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TEST REPORT

ETSI EN 301 489-17
Electromagnetic compatibility and Radio spectrum Matters (ERM);
ElectroMagnetic Compatibility (EMC) standard for radio equipment;
Part 17: Specific conditions for Broadband Data Transmission Systems

Report Reference No. ..... :	10240453EEU1	
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Date of issue ..... :	14-Jun-13	
Report Revision ..... :	2	
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Applicant's name ..... :	Texas Instruments, Inc.	
Address..... :	12500 TI BLVD, Dallas, TX 75243	
Model(s) Tested..... :	GASSENSOREVM	
Test specification:		
Standards ..... :	ETSI EN 301 489-17, V2.1.1 (2009-05)	
Test procedure..... :	CCA	
Non-standard test method..... :	N/A	
TRF Revision..... :	15-Oct-12	

Revision History

#	Description	Date
0	Original Report Release	15-Apr-13
1	Changed model to GasSensorEVM	14-Jun-13
2	Changed model to GASSENSOREVM	14-Jun-13

Notices:

1. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
2. The test results presented in this report relate only to the object tested.
3. The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.
4. "(see Enclosure #)" refers to additional information appended to the report.
5. Throughout this report a point is used as the decimal separator.
6. Dimensions in English units for convenience only, metric units prevail.
7. It is the manufacturer's responsibility to provide special instructions, if needed, to the user regarding the use of special cables (length, shielded/unshielded, type, grounding, etc.), clamp-on ferrite beads, etc for use with their product(s).

Table of Contents

Normative References

The following document(s) have been appropriately considered in the performance of the test results detailed in this report.

ETSI EN 301 489-1, V1.8.1 (2008-04)
Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements

EN 55022:2006
Information technology equipment – Radio disturbance characteristics - Limits and methods of measurement

EN 61000-4-2: 2001
Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test

EN 61000-4-3:2006
Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test

EN 61000-4-4:2004
Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

EN 61000-4-5:2006
Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

EN 61000-4-6:2005
Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

EN 61000-4-11:2004
Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

ISO 7637-2:2004
Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only

EN 61000-3-2:2006 +A1:2009 +A2:2009
Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

EN 61000-3-3:1995
Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection

Equipment Under Test (EUT)

Details:

Test item description:

Model	GASSENSOREVM
Serial Number	None
Dimensions	4x4x4 cm (width x height x depth)
Production Status	☒ Production ☐ Pre-Production ☐ Prototype
Other Status Info	Consists of SAT0009 & SAT0010
EUT Received Date	8-Apr-13
Ratings	3VDC ☐ 1ϕ ☐ 3ϕ
Equipment Type	☒ I - Data ☐ II - Audio ☐ III - Other
Intended Use	☒ Fixed ☐ Mobile ☐ Portable
Frequency Range(s)	2.402 – 2.478 GHz
Modulation(s)	1000kbps, GFSK 250kHz deviation
Operating Temperature Range (°C)	10-40°C
Operating Relative Humidity (%)	10-90%
IF Bandwidth (before demodulator)	None

General product description:

TI Gas Sensor Demo Platform with BLE

Modifications to the EUT required for compliance:

There have been no modifications to the EUT as a result of this evaluation.

Deviations from Test Methodology:

There have been no deviations, additions to, or exclusions from the specified test standard.

Engineering Judgements:
No engineering judgments based on the results in this test report have been made. Approved by (+ signature) ..... : Click here to enter text.

Table 1 – EUT Internal Operating Frequencies

Frequency (MHz)	Description	Frequency (MHz)	Description
2402-2478MHz	Transmit		

Operating mode descriptions, where applicable, include the method used to verify that a communication link has been established and maintained.

Table 2 – EUT Operating Modes

Mode #	Description
1	Powered on
2	
3	

EUT Configuration

The equipment was tested under normal test conditions according to the information accompanying the equipment, and was within the manufacturers declared range of humidity, temperature and supply voltage. The test configuration and mode of operation was representative of the intended use.

The transmitter was operated at maximum rated RF output power and modulated with normal test modulation as specified for that type of equipment. Where transmitters do not have a modulation input port, the internal equipment modulation was used. If an external signal source was used, it was located outside the test environment.

The signal source providing the receiver under test with the wanted RF input signal was located outside the test environment. For receivers with an integral antenna, the wanted RF input signal to establish a communication link was presented to the EUT from an antenna located within the test environment. For receivers with a removable antenna, the wanted RF input signal to establish a communication link was presented to the antenna connector of the EUT by a coaxial cable. The level of the wanted RF input signal was set to a value at least 30 dB above the Maximum Usable Sensitivity (MUS). The receiver output was appropriately monitored.

For radio equipment that was integrated into a host system, the host system is clearly identified in this report.

Classification of SRD Equipment

Hand portable equipment, or combinations of equipment, declared as capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as vehicular mobile equipment.

Hand portable or mobile equipment, or combinations of equipment, declared as capable of being powered for intended use by ac mains shall additionally be considered as fixed station equipment.

