Report Number:	R13747609-E3
Issue Date:	2022-01-18
Product Name:	Control Unit
Model Number:	ISC-B01
FCC ID:	2ANOS-ISC

Electromagnetic Compatibility Test Report

For

Inxpect S.p.a.
Via Serpente, 91
BS 25131 Italy

Test Report Details

Tests Performed By:	UL LLC 12 LABORATORY DR. RESEARCH TRIANGLE PARK, NC 27709, U.S.A.
Tests Performed For:	**I**nxpect S.p.a. Via Serpente, 91 BS 25131 Italy
Issue Date:	2022-01-18
Product Name:	Control Unit
Model Number Tested:	ISC-B01
Sample Serial Number:	ZZ864
FCC ID:	2ANOS-ISC
Applicable Standards:	FCC 47 CFR PART 15 SUBPART B:2021 ICES-003 ISSUE 7:2020 ICES-GEN ISSUE 1 +A1:2021
Date Test Item Received:	2021-09-03
Testing Start Date:	2021-11-24
Date Testing Complete:	2021-11-30
Overall Results:	Compliant

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by a2la, NIST, or any agency of the U.S. government.

Report Directory

Report Revision History

Revision Date	Revision Version	Description	Revised By	Revision Reviewed By
2021-12-20	V1	Initial Issue	B. Kiewra	
2022-01-18	V2	Updated Conducted Emission data with Class A limit	M. Antola	

1.0 SUMMARY

All tests were performed in accordance with ANSI C63.4:2014, ICES-003 ISSUE 7:2020, ICES-GEN ISSUE 1+A1:2021.

1.1 Deviations from standard test methods

None

1.2 Device Modifications Necessary for Compliance

None

1.3 Applicable Standards

Standard
FCC 47 CFR PART 15 SUBPART B:2021
ICES-003 ISSUE 7:2020
ICES-GEN ISSUE1+A1:2021

1.4 Summary of Tests

This product is considered Class A

Requirement – Test	Result (Compliant / Non-Compliant)
CONDUCTED EMISSIONS	Compliant
RADIATED EMISSIONS	Compliant

Approved & Released For
UL LLC. By:

Michael Antola
Staff Engineer
Consumer Technology Division
UL LLC

Prepared By:

Brian Kiewra
Project Engineer
Consumer Technology Division
UL LLC

2.0 DECISION RULES AND MEASUREMENT UNCERTAINTY

2.1 Metrological Traceability

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards

2.2 Decision Rules

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement).

2.3 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	U_{lab}	U_{Cispr}
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.07 db	3.4 db
Worst Case Radiated Disturbance, All ranges	6.01 db	6.3 db

Uncertainty figures are valid to a confidence level of 95%.

2.4 Sample Calculation

RADIATED EMISSIONS
Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS
Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

3.0 GENERAL - Product Description

3.1 Equipment Description

The EUT is a Control Unit used to power and communicate with radar sensors, to collect their status and communicate with other external equipment.

Also considered compliant are models ISC-02 and ICS-03. ISC-B01 is the most populated version of the three variants. The ISC-02 has the fieldbus interface removed and the ISC-03 has the fieldbus and ethernet interfaces removed.

3.2 Equipment Marking Plate

None

3.3 Device Configuration During Test

3.3.1 Equipment Used During Test:

Use	Product Type	Manufacturer	Model	Comments
EUT	Control Unit	Inxpect S.p.A	ISC-B01	None
AE	Radar Sensor	Inxpect S.p.A	SBV-01	None
SIM	Power Supply	Circuit Specialists	CSI3005X5	None
AE	LEDs	Inxpect S.p.A	NA	NA
AE	Resistive dummy load	Inxpect S.p.A	NA	NA
AE	Nethost RTE Hilshcer	Hilscher	E334100	NA
AE	Support laptop	Lenovo	Thinkpad L470	PF0ZV674
Note: **EUT** - Equipment Under Test, **AE** - Auxiliary/Associated Equipment, or **SIM** - Simulator (Not Subjected to Test)				

3.3.2 Input/Output Ports:

Port #	Name	Type*	Cable Max. >3m (Y/N)	Cable Shielded (Y/N)	Comments
0	Enclosure	N/E	—	—	None
1	Mains	DC	N	N	Input power to control unit.
2	CAN	DC	N	N	Provides power to radar sensor
3	ENET	I/O	Y	N	One connected from the EUT J3 port into a support laptop and one connected from the EUT J10 port into the Nethost RTE Hilshcer CH 1

