

FCC Test Report

(Class II Permissive Change)

Product Name	M2M Router
Model No	ER2000T-VZ-CAT1
FCC ID.	2AMRIER2000TNAC1

Applicant	Connected IO Inc.
Address	573 University Ave. Los Gatos, CA 95032

Date of Receipt	Oct. 30, 2017
Issue Date	Nov. 15, 2017
Report No.	17A0398R-RFUSP26V00
Report Version	V1.0



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.

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Test Report

Issue Date: Nov. 15, 2017

Report No.: 17A0398R-RFUSP26V00



Product Name	M2M Router
Applicant	Connected IO Inc.
Address	573 University Ave. Los Gatos, CA 95032
Manufacturer	LINKHIGH INTERNATIONAL LIMITED.
Model No.	ER2000T-VZ-CAT1
FCC ID.	2AMRIER2000TNAC1
EUT Rated Voltage	DC 12V, 2A
EUT Test Voltage	AC 120V/60Hz
Trade Name	Connected IO Inc.
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2016 ANSI C63.4: 2014
Test Result	Complied

Documented By

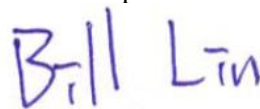
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(Senior Adm. Specialist / Joanne Lin)

Tested By

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(Engineer / Bill Lin)

Approved By

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(Director / Vincent Lin)

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1. GENERAL INFORMATION

1.1. EUT Description

Product Name	M2M Router
Trade Name	Connected IO Inc.
Model No.	ER2000T-VZ-CAT1
FCC ID.	2AMRIER2000TNAC1
Frequency Range	2412-2462MHz for 802.11b/g/n-20BW, 2422-2452MHz for 802.11n-40BW
Number of Channels	802.11b/g/n-20MHz: 11, n-40MHz: 7
Data Speed	802.11b: 1-11Mbps, 802.11a/g: 6-54Mbps, 802.11n: up to 300Mbps
Type of Modulation	802.11b:DSSS, DBPSK, DQPSK, CCK 802.11g/n: OFDM, BPSK, QPSK, 16QAM, 64QAM
Antenna Type	Dipole Antenna
Antenna Gain	Refer to the table "Antenna List"
Channel Control	Auto
Power Adapter (1)	MFR: Sunny, M/N: SYS1531-2412-W2 Input: AC 100-240V~1.0A MAX, 50-60Hz Output: 12V $\overline{=}$ 2.0A Cable Out: Non-shielded, 1.0m, with one ferrite core bonded. Core: Laird Core
Power Adapter (2)	MFR: Sunny, M/N: SYS1531-2412-W2 Input: AC 100-240V~1.0A MAX, 50-60Hz Output: 12V $\overline{=}$ 2.0A Cable Out: Non-shielded, 1.0m, with one ferrite core bonded. Core: WRC Core

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	Grand-Tek	OA-LTE-01-01-GTT	Dipole Antenna	3.1dBi for 2.4 GHz

Note: The antenna of EUT conforms to FCC 15.203.

802.11b/g/n-20MHz Center Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 01:	2412 MHz	Channel 02:	2417 MHz	Channel 03:	2422 MHz	Channel 04:	2427 MHz
Channel 05:	2432 MHz	Channel 06:	2437 MHz	Channel 07:	2442 MHz	Channel 08:	2447 MHz
Channel 09:	2452 MHz	Channel 10:	2457 MHz	Channel 11:	2462 MHz		

802.11n-40MHz (2.4G Band) Center Working Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 03:	2422 MHz	Channel 04:	2427 MHz	Channel 05:	2432 MHz	Channel 06:	2437 MHz
Channel 07:	2442 MHz	Channel 08:	2447 MHz	Channel 09:	2452 MHz		

Note:

1. The EUT is a M2M Router with a built-in WLAN transceiver.
2. This is to request a Class II permissive change for FCC ID: 2AMRIER2000TNAC1, originally granted on 09/01/2017.

