Tantalus Systems Corp.

XR-3100

Report of Measurements

per

Industry Canada RSS-210 Issue 8

and

FCC CFR47 Part 15/B; FCC CFR47 Part 15/C – 15.247

Revision 1.1
Jan 10, 2013

Approval		
Reviewed By:	**Lawrence Gibson, P.Eng**	Jan 11, 2013 **Date**
Checked By:	**Parm Singh, EMC Division Manager**	Jan 10,2013 **Date**
Tested By:	**Aman Jathaul, EMC Project Manager**	Jan 10 2013 **Date**

Quality Auditing Institute
19473 Fraser Way, Pitt Meadows, BC, V3Y 2V4, Canada

Test Report Summary

FCC 15.247 / IC RSS-210

Frequency Hopping 902.17 – 927.83MHz communication Module

FCC ID: OZFDC3100 **IC:** 3669A-DC3100

Class I permissive change verification of Part 90, Subpart I and T

FCC ID: OZFXR3001 **IC:** 3669A-XR3100

Verification of Intentional Emissions due to co-located Antennas

Organization Requesting Report:	Tantalus Systems Corp.
Contact:	Mark Fairburn, RF Design Engineer
Test Organization:	Quality Auditing Institute Ltd.
Contact:	Lawrence Gibson, P. Eng
Test Personnel:	Aman Jathaul

Index

List of Figures

List of Tables

Section 1: Information for Test Report of Measurements

Testing Details

TESTED BY: Aman Jathaul

TEST CONDITIONS: Temperature and Humidity: 22°, 47%

TEST VOLTAGE: 240V A.C. – XR-3100

120V A.C. – XR-3100

Test Facilities

Testing Laboratory: Quality Auditing Institute
Address: 19473 Fraser Way, Pitt Meadows, BC, V3Y 2V4, Canada
Test Site Registration: FCC (OATS 10m and SAC-3m)..: 226383
Industry Canada (SAC-3m)……..: 9543B-1
Industry Canada (OATS-10m)…..: 9543C-1

Accreditations (ISO 17025):

Standard Council of Canada: Accredited Laboratory No. 743
International Accreditation Service Inc: Accredited Laboratory: No. TL-239

Test Equipment List

Device	Model Number	Equipment Description	Serial No.	Next Cal
Antenna	Sunol Sciences JB3	Biconilog Antenna (30MHz-3GHz)	A042004	Mar 12, 2015
EMI Receiver	Rohde & Schwarz ESU40	EMI Receiver (20Hz-40GHz)	100011	June 26, 2015
LISN	COM-POWER LI-115	LISN (150kHz-30MHz)	241036	Mar 9, 2014
Horn Antenna	COM-POWER AHA-118	Horn Antenna with LNA (1-18Ghz)	711040	Mar 11, 2014
Turntable	ETS Lindgren 2165	00043677	N/A	N/A
Mast	ETS Lindgren 2165	00077487	N/A	N/A

Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	±1 x 10-5 MHz
Radiated Emissions	±3 dB
Temperature	±1°C
Humidity	±5 %
DC and low frequency voltages	±3 %

Company Tested

NAME: Tantalus Systems Corp.

ADDRESS: 301–3480 Gilmore Way
Burnaby, BC V5G 4Y1
Canada

CONTACT PERSON: Mr. Mark Fairburn

PHONE NUMBER: 1-604-299-0458 x:229

Equipment Under Test

THE TEST SYSTEM:

The Tantalus Systems XR-3100 is a repeater that houses both the Part 90 WAN transceiver and the Part 15 LAN transceiver to provide range extensionSmart Meter module attaches to various Itron CENTRON C2s family of Electrical Power Meters. The unit can operate either from a 120V or 240V 60Hz AC supply. This device faciltates deployment of the Tantalus real-time two-way communication network in areas of aggressive terrain or to extend coverage. The LAN module can support a variety of data rates and multi-level FSK modulation formats to achieve data rates upto 640kbps.

Product ID: XR-3100

WAN Module:
Manufacturer: Tantalus Systems Corp.
Part Numbers: 100-0060-E
Serial number: 0006335737

LAN Module:
Manufacturer: Tantalus Systems Corp.
Part Numbers: 100-0129-D
Serial number: 000C74491E

TEST SETUP: This EUT is designed to communicate with a base station using a licensed band in the 220-220MHz frequency range for WAN communication and employs a Frequency Hopping Spread Spectrum (FHSS) system operating on the 902-928 MHz band for LAN communication.

CABLING:

Cable	Pins	Connector	Load/Termination	Shielded	Ferrites
Power	3	Terminal	No	No	No

MODIFICATIONS: No modifications were made for this unit to pass.

CONCLUSION: The XR-3100 complies with the requirements of FCC CFR47 and the requirements of Industry Canada RSS-210.

Section II: IC RSS-210 Iss.8 & FCC CFR47 Part 15/B Report of Measurements

Markings

According to FCC Section 15.19 and ICES 003, a statement similar to the following must be included on an identification label, which also uniquely identifies the Manufactured date, either explicitly or through a Serial number etc.:

> "This equipment complies with FCC Rules, Part 15 and Industry Canada's ICES 003 for a Class A Digital Device. Operation is subject to two conditions:
>
> 1) This device may not cause harmful interference, and
>
> 2) This device must accept any interference that may cause any undesired operation"

Additionally, if the manufacturer markets product to Quebec, the following supplemental information should be added to the label:

> "Cet Apparreil numerique de la Classe A respecte toutes les exigences du Reglement sur le material broilleur due Canada."

Labeling

According to FCC Section 15.105, and ICES 003, the following statement must be included in a prominent location in your User's Manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful intereference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

It is also required according to FCC Part B Section 15.21 that a caution is included such as:

> Caution: Changes or modifications to this equipment, not expressly approved by the manufacturer could void the user's authority to operate the equipment.

This product is License Exempt for FCC and IC. There is a requirement for this product to be submitted for certification and requires both an FCC ID and an IC ID number to be added to the labels in accordance with FCC CFR47 Part 2 Subpart J (2.901 to 2.956) as well as IC Self-Marking standards.

Section III: IC RSS-210 Issue 8 Emissions Testing

Test Results – Summary

Testing was performed pursuant to Industry Canada RSS-210 Issue 8.

Test	Standard	Description	Result
Radiated Emissions Idle Mode Subclause 8.2	RSS-210 2.2(b)	The radiated emissions are measured in the 0.009 - 9280MHz range	Complies
Conducted Emissions Idle Mode Subclause 8.3	EN55022 Class A Limits	The Conducted Emissions are measured on the phase and neutral power lines in the 0.15 – 30.0 MHz range	Complies
Radiated Emissions Transmit Mode	RSS-210 A8.5	The radiated emissions are measured in the 0.009 -9280MHz range	Complies
Output Power and EIRP Emissions	RSS-210 A8.4(1)	Output power will not exceed 1 Watt and the E.I.R.P. will not exceed 4 Watts	Complies

Part 1 – Radiated Emissions Testing

DATE Nov 28, 2012

TEST STANDARD: RSS-210 2.2(b)

TEST SETUP: The EUT was operated and tested at 240Vac and 120Vac 60Hz in its normal mode of operation. It was in receive mode for these tests.

MINIMUM STANDARD: Class B Limit:

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer with a 9kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with a 9kHz bandwidth, CISPR Quasi-Peak detector as well as an averaging meter. The EUT was set up in a 3 meter semi-anechoic chamber, using the manufacturer's specified normal cabling configuration, with all cables over 1 meter in length bundled at 1 meter and retained from the floor. A typical application was tested.

Emissions in both horizontal and vertical polarization were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots.

EMISSIONS DATA: See 1 in Appendix A for corresponding frequencies.

PERFORMANCE: Complies.

Part 2 – Conducted Emissions Testing

DATE: Nov 28, 2012

TEST STANDARD: EN55022

MINIMUM STANDARD: Class A Limit:

TEST SETUP: The EUT was connected to the conducted emissions LISN appartus. The device was operated and tested at 240Vac and 120Vac 60Hz.

MINIMUM STANDARD: Class A Limit:

Frequency (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 – 0.5	79	66
0.5 – 30	73	60

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer with a 9kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with a 9kHz bandwidth, CISPR Quasi-Peak detector as well as an averaging meter.

MEASUREMENT DATA: See Appendix A for Plots.

EMISSIONS DATA: See Table 3 to Table 6 in Appendix A for corresponding frequencies.

PERFORMANCE: Complies.

Part 3 – Radiated Emissions – Transmit Mode

DATE: Nov 29, 2012

TEST STANDARD: RSS-210 Iss.8 Annex 8 Frequency Hopping Systems 902-928MHz Band.

MINIMUM STANDARD: **A8.1 – Frequency Hopping Systems (General Conditions)**

Frequency hopping systems are spread spectrum systems in which the carrier is modulated with coded information in a conventional manner causing a conventional spreading of the RF energy about the carrier frequency. The frequency of the carrier is not fixed but changes at fixed intervals under the direction of a coded sequence. Frequency hopping systems are not required to employ all available hopping frequencies during each transmission. However the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream.

Incorporation of intelligence into a frequency hopping system that enables it to recognize other users of the band and to avoid occupied frequencies is permitted, provided that the frequency hopping system does it individually, and independently chooses or adapts its hopset. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

(a) The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The system RF bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The hopset shall be such that the near-term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset while the long-term distribution appears evenly distributed.

(b) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(c) For frequency hopping systems in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20 second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

A8.4 Transmitter Output Power and e.i.r.p. Requirements

(1) For frequency hopping systems operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W, if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W, and the e.i.r.p. shall not exceed 1 W, if the hopset uses less than 50 hopping channels. As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power (see RSS-Gen).

A8.5 Out-of-band Emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB.

TEST SETUP: The EUT was operated and tested at 240Vac and 120V 60Hz for the tests and the unit was transmitting at its maximum rate based on the energy that it could sustain in normal operation.

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer. The EUT was set up in a 3 meter Semi-Anechoic test site, using the manufacturer's specified normal cabling configuration, with all cables over 1 meter in length bundled at 1 meter and retained from the floor.

Emissions in both horizontal and vertical polarization were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots.

All frequencies 0.009 -1000MHz were tested at 3m and all frequencies 1GHz and up were tested at 1m in accordance with ANSI c63.4.

EMISSIONS DATA: See Figures 3-12 and Tables 7-10 in Appendix A for corresponding data. A summary of the results as per the above requirements.

Test	Standard	Results
Spread Spectrum Method of Modulation	RSS-210 A8.1	This product meets the requirements of a Frequency Hopping Spread Spectrum (FHSS) system operating in the 902-928MHz band
Channel Bandwidth	RSS-210 A8.1(a)	See Figure 3 in Appendix A. The 20dB bandwidth was measured to be 100.8 kHz.
Channel Separation	RSS-210 A8.1(c)	See Figure 4 in Appendix A. The Channel separation was measured to be 128.2 kHz.
Number of Hopping Channels	RSS-210 A8.1(c)	See Figures 5 -9 in Appendix A. The number of channels is 50 channels.
Hopping Channels Time of Occupancy	RSS-210 A8.1(c)	See Figures 10 and 11 in Appendix A; the time of occupancy is 5.06 milliseconds at an interval of 4.34 seconds. This is equal to an average time "ON" of 23.3 mSecs within a 20 second period.
Output Power and EIRP	RSS-210 A8.4(1)	See the Measurement Data section in Part 4 of this Section. The output EIRP is a maximum of 3.31W. The conducted output power is 871mW.
Out of Band Emissions	RSS-210 A8.5	See Figures 12 and 13 in Appendix A. All radiated emissions were within the RSS-210 A8.5 limit.

PERFORMANCE: Complies.

Part 4 – Output Power and EIRP Emissions

DATE: Nov 29, 2012

TEST STANDARD: RSS-210 Iss.8 A8.4 – Frequency Hopping Spread Spectrum Systems 902-928MHz

MINIMUM STANDARD: For frequency hopping systems operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W, if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W, and the e.i.r.p. shall not exceed 1 W, if the hopset uses less than 50 hopping channels.

TEST SETUP: Refer to setup in Part 3 above.

METHOD OF MEASUREMENT: The Antenna has a connection at the bulkhead of the internal housing, the conducted output power was measured at this point. A 40dB attenuator was used to protect the instumentation. See Figures 13-16.

EIRP was measured at the 3m distance and the measurement was adjusted to account for cable loss and Antenna factor.

EIRP measurements

Freq(MHz)	Corrected Field at 3m (dBµV/m)	3m EIRP (dBm)
902.17	129.7	34.5
915	130.2	35.0
927.83	130.4	35.2

Conducted Output Power measurements

Freq(MHz)	Meas. Output Power (dBm)	Correction Factor* (dB)	Output Power (dBm)
902.17	-11.4	40.8	29.4
915	-11.5	40.8	29.3
927.83	-11.5	40.8	29.3

* Correction Factor accounts for 40dB attenuator and cable loss.

PERFORMANCE: Complies.

Part 5: Out of Band Emissions

DATE: Nov 30, 2012

TEST STANDARD: RSS-210 A8.5

MINIMUM STANDARD: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB.

TEST SETUP: Refer to the setup in Part 3 above.

METHOD OF MEASUREMENT: Measurements were made using a horn antenna connected directly into a spectrum analyzer. The EUT was set up in a 1 meter open field test site, using the manufacturer's specified normal cabling configuration, with all cables over 1 meter in length bundled at 1 meter and retained from the floor. An application which transmitted a constant CW at the highest output power was used.

Emissions in the horizontal and vertical polarization were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots.

Due to the presence of high ambient noise making it impossible to measure an emission at the required distance, the measurement was performed at 1 meter distance and the limit is adjusted per EN61000-6-3:2001

The following formula was used to convert the maximum field strength (FS) in volts/meter to calculate the EUT output power (TP) in Watts:

$$TP = ((FS \times D) \times 2) / (30 \times G)$$

Where D is the distance in meters between the two antennas and G is the EUT antenna numerical gain referenced to isotropic gain.

MEASUREMENT DATA: See Tables 7 to 10 in Appendix A.

PERFORMANCE: Complies.

Section IV: FCC CFR47 Part 15/C Report of Measurements

General

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15 – Subpart C - Intentional Radiators. The Testing was performed pursuant to ANSI 63.4, 2003.

Additionally, the specific section used for compliance is 15.247 – Operation within the bands 902-928MHz – limited to frequency hopping intentional radiator. This includes the use of the FCC Public Notice DA 00-705 (Filing and Measurement Guidelines for Frequency hopping Spread Spectrum Systems) that was used as a guide to the tests that were performed.

Labeling Requirements

Please refer to labeling requirements as outlined above in Section 1.

Test Results - Summary

Testing was performed pursuant to ANSI 63.4, 2003.

Test	Standard	Description	Result
Radiated Emissions Idle Mode	FCC Part 15 Subpart B Class B Limits	The radiated emissions are measured in the 0.009 - 9280MHz range	Complies
Conducted Emissions Idle Mode	FCC Part 15 Subpart B Class A Limits	The conducted emissions are measured on the phase and neutral power lines in the 0.15 – 30.0 MHz range.	Complies
Antenna Requirement	FCC Part 15 Subpart 15.203	Proper Antenna is specified and used	Complies
Radiated Emissions Transmit Mode – Frequency Hopping Spread Spectrum Operation	FCC Part 15 Subpart C 15.247	Radiated emission characteristics for Spread Sprectrum devices operating in the range 902-928 MHz that use the Spread Spectrum Modulation technique. Emissions are measured in the 0.009 -9280MHz range.	Complies

Part 1 – Radiated Emission Testing

DATE: Nov 28, 2012

TEST STANDARD: FCC CFR47, Part 15, Subpart B Class B and Subpart C-Section 15.247

TEST VOLTAGE: 240Vac 60Hz

TEST SETUP: The equipment was set up in a 3-meter semi-anechoic chamber. Emissions in both horizontal and vertical polarization's were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots. In cases where the presence of high ambient noise makes it impossible to measure an emission at the required distance, the measurement is performed at a closer distance and the limit is adjusted 20dB per Decade using the formula

20*Log (d1/d2)

Where d1 is the required distance and d2 is the new distance.

