



**FCC 47 CFR PART 15 SUBPART B
ICES-003 ISSUE 5**

TEST REPORT

FOR

802.15.4 MODEM MODULE

MODEL NUMBER: 02-0084-00

REPORT NUMBER: 16U23023-E3V1

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Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	03/31/16	Initial Issue	C. Vergonio

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ELECSYS CORPORATION
846 N. Mart-Way Court
Olathe, KS 66061

EUT DESCRIPTION: 802.15.4 MODEM MODULE

MODEL: 02-0084-00

SERIAL NUMBER: SAMPLE Q

DATE TESTED: March 31 – April 1, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC 47 CFR PART 15 SUBPART B	Pass
ICES-003 ISSUE 5	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

All tests were performed in accordance with the procedures documented in ANSI C63.4-2014.

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	☐ Chamber D
☒ Chamber B	☐ Chamber E
☐ Chamber C	☐ Chamber F
	☐ Chamber G
	☐ Chamber H

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.

Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively.

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
Radiated Disturbance, 9KHz to 30 MHz	2.14 dB
Radiated Disturbance, 30 to 1000 MHz	4.98 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 802.15.4 MODEM MODULE.

GENERAL INFORMATION

Power Requirements	2.5-12V External DC
List of frequencies generated or used by the EUT	42MHz(Clock Frequency)

5.2. TEST CONFIGURATIONS

The EUT was performed in X orientation.

Mode	Description
Data Transfer	EUT + micro USB cable + minimum configuration PC + Radio is on Receive mode

5.3. MODE(S) OF OPERATION

Mode	Description
Data Transfer	EUT + micro USB cable + minimum configuration PC.

5.4. MODIFICATIONS

No modification made to the EUT.

5.5. DETAILS OF TESTED SYSTEM

SUPPORT EQUIPMENT & PERIPHERALS

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
DC Power Supply	Sorensen	XT 15-4	N/A	N/A
Laptop	Lenovo	2349CW5	PB05HPL	N/A
AC ADAPTER(Laptop)	Lenovo	ADLX90NLT2A	N/A	N/A

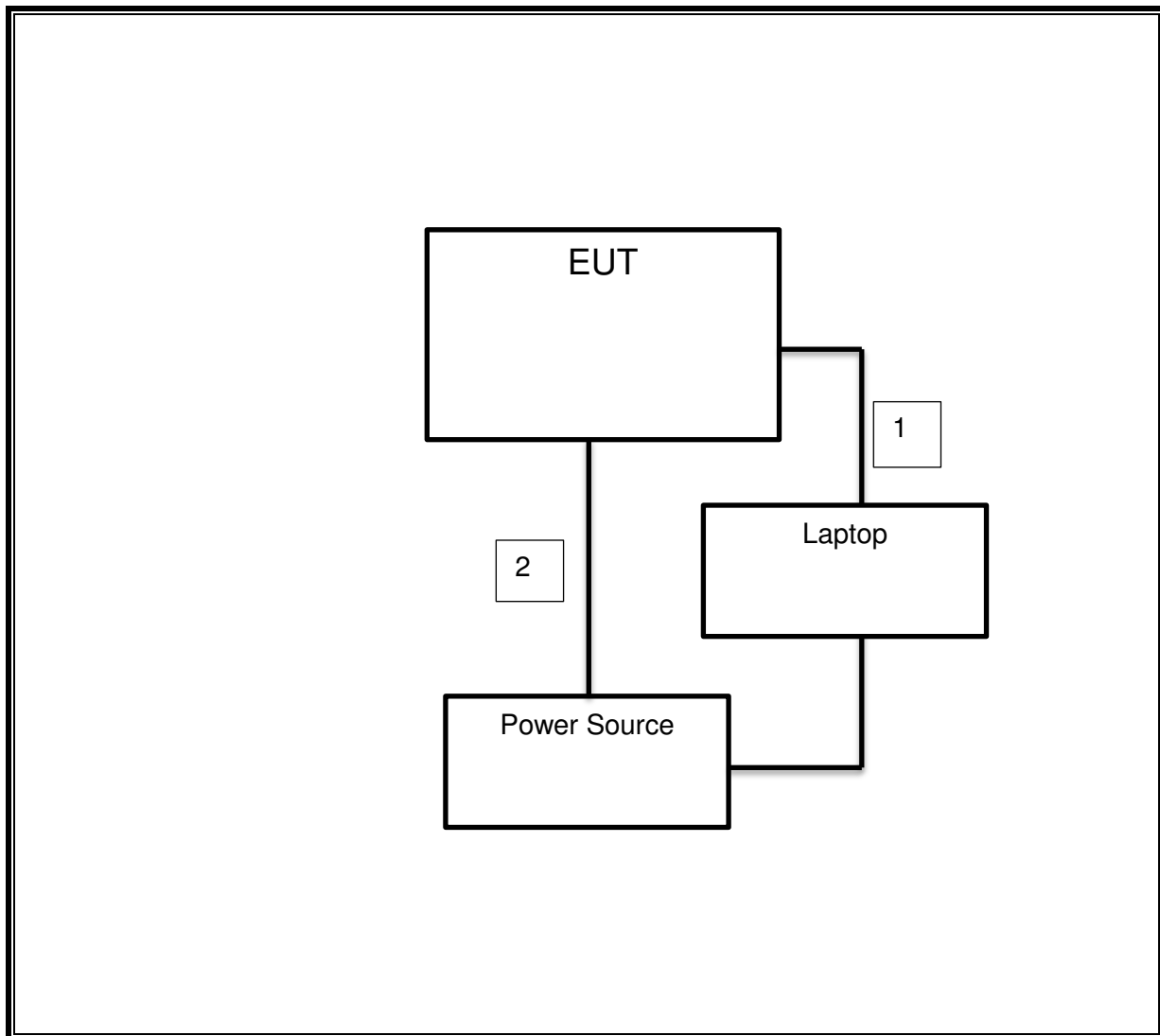
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Data	1	USB	Unshielded	1.2	N/A
2	Power	1	Banana	Unshielded	1.5	N/A

