
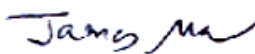


**FCC PART 90**  
**MEASUREMENT AND TEST REPORT**  
For  
**Trimble Navigation Ltd.**

935 Stewart Drive  
Sunnyvale, CA 94085, USA

**FCC ID: JUP-642356X-B1**  
**Model: R8-M2(RoHS) with TNL450I 450 MHz radio**

<p><b>Report Type:</b> <input checked="" type="checkbox"/> Original Submission: Supplemental Report</p>	<p><b>Product Type:</b> GPS Receiver with incorporated UHF and Bluetooth radios</p>
<p><b>Test Engineer:</b></p>	<p>Choon-Sian Ooi </p>
<p><b>Report Number:</b></p>	<p>R0710171-90</p>
<p><b>Report Date:</b></p>	<p>2007-11-12</p>
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## 1 GENERAL INFORMATION

### 1.1 Product Description for Equipment under Test (EUT)

The *Trimble Navigation Ltd.* product, FCC ID: JUP-642356X-B1, model: R8-M2 (RoHS) with TNL450I 450 MHz Radio, or the “EUT” as referred to in this report, is a GPS receiver with integrated Bluetooth module, and is capable of being factory configured with various radio modules, which provide GPS corrections between a base station and a mobile unit. The Bluetooth enables the receiver to communicate with a handheld data collector. The TNL450I is a 450MHz radio which operates in three bands: 410-430MHz, 430-450MHz, and 450-470MHz. The R8-M2 was configured with the TNL450I radio (FCC ID: KEATNL450I) and Bluetooth (FCC ID: Q2331308) for testing.

\* The test data gathered are from typical production samples provided by the customer with serial numbers as follows:

- R8-M2: Part Number: 60250-66; Serial Number RoHSA0001
- TNL450I Radio: Part Number: 64235-66; Serial Number: A02377 M02 0704 3001

### 1.2 Antennae Description

Item Number	Model/Type	
GPS receiver antenna	Model:	Antenna Mobile
	Manufacturer:	SAS (Signal Antenna Systems, Inc.)
	Frequency Range:	Dual Frequency: 902-928 MHz; 2.4 – 2.5 GHz
	Maximum Antenna Gain:	2 dBi at 915 MHz; 2 dBi at 2.5 GHz
	Antenna Type	Monopole omni
	Measurement:	23 cmH

### 1.3 Mechanical Description of EUT

Trimble Navigation Limited’s product, model: *R8-M2(RoHS)* or the “EUT” measures approximately 19 cm(D) x 25.5 cmH (including base stand).

## 1.4 EUT Photograph



*Please refer to Exhibit C for more EUT photographs*

## 1.5 Objective

This report is prepared on behalf of *Trimble Navigation* in accordance with the Part 2 and Part 90 rules of the Federal Communication Commissions rules.

The objective of the manufacturer is to determine compliance with FCC rules spurious radiated emissions.

The objective of the manufacturer is to demonstrate compliance with the applicable FCC rules. The EUT has integrated into its design one UHF radio, and one FHSS radio module already tested for compliance and submitted to the FCC under FCC ID's KEATNL450I, and Q2331308 respectively; thus, the testing in this report concerns the compilation of these modules along with a GPS receiver into the device designated as FCC ID: JUP-642356X-B1. Only those tests affected by this assemblage (bold face type blow) are herein conducted and recorded; for all other test results please see those submission and reports mentioned in the following subsection.

Output Power\*  
Occupied Bandwidth (emission mask)\*  
Spurious Emission at antenna terminal\*  
Frequency Stability\*  
**Spurious radiated emissions**  
Transient frequency behavior\*

*\*Please see related test reports for details*

## 1.6 Related Submittal(s)/Grant(s)

Please refer to FCC submissions FCC ID: KEATNL450I (BACL project number R0604242), and FCC ID: Q2331308 (BACL project number R0702082) for measurements and test results pertaining to the 450 MHz UHF radio and Bluetooth radio modules. Also, please refer to BACL report R0710171-247 for testing and results pertaining to the applicable FCC part 15 requirements for this device.

## 1.7 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 individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA/EIA-603-C, ANSI 63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

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.

## 1.8 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.

## 1.9 Test Facility

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 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/hdocs/210/214/scopes/2001670.htm>.

## 2 SYSTEM TEST CONFIGURATION

### 2.1 Justification

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

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

### 2.2 EUT Exercise Software

During the conducted emissions tests, the EUT was searching for GPS satellites, and the 450 MHz radio was in receive mode. The Bluetooth radio was in listen mode. The EUT was continuously communicating with the laptop over the RS-232 connection. During the radiated emissions tests, the radio being tested was continuously transmitting in CW mode on the selected channel.

