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AUXO INTERNATIONAL LTD

TEST REPORT

SCOPE OF WORK
RF TESTING–15598

REPORT NUMBER
SZHH01957027-001

ISSUE DATE
August 06, 2024

PAGES
16

DOCUMENT CONTROL NUMBER
FCC ID_b-227
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AUXO INTERNATIONAL LTD

Application
For
Certification

FCC ID: SFF-18836

Product Name: R/C Light Tube Racer

Model: 15598

Transmitter

Report No.: SZHH01957027-001

We hereby certify that the sample of the above item is considered to comply with the requirements of FCC Part 15, Subpart C for Intentional Radiator, mention 47 CFR [10-1-23]

Prepared and Checked by:	Approved by:
Sign on file *Maura Wang* *Engineer*	Johnny Wang *Johnny Wang* *Project Engineer* *Date: August 06, 2024*

- The test results reported in this test report shall refer only to the sample actually tested and shall not refer or be deemed to refer to bulk from which such a sample may be said to have been obtained.
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GENERAL INFORMATION

AUXO INTERNATIONAL LTD

MODEL: 15598

FCC ID: SFF-18836

Grantee:	AUXO INTERNATIONAL LTD
Grantee Address:	Rm 1425, Block A, Hoi Luen Ind. Ctr., 55 Hoi Yuen Rd., Kwun Tong, Hong Kong.
Contact Person:	Edward Chan
Tel:	(852)3168 6631
Manufacturer:	AUXO INTERNATIONAL LTD
Manufacturer Address:	Rm 1425, Block A, Hoi Luen Ind. Ctr., 55 Hoi Yuen Rd., Kwun Tong, Hong Kong.
Model:	15598
Type of EUT:	Transmitter
Description of EUT:	R/C Light Tube Racer
Serial Number:	N/A
FCC ID :	SFF-18836
Date of Sample Submitted:	July 24, 2024
Date of Test:	August 02, 2024
Report No.:	SZHH01957027-001
Report Date:	August 06, 2024
Environmental Conidtions:	Temperature: +10 to 40°C Humidity: 10 to 90%

SUMMARY OF TEST RESULT

AUXO INTERNATIONAL LTD

MODEL: 15598

FCC ID: SFF-18836

TEST SPECIFICATION	REFERENCE	RESULTS
Maximum Peak Output Power	15.247(b), (c) / RSS-210 A8.4	N/A
Hopping Channel Carrier Frequencies Separation	15.247(e) / RSS-210 A8.1	N/A
20dB Bandwidth of the Hopping Channel	15.247(a) / RSS-210 A8.1	N/A
Number of Hopping Frequencies	15.247(e) / RSS-210 A8.1	N/A
Average Time of Occupancy of Hopping Frequency	15.247(e) / RSS-210 A8.1	N/A
Anteann Conducted Spurious Emissions	15.247(d) / RSS-210 A8.5	N/A
Radiated Spurious Emissions	15.247(d) / RSS-210 A8.5	N/A
RF Exposure Compliance	15.247(i) / RSS-Gen 5.5	N/A
Transmitter Power Line Conducted Emissions	15.207 / RSS-Gen 7.2.2	N/A
Transmitter Field Strength	15.227 / RSS-310 3.8	Pass
Transmitter Field Strength	15.229 / RSS-210 A2.7	N/A
Transmitter Field Strength, Bandwidth and Timing Requirement	15.231(a) / RSS-210 A1.1.1	N/A
Transmitter Field Strength, Bandwidth and Timing Requirement	15.231(e) / RSS-210 A1.1.5	N/A
Transmitter Field Strength and Bandwidth Requirement	15.239 / RSS-210 A2.8	N/A
Transmitter Field Strength and Bandwidth Requirement	15.249 / RSS-210 A2.9	N/A
Transmitter Field Strength and Bandwidth Requirement	15.235 / RSS-310 3.9	N/A
Receiver / Digital Device Radiated Eissions	15.109 / ICES-003	N/A
Digital Device Conducted Emissions	15.107 / ICES-003	N/A

Note:
1. The EUT uses an dedicated antenna, in accordance to section 15.203, is considered sufficient to comply with the provisions of this section.
2. Pursuant to FCC part 15 Section 15.215(c), the 20 dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.

