Lab Code: 200167-0

# FCC PART 15.247

# INDUSTRY CANADA RSS-210, ISSUE 7, JUNE 2007 MEASUREMENT AND TEST REPORT

For

# Trimble Navigation Limited

935 Stewart Drive
Sunnyvale, CA 94085, USA

**FCC ID: JUP-5855590**
**IC: 1756A-5855590**

| **This Report Concerns:** Supplemental Report | **Equipment Type:** GPS Receiver with 900 MHz FHSS Transceiver |
|---|---|
| **Test Engineer:** | Xiao Ming Hu |
| **Report Number:** | R0805277 |
| **Report Date:** | 2008-06-03 |
| **Reviewed By:** | Boni Baniqued<br>RF Sr. Engineer |
| **Prepared By:**<br>**(21)** | Bay Area Compliance Laboratories Corp<br>1274 Anvilwood Ave.<br>Sunnyvale, CA 94089, USA<br>Tel: (408) 732-9162<br>Fax: (408) 732-9164<br>www.baclcorp.com |

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# 1 GENERAL INFORMATION

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

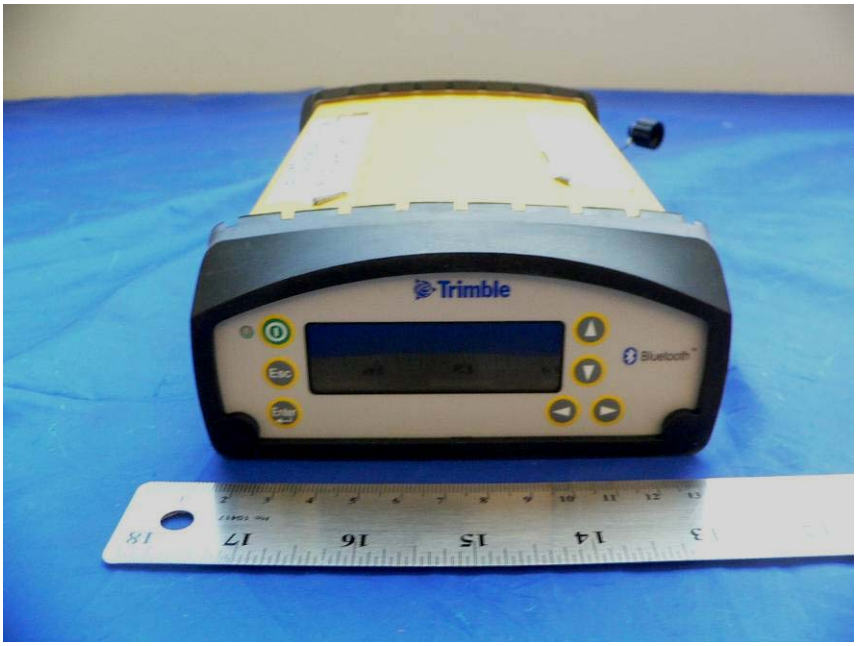
The *Trimble Navigation Limited* Product, *FCC ID: JUP-5855590, IC: 1756A-5855590, model: Wamel* or the "EUT" as referred to this report is a triple-frequency GPS plus GLONASS receiver with the ability to receive OmniSTAR corrections. The SPS851 can operate as a base station or rover. The receiver can be configured using the keypad and display, web browser, or Trimble SCS900 Site Controller software. The SPS851 makes it easy to set up a mobile base station or a permanent base station for continuous operation. The SPS851 is also an ideal mobile receiver for semi-permanent mounting on vehicles and marine vessels. The SPS851 has an optional 900 MHz FHSS transceiver used to transmit or receive RTK (Real Time Kinematic) GPS data. The SPS851 also has an Infineon Bluetooth module PBA31308 for Bluetooth connectivity with other devices. The SPS751, SPS651 and SPS551 are less functional versions of the SPSx51 family, with fewer options than the SPS851. The AgGPS RTK Base 900, AgGPS 432 and AgGPS 442 are equivalent products aimed for the agricultural industry. All aforementioned models will be referred to in internal documentation as models: 58555-6X, 58555-90, and 58555-00.

## 1.2 Mechanical Description

The EUT is a metallic construction that measures approximately 226 mm **(L)** x 121 mm **(W)** x 57 mm **(H)** and weighs 1652 grams.

** The test data gathered are from typical production sample, serial number: 4814K55008, provided by the manufacturer.*

## 1.3 EUT Photo




*Please see additional photos in Exhibit C*

## 1.4 Objective

This report is prepared on behalf of Trimble Navigation New Zealand in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communication Commissions rules and Industry Canada RSS-210 Issue 7, June 2007 standard.

