

Dust Networks

TEST REPORT FOR

**802.15.4 Wireless Mesh Mote
Model: ETERNA2**

Tested To The Following Standards:

ETSI EN 301 489-17 V2.1.1

Report No.: 93692-13

Date of issue: October 29, 2012



This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of EMC testing for CKC Laboratories, Inc.

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
30695 Huntwood Avenue
Hayward, CA 94544

Representative: Gordon Charles
Customer Reference Number: X9074F

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

Dianne Dudley
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338


Project Number: 93692

October 10, 2012

October 10-19, 2012

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, reading "Steve Behm", is written over a horizontal line.

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.
110 Olinda Place
Brea, CA 92823

SUMMARY OF RESULTS

Standard / Specification: ETSI EN 301 489-17 V2.1.1 / ETSI EN 301 489-1 V1.9.2

Description	Test Procedure/Method	Results
Conducted Emissions	EN 301 489-17	Pass
Radiated Emissions	EN 301 489-17	NA
Harmonic Emissions	EN 61000-3-2 (2006) +A1	NA
Voltage Fluctuations and Flicker Emissions	EN 61000-3-3 (1995)	NA
Radiated Immunity	EN 61000-4-3 (2006)	Pass
Electrostatic Discharge	EN 61000-4-2 (2001)	Pass
Electrical Fast Transient Burst	EN 61000-4-4 (2004)	NA
Transients and Surges in the Vehicle Environment	ISO 7637-2 (2004)	NA
Conducted Immunity	EN 61000-4-6 (2005)	NA
Voltage Dips and Interrupts	EN 61000-4-11 (2004)	NA
Surge	EN 61000-4-5 (2006)	NA

NA = Not Applicable

Conditions During Testing

This list is a summary of the conditions noted for or modifications made to the equipment during testing.

Summary of Conditions
None

EQUIPMENT UNDER TEST

EQUIPMENT UNDER TEST

802.15.4 Wireless Mesh Mote

Manuf: Dust Networks

Model: ETERNA2

Serial: 0018e4

PERIPHERAL DEVICES

The EUT was tested with the following peripheral device(s):

Eterna Serial Programmer

Manuf: Dust Networks

Model: NA

Serial: NA

Laptop

Manuf: Lenovo

Model: X61

Serial: 7675CTO

ETSI EN 301 489-17 V2.1.1

This report contains EMC emissions and immunity test results under European Union (CE) requirements.

Conducted Emissions

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

Test Procedure: ETSI EN 301 489-1

Test Data Sheets

Test Location: CKC Laboratories, Inc. • 110 North Olinda Place • Brea, CA 92823 • 714-993-6112

Customer: **Dust Networks**

Specification: **EN 301 489-17 AC/DC Mains Input/Output - Average**

Work Order #: **93692**

Date: 10/10/2012

Test Type: **Conducted Emissions**

Time: 11:50:33

Equipment: **802.15.4 Wireless Mesh Mote**

Sequence#: 10

Manufacturer: Dust Networks

Tested By: E. Wong

Model: ETERNA2

230V 50Hz

S/N: 0018e4

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	2/12/2011	2/12/2013
T1	ANP01910	Cable	RG-142	2/6/2012	2/6/2014
T2	ANP06085	Attenuator	SA18N10W-09	12/8/2010	12/8/2012
T3	AN02343	High Pass Filter	HE9615-150K-50-720B	1/4/2011	1/4/2013
T4	AN02128	50uH LISN-L1 (dB)	3816/2NM	8/1/2011	8/1/2013
	AN02128	50uH LISN-L2 (dB)	3816/2NM	8/1/2011	8/1/2013

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote*	Dust Networks	ETERNA2	0018e4

Support Devices:

Function	Manufacturer	Model #	S/N
Eterna Serial Programmer	Dust Networks	NA	NA
Laptop	Lenovo	X61	7675CTO

Test Conditions / Notes:

The EUT seeking modular approval is placed on the test bench, the EUT is connected to a support laptop via a section of data cable and Serial Programmer. The Support laptop issues command to exercise the EUT, setting the EUT in continuous transmit mode.

Modulation: 802.15.4

Freq range: 2405-2475MHz

Freq: 2440MHz

Firmware power setting = 8dBm

Frequency range of measurement = 150kHz- 30MHz.

