

FCC PART 15.247
MEASUREMENT AND TEST REPORT
For
Trimble Navigation

935 Stewart Drive
Sunnyvale, CA 94085

FCCID: JUP-5855590

This Report Concerns: ☒ Supplemental Report	Equipment Type: 900 MHz GPS and FHSS Transceiver
Test Engineer: Choon Sian Ooi 	
Report Number: R0701294	
Report Date: 2007-03-28	
Reviewed By: Hans Mellberg: VP of Engineering	
Prepared By: Bay Area Compliance Laboratories Corp. (BACL) (i0) 1274 Anvilwood Ave. Sunnyvale, CA 94089 Tel: (408) 732-9162 Fax: (408) 732-9164 www.baclcorp.com	

Note: This test report is for the customer shown above and their specific product only. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

TABLE OF CONTENTS

1 - GENERAL INFORMATION	3
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
1.2 MECHANICAL DESCRIPTION	3
1.3 EUT PHOTO	3
1.4 OBJECTIVE	4
1.5 RELATED SUBMITTAL(S)/ GRANT(S)	4
1.6 TEST METHODOLOGY	4
1.7 MEASUREMENT UNCERTAINTY	4
1.8 TEST FACILITY	4
2 SYSTEM TEST CONFIGURATION	5
2.1 JUSTIFICATION	5
2.2 SPECIAL ACCESSORIES	5
2.3 EQUIPMENT MODIFICATIONS	5
2.4 POWER SUPPLY AND LINE FILTERS	5
2.5 INTERNAL CONFIGURATION	5
2.6 LOCAL SUPPORT EQUIPMENT LIST AND DETAILS	5
2.7 INTERFACE PORTS AND CABLING	5
2.8 TEST SETUP BLOCK DIAGRAM	6
3 SUMMARY OF TEST RESULTS FOR FCC PART 15	7
4 §15.205, §15.209(A) & §15.247(D) - RADIATED EMISSIONS	8
4.1 APPLICABLE STANDARD	8
4.2 TEST SETUP	9
4.3 TEST EQUIPMENT LIST AND DETAILS	9
4.4 ENVIRONMENTAL CONDITIONS	9
4.5 TEST PROCEDURE	9
4.6 CORRECTED AMPLITUDE & MARGIN CALCULATION	9
4.7 SUMMARY OF TEST RESULTS	10
4.8 RADIATED SPURIOUS EMISSIONS TEST DATA	10
EXHIBIT A – FCC PRODUCT LABELING AND WARNING STATEMENT	12
4.9 FCC ID LABEL	12
4.10 PROPOSED LABEL LOCATION ON EUT	12
5 EXHIBIT B TEST SETUP PHOTOS	13
5.1 RADIATED EMISSIONS – FRONT VIEW	13
5.2 RADIATED EMISSIONS – REAR VIEW	13
6 EXHIBIT C - EUT PHOTOGRAPHS	14
6.1 EUT- TOP SIDE VIEW	14
6.2 EUT- BOTTOM SIDE VIEW	14
6.3 EUT- FRONT SIDE VIEW	15
6.4 EUT- REAR SIDE VIEW	15
6.5 EUT- MAIN BOARD A-TOP SIDE VIEW	16
6.6 EUT- MAIN BOARD A-BOTTOM SIDE VIEW	16
6.7 EUT- DISPLAY PCB BOARD-TOP SIDE VIEW	17
6.8 EUT- MAIN BOARD B	17
6.9 EUT- 900MHZ RADIO BOARD WITH RF SHIELD-TOP SIDE VIEW	18
6.10 EUT- 900MHZ RADIO BOARD WITHOUT RF SHIELD-TOP SIDE VIEW	18
6.11 EUT- 900MHZ RADIO BOARD -BOTTOM SIDE VIEW	19
6.12 EUT- GPS RECEIVER ANTENNA	19
6.13 EUT- 5 dBi ANTENNA	20
6.14 EUT- AC/DC POWER SUPPLY-VIEW 1	20
6.15 EUT- AC/DC POWER SUPPLY-VIEW 2	21

