Lab Code: 200167-0

FCC PART 90 SUBPART F

TEST AND MEASUREMENT REPORT

For

Infinition Inc.

3630 Jean-Talon,Trois-Rivières,

Québec, Canada, G8Y 2G7

FCC ID: PDGBR-3503
MODEL: BR-3503

Report Type:	**Product Type:**
Original Report	Doppler Radar

Test Engineer:	Dennis Huang
Report Number:	R1004121-90
Report Date:	2010-04-29
Reviewed By:	Boni Baniqued EMC/RF Supervisor
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1004121-90	Original Report	2010-04-29

1 GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of Infinition Inc. and their product, FCC ID: PDGBR-3503, Model: BR-3503 or the "EUT" as referred to in this report. The EUT is a Doppler radar antenna which utilizes the Doppler principle to measure the velocity of moving objects. It is a low cost radar that can be used in a variety of applications such as projectile muzzle velocity, in-bore measurement, very short range velocity measurement, etc. It is a great alternative to optical chronographs. The BR-3503 is compact as well as easy to deploy and use. It works at 35.5GHz and provides more than 3 times better resolution than a 10.5GHz (X-Band) radar, and can therefore be used on very small projectile calibers (ex: 1mm). The BR-3503 is particularly well suited for interior ballistic ranges where very short range measurements (down to few meters) are performed. It can also be used outside for short range measurement up to 250 meters (and more), depending on projectile caliber.

1.2 Mechanical Description

The EUT measures approximately 205 mm (L) x 145 mm (W) x 60 mm (H) and weighs: 3.17 kg.
The Antenna Measures approximately 350mm (L) and 190mm (Radius) and weighs: 3.4 kg.

** The test data gathered is from production samples, serial number: BR3502-09-128-0811, assigned by the manufacturer.*

1.3 EUT Photo

Please see additional photos in Exhibit C

1.4 Objective

This type approval report is prepared on behalf of *Infinition Inc.* in accordance with Part 2, Subpart J, and Part 90, Subpart F of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules for Radiated Emissions, Frequency Stability, Output Power, Spurious Emissions at Antenna Terminal, and Occupied Bandwidth.

1.5 Related Submittal(s)/Grant(s)

No Related Submittals.

1.6 Test Methodology

All measurements contained in this report were conducted with TIA/EIA 603-C.

All radiated and conducted emissions measurements were performed at Bay Area Compliance Laboratories Corp.

1.7 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in 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 NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from $\pm$2.0 for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

Detailed instrumentation measurement uncertainties can be found in BACL report QAP-018.

1.8 Test Facility

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

The test sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has 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 facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm

2 SYSTEM TEST CONFIGURATION

2.1 Justification

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

The EUT was tested in the normal operating mode to represent *worst*-case results during the final qualification test.

2.2 EUT Exercise Software

N/A

2.3 Special Accessories

N/A

2.4 Equipment Modifications

No modifications were made to the EUT

2.5 Remote Support Equipment

N/A

2.6 Local Support Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers
-	-	-	-

2.7 Internal Configuration, Details of EUT and Host System

Manufacturer	Description	Model	Serial Number
Crydom	Solid State Relay	DC60S3	-
Infinition Inc.	Main PCB Board	Assy 1000000 Rev 001	-

2.8 Interface Ports and Cabling

Cable Description	Length (m)	From	To
Power Cable	< 1	EUT	AC line Power Source
RF Cable	1	Spectrum Analyzer	Horn Antenna

3 SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§1.1307(b)(1) & §2.1091	RF Exposure	Compliant
§2.1046	RF Power Output	Compliant
§2.1049	Occupied Bandwidth	Compliant
§2.1051	Spurious Emission at Antenna Terminals	NA*
§2.1053	Field Strength of Spurious Radiation	Compliant
§2.1055	Frequency Stability/ Tolerance	Compliant
§2.1047	Audio Frequency Response	NA**
§2.1047	Audio Low Pass Filter Response	NA**
§2.1047	Modulation Characteristics	NA***

*Note: * EUT antenna port is permanently attached to the antenna.*
*** EUT contains no audio circuit.*
**** EUT has no modulation capability.*

4 FCC §1.1307(b) (1) & §2.1091 - RF EXPOSURE

4.1 Applicable Standard

According to §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.

