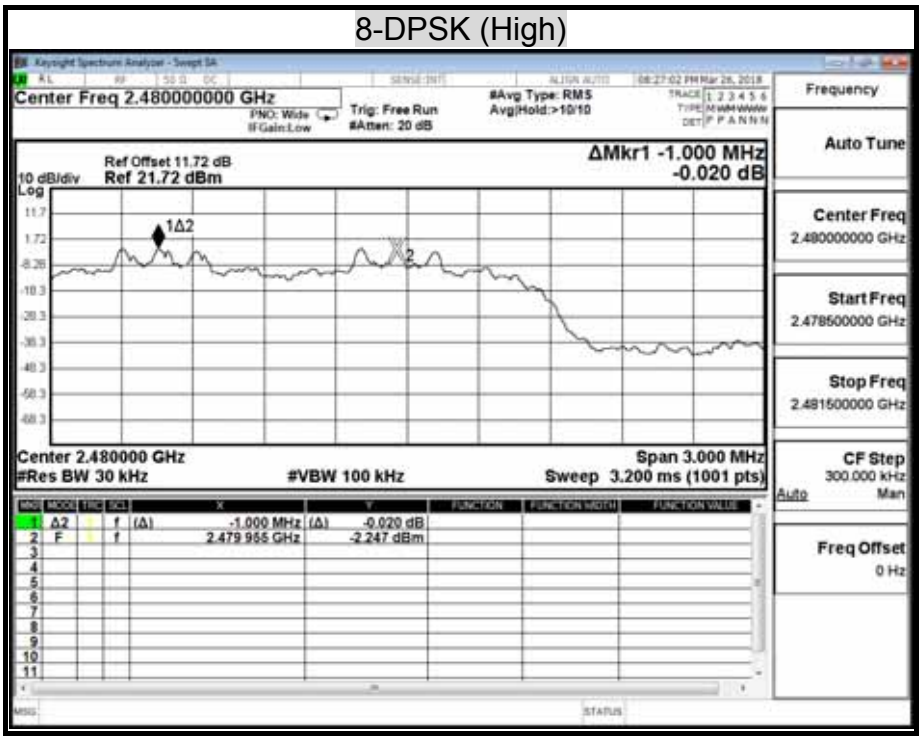
8-DPSK (Low)



8-DPSK (Middle)



8-DPSK (High)



7.4 NUMBER OF HOPPING FREQUENCY USED

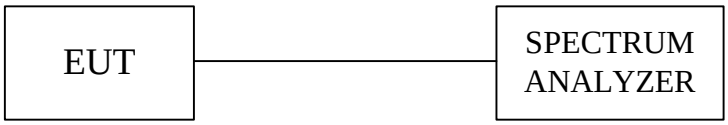
LIMIT

§15.247(a)(1)(iii) For frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	05/08/2018

TEST SETUP



TEST PROCEDURE

1 Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2 Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3 Set the spectrum analyzer on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
4 Set the spectrum analyzer on View mode and then plot the result on spectrum analyzer screen.
5 Repeat above procedures until all frequencies measured were complete.

TEST RESULTS

Model Name	TN-180BT	Test By	Ted Huang
Temp & Humidity	24.5°C, 52%	Test Date	2018/3/26

Modulation Type: GFSK / DH5

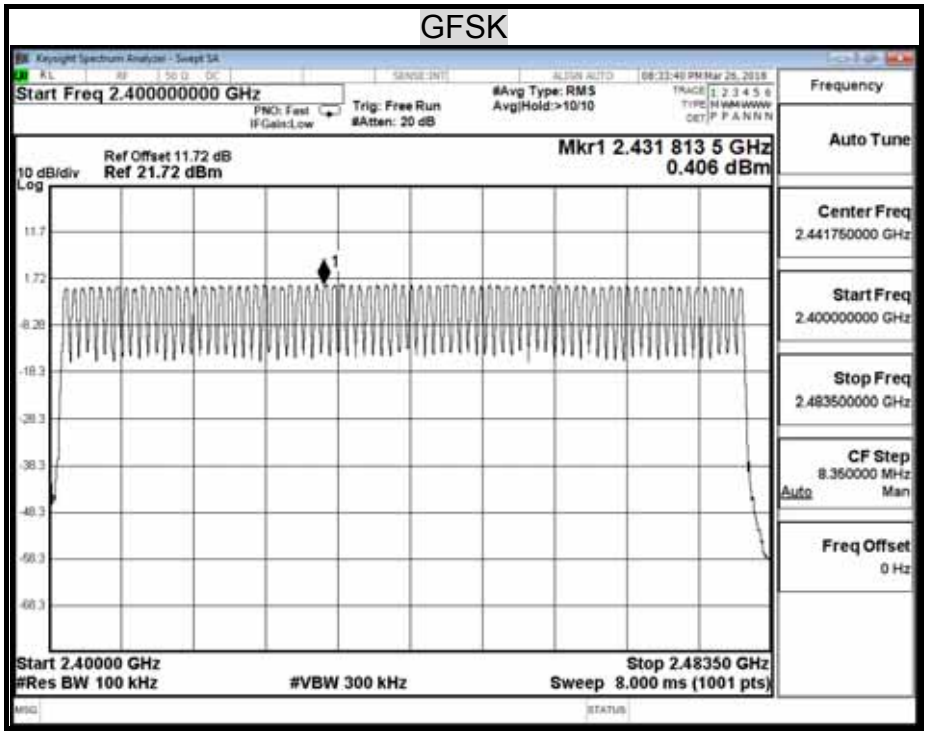
Result(No.of CH)	Limit(No.of CH)	Result
79	>75	PASS

Modulation Type: 8-DPSK / 3-DH5

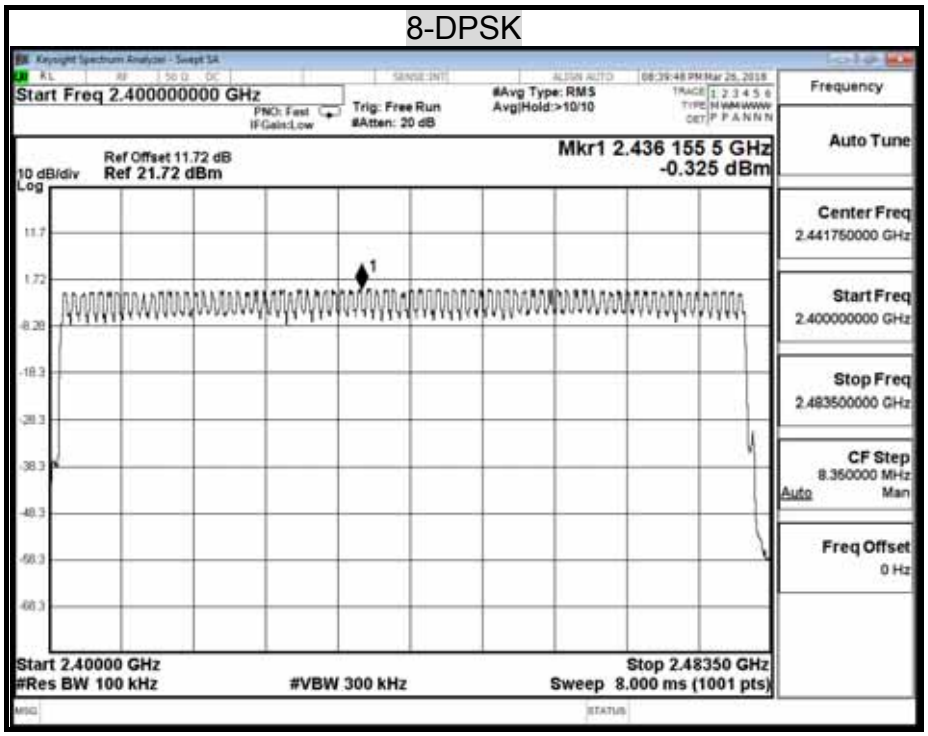
Result(No.of CH)	Limit(No.of CH)	Result
79	>75	PASS

NUMBER OF HOPPING FREQUENCY USED

GFSK



8-DPSK



7.5 DWELL TIME ON EACH CHANNEL

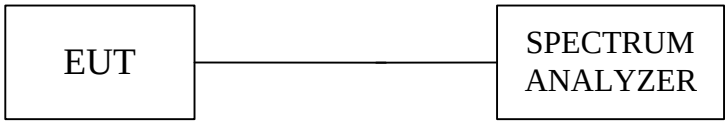
LIMIT

§15.247(a)(1)(iii) For frequency hopping system operating in the 2400-2483.5MHz band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 31.6 second period.

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	05/08/2018

TEST SETUP



TEST PROCEDURE

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of spectrum analyzer on any frequency be measured and set spectrum analyzer to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.
6. The Bluetooth Headset has 3 type of payload, DH1, DH3, DH5. The hopping rate is 1600 per second. The longer the payload is, the slower the hopping rate is.

TEST RESULTS

Time of occupancy on the TX channel in 31.6sec = time domain slot length × hop rate ÷ number of hop per channel × 31.6
Refer to the attached graph.
The hopping rates of Bluetooth devices change with different types of payload. The longer the payload is, the slower the hopping rate. The hopping rate scenario is defined in Bluetooth core specification.

Model Name	TN-180BT	Test By	Ted Huang
Temp & Humidity	24.5°C, 52%	Test Date	2018/3/26

Modulation Type: GFSK / DH5

Transmitting Frequency	Packet type	Dwell time (ms)	Time of occupancy on the TX channel in 31.6sec (ms)	Limit for Time of occupancy on the TX channel in 31.6sec (ms)	Results
2441MHz	DH1	0.400	128.00	400.00	PASS
2441MHz	DH3	1.660	265.60	400.00	PASS
2441MHz	DH5	2.900	309.33	400.00	PASS
2441MHz	AFH	2.900	154.67	400.00	PASS

DH1 Dwell tine= 0.400 ms×(1600÷2)÷79×31.6= 128.00 (ms)
DH3 Dwell tine= 1.660 ms×(1600÷4)÷79×31.6= 265.60 (ms)
DH5 Dwell tine= 2.900 ms×(1600÷6)÷79×31.6= 309.33 (ms)
AFH Dwell tine= 2.900 ms×(800÷6)÷20×8= 154.67 (ms)

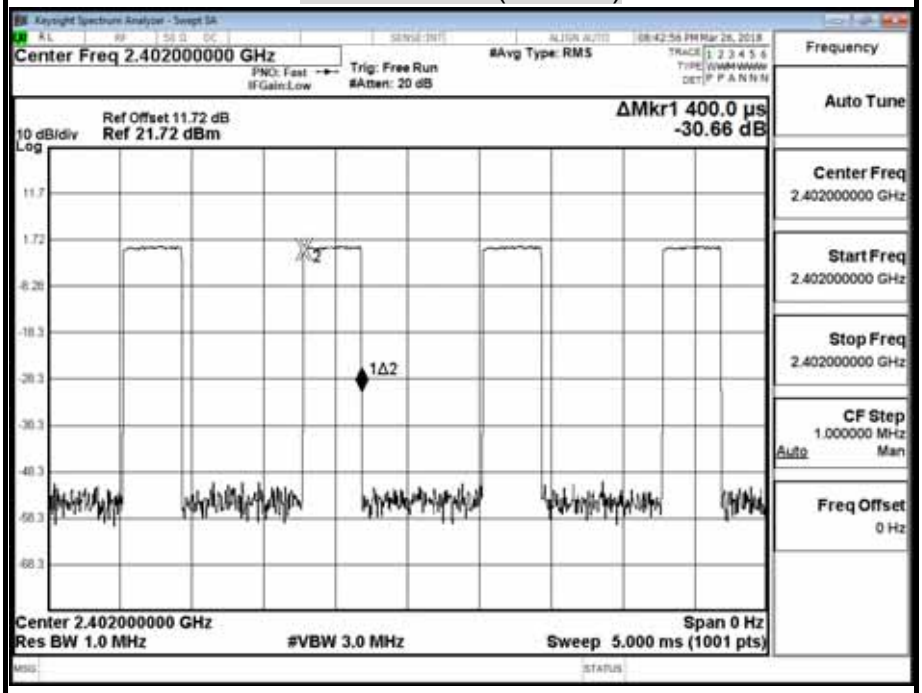
Modulation Type: 8-DPSK / 3-DH5

Transmitting Frequency	Packet type	Dwell time (ms)	Time of occupancy on the TX channel in 31.6sec (ms)	Limit for Time of occupancy on the TX channel in 31.6sec (ms)	Results
2441MHz	3DH1	0.400	128.00	400.00	PASS
2441MHz	3DH3	1.660	265.60	400.00	PASS
2441MHz	3DH5	2.900	309.33	400.00	PASS
2441MHz	AFH	2.900	154.67	400.00	PASS

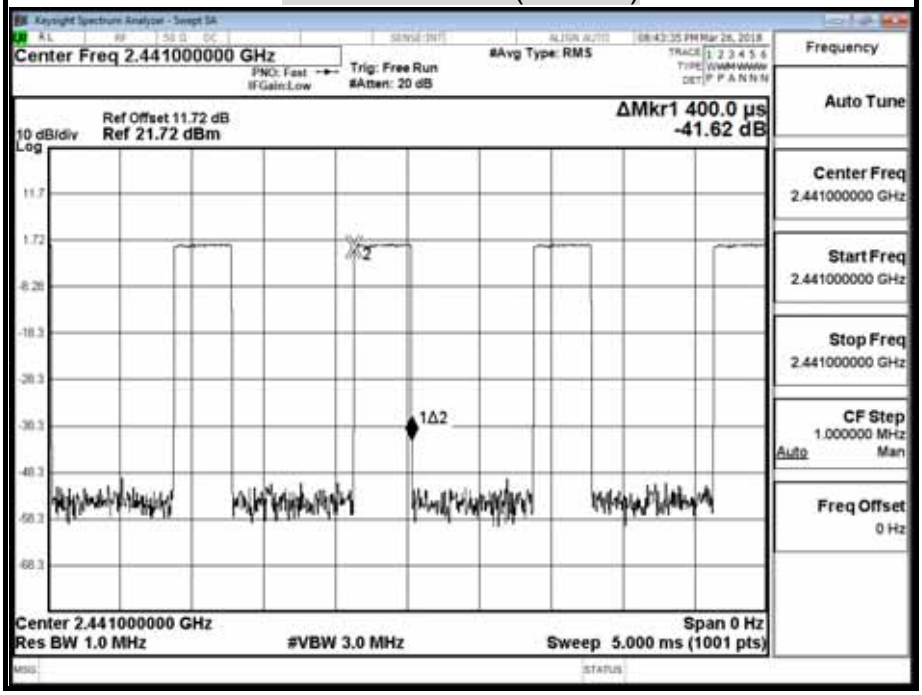
3DH1 Dwell tine= 0.400 ms×(1600÷2)÷79×31.6= 128.00 (ms)
3DH3 Dwell tine= 1.660 ms×(1600÷4)÷79×31.6= 265.60 (ms)
3DH5 Dwell tine= 2.900 ms×(1600÷6)÷79×31.6= 309.33 (ms)
AFH Dwell tine= 2.900 ms×(800÷6)÷20×8= 154.67 (ms)

DWELL TIME ON EACH PAYLOAD

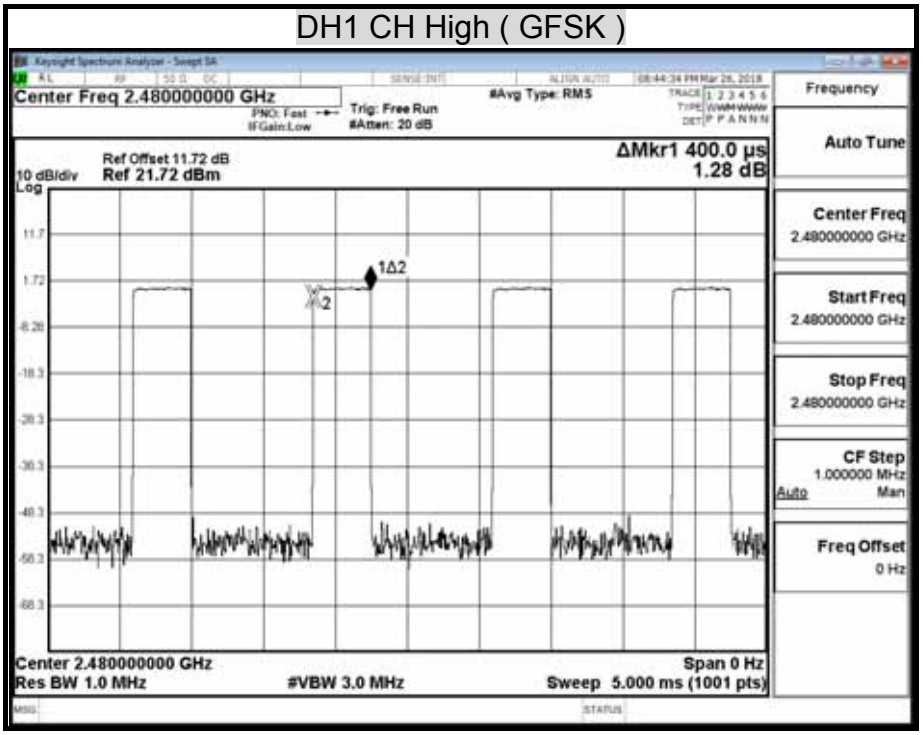
DH1 CH Low (GFSK)



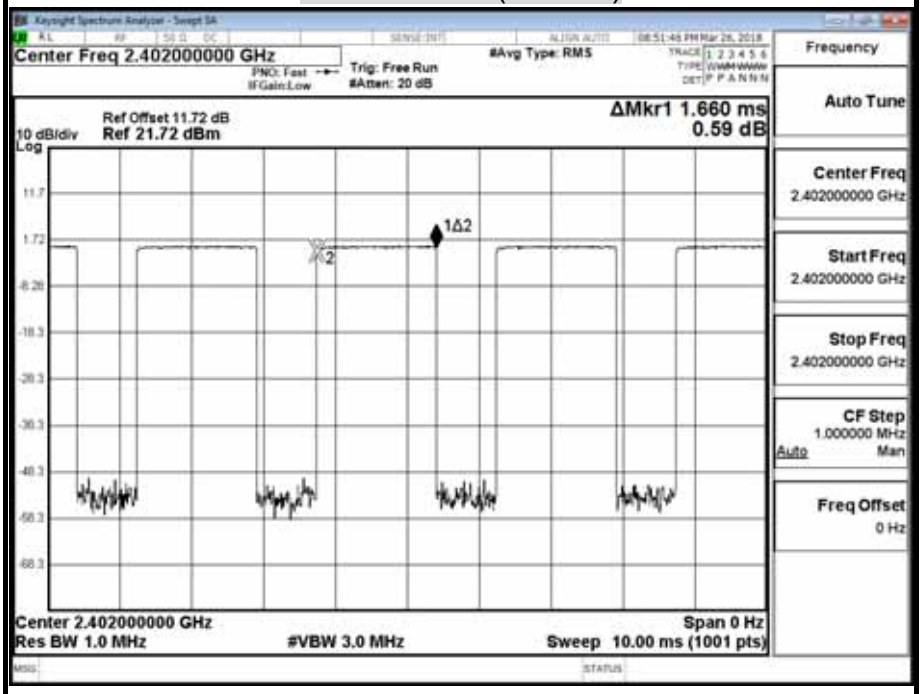
DH1 CH Middle (GFSK)



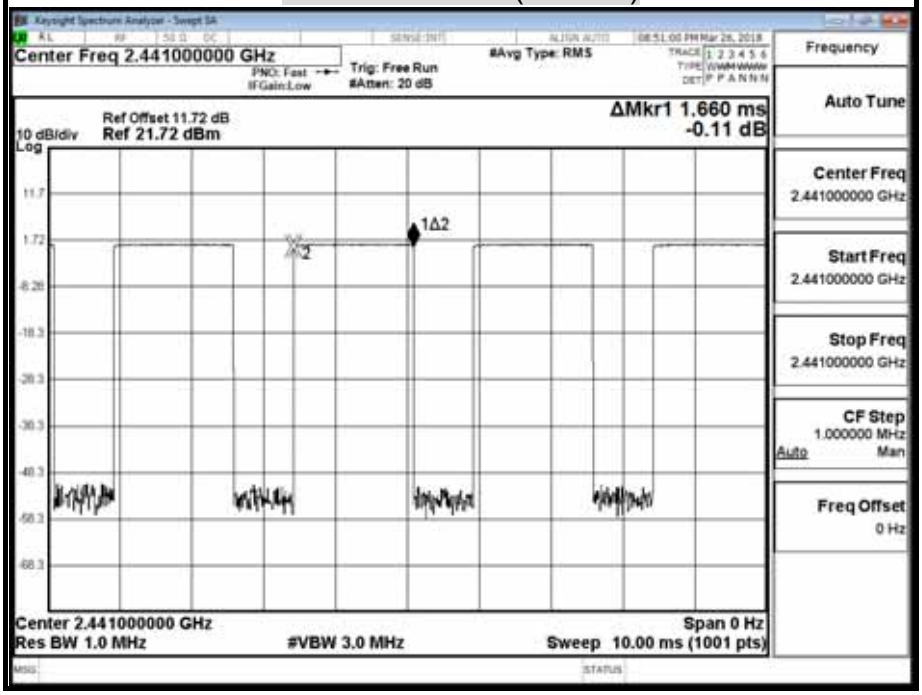
DH1 CH High (GFSK)