The major change filed under this application is:

Change #1: Addition of new core for adapter (WRC cord)

#2: Change the Model No.: ER2000T-VZ-CAT1

#2: Change 4G module (LE910-SV1)

4G module card	Orginal	New
Model No.	LE910-NA1	LE910-SV1
FCC ID	RI7LE910NAV2	RI7LE910SVV2

Test Mode:	Mode 1: Normal Operation_Power adapter with Laird Core
	Mode 2: Normal Operation_Power adapter with WRC Core

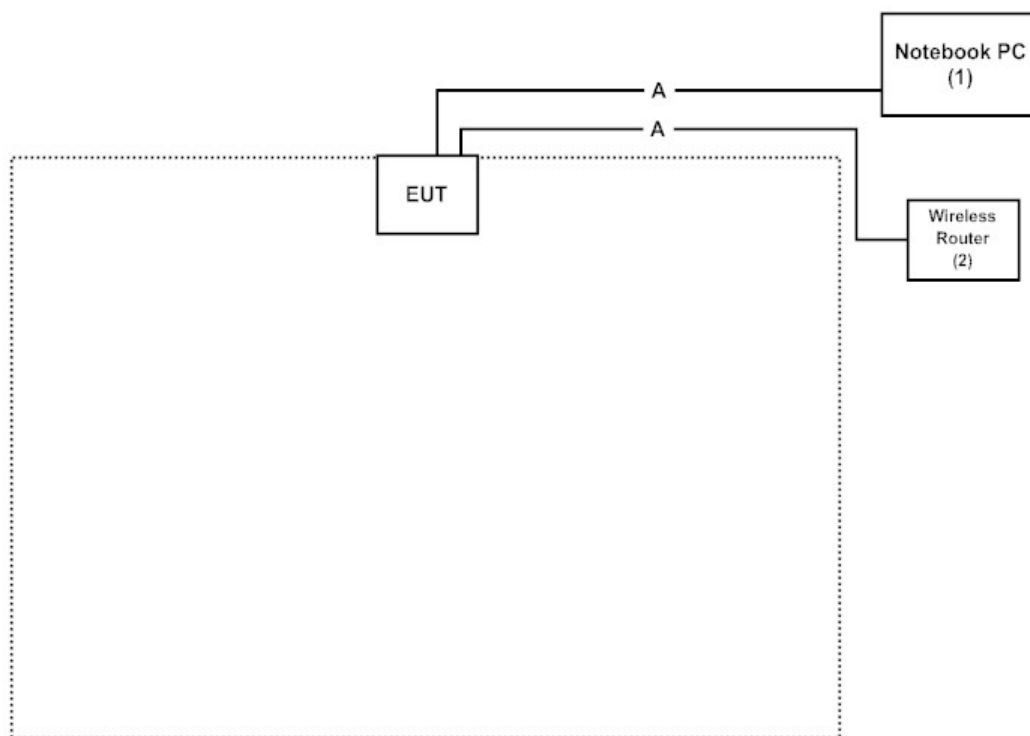
1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	Notebook PC	DELL	Latitude E7440	2BMFTY1	Non-Shielded, 0.8m
2	Wireless Router	ASUS	RT-N15U	B41AF3TW0010	Non-Shielded, 1.8m

Signal Cable Type	Signal cable Description
A LAN Cable	Non-shielded, 10m, two PCS.

1.4. Configuration of Tested System



1.5. EUT Exercise Software

- (1) Setup the EUT and simulators as shown on 1.4.
- (2) Turn on the power of all equipment.
- (3) Boot the PC from Hard Disk.
- (4) Data will communicate between PC and partner PC through EUT that is connected to LAN port of PC.

