NTS Silicon Valley
www.nts.com
41089 Boyce Road
Fremont, CA 94538
510-578-3500 Phone
510-440-9525 Fax

EMC Test Report

Application for Grant of Equipment Authorization

Industry Canada RSS-Gen Issue 3 / RSS 210 Issue 8
FCC Part 15 Subpart C

Model: Link Data Transceiver

IC CERTIFICATION #:	8505A-MSLINK0003
FCC ID:	XJQMSLINK003
APPLICANT:	MicroStrain, Inc. 459 Hurricane Lane Suite 102 Williston, VT 05495
TEST SITE(S):	NTS Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-7
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PROGRAM MGR /
TECHNICAL REVIEWER:

David W. Bare
Chief Engineer

QUALITY ASSURANCE DELEGATE /
FINAL REPORT PREPARER:

David Guidotti
Senior Technical Writer

A2LA ACCREDITED
Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	08-02-2012	First release	
1	8-28-2012	Revised to clarify how the EUT was tested in 3 orthogonal orientations	Dave Guidotti David Bare

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SCOPE

An electromagnetic emissions test has been performed on the MicroStrain, Inc. model Link Data Transceiver, pursuant to the following rules:

Industry Canada RSS-Gen Issue 3
RSS 210 Issue 8 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in NTS Silicon Valley test procedures:

ANSI C63.4:2003
FCC DTS Measurement Procedure KDB558074

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification. Class II devices are required to meet the appropriate technical requirements but are exempt from certification requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested samples of MicroStrain, Inc. model Link Data Transceiver complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 3
RSS 210 Issue 8 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of MicroStrain, Inc. model Link Data Transceiver and therefore apply only to the tested samples. The samples were selected and prepared by Matt Bissonnette of MicroStrain, Inc.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz)

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)	RSS 210 A8.2	Digital Modulation	Systems uses DSSS techniques (IEEE 802.15.4)	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	RSS 210 A8.2 (1)	6dB Bandwidth	1.5 MHz	>500kHz	Complies
15.247 (b) (3)	RSS 210 A8.2 (4)	Output Power (multipoint systems)	11.6 dBm (0.015 Watts) EIRP = 0.029 W Note 1	1Watt, EIRP limited to 4 Watts.	Complies
15.247(d)	RSS 210 A8.2 (2)	Power Spectral Density	-1.7 dBm / 3kHz	8dBm/3kHz	Complies
15.247(c)	RSS 210 A8.5	Antenna Port Spurious Emissions 30MHz – 25 GHz	All emissions below -30dBc limit	< -30dBc Note 2	Complies
15.247(c) / 15.209	RSS 210 A8.5	Radiated Spurious Emissions 30MHz – 25 GHz Internal Antenna	67.7 dBµV/m @ 2494.6 MHz (-6.3 dB)	15.207 in restricted bands, all others <-30dBc Note 2	Complies
15.247(c) / 15.209	RSS 210 A8.5	Radiated Spurious Emissions 30MHz – 25 GHz External Antenna	53.0 dBµV/m @ 4950.9 MHz (-1.0 dB)	15.207 in restricted bands, all others <-30dBc Note 2	Complies

Note 1: EIRP calculated using antenna gain of 3 dBi for the highest EIRP system.
Note 2: Limit of -30dBc used because the power was measured using the UNII test procedure (maximum power averaged over a transmission burst).

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Unique u.fl connector or integral antenna used	Unique or integral antenna required	Complies
15.207	RSS GEN Table 2	AC Conducted Emissions	19.7dBµV @ 2.62MHz (-26.3dB)	Refer to page 17	Complies
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to MPE calculations in RSS 102 declaration and User Manual statements.	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSP 100 RSS GEN 7.1.5	User Manual		Statement required regarding non-interference	Complies
-	RSP 100 RSS GEN 7.1.5	User Manual		Statement for products with detachable antenna	Complies
-	RSP 100 RSS GEN 4.4.1	99% Bandwidth	3.3 MHz	Information only	N/A

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission (field strength)	dBµV/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dBµV	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The MicroStrain, Inc. model Link Data Transceiver is a 2.4GHz radio module. Since the EUT would be placed in various products during operation, the EUT was treated as table-top equipment during testing to simulate the end-user environment. The EUT was powered from 4 C sized batteries.

The sample was received on July 5, 2012 and tested on July 5 and 6, 2012. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
MicroStrain, Inc.	Link Data Transceiver	2.4GHz transceiver (on-board antenna)	1111	XJQMSLINK0003
MicroStrain, Inc.	Link Data Transceiver	2.4GHz transceiver (external antenna)	1313	XJQMSLINK0003

ANTENNA SYSTEM

There were two antenna configurations evaluated:
1) On-board chip antenna (Johannsen 2450at45a100e), 3dBi
2) External folded sleeve dipole antenna (HyperLink, HG2402RD-RSF), 2.2dBi
The external antenna connects to the module via a u.FL connnector.

ENCLOSURE

The EUT does not have an enclosure as it is designed to be installed within the enclosure of a host computer or system.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Silicon Valley.

SUPPORT EQUIPMENT

No local support equipment was used during testing.

The following equipment was used as remote support equipment for emissions testing:

Company	Model	Description	Serial Number	FCC ID
Dell	-	Laptop Computer	-	-
Dell	LA65NS1-00	AC/DC Adapter	CN0YD637-71615-9BK-081A	-
Microstrain	WSDA -Base	Basestation	1040-0262-I04YL	XJQMSLINK0001

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
EUT - DC Power	Battery Pack	2wire	Unshielded	1
Remote Laptop - USB	Basestation	Multiconductor	Shielded	1.5
Remote Laptop - DC Power In	AC/DC Adapter	Multiconductor	Shielded	1.5

EUT OPERATION

During emissions testing the EUT was configured to continuously transmit on the channel noted at the maximum power setting.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
Chamber 7	A2LA accreditation	2845B-7	41039 Boyce Road Fremont, CA 94538-2435

ANSI C63.4:2003 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4:2003.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4:2003. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4:2003.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.4:2003 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4:2003, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

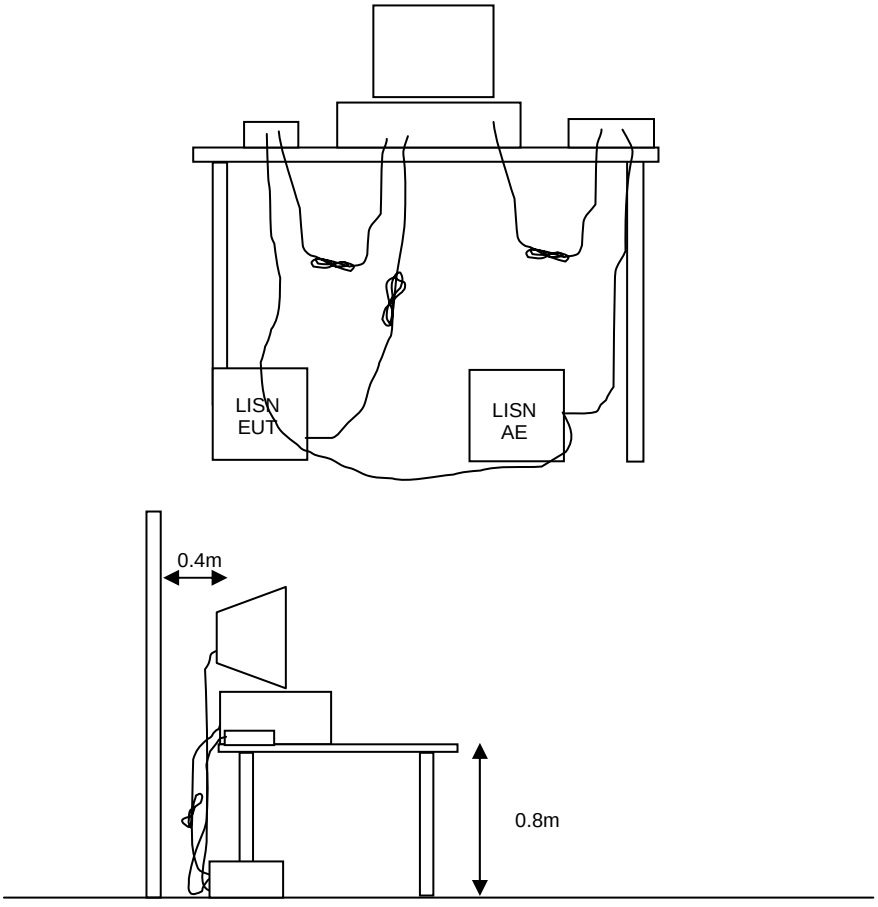


Figure 1 Typical Conducted Emissions Test Configuration

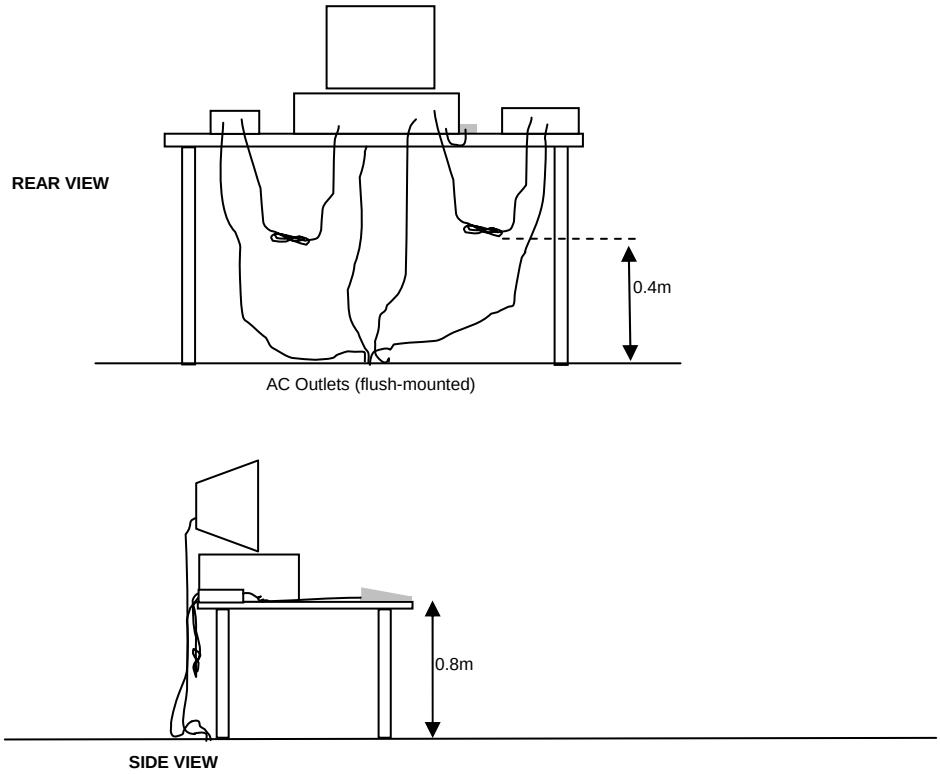
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

