FCC Test Report

FOR:

Manufacturer: Pacific Industrial Co., Ltd

Model Name: PMV-C871

Product Description: Tire Pressure Monitoring System Transmitter

FCC ID: PAXPMVC871
IC ID: 3729A-PMVC871

47 CFR Part 15.231

IC RSS-210 Issue 8

TEST REPORT #: EMC_CET10_170_12301_C871_FCC15
DATE: 2013-05-01

FCC Accredited

IC recognized # 3462B

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1 Assessment

The following device was tested against the applicable criteria specified in FCC rules Parts 15.231 of Title 47 of the Code of Federal Regulations.
No deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Pacific Industrial Co., Ltd	Tire Pressure Monitoring System Transmitter	PMV-C871

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2013-05-01	Compliance	Sajay Jose (Test Lab Manager)	

Responsible for the Report:

Date	Section	Name	Signature
2013-05-01	Compliance	Tunji Yusuf (EMC Engineer)	

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Test Lab Manager:	Sajay Jose
Test Engineer:	Tunji Yusuf

2.2 Identification of the Client

Applicant's Name:	Pacific Industrial Co., Ltd
Street Address:	Godo-Cho, Anapchi
City/Zip Code	Gifu/ 503-2397
Country	Japan
Contact Person:	Kunitaka Yano
Phone No.	+81-(0)584-28-0111
Fax:	+81-(0)584-28-0130
e-mail:	knyano@pacific-ind.co.jp

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as client.
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name / Model No:	PMV-C871
FCC ID:	PAXPMVC871
IC ID:	3729A-PMVC871
Product Description:	Tire Pressure Monitoring System Transmitter
Frequency of operation:	UHF Transmitter: 314.975 MHz
Modulation:	FSK
Modes of Operation:	See Section 5.2
Antenna Info:	Built-in Loop Antenna Gain: -26.0 dBi
Power Supply:	3VDC Lithium battery
Rated Operating Voltage Range:	Low: 1.9V, Nom: 3.0V, High:3.6 V
Rated Operating Temperature Range:	Low: -35℃, Nom: +25℃, High: +100℃
Test Sample Status:	Prototype

3.2 Identification of the Equipment Under Test (EUT)

EUT #	Type	Serial Number
1	TPMS Transmitter	044301

3.3 Identification of Accessory equipment

AE #	Type	Manufacturer	Serial No.	Cetecom ID
1	Trigger Box	Pacific Industrial Co., Ltd	D0007	For programming the EUT to transmit. Not used for testing.

4 Subject of Investigation

The objective of the measurements done by Cetecom Inc. was to measure the performance of the EUT as specified by requirements listed in FCC rules Part 15.231 of Title 47 of the Code of Federal Regulations and Industry Canada Standards RSS 210 Issue 8.

This test report is to support a request for new equipment authorization under the
FCC ID: **PAXPMVC871** and IC ID**: 3729A-PMVC871**

All testing was performed on the product referred to in Section 3 as EUT.
This test report contains full radiated and conducted testing results as per

- 47 CFR Part 15: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission subchapter A- General, Part 15- Radio Frequency Devices.
- RSS-210 Issue 8: Spectrum Management and Telecommunications- Radio Standards Specification. Low-power License-exempt radio communication devices (All frequency bands): Category 1 equipment.

5 Modes of operation:

Three modes of operation are possible: Stationary, Rotating and Pressure Alert.

As the average output power is the same for all modes, it was deemed necessary to only measure the timing behavior in one mode.

The Trigger box provided by the customer was used to force transmit modulated signal for 30 minutes (18000 frames/ 0.1 sec interval) for performing the measurements.

