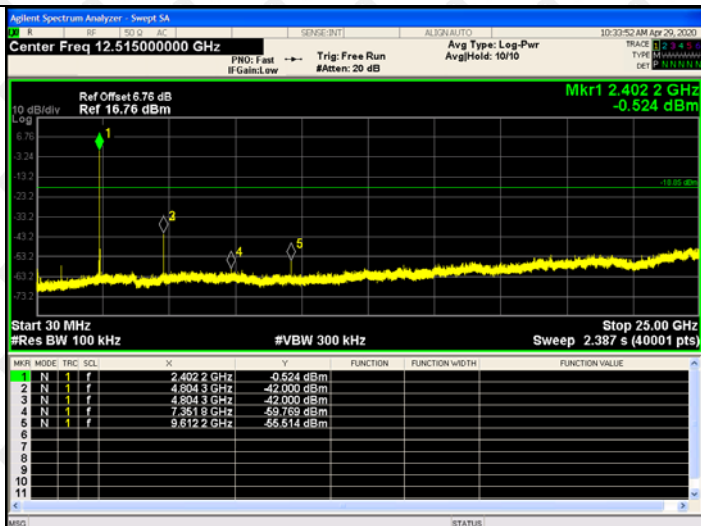
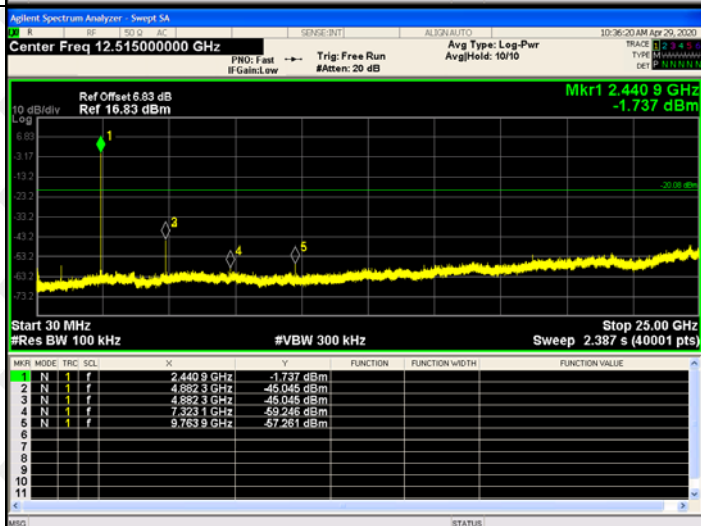
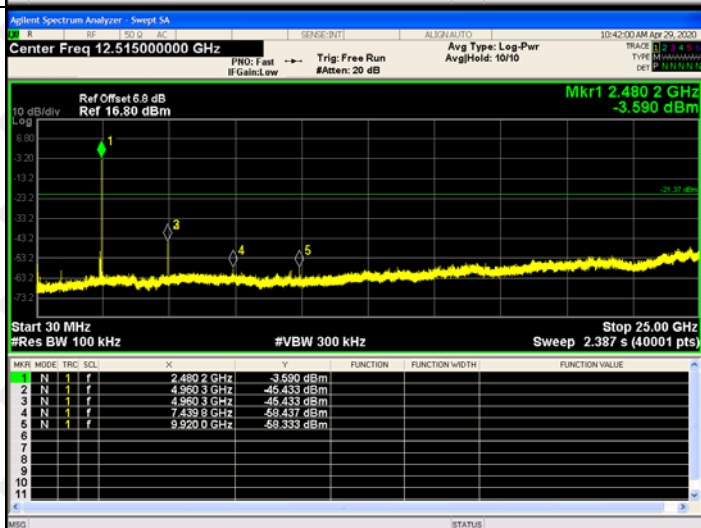


8DPSK/LCH
p


8DPSK/MCH

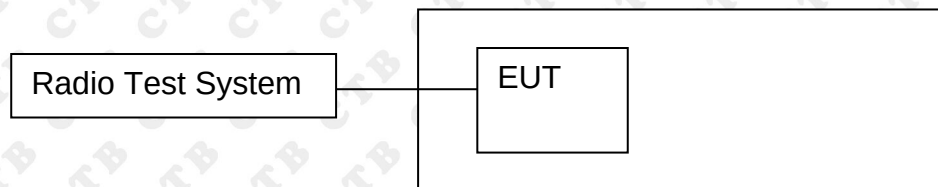


8DPSK/HCH



9. COUDUCTED PEAK OUTPUT POWER

9.1 Block Diagram Of Test Setup



9.2 Limit

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.

