



Radio Frequency Exposure Evaluation Report

For

Multi-Tech Systems, Inc.

MultiModem rCell®100 Series Router

FCC ID: AU792U13A16854

IC ID: 125A-0049

model numbers: MTR-H5-B10, MTR-H5-B09

Applied Rules and Standards

**CFR Part Part 1 (1.1307 &1.1310), Part 2 (2.1091),
FCC OET Bulletin 65 (1997-01) Supplement C (2001-01),
FCC KDB 447498 D01 General 24 RF Exposure Guidance v05r01**

Industry Canada RSS-102, Issue 4 of March 2010

Report number: EMC_MULTI_053_MTR_H5-V-BW_MPE_Rev1

DATE: 2014-01-27

1 Administrative Data

1.1 Identification of the Testing Laboratory Issuing the Test Report

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1.2 Identification of the Client / Manufacturer

Applicant's Name:	Multi-Tech Systems, Inc.
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Country	USA
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2 Equipment under Assessment

Marketing Name / Description:	MultiModem rCell® 100 Series Router
FCC-ID:	AU792U13A16854
IC certification no.:	125A-0049
Model Numbers (IC model numbers):	MTR-H5-B10, MTR-H5-B09
Product Description:	WLAN router incorporating a pre-certified IEEE 802.11bgn / Bluetooth combo module and a 3G module. (details see below)
Transmitter information:	<p>1.Telit HE910 FCC ID: RI7HE910; IC ID: 5131A-HE910</p> <ul style="list-style-type: none"> • 850/900/1800/1900Mhz GSM/GPRS/EDGE; modulation: GSM&GPRS&EDGE(MCS-1-4): GMSK; EDGE(MCS-5-8): 8PSK; • 850/900/1700/1900/2100 Mhz WCDMA / HSPA+; HSDPA Category 14 data rate - 21 Mbps; HSUPA Category 6 data rate - 5.76 Mbps; modulation: all QPSK (no QAM in uplink for given data rates); <p>2.Murata LBEE5ZSTNC, 802.11bgn 2.4 GHz / Bluetooth 4.0 combo module, FCC-ID: VPYLBTN, IC: 772C-LBTN;</p> <p>3.GPS 1575.42 MHz (model MTR-H5-B09 only)</p>
Antennae:	<p>cellular: external screw mount dipole antenna with SMA connector (Laird Hepta-SM MAF94300); 3dBi peak gain;</p> <p>WLAN/BT: 2.4GHz 2.3dBi Screw mount Dipole Antenna with RP-SMA(M) Connector (Taoglas GW.11.A153); 2.3dBi peak gain;</p> <p>The listed antennae are provided as accessories with the equipment.</p>
Co-located Transmitters/ Antennas?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Device Category:	<input checked="" type="checkbox"/> Fixed Installation <input type="checkbox"/> Mobile (mark mobile if both possible) <input type="checkbox"/> Portable <input type="checkbox"/> mixed Mobile and Portable
Exposure Category:	<input type="checkbox"/> Occupational/ Controlled <input checked="" type="checkbox"/> General Population/ Uncontrolled
Rated Operating Voltage:	Vmin: 7.0V/ Vnom: 9.0V/ Vmax: 32V through bundled AC/DC power supply, see accessories below;
Rated Operating temperature range:	Tmin: -40°C / Tmax: 80°C
Test Sample Status:	Production

3 Assessment

This RF Exposure evaluation report provides information about compliance of the below identified device with the RF Exposure limits for mobile devices as defined in FCC CFR Part 1 (1.1307 & 1.1310), Part 2 (2.1091) and IC standard RSS-102 under given conditions (measured or rated RF output power, antenna gain, distance towards human body, multiple transmitter information as presented by the applicant).

In addition, maximum antenna gain or minimum distance towards the human body is calculated, respectively, where relevant.

The device meets the limits as stipulated by the above given FCC and IC rule parts based on available specifications.