The objective is to determine compliance with FCC and IC standards, rules and limits for this device due to the revision change on the radio board including:

- Radiated Spurious Emissions

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

The original RoHS 900MHz FHSS Radio was tested in BACL with FCC ID: JUP-59645 and IC ID: 1756A-5855590. Additional testing was performed.

Please refer to original report Number: R0703211 which was prepared by BACL for other FCC 15.247 radio tests which include Channel Bandwidth, Channel Output Power, Channel Separation and Number of Channels.

## 1.6 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2003.

## 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 dB 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 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, 1997 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the test methods and procedures set forth in ANSI C63.4-2003 & TIA/EIA-603.

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.: R-2463 and C-2698. 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 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 EUT was configured for testing according to ANSI C63.4-2003.

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

## 2.2 Special Accessories

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

## 2.3 Equipment Modifications

N/A

## 2.4 Power Supply and Line Filters

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| AULT | AC Adaptor (base) | PW174KA1802F02 | NA |

## 2.5 Internal Configuration

| Manufacturer | Description | Part Number | Rev |
|---|---|---|---|
| Trimble Navigation | Main Board A | 55212-20-C | 7 |
| Trimble Navigation | Display PCB Board | PW-130-10K | NA |
| Trimble Navigation | Main Board B | 55212-C | NA |

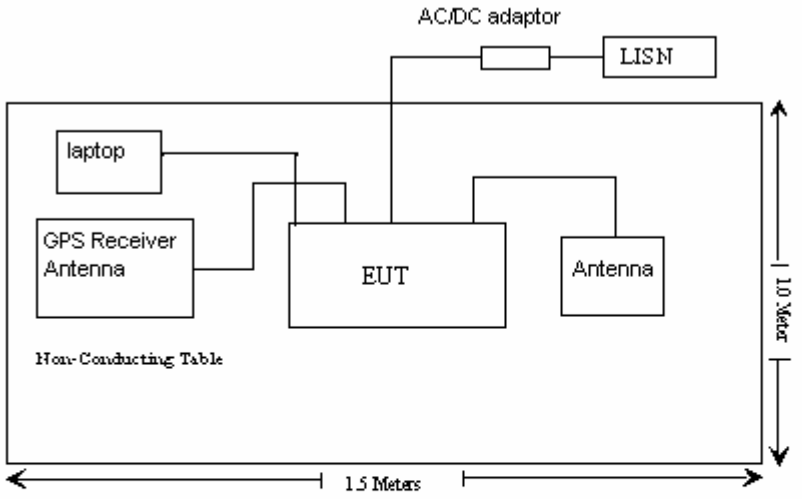
## 2.6 Local Support Equipment List and Details

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| Dell | Laptop | Latitude D620 | - |
| Trimble Navigation | 5 dBi Antenna | - | NA |
| Trimble Navigation | GPS Receiver Antenna | ZEHYR model 2 | - |

## 2.7 Interface Ports and Cabling

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

## 2.8 Test Setup Block Diagram



# 3 SUMMARY OF TEST RESULTS FOR FCC PART15.247 & IC RSS-210

| FCC 15.247/ RSS-210, RSS-Gen Rules | Description of Test | Result |
|---|---|---|
| FCC §15.247 (i) and §2.1091, IC RSS-Gen 5.5 & RSS-102 | RF Exposure | Please refer to Original Report* |
| FCC §15.203, IC RSS-Gen §7.1.4 | Antenna Requirement | Please refer to Original Report* |
| FCC §15.207 (a), IC RSS-Gen §7.2.2 | Conducted Emissions | Please refer to Original Report* |
| FCC §15.247(d), RSS210 § A8.5 § RSS-Gen §7.2 | Spurious Emissions at Antenna Port | Please refer to Original Report* |
| FCC §15.205, §15.209 & §15.247(c), IC RSS-210 §A8.5 | Radiated Spurious Emissions | Compliant |
| FCC §15.205, RSS-210 §A8.5 | Restricted Band | Compliant |
| §15.109, 15.209 (a) & §15.247(d), RSS-Gen §6(a) | Receiver Spurious Emissions | Please refer to Original Report* |
| §15.247 (a)(1), RSS-210 §A8.1 (a) | 20 dB Bandwidth & 99% Bandwidth | Please refer to Original Report* |
| §15.247 (a)(1), RSS-210 §A8.1(2) | Hopping Channel Separation | Please refer to Original Report* |
| §15.247 (a)(1)(iii), RSS-210 §A8.1(4) | Number of Hopping Frequencies Channel Used | Please refer to Original Report* |
| §15.247 (a)(1)(iii), RSS-210 §A8.1(4) | Dwell Time | Please refer to Original Report* |
| §15.247 (b)(3), RSS210 § A8.4 | Maximum Peak Output Power | Please refer to Original Report* |
| § 15.247 (d), RSS210 § A8.5 | 100 kHz Bandwidth of Frequency Band Edge | Please refer to Original Report* |