*Note:
AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
TP = Telecommunication Ports

3.3.3 EUT Internal Operating Frequencies:

Frequency (MHz)	Description
<108MHz	Highest Internal Frequency

3.3.4 Power Interface:

Mode # /Rated	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
Rated	24VDC	-	-	DC	-	None
1	24VDC	-	-	DC	-	None

3.3.5 Subassemblies

Description	Manufacturer	Model
None		

3.3.6 Manufacturer's Description of Model Differences

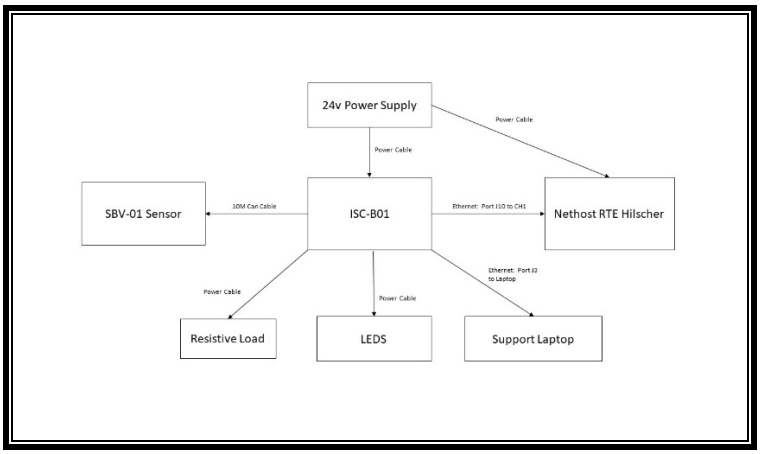
None

3.3.7 Software and Firmware

The test utility software used to exercise the device during testing was ISC-CMD-LINE, rev. 2.10.42, running START_COMMUNICATION.BAT batch file.

3.4 Block Diagram:

The diagram below illustrates the configuration of the equipment above.



3.5 EUT Configurations

Configuration #	Description
1	Configured as tabletop equipment.

3.6 EUT Operation Modes

Mode of Operation#	Description
1	Operating as intended.

3.7 Rationale for EUT Configurations

Configuration #	Description
1	EUT was investigated in three orientations, X, Y, and Z. It was determined that Y was worst-case orientation. Therefore all radiated testing done with EUT in Y orientation.

3.8 Rationale for EUT Mode of Operation

Mode of Operation #	Description
1	EUT tested under normal intended operation.

4.0 APPLICABLE EMISSIONS LIMITS AND TEST RESULTS

4.1 Test Conditions and Results - MAINS TERMINAL - CONDUCTED EMISSIONS

Test Description	Measurements were made on a ground plane. All power was connected to the system through Artificial Mains Network (AMN). Conducted voltage measurements on mains lines were made at the output of the AMN.		
Test Standards		ANSI C63.4-2014 ICES-003 ISSUE 6:2016	
Test Engineer		40882	
Test Date		2021-11-30	
Laboratory Parameters		Required prior to the test	During the test
Ambient Temperature		10 to 40 °C	21.8°C
Humidity		10 % to 90 %	20.7%
		Frequency range on each side of line	Measurement Point
Fully configured sample scanned over the following frequency range		150kHz to 30MHz	Mains
Limits - Class A			
Frequency (MHz)	Limit (dBµV)		
	Quasi-Peak	Average	
0.15-0.5	79	66	
0.5-30	73	60	
Supplementary information: None			