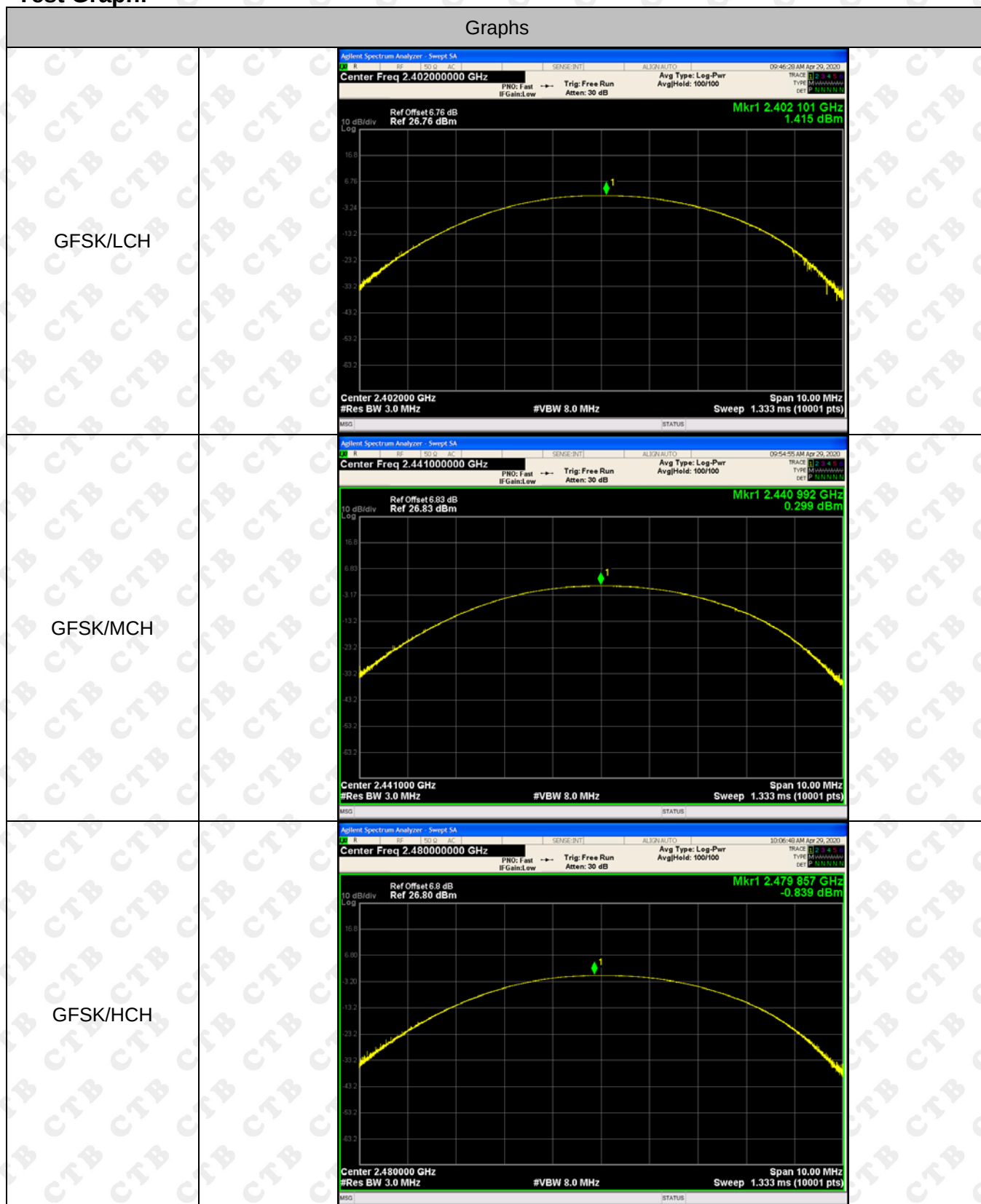
9.3 Test procedure

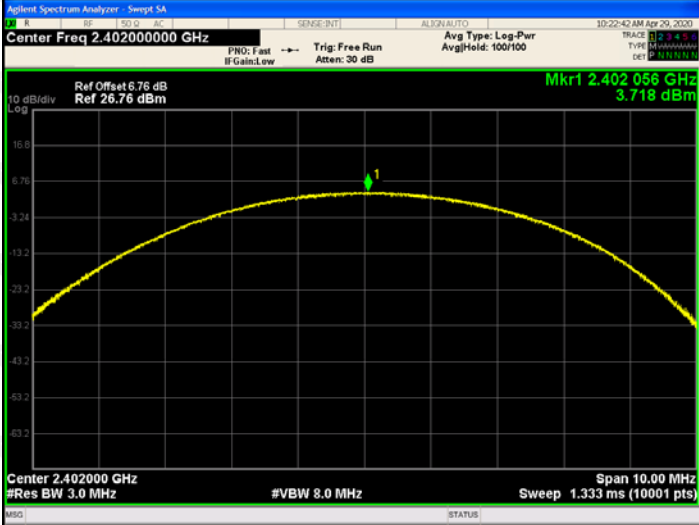
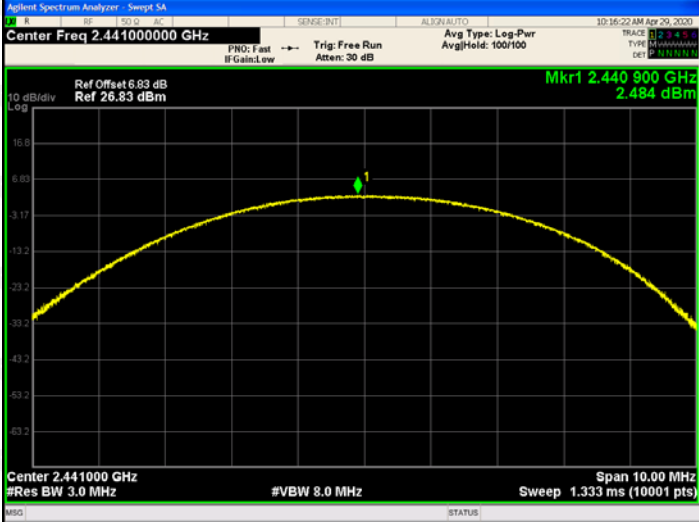
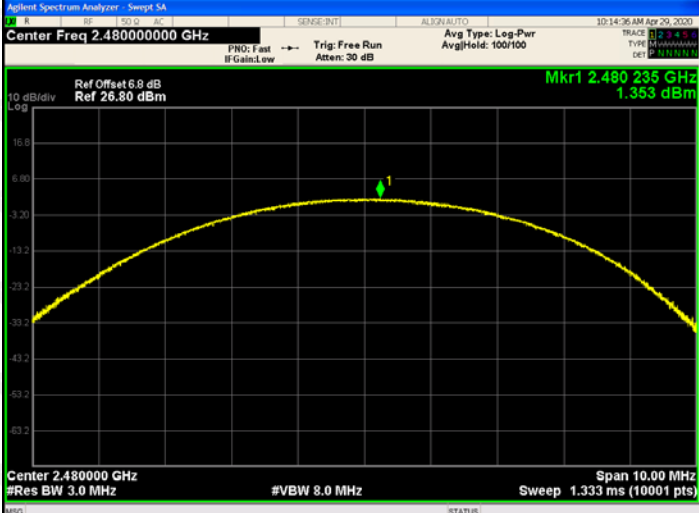
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

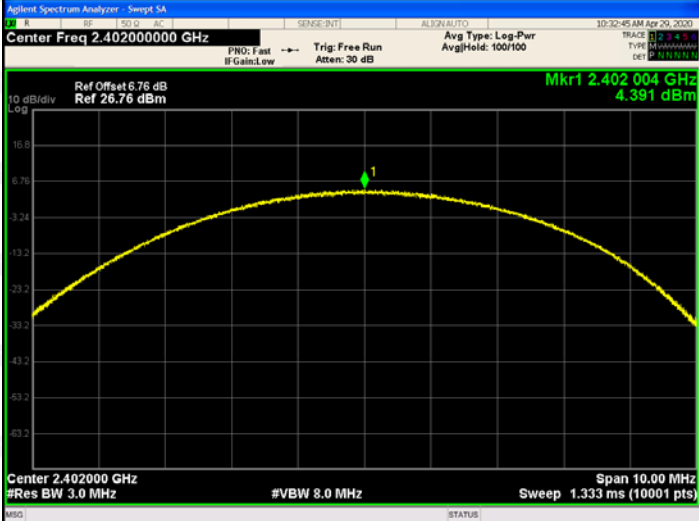
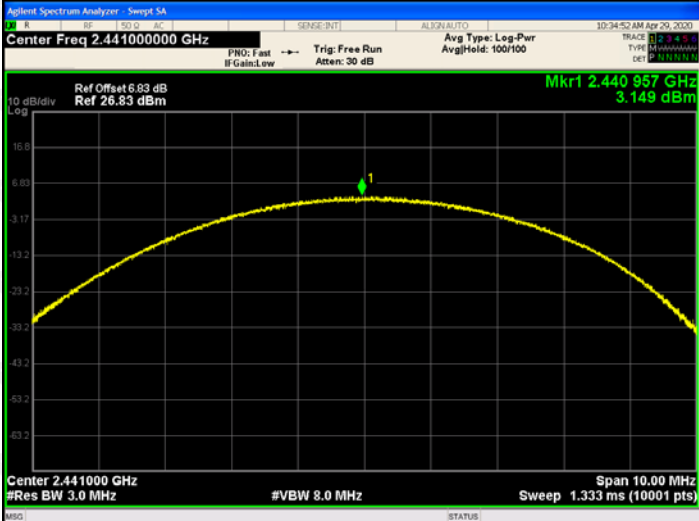
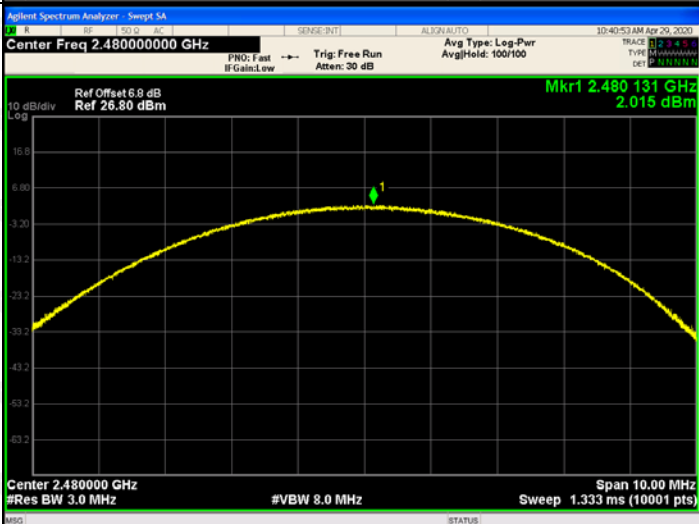
9.4 Test Result

Mode	Channel.	Maximum Peak Output Power [dBm]	Verdict
BDR mode (GFSK)	LCH	1.415	PASS
	MCH	0.299	PASS
	HCH	-0.839	PASS
EDR mode ($\pi/4$ DQPSK)	LCH	3.718	PASS
	MCH	2.484	PASS
	HCH	1.353	PASS
EDR mode (8DPSK)	LCH	4.391	PASS
	MCH	3.149	PASS
	HCH	2.015	PASS

Test Graph:

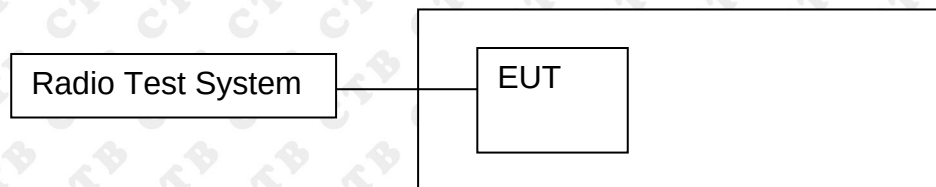


$\pi/4$ DQPSK/LCH	 Agilent Spectrum Analyzer - Sweep SA Center Freq 2.40200000 GHz Ref Offset 6.76 dB Ref 26.76 dBm Mkr1 2.402 056 GHz 3.718 dBm Center 2.402000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)
$\pi/4$ DQPSK/MCH	 Agilent Spectrum Analyzer - Sweep SA Center Freq 2.44100000 GHz Ref Offset 6.83 dB Ref 26.83 dBm Mkr1 2.440 900 GHz 2.484 dBm Center 2.441000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)
$\pi/4$ DQPSK/HCH	 Agilent Spectrum Analyzer - Sweep SA Center Freq 2.48000000 GHz Ref Offset 6.80 dB Ref 26.80 dBm Mkr1 2.480 235 GHz 1.353 dBm Center 2.480000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)

