



CERTIFICATION TEST REPORT

Report Number. : 11692709-E4V1

Applicant : QUALCOMM TECHNOLOGIES, INC.
5770 MOREHOUSE DRIVE,
SAN DIEGO, CA 92121, USA

FCC ID : J9C2NET2LTE
IC : 2723A-2NET2LTE

Model Number : QCL-HUB-2.0-US

EUT Description : WIRELESS DATA HUB

Test Standard(s) : FCC 47 CFR PART 15 SUBPART B
INDUSTRY OF CANADA ICES-003 ISSUE 6

Date Of Issue:

September 15, 2017

Prepared by:

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	09/15/2017	Initial Issue	--

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: QUALCOMM TECHNOLOGIES, INC.
5770 MOREHOUSE DRIVE,
SAN DIEGO, CA 92121 USA

EUT DESCRIPTION: WIRELESS DATA HUB

SERIAL NUMBER: QUALC001TN10M1RN3C

DATE TESTED: JUNE 7 to AUGUST 02, 2017

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC 47 CFR PART 15 SUBPART B	Pass
ICES-003 ISSUE 6	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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, any agency of the Federal Government, or any agency of any government.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2014, ICES-003 Issue 6.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. 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.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A(IC: 2324B-1)	☐ Chamber D(IC: 22541-1)
☒ Chamber B(IC: 2324B-2)	☐ Chamber E(IC: 22541-2)
☐ Chamber C(IC: 2324B-3)	☐ Chamber F(IC: 22541-3)
	☐ Chamber G(IC: 22541-4)
	☐ Chamber H(IC: 22541-5)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

4. CALIBRATION AND UNCERTAINTY

4.1. 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.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned}\text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m}\end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

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

Parameter	Uncertainty
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

This EUT is a 2net2 device (LTE North American Version AT&T) that has the following radio modules:

- Wistron WWAN module, M14Q2FG.
- Qualcomm Unlicensed Module, QCA WCN 3660.

GENERAL INFORMATION

Highest frequency generated or used by the EUT	5825MHz
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5.2. TEST CONFIGURATIONS

The following configuration was tested:

EUT Configuration	Description
Typical	The EUT was installed in a typical configuration which connected to the host laptop via USB cable and with minimal peripherals such as mouse, keyboard, and the hub.

5.3. MODE(S) OF OPERATION

Mode	Description
Normal mode	The EUT was powered on during testing.

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was adb Ver.1.0.26, QRCT Ver.3.0.84.0

5.5. DETAILS OF TESTED SYSTEM

SUPPORT EQUIPMENT & PERIPHERALS

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	HP	EliteBook 6930P	2CE00821BZ	N/A
AC Adapter	HP	PPP012D-S	WCN XF0AAR4QOCS	N/A
Mouse	Logitech	M-U0026	1304HS02AX68	N/A
Keyboard	Lenovo	KU-0225	54Y9400	N/A
Switch	Netgear	FS105 v2	1D52163304A74	DoC
AC Adapter	Netgear	FA-0751000SUA	332-10154-01	N/A

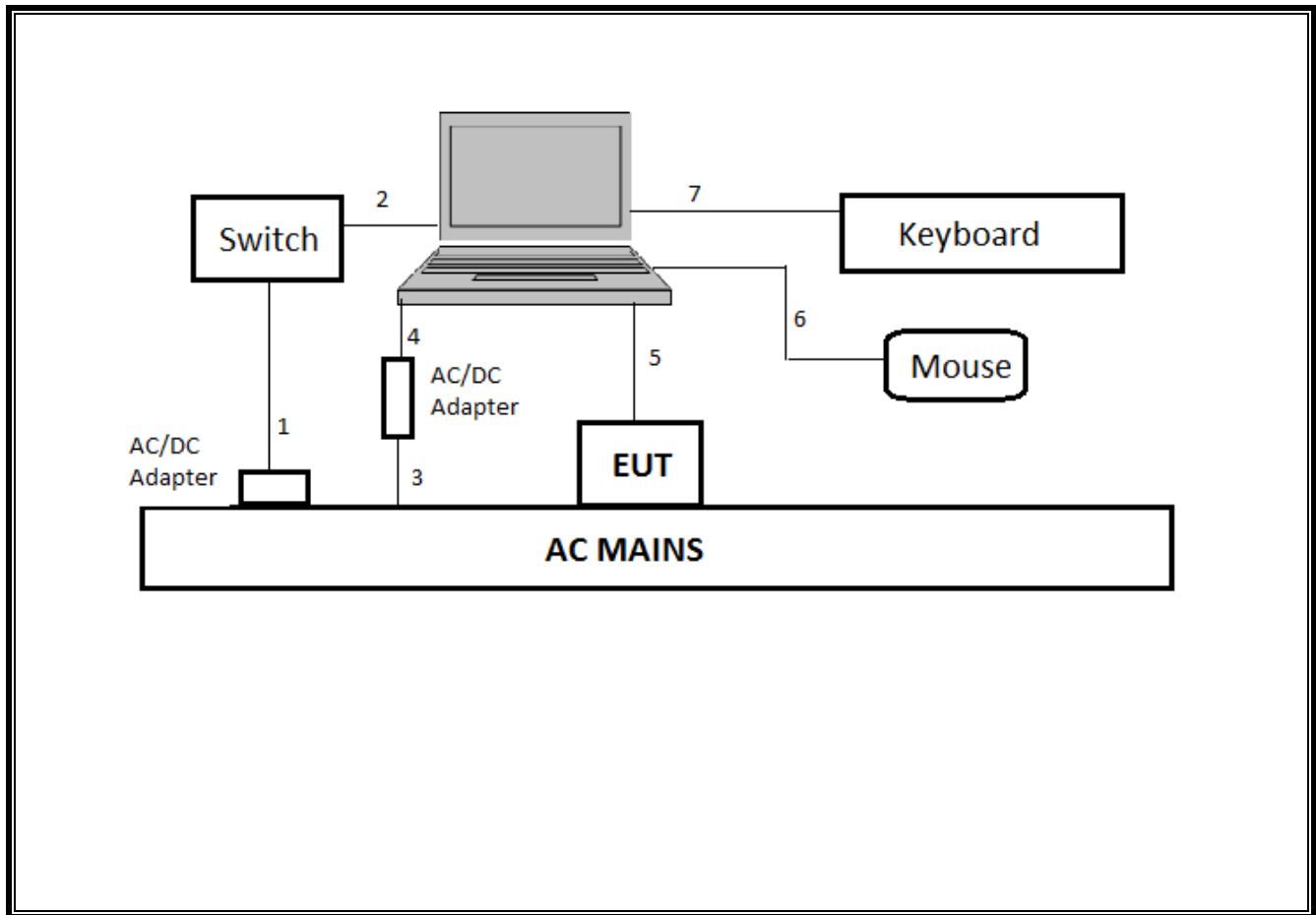
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC Power	1	Power	Shielded	1.2m	AC Mains to Switch
2	Ethernet	1	RJ45	Unshielded	5m	N/A
3	AC Power	1	AC Power	Unshielded	1m	AC Mains to AC/DC Adapter
4	DC Power	1	DC Power	Shielded	1m	AC/DC Adapter to Laptop
5	USB	1	USB	Unshielded	1m	EUT to Laptop
6	USB	1	USB	Unshielded	1m	Mouse to Laptop
7	USB	1	USB	Unshielded	1m	Keyboard to Laptop