5.1 Timing Diagrams of different transmission modes:

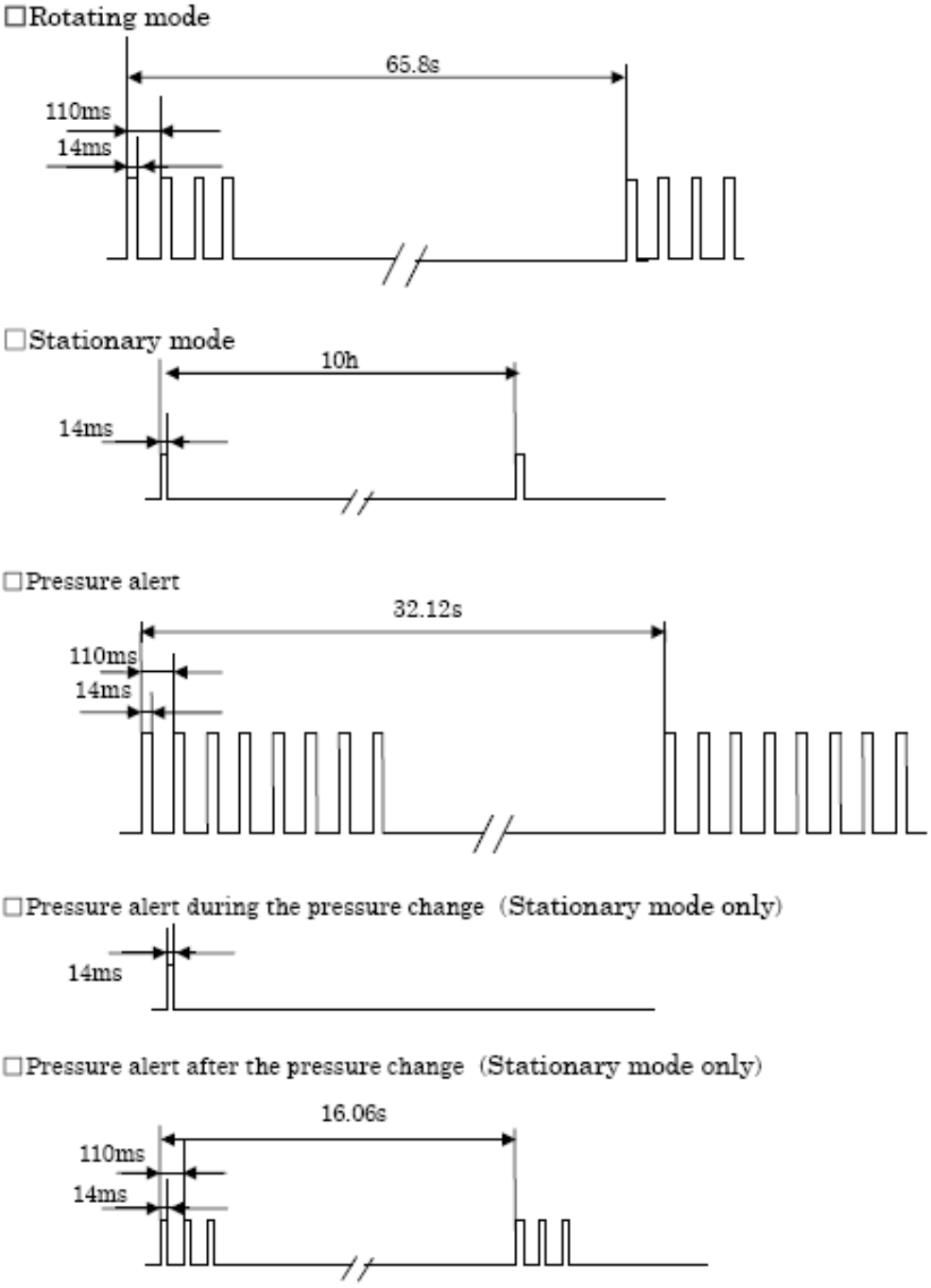


Fig 4

Worst Case modes:
Rotating mode: 4 frames/ minute
Stationary mode: 1 frame/ 10 hours
Pressure Alert mode: 8 frames/ 32.12 seconds

6 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Pass	Fail	NA	NP	Result
§15.231 (e) RSS 210 A1.1.2	Transmitter Fundamental Field Strength	Nominal	■	☐	☐	☐	Complies
§15.231 (c)	Transmitter 20dB bandwidth	Nominal	■	☐	☐	☐	Complies
§15.231 (a)	Transmitter Duration	Nominal	■	☐	☐	☐	Complies
§15.35 (c)	Transmitter Duty Cycle	Nominal	■	☐	☐	☐	Complies
§15.231 (e) §15.209	Transmitter Radiated Emissions	Nominal	■	☐	☐	☐	Complies
§15.109	RX Spurious Emissions Radiated	Nominal	☐	☐	■	☐	-
§15.207	TX Conducted Emissions <30MHz	Nominal	☐	☐	■	☐	-
§15.107(a)	RX Conducted Emissions <30MHz	Nominal	☐	☐	■	☐	-

Note: NA= Not Applicable; NP= Not Performed.

7 Measurements

7.1 Radiated Measurement Procedure

ANSI C63.4 (2009) Section 8.3.1.1: Exploratory radiated emission measurements

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. A shielded room may be used for exploratory testing, but may have anomalies that can lead to significant errors in amplitude measurements.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of testing. It is recommended that either a headset or loudspeaker be connected as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT when the exploratory and final testing is performed in an OATS with strong ambient signals. Caution should be taken if either antenna height between 1 and 4 meters or EUT azimuth is not fully explored. Not fully exploring these parameters during exploratory testing may require complete testing at the OATS or semi-anechoic chamber when the final full spectrum testing is conducted.

The EUT should be set up in its typical configuration and arrangement, and operated in its various modes. For tabletop systems, cables or wires should be manipulated within the range of likely arrangements. For floor-standing equipment, the cables or wires should be located in the same manner as the user would install them and no further manipulation is made. For combination EUTs, the tabletop and floor-standing portions of the EUT shall follow the procedures for their respective setups and cable manipulation. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions.

For each mode of operation required to be tested, the frequency spectrum shall be monitored. Variations in antenna height between 1 and 4 m, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) shall be explored to produce the emission that has the highest amplitude relative to the limit. A step-by-step technique for determining this emission can be found in Annex C.

When measuring emissions above 1 GHz, the frequencies of maximum emission shall be determined by manually positioning the antenna close to the EUT and by moving the antenna over all sides of the EUT while observing a spectral display. It will be advantageous to have prior knowledge of the frequencies of emissions above 1 GHz. If the EUT is a device with dimensions approximately equal to that of the measurement antenna beamwidth, the measurement antenna shall be aligned with the EUT.

ANSI C63.4 (2009) Section 8.3.1.2: Final radiated emission measurements

Based on the measurement results in 8.3.1.1, the one EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurement is then performed on a site meeting the requirements of 5.3, 5.4, or 5.5 as appropriate without variation of the EUT arrangement or EUT mode of operation. If the EUT is relocated from an exploratory test site to a final test site, the highest emission shall be remaximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarity and EUT azimuth are to be varied. In addition, the full frequency spectrum (for the range to be checked for meeting compliance) shall be investigated.

This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on those frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full spectrum test constitutes the compliance measurement.