150 kHz-30 MHz; RBW=9 kHz, VBW=9kHz

Test environment conditions: 21°C, 52% Relative Humidity, 100kPa

Ext Attn: 0 dB

Measurement Data:

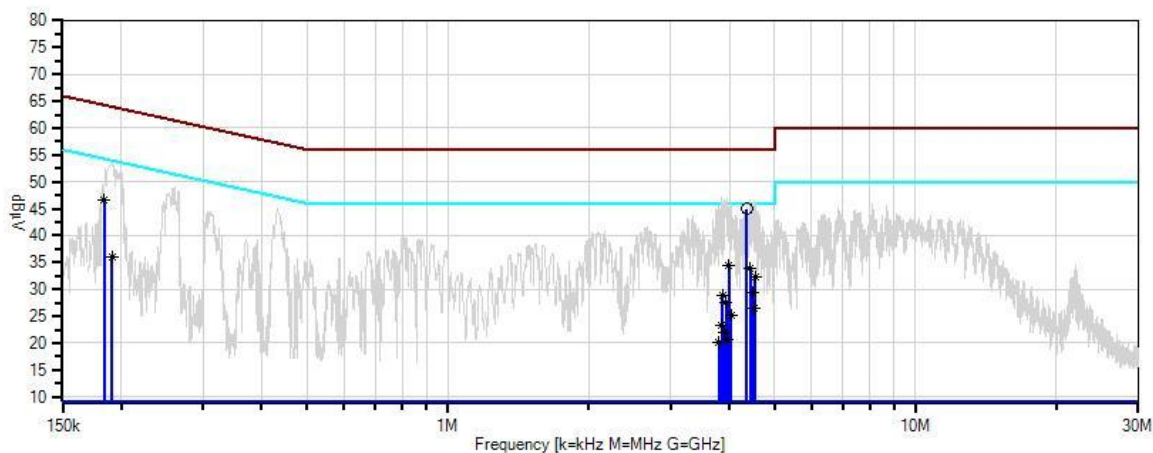
Reading listed by margin.

Test Lead: Black

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	4.364M	38.8	+0.2	+5.7	+0.2	+0.1	+0.0	45.0	46.0	-1.0	Black
2	184.447k Ave	40.5	+0.1	+5.7	+0.3	+0.0	+0.0	46.6	54.3	-7.7	Black
3	3.999M Ave	28.2	+0.2	+5.7	+0.2	+0.1	+0.0	34.4	46.0	-11.6	Black
^	3.999M	39.1	+0.2	+5.7	+0.2	+0.1	+0.0	45.3	46.0	-0.7	Black
5	4.428M Ave	27.6	+0.2	+5.7	+0.2	+0.1	+0.0	33.8	46.0	-12.2	Black
^	4.428M	40.5	+0.2	+5.7	+0.2	+0.1	+0.0	46.7	46.0	+0.7	Black
7	4.547M Ave	26.2	+0.2	+5.7	+0.2	+0.1	+0.0	32.4	46.0	-13.6	Black
^	4.547M	39.7	+0.2	+5.7	+0.2	+0.1	+0.0	45.9	46.0	-0.1	Black
9	4.484M Ave	23.3	+0.2	+5.7	+0.2	+0.1	+0.0	29.5	46.0	-16.5	Black
^	4.484M	39.9	+0.2	+5.7	+0.2	+0.1	+0.0	46.1	46.0	+0.1	Black
11	3.867M Ave	22.7	+0.2	+5.7	+0.2	+0.1	+0.0	28.9	46.0	-17.1	Black
^	3.867M	40.0	+0.2	+5.7	+0.2	+0.1	+0.0	46.2	46.0	+0.2	Black
13	191.450k Ave	30.1	+0.1	+5.7	+0.2	+0.0	+0.0	36.1	54.0	-17.9	Black
^	191.450k	47.5	+0.1	+5.7	+0.2	+0.0	+0.0	53.5	54.0	-0.5	Black
15	3.935M Ave	21.3	+0.2	+5.7	+0.2	+0.1	+0.0	27.5	46.0	-18.5	Black
^	3.935M	40.3	+0.2	+5.7	+0.2	+0.1	+0.0	46.5	46.0	+0.5	Black

17	4.526M	20.4	+0.2	+5.7	+0.2	+0.1	+0.0	26.6	46.0	-19.4	Black
Ave											
^	4.526M	40.5	+0.2	+5.7	+0.2	+0.1	+0.0	46.7	46.0	+0.7	Black
^	4.518M	40.0	+0.2	+5.7	+0.2	+0.1	+0.0	46.2	46.0	+0.2	Black
20	4.028M	18.9	+0.2	+5.7	+0.2	+0.1	+0.0	25.1	46.0	-20.9	Black
Ave											
^	4.028M	39.7	+0.2	+5.7	+0.2	+0.1	+0.0	45.9	46.0	-0.1	Black
22	3.850M	17.2	+0.2	+5.7	+0.2	+0.1	+0.0	23.4	46.0	-22.6	Black
Ave											
^	3.850M	41.0	+0.2	+5.7	+0.2	+0.1	+0.0	47.2	46.0	+1.2	Black
24	3.897M	15.8	+0.2	+5.7	+0.2	+0.1	+0.0	22.0	46.0	-24.0	Black
Ave											
^	3.897M	40.4	+0.2	+5.7	+0.2	+0.1	+0.0	46.6	46.0	+0.6	Black
26	3.956M	14.5	+0.2	+5.7	+0.2	+0.1	+0.0	20.7	46.0	-25.3	Black
Ave											
^	3.956M	40.6	+0.2	+5.7	+0.2	+0.1	+0.0	46.8	46.0	+0.8	Black
28	3.803M	13.8	+0.2	+5.7	+0.2	+0.1	+0.0	20.0	46.0	-26.0	Black
Ave											
^	3.803M	39.4	+0.2	+5.7	+0.2	+0.1	+0.0	45.6	46.0	-0.4	Black

