COMPATIBLE ELECTRONICS

FCC PART 15, SUBPART B and C; FCC 15.231; and RSS-210 & RSS GEN
TEST REPORT

for

Wireless Solar Sync Sensor

Model: WSS-TR

Prepared for

HUNTER INDUSTRIES INC.
1940 DIAMOND STREET
SAN MARCOS, CALIFORNIA 92078

Prepared by: _____

TAE HYUN KIM

Approved by: _____

JAMES ROSS

COMPATIBLE ELECTRONICS INC.
114 OLINDA DRIVE
BREA, CALIFORNIA 92823
(714) 579-0500

DATE: NOVEMBER 5, 2021

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NVLAP® TESTING
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GENERAL REPORT SUMMARY

This electromagnetic emission test 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 without the written permission of Compatible Electronics, unless done so in full.

This report must not be used by the client to claim product certification, approval or endorsement by NVLAP, NIST or any agency of the United States government.

Device Tested: Wireless Solar Sync Sensor
Model: WSS-TR
S/N: N/A

Product Description: The EUT is a battery operated sensor device for use with irrigation systems.

Dimensions: 4.5 inches (H) x 8.5 inches (W) x 1 inch (D)

Modifications: The EUT was not modified to meet the specifications.

Customer: Hunter Industries Inc.
1940 Diamond Street
San Marcos, California 92078

Test Dates: November 4th, 2021

Test Specifications covered by accreditation:

Test Specifications: Emissions requirements
CFR Title 47, Part 15, Subpart B;
CFR Title 47, Part 15, Subpart C, sections 15.205, 15.207, 15.209, and 15.231;
RSS-210 and RSS-Gen

NVLAP TESTING
NVLAP LAB CODE 200528-0

Test Procedures: ANSI C63.4 and ANSI C63.10

Test Deviations: The test procedure was not deviated from during the testing.

COMPATIBLE ELECTRONICS

SUMMARY OF TEST RESULTS

TEST	DESCRIPTION	RESULTS
1	Conducted RF Emissions, 150 kHz – 30 MHz	This test was not performed because the EUT operates on battery power only and cannot be connected to the AC public mains.
2	Spurious Radiated RF Emissions, 9 kHz – 4.34 GHz (Transmitter and Digital portion)	Complies with the **Class B** limits of CFR Title 47, Part 15 Subpart B; the limits of CFR Title 47, Part 15 Subpart C, sections 15.205, 15.209, and 15.231; and the limits of RSS-210 and RSS-Gen Highest reading in relation to spec limit 42.65 dBuV/m (QP) @ 542.40 MHz (*U = 3.27 dB)
3	99% Bandwidth	This test was performed to obtain the emission designator required by Innovation, Science and Economic Development Canada.
4	-20 dB Bandwidth	Complies with limits of CFR Title 47, Part 15 Subpart C, section 15.231 (c); and the limits of RSS-210
5	Transmission Time	Complies with limits of CFR Title 47, Part 15 Subpart C, section 15.231 (a)(1) and (a)(2); and the limits of RSS-210

*U = Expanded Uncertainty with a coverage factor of k=2

1. PURPOSE

This document is a qualification test report based on the emissions tests performed on the Wireless Solar Sync Sensor, Model: WSS-TR (EUT). The emissions measurements were performed according to the measurement procedure described in ANSI C63.4 and ANSI C63.10. The tests were performed 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 section, 15.109; the specification limits defined by CFR Title 47, Part 15 Subpart C sections 15.205, 15.207, 15.209 and 15.231; and the specifications limits defined by RSS-210 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 considering 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, 114 Olinda Drive, Brea, California 92823.

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

Hunter Industries Inc.

Nathan Escalante	Product Reliability Manager
Michael Abbate	Assoc. Regulatory Compliance Engineer

Compatible Electronics Inc.

James Ross	Test Engineer
Tae Hyun Kim	Test Technician
Michael Christensen	Lab Manager

2.4 Date Test Sample was Received

The test sample was received prior to the date of this report.

2.5 Disposition of the Test Sample

The test sample has not been returned to Hunter Industries Inc. as of the date of this report.

2.6 Abbreviations and Acronyms

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

EMI	Electromagnetic Interference
EUT	Equipment Under Test
P/N	Part Number
FCC	Federal Communications Commission
DoC	Declaration of Conformity
N/A	Not Applicable
Tx	Transmit
Inc.	Incorporated
ET	Evapotranspiration
DC	Direct Current

3. APPLICABLE DOCUMENTS

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

SPEC	TITLE
FCC Title 47, Part 15 Subpart B	FCC Rules – Radio frequency devices (including digital devices) –Unintentional Radiators
FCC Title 47, Part 15 Subpart C	FCC Rules – Radio frequency devices (including digital devices) – Intentional Radiators
RSS-210 Issue 10: 2019 + Amendment 1	License-exempt Radio Apparatus: Category I Equipment
RSS-Gen Issue 5: 2019 + Amendment 1 + Amendment 2	General Requirements for Compliance of Radio Apparatus
ANSI C63.4: 2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10: 2013	American National Standard of procedure for compliance testing of unlicensed wireless devices

4. DESCRIPTION OF TEST CONFIGURATION

4.1 Description of Test Configuration – Emissions

The Wireless Solar Sync Sensor, Model: WSS-TR (EUT) runs only on battery and was mounted on a wooden board for testing. The EUT was continuously transmitting at 433.92 MHz during the test.

The EUT was tested for emissions only in the Y-Axis. The Y orientation is when the EUT is perpendicular to the ground mounted vertically.

The final radiated emissions data for the EUT was taken in the configuration described above. Please see Appendix E for the data sheets.

4.1.1 Cable Construction and Termination

This EUT does not have any cables.

5. LISTS OF EUT, ACCESSORIES AND TEST EQUIPMENT

5.1 EUT and Accessory List

EQUIPMENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID
WIRELESS SOLAR SYNC SENSOR (EUT)	HUNTER INDUSTRIES INC.	WSS-TR	N/A	M3UWSS

5.2 Emissions Test Equipment

EQUIPMENT TYPE	MANU-FACTURER	MODEL NUMBER	SERIAL NUMBER	CALIBRATION DATE	CAL. CYCLE
RADIATED EMISSIONS TEST EQUIPMENT					
TDK TestLab	TDK RF Solutions, Inc.	9.22	700145	N/A	N/A
MXE EMI Receiver, 3 Hz – 44 GHz	Keysight Technologies, Inc.	N9038A	MY51210150	September 17, 2021	1 Year
Loop Antenna	Com-Power	AL-130R	121090	February 5, 2019	3 Year
CombiLog Antenna	Com-Power	AC-220	10030004	January 14, 2020	2 Year
Horn Antenna	Com-Power	AH-118	10050113	February 4, 2020	2 Year
Preamplifier	Com-Power	PA-118	181653	March 3, 2021	1 Year
System Controller	Sunol Sciences Corporation	SC110V	112213-1	N/A	N/A
Turntable	Sunol Sciences Corporation	2011VS	N/A	N/A	N/A
Antenna-Mast	Sunol Sciences Corporation	TWR95-4	112213-3	N/A	N/A
Computer	Hewlett Packard	p6716f	MXX1030PX0	N/A	N/A
LCD Monitor	Hewlett Packard	52031a	3CQ046N3MG	N/A	N/A

6. TEST SITE DESCRIPTION

6.1 Test Facility Description

Please refer to section 2.1 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 0.6 by 1.2 meter non-conductive table 0.8 meters above the ground plane.

For frequencies above 1 GHz: The EUT was mounted on a 0.6 by 1.2 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	3.27 dB (Vertical) 3.19 dB (Horizontal)
Radiated disturbance (electric field strength on an open area test site or alternative test site)	(1 GHz - 6 GHz)	5.2 dB	3.95 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site)	(6 GHz – 18 GHz)	5.5 dB	3.95 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site)	(18 GHz – 26.5 GHz)	N/A	4.69 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site)	(26.5 GHz – 40 GHz)	N/A	4.55 dB

7. TEST PROCEDURES

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

7.1 RF Emissions

7.1.1 Conducted Emissions Test

The EMI Receiver was used as a measuring meter. A quasi-peak and/or average reading was taken only where indicated in the data sheets. 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 63:4. 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.

The six highest emissions are listed in Table 1.

Test Results:

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

7.1.2 Radiated Emissions Test

The EMI Receiver was used as the measuring meter. An internal preamplifier was used to increase the sensitivity of the instrument during emissions tests up to 1000 MHz, and an external preamplifier was used to increase the sensitivity of the instrument during emissions tests above 1 GHz. 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 considers the cable loss, amplifier gain and antenna factors, so that a true reading is compared to the true limit. The effective measurement bandwidth used for the radiated emissions test was according to the frequency measured.

The frequencies below 1 GHz, except for the fundamental frequency and the 2nd harmonic of the fundamental frequency, were quasi-peaked using the quasi-peak detector of the EMI Receiver.

The harmonic frequencies above 1 GHz, the fundamental frequency, and the 2nd harmonic were averaged using the duty cycle correction calculation.

All other frequencies above 1 GHz were averaged using the average detector of the EMI Receiver.

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 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 to ensure accurate results.

The EUT was tested at a 3-meter test distance. The six highest emissions are listed in Table 1.

Radiated Emissions Test (Continued)

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 4.34 GHz	1 MHz	Horn Antenna

Test Results:

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 sections 15.205, 15.209 and 15.231; and the limits of RSS-210 and RSS-Gen for radiated emissions.