For measurements above 1 GHz, use the cable, EUT arrangement, and mode of operation determined in the exploratory testing to produce the emission that has the highest amplitude relative to the limit. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the antenna in the “cone of radiation” from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response. The antenna may have to be higher or lower than the EUT, depending on the EUT’s size and mounting height, but the antenna should be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. If the transmission line for the measurement antenna restricts its range of height and polarization, the steps needed to ensure the correct measurement of the maximum emissions, shall be described in detail in the report of measurements. Data collected shall satisfy the report requirements of Clause 10.

NOTES

1— Where limits are specified by agencies for both average and peak (or quasi-peak) detection, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.
2—Use of waveguide and flexible waveguide may be necessary at frequencies above 10 GHz to achieve usable signal-to noise ratios at required measurement distances. If so, it may be necessary to restrict the height search of the antenna, and special care should be taken to ensure that maximum emissions are correctly measured.
3—All presently known devices causing emissions above 10 GHz are physically small compared with the beam-widths of typical horn antennas used for EMC measurements. For such EUTs and frequencies, it may be preferable to vary the height and polarization of the EUT instead of the receiving antenna to maximize the measured emissions.

7.1.1 Sample Calculations for Radiated Measurements

7.1.1.1 Field Strength Measurements:

Measurements from the Spectrum Analyzer/ Receiver is used to calculate the Field Strength, taking into account the following parameters:

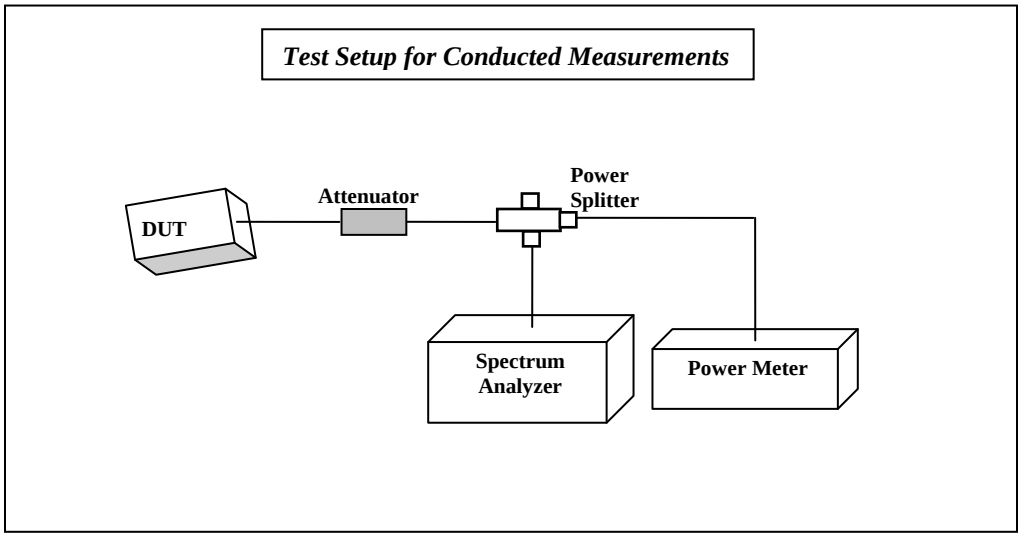
1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

FS (dBµV/m)= Measured Value on SA (dBµV)+ Cable Loss (dB)+ Antenna Factor (dB/m)
Eg:

Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the above equation.

7.2 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. The EUT is programmed using test utility provided by the manufacturer to set the required channel and operating mode.
3. Measurements are to be performed with the EUT set to the required transmit channel.

7.3 Transmitter Fundamental Field Strength

7.3.1 Limits:

RSS 210 Issue 8 A.1.1.2
§15.231 (e)
Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66–40.70	1,000	100
70–130	500	50
130–174	500 to 1,500[1]	50 to 150[1]
174–260	1,500	150
260–470	1,500 to 5,000[1]	150 to 500[1]
Above 470	5,000	500

[1]Linear interpolations.
The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.
Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

For the EUT operating at 314.98 MHz, the fundamental field strength limit is calculated as follows:

Field Strength = (16.67x F) – 2833.33 where F is the frequency in MHz
= 2417.30 μV/m
= 67.66 dB μV/m

