

TEST REPORT
IC/FCC
IC RSS-Gen Issue 3 and RSS-210 Issue8
FCC 47CFR Part 15/C Section 15.249
Transmitter Intentional Radiator

Report Reference No. : E10415-1108

Issue: : Original - Rev 1.0

Date of issue : 2011-11-08

Total number of pages : 43

Testing Laboratory : Quality Auditing Institute

Address : 16 – 211 Schoolhouse Street, Coquitlam, BC, V3K 4X9, Canada

Accreditations



IAS ISO17025 Accredited Laboratory No TL-239

This report has been completed in accordance with the requirements of ISO/IEC 17025. Test results contained in this report are with in QAI Laboratories ISO/IEC 17025 accreditation. QAI Laboratories authorizes the applicant to reproduce this report provided it is reproduced entirely and for the use by company's employees only.

Applicant's name : Recon Instruments Inc.

Address : 220-1050 Homer St. Vancouver BC, V6B 2W9, Canada

Contact : Hamid Abdollahi

hamid@reconinstruments.com

Industry Canada Registration : **9717A-007**

FCC Registration: **ZW5007**

Test specification:

Standard : RSS-Gen; RSS-210; FCC Part 15.249

Test procedure : RSS-Gen; FCC Part15/C; ANSI C63.4-2009

Non-standard test method : N/A



CANADA:

16 - 211 Schoolhouse Street

Coquitlam, British Columbia

Canada V3K 4X9

Test item description..... :	Head-mounted display system with GPS and Bluetooth for Recon Ready sport goggles.
Trade Mark..... :	N/A
Manufacturer..... :	Recon Instruments Inc.
Model/Type reference	RI-MOD-L
Ratings	+5Vdc Rechargeable Battery – charged by 100-240Vac 50-60Hz adapter via mini-USB cable



Testing procedure and testing location:

Testing Laboratory: Quality Auditing Institute

Testing location/ address: 16 – 211 Schoolhouse Street, Coquitlam, BC, 3K 4X9, Canada

Associated Laboratory: Quality Auditing Institute EMC lab (Remote location)

Testing location/ address: 19473 Fraser Way, Pitt Meadows, BC, V3Y 2V4, Canada

FCC Test Site Registration Number (OATS 10m and SAC-3m): 226383

Industry Canada Site Registration Number (SAC-3m).....: 9543B-1

Industry Canada Test Site Registration Number (OATS-10m)...: 9543C-1

Testing procedure:

Tested by (name + signature).....: David Johanson

Approved by (+ signature): Aman Jathaul

Testing location/ address: 19473 Fraser Way, Pitt Meadows, BC, V3Y 2V4, Canada

Sample Information:

Model Number.....: RI-MOD-L

Company:.....: Recon Instruments Inc.

Received Date:.....: October 11, 2011

Received By.....: David Johanson

Sample Log.....: QAI Product Control Log (QM 1301 - Sample Inventory)

Environmental Conditions:

Day 1: Oct 11-2011	Indoor Temperature: 22°C	R.H.: 39%
Day 2: Oct 13-2011	Indoor Temperature: 21°C	R.H.: 45%
Day 3: Oct 14-2011	Indoor Temperature: 19°C	R.H.: 52%
Day 4: Oct 17-2011	Indoor Temperature: 22°C	R.H.: 40%
Day 5: Oct 20-2011	Indoor Temperature: 20°C	R.H.: 44%
Day 6: Oct 21 2011	Indoor Temperature: 21°C	R.H.: 42%
Day 7: Oct 26-2011	Indoor Temperature: 20°C	R.H.: 44%
Day 8: Nov 01 2011	Indoor Temperature: 21°C	R.H.: 42%



The following tests demonstrate the testimony to FCC and IC Electromagnetic compatibility testing for this product.

EMISSIONS
North America Regions: <ul style="list-style-type: none">• CFR 47 Part 15 Subpart B and Subpart C, Section 15.249• Industry Canada ICES-003, RSS-Gen and RSS-210

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Industry Canada and FCC Regulations for an un-licensed Intentional Radiator. Recon Instruments Inc. is responsible for the tested product configuration, continued product compliance with these standards listed, and for the appropriate auditing of subsequent products, as required.

This is to certify that the following report is true and correct to the best of our knowledge.

X

Tested By
David Johanson RF/EMC Test Engineer

X

Reviewed By
Aman Jathaul RF/ EMC Engineer



Measurement Uncertainty

Radio Frequency: $\pm 1,5 \times 10^{-5}$

Total RF power, conducted.....: ± 1 dB

RF power density, conducted.....: ± 2.75 dB

Spurious emissions, conducted.....: ± 3 dB

All emissions, radiated.....: ± 3.5 dB

Temperature.....: $\pm 1^{\circ}\text{C}$

Humidity.....: ± 5 %

DC and low frequency voltages.....: ± 3 %

Test Equipment List

Emissions

Manufacturer	Model	Description	Serial No.	Cal Due Date
ETS Lindgren	S201	3M Chamber 40GHz	1030	N/R
ETS Lindgren	Custom	Mast with Motor	N/R	N/R
ETS Lindgren	Custom	Turntable	N/R	N/R
Sunol Sciences	JB3	Biconilog Antenna 20MHz-3GHz	A120106	28-Oct-2011
Com-Power	AHA-118	Horn Antenna 1- 18GHz	711041	11-Mar-2014
Com-Power	LI-115	LISN	241036	11-Feb-2012
Rohde & Schwarz	ESU	EMI Receiver	100011	29-Mar-2012



Product Description

MOD Live is a Head Mounted Display system that can be installed into Recon-Ready sports goggles. It measures the athlete's performance using an onboard GPS receiver and multiple motion sensors. It displays the sensor data in real-time on a small LCD and stores the sensor data in non-volatile memory for post processing.

The MOD Live uses a Bluetooth Low Energy (GBLE) to receive control signals from a Recon-Ready Remote.

The MOD Live uses a Bluetooth (GBT) connection to send both real-time and recorded data to a Smartphone. This connection is also used to receive data such as a SMS messages from the Smartphone and to receive video data from a Bluetooth enabled sports camera.

Operational Description

The GPS receiver and the sensors in the MOD Live measures the athlete's performances, displays the sensor data in real-time on a small LCD, and records the sensor data in non-volatile memory for post processing.

To navigate through the manual on LCD, the BLE transceiver is also implemented to receive control signals from a Recon-Ready Remote with FCC ID: ZW5001.

The test results for the Recon Remote can be found in a separate document.

EUT Testing Configuration

For the purpose of compliance testing, the MOD Live was powered using the +5Vdc power supply since the battery would not have enough power to complete the testing. The GBLE transceiver inside the MOD Live was programmed to transmit the maximum output power at the low, mid and high channels of the Bluetooth band (2402, 2441 and 2480 MHz respectively). In order to set the GBLE transceiver into a continuous transmission mode, with modulation, a command sender, based on a Recon-Ready Remote, is used.

The GBT transceiver inside the MOD Live was programmed to transmit the maximum output power at the low, mid and high channels of the Bluetooth band (2402, 2441 and 2480 MHz respectively) on each of 3 different modulations GFSK, $\pi/4$ DPSK and 8 DPSK. In order to set the GBT transceiver into a continuous transmission mode, with modulation, a netbook PC with the appropriate software is used.

Both of the GBT and GBLE transceivers share the same antenna. They can transmit independently and can transmit at the same time, although on different channels. The transceivers were tested individually as well as jointly to verify spurious emissions.

Manufacturer	Recon Instruments Inc.
Product Name	Head-mounted display system with GPS and Bluetooth for Recon Ready sport goggles.
Model No.	RI-MOD-L
Serial No.	Zeal Z3B20002
Product Software/Firmware Revision	2.0.0
Operating temperature range	-20° to +30° Celsius

Auxiliary Equipment

Description	+5Vdc Switch Mode Power Supply
Manufacturer	ENG
Model No.	3A-053WP05
Input	100-240Vac 50-60Hz 0.2A
Output	+5Vdc
Plug	NEMA 1-15 Un-polarized 2 prong blade Type A



Description	Netbook PC
Manufacturer	Gateway
Model No.	LT2107h
Operating System	Windows 7
Software	DOS Command / Android Software Development Kit

Description	Command Sending Device
Manufacturer	Recon
Serial No.	846E3F

Cables

Description	Length	Connector A	Connector B	Shielded	Ferrites
USB Power/Communications	1m	USB A	USB Micro B	Yes	No



Index

Product Description	6
Operational Description	6
EUT Testing Configuration	6
Requirements for the Canadian Market- IC	9
Part 1 - AC Mains Conducted Emissions	10
Part 2 - Digital Circuits Radiated Emission Testing	11
Part 3 - Antenna Requirements	12
Part 4 - Radiated Peak Power of the Fundamental and Harmonics	13
Part 5 - Spurious Radiated Emissions Testing	14
Part 6 - Spurious Radiated Emissions at Bandedge Testing	15
Part 7 - Occupied Bandwidth Testing	16
Part 8 - Transmitter Frequency Stability	17
Section II: Requirements for the US Market - FCC	18
Part 1 - AC Mains Conducted Emission	19
Part 2 - Digital Circuits Radiated Emission Testing	20
Part 3 - Antenna Requirements	21
Part 4 - Radiated Peak Power of the Fundamental and Harmonics	22
Part 5 - Spurious Radiated Emissions and Bandedge Testing	23
Part 6 - Transmitter Frequency Stability	24
Appendix A. Report of Measurements Data and Plots	26
Appendix B. Bandwidth and Bandedge Plots	33
Appendix C. EUT photos during the testing	41