Company	Description	Model #
Multi-Tech Systems, Inc	MultiModem rCell®100 Series Router	MTR-H5-B09, MTR-H5-B10

Report reviewed by:

2014-01-27 Compliance Franz Engert
 (Test Lab Manager)

Date	Section	Name	Signature
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Responsible for the Report:

2014-01-27 Compliance Ashley Armenta
 (EMC Engineer)

Date	Section	Name	Signature
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4 RF Exposure Limits and FCC and IC Basic Rules

For the specific described radio apparatus the following basic limits and rules apply for both, FCC and IC where not indicated differently.

4.1 Maximum Permissible Exposure (MPE) Limits acc. to FCC 1.1310(e) / RSS-102, cl. 4.2:

Frequency Range (MHz)	Power density (mW/cm ²)	Averaging time (minutes)
300 – 1500	f (MHz) /1500	30 (IC:6)
1500 – 100.000 (IC:1500 – 150000)	1.0	30 (IC:6)

4.2 Routine Environmental Evaluation Categorical Exclusion Limits acc. to FCC 2.109(c) / RSS-102, cl. 2.5 (rounded to 1 decimal point):

Operating frequency < 1.5GHz: excluded if ERP < 1.5W / 31.8dBm (IC: 2.5W / 34.0dBm EIRP);
 Operating frequency > 1.5GHz: excluded if ERP < 3.0W / 34.8dBm (IC: 5.0W / 37.0dBm EIRP);

4.3 EMC Output Power Limits (ERP/EIRP) acc. to FCC part 22/24/27 / IC RSS-132, RSS-133, RSS-139 (to be additionally taken into account for maximum antenna gain considerations)

part 22: 7W ERP / 38.5dBm (IC: 11.5W / 40.6dBm EIRP)
 part 24: 2W EIRP / 33.0dBm
 part 27: 1W EIRP / 30.0dBm

Per KDB 447498 D01 FCC allows calculative estimation of RF exposure for mobile applications when routine environmental evaluation categorical exclusion applies and also for fixed applications. When categorical exclusion can not be claimed for mobile applications MPE measurement is required for TCB approval.

RSS-102 of Industry Canada does generally not require RF exposure evaluation for fixed or mobile applications which stay below the given exclusion limits.

4.4 RF Exposure Estimation (MPE Estimation)

Having available the source based average output power and peak antenna gain or the ERP/EIRP of the specified device and for a known minimum distance of it's radiating structures from the body of persons according to it's use cases (at least 20cm) the power density at that distance can be estimated by the following formula for plane-wave equivalent conditions (far-field conditions), when ground reflection is neglected.

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

where: S = power density (mW/cm² or W/m²)
 P = power input to the antenna (mW or W)
 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 (cm or m)

5 Evaluations

The following calculations are – for the portion of the cellular transmitter - based on the the specified maximum conducted average output power of the cellular module incorporated in the EUT and thus – with the given peak antenna gain - resulting in the theoretical worst case maximum average ERP/EIRP, because all measured conducted average values are lower.

5.1 Routine Environmental Evaluation Applicability

Based on the theoretical maximum average ERP/EIRP, see above.

Pr is the declared (rated) conducted output power upper tune-up tolerance limit value (of the integrated cellular module);