7.1.3 RF Emissions Test Results

Table 1 RADIATED EMISSION RESULTS
Wireless Solar Sync Sensor, Model: WSS-TR

Frequency (MHz)	Quasi-Peak EMI Reading (dBµV/m)	Specification Limit (dBµV/m)	Delta (Cor. Reading – Spec. Limit) (dB)
542.40 (V)	42.65	46.00	-3.35
433.92 (V)	73.44	80.82	-7.38
867.84 (V)	51.22	60.82	-9.60
867.84 (H)	50.43	60.82	-10.39
488.20 (V)	30.08	46.00	-15.92
1301.76 (V)	36.17	53.97	-17.80

Notes:

* The complete emissions data is given in Appendix E of this report.
(V) Vertical
(H) Horizontal

7.1.4 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.

When the limit is in terms of magnetic field, the following equation applies:

$$H[dB(\mu A/m)] = V[dB(\mu V)] + L_C\,[dB] - G_{PA}\,[dB] + AF^H\,[dB(S/m)]$$

where: H is the magnetic field strength (to be compared with the limit),
V is the voltage level measured by the receiver or spectrum analyzer,
L_C is the cable loss,
G_{PA} is the gain of the preamplifier (if used), and
AF^H is the magnetic antenna factor.

The G_{PA} term is only included in the equation when an external preamplifier is used in the measurement chain, in front of the receiver or spectrum analyzer. An external preamplifier is not usually necessary (or even advisable, due to risk of saturating the input mixer of the receiver) when an active loop antenna is used. In that case, the antenna factor of the loop already includes the gain of its built-in preamplifier.

If the "electrical" antenna factor is used instead, the above equation becomes:

$$H[dB(\mu A/m)] = V[dB(\mu V)] + L_C\,[dB] - G_{PA}[dB] + AF^E\,[dB(m^{-1})] - 51.5\,[dB\Omega]$$

where: AF^E is the "electric" antenna factor, as provided by the antenna calibration laboratory.

When the limit is in terms of electric field, the following equation applies:

$$E[dB(\mu V/m)] = V[dB(\mu V)] + L_C[dB] - G_{PA}[dB] + AF^E\,[dB(m^{-1})]$$

or, if the magnetic antenna factor is used:

$$E[dB(\mu V/m)] = V[dB(\mu V)] + L_C[dB] - G_{PA}[dB] + AF^H\,[dB(S/m)] + 51.5[dB\Omega]$$

The display of the receiver (or spectrum analyzer) **shall not** be configured in units of current, e.g. µA or dB(µA). That conversion is calculated inside the receiver (or spectrum analyzer) using its input impedance, which is 50 Ω, while the magnetic field calculation is based on the free-space impedance of 377 Ω.

7.1.5 Duty Cycle Calculation

The fundamental and harmonics were measured at a 3-meter test distance. The EMI Receiver was used to obtain the final test data. The final qualification data sheets are in Appendix E.

Where

$$\delta(\mathrm{dB}) = 20\log\left[\sum\left(nt_1 + mt_2 + \ldots + \xi t_x\right)/T\right]$$

n is the number of pulses of duration *t*1
m is the number of pulses of duration *t*2
ξ is the number of pulses of duration *Tx*
T is the period of the pulse train or 100 ms if the pulse train length is greater than 100 ms

Duty Cycle Correction Factor = -17.70 dB

Time of One Small Pulse = 280 µs

Time of One Large Pulse = 460 µs

Number of Small Pulses = 42

Number of Large Pulses = 7

Total On Time = 13020 µs = 13.020 ms

The time between pulses is greater than 100 ms

Duty Cycle = 13.020 ms / 100 ms = 13.020 %

7.1.6 99 % Bandwidth

The 99 % bandwidth was measured using an EMI Receiver.

The following steps were performed for measuring the 99 % bandwidth per RSS-GEN, Issue 5, clause 6.7:

1. Set RBW to 1 % to 5 % of the actual occupied bandwidth.
2. Set VBW to greater than 3 times the RBW.
3. Set the EMI Receiver to the occupied bandwidth Function set at 99 %
4. Set the peak detector to max hold.
5. Set the sweep time to auto
6. Allow the trace to stabilize.

Please note that this was only used to determine the emission bandwidth and that there are no limits or pass/fail criteria for this test. Please see the data sheets located in Appendix E.

7.1.7 -20 dB Bandwidth

The -20 dB bandwidth was measured using an EMI Receiver.

The following steps were performed for measuring the -20 dB bandwidth:

1. Set RBW to at least 1 % to 5 % of the occupied bandwidth.
2. Set VBW to greater than 3 times the RBW.
3. Set the peak detector to max hold.
4. Set the sweep time to auto
5. Allow the trace to stabilize.
6. Set the markers to -20 dB of the peak fundamental emission

Test Results:

The EUT complies with limits of CFR Title 47, Part 15, Subpart C section 15.231 (c); and the limits of RSS-210.

7.1.8 Transmission Time

The transmission time was measured using an EMI Receiver.

The following steps were performed for measuring transmission time:

1. Set RBW = 120 kHz.
2. Set VBW = 510 kHz
3. Span = 0 Hz
4. Set the sweep time to 10 seconds
5. Push a button on the EUT, which activated the transmitter.
6. Allow the trace to stabilize.
7. Set the 1st marker to start of the transmission
8. Set the 2nd marker for 5 seconds after the start of the transmission
9. Verify the transmission does not go beyond the 2nd marker.

Test Results:

The EUT complies with limits of CFR Title 47, Part 15, Subpart C section 15.231 (a)(1) and (a)(2); and the limits of RSS-210.

8. CONCLUSIONS

The Wireless Solar Sync Sensor, Model: WSS-TR (EUT), as tested, meets all the specification limits defined in RSS-210, RSS-Gen, the **Class B** specification limits defined in CFR Title 47, Part 15, Subpart B; and the specification limits defined in CFR Title 47, Part, 15, Subpart C, sections 15.205, 15.207, 15.209 and 15.231.

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 the Management System Requirements of ISO/IEC 17025, General Requirements for the competence of testing and calibration laboratories:

"A laboratory's fulfilment of the requirements of ISO/IEC 17025 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 are written in language relevant to laboratory operations and operated generally in accordance with the principles of ISO 9001."

APPENDIX B

MODIFICATIONS TO THE EUT

MODIFICATIONS TO THE EUT

No modifications were made to the EUT during the testing.

APPENDIX C

MODELS COVERED UNDER THIS REPORT

MODELS COVERED UNDER THIS REPORT

USED FOR THE PRIMARY TEST

Wireless Solar Sync Sensor
Model: WSS-TR
S/N: N/A

There are no additional models or part numbers covered under this report.

