Pi/4 DQPSK High Channel

Agilent Spectrum Analyzer - Occupied BW

LXI R L   RF   50 Ω   AC   SENSE:INT   ALIGN AUTO   09:03:02 AM Nov 03, 2020

Center Freq 2.480000000 GHz

Center Freq: 2.480000000 GHz   Radio Std: None

Trig: Free Run   Avg|Hold:>10/10

#IFGain:Low   #Atten: 20 dB   Radio Device: BTS

Ref Offset 0.5 dB
Ref 10.00 dBm

10 dB/div
Log

Center 2.48 GHz   Span 3 MHz
#Res BW 30 kHz   #VBW 100 kHz   Sweep 3.2 ms

Occupied Bandwidth

1.1373 MHz

Transmit Freq Error	6.793 kHz	OBW Power	99.00 %
x dB Bandwidth	1.214 MHz	x dB	-20.00 dB

8DPSK Low Channel

Agilent Spectrum Analyzer - Occupied BW

LXI R L   RF   50 Ω   AC   SENSE:INT   ALIGN AUTO   09:04:31 AM Nov 03, 2020

Center Freq 2.402000000 GHz

Center Freq: 2.402000000 GHz   Radio Std: None

Trig: Free Run   Avg|Hold:>10/10

#IFGain:Low   #Atten: 20 dB   Radio Device: BTS

Ref Offset 0.5 dB
Ref 10.00 dBm

10 dB/div
Log

Center 2.402 GHz   Span 3 MHz
#Res BW 30 kHz   #VBW 100 kHz   Sweep 3.2 ms

Occupied Bandwidth

1.1270 MHz

Transmit Freq Error	12.846 kHz	OBW Power	99.00 %
x dB Bandwidth	1.219 MHz	x dB	-20.00 dB

8DPSK Middle Channel

Occupied Bandwidth

1.1279 MHz

Transmit Freq Error	14.249 kHz	OBW Power	99.00 %
x dB Bandwidth	1.214 MHz	x dB	-20.00 dB

8DPSK High Channel

Occupied Bandwidth

