# FCC Test Report

| | |
|---|---|
| **FCC Rule(s):** | FCC Part 15.247 |
| **Applicant:** | Sonnenschein(Shenzhen) Ind. Co., Ltd. |
| **Product Name:** | Bluetooth Headphone Receiver Adapter |
| **Model:** | GC42924 |
| **FCC ID:** | 2AI8V-GC42924 |
| **Report No.:** | ZKS160700019E |
| **Tested Date:** | 2016-07-08 to 2016-07-22 |
| **Issued Date:** | 2016-07-26 |
| **Tested By :** | William Liu (Engineer) |
| **Approved By:** | Lahm Peng (Manager) |
| **Prepared By:** | |

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# 1. General Information

## 1.1 Product Information

| **Applicant and Manufacturer** | |
|---|---|
| Applicant: | Sonnenschein(Shenzhen) Ind. Co., Ltd. |
| Address of Applicant: | Building 5, Baishixia New Development Zone, Fuyong Town, Baoan |
| | District, Shenzhen City, Guangdong Province, China |
| | |
| Manufacturer: | Sonnenschein(Shenzhen) Ind. Co., Ltd. |
| Address of Manufacturer: | Building 5, Baishixia New Development Zone, Fuyong Town, Baoan |
| | District, Shenzhen City, Guangdong Province, China |
| | |

| **General Description of EUT** | |
|---|---|
| Product Name: | Bluetooth Headphone Receiver Adapter |
| Model No.: | GC42924 |
| Trade Name: | Griffin |
| Adding Model(s): | BR1001 |
| Class of Equipment: | DSS |
| Rated Voltage: | DC 3.7V by battery, and DC 5V by USB |
| Frequency Range: | 2402-2480MHz |
| Bluetooth Version: | V4.1 (BR+EDR) |
| Modulation: | GFSK, Pi/4 DQPSK, 8DPSK |
| Type of Antenna: | PCB Antenna |
| Antenna Gain: | 2.3 dBi |
| Note 1: The test data is gathered from a production sample, provided by the manufacturer.<br>Note 2: Added model BR1001 basis of the original product GC42924, the model are same to original model only for different model name, and the circuitry, electrical design and the construction are the same. | |

## 1.2 Compliance Standards

| **Compliance Standards or Rules** | |
|---|---|
| FCC Part 15 Subpart C | FEDERAL COMMUNICATIONS COMMISSION, RADIO FREQUENCY DEVICES, Intentional Radiators |
| FCC Part 15.247 | Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz. |
| The objective of the manufacturer or applicant is to demonstrate compliance with the above standards. | |
| According to standards for test methodology | |
| ANSI C63.10-2013 | American National Standard for Testing Unlicensed Wireless Devices Accredited Standards Committee C63®—Electromagnetic Compatibility |
| All measurements contained in this report were conducted with all above standards | |
| Maintenance of compliance is the responsibility of the manufacturer or applicant. Any modification of the product, which result is lowering the emission, should be checked to ensure compliance has been maintained. | |

## 1.3 Test Facilities

| **Testing Lab: Shenzhen BALUN Technology Co., Ltd.** |
|---|
| |
| The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is **L6791**. |
| The laboratory has been listed by US Federal Communications Commission to perform electromagnetic emission measurements. The recognition numbers of test site are **832625**. |
| The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are **11524A-1**. |
| |
| All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055 |

## 1.4 Test Setup Information

| List of Test Modes | | | |
|---|---|---|---|
| Test Mode | Description | Remark | |
| TM1 | Low Channel | 2402MHz | |
| TM2 | Middle Channel | 2441MHz | |
| TM3 | High Channel | 2480MHz | |
| TM4 | Hopping | 2402-2480MHz | |
| TM5 | Charging | Through USB Charging | |
| List and Details of Auxiliary Equipment | | | |
| Description | Manufacturer | Model | Serial Number |
| AC Adapter | HUAWEI | HW-050100C2W | -- |
| Notebook | Lenovo | G405S | -- |
| Conversion Board | ZRLK | Serial-USB | -- |
| Note 1: The equipment under test (EUT) was configured to measure its highest possible emission level.<br>Note 2: The test modes were adapted according to the operation manual for use.<br>Note 3: The equipment under test (EUT) was tested under fully-charged battery. | | | |

| Modulation Configure | | | |
|---|---|---|---|
| Modulation | Packet | Packet Type | Packet Size |
| GFSK | DH1 | 4 | 27 |
| | DH3 | 11 | 183 |
| | DH5 | 15 | 339 |
| Pi/4 DQPSK | 2DH1 | 20 | 54 |
| | 2DH3 | 26 | 367 |
| | 2DH5 | 30 | 379 |
| 8DPSK | 3DH1 | 24 | 83 |
| | 3DH3 | 27 | 552 |
| | 3DH5 | 31 | 1021 |
| Note 1: The Bluetooth has been tested on the modulation of GFSK, (Pi/4)DQPSK and 8DPSK, compliance test and record the worst case.<br>Note 2: The Bluetooth has been tested under continuous transmission mode.<br>Note 3: The Bluetooth is connected to PC through a serial to USB conversion board, and to use a test set software to control the Bluetooth device work in different modes, e.g. GFSK, Pi/4 DQPSK, 8DPSK etc. | | | |

## 1.5 Measurement Uncertainty

| Parameter | Conditions | Uncertainty |
|---|---|---|
| Conducted Emissions | 9kHz ~30MHz | ±2.79 dB |
| Radiated Emissions | 9kHz ~ 30MHz | ±4.12 dB |
| | 30MHz ~ 1GHz | ±4.16 dB |
| | 1GHz ~ 18GHz | ±5.97dB |
| | 18GHz ~ 26.5GHz | ±6.71dB |

## 1.6 List of Test and Measurement Instruments

| Description | Manufacturer | Model | Serial Number | Due. Date |
|---|---|---|---|---|
| EMI Receiver | ROHDE&SCHWARZ | ESRP | 101036 | 2017-07-04 |
| Test Antenna-Bi-Log | SCHWARZBECK | VULB 9163 | 9163-624 | 2017-07-21 |
| Test Antenna-Horn | SCHWARZBECK | BBHA 9120D | 9120D-1148 | 2017-07-21 |
| Test Antenna-Loop | SCHWARZBECK | FMZB 1519 | 1519-037 | 2017-07-21 |
| Anechoic Chamber | RAINFORD | 9m*6m*6m | N/A | 2017-02-27 |
| Spectrum Analyzer | Agilent | E4407B | US40521006 | 2017-07-04 |
| Amplifier | Mini-Circuits | ZHL-42W+ | N/A | 2017-07-04 |
| Wideband Amplifier | Mini-Circuits | ZVA-213-S+ | N/A | 2017-07-04 |
| Test Cable | BALUN | BLEMC001 | N/A | 2017-07-04 |
| LISN | SCHWARZBECK | NSLK 8127 | 8127-687 | 2017-07-04 |
| Temporary Antenna Connector | ZRLK | SMA-01 | N/A | 2017-07-04 |
| Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list. | | | | |

## 2. Summary of Test Results

| FCC Rules | Description of Test Items | Result |
|---|---|---|
| FCC Part 2.1093 | RF Exposure | Passed |
| FCC Part 15.203, FCC Part 15.247(b)(4)(i) | Antenna Requirement | Passed |
| FCC Part 15.205 | Restricted Band of Operation | Passed |
| FCC Part 15.207(a) | Conducted Emission | Passed |
| FCC Part 15.209(a) | Radiated Spurious Emissions | Passed |
| FCC Part 15.247(a)(1)(iii) | Quantity of Hopping Channel | Passed |
| FCC Part 15.247(a)(1) | Channel Separation | Passed |
| FCC Part 15.247(a)(1)(iii) | Time of Occupancy (Dwell time) | Passed |
| FCC Part 15.247(a) | 20dB Bandwidth | Passed |
| FCC Part 15.247(b)(1) | RF Power Output | Passed |
| FCC Part 15.247(d) | Band Edge (Out of Band Emissions) | Passed |
| FCC Part 15.247(a)(1) | Frequency Hopping Sequence | Passed |
| FCC Part 15.247(g), (h) | Frequency Hopping System | Passed |
| Passed: The EUT complies with the essential requirements in the standard<br>Failed: The EUT does not comply with the essential requirements in the standard<br>N/A: Not applicable | | |

# 3. RF Exposure

## 3.1 Standard and Limit

According to FCC Part 1.1307 and FCC Part 2.1093, the portable transmitter must comply the RF exposure requirements.

## 3.2 Test Result

This product complied with the requirement of the RF exposure, Please see the RF Exposure Report.

# 4. Antenna Requirement

## 4.1 Standard and Limit

According to FCC Part 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

## 4.2 Test Result

This product has a permanent antenna (PCB antenna), fulfill the requirement of this section.

# 5. Frequency Hopping System Requirements

## 5.1 Standard and Limit

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly 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.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

## 5.2 Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with a bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements FCC Part 15.247 rule.

## 5.3 EUT Pseudorandom Frequency Hopping Sequence

Pseudorandom Frequency Hopping Sequence Table as below:
Channel: 08, 24, 40, 56, 34, 51, 72, 09, 01, 64, 22, 33, 41, 32, 47, 65, 73, 53, 69, 06, 17, 04, 20, 36, 52, 38, 66, 70, 78, 68, 76, 21, 29, 10, 26, 49, 00, 58, 44, 59, 75, 13, 03, 14, 11, 35, 43, 37, 50, 61, 77, 55, 71, 02, 23, 07, 27, 39, 54, 46, 48, 15, 63, 62, 67, 25, 31, 12, 28, 19, 60, 42, 57, 74, 16, 05, 18, 30, 45, etc.

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

# 6. Quantity of Hopping Channels and Channel Separation

## 6.1 Standard and Limit

According to FCC 15.247(a)(1), 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, and frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

## 6.2 Test Procedure

According to the ANSI C63.10, the number of hopping frequencies test method as follows.

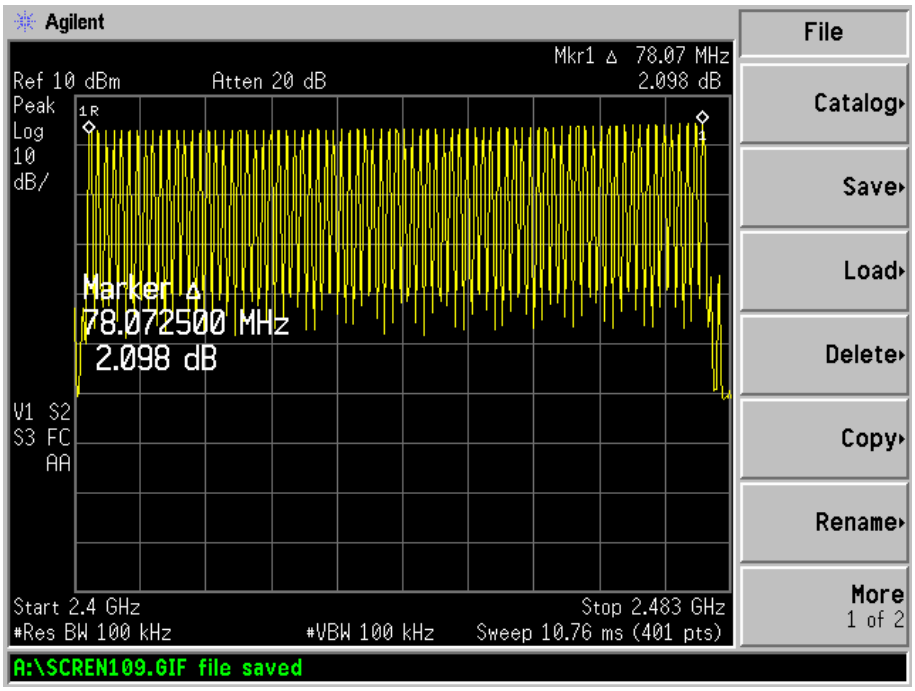
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Set span = the frequency band of operation (2400MHz to 2483.5MHz)
RBW = 100kHz, VBW = 100kHz
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize, observed the band of 2400MHz to 2483.5MHz, than count it out the number of channels for comparing with the FCC rules.

The channel spacing test method as follows:

Set span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span
Video (or Average) Bandwidth (VBW) ≥ RBW
Sweep = auto; Detector function = peak; Trace = max hold
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.

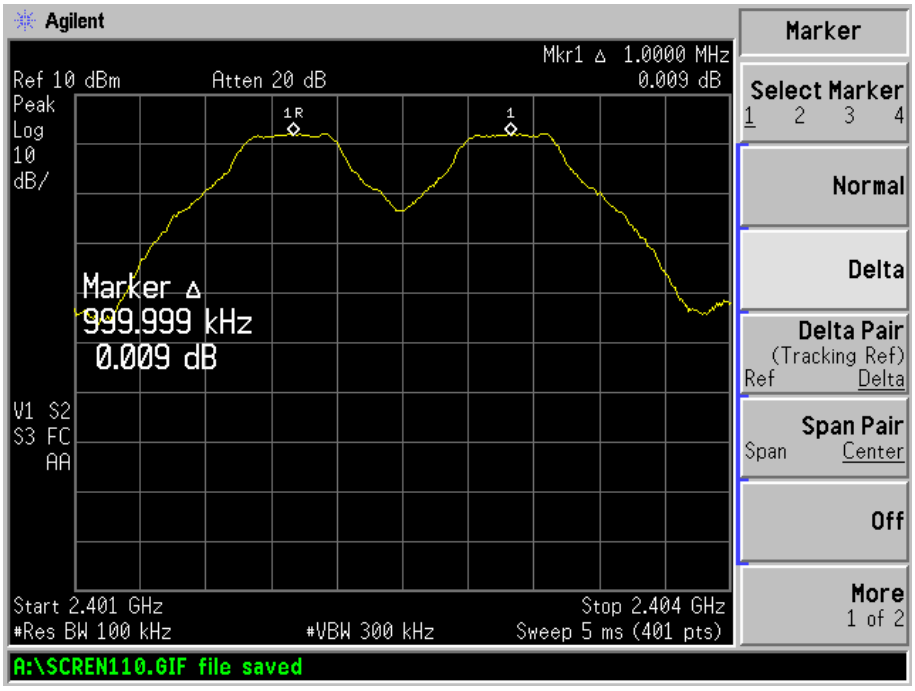
## 6.3 Test Data and Results

No. of Channel = 79 (GFSK mode)

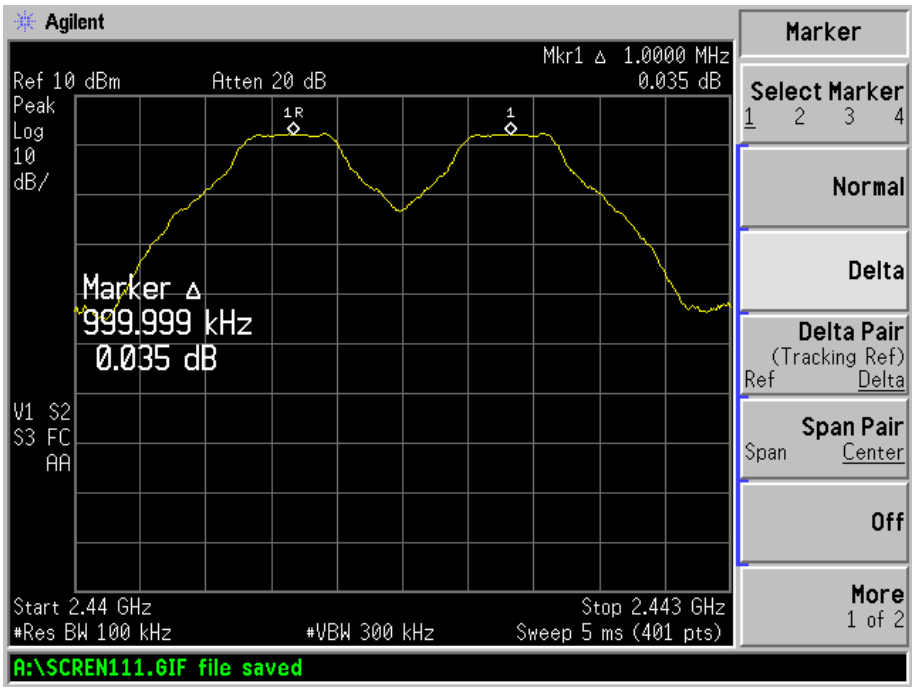



For GFSK mode

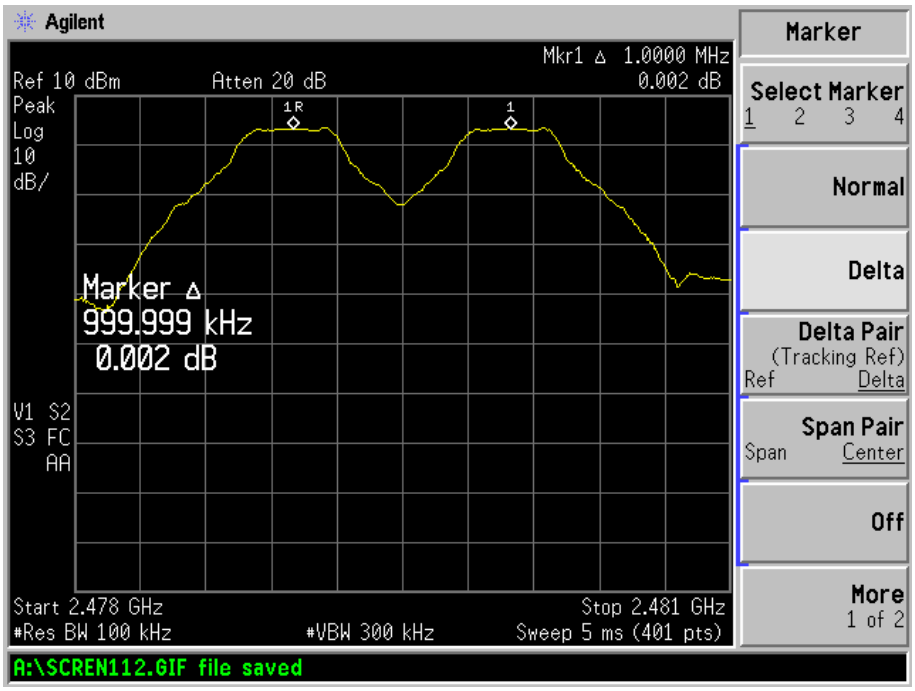
Channel Spacing (Low CH=1MHz)