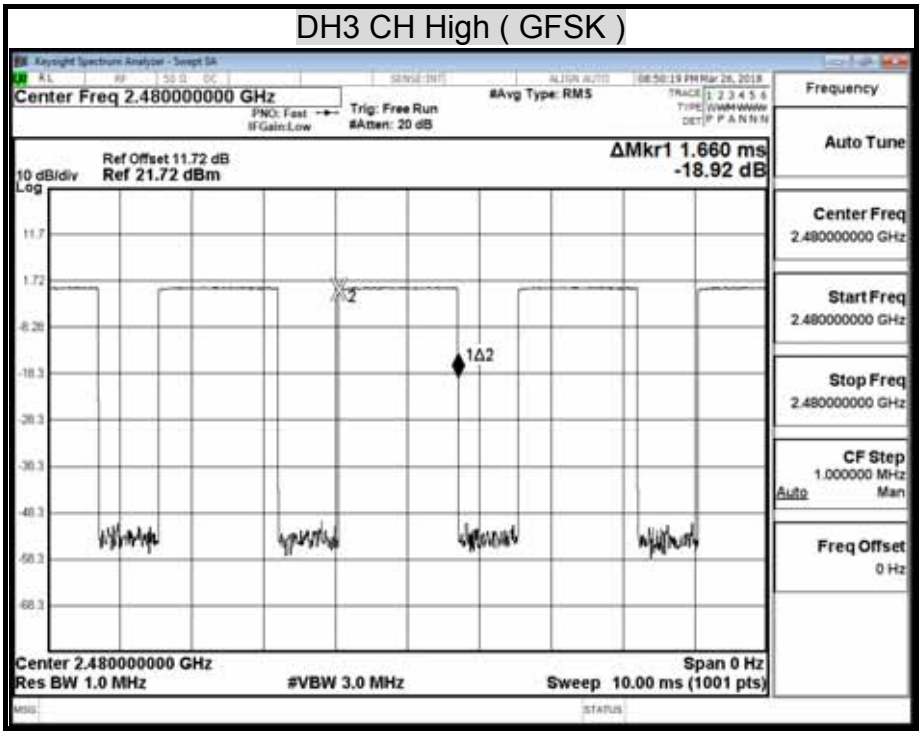
DH3 CH Low (GFSK)



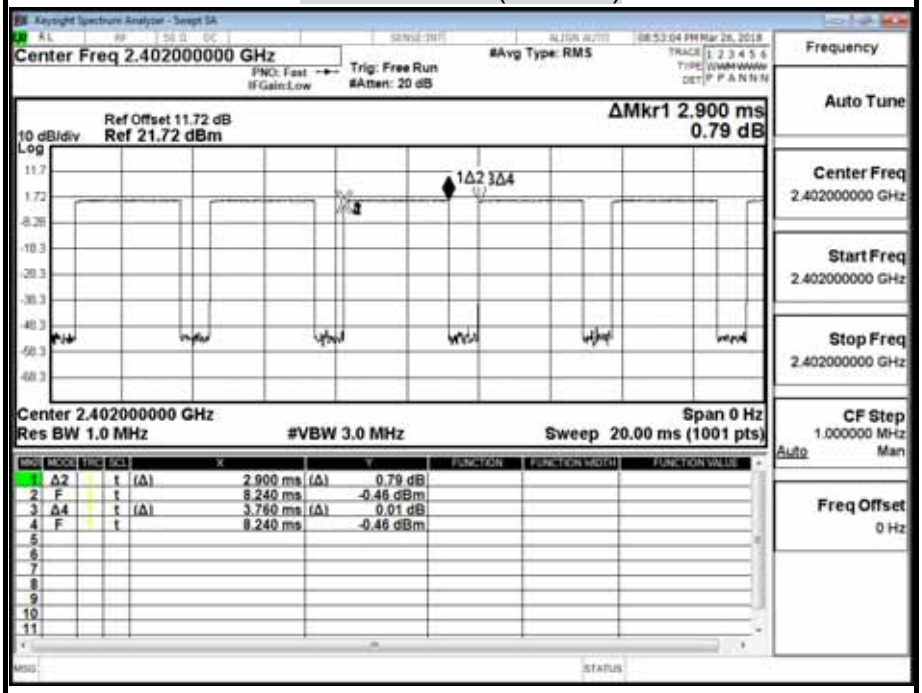
DH3 CH Middle (GFSK)



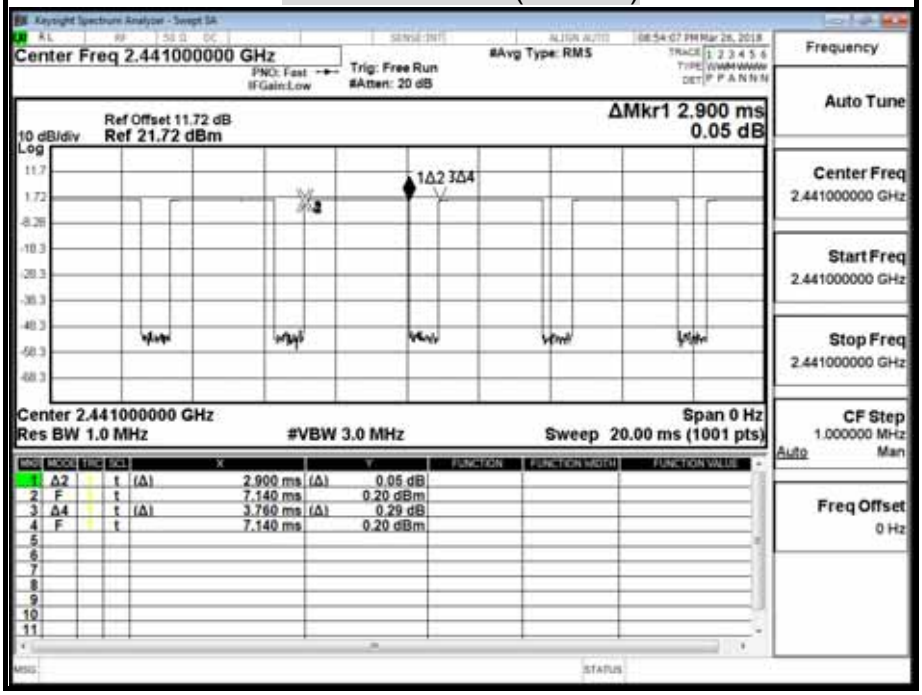
DH3 CH High (GFSK)



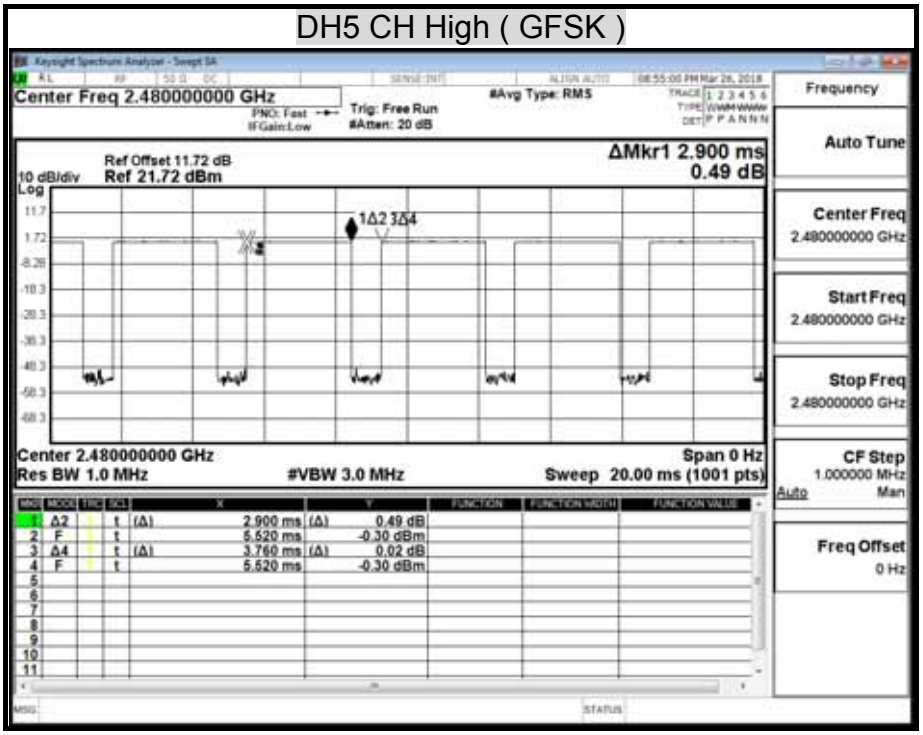
DH5 CH Low (GFSK)



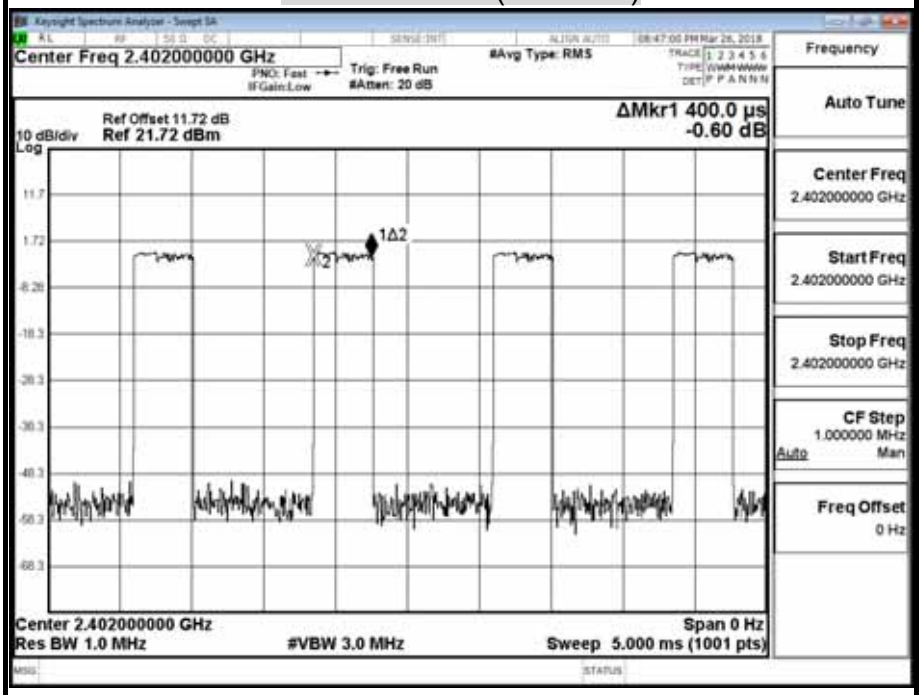
DH5 CH Middle (GFSK)



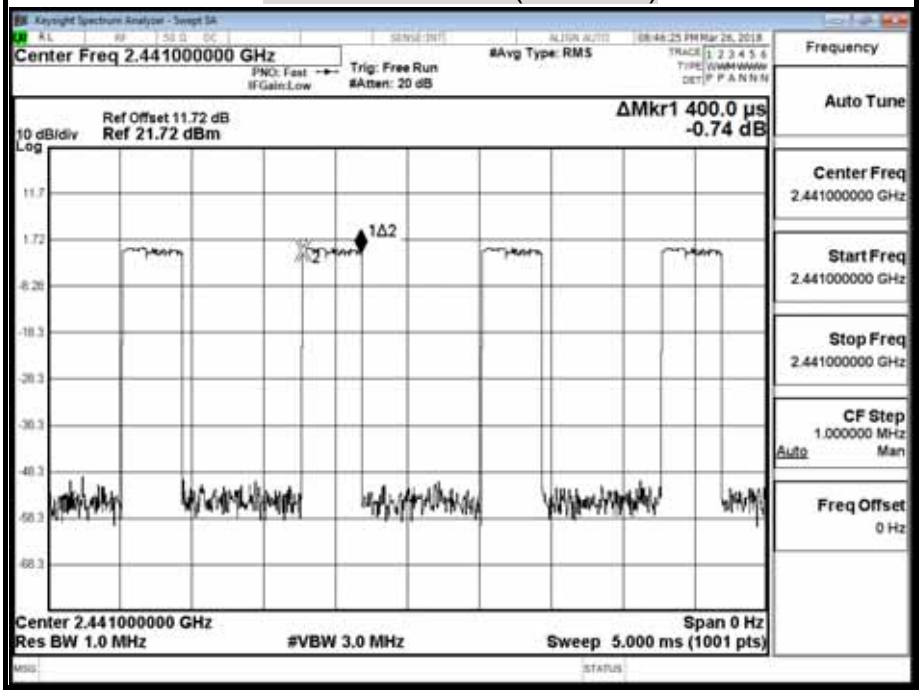
DH5 CH High (GFSK)



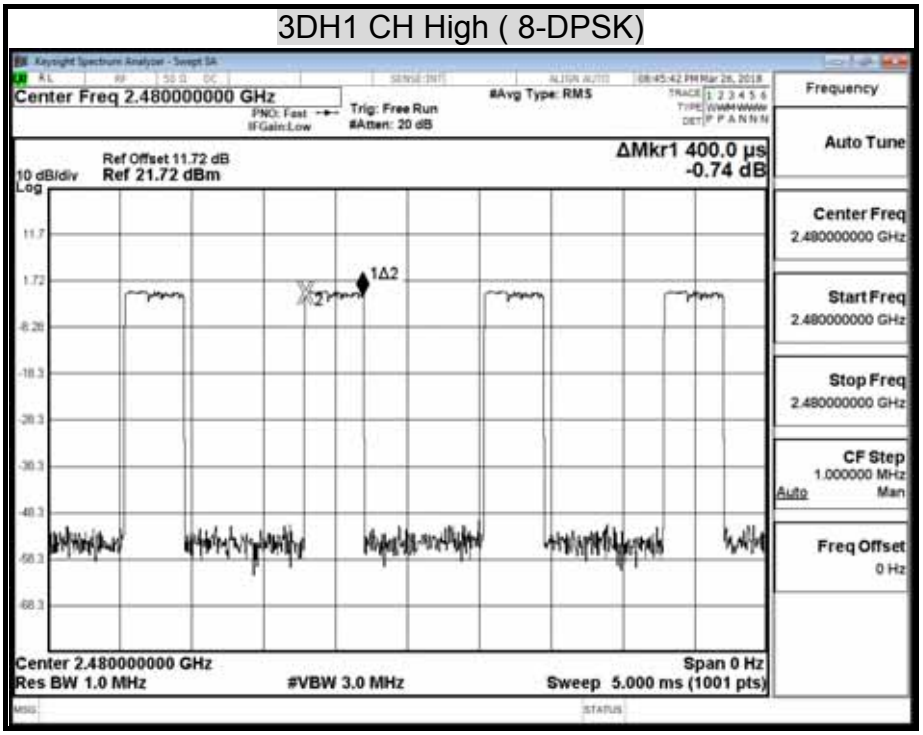
3DH1 CH Low (8-DPSK)



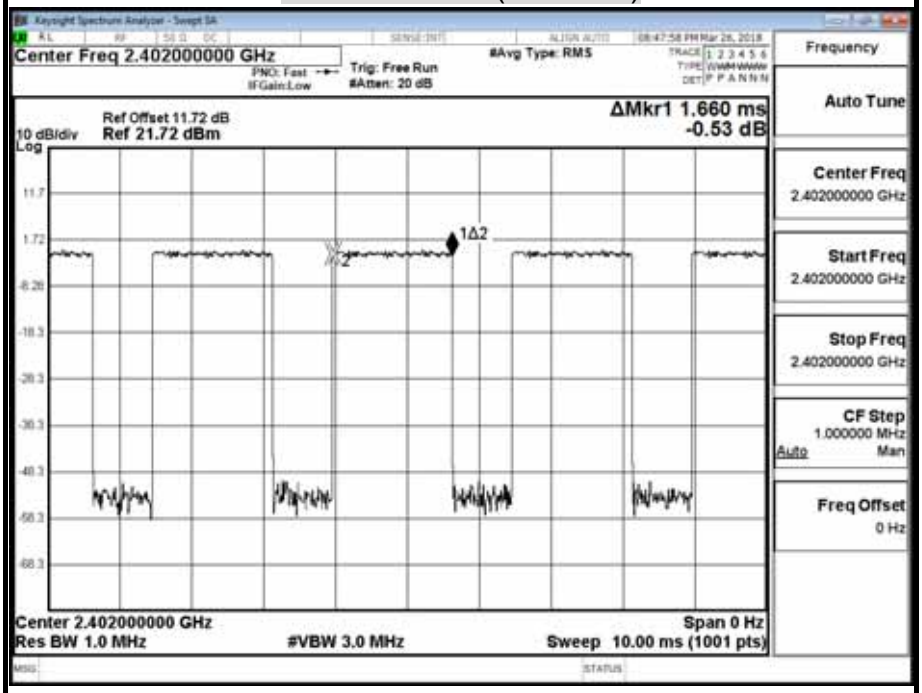
3DH1 CH Middle (8-DPSK)



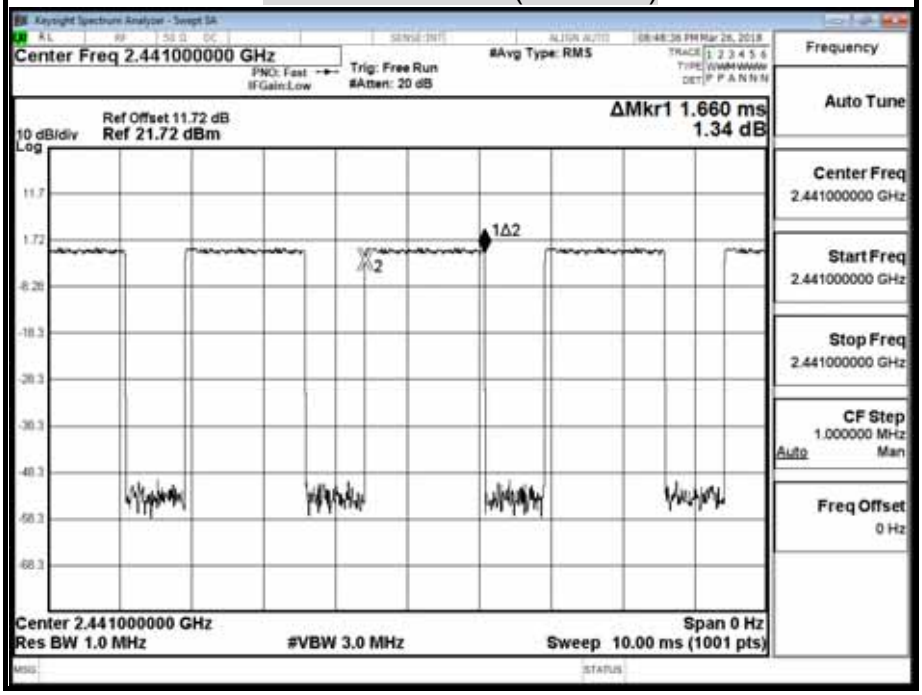
3DH1 CH High (8-DPSK)



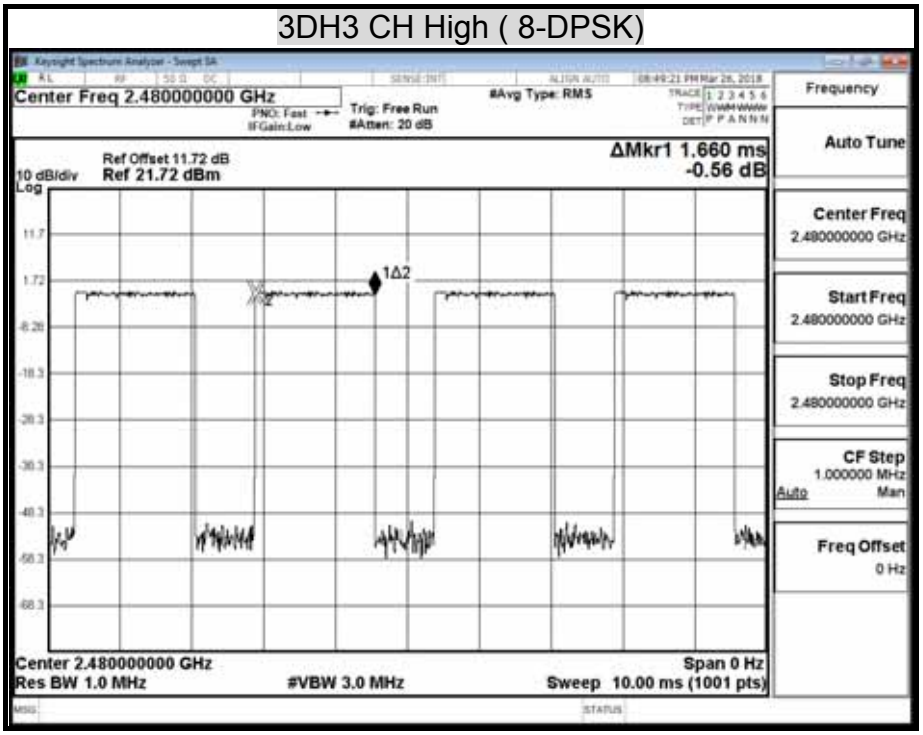
3DH3 CH Low (8-DPSK)



