41039 Boyce Road
Fremont, CA. 94538

510-578-3500 Phone
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Radio Test Report

FCC Part 90 and RSS-119
(406.1 MHz to 430 MHz and 450 MHz to 470 MHz)

Model: R2L UHF
Marketing name: R2Lite UHF Radio Modem

IC CERTIFICATION #:	6050B-1003627
FCC ID:	WR4-1003627
COMPANY:	Topcon Positioning Systems 7400 National Dr. Livermore, CA 94550
TEST SITE(S):	National Technical Systems 41039 Boyce Road. Fremont, CA. 94538-2435
PROJECT NUMBER:	PR079758
REPORT DATE:	August 1, 2018
REISSUE DATE:	August 27, 2018
FINAL TEST DATES:	May 9, 11, 16 and 17, 2018
TOTAL NUMBER OF PAGES:	56

A2LA ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

PROGRAM MGR

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Senior Wireless / EMC Engineer

TECHNICAL REVIEWER:

Deniz Demirci
Senior Wireless / EMC Engineer

FINAL REPORT PREPARER:

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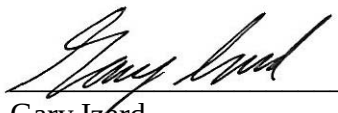
QUALITY ASSURANCE DELEGATE



Gary Izard
Technical Writer

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	August 1, 2018	First release	
1	August 1, 2018	Added statement concerning correlation of results below 30 MHz	David Guidotti
2	August 27, 2018	Test results table revised.	Deniz Demirci

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SCOPE

Tests have been performed on the Topcon Positioning Systems model R2L UHF, pursuant to the relevant requirements of the following standard(s) in order to obtain device certification against the regulatory requirements of the Federal Communications Commission and Innovation Science and Economic Development Canada.

- Code of Federal Regulations (CFR) Title 47 Part 2
- RSS-Gen Issue 5, April 2018
- CFR 47 Part 90 (Private Land Mobile Radio Service)
- RSS-119, Issue 12, May 2015 (Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41-960 MHz)

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 National Technical Systems test procedures:

ANSI C63.26: 2015
ANSI TIA-603-E: 2016
FCC KDB 971168 Licensed Digital Transmitters

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

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.

National Technical Systems is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise.

The test results recorded herein are based on a single type test of the Topcon Positioning Systems model R2L UHF and therefore apply only to the tested sample. The sample was selected and prepared by Ferdinand Riodique of Topcon Positioning Systems.

OBJECTIVE

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

Prior to marketing in the USA, the device requires certification. Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification.

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.).

Testing was performed only on model R2L UHF.

STATEMENT OF COMPLIANCE

The tested sample of Topcon Positioning Systems model R2L UHF complied with the requirements of the standards and frequency bands declared in the scope of this test report.

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.

DEVIATIONS FROM THE STANDARDS

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

TEST RESULTS

FCC Part 90 and RSS-119

FCC	Canada	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§2.1033 (c) (5)	RSS-119	Frequency range(s)	406.1 - 430 MHz 450 - 470MHz	406.1 - 430 MHz 450 - 470MHz	Pass
§2.1033 (c) (6) §2.1033 (c) (7) § 2.1046 § 90.205	RSS-119	RF power output at the antenna terminals	30.2 dBm	(Mobile – 60 W) 47.8 dBm	Pass
§2.1033 (c) (4) § 2.1047 § 90.210	RSS-119	Emission types	F1D, G1D		
		Emission mask	Mask D and Mask C	Emission within Mask D Emission within Mask C	Pass
§ 2.1049 § 90.209	RSS-GEN 6.7 RSS-119	Occupied Bandwidth	12.5 kHz BW; 5.72 kHz 25.0 kHz BW; 11.50 kHz	12.5 kHz BW; 11.25 kHz 25.0 kHz BW; 20.00 kHz	Pass
§ 90.214	RSS-119	Transient Frequency Behaviour	Within Limits	FCC Part 90 and Table 17 of RSS-119	Pass
Transmitter spurious emissions					
§ 2.1051 § 2.1057	RSS-119	At the antenna terminals	-36.7 dBm @ 939.84 MHz (-16.7 dB)	-20 dBm (Mask D as worst case)	Pass
§ 2.1053 § 2.1057	RSS-119	Field strength	-34.4 dBm @ 1879.99 MHz (-14.4 dB)	-20 dBm (Mask D as worst case)	Pass
Other details					
§ 2.1055 § 90.213	RSS-119	Frequency stability	0.7 ppm	1 ppm	Pass
§ 2.1093	RSS-102	RF Exposure	See separate exhibit		
§2.1033 (c) (8)	Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range		See operational description exhibit		
-	Antenna Gain		2.5 dBi		

EXTREME CONDITIONS

Frequency stability is determined over extremes of temperature and voltage.

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 (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF frequency	Hz	25 to 7,000 MHz	1.7×10^{-7}
RF power, conducted	dBm	25 to 7,000 MHz	± 0.52 dB
Conducted emission of transmitter	dBm	25 to 40,000 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 40,000 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 40,000 MHz	± 2.5 dB
Radiated emission (field strength)	dBµV/m	9 kHz to 1 GHz 1 to 40 GHz	± 3.6 dB ± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Topcon Positioning Systems model R2L UHF is a 400 MHZ band (406.1 to 470 MHz) radio transceiver module for land surveying. The EUT is battery operated. The EUT is rated at 3.57 to 4.83 Vdc, 5.6 W max

The sample was received on May 9, 2018 and tested on May 9, 11, 16 and 17, 2018. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Topcon	R2Lite-UHF	400 MHz Radio Module	F11017440155	FCC ID: WR4-1003627 IC: 6050B-1003627

OTHER EUT DETAILS

The EUT is a licensed radio module. Antenna gain and height will be determined with a host unit during licensing. Declared maximum antenna gain is 2.5 dBi.

ENCLOSURE

The EUT is a radio module. The module enclosure is primarily constructed of stainless steel. It measures approximately 80 mm wide by 45 mm deep by 10 mm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at National Technical Systems.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Topcon	-	Test bed	-	-
HP	6024A	AC/DC power supply	Asset# 3004	-

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

Company	Model	Description	Serial Number	FCC ID
Dell	Inspiron 2200	Laptop	Asset # 1754	-

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Serial over USB	Laptop	USB	Shielded	1.2
DC power	AC/DC power supply	DC power cable	Unshielded.	1.0

EUT OPERATION

During emissions testing the UHF radio was configured to transmit at rated power with frequencies and modulations indicated in each run.

TESTING

GENERAL INFORMATION

Antenna port measurements were taken at the National Technical Systems test site located at 41039 Boyce Road, Fremont, CA 94538-2435.

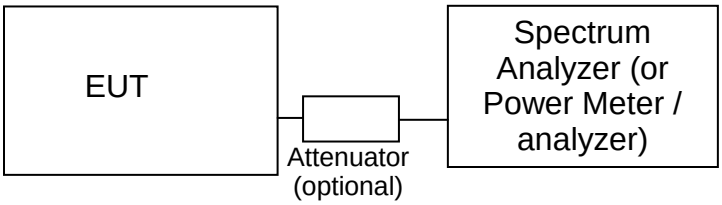
Radiated spurious emissions measurements were taken at the National Technical Systems Anechoic Chambers and/or Open Area Test Site(s) listed below. The sites conform to the requirements of ANSI C63.4 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4:2007 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are on file with the FCC and Innovation Science and Economic Development Canada.

Site	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 5	US0027	IC 2845B-5	41039 Boyce Road Fremont, CA 94538-2435
Chamber 7	US0027	IC 2845B-7	

ANSI C63.4 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. Results from testing performed in this chamber have been correlated with results from an open area test site. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4.

RF PORT MEASUREMENT PROCEDURES

Conducted measurements are performed with the EUT's rf input/output connected to the input of a spectrum analyzer, power meter or modulation analyzer. When required an attenuator, filter and/or DC block is placed between the EUT and the spectrum analyzer to avoid overloading the front end of the measurement device. Measurements are corrected for the insertion loss of the attenuators and cables inserted between the rf port of the EUT and the measurement equipment.



Test Configuration for Antenna Port Measurements

For devices with an integral antenna the output power and spurious emissions are measured as a field strength at a test distance of (typically) 3m and then converted to an eirp using a substitution measurement (refer to RADIATED EMISSIONS MEASUREMENTS). All other measurements are made as detailed below but with the test equipment connected to a measurement antenna directed at the EUT.

OUTPUT POWER

Output power is measured using a power meter and an average sensor head, a spectrum analyzer or a power meter and peak power sensor head as required by the relevant rule part(s). Where necessary measurements are gated to ensure power is only measured over periods that the device is transmitting.

Power measurements made directly on the rf power port are, when appropriate, converted to an EIRP by adding the gain of the highest gain antenna that can be used with the device under test, as specified by the manufacturer.

BANDWIDTH MEASUREMENTS

The 99% bandwidth is measured using the methods detailed in RSS-GEN. The measurement bandwidth is set to be at least 1% of the instrument's frequency span.

CONDUCTED SPURIOUS EMISSIONS

Initial scans are made using a peak detector (RBW $\geq$ 3xVBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode measurements). For transmitter measurements the appropriate detector (average, peak, normal ,sample, quasi-peak) is used when making measurements for licensed devices.

TRANSMITTER MASK MEASUREMENTS

The transmitter mask measurements are made using resolution bandwidths as specified in the pertinent rule part(s). Where narrower bandwidths are used the measurement is corrected to account for the reduced bandwidth by either using the adjacent channel power function of the spectrum analyzer to sum the power across the required measurement bandwidth. The frequency span of the analyzer is set to ensure the fundamental signal and all significant sidebands are displayed.

The top of the mask may be set by the total output power of the signal, the power of the unmodulated signal or the peak value of the signal in the reference bandwidth being used for the mask measurement.

FREQUENCY STABILITY

The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The temperature is varied across the specified frequency range in 10 degree increments with frequency measurements made at each temperature step. The EUT is allowed enough time to stabilize at each temperature variation.

The spectrum analyzer is configured to give a 5- or 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature. Where possible the device is set to transmit an unmodulated signal. Where this is not possible the frequency drift is determined by finding a stable point on the signal (e.g. the null at the centre of an OFDM signal) or by calculating a centre frequency based on the upper and lower XdB points (where X is typically 6dB or 10dB) on the signal’s skirts.

TRANSIENT FREQUENCY BEHAVIOR:

The TIA/EIA 603 procedure is used to determine compliance with transient frequency timing requirements as the radio is keyed on and off.

The EUTs rf output is connected via a combiner/splitter to the test receiver/spectrum analyzer and to a diode detector. The test receiver or spectrum analyzer video output is connected to an oscilloscope, which is triggered by the output from the diode detector.

Plots showing Ton, T1, and T2 are made when turning on the transmitter and showing T3 when turning off the transmitter.

RADIATED EMISSIONS MEASUREMENTS

Transmitter radiated spurious emissions are initially measured as a field strength. The eirp or erp limit as specified in the relevant rule part(s) is converted to a field strength at the test distance and the emissions from the EUT are then compared to that limit. Emissions within 20dB of this limit are the subjected to a substitution measurement.

All radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in either an anechoic chamber or on an OATS during which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed across the complete frequency range of interest and at each operating frequency identified in the reference standard. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode).

During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit. For transmitter spurious emissions, where the limit is expressed as an effective radiated power, the eirp or erp is converted to a field strength limit.

Final measurements are made in a semi-anechoic chamber at the significant frequencies observed during the preliminary scan(s) using the same process of rotating the EUT and raising/lowering the measurement antenna to find the highest level of the emission.

For transmitter spurious emissions, the radiated power of all emissions within 10 dB of the calculated field strength limit are determined using a substitution measurement. The substitution measurement is made by replacing the EUT with an antenna of known gain (typically a dipole antenna or a double-ridged horn antenna), connected to a signal source. The output power of the signal generator is adjusted until the maximum field strength from the substitution antenna is similar to the field strength recorded from the EUT. The erp of the EUT is then calculated.

INSTRUMENTATION

An EMI receiver as specified in CISPR 16-1-1 is used for radiated emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7000 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.

For measurements above the frequency range of the receivers and for all conducted measurements a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis.

Measurement bandwidths for the test instruments are set in accordance with the requirements of the standards referenced in this document.

Software control is used to correct the measurements for transducer factors (e.g. antenna) and the insertion loss of cables, attenuators and other series elements to obtain the final measurement value. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are exported in a graphic and/or tabular format, as appropriate.

FILTERS/ATTENUATORS

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

ANTENNAS

A combination of biconical, log periodic or bi-log antennas are used to cover the range from 30 MHz to 1000 MHz. Broadband antennas or tuned dipole antennas are used over the entire 25 to 1000 MHz frequency range as the reference antenna for substitution measurements.

Above 1000 MHz, a dual-ridge guide horn antenna or octave horn antenna are used as reference and measurement antennas.

The antenna calibration factors are included in site factors that are programmed into the test receivers and instrument control software when measuring the radiated field strength.

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.

Table mounted devices are placed on a non-conductive table at a height of 80 centimeters above the floor. The EUT is positioned on a motorized turntable to allow it to be rotated during testing to determine the angel with the highest level of emissions.

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS - CONDUCTED SPURIOUS EMISSIONS

Measurements are compared directly to the conducted emissions specification limit (decibel form). The calculation is as follows:

$$R_r - S = M$$

where:

R_r = Measured value in dBm
S = Specification Limit in dBm
M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH

Measurements of radiated field strength are compared directly to the specification limit (decibel form). The receiver and/or control software 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 is sued when measurements are made at a test distance that is different to the specified limit distance 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 30 MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

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

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 dBµV/m
F_d = Distance Factor in dB
R_c = Corrected Reading in dBµV/m
L_s = Specification Limit in dBµV/m
M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS –RADIATED POWER

The erp/eirp limits for transmitter spurious measurements are converted to a field strength in free space using the following formula:

$$E = \frac{\sqrt{30\ P\ G}}{d}$$

where:

E = Field Strength in V/m
P = Power in Watts
G = Gain of isotropic antenna (numeric gain) = 1
D = measurement distance in meters

The field strength limit is then converted to decibel form (dBuV/m) and the margin of a given emission peak relative to the limit is calculated (refer to *SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH*).

When substitution measurements are required (all signals with less than 20dB of margin relative to the calculated field strength limit) the eirp of the spurious emission is calculated using:

$$P_{EUT} = P_S - (E_S - E_{EUT})$$

and

$$P_S = G + P_{in}$$

where:

P_S = effective isotropic radiated power of the substitution antenna (dBm)
P_{in} = power input to the substitution antenna (dBm)
G = gain of the substitution antenna (dBi)
E_S = field strength the substitution antenna (dBm) at eirp P_S
E_{EUT} = field strength measured from the EUT

Where necessary the effective isotropic radiated power is converted to effective radiated power by subtracting the gain of a dipole (2.2 dBi) from the eirp value.