MINIMUM STANDARD: When the EUT is operating in Receive mode FCC Part 15 Subpart B Unintentional Radiators Limits for a Class B product.:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
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

DEVICE DESCRIPTIONS: Refer to the Equipment Under Test information in the Section 1 above, for EUT Descriptions.

CABLING DETAILS: The EUT was set up using the manufacturer's specified normal cabling configuration.

CABLING:

Cable	Pins	Connector	Load/Termination	Shielded	Ferites
Power	3	Terminal	No	No	No

MODIFICATIONS: No modifications were required for the devices to pass the test.

MEASUREMENT DATA: See Appendix A for Plots.

EMISSIONS DATA: See Table 1 in Appendix A for corresponding frequencies. Emmisions that were attenuated by more than 20dB from the permissible value are not reported in accordance with 15.31(o). The device was tested to 12MHz since it uses clock circuitry at this frequency.

PERFORMANCE: Complies.

Part 2 – Antenna Requirement – 15.203

2.1 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 a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

2.2 RESULTS: The Part 15 device inside the EUT is comprised of an internal antenna that connects to a bulhead SMA connection, The Part 90 device inside the EUT can either use its internal antenna or it has the provisions to install one of 2 antennas that must be purchased directly from Tantalus Systems Corp. The EUT must be professionally installed and it is protected with a locking mechanism that requires a key to open the EUT to get access to the internal or external antenna connections.

Part 3 – Conducted Emissions Tests – 15.207

3.1 Applicable Regulations

15.207 - (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	**Conducted Limit (dbµV)**	
	Quasi-Peak	**Average**
0.15 – 0.5	79	66
0.5 – 30	73	60

3.2 RESULT

MEASUREMENT DATA: See Appendix A for Plots.

EMISSIONS DATA: See Tables 3 to 6 in Appendix A for corresponding frequencies.

PERFORMANCE: Complies.

Part 4 – Frequency Hopping Spread Spectrum Operation – 15.247

4.1 APPLICABLE REGULATIONS:

15.247(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

4.2 TEST PROCEDURES:

TEST STANDARD: FCC CFR47, Part 15, Subpart C 15.247

DEVICE DESCRIPTIONS: Refer to the Equipment Under Test Section, above, for EUT Descriptions.

TEST SETUP:

Frequency Range Measured	30MHz – 10000MHz
Test Distance	1m and 3m
Test Instrumentation Resolution	120kHz (30MHz to 1000MHz) 1MHz (1000MHz to 10000MHz)
Receive Antenna Scan Height	1m – 4m
Receive Antenna Polarization	Vertical and Horizontal

The EUT was set up in a semi-anechoic chamber for the tests. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots. The EUT was programmable to broadcast on standalone frequencies at the low (902), middle (915) and high (928) channels; 2 channel hopping at the end frequencies (902.5 and 927.5); standalone hopping at the middle frequency (915) and full 50 channel hopping frequencies 902.5 to 927.5MHz.

For this product, the EUT worst case “ON” time was measured to be 5.06 ms per 100ms interval. This equates to a possible correction factor of -25.9dB, which is applied to the emissions data in Table 13 and Table 14.

CABLING DETAILS:

Cable	Pins	Connector	Load/Termination	Shielded	Ferrites
Power	3	Terminal	No	No	No

4.3 RESULTS: A sequence of 50 frequencies out of a possible 201 frequencies is generated where the seed for the generator is factory preset and is a function of the customer and network configuration. The payload/packet is equally divided into the 50 frequencies. In order to receive the packet successfully the receiver must hop in synchronization with the transmitter. This design inherently meets the FCC requirements of a frequency hopping system, since each frequency is used to receive the packet and therefore all frequencies are used equally.

MODIFICATIONS No modifications were required for the devices to pass the test.

MEASUREMENT DATA: See Figures 3-13 and Tables 7-10 in Appendix A.

PERFORMANCE: Complies.

Part 5: Output Power and EIRP Emissions

DATE: Nov 29, 2012

TEST STANDARD: FCC 15.247(b)(2) – Hopping Frequency Systems 902-928MHz

MINIMUM STANDARD: **15.247(b)(2)** – For the band 902-928MHz, the transmitter output power shall not exceed 1.0 watt and the E.I.R.P shall not exceed 4W for systems employing at least 50 Hopping Channels.

TEST SETUP: Refer to setup in Part 1 above.

METHOD OF MEASUREMENT: The Antenna has a connection at the bulkhead of the internal housing, the conducted output power was measured at this point. A 40dB attenuator was used to protect the instumentation. See Figures 13-16.

EIRP was measured at the 3m distance and the measurement was adjusted to account for cable loss and Antenna factor.

MEASUREMENT DATA:

EIRP

Freq(MHz)	Corrected Field at 3m (dBµV/m)	3m EIRP (dBm)
902.17	129.7	34.5
915	130.2	35.0
927.83	130.4	35.2

Conducted Output Power measurements

Freq(MHz)	Meas. Output Power (dBm)	Correction Factor* (dB)	Output Power (dBm)
902.17	-11.4	40.8	29.4
915	-11.5	40.8	29.3
927.83	-11.5	40.8	29.3

* Correction Factor accounts for 40dB attenuator and cable loss.

PERFORMANCE: Complies.

Part 6: Restricted Bands Review – 15.205(b)

6.1 APPLICABLE REGULATIONS:

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

6.2 PART 15 RESULT

All of the measurements for the Part 15 device were made when the EUT was set into transmitting mode to allow measurements of spurious emissions. The spurious frequencies that have been identified to fall into restricted bands are the various harmonics generated from 902 to 928 MHz. The restricted bands affected are 2655-2900MHz, 3600-4400MHz, 4500-5150MHz, 5350- 5460MHz, 7250-7750MHz, 8025-8500MHz and 9000-9200MHz.

6.2 CO-LOCATED ANTENNA

RESULT

For these measurements, both transmitters were operating simultaneously. All mixing products produced by up to and including the 10^{th} harmonic of each transmitter were calculated. Those products that fell within the restricted band were checked for compliance.

EMISSIONS DATA:

See Tables 7-10 in Appendix A for corresponding data.

Appendix A: Test Plots XR-3100

Unintentional Radiated Emissions, Idle Mode

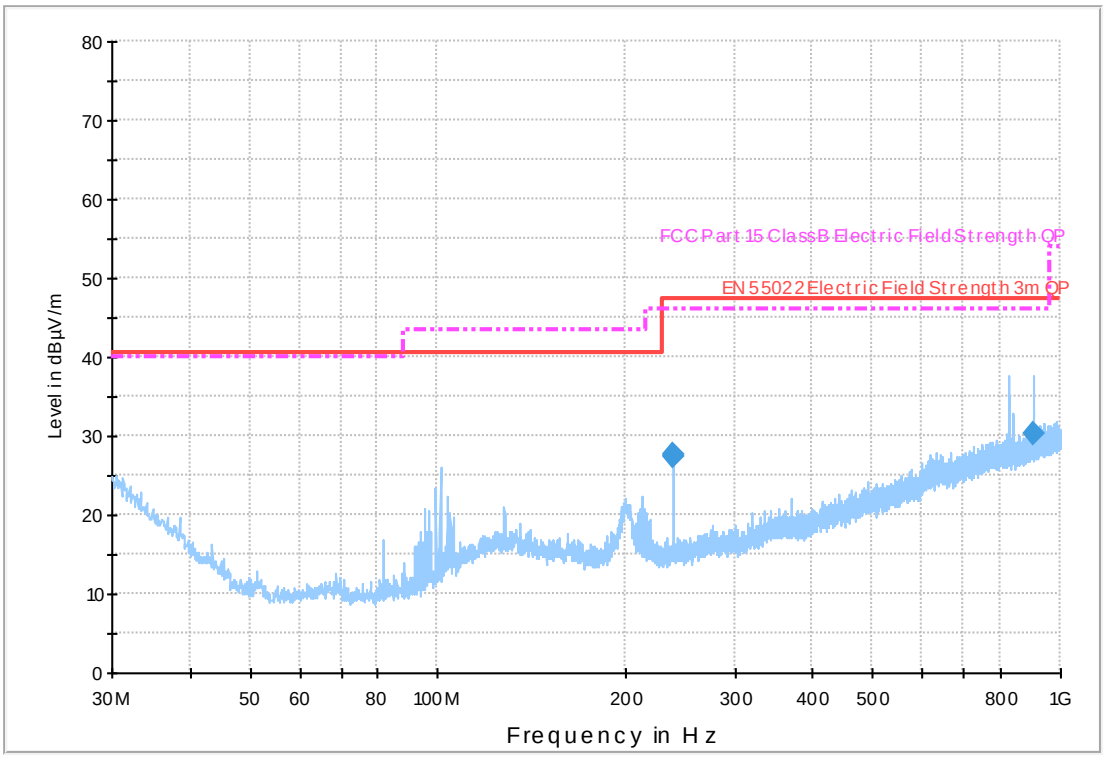


Table 1: FCC Class B Emissions, Idle Mode - 3m

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height	Polarity	Turntable position	Del Lim - Pk (dB)	Limit (dBµV/m)
239.423000	27.4	150.0	H	180.0	16.1	43.5
904.261000	37.7	150.0	V	45.0	5.8	43.5

Intentional Radiated Emissions, Tx Mode

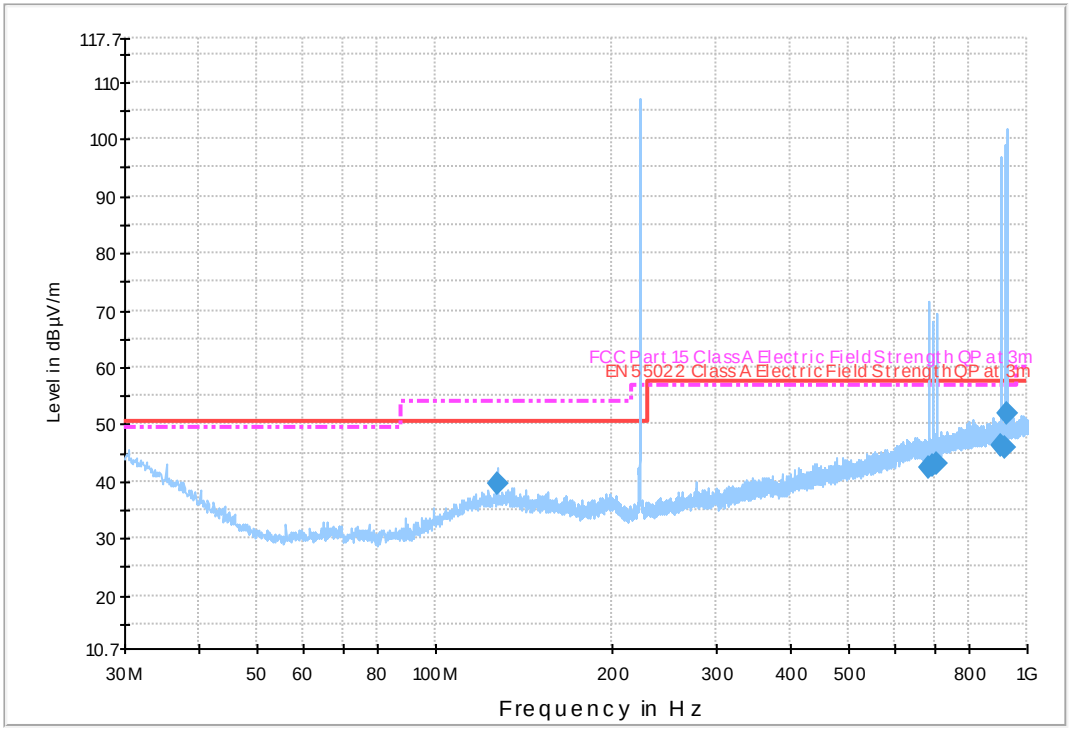


Table 2: FCC Class B Emissions, Tx Mode - 3m

Frequency	Corrected Peak	QuasiPeak	Antenna height	Polarity	Turntable position	Corr.	Margin	Limit
(MHz)	(dBµV/m)	(dBµV/m)	(cm)		(deg)	(dB)	(dB)	(dBµV/m)
191.9	44.1	42.5	100	H	238	13	1	43.5
243.5	40.8	35.8	100	H	198	13.8	10.3	46.1
251.98	43.4	41.7	100	H	344	13.7	4.4	46.1

Note:Above plot shows the limit line as per FCC Part 15.209. Frequency signal above the limit lines are either fundamental frequencies at 221.99MHz and around 902-928MHz or intermodulated frequencies at 680.48MHz, 692.899MHz and 705.66 MHz which do not fall under the restricted bands as described in FCC Part 15.205 and RSS-210 and their field strength is more than 20dB lower than the fundamental field strength.

A.C. Mains Conducted Emissions (Idle Mode)

FCC/CE Class A - Emissions

Table 3: AC Conducted Emissions, Idle Mode – Line 1

120VAC 60Hz

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.163131	53.5	1000.000	9.000	On	L1	0.4	12.5	66.0
0.169442	60.8	1000.000	9.000	On	L1	0.4	5.2	66.0
0.176703	46.1	1000.000	9.000	On	L1	0.3	19.9	66.0
0.509491	27.8	1000.000	9.000	On	L1	0.2	32.2	60.0
0.520813	12.0	1000.000	9.000	On	L1	0.2	48.0	60.0
0.677986	39.5	1000.000	9.000	On	L1	0.2	20.5	60.0
0.688910	35.2	1000.000	9.000	On	L1	0.2	24.8	60.0
0.846327	43.4	1000.000	9.000	On	L1	0.2	16.6	60.0
1.015081	36.0	1000.000	9.000	On	L1	0.2	24.0	60.0
1.155853	24.5	1000.000	9.000	On	L1	0.2	35.5	60.0
1.183901	37.5	1000.000	9.000	On	L1	0.2	22.5	60.0
1.321417	27.2	1000.000	9.000	On	L1	0.2	32.8	60.0
1.358902	40.8	1000.000	9.000	On	L1	0.2	19.2	60.0
1.489715	21.9	1000.000	9.000	On	L1	0.2	38.1	60.0
1.550450	14.3	1000.000	9.000	On	L1	0.2	45.7	60.0
2.006290	21.3	1000.000	9.000	On	L1	0.2	38.7	60.0
2.038617	34.0	1000.000	9.000	On	L1	0.2	26.0	60.0
2.372916	37.9	1000.000	9.000	On	L1	0.2	22.1	60.0
3.058321	35.6	1000.000	9.000	On	L1	0.3	24.4	60.0
3.386389	34.2	1000.000	9.000	On	L1	0.3	25.8	60.0

240VAC 60Hz

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.207330	55.4	1000.000	9.000	On	L1	0.3	10.6	66.0
0.213638	48.5	1000.000	9.000	On	L1	0.3	17.5	66.0
0.418890	50.8	1000.000	9.000	On	L1	0.2	15.2	66.0
0.615985	47.9	1000.000	9.000	On	L1	0.2	12.1	60.0
0.622170	43.6	1000.000	9.000	On	L1	0.2	16.4	60.0
0.808315	27.6	1000.000	9.000	On	L1	0.2	32.4	60.0
0.829585	50.2	1000.000	9.000	On	L1	0.2	9.8	60.0
1.015081	26.9	1000.000	9.000	On	L1	0.2	33.1	60.0
1.037638	31.6	1000.000	9.000	On	L1	0.2	28.4	60.0
1.277288	0.6	1000.000	9.000	On	L1	0.2	59.4	60.0
1.437091	25.0	1000.000	9.000	On	L1	0.2	35.0	60.0
1.460246	31.0	1000.000	9.000	On	L1	0.2	29.0	60.0
1.629862	45.6	1000.000	9.000	On	L1	0.2	14.4	60.0
1.659435	10.6	1000.000	9.000	On	L1	0.2	49.4	60.0
1.837444	29.6	1000.000	9.000	On	L1	0.2	30.4	60.0
1.867049	44.2	1000.000	9.000	On	L1	0.2	15.8	60.0
2.071464	39.2	1000.000	9.000	On	L1	0.2	20.8	60.0
2.897708	26.4	1000.000	9.000	On	L1	0.2	33.6	60.0
3.107598	30.5	1000.000	9.000	On	L1	0.3	29.5	60.0