Conducted Emissions EUT Configuration Settings

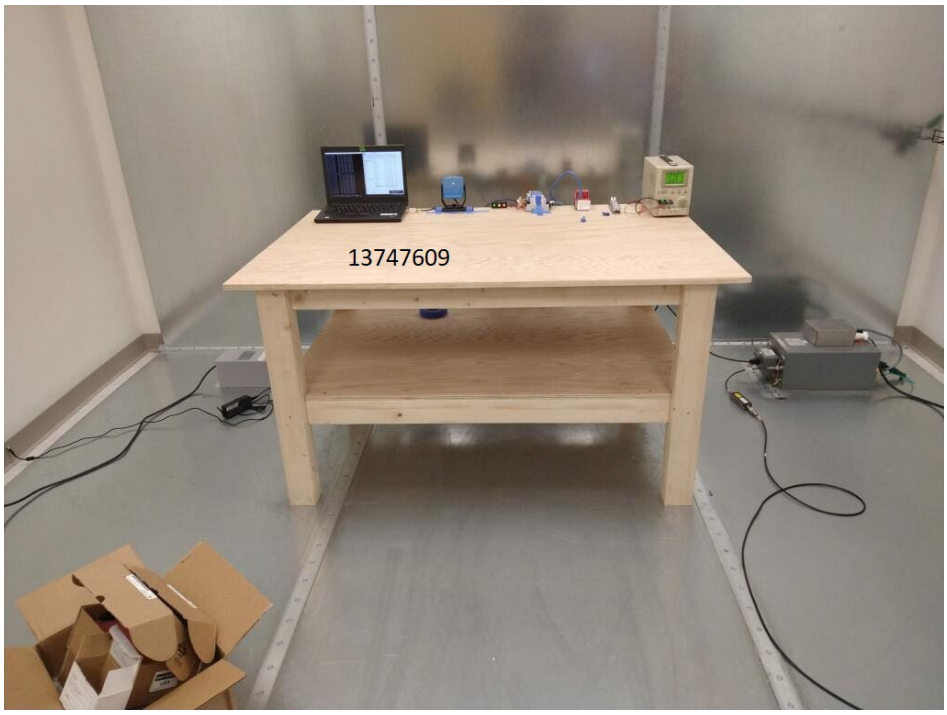
Power Interface #	EUT Configurations #	EUT Mode of Operation#
1	1	1
Supplementary information: None		

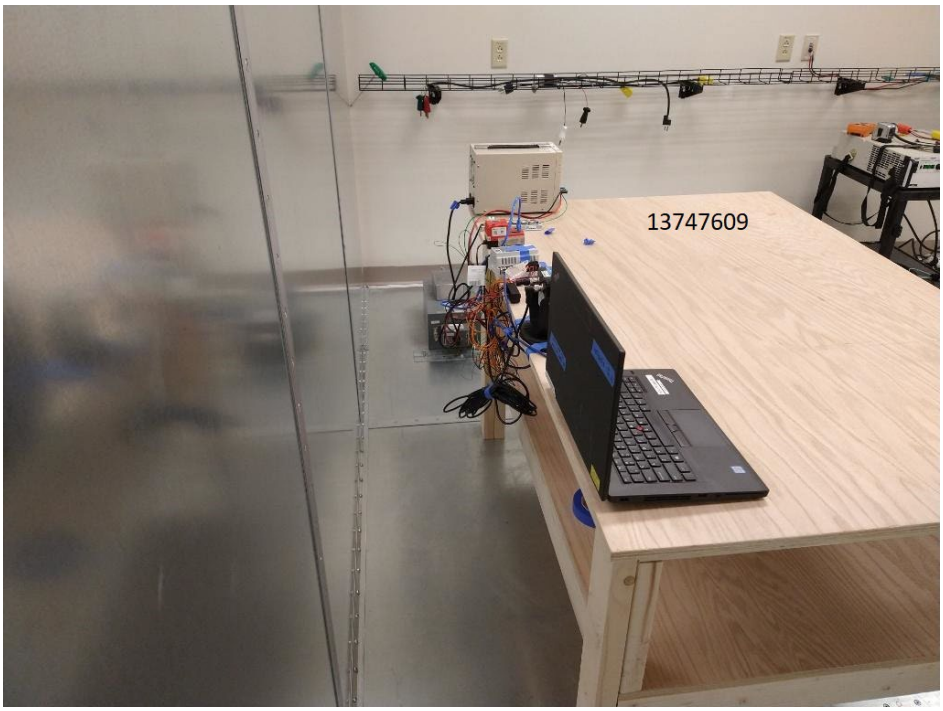
Conducted Emissions Test Equipment

Test Equipment Used - Line-Conducted Emissions – Voltage (Morrisville – Conducted 1)

