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ELECTROMAGNETIC COMPATIBILITY MEMORANDUM

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Manufacturer:	**National Research Council of Canada (NRC) – Astronomy Technology Research Group**
Address:	Dominion Radio Astrophysical Observatory 717 White Lake Rd., Kaleden BC V0H 1K0, Canada
Equipment Tested:	**Air-cooled TALON-DX Processing Board**
Model Number(s):	TALON-DX LRU

National Research Council Canada

REVISION HISTORY

Report Title: E11131-2001_TALON-DX_LRU_FCC-ISED-CE			
Date	**Rev.**	**Details**	**Author's Initials**
February 9, 2020	0.0	Initial draft	MK
February 25, 2020	1.1	Released for client's feedback	MK
All previous versions of this report have been superseded by the latest dated revision as listed in the above table.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 memorandum 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 I of this report as agreed upon by the Manufacturer under the quote 19MZ11062R1.

The Manufacturer is responsible for the tested product configurations, continued product compliance, and for the appropriate auditing of subsequent products as required.

This memorandum comprise a partial list of tests to demonstrate conformity with required FCC, ISED and CE standard listed in Section 1.1, and can only be produced by the manufacturer.
This is to declare the following report is true and correct to the best of our knowledge.

Testing and Report by
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EMC/RF Test Engineer

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Section I: Executive Summary of Standards and Limits

1.1 Applicable Standards and Results

No.	Test	Report Section	Applicable Standard	Specifications	Result
1	Radiated Emissions	3.1.1	CISPR32/EN 55032:2012/AC:2013	Meausrement Freq. Limit: 5 x highest internal freq. within EUT up to max of 6 GHz	Complies
			ICES-003 Issue 6 CFR Title 47 FCC Part 15, Subpart B Unintentional Radiators	Meausrement Freq. Limit: 5th harmonic of the highest frequency or 40 GHz, whichever is lower.	
		3.1.2	MIL-STD-461G – RE102 Ground	Meausrement Freq. Limit: 18 GHz	Complies
2	Conducted Emissions	3.2	CISPR32/EN 55032:2012/AC:2013 ICES-003 Issue 6 FR Title 47 FCC Part 15	N/A	Complies
3	Harmonic Current Emissions	3.3	EN 61000-3-2:2018	N/A	Complies
4	Voltage Changes, Fluctuations and Flicker	3.4	EN 61000-3-3:2013+A1:2017	N/A	Complies
5	In-rush Current	3.5	EN 61000-3-3:2013+A1:2017	N/A	Complies
6	Voltage Dips & Interruptions	4.7	CISPR 35 / EN 55035: 2016	N/A	Complies

1.2 Applicable Radiated Emission Limits

EN 55032:2012/AC:2013: Class B

Frequency (MHz)	Field Strength Quasi Peak (Class B)	
	(dBµV/m @ 3m SAC)	(dBµV/m @ 10m OATS)
30 – 230	40	30
230 – 1000	47	37
Maximum Field Strength (dB mV/m at 3 m)		
Frequency (GHz)	**Peak**	**Average**
1-3	70	50
3-6	74	54
Note 1: The lower limit shall apply at the transition frequency **Note 2**: Additional provisions may be required for cases where interference occurs		

CFR Title 47 FCC Part 15/ICES-003 Issue 6

Frequency (MHz)	Field Strength Quasi Peak	
	dBµV/m @ 3m SAC Class B	dBµV/m @ 10m OATS Class A
30 – 88	40.0	39.1
88 – 216	43.5	43.5
216 – 960	46.0	46.4
Above 960	53.9	49.5
Maximum Field Strength (dB mV/m at 3 m)		
Frequency (GHz)	**Peak**	**Average**
1-40	80	60
Note 1: The lower limit shall apply at the transition frequency **Note 2**: Additional provisions may be required for cases where interference occurs		

MIL-STD-416G: RE102 Ground

Frequency	Field Strength Quasi Peak (dBuV/m)	
	Navy Mobile & Army	Navy Fixed & Air Force
100 kHz – 100 MHz	24	44
100 MHz – 18 GHz	69	89
18 – 100 GHz	89	89

The tests documented in this memorandum were performed in accordance with ANSI C63.4-2014, ANSI C63.10-2013.