Appendix A Test Equipment Calibration Data

Manufacturer	Description	Model	Asset#	Calibrated	Cal Due
Antenna port measurements, 9-May-18					
Rohde & Schwarz	Power Meter, Single Channel, +1795+1796	NRVS	1422	2/6/2018	2/6/2019
Rohde & Schwarz	Peak Power Sensor 1 uW - 20 mW	NRV-Z31	3428	2/9/2018	2/9/2019
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2139	7/31/2017	7/31/2018
Fluke	Mulitmeter, True RMS	111	1557	3/27/2018	3/27/2019
Antenna port measurements, 11-May-18					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
National Technical Systems	NTS Mask Software (rev 3.8)	N/A	0		N/A
National Technical Systems	NTS Capture Analyzer Software (rev 3.8)	N/A	0		N/A
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	2/6/2018	2/6/2019
Agilent Technologies	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	7/31/2017	7/31/2018
Keysight Technologies	ESG Vector Signal Generator	E4438C	3254	1/22/2016	N/A
Rohde & Schwarz	Peak Power Sensor 1uW - 20mW	NRV-Z31	3428	2/9/2018	2/9/2019
Radiated Emissions, 30 - 5,000 MHz, 16-May-18					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
Filtek	Filter, 1 GHz High Pass	HP12/1000-5BA	957	4/2/2018	4/2/2019
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	9/29/2016	9/29/2018
Hewlett Packard	Spectrum Analyzer (SA40) Red 30 Hz - 40 GHz	8564E (84125C)	1148	10/14/2017	10/14/2018
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1657	7/27/2016	7/27/2018
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESI 40	2493	3/22/2018	3/22/2019
Substitution measurements, 16-May-18					
EMCO	Antenna, Horn, 1-18 GHz	3115	1242	4/11/2017	4/19/2019
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	2/6/2018	2/6/2019
Rohde & Schwarz	Power Sensor, 1 nW-20 mW, 10 MHz-18 GHz, 50ohms	NRV-Z1	2114	11/5/2017	11/5/2018
Agilent Technologies	MXG Analog Signal Generator 6 GHz	N5181A	2146	3/7/2018	3/7/2019
Radio Antenna Port (Power and Spurious Emissions), 17-May-18					
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/22/2017	5/22/2018

Appendix B Test Data

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Client:	Topcon Positioning Systems	PR Number:	PR079758
Product	R2L UHF	T-Log Number:	TL079758-Radio
System Configuration:		Project Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Emissions Standard(s):	FCC Part 90, RSS-119 Issue 12	Class:	B
Immunity Standard(s):		Environment:	

EMC Test Data

For The

Topcon Positioning Systems

Product

R2L UHF

Date of Last Test: 7/30/2018

Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

FCC Part 90 and RSS 119 Issue 12

Power, Occupied Bandwidth, Frequency Stability 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. Frequency range of operation is 406.1 - 430 MHz and 450 - 470 MHz

General Test Configuration

With the exception of the radiated spurious emissions tests, all measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator or dc-block if necessary. All amplitude measurements are adjusted to account for the a

Radiated measurements are made with the EUT located on a non-conductive table, 3 m from the measurement antenna.

Ambient Conditions:

Temperature: 20-21 °C

Rel. Humidity: 30-35 %

Summary of Results

Run #	Spacing	Data Rate	Test Performed	Limit	Pass / Fail	Result / Margin
1	-	-	Output Power	(30 W) Within 1 dB of mnfc rated pwr	Pass	30.2 dBm
2	-	-	Spectral Mask	12.5 kHz BW; Mask D 25.0 kHz BW; Mask C	Pass	Within mask
3	-	-	Channel spacing, Occupied Bandwidth, Authorized bandwidth	12.5 kHz BW; 11.25 kHz 25.0 kHz BW; 20.00 kHz	Pass	12.5 kHz BW; 5.72 kHz 25.0 kHz BW; 11.50 kHz
4	-	-	Tx Unwanted Emissions (conducted)	-20 dBm, (D) -13 dBm, (C)	Pass	-36.7 dBm @ 939.84 MHz (-16.7 dB)
5	-	-	Tx Unwanted Emissions (radiated)	-20 dBm, (D) -13 dBm, (C)	Pass	-34.4 dBm @ 1879.99 MHz (-14.4 dB)
6	-	-	Transient Frequency Behaviour	FCC Part 90 and Table 17 of RSS-119	Pass	Within limits
7	-	-	Frequency Stability	Ch spacing:12.5, 1.5 ppm	Pass	0.7 ppm @ -30°C

Modifications Made During Testing

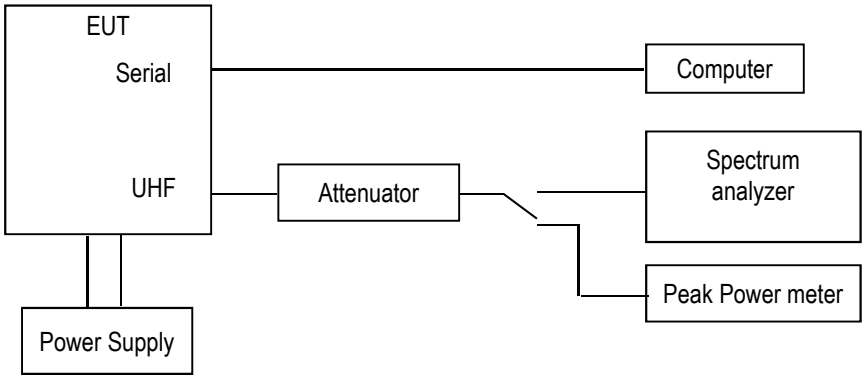
No modifications were made during testing.

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Conducted RF measurements setup



Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Run #1: Output Power

Date: 5/9/2018 Engineer: Deniz Demirci Location: FT Lab #4a
Cable Loss: 0.1 dB Attenuator: 30.0 dB Total Loss: 30.1 dB
Cable ID(s): Custom Attenuator IDs: Asset #Midwest 20 dB, #3174 10 dB

Power Setting	Frequency (MHz)	Channel Bandwidth	Modulation	Output Power (dBm) [1]	Output Power mW	Antenna Gain (dBi)	EIRP dBm	EIRP W	Result
Max	406.11250	12.5 kHz	GMSK	30.1	1023	2.5	32.6	1.820	Pass
Max	406.11250	12.5 kHz	4LFSK	30.2	1047	2.5	32.7	1.862	Pass
Max	418.00000	12.5 kHz	GMSK	30.1	1023	2.5	32.6	1.820	Pass
Max	418.00000	12.5 kHz	4LFSK	30.1	1023	2.5	32.6	1.820	Pass
Max	429.98750	12.5 kHz	GMSK	30.1	1023	2.5	32.6	1.820	Pass
Max	429.98750	12.5 kHz	4LFSK	30.1	1023	2.5	32.6	1.820	Pass
Max	450.01250	12.5 kHz	GMSK	29.7	933	2.5	32.2	1.660	Pass
Max	450.01250	12.5 kHz	4LFSK	29.7	933	2.5	32.2	1.660	Pass
Max	460.00000	12.5 kHz	GMSK	29.7	933	2.5	32.2	1.660	Pass
Max	460.00000	12.5 kHz	4LFSK	29.7	933	2.5	32.2	1.660	Pass
Max	469.98750	12.5 kHz	GMSK	30.1	1023	2.5	32.6	1.820	Pass
Max	469.98750	12.5 kHz	4LFSK	30.1	1023	2.5	32.6	1.820	Pass

Note 1:	Output power measured using a peak power meter

Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Run #2: Spectral Mask,

Date: 5/9/2018 Engineer: Deniz Demirci Location: FT Lab #4a

406.1 - 430 MHz band

Power setting	Data rate	Channel Bandwidth	Modulation	Frequency (MHz)	Spectrum mask	Result
Max	4800	12.5 kHz	GMSK	418.0000	D	Pass
Max	9600	12.5 kHz	4LFSK	418.0000	D	Pass
Max	9600	25.0 kHz	GMSK	418.0125	C	Pass
Max	19200	25.0 kHz	4LFSK	418.0125	C	Pass

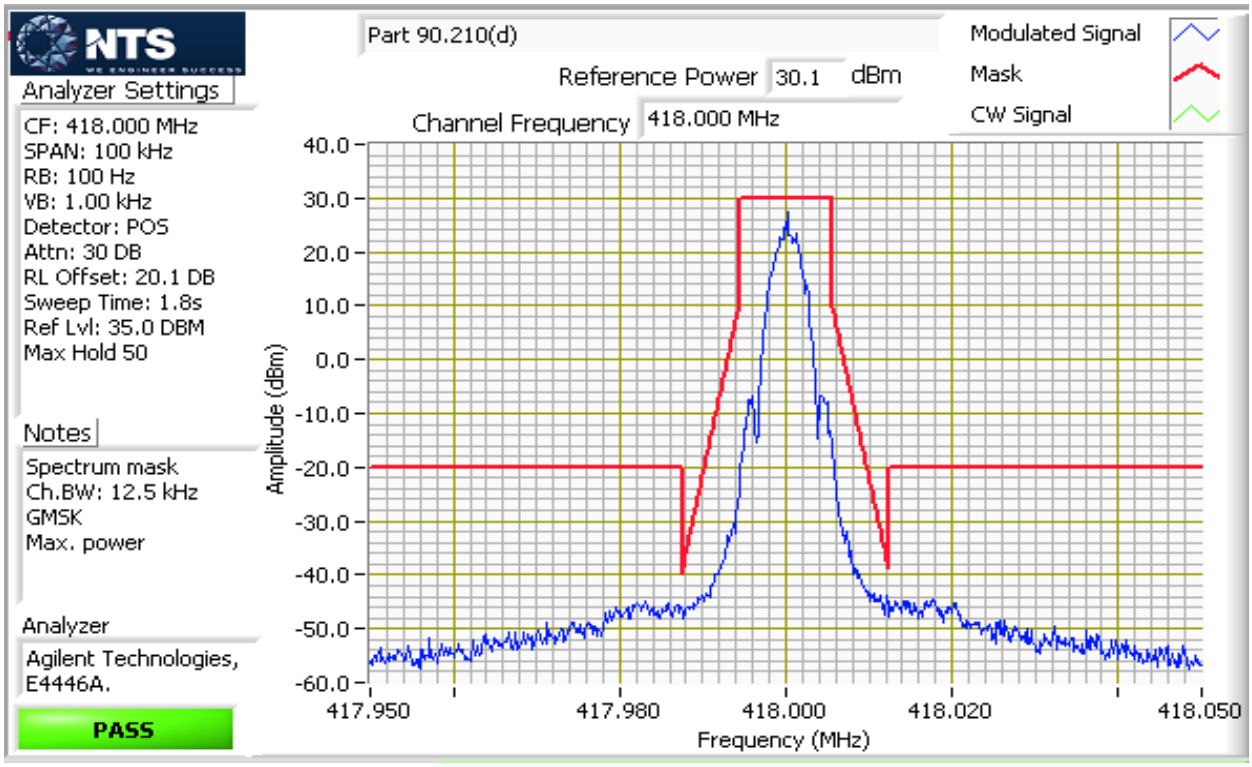
450 - 470 MHz band

Power setting	Data rate	Channel Bandwidth	Modulation	Frequency (MHz)	Emission mask	Result
Max	4800	12.5 kHz	GMSK	460.0000	D	Pass
Max	9600	12.5 kHz	4LFSK	460.0000	D	Pass
Max	9600	25.0 kHz	GMSK	460.0000	C	Pass
Max	19200	25.0 kHz	4LFSK	460.0000	C	Pass

Note 1:	Reference power measured using a peak power meter

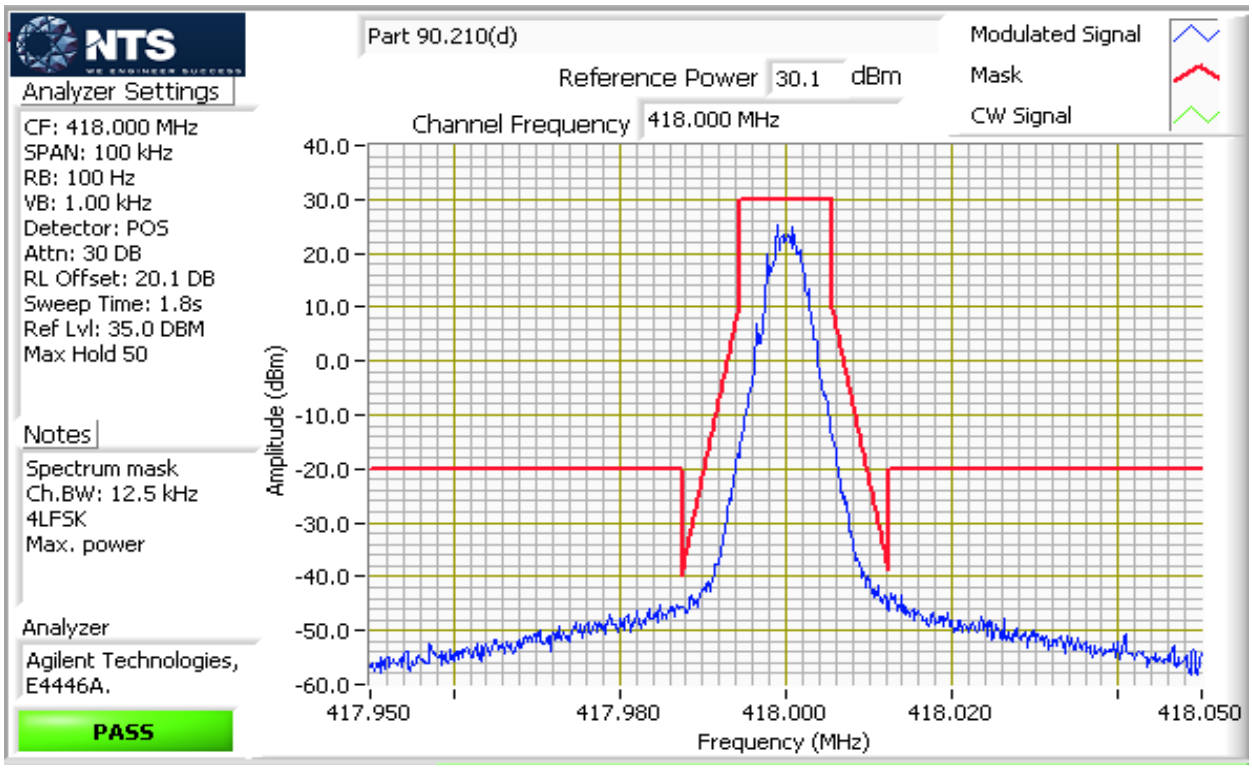
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Spectrum Mask - Channel bandwidth 12.5 kHz, Modulation GMSK (Mask D)



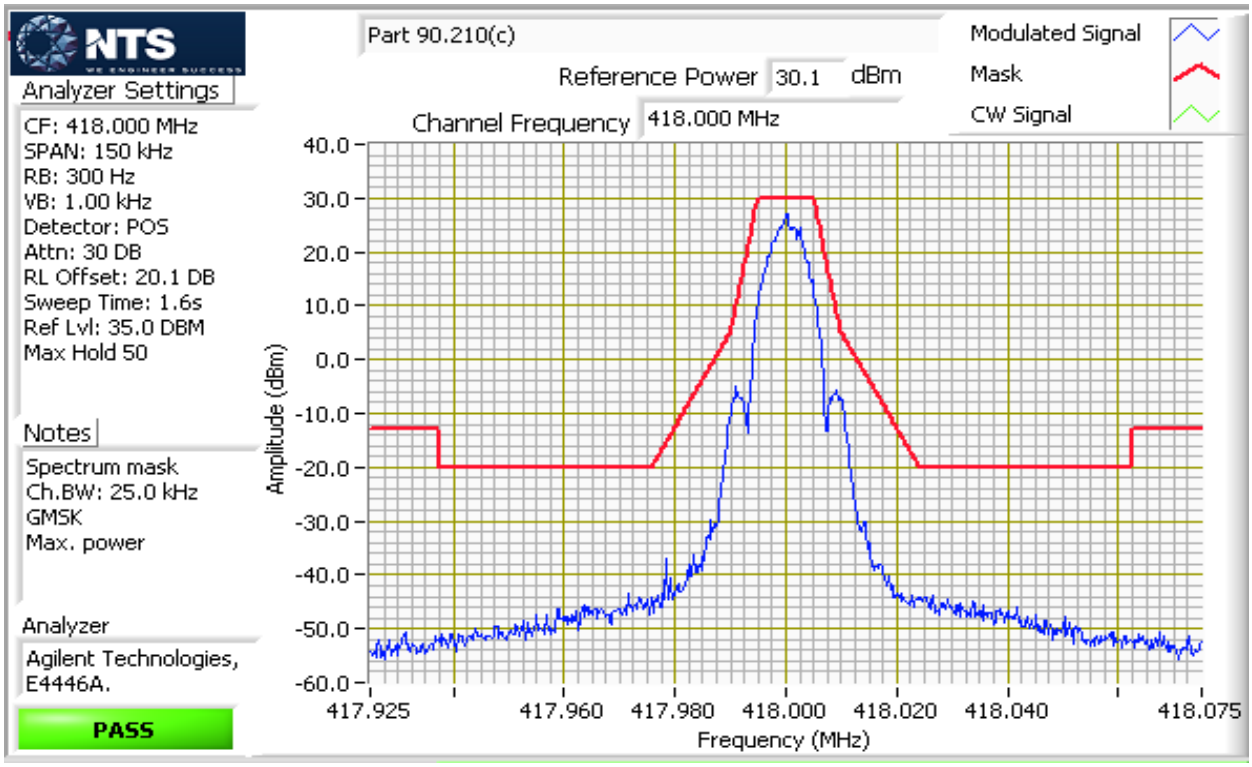
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Spectrum Mask - Channel bandwidth 12.5 kHz, Modulation 4LFSK (Mask D)