Transmission Mode	Pr	peak gain	attenuation	duty cycle	EIRP, source based time averaged (EIRPmax)	total EIRP simul taneous trans missions intra-band (worst cases only)	FCC & IC Limit for Routine Environmental Evaluation Applicability, EIRP	excluded?
	dBm	dBi	dB	%	dBm	dBm	dBm	
GSM 850	33	3.0	n.a.	12.5	27	n.a.	33.9	yes
GPRS 850 1TS	33	3.0	n.a.	12.5	27	n.a.	33.9	yes
GPRS 850 2TS	33	3.0	n.a.	25	30	n.a.	33.9	yes
GPRS 850 3TS	32	3.0	n.a.	37.5	30.7	n.a.	33.9	yes
GPRS 850 4TS	31	3.0	n.a.	50	31	n.a.	33.9	yes
EDGE 850 1TS	27	3.0	n.a.	12.5	21	n.a.	33.9	yes
EDGE 850 2TS	27	3.0	n.a.	25	24	n.a.	33.9	yes
EDGE 850 3TS	26	3.0	n.a.	37.5	24.7	n.a.	33.9	yes
EDGE 850 4TS	25	3.0	n.a.	50	25	n.a.	33.9	yes
WCDMA Bd V	23.5	3.0	n.a.	100	26.5	n.a.	33.9	yes
GSM 1900	30	3.0	n.a.	12.5	24	n.a.	36.9	yes
GPRS 1900 1TS	30	3.0	n.a.	12.5	24	n.a.	36.9	yes
GPRS 1900 2TS	30	3.0	n.a.	25	27	n.a.	36.9	yes
GPRS 1900 3TS	29	3.0	n.a.	37.5	27.7	n.a.	36.9	yes
GPRS 1900 4TS	28	3.0	n.a.	50	28	n.a.	36.9	yes
EDGE 1900 1TS	26.5	3.0	n.a.	12.5	20.5	n.a.	36.9	yes
EDGE 1900 2TS	26.5	3.0	n.a.	25	23.5	n.a.	36.9	yes
EDGE 1900 3TS	25.5	3.0	n.a.	37.5	24.2	n.a.	36.9	yes
EDGE 1900 4TS	24.5	3.0	n.a.	50	24.5	n.a.	36.9	yes
WCDMA Bd II	23.5	3.0	n.a.	100	26.5	n.a.	36.9	yes
WCDMA Bd IV	23.5	3.0	n.a.	100	26.5	n.a.	36.9	yes
WLAN 2.4 GHz	22.35	2.3	n.a.	100	24.65	n.a.	36.9	yes

Result: The transmitters in the equipment are categorically excluded from Routine Environmental Evaluation. There are no intra-band co-transmissions possible in the device.

5.2 Compliance with MPE (Power Density) limits

Limits:

S_{max} @ 824MHz = 0.55mW/cm² (824MHz is worst case as lowest operating frequency in the cellular band);

S_{max} @ 1900MHz and @ 2400MHz = 1.0mW/cm²:

The highest source base time averaged EIRP_{max} per band calculated with the rated peak antenna gain values are taken from the table in section 5.1 above;

The highest power density is resulting from the formula: $S = \text{EIRP}_{\text{max}} / 4 * \pi * r^2$;

The power density is calculated for the minimum distance $r = 20\text{cm}$;

Highest source base time averaged EIRP with GPRS 850 MHz, 4TS: 31.0dBm;

Resulting maximum power density at 850MHz: **S(850MHz) = 0.25mW/cm²**

Highest source base time averaged EIRP with GPRS 1900 MHz, 4TS: 28dBm;

Resulting maximum power density at 1900MHz: **S(1900MHz) = 0.126mW/cm²**

Highest source base time averaged EIRP with WLAN 2.4GHz: 24.94dBm;

Resulting maximum power density at 2400MHz: **S(2400MHz) = 0.062mW/cm²**

Result: The equipment fulfills the MPE limits for the minimum distance between the antenna and the human body of 20cm, for the rated peak antenna gain.

5.3 Simultaneous Transmission MPE Test Exclusion (per KDB 447498 D01)

Possible simultaneous transmissions: Cellular Radio and WLAN or Cellular Radio and Bluetooth.

Simultaneous transmission with the Bluetooth radio is not considered due to the low power.

Highest power density to the limit ratio for the Cellular Transmitter: $0.25\text{mW/cm}^2 / 0.55\text{mW/cm}^2 = \mathbf{0.454}$

Power density to the limit ratio for the WLAN Transmitter: $0.062\text{mW/cm}^2 / 1.0\text{mW/cm}^2 = \mathbf{0.058}$

Σ of Power Density (MPE) ratios = 0.454 + 0.058 = 0.512 < 1

Result: The equipment is excluded from simultaneous transmission MPE test.

