National Technical Systems Canada Inc.
1490-D, Nobel
Boucherville, QC
J4B 5H3, Canada
Phone: 450-868-0360
www.nts-canada.ca

EMC/EMI Test Report

Tested Product:

TOGGLE

Test Report TR-0621251_R1

Prepared for: **Inogeni**
979 Av de Bourgogne, #530
Québec, QC
G1W 2L4, Canada

Reviewed by:
Xavier Couste, P. Eng. DESS EMC
EMC Lab Manager

Xavier COUSTE Digitally signed by Xavier COUSTE
Date: 2022.10.04 17:46:25 -04'00'

REVISION HISTORY

Revision	Description	Date
0	Initial Release	2022-09-09
1	Correction in the address of the customer	2022-10-04

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1 INTRODUCTION

This test report describes EMC tests on the product TOGGLE:

- in compliance with electromagnetic compatibility directive 2014/30/EU as part of the requirements leading to the CE marking
- in compliance with FCC part 15 subpart B
- in compliance with ICES-003

The essential requirements of the directive 2014/30/EU and the Electromagnetic Compatibility Regulations 2016 No. 1091 are covered by the following harmonized standards:

- EN 55032 (2015) A11 (2020) – *Electromagnetic compatibility of multimedia equipment - Emission requirements*
- EN 55035 (2017) A11 (2020) – *Electromagnetic compatibility of multimedia equipment – Immunity requirements*

2 ACRONYMS

EMC: ElectroMagnetic Compatibility
EUT: Equipment Under Test
S/N: Serial Number
N/A: Not Applicable / Not Available
NCR: No Calibration Required
VERIF: Internal Verification of Equipment Characteristics
AC: Alternating Current
DC: Direct Current
PSU: Power Supply Unit
AE: Auxiliary Equipment
QTP: Qualification Test Procedure.
LISN: Line Impedance Stabilisation Network
AM: Amplitude Modulation
CDN: Coupling/Decoupling Network
EM Clamp: Electromagnetic Clamp
I/O: Inputs/Outputs
PE: Protective Earth
HCP: Horizontal Coupling Plane
VCP: Vertical Coupling Plane
ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
Pst: short-term flicker
Plt: long-term flicker
Un: Nominal Voltage

3 PROJECT DATES

RECEPTION DATE(S) (yyyy-mm-dd)	2022-08-15 (LABCEM#3248, LABCEM#3251)
TESTS DATE(S) (yyyy-mm-dd)	From 2022-08-15 to 2022-08-18 (LABCEM#3248) 2022-08-18 (LABCEM#3251)

4 DESCRIPTION OF EQUIPMENT UNDER TEST

4.1 EUT

TYPE:	USB 3.0 Switcher	
PRODUCT NAME:	TOGGLE	
MANUFACTURER:	Inogeni	
LABCEM NUMBER:	LABCEM#3248	LABCEM#3251 (ESD)
PART NUMBER:	TOGGLE	TOGGLE
SERIAL NUMBER:	TGM2240773	TGM2240777
VOLTAGE RATING:	12Vdc	12Vdc
EXTERNAL PSU INFO:	Manufacturer: Phihong Model: PSA15R-120P P/N: PSA15R-120P S/N: PN10010005A1 Input Voltage: 120-240V, 50-60Hz Output Voltage: 12Vdc	Manufacturer: Phihong Model: PSA15R-120P P/N: PSA15R-120P S/N: PN10010005A1 Input Voltage: 120-240V, 50-60Hz Output Voltage: 12Vdc
EUT SIZE:	Width = 8cm Height = 2cm Depth = 7cm	Width = 8cm Height = 2cm Depth = 7cm
FIRMWARE:	1.3	1.3
HIGHEST INTERNAL FREQUENCY:	100MHz	100MHz

Photo 1: EUT

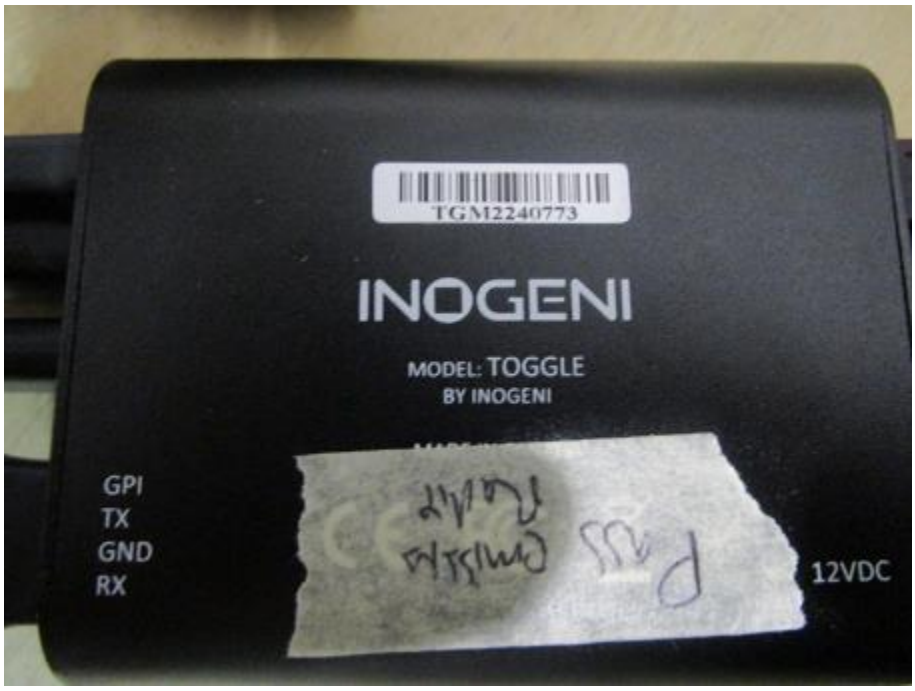


Photo 2: EUT – S/N (TGM2240773)

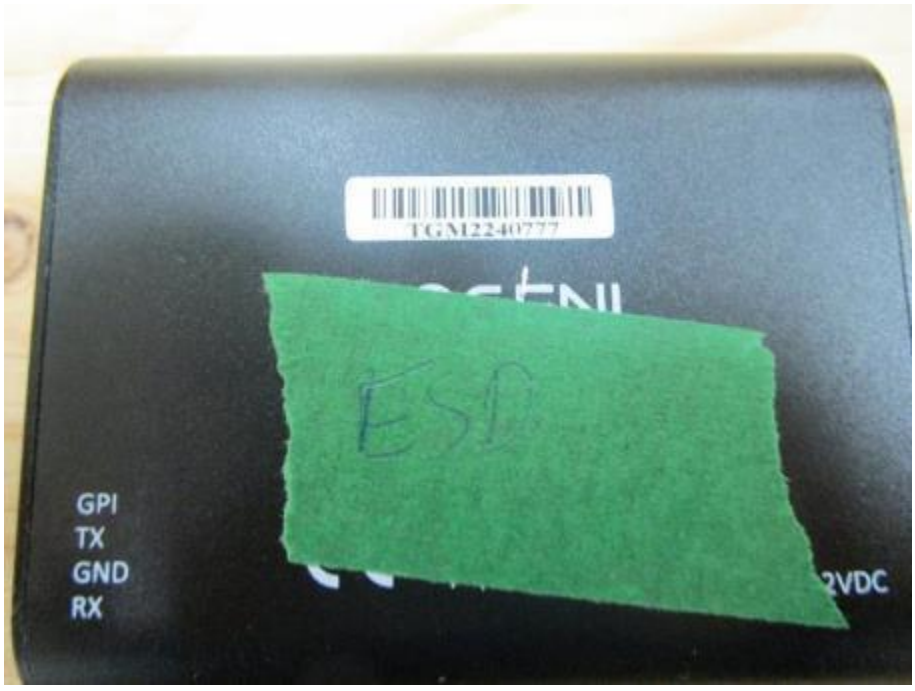


Photo 3: EUT – S/N (TGM2240777)

Photo 4: PSU

Photo 5: PSU – S/N

4.2 AE

TYPE:	Webcam
PRODUCT NAME:	Logitech C920
MANUFACTURER:	Logitech
SERIAL NUMBER:	2147LV038MV8
VOLTAGE RATING:	5Vdc (USB)
FIRMWARE:	N/A

Photo 6: AE – Webcam #1

TYPE:	Webcam
PRODUCT NAME:	Logitech C920
MANUFACTURER:	Logitech
SERIAL NUMBER:	2133LV0181P8
VOLTAGE RATING:	5Vdc (USB)
FIRMWARE:	N/A

Photo 7: AE – Webcam #2

TYPE:	Webcam
PRODUCT NAME:	Logitech BRIO
MANUFACTURER:	Logitech
SERIAL NUMBER:	2108LZ06AF38
VOLTAGE RATING:	5Vdc (USB)
FIRMWARE:	N/A

Photo 8: AE – Webcam #3

4.3 Support Equipment

EUT was exercised with support equipment supplied by client.

Photo 9: Support Equipment – Laptop #1

Photo 10: Support Equipment – Laptop #2

Photo 11: Support Equipment – Desktop + Monitor

4.4 EUT Setup Diagram

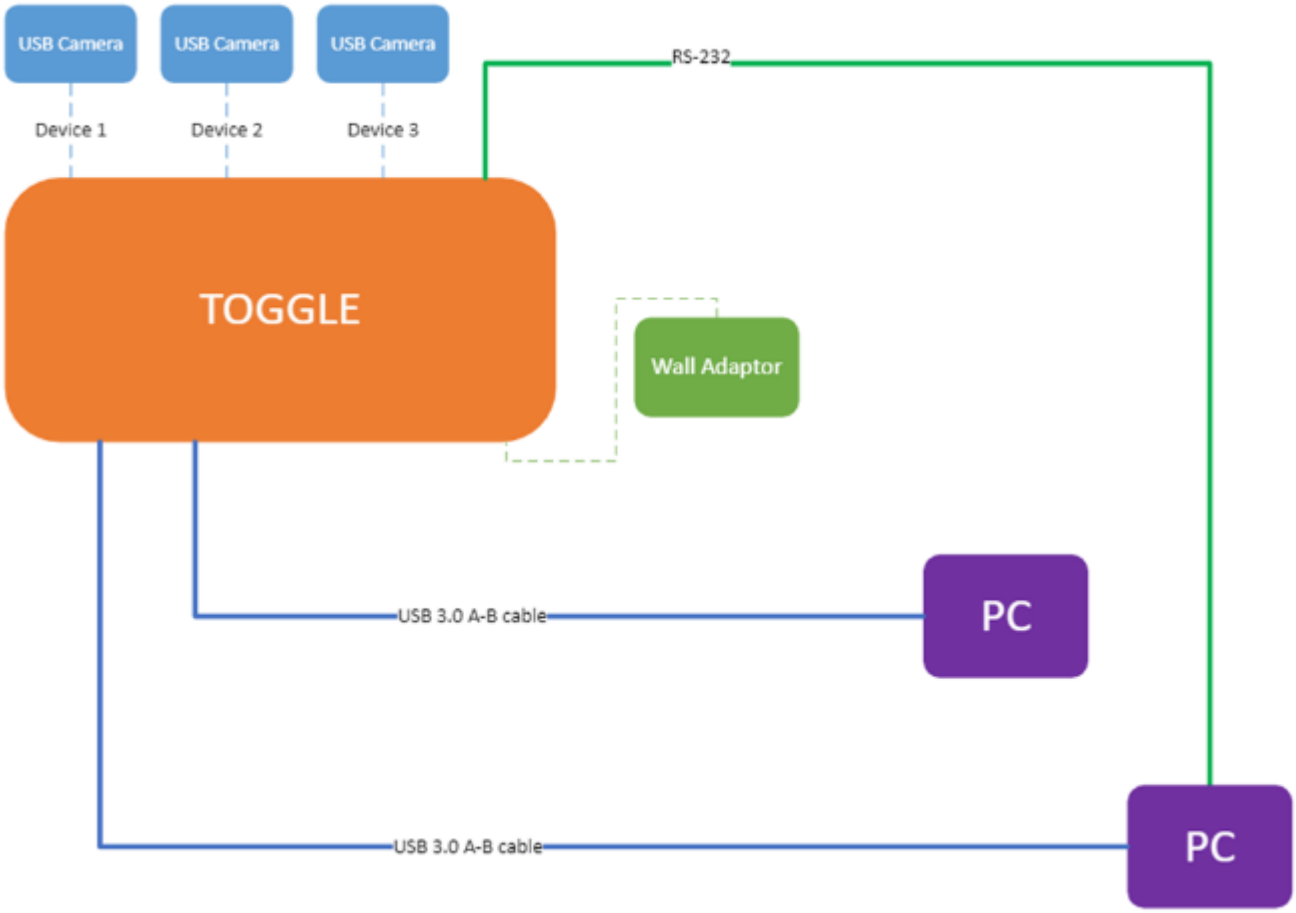


Figure 1: EUT Setup Diagram

4.5 Mode of Operation

During the tests, the EUT was exercised by sharing 3 USB devices to the selected USB host (Can be PC1 or PC2).

4.6 Method of Monitoring

During the tests, the EUT was monitored by observing the shared USB camera on the selected USB host PC.

5 PERFORMANCE CRITERIA

During the tests, EUT shall operate normally and the picture shall remain stable on host PC (PC1 or PC2).

The performance criteria for the evaluation of the immunity test results are defined by EN 55035 standard (Electromagnetic compatibility of multimedia equipment – Immunity requirements).

Performance criterion A: The equipment shall continue to operate as intended without operator intervention. No degradation of performance, loss of function or change of operating state is allowed below a performance level specified by the manufacturer when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

Performance criterion B: During the application of the disturbance, degradation of performance is allowed. However, no unintended change of actual operating state or stored data is allowed to persist after the test.

After the test, the equipment shall continue to operate as intended without operator intervention; no degradation of performance or loss of function is allowed, below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance.

If the minimum performance level (or the permissible performance loss), or recovery time, is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

Performance criterion C: Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. A reboot or re-start operation is allowed. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

6 CALCULATION OF THE COMPLIANCE MARGIN

Conducted Emission Level (dBµV) =	Value Reading at the EMI receiver (dBµV) + Correction Factor (dB)
Correction Factor (dB) =	LISN Attenuation (dB) + Cable Loss (dB) – Amplifier Gain (dB) + Attenuator (dB)
Margin (dB) =	Conducted Emission Level (dBµV) – Limit Value (dBµV)

Table 1: Example of Conducted Emissions Margin Calculation

Radiated Emission Level (dBµV/m) =	Value reading at the EMI receiver (dBµV) + Antenna Factor (dB/m) + Correction Factor (dB)
Correction Factor (dB) =	Cable Loss (dB) – Amplifier Gain (dB) + Attenuator (dB)
Margin (dB) =	Radiated Emission Level (dBµV/m) – Limit Value (dBµV/m)

Table 2: Example of Radiated Emissions Margin Calculation

7 MEASUREMENT UNCERTAINTIES

All measurements under compliance testing, involve certain levels of uncertainties based on test equipment and facilities. The measurement uncertainties of National Technical Systems Canada Inc. (U_{LAB}) were calculated according to CISPR16-4-2 standard and were lower than the maximum allowed by the standard (U_{CISPR}). Therefore, the measurement uncertainties need not to be considered for compliance.

The following table presents uncertainty calculation for emission measurements as requested by ANSI C63.4 (2014):

Test	Expanded Uncertainty with k=2 Coverage Factor (95% Confidence Level)
Conducted Emissions with LISN (9kHz-150kHz)	± 3.77 dB
Conducted Emissions with LISN (150kHz-30MHz)	± 3.33 dB
Radiated Emissions (30MHz-1GHz)	± 5.87 dB
Radiated Emissions (1GHz-18GHz)	± 5.10 dB

Table 3: Measurement Uncertainties

All other calculations of uncertainties evaluation are available upon request.

8 ENGINEERING COMMENTS

8.1 Modifications incorporated in the EUT

No modification was performed on the EUT during testing.

8.2 Deviations from the standards and/or laboratory tests procedure

No deviation from standards and/or test laboratory procedure was performed during testing.

9 TEST SUMMARY

The following table lists all tests called by the harmonized standards indicated in the test report introduction.