1.6. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	50-65
Barometric pressure (mbar)	860-1060	950-1000

The related certificate for our laboratories about the test site and management system can be downloaded from DEKRA Testing and Certification Co., Ltd. Web Site:

<http://www.dekra.com.tw/english/about/certificates.aspx?bval=5>

The address and introduction of DEKRA Testing and Certification Co., Ltd. laboratories can be founded in our Web site: http://www.dekra.com.tw/index_en.aspx

Site Description: Accredited by TAF
Accredited Number: 3023

Site Name: DEKRA Testing and Certification Co., Ltd
Site Address: No.5-22, Ruishukeng, Linkou Dist., New Taipei City 24451,
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E-Mail : info.tw@dekra.com

FCC Accreditation Number: TW3023

1.7. List of Test Equipment

Conducted Emission / SR1

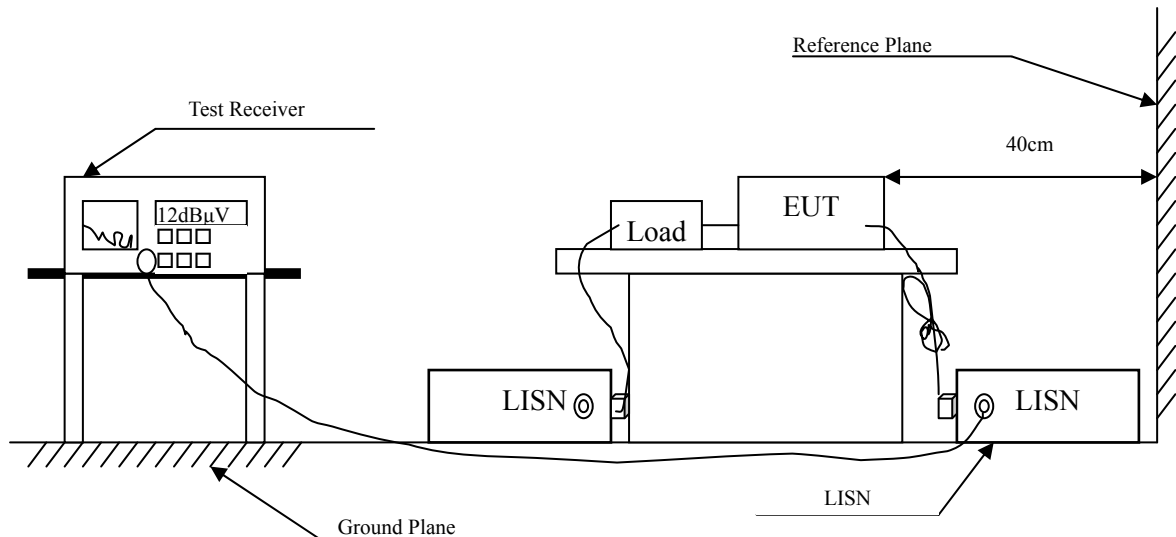
Instrument	Manufacturer	Type No.	Serial No	Cal. Date
EMI Test Receiver	R&S	ESCS 30	100367	2017/01/06
LISN	R&S	ENV216	100085	2017/01/25
LISN	R&S	ESH2-Z5	836679/023	2017/07/28
Coaxial Cable	DEKRA	RG 400	LC016-RG	2017/06/22

Radiated Emission / Site 7

Instrument	Manufacturer	Type No.	Serial No	Cal. Date
Bilog Antenna	Schaffner Chase	CBL6112B	2930	2017/06/25
EMI Test Receiver	R&S	ESCI	100649	2017/07/04
Coaxial Cable	DEKRA	RG 214	LC007-RG	2017/06/19
Pre-Amplifier	DEKRA	AP/0100A	CHM/1009094	2017/06/19
Site7 NSA	DEKRA	N/A	N/A	2017/06/19

2. Conducted Emission

2.1. Test Setup



2.2. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dB μ V) Limit		
Frequency MHz	Limits	
	QP	AVG
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