Date: 10/10/2012 Time: 11:50:33 Dust Networks WO#: 93692
EN 301 489-17 AC/DC Mains Input/Output - Average Test Lead: Black 230V 50Hz Sequence#: 10 Ext ATTN: 0 dB



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

Test Location: CKC Laboratories, Inc. • 110 North Olinda Place • Brea, CA 92823 • 714-993-6112

Customer: **Dust Networks**
 Specification: **EN 301 489-17 AC/DC Mains Input/Output - Average**
 Work Order #: **93692** Date: 10/10/2012
 Test Type: **Conducted Emissions** Time: 11:58:11
 Equipment: **802.15.4 Wireless Mesh Mote** Sequence#: 11
 Manufacturer: Dust Networks Tested By: E. Wong
 Model: ETERNA2 230V 50Hz
 S/N: 0018e4

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	2/12/2011	2/12/2013
T1	ANP01910	Cable	RG-142	2/6/2012	2/6/2014
T2	ANP06085	Attenuator	SA18N10W-09	12/8/2010	12/8/2012
T3	AN02343	High Pass Filter	HE9615-150K-50-720B	1/4/2011	1/4/2013
	AN02128	50uH LISN-L1 (dB)	3816/2NM	8/1/2011	8/1/2013
T4	AN02128	50uH LISN-L2 (dB)	3816/2NM	8/1/2011	8/1/2013

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote*	Dust Networks	ETERNA2	0018e4

Support Devices:

Function	Manufacturer	Model #	S/N
Eterna Serial Programmer	Dust Networks	NA	NA
Laptop	Lenovo	X61	7675CTO

Test Conditions / Notes:

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Modulation: 802.15.4

Freq range: 2405-2475MHz

Freq: 2440MHz

Firmware power setting = 8dBm

Frequency range of measurement = 150kHz- 30MHz.

150 kHz-30 MHz; RBW=9 kHz, VBW=9kHz

Test environment conditions: 21°C, 52% Relative Humidity, 100kPa

Ext Attn: 0 dB

Measurement Data:

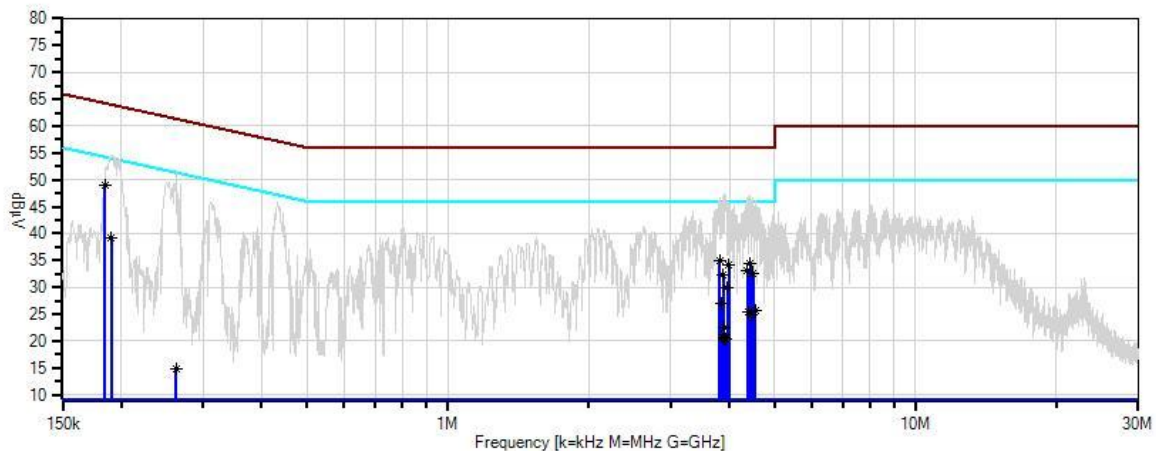
Reading listed by margin.