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1.0 General Description

1.1 Product Description

The equipment under test (EUT) is a transmitter for a R/C Light Tube Racer operating at 27.145 MHz which is controlled by a crystal. The EUT is powered by two 1.5 V AA batteries. For more detail information pls. refer to the user manual.

Antenna Type: dedicated antenna
Type of modulation: Pulse modulation
Antenna Gain: 0 dBi.
For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is an application for certification of a controller unit for the R/C Light Tube Racer, and the corresponding receiver unit which associated with this EUT is subjected to FCC SDOC.

1.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated Emission measurement was performed in a Semi-anechoic chamber. Preliminary scans were performed in the Semi-anechoic chamber only to determine worst case modes. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the **"Justification Section"** of this Application.

1.4 Test Facility

The Semi-anechoic chamber and shielding room used to collect the radiated data and conducted data are Intertek **Testing Services Shenzhen Ltd. Longhua Branch** and located at 101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community GuanHu Subdistrict, LongHua District, Shenzhen, People's Republic of China. This test facility and site measurement data have been fully placed on file with File Number: CN1188.

2.0 System Test Configuration

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.10 (2013).

The EUT was powered by two new 1.5 V AA batteries during test.

For maximizing emissions below 30 MHz, the EUT was rotated through 360°, the bottom of the loop antenna was placed 1 meter above the ground, and the antenna polarization was changed. For maximizing emission at and above 30 MHz, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data report in Exhibit 3.0.

The unit was operated standalone and placed in the centre of the turntable.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was mounted to a plastic stand if necessary and placed on the polystyrene turntable, which enabled the Senior Engineer to maximize emissions through its placement in the three orthogonal axes.

2.2 EUT Exercising Software

There was no special software to exercise the device. Once the unit is powered up, it can transmit the RF signal continuously.

2.3 Special Accessories

There are no special accessories necessary for compliance of this product.

2.4 Equipment Modification

Any modifications installed previous to testing by AUXO INTERNATIONAL LTD will be incorporated in each production model sold/leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Longhua Branch.

2.5 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

2.6 Support Equipment List and Description

N/A.

3.0 Emission Results

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

3.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any), Average Factor (optional) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG - AV

where FS = Field Strength in dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
AV = Average Factor in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows:

FS = RR + LF

where FS = Field Strength in dBµV/m
RR = RA - AG - AV in dBµV
LF = CF + AF in dB

Assume a receiver reading of 52.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB are added. The amplifier gain of 29 dB and average factor of 5 dB are subtracted, giving a field strength of 27 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

RA = 52.0 dBµV/m
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
AV = 5.0 dB
FS = RR + LF
FS = 18 + 9 = 27 dBµV/m

RR = 18.0 dBµV
LF = 9.0 dB

Level in µV/m = Common Antilogarithm [(27 dBµV/m)/20] = 22.4 µV/m

3.2 Radiated Emission Configuration Photograph

Worst Case Radiated Emission at 868.64 MHz

For electronic filing, the worst case radiated emission configuration photographs are saved with filename: radiated photos.pdf.

3.3 Radiated Emission Data

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgment: Passed by 13.7dB

TEST PERSONNEL:

Sign on file

Maura Wang Engineer
Typed/Printed Name

August 02, 2024
Date

Applicant: AUXO INTERNATIONAL LTD
Date of Test: August 02, 2024 Model: 15598
Worst Case Operating Mode: Transmitting

Table 1

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
Vertical	27.145	46.3	0.0	18.4	5.4	59.3	80.0	-20.7
Vertical	54.29	29.6	20.0	5.8	-	15.4	40.0	-24.6
Vertical	868.64	36.7	20.0	15.6	-	32.3	46.0	-13.7
Horizontal	54.29	24.3	20.0	5.8	-	10.1	40.0	-29.9
Horizontal	868.64	30.7	20.0	15.6	-	26.3	46.0	-19.7

NOTES:

1. Peak Detector Data unless otherwise stated.
2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Loop antenna is used for the emissions below 30 MHz.
5. Emission is at least 35.47dB below the carrier level at the band edge (26.96MHz and 27.28 MHz).

4.0 Equipment Photographs

For electronic filing, the photographs are saved with filename: external photos.pdf and internal photos.pdf.