1 - GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

The *Trimble Navigation Limited* product, *FCC ID: JUP-5855590*, *model: WAMEL* or the “EUT” as referred to in this report is a 900 MHz FHSS Radio Transceiver. The half-duplex transceiver uses 50 channels for frequency hopping in the 902.0 to 928.0 MHz band. The lowest channel is centered at 902.621 MHz. The highest channel is centered at 927.588 MHz

The transmitter uses direct BPSK modulation of a carrier at the final output frequency. The transmitter data rate is 127,381 bits per second.

The receiver uses two stages for down conversion. The first LO (1073.821 to 1098.788 MHz) is 171.2 MHz above the tuned input frequency giving a first IF of 171.2 MHz. The second LO is at 160.5 MHz giving a second IF of 10.7 MHz. The second IF is amplified, sampled at 26.750 MHz and then digitally demodulated.

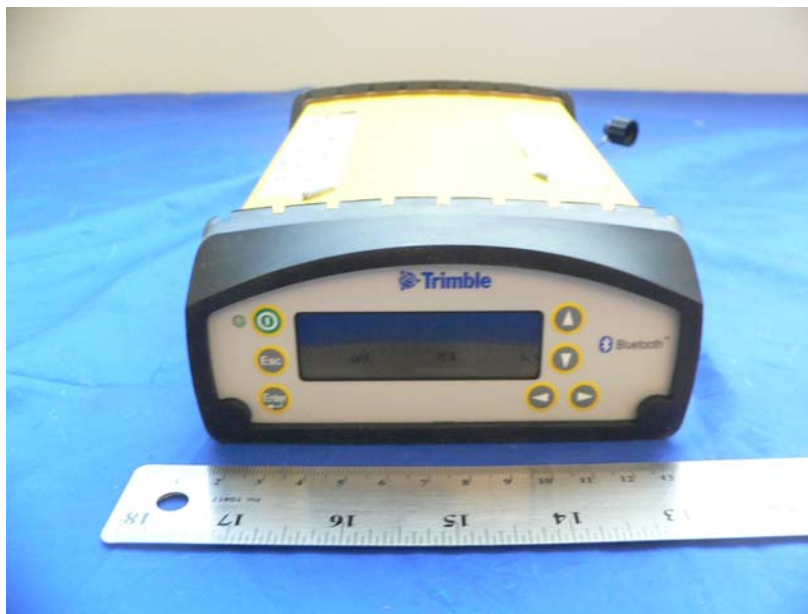
All frequencies used in the transceiver are synthesized from a single 26.750 MHz TCXO reference. The transmitter's carrier and the receiver's first LO are both generated by a VCO that is phase-locked to the reference signal using a fractional synthesizer. The second LO is synthesized by generating the sixth harmonic of the reference.

1.2 Mechanical Description

The EUT is a 900 MHz FHSS Radio Transceiver of metallic construction that measures approximately 226 mmL x 121 mmW x 57 mmH and weighs 1652 grams.

** The test data gathered are from typical production sample, serial number: 4636K00303, provided by the manufacturer.*

1.3 EUT Photo



Please see additional photos in Exhibit C

1.4 Objective

This supplemental report is prepared on behalf of *Trimble Navigation Limited.* in accordance with Part 2, Subpart J, Part 15, Subparts A, B, and C. The objective is to determine continued compliance with FCC 15.247 Standard's limits rules for Radiated Spurious Emission after the modification of the 900 MHz RF portion of this device in order to comply with the RoHS directive concerning hazardous waste.

1.5 Related Submittal(s)/ Grant(s)

The original Non-RoHS 900MHz FHSS Radio was tested in Elliot Lab with FCC ID: JUP-5580090. Additional testing was performed

Please refer to original report T-Log Number: T61593 which was prepared by Elliot Lab 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 ± 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.