Test Lead: White

#	Freq MHz	Rdng dB μ V	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V	Spec dB μ V	Margin dB	Polar Ant
1	184.524k	42.8	+0.1	+5.7	+0.3	+0.0	+0.0	48.9	54.3	-5.4	White
Ave											
2	3.812M	28.6	+0.2	+5.7	+0.2	+0.2	+0.0	34.9	46.0	-11.1	White
Ave											
^	3.812M	40.5	+0.2	+5.7	+0.2	+0.2	+0.0	46.8	46.0	+0.8	White
4	4.428M	28.1	+0.2	+5.7	+0.2	+0.2	+0.0	34.4	46.0	-11.6	White
Ave											
^	4.428M	41.0	+0.2	+5.7	+0.2	+0.2	+0.0	47.3	46.0	+1.3	White
6	3.994M	27.9	+0.2	+5.7	+0.2	+0.2	+0.0	34.2	46.0	-11.8	White
Ave											
^	3.994M	39.7	+0.2	+5.7	+0.2	+0.2	+0.0	46.0	46.0	+0.0	White
8	4.369M	26.8	+0.2	+5.7	+0.2	+0.2	+0.0	33.1	46.0	-12.9	White
Ave											
^	4.369M	40.4	+0.2	+5.7	+0.2	+0.2	+0.0	46.7	46.0	+0.7	White
10	4.492M	26.2	+0.2	+5.7	+0.2	+0.2	+0.0	32.5	46.0	-13.5	White
Ave											
^	4.492M	40.3	+0.2	+5.7	+0.2	+0.2	+0.0	46.6	46.0	+0.6	White
12	3.880M	25.9	+0.2	+5.7	+0.2	+0.2	+0.0	32.2	46.0	-13.8	White
Ave											
^	3.880M	40.6	+0.2	+5.7	+0.2	+0.2	+0.0	46.9	46.0	+0.9	White
14	190.724k	33.1	+0.1	+5.7	+0.2	+0.0	+0.0	39.1	54.0	-14.9	White
Ave											
^	190.724k	48.7	+0.1	+5.7	+0.2	+0.0	+0.0	54.7	54.0	+0.7	White
16	3.960M	23.5	+0.2	+5.7	+0.2	+0.2	+0.0	29.8	46.0	-16.2	White
Ave											
^	3.960M	39.6	+0.2	+5.7	+0.2	+0.2	+0.0	45.9	46.0	-0.1	White
18	3.841M	20.8	+0.2	+5.7	+0.2	+0.2	+0.0	27.1	46.0	-18.9	White
Ave											
^	3.841M	39.7	+0.2	+5.7	+0.2	+0.2	+0.0	46.0	46.0	+0.0	White
20	4.547M	19.5	+0.2	+5.7	+0.2	+0.2	+0.0	25.8	46.0	-20.2	White
Ave											
^	4.547M	39.8	+0.2	+5.7	+0.2	+0.2	+0.0	46.1	46.0	+0.1	White

22	4.398M	19.0	+0.2	+5.7	+0.2	+0.2	+0.0	25.3	46.0	-20.7	White
Ave											
^	4.398M	40.6	+0.2	+5.7	+0.2	+0.2	+0.0	46.9	46.0	+0.9	White
24	4.467M	18.6	+0.2	+5.7	+0.2	+0.2	+0.0	24.9	46.0	-21.1	White
Ave											
^	4.467M	40.2	+0.2	+5.7	+0.2	+0.2	+0.0	46.5	46.0	+0.5	White
26	3.892M	16.3	+0.2	+5.7	+0.2	+0.2	+0.0	22.6	46.0	-23.4	White
Ave											
27	3.892M	14.8	+0.2	+5.7	+0.2	+0.2	+0.0	21.1	46.0	-24.9	White
Ave											
28	3.892M	14.4	+0.2	+5.7	+0.2	+0.2	+0.0	20.7	46.0	-25.3	White
Ave											
29	3.892M	14.2	+0.2	+5.7	+0.2	+0.2	+0.0	20.5	46.0	-25.5	White
Ave											
^	3.892M	41.1	+0.2	+5.7	+0.2	+0.2	+0.0	47.4	46.0	+1.4	White
31	3.918M	14.0	+0.2	+5.7	+0.2	+0.2	+0.0	20.3	46.0	-25.7	White
Ave											
^	3.918M	41.1	+0.2	+5.7	+0.2	+0.2	+0.0	47.4	46.0	+1.4	White
33	262.717k	8.7	+0.1	+5.7	+0.2	+0.0	+0.0	14.7	51.3	-36.6	White
Ave											
^	262.717k	45.6	+0.1	+5.7	+0.2	+0.0	+0.0	51.6	51.3	+0.3	White

Date: 10/10/2012 Time: 11:58:11 Dust Networks WO#: 93692
EN 301 489-17 AC/DC Mains Input/Output - Average Test Lead: White 230V 50Hz Sequence#: 11 Ext ATTN: 0 dB



- Sweep Data
- Readings
- Peak Readings
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- * Average Readings
- ▼ Ambient
- 1 - EN 301 489-17 AC/DC Mains Input/Output - Average
- 2 - EN 301 489-17 AC/DC Mains Input/Output - Quasi-peak

Test Setup Photos



Radiated Emissions

Test Notes: Radiated disturbances emanating from enclosure.