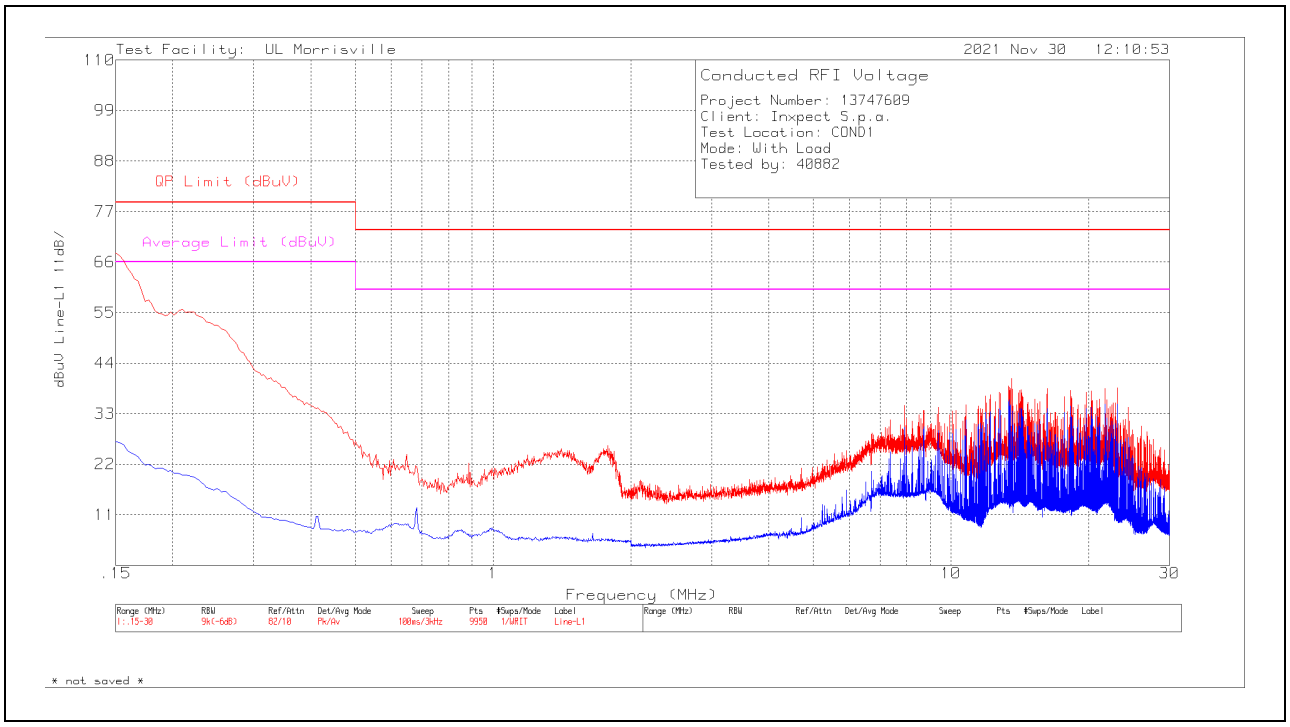
Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2021-04-05	2022-04-05
HI0091	Environmental Meter	Fisher Scientific	15-077-963	2021-07-12	2022-07-12
LISN001	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2021-08-16	2022-08-16
75141	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2021-08-17	2022-08-17
ATA222	Transient Limiter, 0.009-100MHz	Electro-Metrics	EM-7600	2021-04-05	2022-04-05
PS214	AC Power Source	Elgar	CW2501M (s/n 1523A02396)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5 (18 OCT 2021)		
CDECABLE001	ANSI C63.4 1m extension cable.	UL	Per Annex B of ANSI C63.4	2021-09-13	2022-09-13