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

A Wurth Elektronik ferrite (74271111) was added on the Octopus cable with two turns

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

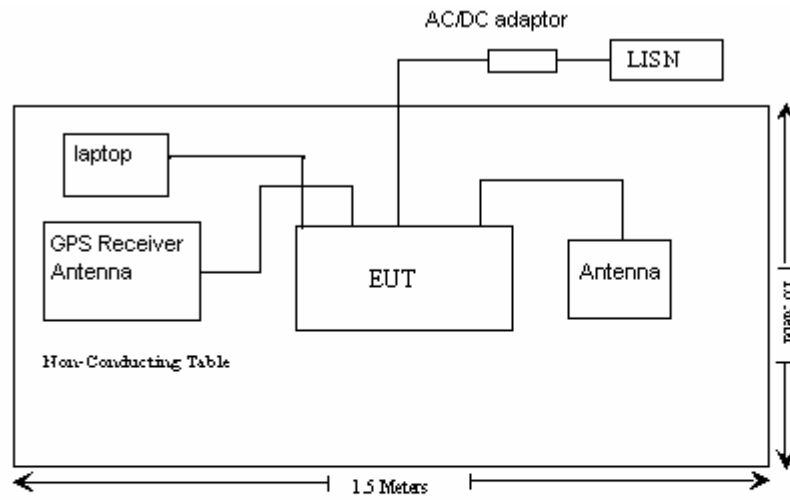
2.6 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Dell	Laptop	-	-
Trimble Navigation	5 dBi Antenna	6	NA
Trimble Navigation	GPS Receiver Antenna	ZEHYR	30123273

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 PART 15

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.203	Antenna Requirements	Please refer to Original Report*
§15.207 (a)	Conducted Emissions	Please refer to Original Report*
§ 15.205	Restricted Bands	Compliant
§15.209 & §15.247 (d)	Radiated Emissions	Compliant
§15.247 (a) (1)	Hopping Channel Separation	Please refer to Original Report*
§15.247 (a) (1)	Channel Bandwidth	Please refer to Original Report*
§15.247 (a) (1) (iii)	Number of Hopping Frequencies Used	Please refer to Original Report*
§15.247 (a) (1) (iii)	Dwell Time	Please refer to Original Report*
§15.247 (b) (1)	Maximum Peak Output Power	Please refer to Original Report*
§ 15.247 (d)	100 kHz Bandwidth of Frequency Band Edge	Please refer to Original Report*
§ 2.1051	Spurious Emissions at Antenna Port	Please refer to Original Report*
§ 15.247 (i) & §2.1091	RF Exposure	Please refer to Original Report*

*Original submission FCC ID: JUP-5580090 filed 2006-03-13.

4 §15.205, §15.209(a) & §15.247(d) - RADIATED EMISSIONS

4.1 Applicable Standard

As per 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 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/m)	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 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:

MHz	MHz	MHz	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	3.600 – 4.400	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		

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
Sonoma Instruments	Pre amplifier	317	260406	2006-02-03
Agilent	Pre amplifier	8449B	3008A01978	2006-08-21
Sunol Science	Combination Antenna	JB3 Antenna	A013105	2006-03-15
DRG	Horn Antenna	SAS-200/571	261	2006-04-20
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.595 0K03	100044	2007-02-19
Sunol Science	System Controller	SC99V	122303-1	NR
Agilent	Spectrum analyzer	8565EC	3946A00131	2006-11-12

*** 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:	20-22° C
Relative Humidity:	40-50 %
ATM Pressure:	1012-1014 mbar

**The testing was performed by Choon Sian Ooi on 2007-03-25.*

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:

$$\text{Corrected Amplitude} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

4.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, 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

-5 dB at 2707.7 MHz in the **Vertical & Horizontal** polarization, 1 GHz –10 GHz, Low Channel

-5 dB at 2746.00 MHz in the **Horizontal** polarization, 1 GHz – 10 GHz, Middle Channel

