Valeo North America Inc.

TEST REPORT

SCOPE OF WORK
FCC TESTING–RFH1A

REPORT NUMBER
230206036SZN-001

ISSUE DATE	**[REVISED DATE]**
April 03, 2023	[----------]

PAGES
18

DOCUMENT CONTROL NUMBER
FCC ID 209_b

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TEST REPORT

Intertek Report No.: 230206036SZN-001

Valeo North America Inc.

Application
For
Certification

FCC ID: 2BAHD-RFH1

RFHM

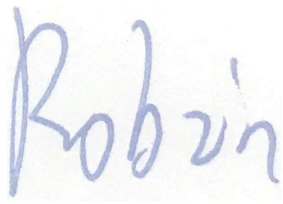
Model: RFH1A

Transmitter

Report No.: 230206036SZN-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 [10-1-21]

Prepared and Checked by:



Robin Zhou
Senior Project Engineer

Approved by:

Ryan Chen
Project Engineer
Date: April 03, 2023

MEASUREMENT/TECHNICAL REPORT

This report concerns (check one) Original Grant ___X___ Class II Change _____

Equipment Type: DCD - Part 15 Low Power Transmitter Below 1705 kHz

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes _____ No ___X_____

If yes, defer until : _____
date

Company Name agrees to notify the Commission by: _____
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes _____ No ___X___

If no, assumed Part 15, Subpart C for intentional radiator - the new 47 CFR [10-01-21] Edition] provision.

Report prepared by:

Robin Zhou
Intertek Testing Services Shenzhen Ltd. Longhua Branch
101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, ShenZhen.
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Table of Contents

1.0 Summary of Test Results

Applicant: Valeo North America Inc.
Applicant Address: 150 Stephenson Hwy, Troy, Michigan 48083, United States

Manufacturer: Valeo North America Inc.
Manufacturer Address: 150 Stephenson Hwy, Troy, Michigan 48083, United States

Equipment Under Test (EUT):

Product Description:	RFHM
Model:	RFH1A
Variants:	See section 3.7 Variants Description
Part ID No.:	T03FC350200762
Type of device:	Tx (125kHz), Rx (433.92MHz)
Operating frequency:	125kHz
Number of Channels:	1
Modulation Type:	OOK
Type of Antenna:	External: “Standard” and “Mid-range”
Antenna Gain:	NA
HW version:	B792302 Rev E
SW version:	V5.45
FW version:	NA
Standards/guidance:	FCC Title 47 CFR Part 15.209:2021 ANSI C63.10:2013
Sample Receipt Date:	February 06, 2023
Test Conducted Date:	February 06, 2023 to March 29, 2023
Test Condition:	21.9 ℃, 43% HR, 101 kPa

FCC ID: 2BAHD-RFH1

TEST ITEM	REFERENCE	RESULTS
20 dB Bandwidth	15.215(c)	Pass
Transmitter Radiated Emissions	15.209&15.205	Pass
Antenna Requirement	15.203	N/A (See Notes)

Notes: The EUT is designed to be professionally installed by a qualified and trained System integrator or professional installer which no need to meet the requirements of Section 15.203.

2.0 General Description

2.1 Product Description

The Equipment Under Test (EUT) is a RFHM operating at 125 kHz. The EUT is powered by DC 12V Car Battery. The EUT is equipped with five antennas (Antenna 1: Rear Left Door LF mid-range Antenna, Antenna 2: Rear Right Door LF mid-range Antenna, Antenna 3: Trunk LF standard antenna, Antenna 4: Front Console LF standard Antenna, Antenna 5: Rear bumper LF standard antenna), but cannot be simultaneous operation, only one antenna is active at a time. EUT will select the antenna during time sharing cycle. For more detailed features description, please refer to the user's manual.

Antenna Type: External: "Standard" and "Mid-range
Antenna Gain: N/A
For electronic filing, the brief circuit description is saved with filename: descri.pdf.