7.3.2 Test Conditions:

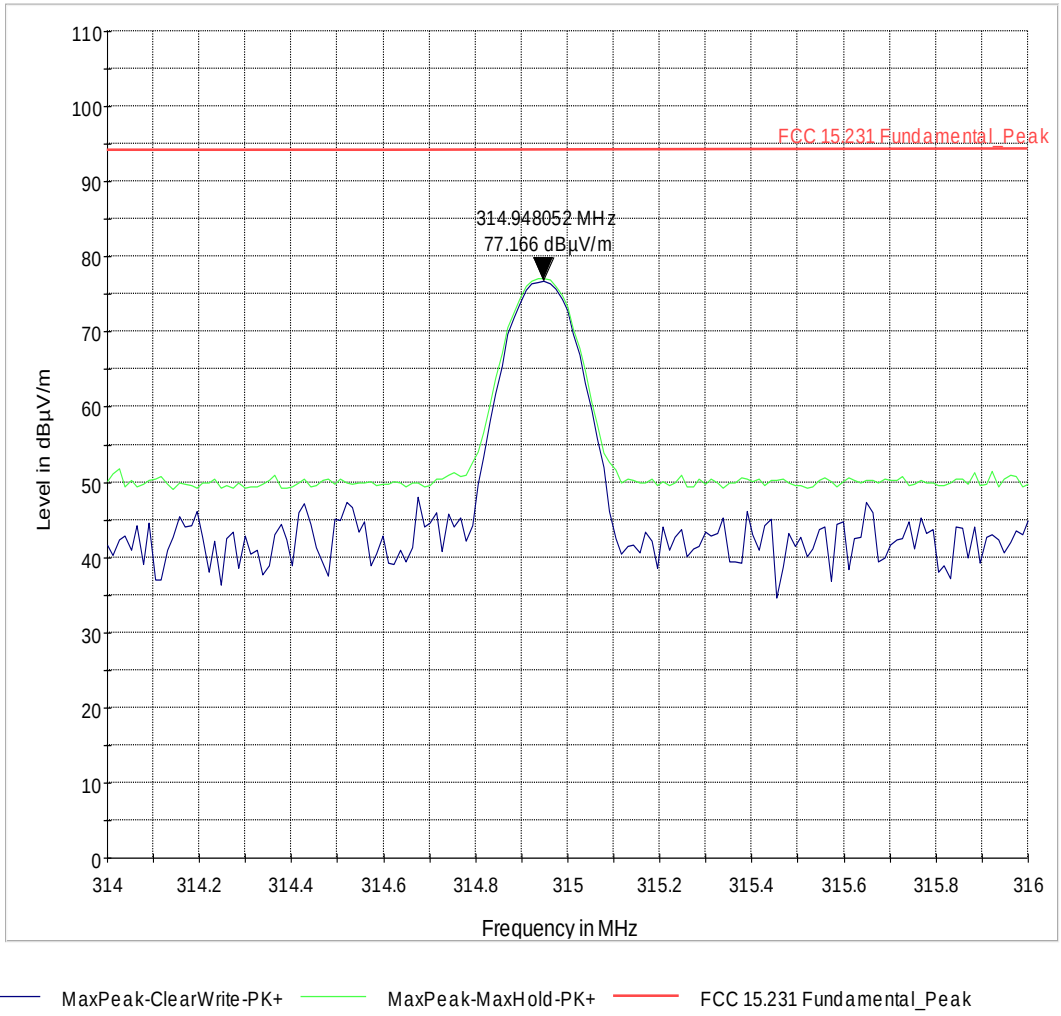
Tnom: 22°C; Vnom: 3V DC

Spectrum Analyzer settings:

RBW=120 kHz; VBW=300 kHz; Detector: Peak; Sweep Time: Auto; Span=2MHz

Maximized result for all orientations of the EUT and H/V measurement antenna polarizations shown here.

7.3.3 Test Data:



7.3.4 Measurement Result

Maximum power (dBµV/m at 3m)		Limit (dBµV/m)	Verdict
Measured Peak value	Calculated Average value		
77.166	77.166 – 17.42 = **59.746**	67.66	Pass

7.4 Transmitter 20dB Bandwidth

7.4.1 Limits:

7.4.1.1 §15.231 (c)

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

For 314.98 MHz transmitter, the 20 dB Bandwidth limit is 0.0025 x 314.98 MHz = **787.45 kHz**.

Therefore, 20dB bandwidth should be < 787.45 kHz.

7.4.2 Test Conditions:

Tnom: 22°C; Vnom: 3V DC

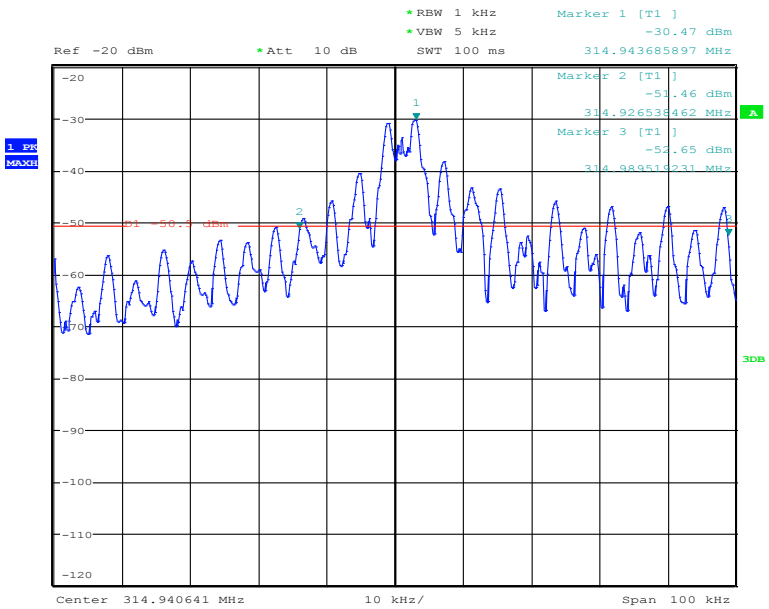
Spectrum Analyzer settings:

RBW=1kHz, VBW=5kHz, Detector: Peak- Max hold;

Sweep Time: 100 ms

Span=100 kHz

7.4.3 Test Data:



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7.4.4 Measurement Result

Measured 20 dB bandwidth (kHz)	20 dB Bandwidth Limit(kHz)	Verdict
62.983	787.45	Pass

7.5 Transmitter Duration

7.5.1 Limits:

7.5.1.1 §15.231 (e)

Devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

7.5.2 Results

Rotating Mode	
Transmission length	4 x 108.65ms = 435.6 ms < 1 second
Minimum silent period	30 x 0.4356s = 13.068s
Silent period	65.8s – 0.4356s = 65.3644s > 13.068s

Pressure Alert Mode	
Transmission length	8x 108.65ms = 869.2 ms < 1 second
Minimum silent period	30 x 0.8692s = 26.076s
Silent period	32.12 – 0.8692s = 31.2508s > 26.076s

Stationary Mode	
Transmission length	1 x 13.46ms = 13.46 ms < 1 second
Minimum silent period	30 x 13.46 ms = 403.8 ms
Silent period	36000s – 13.46ms = 35986.54 s >10 s

Pressure After the Pressure Change Mode	
Transmission length	3 x 108.65ms = 325.95 ms < 1 second
Minimum silent period	30 x 0.3259 s = 9.778s
Silent period	16.06s – 0.3259s =15.7341s > 9.778s

7.6 Transmitter Duty Cycle

This is a reference measurement only.

