FCC PART 15, SUBPART B and C; RSS-247, RSS-GEN
TEST REPORT

for

LORA EDGE TRACKER REFERENCE DESIGN

MODEL NUMBER: LR1110TRK1CKS

Prepared for

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DATE: NOVEMBER 25, 2020

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GENERAL REPORT SUMMARY

This electromagnetic emission report is generated by Compatible Electronics Inc., which is an independent testing and consulting firm. The test report is based on testing performed by Compatible Electronics personnel according to the measurement procedures described in the test specifications given below and in the "Test Procedures" section of this report.

The measurement data and conclusions appearing herein relate only to the sample tested and this report may not be reproduced in any form except in full, without the written permission of Compatible Electronics.

This report must not be used by the client to claim product certification, approval or endorsement by NVLAP, NIST or any agency of the U.S. Government.

Device Tested:	LoRa Edge Tracker Reference Design Model: LR1110TRK1CKS S/N: None
Product Description:	This is an industrial tracker for asset management systems. It consists of 900 – LoRaWAN transceiver radio operating in the frequency band 903 – 914.2 MHz. (Dimensions: 52 x 85 x 27 mm / 2.05" x 3.35" x 1.06")
Modifications:	The EUT was not modified during the testing in order to comply with the specifications.
Manufacturer:	Semtech Corporation 200 Flynn Road Camarillo, CA 93012
Test Dates:	November 20 & 23, 2020

NVLAP TESTING NVLAP LAB CODE 200063-0

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Innovation, Science and Economic Development Canada

Lab Code 22209

Test Specifications covered by accreditation:

Emissions requirements
CFR Title 47, Part 15, Subpart B; and Subpart C, sections 15.205, 15.207, 15.209, 15.247, RSS Gen Issue 10 2019 and RSS 247 Issue 2 2017
Test Procedure: ANSI C63.4: 2014, ANSI C63.10: 2013 and KDB 558074 D01 v05r02

SUMMARY OF TEST RESULTS

TEST	DESCRIPTION	RESULTS
1	Conducted RF Emissions, 150 kHz – 30 MHz	This test was not performed because the EUT is battery powered only.
2	Spurious Radiated RF Emissions, 30 MHz – 1000 MHz	The EUT complies with the **Class B** limits of CFR Title 47, Part 15 Subpart B; the limits of CFR Title 47, Part 15, Subpart C, section 15.209 and 15.247
3	Spurious Radiated RF Emissions, 9 kHz – 30 MHz and 1000 MHz – 9.142 GHz	The EUT complies with the **Class B** limits of CFR Title 47, Part 15, Subpart B; CFR Title 47, Part 15, Subpart C, section 15.247(d); RSS-247 and RSS-Gen
4	Fundamental and Emissions produced by the intentional radiator in non-restricted bands, 9 kHz – 9.142 GHz	Complies with the requirements of CFR Title 47, Part 15, Subpart C, section 15.247(d)
5	Emissions produced by the intentional radiator in restricted bands, 9 kHz – 9.142 GHz	Complies with the requirements of CFR Title 47, Part 15, Subpart C, section 15.205, 15.209, section 15.247 (d)
6	DTS Bandwidth	Complies with the requirements of FCC Title 47, Part 15, Subpart C, section 15.247 (a)(2)
7	Maximum Conducted Output Power	Complies with the requirements of FCC Title 47, Part 15, Subpart C, section 15.247 (b)(3)
8	RF Conducted Antenna Test	This test was not performed because the emissions were all taken via the radiated method.
9	Power Spectral Density from the Intentional Radiator to the Antenna	Complies with the requirements of CFR Title 47, Part 15, Subpart C, section 15.247 (e)

1. PURPOSE

This document is a qualification test report based on the emissions tests performed on the LoRa Edge Tracker Reference Design, Model Number: LR1110TRK1CKS. The emissions measurements were performed according to the measurement procedure described in ANSI C63.10 and ANSI C63.4. The tests were performed in order to determine whether the electromagnetic emissions from the equipment under test, referred to as EUT hereafter, are within the **Class B** specification limits defined by **CFR** Title 47, Part 15, Subpart B and Subpart C, sections 15.205, 15.207, 15.209, and 15.247; RSS-247 and RSS-Gen.

1.1 DECISION RULE & RISK

If a measured value exceeds a specification limit it implies non-compliance. If the value is below a specification limit it implies compliance. Measurement uncertainty of the laboratory is reported with all measurement results but generally not taken into consideration unless a standard, rule or law requires it to be considered.

Qualification test reports are only produced for products that are in compliance with the test requirements, therefore results are always in conformity. Otherwise, an engineering report or just the data is provided to the customer.

When performing a measurement and making a statement of conformity, in or out-of-specification to manufacturer's specifications or Pass/Fail against a requirement, there are two possible outcomes:

- The result is reported as conforming with the specification
- The result is reported as not conforming with the specification

The decision rule is defined below.

When the test result is found to be below the limit but within our measurement uncertainty of the limit, it is our policy that the final acceptance decision is left to the customer, after discussing the implications and potential risks of the decision.

When the test result is found to be exactly on the specification, it is our policy, in the case of unwanted emissions measurements to consider the result non-compliant, however, the final decision is left to the customer, after discussing the implications and potential risks of the decision.

When the test result is found to be over the specification limit under any condition, it is our policy to consider the result non-compliant.

In terms of uncertainty of measurement, the laboratory is a calibrated and tightly controlled environment and generally exceptionally stable, the measurement uncertainties are evaluated without the consideration of the test sample. When it comes to the test sample however, as most testing is performed on a single sample rather than a sample population, and that sample is often a pre-production representation of the final product, that test sample represents a significantly higher source of measurement uncertainty. We advise our customers of this and that when in doubt (small test to limit margins), they may wish to perform statistical sampling on a population to gain a higher confidence in the results. All lab reported results are that of a single sample in any event.

2. ADMINISTRATIVE DATA

2.1 Location of Testing

The emissions tests described herein were performed at the test facility of Compatible Electronics, 1050 Lawrence Drive, Newbury Park, California 91320.

2.2 Traceability Statement

The calibration certificates of all test equipment used during the test are on file at the location of the test. The calibration is traceable to the National Institute of Standards and Technology (NIST).

2.3 Cognizant Personnel

Semtech Corporation

Steven Jillings	Senior RF Applications Engineer

Compatible Electronics Inc.

Reynald O. Ramirez	Sr. Test Engineer
Ruby Hall	Lab Manager

2.4 Date Test Sample Was Received

The test sample was received on August 14, 2020. Received as described in product description.

2.5 Disposition of the Test Sample

The test sample still remains with Compatible Electronics.

2.6 Abbreviations and Acronyms

The following abbreviations and acronyms may be used in this document.

RF	Radio Frequency
EMI	Electromagnetic Interference
EUT	Equipment Under Test
P/N	Part Number
S/N	Serial Number
HP	Hewlett Packard
ITE	Information Technology Equipment
CML	Corrected Meter Limit
LISN	Line Impedance Stabilization Network
N/A	Not Applicable
NCR	No Calibration Required

3. APPLICABLE DOCUMENTS

The following documents are referenced or used in the preparation of this emissions Test Report.

SPEC	TITLE
FCC Title 47, Part 15 Subpart C	FCC Rules - Radio frequency devices (including digital devices) – Intentional Radiators
RSS Gen, Issue 5: 2019	General Requirements for Compliance of Radio Apparatus
RSS-247, Issue 2: 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices
ANSI C63.4 2014	Methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz
ANSI C63.10 2013	American National Standard for Testing Unlicensed Wireless Devices
FCC Title 47, Part 15 Subpart B	FCC Rules - Radio frequency devices (including digital devices) – Unintentional Radiators
KDB 558074 D01 v05r02	Guidance for Performing Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules
EN 50147-2: 1997	Anechoic chambers. Alternative test site suitability with respect to site attenuation

4. DESCRIPTION OF TEST CONFIGURATION

4.1 Description of Test Configuration – Emissions

The EUT was tested in a tabletop configuration. The EUT was powered ON and a special program was used to command the EUT to hybrid mode or a specific channel depending on the test. All 3 orthogonal axis positions were tested. The EUT was tested with fresh batteries. The EUT was utilizing software version 1.0. The source code was developed by the Grenoble, FR team and is stored on Semtech's secure Gitlab repository (this is a password/credential secured domain), a DevOps lifecycle tool provides a Git-repository manager providing version control, wiki, issue-tracking and continuous integration and deployment pipeline. FW can be obtained by contacting the Applicant (Semtech (Interantional) AG) and in the case of ISED, the Agent (Semtech Corporation Canada).

The EUT transmits 900 MHZ LoRaWAN packets as well as BLE advertising and connection modes.

For direct measurement portion of the test – The EUT was directly connected to the EMI receiver. A special program was used to control the channel of the transmitter or to commit the unit to hybrid mode, depending on the nature of the specific test.

The final radiated and direct measurement data was taken in the worst-case configuration described above. Please see Appendix E for the data sheets.

4.1.1 Cable Construction and Termination

There are no external cables connected to the EUT.

5. LISTS OF EUT, ACCESSORIES AND TEST EQUIPMENT

5.1 EUT and Accessory List

EQUIPMENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID
LORA EDGE TRACKER REFERENCE DESIGN (EUT)	SEMTECH CORPORATION	LR1110TRK1CKS	N/A	FCC ID: 2AMUGLR1110TRK IC: 22980-LR1110TRK

5.2 Emissions Test Equipment

EQUIPMENT TYPE	MANU-FACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. DATE	CAL. DUE DATE
TDK Emissions Lab Software	TDK RF Solutions, Inc.	TDK Emissions Lab	Version: 10.78	NCR	NCR
EMI Receiver	Agilent	N9038A	MY51100115	Jan. 07, 2020	Jan .07, 2021
Combi-Log Antenna	Com-Power	AC-220	10030030	Jan. 30, 2020	Jan. 30, 2022
Active Loop Antenna	Com-Power	AL-130	17067	Jun. 05, 2019	Jun. 05, 2021
Antenna Cable	Belden	RG-214/U	A/N: 6014	Apr. 08, 2020	Apr. 08, 2021
Horn Antenna	Com-Power	AH-118	071370	Jun. 29, 2020	Jun. 29, 2022
Horn Antenna	Com-Power	AH-826	081081	NCR	NCR
High Freq. Antenna Cables	SucoFlex	102_EA	A/N: 6012 & 6013	Apr. 08, 2020	Apr. 08, 2021
Turntable	EMCO	2088-2.03	None	NCR	NCR
Antenna Mast	EMCO	2075-2	None	NCR	NCR
Multi-Device Controller	ETS EMCO	2090	9511-1095	NCR	NCR
Temperature and Humidity Indicator	Abbeon	HTAB169B	3428	Mar. 24, 2020	Mar. 24, 2021
Barometer	Maximum	Predictor	3429	Jan. 17, 2020	Jan. 17, 2021
Computer	Dell	Vostro 3900	Asset# 3423	NCR	NCR

6. TEST SITE DESCRIPTION

6.1 Test Facility Description

Please refer to section 2.1 and 7.1 of this report for emissions test location.

6.2 EUT Mounting, Bonding and Grounding

For frequencies 1 GHz and below: The EUT was mounted on a 1.0 by 1.5 meter non-conductive table 0.8 meters above the ground plane.

For frequencies above 1 GHz: The EUT was mounted on a 1.0 by 1.5 meter non-conductive table 1.5 meters above the ground plane.

The EUT was not grounded.

6.3 Measurement Uncertainty

Compatible Electronics' U_{lab} value is less than U_{cispr}, thus based on this − compliance is deemed to occur if no measured disturbance exceeds the disturbance limit

$$u_c(y) = \sqrt{\sum_i c_i^2 \; u^2(x_i)}$$

Measurement		U_{cispr}	$U_{lab} = 2\,uc\,(y)$
Conducted disturbance (mains port)	(150 kHz – 30 MHz)	3.4 dB	2.73 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site)	(30 MHz – 1 000 MHz)	6.3 dB	3.24 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site)	(1 GHz - 6 GHz)	5.2 dB	3.23 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site)	(6 GHz – 18 GHz)	5.5 dB	3.23 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site)	(18 GHz – 26 GHz)	N/A	3.50 dB

7. CHARACTERISTICS OF THE TRANSMITTER

7.1 Channel Description and Frequencies

The EUT operates on 8 downlink channels that are utilized by the network when communicating to the Tracker. i.e. when the device receives. These 8 channels utilize the same 500 kHz DTS modulation but are spectrally inverted to not appear as uplink transmissions. In order to achieve optimal link budget, the radio only utilizes as much receive bandwidth as needed to receive the 500 kHz downlink. I.e. approximately 500 kHz of 1 dB bandwidth.

The low channel is 903 MHz, the middle channel is 909.4 MHz and the high channel is 914.2 MHz.

7.2 Antenna

The 900 MHz antenna has a gain of -1.8 dBi.

8. TEST PROCEDURES

The following sections describe the test methods and the specifications for the tests. Test results are also included in this section.

8.1 RF Emissions

8.1.1 Conducted Emissions Test

Test Results:

This test was not performed because the EUT operates on battery power only and cannot be connected internally or externally to the AC public mains.

Had this test been applicable it would have been performed as described below.

The EMI Receiver was used as a measuring meter. A 10 dB Attenuator was used for the protection of the EMI Receiver input stage, and the offset was adjusted accordingly to read the actual data measured. The LISN output was measured using the EMI Receiver. The output of the second LISN was terminated by a 50-ohm termination. The effective measurement bandwidth used for this test was 9 kHz.

Please see section 6.2 of this report for mounting, bonding, and grounding of the EUT. The EUT was powered through the LISN, which was bonded to the ground plane. The LISN power was filtered and the filter was bonded to the ground plane. The EUT was set up with the minimum distances from any conductive surfaces as specified in ANSI C63.4. The excess power cord was wrapped in a figure eight pattern to form a bundle not exceeding 0.4 meters in length.

The conducted emissions from the EUT were maximized for operating mode as well as cable placement. The final data was collected under program control by computer software. The final qualification data is located in Appendix E.

8.1.2 Radiated Emissions (Spurious and Harmonics) Test

The EMI Receiver was used as the measuring meter. Below 1 GHz, a built-in, internal preamplifier was used to increase the sensitivity of the instrument. At frequencies above 1 GHz, external preamplifiers were used. The EMI Receiver was initially used with the Analyzer mode feature activated. In this mode, the EMI receiver can then record the actual frequency to be measured. This final reading is then taken accurately in the EMI Receiver mode, which takes into account the cable loss, amplifier gain and antenna factors, so that a true reading is compared to the true limit.

The frequencies above 1 GHz were averaged by using the linear average detector function on the EMI Receiver.

The measurement bandwidths and transducers used for the radiated emissions test were:

FREQUENCY RANGE	EFFECTIVE MEASUREMENT BANDWIDTH	TRANSDUCER
9 kHz to 150 kHz	200 Hz	Loop Antenna
150 kHz to 30 MHz	9 kHz	Loop Antenna
30 MHz to 1 GHz	120 kHz	Combilog Antenna
1 GHz to 25 GHz	1 MHz	Horn Antenna

The EMI test chamber of Compatible Electronics, Inc. was used for radiated emissions testing. This test site is in full compliance with ANSI C63.4. Please see section 6.2 of this report for mounting, bonding and grounding of the EUT. The turntable supporting the EUT is remote controlled using a motor. The turntable permits EUT rotation of 360 degrees in order to maximize emissions. Also, the antenna mast allows height variation of the antenna from 1 meter to 4 meters. Data was collected in the worst case (highest emission) configuration of the EUT. At each reading, the EUT was rotated 360 degrees and the antenna height was varied from 1 to 4 meters (for E field radiated field strength). The gunsight method was used when measuring with the horn antenna in order to ensure accurate results.

The six highest reading are listed in Table 1.

Test Results:

The EUT complies with the **Class B** limits of RSS-247, RSS-Gen, **CFR** Title 47, Part 15, Subpart B; the limits of CFR Title 47, Part 15, Subpart C, Sections 15.209 and 15.247 (d) for radiated emissions. Please see Appendix E for the data sheets.