Requirements for the Canadian Market- IC (Exigences pour le marché Canadien)

Summary for RSS-Gen issue 3 and RSS-210 Issue 8

Testing was performed pursuant to Industry Canada standards

Test	Standard	Description	Result
Digital Circuits Radiated Emissions	RSS-Gen (7.1.4) ICES-003	The radiated emissions are measured in the 30-1000MHz range	Complies
Digital Circuits AC Mains Conducted Emissions	RSS-Gen (7.1.4) ICES-003	The AC mains Conducted emissions are measured in the 0.15 to 30MHz range	Complies
Antenna Requirement	RSS-GEN(7.1.2)	Replaceable Antenna must use a unique connector	Complies Soldered non-replaceable antenna
Radiated Peak Power and Harmonics	RSS-210 (A2.9)(a)	Peak Power and Harmonics shall be measured at 3meters	Complies
Spurious Emissions outside of the band	RSS-210 (A2.9)(b)	Radiated Spurious emissions shall be 50dBc or 54dBuV in accordance with RSS-210 Table 2, whichever is less stringent 30-18000MHz	Complies
Spurious Emissions at bandedge	RSS-GEN (7.2.2)(b)	unwanted emissions falling into restricted bands of Table 3 shall comply with the limits specified in RSS-Gen Table 5	Complies
Occupied Bandwidth	RSS-GEN (4.6.1)	When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, is measured.	Complies
Transmitter Frequency Stability	RSS-GEN (4.7) and (7.2.6)	Measure the Frequency Stability over Voltage and temperature ranges	Complies



Part 1 - AC Mains Conducted Emissions

DATE: October 11, 2011

TEST STANDARD: ICES-003 Issue 4

TEST METHOD: RSS-Gen (7.1.4); CAN/CSA – CEI/IEC CISPR 22: 02

TEST VOLTAGE: 5Vdc from AC Power Adapter

MINIMUM STANDARD: Class B Limit:

Frequency (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.5 - 5	56	46
5 - 30	60	50
Note 1 The lower limit shall apply at the transition frequencies		
Note 2 The limit decreases linearly with the logarithm of the frequency in the 0.15 to 0.50 MHz..		

TEST SETUP: The EUT was connected to the conducted emissions LISN apparatus. The equipment was operated and tested at 120Vac 60Hz while in “Continuous Mode” of operation.

METHOD OF MEASUREMENT: Measurements were made using a test receiver with 9 kHz bandwidth, CISPR Quasi-Peak and Average detector.

DEVICE DESCRIPTIONS: As described in the Equipment under Test Section, above.

MEASUREMENT DATA: See Appendix A for Conducted emissions Plots and corresponding data

MODIFICATIONS: The EUT did not require any modifications.

PERFORMANCE: Complies with Standard



Part 2 - Digital Circuits Radiated Emission Testing

DATE: October 11, 2011

TEST STANDARD: ICES-003 Issue 4

TEST METHOD: RSS-Gen (7.1.4); CAN/CSA – CEI/IEC CISPR 22: 02

TEST VOLTAGE: 5Vdc from AC Power Adapter

MINIMUM STANDARD: Class B Limit:

Frequency (MHz)	Maximum Field Strength (calculated) dB μ V/m at 3 m	Maximum Field Strength dB μ V/m at 10 m
30 – 230	40.45	30.0
230 – 1000	47.45	37.0
Note 1. The lower limit shall apply at the transition frequency Note 2. Additional provisions may be required for cases where interference occurs Note 3. The 3meter calculation is done for measurements performed at 3meters.		

METHOD OF MEASUREMENT: The equipment was set up in 3m Semi Anechoic Chamber for preliminary and final measurements; Radiated Emissions were performed at 3 meters for this unit. A typical application was tested.

Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable to maximize the emissions signal strength.

This product is designed to be worn on the body. The EUT was investigated in 3 orthogonal planes and the worst case data and plots were taken.

The transmitter was OFF and set for Receive mode for this test.

MODIFICATIONS: The EUT did not require any modifications.

MEASUREMENT DATA: The plots and data are contained in Appendix A.

PERFORMANCE: Complies with Standard



Part 3 - Antenna Requirements

DATE: October 11, 2011

TEST STANDARD: IC RSS-Gen Section 7.1.2

APPLICABLE REGULATIONS : - "An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited."... "the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded."

RESULT : This unit meets this requirement. There are two antenna's in this unit. Both antenna's are soldered to the circuit board and is not accessible to the end-user.

GPS receiver – Pulse Electronics W3010

Bluetooth transceiver – Ethertronics Inc. p/n:M310210



Part 4 - Radiated Peak Power of the Fundamental and Harmonics

DATE: October 17, 2011
TEST STANDARD: IC RSS-210 Annex 2 Section (A2.9)(a)
TEST VOLTAGE: 5Vdc from AC Power Adapter
MINIMUM STANDARD:

(a) The field strengths measured at 3 meters shall not exceed the following:

Fundamental Frequencies (MHz)	Field Strength (millivolts/m)	
	Fundamental	Harmonics
902-928	50 (94dBuV)	0.5 (54dBuV)
2400-2483.5	50 (94dBuV)	0.5 (54dBuV)
5725-5875	50 (94dBuV)	0.5 (54dBuV)

TEST SETUP: The EUT was tested in our 3meter SAC and was positioned on the center of the Turntable and connected to a 5Vdc power supply. The GBLE and GBT transmitters were set for Continuous transmission. The lowest, middle and highest channels in the 2400-2483.5MHz band were measured for all radiated emissions 30MHz to 26GHz for each modulation.

MEASUREMENT METHOD: Measurements were made using an EMI Receiver with 1MHz RBW, Average detector using the appropriate Antennas, amplifiers and filters.

This product is designed to be worn on the body. The EUT was investigated in 3 orthogonal planes and the worst case data and plots were taken.

DEVICE DESCRIPTIONS: As described in the above EUT description and setup Section.

EMISSIONS DATA: No emissions were detected above 7.5GHz using the appropriate antennas and amplifiers. See data in Appendix B

OBSERVATIONS: The EUT performed as expected.

PERFORMANCE: Complies.



Part 5 - Spurious Radiated Emissions Testing

DATE: October 26, 2011

TEST STANDARD: IC RSS-210 Annex 2 Section (A2.9)(b)
RSS-Gen Section (7.2.5)

TEST VOLTAGE: 5Vdc from AC Power Adapter

MINIMUM STANDARD: (b) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

Table 5: General Field Strength Limits for Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength	
	uV/m @ 3-m	Calculated dBµV/m at 3m
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
960 - 1000	500	54.0

TEST SETUP: The EUT was tested in our 3meter SAC and was positioned on the center of the Turntable and connected to a 5Vdc power supply. The GBLE and GBT transmitters were set for Continuous transmission. The lowest, middle and highest channels in the 2400-2483.5MHz band were measured for all radiated emissions 30MHz to 26GHz for each modulation.

Each transmitter was investigated on its own as well as both transmitters being "ON" at the same time.

MEASUREMENT METHOD: Measurements were made using an EMI Receiver with 120kHz RBW Quasi-Peak or 1MHz RBW, Average detector using the appropriate Antennas, amplifiers and filters.

This product is designed to be worn on the body. The EUT was investigated in 3 orthogonal planes and the worst case data and plots were taken.

DEVICE DESCRIPTIONS: As described in the above EUT description and setup Section.

EMISSIONS DATA: No emissions were detected above 7.5GHz using the appropriate antennas and amplifiers. See data in Appendix B

OBSERVATIONS: The EUT performed as expected.

PERFORMANCE: Complies.



Part 6 - Spurious Radiated Emissions at Bandedge Testing

DATE: October 17, 2011

TEST STANDARD: IC RSS-210 Annex 2 Section (A2.9)(b)
RSS-Gen Section (7.2.2)(b)

TEST VOLTAGE: 5Vdc from AC Power Adapter

MINIMUM STANDARD: unwanted emissions falling into restricted bands of Table 3 shall comply with the limits specified in RSS-Gen Table 5.

Table 5: General Field Strength Limits for Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength	
	uV/m @ 3-m	Calculated dBµV/m at 3m
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
960 +	500	54.0

TEST SETUP: The EUT was tested in our 3meter SAC and was positioned on the center of the Turntable and connected to a 5Vdc power supply. The GBLE and GBT transmitters were set for Continuous transmission. The lowest, middle and highest channels in the 2400-2483.5MHz band were measured for all radiated emissions 30MHz to 26GHz for each modulation.

MEASUREMENT METHOD: Measurements were made using an EMI Receiver with 120kHz RBW Quasi-Peak or 1MHz RBW, Average detector using the appropriate Antennas, amplifiers and filters.

This product is designed to be worn on the body. The EUT was investigated in 3 orthogonal planes and the worst case data and plots were taken.

DEVICE DESCRIPTIONS: As described in the above EUT description and setup Section.

EMISSIONS DATA: See data in Appendix B

OBSERVATIONS: The EUT performed as expected.

PERFORMANCE: Complies.



Part 7 - Occupied Bandwidth Testing

DATE:	October 17, 2011
TEST STANDARD:	RSS-Gen Section (4.6.1)
TEST VOLTAGE:	5Vdc from AC Power Adapter
MINIMUM STANDARD:	When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.
TEST SETUP:	The EUT was tested in our 3meter SAC and was positioned on the center of the Turntable and connected to a 5Vdc power supply. The GBLE and GBT transmitters were set for Continuous transmission. The highest power channel was measured for each modulation.
MEASUREMENT METHOD:	Measurements were made using an EMI Receiver with 120kHz RBW Sample Detector set on maximum hold using the appropriate Antennas, amplifiers and filters.
DEVICE DESCRIPTIONS:	As described in the above EUT description and setup Section.
EMISSIONS DATA:	See Data and Plots in Appendix B
OBSERVATIONS:	Since this product was tested per the requirements of RSS-210 A2.9, there was no reference to a required Bandwidth. We measured the 99% bandwidth was the appropriate measurement as per RSS-Gen 4.6.1. The EUT performed as expected.
PERFORMANCE:	Complies.