7.6.1 Reference:

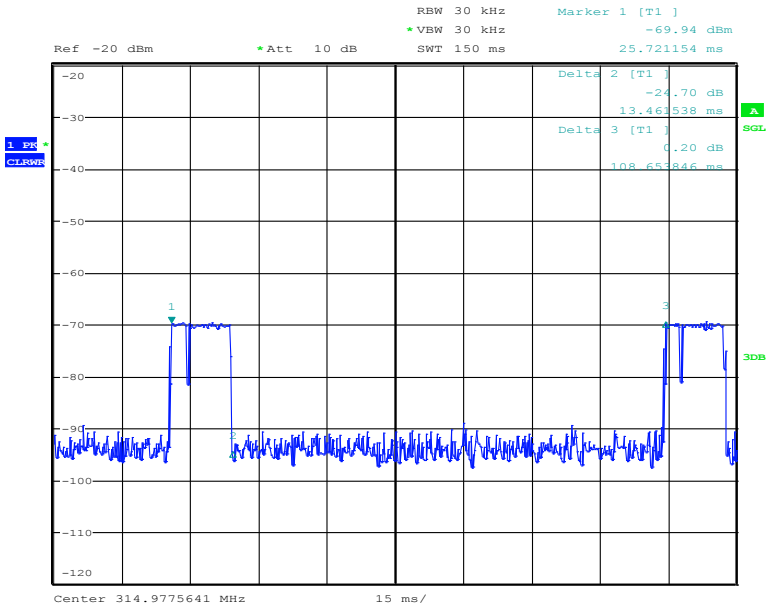
7.6.1.1 §15.35 (c)

7.6.2 Test Conditions:

Tnom: 25°C; Vnom

Spectrum Analyzer settings:
RBW=30 kHz, VBW=30 kHz, Detector: Peak
Sweep Time: 150 ms
Span=Zero

7.6.3 Test Data:



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7.6.4 Measurement Result

Transmit on time = 13.46 ms;
Period= 100 ms;
Duty Cycle=13.46 %

Correction factor = 20 Log (Pulse Duration (ms)/ 100 ms) = 20Log (13.46/100) = -17.42 dB

Note: Regardless of the transmission mode, the maximum number of bursts in 100ms is 1 and therefore the duty cycle can never exceed the above calculated value.

7.7 Transmitter Spurious Emissions- Radiated

7.7.1 References:

FCC CFR 2.1053
FCC CFR 15.231 (e) and 15.209

7.7.2 Measurement requirements:

7.7.2.1 FCC 2.1053: Field strength of spurious radiation.

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission.

7.7.3 Limits:

§15.231 (e)

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66–40.70	1,000	100
70–130	500	50
130–174	500 to 1,500[1]	50 to 150[1]
174–260	1,500	150
260–470	1,500 to 5,000[1]	150 to 500[1]
Above 470	5,000	500

7.7.4 Measurement Settings:

Peak detector used for the measurements- with RBW=120KHz for measurements below 1GHz and RBW= 1MHz for measurements above 1GHz.
Testing performed up to 10x Transmit frequency.

