Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 7:2007 &

FCC Part 15 Subpart C:2010,

15.209 & 15.231(e)

Unlicensed Intentional Radiators

on the

Automated Delivery Measurement (ADM)

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Testing produced for

Lyngsoe Systems
elevating logistics

See Appendix A for full customer & EUT details.

Industry Canada
REGISTRATION #6844A-1

CE

ACCREDITED
Testing Laboratory
Certificate #2555.01

VCCI
R-2621
C-2864

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Report Scope

This report addresses the EMC verification testing and test results of the Combi RFID Master ADM, herein referred to as EUT (Equipment Under Test) performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2010

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.

Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

Client	**Lyngsoe Systems**
Product	Automated Delivery Measurement (ADM)
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2010

Summary

The results contained in this report relate only to the item(s) tested.

EUT FCC Certification #, FCC ID:	PQG-ADM
EUT Industry Canada Certification #, IC:	4113A-ADM
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Scott Drysdale

Client	**Lyngsoe Systems**
Product	Automated Delivery Measurement (ADM)
Standard(s)	RSS 210 Issue 7:2007 / FCC Part 15 Subpart C 15:2010

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS 210 (Table 1)	Restricted Bands for intentional operation	Not allowed	Pass
FCC 15.207	Power line conducted emissions	QuasiPeak Average	See Justification
FCC 15.209 RSS-210 (Table 2) FCC 15.231(e) RSS-210 (Table 5)	Intentional / Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.231(e) RSS-210 A1.1.1(b)	Automatic transmission Transmission time	< 1 seconds	Pass
FCC 15.231 (e) RSS-210 A1.1.1(c)	Transmission off time	> 30 x TX interval > 10 seconds	Pass
FCC 15.231 (c) RSS-210 A1.1.3	20 dB Bandwidth	< 0.25% of carrier	Pass
Overall Result			**PASS**

All tests were performed by Scott Drysdale.

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

Justifications, Descriptions, or Deviations

The following justifications for tests not performed or deviations from the above listed specifications apply:

For the Antenna requirement specified in FCC 15.203 (RSS 210 section 5.5), this device is designed with an integral antenna which meets the requirements of FCC 15.203. No external connectors are provided.

For the Restricted Bands of operation as specified in FCC 15.205, the EUT is designed to only operate at 125 kHz and 433.92 MHz, neither is in a restricted band.

For the power line conducted emissions requirements, the EUT is DC powered by a battery and this test does not apply.

Although this unit is shown connected to a computer during testing, this provision is only available in the test unit provided for the purposes of initiating the continuous test mode operation. Normal operation would not have this device connected to a computer.

The EUT was scanned in both horizontal and vertical polarity for emissions, and the worst case results are presented in this report. Polarity notations represent the polarity of the measuring antenna.

Applicable Standards, Specifications and Methods

ANSI C63.4:2003	- Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CFR 47 FCC 15	- Code of Federal Regulations – Radio Frequency Devices
CISPR 22:1997	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
ICES-003:2004	- Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
ISO 17025:2005	- General Requirements for the competence of testing and calibration laboratories
RSS 210:2007	- Issue 7: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power Licence-Exempt Radiocommunication Devices

Sample calculation(s)

Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)
Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)
Margin = 8.5 dB

Document Revision Status

Revision 1 - Oct 21, 2010

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxiallary Equipment.

BW – Bandwidth. Unless otherwise stated, this is refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity

EUT – Equipment Under Test

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line impedance stabilization network

NCR – No Calibration Required

RF – Radio Frequency

Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

Calibrations and Accreditations

The measurement site used is registered with Federal Communications Commission (FCC) and Industry Canada (IC). This site is calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The semi-anechoic chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Testing Environmental Conditions and Dates

Following were the environmental conditions in the facility during time of testing –

Date	Test	Init.	Temperature (ºC)	Humidity (%)	Pressure (kPa)
Oct 2010	All	SD	20-25ºC	30-45%	100 -103kPa

Detailed Test Results Section

Radiated Emissions of Spurious Emissions and Emissions Below 30 MHz

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limit(s) and Method

The method is as defined in ANSI C63.4:2003.
The limits are as defined in FCC Part 15, Section 15.209 and 15.231 (e), whichever limit permits the higher field strength. The below table represents the 15.209 limits, which are presented as worst case.

0.009 MHz to 0.49 MHz, 2400/F^3 uV/m, at 300 meters
0.49 to 1.7 MHz, 24000/F^3 uV/m, at 30 meters
1.7 MHz to 30 MHz, 30 uV/m, at 30 meters
30 MHZ to 88 MHz, 100 uV/m (40.0 dBuV/m[1]) at 3 m
88 MHz to 216 MHz, 150 uV/m (43.5 dBuV/m[1]) at 3 m
216 MHz to 960 MHz, 200 uV/m (46.4 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz[2], 500 uV/m (54 dBuV/m) at 3m

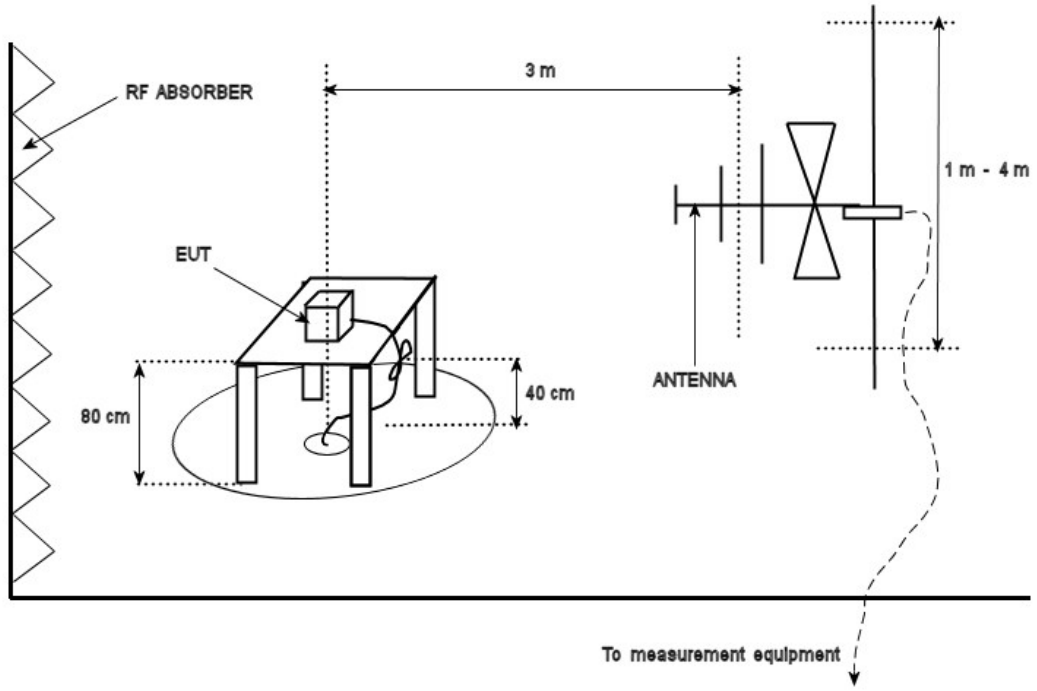
Note: A peak limit that is 20 dB higher than the limits specified above applies.

[1]Limit below 1 GHz is measured with 120 kHz measurement bandwidth and a using a Quasi Peak detector. If the limit is exceeded with the Quasi-Peak detector, it will be re-measured with an Average detector and compared against the limits specified in 15.231(e) if so applicable. The detector (and method) used shall be noted in the final measurement table in this report.

[2]Limit above 1 GHz is is with 1 MHz measurement bandwidth and using an Average detector, and scanned in accordance with 15.33 to above the 5th harmonic.