Part 8 - Transmitter Frequency Stability

DATE:	October 20, 2011
TEST STANDARD:	RSS-Gen Section (4.7) and (7.2.6)
TEST VOLTAGE:	5Vdc from battery
MINIMUM STANDARD:	<p>Not specified.</p> <p>(4.7)With the transmitter installed in an environment test chamber, the unmodulated carrier frequency shall be measured under the conditions specified below:</p> <p>(a) at temperatures of -30°C, +20°C and +50°C, and at the manufacturer's rated supply voltage; and</p> <p>(b) at a temperature of +20°C and at ± 15 percent of the manufacturer's rated supply voltage.</p> <p>(7.2.6) Transmitter frequency stability for licence-exempt radio apparatus shall be measured in accordance with Section 4.7. Also, for licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C, +20°C and +50°C instead of at the temperatures specified in Section 4.7(a). If the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standards, measurement of the frequency stability is not required provided that the occupied bandwidth of the licence-exempt radio apparatus lies entirely outside the restricted bands and the prohibited TV bands of 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz.</p>
TEST SETUP:	The EUT was bench tested and in our temperature chamber. Since this is a battery operated device, there was no measurement resulting from the AC voltage variation. The temperature was varied at +50, +20, and -30° Celsius. The transmitter was set for Carrier Wave (CW) mode and the lowest and highest channel Frequency was measured at each Temperature setting, after the Transmitter stabilized at the temperature.
MEASUREMENT METHOD:	Measurements were made using a Spectrum Analyzer with 1kHz RBW Average detector using the appropriate Antennas, amplifiers and filters.
DEVICE DESCRIPTIONS:	As described in the above EUT description and setup Section.
EMISSIONS DATA:	not required. The Occupied bandwidth lies within the 2.4 to 2.4385GHz designated band. See data below in the FCC Transmitter Frequency Stability section.
OBSERVATIONS:	The EUT performed as expected.
PERFORMANCE:	Complies.



Section II: Requirements for the US Market - FCC

General

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC CFR47 Part 15 subpart B - Unintentional Radiators, Class B and subpart C – Intentional Radiators

Summary for FCC CFR47, Part 15 Subpart B and Subpart C Section 15.249

Test	Standard	Description	Result
AC Mains Conducted Emissions	15.107	The AC mains Conducted emissions are measured in the 0.15 to 30MHz range	Complies
Digital Circuits Radiated Emissions	15.109	The radiated emissions are measured in the 30-1000MHz range	Complies
Antenna Requirement	15.203	Replaceable Antenna must use a unique connector	Complies
Radiated Fundamental and Harmonics Emissions	15.249(a)	Peak Fundamental and Harmonics shall be measured at 3meters	Complies
Spurious Emissions outside of the band and Bandedge	15.249(d) and (e)	Radiated Spurious emissions shall be 50dBc or the levels in 15.209	Complies
Occupied Bandwidth	15.209	Procedures for measuring the band edge requires a 20dB emission bandwidth	Complies
Transmitter Frequency Stability	15.215(c)	The 20dB bandwidth must remain within the designated frequency band over the expected variations in temperature and voltage range	Complies



Part 1 - AC Mains Conducted Emission

DATE: October 11, 2011

TEST STANDARD: FCC Part 15/B

TEST VOLTAGE: 5Vdc from AC Power Adapter

MINIMUM STANDARD: Class B Limit:

Frequency (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.5 - 5	56	46
5 - 30	60	50
Note 1 The lower limit shall apply at the transition frequencies Note 2 The limit decreases linearly with the logarithm of the frequency in the 0.15 to 0.50 MHz..		

TEST SETUP: The EUT was connected to the conducted emissions LISN apparatus. The equipment was operated and tested at 120Vac 60Hz while in "Continuous Mode" of operation.

METHOD OF MEASUREMENT: Measurements were made using a test receiver with 9 kHz bandwidth, CISPR Quasi-Peak and Average detector.

DEVICE DESCRIPTIONS: As described in the Equipment under Test Section, above.

MEASUREMENT DATA: See Appendix A for Conducted emissions Plots and corresponding data

MODIFICATIONS: The EUT did not require any modifications.

PERFORMANCE: Complies with Standard



Part 2 - Digital Circuits Radiated Emission Testing

DATE: October 11, 2011

TEST STANDARD: FCC Part 15/B

TEST VOLTAGE: 5Vdc from AC Power Adapter

MINIMUM STANDARD: Class B Limit:

+Frequency (MHz)	Field Strength	
	uV/m @ 3-m	dBµV/m at 3m
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
960 - 1000	500	54.0

METHOD OF MEASUREMENT: The equipment was set up in 3m Semi Anechoic Chamber for preliminary and final measurements; Radiated Emissions were performed at 3 meters for this unit. A typical application was tested.

Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable to maximize the emissions signal strength.

This product is designed to be worn on the body. The EUT was investigated in 3 orthogonal planes and the worst case data and plots were taken.

The transmitter was OFF and set for Receive mode for this test.

MODIFICATIONS: The EUT did not require any modifications.

MEASUREMENT DATA: See Appendix A for emissions plots and corresponding data

PERFORMANCE: Complies with Standard



Part 3 - Antenna Requirements

DATE: October 11, 2011

TEST STANDARD: FCC Part 15.203

APPLICABLE REGULATIONS : - "An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited."... "the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded."

RESULT : This unit meets this requirement. There are two antenna's in this unit. Both antenna's are soldered to the circuit board and is not accessible to the end-user.

GPS receiver – Pulse Electronics W3010

Bluetooth transceiver – Ethertronics Inc. p/n:M310210



Part 4 - Radiated Peak Power of the Fundamental and Harmonics

DATE: October 17, 2011
TEST STANDARD: FCC Part 15.249(a)
TEST VOLTAGE: 5Vdc
MINIMUM STANDARD:

(a) The field strengths measured at 3 meters shall not exceed the following:

Fundamental Frequencies (MHz)	Field Strength (millivolts/m)	
	Fundamental	Harmonics
902-928	50 (94dBuV)	0.5 (54dBuV)
2400-2483.5	50 (94dBuV)	0.5 (54dBuV)
5725-5875	50 (94dBuV)	0.5 (54dBuV)

TEST SETUP: The EUT was tested in our 3meter SAC and was positioned on the center of the Turntable and connected to a 5Vdc power supply. The GBLE and GBT transmitters were set for Continuous transmission. The lowest, middle and highest channels in the 2400-2483.5MHz band were measured for all radiated emissions 30MHz to 26GHz for each modulation.

MEASUREMENT METHOD: Measurements were made using an EMI Receiver with 1MHz RBW, Average detector using the appropriate Antennas, amplifiers and filters.

This product is designed to be worn on the body. The EUT was investigated in 3 orthogonal planes and the worst case data and plots were taken.

DEVICE DESCRIPTIONS: As described in the above EUT description and setup Section.

EMISSIONS DATA: No emissions were detected above 7.5GHz using the appropriate antennas and amplifiers. See data in Appendix B

OBSERVATIONS: The EUT performed as expected.

PERFORMANCE: Complies.



Part 5 - Spurious Radiated Emissions and Bandedge Testing

DATE: October 26, 2011

TEST STANDARD: FCC Part 15.249(d) and (e)

TEST VOLTAGE: 5Vdc

MINIMUM STANDARD: (d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

(e) As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20dB under any condition of modulation.

15.209 General Field Strength Limits

Frequency (MHz)	Field Strength	
	uV/m @ 3-m	Calculated dBµV/m at 3m
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
960+	500	54.0

TEST SETUP: The EUT was tested in our 3meter SAC and was positioned on the center of the Turntable and connected to a 5Vdc power supply. The GBLE and GBT transmitters were set for Continuous transmission. The lowest, middle and highest channels in the 2400-2483.5MHz band were measured for all radiated emissions 30MHz to 26GHz for each modulation.

MEASUREMENT METHOD: Measurements were made using an EMI Receiver with 120kHz RBW Quasi-Peak or 1MHz RBW, Average detector using the appropriate Antennas, amplifiers and filters.

This product is designed to be worn on the body. The EUT was investigated in 3 orthogonal planes and the worst case data and plots were taken.

DEVICE DESCRIPTIONS: As described in the above EUT description and setup Section.

EMISSIONS DATA: No emissions were detected above 7.5GHz using the appropriate antennas and amplifiers. See data and plots in Appendix A.

OBSERVATIONS: The EUT performed as expected.

PERFORMANCE: Complies.



Part 6 - Transmitter Frequency Stability

DATE: October 20, 2011

TEST STANDARD: FCC Part 15.215(c)

TEST VOLTAGE: 5Vdc provided by 120Vac adapter

MINIMUM STANDARD: The 20dB bandwidth must remain within the designated frequency band over the expected variations in temperature and voltage range

TEST SETUP: The EUT was bench tested and in our temperature chamber. The AC voltage was varied 102, 120 and 138Vac 60Hz and the Bandwidth measured at 20deg. Celsius for each voltage level at the bandedge. The temperature was varied at +30, +20, 0, -20 and -30deg. Celsius as per the manufacturers expected temperature range and the Bandwidth measured at 120Vac 60Hz for each temperature level at the bandedge. The GBLE Transmitter was set for Continuous transmission using the modulation for this transmitter. The GBT Transmitter was wet for continuous transmission using the widest modulation. The lowest, and highest channel bandwidth was measured at each Voltage and Temperature setting for each transmitter.

