ELECTROMAGNETIC COMPATIBILITY

TEST REPORT

Report Reference Number:	E11308-2302_ Textron_ TruPin(FCC)_**Rev 1.0**
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EMC Test Laboratory:	**QAI Laboratories Ltd.**
Address:	3980 North Fraser Way, Burnaby, BC, V5J 5K5 Canada
Phone:	(604) 527-8378
Fax:	(604) 527-8368

Laboratory Accreditations (per ISO/IEC 17025:2017)

ACCREDITED
CERT #3657.02

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Manufacturer:	**Textron Specialized Vehicles**
Address:	1451 Marvin Griffin Road Augusta GA, 30906, USA
Equipment Tested:	**TruPin**
Model/Part Number(s):	10045552

REVISION HISTORY

Date	Report Number	Details	Author's Initials
July 26, 2023	E11308-2302_ Textron_ TruPin(FCC)_**Rev 0.0**	Draft	SS
July 28, 2023	E11308-2302_ Textron_ TruPin(FCC)_**Rev 0.1**	Draft	SS
July 28, 2023	E11308-2302_ Textron_ TruPin(FCC)_**Rev 1.0**	Final	SS
All previous versions of this report have been superseded by the latest dated revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.			

REPORT AUTHORIZATION

The data documented in this report is for the test equipment provided by the manufacturer. The tests were conducted on the sample equipment as requested by the manufacturer for the purpose of demonstrating compliance with the standards outlined in Section II of this report as agreed upon by the Manufacturer under the quote 23RH02221R1.

The Manufacturer is responsible for the tested product configurations, continued product compliance, and for the appropriate auditing of subsequent products as required. This report may comprise a partial list of tests that are required for FCC, ISED, and CE. Declaration of Conformity can only be produced by the manufacturer. This is to certify that the following report is true and correct to the best of our knowledge.

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Testing Performed by
Sandeep Singh
EMC Test Technologist

Report Reviewed by
Faizan Ahmed
EMC/RF Engineering Manager

Report Prepared by
Surya Somarajan
EMC Test Technologist

QAI FACILITIES

British Columbia

QAI Laboratories Inc.
Main Laboratory/Headquarters
3980 North Fraser Way,
Burnaby, BC V5J Canada

Ontario

QAI Laboratories Inc.
25 Royal Group Crescent #3,
Vaughan,
ON L4H 1X9 Canada

Virginia

QAI Laboratories Ltd.
1047 Zachary Taylor Hwy,
Suite A Huntly,
VA 22640 USA

China

QAI Laboratories Ltd
Room 408, No. 228, Jiangchang
3rd Road Jing'An District,
Shanghai, China 200436

California

QAI Laboratories Ltd.
8385 White Oak Avenue Rancho
Cucamonga, CA 91730 USA

Oklahoma

QAI Laboratories Ltd.
5110 North Mingo Road
Tulsa, OK 74117, USA

Miami

QAI Laboratories Ltd.
8148 NW 74th Ave,
Medley, FL 33166 USA

South Korea

QAI Laboratories Ltd
#502, 8, Sanbon-ro 324beon-gil
Gunpo-si, Gyeonggi-do, 15829,
South Korea

QAI EMC ACCREDITATION

QAI EMC is your one-stop regulatory compliance partner for electromagnetic compatibility (EMC) and electromagnetic interference (EMI). Products are tested to the latest and applicable EMC/EMI requirements for domestic and international markets. QAI EMC goes above and beyond being a testing facility—we are your regulatory compliance partner. QAI EMC has the capability to perform RF Emissions and Immunity for all types of electronics manufacturing including Industrial, Scientific, Medical, Information Technology, Telecom, Wireless, Automotive, Marine and Avionics.

EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
Burnaby, BC, Canada	CA9543	9543A	3657.02

EMC Facility Burnaby BC, Canada

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SECTION I: GENERAL INFORMATION

1.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as a complete system.

Equipment Under Test (EUT) Information

EUT System	Description	Manufacturer	Model No.	Serial No.
TruPin	The TruPin is a device designed to mark hole locations on a golf course which gets sent to the Pace Technology server and ultimately displayed on screens inside the golf cart to provide an accurate cart to hole distance.	Textron Specialized Vehicles	10045552	--
Note: Highest frequency generated or tuned upon within the EUT is 2483 MHz Radio Module used in EUT. **WiFi/BT** FCC ID: 2AC7Z-ESP32S2WROOM IC ID: 21098 ESPS2WROOM **BMD-300 (BT)** FCC ID: RI7ME310G1WW IC ID: 5131A-ME310G1WW				

EUT Test Mode/Configuration/Operation During Testing

Test Mode	EUT Test Configuration/Operation	Worst Case
1	Charging mode	Mode 1
2	Battery mode	