Test Name Standards	Test Specifications	Minimum Performance Criterion Required	EUT Serial Number	Results
Conducted Emissions FCC part 15 subpart B (2021)	Class A 150kHz-30MHz	N/A	TGM2240773	Pass
Radiated Emissions FCC part 15 subpart B (2021)	Class A 30MHz-1GHz	N/A	TGM2240773	Pass
Conducted Emissions ICES-003 (2016) + Update (2019)	Class A 150kHz-30MHz	N/A	TGM2240773	Pass
Radiated Emissions ICES-003 (2016) + Update (2019)	Class A 30MHz-1GHz	N/A	TGM2240773	Pass
Conducted Emissions EN 55032 (2015) A11 (2020)	Class A 150kHz-30MHz	N/A	TGM2240773	Pass
Radiated Emissions EN 55032 (2015) A11 (2020)	Class A 30MHz-1GHz	N/A	TGM2240773	Pass
Harmonic Current Emission Limits EN IEC 61000-3-2 (2019) A1 (2021)	Class A	N/A	TGM2240773	Pass
Voltage Fluctuations and Flicker Limitations EN 61000-3-3 (2013) A1 (2019) A2 (2021)	Observation period for P_{st}: 10 min Observation period for P_{lt}: 120 min	N/A	TGM2240773	Pass
Electrostatic Discharge Immunity IEC 61000-4-2 (2008)	Contact: ±4kV Air: ±2kV, ±4kV, ±8kV	B	TGM2240777	Pass
Radiated Electromagnetic Field Immunity IEC 61000-4-3 (2020)	80MHz-1000MHz: 3V/m 1800MHz, 2600MHz, 3500MHz, 5000MHz: 3V/m	A	TGM2240773	Pass
Electrical Fast Transient Immunity IEC 61000-4-4 (2012)	Power: ±1kV / 5kHz I/O Ports: ±0.5kV / 5kHz Communication Ports: ±0.5kV / 5kHz	B	TGM2240773	Pass
Surge Immunity IEC 61000-4-5 (2014) A1 (2017)	Power: ±2kV L-PE / ±1kV L-L I/O Ports: N/A Communication Ports: N/A	B	TGM2240773	Pass
Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields IEC 61000-4-6 (2013)	Power: 3V I/O Ports: 3V Communication Ports: 3V	A	TGM2240773	Pass
Power Frequency Magnetic Field Immunity IEC 61000-4-8 (2009)	Continuous Field: 1A/m / 50Hz & 60Hz	A	TGM2240773	Pass

Test Name Standards	Test Specifications	Minimum Performance Criterion Required	EUT Serial Number	Results
Voltage Dips, Short Interruptions and Voltage Variation Immunity on AC Input IEC 61000-4-11 (2020)	Voltage dips: 0%Un during half cycle 70%Un during 25 cycles (at 50Hz) 70%Un during 30 cycles (at 60Hz) Short interruptions: 0%Un during 250 cycles(at 50Hz) 0%Un during 300 cycles (at 60Hz)	B C C C C	TGM2240773	Pass

Table 4: Test Summary

10 EMISSIONS TESTS

10.1 Conducted Emissions

10.1.1 Test Details

REFERENCE STANDARD	EN55032 (2015) A11 (2020) ANSI C63.4 (2014)

SPECIFICATIONS	
Limit	EN 55032 (2015) A11 (2020) class A FCC part 15 subpart B (2021) class A
Frequency Range	150kHz – 30MHz
Installation	Table-top equipment

EUT	
Identification	TOGGLE
Voltage Input	230V/50Hz 120V/60Hz

TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-16
Temperature °C (For Info Only)	23.5°C
Relative humidity % (For Info Only)	45.3%
Atmospheric pressure kPa (For Info Only)	101.9kPa
Operator	Jean Cadotte
Client Witness	Donatien Crémet (Inogeni)

10.1.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
TDK	Emission Anechoic Chamber	16706-1	5412	24	2022-09-04 (NSA) 2023-01-07 (SVSWR)
NEXIO	Software	BAT-EMC v2022.0.11.0	N/A	N/A	N/A
Rohde&Schwarz	EMI receiver	ESW44	101905	12	2023-01-19
NARDA	LISN	PMM L2-16B	000WX20813	12	2022-09-21

Table 5: Conducted Emissions – Test Equipment

10.1.3 Test Results

Tested Line	Frequency (MHz)	Average Limit (dBµV)	Quasi-Peak Limit (dBµV)	Results
Power – Phase (230V/50Hz)	0.150 – 0.50	66	79	Pass
	0.50 – 30	60	73	
Power – Neutral (230V/50Hz)	0.150 – 0.50	66	79	Pass
	0.50 – 30	60	73	
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client.				

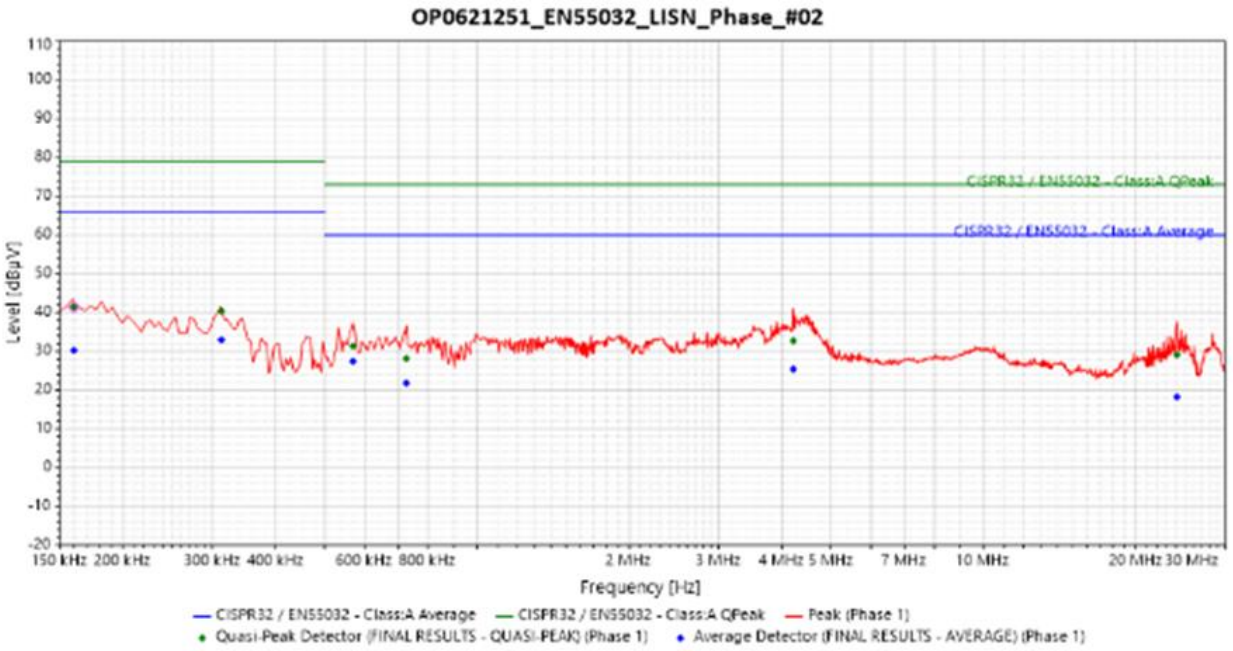
Table 6: Conducted Emissions – Test Results – EN55032 Class A

Tested Line	Frequency (MHz)	Average Limit (dBµV)	Quasi-Peak Limit (dBµV)	Results
Power – Phase (120V/60Hz)	0.150 – 0.50	66	79	Pass
	0.50 – 30	60	73	
Power – Neutral (120V/60Hz)	0.150 – 0.50	66	79	Pass
	0.50 – 30	60	73	
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client.				

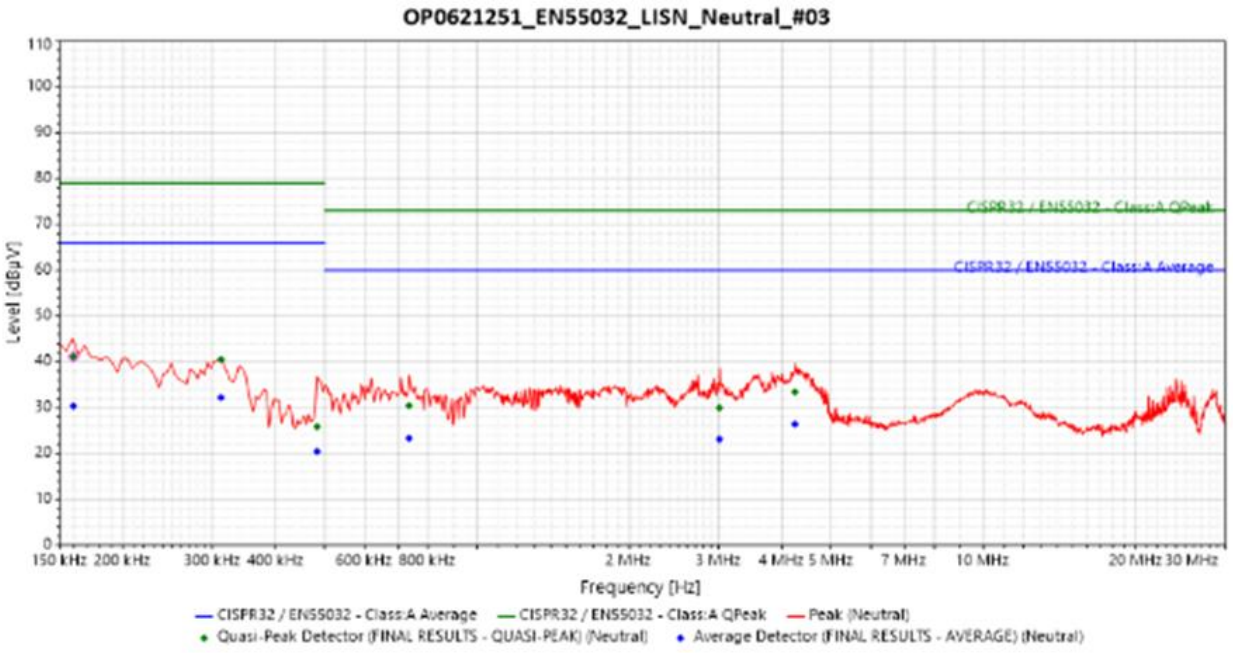
Table 7: Conducted Emissions – Test Results – FCC Part 15 Subpart B / ICES-003 Class A

10.1.4 Test Data

See APPENDIX A for data files.



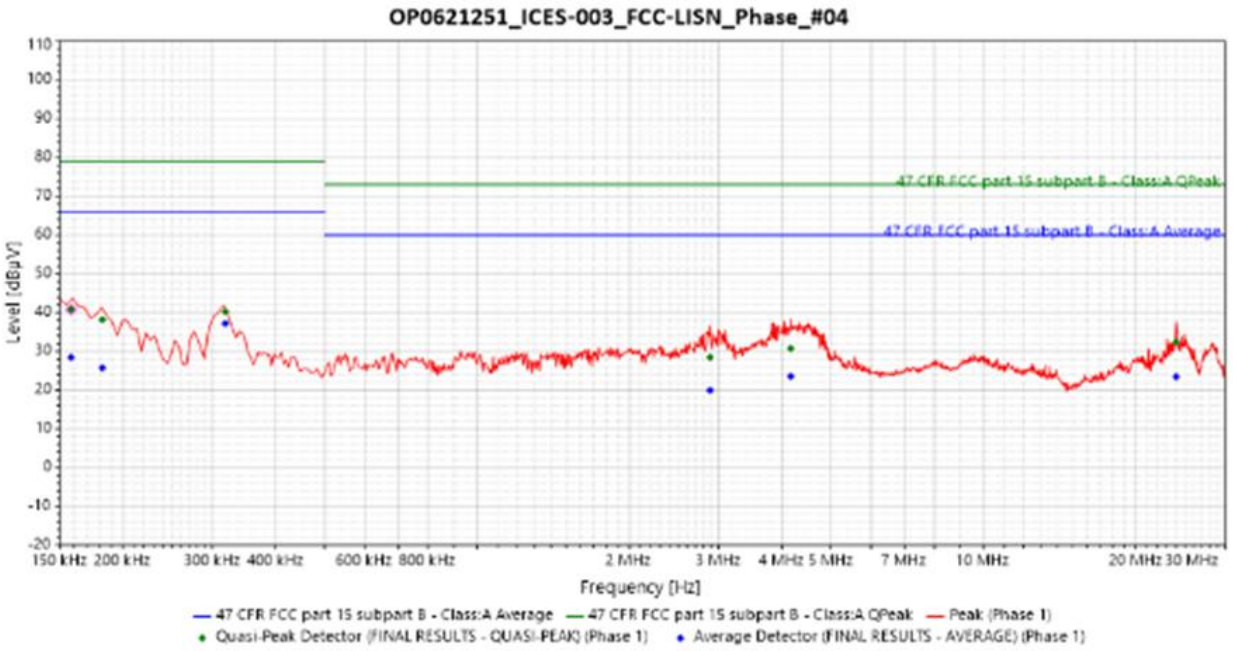
Graph 1: Conducted Emissions – EN55032 – Power – Phase



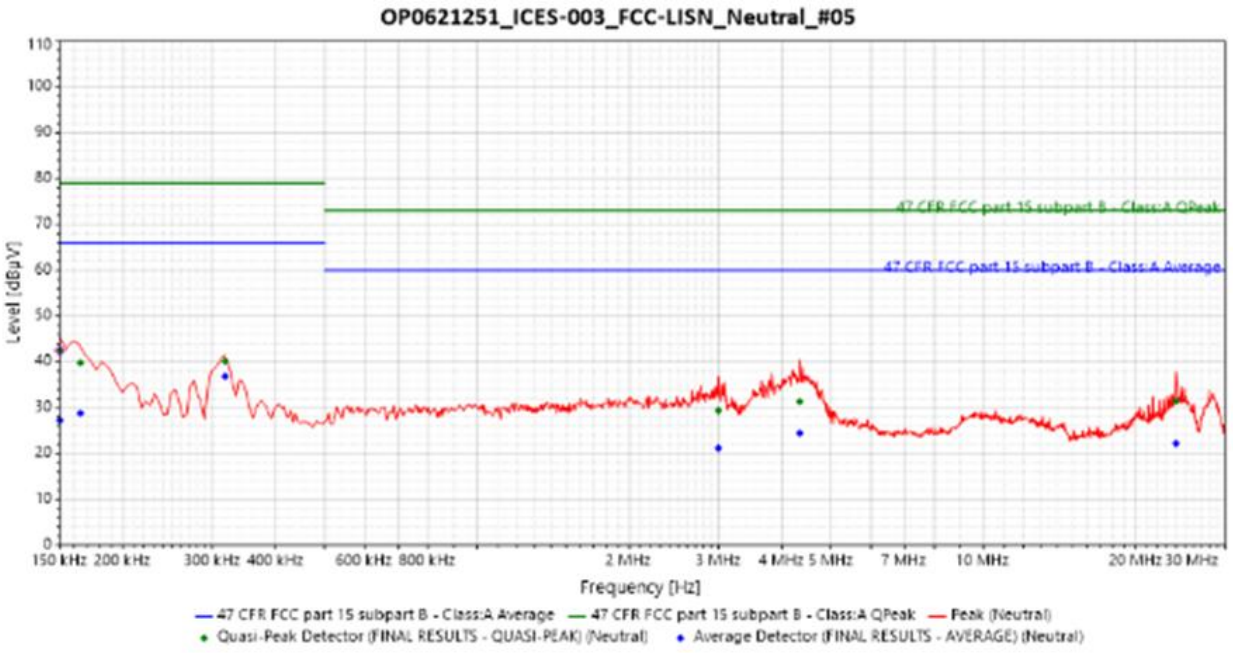
Graph 2: Conducted Emissions – EN55032 – Power – Neutral

Tested Line	Frequency (MHz)	Detector	Level (dBµV)	Limit (dBµV)	Bandwidth (kHz)	Measurement Time (s)	Margin
Power – Phase (230V/50Hz)	0.5690	Average	27.438	60.000	9 kHz	15	35.562
Power – Neutral (230V/50Hz)	4.2429	Average	26.434	60.000	9 kHz	15	33.566

Table 8: Conducted Emissions – Lowest Margin according to EN55032



Graph 3: Conducted Emissions – FCC part 15 Subpart B – Power – Phase



Graph 4: Conducted Emissions – FCC part 15 Subpart B – Power – Neutral

Tested Line	Frequency (MHz)	Detector	Level (dBµV)	Limit (dBµV)	Bandwidth (kHz)	Measurement Time (s)	Margin
Power – Phase (120V/60Hz)	0.3187	Average	37.187	66.000	9 kHz	15	28.813
Power – Neutral (120V/60Hz)	0.3182	Average	36.864	66.000	9 kHz	15	29.136

Table 9: Conducted Emissions – Lowest Margin according to FCC Part 15 Subpart B / ICES-003

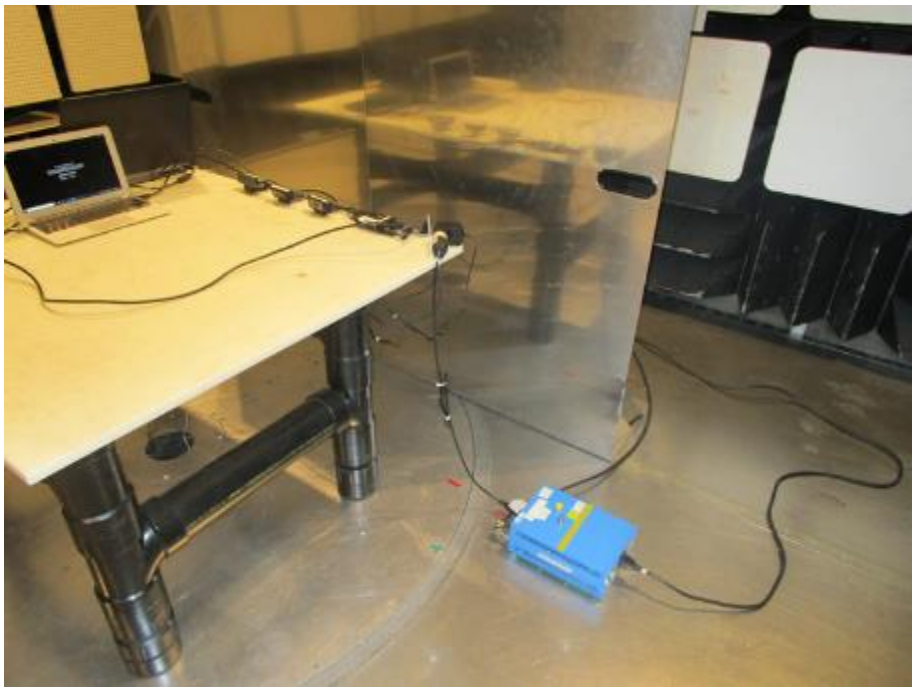


Photo 12: Conducted Emissions – Test Setup

10.1.5 Test Method

Conducted emissions were performed using the procedures of the reference standard.