Figure 1 - EUT Configuration Diagram

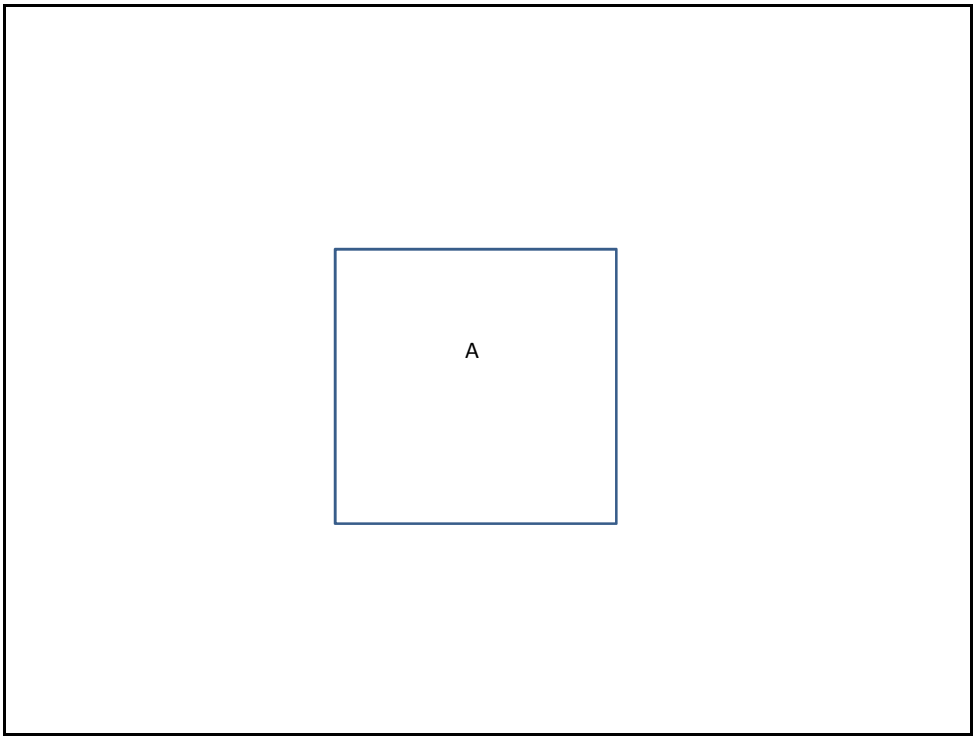


Table 3 – EUT & Auxilliary Equipment List

Item	Use*	Product Type	Manufacturer	Model	Serial No.
A	EUT	TI Gas Sensor	TI	GASSENSOREVM	None

Note:
* Use = EUT - Equipment Under Test,
AE - Auxiliary/Associated Equipment, or
SIM - Simulator (Not Subjected to Test)

A complete list of all the ports, with the maximum allowed cable lengths must be included in the table below. Each must be classified as telecommunication, signal, or control.

Table 4 - Interconnecting Cables List

Item	Use*	Cable Type
1		
2		

General Performance Criteria

If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the EUT if used as intended.

The primary functions of the radio equipment that is to be assessed during and after the exposure to the immunity tests has been provided by the manufacturer, as included below, and includes the intended functions of the radio equipment in accordance with the documentation that accompanies the equipment. The user control functions and stored data that are required for normal operation have been provided by the manufacturer; and the method to assess whether these have been lost after the immunity tests is detailed below or in the user instructions.

Performance Criteria A

Criteria “A” applies to immunity tests of a continuous nature as it is employed for transmitters (CT) and receivers (CR).

During and after the testing, the EUT shall operate as intended. There may be degradation of performance during testing, which 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, but shall have no degradation when testing is completed.

Also during the testing, there shall be no loss of function and no unintentional radio transmissions. After the test, there shall be no change of actual operating data, user programmable functions, or user retrievable data along with no loss of function.

Manufacturer Specific Criteria:
No specific criteria provided by the manufacturer. Laboratory made best effort judgment.

Performance Criteria B

Criteria “B” applies to immunity tests of a transient nature as it is employed for transmitters (TT) and receivers (TR).

During the testing, the EUT may show a loss of one or more functions, but shall be self-recoverable with no operator intervention. There may be degradation of performance during testing, which 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, but shall have no degradation when testing is completed.

Also during the testing, there shall be no unintentional radio transmissions. After the test, there shall be no change of actual operating data, user programmable functions, or user retrievable data is allowed.

Manufacturer Specific Criteria:
No specific criteria provided by the manufacturer. Laboratory made best effort judgment.

Performance Criteria C

Criteria “C” applies to immunity tests with mains power interruptions exceeding a certain time.

During the testing, the EUT may show a loss of one or more functions, but shall be recoverable by the operator when testing is completed and shall operate as intended.

There may be no degradation of performance testing is completed, which 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. After the test, there shall be no change of actual operating data, user programmable functions, or user retrievable data is allowed.

Manufacturer Specific Criteria:
No specific criteria provided by the manufacturer. Laboratory made best effort judgment.

EUT Photo(s)

Photo 1	**EUT Photo – Front/Top View**	

Supplemental Information:

Summary of Testing

Possible test case verdicts:

- test case does not apply to the test object : N/A
- test object does meet the requirement .....: P (Pass)
- test object does not meet the requirement : F (Fail)
- not tested (not part of this evaluation) .....: NT

Date(s) of performance of tests .....: 8-April-2013

Emissions Class.....: ☐ A ☒ B (requirement)

Clause[1]	Test Description	Verdict	Comment
8.2	Radiated Emissions – Below 1 GHz	P	
	Radiated Emissions – Above 1 GHz	P	
8.3	Conducted Emissions – DC in/output ports	N/A	No DC Ports
8.4	Conducted Emissions – AC Mains (in/output ports)	N/A	Note 1
8.5	EN 61000-3-2 Harmonics (AC mains input port)	N/A	Note 1
8.6	EN 61000-3-3 Flicker (AC mains input port)	N/A	Note 1
8.7	Conducted Emissions – Telecommunication Ports	N/A	No Telecom ports
9.2	Radiated Disturbances	P	
9.3	Electrostatic Discharge (ESD)	P	
9.4	Electrical Fast Tansients (EFT)	N/A	Note 1
9.5	Conducted Disturbances	N/A	Note 1
9.7	Voltage Dips and Interruptions	N/A	Note 1
9.8	Surges – AC input ports (fixed use only)	N/A	Note 1
	Surges – Telecommunication Ports (fixed use only)	N/A	No telecom ports
Vehicular Use (mobile)			
B.2.1	Broadband Emissions	N/A	Not mobile equipment
B.2.2	Narrow-Band Emissions	N/A	Not mobile equipment
B.2.3	ISO 7637-2 clause 4.4 – Transients	N/A	Not mobile equipment
B.2.4	ISO 7637-2 clause 4.3 – Conducted Emissions	N/A	Not mobile equipment
8.3	Conducted Emissions – DC input (vehicle only)	N/A	No DC Ports
9.6	Surges (vehicle only)	N/A	Not mobile equipment

1. Clauses listed are from EN 301 489-1 as modified by EN 301 489-17.

Notes:

General remarks:

Summary of compliance with national requirements:
Compliance with this standard provides one means of conformity with the specified essential requirements of EU Directive 2004/108/EC.

Testing Location	
Testing Laboratory:	Nemko USA, Inc. (Dallas)
Testing location/ address ..... :	802 N. Kealy Ave. Lewisville, TX 75057 USA
Testing procedure: TMP	
Tested by (name + signature) :	
Approved by (+ signature) :	
Testing location/ address ..... :	

Supplemental Information:
Testing results contained herein were performed at the location(s) listed above.

General Test Requirements

The frequencies of operation of the EUT were excluded from the conducted and radiated emissions and immunity tests of the transmitters. No frequency band was excluded from the receiver or ancillary equipment tests.

Table 5 – Types of equipment

Equipment Type	Technical nature of the primary function
I	Transfer of messages (digital or analog signals) – modulated with test signal representing a practical selection of usable messages/commands.
II	Transfer of audio (speech or music) – modulated with 1 kHz sinusoidal tone at 60% of peak system modulation.
III	Others - modulated with 1 kHz sinusoidal tone at 60% of peak system modulation.