8.1.3 RF Emissions Test Results

Table 1.0 RADIATED EMISSION RESULTS
LoRa Edge Tracker Reference Design
Model Number: LR1110TRK1CKS
914.2 MHz

Frequency MHz	Corrected Reading* dBuV/m	Specification Limit dBuV/m	Delta (Cor. Reading – Spec. Limit) dB
827.80	40.47#	46.00	-5.53
832.00	43.43#	46.00	-5.38
882.20	44.79#	46.00	-1.21
911.40	47.60#	46.00	-1.30
934.60	42.78#	46.00	-3.22
946.10	44.67#	46.00	-1.33

Quasi-Peak Reading

8.1.4 Sample Calculations

A correction factor for the antenna, cable and a distance factor (if any) must be applied to the meter reading before a true field strength reading can be obtained. This Corrected Meter Reading is then compared to the specification limit in order to determine compliance with the limits.

Conversion to logarithmic terms: Specification limit (µV/m) log x 20 = Specification Limit in dBuV/m

To correct for distance when measuring at a distance other than the specification

For measurements below 30 MHz: (Specification distance / test distance) log x 40 = distance factor

For measurements above 30 MHz: (Specification distance / test distance) log x 20 = distance factor

Note: When using an Active Antenna, the Antenna factor shall be subtracted due to the combination of the internal amplification and antenna loss.

Corrected Meter Reading = meter reading + F – A + C

where: F = antenna factor

A= amplifier gain

C = cable loss

The correction factors for the antenna and the amplifier gain are attached in Appendix D of this report. The data sheets are attached in Appendix E.

The distance factor D is 0 when the test is performed at the required specification distance.

8.2 DTS Bandwidth

The DTS Bandwidth was measured using the EMI Receiver. The bandwidth was measured using a direct connection from the EUT. The following steps were performed for measuring the DTS Bandwidth.

1. Set RBW = 100 kHz
2. Set the video bandwidth (VBW) to equal or greater than 3 times the RBW
3. Detector = Peak
4. Trace Mode = Max Hold
5. Sweep = Auto Couple
6. Allow the trace to stabilize
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Results:

The EUT complies with the requirements of FCC Title 47, Part 15, Subpart C section 15.247 (a)(2).

8.3 Maximum Peak Conducted Output Power

The Maximum Peak Conducted Output Power was measured using the EMI Receiver. The Maximum Peak Conducted Output Power was measured using the procedure described in section 11.9.1.1 of ANSI C63.10. The Maximum Peak Conducted Output Power was then taken. The cable loss was also added back into the reading using the reference level offset. The following steps were performed for measuring the Maximum Peak Conducted Output Power.

1. Set the RBW ≥ DTS bandwidth
2. Set VBW ≥ [3 x RBW]
3. Set span ≥ [3 x RBW]
4. Sweep time = auto couple
5. Detector = peak
6. Trace mode = max hold
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level

Test Results:

The EUT complies with the requirements of FCC Title 47, Part 15, Subpart C section 15.247 (b)(3).

8.4 Emissions in Non-Restricted Bands

The emissions in the non-restricted frequency bands measurements were performed using the methods described in section 8.1.2. The final qualification data sheets are located in Appendix E.

Test Results:

The EUT complies with the requirements of FCC Title 47, Part 15, Subpart C section 15.247 (d).

8.5 RF Band Edges

The RF band edges were taken at the edges of the ISM spectrum (903 MHz when the EUT was on the low channel and 914.2 MHz when the EUT was on the high channel) using the EMI Receiver. The RBW was set to 100 kHz and the VBW was set to 300 kHz. Plots of the fundamental were taken to ensure the amplitude at the band edges were at least 20 dB down from the peak of the fundamental emission. The plots were taken in single channel mode.

Test Results:

The EUT complies with the requirements of FCC Title 47, Part 15, Subpart C section 15.247 (d). The RF power at the band edges at 903 MHz and 914.2 MHz meet the requirements of FCC Title 47, Part 15, Subpart C section 15.247 (d). Please see the data sheets located in Appendix E.

8.6 Spectral Density Test

The spectrum density output was measured using the EMI Receiver. The spectral density output was measured using a direct connection from the RF out on the EUT into the input of the EMI Receiver. The following steps were performed for measuring the spectral density.

1. Set analyzer center frequency to DTS channel center frequency
2. Set the span to 1.5 times the OBW.
3. Set the RBW to 3 kHz ≤ RBW ≤ 10 kHz
4. Set the VBW ≥ [3 X RBW]
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Allow the trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Results:

The EUT complies with the requirements of FCC Title 47, Part 15, Subpart C section 15.247 (e).

8.7 Variation of the Input Power

Test Results:

This test was not performed because the EUT operates on battery power only and cannot be connected internally or externally to the AC public mains.

Had this test been applicable it would have been performed as described below.

The variation of the input power test was performed using the EMI Receiver. The EUT input power was varied between 85% and 115% of the nominal rated supply voltage. The carrier frequency was monitored for any change in amplitude.

9. TEST PROCEDURES (CONTINUED)

9.1 RF Antenna Conducted Test

Test Results:

This test was not performed because the all of the emissions were taken via radiated methods.

Had this test been applicable it would have been performed as described below.

The RF antenna conducted test was performed using the EMI Receiver. The RF antenna conducted test measured using a direct connection from the RF out on the EUT into the input of the EMI Receiver. The resolution bandwidth was 100 kHz, and the video bandwidth was 300 kHz. The spans were wide enough to include all the harmonics and emissions that were produced by the intentional radiator.

10 CONCLUSIONS

The LoRa Edge Tracker Reference Design , Model Number: LR1110TRK1CKS (EUT), as tested, meets all of the specification limits defined in FCC Title 47, Part 15, Subpart B, and Subpart C, sections 15.205, 15.207, 15.209 and 15.247; RSS-247 and RSS-Gen.

APPENDIX A

LABORATORY ACCREDITATIONS AND RECOGNITIONS

LABORATORY ACCREDITATIONS AND RECOGNITIONS

For US, Canada, Australia/New Zealand, Japan, Taiwan, Korea, and the European Union, Compatible Electronics is currently accredited by NVLAP to ISO/IEC 17025.

For the most up-to-date version of our scopes and certificates please visit

http://celectronics.com/quality/scope/

Quote from ISO-ILAC-IAF Communiqué on 17025:

"A laboratory's fulfilment of the requirements of ISO/IEC 17025:2005 means the laboratory meets both the technical competence requirements and management system requirements that are necessary for it to consistently deliver technically valid test results and calibrations. The management system requirements in ISO/IEC 17025:2005 (Section 4) are written in language relevant to laboratory operations and meet the principles of ISO 9001:2008 Quality Management Systems — Requirements."

APPENDIX B

MODIFICATIONS TO THE EUT

MODIFICATIONS TO THE EUT

There were no modifications made to the EUT.

APPENDIX C

ADDITIONAL MODELS

ADDITIONAL MODELS

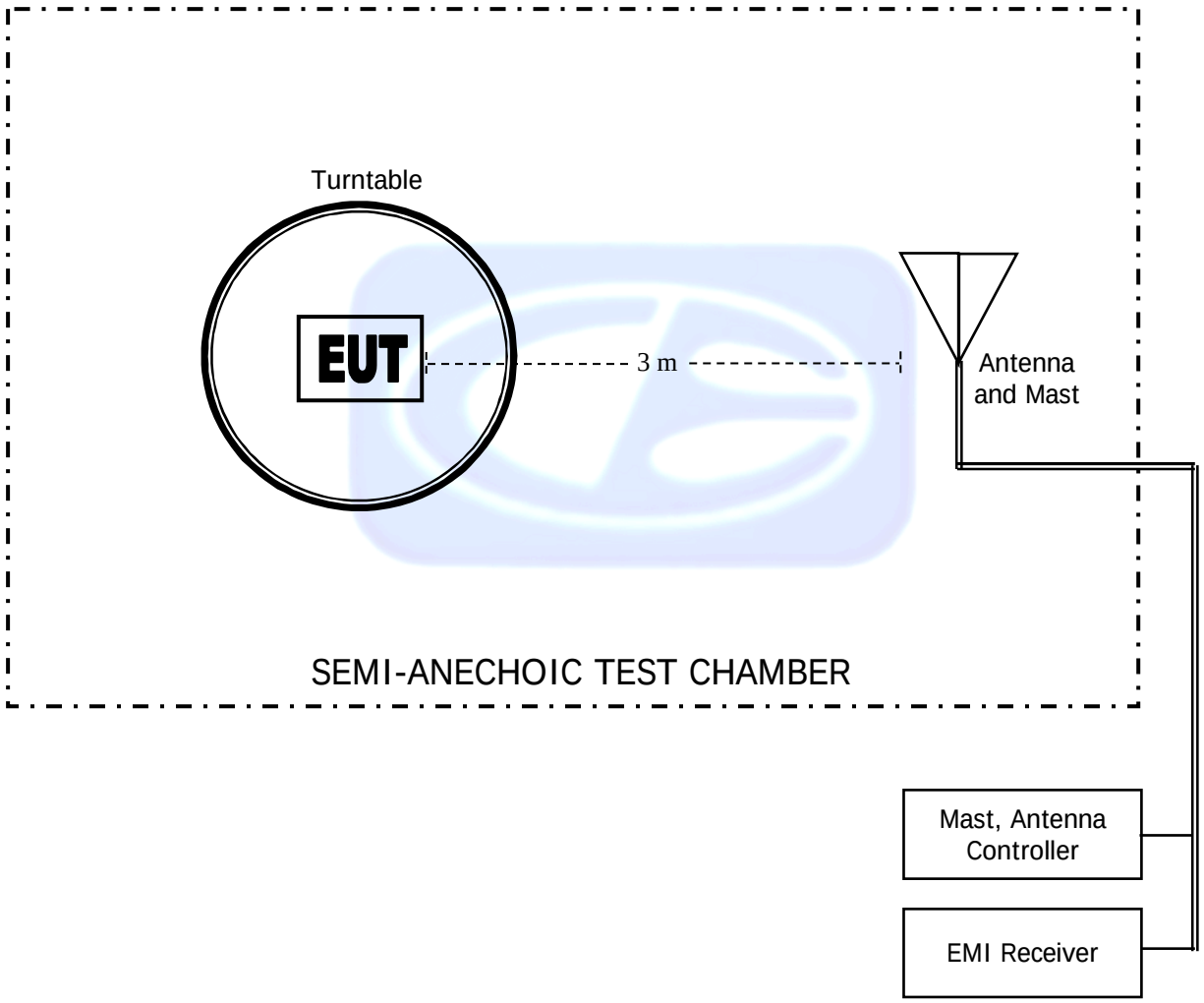
Device Tested	LoRa Edge Tracker Reference Design Model: LR1110TRK1CKS S/N: None

No Additional models.

APPENDIX D

DIAGRAMS AND CHARTS

FIGURE 1: LAYOUT OF THE SEMI-ANECHOIC TEST CHAMBER



COM-POWER AL-130

ACTIVE LOOP ANTENNA

S/N: 17067

CALIBRATION DATE: JUNE 5, 2019

FREQUENCY (MHz)	FACTOR (dB)	FREQUENCY (MHz)	FACTOR (dB)
0.009	10.69	1	10.75
0.01	10.09	2	10.82
0.02	8.49	3	10.89
0.03	9.19	4	11.04
0.04	8.59	5	11.03
0.05	10.77	6	11.00
0.06	10.97	7	11.12
0.07	10.67	8	11.27
0.08	10.67	9	11.38
0.09	10.69	10	11.69
0.1	10.29	15	12.28
0.2	10.32	20	10.13
0.3	10.19	25	9.12
0.4	10.22	30	11.31
0.5	10.40		
0.6	10.34		
0.7	10.42		
0.8	10.33		
0.9	10.53		

COM-POWER AC-220

COMBI-LOG ANTENNA

S/N: 10030030
ASSET: 6037

CALIBRATION DATE: JANUARY 30, 2020

FREQUENCY (MHz)	FACTOR (dB)	FREQUENCY (MHz)	FACTOR (dB)
30	22.5	450	21.4
35	21.5	500	22.1
40	20.7	550	22.6
45	19.9	600	24.4
50	18.6	650	24.5
60	15.0	700	24.6
70	11.9	750	26.1
80	11.9	800	26.5
90	13.5	850	26.8
100	14.5	900	27.8
120	15.5	950	28.4
140	14.2	1000	28.2
160	13.9		
180	14.8		
200	15.3		
225	15.7		
250	16.7		
275	18.4		
300	18.3		
350	19.4		
400	20.5		

AH-118

DOUBLE RIDGE HORN ANTENNA

S/N: 071370

CALIBRATION DATE: JUNE 29, 2020

FREQUENCY (MHz)	FACTOR (dB)	FREQUENCY (MHz)	FACTOR (dB)
1000	24.177	10000	39.425
1500	25.167	10500	39.679
2000	28.57	11000	39.435
2500	28.796	11500	40.078
3000	29.834	12000	40.509
3500	30.662	12500	40.308
4000	31.581	13000	40.259
4500	32.189	13500	40.394
5000	33.467	14000	40.695
5500	33.92	14500	42.451
6000	34.421	15000	41.913
6500	35.051	15500	39.324
7000	36.997	16000	39.617
7500	37.616	16500	39.303
8000	37.76	17000	41.265
8500	38.058	17500	43.367
9000	38.068	18000	45.279
9500	38.947		

AH-826

HORN ANTENNA

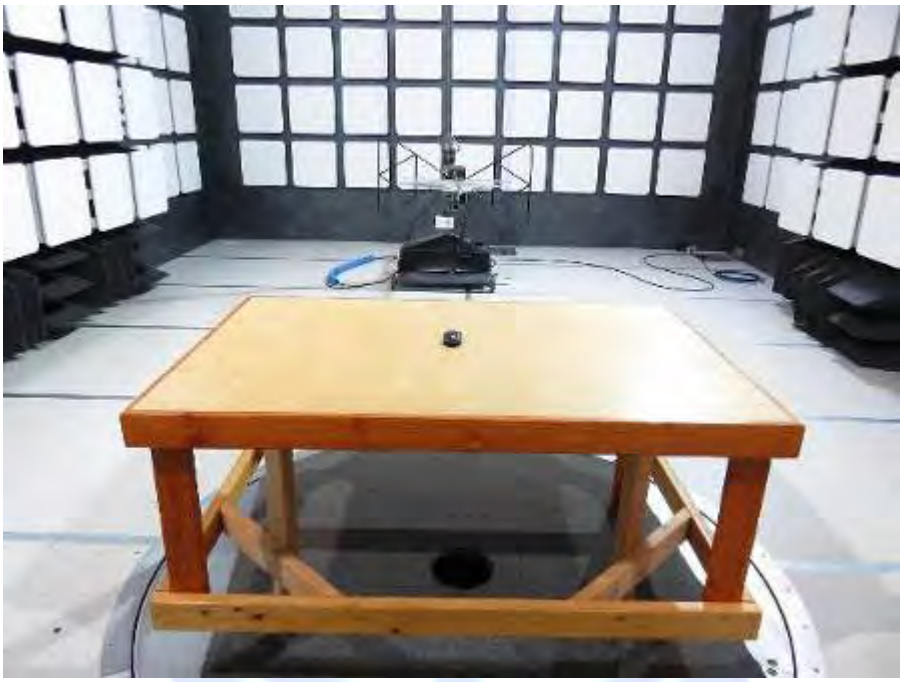
S/N: 081081

FREQUENCY (MHz)	FACTOR (dB)
18000	36.6
18500	36.0
19000	36.1
19500	19.0
20000	38.6
20500	37.2
21000	37.6
21500	37.6
22000	37.4
22500	37.9
23000	37.4
23500	36.7
24000	37.4
24500	37.7
25000	38.3
25500	38.0
26000	38.2
26500	38.1