Once the configuration or mode of operation causing the highest emission level (worst case) was determined, a scan was performed with the Peak detector in the frequency range specified by the reference standard.
Frequencies where level was above the limit or within 20dB of the limit were recorded. The level at these frequencies was measured with the detector specified by the limit.

10.2 Radiated Emissions

10.2.1 Test Details

REFERENCE STANDARD	CISPR 32 (2015) / EN 55032 (2015) A11 (2020) ANSI C63.4 (2014)

SPECIFICATIONS	
Limit	EN 55032 (2015) A11 (2020) class A FCC part 15 subpart B (2021) class A ICES-003 (2016) + Update (2019) class A
Frequency Range	30MHz – 1GHz
Measurement Distance	3m
Installation	Table-top equipment

EUT	
Identification	TOGGLE
Voltage Input	230V/50Hz

TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-15
Temperature °C (For Info Only)	23.4°C
Relative humidity % (For Info Only)	46.3%
Atmospheric pressure kPa (For Info Only)	101.7kPa
Operator	Jean Cadotte
Client Witness	Donatien Crémet (Inogeni) Gilles Chouinard (Inogeni)

10.2.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
TDK	Emission Anechoic Chamber	16706-1	5412	24	2022-09-04 (NSA) 2023-01-07 (SVSWR)
Sunol Sciences Corporation	Antenna Positioning Tower	TLT2	LABCEM #0181	N.C.R.	N.C.R.
Sunol Sciences Corporation	Flush Mount Turntable	FM2011VS/2022VS	LABCEM #0182	N.C.R.	N.C.R.
Sunol Sciences Corporation	System Controller	SC110V	LABCEM #0183	N.C.R.	N.C.R.
NEXIO	Software	BAT-EMC v2022.0.11.0	N/A	N/A	N/A
Rohde&Schwarz	EMI receiver	ESW44	101905	12	2023-01-19
Schaffner	Bilog antenna	CBL6112D	22617	24	2023-06-28

Table 10: Radiated Emissions – Test Equipment

10.2.3 Test Results

Frequency (MHz)	Quasi-Peak Limit extrapolated at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Results
30 – 230	50	-	-	Pass
230 – 1000	57	-	-	
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client.				

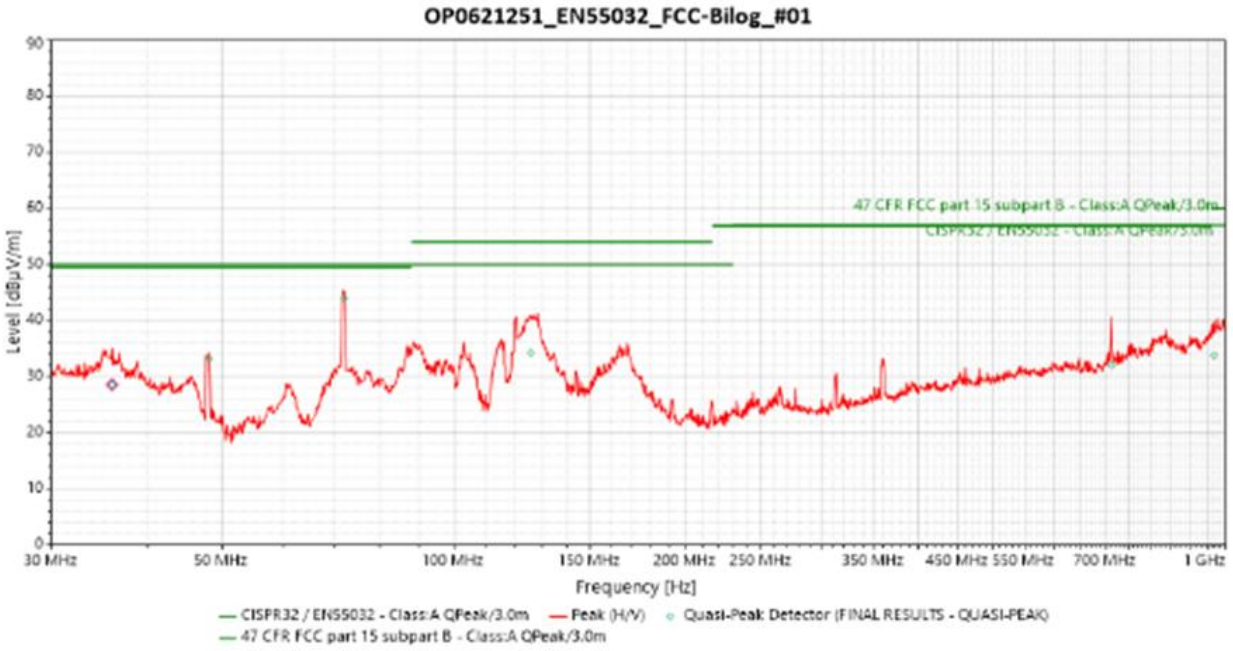
Table 11: Radiated Emissions – Test Results – EN55032 Class A

Frequency (MHz)	Quasi-Peak Limit extrapolated at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Results
30 – 88	49.5	-	-	Pass
88 – 216	54.0	-	-	
216 – 960	56.9	-	-	
960 – 1000	60.0	-	-	
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client.				

Table 12: Radiated Emissions – Test Results – FCC Part 15 Subpart B / ICES-003 Class A

10.2.4 Test Data

See APPENDIX B for data files.



Graph 5: Radiated Emissions 30MHz-1GHz

Frequency (MHz)	Detector	Level (dBµV/m)	Limit (dBµV/m)	Bandwidth (kHz)	Measurement Time(s)	Margin (dB)
72.0000	Quasi-Peak	44.001	50.000	120	15	5.999

Table 13: Radiated Emissions – Lowest Margin according to EN55032

Frequency (MHz)	Detector	Level (dBµV/m)	Limit (dBµV/m)	Bandwidth (kHz)	Measurement Time(s)	Margin (dB)
72.0000	Quasi-Peak	44.001	49.500	120	15	5.899

Table 14: Radiated Emissions – Lowest Margin according to FCC Part 15 Subpart B / ICES-003

Photo 13: Radiated Emissions – Test Setup

Photo 14: Radiated Emissions – Test Setup 30MHz-1GHz

Photo 15: Radiated Emissions – Support Equipment

10.2.5 Test Method

Radiated emissions were performed using the procedures of the reference standard.

Once the configuration or mode of operation causing the highest emission level (worst case) was determined, spectral previews were performed with the Peak detector in the frequency range specified by the reference standard.
Frequencies where level was above the limit or within 10 dB of the limit were recorded. The level at these frequencies was maximized and measured with the detector specified by the limit.

Note: FCC measurements combined with CISPR measurements for frequency above 1 GHz
Measurement methods of radiated emissions are slightly different between FCC regulation and CISPR standard. The FCC through ANSI C63.4 requires boresighting (tilt) and CISPR16-2-3 does not. For better efficiency, only the boresighting method is carried out, which may increase the level of disturbances during the final evaluation with the CISPR limit.

10.3 Harmonic Current Emissions

10.3.1 Test Details

REFERENCE STANDARD	EN IEC 61000-3-2 (2019) A1 (2021)
SPECIFICATIONS	
Limit	Class A
EUT	
Identification	TOGGLE
Voltage Input	230V/50Hz
TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-16
Temperature °C (For Info Only)	23.5°C
Relative humidity % (For Info Only)	45.3%
Atmospheric pressure kPa (For Info Only)	101.9kPa
Operator	Jean Cadotte
Client Witness	Donatien Crémet (Inogeni)

10.3.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
TESEQ	Software	Win2100 v4.9	N/A	N/A	N/A
TESEQ	AC-DC Power source	NSG 1007	1232A04499 (NSG 1007)	12	2022-09-14

Table 15: Harmonic Current Emissions – Test Equipment

10.3.3 Test Results

Class A ☒	Class B ☐	Class C ☐	Class D ☐

Class A:
Equipment not specified as belonging to Class B, C or D shall be considered as Class A equipment.

- balanced three-phase equipment;
- household appliances, excluding those specified as belonging to Class B, C or D;
- vacuum cleaners;
- high pressure cleaners;
- tools, excluding portable tools;
- independent phase control dimmers;
- audio equipment;
- professional luminaires for stage lighting and studios.

NOTE 1 Equipment that can be shown to have a significant effect on the supply system may be reclassified in a future of this document, taking into account the following factors:
– number of pieces of equipment in use;
– duration of use;
– simultaneity of use;
– power consumption;
– harmonic spectrum, including phase.

Class B:

- portable tools;
- arc welding equipment which is not professional equipment.

Class C:

- lighting equipment.

Class D:
Equipment having a specified power according to 6.3.2 less than or equal to 600 W, of the following types:

- personal computers and personal computer monitors;
- television receivers;
- refrigerators and freezers having one or more variable-speed drives to control compressor motor(s).

NOTE 2 Class D limits are reserved for equipment that, by virtue of the factors listed in note 1, can be shown to have a pronounced effect on the public electricity supply system.

*Starting and stopping
When a piece of equipment is brought into operation or is taken out of operation, manually or automatically, harmonic currents and power are not taken into account for the first 10 s following the switching event.
The equipment under test shall not be in stand-by mode (see 3.14) for more than 10 % of any observation period.

Table 16: Harmonic Current Emissions – Classification of Equipment

Tested Line	Limit	Observation Time (min)	Results
Power (230V/50Hz)	Class A	10	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client.			

Table 17: Harmonic Current Emissions – Test Results

10.3.4 Test Data

See APPENDIX C for data files

Photo 16: Harmonic Current Emissions – Test Setup

10.3.5 Test Method

Harmonic current emissions measurements were performed using the procedures of the reference standard.

10.4 Voltage Fluctuations and Flicker Measurements

10.4.1 Test Details

REFERENCE STANDARD	EN 61000-3-3 (2013) A1 (2019) A2 (2021)

SPECIFICATIONS	
P_{st} Observation Period	10 min
P_{lt} Observation Period	120 min

EUT	
Identification	TOGGLE
Voltage Input	230V/50Hz
Manual Switching	NO

TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-16
Temperature °C (For Info Only)	23.5°C
Relative humidity % (For Info Only)	45.3%
Atmospheric pressure kPa (For Info Only)	101.9kPa
Operator	Jean Cadotte
Client Witness	Donatien Crémet (Inogeni)

10.4.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
TESEQ	Software	Win2100 v4.9	N/A	N/A	N/A
TESEQ	AC-DC Power source	NSG 1007	1232A04499 (NSG 1007)	12	2022-09-14
TESEQ	Lumped impedance	CCN 1000-1	1232A04499 (CCN 1000-1)	12	2022-09-14

Table 18: Voltage Fluctuations and Flicker Measurements – Test Equipment

10.4.3 Test Results

Parameters	Limit	Results
Short-term flicker value: P_{st}	1.0	Pass
Long-term flicker value: P_{lt}	0.65	Pass
Voltage change for more than 500ms: d(t)	3.3%	Pass
Relative steady state voltage change: dc	3.3%	Pass
Maximum relative voltage change: d_{max}	4%	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client.		

Table 19: Voltage Fluctuations and Flicker Measurements – Test Results

10.4.4 Test Data

See APPENDIX D for data files

Test setup was identical to harmonic current emissions measurements.

10.4.5 Test Method

Voltage fluctuations and flicker measurements were performed using the procedures of the reference standard.

11 IMMUNITY TESTS

11.1 Electrostatic Discharge Immunity

11.1.1 Test Details

REFERENCE STANDARD	IEC 61000-4-2 (2008)
SPECIFICATIONS	
Test Level	Contact: ±4kV Air: ±2kV, ±4kV
Installation	Table-top equipment
Ungrounded Equipment	YES
PERFORMANCE CRITERION	B
EUT	
Identification	TOGGLE
Voltage Input	230V/50Hz
TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-18
Temperature Min 15°C – Max 35°C	24.1°C
Relative Humidity Min 30% - Max 60%	50.6%
Atmospheric Pressure Min 86kPa – Max 106kPa	101kPa
Operator	Jean Cadotte
Client Witness	Donatien Crémet (Inogeni)

11.1.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
Vaisala	Thermo-Hygrometer	MI70/HMP77	H4610004/JO430012	24	2023-08-13
EMC-Partner	Discharge Generator	ESD3000	1550	18	2023-04-06
EMC-Partner	Relay Module	ESD3000RM32	1892	18	2023-04-06
EMC-Partner	Discharge Network 150pF/330Ohms	ESD3000DN1	1551	18	2023-04-06

Table 20: ESD – Test Equipment

11.1.3 Test Results

Coupling Plane	Position	Polarity Test Level (kV)	Number	Time Interval (s)	Generator Perpendicular	Comments	Results
HCP	Front	±4	10+ / 10-	1	YES	No event	Pass
VCP	Front	±4	10+ / 10-	1	YES	No event	Pass
	Right	±4	10+ / 10-	1	YES	No event	Pass
	Rear	±4	10+ / 10-	1	YES	No event	Pass
	Left	±4	10+ / 10-	1	YES	No event	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.							

Table 21: ESD – Test Results – Indirect Discharges - TOGGLE

Coupling Plane	Position	Polarity Test Level (kV)	Number	Time Interval (s)	Generator Perpendicular	Comments	Results
HCP	Front	±4	10+ / 10-	1	YES	No event	Pass
VCP	Front	±4	10+ / 10-	1	YES	No event	Pass
	Right	±4	10+ / 10-	1	YES	No event	Pass
	Rear	±4	10+ / 10-	1	YES	No event	Pass
	Left	±4	10+ / 10-	1	YES	No event	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.							

Table 22: ESD – Test Results – Indirect Discharges - PSU

ESD Point	ESD Type	Test Level (kV)	Number	Time Interval (s)	Generator Perpendicular	Comments	Results
C1 to C8	Contact	±4	10+ / 10-	1	YES	No event	Pass
C9	Contact	±4	10+ / 10-	1	YES	Note 1	Pass
C10	Contact	±4	10+ / 10-	1	YES	No event	Pass
C11	Contact	±4	10+ / 10-	1	YES	Note 1	Pass
NONE	Air	±2, ±4, ±8	10+ / 10-	1	N/A	Note 2	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.							
Note 1: Self-recoverable degradation: Lost the picture on the desktop. Came back to normal by itself. This test result is considered as a Pass according to performance criteria defined in section 5 Note 2: After discharge points research, no possible air discharge was found on the EUT.							

Table 23: ESD – Test Results – Direct Discharges - TOGGLE

ESD Point	ESD Type	Test Level (kV)	Number	Time Interval (s)	Generator Perpendicular	Comments	Results
NONE	Contact	±4	10+ / 10-	1	N/A	Note 1	Pass
NONE	Air	±2, ±4, ±8	10+ / 10-	1	N/A	Note 2	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.							
Note 1: After discharge points research, no possible contact discharge was found on the EUT. Note 2: After discharge points research, no possible air discharge was found on the EUT.							