Emissions Requirements

Tested according to EN 55022.

Radiated Emissions

The arrangement of the equipment is typical of a normal installation practice and as was practical, the arrangement was varied and emissions investigated for maximum amplitude. Final measurements were performed in a semi-anechoic chamber or on an open area test site (OATS). The equipment was rotated 360° and the antenna height has been varied between 1m and 4m. Measurements were taken at both horizontal and vertical antenna polarities. The receiver bandwidth was set to 120 kHz for measurements below 1 GHz, and 1 MHz for measurements above 1 GHz. A peak detector is used to detect an emission; a quasi-peak detector may be used to record a final measurement below 1 GHz and an average detector may be used above 1 GHz. An inverse proportionality factor of 20 dB/decade (10 dB) was used, as noted in EN 55022, clause 10.3.1, to normalize the measured data to the specified test distance for determining compliance.

30 MHz to 1 GHz

Reading on the measuring receiver showing fluctuations close to the limit, were observed for at least 15 s at each measurement frequency; the highest reading was recorded.

Table 6 – Radiated Emissions Limits (30 MHz to 1 GHz)

Frequency Range	3m		10m	
	Class A (dBµV/m)	Class B (dBµV/m)	Class A (dBµV/m)	Class B (dBµV/m)
	Quasi-Peak	Quasi-Peak	Quasi-Peak	Quasi-Peak
30 MHz – 230 MHz	50	40	40	30
230 MHz – 1 GHz	57	47	47	37

Note: The lower limit applies at the transition frequency.
Note: Ancillary equipment intended to be used in telecommunications centers only can apply the Class A limits, all other equipment must be Class B.

Above 1 GHz

There are no emission limits for frequencies greater than 6 GHz. Emissions measurements above 1 GHz is not required by EN 301 489-17 but has been included for clarity with other standards.

Table 7 – Highest Measurement Frequency

Highest EUT Clock	Highest Measurement
< 108 MHz	1 GHz
108 MHz – 500 MHz	2 GHz
MHz – 1 GHz	5 GHz
> 1 GHz	6 GHz[1]
[1] Five times the highest clock frequency, or 6 GHz, whichever is less.	

Table 8 - Radiated Emissions Limits @ 3m (1 GHz – 6 GHz)

Frequency Range	Class A (dBµV/m)		Class B (dBµV/m)	
	Average	Peak	Average	Peak
1 GHz – 3 GHz	56	76	50	70
3 GHz – 6 GHz	60	80	54	74
Note: The lower limit applies at the transition frequency. Note: Ancillary equipment intended to be used in telecommunications centers only can apply the Class A limits, all other equipment must be Class B.				

Conducted Emissions

The mains cable of the EUT or EUT host unit was connected to the LISN defined in this standard and is bonded to the reference plane. Where applicable, remaining auxiliary equipment was powered through an additional LISN (also bonded to the reference plane), using a multi-socket outlet strip if necessary. The LISNs were at least 0.8m away from the EUT. A vertical ground plane was used while the table-top EUTs were placed on a wooden table 0.8m high. Floor-standing EUTs were insulated from the ground plane and grounded according to the manufacturer's instructions.

Signal cables were positioned for their entire lengths, as far as possible, at a nominal distance of 0.4 m from the ground reference plane. Where the mains cable supplied by the manufacturer was longer than 1 m, the excess was folded at the centre into a bundle no longer than 0.4 m, so that its length is shortened to 1 m. If the 1 m cable length cannot be achieved owing to physical limitations of the EUT arrangement, the cable length shall be as near to 1 m as possible.

All telecommunication and signal ports were correctly terminated using either appropriate associated equipment or a representative termination during the measurement of the conducted disturbances at the mains. If an ISN is connected to a telecommunications port during the measurement of conducted disturbances at the mains port, then the ISN receiver port was terminated in 50Ω. The ISNs were at least 0.8m away from the EUT.

Table 9 – Class A Conducted Emissions Limits

Frequency	Limits (dBµV)	
	Quasi-peak	Average
150 kHz – 500 kHz	79	66
500 kHz – 30 MHz	73	60
NOTE: The lower limit shall apply at the transition frequency. NOTE: Ancillary equipment intended to be used in telecommunications centers only can apply the Class A limits, all other equipment is to be Class B.		

Table 10 – Class B Conducted Emissions Limits

Frequency	Limits (dBµV)	
	Quasi-peak	Average
150 kHz – 500 kHz	66 - 56	56-46
500 kHz – 5 MHz	56	46
5 MHz – 30 MHz	60	50
NOTE 1: The lower limit shall apply at the transition frequency. NOTE 2: The limit decreases linearly with the logarithm of the frequency in the range 150 kHz to 500 kHz.		

AC input/output ports

Testing was performed to EN 55022.

Power cable(s) of equipment for fixed use (e.g. base stations) from the equipment under test that were directly connected to the AC Mains have been tested. For emission measurements on AC output ports of the EUT, the port was connected via an LISN to a load drawing the rated current of the source.

DC input/output ports

Testing was performed to EN 55022.

Applicable to DC cable lengths greater than or equal to 3m for fixed use equipment and for vehicular use, regardless of cable length. If the DC power cable of the radio and/or the ancillary equipment was less than or equal to 3 m in length, and intended for direct connection to a dedicated AC/DC power supply, then the measurement was performed on the AC power input port of that power supply. If the DC power cable between the mobile radio and/or ancillary equipment and the dedicated DC/DC power converter is less than or equal to 3 m in length, then the measurement can be limited to the DC power input port of that power converter only. If this DC power cable is longer than 3 m, then the measurement shall additionally be performed on the DC power port of the mobile radio and/or ancillary equipment.

Harmonics

Testing was performed to EN 61000-3-2.

This standard deals with the limitation of harmonic currents injected into the public supply system. The equipment classes used to classify equipment for harmonics measurement are not related to the classes used for emissions. Equipment not specified in any of the other classes is considered to be Class A. Portable tools or arc welding equipment which is not professional equipment, are Class B. Lighting equipment is Class C. Personal computers & monitors, and television receivers are Class D equipment.

Flicker

Testing was performed to EN 61000-3-3.

This standard is concerned with the limitation of voltage fluctuations and flicker impressed on the public low-voltage system. It specifies limits of voltage changes which may be produced. Equipment which does not comply with the limits of this standard, when tested with the reference impedance, Z_{ref}, and which therefore cannot be declared compliant with this part, may be retested or evaluated to show conformity with EN 61000-3-11, which is applicable to equipment with rated input current ≤75 A per phase and subject to conditional connection.