TEST SETUP

The EUT was installed in a typical configuration and powered on during testing.

SETUP DIAGRAM



NOTE: For Radiated Emission test the switch was setup outside the chamber.

7. MEASUREMENT EQUIPMENT

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

Test Equipment List					
Description	Manufacturer	Model	T Number	Cal Date	Cal Due
Amplifier, 1 to 18 GHz	Miteq	AFS43-00101800-25-S-42	493	02/15/17	02/15/18
Amplifier, 10KHz to 1GHz, 32dB	Keysight	8447D	10	02/05/17	02/05/18
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	899	06/05/17	06/05/18
Horn Antenna, 1-18GHz	ETS-Lindgren	3117	863	06/09/17	06/09/18
EMI Reciever	Rohde & Schwarz	ESR-EMI	1436	01/06/17	01/06/18
LISN	FISCHER	FCC-LISN-50/250-25-2-01	1310	06/15/17	06/15/18
18 - 26.5 GHz Horn Antenna	Seavey Division	MWH-1826/B	449	06/12/17	06/12/18
26.5 - 40 GHz Horn Antenna	ARA	MWH-2640/B	446	06/12/17	06/12/18
Pre-Amp 1-26.5 GHz	Agilent	8449B	404	07/23/17	07/23/18
Pre-Amp, 26-40GHz	MITEQ	NSP4000-SP2	88	04/29/17	04/29/18
Spectrum Analyzer	Agilent	N9030A	907	01/23/17	01/23/18
Spectrum Analyzer	Agilent	8564E	106	09/07/16	09/07/17

Test Software List			
Description	Manufacturer	Model	Version
Radiated Software	UL	UL EMC	Ver 9.5, Dec 01, 2016