Channel Spacing (Middle CH=1MHz)

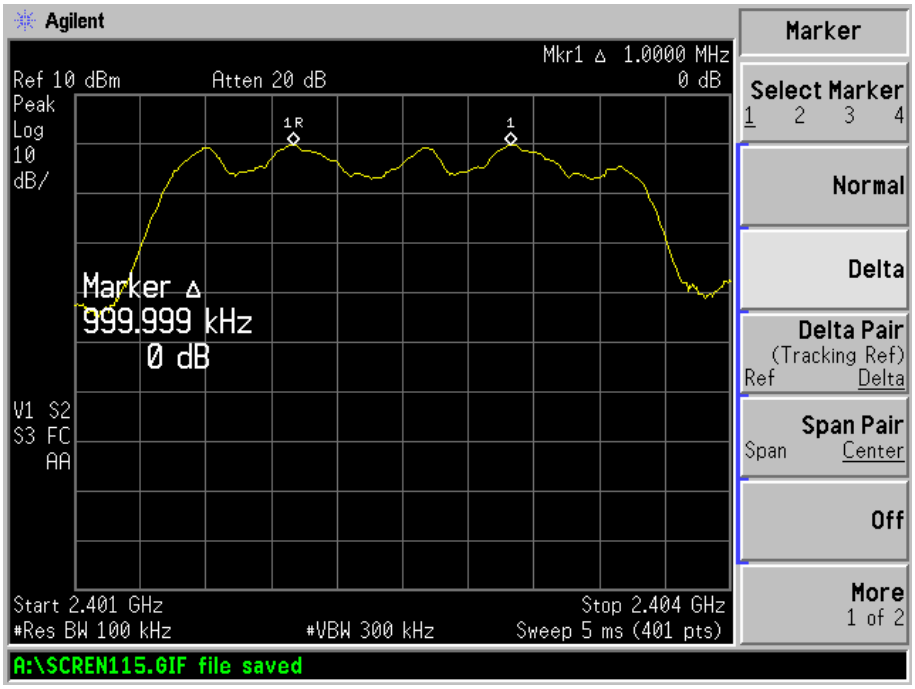



Channel Spacing (High CH=1MHz)

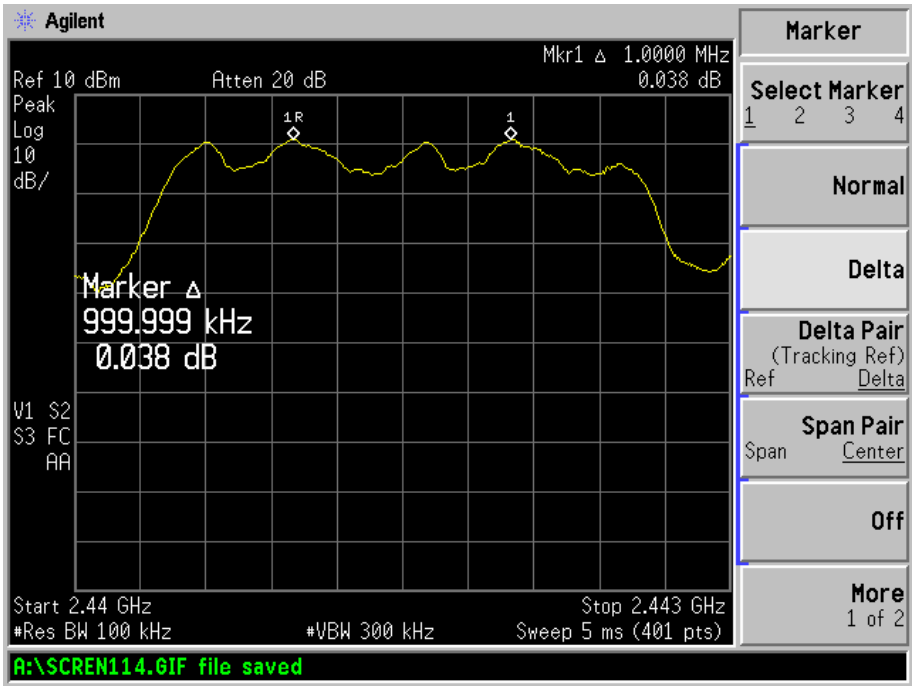


For 8DPSK mode

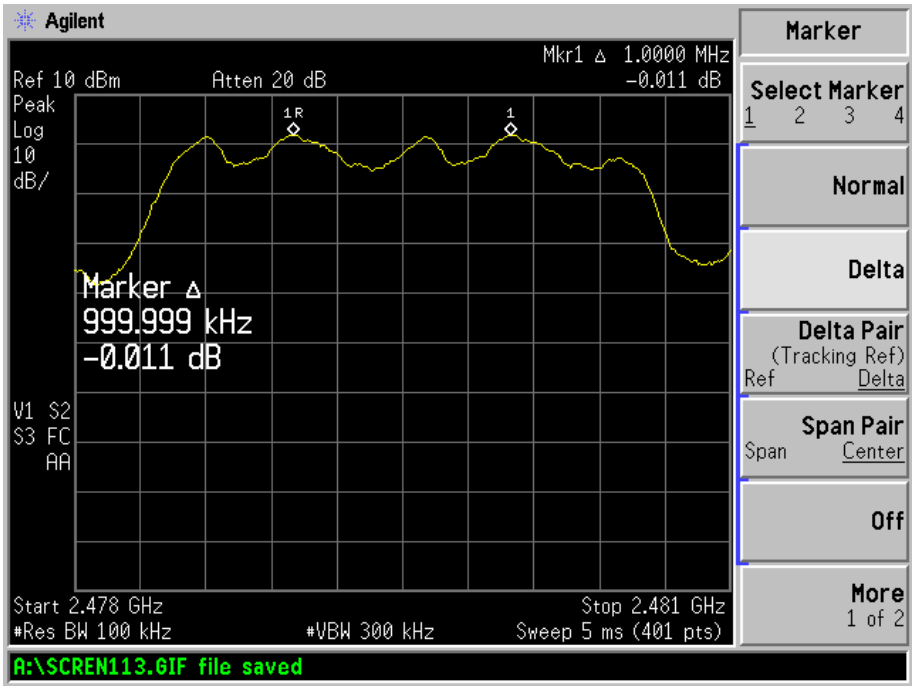
Channel Spacing (Low CH=1MHz)




Channel Spacing (Middle CH=1MHz)



Channel Spacing (High CH=1MHz)



# 7. Dwell Time of Hopping Channel

## 7.1 Standard and Limit

According to 15.247(a)(1)(iii), 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.

## 7.2 Test Procedure

According to the ANSI C63.10, the dwell time of a hopping channel test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Span = zero span, centered on a hopping channel
RBW = 1 MHz
VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold
Use the marker-delta function to determine the dwell time

## 7.3 Test Data and Results

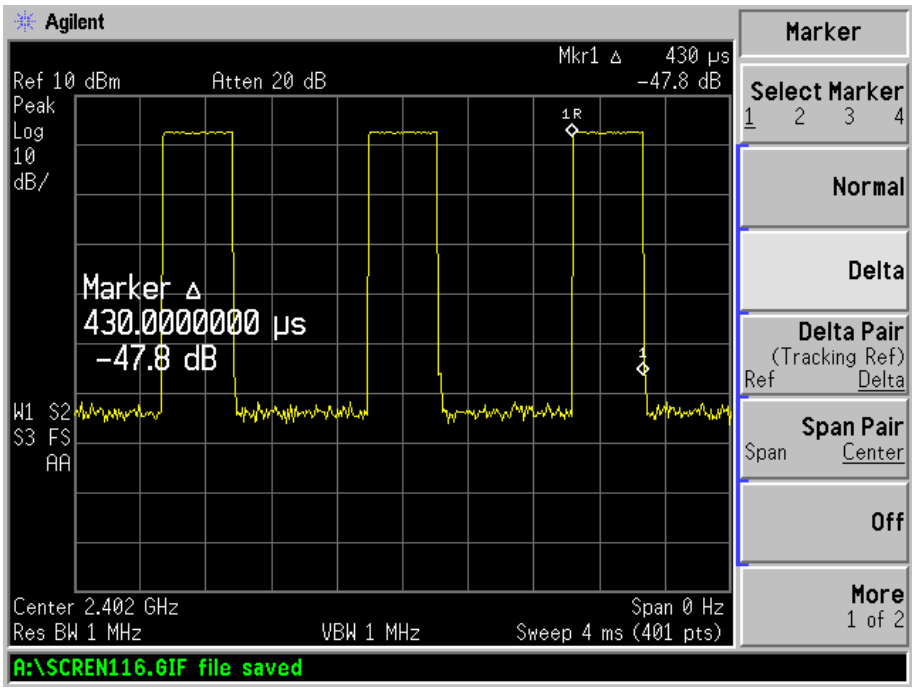
The dwell time within a period in data mode is independent from the packet type (packet length).
Test data is corrected with the worse case, which the packet length is DH1, DH3, and DH5.

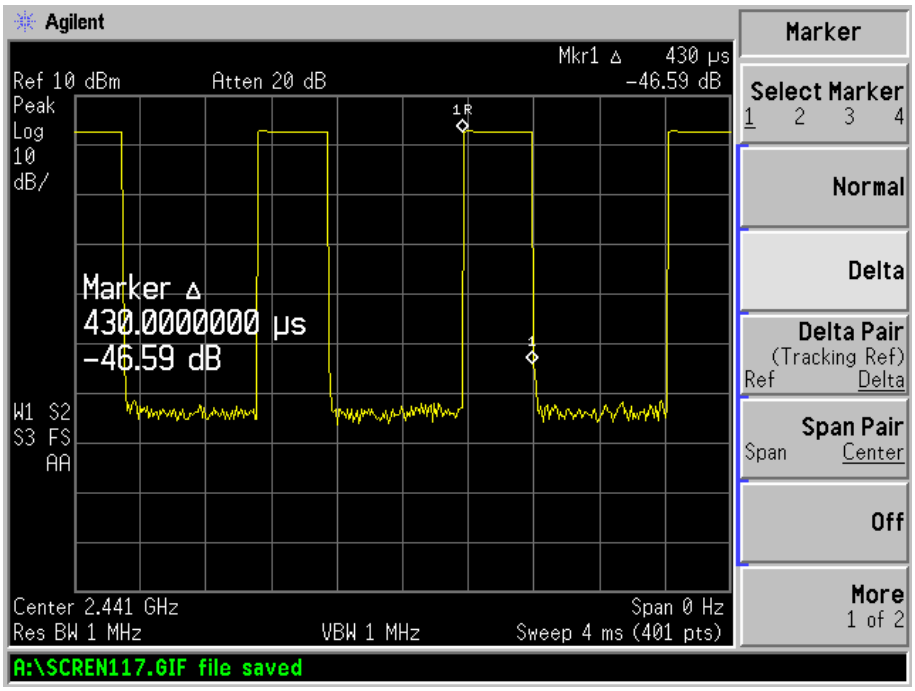
The test period: T = 0.4 Second * 79 Channel = 31.6 s
Dwell time = time slot length * (Hopping rate / Number of hopping channels) * Period

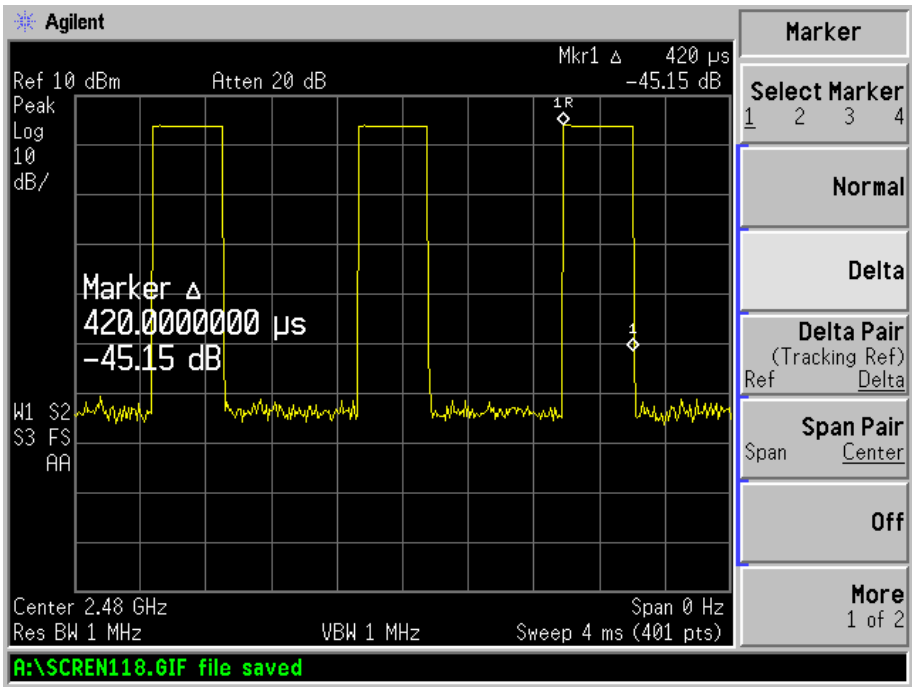
| Modulation | Test Channel | Packet | Time Slot Length | Dwell Time | Limit |
|---|---|---|---|---|---|
| | | | ms | ms | ms |
| GFSK | 2402MHz | DH1 | 0.43 | 137.6 | 400 |
| | | DH3 | 1.69 | 270.4 | 400 |
| | | DH5 | 2.938 | 313.4 | 400 |
| | 2441MHz | DH1 | 0.43 | 137.6 | 400 |
| | | DH3 | 1.69 | 270.4 | 400 |
| | | DH5 | 2.938 | 313.4 | 400 |
| | 2480MHz | DH1 | 0.42 | 134.4 | 400 |
| | | DH3 | 1.69 | 270.4 | 400 |
| | | DH5 | 2.938 | 313.4 | 400 |
| 8DPSK | 2402MHz | 3DH1 | 0.44 | 140.8 | 400 |
| | | 3DH3 | 1.69 | 270.4 | 400 |
| | | 3DH5 | 2.938 | 313.4 | 400 |
| | 2441MHz | 3DH1 | 0.43 | 137.6 | 400 |
| | | 3DH3 | 1.69 | 270.4 | 400 |
| | | 3DH5 | 2.938 | 313.4 | 400 |
| | 2480MHz | 3DH1 | 0.44 | 140.8 | 400 |
| | | 3DH3 | 1.69 | 270.4 | 400 |
| | | 3DH5 | 2.95 | 314.7 | 400 |

*Please refer to the test plots as below:*

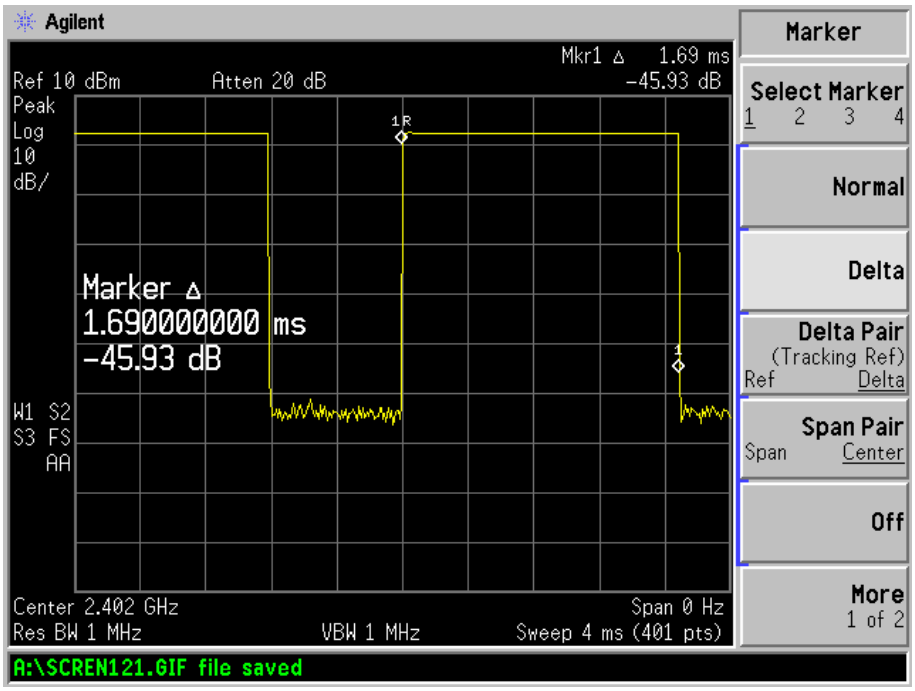
DH1 time slot (Low, Middle, High Channels)