Test Engineer:	E. Wong	Test Procedure:	ETSI EN 301 489-1
Test Level:	NA		
Declarations: 8.2 Enclosure of ancillary equipment measured on a stand-alone basis. This test is only applicable to ancillary equipment not incorporated in the radio equipment and intended to be measured on a stand-alone basis, as declared by the manufacturer. This test shall be performed on a representative configuration of the ancillary equipment. This test is not applicable for ancillary equipment incorporated in the radio equipment, or for ancillary equipment intended to be measured in combination with the radio equipment. In these cases the requirements of the relevant product standard for the effective use of the radio spectrum shall apply. Product related conditions for combined testing of radio and ancillary equipment may be contained in the relevant part of EN 301 489 series [11] dealing with the particular type of radio equipment.			

Harmonic Emissions

Test Notes: Conducted disturbances of current harmonics emanating from equipment power supply to low-voltage public power networks.

Test Engineer:	E. Wong	Test Procedure:	EN 61000-3-2
Test Level:	NA		
Declarations: The manufacturer declares the EUT does not use AC Power.			

Voltage Fluctuation and Flicker Emissions

Test Notes: Conducted disturbances of voltage fluctuations and flicker emanating from equipment power supply to low-voltage public power networks.

Test Engineer:	E. Wong	Test Procedure:	EN 61000-3-3
Test Level:	NA		
Declarations: The manufacturer declares the EUT does not use AC Power.			

Immunity Performance Criteria Definitions

Designation	Definition
Standard / Mfg.	Standard Requirement / Manufacturer's Declaration
A	The EUT shall operate without degradation of performance during and after the application of disturbance.
B	After the disturbance is removed, normal operation of the EUT is self-recoverable.
C	After the disturbance is removed, normal operation of the EUT can be restored by the operator.
CT	Continuous [phenomena applied to] Transmitters
CR	Continuous [phenomena applied to] Receivers
TT	Transient [phenomena applied to] Transmitters
TR	TR=Transient [phenomena applied to] Receivers

Immunity Setup and Monitoring

Equipment Setup: Three modules, ETERNA1, ETERNA2 and ETERNA2 with integral antenna are place on the test bench. The communication scheme is established, transmitting and receive to/from a support Manager and laptop at a predetermined time interval minimum of 15 sec seconds.

Standby mode. Another set of ETERNA 1, ETERNA2 and ETERNA2 with integral antenna are place on the test bench and connected to dedicated transmit antenna. The EUTs are placed in standby mode, command: radio test on, waiting for a transmit command.

Degradation Criteria: TX-mode: Lost of communication upon query from the manager.

Standby model: Unintentional transmit as observed from the monitoring spectrum analyzer.

Monitoring: Transmit mode: Visual inspection of ping status on the support computer.

Stand-by mode: Spectrum analyzer with trace in Max hold tuned to 2.4 – 2.485 GHz. and a horn antenna connected to the spectrum analyzer.

Radiated Immunity

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

Test Engineer:	E. Wong	Test Procedure:	EN 61000-4-3
Test Level:	80MHz to 1GHz and 1.4-2.7GHz (except exclusion band, if applicable), 3V/m @ 80% AM 1kHz		
Declarations:			

Test Equipment					
Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
BC 61000 4 3	Chamber Cal	CKC	Brea	1/27/2011	1/27/2013
01370	BiLog Antenna	EMCO	3143	NCR	NCR
00627	Amplifier	C2630	50W1000A	1/6/2011	1/6/2013
01612	Directional Coupler	C223E-20	C2630	10/12/2011	10/12/2013
05301	Directional Coupler 1-4GHz	Agilent	C223E-20	7/27/2012	7/27/2014
02467	Spectrum Analyzer	Marconi	E7405A	4/5/2011	4/5/2013
02227	Signal Generator	AR	2024	7/6/2011	7/6/2013
00638	Field Probe	AR	FP2000	8/11/2011	8/11/2013
00636	Field Monitor	Andrew	FM2000	8/11/2011	8/11/2013
P04270	Cable	Andrew	Hardline	NCR	NCR
P04286	Cable	LM	Hardline	NCR	NCR
02710	Anechoic Chamber	C2630	NA	1/27/2011	1/27/2013
02551	Signal Generator	HP	8673M	4/27/2011	4/27/2013
02043	Field Probe	AR	FP2080	12/16/2011	12/16/2013
02688	Amplifier	Ophir	5161F	10/11/2012	10/11/2014
00849	Horn Antenna	EMCO	3115	4/13/2012	4/13/2014
00838	Function Generator	HP	33120A	2/23/2011	2/23/2013