Table 24: ESD – Test Results – Direct Discharges - PSU

11.1.4 Test Data

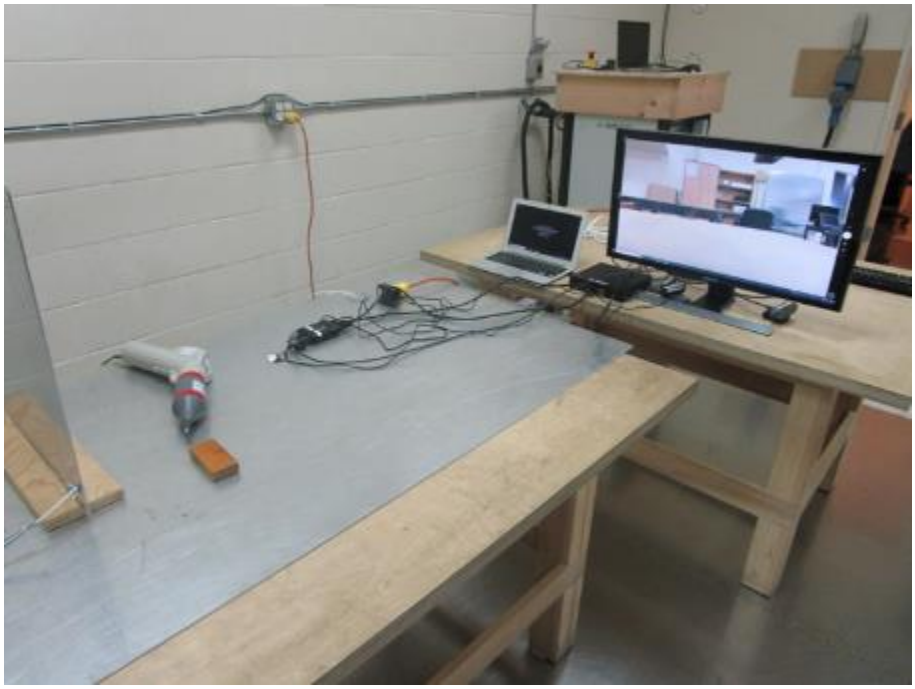


Photo 17: ESD – Test Setup

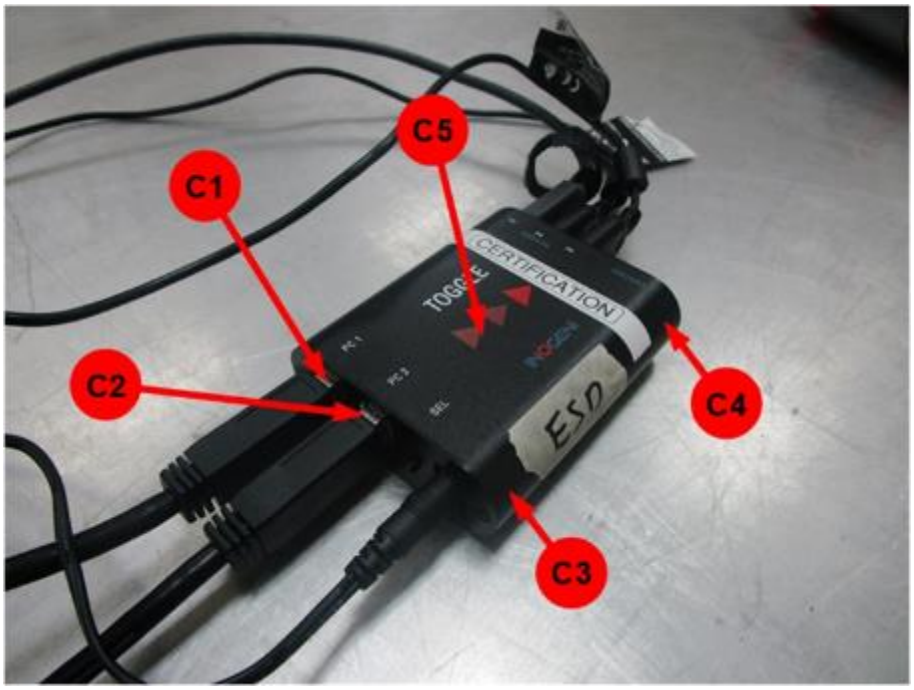


Photo 18: ESD – Location of Discharge Points #1

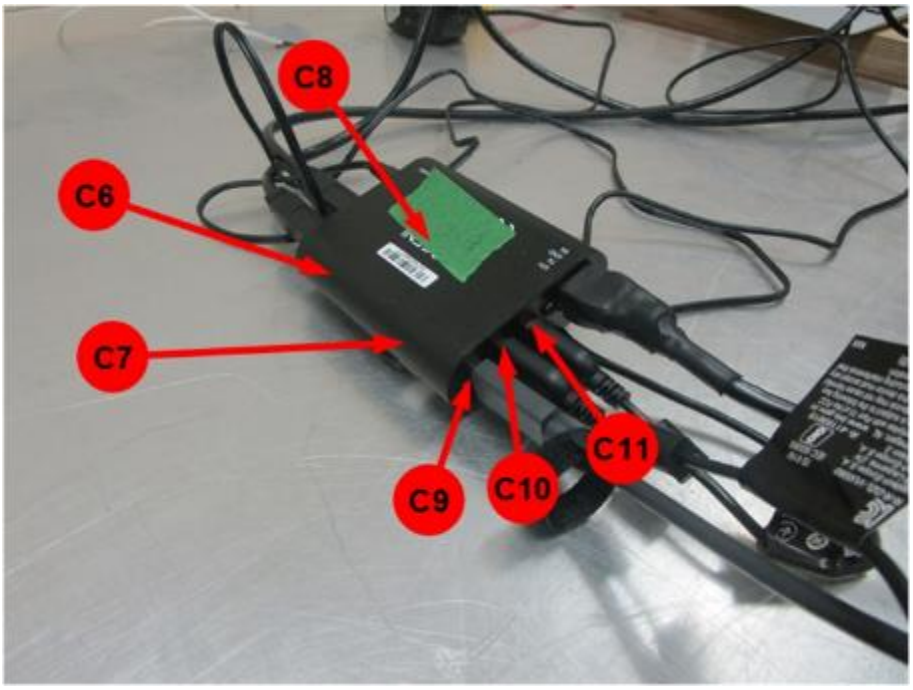


Photo 19: ESD – Location of Discharge Points #2

11.1.5 Test Method

Electrostatic discharge immunity tests were performed using the procedures of the reference standard.

Application of direct discharges was applied to points and surfaces of EUT which are accessible to person during normal use. If contact discharge cannot be applied, the air discharge method shall be performed.

Application of indirect discharges was applied to the horizontal coupling plane (0.1m from the front of EUT) and to vertical coupling plane (VCP is positioned at 0.1m from EUT in order to illuminate the four faces of EUT).

11.2 Radiated Electromagnetic Field Immunity

11.2.1 Test Details

REFERENCE STANDARD	IEC 61000-4-3 (2020)

SPECIFICATIONS			
TEST	#1	#2	#3
Frequency Range	80MHz-1000MHz	1.8GHz, 2.6GHz	3.5GHz, 5.0GHz
Test Level	3V/m	3V/m	3V/m
Test Distance	2m	2m	2.7m
Uniformity Field Area	1.5m x 1.5m Height @ 80cm	1.5m x 1.5m Height @ 80cm	1.5m x 1.5m Height @ 80cm
Modulation	AM 80% / 1kHz	AM 80% / 1kHz	AM 80% / 1kHz
Frequency Step	1%	N/A	N/A
Dwell Time	0.5s	10s	10s
Illuminated Face	4		
Installation	Table-top equipment		

PERFORMANCE CRITERION	A

EUT	
Identification	TOGGLE
Voltage Input	230V/50Hz

TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-17
Temperature °C (For Info Only)	23.7°C
Relative humidity % (For Info Only)	48.9%
Atmospheric pressure kPa (For Info Only)	101.9kPa
Operator	Jean Cadotte
Client Witness	Donatien Crémet (Inogeni)

11.2.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
TDK	Immunity Anechoic Chamber	16706-2	5712	N/A	N/A
NEXIO	Software	BAT-EMC v2022.0.11.0	N/A	N/A	N/A
TESEQ	Signal generator	ITS 6006	33007	12	2022-08-02 Note 1
Werlatone	Directional coupler (80MHz-1GHz)	C3908-10	98552	12	2022-12-22
Werlatone	Directional coupler (0.8GHz-3GHz)	C6721-10	98746	12	2022-12-22
Amplifier Research (AR)	Dual Directional Coupler, 2-8GHz, 600W	DC7281A	348875	12	2023-03-29
TESEQ	Power meter	PM 6006	72804	12	2022-08-05 Note 1
TESEQ	Power meter	PM 6006	72805	12	2022-08-05 Note 1
TESEQ	Power meter	PM 6006	77352	12	2022-08-05 Note 1
TESEQ	Power meter	PM 6006	77353	12	2022-08-05 Note 1
Rohde & Schwarz	3-Path Diode Power Sensor 10MHz-18GHz	NRP18SN	102193	12	2023-04-29
Rohde & Schwarz	3-Path Diode Power Sensor 10MHz-18GHz	NRP18SN	102192	12	2023-04-29
TESEQ	RF amplifier (80MHz-1GHz)	CBA 1G-500	T44193	VERIF	VERIF
TESEQ	RF amplifier (800MHz-3GHz)	CBA 3G-180	T44194	VERIF	VERIF
IFI	RF Amplifier (2GHz-8GHz)	T82-300	O1159-0710	VERIF	VERIF
Schwarzbeck	Antenna	STLP 9128 D special	9128DS 025	VERIF	VERIF
TESEQ	Horn Antenna	BHA9118	33053	24	2022-10-21
Narda	Electric Field Probe	PMM EP601	711WX80868	18	2022-10-28
LABCEM	RF Uniformity Field 80MHz-1GHz (36V/m)	N/A	N/A	12	2022-12-27
LABCEM	RF Uniformity Field 1GHz-3GHz (18V/m)	N/A	N/A	12	2022-12-27

LABCEM	RF Uniformity Field 3GHz-6GHz (18V/m)	N/A	N/A	12	2023-08-02
Note 1: The calibration of the equipment was extended by 30 days due to the replacement equipment being sent for repair.					

Table 25: Radiated EM Field – Test Equipment

11.2.3 Test Results

Illuminated Face	Frequencies (MHz)	Test Level (V/m)	Modulation	Polarization	Comments	Results
Front	80 - 1000	3	AM / 1kHz	Horizontal Vertical	No event Note1	Pass
	1800, 2600	3	AM / 1kHz	Horizontal Vertical	No event Note1	Pass
	3500, 5000	3	AM / 1kHz	Horizontal Vertical	No event Note1	Pass
Right	80 - 1000	3	AM / 1kHz	Horizontal Vertical	No event	Pass
	1800, 2600	3	AM / 1kHz	Horizontal Vertical	No event	Pass
	3500, 5000	3	AM / 1kHz	Horizontal Vertical	No event	Pass
Rear	80 - 1000	3	AM / 1kHz	Horizontal Vertical	No event	Pass
	1800, 2600	3	AM / 1kHz	Horizontal Vertical	No event	Pass
	3500, 5000	3	AM / 1kHz	Horizontal Vertical	No event	Pass
Left	80 - 1000	3	AM / 1kHz	Horizontal Vertical	No event	Pass
	1800, 2600	3	AM / 1kHz	Horizontal Vertical	No event	Pass
	3500, 5000	3	AM / 1kHz	Horizontal Vertical	No event	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.						
Note 1: 1m of cable was exposed to the electromagnetic field						

Table 26: Radiated EM Field – Test Results

11.2.4 Test Data

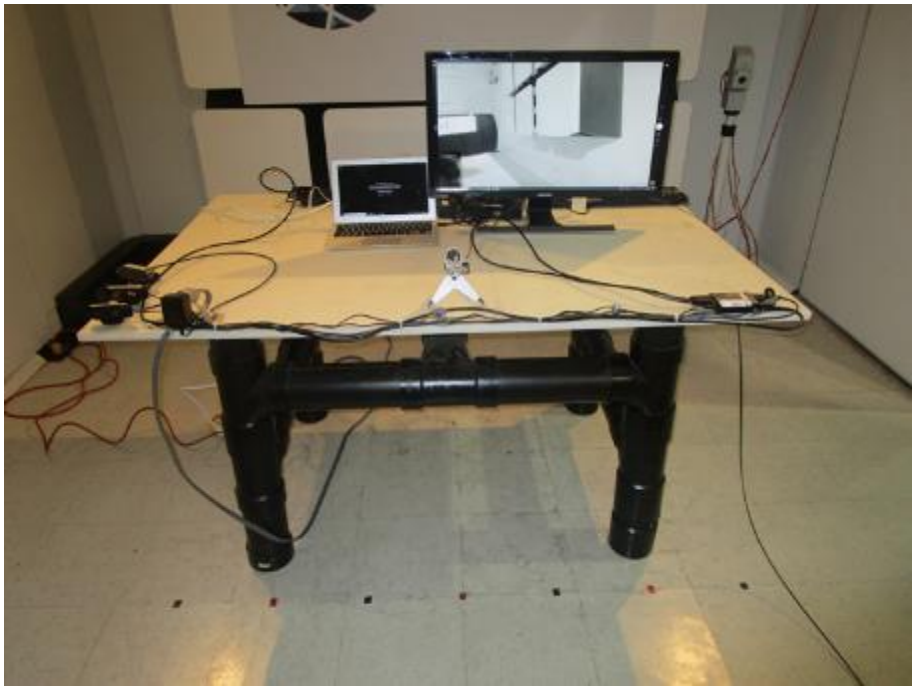


Photo 20: Radiated EM Field – Test setup – Front

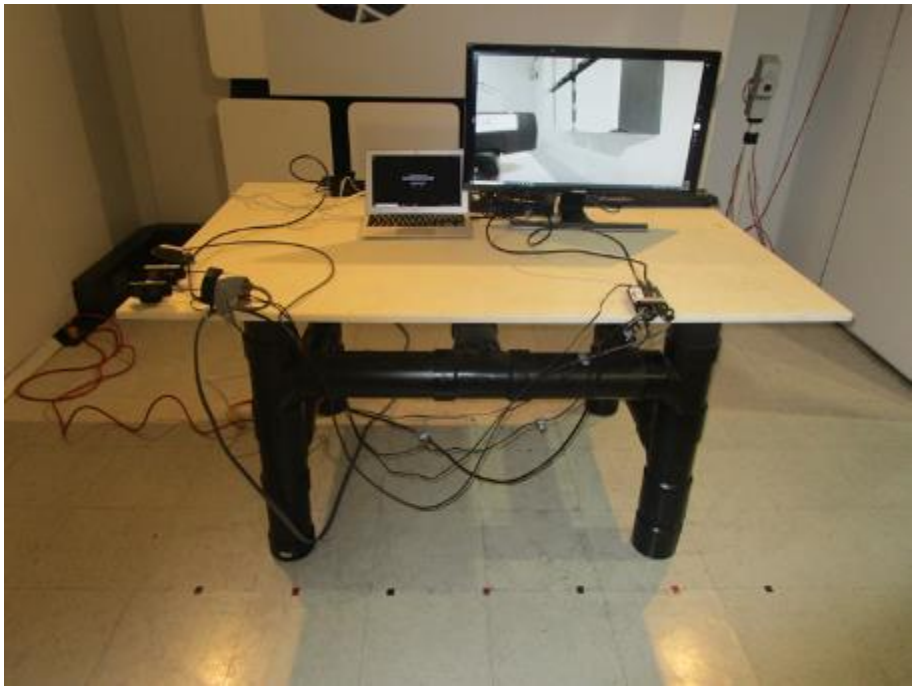


Photo 21: Radiated EM Field – Test setup – Right

Photo 22: Radiated EM Field – Test setup – Rear

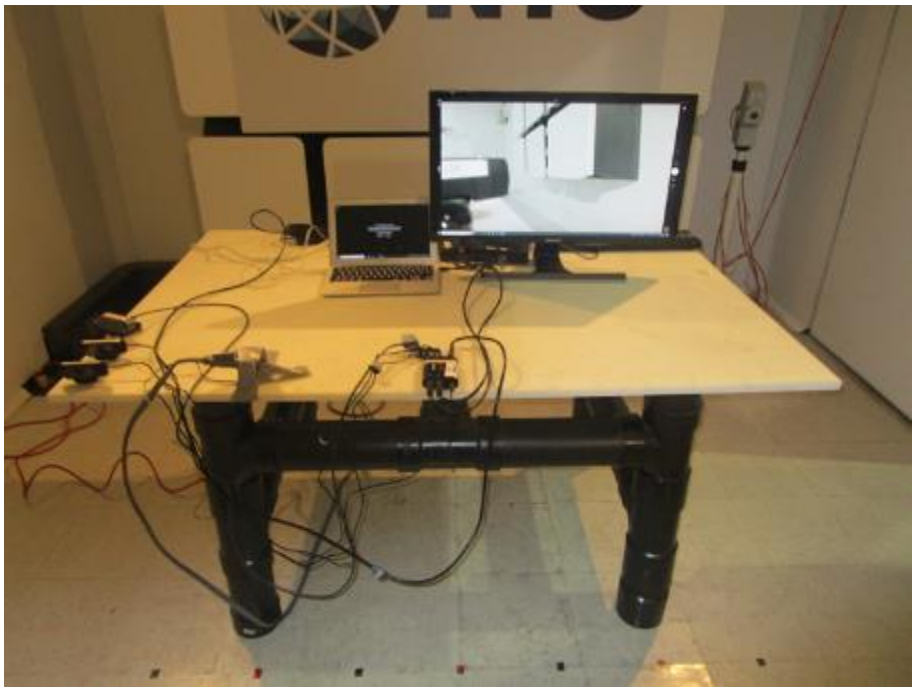


Photo 23: Radiated EM Field – Test setup – Left

Photo 24: Radiated EM Field – Test setup – >3GHz

11.2.5 Test Method

Radiated field immunity tests were performed using the procedures of the reference standard.