3.517415	**26.8**	**1000.000**	**9.000**	**On**	**L1**	**0.3**	**33.2**	**60.0**

Table 4: AC Conducted Emissions, Idle Mode - Line 2

120VAC 60Hz

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.164440	**57.1**	**1000.000**	**9.000**	**On**	**L2**	**0.4**	**8.9**	**66.0**
0.174947	**48.9**	**1000.000**	**9.000**	**On**	**L2**	**0.3**	**17.1**	**66.0**
0.336241	**47.4**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**18.6**	**66.0**
0.341659	**42.7**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**23.3**	**66.0**
0.657969	**31.0**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**29.0**	**60.0**
0.673935	**43.8**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**16.2**	**60.0**
0.824627	**21.8**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**38.2**	**60.0**
0.844638	**42.8**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**17.2**	**60.0**
1.011033	**35.6**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**24.4**	**60.0**
1.115023	**31.7**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**28.3**	**60.0**
1.130727	**3.5**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**56.5**	**60.0**
1.345394	**39.7**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**20.3**	**60.0**
1.686173	**33.8**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**26.2**	**60.0**
1.859604	**39.5**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**20.5**	**60.0**
1.974477	**21.6**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**38.4**	**60.0**
2.026434	**35.1**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**24.9**	**60.0**
2.316700	**24.0**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**36.0**	**60.0**
2.358736	**35.0**	**1000.000**	**9.000**	**On**	**L2**	**0.2**	**25.0**	**60.0**
3.082861	**16.5**	**1000.000**	**9.000**	**On**	**L2**	**0.3**	**43.5**	**60.0**
3.306162	**22.6**	**1000.000**	**9.000**	**On**	**L2**	**0.3**	**37.4**	**60.0**

240VAC 60Hz

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.207330	59.6	1000.000	9.000	On	L2	0.3	6.4	66.0
0.213638	48.7	1000.000	9.000	On	L2	0.3	17.3	66.0
0.412248	52.5	1000.000	9.000	On	L2	0.2	13.5	66.0
0.418054	43.9	1000.000	9.000	On	L2	0.2	22.1	66.0
0.538807	41.6	1000.000	9.000	On	L2	0.2	18.4	60.0
0.548583	3.8	1000.000	9.000	On	L2	0.2	56.2	60.0
0.624661	27.9	1000.000	9.000	On	L2	0.2	32.1	60.0
0.832907	34.5	1000.000	9.000	On	L2	0.2	25.5	60.0
1.039713	41.1	1000.000	9.000	On	L2	0.2	18.9	60.0
1.431360	31.1	1000.000	9.000	On	L2	0.2	28.9	60.0
1.454423	41.5	1000.000	9.000	On	L2	0.2	18.5	60.0
1.629862	28.8	1000.000	9.000	On	L2	0.2	31.2	60.0
1.666079	24.3	1000.000	9.000	On	L2	0.2	35.7	60.0
1.841119	32.2	1000.000	9.000	On	L2	0.2	27.8	60.0
1.870784	40.0	1000.000	9.000	On	L2	0.2	20.0	60.0
2.075607	38.5	1000.000	9.000	On	L2	0.2	21.5	60.0
2.377662	-0.7	1000.000	9.000	On	L2	0.2	60.7	60.0
2.514469	8.2	1000.000	9.000	On	L2	0.2	51.8	60.0
2.560094	3.1	1000.000	9.000	On	L2	0.2	56.9	60.0
2.740049	-0.4	1000.000	9.000	On	L2	0.2	60.4	60.0

A.C. Mains Conducted Emissions (Tx Mode)

FCC/CE Class A - Emissions

Table 5: AC Conducted Emissions, Tx Mode - Line 1

120VAC 60Hz

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.156740	29.9	1000.000	9.000	On	L1	0.4	36.1	66.0
0.225930	48.0	1000.000	9.000	On	L1	0.3	18.0	66.0
0.278667	41.7	1000.000	9.000	On	L1	0.2	24.3	66.0
0.396099	38.8	1000.000	9.000	On	L1	0.2	27.2	66.0
0.520813	24.7	1000.000	9.000	On	L1	0.2	35.3	60.0
0.566404	35.8	1000.000	9.000	On	L1	0.2	24.2	60.0
0.628417	30.4	1000.000	9.000	On	L1	0.2	29.6	60.0
0.660603	29.7	1000.000	9.000	On	L1	0.2	30.3	60.0
0.735864	33.6	1000.000	9.000	On	L1	0.2	26.4	60.0
0.827929	31.6	1000.000	9.000	On	L1	0.2	28.4	60.0
0.907629	32.4	1000.000	9.000	On	L1	0.2	27.6	60.0
0.989055	32.0	1000.000	9.000	On	L1	0.2	28.0	60.0
1.106147	31.6	1000.000	9.000	On	L1	0.2	28.4	60.0
1.160481	31.8	1000.000	9.000	On	L1	0.2	28.2	60.0
1.249522	28.5	1000.000	9.000	On	L1	0.2	31.5	60.0
1.939289	30.3	1000.000	9.000	On	L1	0.2	29.7	60.0
2.138754	30.3	1000.000	9.000	On	L1	0.2	29.7	60.0
2.221507	32.0	1000.000	9.000	On	L1	0.2	28.0	60.0

2.459809	**32.7**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**27.3**	**60.0**
3.151366	**34.4**	**1000.000**	**9.000**	**On**	**L1**	**0.3**	**25.6**	**60.0**

240VAC 60Hz

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.163457	**60.3**	**1000.000**	**9.000**	**On**	**L1**	**0.4**	**5.7**	**66.0**
0.245708	**56.3**	**1000.000**	**9.000**	**On**	**L1**	**0.3**	**9.7**	**66.0**
0.572090	**49.3**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**10.7**	**60.0**
0.652731	**48.7**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**11.3**	**60.0**
0.737336	**41.8**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**18.2**	**60.0**
0.898607	**39.5**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**20.5**	**60.0**
0.927798	**21.2**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**38.8**	**60.0**
0.998985	**22.4**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**37.6**	**60.0**
1.075634	**24.8**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**35.2**	**60.0**
1.142079	**31.4**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**28.6**	**60.0**
1.308282	**42.1**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**17.9**	**60.0**
1.389099	**45.1**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**14.9**	**60.0**
1.471963	**42.6**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**17.4**	**60.0**
1.797501	**18.2**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**41.8**	**60.0**
1.882031	**40.3**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**19.7**	**60.0**
2.203823	**43.6**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**16.4**	**60.0**
2.293671	**37.5**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**22.5**	**60.0**
2.368180	**38.9**	**1000.000**	**9.000**	**On**	**L1**	**0.2**	**21.1**	**60.0**
3.427229	**39.6**	**1000.000**	**9.000**	**On**	**L1**	**0.3**	**20.4**	**60.0**
3.510394	**40.5**	**1000.000**	**9.000**	**On**	**L1**	**0.3**	**19.5**	**60.0**

Table 6: AC Conducted Emissions, Tx Mode - Line 2

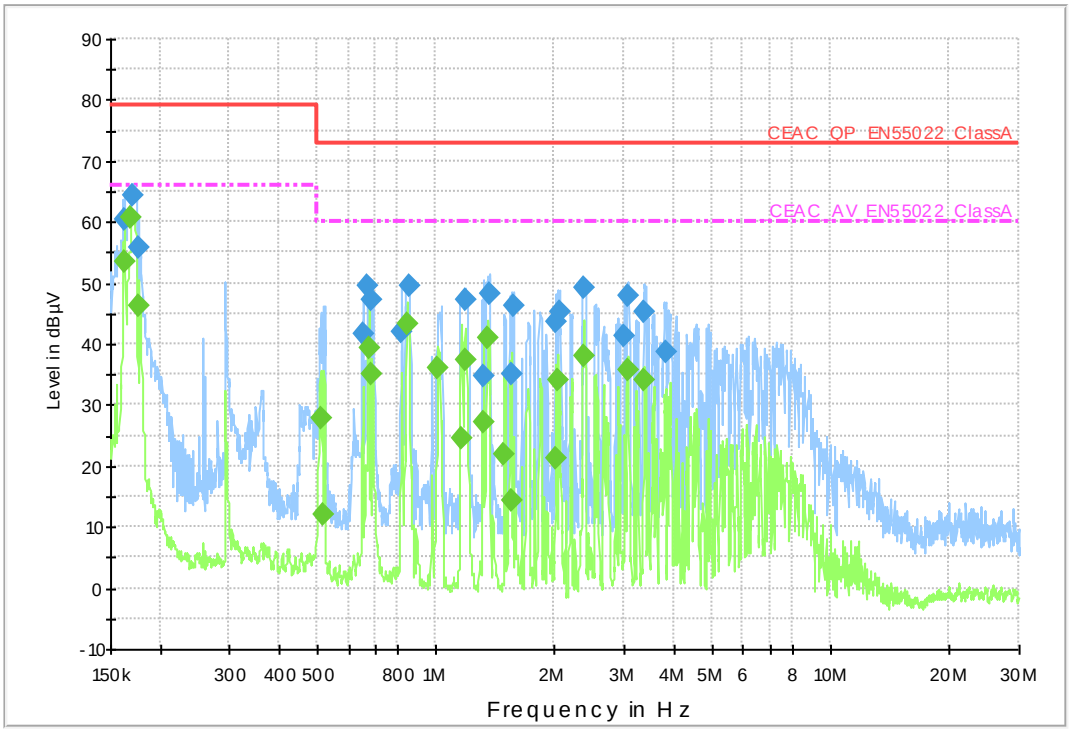
120VAC 60Hz

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.167758	42.6	1000.000	9.000	On	L2	0.4	23.4	66.0
0.211514	48.0	1000.000	9.000	On	L2	0.3	18.0	66.0
0.225029	44.5	1000.000	9.000	On	L2	0.3	21.5	66.0
0.283157	40.9	1000.000	9.000	On	L2	0.2	25.1	66.0
0.400076	37.1	1000.000	9.000	On	L2	0.2	28.9	66.0
0.501412	16.5	1000.000	9.000	On	L2	0.2	43.5	60.0
0.534518	15.2	1000.000	9.000	On	L2	0.2	44.8	60.0
0.627162	28.9	1000.000	9.000	On	L2	0.2	31.1	60.0
0.668570	30.9	1000.000	9.000	On	L2	0.2	29.1	60.0
0.737336	32.7	1000.000	9.000	On	L2	0.2	27.3	60.0
0.834572	30.9	1000.000	9.000	On	L2	0.2	29.1	60.0
0.916742	29.2	1000.000	9.000	On	L2	0.2	30.8	60.0
0.991033	31.7	1000.000	9.000	On	L2	0.2	28.3	60.0
1.167458	29.3	1000.000	9.000	On	L2	0.2	30.7	60.0
2.038617	30.1	1000.000	9.000	On	L2	0.2	29.9	60.0
2.088085	31.5	1000.000	9.000	On	L2	0.2	28.5	60.0
2.221507	30.9	1000.000	9.000	On	L2	0.2	29.1	60.0
2.275413	31.6	1000.000	9.000	On	L2	0.2	28.4	60.0
2.330628	31.7	1000.000	9.000	On	L2	0.2	28.3	60.0
3.189372	33.7	1000.000	9.000	On	L2	0.3	26.3	60.0

240VAC 60Hz

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.163131	60.0	1000.000	9.000	On	L2	0.4	6.0	66.0
0.243265	55.7	1000.000	9.000	On	L2	0.3	10.3	66.0
0.326966	41.9	1000.000	9.000	On	L2	0.2	24.1	66.0
0.570949	49.0	1000.000	9.000	On	L2	0.2	11.0	60.0
0.654037	47.7	1000.000	9.000	On	L2	0.2	12.3	60.0
0.842952	16.1	1000.000	9.000	On	L2	0.2	43.9	60.0
0.898607	44.6	1000.000	9.000	On	L2	0.2	15.4	60.0
0.981182	46.7	1000.000	9.000	On	L2	0.2	13.3	60.0
1.060695	46.4	1000.000	9.000	On	L2	0.2	13.6	60.0
1.305671	43.2	1000.000	9.000	On	L2	0.2	16.8	60.0
1.386326	45.4	1000.000	9.000	On	L2	0.2	14.6	60.0
1.469025	37.2	1000.000	9.000	On	L2	0.2	22.8	60.0
1.793913	42.5	1000.000	9.000	On	L2	0.2	17.5	60.0
1.874525	43.0	1000.000	9.000	On	L2	0.2	17.0	60.0
2.071464	38.3	1000.000	9.000	On	L2	0.2	21.7	60.0
2.151613	20.6	1000.000	9.000	On	L2	0.2	39.4	60.0
2.454899	28.8	1000.000	9.000	On	L2	0.2	31.2	60.0
3.346035	39.0	1000.000	9.000	On	L2	0.3	21.0	60.0

3.427229	**41.2**	**1000.000**	**9.000**	**On**	**L2**	**0.3**	**18.8**	**60.0**
3.832971	**35.3**	**1000.000**	**9.000**	**On**	**L2**	**0.3**	**24.7**	**60.0**



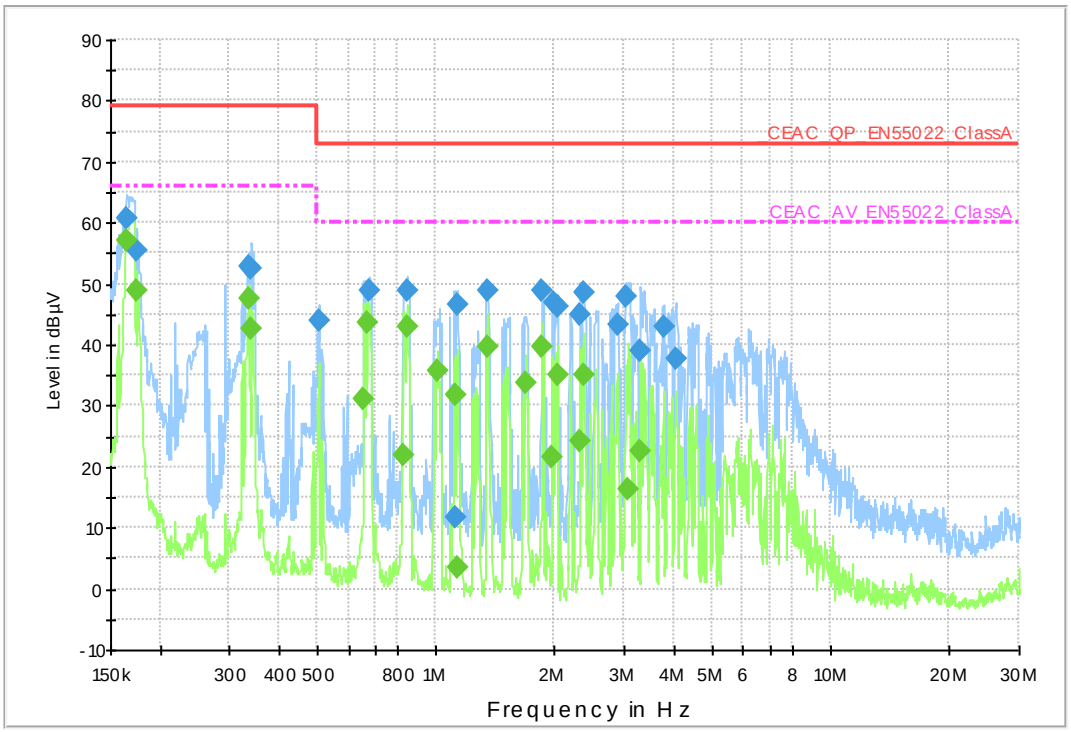
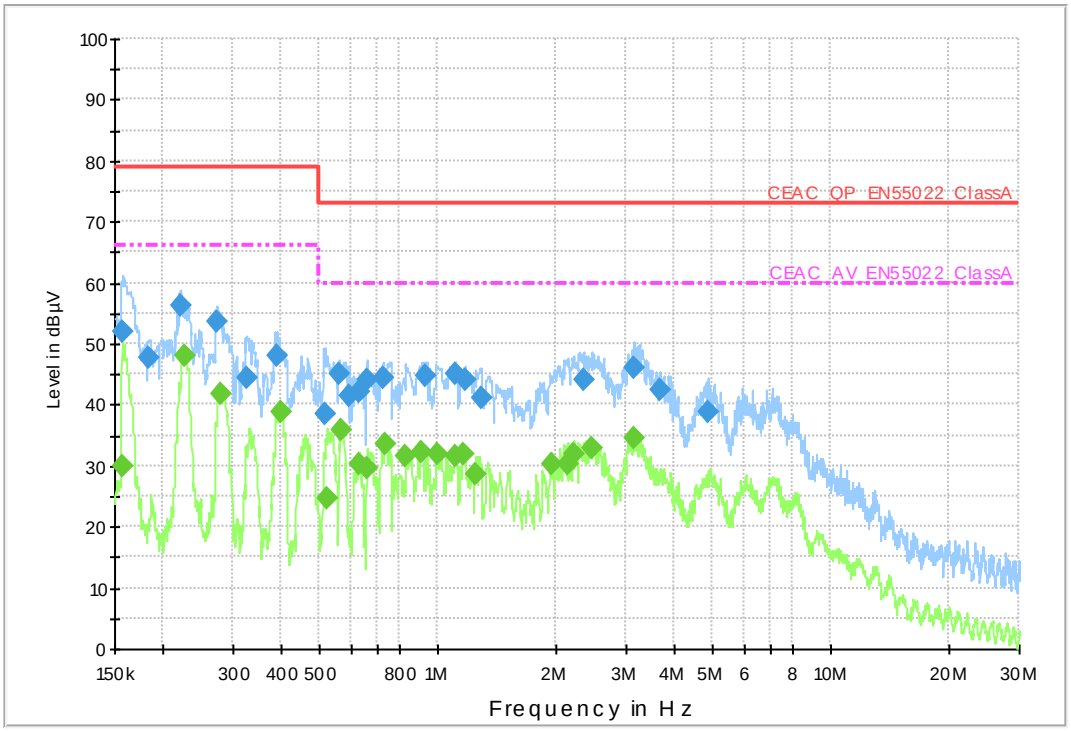