1.1275 MHz

Transmit Freq Error	13.003 kHz	OBW Power	99.00 %
x dB Bandwidth	1.218 MHz	x dB	-20.00 dB

11. MAXIMUM PEAK OUTPUT POWER

11.1 Block Diagram Of Test Setup

```
┌──────────┐                    ┌─────────────────┐
│          │                    │    SPECTRUM     │
│   EUT    │────────────────────│                 │
│          │                    │    ANALYZER     │
└──────────┘                    └─────────────────┘
```

11.2 Limit

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(1)	Peak Output Power	0.125 watt or 21dBm	2400-2483.5	PASS

11.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 3MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak.

3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

11.4 Test Result

Temperature：	26℃	Relative Humidity：	54%
Test Voltage ：	DC 3.7V	Remark:	N/A

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	-0.170	21
GFSK	Middle	-0.284	21
GFSK	High	-0.747	21
Pi/4 DQPSK	Low	-0.188	21
Pi/4 DQPSK	Middle	-0.316	21
Pi/4 DQPSK	High	-0.777	21
8DPSK	Low	-0.020	21
8DPSK	Middle	-0.097	21
8DPSK	High	-0.577	21

Test plots
GFSK Low Channel
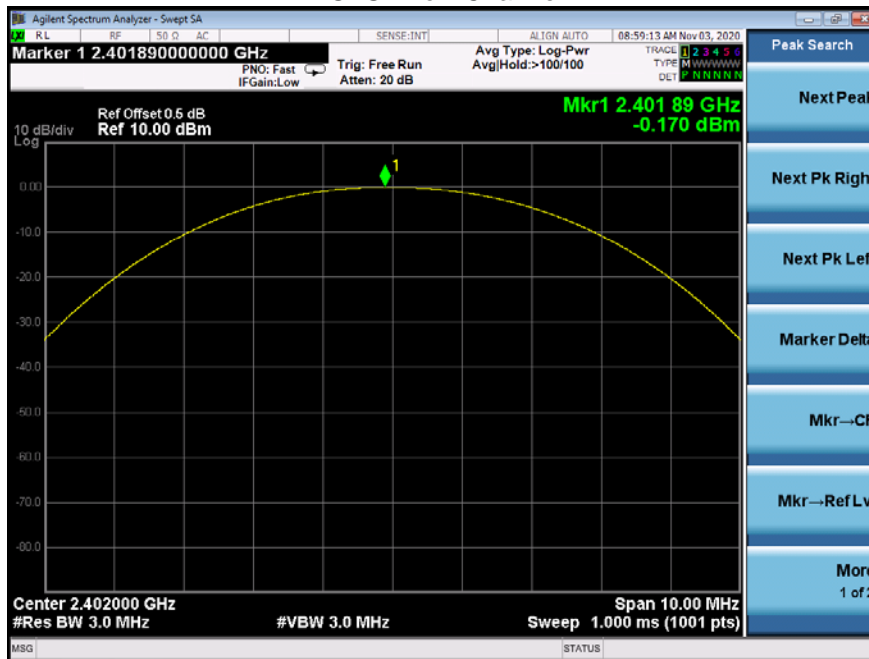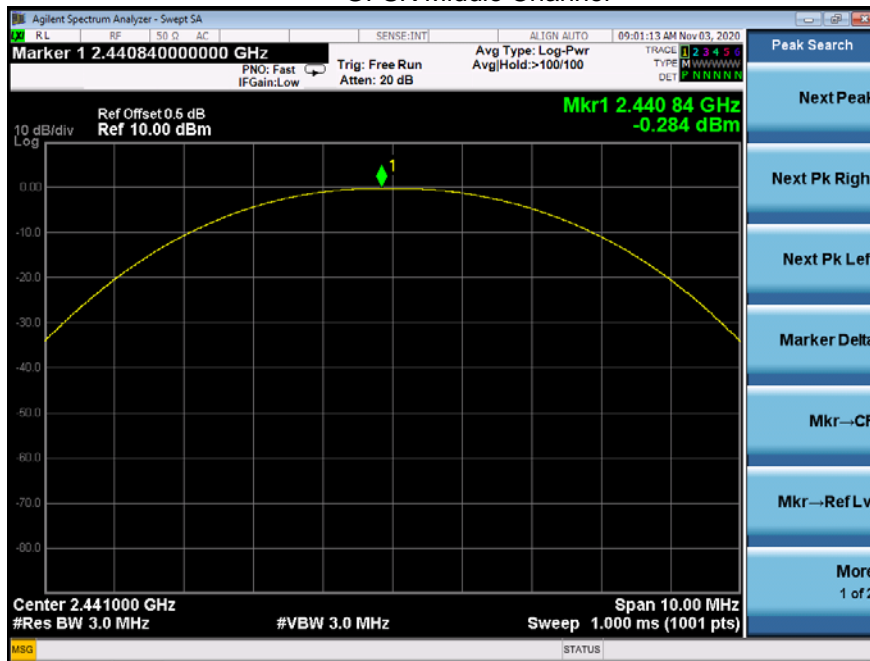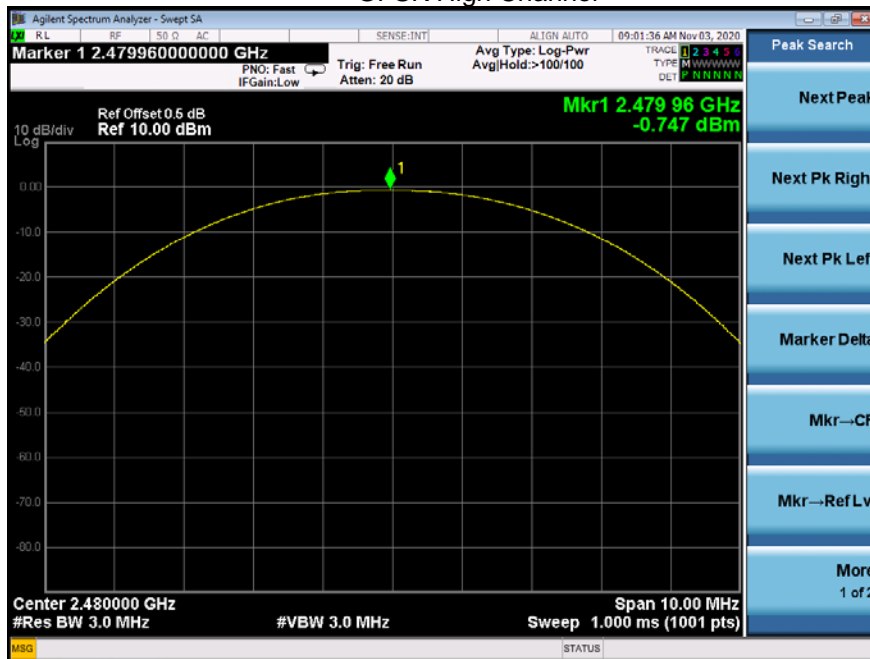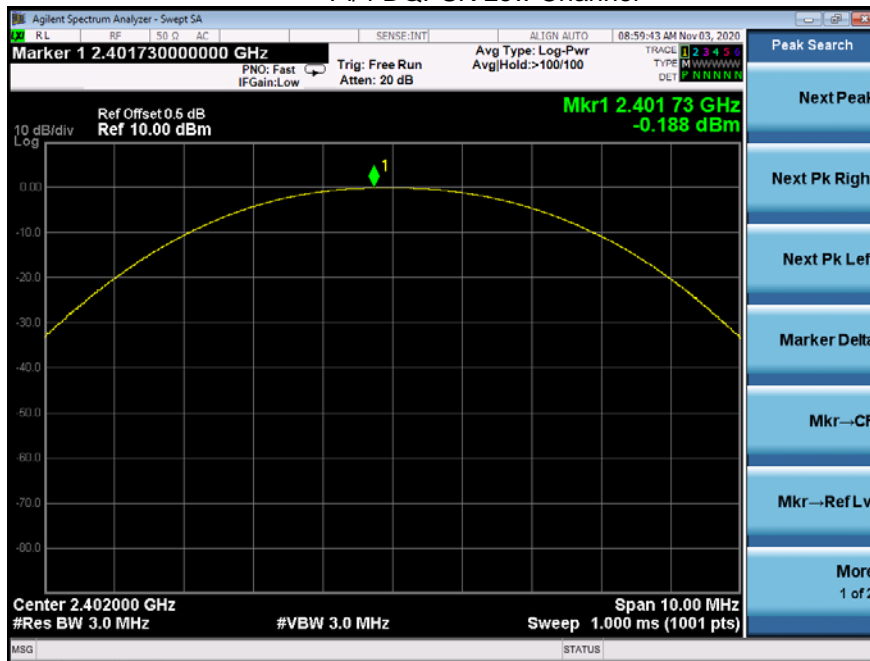
GFSK Middle Channel