2.2 Related Submittal(s) Grants

This is an application for certification of the RFHM portion.
which has 125kHz transmitting function and 433.92MHz receiving function,
and related report for FCC SDOC is subjected to report number: 230206036SZN-003.

2.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated emission measurement was performed in Semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the 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.

2.4 Test Facility

The Semi-Anechoic chamber and shield 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. This test facility and site measurement data have been fully placed on file with File Number: CN1188.

3.0 System Test Configuration

3.1 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 DC 12V Car Battery (fully charged) during the test. The test system was pre-scanning tested based on the consideration of following EUT operation mode. The EUT is equipped with five antennas (Antenna 1: Rear Left Door LF mid-range Antenna, Antenna 2: Rear Right Door LF mid-range Antenna, Antenna 3: Trunk LF standard antenna, Antenna 4: Front Console LF standard Antenna, Antenna 5: Rear bumper LF standard antenna), but cannot be simultaneous operation, only one antenna is active at a time. EUT will select the antenna during time sharing cycle, five antennas have been tested. Only the worst-case data was shown in this report.

Test mode	Description
Mode 1	Antenna 1 125kHz Transmitting
Mode 2	Antenna 2 125kHz Transmitting
Mode 3	Antenna 3 125kHz Transmitting
Mode 4	Antenna 4 125kHz Transmitting
Mode 5	Antenna 5 125kHz Transmitting

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 Section 4.0.

The rear of unit shall be flushed with the rear of the table.

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 styrene turntable, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

3.2 EUT Exercising Software

Stallantis WLWS Homogation Tester: TSMASTERR V2022.12.20.810

3.3 Special Accessories

No Special accessories used.

3.4 Equipment Modification

Any modifications installed previous to testing by Valeo North America Inc. 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.

3.5 Measurement Uncertainty

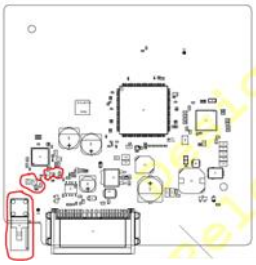
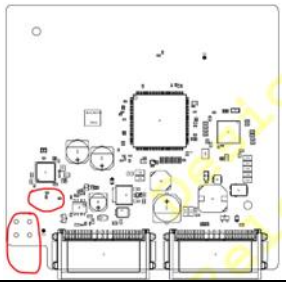
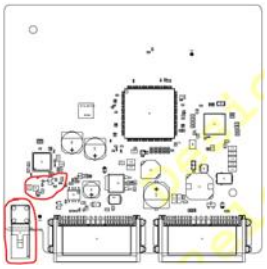
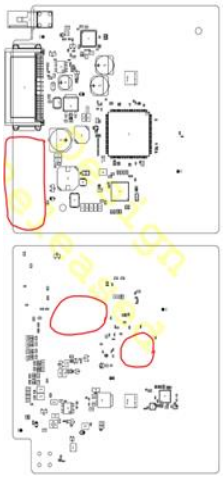
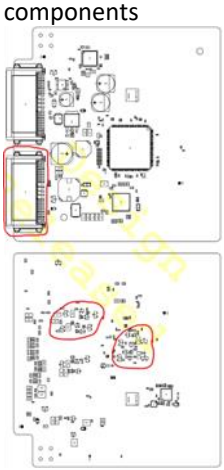
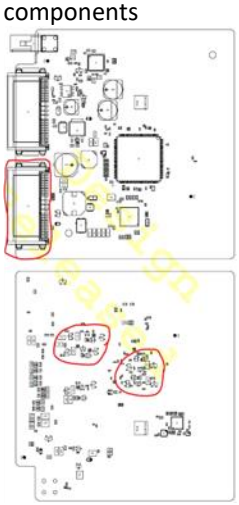
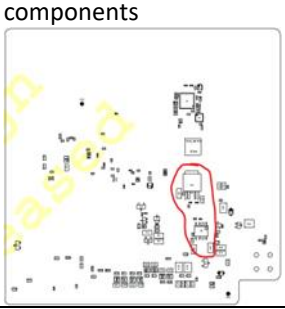
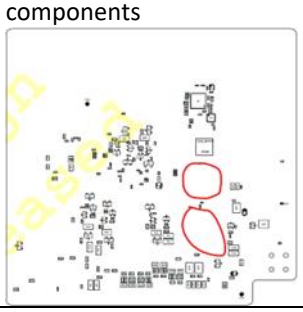
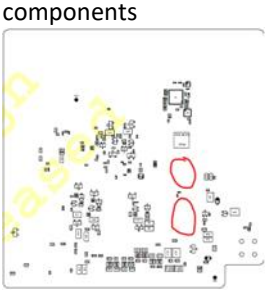
When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