Figure 1: 120V AC Conducted Emissions - Line 1 and Line 2 (Idle Mode)



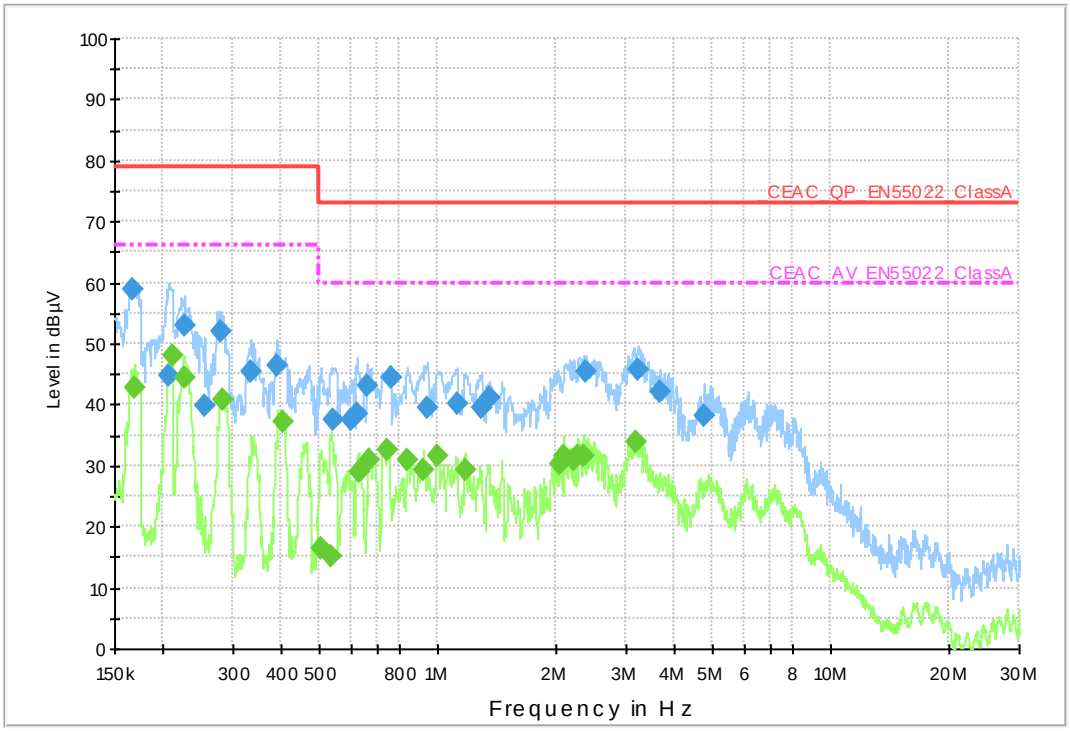
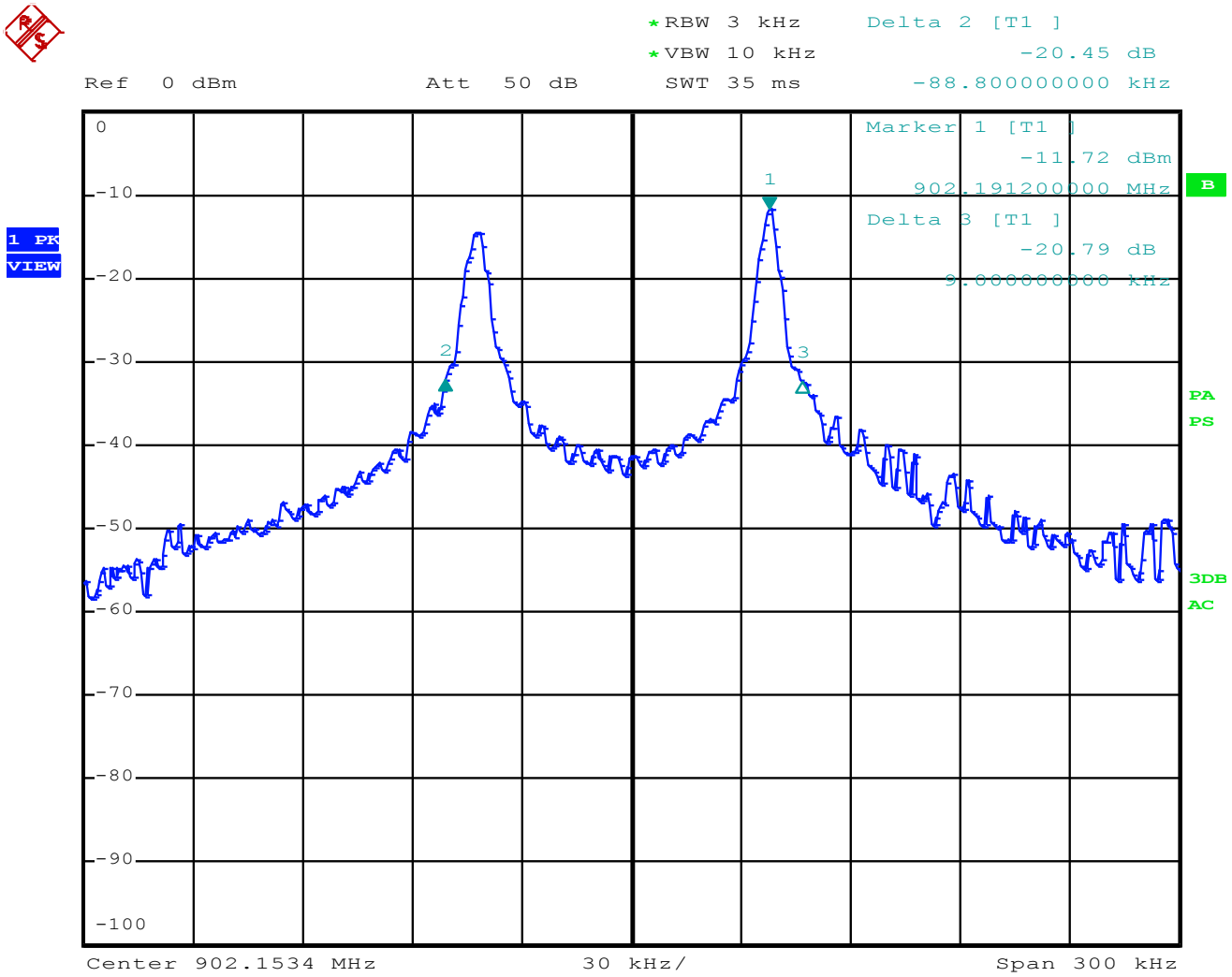


Figure 2: 120V AC Conducted Emissions - Line 1 and Line 2 (Tx Mode)

