



41039 Boyce Road
Fremont, CA. 94538

510-578-3500 Phone
510-440-9525 Fax

EMC Test Report

Application for FCC Grant of Equipment Authorization Canada Certification

Innovation, Science and Economic Development Canada RSS-Gen Issue 4 / RSS-247 Issue 2 FCC Part 15 Subpart C

Model: TNIT100915

IC CERTIFICATION #: 22980-TNIT100
FCC ID: 2AMUGTNIT100

APPLICANT: TrackNet, Inc.
900 LAFAYETTE ST #329
Santa Clara, CA 95050

TEST SITE(S): National Technical Systems
41039 Boyce Road.
Fremont, CA. 94538-2435

IC SITE REGISTRATION #: 2845B-3; 2845B-4, 2845B-5, 2845B-7

PROJECT NUMBER: PR073580

REPORT DATE: March 9, 2018

FINAL TEST DATES: January 4, 8 and 30 and February 2, 12, 14 and
26 and March 1, 2018

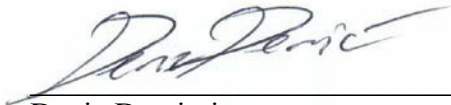
TOTAL NUMBER OF PAGES: 81



This report and the information contained herein represent the results of testing test articles identified and selected by the client performed to specifications and/or procedures selected by the client. National Technical Systems (NTS) makes no representations, expressed or implied, that such testing is adequate (or inadequate) to demonstrate efficiency, performance, reliability, or any other characteristic of the articles being tested, or similar products. This report should not be relied upon as an endorsement or certification by NTS of the equipment tested, nor does it represent any statement whatsoever as to its merchantability or fitness of the test article, or similar products, for a particular purpose. This report shall not be reproduced except in full

VALIDATING SIGNATORIES

PROGRAM MGR



Deniz Demirci
Senior Wireless / EMC Engineer

TECHNICAL REVIEWER:



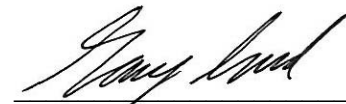
Deniz Demirci
Senior Wireless / EMC Engineer

FINAL REPORT PREPARER:



David Guidotti
Senior Technical Writer

QUALITY ASSURANCE DELEGATE



Gary Izard
Technical Writer



REVISION HISTORY

Rev#	Date	Comments	Modified By
-	March 9, 2018	First release	

TABLE OF CONTENTS

VALIDATING SIGNATORIES	2
REVISION HISTORY	3
TABLE OF CONTENTS	4
SCOPE.....	5
OBJECTIVE.....	5
STATEMENT OF COMPLIANCE.....	6
DEVIATIONS FROM THE STANDARDS.....	6
TEST RESULTS SUMMARY	7
DIGITAL TRANSMISSION SYSTEMS (902 – 928 MHZ).....	7
HYBRID SYSTEMS (902 – 928 MHZ)	7
MEASUREMENT UNCERTAINTIES.....	9
EQUIPMENT UNDER TEST (EUT) DETAILS.....	10
GENERAL.....	10
OTHER EUT DETAILS.....	10
ANTENNA SYSTEM	10
ENCLOSURE.....	10
MODIFICATIONS.....	10
SUPPORT EQUIPMENT.....	10
EUT INTERFACE PORTS	11
EUT OPERATION	11
TEST SITE.....	12
GENERAL INFORMATION.....	12
RADIATED EMISSIONS CONSIDERATIONS	12
MEASUREMENT INSTRUMENTATION	13
RECEIVER SYSTEM	13
INSTRUMENT CONTROL COMPUTER	13
FILTERS/ATTENUATORS	13
ANTENNAS.....	13
ANTENNA MAST AND EQUIPMENT TURNTABLE.....	14
INSTRUMENT CALIBRATION.....	14
TEST PROCEDURES	15
EUT AND CABLE PLACEMENT	15
RADIATED EMISSIONS	15
CONDUCTED EMISSIONS FROM ANTENNA PORT	18
BANDWIDTH MEASUREMENTS.....	18
SPECIFICATION LIMITS AND SAMPLE CALCULATIONS.....	19
GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS	20
RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS.....	20
OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS	21
OUTPUT POWER LIMITS – FHSS SYSTEMS	21
TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS AND DTS SYSTEMS.....	21
SAMPLE CALCULATIONS - RADIATED EMISSIONS.....	22
APPENDIX A TEST EQUIPMENT CALIBRATION DATA	23
APPENDIX B TEST DATA	24
END OF REPORT	81

SCOPE

An electromagnetic emissions test has been performed on the TrackNet, Inc. model TNIT100915, pursuant to the following rules:

RSS-Gen Issue 4 “General Requirements for Compliance of Radio Apparatus”

RSS 247 Issue 2 “Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices”

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 National Technical Systems test procedures:

ANSI C63.10-2013

FCC DTS Measurement Guidance KDB558074 D01 v04

FHSS test procedure DA 00-0705A1

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.

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.

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 sample of TrackNet, Inc. model TNIT100915 complied with the requirements of the following regulations:

RSS-Gen Issue 4 "General Requirements for Compliance of Radio Apparatus"
RSS 247 Issue 2 "Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices"
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 TrackNet, Inc. model TNIT100915 and therefore apply only to the tested sample. The sample was selected and prepared by Joseph Knapp of TrackNet, 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 (902 – 928 MHz)

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247 (a)	RSS 247 5.2	Digital Modulation	Systems uses chirp modulation	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	RSS 247 5.2 (1)	6 dB Bandwidth	709 kHz	>500 kHz	Complies
15.247 (b) (3)	RSS 247 5.4 (4)	Output Power, 902 – 928 MHz	18.4 dBm (0.069 Watts) EIRP = 0.069 W ^{Note 1}	1 Watt, EIRP limited to 4 Watts.	Complies
15.247 (e)	RSS 210 5.2 (2)	Power Spectral Density	3.3 dBm/3 kHz	8 dBm/3 kHz	Complies
15.247 (d)	RSS 247 5.5	Antenna Port Spurious Emissions	All spurious emissions < -30 dBc	< -30 dBc ^{Note 2}	Complies
15.247(d) / 15.209	RSS 247 5.5	Radiated Spurious Emissions 9 kHz – 10 GHz	47.7 dBμV/m @ 1854.0 MHz (-6.3 dB)	Refer to the limits section (p20) for restricted bands, all others <-30 dBc ^{Note 2}	Complies
Note 1: EIRP calculated using antenna gain of 0 dBi for the highest EIRP system.					
Note 2: Limit of -30 dBc used because the power was measured with AVGSA-1 in ANSI C63.10.					

HYBRID SYSTEMS (902 – 928 MHz)

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247 (a) (1) (i)	RSS 247 5.1 (1) & (3)	20 dB Bandwidth	138 kHz	<= 500 kHz	Complies
15.247 (a) (1)	RSS 247 5.1 (2)	Channel Separation	200 kHz	Channel spacing > 20 dB bandwidth	Complies
15.247 (a) (1) (i)	RSS 247 5.1 (3)	Number of Channels	4	N/A	N/A
15.247 (a) (1) (i)	RSS 247 5.1 (3)	Channel Dwell Time (average time of occupancy)	0.375 seconds per channel maximum dwell time	< 0.4 second per channel maximum dwell time	Complies
15.247 (a) (1)	RSS 247 5.1 (1)	Channel Utilization	Refer to operational description	All channels shall, on average, be used equally	Complies
15.247 (b) (3)	RSS 247 5.4 (1)	Output Power	19.6 dBm (0.091 W) EIRP = 0.091 W ^{Note 1}	0.125 Watt, EIRP <= 0.5W	Complies
15.247(e)	RSS 210 5.2 (2)	Power Spectral Density	7.3 dBm/3 kHz	8 dBm/3 kHz	Complies
15.247(d)	RSS 247 5.5	Antenna Port Spurious Emissions	All spurious emissions < -30 dBc	< -30 dBc	Complies
15.247(d) / 15.209	RSS 247 5.5	Radiated Spurious Emissions 9 kHz – 10 GHz	47.7 dBμV/m @ 1854.0 MHz (-6.3 dB)	Refer to the limits section (p20) for restricted bands, all others < -30 dBc	Complies
15.247 (a) (1)	RSS 247 5.1(2)	Receiver bandwidth	Refer to operational description	Shall match the channel bandwidth	Complies
Note 1: EIRP calculated using antenna gain of 0 dBi for the highest EIRP system.					

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Integral antenna	Unique or integral antenna required	Complies
15.407 (b) (6)	RSS-Gen Table 3	AC Conducted Emissions	Testing was not performed as the EUT is battery operated.		
15.247 (i) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to MPE calculations in separate exhibit, RSS 102 declaration and User Manual statements.	Refer to OET 65, FCC Part 1 and RSS-102	Complies
-	RSS-Gen 8.3	User Manual	Integral antenna	Statement for products with detachable antenna	Complies
-	RSS-Gen 8.4	User Manual	Refer to user manual	Statement for all products	Complies
-	RSP-100 RSS-Gen 6.6	Occupied Bandwidth	DTS Mode; 99% BW: 646 kHz Hybrid Mode; 20 dB BW: 138 kHz	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 MHz to 7 GHz	± 0.5 dB
RF power, conducted (Spectrum analyzer)	dBm	25 MHz to 7 GHz	± 0.7 dB
Conducted emission of transmitter	dBm	9 kHz to 26.5 GHz	± 0.7 dB
Conducted emission of receiver	dBm	25 MHz to 26.5 GHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 MHz to 26.5 GHz	± 2.5 dB
Radiated emission (field strength)	dB μ V/m	9 kHz to 1 GHz	± 3.6 dB
		1 GHz to 40 GHz	± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS**GENERAL**

The TrackNet, Inc. model TNIT100915 is an Industrial Tracker that is designed to track outdoor devices. Since the EUT would be placed on a tabletop during operation, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is (Battery operated)

The sample was received on January 4, 2018 and tested on January 4, 8 and 30 and February 2, 12, 14 and 26 and March 1, 2018. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID / IC
TrackNet	TNIT100915	Outdoor tracker	-	2AMUGTNIT100 22980-TNIT100

OTHER EUT DETAILS

The highest internal source of a EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes. In some cases, the highest internal source determines the frequency range of test for radiated emissions. The highest internal source of the EUT was declared as: 928 MHz

The device is battery operated. The batteries are not re-chargeable in the device. The device also has a GNSS receiver (GPS, Glonass).

ANTENNA SYSTEM

The device has 902 - 928 MHz Transceiver with 0 dBi integral antenna gain. Maximum RF power is 19 dBm. It has LoRaWAN chipset.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 5.2 cm wide by 8.5 cm deep by 2.7 cm high.

MODIFICATIONS

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

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
HP	ProBook	Laptop	-	-

The laptop was used to configure the EUT and was not connected during radiated emission testing.

EUT INTERFACE PORTS

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

Port	Connected To	Description	Cable(s)	Length(m)
			Shielded or Unshielded	
None	-	-	-	-

EUT OPERATION

During testing, the EUT was transmitting with required modes and regulatory RF power.

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	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 4	US0027	2845B-4	41039 Boyce Road Fremont, CA 94538-2435
Chamber 5	US0027	2845B-4	

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. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4.

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 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4.

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 20 Hz, 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 1000 MHz 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

Software is used to view and convert receiver measurements to the field strength at an antenna 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 software used for radiated and conducted emissions measurements is NTS EMI Test Software (rev 2.10)

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna 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 C63.10 specifies that the test height above ground for table mounted devices shall be 80 cm for testing below 1 GHz and 1.5 m for testing above 1 GHz. 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 as specified in ANSI C63.4. 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

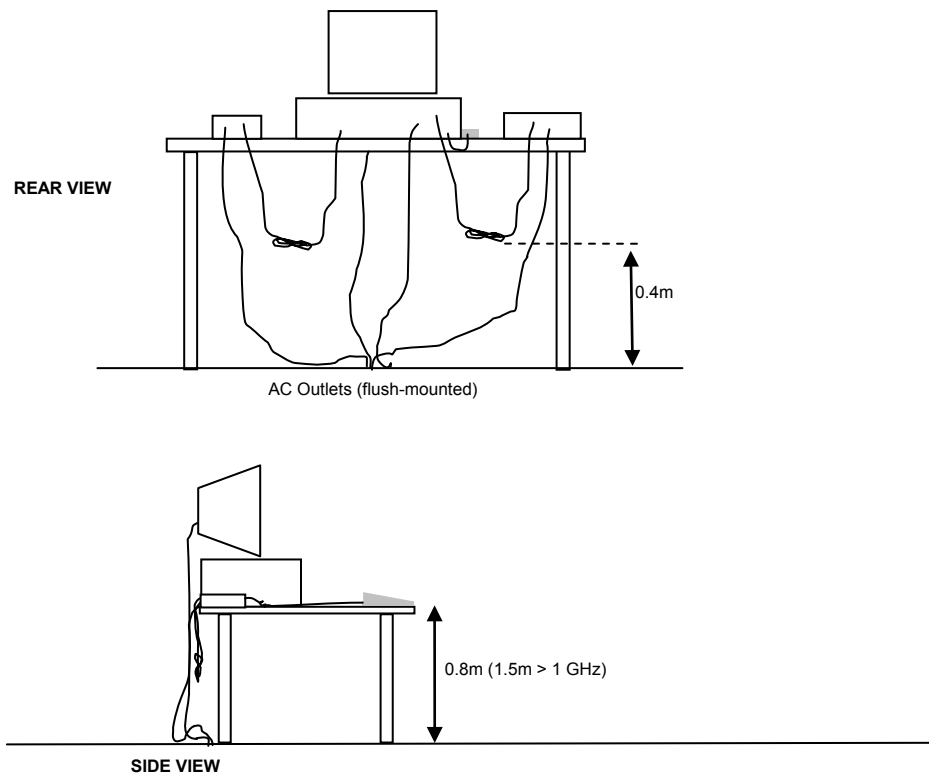
The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.10, and the worst-case orientation is used for final measurements.

RADIATED EMISSIONS

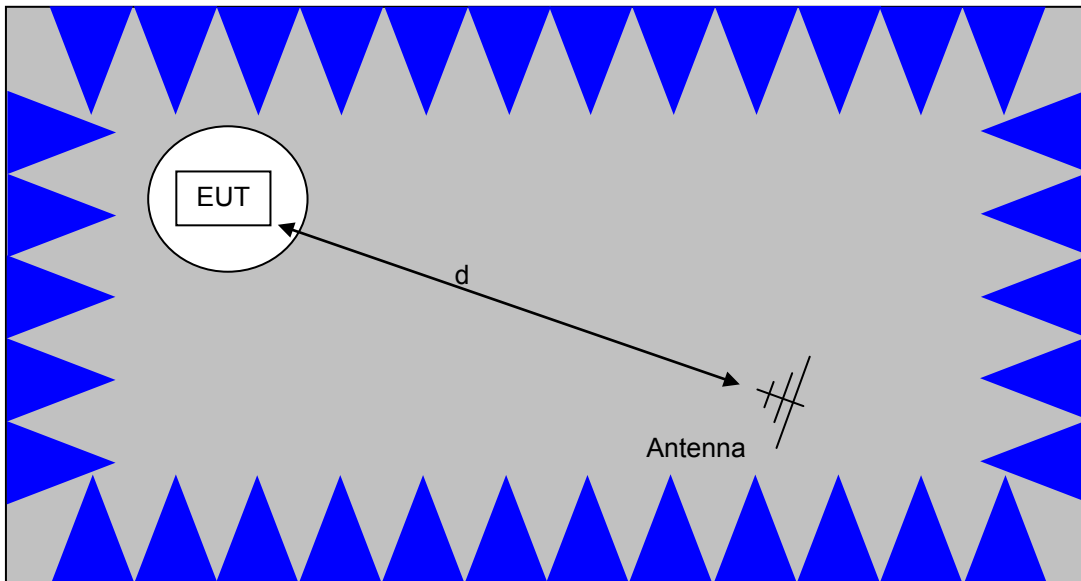
A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). 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.

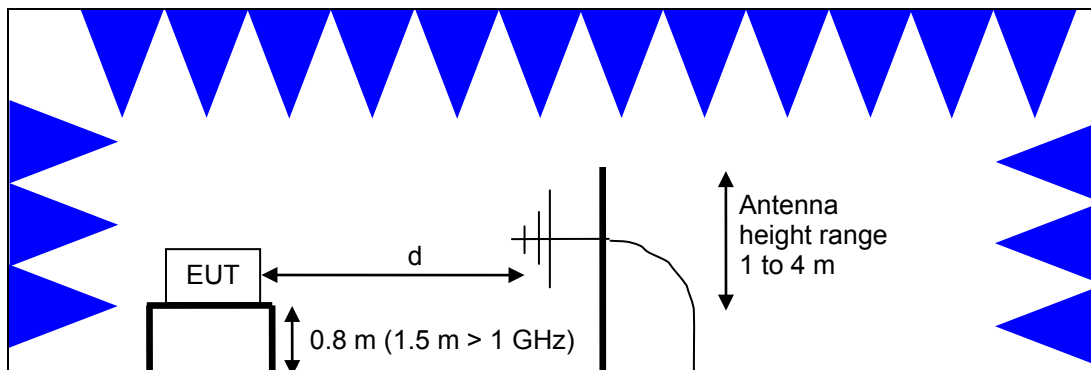


Typical Test Configuration for Radiated Field Strength Measurements



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.

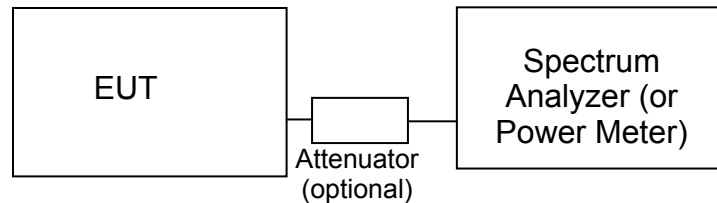
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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 6 dB, 20 dB, 26 dB and/or 99% signal bandwidth are measured using the bandwidths recommended by ANSI C63.10 and 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 (dB μ V). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dB μ V/m). The results are then converted to the linear forms of μ V and μ V/m for comparison to published specifications.

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands¹.

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 and RSS GEN Table 2. Note that receivers operating outside of the frequency range 30 MHz – 960 MHz are exempt from the requirements of 15.109 and receivers that are not stand-alone are exempt from the ISED Canada requirements per RSS-GEN.

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 15.205 and RSS-Gen Table 6

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.

OUTPUT POWER LIMITS – FHSS SYSTEMS

The table below shows the limits for output power based on the number of channels available for the hopping system.

Operating Frequency (MHz)	Number of Channels	Output Power
902 – 928	≥ 50	1 Watt (30 dBm)
902 – 928	25 to 49	0.25 Watts (24 dBm)
2400 – 2483.5	≥ 75	1 Watt (30 dBm)
2400 – 2483.5	< 75	0.125 Watts (21 dBm)
5725 – 5850	75	1 Watt (30 dBm)

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 - 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:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

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:

$$F_d = 40 * \text{LOG}_{10} (D_m/D_s)$$

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 dB μ V/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dB μ V/m

L_s = Specification Limit in dB μ V/m

M = Margin in dB Relative to Spec

Appendix A Test Equipment Calibration Data

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Radiated Emissions, 9 kHz - 10,000 MHz, 04-Jan-18					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
Hewlett Packard	Spectrum Analyzer (SA40) Red 30 Hz -40 GHz	8564E (84125C)	1148	10/14/2017	10/14/2018
Hewlett Packard	High Pass filter, 1.5 GHz (Blue System)	P/N 84300-80037 (84125C)	1389	8/23/2017	8/23/2018
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1657	7/27/2016	7/27/2018
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	8/30/2017	8/30/2018
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESI 40	2493	3/17/2017	3/17/2018
Hewlett Packard	9KHz-1300MHz pre-amp	8447F	2777	12/27/2017	12/27/2018
EMCO	Antenna, Horn, 1-18 GHz	3115	2870	8/24/2017	8/24/2019
Compower	Magnetic Loop Antenna, 9 kHz-30 MHz	AL-130	3003	8/9/2016	8/9/2018
Radiated Emissions, 1000 - 10,000 MHz, 26-Feb-18					
EMCO	Antenna, Horn, 1-18GHz	3115	868	6/30/2016	6/30/2018
Hewlett Packard	Spectrum Analyzer (SA40) Red 30 Hz -40 GHz	8564E (84125C)	1148	10/14/2017	10/14/2018
Hewlett Packard	High Pass filter, 1.5 GHz (Blue System)	P/N 84300-80037 (84125C)	1389	8/23/2017	8/23/2018
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	8/30/2017	8/30/2018
Radiated Emissions, 9 kHz - 1500 MHz, 01-Mar-18					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18GHz	3115	868	6/30/2016	6/30/2018
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	1549	5/30/2017	5/30/2019
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	8/30/2017	8/30/2018
Com-Power	Preamplifier, 1-1000 MHz	PAM-103	2885	8/30/2017	8/30/2018
Compower	Magnetic Loop Antenna, 9 kHz-30 MHz	AL-130	3003	8/9/2016	8/9/2018
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	9482	10/28/2016	10/28/2018
Radio Antenna Port (Power), 01-Mar-18					
Agilent Technologies	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HX,	E4446A	2139	7/31/2017	7/31/2018



Appendix B Test Data

TL073580-RA Pages 25 – 80



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Product	Industrial Tracker	T-Log Number:	PR073580-T
System Configuration:		Project Manager:	Deepa Shetty
Contact:	Joe Knapp	Project Coordinator:	
Emissions Standard(s):	FCC 15.247, RSS-247	Class:	B
Immunity Standard(s):		Environment:	

EMC Test Data

For The

TrackNet, Inc.