1.3 Applicable Conducted Emissions Limits

FCC/ISED/CE -Class B

Frequency (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 – 0.50	66 to 56	56 to 46
0.50 – 5	56	46
5 – 30	60	50
Note 1: The lower limit shall apply at the transition frequencies. **Note 2:** The limit decreases linearly with the logarithm of the frequency in the 0.15 to 0.50 MHz		

1.4 Applicable Immunity Standards for European Compliance, Limits and Summary

CISPR 35 / EN 55035:2016

Environmental Phenomenon	Port	Test specification		Units	Basic standard	Remarks	Required Criterion	EUT Performance
						N/A	N/A	N/A
Voltage dips	AC mains power	Residual voltage	<5	%	IEC 61000-4-11	See [a] Apply at only one supply frequency of the MME.	B	A
		Number of cycles	0.5					
		Residual voltage	70	%	IEC 61000-4-11		C	A
		Number of cycles	25 for 50 Hz					
Voltage Interruptions	AC mains power	Residual voltage	<5	%	IEC 61000-4-11	See [a] Apply at only one supply frequency of the MME.	C	C – PASS
		Number of cycles	250 for 50 Hz					
[a] Changes to occur at 0 degree crossover point of the voltage waveform. If the EUT does not demonstrate compliance when tested with 0 degree switching, the test shall be repeated with the switching occurring at both 90 degrees and 270 degrees If the EUT satisfies these alternative requirements, then it fulfils the requirements. This condition shall be recorded in the test report.								

1.3 General Performance Criteria (CISPR 35 / EN 55035:2016)

1.3.1 General

General performance criteria are defined in 8.2, 8.3 and 8.4. These criteria shall be used during the testing of primary functions where no relevant annex is applicable.

When assessing the impact of a disturbance on a function, the assessment should take into consideration the function's performance prior to the application of the disturbance and only identify as failures those changes in performance that are a result of the disturbance.

1.3.2 Performance criterion A

The equipment shall continue to operate as intended without operator intervention. Ne 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.

1.3.3 Performance criterion B

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.

1.3.3 Performance criterion C

Loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the control 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.

Section II: GENERAL INFORMATION

2.1 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

Equipment	Item/Description	Manufacturer	Model No.	Serial No.
Air-cooled TALON-DX Processing Board	A 2U high, 19" rack mount metal enclosure encompassing 2 TALON-DX PCB's. It is fan cooled with a 120VAC to +12VDC PSU	National Research Council of Canada (NRC)	TALON-X LRU	N/A
Note: Clock frequencies tuned upon within the EUT: 25 , 125, 266.667, 300, 312.5, 644.53125, 650 MHz Highest frequency generated within the EUT: 26 GHz				

Equipment Under Test (EUT) Information

Dimensions	71cm L, 46cm W, 8.3cm H
Power requirements	450 W max
Input voltage	115 VAC (x2)
Grounding	Via AC input

Auxiliary Equipment Information

EUT had no accompanying auxiliary.

Manufacture-defined monitoring Method (Immunity Testing):

In case of loss of power, EUT should with fan sounding off (operating) without operator's intervention.

2.2 Environmental Conditions

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

Parameter	Conditions
Location	Indoors
Temperature	21ºC
Relative Humidity	79.4%
Atmospheric Pressure	101 kPa

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 30MHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 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 %

2.4 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 1.

Emissions Test Equipment

Sl. NO.	Manufacturer	Model	Description	Serial No.	S/W Version	Calibration Due Date
1	ETS Lindgren	2165	Turntable	00043677	N/A	N/A
2	ETS Lindgren	2125	Mast	00077487	N/A	N/A
3	Sunol Sciences	JB3	Biconilog Antenna 30MHz – 3GHz	A042004	N/A	2020-Nov-10
4	Emco	3110B	Biconical Antenna 30 – 300 MHz	8907-1018	N/A	2020-Nov-16
5	A.H. Systems	SAS-570	Double Ridge Guide Horn Antenna 170 MHz- 3 GHz	323	N/A	2020-Nov-22
6	ETS-Lindgren	3117	Horn Antenna 1GHz-18GHz	75944	N/A	2020-Aug-29
7	Emco	3160-09	Horn Antenna 18 – 26.5 GHz	9701-1071	N/A	2020-Sep-20
8	Rohde & Schwarz	ESU40	EMI Receiver	100011	EMC32 v10.35.10/ FV 4.73 SP4	2019-Dec-01
9	Hewlett Packard	8449B OPT H02	Preamplifier (1-26.5GHz)	2933A00198	N/A	2022-Jun-22
10	A.H. Systems	PAM-1840VH	Preamplifier	N/A	N/A	N/A
11	Rohde & Schwarz	FSU67	Spectrum Analyzer 20 Hz – 67 GHz	101388	N./A	2022-Jan-19
12	Solar Electronics	9408-50-R-24-BNC	MIL LISN	941702	N/A	2020-Aug.30
13	Rohde & Schwarz	FSP	Spectrum Analyzer 9 kHz – 67 GHz	100184	N/A	2021-Mar-16
14	ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A	N/A

Note: Equipment listed above have 3 years calibration interval.