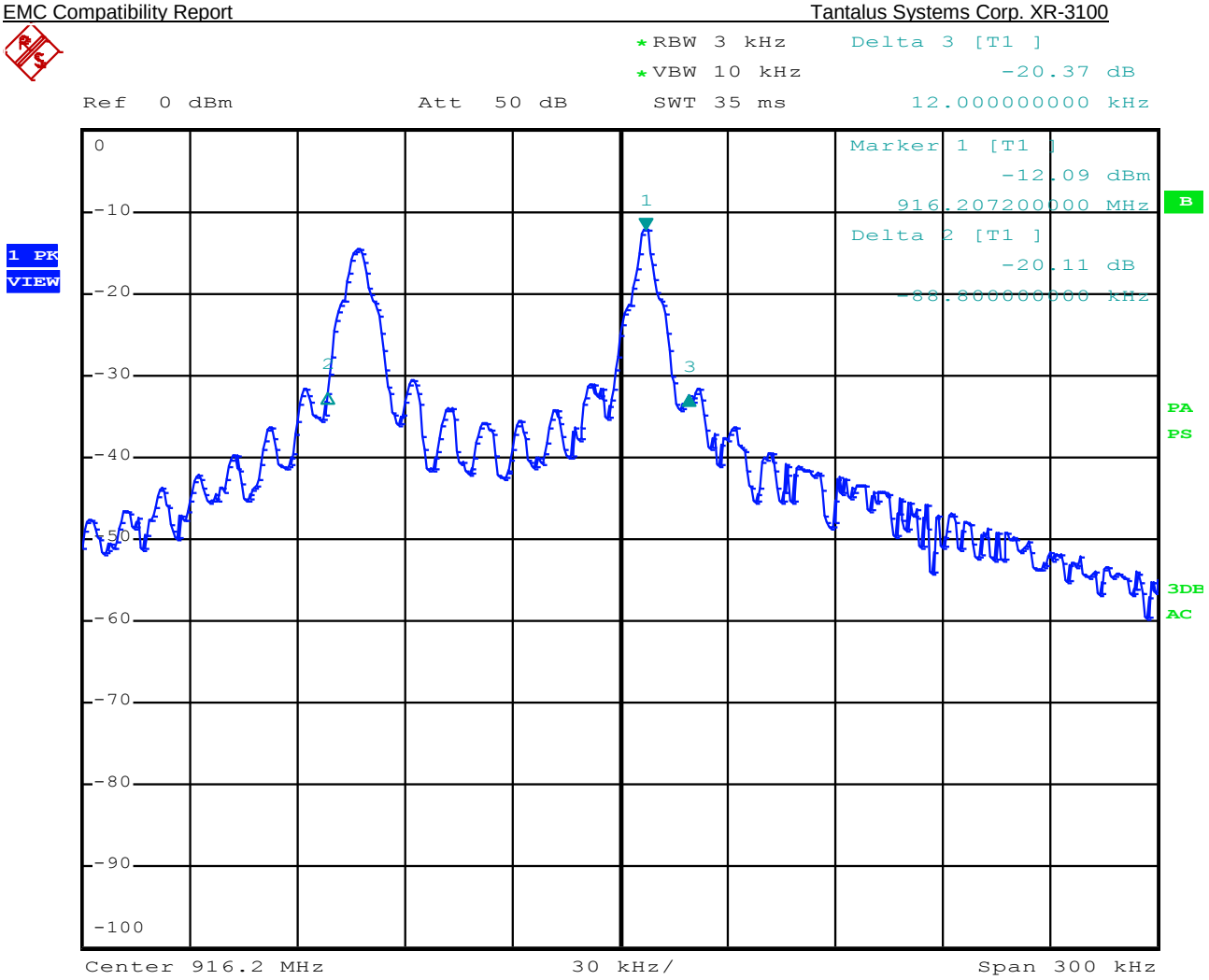
FHSS Compliance Tests

20 dB Bandwidth



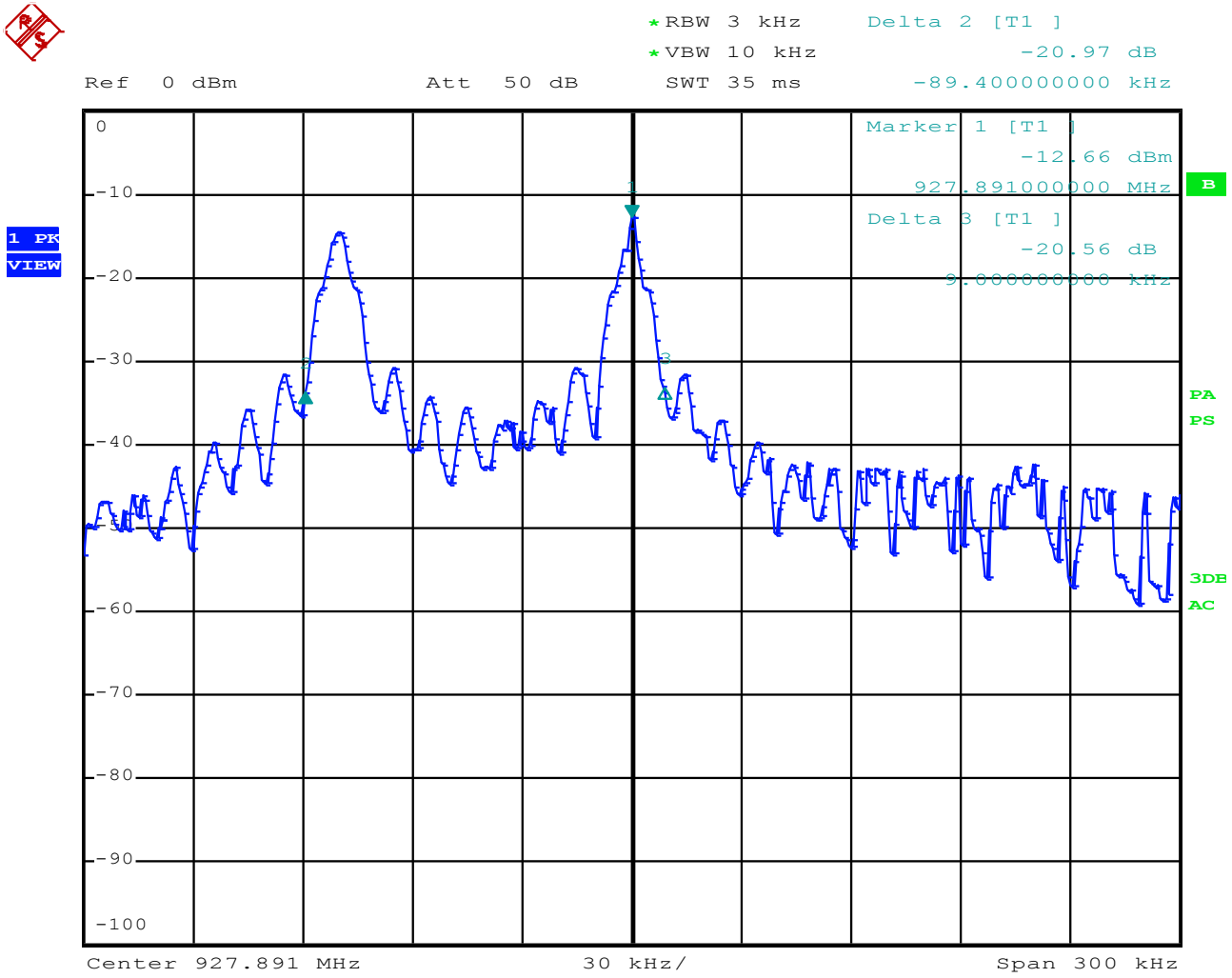
Date: 20.DEC.2012 12:04:47

Figure 3: 20dB Bandwidth at LOW Frequency – 97.8kHz



Date: 20.DEC.2012 12:29:18

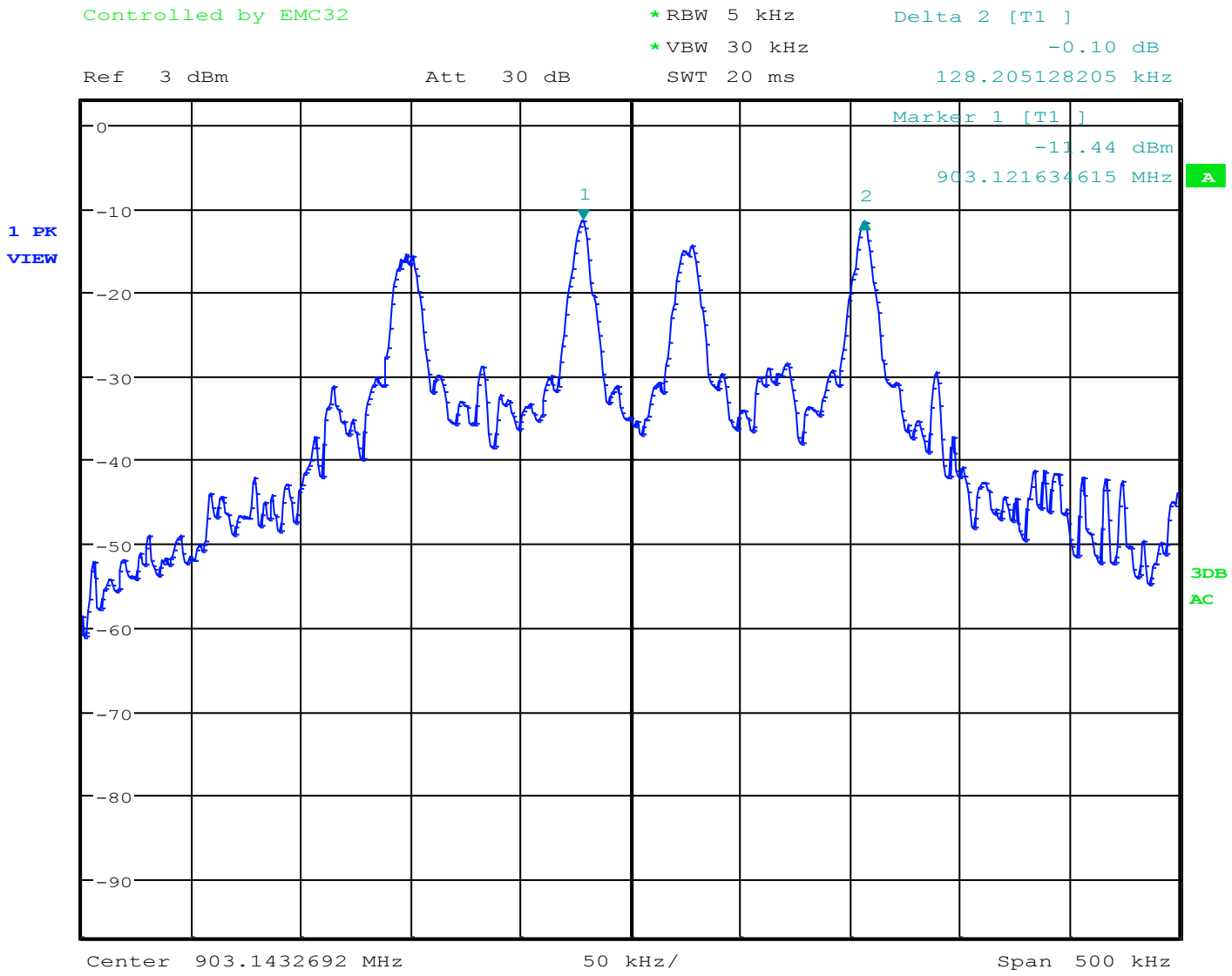
Figure 4: 20dB Bandwidth at MID Frequency – 100.8kHz



