RF Exposure Evaluation Report

FOR:

Model Name: Ranger 4 HSPA
Rugged and compact vehicular computer connecting the fleet and the office, supports voice and data, automatic vehicle location, e-work orders and vehicle telemetry

FCC ID: RZ3RAN48790
IC ID: 2234A-RAN48790

References:

1. FCC OET Bulletin 65 Supplement C
2. FCC CFR Part 2
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:	Satya Radhakrishna

1.2 Identification of the Client

Applicant's Name:	Mentor Engineering Inc.
Street Address:	10, 2175 - 29th St NE
City/Zip Code	Calgary, Alberta /T1Y 7H8
Country	Canada
Contact Person:	Dominic Pituch
Phone No.	403-777-3760 x289
Fax:	403-777-3769
e-mail:	dpituch@mentoreng.com

1.3 Identification of the Manufacturer

Same as above.

2 Equipment under Test (EUT)

2.1 Specification of the Equipment under Test

Marketing Name:	Ranger 4.0
Model No:	Ranger 4 HSPA
HW Revision/ SW Revision:	4 1.02
FCC-ID/ IC-ID:	RZ3RAN48790 2234A-RAN48790
Product Description:	Rugged and compact vehicular computer, connecting the fleet and the office, supports voice and data, automatic vehicle location, e-work orders and vehicle telemetry
Frequency Range:	GSM 850: 824.2-848.8MHz; PCS 1900: 1850.2-1909.8MHz FDD V: 826.4-846.6MHz; FDD II: 1852.4-1907.6MHz WLAN: 802.11b,g ,n: 2412 – 2462 MHz BT: 2402- 2480 MHz
Number of channels:	GSM850: 125 and PCS 1900: 300 FDD II: 278/ FDD V: 103 WLAN: 802.11b,g ,n: 11 BT: 79
Type(s) of Modulation:	GMSK; 8-PSK; QPSK; 16QAM 802.11b: DSSS/ 802.11g,n: OFDM BT: GFSK, π/4DQPSK, 8DPSK
Antenna Type and Gain: **(As stated by manufacturer)**	GSM PCS & Cellular: Monopole Printed Trace Antenna 850 Band Peak Gain:-3.97 dBi 1900 Band Peak Gain:-1.39 dBi WLAN: Flexible Printed Circuit Antenna/ 5dBi Peak Gain.
Co-located Transmitters/ Antennas?	Yes. WWAN and WLAN WWAN and BT
Power supply:	12 Vdc ; Car battery
Operating temperature range:	-40ºC to 85ºC
Prototype / Production unit:	Rugged and compact vehicular computer, connecting the fleet and the office, supports voice and data, automatic vehicle location, e-work orders and vehicle telemetry
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 against the requirements in 47 CFR 2.1091and as the RF Exposure Technical Brief according to RSS-102 Ch. 2.2.

The following device has been evaluated and meets/is exempt from the RF Exposure Limits defined in 47 CFR 1.310 and RSS-102 Issue 4 Ch. 4.

Company	Description	Model #
Mentor Engineering Inc.	**Rugged and compact vehicular computer, connecting the fleet and the office, supports voice and data, automatic vehicle location, e-work orders and vehicle telemetry**	**Ranger 4 HSPA**

Date	Section	Name	Signature
2012-02-17	Compliance	Sajay Jose (EMC Lab Manager)	