Immunity Testing Equipment

Sl. No.	Manufacturer	Model	Description	Serial No.	S/W Version	Calibration Due Date
1	California Instruments	3001i-411-OMNI	Power Source	HK 52117	N/A	2020-May-23
2	California Instruments	OMNI 1-18 i	Reference impedance network	7127	N/A	2020-May-23
3	California Instruments	PACS-1	Harmonics and flicker test system	72569	N/A	2020-May-23
4	Teseq	NSG 3060	EMC multifunction Generator 6kV with CDN and INA	184	WIN3000 v1.3.2 / FV V2.20	2020-March-05
5	Teseq	CDN 3061	Surge CDN	184	N/A	2020-March-05
6	Teseq	INA 6502-CIB	Step up Transformer	124	N/A	2020-March-05

Note: Equipment listed above have 3 years calibration interval.

Measurement Software List

Sl. No.	Manufacturer	Model	Version	Description
1	Rhode & Schwarz	EMC 32	6.20.0	Emissions Test Software
2	TESEQ	WIN 3000	1.2.0	Voltage Dips and Interruptions Immunity Test Program
3	Thurlby Thandar Instruments	HA-PC Link Version	2.02	Harmonics, Flicker and In-rush Current Test Program

Section III: DATA & TEST RESULTS

3.1 Radiated Emissions

Measurement Method:

3.1.1 CISPR 32/EN 55032, ICES-003 Issue 6 and FCC Part 15 Subpart B

30 MHz – 1 GHz: The EUT was positioned at the edge of the turntable with 80 m height in the SAC with all cables draped down the side 40 cm off the ground plate, with measuring antenna at 3 m distance.
Emissions in both horizontal and vertical polarizations and antenna height ranging 1-4 m were measured while rotating the Equipment Under Test (EUT) 360° on the turntable, to maximize measured emissions.

1 - 18 GHz: The EUT was positioned at the edge of the turntable with 150 m height in the FAC with all cables draped down the side of the table, with measuring antenna at 3 m distance.
Emissions in both horizontal and vertical polarizations and antenna height ranging 1-4 m were measured while rotating the Equipment Under Test (EUT) 360° on the turntable, to maximize measured emissions.

18 - 26 GHz: The EUT was positioned at the edge of the turntable with 150 m height in the FAC with all cables draped down the side of the table, with measuring antenna at 1 m distance.
Emissions in both horizontal and vertical polarizations and antenna height of 150 cm were measured while rotating the Equipment Under Test (EUT) 360° on the turntable, to maximize measured emissions.

3.1.2 MIL-STD-461G

EUT was place in the MIL-SPEC-compliant SAC on a ground plane placed on a non-conductive table of 80 cm height. Ground plane was attached to the wall with bond straps. EUT was placed 2m from a LISN attached to the ground plane. A non-conductive surface of 5 cm thickness was placed in between to boost off the ground plane the EUT power cable connecting the EUT to the LISN. Cable was placed 10 cm from the edge of the table. Measuring antennas were placed as per RE102-5 of the standard 1m from the plane passing through the side of the EUT closest to the antenna.
At client's request, different rotations of EUT was scanned to find highest emissions. Antenna was first positioned at the EUT and moved towards the opposite end in two increments of 80 cm.
A calibrated measuring set-up with known correction factors was used along with measuring software to conduct automated measurements.

Emissions were measured in above frequency ranges using appropriate receiver, spectrum analyzer, antennas, amplifiers, and cables.

Sample calculations are:

Final reading (dBµV/m) = Raw reading (dBuV/m) + Correction factor (Corr.) (dB)
Margin (dB) = Limit (dBuV/m) – Final reading (dBuV/m)

Modification:
No modifications required for radiated emissions tests.

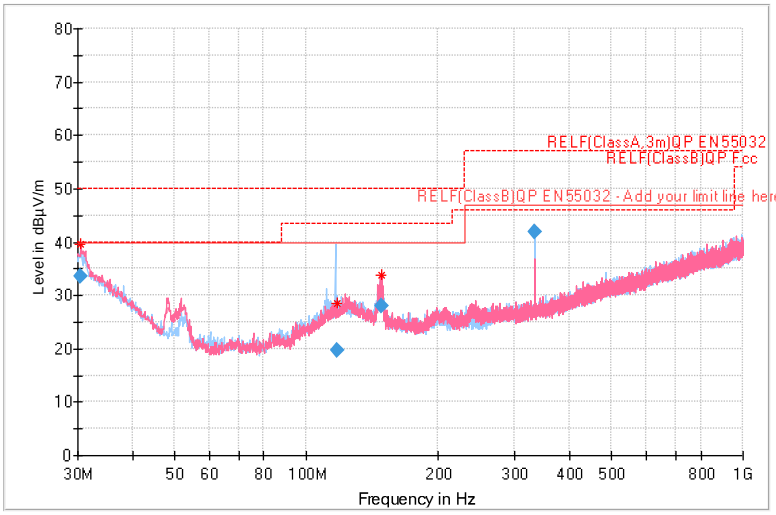
Result: The EUT complies with the applicable standards.