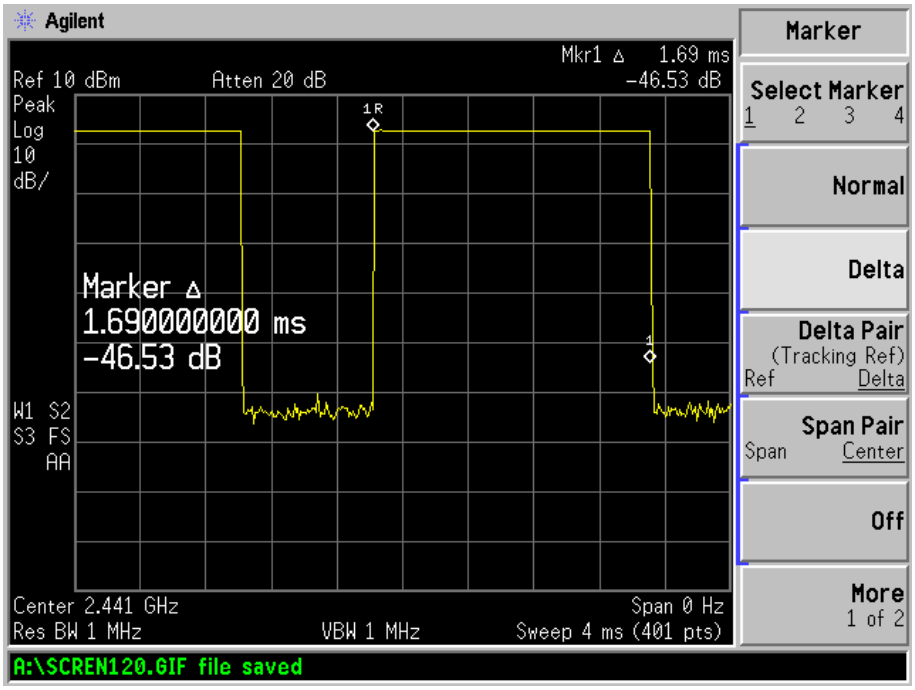


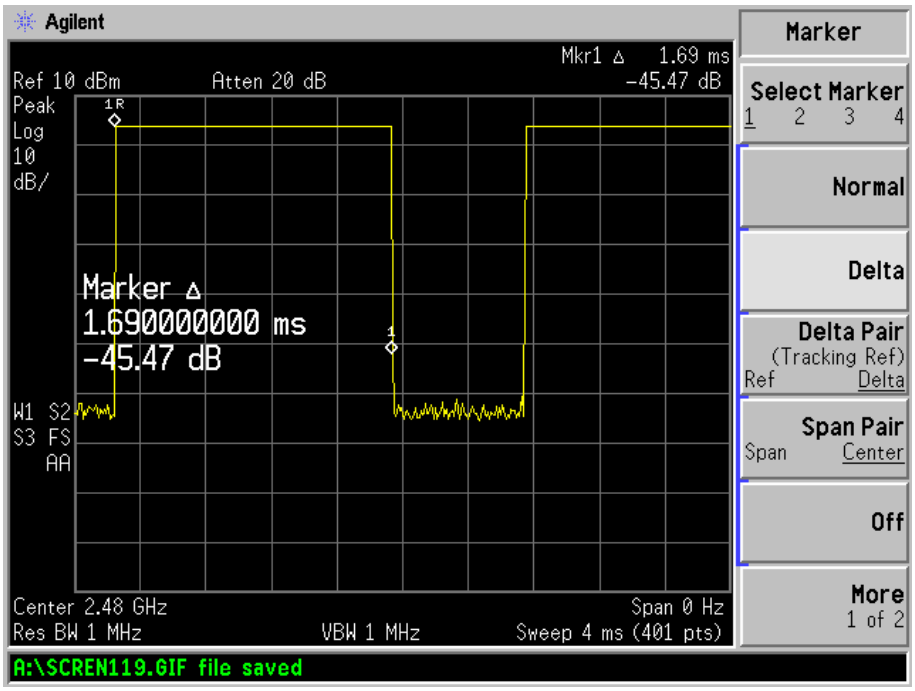





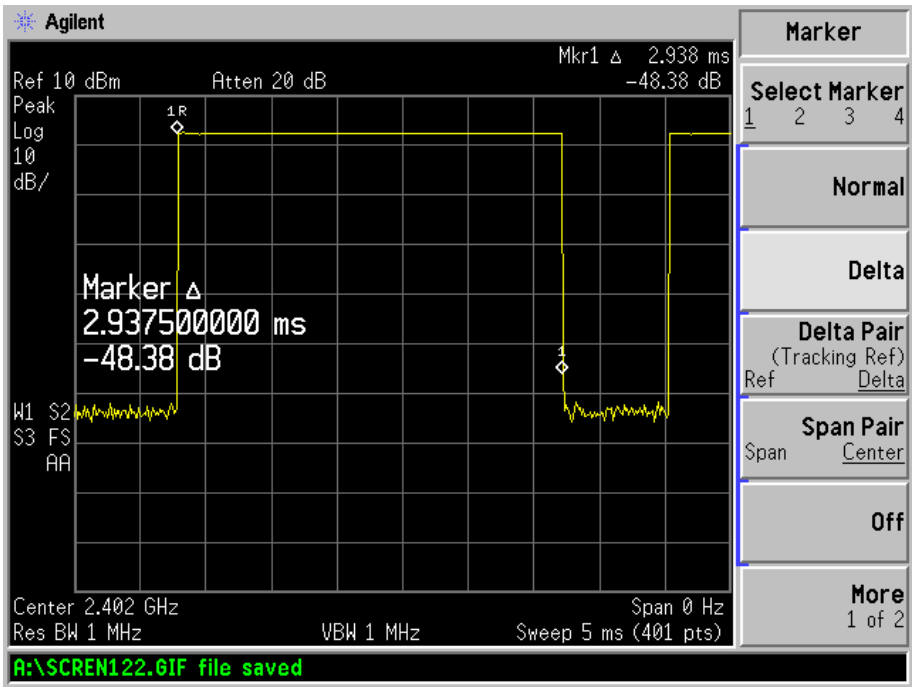

DH3 time slot (Low, Middle, High Channels)

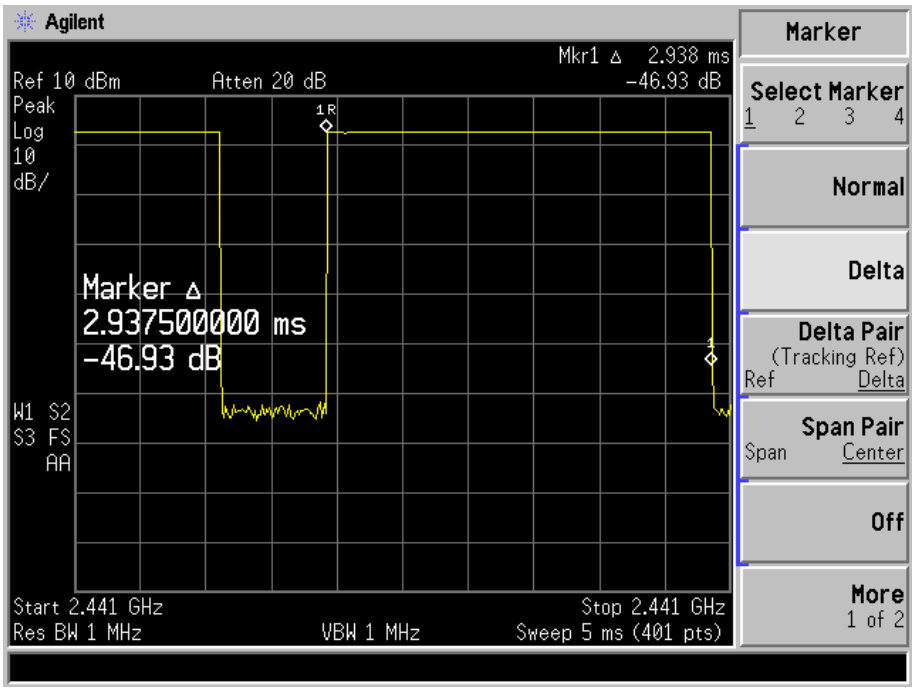


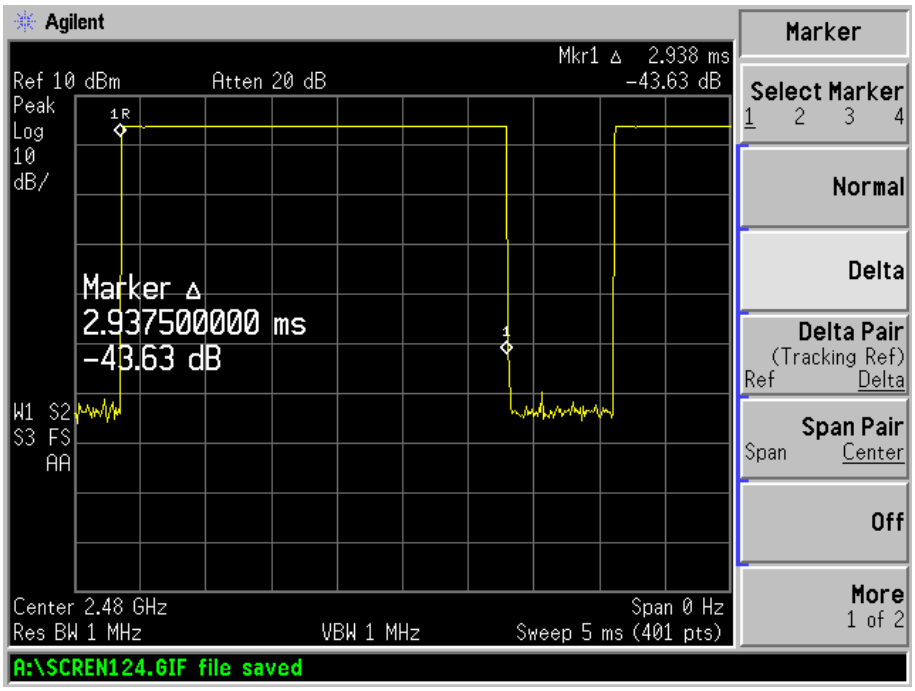

Agilent
Mkr1 Δ 1.69 ms
Ref 10 dBm
Atten 20 dB
-46.53 dB
Peak
Log
10
dB/
1R
Marker Δ
1.690000000 ms
-46.53 dB
W1 S2
S3 FS
AA
Center 2.441 GHz
Res BW 1 MHz
VBW 1 MHz
Span 0 Hz
Sweep 4 ms (401 pts)
A:\SCREN120.GIF file saved
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2


Agilent
Mkr1 Δ 1.69 ms
Ref 10 dBm
Atten 20 dB
-45.47 dB
Peak
Log
10
dB/
1R
Marker Δ
1.690000000 ms
-45.47 dB
W1 S2
S3 FS
AA
Center 2.48 GHz
Res BW 1 MHz
VBW 1 MHz
Span 0 Hz
Sweep 4 ms (401 pts)
A:\SCREN119.GIF file saved
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2

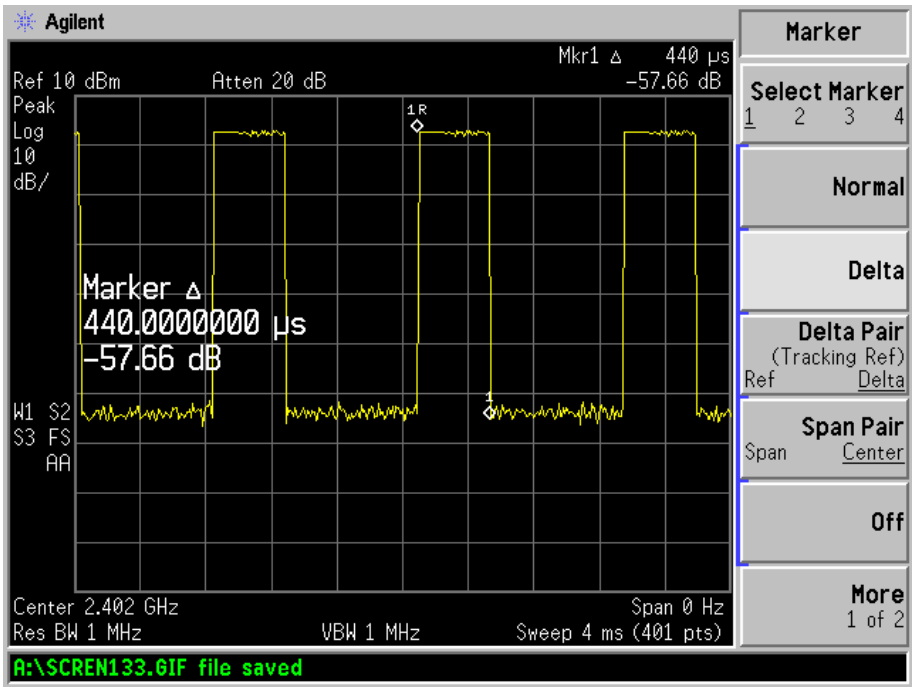
DH5 time slot (Low, Middle, High Channels)

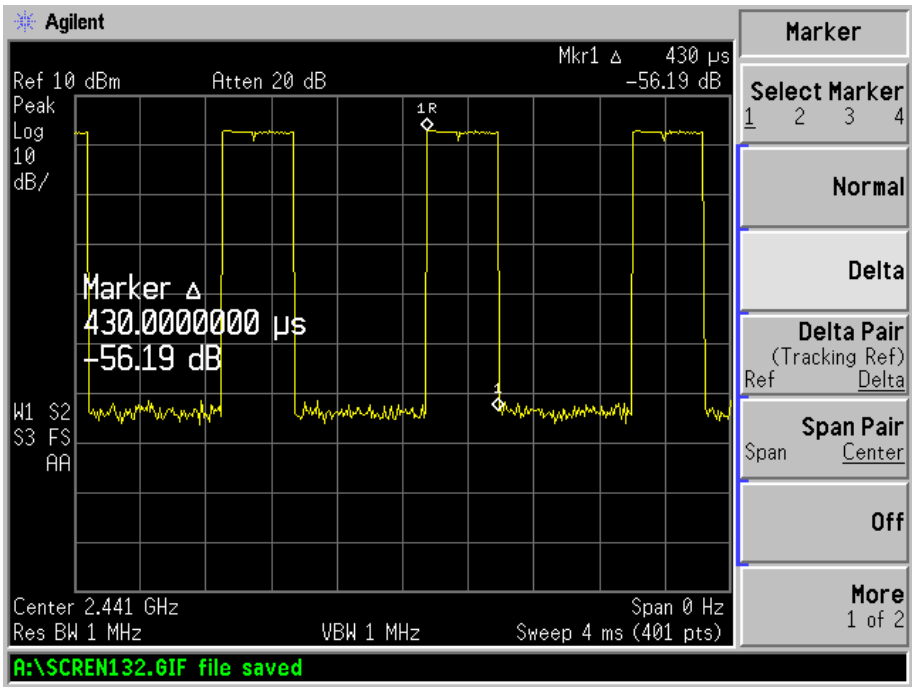


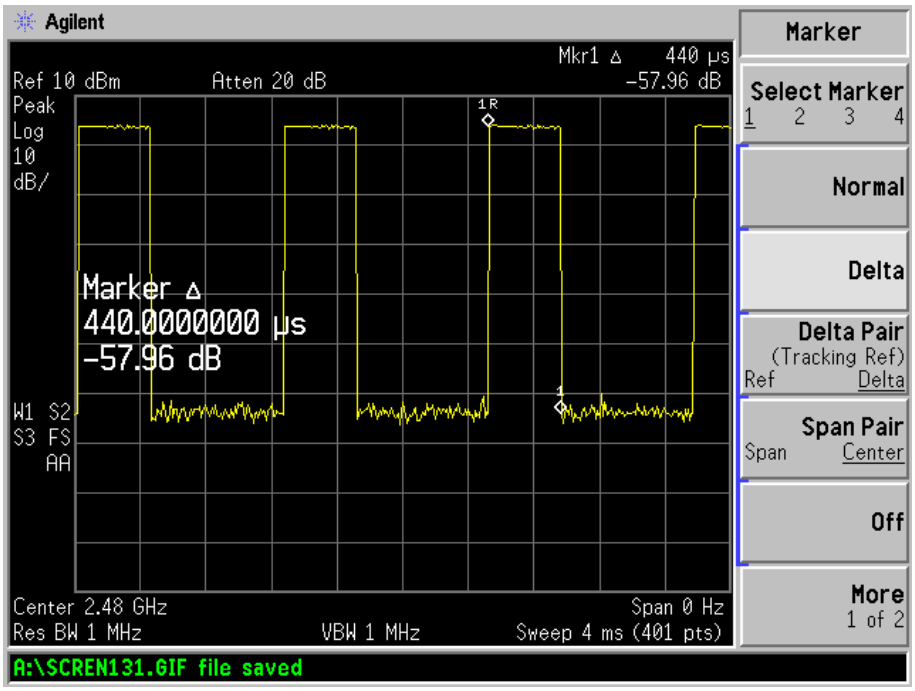





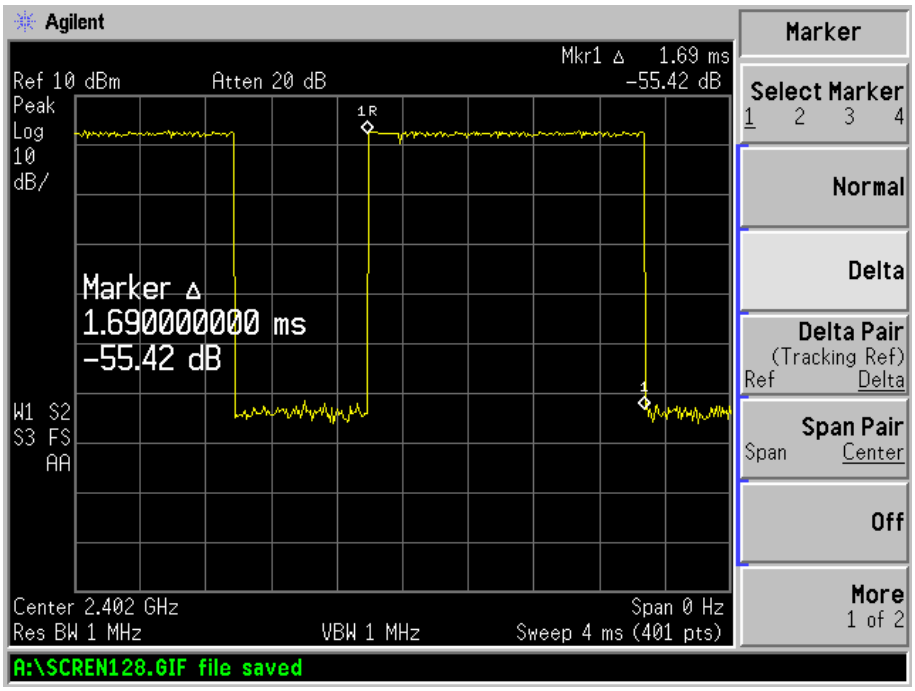

3DH1 time slot (Low, Middle, High Channels)