Measurement Uncertainty	Uncertainty
Channel Bandwidth	±3.46%
Radiated emission (Up to 1GHz)	±4.8dB
Temperature	±1°C
Humidity	±5%

3.6 Support Equipment List and Description

Description	Manufacturer	Model/ Cable length
KIN	Valeo	KNW1
Loadbox	Valeo	TF6208
ToSun CANoE	Tosun	TC1012
Relay	Zhisheng	6QMBS
24 pins connect cable*2	Valeo	2m
USB Cable*2	Valeo	2m
DC input cable*4	Valeo	1m
Relay connect cable*1	Valeo	5m
ToSun CANoE connect cable*1	Valeo	5m
Laptop	DELL	Latitude 3480

3.7 Variants Description

STLA Part Number	68577119AA	68577118AA	68606409AA	68607122AA
Valeo Part Number	E884421	E896953	EA19835	EA19838
PCBA Part Number	b792302_01	b792302_02	b792302_03	b792302_03
Model	RFH1A	RFH1A	RFH1A	RFH1A
Difference 1	With J1 connector and related resistor, capacitor, transistor components 	Without J1 connector and related resistor, capacitor, transistor components 	With J1 connector and related resistor, capacitor, transistor components 	Same as 68606409AA
Difference 2	Without J3 connector and related resistor, capacitor, transistor components 	With J3 connector and related resistor, capacitor, transistor components 	With J3 connector and related resistor, capacitor, transistor components 	Same as 68606409AA
Difference 3	With U12&U8 chips and related resistor, capacitor, transistor components 	Without U12&U8 chips and related resistor, capacitor, transistor components 	Without U12&U8 chips and related resistor, capacitor, transistor components 	Same as 68606409AA

Summary analysis:
1. Variants with J1 connector need to be connected to external RF antenna, otherwise the reception distance does not meet the design requirements. For Variants without J1 connector, directly use the printed antenna on the PCB, as shown in the following figure. Internal antenna or external antenna, only slightly different in RF signal reception distance, no impact on function. Only for the receiving part, not associated with transmitter.

2. Variants with J3 connector supports hard wire door handle sensor (the door handle sensor is connected to the product through a wire), which has no impact on the high/low frequency communication function of the product, not associated with transmitter.
3. Variants with U12&U8 chips can use a private CAN network to connect the CAN door handle sensor (the door handle sensor connects to the product through a private CAN network), which has no impact on the high/low frequency communication function of the product, not associated with transmitter.

All variants have been evaluated, after the pre-scanning tests, the variant 68606409AA was shown in this report as the final test sample.