### 2.3 Equipment Modifications

No modifications to the EUT were made.

### 2.4 Special Accessories

As shown in following test block diagram, all interface cables used for compliance testing are shielded.

### 2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Dell	Laptop	DELL610	8273581345

### 2.6 Power Supply Lines

Manufacturer	Description	Model	Serial Number
AULT	AC/DC Adapter	PW174KA1802FXX	201

### 2.7 Internal Configuration

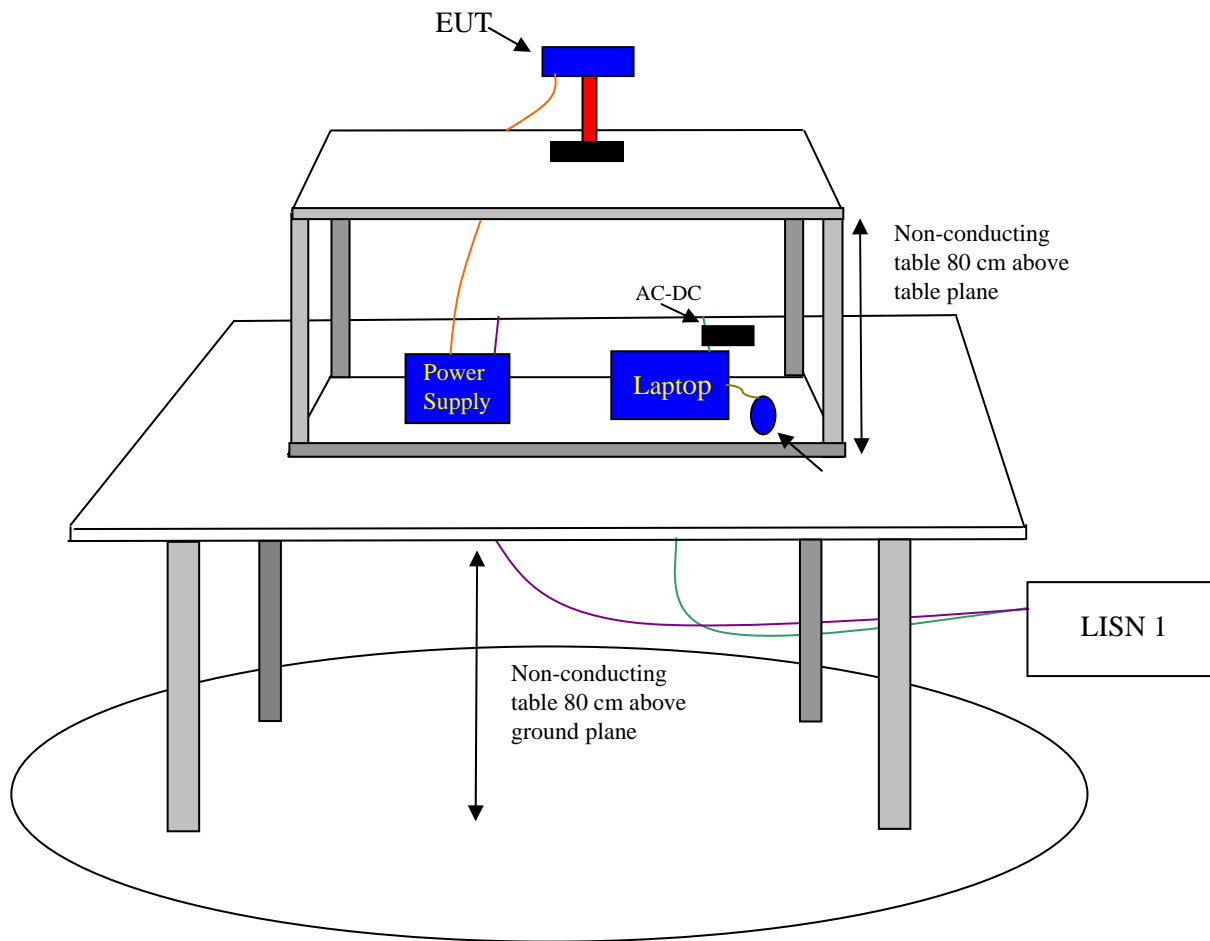
Manufacturer	Description	Part Number	Rev
Trimble Navigation	Control Board	53646-00-E	B
Trimble Navigation	Bluetooth Board	55155-00-D	1