[3]F is frequency in kHz.

Typical Radiated Emissions Setup



Measurement Uncertainty

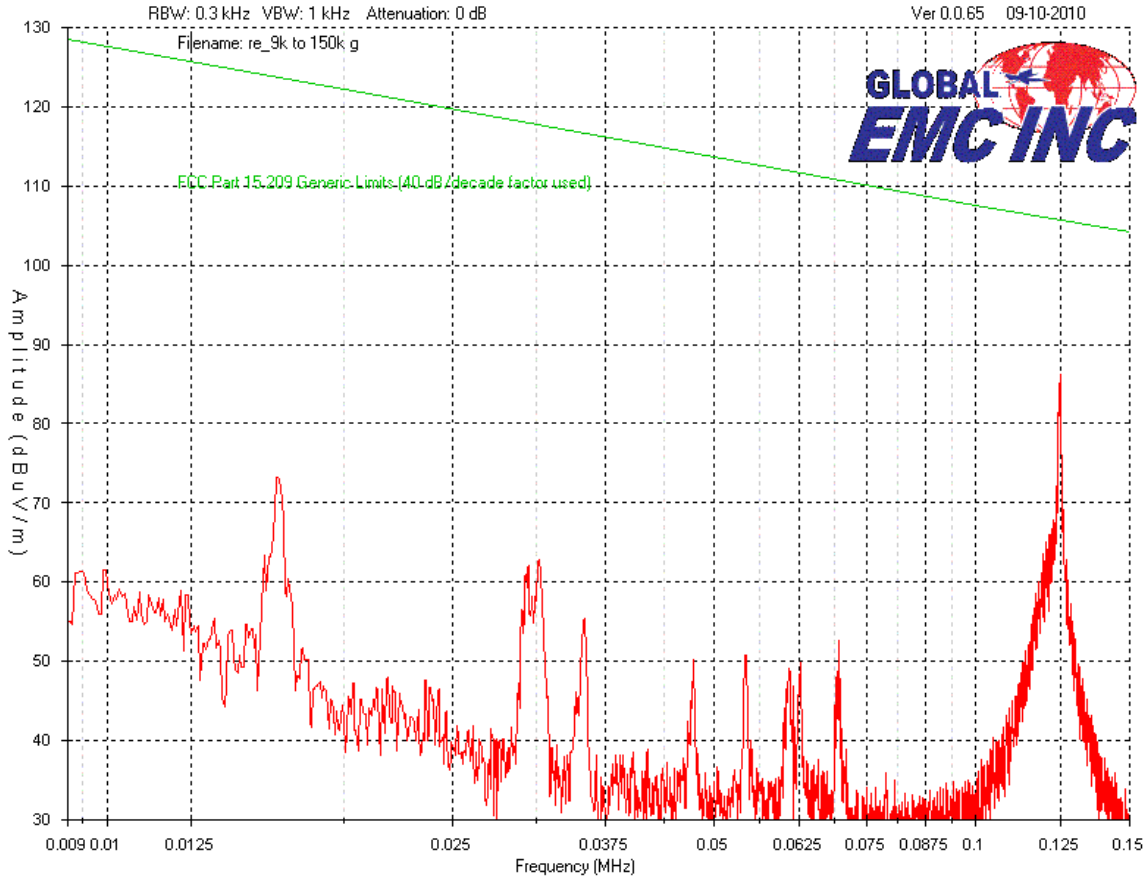
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, or with the appropriate factors taken into account please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater then the final required detector and over a full 0-360 rotation of the EUT. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to a minimum of a 5 GHz.

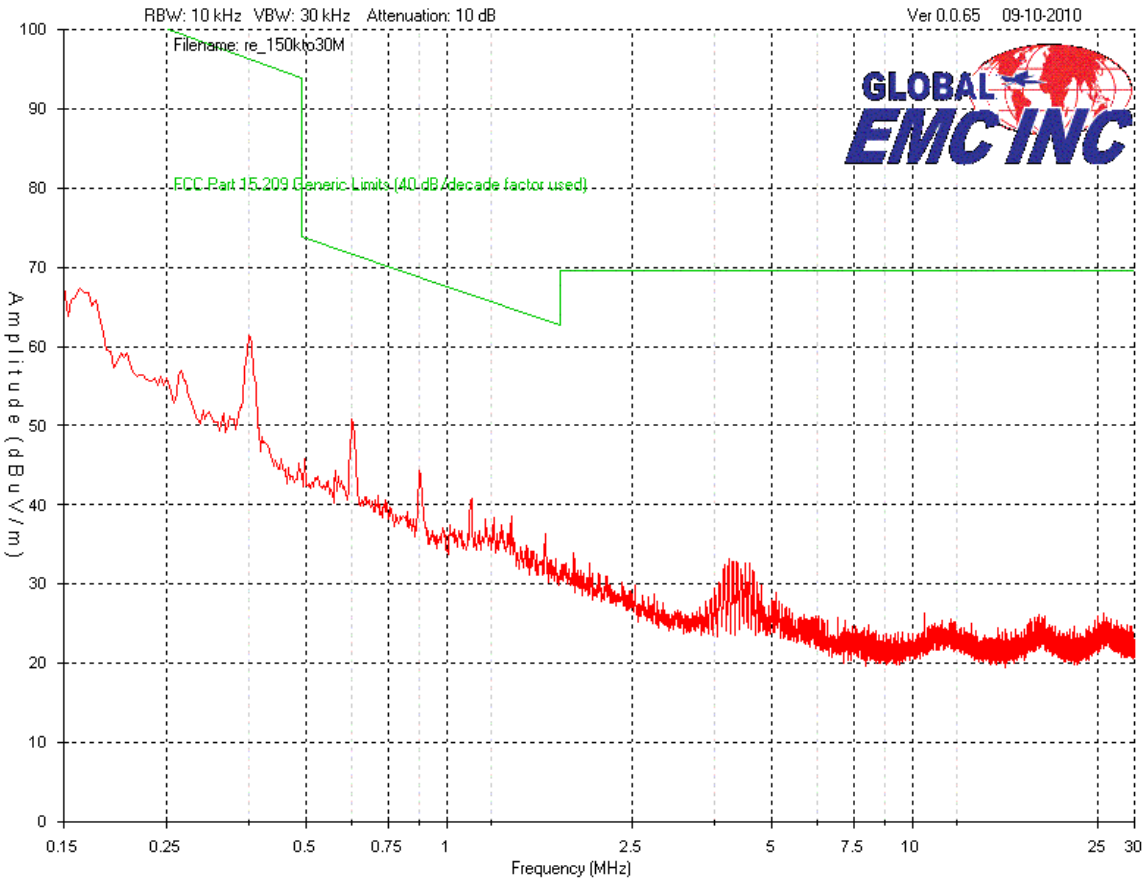
9 kHz to 150 kHz at 3 meters



Note: The peak shown at 125 kHz was found to meet the requirement. Refer to tables.

