

Dust Networks

EMC TEST REPORT FOR

**802.15.4 Wireless Mesh Mote
Model: ETERNA2**

Tested to The Following Standard:

EN 301 489-17 v3.1.1

Report No.: 98876-14

Date of issue: January 4, 2017

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Dust Networks
32990 Alvarado-Niles Road, Suite 910
Union City, CA 94587

Representative: Gordon Charles
Customer Reference Number: 8783B

DATE OF EQUIPMENT RECEIPT:**DATE(S) OF TESTING:****REPORT PREPARED BY:**

Terri Rayle
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

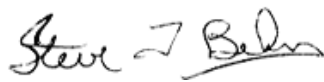
Project Number: 98876

December 12, 2016

December 12, 2016 and January 25, 2017

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

A handwritten signature in black ink that reads "Steve Behm".

Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
 CKC Laboratories, Inc.
 1120 Fulton Place
 Fremont, CA 94539

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.02
EMITest Immunity	5.03.02

Site Registration & Accreditation Information

Location	CB #	TAIWAN	CANADA	FCC	JAPAN
Fremont	US0082	SL2-IN-E-1148R	3082B-1	US1023	A-0149

SUMMARY OF RESULTS

Standard / Specification: EN 301 489-17 v3.1.1 / EN 301 489-1 v2.1.1

Test Procedure	Description	Modifications	Results
EN 301 489-17	Conducted Emissions	NA	Pass
EN 301 489-17	Telecom Conducted Emissions	NA	NP
EN 301 489-17	Radiated Emissions	NA	NP
EN 61000-3-2 (2014) ¹	Harmonic Emissions	NA	NP
EN 61000-3-3 (2013) ¹	Voltage Fluctuations and Flicker Emissions	NA	NP
EN 61000-4-2 (2009)	Electrostatic Discharge	NA	NP
EN 61000-4-3 (2006)+A1+A2	Radiated Immunity: 1 – 6GHz < 1GHz	NA NA	Pass NP
EN 61000-4-4 (2012)	Electrical Fast Transient Burst	NA	NP
EN 61000-4-5 (2006)	Surge	NA	NP
EN 61000-4-6 (2009)	Conducted Immunity	NA	NP
EN 61000-4-11 (2004)	Voltage Dips and Interrupts	NA	NP
ISO 7637-2 (2011)	Transients and Surges in the Vehicle Environment	NA	NP

NA= Not Applicable

NP = CKC Laboratories was not contracted to perform test.

¹The AC mains current harmonics and voltage flicker test requirements are derived from European Union CE mark directives.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
The accreditation symbol was removed from this report because EN 301 489-17 v3.1.1 is still in draft.
Only testing performed were those required to update the EUT from the standard version V2.2.1 to V3.1.1.

EQUIPMENT UNDER TEST

During testing numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote	Dust Networks	ETERNA 2	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Network Manager	Dust Networks	DLM6000-01EE	NA
AC/DC Adapter for Raspberry	None	GEO151UB-6025	NA
Raspberry Pi	PIMORONI	M1 3501-A0 C3	NA
PCB Kit	Dust Networks	DC9010	NA
Ethernet Switch	R.O.C	8816TPC	NN021134
AC/DC Adapter	Lenovo	45N0121	11S45NO121Z1ZHXU28G92M
Laptop	Lenovo	X61	C17329C
Power Supply	Tenma	72-6610	1002222

Configuration B

Equipment Tested:

Device	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote	Dust Networks	ETERNA 2	NA
Swivel Antenna	Nearson	S181XX-2450S	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Network Manager	Dust Networks	DLM6000-01EE	NA
AC/DC Adapter for Raspberry	None	GEO151UB-6025	NA
Raspberry Pi	PIMORONI	M1 3501-A0 C3	NA
PCB Kit	Dust Networks	DC9010	NA
Ethernet Switch	R.O.C	8816TPC	NN021134
AC/DC Adapter	Lenovo	45N0121	11S45NO121Z1ZHXU28G92M
Laptop	Lenovo	X61	C17329C
Power Supply	Tenma	72-6610	1002222

EN 301 489-17

Conducted Emissions

Test Notes: Conducted Disturbances at Mains Terminals, LISN method.

