RF Exposure Evaluation Report

FOR:

Model Name: Xirgo 6000
Reefer container monitoring devices

FCC ID: GKM-XT6000
IC ID: 10281A-XT6000

References:

1. FCC OET Bulletin 65 Supplement
2. FCC CFR Part 1 (1.1307 &1.1310), Part 2 (2.1091)
3. RSS-102- Radio Frequency Exposure Compliance of Radiocommunication Apparatus Issue 4 March 2010

1 Administrative Data

1.1 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 Director:	Heiko Strehlow
Responsible Project Leader:	Calvin Lee

1.2 Identification of the Client

Applicant's Name:	Xirgo Technologies
Street Address:	188 Camino Ruiz
City/Zip Code	Camarillo, CA 93012
Country	USA
Contact Person:	Shawn Aleman
Phone No.	805-426-5243
e-mail:	saleman@xirgotech.com

1.3 Identification of the Manufacturer

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

2 Equipment under Test (EUT)

2.1 Specification of the Equipment under Test

Model No:	XT-6000
Hardware Revision :	XT6000-001;
Software Revision :	XT6000-01;
Integrated Module Information:	uBlox LISA-U200 HW Ver: 146A00 SW Ver: 21.21
FCC-ID:	GKM-XT6000
IC-ID:	10281A-XT6000
Frequency:	GSM 850: 824.2-848.8MHz; PCS 1900: 1850.2-1909.8MHz FDD V: 826.4-846.6MHz; FDD II: 1852.4-1907.6MHz GPS RX 1.575 GHz ZigBee: 2405-2475 MHz
Type(s) of Modulation:	GSM/UMTS: GMSK; 8-PSK; QPSK; 16QAM Zigbee: OQPSK
Number of channels:	GSM850: 125 and PCS 1900: 300 FDD II: 278/ FDD V: 103 Zigbee: 15
Antenna Type:	Hirschmann HCEL-S2-0125A-01 Tri-Band Antenna: GPS, Cellular and WLAN Antenna Gain @ 2.4 GHz band = 5dBi (As reported by the manufacturer)
Co-located Transmitters/ Antennas?	■ Yes ☐No
Rated Power supply:	20V – 48V AC (or) 30V DC
Rated Operating temperature range:	-40°C ~ 70°C
Prototype / Production unit:	Prototype
Device Category:	■ Fixed Installation ☐ Mobile ☐ Portable
Exposure Category:	☐ Occupational/ Controlled ■ General Population/ Uncontrolled

3 Assessment

This report serves as the Technical Information regarding RF Exposure evaluation of the below identified device according to the rules as stipulated in the documents listed under References above.

The device meets the RF exposure limits, or - for some of it's radio functions / bands - the conditions for exemption from routine evaluation as defined in the referenced FCC and IC rule parts.

Company	Description	Model #
Xirgo Technologies	Reefer container monitoring devices	XT-6000

Date	Section	Name	Signature
2012-05-17	Compliance	Calvin Lee (EMC Engineer)	Calvin Lee Digitally signed by Calvin Lee DN: cn=Calvin Lee, c=US, o=CETECOM Inc, ou=Compliance, email=calvin.lee@cetecomusa.com Date: 2012.05.17 09:50:50 -07'00'

4 RF Exposure Evaluation Requirements

4.1 FCC:

Calculations can be made to predict RF field strength and power density levels around typical RF sources using the general equations (3) and (4) on page 19 of the following FCC document:
"OET Bulletin 65, Edition 97-01 - Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields".

The table below is excerpted from Table 1B of 47 CFR 1.1310 titled Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure:

Frequency Range (MHz)	Power density (mW/cm^2)	Averaging time (minutes)
300 – 1500	f (MHz) /1500	30
1500 – 100.000	1.0	30

Using the equation from page 19 of OET Bulletin 65, Edition 97-01:

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Note:
1. This device is to be used only for fixed and mobile applications.
2. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all the persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Additionally, according to § 2.1091:
The limit for <1.5 GHz mobile operations where no routine evaluation is required is: 1.5W ERP
The limit for >1.5 GHz mobile operations where no routine evaluation is required is: 3W ERP