Photo of test setup for Mains Conducted Emissions





Conducted Emissions Graph – Line 1

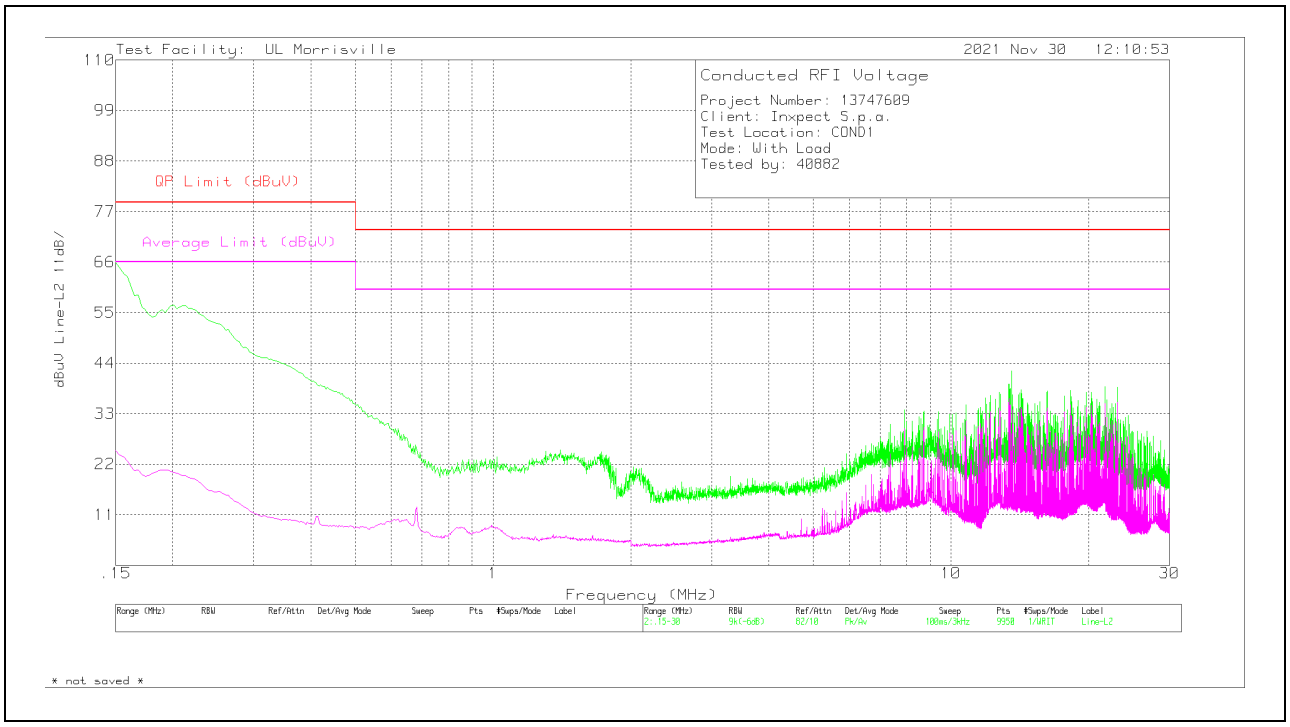


Conducted Emissions Data Points – Line 1

Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
Line - L1 0.15-30MHz									
.153	57.46	Pk	.2	9.8	67.46	79	-11.54	-	-
.153	16.79	Av	.2	9.8	26.79	-	-	66	-39.21
.21	45.82	Pk	.1	9.8	55.72	79	-23.28	-	-
.204	10.2	Av	.1	9.8	20.1	-	-	66	-45.9
1.779	16.29	Pk	0	9.8	26.09	73	-46.91	-	-
1.785	-4.11	Av	0	9.8	5.69	-	-	60	-54.31
7.923	24.73	Pk	.1	10	34.83	73	-38.17	-	-
7.923	19.86	Av	.1	10	29.96	-	-	60	-30.04
13.56	30.48	Pk	.1	10.1	40.68	73	-32.32	-	-
13.563	18.9	Av	.1	10.1	29.1	-	-	60	-30.9
23.13	28.22	Pk	.2	10.2	38.62	73	-34.38	-	-
23.13	24.72	Av	.2	10.2	35.12	-	-	60	-24.88

Pk - Peak detector
Av - Average detection

Conducted Emissions Graph – Line 2



Conducted Emissions Data Points – Line 2

Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
Line – L2 0.15-30MHz									
.153	54.84	Pk	.2	9.8	64.84	79	-14.16	-	-
.153	14.05	Av	.2	9.8	24.05	-	-	66	-41.95
.201	46.74	Pk	.1	9.8	56.64	79	-22.36	-	-
.195	10.78	Av	.2	9.8	20.78	-	-	66	-45.22
1.725	14.9	Pk	0	9.8	24.7	73	-48.3	-	-
1.722	-3.93	Av	0	9.8	5.87	-	-	60	-54.13
7.923	23.77	Pk	.1	10	33.87	73	-39.13	-	-
7.923	19.64	Av	.1	10	29.74	-	-	60	-30.26
13.56	32.16	Pk	.1	10.1	42.36	73	-30.64	-	-
13.56	18.48	Av	.1	10.1	28.68	-	-	60	-31.32
23.127	28.32	Pk	.2	10.2	38.72	73	-34.28	-	-
23.13	25.02	Av	.2	10.2	35.42	-	-	60	-24.58