GFSK High Channel

Pi/4 DQPSK Low Channel

Pi/4 DQPSK Middle Channel
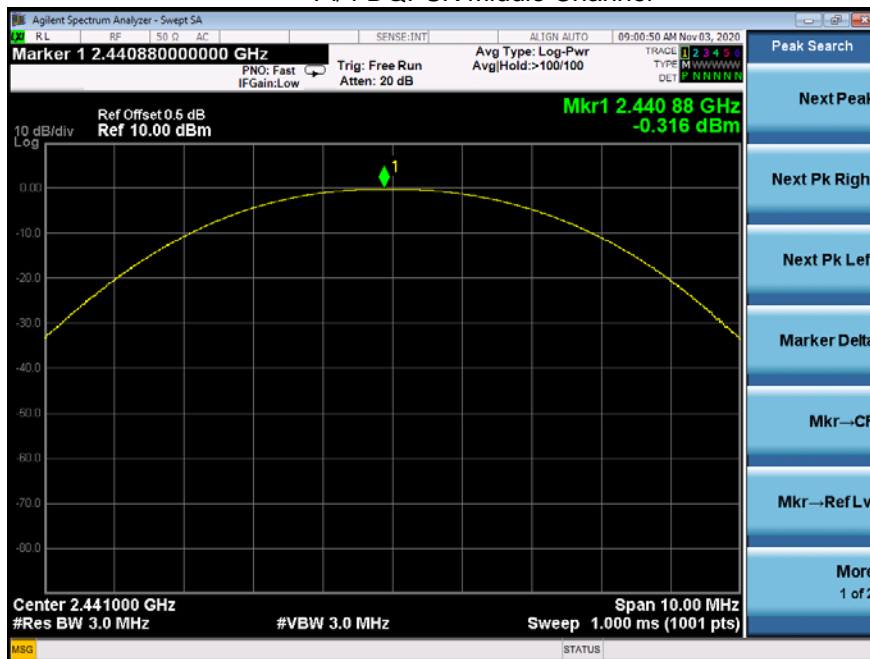
Pi/4 DQPSK High Channel
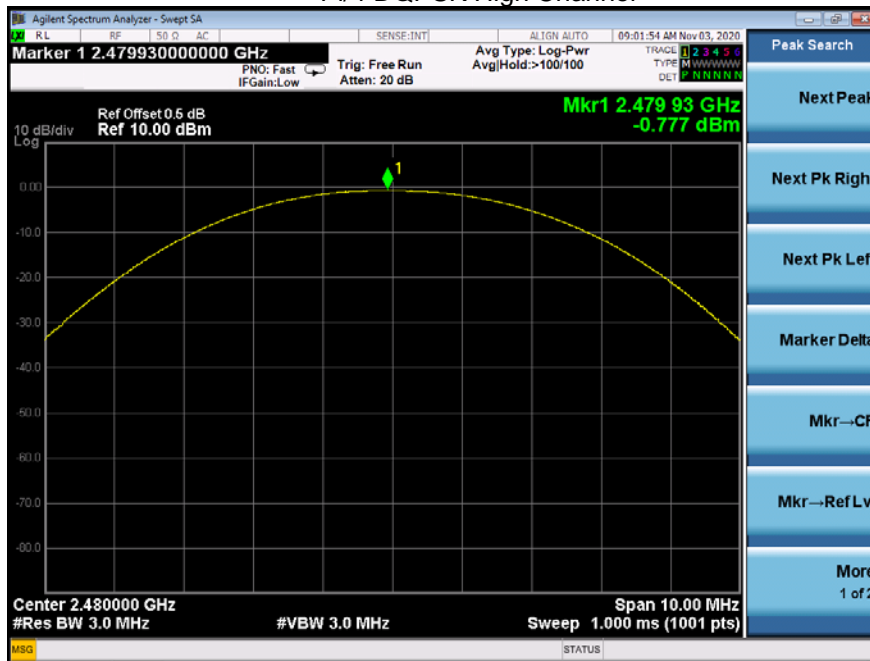
## 8DPSK Low Channel
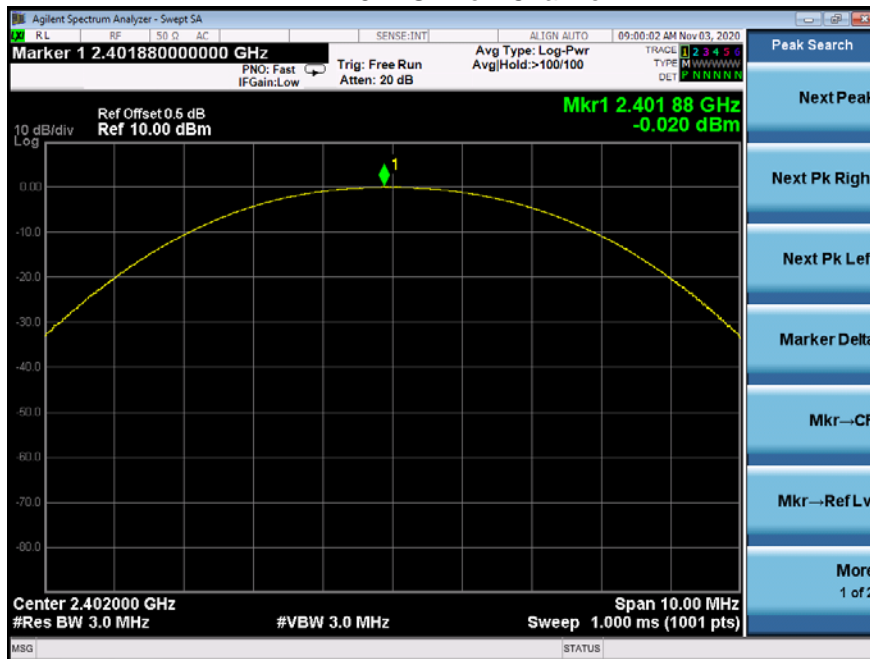
8DPSK Middle Channel
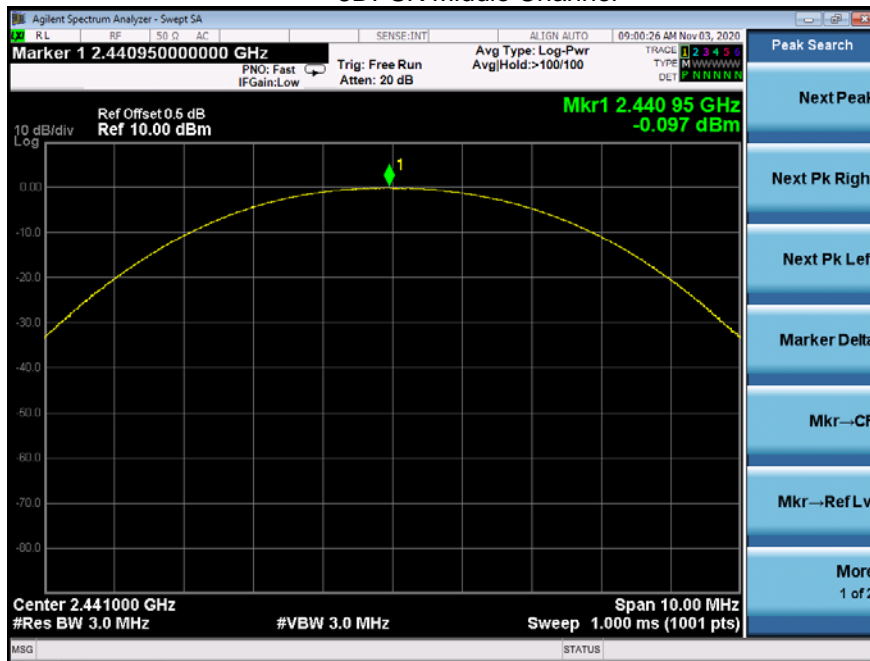
8DPSK High Channel
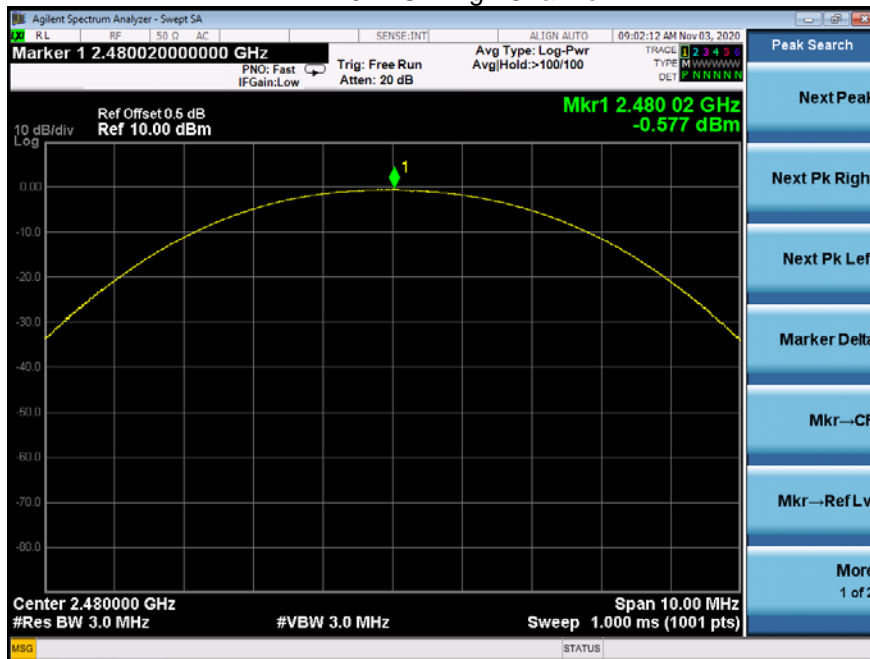
12. HOPPING CHANNEL SEPARATION

12.1 Block Diagram Of Test Setup

```
┌─────────┐                    ┌──────────────┐
│   EUT   │────────────────────│   SPECTRUM   │
│         │                    │   ANALYZER   │
└─────────┘                    └──────────────┘
```