FRONT VIEW

SEMTECH CORPORATION
LORA EDGE TRACKER REFERENCE DESIGN
MODEL NUMBER: LR1110TRK1CKS
FCC SUBPART B AND C – RADIATED EMISSIONS – BELOW 1 GHz

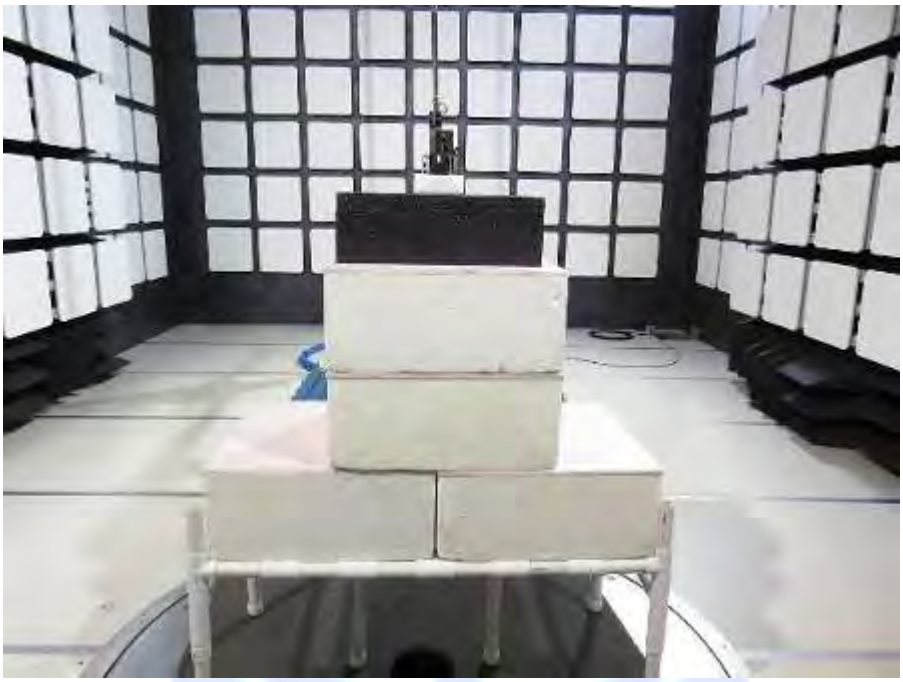
PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS



REAR VIEW

SEMTECH CORPORATION
LORA EDGE TRACKER REFERENCE DESIGN
MODEL NUMBER: LR1110TRK1CKS
FCC SUBPART B AND C – RADIATED EMISSIONS – BELOW 1 GHz

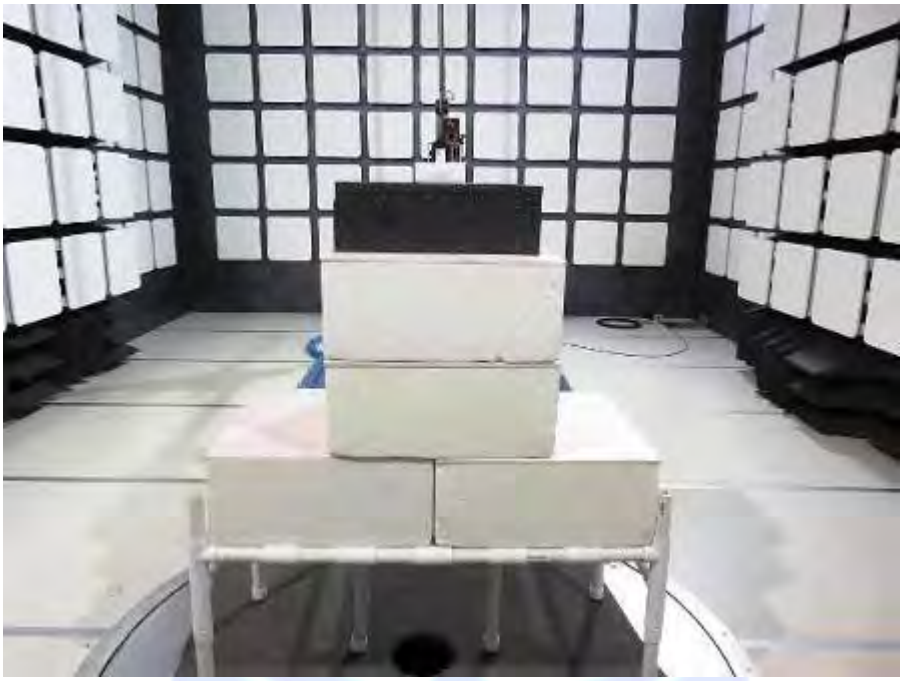
PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS



FRONT VIEW

SEMTECH CORPORATION
LORA EDGE TRACKER REFERENCE DESIGN
MODEL NUMBER: LR1110TRK1CKS
FCC SUBPART B AND C – RADIATED EMISSIONS – ABOVE 1 GHz

PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS



REAR VIEW

SEMTECH CORPORATION
LORA EDGE TRACKER REFERENCE DESIGN
MODEL NUMBER: LR1110TRK1CKS
FCC SUBPART B AND C – RADIATED EMISSIONS – ABOVE 1 GHz

PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS

APPENDIX E

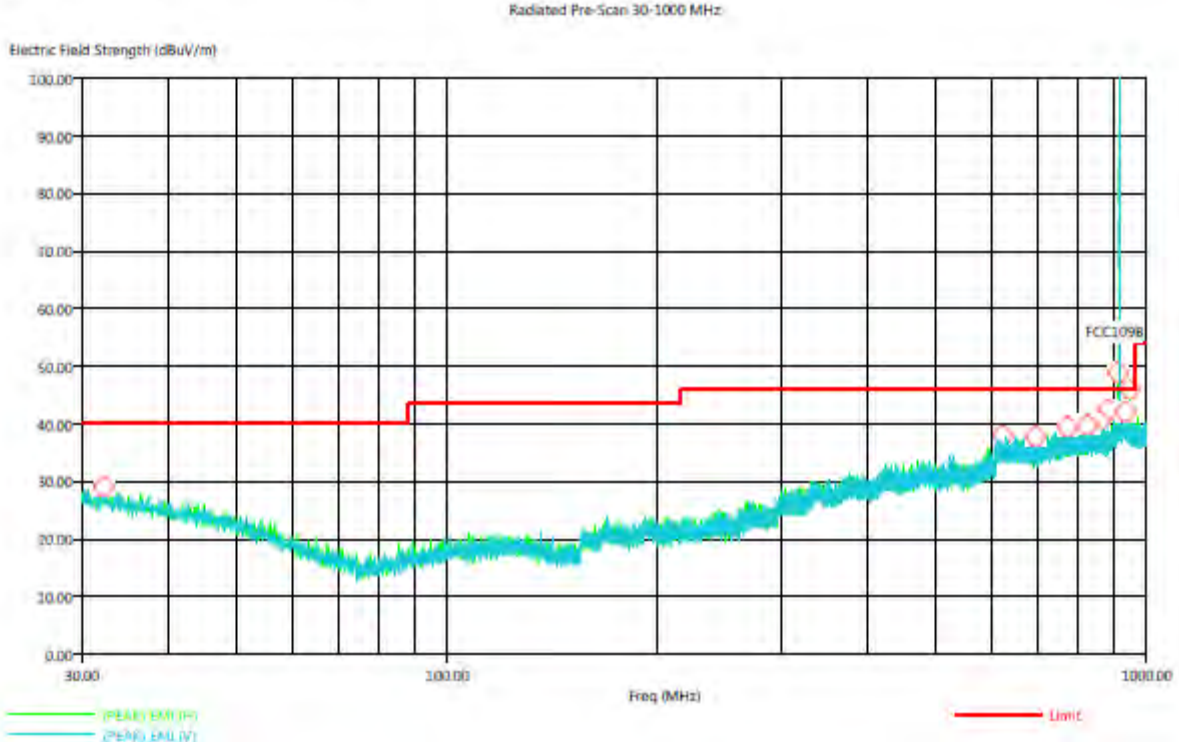
DATA SHEETS

RADIATED EMISSIONS

DATA SHEETS

Title: Radiated Pre-Scan 30-1000 MHz
File: Radiated Pre-Scan 30-1000 MHz 914.2 x axis
Operator: R. Ramirez
EUT Type: LoRa Edge Tracker Reference Design
EUT Condition: 914.2 MHz, X axis
Comments: Lab T
Clock Oscillators:
Company: Semtech Corporation
Model: LR1110TRK1CKS
Temperature: 67 F Humicity: 60 % Pressure: 29.3 inHg
Tested to: 9.142 GHz (no spurious emissions found above 1 GHz)

11/20/2020 10:18:14 AM
Sequence: Preliminary Scan



Title: Radiated Final 30-1000 MHz
File: Radiated Final 30-1000 MHz final
Operator: R. Ramirez
EUT Type: LoRa Edge Tracker Reference Design
EUT Condition: 914.2 MHz, X axis
Comments: Lab T
Clock Oscillators:
Company: Semtech Corporation
Model: LR1110TRK1CKS
Temperature: 67 F Humidity: 60 % Pressure: 29.3 inHg
Tested to: 9.142 GHz (no spurious emissions found above 1 GHz)

11/20/2020 10:51:58 AM
Sequence: Final Measurements

Data

Freq (MHz)	Pol	(PEAK) Trace (dBuV)	Cable (dB)	Transducer (dB)	(PEAK) EMI (dBuV/m)	(QP) EMI (dBuV/m)	Limit (dBuV/m)	(QP) Margin (dB)	Twr Ht (cm)	Tbl Aql (deg)
32.30	V	11.47	0.47	21.94	33.88	30.50	40.00	-9.50	187.30	119.80
623.50	H	14.32	2.65	24.20	41.17	38.59	46.00	-7.41	359.80	91.50
694.50	V	14.45	2.79	24.40	41.64	38.25	46.00	-7.75	339.10	220.60
771.80	V	13.79	3.04	26.20	43.03	39.65	46.00	-6.35	263.90	135.90
823.10	V	12.97	3.15	27.00	43.12	40.33	46.00	-5.67	210.80	258.60
827.80	H	13.19	3.16	27.10	43.45	40.47	46.00	-5.53	365.10	2.20
832.00	V	13.37	3.16	27.20	43.73	40.62	46.00	-5.38	327.70	88.00
856.80	H	13.70	3.21	26.80	43.71	40.13	46.00	-5.87	129.70	186.40
882.20	H	16.84	3.26	26.90	47.00	44.79	46.00	-1.21	133.60	352.20
911.40	H	15.66	3.35	28.17	47.12	47.60	46.00	-1.30	140.10	353.10
934.60	V	13.43	3.44	29.56	46.43	42.78	46.00	-3.22	272.00	225.30
946.10	H	15.78	3.49	28.50	47.77	44.67	46.00	-1.33	125.00	267.10

1

FCC 15.247

Semtech Corporation.
LoRa Edge Tracker Reference Design
M/N: LR1110TRK1CKS

Date: 11/20/2020
Lab: T
Tested By: Rey Ramirez

Non Harmonic Emissions from the Tx and Digital Portion - 9 kHz to 30 MHz
Non Harmonic Emissions from the Tx and Digital Portion - 1 GHz to 9.142 GHz

Freq. (MHz)	Level (dBuV/m)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Table Angle (deg)	Ant. Height (cm)	Comments
								No Emissions Detected
								from 9 kHz to 30 MHz
								for the digital portion
								of the EUT
								No Emissions Detected
								from 9 kHz to 30 MHz
								for the Non-Harmonic Emissions
								of the Transmitter for the EUT
								No Emissions Detected
								from 1 GHz to 9.142 GHz
								for the digital portion
								of the EUT
								No Emissions Detected
								from 1 GHz to 9.142 GHz
								for the Non-Harmonic Emissions
								of the Transmitter for the EUT
								Investigated in the X-Axis,
								Y-Axis, and Z-Axis

HARMONIC EMISSIONS LOW CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 903 MHz						Axis: X	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1806.00	50.82	H	73.97	-23.15	Peak	2.3	352.7	
1806.00	39.83	H	53.97	-14.14	Avg	2.3	352.7	
2709.00	54.08	H	73.97	-19.89	Peak	2.72	64.7	**Restricted Band**
2709.00	42.73	H	53.97	-11.24	Avg	2.72	64.7	**Restricted Band**
3612.00	52.29	H	73.97	-21.68	Peak	2.92	109.2	**Restricted Band**
3612.00	40.23	H	53.97	-13.74	Avg	2.92	109.2	**Restricted Band**
4515.00	55.58	H	73.97	-18.39	Peak	3.61	358.9	**Restricted Band**
4515.00	43.83	H	53.97	-10.14	Avg	3.61	358.9	**Restricted Band**
5418.00		H	73.97	-73.97	Peak			**Restricted Band**
5418.00		H	53.97	-53.97	Avg			**No emission found**
6321.00		H	73.97	-73.97	Peak			**No emission found**
6321.00		H	53.97	-53.97	Avg			
7224.00		H	73.97	-73.97	Peak			**No emission found**
7224.00		H	53.97	-53.97	Avg			
8127.00		H	73.97	-73.97	Peak			**Restricted Band**
8127.00		H	53.97	-53.97	Avg			**No emission found**
9030.00		H	73.97	-73.97	Peak			**Restricted Band**
9030.00		H	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS LOW CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 903 MHz						Axis: X	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1806.00	50.58	V	73.97	-23.39	Peak	2.84	95.1	
1806.00	39.42	V	53.97	-14.55	Avg	2.84	95.1	
2709.00	53.32	V	73.97	-20.65	Peak	2.29	179.9	**Restricted Band**
2709.00	42.69	V	53.97	-11.28	Avg	2.29	179.9	**Restricted Band**
3612.00	52.00	V	73.97	-21.97	Peak	2.14	96	**Restricted Band**
3612.00	40.27	V	53.97	-13.70	Avg	2.14	96	**Restricted Band**
4515.00	53.52	V	73.97	-20.45	Peak	3.15	175.7	**Restricted Band**
4515.00	42.78	V	53.97	-11.19	Avg	3.15	175.7	**Restricted Band**
5418.00		V	73.97	-73.97	Peak			**Restricted Band**
5418.00		V	53.97	-53.97	Avg			**No emission found**
6321.00		V	73.97	-73.97	Peak			**No emission found**
6321.00		V	53.97	-53.97	Avg			
7224.00		V	73.97	-73.97	Peak			**No emission found**
7224.00		V	53.97	-53.97	Avg			
8127.00		V	73.97	-73.97	Peak			**Restricted Band**
8127.00		V	53.97	-53.97	Avg			**No emission found**
9030.00		V	73.97	-73.97	Peak			**Restricted Band**
9030.00		V	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS MID CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 909.4 MHz						Axis: X	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1818.80	50.04	H	73.97	-23.93	Peak	1.88	50.1	
1818.80	39.09	H	53.97	-14.88	Avg	1.88	50.1	
2728.20	53.84	H	73.97	-20.13	Peak	3.12	334.4	**Restricted Band**
2728.20	42.50	H	53.97	-11.47	Avg	3.12	334.4	**Restricted Band**
3637.60	58.64	H	73.97	-15.33	Peak	3.32	219.9	**Restricted Band**
3637.60	47.33	H	53.97	-6.64	Avg	3.32	219.9	**Restricted Band**
4547.00	55.37	H	73.97	-18.60	Peak	2.83	129	**Restricted Band**
4547.00	44.00	H	53.97	-9.97	Avg	2.83	129	**Restricted Band**
5456.40		H	73.97	-73.97	Peak			**No emission found**
5456.40		H	53.97	-53.97	Avg			
6365.80		H	73.97	-73.97	Peak			**No emission found**
6365.80		H	53.97	-53.97	Avg			
7275.20		H	73.97	-73.97	Peak			**Restricted Band**
7275.20		H	53.97	-53.97	Avg			**No emission found**
8184.60		H	73.97	-73.97	Peak			**Restricted Band**
8184.60		H	53.97	-53.97	Avg			**No emission found**
9094.00		H	73.97	-73.97	Peak			**No emission found**
9094.00		H	53.97	-53.97	Avg			