MEASUREMENT METHOD: Measurements were made using a Spectrum Analyzer with 1MHz RBW Average detector using the appropriate Antennas, amplifiers and filters.

DEVICE DESCRIPTIONS: As described in the above EUT description and setup Section.

EMISSIONS DATA:

GBLE Channel 0 – 2.402GHz

Temperature (deg. Celsius)	Voltage (Vac at 60Hz)	Bandwidth level at band edge (dB from peak emission)
20	102	-22.8
20	120	-22.8
20	138	-22.8
-30	120	-24.7
-20	120	-23.8
0	120	-22.7
20	120	-22.8
30	120	-22.3

GBLE Channel 39 – 2.480GHz

Temperature (deg. Celsius)	Voltage (Vac at 60Hz)	Bandwidth level at band edge (dB from peak emission)
20	102	-39.3
20	120	-39.3
20	138	-39.3
-30	120	-37.6
-20	120	-37.9
0	120	-38.9
20	120	-39.3
30	120	-39.2



EMISSIONS DATA:

GBT Modulation = 8 DPSK Channel 0 – 2.402GHz

Temperature (deg. Celsius)	Voltage (Vac at 60Hz)	Bandwidth level at band edge (dB from peak emission)
20	102	-34.9
20	120	-34.9
20	138	-34.9
-30	120	-35.7
-20	120	-35.9
0	120	-22.6
20	120	-34.9
30	120	-22.7

GBT Modulation = 8 DPSK Channel 78 – 2.480GHz

Temperature (deg. Celsius)	Voltage (Vac at 60Hz)	Bandwidth level at band edge (dB from peak emission)
20	102	-43.3
20	120	-43.4
20	138	-43.4
-30	120	-47.8
-20	120	-47.8
0	120	-46.8
20	120	-43.4
30	120	-42.7

OBSERVATIONS:

The EUT performed as expected.

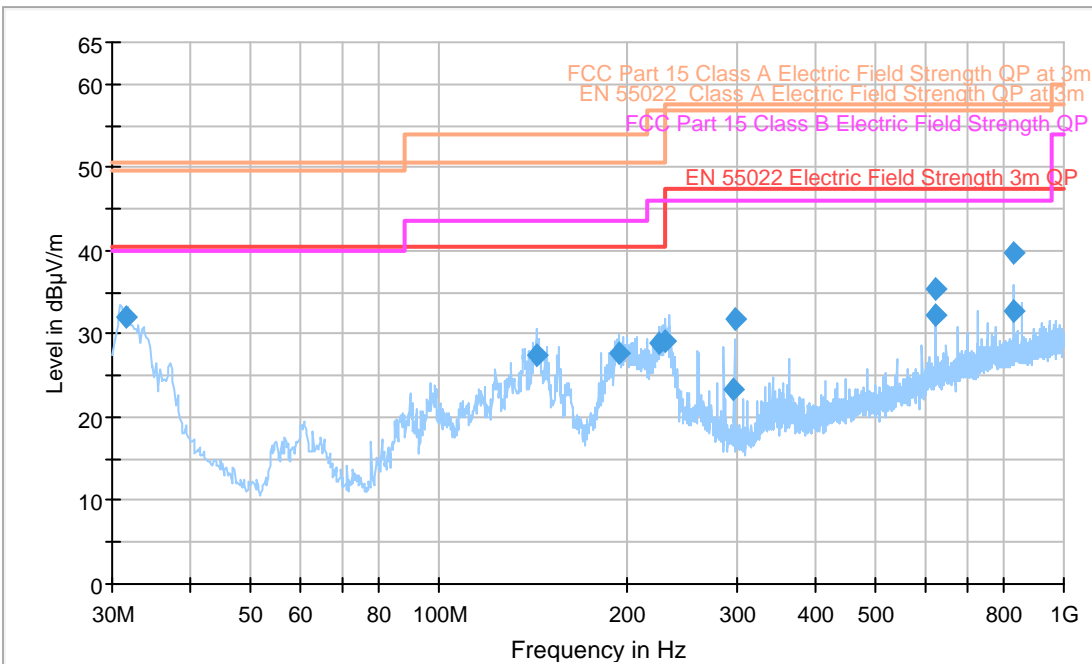
PERFORMANCE:

Complies.



Appendix A. Report of Measurements Data and Plots

Quiescent Mode/Transmitter turned off



Plot for reference purposes only

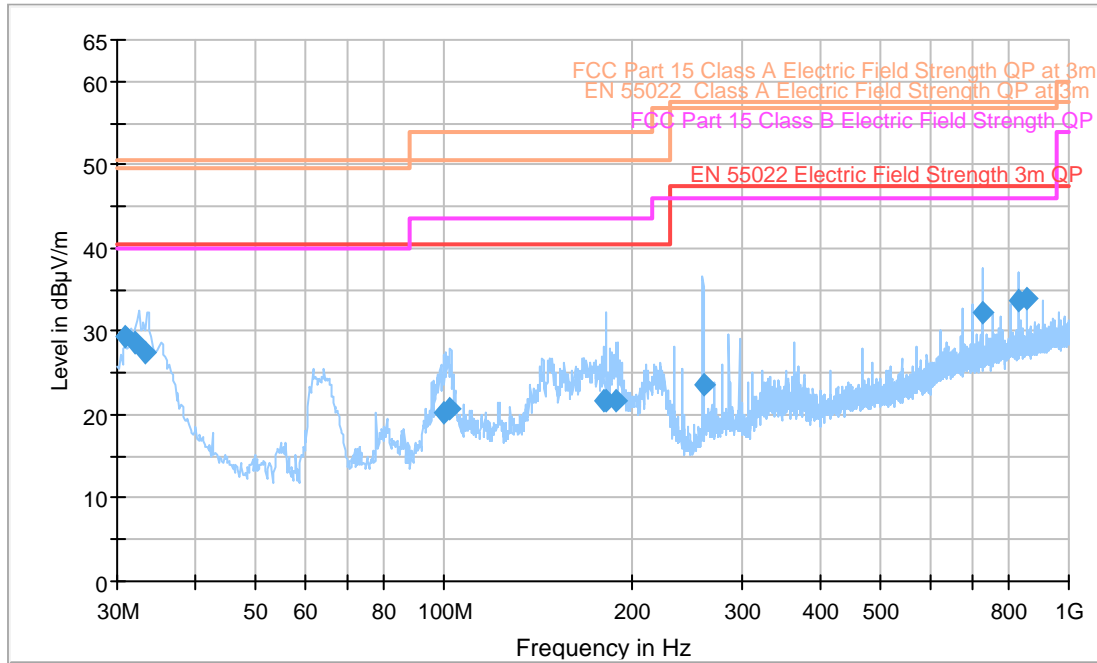
Spurious Emissions 30-1000MHz

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
31.558240	32.1	1000.00	120.000	100.0	V	187.0	20.0	8.4	40.5
143.337120	27.5	1000.00	120.000	232.0	H	292.0	14.0	13.0	40.5
194.081120	27.6	1000.00	120.000	121.0	H	-82.0	12.8	12.9	40.5
225.003280	28.9	1000.00	120.000	135.0	H	38.0	12.5	11.6	40.5
229.428000	29.0	1000.00	120.000	100.0	H	284.0	12.7	11.5	40.5
296.716960	23.3	1000.00	120.000	219.0	V	12.0	14.6	24.2	47.5
297.000000	31.8	1000.00	120.000	100.0	H	5.0	15.0	15.7	47.5
624.012160	35.5	1000.00	120.000	135.0	H	253.0	21.2	12.0	47.5
624.041920	32.4	1000.00	120.000	133.0	V	190.0	21.1	15.1	47.5
831.860720	32.8	1000.00	120.000	203.0	V	129.0	23.4	14.7	47.5
832.009280	39.8	1000.00	120.000	100.0	H	227.0	24.0	7.7	47.5

No spurious emissions detected from 1GHz to 25GHz with transmitters turned off.



Spurious Emissions Dual Transmitter On GBLE Channel 0 - 2.402GHz GBT Channel 04 – 2.410GHz