5.4 Maximum allowed Antenna Gain - Gmax

The maximum antenna gain to comply with the RF exposure limits as given in section 4 is provided through the formula $G_{max}(RF_{exp}) = S_{max} * 4 * \pi * r^2 / P_{avg}$ or

by the maximum ERP/EIRP limits as per FCC parts 22/24/27 and RSS-132/133/139 respectively whichever results in the lower gain value for the frequency band under consideration.

Maximum gain consideration is limited to the cellular transmitter in the device, since the maximum antenna gain for the WLAN/Bluetooth transmitter is considered fixed per instruction in the user / OEM manual.

- r = distance between antenna and body (here: minimum for mobile fixed applications = 20 cm);
- $G_{max}(RF_{exp})$ = max allowed peak gain to fulfil RF exposure limit;
- $G_{max}(eirp)$ = max allowed peak gain to fulfil FCC and IC ERP/EIRP limits
- G_{max} = resulting maximum allowed gain (lower of $G_{max}(RF_{exp})$ and $G_{max}(eirp)$)
- S_{max} = power density limit, see section 4;
- P_r = declared conducted output power upper tune-up tolerance limit value (of the integrated cellular module);
- P_{avg} = P_r minus duty cycle factor; for duty cycle factor see table under section 5.1;

Result

Transmission Mode	S_{max}	P_r	P_{avg}	$G_{max}(RF_{exp})$	FCC p22/24/27, RSS-132/133/139 EIRP limit	$G_{max}(eirp)$ (EIRP limit minus P_r)	G_{max} (for $r=20cm$)
	$\frac{mW}{c^2 m^2}$	dBm	dBm	dBm	dBm	dBm	dBm
GSM 850	0.55	33	24	10.42	40.6	7.6	
GPRS 850 1TS	0.55	33	24	10.42	40.6	7.6	
GPRS 850 2TS	0.55	33	27	7.42	40.6	7.6	
GPRS 850 3TS	0.55	32	27.7	6.72	40.6	8.6	
GPRS 850 4TS	0.55	31	28	6.42	40.6	9.6	6.42
EDGE 850 1TS	0.55	27	18	16.62	40.6	13.6	
EDGE 850 2TS	0.55	27	21	13.62	40.6	13.6	
EDGE 850 3TS	0.55	26	21.7	12.72	40.6	14.6	
EDGE 850 4TS	0.55	25	22	12.42	40.6	15.6	
WCDMA Bd V	0.55	23.5	23.5	10.92	40.6	17.1	
GSM 1900	1.0	30	21	16.01	33	3.0	3.0
GPRS 1900 1TS	1.0	30	21		33	3.0	
GPRS 1900 2TS	1.0	30	24		33	3.0	
GPRS 1900 3TS	1.0	29	24.7	12.31	33	4.0	
GPRS 1900 4TS	1.0	28	25	12.01	33	5.0	
EDGE 1900 1TS	1.0	26.5	17.5		33	6.5	
EDGE 1900 2TS	1.0	26.5	20.5		33	6.5	
EDGE 1900 3TS	1.0	25.5	21.2		33	7.5	
EDGE 1900 4TS	1.0	24.5	21.5		33	8.5	
WCDMA Bd II	1.0	23.5	23.5		33	9.5	
WCDMA Bd IV	1.0	23.5	23.5	13.51	30	6.5	6.5

Summary

The maximum cellular antenna gain at 850MHz to meet the power density limit at 20cm distance is: **6.4 dBi**

The maximum cellular antenna gain at 1900 MHz to meet the EIRP limit of 2W is: **3.0 dBi**

The maximum cellular antenna gain at 1700 MHz to meet the EIRP limit of 1W is: **6.5 dBi**

6 Revision History

Date	Change Description	Revision
2014-01-15	n.a.	initial
2014-01-27	Amendments reg. limits and rules in section 4; Product description amendmends;	Rev. 1