Test distance
3 meter

HARMONIC EMISSIONS MID CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 909.4 MHz						Axis: X	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1818.80	52.39	V	73.97	-21.58	Peak	2.96	287.5	
1818.80	41.81	V	53.97	-12.16	Avg	2.96	287.5	
2728.20	53.77	V	73.97	-20.20	Peak	2.7	176.8	**Restricted Band**
2728.20	42.43	V	53.97	-11.54	Avg	2.7	176.8	**Restricted Band**
3637.60	55.24	V	73.97	-18.73	Peak	2.55	96.7	**Restricted Band**
3637.60	44.76	V	53.97	-9.21	Avg	2.55	96.7	**Restricted Band**
4547.00	54.76	V	73.97	-19.21	Peak	1.9	157.1	**Restricted Band**
4547.00	43.08	V	53.97	-10.89	Avg	1.9	157.1	**Restricted Band**
5456.40		V	73.97	-73.97	Peak			**No emission found**
5456.40		V	53.97	-53.97	Avg			
6365.80		V	73.97	-73.97	Peak			**No emission found**
6365.80		V	53.97	-53.97	Avg			
7275.20		V	73.97	-73.97	Peak			**Restricted Band**
7275.20		V	53.97	-53.97	Avg			**No emission found**
8184.60		V	73.97	-73.97	Peak			**Restricted Band**
8184.60		V	53.97	-53.97	Avg			**No emission found**
9094.00		V	73.97	-73.97	Peak			**No emission found**
9094.00		V	53.97	-53.97	Avg			

Test distance
3 meter

HARMONIC EMISSIONS HIGH CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 914.2 MHz						Axis: X	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1828.40	50.32	H	73.97	-23.65	Peak	2.17	103.5	
1828.40	39.21	H	53.97	-14.76	Avg	2.17	103.5	
2742.60	53.53	H	73.97	-20.44	Peak	3.13	202.7	**Restricted Band**
2742.60	43.05	H	53.97	-10.92	Avg	3.13	202.7	**Restricted Band**
3656.80	50.88	H	73.97	-23.09	Peak	2.55	172.1	**Restricted Band**
3656.80	40.06	H	53.97	-13.91	Avg	2.55	172.1	**Restricted Band**
4571.00	54.14	H	73.97	-19.83	Peak	2.35	142.9	**Restricted Band**
4571.00	42.54	H	53.97	-11.43	Avg	2.35	142.9	**Restricted Band**
5485.20		H	73.97	-73.97	Peak			**No emission found**
5485.20		H	53.97	-53.97	Avg			
6399.40		H	73.97	-73.97	Peak			**No emission found**
6399.40		H	53.97	-53.97	Avg			
7313.60		H	73.97	-73.97	Peak			**Restricted Band**
7313.60		H	53.97	-53.97	Avg			**No emission found**
8227.80		H	73.97	-73.97	Peak			**Restricted Band**
8227.80		H	53.97	-53.97	Avg			**No emission found**
9142.00		H	73.97	-73.97	Peak			**Restricted Band**
9142.00		H	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS HIGH CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 914.2 MHz						Axis: X	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1828.40	50.57	V	73.97	-23.40	Peak	2.09	144.7	
1828.40	39.25	V	53.97	-14.72	Avg	2.09	144.7	
2742.60	58.07	V	73.97	-15.90	Peak	2.45	167.2	**Restricted Band**
2742.60	46.45	V	53.97	-7.52	Avg	2.45	167.2	**Restricted Band**
3656.80	58.26	V	73.97	-15.71	Peak	2.07	73.1	**Restricted Band**
3656.80	47.00	V	53.97	-6.97	Avg	2.07	73.1	**Restricted Band**
4571.00	53.89	V	73.97	-20.08	Peak	2.67	57.7	**Restricted Band**
4571.00	42.48	V	53.97	-11.49	Avg	2.67	57.7	**Restricted Band**
5485.20		V	73.97	-73.97	Peak			**No emission found**
5485.20		V	53.97	-53.97	Avg			
6399.40		V	73.97	-73.97	Peak			**No emission found**
6399.40		V	53.97	-53.97	Avg			
7313.60		V	73.97	-73.97	Peak			**Restricted Band**
7313.60		V	53.97	-53.97	Avg			**No emission found**
8227.80		V	73.97	-73.97	Peak			**Restricted Band**
8227.80		V	53.97	-53.97	Avg			**No emission found**
9142.00		V	73.97	-73.97	Peak			**Restricted Band**
9142.00		V	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS LOW CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 903 MHz						Axis: Y	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1806.00	49.98	H	73.97	-23.99	Peak	3.65	261.4	
1806.00	39.02	H	53.97	-14.95	Avg	3.65	261.4	
2709.00	53.06	H	73.97	-20.91	Peak	2.34	259.2	**Restricted Band**
2709.00	42.14	H	53.97	-11.83	Avg	2.34	259.2	**Restricted Band**
3612.00	57.14	H	73.97	-16.83	Peak	1.96	66.6	**Restricted Band**
3612.00	47.64	H	53.97	-6.33	Avg	1.96	66.6	**Restricted Band**
4515.00	53.25	H	73.97	-20.72	Peak	3.43	144.8	**Restricted Band**
4515.00	42.48	H	53.97	-11.49	Avg	3.43	144.8	**Restricted Band**
5418.00		H	73.97	-73.97	Peak			**Restricted Band**
5418.00		H	53.97	-53.97	Avg			**No emission found**
6321.00		H	73.97	-73.97	Peak			**No emission found**
6321.00		H	53.97	-53.97	Avg			
7224.00		H	73.97	-73.97	Peak			**No emission found**
7224.00		H	53.97	-53.97	Avg			
8127.00		H	73.97	-73.97	Peak			**Restricted Band**
8127.00		H	53.97	-53.97	Avg			**No emission found**
9030.00		H	73.97	-73.97	Peak			**Restricted Band**
9030.00		H	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS LOW CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 903 MHz						Axis: Y	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1806.00	50.11	V	73.97	-23.86	Peak	2.45	355.9	
1806.00	39.09	V	53.97	-14.88	Avg	2.45	355.9	
2709.00	57.01	V	73.97	-16.96	Peak	2.48	195.6	**Restricted Band**
2709.00	45.60	V	53.97	-8.37	Avg	2.48	195.6	**Restricted Band**
3612.00	51.66	V	73.97	-22.31	Peak	2.16	58.1	**Restricted Band**
3612.00	40.20	V	53.97	-13.77	Avg	2.16	58.1	**Restricted Band**
4515.00	53.85	V	73.97	-20.12	Peak	3.19	350.2	**Restricted Band**
4515.00	42.99	V	53.97	-10.98	Avg	3.19	350.2	**Restricted Band**
5418.00		V	73.97	-73.97	Peak			**Restricted Band**
5418.00		V	53.97	-53.97	Avg			**No emission found**
6321.00		V	73.97	-73.97	Peak			**No emission found**
6321.00		V	53.97	-53.97	Avg			
7224.00		V	73.97	-73.97	Peak			**No emission found**
7224.00		V	53.97	-53.97	Avg			
8127.00		V	73.97	-73.97	Peak			**Restricted Band**
8127.00		V	53.97	-53.97	Avg			**No emission found**
9030.00		V	73.97	-73.97	Peak			**Restricted Band**
9030.00		V	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS MID CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 909.4 MHz						Axis: Y	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1818.80	50.94	H	73.97	-23.03	Peak	2.61	312.2	
1818.80	39.00	H	53.97	-14.97	Avg	2.61	312.2	
2728.20	52.74	H	73.97	-21.23	Peak	2.55	301.5	**Restricted Band**
2728.20	42.13	H	53.97	-11.84	Avg	2.55	301.5	**Restricted Band**
3637.60	58.41	H	73.97	-15.56	Peak	2.47	295	**Restricted Band**
3637.60	47.31	H	53.97	-6.66	Avg	2.47	295	**Restricted Band**
4547.00	55.05	H	73.97	-18.92	Peak	3.40	198.3	**Restricted Band**
4547.00	43.55	H	53.97	-10.42	Avg	3.40	198.3	**Restricted Band**
5456.40		H	73.97	-73.97	Peak			**No emission found**
5456.40		H	53.97	-53.97	Avg			
6365.80		H	73.97	-73.97	Peak			**No emission found**
6365.80		H	53.97	-53.97	Avg			
7275.20		H	73.97	-73.97	Peak			**Restricted Band**
7275.20		H	53.97	-53.97	Avg			**No emission found**
8184.60		H	73.97	-73.97	Peak			**Restricted Band**
8184.60		H	53.97	-53.97	Avg			**No emission found**
9094.00		H	73.97	-73.97	Peak			**No emission found**
9094.00		H	53.97	-53.97	Avg			

Test distance
3 meter

HARMONIC EMISSIONS MID CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 909.4 MHz						Axis: Y	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1818.80	50.48	V	73.97	-23.49	Peak	1.96	153.7	
1818.80	39.29	V	53.97	-14.68	Avg	1.96	153.7	
2728.20	53.75	V	73.97	-20.22	Peak	2.92	356	**Restricted Band**
2728.20	42.50	V	53.97	-11.47	Avg	2.92	356	**Restricted Band**
3637.60	58.75	V	73.97	-15.22	Peak	2.87	0.1	**Restricted Band**
3637.60	47.33	V	53.97	-6.64	Avg	2.87	0.1	**Restricted Band**
4547.00	53.98	V	73.97	-19.99	Peak	2.04	150.4	**Restricted Band**
4547.00	43.19	V	53.97	-10.78	Avg	2.04	150.4	**Restricted Band**
5456.40		V	73.97	-73.97	Peak			**No emission found**
5456.40		V	53.97	-53.97	Avg			
6365.80		V	73.97	-73.97	Peak			**No emission found**
6365.80		V	53.97	-53.97	Avg			
7275.20		V	73.97	-73.97	Peak			**Restricted Band**
7275.20		V	53.97	-53.97	Avg			**No emission found**
8184.60		V	73.97	-73.97	Peak			**Restricted Band**
8184.60		V	53.97	-53.97	Avg			**No emission found**
9094.00		V	73.97	-73.97	Peak			**No emission found**
9094.00		V	53.97	-53.97	Avg			

Test distance
3 meter

HARMONIC EMISSIONS HIGH CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 914.2 MHz						Axis: Y	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1828.40	50.56	H	73.97	-23.41	Peak	2.53	329.1	
1828.40	39.13	H	53.97	-14.84	Avg	2.53	329.1	
2742.60	53.91	H	73.97	-20.06	Peak	3.12	8.8	**Restricted Band**
2742.60	42.59	H	53.97	-11.38	Avg	3.12	8.8	**Restricted Band**
3656.80	50.79	H	73.97	-23.18	Peak	3.48	97.7	**Restricted Band**
3656.80	39.91	H	53.97	-14.06	Avg	3.48	97.7	**Restricted Band**
4571.00	54.47	H	73.97	-19.50	Peak	2.6	353.4	**Restricted Band**
4571.00	43.57	H	53.97	-10.40	Avg	2.6	353.4	**Restricted Band**
5485.20		H	73.97	-73.97	Peak			**No emission found**
5485.20		H	53.97	-53.97	Avg			
6399.40		H	73.97	-73.97	Peak			**No emission found**
6399.40		H	53.97	-53.97	Avg			
7313.60		H	73.97	-73.97	Peak			**Restricted Band**
7313.60		H	53.97	-53.97	Avg			**No emission found**
8227.80		H	73.97	-73.97	Peak			**Restricted Band**
8227.80		H	53.97	-53.97	Avg			**No emission found**
9142.00		H	73.97	-73.97	Peak			**Restricted Band**
9142.00		H	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS HIGH CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 914.2 MHz						Axis: Y	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1828.40	50.48	V	73.97	-23.49	Peak	3.15	297.7	
1828.40	39.14	V	53.97	-14.83	Avg	3.15	297.7	
2742.60	53.31	V	73.97	-20.66	Peak	2.63	357.8	**Restricted Band**
2742.60	42.10	V	53.97	-11.87	Avg	2.63	357.8	**Restricted Band**
3656.80	50.84	V	73.97	-23.13	Peak	3.37	251.8	**Restricted Band**
3656.80	39.92	V	53.97	-14.05	Avg	3.37	251.8	**Restricted Band**
4571.00	53.50	V	73.97	-20.47	Peak	3.46	175.4	**Restricted Band**
4571.00	42.14	V	53.97	-11.83	Avg	3.46	175.4	**Restricted Band**
5485.20		V	73.97	-73.97	Peak			**No emission found**
5485.20		V	53.97	-53.97	Avg			
6399.40		V	73.97	-73.97	Peak			**No emission found**
6399.40		V	53.97	-53.97	Avg			
7313.60		V	73.97	-73.97	Peak			**Restricted Band**
7313.60		V	53.97	-53.97	Avg			**No emission found**
8227.80		V	73.97	-73.97	Peak			**Restricted Band**
8227.80		V	53.97	-53.97	Avg			**No emission found**
9142.00		V	73.97	-73.97	Peak			**Restricted Band**
9142.00		V	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS LOW CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 903 MHz						Axis: Z	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1806.00	51.39	H	73.97	-22.58	Peak	2.78	45	
1806.00	38.89	H	53.97	-15.08	Avg	2.78	45	
2709.00	57.74	H	73.97	-16.23	Peak	2.01	264.8	**Restricted Band**
2709.00	47.56	H	53.97	-6.41	Avg	2.01	264.8	**Restricted Band**
3612.00	51.16	H	73.97	-22.81	Peak	1.85	11.6	**Restricted Band**
3612.00	40.27	H	53.97	-13.70	Avg	1.85	11.6	**Restricted Band**
4515.00	53.61	H	73.97	-20.36	Peak	298.2	302.5	**Restricted Band**
4515.00	42.20	H	53.97	-11.77	Avg	298.2	302.5	**Restricted Band**
5418.00		H	73.97	-73.97	Peak			**Restricted Band**
5418.00		H	53.97	-53.97	Avg			**No emission found**
6321.00		H	73.97	-73.97	Peak			**No emission found**
6321.00		H	53.97	-53.97	Avg			
7224.00		H	73.97	-73.97	Peak			**No emission found**
7224.00		H	53.97	-53.97	Avg			
8127.00		H	73.97	-73.97	Peak			**Restricted Band**
8127.00		H	53.97	-53.97	Avg			**No emission found**
9030.00		H	73.97	-73.97	Peak			**Restricted Band**
9030.00		H	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS LOW CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 903 MHz						Axis: Z	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1806.00	50.88	V	73.97	-23.09	Peak	3.08	208.8	
1806.00	39.01	V	53.97	-14.96	Avg	3.08	208.8	
2709.00	53.37	V	73.97	-20.60	Peak	1.83	276	**Restricted Band**
2709.00	42.61	V	53.97	-11.36	Avg	1.83	276	**Restricted Band**
3612.00	58.69	V	73.97	-15.28	Peak	2.98	331.7	**Restricted Band**
3612.00	47.20	V	53.97	-6.77	Avg	2.98	331.7	**Restricted Band**
4515.00	55.22	V	73.97	-18.75	Peak	2.11	45.6	**Restricted Band**
4515.00	43.62	V	53.97	-10.35	Avg	2.11	45.6	**Restricted Band**
5418.00		V	73.97	-73.97	Peak			**Restricted Band**
5418.00		V	53.97	-53.97	Avg			**No emission found**
6321.00		V	73.97	-73.97	Peak			**No emission found**
6321.00		V	53.97	-53.97	Avg			
7224.00		V	73.97	-73.97	Peak			**No emission found**
7224.00		V	53.97	-53.97	Avg			
8127.00		V	73.97	-73.97	Peak			**Restricted Band**
8127.00		V	53.97	-53.97	Avg			**No emission found**
9030.00		V	73.97	-73.97	Peak			**Restricted Band**
9030.00		V	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS MID CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 909.4 MHz						Axis: Z	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1818.80	50.27	H	73.97	-23.70	Peak	3.65	334.7	
1818.80	39.39	H	53.97	-14.58	Avg	3.65	334.7	
2728.20	59.36	H	73.97	-14.61	Peak	2.38	271.9	**Restricted Band**
2728.20	48.66	H	53.97	-5.31	Avg	2.38	271.9	**Restricted Band**
3637.60	52.37	H	73.97	-21.60	Peak	2.16	280.6	**Restricted Band**
3637.60	40.35	H	53.97	-13.62	Avg	2.16	280.6	**Restricted Band**
4547.00	55.64	H	73.97	-18.33	Peak	1.95	69.4	**Restricted Band**
4547.00	43.66	H	53.97	-10.31	Avg	1.95	69.4	**Restricted Band**
5456.40		H	73.97	-73.97	Peak			**No emission found**
5456.40		H	53.97	-53.97	Avg			
6365.80		H	73.97	-73.97	Peak			**No emission found**
6365.80		H	53.97	-53.97	Avg			
7275.20		H	73.97	-73.97	Peak			**Restricted Band**
7275.20		H	53.97	-53.97	Avg			**No emission found**
8184.60		H	73.97	-73.97	Peak			**Restricted Band**
8184.60		H	53.97	-53.97	Avg			**No emission found**
9094.00		H	73.97	-73.97	Peak			**No emission found**
9094.00		H	53.97	-53.97	Avg			

