CERTIFICATION TEST REPORT

Report Number. : R12935938-E2

Applicant	:	Microsoft Corporation One Microsoft Way Redmond, WA 98052-6399 USA
Model	:	1868
FCC ID	:	C3K1868
IC	:	3048A-1868
EUT Description	:	Portable Computing Device
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
2019-09-16

Prepared by:
UL LLC
12 Laboratory Dr.
Research Triangle Park, NC 27709 U.S.A.
TEL: (919) 549-1400

NVLAP TESTING

NVLAP Lab code: 200246-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	--	Initial Issue	
2	2019-09-06	Added AC adaptor to support equipment. Revised ending test date.	Brian T. Kiewra
3	2019-09-16	Added model similarity explanation to Section 4.	Brian T. Kiewra

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399
USA

EUT DESCRIPTION: Portable Computing Device

MODEL: 1868

SERIAL NUMBER: See section 6.4

DATE TESTED: 2019-07-15 to 2019-08-14

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5	Complies

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. government.

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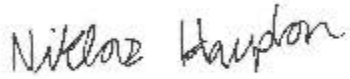
Approved & Released For
UL LLC By:

Jeffrey Moser
Operations Leader
Consumer Technology Division
UL LLC

Prepared By:



Niklas Haydon
Engineer
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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, RSS-GEN Issue 5, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Drive, Research Triangle Park, North Carolina, USA and 2800 Perimeter Park Dr. Suite B, Morrisville, North Carolina, USA. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

12 Laboratory Dr.	2800 Perimeter Park Dr. Suite B
ISED Site Code: 2180C	
☐ Chamber A	☒ Chamber North
☐ Chamber C	☒ Chamber South

The above test sites and facilities are covered under FCC Test Firm Registration # 703469. Chambers above are covered under Industry Canada company address and respective code.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0

4. SCOPE OF REPORT

This test report covers the radiated emissions, antenna port conducted emissions, and AC power line conducted emissions data for model 1868. Antenna port conducted emissions data in this report is leveraged by model 1867. For model 1867, radiated emissions and AC power line conducted emissions can be found in UL report number R12922855-E2.

Models 1867 and 1868 are electrically and RF equivalent as they use the same motherboard, radio module and on-board RF components. Both models share a common WiFi and BT power table. The radio-related firmware and driver versions are the same for the two models. The peak antenna gains are in the antenna gain section of the report. Antenna port conducted emissions measurements are done on model 1868 (FCC ID: C3K1868, IC: 3048A-1868) and the data is leveraged for model 1867 (FCC ID: C3K1867, IC: 3048A-1867). Highest antenna gain across the two models in each band has been considered while doing the conducted emissions measurements. Separate radiated & SAR measurements are done on each model.

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5. CALIBRATION AND UNCERTAINTY

5.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

5.2. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radio Frequency (Spectrum Analyzer)	141.2 Hz
Occupied Channel Bandwidth	2.00%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
RF output power, radiated (SAC)	4.52 dB
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	2.50 dB
All emissions, radiated	4.88 dB
Temperature	2.26°C
Humidity	6.79%
DC Supply voltages	1.70%
Time	3.39%

Uncertainty figures are valid to a confidence level of 95%.

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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a Portable Computing Device that contains 802.11 a/ac/ax/b/g/n 20/40/80/160MHz 2x2 dual band and BT/BLE radios.

6.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	Basic GFSK	2.48	1.77
2402 - 2480	Enhanced DQPSK	5.14	3.27
2402 - 2480	Enhanced 8PSK	4.86	3.06

Note: GFSK, DQPSK, 8PSK power are all investigated, The GFSK & 8PSK power are the worst case. Testing is based on these modes to showing compliance. For average power data please refer to section 9.7.

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Range (GHz)	Antenna Type	Peak Gain (dBi) Antenna 1 (Right)	Peak Gain (dBi) Antenna 2 (Left)
Model 1867			
2.4 to 2.48	PIFA	0.7	2.6
5.15 to 5.25		4.9	4.4
5.25 to 5.35		6.1	5.0
5.47 to 5.72		7.2	5.5
5.725 to 5.85		9.4	5.6
Model 1868			
2.4 to 2.48	PIFA	0.4	1.0
5.15 to 5.25		3.6	2.2
5.25 to 5.35		5.2	3.5
5.47 to 5.72		6.4	4.7
5.725 to 5.85		7.8	4.5

The BT radio utilizes Antenna 1.

Antenna 1 = Chain 0
Antenna 2 = Chain 1

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6.4. SOFTWARE AND FIRMWARE

EUT	Serial Number	DRTU Version	OS Version	BT Driver Version	WiFi Driver Version	EUT's Power Supply (s/n)
R-557-1868-FCC-CONDUCTED-02	005210692757	11.1916.0 -09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P01P9596
R-557-1868-FCC-CONDUCTED-03	005216792757	11.1916.0 -09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P03GE596
R-557-1868-FCC-RADIATED-10	013886292757	11.1916.0 -09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P02KC596
R-557-1868-FCC-RADIATED-11	013891692757	11.1916.0 -09531	MTEOS 1.652.0	21.0.19157.20088	99.0.43.8	0D130P01S7596

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

The EUT has one intended orientations, X; therefore, all final radiated testing was performed with the EUT in X orientation.

Worst-case data rates/packet sizes were:

GFSK mode: DH5
DQPSK mode: 2-DH5
8PSK mode: 3-DH5

All radios that can transmit simultaneously have been evaluated for radiated for all possible combinations of transmission and found to be in compliance.

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6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
USB Hub	J5 Create	JCA374	AY2A1904000477 / AY6A1903004261	N/A
Earbuds	Sony	MDR-EX14AP	Non-serialized	N/A
USB Flash Drive	Kingston	DataTraveler G4	Non-serialized	N/A
AC Power Adaptor	Microsoft	1706	0D130P02KC596	N/A

I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	Mains	1	12-pin	Mains	<3	None
2	USB-A	1	USB-A	USB	<3	None
3	USB-C	1	USB-C	USB	<3	None
4	Aux	1	Aux	Aux	<3	None

TEST SETUP

The test utility software was located on the EUT during the tests and was used to exercised the radios.

SETUP DIAGRAMS

Please refer to R12935938-EP1 for setup diagrams

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7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2019-04-22	2020-04-22
	18-40 GHz				
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2018-11-08	2019-11-08
	Gain-Loss Chains				
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2019-03-13	2020-03-13
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2018-09-30	2019-09-30
	Receiver & Software				
SA0025	Spectrum Analyzer	Agilent	N9030A	2019-02-28	2020-02-28
SA0027 (18-40GHz RSE)	Spectrum Analyzer	Agilent	N9030A	2019-05-15	2020-05-15
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 181474409	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

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Test Equipment Used – Line Conducted Emissions Voltage (Morrisville – Conducted 1)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2019-05-29	2020-05-29
s/n 161016511	Environmental Meter	Fisher Scientific	14-650-118	2018-09-04	2020-09-04
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2018-08-21	2019-08-21
75141 (PRE0101521)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2018-08-22	2019-08-22
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2019-05-29	2020-05-29
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

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Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	**(Loop Ant.)**			
AT0059	Active Loop Antenna	ETS-Lindgren	6502	2018-07-20	2019-07-31
	30-1000 MHz				
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2018-08-06	2019-08-31
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2019-05-02	2020-05-02
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2019-05-02	2020-05-02
	Receiver & Software				
SA0026	Spectrum Analyzer	Agilent	N9030A	2019-03-19	2020-03-19
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 181474341	Environmental Meter	Fisher Scientific	15-077-963	2018-07-27	2020-07-27

NOTES:

1. For equipment listed above that was calibrated during the testing period, please note the equipment was used for testing after calibration.
2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

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Test Equipment Used – Antenna Port Conducted Testing (Morrisville – RP)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0027	PXA Signal Analyzer	Keysight Technologies	MY54490254	2019-05-15	2020-05-15
s/n 160938893	Environmental Meter	Fisher Scientific	14-650-118	2019-06-17	2020-06-17
224604-002	Coaxial Testing Cable	Uti-flex	UFA147A-0-0180-200200	NA	NA
Antenna Port	Antenna Port Software	Antenna	Version 10.0.1	NA	NA
126431 (PRE0128068)	RF Power Meter	Anritsu	ML2495A	2019-04-30	2020-04-30
126430 (PRE0128067)	Pulse Power Sensor, 300MHz to 40GHz	Anritsu	MA2411B	2019-04-30	2020-04-30
PWM001 (PRE0136343)	RF Power Meter	Keysight Technologies	N1912A	2019-06-14	2020-06-14
PWS001 (PRE0137347)	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2019-05-06	2020-05-06

NOTES:

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2. For equipment listed above that has a calibration due date during the testing period, the testing was completed before the equipment expiration date.

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8. MEASUREMENT METHODS

On Time and Duty Cycle: ANSI C63.10-2013 Section 11.6

Emissions BW (20dB): ANSI C63.10-2013 Section 6.9.2

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

Carrier Frequency Separation: ANSI C63.10-2013 Section 7.8.2

Number of Hopping Frequencies: ANSI C63.10-2013 Section 7.8.3

Time of Occupancy (Dwell Time): ANSI C63.10-2013 Section 7.8.4

Peak Output Power: ANSI C63.10-2013 Section 7.8.5

Conducted Spurious Emissions: ANSI C63.10-2013 Section 7.8.8

Conducted Band-Edge: ANSI C63.10-2013 Section 6.10.4

Radiated Spurious Emissions: ANSI C63.10-2013 Section 6.3 and 6.6

Radiated Band-edge: ANSI C63.10-2013 Section 6.10.5

AC Power-line conducted emissions: ANSI C63.10-2013, Section 6.2.

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9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

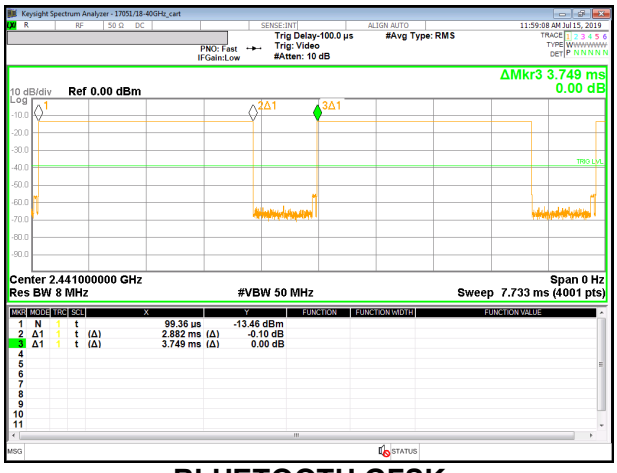
PROCEDURE

ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

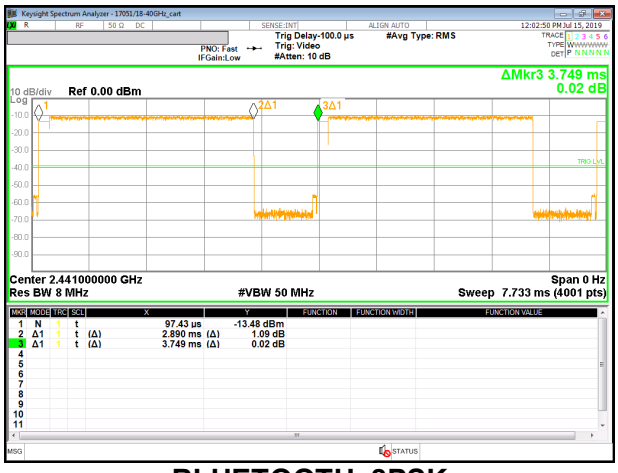
ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
Bluetooth GFSK	2.882	3.749	0.769	76.9%	1.14	0.347
Bluetooth 8PSK	2.890	3.749	0.771	77.1%	1.13	0.346

DUTY CYCLE PLOTS



BLUETOOTH GFSK



BLUETOOTH 8PSK

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9.2. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB or 99% bandwidth. The VBW is set to ≥ RBW (Approx 3x). The sweep time is coupled.

RESULTS

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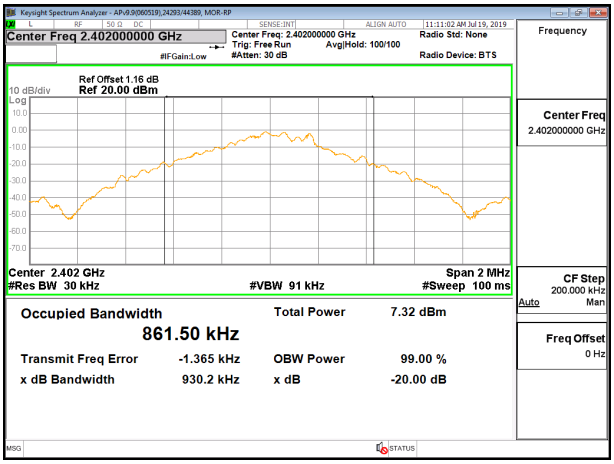
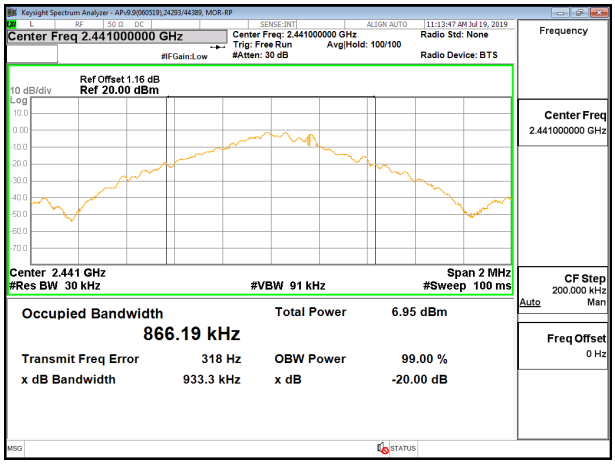
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

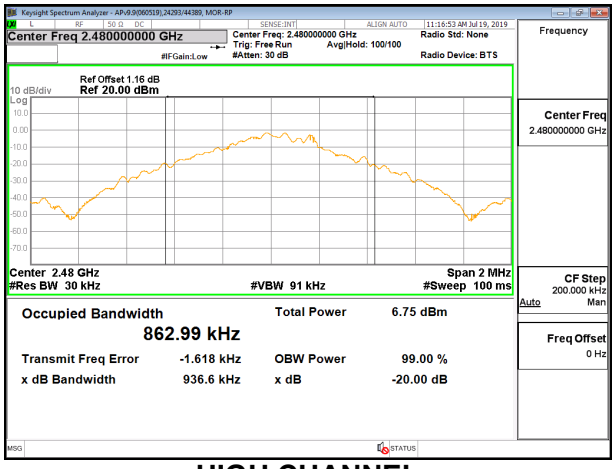
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.93	0.862
Mid	2441	0.933	0.866
High	2480	0.937	0.863



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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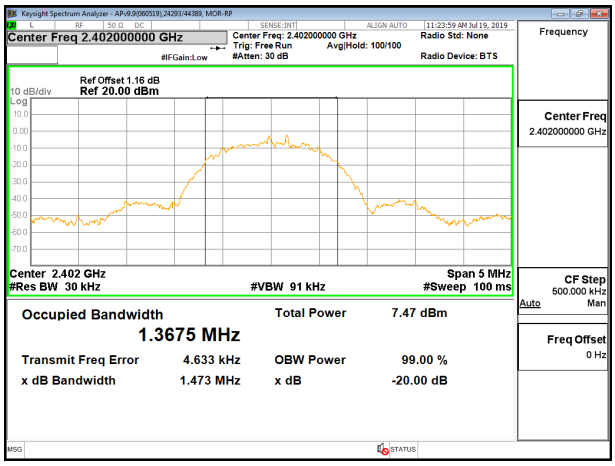
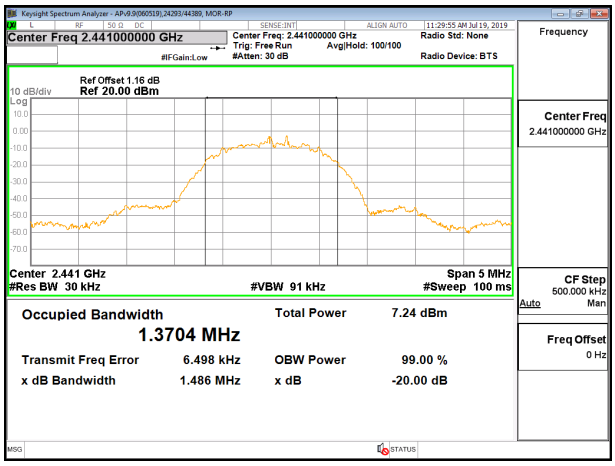
9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

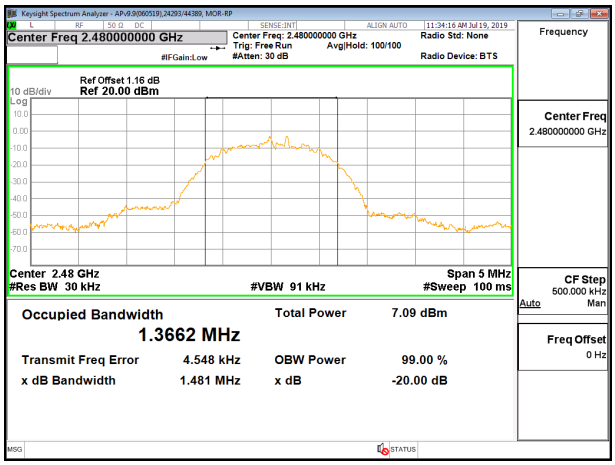
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.473	1.3675
Mid	2441	1.486	1.3704
High	2480	1.481	1.3662



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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9.3. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

RSS-247 (5.1) (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to VBW >= RBW. The sweep time is coupled.

RESULTS

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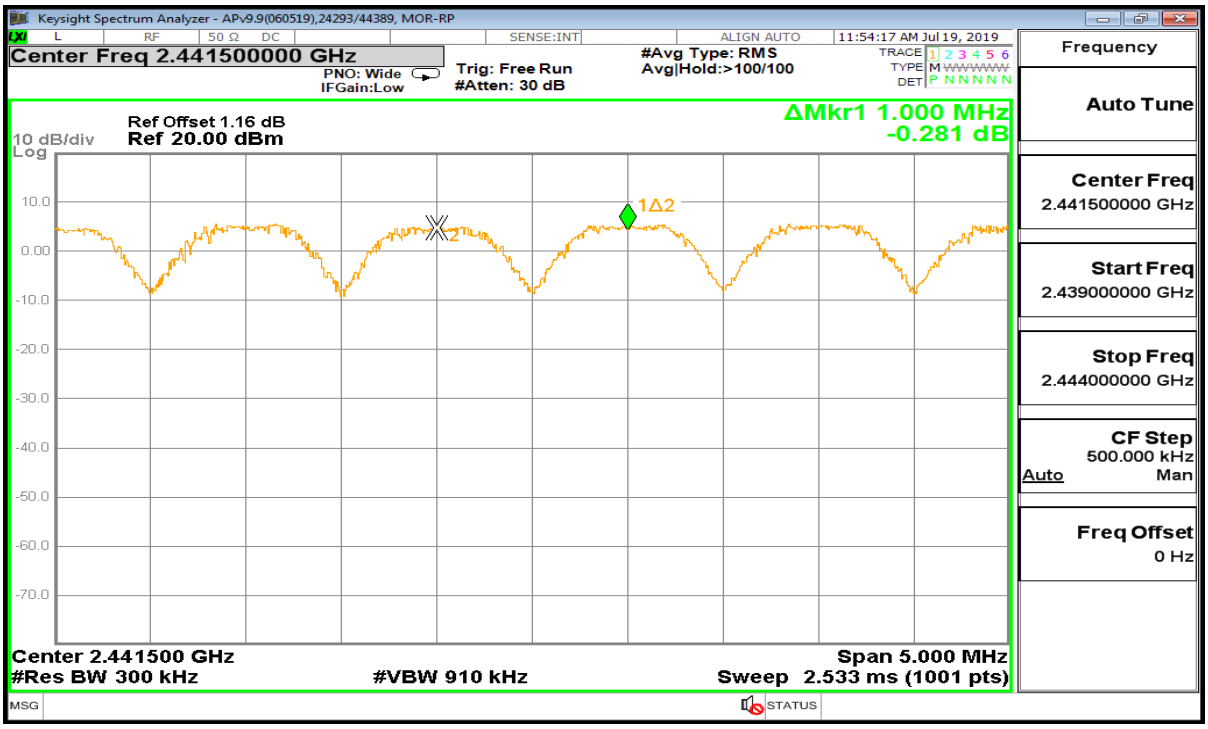
9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

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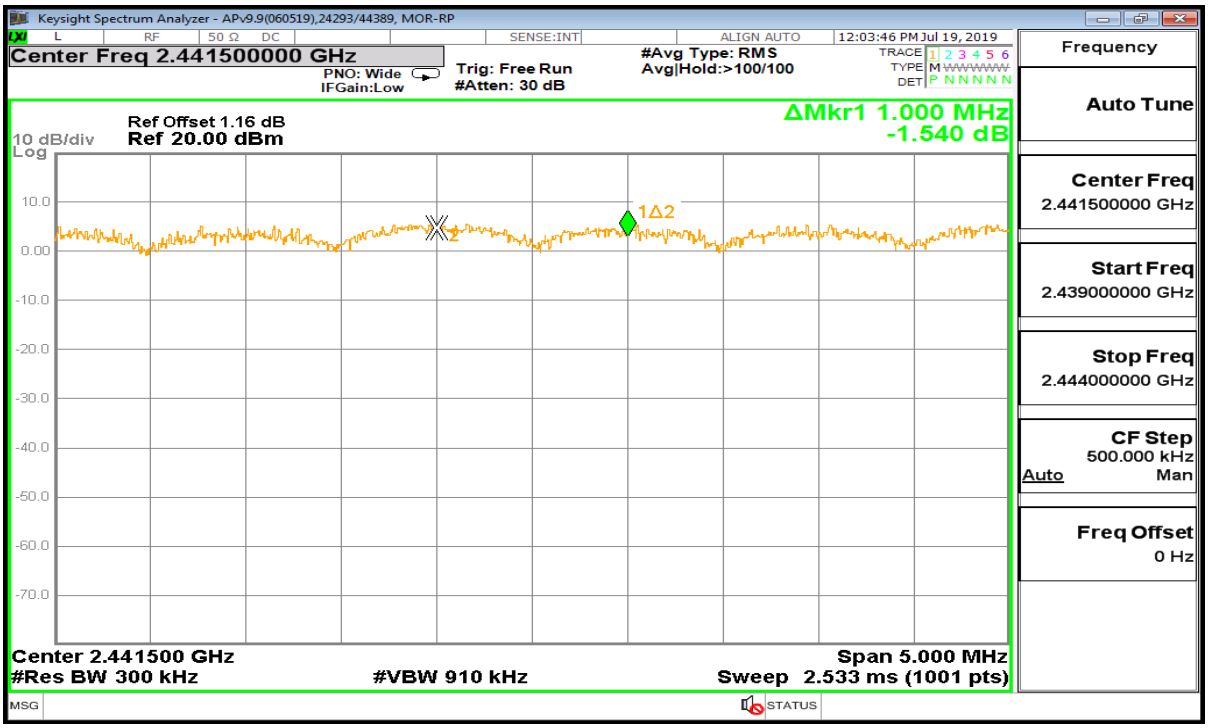
9.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

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9.4. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels. The RBW is set to 30% of the channel spacing (approx. 300kHz). The analyzer is set to Max Hold.