EUT Cabling Configuration

Port	Description	Shielded	Ferrites	Length
USB Cable	CABLE A PLUG TO C PLUG 4.92'	Yes	No	1.5 m

Ancillary Equipment Information

Item/Description	Manufacturer	Product No.	Serial No.
USB Adapter (AC/DC WALL MOUNT ADAPTER 5V 10W)	Phihong USA	AQ10A-050BP-H	--

Monitoring the EUT

As per client's instructions and procedures

1.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	Indoors
Temperature	22.4ºC
Relative Humidity	47.9 %
Atmospheric Pressure	102.1 kPa

1.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 10kHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 dB
Conducted Emissions, 10kHz. to 40GHz.	± 2.82 dB
Radio Frequency	±1.5 x 10-5 MHz
Total RF Power Conducted	±1.36 dB
Spurious Emissions, Conducted	±1.36 dB
RF Power Density, Conducted	±1.36 dB
Temperature	±1ºC
Humidity	±5 %
DC and low frequency voltages	±3 %

1.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing. The final radiated emissions were performed in the worst-case orientation.

1.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohde & Schwarz. Transducer factors like Antenna factors, Cable Losses and Amplifier gains were stored in the test templates which are used to perform the emissions measurements. After test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	Q-Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Ant. Ht. (cm)	Pol	Turntable Position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.663900	33.0	1000.000	120.000	100.0	H	70.0	13.2	7.5	40.5

Quasi-Peak reading shown in the table above is already corrected by the software using correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

Or

Corr.(dB) = Antenna factor + Cable Loss - Amp gain (if pre-amplifier was used)

The final Quasi peak reading shown in the data is calculated by the software using following equation:

Corrected Quasi-Peak (dBµV/m) = Raw Quasi-Peak Reading + Antenna factor + Cable loss

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency (MHz)	Quasi Peak (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150	44.3	66.0	21.7	1000.000	9.000	L1	GND	0.6

Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150	27.2	56.0	28.8	1000.000	9.000	L1	GND	0.6

Quasi Peak or Average reading shown in above table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

The final Quasi-peak or Average reading shown in the data is calculated by the software using following equation:

Corr. Quasi-Peak/Average Reading (dBµV) = Raw Quasi-Peak/Average Reading + Antenna factor + Cable loss

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

Margin(dB) = Limit – Quasi-Peak or Average reading

1.6 Test Equipment List

The tables below contain all the equipment used by 'QAI Laboratories' in conducting all tests on the Equipment Under Test (EUT) as per Section I.

Emissions Test Equipment

Sl. NO.	Manufacturer	Model	Description	Serial No.	S/W Version	Calibration Due Date
1	Com-Power Corporation	LI-220C	Line Impedance Stabilization Network (9kHz-30MHz)	20070025	N/A	2026-Jan-23
2	ETS Lindgren	2165	Turntable	00043677	N/A	N/A
3	Sunol Sciences	SM46C	Turntable	071705-2	N/A	N/A
4	Maturo GmbH	BAM 4.0-P	Boresight Antenna Mast	364	3382.01	N/A
5	Maturo GmbH	BAM 4.0-P	Boresight Antenna Mast	365	3382.01	N/A
6	ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A	N/A
7	Hewlett Packard	8449B	Preamplifier (1-26 GHz)	3008A00982	N/A	2025-Feb-15
8	Rohde & Schwarz	ESW44	EMI Receiver	101604	EMC32 v10.35.10/ FV 4.73 SP5	2025-Jul-20
9	ETS-Lindgren	3117	Horn, Double-Ridge Guide Ant, 1.0 - 18 GHz	75944	N/A	2026-Jan-25
10	Sunol Sciences	JB1	Biconilog Antenna 30MHz – 2GHz	A070209	N/A	2026-Jan-04
11	California Instruments	PACS-1	Power Supply	72596	N/A	2025-Dec-15
12	California Instruments	OMNI 1-18i	CDN	7127	N/A	2025-Dec-15
13	California Instruments	3001i	Power Analyzer/ Display/ Control	52117	CTS3.0 v3.2.0.35	2025-Dec-15
14	TESEQ	ISN T800	Impedance Stabilization Network (150kHz – 30MHz)	27133	N/A	2026-Feb-08

Note: Equipment listed above have 3 years calibration interval.

