

Certification Test Report

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IC: 1792A-0163700

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-247

ACS Report Number: 15-2072.W06.1B

Manufacturer: Garmin International
Model(s): GMN-00831, GMN-00871

Test Begin Date: **August 10, 2015**
Test End Date: **September 1, 2015**

Report Issue Date: October 15, 2015



FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

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This report contains 69 pages

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1 GENERAL**1.1 Purpose**

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-247.

1.2 Product Description

The Garmin International's models GMN-00831 and GMN-00871 are avionic audio devices and marker beacon systems designed to obtain, process and distribute audio to aircraft and crew. These devices implement a Bluetooth transceiver to connect compatible devices to the aircraft.

The model variants are identical except for the following differences:

The GMN-00831 provides an external antenna and no front panel interface.

The GMN-00871 includes a front panel interface and uses an internal surface mount antenna. The GMN-00871 is also available with and without the marker beacon LEDs.

Technical Details

Mode of Operation:	Bluetooth 2.1+EDR
Frequency Range:	2402 MHz - 2480 MHz
Number of Channels:	79
Channel Separation:	1 MHz
Modulations:	GFSK, $\pi/4$ -DQPSK, 8DPSK
TX Data Rates:	GFSK: 1Mbps $\pi/4$ -DQPSK: 2Mbps 8DPSK: 3Mbps
Antenna Type/Gain:	0 dBi Rubber Duck Stub Antenna 2.5 dBi ceramic chip antenna

1.3 Manufacturer Information

Garmin International
1200 East 151st St.
Olathe, Kansas 66062

Model Number: GMN-00831, GMN-00871

Test Sample Serial Number(s): GMN-00831: 011-02299-40 (1T6200014), GMN-00871: 011-02385-50 (1YQ200000) (Radiated Emissions), GMN-00831: 011-02299-40 (1T6200014) (RF Conducted)

Test Sample Condition: The samples were in good conditions with no observable physical damages.

1.4 Test Methodology and Considerations

The EUT was evaluated while powered using an external DC bench top power supply and was connected to a load box. The unit was programmed using a host PC via a serial cable interface. The evaluation consisted of radiated and RF conducted emissions evaluation. The EUT is intended to be installed inside of aircrafts. The EUT does not connect to the AC mains and is therefore exempted from the powerline conducted emissions requirements.

The radiated emission evaluation was performed on both GMN-00831 and GMN-00871 models. The unit under test was set in the orientation typical to installation.

The RF conducted measurements were carried on the model GMN-00831 since it provides the external antenna connector. The RF conducted data is deemed representative of both models based on similarity.

The evaluation was performed for all available modulations. Where applicable, data is provided for the worst case. The EUT radio test configuration used for the testing is provided below.

Table 1.4-1: Bluetooth Radio Test configuration

Mode of Operations	Frequency (MHz)	Data Rate (kbps)
GFSK	2402	1000
	2441	1000
	2480	1000
$\pi/4$ DQPSK	2402	2000
	2441	2000
	2480	2000
8 DPSK	2402	3000
	2441	3000
	2480	3000

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

FCC Test Firm Registration #: 475089
Industry Canada Lab Code: 4175C

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1533 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl floor.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flushed with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1050 Multi-device Controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

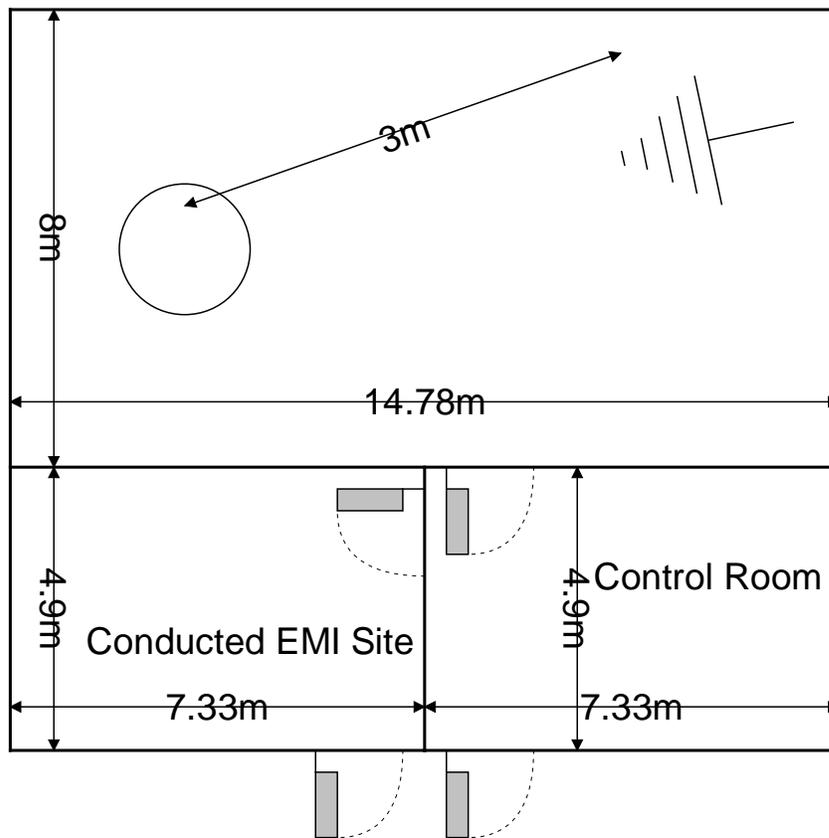


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m³. Data is taken using two LISNs; a Solar Model 8028-50 50 Ω/50 μH and an EMCO Model 3825, which are installed as shown in Photograph 3. For evaluations requiring 220 V, 50 Hz AC input, a Polarad LISN (S/N 879341/048) is used in conjunction with a 1 kVA, 50 Hz/220 V EDGAR variable frequency generator, Model 1001B, to filter conducted noise from the generator.

A diagram of the room is shown below in figure 2.3.2-1:

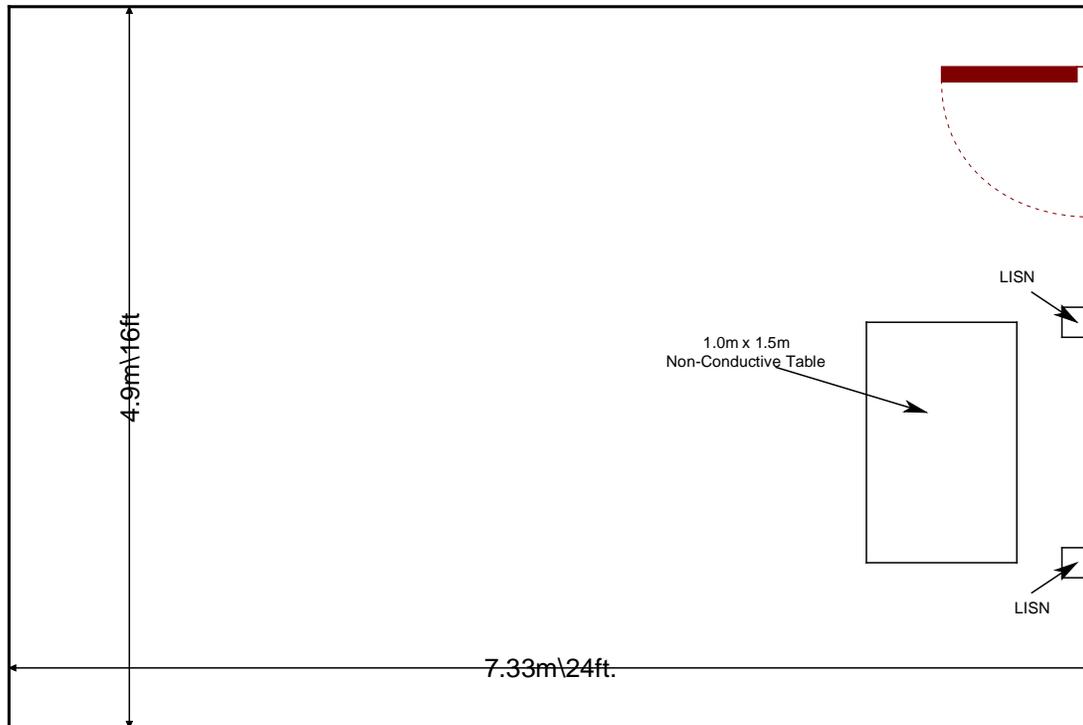


Figure 2.3.2-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.4-2014: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9kHz to 40GHz
- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2015
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2015
- ❖ Industry Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015.
- ❖ Industry Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, November 2014.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
78	EMCO	6502	Antennas	9104-2608	2/13/2015	2/13/2017
523	Agilent	E7405	Spectrum Analyzers	MY45103293	12/26/2014	12/26/2016
653	Suhner	SF-102A	Cables	0944/2A	4/13/2015	4/13/2016
2002	EMCO	3108	Antennas	2147	11/22/2013	11/22/2015
2004	EMCO	3146	Antennas	1385	11/22/2013	11/22/2015
2006	EMCO	3115	Antennas	2573	4/14/2015	4/14/2017
2008	COM-Power	AH-826	Antennas	81009	NCR	NCR
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	12/31/2014	12/31/2015
2037	ACS Boca	Chamber EMI Cable Set	Cable Set	2037	2/17/2015	2/17/2016
2070	Mini Circuits	VHF-8400+	Filter	2070	12/31/2014	12/31/2015
2072	Mini Circuits	VHF-3100+	Filter	30737	12/31/2014	12/31/2015
2082	Teledyne Storm Products	90-010-048	Cables	2082	4/22/2015	4/22/2016
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	12/31/2014	12/31/2015
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/12/2014	12/12/2015
2095	ETS Lindgren	TILE4! - Version 4.2.A	Software	85242	NCR	NCR
2111	Aeroflex Inmet	40AH2W-20	Attenuator	2111	7/22/2015	7/22/2016

NCR=No Calibration Required

5 SUPPORT EQUIPMENT

GMN-00831 Test Configuration

Table 5-1: EUT and Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Garmin	GMN-00831	1T6200014
2	Bench Power Supply	BK Precision	1692	S940035931
3	Load Box	Garmin	N/A	N/A
4	Laptop	DELL	Latitude D531	CN-0XM006-48643-789-2125
5	Laptop AC Adapter	Dell	LA65NS2-01	CN-06TM1C-72438-358-218F-A01
6	P402/P404 Junction Box	Garmin	N/A	N/A
7	P401/P403 Junction Box	Garmin	N/A	N/A
8	2.4 GHz Stubby BT Antenna	N/A	N/A	N/A

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	P3502 Wire Harness	4 m	No	EUT to P402 Junction
B	P3501 Wire Harness	4 m	No	EUT to P401 Junction
C	RF Coaxial Cable	4.2 m	Yes	EUT to load box
D	RF Coaxial Cable	0.53 m	No	EUT to Antenna
E	Power Leads	3.8 m	No	Bench Power Supply to Wire Harness
F	P402/P404 Wires	0.1 m	No	P402/P404 Junction to Load box
G	P401/P403 Wires	0.1 m	No	P401/P403 Junction to Load box
H	Power Cord	2.3 m	No	Bench Power Supply to AC Mains
I	Serial cable	10 m	No	Load box to Remote Laptop
J	Power cable	1.8 m	No	Laptop to AC Adapter
K	Power cord	1 m	No	AC Adapter to Mains

GMN-00871 Test Configuration

Table 5-3: EUT and Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Garmin	GMN-00871	1YQ200000
2	Bench Power Supply	BK Precision	1692	S940035931
3	Load box	Garmin	N/A	N/A
4	Laptop	DELL	Latitude D531	CN-0XM006-48643-789-2125
5	Laptop AC Adapter	Dell	LA65NS2-01	CN-06TM1C- 72438-358-218F- A01
6	P402 Junction Box	Garmin	N/A	N/A
7	P401 Junction Box	Garmin	N/A	N/A

Table 5-4: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	P3502 Wire Harness	4 m	No	EUT to P402 Junction
B	P3501 Wire Harness	4 m	No	EUT to P401 Junction
C	RF Coaxial Cable	4.2 m	Yes	EUT to load box
D	Audio cable	4 m	No	EUT to P402 Junction
E	Power Leads	3.8 m	No	Bench Power Supply to Wire Harness
F	P402/P404 Wires	0.1 m	No	P402/P404 Junction to Load Box
G	P401/P403 Wires	0.1 m	No	P401/P403 Junction to Load box
H	Power Cord	2.3 m	No	Bench Power Supply to AC Mains
I	Serial cable	10 m	No	Load Box to Remote Laptop
J	Power cable	1.8 m	No	Laptop to AC Adapter
K	Power cord	1 m	No	AC Adapter to Mains

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

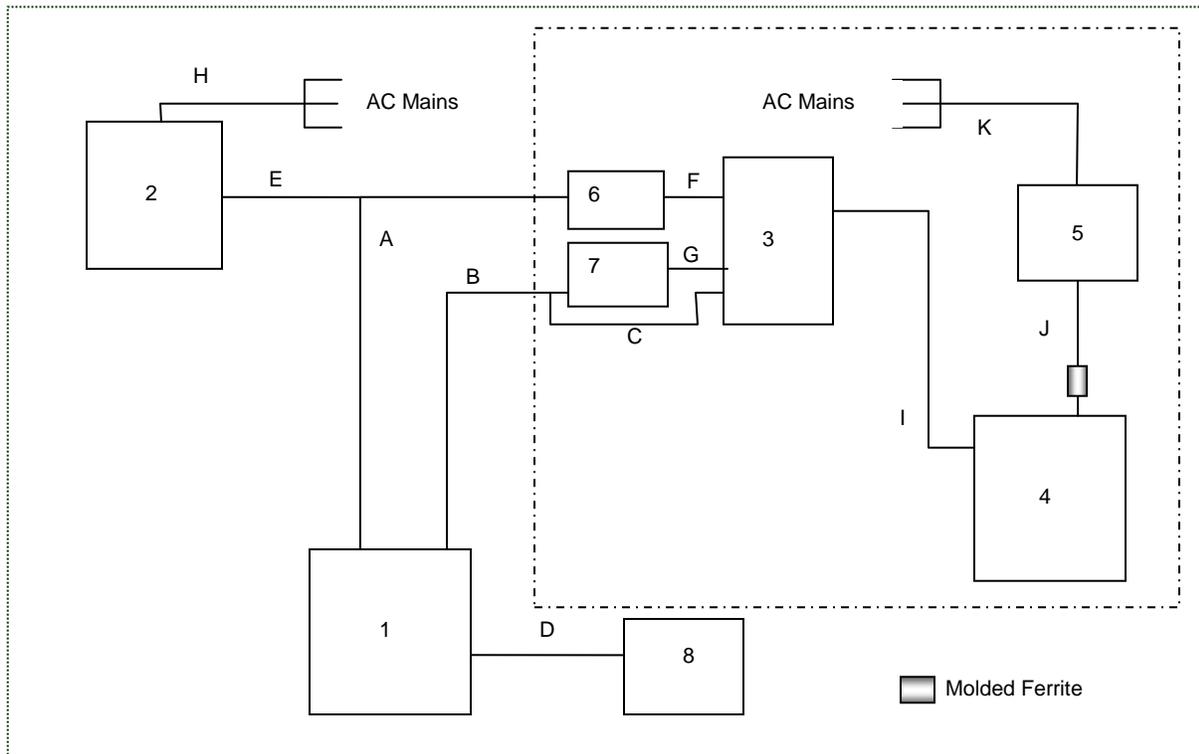


Figure 6-1: EUT Test Setup (GMN-00831 Test Configuration)

Note: the equipment within the dotted box was set outside of the test environment. Items 3, 6 and 7 were set beneath the ground plane while the laptop computer was set to the room adjacent to the test chamber.

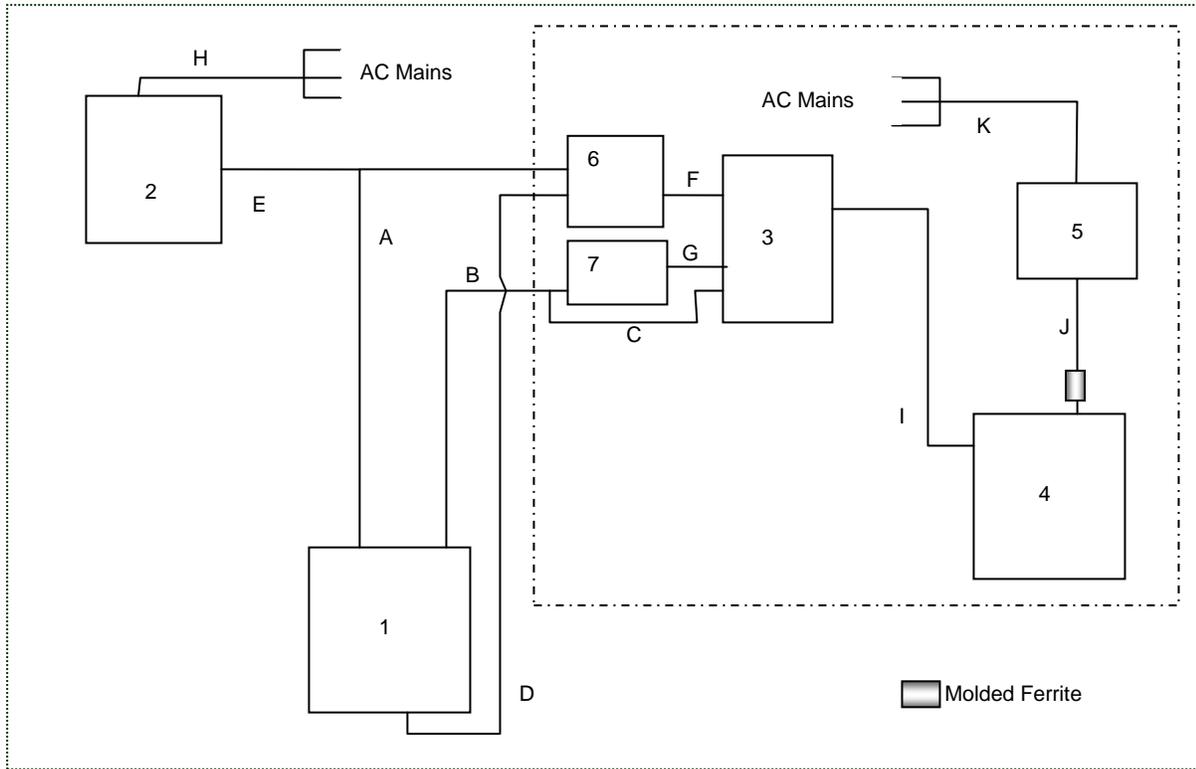


Figure 6-2: EUT Test Setup (GMN-00871 Test Configuration)

Note: the equipment within the dotted box was set outside of the test environment. Items 3, 6 and 7 were set beneath the ground plane while the laptop computer was set to the room adjacent to the test chamber.

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The model GMN-00871 is provided with an internal surface mount antenna. The antenna is not accessible to the end-user and cannot be replaced without damaging the equipment.

The model GMN-00831 provides an external SMA antenna connector to be connected to a stubby antenna via an SMA to R-SMA cable. The GMN-00831 is professionally installed and not accessible to the general public. Justification for professional installation is provided in the equipment manual.

The EUT meets the antenna requirements of FCC Section 15.203 based on the aforementioned justifications.

7.2 Peak Output Power - FCC Section 15.247(b)(1) IC: RSS-247 5.4(2)

7.2.1 Measurement Procedure (Conducted Method)

The RF output port of the EUT was directly connected to the input of the spectrum analyzer through suitable attenuation.

7.2.2 Measurement Results

Results are shown below:

Table 7.2.2-1: RF Output Power (GFSK)

Frequency (MHz)	Power (dBm)
2402	0.502
2441	0.075
2480	0.106

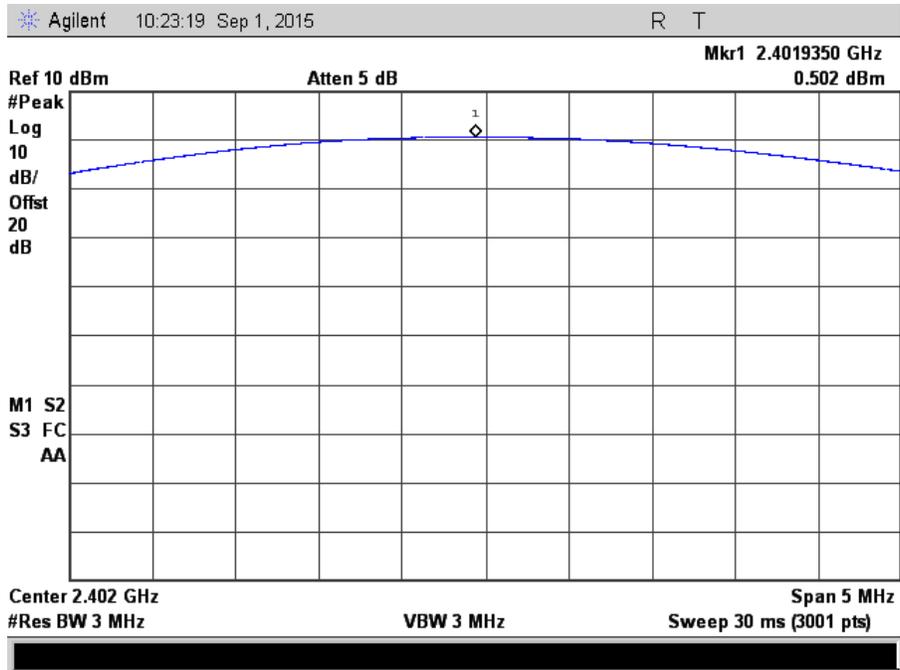


Figure 7.2.2-1: RF Output Power (GFSK) - Low Channel

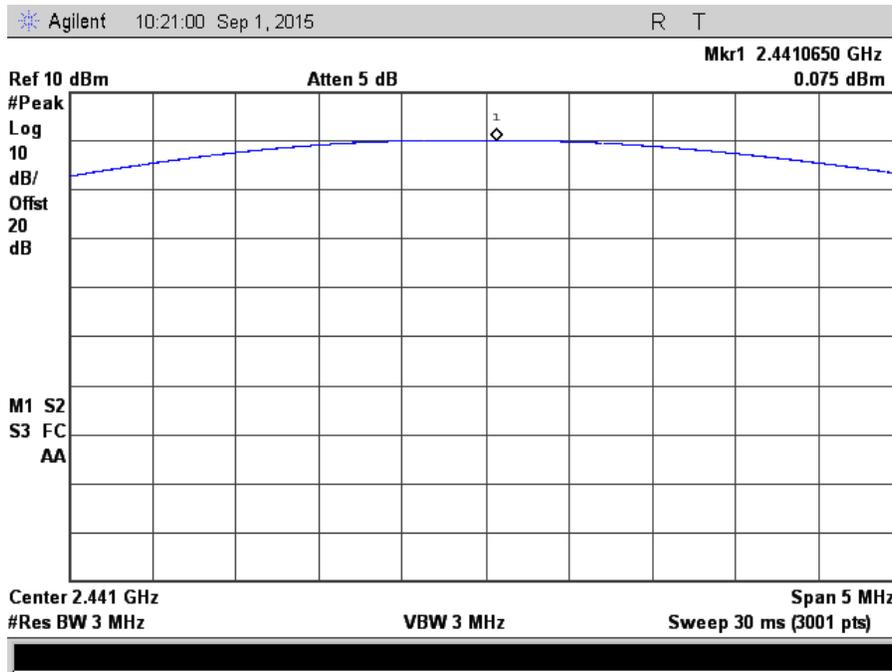


Figure 7.2.2-2: RF Output Power (GFSK) - Middle Channel

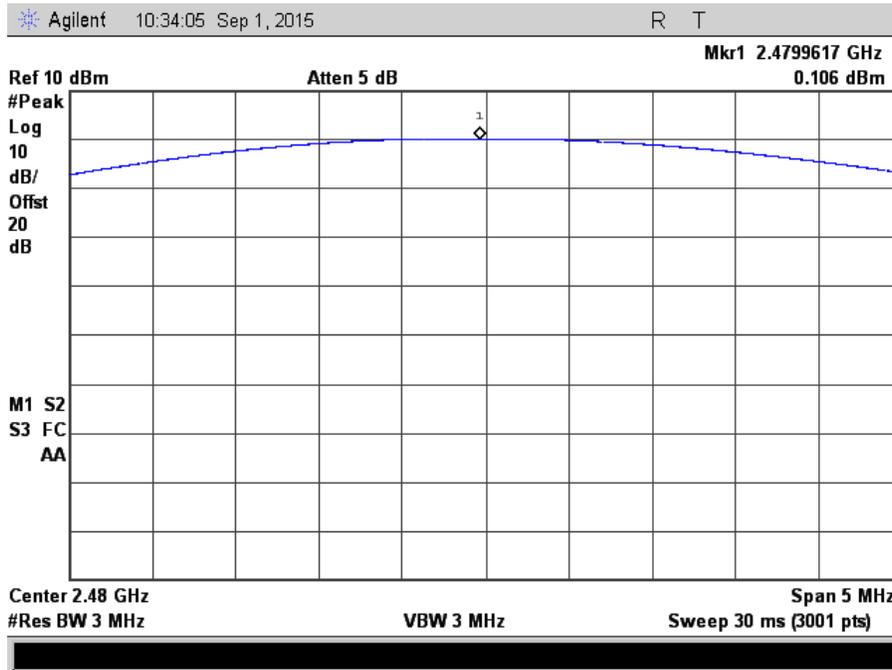


Figure 7.2.2-3: RF Output Power (GFSK) - High Channel

Table 7.2.2-2: RF Output Power ($\pi/4$ DQPSK)