RESULTS

Normal Mode: All Channels Observed

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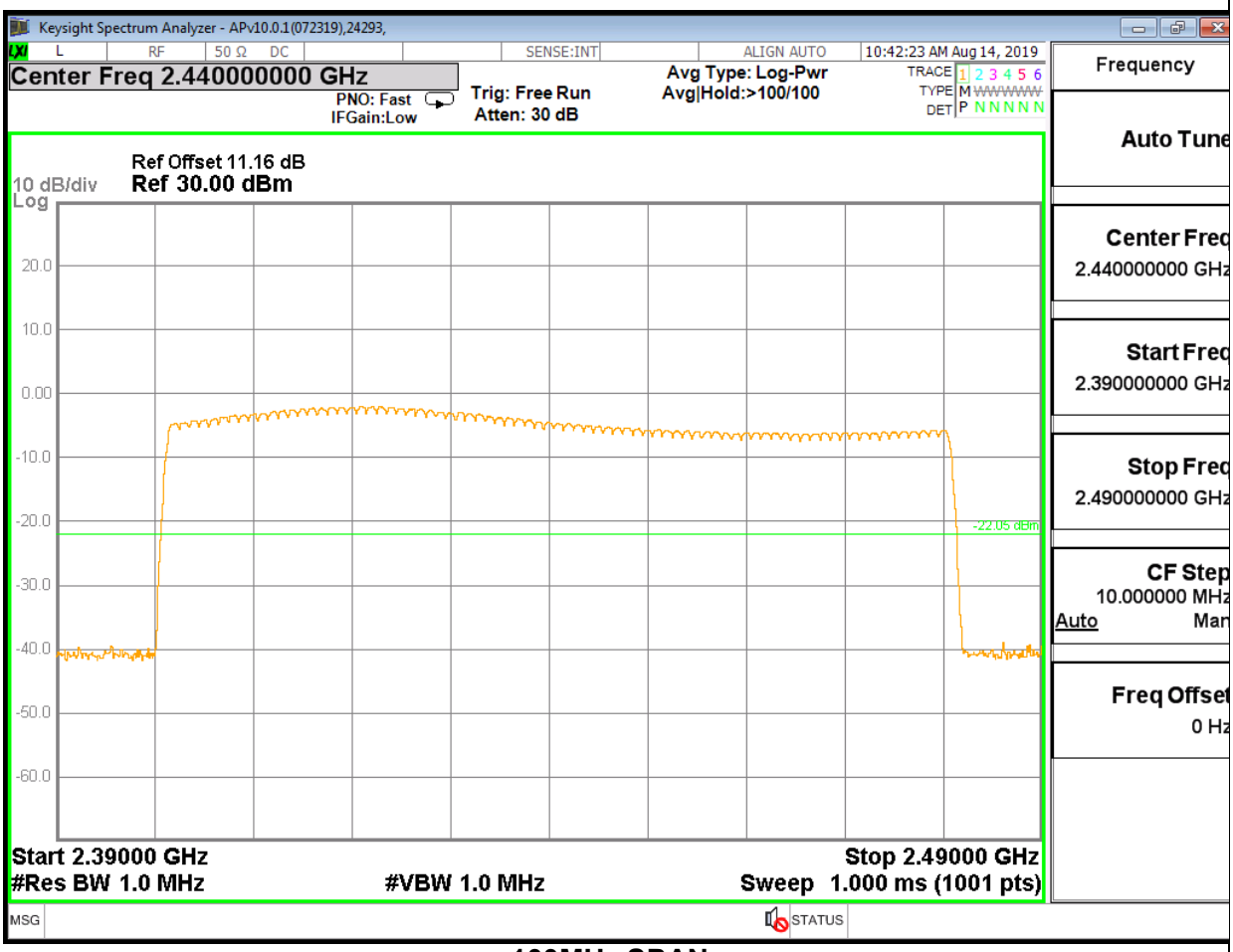
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



100MHz SPAN

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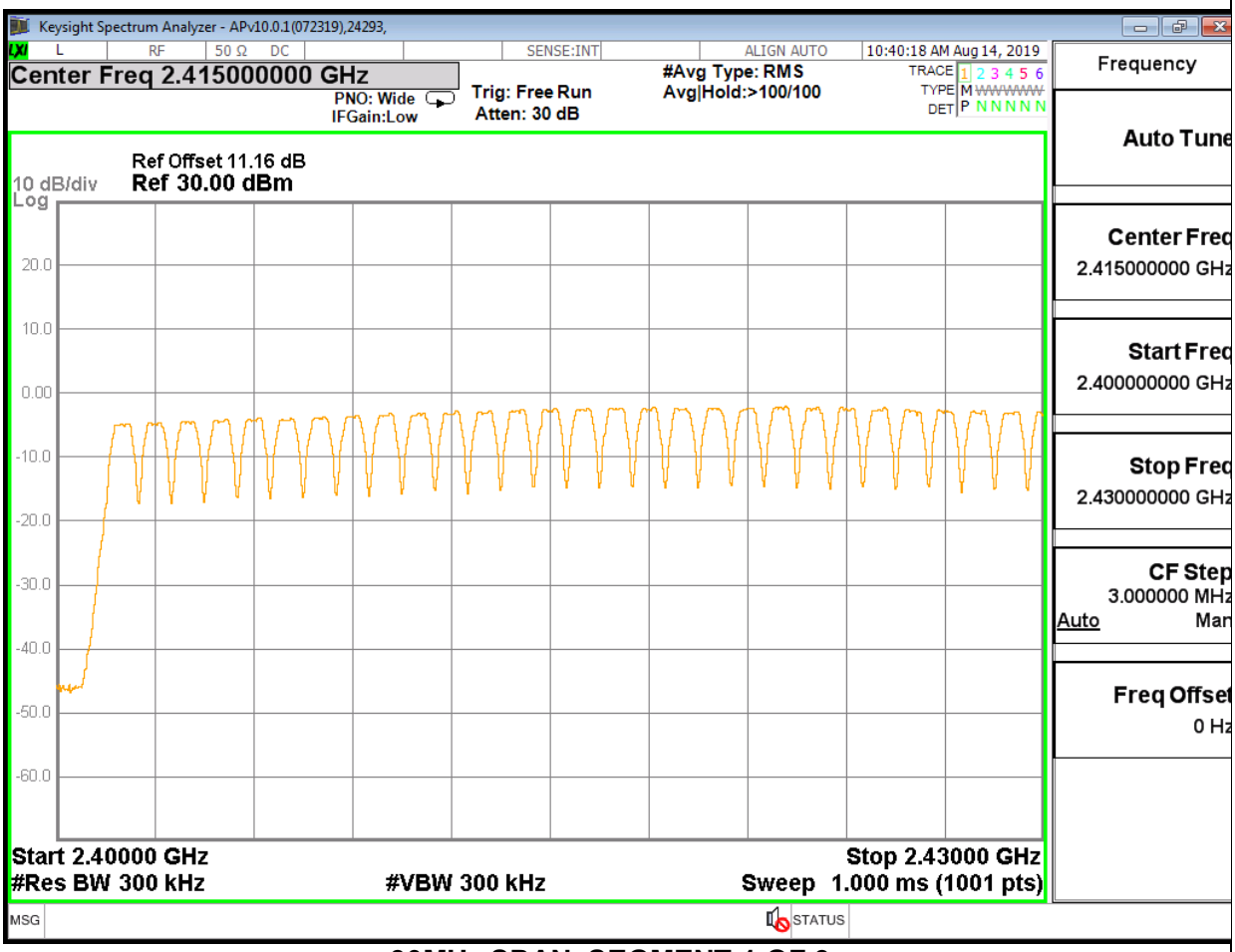

30MHz SPAN, SEGMENT 1 OF 3

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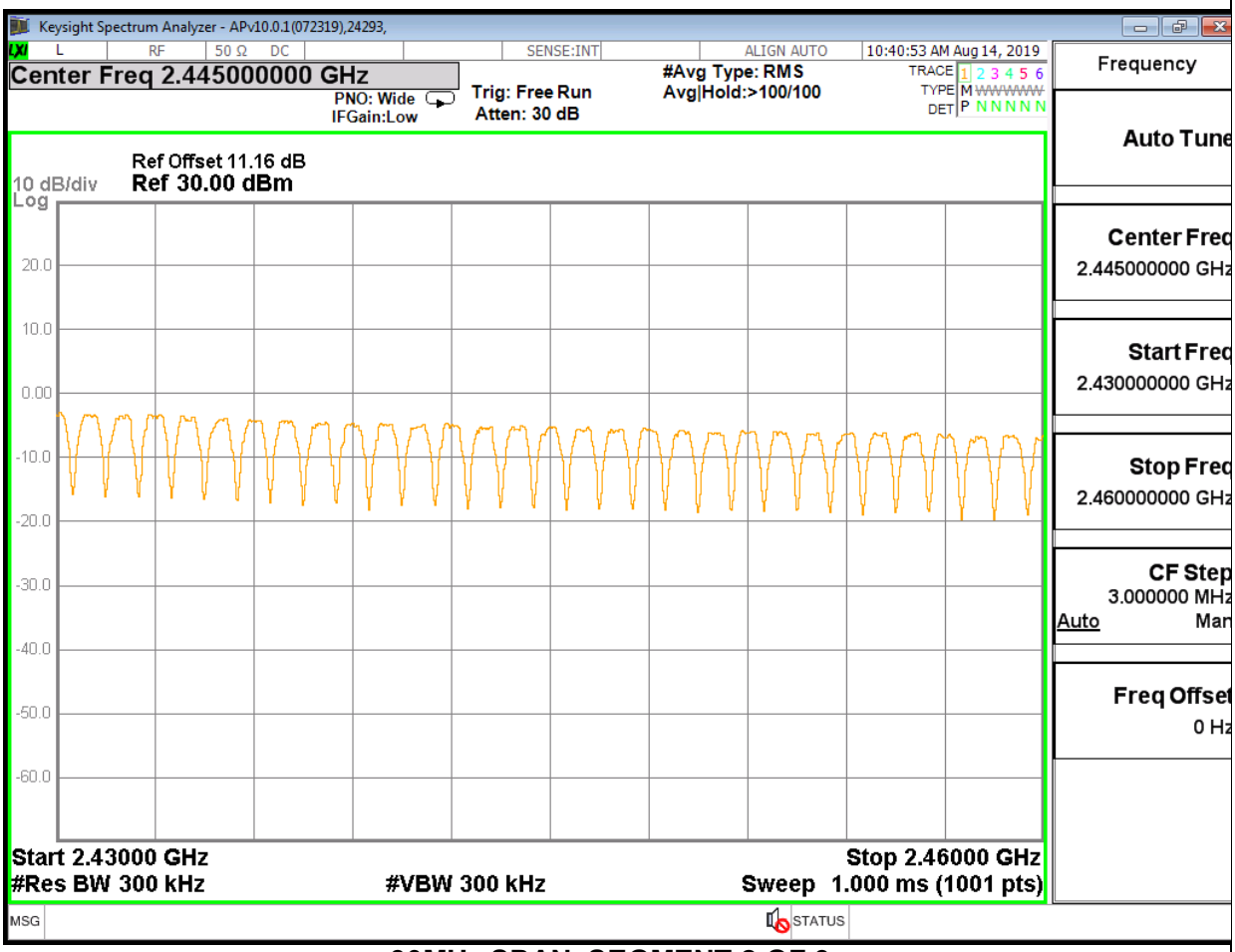

30MHz SPAN, SEGMENT 2 OF 3

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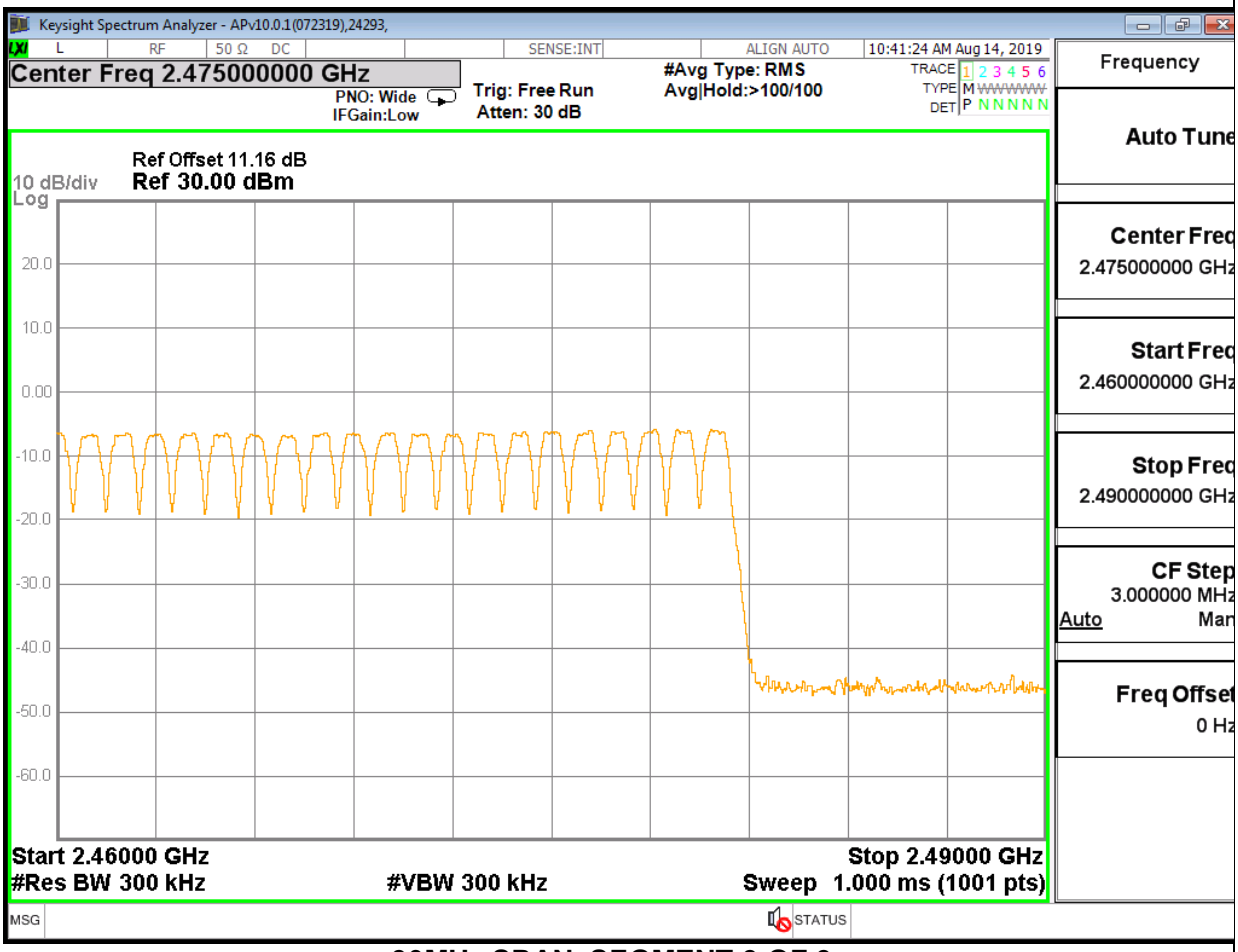

30MHz SPAN, SEGMENT 3 OF 3

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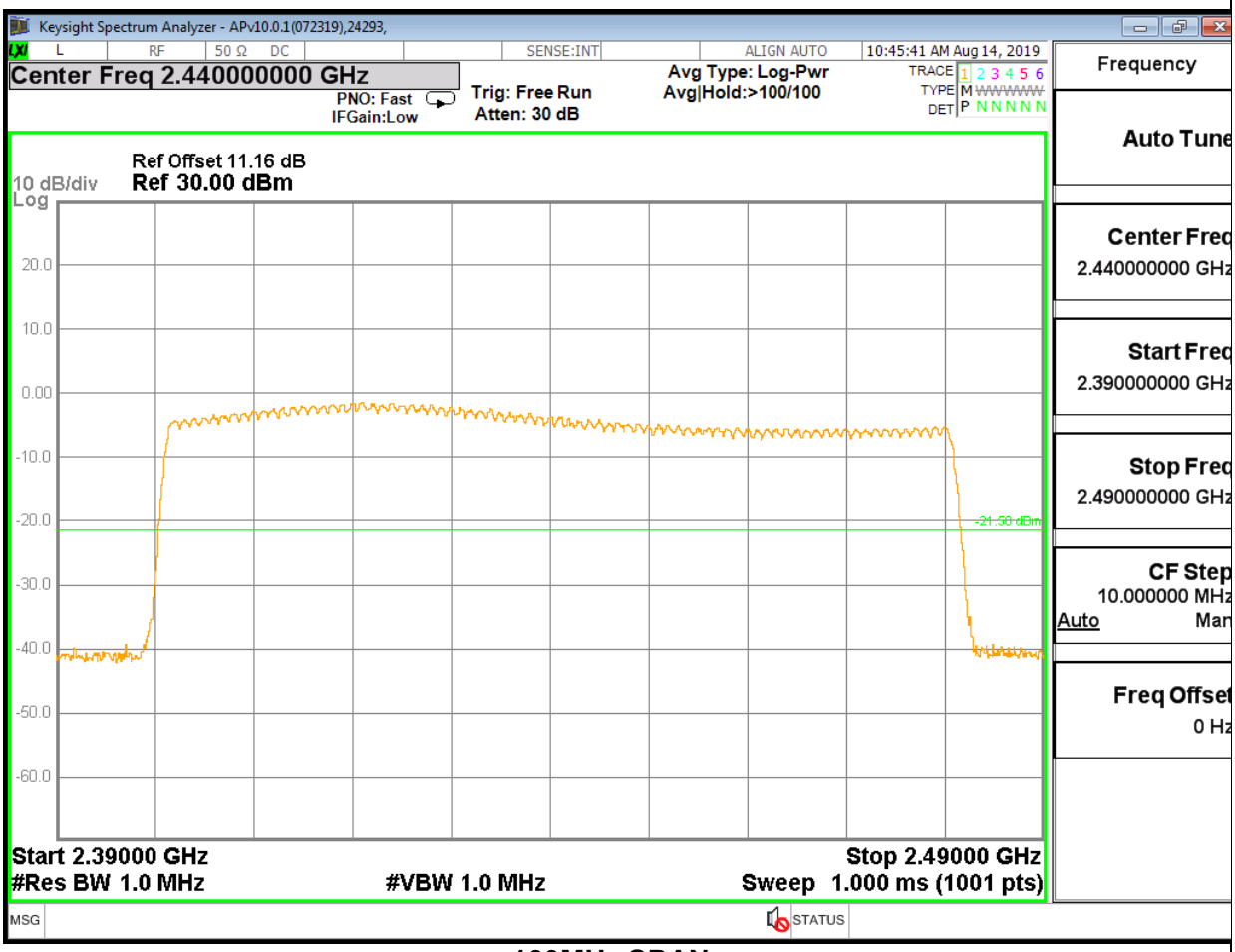
9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



100MHz SPAN

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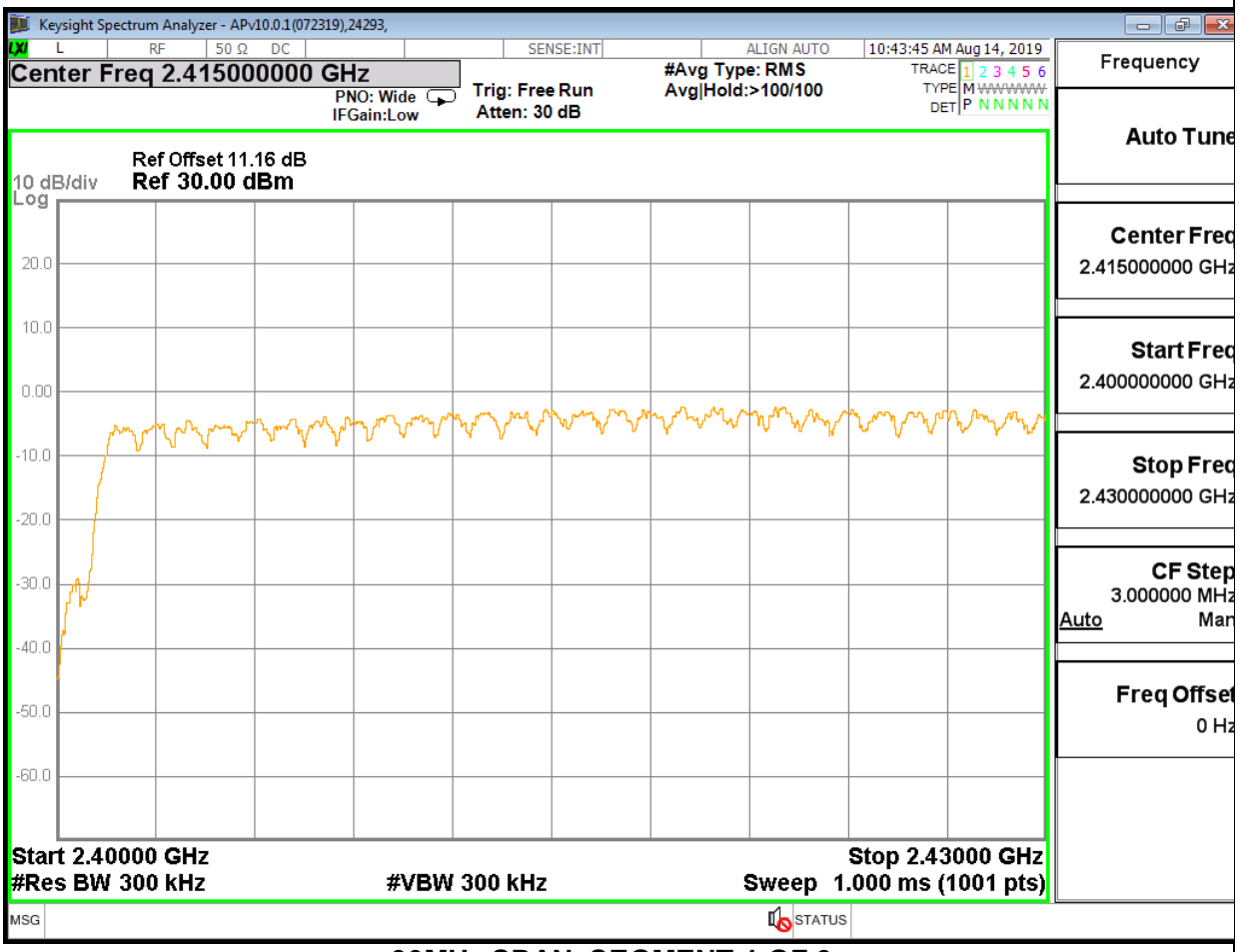