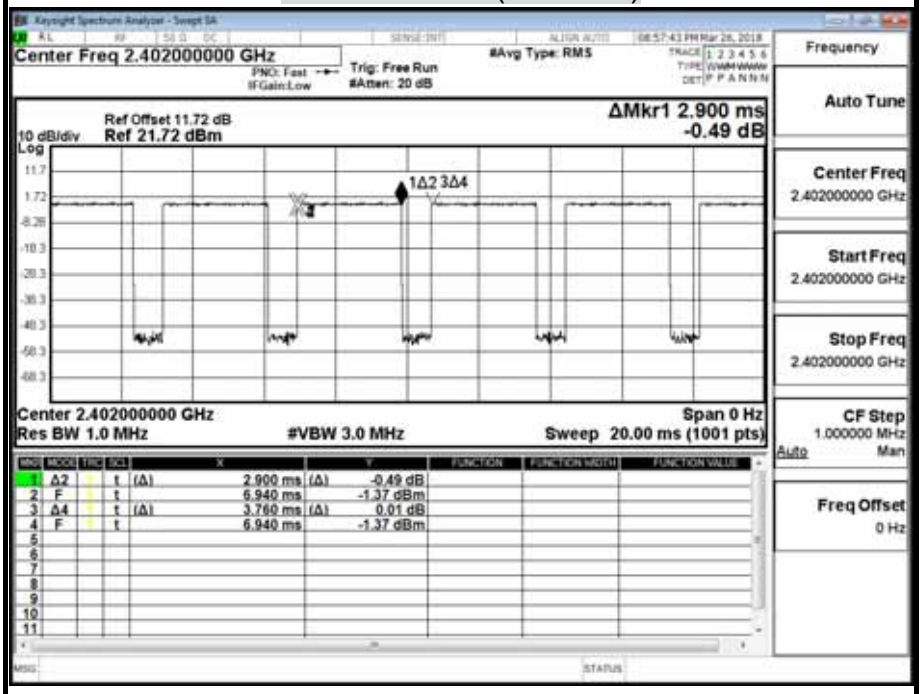
3DH3 CH Middle (8-DPSK)



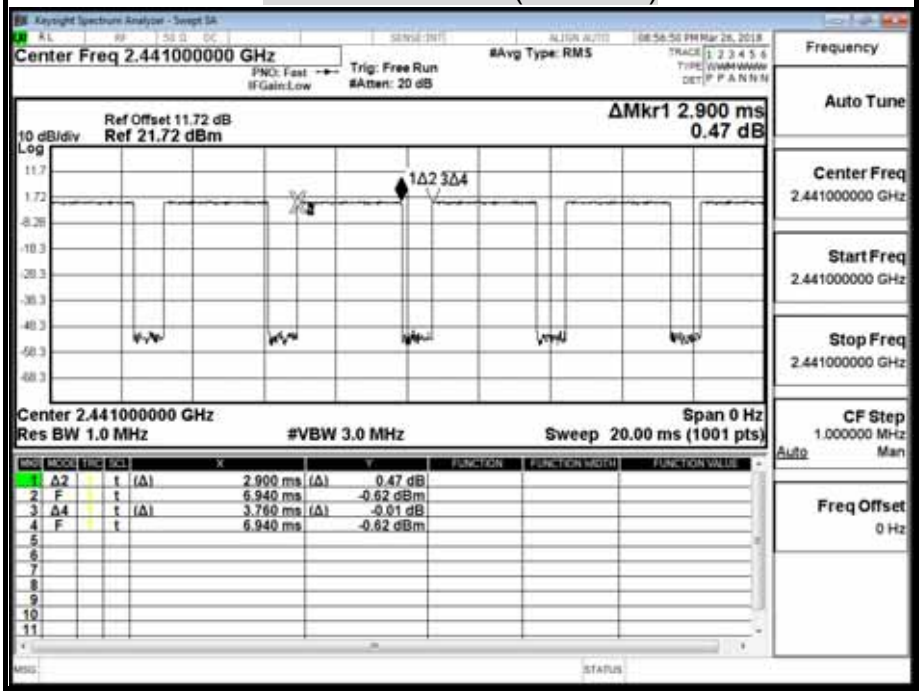
3DH3 CH High (8-DPSK)



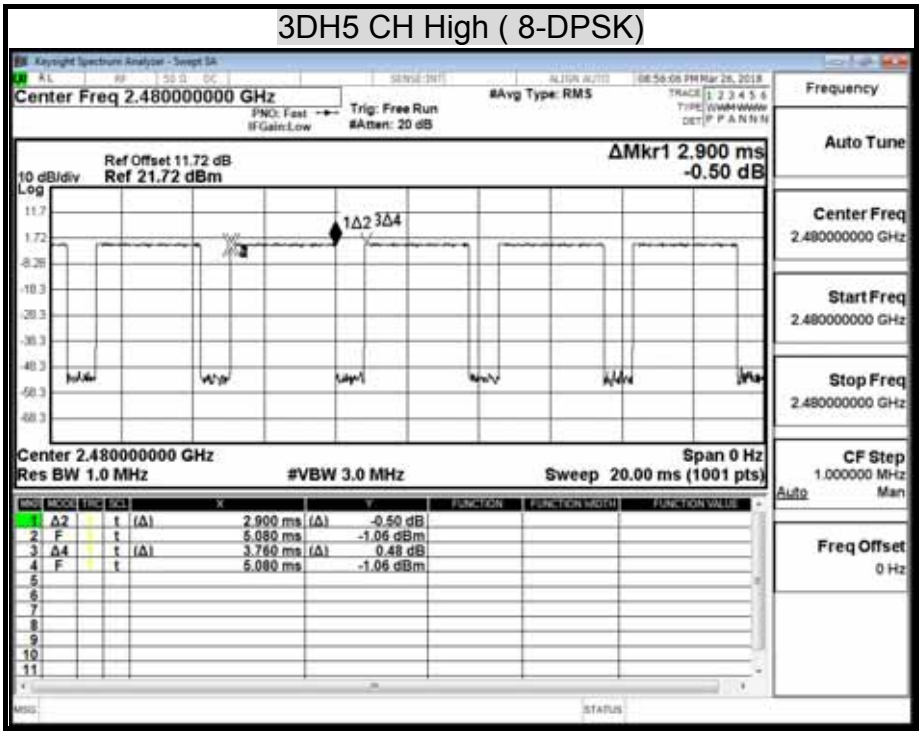
3DH5 CH Low (8-DPSK)



3DH5 CH Middle (8-DPSK)



3DH5 CH High (8-DPSK)



7.6 DUTY CYCLE

LIMIT

Nil (No dedicated limit specified in the Rules)

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	05/08/2018

Remark: *Each piece of equipment is scheduled for calibration once a year.*

TEST SETUP

TEST 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 loss RF cable from the antenna port to the spectrum analyzer.
3. The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

TEST RESULTS

No non-compliance noted.

TEST DATA

Model Name	TN-180BT	Test By	Ted Huang
Temp & Humidity	24.5°C, 52%	Test Date	2018/3/26

Modulation Type: GFSK / DH5

	us	Times	Ton	Total Ton time(ms)
Ton1	2900.000	1	2900	
Ton2		0	0	
Ton3			0	2.9
Tp				3.76

Ton	2.9
Tp(Ton+Toff)	3.76
Duty Cycle	0.771276596
Duty Factor	1.12789847

Modulation Type: 8-DPSK / 3-DH5

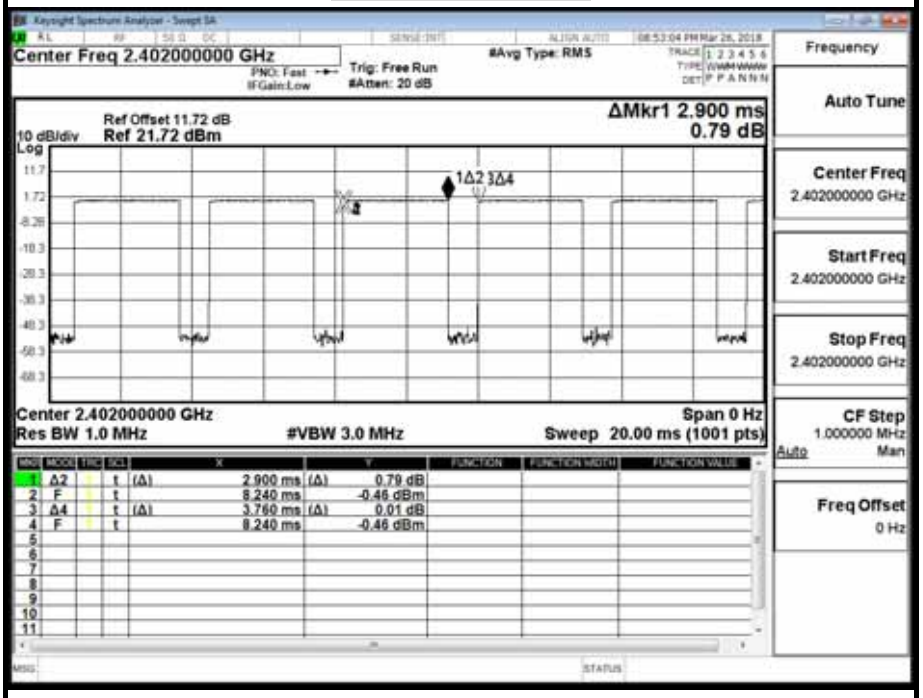
	us	Times	Ton	Total Ton time(ms)
Ton1	2900.000	1	2900	
Ton2		0	0	
Ton3			0	2.9
Tp				3.76

Ton	2.9
Tp(Ton+Toff)	3.76
Duty Cycle	0.771276596
Duty Factor	1.12789847

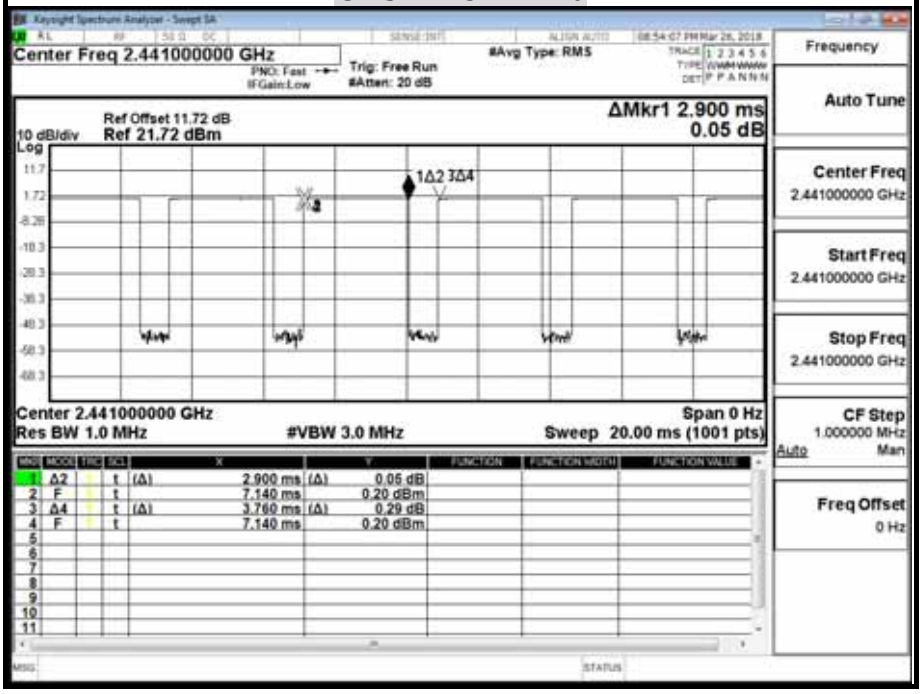
TEST PLOT

Duty Cycle

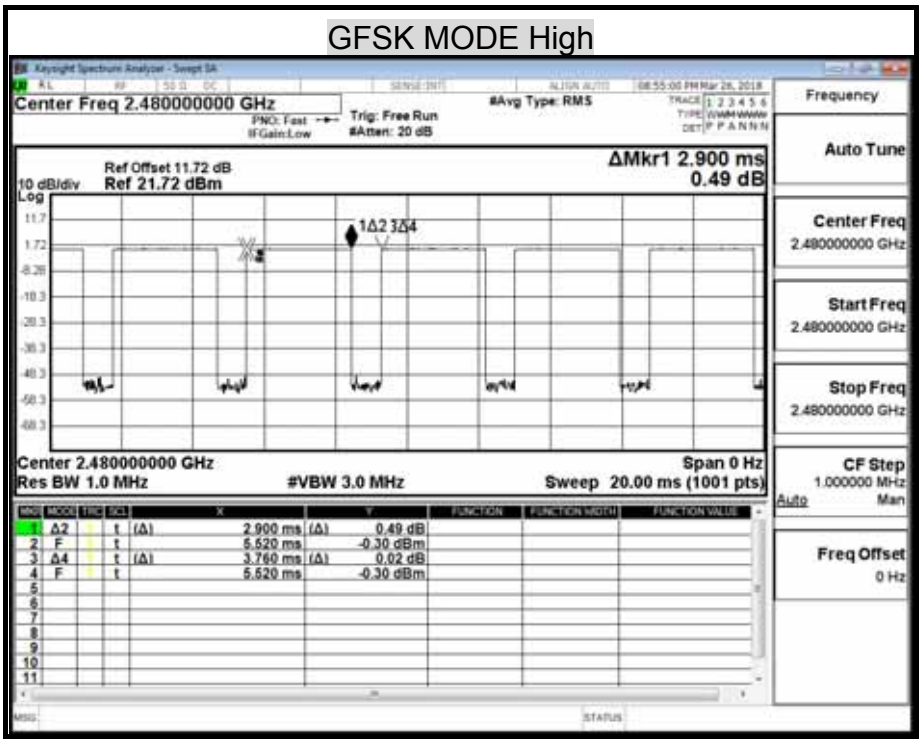
GFSK MODE Low



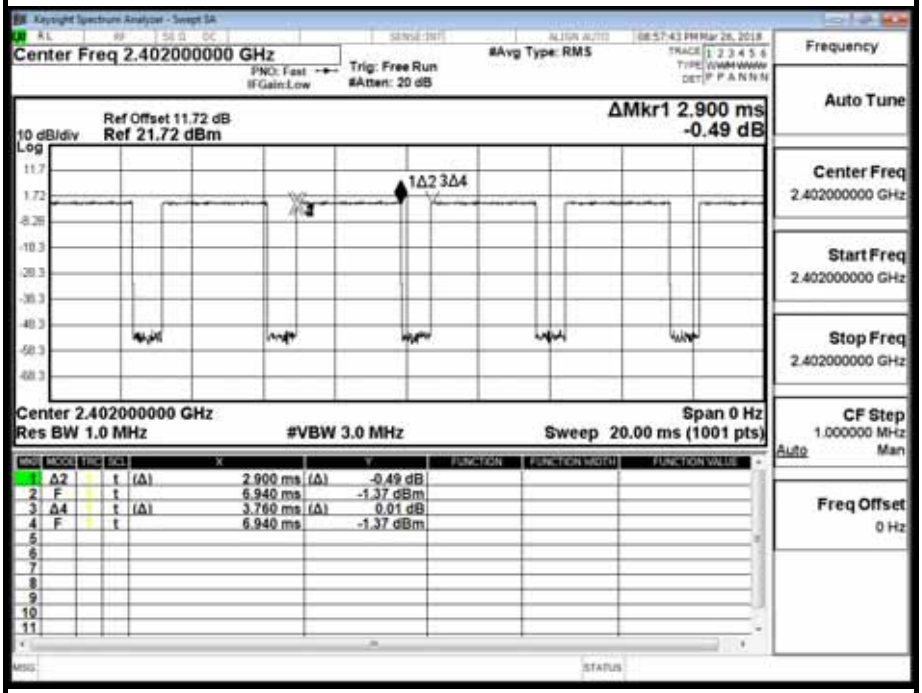
GFSK MODE Mid



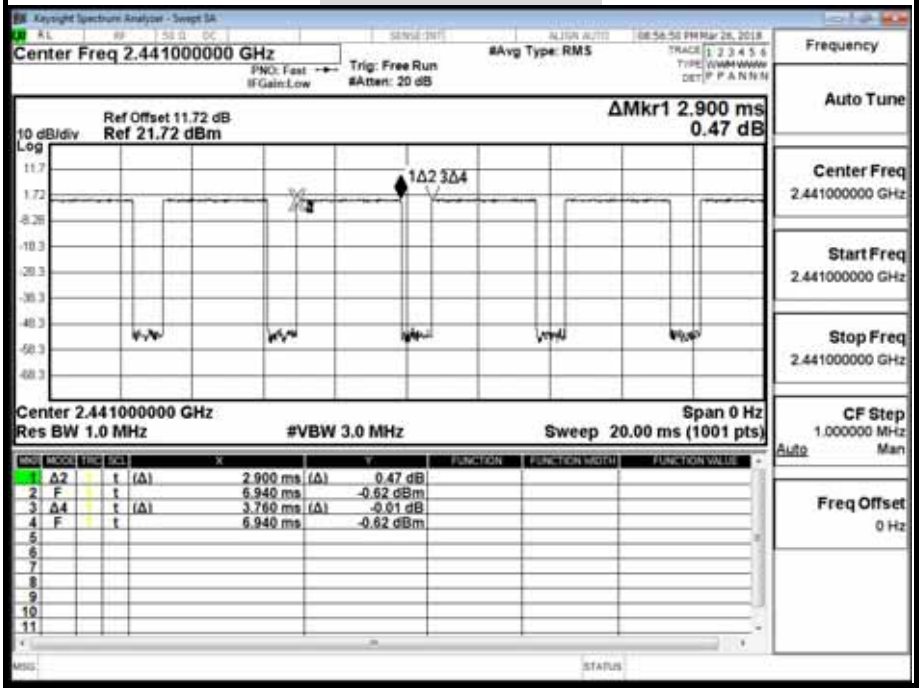
GFSK MODE High



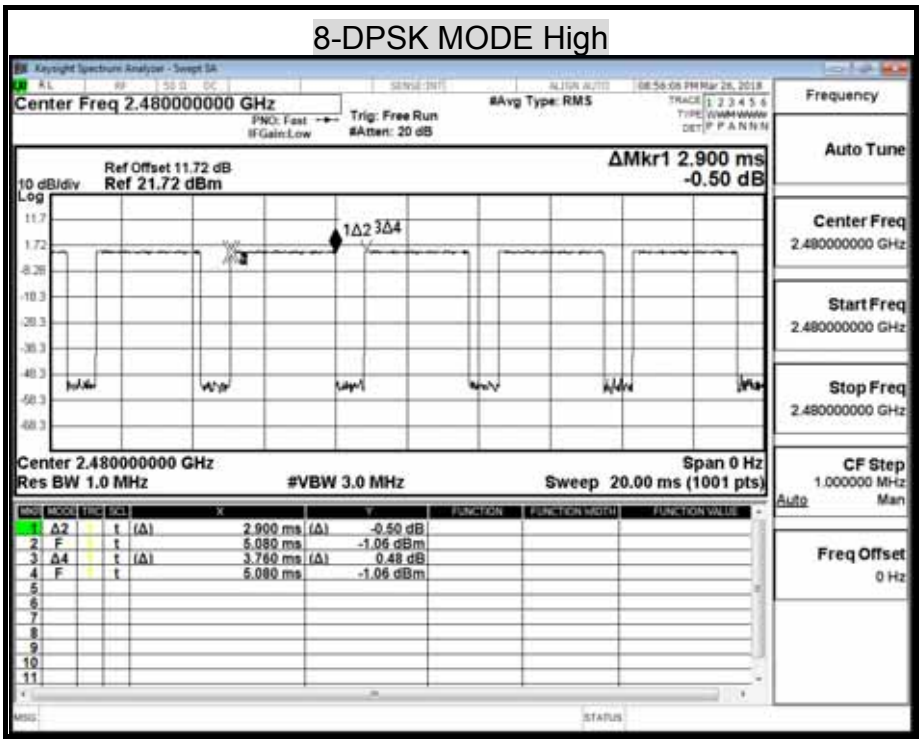
8-DPSK MODE Low



8-DPSK MODE Mid



8-DPSK MODE High



7.7 CONDUCTED SPURIOUS EMISSION

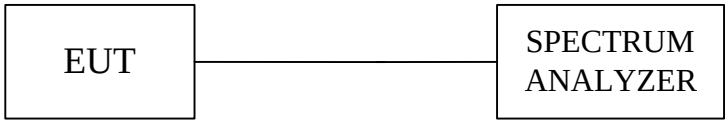
LIMITS

§ 15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the and that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated 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) (see § 15.205(c)).