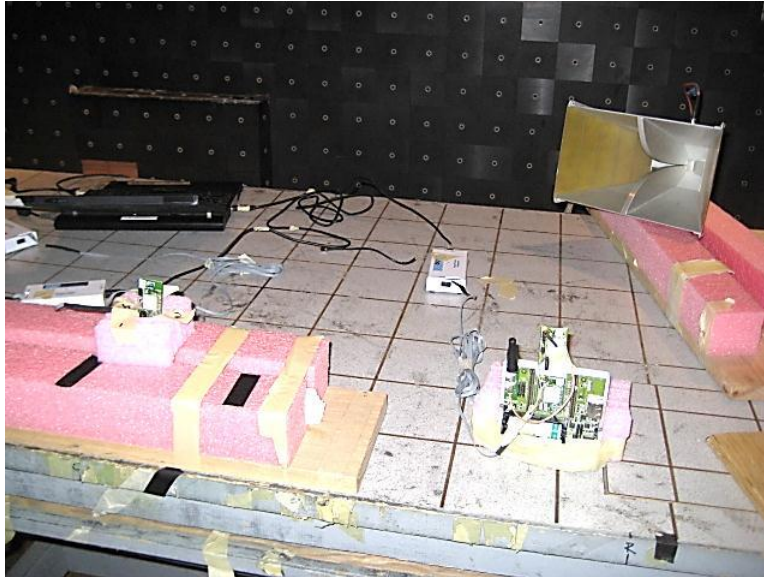
NCR = No Calibration Required.

Radiated Immunity Results		
Surface Tested	Test Results	Test Observations
Front	No degradation	
Back	No degradation	
Left Side	No degradation	
Right Side	No degradation	

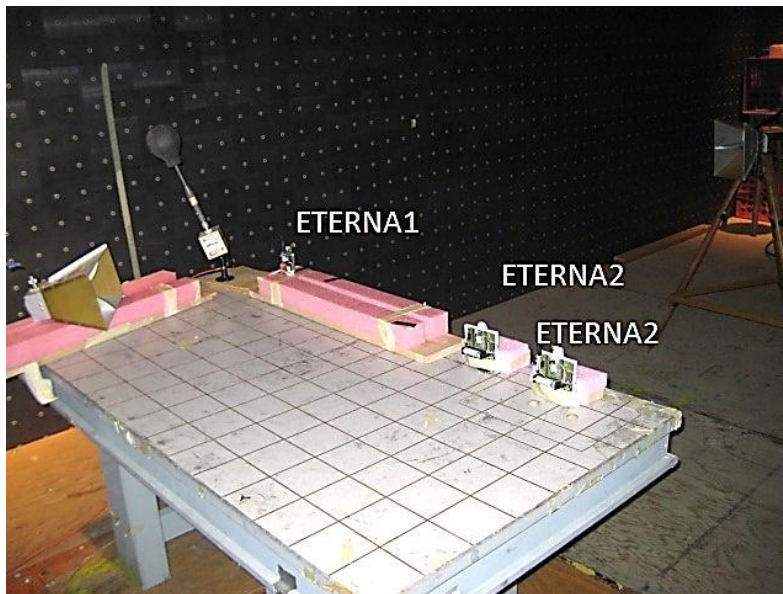
Test Distance: 80-1000 = 1.5 meters and 1.4-2.7 = 2.0 meters.

For this test, the EUT met performance criteria: CT/CR A

Test Setup Photos



STANDBY MODE



TRANSMITTING MODE

Electrostatic Discharge

Test Engineer:	E. Wong	Test Procedure:	EN 61000-4-2
Test Level:	Contact: 4kV Air: 2, 4 and 8kV		
Declarations:			

Temperature:	23.4	°C
Relative Humidity:	51	%
Atmospheric Pressure:	100.8	kPa

Test Equipment

Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
01650	ESD Simulator	KeyTek	MZ-15/ec	12/18/2010	12/18/2012

ESD Contact Discharge Results

Surface Tested	Test Results	Test Observations
Horizontal Coupling Plane	No degradation	
Vertical Coupling Plane	No degradation	
Front	NA	Non- conductive surfaces.
Back	NA	Non- conductive surfaces.
Left Side	NA	Non- conductive surfaces.
Right Side	NA	Non- conductive surfaces.
Top	NA	Non- conductive surfaces.
Bottom	NA	Non- conductive surfaces.