Frequency (MHz)	Power (dBm)
2402	1.282
2441	0.891
2480	1.047

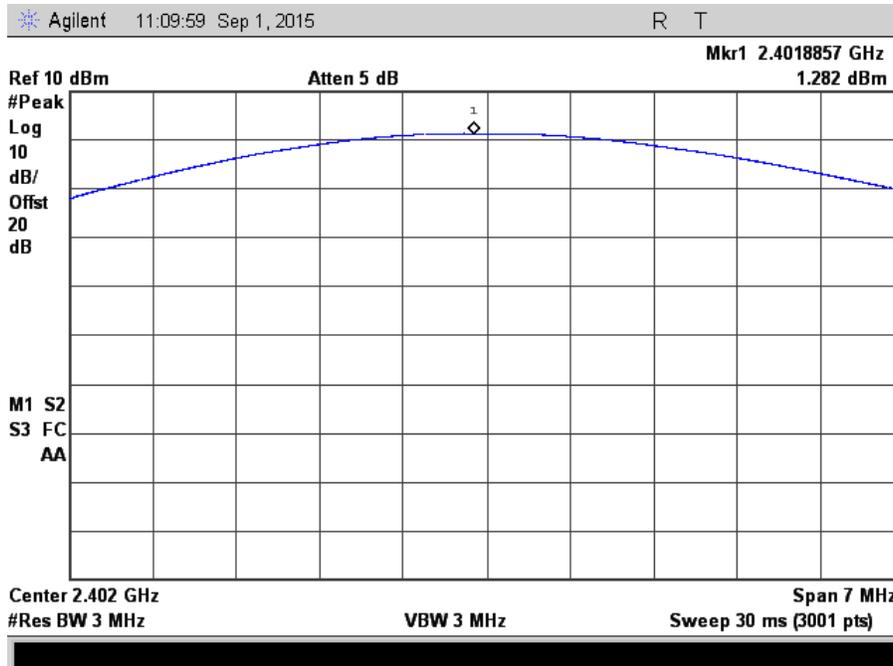


Figure 7.2.2-4: RF Output Power ($\pi/4$ DQPSK) - Low Channel

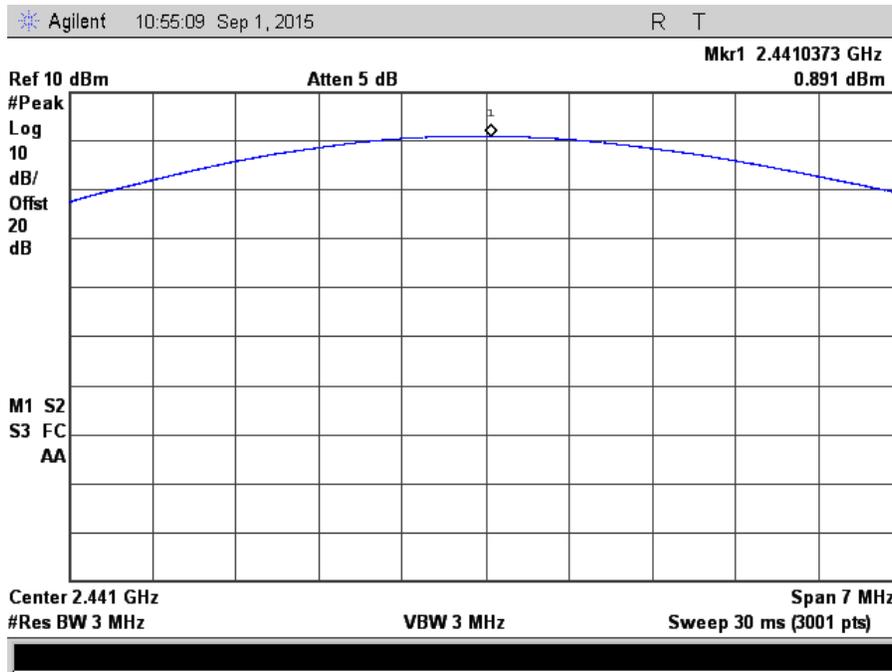


Figure 7.2.2-5: RF Output Power ($\pi/4$ DQPSK) - Middle Channel

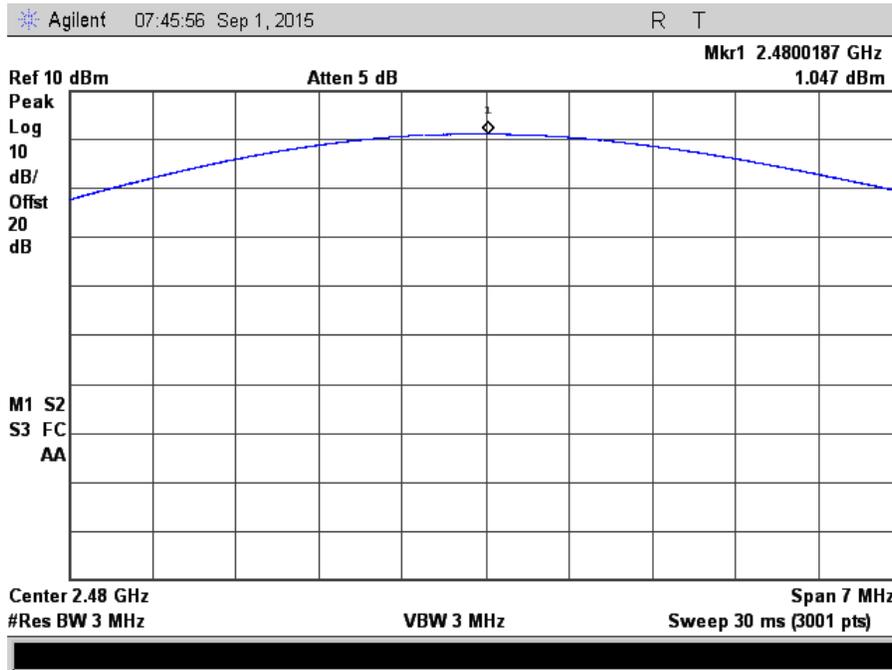


Figure 7.2.2-6: RF Output Power ($\pi/4$ DQPSK) - High Channel

Table 7.2.2-3 RF Output Power (8DPSK)

Frequency (MHz)	Power (dBm)
2402	1.832
2441	1.533
2480	1.556

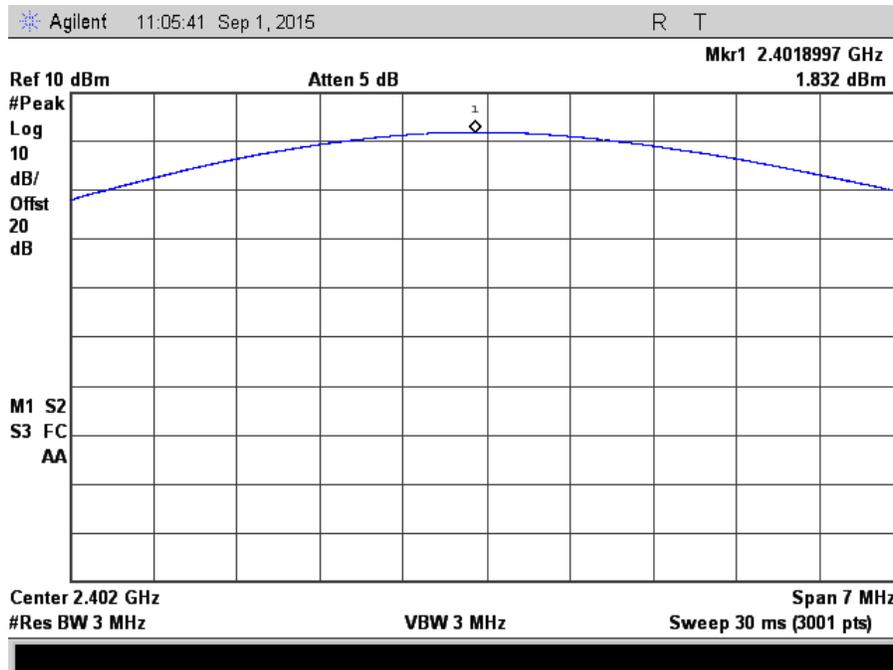


Figure 7.2.2-7: RF Output Power (8DPSK) - Low Channel

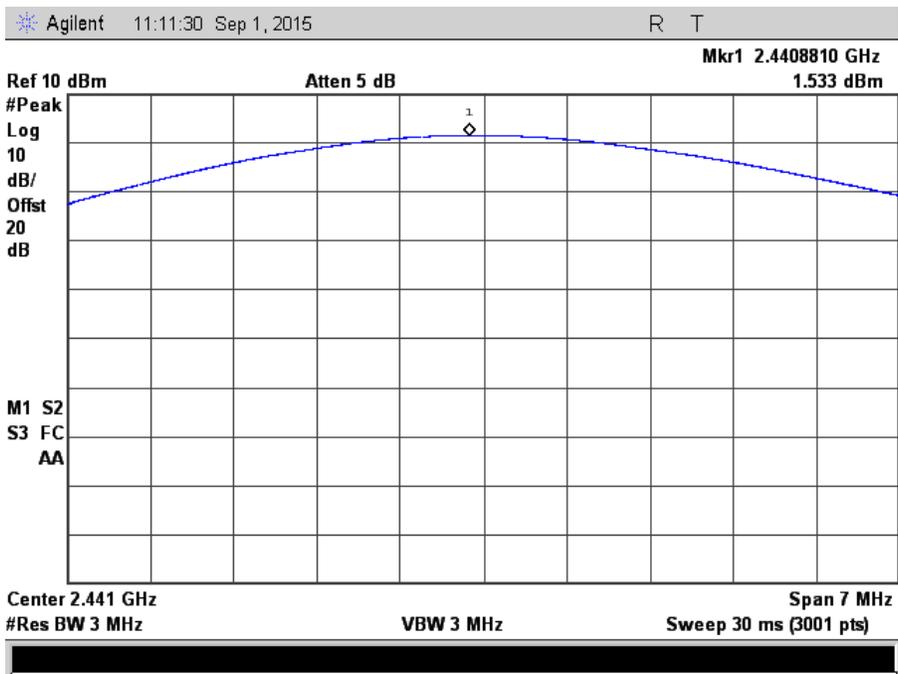


Figure 7.2.2-8: RF Output Power (8DPSK) - Middle Channel

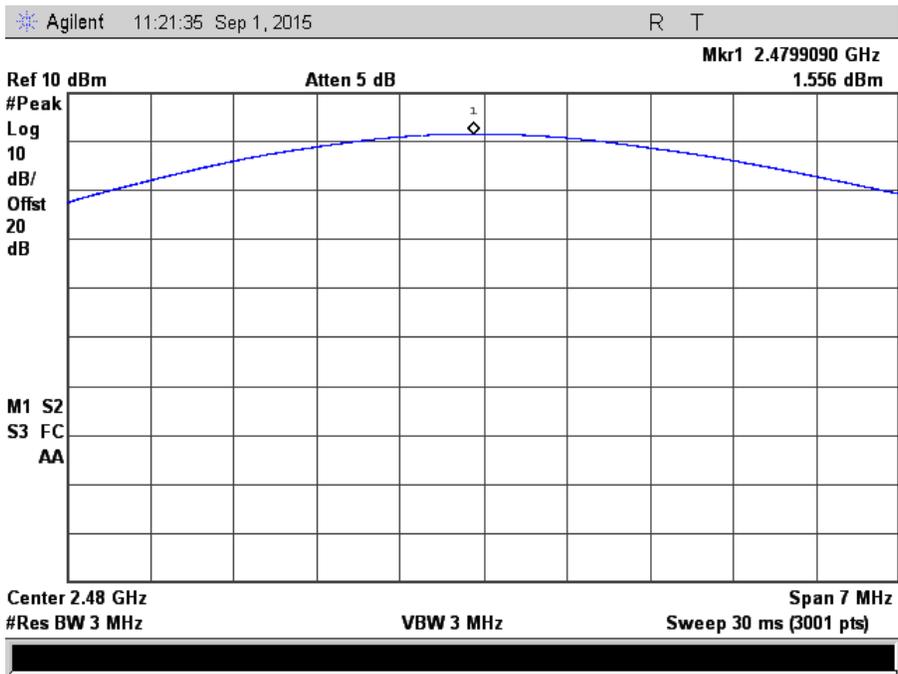


Figure 7.2.2-9: RF Output Power (8DPSK) - High Channel

7.3 Channel Usage Requirements

7.3.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1) IC: RSS-247 5.1(2)

7.3.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW and VBW were set to approximately 30% of the channel spacing.

7.3.1.2 Measurement Results

Results are shown below:

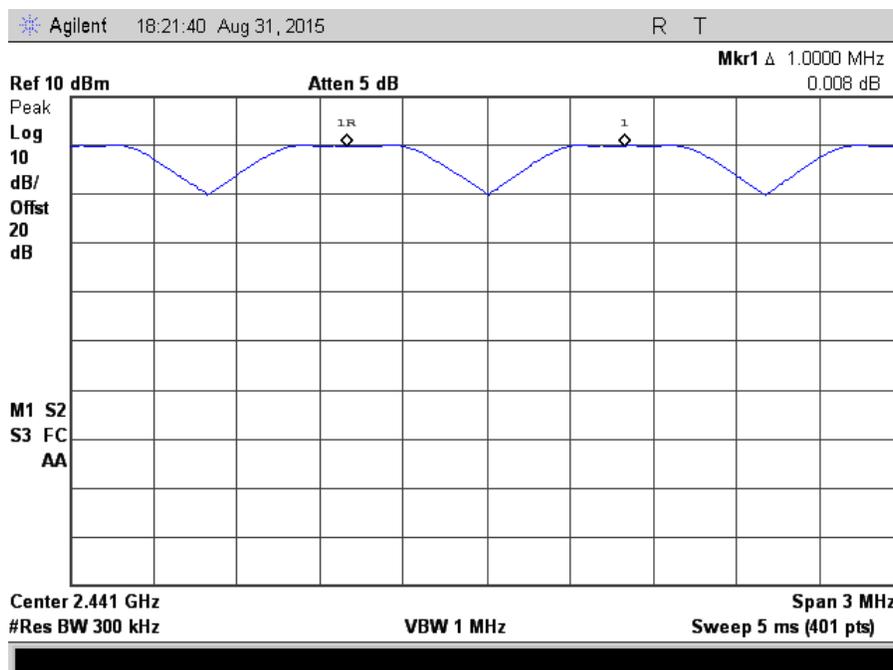


Figure 7.3.1.2-1: Carrier Frequency Separation

7.3.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(iii) IC: RSS-247 5.1(4)

7.3.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture the number of hopping channels. The peak detector max hold function was enabled for the measurements.

7.3.2.2 Measurement Results

Results are shown below:

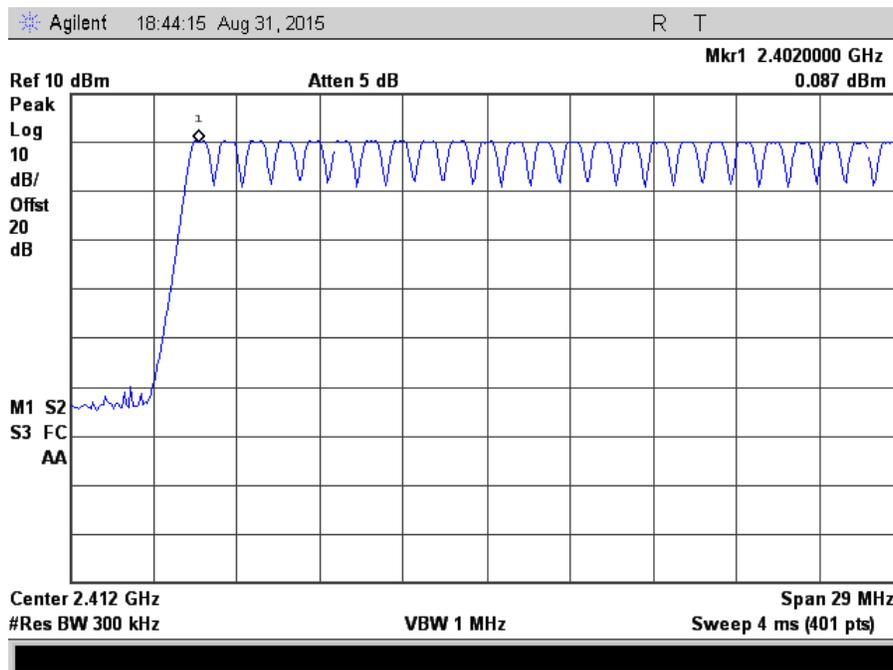


Figure 7.3.2.2-1: Number of Hopping Channels (1 – 25)

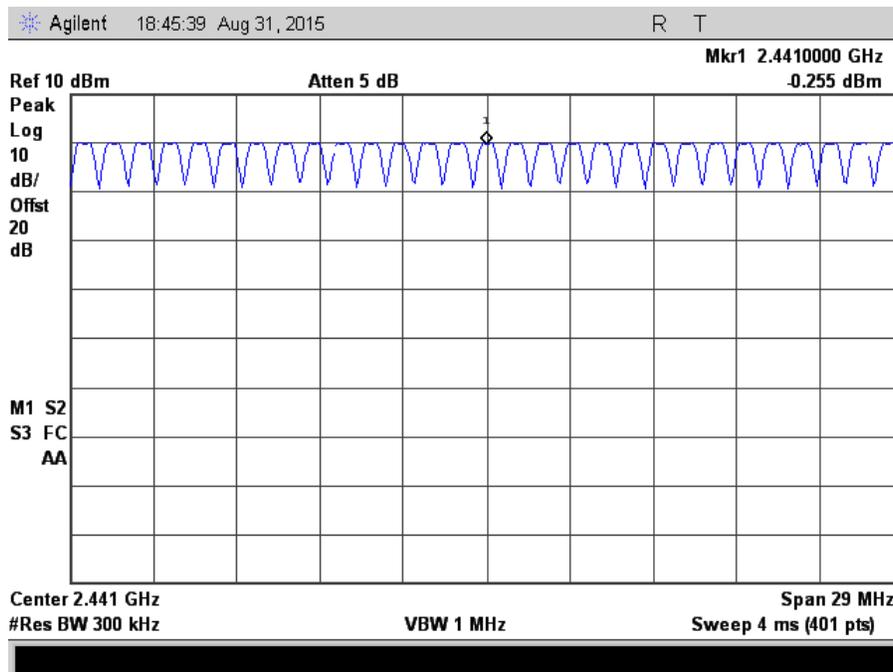


Figure 7.3.2.2-2: Number of Hopping Channels (26 – 54)

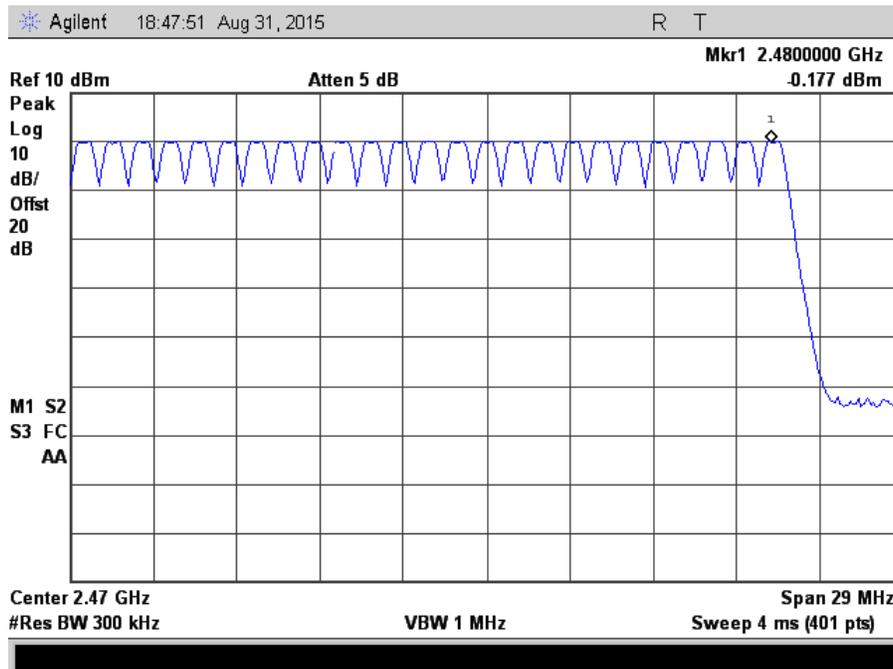


Figure 7.3.2.2-3: Number of Hopping Channels (55 – 79)

7.3.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(iii) IC: RSS-247 5.1(4)

7.3.3.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set 0 Hz centered on a hopping channel. The RBW was set to 1 MHz and the sweep time adjusted to capture the entire dwell time per channel with peak detector max hold function.