8DPSK/LCH	 Agilent Spectrum Analyzer - Sweep SA Center Freq 2.40200000 GHz Ref Offset 6.76 dB Ref 26.76 dBm Mkr1 2.402 004 GHz 4.391 dBm Center 2.402000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)
8DPSK/MCH	 Agilent Spectrum Analyzer - Sweep SA Center Freq 2.441000000 GHz Ref Offset 6.83 dB Ref 26.83 dBm Mkr1 2.440 957 GHz 3.149 dBm Center 2.441000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)
8DPSK/HCH	 Agilent Spectrum Analyzer - Sweep SA Center Freq 2.480000000 GHz Ref Offset 6.8 dB Ref 26.80 dBm Mkr1 2.480 131 GHz 2.015 dBm Center 2.480000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)

10. 20DB OCCUPIED BANDWIDTH

10.1 Block Diagram Of Test Setup



10.2 Limit

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

10.3 Test procedure

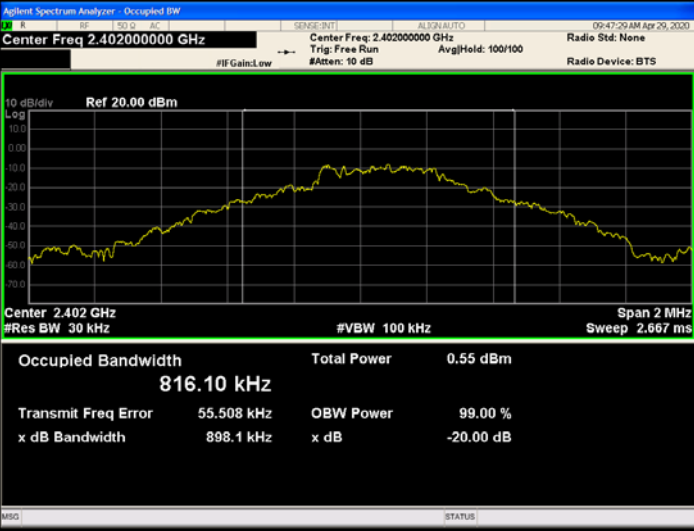
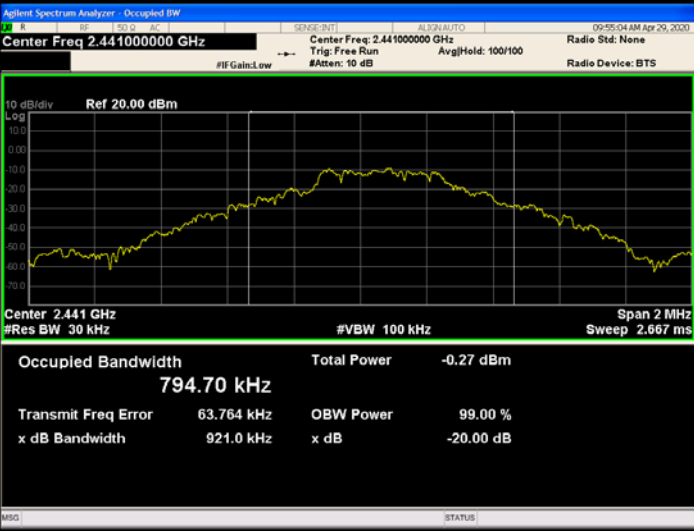
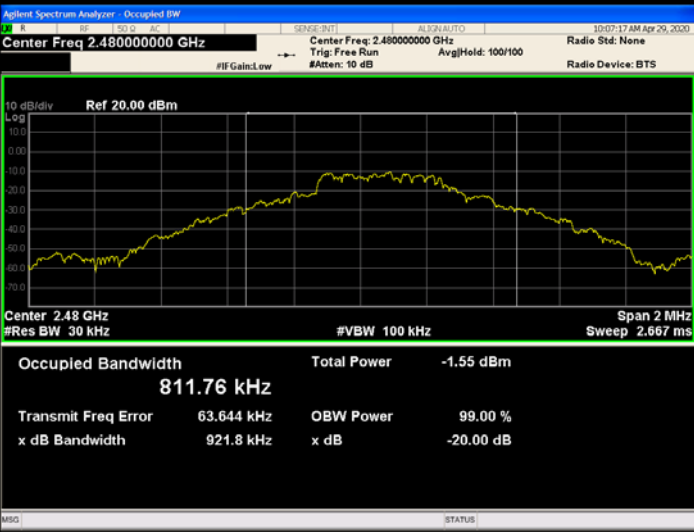
1. Rem1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

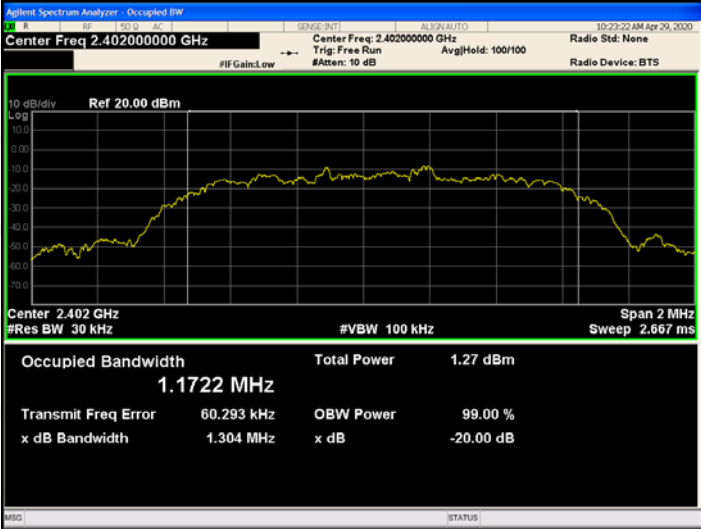
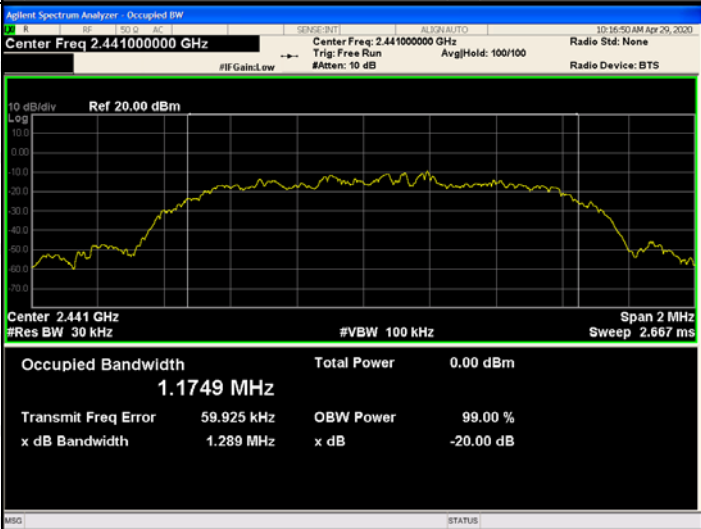
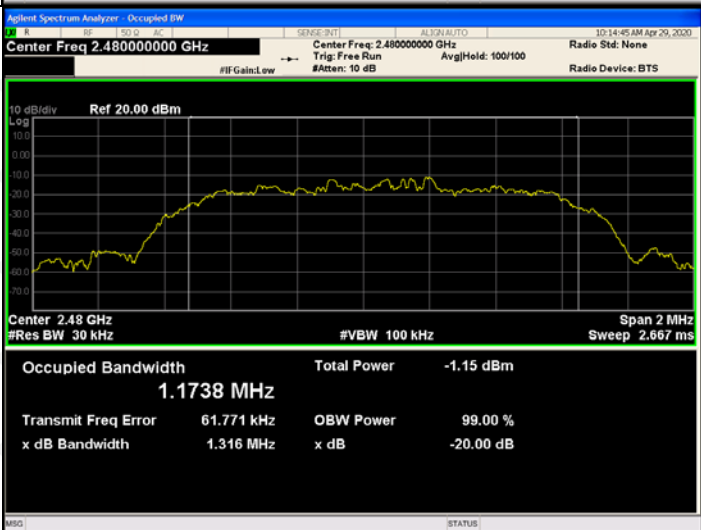
10.4 Test Result