5.0 Product Labelling

For electronics filing, the FCC ID label artwork and the label location are saved with filename: label.pdf.

6.0 Technical Specifications

For electronic filing, the block diagram and schematic of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.

7.0 Instruction Manual

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.

8.0 Miscellaneous Information

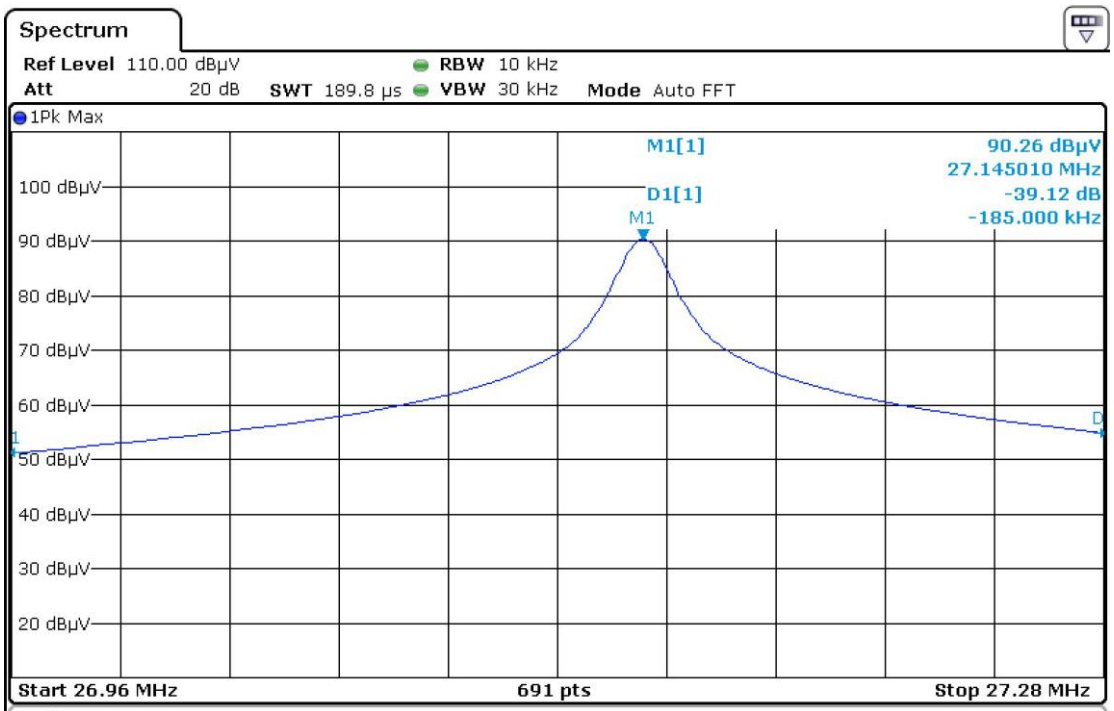
This miscellaneous information includes details of the measured bandwidth, the test procedure and calculation of factors such as pulse desensitization and averaging factor.

8.1 Measured Bandwidth

The test plots are attached as below which shows the fundamental emission is confined in the specified band. And it also shows that the emission is at least 35.47dB below the carrier level at the band edge (26.96MHz and 27.28 MHz). It meets the requirement of Section 15.227(b).

Pursuant to FCC part 15 Section 15.215(c), the 20dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.

The test plots are attached as below.



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	27.14501 MHz	90.26 dBµV		
D1	M1	1	-185.0 kHz	-39.12 dB		
D2	M1	1	134.99 kHz	-35.47 dB		

8.2 Discussion of Pulse Desensitization

The determination of pulse desensitivity was made in accordance with Hewlett Packard Application Note 150-2, *Spectrum Analysis ... Pulsed RF.*

The effective period (T_{eff}) was approximately 0.5072ms and 1.4928ms for a digital "1" bit, as shown in the plots of Exhibit 8.3. With a resolution bandwidth (3 dB) of 100 kHz, the pulse desensitivity factor was 0 dB.