Pk - Peak detector
Av - Average detection

4.2 Test Conditions and Results - RADIATED EMISSIONS

Test Description	Measurements were made in a 3-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 meter. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in both horizontal and vertical polarities. Final measurements (quasi-peak or average as noted) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4-meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.

Test Standards	ANSI C63.4-2014 ICES-003 ISSUE 7:2020	
Test Engineer	23854/46722, 25674/46722	
Test Date	2021-11-24 to 2021-11-30	
Laboratory Parameters	Required prior to the test	During the test
Ambient Temperature	10 to 40 °C	20.8 – 24.8°C
Humidity	10 % to 90 %	16.6 – 74.0%
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30-1000MHz	3m

Limits - Class A

Frequency (MHz)	Limit (dBµV/m)	
30-88	39 (FCC) / 40 (ICES)	NA
88-216	43.5	NA
216-230	46.4	NA
230-960	46.4(FCC) / 47 (ICES)	NA
Above 960	49.5	NA

Supplementary information: FCC limits used as worst-case.

Radiated Emissions EUT Configuration Settings

Power Interface #	EUT Configurations #	EUT Mode of Operation#
1	1	1

Supplementary information: None

Radiated Emissions Test Equipment

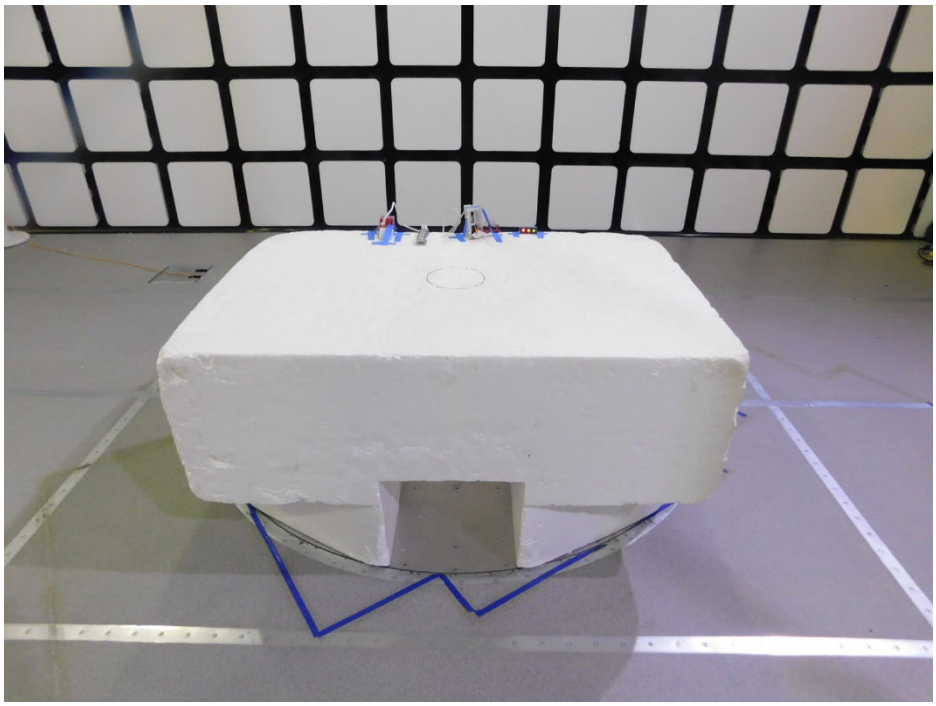
Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