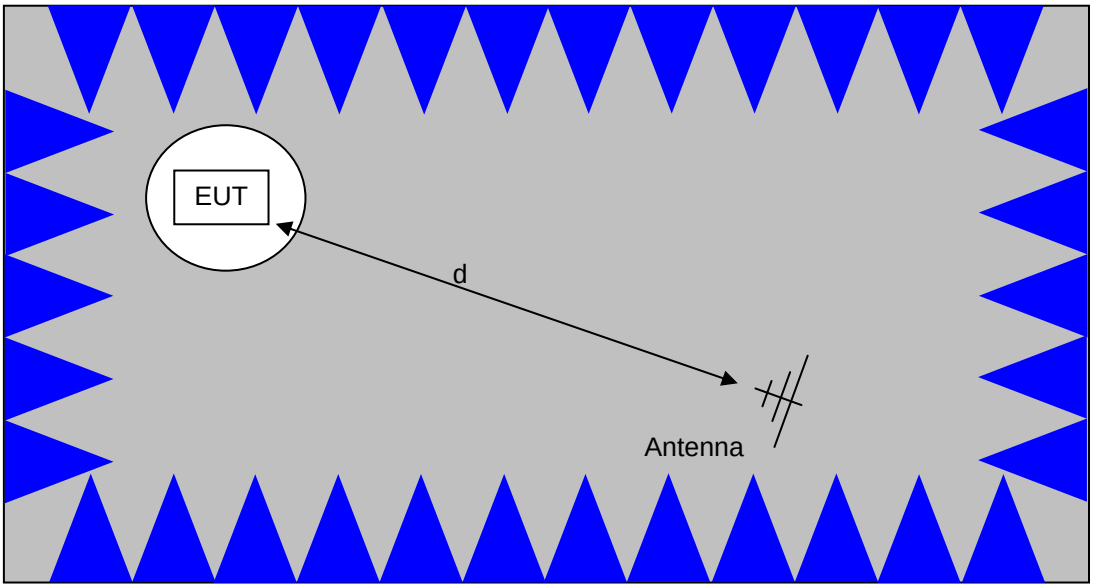
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

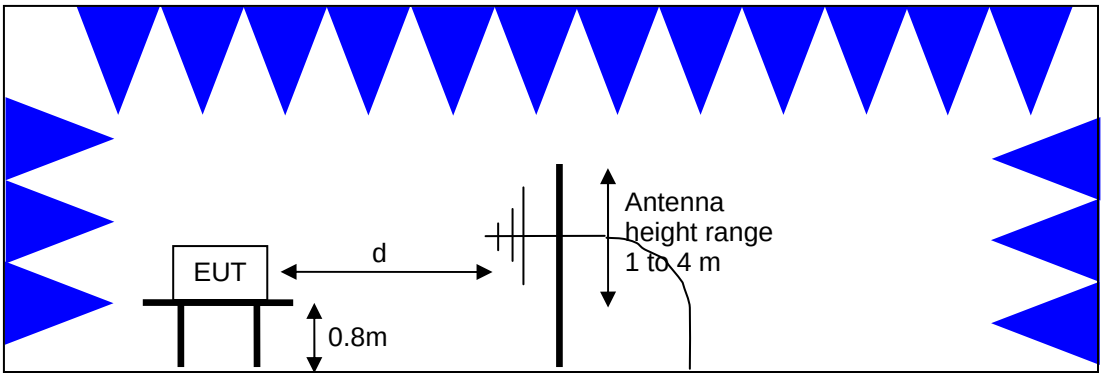


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

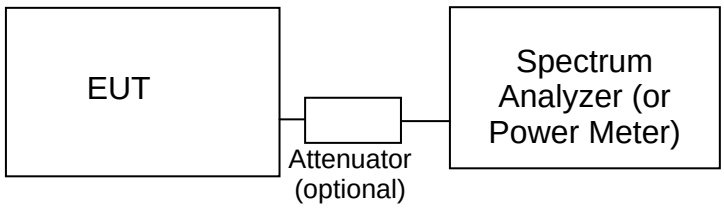
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements of power, bandwidth and power spectral density are performed, where possible, with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.



Test Configuration for Antenna Port Measurements

Measurement bandwidths (video and resolution) are set in accordance with the relevant standards and NTS Silicon Valley's test procedures for the type of radio being tested. When power measurements are made using a resolution bandwidth less than the signal bandwidth the power is calculated by summing the power across the signal bandwidth using either the analyzer channel power function or by capturing the trace data and calculating the power using software. In both cases the summed power is corrected to account for the equivalent noise bandwidth (ENBW) of the resolution bandwidth used.

If power averaging is used (typically for certain digital modulation techniques), the EUT is configured to transmit continuously. Power averaging is performed using either the built-in function of the analyzer or, if the analyzer does not feature power averaging, using external software. In both cases the average power is calculated over a number of sweeps (typically 100). When the EUT cannot be configured to continuously transmit then either the analyzer is configured to perform a gated sweep to ensure that the power is averaged over periods that the device is transmitting or power averaging is disabled and a max-hold feature is used.

If a power meter is used to make output power measurements the sensor head type (peak or average) is stated in the test data table.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(a), RSS GEN

The table below shows the limits for the emissions on the AC power line from an intentional radiator and a receiver.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1] (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from receivers as detailed in FCC Part 15.109, RSS 210 Table 2, RSS GEN Table 1 and RSS 310 Table 3. Note that receivers operating outside of the frequency range 30 MHz – 960 MHz are exempt from the requirements of 15.109.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

[1] The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
902 – 928	1 Watt (30 dBm)	8 dBm/3kHz
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz
5725 – 5850	1 Watt (30 dBm)	8 dBm/3kHz

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level (30dB if the power is measured using the sample detector/power averaging method).

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of d (meters) from the equipment under test:

$$E = \frac{1000000 \sqrt{30 P}}{d} \text{ microvolts per meter}$$

where P is the eirp (Watts)

For a measurement at 3m the conversion from a logarithmic value for field strength (dBuV/m) to an eirp power (dBm) is -95.3dB.

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

Appendix A Test Equipment Calibration Data

Radiated Emissions, 30 - 26,500 MHz, 05-Jul-12

Manufacturer	Description	Model	Asset #	Cal Due
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/19/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	5/21/2013
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	2/23/2013
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	10/4/2012
Hewlett Packard	SpecAn 9 kHz - 40 GHz, (SA40) Purple	8564E (84125C)	2415	7/28/2012

Radio Antenna Port (Power and Spurious Emissions), 09-Jul-12

Manufacturer	Description	Model	Asset #	Cal Due
Agilent	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	2/23/2013

Radiated Emissions, 30 - 1,000 MHz, 09-Jul-12

Manufacturer	Description	Model	Asset #	Cal Due
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1549	5/25/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	5/21/2013
Hewlett Packard	Preamplifier, 100 kHz - 1.3 GHz	8447D OPT 010	1826	5/18/2013

Conducted Emissions - AC Power Ports, 09-Jul-12

Manufacturer	Description	Model	Asset #	Cal Due
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	372	1/20/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	5/21/2013
Com-Power	9KHz-30MHz, 50uH, 15Aac, 10Adc, max	LI-215A	2671	5/25/2013

Appendix B Test Data

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Client:	MicroStrain, Inc.	Job Number:	J87865
Product	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		-
Emissions Standard(s):	FCC 15.247, RSS-210	Class:	-
Immunity Standard(s):	-	Environment:	Radio

EMC Test Data

For The

MicroStrain, Inc.

Product

Link Transceiver Module

Date of Last Test: 8/2/2012

Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	-

Conducted Emissions

(Elliott Laboratories Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 7/9/2012
Test Engineer: M. Birgani
Test Location: FT Chamber #7

Config. Used: 1
Config Change: -
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT was located on a wooden table inside the semi-anechoic chamber, 40 cm from a vertical coupling plane and 80cm from the LISN.

Ambient Conditions:

Temperature: 18-20 °C
Rel. Humidity: 30-35 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power,120V/60Hz	15.207	PASS	19.7dBµV @ 2.62MHz (-26.3dB)

Modifications Made During Testing

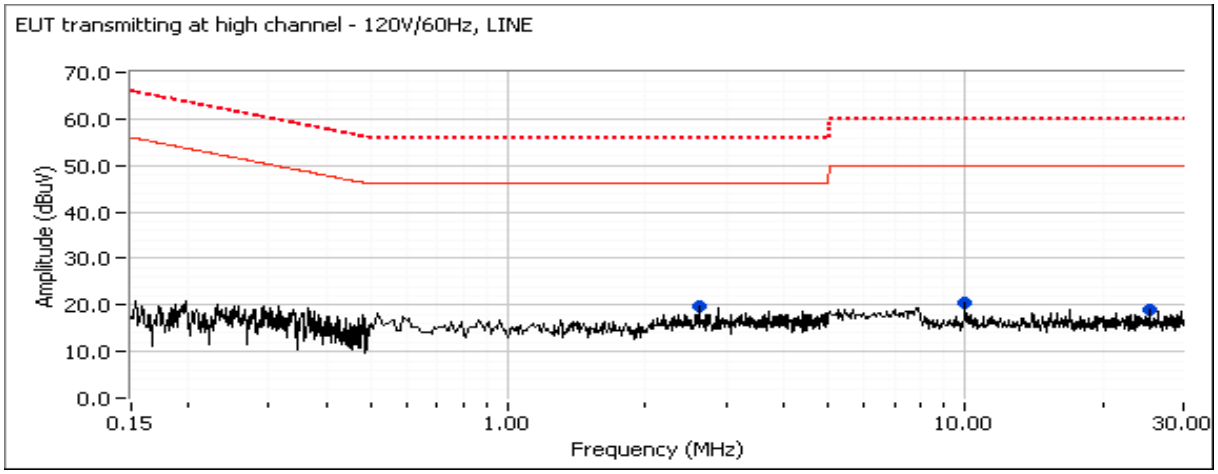
No modifications were made to the EUT during testing