Date: 20.DEC.2012 13:09:51

Figure 5: 20dB Bandwidth at HIGH Frequency – 98.4kHz

Channel Separation

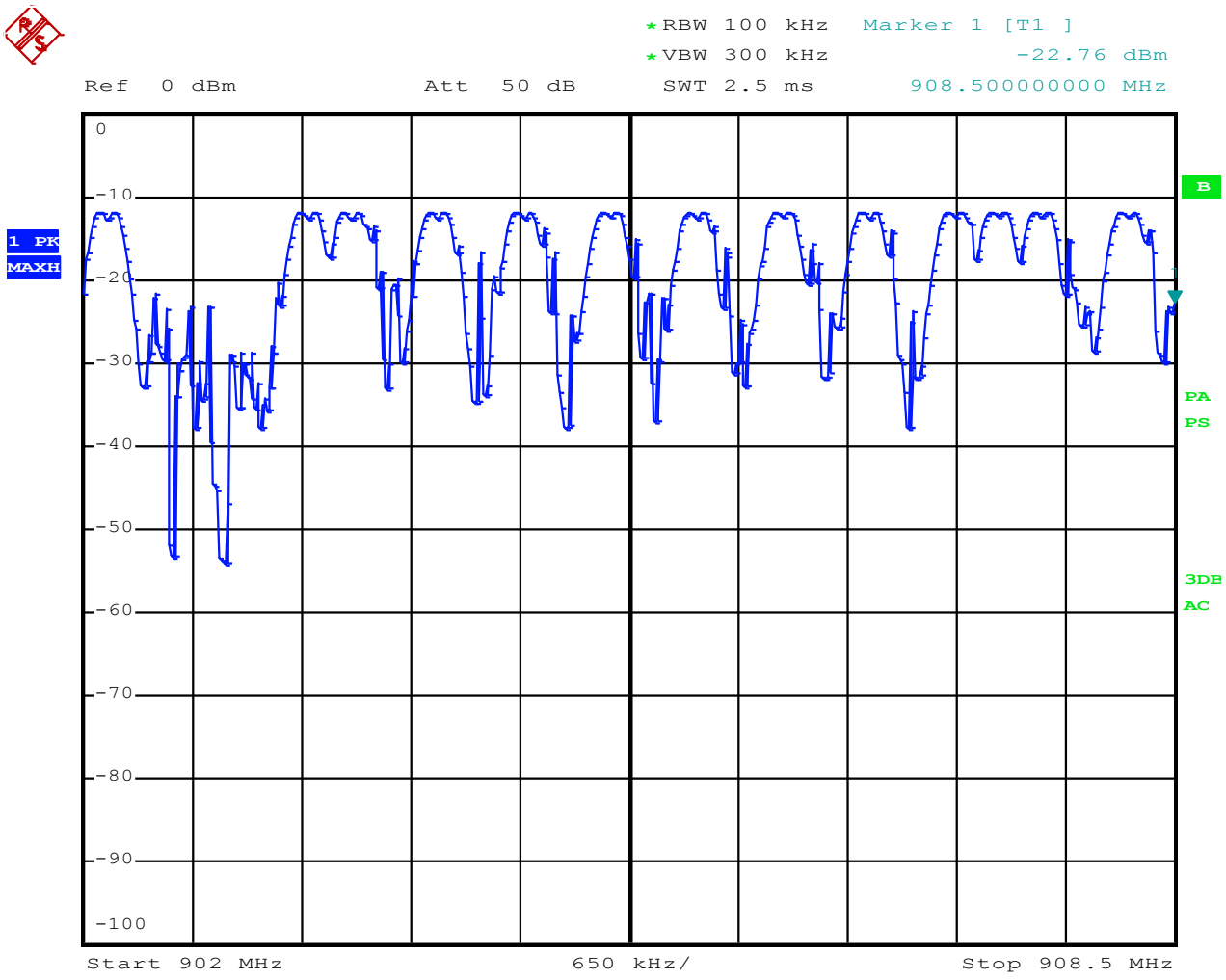


TTTTTT

Date: 22.NOV.2012 14:58:57

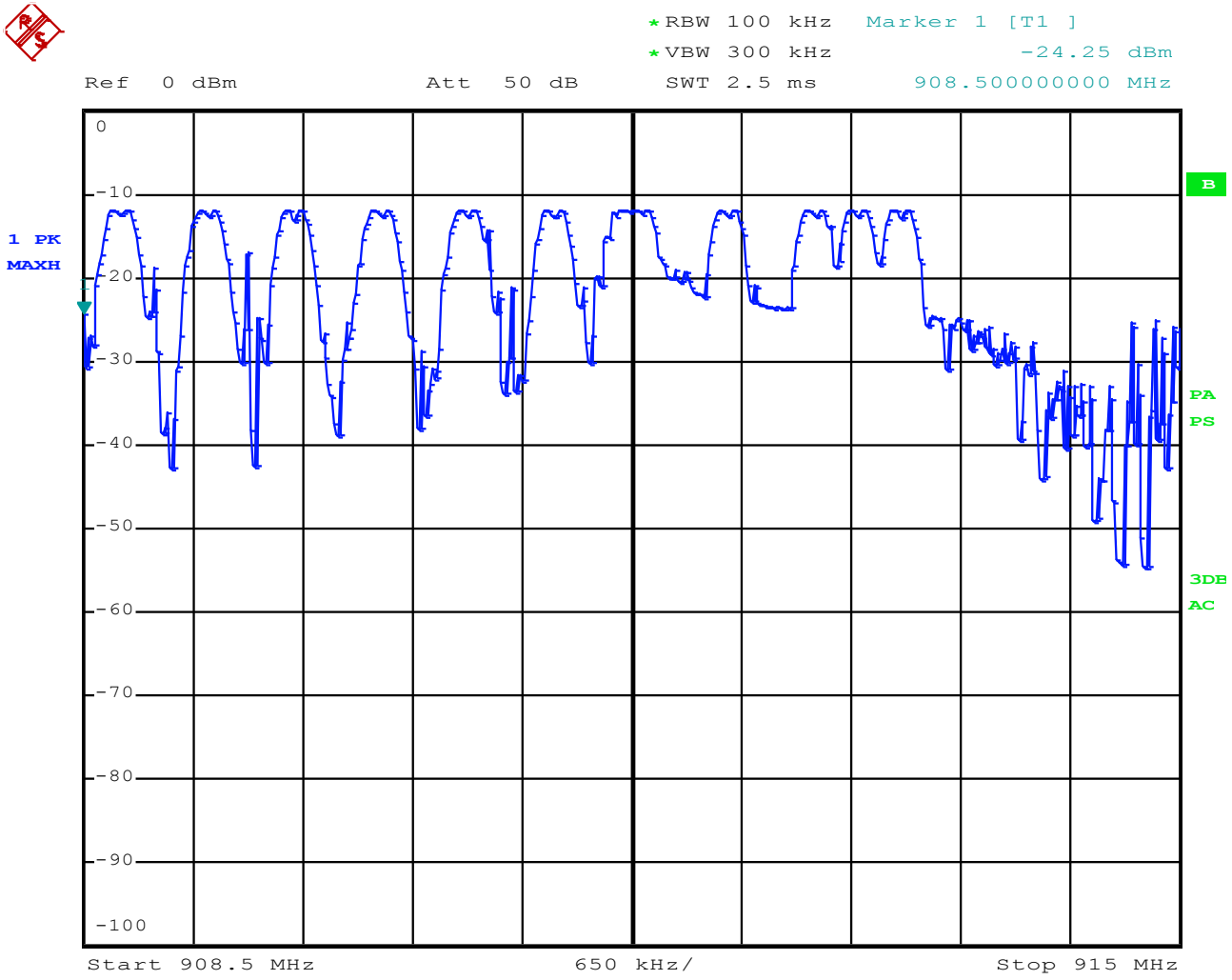
Figure 6: Channel Separation

Number of Hopping Channels



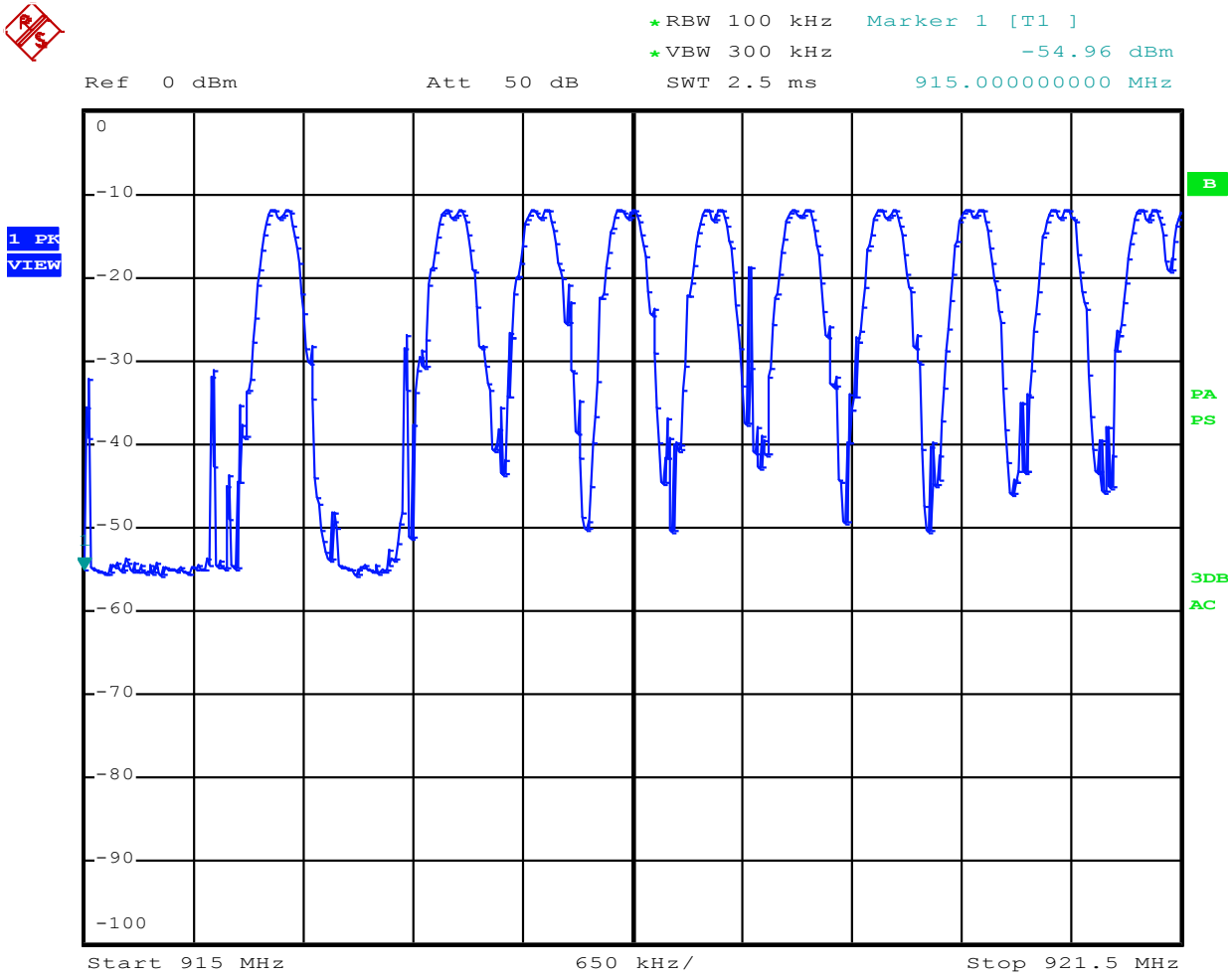
Date: 20.DEC.2012 14:19:31

Figure 7: Number of Hopping Channels 902MHz to 908.5MHz - 13 Hops



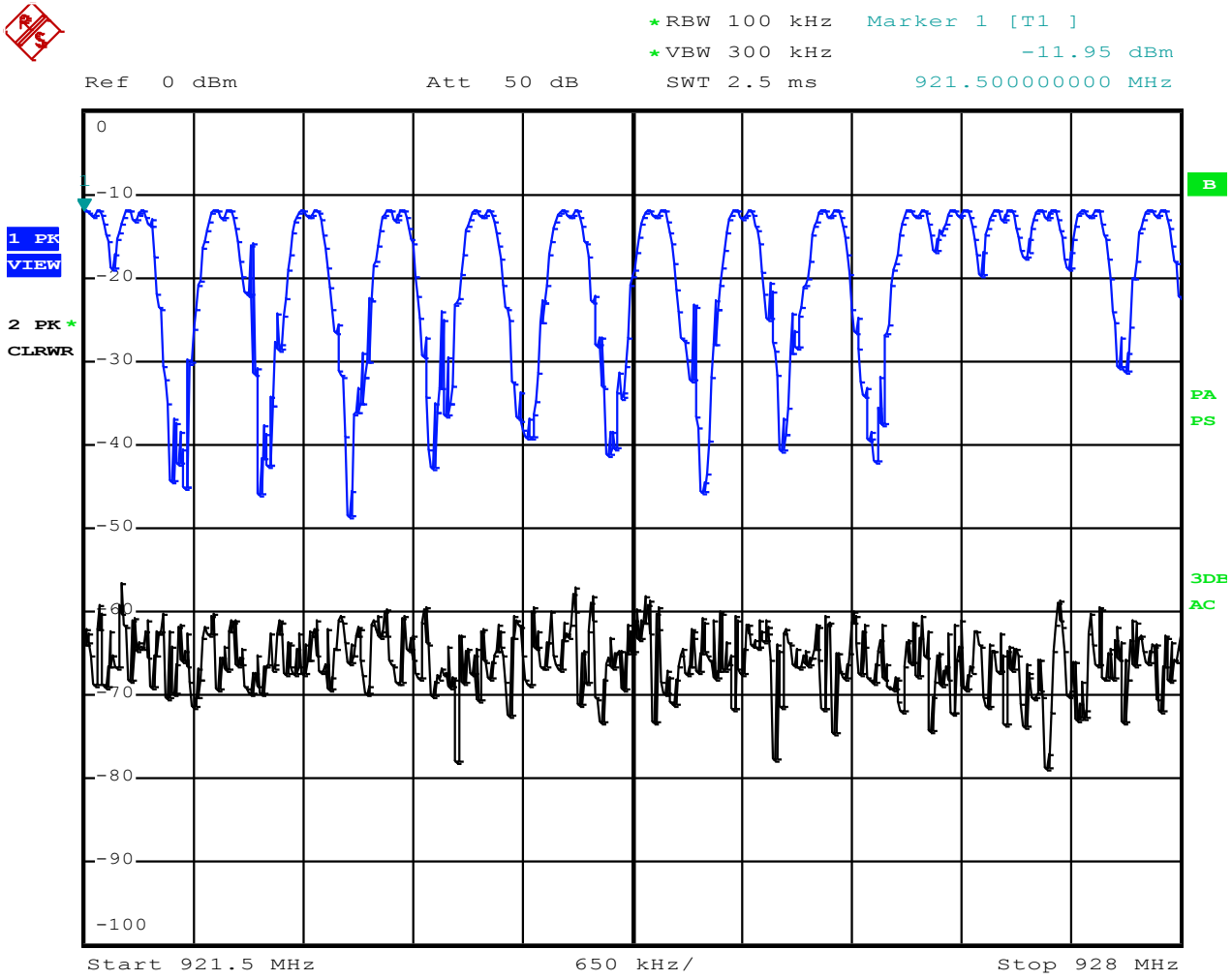
Date: 20.DEC.2012 14:37:52

Figure 8: Number of Hopping Channels 908.5MHz to 915MHz - 11 Hops



Date: 20.DEC.2012 14:42:33

Figure 9: Number of Hopping Channels 915MHz to 921.5MHz - 10 Hops



Date: 20.DEC.2012 16:14:37

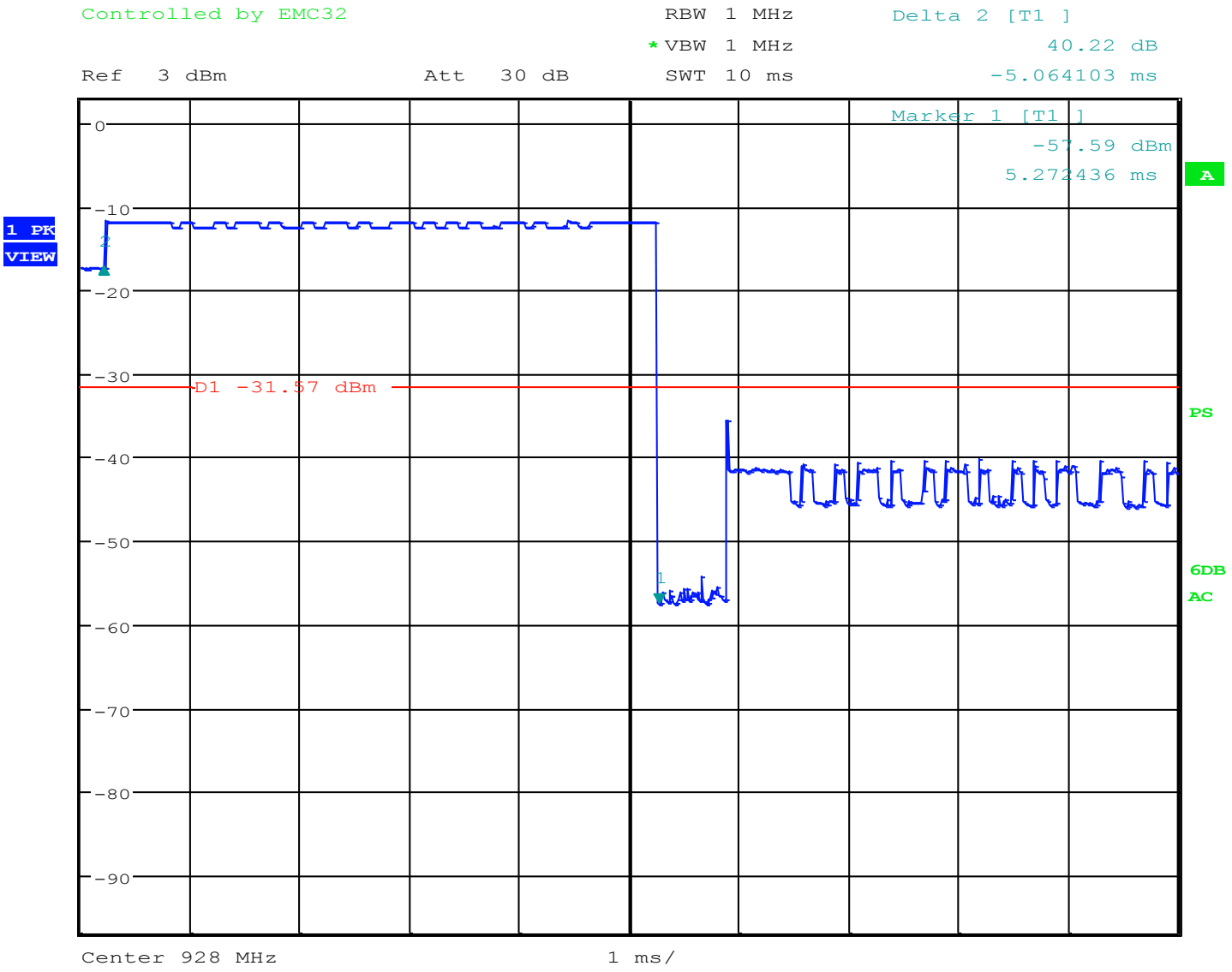
Figure 10: Number of Hopping Channels 921.5MHz to 928MHz - 16 Hops

Frequency Hop Number	Frequency (MHz)
0	916.7
1	923.1
2	904.6
3	909.2
4	919.6
5	923.5
6	918.6
7	908.9
8	905.0
9	908.7
10	922.5
11	905.6
12	907.4
13	914.8
14	920.3
15	907.3
16	917.5
17	915.9
18	914.2
19	904.0
20	916.4
21	927.6
22	920.0
23	922.7
24	916.2
25	915.0
26	915.8
27	915.5
28	907.6
29	913.7
30	907.1
31	906.5
32	926.9

33	923.7
34	915.7
35	923.6
36	920.9
37	927.5
38	920.4
39	905.3
40	916.3
41	922.4
42	916.0
43	918.5
44	903.2
45	926.7
46	921.8
47	922.2
48	919.1
49	915.3