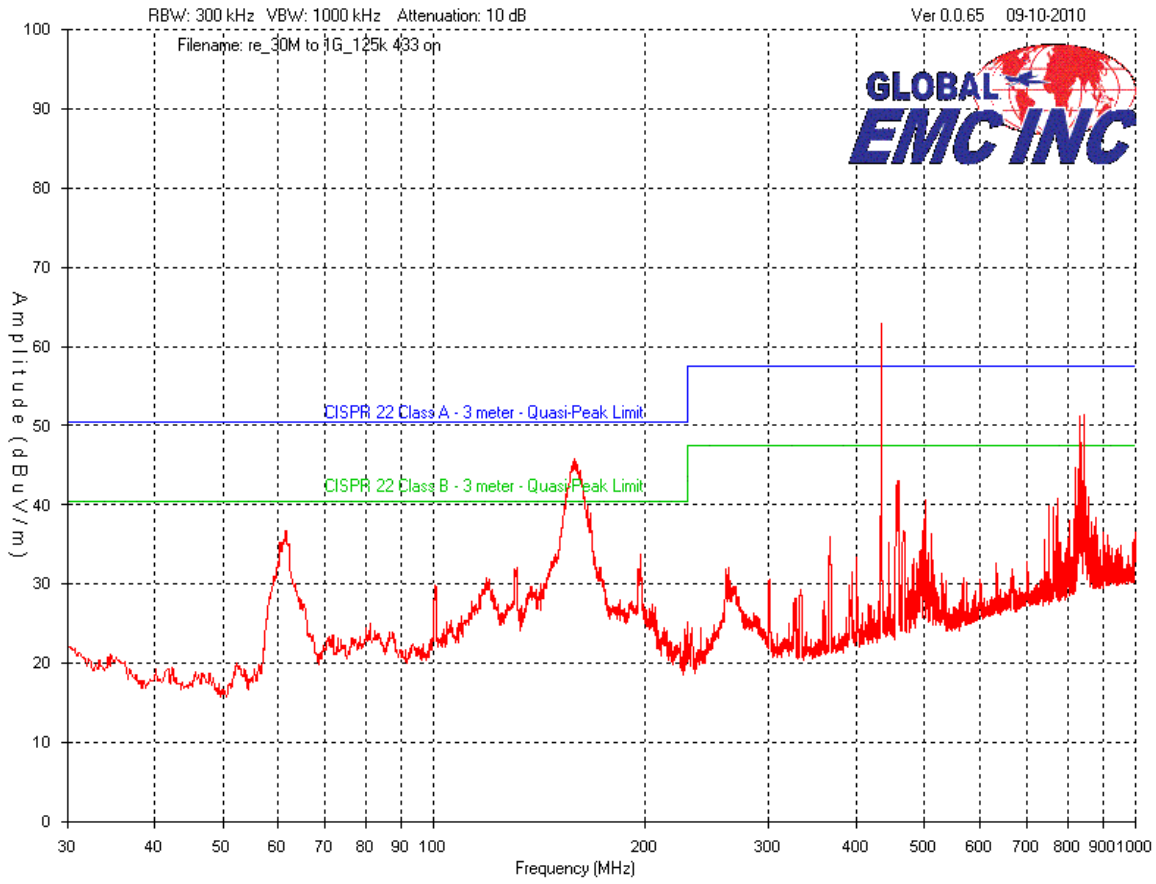
No emissions were detected in receive mode in this frequency band.

150 kHz to 30 MHz

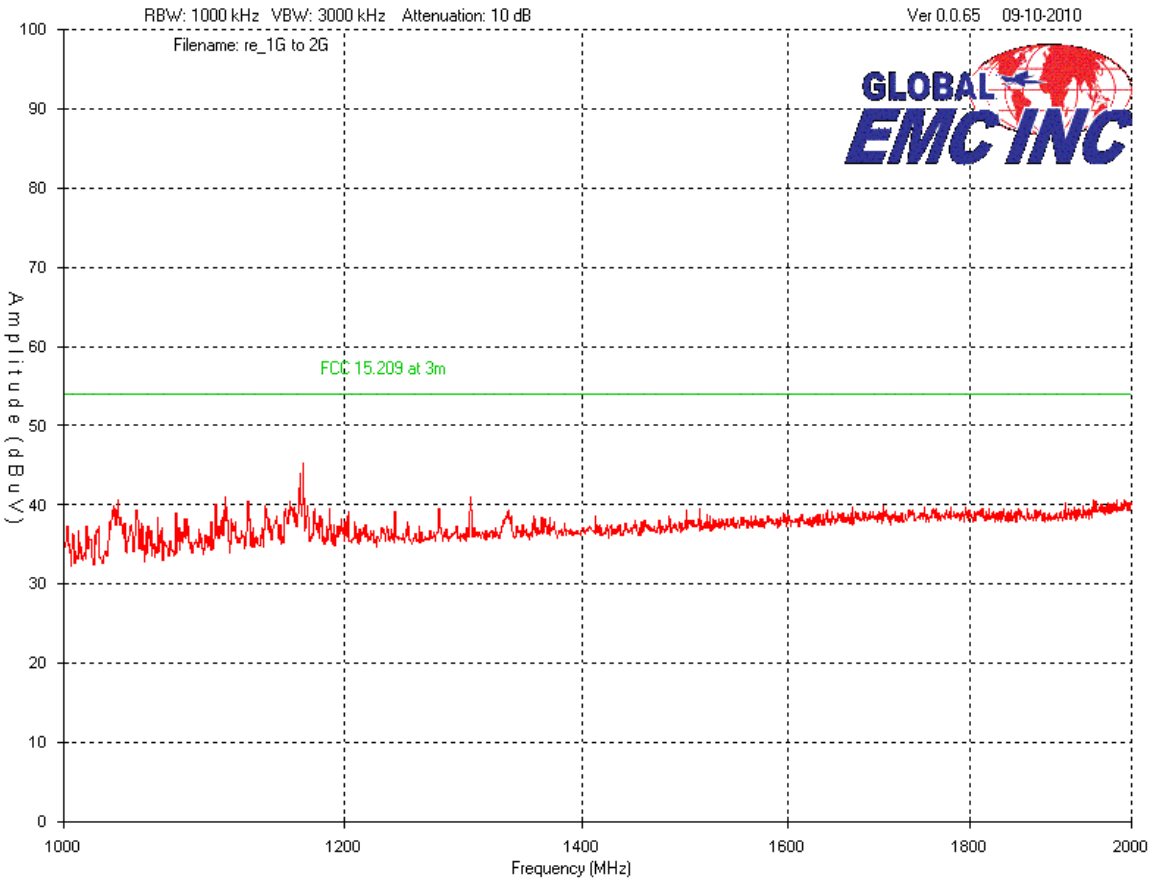


No emissions were detected in receive mode in this frequency band.

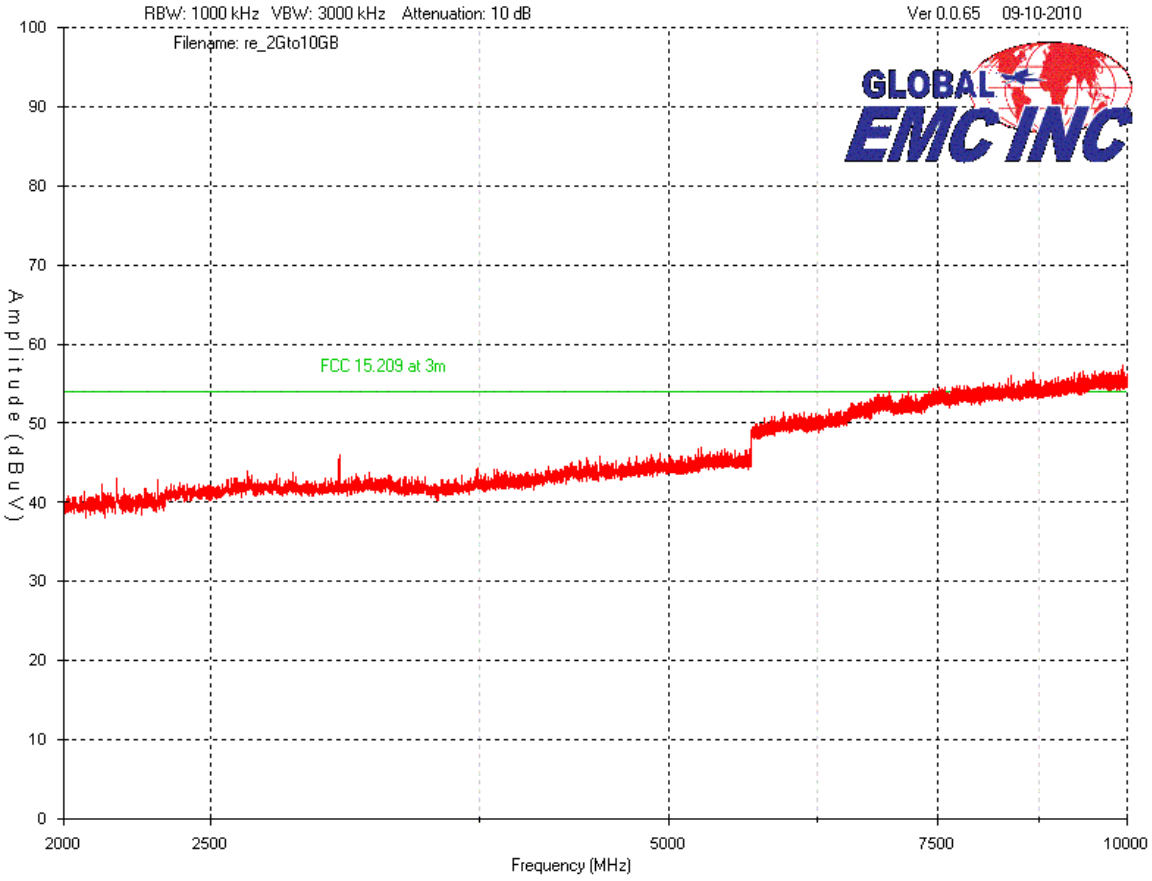
Vertical – Peak Emissions Graphs (125 kHz & 433 MHz on)