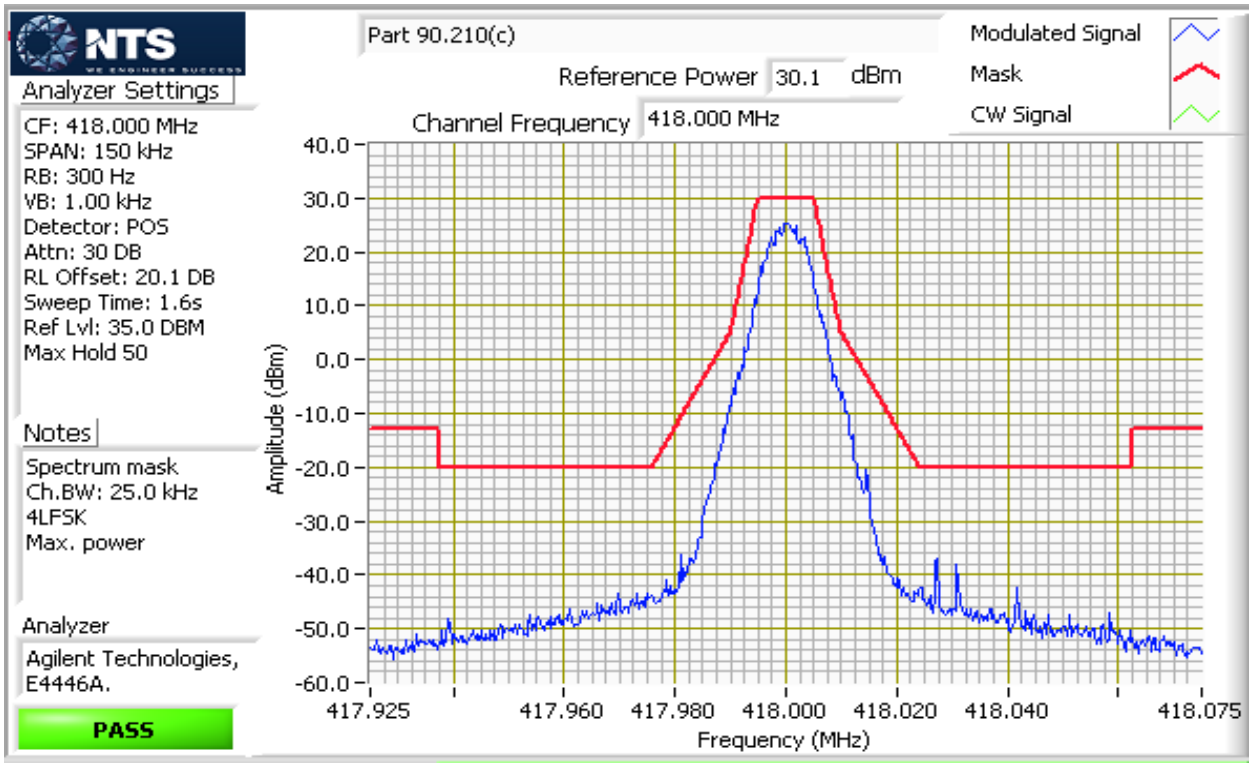
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Spectrum Mask - Channel bandwidth 25.0 kHz, Modulation GMSK (Mask C)



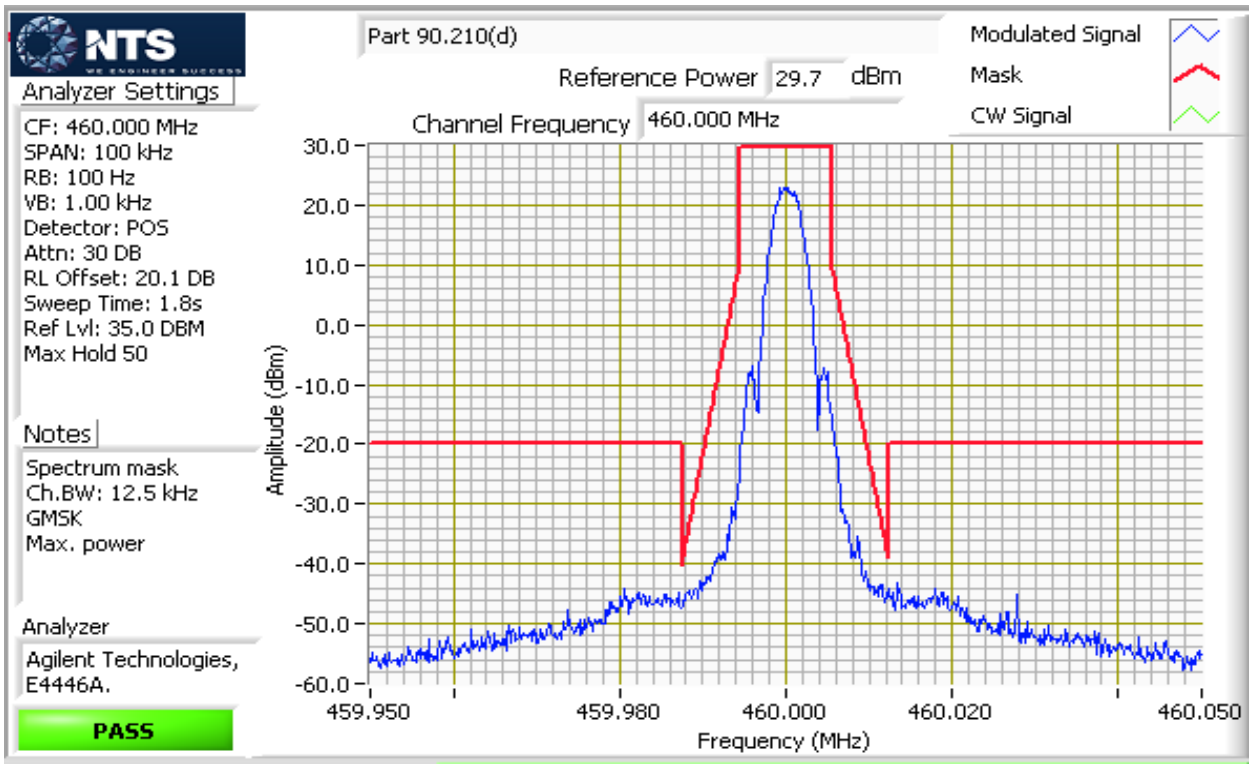
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Spectrum Mask - Channel bandwidth 25.0 kHz, Modulation 4LFSK (Mask C)



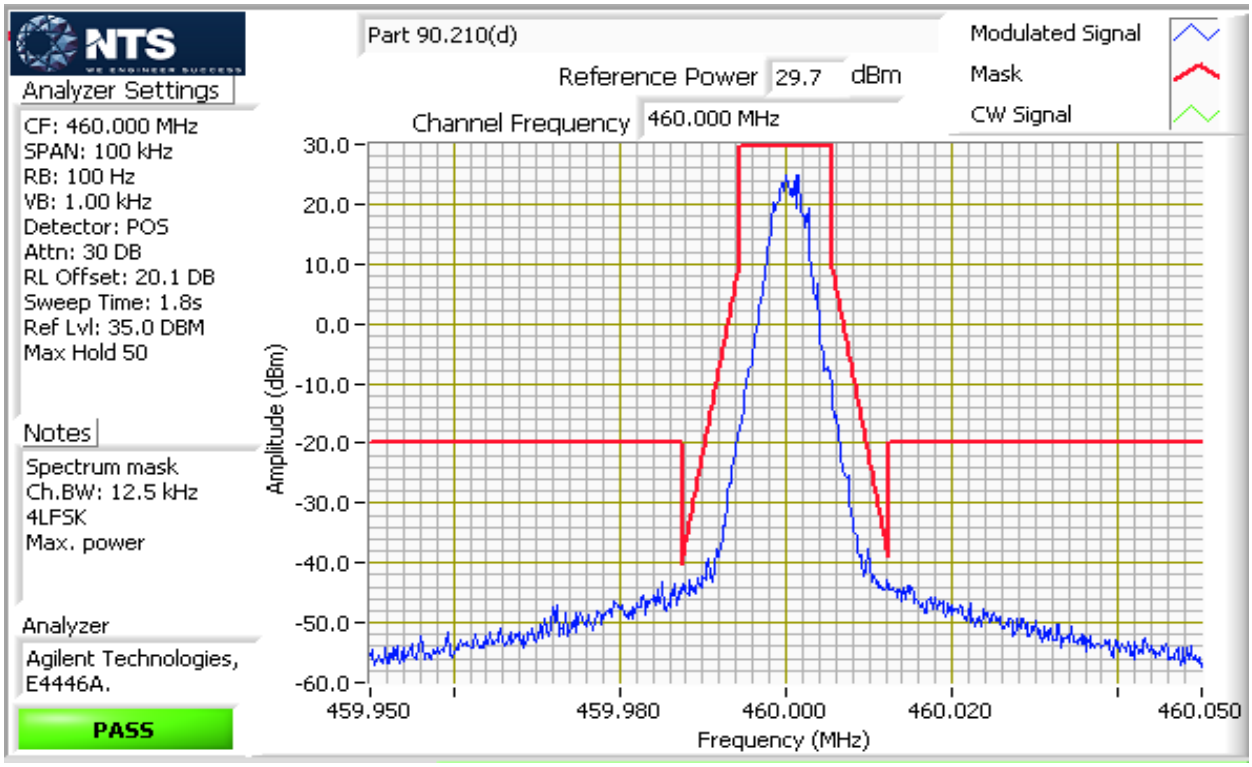
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Spectrum Mask - Channel bandwidth 12.5 kHz, Modulation GMSK (Mask D)



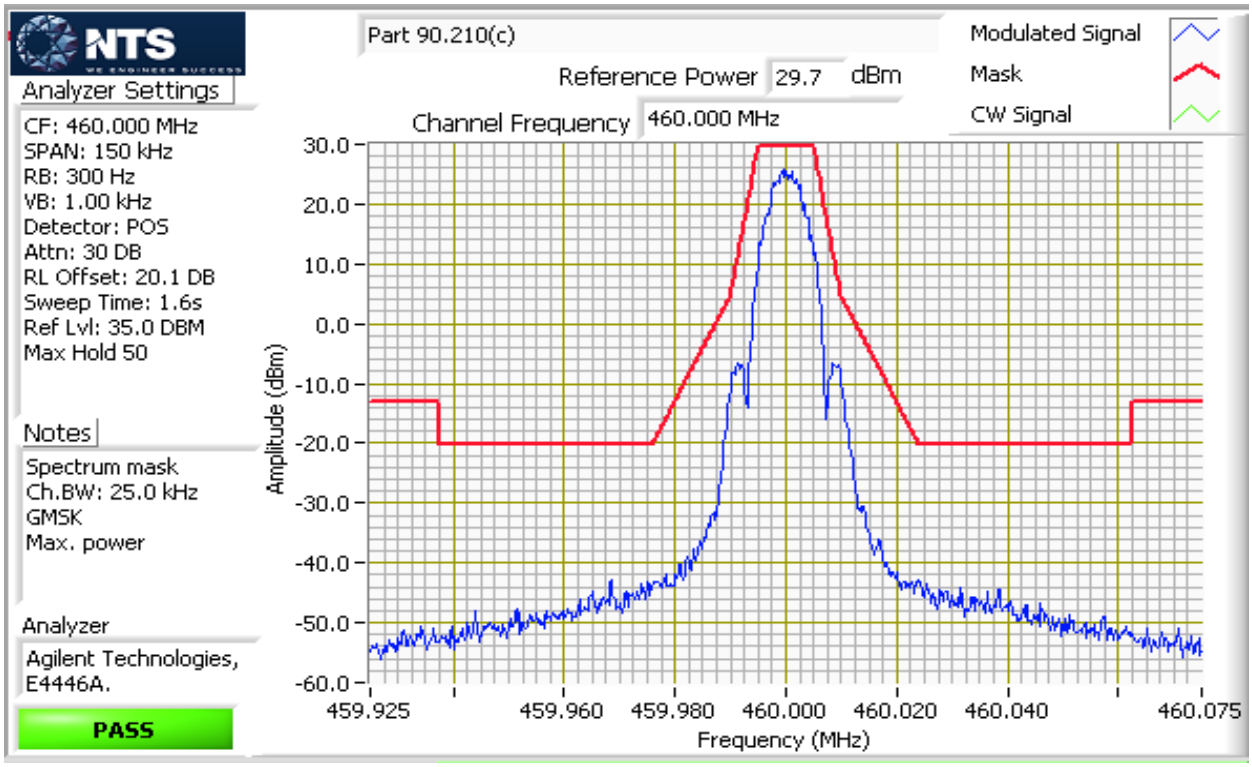
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Spectrum Mask - Channel bandwidth 12.5 kHz, Modulation 4LFSK (Mask D)



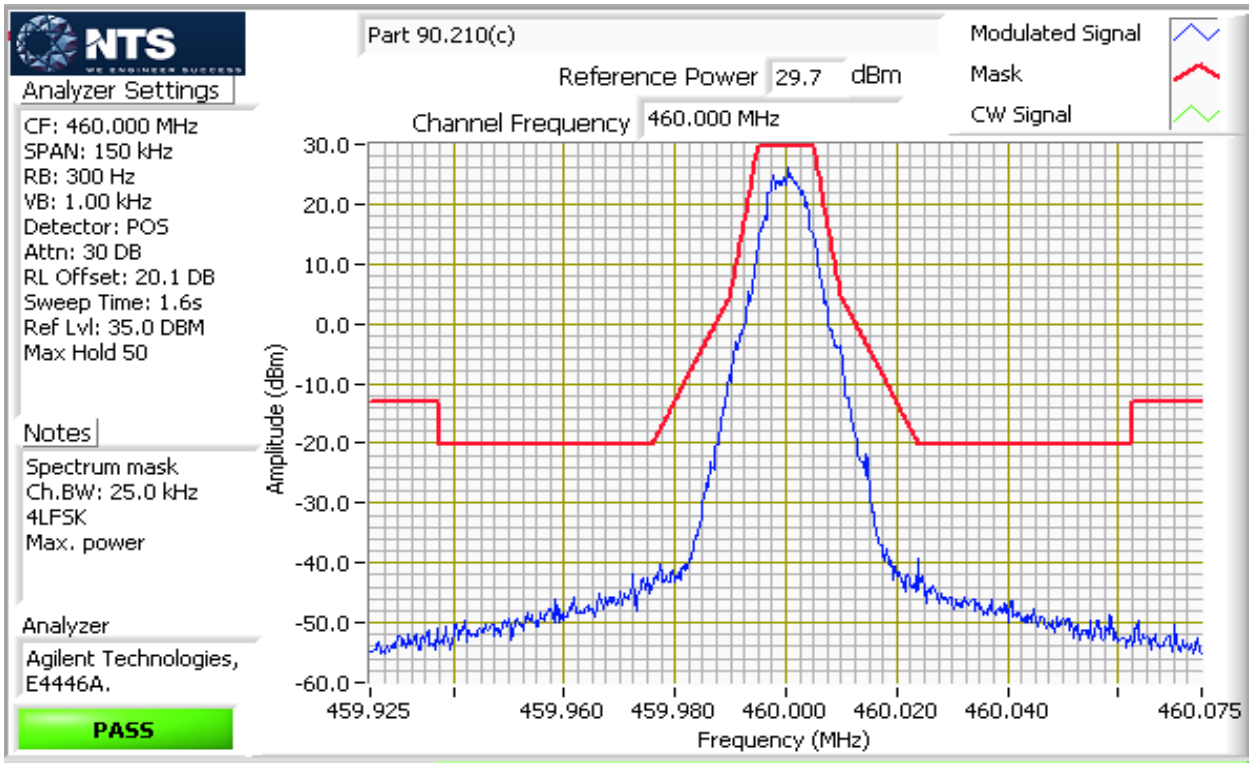
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Spectrum Mask - Channel bandwidth 25.0 kHz, Modulation GMSK (Mask C)



Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Spectrum Mask - Channel bandwidth 25.0 kHz, Modulation 4LFSK (Mask C)



Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Run #3: Signal Bandwidth

Date: 5/8/2018 Engineer: Deniz Demirci Location: FT Lab #4a

406.1 - 430 MHz band

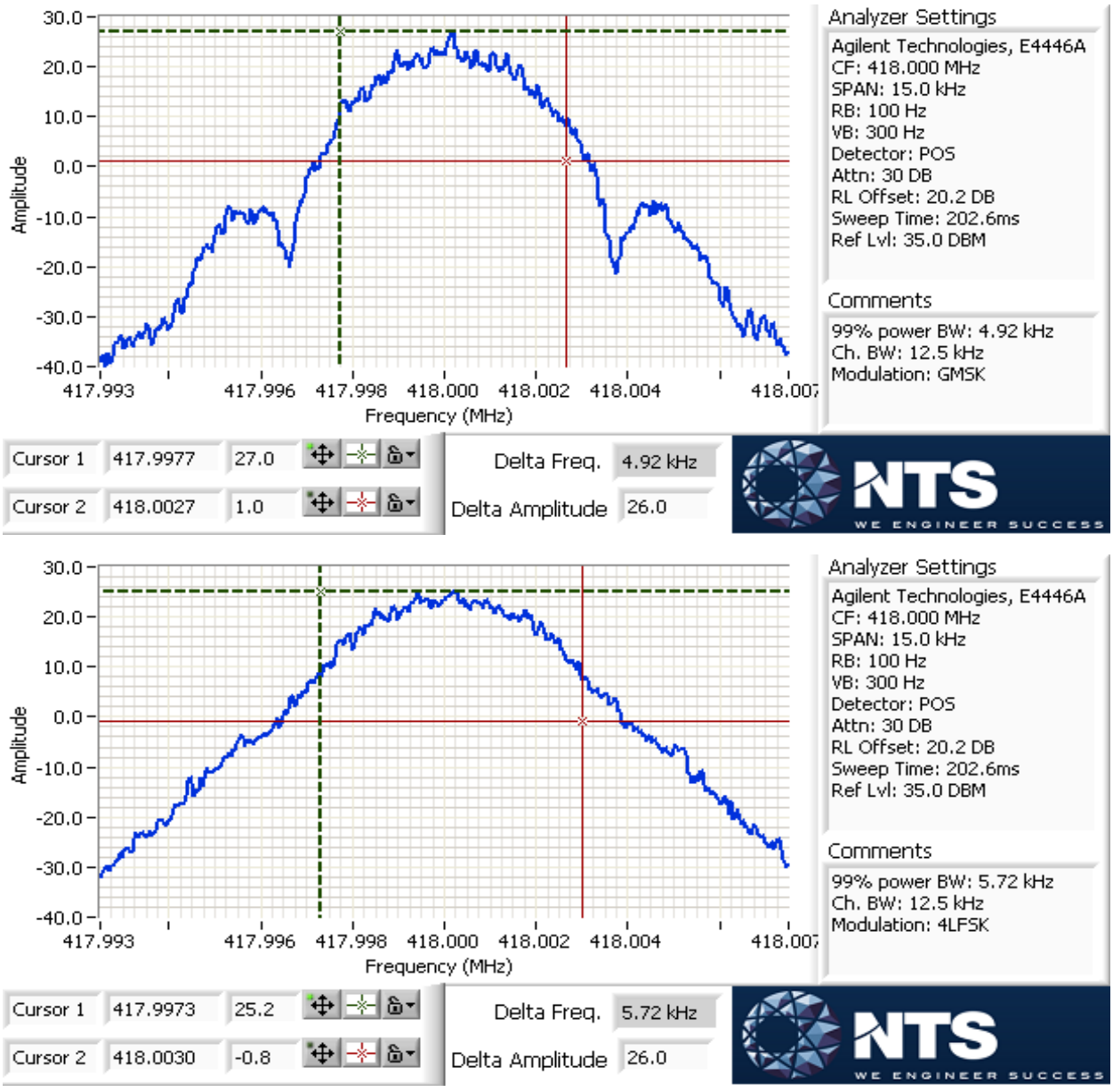
Power setting	Data rate	Channel Bandwidth	Modulation	Frequency MHz	RB (Hz)	Bandwidth (kHz) 26 dB	Bandwidth (kHz) 99%	Authorized bandwidth
Max	4800	12.5 kHz	GMSK	418.0000	100		4.92	11.25 kHz
Max	9600	12.5 kHz	4LFSK	418.0000	100		5.72	11.25 kHz
Max	9600	25.0 kHz	GMSK	418.0000	200		9.73	20.00 kHz
Max	19200	25.0 kHz	4LFSK	418.0000	200		11.50	20.00 kHz

450 - 470 MHz band

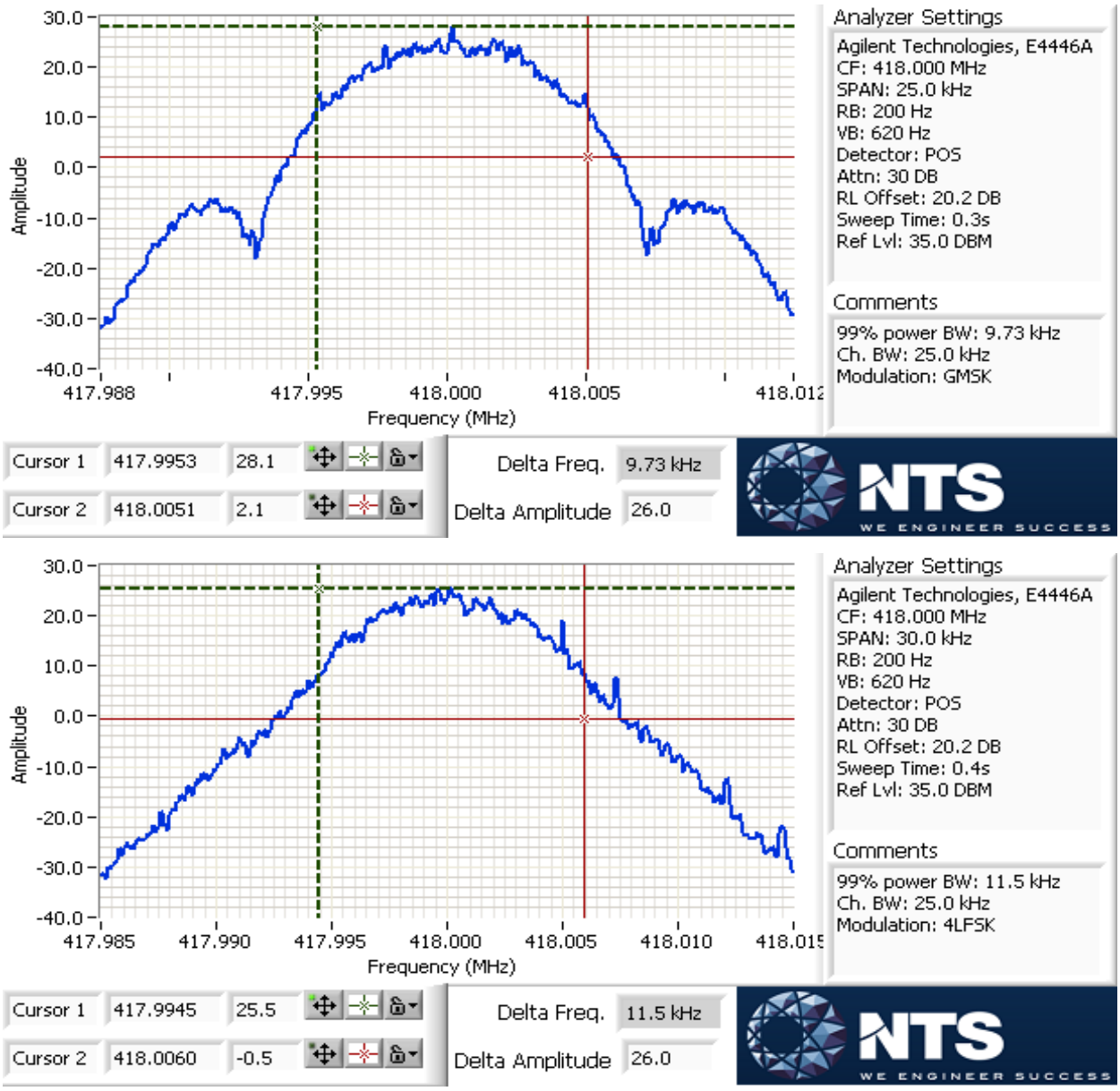
Power setting	Data rate	Channel plan	Modulation	Frequency MHz	RB (Hz)	Bandwidth (kHz) 26 dB	Bandwidth (kHz) 99%	Authorized bandwidth
Max	4800	12.5 kHz	GMSK	460.0000	100		4.92	11.25 kHz
Max	9600	12.5 kHz	4LFSK	460.0000	100		5.70	11.25 kHz
Max	9600	25.0 kHz	GMSK	460.0000	200		9.73	20.00 kHz
Max	19200	25.0 kHz	4LFSK	460.0000	200		11.50	20.00 kHz

Note 1:	99% bandwidth measured in accordance with ANSI C63.10 and RSS GEN, with RBW 1% to 5% of the OBW and VB ≥ 3xRBW

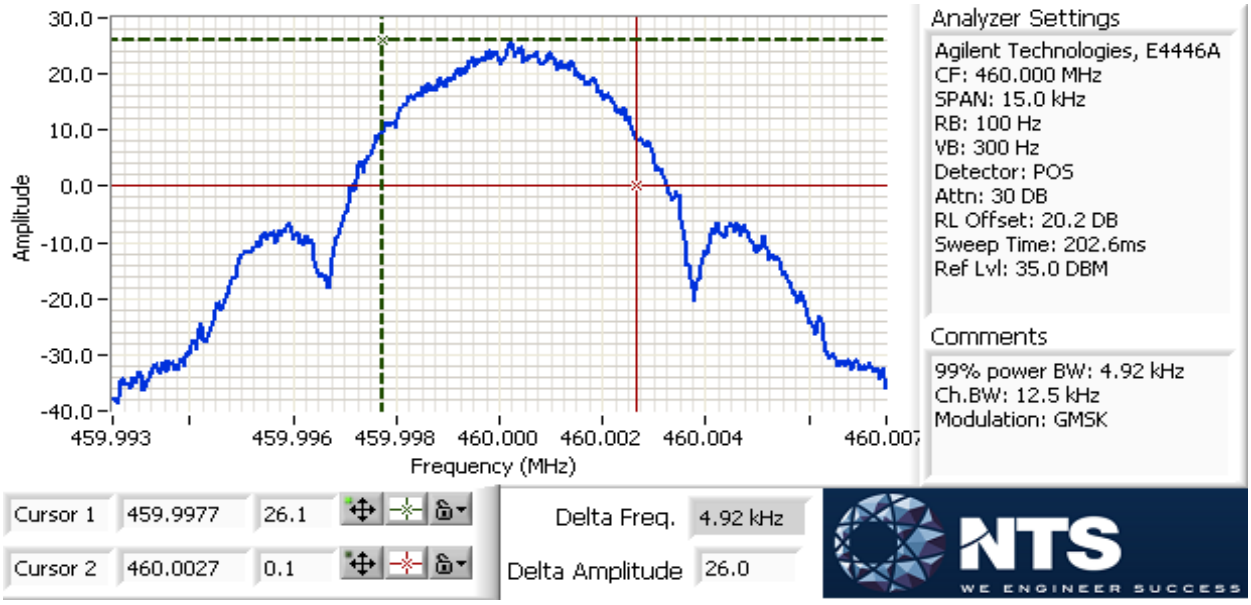
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

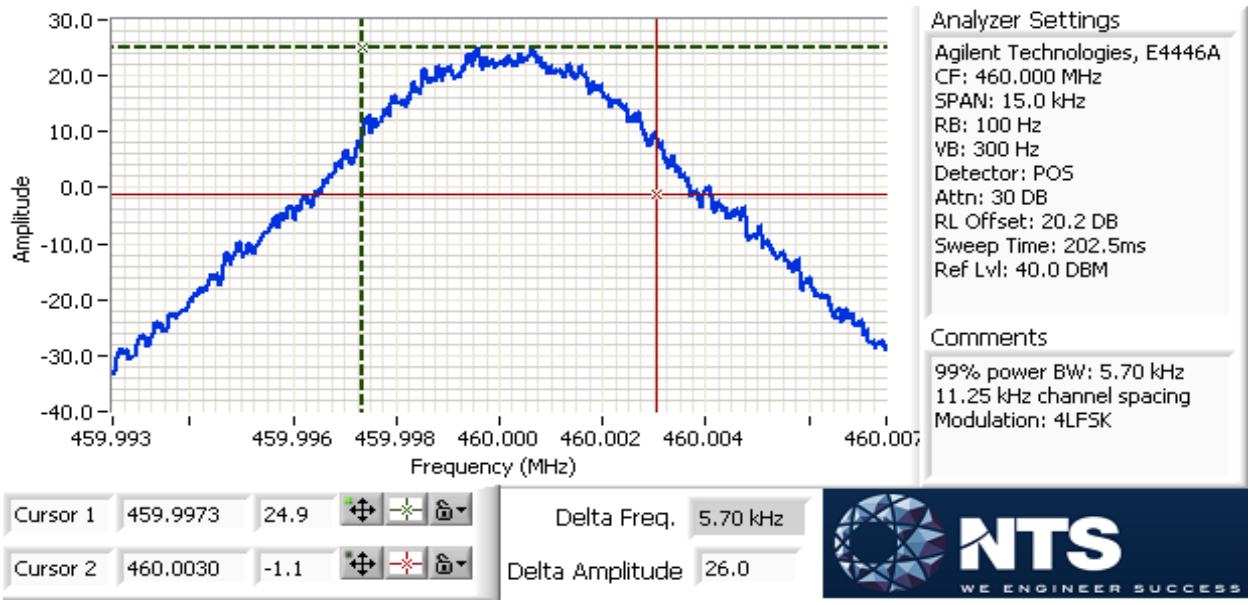


Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

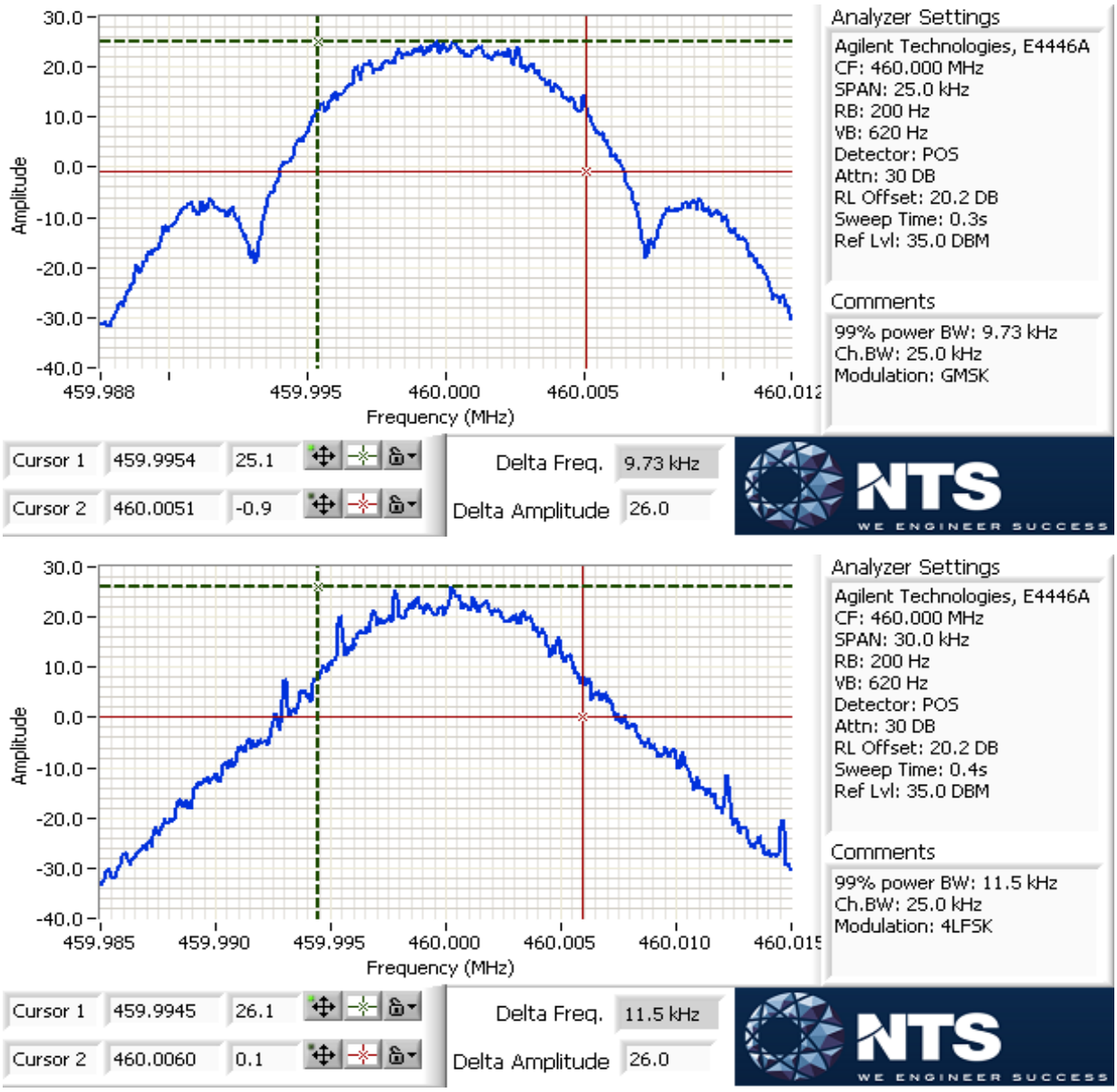


Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B





Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B



Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Run #4: Out of Band Spurious Emissions, Conducted

