FCC PART 22H & 24E

TEST AND MEASUREMENT REPORT

For

Mobile Communications, Inc.

230 Earl Steward Drive,

Aurora, Ontario L4G 6V8, Canada

FCC ID: S4RBRM22050

Report Type:	**Product Type:**
Original Report	Dual Band Wireless Booster

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TABLE OF CONTENTS

1 GENERAL INFORMATION 4
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 4
1.2 MECHANICAL DESCRIPTION 4
1.3 OBJECTIVE 4
1.4 RELATED SUBMITTAL(S)/GRANT(S) 4
1.5 TEST METHODOLOGY 4
1.6 MEASUREMENT UNCERTAINTY 5
1.7 TEST FACILITY 5
2 SYSTEM TEST CONFIGURATION 7
2.1 JUSTIFICATION 7
2.2 EUT EXERCISE SOFTWARE 7
2.3 EQUIPMENT MODIFICATIONS 7
2.4 EUT INTERNAL CONFIGURATION 7
2.5 LOCAL SUPPORT EQUIPMENT LIST AND DETAILS 7
2.6 POWER SUPPLY AND LINE FILTERS 7
2.7 INTERFACE PORTS AND CABLING 7
3 SUMMARY OF TEST RESULTS 8
4 FCC §1.1310 & §2.1091 - RF EXPOSURE INFORMATION 9
4.1 APPLICABLE STANDARDS 9
4.2 MPE PREDICTION 9
4.3 TEST RESULT 10
FCC §2.1053, §22.917 & §24.238 - RADIATED SPURIOUS EMISSIONS 11
4.4 APPLICABLE STANDARD 11
4.5 TEST PROCEDURE 11
4.6 TEST SETUP BLOCK DIAGRAM 12
4.7 TEST EQUIPMENT LIST AND DETAILS 13
4.8 TEST ENVIRONMENTAL CONDITIONS 13
4.9 TEST RESULTS 13
5 EXHIBIT A - FCC ID LABELING REQUIREMENTS 16
5.1 FCC ID LABEL REQUIREMENT 16
5.2 FCC ID LABEL CONTENTS AND LOCATION 17
6 EXHIBIT B - TEST SETUP PHOTOGRAPHS 18
6.1 RADIATED EMISSIONS – ABOVE 1GHZ FRONT VIEW 18
6.2 RADIATED EMISSIONS – ABOVE 1 GHZ REAR VIEW 18
6.3 RADIATED EMISSIONS – BELOW 1 GHZ REAR VIEW 19
6.4 RADIATED EMISSIONS – BELOW 1 GHZ FRONT VIEW 19
7 EXHIBIT C- EUT PHOTOGRAPHS 20
7.1 EUT TOP VIEW 20
7.2 EUT - BOTTOM VIEW 20
7.3 EUT - FRONT VIEW 21
7.4 EUT - REAR VIEW 21
7.5 EUT – SIDE VIEW (1) 21
7.6 EUT – SIDE VIEW (2) 21
7.7 EUT – OPEN CHASSIS VIEW 22
7.8 EUT – PCB TOP VIEW 22
7.9 EUT – PCB BOTTOM VIEW 23
7.10 EUT – AC/DC ADAPTER 23

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1401272-2224	Original Report	2014-01-31

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report has been complied on behalf of *Mobile Communications, Inc.* and their product model: BRM220-50, FCC ID: S4RBM22050, which will be henceforth in this report referred to as the EUT (Equipment Under Test). The EUT is a Cellular/PCS Dual-band, bi-directional booster/amplifier.

EUT Description	Dual-Band, Bi-Directional coupling Booster/Amplifier
FCC ID	S4RBM22050
Operation Frequency	Cellular Band: 824-849 MHz, 869-894 MHz PCS Band: 1850-1910 MHz, 1930-1990 MHz
Modulation	CDMA, WCDMA, LTE, HSPA, GSM, GPRS, EDGE
Type of Equipment	Mobile and Fixed

1.2 Mechanical Description

The EUT measures approximately 160mm (L) x 90mm (W) x 25mm (H), and weighs approximately 454 g.
The test data gathered are from typical production sample, serial number: 1000000 provided by the Manufacturer.