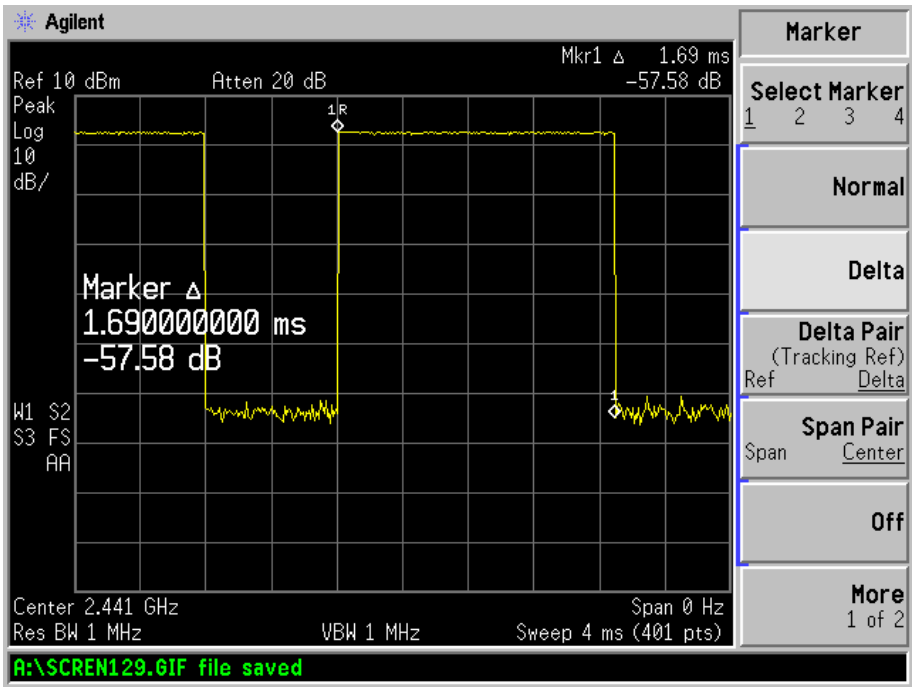


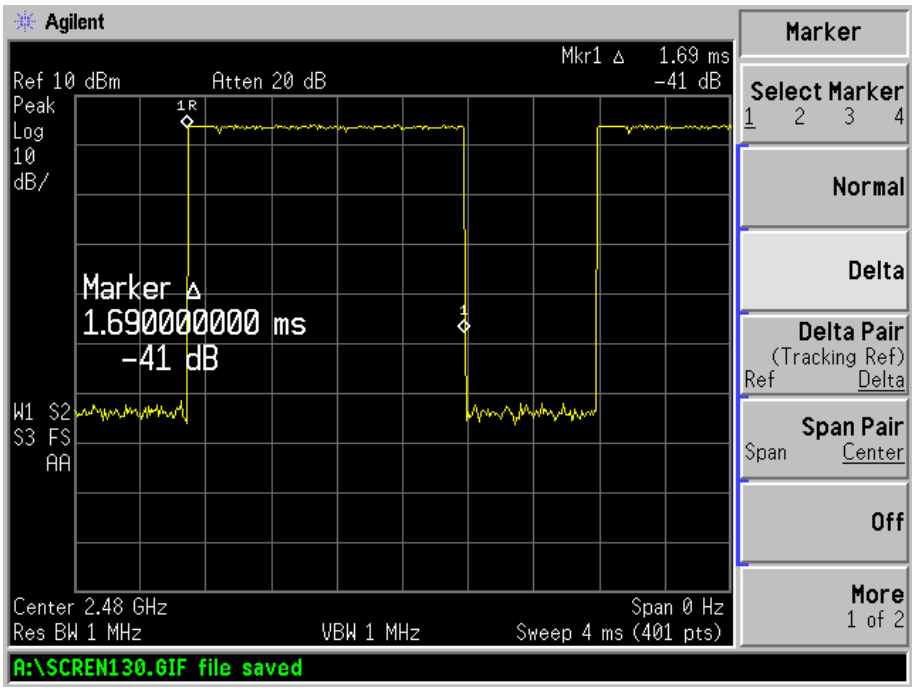

Agilent
Mkr1 Δ 430 µs
Ref 10 dBm
Atten 20 dB
-56.19 dB
Peak
Log
10
dB/
1R
Marker Δ
430.0000000 µs
-56.19 dB
W1 S2
S3 FS
AA
Center 2.441 GHz
Res BW 1 MHz
VBW 1 MHz
Span 0 Hz
Sweep 4 ms (401 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2
A:\SCREN132.GIF file saved


Agilent
Mkr1 Δ 440 µs
Ref 10 dBm
Atten 20 dB
-57.96 dB
Peak
Log
10
dB/
1R
Marker Δ
440.0000000 µs
-57.96 dB
W1 S2
S3 FS
AA
Center 2.48 GHz
Res BW 1 MHz
VBW 1 MHz
Span 0 Hz
Sweep 4 ms (401 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2
A:\SCREN131.GIF file saved

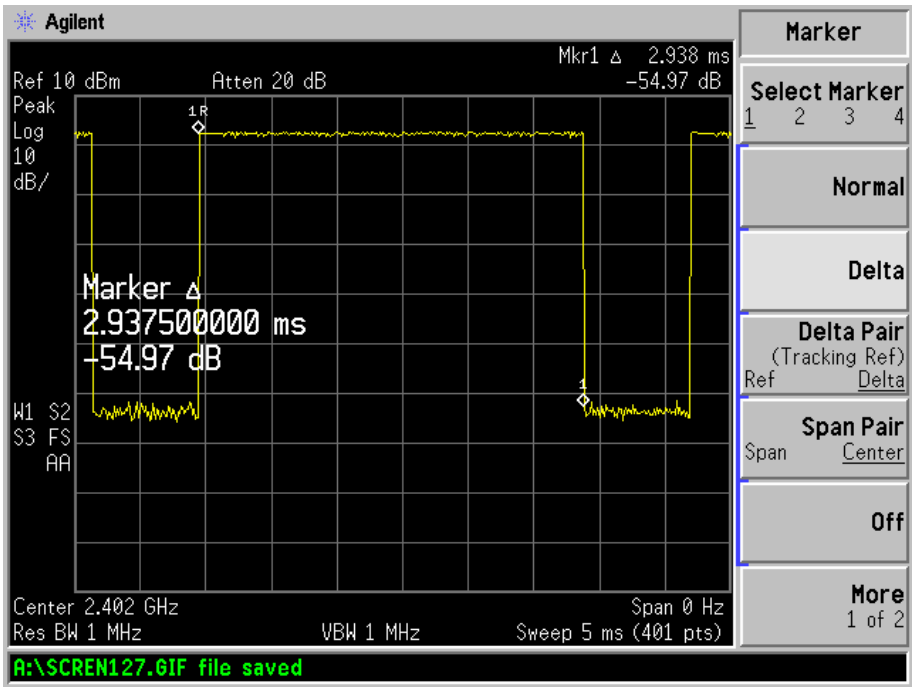
3DH3ime slot (Low, Middle, High Channels)

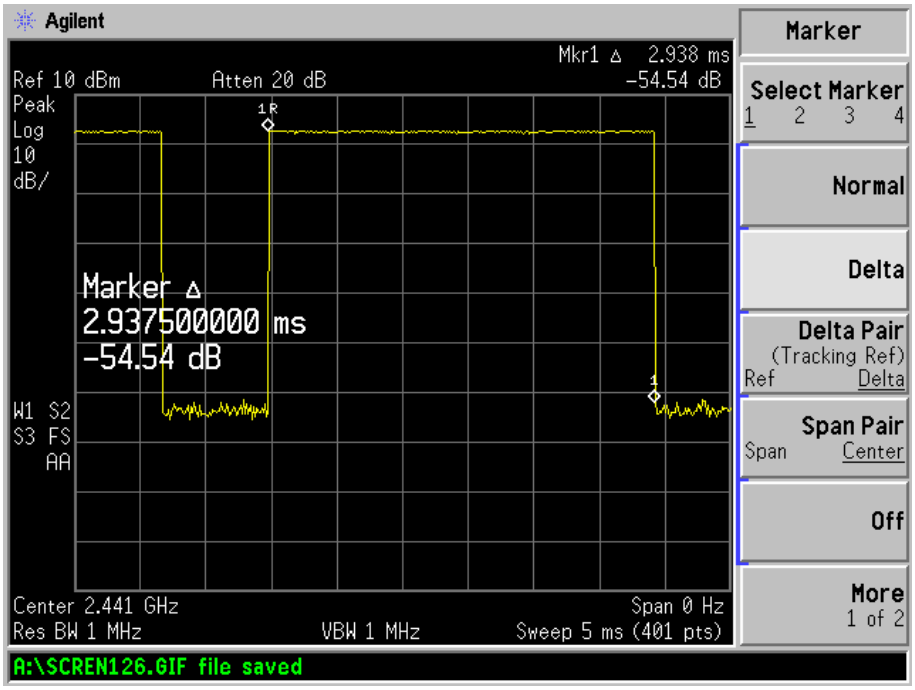


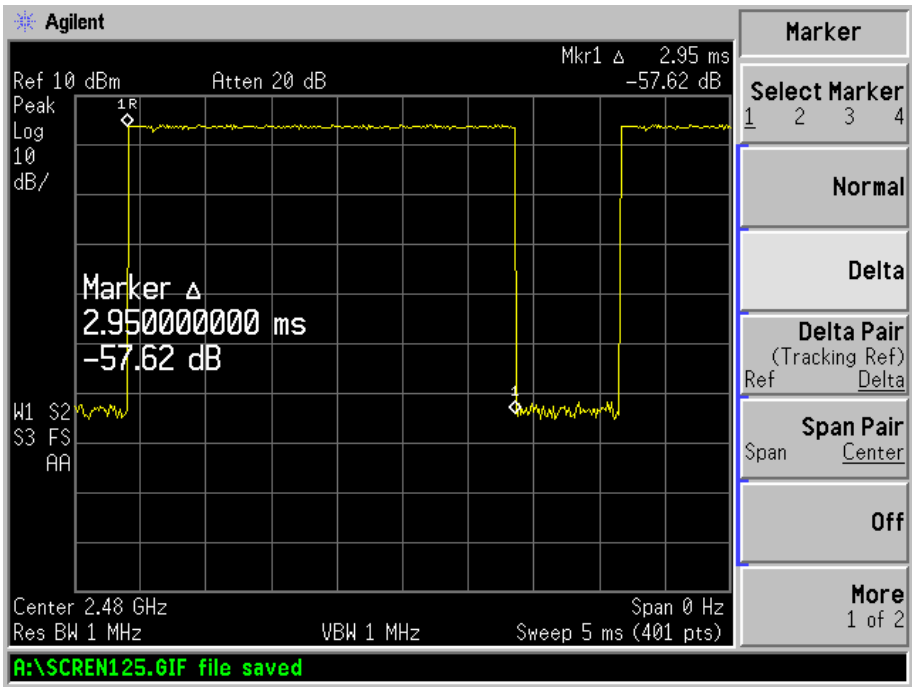






3DH5 time slot (Low, Middle, High Channels)




Agilent
Mkr1 Δ 2.938 ms
-54.54 dB
Ref 10 dBm
Atten 20 dB
Peak
Log
10
dB/
Marker Δ
2.937500000 ms
-54.54 dB
W1 S2
S3 FS
AA
Center 2.441 GHz
Res BW 1 MHz
VBW 1 MHz
Span 0 Hz
Sweep 5 ms (401 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2
A:\SCREN126.GIF file saved


Agilent
Mkr1 Δ 2.95 ms
-57.62 dB
Ref 10 dBm
Atten 20 dB
Peak
Log
10
dB/
Marker Δ
2.950000000 ms
-57.62 dB
W1 S2
S3 FS
AA
Center 2.48 GHz
Res BW 1 MHz
VBW 1 MHz
Span 0 Hz
Sweep 5 ms (401 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2
A:\SCREN125.GIF file saved

# 8. 20dB Bandwidth

## 8.1 Standard and Limit

According to 15.247(a) (1) (iii). For frequency hopping systems operating in the 2400~2483.5 MHz, no limit for 20dB bandwidth.

## 8.2 Test Procedure

According to the ANSI C63.10, the 20dB bandwidth test method as follows.

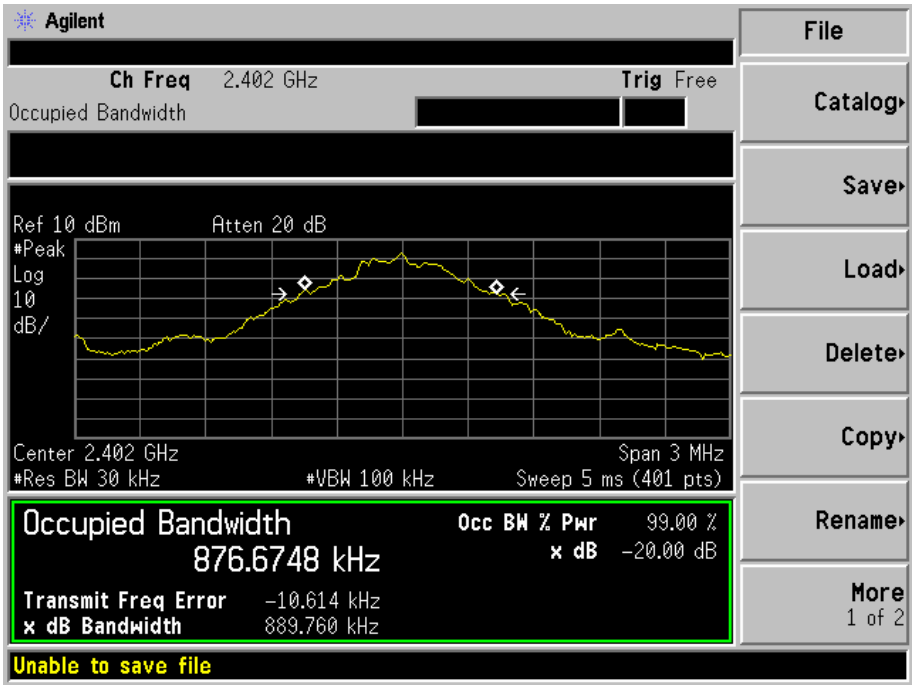
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto; Detector function = peak
Trace = max hold
All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down bandwidth of the emission.