During the first illuminated face of EUT, radiated immunity test equipment's were verified by monitoring the EM field.

11.3 Electrical Fast Transient Immunity

11.3.1 Test Details

REFERENCE STANDARD	IEC 61000-4-4 (2012)
SPECIFICATIONS	
Test Level	Power Ports: ±1kV I/O Ports: ±0.5kV Communication Ports: ±0.5kV
Repetition Frequency	5kHz
Installation	Table-top equipment
PERFORMANCE CRITERION	B
EUT	
Identification	TOGGLE
Voltage Input	230V/50Hz
TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-18
Temperature °C (For Info Only)	23.9°C
Relative humidity % (For Info Only)	50.9%
Atmospheric pressure kPa (For Info Only)	101kPa
Operator	Lyes Rahni
Client Witness	Donatien Crémet (Inogeni)

11.3.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
TESEQ	Software	Win3000 v1.3.2	N/A	N/A	N/A
TESEQ	Multifunction generator	NSG 3040	1918	12	2022-09-08
TESEQ	EFT Clamp	CDN 3425	1730	VERIF	VERIF

Table 27: EFT – Test Equipment

11.3.3 Test Results

Tested Line	Polarity Test level (kV)	Coupling Method	Repetition Frequency (kHz)	Test Duration By Polarity (s)	Comments	Results
L, N, PE	±1	CDN	5	60	No event	Pass
PC1 – PC2 (USB)	±0.5	Capacitive clamp	5	60	No event	Pass
Serial	±0.5	Capacitive clamp	5	60	No event	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.						

Table 28: EFT – Test Results

11.3.4 Test Data

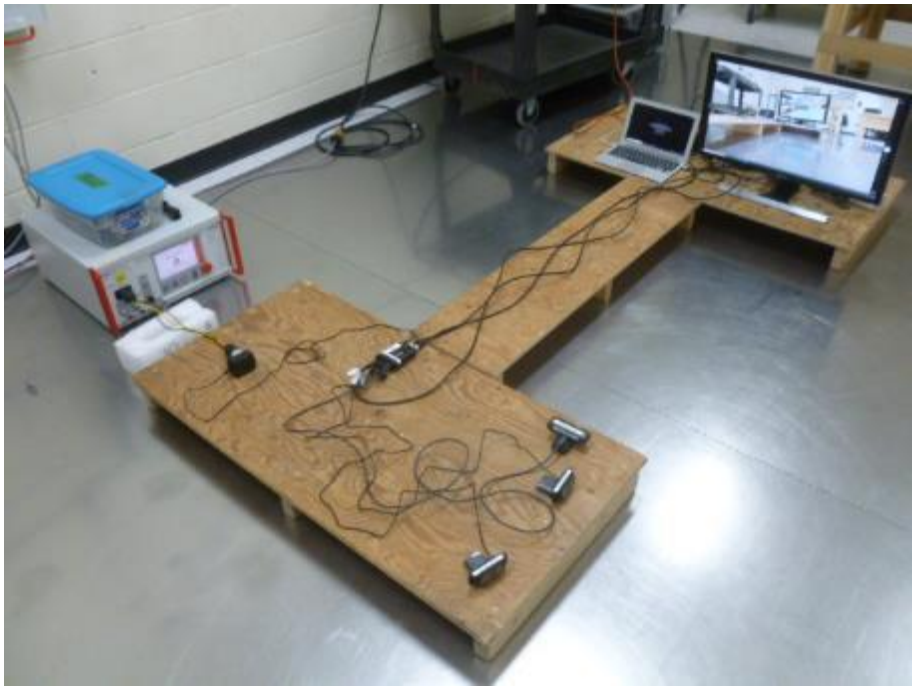


Photo 25: EFT – Test Setup

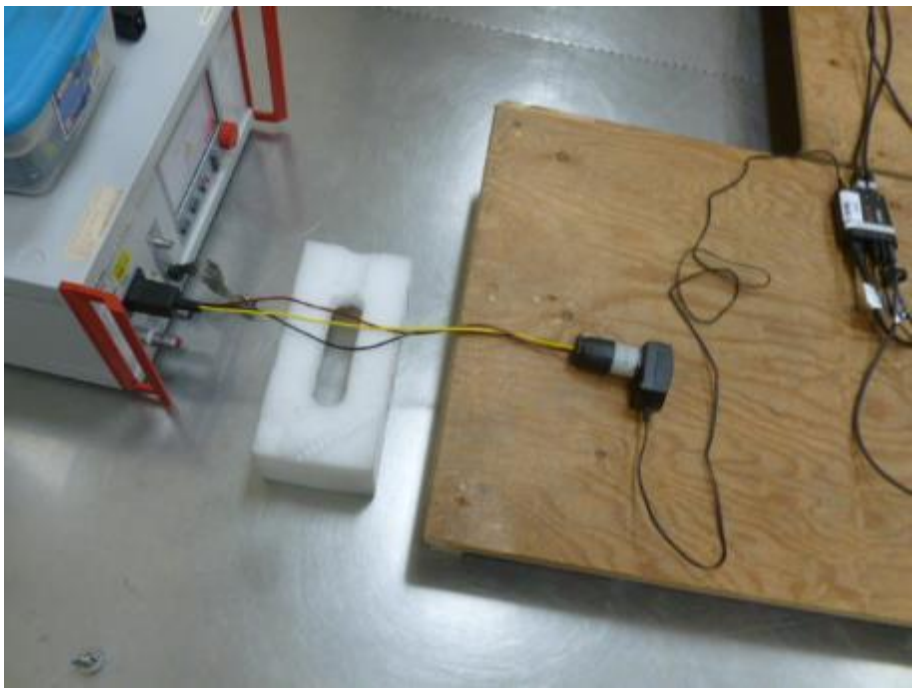


Photo 26: EFT – Test Setup – CDN – Power

Photo 27: EFT – Test Setup – Capacitive Clamp – PC1 – PC2 (USB)

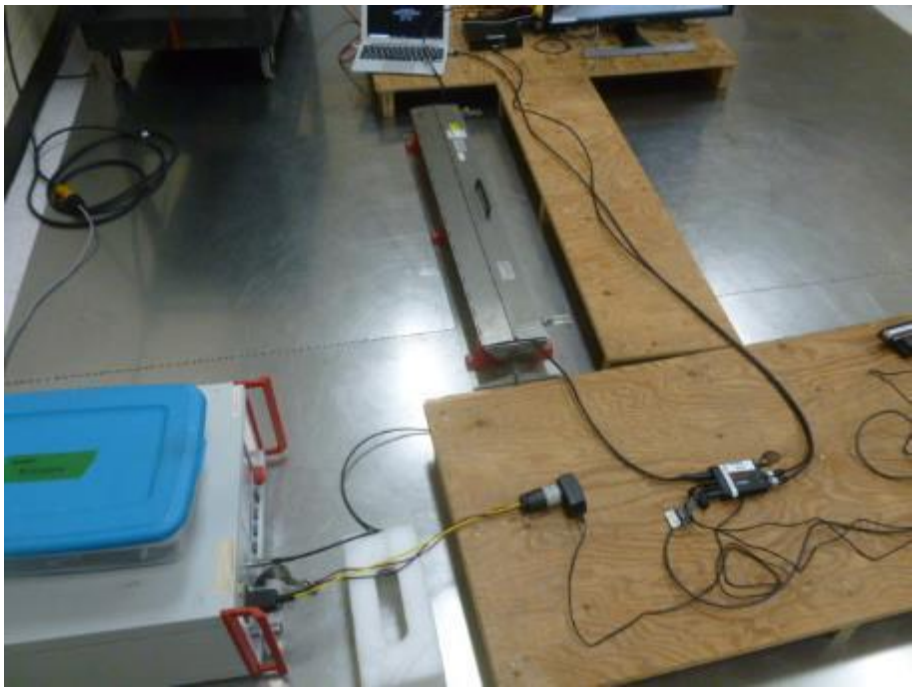


Photo 28: EFT – Test Setup – Capacitive Clamp – Serial

11.3.5 Test Method

Electrical fast transient immunity tests were performed using the procedures of the reference standard.

11.4 Surge Immunity

11.4.1 Test Details

REFERENCE STANDARD	IEC 61000-4-5 (2014) A1 (2017)
SPECIFICATIONS	
1.2/50µs Waveform	Open-Circuit Voltage: 1.2µs/50µs Short-Circuit Current: 8µs/20µs
Test level	Power: ±2kV L-PE / ±1kV L-L I/O Ports: N/A Communication Ports: N/A
PERFORMANCE CRITERION	B
EUT	
Identification	TOGGLE
Voltage Input	230V/50Hz
TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-18
Temperature °C (For Info Only)	23.9°C
Relative humidity % (For Info Only)	50.9%
Atmospheric pressure kPa (For Info Only)	101kPa
Operator	Lyes Rahni
Client Witness	Donatien Crémet (Inogeni)

11.4.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
TESEQ	Software	Win3000 v1.3.2	N/A	N/A	N/A
TESEQ	Multifunction generator	NSG 3040	1918	12	2022-09-08

Table 29: Surge – Test Equipment

11.4.3 Test Results

Application		Polarity Test Level (kV)	Additional Impedance	Number	Interval (s)	Phase Shifting (°)	Comments	Results
between	and							
L	PE	±0.5 ±1 ±2	10Ω	5+	30	90	Note 1	Pass
						270	Note 1	Pass
N	PE	±0.5 ±1 ±2	10Ω	5+	30	90	Note 1	Pass
						270	Note 1	Pass
L	N	±0.5 ±1	0Ω	5+	30	90	No event	Pass
						270	No event	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.								
Note 1: EUT without PE, no L vs PE test performed								

Table 30: 1.2/50µs Surge – Test Results – Power Ports

11.4.4 Test Data

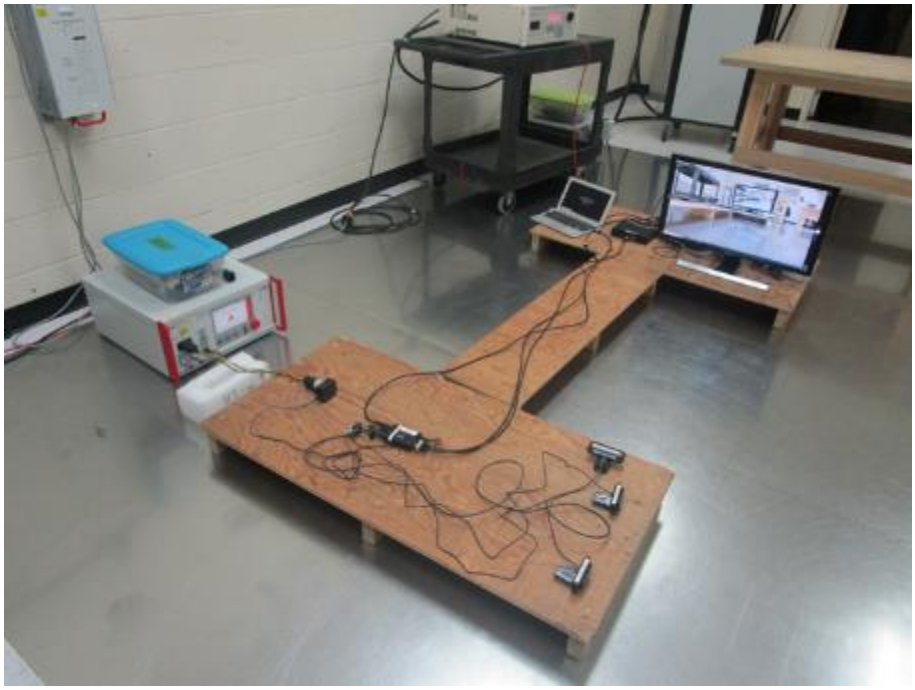


Photo 29: 1.2/50µs Surge – Test Setup – Power Ports

11.4.5 Test Method

Surge immunity tests were performed using the procedures of the reference standard.

11.5 Conducted Disturbances Immunity

11.5.1 Test Details

REFERENCE STANDARD	IEC 61000-4-6 (2013)

SPECIFICATIONS	
Test level	Power: 3Vrms I/O Ports: 3Vrms Communication Ports: 3Vrms
Frequency Range	150kHz-80MHz
Modulation	AM: 80% / 1kHz
Frequency Step	1%
Dwell Time	0.5s

PERFORMANCE CRITERION	A

EUT	
Identification	TOGGLE
Voltage Input	230V/50Hz

TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-17
Temperature °C (For Info Only)	23.7°C
Relative humidity % (For Info Only)	48.9%
Atmospheric pressure kPa (For Info Only)	101.9kPa
Operator	Jean Cadotte
Client Witness	Donatien Crémet (Inogeni)

11.5.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
NEXIO	Software	BAT-EMC v2022.0.11.0	N/A	N/A	N/A
TESEQ	Conducted Immunity Test Generator	NSG 4070C-110	59017	12	2023-01-25
TESEQ	CDN M2/M3	CDN M016	34597	24	2022-09-24
TESEQ	CDN M2	CDN M216	32740	24	2022-09-24
TESEQ	EM Clamp	KEMZ 801A	33460	24	2022-09-22
TESEQ	Attenuation Clamp	KEMA 801A	33174	NCR	NCR
Pasternack	6dB Fixed Attenuator 150W	PE7AP150-06	LABCEM #0287	VERIF	VERIF
LABCEM	Laboratory 3 - Conducted Voltage Immunity Calibration CDN-M2 - CI Injection Cable	N/A	N/A	12	2023-08-03
LABCEM	Laboratory 3 - Conducted Voltage Immunity Calibration EM Clamp (sn:33460) - CI Injection Cable + CI Monitoring Cable	N/A	N/A	12	2023-08-03

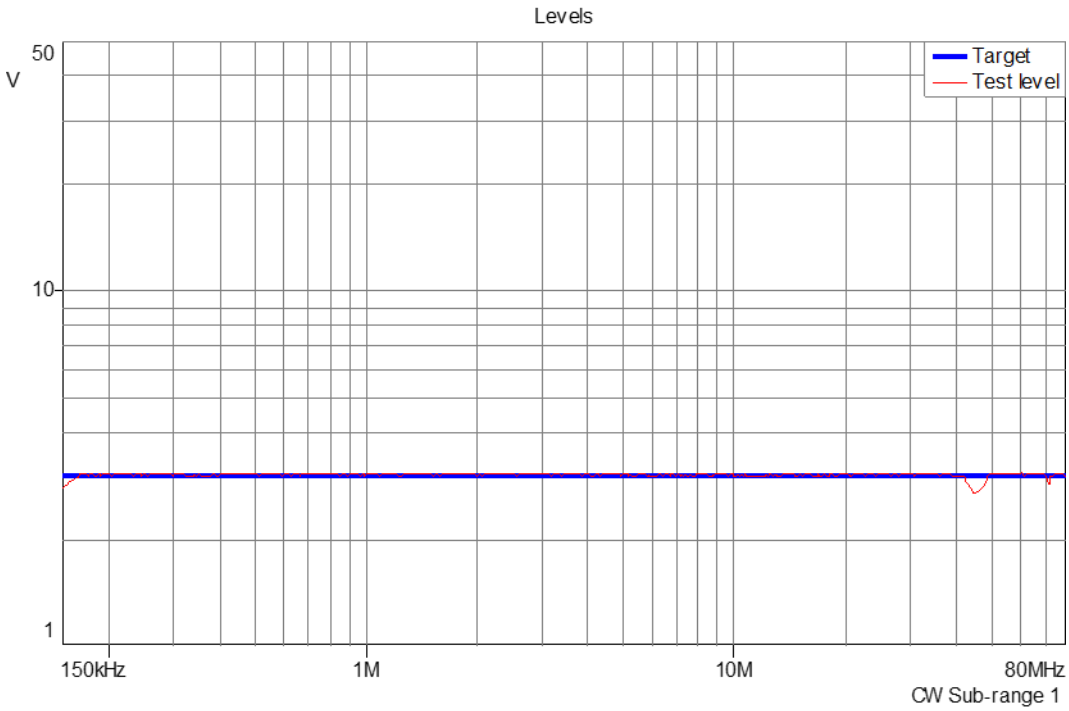
Table 31: Conducted Disturbances – Test Equipment

11.5.3 Test Results

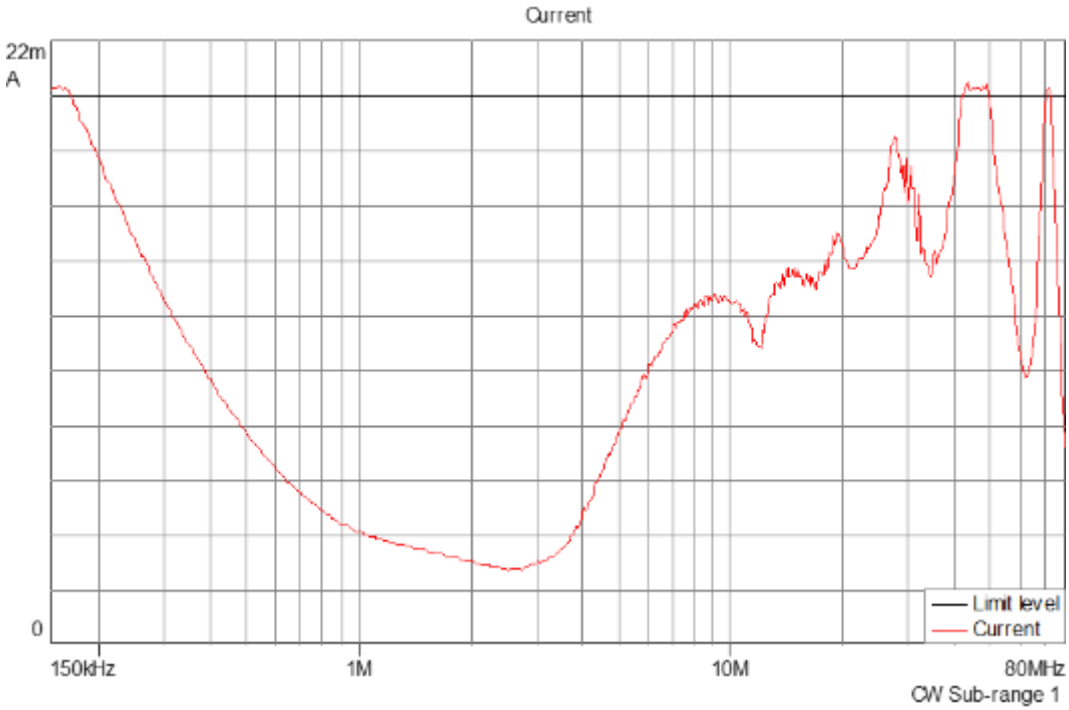
Tested Line	Coupling Method	Frequency (MHz)	Test Level (V)	Modulation	Comments	Results
Power (230V/50Hz)	CDN-M2	0.150 - 80	3	AM / 1kHz	No event	Pass
PC1, PC2 (USB)	EM Clamp	0.150 - 80	3	AM / 1kHz	No event	Pass
Serial	EM Clamp	0.150 - 80	3	AM / 1kHz	No event	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.						