7.3.3.2 Measurement Results

Results are shown below:

Table 7.3.3.2-1 Dwell Time on a 31.6 Second Cycle

Packet Format	Number of Hops Per Sec. (NHPS)	Number of Hops per Channel Per Sec. (NHPCPS)	Number of hops on a 31.6 s Cycle (NHPC)	Measured Dwell Times (ms)	Dwell Times on a 31.6 s Cycle	Limit (ms)	Status
DH1	800	10.13	320	0.4018	128.58	400	PASS
DH3	400	5.06	160	1.673	267.68	400	PASS
DH5	266.67	3.38	106.67	2.917	311.16	400	PASS

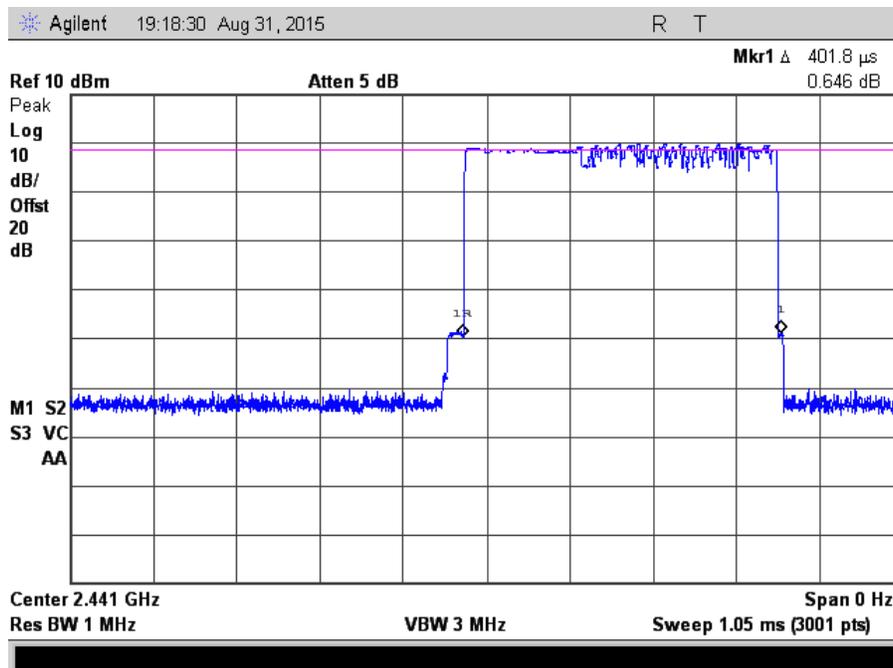


Figure 7.3.3.2-1: Channel Dwell Time – DH1

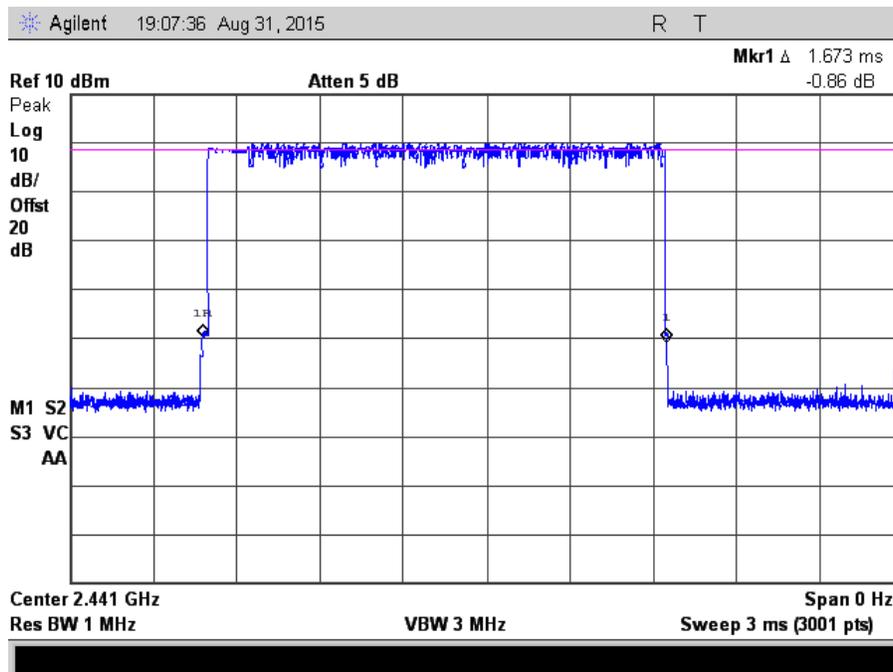


Figure 7.3.3.2-2: Channel Dwell Time – DH3

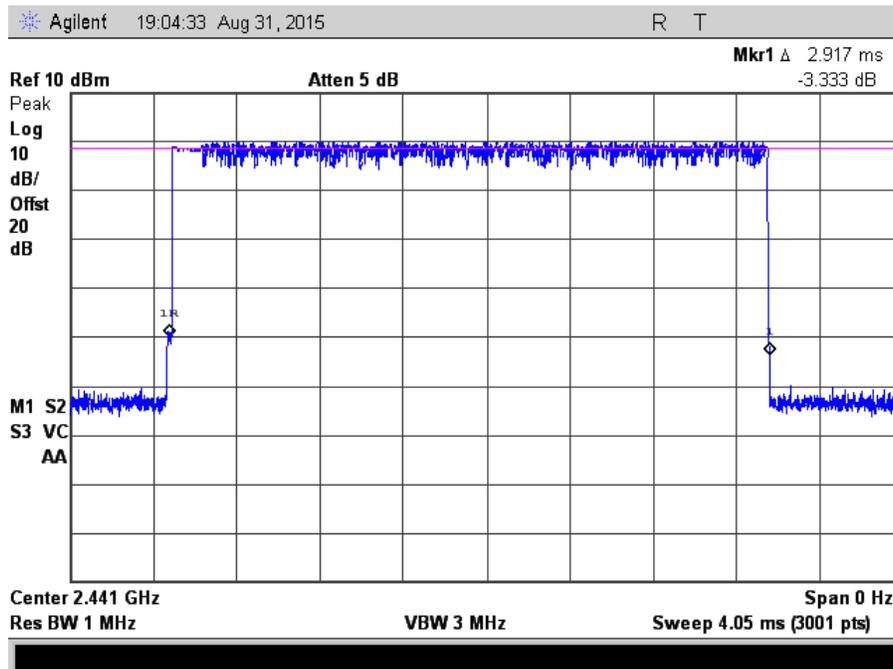


Figure 7.3.3.2-3: Channel Dwell Time – DH5

7.3.4 20dB / 99% Bandwidth - FCC: Section 15.247(a)(1)(i) IC: RSS-247 5.1(1)

7.3.4.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The spectrum analyzer span was set to 2 to 5 times the estimated bandwidth of the emission. The RBW was set to 1% to 5% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission. The RBW was set to 1% to 5% of the approximated bandwidth. The occupied 99% bandwidth was measured by using a delta marker at the lower and upper frequencies leading to 0.5% of the total power.

7.3.4.2 Measurement Results

Results are shown below:

Table 7.3.4.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
2402	955	872
2441	974	882
2480	970	866

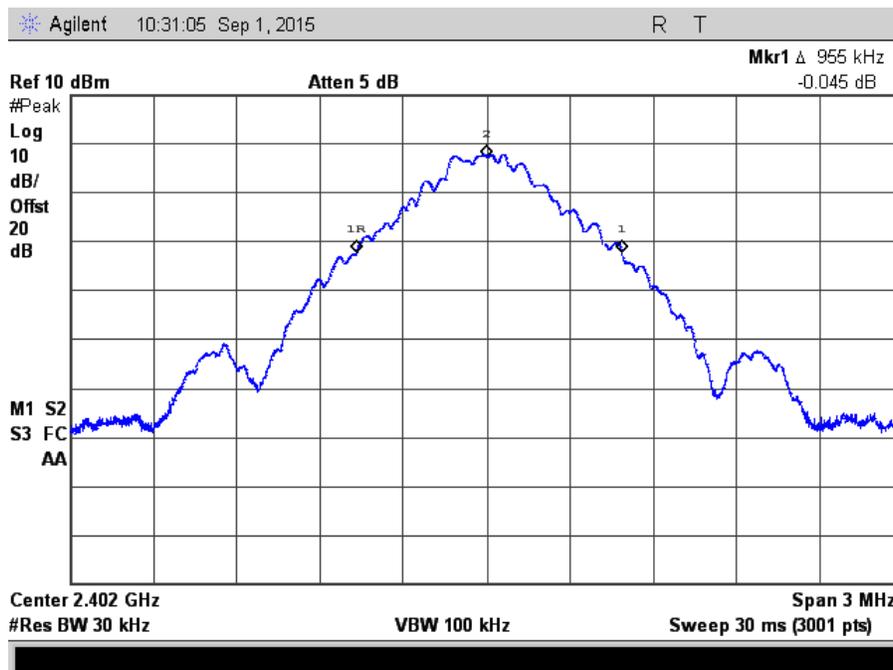


Figure 7.3.4.2-1: 20dB BW Low Channel (GFSK)

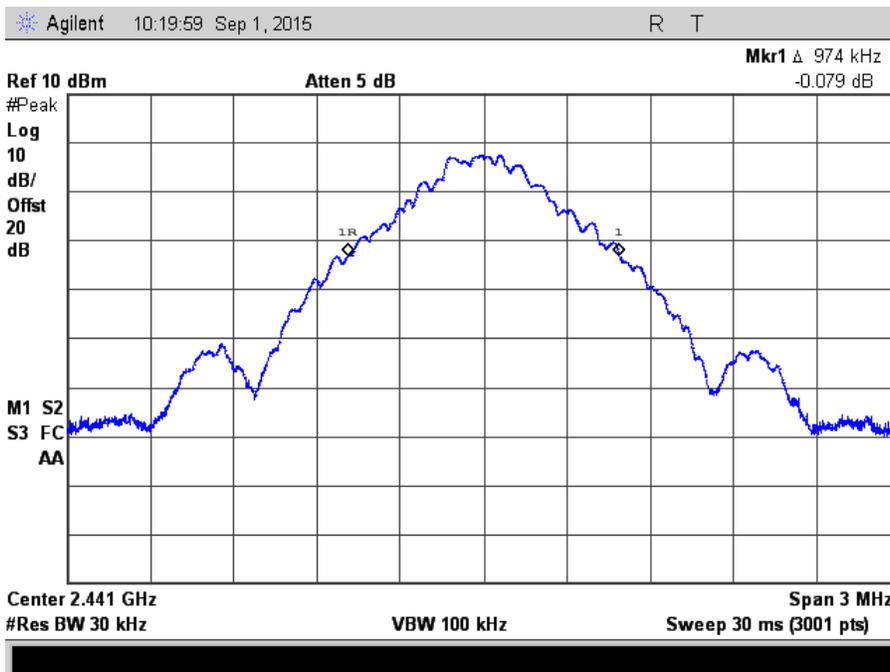


Figure 7.3.4.2-2: 20dB BW Middle Channel (GFSK)

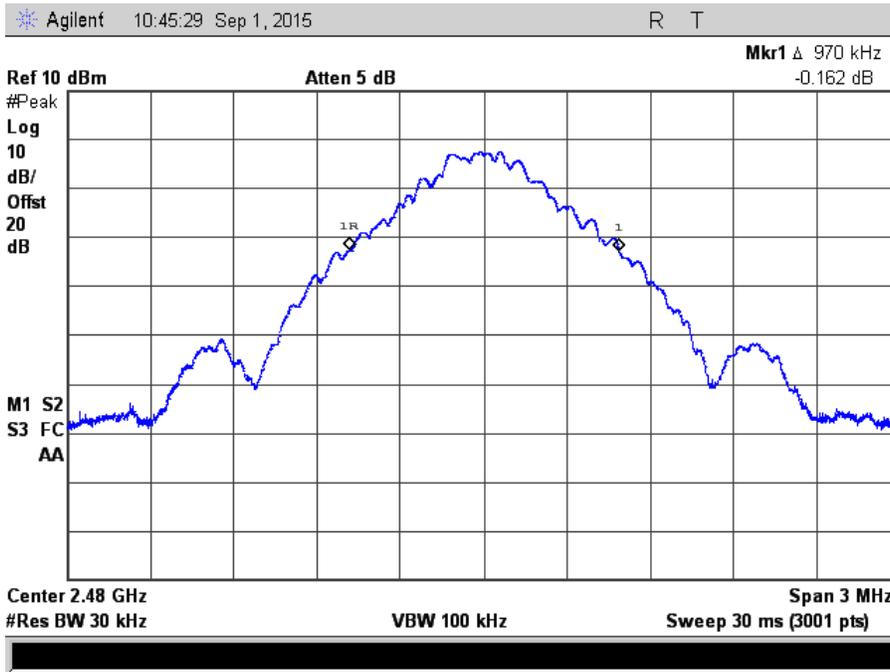


Figure 7.3.4.2-3: 20dB BW High Channel (GFSK)

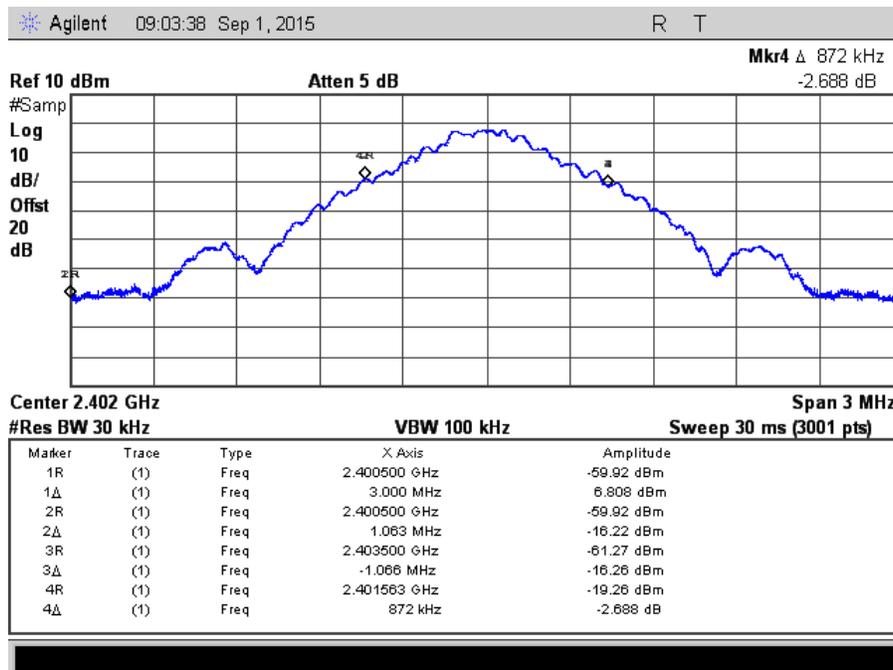


Figure 7.3.4.2-4: 99% OBW Low Channel (GFSK)

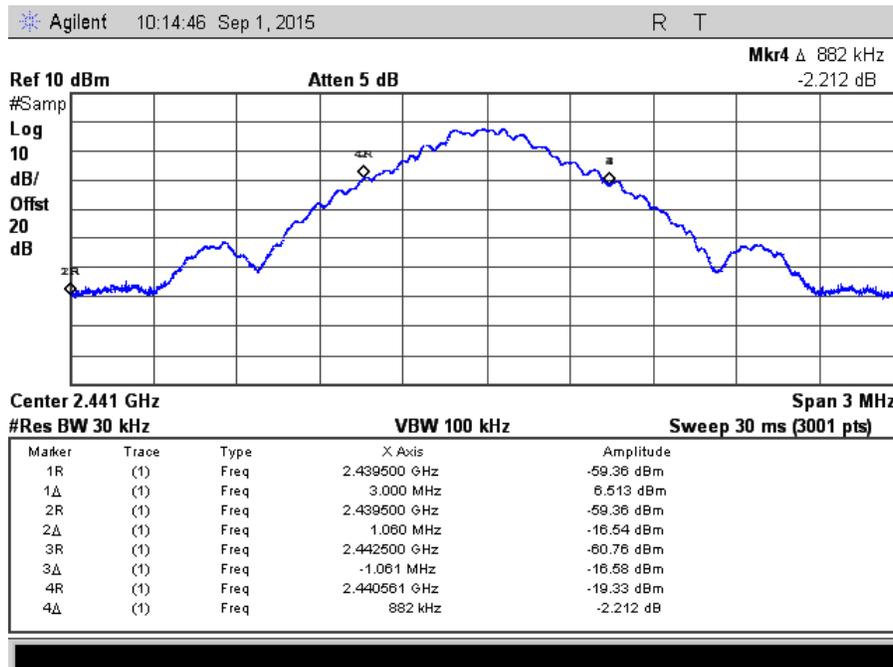


Figure 7.3.4.2-5: 99% OBW Middle Channel (GFSK)

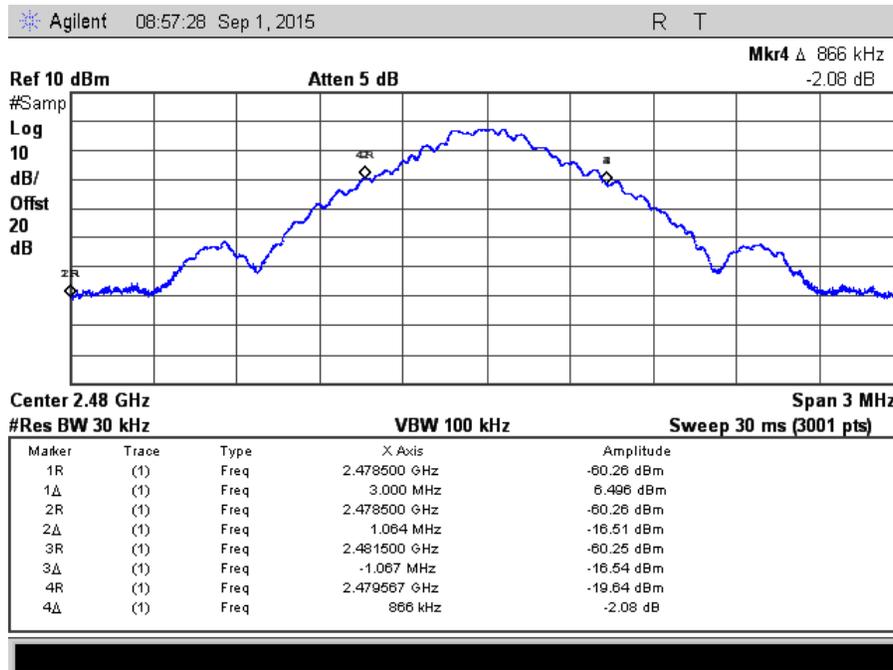


Figure 7.3.4.2-6: 99% OBW High Channel (GFSK)

Table: 7.3.4.2-2: 20dB / 99% Bandwidth ($\pi/4$ DQPSK)

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
2402	1381.7	1226.6
2441	1383.4	1225.0
2480	1381.7	1231.7

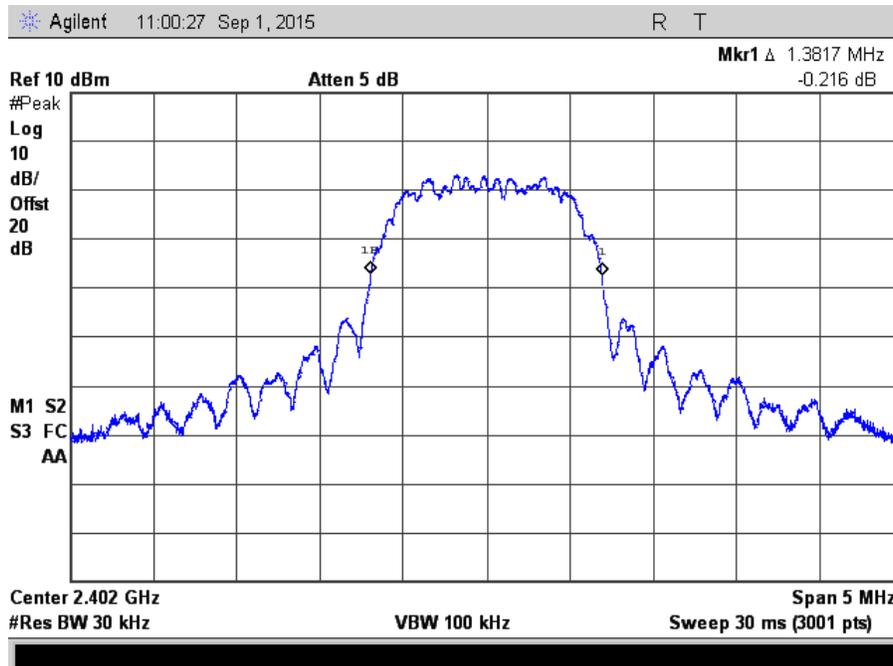


Figure 7.3.4.2-7: 20dB BW Low Channel ($\pi/4$ DQPSK)

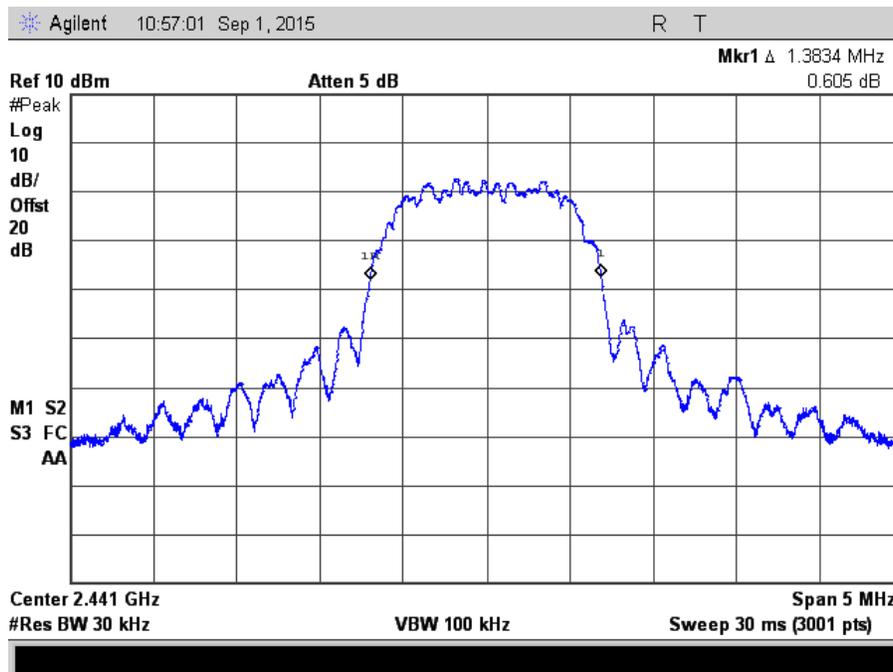


Figure 7.3.4.2-8: 20dB BW Middle Channel ($\pi/4$ DQPSK)

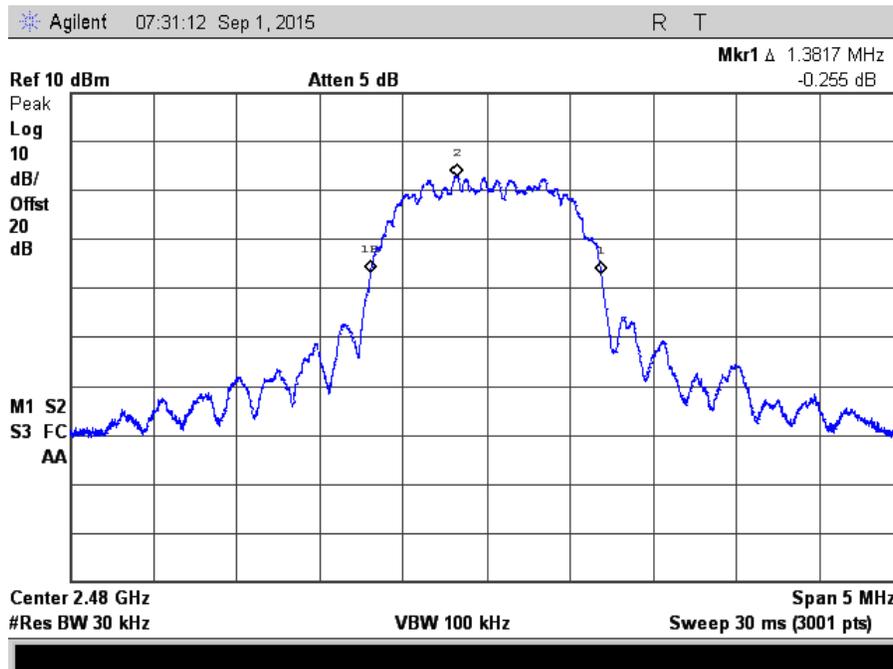


Figure 7.3.4.2-9: 20dB BW High Channel ($\pi/4$ DQPSK)

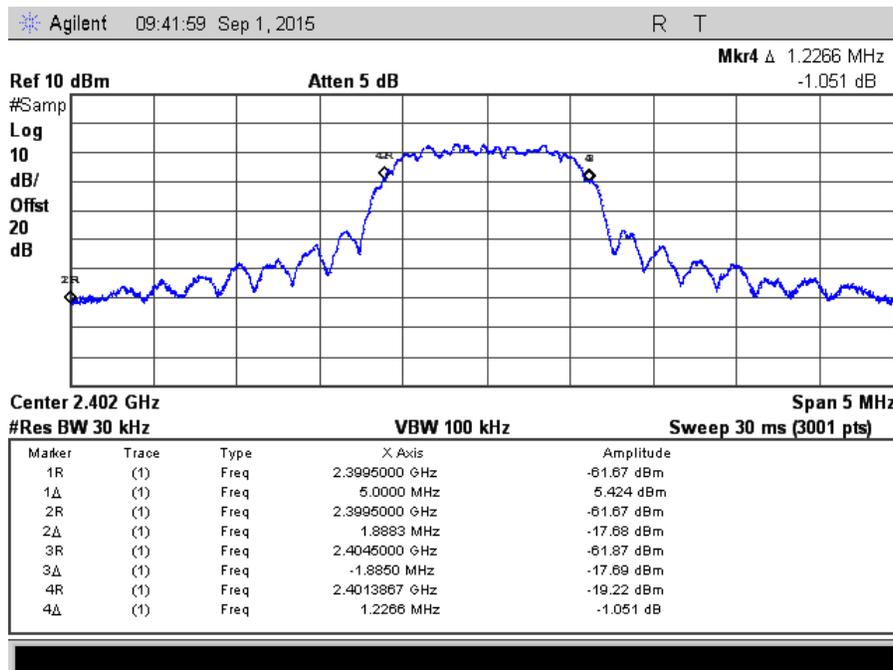


Figure 7.3.4.2-10: 99% OBW Low Channel ($\pi/4$ DQPSK)