30MHz SPAN, SEGMENT 1 OF 3

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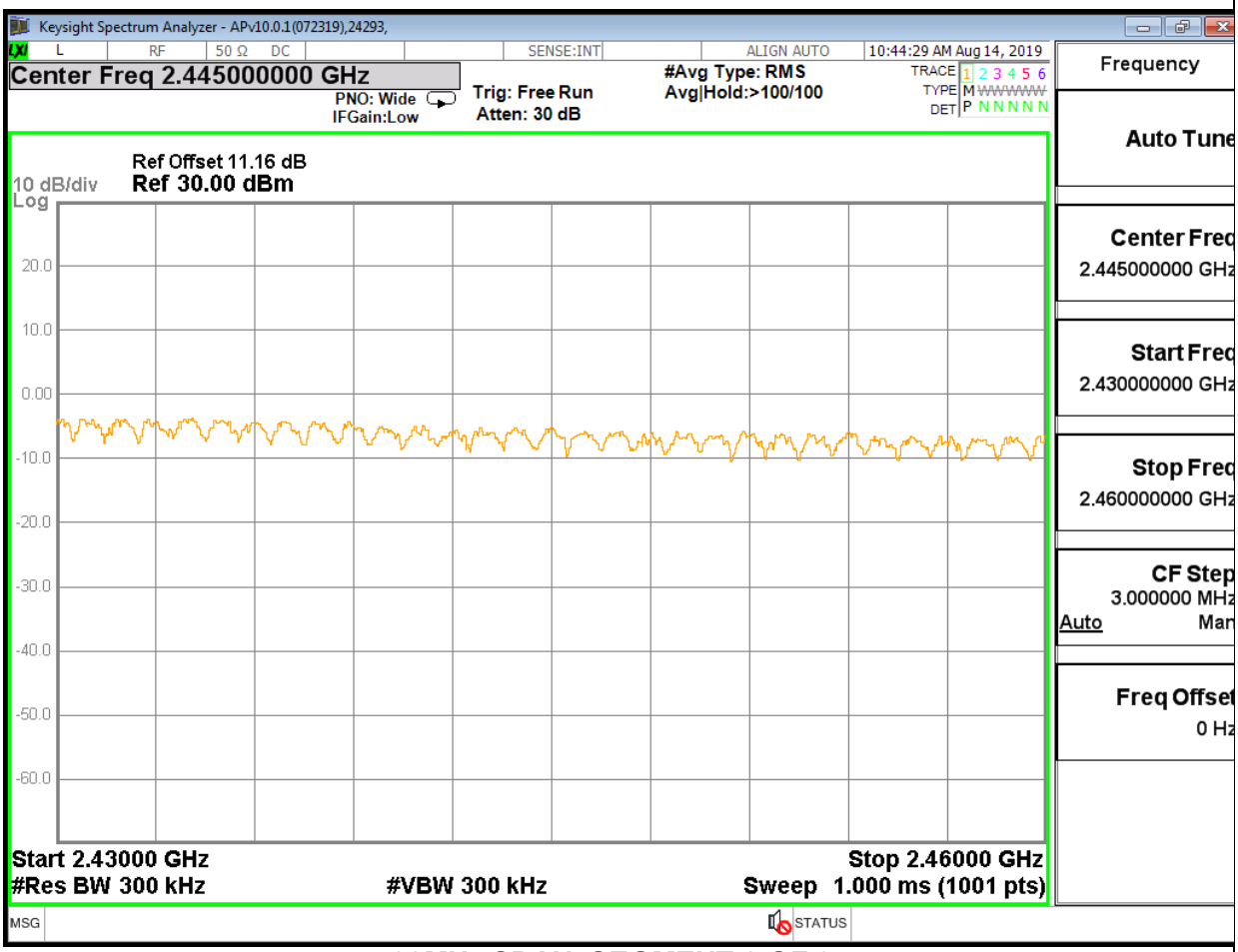

30MHz SPAN, SEGMENT 2 OF 3

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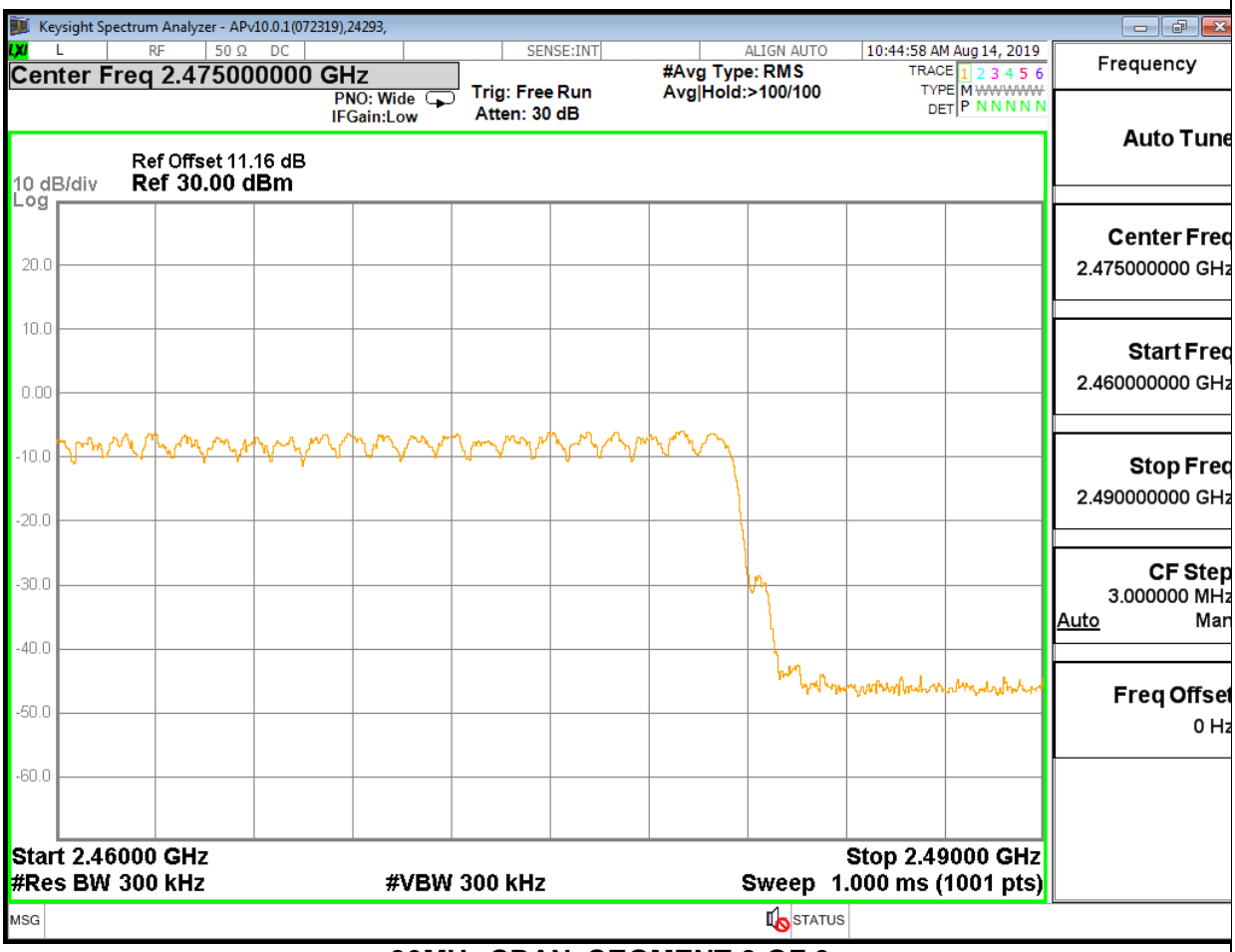

30MHz SPAN, SEGMENT 3 OF 3

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9.5. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

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.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 3.16 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

RESULTS

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9.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.38	32	0.1216	0.4	-0.2784
DH3	1.634	16	0.2614	0.4	-0.1386
DH5	2.884	9	0.2596	0.4	-0.1404
DH Packet	Pulse Width (sec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.38	8	0.03040	0.4	-0.3696
DH3	1.634	4	0.06536	0.4	-0.3346
DH5	2.884	2.25	0.06489	0.4	-0.3351

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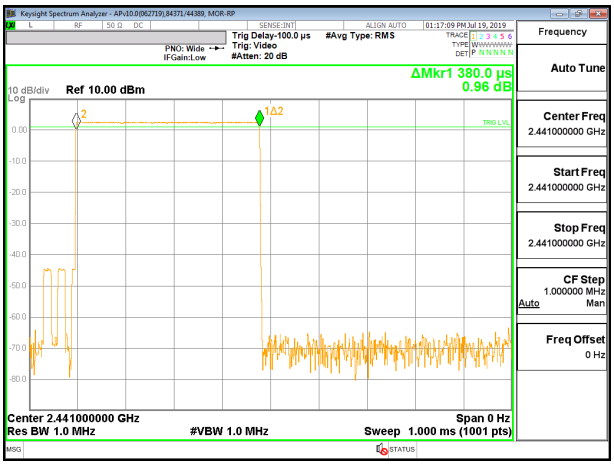
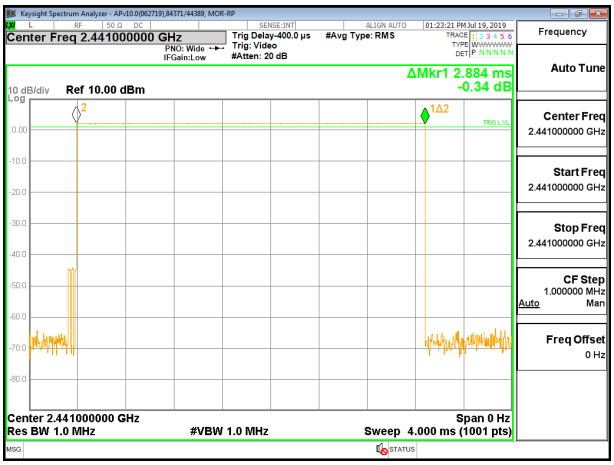


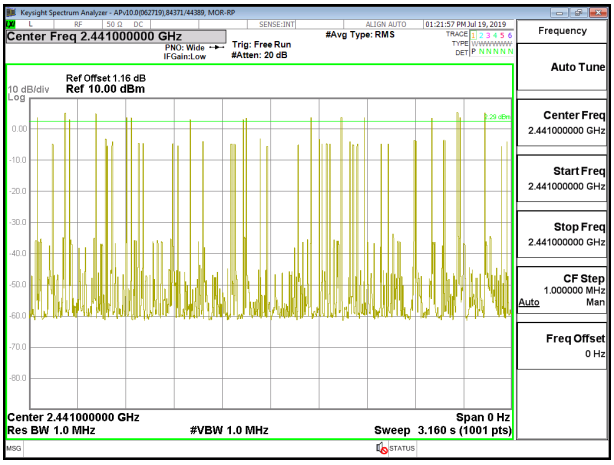
PULSE WIDTH – DH1

PULSE WIDTH – DH3



PULSE WIDTH – DH5

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5

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9.5.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
DQPSK Normal					
2DH1	0.388	32	0.12416	0.4	-0.2758
2DH3	1.64	15	0.246	0.4	-0.154
2DH5	2.888	7	0.20216	0.4	-0.1978

Note: for AFH(DQPSK) mode, please refer to the results of AFH(GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate demonstrates compliance with channel occupancy when AFH is employed.

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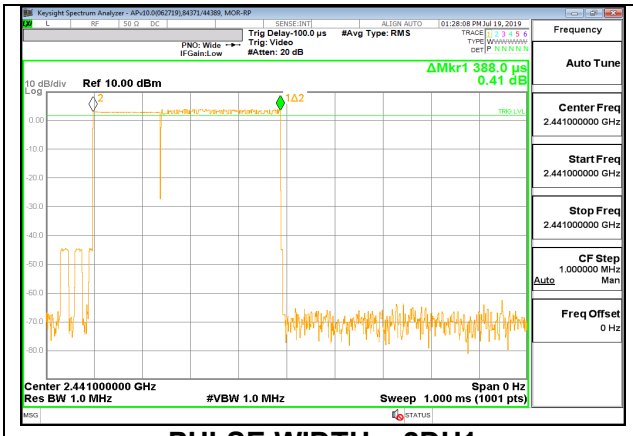
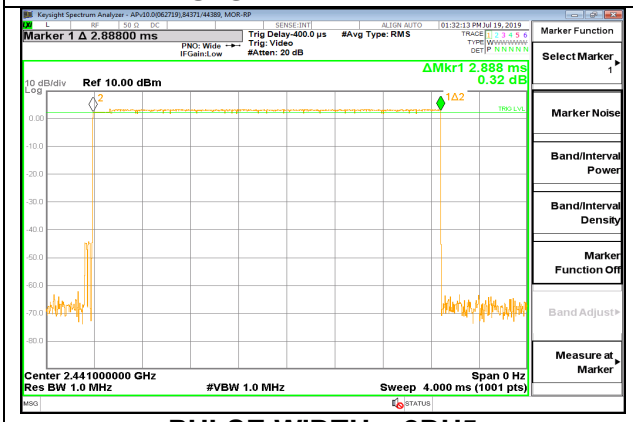
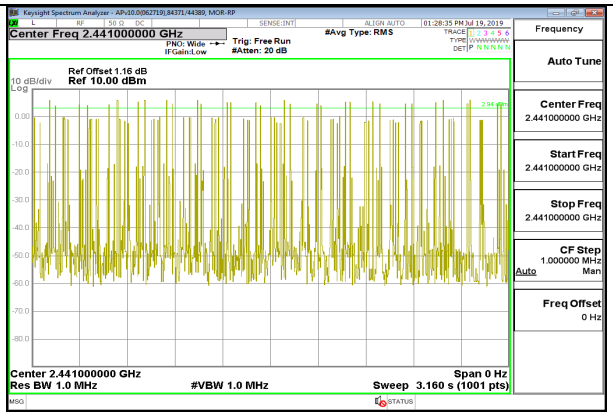


PULSE WIDTH – 2DH1

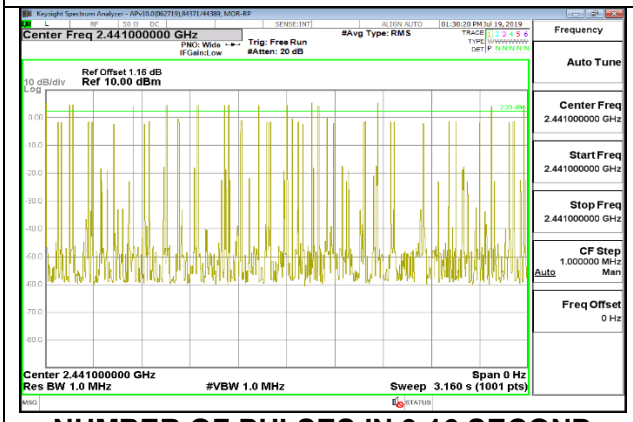
PULSE WIDTH – 2DH3



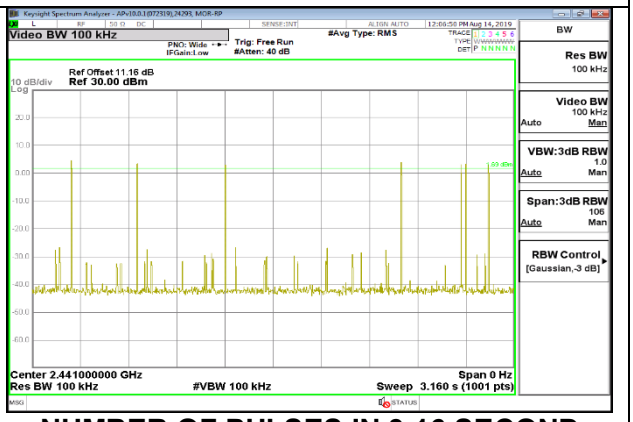
PULSE WIDTH – 2DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 2DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 2DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 2DH5

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9.5.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
8PSK Normal Mode					
3DH1	0.389	32	0.12448	0.4	-0.2755
3DH3	1.638	16	0.26208	0.4	-0.1379
3DH5	2.892	11	0.31812	0.4	-0.0819

Note: for AFH(8PSK) mode, please refer to the results of AFH(GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate demonstrates compliance with channel occupancy when AFH is employed.

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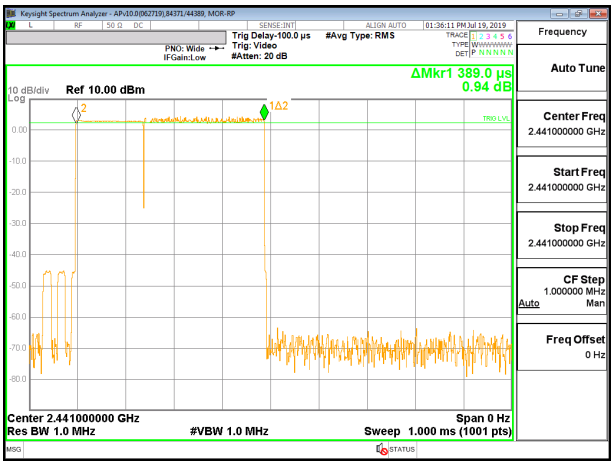
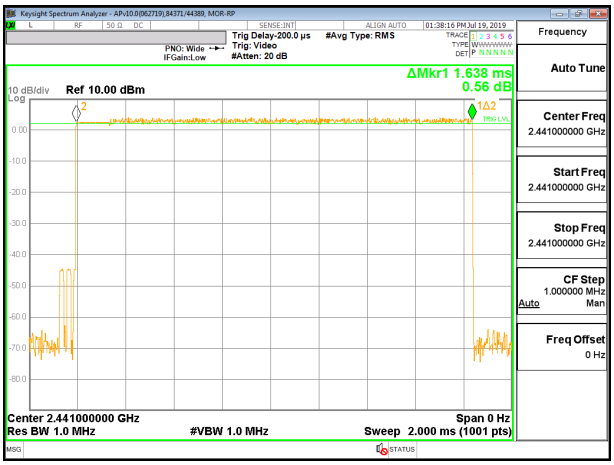
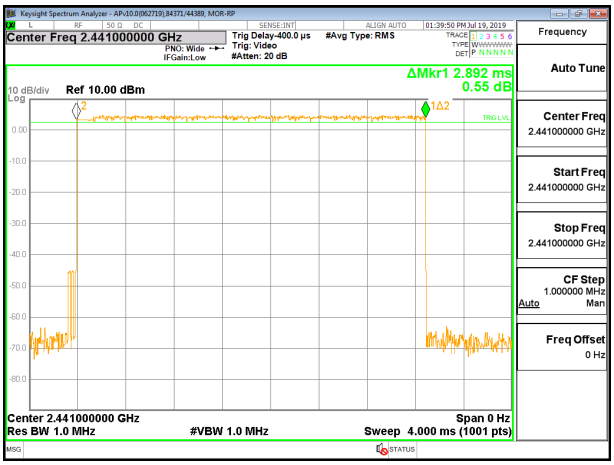


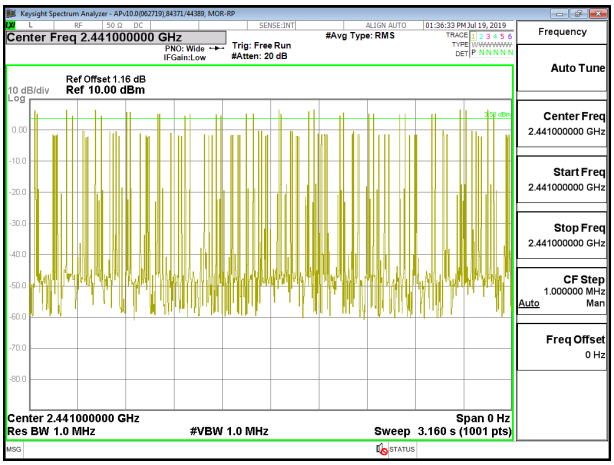
PULSE WIDTH – 3DH1



PULSE WIDTH – 3DH3

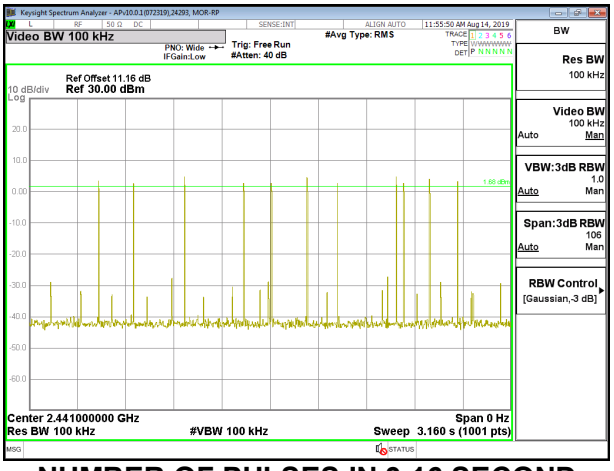


PULSE WIDTH – 3DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH1

NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH5

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9.6. OUTPUT POWER

LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

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

TEST PROCEDURE

Measurements perform using a wideband RF Peak power meter.

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for a peak reading of power.

RESULTS

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9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.48	30	-27.52
Middle	2441	2.19	30	-27.81
High	2480	2.17	30	-27.83

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9.6.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	5.01	21	-15.99
Middle	2441	5.14	21	-15.86
High	2480	5.12	21	-15.88

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9.6.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	11993
Date:	2019-08-22

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	4.75	21	-16.25
Middle	2441	4.69	21	-16.31
High	2480	4.86	21	-16.14

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9.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power.