3.1.1 Measurement Data - CISPR 32/EN 55032, ICES-003 Issue 6 & FCC Part 15 Subpart B

Only data yielding the worst case presented for each section.

Part 3.1.1 i) 30 MHz – 1 GHz

- **Date performed:** January 29, 2020
- **Input voltage:** 115V 60 Hz (x2)



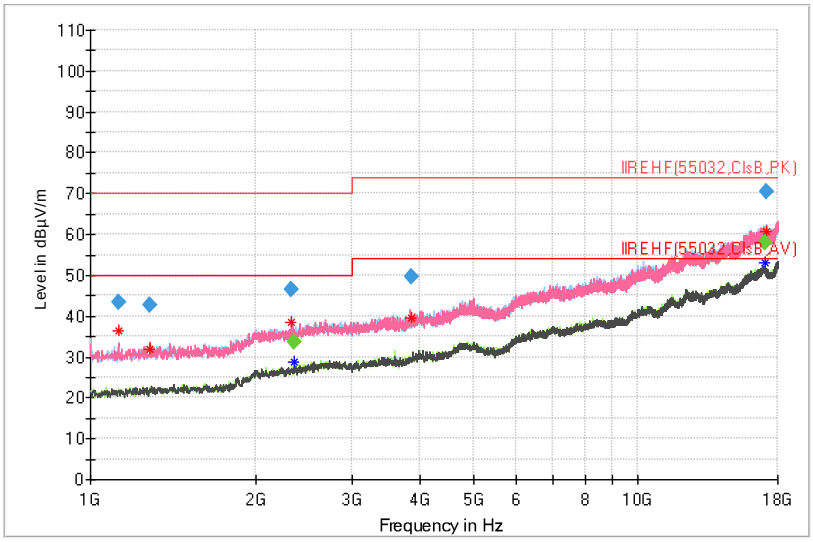
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Corr. (dB)
30.514431	33.50	40.00	6.50	1000.0	120.000	V	27.4
117.533200	19.78	40.00	20.22	1000.0	120.000	H	19.4
148.420400	28.13	40.00	11.87	1000.0	120.000	V	18.1
333.332920	41.98	47.00	5.02	1000.0	120.000	H	20.3

Quasi-Peak Data of Radiated Emissions measured at 3m–FCC /ISED/CE Class B Limit−for reference only

Note: 116-117 MHz emission was manually checked and confirmed to be transient.

Part 3.1.1 ii) 1- 12 GHz

- **Date performed:** January 29, 2020
- **Input voltage:** 230V 50 Hz (x2)

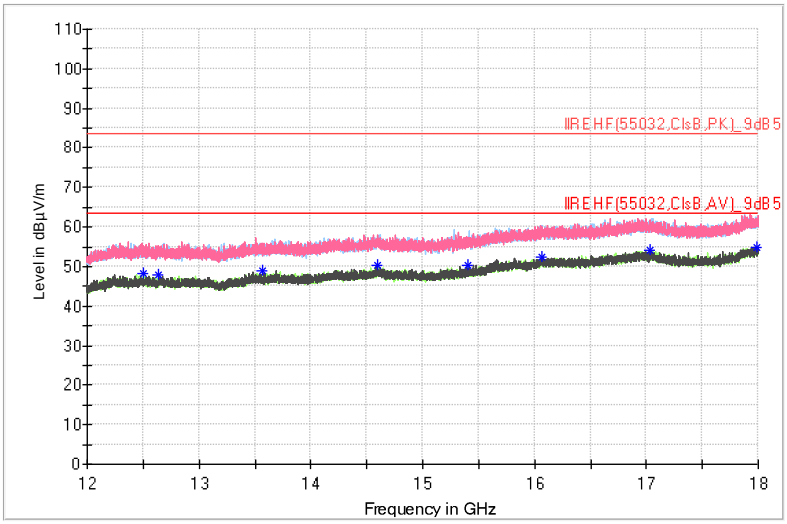


Results: No significant emissions observed above the noise floor.