According to §1.1310 and §2.1091 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

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

4.2 MPE Prediction

Prediction 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

Maximum peak output power at antenna input terminal (dBm):	20 (dBm)
Maximum peak output power at antenna input terminal (mW):	100 (mW)
Predication distance (cm):	100 cm
Predication frequency (MHz):	35500 (MHz)
Maximum Antenna Gain, typical (dBi):	28 (dBi)
Maximum Antenna Gain (numeric):	630.9 (numeric)
Power density of predication frequency at 1m (mW/cm^2):	0.5 (mW/cm^2)
MPE limit for uncontrolled exposure at predication frequency (mW/cm^2):	1.0 (mW/cm^2)

4.3 Result

The power density of predication frequency at 1 m is 0.5 mW/cm^2 for a 28dBi antenna which was according to calculation under the MPE limit for uncontrolled exposure of 1.00 mW/cm^2, the safety distance has been addressed in the user manual.

5 FCC §2.1046 – OUTPUT POWER

5.1 Applicable Standard

FCC §2.1046

The limit should comply with manufacturer's rated output power: ±1dB.

5.2 Measurement Procedure

The transmitter was placed on top of 1 m non-reflective foam table, and it was transmitting.

The measurement antenna was placed at a distance of 1 meter 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 output power was measured using the signal substitution method as follows.
The field strength of EUT was measured at a distance of 1 meter; the EUT was replaced by a signal generator and a standard gain horn antenna. The absolute levels of the spurious emissions were measured by the substitution.

5.3 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Wise Wave	Antenna, Horn	2823-02	10555-01	2009-05-16
Agilent	PSA Series Spectrum Analyzer	E4446A	US44300386	2009-06-29
HP	Signal Generator	83650B	3614A00276	2008-05-28**

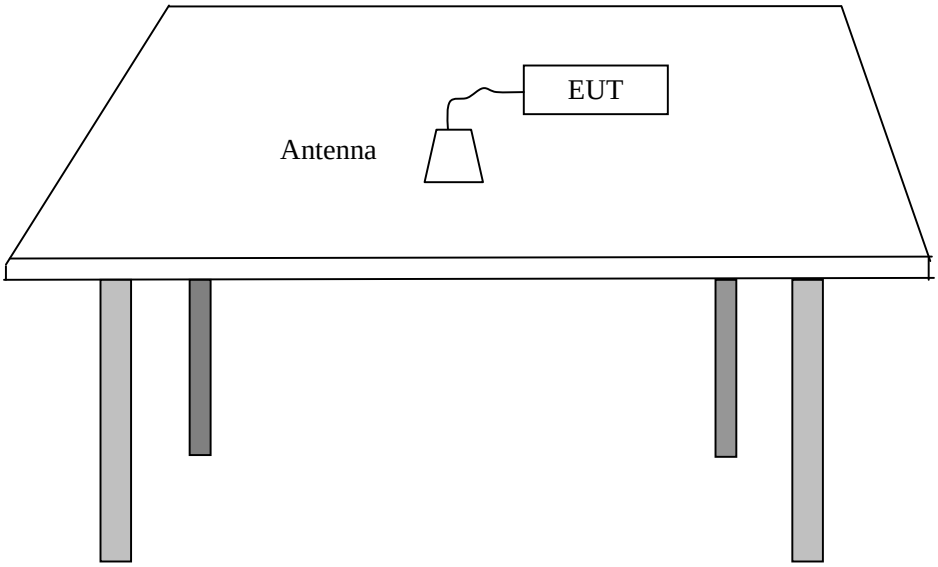
* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.
** Two years calculation cycle.

5.4 Test Environmental Conditions

Temperature:	20~23°C
Relative Humidity:	33~45.2 %
ATM Pressure:	99~102.1kPa

** The testing was performed by Dennis Huang on 2010-04-20 in 5m chamber 3.*

5.5 Test Setup Block Diagram



5.6 Test Results

Indicated		Table Azimuth (degree)	Test Antenna		Substituted				Absolute Level (dBm)	Calculated Conducted Power (dBm)	Rated Output Power (dBm)
Freq. (MHz)	S.A. Amp. (dBuV)		Height (m)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Ant. Gain Cord.	Cable Loss (dB)			
35500	98.66	360	1.48	H	35500	29.56	21.9	4.0	47.46	19.46	20
35500	93.69	360	1.56	V	35500	24.59	21.9	4.0	42.49	14.49	20

Note: The manufacturer states that the gain of their antenna is 28 dBi, therefore the calculated power at the output of the transmitter is 47.46-28 = 19.46 dBm which is within 1dB of the manufacturer's rating of RF power. The power reported in Form 731 is conducted power based on this.