1.3 Objective

This type approval report is prepared on behalf of *Mobile Communications, Inc.* in accordance with Part 2, Subpart J, Part 22 Subpart H, and Part 24 Subpart E of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC rules for RF output power, modulation characteristics, occupied bandwidth, spurious emissions at antenna terminal, field strength of spurious radiation, frequency stability, band edge, and conducted and radiated margin.

1.4 Related Submittal(s)/Grant(s)

No Related Submittals

1.5 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

Part 20.21 – Signal Boosters
Part 22 Subpart H - Cellular Radiotelephone Service
Part 24 Subpart E – Broadband PCS

Applicable Standards: TIA/EIA603-C, ANSI C63.4-2009.
All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.6 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.

1.7 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 Luminares 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 System Test Configuration

2.1 Justification

The EUT was configured for testing according to TIA/EIA-603-C.

The final qualification test was performed with the EUT operating at normal mode.

2.2 EUT Exercise Software

Signal was sent through EUT using a wireless communications test set, device was set to normal operating mode.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 EUT Internal Configuration

Manufacturer	Description	Model	Serial Number
Mobile Communications Inc.	Wireless Booster/Amplifier	BRM22050	1000000

2.5 Local Support Equipment List and Details

N/A

2.6 Power Supply and Line Filters

Manufacturer	Description	Model	Serial Number
Smooth Talker	AC Adapter	BLC240603000WU	-

2.7 Interface Ports and Cabling

Cable Description	Length (m)	From	To
RF cable	<1	Signal Generator	EUT

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1046, §22.913, §24.232	RF Output Power	N/A[2]
§2.1091	RF Exposure	Compliant
§2.1047	Modulation Characteristics	N/A[1]
§2.1049, §22.917, §24.238	Occupied Bandwidth	N/A[2]
§2.1053, §22.917(a), §24.238(a)	Spurious Radiated Emissions	Compliant
§2.1051, §22.917, §24.238(a)	Spurious Emissions at Antenna Terminals	N/A[2]
§22.917, §24.238	Band Edge	N/A[2]
§2.1055, §22.355, §24.235	Frequency Stability	N/A[1]

Note: N/A[1] EUT is a signal booster.
N/A[2] Please refer to the conducted report provided by Mobile Communications Inc., Report number: BRM22050

4 FCC §1.1310 & §2.1091 - RF Exposure Information

4.1 Applicable Standards

According to §1.1310 and §2.1091 (Mobile Devices) RF exposure is calculated.

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 (minute)
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

Note: f = frequency in MHz
* = Plane-wave equivalent power density

4.2 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

Cellular Band

Uplink:

Maximum peak output power at antenna input terminal (dBm):	21.35
Maximum peak output power at antenna input terminal (mW):	136.46
Prediction distance (cm):	20
Prediction frequency (MHz):	836.5
Maximum Antenna Net Gain (dBi):	7.14
Maximum Antenna Net Gain (numeric):	5.176
Power density at predication frequency and distance (mW/cm^2):	0.141
MPE limit for uncontrolled exposure at predication frequency (mW/cm^2):	0.558

PCS Band

Uplink:

Maximum peak output power at antenna input terminal (dBm):	21.31
Maximum peak output power at antenna input terminal (mW):	135.21
Prediction distance (cm):	20
Prediction frequency (MHz):	1864
Maximum Antenna Net Gain (dBi):	7.14
Maximum Antenna Net Gain (numeric):	5.176
Power density at predication frequency and distance (mW/cm^2):	0.139
MPE limit for uncontrolled exposure at predication frequency (mW/cm^2):	1.0

4.3 Test Result

The device complies with the MPE requirements by providing a safe separation distance of 20 cm between the antenna, including any radiating structure, and any persons when normally operated based on the maximum antenna gain of 7.14. The proposed RF exposure safety information has been included in the User's Manual.