RESULTS

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9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	11993
Date	2019-08-22

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	2.26
Middle	2441	1.98
High	2480	1.96

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9.7.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	11993
Date	2019-08-22

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	2.09
Middle	2441	2.17
High	2480	2.12

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9.7.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	11993
Date	2019-08-22

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	1.97
Middle	2441	1.99
High	2480	2.17

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9.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

RSS-247 5.5

Limit = -20 dBc

TEST PROCEDURE

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

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

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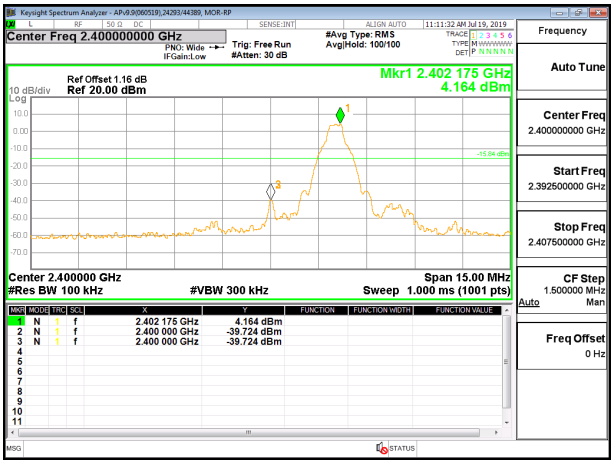
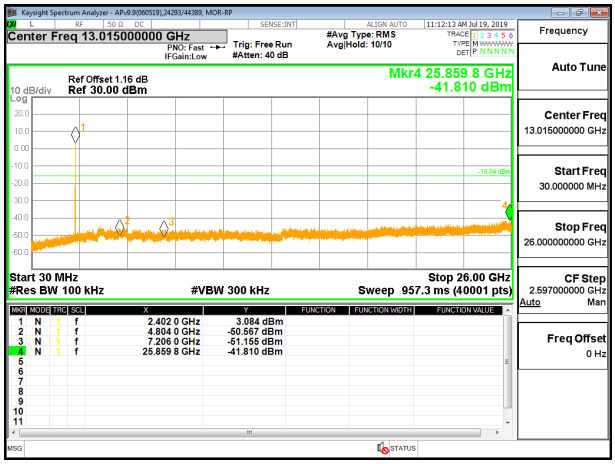
9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

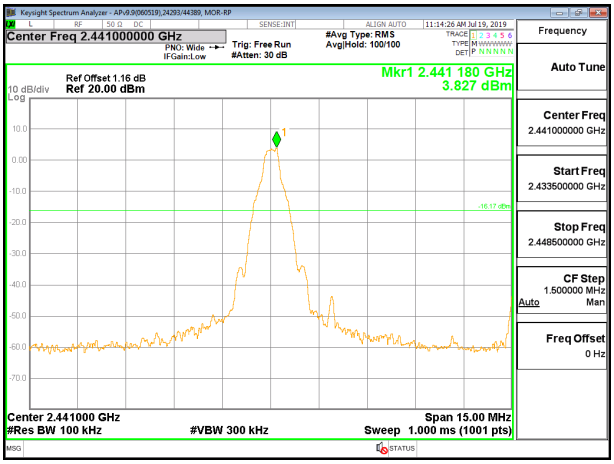
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



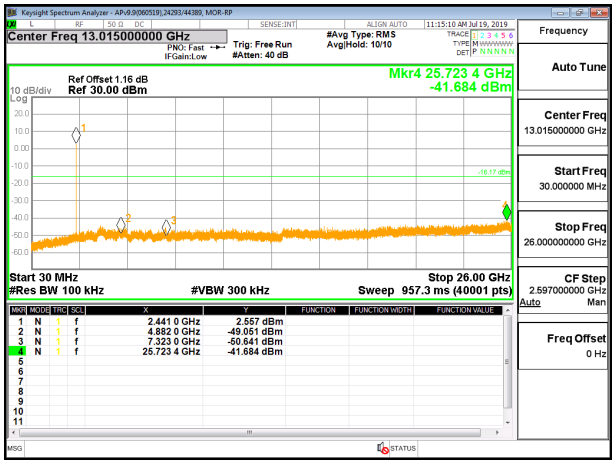
LOW CHANNEL BANDEDGE



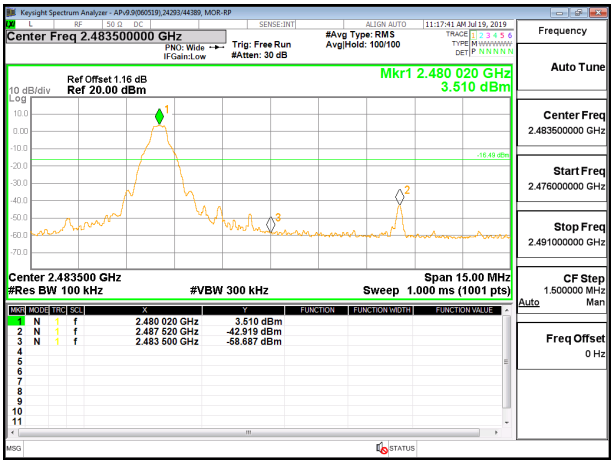
OUT-OF-BAND LOW CHANNEL



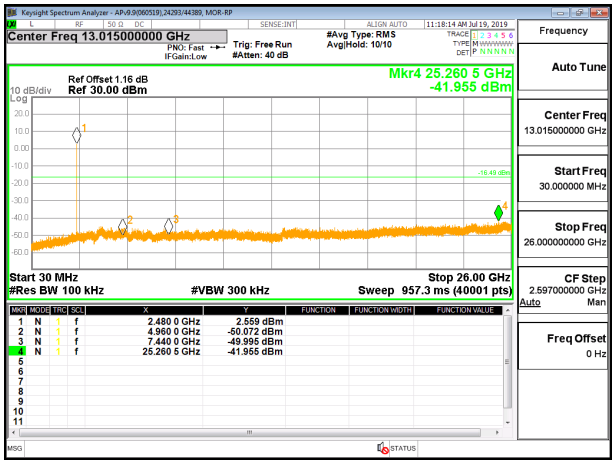
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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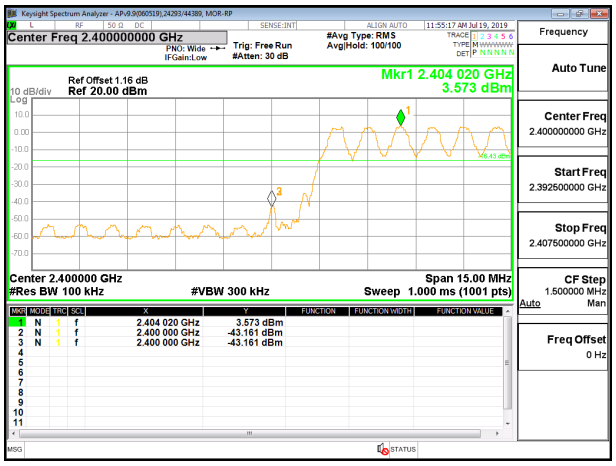
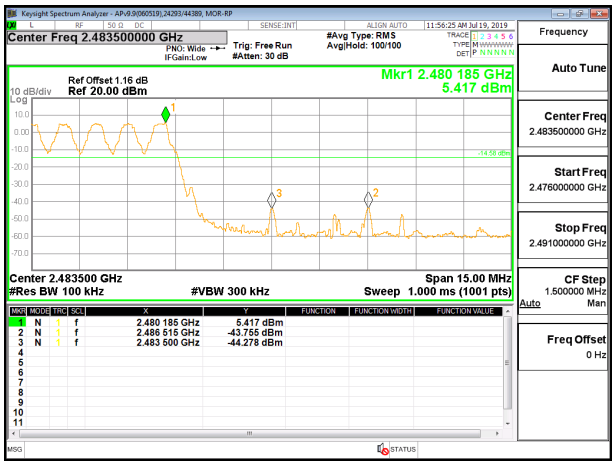
Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

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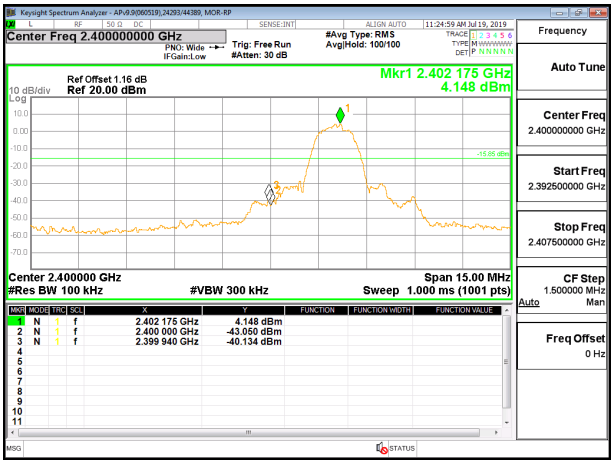
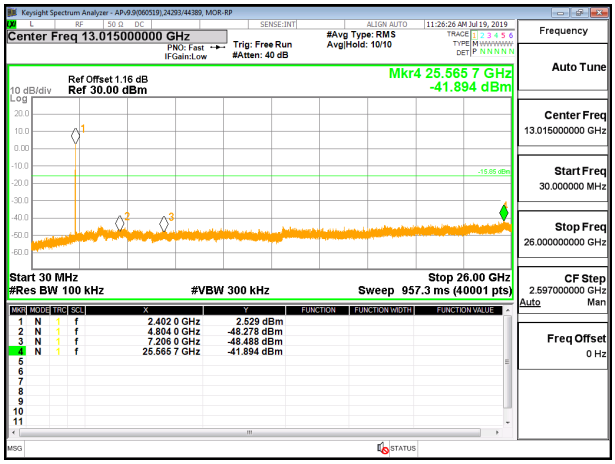
9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

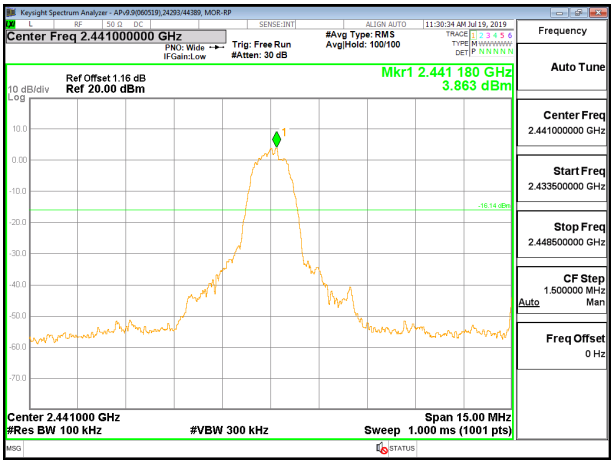
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



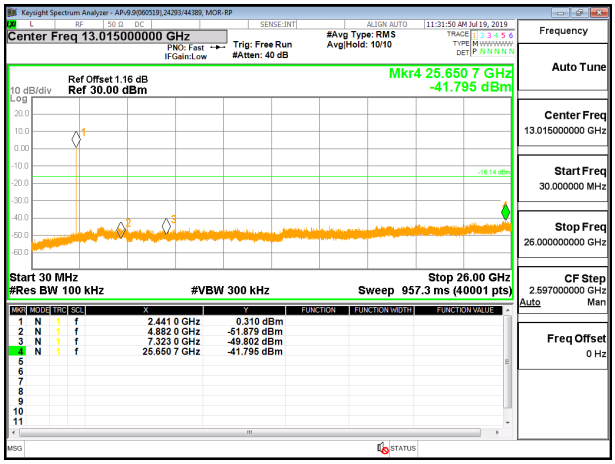
LOW CHANNEL BANDEDGE



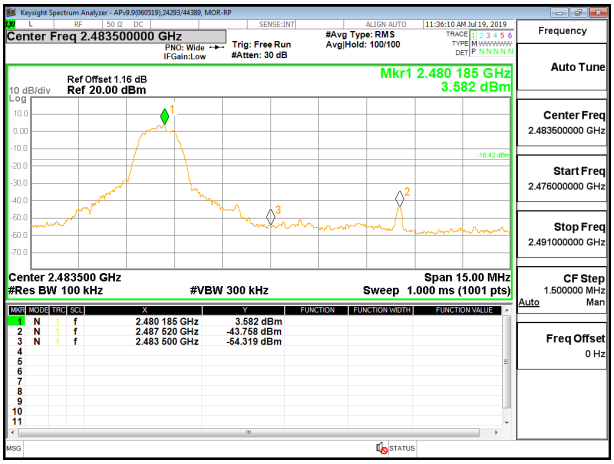
OUT-OF-BAND LOW CHANNEL



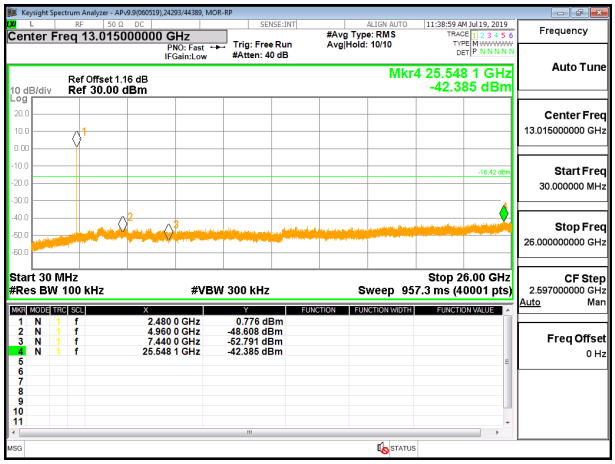
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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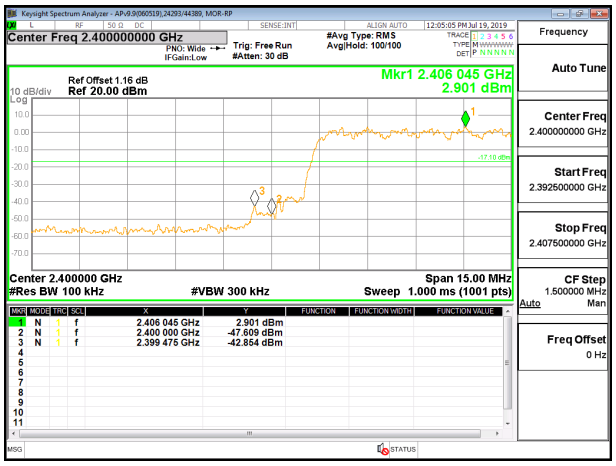
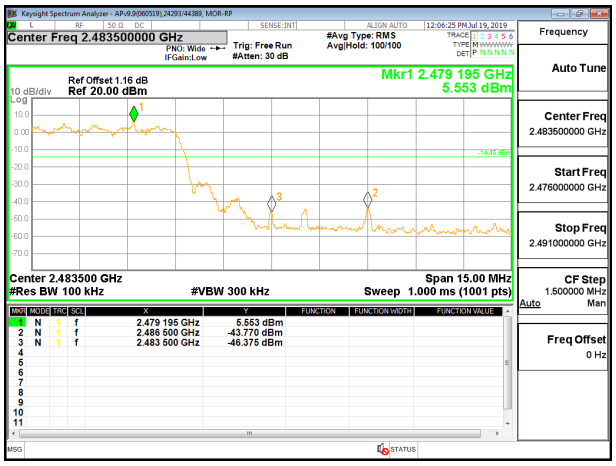
Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

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10. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 120 kHz for peak and/or quasi-peak detection measurements in the 30-1000MHz range, 9kHz for peak and/or quasi-peak detection measurements in the 0.15-30MHz range and 200Hz for peak and/or quasi-peak detection measurements in the 9 to 150kHz range. Peak detection is used unless otherwise noted as quasi-peak.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements where T = the on time.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

3D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel).

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KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

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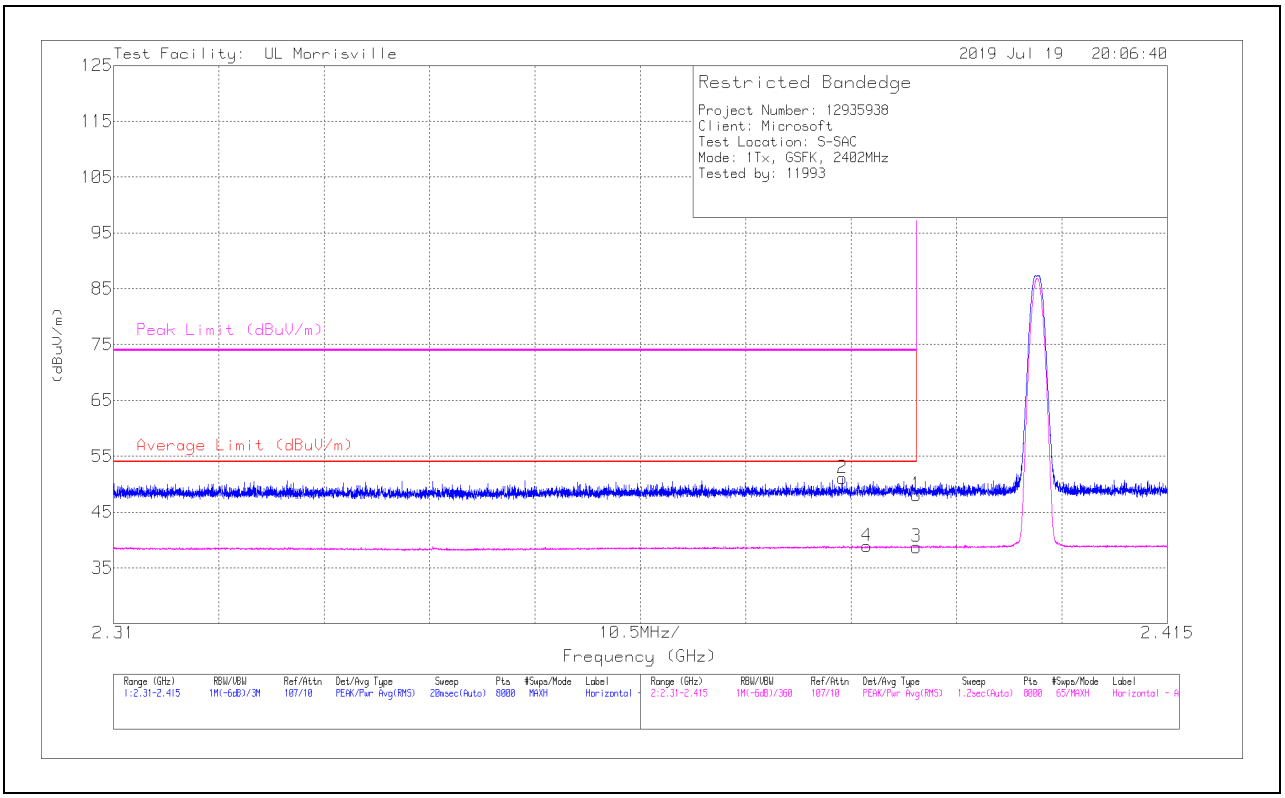
10.1. TRANSMITTER ABOVE 1 GHz

10.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	40.25	Pk	31.9	-24.1	48.05	-	-	74	-25.95	90	112	H
2	* ** 2.38259	43.3	Pk	31.9	-24.1	51.1	-	-	74	-22.9	90	112	H
3	* ** 2.39	30.94	V1TR	31.9	-24.1	38.74	54	-15.26	-	-	90	112	H
4	* ** 2.38505	31.14	V1TR	31.9	-24.1	38.94	54	-15.06	-	-	90	112	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, Average where: Ton is packet duration

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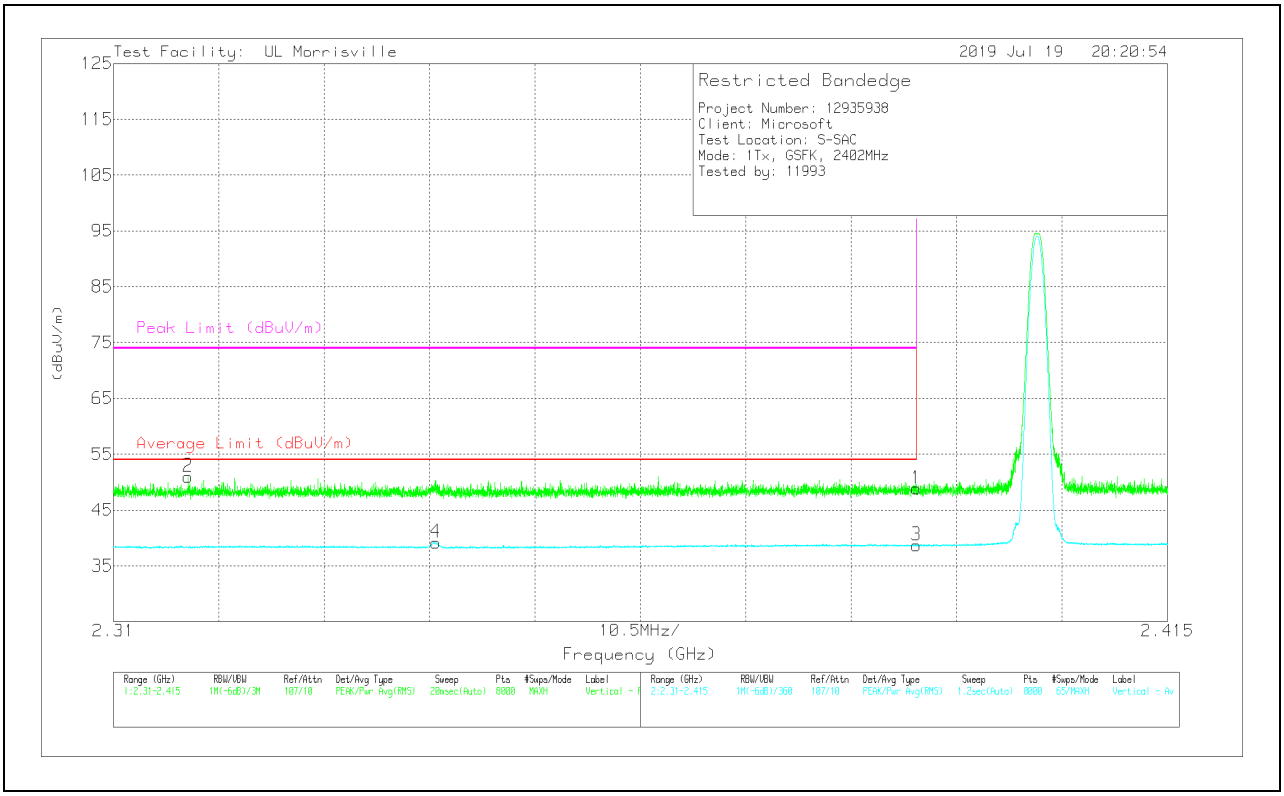
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	41.03	Pk	31.9	-24.1	48.83	-	-	74	-25.17	242	115	V
2	* ** 2.31743	43.4	Pk	31.7	-24.1	51	-	-	74	-23	242	115	V
3	* ** 2.39	30.9	V1TR	31.9	-24.1	38.7	54	-15.3	-	-	242	115	V
4	* ** 2.3421	31.81	V1TR	31.6	-24.2	39.21	54	-14.79	-	-	242	115	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, Average where: Ton is packet duration