APPENDIX D

DIAGRAMS, CHARTS, AND PHOTOS

FIGURE 1: CONDUCTED EMISSIONS TEST SETUP

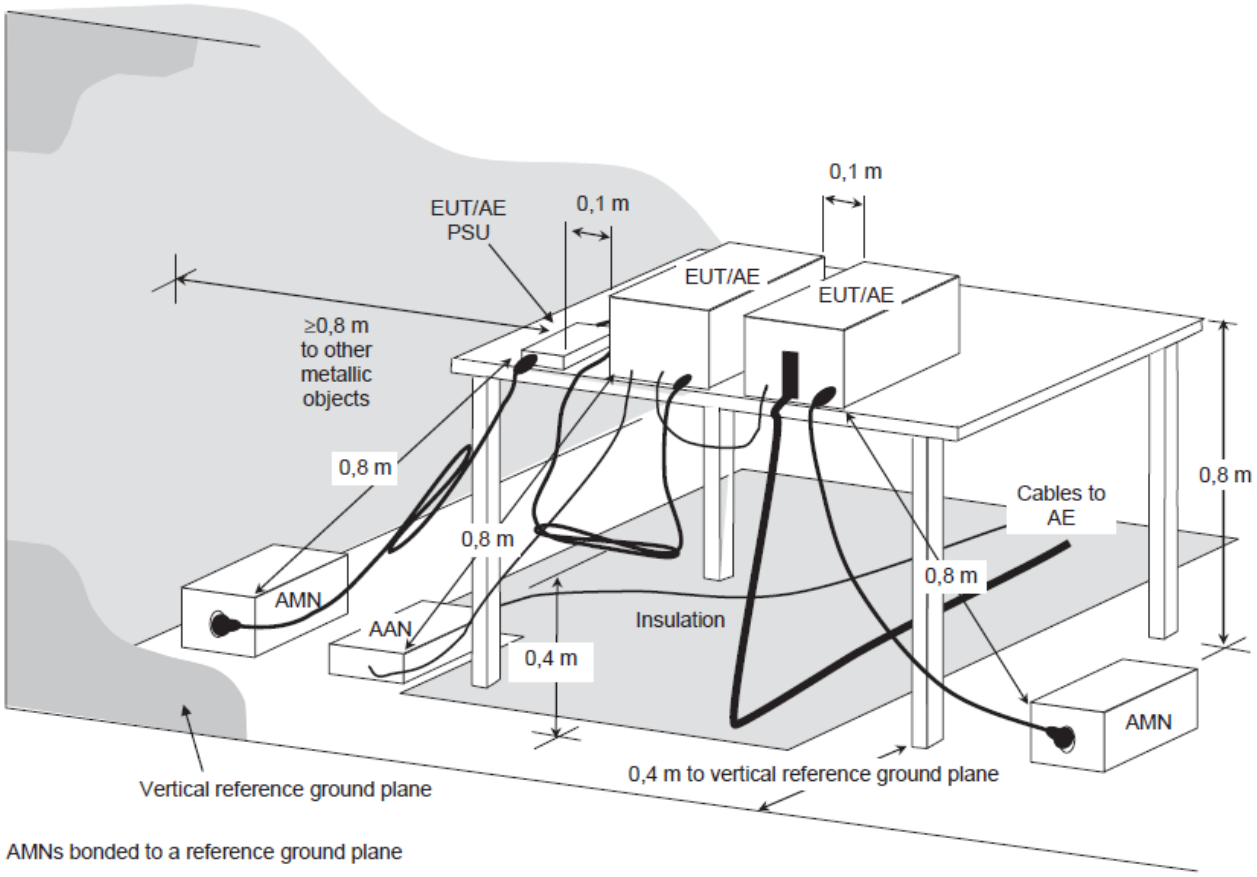
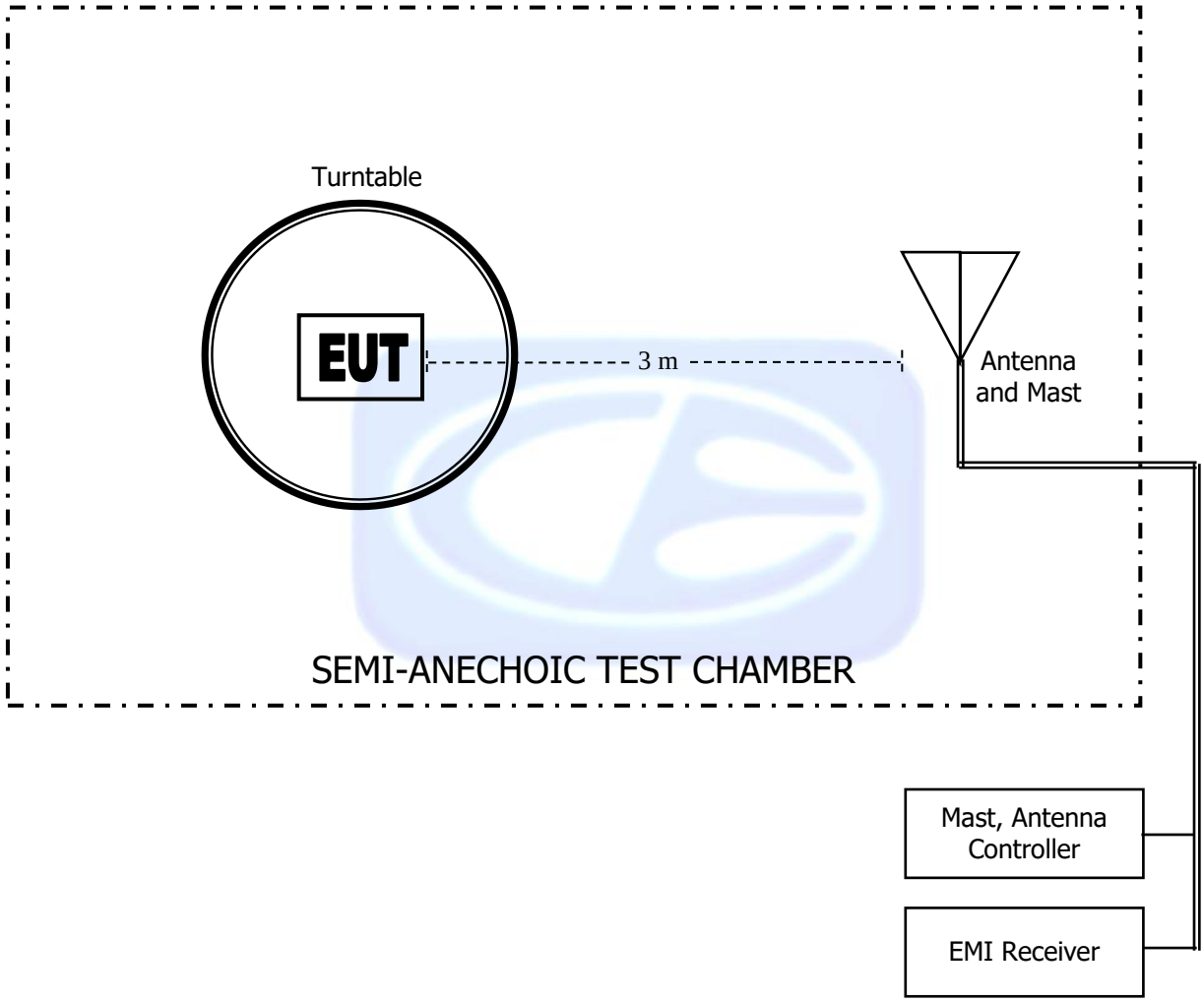


FIGURE 2: LAYOUT OF THE SEMI -ANECHOIC TEST CHAMBER



COMPATIBLE ELECTRONICS

COM-POWER AL-130R

LOOP ANTENNA

S/N: 121090

CALIBRATION DATE: FEBRUARY 5, 2019

FREQUENCY (MHz)	MAGNETIC (dB/m)	ELECTRIC (dB/m)
0.009	16.1	-35.4
0.01	15.6	-35.9
0.02	14.8	-36.7
0.03	15.6	-35.9
0.04	15.1	-36.4
0.05	14.4	-37.0
0.06	14.6	-36.9
0.07	14.4	-37.1
0.08	14.3	-37.1
0.09	14.5	-36.9
0.10	14.1	-37.3
0.20	14.1	-37.3
0.30	14.0	-37.4
0.40	14.0	-37.4
0.50	14.2	-37.2
0.60	14.2	-37.2
0.70	14.2	-37.2
0.80	14.2	-37.3
0.90	14.3	-37.2
1.00	14.5	-37.0
2.00	14.5	-36.9
3.00	14.5	-36.9
4.00	14.7	-36.8
5.00	14.6	-36.9
6.00	14.6	-36.9
7.00	14.6	-36.9
8.00	14.6	-36.9
9.00	14.6	-36.9
10.00	14.8	-36.6
11.00	14.9	-36.6
12.00	14.8	-36.6
13.00	14.8	-36.7
14.00	14.6	-36.8
15.00	14.5	-36.9
16.00	14.5	-37.0
17.00	14.6	-36.9
18.00	14.7	-36.7
19.00	14.8	-36.6
20.00	14.9	-36.6
21.00	14.6	-36.8
22.00	14.2	-37.2
23.00	13.7	-37.7
24.00	13.3	-38.2
25.00	13.0	-38.5
26.00	12.9	-38.6
27.00	13.0	-38.5
28.00	13.1	-38.4
29.00	13.1	-38.4
30.00	12.9	-38.5

COM-POWER AC-220

COMBILOG ANTENNA

S/N: 10030004

CALIBRATION DATE: JANUARY 14, 2020

FREQUENCY (MHz)	FACTOR (dB)	FREQUENCY (MHz)	FACTOR (dB)
30	22.5	200	15.1
35	21.2	250	16.7
40	20.2	300	18.2
45	19.2	350	19.2
50	18.1	400	20.7
60	14.5	450	21.2
70	11.7	500	22.0
80	11.5	550	22.6
90	13.2	600	24.1
100	14.3	650	24.2
120	15.1	700	24.3
125	15.0	750	25.6
140	13.6	800	25.9
150	13.6	850	26.1
160	13.9	900	27.0
175	14.8	950	28.0
180	14.5	1000	27.6

COM POWER AH-118

HORN ANTENNA

S/N: 10050113

CALIBRATION DATE: FEBRUARY 4, 2020

FREQUENCY (GHz)	FACTOR (dB)	FREQUENCY (GHz)	FACTOR (dB)
1.0	24.343	10.0	38.826
1.5	25.419	10.5	39.102
2.0	28.838	11.0	38.259
2.5	28.971	11.5	39.920
3.0	29.919	12.0	40.149
3.5	30.674	12.5	40.576
4.0	31.670	13.0	40.264
4.5	32.437	13.5	40.364
5.0	33.414	14.0	40.424
5.5	34.003	14.5	41.677
6.0	34.799	15.0	43.010
6.5	35.381	15.5	39.799
7.0	37.024	16.0	40.187
7.5	37.403	16.5	40.155
8.0	37.445	17.0	40.507
8.5	37.390	17.5	41.963
9.0	38.076	18.0	43.196
9.5	38.809		