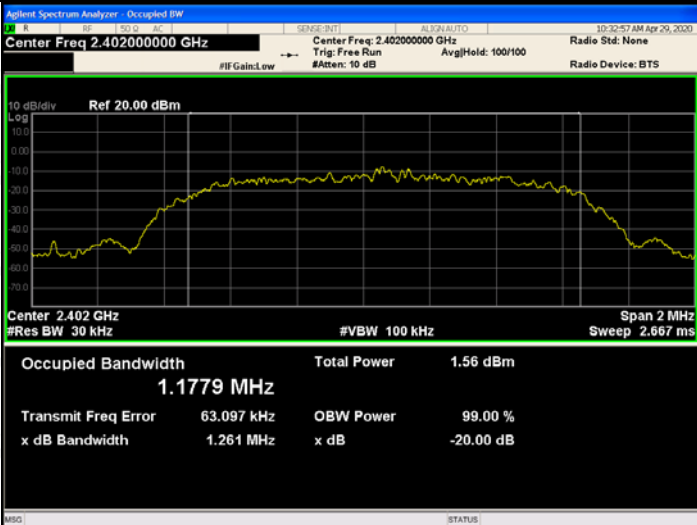
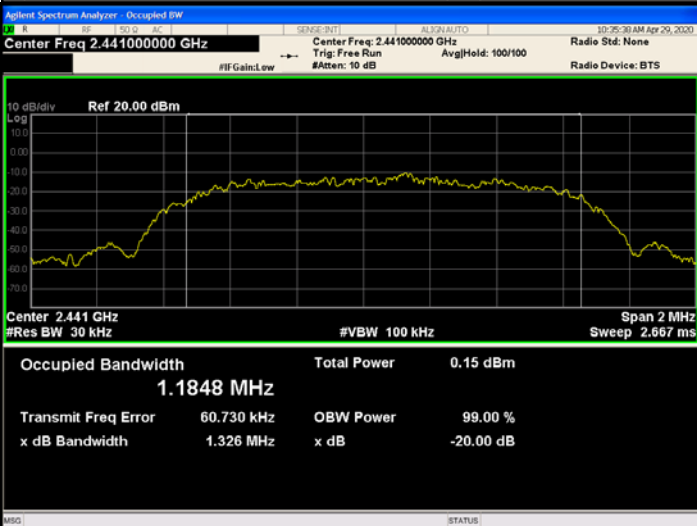
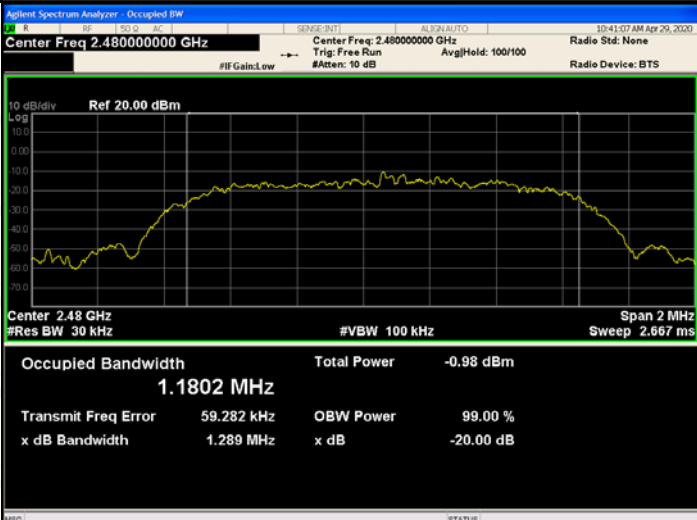
Test Mode	Frequency	20dB Bandwidth (MHz)	Result
GFSK	Low channel	0.8981	PASS
	Mid channel	0.921	PASS
	High channel	0.9218	PASS
$\pi/4$ DQPSK	Low channel	1.3038	PASS
	Mid channel	1.2894	PASS
	High channel	1.3161	PASS
8DPSK	Low channel	1.2609	PASS
	Mid channel	1.3256	PASS
	High channel	1.2894	PASS

Note: All modes of operation were Pre-scan and the worst-case emissions are reported.

Test Graph:

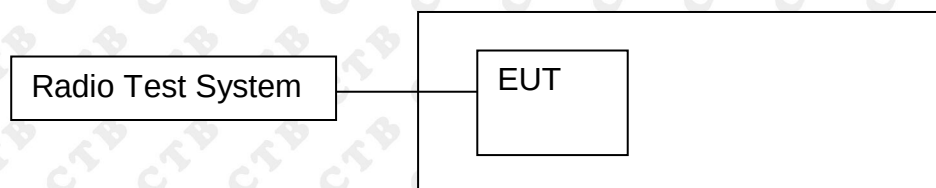
GFSK Low channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.40200000 GHz Center Freq: 2.40200000 GHz Trig: Free Run Avg/Hold: 100/100 Radio Std: None Radio Device: BTS #IF Gain: Low #Att: 10 dB Ref 20.00 dBm Center 2.402 GHz #Res BW 30 kHz #VBW 100 kHz Span 2 MHz Sweep 2.667 ms Occupied Bandwidth 816.10 kHz Total Power 0.55 dBm Transmit Freq Error 55.508 kHz OBW Power 99.00 % x dB Bandwidth 898.1 kHz x dB -20.00 dB
GFSK Mid channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.44100000 GHz Center Freq: 2.44100000 GHz Trig: Free Run Avg/Hold: 100/100 Radio Std: None Radio Device: BTS #IF Gain: Low #Att: 10 dB Ref 20.00 dBm Center 2.441 GHz #Res BW 30 kHz #VBW 100 kHz Span 2 MHz Sweep 2.667 ms Occupied Bandwidth 794.70 kHz Total Power -0.27 dBm Transmit Freq Error 63.764 kHz OBW Power 99.00 % x dB Bandwidth 921.0 kHz x dB -20.00 dB
GFSK High channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.48000000 GHz Center Freq: 2.48000000 GHz Trig: Free Run Avg/Hold: 100/100 Radio Std: None Radio Device: BTS #IF Gain: Low #Att: 10 dB Ref 20.00 dBm Center 2.48 GHz #Res BW 30 kHz #VBW 100 kHz Span 2 MHz Sweep 2.667 ms Occupied Bandwidth 811.76 kHz Total Power -1.55 dBm Transmit Freq Error 63.644 kHz OBW Power 99.00 % x dB Bandwidth 921.8 kHz x dB -20.00 dB

$\pi/4$-DQPSK Low channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.402000000 GHz Center Freq: 2.402000000 GHz Trig: Free Run Avg/Hold: 100/100 Radio Std: None Radio Device: BTS 10 dB/div Ref 20.00 dBm Center 2.402 GHz #Res BW 30 kHz #VBW 100 kHz Span 2 MHz Sweep 2.667 ms Occupied Bandwidth 1.1722 MHz Total Power 1.27 dBm Transmit Freq Error 60.293 kHz OBW Power 99.00 % x dB Bandwidth 1.304 MHz x dB -20.00 dB
$\pi/4$-DQPSK Mid channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.441000000 GHz Center Freq: 2.441000000 GHz Trig: Free Run Avg/Hold: 100/100 Radio Std: None Radio Device: BTS 10 dB/div Ref 20.00 dBm Center 2.441 GHz #Res BW 30 kHz #VBW 100 kHz Span 2 MHz Sweep 2.667 ms Occupied Bandwidth 1.1749 MHz Total Power 0.00 dBm Transmit Freq Error 59.925 kHz OBW Power 99.00 % x dB Bandwidth 1.289 MHz x dB -20.00 dB
$\pi/4$-DQPSK High channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.480000000 GHz Center Freq: 2.480000000 GHz Trig: Free Run Avg/Hold: 100/100 Radio Std: None Radio Device: BTS 10 dB/div Ref 20.00 dBm Center 2.48 GHz #Res BW 30 kHz #VBW 100 kHz Span 2 MHz Sweep 2.667 ms Occupied Bandwidth 1.1738 MHz Total Power -1.15 dBm Transmit Freq Error 61.771 kHz OBW Power 99.00 % x dB Bandwidth 1.316 MHz x dB -20.00 dB