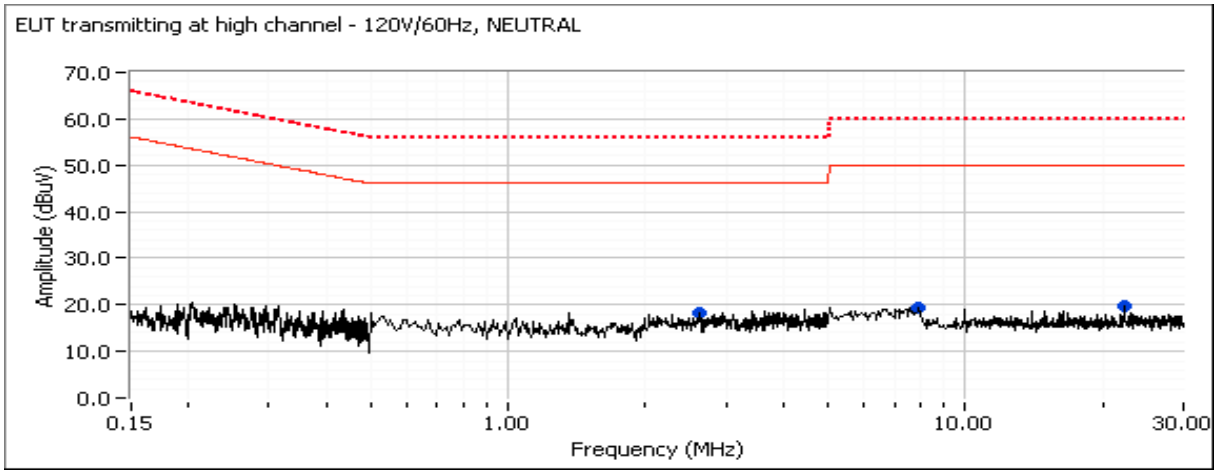
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	-

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz





Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency MHz	Level dBµV	AC Line	FCC 15.207 Limit	FCC 15.207 Margin	Detector QP/Ave	Comments
2.619	19.7	Line	46.0	-26.3	Peak	Peak reading with average limit
2.610	18.2	Neutral	46.0	-27.8	Peak	Peak reading with average limit
10.010	20.6	Line	50.0	-29.4	Peak	Peak reading with average limit
22.184	19.9	Neutral	50.0	-30.1	Peak	Peak reading with average limit
7.906	19.2	Neutral	50.0	-30.8	Peak	Peak reading with average limit
25.240	19.1	Line	50.0	-30.9	Peak	Peak reading with average limit

Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Antenna Port Measurements

Power, PSD, Bandwidth and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 7/6/2012
Test Engineer: Rafael Varelas
Test Location: FT Chamber #7

Config. Used: 1
Config Change: None
EUT Voltage: 3.4Vdc

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions:

Temperature: 18-21 °C
Rel. Humidity: 35-45 %

Summary of Results

Run #	Pwr setting	Test Performed	Limit	Pass / Fail	Result / Margin
1	16	Output Power	15.247(b)	Pass	11.6 dBm
2		Power spectral Density (PSD)	15.247(d)	Pass	-1.7 dBm/3kHz
3		Minimum 6dB Bandwidth	15.247(a)	Pass	1.5 MHz
3		99% Bandwidth	RSS GEN	-	3.3 MHz
4		Spurious emissions	15.247(b)	Pass	All emissions below -30dBc limit

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

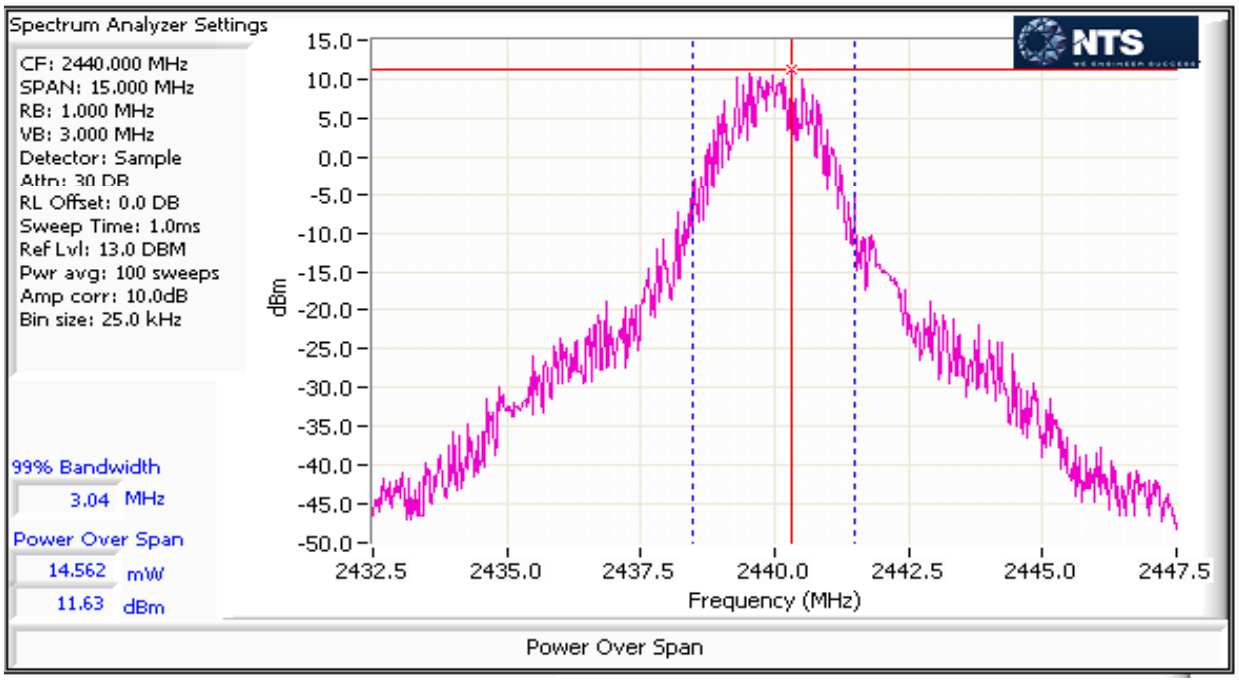
No deviations were made from the requirements of the standard.

Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Run #1: Maximum Conducted Output Power

Power Setting[2]	Frequency (MHz)	Output Power (dBm) [1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP [Note 2] dBm	EIRP W	Output Power (dBm) [3]	Output Power mW
16	2405	11.5	14.0	3.0	Pass	14.5	0.028	8.9	7.8
16	2440	11.6	14.6	3.0	Pass	14.6	0.029	8.9	7.8
16	2475	11.4	13.7	3.0	Pass	14.4	0.027	8.8	7.6

Note 1:	Output power measured using a spectrum analyzer (see plots below) with RBW=1MHz, VB=3 MHz, sample detector, power averaging on (transmitted signal was continuous) and power integration over 15 MHz (option #2, method 1 in KDB 558074, equivalent to method 1 of DA-02-2138A1 for U-NII devices) and gating enabled. Spurious limit becomes -30dBc.
Note 2:	Power setting - the software power setting used during testing, included for reference only.
Note 3:	Power measured using average power meter and is included for reference only.

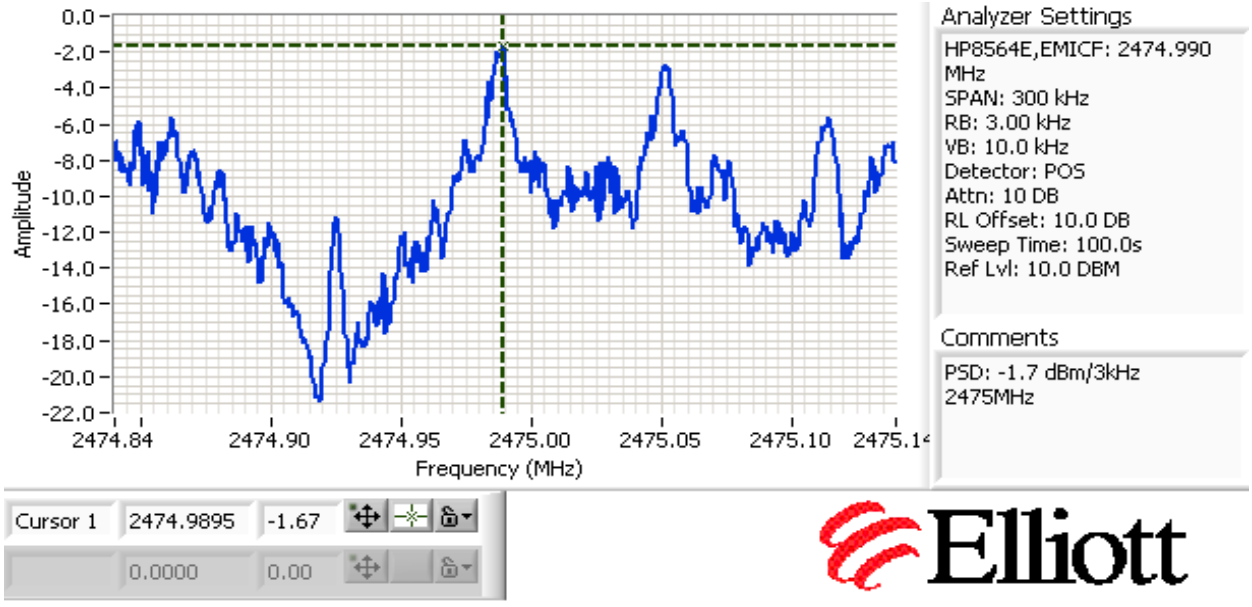


Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Run #2: Power spectral Density

Power Setting	Frequency (MHz)	PSD (dBm/3kHz) Note 1	Limit dBm/3kHz	Result
16	2405	-1.8	8.0	Pass
16	2440	-1.8	8.0	Pass
16	2475	-1.7	8.0	Pass

Note 1:	Power spectral density measured using RB=3 kHz, VB=10kHz, analyzer with peak detector and with a sweep time set to ensure a dwell time of at least 1 second per 3kHz. The measurement is made at the frequency of PPSD determined from preliminary scans using RB=3kHz using multiple sweeps at a faster rate over the 6dB bandwidth of the signal.