4.0 Measurement Results

4.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

$FS = RA + AF + CF - AG + PD + AV$

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/m
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB
AV = Average Factor in –dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:
$FS = RA + AF + CF - AG + PD + AV$

Example

Assume a receiver reading of 62.0dBμV is obtained. The antenna factor of 7.4dB and cable factor of 1.6dB is added. The amplifier gain of 29dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0dB, and the resultant average factor was –10dB. The net field strength for comparison to the appropriate emission limit is 32dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 62.0dBμV
AF = 7.4 dB/m
CF = 1.6dB
AG = 29.0dB
PD = 0dB
AV = –10dB
FS = $62 + 7.4 + 1.6 - 29 + 0 + (-10) = 32$dBμV/m
Level in μV/m = Common Antilogarithm [(32dBμV/m)/20] = 39.8μV/m

4.2 Radiated Emission Configuration Photograph

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

4.3 Radiated Spurious Emission

Worst Case Radiated Spurious Emission
at
0.125MHz

Judgement: Passed by 2.8dB margin

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

Sign on file

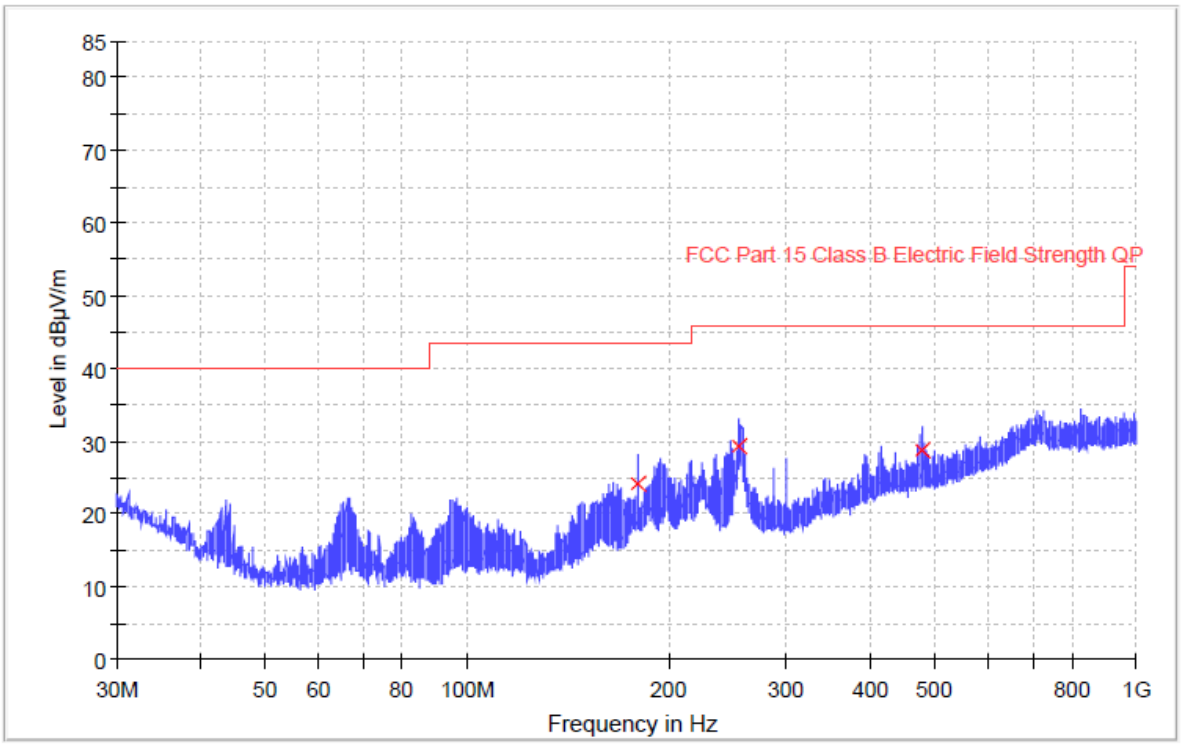
Robin Zhou, Senior Project Engineer
Typed/Printed Name

March 21, 2023
Date

Applicant: Valeo North America Inc.
Date of Test: March 21, 2023 Model: RFH1A
Worst Case Operating Mode: Antenna 1 125kHz Transmitting

Radiated Emissions (30MHz – 1000MHz)