## 8.3 Test Data and Results

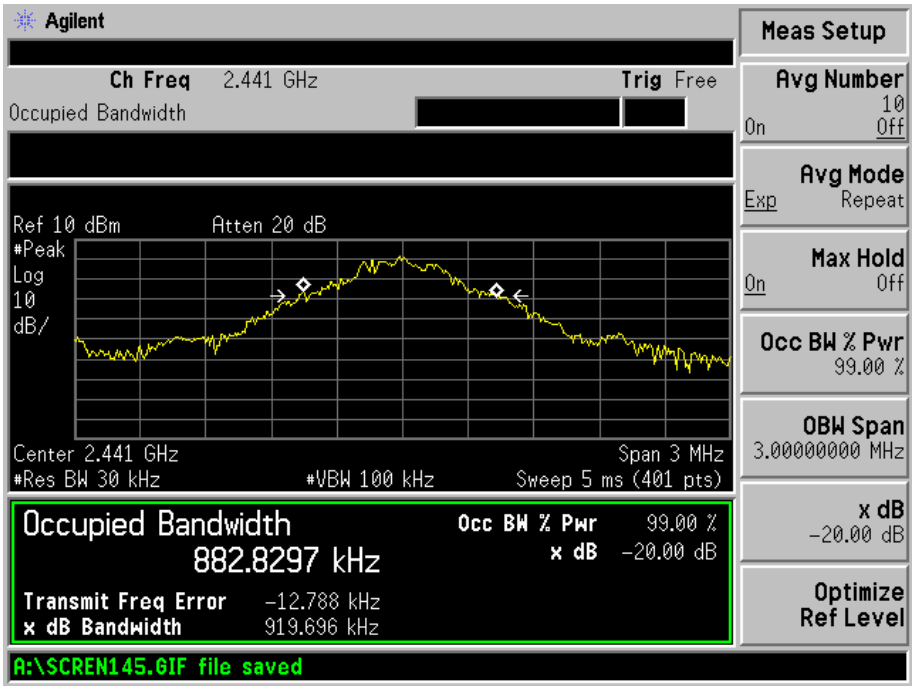
| Test Mode | Test Channel MHz | 20 dB Bandwidth kHz | 99% Bandwidth kHz |
|---|---|---|---|
| GFSK | 2402 | 889.760 | 876.6748 |
| | 2441 | 919.696 | 882.8297 |
| | 2480 | 881.781 | 881.0840 |
| 8DPSK | 2402 | 1209 | 1159.9 |
| | 2441 | 1202 | 1242.5 |
| | 2480 | 1221 | 1212.5 |

For GFSK

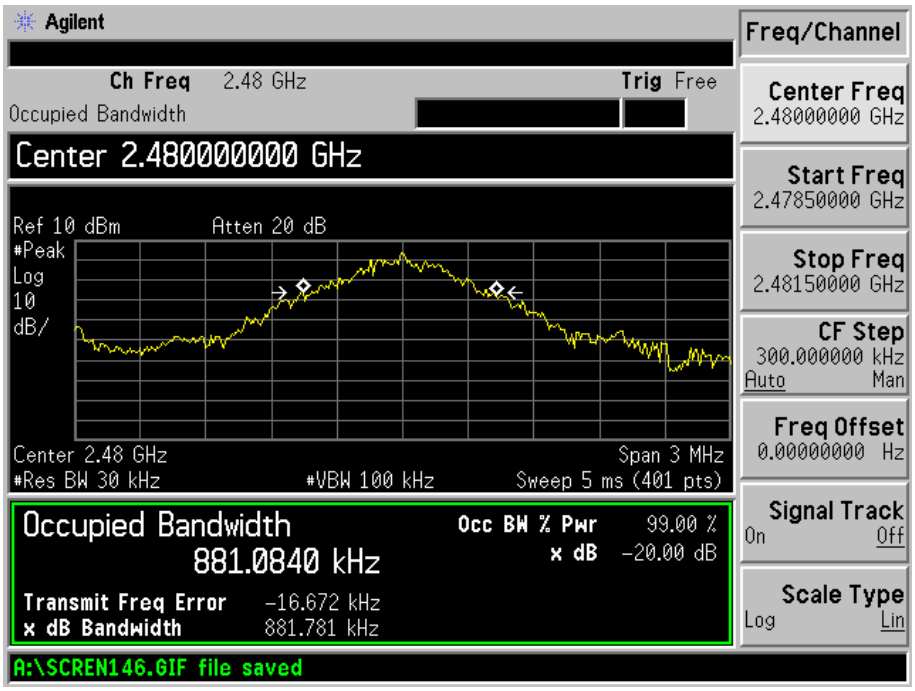
Low Channel:




Middle Channel:

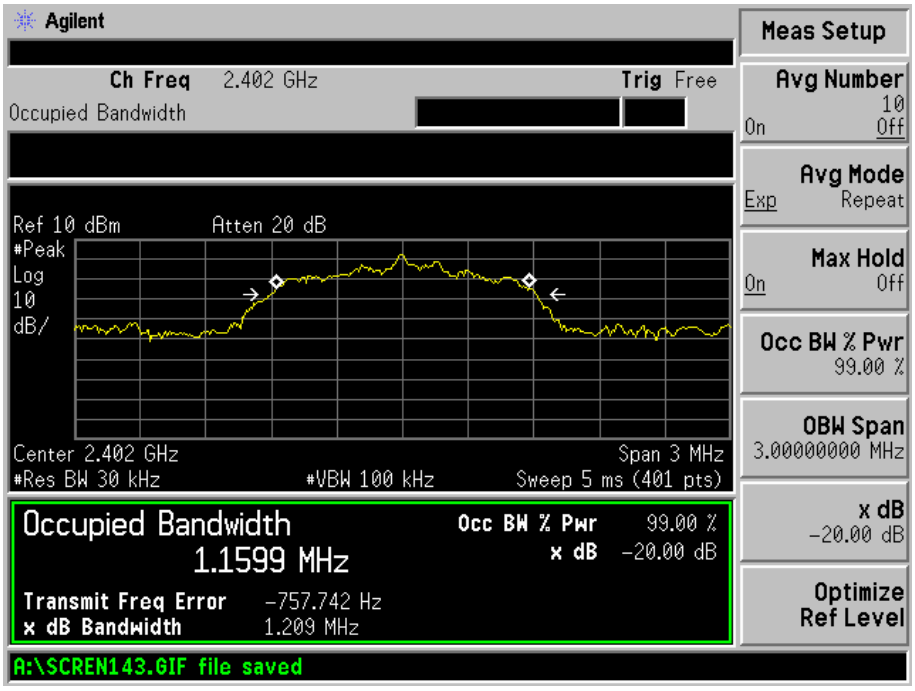


High Channel:

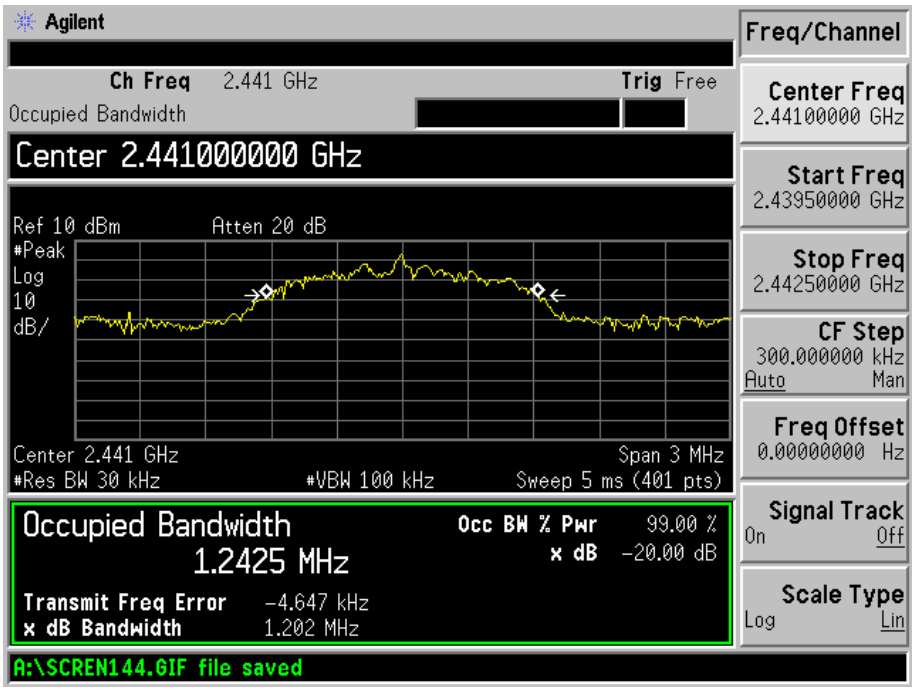



For 8DPSK

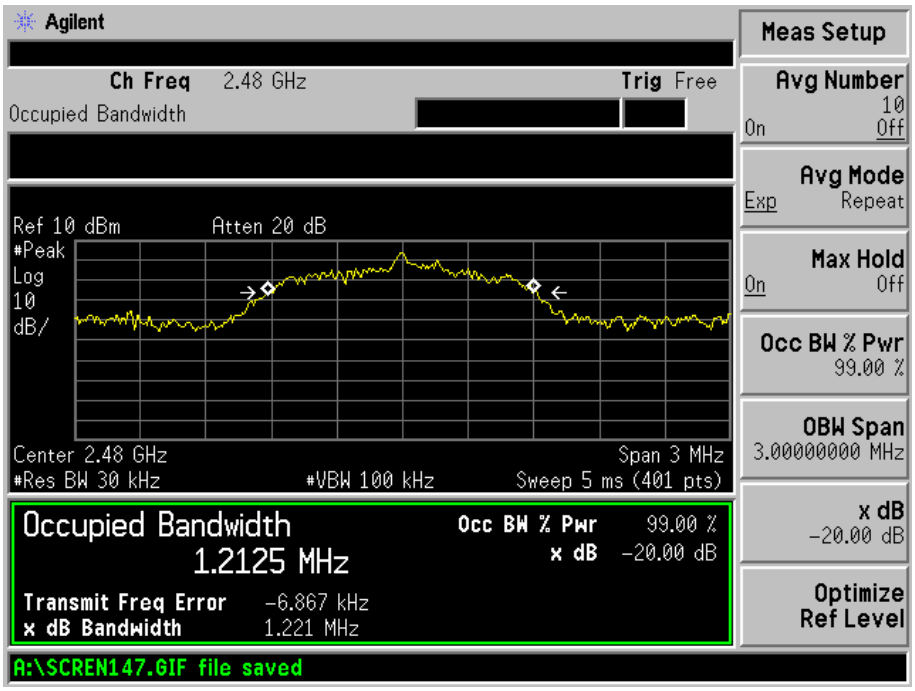
Low Channel:



Middle Channel:




High Channel:



# 9. RF Output Power

## 9.1 Standard and Limit

According to 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.

## 9.2 Test Procedure

According to the ANSI C63.10, the peak output power test method as follows.
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
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
All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, the indicated level is the peak output power (the external attenuation and cable loss shall be considered).

## 9.3 Test Data and Results

| Channel | Frequency MHz | Measured Value dBm | Output Power mW | Limit mW |
|---|---|---|---|---|
| GFSK | | | | |
| Low Channel | 2402 | 2.914 | 1.956 | 125 |
| Middle Channel | 2441 | 2.764 | 1.890 | 125 |
| High Channel | 2480 | 3.946 | 2.481 | 125 |
| Pi/4 DQPSK | | | | |
| Low Channel | 2402 | 3.486 | 2.232 | 125 |
| Middle Channel | 2441 | 2.980 | 1.986 | 125 |
| High Channel | 2480 | 4.251 | 2.661 | 125 |
| 8DPSK | | | | |
| Low Channel | 2402 | 3.614 | 2.298 | 125 |
| Middle Channel | 2441 | 3.089 | 2.037 | 125 |
| High Channel | 2480 | 4.398 | 2.753 | 125 |
| *Note: the antenna gain of 0dBi less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.* | | | | |

# 10. Field Strength of Spurious Emissions

## 10.1 Standard and Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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 band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious radiated emissions measurements starting below or at the lowest crystal frequency.

The general limits in FCC Part 15.209

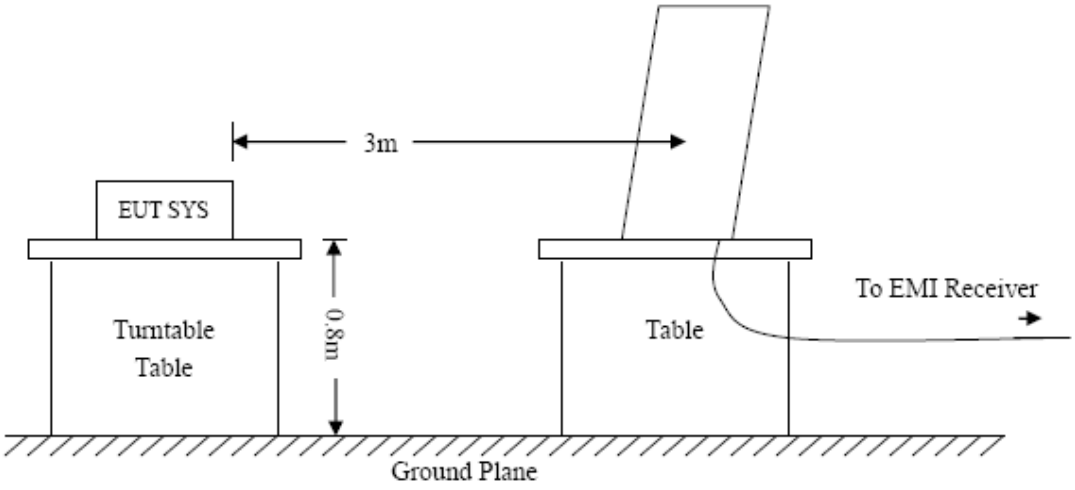
| Frequency of Emission (MHz) | Field Strength (uV/m) | Field Strength (dBuV/m) | |
|---|---|---|---|
| | QP | QP | AV |
| 30-88 | 100 | 40 | -- |
| 88-216 | 150 | 43.5 | -- |
| 216-960 | 200 | 46 | -- |
| Above 960 | 500 | 54 | 74 |
| Limits at a measurement distance of 3 m | | | |

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious radiated emissions measurements starting below or at the lowest crystal frequency.

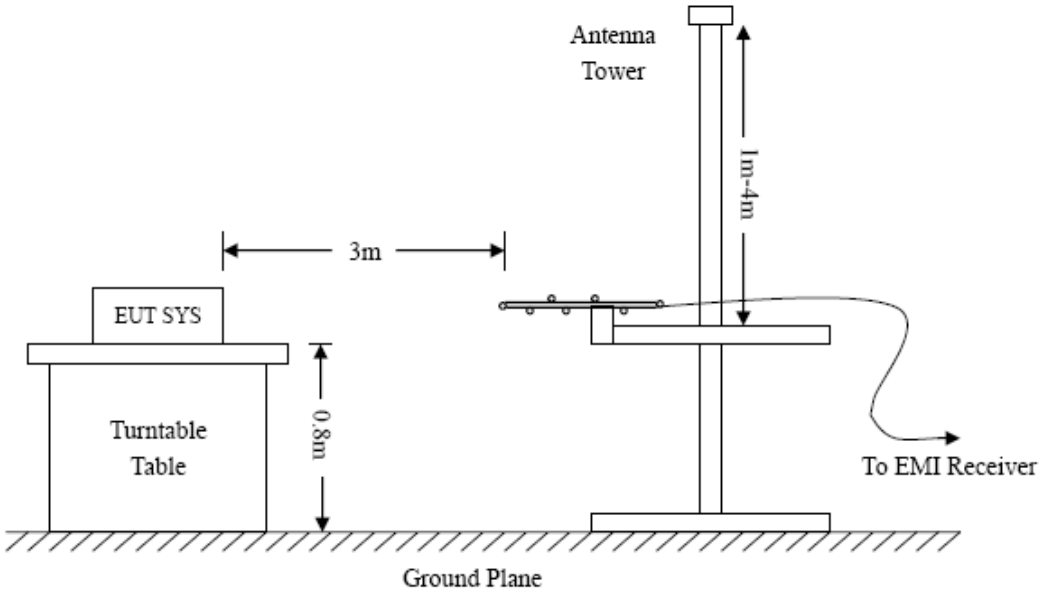
Compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

## 10.2 Test Procedure

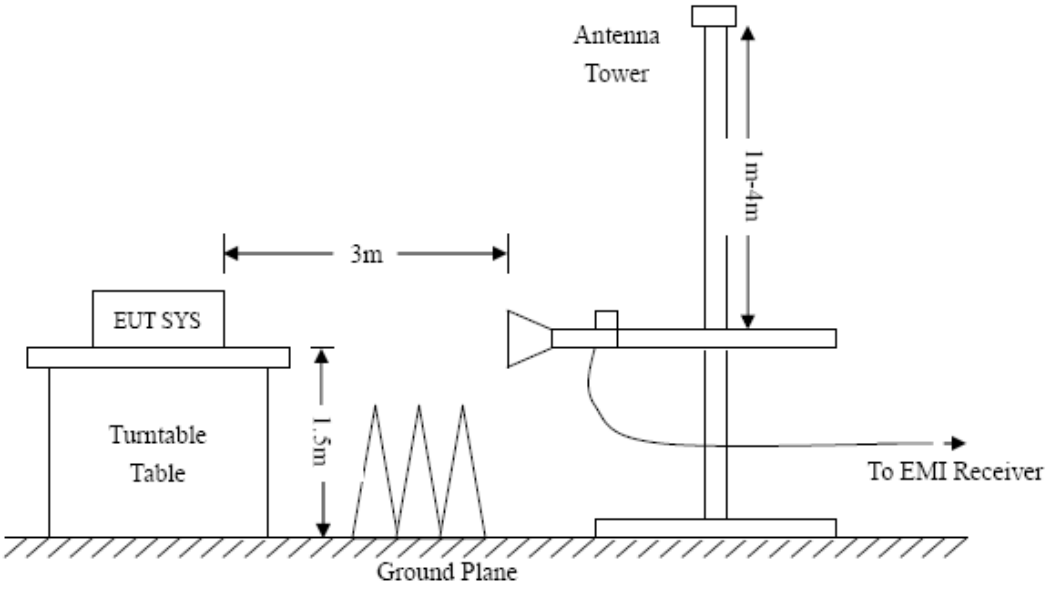
The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.