8DPSK Low channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.402000000 GHz Span: 2 MHz Sweep: 2.667 ms Occupied Bandwidth: 1.1779 MHz Total Power: 1.56 dBm Transmit Freq Error: 63.097 kHz OBW Power: 99.00 % x dB Bandwidth: 1.261 MHz x dB: -20.00 dB
8DPSK Mid channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.441000000 GHz Span: 2 MHz Sweep: 2.667 ms Occupied Bandwidth: 1.1848 MHz Total Power: 0.15 dBm Transmit Freq Error: 60.730 kHz OBW Power: 99.00 % x dB Bandwidth: 1.326 MHz x dB: -20.00 dB
8DPSK High channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.480000000 GHz Span: 2 MHz Sweep: 2.667 ms Occupied Bandwidth: 1.1802 MHz Total Power: -0.98 dBm Transmit Freq Error: 59.282 kHz OBW Power: 99.00 % x dB Bandwidth: 1.289 MHz x dB: -20.00 dB

11. CARRIER FREQUENCIES SEPARATION

11.1 Block Diagram Of Test Setup



11.2 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.

11.3 Test procedure

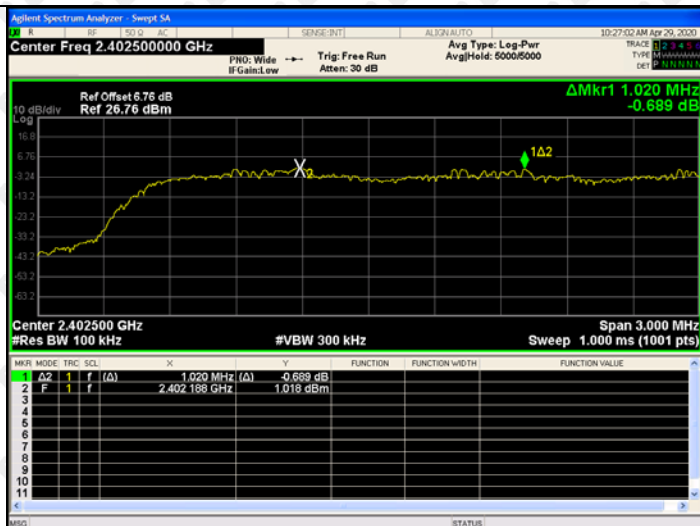
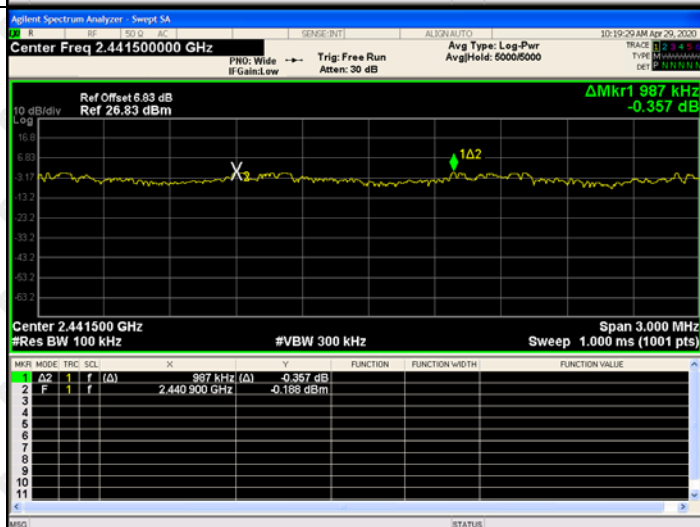
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to 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.

11.4 Test Result

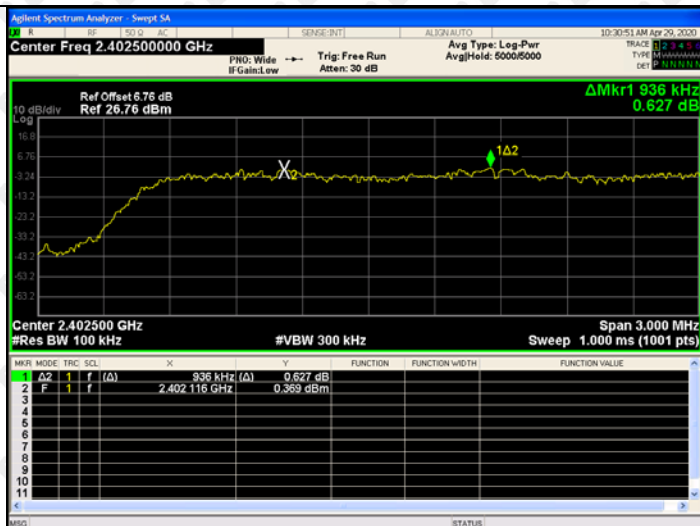
Mode	Channel.	Carrier Frequency Separation [MHz]	Verdict
GFSK	LCH	0.993	PASS
GFSK	MCH	0.999	PASS
GFSK	HCH	0.999	PASS
$\pi/4$ DQPSK	LCH	1.02	PASS
$\pi/4$ DQPSK	MCH	0.987	PASS
$\pi/4$ DQPSK	HCH	1.068	PASS
8DPSK	LCH	0.936	PASS
8DPSK	MCH	1.137	PASS
8DPSK	HCH	1.323	PASS

Test Graph

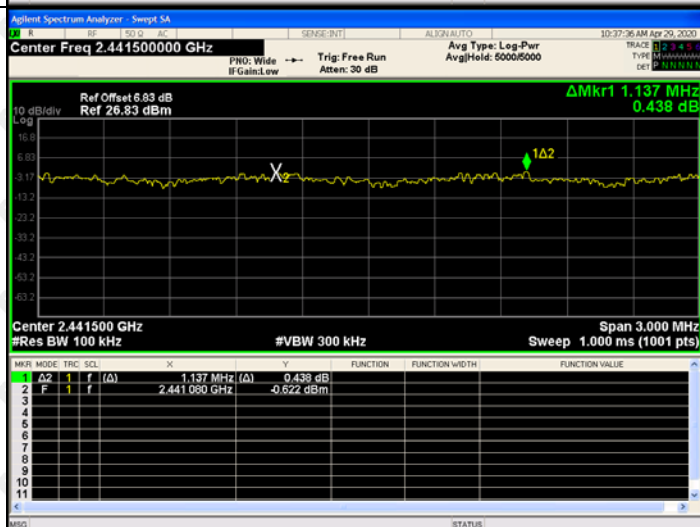


$\pi/4$ DQPSK/LCH

 $\pi/4$ DQPSK/MCH

 $\pi/4$ DQPSK/HCH

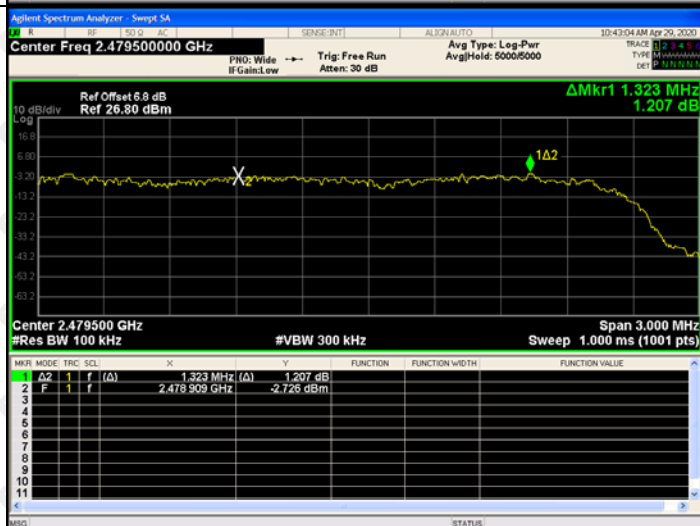

8DPSK/LCH



8DPSK/MCH

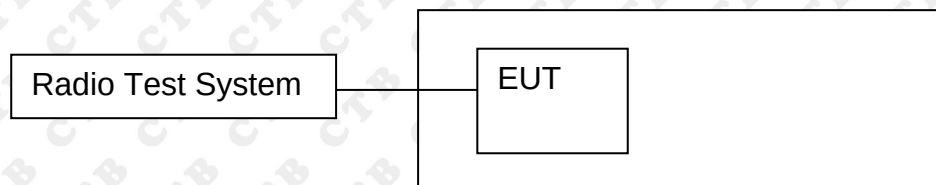


8DPSK/HCH



12. HOPPING CHANNEL NUMBER

12.1 Block Diagram Of Test Setup



12.2 Limit

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

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 = 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;