COM-POWER PA-118

PREAMPLIFIER

S/N: 181653

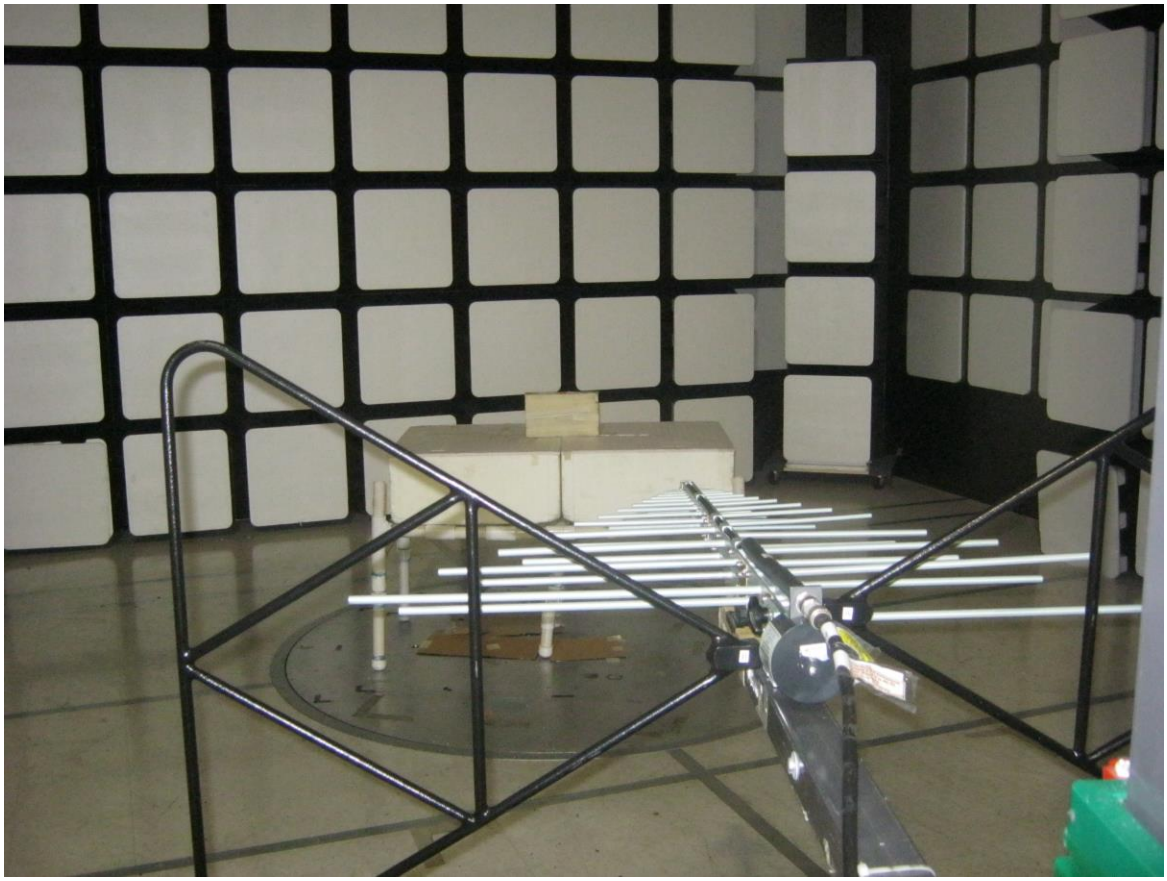
CALIBRATION DATE: MARCH 3, 2021

FREQUENCY (GHz)	FACTOR (dB)	FREQUENCY (GHz)	FACTOR (dB)
1.0	40.18	6.0	39.04
1.1	39.92	6.5	39.16
1.2	39.99	7.0	39.70
1.3	40.19	7.5	39.70
1.4	40.07	8.0	39.56
1.5	40.22	8.5	38.69
1.6	40.23	9.0	39.16
1.7	40.35	9.5	39.70
1.8	40.24	10.0	39.69
1.9	40.29	11.0	38.64
2.0	40.31	12.0	40.41
2.5	40.41	13.0	39.49
3.0	40.59	14.0	39.46
3.5	40.91	15.0	40.38
4.0	40.42	16.0	38.02
4.5	39.92	17.0	39.34
5.0	40.35	18.0	39.86
5.5	39.13		

FRONT VIEW

HUNTER INDUSTRIES INC.
WIRELESS SOLAR SYNC SENSOR
MODEL: WSS-TR
FCC SUBPART B AND C; RSS-210 AND RSS-GEN – RADIATED EMISSIONS – BELOW 1 GHz

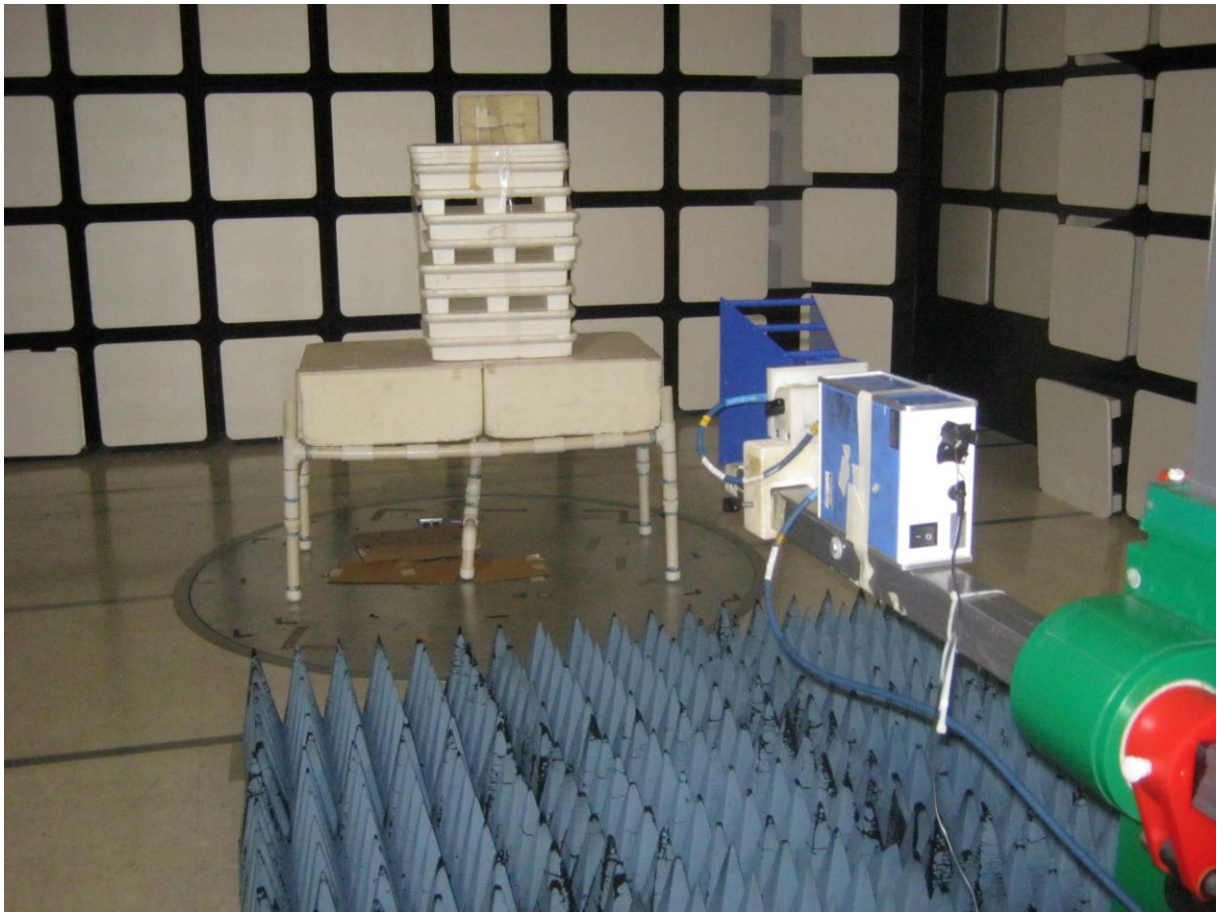
PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS



REAR VIEW

HUNTER INDUSTRIES INC.
WIRELESS SOLAR SYNC SENSOR
MODEL: WSS-TR
FCC SUBPART B AND C; RSS-210 AND RSS-GEN – RADIATED EMISSIONS – BELOW 1 GHz

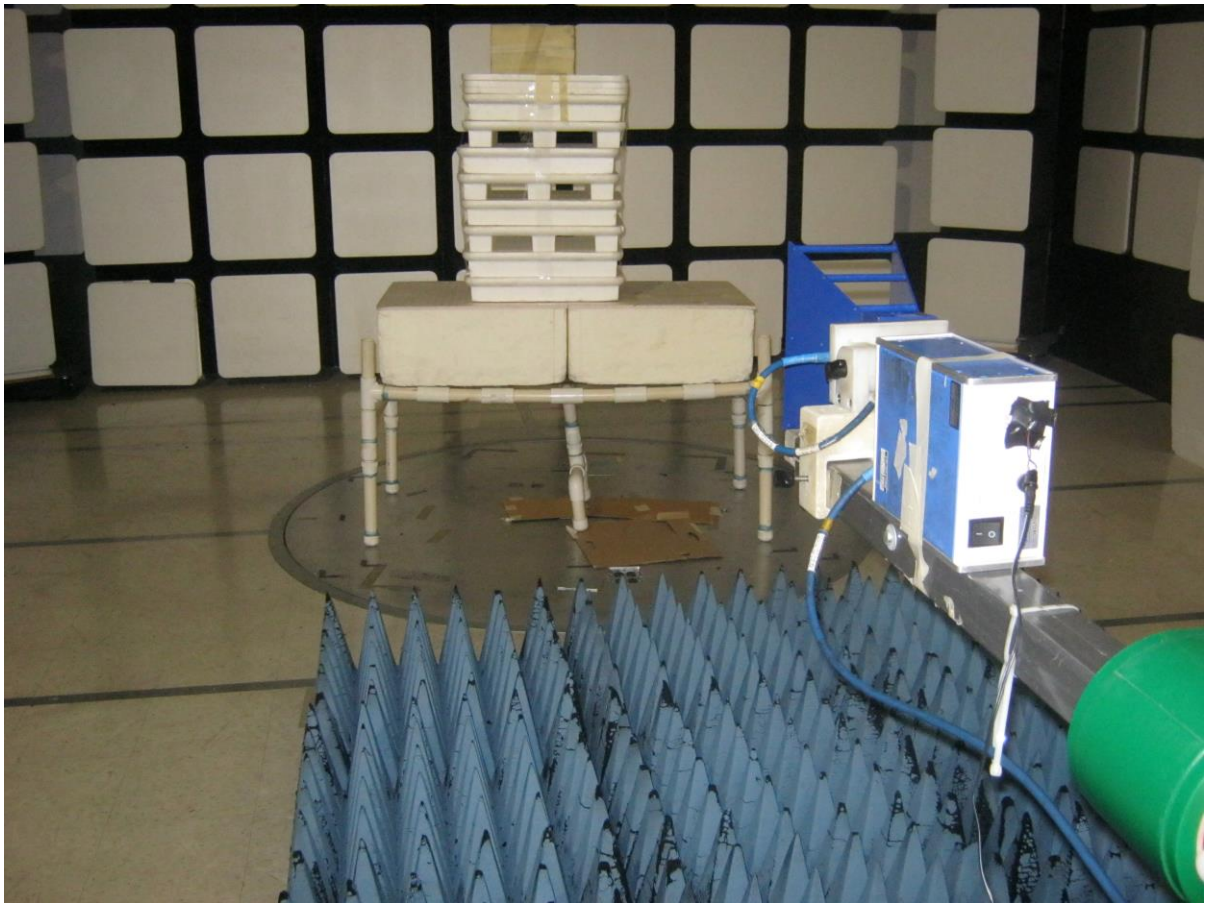
PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS



FRONT VIEW

HUNTER INDUSTRIES INC.
WIRELESS SOLAR SYNC SENSOR
MODEL: WSS-TR
FCC SUBPART B AND C; RSS-210 AND RSS-GEN – RADIATED EMISSIONS – ABOVE 1 GHz

PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONS



REAR VIEW

HUNTER INDUSTRIES INC.
WIRELESS SOLAR SYNC SENSOR
MODEL: WSS-TR
FCC SUBPART B AND C; RSS-210 AND RSS-GEN – RADIATED EMISSIONS – ABOVE 1 GHz

PHOTOGRAPH SHOWING THE EUT CONFIGURATION FOR MAXIMUM EMISSIONs

APPENDIX E

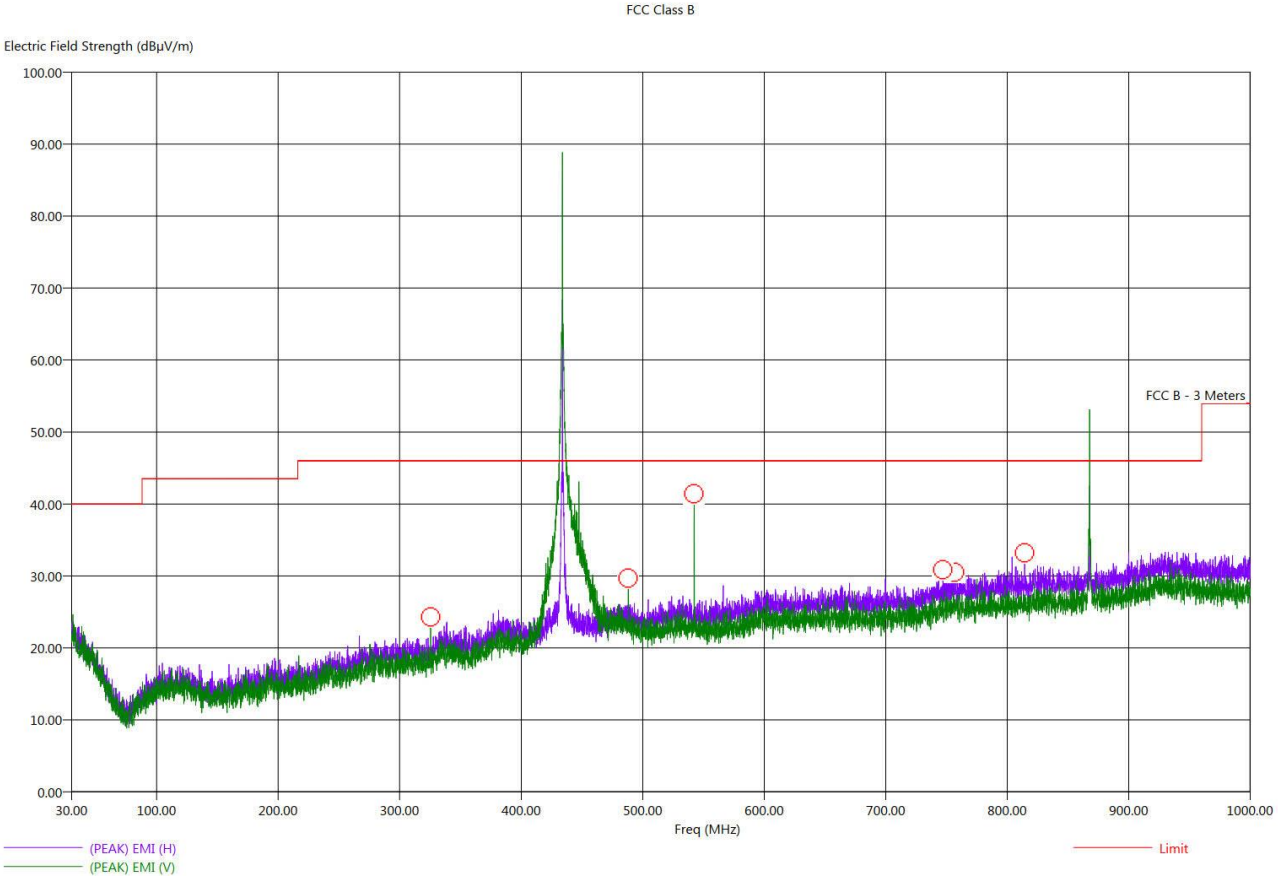
DATA SHEETS

RADIATED EMISSIONS

DATA SHEETS

Title: Pre-Scan - FCC Class B
File: Keysight - Pre-Scan - FCC Class B - 30 MHz to 1000 MHz - 11-04-2021.set
Operator: Tae Hyun Kim
EUT Type: Wireless Solar Sync Sensor
EUT Condition: The EUT will continuously transmit via 433.92 MHz Radio
Company: Hunter Industries
Model: WSS-TR
S/N: N/A
The frequencies at 433.92 MHz and 867.84 MHz are subject to the limits of FCC 15.231 instead

11/4/2021 10:55:26 AM
Sequence: Preliminary Scan



Title: Radiated Final - FCC Class B
File: Keysight - Final Scan - FCC Class B - 30 MHz to 1000 MHz - 11-04-2021.set
Operator: Tae Hyun Kim
EUT Type: The EUT will continuously transmit via 433.92 MHz Radio
EUT Condition: Wireless Solar Sync Sensor
Company: Hunter Industries
Model: WSS-TR
S/N: N/A

11/4/2021 11:09:40 AM
Sequence: Final Measurements

FCC Class B

Freq (MHz)	Pol	(PEAK) EMI (dBµV/m)	(QP) EMI (dBµV/m)	(PEAK) Margin (dB)	(QP) Margin (dB)	Limit (dBµV/m)	Transducer (dB)	Cable (dB)	Ttbl Aql (deg)	Twr Ht (cm)
325.50	V	29.03	25.98	-16.97	-20.02	46.00	18.50	1.50	108.00	158.56
488.20	V	32.88	30.08	-13.12	-15.92	46.00	22.60	1.82	130.50	110.08
542.40	V	43.29	42.65	-2.71	-3.35	46.00	22.90	1.95	118.00	110.98
747.10	H	30.37	25.48	-15.63	-20.52	46.00	25.60	2.33	220.25	111.28
756.70	H	30.00	25.52	-16.00	-20.48	46.00	25.60	2.37	15.00	159.04
814.30	H	30.90	26.26	-15.10	-19.74	46.00	26.10	2.54	104.00	206.26

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FUNDAMENTAL AND HARMONICS

DATA SHEETS

FCC 15.231

Hunter Industries, Inc.
Wireless Solar Sync Sensor
Model: WSS-TR

Date: 11/04/2021
Lab: D
Tested By: Tae Hyun Kim

Fundamental

Freq. (MHz)	Level (dBuV/m)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Table Angle (deg)	Ant. Height (cm)	Comments
433.92	91.14	V	100.82	-9.68	Peak	312.00	116.77	**Y-Axis**
433.92	73.44	V	80.82	-7.38	Avg	312.00	116.77	**Vertical Polarization**
433.92	70.81	H	100.82	-30.01	Peak	156.50	115.28	**Y-Axis**
433.92	53.11	H	80.82	-27.71	Avg	156.50	115.28	**Horizontal Polarization**

FCC 15.231

Hunter Industries, Inc.
Wireless Solar Sync Sensor
Model: WSS-TR

Date: 11/04/2021
Lab: D
Tested By: Tae Hyun Kim

Harmonics
Transmit Mode - Y-Axis

Freq. (MHz)	Level (dBuV/m)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Table Angle (deg)	Ant. Height (cm)	Comments
867.84	68.92	V	80.82	-11.90	Peak	338.50	100.00	
867.84	51.22	V	60.82	-9.60	Avg	338.50	100.00	
1301.76	53.87	V	73.97	-20.10	Peak	80.50	136.00	
1301.76	36.17	V	53.97	-17.80	Avg	80.50	136.00	
1735.68	51.91	V	80.82	-28.91	Peak	257.50	183.58	
1735.68	34.21	V	60.82	-26.61	Avg	257.50	183.58	
2169.60	46.54	V	80.82	-34.28	Peak	154.50	152.89	
2169.60	28.84	V	60.82	-31.98	Avg	154.50	152.89	
2603.52	49.11	V	80.82	-31.71	Peak	304.50	100.00	
2603.52	31.41	V	60.82	-29.41	Avg	304.50	100.00	
3037.44	51.61	V	80.82	-29.21	Peak	297.50	237.19	
3037.44	33.91	V	60.82	-26.91	Avg	297.50	237.19	
3471.36	55.81	V	80.82	-25.01	Peak	298.25	100.00	
3471.36	38.11	V	60.82	-22.71	Avg	298.25	100.00	
3905.28	47.59	V	73.97	-26.38	Peak	269.25	172.89	
3905.28	29.89	V	53.97	-24.08	Avg	269.25	172.89	
4339.20	46.88	V	73.97	-27.09	Peak	257.50	194.02	
4339.20	29.18	V	53.97	-24.79	Avg	257.50	194.02	