2.3. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

2.4. Uncertainty

$\pm 3.44\text{dB}$

2.5. Test Result of Conducted Emission

Product : M2M Router
 Test Item : Conducted Emission Test
 Power Line : Line 1
 Test Date : 2017/11/09
 Test Mode : Mode 1: Normal Operation_Power adapter with Laird Core

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dB μ V	dB μ V	dB	dB μ V
Line 1					
Quasi-Peak					
0.158	9.768	34.000	43.769	-22.002	65.771
0.197	9.668	27.510	37.179	-27.478	64.657
0.400	9.680	30.890	40.570	-18.287	58.857
1.834	9.851	15.960	25.811	-30.189	56.000
5.029	9.917	13.760	23.677	-36.323	60.000
15.927	10.177	27.760	37.937	-22.063	60.000
Average					
0.158	9.768	17.540	27.309	-28.462	55.771
0.197	9.668	14.560	24.229	-30.428	54.657
0.400	9.680	23.500	33.180	-15.677	48.857
1.834	9.851	7.320	17.171	-28.829	46.000
5.029	9.917	7.360	17.277	-32.723	50.000
15.927	10.177	21.910	32.087	-17.913	50.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. “ ” means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : M2M Router
 Test Item : Conducted Emission Test
 Power Line : Line 2
 Test Date : 2017/11/09
 Test Mode : Mode 1: Normal Operation_Power adapter with Laird Core

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dB μ V	dB μ V	dB	dB μ V
Line 2					
Quasi-Peak					
0.158	9.697	34.140	43.837	-21.934	65.771
0.212	9.690	24.320	34.010	-30.219	64.229
0.408	9.683	30.710	40.393	-18.236	58.629
0.763	9.798	17.770	27.568	-28.432	56.000
1.646	9.852	16.290	26.142	-29.858	56.000
15.920	10.317	27.410	37.727	-22.273	60.000
Average					
0.158	9.697	17.540	27.237	-28.534	55.771
0.212	9.690	9.570	19.260	-34.969	54.229
0.408	9.683	23.960	33.643	-14.986	48.629
0.763	9.798	9.840	19.638	-26.362	46.000
1.646	9.852	7.290	17.142	-28.858	46.000
15.920	10.317	21.570	31.887	-18.113	50.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. “ ” means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : M2M Router
 Test Item : Conducted Emission Test
 Power Line : Line 1
 Test Date : 2017/11/09
 Test Mode : Mode 2: Normal Operation_Power adapter with WRC Core

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dB μ V	dB μ V	dB	dB μ V
Line 1					
Quasi-Peak					
0.197	9.668	27.790	37.459	-27.198	64.657
0.306	9.664	20.780	30.444	-31.099	61.543
0.408	9.680	29.060	38.740	-19.889	58.629
0.951	9.751	13.330	23.081	-32.919	56.000
10.322	10.014	21.790	31.804	-28.196	60.000
17.537	10.219	25.940	36.159	-23.841	60.000
Average					
0.197	9.668	13.090	22.759	-31.898	54.657
0.306	9.664	11.270	20.934	-30.609	51.543
0.408	9.680	21.460	31.140	-17.489	48.629
0.951	9.751	4.630	14.381	-31.619	46.000
10.322	10.014	4.360	14.374	-35.626	50.000
17.537	10.219	20.280	30.499	-19.501	50.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. “ ” means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : M2M Router
 Test Item : Conducted Emission Test
 Power Line : Line 2
 Test Date : 2017/11/09
 Test Mode : Mode 2: Normal Operation_Power adapter with WRC Core