8. RADIATED EMISSIONS LIMITS AND TEST RESULTS

LIMIT

§15.109 (a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

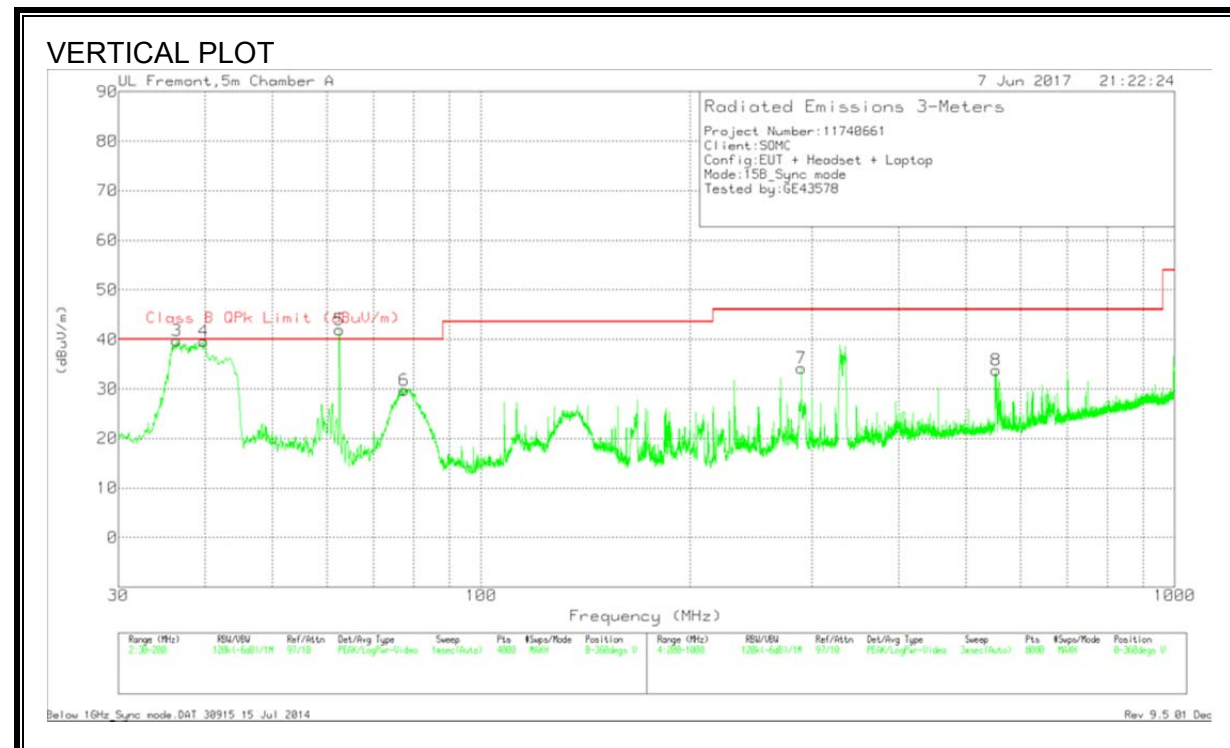
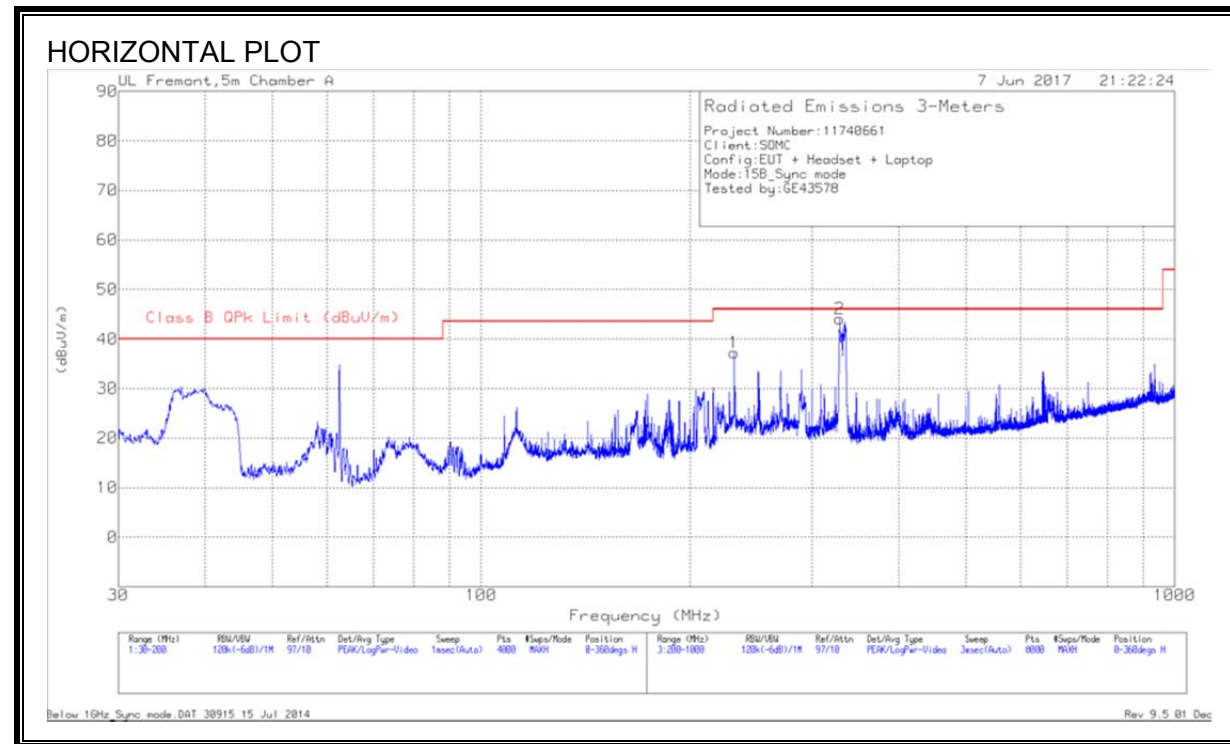
Limits for radiated disturbance of Class B ITE at measuring distance of 3 m	
Frequency range (MHz)	Quasi-peak limits (dBµV/m)
30 to 88	40
88 to 216	43.5
216 to 960	46
Above 960 MHz	54
Note: The lower limit shall apply at the transition frequency.	

TEST PROCEDURE

ANSI C63.4: 2014

The highest frequency generated or used in the EUT is 5.8 GHz therefore the frequency range was investigated from 30 MHz to 40 GHz.

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 108	1000
108-500	2000
500-1000	5000
Above 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower

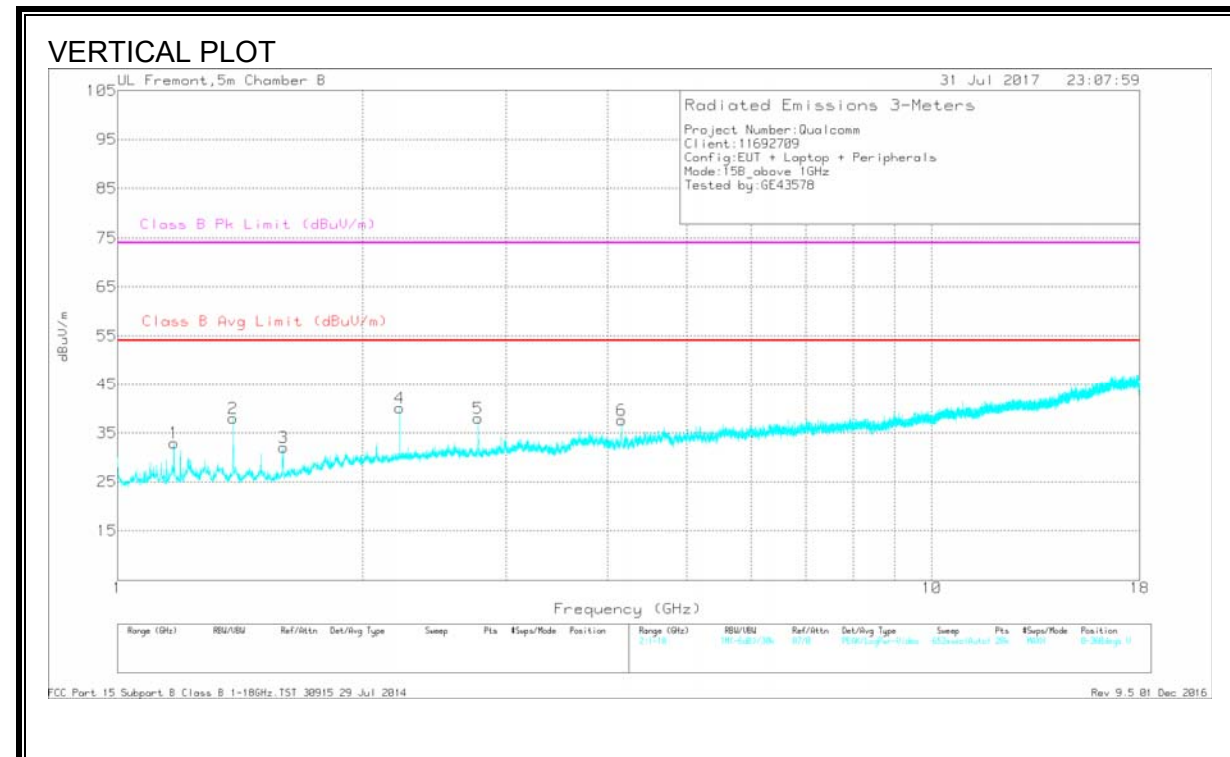
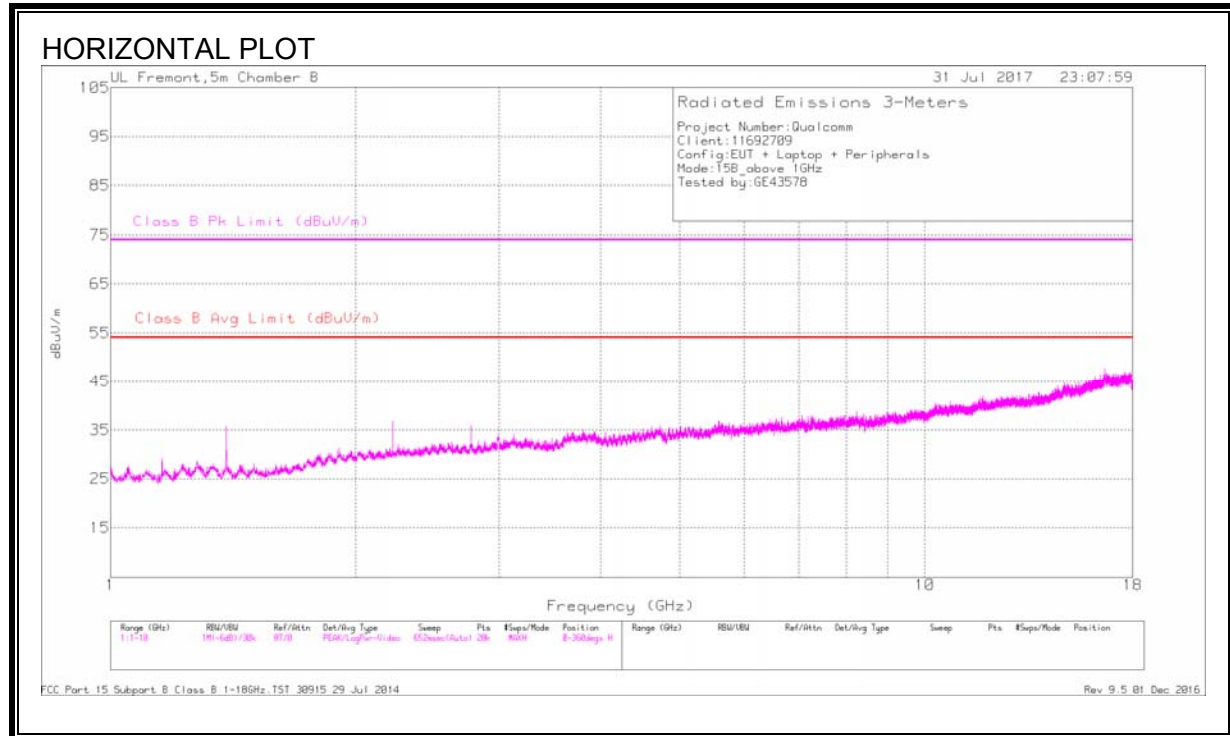
RESULTS**8.1.1. RADIATED EMISSIONS 30 MHz to 1 GHz**

HORIZONTAL AND VERTICAL DATA**Radiated Emissions**

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	36.6184	47.18	Qp	20.4	-31.2	36.38	40	-3.62	148	101	V
4	39.9884	48.73	Qp	18.1	-31.1	35.73	40	-4.27	192	101	V
5	62.4966	56.97	Qp	12	-30.8	38.17	40	-1.83	317	102	V
6	77.3967	45.02	Qp	12	-30.8	26.22	40	-13.78	268	118	V
1	231.6516	49.81	Qp	15.2	-29.8	35.21	46.02	-10.81	176	162	H
7	289.5716	44.49	Qp	17.3	-29.4	32.39	46.02	-13.63	265	170	V
2	328.7963	49.12	Qp	18	-29.3	37.82	46.02	-8.2	220	105	H
8	553.1749	23.71	Qp	22.4	-28.6	17.51	46.02	-28.51	344	141	V