ESD Air Discharge Results

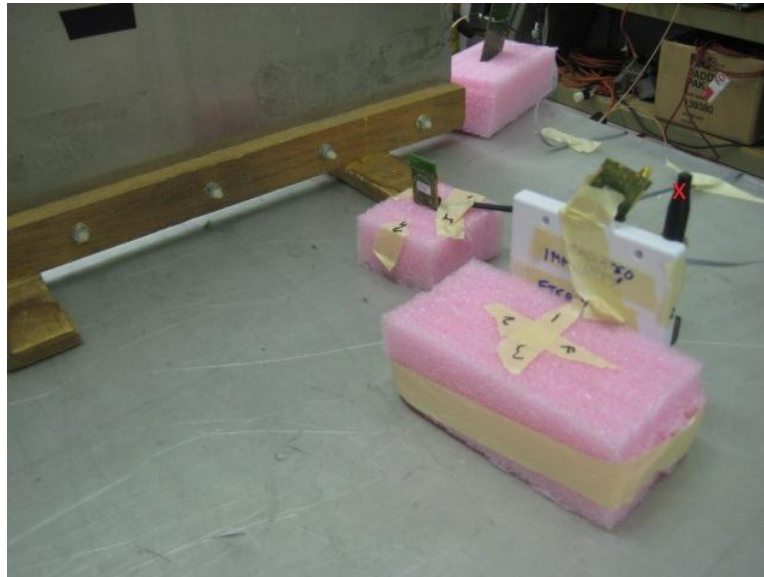
Surface Tested	Test Results	Test Observations
Front	No discharge	No discharge at the removable antenna.
Back	NA	The device is a module.
Left Side	NA	The device is a module.
Right Side	NA	The device is a module.
Top	NA	The device is a module.
Bottom	NA	The device is a module.