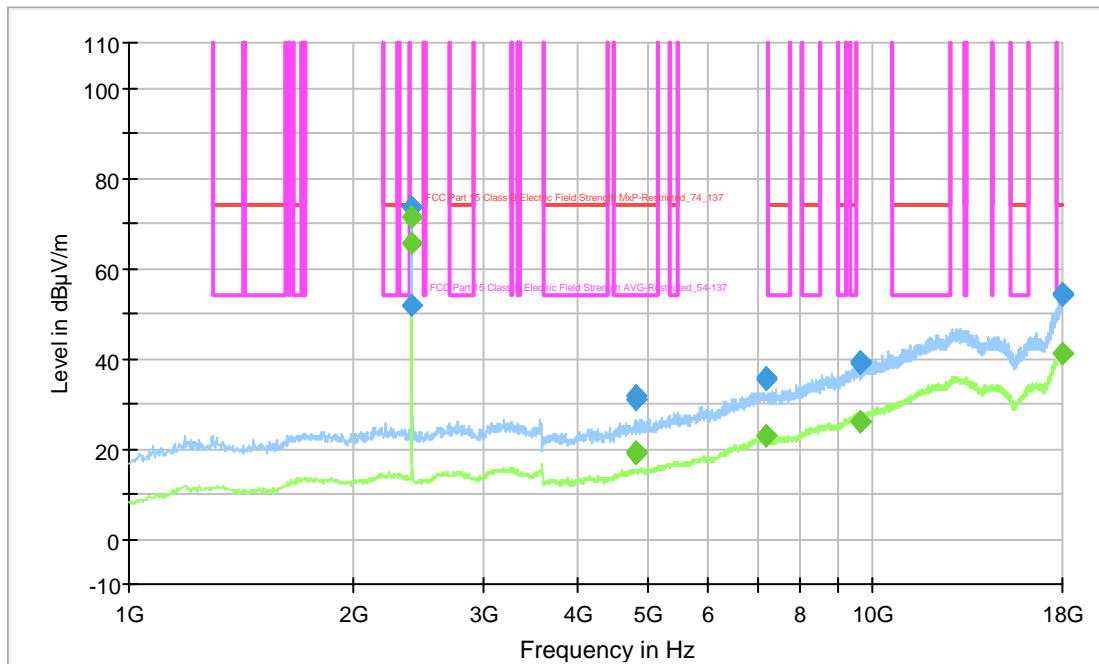
Plot for Reference purposes only

Spurious Emissions 30-1000MHz

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
30.957760	29.3	1000.00	120.000	176.0	V	300.0	20.3	11.2	40.5
32.133920	28.6	1000.00	120.000	121.0	V	206.0	19.6	11.9	40.5
33.343520	27.6	1000.00	120.000	225.0	V	24.0	18.6	12.9	40.5
100.226080	20.2	1000.00	120.000	177.0	H	232.0	11.4	20.3	40.5
102.386480	20.7	1000.00	120.000	315.0	H	1.0	12.1	19.8	40.5
180.382240	21.7	1000.00	120.000	149.0	H	43.0	12.2	18.8	40.5
181.839840	21.6	1000.00	120.000	190.0	H	38.0	12.2	18.9	40.5
189.244160	21.6	1000.00	120.000	177.0	H	-18.0	12.3	18.9	40.5
260.023920	23.5	1000.00	120.000	100.0	H	166.0	13.6	24.0	47.5
728.152880	32.2	1000.00	120.000	166.0	H	206.0	22.7	15.3	47.5
831.965600	33.8	1000.00	120.000	100.0	H	2.0	24.0	13.7	47.5
858.251040	33.9	1000.00	120.000	149.0	H	207.0	24.0	13.6	47.5

Same results for all 3 channels; no channel specific emissions detected.

No Spurious Emissions detected 1000 to 2.4GHz



**Plot: Ch0 harmonic emissions 1 to 18GHz– Reference only
(the other channels are not shown since they have similar plots)**



GBLE Channel 0 - 2.402GHz Modulated Fundamental and Harmonics 2.4-18GHz Peak

Frequency (MHz)	MaxPeak (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2401.965440	85.4	1000.000	210.0	H	68.0	28.6	114.0
4803.306640	31.7	1000.000	210.0	H	244.0	42.3	74.0
7206.480960	35.8	1000.000	149.0	H	248.0	38.2	74.0

GBLE Channel 0 - 2.402GHz Modulated Fundamental and Harmonics 2.4-18GHz Average

Frequency (MHz)	Average (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2401.938800	85.1	1000.000	180.0	H	66.0	8.9	94.0
4804.738720	19.3	1000.000	177.0	V	194.0	34.7	54.0
7204.736400	22.8	1000.000	222.0	H	4.0	31.2	54.0

GBLE Channel 20 - 2.441GHz Modulated Fundamental Peak

Frequency (MHz)	MaxPeak (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2.4422	83.6	1000.000	215.0	H	70.0	30.4	114.0

All harmonics are > 20dB below the limit line

GBLE Channel 20 - 2.441GHz Modulated Fundamental Average

Frequency (MHz)	Average (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2401.938800	83.4	1000.000	210.0	H	42.0	10.6	94.0

All harmonics are > 20dB below the limit line

GBLE Channel 39 - 2.480GHz Modulated Fundamental Peak

Frequency (MHz)	MaxPeak (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2.4422	77.4	1000.000	183.0	H	92.0	36.6	114.0

All harmonics are > 20dB below the limit line

GBLE Channel 39 - 2.480GHz Modulated Fundamental Average

Frequency (MHz)	Average (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2401.938800	77.0	1000.000	201.0	H	53.0	17.0	94.0

All harmonics are > 20dB below the limit line



GBT MOD= 8 DPSK Channel 0 - 2.402GHz Modulated Fundamental and Harmonics Peak

Frequency (MHz)	MaxPeak (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2402.200	92.4	1000.000	100.0	V	104.0	21.6	114.0
4803.995	50.3	1000.000	100.0	V	208	23.7	74.0
7206.539	43.3	1000.000	133.0	V	262.0	30.7	74.0

GBT MOD= 8 DPSK Channel 0 - 2.402GHz Modulated Fundamental and Harmonics Average

Frequency (MHz)	Average (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2402.200	89.1	1000.000	100.0	V	104.0	4.9	94.0
4803.995	45.6	1000.000	100.0	V	208.0	8.4	54.0
7206.539	34.5	1000.000	133.0	V	262.0	19.5	54.0

GBT MOD= 8 DPSK Channel 43 - 2.441GHz Modulated Fundamental Peak

Frequency (MHz)	MaxPeak (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2440.977	89.1	1000.000	100.0	V	103	24.9	114.0

All harmonics are > 20dB below the limit line

GBT MOD= 8 DPSK Channel 43 - 2.441GHz Modulated Fundamental Average

Frequency (MHz)	Average (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2440.997	85.6	1000.000	100.0	V	103	8.4	94.0
4881.993	42.9	1000.000	100.0	V	186.0	11.1	54.0
7206.539	33.0	1000.000	100.0	V	226.0	21.1	54.0

All harmonics are > 20dB below the limit line

GBT MOD= 8 DPSK Channel 78 - 2.480GHz Modulated Fundamental Peak

Frequency (MHz)	MaxPeak (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2479.978	88.1	1000.000	100.0	V	102.0	25.9	114.0

GBT MOD= 8 DPSK Channel 78 - 2.480GHz Modulated Fundamental Average

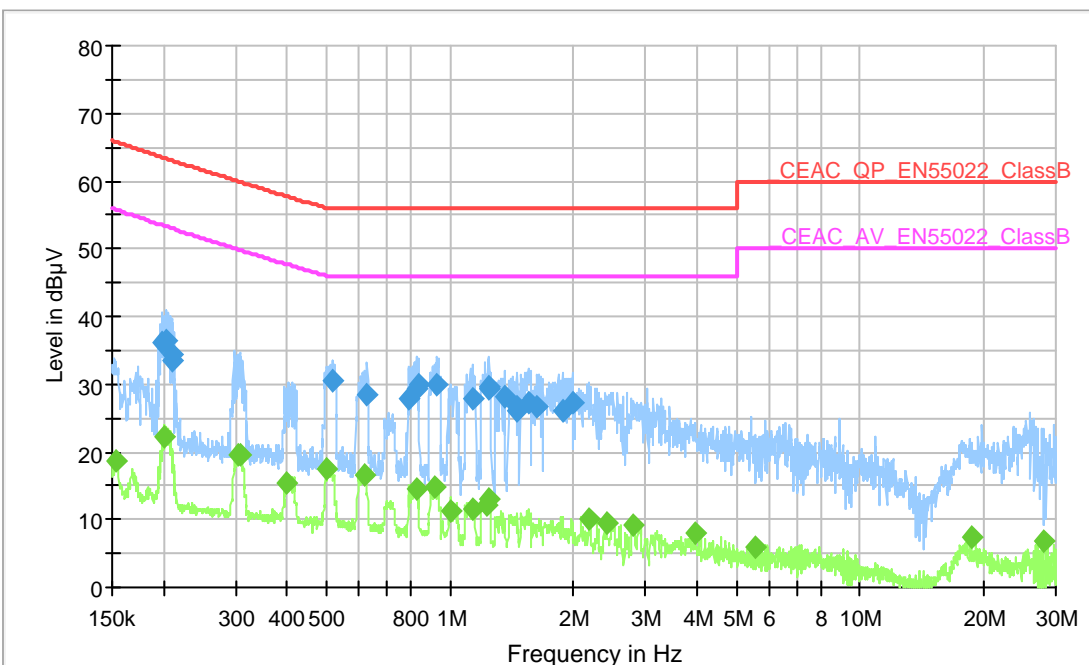
Frequency (MHz)	Average (dBμV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBμV/m)
2479.978	84.2	1000.000	100.0	V	102.0	9.8	94.0

All harmonics are > 20dB below the limit line

All other modulations have lower emissions.