Date of Test: 5/17/2018
Test Engineer: Mehran Birgani
Test Location: Ft Lab# 4a

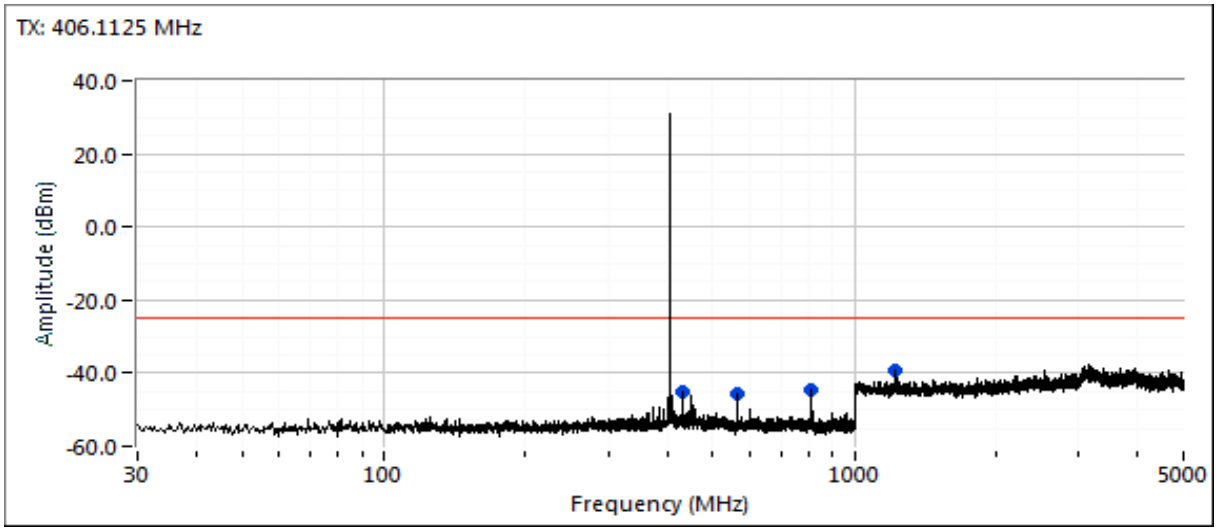
Config. Used: 1
Config Change: None
EUT Voltage: 4.2 Vdc

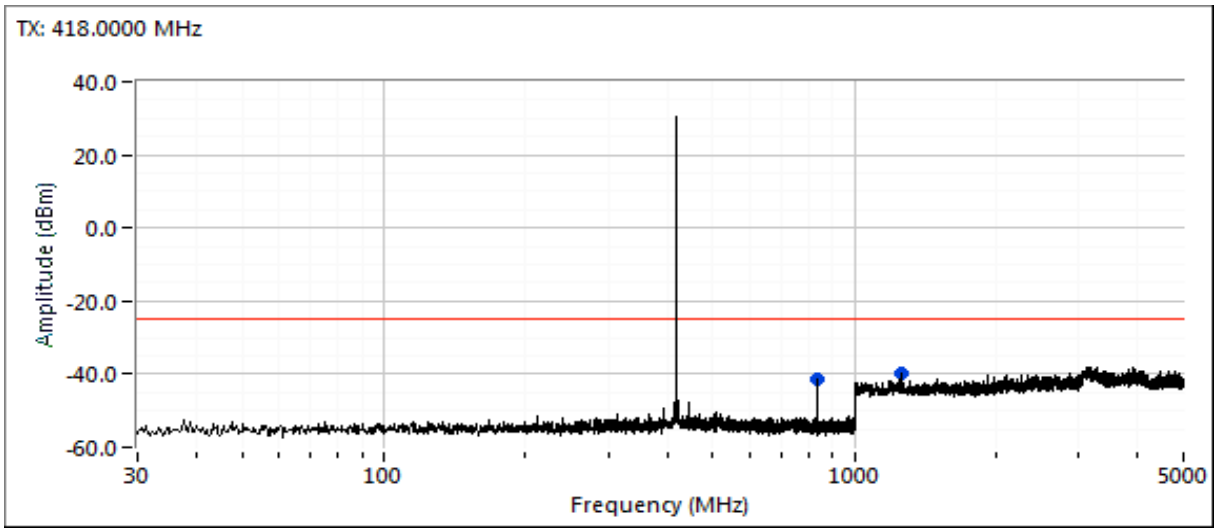
The limit is taken from FCC Part 90.210 Mask E (-25 dBm) as a worst case limit.

Frequency	Level	Port	FCC Part 90, RSS-119		Detector	Comments	Channel
MHz	dBm	-	Limit	Margin	Pk/QP/Avg		MHz
432.037	*-45.1*	*RF Port*	*-25.0*	*-20.1*	*Peak*		*406.1125*
562.384	*-45.8*	*RF Port*	*-25.0*	*-20.8*	*Peak*		*406.1125*
812.081	*-44.5*	*RF Port*	*-25.0*	*-19.5*	*Peak*		*406.1125*
1217.410	*-39.0*	*RF Port*	*-25.0*	*-14.0*	*Peak*		*406.1125*
836.015	*-41.4*	*RF Port*	*-25.0*	*-16.4*	*Peak*		*418.0000*
1253.420	*-39.8*	*RF Port*	*-25.0*	*-14.8*	*Peak*		*418.0000*
859.950	*-39.8*	*RF Port*	*-25.0*	*-14.8*	*Peak*		*429.9875*
3246.080	*-37.0*	*RF Port*	*-25.0*	*-12.0*	*Peak*		*429.9875*
476.025	*-45.7*	*RF Port*	*-25.0*	*-20.7*	*Peak*		*450.0125*
900.057	*-38.7*	*RF Port*	*-25.0*	*-13.7*	*Peak*		*450.0125*
1349.450	*-39.5*	*RF Port*	*-25.0*	*-14.5*	*Peak*		*450.0125*
920.110	*-37.0*	*RF Port*	*-25.0*	*-12.0*	*Peak*		*460.0000*
1380.130	*-38.8*	*RF Port*	*-25.0*	*-13.8*	*Peak*		*460.0000*
939.840	*-36.7*	*RF Port*	*-25.0*	*-11.7*	*Peak*		*469.9875*
1409.470	*-39.6*	*RF Port*	*-25.0*	*-14.6*	*Peak*		*469.9875*

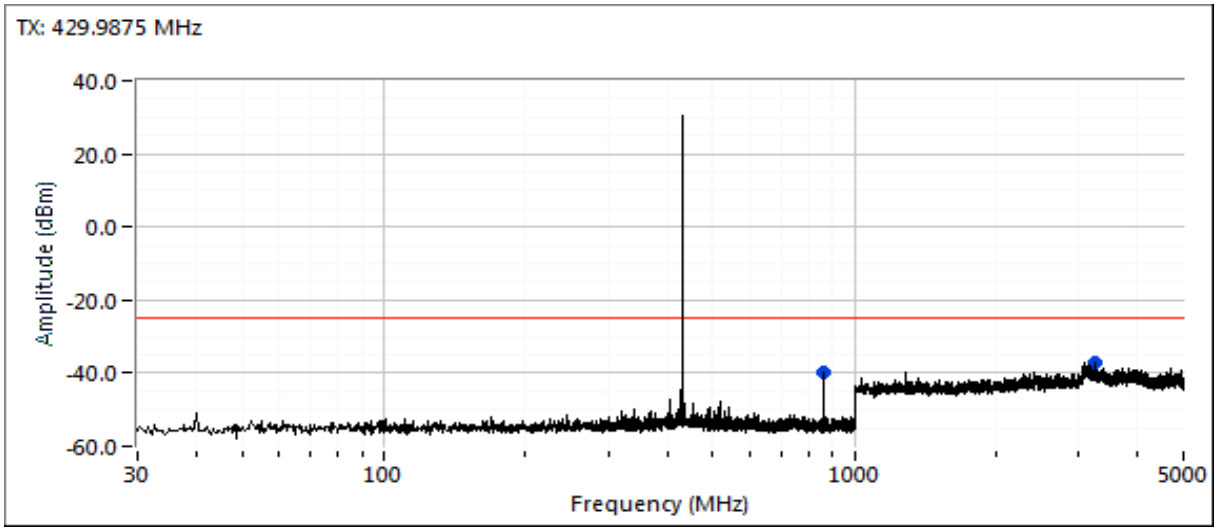
Note 1:	The limits shown on the graphs are -25 dBm.
Note 2:	EUT was set to transmit an un-modulated carrier with power setting of 1 watt during the spurious emission tests.
Note 3:	Spurious emission scans and final measurements were performed with peak detector, RBW: 100 kHz, VBW: 300 kHz for below 1 GHz measurements and RBW: 1 MHz, VBW: 3 MHz for above 1 GHz measurements.

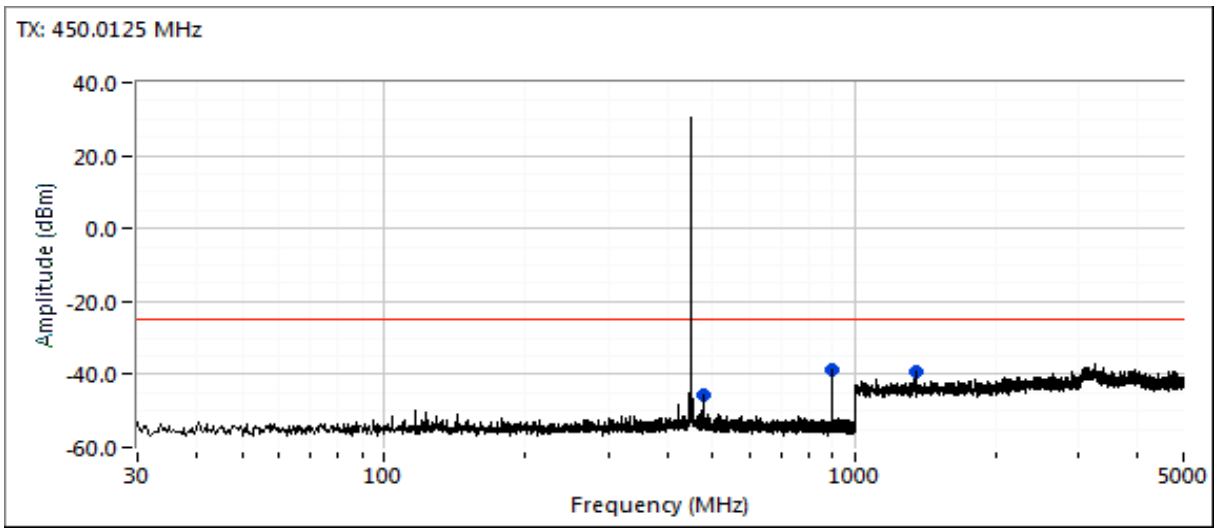
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B



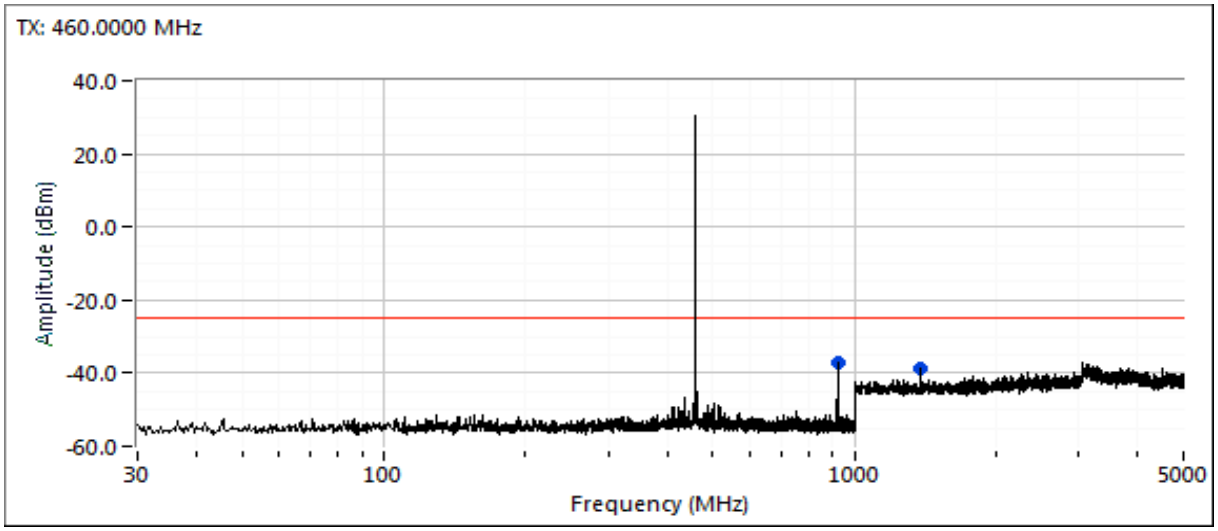


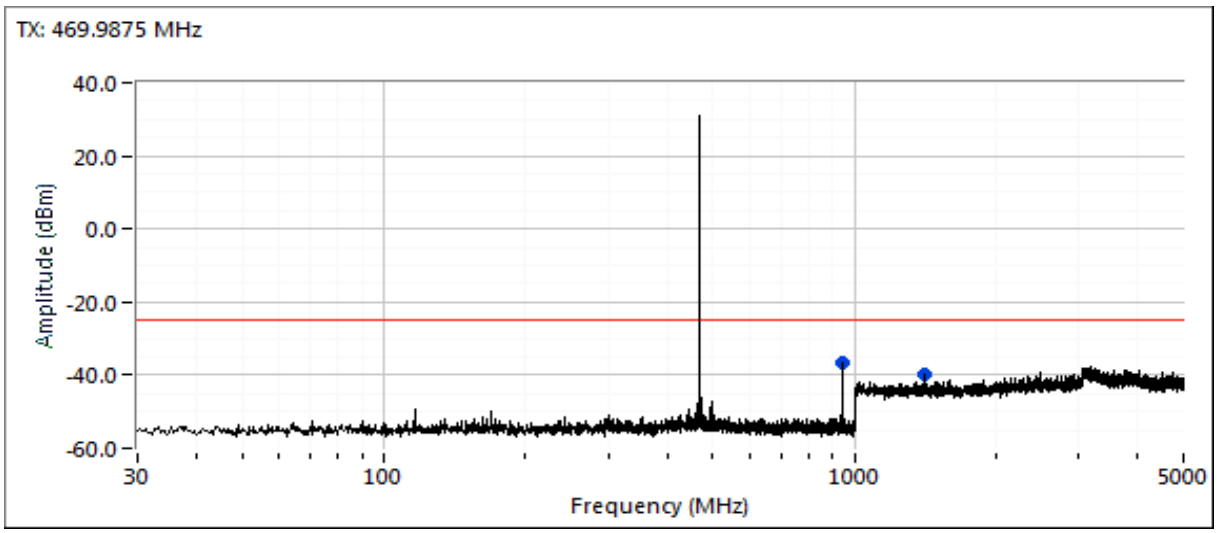
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B





Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B





Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Run #5: Out of Band Spurious Emissions, Radiated

Run #5a - Preliminary measurements

Date of Test: 5/16/2018 Config. Used: 1

Test Engineer: Deniz Demirci Config Change: None

Test Location: Ft Ch# 7 EUT Voltage: 4.2 Vdc

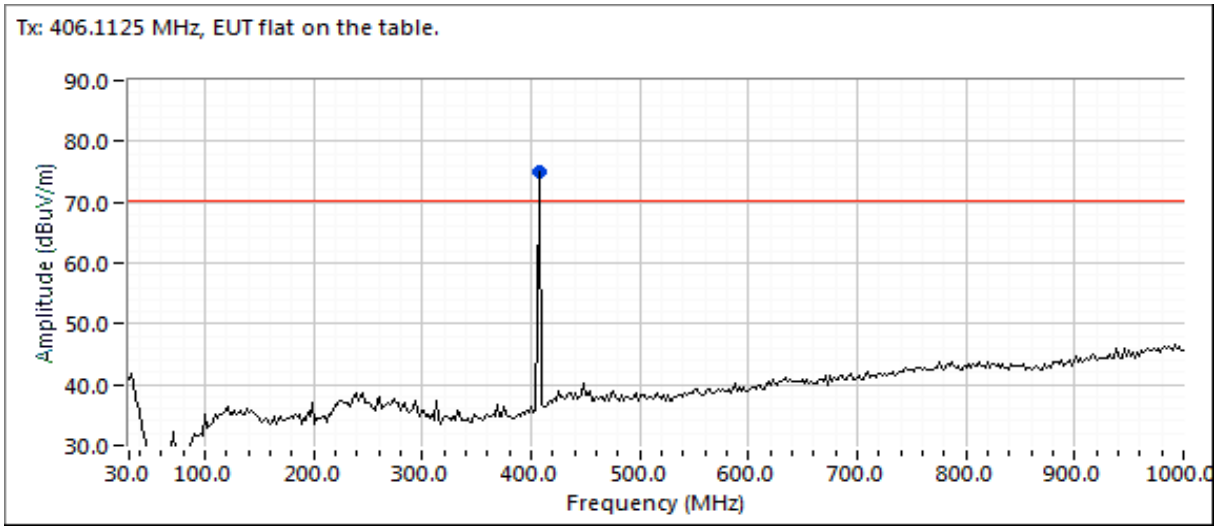
The limit is taken from FCC Part 90.210 Mask E as worst case limit.

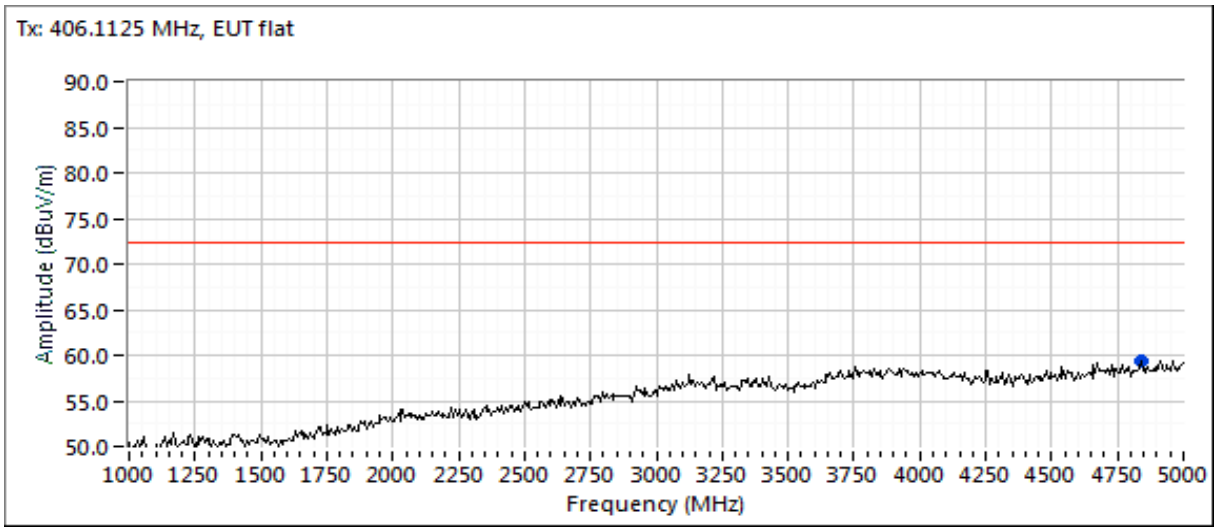
Frequency	Level	Pol	FCC Part 90, RSS-119		Detector	Azimuth	Height	Comments	Channel	Orientation
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters			
406.113	75.1	H	-	-	PK	115	1.0	Carrier	406.1125	Flat
4840.000	59.3	V	72.4	-13.1	PK	232	1.5	Noise floor	406.1125	Flat
406.113	77.7	V	-	-	PK	208	1.0	Carrier	406.1125	Side
406.113	80.5	H	-	-	PK	96	3.0	Carrier	406.1125	Upright
4966.670	59.3	V	72.4	-13.1	PK	340	1.0	Noise floor	406.1125	Upright
418.001	78.4	H	-	-	PK	252	1.0	Carrier	418.0000	Upright
4906.670	59.9	H	72.4	-12.5	PK	209	1.5	Noise floor	418.0000	Upright
429.989	78.2	H	-	-	PK	97	3.0	Carrier	429.9875	Upright
4933.330	59.4	H	72.4	-13.0	PK	116	1.5	Noise floor	429.9875	Upright
450.013	77.8	H	-	-	PK	261	1.0	Carrier	450.0125	Upright
1800.000	58.3	H	72.4	-14.1	PK	109	1.0	Note 5	450.0125	Upright
460.001	78.1	H	-	-	PK	288	2.0	Carrier	460.0000	Upright
1840.330	62.2	H	72.4	-10.2	PK	122	1.5	Note 5	460.0000	Upright
469.988	78.5	H	-	-	PK	69	2.0	Carrier	469.9875	Upright
1879.999	63.8	H	72.4	-8.6	PK	124	1.5	Note 5	469.9875	Upright
1879.997	62.7	V	72.4	-9.7	PK	215	1.0	Note 5	469.9875	Side
1879.999	62.4	V	72.4	-10.0	PK	251	1.1	Note 5	469.9875	Flat

Note 1:	The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: E=√(30PG)/d. This limit is conservative - it does not consider the presence of the ground plane. The erp or eirp for all signals with less than 10 dB of margin relative to this field strength limit is determined using substitution measurements.
Note 2:	Measurements are made with the antenna port terminated.
Note 3:	EUT was set to transmit an un-modulated carrier with power setting of 1 Watt during the spurious emission tests.
Note 4:	EUT was pre-scanned in all 3 orientations. Pre-scan results show EUT upright orientation has the highest spurious emission. Final measurements were taken with EUT side orientation.
Note 5:	Spurious emission final measurements were performed with peak detector, RBW: 100 kHz, VBW: 300 kHz for below 1 GHz measurements and RBW: 1 MHz, VBW: 3 MHz for above 1 GHz measurements.
Note 6:	Pre-scan measurements were performed between 9 kHz and 30 MHz with the fixed measurement antenna height of 1 m. There were no significant emissions observed in this frequency range.

Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

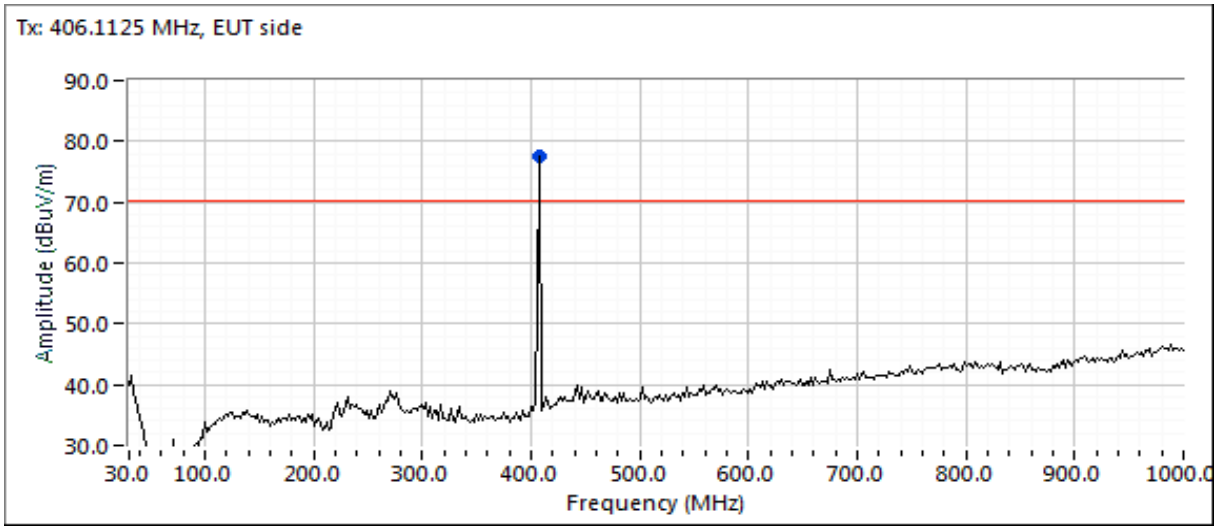
Tx: 406.1125 MHz, EUT flat on the table.