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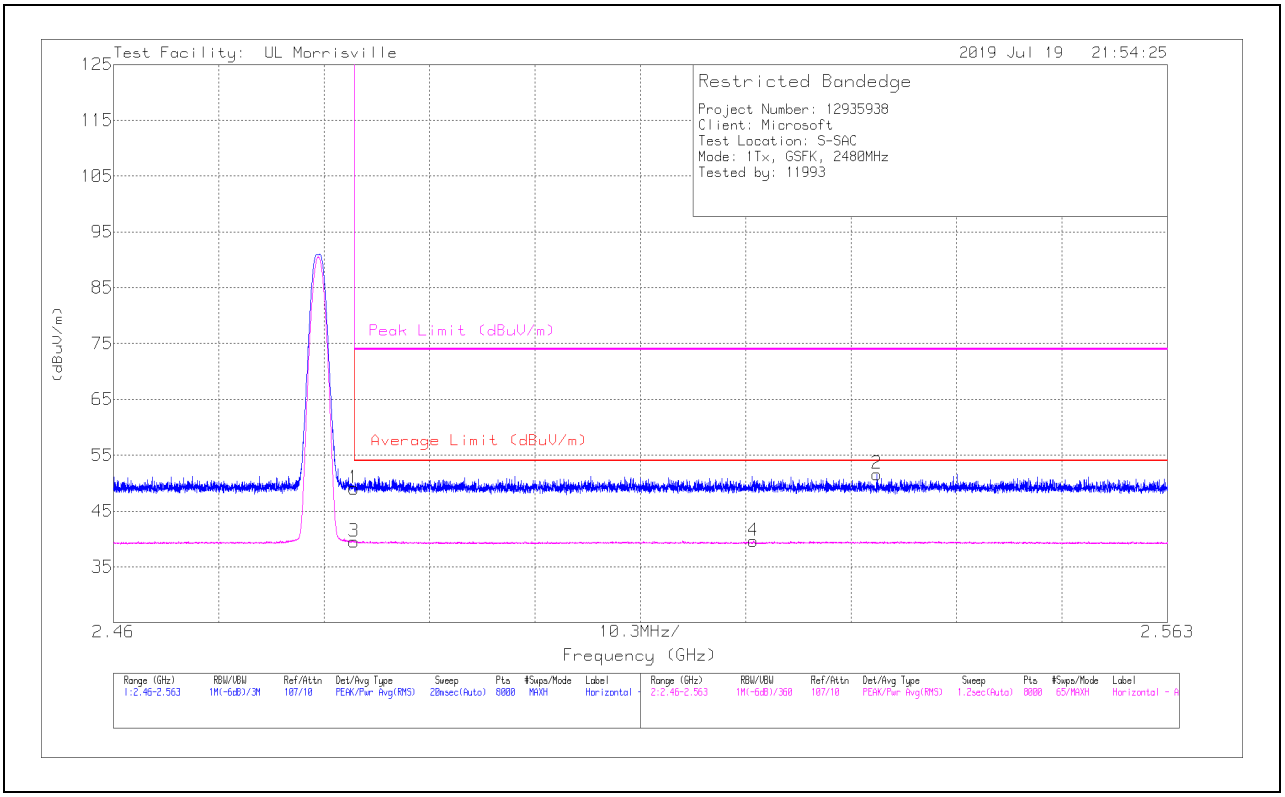
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	40.77	Pk	32.3	-24	49.07	-	-	74	-24.93	98	128	H
2	** 2.5346	43.23	Pk	32.4	-24	51.63	-	-	74	-22.37	98	128	H
3	* ** 2.4835	31.21	V1TR	32.3	-24	39.51	54	-14.49	-	-	98	128	H
4	** 2.52254	31.23	V1TR	32.4	-24	39.63	54	-14.37	-	-	98	128	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, Average where: Ton is packet duration

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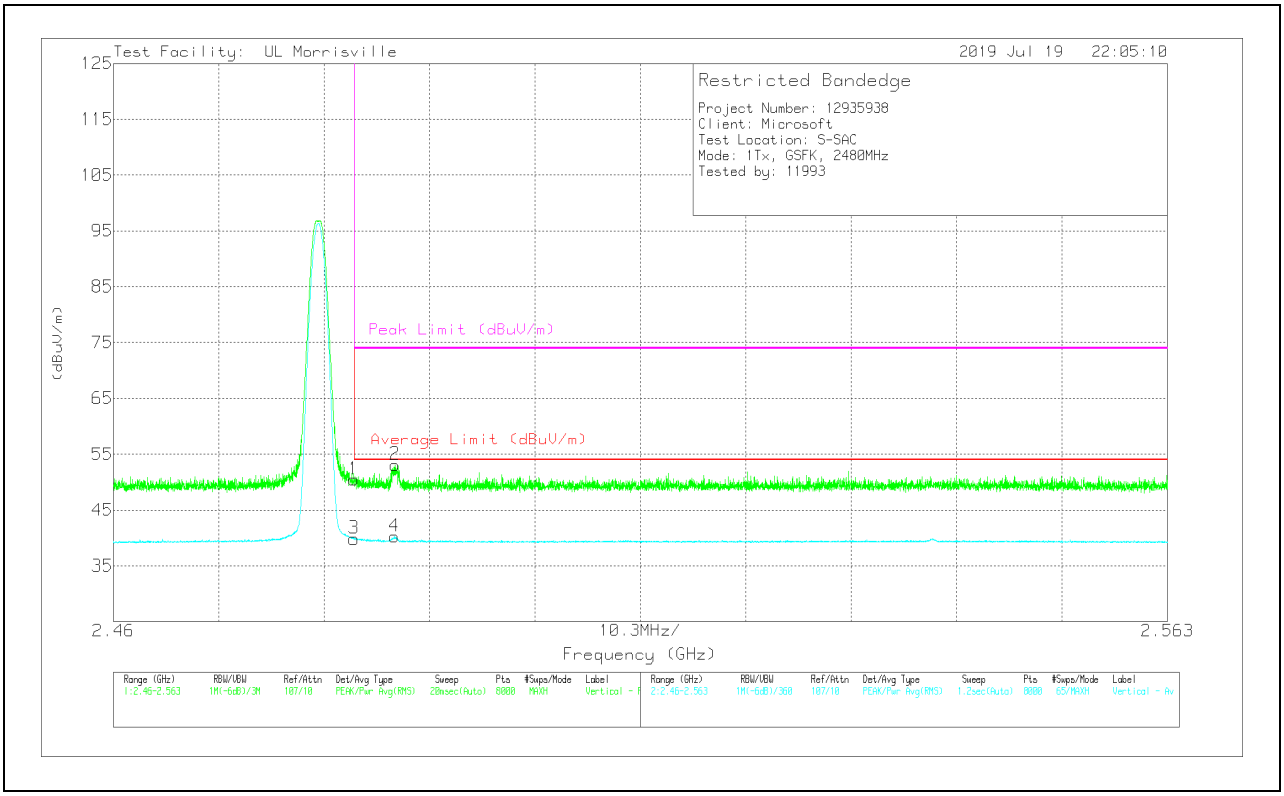
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	42.19	Pk	32.3	-24	50.49	-	-	74	-23.51	231	111	V
2	* ** 2.48753	44.8	Pk	32.3	-24	53.1	-	-	74	-20.9	231	111	V
3	* ** 2.4835	31.55	V1TR	32.3	-24	39.85	54	-14.15	-	-	231	111	V
4	* ** 2.48747	31.93	V1TR	32.3	-24	40.23	54	-13.77	-	-	231	111	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, Average where: Ton is packet duration

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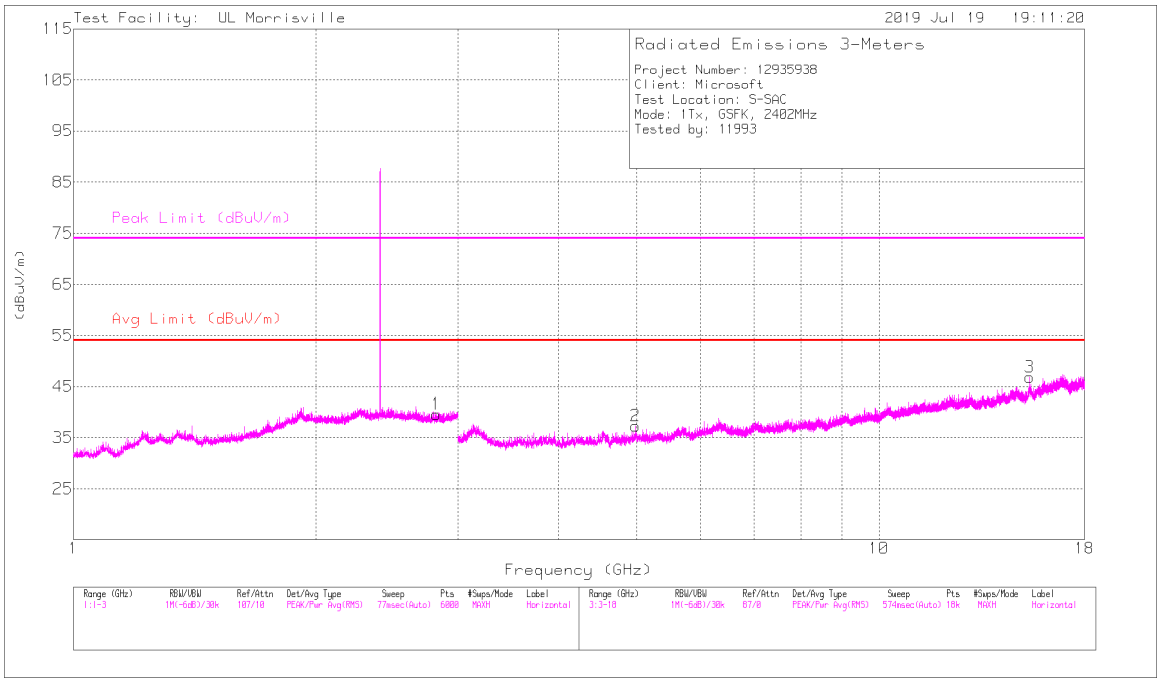
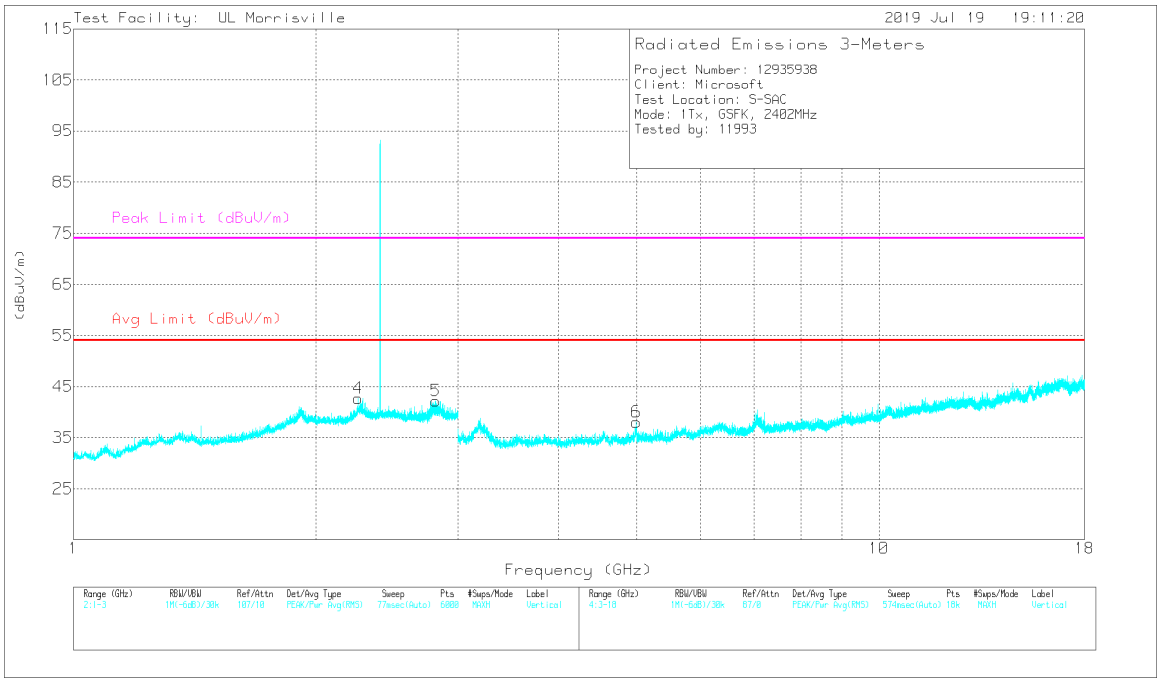
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.81876	42.58	PK-U	32.1	-25.9	48.78	-	-	74	-25.22	67	300	H
	* ** 2.8184	30.02	V1TR	32.1	-25.9	36.22	54	-17.78	-	-	67	300	H
4	* ** 2.25525	40.45	PK-U	31.7	-23.4	48.75	-	-	74	-25.25	103	244	V
	* ** 2.25559	28.55	V1TR	31.7	-23.4	36.85	54	-17.15	-	-	103	244	V
5	* ** 2.8162	44.34	PK-U	32.1	-25.9	50.54	-	-	74	-23.46	101	230	V
	* ** 2.81672	33.05	V1TR	32.1	-25.9	39.25	54	-14.75	-	-	101	230	V
2	* ** 4.9883	42.35	PK-U	34.1	-31.1	45.35	-	-	74	-28.65	328	104	H
	* ** 4.98902	28.84	V1TR	34.1	-31.1	31.84	54	-22.16	-	-	328	104	H
3	* ** 15.39894	33.59	PK-U	39.9	-21.4	52.09	-	-	74	-21.91	309	157	H
	* ** 15.39906	21.93	V1TR	39.9	-21.4	40.43	54	-13.57	-	-	309	157	H
6	* ** 4.99915	41.83	PK-U	34.2	-31.1	44.93	-	-	74	-29.07	294	109	V
	* ** 4.99899	29.36	V1TR	34.2	-31.1	32.46	54	-21.54	-	-	294	109	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, Average where: Ton is packet duration

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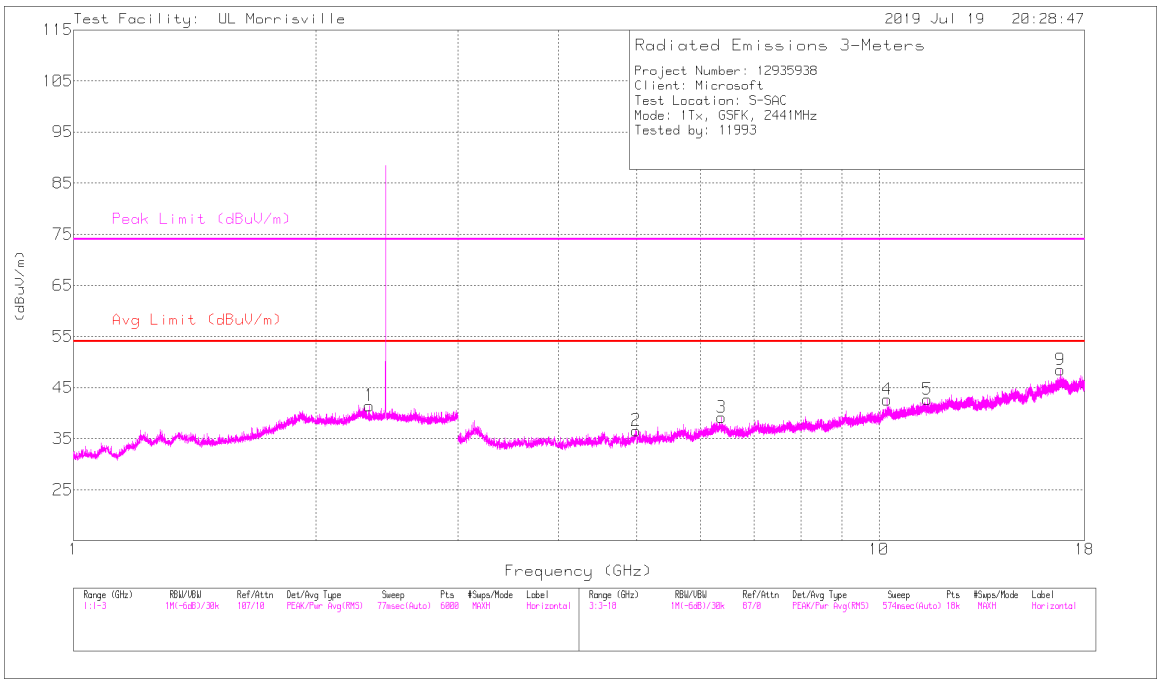
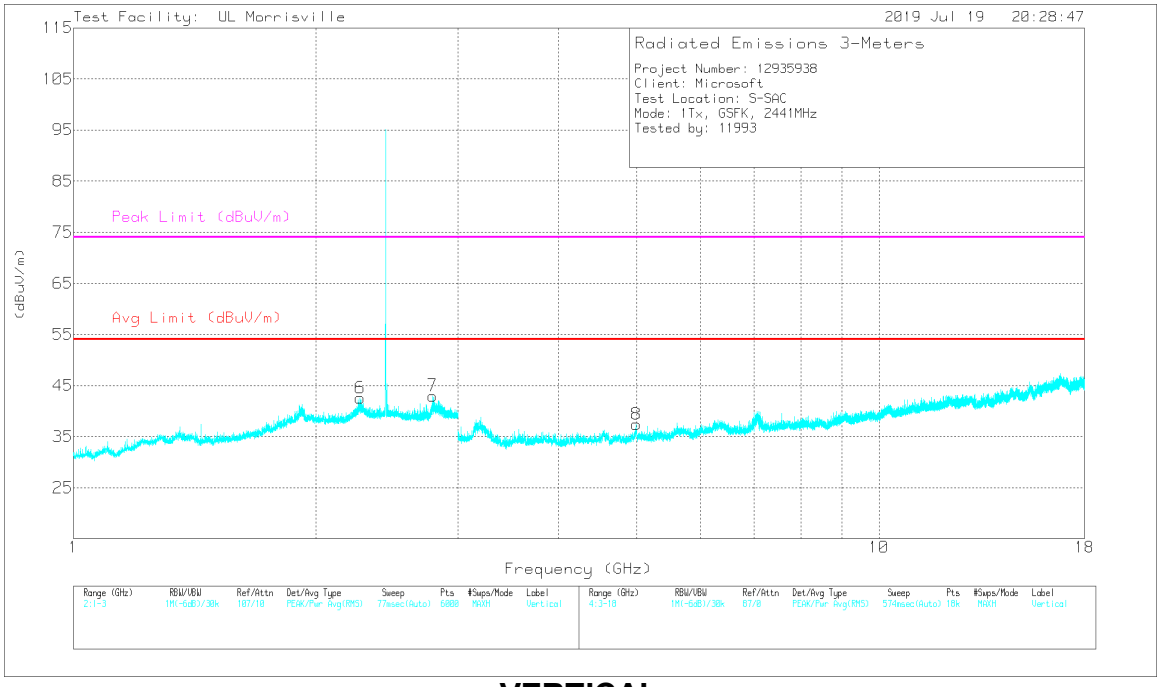
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.32977	38.18	PK-U	31.7	-23.7	46.18	-	-	74	-27.82	284	182	H
	* ** 2.32757	26.57	V1TR	31.7	-23.7	34.57	54	-19.43	-	-	284	182	H
6	* ** 2.27007	39.18	PK-U	31.8	-23.4	47.58	-	-	74	-26.42	155	160	V
	* ** 2.2699	27.42	V1TR	31.8	-23.4	35.82	54	-18.18	-	-	155	160	V
7	* ** 2.79439	43.34	PK-U	32.2	-25.8	49.74	-	-	74	-24.26	108	263	V
	* ** 2.79361	31.93	V1TR	32.2	-25.8	38.33	54	-15.67	-	-	108	263	V
2	* ** 4.99352	42.05	PK-U	34.2	-31.1	45.15	-	-	74	-28.85	353	112	H
	* ** 4.99348	29.07	V1TR	34.2	-31.1	32.17	54	-21.83	-	-	353	112	H
5	* ** 11.49011	34.16	PK-U	38.1	-24.1	48.16	-	-	74	-25.84	347	294	H
	* ** 11.49003	22.68	V1TR	38.1	-24.1	36.68	54	-17.32	-	-	347	294	H
8	* ** 4.99908	41.67	PK-U	34.2	-31.1	44.77	-	-	74	-29.23	177	135	V
	* ** 4.99894	28.99	V1TR	34.2	-31.1	32.09	54	-21.91	-	-	177	135	V
3	6.38102	31.95	Pk	35.5	-28.3	39.15	-	-	-	-	0-360	199	H
4	10.23624	29.74	Pk	37.5	-24.6	42.64	-	-	-	-	0-360	101	H
9	16.80494	29.06	Pk	42	-22.6	48.46	-	-	-	-	0-360	101	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, Average where: Ton is packet duration
Pk - Peak detector