8.3 Calculation of Average Factor

Averaging factor in dB = 20 log (duty cycle)

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

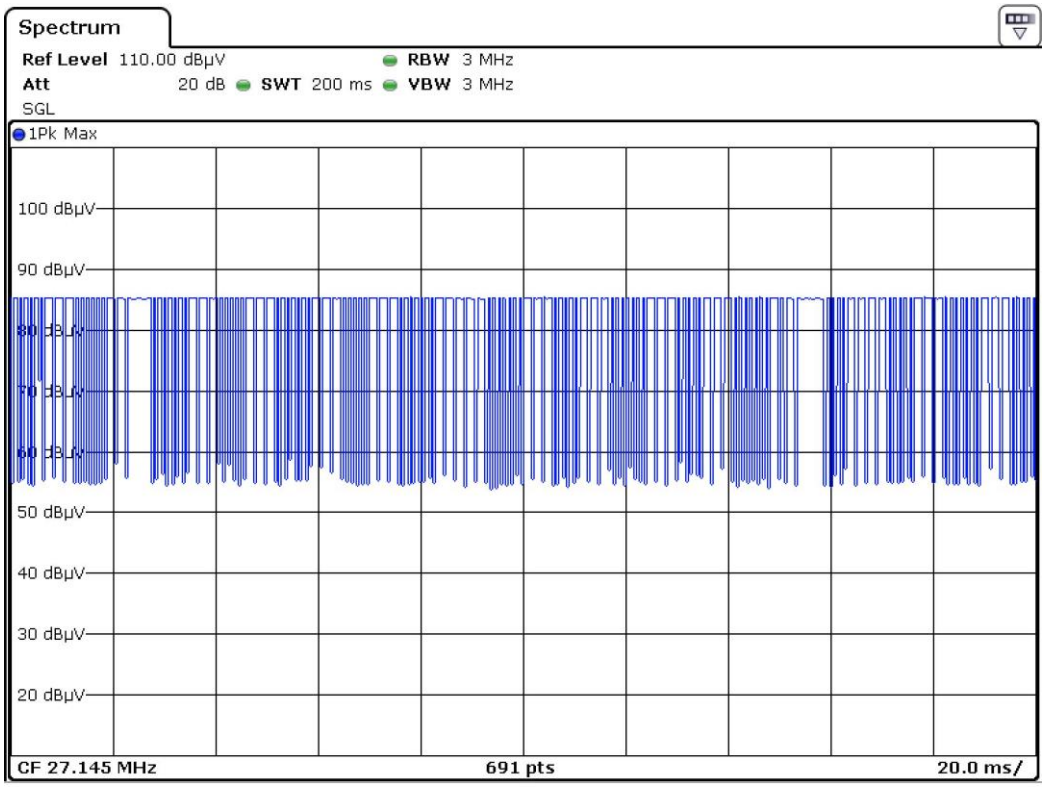
The time period over which the duty cycle is measured is 100 milliseconds, or the repetition cycle, whichever is a shorter time frame. The worst case (highest percentage on) duty cycle is used for the calculation. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities.

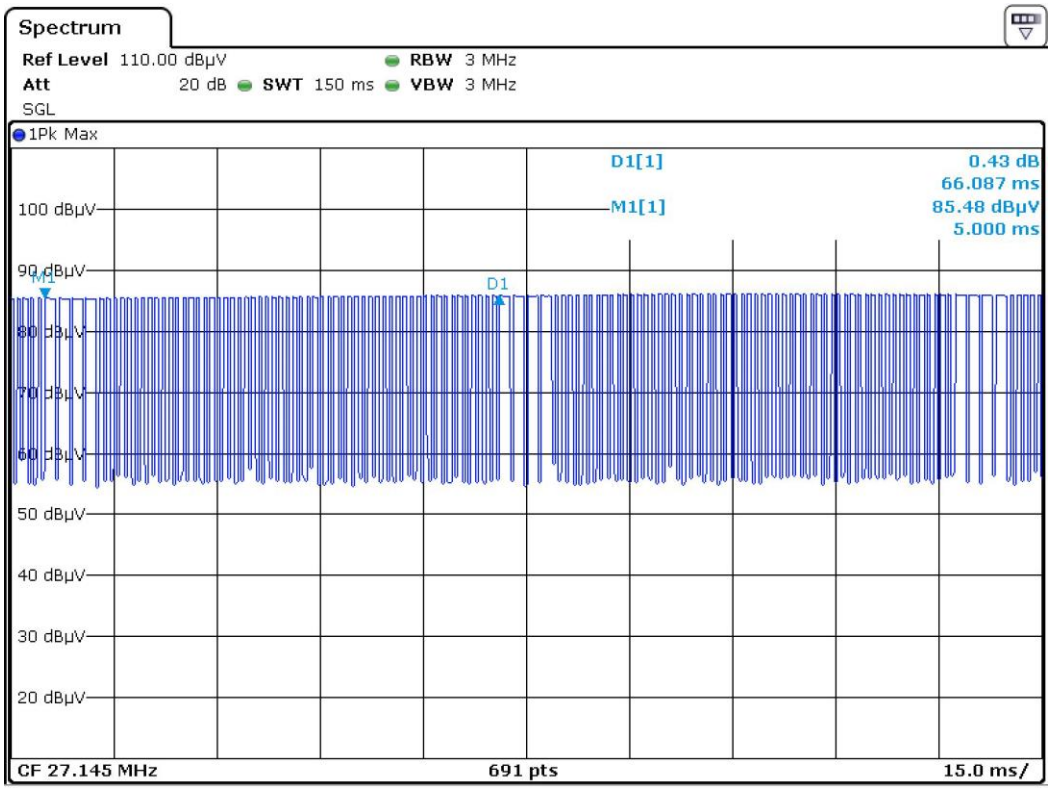
The duty cycle is simply the on-time divided by the period:

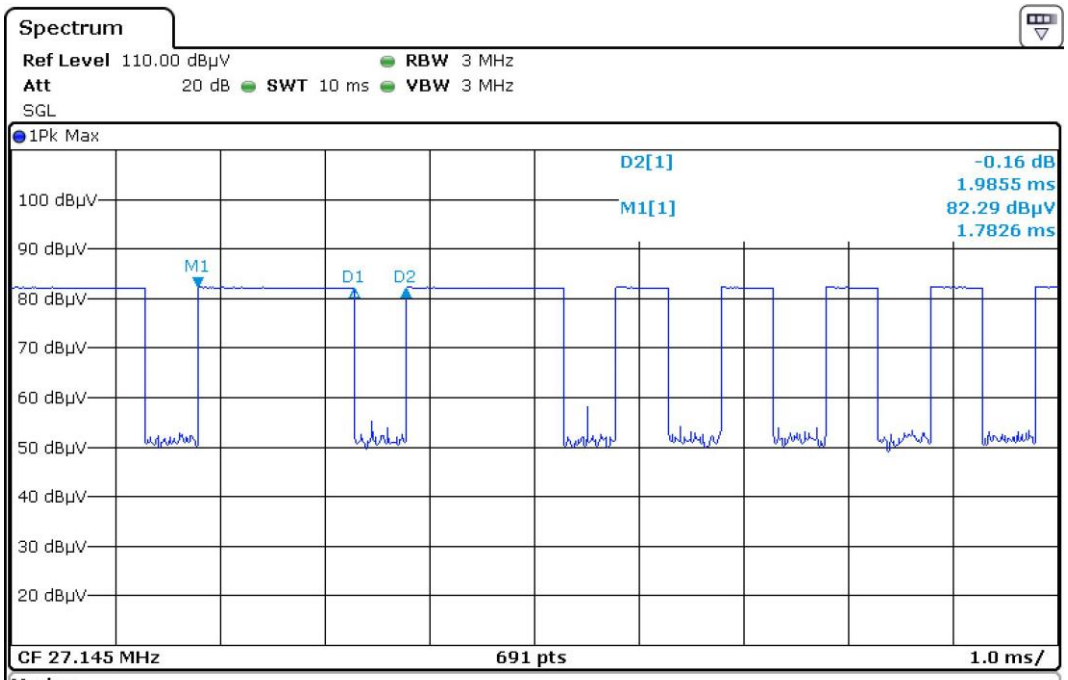
The duration of one cycle = 66.087ms
Effective period of the cycle = 1.4928ms x 4 + 0.5072ms x 58 =35.3888ms
DC =35.3888 / 66.087ms =0.5355 or 53.55%

Therefore, the averaging factor is found by 20 $\log_{10}$(0.5355) =-5.4dB

The test plots are attached as below.