Test Setup / Conditions / Data

Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
 Customer: **Dust Networks**
 Specification: **EN 301 489-17 AC/DC Mains Input/Output - Average**
 Work Order #: **98876** Date: 12/12/2016
 Test Type: **Conducted Emissions** Time: 14:25:06
 Tested By: Hieu Song Nguyenpham Sequence#: 1
 Software: EMITest 5.03.02 3VDC

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Frequency Range: 150kHz to 30MHz

Temperature: 20.1°C

Humidity: 48 %

Atmospheric Pressure: 101.4kPa

Highest Generation Frequency: 2475MHz

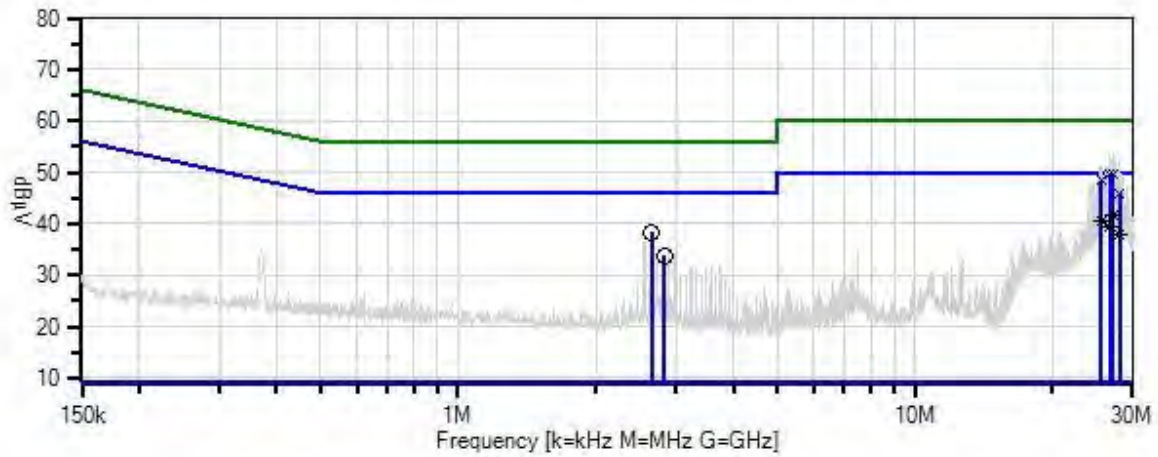
Method: EN 55032 2015

The EUT is set as intended. It is supported by DC9010 and powered up at 3VDC. The DC 9010 and a Network Manager are connected to a Raspberry Pi. The Raspberry Pi is connected to Ethernet Switch which is outside of the chamber through a RJ45 Cable.

The laptop is connected to Ethernet Switch in order to adjust and monitor the EUT.

TX Mode on Middle Channel

Dust Networks W/O#: 98876 Sequence#: 1 Date: 12/12/2016
 EN 301 489-17 AC/DC Mains Input/Output - Average Test Lead: 3VDC



- Sweep Data
- Readings
- Peak Readings
- × QP Readings
- * Average Readings
- ▼ Ambient
- Software Version: 5.03.02
- 1 - EN 301 489-17 AC/DC Mains Input/Output - Average
- 2 - EN 301 489-17 AC/DC Mains Input/Output - Quasi-peak

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	3/31/2015	3/31/2017
T2	ANP00880	Cable	RG214U	5/10/2016	5/10/2018
T3	ANP06691	Cable	PE3062-180	6/23/2016	6/23/2018
T4	AN02642	5uH LISN- Amplitude (dB)	9117-5-TS-50-N	1/26/2016	1/26/2018
	AN02642	5uH LISN-Place Holder	9117-5-TS-50-N	1/26/2016	1/26/2018
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
T5	ANP05258	High Pass Filter	HE9615-150K- 50-720B	9/15/2016	9/15/2018

Measurement Data:

Reading listed by margin.