Table 32: Conducted Disturbances – Test Results

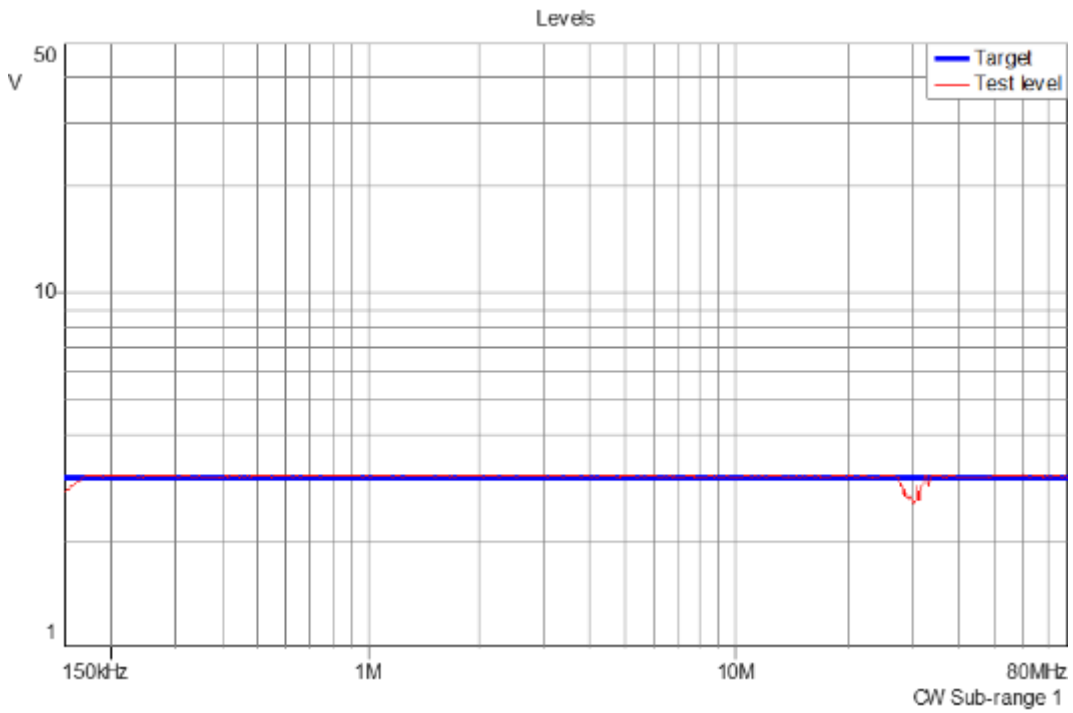
11.5.4 Test Data



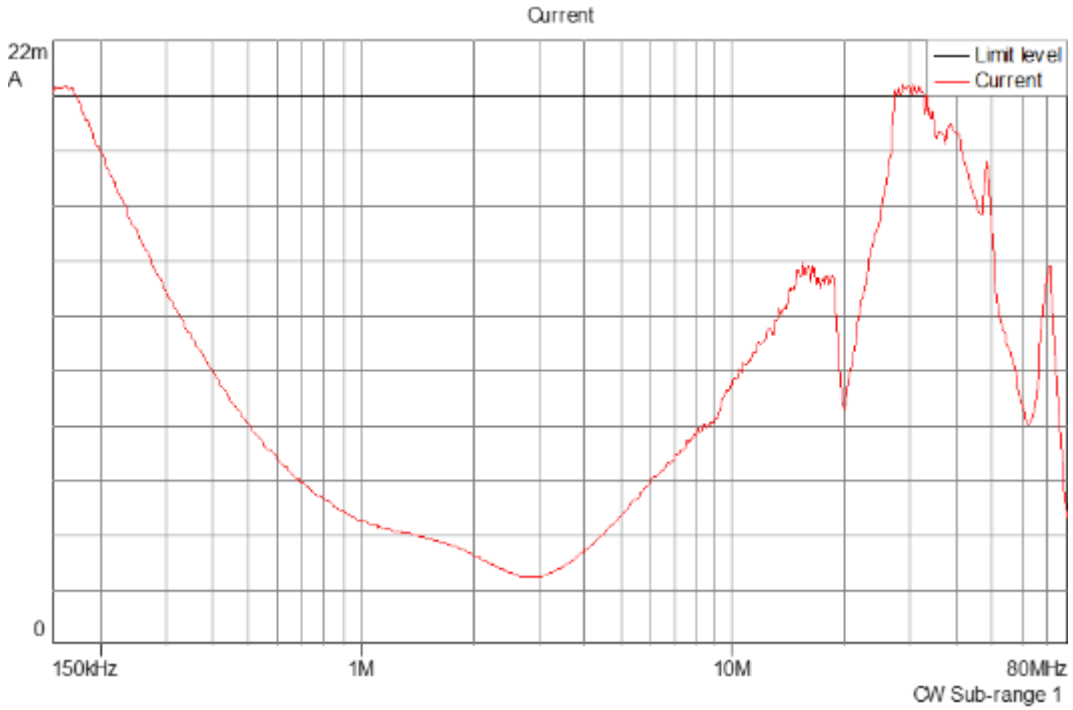
Graph 6: Conducted Disturbances – Voltage Level – EM Clamp – PC1 – PC2 (USB)



Graph 7: Conducted Disturbances – Current Measurements – EM Clamp – PC1 – PC2 (USB)



Graph 8: Conducted Disturbances – Voltage Level – EM Clamp – Serial



Graph 9: Conducted Disturbances – Current Measurements – EM Clamp – Serial

Photo 30: Conducted Disturbances – Test Setup

Photo 31: Conducted Disturbances – Test Setup – CDN – Power

Photo 32: Conducted Disturbances – Test Setup – EM Clamp – PC1 – PC2 (USB)

Photo 33: Conducted Disturbances – Test Setup – EM Clamp – Serial

11.5.5 Test Method

Conducted Disturbances immunity tests were performed using the procedures of the reference standard.

11.6 Power Frequency Magnetic Field Immunity

11.6.1 Test Details

REFERENCE STANDARD	IEC 61000-4-8 (2009)
SPECIFICATIONS	
Test Level	Continuous field: 1A/m (60s)
Frequency	50Hz / 60Hz
Induction Coil	1m x 1m
PERFORMANCE CRITERION	A
EUT	
Identification	TOGGLE
Voltage Input	230V/50Hz 120V/60Hz
TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-18
Temperature °C (For Info Only)	24.1°C
Relative humidity % (For Info Only)	50.6%
Atmospheric pressure kPa (For Info Only)	101kPa
Operator	Jean Cadotte
Client Witness	Donatien Crémet (Inogeni)

11.6.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
TESEQ	Software	Win2120 v6.0 BETA	N/A	N/A	N/A
TESEQ	AC-DC Power source	NSG 1007	1232A04499 (NSG 1007)	12	2022-09-14
TESEQ	Magnetic coil interface	INA 2141	1417	NCR	NCR
TESEQ	Magnetic coil	INA 703	1978	VERIF	VERIF
Fluke	Digital Clamp Meter	353	21950072	12	2023-07-25
F.W. Bell	ELF Meter	4190	1237005	24	2022-10-08

Table 33: Magnetic Field – Test Equipment

11.6.3 Test Results

Position	Frequency (Hz)	Test Level (A/m)	Test Duration (s)	Comments	Results
1	50	1	60	No event	Pass
2	50	1	60	No event	Pass
3	50	1	60	No event	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.					

Table 34: Magnetic Field – Test Results – 230V/50Hz

Position	Frequency (Hz)	Test Level (A/m)	Test Duration (s)	Comments	Results
1	60	1	60	No event	Pass
2	60	1	60	No event	Pass
3	60	1	60	No event	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.					

Table 35: Magnetic Field – Test Results – 120V/60Hz

11.6.4 Test Data

Photo 34: Magnetic Field – Test Setup – Position #1

Photo 35: Magnetic Field – Test Setup – Position #2

Photo 36: Magnetic Field – Test Setup – Position #3

11.6.5 Test Method

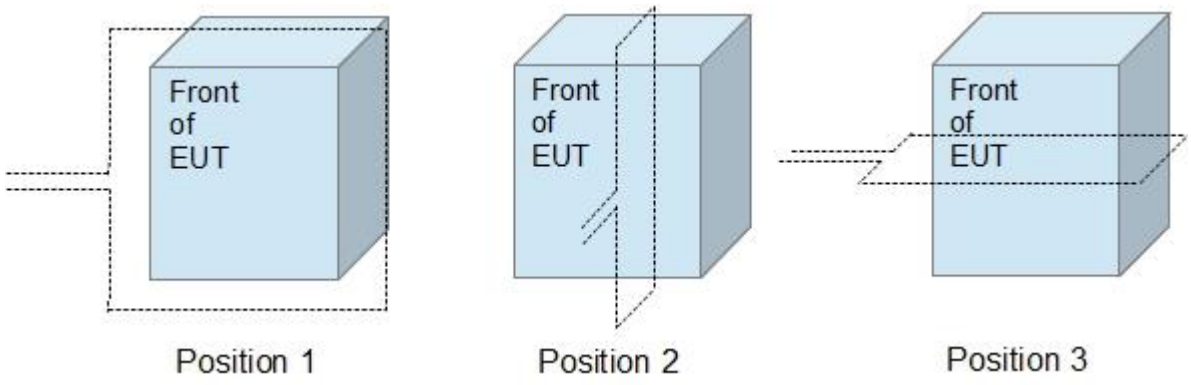


Figure 2: Magnetic Field – Position of Induction Coil

Power frequency field magnetic immunity tests were performed using the procedures of the reference standard.

11.7 Voltage Dips, Short Interruptions and Voltage Variation Immunity on AC input

11.7.1 Test Details

REFERENCE STANDARD	IEC 61000-4-11 (2020)

SPECIFICATIONS	
Voltage Dips	0%Un: ½ cycle 70%Un: 25 cycles 70%Un: 30 cycles
Short Interruptions	0%Un: 250 cycles 0%Un: 300 cycles

PERFORMANCE CRITERION	0%Un / ½ cycle: B 70%Un / 25 cycles: C 70%Un / 30 cycles: C 0%Un / 250 cycles: C 0%Un / 300 cycles: C

EUT	
Identification	TOGGLE
Voltage Input	240V/50Hz 100V/60Hz

TEST INFO	
Test Date (yyyy-mm-dd)	2022-08-18
Temperature °C (For Info Only)	23.9°C
Relative humidity % (For Info Only)	50.9%
Atmospheric pressure kPa (For Info Only)	101kPa
Operator	Jean Cadotte
Client Witness	Donatien Crémet (Inogeni)

11.7.2 Test Equipment

Manufacturer	Description	Model	Serial No	Calibration Cycle (month)	Next Calibration (y-m-d)
TESEQ	Software	Win3000 v1.3.2	N/A	N/A	N/A
TESEQ	Multifunction generator	NSG 3040	1918	12	2022-09-08
TESEQ	Step transformer	INA 6502	190	12	2022-09-08

Table 36: Voltage Variations on AC Input – Test Equipment

11.7.3 Test Results

Tested line	Test Level (% Un)	Duration (Cycle)	Number	Interval (s)	Phase Shifting (°)	Comments	Results
Power (240V/50Hz)	0	1/2	3	10	0	No event	Pass
	70	25	3	10	0	No event	Pass
	0	250	3	10	0	Note 1	Pass
Power (100V/60Hz)	0	1/2	3	10	0	No event	Pass
	70	30	3	10	0	No event	Pass
	0	300	3	10	0	Note 1	Pass
The decision rule used to determine the test results is based on the limits stated in the test standard and the functional requirement provided by the client. See section 5 for further detail.							
Note 1: Self-recoverable degradation: EUT turned off during the interruptions. Came back to normal by itself. This test result is considered as a Pass according to performance criteria defined in section 5							

Table 37: Voltage Variations on AC Input – Test Results

11.7.4 Test Data

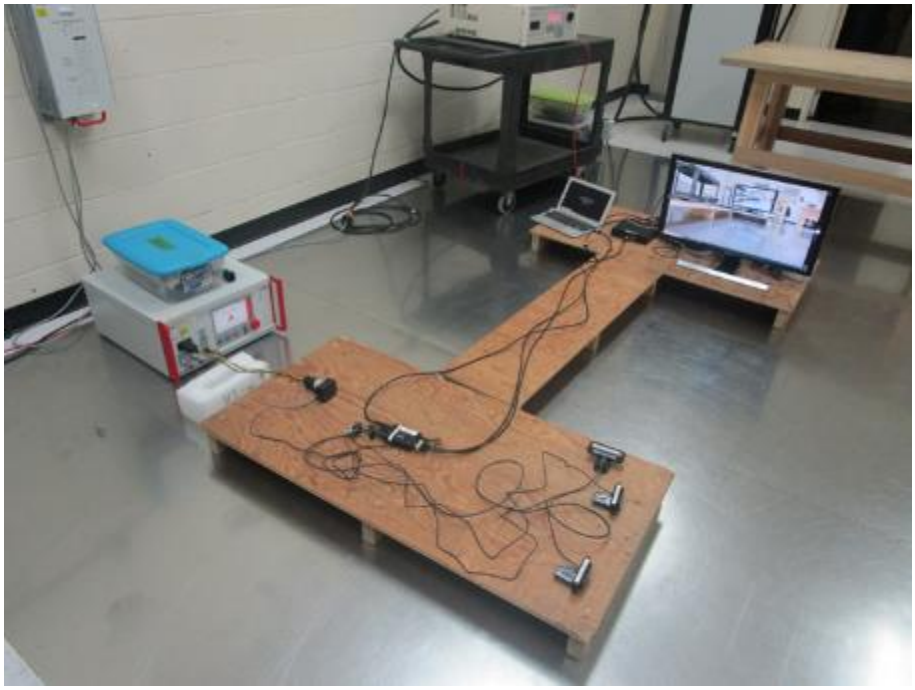


Photo 37: Voltage Variations on AC Input – Test Setup

11.7.5 Test Method

Voltage dips, short interruptions and voltage variation on AC Input immunity tests were performed using the procedures of the reference standard.