*Original submission FCC ID: JUP-59645 filed 2007-04-26.
*Original submission IC ID: 1756A-5855590 filed 2007-03-29.

# 4 FCC §15.205, §15.209 & §15.247(c), IC RSS-210 §A8.5 - Spurious Radiated Emissions

## 4.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

| Frequency (MHz) | Field Strength (micro volts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009 - 0.490 | 2400/F(kHz) | 300 |
| 0.490 - 1.705 | 24000/F(kHz) | 30 |
| 1.705 - 30.0 | 30 | 30 |
| 30 - 88 | 100** | 3 |
| 88 - 216 | 150** | 3 |
| 216 - 960 | 200** | 3 |
| Above 960 | 500 | 3 |

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC §15.247(c)(1)(i): Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| F (MHz) | F (MHz) | F (MHz) | F (GHz) |
|---|---|---|---|
| 0.090 – 0.110 | 16.42 – 16.423 | 960 – 1240 | 4. 5 – 5. 15 |
| 0.495 – 0.505 | 16.69475 – 16.69525 | 1300 – 1427 | 5. 35 – 5. 46 |
| 2.1735 – 2.1905 | 25.5 – 25.67 | 1435 – 1626.5 | 7.25 – 7.75 |
| 4.125 – 4.128 | 37.5 – 38.25 | 1645.5 – 1646.5 | 8.025 – 8.5 |
| 4.17725 – 4.17775 | 73 – 74.6 | 1660 – 1710 | 9.0 – 9.2 |
| 4.20725 – 4.20775 | 74.8 – 75.2 | 1718.8 – 1722.2 | 9.3 – 9.5 |
| 6.215 – 6.218 | 108 – 121.94 | 2200 – 2300 | 10.6 – 12.7 |
| 6.26775 – 6.26825 | 123 – 138 | 2310 – 2390 | 13.25 – 13.4 |
| 6.31175 – 6.31225 | 149.9 – 150.05 | 2483.5 – 2500 | 14.47 – 14.5 |
| 8.291 – 8.294 | 156.52475 – 156.52525 | 2690 – 2900 | 15.35 – 16.2 |
| 8.362 – 8.366 | 156.7 – 156.9 | 3260 – 3267 | 17.7 – 21.4 |
| 8.37625 – 8.38675 | 162.0125 –167.17 | 3.332 – 3.339 | 22.01 – 23.12 |
| 8.41425 – 8.41475 | 167.72 – 173.2 | 3 3458 – 3 358 | 23.6 – 24.0 |
| 12.29 – 12.293 | 240 – 285 | 3600 – 4400 | 31.2 – 31.8 |
| 12.51975 – 12.52025 | 322 – 335.4 | | 36.43 – 36.5 |
| 12.57675 – 12.57725 | 399.9 – 410 | | Above 38.6 |
| 13.36 – 13.41 | 608 – 614 | | |

As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC RSS-GEN §4.9 the measurement method shall be described in the test report. The same parameter, peak power or average power, used for the transmitter output power measurement shall be used for unwanted emission measurements. The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency), or from 30 MHz, whichever is the lower, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

## 4.2 Test Setup

The radiated emissions tests were performed in the shielded room, using the setup in accordance with ANSI C63.4-2003. The specification used was the FCC 15 Subpart C limits.

## 4.3 Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date |
|---|---|---|---|---|
| HP | Pre amplifier | 8447D | 2944A07030 | 2007-11-12 |
| Agilent | Pre amplifier | 8449B | 3008A01978 | 2007-11-02 |
| Sunol Science | Combination Antenna | JB1 Antenna | A013105-3 | 2008-03-25 |
| Antenna Research Associates, Inc. | Horn Antenna | DRG-118/A | 1132 | 2007-06-18 |
| Rohde & Schwarz | EMI Test Receiver | ESCI 1166.595 0K03 | 1000337 | 2008-04-21 |
| Sunol Science | System Controller | SC99V | 122303-1 | NR |
| Agilent | Spectrum analyzer | E4440A | MY44303352 | 2008-04-28 |

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

## 4.4 Environmental Conditions

| | |
|---|---|
| **Temperature:** | 20° C |
| **Relative Humidity:** | 40% |
| **ATM Pressure:** | 1012 mbar |

**The testing was performed by Xiao Ming Hu on 2008-05-30.*

## 4.5 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data were recorded in the peak detection mode. Quasi-peak readings was performed only when an emissions was found to be marginal (within -4 dB of specification limits), and are distinguished with a "**QP**" in the data table.