Voltage Transient Emissions Test

Testing was performed to ISO 7637-2.

All wiring connections between the 5 µHLISN, switch, shunt resistor, and the EUT were placed 50 – 60 mm (2 to 2-3/8 in) above the ground reference plane (GRP), which is identical to that described for ESD. The setup of ISO 7637-2 figure 1(a) was used to measure slow pulses (msec range or slower) and the setup of figure 1(b) was used to measure fast pulses (nsec to µsec range).The measured emission voltage was measured as close to the EUT as was possible using a 100:1 voltage probe and a 400 MHz minimum bandwidth oscilloscope.

Immunity Requirements

Electrostatic Discharge (ESD)

Testing was performed according to EN 61000-4-2.

The ground reference plane (GRP) consists of two sheets of galvanized steel that meet the minimum thickness requirements of 0.65 mm (0.0256 inches or 23 gauge) bonded together at the seam and bonded to the protective earth of the building. The overall dimensions of the GRP are 2.4m x 2.4m (8 ft x 8 ft) and the EUT was placed on the GRP with a minimum of 0.1m of the GRP protruding beyond the EUT. The EUT has been placed a minimum of 0.8m (31.6 inches) from the walls of the laboratory or any other metallic surface.

The discharge return cable of the ESD generator was connected to the GRP and was at least 0.2m (7.9 inches) away from other conductive parts of the test setup (except the GRP). The vertical coupling plane (VCP) is a 0,5m square (19.7 inches) metallic plate bonded to the GRP with the same type of cable as the HCP and is always postioned 0.1m (4 inches) from the EUT.

For table-top equipment, the horizontal coupling plane (HCP), made of the same material as the GRP, is 1.6m x 0.8m (63.2 inches x 31.6 inches) ±0.02m (0.8 inches) and is placed on a table that is 0.8m (31.6 inches) above the GRP. For desktop equipment, the EUT and its cables were isolated from the HCP by an insulator of 0.5 mm (0.002 inches) ± 0.05 mm (0.0002 inches) thickness. The EUT was placed on the HCP with a minimum of 0.1m (4 inches) protruding on all sides of the EUT. The HCP is bonded to the GRP through a cable with a 470 kΩ resistor located at each end. For floor-standing equipment, the EUT is isolated from the GRP by an insulator that is 0.05m to 0.15m (2 inches to 6 inches) in thickness as appropriate for the EUT.

Electrostatic discharges were applied only to those points and surfaces of the EUT which are expected to be touched during usual operation, including user access as specified by the manufacturer. Contact Discharges were applied to conductive surfaces, including those on the EUT, Horizontal Coupling Plane (HCP), and Vertical Coupling Plane (VCP). Air discharges were applied to those points where a contact discharge was not possible.

The EUT was exposed to at least 200 discharges, 100 each at negative and positive polarity, at a minimum of four test points, as detailed in the attached data. For table-top equipment one of the test points was the center front edge of the horizontal coupling plane, which was subjected to at least 50 indirect discharges (25 of each polarity). All other test points shall each receive at least 50 direct contact discharges (25 of each polarity). All areas normally touched by the user were tested. If no direct contact test points were available, then at least 200 indirect discharges were applied in the indirect mode using the coupling planes. For ungrounded equipment, the time interval between successive discharges was extended to allow natural decay of the charge from the EUT.

Table 11 – ESD Levels

Port	Contact	Air	Minimum Performance Criteria
Enclosure	±4 kV	±8 kV	B

Electrical Fast Transients (EFT)

Testing was performed according to EN 61000-4-4.

The ground reference plane (GRP) is identical to that described for ESD. Regardless of whether the EUT is table-top, floor-standing, or any other configuration, it is placed on a 0.1m ± 0.01m (4 inches ± 0.4 inches)

insulated support over the GRP. All cables associated with the EUT are placed on the same insulating support. If the EUT contains several ports with the same type of interface, only one cable was tested. Decoupling networks were utilized to protect auxiliary equipment, where applicable.

Cables with a length greater than 3m or that can be greater than 3m (e.g. Ethernet, phone) were tested. Multi-conductor signal cables were tested as a single cable. The cable length between coupling device and EUT was as short as possible with the length being no less than 0.5m (19.7 inches) and no more than 3m (118.4 inches). All cables were placed on the 0.1m insulated support.

Table 12 – EFT Levels

Port[1]	Level	Minimum Performance Criteria
Signal, Telecommunications	±0.5 kV	B
DC Input Power	±0.5 kV	B
AC Input Power	±1 kV	B
1. Performed on cables >3m.		

Radiated Disturbances

Testing was performed according to EN 61000-4-3.

The testing is performed within an anechoic chamber with anechoic material placed on the floor between the antenna and the EUT. Table-top equipment is placed on a 0.8m (31.6 inches) high table and floor-standing equipment is supported 0.1m (4 inches) above the supporting plane. Cabling specified by the manufacturer to be less than 3m (118.4 inches) are the specified length. Excess length are non-inductively bundled to a 1m (39.5 inches) length. The configuration of the wiring duplicates a typical use setup as specified by the manufacturer.

Prior to testing and placement of the EUT, the intensity of the established field was verified by placing the sensor at a calibration grid point, and the field measured at three frequencies; and confirmed to be within 20% of the calibrated value.

The frequency range of 80 MHz to 1 GHz was tested with a step size of 1%. Testing using continuous swept frequency is not performed, therefore the frequency sweep rate is non-applicable. The applied signal was a 1 kHz sine wave with an 80% modulation depth. The dwell time at each frequency allowed the EUT to be exercised and respond, but was not longer than 5 seconds.

Table 13 – Radiated Disturbance Levels

Port	Frequency Range	Level	Minimum Performance Criteria
Enclosure	80 MHz - 1 GHz	3 V/m 1 kHz (80% AM)	A
	1.4 GHz – 2.7 GHz	3 V/m 1 kHz (80% AM)	A

Conducted Disturbances

Testing was performed according to EN 61000-4-6 as modified by EN 55024.

The ground reference plane (GRP) is identical to that described for ESD. Regardless of whether the EUT is table-top, floor-standing, or any other configuration, it was placed on a 0.1m ± 0.01m (4 inches ± 0.4 inches) insulated support over the GRP. All cables associated with the EUT are placed at least 30 mm (1.2 inches) above the GRP. Where coupling and/or decoupling devices were used, they were located between 0.1 m (4 inches) and

0.3 m (11.8 inches) from the EUT. This distance was measured horizontally from the projection of the EUT on to the GRP to the coupling and/or decoupling device. Auxiliary equipment is placed on an insulating support of 0.1 m (4 inches) above the GRP.