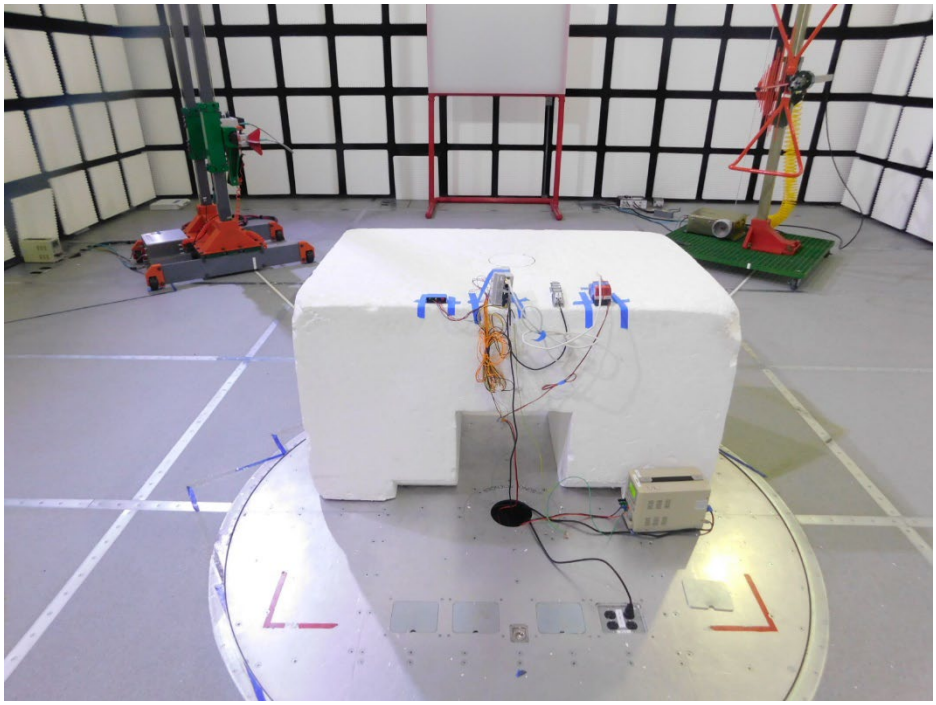
Equipment ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
30-1000 MHz					
AT0066	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB1	2021-02-19	2022-02-19
1-18 GHz					
AT0067	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2021-05-13	2022-05-13
18-40 GHz					
AT0061	Horn Antenna, 26-40GHz	ARA	MWH-2640/B	2021-11-04	2022-11-04
Gain-Loss Chains					
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2021-07-20	2022-07-20
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2021-07-20	2022-07-20
N-SAC04	Gain-loss string: 18-40GHz	Various	Various	2021-07-20	2022-07-20
Receiver & Software					
197954	Spectrum Analyzer	Rohde & Schwarz	ESW44	2021-03-30	2022-03-30
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
Additional Equipment used					
s/n 200037610	Environmental Meter	Fisher Scientific	06-662-4	2020-01-22	2022-01-22

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equipment ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
18-40 GHz					
AT0063	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2021-11-04	2022-11-04
Gain-Loss Chains					
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2021-07-09	2022-07-09
Receiver & Software					
197955	Spectrum Analyzer	Rohde & Schwarz	ESW44	2021-03-10	2022-03-10
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
s/n 200037635	Environmental Meter	Fisher Scientific	06-662-4	2020-01-22	2022-01-22