## 4.6 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emissions are 7dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Limit

## 4.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC, Part 15 sections 15.205, 15.209 and Subpart C 15.247 standards' limits, and had the margin from the limits of:

Radiated spurious emissions above 1GHz

**-12.47 dB** at **8704.518 MHz** in the **Vertical** polarization, 1 GHz –10 GHz, Low Channel

**-14.60 dB** at **8728.332 MHz** in the **Vertical** polarization, 1 GHz – 10 GHz, Middle Channel

**-14.87 dB** at **9795.072 MHz** in the **Horizontal** polarization, 1 GHz – 10 GHz, High Channel

## 4.8 Radiated Spurious Emissions Test Data

**Low Channel @ 902.621MHz**

| Frequency (MHz) | Raw data (dBuV/m) | Cable Loss (dB) | Antenna Factor & Pre-Amp Gain (dB) | Corrected Reading (dBuV/m) | Measurement Type (PK/AV) | Ant. Polarity (V/H) | Ant. Height (cm) | Azt (Deg) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 8704.518 | 28 | 11.17 | 2.36 | 41.53 | AV | V | 198 | 49 | 54 | -12.47 |
| 1804.894 | 61.13 | 4.94 | -9.4 | 56.67 | PK | V | 200 | 0 | 74 | -17.33 |
| 8703.057 | 41.68 | 11.17 | 2.36 | 55.21 | PK | V | 100 | 0 | 74 | -18.79 |
| 1805.226 | 27.23 | 4.83 | -10.43 | 21.63 | AV | V | 169 | 263 | 54 | -32.37 |

**Middle Channel @ 914.8496MHz**

| Frequency (MHz) | Raw data (dBuV/m) | Cable Loss (dB) | Antenna Factor & Pre-Amp Gain (dB) | Corrected Reading (dBuV/m) | Measurement Type (PK/AV) | Ant. Polarity (V/H) | Ant. Height (cm) | Azt (Deg) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 8728.438 | 25.85 | 11.19 | 2.35 | 39.4 | AV | V | 171 | 45 | 54 | -14.60 |
| 8728.322 | 41.38 | 11.19 | 2.35 | 54.92 | PK | V | 200 | 0 | 74 | -19.08 |
| 1892.701 | 50.56 | 4.94 | -9.37 | 46.14 | PK | V | 100 | 0 | 74 | -27.86 |
| 1894.277 | 29.86 | 4.95 | -9.35 | 25.46 | AV | V | 98 | 209 | 54 | -28.54 |
| 1995.367 | 26.7 | 5.07 | -8.21 | 23.56 | AV | V | 186 | 244 | 54 | -30.44 |
| 1996.569 | 46.12 | 5.08 | -8.2 | 42.99 | PK | V | 100 | 0 | 74 | -31.01 |
| 1447.600 | 28.34 | 4.32 | -12.4 | 20.26 | AV | V | 160 | 14 | 54 | -33.74 |
| 1449.158 | 47.4 | 4.32 | -12.4 | 39.33 | PK | V | 100 | 0 | 74 | -34.67 |

**High Channel @ 927.5877MHz**

| Frequency (MHz) | Raw data (dBuV/m) | Cable Loss (dB) | Antenna Factor & Pre-Amp Gain (dB) | Corrected Reading (dBuV/m) | Measurement Type (PK/AV) | Ant. Polarity (V/H) | Ant. Height (cm) | Azt (Deg) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 9794.851 | 24.9 | 11.9 | 2.33 | 39.13 | AV | H | 148 | 103 | 54 | -14.87 |
| 9795.072 | 41.32 | 11.9 | 2.33 | 55.54 | PK | H | 100 | 0 | 74 | -18.46 |
| 1665.315 | 54.2 | 4.63 | -11.52 | 47.31 | PK | H | 100 | 0 | 74 | -26.69 |
| 1666.731 | 31.81 | 4.63 | -11.51 | 24.93 | AV | H | 140 | 247 | 54 | -29.07 |