Tests are performed on all cables. For performing the tests, CDNs are used when possible. Otherwise, the EM clamp is used as the injection method for unshielded cables. For instances where the common mode impedance requirements cannot be met at the points closest to the auxiliary equipment (AE), then a 150 Ω resistor is placed from the AE to the GRP. Direct injection is used for shielded cables via the use of a 150 Ω injection probe.

Table 14 – Conducted Disturbance Levels

Port	Frequency Range	Level	Minimum Performance Criteria
Signal, Telecommunications[1]	150 kHz - 80 MHz	3 V 1 kHz (80% AM)	A
DC Input	150 kHz - 80 MHz	3 V 1 kHz (80% AM)	A
AC Input	150 kHz - 80 MHz	3 V 1 kHz (80% AM)	A

1. Applicable only to cables which according to the manufacturer's specification supports communication on cable lengths greater than 3 m.

Surge

Testing was performed according to EN 61000-4-5.

The ground reference plane (GRP), when used, is identical to that described for ESD. The GRP is only necessary when high frequency events are likely (i.e., coupling via gas arrestors) and for tests to shielded lines. The power cord between the EUT and the coupling/decoupling network did not exceed 2 m in length. For purposes of this test, power ports are considered to be only those ports directly connected to the AC Mains or distributed DC power systems (e.g. -48V buss in a telecommunication center).

Table 15 – Surge Levels

Port	Waveform (Tr/Th)	Level	Minimum Performance Criteria
Signal, Telecommunications (Indoor Cables > 10m)	1.2/50 µsec	±0.5 kV	B
Signal, Telecommunications (Outdoor Cables)	1.2/50 µsec	±1 kV	B
Signal, Telecommunications (Outdoor Cables in telecommunications centers)	1.2/50 µsec	±0.5 kV	B
AC Input	1.2/50 µsec	L-L: ±0.5 kV L-PE: ±1 kV	B

Surge – Vehicular

Testing was done according to ISO 7637-2.

The EUT was connected to the test pulse generator, and for pulses 3a and 3b, the leads between them were laid out in a straight parallel line 50 – 60 mm (2 to 2-3/8 in) above the RGP and were 0.5m (20 in) long ±0.1m (4 in).

Table 16 – Vehicular Surge (12V Systems)

Pulse	Test Level, U_s (V)		Applied	Minimum Performance Criteria
	III	IV		
1	-75	-100	10 times	B
2a	+37	+50	10 times	B
2b	+10	+10	10 times	B
3a	-112	-150	20 minutes	A
3b	+75	+100	20 minutes	A
4	-6	-7	10 times	B

Voltage Dips & Interruptions

Testing was performed according to EN 61000-4-11.

The test was performed with the EUT connected to the test generator with the shortest power supply cable as specified by the EUT manufacturer, or; the shortest possible length suitable to the application of the EUT. Voltage dips and short interruptions performed at 0° voltage crossover.

Table 17 – Voltage Dips & Interrupts Levels

Port	Reduction (%)	Duration	Minimum Performance Criteria
AC Input	100	½ cycle	B
AC Input	100	1 cycle	B
AC Input	30	25 cycles	C
AC Input	100	250 cycles	C
1. Changes to occur at 0 degree crossover point of the voltage waveform.			

Measurement Uncertainty

Per the requirement of clause 11 of this standard, determining compliance with the limits in this standard was based on the results of the measurement, and does not take into account the measurement instrumentation uncertainty.

Referencing the measurement instrumentation uncertainty considerations contained in CISPR 16-4-2, the expanded measurement uncertainty is ±4.90 dB for radiated emissions, ±3.46 dB for mains conducted emissions, and ±4.31 dB for telecommunication ports conducted emissions.

List of Test Equipment

The following test equipment was used in the performance of the testing herein.