Test Lead: Supply

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V	dB μ V	dB	Ant
1	2.654M	27.4	+9.8 +0.1	+0.1	+0.0	+0.9	+0.0	38.3	46.0	-7.7	Suppl
2	27.189M Ave	25.8	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	41.6	50.0	-8.4	Suppl
3	25.512M Ave	25.2	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	40.5	50.0	-9.5	Suppl
4	26.718M QP	34.0	+9.9 +0.2	+0.5	+0.2	+4.9	+0.0	49.7	60.0	-10.3	Suppl
5	27.189M QP	33.8	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	49.6	60.0	-10.4	Suppl
^	27.189M	38.1	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	53.9	50.0	+3.9	Suppl
7	26.718M Ave	23.6	+9.9 +0.2	+0.5	+0.2	+4.9	+0.0	39.3	50.0	-10.7	Suppl
^	26.718M	37.6	+9.9 +0.2	+0.5	+0.2	+4.9	+0.0	53.3	50.0	+3.3	Suppl
9	25.512M QP	33.1	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	48.4	60.0	-11.6	Suppl
^	25.512M	36.5	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	51.8	50.0	+1.8	Suppl
11	28.125M Ave	21.9	+9.9 +0.2	+0.5	+0.2	+5.2	+0.0	37.9	50.0	-12.1	Suppl
12	2.822M	22.8	+9.8 +0.1	+0.1	+0.0	+0.9	+0.0	33.7	46.0	-12.3	Suppl
13	28.125M QP	29.9	+9.9 +0.2	+0.5	+0.2	+5.2	+0.0	45.9	60.0	-14.1	Suppl
^	28.125M	35.4	+9.9 +0.2	+0.5	+0.2	+5.2	+0.0	51.4	50.0	+1.4	Suppl

Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
 Customer: **Dust Networks**
 Specification: **EN 301 489-17 AC/DC Mains Input/Output - Average**
 Work Order #: **98876** Date: 12/12/2016
 Test Type: **Conducted Emissions** Time: 14:40:41
 Tested By: Hieu Song Nguyenpham Sequence#: 2
 Software: EMITest 5.03.02 3VDC

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

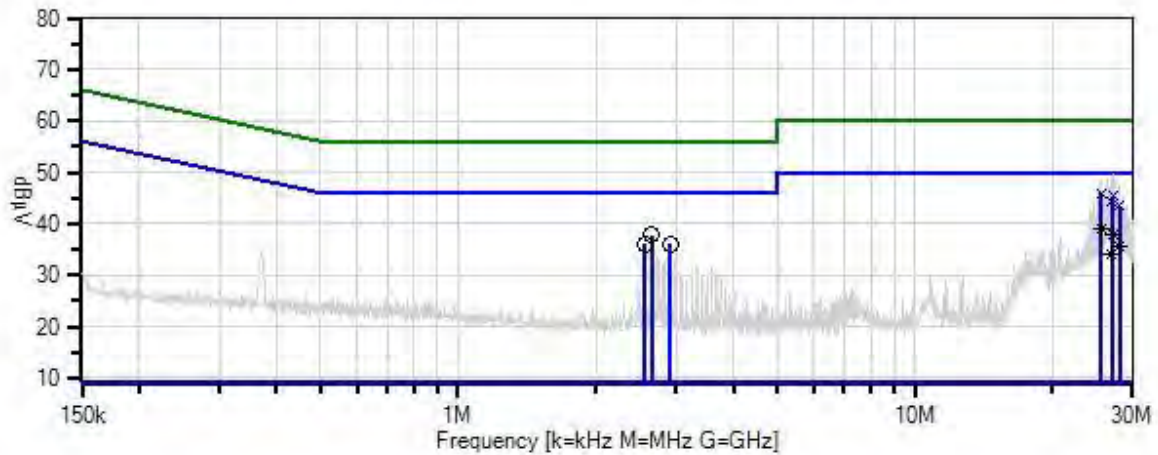
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

<p>Frequency Range: 150kHz to 30MHz</p> <p>Temperature: 20.1°C</p> <p>Humidity: 48 %</p> <p>Atmospheric Pressure: 101.4kPa</p> <p>Highest Generation Frequency: 2475MHz</p> <p>Method: EN 55032 2015</p> <p>The EUT is set as intended. It is supported by DC9010 and powered up at 3VDC. The DC 9010 and a Network Manager are connected to a Raspberry Pi. The Raspberry Pi is connected to Ethernet Switch which is outside of the chamber through a RJ45 Cable.</p> <p>The Laptop is connected to Ethernet Switch in order to adjust and monitor the EUT.</p> <p>TX Mode on Middle Channel</p>