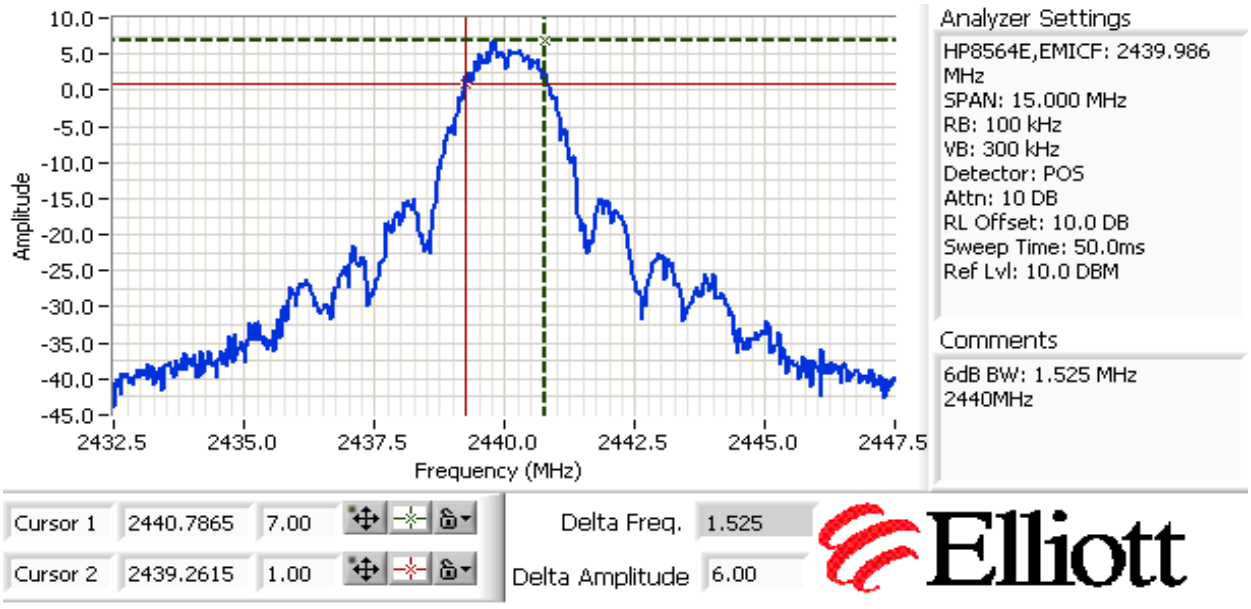


Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Run #3: Signal Bandwidth

Power Setting	Frequency (MHz)	Resolution Bandwidth	Bandwidth (MHz) 6dB	99%
16	2405	100kHz	1.6	3.2
16	2440	100kHz	1.5	3.2
16	2475	100kHz	1.6	3.3

Note 1:	99% bandwidth measured in accordance with RSS GEN, with RB > 1% of the span and VB > 3xRB

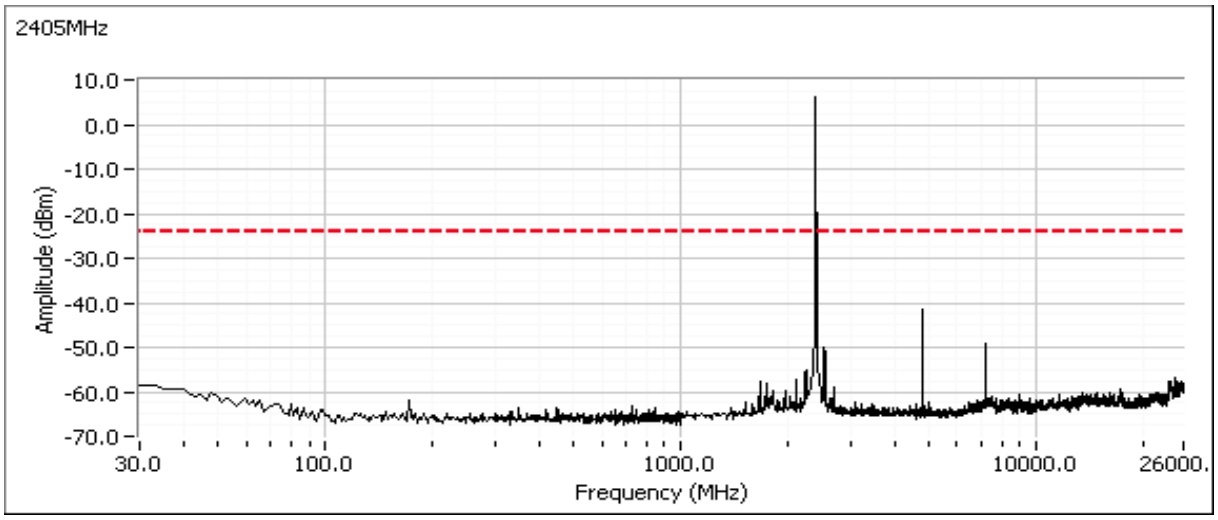


Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

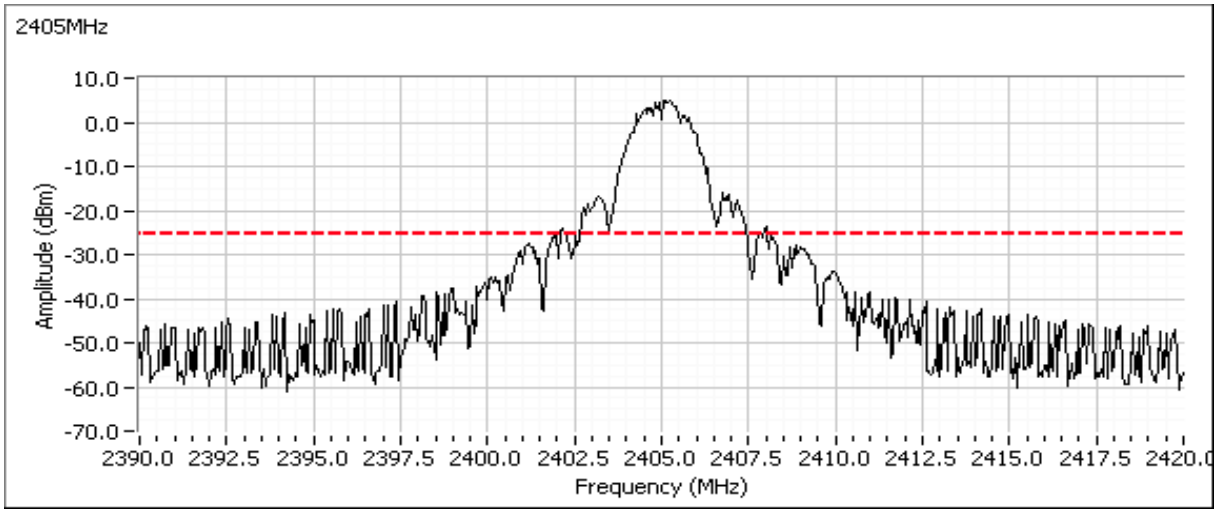
Run #4: Out of Band Spurious Emissions

Frequency (MHz)	Limit	Result
2405	-30dBc	Pass
2440	-30dBc	Pass
2475	-30dBc	Pass

Plots for low channel, power setting(s) = 16

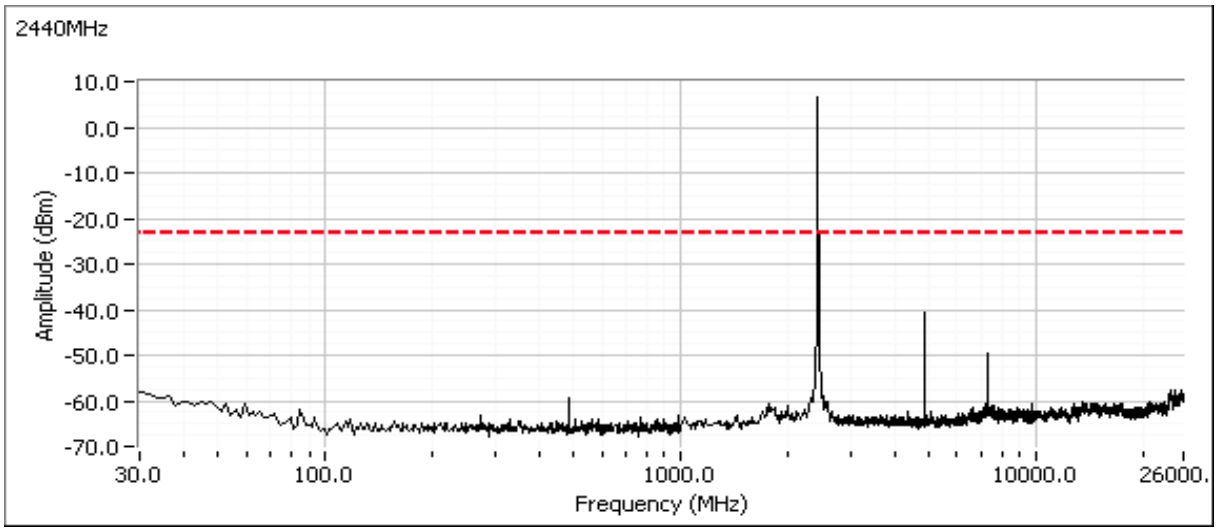


Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.