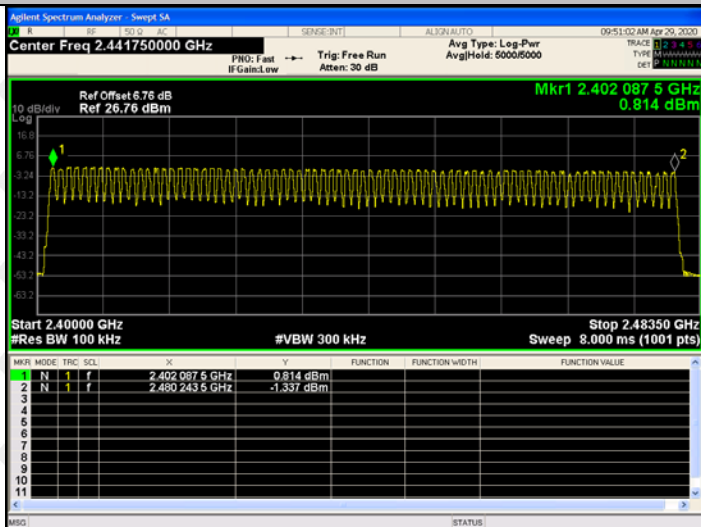
12.4 Test Result

Mode	Channel.	Number of Hopping Channel	Verdict
GFSK	Hop	79	PASS
$\pi/4$ DQPSK	Hop	79	PASS
8DPSK	Hop	79	PASS

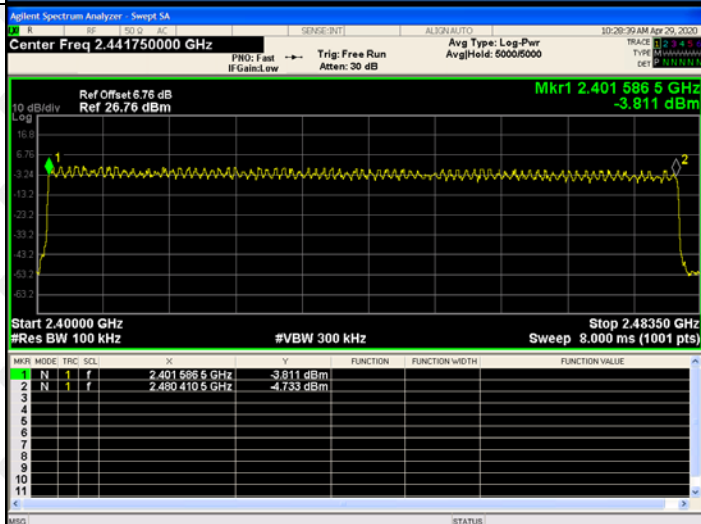
Test Graph

Graphs

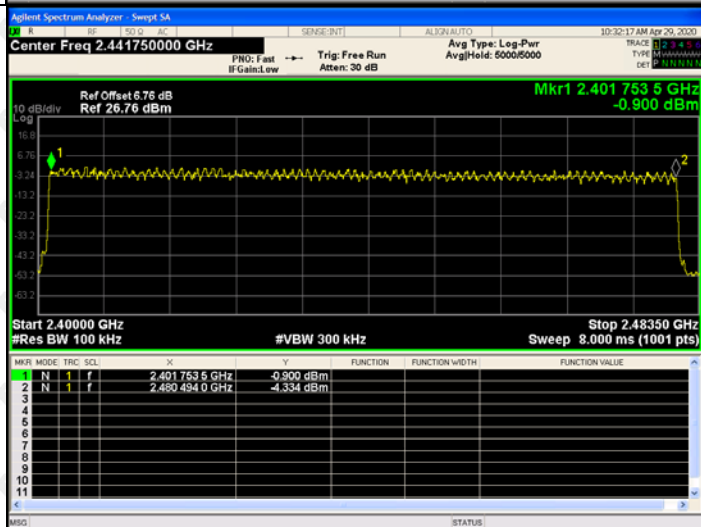
GFSK/Hop



$\pi/4$ DQPSK/Hop

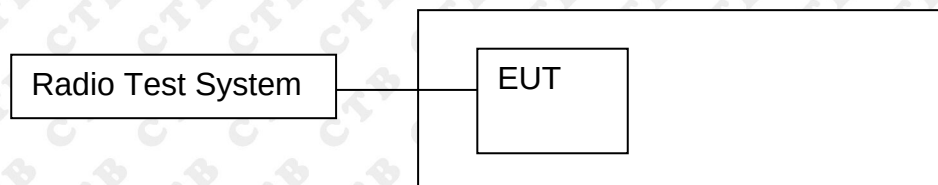


8DPSK/Hop



13. DWELL TIME

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. 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.

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 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).

13.4 Test Result

Mode	Packet	Channel	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Verdict
GFSK	DH1	LCH	0.385	123.20	400	PASS
	DH1	MCH	0.385	123.20	400	PASS
	DH1	HCH	0.385	123.20	400	PASS
	DH3	LCH	1.646	263.36	400	PASS
	DH3	MCH	1.646	263.36	400	PASS
	DH3	HCH	1.646	263.36	400	PASS
	DH5	LCH	2.897	309.01	400	PASS
	DH5	MCH	2.896	308.91	400	PASS
	DH5	HCH	2.897	309.01	400	PASS

Remark: 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: $1600/79/4*0.4*79*(MkrDelta)/1000$

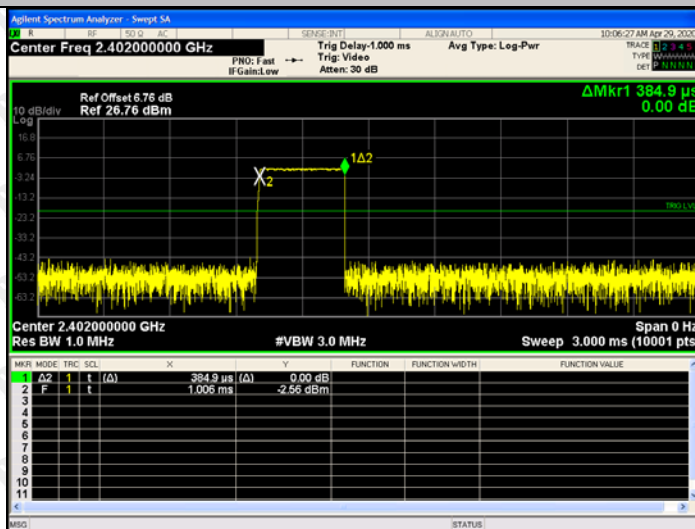
DH1: $1600/79/2*0.4*79*(MkrDelta)/1000$

Remark: Mkr Delta is once pulse time.