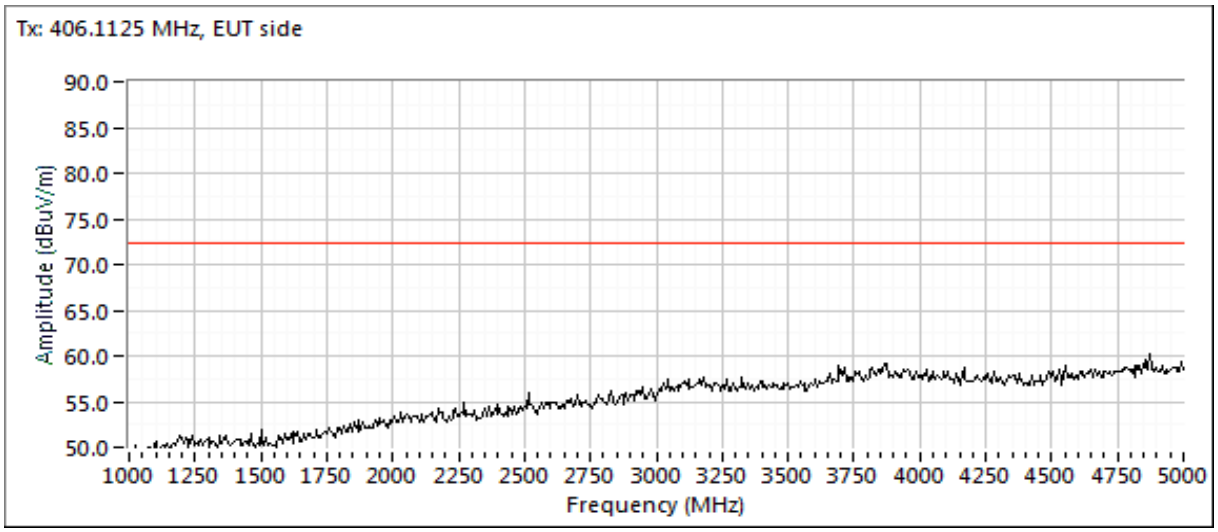




Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

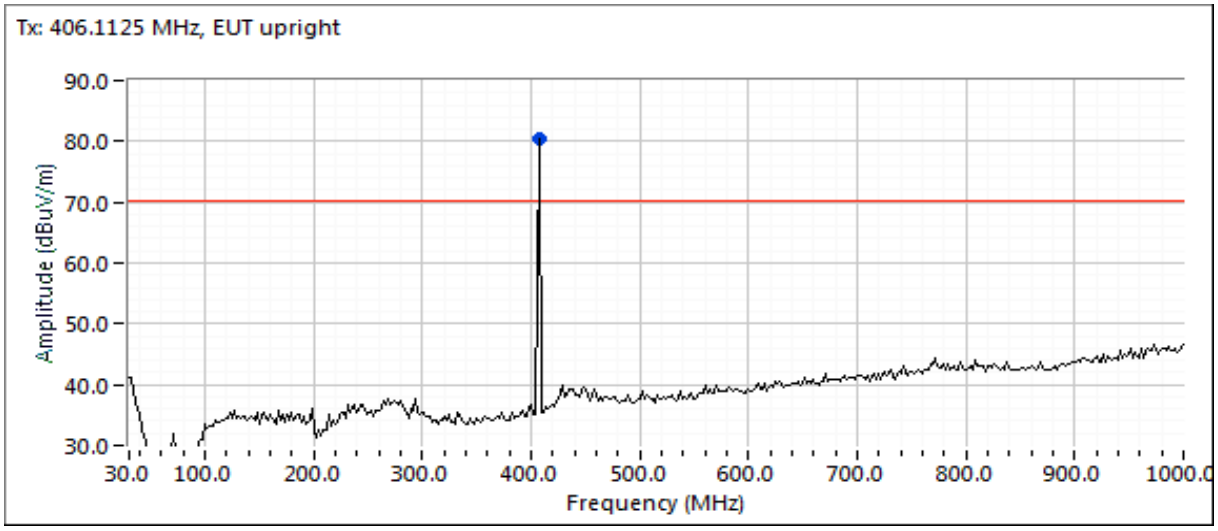
Tx: 406.1125 MHz, EUT side

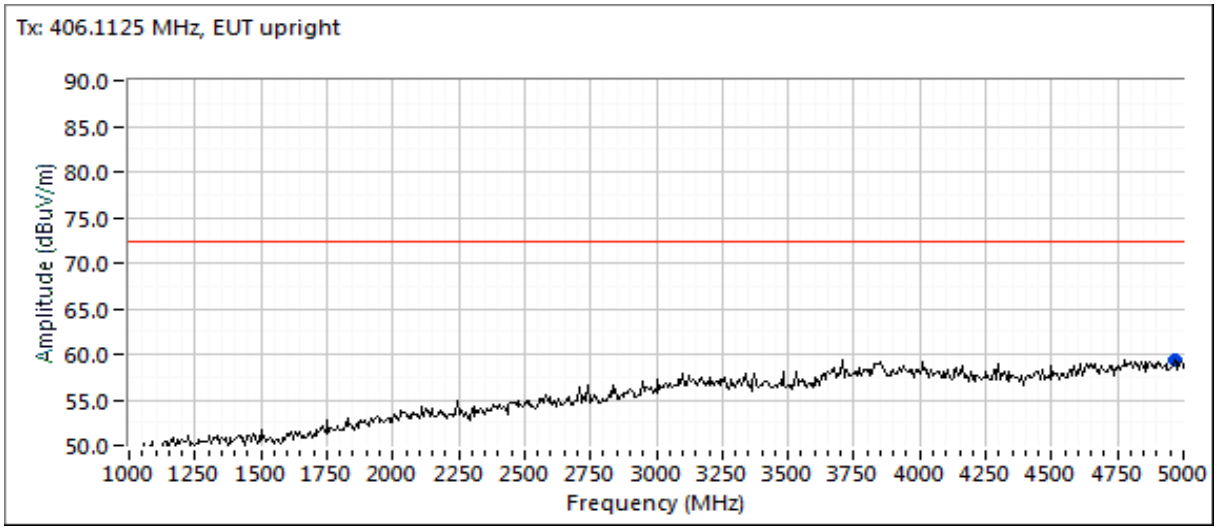




Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

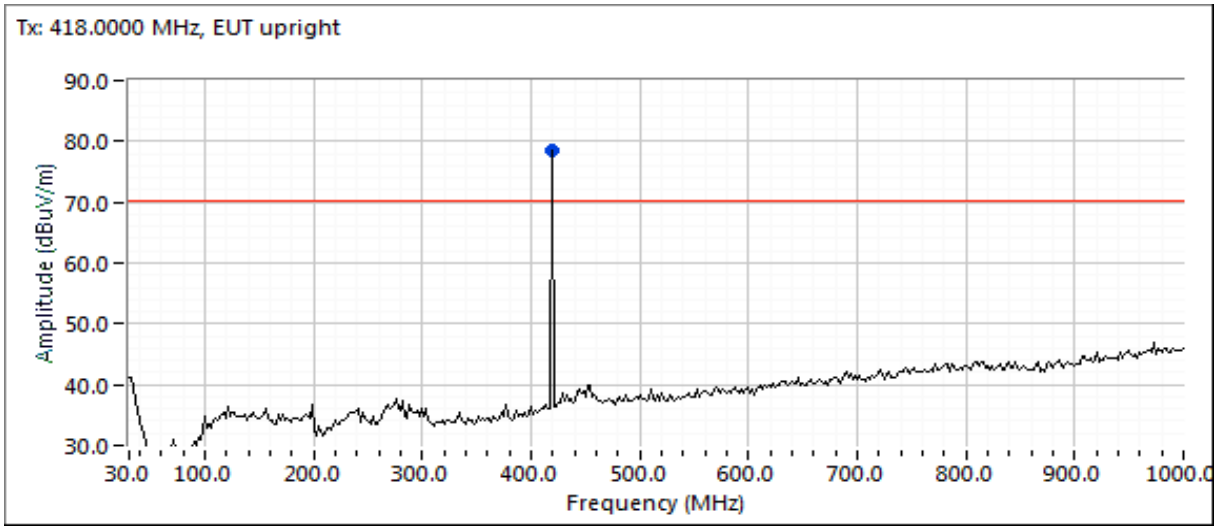
Tx: 406.1125 MHz, EUT upright

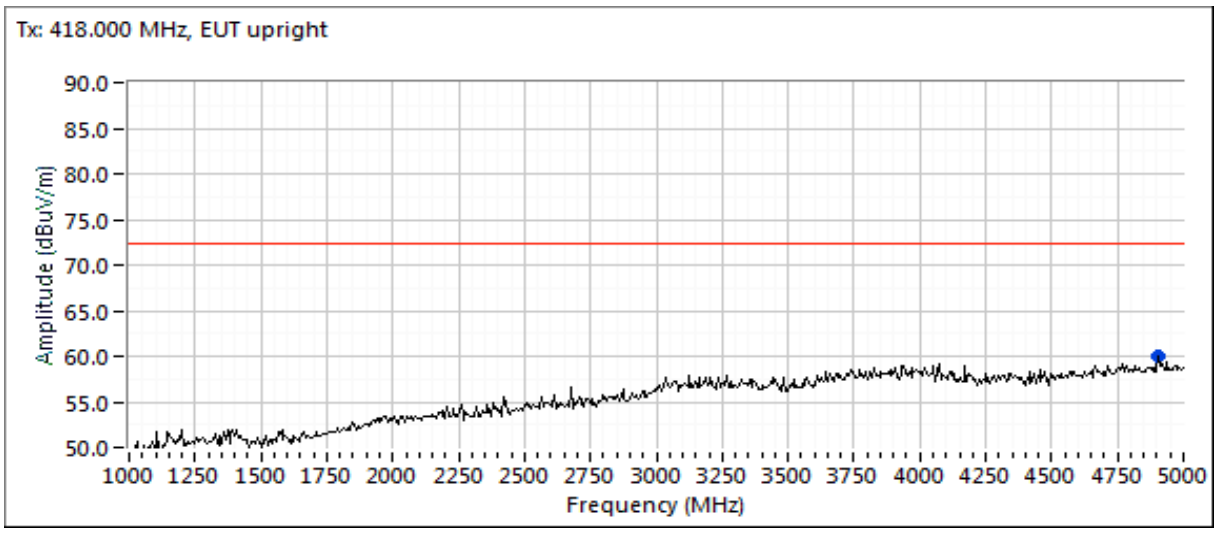




Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

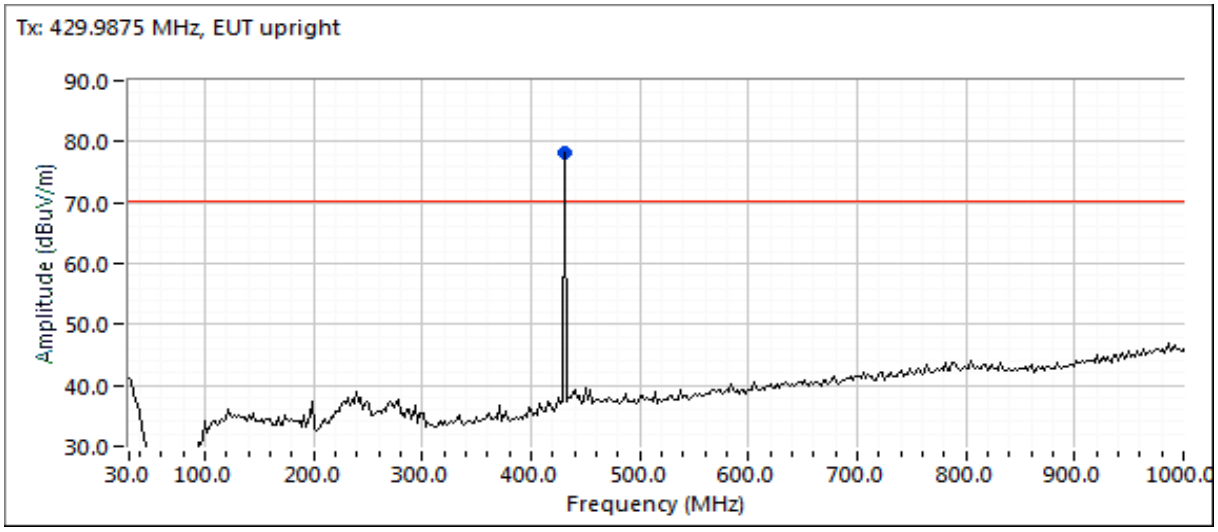
Tx: 418.0000 MHz, EUT upright

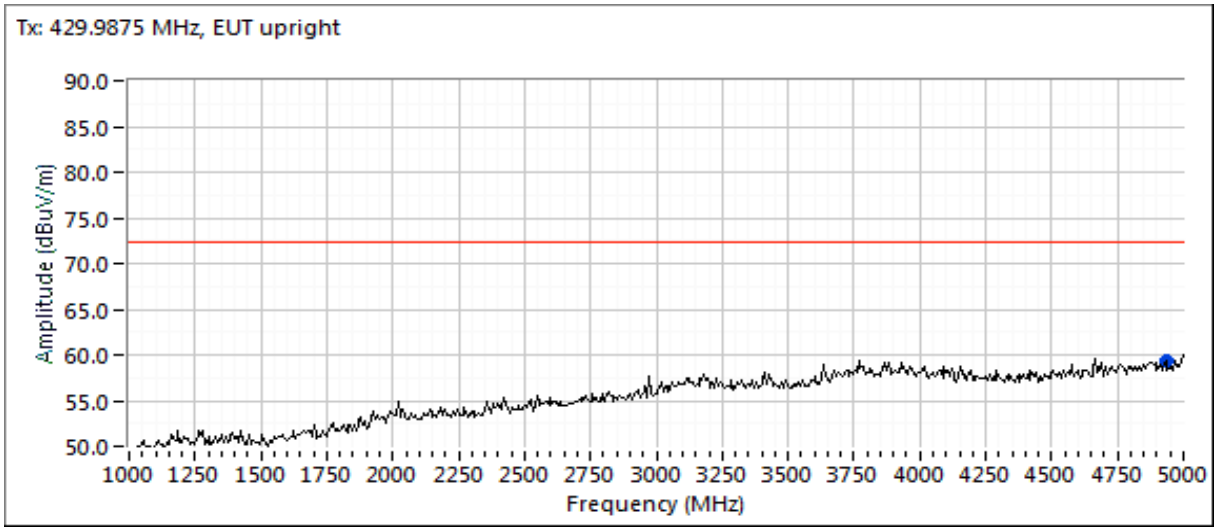




Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

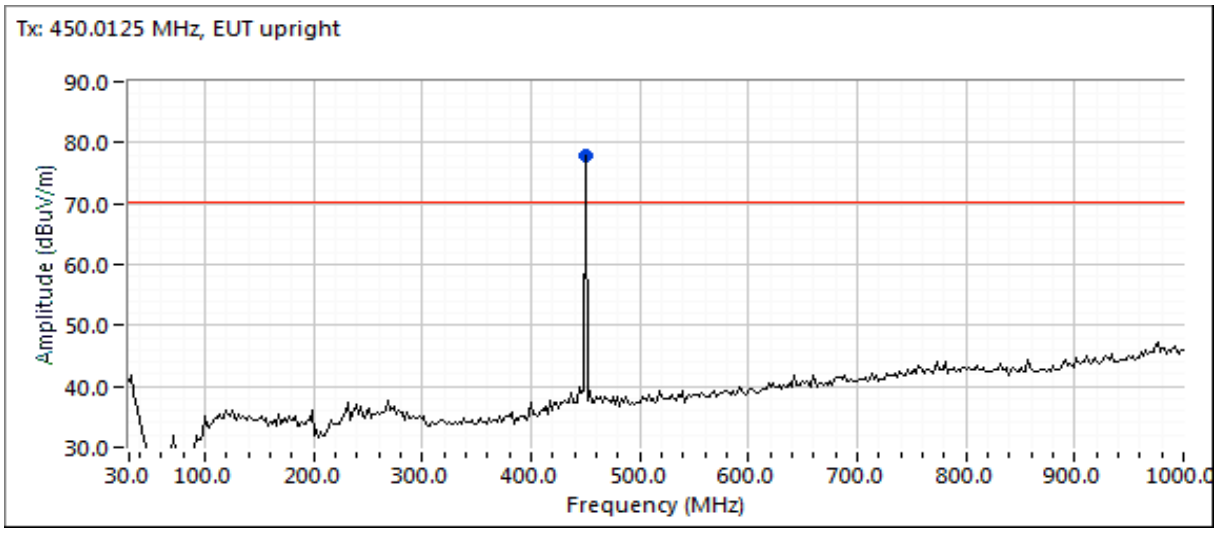
Tx: 429.9875 MHz, EUT upright

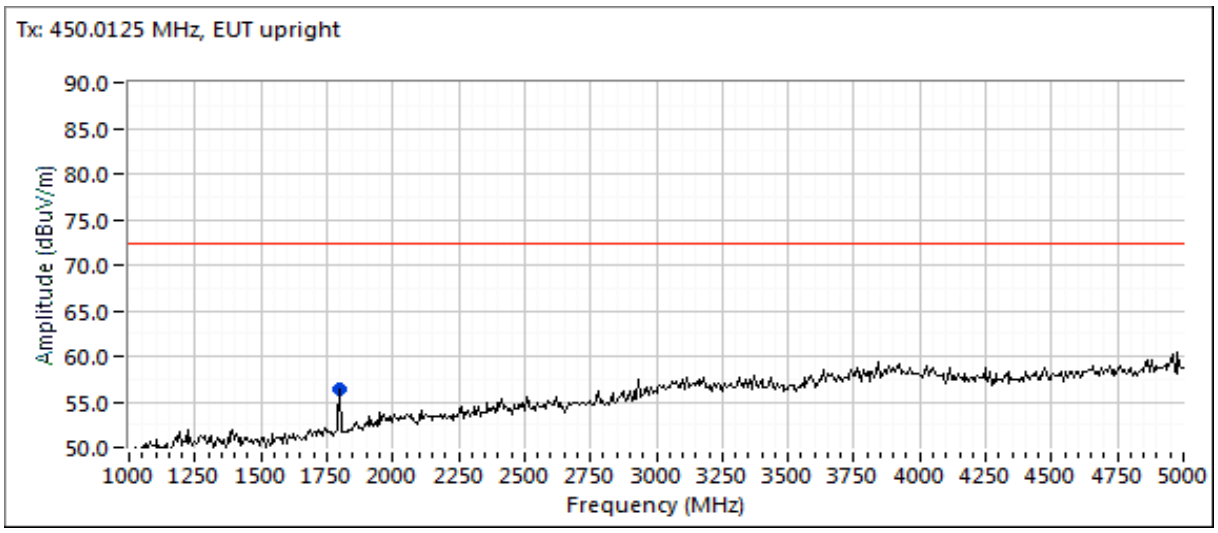




Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

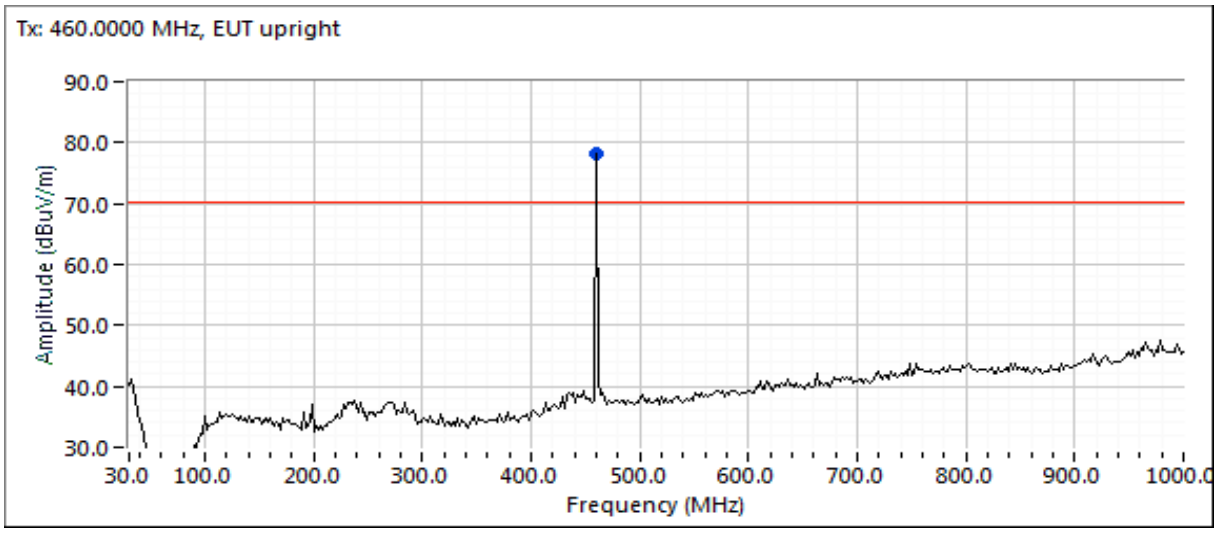
Tx: 450.0125 MHz, EUT upright

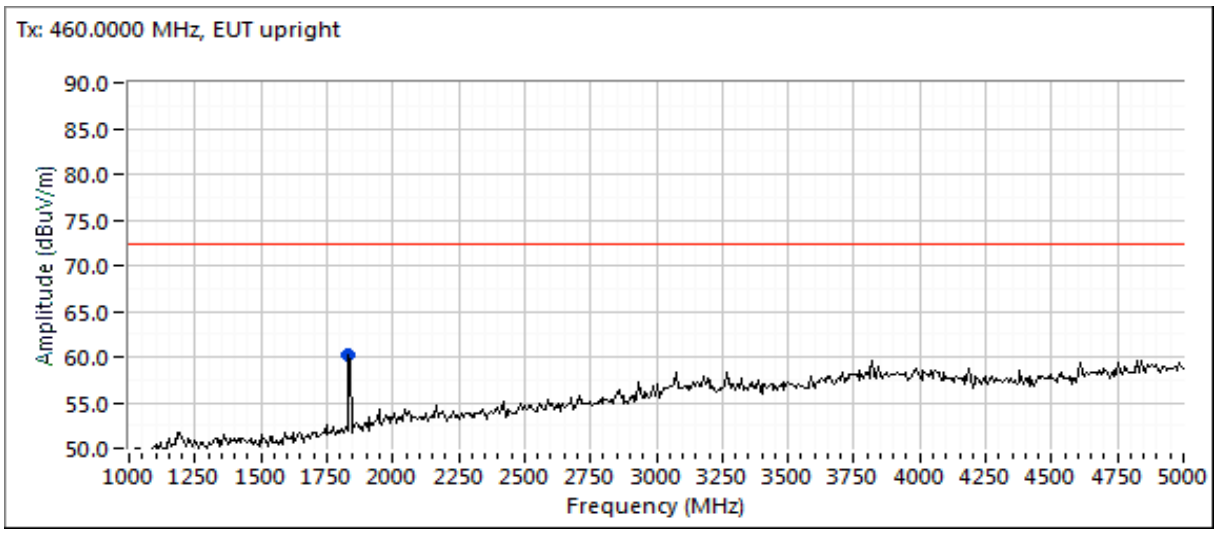




Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

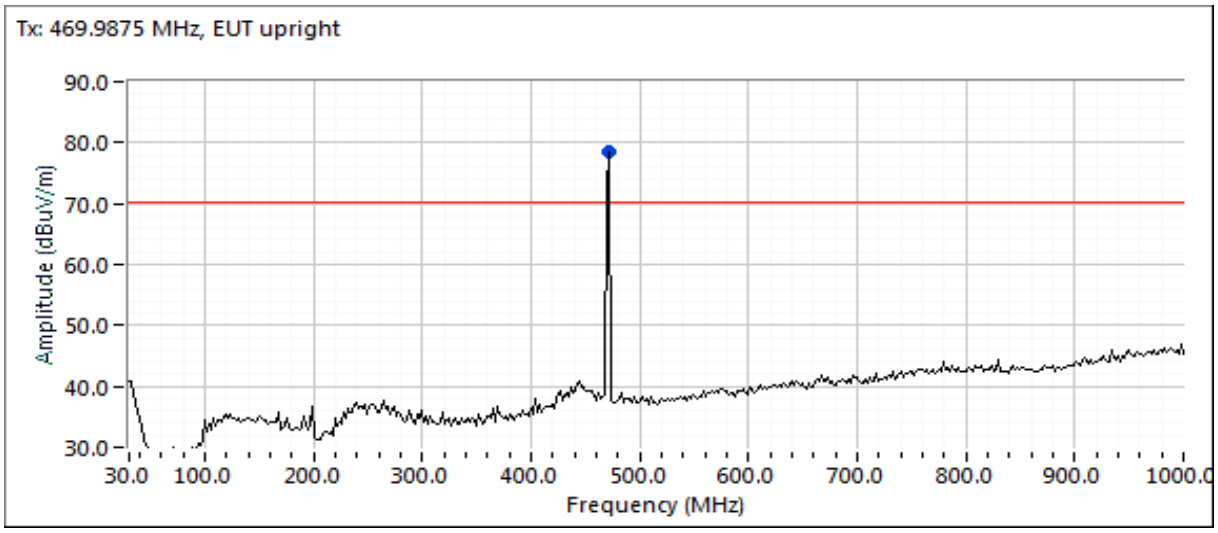
Tx: 460.0000 MHz, EUT upright

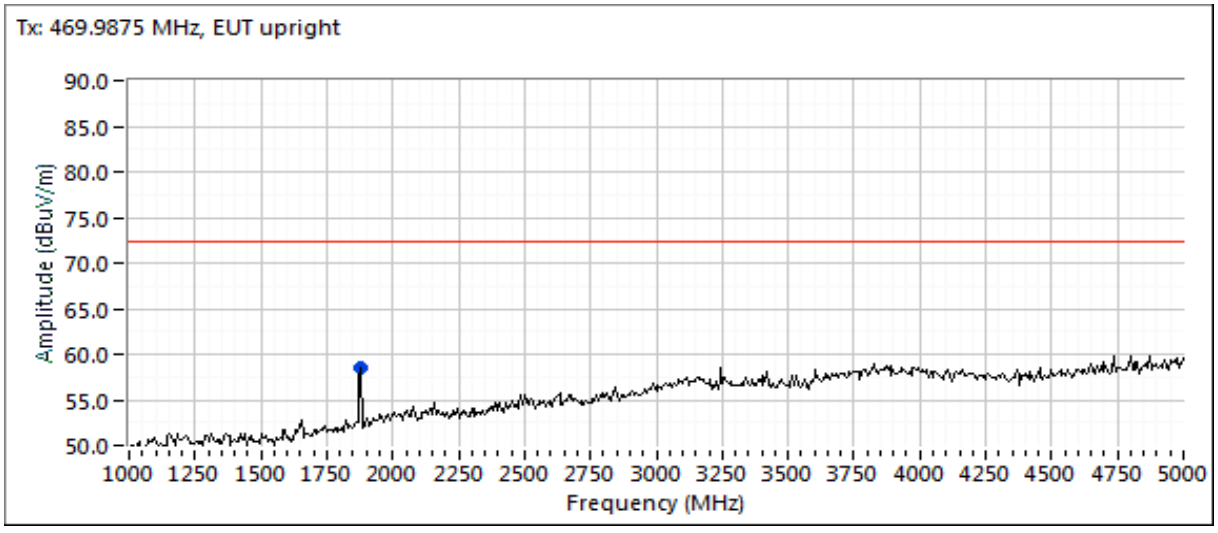




Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Tx: 469.9875 MHz, EUT upright





Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Run #5b: - Substitution Measurements

Horizontal

Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
1879.999	-40.0	8.7	64.7	96.0	63.8	-32.2	-34.4		-25.0	-9.4

Vertical

Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
1879.997	-40.0	8.7	64.3	95.6	62.7	-32.9	-35.1		-25.0	-10.1

Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm.
Note 5:	EUT field strength as measured during initial run.

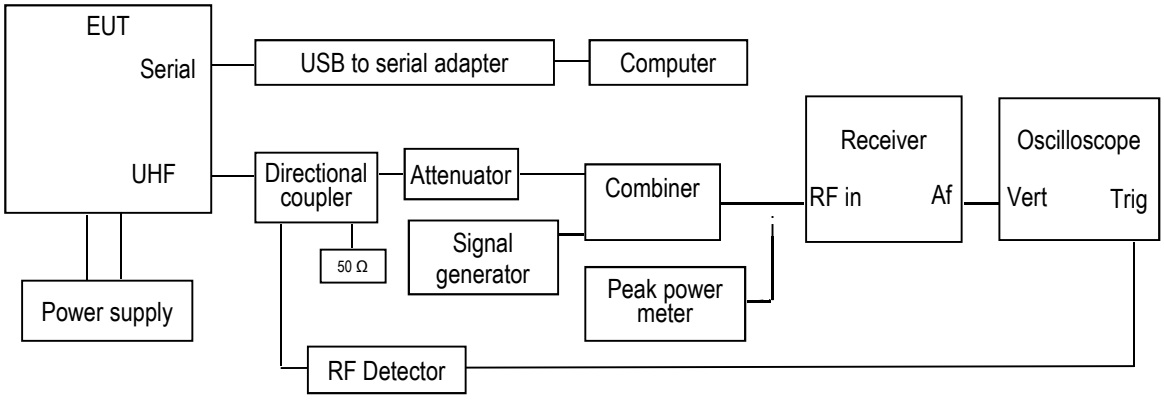
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Run #6: Transient Frequency Behaviour