Photo of test setup for Radiated Emissions: 30-1000 MHz

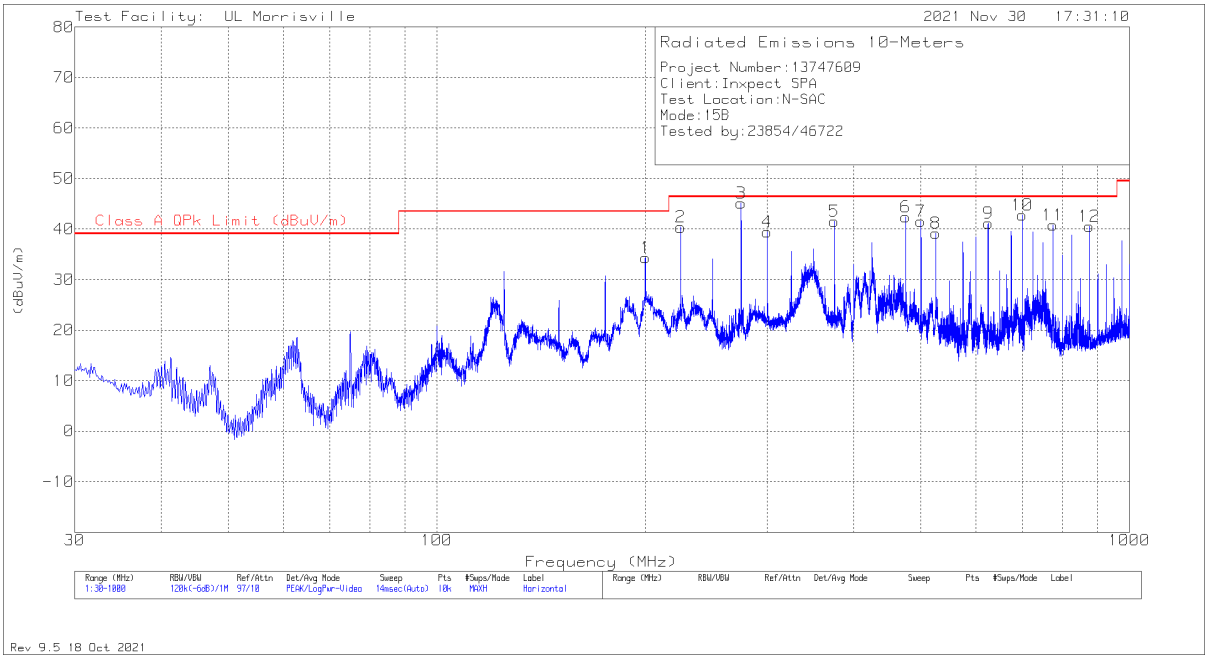




RADIATED EMISSIONS 30 TO 1000 MHz

Radiated Emissions Graph

HORIZONTAL AND VERTICAL PLOTS



Radiated Emissions Data Points

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0066 (dB/m)	Amp/Cbl (dB)	Dist Cor (dB)	Corrected Reading (dBuV/m)	Class A QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
13	40.476	52.72	Pk	19.9	-31.2	-10.5	30.92	39.08	-8.16	0-360	100	V
14	75.008	56.66	Pk	14.2	-30.6	-10.5	29.76	39.08	-9.32	0-360	100	V
1	200.041	55.78	Pk	18.4	-29.3	-10.5	34.38	43.52	-9.14	0-360	100	H
15	200.041	56.27	Pk	18.4	-29.3	-10.5	34.87	43.52	-8.65	0-360	100	V
2	224.97	63.07	Pk	17	-29.2	-10.5	40.37	46.44	-6.07	0-360	100	H
3	275.0067	64.63	Qp	19.6	-28.9	-10.5	44.83	46.44	-1.61	89	101	H
4	300.048	59.06	Pk	19.7	-28.8	-10.5	39.46	46.44	-6.98	0-360	100	H
5	375.0233	58.21	Qp	21.1	-27.9	-10.5	40.91	46.44	-5.53	231	101	H
6	475.035	56.78	Qp	23.8	-27.6	-10.5	42.48	46.44	-3.96	217	101	H
7	500.0265	52.82	Qp	24.1	-27.1	-10.5	39.32	46.44	-7.12	314	160	H
16	499.9906	51.49	Qp	24.1	-27.1	-10.5	37.99	46.44	-8.45	30	109	V
8	525.088	52.69	Pk	24	-27	-10.5	39.19	46.44	-7.25	0-360	200	H
17	525.018	58.09	Qp	24	-27	-10.5	44.59	46.44	-1.85	77	103	V
9	625.0317	56.13	Qp	25.6	-26.6	-10.5	44.63	46.44	-1.81	51	142	H
18	625.0427	54.28	Qp	25.6	-26.6	-10.5	42.78	46.44	-3.66	187	139	V
10	700.0295	52.66	Qp	26.6	-26.4	-10.5	42.36	46.44	-4.08	2	102	H
11	775.0306	50.4	Qp	27.6	-25.9	-10.5	41.6	46.44	-4.84	65	107	H
12	875.0477	46.93	Qp	28.2	-25	-10.5	39.63	46.44	-6.81	249	100	H

Pk - Peak detector
Qp - Quasi-Peak detector

Appendix A

Facilities, Accreditations and Authorizations

UL LLC is accredited by A2LA, cert. # 0751.06., for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
☐	Building: 12 Laboratory Dr RTP, NC 27709, U.S.A	US0067	2180C	825374
☒	Building: 2800 Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A		27265	

END OF TEST REPORT