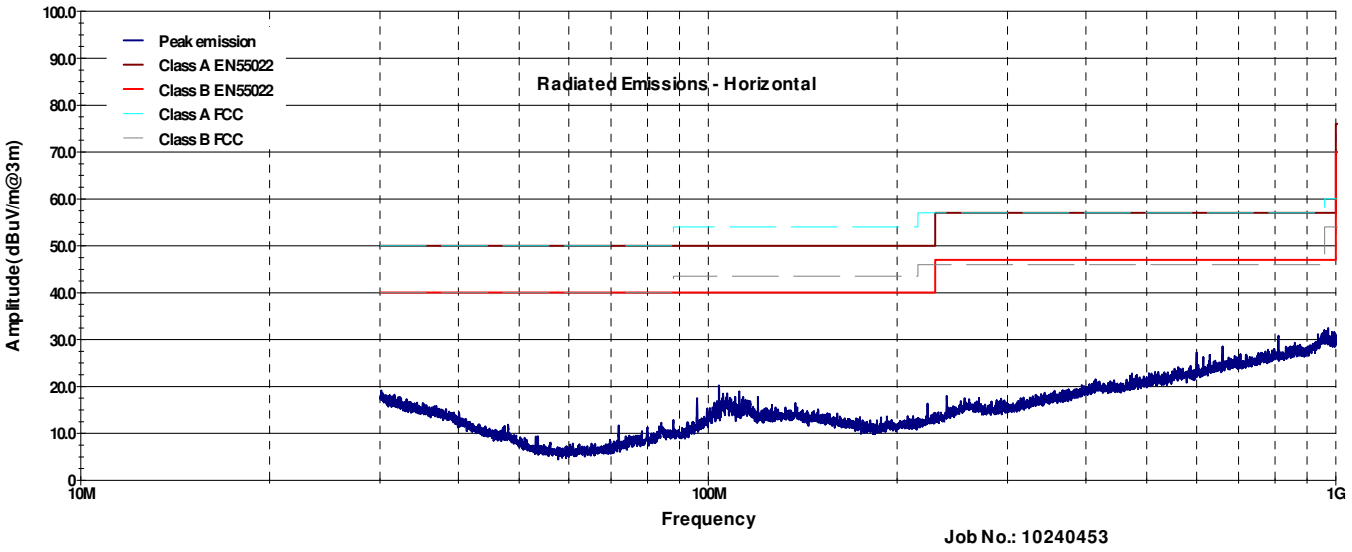
Table 18 – Test Equipment Used

Asset Tag	Description	Manufacturer	Model	Serial Number	Cal. Date	Cal. Due
1942	Weather Station	Omega	wTHBP-LCD	none	25-Apr-2012	25-Apr-2013
1	3m Semi-Anechoic Chamber	Nemko USA, Inc.	Chamber	1	25-Sep-2012	25-Sep-2013
1025	Preamplifier, 25dB	Nemko USA, Inc.	LNA25	399	5-Mar-2013	5-Mar-2014
1304	Antenna, Horn	Electro Metrics	RGA-60	6151	24-Nov-2011	24-Nov-2014
1763	Antenna, Bilog	Schaffner	CBL 6111D	22926	07-Mar-2013	07-Mar-2014
1767	Receiver, EMI Test 20Hz - 26.5 GHz - 150 - +30 dBm LCD	Rohde & Schwartz	ESIB26	837491/0002	19-Dec-2012	19-Dec-2013
1783	Cable Assy, 3m Chamber	Nemko	Chamber		26-Sep-2012	26-Sep-2013
1785	Preamplifier	A.H. Systems	PAM-0126	143	09-Jan-2013	09-Jan-2014
412	Amplifier, RF Power	Amplifier Research	100W1000M1A	21233	N/R	
1738	All-In-One ESD3000 Gun	EMC-PARTNER /HV Technologies	ESD3000	294	23-Oct-2012	23-Oct-2013
1754	All-In-One Relay Module (Tip)	EMC-PARTNER /HV Technologies	ESD3000RM32	99	20-Oct-2010	
1770	Generator, Signal	Rohde & Schwarz	SMIQ-06L		N/R	
1862	250Watt Amplifier (Freq. 1 to 3GHz)	Amplifier Research	250T1G3	330041	N/R	
1765	Log Antenna	AR	AT1080	0325162	N/R	
1928	Emissions Cable for RFi Chamber	Nemko			06-Jun-2012	06-Jun-2013
1929	Emissions Cable for RFi Chamber	Nemko			06-Jun-2012	06-Jun-2013
1930	Emissions Cable for RFi Chamber	Nemko			06-Jun-2012	06-Jun-2013
4029	Field Monitor	Associated Research	FL7000 Laser Probe I	0342144	14-Jun-2012	14-Jun-2013
4023	Laser Powered Field Probe 2 MHz – 40 GHz	Associated Research	FL7040 Starprobe 3	0342144	14-Jun-2012	14-Jun-2013

Test Results – Radiated Emissions (below 1 GHz)

Table No. 1	Radiated Emissions	Verdict
		P

Frequency Range ..... : 30 MHz to 1 GHz
Test Location ..... : 3m Chamber
Test Method..... : EN 55022 clause 10
Test Distance ..... : 3m
EUT Configuration ..... : EUT
Test Date ..... : 8-Apr-13
Temperature ..... : 23.3℃
Relative Humidity .... : 62.1 %
Test Equipment Asset Tag List : 1,1025,1763,1767,1783



(1) Antenna Polarity (H/V)	(2) Detector	(3) Frequency (MHz)	(6) Receiver Reading (dBµV/m)	(7) Site Correction Factor (dB/m)	(8) Emission Level (dBµV/m)	(9) Limit (dBµV/m)	(10) Margin (dB)	(11) Pass/ Fail
H	QPK	104.0150	32.1	-15.4	16.7	40.0	23.3	Pass
H	QPK	972.3080	18.0	1.3	19.2	47.0	27.8	Pass
H								
H								
H								
H								
H								
H								
H								
H								

Supplemental Information:

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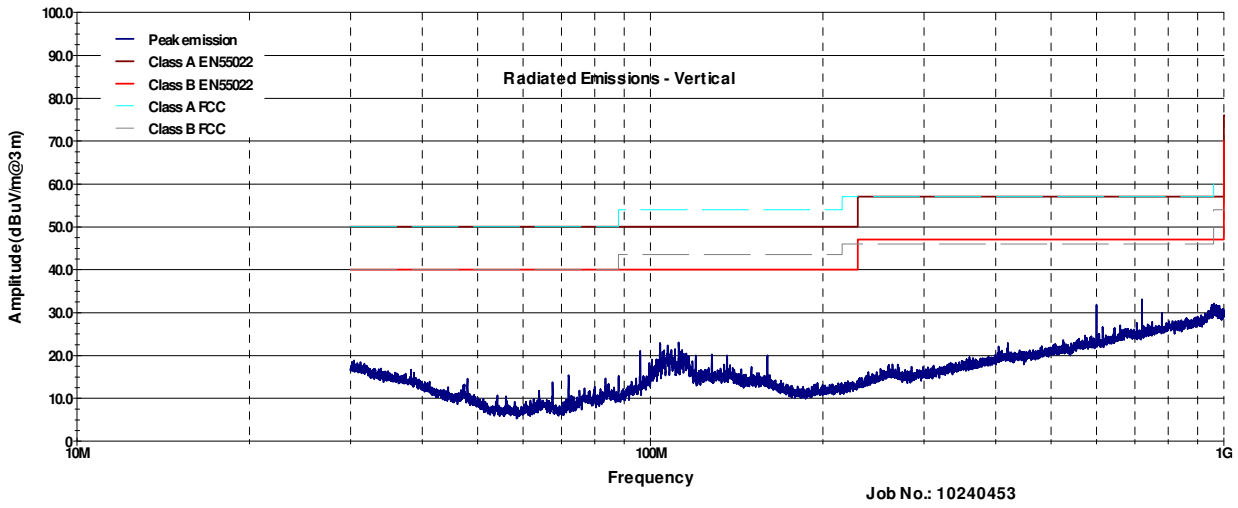
Table No. 2	Radiated Emissions	Verdict
		P

Frequency Range ..... : 30 MHz to 1 GHz
Test Location ..... : 3m Chamber
Test Method..... : EN 55022 clause 10
Test Distance ..... : 3m
EUT Configuration ..... : EUT
Test Date ..... : 8-Apr-13
Temperature ..... : 23.3°C
Relative Humidity .... : 62.1 %
Test Equipment Asset Tag List : 1,1025,1763,1767,1783



(1) Antenna Polarity (H/V)	(2) Detector	(3) Frequency (MHz)	(6) Receiver Reading (dBµV/m)	(7) Site Correction Factor (dB/m)	(8) Emission Level (dBµV/m)	(9) Limit (dBµV/m)	(10) Margin (dB)	(11) Pass/ Fail
V	QPK	30.8359	17.3	-9.0	8.3	40.0	31.7	Pass
V	QPK	96.0298	38.8	-16.4	22.4	40.0	17.6	Pass
V	QPK	112.0280	39.7	-14.6	25.1	40.0	14.9	Pass
V	QPK	720.0120	33.2	-2.8	30.4	47.0	16.6	Pass
V								
V								
V								
V								
V								
V								