Date of Test:	5/17/2018	Config. Used:	1
Test Engineer:	Mehran Birgani	Config Change:	None
Test Location:	Fremont Chamber #5	EUT Voltage:	4.2 Vdc

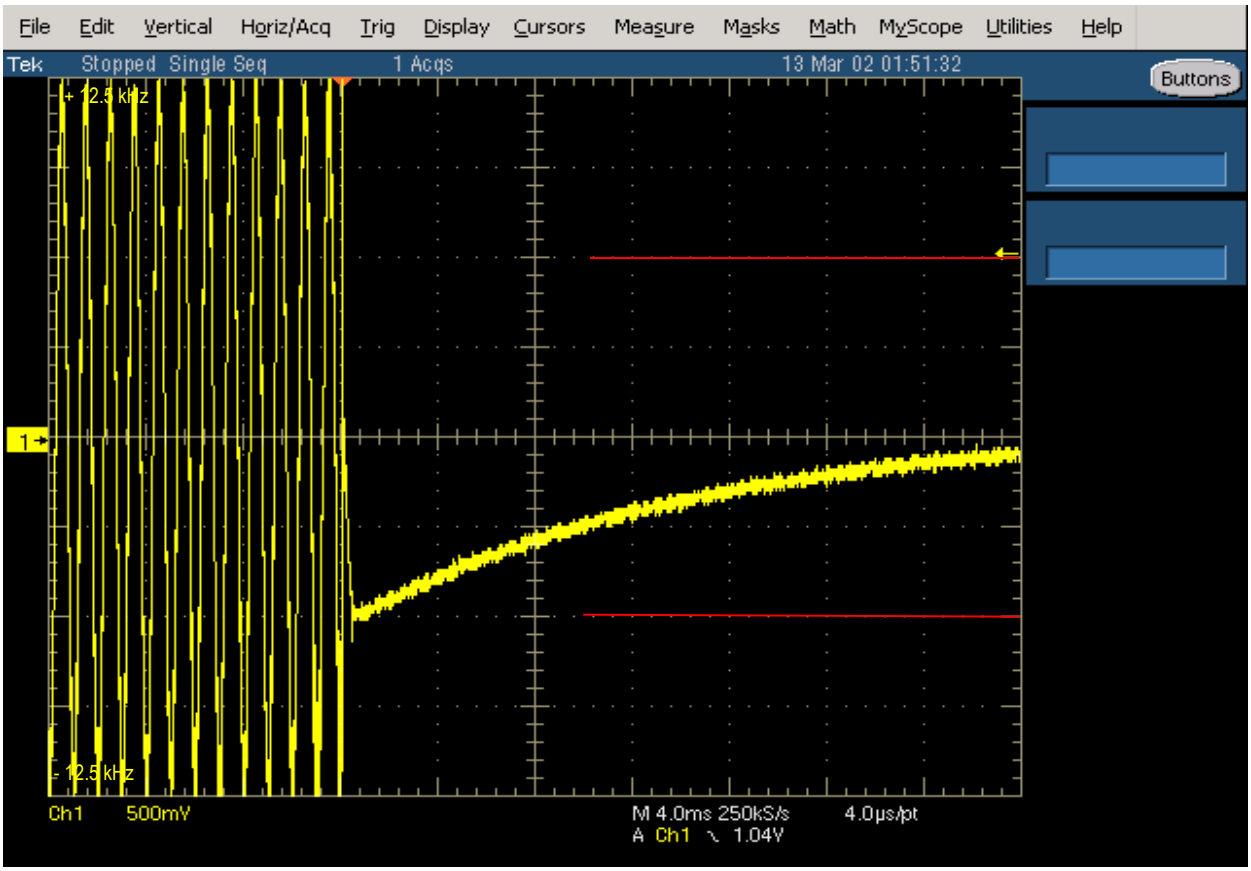
Transient frequency Behaviour measurements setup

Note: The test has been performed with the method given in ANSI / TIA 603-C (2.2.19)



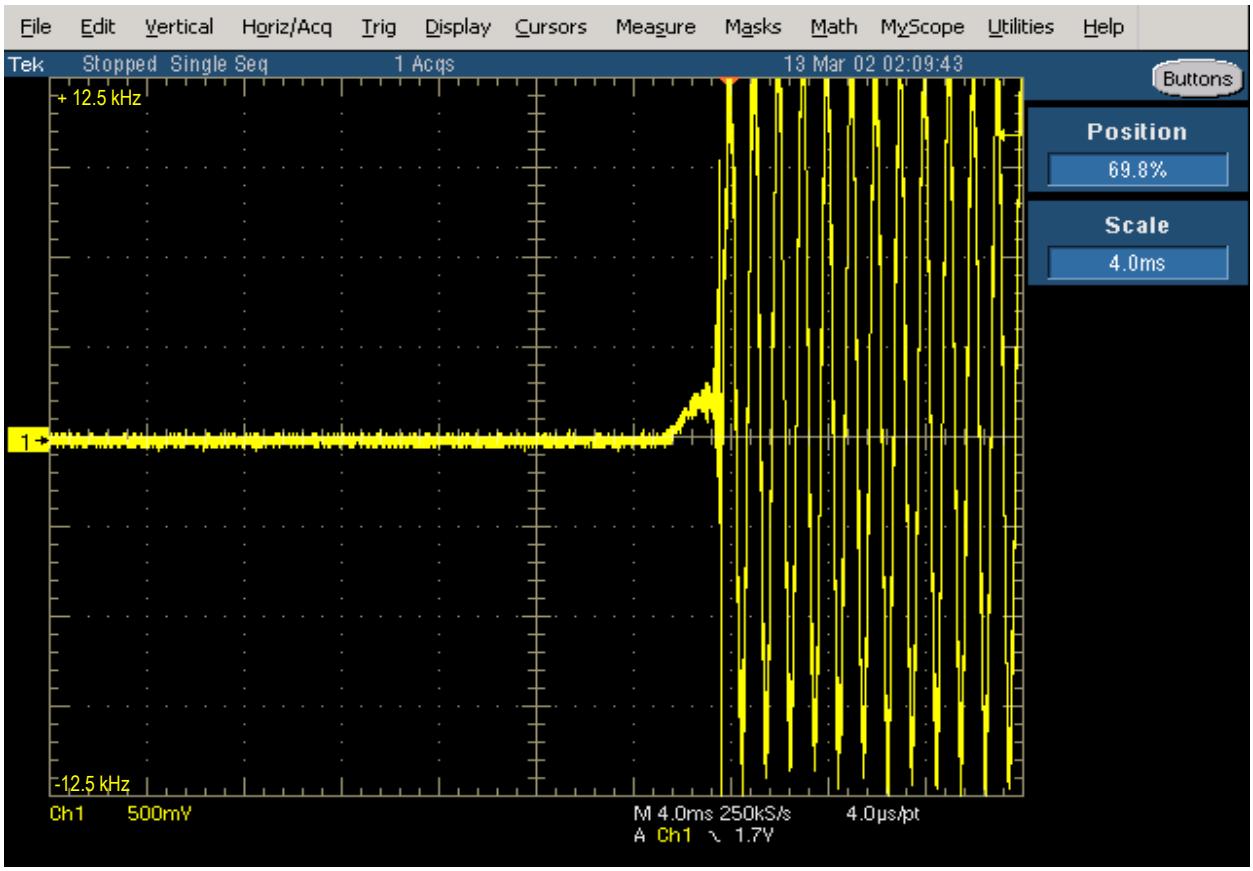
Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Run #6a
Carrier Frequency: 429.9875 MHz
Channel Spacing: 12.5 kHz (worst case)
Modulation: CW
Description: Switch on condition ton, t1, and t2



Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Run #6b
Carrier Frequency: 429.9875 MHz
Channel Spacing: 12.5 kHz (worst case)
Modulation: CW
Description: Switch off condition t3 and toff



Client:	Topcon Positioning Systems	Job Number:	PR079758
Model:	R2L UHF	T-Log Number:	TL079758-Radio
		Account Manager:	Suzan Hill
Contact:	Ferdinand Riodique	Project Engineer:	Deniz Demirci
Standard:	FCC Part 90, RSS-119 Issue 12	Class:	B

Run #7: Frequency stability

Date of Test: 5/8/2015
Test Engineer: Deniz Demirci
Test Location: FT Lab #4b

Config. Used: 1
Config Change: None
EUT Voltage: 4.2 Vdc nominal

Temperature	Frequency Measured	Drift	
(Celsius)	(MHz)	(Hz)	(ppm)
-30	429.987820	320	0.7
-20	429.987763	263	0.6
-10	429.987713	213	0.5
0	429.987693	193	0.4
10	429.987633	133	0.3
20	429.987547	47	0.1
30	429.987683	183	0.4
40	429.987683	183	0.4
50	429.987699	199	0.5
Worst case:	429.987681	320	0.7

Frequency Stability Over Input Voltage
Nominal Voltage is 4.2 Vdc

Voltage	Frequency Measured	Drift	
(Dc)	(MHz)	(Hz)	(ppm)
3.57	429.987547	47	0.1
4.83	429.987547	47	0.1

End of Report

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