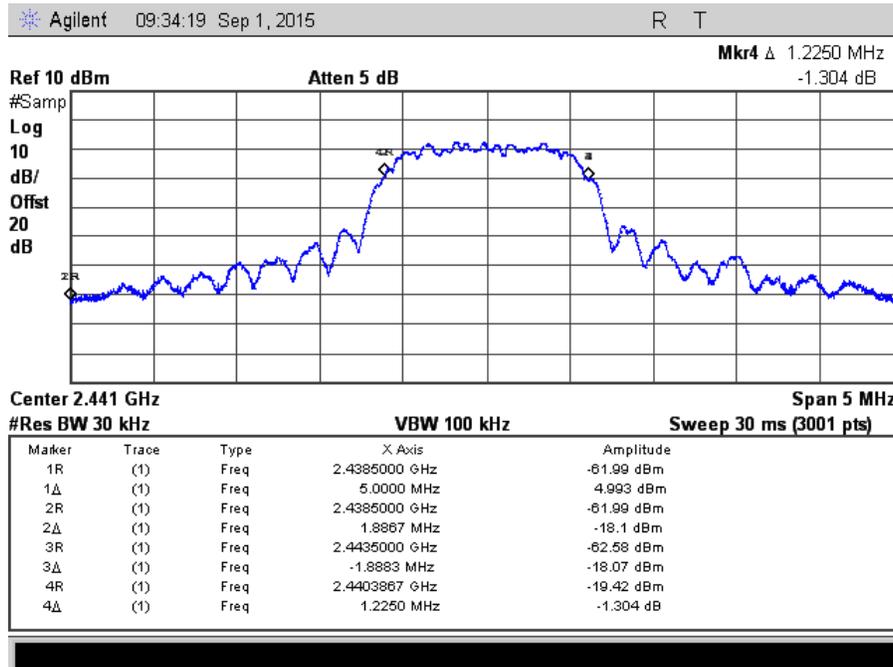


Figure 7.3.4.2-11: 99% OBW Middle Channel ($\pi/4$ DQPSK)

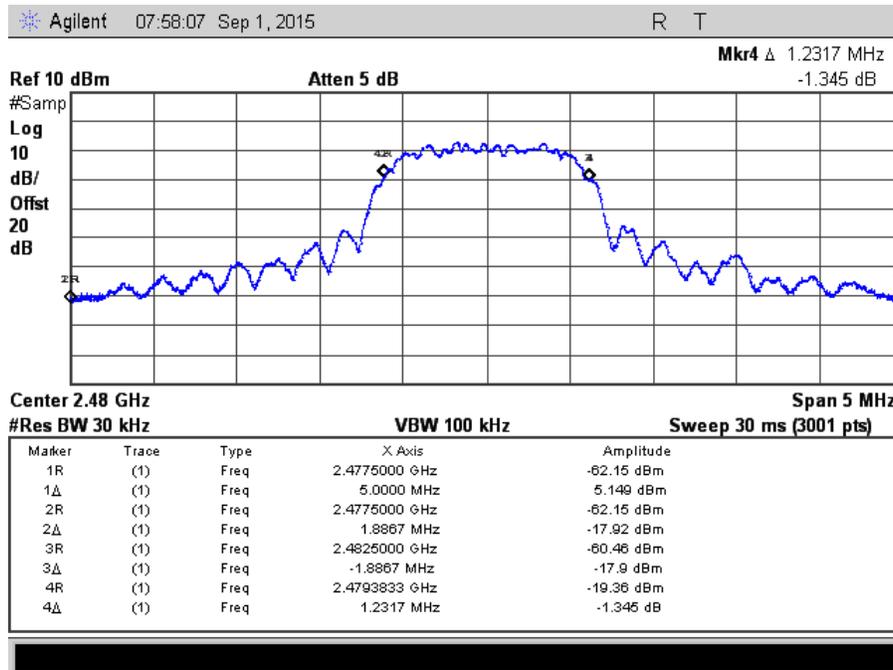


Figure 7.3.4.2-12: 99% OBW High Channel ($\pi/4$ DQPSK)

Table 7.3.4.2-3: 20dB / 99% Bandwidth (8DPSK)

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
2402	1371.6	1228.3
2441	1373.4	1223.3
2480	1370.0	1221.7

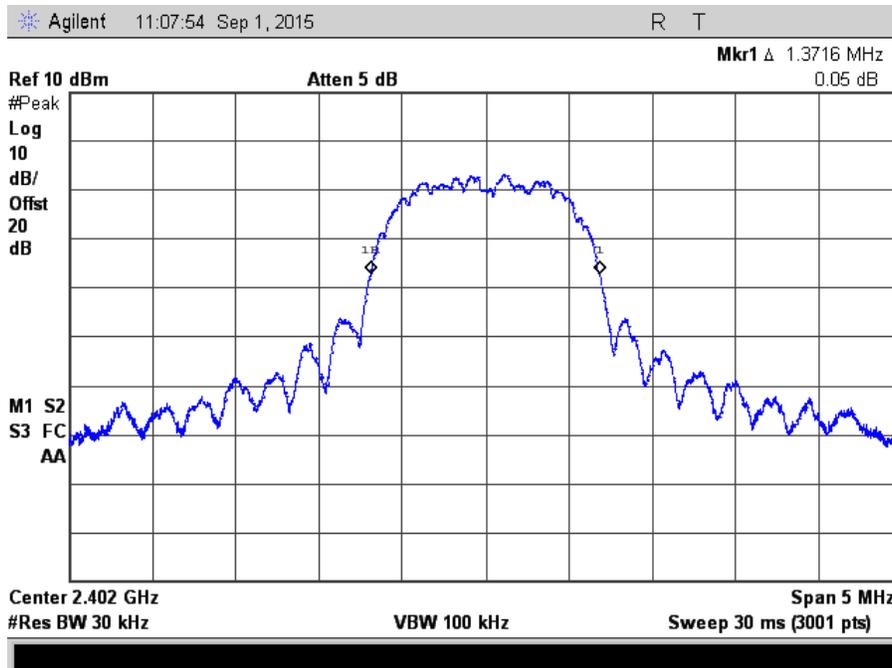


Figure 7.3.4.2-13: 20dB BW Low Channel (8DPSK)

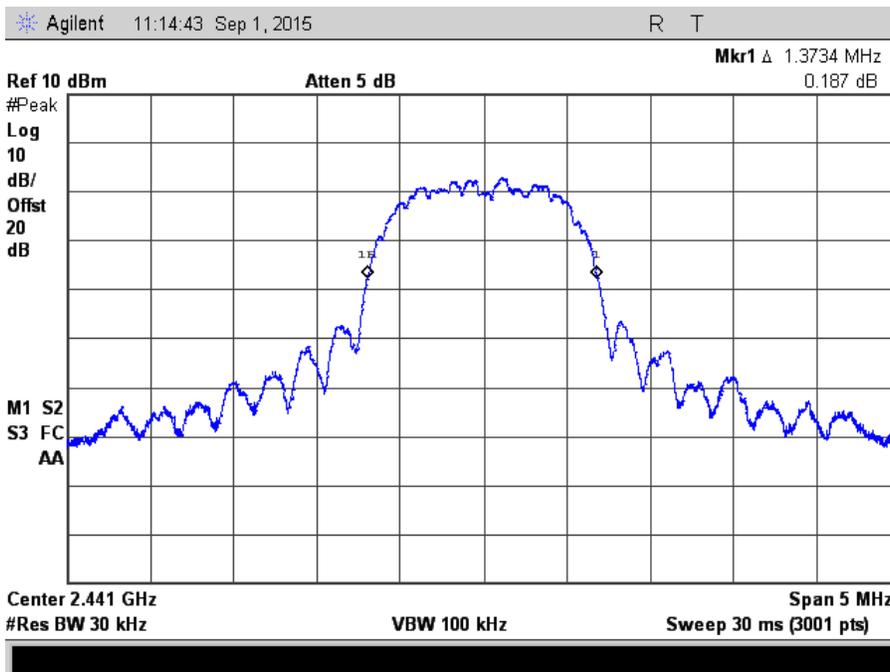


Figure 7.3.4.2-14: 20dB BW Middle Channel (8DPSK)

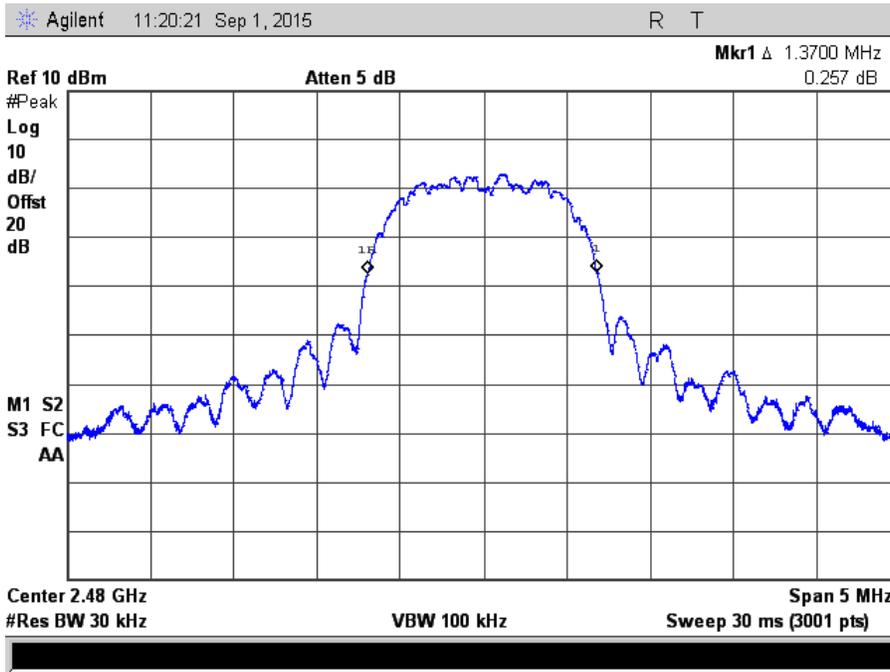


Figure 7.3.4.2-15: 20dB BW High Channel (8DPSK)

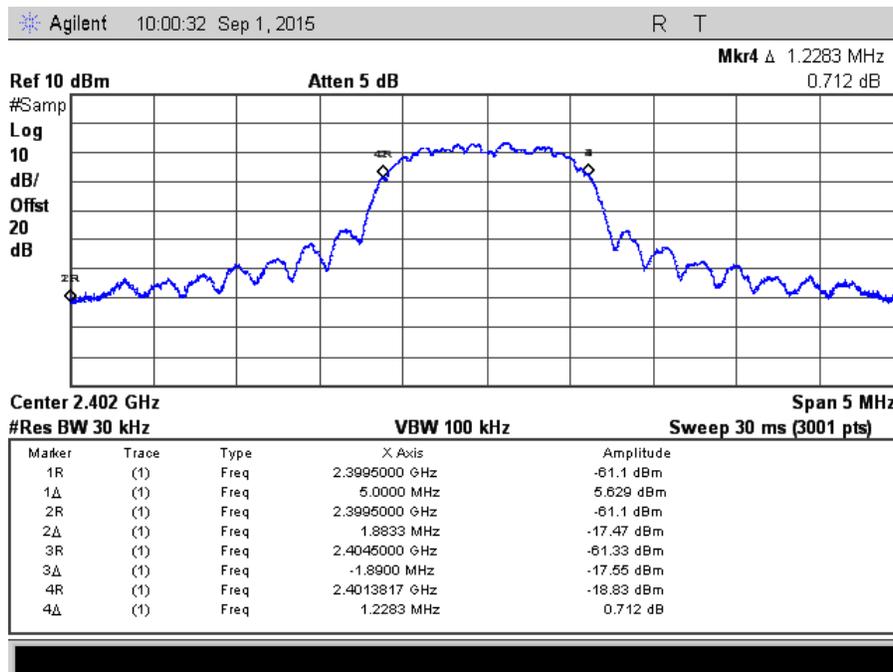


Figure 7.3.4.2-16: 99% OBW Low Channel (8DPSK)

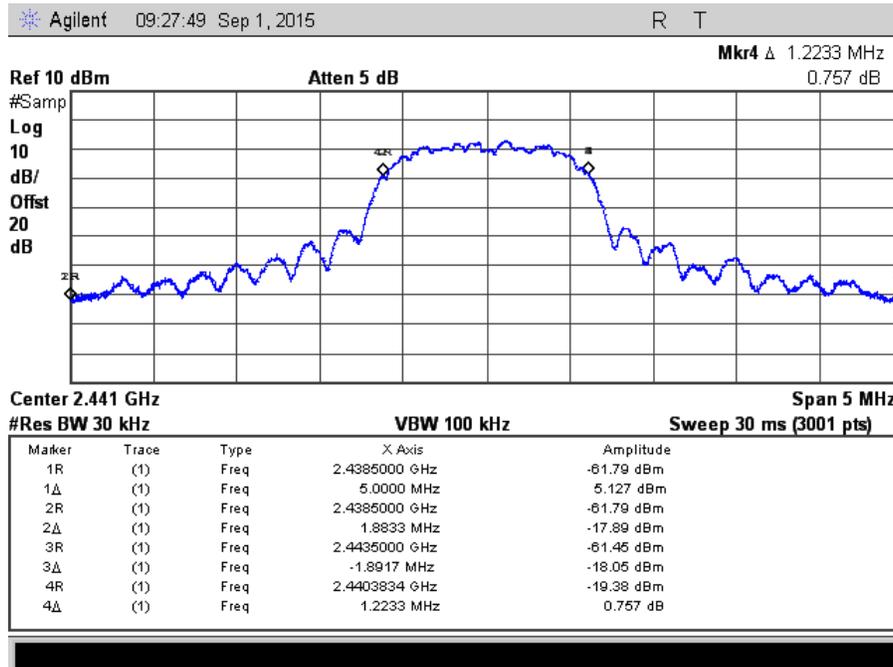


Figure 7.3.4.2-17: 99% OBW Middle Channel (8DPSK)

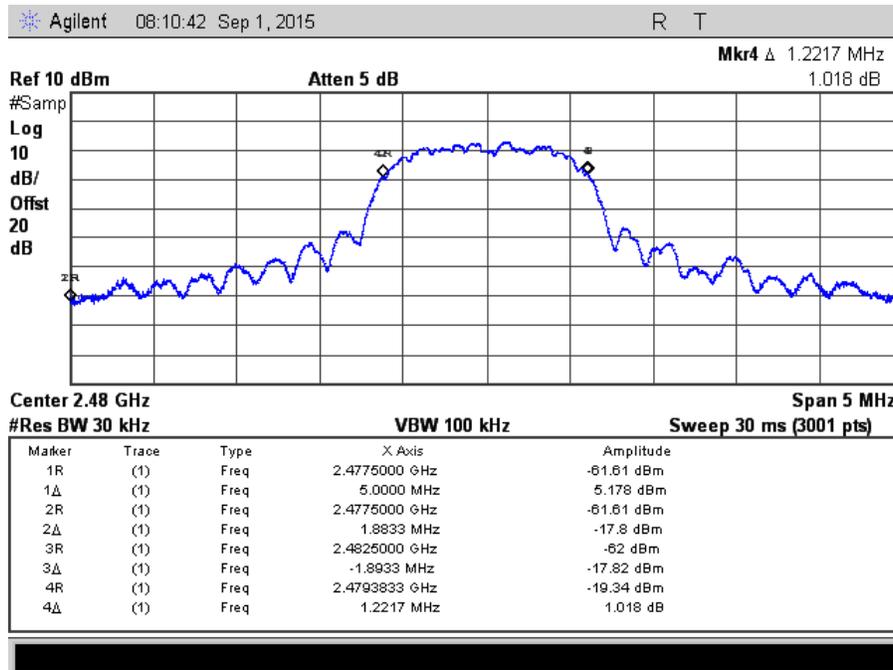


Figure 7.3.4.2-18: 99% OBW High Channel (8DPSK)

7.4 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC: RSS-247 5.5

7.4.1 Band-Edge Compliance of RF Conducted Emissions

7.4.1.1 Measurement Procedure

The RF output port of the EUT was connected to the input of the spectrum analyzer through suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, which is \geq 1% of the span, and the VBW was set to \geq 300 kHz.

7.4.1.2 Measurement Results

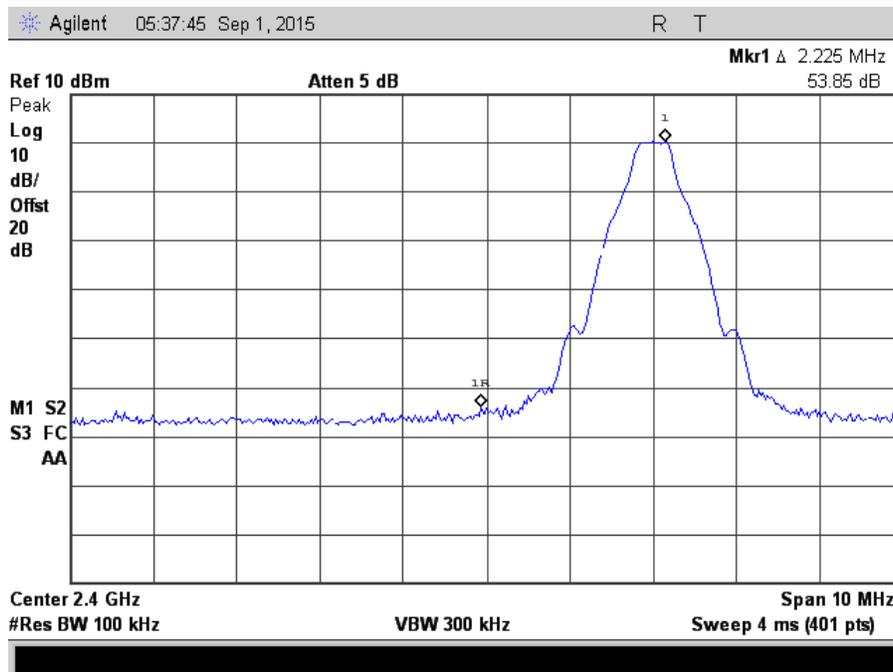


Figure 7.4.1.2-1: Lower Band-edge (GFSK)

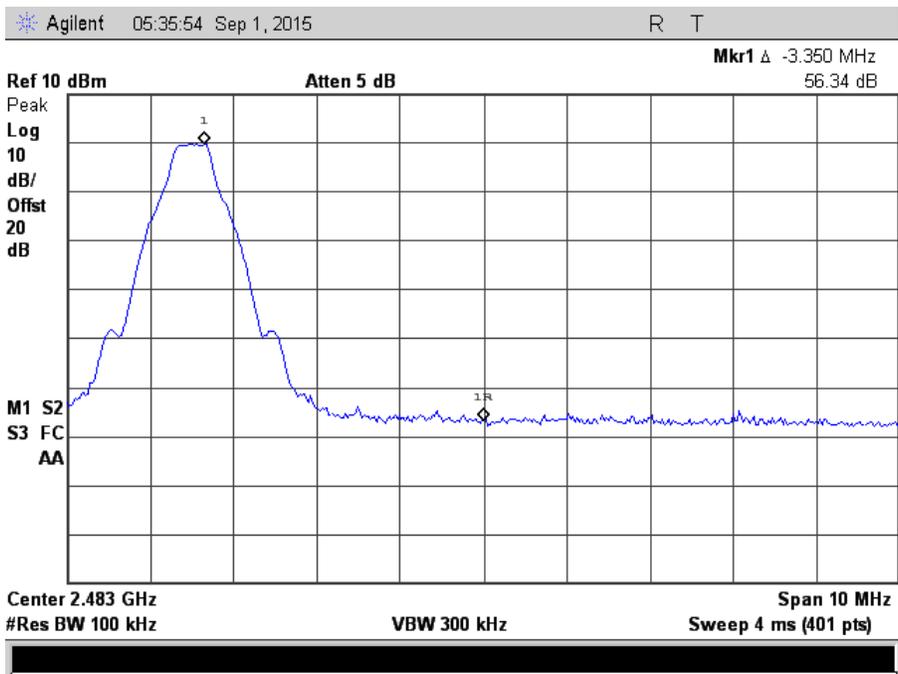


Figure 7.4.1.2-2: Upper Band-edge (GFSK)

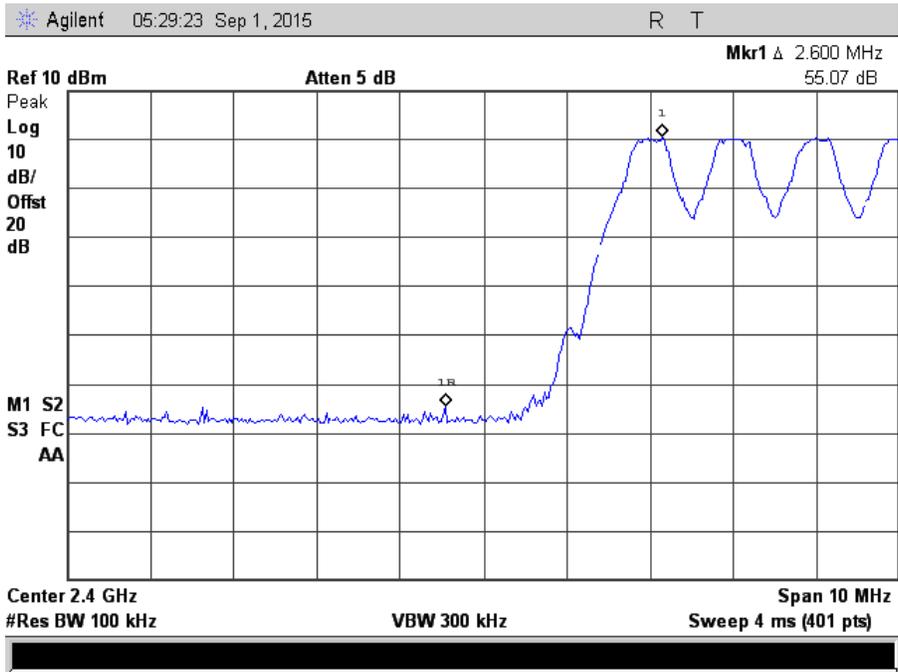


Figure 7.4.1.2-3: Lower Band-edge - Hopping Mode (GFSK)

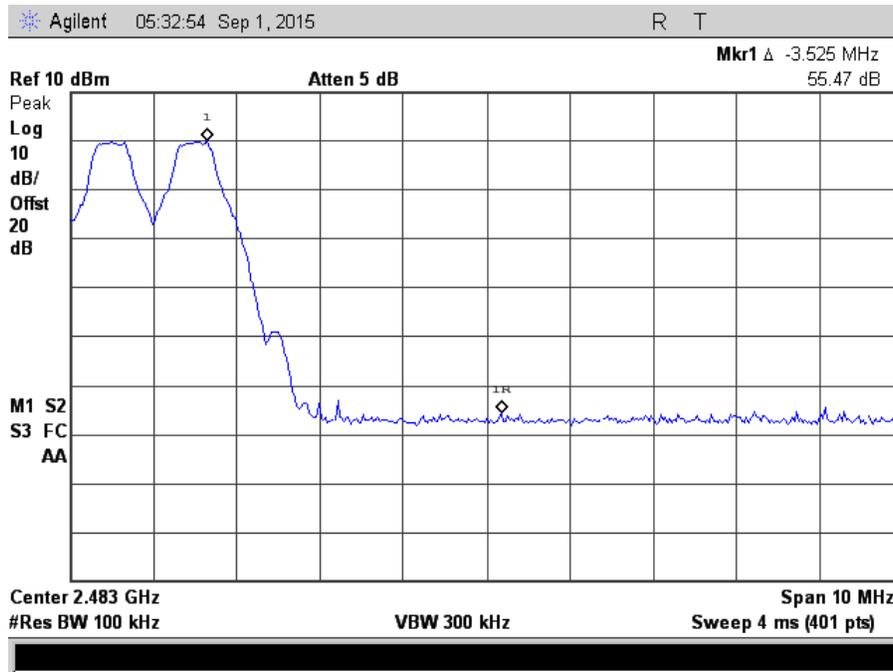


Figure 7.4.1.2-4: Upper Band-edge – Hopping Mode (GFSK)

