



FCC PART 2.1091/IC RSS-102

RF EXPOSURE REPORT



For

Sentient Energy, Inc.

880 Mitten Road,

Burlingame, CA 94010, USA

FCC ID: Z2E-MC5728V
IC: 9908A-MC5728V

Report Type: Original Report	Product Type: EV-DO/CDMA PCI Module
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* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*” (Rev.2)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R13083016-MPE	Original Report	2013-10-03

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of the company *Sentient Energy Inc.*, and their product FCC ID: Z2E-MC5728V, model MC5728V, which will henceforth be referred to as the EUT (Equipment under Test). The EUT is a WWAN module installed in host system model MM3CLL1.

Model MM3CLL1 contains Sentient Energy Inc. cellular radio module: MC5728V, which is a multi-band wireless module operating on the CDMA2000/EVDO/GSM/GPRS/EDGE/UMTS network with FCC ID: Z2E-MC5728V, IC: 9008A-MC5728V and Radicom Research Inc's CSR8311 Bluetooth Module, Model: BPM2001, FCC ID: K7T-BPM2001, IC: 2377A-BPM2001 respectively.

The data gathered are from a production sample provided by the manufacturer, serial number: RE3513021 which assigned by manufacturer.

1.2 Objective

This report is prepared on behalf of *Sentient Energy Inc.* in accordance with FCC 2.1091 of the Federal Communication Commissions rules and IC RSS 102, Issue 4.

1.3 Related Submittal(s)/Grant(s)

No related submittals.

1.4 Test Methodology/Calculation

All measurements contained in this report were calculated in accordance with FCC Part 2.1091 of the Federal Communication Commissions rules and IC RSS 102, Issue 4.

1.5 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2: 2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from ± 2.0 dB for Conducted Emissions tests and ± 4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.6 Test Facility

Bay Area Compliance Laboratories Corp. (BACL) is:

- 1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.
- 2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminaires and Computers.
- 3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC (Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.
- 4 - A Product Certification Body accredited to **ISO Guide 65: 1996** by **A2LA** to certify:
 - 1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
 2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
 3. Radio Communication Equipment for Singapore.
 4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
 5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
 6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (including GU24s), Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz, as well as ANSI C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

<http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b>

2 EUT Test Configuration

2.1 Justification

The system was configured for evaluation under FCC §2.1091 & IC RSS-102.

2.2 Host Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Sentient Energy	Wireless Card Board	MC5728V	132-0003-01
Sentient Energy	Main Board 1	310-0007-04 Rev. 1	-
Sentient Energy	Main Board 2	310-0003-04 Rev. 1	-
Sentient Energy	Main Board 3	310-0010-03 Rev. 1	-
Sentient energy	Main Board 4	310-0002-03 Rev. 1	-

2.3 Product Declaration

This table summarizes the worst case transmitter parameters and the antenna information of the equipment under test

Bluetooth Module (FCC ID: K7T-BPM2001, IC: 2377A-BPM2001):

Mode	Transmitter Range (MHz)	Max Conducted Power (dBm/mW)	Max Antenna Gain (dBi)
BT EDR	2402-2480	9.16/8.24	-1.0
BT LE	2402-2480	8.93/7.82	-1.0

EV-DO/CDMA Module (FCC ID: Z2E-MC5728V, IC: 9908A-MC5728V):

Mode	Transmitter Range (MHz)	Max Conducted Power (Watt)	Max Antenna Gain (dBi)
CDMA	824-849	0.8222	4.55
EV-DO	824-849	0.9594	4.55
CDMA	1850-1910	0.7228	2.85
EV-DO	1850-1910	0.8147	2.85

2.4 Equipment Modifications

N/A

3 FCC §2.1091 & IC RSS-102 – RF Exposure Information

3.1 Applicable Standards

According to FCC §2.1091 and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF fields.

According to IC RSS-102 Issue 4 section 4, RF limits used for general public will be applied to the EUT.

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Averaging Time (Minutes)
0.003-1	280	2.19	-	6
1-10	280/f	2.19/f	-	6
10-30	28	2.19/f	-	6
30-300	28	0.073	2*	6
300-1 500	1.585 f ^{0.5}	0.0042 f ^{0.5}	f/150	6
1 500-15 000	61.4	0.163	10	6
15 000-150 000	61.4	0.163	10	616000 / f ^{1.2}
150 000-300 000	0.158 f ^{0.5}	4.21 x 10 -4 f ^{0.5}	6.67 x 10 ⁻⁵ f	616000 / f ^{1.2}

Note: f is frequency in MHz

22.□ Power density limit is applicable at frequencies greater than 100 MHz

3.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

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

3.3 MPE Results

Maximum Permissible Exposure (MPE) Calculations

Bluetooth Module:

Radio Mode	Frequency (MHz)	Max Antenna Gain (dBi)	Max Conducted Power (dBm)	Duty Cycle (%)	Power Density @ 20 cm (mW/cm ² /W/m ²)	Limit (mW/cm ² /W/m ²)	% of MPE
BT EDR	2480	-1	9.16	100%	0.0013/0.013	1/10	0.13
BT LE	2480	-1	8.93	100%	0.0012/0.012	1/10	0.12

EV-DO/CDMA Module:

Radio Mode	Frequency (MHz)	Max Antenna Gain (dBi)	Max Conducted Power (dBm)	Duty Cycle (%)	Power Density @ 20 cm (mW/cm ² /W/m ²)	Limit (mW/cm ² /W/m ²)	% of MPE
CDMA	836.4	4.55	29.15	100	0.467/4.67	0.558/5.58	83.69
EV-DO	836.4	4.55	29.82	100	0.544/5.44	0.558/5.58	97.49
CDMA	1880	2.85	28.59	100	0.277/2.77	1/10	27.70
EV-DO	1880	2.85	29.11	100	0.313/3.13	1/10	31.3

Co-location Calculation:

Item	Colocation Radios Band & Mode	% of MPE
1	BT EDR & Cellular Band CDMA	83.82
2	BT EDR & PCS Band CDMA	27.83
3	BT EDR & Cellular Band EV-DO	97.62
4	BT EDR & PCS Band EV-DO	31.43
5	BT LE & Cellular Band CDMA	83.81
6	BT LE & PCS Band CDMA	27.82
7	BT LE & Cellular Band EV-DO	97.61
8	BT LE & PCS Band EV-DO	31.42

Result: The device complies with the MPE requirements by providing a safe separation distance of at least 20 cm. The MAX Co-located % of MPE is 97.62%.