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dB μ V	dB μ V	dB	dB μ V
Line 2					
Quasi-Peak					
0.154	9.697	36.650	46.347	-19.539	65.886
0.209	9.690	26.620	36.310	-28.004	64.314
0.420	9.688	27.000	36.687	-21.599	58.286
1.408	9.860	16.320	26.180	-29.820	56.000
6.990	10.037	14.280	24.317	-35.683	60.000
17.959	10.375	24.640	35.015	-24.985	60.000
Average					
0.154	9.697	18.530	28.227	-27.659	55.886
0.209	9.690	10.340	20.030	-34.284	54.314
0.420	9.688	18.900	28.587	-19.699	48.286
1.408	9.860	8.380	18.240	-27.760	46.000
6.990	10.037	6.890	16.927	-33.073	50.000
17.959	10.375	19.760	30.135	-19.865	50.000

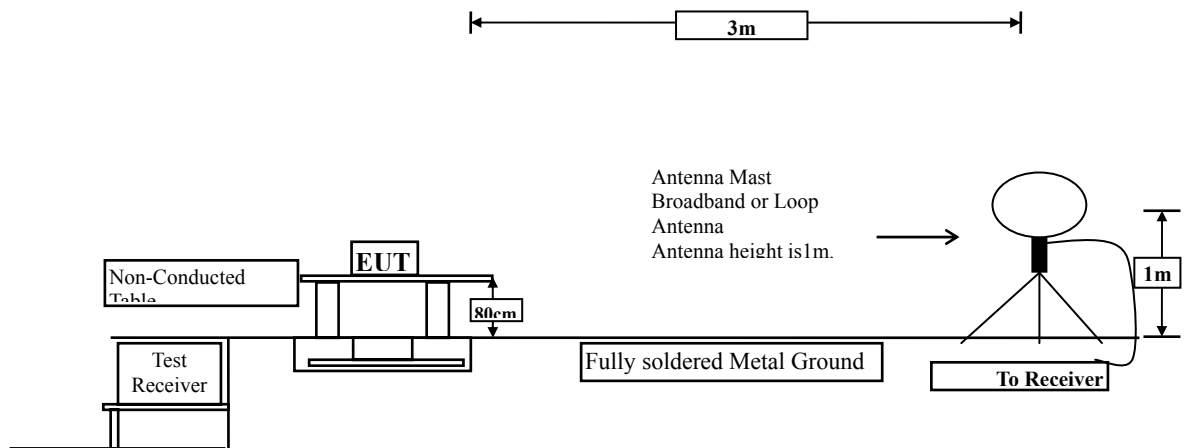
Note:

1. All Reading Levels are Quasi-Peak and average value.
2. “ ” means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