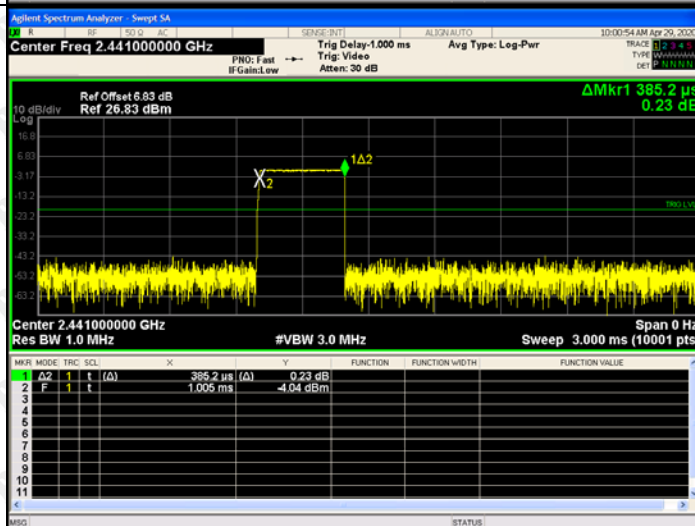
Test Graph

Graphs

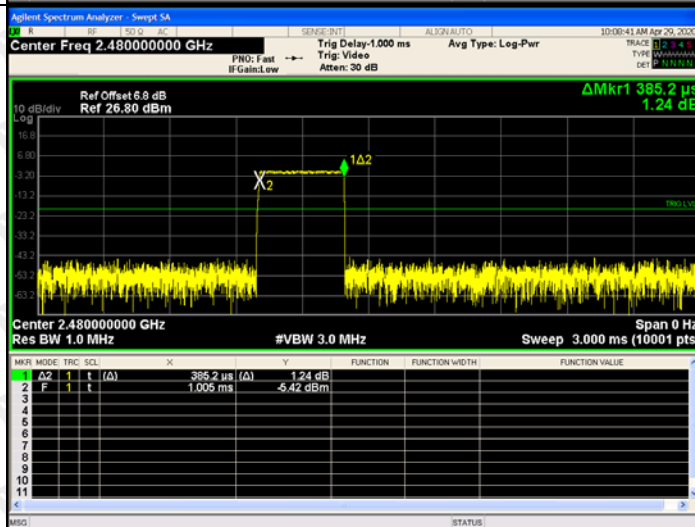
GFSK_DH1/LCH



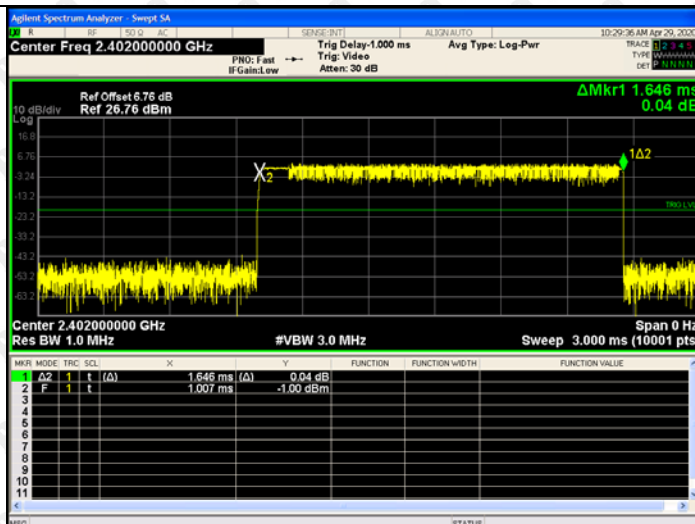
GFSK_DH1/MCH



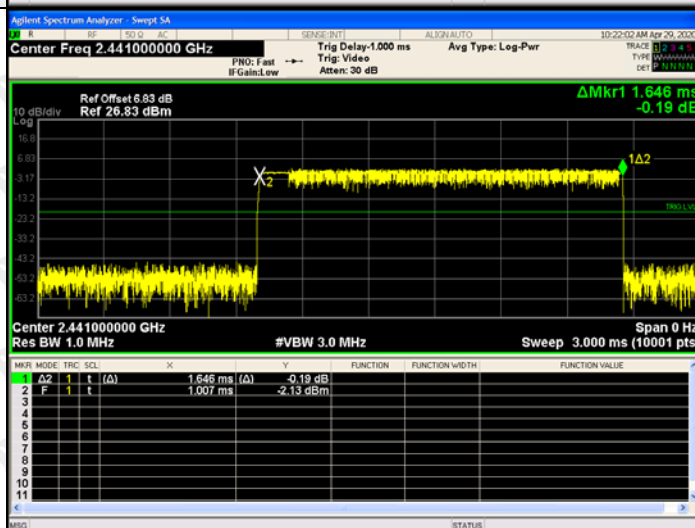
GFSK_DH1/HCH



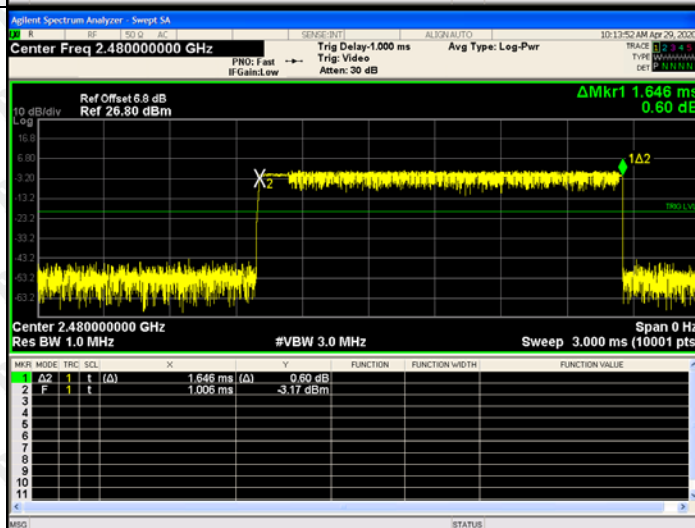
GFSK_DH3/LCH



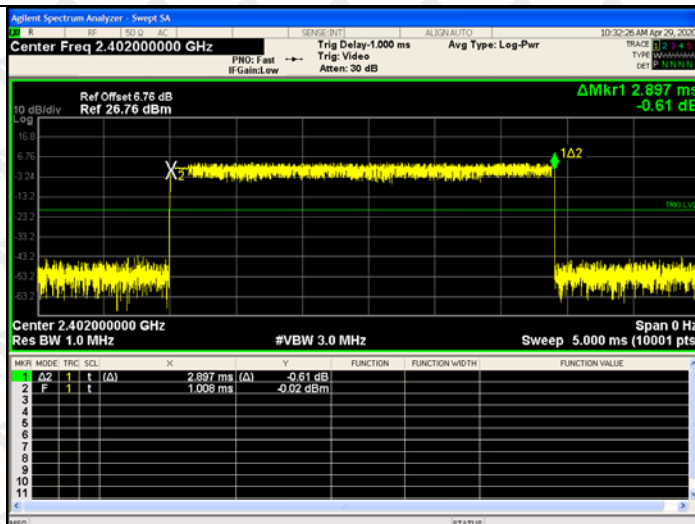
GFSK_DH3/MCH



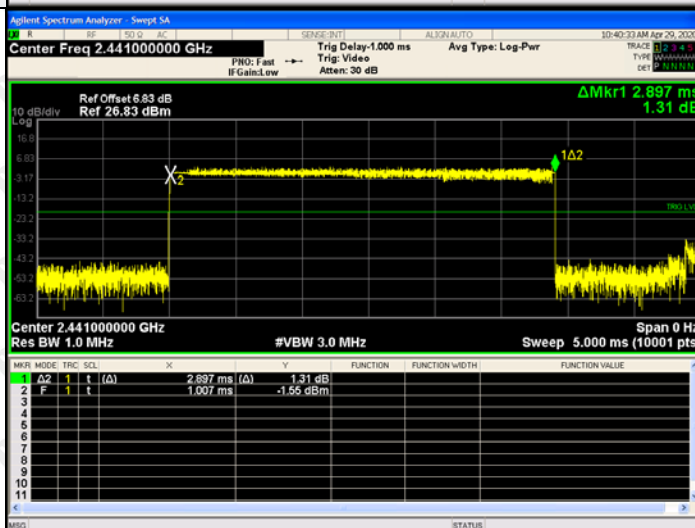
GFSK_DH3/HCH



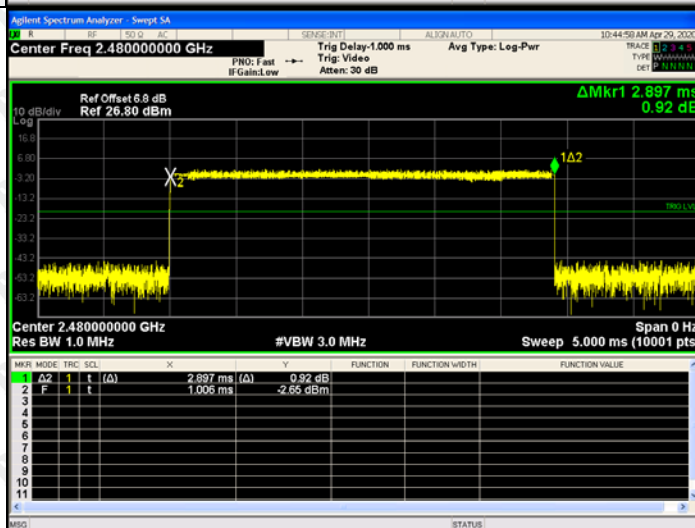
GFSK_DH5/LCH



GFSK_DH5/MCH



GFSK_DH5/HCH



14. PSEUDORANDOM FREQUENCY

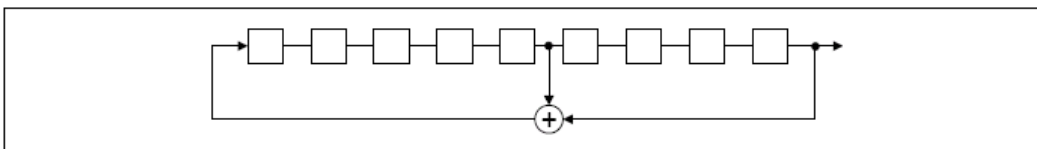
14.1 Limit

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

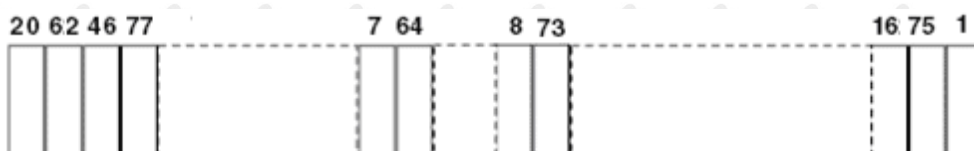
14.2 Test procedure

The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence: $2^9 - 1 = 511$ bits
- Longest sequence of zeros: 8 (non-inverted signal)



An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