ANT Polarity: Horizontal

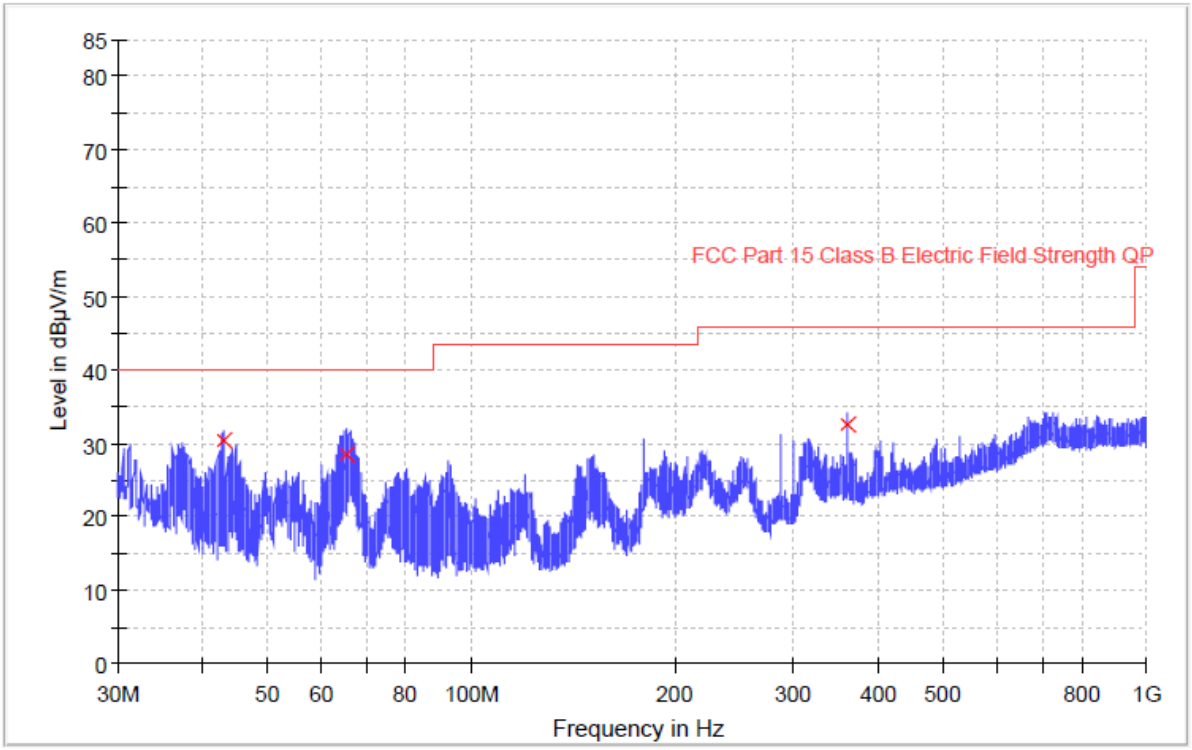


Frequency (MHz)	Quasi Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
179.994333	24.1	1000.0	120.000	Horizontal	17.5	19.4	43.5
255.360000	29.2	1000.0	120.000	Horizontal	20.0	16.8	46.0
478.851333	28.7	1000.0	120.000	Horizontal	26.3	17.3	46.0

Remark:
1. Corr. (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)
2. Quasi Peak (dBµV/m) = Corr. (dB/m) + Read Level (dBµV)
3. Margin (dB) = Limit Line(dBµV/m) – Level (dBµV/m)

Applicant: Valeo North America Inc.
Date of Test: March 21, 2023 Model: RFH1A
Worst Case Operating Mode: Antenna 1 125kHz Transmitting