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Pol	Corr. (dB)
1124.969600	43.32	---	70.00	26.68	1000.0	1000.000	H	-7.0
1284.022400	42.66	---	70.00	27.34	1000.0	1000.000	V	-6.1
2333.307600	46.65	---	70.00	23.35	1000.0	1000.000	H	0.3
2351.289600	---	33.64	50.00	16.36	1000.0	1000.000	V	0.4
3846.213200	49.65	---	74.00	24.35	1000.0	1000.000	V	3.9

Average and Peak Data of Radiated Emissions measured at 3m–FCC /ISED/CE Class B Limit−for reference only

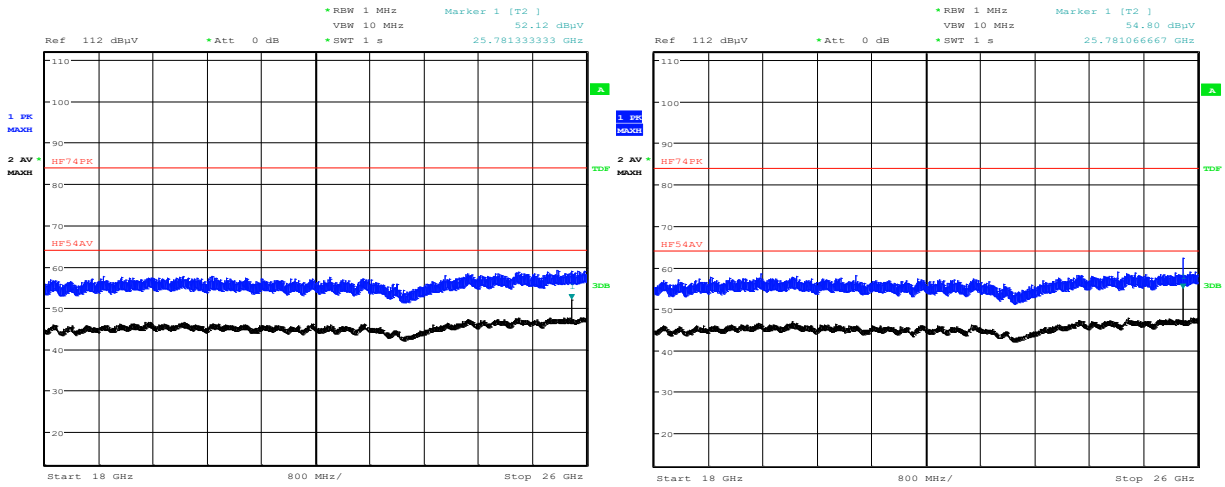
Part 3.1.1 iii) 12- 18 GHz



Results: No emissions observed above the noise floor.

Part 3.1.1 iv) 18-26 GHz

- **Date performed:** January 29, 2020
- **Input voltage:** 230V 50 Hz (x2)



Average and Peak Traces of Radiated Emissions measured at 1m–FCC /ISED Class B Limit: V pol (L) and H pol (R)

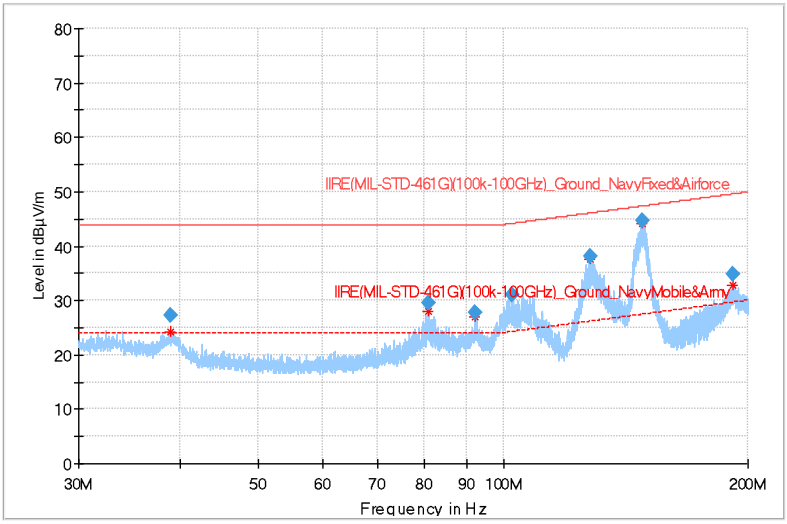
Results: No unintentional emissions observed above the noise floor.

3.1.2 Measurement Data – MIL-STD-416G (120V 60 Hz x2)

Only data for settings yielding the worst case presented for each section.