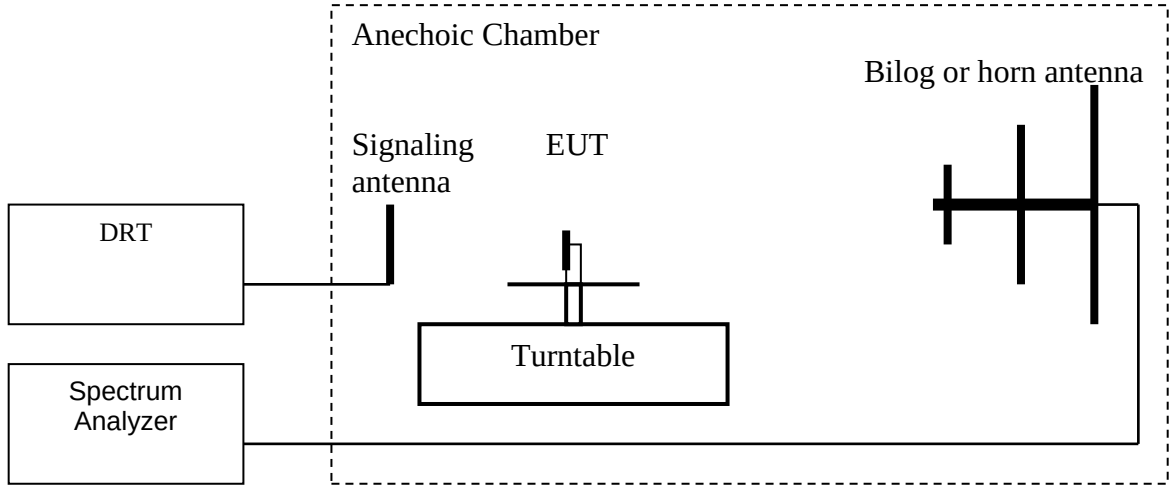
4.2 IC:

RSS-102 Section 2.5.2
RF exposure evaluation is required if the separation distance between the user and the device's radiating element is greater than 20 cm, except when the device operates as follows:
- below 1.5 GHz and the maximum EIRP of the device is equal to or less than 2.5 W;
- at or above 1.5 GHz and the maximum EIRP of the device is equal to or less than 5 W.

RSS-102 4.2: RF Field strength limits for devices used by the General Public (Uncontrolled Environment):
Power density
300MHz- 1500 MHz= f/150 W/m^2
1500 MHz- 1500000 MHz= 10 W/m^2