FCC §2.1053, §22.917 & §24.238 - Radiated Spurious Emissions

4.4 Applicable Standard

Requirements: FCC §2.1053, §22.917, §24.238.

4.5 Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

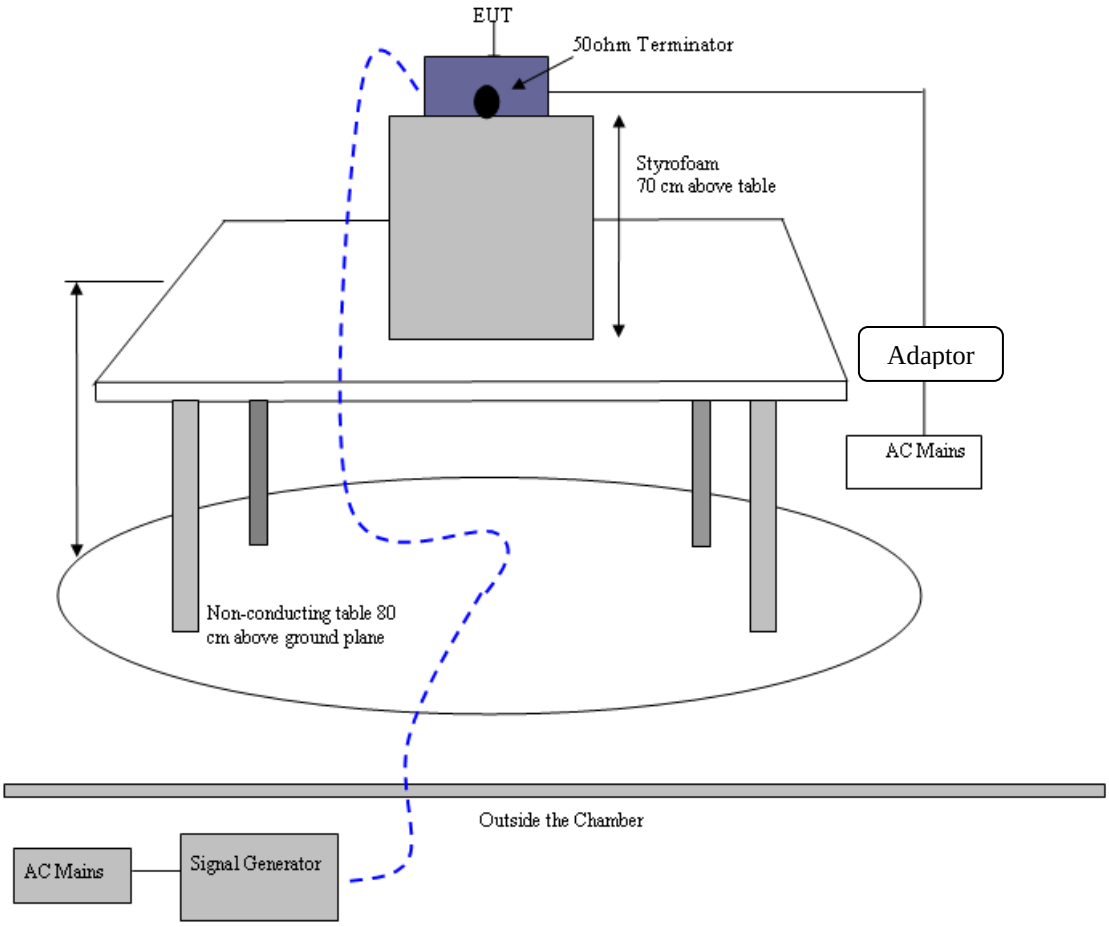
The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001) – the absolute level

Spurious attenuation limit in dB = $43 + 10 \text{Log}_{10}$ (power out in Watts)