Measurement Software List

Sl. No.	Manufacturer	Model	Version	Description
1	Rohde & Schwarz	EMC 32	10.35.10	Emissions Test Software

SECTION II: EXECUTIVE SUMMARY OF STANDARDS AND LIMITS

2.1 Applicable Emission Standards

ISED &FCC −Emissions

Test or Measurement	Applicable Standards	Description	Result
Radiated Emissions	ICES-003 Issue 7 CFR Title 47 FCC Part 15 ICES-Gen Issue 1	The radiated emissions are measured in the **30-18000MHz** range or up to the highest EUT frequency required by the standard.	Comply
Conducted Emissions		The Conducted Emissions are measured on the phase and Neutral Power lines in the **0.15 - 30.0 MHz** range.	Comply

Method of Measurement:

For the radiated emissions, the Equipment under test (EUT) is positioned in the center of the turntable in the SAC. The Equipment under test (EUT) is then measured for all the radiated emissions using the spectrum analyzer and receiver using the appropriate antennas, amplifiers, attenuators, and filters.

The required Quasi-Peak CISPR bandwidth shall be 120 kHz for the range 30 – 1000 MHz. A 1 MHz Resolution Bandwidth (RBW, CISPR Band E) shall be used and a 10 Hz Video Bandwidth (VBW). The ANSI C63.4 requirement for the placement of RF Absorber on the turntable Ground Plane shall be satisfied.

Emissions in both horizontal and vertical polarizations were measured while rotating the Equipment Under Test (EUT) on the turntable to maximize signal strength and the limit is adjusted as per the equation below. The result is added or subtracted to the required emission level to ensure compliance at the new distance.

$20 \log\left(\frac{D1}{D2}\right)$; Where D1 = Current Distance
D2 = Required Distance

2.2 Applicable Radiated Emission Limits

CFR Title 47 FCC Part 15- Class A

Frequency (MHz)	Field Strength Quasi Peak − Class A		Result
	(dBµV/m @ 3m SAC)	(dBµV/m @ 10m OATS)	
30 – 88	49.5	39.1	Comply up to 18GHz
88 – 216	53.9	43.5	
216 – 960	56.9	46.4	
Above 960	59.9	49.5	
Note 1: The lower limit shall apply at the transition frequency. **Note 2**: Additional provisions may be required for cases where interference occurs.			

ICES-003 Issue 7 − Class A

Frequency (MHz)	Field Strength Quasi Peak − Class A		Result
	(dBµV/m @ 3m SAC)	(dBµV/m @ 10m OATS)	
30 – 88	50.0	40.0	Comply
88 – 216	53.5	43.5	
216 – 230	56.9	46.4	
230 – 960	57.0	47.0	
960 – 1000	60.0	49.5	
Frequency (GHz)	**Maximum Field Strength (dB mV/m @ 3 m)**		**Result**
	Peak	**Average**	
1-40	80.0	60.0	Comply up to 18 GHz
Note 1: The lower limit shall apply at the transition frequency. **Note 2**: Additional provisions may be required for cases where interference occurs.			

2.3 Applicable Conducted Emission Limits

CE/ FCC/ISED for above standards − Class A

Frequency (MHz)	Conducted Limit (dBµV) − Class A		Result
	Quasi-Peak	Average	
0.15 – 0.50	79.0	66.0	Comply
0.50 – 30	73.0	60.0	
Note 1: The lower limit shall apply at the transition frequencies.			

SECTION III: DATA & TEST RESULTS

3.1 Radiated Emissions

- **Date Performed:**
  April 14, 2023

- **Test Standard:**
  As per Section 2.1 of this report

- **Required Limit:**
  As per Section 2.2 of this report

- **Test Method:**
  As per Section 2.1 of this report

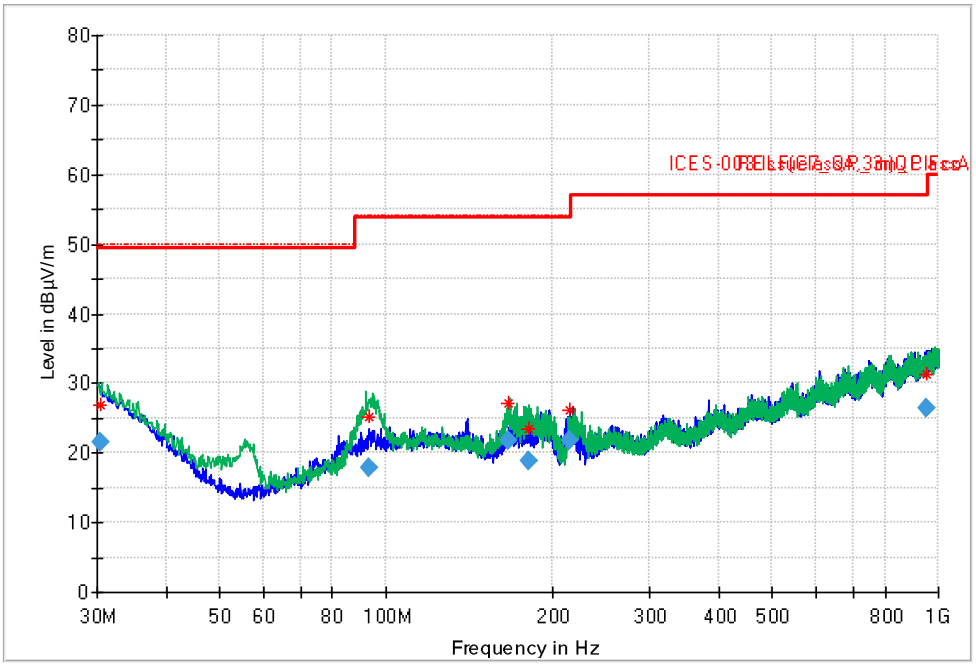
- **Modifications:**
  No modification was required to **comply** for this test.