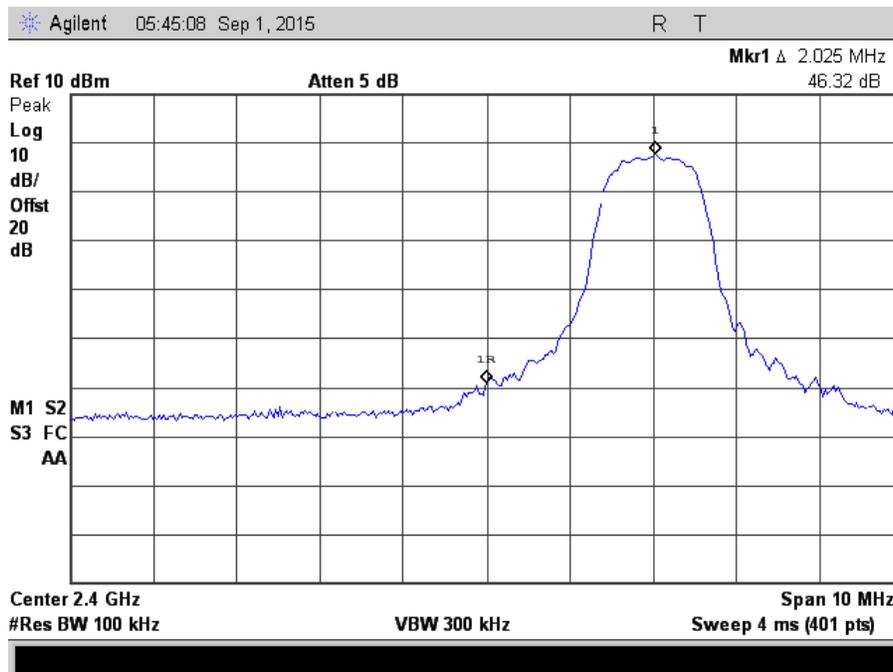


Figure 7.4.1.2-5: Lower Band-edge ($\pi/4$ DQPSK)

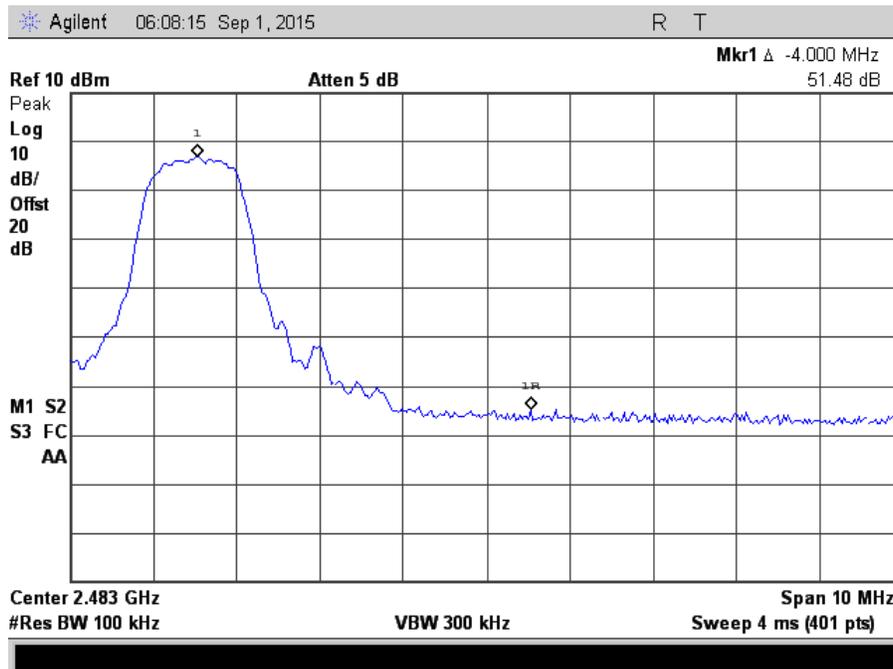


Figure 7.4.1.2-6: Upper Band-edge ($\pi/4$ DQPSK)

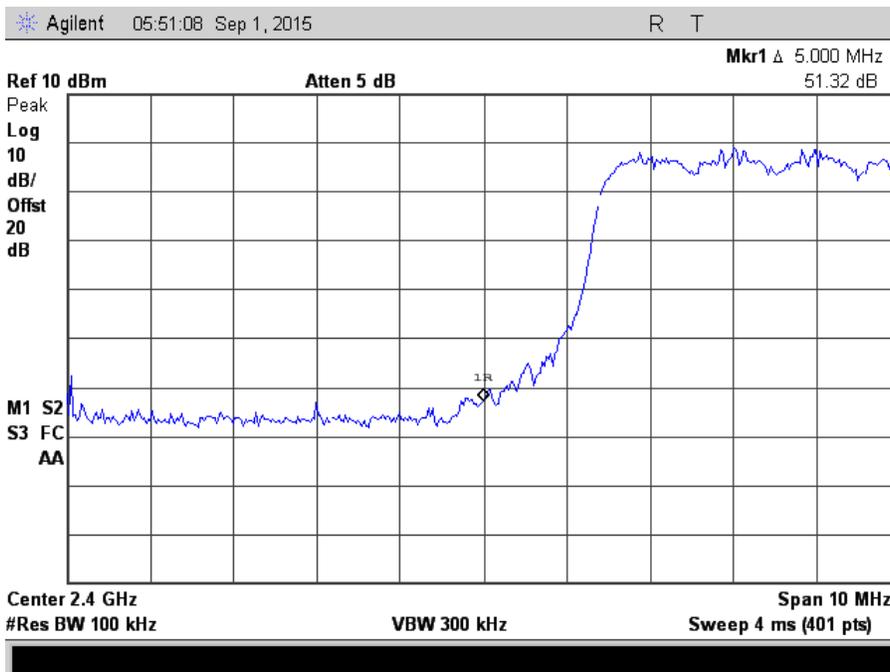


Figure 7.4.1.2-7: Lower Band-edge – Hopping Mode ($\pi/4$ DQPSK)

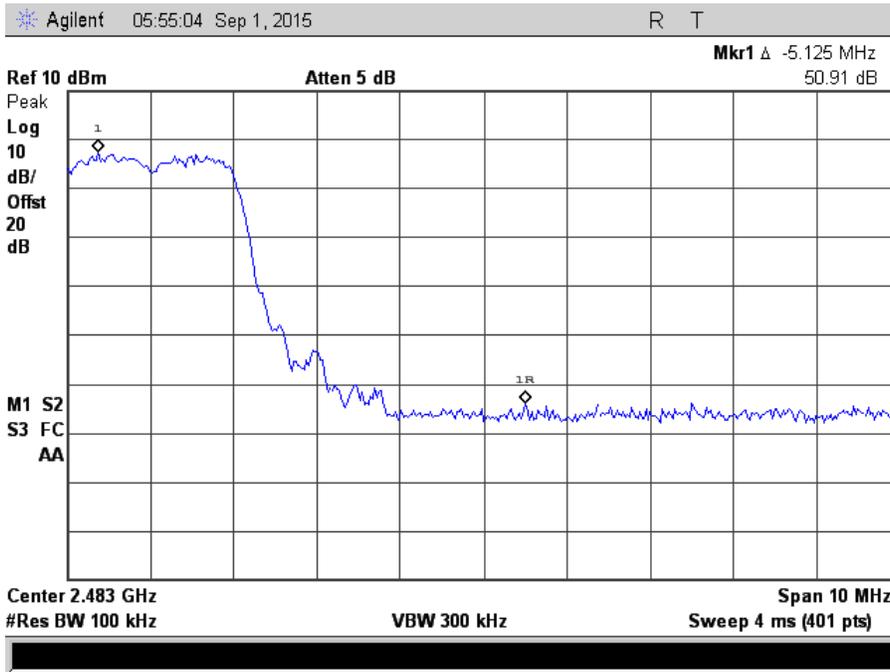


Figure 7.4.1.2-8: Upper Band-edge – Hopping Mode ($\pi/4$ DQPSK)

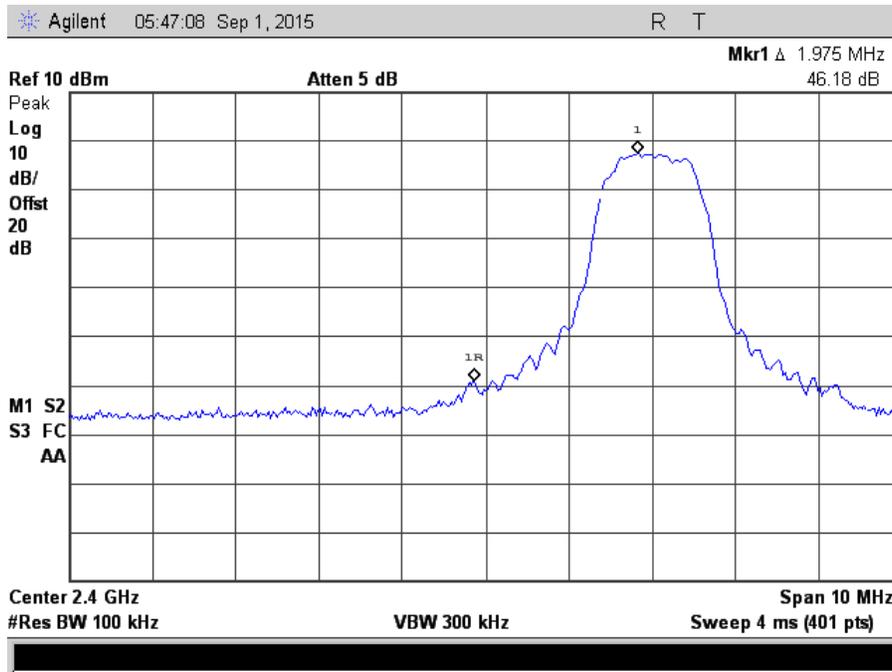


Figure 7.4.1.2-9: Lower Band-edge (8DPSK)

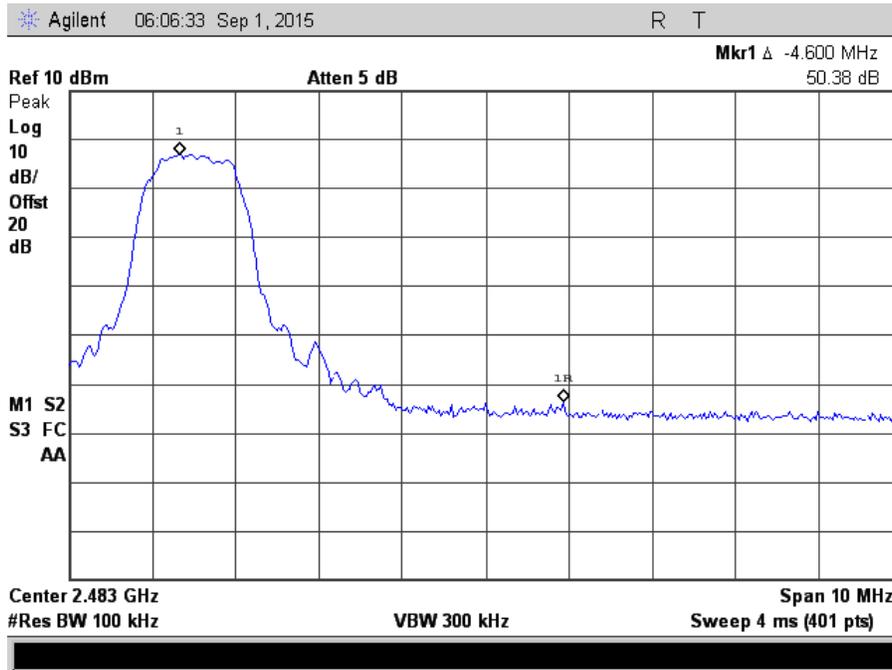


Figure 7.4.1.2-10: Upper Band-edge (8DPSK)

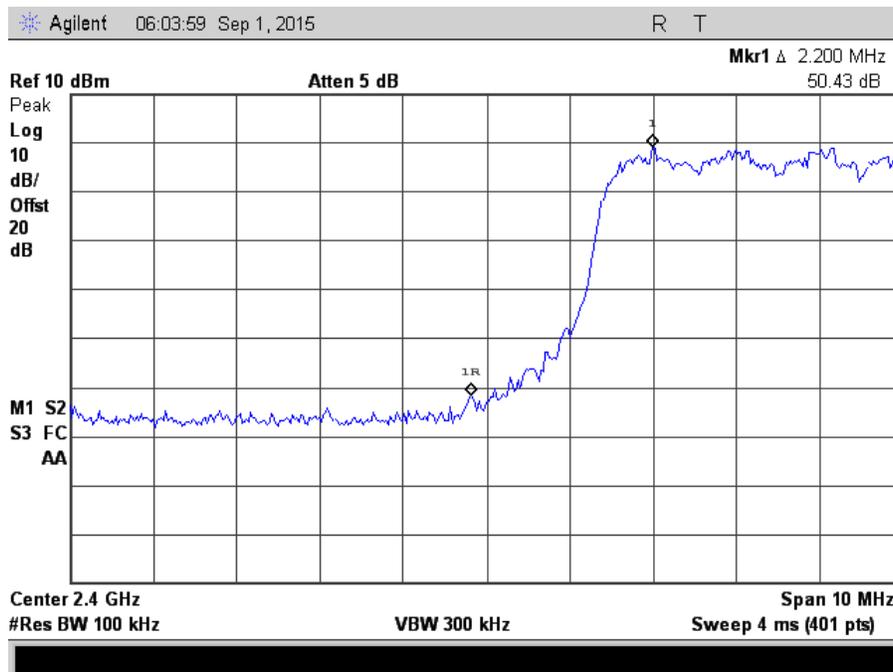


Figure 7.4.1.2-11: Lower Band-edge – Hopping Mode (8DPSK)

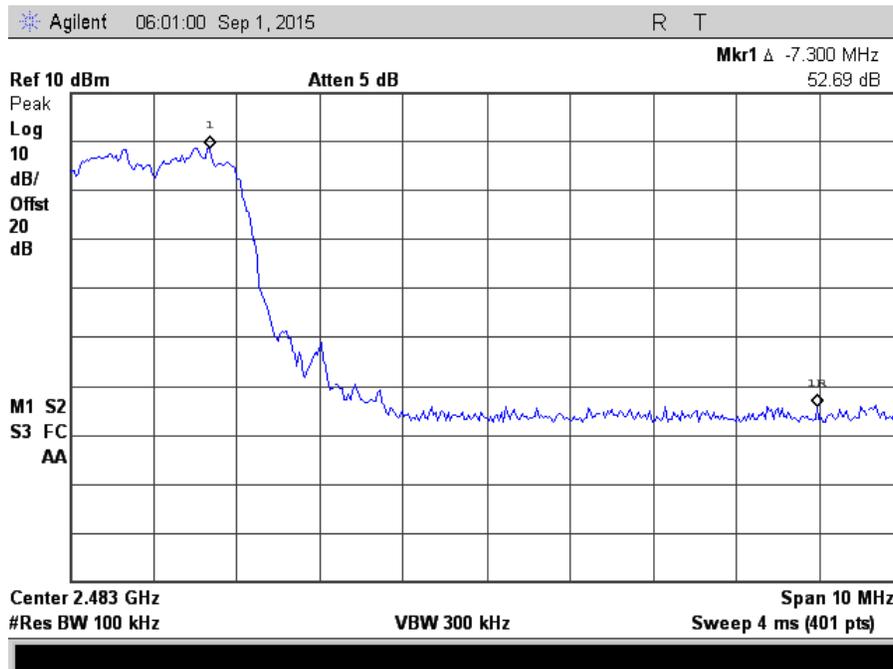


Figure 7.4.1.2-12: Upper Band-edge – Hopping Mode (8DPSK)

7.4.2 RF Conducted Spurious Emissions

7.4.2.1 Measurement Procedure

The RF output port of the EUT was connected to the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 26 GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100 kHz. A peak detector function was used with the trace set to max hold. The levels were corrected for cable and attenuator losses.

7.4.2.2 Measurement Results

Results are shown below:

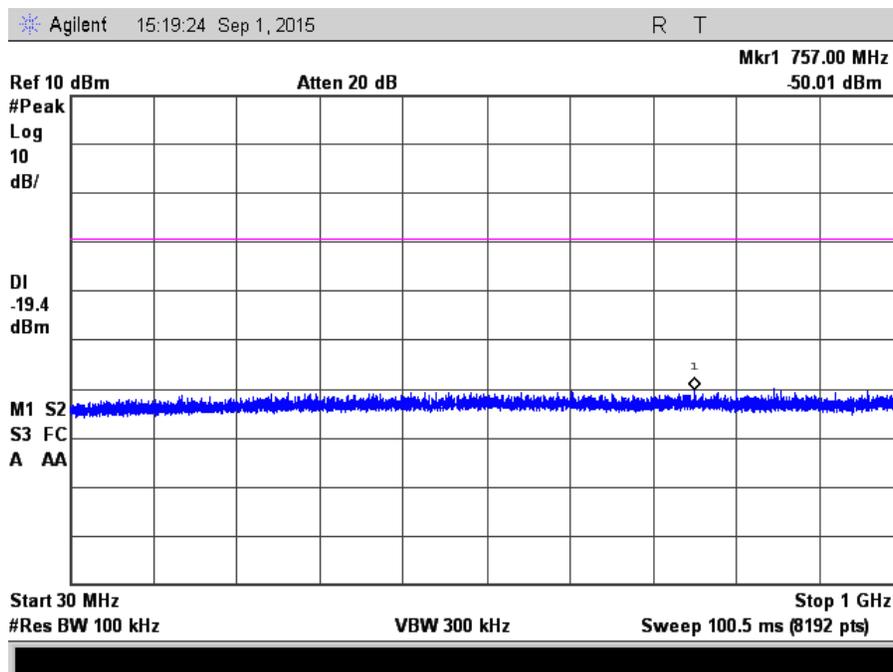


Figure 7.4.2.2-1: 30 MHz – 1 GHz – Low Channel (GFSK)

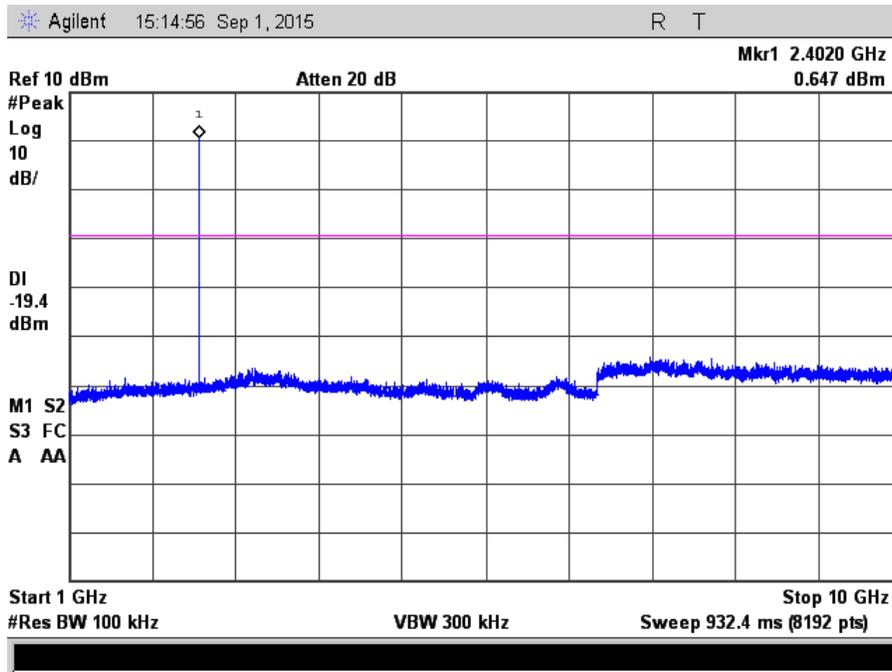


Figure 7.4.2.2-2: 1 GHz –10 GHz – Low Channel (GFSK)

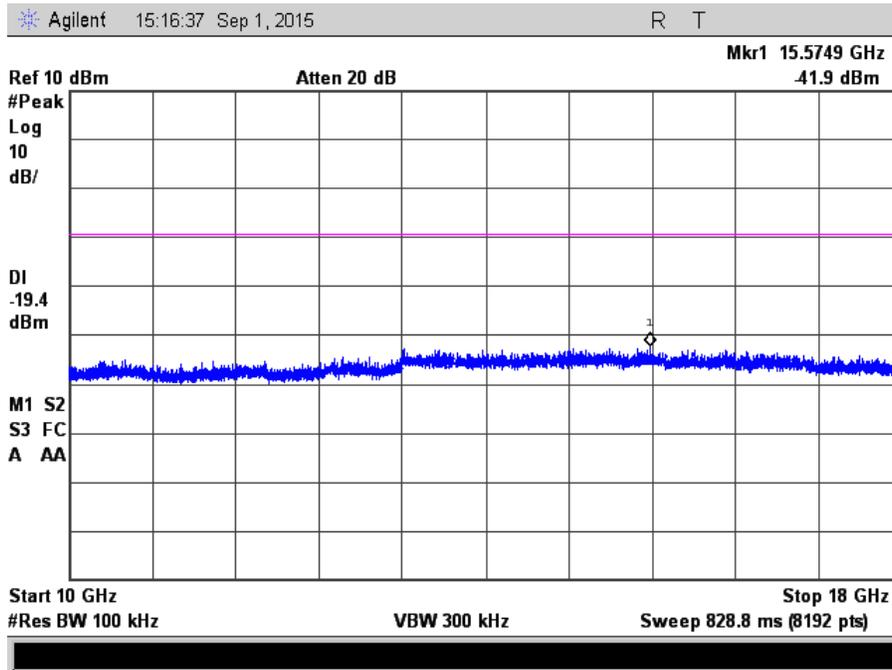


Figure 7.4.2.2-3: 10 GHz –18 GHz – Low Channel (GFSK)

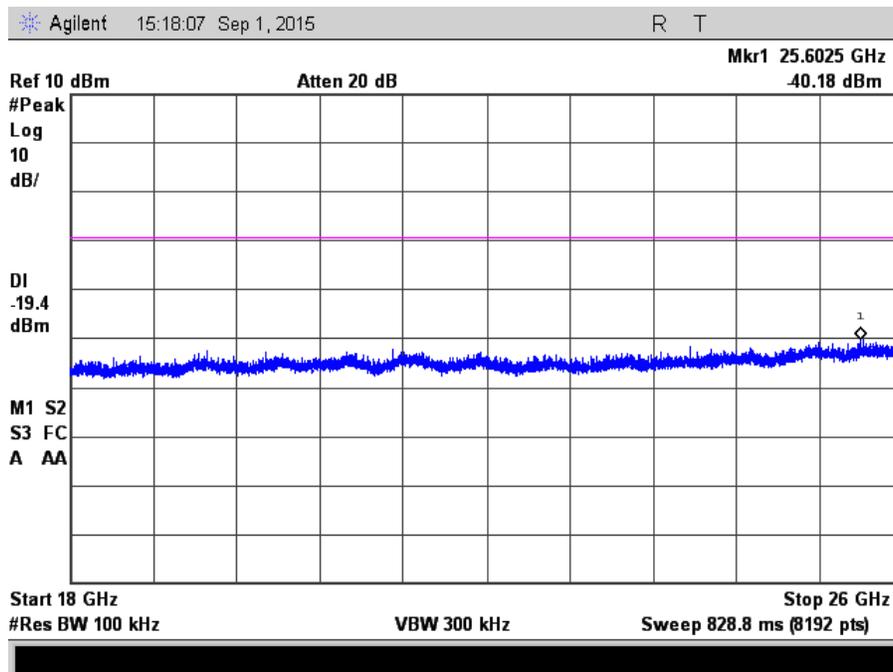


Figure 7.4.2.2-4: 18 GHz –26 GHz – Low Channel (GFSK)