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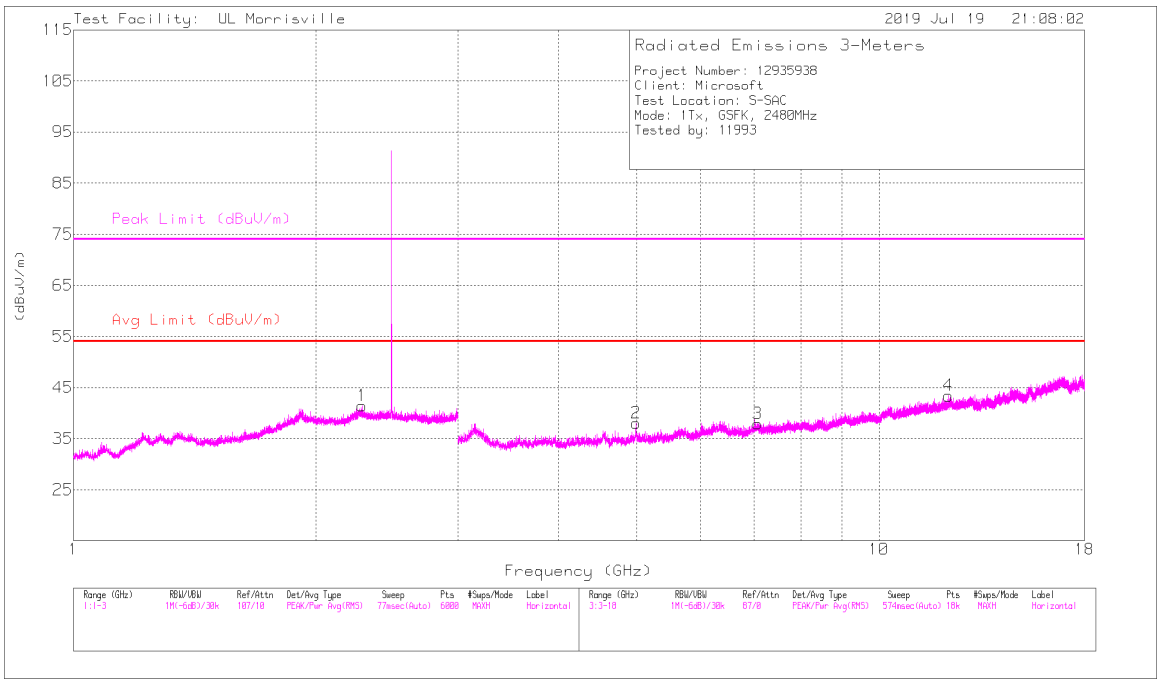
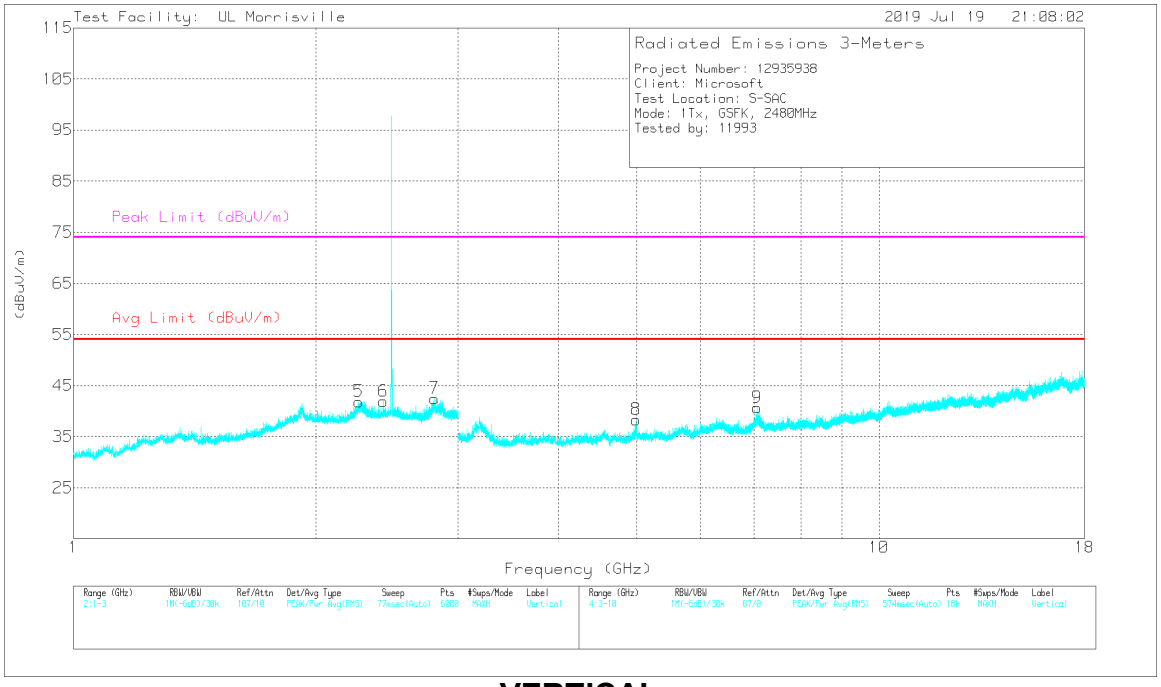
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.28224	40.07	PK-U	31.8	-23.5	48.37	-	-	74	-25.63	148	110	H
	* ** 2.28195	27.72	V1TR	31.8	-23.5	36.02	54	-17.98	-	-	148	110	H
5	* ** 2.25873	41.17	PK-U	31.7	-23.4	49.47	-	-	74	-24.53	89	260	V
	* ** 2.26037	29.54	V1TR	31.7	-23.4	37.84	54	-16.16	-	-	89	260	V
7	* ** 2.80656	43.81	PK-U	32.2	-25.9	50.11	-	-	74	-23.89	102	240	V
	* ** 2.80502	32.72	V1TR	32.2	-25.9	39.02	54	-14.98	-	-	102	240	V
2	* ** 4.99932	42.25	PK-U	34.2	-31.1	45.35	-	-	74	-28.65	289	108	H
	* ** 4.99889	29.06	V1TR	34.2	-31.1	32.16	54	-21.84	-	-	289	108	H
4	* ** 12.19079	34.11	PK-U	38.9	-23.9	49.11	-	-	74	-24.89	72	164	H
	* ** 12.19044	22.57	V1TR	38.9	-23.9	37.57	54	-16.43	-	-	72	164	H
8	* ** 4.99632	43.31	PK-U	34.2	-31.1	46.41	-	-	74	-27.59	298	105	V
	* ** 4.9962	29.45	V1TR	34.2	-31.1	32.55	54	-21.45	-	-	298	105	V
6	2.42491	34.04	Pk	32.1	-24.2	41.94	-	-	-	-	0-360	199	V
9	7.06189	32.55	Pk	35.8	-27.7	40.65	-	-	-	-	0-360	101	V
3	7.06689	29.93	Pk	35.7	-27.7	37.93	-	-	-	-	0-360	199	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, Average where: Ton is packet duration
Pk - Peak detector

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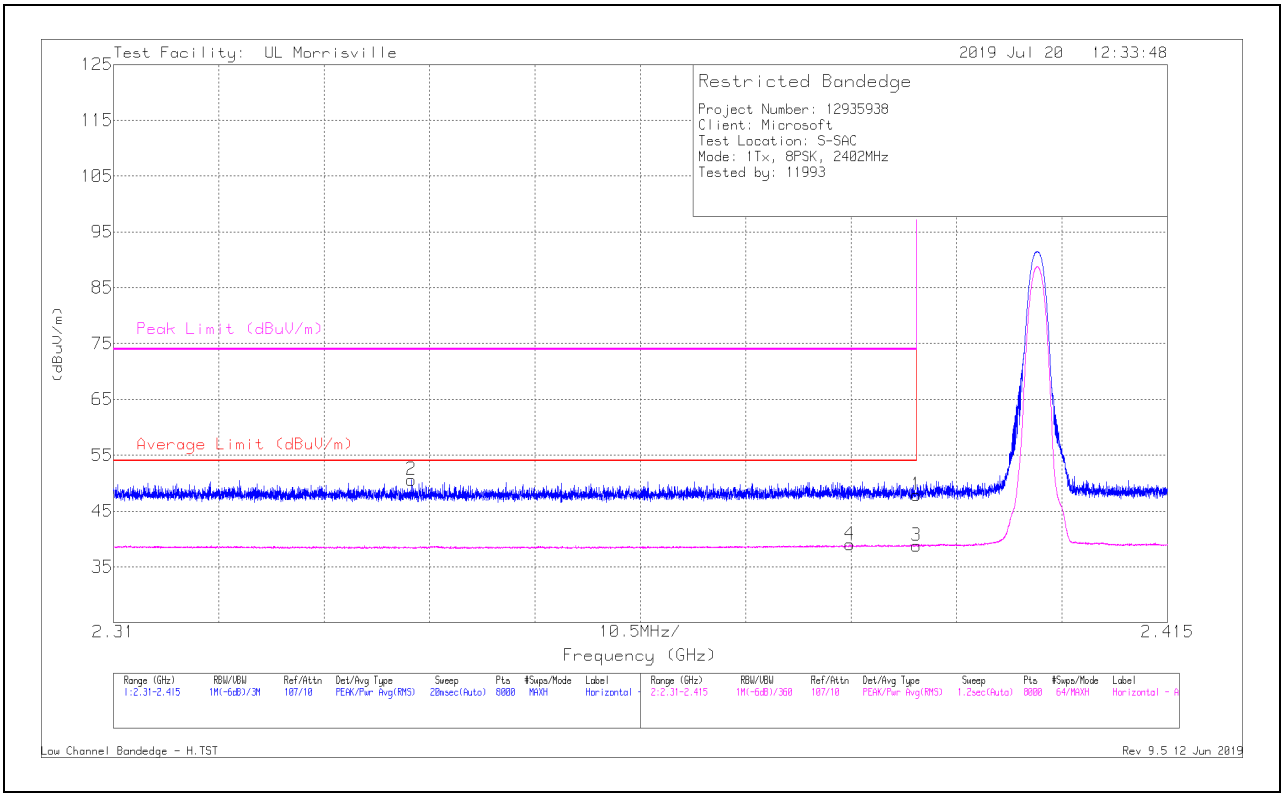
10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	40.07	Pk	31.9	-24.1	47.87	-	-	74	-26.13	259	340	H
2	* ** 2.33968	43.2	Pk	31.6	-24.2	50.6	-	-	74	-23.4	259	340	H
3	* ** 2.39	30.98	V1TR	31.9	-24.1	38.78	54	-15.22	-	-	259	340	H
4	* ** 2.38335	31.22	V1TR	31.9	-24.1	39.02	54	-14.98	-	-	259	340	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, Average where: Ton is packet duration

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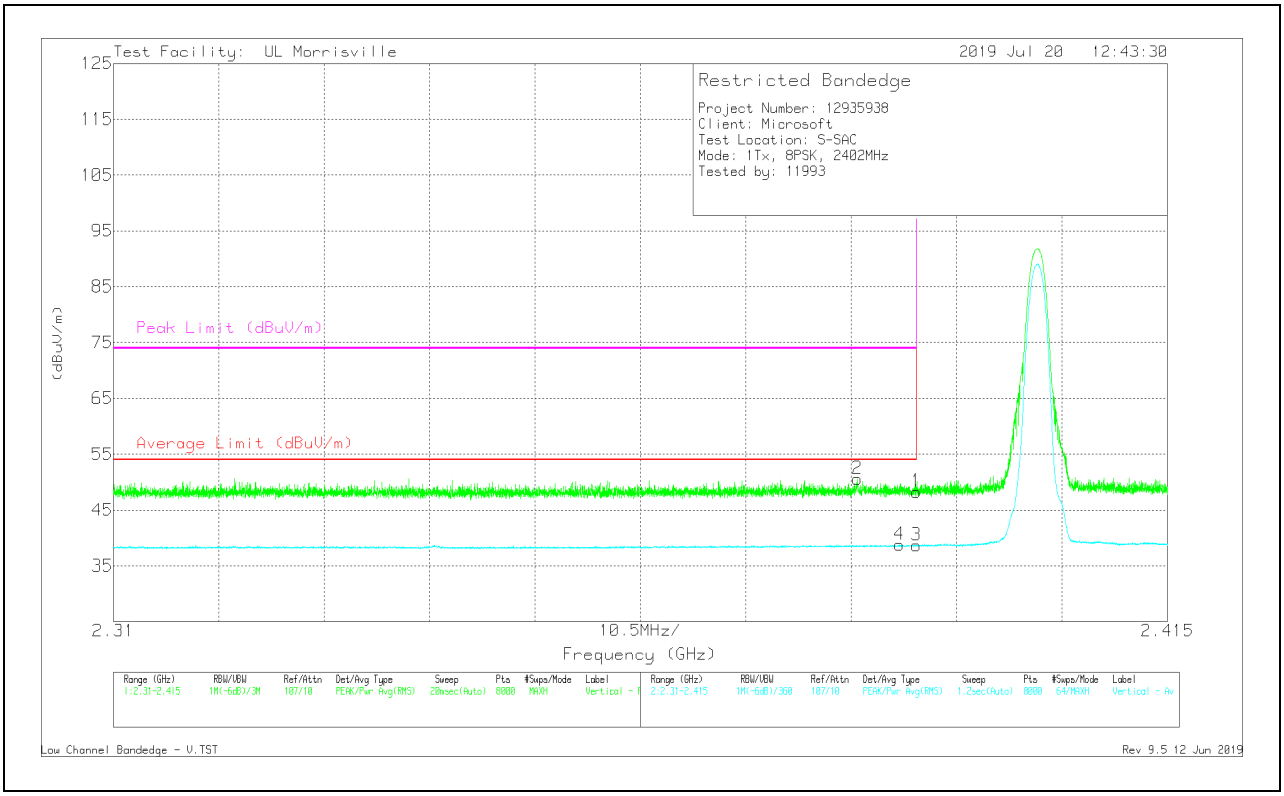
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	40.49	Pk	31.9	-24.1	48.29	-	-	74	-25.71	246	376	V
2	* ** 2.3841	42.76	Pk	31.9	-24.1	50.56	-	-	74	-23.44	246	376	V
3	* ** 2.39	30.84	V1TR	31.9	-24.1	38.64	54	-15.36	-	-	246	376	V
4	* ** 2.38829	30.95	V1TR	31.9	-24.1	38.75	54	-15.25	-	-	246	376	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, Average where: Ton is packet duration

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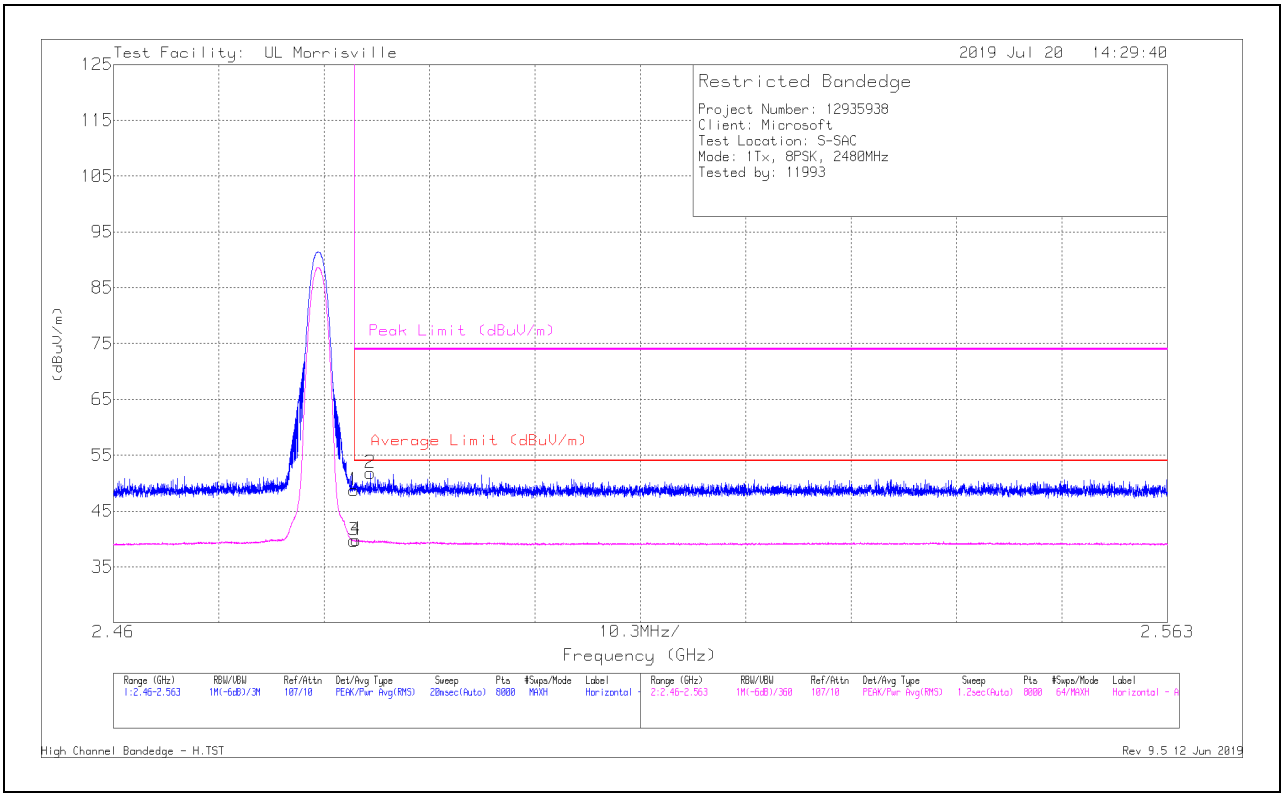
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	40.46	Pk	32.3	-24	48.76	-	-	74	-25.24	83	108	H
2	* ** 2.4851	43.5	Pk	32.3	-24	51.8	-	-	74	-22.2	83	108	H
3	* ** 2.4835	31.42	V1TR	32.3	-24	39.72	54	-14.28	-	-	83	108	H
4	* ** 2.48371	31.53	V1TR	32.3	-24	39.83	54	-14.17	-	-	83	108	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, Average where: Ton is packet duration

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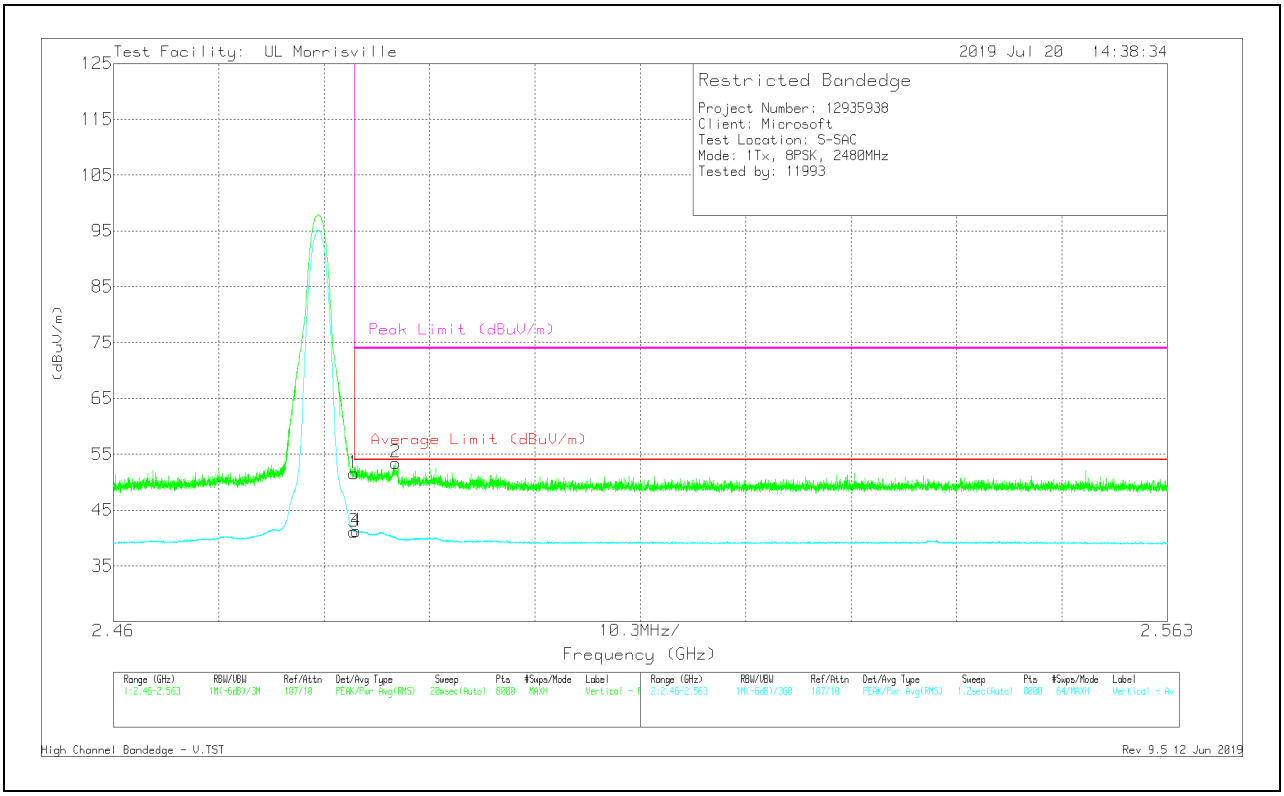
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.4835	43.28	Pk	32.3	-24	51.58	-	-	74	-22.42	229	220	V
2	* ** 2.48757	45.18	Pk	32.3	-24	53.48	-	-	74	-20.52	229	220	V
3	* ** 2.4835	32.83	V1TR	32.3	-24	41.13	54	-12.87	-	-	229	220	V
4	* ** 2.48371	32.96	V1TR	32.3	-24	41.26	54	-12.74	-	-	229	220	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, Average where: Ton is packet duration