4.6 Test Setup Block Diagram



4.7 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Hewlett-Packard	Pre-amplifier	8447D	2944A07030	2013-04-09	1 year
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2013-07-11	1 year
Agilent	Spectrum Analyzer	E4440A	MY44303352	2013-11-07	1 year
Hewlett-Packard	Signal Generator	8648C	3426A00417	2013-09-28	1 year
Com-Power	Dipole Sub. Antenna	AD-100	2220	2012-10-17	2 years
Hewlett-Packard	Signal Generator	83650B	3614A00276	2012-07-13	2 years
MiniCircuits	Pre-amplifier	ZVA-183-S	570400946	2013-05-09	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2013-03-07	1 year
EMCO	Antenna, Horn	3115	9511-4627	2014-01-06	1 year

Statement of Traceability: BACL Corp. *attests that all calibrations or verifications have been performed according to A2LA requirements, traceable to the NIST.*

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4.8 Test Environmental Conditions

Temperature:	21 °C
Relative Humidity:	52 %
ATM Pressure:	101.2 kPa

Testing was performed by Chen Ge from 2014-01-31 in 5 meter chamber 3.

4.9 Test Results

Worst case reading as follows:

Mode: Transmitting		
Margin (dB)	**Frequency (MHz)**	**Antenna Polarization (Horizontal/Vertical)**
-3.213	7045	Vertical

Cellular Band, Downlink (Input frequency = 881 MHz)

Indicated		Turntable Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Cord. (dB)	Cable Loss (dB)	Absolute Level (dBm)		
51.11	49.44	13	150	H	51.11	-61.21	0	0.183	-61.393	-13	-48.393
51.11	61.39	8	150	V	51.11	-53.93	0	0.183	-54.113	-13	-41.113
500	57.42	31	150	H	500	-41.17	0	0.307	-41.477	-13	-28.477
500	56.27	28	150	V	500	-44.88	0	0.307	-45.187	-13	-32.187
7045	64.45	42	150	H	7045	-29.77	11.871	1.136	-19.035	-13	-6.035
7045	63.72	40	150	V	7045	-26.97	11.893	1.136	-16.213	-13	-3.213

Cellular Band, Uplink (Input frequency = 836 MHz)

Indicated		Turntable Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Cord. (dB)	Cable Loss (dB)	Absolute Level (dBm)		
75.3	52	52	150	H	75.3	-60.53	0	0.215	-60.745	-13	-47.745
75.3	57.48	61	150	V	75.3	-56.59	0	0.215	-56.805	-13	-43.805
222.4	39.61	73	150	H	222.4	-71.04	0	0.245	-71.285	-13	-58.285
222.4	32.87	68	150	V	222.4	-80.14	0	0.245	-80.385	-13	-67.385
7122	64.02	21	150	H	7122	-29.22	11.942	1.141	-18.419	-13	-5.419
7122	63.72	23	150	V	7122	-31.49	11.955	1.141	-20.676	-13	-7.676

PCS Band, Downlink (Input frequency = 1960 MHz)

Indicated		Turntable Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Cord. (dB)	Cable Loss (dB)	Absolute Level (dBm)		
50.88	65.22	62	150	H	50.88	-45.35	0	0.183	-45.533	-13	-32.533
50.88	61.78	70	150	V	50.88	-50.46	0	0.183	-50.643	-13	-37.643
17340	66.61	52	150	H	17340	-31.63	11.129	2.022	-22.523	-13	-9.523
17340	64.24	49	150	V	17340	-33.3	11.176	2.022	-24.146	-13	-11.146

PCS Band, Uplink (Input frequency = 1880 MHz)

Indicated		Turntable Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Cord. (dB)	Cable Loss (dB)	Absolute Level (dBm)		
76.4	53.4	83	150	H	76.4	-60.9	0	0.215	-61.115	-13	-48.115
76.4	58.62	87	150	V	76.4	-54.23	0	0.215	-54.445	-13	-41.445
221.3	40.18	65	150	H	221.3	-70.36	0	0.245	-70.605	-13	-57.605
221.3	39.48	61	150	V	221.3	-73.76	0	0.245	-74.005	-13	-61.005
15663	62.35	23	150	H	15663	-36.05	16.113	1.96	-21.897	-13	-8.897
15663	63.94	25	150	V	15663	-33.84	16.211	1.96	-19.589	-13	-6.589