12.2 Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125W.
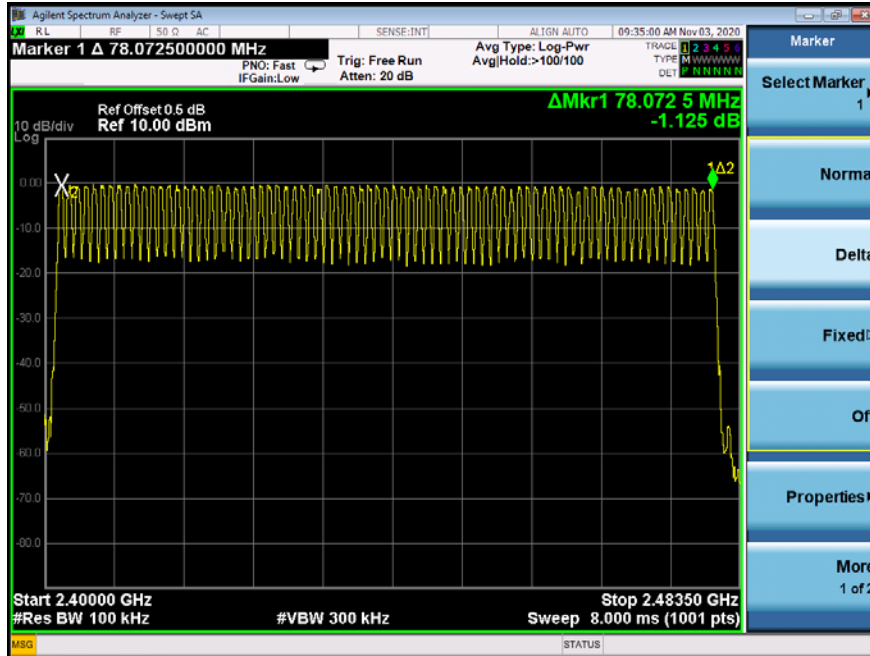
12.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port

to the spectrum.

2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 2.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

12.4 Test Result

Modulation	Test Channel	Separation (MHz)	Limit(MHz)	Result
GFSK	Low	1.004	0.622	PASS
GFSK	Middle	1.006	0.619	PASS
GFSK	High	0.996	0.587	PASS
Pi/4 DQPSK	Low	0.998	0.809	PASS
Pi/4 DQPSK	Middle	1.004	0.809	PASS
Pi/4 DQPSK	High	0.996	0.809	PASS
8DPSK	Low	1.000	0.813	PASS
8DPSK	Middle	1.002	0.809	PASS
8DPSK	High	0.996	0.812	PASS

Test plots
GFSK Low Channel

GFSK Middle Channel

GFSK High Channel

Pi/4 DQPSK Low Channel

Pi/4 DQPSK Middle Channel

Pi/4 DQPSK High Channel

8DPSK Low Channel
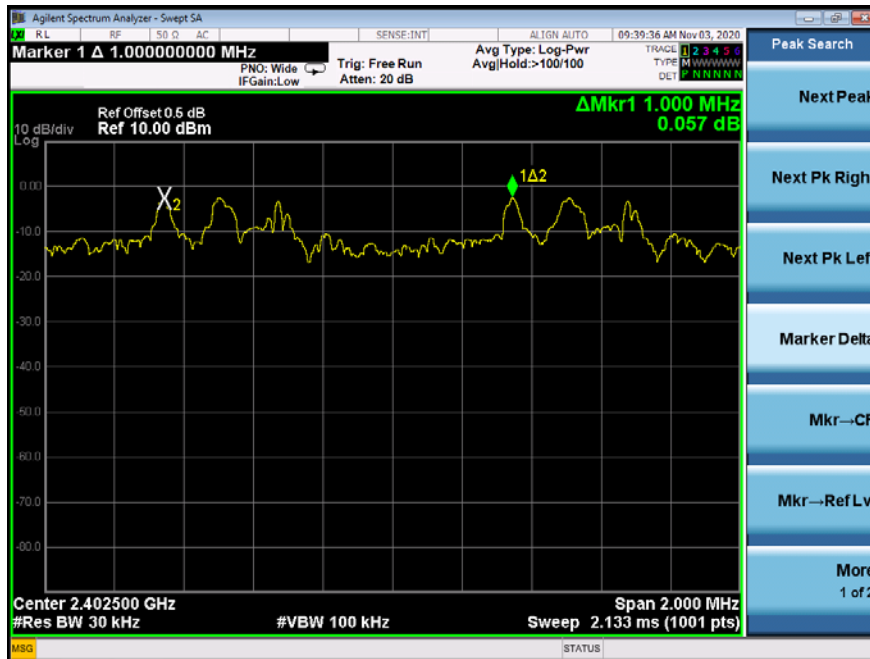
8DPSK Middle Channel
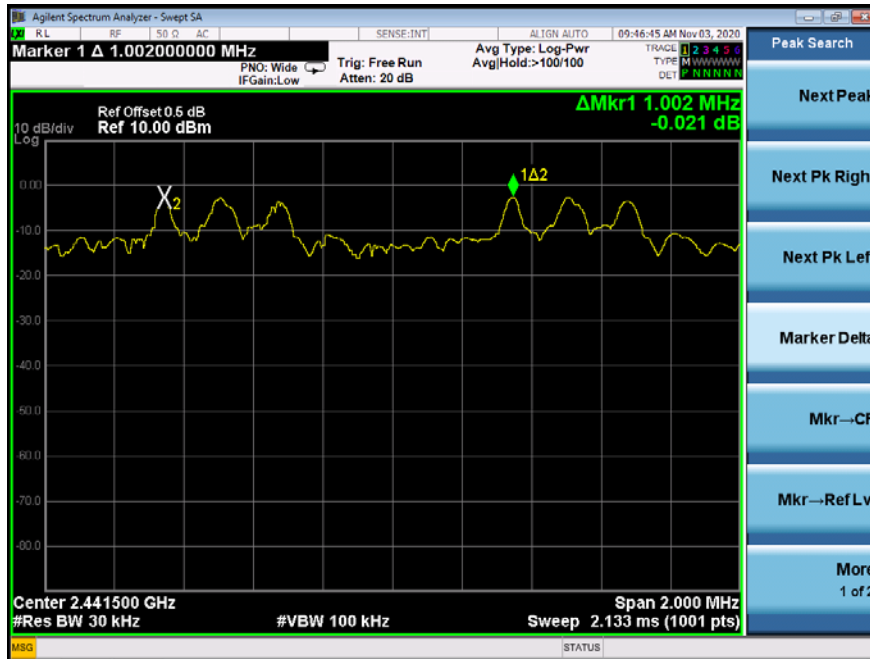
8DPSK High Channel
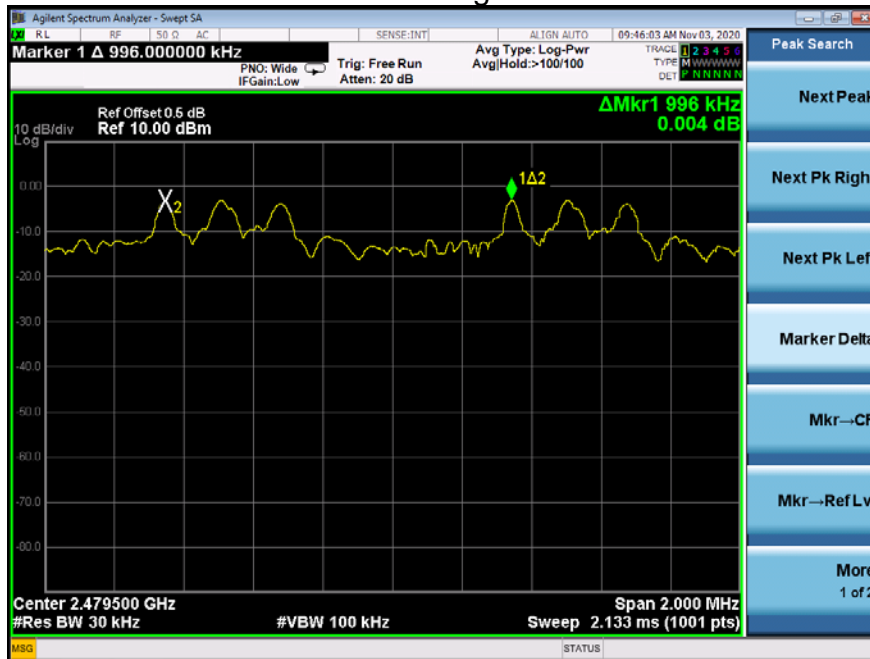
13. NUMBER OF HOPPING FREQUENCY