Emissions in receive mode in this frequency band, were the same as shown above, except the 433.92 MHz spike is not present.

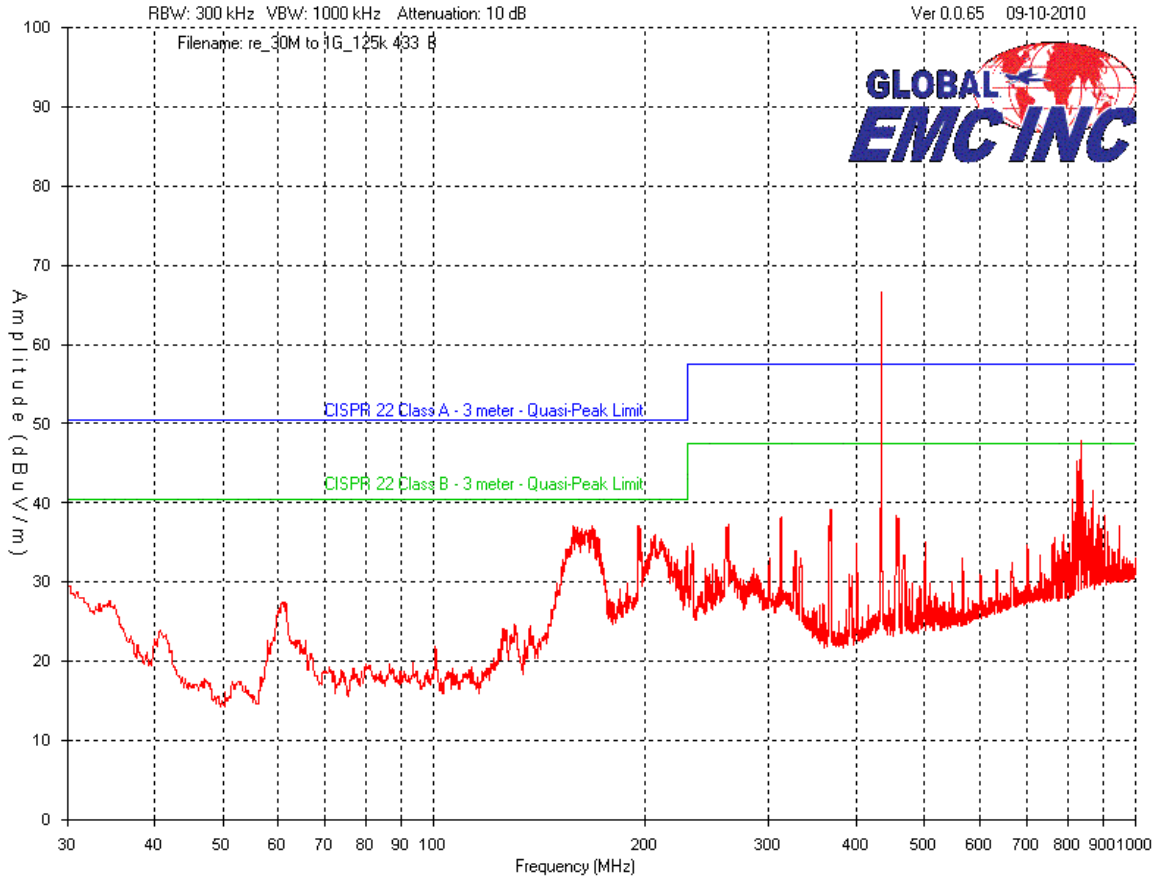


Emissions in receive mode in this frequency band, were the same as shown above

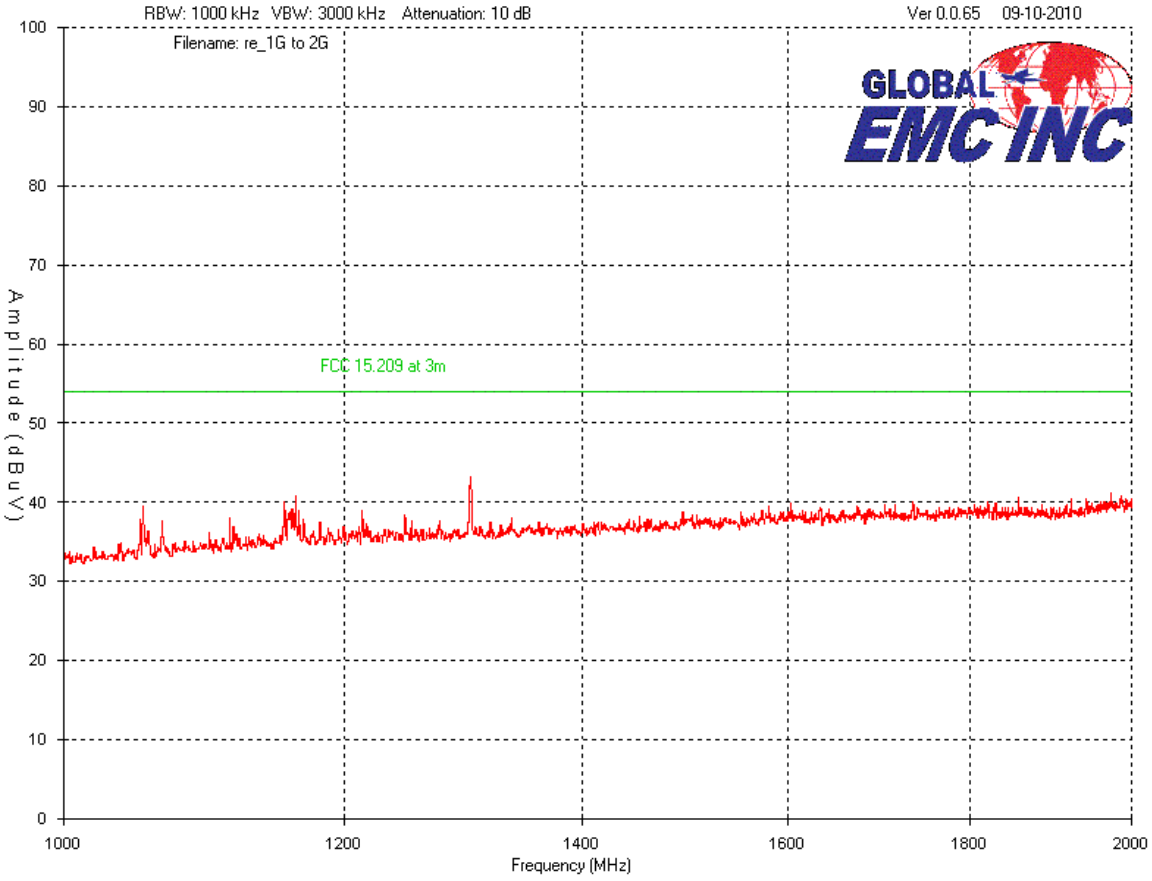


Emissions in receive mode in this frequency band, were the same as shown above

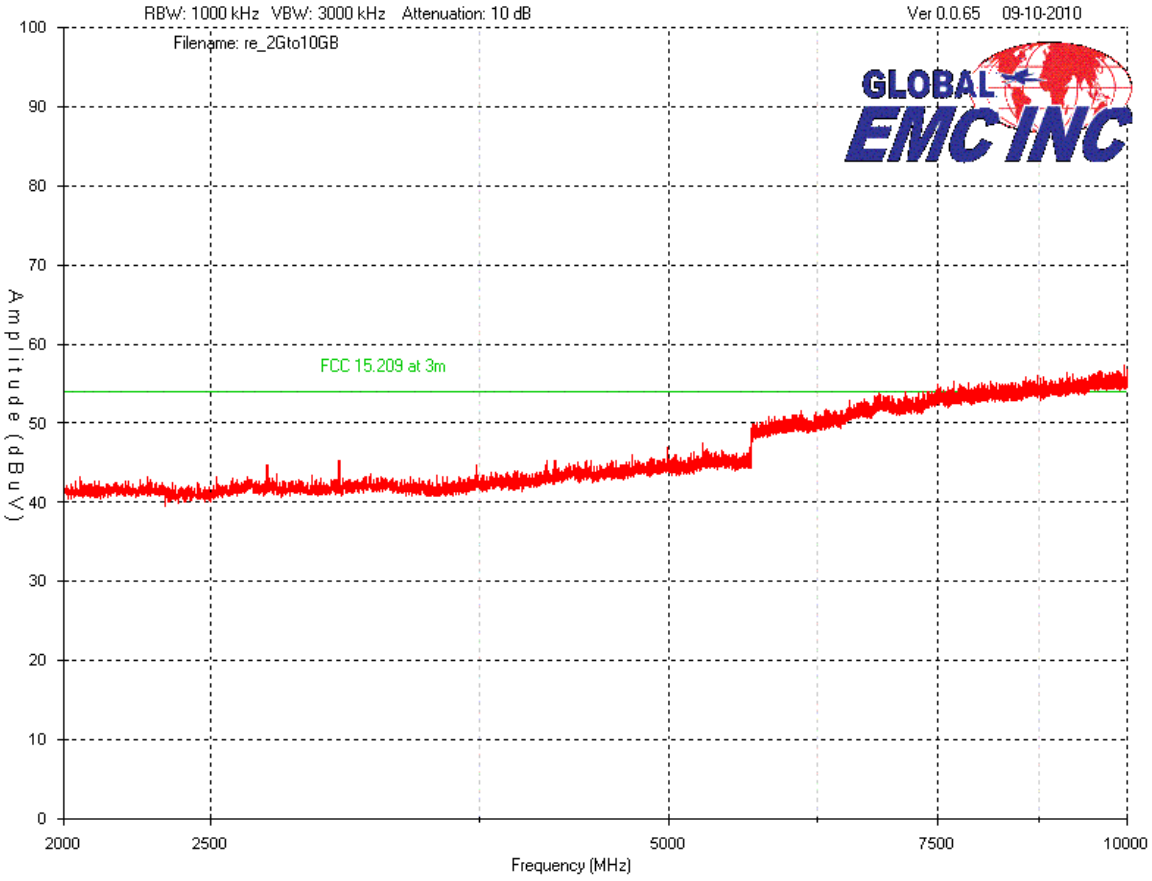
Horizontal – Peak Emissions Graph (125 kHz & 433 MHz ON)



Emissions in receive mode in this frequency band, were the same as shown above, except the 433.92 MHz spike is not present.



Emissions in receive mode in this frequency band, were the same as shown above



Emissions in receive mode in this frequency band, were the same as shown above

Final Measurements

9 kHz to 30 MHz

Frequency	Raw Reading	Ant Factor	Current to Voltage Factor	Preamp –(dB)	Level (dBuV/m)	Limits (40 dB/decade factor)	Margin
0.125	62.8	3.9	51.5	-32	86.2	105.7	19.5

Vertical – 30 MHz to 1 GHz

Frequency (MHz)	Reading (dBuV)	Ant – Factor (dB/m)	Cable (dB)	Preamp – Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass / Fail
433.92	76.1	17.3	0.7	-31.2	62.9			
158.331	63.9	9.2	0.5	-31.9	41.7	43.5	1.8	Pass
833.451	52.8	22.6	1.2	-30.3	46.3	46.4	0.1	Pass
61.428	60.9	7.5	0.4	-32	36.8	40	3.2	Pass
458.837	55.8	17.6	0.7	-31.1	43	46.4	3.4	Pass
500.741	53	18	0.7	-31	40.7	46.4	5.7	Pass
772.341	48.1	22	1.1	-30.5	40.7	46.4	5.7	Pass