- **Comments:**
  The transmitters were off during the test.

- **Result:**
  The EUT **comply** with the applicable standard.

Measurement Data and Plots:

- Test Voltage Used: 120VAC/60 Hz
- Frequency Range: 30MHz to 1GHz

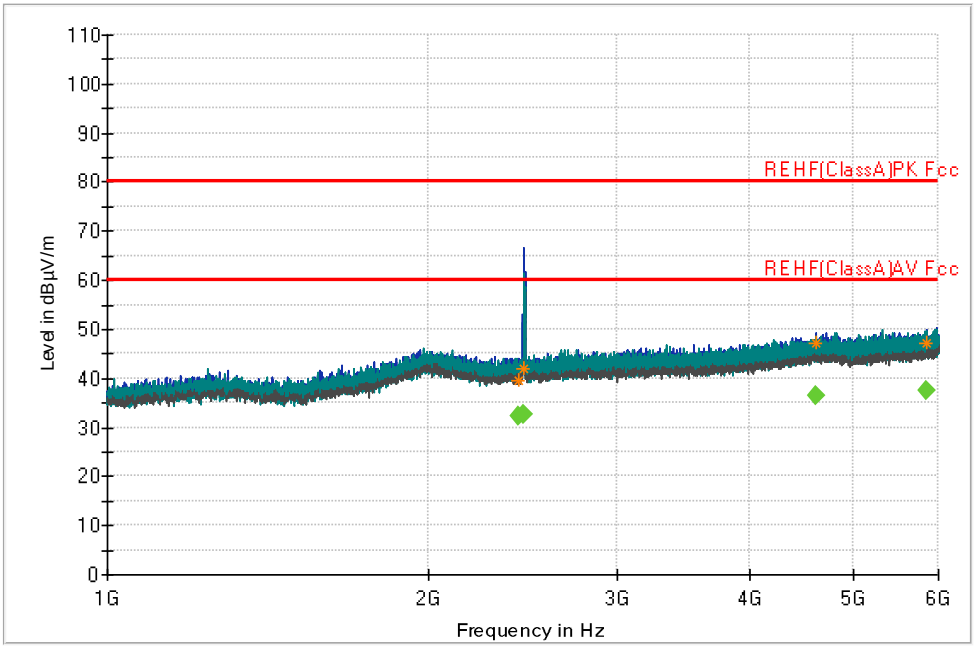


Plot 1: Radiated Emissions at 3m SAC

Table 1: Quasi Peak Data of Radiated Emissions at 3m SAC – Class A Limit

Frequency (MHz)	Quasi Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band width (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.5342	21.6	49.5	27.9	1000	120.000	228.0	V	53	25.1
93.0285	17.8	53.9	36.1	1000	120.000	211.0	V	316	17.2
167.1250	21.7	53.9	32.2	1000	120.000	135.0	V	325	18.2
181.9984	18.8	53.9	35.1	1000	120.000	105.0	V	126	18.1
215.6730	21.7	53.9	32.2	1000	120.000	146.0	H	95	14.9
952.4368	26.4	56.9	30.5	1000	120.000	302.0	H	222	29.2

- Test Voltage Used: 120VAC/60 Hz
- Frequency Range: 1GHz to 6GHz

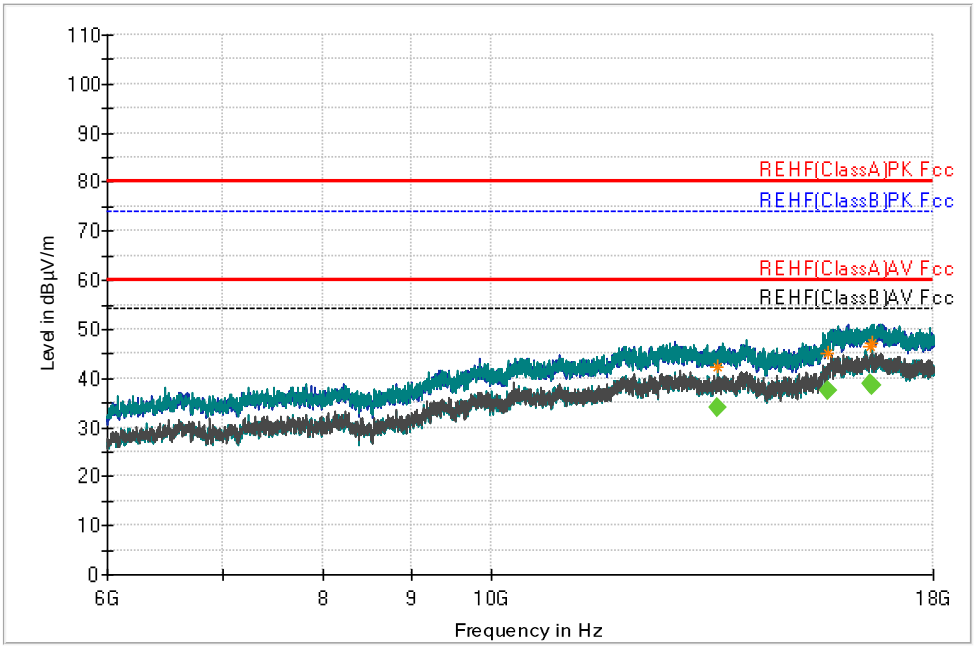


Plot 2: Radiated Emissions at 3m SAC

Table 2: Quasi Peak Data of Radiated Emissions at 3m SAC – Class A Limit

Frequency (MHz)	Max. Peak (dBµV/m)	Avg. Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band width (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2429.0440	---	32.34	60.00	27.66	1000.0	1000.0	249.0	H	254	0.2
2457.6440	---	32.66	60.00	27.34	1000.0	1000.0	299.0	H	268	0.3
4611.8200	---	36.53	60.00	23.47	1000.0	1000.0	349.0	H	25	6.6
5850.2840	---	37.47	60.00	22.53	1000.0	1000.0	299.0	H	65	8.3

- Test Voltage Used: 120VAC/60 Hz
- Frequency Range: 6GHz to 18GHz



Plot 3: Radiated Emissions at 3m SAC

Table 3: Quasi Peak Data of Radiated Emissions at 3m SAC – Class A Limit

Frequency (MHz)	Max. Peak (dBµV/m)	Avg. Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band width (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
13516.2600	---	34.02	60.00	25.98	1000.0	1000.0	124.0	H	180	7.0
15661.4240	---	37.33	60.00	22.67	1000.0	1000.0	325.0	V	229	12.1
16569.9200	---	38.75	60.00	21.25	1000.0	1000.0	122.0	H	65	12.9
16586.1600	---	38.64	60.00	21.36	1000.0	1000.0	250.0	H	21	12.9

3.2 Conducted Emissions

- **Date Performed:**
  April 14, 2023

- **Test Standard:**
  As per Section 2.1 of this report

- **Required Limit:**
  As per Section 2.3 of this report

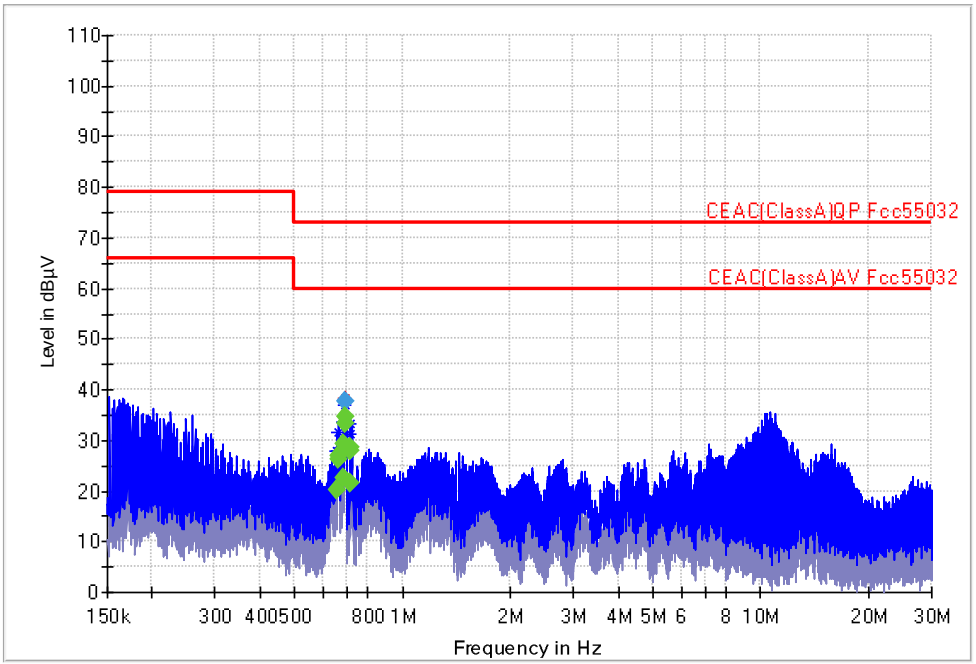
- **Test Method:**
  As per Section 2.1 of this report

- **Modifications:**
  No modification was required to **comply** for this test.

- **Result:**
  The EUT **comply** with the applicable standard.

Measurement Data and Plot:

- Test Voltage Used: 120VAC/60Hz
- Frequency Range: 150 KHz to 30 MHz

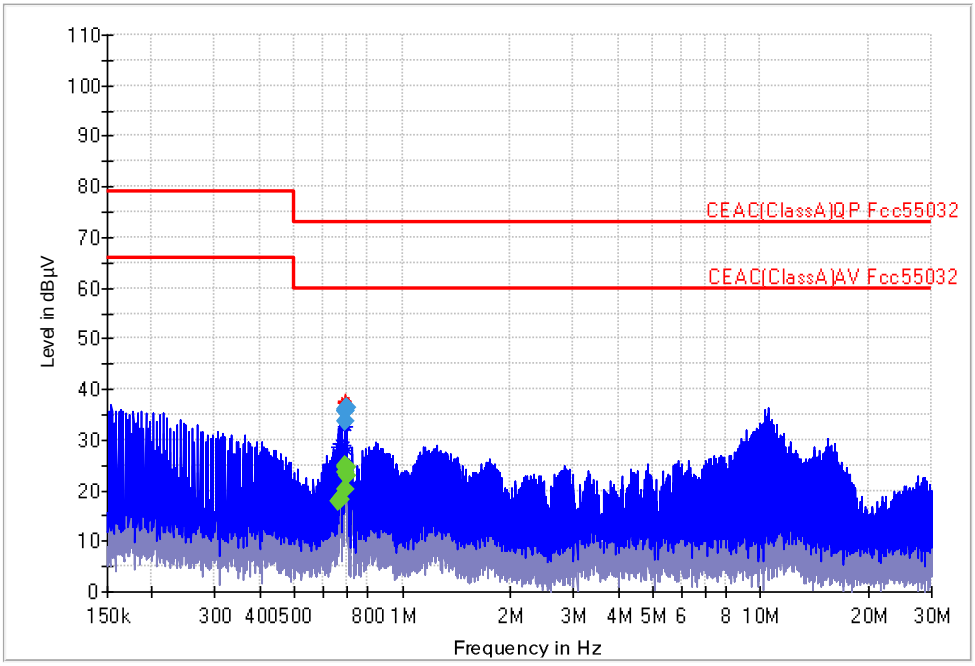


Plot 4: Conducted Emissions – Line 1

Table 4: Quasi-Peak and Average Data of Conducted Emissions – Class A Limit – Line 1

Frequency (MHz)	Quasi Peak (dBµV)	Average (dBµV)	Limit (dBµV /m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.6576	---	20.1	60.0	39.9	1000	9.000	L1	GND	10.5
0.6624	---	27.0	60.0	33.0	1000	9.000	L1	GND	10.5
0.6648	---	26.2	60.0	33.8	1000	9.000	L1	GND	10.5
0.6844	---	22.4	60.0	37.6	1000	9.000	L1	GND	10.5
0.6868	---	29.2	60.0	30.8	1000	9.000	L1	GND	10.5
0.6892	---	33.2	60.0	26.8	1000	9.000	L1	GND	10.5
0.6908	37.6	---	73.0	35.4	1000	9.000	L1	GND	10.5
0.6908	---	34.5	60.0	25.5	1000	9.000	L1	GND	10.5
0.7144	---	21.5	60.0	38.5	1000	9.000	L1	GND	10.6
0.7176	---	27.8	60.0	32.2	1000	9.000	L1	GND	10.6
0.7192	---	28.7	60.0	31.3	1000	9.000	L1	GND	10.6

- Test Voltage Used: 120VAC/60Hz
- Frequency Range: 150 KHz to 30 MHz



Plot 5: Conducted Emissions – Line 2

Table 5: Quasi-Peak and Average Data of Conducted Emissions – Class A Limit – Line 2

Frequency (MHz)	Quasi Peak (dBµV)	Average (dBµV)	Limit (dBµV /m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.6652	---	17.9	60.0	42.1	1000	9.000	L2	GND	10.5
0.6676	---	18.2	60.0	41.8	1000	9.000	L2	GND	10.5
0.6700	---	18.3	60.0	41.7	1000	9.000	L2	GND	10.5
0.6724	---	18.1	60.0	41.9	1000	9.000	L2	GND	10.5
0.6888	---	20.1	60.0	39.9	1000	9.000	L2	GND	10.5
0.6888	33.5	---	73.0	39.5	1000	9.000	L2	GND	10.5
0.6912	35.5	---	73.0	37.5	1000	9.000	L2	GND	10.5
0.6912	---	23.5	60.0	36.5	1000	9.000	L2	GND	10.5
0.6936	---	24.4	60.0	35.6	1000	9.000	L2	GND	10.5
0.6936	35.8	---	73.0	37.2	1000	9.000	L2	GND	10.5
0.6960	35.9	---	73.0	37.1	1000	9.000	L2	GND	10.6
0.6960	---	25.0	60.0	35.0	1000	9.000	L2	GND	10.6
0.6984	36.2	---	73.0	36.8	1000	9.000	L2	GND	10.6
0.6984	---	24.6	60.0	35.4	1000	9.000	L2	GND	10.6
0.7008	---	22.8	60.0	37.2	1000	9.000	L2	GND	10.6