FCC 15.231

Hunter Industries, Inc.
Wireless Solar Sync Sensor
Model: WSS-TR

Date: 11/04/2021
Lab: D
Tested By: Tae Hyun Kim

Harmonics
Transmit Mode - Y-Axis

Freq. (MHz)	Level (dBuV/m)	Pol (v/h)	Limit	Margin	Peak / QP / Avg	Table Angle (deg)	Ant. Height (cm)	Comments
867.84	68.13	H	80.82	-12.69	Peak	0.00	100.00	
867.84	50.43	H	60.82	-10.39	Avg	0.00	100.00	
1301.76	44.57	H	73.97	-29.40	Peak	234.25	145.07	
1301.76	26.87	H	53.97	-27.10	Avg	234.25	145.07	
1735.68	44.52	H	80.82	-36.30	Peak	250.00	202.62	
1735.68	26.82	H	60.82	-34.00	Avg	250.00	202.62	
2169.60	47.38	H	80.82	-33.44	Peak	255.25	187.16	
2169.60	29.68	H	60.82	-31.14	Avg	255.25	187.16	
2603.52	52.57	H	80.82	-28.25	Peak	253.00	200.47	
2603.52	34.87	H	60.82	-25.95	Avg	253.00	200.47	
3037.44	51.46	H	80.82	-29.36	Peak	242.75	201.91	
3037.44	33.76	H	60.82	-27.06	Avg	242.75	201.91	
3471.36	52.90	H	80.82	-27.92	Peak	267.25	100.00	
3471.36	35.20	H	60.82	-25.62	Avg	267.25	100.00	
3905.28	42.46	H	73.97	-31.51	Peak	306.00	154.62	
3905.28	24.76	H	53.97	-29.21	Avg	242.75	204.71	
4339.20	43.99	H	73.97	-29.98	Peak	243.50	201.07	
4339.20	26.29	H	53.97	-27.68	Avg	243.50	201.07	

FCC 15.231 and FCC Class B

Hunter Industries, Inc.
Wireless Solar Sync Sensor
Model: WSS-TR

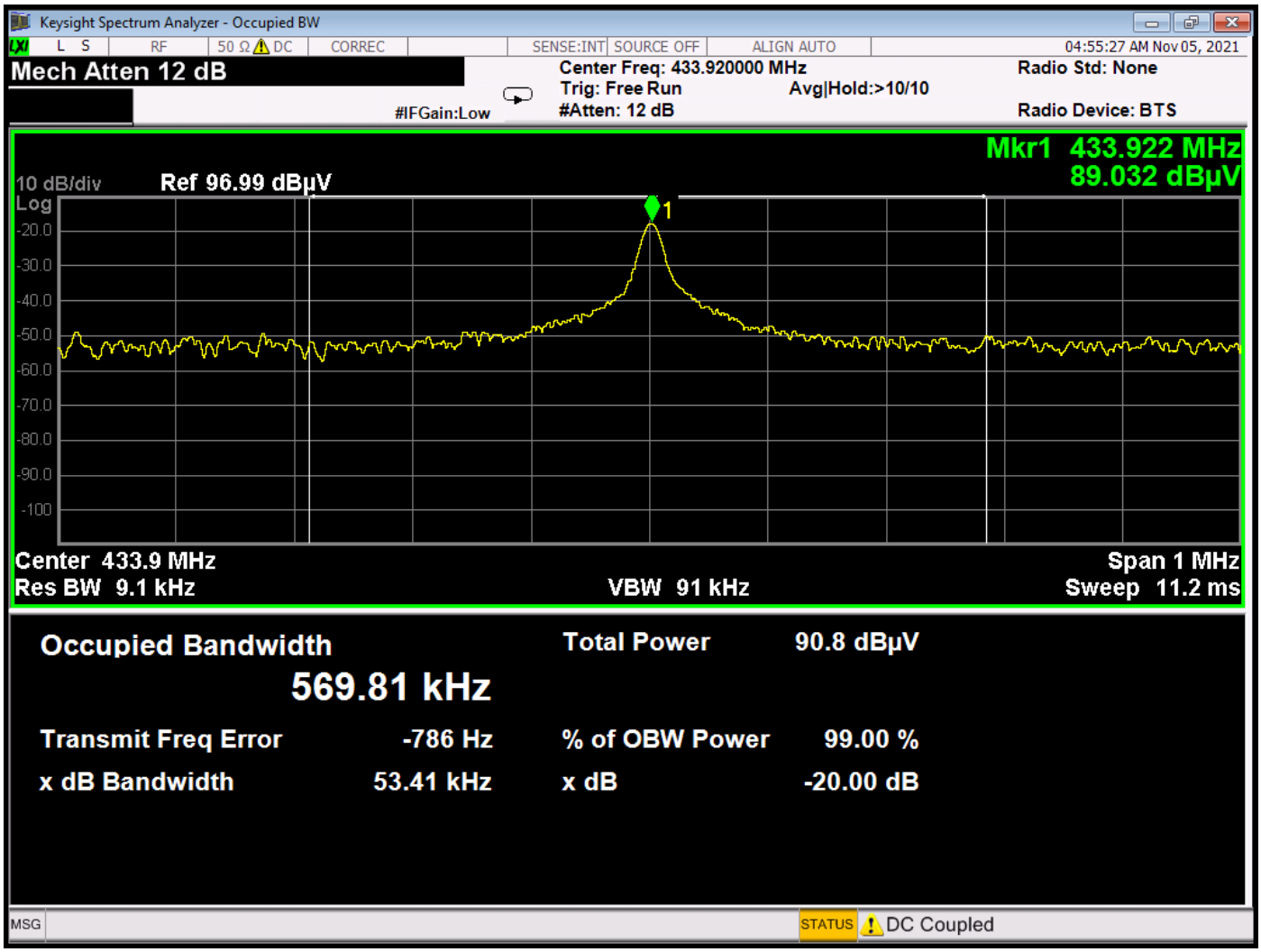
Date: 11/04/2021
Lab: D
Tested By: Tae Hyun Kim

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 4.4 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 1 GHz to 4.4 GHz
								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 4.4 GHz
								for the Non-Harmonic Emissions
								of the Transmitter for the EUT