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

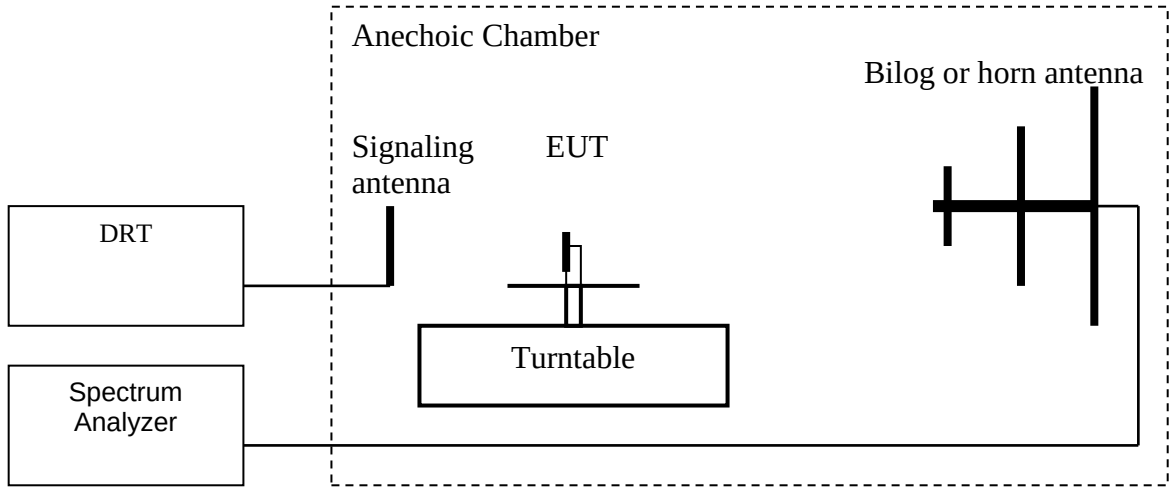
4.2 IC:

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-

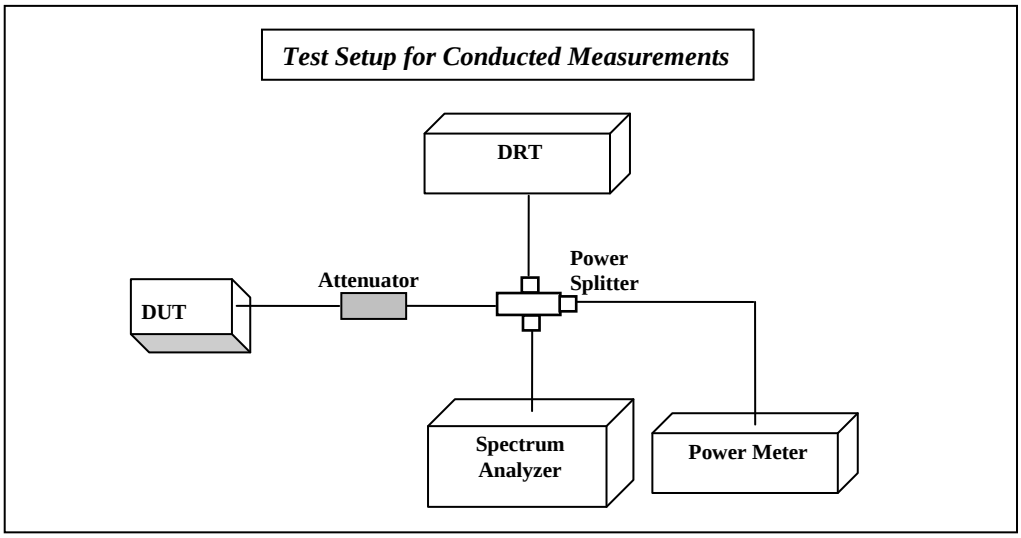


1. Connect the equipment as shown in the above diagram with the EUT's antenna in center of the turn table.
2. Adjust the settings of the Digital Radio Communication Tester (DRT) to set the EUT to its maximum power at the required channel.
3. Set the spectrum analyzer to the channel frequency. Set the 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

Measurement uncertainty: +/-0.5 dB

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	June 2009	3 years
Horn Antenna (1-18GHz)	3115	ETS	00035114	Mar 2009	3 years
Horn Antenna (1-18GHz)	3115	ETS	00035111	Jan 2009	3.5 years
Horn Antenna (18-40GHz)	3116	ETS	00070497	Aug 2011	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		Peak Radiated Power ERP		Procedure used for power estimation.
	dBm	W	dBm	W	
824.2- 848.8 MHz	36.42	4.39	34.28	2.68	Measured acc. to 5.1
1850.2- 1909.8 MHz	31.75	1.5	29.61	0.914	Measured acc. to 5.1
2412- 2462 MHz	19.68	0.0929	17.68	0.0586	Calculated acc. to 5.2
2402- 2480 MHz	8.45	0.007	6.31	0.004	Calculated acc. to 5.2

Based on the limits defined in Sec 4 of this report, routine evaluation is only required for the 824.2- 848.8 MHz band of operation.