Test distance
3 meter

HARMONIC EMISSIONS MID CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 909.4 MHz						Axis: Z	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1818.80	51.09	V	73.97	-22.88	Peak	3.06	305.8	
1818.80	39.25	V	53.97	-14.72	Avg	3.06	305.8	
2728.20	54.16	V	73.97	-19.81	Peak	3.19	20.1	**Restricted Band**
2728.20	42.76	V	53.97	-11.21	Avg	3.19	20.1	**Restricted Band**
3637.60	51.51	V	73.97	-22.46	Peak	3.1	74.6	**Restricted Band**
3637.60	40.53	V	53.97	-13.44	Avg	3.1	74.6	**Restricted Band**
4547.00	54.26	V	73.97	-19.71	Peak	2.17	74.5	**Restricted Band**
4547.00	42.81	V	53.97	-11.16	Avg	2.17	74.5	**Restricted Band**
5456.40		V	73.97	-73.97	Peak			**No emission found**
5456.40		V	53.97	-53.97	Avg			
6365.80		V	73.97	-73.97	Peak			**No emission found**
6365.80		V	53.97	-53.97	Avg			
7275.20		V	73.97	-73.97	Peak			**Restricted Band**
7275.20		V	53.97	-53.97	Avg			**No emission found**
8184.60		V	73.97	-73.97	Peak			**Restricted Band**
8184.60		V	53.97	-53.97	Avg			**No emission found**
9094.00		V	73.97	-73.97	Peak			**No emission found**
9094.00		V	53.97	-53.97	Avg			

Test distance
3 meter

HARMONIC EMISSIONS HIGH CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 914.2 MHz						Axis: Z	

Compatible Electronics, Inc. (Lab T)

Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1828.40	51.50	H	73.97	-22.47	Peak	3.12	297.9	
1828.40	39.22	H	53.97	-14.75	Avg	3.12	297.9	
2742.60	56.58	H	73.97	-17.39	Peak	3.05	271.8	**Restricted Band**
2742.60	47.64	H	53.97	-6.33	Avg	3.05	271.8	**Restricted Band**
3656.80	52.29	H	73.97	-21.68	Peak	1.92	328.2	**Restricted Band**
3656.80	40.24	H	53.97	-13.73	Avg	1.92	328.2	**Restricted Band**
4571.00	54.09	H	73.97	-19.88	Peak	2.47	338.4	**Restricted Band**
4571.00	42.28	H	53.97	-11.69	Avg	2.47	338.4	**Restricted Band**
5485.20		H	73.97	-73.97	Peak			**No emission found**
5485.20		H	53.97	-53.97	Avg			
6399.40		H	73.97	-73.97	Peak			**No emission found**
6399.40		H	53.97	-53.97	Avg			
7313.60		H	73.97	-73.97	Peak			**Restricted Band**
7313.60		H	53.97	-53.97	Avg			**No emission found**
8227.80		H	73.97	-73.97	Peak			**Restricted Band**
8227.80		H	53.97	-53.97	Avg			**No emission found**
9142.00		H	73.97	-73.97	Peak			**Restricted Band**
9142.00		H	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

HARMONIC EMISSIONS HIGH CHANNEL

FCC 15.247							
Company:	Semtech Corporation					Date:	11/23/2020
EUT:	LoRa Edge Tracker					Lab:	T
Model:	LR1110TRK1CKS					Test ENG:	R. Ramirez
Transmitting Frequency: 914.2 MHz						Axis: Z	

Compatible Electronics, Inc. (Lab T)

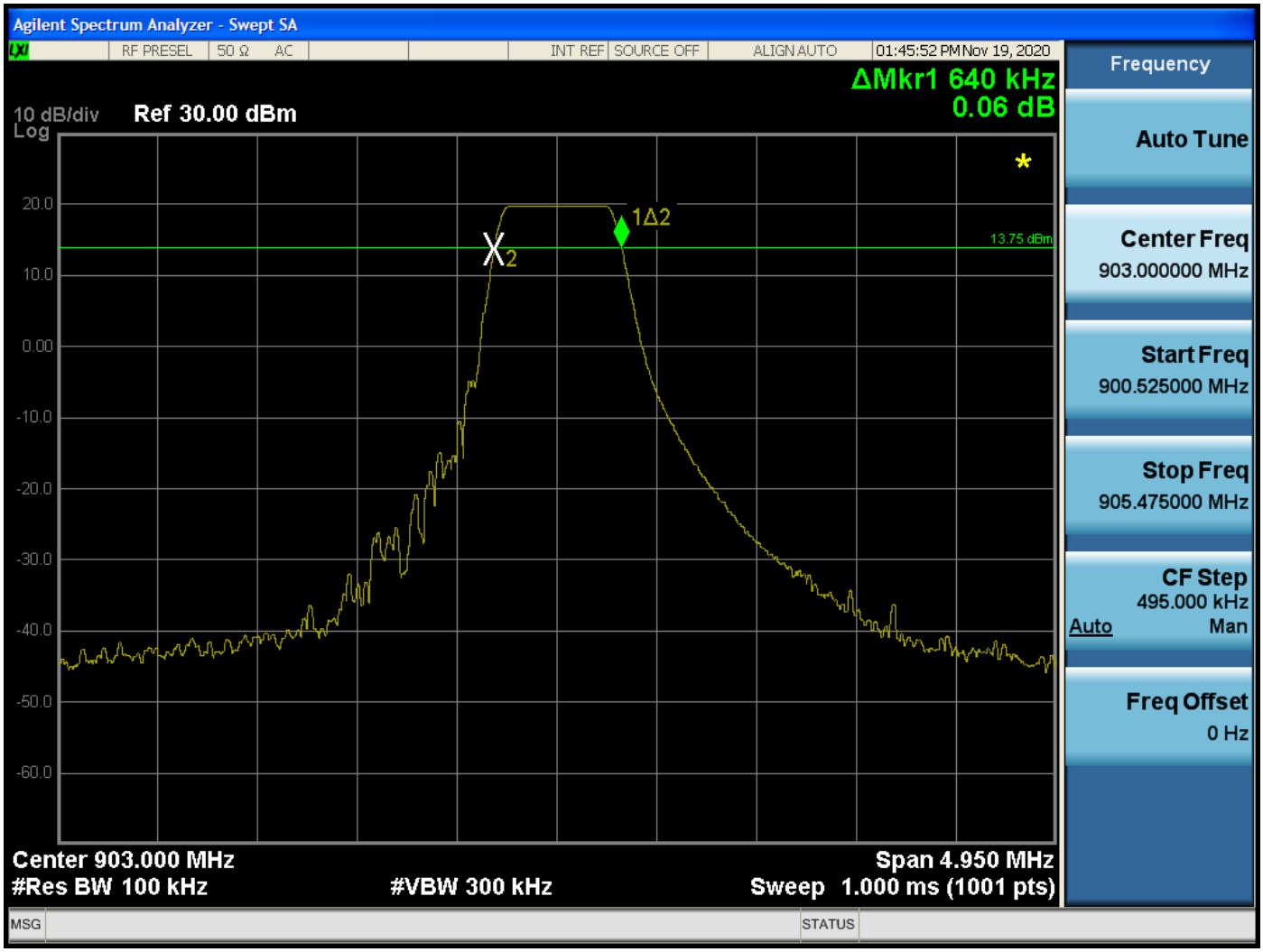
Freq. (MHz)	Level (dBuV)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Ant. Height (m)	Table Angle (deg)	Comments
1828.40	50.68	V	73.97	-23.29	Peak	2.35	287.6	
1828.40	39.47	V	53.97	-14.50	Avg	2.35	287.6	
2742.60	53.81	V	73.97	-20.16	Peak	2.08	220.1	**Restricted Band**
2742.60	42.84	V	53.97	-11.13	Avg	2.08	220.1	**Restricted Band**
3656.80	52.06	V	73.97	-21.91	Peak	3.46	333.6	**Restricted Band**
3656.80	40.01	V	53.97	-13.96	Avg	3.46	333.6	**Restricted Band**
4571.00	54.72	V	73.97	-19.25	Peak	3.55	181.9	**Restricted Band**
4571.00	43.10	V	53.97	-10.87	Avg	3.55	181.9	**Restricted Band**
5485.20		V	73.97	-73.97	Peak			**No emission found**
5485.20		V	53.97	-53.97	Avg			
6399.40		V	73.97	-73.97	Peak			**No emission found**
6399.40		V	53.97	-53.97	Avg			
7313.60		V	73.97	-73.97	Peak			**Restricted Band**
7313.60		V	53.97	-53.97	Avg			**No emission found**
8227.80		V	73.97	-73.97	Peak			**Restricted Band**
8227.80		V	53.97	-53.97	Avg			**No emission found**
9142.00		V	73.97	-73.97	Peak			**Restricted Band**
9142.00		V	53.97	-53.97	Avg			**No emission found**