99 % BANDWIDTH

DATA SHEET



99 Percent Bandwidth Plot

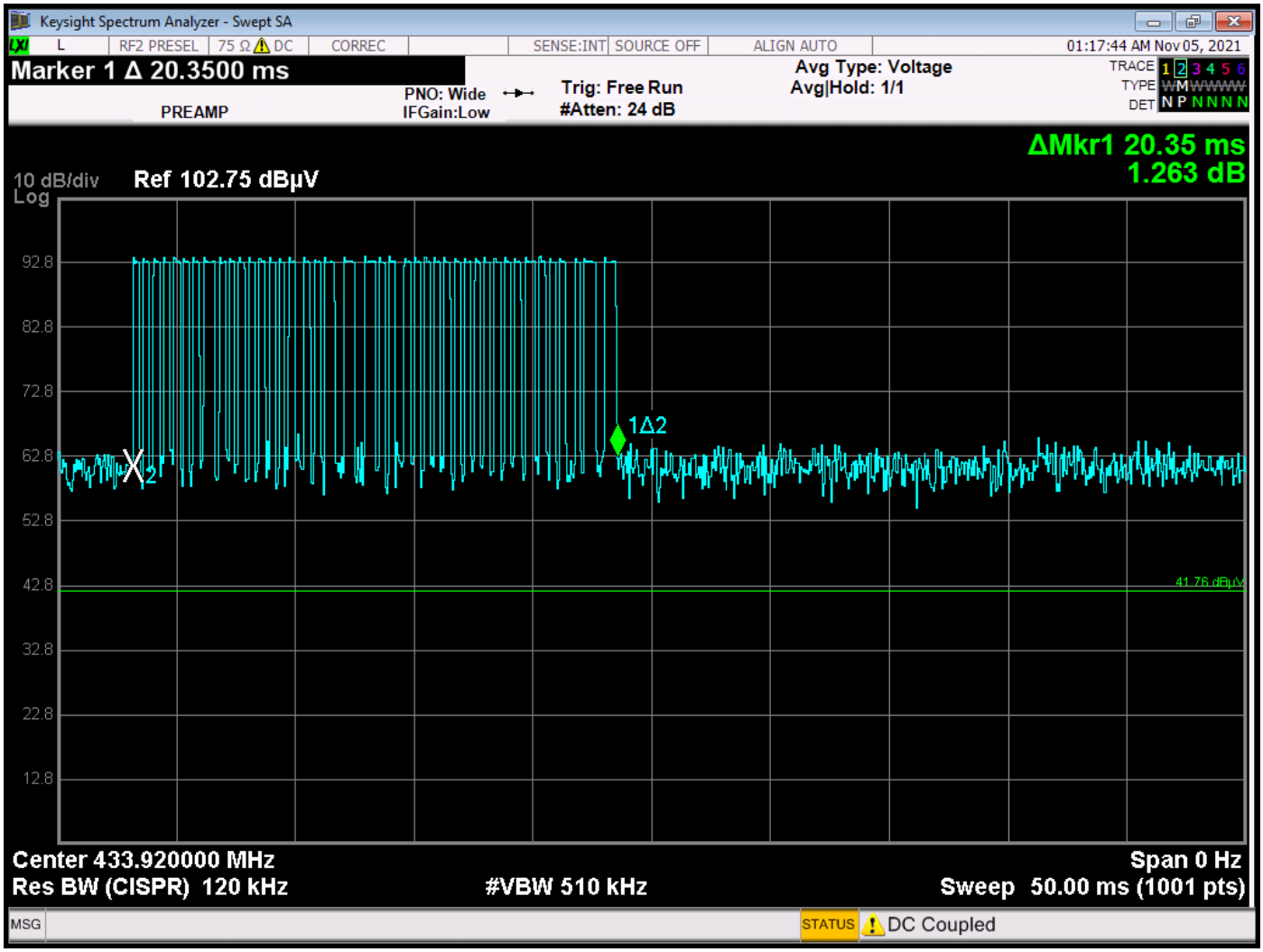
-20 dB BANDWIDTH PLOT

DATA SHEET

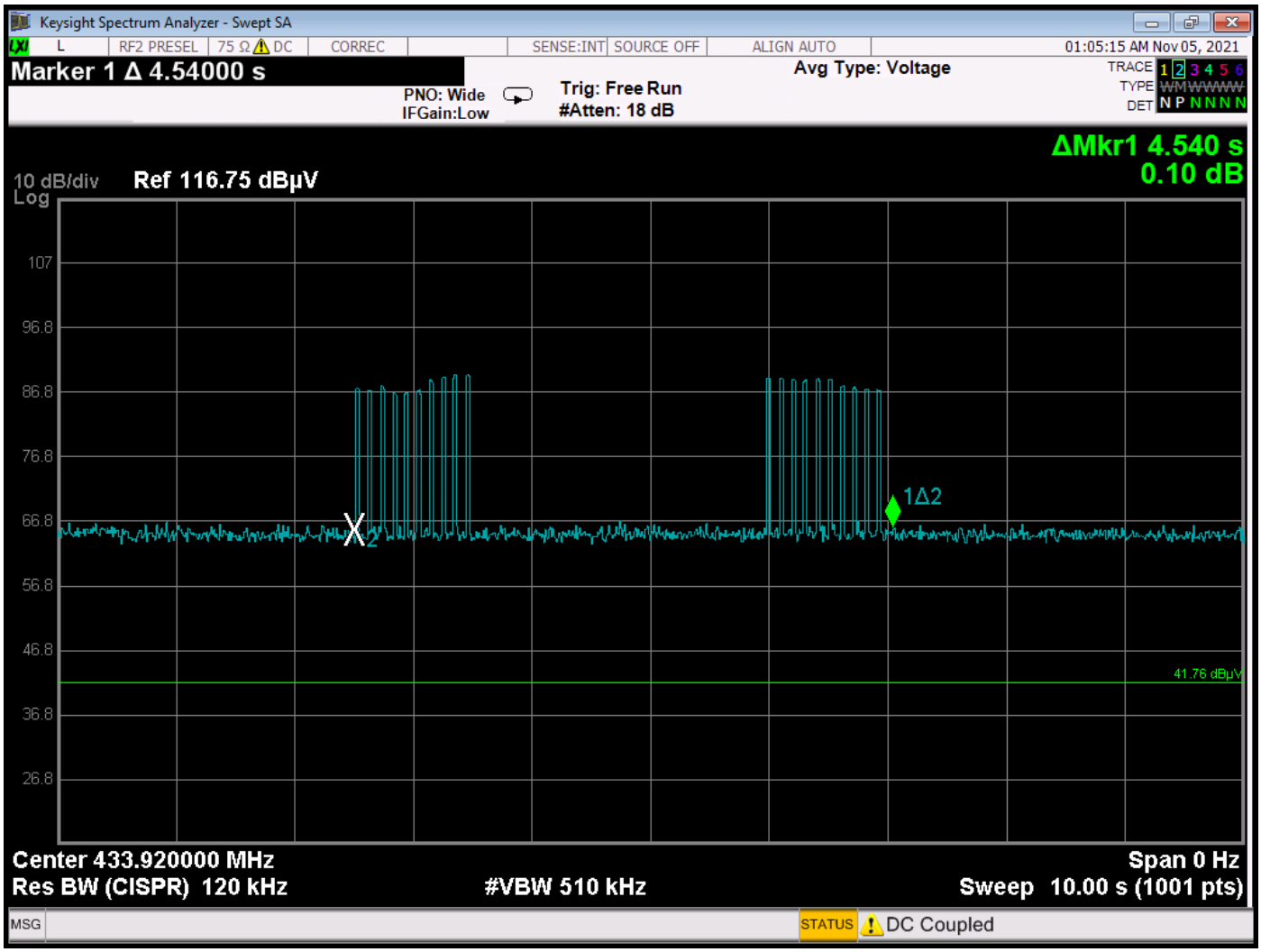
-20 dB Bandwidth Plot

TRANSMISSION TIME

DATA SHEET



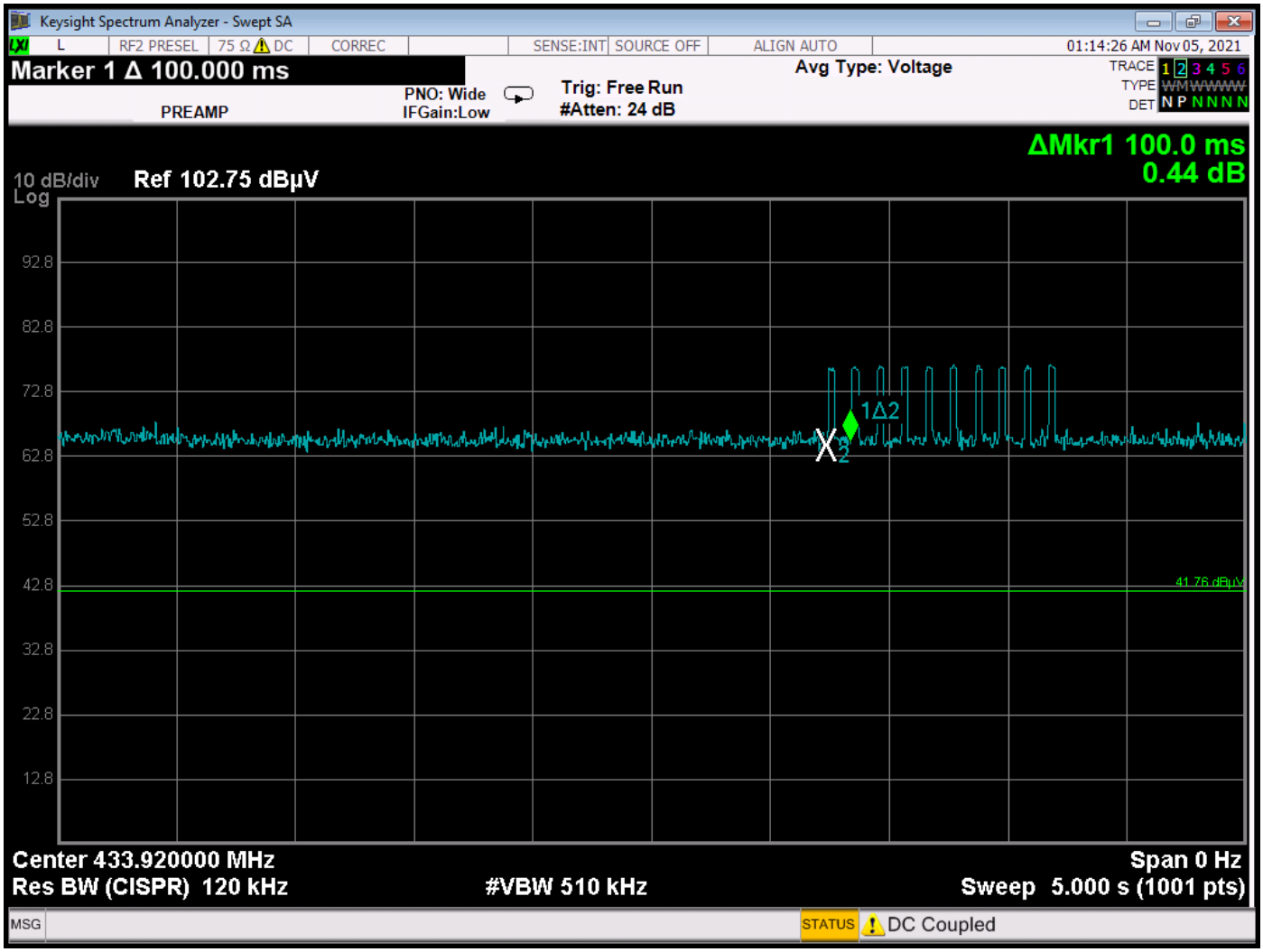
The total on time for one transmission is 20.35ms



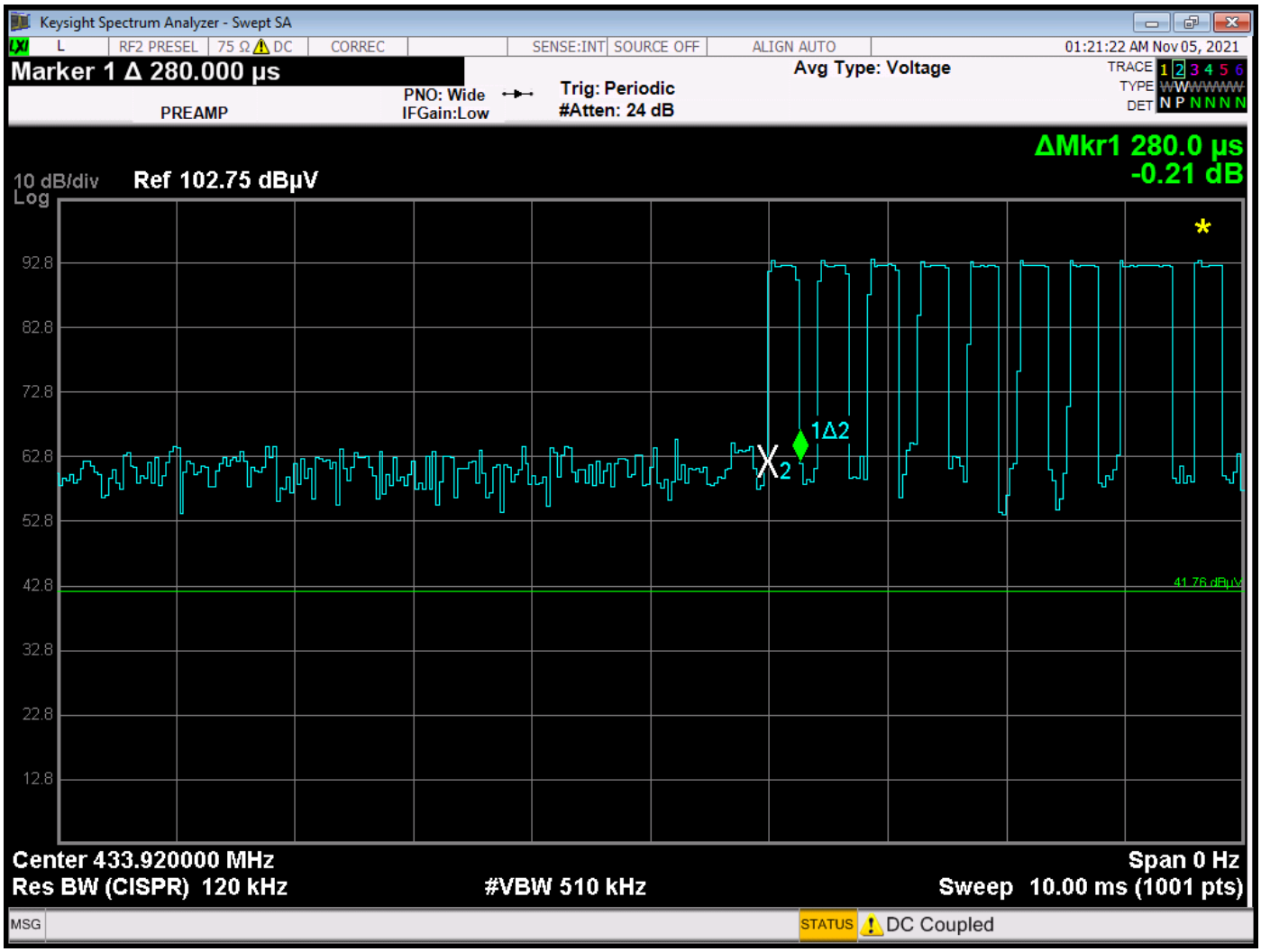
Plot showing the transmission time is less than 5 seconds