TEST SETUP

The EUT is stand-alone unit during the tests.

TEST SETUP DIAGRAM



6. TEST AND 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 Due
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	477	06/10/16
RF Preamplifier, 10 KHz-1000 MHz	Sonoma	310N	300	11/05/16
Spectrum Analyzer, PXA, 3 Hz to 44 GHz	Keysight	N9030A	146	06/17/16
EMI Test Receiver, 9Khz to 7GHz	Rohde & Schwarz	ECSI7	284	9/10/2016
LISN, 30MHz	FCC	50/250-25-2	24	9/16/2016

Test Software List			
Description	Manufacturer	Model	Version
Radiated Software	UL	UL EMC	Ver 9.5, June 24, 2015
Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015

6.1. RADIATED EMISSIONS LIMITS AND RESULTS

LIMIT

FCC Part 15 Subpart B Class B

FCC §15.109 (a)

Class B Limits below 1 GHz

Limits for radiated disturbance of Class B ITE at measuring distance of 3 m	
Frequency range (MHz)	Quasi-peak limits (dB μ V/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

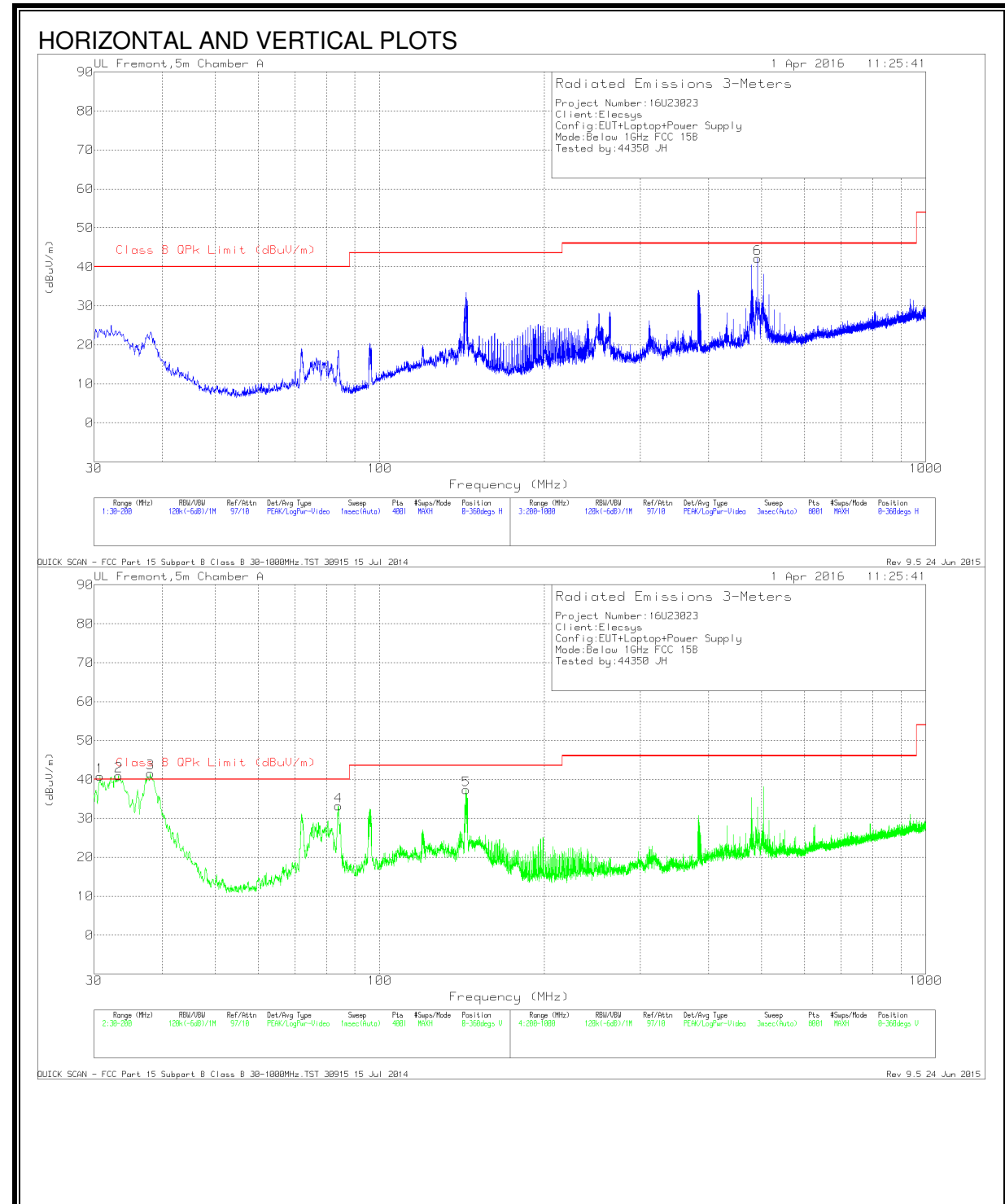
ANSI C63.4

The highest clock frequency generated or used in the EUT was 42 MHz. Therefore, the frequency range was investigated from 30MHz to 1000MHz.