Test Setup Block Diagram below 30MHz




Test Setup Block Diagram for 30MHz-1GHz




Test Setup Block Diagram above 1GHz

For the radiated emission test above 1GHz:
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

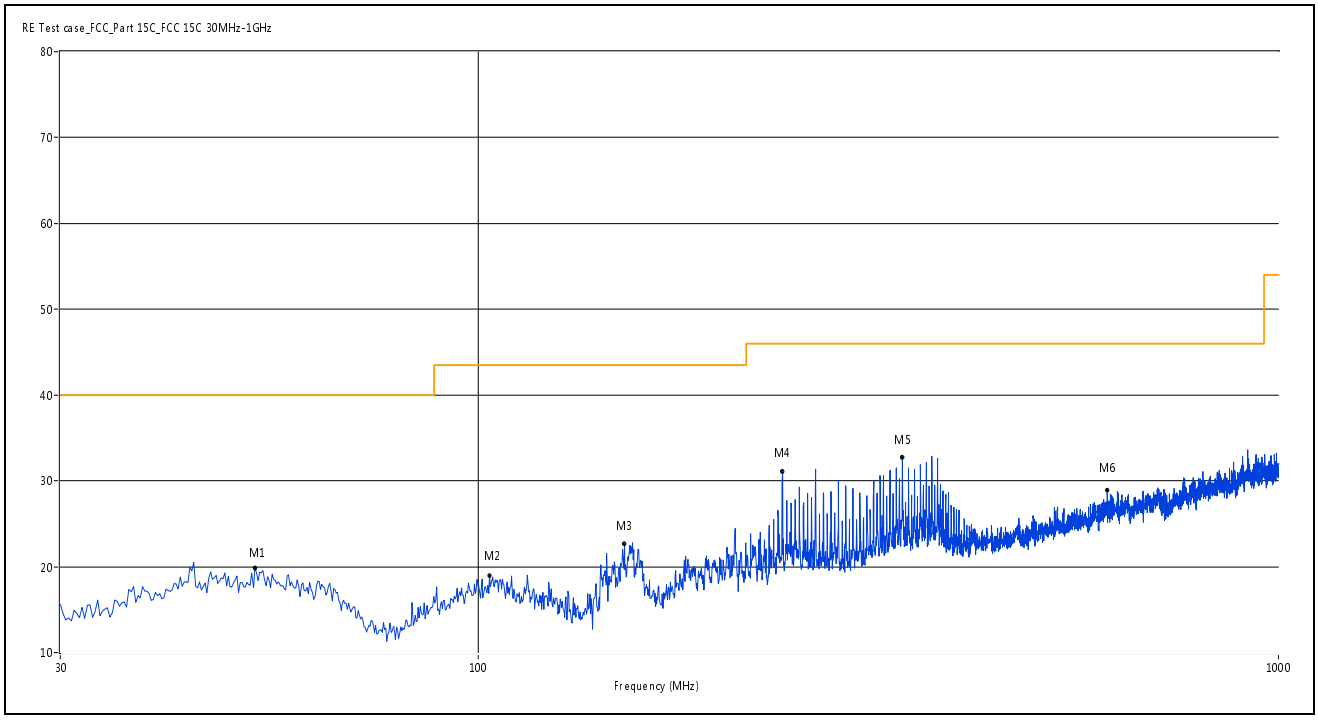
## 10.3 Test Data and Results

According to the data below, the FCC Part 15.205, 15.209 and 15.247 standards, and had the worst case:

*Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.*

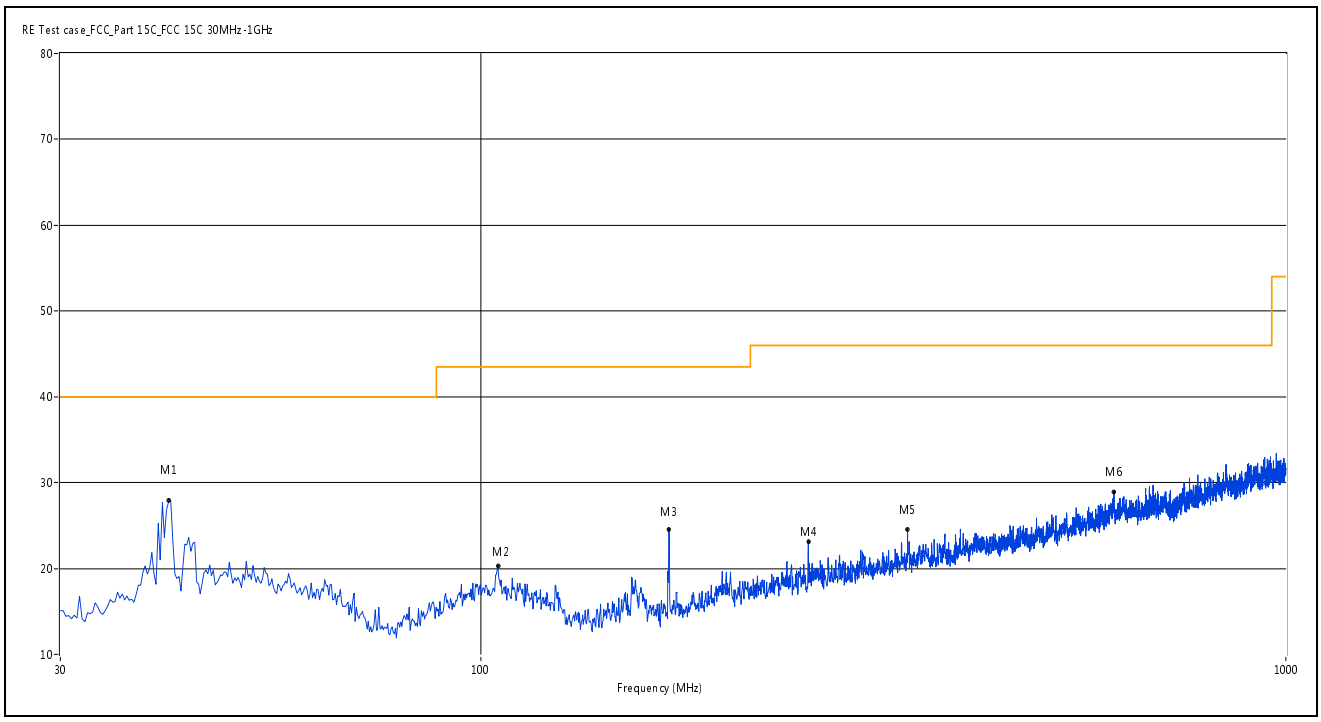
Worst case_GFSK mode

| Test Plots and Data of Radiated Emissions (30MHz to 1GHz) | |
|---|---|
| Tested Model: | GC42924 |
| Tested Mode: | TM1 |
| Test Power Specification: | DC 3.7V |
| Test Antenna Polarization: | Horizontal |




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (o) | Height (cm) | ANT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 52.55 | 19.89 | -18.66 | 40.0 | 20.11 | Peak | 58.40 | 100 | Horizontal |
| 2 | 103.22 | 18.93 | -20.30 | 43.5 | 24.57 | Peak | 63.50 | 100 | Horizontal |
| 3 | 152.19 | 22.65 | -23.49 | 43.5 | 20.85 | Peak | 33.10 | 100 | Horizontal |
| 4 | 239.95 | 31.08 | -19.10 | 46.0 | 14.92 | Peak | 28.40 | 100 | Horizontal |
| 5 | 338.87 | 32.79 | -16.36 | 46.0 | 13.21 | Peak | 275.50 | 100 | Horizontal |
| 6 | 611.13 | 28.97 | -10.43 | 46.0 | 17.03 | Peak | 230.30 | 100 | Horizontal |

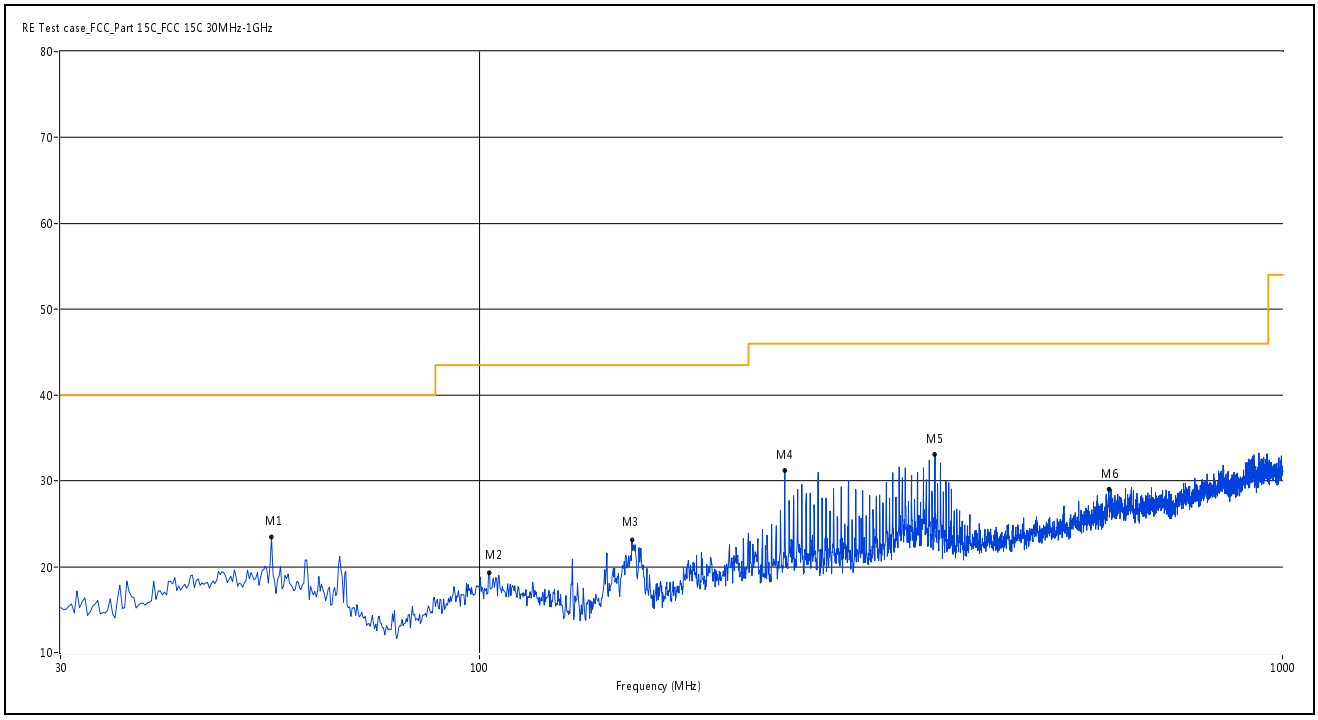
| Test Plots and Data of Radiated Emissions (30MHz to 1GHz) | |
|---|---|
| Tested Model: | GC42924 |
| Tested Mode: | TM1 |
| Test Power Specification: | DC 3.7V |
| Test Antenna Polarization: | Vertical |




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (o) | Height (cm) | ANT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 40.91 | 27.89 | -19.48 | 40.0 | 12.11 | Peak | 205.50 | 100 | Vertical |
| 2 | 104.91 | 20.25 | -20.19 | 43.5 | 23.25 | Peak | 119.90 | 100 | Vertical |
| 3 | 171.10 | 24.60 | -22.67 | 43.5 | 18.90 | Peak | 37.90 | 100 | Vertical |
| 4 | 254.98 | 23.15 | -18.70 | 46.0 | 22.85 | Peak | 296.00 | 100 | Vertical |
| 5 | 338.87 | 24.59 | -16.36 | 46.0 | 21.41 | Peak | 256.30 | 100 | Vertical |
| 6 | 611.37 | 28.93 | -10.43 | 46.0 | 17.07 | Peak | -0.00 | 100 | Vertical |

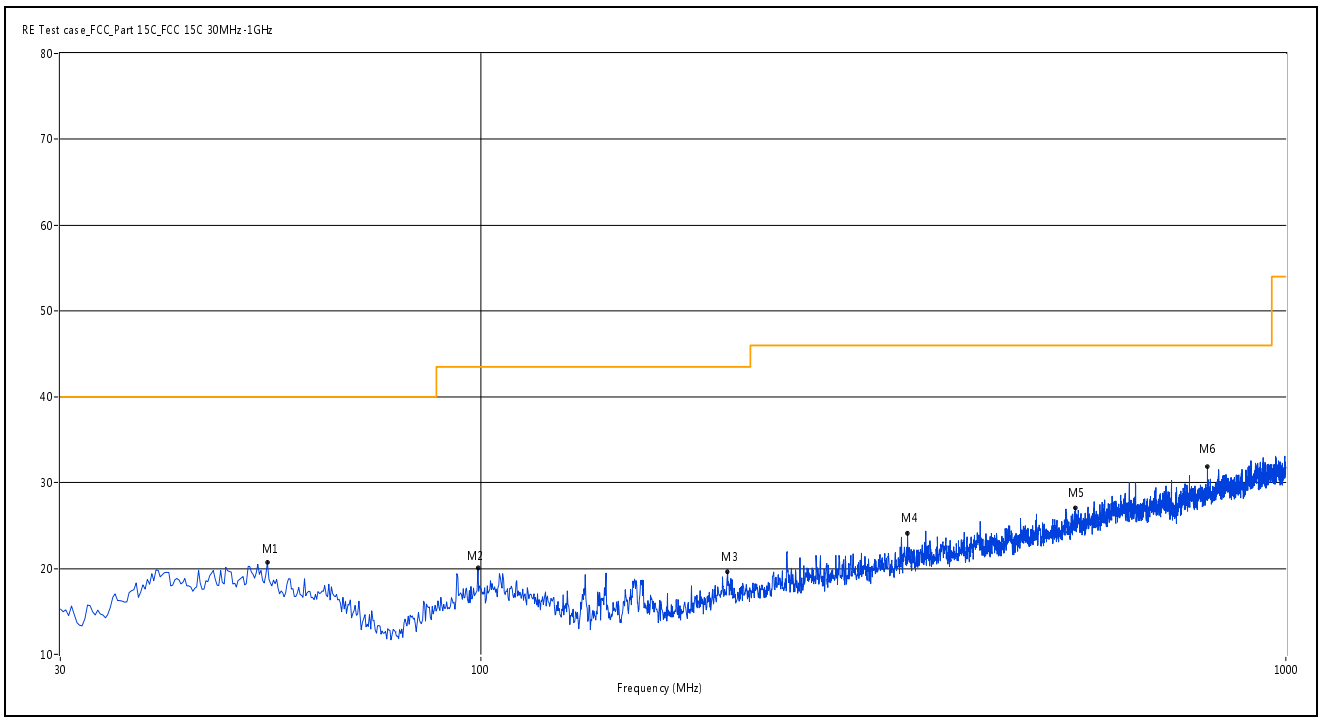
Worst case_GFSK mode

| Test Plots and Data of Radiated Emissions (30MHz to 1GHz) | |
|---|---|
| Tested Model: | GC42924 |
| Tested Mode: | TM2 |
| Test Power Specification: | DC 3.7V |
| Test Antenna Polarization: | Horizontal |




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (o) | Height (cm) | ANT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 54.97 | 23.47 | -19.01 | 40.0 | 16.53 | Peak | 123.70 | 100 | Horizontal |
| 2 | 102.73 | 19.30 | -20.25 | 43.5 | 24.20 | Peak | 229.50 | 100 | Horizontal |
| 3 | 154.61 | 23.08 | -23.35 | 43.5 | 20.42 | Peak | 219.50 | 100 | Horizontal |
| 4 | 239.95 | 31.26 | -19.10 | 46.0 | 14.74 | Peak | 38.60 | 100 | Horizontal |
| 5 | 368.93 | 33.10 | -15.97 | 46.0 | 12.90 | Peak | 194.50 | 100 | Horizontal |
| 6 | 607.73 | 29.02 | -10.55 | 46.0 | 16.98 | Peak | 53.60 | 100 | Horizontal |

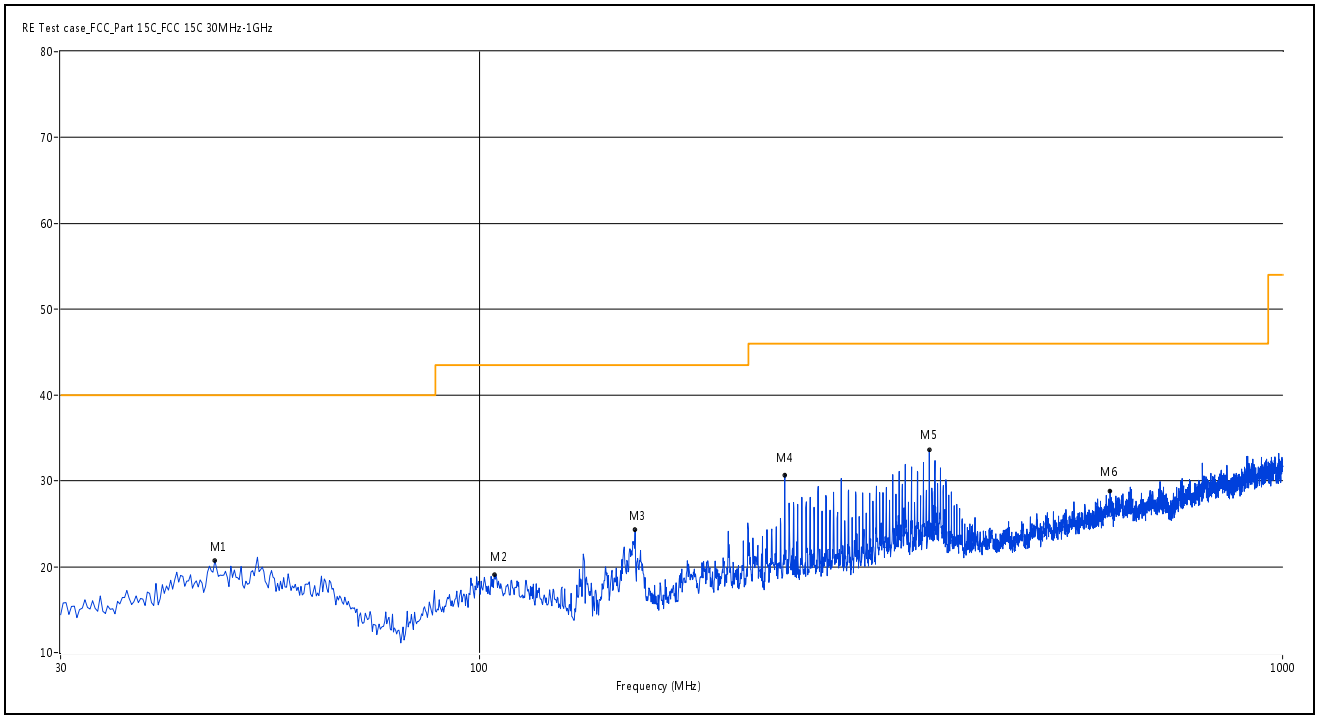
| Test Plots and Data of Radiated Emissions (30MHz to 1GHz) | |
|---|---|
| Tested Model: | GC42924 |
| Tested Mode: | TM2 |
| Test Power Specification: | DC 3.7V |
| Test Antenna Polarization: | Vertical |