Horizontal – 30 MHz to 1 GHz

Frequency (MHz)	Reading (dBuV)	Ant – Factor (dB/m)	Cable (dB)	Preamp – Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass / Fail
433.92	79.7	17.3	0.7	-31.2	66.5			
834.227	52.3	22.6	1.2	-30.3	45.8	46.4	0.6	Pass
825.109	51.1	22.4	1.2	-30.3	44.4	46.4	2	Pass
168.031	59.5	9	0.5	-31.8	37.2	43.5	6.3	Pass
195.482	57.8	10.6	0.5	-31.8	37.1	43.5	6.4	Pass
866.431	45.2	23.1	1.3	-30.3	39.3	46.4	7.1	Pass
367.657	53.7	16.2	0.6	-31.3	39.2	46.4	7.2	Pass

Note: Quasi-peak measurements applied above were made with a quasi-peak or peak detector with the device continuously transmitting data. These measurements do not apply a duty cycle correction factor to the peak data to correct for the average measurement.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
IFR Spectrum Analyzer	AN940	IFR	12/29/2009	12/29/2011	GEMC 6350
BiLog Antenna	3142-C	ETS	2009-02-12	2011-02-12	GEMC 8
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	8/25/2010	8/25/2012	GEMC 6403
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31
Q-Par 1.5-18 GHz Horn	6878/24	Q-par	8/25/2010	8/25/2012	GEMC 6365
Loop Antenna	EM 6871	Electro-Metrics	On file	2011-08-16	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	On file	2011-08-16	GEMC 71
HP Preamp	HP-8449B	HP	8/25/2010	8/25/2012	GEMC 6351

This report module is based on GEMC template “FCC - 15.209 - Radiated Emissions_Rev1.doc”