Test distance
3 meter

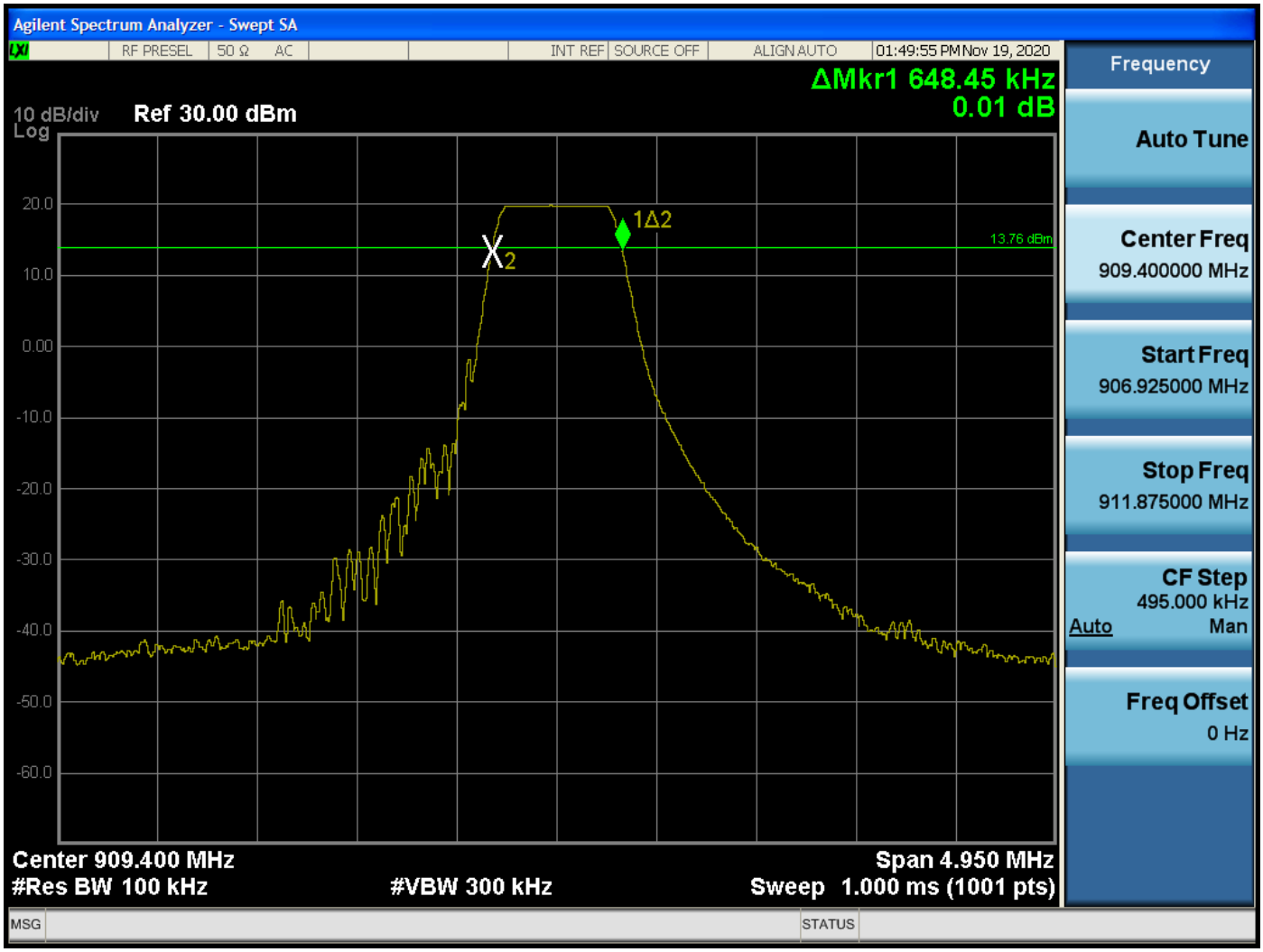
DATA SHEETS

BANDWIDTH

DATA SHEETS



DTS Bandwidth – Low Channel

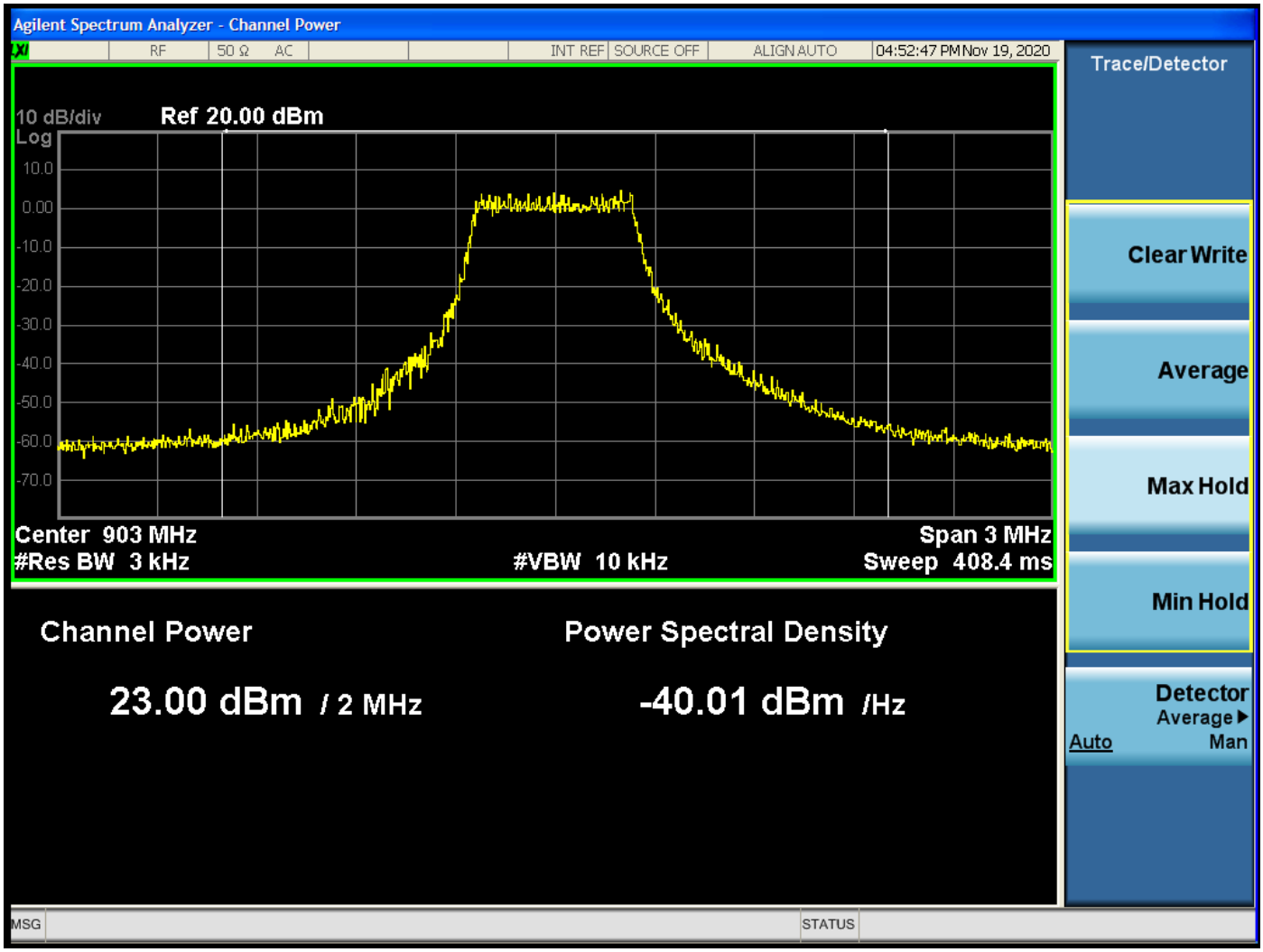


DTS Bandwidth – Middle Channel

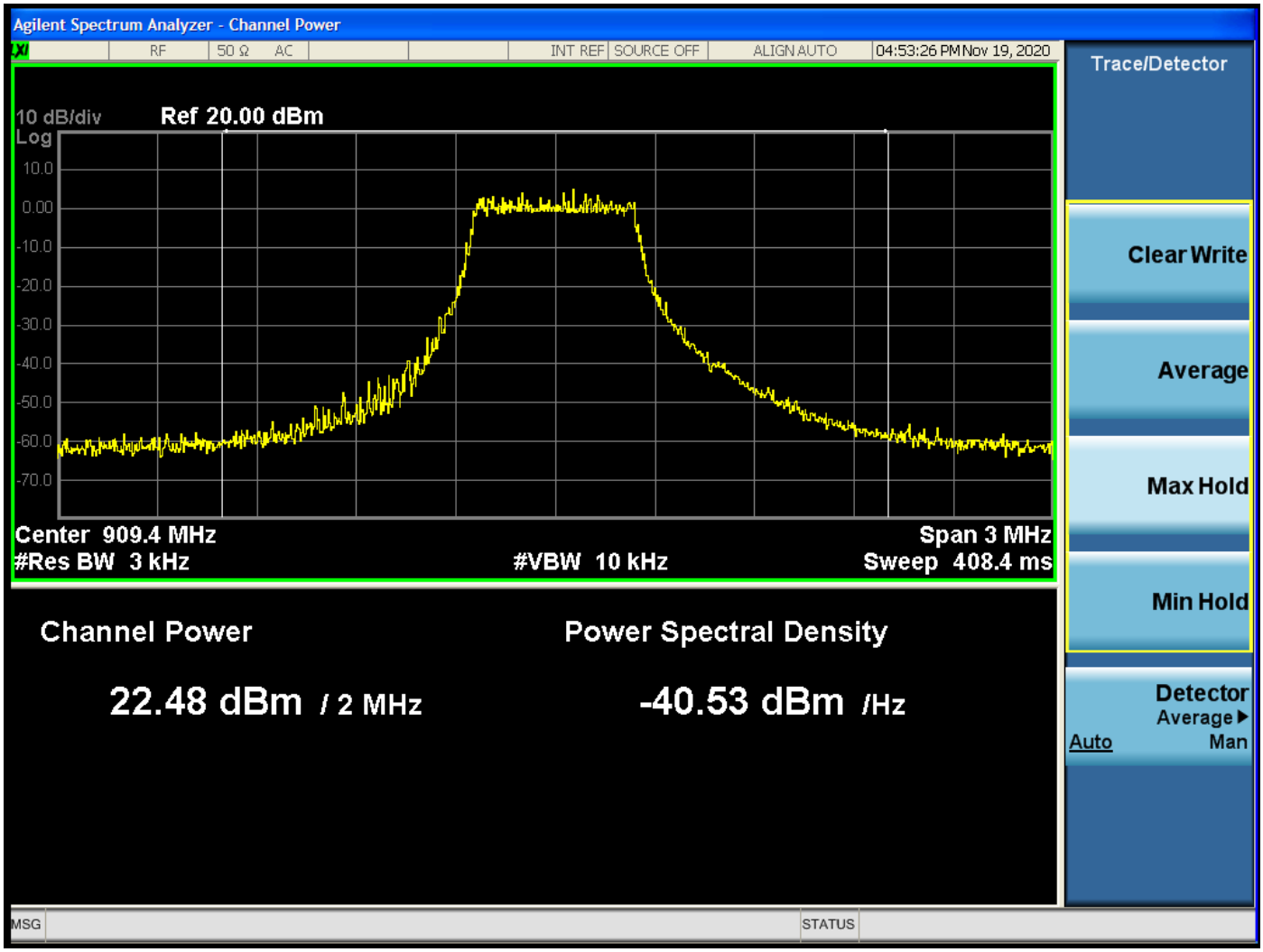
DTS Bandwidth – High Channel

SPECTRAL DENSITY OUTPUT

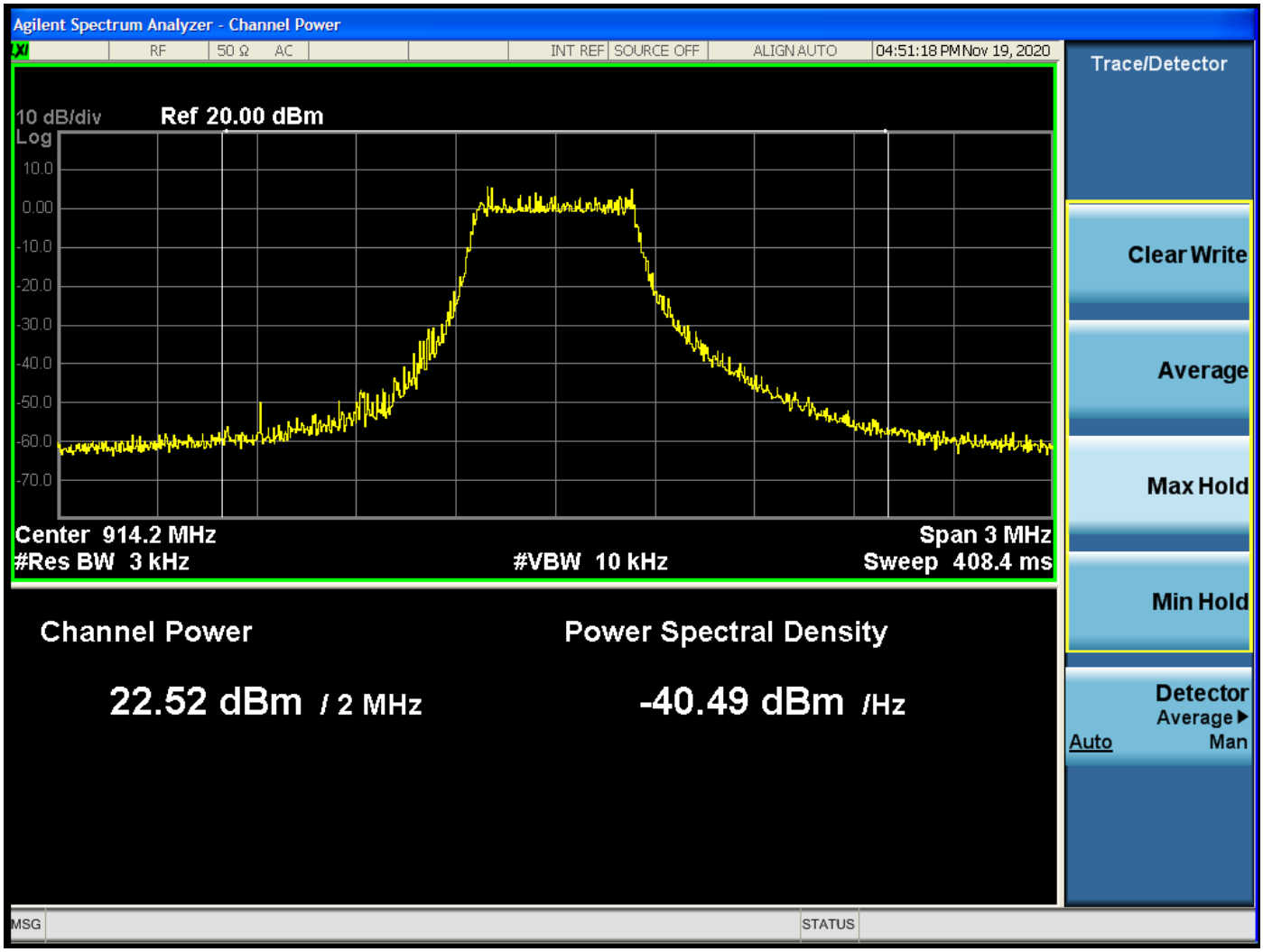
DATA SHEETS



Power Spectral Density – Low Channel



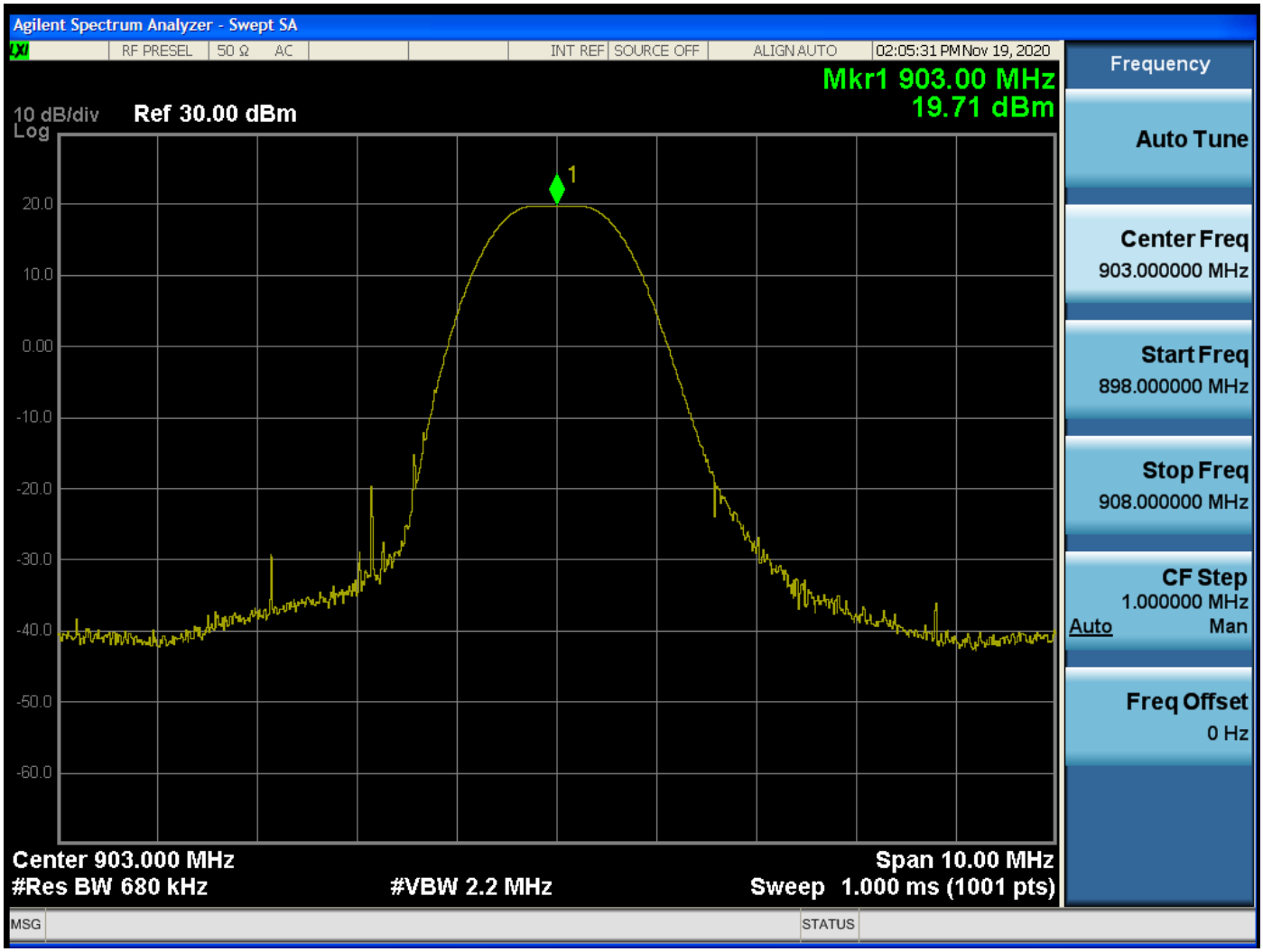
Power Spectral Density – Middle Channel



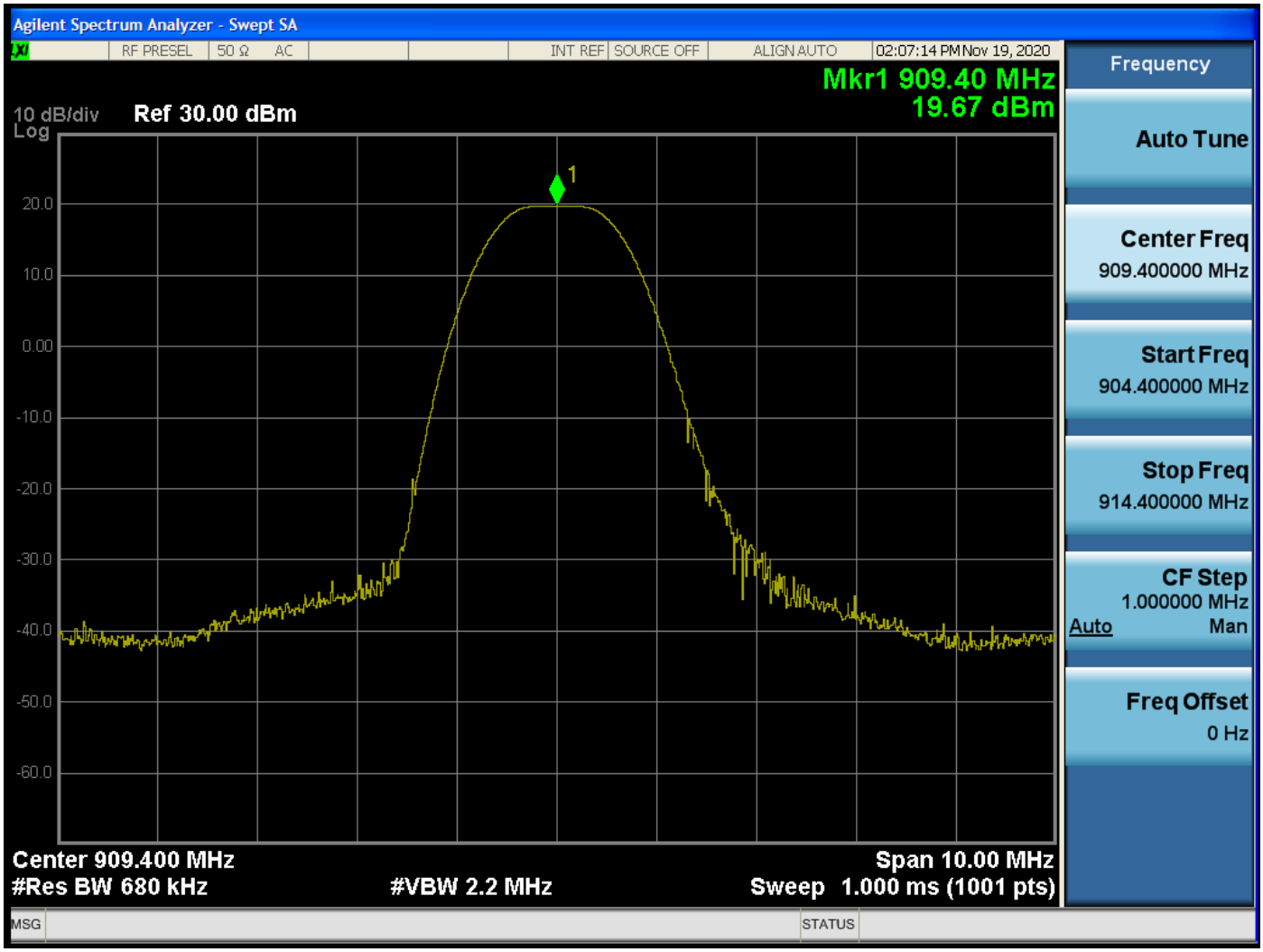