Part 3.1.2 i) 30 – 200 MHz, Pol V

- **Date performed:** January 30, 2020
- **Specifications:** EUT front-facing, Bicon antenna at EUT

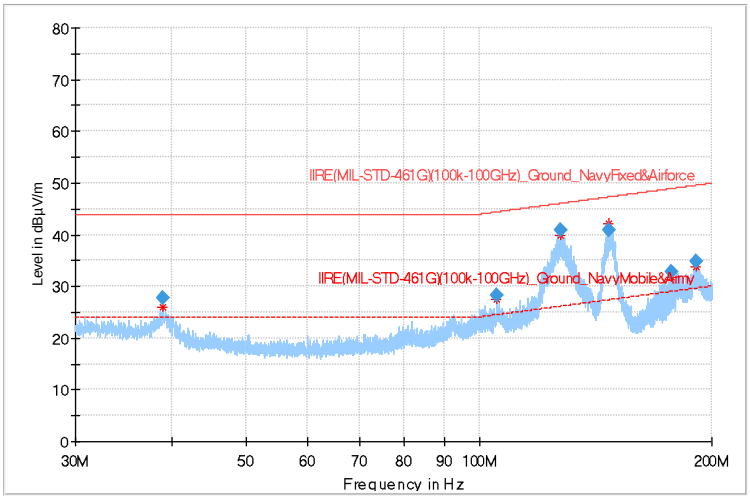


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Corr. (dB)
38.857000	27.22	44.00	16.78	5000.0	100.000	120.0	13.7
80.813000	29.49	44.00	14.51	5000.0	100.000	120.0	12.4
92.339000	27.88	44.00	16.12	5000.0	100.000	120.0	12.7
102.437000	31.14	44.21	13.07	5000.0	100.000	120.0	13.3
128.039000	38.15	46.14	7.99	5000.0	100.000	120.0	14.6
148.439000	44.74	47.42	2.68	5000.0	100.000	120.0	15.6
191.347000	34.72	49.62	14.90	5000.0	100.000	120.0	17.9

MaxPeak Data of Radiated Emissions measured at 1m–FCC Ground Unit Limit–for reference only

Part 3.1.2 ii) 30 – 200 MHz, Pol H

- **Date performed:** January 30, 2020
- **Specifications:** EUT front-facing, Bicon antenna at EUT

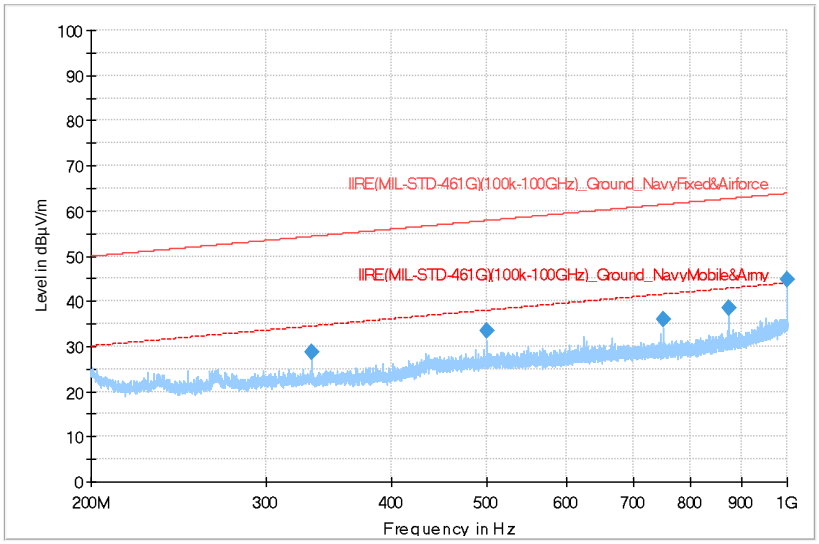


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Corr. (dB)
38.925000	27.75	44.00	16.25	5000.0	100.000	120.0	13.7
105.225000	28.30	44.44	16.14	5000.0	100.000	120.0	13.5
127.308000	40.95	46.09	5.14	5000.0	100.000	120.0	14.6
146.977000	41.00	47.34	6.34	5000.0	100.000	120.0	15.6
177.611000	32.69	48.98	16.29	5000.0	100.000	120.0	16.4
190.786000	34.84	49.60	14.76	5000.0	100.000	120.0	17.8

MaxPeak Data of Radiated Emissions measured at 1m–FCC Ground Unit Limit–for reference only

Part 3.1.2 iii) 200 MHz – 1 GHz, Pol V

- **Date performed:** January 30, 2020
- **Specifications:** EUT front-facing, double-ridge horn antenna at EUT