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 for FCC/IC, or 6 GHz for EU and others

RESULTS

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



WORST CASE EMISSIONS – DATA FOR 30 TO 1000 MHz

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T477 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	30.765	47.4	Pk	24.6	-31.2	40.8	40	.8	0-360	100	V
2	33.2725	49.27	Pk	22.9	-31.2	40.97	40	.97	0-360	100	V
3	38.0325	53.41	Pk	19.4	-31.2	41.61	40	1.61	0-360	100	V
4	83.975	52.72	Pk	11.1	-30.7	33.12	40	-6.88	0-360	100	V
5	143.8575	50.93	Pk	16.7	-30.3	37.33	43.52	-6.19	0-360	100	V
6	492	49.21	Pk	21.7	-28.7	42.21	46.02	-3.81	0-360	100	H

Pk - Peak detector

Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T477 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
30.6992	43.53	Qp	24.7	-31.2	37.03	40	-2.97	91	131	V
33.2749	46.69	Qp	22.9	-31.2	38.39	40	-1.61	81	105	V
38.0239	50.15	Qp	19.4	-31.2	38.35	40	-1.65	102	104	V
492.0432	41.51	Qp	21.7	-28.7	34.51	46.02	-11.51	126	107	H

Qp - Quasi-Peak detector

7. AC POWER LINE CONDUCTED EMISSIONS LIMITS

TEST PROCEDURE

ANSI C63.4

LIMITS

FCC Part 15 Subpart B Class B

FCC §15.107 (a)

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.