**2.8 Interface Ports and Cabling**

Cable Description	Length (m)	From	To
Serial Cable	< 3m	EUT	Laptop

**2.9 Test Setup Block Diagrams**

**Radiated Emissions and Conducted Emissions**





### 3 SUMMARY OF TEST RESULTS FOR FCC PART 15

FCC Rule	Description	Result
§ 2.1046, § 90.205	RF Output Power	<b>Compliant</b> , Please refer to <i>FCC ID: KEATNL450I for UHF 450 MHz</i>
§ 2.1091	RF Exposure	<b>Compliant</b> , Please refer to <i>FCC ID: KEATNL450I for UHF 450 MHz</i>
§ 2.1049 § 90.209	Emission mask, Occupied Bandwidth	<b>Compliant</b> , Please refer to <i>FCC ID: KEATNL450I for UHF 450 MHz</i>
§ 2.1051 § 90.210	Spurious emissions at antenna terminals	<b>Compliant</b> , Please refer to <i>FCC ID: KEATNL450I for UHF 450 MHz</i>
§ 2.1053 § 90.210	Field strength of spurious radiation	Compliant
§ 2.1055 § 90.213	Frequency stability vs. temperature Frequency stability vs. voltage	<b>Compliant</b> , Please refer to <i>FCC ID: KEATNL450I for UHF 450 MHz</i>
§ 90.214	Transient Frequency Behavior	<b>Compliant</b> , Please refer to <i>FCC ID: KEATNL450I for UHF 450 MHz</i>

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## **4 §2.1053 & §90.210 – FIELD STENGTH OF SUPRIOUS RADIATION**

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### **4.1 Applicable Standard**

§2.1053 and §90.210

### **4.2 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 =  $10 \lg(\text{TXpwr in Watts}/0.001)$  – the absolute level

Spurious attenuation limit in dB =  $43 + 10 \text{Log}_{10}(\text{power out in Watts})$  for EUT with a 25 KHz channel bandwidth.

Spurious attenuation limit in dB =  $50 + 10 \text{Log}_{10}(\text{power out in Watts})$  for EUT with a 12.5 KHz channel bandwidth.

### **4.3 Test Setup**

The test setup used was that of TIA/EIA-603-C, ANSI 63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

#### 4.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2007-04-26
HP	Amplifier, Pre	8447D	2944A10198	2007-01-08
A. H. Systems	Antenna, Horn, DRG	SAS-200/571	261	2007-06-07
HP	Generator, Signal	83650B	3614A00276	2007-05-18
A.R.A.	Antenna, Horn	DRG-118/A	1132	2007-06-18
Sonama Instrument	Pre- Amplifier	317	260407	N/R
Sunol Science	Broadband Antenna	JB3 Antenna	A020106-2	2007-04-05
Rohde & Schwarz	EMI Test Receiver	ESCI 3	100337	2007-03-08
Sunol Science	System Controller	SC99V	011003-1	N/R

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

#### 4.5 Environmental Conditions

Temperature:	22-24 ° C
Relative Humidity:	33-36 %
ATM Pressure:	104.5-106 kPa

\* The testing was performed by Choon-Sian Ooi on 2007-10-17 to 2007-10-24.

#### Summary of Test Results

According to the data hereinafter, the EUT complied with the limits presented in FCC Title 47 part 2 and part 90 rules for radiated emissions applicable to intentional radiators, and had the worst margin reading of:

Mode: 450 MHz (UHF)			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Range
-52	400	Horizontal	30-1000 MHz
-46.1	2800	Vertical	Above 1 GHz

Please refer to the following tables for full test results

#### 4.6 Spurious Radiated Emissions Test Data

##### Spurious Radiated Emissions – UHF Radio (Transmitting mode)

Frequency (MHz)	Peak (dB $\mu$ V/m)	Antenna Height (cm)	Polarity (H/V)	Turntable Position (deg)	Power (Substitution) (dBm)	Limit (dBm)	Margin (dB)
400	40.5	100	H	146	-65	-13	-52
401.33	38.9	100	H	152	-66.5	-13	-53.5
600	43.1	100	H	138	-67	-13	-54
479.833	32.5	100	V	148	-77	-13	-64

Frequency (GHz)	Peak (dB $\mu$ V/m)	Antenna Height (cm)	Polarity (H/V)	Turntable Position (deg)	Power (Substitution) (dBm)	Limit (dBm)	Margin (dB)
2.8	52.6	158	V	48	-59.1	-13	-46.1
1.4	54	158	H	249	-60.8	-13	-47.8
1.8	50.91	158	H	322	-61.5	-13	-48.5