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	05/08/2018

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

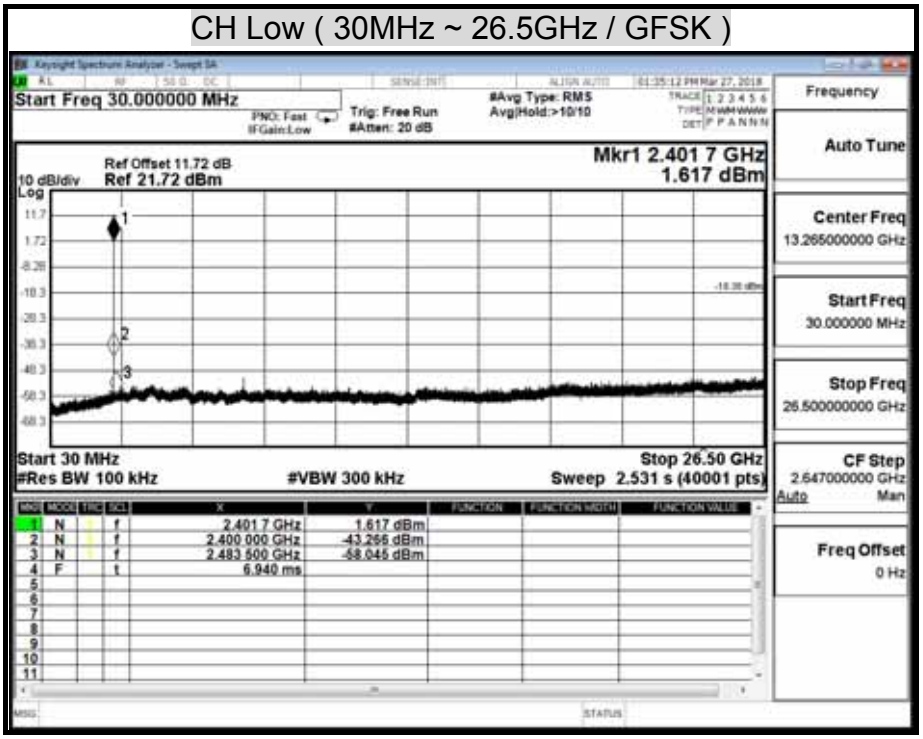
The spectrum from 30 MHz to 26.5 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

TEST RESULTS

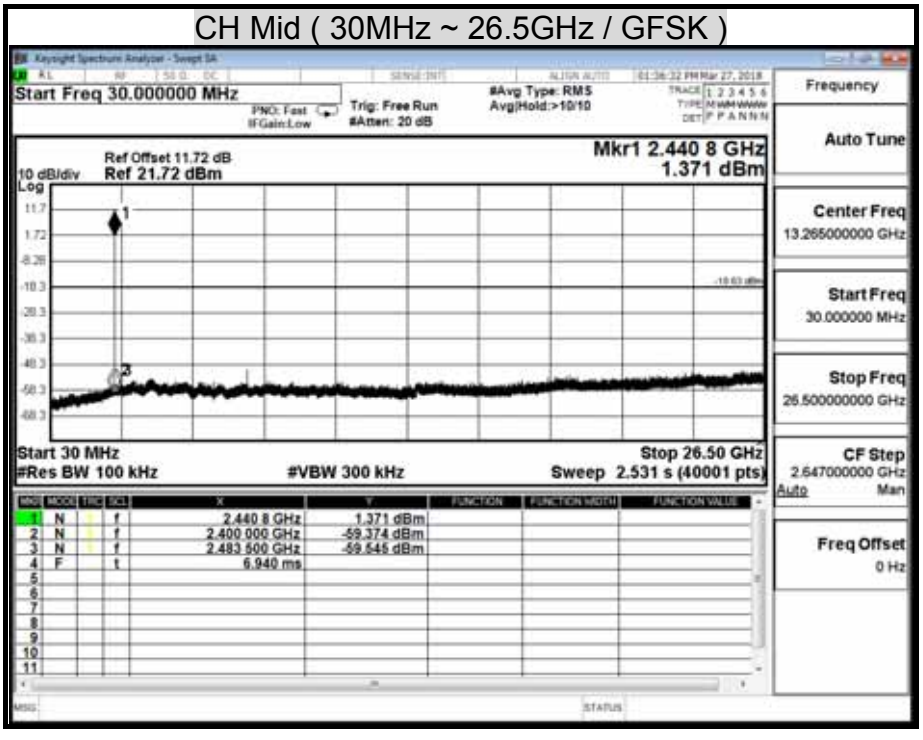
Model Name	TN-180BT	Test By	Ted Huang
Temp & Humidity	24.5°C, 52%	Test Date	2018/3/26

OUT-OF-BAND SPURIOUS EMISSIONS-CONDUCTED MEASUREMENT

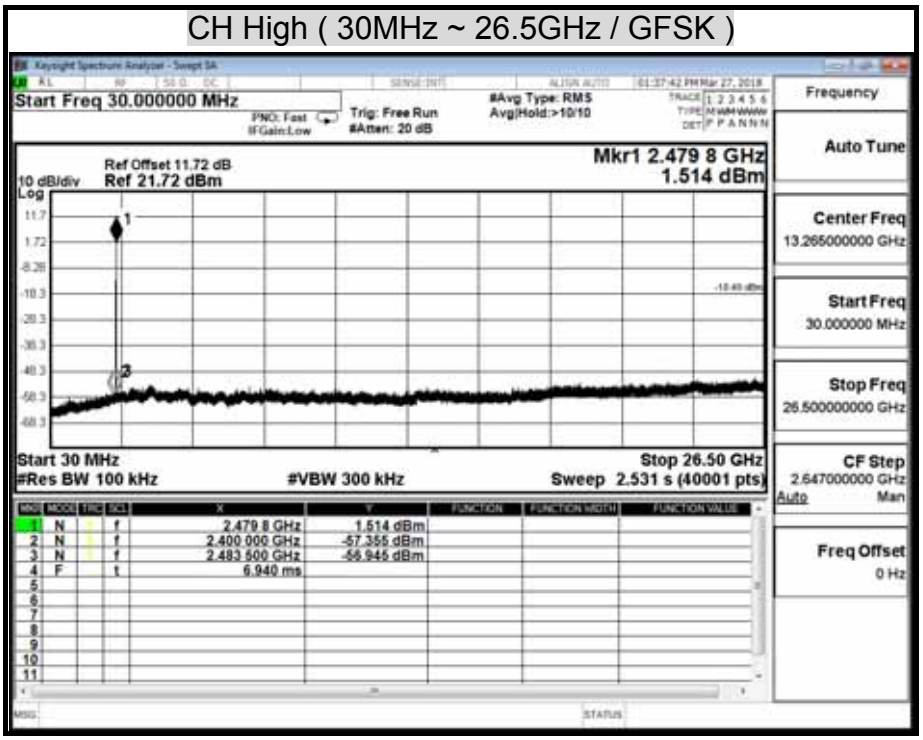
CH Low (30MHz ~ 26.5GHz / GFSK)



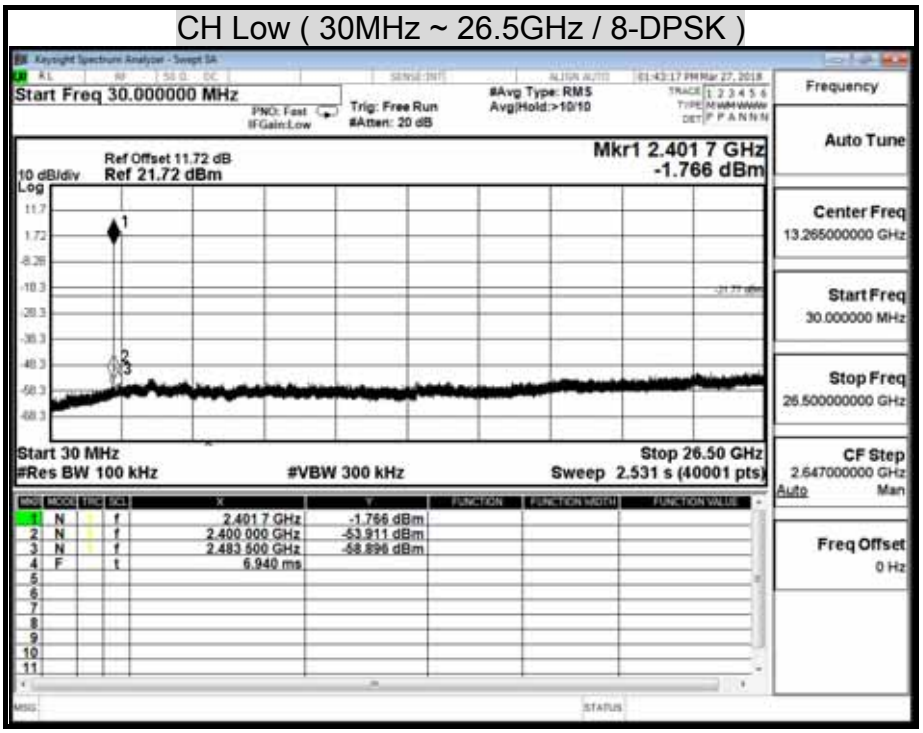
CH Mid (30MHz ~ 26.5GHz / GFSK)



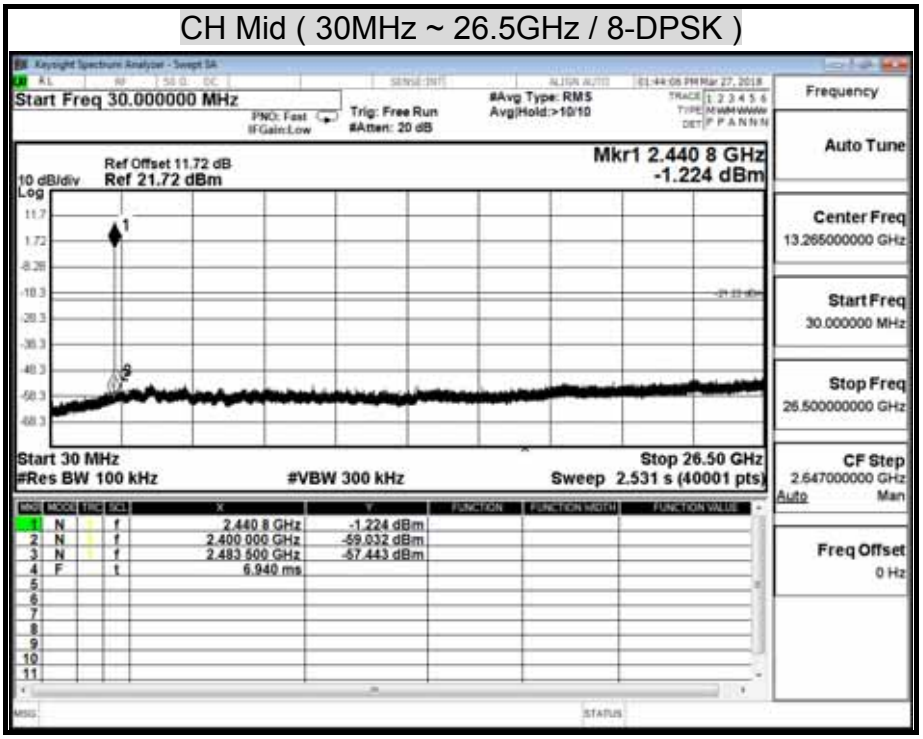
CH High (30MHz ~ 26.5GHz / GFSK)



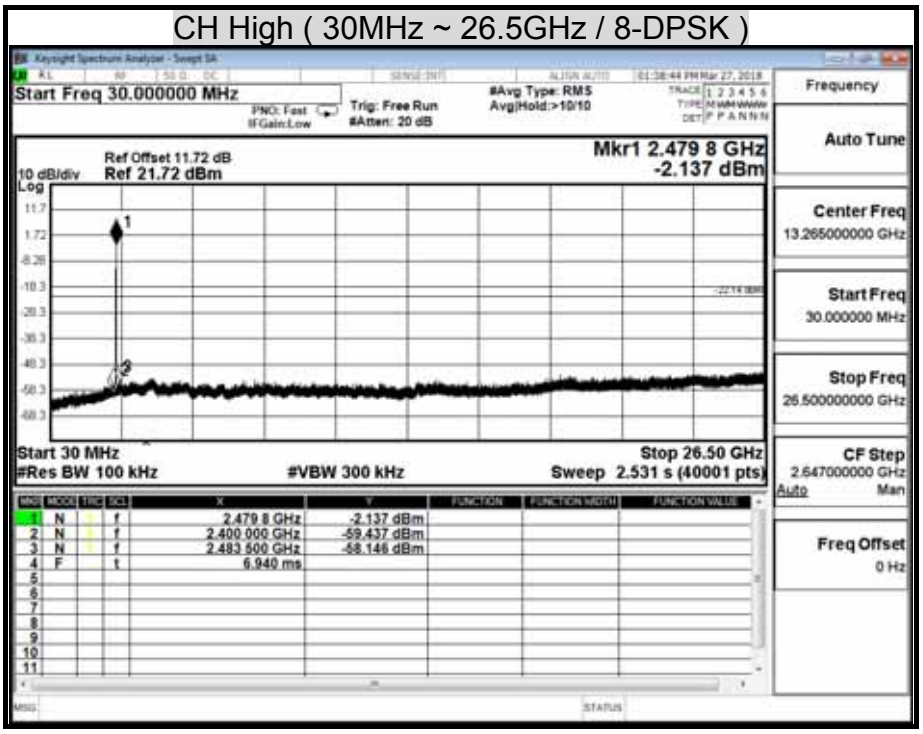
CH Low (30MHz ~ 26.5GHz / 8-DPSK)



CH Mid (30MHz ~ 26.5GHz / 8-DPSK)

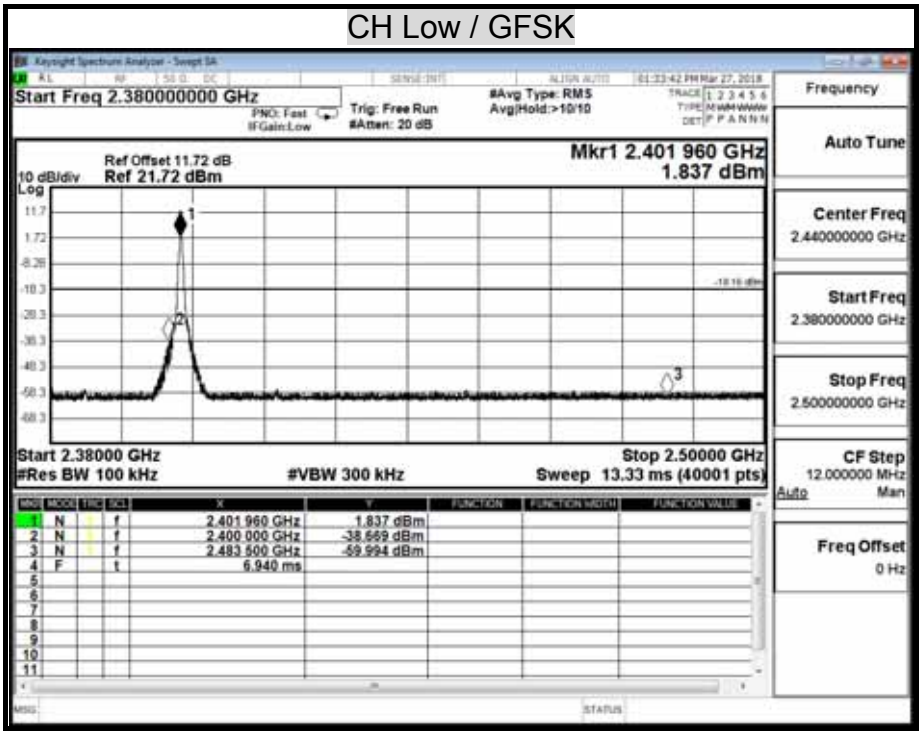


CH High (30MHz ~ 26.5GHz / 8-DPSK)