Power Spectral Density – High Channel

PEAK OUTPUT POWER

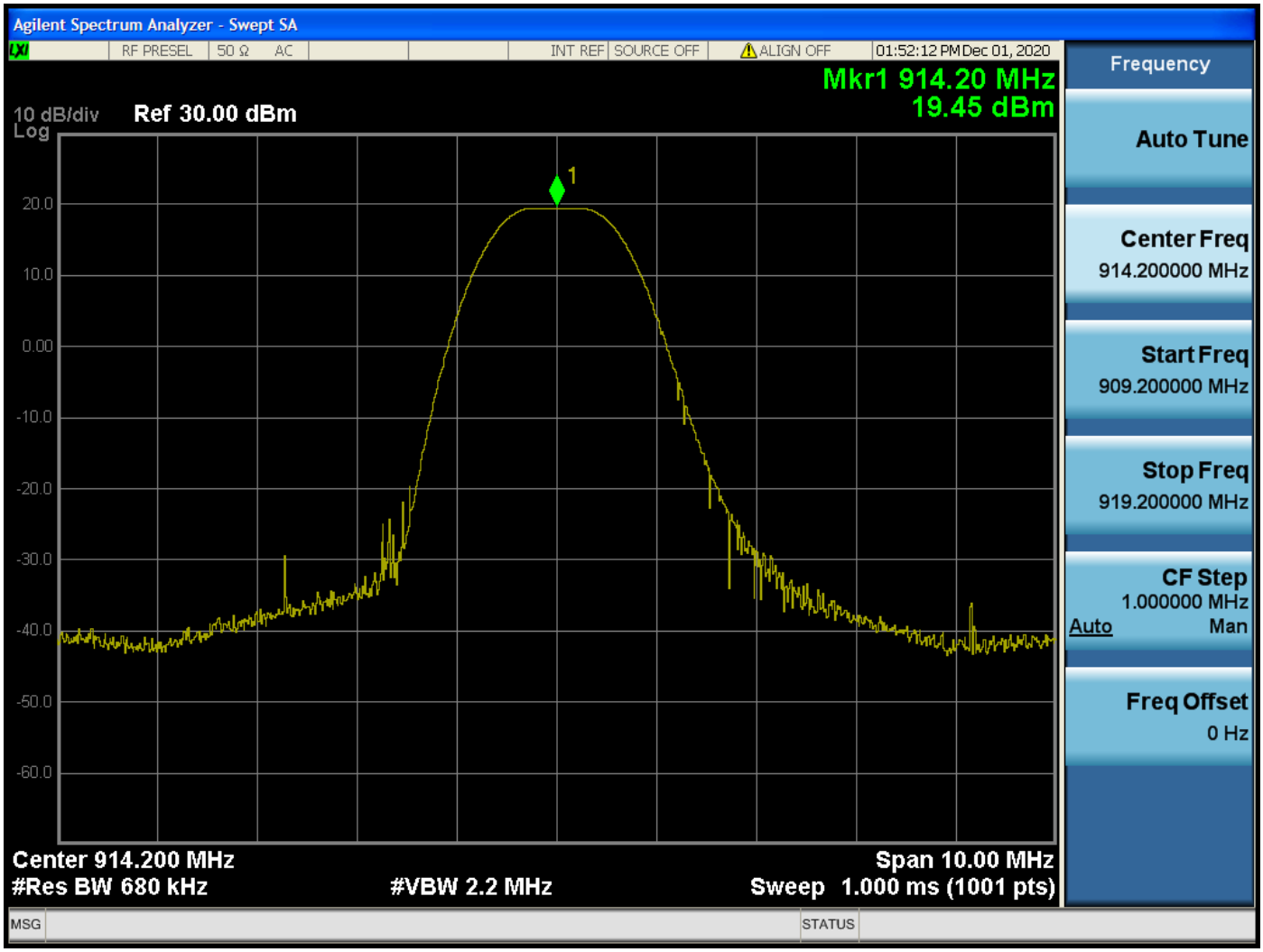
DATA SHEETS



Peak Output Power – Low Channel



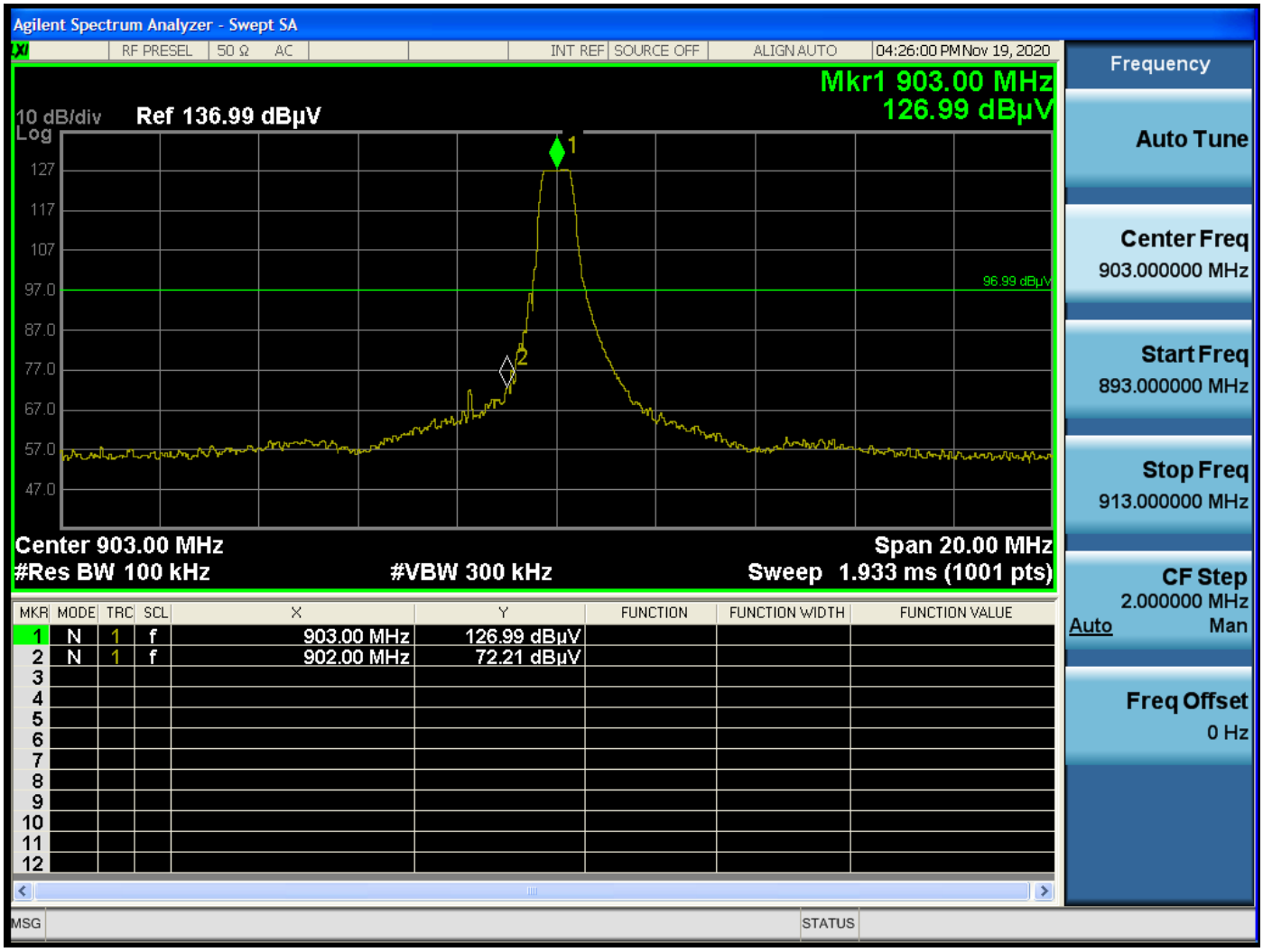
Peak Output Power – Middle Channel



Peak Output Power – High Channel

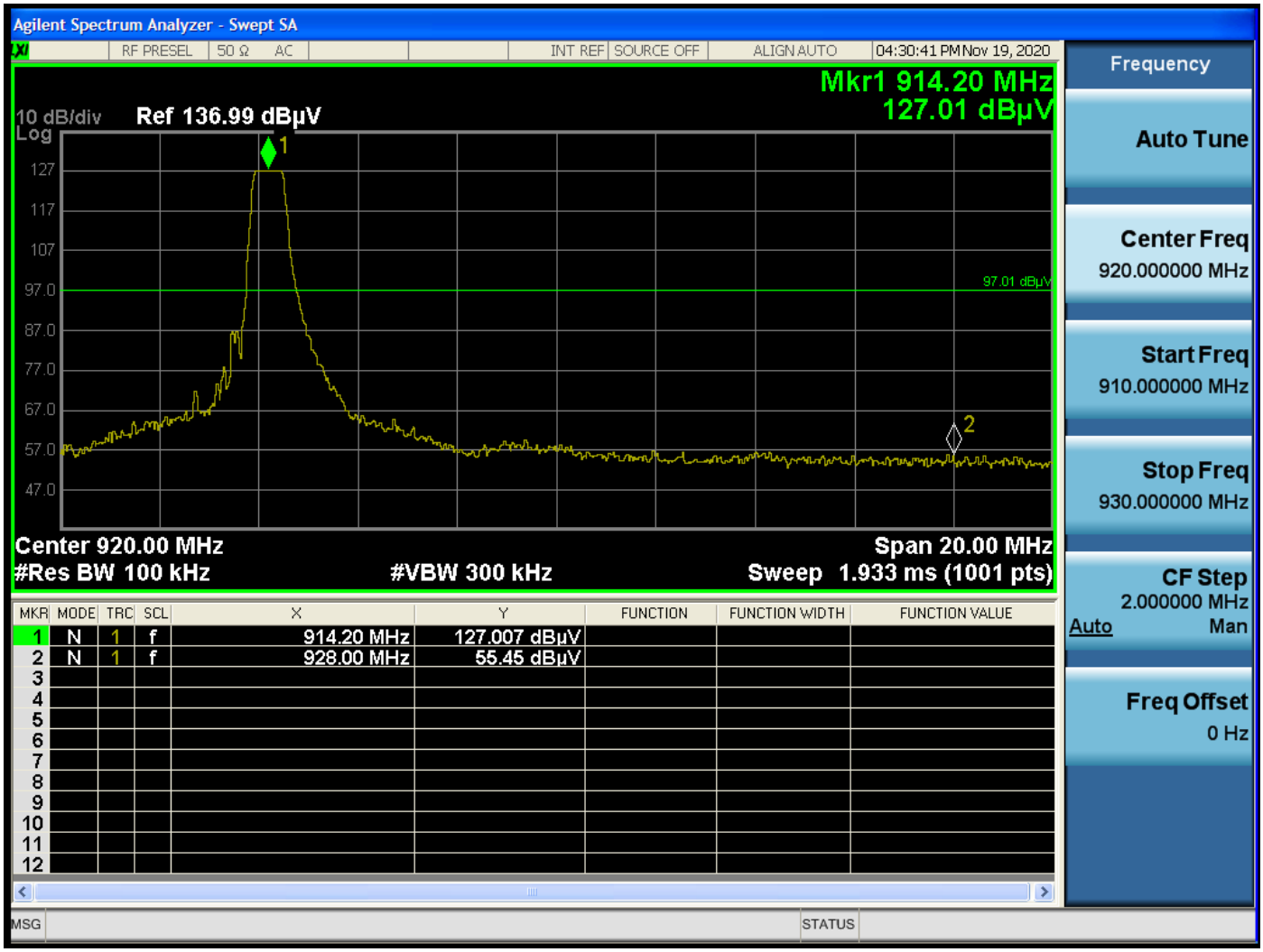
BAND EDGES

DATA SHEETS



Band Edges – Low channel

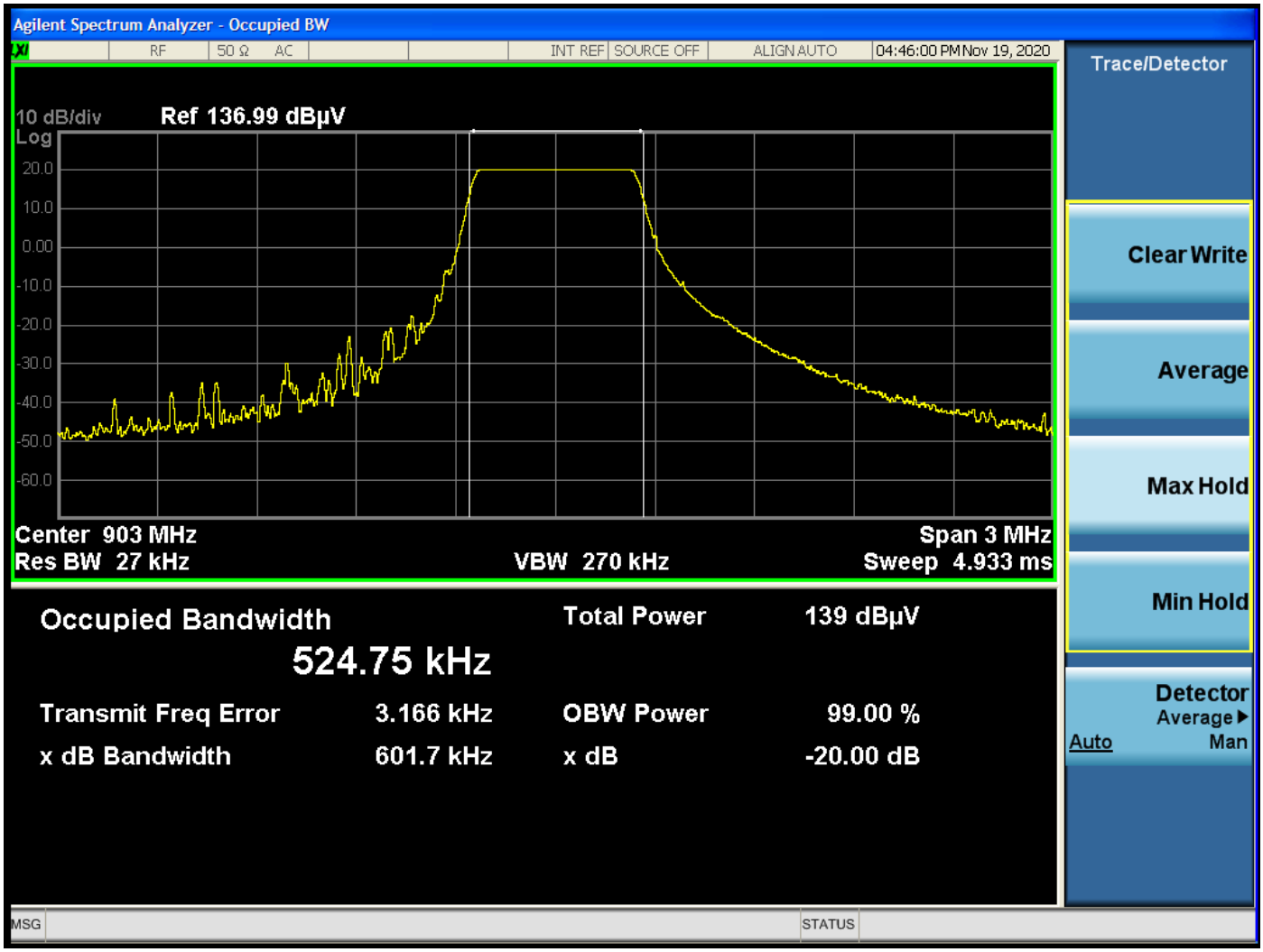
Note: Radiated emissions which fall in the restricted bands were verified with the limits under 15.209.