APPENDIX A
CONDUCTED EMISSIONS

CONDUCTED EMISSIONS - VOLTAGE
page 1 / 2

Project: OP0621251 ***Customer: Inogeni***

DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

Equipment: TOGGLE
Manufacturer: Inogeni
Hardware Version:
Software Version:

CONDUCTED EMISSIONS MEASUREMENT: *OP0621251_EN55032_LISN_Phase_#02*

Test Location: Anechoic chamber
Test Date: 2022-08-16 2:58:55 PM
Operator(s): Jean Cadotte
Test Standard: EN55032 Class A
Power: 230V/50Hz
Tested Line: Phase
Operating Mode:
Comments:

TEST PARAMETERS

Frequency Range
150 kHz - 30 MHz

Bandwidth
9 kHz

TEST EQUIPMENT USED

LF#1+LF#2

LISN : PMM L2-16B#20813-yellow
Rohde & Schwarz : ESW44

FINAL RESULTS - QUASI-PEAK

Frequency	SR #	Quasi-Peak Detector (dBµV)	Quasi-Peak Limit (dBµV)	Margin (dB)	Correction (dB)
160.022 kHz	1	41.422	79	37.578	-0.05
312.846 kHz	1	40.405	79	38.595	-0.058
568.989 kHz	1	31.352	73	41.648	-0.075
724.762 kHz	1	28.152	73	44.848	-0.07
4.212301 MHz	1	32.736	73	40.264	-0.019
24.084317 MHz	1	29.078	73	43.922	0.362

FINAL RESULTS - AVERAGE

Frequency	SR #	Average Detector (dBµV)	Average Limit (dBµV)	Margin (dB)	Correction (dB)
160.022 kHz	1	30.245	66	35.755	-0.05
312.846 kHz	1	32.937	66	33.063	-0.058
568.989 kHz	1	27.438	60	32.562	-0.075
724.762 kHz	1	21.84	60	38.16	-0.07
4.212301 MHz	1	25.411	60	34.589	-0.019
24.084317 MHz	1	18.235	60	41.765	0.362

PR / OP0621251_EN55032_LISN_Phase_#02

CONDUCTED EMISSIONS - VOLTAGE
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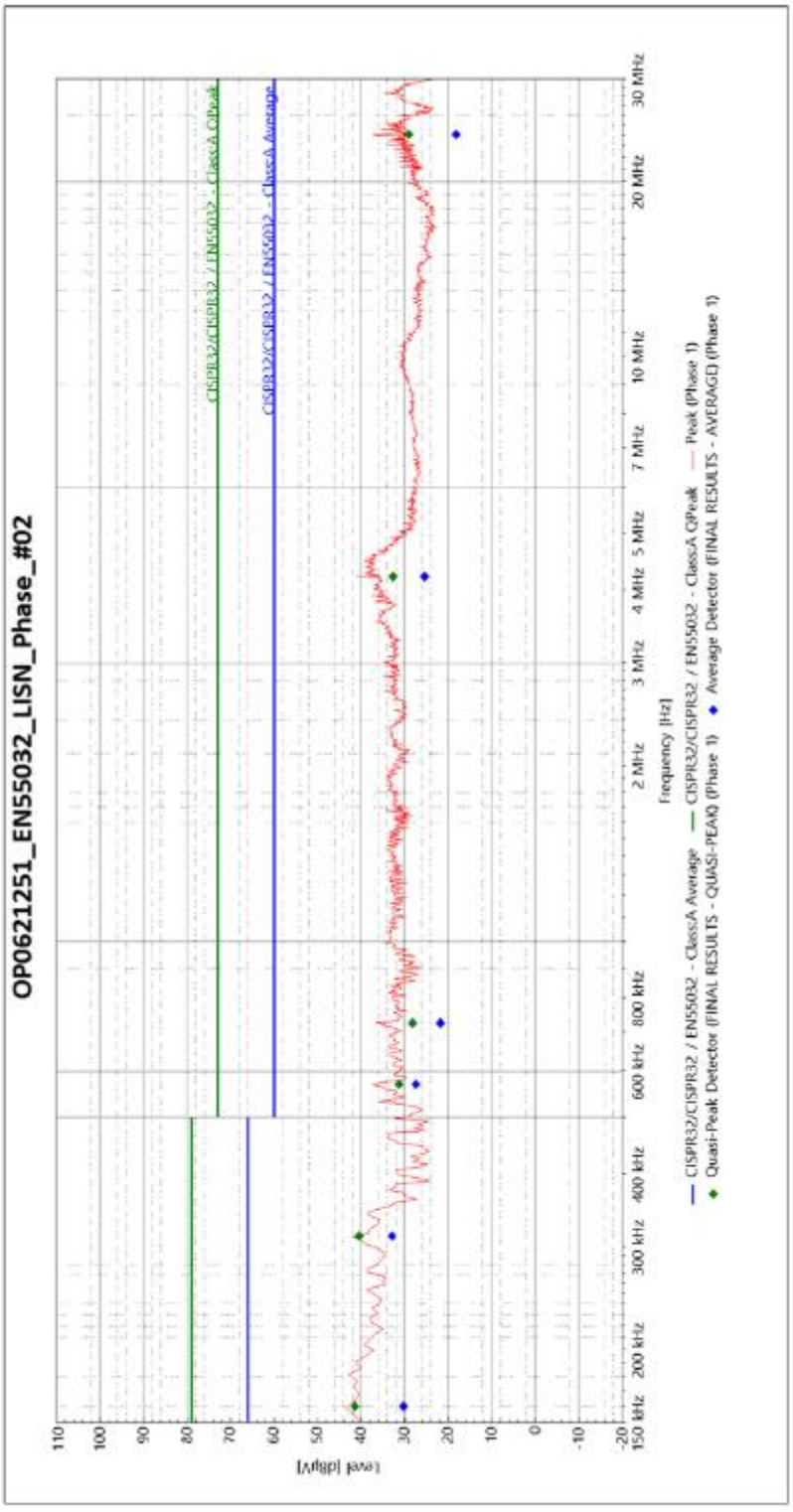

PR / OP0621251_EN55032_LISN_Phase_#02

CONDUCTED EMISSIONS - VOLTAGE
page 1 / 2

Project: OP0621251 ***Customer: Inogeni***

DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

Equipment: TOGGLE
Manufacturer: Inogeni
Hardware Version:
Software Version:

CONDUCTED EMISSIONS MEASUREMENT: *OP0621251_EN55032_LISN_Neutral_#03*

Test Location: Anechoic chamber
Test Date: 2022-08-16 3:13:26 PM
Operator(s): Jean Cadotte
Test Standard: EN55032 Class A
Power: 230V/50Hz
Tested Line: Neutral
Operating Mode:
Comments:

TEST PARAMETERS		TEST EQUIPMENT USED
Frequency Range 150 kHz - 30 MHz	Bandwidth 9 kHz	LF#1+LF#2 LISN : PMM L2-16B#20813-yellow Rohde & Schwarz : ESW44

FINAL RESULTS - QUASI-PEAK

Frequency	SR #	Quasi-Peak Detector (dBµV)	Quasi-Peak Limit (dBµV)	Margin (dB)	Correction (dB)
159.659 kHz	1	41.146	79	37.854	-0.149
312.34 kHz	1	40.547	79	38.453	-0.167
483.445 kHz	1	25.875	79	53.125	-0.176
734.092 kHz	1	30.445	73	42.555	-0.164
3.011169 MHz	1	29.973	73	43.027	-0.155
4.242866 MHz	1	33.432	73	39.568	-0.139

FINAL RESULTS - AVERAGE

Frequency	SR #	Average Detector (dBµV)	Average Limit (dBµV)	Margin (dB)	Correction (dB)
159.659 kHz	1	30.371	66	35.629	-0.149
312.34 kHz	1	32.227	66	33.773	-0.167
483.445 kHz	1	20.462	66	45.538	-0.176
734.092 kHz	1	23.344	60	36.656	-0.164
3.011169 MHz	1	23.131	60	36.869	-0.155
4.242866 MHz	1	26.434	60	33.566	-0.139

PR / OP0621251_EN55032_LISN_Neutral_#03

CONDUCTED EMISSIONS - VOLTAGE
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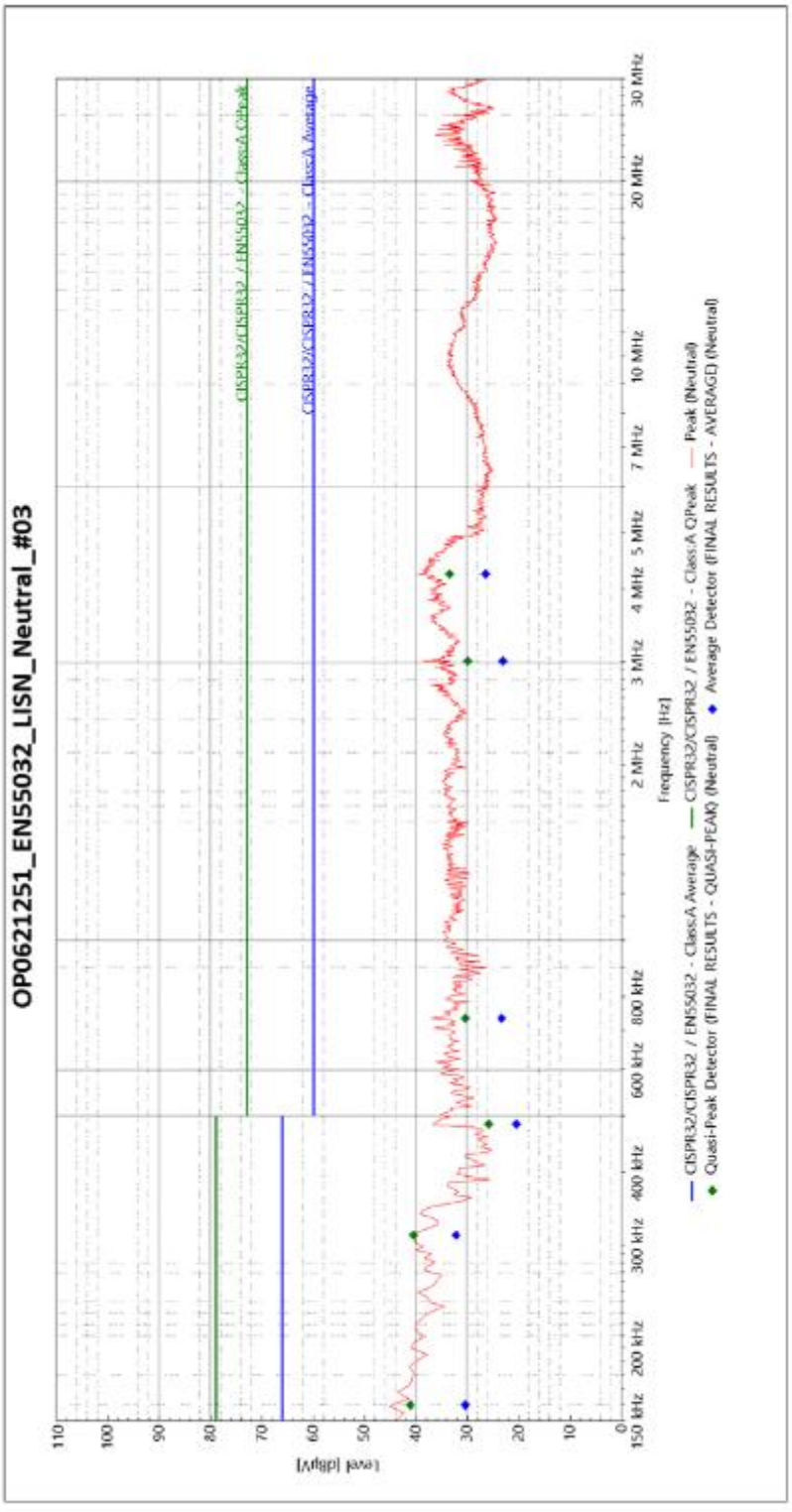

PR / OP0621251_EN55032_LISN_Neutral_#03

CONDUCTED EMISSIONS - VOLTAGE
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Project: OP0621251 ***Customer: Inogeni***

DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

Equipment: TOGGLE
Manufacturer: Inogeni
Hardware Version:
Software Version:

CONDUCTED EMISSIONS MEASUREMENT: *OP0621251_ICES-003_FCC-LISN_Phase_#04*

Test Location: Anechoic chamber
Test Date: 2022-08-16 3:28:20 PM
Operator(s): Jean Cadotte
Test Standard: ICES-003 / FCC part 15 subpart B / Class A
Power: 120V/60Hz
Tested Line: Phase
Operating Mode:
Comments:

TEST PARAMETERS		TEST EQUIPMENT USED
Frequency Range 150 kHz - 30 MHz	Bandwidth 9 kHz	LF#1+LF#2 LISN : PMM L2-16B#20813-yellow Rohde & Schwarz : ESW44

FINAL RESULTS - QUASI-PEAK

Frequency	SR #	Quasi-Peak Detector (dBµV)	Quasi-Peak Limit (dBµV)	Margin (dB)	Correction (dB)
157.999 kHz	1	40.793	79	38.207	-0.056
182.093 kHz	1	38.194	79	40.806	-0.049
318.71 kHz	1	40.209	79	38.791	-0.058
2.886098 MHz	1	26.426	73	44.574	-0.052
4.163444 MHz	1	30.736	73	42.264	-0.019
24.007075 MHz	1	32.447	73	40.553	0.359

FINAL RESULTS - AVERAGE

Frequency	SR #	Average Detector (dBµV)	Average Limit (dBµV)	Margin (dB)	Correction (dB)
157.999 kHz	1	28.449	66	37.551	-0.056
182.093 kHz	1	25.734	66	40.266	-0.049
318.71 kHz	1	37.187	66	28.813	-0.058
2.886098 MHz	1	19.951	60	40.049	-0.052
4.163444 MHz	1	23.537	60	36.463	-0.019
24.007075 MHz	1	23.465	60	36.535	0.359

PR / OP0621251_ICES-003_FCC-LISN_Phase_#04

CONDUCTED EMISSIONS - VOLTAGE
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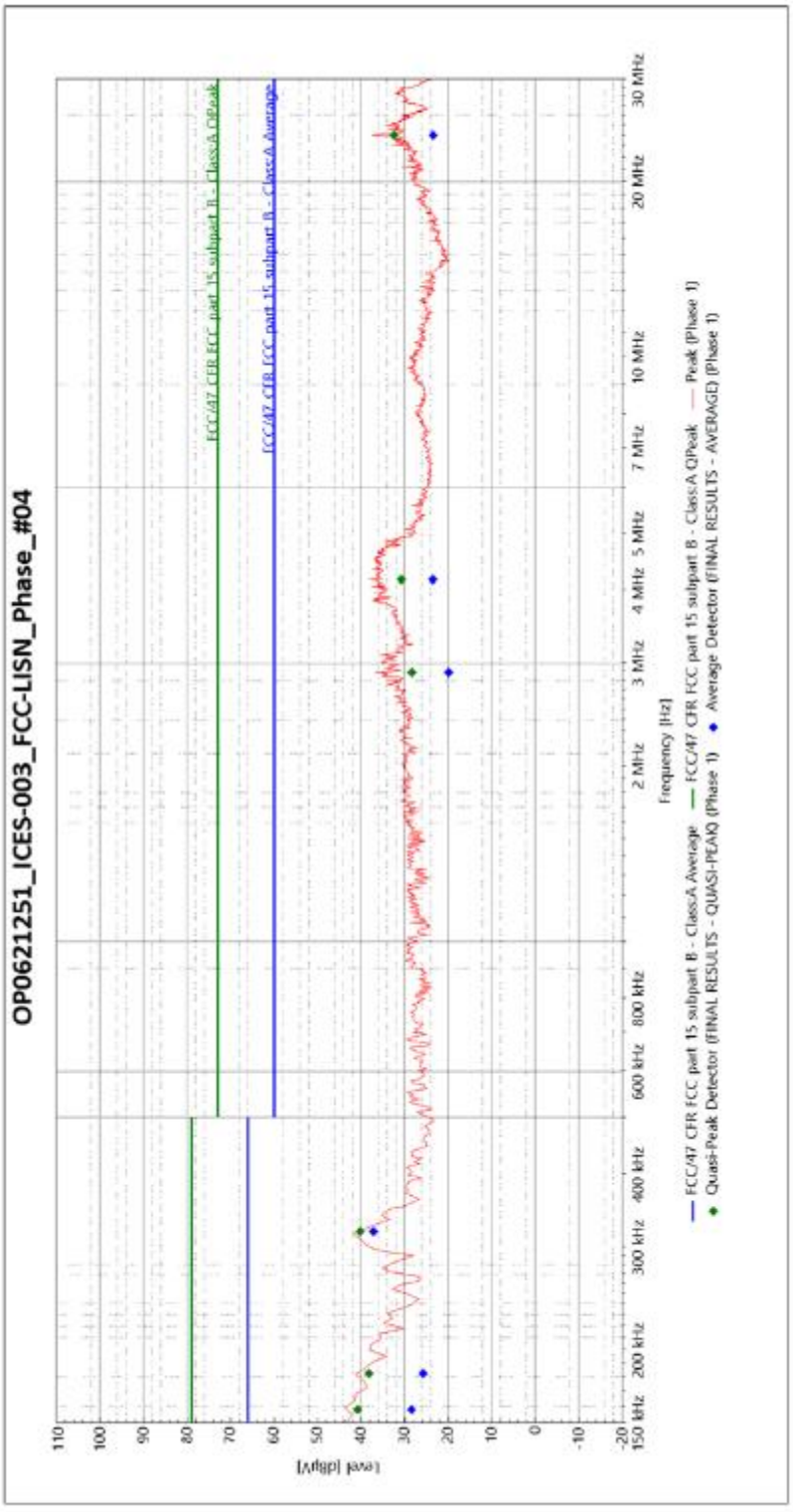