For the unit tested by Cetecom Inc., the power density at a distance of 20cm can be deducted as follows-

Operation in cellular band (824.2-848.8 MHz)

FCC Limit: f (MHz) /1500=836.6/1500= 0.5577 mW/cm^2
IC Limit: f (MHz)/150 W/m^2 = 836.6/150= 5.577 W/m^2

Measured max EIRP= 36.42dBm= 4390 mW
Power density= EIRP*DutyCycle/($4\pi R^2$)
= 4390 *0.50/($4*\pi*20^2$)
= 0.44mW/cm^2 (4.4 W/m^2)

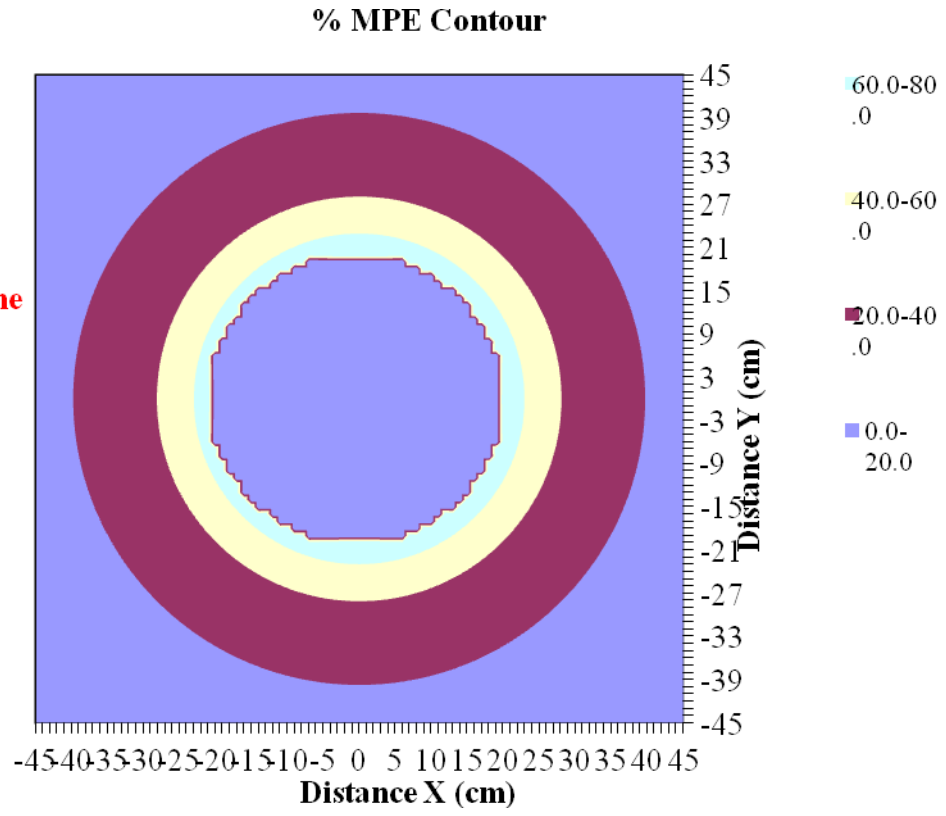
where duty cycle factor is 0.50 (worst case for GSM/GPRS) and R is 20cm.

Worst case prediction for simultaneous transmission

The MPE limit was made using a separation distance of 1 cm to represent the worse case.
WWAN 850 Tx and WLAN TX.
Max %MPE= 78.2 < 100%.

Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		2437	850
MPE Limit	mW/cm^2		1.00	0.57
Max % MPE	%	78.2	1.9	77.1
Power	(W)	2.288	0.093	2.195
Antenna Gain	dBi		0.00	0.00
EIRP	(W)	2.29	0.093	2.195
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

Note: The 0% contour surrounding the antennas



WWAN 1900 Tx and WLAN TX.

Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		2437	1850
MPE Limit	mW/cm^2		1.00	1.00
Max % MPE	%	16.8	1.9	14.9
Power	(W)	0.843	0.093	0.750
Antenna Gain	dBi		0.00	0.00
EIRP	(W)	0.84	0.093	0.750
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

Note: The 0% contour surrounding the antennas