5 Measurement procedure:

5.1 Radiated power measurement- ERP/EIRP-

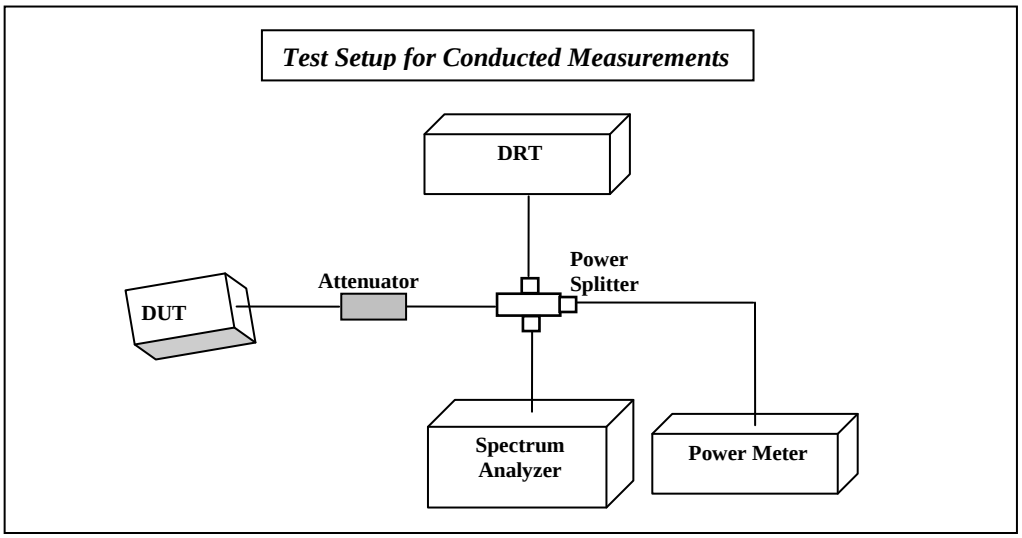


1. Connect the equipment as shown in the above diagram with the EUT's antenna in center of the turn table.
2. Adjust the settings of the Digital Radio Communication Tester (DRT) to set the EUT to its maximum power at the required channel.
3. Set the spectrum analyzer to the channel frequency. Set the analyzer to measure peak hold with the required settings.
4. Rotate the EUT 360°. Record the peak level in dBm (**LVL**).
5. Replace the EUT with a vertically polarized half wave dipole or known gain antenna. The center of the antenna should be at the same location as the center of the EUT's antenna.
6. Connect the antenna to a signal generator with known output power and record the path loss in dB (**LOSS)**. **LOSS** = Generator Output Power (dBm) – Analyzer reading (dBm).
7. Determine the ERP using the following equation:
   ERP (dBm) = **LVL** (dBm) + **LOSS** (dB)
8. Determine the EIRP using the following equation:
   EIRP (dBm) = **ERP** (dBm) + 2.14 (dB)
9. Measurements are to be performed with the EUT set to the low, middle and high channel of each frequency band.

Measurement uncertainty: +/-3.0 dB

(**Note:** Steps 5 and 6 above are performed prior to testing and **LOSS** is recorded by test software. Steps 3, 4, 7 and 8 above are performed with test software.)

5.2 Radiated power Calculation- ERP/EIRP-



1. Connect the equipment as shown in the above diagram.
2. Adjust the settings of the Digital Radio Communication Tester (DRT) to connect the EUT at the required channel (OR) alternatively use the EUT to set to transmit at a specific mode.
3. Measure conducted power using the power meter or the Spectrum Analyzer.
4. ERP/EIRP is calculated by adding the antenna gain to the measured conducted power.
   EIRP= Measured conducted power+ Antenna Gain (dBi)
   (Antenna gain based on measurement or data from the antenna manufacturer.)
   ERP= EIRP- 2.14

5.3 Measurement Equipment information:

Instrument/Ancillary	Model	Manufacturer	Serial No.	Cal Date	Cal Interval
Radio Communication Tester	CMU 200	Rohde & Schwarz	101821	May 2011	2 Years
EMI Receiver/Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2011	2 Years
Spectrum Analyzer	FSU	Rohde & Schwarz	200302	May 2011	2 Years
Loop Antenna	6512	EMCO	00049838	Aug 2011	3 years
Biconilog Antenna	3141	EMCO	0005-1186	Apr 2012	3 years
Horn Antenna (1-18GHz)	3115	ETS	00035114	Mar 2012	3 years
Horn Antenna (1-18GHz)	3115	ETS	00035111	Apr 2012	3 years
Horn Antenna (18-40GHz)	3116	ETS	00070497	Feb 2012	3 years
Communication Antenna	IBP5-900/1940	Kathrein	n/a	n/a	n/a
High Pass Filter	5HC2700	Trilithic Inc.	9926013	Part of system calibration	
High Pass Filter	4HC1600	Trilithic Inc.	9922307	Part of system calibration	
Pre-Amplifier	JS4-00102600	Miteq	00616	Part of system calibration	
Power Smart Sensor	R&S	NRP-Z81	100161	May 2011	2 Years

5.4 Measurement Summary:

Band of operation	**Peak Radiated Power- EIRP**		**Limits (IC)** (where no routine evaluation is required)	**Peak Radiated Power ERP**		**Limits (FCC)** (where no routine evaluation is required)
MHz	dBm	mW	W	dBm	mW	W
GSM/GPRS/EDGE 824.2-848.8	35.34	3,419.8	2.5	33.2	2089.3	1.5
GSM/GPRS/EDGE 1850.2-1909.8	30.1	1,023.3	5	27.96	625.2	3
UMTS FDDV 826.4-846.6MHz	28.64	731.1	2.5	26.5	446.7	1.5
UMTS FDDII 1852.4-1907.6MHz	27.1	512.9	5	24.96	313.3	3
Zigbee 2.4GHz	12.98	19.86	5	10.84	12.13	3

Radios highlighted in green exempted from routine evaluation.