AC Mains Conducted Emissions both Transmitters On 120Vac 60Hz Line



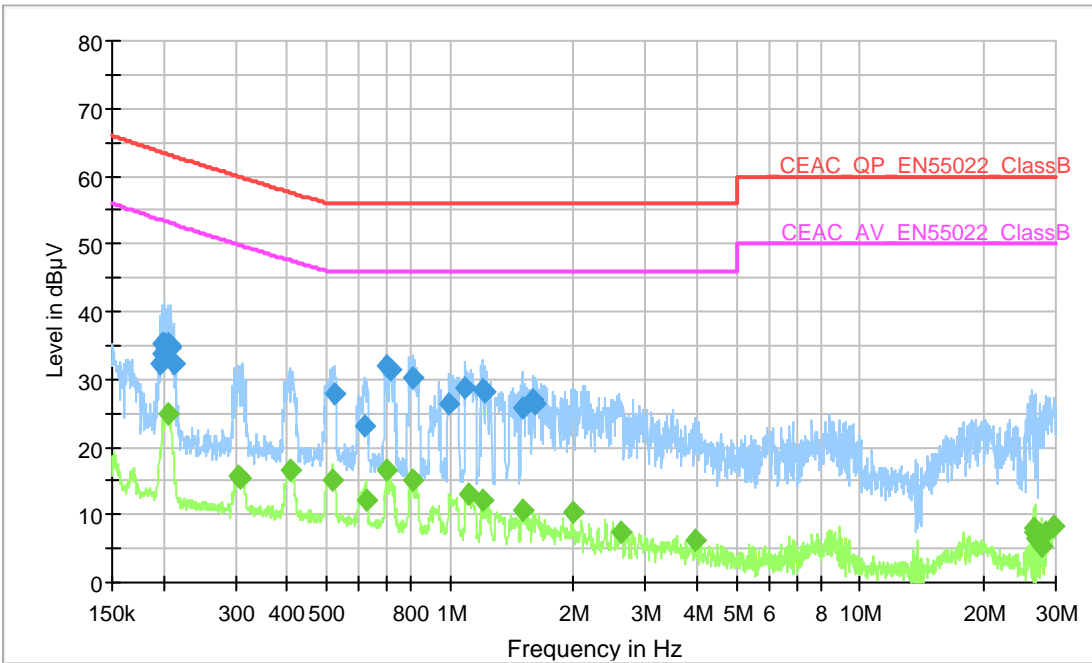
Quasi Peak emissions

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.199208	36.2	1000.00	9.000	On	L1	0.1	27.3	63.5
0.203229	36.4	1000.00	9.000	On	L1	0.1	26.9	63.3
0.209412	34.5	1000.00	9.000	On	L1	0.1	28.6	63.1
0.210250	33.5	1000.00	9.000	On	L1	0.1	29.5	63.0
0.518736	30.4	1000.00	9.000	On	L1	0.1	25.6	56.0
0.628417	28.6	1000.00	9.000	On	L1	0.2	27.4	56.0
0.792325	27.8	1000.00	9.000	On	L1	0.2	28.2	56.0
0.826277	29.4	1000.00	9.000	On	L1	0.2	26.6	56.0
0.836242	29.8	1000.00	9.000	On	L1	0.2	26.2	56.0
0.931513	29.8	1000.00	9.000	On	L1	0.2	26.2	56.0
1.132988	27.8	1000.00	9.000	On	L1	0.2	28.2	56.0
1.237101	29.2	1000.00	9.000	On	L1	0.2	26.8	56.0
1.249522	29.5	1000.00	9.000	On	L1	0.2	26.5	56.0
1.358902	28.1	1000.00	9.000	On	L1	0.2	27.9	56.0
1.448622	26.0	1000.00	9.000	On	L1	0.2	30.0	56.0
1.463167	26.6	1000.00	9.000	On	L1	0.2	29.4	56.0
1.550450	27.4	1000.00	9.000	On	L1	0.2	28.6	56.0
1.636388	26.6	1000.00	9.000	On	L1	0.2	29.4	56.0
1.874525	26.0	1000.00	9.000	On	L1	0.2	30.0	56.0
1.986347	27.2	1000.00	9.000	On	L1	0.2	28.8	56.0

Average Data Not required.



120Vac 60Hz Neutral



Quasi Peak emissions

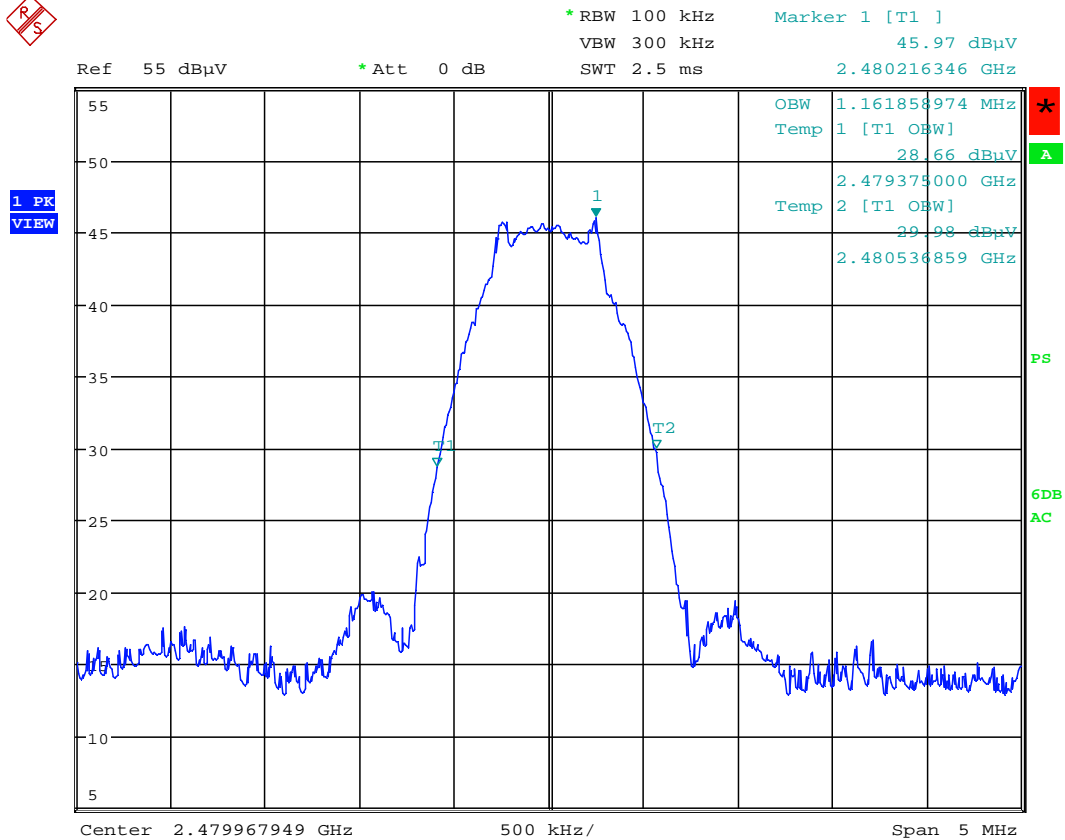
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.196442	32.2	1000.00	9.000	On	L1	0.1	31.4	63.6
0.197623	33.9	1000.00	9.000	On	L1	0.1	29.7	63.6
0.199607	35.3	1000.00	9.000	On	L1	0.1	28.2	63.5
0.200406	35.3	1000.00	9.000	On	L1	0.1	28.1	63.4
0.204450	35.2	1000.00	9.000	On	L1	0.1	28.1	63.3
0.208160	35.0	1000.00	9.000	On	L1	0.1	28.1	63.1
0.208994	34.8	1000.00	9.000	On	L1	0.1	28.3	63.1
0.211514	32.4	1000.00	9.000	On	L1	0.1	30.6	63.0
0.523944	27.9	1000.00	9.000	On	L1	0.2	28.1	56.0
0.618452	23.1	1000.00	9.000	On	L1	0.2	32.9	56.0
0.697219	32.0	1000.00	9.000	On	L1	0.2	24.0	56.0
0.712712	31.3	1000.00	9.000	On	L1	0.2	24.7	56.0
0.809931	30.3	1000.00	9.000	On	L1	0.2	25.7	56.0
0.995001	26.5	1000.00	9.000	On	L1	0.2	29.5	56.0
1.090784	28.6	1000.00	9.000	On	L1	0.2	27.4	56.0
1.195787	28.5	1000.00	9.000	On	L1	0.2	27.5	56.0
1.217484	28.2	1000.00	9.000	On	L1	0.2	27.8	56.0
1.498672	25.8	1000.00	9.000	On	L1	0.2	30.2	56.0
1.588073	26.8	1000.00	9.000	On	L1	0.2	29.2	56.0
1.610440	26.3	1000.00	9.000	On	L1	0.2	29.7	56.0

Average Data not required.



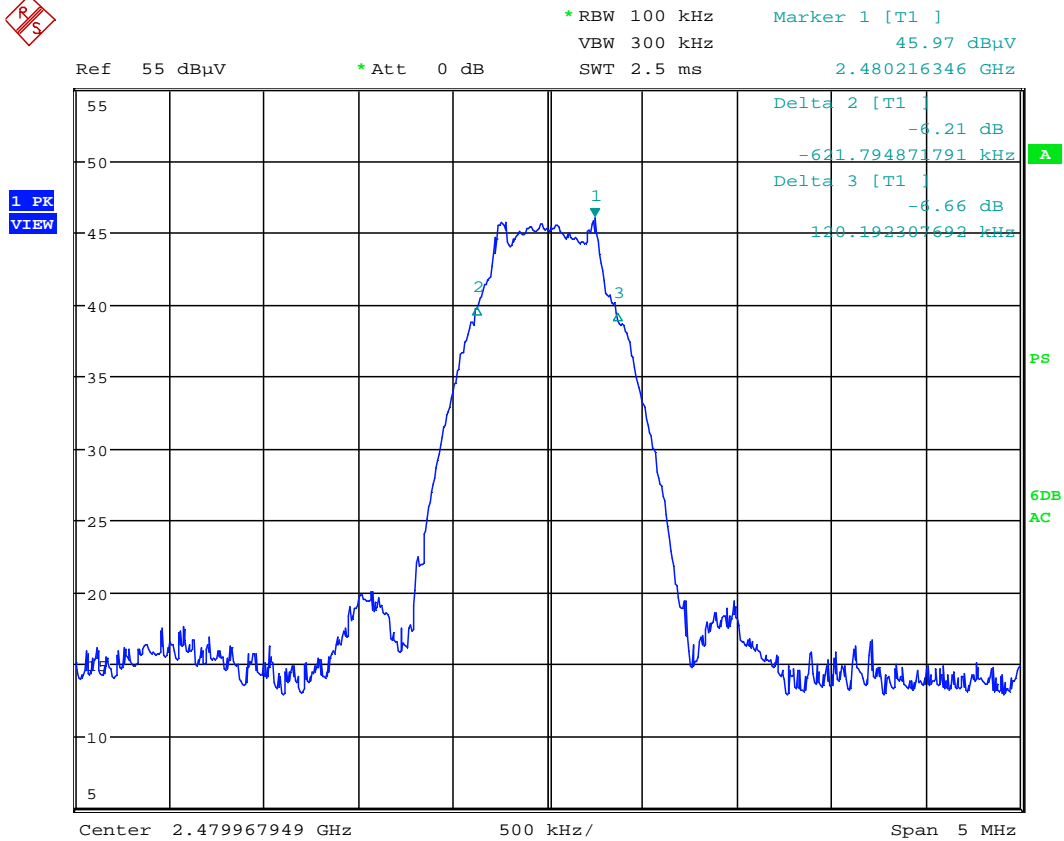
Appendix B. Bandwidth and Bandedge Plots