Product

Industrial Tracker

Date of Last Test: 3/6/2018



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

RSS-247 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: 3/1/2018
Test Engineer: John Caizzi / R. Varelas
Test Location: Lab 4B

Config. Used: 2
Config Change: none
EUT Voltage: Internal battery (3.6 VDC)

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: 20.6 °C
Rel. Humidity: 39 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	Max.	Max.	Output Power	15.247(b)	Pass	18.4 dBm (0.069 W)
2	Max.	Max.	Power spectral Density (PSD)	15.247(e)	Pass	3.3 dBm/3 kHz
3	Max.	Max.	Minimum 6 dB Bandwidth	15.247(a)	Pass	709 kHz
3	Max.	Max.	Band edge	15.247(d)	Pass	< 30 dBc
3	Max.	Max.	99% Bandwidth	RSS GEN	-	646 kHz

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.



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
DTS	-	1.00	Yes	-	0	0	10

Sample Notes

Sample S/N: -

Driver: FW: 20171211-amm-tracker-us915.fw

Antenna: Integral PCB trace, inverted F



EMC Test Data

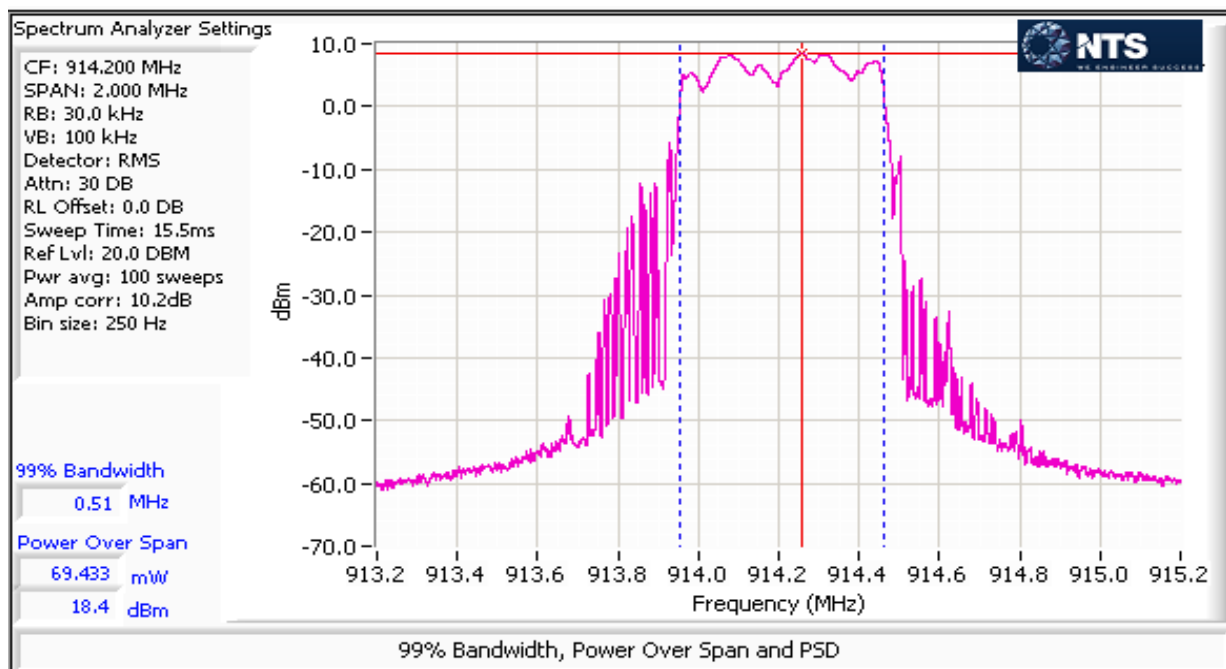
Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1: Output Power

Mode:

Power Setting ²	Frequency (MHz)	Output Power		Antenna Gain (dBi)	Result	EIRP		Output Power	
		(dBm) ¹	mW			dBm	W	(dBm) ³	mW
20	903.0	18.3	67.6	0.0	Pass	18.3	0.068		
	914.2	18.4	69.2	0.0	Pass	18.4	0.069		
	927.0	17.2	52.5	0.0	Pass	17.2	0.052		

Note 1:	Duty Cycle $\geq 98\%$. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW and ≤ 1 MHz, VB $\geq 3^*$ RBW, Span ≥ 1.5 of OBW, auto sweep time, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces (option AVGSA-1 in ANSI C63.10). Spurious limit becomes -30dBc.
Note 2:	Power setting - the software power setting used during testing, included for reference only.





EMC Test Data

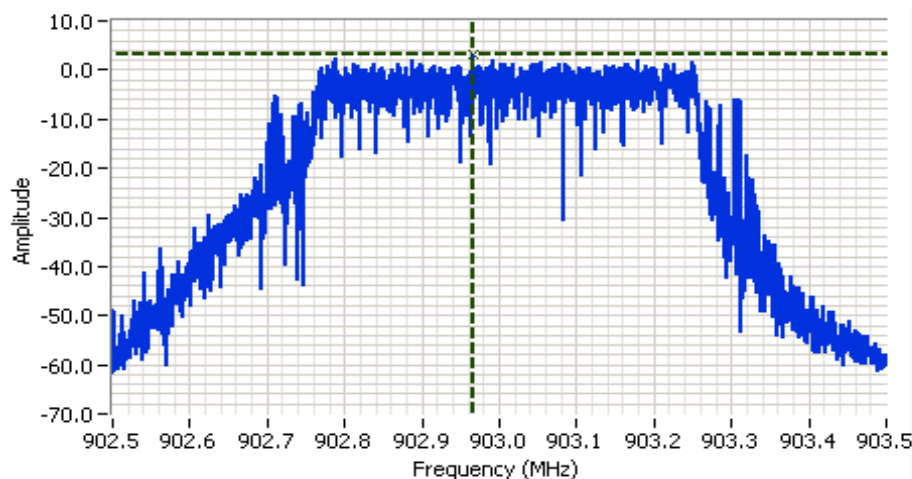
Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #2: Power spectral Density

Mode:

Power Setting	Frequency (MHz)	PSD	Limit dBm/3kHz	Result
		(dBm/3kHz) ^{Note 1}		
20	903.0	3.3	8.0	Pass
	914.2	2.2	8.0	Pass
	927.0	2.6	8.0	Pass

Note 1: Test performed per method AVGPSSD-1, in KDB 558074. Power spectral density measured using: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$, $\text{VBW}=3*\text{RBW}$, RMS detector, span = $1.5*\text{DTS BW}$, auto sweep time, 100 traces.



Analyzer Settings

Agilent Technologies, E4446A
CF: 903.000 MHz
SPAN: 1.000 MHz
RB: 3.00 kHz
VB: 10.0 kHz
Detector: RMS
Attn: 30 DB
RL Offset: 10.2 DB
Sweep Time: 0.3s
Ref Lvl: 30.2 DBM
RMS: 100

Comments

DTS mode
PSD = 3.3 dBm/3kHz

Cursor 1	902.9654	3.3	
	0.0000	0.0	





EMC Test Data

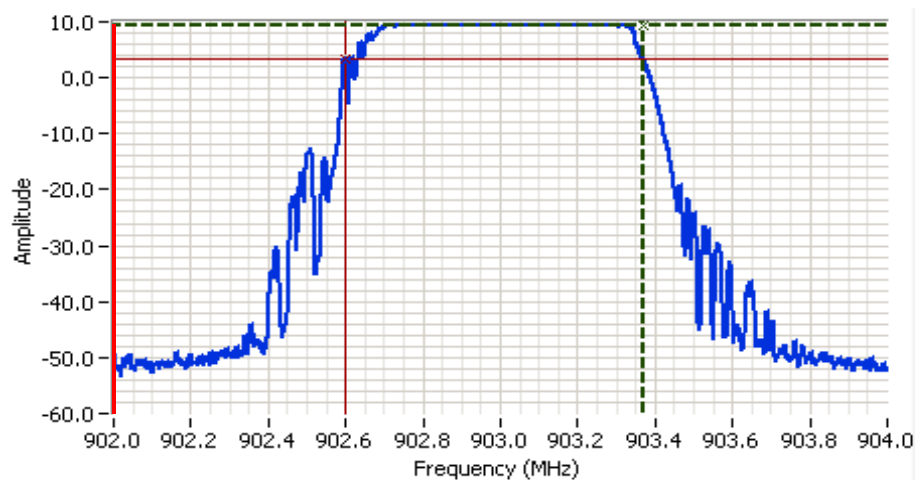
Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #3: Signal Bandwidth

Mode: DTS

Power Setting	Frequency (MHz)	Bandwidth (kHz)		RBW Setting (kHz)	
		6 dB	99%	6 dB	99%
20	903.0	773	620	100	20
	914.2	759	646		
	927.0	709	630		

Note 1: DTS BW: RBW=100kHz, VBW $\geq 3 \times$ RBW, peak detector, max hold, auto sweep time, Span 2-5 times measured BW.
99% BW: RBW=1-5% of 99%BW, VBW $\geq 3 \times$ RBW, peak detector, max hold, auto sweep time. Span 1.5-5 times OBW.



Analyzer Settings

Agilent Technologies, E4446A
CF: 903.000 MHz
SPAN: 2.000 MHz
RB: 100 kHz
VB: 300 kHz
Detector: POS
Attn: 40 DB
RL Offset: 0.0 DB
Sweep Time: 1.1ms
Ref Lvl: 30.0 DBM

Comments

DTS mode
6dB BW: 773 kHz

Cursor 1	903.3692	9.3	
Cursor 2	902.5966	3.3	

Delta Freq. 773 kHz
Delta Amplitude 6.0

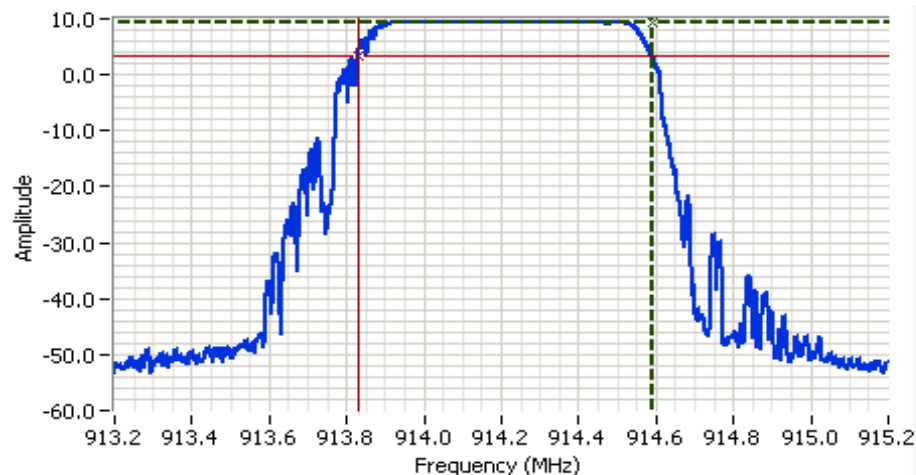


BA @ 902 MHz: Pass, < 30 dBc



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A



Analyzer Settings

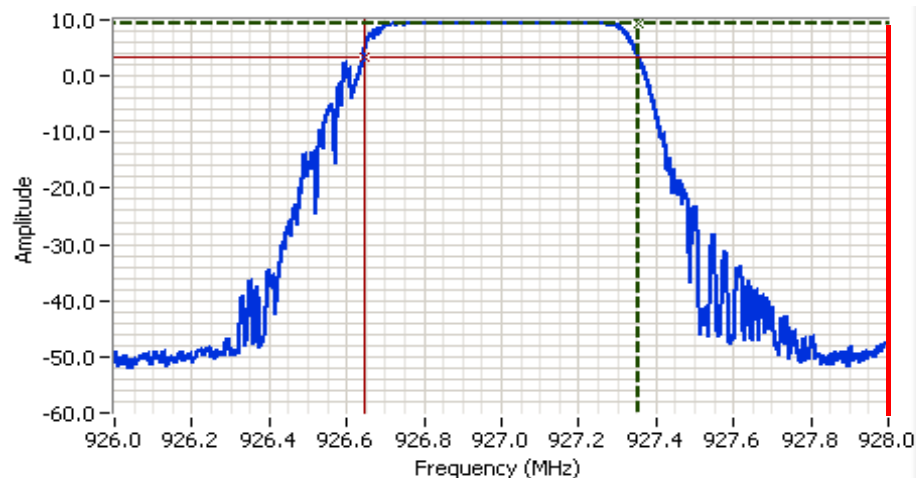
Agilent Technologies, E4446A
CF: 914.200 MHz
SPAN: 2.000 MHz
RB: 100 kHz
VB: 300 kHz
Detector: POS
Attn: 40 DB
RL Offset: 0.0 DB
Sweep Time: 1.1ms
Ref Lvl: 30.0 DBM

Comments

DTS mode
6dB BW: 759 kHz

Cursor 1 914.5899 9.3
Cursor 2 913.8311 3.3

Delta Freq. 759 kHz
Delta Amplitude 6.0



Analyzer Settings

Agilent Technologies, E4446A
CF: 927.000 MHz
SPAN: 2.000 MHz
RB: 100 kHz
VB: 300 kHz
Detector: POS
Attn: 40 DB
RL Offset: 0.0 DB
Sweep Time: 1.1ms
Ref Lvl: 30.0 DBM

Comments

DTS mode
6dB BW: 709 kHz

Cursor 1 927.3554 9.2
Cursor 2 926.6466 3.2

Delta Freq. 709 kHz
Delta Amplitude 6.0

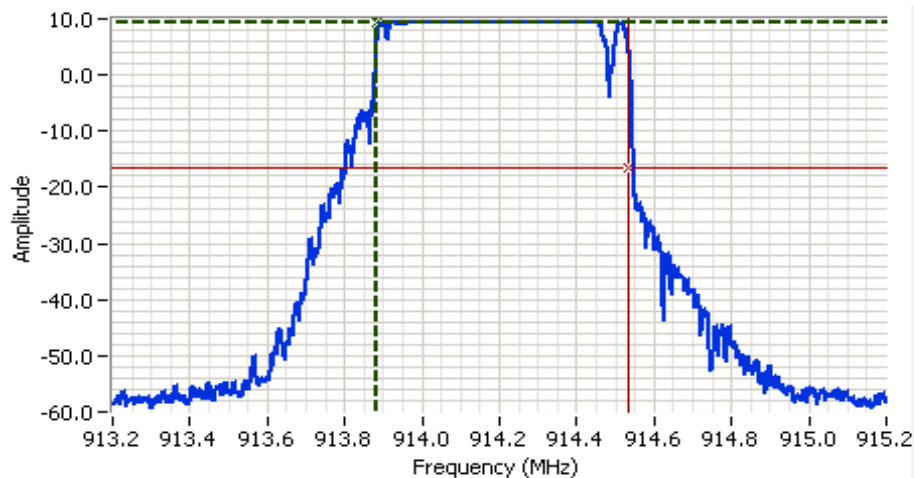


BA @ 928 MHz: Pass, < 30 dBc



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A



Analyzer Settings

Agilent Technologies, E4446A
CF: 914.200 MHz
SPAN: 2.000 MHz
RB: 20.0 kHz
VB: 62.0 kHz
Detector: POS
Attn: 40 DB
RL Offset: 0.0 DB
Sweep Time: 4.8ms
Ref Lvl: 30.0 DBM

Comments

DTS mode
99% power BW: 646 kHz

Cursor 1	913.8848	9.5	
Cursor 2	914.5312	-16.5	

Delta Freq. 646 kHz
Delta Amplitude 26.0





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

RSS-247 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 was located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 21-23 °C
Rel. Humidity: 45-50 %

Summary of Results - Device Operating in the 900 MHz Band

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a	DTS	low	-	-	Radiated Emissions, 9 kHz - 1 GHz	FCC Part 15.209 / 15.247(c)	28.1 dBµV/m @ 966.52 MHz (-25.9 dB)
1b	DTS	center	-	-	Radiated Emissions, 9 kHz - 1 GHz	FCC Part 15.209 / 15.247(c)	27.5 dBµV/m @ 979.05 MHz (-26.5 dB)
1c	DTS	high	-	-	Restricted Band at 960 MHz	FCC Part 15.209 / 15.247(c)	Pass
			-	-	Radiated Emissions, 9 kHz - 1 GHz	FCC Part 15.209 / 15.247(c)	29.8 dBµV/m @ 863.52 MHz (-16.2 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.

Sample Notes

Sample S/N: -

Driver: FW: 20171211-amm-tracker-us915.fw

Antenna: Integral PCB trace, inverted F



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1 MHz, VBW=3 MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
DTS	-	1.00	Yes	-	0	0	10

Measurement Specific Notes:

Note 1:	The preliminary measurements were performed with the EUT positioned in three orientations (Upright, Side and Flat). The flat orientation of the EUT has the worst case fundamental power and spurious emission results. Final measurements were presented with flat orientation.
Note 2:	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.
Note 3:	Emission in non-restricted band, but limit of 15.209 used.
Note 4:	for 300 MHz to 1 GHz measurement range, a narrow band tunable band reject filter (K&L 3 TNF-800/1000) was used and tuned to suppress fundamental signal.



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1: Radiated Spurious Emissions, 9 kHz - 10 GHz. Operating Mode: DTS

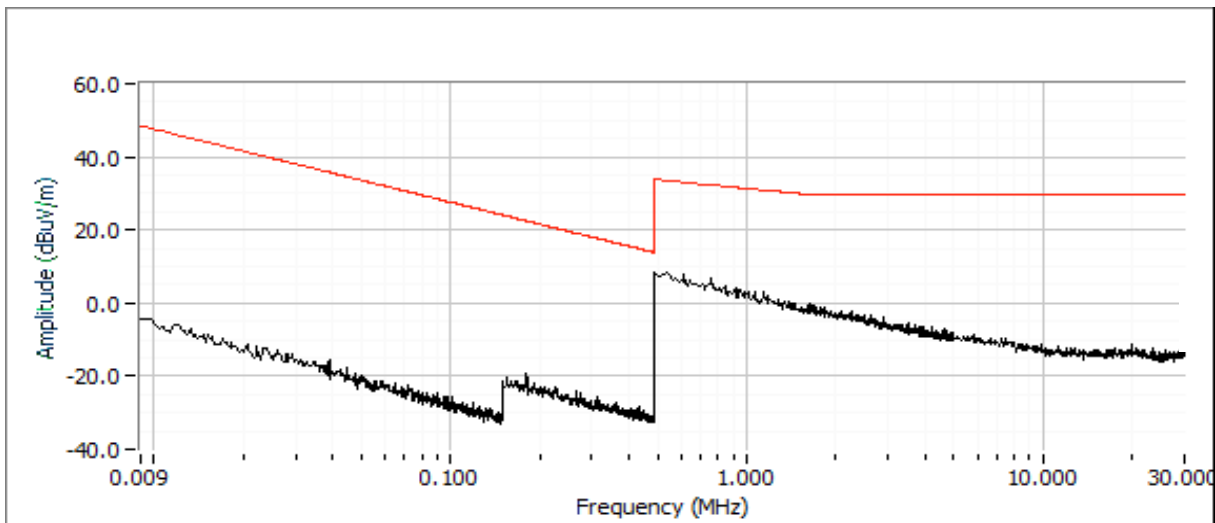
Date of Test: 1/4/2018
 Test Engineer: Deniz Demirci
 Test Location: FT Ch #7

Config. Used: 1
 Config Change: None
 EUT Voltage: Battery operated

Run #1a: Low Channel @ 903 MHz

Spurious Emissions

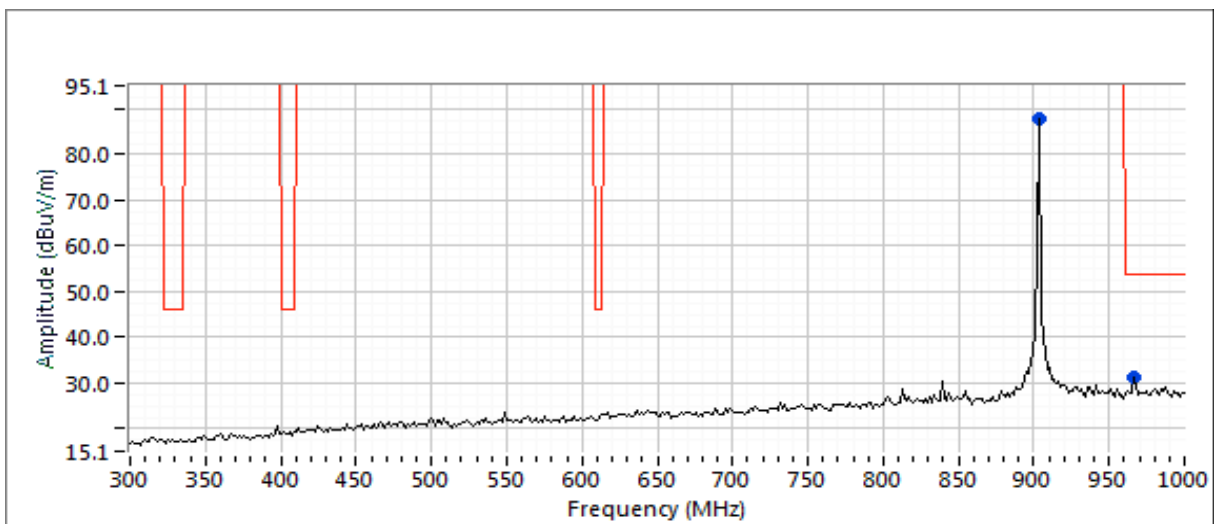
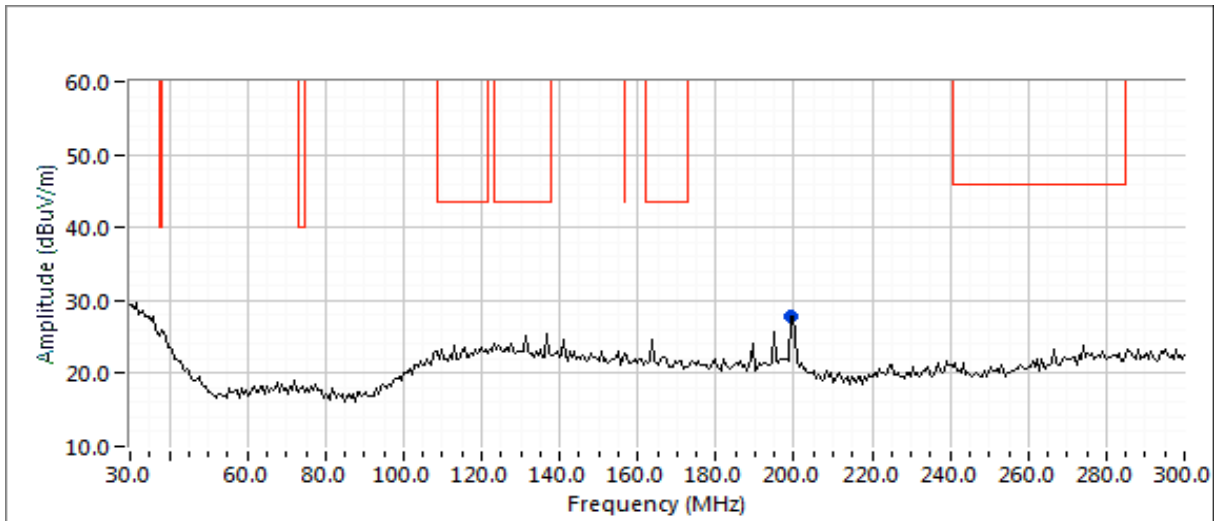
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
199.096	18.7	V	43.5	-24.8	QP	165	1.0	QP (1.00s) - Note 3
903.000	88.0	H	-	-	PK	1	1.0	Fundamental - Note 4 - EUT Flat
966.521	28.1	H	54.0	-25.9	QP	354	1.0	QP (1.00s)