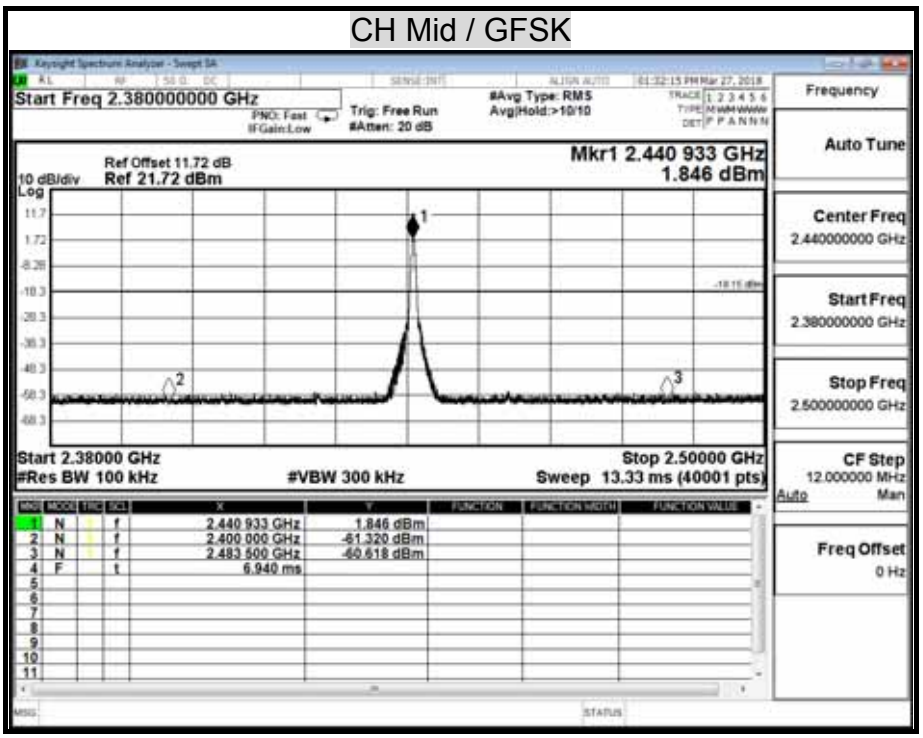


Band-edge Compliance of RF Conducted Emissions

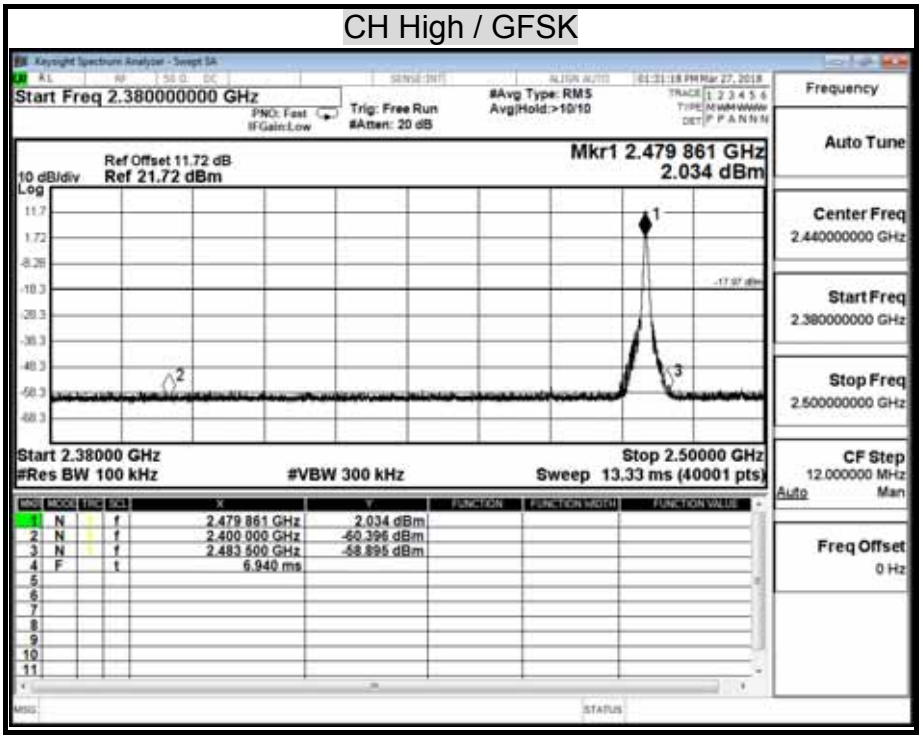
CH Low / GFSK



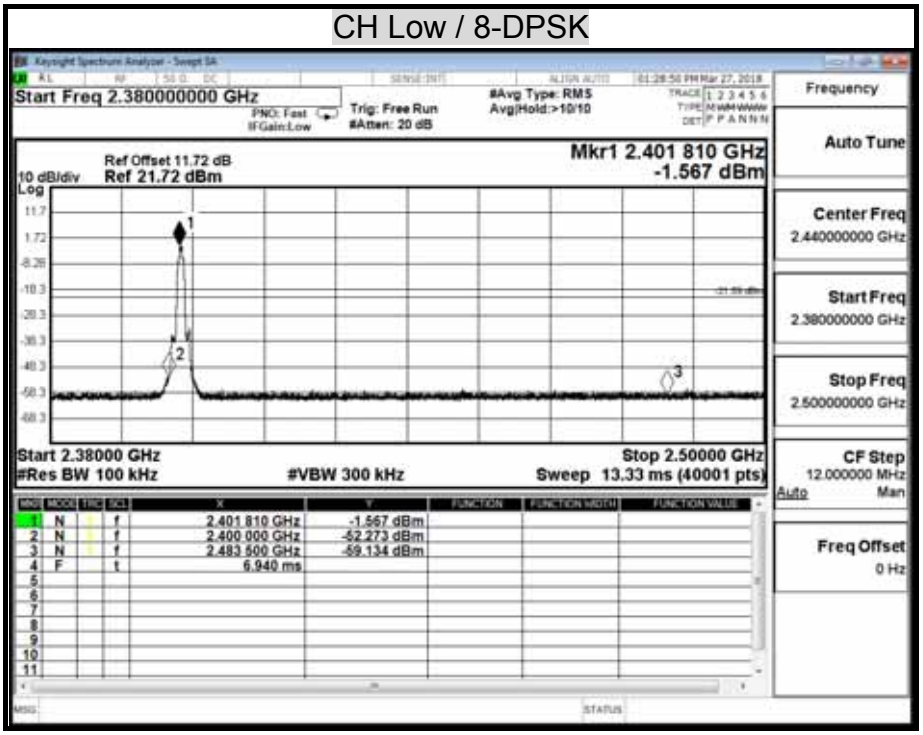
CH Mid / GFSK



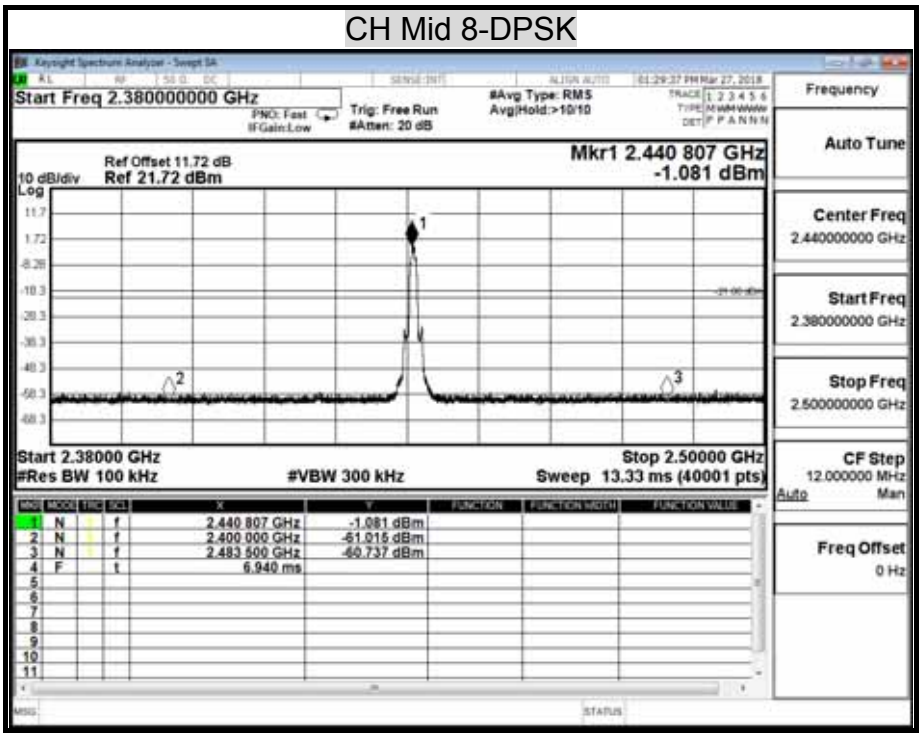
CH High / GFSK


Start Freq 2.380000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>10/10
Ref Offset 11.72 dB
10 dB/div Ref 21.72 dBm
Log
Mkr1 2.479 861 GHz
2.034 dBm
Start 2.38000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 13.33 ms (40001 pts)
1 N 1 f 2.479 861 GHz 2.034 dBm
2 N 1 f 2.400 000 GHz -60.396 dBm
3 N 1 f 2.483 500 GHz -58.895 dBm
4 F 1 t 6.940 ms
Frequency
Auto Tune
Center Freq
2.440000000 GHz
Start Freq
2.380000000 GHz
Stop Freq
2.500000000 GHz
CF Step
12.000000 MHz
Auto Man
Freq Offset
0 Hz

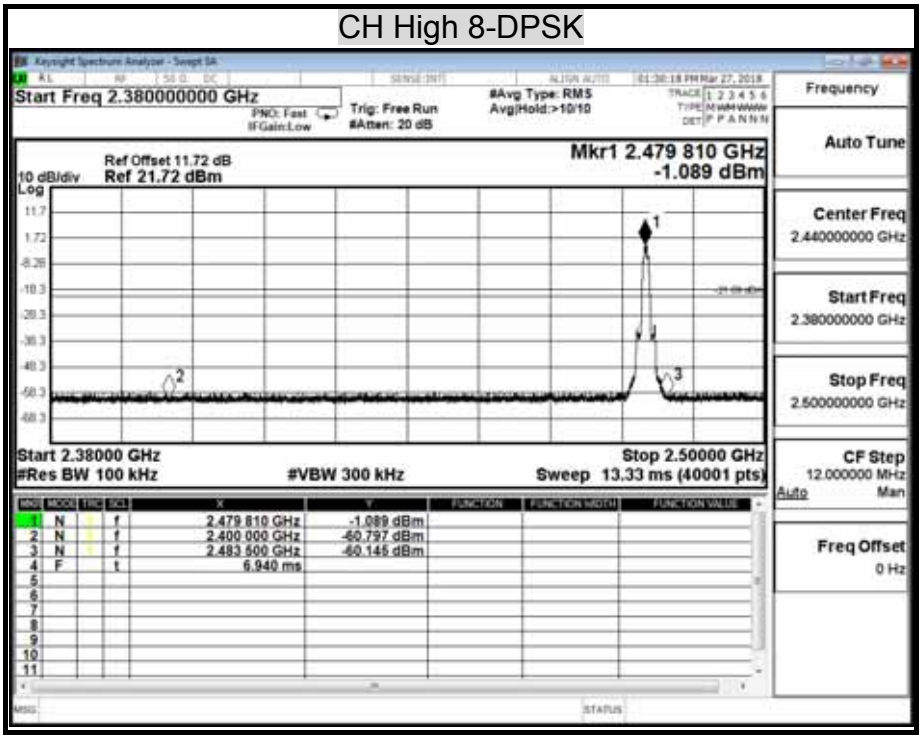
CH Low / 8-DPSK



CH Mid 8-DPSK



CH High 8-DPSK



7.8 RADIATED EMISSIONS

7.7.1 TRANSMITTER RADIATED SUPURIOUS EMSSIONS

LIMITS

§ 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 -1710	10.6 -12.7
6.26775 - 6.26825	108 -121.94	1718.8 - 1722.2	13.25 -13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 – 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 -16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3338	36.43 - 36.5
12.57675 - 12.57725	322 -335.4	3600 - 4400	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown is Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§ 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz, However, operation within these frequency bands is permitted under other sections of this Part, e-g, Sections 15.231 and 15.241.

§ 15.209 (b) In the emission table above, the tighter limit applies at the band edges.

TEST EQUIPMENT

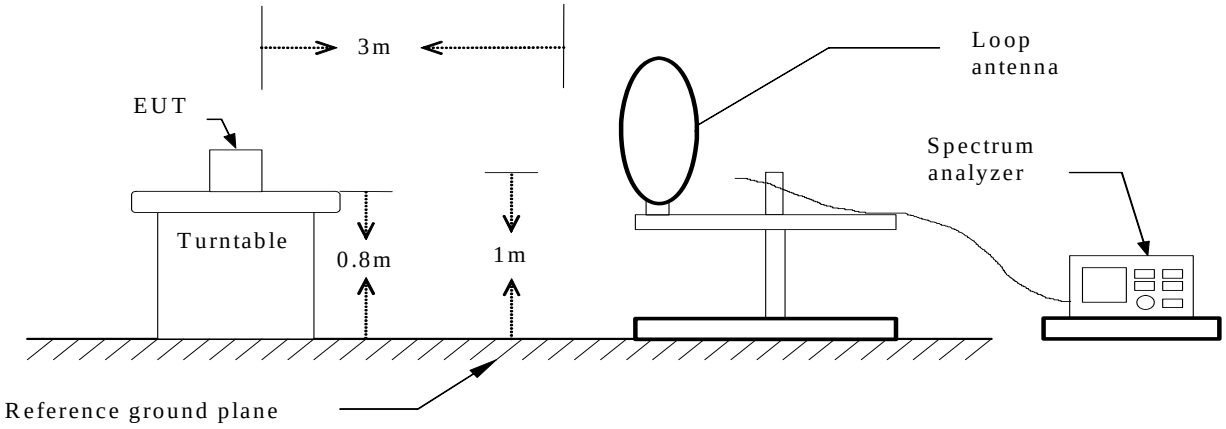
Chamber 966				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Active Loop Antenna	ETS-LINDREN	6502	8905-2356	07/19/2019
Amplifier	HP	8447F	2443A01671	01/21/2019
Bi-Log Antenna	Sunol	JB1	A070506-2	02/08/2019
Cable	Rosnol+Suhner	SUCOFLEX 104PEA	SN25737 /4PEA	01/26/2019
Double Ridged Guide Horn Antenna	ETS-LINDGREN	3116	00078900	03/19/2019
EMI Test Receiver	R&S	ESCI	100782	06/11/2018
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	05/08/2018
Horn Antenna	Com-Power	AH-118	071032	02/08/2019
Pre-Amplifier	EMCI	EMC012645	980098	01/21/2019

Remark: 1. Each piece of equipment is scheduled for calibration once a year.
2. N.C.R = No Calibration Request.

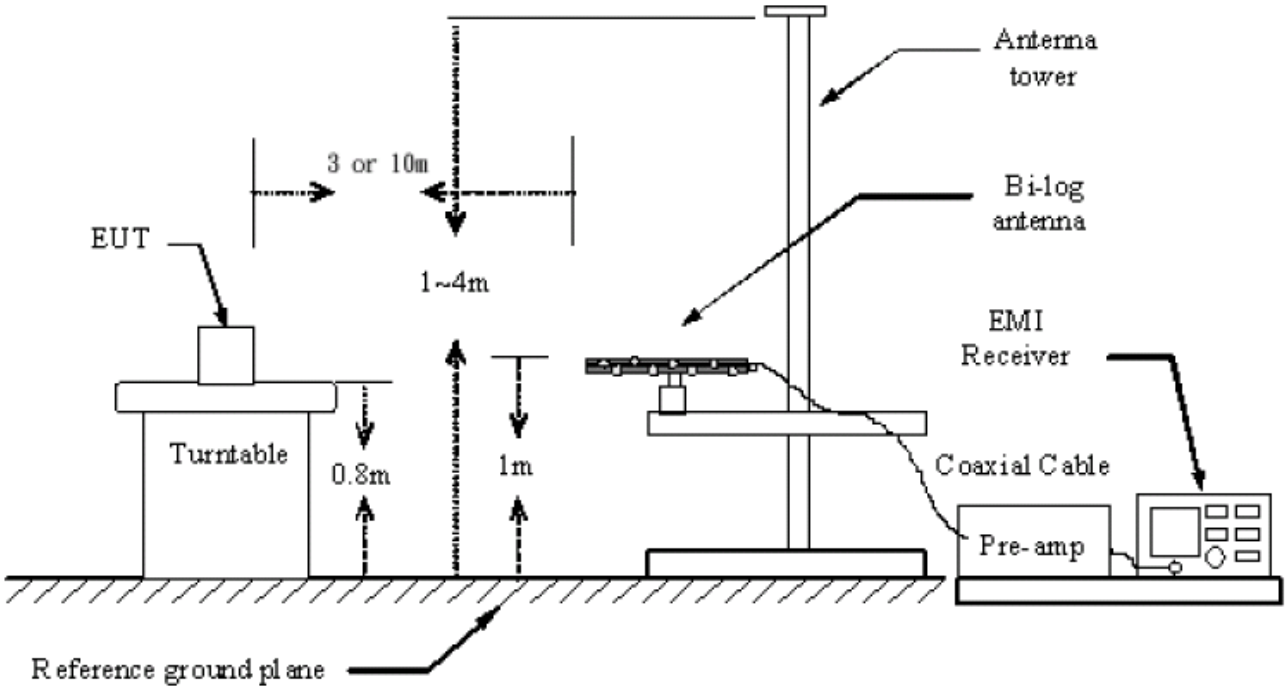
TEST SETUP

The diagram below shows the test setup that is utilized to make the measurements for emission from below 1GHz.

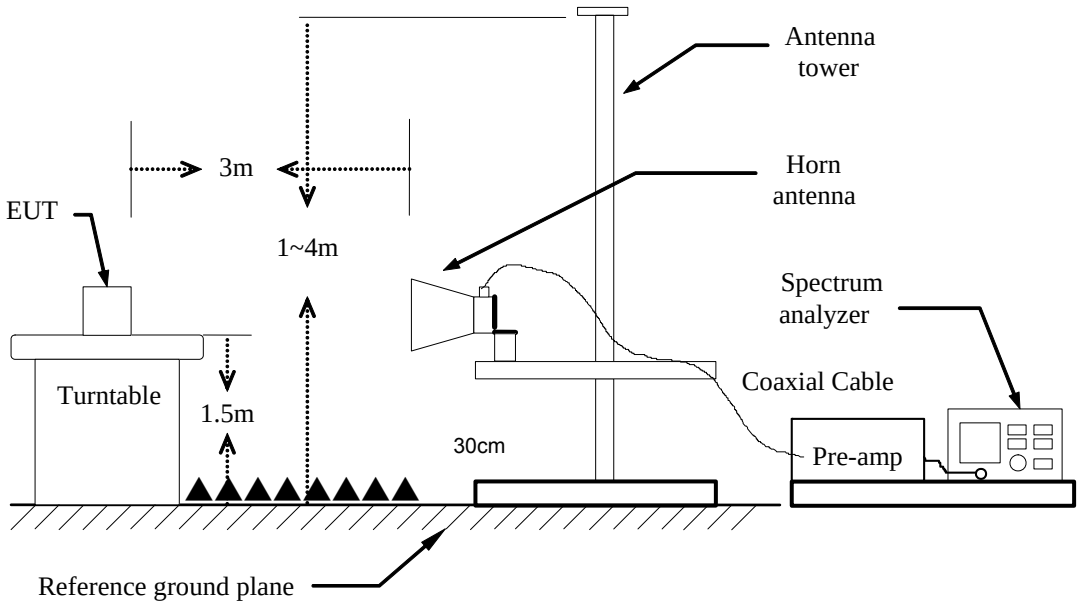
9kHz ~ 30MHz



30MHz ~ 1GHz



The diagram below shows the test setup that is utilized to make the measurements for emission above 1GHz.



TEST PROCEDURE

a. The EUT was placed on the top of a rotating table 0.8/1.5 meters above the ground at a 10/3 meter open site/chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. White measuring the radiated emission below 1GHz, the EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. White measuring the radiated emission above 1GHz, the EUT was set 3 or 10 meters away from the interference-receiving antenna
c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarization of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Note：

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 510 Hz for Average detection (AV) at frequency above 1GHz.

7.7.2 WORST-CASE RADIATED EMISSION BELOW 1 GHz

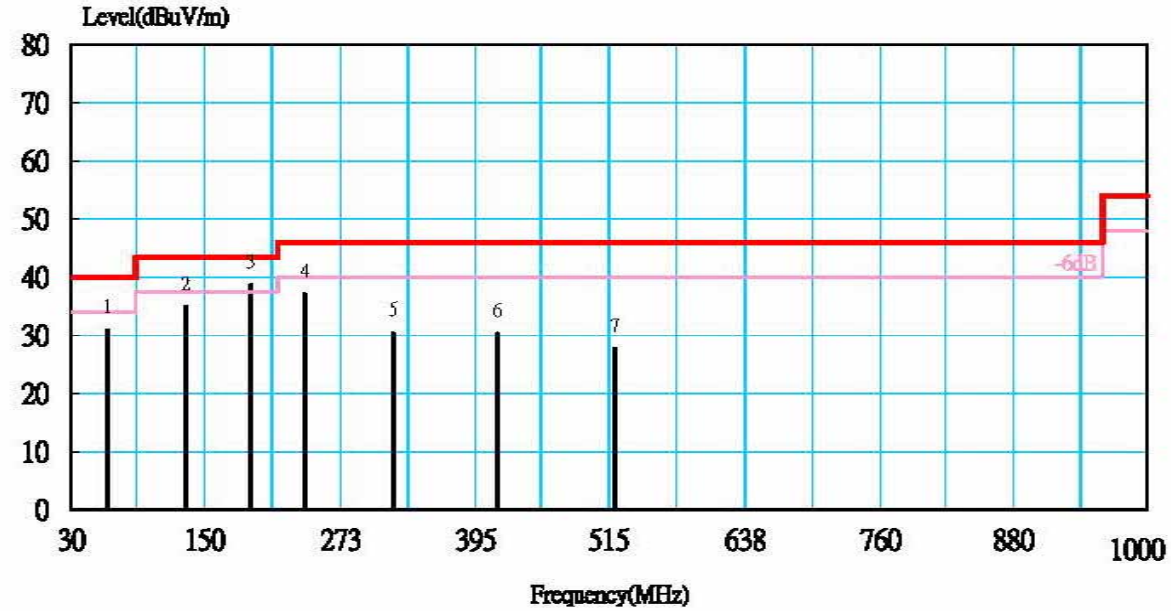
BELOW 1 GHz (9kHz ~ 30MHz)

No emission found between lowest internal used/generated frequency to 30MHz.

BELOW 1 GHz (30MHz ~ 1GHz)

Product Name	ANALOG PLAYER	Test Date	2018/3/26
Model Name	TN-180BT	Test By	Ted Huang
Test Mode	TX	Temp & Humidity	26.5°C, 52%

Vertical



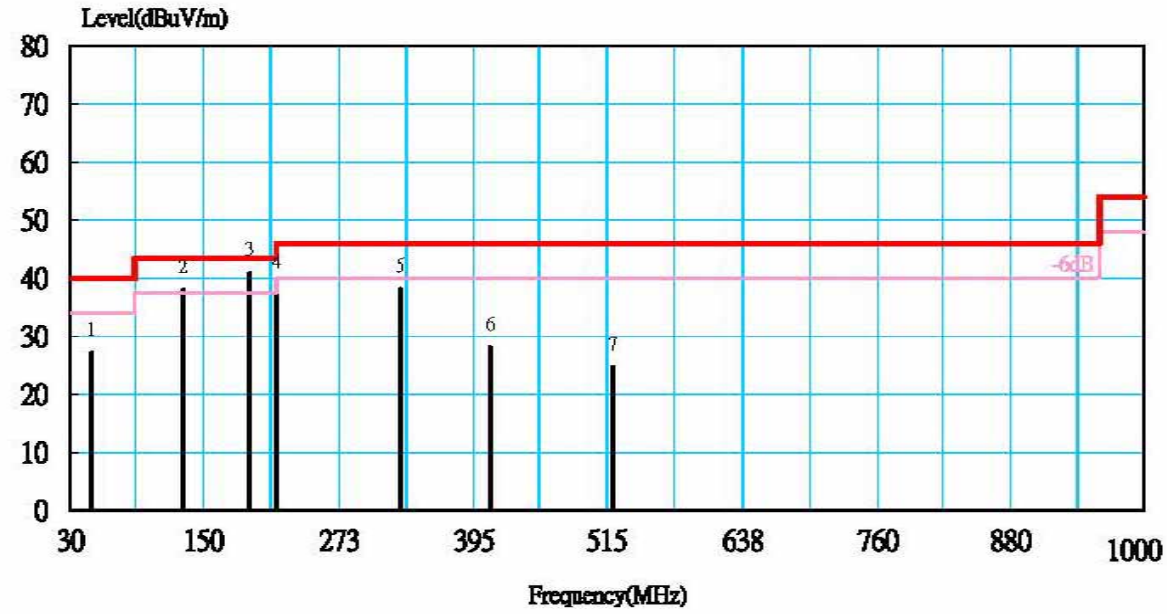
No.	Freq-Uency (MHz)	Meter Reading at 3 m Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Emission at 3 m Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Mode PK/QP
1	62.36	21.73	8.09	1.11	30.93	40.00	-9.07	QP
2	133.22	19.05	14.21	1.73	34.99	43.50	-8.51	QP
3	192.00	24.27	12.26	2.20	38.73	43.50	-4.77	QP
4	240.00	21.98	12.66	2.57	37.21	46.00	-8.79	QP
5	320.00	12.81	14.42	3.22	30.45	46.00	-15.55	QP
6	414.10	9.94	16.37	4.05	30.35	46.00	-15.65	QP
7	520.00	4.66	18.26	4.84	27.76	46.00	-18.24	QP

Remark:

1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).
2. Radiated emissions measured were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.
4. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A "remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable imit) and considered that's already beyond the background noise floor.
5. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).