Duty Cycle of Periodically Operated Transmitters

Purpose

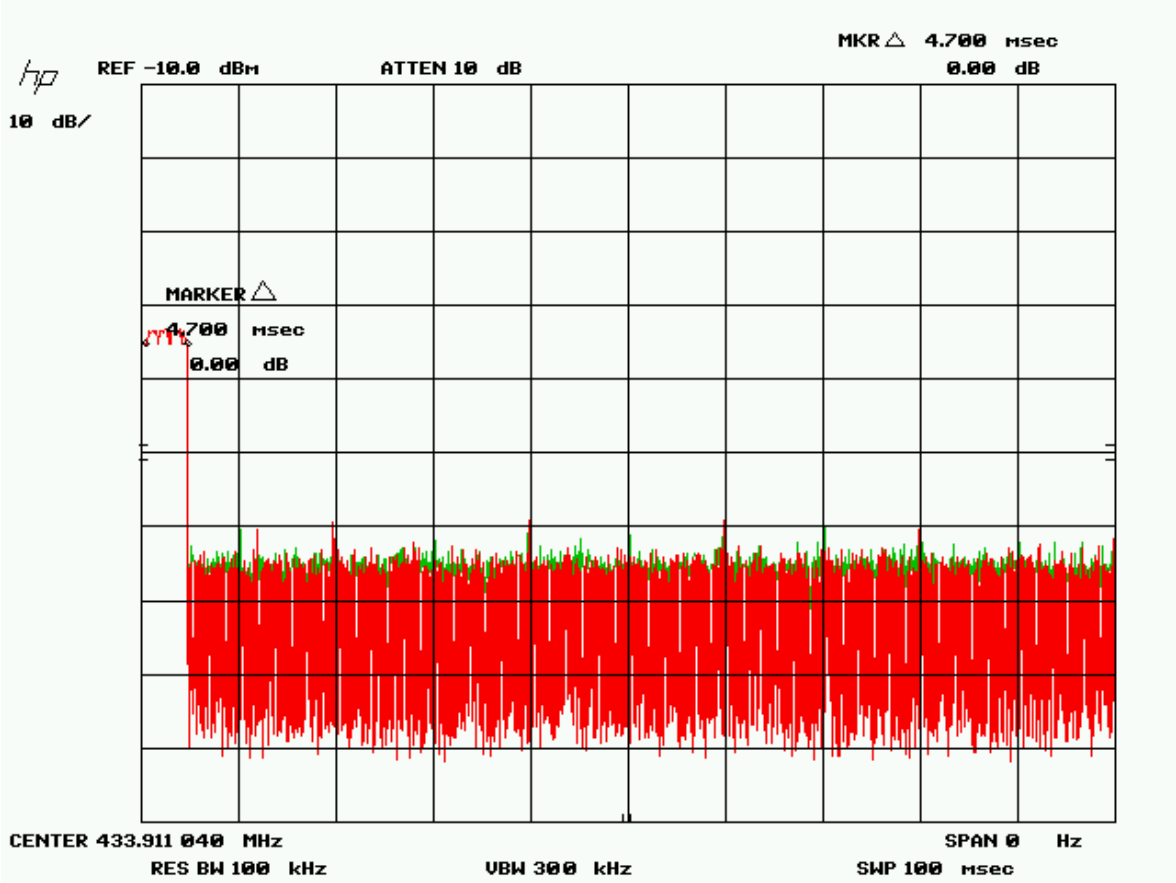
The purpose of this test is to measure the duty cycle of the transmitter. This calculation allows a true peak to average correction factor to be obtained. An average measurement may not be possible, as the device may be set to continually transmitting. Also, an average measurement may not be correct if the device transmits more frequently or less frequently than every 100 mS.

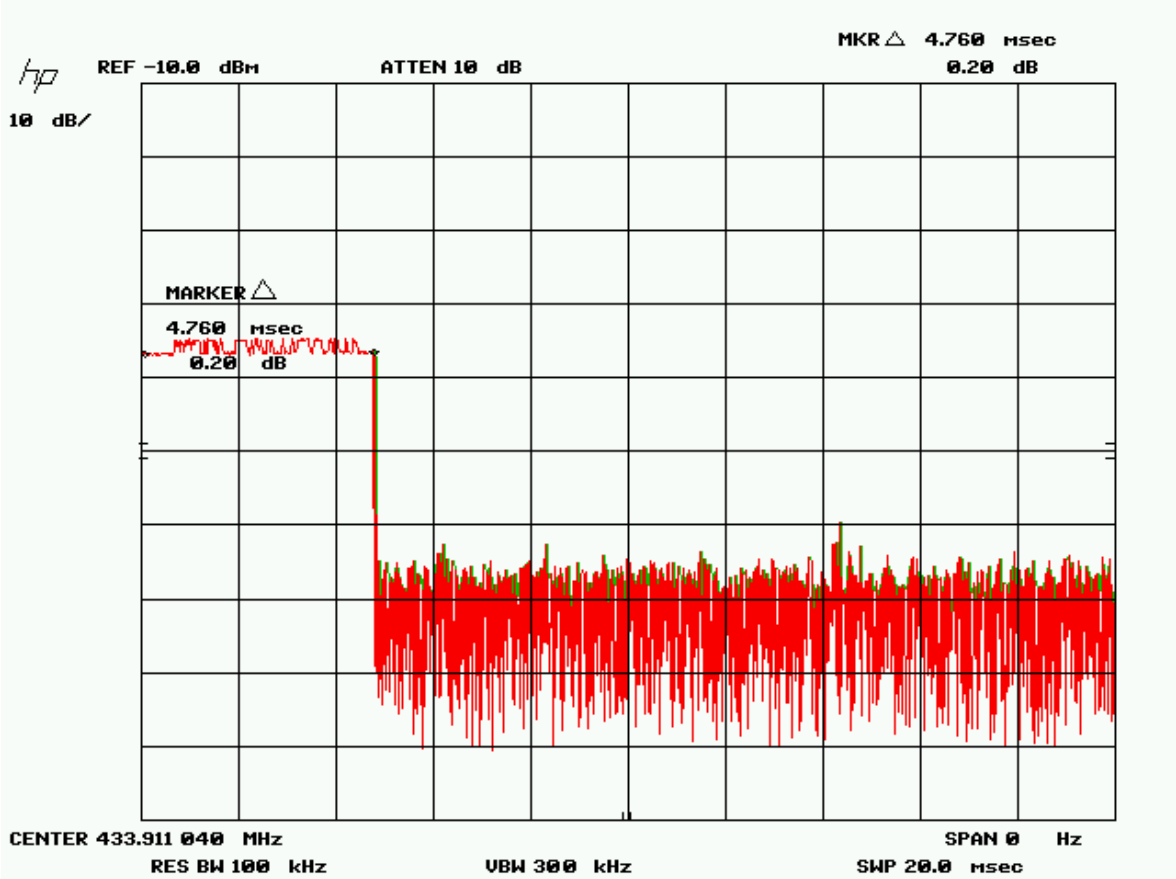
This calculation of duty cycle correction is then applied to the radiated emissions peak reading to obtain the calculated average

Limits

No limit applies, however this calculation is applied to the peak reading to obtain the average reading which must be under the average limit.

Results





Time on = 4.76 mSec
Duty cycle = 20 Log (4.76 / 100)
Duty cycle = -26.4 dB

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
IFR Spectrum Analyzer	AN940	IFR	12/29/2009	12/29/2011	GEMC 6350
BiLog Antenna	3142-C	ETS	2009-02-12	2011-02-12	GEMC 8
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	8/25/2010	8/25/2012	GEMC 6403
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31
Q-Par 1.5-18 GHz Horn	6878/24	Q-par	8/25/2010	8/25/2012	GEMC 6365
Loop Antenna	EM 6871	Electro-Metrics	On file	2011-08-16	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	On file	2011-08-16	GEMC 71
HP Preamp	HP-8449B	HP	8/25/2010	8/25/2012	GEMC 6351

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Radiated Emissions of 433.92 MHz Fundamental

Purpose

The purpose of this test is to ensure that the RF energy intentionally emitted from the EUT does not exceed the limit listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect other periodic operating devices, and licensed broadcasting devices, and so on, from unwanted interference.