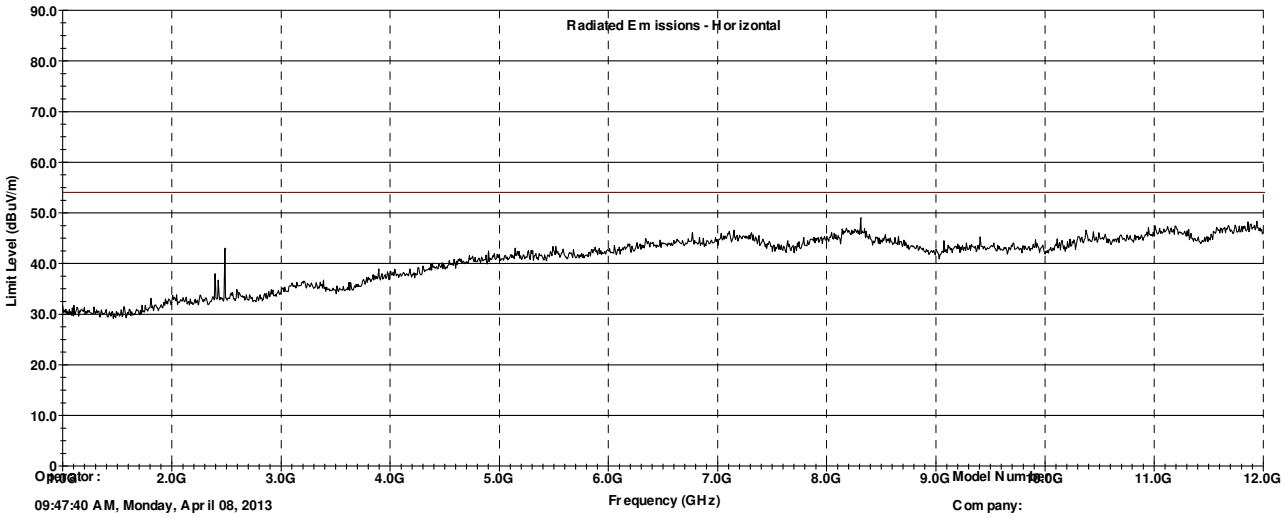
Supplemental Information:

Tested by (+ signature) .....: Brian Boyea

Test Results – Radiated Emissions (above 1 GHz)

Table No. 3	Radiated Emissions	Verdict
		P

Frequency Range ..... : 1 GHz to 6 GHz
Test Location ..... : 3m Chamber
Test Method..... : EN 55022 clause 10
Test Distance ..... : 3m
EUT Configuration ..... : EUT
Test Date ..... : 8-Apr-13
Temperature ..... : 23.3°C
Relative Humidity .... : 61.5 %
Test Equipment Asset Tag List : 1,1785,1304,1783,1767



(1) Antenna Polarity (H/V)	(2) Detector	(3) Frequency (MHz)	(8) Emission Level (dBµV/m)	(9) Limit (dBµV/m)	(10) Margin (dB)	(11) Pass/ Fail
H	PK	8.3113	49.0	54.0	5.0	Pass
H						
H						
H						
H						
H						
H						
H						
H						
H						

Supplemental Information:

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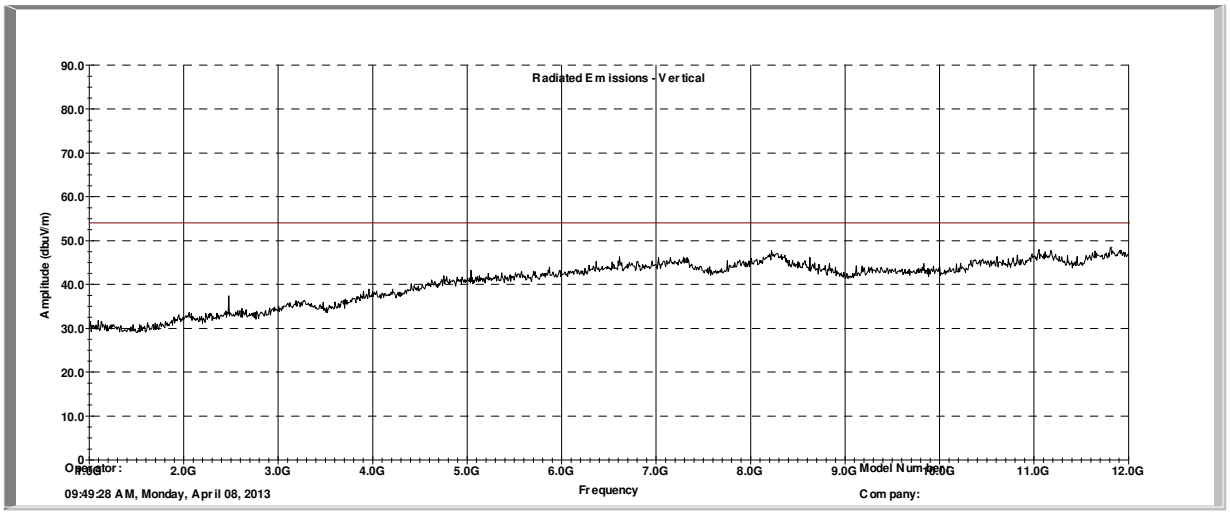
Table No. 4	Radiated Emissions	Verdict
		P

Frequency Range ..... : 1 GHz to 6 GHz
Test Location ..... : 3m Chamber
Test Method..... : EN 55022 clause 10
Test Distance ..... : 3m
EUT Configuration ..... : EUT
Test Date ..... : 8-Apr-13
Temperature ..... : 23.3°C
Relative Humidity .... : 61.5 %
Test Equipment Asset Tag List : 1,1785,1304,1783,1767



(1) Antenna Polarity (H/V)	(2) Detector	(3) Frequency (MHz)	(8) Emission Level (dBµV/m)	(9) Limit (dBµV/m)	(10) Margin (dB)	(11) Pass/ Fail
V	PK	11.8090	48.4	54.0	5.6	Pass
V						
V						
V						
V						
V						
V						
V						
V						
V						

Supplemental Information:

Tested by (+ signature) .....: Brian Boyea

Test Results – Electrostatic Discharge (ESD)