-6.2 dB at 2782.8 MHz in the **Horizontal** polarization, 1 GHz – 10 GHz, High Channel

4.8 Radiated Spurious Emissions Test Data

Low Channel

Frequency (MHz)	Reading (dBμV)	Azimuth Degree	Antenna Height (m)	Polarization (H / V)	Antenna Factor (dB/m)	Cable loss (dB)	Pre- Amplifier (dB)	Corrected Amp. (dBμV/m)	15.247		Comment
									Limit (dBμV/m)	Margin (dB)	
2707.7	53.7	210	1	V	28.9	1.5	35.1	49	54	-5	Ave
2707.7	52.8	173	1.4	H	28.9	1.5	35.1	48.1	54	-5.9	Ave
1805.18	54.8	47	1.6	V	24.8	1.5	35.9	45.2	54	-8.8	Ave
1805.18	54.7	132	1.5	H	24.8	1.5	35.9	45.1	54	-9	Ave
2707.7	57.5	351	1.5	V	28.9	1.5	35.1	52.8	74	-21.2	Peak
2707.7	56.3	173	1.5	H	28.9	1.5	35.1	51.7	74	-22.3	Peak
1805.18	58.1	47	1.6	V	24.8	1.5	35.9	48.5	74	-25.5	Peak
1805.18	57.5	132	1.5	H	24.8	1.5	35.9	47.9	74	-26.1	Peak

Middle Channel

Frequency (MHz)	Reading (dBμV)	Azimuth Degree	Antenna Height (m)	Polarization (H / V)	Antenna Factor (dB/m)	Cable loss (dB)	Pre-Amplifier (dB)	Corrected Amp. (dBμV/m)	15.247		Comment
									Limit (dBμV/m)	Margin (dB)	
2746.00	53.7	95	1.6	H	28.9	1.5	35.1	49.0	54	-5.0	Ave
2746.00	53.3	193	1.7	V	28.9	1.5	35.1	48.7	54	-5.3	Ave
1830.70	54.2	186	1.3	V	24.8	1.5	35.9	44.6	54	-9.5	Ave
1830.70	53.5	354	1.8	H	24.8	1.5	35.9	43.9	54	-10.1	Ave
2746.00	57.2	193	1.7	V	28.9	1.5	35.1	52.5	74	-21.5	Peak
2746.00	56.2	95	1.6	H	28.9	1.5	35.1	51.5	74	-22.5	Peak
1830.70	58.0	186	1.3	V	24.8	1.5	35.9	48.4	74	-25.6	Peak
1830.70	57.2	354	1.8	H	24.8	1.5	35.9	47.6	74	-26.5	Peak

High Channel

Frequency (MHz)	Reading (dBμV)	Azimuth Degree	Antenna Height (m)	Polarization (H / V)	Antenna Factor (dB/m)	Cable loss (dB)	Pre-Amplifier (dB)	Corrected Amp. (dBμV/m)	15.247		Comment
									Limit (dBμV/m)	Margin (dB)	
2782.80	52.9	202	1.5	H	28.9	1.5	35.5	47.8	54	-6.2	Ave
2782.80	51.1	197	1.8	V	28.9	1.5	35.5	46.0	54	-8.0	Ave
1855.00	54.1	235	1.5	V	24.8	1.5	36.3	44.0	54	-10.0	Ave
1855.00	53.8	282	1.9	H	24.8	1.5	36.3	43.7	54	-10.3	Ave
2782.80	57.4	197	1.8	V	28.9	1.5	35.5	52.3	74	-21.7	Peak
2782.80	56.0	202	1.5	H	28.9	1.5	35.5	50.9	74	-23.1	Peak
1855.00	58.4	165	1.6	V	24.8	1.5	34.8	49.8	74	-24.2	Peak
1855.00	56.1	282	1.9	H	24.8	1.5	34.8	47.5	74	-26.5	Peak