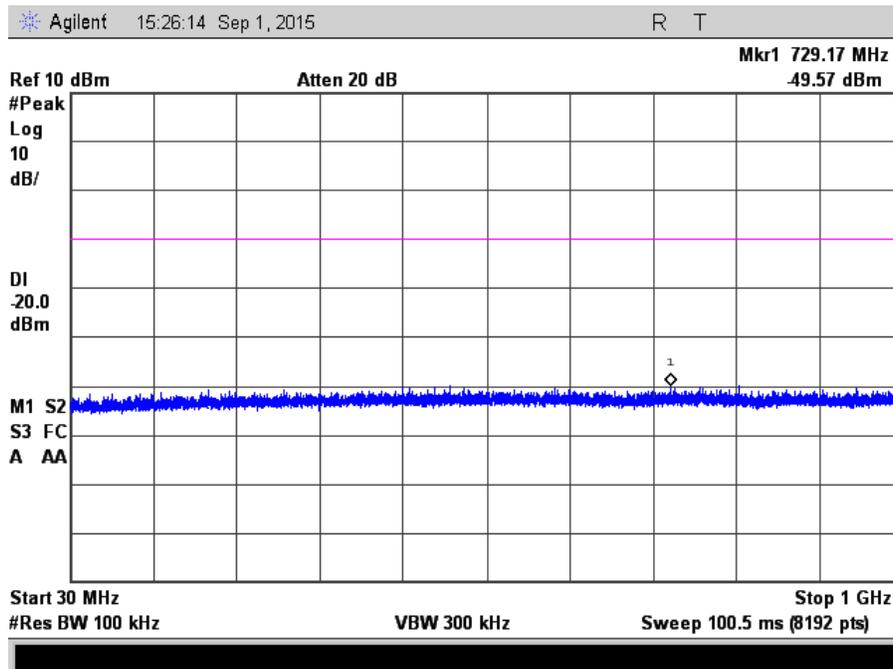


Figure 7.4.2.2-5: 30 MHz – 1 GHz –Middle Channel (GFSK)

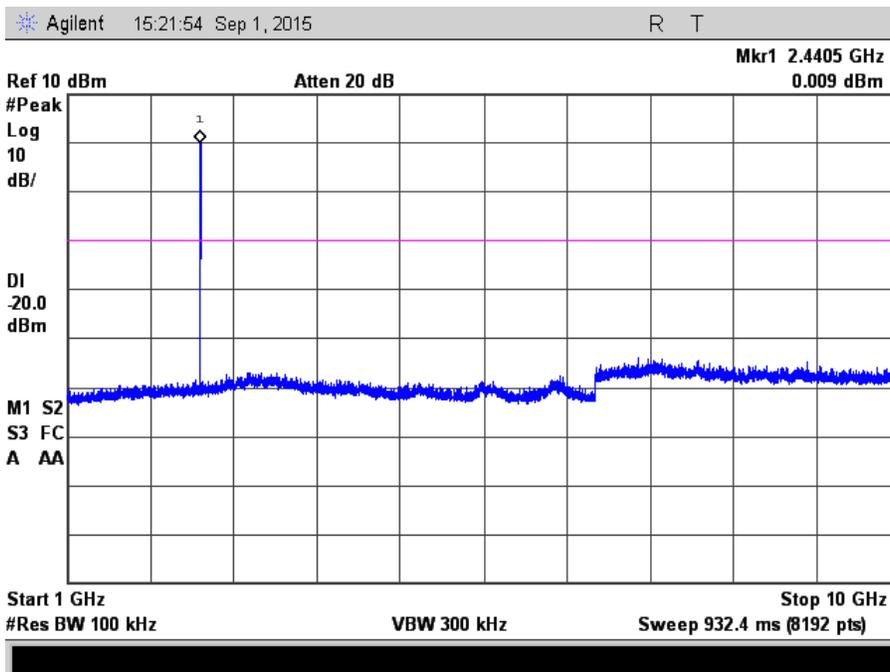


Figure 7.4.2.2-6: 1 GHz - 10 GHz - Middle Channel (GFSK)

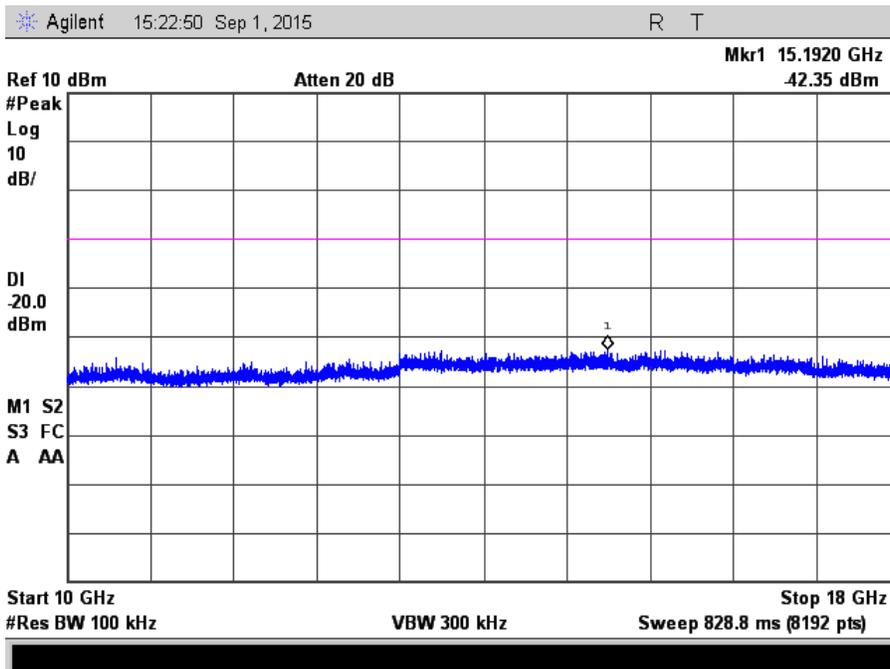


Figure 7.4.2.2-7: 10 GHz - 18 GHz - Middle Channel (GFSK)

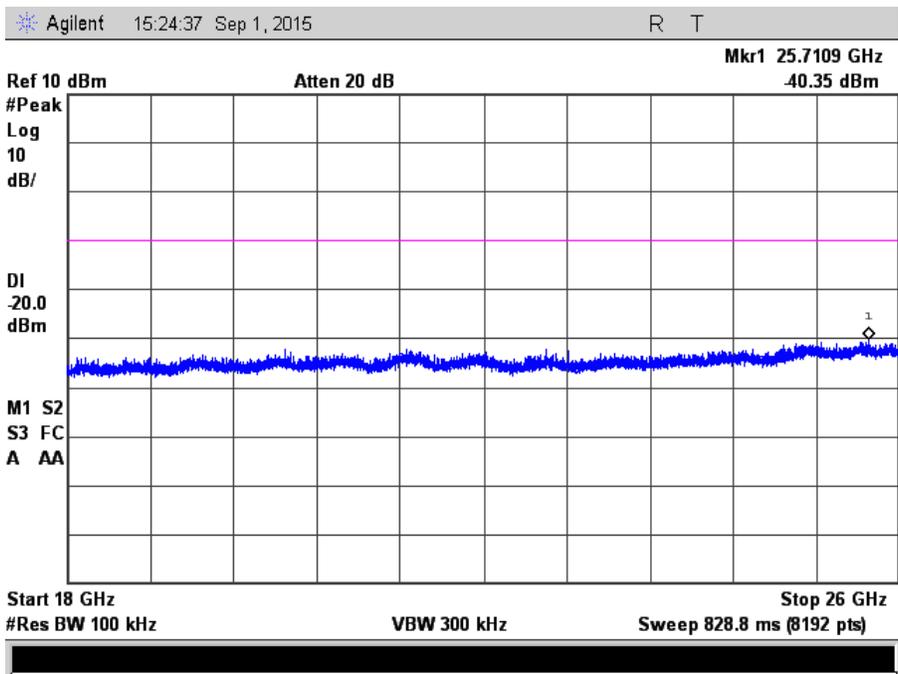


Figure 7.4.2.2-8: 18 GHz –26 GHz – Middle Channel (GFSK)

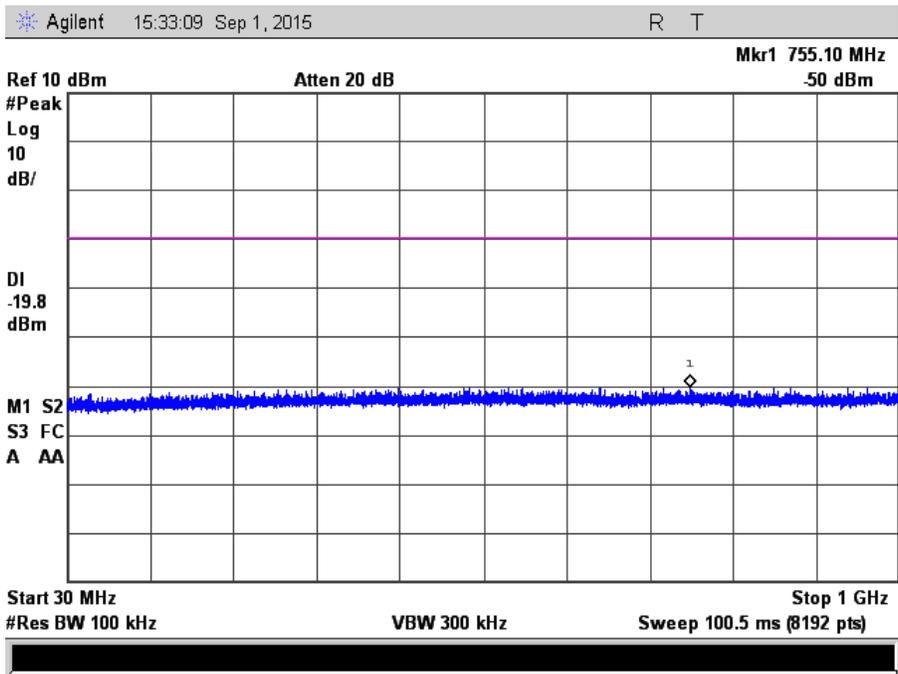


Figure 7.4.2.2-9: 30 MHz – 1 GHz – High Channel (GFSK)

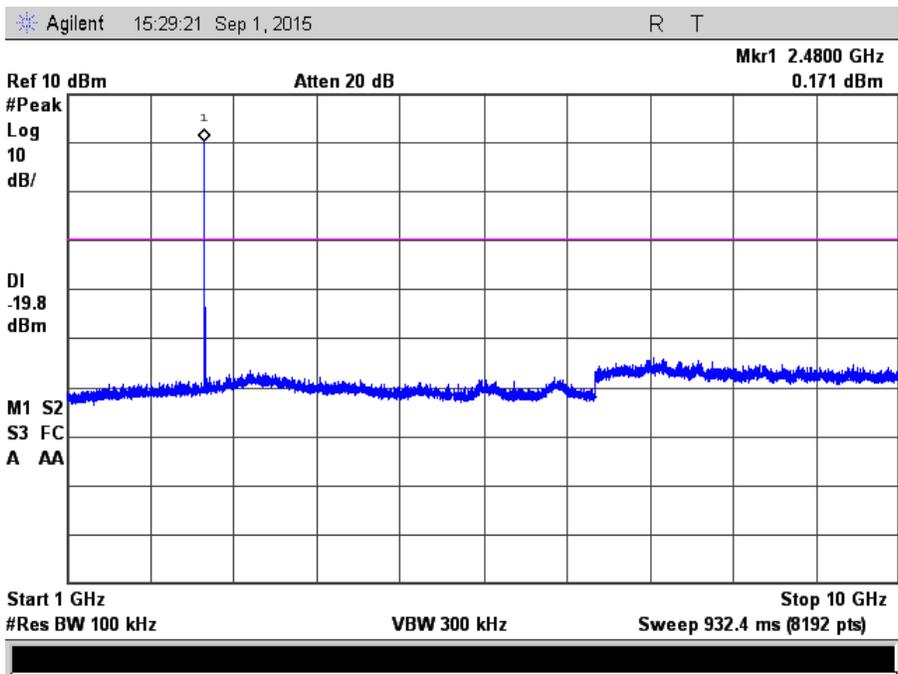


Figure 7.4.2.2-10: 1 GHz –10 GHz –High Channel (GFSK)

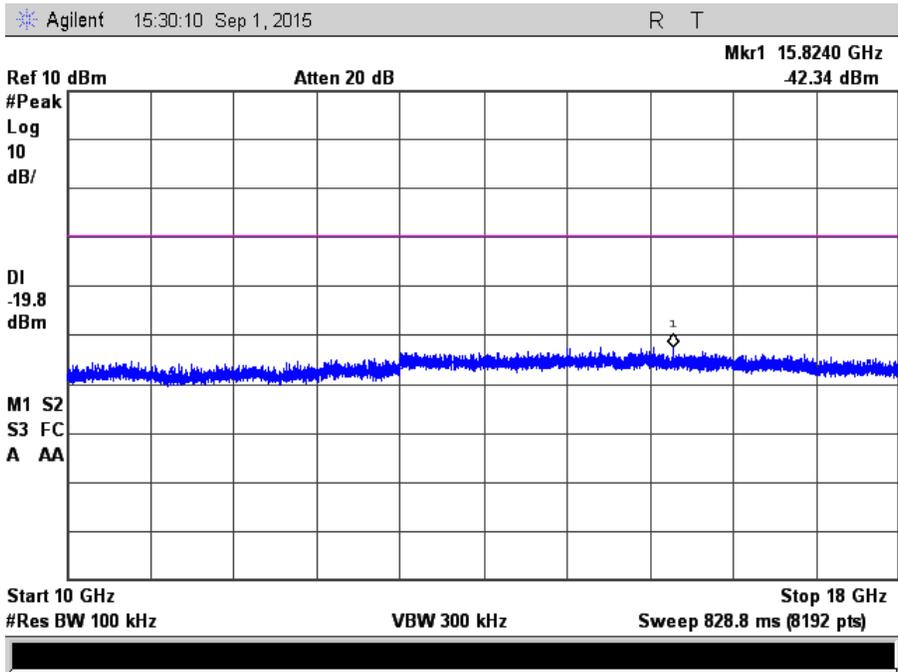


Figure 7.4.2.2-11: 10 GHz –18 GHz – High Channel (GFSK)

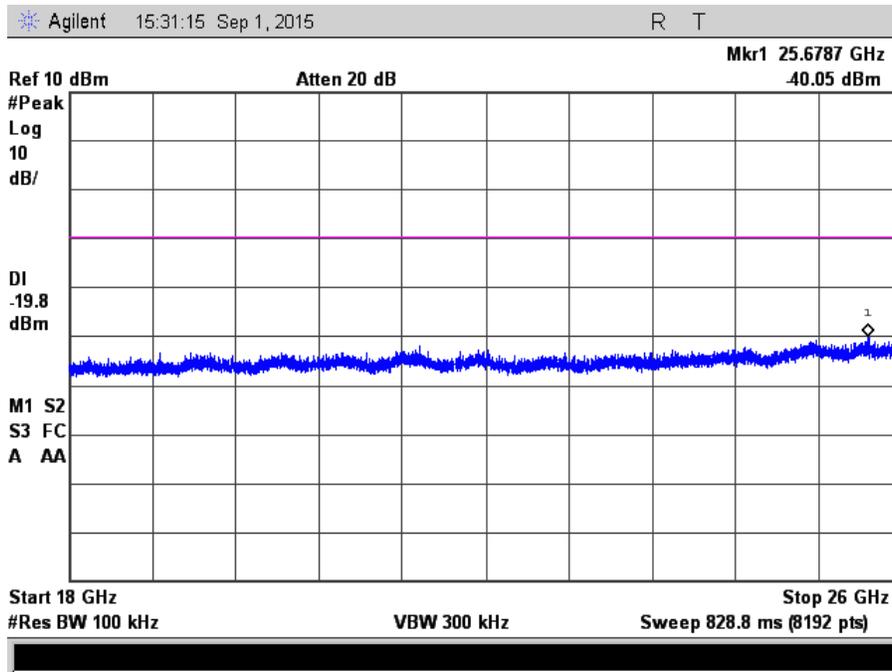


Figure 7.4.2.2-12: 18 GHz –26 GHz – High Channel (GFSK)

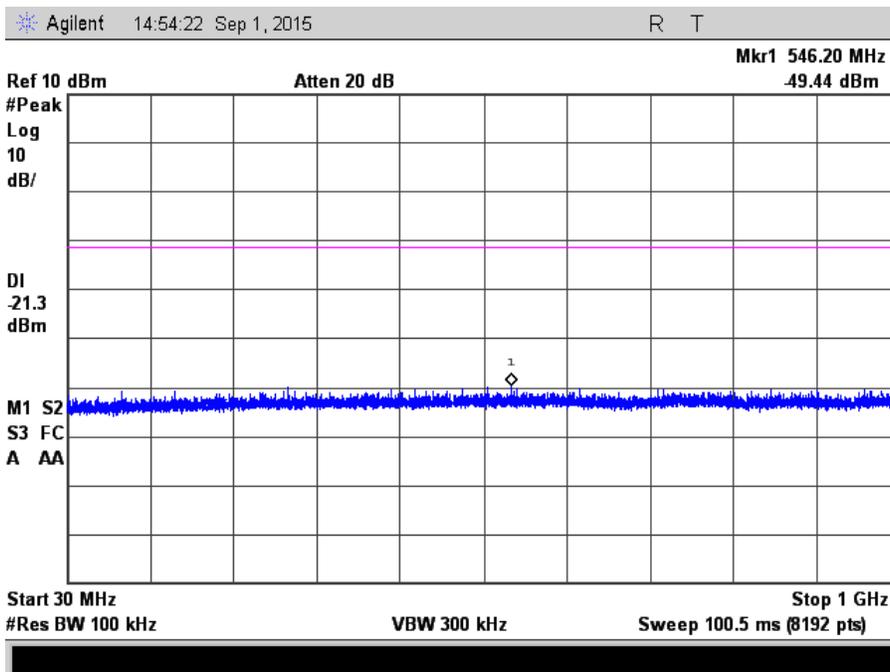


Figure 7.4.2.2-13: 30 MHz – 1 GHz – Low Channel ($\pi/4$ DQPSK)

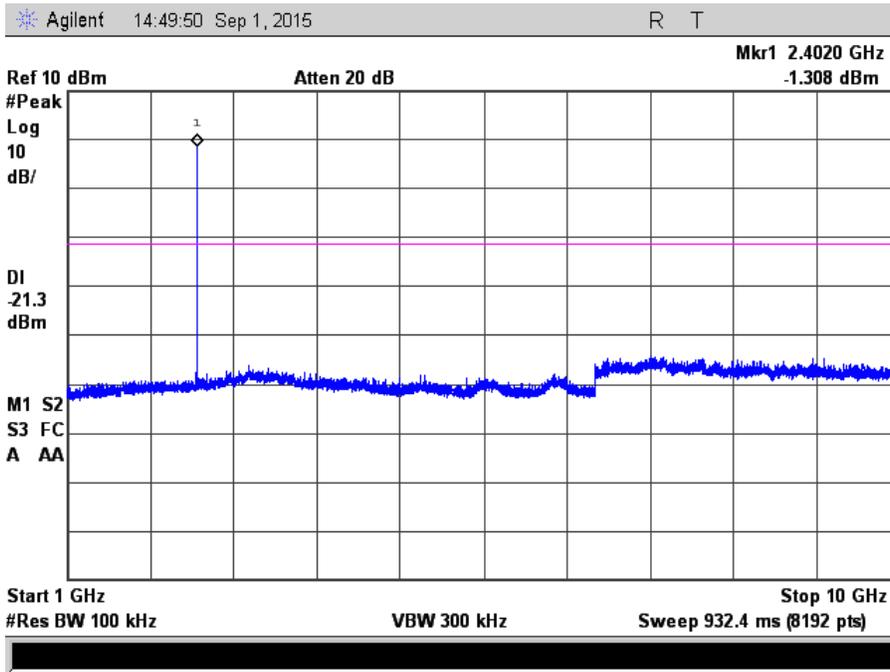


Figure 7.4.2.2-14: 1 GHz – 10 GHz – Low Channel ($\pi/4$ DQPSK)

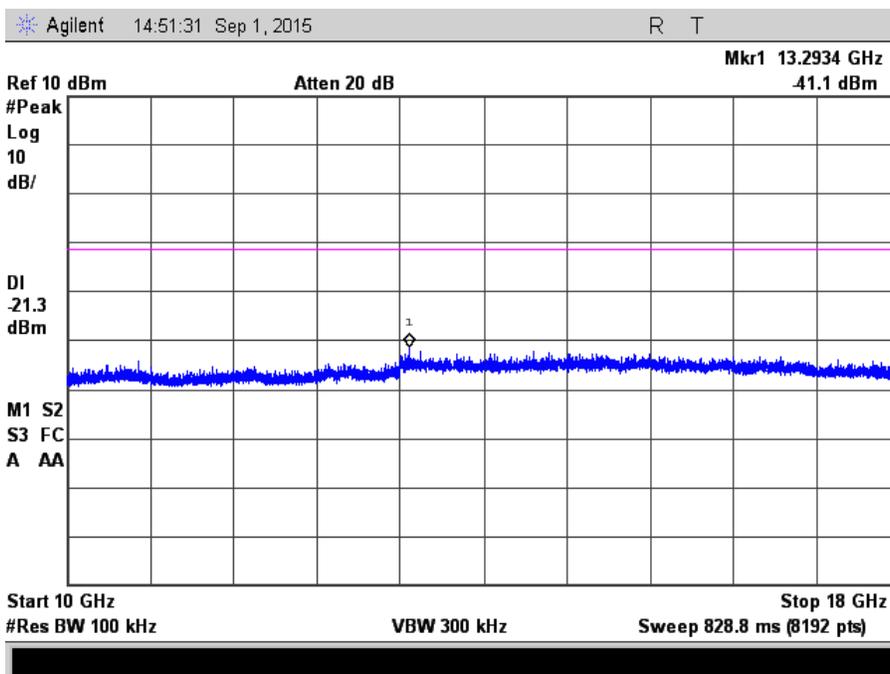


Figure 7.4.2.2-15: 10 GHz –18 GHz – Low Channel ($\pi/4$ DQPSK)

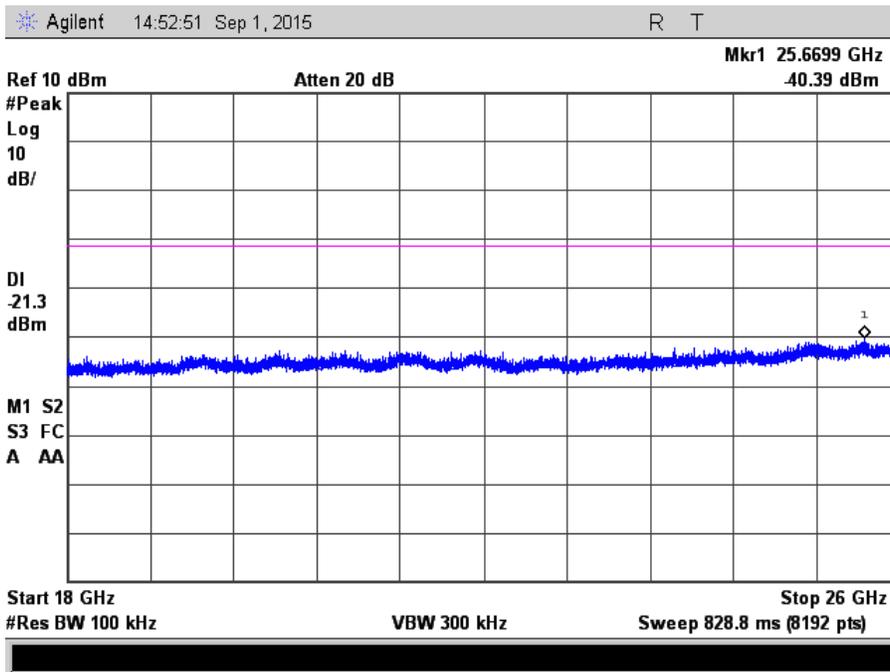


Figure 7.4.2.2-16: 18 GHz –26 GHz – Low Channel ($\pi/4$ DQPSK)

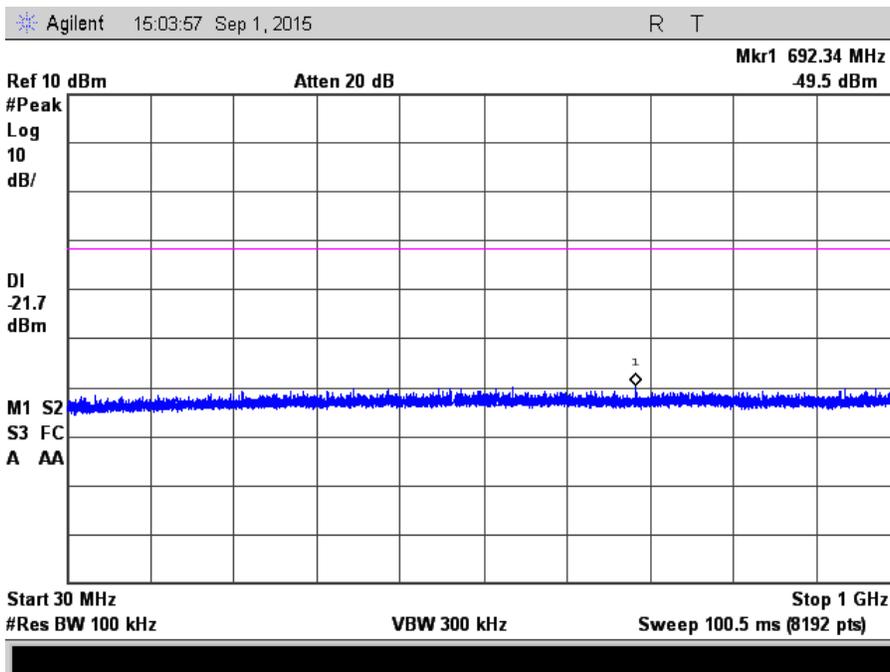


Figure 7.4.2.2-17: 30 MHz – 1 GHz –Middle Channel ($\pi/4$ DQPSK)