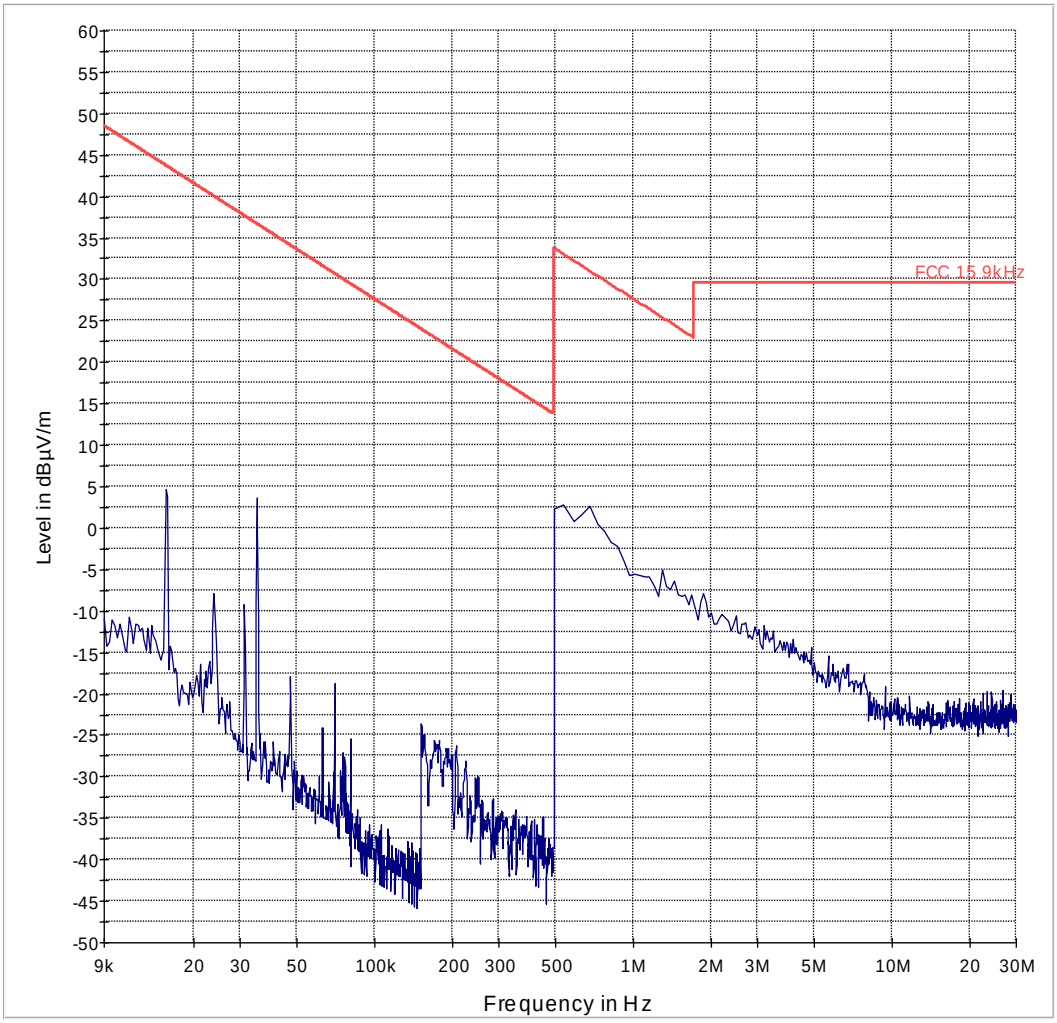
Measurement distance= 3m

7.7.4.1 Measurement Result

Pass.

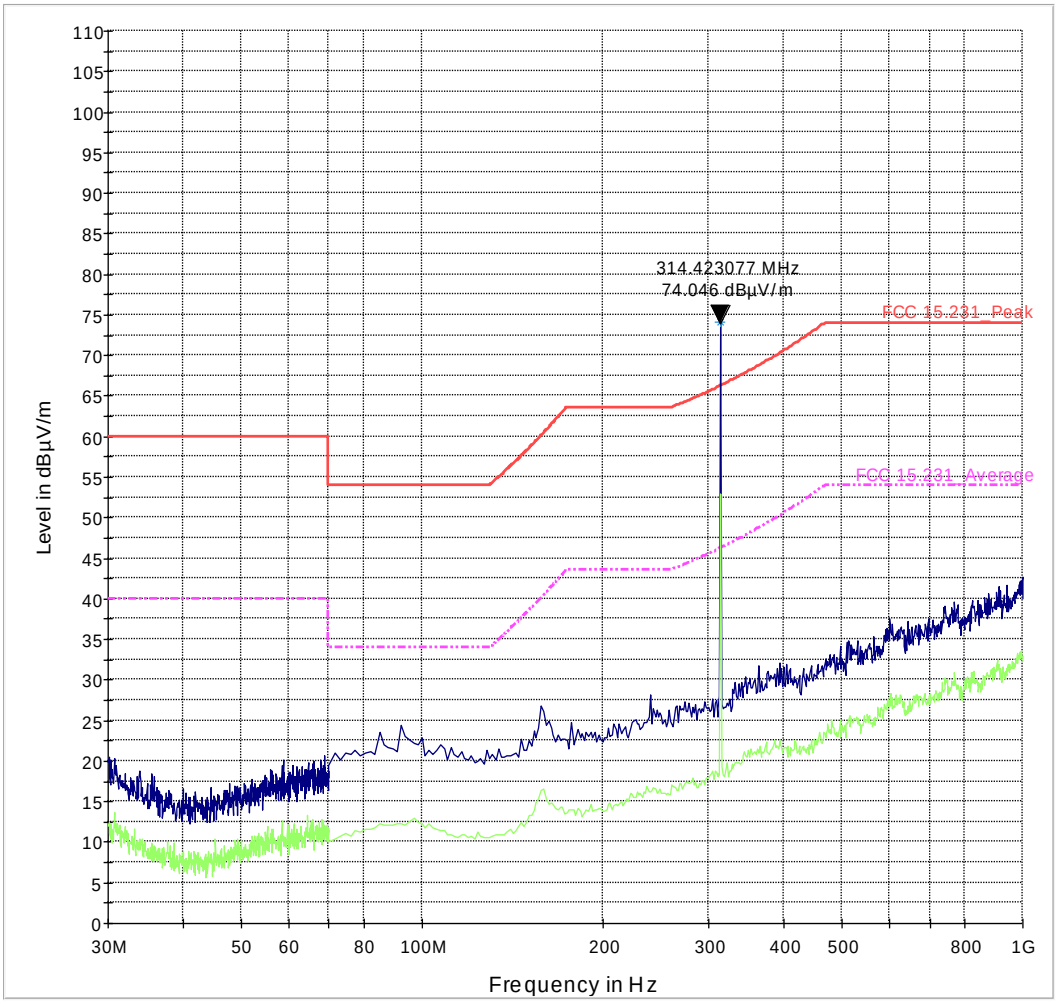
7.7.5 Test data/ plots:

Radiated spurious emissions: 9kHz- 30MHz



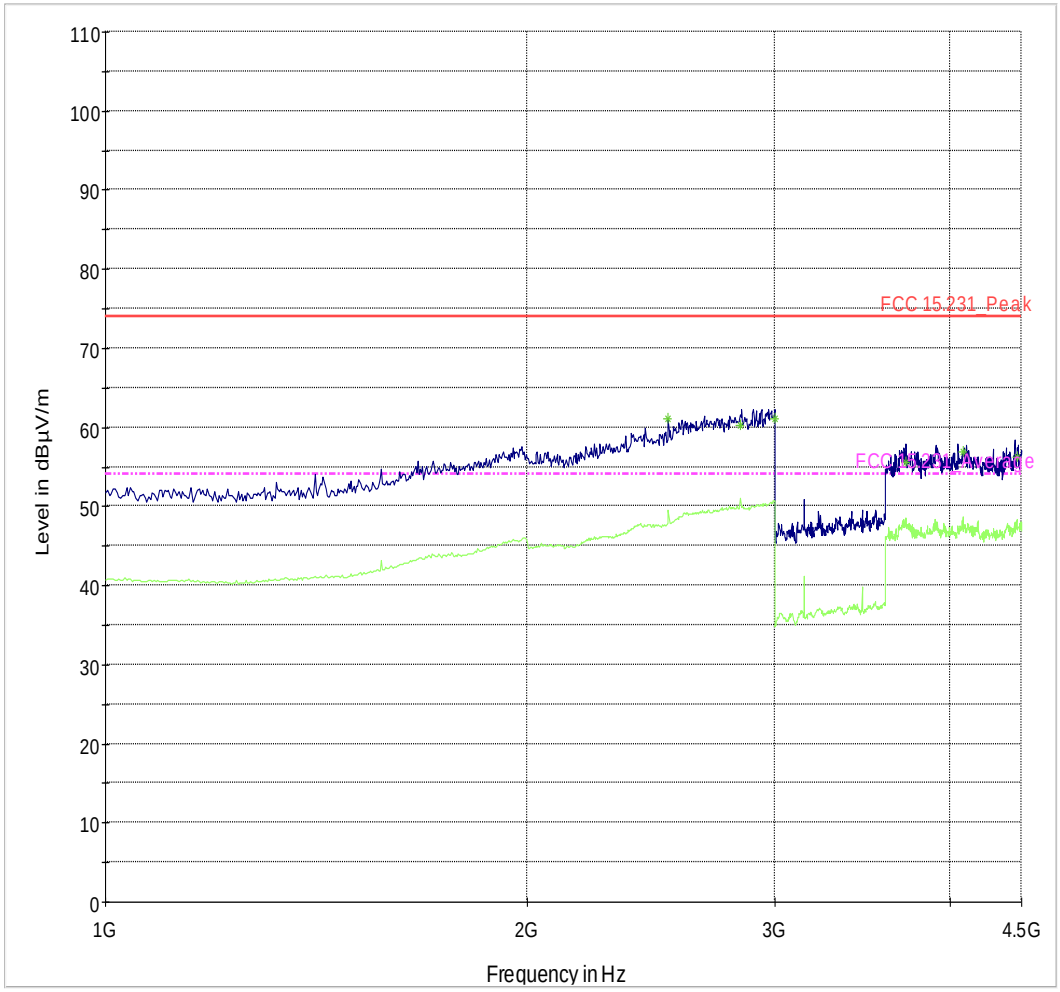
Radiated spurious emissions: 30M-1GHz

Measurement with both Peak and Average detector shown below.
Signal above the limit line is from the 314.98 MHz Transmitter.



Radiated spurious emissions: >1GHz

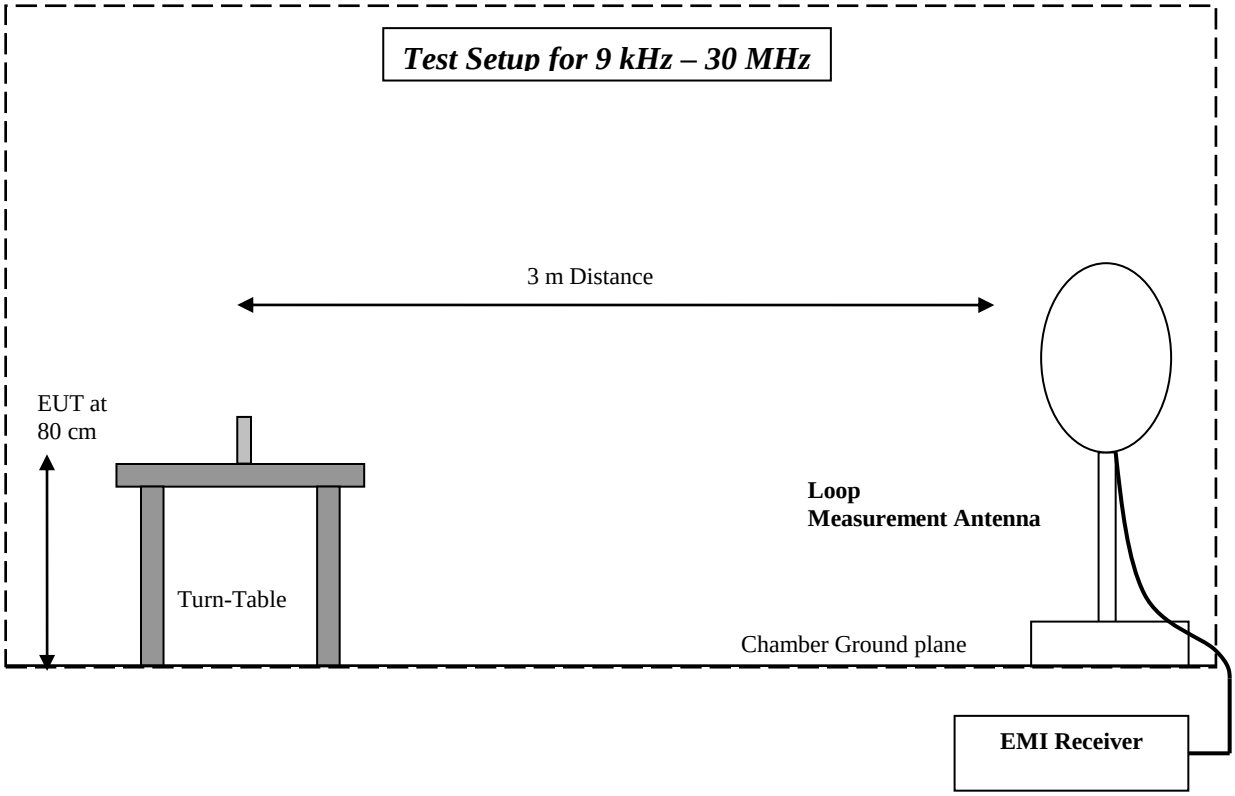
Measurement with both Peak and Average detector shown below.