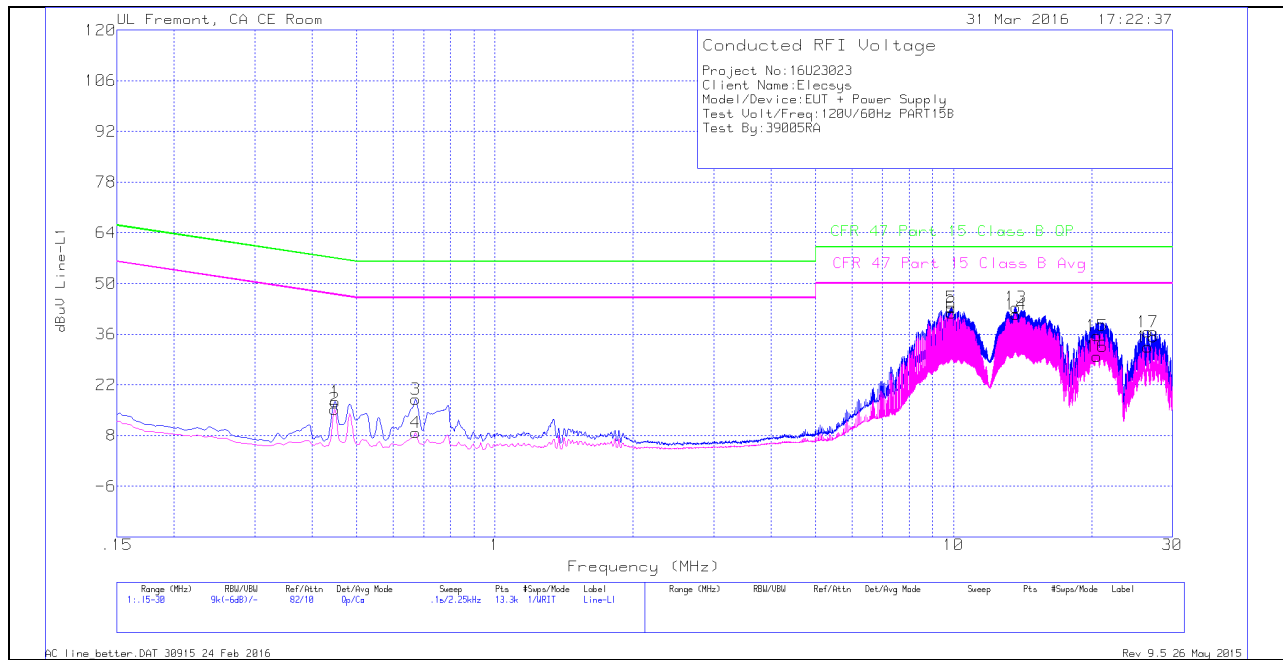
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