Power Density calculation:

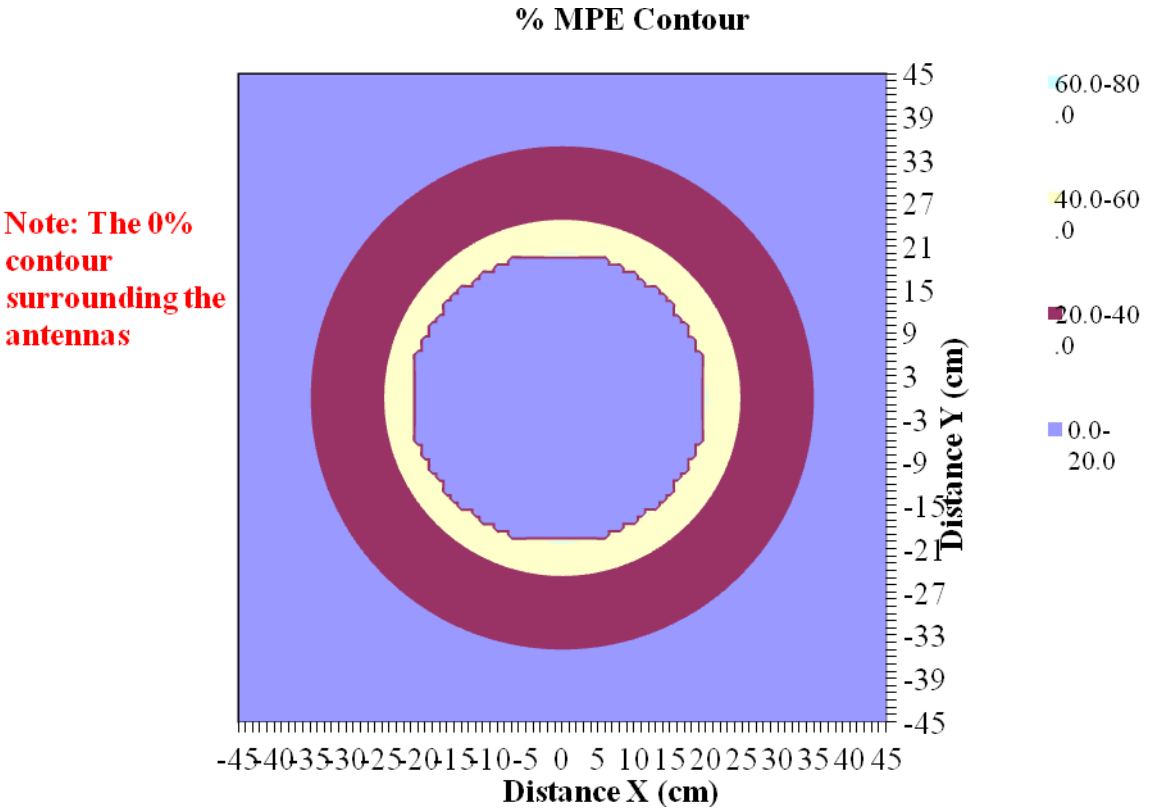
Band of operation	**Peak Radiated Power- EIRP**		**Duty Cycle (worst Case)**	**Distance (R)**	**Power Density** $(EIRP*DutyCycle)/(4\pi R^2)$	**Limit**	**Verdict**
	dBm	mW		cm	mW/cm^2	mW/cm^2	
GSM/GPRS/EDGE 824.2-848.8	35.34	3,419.8	50%	20	0.34	0.57	Pass

Prediction for Simultaneous Transmission

The MPE limit was made using a separation distance of 1 cm to represent the worse case.
Output power listed below is for 50% duty cycle in GSM mode.