Dust Networks W/O#: 98876 Sequence#: 2 Date: 12/12/2016
EN 301 489-17 AC/DC Mains Input/Output - Average Test Lead: 3VDC



- Sweep Data
- Readings
- Peak Readings
- × QP Readings
- * Average Readings
- ▼ Ambient
- Software Version: 5.03.02
- 1 - EN 301 489-17 AC/DC Mains Input/Output - Average
- 2 - EN 301 489-17 AC/DC Mains Input/Output - Quasi-peak

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	3/31/2015	3/31/2017
T2	ANP00880	Cable	RG214U	5/10/2016	5/10/2018
T3	ANP06691	Cable	PE3062-180	6/23/2016	6/23/2018
T4	AN02642	5uH LISN- Amplitude (dB)	9117-5-TS-50-N	1/26/2016	1/26/2018
	AN02642	5uH LISN-Place Holder	9117-5-TS-50-N	1/26/2016	1/26/2018
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
T5	ANP05258	High Pass Filter	HE9615-150K- 50-720B	9/15/2016	9/15/2018

Measurement Data:

Reading listed by margin.

Test Lead: Return

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV	dBμV	dB	Ant
1	2.651M	26.9	+9.8 +0.1	+0.1	+0.0	+0.9	+0.0	37.8	46.0	-8.2	Retur
2	2.566M	25.2	+9.8 +0.1	+0.1	+0.0	+0.9	+0.0	36.1	46.0	-9.9	Retur
3	2.910M	25.1	+9.8 +0.1	+0.2	+0.0	+0.9	+0.0	36.1	46.0	-9.9	Retur
4	25.511M Ave	23.6	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	38.9	50.0	-11.1	Retur
5	27.188M Ave	22.0	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	37.8	50.0	-12.2	Retur
6	25.511M QP	30.5	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	45.8	60.0	-14.2	Retur
^	25.511M	34.3	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	49.6	50.0	-0.4	Retur
8	28.124M Ave	19.7	+9.9 +0.2	+0.5	+0.2	+5.2	+0.0	35.7	50.0	-14.3	Retur
9	27.188M QP	29.6	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	45.4	60.0	-14.6	Retur
^	27.188M	34.5	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	50.3	50.0	+0.3	Retur
11	26.977M Ave	18.4	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	34.2	50.0	-15.8	Retur
12	26.977M QP	28.3	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	44.1	60.0	-15.9	Retur
^	26.977M	34.0	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	49.8	50.0	-0.2	Retur
14	28.124M QP	27.5	+9.9 +0.2	+0.5	+0.2	+5.2	+0.0	43.5	60.0	-16.5	Retur
^	28.124M	32.6	+9.9 +0.2	+0.5	+0.2	+5.2	+0.0	48.6	50.0	-1.4	Retur

Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
 Customer: **Dust Networks**
 Specification: **EN 301 489-17 AC/DC Mains Input/Output - Average**
 Work Order #: **98876** Date: 12/12/2016
 Test Type: **Conducted Emissions** Time: 15:05:37
 Tested By: Hieu Song Nguyenpham Sequence#: 4
 Software: EMITest 5.03.02 3VDC

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Frequency Range: 150kHz to 30MHz