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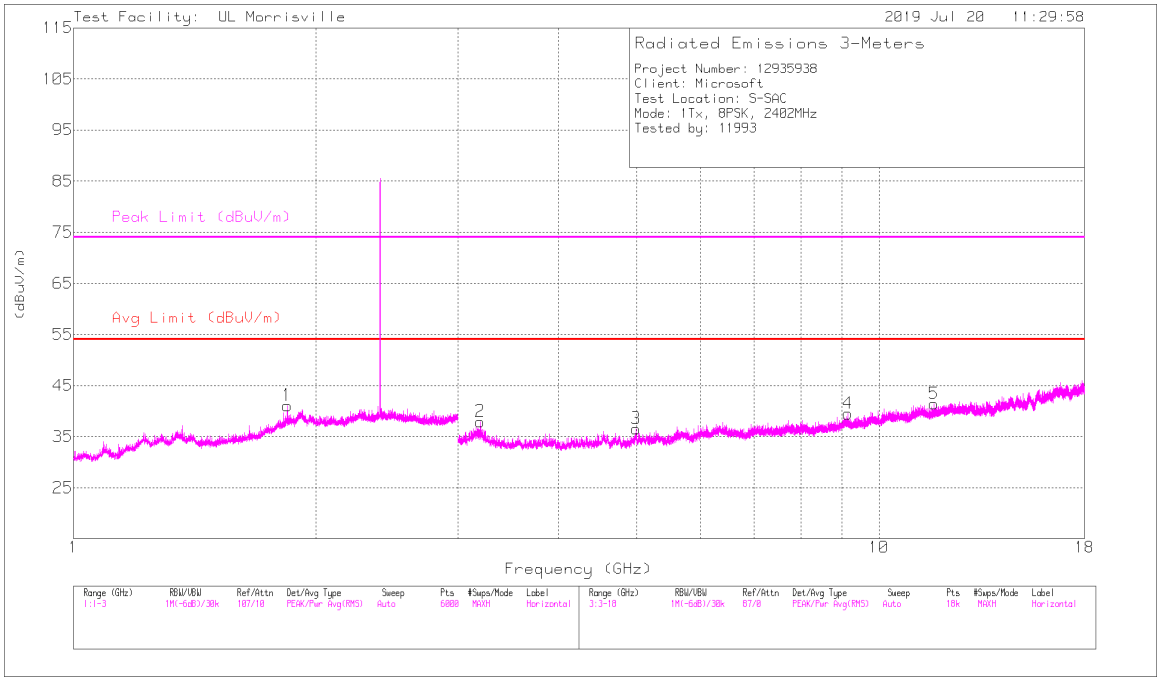
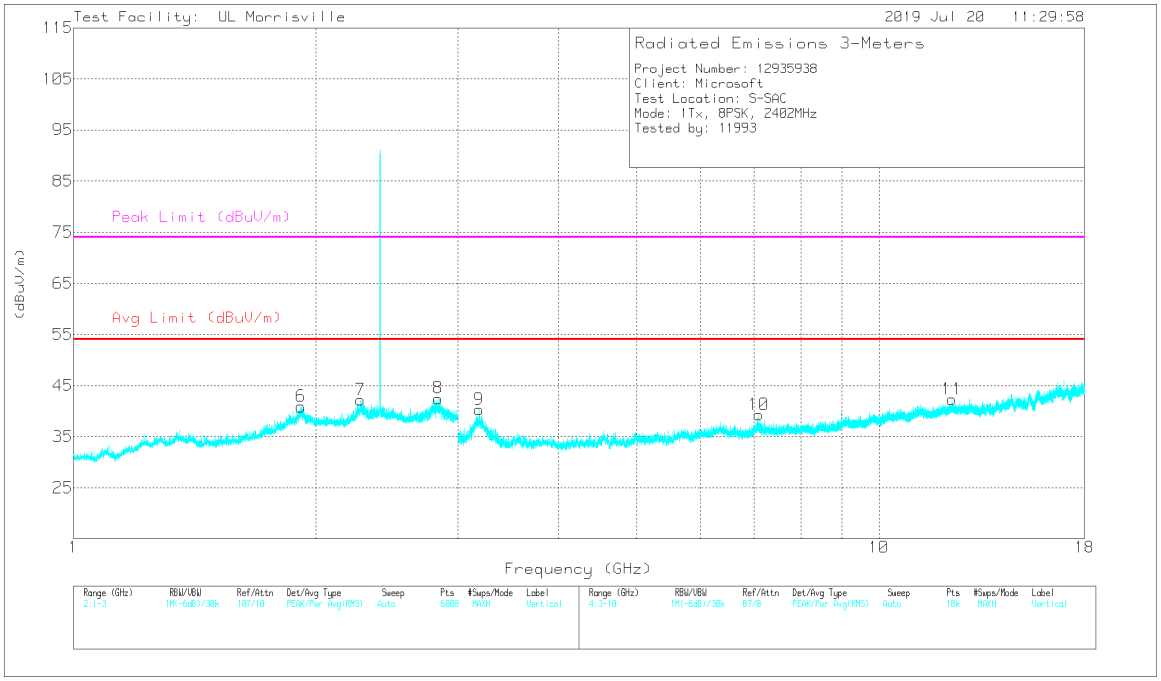
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	** 1.84096	38.56	PK-U	30.8	-22.3	47.06	-	-	74	-26.94	356	190	H
	** 1.8432	28.06	V1TR	30.8	-22.3	36.56	54	-17.44	-	-	356	190	H
6	** 1.91677	39.8	PK-U	31.2	-22.4	48.6	-	-	74	-25.4	86	197	V
	** 1.91711	29.41	V1TR	31.2	-22.4	38.21	54	-15.79	-	-	86	197	V
7	* ** 2.27019	41.38	PK-U	31.8	-23.4	49.78	-	-	74	-24.22	96	232	V
	* ** 2.27133	31.07	V1TR	31.8	-23.4	39.47	54	-14.53	-	-	96	232	V
8	* ** 2.8371	43.92	PK-U	32.1	-25.8	50.22	-	-	74	-23.78	97	225	V
	* ** 2.83711	33.94	V1TR	32.1	-25.8	40.24	54	-13.76	-	-	97	225	V
3	* ** 4.99624	42.24	PK-U	34.2	-31.1	45.34	-	-	74	-28.66	333	136	H
	* ** 4.9959	30.15	V1TR	34.2	-31.1	33.25	54	-20.75	-	-	333	136	H
4	* ** 9.14841	34.94	PK-U	36.7	-25.8	45.84	-	-	74	-28.16	320	127	H
	* ** 9.14866	24.64	V1TR	36.7	-25.8	35.54	54	-18.46	-	-	320	127	H
5	* ** 11.7115	33.63	PK-U	38.4	-23.9	48.13	-	-	74	-25.87	17	134	H
	* ** 11.71152	23.47	V1TR	38.4	-23.9	37.97	54	-16.03	-	-	17	134	H
11	* ** 12.31984	34.13	PK-U	38.8	-23.8	49.13	-	-	74	-24.87	255	335	V
	* ** 12.31974	24.05	V1TR	38.8	-23.8	39.05	54	-14.95	-	-	255	335	V
9	3.18751	39.73	Pk	33.1	-32.5	40.33	-	-	-	-	0-360	199	V
2	3.19834	37.36	Pk	33.1	-32.5	37.96	-	-	-	-	0-360	101	H
10	7.09023	31.73	Pk	35.7	-28.1	39.33	-	-	-	-	0-360	101	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, Average where: Ton is packet duration
Pk - Peak detector

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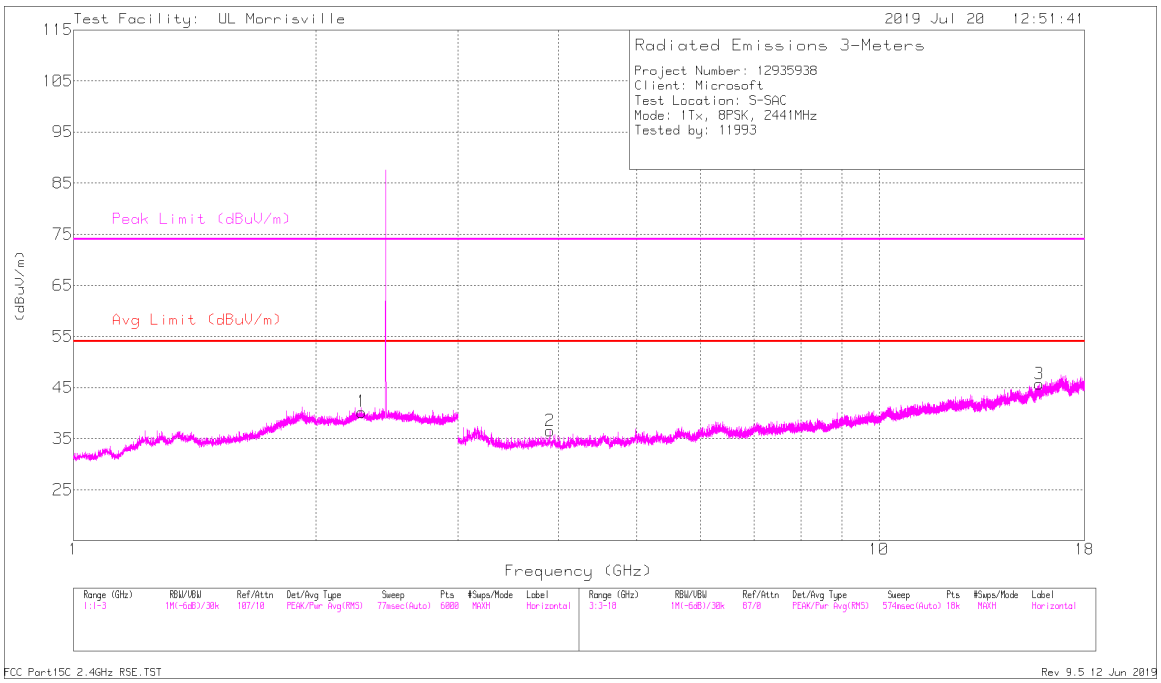
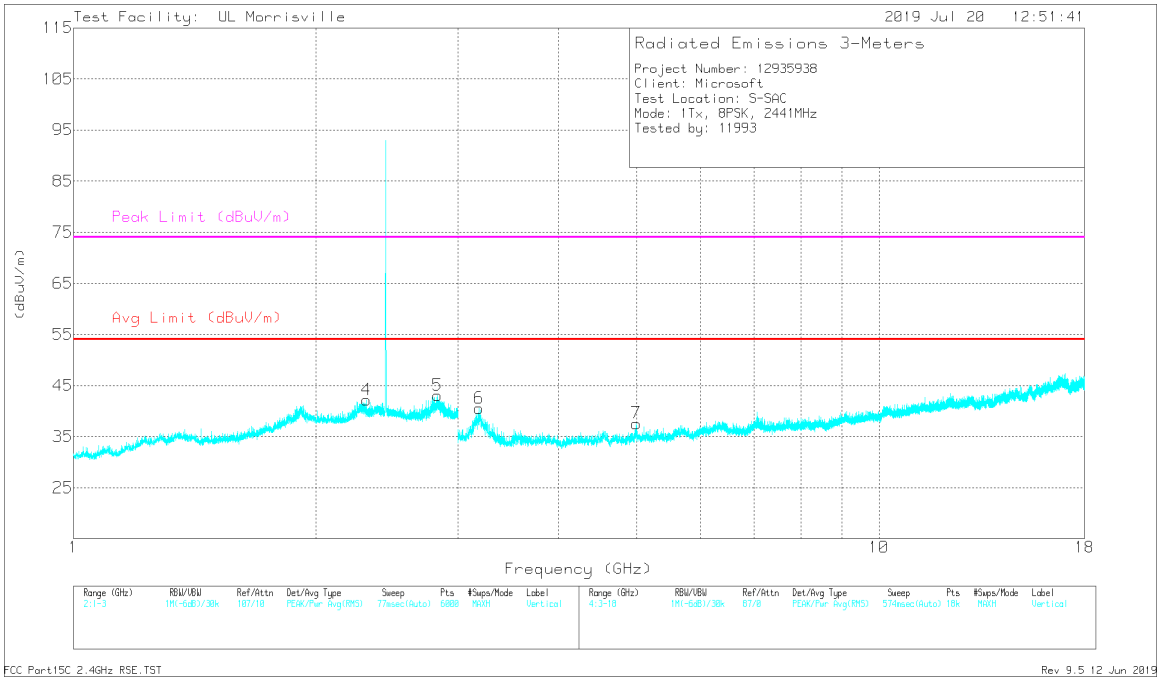
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.27958	39.24	PK-U	31.8	-23.5	47.54	-	-	74	-26.46	143	136	H
	* ** 2.28012	26.91	V1TR	31.8	-23.5	35.21	54	-18.79	-	-	143	136	H
4	* ** 2.36224	41.01	PK-U	31.7	-23.9	48.81	-	-	74	-25.19	94	225	V
	* ** 2.3676	29.8	V1TR	31.8	-24	37.6	54	-16.4	-	-	94	225	V
5	* ** 2.82981	43.99	PK-U	32.1	-25.9	50.19	-	-	74	-23.81	99	206	V
	* ** 2.83005	32.55	V1TR	32.1	-25.9	38.75	54	-15.25	-	-	99	206	V
2	* ** 3.90719	40.4	PK-U	33.4	-31.8	42	-	-	74	-32	108	310	H
	* ** 3.90717	28.55	V1TR	33.4	-31.8	30.15	54	-23.85	-	-	108	310	H
3	* ** 15.81048	34.39	PK-U	40.4	-23	51.79	-	-	74	-22.21	101	204	H
	* ** 15.80997	22.46	V1TR	40.4	-23	39.86	54	-14.14	-	-	101	204	H
7	* ** 4.99894	43.15	PK-U	34.2	-31.1	46.25	-	-	74	-27.75	92	102	V
	* ** 4.99879	29.28	V1TR	34.2	-31.1	32.38	54	-21.62	-	-	92	102	V
6	3.18751	39.95	Pk	33.1	-32.5	40.55	-	-	-	-	0-360	199	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, Average where: Ton is packet duration
Pk - Peak detector

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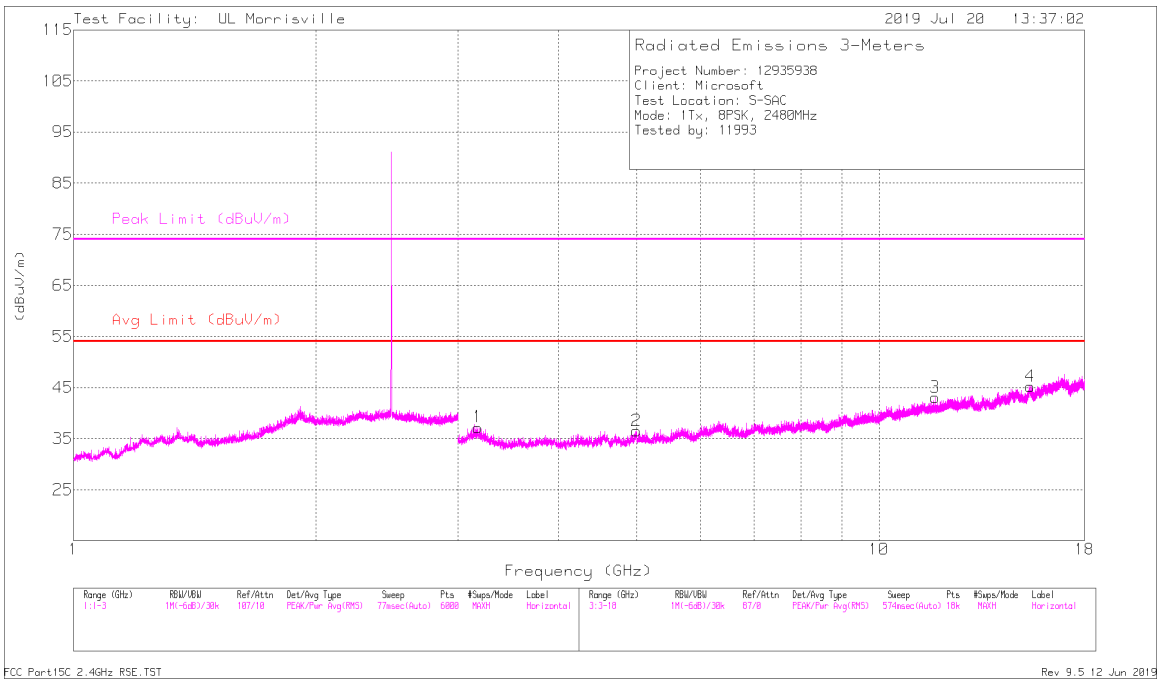
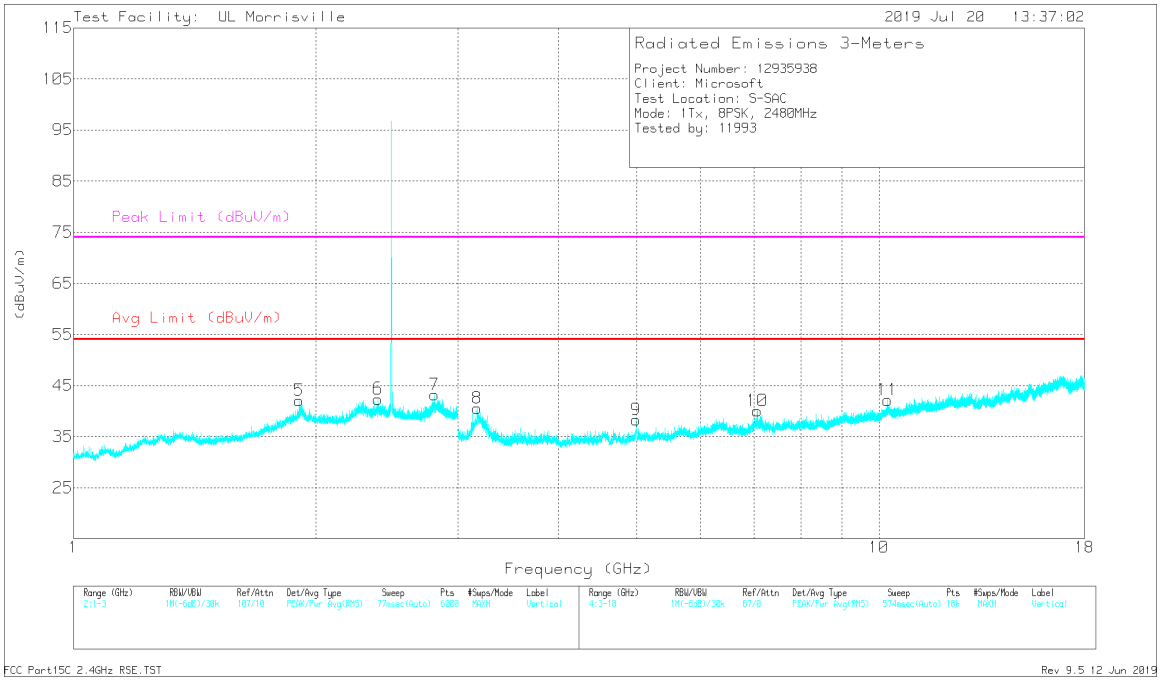
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	** 1.9056	39.56	PK-U	31.1	-22.3	48.36	-	-	74	-25.64	85	227	V
	** 1.90689	27.72	V1TR	31.1	-22.4	36.42	54	-17.58	-	-	85	227	V
6	* ** 2.38832	41.19	PK-U	31.9	-24	49.09	-	-	74	-24.91	94	203	V
	* ** 2.38842	29.01	V1TR	31.9	-24	36.91	54	-17.09	-	-	94	203	V
7	* ** 2.80765	43.87	PK-U	32.1	-25.9	50.07	-	-	74	-23.93	96	261	V
	* ** 2.80736	32.15	V1TR	32.1	-25.9	38.35	54	-15.65	-	-	96	261	V
2	* ** 4.99816	41.95	PK-U	34.2	-31.1	45.05	-	-	74	-28.95	331	102	H
	* ** 4.99806	28.85	V1TR	34.2	-31.1	31.95	54	-22.05	-	-	331	102	H
3	* ** 11.74118	33.78	PK-U	38.5	-23.8	48.48	-	-	74	-25.52	199	178	H
	* ** 11.74128	22.32	V1TR	38.5	-23.8	37.02	54	-16.98	-	-	199	178	H
4	* ** 15.40832	33.78	PK-U	39.9	-21.6	52.08	-	-	74	-21.92	290	399	H
	* ** 15.40828	21.66	V1TR	39.9	-21.6	39.96	54	-14.04	-	-	290	399	H
9	* ** 4.99798	42.48	PK-U	34.2	-31.1	45.58	-	-	74	-28.42	301	101	V
	* ** 4.99772	29.07	V1TR	34.2	-31.1	32.17	54	-21.83	-	-	301	101	V
8	3.17334	39.85	Pk	33.2	-32.5	40.55	-	-	-	-	0-360	199	V
1	3.17668	36.53	Pk	33.2	-32.5	37.23	-	-	-	-	0-360	199	H
10	7.06356	31.98	Pk	35.8	-27.7	40.08	-	-	-	-	0-360	101	V
11	10.24874	29.14	Pk	37.5	-24.5	42.14	-	-	-	-	0-360	199	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, Average where: Ton is packet duration
Pk - Peak detector

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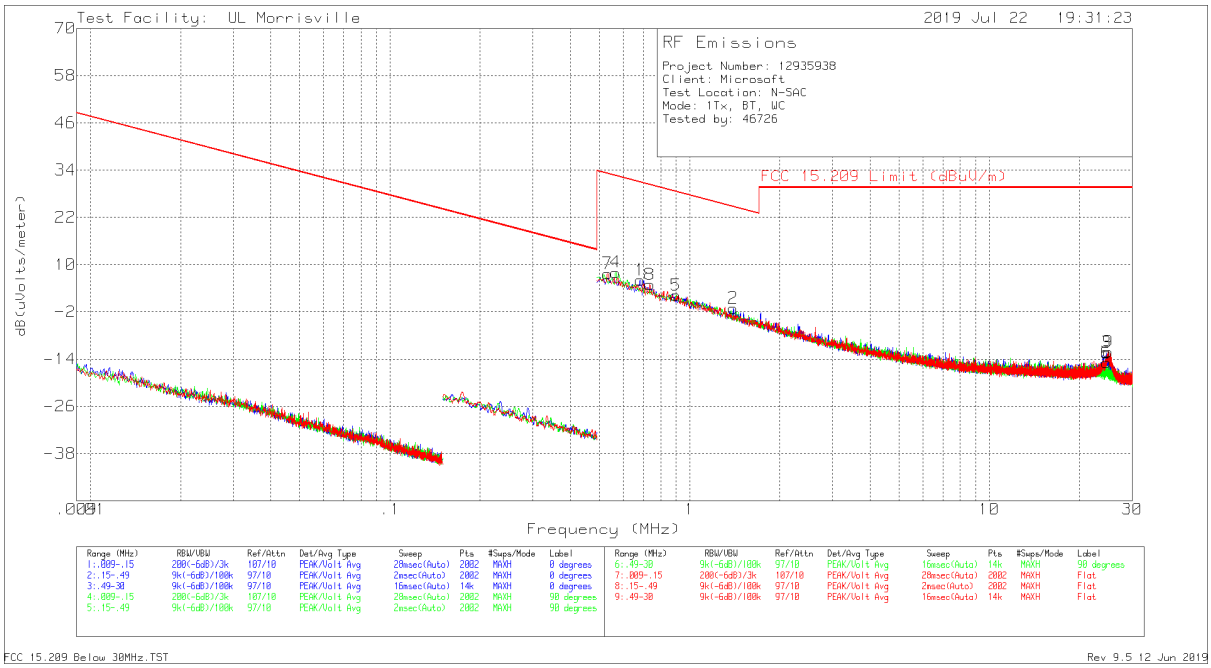
10.2. WORST CASE BELOW 30MHz

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)

Note: All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (test distance / specification distance).