Qp - Quasi-Peak detector

8.1.2. RADIATED EMISSIONS 1 GHz to 18 GHz



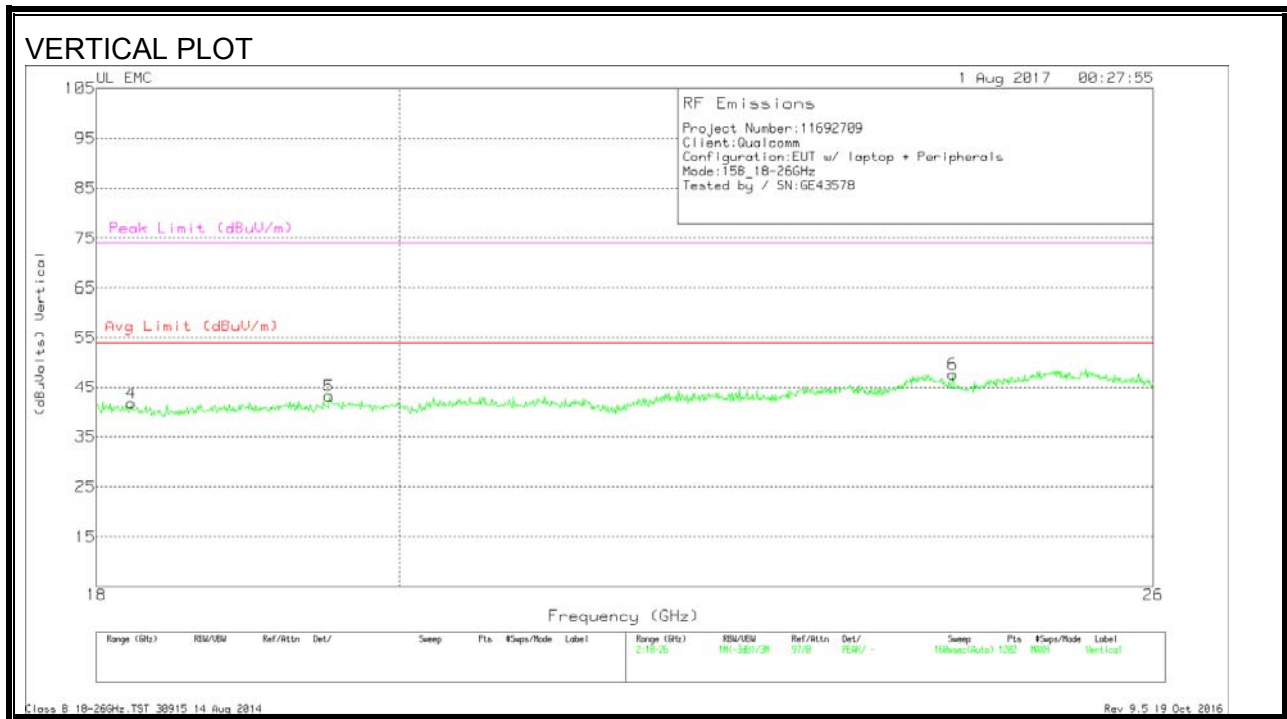
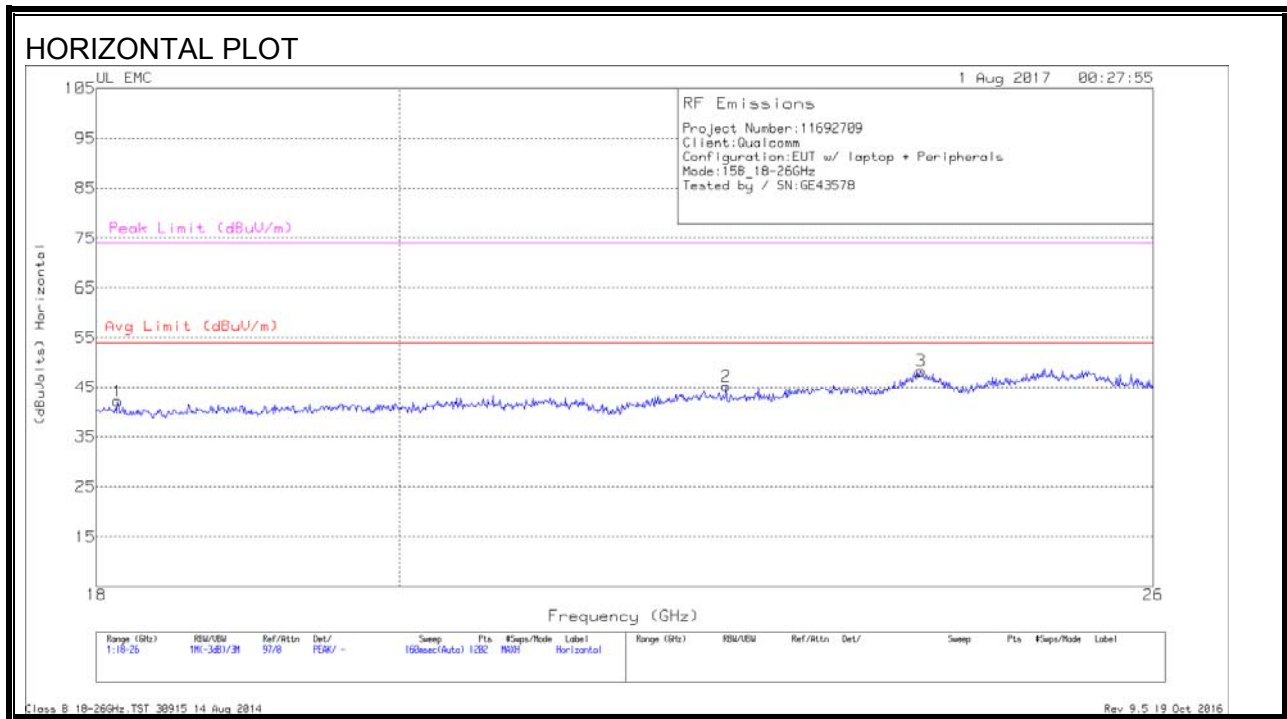
HORIZONTAL AND VERTICAL DATA**Radiated Emissions**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Margin (dB)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.171	47.48	Pk	27.7	-34.1	41.08	-	-	74	-32.92	24	211	V
	1.171	29.04	Av	27.7	-34.1	22.64	54	-31.36	-	-	24	211	V
2	1.386	48.92	Pk	28.4	-33.8	43.52	-	-	74	-30.48	123	326	V
	1.386	41.11	Av	28.4	-33.8	35.71	54	-18.29	-	-	123	326	V
3	1.599	48.3	Pk	28.3	-33.6	43	-	-	74	-31	265	190	V
	1.599	29.06	Av	28.3	-33.6	23.76	54	-30.24	-	-	265	190	V
4	2.22	48.2	Pk	31.7	-32.6	47.3	-	-	74	-26.7	0	238	V
	2.22	38.79	Av	31.7	-32.6	37.89	54	-16.11	-	-	0	238	V
5	2.771	45.52	Pk	32.3	-32	45.82	-	-	74	-28.18	93	108	V
	2.771	35.95	Av	32.3	-32	36.25	54	-17.75	-	-	93	108	V
6	4.157	43.92	Pk	33.4	-30.6	46.72	-	-	74	-27.28	77	249	V
	4.157	32.91	Av	33.4	-30.6	35.71	54	-18.29	-	-	77	249	V