Table No. 5	Electrostatic Discharge (ESD)	Verdict
		P

Test Method..... : EN 61000-4-2
EUT Configuration ..... : EUT
☒ Table-Top ☐ Floor-Standing
Test Location ..... : Lab 5
Test Date ..... : 8-Apr-13
Bleeder Resistor Verification.... : HCP: 1.023 kΩ VCP: 1.025 kΩ 752 – 1,128 kΩ
Temperature ..... : 23.4 °C 15 °C - 35 °C (59 °F - 95 °F)
Relative Humidity ..... : 58.7 % 30% - 60%
Atmospheric Pressure..... : 989.1 mbars 860 mbars – 1060 mbars
Test Equipment Asset Tag List : 1738,1754

Test Results: (25 discharges per application, minimum of 4 test points)

Actual performance criteria recorded in table (Minimum Performance Criteria: B)

	Test Points	Contact		Air						Pass/ Fail
		-4	+4	-8	-4	-2	+2	+4	+8	
A	Horizontal Coupling Plane – Front of EUT	A	A	N/A	N/A	N/A	N/A	N/A	N/A	Pass
B	Vertical Coupling Plane – Right Side of EUT	A	A	N/A	N/A	N/A	N/A	N/A	N/A	Pass
C	Vertical Coupling Plane – Left Side of EUT	A	A	N/A	N/A	N/A	N/A	N/A	N/A	Pass
D	Vertical Coupling Plane – Front of EUT	A	A	N/A	N/A	N/A	N/A	N/A	N/A	Pass
E	Vertical Coupling Plane – Rear of EUT	A	A	N/A	N/A	N/A	N/A	N/A	N/A	Pass
F										NT
G										NT
H										NT
I										NT
J										NT
K										NT
L										NT
M										NT
N										NT

Supplemental Information:

Tested by (+ signature) .....: Brian Boyea

Test Results – Radiated Disturbances

Table No. 6	**Radiated Disturbances**	Verdict
		P

Test Method..... : EN 61000-4-3
EUT Configuration ..... : EUT
Test Height ..... : ☒ Table-Top (0.8m) ☐ Floor-Standing (0.1m)
Test Location ..... : AC1
Test Date ..... : 8-Apr-13
Temperature ..... : 23.4°C
Relative Humidity ..... : 58.7 %
Test Equipment Asset Tag List : 1765,1770,4029,4023,412,1862,1928,1929,1930,1304

Test Parameters:

Dwell Time ..... : 3 seconds
Step Size ..... : 1%

Test Results: Minimum Performance Criteria: A

Frequency Range(s)	Polarity (H/V)	Field Strength (V/m)	Position	Result	Verdict	Comment
80 MHz to 1 GHz and 1.4 GHz to 2.7 GHz	H	3	Front	A	P	
	H	3	Rear	A	P	
	H	3	Left	A	P	
	H	3	Right	A	P	
	V	3	Front	A	P	
	V	3	Rear	A	P	
	V	3	Left	A	P	
	V	3	Right	A	P	

Supplemental Information:

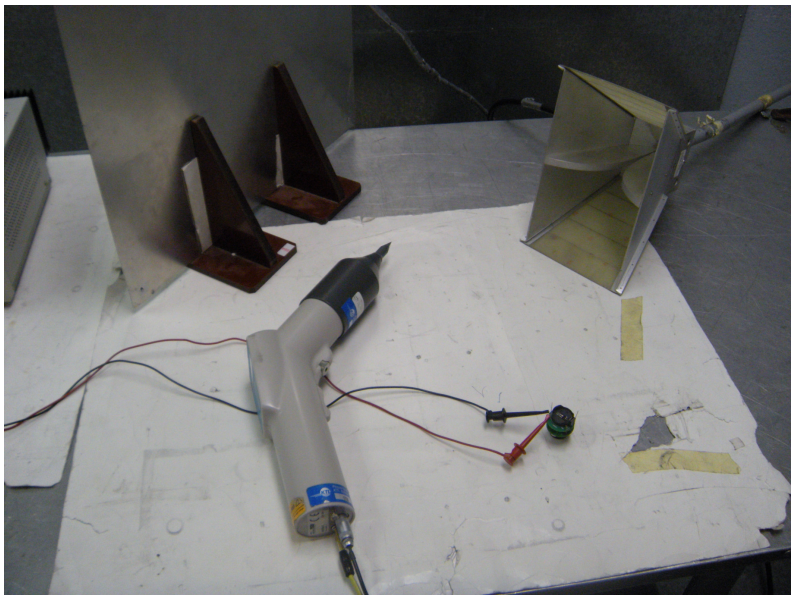
Tested by (+ signature) .....: Brian Boyea

Setup Photos

Photo 2	**Test Setup – Radiated Emissions (below & above 1 GHz)**	

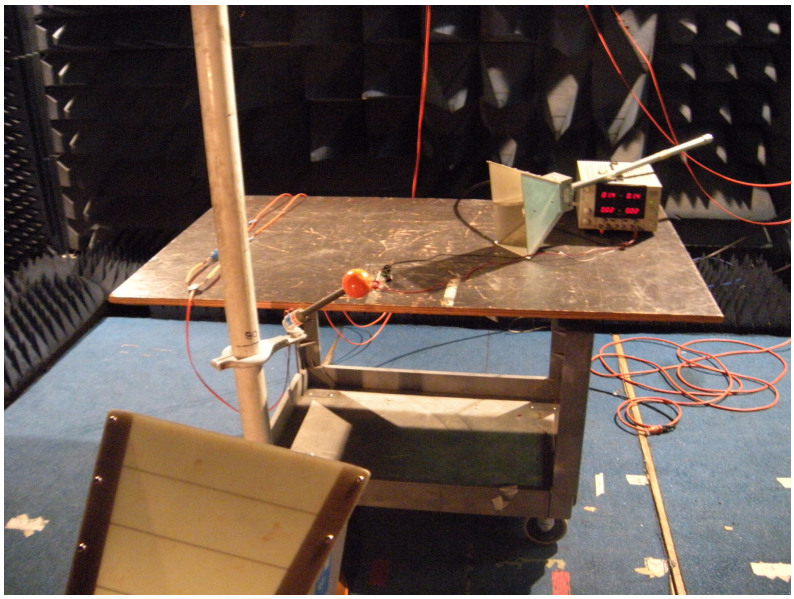
Supplemental Information:

Photo 3	**Test Setup – Electrostatic Discharge (ESD)**	



Supplemental Information:

Photo 4	**Test Setup – Radiated Disturbances**	



Supplemental Information: