



## **Application for Certification For a Transmitter.**

IOSix LLC  
1300 Tefft Ct #1  
Saline, MI 48176

IOSiX OBDv5 Vehicle Data Logger

M/N: IO-2050

FCC ID: 2AICQ-2050  
IC:21520-2050

REPORT # UT06125A-005

This report was prepared in accordance with the requirements of the FCC Rules and Regulations Part 2, Subpart J, 2.1033, Part 15.247, RSS-247 Issue 2, and other applicable sections of the rules as indicated herein.

Prepared By:

DNB Engineering, Inc.  
1100 E Chalk Creek Road  
Coalville, UT 84017

15 Nov 2021

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Paragraph numbers in this report follow the application section numbers found in the FEDERAL COMMUNICATIONS COMMISSION Rules and Regulations, Part 2, Subpart J for Certification of electronic equipment.

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REVISION HISTORY				
Rev	Pgs	Init	Description	Date
001	49	LP	Original Release	12 Sep 2020
002	50	LP	Add revision history page and NVLAP disclaimers	17 Sep 2020
003	54	LP	Correct typos add additional data	28 Jun 2021
004	54	LP	Add missing data	20 Aug 2021
005	54	LP	Re-validate and re-issue test report	15 Nov 2021

General information:

This report shall not be reproduced without the written approval of DNB ENGINEERING, INC. Results contained in this report relate only to the item tested.

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

This is a statement required by NVLAP in our ISO/IEC17025 accreditation process. What this means is the testing performed does not carry any governmental sponsorship. The efforts of the Accrediting Agency relate only to documented processes and not the actual test conduct. It in no way diminishes the validity or value of the test results. It only assigns ultimate responsibility for the result of testing to the test laboratory, not the U.S. government.

## 1.0 ADMINISTRATIVE DATA

### 1.1 Certifications and Qualifications

I certify that DNB Engineering, Inc conducted the tests performed in order to obtain the technical data presented in this application. Also, based on the results of the enclosed data, I have concluded that the equipment tested meets or exceeds the requirements of the Rules and Regulations governing this application.

### 1.2 Measurement Repeatability Information

The test data presented in this report has been acquired using the guidelines set forth in FCC Part 2.1031 through 2.1057, Part 15. The test results presented in this document are valid only for the equipment identified herein under the test conditions described. Repeatability of these test results will only be achieved with identical measurement conditions. These conditions include: The same test distance, EUT Height, Measurement Site Characteristics, and the same EUT System Components. The system must have the same Interconnecting Cables arranged in identical placement to that in the test set-up, with the system and/or EUT functioning in the identical mode of operation (i.e. software and so on) as on the date of the test. Any deviation from the test conditions and the environment on the date of the test may result in measurement repeatability difficulties.

All changes made to the EUT during the course of testing as identified in this test report must be incorporated into the EUT or identical models to ensure compliance with the FCC regulations.



C. L. Payne III (Para. 1.1)  
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### 1.3 Test Equipment List

TEST EQUIPMENT LIST - CONDUCTED EMISSIONS					
Description	Manufacturer	Model No.	Asset #	Serial #	Cal Due
LISN	Fisher Custom Communications	FCCLISN5032401	U-286	2020	03 Feb 2021
10 dB Attenuator	Inmet	9401	U-232K	U232K	13 Jan 2021
Spectrum Analyzer	Rhode & Schwarz	FSV30	U-248	101367	17 Aug 2020
TILE Software	ETS Lindgren	3.4.11.13	U-317	8112006	07 Mar 2021
Site 1 Cable - Cond	DNB	DNB	U-400B	1.1	1 Dec 2020

TEST EQUIPMENT LIST - RADIATED EMISSIONS					
Description	Manufacturer	Model No.	Asset #	Serial #	Cal Due
Pre-Amplifier	Hewlett Packard	8447D	U-068	2727A06184	04 Aug 2021
Pre-Amplifier	DNB	S-21G	U-095	U-095-1	03 Feb 2021
DRG Horn Antenna	AH Systems	SAS-571	U-071	417	11 Jul 2021
Spectrum Analyzer	Rhode & Schwarz	FSV30	U-248	101367	17 Aug 2020
TILE Software	ETS- Lindgern	3.4.11.13	U-317	8112006	07 Mar 2021
Site 1 Cable - Rad	DNB	DNB	U-400B	1.2	1 Dec 2020
HF Cable	TRU Corporation	210	U-066	TRU-21B1111-080M	4 Feb 2021

TEST EQUIPMENT LIST - ANTENNA CONDUCTED					
Description	Manufacturer	Model No.	Asset #	Serial #	Cal Due
Spectrum Analyzer	Rhode & Schwarz	FSV30	U-248	101367	17 Aug 2020
20dB Attenuator	Inmet	64671	U-316	U-316	24 Jun 2021

## 1.4 Test Summary Cross Reference

Test Item	FCC Requirement	IC Requirement	Test Method	Result
Antenna Requirement	15.203/15.247	RSS-Gen 6.8	---	Pass
Conducted Emissions (General Provisions)	15.207	RSS-Gen 8.8	ANSI C63.10-2013	N/A
Radiated Emissions (General Provisions)	15.209	RSS-Gen 8.9	ANSI C63.10-2013	Pass
Output Power (FHSS)	15.247 (b,2)	RSS-247 5.4 d)	ANSI C63.10-2013 Clause 11.9.1.1	Pass
Power Spectral Density	15.247 (e)	RSS-247 5.2 b)	ANSI C63.10-2013 Clause 11.10.2	Pass
Band-edge RF Conducted	15.247 (d)	RSS-247 5.5	ANSI C63.10-2013 Clause 11.13.2	Pass
DTS Bandwidth	15.247 (a,2)	RSS-247 5.2 a)	ANSI C63.10-2013 Clause 11.8.1	Pass
Conducted Spurious	15.247 (d)	RSS-247 5.5	ANSI C63.10-2013 Clause 11.11.3	Pass
Radiated Spurious Emissions	15.247 (d)	RSS-247 5.5	ANSI C63.10-2013 Clause 11.12.2.7	Pass
Restricted Bands	15.247 (d)	RSS-Gen 8.10	ANSI C63.10-2013 Clause 11.12.1	Pass

RSS-GEN      Issue 5      Mar 2019  
 RSS-247      Issue 2      Feb 2017

Preliminary scans were performed to determine worst case modulation, packet length, and data rates. Only worst case data has been recorded within the body of the test report.

## 1.5 Measurement Uncertainty

Measurement Type	Uncertainty
AC Conducted Emissions	± 1.67 dB
OATS - Radiated Emissions - Vertical Biconical (30-300MHz)	± 4.17 dB
OATS - Radiated Emissions - Horizontal Biconical (30-300MHz)	± 4.22 dB
OATS - Radiated Emissions - Vertical Log Periodic (300-100MHz)	± 4.92 dB
OATS - Radiated Emissions - Horizontal Log Periodic (300-1000MHz)	± 4.79 dB
OATS - Radiated Emissions - Vertical DRG Horn (> 1GHz)	± 5.74 dB
OATS - Radiated Emissions - Horizontal DRG Horn (>1GHz)	± 5.80 dB
Antenna Conducted Measurements	± 1.96 dB

## 2.1033 (b) (1) Application for Certification

Name of Applicant:	IOSix LLC 1300 Tefft Ct #1 Saline, MI 48176
FRN Number:	0025564303
Name of Manufacturer :	IOSix LLC 1300 Tefft Ct #1 Saline, MI 48176
Description:	IOSiX OBDv5 Vehicle Data Logger
Model Number(s):	IO-2050
Anticipated Production Quantity:	Multiple Units
Frequency Band:	2404 - 2480 MHz
Rated Output Power: (Conducted)	-1.13 dBm     (0.77 mW)
Type of Signal:	Digital Transmission System (DTS)
Max Data Rate:	BLE - 1Mb/s
Antenna Type:	Internal - Monopole - Meander
Antenna Gain:	-15.83 dBi

2.1033 (b,2) FCC Identifier

Model Number: IO-2050  
FCC ID: 2AICQ-2050  
IC: 21520-2050

Label is polyester with a permanent acrylic adhesive and black resin text

Service temperature is -40 to +150C

'Extreme resistance to chemicals' - resistant to Gasoline, Grease, Oil, Bleach, Alcohol, Ammonia, Cleaning products



Model: IO-2050

MFG: 2020-04-23

MAC: 30AEA4A55CF2

SIM: 89460800244098412535

IMEI: 869951030145456



FCCID: 2AICQ-2050 IC: 21520-2050 Contains FCCID: 2AJYU-SIM7000G IC: 23761-SIM7000G



2.1033 (b,3)	Installation and Operating Instructions -	Supplied separately.
2.1033 (b,4)	Brief Description of Circuit Function -	Supplied separately.
2.1033 (b,5)	Block Diagram -	Supplied separately.
2.1033 (b,7)	Equipment Photographs -	Supplied separately.

## 2.1033 (b,6) Report of Measurements

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Pass - Antenna gain is equal to or less than -15.83dBi

Pass - Antenna is an internal meander antenna (Monopole)

15.207

Conducted Emissions - Not Applicable

Not Applicable EUT is intended to be installed in a vehicle and is connected to the vehicle battery. There is no direct or indirect connection to the AC Mains.

Test Procedure: ANSI C63.10-2013

The EUT was measured on an open area test site (OATS).

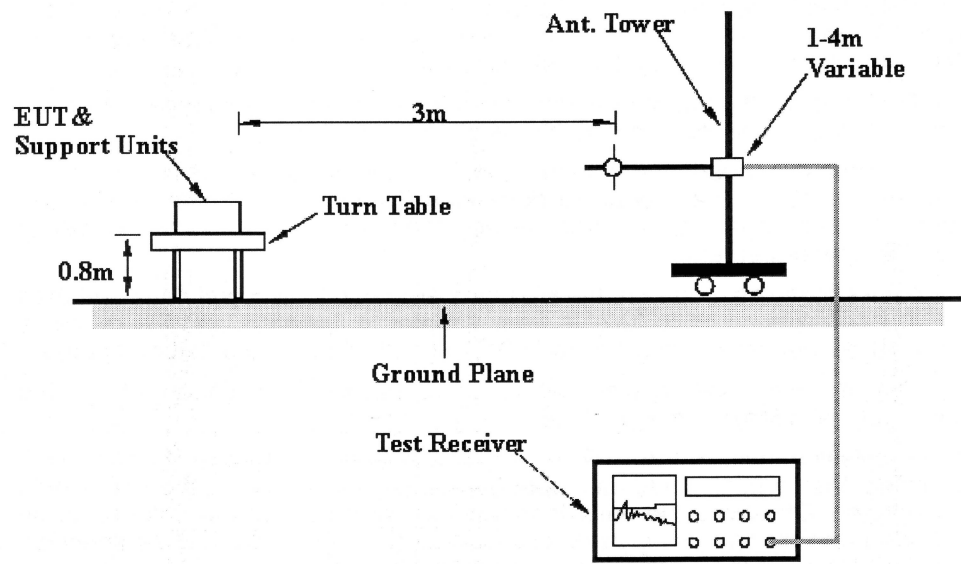
A measuring distance of at least 3 m shall be used for measurements at frequencies up to 1 GHz. For frequencies above 1 GHz, any suitable measuring distance may be used. The equipment size (excluding the antenna) shall be less than 20 % of the measuring distance.


Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site do not degrade the measurement results, in particular:

- no extraneous conducting objects having any dimension in excess of a quarter wavelength of the highest frequency tested shall be in the immediate vicinity of the site;
- all cables shall be as short as possible; as much of the cables as possible shall be on the ground plane or preferably below; and the low impedance cables shall be screened.
- EUT was positioned in three orthogonal axis - only the worst case data (X-Axis) has been recorded

The EUT shall be placed upon a non-conductive table (wooden for below 1GHz and styrene above 1GHz) 0.80 meters above the ground plane for frequencies from 30 to 1000MHz and 1.5 meters above the ground plane above 1 GHz and shall be placed in the “worst case” transmitting mode. The EUT shall be rotated 360 degrees to find the azimuth maxima. The receive antenna shall then be raised and lowered between 1 to 4 meters to find the maximum signal emanating from the EUT. This signal strength is then recorded on the data sheets.

Frequency (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measurement Distance (meters)
.0009 - 0.490	2400/F(kHz)	$20*(\text{Log}_{10}(2400/F(\text{kHz})))$	300
0.490 - 1.705	24000/F(kHz)	$20*(\text{Log}_{10}(24000/F(\text{kHz})))$	30
1.705 - 30.0	30	29.5	30
30 - 88	100	40.0	3
88 - 216	150	43.5	3
216 - 960	200	46.0	3
Above 960	500	54.0	3



		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>Radiated Emissions</b> (General)							
DNB Job Number:		06125		Date:		14 Aug 2020		Specification [X] 15.209 [X] ANSI C63.10-2013			
Customer:		IOSix LLC									
Model Number:		IO-2050									
Description:		IOSiX OBDv5 Vehicle Data Logger									
EUT is in conformance with FCC 15.209				X	YES		NO	Signed		B Williams	
Radiated Emissions											
FREQ (Mhz)	S/A Reading (dBuV/m)	Correction Factors (dB)			dBuV/m			Positions			
		Ant	Cbl	Amp	Corr	Lim	Delta	Typ	Tbl	Pl	Hgt
30.001	27.20	20.30	0.50	26.60	21.40	40.0	-18.61	QP	282	Horz	2.65
31.849	27.97	19.23	0.57	26.60	21.17	40.0	-18.84	QP	303	Horz	2.82
36.844	36.01	16.33	0.77	26.56	26.55	40.0	-13.46	QP	108	Horz	2.77
47.894	32.47	10.25	1.15	25.38	18.48	40.0	-21.52	QP	257	Horz	2.64
49.709	40.75	10.64	1.19	26.35	26.23	40.0	-13.77	QP	120	Horz	4.00
55.280	38.00	10.86	1.15	26.50	23.51	40.0	-16.50	QP	76	Horz	3.43
79.930	34.90	10.90	1.30	26.50	20.60	40.0	-19.41	QP	270	Horz	2.45
80.093	40.53	10.90	1.30	26.50	26.23	40.0	-13.77	QP	330	Horz	2.80
88.124	46.72	10.98	1.38	26.42	32.66	43.5	-10.84	QP	294	Horz	2.49
192.568	31.45	14.43	2.29	26.07	22.09	43.5	-21.42	QP	262	Horz	2.81
195.808	31.79	14.46	2.34	26.04	22.54	43.5	-20.96	QP	268	Horz	1.73
30.001	43.58	20.30	0.50	26.60	37.78	40.0	-2.23	QP	277	Vert	1.56
31.916	44.84	19.19	0.58	26.60	38.01	40.0	-2.00	QP	181	Vert	1.48
33.179	41.18	18.46	0.63	26.60	33.66	40.0	-6.34	QP	240	Vert	3.89
35.728	39.70	16.98	0.73	26.59	30.82	40.0	-9.19	QP	304	Vert	3.40
36.888	43.49	16.30	0.78	26.56	34.01	40.0	-6.00	QP	286	Vert	2.55
79.995	42.12	10.90	1.30	26.50	27.82	40.0	-12.19	QP	207	Vert	1.84
304.546	38.22	17.21	3.31	25.83	32.92	46.0	-13.09	QP	131	Vert	1.96
935.560	26.48	28.48	6.81	27.09	34.68	46.0	-11.33	QP	128	Vert	2.23

**11.9.1 Maximum peak conducted output power****11.9.1.1  $RBW \geq DTS$  bandwidth**

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

- a) Set the  $RBW \geq DTS$  bandwidth.
- b) Set  $VBW \geq [3 \times RBW]$ .
- c) Set span  $\geq [3 \times RBW]$ .
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

Requirement: FCC Part 15.247 Clause (b,3)

15.247 Operation within the bands 2400-2483.5 MHz.

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
- (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Limit : 1 watt or 30dBm



Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement  $\leq 1$  Watt or 30dBm

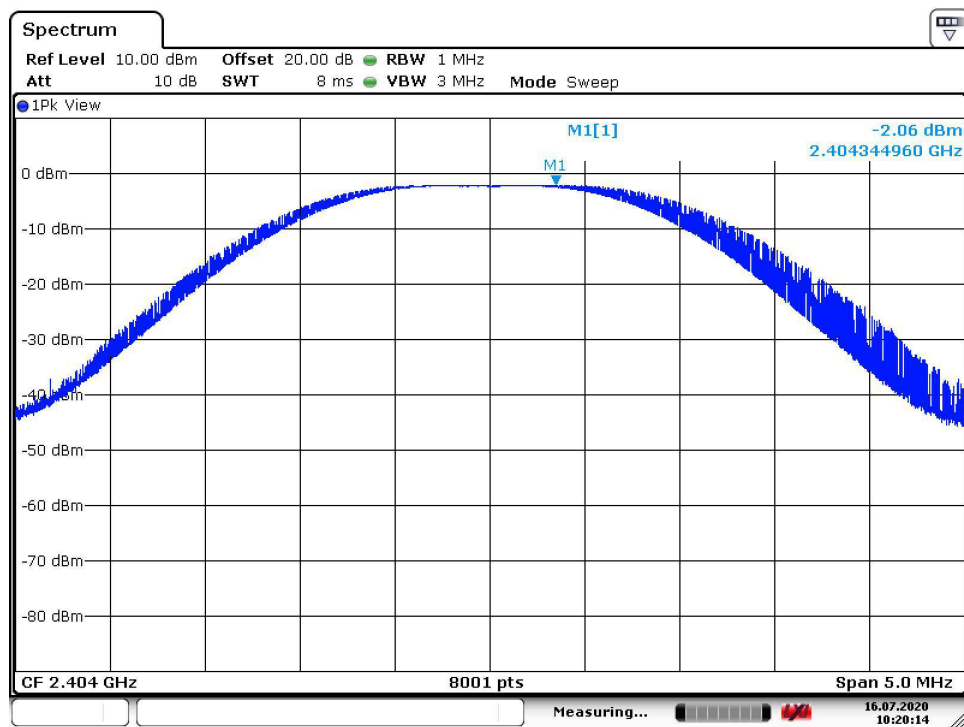
Tech: CL Payne

Data Rate 1Mb/s

Low Channel: 2404 MHz

Power: -2.06 dBm

Result: Pass



Date: 16.JUL.2020 10:20:14

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement  $\leq 1$  Watt or 30dBm

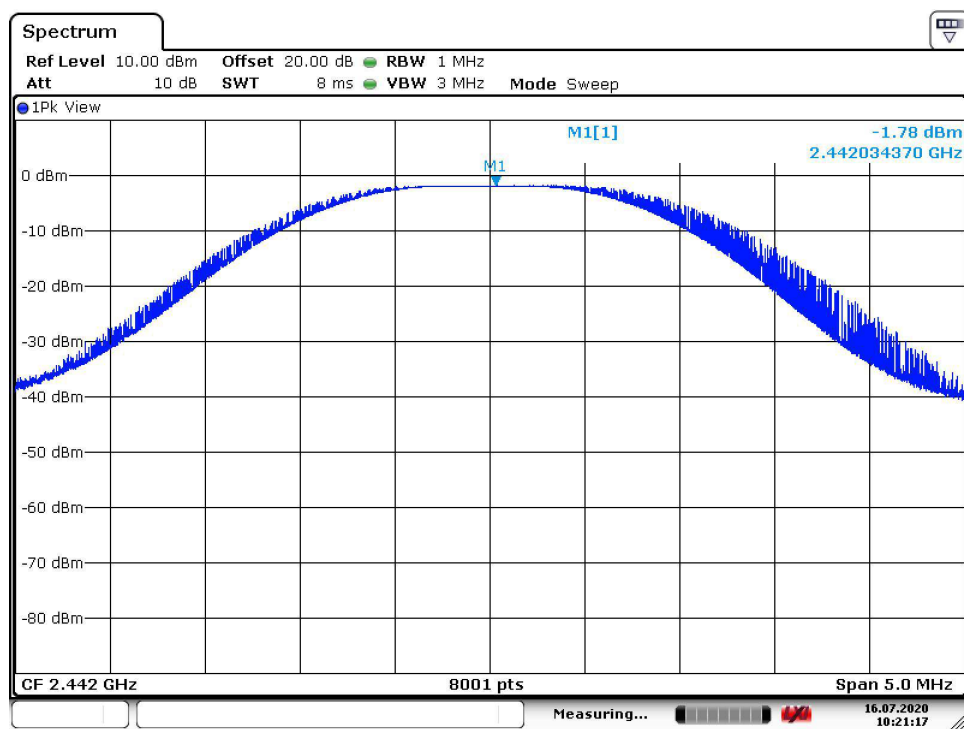
Tech: CL Payne

Data Rate 1Mb/s

Mid Channel: 2442 MHz

Power: -1.78 dBm

Result: Pass



Date: 16.JUL.2020 10:21:17

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement  $\leq 1$  Watt or 30dBm

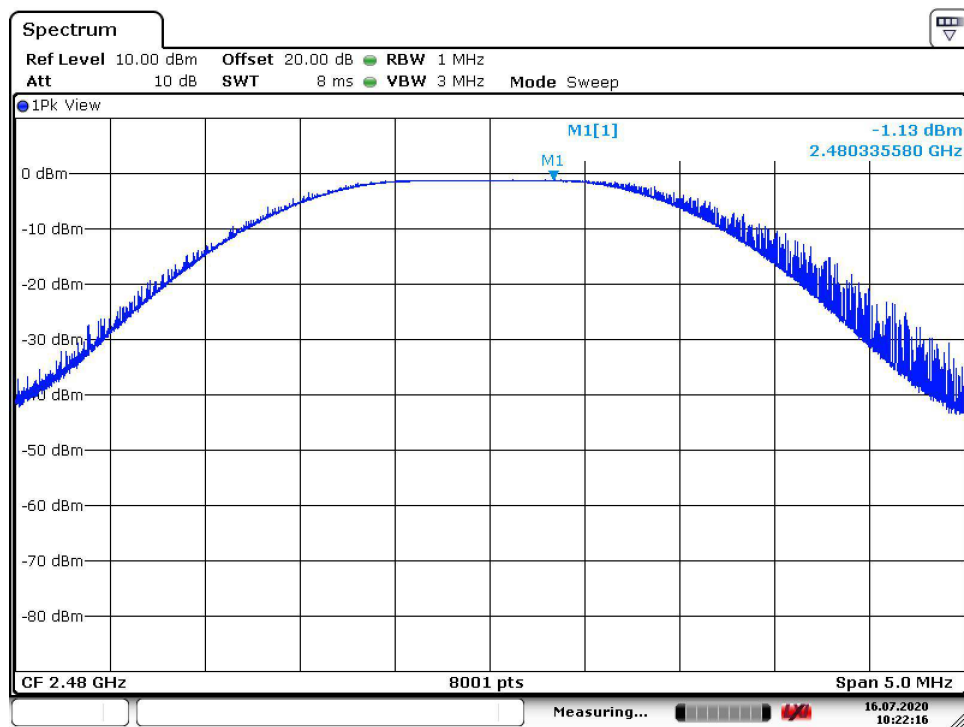
Tech: CL Payne

Data Rate 1Mb/s

High Channel: 2480 MHz

Power: -1.13 dBm

Result: Pass



Date: 16.JUL.2020 10:22:17

## Clause 11.10.2 Method PKPSD (peak PSD)

The following procedure shall be used if the maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted ( average ) output power was used to determine compliance:

- a) Set analyzer center frequency to DTS channel center frequency
- b) Set the span to 1.5 times the DTS bandwidth
- c) Set the RBW to  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- d) Set the VBW  $\geq [ 3 \times \text{RBW} ]$
- e) Detector = peak
- f) Sweep time = auto couple
- g) Trace mode = max hold
- h) Allow trace to fully stabilize
- i) Use the peak marker function to determine the maximum amplitude level within the RBW
- j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz ) and repeat
- k) Submit plots

Requirement: FCC Part 15.247 Clause (e)

## 15.247 Power Spectral Density.

- (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement  $\leq 8\text{dBm}$

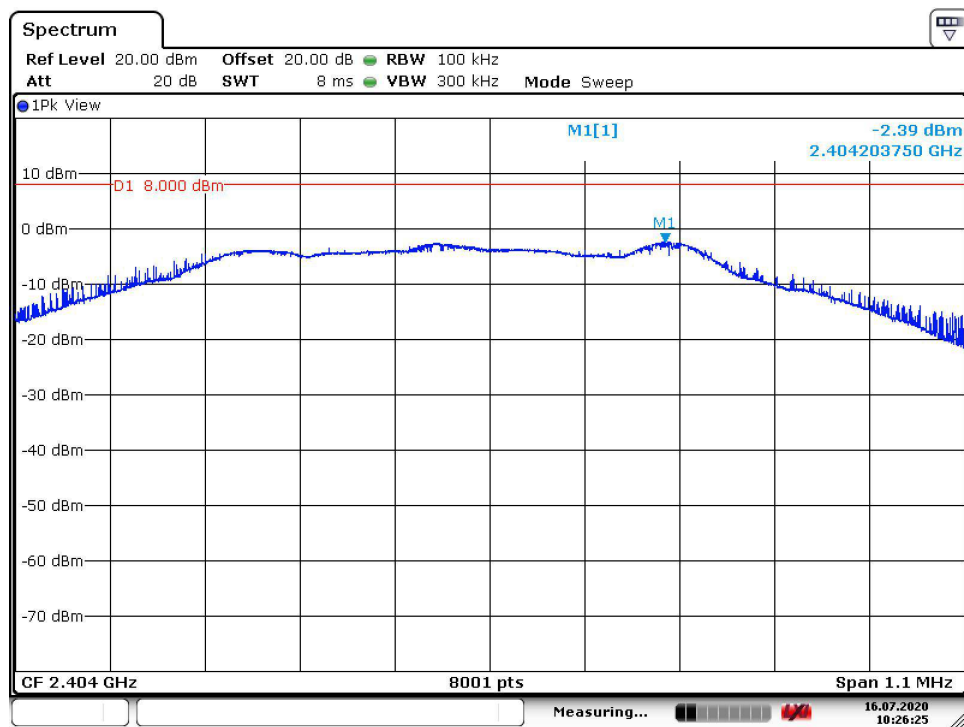
Tech: CL Payne

Data Rate 1Mb/s

Low Channel: 2404 MHz

Power: -2.39 dBm

Result: Pass



Date: 16.JUL.2020 10:26:26

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement  $\leq 8\text{dBm}$

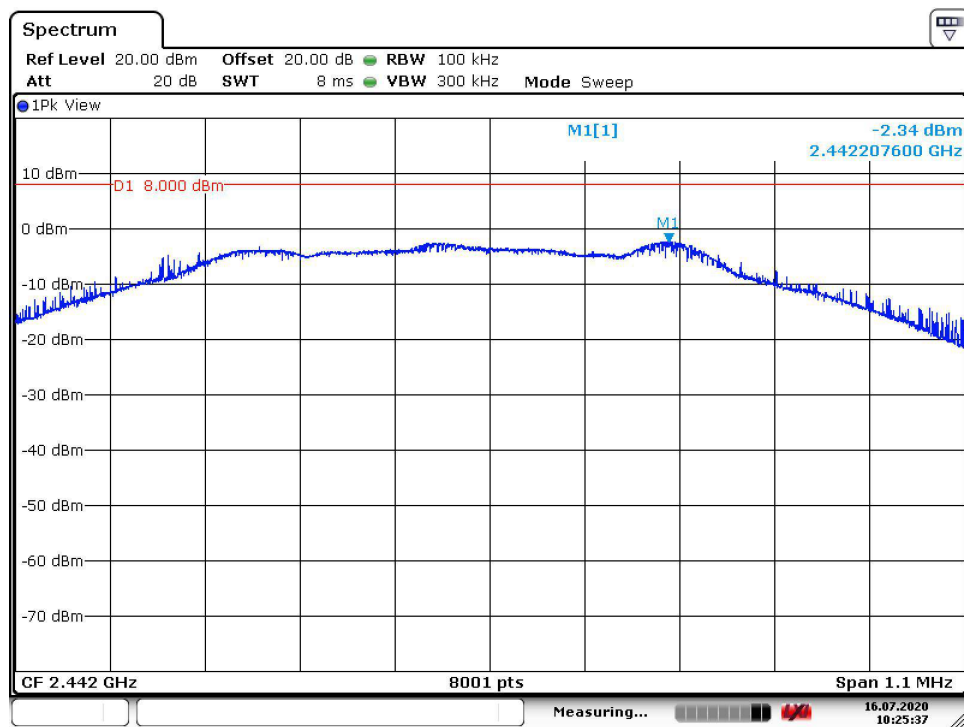
Tech: CL Payne

Data Rate 1Mb/s

Mid Channel: 2442 MHz

Power: -2.34 dBm

Result: Pass



Date: 16.JUL.2020 10:25:38

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement  $\leq 8\text{dBm}$

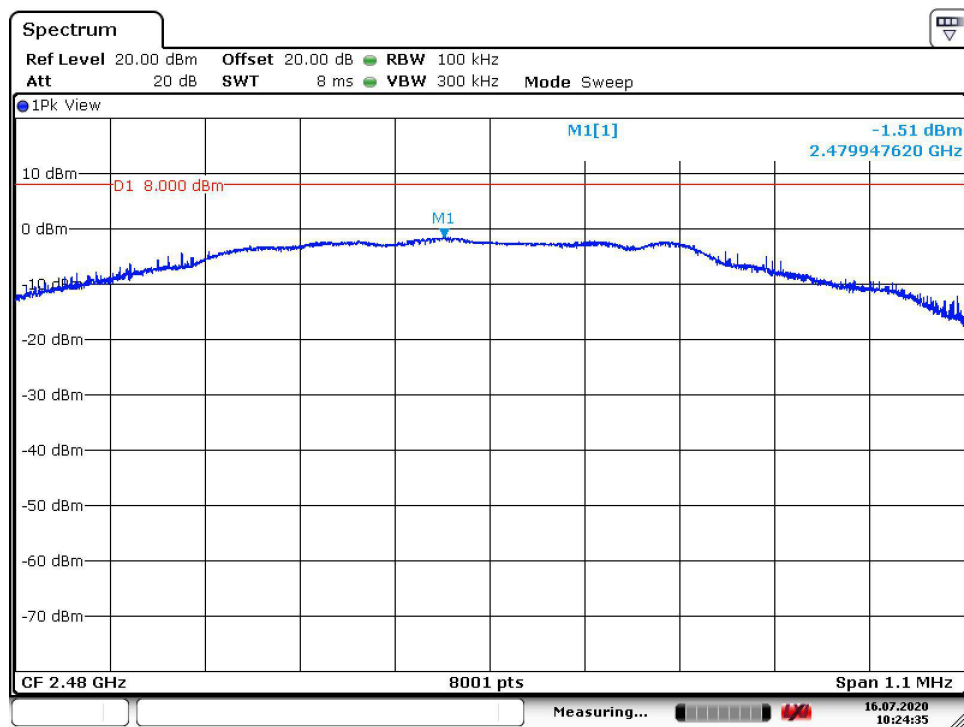
Tech: CL Payne

Data Rate 1Mb/s

High Channel: 2480 MHz

Power: -1.51 dBm

Result: Pass



Date: 16.JUL.2020 10:24:35

For band-edge measurements, use the band-edge procedure in 6.10. Band-edge measurements shall be tested both on single channels, and with the EUT hopping.

#### 6.10 Band-edge testing

The following procedure shall be used when band-edge measurements are required.

##### 6.10.1 Band-edge data reporting requirements

These reporting requirements are applicable to all devices for which band-edge measurements are required. On each operating frequency measured, band-edge emissions shall be reported by providing plots of the measuring instrument display. The axes, the scale units per division, and the limit shall be clearly labeled in the test report. Tabular data are not suitable for reporting band-edge emissions.

##### 6.10.4 Authorized-band band-edge measurements (relative method)

These procedures are applicable for determining compliance at authorized-band band-edges where the requirements are expressed as a value relative to the in-band signal level.

For devices that support frequency hopping, this test sequence shall be performed twice: once with the hopping function turned OFF and then repeated with the hopping function turned ON.

- a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).
- b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).
- c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normal mode of operation”.
- d) Blank
- e) Perform the test as follows:
  - 1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.



15.247 (d) Band-edge RF Conducted (*continued*)

- 2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than  $[10 \log (\text{OBW/RBW})]$  below the reference level. Specific guidance is given in 4.1.5.2.
  - 3) Attenuation: Auto (at least 10 dB preferred).
  - 4) Sweep time: Coupled.
  - 5) Resolution bandwidth: 100 kHz
  - 6) Video bandwidth: 300 kHz
  - 7) Detector: Peak.
  - 8) Trace: Max hold.
- f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can take several minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot.
- g) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- h) Repeat step c) through step e) for every applicable modulation.
- i) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).
- j) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Requirement: FCC Part 15.247 Clause (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

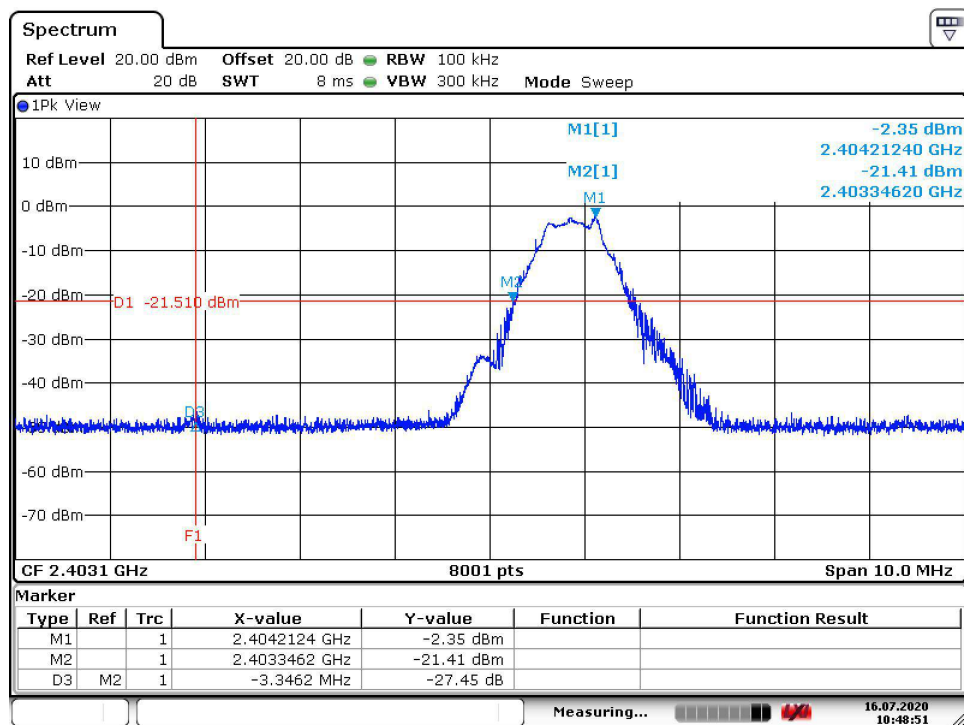
Requirement: Band-Edge Compliance (DTS)

Tech: CL Payne

Low Channel: 2404 MHz

Data Rate: 1Mb/s

Result: Pass



Date: 16.JUL.2020 10:48:51

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

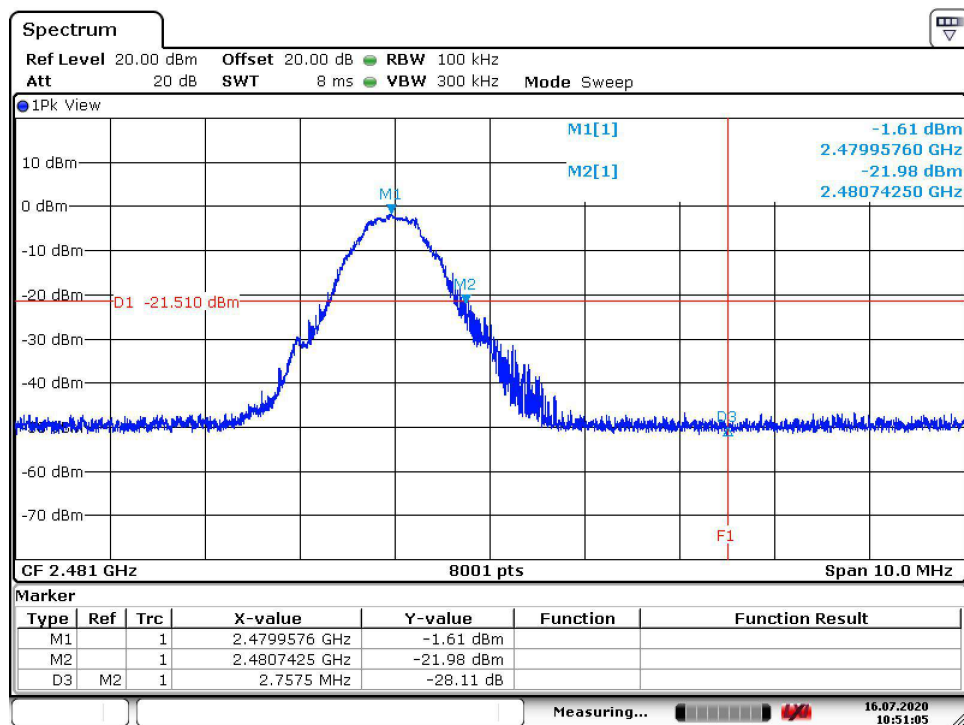
Requirement: Band-Edge Compliance (DTS)

Tech: CL Payne

High Channel: 2480 Mhz

Data Rate: 1Mb/s

Result: Pass



Date: 16.JUL.2020 10:51:05

## DTS bandwidth measurement procedure

- a) Set RBW = 100 kHz
- b) Set the VBW  $\geq [ 3 \times \text{RBW} ]$ 
  - \* per ANSI C63.10-2013 clause 6.9.2      Set the span to 2 to 5 times the OBW
- c) Detector = peak
- d) Trace mode = max hold
- e) Sweep = auto couple
- f) Allow trace to stabilize
- g) 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 6dB relative to the maximum level measured in the fundamental emission.
- h) Submit this plot(s).

Requirement: FCC Part 15.247 Clause (a,2)

The 6 dB DTS bandwidth shall be greater than 500 kHz.

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: 6dB Bandwidth greater than 500kHz

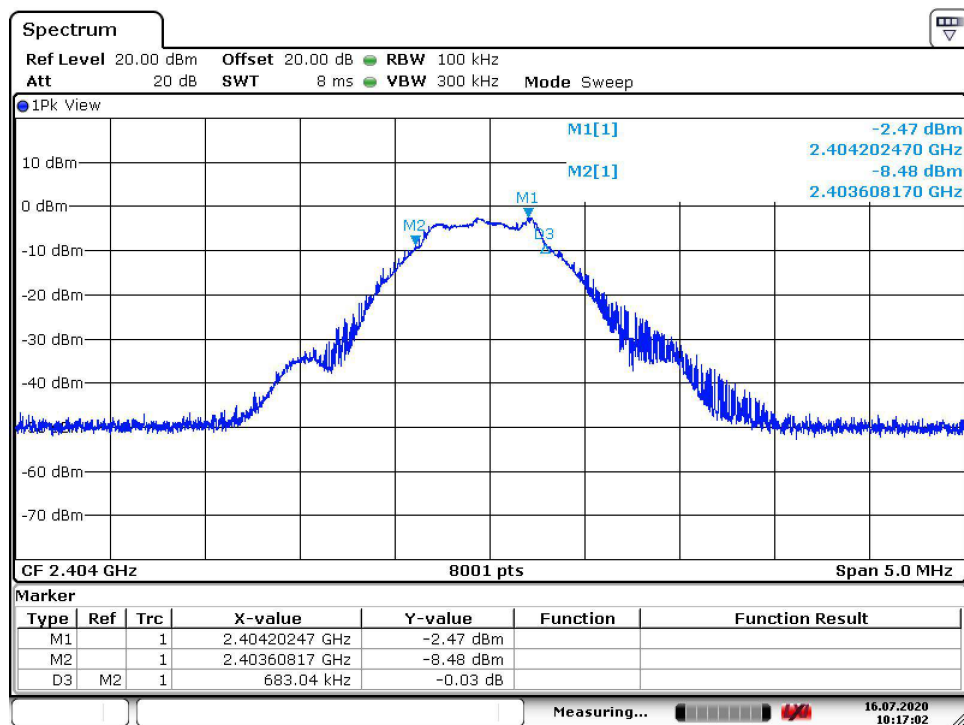
Tech: CL Payne

Data Rate: 1 Mb/s

Low Channel: 2404

6dB Bandwidth = 683.04 kHz

Result: Pass



Date: 16.JUL.2020 10:17:02

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: 6dB Bandwidth greater than 500kHz

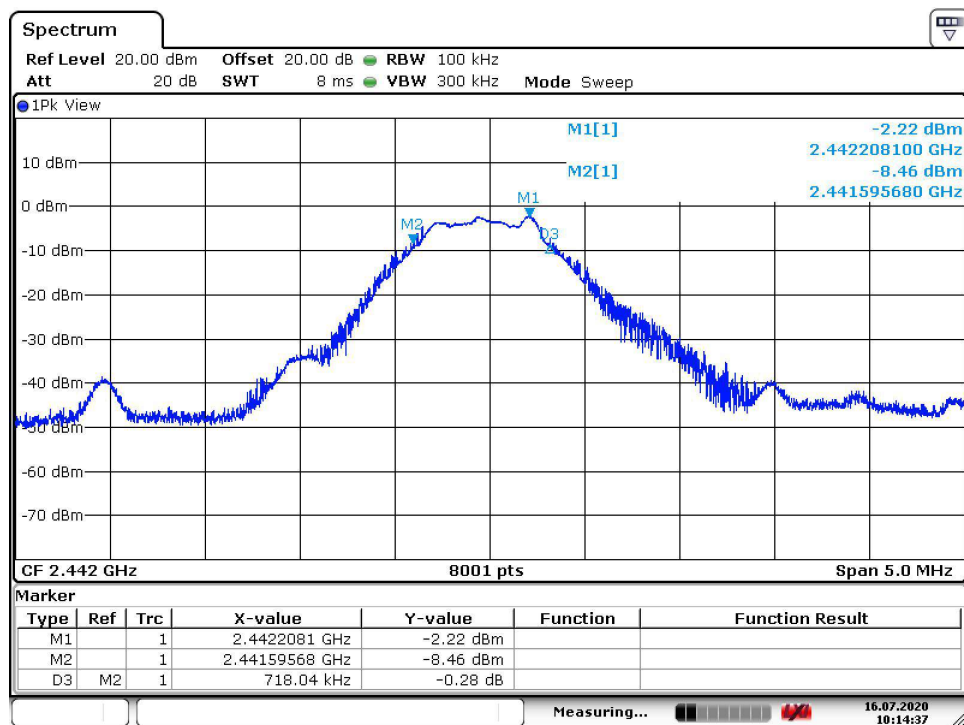
Tech: CL Payne

Data Rate: 1 Mb/s

Mid Channel: 2442

6dB Bandwidth = 718.04 kHz

Result: Pass



Date: 16.JUL.2020 10:14:37

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: 6dB Bandwidth greater than 500kHz

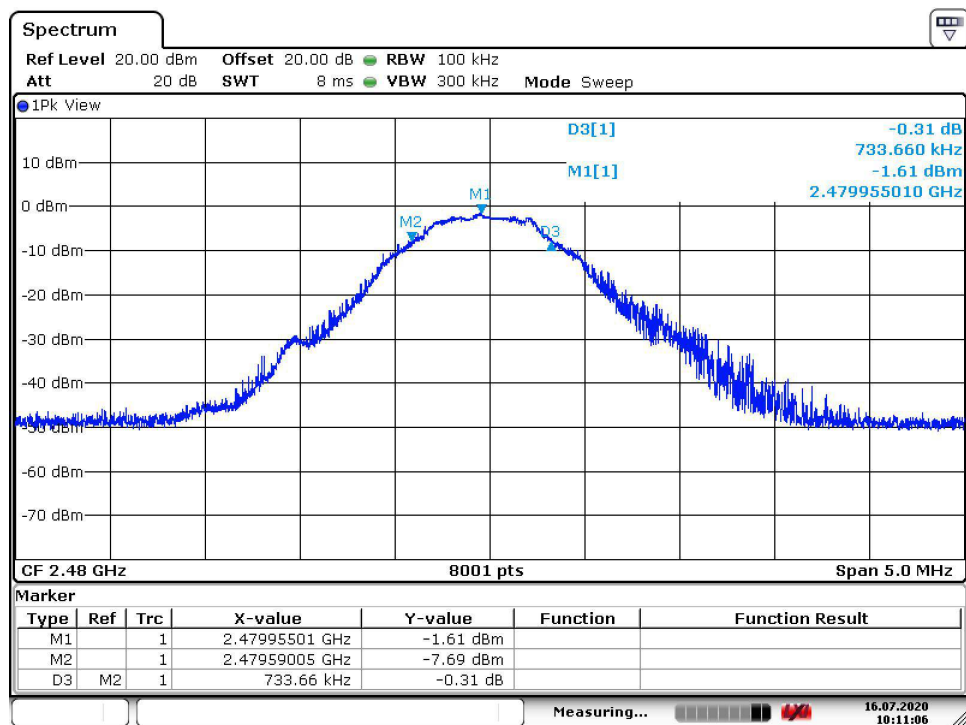
Tech: CL Payne

Data Rate: 1 Mb/s

High Channel: 2480

6dB Bandwidth = 733.66 kHz

Result: Pass



Date: 16.JUL.2020 10:11:07

**Occupied bandwidth—power bandwidth (99%) measurement procedure**

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

- a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than  $[10 \log (\text{OBW}/\text{RBW})]$  below the reference level. Specific guidance is given in 4.1.5.2.
- d) Step a) through step c) might require iteration to adjust within the specified range.
- e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).



Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

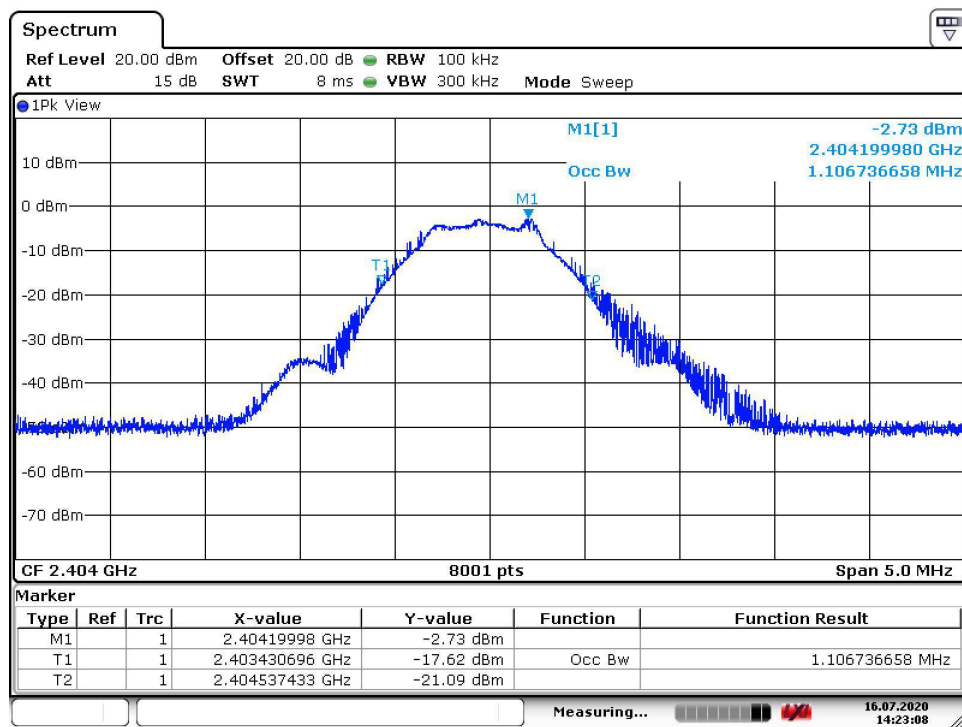
Requirement: 99% Occupied Bandwidth

Tech: CL Payne

Data Rate: 1 Mb/s

Low Channel: 2404

99% Occupied Bandwidth = 1.106736658 MHz



Date: 16.JUL.2020 14:23:09

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

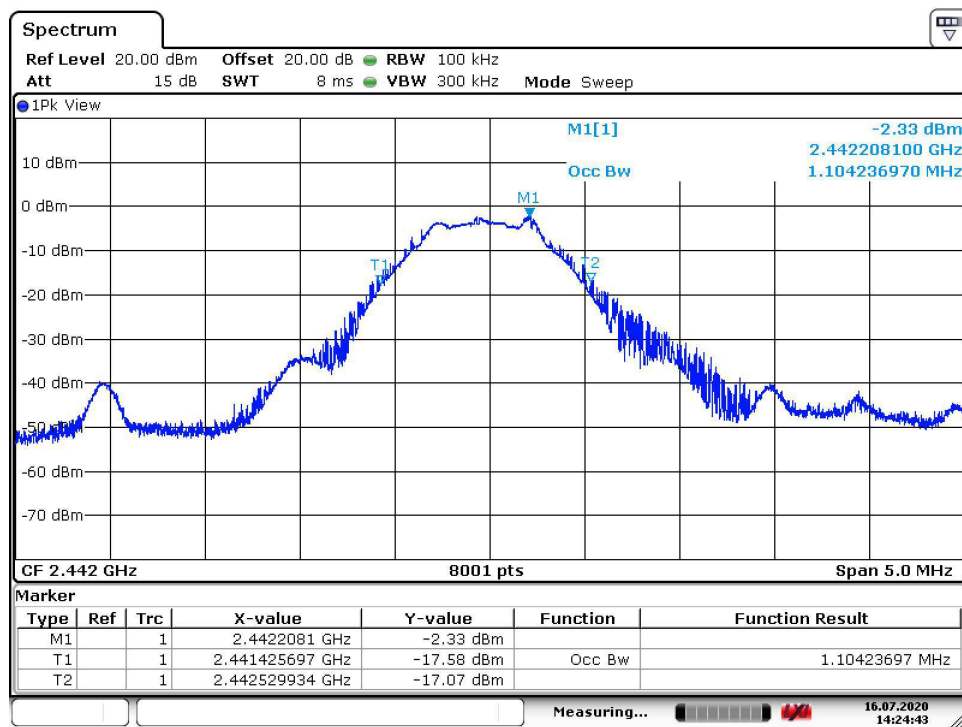
Requirement: 99% Occupied Bandwidth

Tech: CL Payne

Data Rate: 1 Mb/s

Mid Channel: 2442

99% Occupied Bandwidth = 1.104236970 MHz



Date: 16.JUL.2020 14:24:44

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

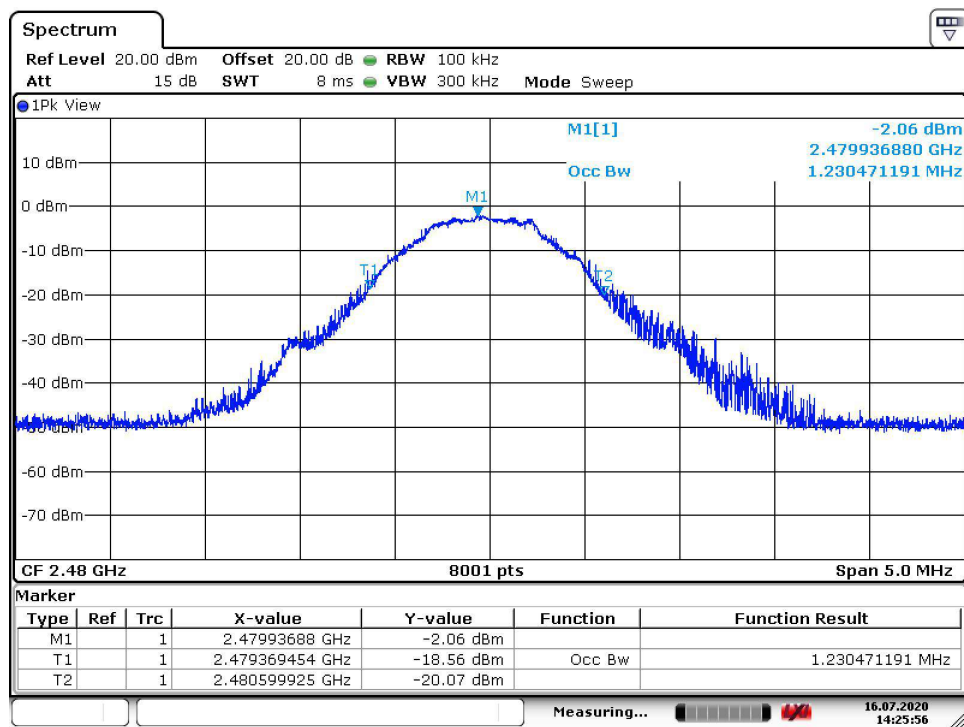
Requirement: 99% Occupied Bandwidth

Tech: CL Payne

Data Rate: 1 Mb/s

High Channel: 2480

99% Occupied Bandwidth = 1.230471191 MHz



Date: 16.JUL.2020 14:25:56

Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers.

Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

Requirement: FCC Part 15.247 Clause (d)

- (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

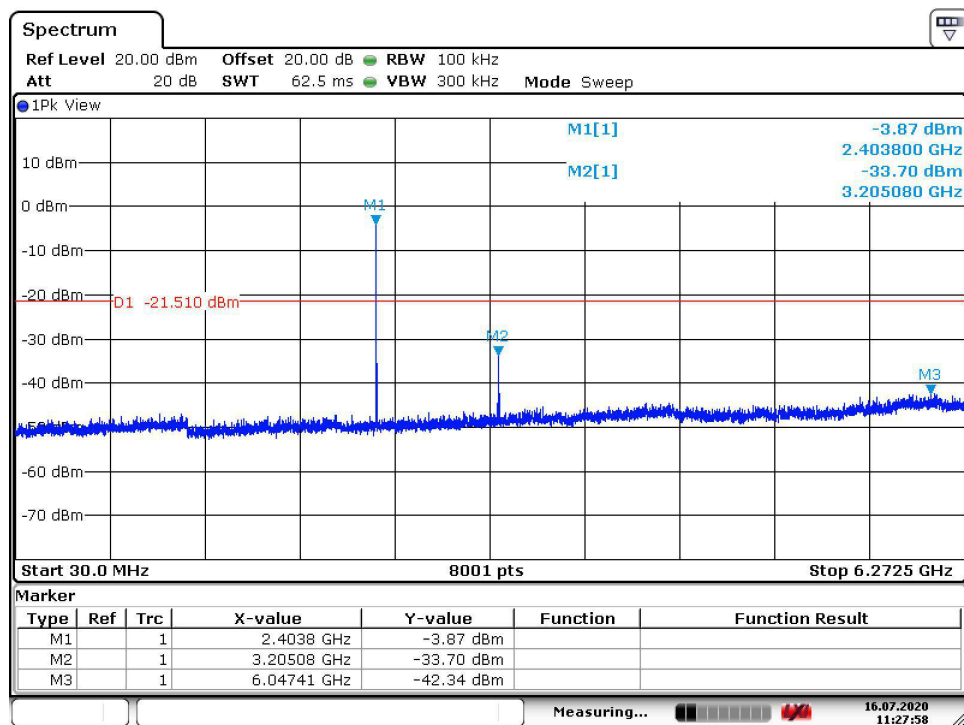
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

Low Channel: 2404 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 11:27:59

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

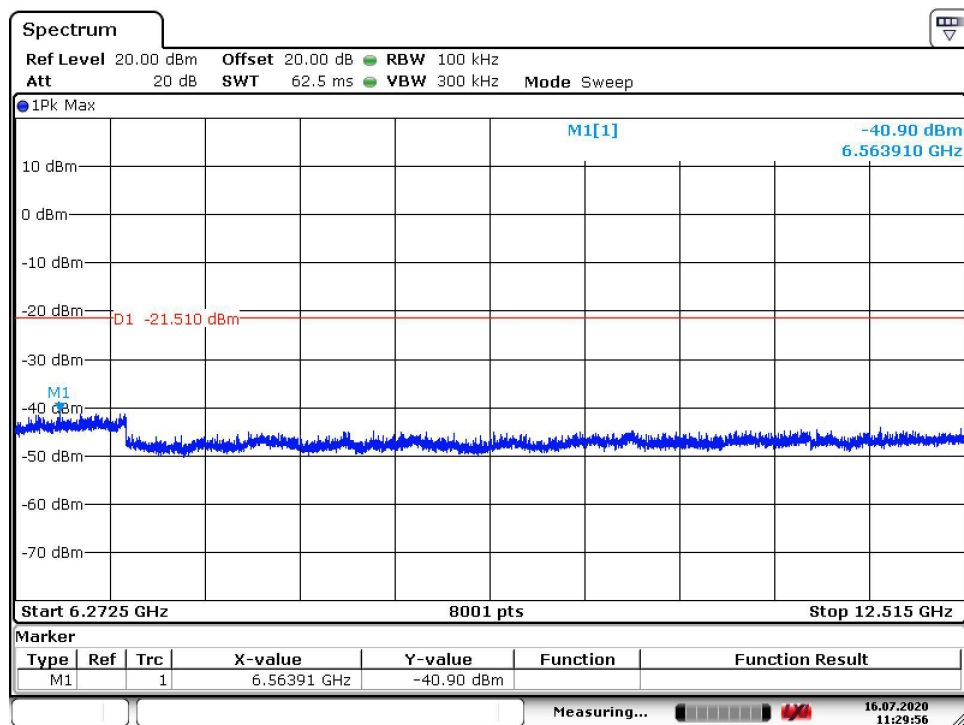
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

Low Channel: 2404 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 11:29:57

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

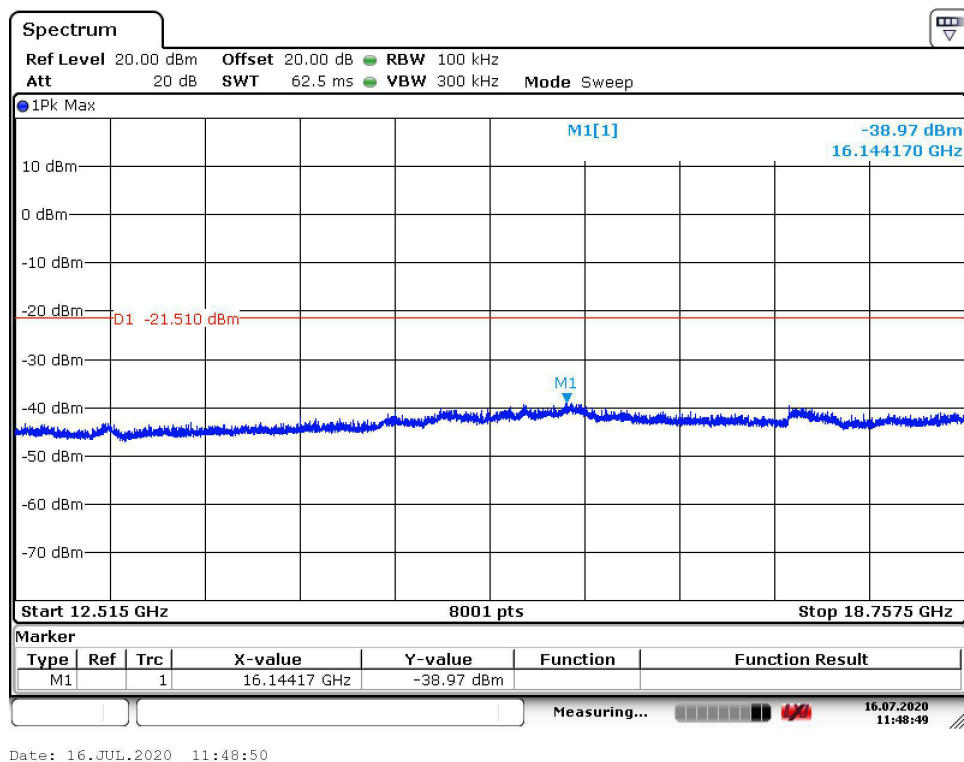
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

Low Channel: 2404 MHz

Requirement = -21.51 dBm

Result: Pass



Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

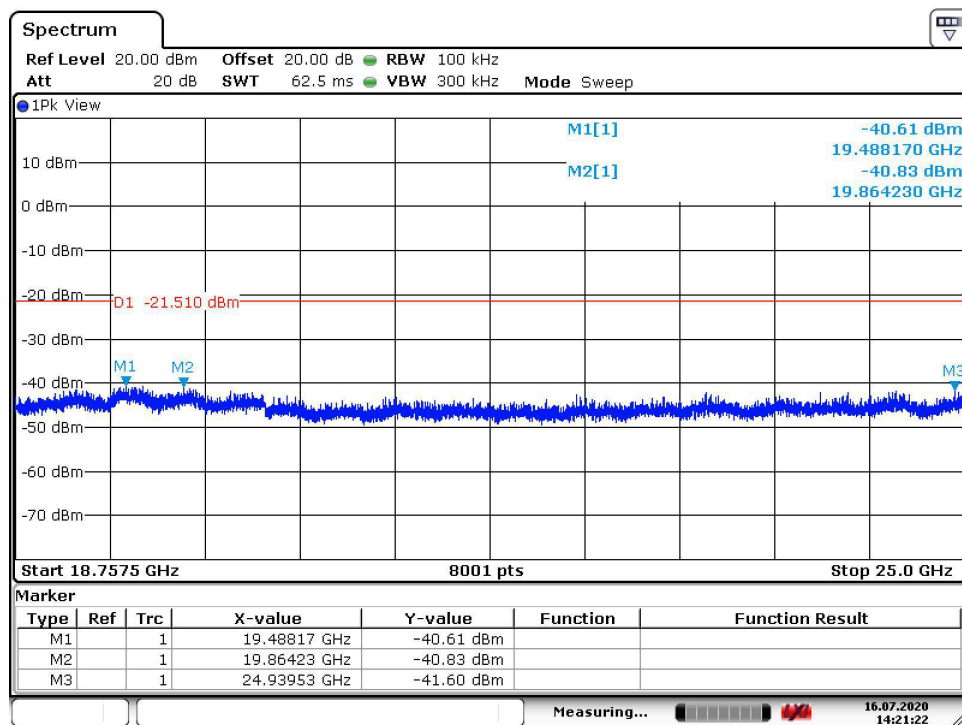
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

Low Channel: 2404 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 14:21:22



Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

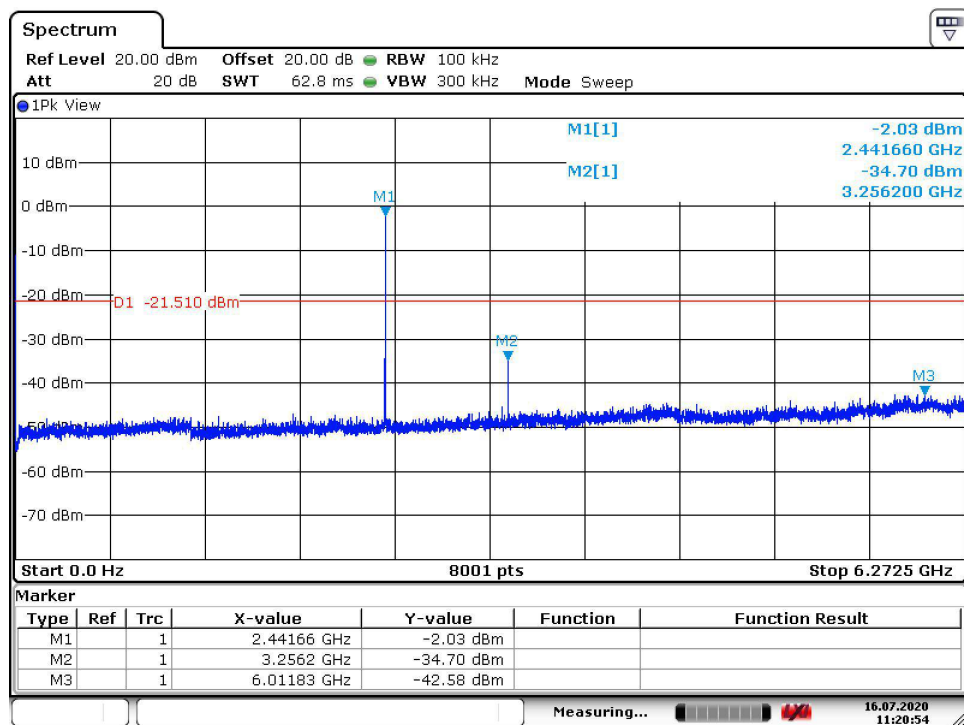
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

Mid Channel: 2442 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 11:20:54

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

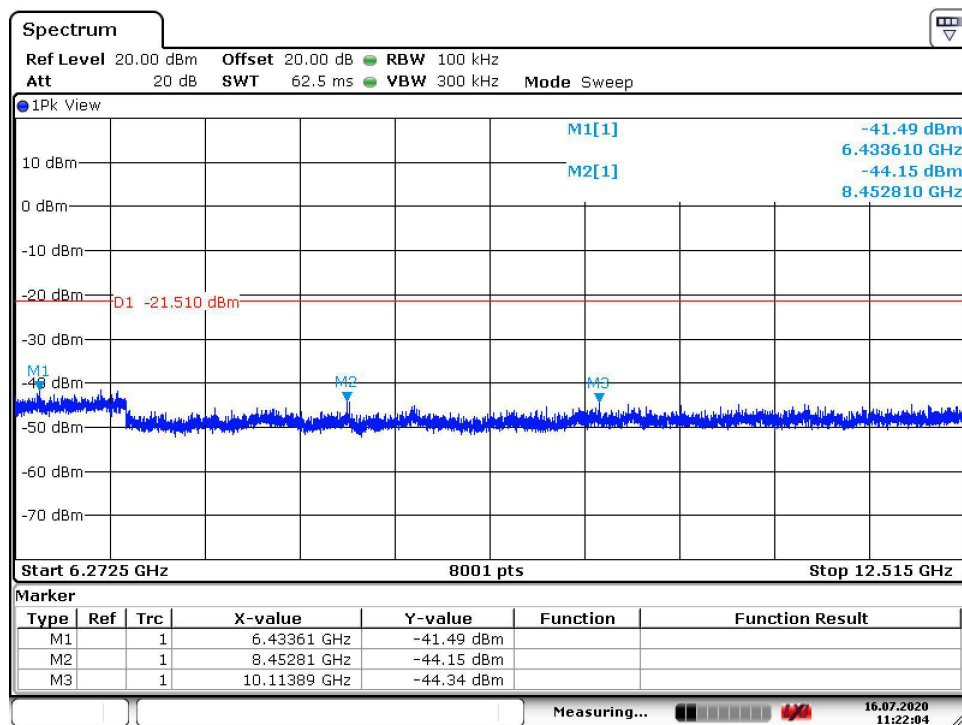
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

Mid Channel: 2442 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 11:22:04

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

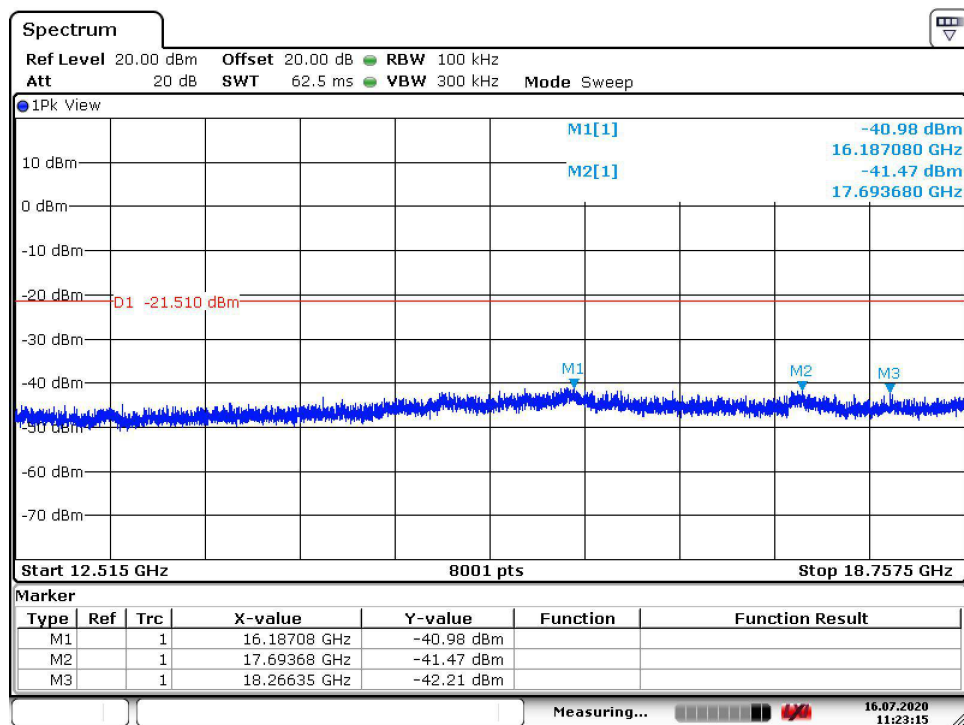
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

Mid Channel: 2442 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 11:23:16

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

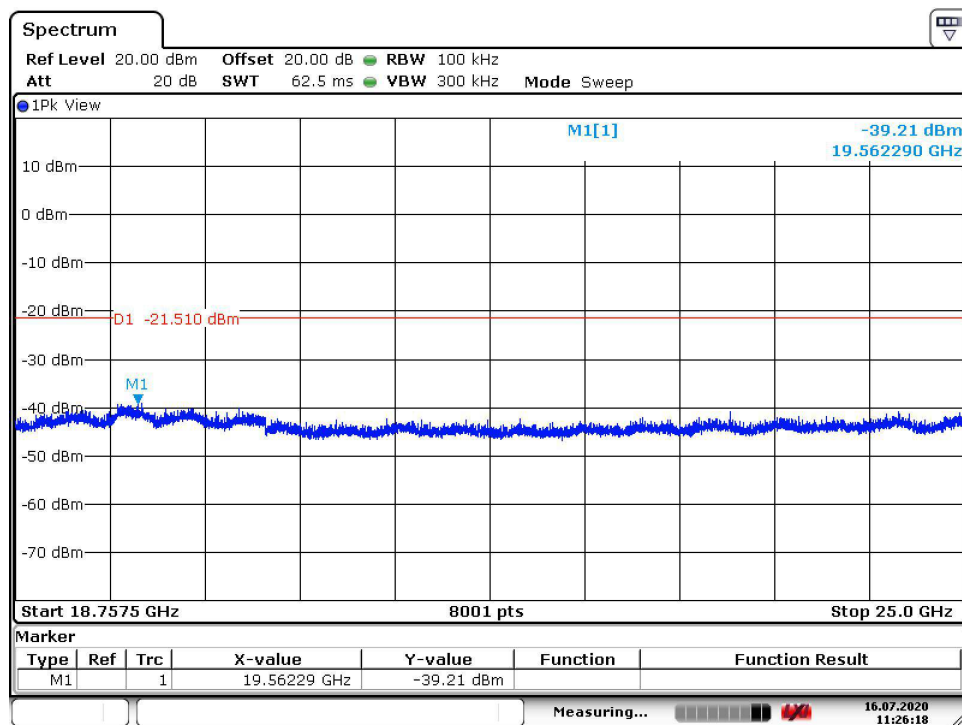
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

Mid Channel: 2442 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 11:26:19

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

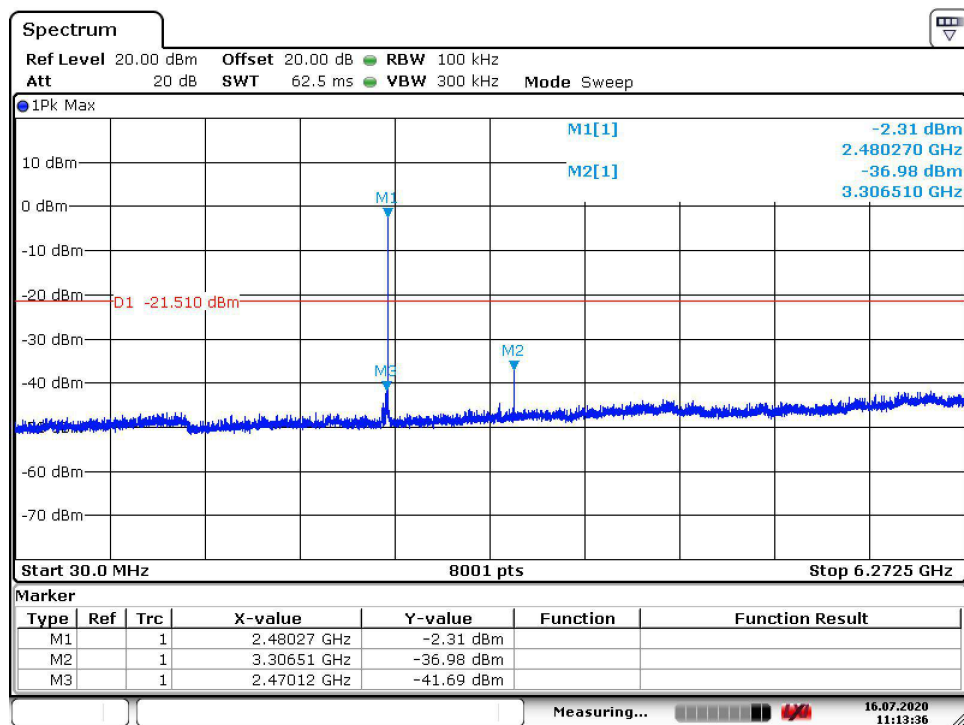
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

High Channel: 2480 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 11:13:37

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

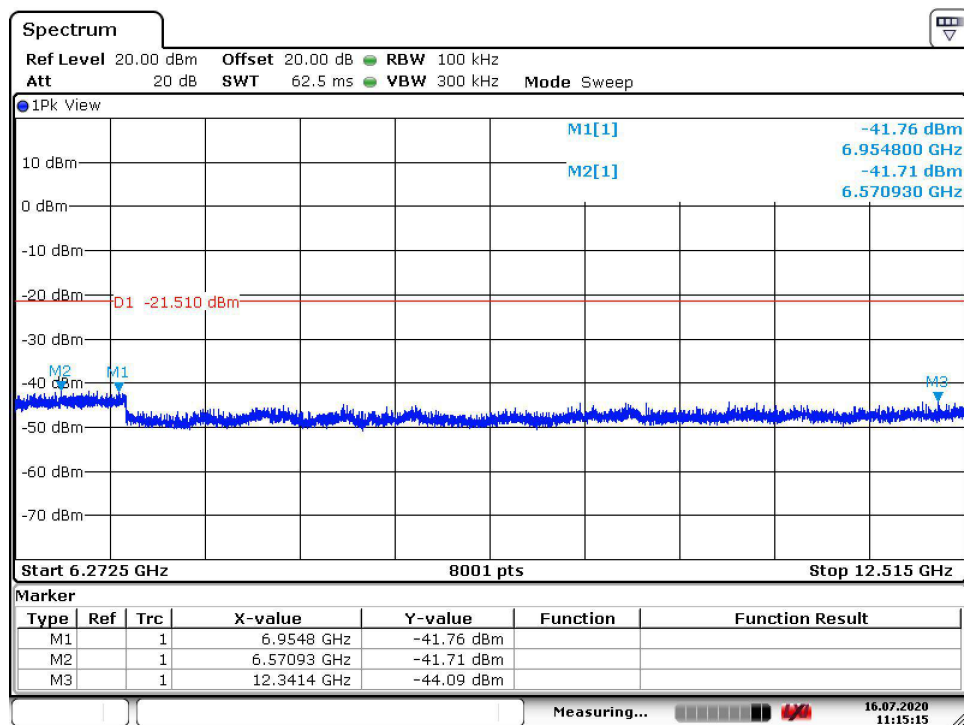
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

High Channel: 2480 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 11:15:15

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

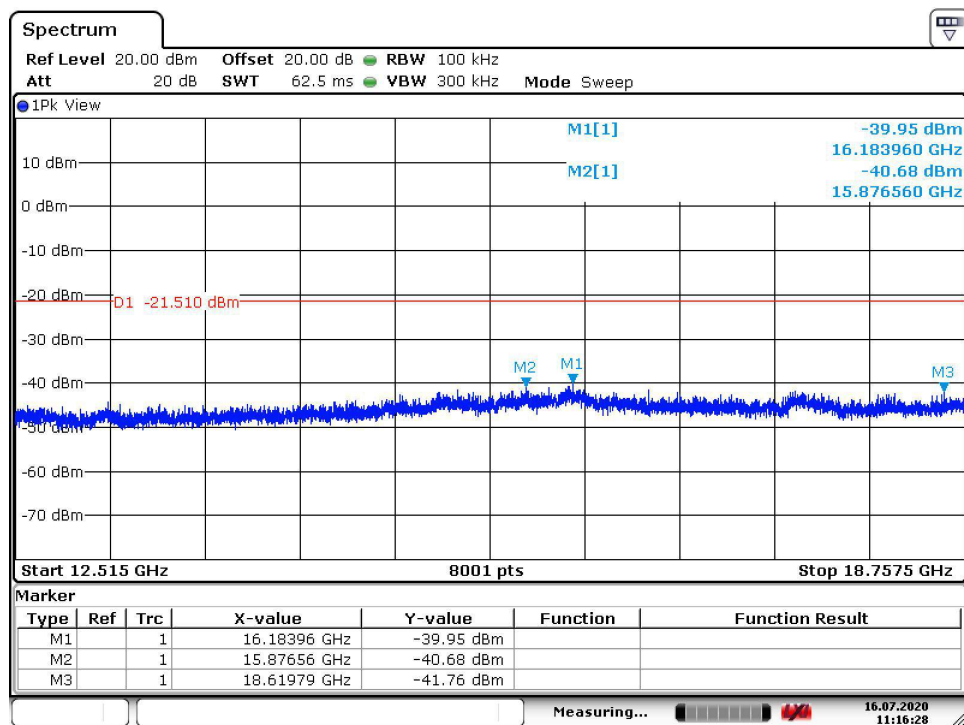
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

High Channel: 2480 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 11:16:28

Client: IOSix LLC

Date: 16 Jul 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: Conducted spurious emission <20dB of peak

Tech: CL Payne

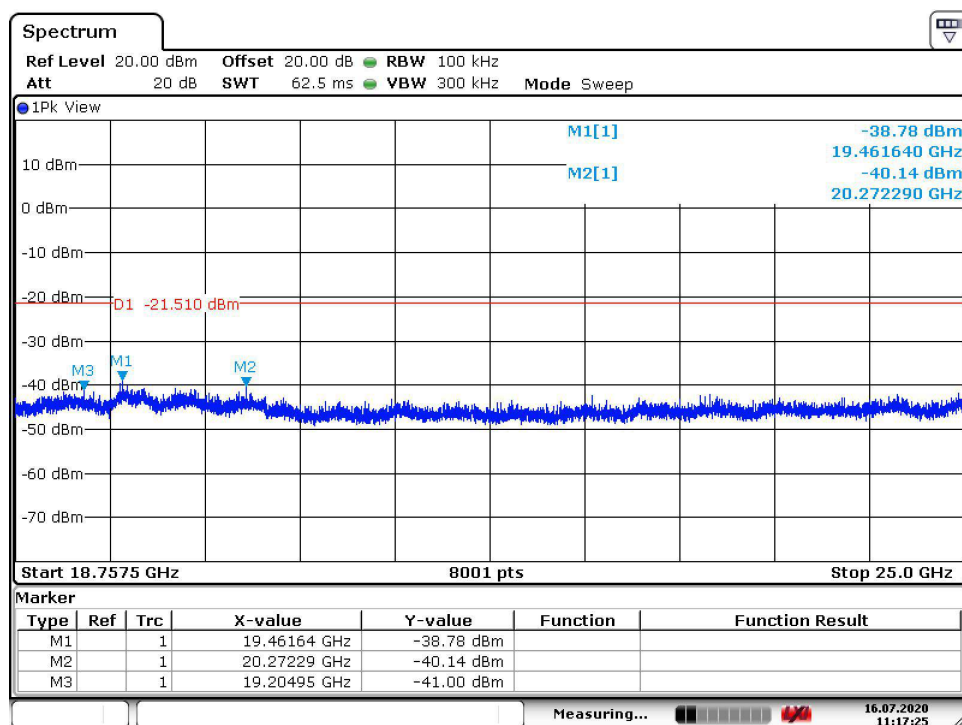
Data Rate: 1Mb/s

Maximum Reading = -1.51 dBm

High Channel: 2480 MHz

Requirement = -21.51 dBm

Result: Pass



Date: 16.JUL.2020 11:17:25



An additional consideration when performing conducted measurements of restricted-band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than from the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements, the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in 6.3, 6.5, and 6.6. All detected emissions shall comply with the applicable requirements.

This test is required for any spurious emission or modulation product that falls in an Unrestricted Band, as defined in Section 15.209. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

Span	=	wide enough to fully capture the emission being measured
RBW	=	1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz
VBW	=	RBW
Sweep	=	auto
Detector function	=	peak
Trace	=	max hold

Follow the guidelines in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

Now repeat the measurement using the average detector of the spectrum analyzer. Submit this data.

Note 1: Limit listed is the general limit as specified in 15.209 in order to show compliance with the restricted bands of operation as well as the out of band limit in 15.247. No other identifiable signals were observed in the restricted bands as specified in 15.205.

Note 2: Highest frequency investigated was the tenth harmonic of the fundamental, no radiated emissions were detected above the 3rd harmonic.

Note 3: The worst case emissions are recorded within this test report.

Requirement: FCC Part 15.247 Clause (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

15.247 (d)                      Restricted Bands                      ANSI C63.10-2013 Clause 11.12.2

11.12                      Emissions in restricted frequency bands

11.12.1                      Radiated emission measurements

Because the typical emission requirements are specified in terms of radiated field strength levels, measurements performed to determine compliance have traditionally relied on a radiated test configuration. Radiated measurements remain the principal method for determining compliance to the specified requirements; however antenna-port conducted measurements are also now acceptable to determine compliance (see 11.12.2 for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in 6.3, 6.5, and 6.6 shall be followed.

Requirement: FCC Part 15.247 Clause (d)

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Note 4: Limit listed is the general limit as specified in 15.209 in order to show compliance with the restricted bands of operation as well as the out of band limit in 15.247. No other identifiable signals were observed in the restricted bands as specified in 15.205.

Client: IOSix LLC

Date: 14 Aug 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: General limit of 15.209

Tech: B Williams

Low Channel: 2404

Result: Pass

RADIATED SPURIOUS and RESTRICTED FREQUENCY BANDS										
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type	Antenna Polarity	Pass Fail
4808.000	39.2	25.7	5.9	33.1	52.58	74.0	-21.42	PK	Vert	Pass
4808.000	31.4	25.7	5.9	33.1	44.80	54.0	-9.20	AVE	Vert	Pass
7212.000	32.9	25.6	7.2	37.0	51.52	74.0	-22.48	PK	Vert	Pass
7212.000	19.9	25.6	7.2	37.0	38.54	54.0	-15.46	AVE	Vert	Pass
9616.000	33.2	24.6	9.1	37.9	55.67	74.0	-18.33	PK	Vert	Pass
9616.000	20.1	24.6	9.1	37.9	42.58	54.0	-11.42	AVE	Vert	Pass
4808.000	38.0	25.7	5.9	33.1	51.35	74.0	-22.65	PK	Horz	Pass
4808.000	29.3	25.7	5.9	33.1	42.65	54.0	-11.35	AVE	Horz	Pass
7212.000	33.3	25.6	7.2	37.0	51.95	74.0	-22.05	PK	Horz	Pass
7212.000	27.0	25.6	7.2	37.0	45.59	54.0	-8.41	AVE	Horz	Pass
9616.000	33.7	24.6	9.1	37.9	56.19	74.0	-17.81	PK	Horz	Pass
9616.000	20.1	24.6	9.1	37.9	42.59	54.0	-11.41	AVE	Horz	Pass

Client: IOSix LLC

Date: 14 Aug 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: General limit of 15.209

Tech: B Williams

Mid Channel: 2442

Result: Pass

RADIATED SPURIOUS and RESTRICTED FREQUENCY BANDS										
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type	Antenna Polarity	Pass Fail
4884.000	38.1	25.6	6.0	33.4	51.79	74.0	-22.21	PK	Vert	Pass
4884.000	20.9	25.6	6.0	33.4	34.62	54.0	-19.38	AVE	Vert	Pass
7326.000	33.2	25.6	7.2	37.0	51.88	74.0	-22.12	PK	Vert	Pass
7326.000	19.5	25.6	7.2	37.0	38.20	54.0	-15.80	AVE	Vert	Pass
9768.000	32.9	24.7	9.1	37.9	55.25	74.0	-18.75	PK	Vert	Pass
9768.000	20.2	24.7	9.1	37.9	42.62	54.0	-11.38	AVE	Vert	Pass
4884.000	41.2	25.6	6.0	33.4	54.91	74.0	-19.09	PK	Horz	Pass
4884.000	28.0	25.6	6.0	33.4	41.71	54.0	-12.29	AVE	Horz	Pass
7326.000	32.9	25.6	7.2	37.0	51.58	74.0	-22.42	PK	Horz	Pass
7326.000	19.6	25.6	7.2	37.0	38.30	54.0	-15.70	AVE	Horz	Pass
9768.000	33.6	24.6	9.2	38.0	56.16	74.0	-17.84	PK	Horz	Pass
9768.000	20.0	24.6	9.2	38.0	42.54	54.0	-11.46	AVE	Horz	Pass

Client: IOSix LLC

Date: 14 Aug 2020

DNB Job: 06125

EUT: IOSiX OBDv5 Vehicle Data Logger

Model No: IO-2050

Requirement: General limit of 15.209

Tech: B Williams

High Channel: 2480

Result: Pass

RADIATED SPURIOUS and RESTRICTED FREQUENCY BANDS										
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type	Antenna Polarity	Pass Fail
4960.000	35.6	25.6	6.0	33.4	49.25	74.0	-24.75	PK	Vert	Pass
4960.000	21.2	25.6	6.0	33.4	34.83	54.0	-19.17	AVE	Vert	Pass
7440.000	33.1	25.5	7.3	37.0	51.84	74.0	-22.16	PK	Vert	Pass
7440.000	19.5	25.5	7.3	37.0	38.29	54.0	-15.71	AVE	Vert	Pass
9920.000	33.0	24.6	9.2	38.0	55.58	74.0	-18.42	PK	Vert	Pass
9920.000	19.5	24.6	9.2	38.0	42.10	54.0	-11.90	AVE	Vert	Pass
4960.000	41.7	25.6	6.0	33.4	55.37	74.0	-18.63	PK	Horz	Pass
4960.000	28.3	25.6	6.0	33.4	41.97	54.0	-12.03	AVE	Horz	Pass
7440.000	32.9	25.5	7.3	37.0	51.64	74.0	-22.36	PK	Horz	Pass
7440.000	19.5	25.5	7.3	37.0	38.32	54.0	-15.68	AVE	Horz	Pass
9920.000	35.3	24.4	9.3	38.1	58.23	74.0	-15.77	PK	Horz	Pass
9920.000	20.5	24.4	9.3	38.1	43.47	54.0	-10.53	AVE	Horz	Pass

End of Report UT06125A-005