ANTENNA- THREE ORIENTATIONS

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0059 (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	FCC 15.209 QP/Avg Limit (dBuV/m)	FCC 15.209 Pk Limit (dBuV/m)	Worst-Case Margin (dB)	Azimuth (Degs)
7	.53216	37.2	Pk	10.4	.1	-40	7.7	33.08	-	-25.38	0-360
4	.56589	37.54	Pk	10.4	.1	-40	8.04	32.55	-	-24.51	0-360
1	.68394	35.59	Pk	10.4	.1	-40	6.09	30.9	-	-24.81	0-360
8	.73664	34.46	Pk	10.4	.1	-40	4.96	30.26	-	-25.3	0-360
5	.90106	31.61	Pk	10.4	.2	-40	2.21	28.51	-	-26.3	0-360
2	1.39855	28.11	Pk	10.6	.2	-40	-1.09	24.69	-	-25.78	0-360
6	24.58022	14.99	Pk	9.4	.8	-40	-14.81	29.54	-	-44.35	0-360
3	24.60341	17.4	Pk	9.4	.8	-40	-12.4	29.54	-	-41.94	0-360
9	24.93226	17.6	Pk	9.3	.9	-40	-12.2	29.54	-	-41.74	0-360

Pk - Peak detector

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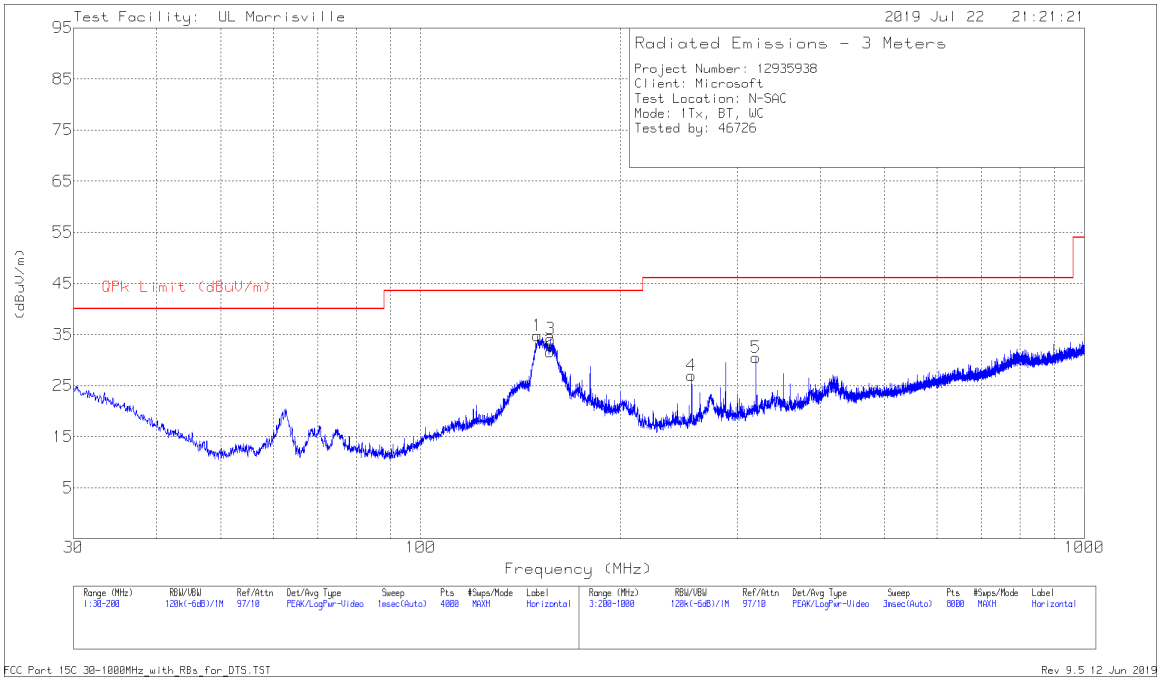
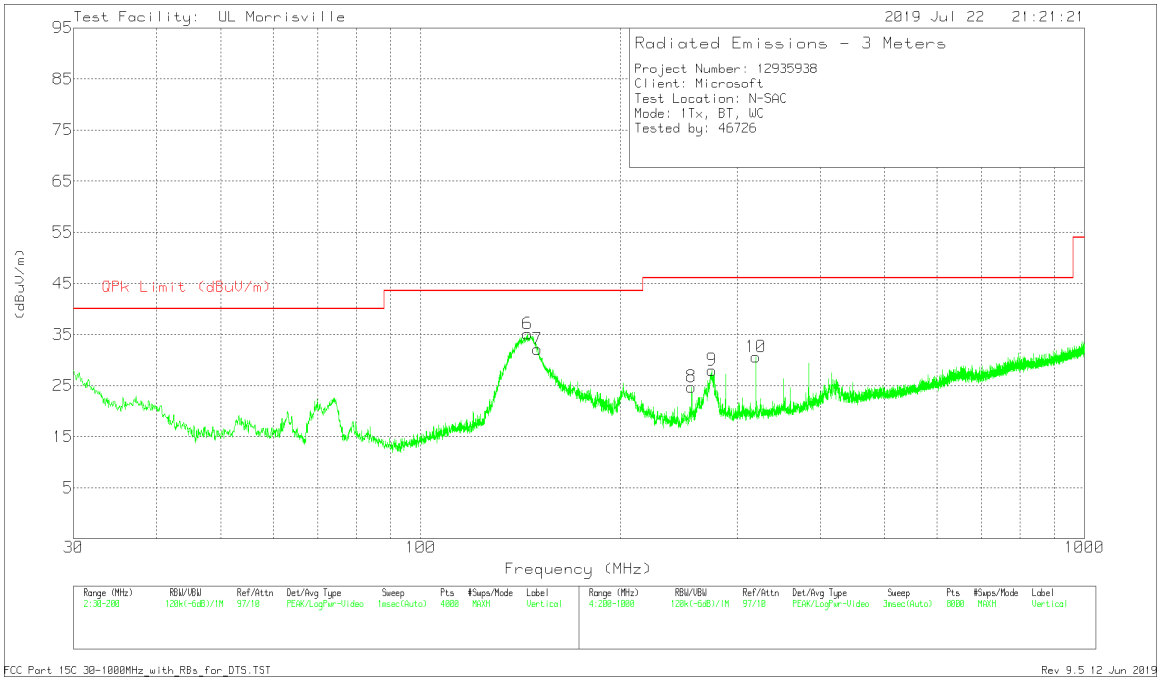
10.3. WORST CASE BELOW 1 GHZ

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



HORIZONTAL



VERTICAL

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Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 ACF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 150.0086	46.24	Pk	19	-30.5	34.74	43.52	-8.78	0-360	199	H
2	* ** 156.7678	43.28	Pk	18.8	-30.4	31.68	43.52	-11.84	0-360	199	H
7	* ** 149.966	43.6	Pk	19	-30.5	32.1	43.52	-11.42	0-360	102	V
4	* ** 256.0073	38.25	Pk	18.4	-29.7	26.95	46.02	-19.07	0-360	102	H
8	* ** 256.0073	36.06	Pk	18.4	-29.7	24.76	46.02	-21.26	0-360	199	V
9	* ** 274.7097	37.72	Pk	19.8	-29.5	28.02	46.02	-18	0-360	102	V
6	144.8647	46.51	Pk	19.2	-30.6	35.11	43.52	-8.41	0-360	102	V
3	157.0229	45.74	Pk	18.8	-30.4	34.14	43.52	-9.38	0-360	199	H
5	320.0156	39.3	Pk	20.6	-29.4	30.5	46.02	-15.52	0-360	102	H
10	320.0156	39.37	Pk	20.6	-29.4	30.57	46.02	-15.45	0-360	199	V

Pk – Peak detector

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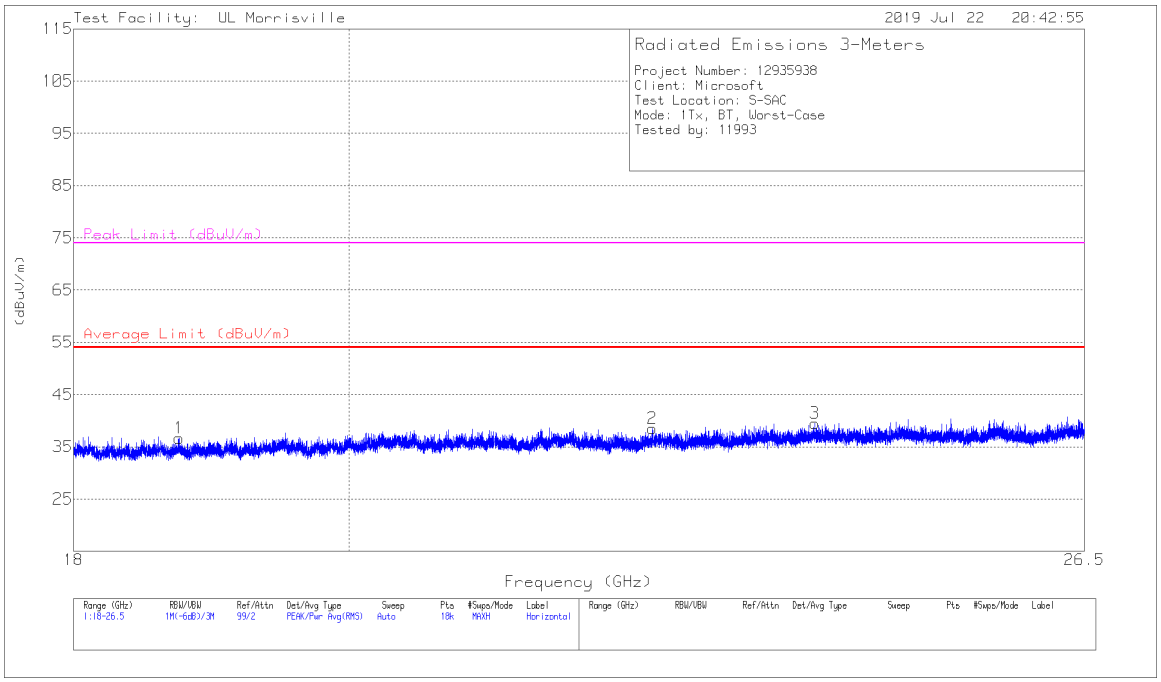
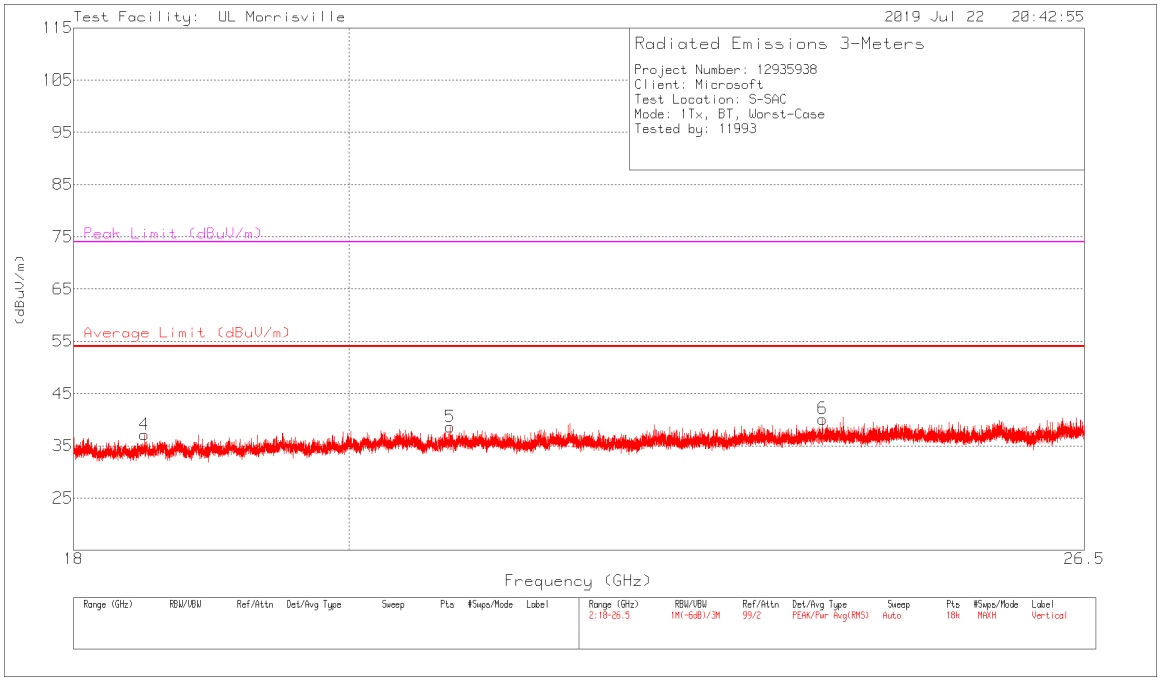
10.4. WORST CASE 18-26 GHZ

SPURIOUS EMISSIONS 18-26 GHz (WORST-CASE CONFIGURATION)



HORIZONTAL



VERTICAL

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18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0076 AF (dB/m)	Cbl/Amp (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 18.74143	42.96	Pk	32.5	-38.8	36.66	54	-17.34	74	-37.34	0-360	299	H
2	* ** 22.45991	42.99	Pk	33.5	-38	38.49	54	-15.51	74	-35.51	0-360	199	H
3	* ** 23.90074	42.77	Pk	34	-37.3	39.47	54	-14.53	74	-34.53	0-360	249	H
4	* ** 18.49397	43.82	Pk	32.4	-39.1	37.12	54	-16.88	74	-36.88	0-360	299	V
5	* ** 20.79004	43.82	Pk	33	-38.2	38.62	54	-15.38	74	-35.38	0-360	151	V
6	* ** 23.97158	43.36	Pk	34	-37.2	40.16	54	-13.84	74	-33.84	0-360	101	V

Pk – Peak detector

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11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

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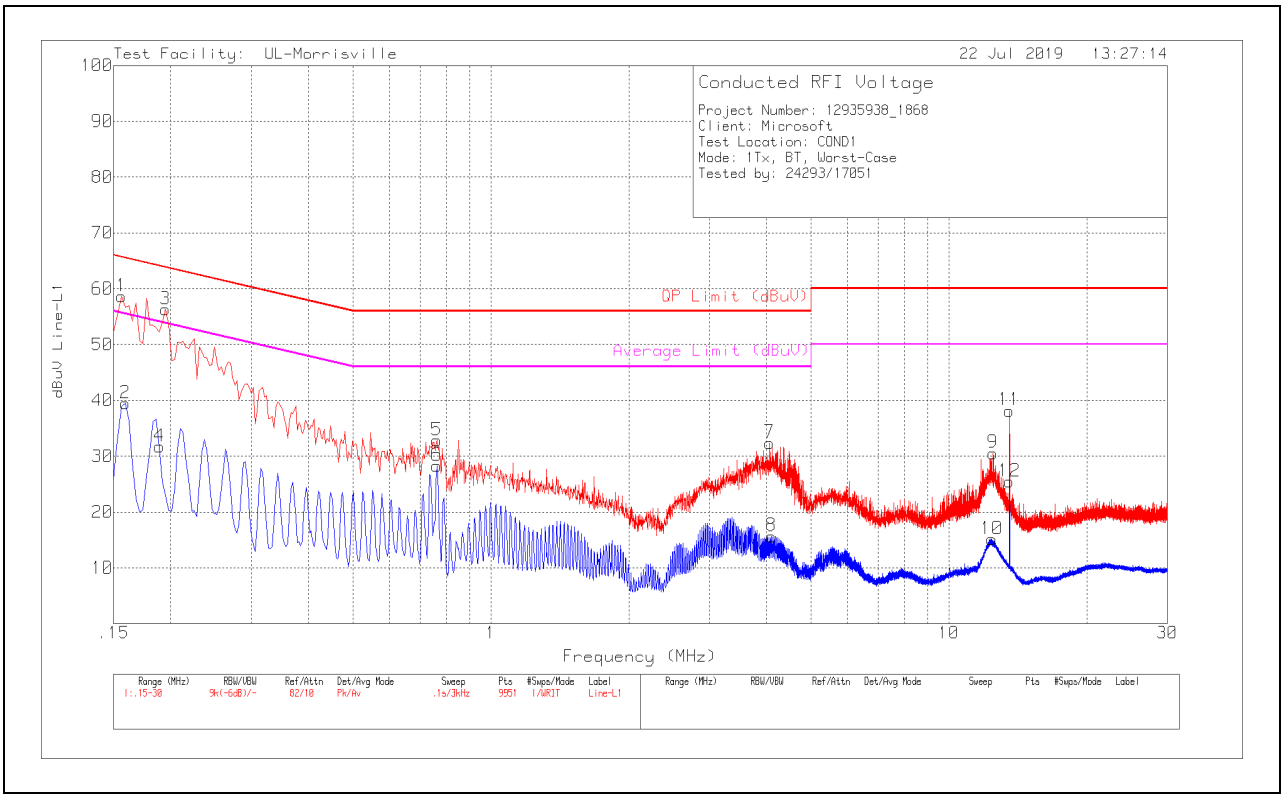
11.1.1. AC Power Line Host

LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
1	.156	48.41	Pk	.2	10	58.61	65.67	-7.06	-	-
2	.159	29.29	Av	.2	10	39.49	-	-	55.52	-16.03
3	.195	46.18	Pk	.1	10	56.28	63.82	-7.54	-	-
4	.189	21.56	Av	.2	10	31.76	-	-	54.08	-22.32
5	.762	22.87	Pk	0	10	32.87	56	-23.13	-	-
6	.762	18.34	Av	0	10	28.34	-	-	46	-17.66
7	4.062	22.29	Pk	0	10.1	32.39	56	-23.61	-	-
8	4.095	5.59	Av	0	10.1	15.69	-	-	46	-30.31
9	12.474	20.07	Pk	.1	10.4	30.57	60	-29.43	-	-
10	12.417	4.61	Av	.1	10.4	15.11	-	-	50	-34.89
11	13.56	27.69	Pk	.1	10.4	38.19	60	-21.81	-	-
12	13.56	14.95	Av	.1	10.4	25.45	-	-	50	-24.55

Pk – Peak detector
Av – Average detector

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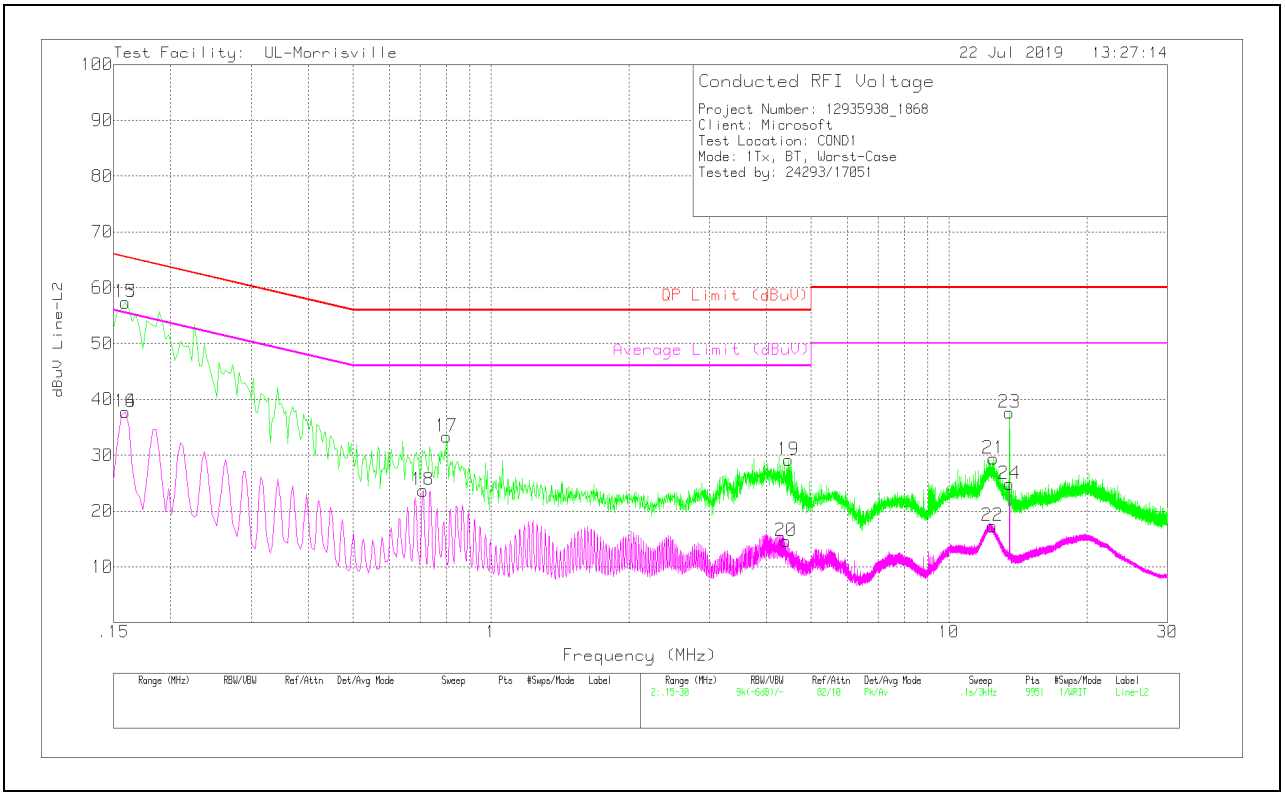
LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz										
Marker	**Frequency (MHz)**	**Meter Reading (dBuV)**	**Det**	**LISN VCF (dB)**	**Cbl/Limiter (dB)**	**Corrected Reading dBuV**	**QP Limit (dBuV)**	**Margin (dB)**	**Average Limit (dBuV)**	**Margin (dB)**
13	.159	47.17	Pk	.2	10	57.37	65.52	-8.15	-	-
14	.159	27.54	Av	.2	10	37.74	-	-	55.52	-17.78
15	.159	47.17	Pk	.2	10	57.37	65.52	-8.15	-	-
16	.159	27.54	Av	.2	10	37.74	-	-	55.52	-17.78
17	.801	23.33	Pk	0	10	33.33	56	-22.67	-	-
18	.711	13.69	Av	0	10	23.69	-	-	46	-22.31
19	4.464	18.96	Pk	0	10.2	29.16	56	-26.84	-	-
20	4.41	4.42	Av	0	10.2	14.62	-	-	46	-31.38
21	12.501	18.88	Pk	.1	10.4	29.38	60	-30.62	-	-
22	12.441	6.81	Av	.1	10.4	17.31	-	-	50	-32.69
23	13.56	27.1	Pk	.1	10.4	37.6	60	-22.4	-	-
24	13.56	14.32	Av	.1	10.4	24.82	-	-	50	-25.18

Pk – Peak detector
Av – Average detector

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12. SETUP PHOTOS

Please refer to R12935938-EP1 for setup photos

END OF TEST REPORT

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