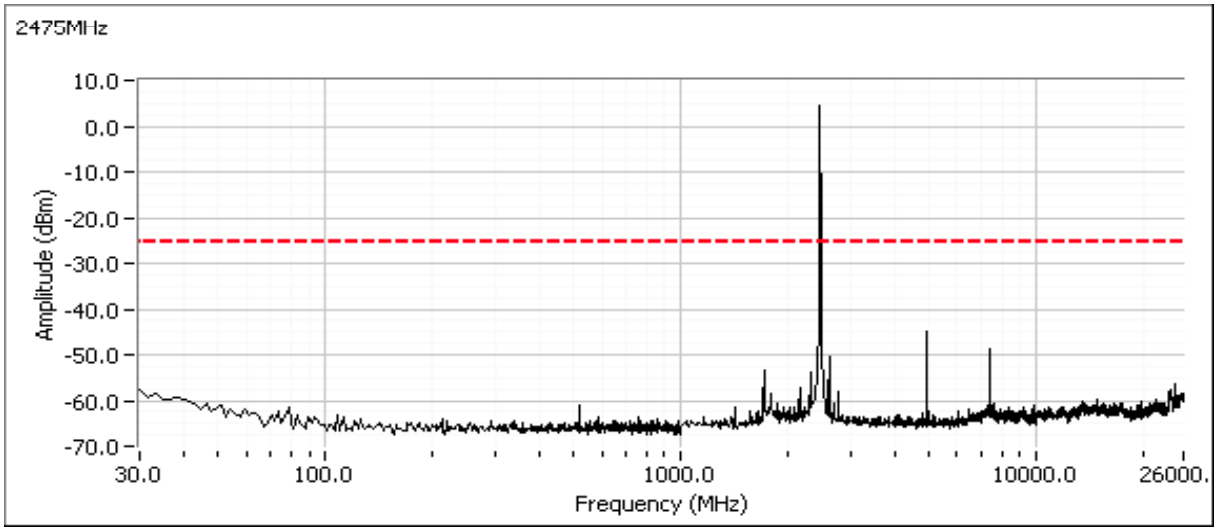


Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Plots for center channel, power setting(s) = 16



Plots for high channel, power setting(s) = 16



Radiated measurements used to show compliance with the limits in the restricted band above 2483.5 MHz.

Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 18-23 °C

Rel. Humidity: 30-40 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Channel	Frequency	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a	11	2405	16		Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	65.6 dBµV/m @ 2388.4 MHz (-8.4 dB)
			16		Radiated Emissions 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	39.9 dBµV/m @ 4810.9 MHz (-14.1 dB)
1b	18	2440	16		Radiated Emissions 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	41.2 dBµV/m @ 7321.2 MHz (-12.8 dB)
1c	25	2475	16		Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	67.7 dBµV/m @ 2494.6 MHz (-6.3 dB)
			16		Radiated Emissions 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	31.0 dBµV/m @ 4870.0 MHz (-23.0 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Notes

The EUT is a modular transmitter and tests were performed in 3 orthogonal orientations on one channel to determine worst case emissions as the final orientation in the host product is not known. This orientation was then used during testing of the other channels. Near field scan of EUT from18-26GHz showed no significant emissions. All emission were more than 20dB below the limit.

Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Run #1: Radiated Spurious Emissions, 1,000 - 25,000 MHz

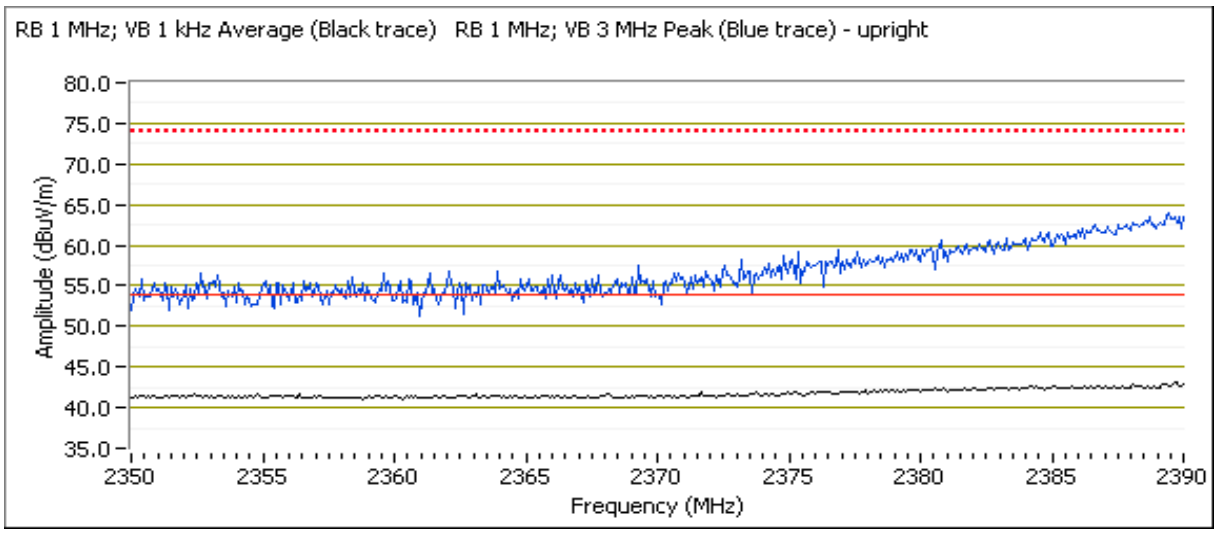
Run #1a: Low Channel @ 2405 MHz (All three orientations)

Date of Test: 7/5/2012 Test Location: FT Chamber #7

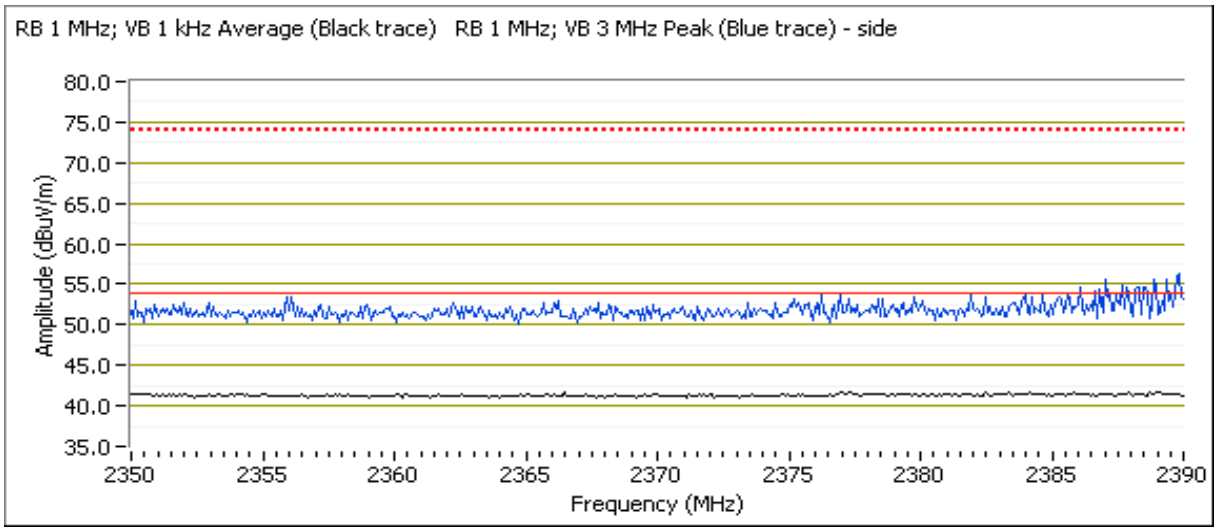
Test Engineer: M. Birgani

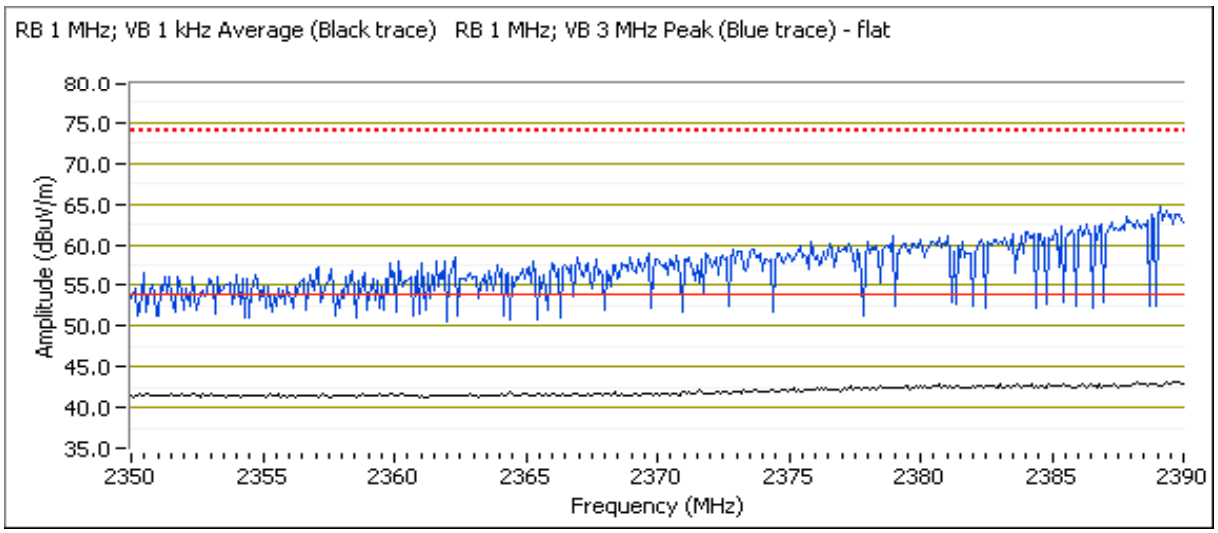
Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2388.400	65.6	V	74.0	-8.4	PK	264	1.0	Side
2389.520	65.4	H	74.0	-8.6	PK	166	1.1	Upright
2389.520	65.0	V	74.0	-9.0	PK	25	1.0	Upright
2389.440	63.7	H	74.0	-10.3	PK	164	1.1	Flat
2389.760	42.2	V	54.0	-11.8	AVG	264	1.0	Side
2389.840	41.4	H	54.0	-12.6	AVG	164	1.1	Flat
2389.200	40.9	V	54.0	-13.1	AVG	31	1.7	Flat
2385.670	40.8	V	54.0	-13.2	AVG	25	1.0	Upright
2385.670	40.1	H	54.0	-13.9	AVG	0	3.2	Side
2385.670	38.2	H	54.0	-15.8	AVG	166	1.1	Upright
2367.880	56.2	H	74.0	-17.8	PK	0	3.2	Side
2389.440	55.8	V	74.0	-18.2	PK	31	1.7	Flat



Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A



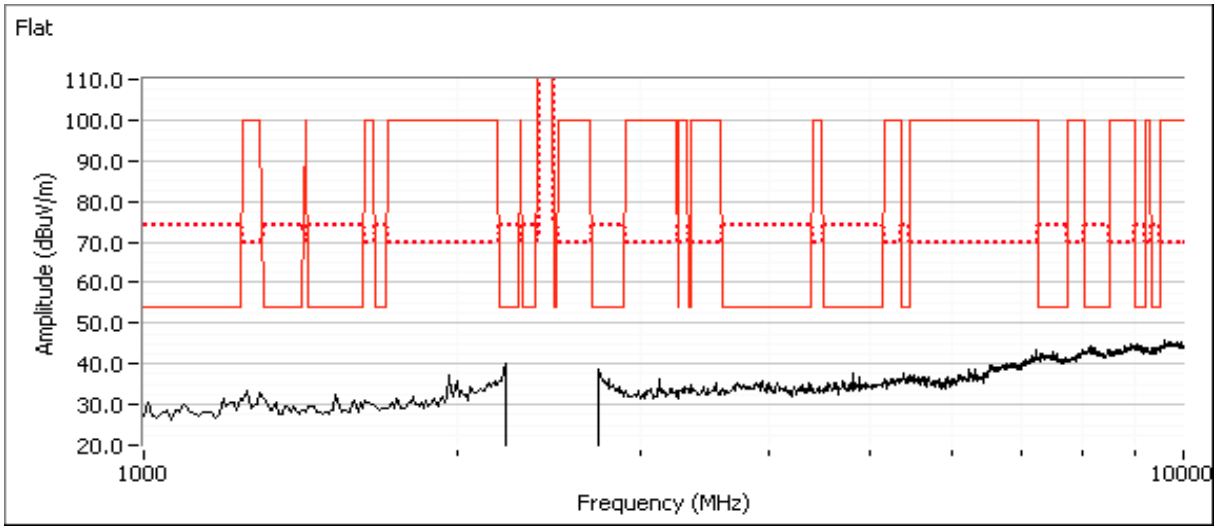


Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

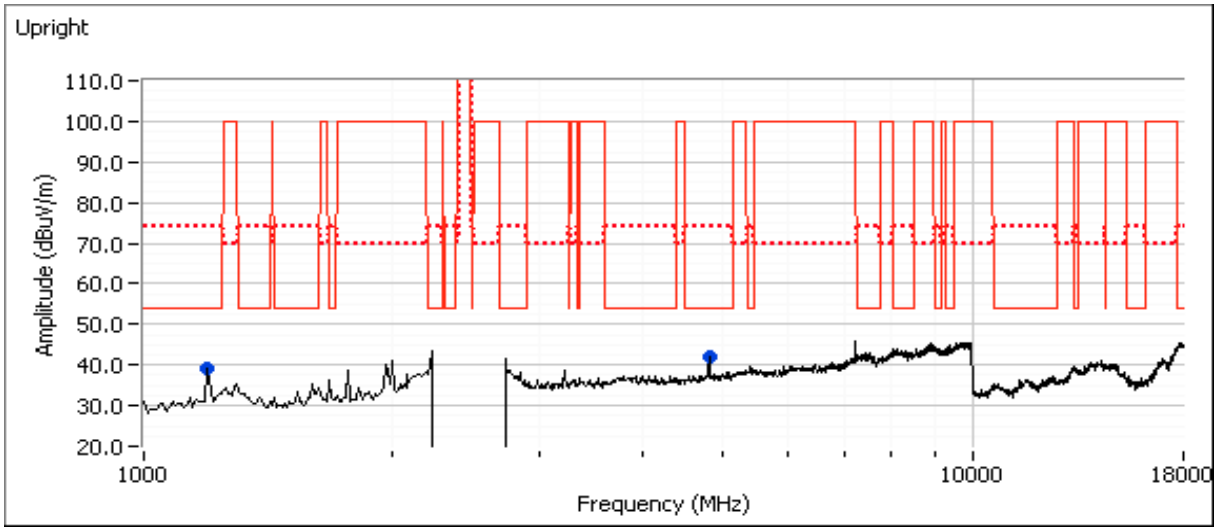
Other Spurious Emissions (All three orientations)

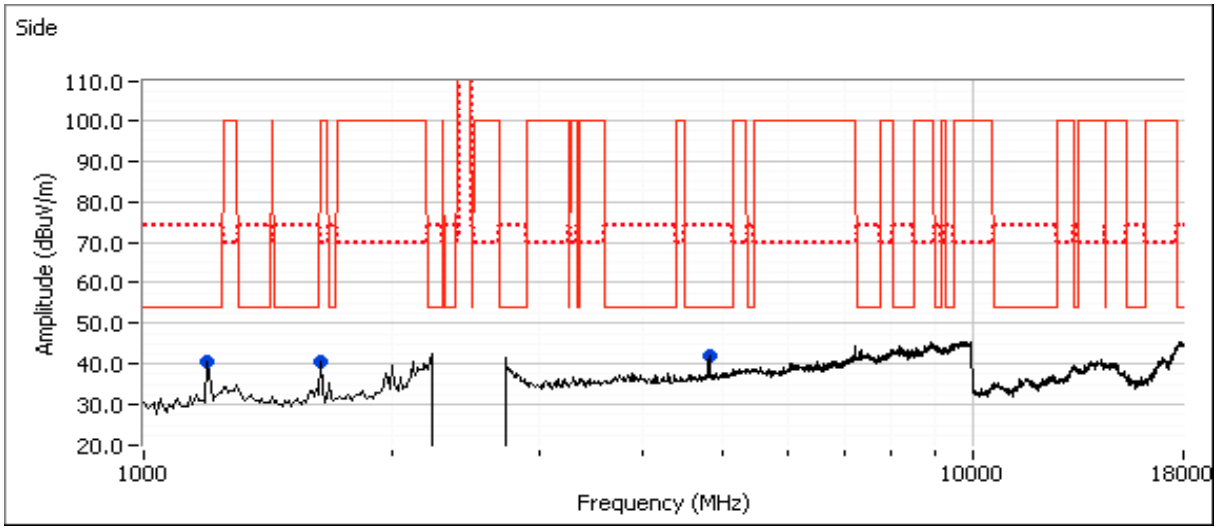
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4810.880	39.9	V	54.0	-14.1	AVG	324	1.4	Upright
4810.900	36.9	V	54.0	-17.1	AVG	151	1.2	Side
1620.990	34.1	V	54.0	-19.9	AVG	193	1.2	Side
1195.700	29.0	V	54.0	-25.0	AVG	74	1.4	Upright
1196.200	28.9	V	54.0	-25.1	AVG	244	2.1	Side
4810.680	48.8	V	74.0	-25.2	PK	324	1.4	Upright
1196.350	47.5	V	74.0	-26.5	PK	244	2.1	Side
4808.750	46.6	V	74.0	-27.4	PK	151	1.2	Side
1194.950	43.0	V	74.0	-31.0	PK	74	1.4	Upright
1620.870	39.4	V	74.0	-34.6	PK	193	1.2	Side

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.



Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A





Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

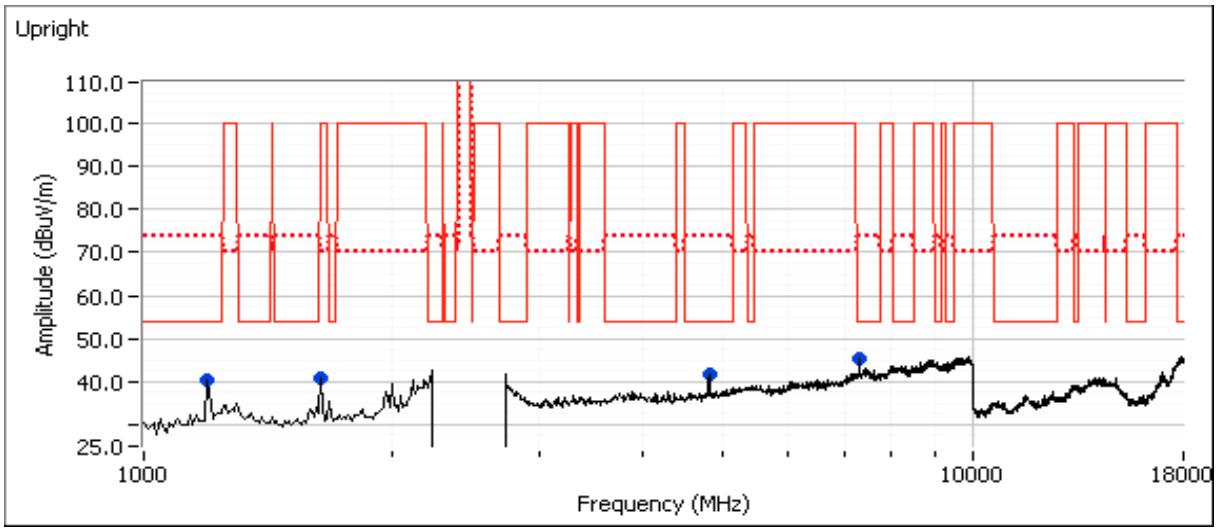
Run #1b: Center Channel @ 2440 MHz

Date of Test: 7/5/2012 Test Location: FT Chamber #7

Test Engineer: M. Birgani

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7321.230	41.2	V	54.0	-12.8	AVG	14	1.8	Upright
4876.120	36.9	V	54.0	-17.1	AVG	38	1.1	Upright
7321.450	51.0	V	74.0	-23.0	PK	14	1.8	Upright
1195.700	29.2	V	54.0	-24.8	AVG	70	1.3	Upright
4880.670	45.5	V	74.0	-28.5	PK	38	1.1	Upright
1194.950	43.5	V	74.0	-30.5	PK	70	1.3	Upright

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.



Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Run #1c: High Channel @ 2475 MHz

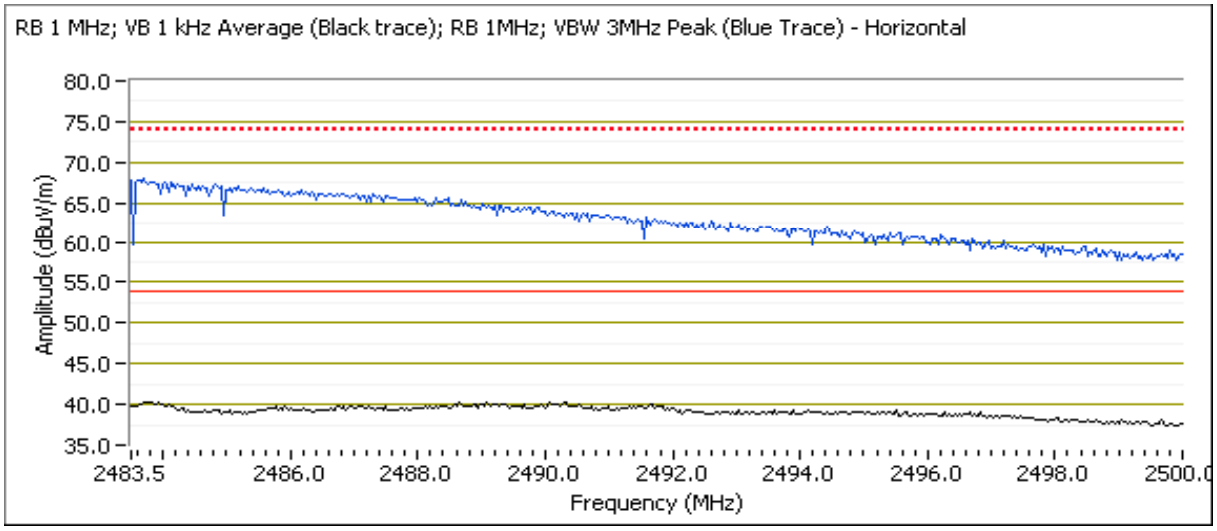
Date of Test: 7/6/2012 Test Location: FT Chamber #7

Test Engineer: Mark Hill

Power = 16. EUT upright

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2489.120	37.9	H	54.0	-16.1	AVG	166	1.1	POS; RB 1 MHz; VB: 1 kHz
2484.590	67.7	H	74.0	-6.3	PK	166	1.1	POS; RB 1 MHz; VB: 3 MHz
2493.420	36.3	V	54.0	-17.7	AVG	143	1.0	POS; RB 1 MHz; VB: 1 kHz
2484.720	64.6	V	74.0	-9.4	PK	143	1.0	POS; RB 1 MHz; VB: 3 MHz

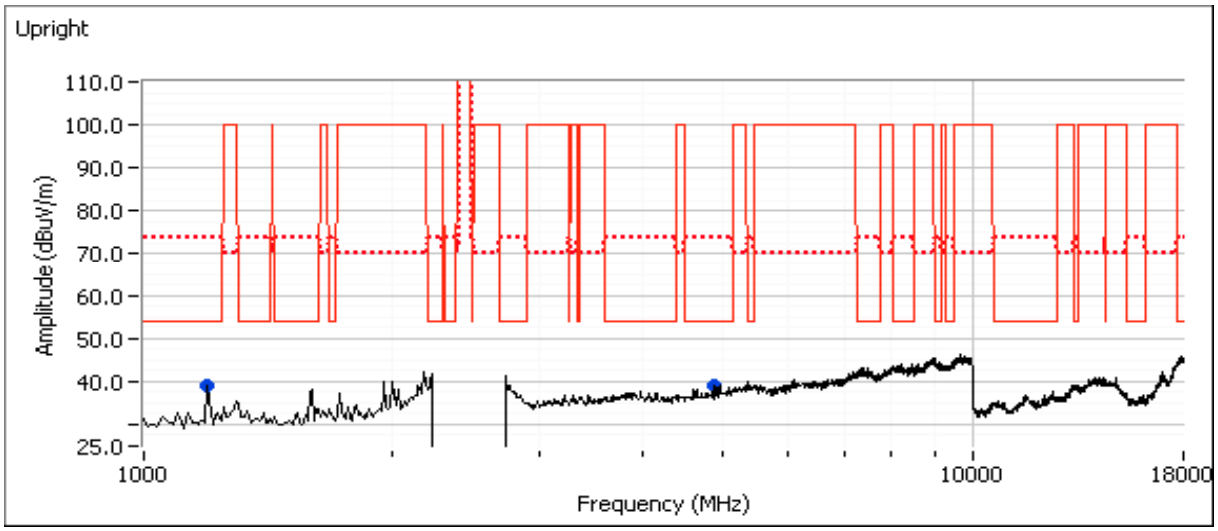


Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4869.960	31.0	V	54.0	-23.0	AVG	11	1.0	Upright
1195.700	29.0	V	54.0	-25.0	AVG	74	1.4	Upright
4865.850	43.1	V	74.0	-30.9	PK	11	1.0	Upright
1194.950	43.0	V	74.0	-31.0	PK	74	1.4	Upright

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.



Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 18-23 °C

Rel. Humidity: 30-40 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Channel	Frequency	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a	11	2405	16		Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	70.3 dBµV/m @ 2382.9 MHz (-3.7 dB)
			16		Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	49.8 dBµV/m @ 7213.3 MHz (-4.2 dB)
1b	18	2440	16		Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	52.3 dBµV/m @ 7321.2 MHz (-1.7 dB)
1c	25	2475	10		Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	70.4 dBµV/m @ 2484.5 MHz (-3.6 dB)
			16		Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	53.0 dBµV/m @ 4950.9 MHz (-1.0 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Notes

The EUT is a modular transmitter and tests were performed in 3 orthogonal orientations on one channel to determine worst case emissions as the final orientation in the host product is not known. This orientation was then used during testing of the other channels. As the antenna was configured in a vertical polarization, the bandedge measurements were performed in this orientation only.

Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Run #1: Radiated Spurious Emissions, 1,000 - 25,000 MHz

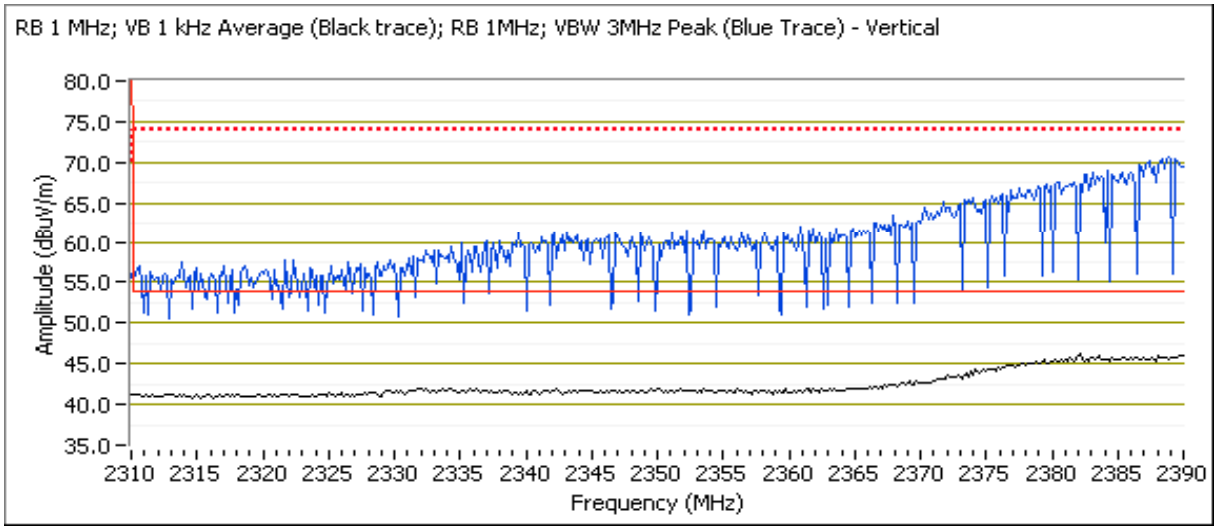
Run #1a: Low Channel @ 2405 MHz

Date of Test: 7/6/2012 Test Location: FT #7

Test Engineer: Mark Hill

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2389.680	44.4	V	54.0	-9.6	AVG	296	1.4	POS; RB 1 MHz; VB: 1 kHz
2389.680	43.8	V	54.0	-10.2	AVG	296	1.4	POS; RB 1 MHz; VB: 10 Hz
2382.950	70.3	V	74.0	-3.7	PK	296	1.4	POS; RB 1 MHz; VB: 3 MHz

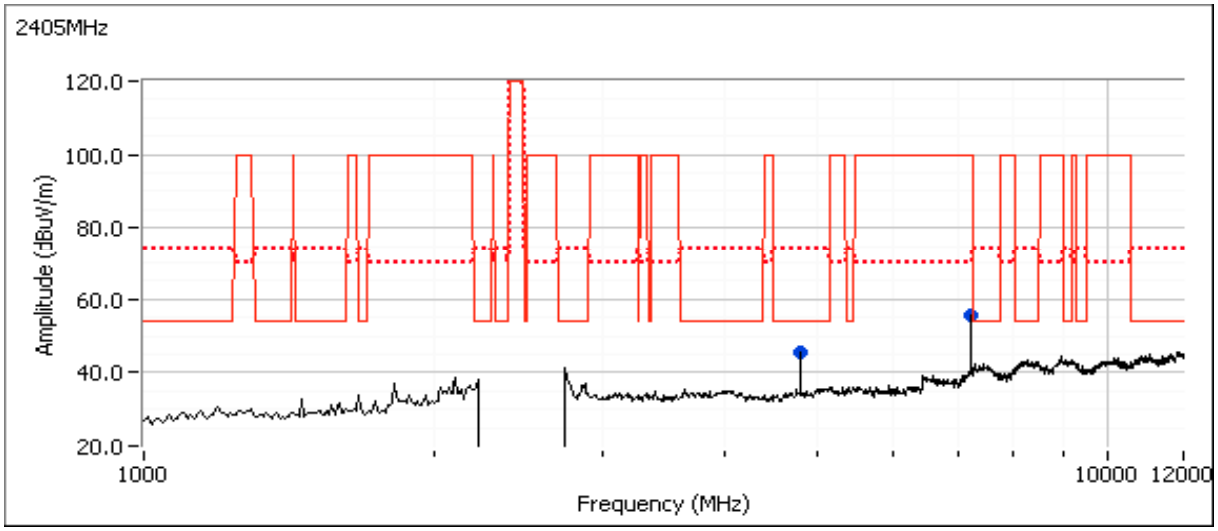


Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7213.330	49.8	V	54.0	-4.2	AVG	246	1.1	Note 1
7213.200	59.5	V	74.0	-14.5	PK	246	1.1	Note 1
4810.890	40.1	V	54.0	-13.9	AVG	57	1.0	RB 1 MHz;VB 10 Hz;Peak
4808.990	48.0	V	74.0	-26.0	PK	57	1.0	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.



Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

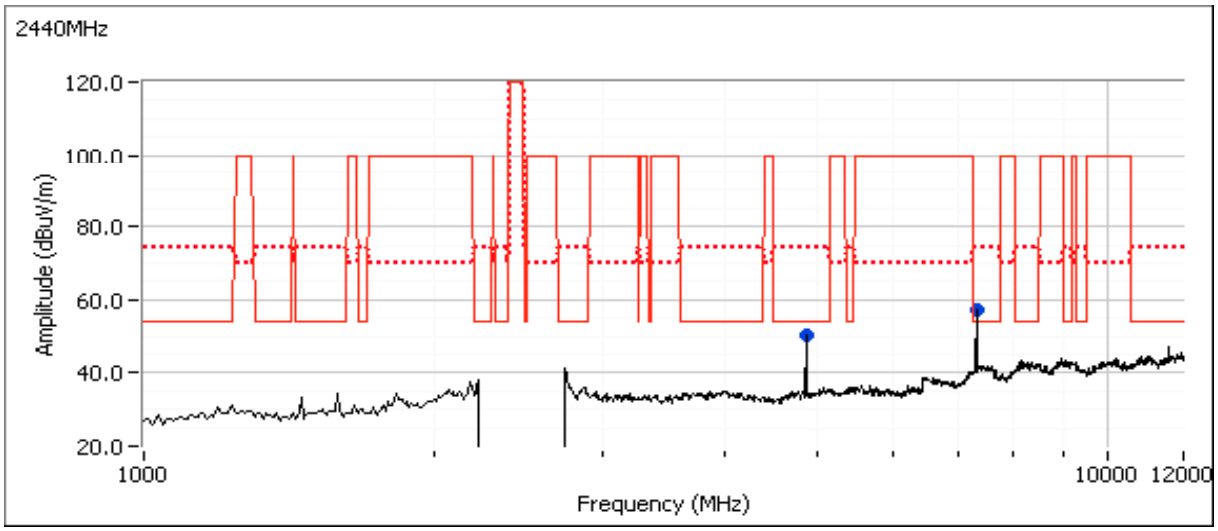
Run #1b: Center Channel @ 2440 MHz

Date of Test: 7/6/2012 Test Location: FT #7

Test Engineer: Rafael Varelas

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7321.240	52.3	V	54.0	-1.7	AVG	71	1.2	RB 1 MHz;VB 10 Hz;Peak
7321.270	60.7	V	74.0	-13.3	PK	71	1.2	RB 1 MHz;VB 3 MHz;Peak
4880.870	44.7	V	54.0	-9.3	AVG	99	1.9	RB 1 MHz;VB 10 Hz;Peak
4880.840	52.2	V	74.0	-21.8	PK	99	1.9	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.

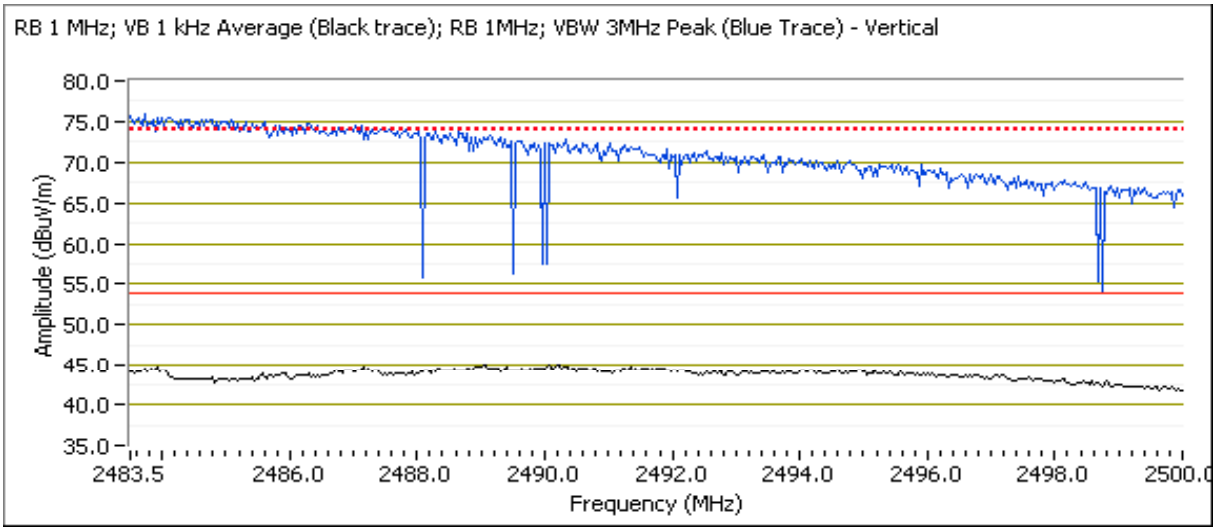


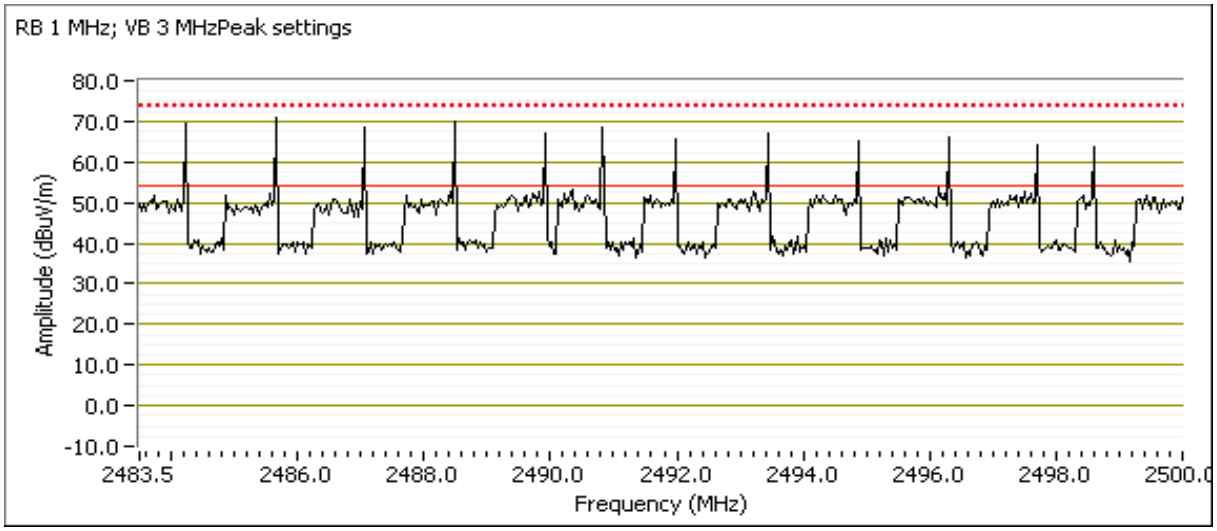
Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Run #1c: High Channel @ 2475 MHz
Power = 10. EUT upright

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2491.630	41.7	V	54.0	-12.3	AVG	294	1.3	POS; RB 1 MHz; VB: 1 kHz
2484.490	70.4	V	74.0	-3.6	PK	294	1.3	POS; RB 1 MHz; VB: 3 MHz



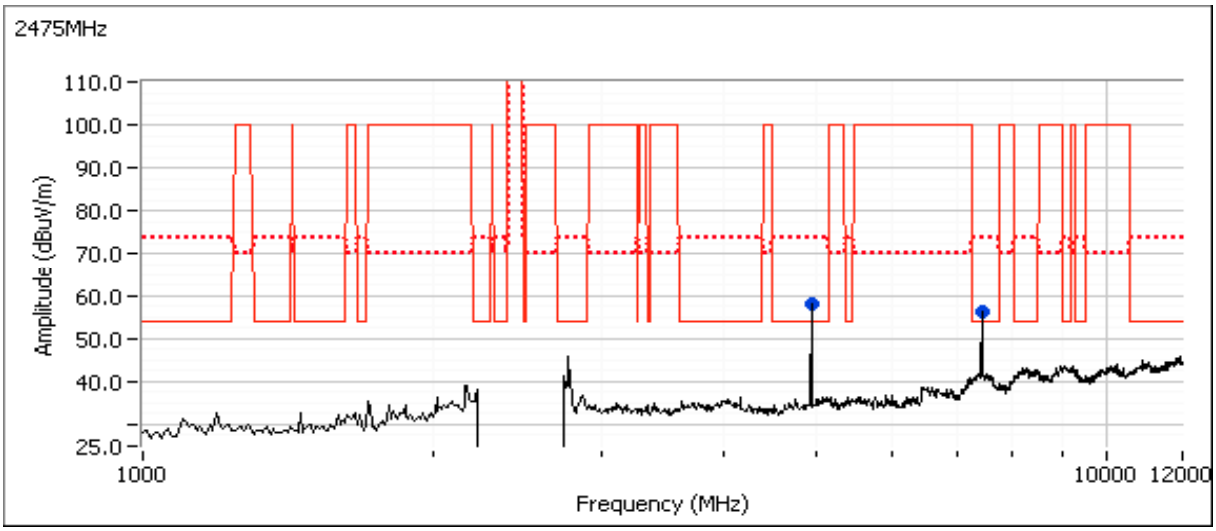


Client:	MicroStrain, Inc.	Job Number:	J87865
Model:	Link Transceiver Module	T-Log Number:	T88104
		Account Manager:	Christine Krebill
Contact:	Matt Bissonnette		
Standard:	FCC 15.247, RSS-210	Class:	N/A

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4950.900	53.0	V	54.0	-1.0	AVG	166	1.1	RB 1 MHz;VB 10 Hz;Peak
4948.800	60.5	V	74.0	-13.5	PK	166	1.1	RB 1 MHz;VB 3 MHz;Peak
7426.270	52.9	V	54.0	-1.1	AVG	276	1.9	RB 1 MHz;VB 10 Hz;Peak
7423.340	61.5	V	74.0	-12.5	PK	276	1.9	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.



End of Report

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