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (o) | Height (cm) | ANT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 54.24 | 20.69 | -18.81 | 40.0 | 19.31 | Peak | 181.10 | 100 | Vertical |
| 2 | 99.10 | 20.07 | -20.25 | 43.5 | 23.43 | Peak | 256.00 | 100 | Vertical |
| 3 | 202.37 | 19.61 | -20.15 | 43.5 | 23.89 | Peak | 265.60 | 100 | Vertical |
| 4 | 338.87 | 24.12 | -16.36 | 46.0 | 21.88 | Peak | 176.00 | 100 | Vertical |
| 5 | 547.85 | 27.03 | -12.12 | 46.0 | 18.97 | Peak | 114.80 | 100 | Vertical |
| 6 | 798.78 | 31.82 | -7.30 | 46.0 | 14.18 | Peak | 125.10 | 100 | Vertical |

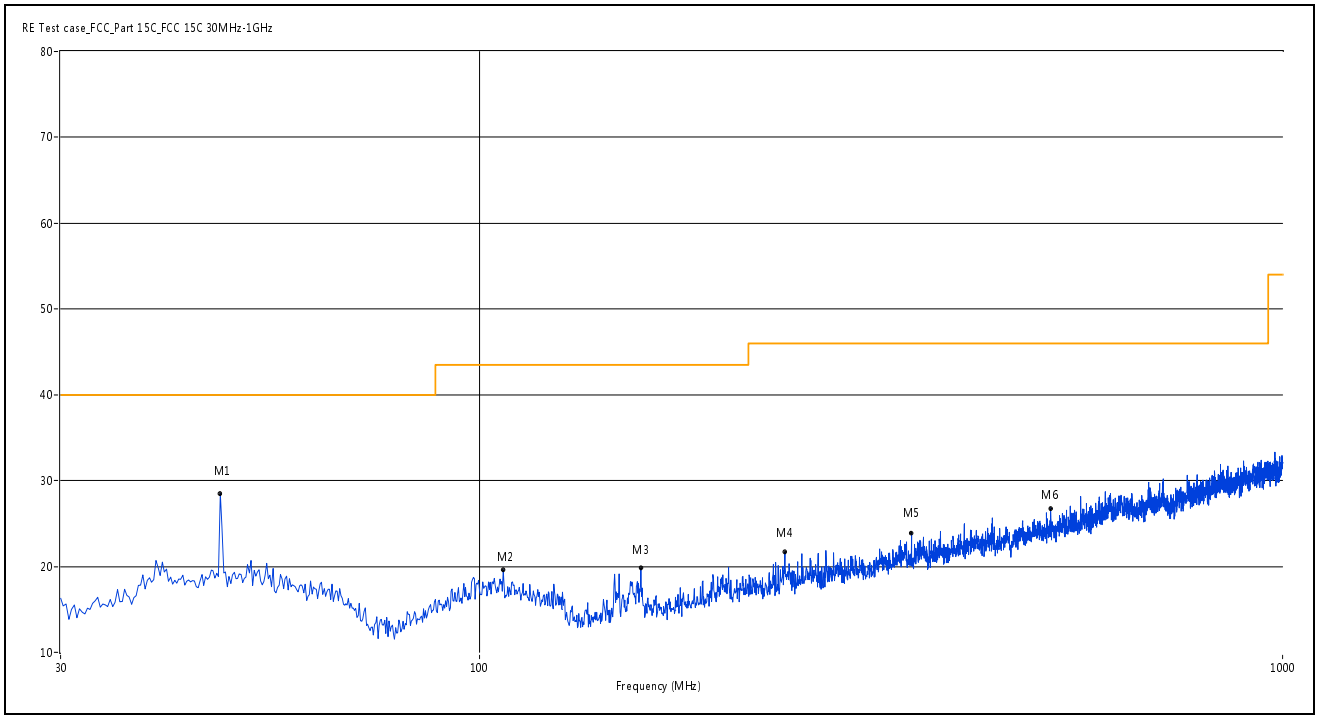
Worst case_GFSK mode

| Test Plots and Data of Radiated Emissions (30MHz to 1GHz) | |
|---|---|
| Tested Model: | GC42924 |
| Tested Mode: | TM3 |
| Test Power Specification: | DC 3.7V |
| Test Antenna Polarization: | Horizontal |




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (o) | Height (cm) | ANT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 46.73 | 20.72 | -18.72 | 40.0 | 19.28 | Peak | 305.80 | 100 | Horizontal |
| 2 | 104.19 | 19.08 | -20.30 | 43.5 | 24.42 | Peak | 189.80 | 100 | Horizontal |
| 3 | 156.07 | 24.32 | -23.23 | 43.5 | 19.18 | Peak | 34.40 | 100 | Horizontal |
| 4 | 239.95 | 30.72 | -19.10 | 46.0 | 15.28 | Peak | 9.30 | 100 | Horizontal |
| 5 | 362.87 | 33.60 | -16.13 | 46.0 | 12.40 | Peak | 189.80 | 100 | Horizontal |
| 6 | 609.67 | 28.77 | -10.44 | 46.0 | 17.23 | Peak | 311.00 | 100 | Horizontal |

| Test Plots and Data of Radiated Emissions (30MHz to 1GHz) | |
|---|---|
| Tested Model: | GC42924 |
| Tested Mode: | TM3 |
| Test Power Specification: | DC 3.7V |
| Test Antenna Polarization: | Vertical |




| No. | Frequency (MHz) | Results (dBuV/m) | Factor (dB) | Limit (dBuV/m) | Margin (dB) | Detector | Table (o) | Height (cm) | ANT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 47.46 | 28.52 | -18.74 | 40.0 | 11.48 | Peak | 319.50 | 100 | Vertical |
| 2 | 106.85 | 19.60 | -20.23 | 43.5 | 23.90 | Peak | 204.80 | 100 | Vertical |
| 3 | 158.74 | 19.81 | -23.12 | 43.5 | 23.69 | Peak | 13.10 | 100 | Vertical |
| 4 | 239.95 | 21.70 | -19.10 | 46.0 | 24.30 | Peak | 312.50 | 100 | Vertical |
| 5 | 344.93 | 23.94 | -16.31 | 46.0 | 22.06 | Peak | 113.40 | 100 | Vertical |
| 6 | 514.15 | 26.77 | -13.00 | 46.0 | 19.23 | Peak | 3.70 | 100 | Vertical |

| Test Plots and Data of Radiated Emissions (1GHz to 25GHz) | |
|---|---|
| Tested Model: | GC42924 |
| Tested Mode: | TM1/TM2/TM3 |
| Test Power Specification: | DC 3.7V |
| Remark: | Worst cases (GFSK) |

| Frequency (MHz) | Result (dBuV/m) | Correct dB/m | Limit (dBuV/m) | Margin (dB) | Detector PK/AV | Polar H/V |
|---|---|---|---|---|---|---|
| GFSK_Low Channel (2402MHz) | | | | | | |
| 4804 | 69.26 | 13.77 | 74 | -4.74 | PK | H |
| 4804 | 45.98 | 13.77 | 54 | -8.02 | AV | H |
| 4804 | 63.28 | 13.77 | 74 | -10.72 | PK | V |
| 4804 | 40.11 | 13.77 | 54 | -13.89 | AV | V |
| GFSK_Middle Channel (2441MHz) | | | | | | |
| 4882 | 70.73 | 13.60 | 74 | -3.27 | PK | H |
| 4882 | 47.32 | 13.60 | 54 | -6.68 | AV | H |
| 4882 | 63.04 | 13.60 | 74 | -10.96 | PK | V |
| 4882 | 39.48 | 13.60 | 54 | -14.52 | AV | V |
| GFSK_High Channel (2480MHz) | | | | | | |
| 4960 | 70.15 | 14.22 | 74 | -3.85 | PK | H |
| 4960 | 46.82 | 14.22 | 54 | -7.18 | AV | H |
| 4960 | 62.11 | 14.22 | 74 | -11.89 | PK | V |
| 4960 | 38.59 | 14.22 | 54 | -15.41 | AV | V |

*Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, which above 3$^{th}$ Harmonics are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
*The measurements greater than 20dB below the limit from 9kHz to 30MHz..*

# 11. Out of Band Emissions

## 11.1 Standard and Limit

According to §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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 band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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).

## 11.2 Test Procedure

According to the ANSI C63.10, the band-edge radiated test method as follows.

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2410MHz for low bandedge, 2470MHz to 2500MHz for the high bandedge)
RBW = 1MHz, VBW = 3MHz for peak value measured
RBW = 1MHz, VBW = 10Hz for average value measured
Sweep = auto;  Detector function = peak;  Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation porduct outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

According to the ANSI C63.10, the band-edge conducted test method as follows:

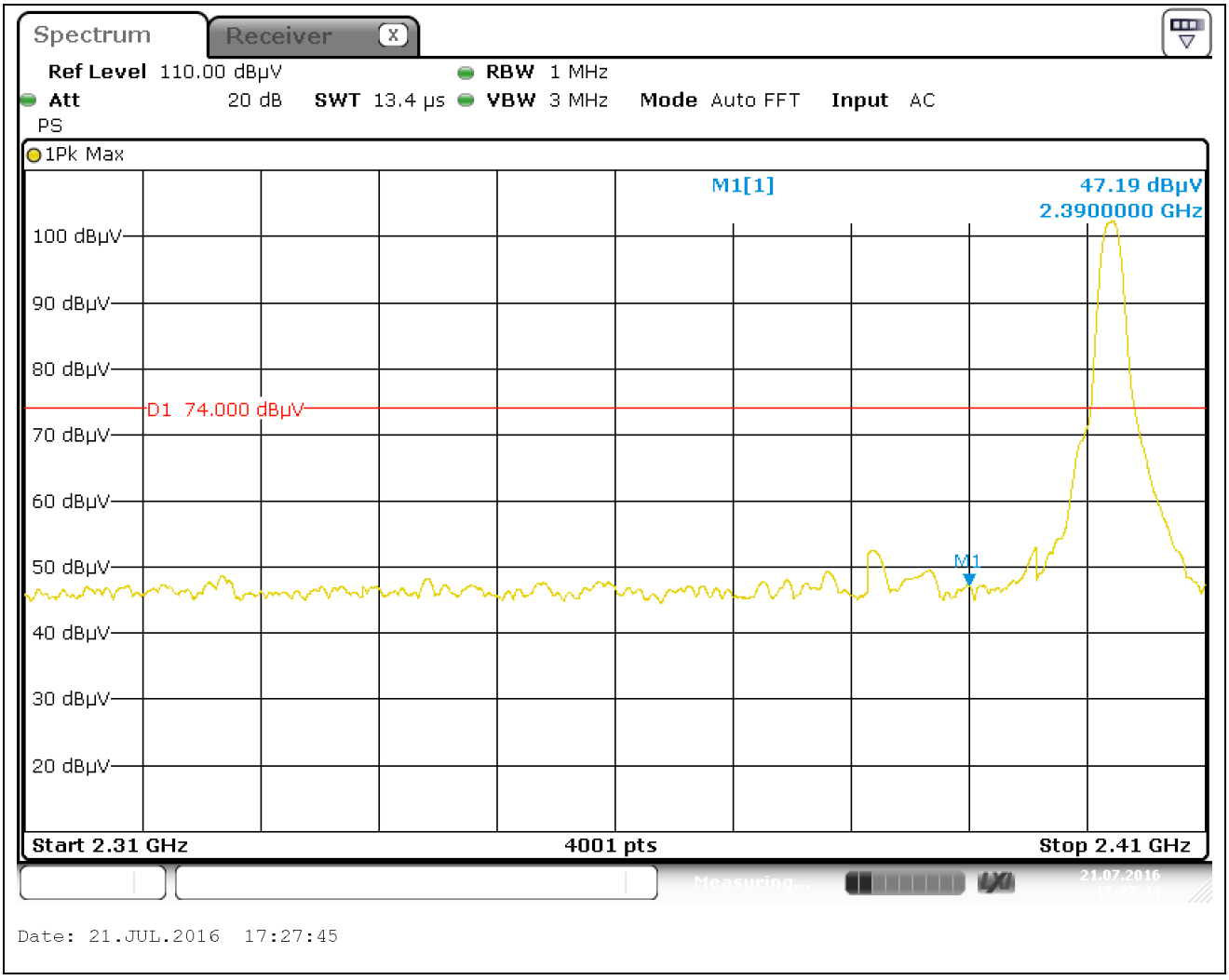
Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2380MHz to 2410MHz for low bandedge, 2470MHz to 2500MHz for the high bandedge)
RBW = 100kHz, VBW = 300kHz
Sweep = auto;  Detector function = peak;  Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation porduct outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the limit specified in this section (at least 20dB attenuation).

## 11.3 Test Data and Results

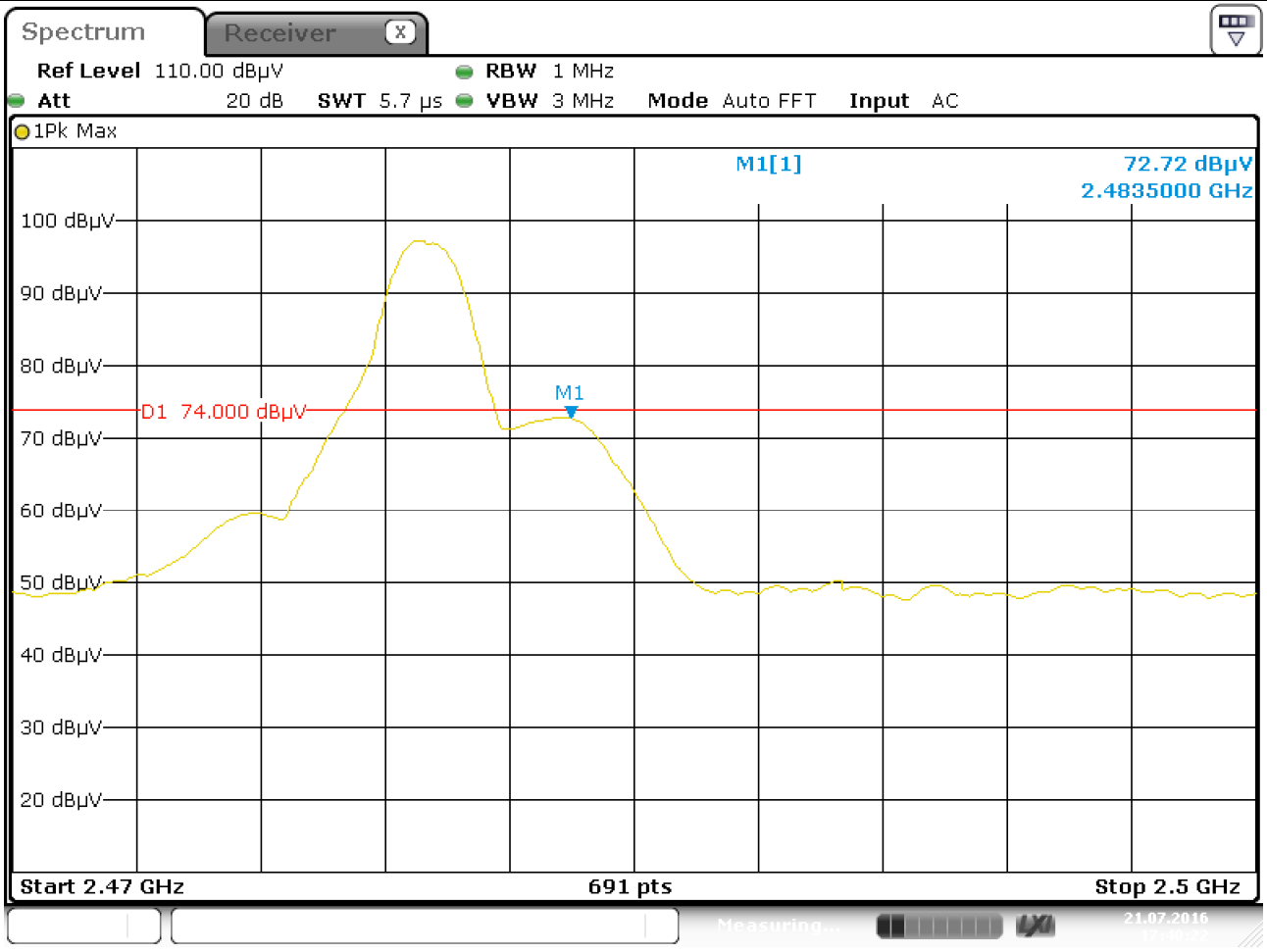
Please refer to the test plots as below.