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





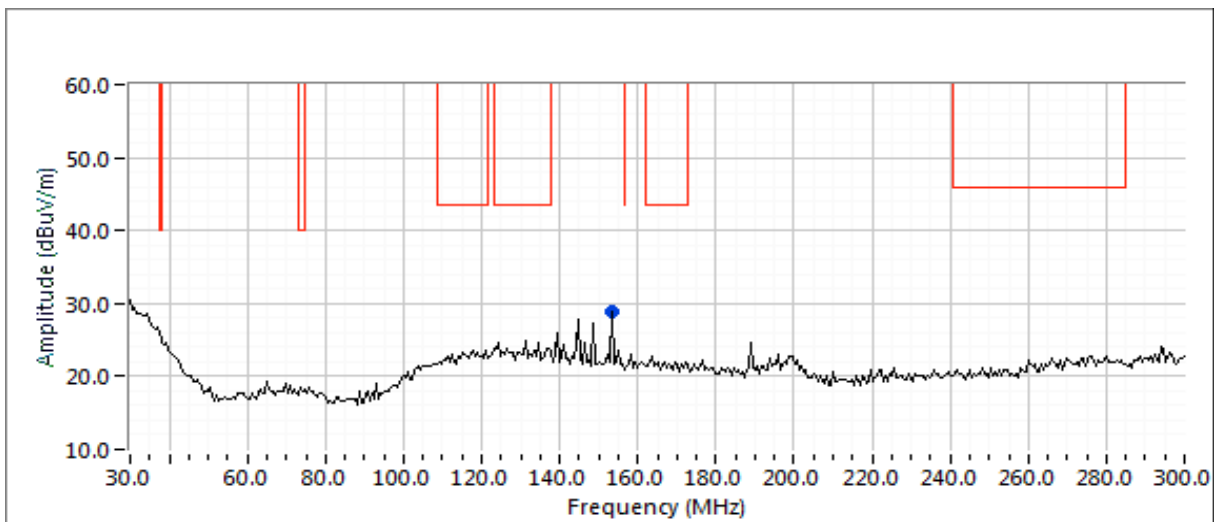
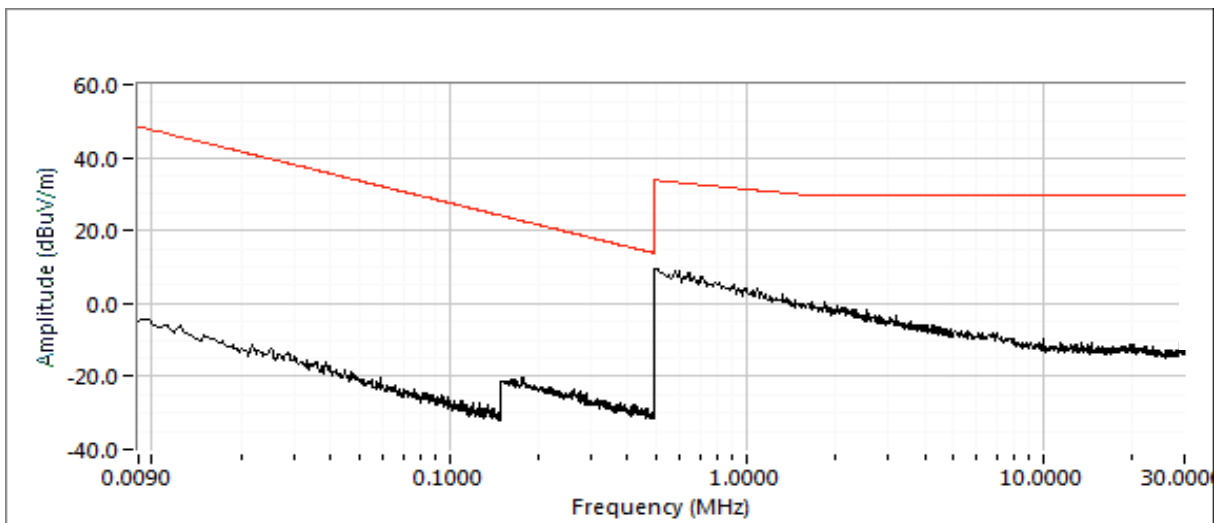
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1b: Center Channel @ 914.2 MHz

Spurious Emissions

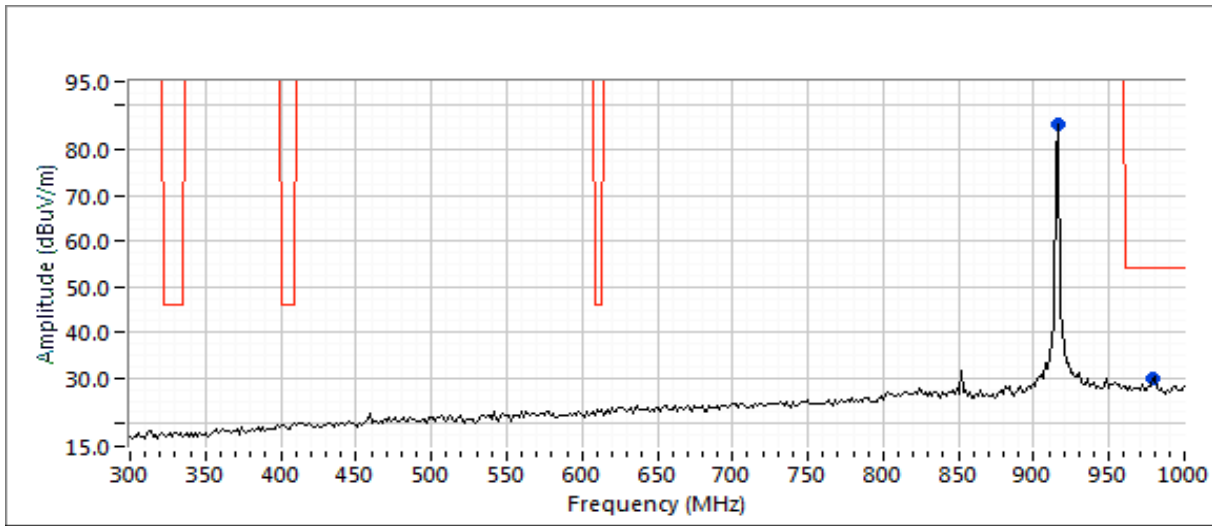
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
152.909	16.1	H	43.5	-27.4	QP	80	3.5	QP (1.00s) - Note 3
914.200	85.8	H	-	-	PK	273	3.0	Fundamental - Note 4 - EUT Flat
979.045	27.5	H	54.0	-26.5	QP	243	1.0	QP (1.00s)





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





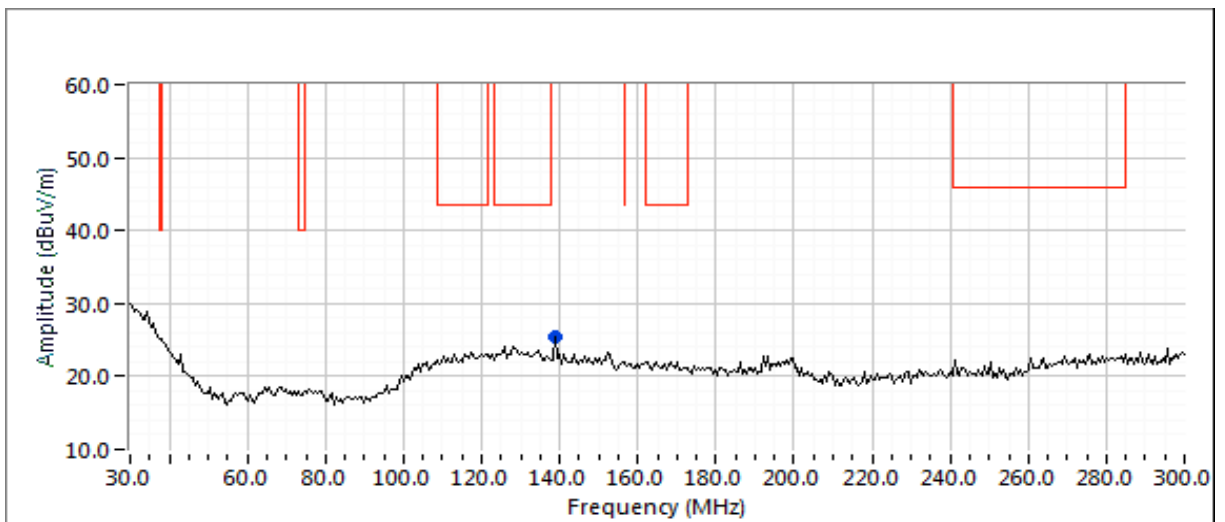
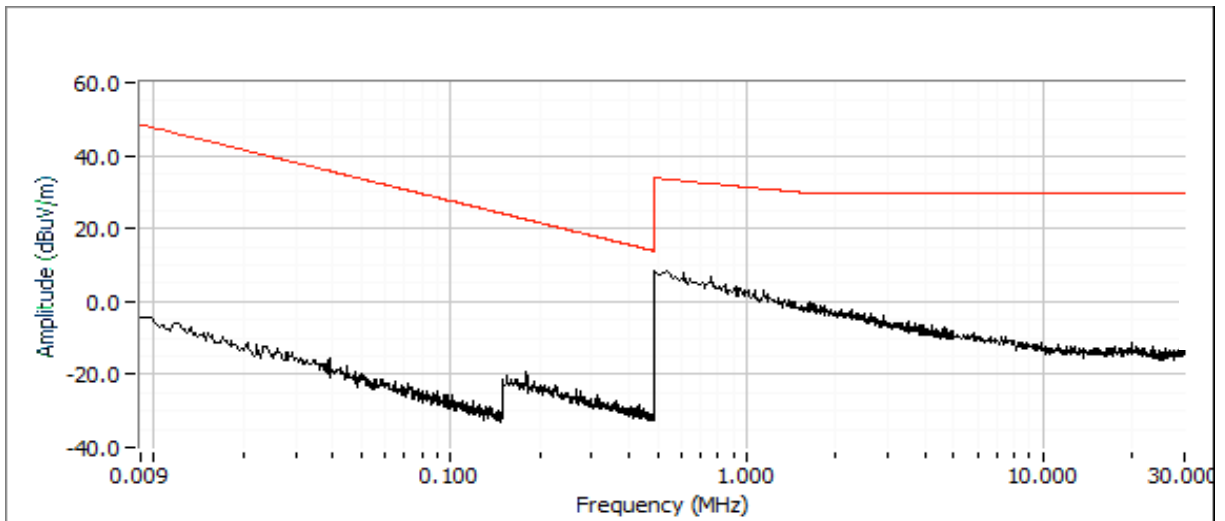
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1c: High Channel @ 927 MHz

Spurious Emissions

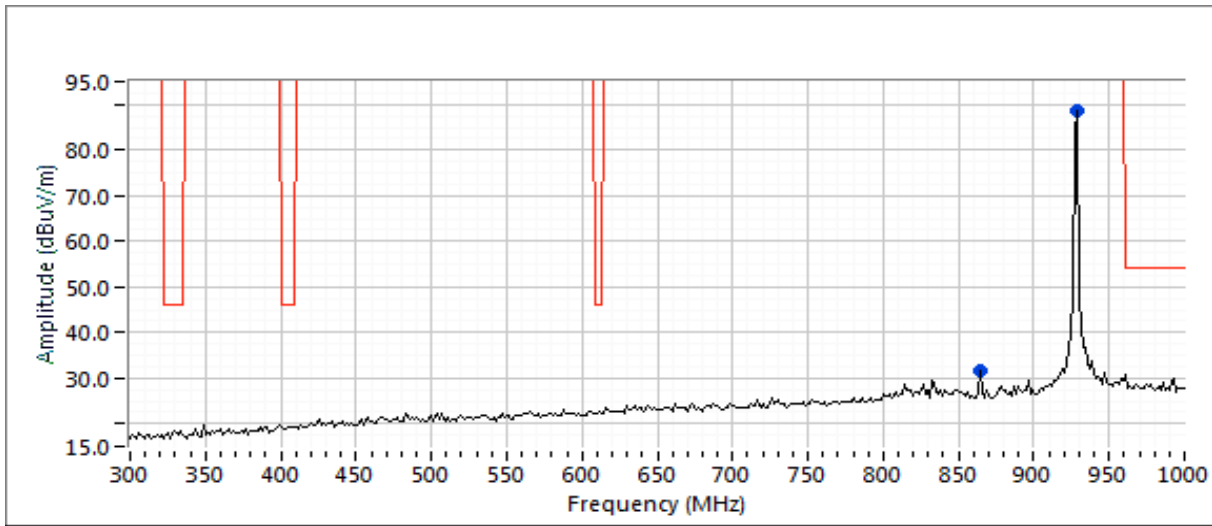
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
138.798	18.6	H	43.5	-24.9	QP	294	2.5	QP (1.00s) - Note 3
863.521	29.8	H	46.0	-16.2	QP	345	1.0	QP (1.00s) - Note 3
927.000	88.5	H	-	-	PK	345	1.0	Fundamental - Note 4 - EUT Flat





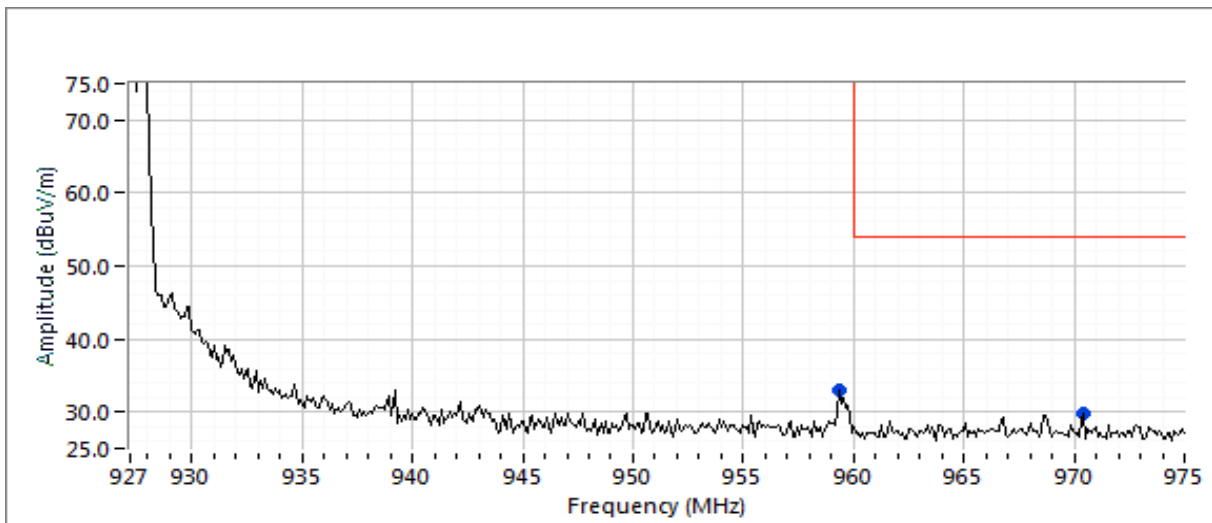
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A



Band Edge

Frequency	Level	Pol	15.247		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
959.523	29.1	H	46.0	-16.9	QP	17	1.0	QP (1.00s) - Note 3
971.639	25.2	H	54.0	-28.8	QP	354	1.0	QP (1.00s)





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

RSS-247 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 was located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 21.6 °C
Rel. Humidity: 38 %

Summary of Results - Device Operating in the 900 MHz Band

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a - EUT Flat	DTS	low	-	-	Radiated Emissions, 1 GHz - 10 GHz	FCC Part 15.209 / 15.247(c)	45.7 dBµV/m @ 2709.0 MHz (-8.3 dB)
1b - EUT Flat	DTS	center	-	-	Radiated Emissions, 1 GHz - 10 GHz	FCC Part 15.209 / 15.247(c)	45.8 dBµV/m @ 1828.7 MHz (-8.2 dB)
1c - EUT Flat	DTS	High	-	-	Radiated Emissions, 1 GHz - 10 GHz	FCC Part 15.209 / 15.247(c)	47.7 dBµV/m @ 1854.0 MHz (-6.3 dB)
1d - EUT Side	DTS	low	-	-	Radiated Emissions, 1 GHz - 10 GHz	FCC Part 15.209 / 15.247(c)	47.0 dBµV/m @ 2709.5 MHz (-7.0 dB)
1e - Upright	DTS	low	-	-	Radiated Emissions, 1 GHz - 10 GHz	FCC Part 15.209 / 15.247(c)	41.3 dBµV/m @ 2708.8 MHz (-12.7 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.

Sample Notes

Sample S/N: -

Driver: FW: 20171211-amm-tracker-us915.fw

Antenna: Integral PCB trace, inverted F



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1 MHz, VBW=3 MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
DTS	-	1.00	Yes	-	0	0	10

Measurement Specific Notes:

Note 1:	The preliminary measurements were performed with the EUT positioned in three orientations (Upright, Side and Flat). The flat orientation of the EUT has the worst case fundamental power and spurious emission results. Final measurements were presented with flat orientation.
Note 3:	Emission in non-restricted band, but limit of 15.209 used.
Note 4:	for 1 GHz to 1.5 GHz measurement range, a narrow band tunable band reject filter (K&L 3 TNF-800/1000) was used and tuned to suppress fundamental signal.