GSM 850 Band and Zigbee co-transmission:

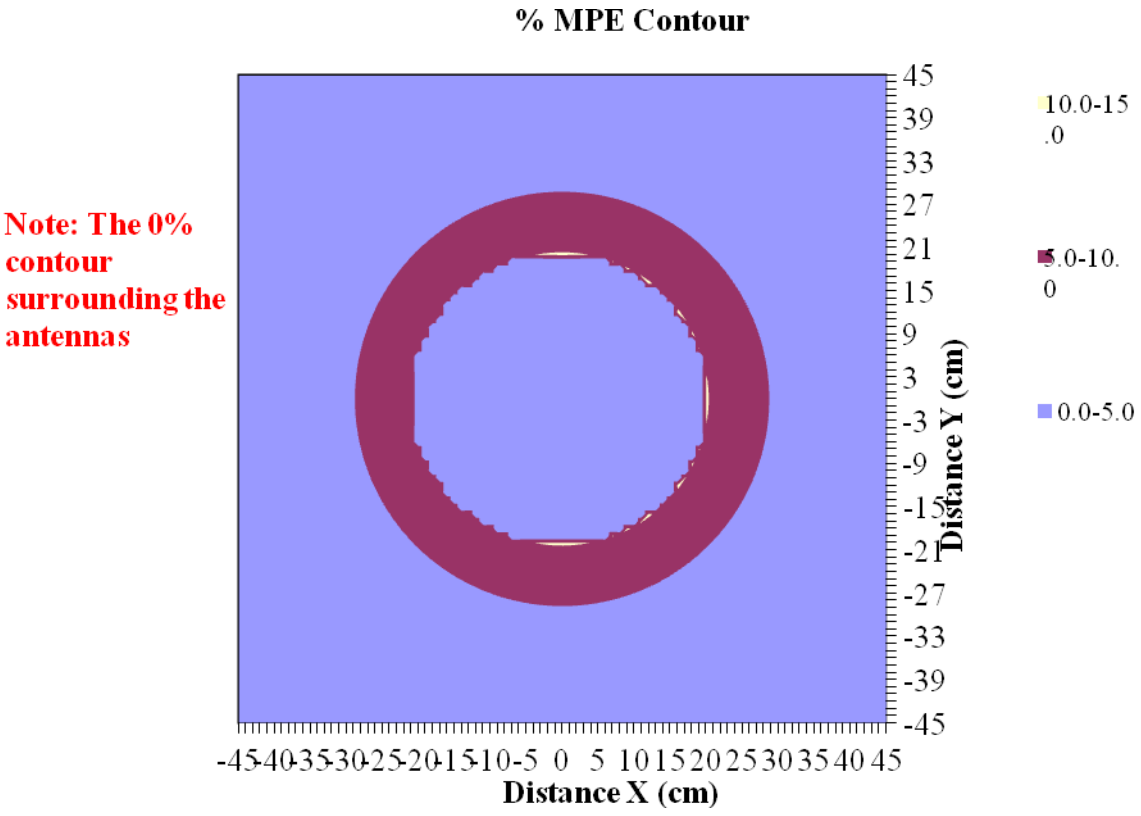
Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		2440	836
MPE Limit	mW/cm^2		1.00	0.56
Max % MPE	%	61.1	0.4	60.7
Power	(W)	1.720	0.020	1.700
Antenna Gain	dBi		0.00	0.00
EIRP	(W)	1.72	0.020	1.700
X	(cm)		-1.0	0.0
Y	(cm)		0.0	0.0
Sector			FALSE	FALSE
Arc			FALSE	FALSE
θ_1	degs	input	-120	-120
θ_2			60	60
θ_1		actual	-120	-120
θ_2			60	60



Verdict: Since the max MPE is <100%, the device is compliant in simultaneous transmission mode for GSM 850 and Zigbee.

GSM 1900 Band and Zigbee co-transmission:

Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		2440	1880
MPE Limit	mW/cm^2		1.00	1.00
Max % MPE	%	10.3	0.4	9.9
Power	(W)	0.520	0.020	0.500
Antenna Gain	dBi		0.00	0.00
EIRP	(W)	0.52	0.020	0.500
X	(cm)		-1.0	0.0
Y	(cm)		0.0	0.0
Sector			FALSE	FALSE
Arc			FALSE	FALSE
θ_1	degs	input	-120	-120
θ_2			60	60
θ_1		actual	-120	-120
θ_2			60	60



Verdict: Since the max MPE is <100%, the device is compliant in simultaneous transmission mode for GSM 1900 and Zigbee.