6 FCC §2.1049 – OCCUPIED BANDWIDTH

6.1 Applicable Standard

FCC §2.1049

6.2 Test Results

Not Applicable. No modulation.

7 FCC §2.1051 & §90.210 – SPURIOUS EMISSIONS AT ANTENNA TERMINALS

7.1 Applicable Standard

FCC §2.1051

7.2 Test Results

EUT antenna port is permanently attached to the Antenna; thus, it is not applicable.

8 FCC §2.1053 & §90.210 – FIELD STRENGTH OF SPURIOUS RADIATION

8.1 Applicable Standard

FCC §2.1053 &: §90.210 (b)(c) 3) on any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

8.2 Test Procedure

The transmitter was placed on top of an 80 cm non-reflective foam table, and it was transmitting.

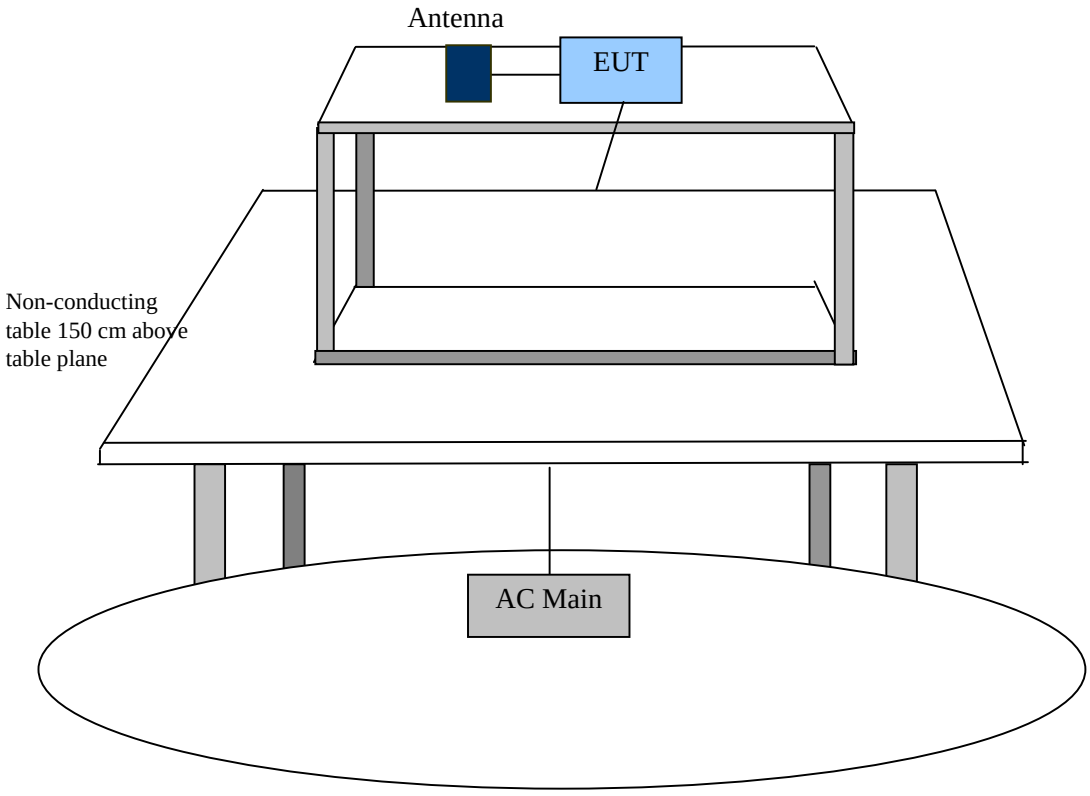
The measurement antenna was placed at a distance of 1 or 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