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1: Radiated Spurious Emissions, 1,000 - 10,000 MHz. Operating Mode: DTS

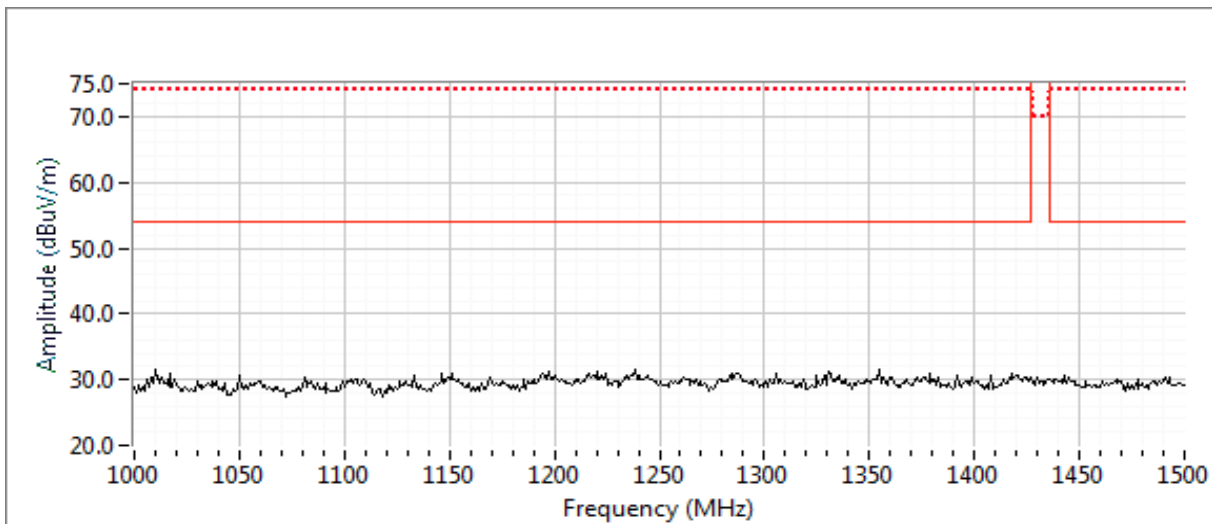
Date of Test: 2/26/2018 & 3/1/18
 Test Engineer: Rafael Varelas & John Caizzi
 Test Location: FT Ch #5

Config. Used: 1
 Config Change: None
 EUT Voltage: Battery operated

Run #1a: Low Channel @ 903 MHz

EUT Flat

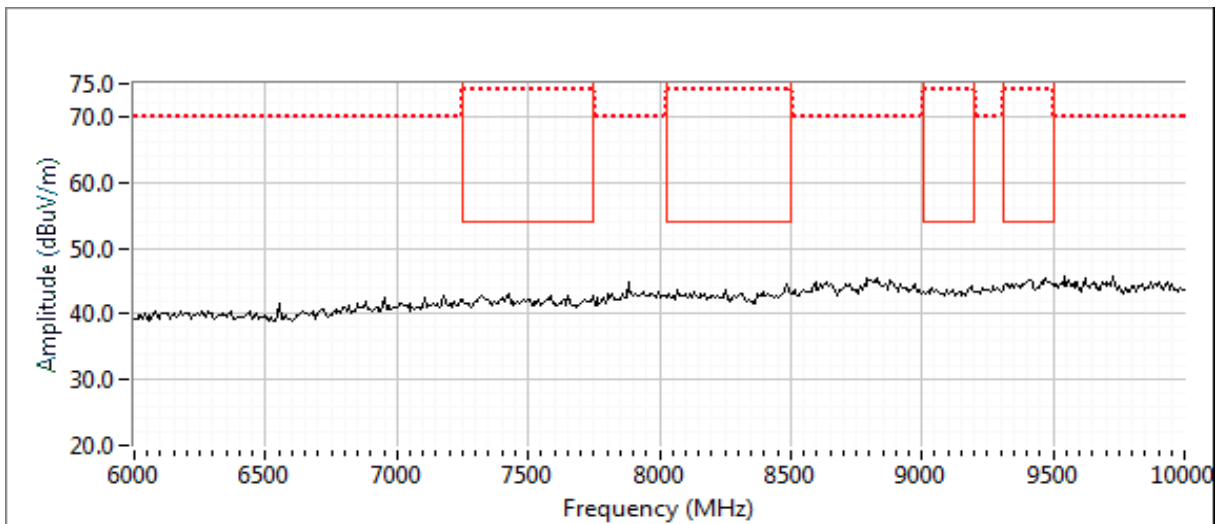
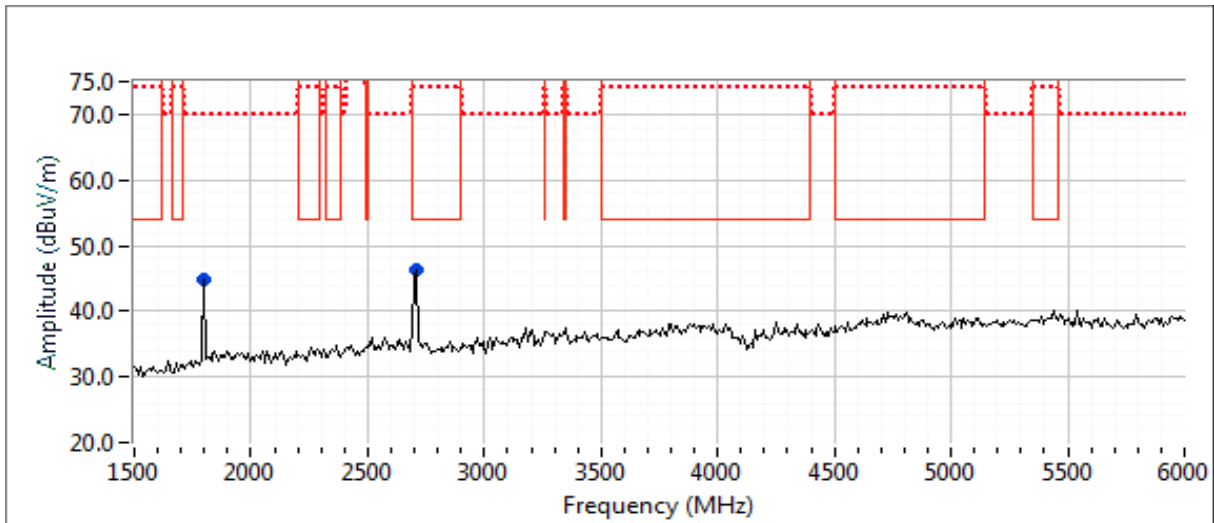
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2709.030	45.7	H	54.0	-8.3	AVG	127	1.6	RB 1 MHz;VB 10 Hz;Peak
2708.840	50.3	H	74.0	-23.7	PK	127	1.6	RB 1 MHz;VB 3 MHz;Peak
1806.470	44.7	H	54.0	-9.3	AVG	249	1.7	Note 3
1806.190	48.4	H	74.0	-25.6	PK	249	1.7	Note 3





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





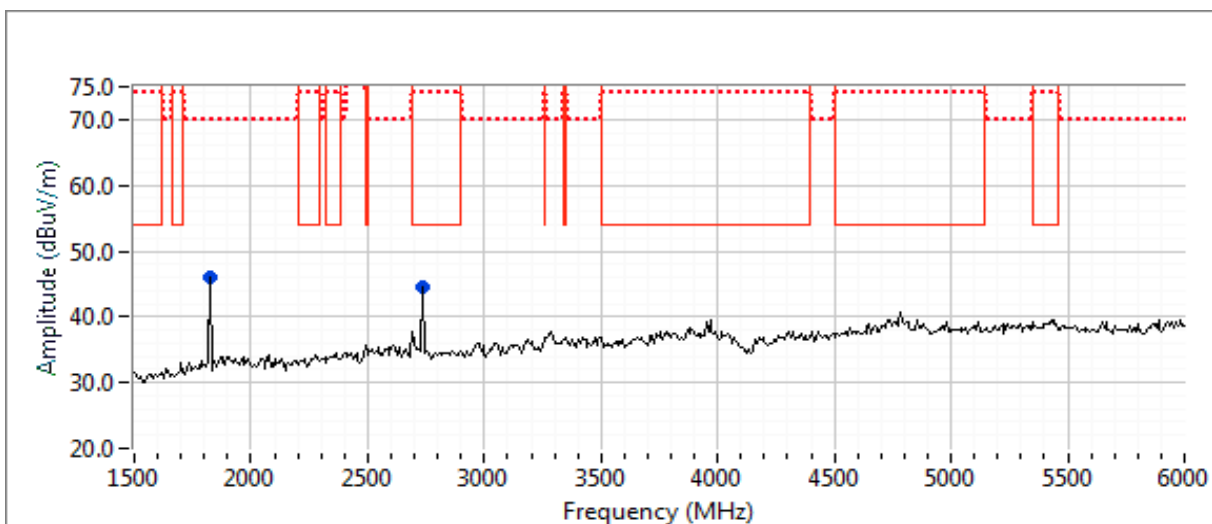
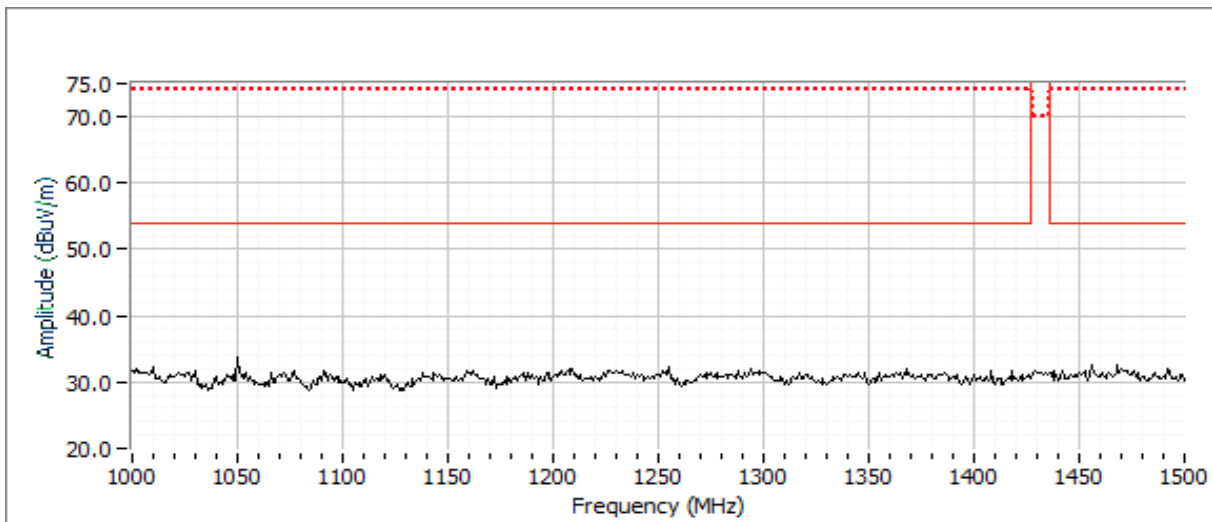
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1b: Center Channel @ 914.2 MHz

EUT Flat

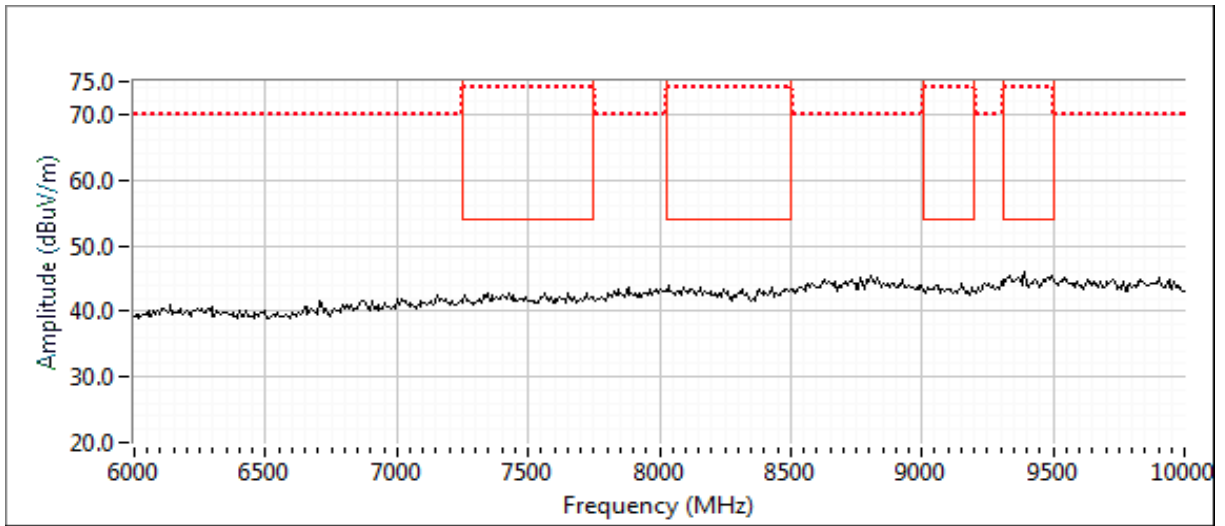
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
1828.670	45.8	H	54.0	-8.2	AVG	234	1.0	Note 3
1828.330	49.4	H	74.0	-24.6	PK	234	1.0	Note 3
2742.640	44.1	H	54.0	-9.9	AVG	213	1.4	RB 1 MHz;VB 10 Hz;Peak
2742.050	49.6	H	74.0	-24.4	PK	213	1.4	RB 1 MHz;VB 3 MHz;Peak





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





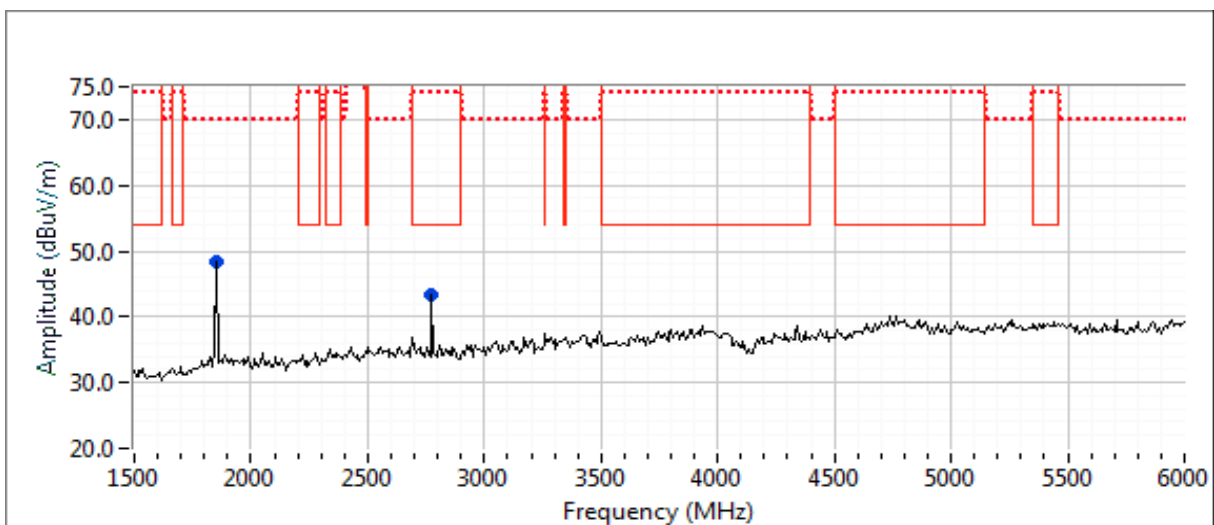
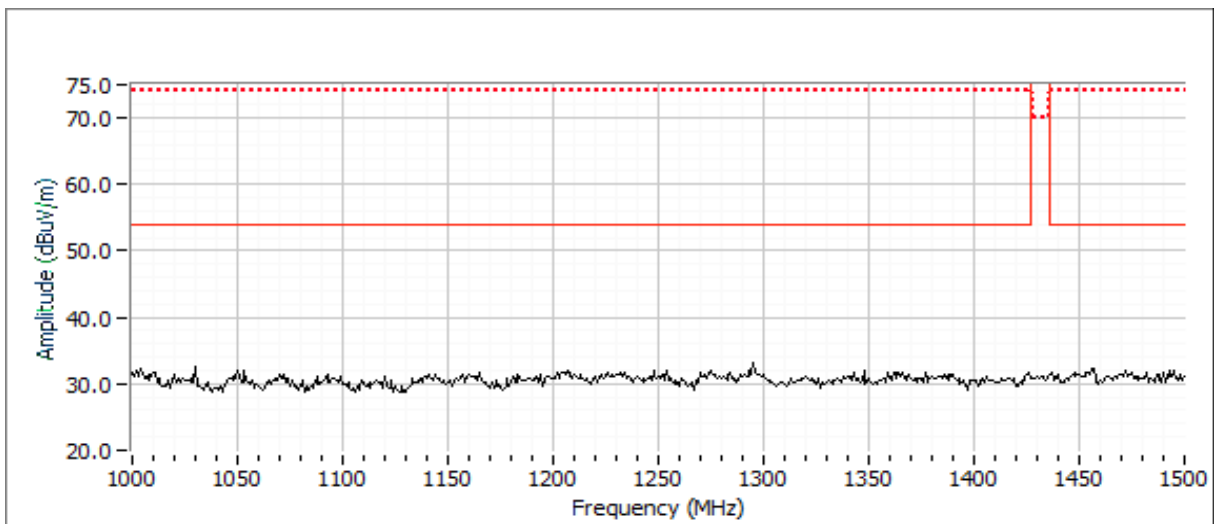
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1c: High Channel @ 927 MHz

EUT Flat

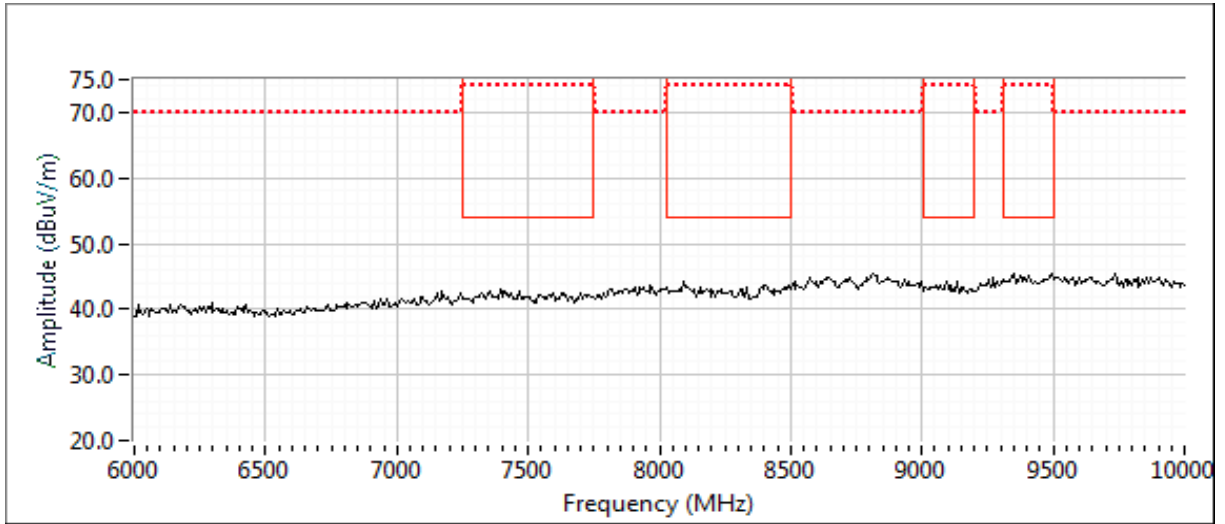
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1854.020	47.7	H	54.0	-6.3	AVG	78	1.0	Note 3
1853.960	51.1	H	74.0	-22.9	PK	78	1.0	Note 3
1853.750	48.6	H	-	-	PK	78	1.0	RB 100 kHz;VB 300 kHz;Peak
2780.980	43.5	H	54.0	-10.5	AVG	142	1.2	RB 1 MHz;VB 10 Hz;Peak
2781.240	49.4	H	74.0	-24.6	PK	142	1.2	RB 1 MHz;VB 3 MHz;Peak





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





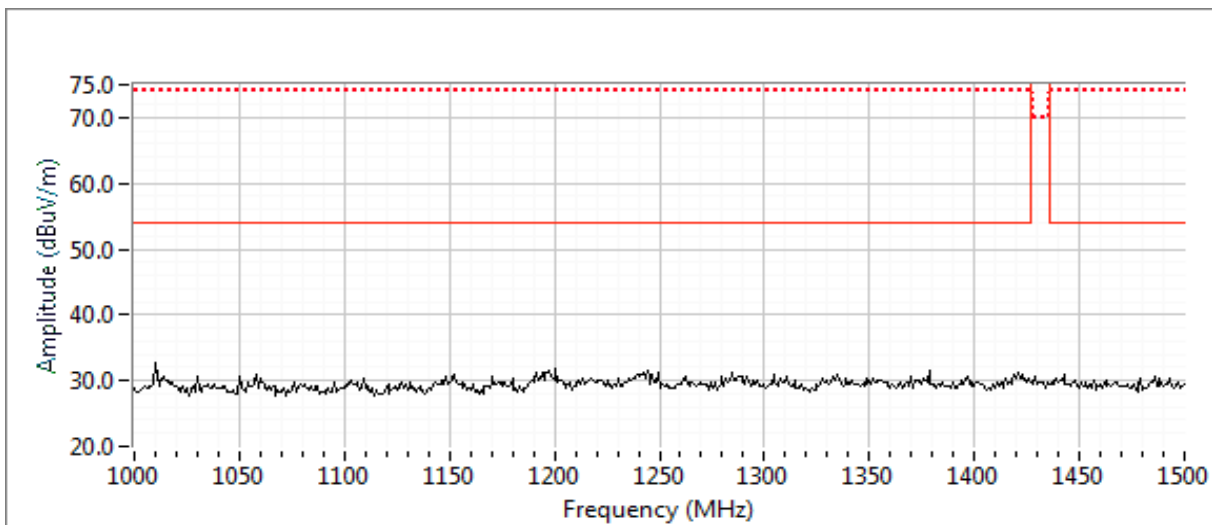
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1d: Low Channel @ 903 MHz