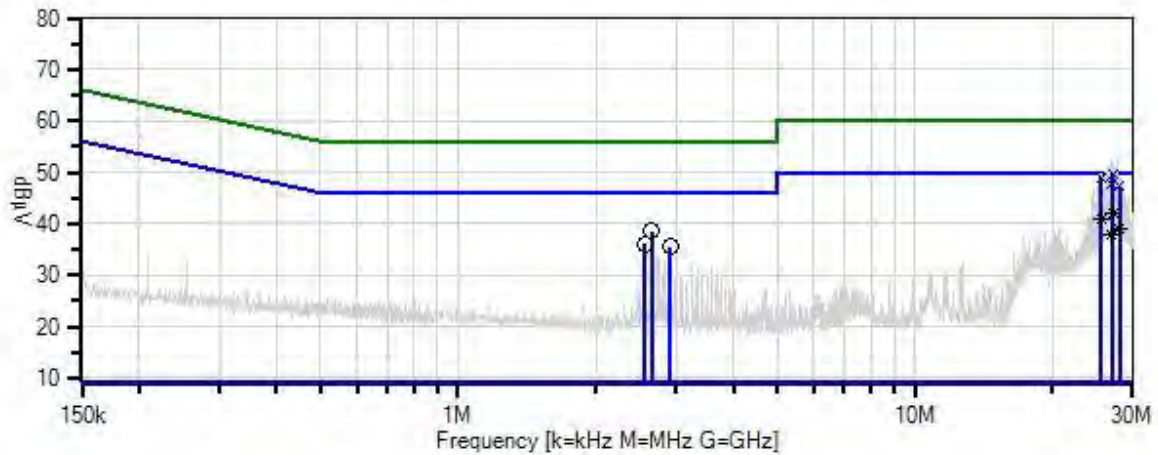
 Temperature: 20.1°C
 Humidity: 48 %
 Atmospheric Pressure: 101.4kPa

 Highest Generation Frequency: 2475MHz
 Method: EN 55032 2015

 The EUT is set as intended. It is supported by DC9010 and powered up at 3VDC. The DC 9010 and a Network Manager are connected to a Raspberry Pi. The Raspberry Pi is connected to Ethernet Switch which is outside of the chamber through a RJ45 Cable.
 The Laptop is connected to Ethernet Switch in order to adjust and monitor the EUT.

RX Mode on Middle Channel

Dust Networks W/O#: 98876 Sequence#: 4 Date: 12/12/2016
EN 301 489-17 AC/DC Mains Input/Output - Average Test Lead: 3VDC



- Sweep Data
- Readings
- Peak Readings
- × QP Readings
- * Average Readings
- ▼ Ambient
- Software Version: 5.03.02
- 1 - EN 301 489-17 AC/DC Mains Input/Output - Average
- 2 - EN 301 489-17 AC/DC Mains Input/Output - Quasi-peak

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	3/31/2015	3/31/2017
T2	ANP00880	Cable	RG214U	5/10/2016	5/10/2018
T3	ANP06691	Cable	PE3062-180	6/23/2016	6/23/2018
T4	AN02642	5uH LISN- Amplitude (dB)	9117-5-TS-50-N	1/26/2016	1/26/2018
	AN02642	5uH LISN-Place Holder	9117-5-TS-50-N	1/26/2016	1/26/2018
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
T5	ANP05258	High Pass Filter	HE9615-150K- 50-720B	9/15/2016	9/15/2018

Measurement Data:

Reading listed by margin.

Test Lead: Supply

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V	dB μ V	dB	Ant
1	2.655M	27.6	+9.8 +0.1	+0.1	+0.0	+0.9	+0.0	38.5	46.0	-7.5	Suppl
2	27.189M Ave	26.2	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	42.0	50.0	-8.0	Suppl
3	25.512M Ave	25.6	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	40.9	50.0	-9.1	Suppl
4	2.566M	25.2	+9.8 +0.1	+0.1	+0.0	+0.9	+0.0	36.1	46.0	-9.9	Suppl
5	27.189M QP	33.9	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	49.7	60.0	-10.3	Suppl
^	27.189M	37.9	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	53.7	50.0	+3.7	Suppl
7	2.910M	24.5	+9.8 +0.1	+0.2	+0.0	+0.9	+0.0	35.5	46.0	-10.5	Suppl
8	28.125M Ave	23.1	+9.9 +0.2	+0.5	+0.2	+5.2	+0.0	39.1	50.0	-10.9	Suppl
9	25.512M QP	33.6	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	48.9	60.0	-11.1	Suppl
^	25.512M	36.2	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	51.5	50.0	+1.5	Suppl
11	26.977M Ave	22.2	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	38.0	50.0	-12.0	Suppl
12	26.977M QP	32.0	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	47.8	60.0	-12.2	Suppl
^	26.977M	37.3	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	53.1	50.0	+3.1	Suppl
14	28.125M QP	31.2	+9.9 +0.2	+0.5	+0.2	+5.2	+0.0	47.2	60.0	-12.8	Suppl
^	28.125M	36.5	+9.9 +0.2	+0.5	+0.2	+5.2	+0.0	52.5	50.0	+2.5	Suppl