Table 7: Example of a Channel Vector of 50 frequencies

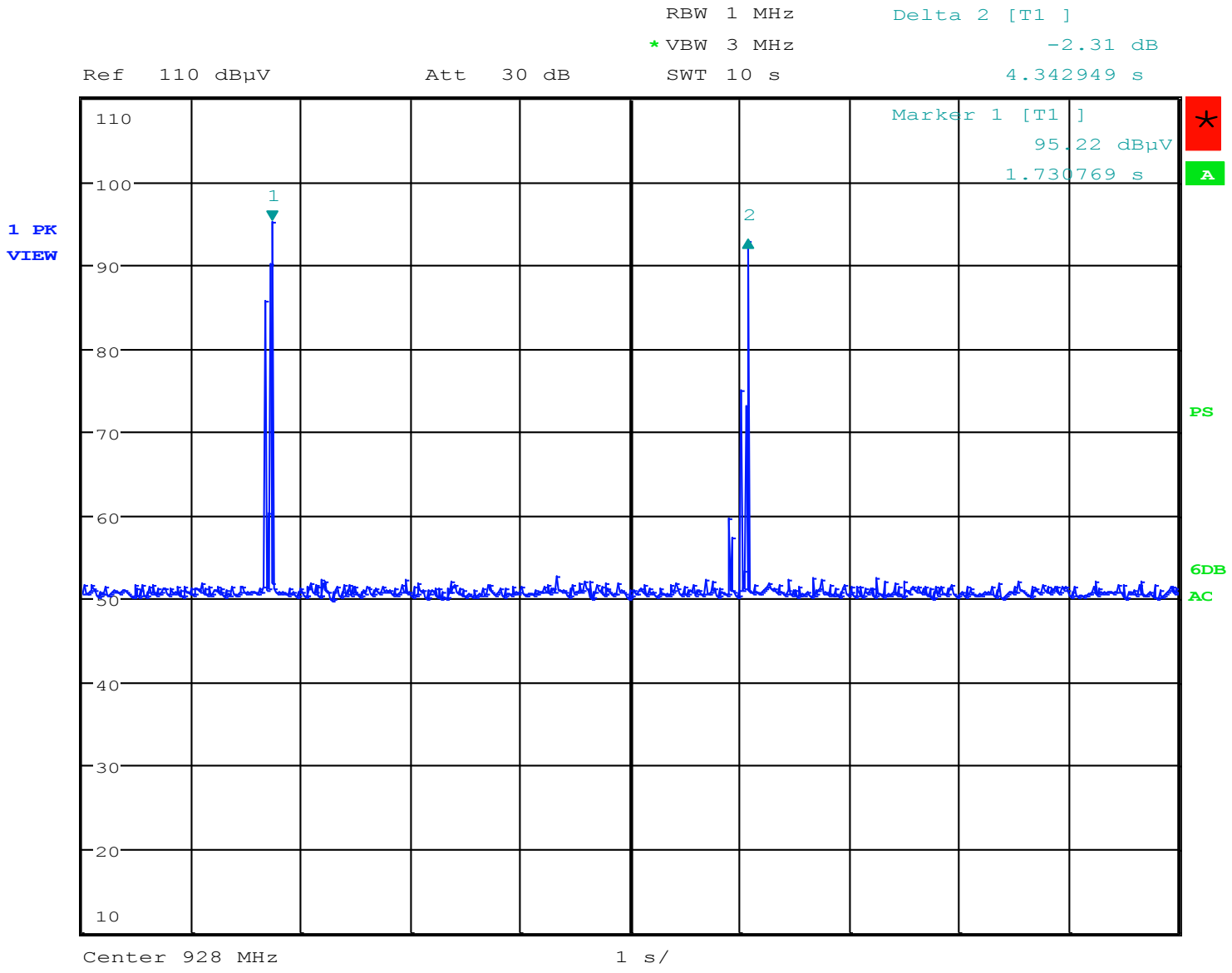
Dwell Time and Time of Occupancy



TTTTTT

Date: 22.NOV.2012 14:09:28

Figure 11: Dwell Time

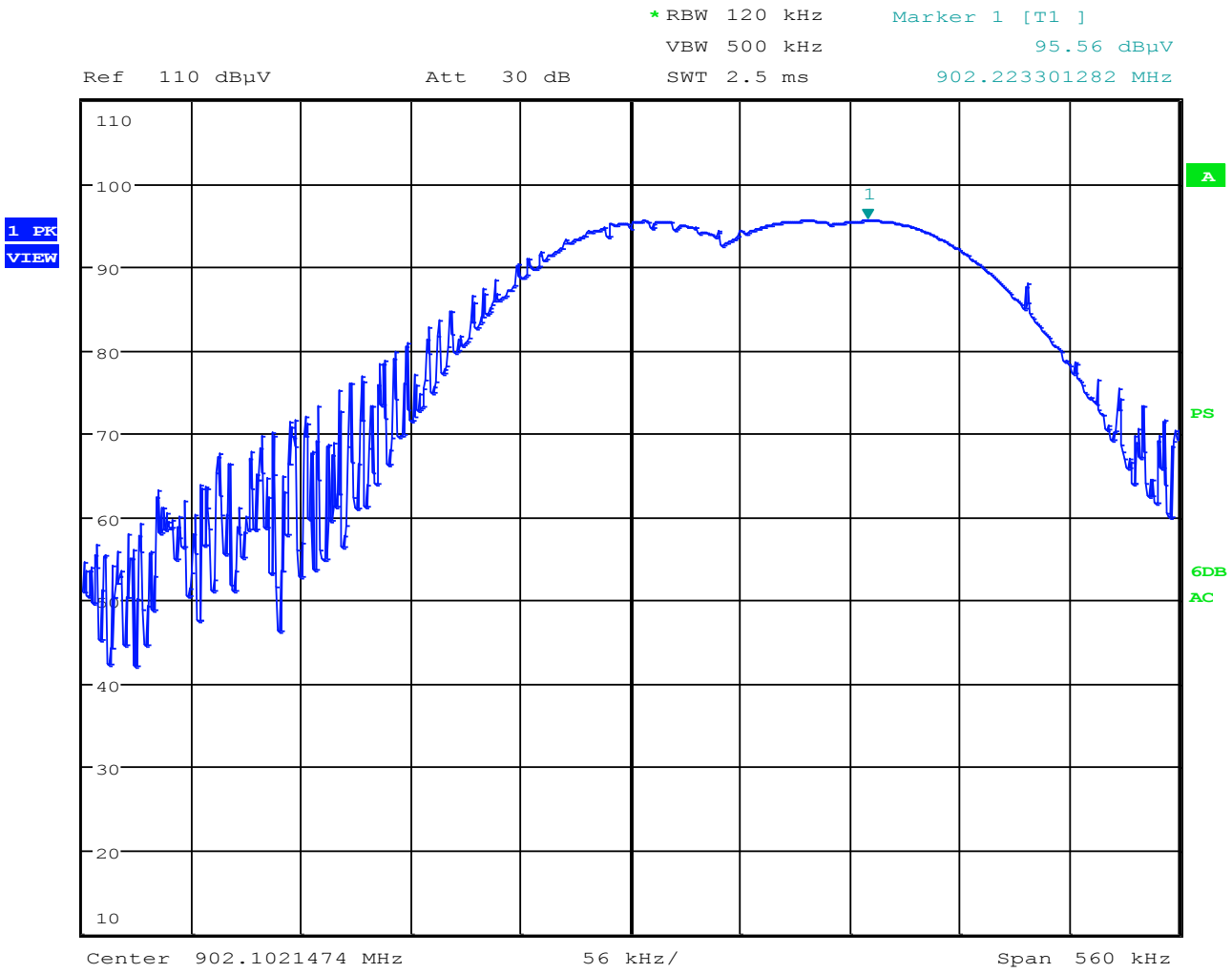


TTTTTT

Date: 22.NOV.2012 21:35:15

Figure 12: Time Occupancy Per Pulse

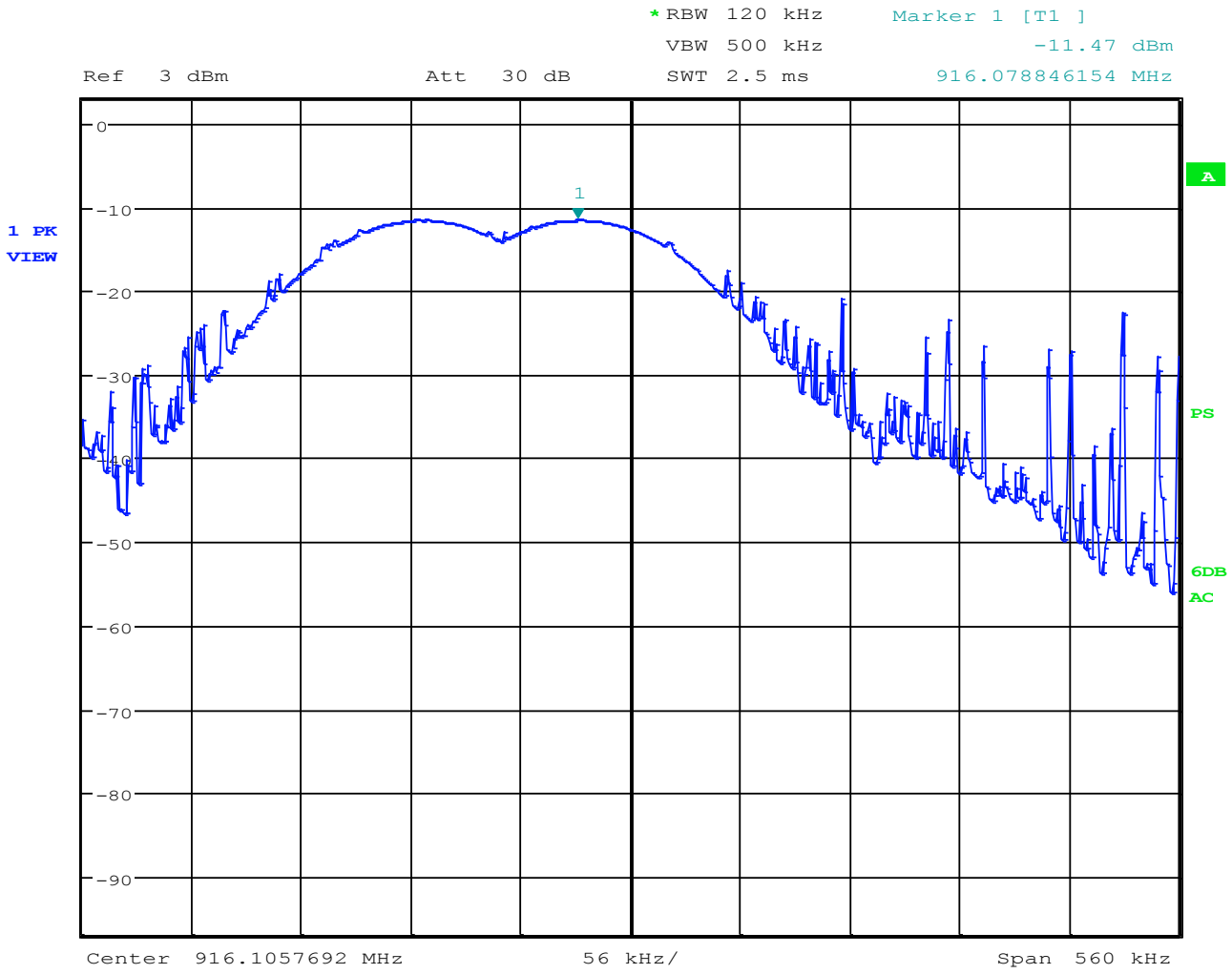
Output Power



TTTTTT

Date: 22.NOV.2012 21:15:57

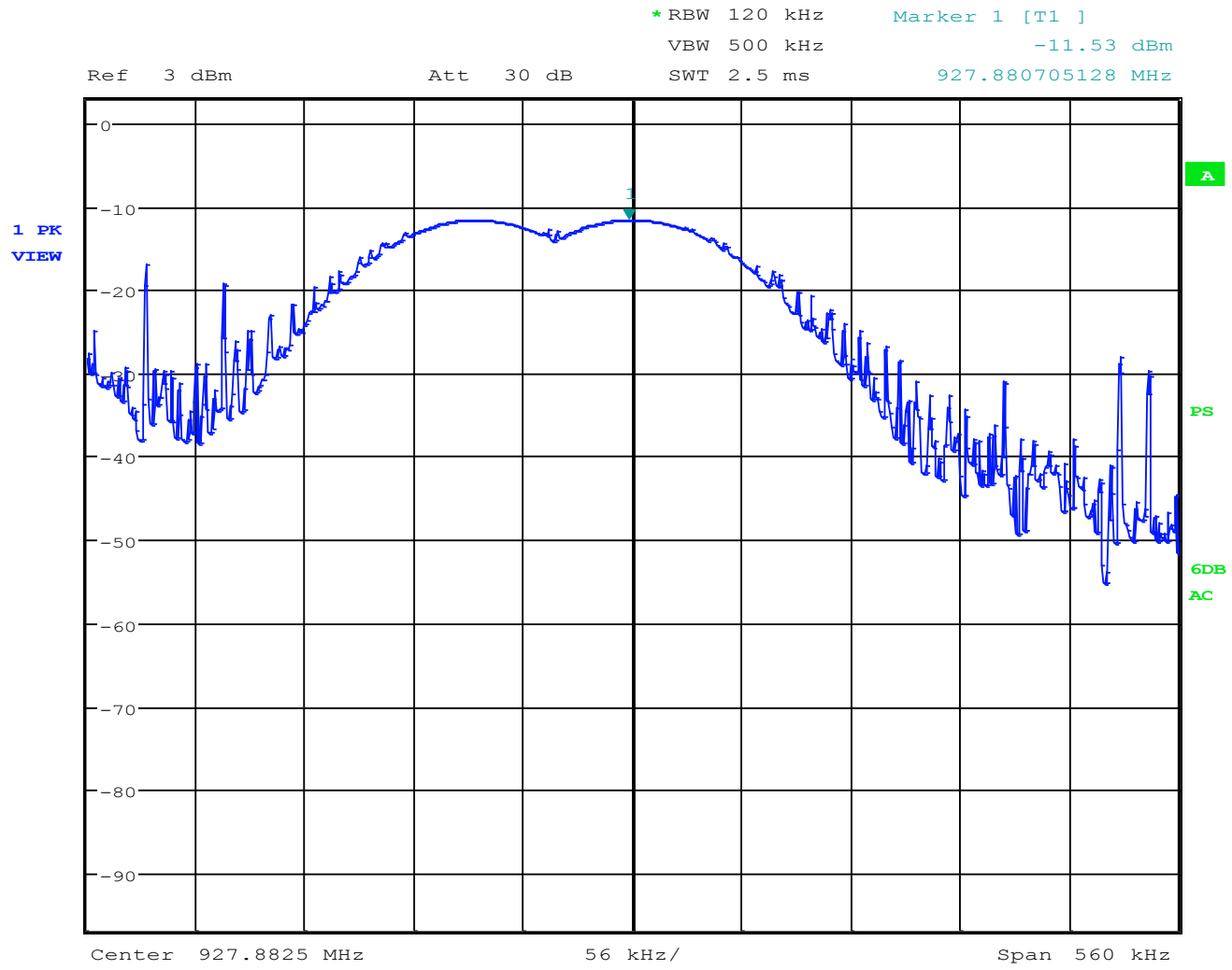
Figure 13: Output Power at LOW Frequency



TTTTTT

Date: 22.NOV.2012 21:07:41

Figure 14: Output Power at MID Frequency

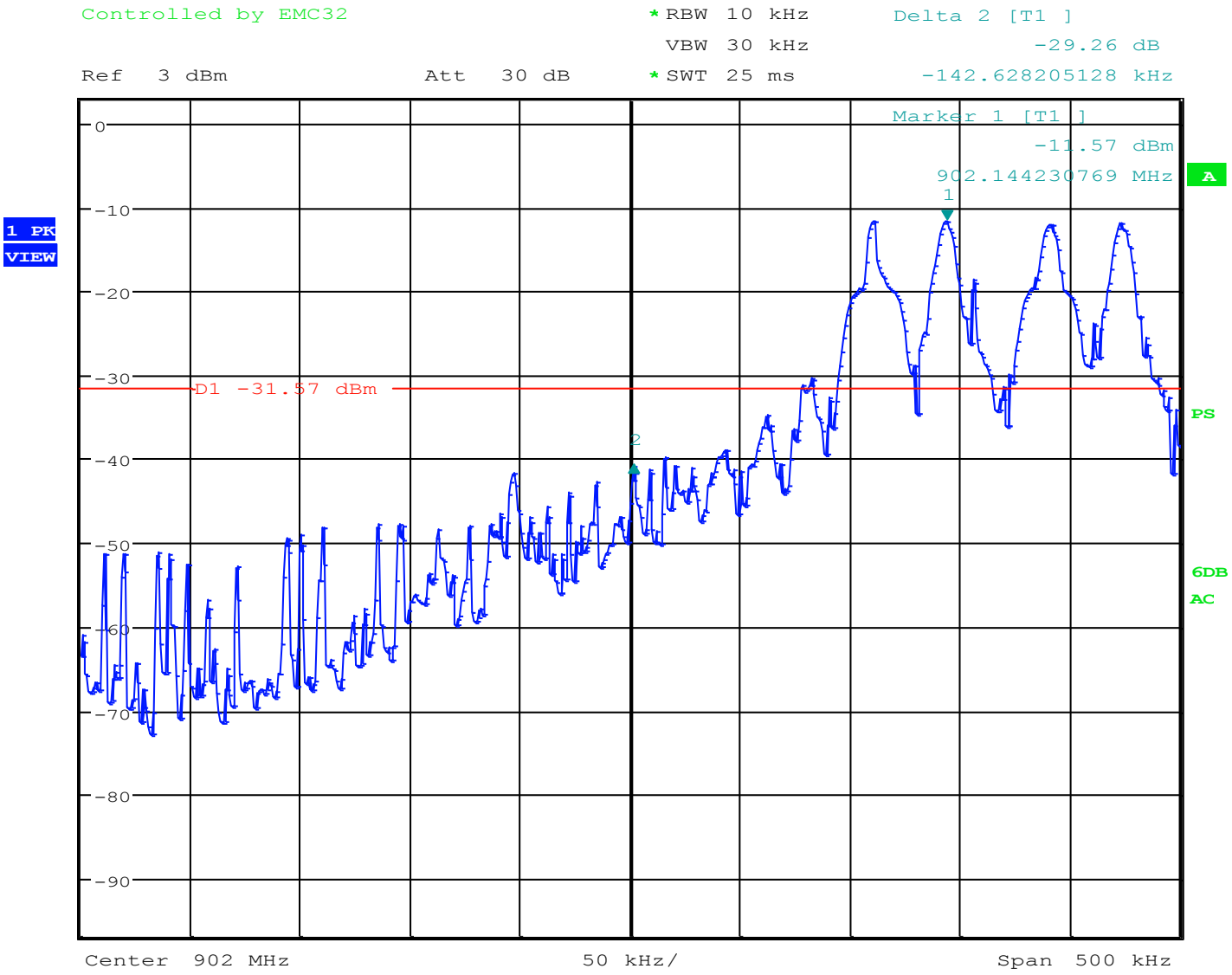


TTTTTT

Date: 22.NOV.2012 20:52:35

Figure 15: Output Power at HIGH Frequency

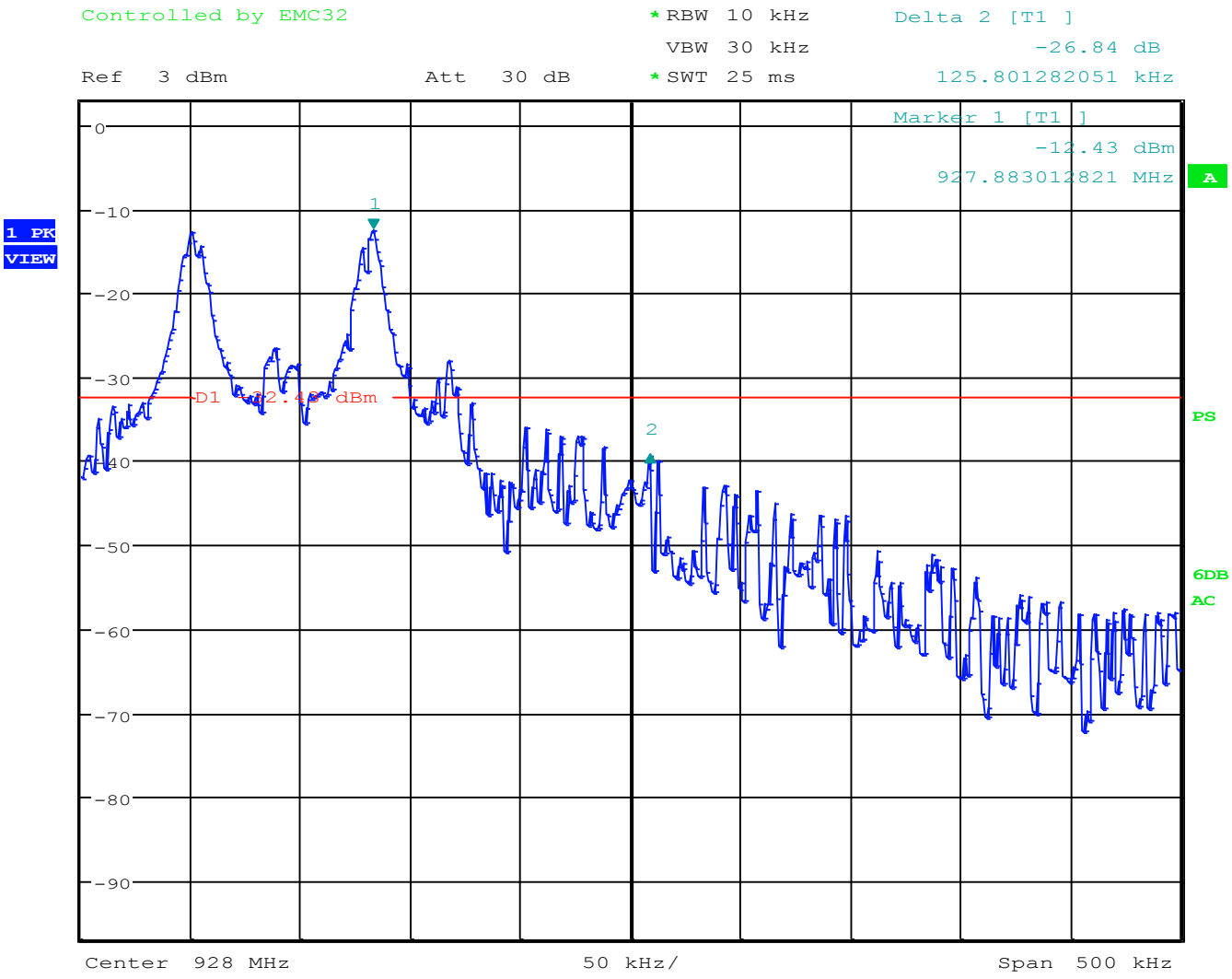
Channel Bandedge



TTTTTT

Date: 22.NOV.2012 13:35:58

Figure 16: Low Channel Bandedge



TTTTTT

Date: 22.NOV.2012 13:24:19

Figure 17: High Channel Bandedge

Radiated Spurious Harmonics

Measurement Date: Nov 23,26 2012

Setup:

Correction factor includes antenna, cables.