For this test, the EUT met performance criteria: TT/ TR A

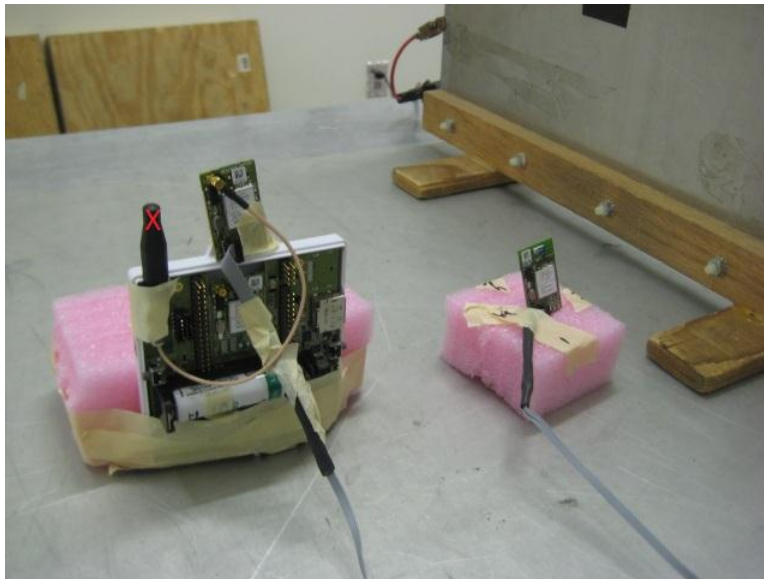
Test Setup Photos



STANDBY MODE



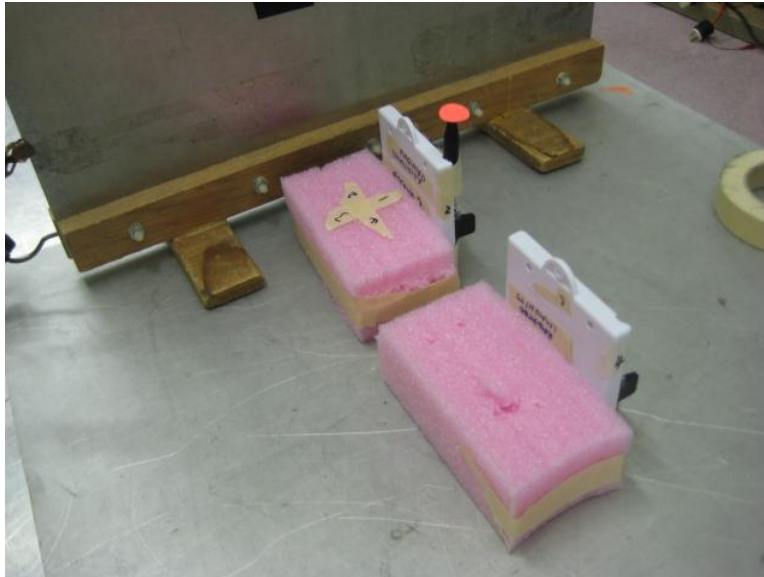
STANDBY MODE



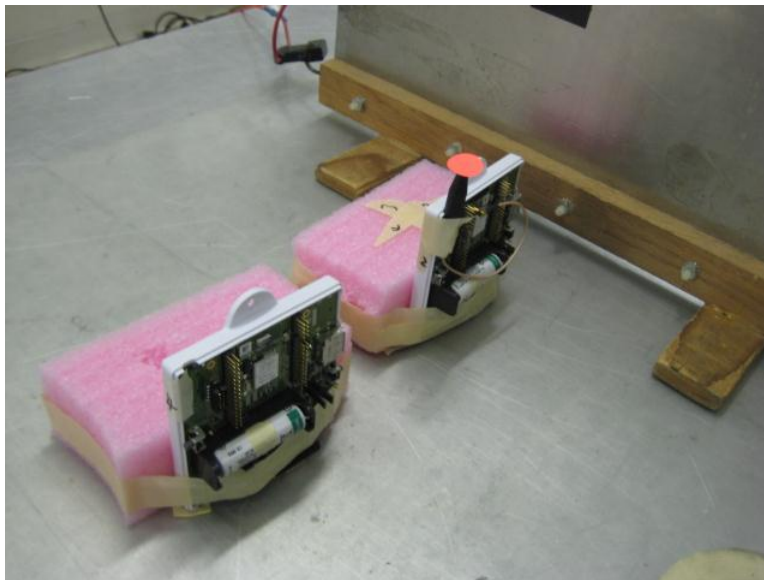
STANDBY MODE



TRANSMITTING MODE



TRANSMITTING MODE



TRANSMITTING MODE

Electrical Fast Transients / Bursts – AC/DC Mains Power Lines

Test Engineer:	E. Wong	Test Procedure:	EN 61000-4-4
Test Level:	AC Mains: NA DC Mains: NA		
Declarations: AC Mains: The manufacturer declares that the EUT is a module. DC Mains: The manufacturer declares that the EUT is a module.			

Electrical Fast Transients / Bursts - IO Lines

Test Engineer:	E. Wong	Test Procedure:	EN 61000-4-4
Test Level:	IO Lines: NA		
Declarations: IO Lines: The manufacturer declares that the EUT is a module.			

Transients and Surges in the Vehicle Environment – 12/24VDC Supply

Test Engineer:	E. Wong	Test Procedure:	ISO 7637-2 (2004)
Test Level:	NA		
Declarations: NA = Not Applicable because this test is only required for units that will be used in a vehicular environment.			

Conducted Immunity

Test Engineer:	E. Wong	Test Procedure:	EN 61000-4-6
Test Level:	AC Mains: NA DC Mains: NA IO Lines: NA		
Declarations: AC Mains: The manufacturer declares that the EUT is a module. DC Mains: The manufacturer declares that the EUT is a module. IO Lines: The manufacturer declares that the EUT is a module.			

Voltage Dips and Interrupts

Test Engineer:	E. Wong	Test Procedure:	EN 61000-4-11
Test Level:	NA		
Declarations:			
The manufacturer declares that the EUT is a module.			

Surge

Test Engineer:	E. Wong	Test Procedure:	EN 61000-4-5
Test Level:	AC Mains: NA DC Mains: NA		
Declarations: AC Mains: The manufacturer declares that the EUT is a module. DC Mains: The manufacturer declares that the EUT is a module.			

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

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

The reported measurement uncertainties are calculated based on the worst case of all laboratory environments from CKC Laboratories, Inc. test sites. Only those parameters which require estimation of measurement uncertainty are reported. The reported worst case measurement uncertainty is less than the maximum values derived in CISPR 16-4-2. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k=2$. Compliance is deemed to occur provided measurements are below the specified limits.

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 dB μ V/m, the spectrum analyzer reading in dB μ V was corrected by using the following formula. This reading was then compared to the applicable specification limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBμV)
+	Antenna Factor	(dB)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBμV/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 carrot ("^") 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

EN 61000-4-3 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	0.7	2.8	8.2	NA	NA
Fremont C2	0.6	2.5	9.1	10.3	NA
Mariposa	1.9	6.2	19.4	NA	NA
Brea	1.0	3.0	17.4	NA	NA
Bothell C1	0.7	3.1	10.4	22.3	31.2
Bothell C2	1.1	3.3	11.9	NA	NA

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