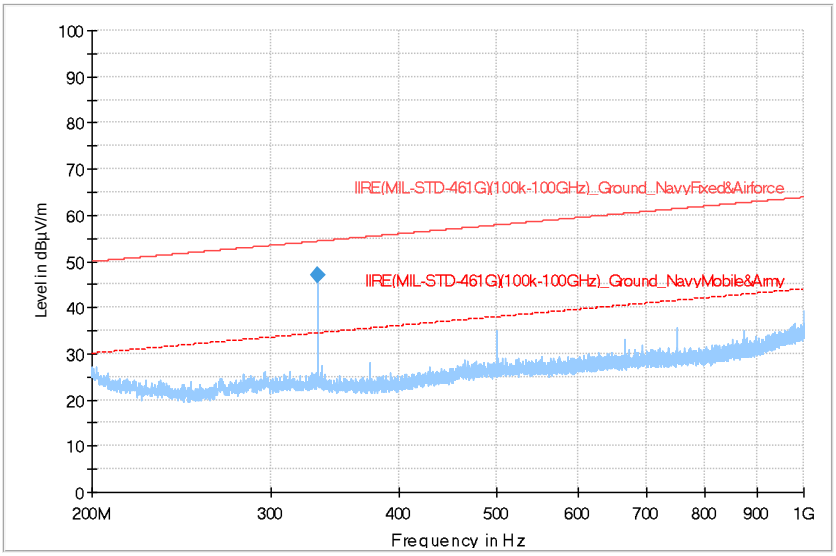


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Corr. (dB)
333.329600	28.81	54.43	25.62	5000.0	100.000	120.0	17.0
499.962800	33.36	57.95	24.58	5000.0	100.000	120.0	21.1
749.976800	35.93	61.46	25.53	5000.0	100.000	120.0	23.2
874.973600	38.43	62.80	24.36	5000.0	100.000	120.0	24.9
999.969600	44.92	63.95	19.04	5000.0	100.000	120.0	28.7

MaxPeak Data of Radiated Emissions measured at 1m–FCC Ground Unit Limit–for reference only

Part 3.1.2 iv) 200 MHz – 1 GHz, Pol H

- **Date performed:** January 30, 2020
- **Specifications:** EUT front-facing, double-ridge horn antenna at EUT

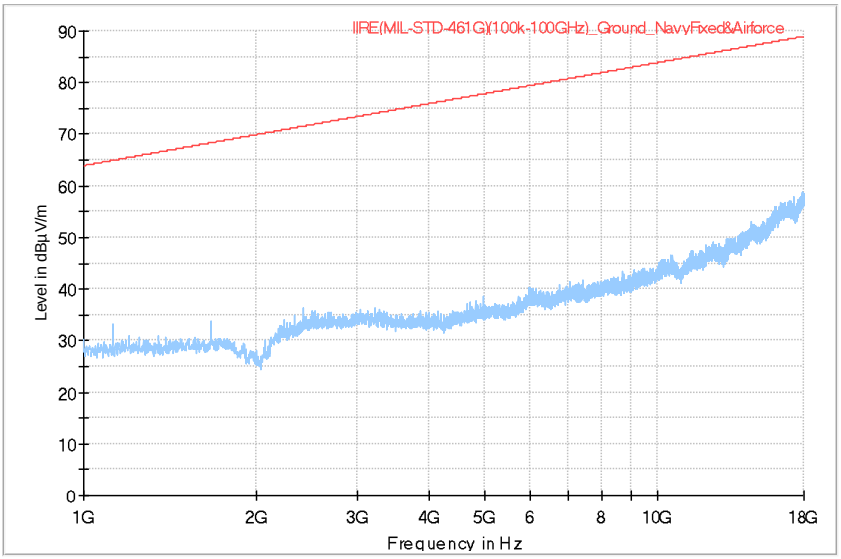


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Corr. (dB)
333.335200	47.06	54.43	7.37	5000.0	100.000	120.0	16.3

MaxPeak Data of Radiated Emissions measured at 1m–FCC Ground Unit Limit–for reference only