NOTE: For this product, the EUT worst case "ON" time was measured to be 5.06 ms per 100ms. This equates to a duty cycle correction factor of -25.91dB that has been applied to the measured average values in accordance with 15.35(c). In accordance with 15.31(o) emissions that are 20dB below the permissible value have not been reported.

Frequency	Pol.	Corrected Value	Average Limit at 3m	Duty Cycle Correction	Delta Lim-Avg	Peak Limit at 3m	Delta Lim-Peak
(MHz)		(dBuV/m)			(dB)	dB(uV/m)	(dB)
2706.4	H	62.3	54	25.9	**17.7**	74	**11.8**
2706.4	V	64.2	54	25.9	**15.8**	74	**9.8**
3608.7	H	61.3	54	25.9	**18.6**	74	**12.7**
3608.7	V	59.5	54	25.9	**20.4**	74	**14.5**
4510.6	H	55.8	54	25.9	**24.2**	74	**18.3**
4510.6	V	54.2	54	25.9	**25.8**	74	**19.9**
5413.1	V	66.1	54	25.9	**13.8**	74	**7.9**
5413.1	H	68.5	54	25.9	**11.4**	74	**5.5**
8119.6	H	60.5	54	25.9	**19.4**	74	**13.5**
8119.6	V	60.0	54	25.9	**19.9**	74	**14.0**
9021.7	H	59.5	54	25.9	**20.4**	74	**14.5**
9021.7	V	64.9	54	25.9	**15.0**	74	**9.1**

Table 8: Harmonics at Low Frequency

Frequency	Pol.	Corrected Value	Average Limit at 3m	Duty Cycle Correction	Delta Lim-Avg	Peak Limit at 3m	Delta Lim-Peak
(MHz)		(dBuV/m)			(dB)	dB(uV/m)	(dB)
2745.1	H	64.7	54	25.9	**15.2**	74	**9.3**
2745.1	V	61.8	54	25.9	**18.1**	74	**12.2**
3660.1	H	63.8	54	25.9	**16.1**	74	**10.2**
3660.1	V	62.7	54	25.9	**17.2**	74	**11.3**
4575.4	H	55.3	54	25.9	**24.6**	74	**18.7**
4575.4	V	56.7	54	25.9	**23.2**	74	**17.3**
7320.3	H	67.0	54	25.9	**12.9**	74	**7.0**
7320.3	V	62.1	54	25.9	**17.8**	74	**11.9**
8234.6	V	58.8	54	25.9	**21.1**	74	**15.2**
8234.6	H	59.8	54	25.9	**20.1**	74	**14.2**
9150.4	H	60.0	54	25.9	**19.9**	74	**14.0**
9150.4	V	59.2	54	25.9	**20.7**	74	**14.8**

Table 9: Harmonics at Mid Frequency

Frequency	Pol.	Corrected Value	Average Limit at 3m	Duty Cycle Correction	Delta Lim-Avg	Peak Limit at 3m	Delta Lim-Peak
(MHz)		(dBuV/m)			(dB)	dB(uV/m)	(dB)
2783.5	H	63.7	54	25.9	**16.2**	74	**10.3**
2783.5	V	61.9	54	25.9	**18.0**	74	**12.1**
3711.2	H	63.8	54	25.9	**16.1**	74	**10.2**
3711.2	V	64.8	54	25.9	**15.1**	74	**9.2**
4639.3	H	53.5	54	25.9	**26.4**	74	**20.5**
4639.3	V	54.2	54	25.9	**25.7**	74	**19.8**
7422.4	H	71.4	54	25.9	**8.5**	74	**2.6**
7422.4	V	66.3	54	25.9	**13.6**	74	**7.7**
8350.9	H	59.9	54	25.9	**20.0**	74	**14.1**
8350.9	V	61.1	54	25.9	**18.8**	74	**12.9**

Table 10: Harmonics at High Frequency

Radiated Spurious Emmission due to Intermods from co-located Antennas

Frequency	Pol.	Corrected Value	Average Limit at 3m	Duty Cycle Correction	Delta Lim-Avg	Peak Limit at 3m	Delta Lim-Peak
(MHz)		(dBuV/m)			(dB)	dB(uV/m)	(dB)
1346.17	H	61.8	54	25.9	**18.1**	74	**12.2**
1346.17	V	67.9	54	25.9	**12.0**	74	**6.1**
1568.2	V	62.2	54	25.9	**17.7**	74	**11.8**

Table 11: Spurious Emmissions due to Co-Located Antennas

Appendix B: Test Setup Photos

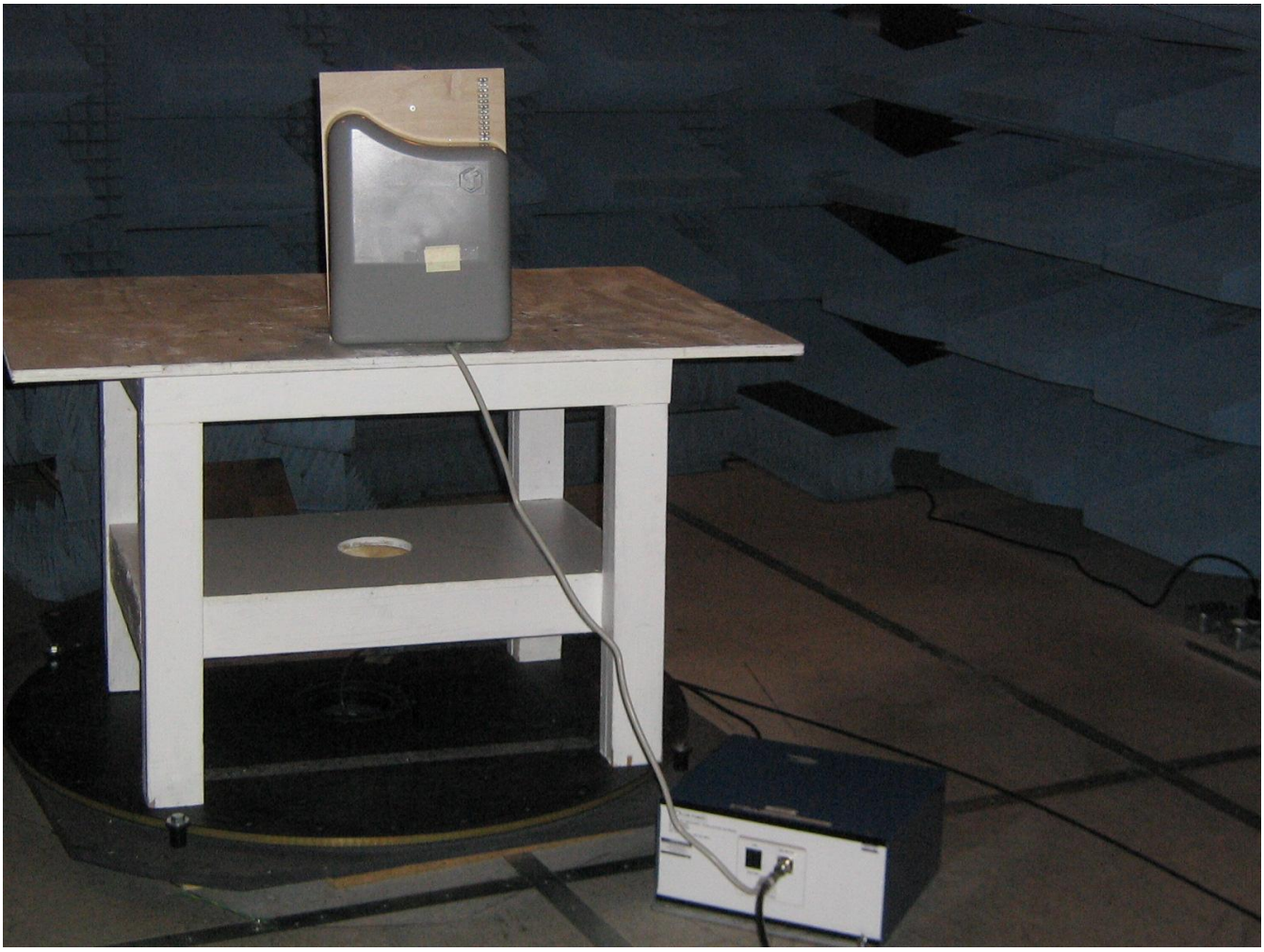
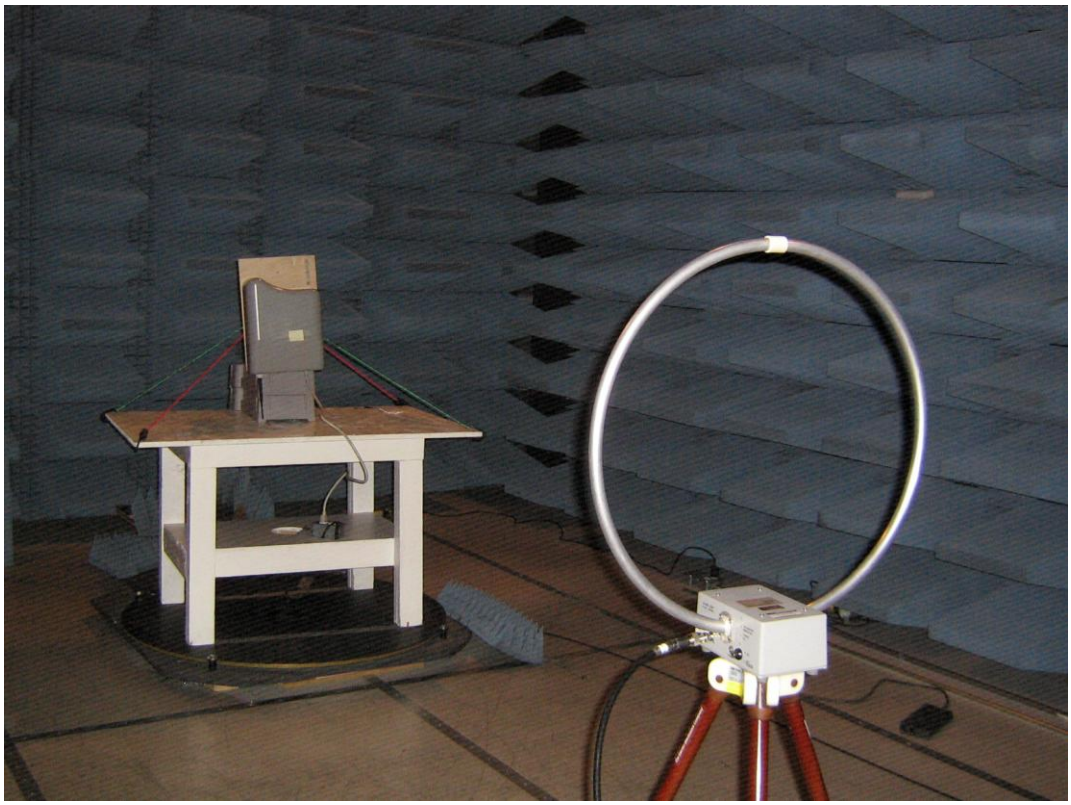


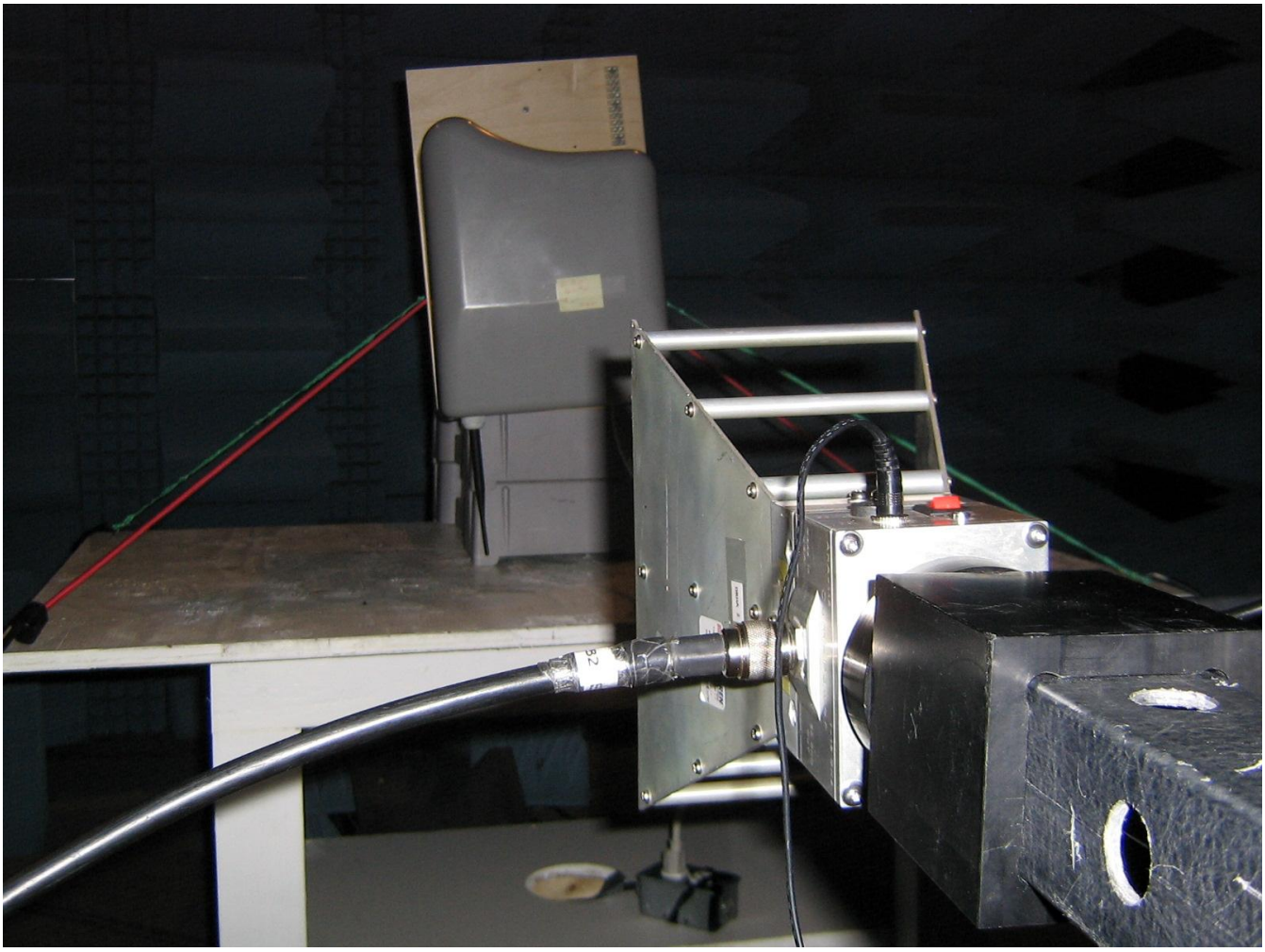
Figure 18: AC Conducted Test Setup

Intentional / Unintentional Radiated Emmission 30 – 1000 MHz setup



Intentional / Unintentional Radiated Emmission 0.009 – 30 MHz setup.

Figure 19: Emissions Test Setup – Intentional / Unintentional Radiated Emissions



Intentional Radiated Emmissions 1000 – 10000 MHz setup.

Figure 20: Emissions Test Setup – Intentional Harmonics