Test Location: CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170
 Customer: **Dust Networks**
 Specification: **EN 301 489-17 AC/DC Mains Input/Output - Average**
 Work Order #: **98876** Date: 12/12/2016
 Test Type: **Conducted Emissions** Time: 14:52:21
 Tested By: Hieu Song Nguyenpham Sequence#: 3
 Software: EMITest 5.03.02 3VDC

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

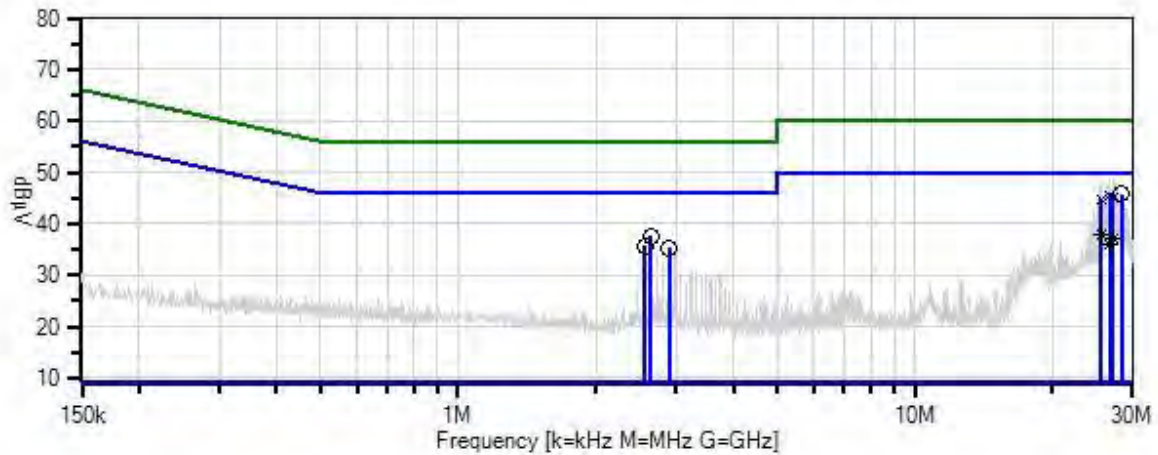
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Frequency Range: 150kHz to 30MHz
 Temperature: 20.1°C
 Humidity: 48 %
 Atmospheric Pressure: 101.4kPa
 Highest Generation Frequency: 2475MHz
 Method: EN 55032 2015
 The EUT is set as intended. It is supported by DC9010 and powered up at 3VDC. The DC 9010 and a Network Manager are connected to a Raspberry Pi. The Raspberry Pi is connected to Ethernet Switch which is outside of the chamber through a RJ45 Cable.
 The Laptop is connected to Ethernet Switch in order to adjust and monitor the EUT.
RX Mode on Middle Channel

Dust Networks W/O#: 98876 Sequence#: 3 Date: 12/12/2016
EN 301 489-17 AC/DC Mains Input/Output - Average Test Lead: 3VDC



- Sweep Data
- Readings
- Peak Readings
- × QP Readings
- * Average Readings
- ▼ Ambient
- Software Version: 5.03.02
- 1 - EN 301 489-17 AC/DC Mains Input/Output - Average
- 2 - EN 301 489-17 AC/DC Mains Input/Output - Quasi-peak

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	3/31/2015	3/31/2017
T2	ANP00880	Cable	RG214U	5/10/2016	5/10/2018
T3	ANP06691	Cable	PE3062-180	6/23/2016	6/23/2018
T4	AN02642	5uH LISN- Amplitude (dB)	9117-5-TS-50-N	1/26/2016	1/26/2018
	AN02642	5uH LISN-Place Holder	9117-5-TS-50-N	1/26/2016	1/26/2018
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
T5	ANP05258	High Pass Filter	HE9615-150K- 50-720B	9/15/2016	9/15/2018

Measurement Data:

Reading listed by margin.