13.1 Block Diagram Of Test Setup
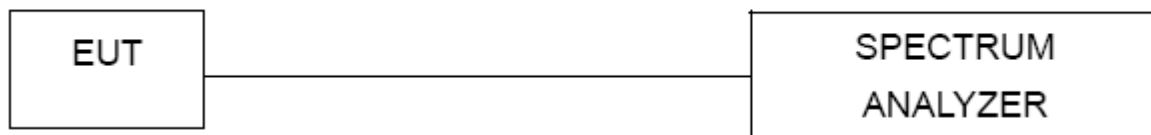
13.2 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

13.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of   this Section.

4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;
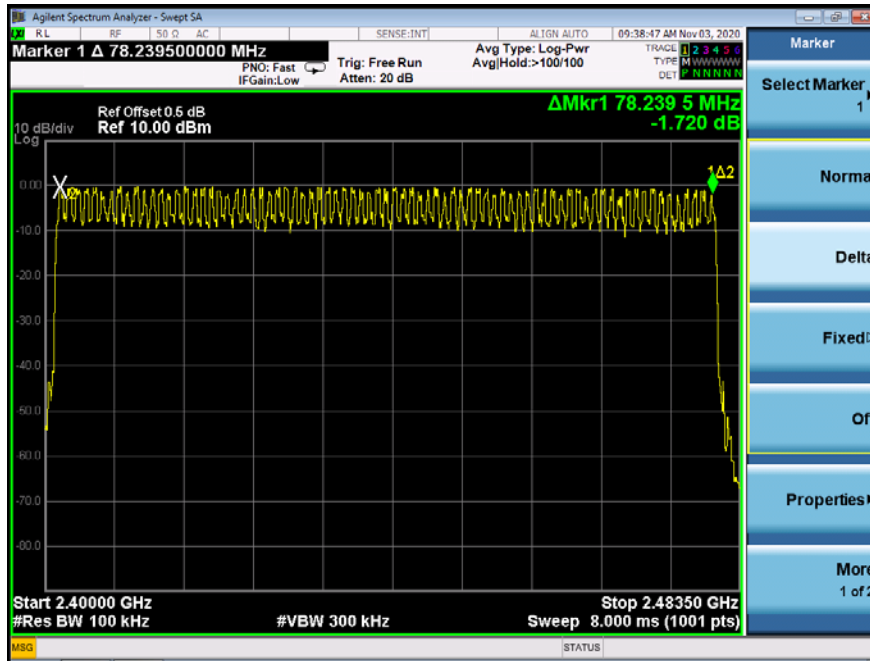
13.4 Test Result

Test Plots:

79 Channels in total
GFSK

Pi/4 DQPSK
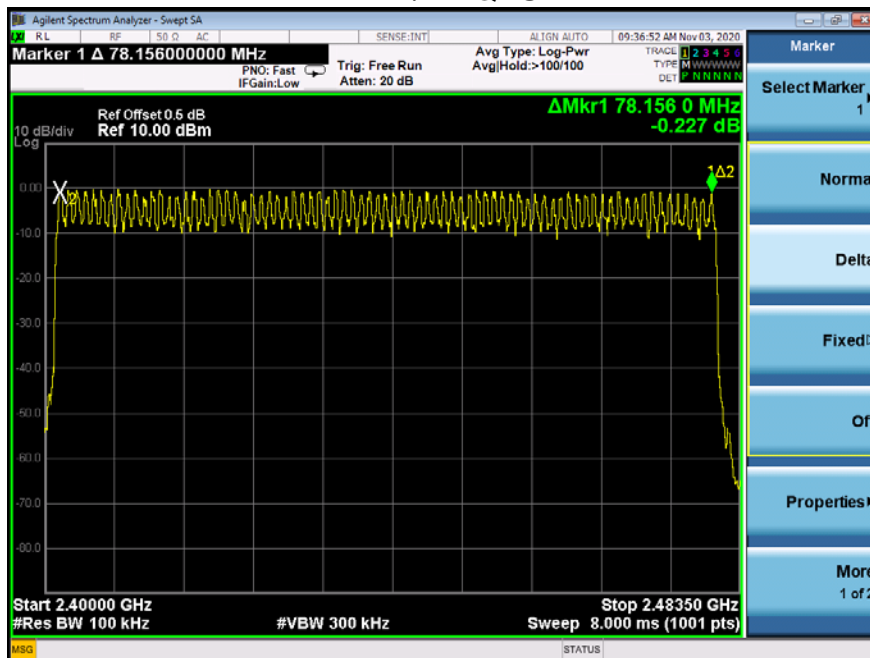
8DPSK

14. DWELL TIME

14.1 Block Diagram Of Test Setup

14.2 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

14.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set spectrum analyzer span = 0.　Centred on a hopping channel;

3. Set RBW = 1MHz and VBW = 3MHz.Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.

4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

14.4 Test Result

DH5 Packet permit maximum 1600 / 79 / 6   hops per second in each channel
(5 time slots RX, 1 time slot TX).
DH3 Packet permit maximum 1600 / 79 / 4   hops per second in each channel
(3 time slots RX, 1 time slot TX).
DH1 Packet permit maximum 1600 / 79 /2   hops per second in each channel
(1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

DH5:1600/79/6*0.4*79*(MkrDelta)/1000
DH3:1600/79/4*0.4*79*(MkrDelta)/1000
DH1:1600/79/2*0.4*79*(MkrDelta)/1000
Remark: Mkr Delta is once pulse time.