ANT Polarity: Vertical

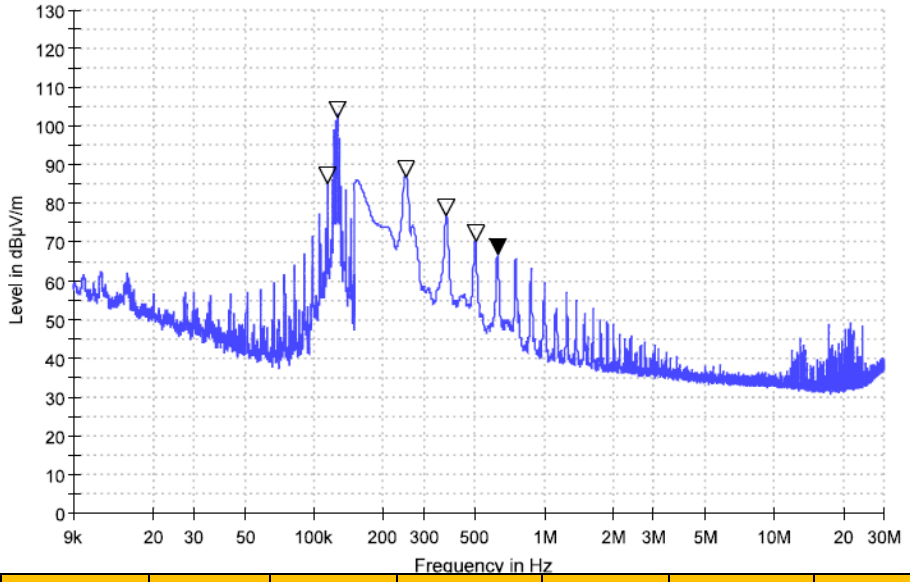


Frequency (MHz)	Quasi Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
42.965667	30.4	1000.0	120.000	Vertical	15.9	9.6	40.0
65.520000	28.4	1000.0	120.000	Vertical	13.7	11.6	40.0
359.994000	32.6	1000.0	120.000	Vertical	23.2	13.4	46.0

Remark:
1. Corr. (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)
2. Quasi Peak (dBµV/m) = Corr. (dB/m) + Read Level (dBµV)
3. Margin (dB) = Limit Line(dBµV/m) – Level (dBµV/m)

Applicant: Valeo North America Inc.
Date of Test: March 21, 2023 Model: RFH1A
Worst Case Operating Mode: Antenna 1 125kHz Transmitting

Fundamental & Spurious Emission Below 30MHz



Polarization	Frequency (MHz)	Reading (dBµV)	Antenna Factor (dB/m)	Net at 3m (dBµV/m)	Distance Factor (-dB)	Calulated at 300m (dBµV/m)	Limit at 300m (dBµV/m)	Margin (dB)
Vertical	0.125	87.7	15.2	102.9	80	22.9	25.7	-2.8
Vertical	0.110*	70.5	15.2	85.7	80	5.7	26.8	-21.1
Vertical	0.250	72.2	15.1	87.3	80	7.3	19.7	-12.4
Vertical	0.375	62.2	14.9	77.1	80	-2.9	16.1	-19.0
Polarization	Frequency (MHz)	Reading (dBµV)	Antenna Factor (dB/m)	Net at 3m (dBµV/m)	Distance Factor (-dB)	Calulated at 30m (dBµV/m)	Limit at 30m (dBµV/m)	Margin (dB)
Vertical	0.500	55.9	14.6	70.5	40	30.5	33.6	-3.1
Vertical	0.625	53.1	14.3	67.4	40	27.4	31.7	-4.3

Notes:
1. The specified limits of frequency band 9~90 kHz, 110~490 kHz are in average and measurements are made with peak detectors. Quasi-Peak detector is used for other frequency band.

2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance 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 value in the margin column shows emission below limit.

4. Loop antenna is used for the emission under 30MHz.

5. "*" Emission within restricted band fulfils the requirement of section 15.205.