Appendix A: TEST SETUP PHOTOS

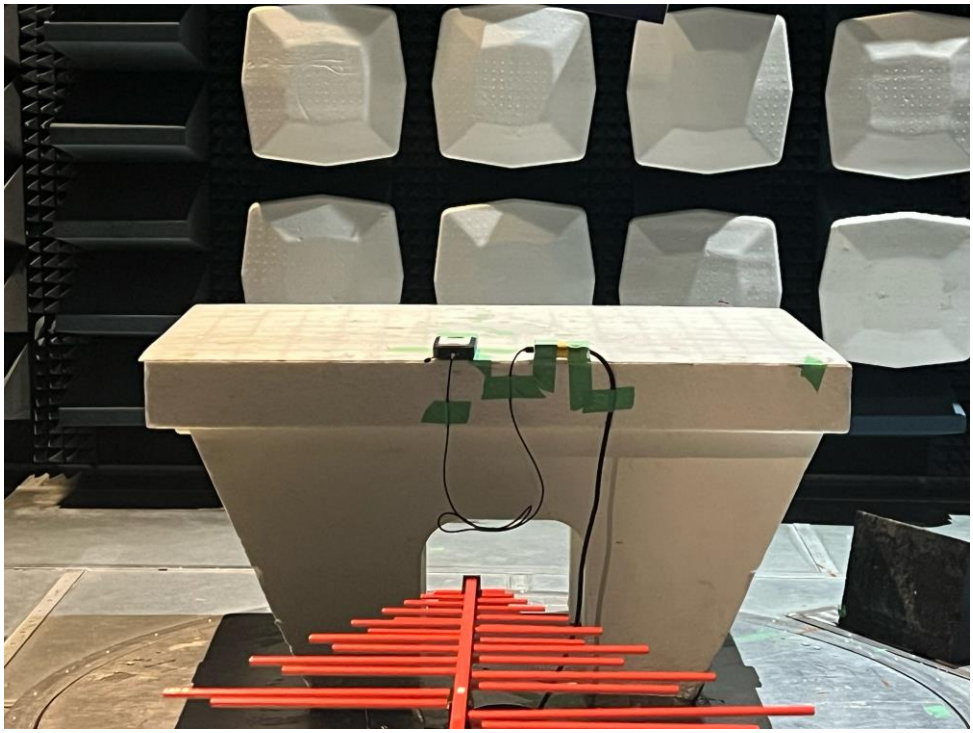


Figure 1: Radiated Emissions (30 MHz-1GHz) performed at the SAC Test Setup

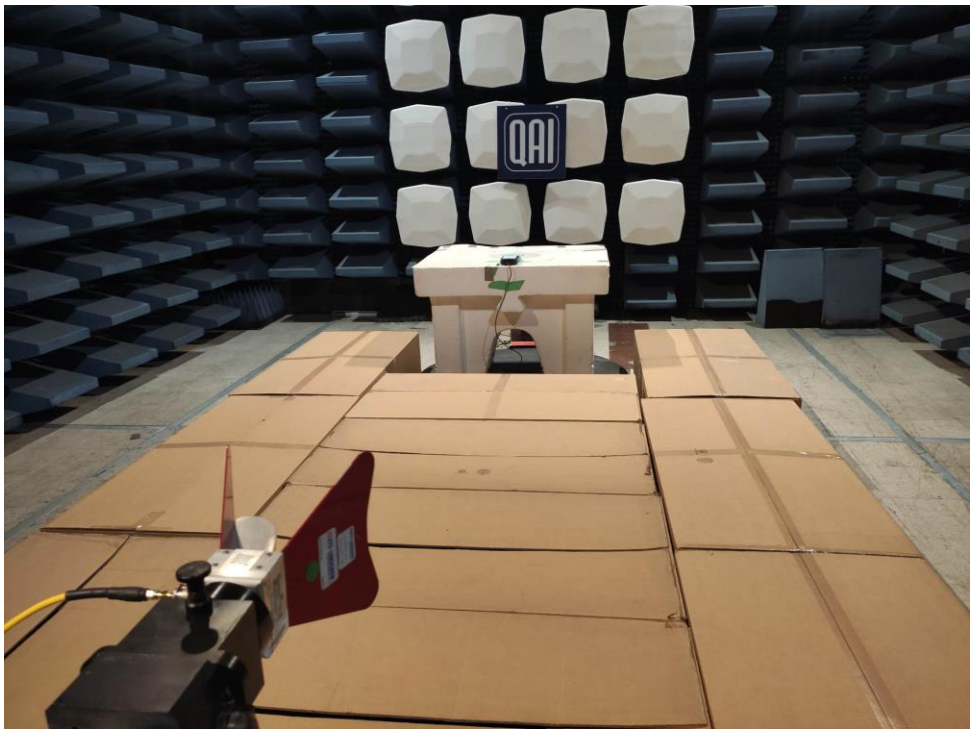


Figure 2: Radiated Emissions (1 GHz-18GHz)) performed at the SAC Test Setup

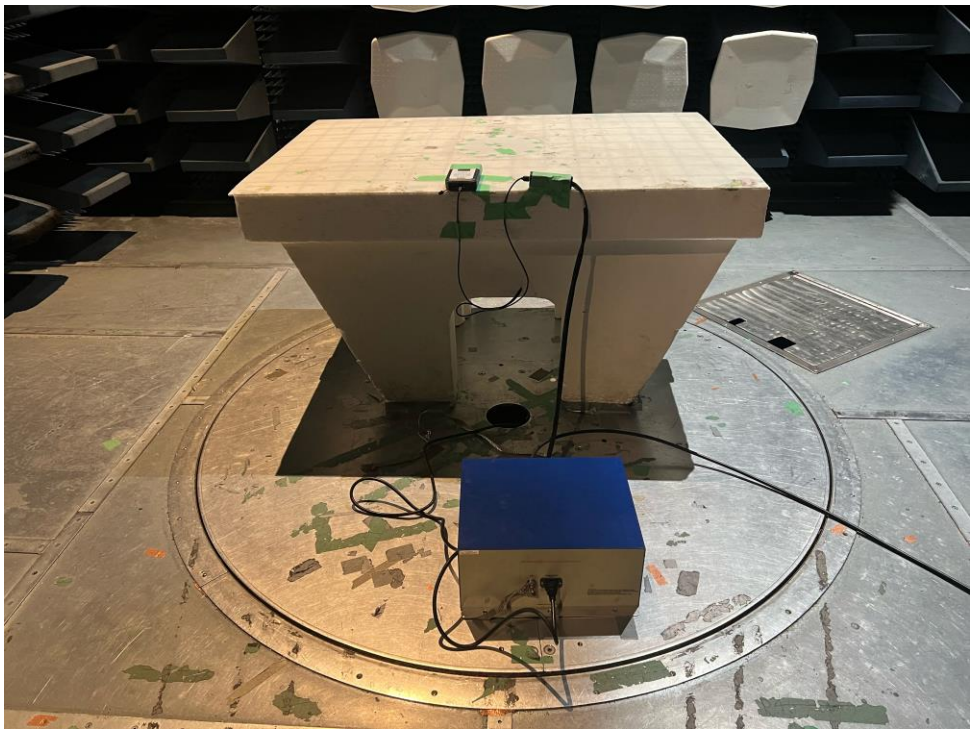


Figure 3: Conducted Emissions performed at the SAC Test Setup

Appendix B: ABBREVIATIONS

Abbreviation	Definition
AC	Alternating Current
AM	Amplitude Modulation
ASW	Anti-Submarine Warfare
BIT	Built-in-Test
CE	European Conformity
CISPR	Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference)
DC	Direct Current
EFT	Electrical Fast Transient
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
ERP	Effective Radiated Power
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FCC	Federal Communications Commission
FVIN	Firmware Version Identification Number FVIN
GFE	Government Furnished Equipment
IC	Industry Canada
ICES	Interference Causing Equipment Standard
IEC	International Electrotechnical Commission
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
SAC	Semi-Anechoic Chamber
TEM	Transverse Electromagnetic
TPD	Terminal Protection Device

END OF REPORT