Test Lead: Return

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	28.349M	29.6	+9.9 +0.2	+0.5	+0.2	+5.3	+0.0	45.7	50.0	-4.3	Retur
2	2.642M	26.6	+9.8 +0.1	+0.1	+0.0	+0.9	+0.0	37.5	46.0	-8.5	Retur
3	2.557M	24.7	+9.8 +0.1	+0.1	+0.0	+0.9	+0.0	35.6	46.0	-10.4	Retur
4	2.897M	24.4	+9.8 +0.1	+0.1	+0.0	+0.9	+0.0	35.3	46.0	-10.7	Retur
5	25.511M Ave	22.5	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	37.8	50.0	-12.2	Retur
6	27.188M Ave	21.3	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	37.1	50.0	-12.9	Retur
7	26.719M Ave	20.4	+9.9 +0.2	+0.5	+0.2	+4.9	+0.0	36.1	50.0	-13.9	Retur
8	26.719M QP	29.9	+9.9 +0.2	+0.5	+0.2	+4.9	+0.0	45.6	60.0	-14.4	Retur
^	26.719M	33.8	+9.9 +0.2	+0.5	+0.2	+4.9	+0.0	49.5	50.0	-0.5	Retur
10	27.188M QP	29.4	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	45.2	60.0	-14.8	Retur
^	27.188M	34.0	+9.9 +0.2	+0.5	+0.2	+5.0	+0.0	49.8	50.0	-0.2	Retur
12	25.511M QP	29.5	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	44.8	60.0	-15.2	Retur
^	25.511M	32.6	+9.9 +0.2	+0.4	+0.1	+4.7	+0.0	47.9	50.0	-2.1	Retur

Test Setup Photos



Immunity

Immunity Performance Criteria Definitions

Designation	Definition
Standard / Mfg.	Standard Requirement / Manufacturer's Declaration
A	<p>During test: Shall operate as intended. (see Note 1) Shall be no loss of function. Shall be no unintentional transmissions.</p> <p>After Test: Shall operate as intended. Shall be no degradation of performance (see Note 3). Shall be no loss of function. Shall be no loss of stored data or user programmable functions</p>
B	<p>During test: May show loss of function (one or more). May show degradation of performance. (see Note 2) Shall be no unintentional transmissions.</p> <p>After Test: Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see Note 3). Shall be no loss of stored data or user programmable functions.</p>
C	<p>During test: May be loss of function (one or more). After Test: Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no degradation of performance (see Note 3).</p>
CT	Continuous [phenomena applied to] Transmitters
CR	Continuous [phenomena applied to] Receivers
TT	Transient [phenomena applied to] Transmitters
TR	Transient [phenomena applied to] Receivers

NOTE 1: Operate as intended during the test allows a level of degradation not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 2: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 3: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

Immunity Setup and Monitoring

Equipment Setup:**Transmit Mode:**

The EUT is powered by a DC power supply. It is set up as intended and following procedure.

The EUT and Manager Network are connected to the Raspberry Pi.

The Raspberry Pi and the laptop which is outside of the chamber are connected to Ethernet Switch.

The Communication scheme is established, transmitting and receiving to/from a support Manager and laptop at a predetermined time interval minimum of 15 sec seconds.

Standby Mode:

The EUT is powered by a DC power supply. It is set up as intended and following procedure.

The EUT and Manager Network are connected to the Raspberry Pi.

The Raspberry Pi and the laptop which is outside of the chamber are connected to Ethernet Switch.

The EUT is place in the standby mode, command radio test on and waiting for a transmit command.

Degradation Criteria:

Transmit Mode: If the EUT has degradation, the communication will be lost upon query from the manager.

Standby Mode: If the EUT has degradation, Unintentional transmit will be observed from the monitor of spectrum analyzer.

Monitoring:

Transmit Mode: Visual inspection of ping status on the laptop

Standby Mode: Using a Spectrum Analyzer which is connected to a horn antenna to monitor the signal

Radiated Immunity

Test Notes: Immunity threat to simulate radiated electro-magnetic fields.