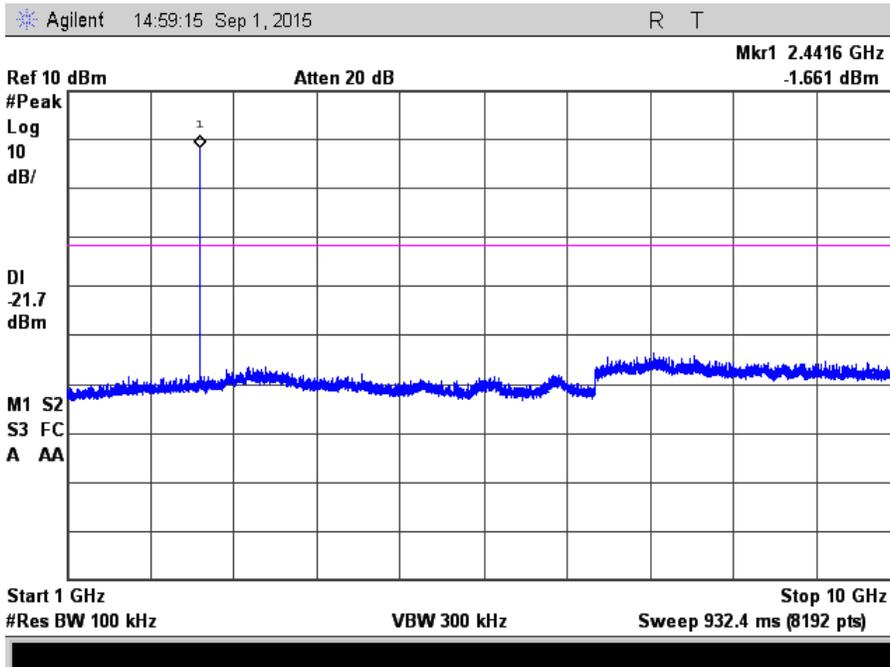


Figure 7.4.2.2-18: 1 GHz –10 GHz – Middle Channel ($\pi/4$ DQPSK)

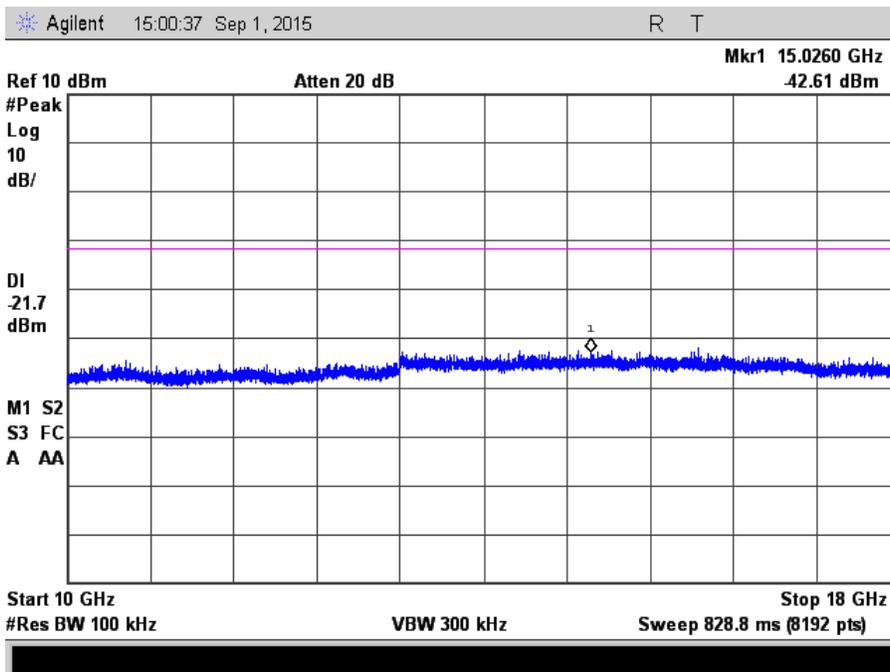


Figure 7.4.2.2-19: 10 GHz –18 GHz – Middle Channel ($\pi/4$ DQPSK)

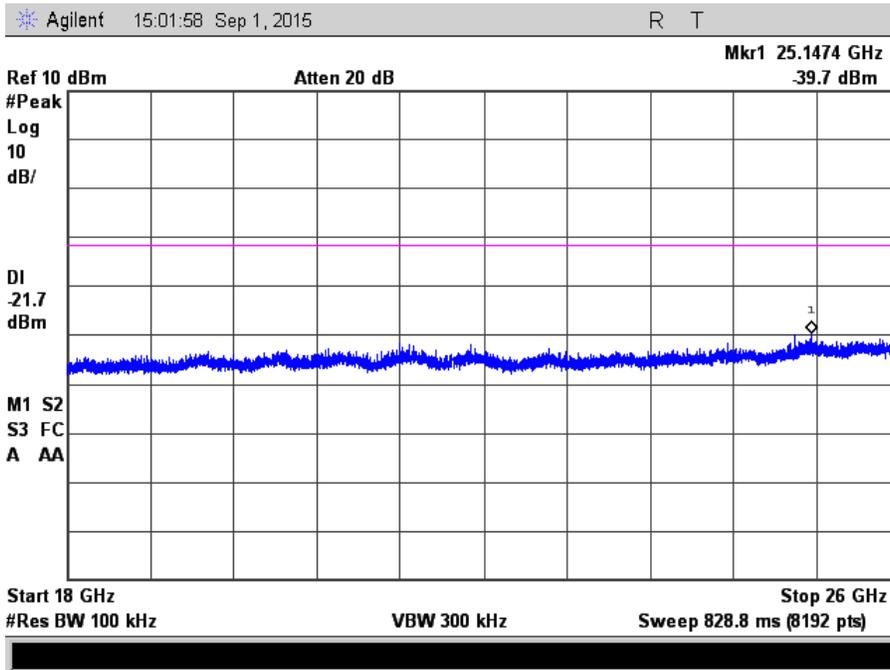


Figure 7.4.2.2-20: 18 GHz –26 GHz – Middle Channel ($\pi/4$ DQPSK)

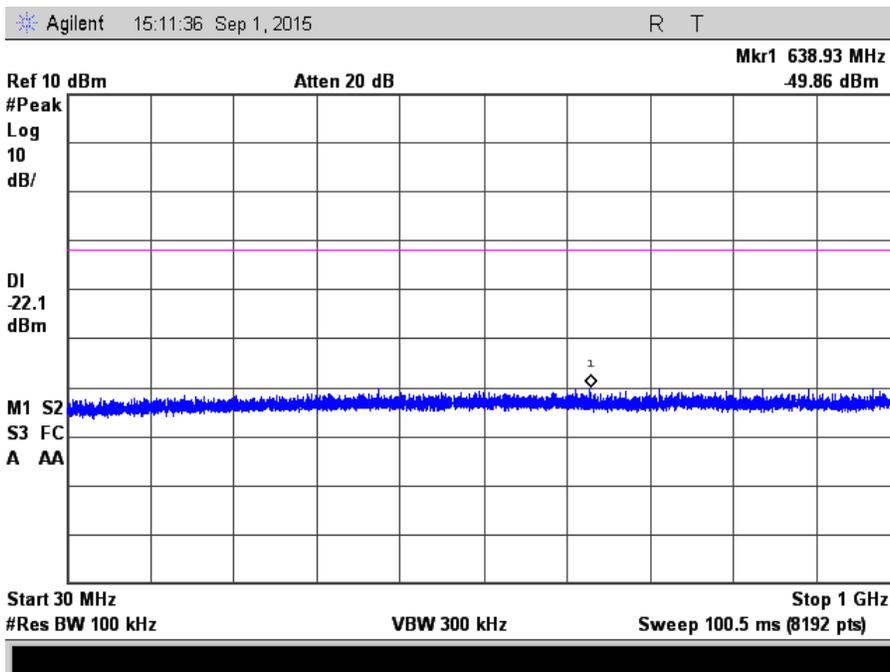


Figure 7.4.2.2-21: 30 MHz – 1 GHz – High Channel ($\pi/4$ DQPSK)

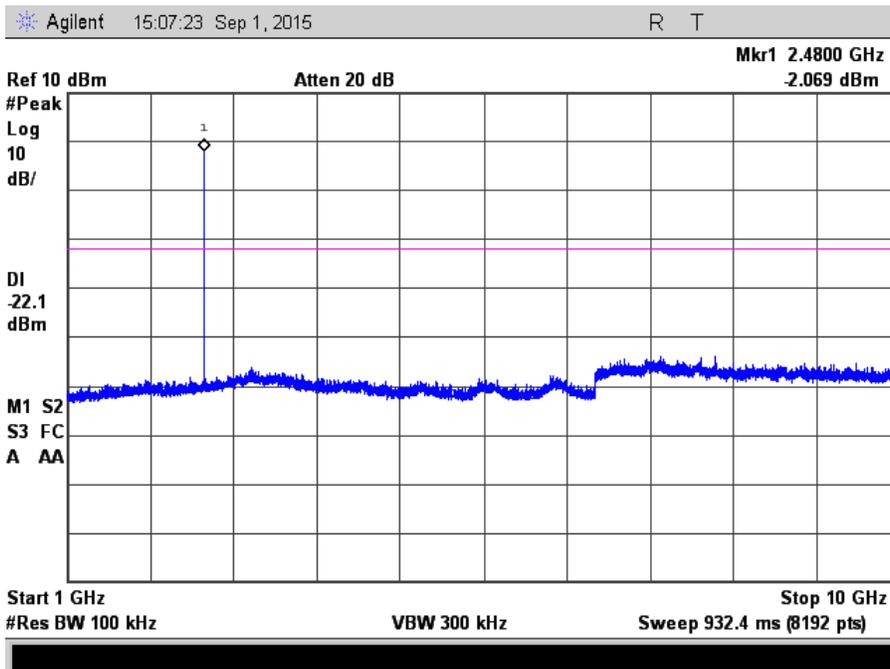


Figure 7.4.2.2-22: 1 GHz –10 GHz –High Channel ($\pi/4$ DQPSK)

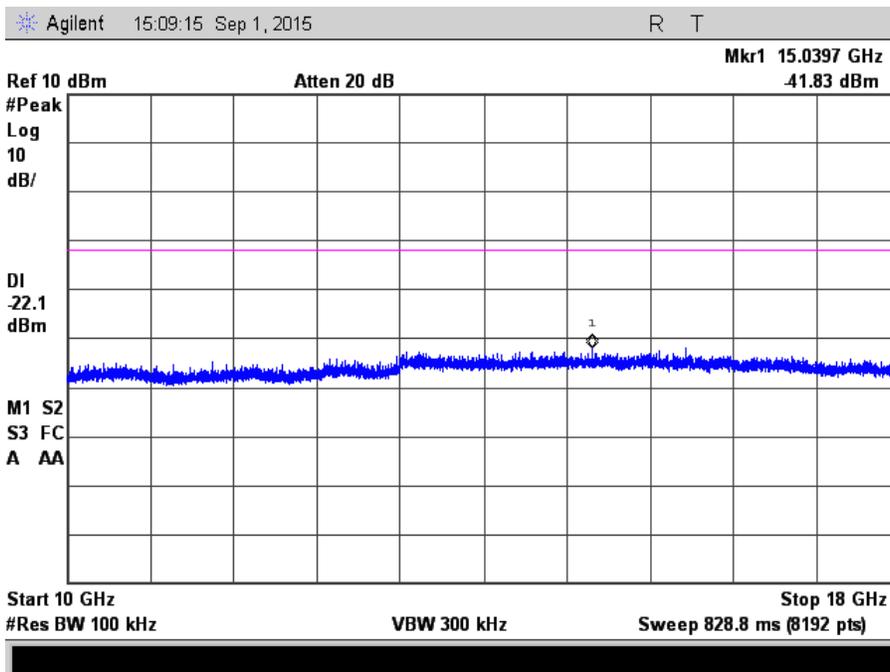


Figure 7.4.2.2-23: 10 GHz –18 GHz – High Channel ($\pi/4$ DQPSK)

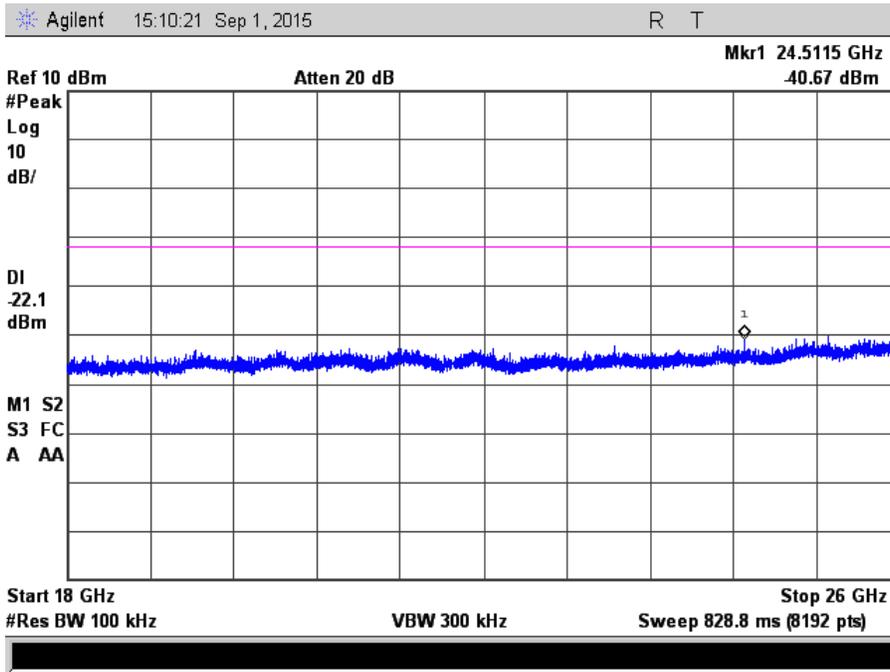


Figure 7.4.2.2-24: 18 GHz –26 GHz – High Channel ($\pi/4$ DQPSK)

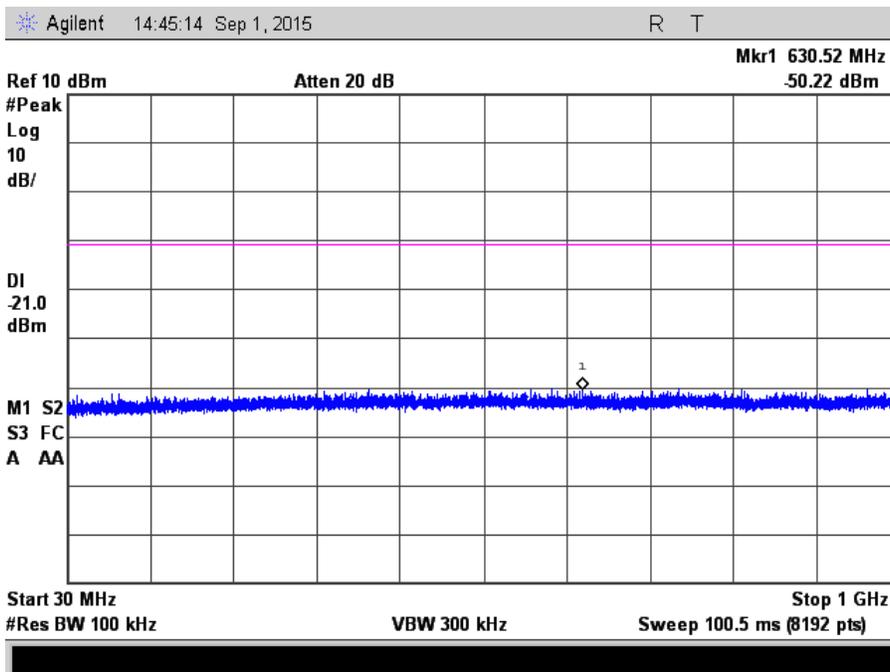


Figure 7.4.2.2-25: 30 MHz – 1 GHz – Low Channel (8DPSK)

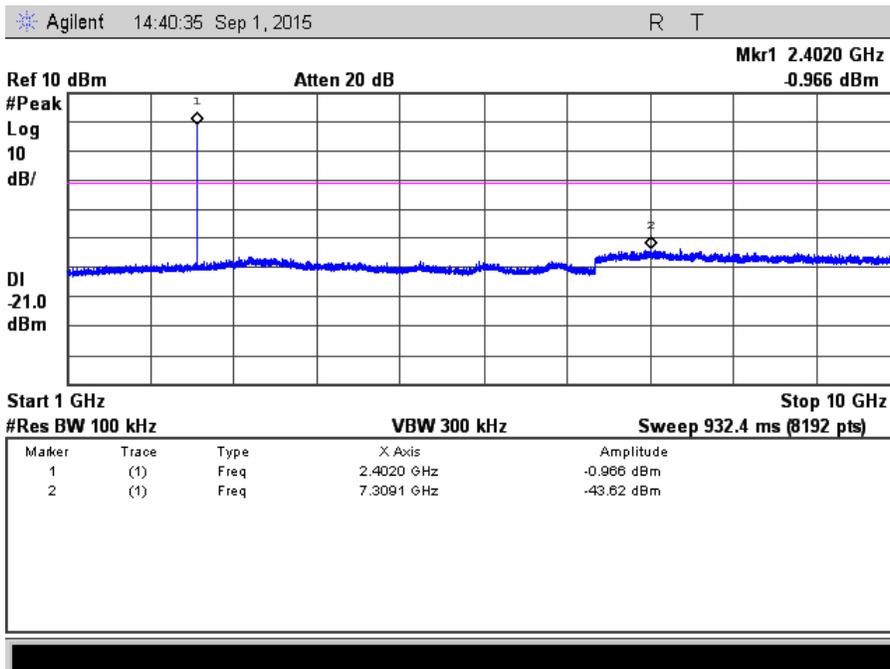


Figure 7.4.2.2-26: 1 GHz –10 GHz – Low Channel (8DPSK)

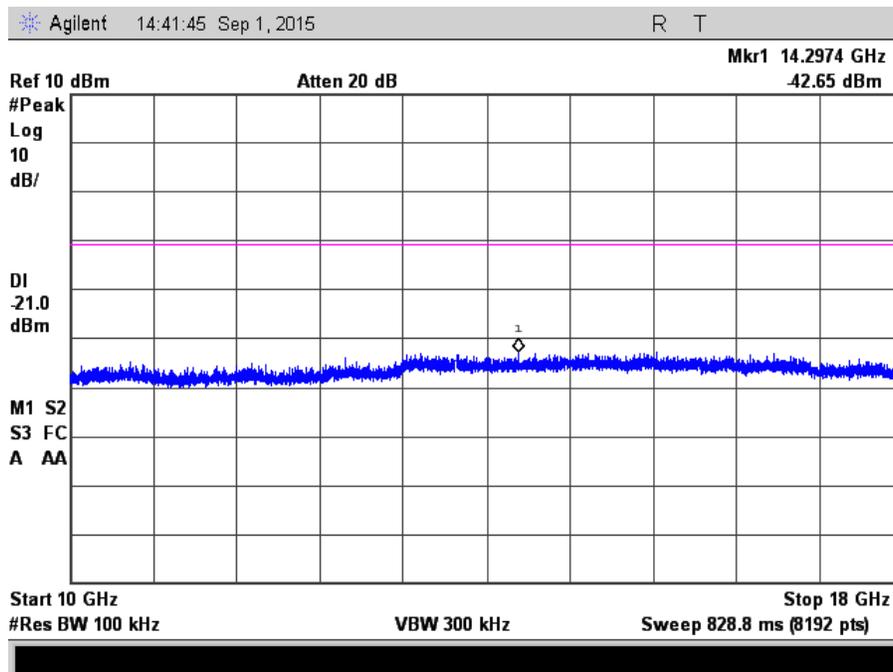


Figure 7.4.2.2-27: 10 GHz –18 GHz – Low Channel (8DPSK)

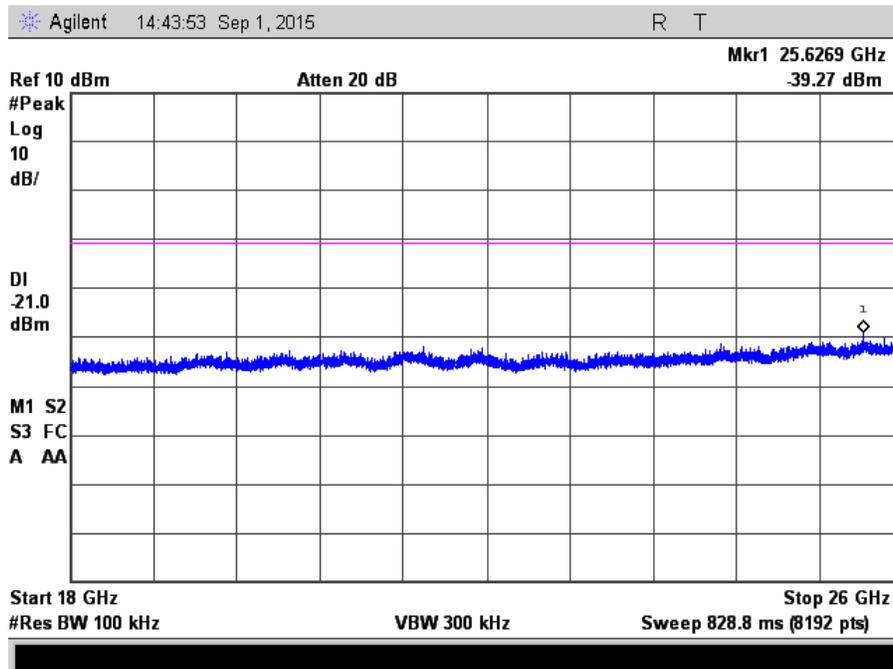


Figure 7.4.2.2-28: 18 GHz –26 GHz – Low Channel (8DPSK)

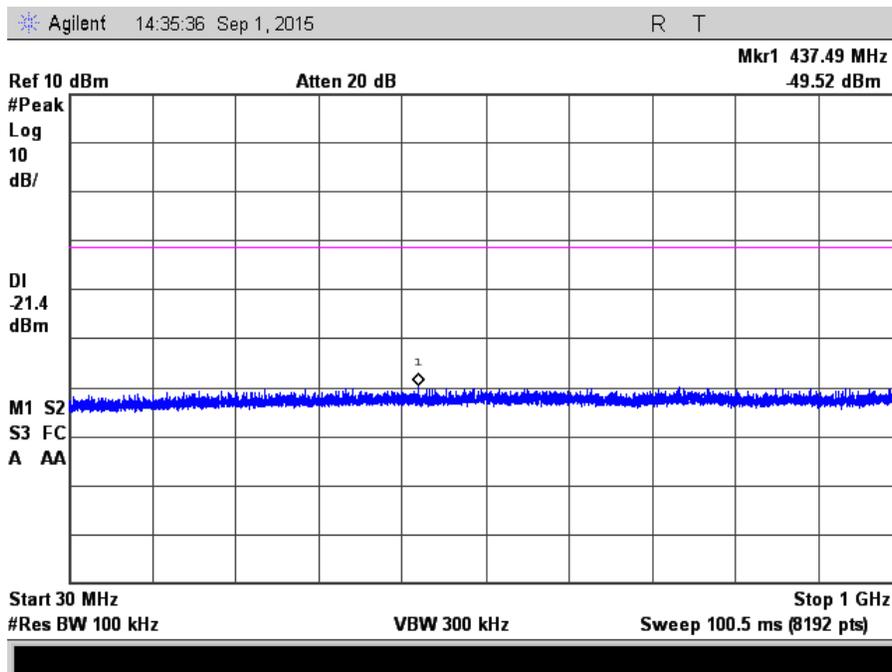


Figure 7.4.2.2-29: 30 MHz – 1 GHz –Middle Channel (8DPSK)