Limit(s) and Method

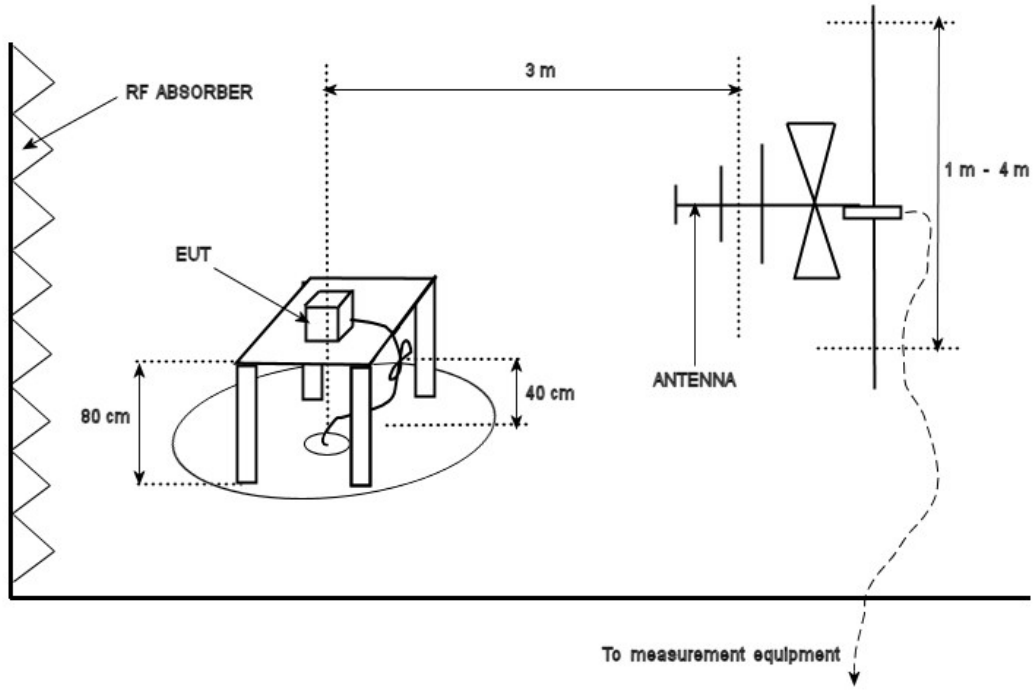
The method is as defined in ANSI C63.4:2003.
The limits are as defined in FCC Part 15, Section 15.231 (e), and is specific for the one frequency for the fundamental transmit frequency.

433.92 MHz – 72.5 dBuV/m[1] and 92.5 dBuV/m[2]

[1]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.

[2]Based on the peak value of the measured emissions

Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a ‘k=2’ coverage factor and a 95% confidence level.

Final Measurements

Peak readings vs. average limit.

Frequency (MHz)	Reading (dBuV)	Det.	Pol.	Ant – Factor (dB/m)	Preamp – Factor (dB)	Cor.	Level (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Pass / Fail
433.92	76.1	Pk	V	17.3	0.7	-31.2	62.9	72.5	9.6	Pass
433.92	79.7	Pk	H	17.3	0.7	-31.2	66.5	72.5	6	Pass

Note a duty cycle of -26.4 applies, as calculated in the duty cycle section of this report, however due to margin exhibited, was not applied.
The device complies with the requirement. A worst case measurement of 72.9 dBuV/m at 3 meters was obtained using a peak detector at a center frequency of 433.92 MHz in the vertical polarity.

Test Equipment List

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
IFR Spectrum Analyzer	AN940	IFR	12/29/2009	12/29/2011	GEMC 6350
BiLog Antenna	3142-C	ETS	2009-02-12	2011-02-12	GEMC 8
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
Chase Preamp 9kHz - 2 GHz	CPA9231A	Chase	8/25/2010	8/25/2012	GEMC 6403
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev1.doc"

20 dB Bandwidth of Periodically Operated Transmitters

Purpose

The purpose of this test is to ensure that the bandwidth occupied does not exceed a stated minimum. This helps ensure the utilization of the frequency allocation is sufficiently narrow and not occupying excessive spectrum. This also helps prevent accidently interference of data by ensuring adequate data separation to distinguish the reception of the intended information by enabling the receiver to have a relatively narrow band response tuned to the transmitter's frequency.

Limits

The Limit is as specified in FCC Part 15 and RSS 210.

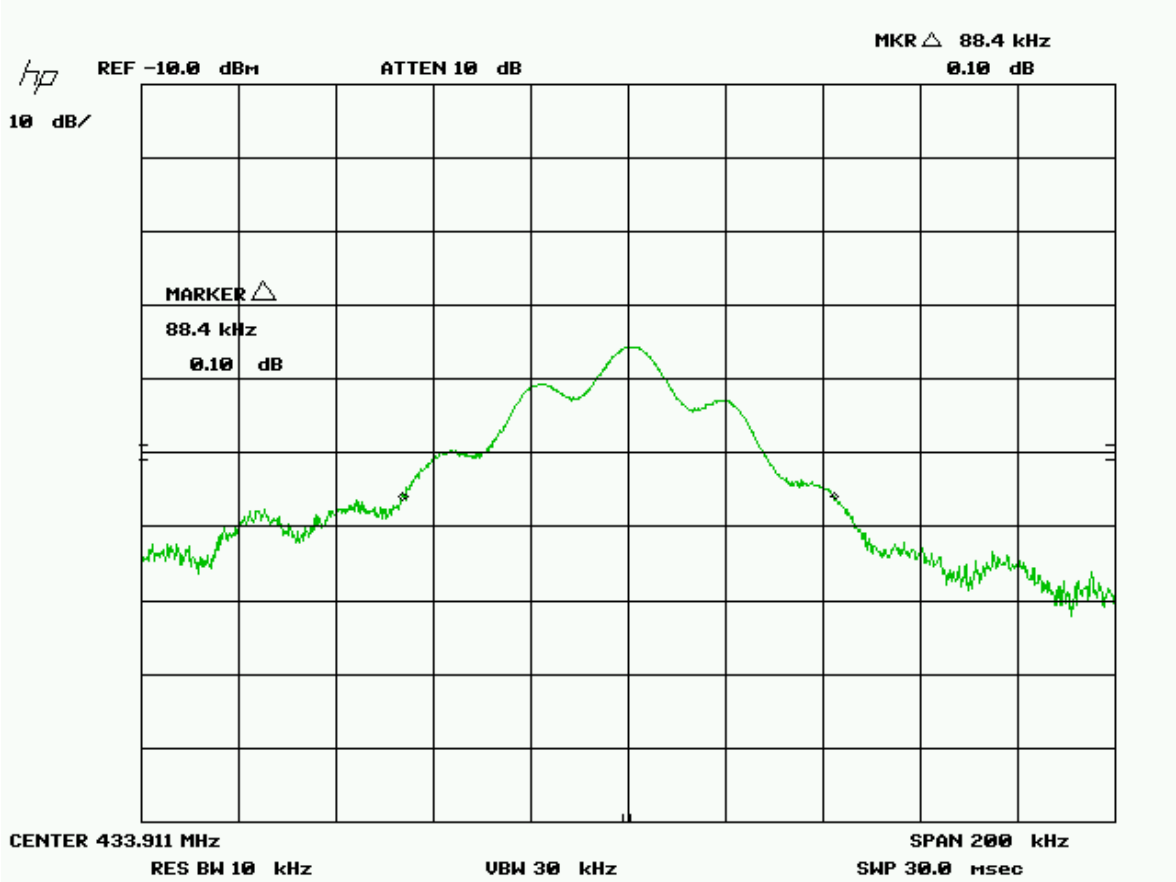
For periodic transmitters below 900 MHz, this should not exceed 0.25 % of the fundamental frequency. The limit for 433.92 MHz is 108.5 kHz. This should be measured with a RBW equal to approximately %1 (or greater) of the 20 dB bandwidth of the signal and a VBW > then the RBW.