The system receivers have input bandwidths that match the hopping channel bandwidths of their Corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

14.3 Test Result

The device does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

15. ANTENNA REQUIREMENT

15.203 requirement:

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

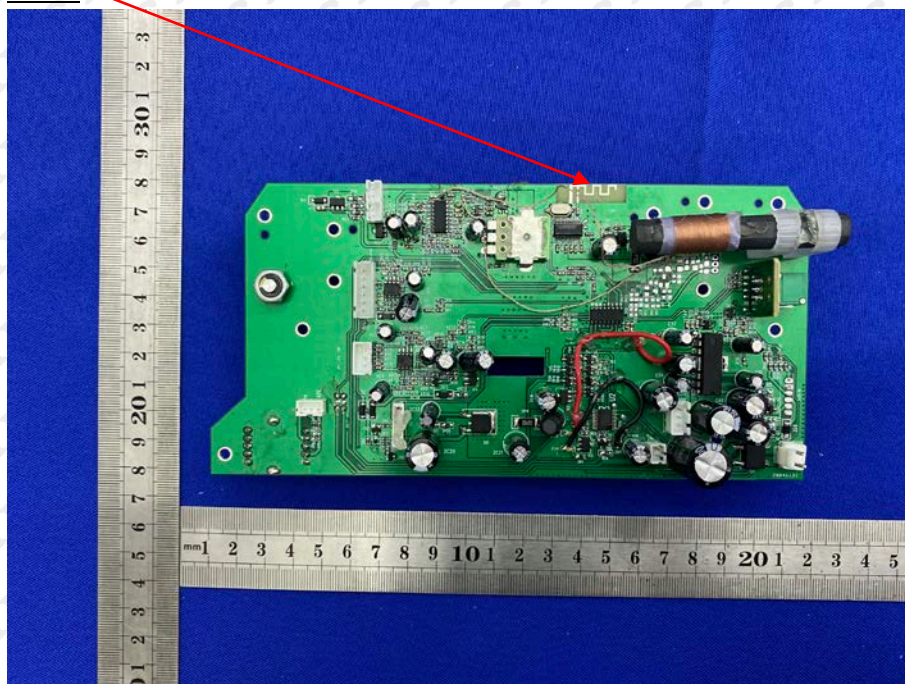
15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is PCB antenna. The best case gain of the antenna is 0.8dBi.

ANT:



16. EUT PHOTOGRAPHS

EUT Photo 1



EUT Photo 2



EUT Photo 3



EUT Photo 4



EUT Photo 5



EUT Photo 6



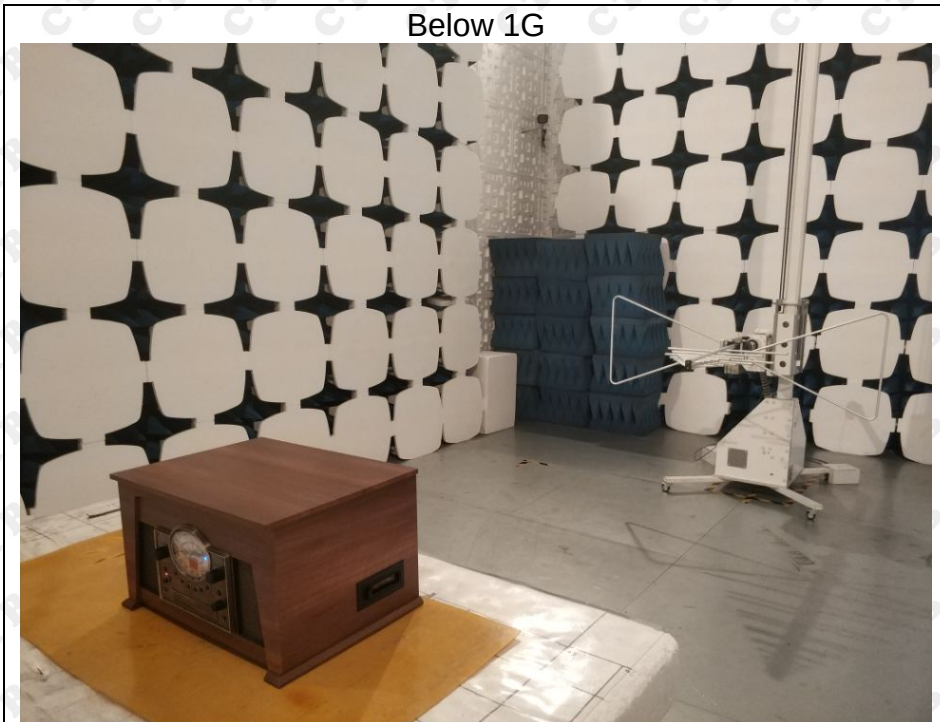
EUT Photo 7



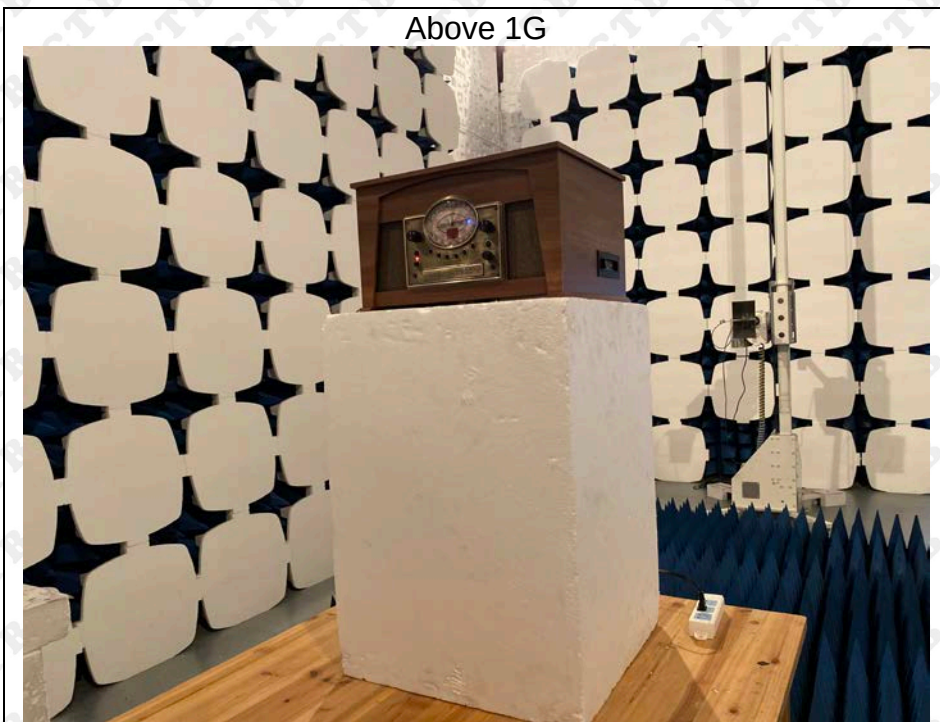
17. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

Below 1G



Above 1G



Conducted Emission



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