EUT Side

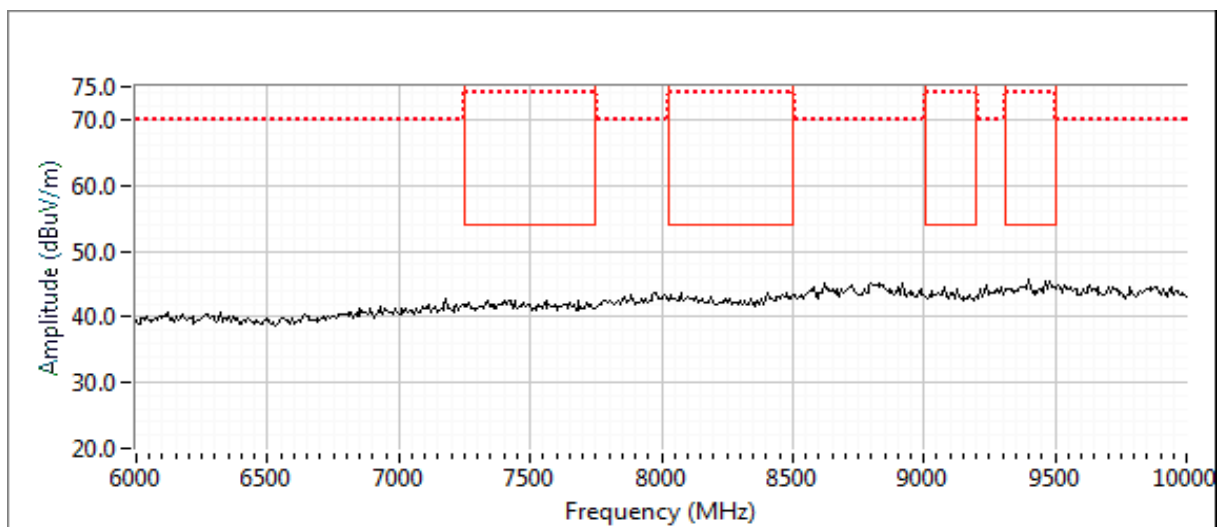
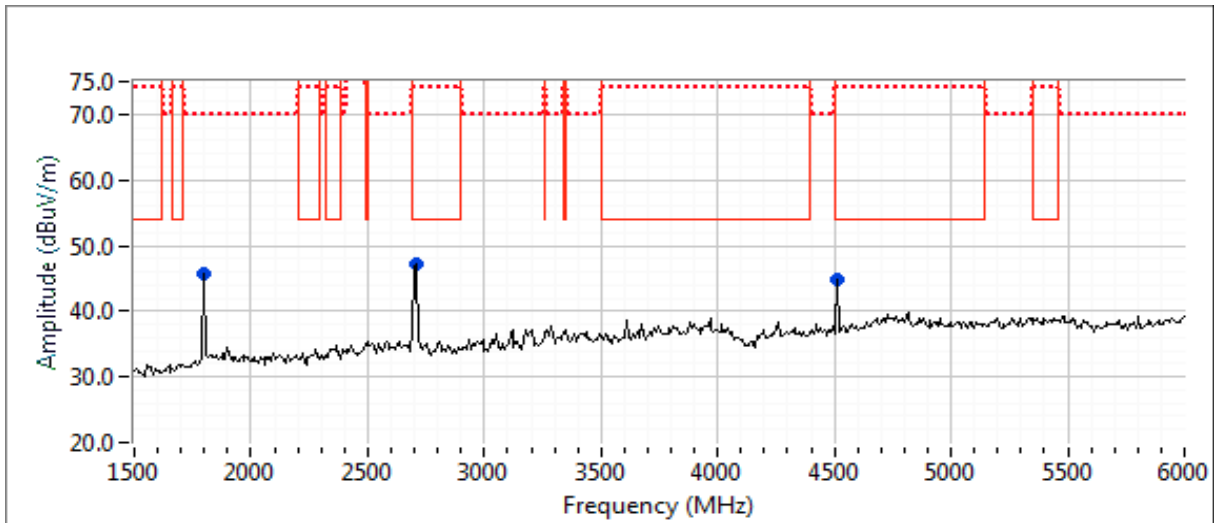
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2709.510	47.0	H	54.0	-7.0	AVG	48	1.0	RB 1 MHz;VB 10 Hz;Peak
2709.960	50.8	H	74.0	-23.2	PK	48	1.0	RB 1 MHz;VB 3 MHz;Peak
4505.440	34.1	V	54.0	-19.9	AVG	345	1.0	RB 1 MHz;VB 10 Hz;Peak
4509.570	46.7	V	74.0	-27.3	PK	345	1.0	RB 1 MHz;VB 3 MHz;Peak
1805.980	41.7	H	54.0	-12.3	AVG	238	1.0	Note 3
1805.720	46.4	H	74.0	-27.6	PK	238	1.0	Note 3
1805.720	43.0	H	-	-	PK	238	1.0	RB 100 kHz;VB 300 kHz;Peak





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





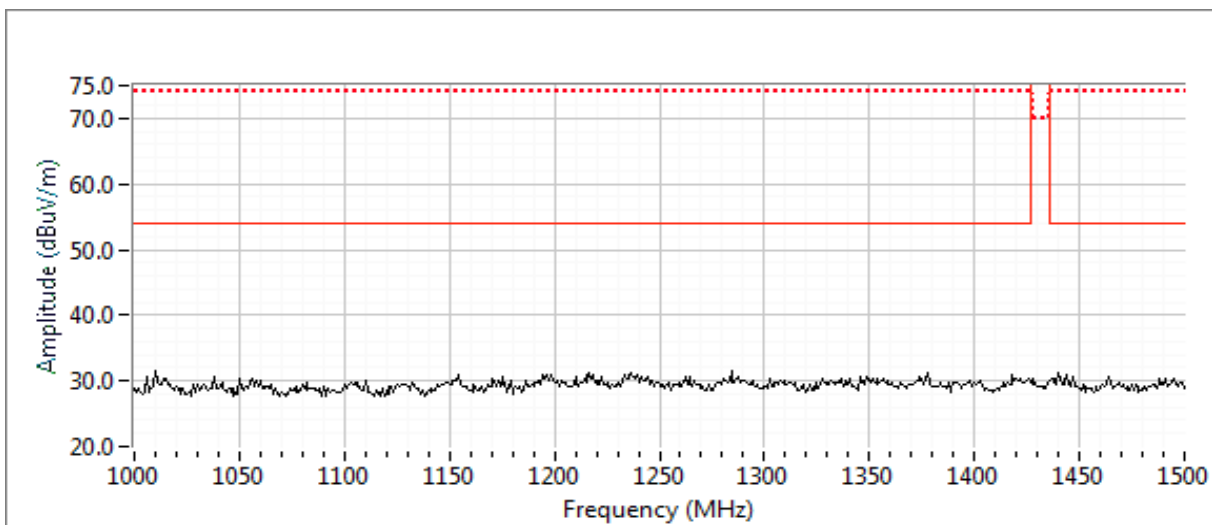
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1e: Low Channel @ 903 MHz

EUT Upright

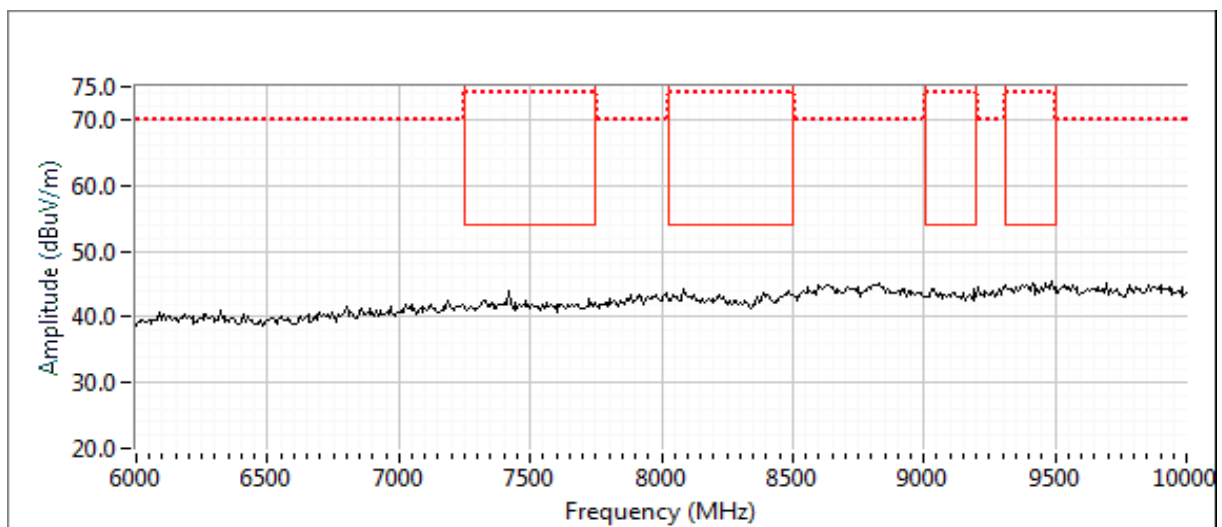
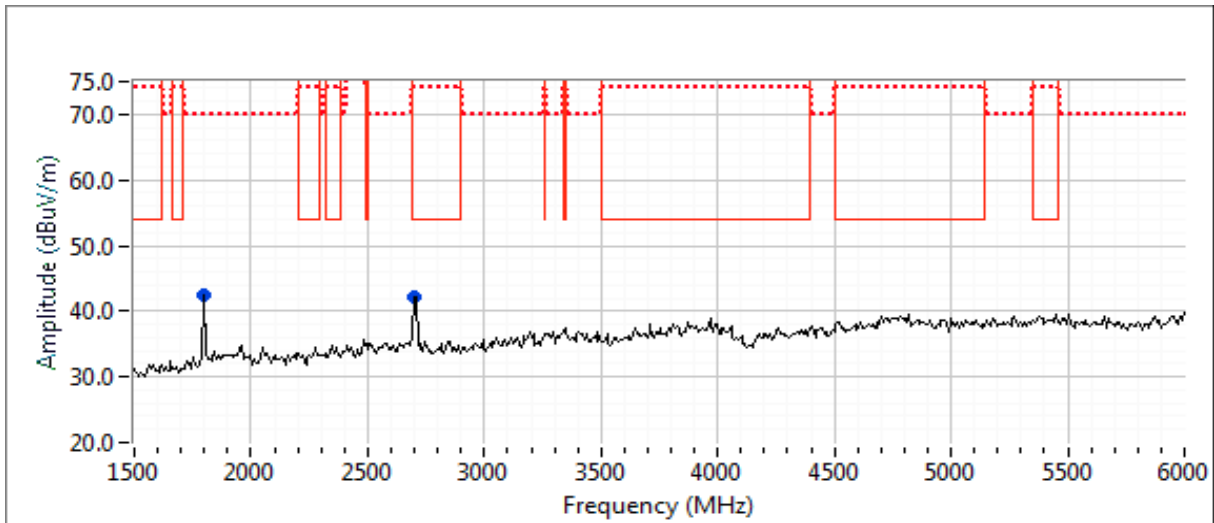
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2708.770	41.3	H	54.0	-12.7	AVG	0	1.0	RB 1 MHz;VB 10 Hz;Peak
2708.880	47.9	H	74.0	-26.1	PK	0	1.0	RB 1 MHz;VB 3 MHz;Peak
1805.810	39.5	V	54.0	-14.5	AVG	154	1.0	Note 3
1806.240	46.5	V	74.0	-27.5	PK	154	1.0	Note 3
1805.960	41.3	V	-	-	PK	154	1.0	RB 100 kHz;VB 300 kHz;Peak





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

RSS-247 and FCC 15.247 (HYBRID System) Measurements Power, 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: 3/1/2018, 3/6/2018
Test Engineer: Rafael Varelas, Deniz Demirci
Test Location: FT lab #4b

Config. Used: 2
Config Change: none
EUT Voltage: Internal battery (3.6 VDC)

General Test Configuration

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators used.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature: 20.6 °C
Rel. Humidity: 39 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	Output Power	15.247(b)	Pass	19.6 dBm (0.0912 W)
2	Power spectral Density (PSD)	15.247(e)	Pass	7.3 dBm/3kHz
3	20 dB Bandwidth	15.247(a)	Pass	138 kHz
3	Channel Occupancy	15.247(a)	Pass	200 kHz
3	Number of Channels	15.247(a)	N/A	4 Channels
4	Spurious emissions (Band edge)	15.247(d)	Pass	< 30 dBc

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.



EMC Test Data

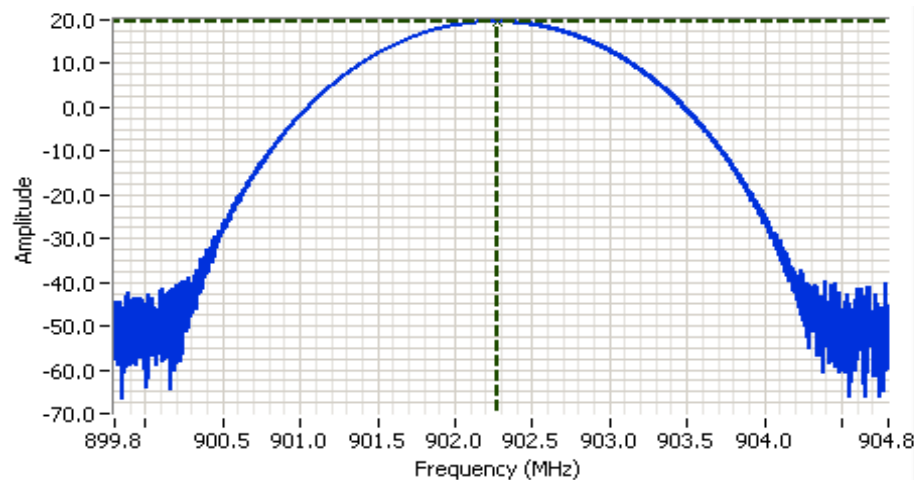
Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1: Output Power

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

Maximum antenna gain: 0 dBi

Channel	Frequency (MHz)	Res BW	Output Power (dBm)	Output Power (W)	EIRP (W)
Low	902.3	1 MHz	19.6	0.091	0.091
Mid	914.9	1 MHz	19.5	0.089	0.089
High	927.5	1 MHz	19.5	0.089	0.089



Analyzer Settings

Agilent Technologies, E4446A
CF: 902.300 MHz
SPAN: 5.000 MHz
RB: 1.000 MHz
VB: 3.000 MHz
Detector: POS
Attn: 30 DB
RL Offset: 10.2 DB
Sweep Time: 1.1ms
Ref Lvl: 27.2 DBM

Comments

Hibrid mode
Power = 19.6 dBm

Cursor 1	902.2678	19.6		
	0.0000	0.0		





EMC Test Data

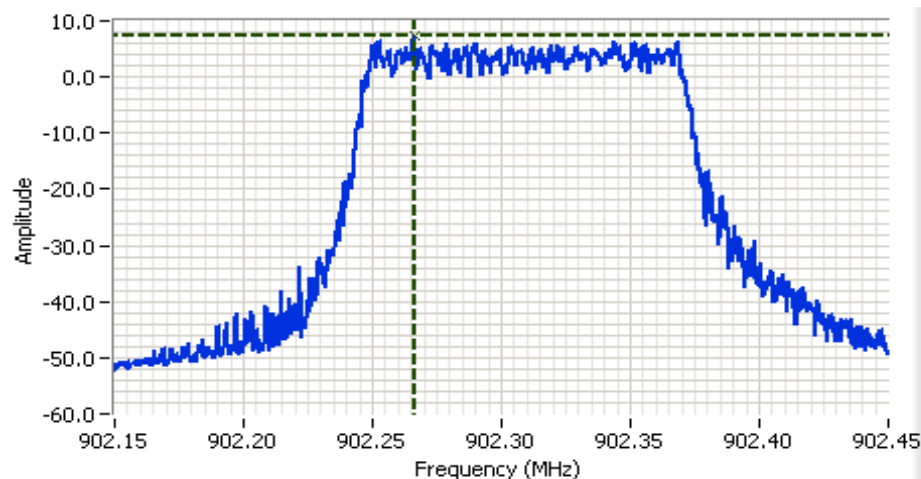
Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #2: Power spectral Density

Mode: Hybrid

Power Setting	Frequency (MHz)	PSD	Limit	Result
		(dBm/3 kHz) ^{Note 1}		
20	902.2662	7.3	8.0	Pass
	914.9046	7.1	8.0	Pass
	927.4937	7.2	8.0	Pass

Note 1: Test performed per method AVGPSD-1, in KDB 558074. Power spectral density measured using: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$, $\text{VBW}=3*\text{RBW}$, RMS detector, span = $1.5*\text{DTS BW}$, auto sweep time, 100 traces.



Analyzer Settings

Agilent Technologies, E4446A
CF: 902.300 MHz
SPAN: 300 kHz
RB: 3.00 kHz
VB: 10.0 kHz
Detector: RMS
Attn: 30 DB
RL Offset: 10.2 DB
Sweep Time: 100.3ms
Ref Lvl: 27.2 DBM
RMS: 100

Comments

Hibrid mode
PSD = 7.3 dBm/3kHz

Cursor 1	902.2662	7.3	
	0.0000	0.0	





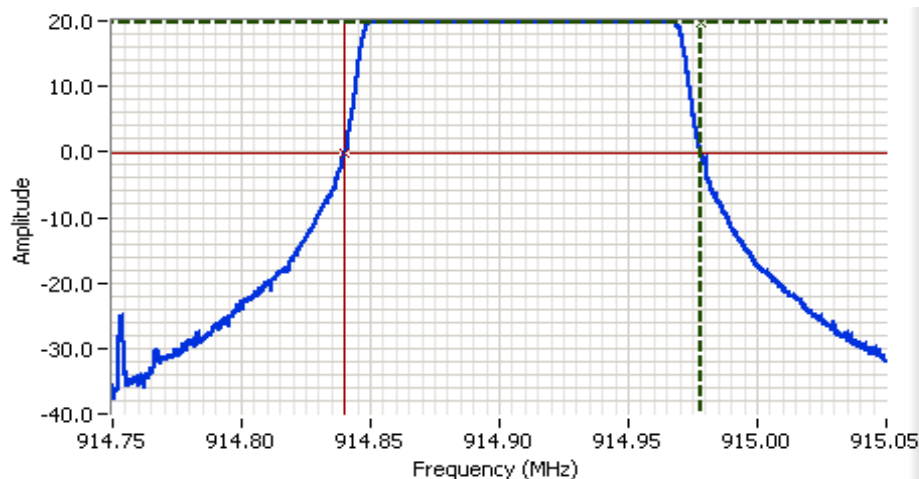
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #3: Bandwidth, Channel Occupancy, Spacing and Number of Channels

Channel	Frequency (MHz)	Resolution Bandwidth	20 dB Bandwidth (kHz)
Low	902.3	3 kHz	138
Mid	914.9	3 kHz	138
High	927.5	3 kHz	138

Note 1: 20 dB bandwidth measured using RB = 3 kHz, VB = 10 kHz (VB > RB)



Analyzer Settings

Agilent Technologies, E4446A
 CF: 914.900 MHz
 SPAN: 300 kHz
 RB: 3.00 kHz
 VB: 10.0 kHz
 Detector: POS
 Attn: 30 DB
 RL Offset: 10.2 DB
 Sweep Time: 32.0ms
 Ref Lvl: 27.2 DBM

Comments

20dB BW: 138 kHz

Cursor 1	914.9780	19.8	
Cursor 2	914.8399	-0.2	

Delta Freq. 138 kHz
 Delta Amplitude 20.0





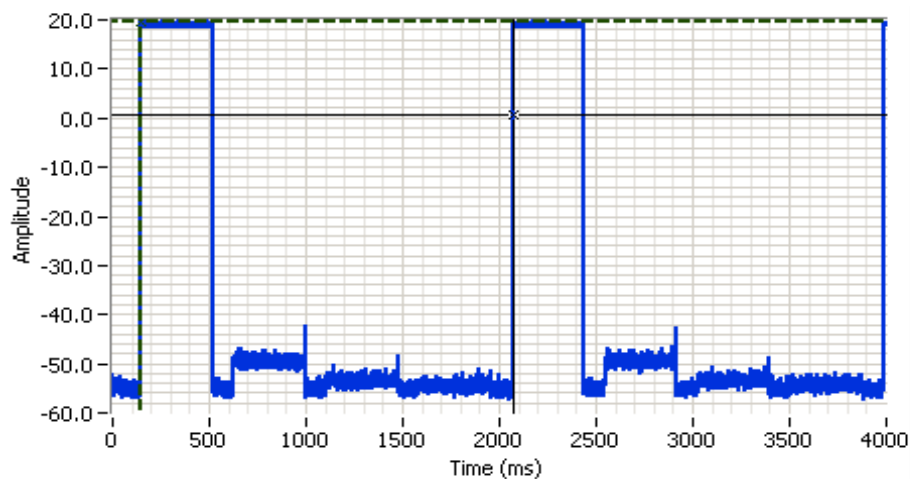
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

For Hybrid systems operating in the **902-928 MHz** band:

The average time of occupancy on any frequency shall not be greater than 0.4 seconds/channel maximum dwell time.