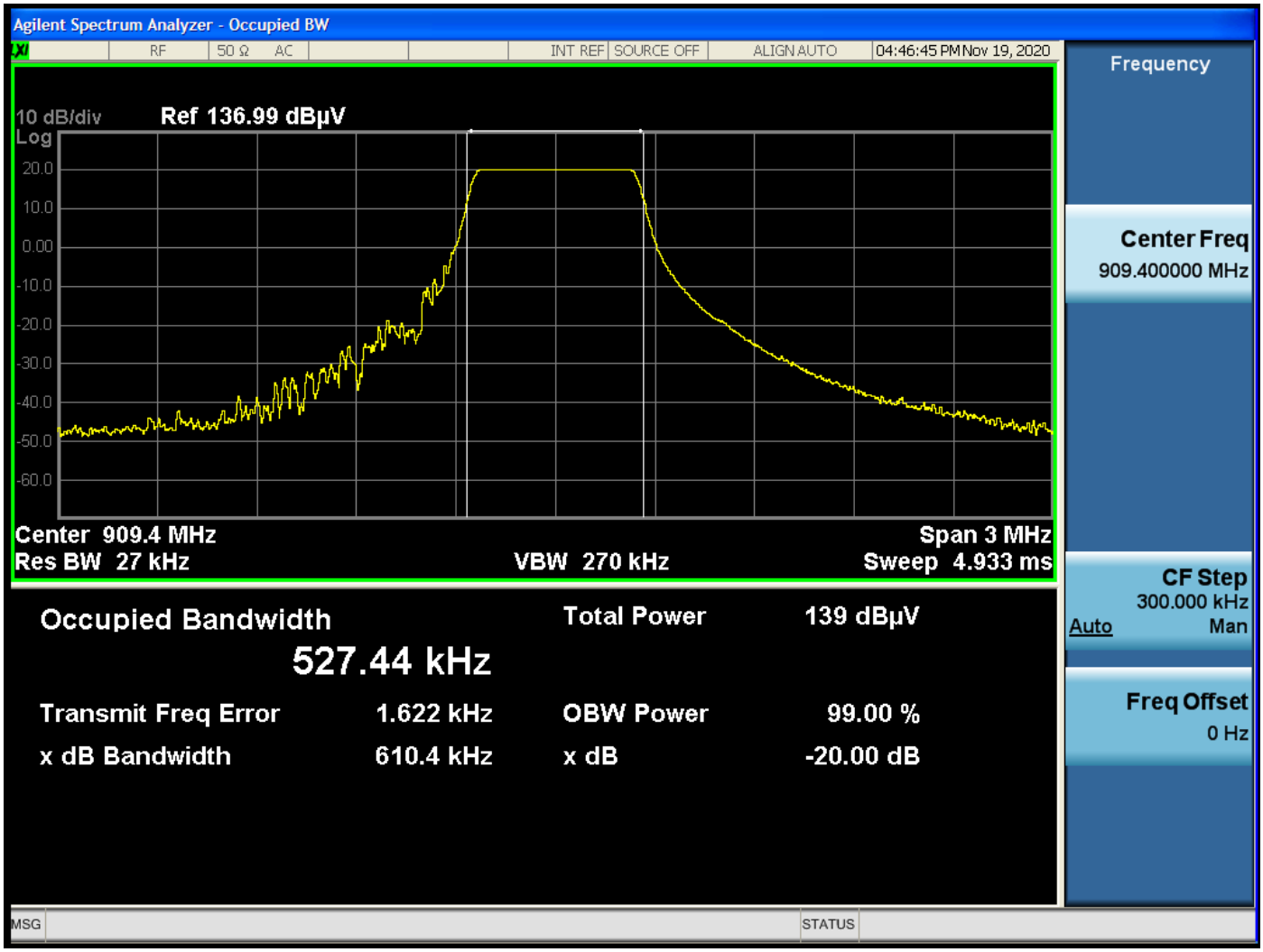
Band Edges – High channel

Note: Radiated emissions which fall in the restricted bands were verified with the limits under 15.209.

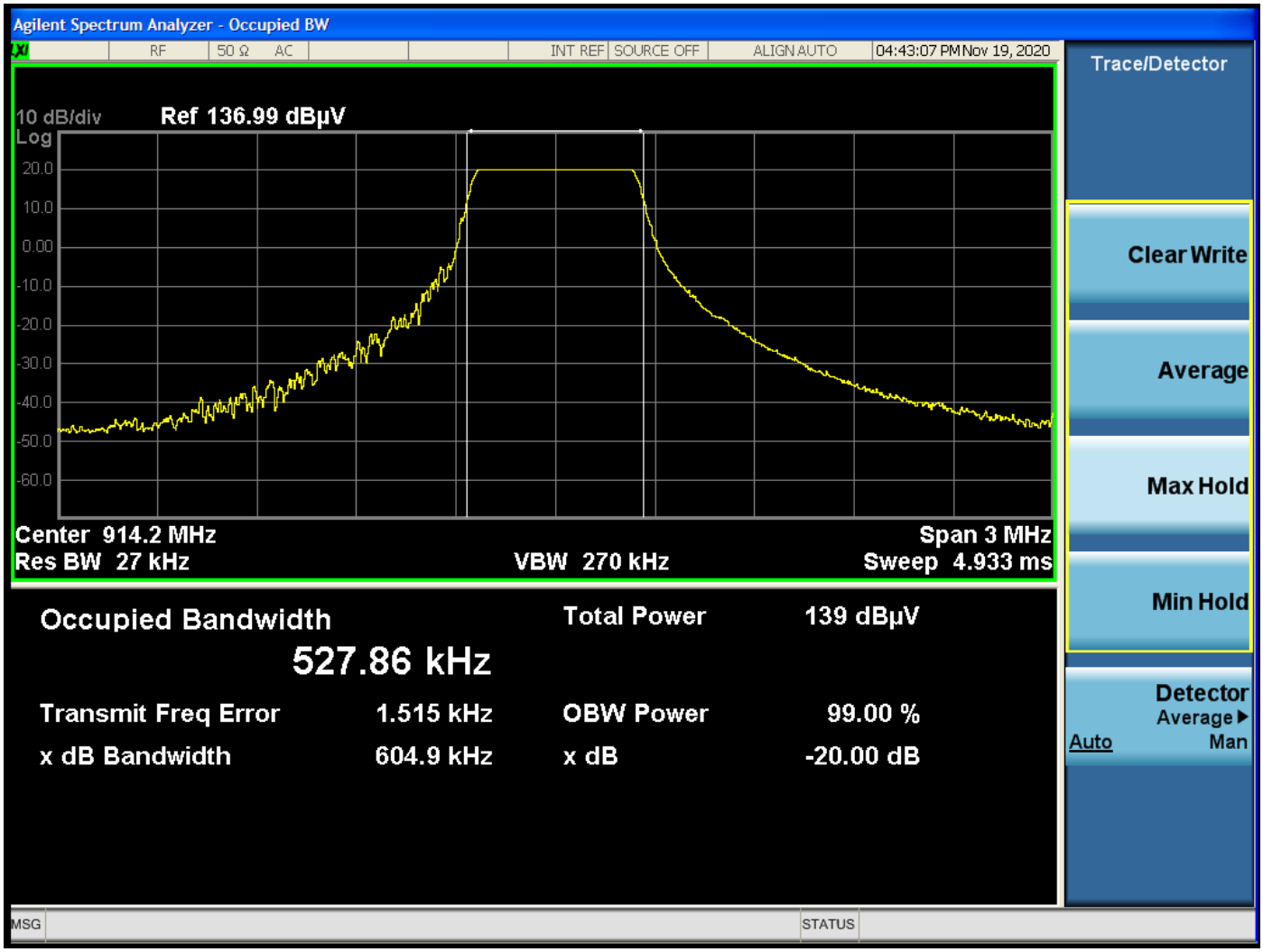
99 % BANDWIDTH DATA SHEETS



99 Percent BW – Low Channel



99 Percent BW – Mid Channel



99 Percent BW – High Channel

HYBRID SYSTEM RADIATED EMISSIONS DATA SHEETS

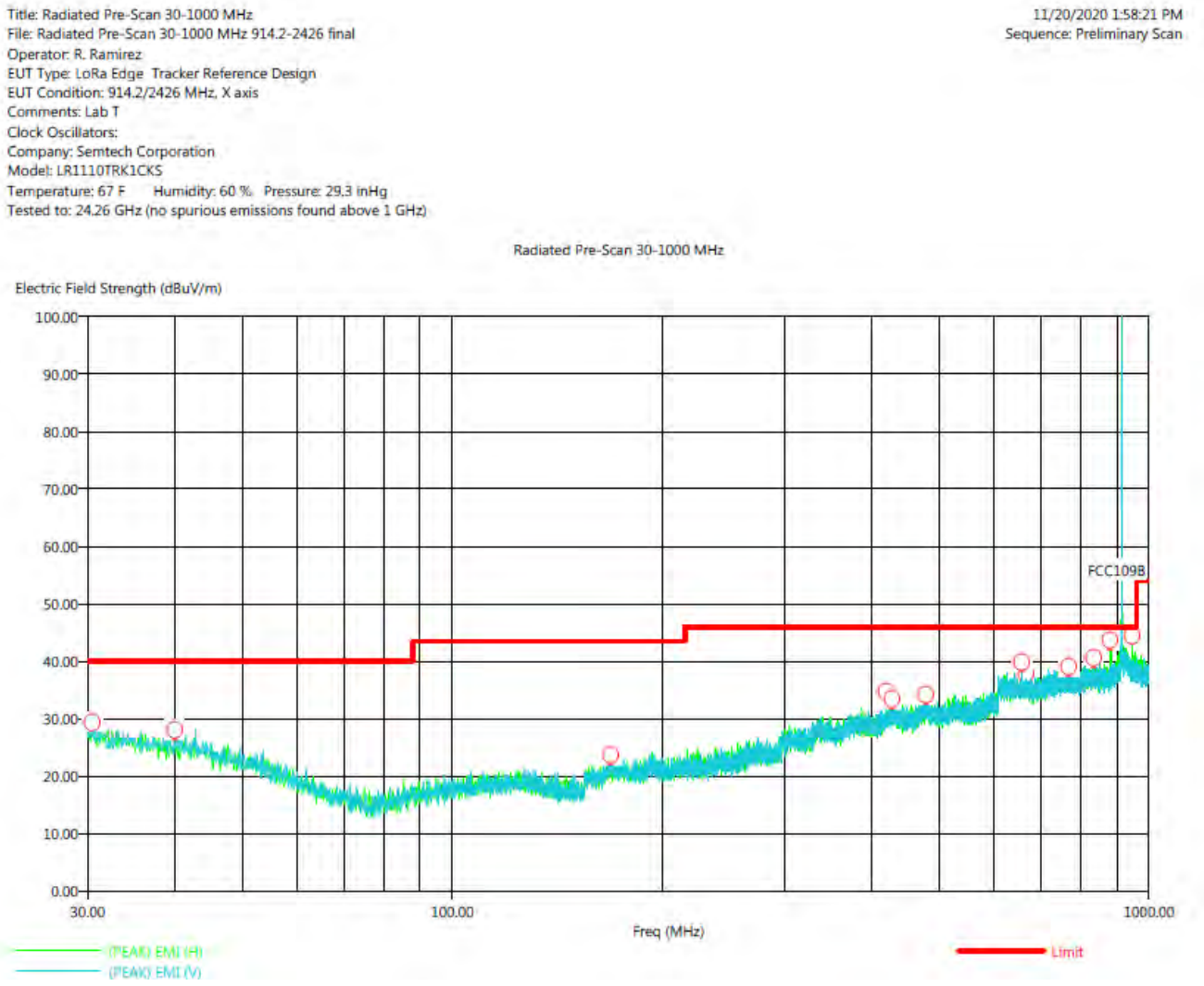
FCC 15.247

Semtech Corporation.
LoRa Edge Tracker Reference Design
M/N: LR1110TRK1CKS

Date: 11/20/2020
Lab: T
Tested By: Rey Ramirez

Non Harmonic Emissions from the Tx and Digital Portion - 9 kHz to 30 MHz
Non Harmonic Emissions from the Tx and Digital Portion - 1 GHz to 24.26 GHz

Freq. (MHz)	Level (dBuV/m)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Table Angle (deg)	Ant. Height (cm)	Comments
								No Emissions Detected
								from 9 kHz to 30 MHz
								for the digital portion
								of the EUT
								No Emissions Detected
								from 9 kHz to 30 MHz
								for the Non-Harmonic Emissions
								of the Transmitter for the EUT
								No Emissions Detected
								from 1 GHz to 24.26 GHz
								for the digital portion
								of the EUT
								No Emissions Detected
								from 1 GHz to 24.26 GHz
								for the Non-Harmonic Emissions
								of the Transmitter for the EUT
								Investigated in the X-Axis,
								Y-Axis, and Z-Axis



Both radios active spurious emissions

Title: Radiated Final 30-1000 MHz
File: Radiated Final 30-1000 MHz 914.2-2426 final
Operator: R. Ramirez
EUT Type: LoRa Edge Tracker Reference Design
EUT Condition: 914.2/2426 MHz, X axis
Comments: Lab T
Clock Oscillators:
Company: Semtech Corporation
Model: LR1110TRK1CKS
Temperature: 67 F Humidity: 60 % Pressure: 29.3 inHg
Tested to: 24.26 GHz (no spurious emissions found above 1 GHz)

11/20/2020 2:09:41 PM
Sequence: Final Measurements

Data

Freq (MHz)	Pol	(PEAK) Trace (dBuV)	Cable (dB)	Transducer (dB)	(PEAK) EMI (dBuV/m)	(QP) EMI (dBuV/m)	Limit (dBuV/m)	(QP) Margin (dB)	Twr Ht (cm)	Ttbl Aql (deg)
30.50	H	4.83	0.50	22.40	27.72	25.02	40.00	-14.98	177.20	253.30
40.00	V	5.27	0.40	20.76	26.43	23.13	40.00	-16.87	186.60	12.30
169.40	V	5.24	1.08	15.66	21.98	19.19	43.52	-24.33	208.70	74.40
419.30	H	6.98	2.02	21.64	30.63	27.35	46.00	-18.65	290.00	300.90
427.70	V	6.06	2.07	22.20	30.33	27.89	46.00	-18.11	240.10	90.90
478.10	V	5.73	2.20	23.00	30.93	28.90	46.00	-17.10	291.10	216.50
657.40	V	8.64	2.72	24.60	35.96	32.77	46.00	-13.23	146.10	329.90
665.90	H	7.98	2.73	24.69	35.40	32.80	46.00	-13.20	273.60	226.50
768.20	V	7.68	3.04	26.20	36.92	33.80	46.00	-12.20	200.10	26.10
832.40	H	8.81	3.17	27.13	39.11	36.37	46.00	-9.63	162.30	321.60
882.20	H	16.75	3.27	26.90	46.92	44.31	46.00	-1.69	139.80	343.60
946.20	H	14.09	3.49	28.50	46.08	43.76	46.00	-2.24	142.20	299.80

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Both radios active spurious emissions