6. Horizontal and Vertical polarization were tested and only the worst Case Data were shown.

5.0 Equipment Photographs

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

6.0 Product Labeling

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

7.0 Technical Specifications

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

8.0 Instruction Manual

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

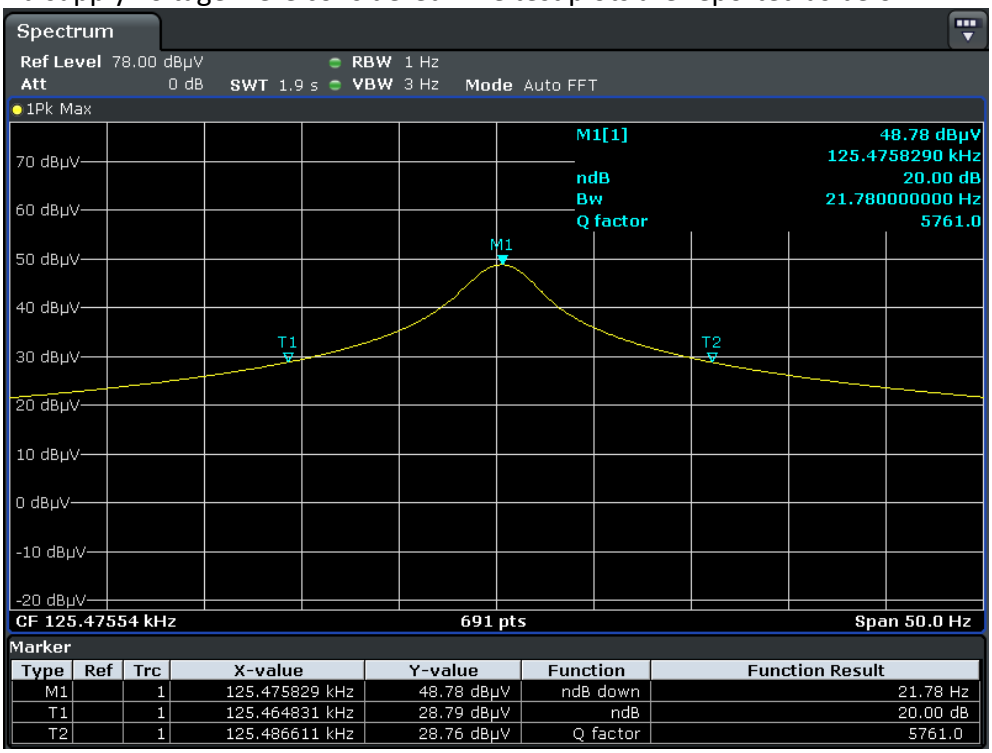
This manual will be provided to the end-user with each unit sold/leased in the United States.

9.0 Miscellaneous Information

This miscellaneous information includes 20dB bandwidth and emission measuring procedure.

9.1 20dB bandwidth

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 reported as below.



9.2 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 styrene 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.

Average detector is used for 9–90 KHz, 110–490 KHz and Quasi-Peak detector is used for other frequency band. The IF bandwidth used for measurement of radiated signal strength was 10 KHz for emission below 30 MHz and 120 KHz for emission from 30 MHz to 1000 MHz.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz up to the 1GHz. For line-conducted emissions, the range scanned is 150kHz to 30MHz.

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 10 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.

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.

10.0 Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ061-12	BiConiLog Antenna	ETS	3142E	00166158	2021-08-04	2024-08-04
SZ185-03	EMI Receiver	R & S	ESCI	100547	2022-12-26	2023-12-26
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	2021-05-18	2023-05-18
SZ056-03	Spectrum Analyzer	R&S	FSP 30	101148	2022-05-16	2023-05-16
SZ056-06	Signal Analyzer	R&S	FSV 40	101101	2022-12-19	2023-12-19
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	2021-12-12	2024-12-12
SZ062-02	RF Cable	RADIALL	RG 213U	--	2022-11-20	2023-05-20
SZ062-05	RF Cable	RADIALL	0.04-26.5GHz	--	2022-11-20	2023-05-20
SZ062-12	RF Cable	RADIALL	0.04-26.5GHz	--	2022-11-20	2023-05-20

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