Maximum 20 dB bandwidth:	138 kHz	Pass
Channel spacing:	200 kHz	Pass
Transmission time per hop:	375 ms	
The time between successive hops on a channel:	1927 ms	
Number of channels (N):	4	Pass
Channel dwell time:	375 ms	Pass



Analyzer Settings

Agilent Technologies, E4446A
CF: 902.300 MHz
SPAN: 0.000 MHz
RB: 200 kHz
VB: 30.0 kHz
Detector: POS
Attn: 30 DB
RL Offset: 10.2 DB
Sweep Time: 4.0s
Ref Lvl: 27.2 DBM

Comments

Hybrid mode
The Time between successive hops on a channel

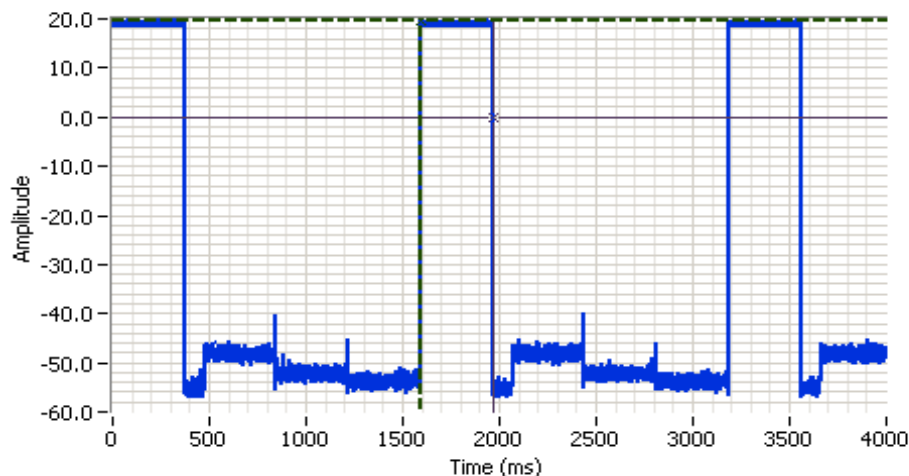
Cursor 1	145.8345	19.6		Delta Time (ms)	1927.1
Cursor 1	2072.9339	0.7		Delta Amplitude	18.9





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A



Analyzer Settings

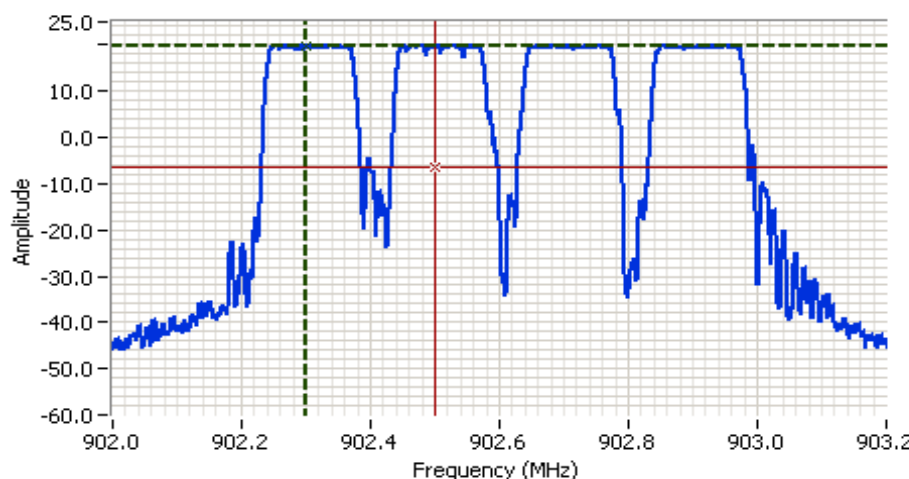
Agilent Technologies, E4446A
CF: 902.300 MHz
SPAN: 0.000 MHz
RB: 200 kHz
VB: 30.0 kHz
Detector: POS
Attn: 30 DB
RL Offset: 10.2 DB
Sweep Time: 4.0s
Ref Lvl: 27.2 DBM

Comments

Hibrid mode
transmission time per Hop

Cursor 1 1593.7632 19.5
Cursor 1 1968.7663 0.0

Delta Time (ms) 375.0
Delta Amplitude 19.5



Analyzer Settings

Agilent Technologies, E4446A
CF: 903.000 MHz
SPAN: 2.000 MHz
RB: 10.0 kHz
VB: 30.0 kHz
Detector: POS
Attn: 30 DB
RL Offset: 10.2 DB
Sweep Time: 19.2ms
Ref Lvl: 27.2 DBM

Comments

Hibrid mode
number of channels = 4

Cursor 1 902.3000 19.7
Cursor 2 902.5000 -6.3

Delta Freq. 200 kHz
Delta Amplitude 26.0





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #4: Spurious Emissions (Band edge)

Date of Test: 3/6/2018

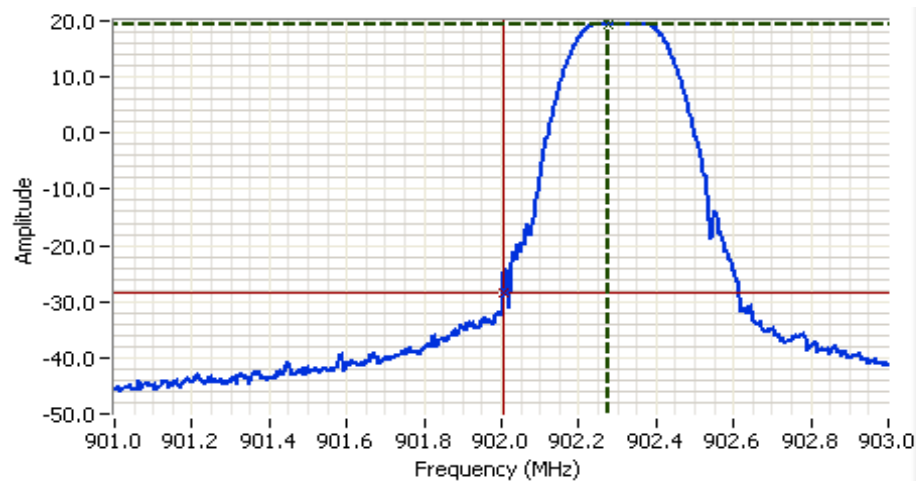
Test Engineer: Deniz Demirci

Test Location: FT lab #4b

Config. Used: 2

Config Change: none

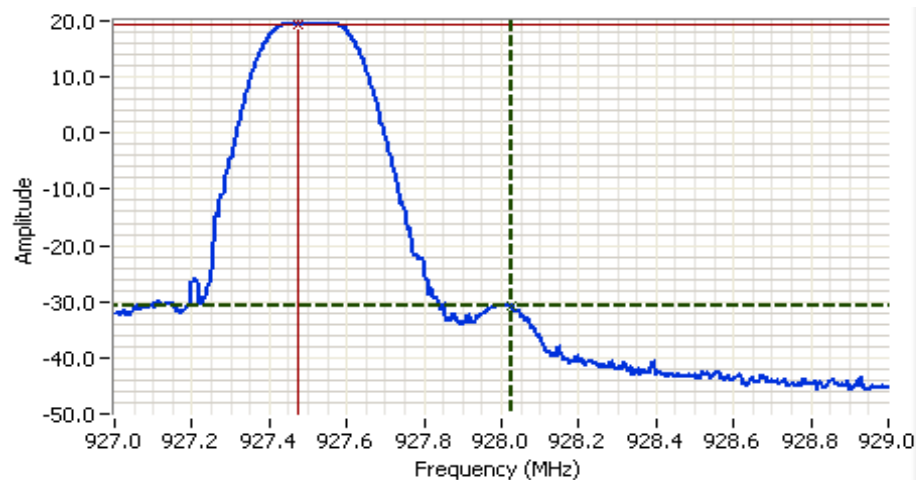
EUT Voltage: Internal battery (3.6 VDC)



Analyzer Settings

Agilent Technologies, E4446A
CF: 902.000 MHz
SPAN: 2.000 MHz
RB: 100 kHz
VB: 300 kHz
Detector: POS
Attn: 30 DB
RL Offset: 10.0 DB
Sweep Time: 1.0ms
Ref Lvl: 30.0 DBM

Comments



Analyzer Settings

Agilent Technologies, E4446A
CF: 928.000 MHz
SPAN: 2.000 MHz
RB: 100 kHz
VB: 300 kHz
Detector: POS
Attn: 30 DB
RL Offset: 10.0 DB
Sweep Time: 1.0ms
Ref Lvl: 30.0 DBM

Comments



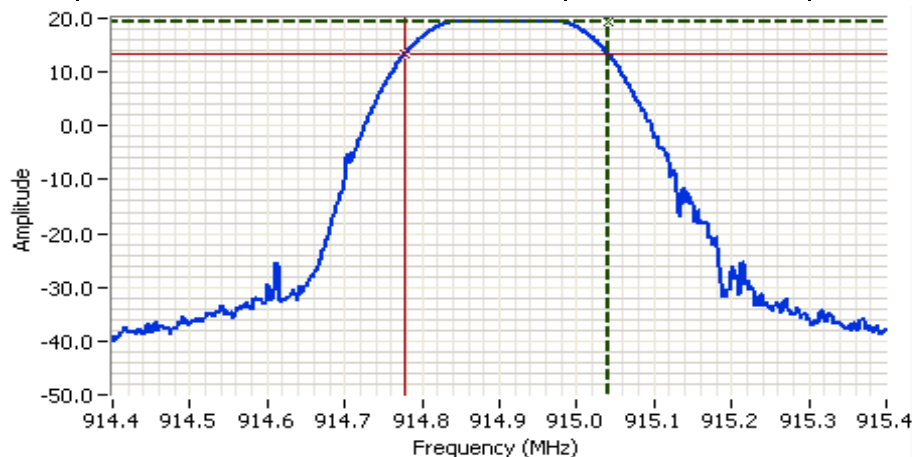


EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

DTS Bandwidth for Hybrid operation - For information only

Power Setting	Frequency (MHz)	Bandwidth (kHz)		RBW Setting (kHz)	
		6 dB	99%	6 dB	99%
20	902.3	262	126	100	3
	914.9	262	126		
	927.5	262	126		



Analyzer Settings

Agilent Technologies, E4446A
 CF: 914.900 MHz
 SPAN: 1.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 30 DB
 RL Offset: 10.0 DB
 Sweep Time: 1.0ms
 Ref Lvl: 30.0 DBM

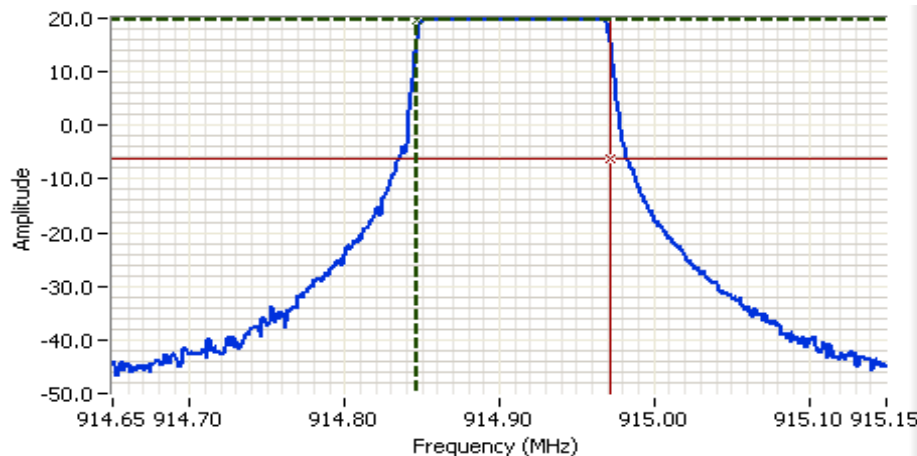
Comments

6dB BW: 262 kHz

Cursor 1	915.0400	19.4	
Cursor 2	914.7783	13.4	

Delta Freq. 262 kHz

Delta Amplitude 6.0



Analyzer Settings

Agilent Technologies, E4446A
 CF: 914.900 MHz
 SPAN: 500 kHz
 RB: 3.00 kHz
 VB: 10.0 kHz
 Detector: POS
 Attn: 30 DB
 RL Offset: 10.0 DB
 Sweep Time: 52.7ms
 Ref Lvl: 30.0 DBM

Comments

99% power BW: 126 kHz

Cursor 1	914.8463	19.6	
Cursor 2	914.9720	-6.4	

Delta Freq. 126 kHz

Delta Amplitude 26.0





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

RSS-247 and FCC 15.247 (HYBRID) 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 was located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 21-23 °C
Rel. Humidity: 45-50 %

Summary of Results - Device Operating in the 900 MHz Band

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a	Hybrid	low	-	-	Radiated Emissions, 9 kHz - 1 GHz	FCC Part 15.209 / 15.247(c)	28.9 dBµV/m @ 966.29 MHz (-25.1 dB)
1b	Hybrid	center	-	-	Radiated Emissions, 9 kHz - 1 GHz	FCC Part 15.209 / 15.247(c)	28.8 dBµV/m @ 947.00 MHz (-17.2 dB)
1c	Hybrid	high	-	-	Restricted Band at 960 MHz	FCC Part 15.209 / 15.247(c)	23.6 dBµV/m @ 970.14 MHz (-30.4 dB)
			-	-	Radiated Emissions, 9 kHz - 1 GHz	FCC Part 15.209 / 15.247(c)	30.8 dBµV/m @ 863.49 MHz (-15.2 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.

Sample Notes

Sample S/N: -

Driver: FW: 20171211-amm-tracker-us915.fw

Antenna: Integral PCB trace, inverted F



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1 MHz, VBW=3 MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
DTS	-	1.00	Yes	-	0	0	10

Measurement Specific Notes:

Note 1:	The preliminary measurements were performed with the EUT positioned in three orientations (Upright, Side and Flat). The flat orientation of the EUT has the worst case fundamental power and spurious emission results. Final measurements were presented with flat orientation.
Note 2:	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.
Note 3:	Emission in non-restricted band, but limit of 15.209 used.
Note 4:	For 300 MHz to 1 GHz measurement range, a narrow band tunable band reject filter (K&L 3 TNF-800/1000) was used and tuned to suppress fundamental signal.



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1: Radiated Spurious Emissions, 9 kHz - 10 GHz. Operating Mode: Hybrid

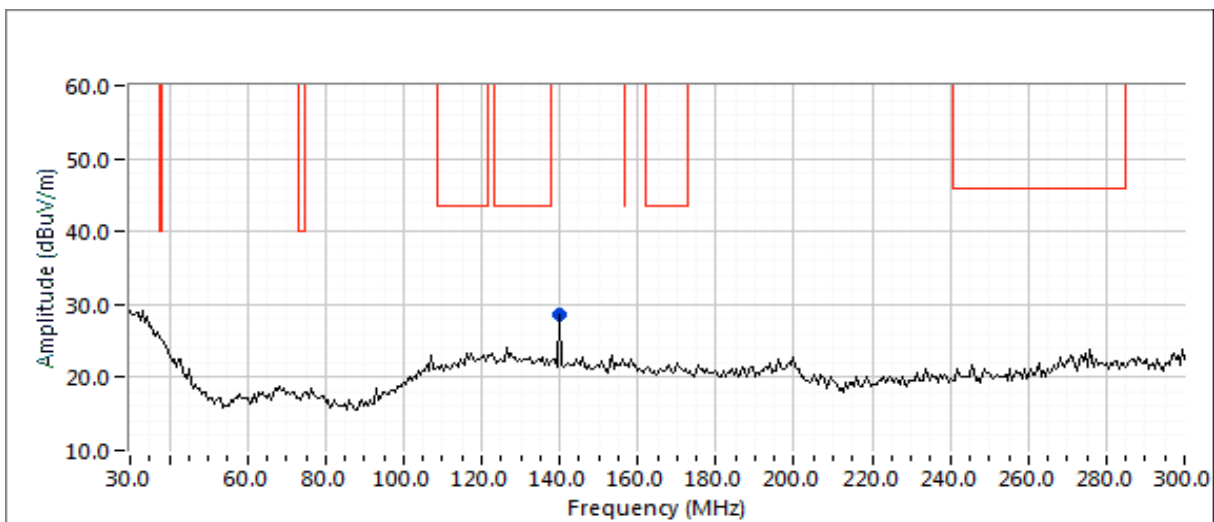
Date of Test: 1/4/2018 & 3/1/18
 Test Engineer: Deniz Demirci & John Caizzi
 Test Location: FT Ch #7

Config. Used: 1
 Config Change: None
 EUT Voltage: Battery operated

Run #1a: Low Channel @ 902.3 MHz

Spurious Emissions

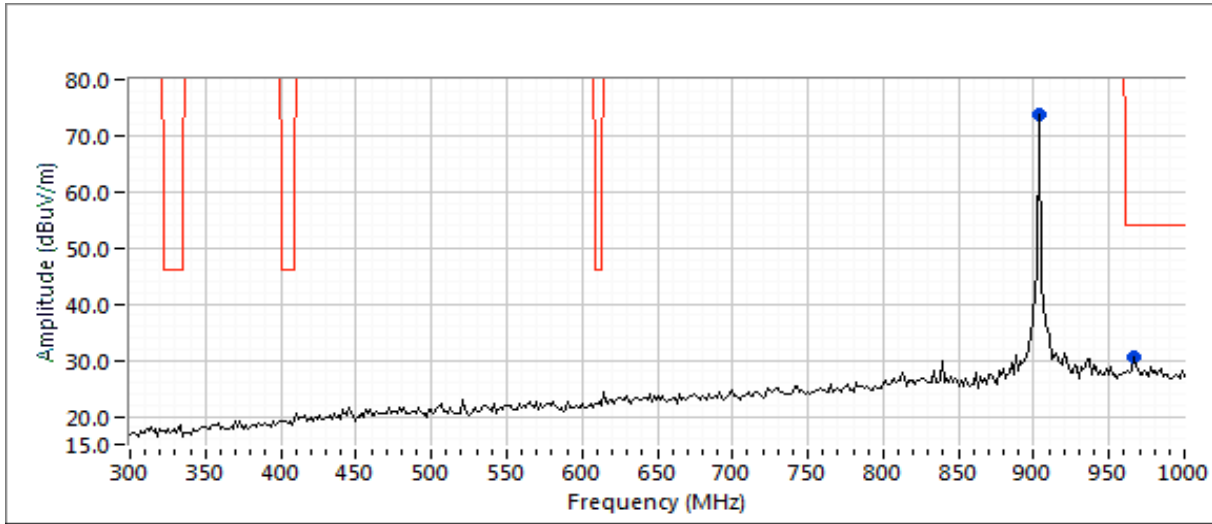
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
139.655	18.0	H	43.5	-25.5	QP	154	2.0	QP (1.00s) - Note 3
902.296	-	H	-	-	PK	1	1.5	Fundamental - Note 4 - EUT Flat
966.291	28.9	H	54.0	-25.1	QP	14	1.0	QP (1.00s)





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





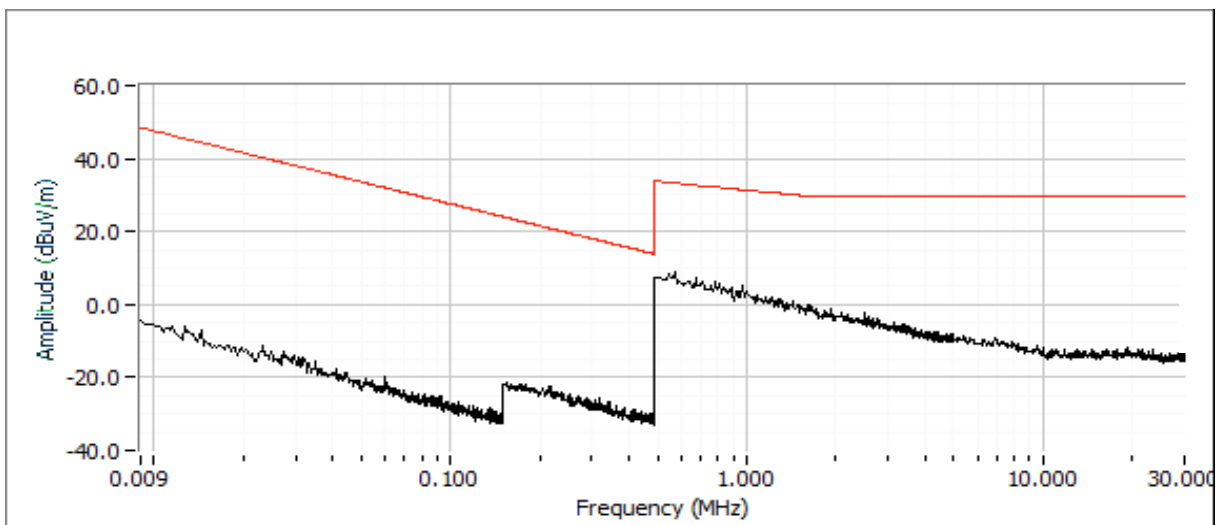
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1b: Center Channel @ 915 MHz

Spurious Emissions

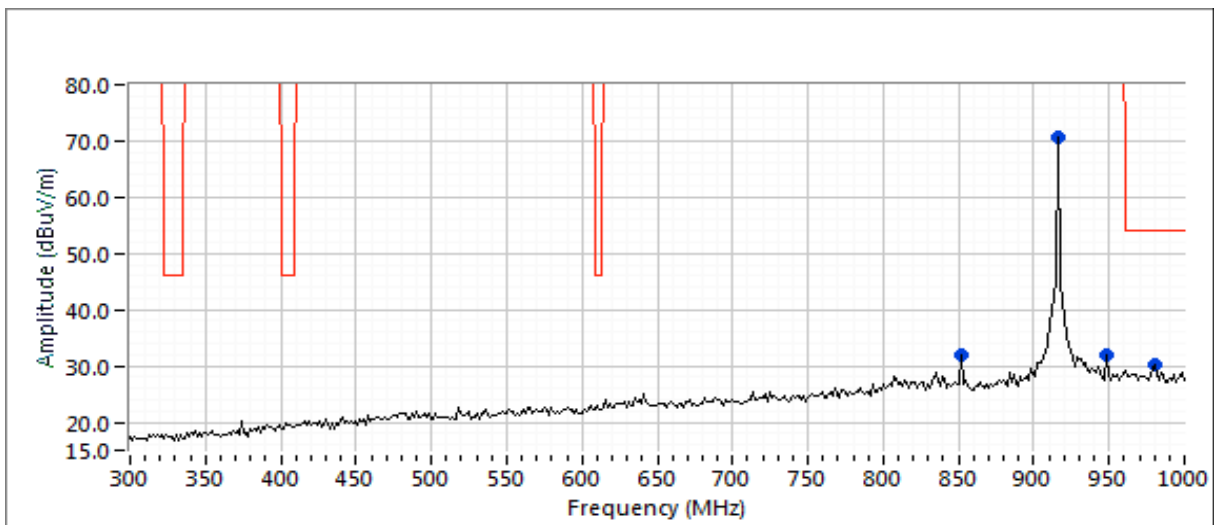
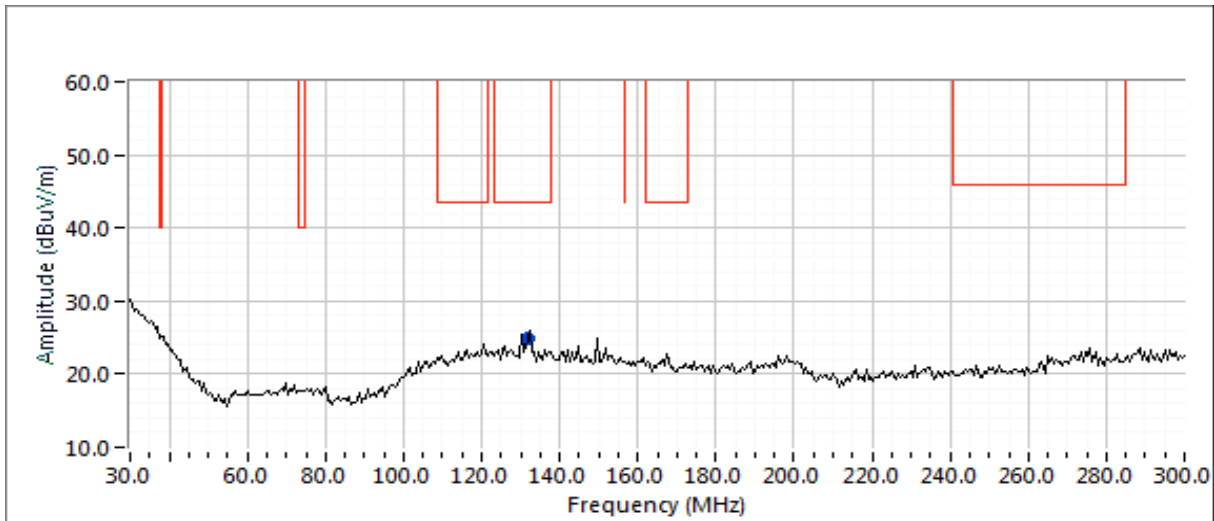
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
132.079	18.9	H	43.5	-24.6	QP	294	2.5	QP (1.00s)
851.006	28.1	V	46.0	-17.9	QP	0	1.0	QP (1.00s) - Note 3
915.002	70.5	H	-	-	PK	4	1.0	Fundamental - Note 4 - EUT Flat
946.999	28.8	H	46.0	-17.2	QP	334	1.0	QP (1.00s) - Note 3
979.005	23.7	V	54.0	-30.3	QP	1	1.5	QP (1.00s)