Radiated Bandedge (Worst case)
Test Mode: 8DPSK
Lowest Bandedge
Horizontal




| No. | Frequency | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|
| | (MHz) | (dBuV/m) | (dBuV/m) | (dB) | |
| 1 | 2390.0 | 47.19 | 74.00 | -26.81 | Peak Detector |
| | 2390.0 | 37.55 | 54.00 | -16.45 | Average Detector |

Test Mode: 8DPSK
Highest Bandedge
Horizontal

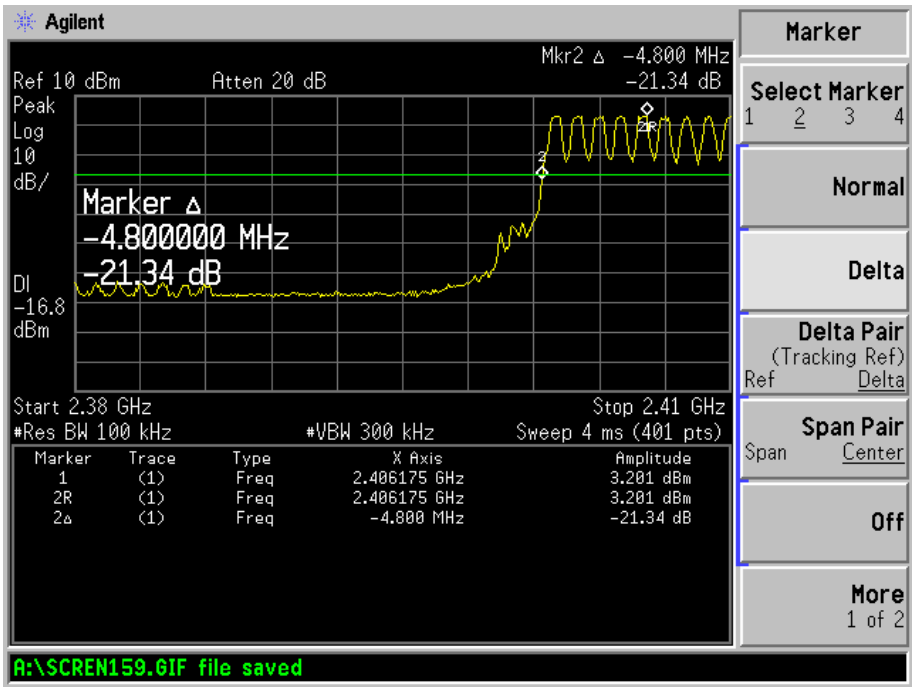



| No. | Frequency | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|
| | (MHz) | (dBuV/m) | (dBuV/m) | (dB) | |
| 1 | 2483.5 | 72.72 | 74.00 | -1.28 | Peak Detector |
| | 2483.5 | 40.85 | 54.00 | -13.15 | Average Detector |

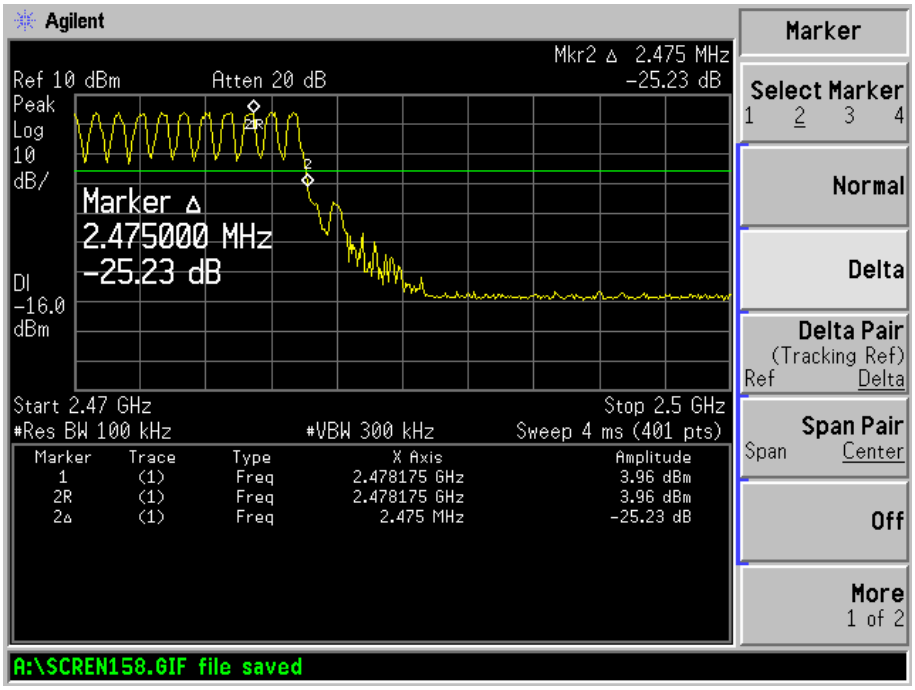
Conducted Bandedge

Test Mode: 8DPSK

Lowest Bandedge




Highest Bandedge



# 12. Conducted Emissions

## 12.1 Standard and Limit

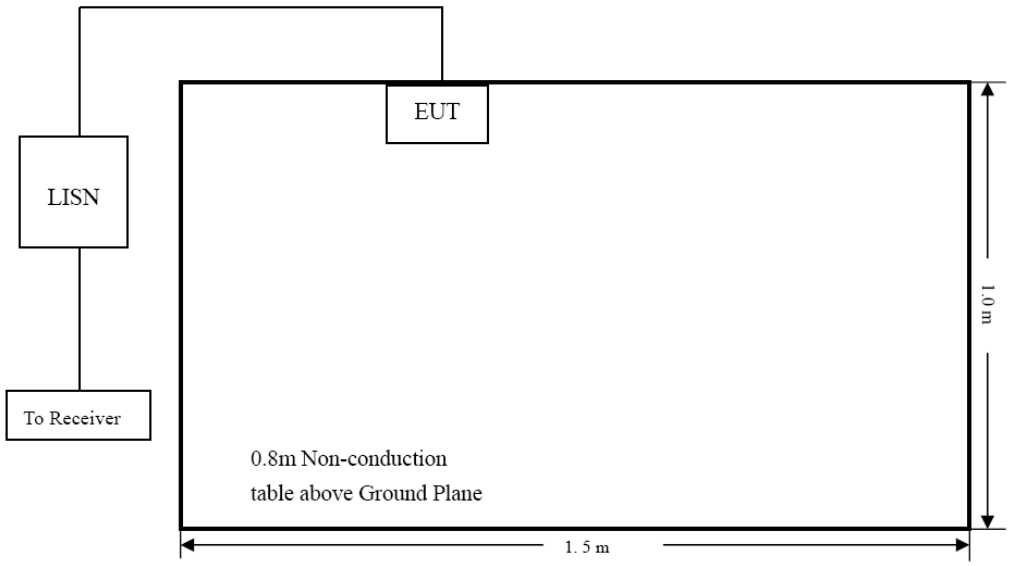
According to the rule FCC Part 15.207, Conducted limit, the limit for a class B device as below:

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56 | 56 to 46 |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |
| Note 1: Decreases with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz<br>Note 2: The lower limit applies at the band edges | | |

AC Power Line

## 12.2 Test Procedure

Test is conducting under the description of ANSI C63.10-2013 measurement procedure.



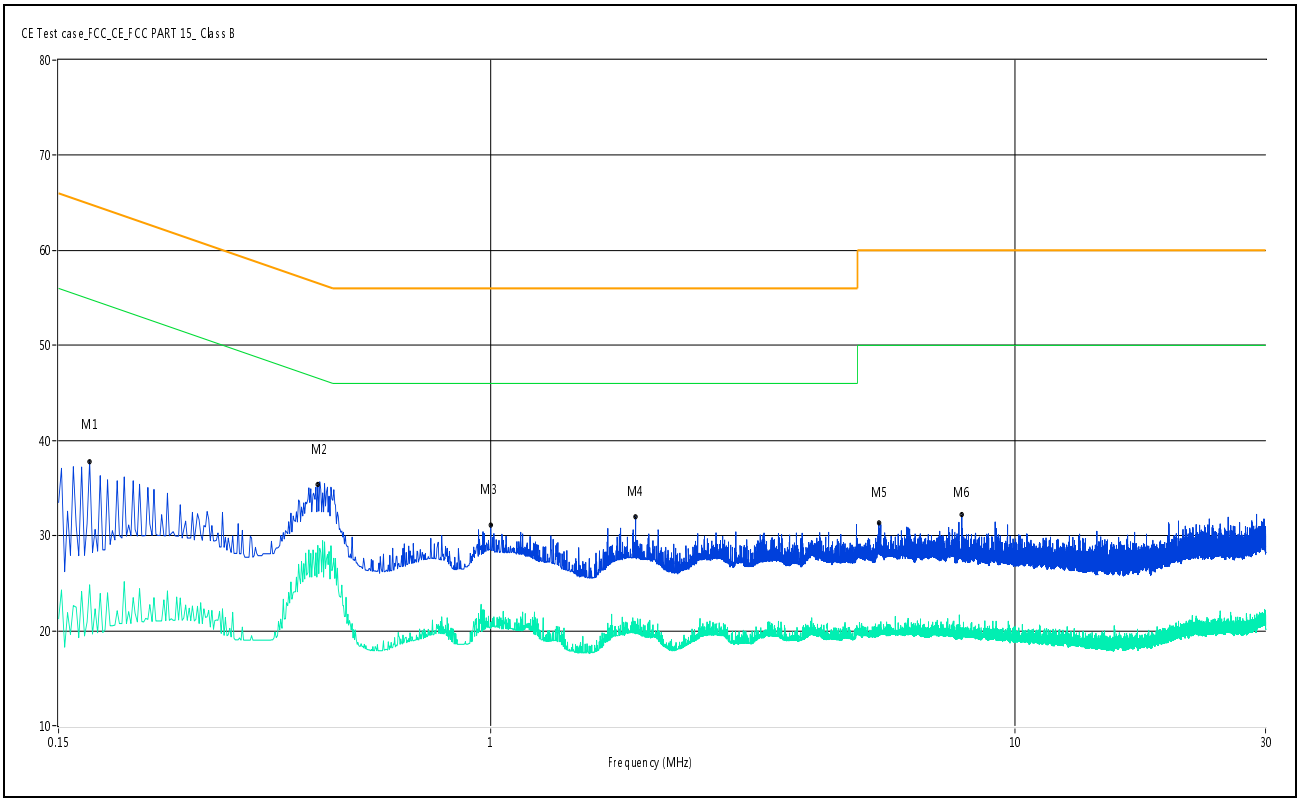

Test Setup Block Diagram

## 12.3 Test Data and Results

Based on all tested data, the EUT complied with the FCC Part 15.207 standard limit for a Class B device, and with the worst case as below:

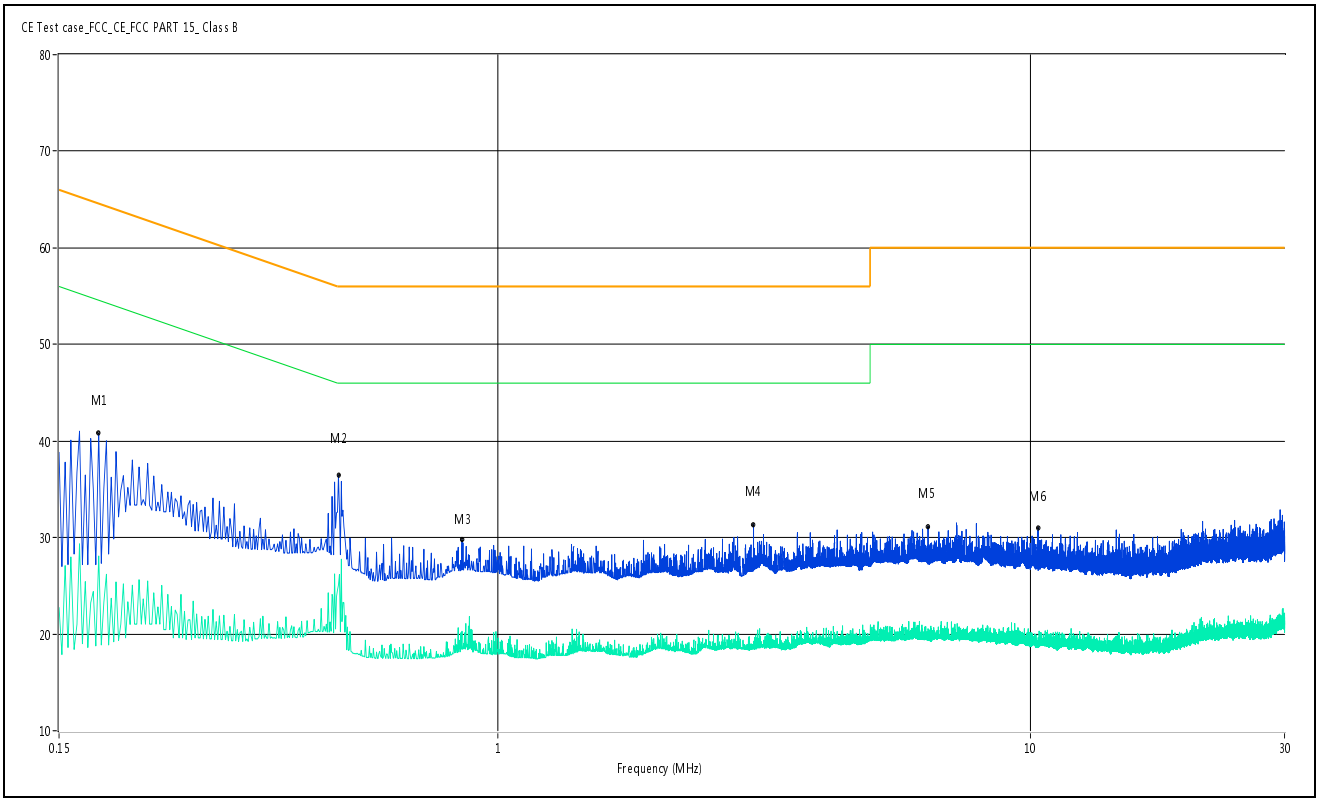
Note: During the charging condition, the wireless function of this device is inactive. Therefore, only test results of charging mode (TM5) were recorded here.

| Test Plots and Data of Conducted Emissions | |
|---|---|
| Tested Model: | GC42924 |
| Tested Mode: | TM5 |
| Test Power Specification: | AC 120V/60Hz |
| Test Power Line: | Neutral |




| No. | Frequency | Results | Factor | Limit | Margin | Detector | Line |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | (dB) | (dBuV) | (dB) | | |
| 1 | 0.17 | 37.8 | 11.00 | 65.4 | 27.60 | Peak | N Line |
| 1** | 0.17 | 24.8 | 11.00 | 55.4 | 30.60 | AV | N Line |
| 2 | 0.47 | 35.4 | 11.00 | 56.9 | 21.50 | Peak | N Line |
| 2** | 0.47 | 29.0 | 11.00 | 46.9 | 17.90 | AV | N Line |
| 3 | 1.00 | 31.1 | 11.00 | 56.0 | 24.90 | Peak | N Line |
| 3** | 1.00 | 20.9 | 11.00 | 46.0 | 25.10 | AV | N Line |
| 4 | 1.89 | 32.0 | 11.00 | 56.0 | 24.00 | Peak | N Line |
| 4** | 1.89 | 20.1 | 11.00 | 46.0 | 25.90 | AV | N Line |
| 5 | 5.49 | 31.4 | 11.00 | 60.0 | 28.60 | Peak | N Line |
| 5** | 5.49 | 19.4 | 11.00 | 50.0 | 30.60 | AV | N Line |
| 6 | 7.91 | 32.2 | 11.00 | 60.0 | 27.80 | Peak | N Line |
| 6** | 7.91 | 20.0 | 11.00 | 50.0 | 30.00 | AV | N Line |

| Test Plots and Data of Conducted Emissions | |
|---|---|
| Tested Model: | GC42924 |
| Tested Mode: | TM5 |
| Test Power Specification: | AC 120V/60Hz |
| Test Power Line: | Line |




| No. | Frequency | Results | Factor | Limit | Margin | Detector | Line |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | (dB) | (dBuV) | (dB) | | |
| 1 | 0.18 | 40.8 | 11.00 | 65.2 | 24.40 | Peak | L Line |
| 1** | 0.18 | 28.1 | 11.00 | 55.2 | 27.10 | AV | L Line |
| 2 | 0.50 | 36.5 | 11.00 | 56.0 | 19.50 | Peak | L Line |
| 2** | 0.50 | 25.1 | 11.00 | 46.0 | 20.90 | AV | L Line |
| 3 | 0.86 | 29.8 | 11.00 | 56.0 | 26.20 | Peak | L Line |
| 3** | 0.86 | 20.3 | 11.00 | 46.0 | 25.70 | AV | L Line |
| 4 | 3.02 | 31.4 | 11.00 | 56.0 | 24.60 | Peak | L Line |
| 4** | 3.02 | 19.3 | 11.00 | 46.0 | 26.70 | AV | L Line |
| 5 | 6.42 | 31.2 | 11.00 | 60.0 | 28.80 | Peak | L Line |
| 5** | 6.42 | 19.0 | 11.00 | 50.0 | 31.00 | AV | L Line |
| 6 | 10.35 | 31.0 | 11.00 | 60.0 | 29.00 | Peak | L Line |
| 6** | 10.35 | 18.6 | 11.00 | 50.0 | 31.40 | AV | L Line |