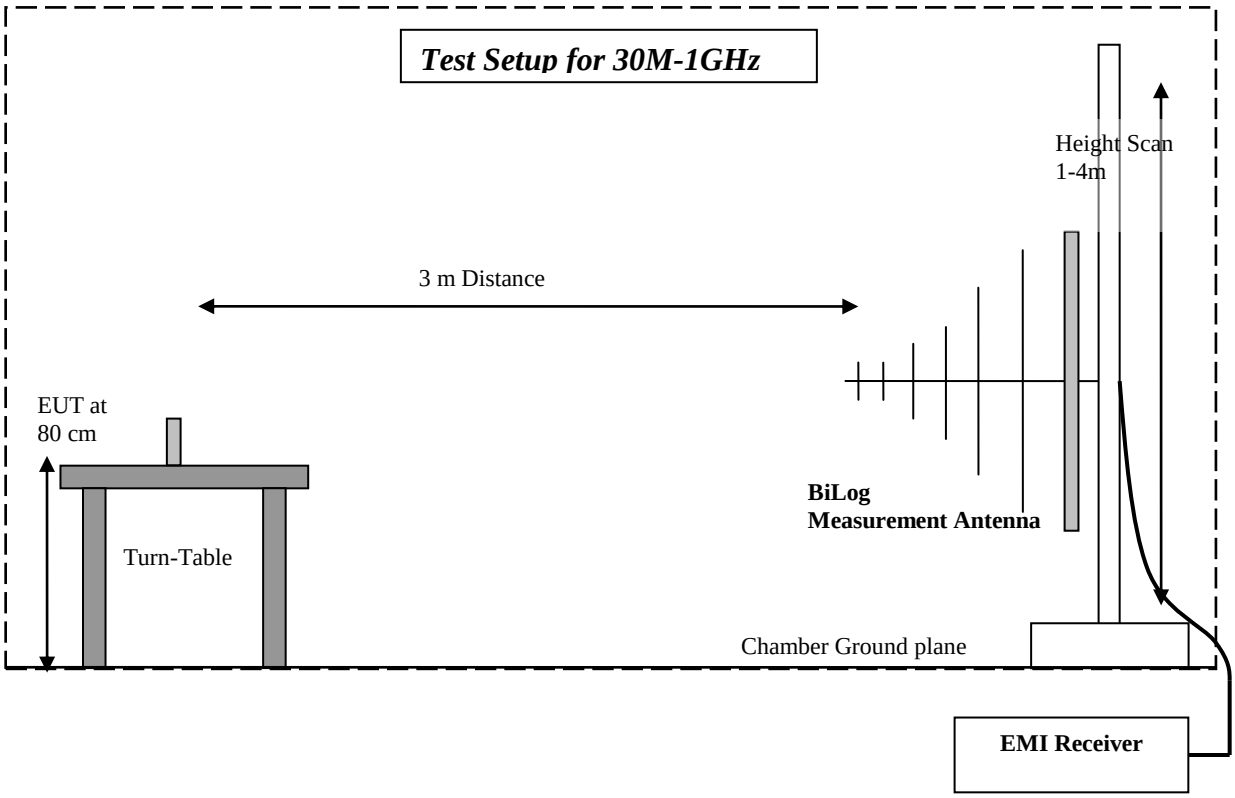


8 Test Equipment and Ancillaries used for tests

No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
3m Semi- Anechoic Chamber:						
	Turn table	EMCO	2075	N/A	N/A	N/A
	MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
	Antenna Mast	EMCO	2075	N/A	N/A	N/A
	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
	EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	May 2012	1 Year
	Spectrum Analyzer	Rohde&Schwarz	FSU	200302	May 2011	2 Years
	1500MHz HP Filter	Filtek	HP12/1700	14c48	N/A	N/A
	2800 MHz HP Filter	Filtek	HP12/2800	14C47	N/A	N/A
	Pre-Amplifier	Miteq	JS40010260	340125	N/A	N/A
	Binconilog Antenna	EMCO	3141	0005-1186	Apr 2012	3 Years
	Binconilog Antenna	ETS	3149	J000123908	Feb 2012	3 years
	Horn Antenna	EMCO	3115	35114	Mar 2012	3 Years
	LISN	FCC	50-25-2-08	08014	Jul 2012	1 Year
Ancillary equipment						
	Multimeter	Klein Tools	MM200	001	Apr 2011	2 Years
	Humidity Temperature Logger	Dickson	TM320	03280063	Apr 2013	1 Year
	Digital Barometer	VWR	35519-055	91119547	Nov 2011	2 Years
	DC Power Supply	HP	E3610A	KR83023316	N/A	N/A
	DC Power Supply	Protek	3003B	H012771	N/A	N/A
	Communication Antenna	IBP5-900/1940	Kathrein	N/A	N/A	N/A

9 Test Setup Info:





10 Revision History

Date	Report Name	Changes to report	Report prepared by
2013-05-01	EMC_CET10_170_12301_C871_FCC15	First Version	Tunji Yusuf