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





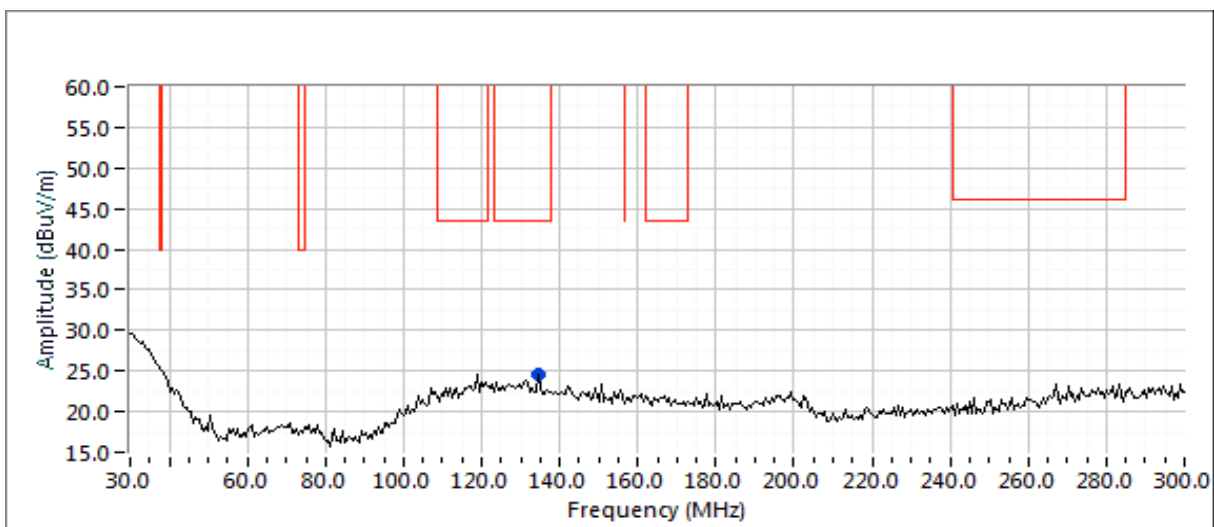
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1c: High Channel @ 927.5 MHz

Spurious Emissions

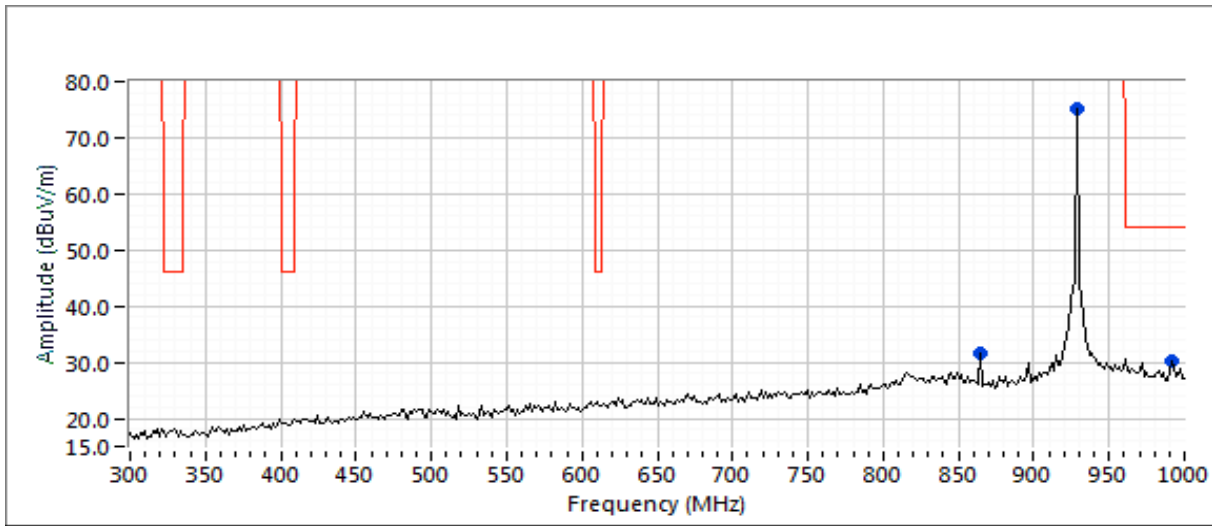
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
134.429	18.7	H	43.5	-24.8	QP	134	3.5	QP (1.00s)
863.493	30.8	H	46.0	-15.2	QP	4	1.0	QP (1.00s) - Note 3
927.497	75.2	H	-	-	PK	359	1.5	Fundamental - Note 4 - EUT Flat
991.513	27.8	H	54.0	-26.2	QP	334	1.0	QP (1.00s)





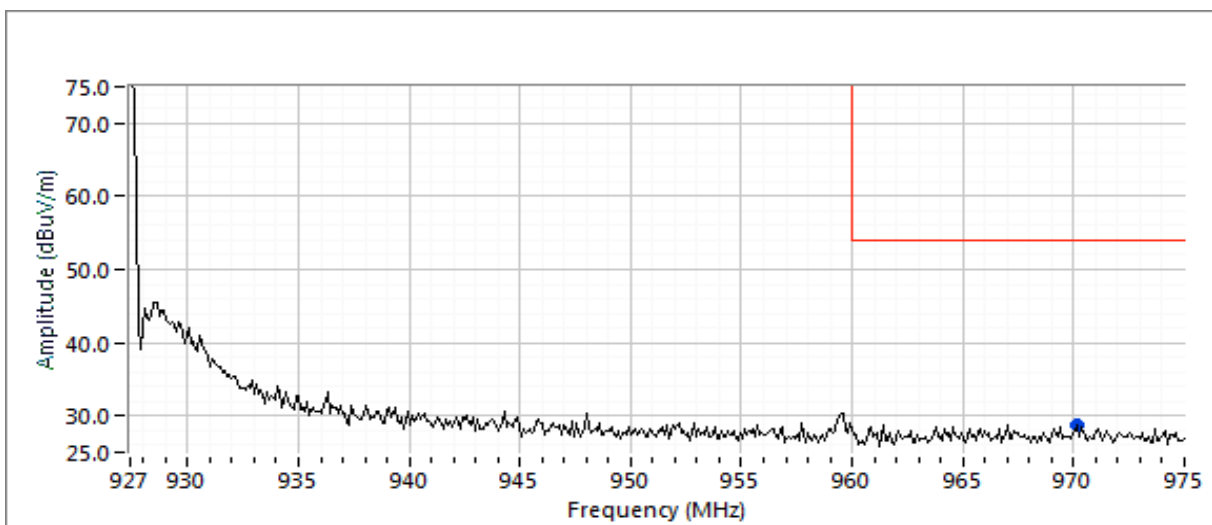
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A



Band Edge

Frequency	Level	Pol	15.247		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
970.135	23.6	V	54.0	-30.4	QP	193	3.0	QP (1.00s)





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

RSS-247 and FCC 15.247 (HYBRID) 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 was located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 21.6 °C
Rel. Humidity: 38 %

Summary of Results - Device Operating in the 900 MHz Band

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a - Flat	Hybrid	low	-	-	Radiated Emissions, 1 MHz - 10 GHz	FCC Part 15.209 / 15.247(c)	45.5 dBμV/m @ 2706.9 MHz (-8.5 dB)
1b - Flat	Hybrid	center	-	-	Radiated Emissions, 1 MHz - 10 GHz	FCC Part 15.209 / 15.247(c)	47.1 dBμV/m @ 1829.9 MHz (-6.9 dB)
1c - Flat	Hybrid	High	-	-	Radiated Emissions, 1 MHz - 10 GHz	FCC Part 15.209 / 15.247(c)	47.7 dBμV/m @ 1855.1 MHz (-6.3 dB)
1d - Side	Hybrid	low	-	-	Radiated Emissions, 1 MHz - 10 GHz	FCC Part 15.209 / 15.247(c)	43.4 dBμV/m @ 2707.1 MHz (-10.6 dB)
1e - Upright	Hybrid	low	-	-	Radiated Emissions, 1 MHz - 10 GHz	FCC Part 15.209 / 15.247(c)	43.7 dBμV/m @ 1804.6 MHz (-10.3 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.

Sample Notes

Sample S/N: -

Driver: FW: 20171211-amm-tracker-us915.fw

Antenna: Integral PCB trace, inverted F



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1 MHz, VBW=3 MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
Hybrid	-	1.00	Yes	-	0	0	10

Measurement Specific Notes:

Note 1:	The preliminary measurements were performed with the EUT positioned in three orientations (Upright, Side and Flat). The flat orientation of the EUT has the worst case fundamental power and spurious emission results. Final measurements were presented with flat orientation.
Note 3:	Emission in non-restricted band, but limit of 15.209 used.
Note 4:	For 1 GHz to 1.5 GHz measurement range, a narrow band tunable band reject filter (K&L 3 TNF-800/1000) was used and tuned to suppress fundamental signal.



EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1: Radiated Spurious Emissions, 1,000 - 10,000 MHz. Operating Mode: Hybrid

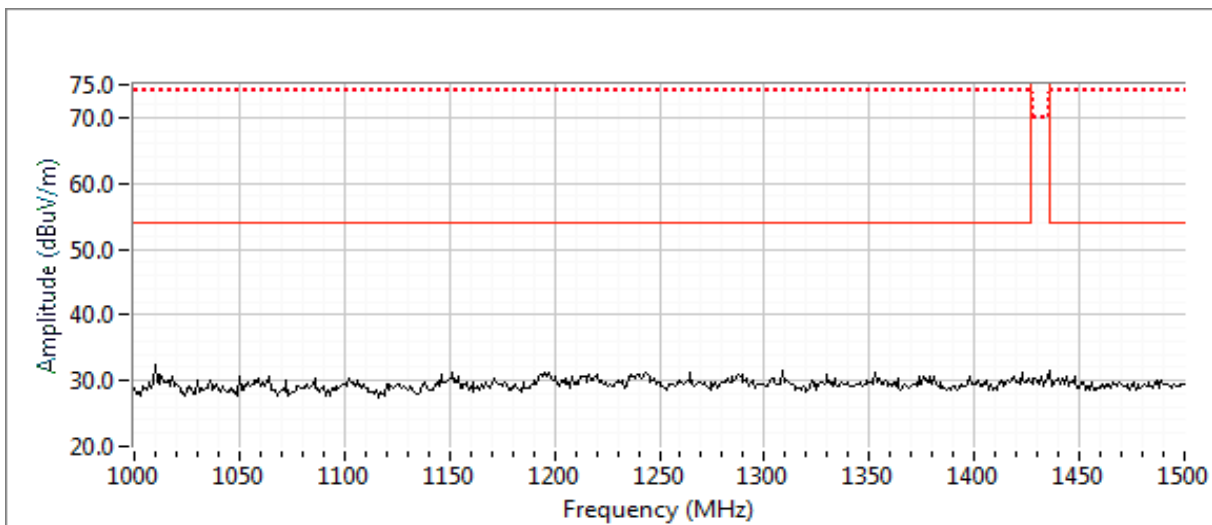
Date of Test: 2/26/2018 & 3/1/18
 Test Engineer: Rafael Varelas & John Caizzi
 Test Location: FT Ch #5

Config. Used: 1
 Config Change: None
 EUT Voltage: Battery operated

Run #1a: Low Channel @ 902.3 MHz

EUT Flat

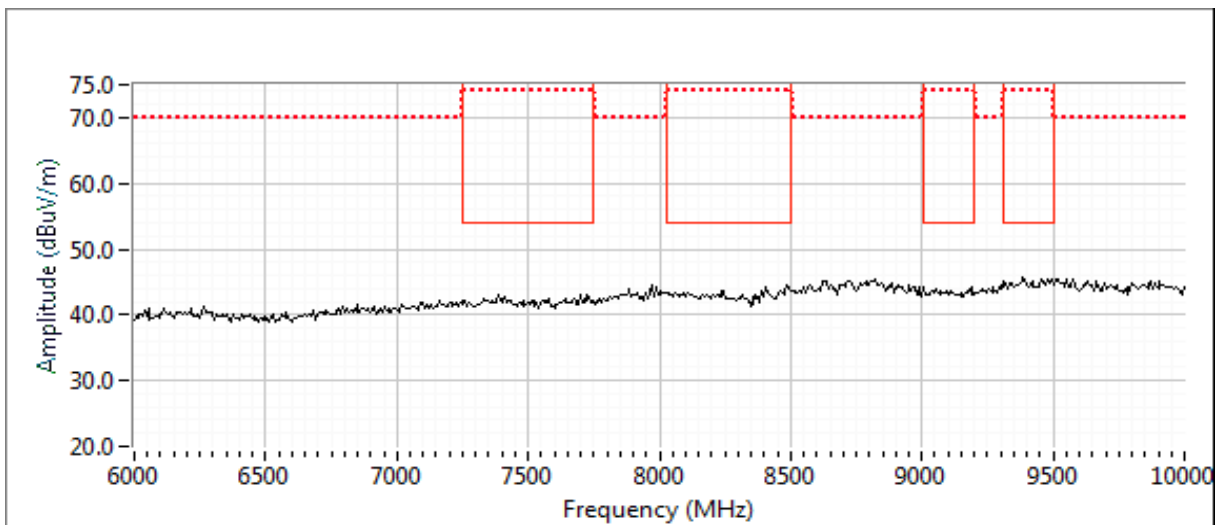
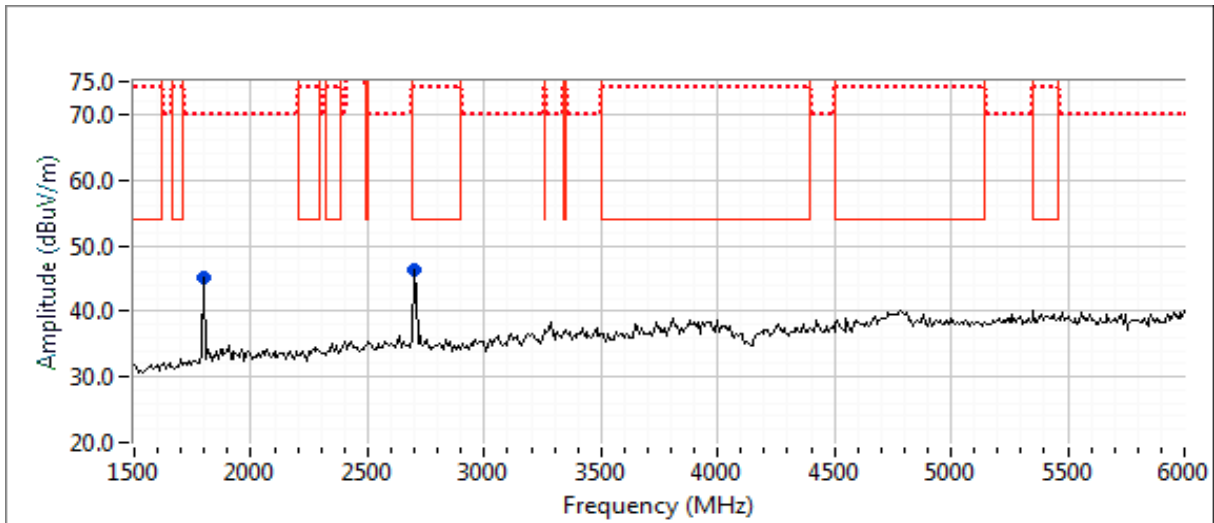
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2706.860	45.5	H	54.0	-8.5	AVG	303	1.0	RB 1 MHz;VB 10 Hz;Peak
2706.950	49.8	H	74.0	-24.2	PK	303	1.0	RB 1 MHz;VB 3 MHz;Peak
1804.750	45.1	H	54.0	-8.9	AVG	52	1.5	Note 3
1804.700	48.6	H	74.0	-25.4	PK	52	1.5	Note 3





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





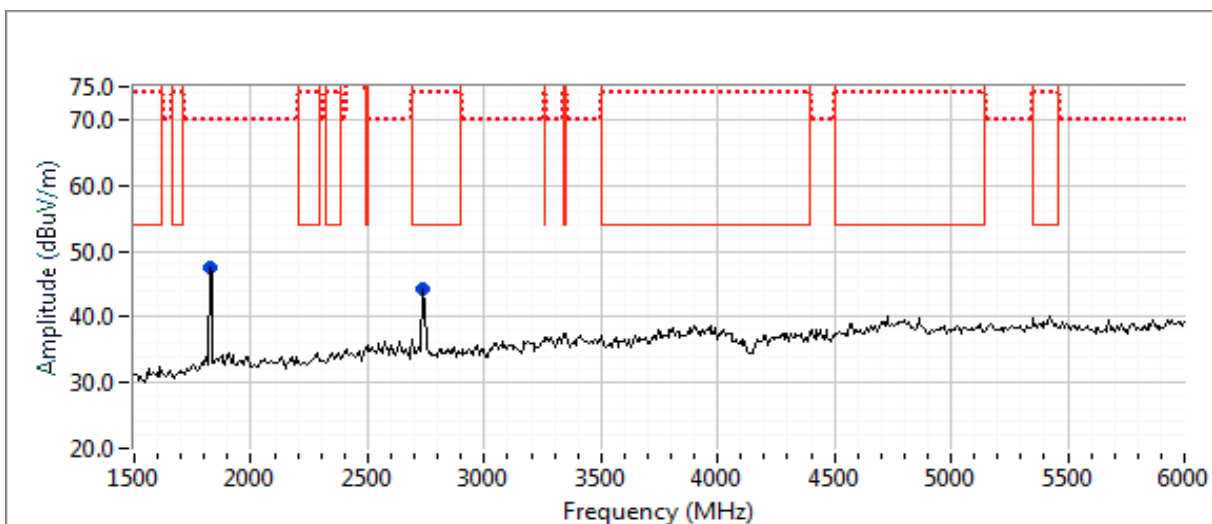
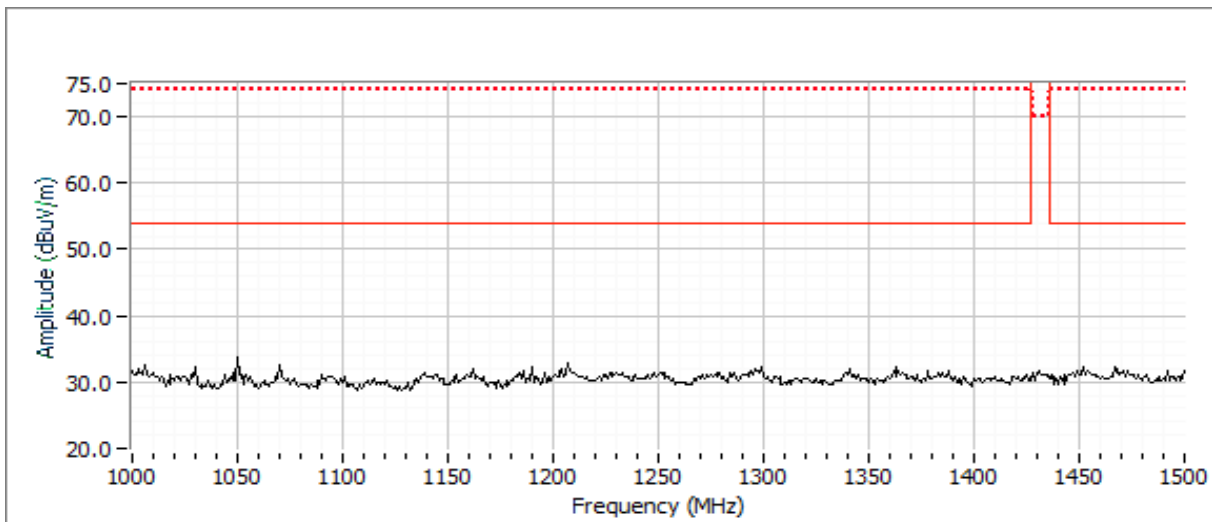
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1b: Center Channel @ 914.9 MHz