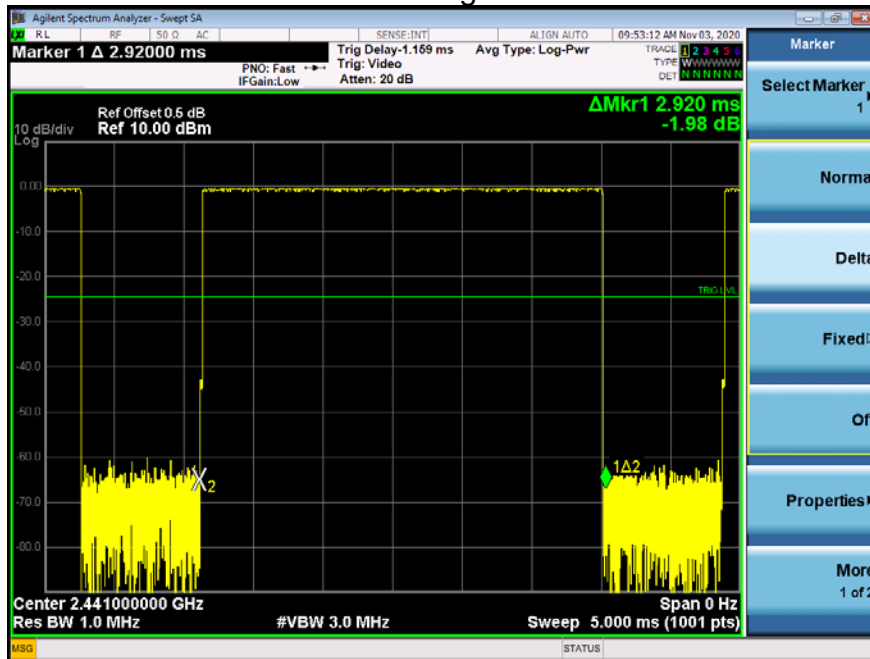| Modulation	Channel Data	Packet	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	Middle	DH1	0.408	0.131	0.4
		DH3	1.668	0.267	0.4
		DH5	2.920	0.311	0.4
Pi/4DQPSK	Middle	2DH1	0.416	0.133	0.4
		2DH3	1.680	0.269	0.4
		2DH5	2.960	0.316	0.4
8DPSK	Middle	3DH1	0.416	0.133	0.4
		3DH3	1.692	0.271	0.4
		3DH5	2.930	0.313	0.4

Test Plots
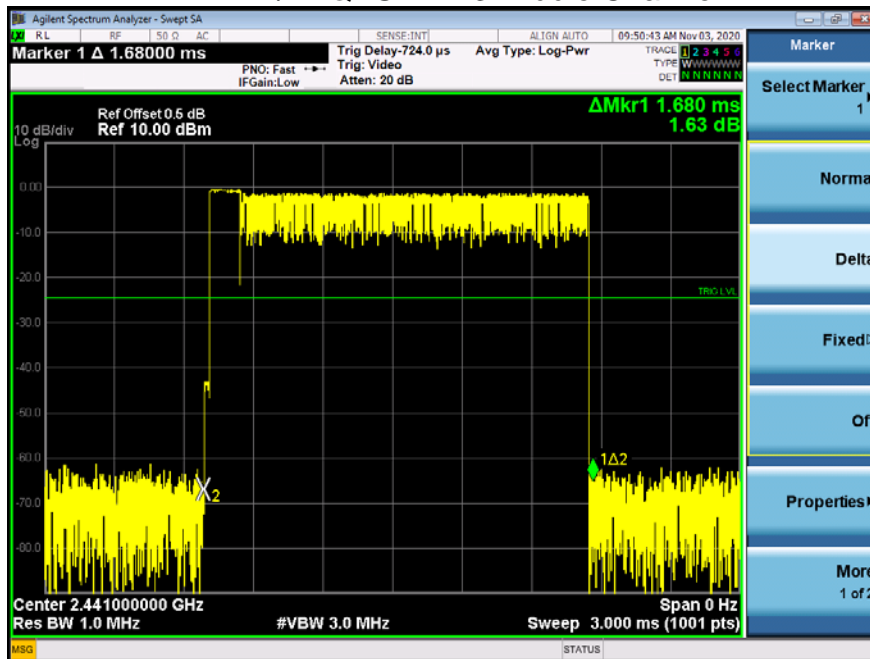GFSK DH1 Middle Channel
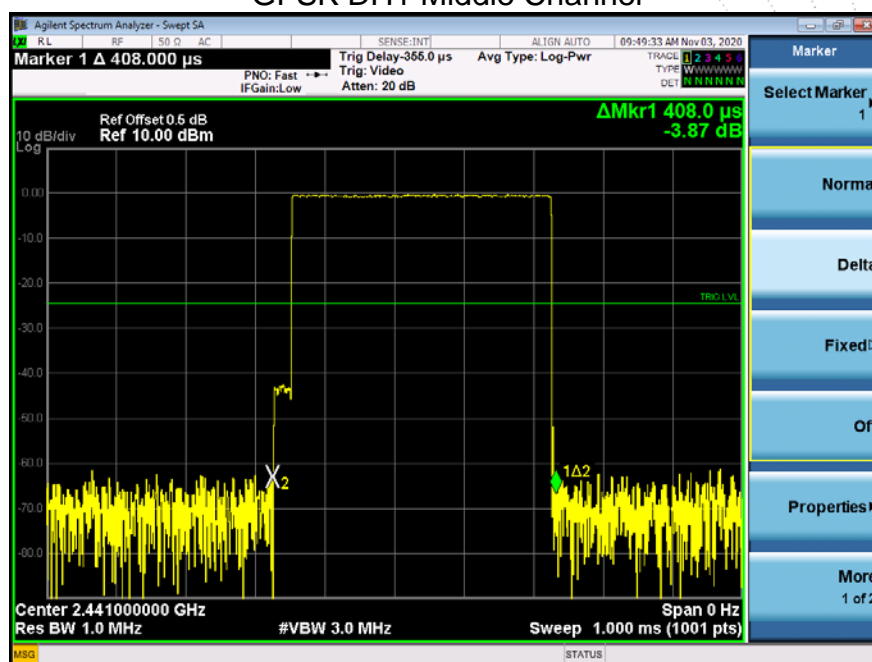
GFSK DH3 Middle Channel
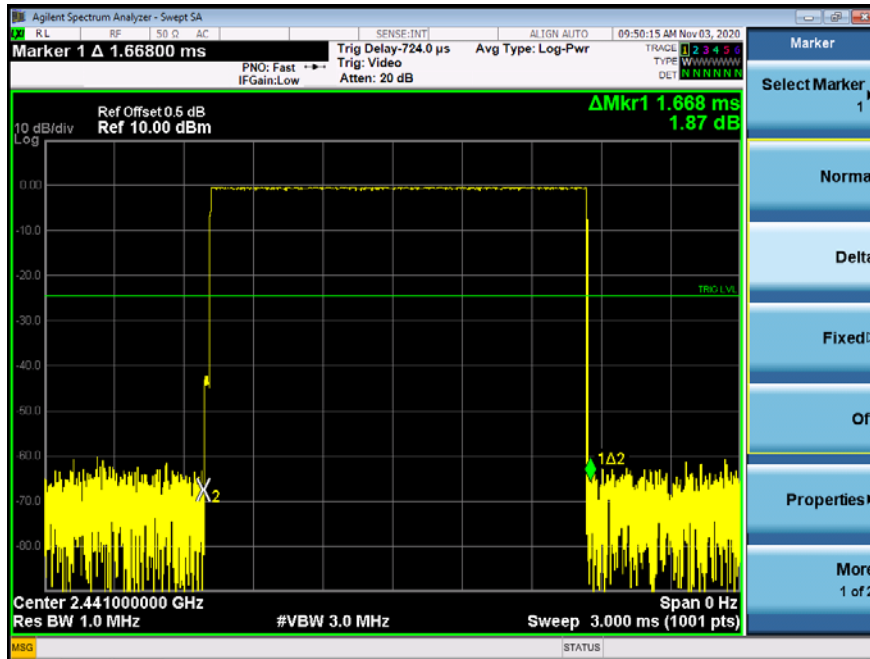
GFSK DH5 High Middle Channel