Product Name	ANALOG PLAYER	Test Date	2018/3/26
Model Name	TN-180BT	Test By	Ted Huang
Test Mode	TX	Temp & Humidity	26.5°C, 52%

Horizontal



No.	Freq-Uency (MHz)	Meter Reading at 3 m Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Emission at 3 m Level (dBµV/m)	Limits (dBµV/m)	Margin (dB)	Detector Mode PK/QP
1	49.84	17.60	8.70	1.00	27.29	40.00	-12.71	QP
2	132.66	22.14	14.26	1.72	38.12	43.50	-5.38	QP
3	192.00	26.58	12.26	2.20	41.04	43.50	-2.46	QP
4	216.00	23.46	13.04	2.38	38.88	43.50	-4.62	QP
5	328.00	20.35	14.59	3.29	38.23	46.00	-7.77	QP
6	409.80	7.88	16.29	4.01	28.18	46.00	-17.82	QP
7	520.00	1.68	18.26	4.84	24.78	46.00	-21.22	QP

Remark:

1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).
2. Radiated emissions measured were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.
4. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A "remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable imit) and considered that's already beyond the background noise floor.
5. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).

7.7.3 TRANSMITTER RADIATED EMISSION ABOVE 1 GHz

Product Name	ANALOG PLAYER	Test Date	2018/03/26
Model Name	TN-180BT	Test By	Ted Huang
Test Mode	CH Low TX / GFSK	Temp & Humidity	24.5°C, 52%

Horizontal

	TX mode / CH Low				Measurement Distance at 3m		Horizontal polarity			
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
	1659.70	58.26	27.81	2.43	44.92	0.63	44.21	74.00	-29.79	P
	1659.70	46.61	27.81	2.43	44.92	0.63	32.56	54.00	-21.44	A
*	4803.92	55.89	33.79	4.37	44.32	0.22	49.97	74.00	-24.03	P
*	4803.92	45.27	33.79	4.37	44.32	0.22	39.34	54.00	-14.66	A
	7205.87	55.39	38.72	5.50	44.04	0.27	55.85	74.00	-18.15	P
	7205.87	45.10	38.72	5.50	44.04	0.27	45.56	54.00	-8.44	A

Vertical

	TX mode / CH Low				Measurement Distance at 3m		Vertical polarity			
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
*	1115.61	60.05	25.06	1.97	45.34	0.41	42.16	74.00	-31.84	P
*	1115.61	47.90	25.06	1.97	45.34	0.41	30.01	54.00	-23.99	A
*	4803.98	56.28	33.79	4.37	44.32	0.22	50.35	74.00	-23.65	P
*	4803.98	46.60	33.79	4.37	44.32	0.22	40.67	54.00	-13.33	A
	7205.67	55.64	38.72	5.50	44.04	0.27	56.10	74.00	-17.90	P
	7205.67	45.31	38.72	5.50	44.04	0.27	45.77	54.00	-8.23	A

Remark:
1. AF: Antenna Factor, Cable: Cable Loss, Pre-Amp: Preamplifier gain, Filter: High Pass Filter Insertion Loss (3.5GHz)
2. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=510Hz
3. The result basic equation calculation is as follow:
   Level = Reading + AF + Cable – Preamp + Filter, Margin = Level-Limit
4. The other emission levels were 20dB below the limit
5. The test limit distance is 3M limit.

Product Name	ANALOG PLAYER	Test Date	2018/03/26
Model Name	TN-180BT	Test By	Ted Huang
Test Mode	CH Mid TX / GFSK	Temp & Humidity	24.5°C, 52%

Horizontal

	TX mode / CH Mid				Measurement Distance at 3m		Horizontal polarity			
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
	1659.86	58.48	27.81	2.44	44.92	0.63	44.44	74.00	-29.56	P
	1659.86	46.78	27.81	2.44	44.92	0.63	32.74	54.00	-21.26	A
*	4881.95	56.27	34.08	4.42	44.34	0.23	50.66	74.00	-23.34	P
*	4881.95	46.66	34.08	4.42	44.34	0.23	41.04	54.00	-12.96	A
*	7322.68	54.95	39.19	5.53	43.94	0.27	56.01	74.00	-17.99	P
*	7322.68	44.68	39.19	5.53	43.94	0.27	45.73	54.00	-8.27	A

Vertical

	TX mode / CH Mid				Measurement Distance at 3m		Vertical polarity			
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
*	1115.52	59.86	25.06	1.97	45.34	0.41	41.97	74.00	-32.03	P
*	1115.52	47.46	25.06	1.97	45.34	0.41	29.57	54.00	-24.43	A
*	4881.97	57.06	34.08	4.42	44.34	0.23	51.44	74.00	-22.56	P
*	4881.97	48.92	34.08	4.42	44.34	0.23	43.30	54.00	-10.70	A
*	7322.74	54.85	39.19	5.53	43.94	0.27	55.91	74.00	-18.09	P
*	7322.74	44.05	39.19	5.53	43.94	0.27	45.11	54.00	-8.89	A

Remark:

1. AF: Antenna Factor, Cable: Cable Loss, Pre-Amp: Preamplifier gain, Filter: High Pass Filter Insertion Loss (3.5GHz)
2. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=510Hz
3. The result basic equation calculation is as follow:
   Level = Reading + AF + Cable – Preamp + Filter, Margin = Level-Limit
4. The other emission levels were 20dB below the limit
5. The test limit distance is 3M limit.

Product Name	ANALOG PLAYER	Test Date	2018/03/26
Model Name	TN-180BT	Test By	Ted Huang
Test Mode	CH High TX / GFSK	Temp & Humidity	24.5°C, 52%

Horizontal

	TX mode / CH High				Measurement Distance at 3m Horizontal polarity					
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
*	1660.08	58.42	27.82	2.44	44.92	0.63	44.38	74.00	-29.62	P
*	1660.08	46.86	27.82	2.44	44.92	0.63	32.82	54.00	-21.18	A
*	4959.95	57.07	34.36	4.46	44.36	0.24	51.76	74.00	-22.24	P
*	4959.95	47.16	34.36	4.46	44.36	0.24	41.85	54.00	-12.15	A
*	7439.91	55.97	39.66	5.56	43.83	0.27	57.63	74.00	-16.37	P
*	7439.91	45.74	39.66	5.56	43.83	0.27	47.40	54.00	-6.60	A

Vertical

	TX mode / CH High				Measurement Distance at 3m Vertical polarity					
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
*	1115.75	60.42	25.06	1.97	45.34	0.41	42.53	74.00	-31.47	P
*	1115.75	48.26	25.06	1.97	45.34	0.41	30.37	54.00	-23.63	A
*	4959.92	57.79	34.36	4.46	44.36	0.24	52.48	74.00	-21.52	P
*	4959.92	48.83	34.36	4.46	44.36	0.24	43.52	54.00	-10.48	A
*	7439.87	56.05	39.66	5.56	43.83	0.27	57.70	74.00	-16.30	P
*	7439.87	45.85	39.66	5.56	43.83	0.27	47.51	54.00	-6.49	A

Remark:

1. AF: Antenna Factor, Cable: Cable Loss, Pre-Amp: Preamplifier gain, Filter: High Pass Filter Insertion Loss (3.5GHz)
2. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=510Hz
3. The result basic equation calculation is as follow:
   Level = Reading + AF + Cable – Preamp + Filter, Margin = Level-Limit
4. The other emission levels were 20dB below the limit
5. The test limit distance is 3M limit.

Product Name	ANALOG PLAYER	Test Date	2018/03/26
Model Name	TN-180BT	Test By	Ted Huang
Test Mode	CH Low TX / 8-DPSK	Temp & Humidity	24.5°C, 52%

Horizontal

	TX mode / CH Low				Measurement Distance at 3m		Horizontal polarity			
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
	1659.58	58.56	27.81	2.43	44.92	0.63	44.51	74.00	-29.49	P
	1659.58	46.86	27.81	2.43	44.92	0.63	32.81	54.00	-21.19	A
*	4804.07	56.29	33.79	4.37	44.32	0.22	50.37	74.00	-23.63	P
*	4804.07	45.40	33.79	4.37	44.32	0.22	39.47	54.00	-14.53	A
	7205.64	54.97	38.72	5.50	44.04	0.27	55.42	74.00	-18.58	P
	7205.64	45.13	38.72	5.50	44.04	0.27	45.58	54.00	-8.42	A

Vertical

	TX mode / CH Low				Measurement Distance at 3m		Vertical polarity			
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
*	1115.68	60.25	25.06	1.97	45.34	0.41	42.36	74.00	-31.64	P
*	1115.68	48.13	25.06	1.97	45.34	0.41	30.24	54.00	-23.76	A
*	4803.70	56.64	33.79	4.37	44.32	0.22	50.71	74.00	-23.29	P
*	4803.70	45.62	33.79	4.37	44.32	0.22	39.70	54.00	-14.30	A
	7205.87	56.26	38.72	5.50	44.04	0.27	56.72	74.00	-17.28	P
	7205.87	45.26	38.72	5.50	44.04	0.27	45.72	54.00	-8.28	A

Remark:
1. AF: Antenna Factor, Cable: Cable Loss, Pre-Amp: Preamplifier gain, Filter: High Pass Filter Insertion Loss (3.5GHz)
2. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=510Hz
3. The result basic equation calculation is as follow:
   Level = Reading + AF + Cable – Preamp + Filter, Margin = Level-Limit
4. The other emission levels were 20dB below the limit
5. The test limit distance is 3M limit.

Product Name	ANALOG PLAYER	Test Date	2018/03/26
Model Name	TN-180BT	Test By	Ted Huang
Test Mode	CH Mid TX / 8-DPSK	Temp & Humidity	24.5°C, 52%

Horizontal

	TX mode / CH Mid				Measurement Distance at 3m		Horizontal polarity			
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
	1659.76	58.73	27.81	2.44	44.92	0.63	44.68	74.00	-29.32	P
	1659.76	46.92	27.81	2.44	44.92	0.63	32.87	54.00	-21.13	A
*	4881.84	55.23	34.07	4.42	44.34	0.23	49.61	74.00	-24.39	P
*	4881.84	44.71	34.07	4.42	44.34	0.23	39.09	54.00	-14.91	A
*	7322.89	54.39	39.19	5.53	43.94	0.27	55.45	74.00	-18.55	P
*	7322.89	43.94	39.19	5.53	43.94	0.27	45.00	54.00	-9.00	A

Vertical

	TX mode / CH Mid				Measurement Distance at 3m		Vertical polarity			
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
*	1115.47	60.13	25.06	1.97	45.34	0.41	42.24	74.00	-31.76	P
*	1115.47	47.62	25.06	1.97	45.34	0.41	29.73	54.00	-24.27	A
*	4881.93	56.39	34.07	4.42	44.34	0.23	50.77	74.00	-23.23	P
*	4881.93	46.32	34.07	4.42	44.34	0.23	40.70	54.00	-13.30	A
*	7322.72	55.66	39.19	5.53	43.94	0.27	56.72	74.00	-17.28	P
*	7322.72	44.94	39.19	5.53	43.94	0.27	46.00	54.00	-8.00	A

Remark:

1. AF: Antenna Factor, Cable: Cable Loss, Pre-Amp: Preamplifier gain, Filter: High Pass Filter Insertion Loss (3.5GHz)
2. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=510Hz
3. The result basic equation calculation is as follow:
   Level = Reading + AF + Cable – Preamp + Filter, Margin = Level-Limit
4. The other emission levels were 20dB below the limit
5. The test limit distance is 3M limit.

Product Name	ANALOG PLAYER	Test Date	2018/03/26
Model Name	TN-180BT	Test By	Ted Huang
Test Mode	CH High TX / 8-DPSK	Temp & Humidity	24.5°C, 52%

Horizontal

	TX mode / CH High				Measurement Distance at 3m			Horizontal polarity		
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
*	1660.12	58.75	27.82	2.44	44.92	0.63	44.71	74.00	-29.29	P
*	1660.12	47.13	27.82	2.44	44.92	0.63	33.09	54.00	-20.91	A
*	4959.95	56.75	34.36	4.46	44.36	0.24	51.44	74.00	-22.56	P
*	4959.95	46.29	34.36	4.46	44.36	0.24	40.98	54.00	-13.02	A
*	7440.06	54.74	39.66	5.56	43.83	0.27	56.40	74.00	-17.60	P
*	7440.06	44.02	39.66	5.56	43.83	0.27	45.68	54.00	-8.32	A

Vertical

	TX mode / CH High				Measurement Distance at 3m			Vertical polarity		
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
*	1115.78	60.26	25.06	1.97	45.34	0.41	42.37	74.00	-31.63	P
*	1115.78	48.08	25.06	1.97	45.34	0.41	30.19	54.00	-23.81	A
*	4959.74	57.19	34.36	4.46	44.36	0.24	51.87	74.00	-22.13	P
*	4959.74	47.22	34.36	4.46	44.36	0.24	41.90	54.00	-12.10	A
*	7439.53	55.32	39.66	5.56	43.83	0.27	56.98	74.00	-17.02	P
*	7439.53	44.59	39.66	5.56	43.83	0.27	46.25	54.00	-7.75	A

Remark:

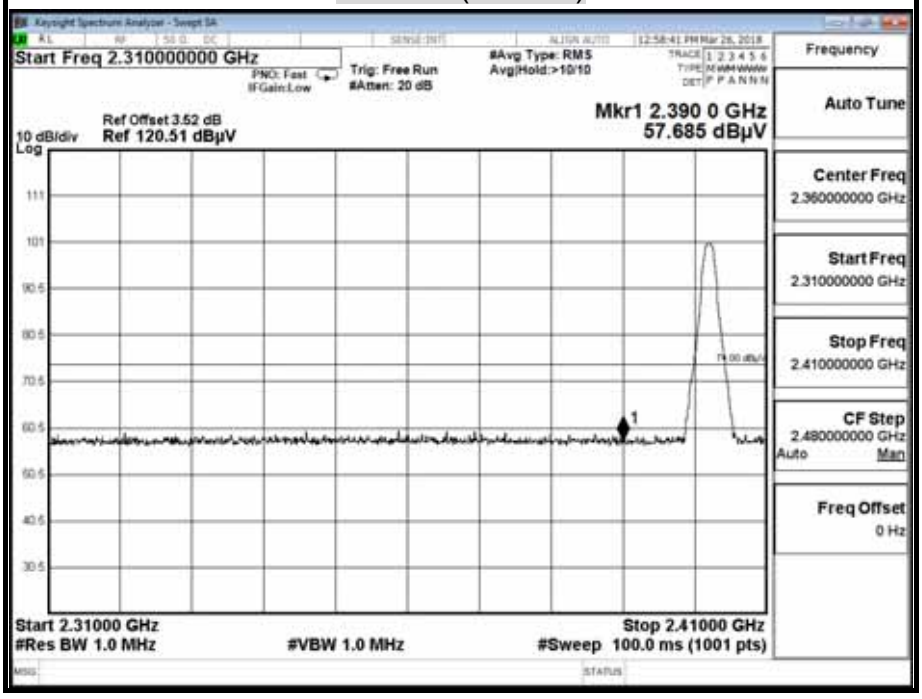
1. AF: Antenna Factor, Cable: Cable Loss, Pre-Amp: Preamplifier gain, Filter: High Pass Filter Insertion Loss (3.5GHz)
2. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=510Hz
3. The result basic equation calculation is as follow:
   Level = Reading + AF + Cable – Preamp + Filter, Margin = Level-Limit
4. The other emission levels were 20dB below the limit
5. The test limit distance is 3M limit.

7.7.4 RESTRICTED BAND EDGES

Model Name	TN-180BT	Test By	Ted Huang
Temp & Humidity	24.5°C, 52%	Test Date	2018/03/26

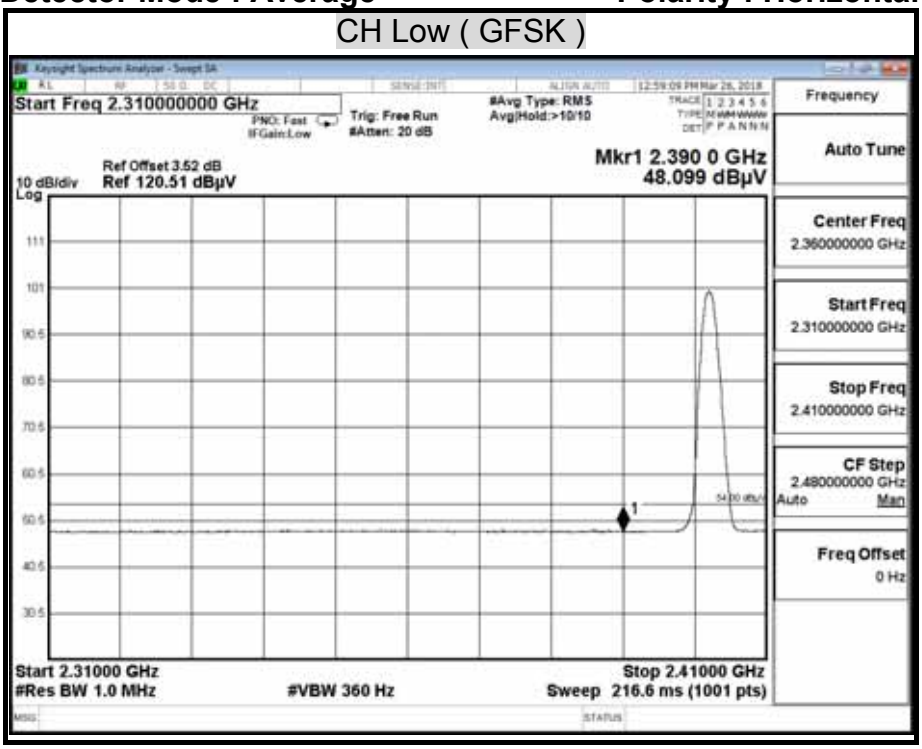
Detector Mode : Peak **Polarity : Horizontal**

CH Low (GFSK)



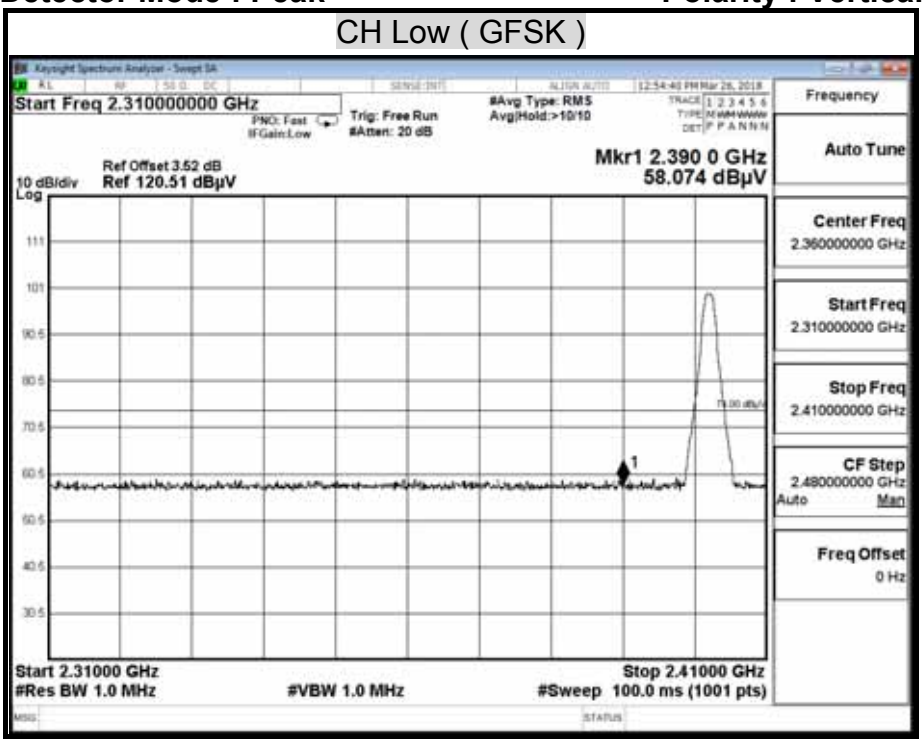
Detector Mode : Average **Polarity : Horizontal**

CH Low (GFSK)