EUT Flat

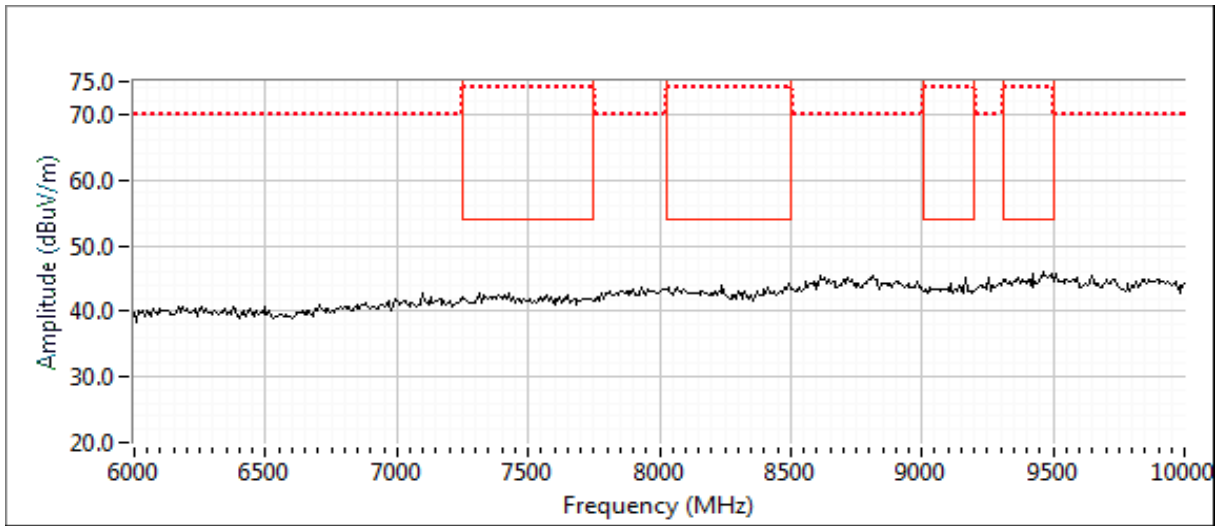
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
1829.850	47.1	H	54.0	-6.9	AVG	59	1.0	Note 3
1829.860	50.3	H	74.0	-23.7	PK	59	1.0	Note 3
2744.790	42.7	H	54.0	-11.3	AVG	308	1.4	RB 1 MHz;VB 10 Hz;Peak
2744.920	49.0	H	74.0	-25.0	PK	308	1.4	RB 1 MHz;VB 3 MHz;Peak





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





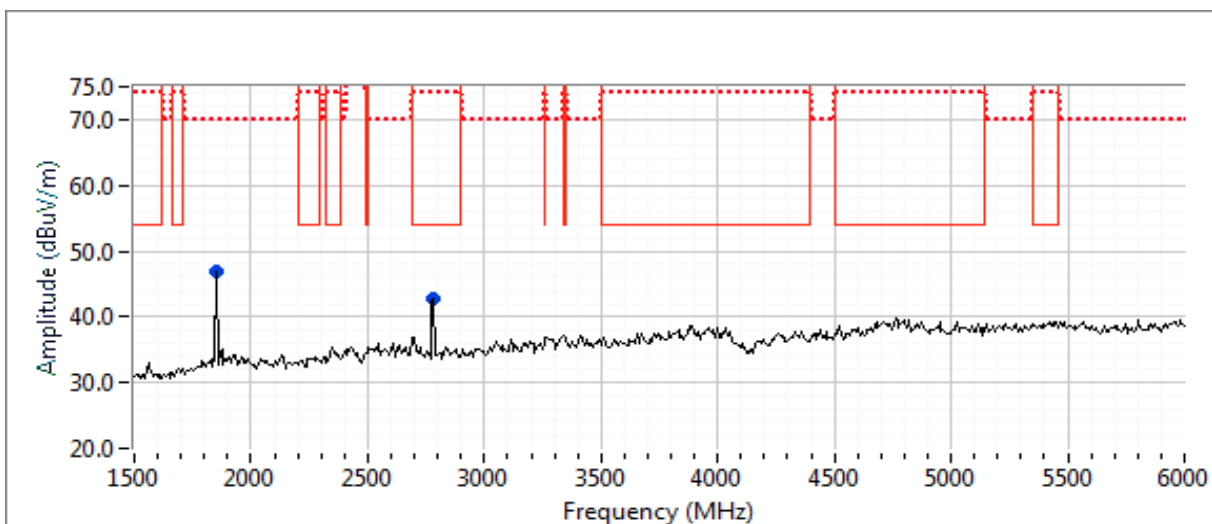
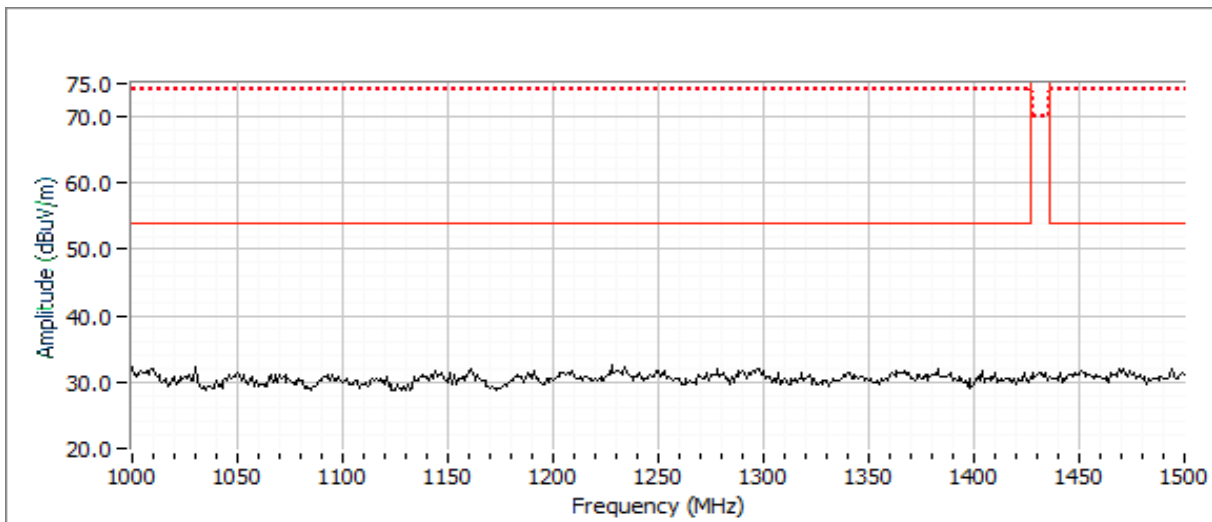
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1c: High Channel @ 927.5 MHz

EUT Flat

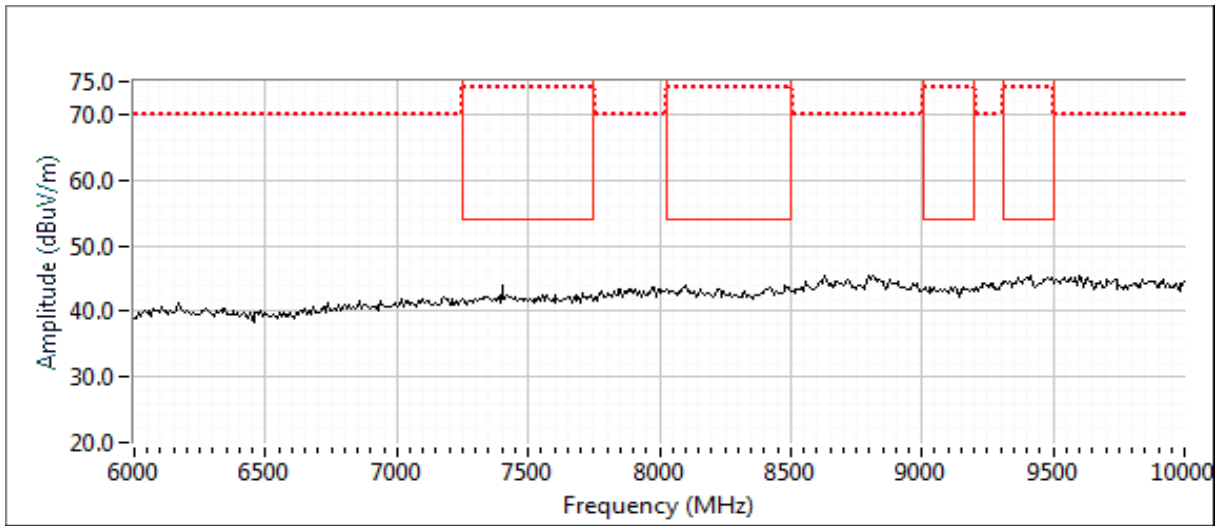
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
1855.110	47.7	H	54.0	-6.3	AVG	253	1.7	Note 3
1855.080	50.8	H	74.0	-23.2	PK	253	1.7	Note 3
2782.510	42.2	H	54.0	-11.8	AVG	310	1.8	RB 1 MHz;VB 10 Hz;Peak
2782.200	48.2	H	74.0	-25.8	PK	310	1.8	RB 1 MHz;VB 3 MHz;Peak





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





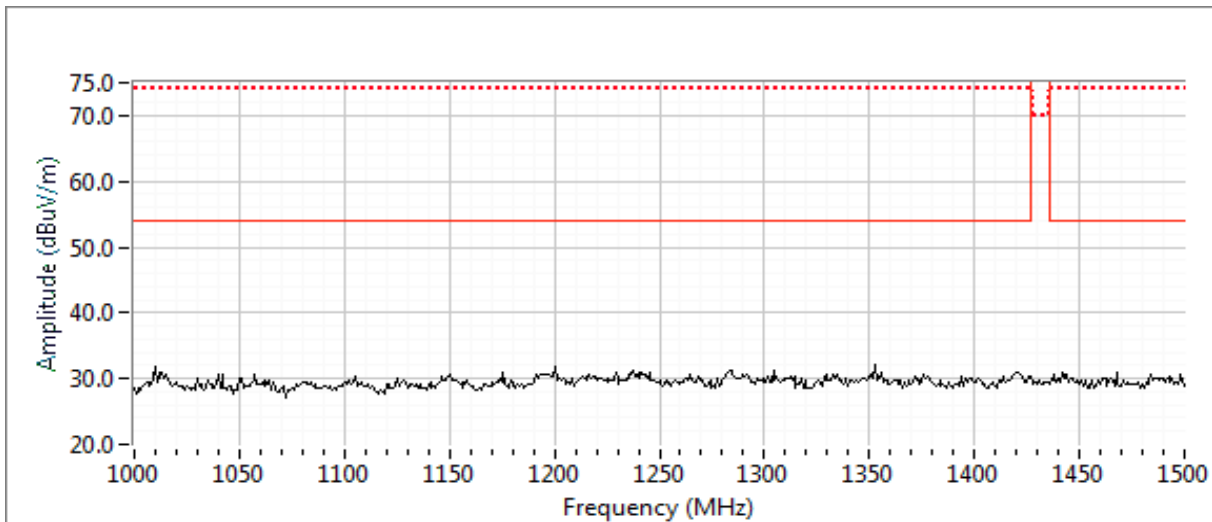
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1d: Low Channel @ 902.3 MHz

EUT Side

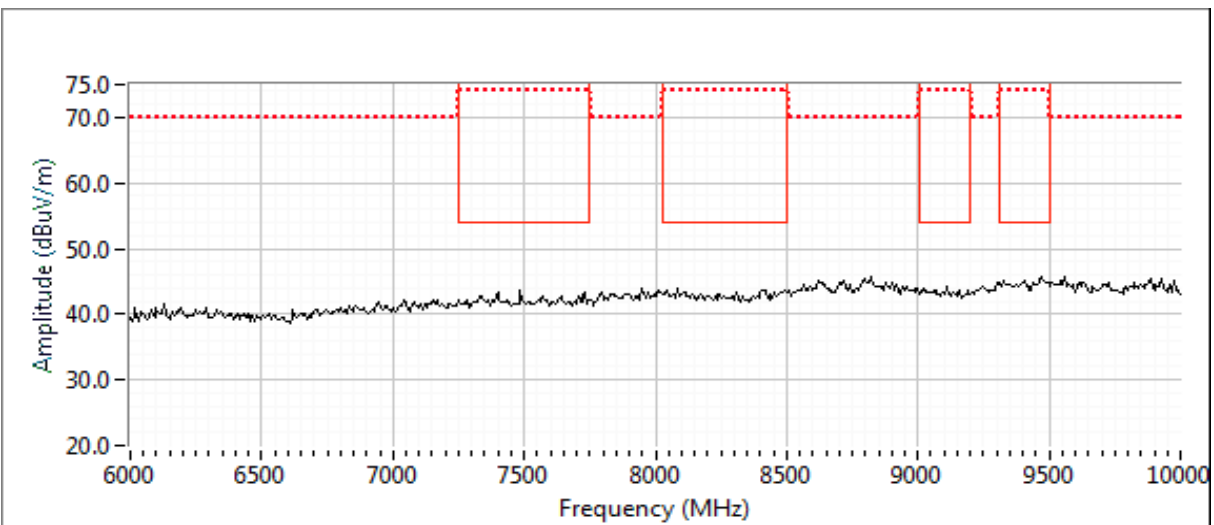
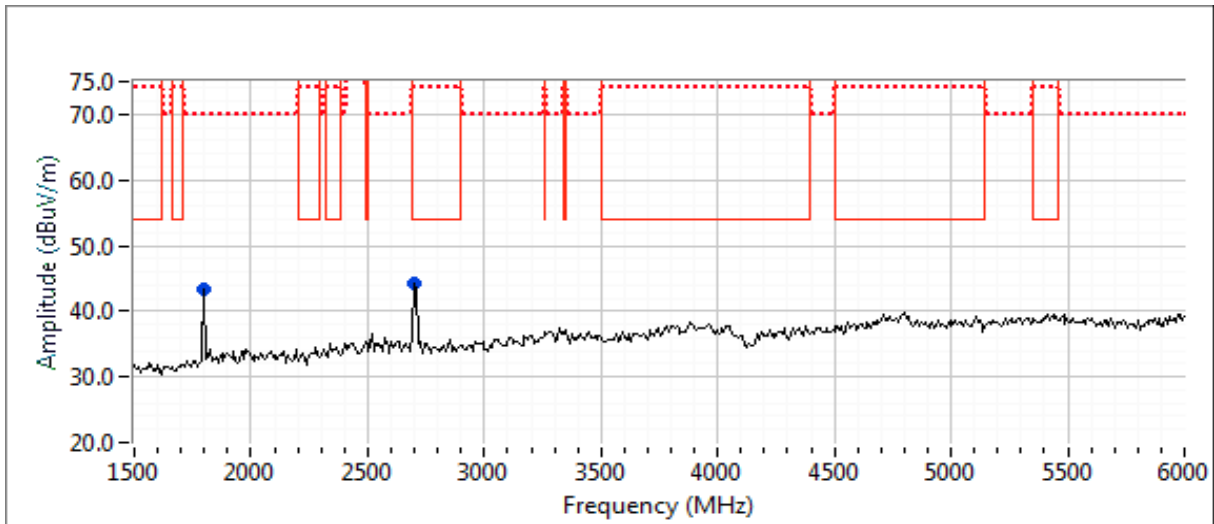
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2707.100	43.4	H	54.0	-10.6	AVG	308	1.0	RB 1 MHz;VB 10 Hz;Peak
2707.190	49.3	H	74.0	-24.7	PK	308	1.0	RB 1 MHz;VB 3 MHz;Peak
1804.620	43.0	H	54.0	-11.0	AVG	260	1.0	Note 3
1804.720	47.4	H	74.0	-26.6	PK	260	1.0	Note 3





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A





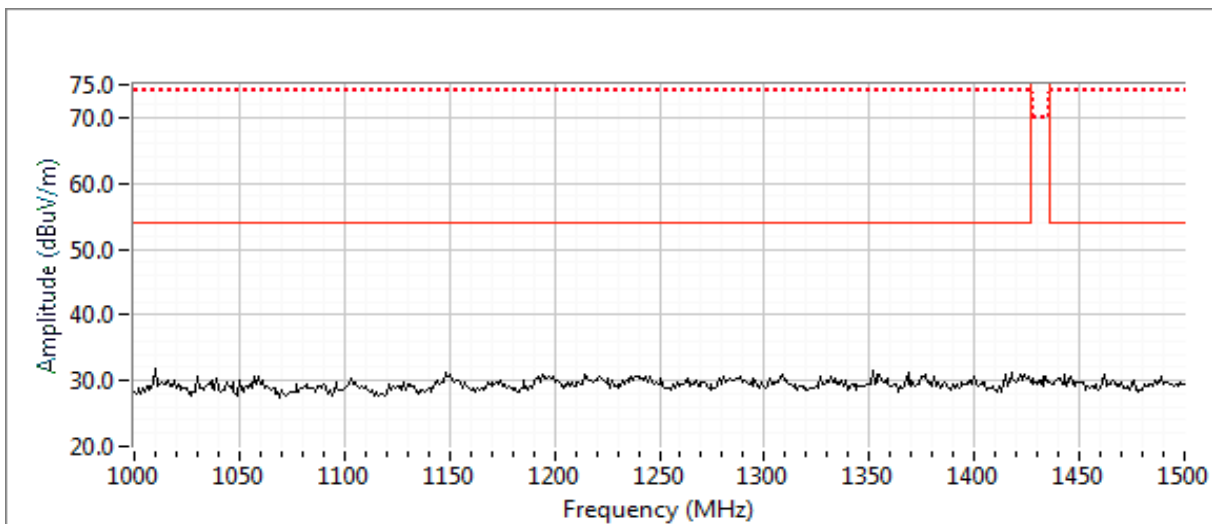
EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A

Run #1e: Low Channel @ 902.3 MHz

EUT Upright

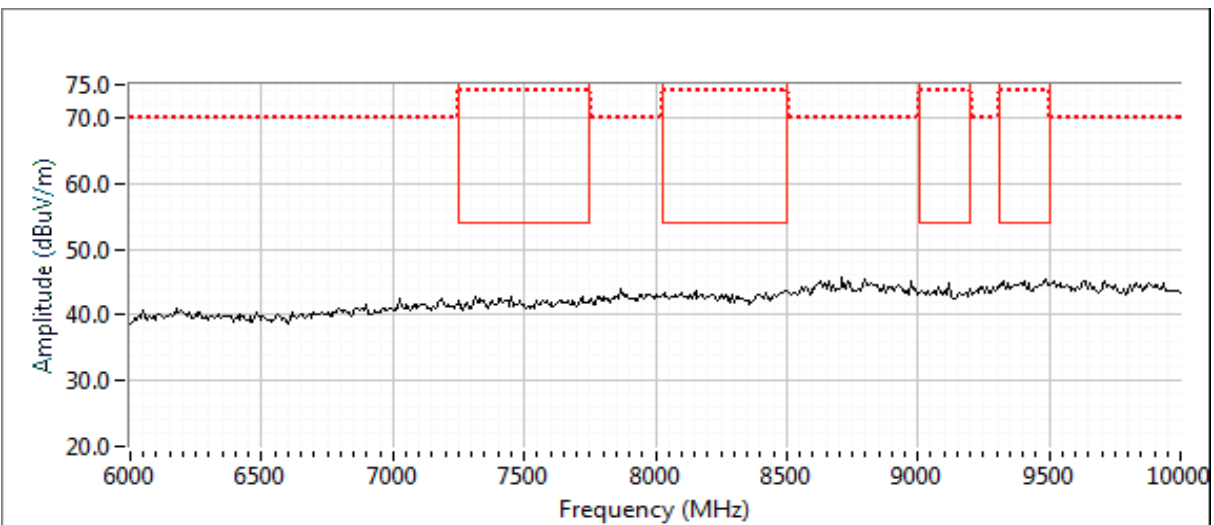
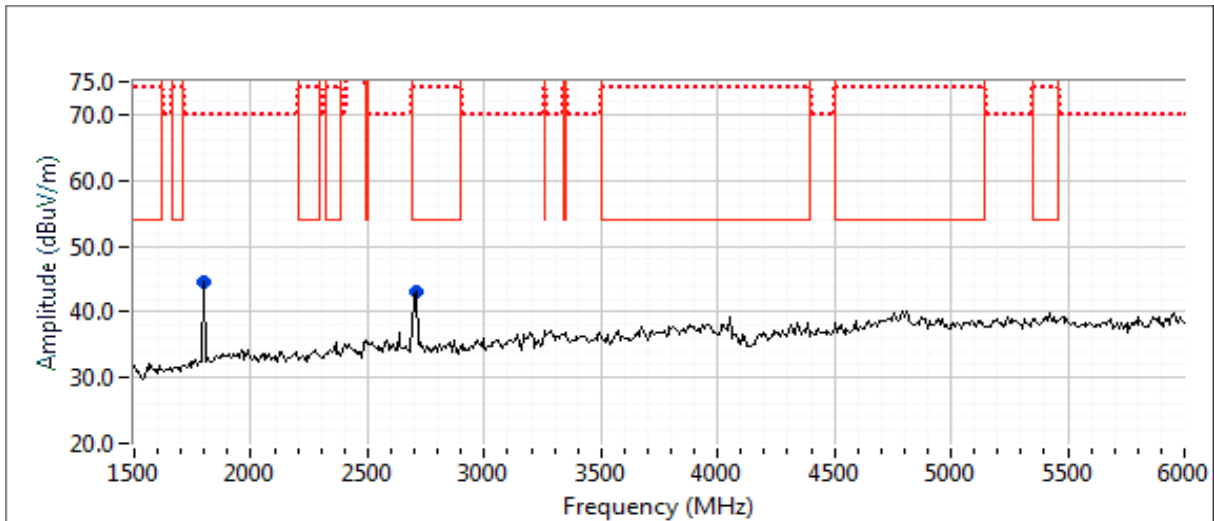
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1804.620	43.7	V	54.0	-10.3	AVG	244	1.0	Note 3
1804.700	47.9	V	74.0	-26.1	PK	244	1.0	Note 3
2706.830	42.1	V	54.0	-11.9	AVG	243	1.0	RB 1 MHz;VB 10 Hz;Peak
2706.610	48.4	V	74.0	-25.6	PK	243	1.0	RB 1 MHz;VB 3 MHz;Peak





EMC Test Data

Client:	TrackNet, Inc.	Job Number:	PR073580
Model:	Industrial Tracker	T-Log Number:	PR073580-T
Contact:	Joe Knapp	Project Manager:	Deepa Shetty
Standard:	FCC 15.247, RSS-247	Project Coordinator:	-
		Class:	N/A



End of Report

This page is intentionally blank and marks the last page of this test report.