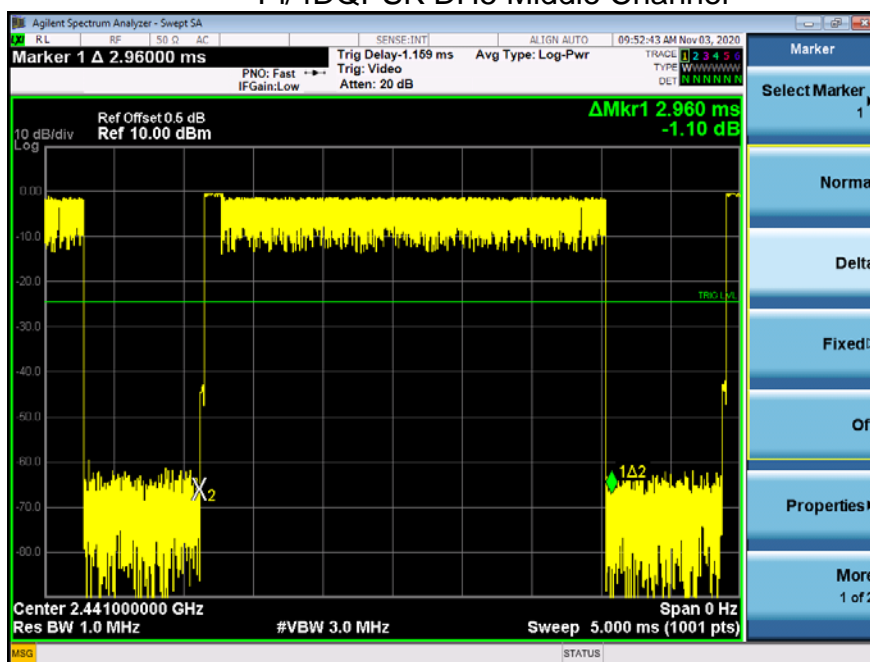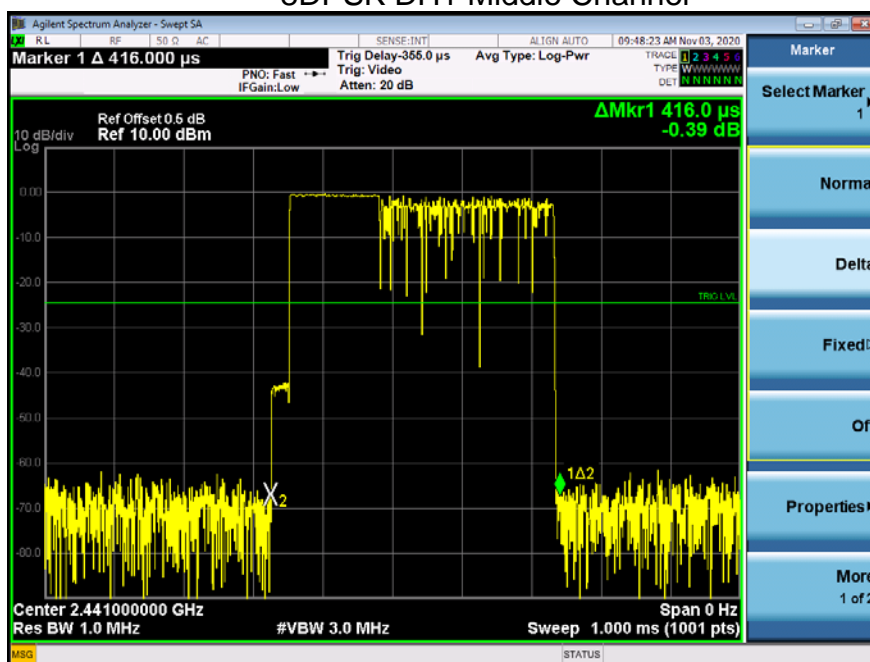## Pi/4DQPSK DH1 Middle Channel
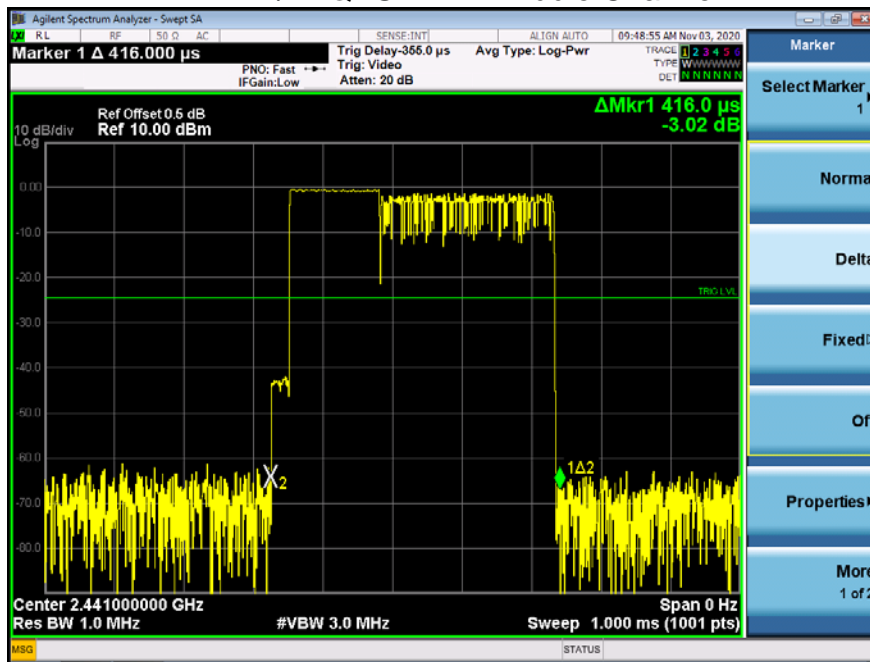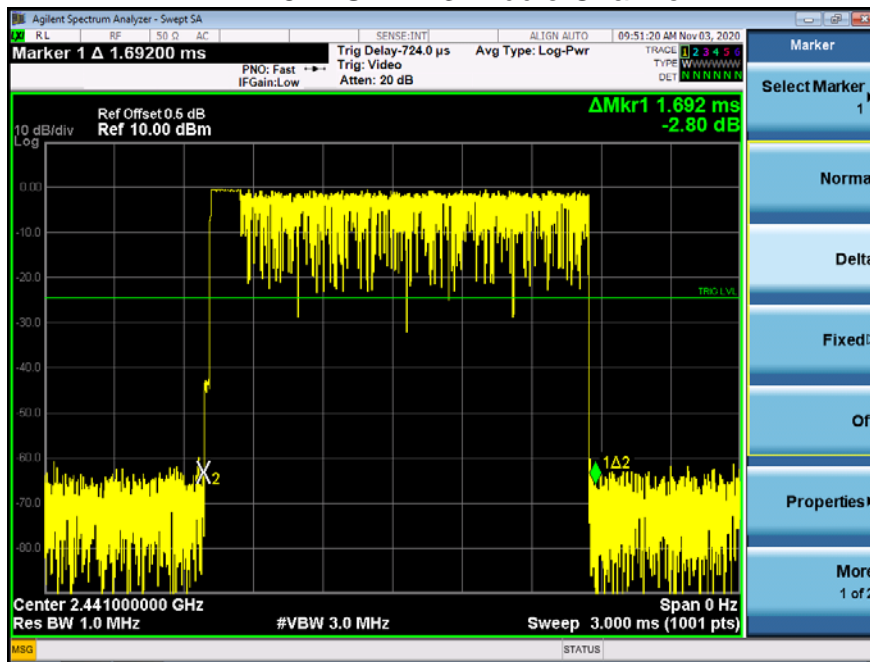

Pi/4DQPSK DH3 Middle Channel

Pi/4DQPSK DH5 Middle Channel

8DPSK DH1 Middle Channel

8DPSK DH3 Middle Channel


8DPSK DH5 Middle Channel

15. ANTENNA REQUIREMENT

15.1   Limit

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.