Results

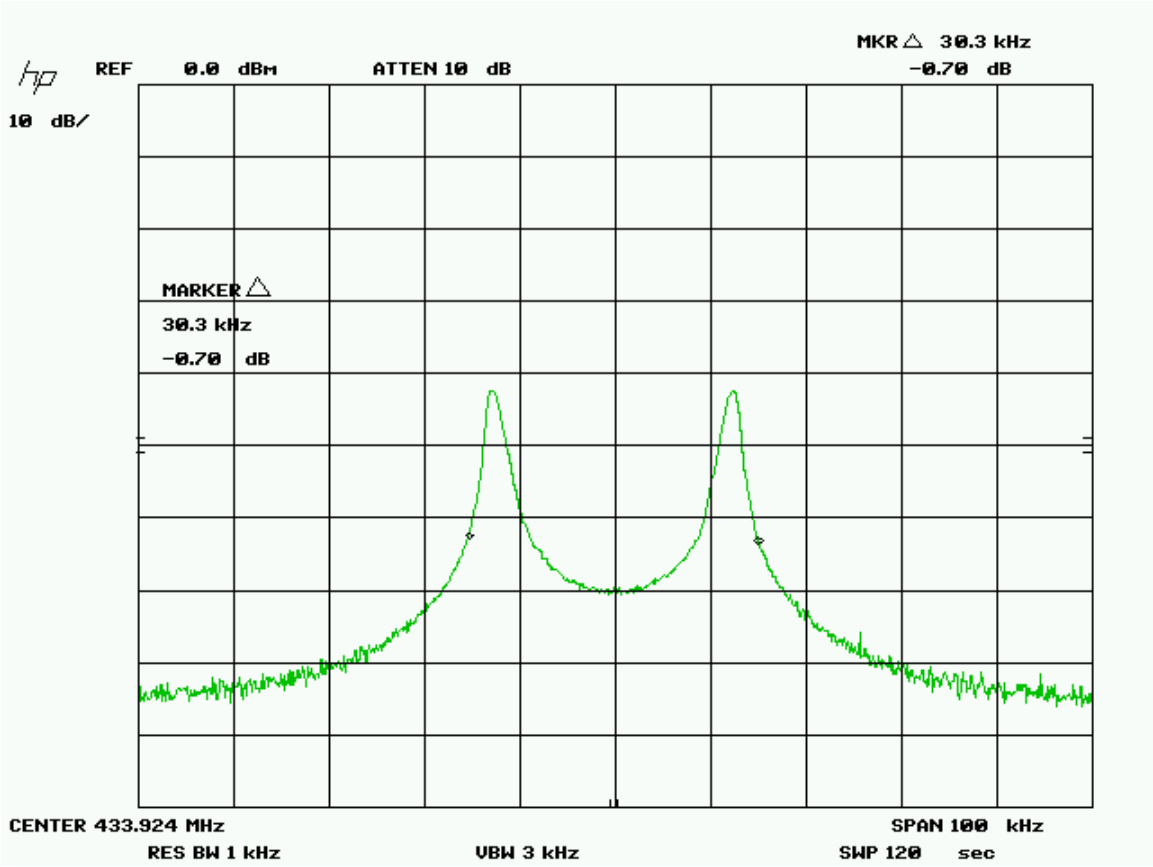
The EUT passed. The 20 dB bandwidth measured was 88.4 kHz and the requirement was that this be less than 108.5 kHz.

Graph(s)

The graphs shown below shows the channel spacing during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is approximately 1 % of the 20 dB BW during operation of the EUT. This measurement is a peak measurement. Max hold is performed for a duration of not less then 1 minute.



Transmitter with predetermined data pattern.



Transmitter with predetermined ON/OFF Pattern.

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Attenuator 20 dB	FP-50-20	Trilithic	NCR	NCR	GEMC 43
IFR Spectrum Analyzer	AN940	IFR	12/29/2009	12/29/2011	GEMC 6350
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	GEMC 49

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Appendix A – EUT/Customer Summary

For further details for filing purposes, refer to filing package.

General EUT Description

Manufacturer	Lyngsoe Systems
EUT Name	ADM (Automated Delivery Measurement)
FCCID	PQG-ADM
IC #	4113A-ADM
Approximate Size (LxWxH)	18.5 cm x 9 cm x 2 cm
Equipment Category (Commercial / Residential / Medical)	Commercial
Input Voltage and Frequency	Battery powered
Table Top / Wall mount / Floor standing (choose table top if unsure)	Table top
I/O Connectors available on EUT	None – self contained
Peripherals required for test	None
Minimum Separation distance from operator	20 cm.
Types and lengths of all I/O cables	Ethernet, up to 100 meters.

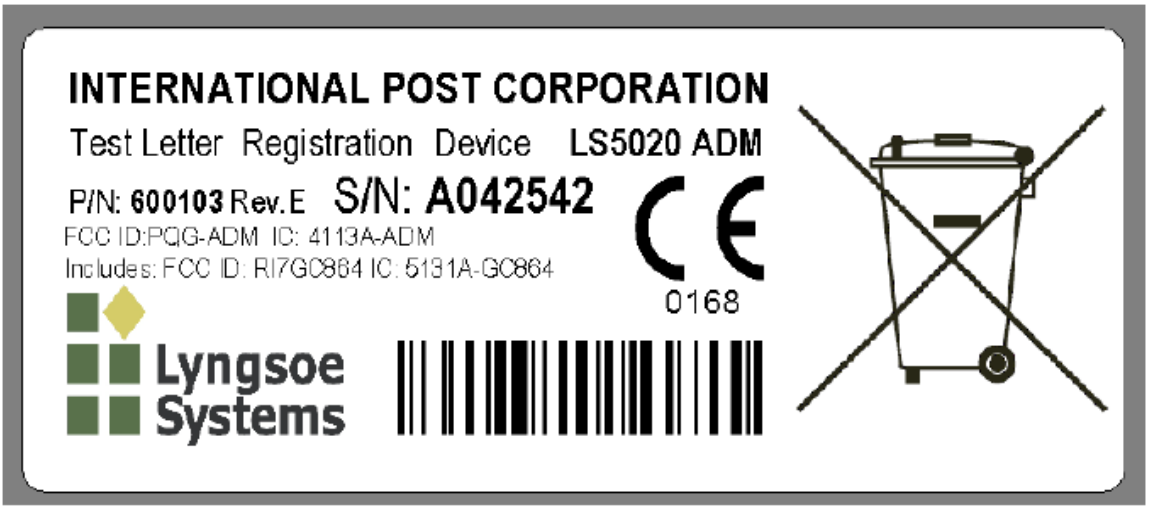
Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see 'Appendix B – EUT & Test Setup Photographs'.

Appendix B – EUT and Test Setup Photographs

Note: These photos are for information purposes only. Also refer to PDF files that are separate from this test report.

EUT

EUT reverse



EUT – Labels

Radiated Emissions – 9 kHz to 30 MHz setup

Radiated emissions – 30 MHz to 1 GHz

Note: Although this unit is shown connected to a computer during testing, this provision is only available in the test unit provided for the purposes of initiating the continuous test mode operation. Normal operation would not have this device connected to a computer.

Radiated Emissions – 1 GHz to 10 GHz

Although this unit is shown connected to a computer during testing, this provision is only available in the test unit provided for the purposes of initiating the continuous test mode operation. Normal operation would not have this device connected to a computer.