PR / OP0621251_ICES-003_FCC-LISN_Phase_#04

CONDUCTED EMISSIONS - VOLTAGE
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Project: OP0621251 ***Customer: Inogeni***

DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

Equipment: TOGGLE
Manufacturer: Inogeni
Hardware Version:
Software Version:

CONDUCTED EMISSIONS MEASUREMENT: *OP0621251_ICES-003_FCC-LISN_Neutral_#05*

Test Location: Anechoic chamber
Test Date: 2022-08-16 3:41:53 PM
Operator(s): Jean Cadotte
Test Standard: ICES-003 / FCC part 15 subpart B / Class A
Power: 120V/60Hz
Tested Line: Neutral
Operating Mode:
Comments:

TEST PARAMETERS		TEST EQUIPMENT USED
Frequency Range 150 kHz - 30 MHz	Bandwidth 9 kHz	LF#1+LF#2 LISN : PMM L2-16B#20813-yellow Rohde & Schwarz : ESW44

FINAL RESULTS - QUASI-PEAK

Frequency	SR #	Quasi-Peak Detector (dBµV)	Quasi-Peak Limit (dBµV)	Margin (dB)	Correction (dB)
150.138 kHz	1	42.49	79	36.51	-0.139
164.885 kHz	1	39.818	79	39.182	-0.159
318.182 kHz	1	40.162	79	38.838	-0.168
2.996591 MHz	1	29.382	73	43.618	-0.157
4.33939 MHz	1	31.326	73	41.674	-0.138
23.996649 MHz	1	31.406	73	41.594	0.359

FINAL RESULTS - AVERAGE

Frequency	SR #	Average Detector (dBµV)	Average Limit (dBµV)	Margin (dB)	Correction (dB)
150.138 kHz	1	27.249	66	38.751	-0.139
164.885 kHz	1	26.804	66	37.196	-0.159
318.182 kHz	1	36.864	66	29.136	-0.168
2.996591 MHz	1	21.17	60	38.83	-0.157
4.33939 MHz	1	24.46	60	35.54	-0.138
23.996649 MHz	1	22.203	60	37.797	0.359

PR / OP0621251_ICES-003_FCC-LISN_Neutral_#05

CONDUCTED EMISSIONS - VOLTAGE
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APPENDIX B
RADIATED EMISSIONS

RADIATED EMISSIONS – ELECTRIC FIELD
page 1 / 2

Project: *OP0621251* ***Customer:*** *Inogeni*

DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

Equipment: TOGGLE
Manufacturer: Inogeni
Hardware Version:
Software Version:

RADIATED EMISSIONS MEASUREMENT: *OP0621251_EN55032_FCC-Bilog_#01*

Test Location: Anechoic chamber
Test Date: 2022-08-15 10:37:40 AM
Operator(s): Jean Cadotte
Test Standard: EN55032 / FCC part 15 subpart B / Class A
Power: 230V/50Hz
Operating Mode:
Comments:

TEST PARAMETERS

Frequency Range	Bandwidth	Test Distance
30 MHz - 1 GHz	120 kHz	3 m

TEST EQUIPMENT USED

Antenna Mast : SUNOL
Bilog Antenna + 6dB : Schaffner CBL6112D#22617
HF#1 + HF#2
Rohde & Schwarz : ESW44
Turntable : SUNOL

FINAL RESULTS - QUASI-PEAK

Frequency	SR #	Quasi-Peak Detector (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Margin (dB)	Polarization	Azimuth (degree)	Height (m)	Correction (dB)
36.001792 MHz	1	28.592	50	21.408	0	22.5	1.102	21.798
48.093116 MHz	1	33.19	50	16.81	0	118	1	15.335
72.000023 MHz	1	44.001	50	5.999	0	7.75	1	13.139
125.73018 MHz	1	34.29	50	15.71	0	58.5	1.204	19
712.821467 MHz	1	32.036	57	24.964	0	61.25	1	27.62
967.393824 MHz	1	33.793	57	23.207	0	335.25	1	30.23

PR / OP0621251_EN55032_FCC-Bilog_#01

RADIATED EMISSIONS – ELECTRIC FIELD
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APPENDIX C
HARMONIC CURRENT EMISSIONS LIMITS

Teseq Profline
4542 Luterbach, Switzerland

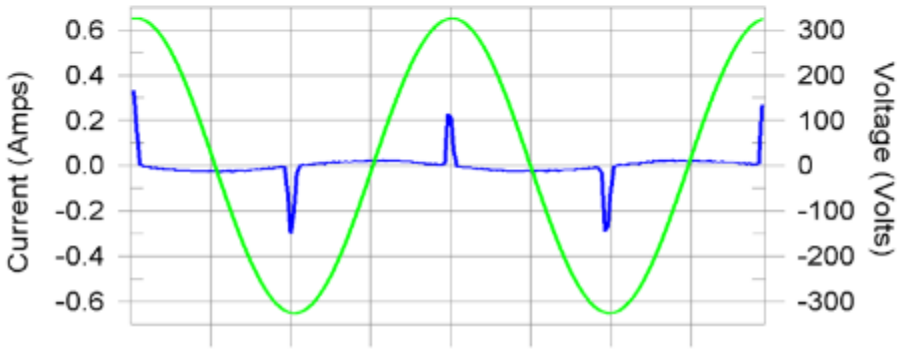
2022-08-19
10:27 AM

Harmonics – Class-A per Ed. 4.0 (2014)(Run time)

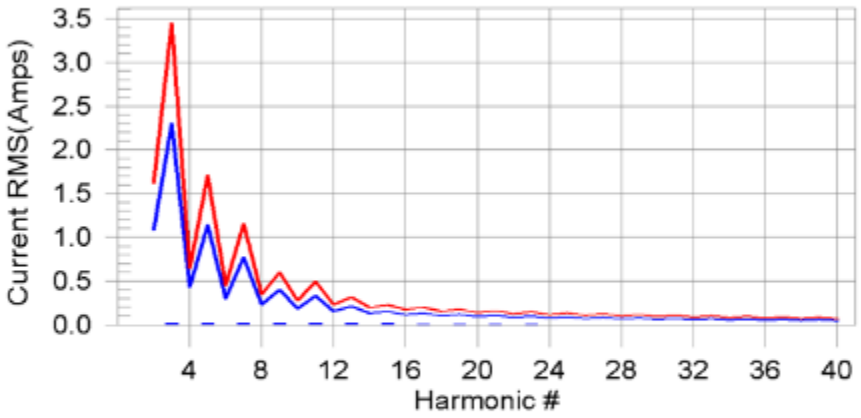
EUT: TOGGLE **Tested by: Jean Cadotte**
Test category: Class-A per Ed. 4.0 (2014) (European limits) **Test Margin: 100**
Test date: 8/16/2022 **Start time: 9:33:41 AM** **End time: 9:44:02 AM**
Test duration (min): 10 **Data file name: H-000108.cts_data**
Comment: Harmonics Fluctuations
Customer: Inogeni

Test Result: Pass **Source qualification: Normal**

Current & voltage waveforms



Harmonics and Class A limit line **European Limits**



Test result: Pass **Worst harmonic was #21 with 6.5% of the limit.**

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Teseq Profline
4542 Luterbach, Switzerland

2022-08-19
10:27 AM

Current Test Result Summary (Run time)

EUT: TOGGLE **Tested by: Jean Cadotte**
Test category: Class-A per Ed. 4.0 (2014) (European limits) **Test Margin: 100**
Test date: 8/16/2022 **Start time: 9:33:41 AM** **End time: 9:44:02 AM**
Test duration (min): 10 **Data file name: H-000108.cts_data**
Comment: Harmonics Fluctuations
Customer: Inogeni

Test Result: Pass **Source qualification: Normal**
THC(A): 0.050 **I-THD(%): 199.0** **POHC(A): 0.019** **POHC Limit(A): 0.251**

Highest parameter values during test:

V_RMS (Volts):	230.55	Frequency(Hz):	50.00
I_Peak (Amps):	0.341	I_RMS (Amps):	0.056
I_Fund (Amps):	0.025	Crest Factor:	6.346
Power (Watts):	4.1	Power Factor:	0.323

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	1.080	N/A	0.001	1.620	N/A	Pass
3	0.018	2.300	0.8	0.018	3.450	0.5	Pass
4	0.000	0.430	N/A	0.001	0.645	N/A	Pass
5	0.017	1.140	1.5	0.017	1.710	1.0	Pass
6	0.001	0.300	N/A	0.001	0.450	N/A	Pass
7	0.017	0.770	2.2	0.017	1.155	1.4	Pass
8	0.001	0.230	N/A	0.001	0.345	N/A	Pass
9	0.016	0.400	4.0	0.016	0.600	2.7	Pass
10	0.000	0.184	N/A	0.001	0.276	N/A	Pass
11	0.015	0.330	4.7	0.015	0.495	3.1	Pass
12	0.000	0.153	N/A	0.001	0.230	N/A	Pass
13	0.015	0.210	6.9	0.015	0.315	4.6	Pass
14	0.000	0.131	N/A	0.001	0.197	N/A	Pass
15	0.014	0.150	9.1	0.014	0.225	6.1	Pass
16	0.000	0.115	N/A	0.001	0.173	N/A	Pass
17	0.013	0.132	9.5	0.013	0.198	6.4	Pass
18	0.000	0.102	N/A	0.001	0.153	N/A	Pass
19	0.012	0.118	9.7	0.012	0.178	6.5	Pass
20	0.000	0.092	N/A	0.001	0.138	N/A	Pass
21	0.010	0.107	9.8	0.011	0.161	6.5	Pass
22	0.000	0.084	N/A	0.000	0.125	N/A	Pass
23	0.009	0.098	9.5	0.009	0.147	6.4	Pass
24	0.000	0.077	N/A	0.000	0.115	N/A	Pass
25	0.008	0.090	9.1	0.008	0.135	6.1	Pass
26	0.000	0.071	N/A	0.000	0.107	N/A	Pass
27	0.007	0.083	8.5	0.007	0.125	5.7	Pass
28	0.000	0.066	N/A	0.000	0.099	N/A	Pass
29	0.006	0.078	7.8	0.006	0.116	5.3	Pass
30	0.000	0.061	N/A	0.000	0.092	N/A	Pass
31	0.005	0.073	7.0	0.005	0.109	4.7	Pass
32	0.000	0.058	N/A	0.000	0.086	N/A	Pass
33	0.004	0.068	N/A	0.004	0.102	N/A	Pass
34	0.000	0.054	N/A	0.000	0.081	N/A	Pass
35	0.003	0.064	N/A	0.003	0.096	N/A	Pass
36	0.000	0.051	N/A	0.000	0.077	N/A	Pass
37	0.003	0.061	N/A	0.003	0.091	N/A	Pass
38	0.000	0.048	N/A	0.000	0.073	N/A	Pass
39	0.002	0.058	N/A	0.002	0.087	N/A	Pass
40	0.000	0.046	N/A	0.000	0.069	N/A	Pass

Teseq AG Win2100 V4.9.0

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Teseq Profline
4542 Luterbach, Switzerland

2022-08-19
10:27 AM

Voltage Source Verification Data (Run time)

EUT: TOGGLE **Tested by: Jean Cadotte**
Test category: Class-A per Ed. 4.0 (2014) (European limits) **Test Margin: 100**
Test date: 8/16/2022 **Start time: 9:33:41 AM** **End time: 9:44:02 AM**
Test duration (min): 10 **Data file name: H-000108.cts_data**
Comment: Harmonics Fluctuations
Customer: Inogeni

Test Result: Pass **Source qualification: Normal**

Highest parameter values during test:

Voltage (Vrms):	230.55	Frequency(Hz):	50.00
I_Peak (Amps):	0.341	I_RMS (Amps):	0.056
I_Fund (Amps):	0.025	Crest Factor:	6.346
Power (Watts):	4.1	Power Factor:	0.323

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.028	0.461	6.15	OK
3	0.415	2.075	19.98	OK
4	0.029	0.461	6.23	OK
5	0.039	0.922	4.19	OK
6	0.027	0.461	5.89	OK
7	0.021	0.692	3.10	OK
8	0.007	0.461	1.53	OK
9	0.021	0.461	4.63	OK
10	0.007	0.461	1.54	OK
11	0.009	0.231	3.92	OK
12	0.012	0.231	5.09	OK
13	0.013	0.231	5.52	OK
14	0.004	0.231	1.74	OK
15	0.006	0.231	2.79	OK
16	0.011	0.231	4.83	OK
17	0.011	0.231	4.77	OK
18	0.015	0.231	6.49	OK
19	0.013	0.231	5.51	OK
20	0.015	0.231	6.49	OK
21	0.014	0.231	5.87	OK
22	0.003	0.231	1.27	OK
23	0.010	0.231	4.45	OK
24	0.002	0.231	1.03	OK
25	0.010	0.231	4.42	OK
26	0.001	0.231	0.65	OK
27	0.006	0.231	2.40	OK
28	0.002	0.231	1.03	OK
29	0.012	0.231	5.12	OK
30	0.002	0.231	1.00	OK
31	0.008	0.231	3.59	OK
32	0.002	0.231	0.66	OK
33	0.007	0.231	3.11	OK
34	0.002	0.231	0.80	OK
35	0.007	0.231	2.97	OK
36	0.002	0.231	0.82	OK
37	0.007	0.231	2.98	OK
38	0.002	0.231	0.67	OK
39	0.006	0.231	2.49	OK
40	0.005	0.231	2.25	OK

APPENDIX D
VOLTAGE FLUCTUATIONS AND FLICKER LIMITATIONS

Teseq Profline
4542 Luterbach, Switzerland

2022-08-19
10:27 AM

Flicker Test Summary per EN/IEC61000-3-3 Ed. 3.0 (2013) (Run time)

EUT: TOGGLE
Test category: All parameters (European limits)
Test date: 8/16/2022 **Start time: 9:45:47 AM** **End time: 9:56:18 AM**
Test duration (min): 10 **Data file name: F-000109.cts_data**
Comment: Flickers Pst
Customer: Inogeni

Tested by: Jean Cadotte
Test Margin: 100

Test Result: Pass **Status: Test Completed**

Pst and limit line **European Limits**

Plt and limit line

Parameter values recorded during the test:

Vrms at the end of test (Volt):	**230.51**			
Highest dt (%):	**0.00**	**Test limit (%):**	**N/A**	**N/A**
T-max (mS):	**0**	**Test limit (mS):**	**500.0**	**Pass**
Highest dc (%):	**0.00**	**Test limit (%):**	**3.30**	**Pass**
Highest dmax (%):	**0.03**	**Test limit (%):**	**4.00**	**Pass**
Highest Pst (10 min. period):	**0.224**	**Test limit:**	**1.000**	**Pass**
Highest Plt (2 hr. period):	**0.098**	**Test limit:**	**0.650**	**Pass**

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Teseq Profline
4542 Luterbach, Switzerland

2022-08-19
10:27 AM

Flicker Test Summary per EN/IEC61000-3-3 Ed. 3.0 (2013) (Run time)

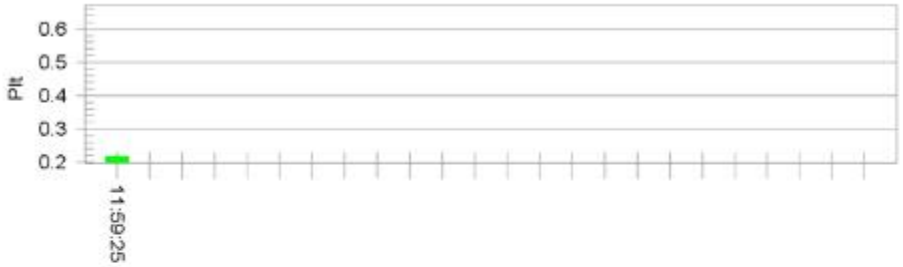
EUT: TOGGLE
Test category: All parameters (European limits)
Test date: 8/16/2022 **Start time: 9:57:16 AM**
Test duration (min): 120 **Data file name: F-000110.cts_data**
Comment: Flickers Plt
Customer: Inogeni

Tested by: Jean Cadotte
Test Margin: 100
End time: 11:59:26 AM

Test Result: Pass **Status: Test Completed**

Pst and limit line **European Limits**

Plt and limit line



Parameter values recorded during the test:

Vrms at the end of test (Volt):	**230.48**			
Highest dt (%):	**0.00**	**Test limit (%):**	**N/A**	**N/A**
T-max (mS):	**0**	**Test limit (mS):**	**500.0**	**Pass**
Highest dc (%):	**0.00**	**Test limit (%):**	**3.30**	**Pass**
Highest dmax (%):	**0.09**	**Test limit (%):**	**4.00**	**Pass**
Highest Pst (10 min. period):	**0.229**	**Test limit:**	**1.000**	**Pass**
Highest Plt (2 hr. period):	**0.220**	**Test limit:**	**0.650**	**Pass**

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END OF TEST REPORT