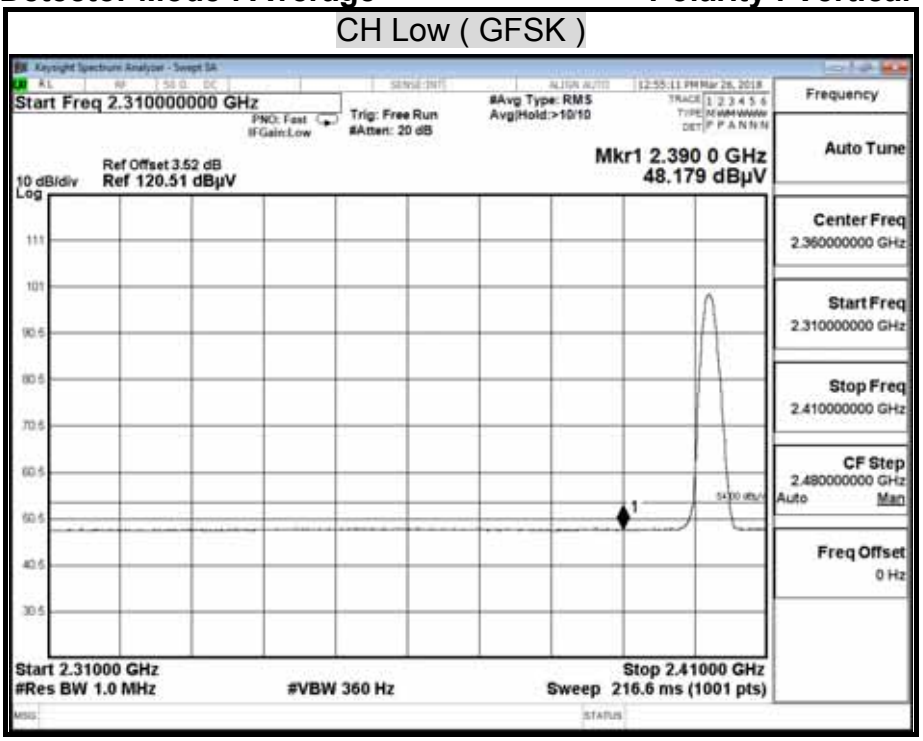
Detector Mode : Peak **Polarity : Vertical**

CH Low (GFSK)



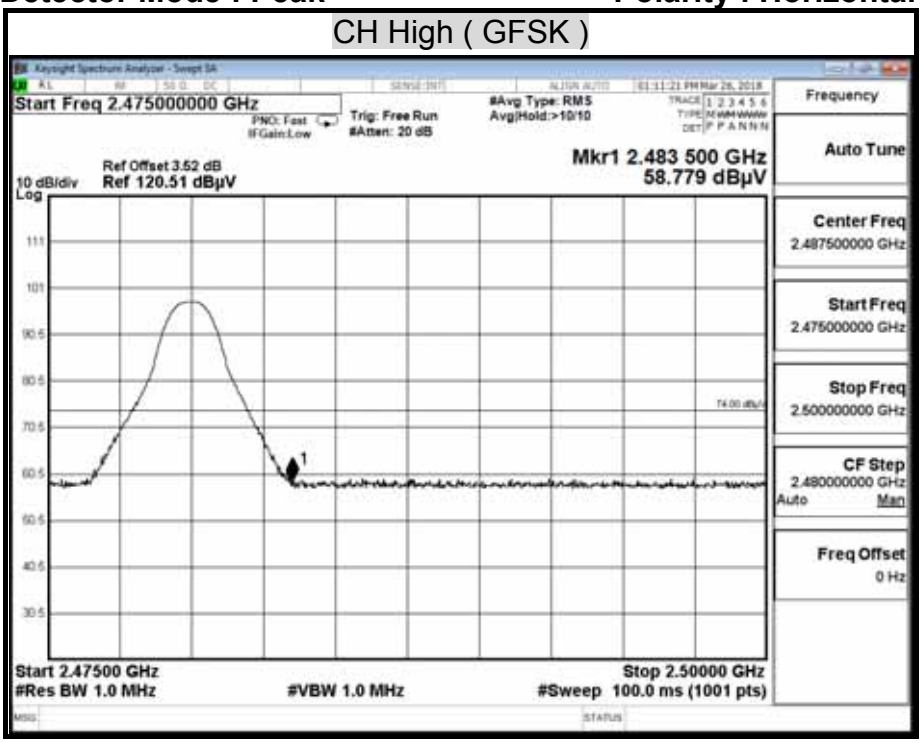
Detector Mode : Average **Polarity : Vertical**

CH Low (GFSK)



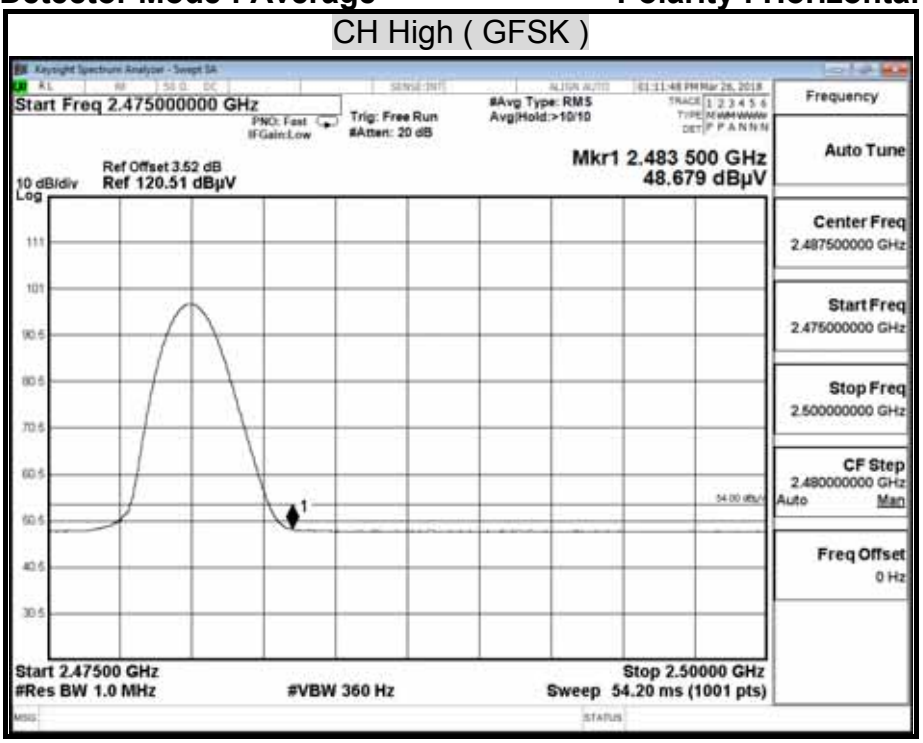
Detector Mode : Peak **Polarity : Horizontal**

CH High (GFSK)



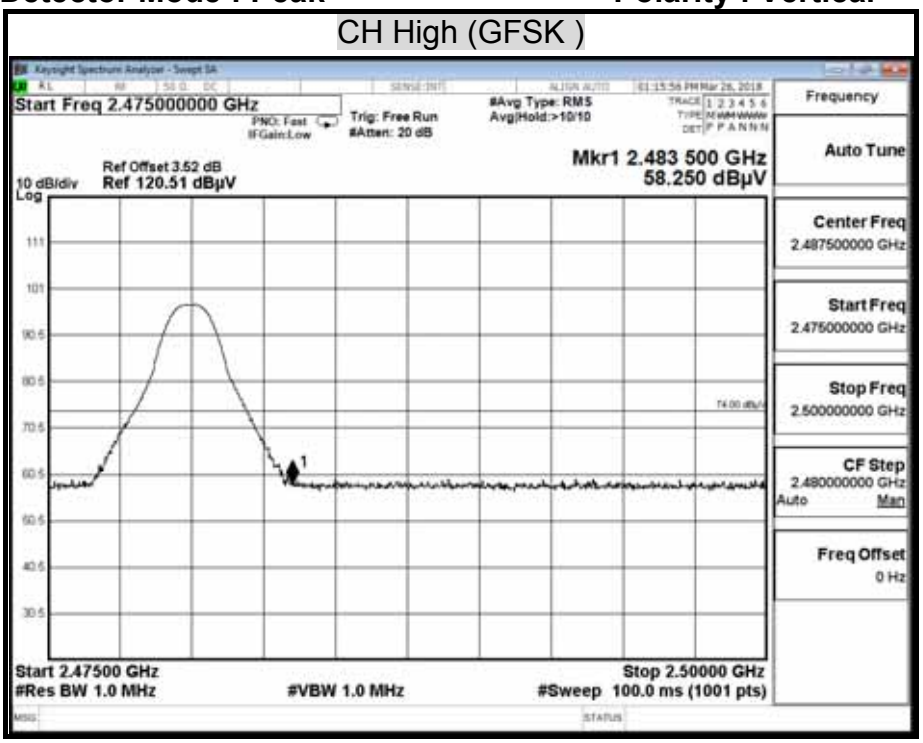
Detector Mode : Average **Polarity : Horizontal**

CH High (GFSK)



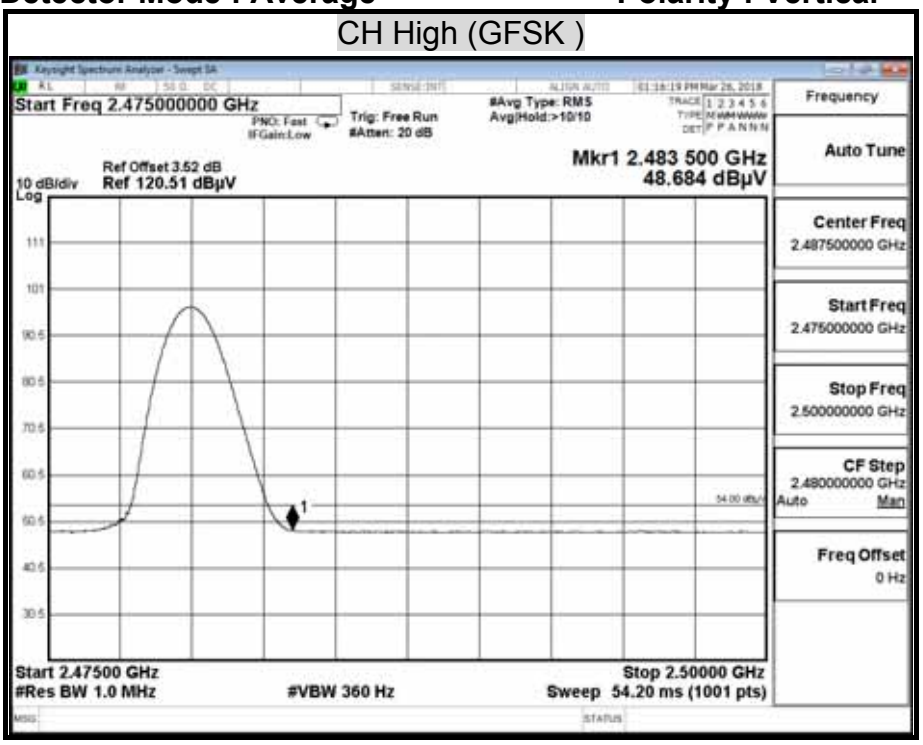
Detector Mode : Peak **Polarity : Vertical**

CH High (GFSK)



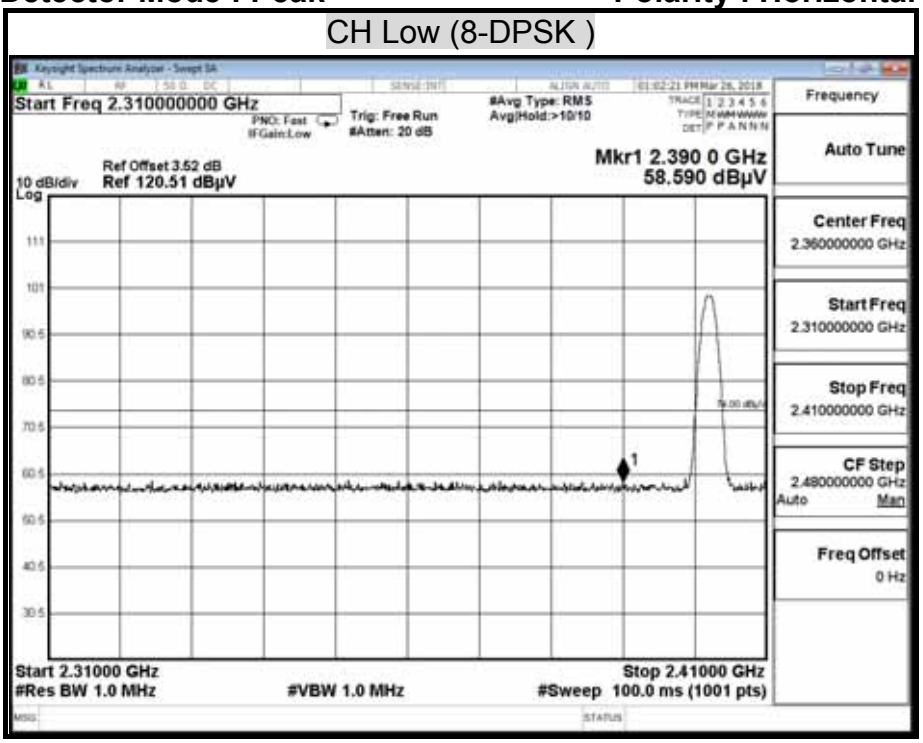
Detector Mode : Average **Polarity : Vertical**

CH High (GFSK)



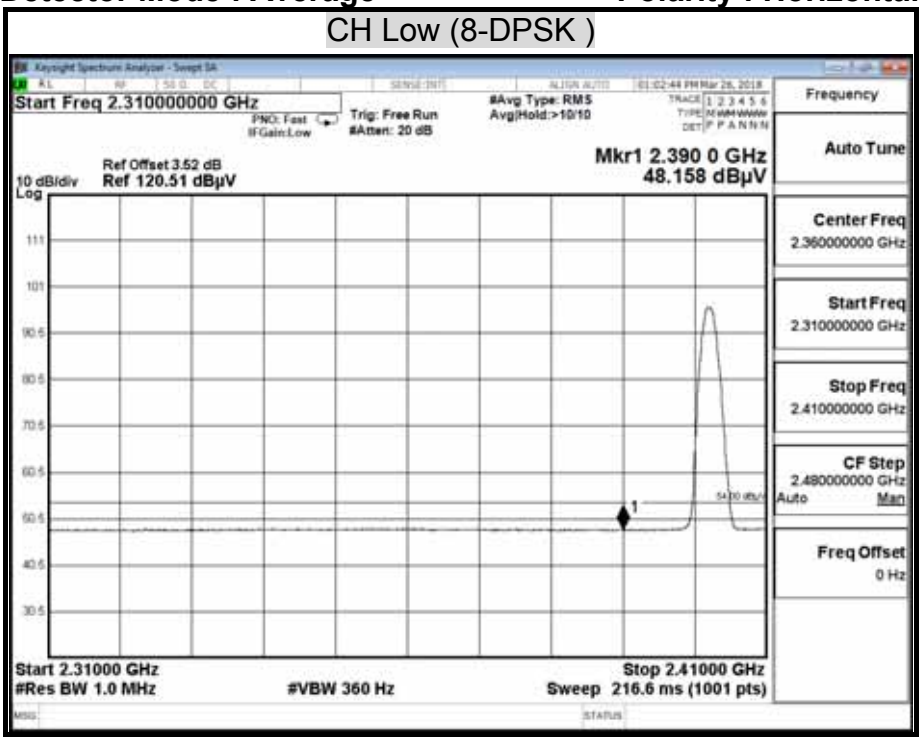
Detector Mode : Peak **Polarity : Horizontal**

CH Low (8-DPSK)



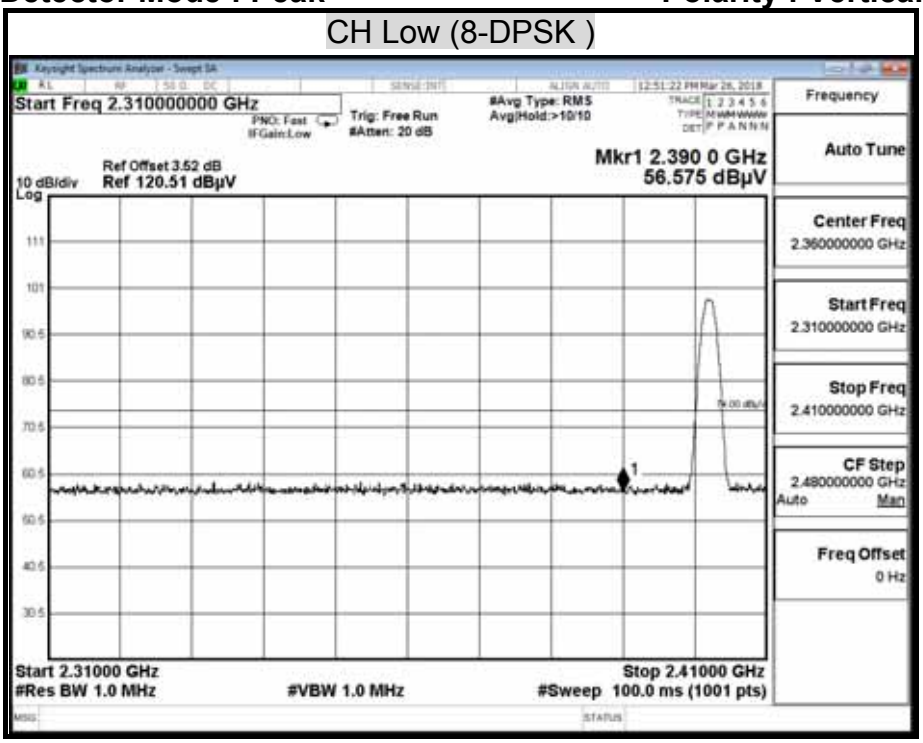
Detector Mode : Average **Polarity : Horizontal**

CH Low (8-DPSK)



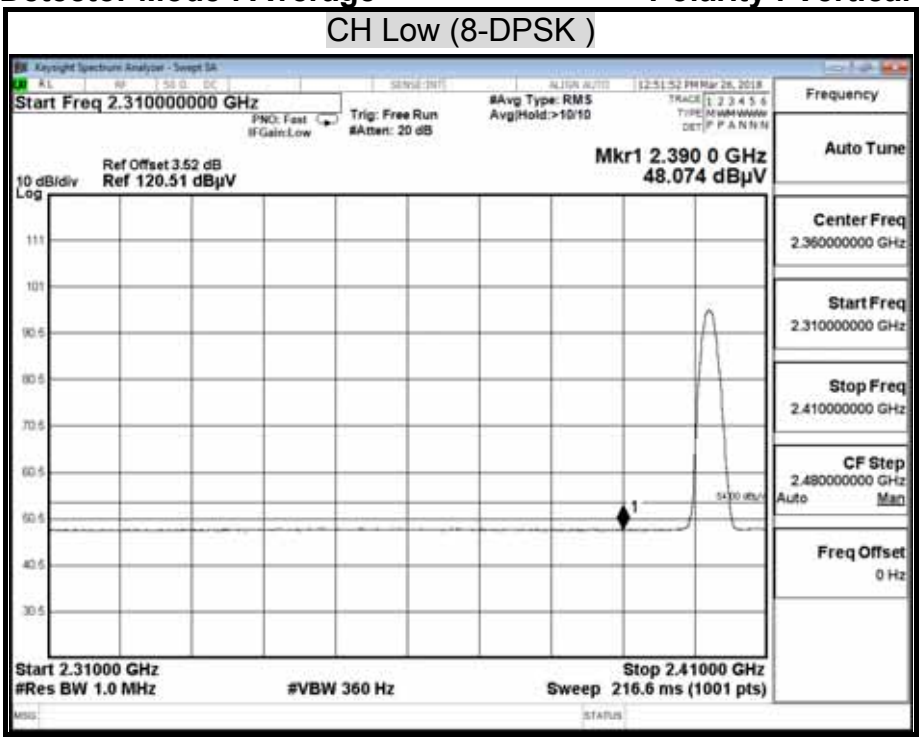
Detector Mode : Peak **Polarity : Vertical**

CH Low (8-DPSK)



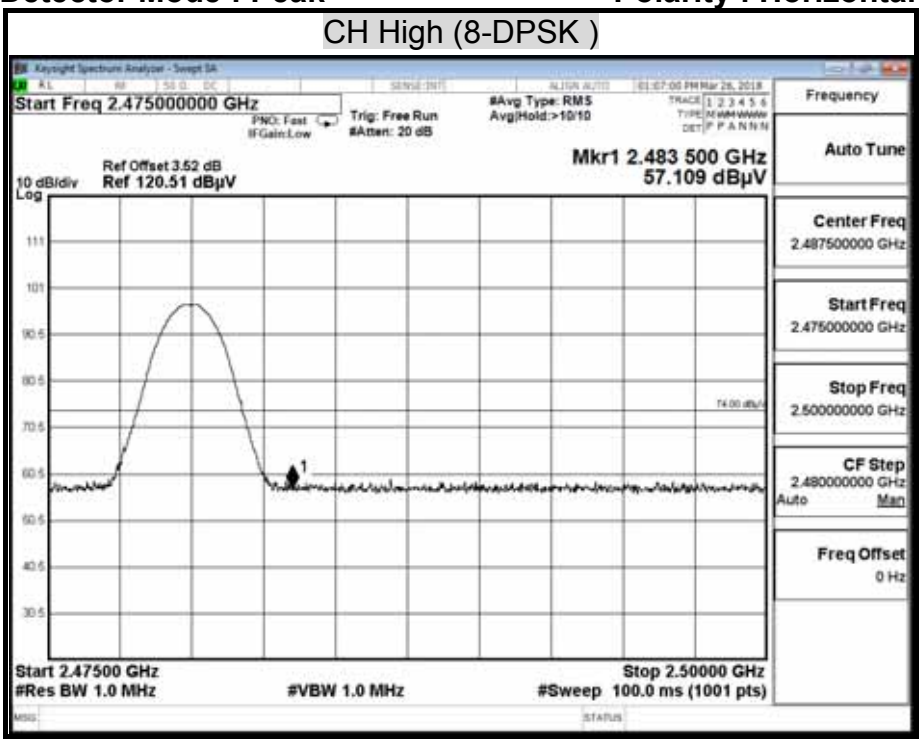
Detector Mode : Average **Polarity : Vertical**