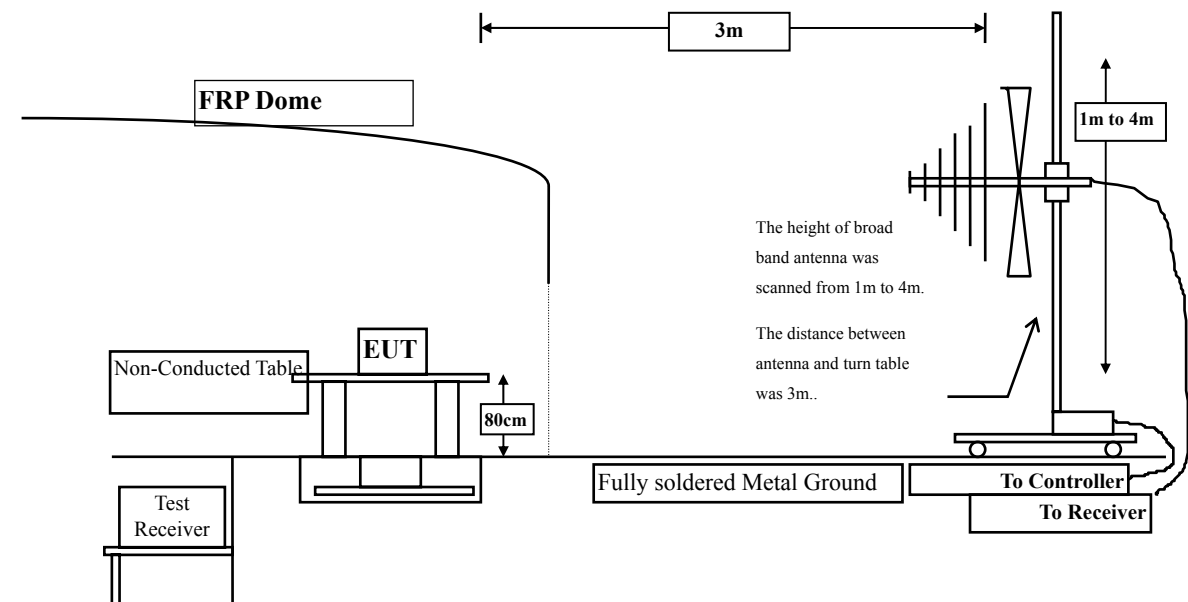
3. Radiated Emission

3.1. Test Setup

Radiated Emission Under 30MHz



Radiated Emission Below 1GHz



3.2. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks: E field strength (dB μ V/m) = 20 log E field strength (uV/m)

3.3. Test Procedure

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground, when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4:2014 on radiated measurement.

The resolution bandwidth below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz.

Radiated emission measurements below 1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB beamwidth of the antenna. The frequency range from 30MHz to 10th harmonics is checked.

3.4. Uncertainty

± 4.22 dB

3.5. Test Result of Radiated Emission

Product : M2M Router
 Test Item : General Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2017/10/31
 Test Mode : Mode 1: Normal Operation_Power adapter with Laird Core

Frequency MHz	Correct Factor dB	Reading Level dB μ V	Measurement Level dB μ V/m	Margin dB	Limit dB μ V/m
Horizontal					
151.500	-12.680	44.200	31.520	-11.980	43.500
210.200	-12.467	49.400	36.933	-6.567	43.500
296.060	-8.334	49.400	41.066	-4.934	46.000
305.000	-8.015	50.800	42.785	-3.215	46.000
402.800	-4.524	32.500	27.977	-18.023	46.000
580.000	-0.370	32.500	32.130	-13.870	46.000
750.000	2.163	29.100	31.263	-14.737	46.000
Vertical					
51.800	-16.661	50.000	33.340	-6.660	40.000
144.000	-12.292	46.000	33.708	-9.792	43.500
151.200	-12.668	50.000	37.332	-6.168	43.500
210.980	-12.460	52.100	39.640	-3.860	43.500
303.580	-8.069	42.900	34.832	-11.168	46.000
410.440	-4.356	30.600	26.244	-19.756	46.000
822.140	3.216	29.000	32.216	-13.784	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.
8. No emission found between lowest internal used/generated frequency to 30MHz.

Product : M2M Router
 Test Item : General Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2017/10/31
 Test Mode : Mode 2: Normal Operation_Power adapter with WRC Core

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dB μ V	dB μ V/m	dB	dB μ V/m
Horizontal					
151.200	-12.668	46.900	34.232	-9.268	43.500
210.410	-12.460	49.900	37.440	-6.060	43.500
295.740	-8.341	49.200	40.859	-5.141	46.000
304.760	-8.022	49.700	41.678	-4.322	46.000
580.000	-0.370	32.000	31.630	-14.370	46.000
750.000	2.163	29.200	31.363	-14.637	46.000
1000.000	5.300	28.000	33.300	-20.700	54.000
Vertical					
51.800	-16.661	51.600	34.940	-5.060	40.000
151.520	-12.681	52.300	39.619	-3.881	43.500
157.560	-12.900	50.000	37.100	-6.400	43.500
210.600	-12.460	55.300	42.840	-0.660	43.500
304.580	-8.028	42.600	34.572	-11.428	46.000
410.440	-4.356	31.400	27.044	-18.956	46.000
750.000	2.163	28.200	30.363	-15.637	46.000
822.140	3.216	28.600	31.816	-14.184	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.
8. No emission found between lowest internal used/generated frequency to 30MHz.