DUTY CYCLE

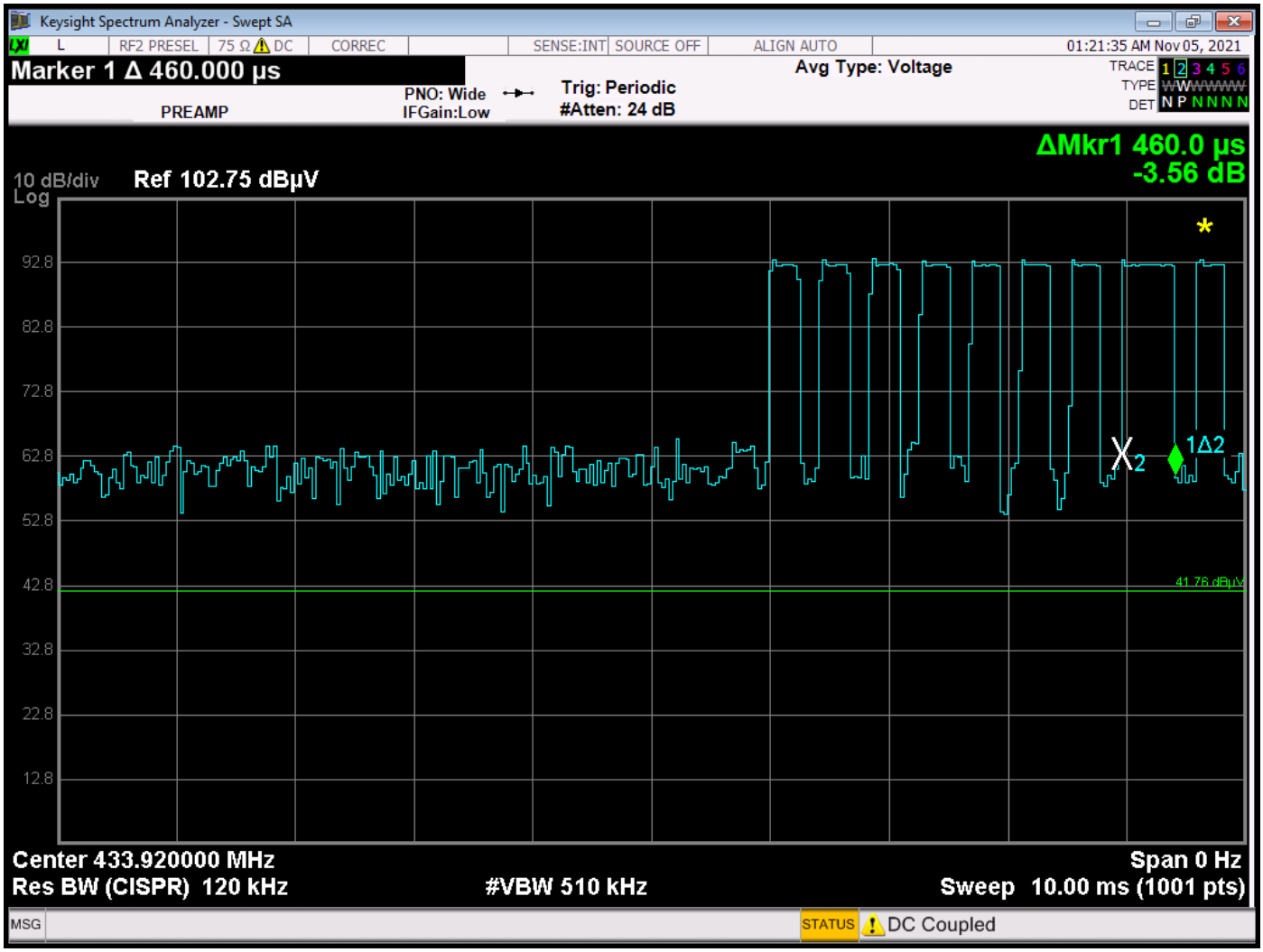
DATA SHEETS



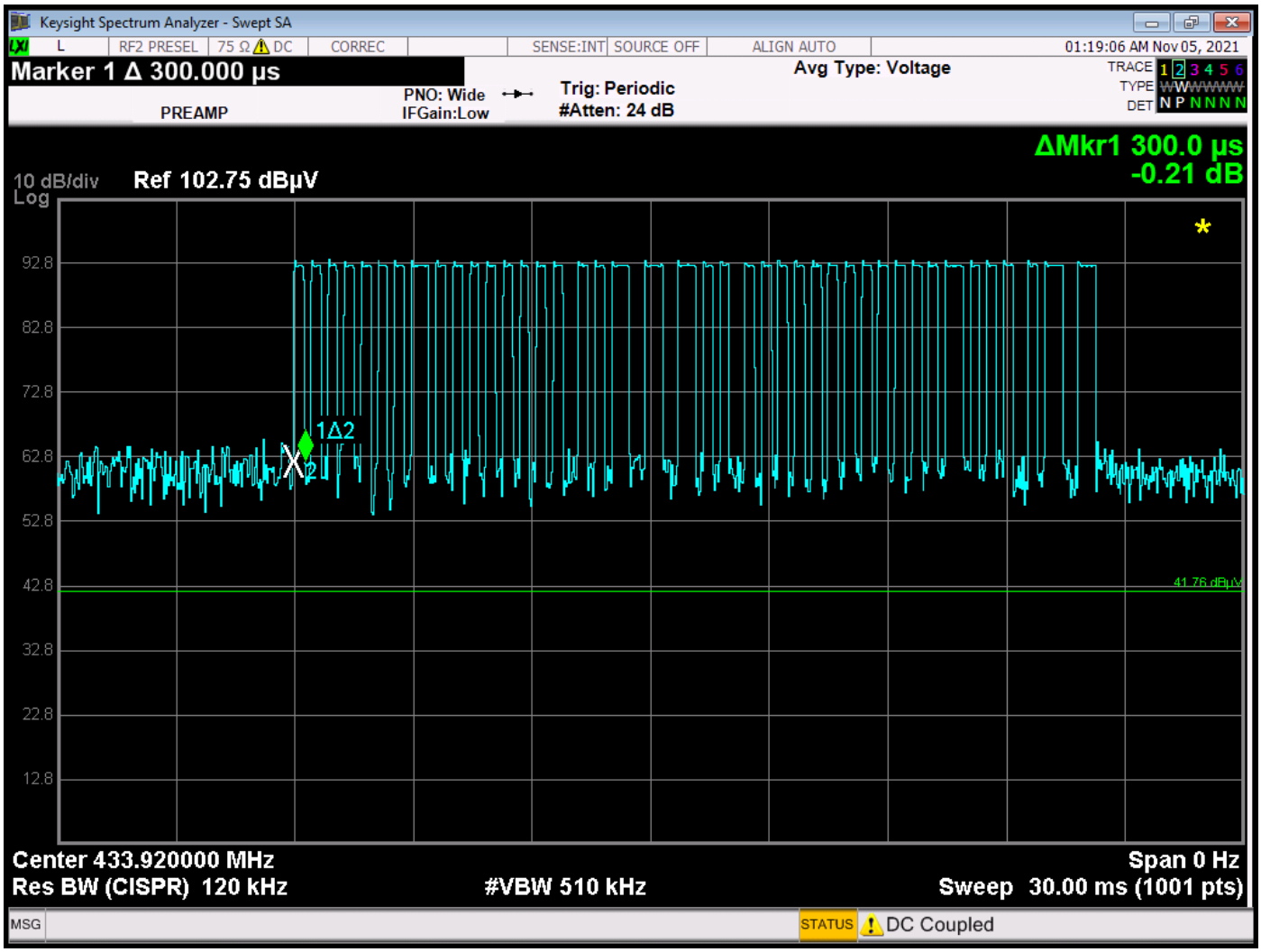
The pulse train only appears once every 100 ms



Time of Small Pulse = 280 us



Time of Large Pulse = 460 us



Number of Small Pulses = 35 = (35*280 us) = 9800 us
Number of Large Pulses = 7 = (7*460 us) = 3220 us

Total On Time = 13020 us = 13.020 ms

Duty Cycle = 13.020 ms / 100 ms = 13.020%

The peak to average ratio is -17.70 dB