CH Low (8-DPSK)



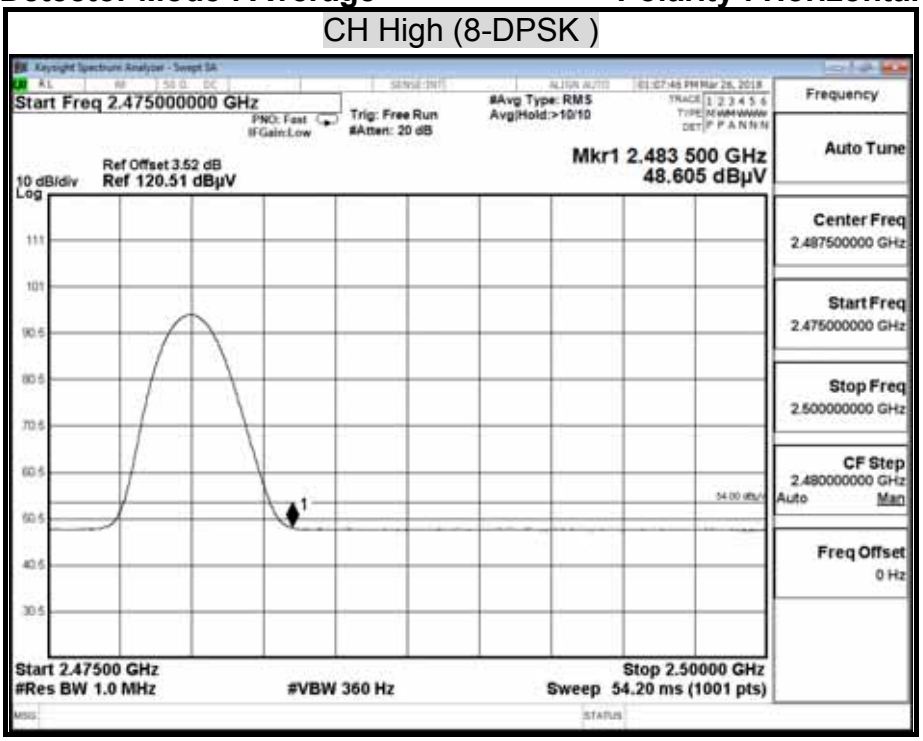
Detector Mode : Peak **Polarity : Horizontal**

CH High (8-DPSK)



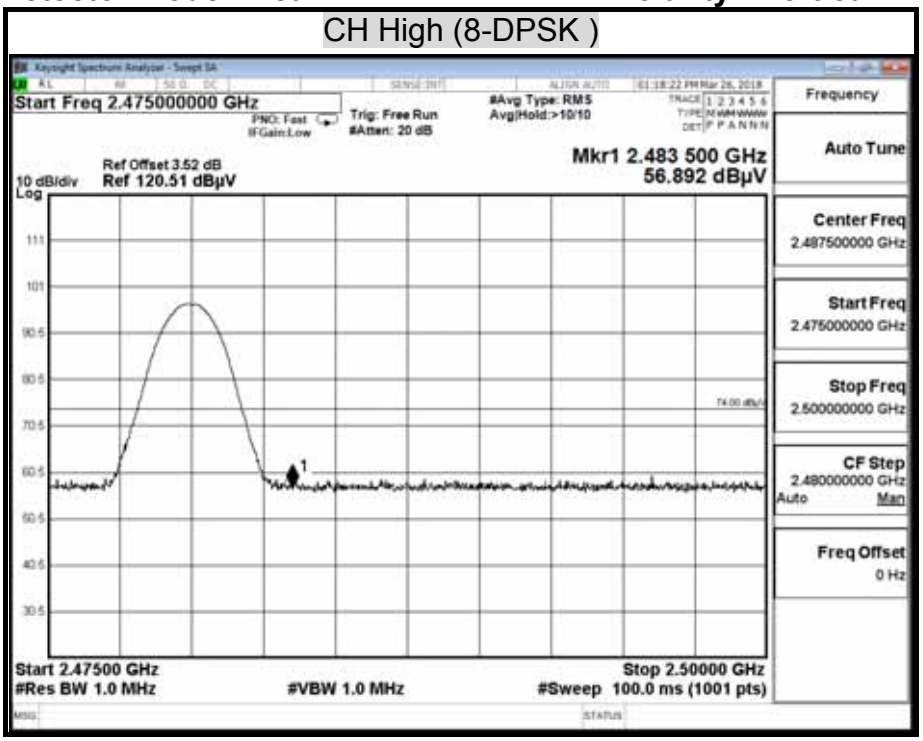
Detector Mode : Average **Polarity : Horizontal**

CH High (8-DPSK)



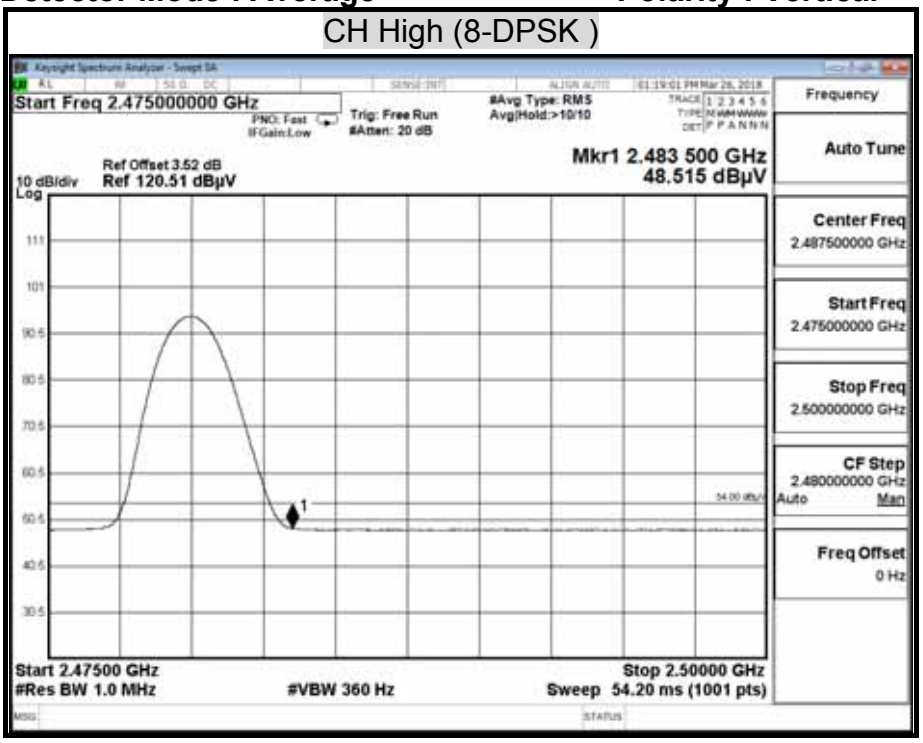
Detector Mode : Peak **Polarity : Vertical**

CH High (8-DPSK)



Detector Mode : Average **Polarity : Vertical**

CH High (8-DPSK)



7.9 POWERLINE CONDUCTED EMISSIONS

LIMITS

§ 15.207 (a) Except as shown in paragraph (b) and (c) this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

The lower limit applies at the boundary between the frequency ranges.

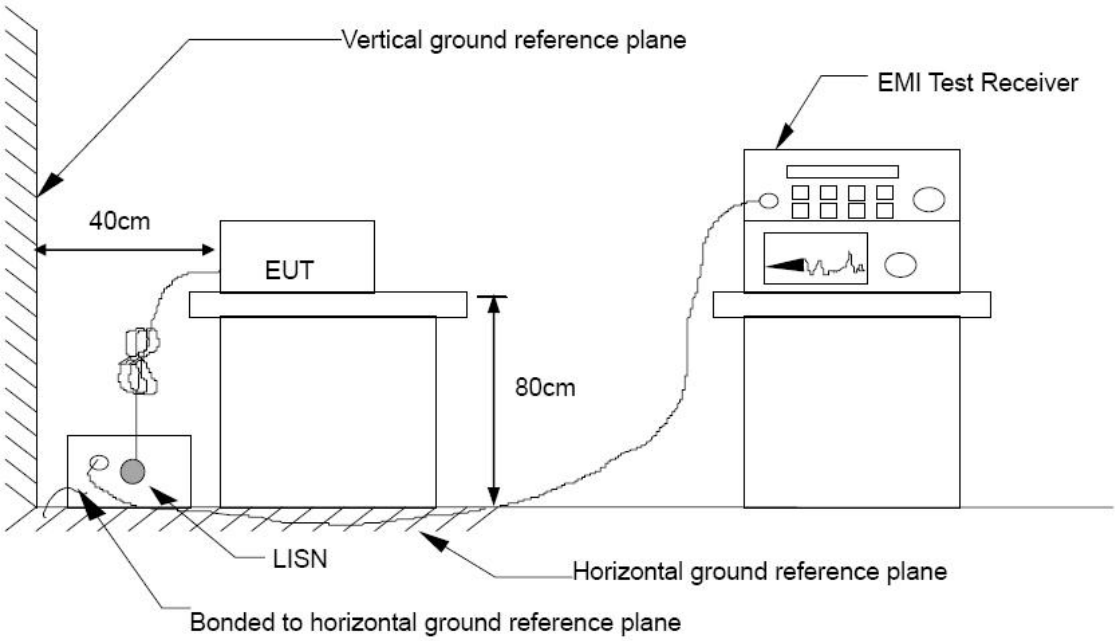
Frequency of Emission (MHz)	Conducted limit (dBμv)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56	56 to 46
0.5 - 5	56	46
5 - 30	60	50

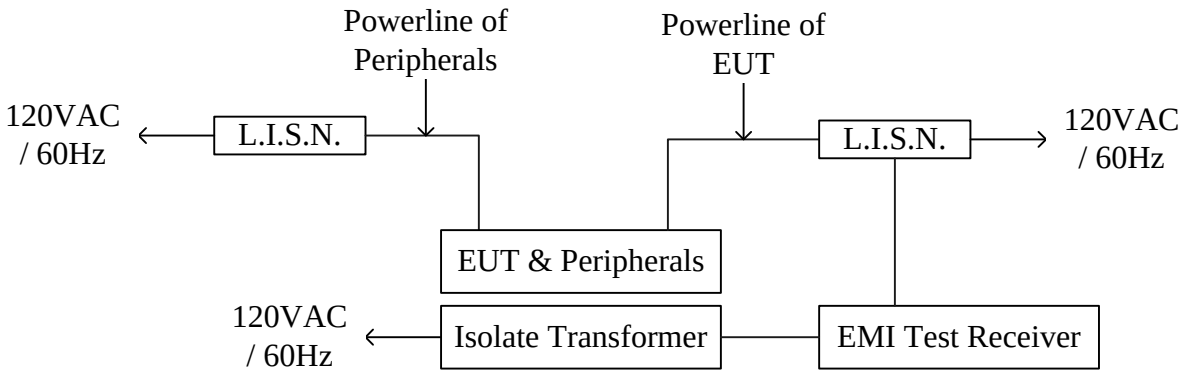
TEST EQUIPMENT

Conducted Emission room #1				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
BNC Coaxial Cable	CCS	BNC50	11	01/23/2019
EMI Test Receiver	R&S	ESCS 30	100348	01/30/2019
LISN	SCHWARZBECK	NNLK8130	8130124	11/30/2018
LISN	FCC	FCC-LISN-50-32-2	08009	05/07/2018
Pulse Limiter	R&S	ESH3-Z2	100116	01/23/2019
Test S/W	e-3 (5.04211j)			

Remark: Each piece of equipment is scheduled for calibration once a year.

TEST SETUP





TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80cm above the horizontal ground plane. The EUT IS CONFIGURED IN ACCORDANCE WITH ANSI C63.10 : 2013.

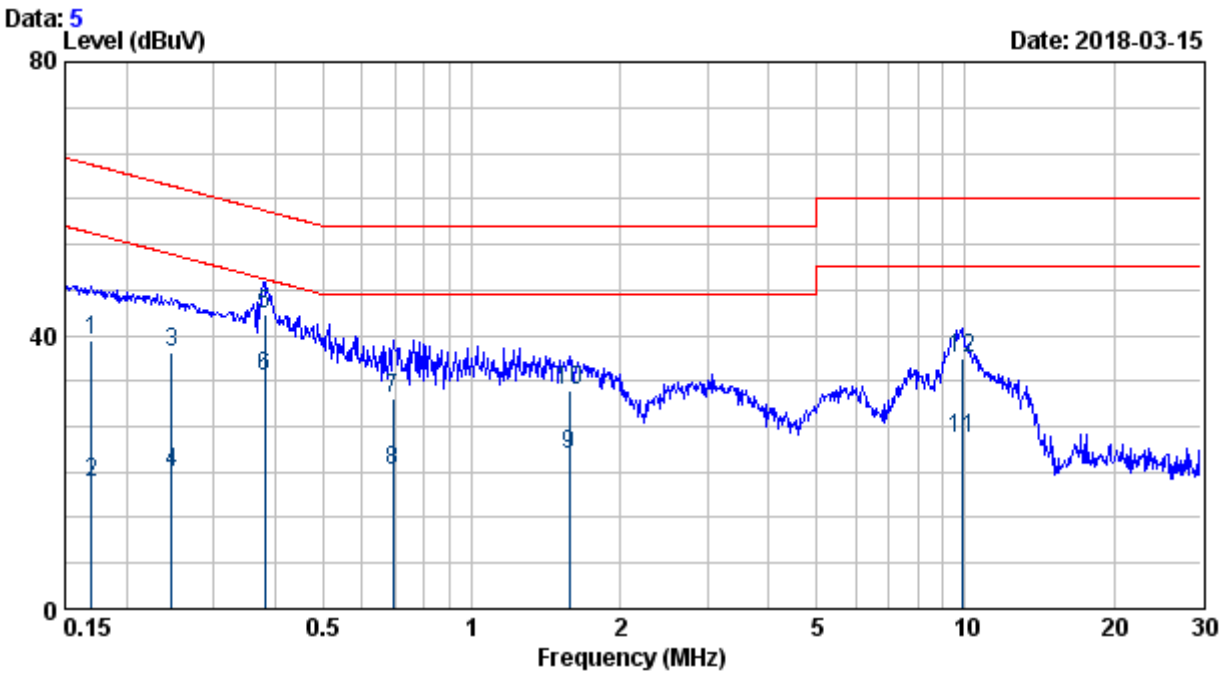
The resolution bandwidth is set to 9 kHz for both quasi-peak detection and average detection measurements.

Line conducted data is recorded for both NEUTRAL and LINE.

TEST RESULTS

Product Name	ANALOG PLAYER	Test Date	2018/03/15
Model Name	TN-180BT	Test By	Peter Chu
Test Mode	Normal Operation	Temp & Humidity	24.7°C, 62%

LINE



Freq. MHz	LISN Factor dB	Cable Loss dB	Meter Reading dBuV	Measured Level dBuV	Limits dBuV	Over Limits dBuV	Detector
0.169	8.66	0.05	30.57	39.28	64.99	-25.70	QP
0.169	8.66	0.05	9.83	18.54	54.99	-36.44	AVERAGE
0.247	8.70	0.06	28.74	37.50	61.86	-24.37	QP
0.247	8.70	0.06	11.06	19.82	51.86	-32.05	AVERAGE
0.381	8.75	0.07	34.20	43.02	58.25	-15.23	QP
0.381	8.75	0.07	25.22	34.04	48.25	-14.21	AVERAGE
0.694	8.81	0.10	21.92	30.83	56.00	-25.17	QP
0.694	8.81	0.10	11.16	20.07	46.00	-25.93	AVERAGE
1.577	8.87	0.12	13.46	22.45	46.00	-23.55	AVERAGE
1.577	8.87	0.12	23.05	32.04	56.00	-23.96	QP
9.861	9.15	0.24	15.62	25.01	50.00	-24.99	AVERAGE
9.861	9.15	0.24	27.17	36.56	60.00	-23.44	QP

Remark:

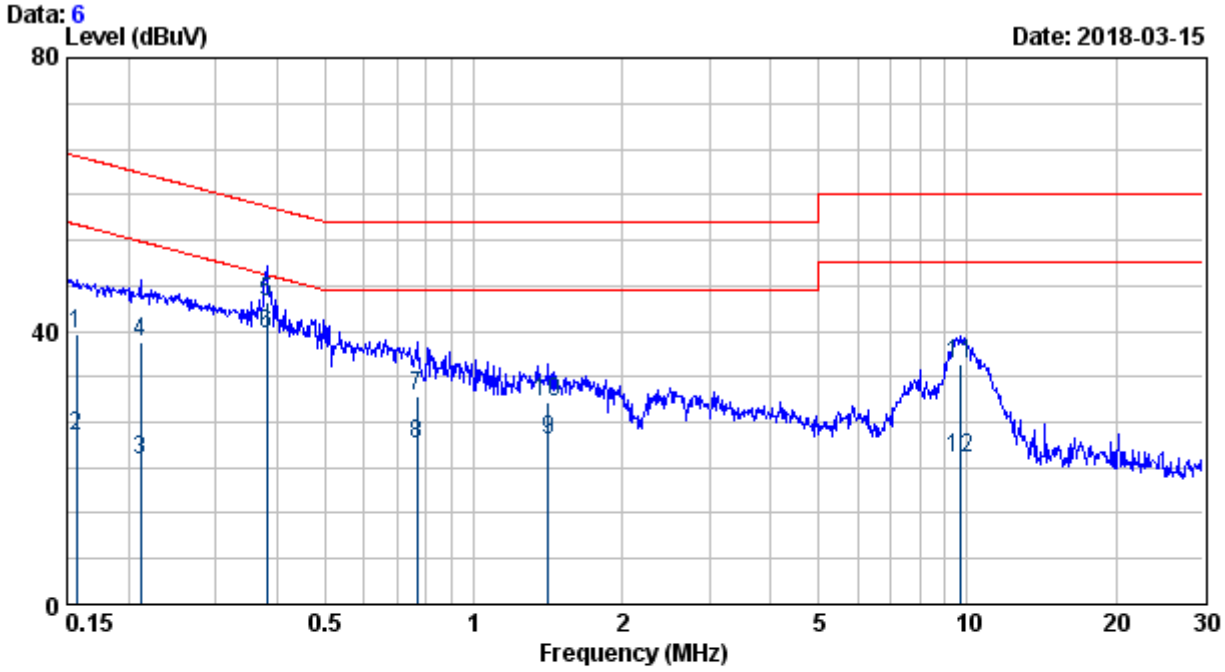
1. Correction Factor = Insertion loss + Cable loss

2. Emission level = Reading Value + Correction factor

3. Margin value = Emission level – Limit value

Product Name	ANALOG PLAYER	Test Date	2018/03/15
Model Name	TN-180BT	Test By	Peter Chu
Test Mode	Normal Operation	Temp & Humidity	24.7°C, 62%

NEUTRAL



Freq. MHz	LISN Factor dB	Cable Loss dB	Meter Reading dBuV	Measured Level dBuV	Limits dBuV	Over Limits dBuV	Detector
0.156	8.67	0.05	30.73	39.45	65.65	-26.20	QP
0.156	8.67	0.05	15.76	24.48	55.65	-31.17	AVERAGE
0.212	8.70	0.05	12.42	21.17	53.14	-31.97	AVERAGE
0.212	8.70	0.05	29.56	38.31	63.14	-24.83	QP
0.381	8.76	0.07	35.32	44.15	58.25	-14.10	QP
0.381	8.76	0.07	30.73	39.56	48.25	-8.69	AVERAGE
0.767	8.84	0.10	21.41	30.35	56.00	-25.65	QP
0.767	8.84	0.10	14.56	23.50	46.00	-22.50	AVERAGE
1.418	8.89	0.12	15.14	24.15	46.00	-21.85	AVERAGE
1.418	8.89	0.12	20.50	29.51	56.00	-26.49	QP
9.654	9.15	0.24	25.89	35.28	60.00	-24.72	QP
9.654	9.15	0.24	11.97	21.36	50.00	-28.64	AVERAGE

Remark:

1. Correction Factor = Insertion loss + Cable loss

2. Emission level = Reading Value + Correction factor

3. Margin value = Emission level – Limit value