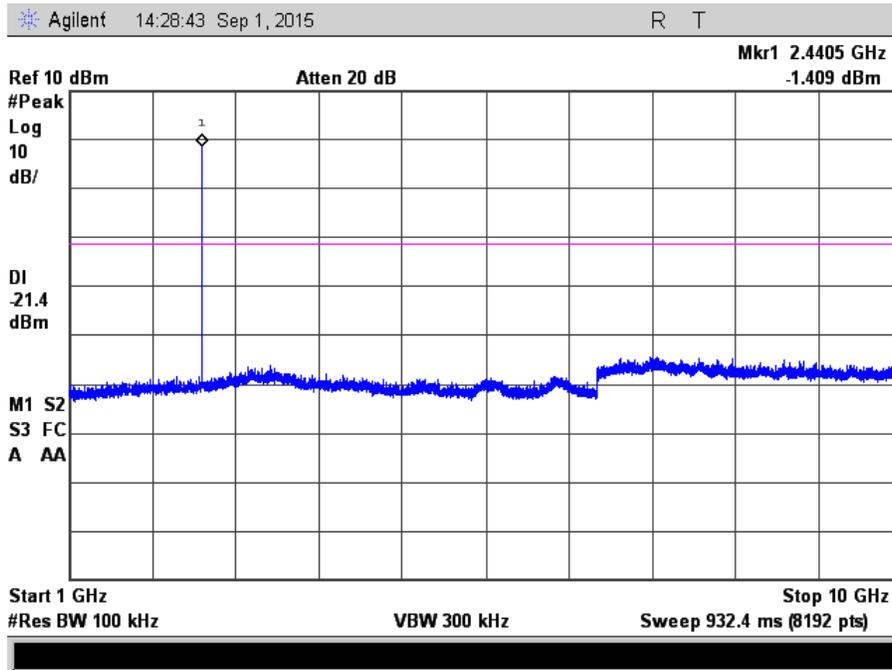


Figure 7.4.2.2-30: 1 GHz –10 GHz – Middle Channel (8DPSK)

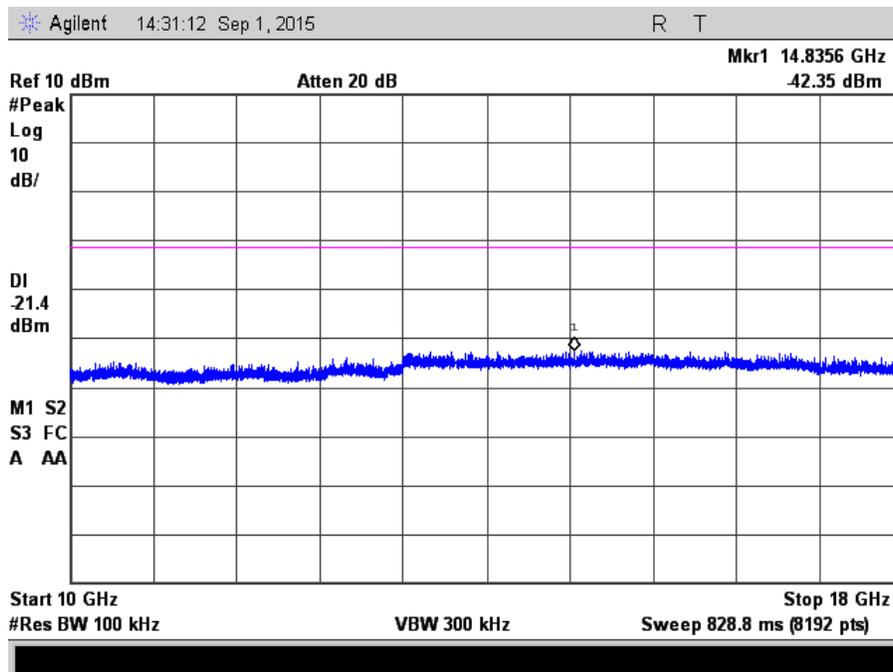


Figure 7.4.2.2-31: 10 GHz -18 GHz - Middle Channel (8DPSK)

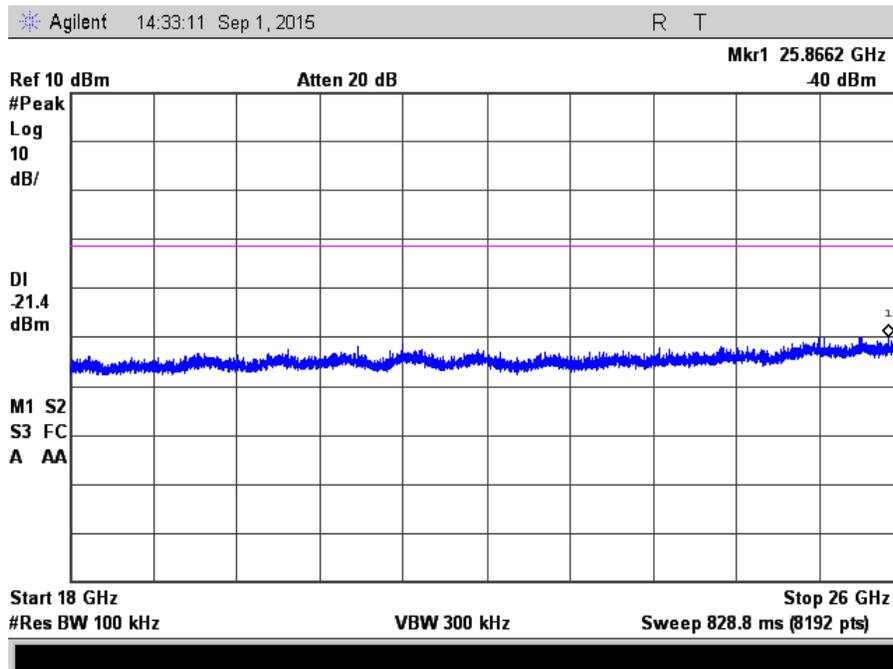


Figure 7.4.2.2-32: 18 GHz -26 GHz - Middle Channel (8DPSK)

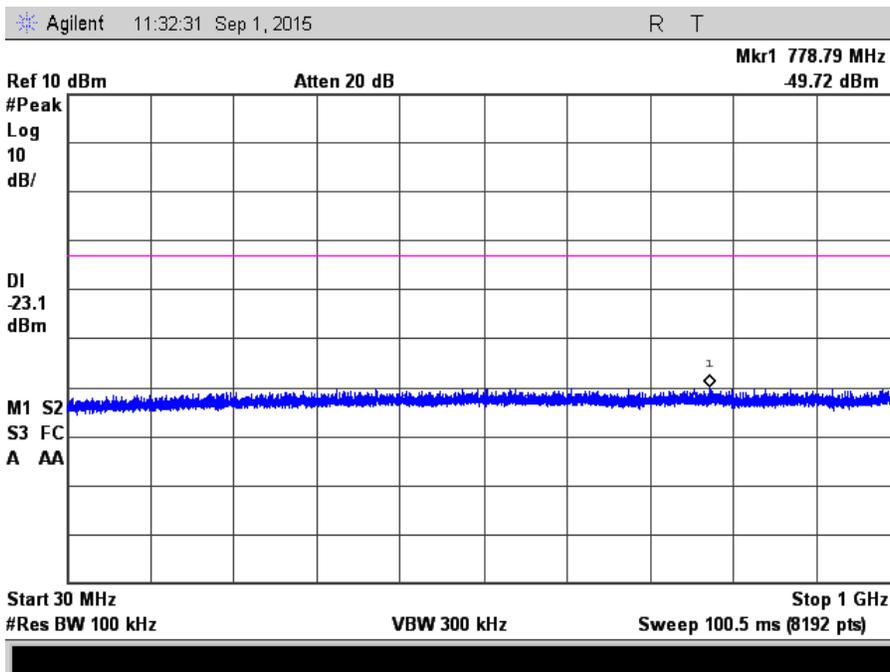


Figure 7.4.2.2-33: 30 MHz – 1 GHz – High Channel (8DPSK)

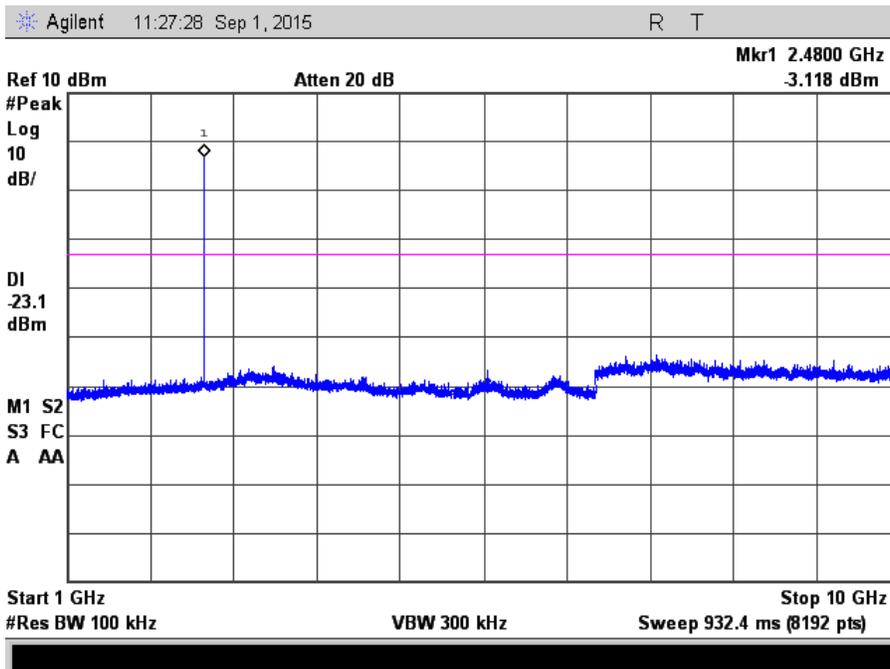


Figure 7.4.2.2-34: 1 GHz –10 GHz –High Channel (8DPSK)

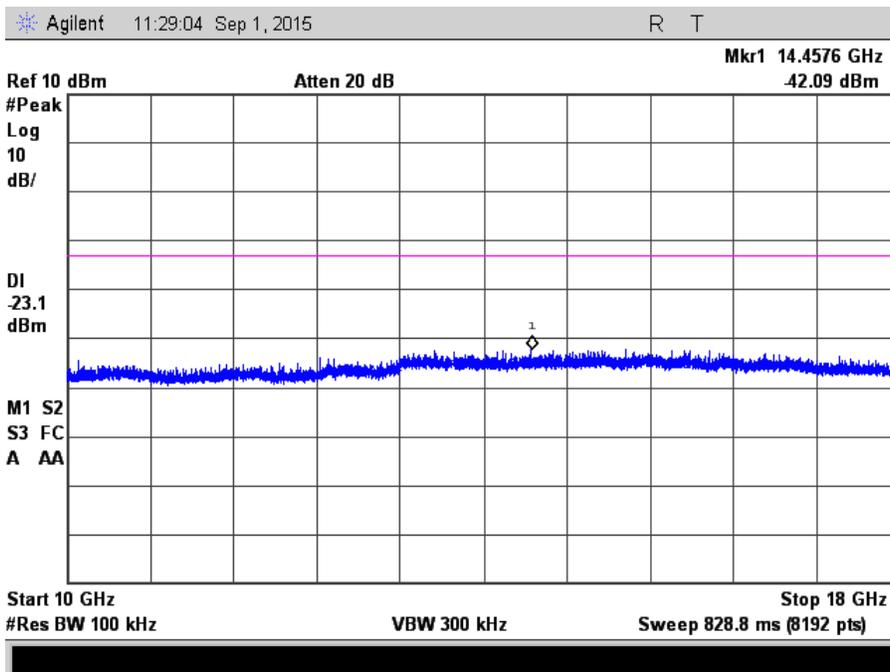


Figure 7.4.2.2-35: 10 GHz –18 GHz – High Channel (8DPSK)

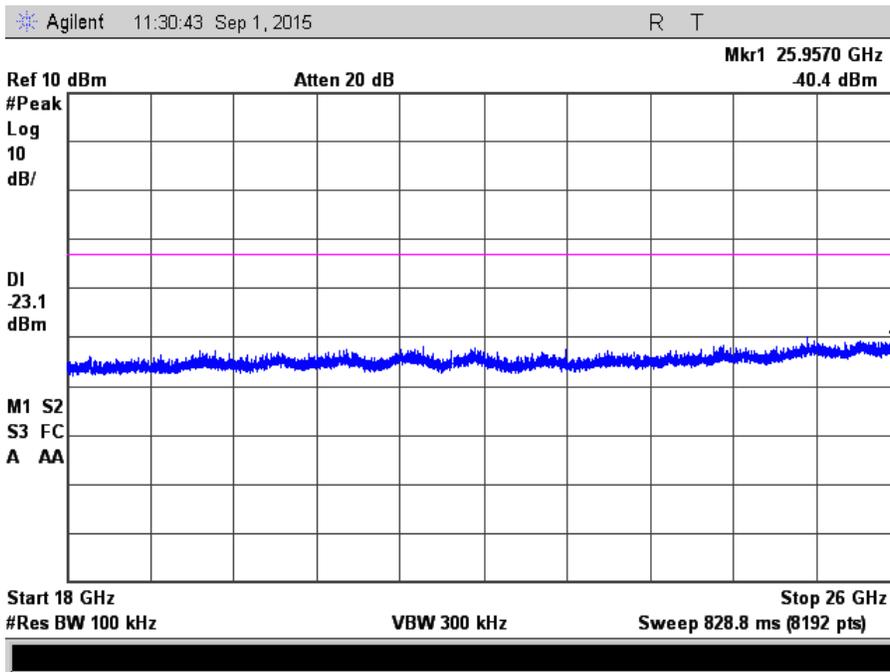


Figure 7.4.2.2-36: 18 GHz –26 GHz – High Channel (8DPSK)

7.4.3 Radiated Spurious Emissions within the Restricted Bands - FCC Sections 15.205, 15.209; IC: RSS-Gen 8.9, 8.10

7.4.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 26 GHz, 10 times the highest fundamental frequency. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

For measurements below 30 MHz, the receive antenna height was set to 1m and the EUT was rotated through 360 degrees. The resolution bandwidth was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

For measurements above 30 MHz, the EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively. Average measurements were collected in the linear amplitude scale with VBW of 30 Hz.

The EUT was caused to generate a continuous carrier signal on the hopping channel.

7.4.3.2 Measurement Results

Band-edge and radiated spurious emissions found in the restricted bands of 9 kHz to 26 GHz are reported in the tables below.

Model GMN-00831

Table 7.4.3.2-1: Radiated Spurious Emissions Tabulated Data - GFSK

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
Noise Floor										
Middle Channel										
7323	47.40	34.28	V	6.20	53.60	40.48	74.0	54.0	20.4	13.5
12205	45.33	32.39	V	13.67	59.00	46.06	83.5	63.5	24.5	17.4
High Channel										
2483.5	59.24	50.78	H	-6.21	53.03	44.57	74.0	54.0	21.0	9.4
2483.5	59.10	50.31	V	-6.21	52.89	44.10	74.0	54.0	21.1	9.9
7440	47.50	33.80	V	6.51	54.01	40.31	74.0	54.0	20.0	13.7

Note: All emissions above 12.21 GHz were attenuated below the limits and the noise floor of the measurement equipment.

Table 7.4.3.2-2: Radiated Spurious Emissions Tabulated Data – (π/4) DQPSK

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2402 MHz										
2362.5	60.03	47.41	V	-6.76	53.27	40.65	74.0	54.0	20.7	13.3
2362.5	60.19	48.68	H	-6.76	53.43	41.92	74.0	54.0	20.6	12.1
2390	58.86	46.00	H	-6.63	52.23	39.37	74.0	54.0	21.8	14.6
4804	46.01	32.62	H	1.60	47.61	34.22	74.0	54.0	26.4	19.8
4804	46.51	32.65	V	1.60	48.11	34.25	74.0	54.0	25.9	19.7
Middle Channel = 2441 MHz										
4882	46.50	33.00	H	1.86	48.36	34.86	74.0	54.0	25.6	19.1
4882	46.23	32.89	V	1.86	48.09	34.75	74.0	54.0	25.9	19.3
7323	46.71	33.41	H	6.20	52.91	39.61	74.0	54.0	21.1	14.4
7323	46.97	33.56	V	6.20	53.17	39.76	74.0	54.0	20.8	14.2
12205	45.38	31.76	V	13.67	59.05	45.43	83.5	63.5	24.5	18.1
High Channel = 2480 MHz										
2483.5	60.10	50.61	H	-6.21	53.89	44.40	74.0	54.0	20.1	9.6
2483.5	59.88	50.39	V	-6.21	53.67	44.18	74.0	54.0	20.3	9.8
4960	46.91	33.13	H	2.11	49.02	35.24	74.0	54.0	25.0	18.8
4960	45.39	32.74	V	2.11	47.50	34.85	74.0	54.0	26.5	19.1
7440	47.27	33.47	V	6.51	53.78	39.98	74.0	54.0	20.2	14.0

Note: All emissions above 12.21 GHz were attenuated below the limits and the noise floor of the measurement equipment.

Table 7.4.3.2-3: Radiated Spurious Emissions Tabulated Data – 8DPSK

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2402 MHz										
2362.975	59.85	48.28	H	-6.76	53.09	41.52	74.0	54.0	20.9	12.5
2362.975	59.17	48.36	V	-6.76	52.41	41.60	74.0	54.0	21.6	12.4
2390	59.67	45.87	V	-6.63	53.04	39.24	74.0	54.0	21.0	14.8
Middle Channel = 2441 MHz										
12205	45.16	31.74	V	13.67	58.83	45.41	83.5	63.5	24.7	18.1
High Channel = 2480 MHz										
2483.5	60.36	50.85	H	-6.21	54.15	44.64	74.0	54.0	19.8	9.4
2483.5	60.05	50.42	V	-6.21	53.84	44.21	74.0	54.0	20.2	9.8

Note: All emissions above 12.21 GHz were attenuated below the limits and the noise floor of the measurement equipment.

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Table 7.4.3.2-5: Radiated Spurious Emissions Tabulated Data - GFSK

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2402 MHz										
4804	45.48	32.69	H	1.60	47.08	34.29	74.0	54.0	26.9	19.7
4804	46.84	34.00	V	1.60	48.44	35.60	74.0	54.0	25.6	18.4
12010	45.37	32.79	H	13.57	58.94	46.36	83.5	63.5	24.6	17.1
12010	6.81	35.00	V	13.57	20.38	48.57	83.5	63.5	63.1	14.9
Middle Channel = 2441 MHz										
4882	45.86	32.36	V	1.86	47.72	34.22	74.0	54.0	26.3	19.8
7323	47.59	35.29	H	6.20	53.79	41.49	74.0	54.0	20.2	12.5
7323	49.51	39.97	V	6.20	55.71	46.17	74.0	54.0	18.3	7.8
12205	44.61	31.66	H	13.67	58.28	45.33	83.5	63.5	25.2	18.2
12205	46.14	33.68	V	13.67	59.81	47.35	83.5	63.5	23.7	16.2
High Channel = 2480 MHz										
2483.5	57.55	44.92	H	-6.21	51.34	38.71	74.0	54.0	22.7	15.3
2483.5	58.36	45.04	V	-6.21	52.15	38.83	74.0	54.0	21.8	15.2
4960	46.36	33.03	V	2.11	48.47	35.14	74.0	54.0	25.5	18.9
7440	47.37	34.22	H	6.51	53.88	40.73	74.0	54.0	20.1	13.3
7440	48.79	37.12	V	6.51	55.30	43.63	74.0	54.0	18.7	10.4
12400	43.86	31.22	H	13.76	57.62	44.98	83.5	63.5	25.9	18.5
12400	45.96	33.88	V	13.76	59.72	47.64	83.5	63.5	23.8	15.9

Note: All emissions above 12.4 GHz were attenuated below the limits and the noise floor of the measurement equipment.

Table 7.4.3.2-6: Radiated Spurious Emissions Tabulated Data – (π/4) DQPSK

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2402 MHz										
4804	46.04	33.39	H	1.60	47.64	34.99	74.0	54.0	26.4	19.0
4804	47.17	35.49	V	1.60	48.77	37.09	74.0	54.0	25.2	16.9
12010	44.24	32.81	V	13.57	57.81	46.38	83.5	63.5	25.7	17.1
Middle Channel = 2441 Mz										
4882	46.99	34.25	H	1.86	48.85	36.11	74.0	54.0	25.2	17.9
4882	46.97	36.42	V	1.86	48.83	38.28	74.0	54.0	25.2	15.7
7323	46.98	34.72	H	6.20	53.18	40.92	74.0	54.0	20.8	13.1
7323	48.40	38.44	V	6.20	54.60	44.64	74.0	54.0	19.4	9.4
12205	44.83	32.39	V	13.67	58.50	46.06	83.5	63.5	25.0	17.4
High Channel = 2480 MHz										
2483.5	58.29	44.94	H	-6.21	52.08	38.73	74.0	54.0	21.9	15.3
2483.5	57.75	45.11	V	-6.21	51.54	38.90	74.0	54.0	22.5	15.1
4960	46.11	33.54	H	2.11	48.22	35.65	74.0	54.0	25.8	18.3
4960	48.51	37.65	V	2.11	50.62	39.76	74.0	54.0	23.4	14.2
7440	46.29	33.75	H	6.51	52.80	40.26	74.0	54.0	21.2	13.7
7440	47.31	35.65	V	6.51	53.82	42.16	74.0	54.0	20.2	11.8
12400	44.50	31.81	V	13.76	58.26	45.57	83.5	63.5	25.2	17.9

Note: All emissions above 12.4 GHz were attenuated below the limits and the noise floor of the measurement equipment.

Table 7.4.3.2-7: Radiated Spurious Emissions Tabulated Data – 8DPSK

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2402 MHz										
4804	46.15	33.54	H	1.60	47.75	35.14	74.0	54.0	26.2	18.9
4804	47.77	35.69	V	1.60	49.37	37.29	74.0	54.0	24.6	16.7
12010	45.20	32.65	V	13.57	58.77	46.22	83.5	63.5	24.7	17.3
Middle Channel = 2441 MHz										
4882	46.83	34.23	H	1.86	48.69	36.09	74.0	54.0	25.3	17.9
4882	47.30	36.02	V	1.86	49.16	37.88	74.0	54.0	24.8	16.1
7323	47.42	34.63	H	6.20	53.62	40.83	74.0	54.0	20.4	13.2
7323	48.82	38.28	V	6.20	55.02	44.48	74.0	54.0	19.0	9.5
12205	44.69	31.97	V	13.67	58.36	45.64	83.5	63.5	25.1	17.9
High Channel = 2480 MHz										
2483.5	57.21	44.68	H	-6.21	51.00	38.47	74.0	54.0	23.0	15.5
2483.5	57.15	44.96	V	-6.21	50.94	38.75	74.0	54.0	23.1	15.2
4960	45.96	34.16	H	2.11	48.07	36.27	74.0	54.0	25.9	17.7
4960	48.45	37.90	V	2.11	50.56	40.01	74.0	54.0	23.4	14.0
7440	46.03	33.67	H	6.51	52.54	40.18	74.0	54.0	21.5	13.8
7440	47.50	35.47	V	6.51	54.01	41.98	74.0	54.0	20.0	12.0
12400	44.16	31.63	V	13.76	57.92	45.39	83.5	63.5	25.6	18.1

Note: All emissions above 12.4 GHz were attenuated below the limits and the noise floor of the measurement equipment.

7.4.3.3 Sample Calculation:

$$R_C = R_U + CF_T$$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: PeakCorrected Level: $47.4 + 6.2 = 53.6$ dB μ V/mMargin: 74 dB μ V/m – 53.6 dB μ V/m = 20.4 dB**Example Calculation: Average**Corrected Level: $34.28 + 6.2 = 40.48$ dB μ V/mMargin: 54 dB μ V/m – 40.48 dB μ V/m = 13.5 dB**8 CONCLUSION**

In the opinion of ACS, Inc., the model GMN-00831, GMN-00871 manufactured by Garmin International meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-247 for the test procedures documented in the test report.

END REPORT