Test Setup/Conditions			
Test Location:	Fremont Lab C1	Test Engineer:	Hieu Song Nguyenpham
Test Method:	EN 61000-4-3	Test Date(s):	1/25/2017
Test Level:	1GHz to 6GHz, 3V/m @ 80% AM 1kHz, with exclusive band from 2280 MHz to 2607 MHz. < 1GHz: NP		
Declarations:	NP = CKC Laboratories was not contracted to test.		
Configuration:	B		

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
FC1 61000 4 3	Chamber Cal: EN61000-4-3	CKC	Chamber 1	01/18/16	01/18/18
02237	Generator, Function	BK Precision	4011	4/16/2015	4/16/2017
02547	RF Generator	HP	8673C	6/11/2015	6/11/2017
P05302	Directional Coupler	ATM	C223E-20	4/15/2015	4/15/2017
02691	RF Amplifier	Ophir	5162F	3/21/2016	3/21/2018
02157	Horn Antenna	EMCO	3115	NCR	NCR
01406	Spectrum Analyzer	HP	8564E	10/10/2016	10/10/2018
01461	Amplifier, TWT	Hughes	1277H02F000	6/1/2016	6/1/2018
02773	Directional Coupler	ATM	CH225H-35	1/26/2015	1/26/2017

NCR = No Calibration Required

Radiated Immunity Results		
Mode of operation:	Transmit Mode	
Surface Tested	Test Results	Test Observations
Front	No degradation	
Back	No degradation	
Left Side	No degradation	
Right Side	No degradation	

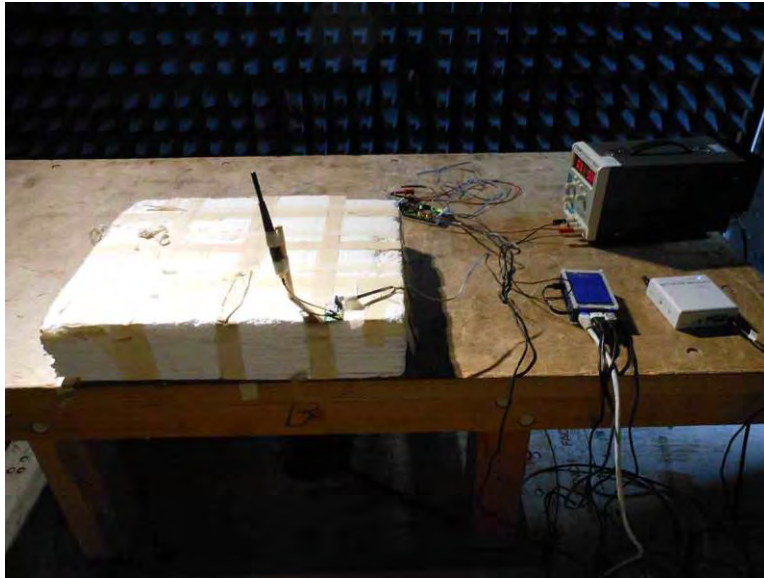
Radiated Immunity Results		
Mode of operation:	Standby	
Surface Tested	Test Results	Test Observations
Front	No degradation	
Back	No degradation	
Left Side	No degradation	
Right Side	No degradation	

Frequency Range	Test Distance (m)
1GHz to 6GHz	1.52

Radiated Immunity Test Summary		
Mode of operation: Transmit Mode		
Standard Minimum Performance Criteria:	CT/CR/A	
For this test, the EUT met performance criteria:	CT/CR/A	Result: Pass

Radiated Immunity Test Summary		
Mode of operation: Standby		
Standard Minimum Performance Criteria:	CT/CR/A	
For this test, the EUT met performance criteria:	CT/CR/A	Result: Pass

Test Setup Photos



SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in $\text{dB}\mu\text{V}/\text{m}$, the spectrum analyzer reading in $\text{dB}\mu\text{V}$ was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	($\text{dB}\mu\text{V}$)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	($\text{dB}\mu\text{V}/\text{m}$)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.

Immunity Test Details

Radiated Immunity Field Intensity at 0.4m

Chamber (80-1000)	1V/m Testing	3V/m Testing	10V/m Testing	20V/m Testing	30V/m Testing
Fremont C1	1.5	5.2	11.0	NA	NA
Fremont C2	1.9	2.7	7.1	16.2	NA
Mariposa	1.0	3.3	9.9	NA	NA
Brea	0.6	2.2	12.4	NA	NA
Bothell C1	1.7	3.1	9.0	17.0	25.4
Bothell C2	0.6	1.9	6.8	NA	NA

NA = Not applicable because these levels are not performed in this chamber.