GBLE Transmitter



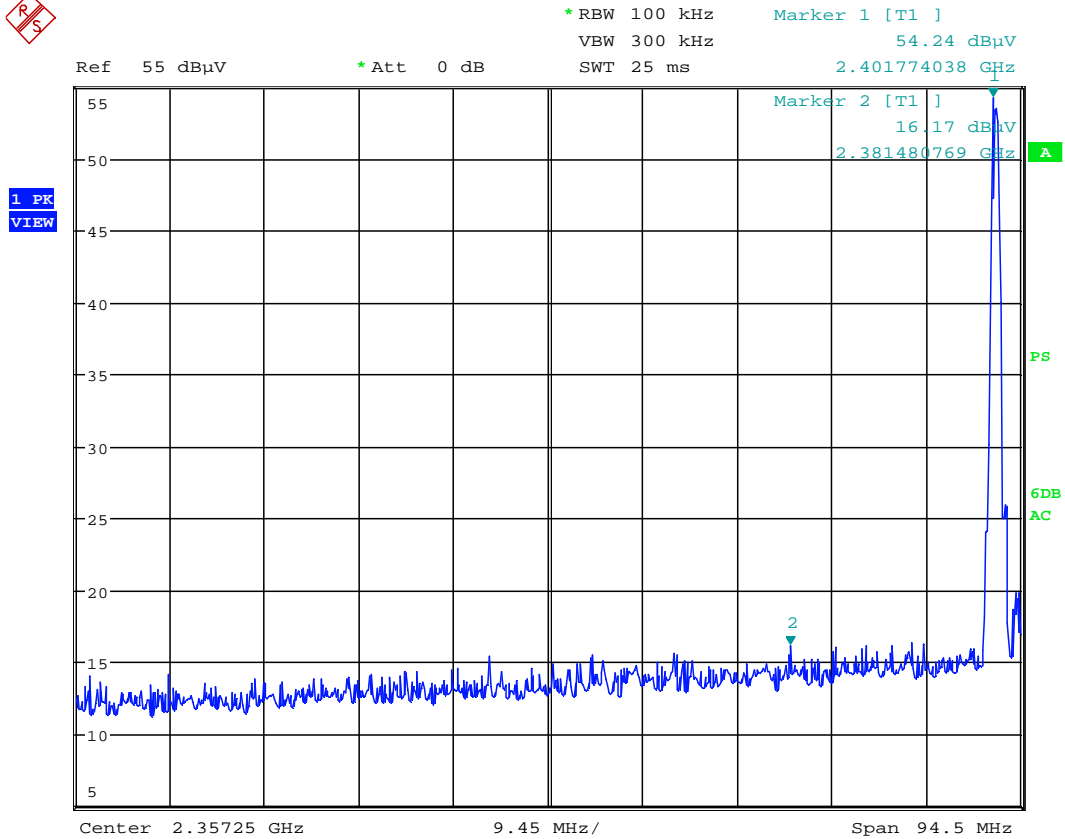
Date: 13.OCT.2011 20:39:50

Channel 39 99% Bandwidth Measurement – 1.16MHz



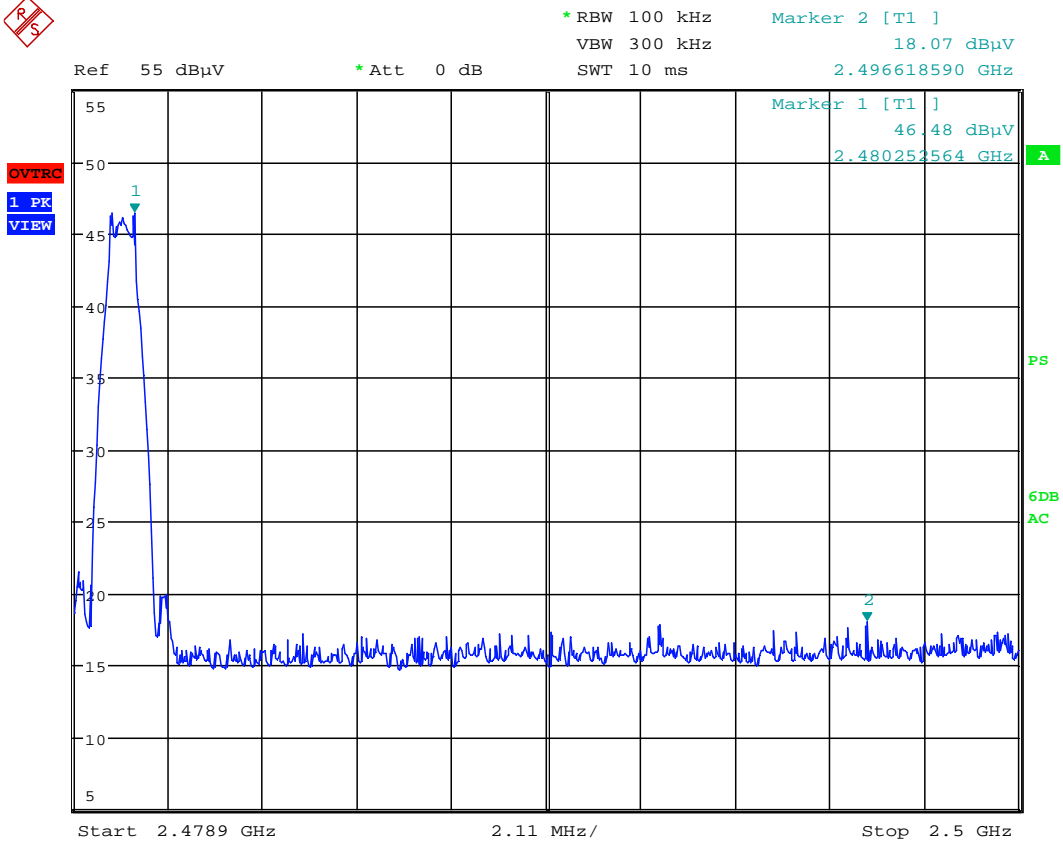
Date: 13.OCT.2011 20:38:47

Channel 39 6dB Bandwidth Measurement – 742kHz



Date: 13.OCT.2011 19:25:47

Low Channel Band Edge

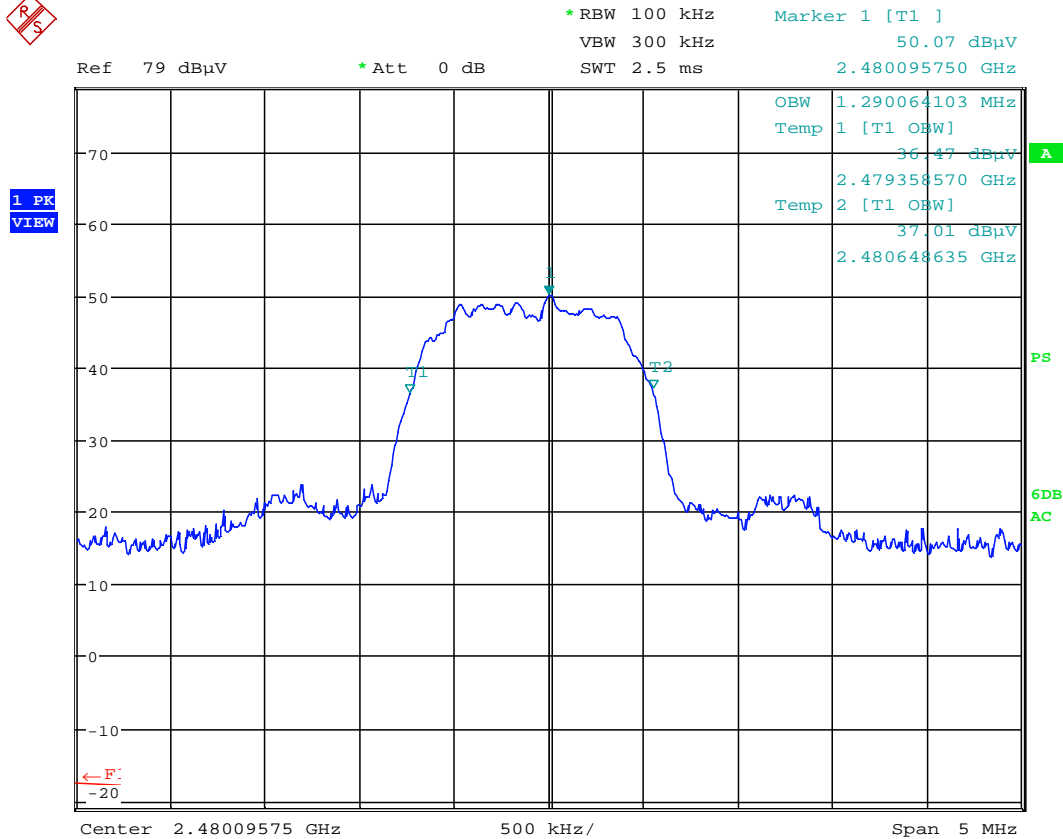


Date: 13.OCT.2011 20:51:03

High Channel Band Edge

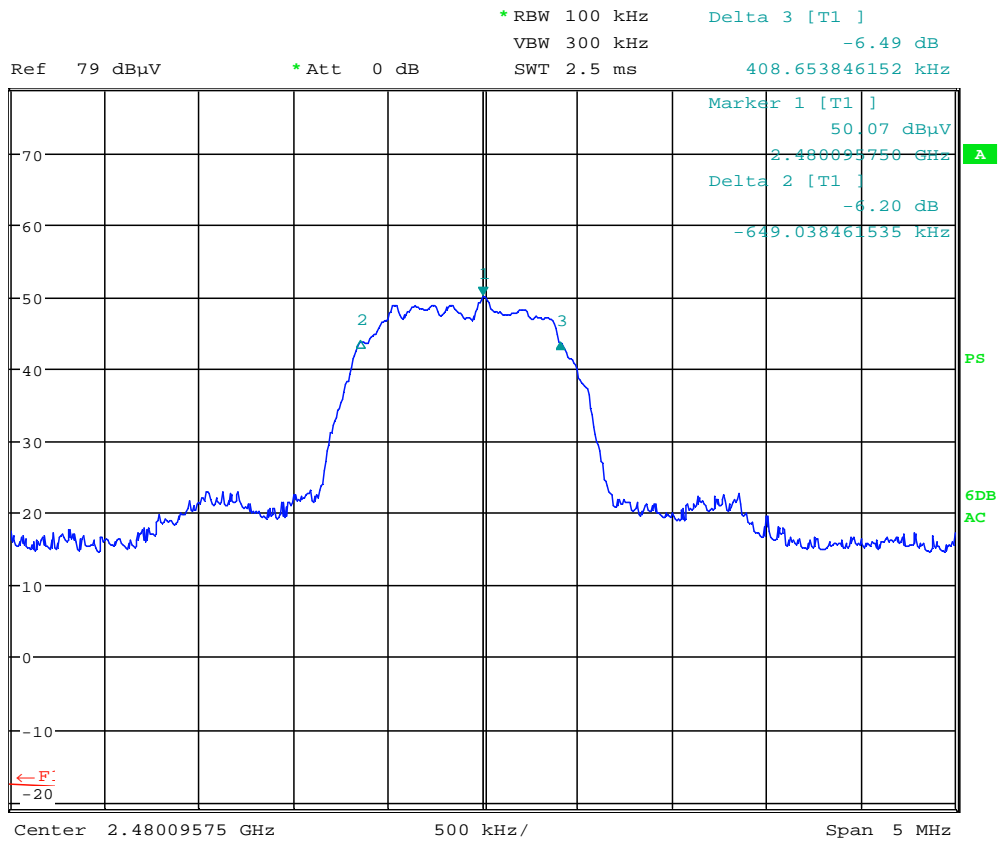


GBT Transmitter