15.2   Test Result

The EUT antenna is Chip antenna, The antenna Gain is 1.06dBi, fulfill the requirement of this section.
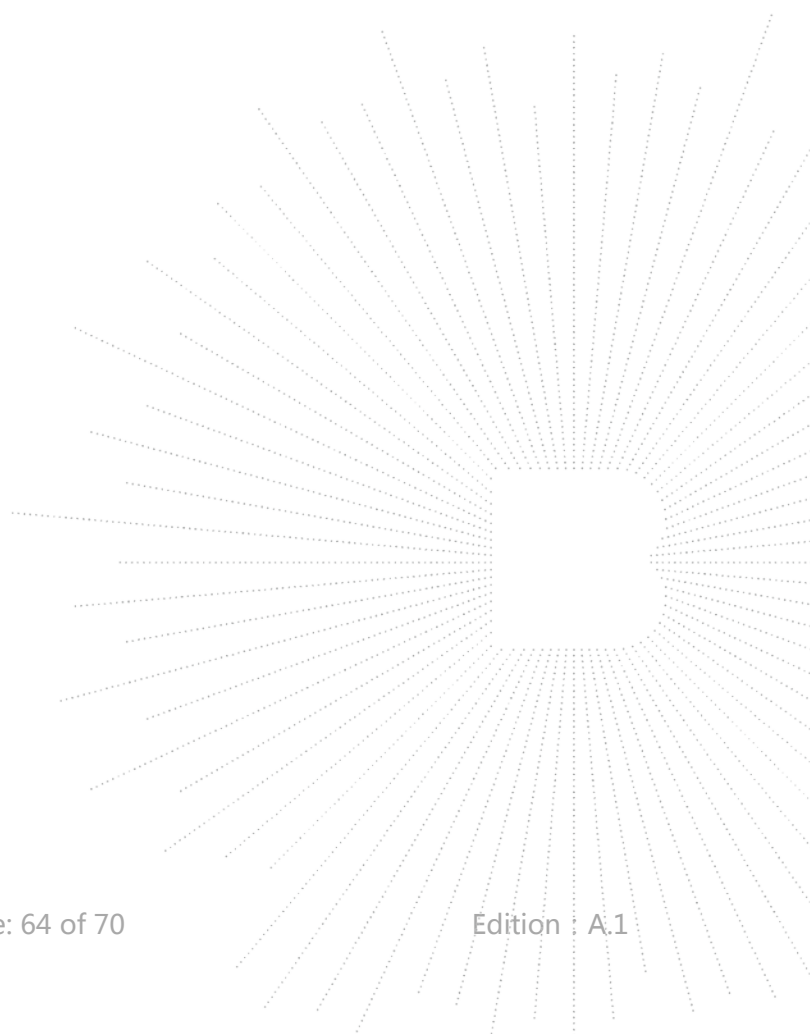
16.　EUT PHOTOGRAPHS

EUT Photo 1

EUT Photo 2
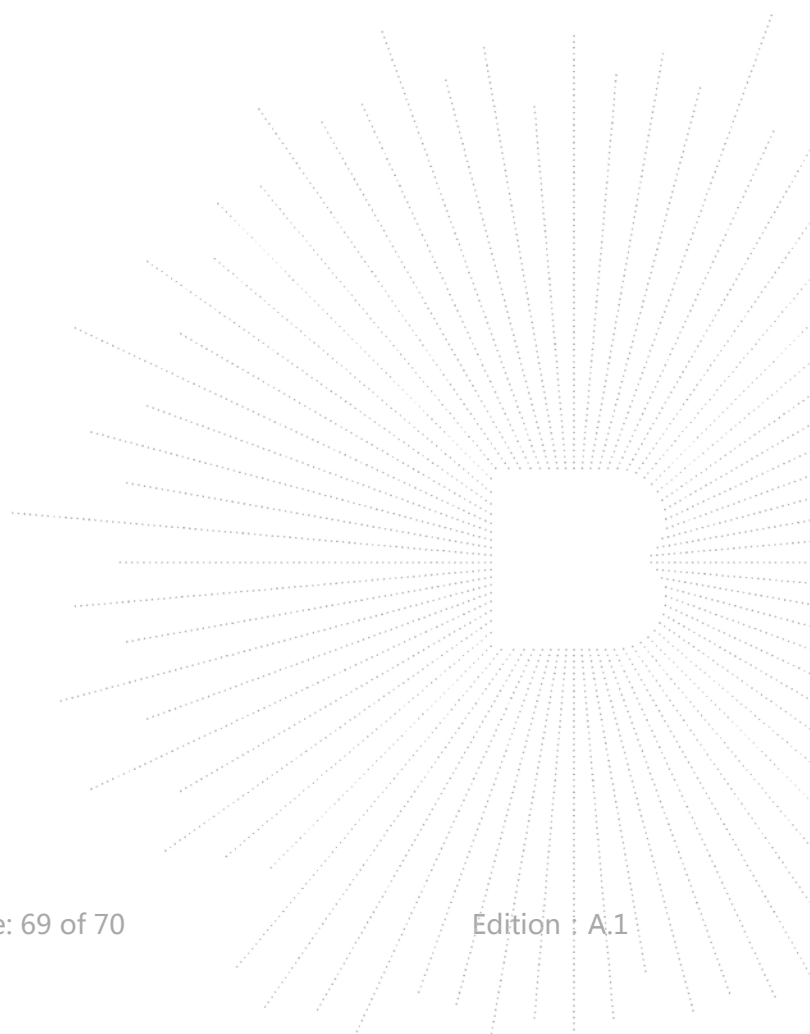
EUT Photo 3

EUT Photo 4

17. EUT TEST SETUP PHOTOGRAPHS

Conducted emissions

Radiated Measurement Photos

STATEMENT

1.The equipment lists are traceable to the national reference standards.

2.The test report can not be partially copied unless prior written approval is issued from our lab.

3.The test report is invalid without stamp of laboratory.

4.The test report is invalid without signature of person(s) testing and authorizing.

5.The test process and test result is only related to the Unit Under Test.

6.The quality system of our laboratory is in accordance with ISO/IEC17025.

7.If there is any objection to report, the client should inform issuing laboratory within 15 days from the date of receiving test report.

Address:
1-2F, East of B Building, Pengzhou Industrial Park, Fuyuan 1st Road, Qiaotou, Fuyong Street, Bao'an District,Shenzhen,Guangdong,China

TEL : 400-788-9558

P.C.: 518103

FAX : 0755-33229357

Website : http://www.bctc-lab.com

E-Mail : bctc@bctc-lab.com.cn

※※※※※ **END** ※※※※※