The 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

8.3 Test Setup Block Diagram



8.4 Test Equipment List and Details

Manufacturers	Description	Model Number	Serial Number	Calibration Dates
HP	Pre-Amplifier	8447D	2944A06639	2009-06-05
Sunol Science Corp	Combination Antenna	JB3	A0020106-3	2009-05-05
HP	Pre, Amplifier (1~18 GHz)	8449B	3147A00400	2009-10-22
A. R.A	Antenna, Horn, DRG (1~18 GHz)	DRG-118/A	1132	2009-09-23
Wise Wave	Antenna, Horn, (18~26.5 GHz)	ARH-4223-02	10555-02	2009-05-16
Wise Wave	Pre, Amplifier (18~26.5 GHz)	ALN-22093530-01	12263-01	2009-03-11
Wise Wave	Antenna, Horn, (26.5~40 GHz)	2823-02	10555-01	2009-05-16
Wise Wave	Pre, Amplifier (26.5~40 GHz)	ALN-33144130-01	11424-01	2009-03-11
OML	WR-12 Harmonic Mixer with Horn Antenna (60~90 GHz)	M12HWD	E60120-1	2009-03-11
OML	WR-12 Harmonic Mixer with Horn Antenna (90~140 GHz)	M08HWD	F60313-1	2009-03-11
OML	WR-12 Harmonic Mixer with Horn Antenna (140~220GHz)	M05HWD	G60106-1	2009-03-11
OML	WR-12 Harmonic Mixer with Horn Antenna (220~325 GHz)	M03HWD	H60120-1	2009-03-11
OML	Diplexer for Agilent Spectrum Analyzer	DPL26	N/A	N/A
Agilent	PSA Series Spectrum Analyzer	E4446A	US44300386	2009-06-29
HP	Signal Generator	83650B	3614A00276	2008-05-28**

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.
** Two years calculation cycle.

8.5 Test Environmental Conditions

Temperature:	20~23°C
Relative Humidity:	33~45.2 %
ATM Pressure:	99~102.1kPa

** The testing was performed by Dennis Huang on 2010-04-20 in 5m chamber 3.*

8.6 Summary of Test Results

According to the data in the following table, the EUT complied with the FCC Part 90. The EUT had the worst margin reading of:

-34.65 dB at **2000 MHz** in the **Vertical Polarization** 30 MHz to 325GHz

Please refer to the following plots for detailed results.

Indicated		Table	Test Antenna		Substituted				Absolute	Limit	Margin
Freq. (MHz)	S.A. Amp. (dBuV)	Azimuth (degree)	Height (m)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Ant. Gain Cord.	Cable Loss (dB)	Level (dBm)	(dBm)	(dB)
2000	53.15	339	1.0	H	2000	-58.24	8.6	1.32	-50.96	-13	-37.96
2000	56.46	181	2.22	V	2000	-54.93	8.6	1.32	-47.65	-13	-34.65

Note: All other emissions were at the noise floor margin.

9 FCC §2.1055 – FREQUENCY STABILITY

9.1 Applicable Standard

(b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

Specified by the Manufacture: Transmitter Stability = ± 1%.

9.2 Test Procedure

Frequency stability versus environmental temperature

The equipment under test was connected to an external AC power supply and the RF output was connected to a frequency counter via feed through attenuators. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

Frequency Stability versus Input Voltage

At room temperature (25±5°C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	PSA Series Spectrum Analyzer	E4446A	US44300386	2009-06-29
Wise Wave	Antenna, Horn, (26.5~40 GHz)	2823-02	10555-01	2009-05-16
Tenney	Temperature Oven	Versa Tenn	12.431-8	N/A

- **Statement of Traceability: BACL Corp**. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

9.4 Test Environmental Conditions

Temperature:	20-22.3 °C
Relative Humidity:	32-30 %
ATM Pressure:	99-100.7 kPa

**The testing was performed by Dennis Huang on 2010-04-26 at RF Site.*

9.5 Test Results

Test Environment		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (MHz)	Limit* (MHz)
Voltage (Vac)	Temperature (^{O}C)				
120	-30	35500.000000	35521.673400	-21.6734	± 35.5
120	-20	35500.000000	35518.955000	-18.955	± 35.5
120	-10	35500.000000	35521.477000	-21.477	± 35.5
120	0	35500.000000	35521.477000	-21.477	± 35.5
120	10	35500.000000	35512.190000	-12.19	± 35.5
120	20	35500.000000	35500.000000	-6.6037	± 35.5
120	30	35500.000000	35505.497000	-5.497	± 35.5
120	40	35500.000000	35493.384000	6.616	± 35.5
120	50	35500.000000	35487.102000	12.898	± 35.5
102	20	35500.000000	35474.512000	25.488	± 35.5
138	20	35500.000000	35492.437500	7.5625	± 35.5

*** Note:** The limit is ± 1% of the operating frequency, the fundamental of EUT is 35500 MHz.