Pk - Peak detector

Av - Average detection

8.1.3. RADIATED EMISSIONS 18 GHz to 26 GHz

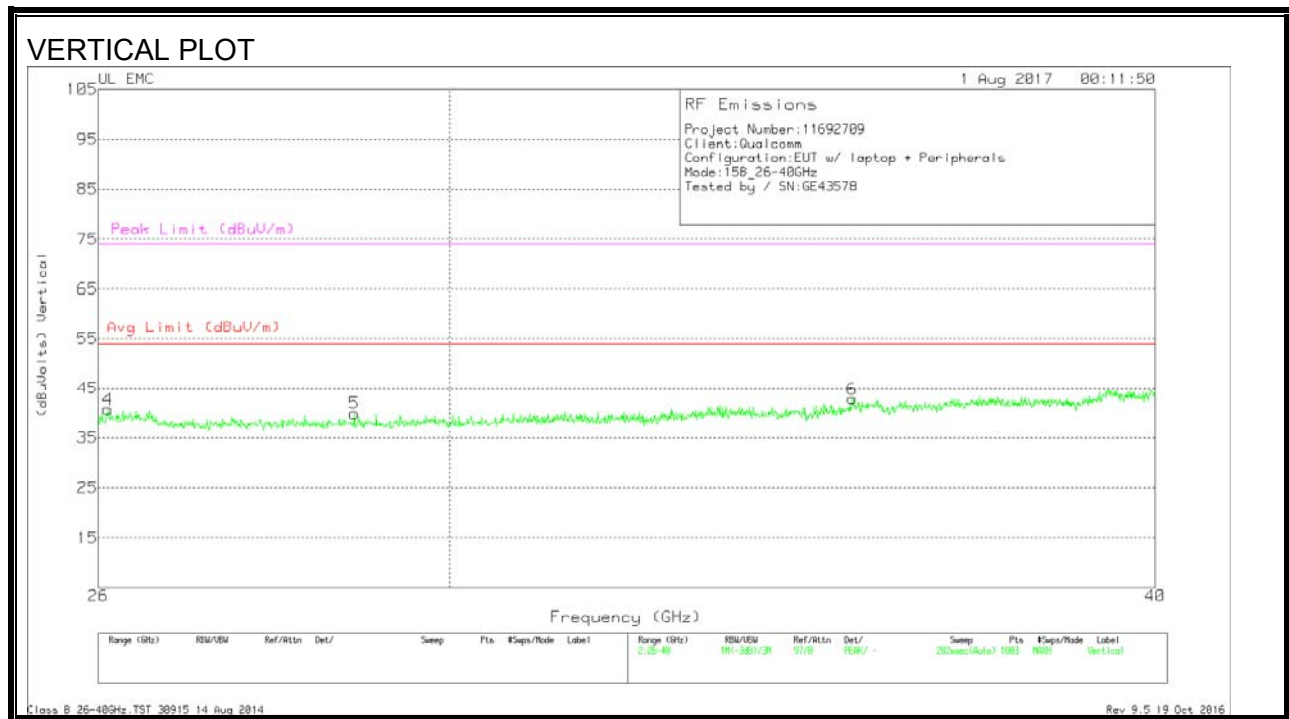
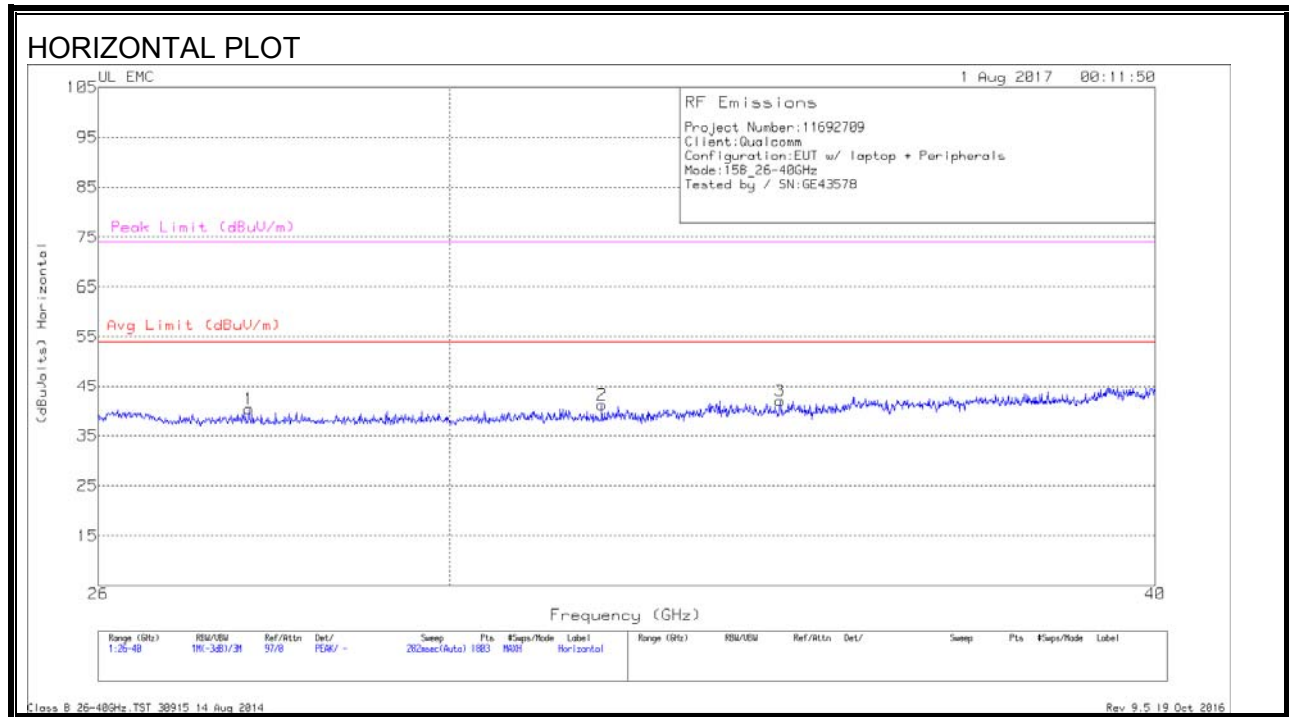


HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T449 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	18.133	41.97	Pk	32.3	-22.6	-9.5	42.17	54	-11.83	74	-31.83
2	22.41	41.97	Pk	33.5	-20.8	-9.5	45.17	54	-8.83	74	-28.83
3	23.982	43.93	Pk	33.9	-20	-9.5	48.33	54	-5.67	74	-25.67
4	18.22	41.37	Pk	32.2	-22.4	-9.5	41.67	54	-12.33	74	-32.33
5	19.519	41.77	Pk	32.7	-21.8	-9.5	43.17	54	-10.83	74	-30.83
6	24.248	43.67	Pk	33.8	-20.3	-9.5	47.67	54	-6.33	74	-26.33

Pk - Peak detector

8.1.4. RADIATED EMISSIONS 26 GHz to 40 GHz

HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T90 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	27.647	45.63	Pk	35.8	-31.6	-9.5	40.33	54	-13.67	74	-33.67
2	31.92	47.77	Pk	36.2	-33.3	-9.5	41.17	54	-12.83	74	-32.83
3	34.329	48.1	Pk	37.1	-33.7	-9.5	42	54	-12	74	-32
4	26.101	45.37	Pk	35.6	-30.8	-9.5	40.67	54	-13.33	74	-33.33
5	28.859	45.93	Pk	35.8	-32.4	-9.5	39.83	54	-14.17	74	-34.17
6	35.354	48.13	Pk	37.8	-33.6	-9.5	42.83	54	-11.17	74	-31.17

Pk - Peak detector

9. AC MAINS LINE CONDUCTED EMISSIONS LIMITS AND TEST RESULTS

LIMIT

§15.107 (a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Notes: 1. The lower limit shall apply at the transition frequencies 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