Date: 17.OCT.2011 16:18:58

MOD= 8DPSK Channel 78 99% Bandwidth Measurement – 1.29MHz

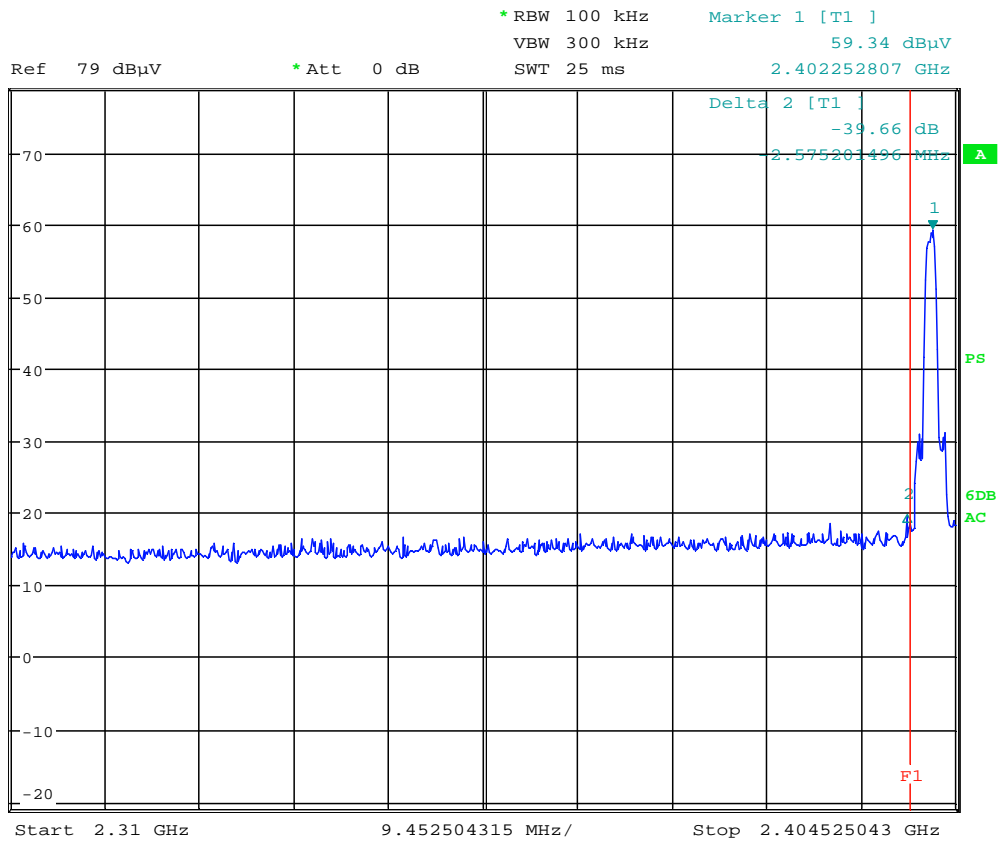


Date: 17.OCT.2011 16:18:10

MOD= 8DPSK Channel 78 6dB Bandwidth Measurement – 1.06MHz

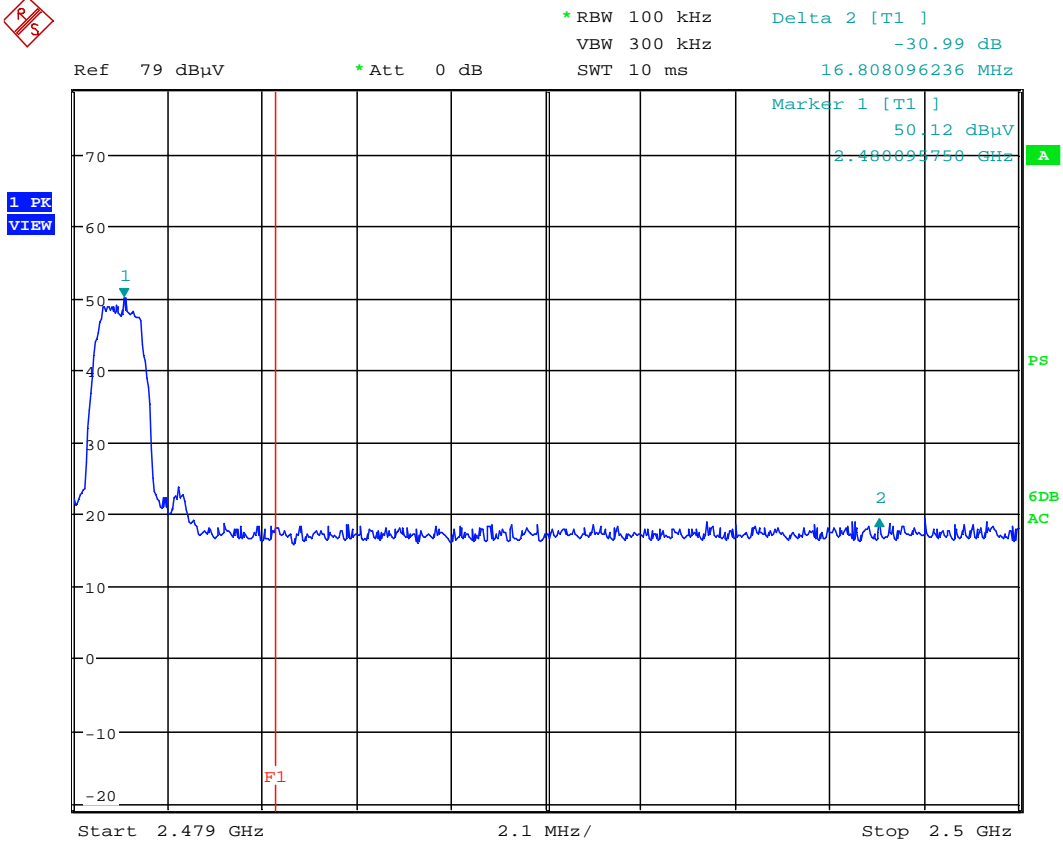


1 PK
VIEW



Date: 17.OCT.2011 15:49:10

MOD= 8DPSK Channel 0 Low Channel Band Edge



Date: 17.OCT.2011 16:26:32

MOD= 8DPSK Channel 78 High Channel Band Edge

Appendix C. EUT photos during the testing