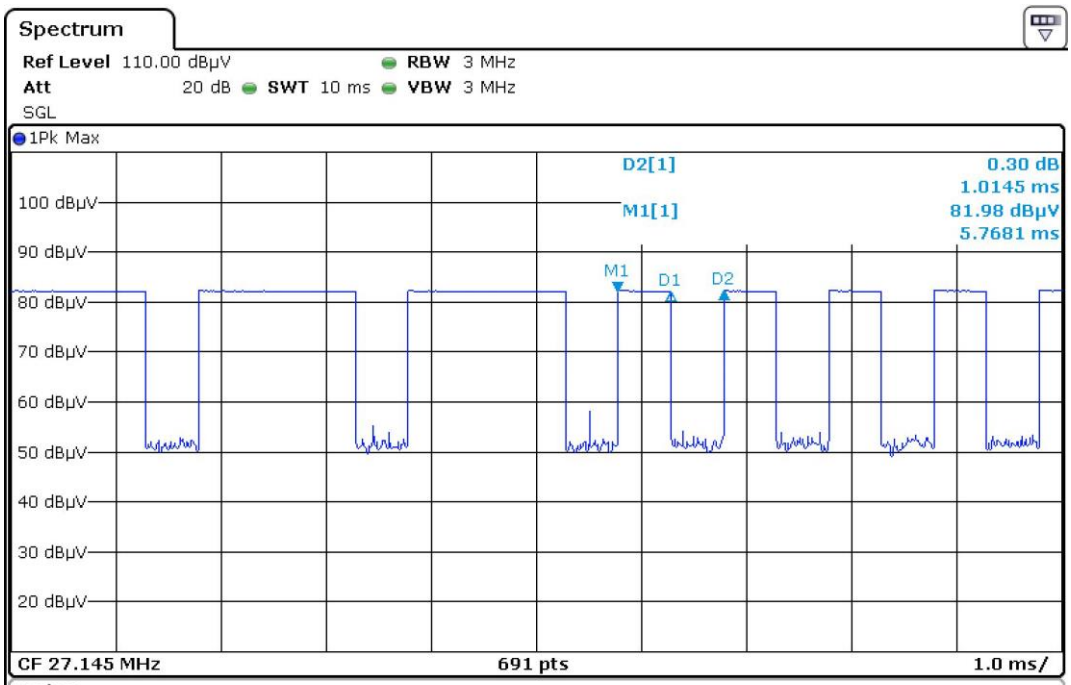

Spectrum
Ref Level 110.00 dBµV
RBW 3 MHz
Att 20 dB
SWT 200 ms
VBW 3 MHz
SGL
1Pk Max
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
CF 27.145 MHz
691 pts
20.0 ms/


Spectrum
Ref Level 110.00 dBµV
RBW 3 MHz
Att 20 dB
SWT 150 ms
VBW 3 MHz
SGL
1Pk Max
D1[1]
0.43 dB
66.087 ms
M1[1]
85.48 dBµV
5.000 ms
M1
D1
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
CF 27.145 MHz
691 pts
15.0 ms/



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.7826 ms	82.29 dBµV		
D1	M1	1	1.4928 ms	-0.15 dB		
D2	M1	1	1.9855 ms	-0.16 dB		



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.7681 ms	81.98 dBµV		
D1	M1	1	507.2 µs	0.08 dB		
D2	M1	1	1.0145 ms	0.30 dB		

8.4 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.10 - 2013.

The transmitting equipment under test (EUT) is placed on a polystyrene turntable which is four feet in diameter and approximately 0.8 meter in height above the ground plane. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.3.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

8.4 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements are made as described in ANSI C63.10 - 2013.

The IF bandwidth used for measurement of radiated signal strength was 60 kHz for emission below 30 MHz and 120 kHz for emission from 30 MHz to 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Exhibit 8.2).

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the restricted bands, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

9.0 Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ185-04	EMI Receiver	R&S	ESR7	102466	10-Nov-2023	10-Nov-2024
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	12-Dec-2021	12-Dec-2024
SZ062-12	RF Cable	RADIALL	RG 213U	--	1-May-2024	1-Nov-2024
SZ062-05	RF Cable	RADIALL	0.04-26.5GHz	--	1-May-2024	1-Nov-2024
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	5-May-2024	5-May-2027
SZ061-12	BiConiLog Antenna	ETS	3142E	00166158	4-Aug-2021	4-Aug-2024

********** End of Report**********