RESULTS

6 WORST EMISSIONS

LINE 1 PLOT



LINE 1 RESULT

Trace Markers

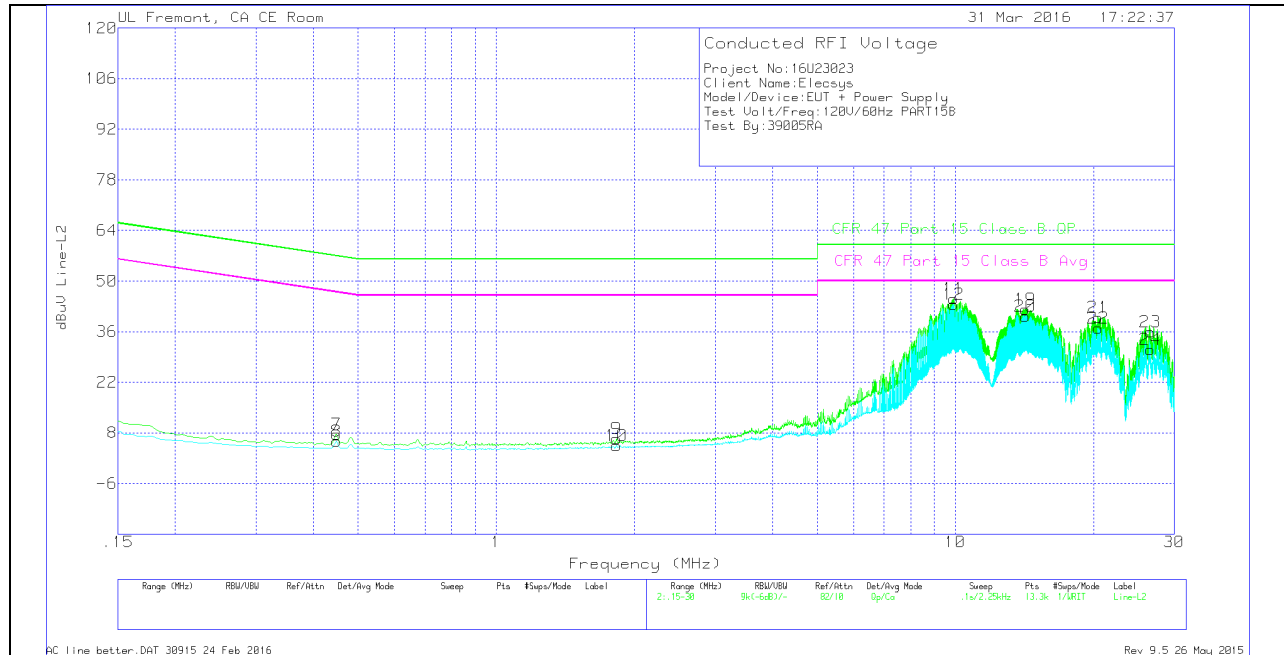
Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1	LC Cables 1&3	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	.44925	6.9	Qp	.4	0	10.1	17.4	56.89	-39.49	-	-
2	.447	4.82	Ca	.4	0	10.1	15.32	-	-	46.93	-31.61
3	.672	7.57	Qp	.3	0	10.1	17.97	56	-38.03	-	-
4	.672	-1.56	Ca	.3	0	10.1	8.84	-	-	46	-37.16
5	9.879	32.75	Qp	.2	.2	10.2	43.35	60	-16.65	-	-
6	9.879	31.25	Ca	.2	.2	10.2	41.85	-	-	50	-8.15
13	13.67925	32.79	Qp	.2	.2	10.2	43.39	60	-16.61	-	-
14	13.67925	30.83	Ca	.2	.2	10.2	41.43	-	-	50	-8.57
15	20.5395	24.79	Qp	.3	.2	10.3	35.59	60	-24.41	-	-
16	20.544	19.04	Ca	.3	.2	10.3	29.84	-	-	50	-20.16
17	26.52	25.49	Qp	.3	.3	10.5	36.59	60	-23.41	-	-
18	26.52	21.4	Ca	.3	.3	10.5	32.5	-	-	50	-17.5

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 PLOT



LINE 2 RESULT

Range 2: Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2	LC Cables 2&3	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)
7	.44925	-2.88	Qp	.4	0	10.1	7.62	56.89	-49.27	-	-
8	.44925	-4.89	Ca	.4	0	10.1	5.61	-	-	46.89	-41.28
9	1.8285	-4.1	Qp	.2	.1	10.1	6.3	56	-49.7	-	-
10	1.8285	-5.87	Ca	.2	.1	10.1	4.53	-	-	46	-41.47
11	9.9195	34.48	Qp	.2	.2	10.2	45.08	60	-14.92	-	-
12	9.9195	32.97	Ca	.2	.2	10.2	43.57	-	-	50	-6.43
19	14.199	31.52	Qp	.2	.2	10.2	42.12	60	-17.88	-	-
20	14.199	29.7	Ca	.2	.2	10.2	40.3	-	-	50	-9.7
21	20.481	29.16	Qp	.3	.2	10.3	39.96	60	-20.04	-	-
22	20.47875	26.13	Ca	.3	.2	10.3	36.93	-	-	50	-13.07
23	26.601	24.75	Qp	.3	.3	10.5	35.85	60	-24.15	-	-
24	26.59875	20.01	Ca	.3	.3	10.5	31.11	-	-	50	-18.89

Qp - Quasi-Peak detector

Ca - CISPR average detection