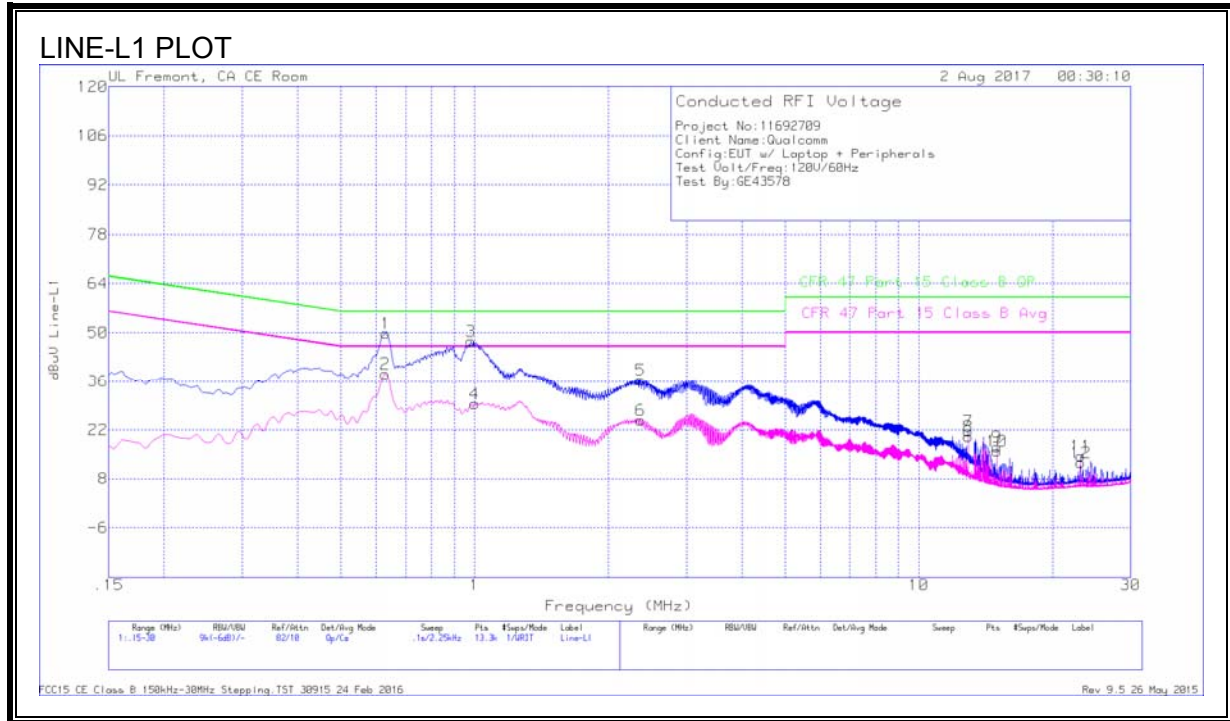
TEST PROCEDURE

ANSI C63.4: 2014

RESULTS

6 WORST EMISSIONS

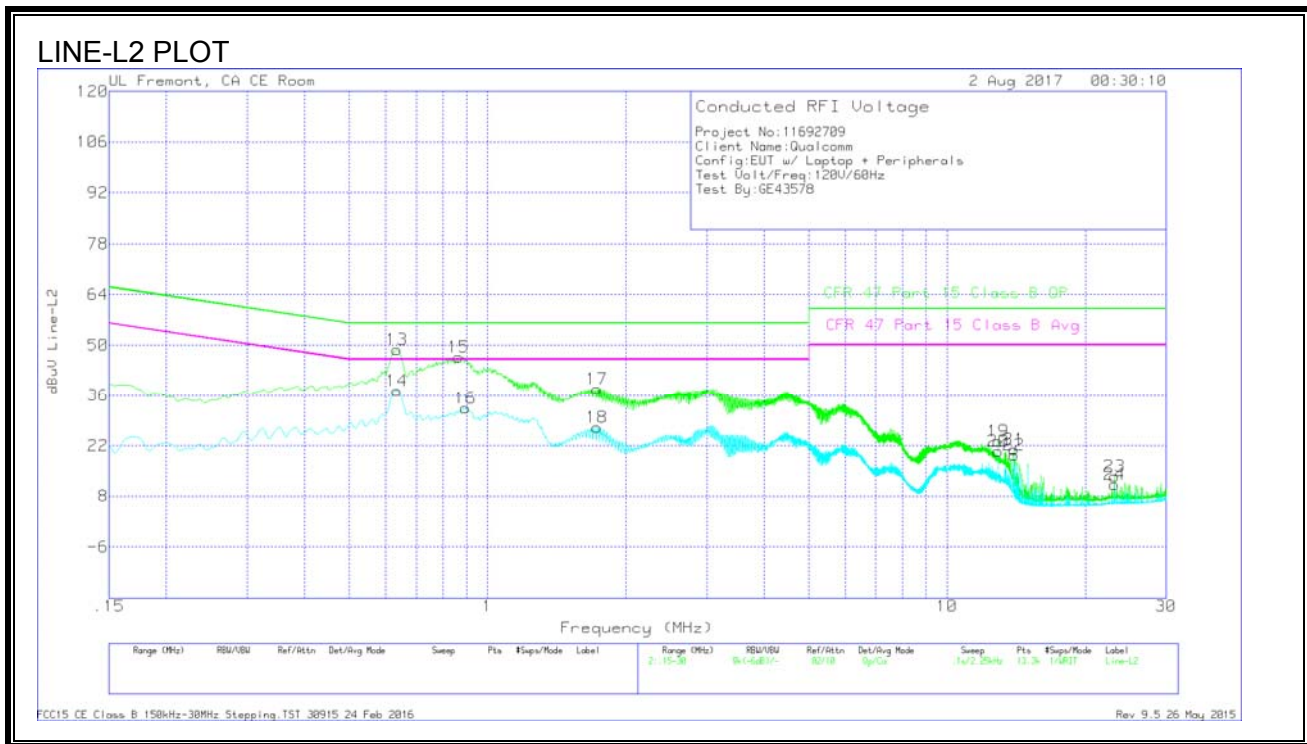
Line-L1 .15 - 30MHz



Trace Markers

Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.6315	39.63	Qp	0	.1	10.1	49.83	56	-6.17	-	-
2	.62925	28.06	Ca	0	.1	10.1	38.26	-	-	46	-7.74
3	.9825	37.31	Qp	0	.1	10.1	47.51	56	-8.49	-	-
4	1.0005	19.21	Ca	0	.1	10.1	29.41	-	-	46	-16.59
5	2.364	26.23	Qp	0	.1	10.1	36.43	56	-19.57	-	-
6	2.36288	14.59	Ca	0	.1	10.1	24.79	-	-	46	-21.21
7	12.93	11.1	Qp	.1	.2	10.2	21.6	60	-38.4	-	-
8	12.93	9.58	Ca	.1	.2	10.2	20.08	-	-	50	-29.92
9	15	6.7	Qp	.1	.2	10.2	17.2	60	-42.8	-	-
10	15	5.35	Ca	.1	.2	10.2	15.85	-	-	50	-34.15
11	23.1315	3.81	Qp	.1	.3	10.4	14.61	60	-45.39	-	-
12	23.1315	1.78	Ca	.1	.3	10.4	12.58	-	-	50	-37.42

Qp - Quasi-Peak detector
Ca - CISPR average detection

Line-L2 .15 - 30MHz**Trace Markers**

Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
13	.636	38.55	Qp	0	.1	10.1	48.75	56	-7.25	-	-
14	.636	27.1	Ca	0	.1	10.1	37.3	-	-	46	-8.7
15	.8655	36.57	Qp	0	.1	10.1	46.77	56	-9.23	-	-
16	.89475	22.3	Ca	0	.1	10.1	32.5	-	-	46	-13.5
17	1.73175	27.63	Qp	0	.1	10.1	37.83	56	-18.17	-	-
18	1.73175	16.93	Ca	0	.1	10.1	27.13	-	-	46	-18.87
19	12.93	12.74	Qp	.1	.2	10.2	23.24	60	-36.76	-	-
20	12.93	9.87	Ca	.1	.2	10.2	20.37	-	-	50	-29.63
21	13.965	10.44	Qp	.1	.2	10.2	20.94	60	-39.06	-	-
22	13.965	8.93	Ca	.1	.2	10.2	19.43	-	-	50	-30.57
23	23.1315	2.86	Qp	0	.3	10.4	13.56	60	-46.44	-	-
24	23.1315	.6	Ca	0	.3	10.4	11.3	-	-	50	-38.7

Qp - Quasi-Peak detector

Ca - CISPR average detection