Part 3.1.2 v) 1 – 18 GHz, Pol V

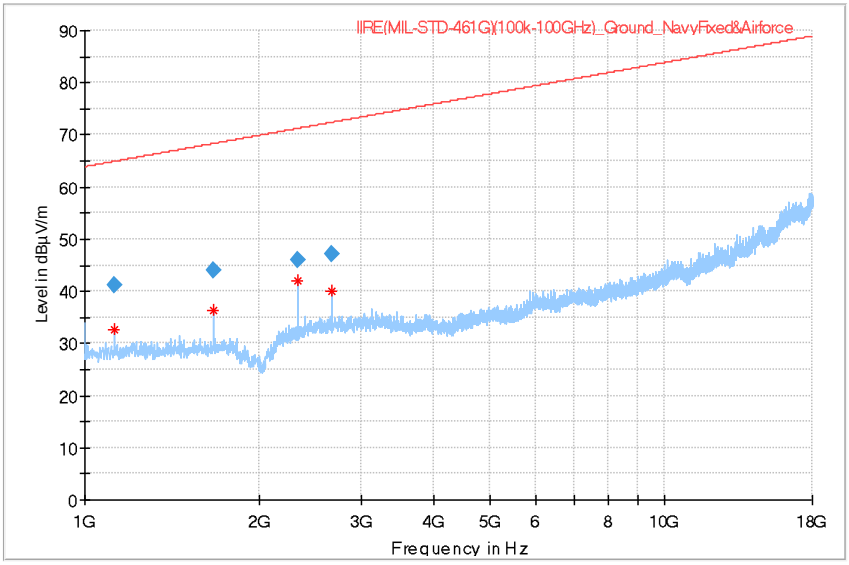
- **Date performed:** January 30, 2020
- **Specifications:** EUT left side, horn antenna at EUT



Results: No significant emissions observed above the noise floor.

Part 3.1.2 vi) 1 – 18 GHz, Pol H

- **Date performed:** January 30, 2020
- **Specifications:** EUT left side, horn antenna at EUT

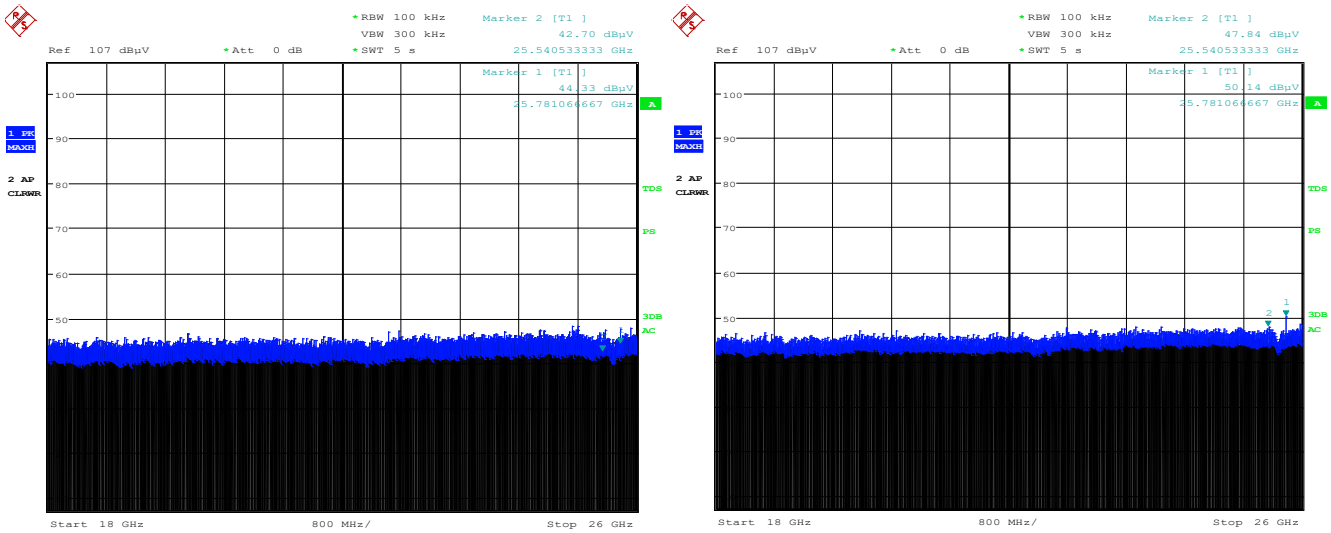


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Corr. (dB)
1124.100000	41.19	64.97	23.77	5000.0	1000.000	120.0	-7.5
1666.400000	44.05	68.38	24.33	5000.0	1000.000	120.0	-4.7
2332.800000	46.06	71.29	25.23	5000.0	1000.000	120.0	-0.8
2666.000000	47.22	72.45	25.23	5000.0	1000.000	120.0	-0.1

MaxPeak Data of Radiated Emissions measured at 1m–FCC Ground Unit Limit–for reference only

Part 3.1.2 vii) 18 -26 GHz

- **Date performed:** January 30, 2020
- **Specifications:** EUT front-facing, horn antenna at EUT



Average and Peak Traces of Radiated Emissions measured at 1m–FCC /ISED Class B Limit: V pol (L) and H pol (R)

Results: No significant emissions observed above the noise floor.

3.2 AC Mains Conducted Emissions

- **Date Performed:**

  January 29, 2020

- **Input Voltage:** 120V 50Hz (x2)

- **Method of Measurement:**

  Measurements were made using an EMI receiver with 9kHz bandwidth, CISPR Quasi-Peak and Average detector.

- **Modifications:**

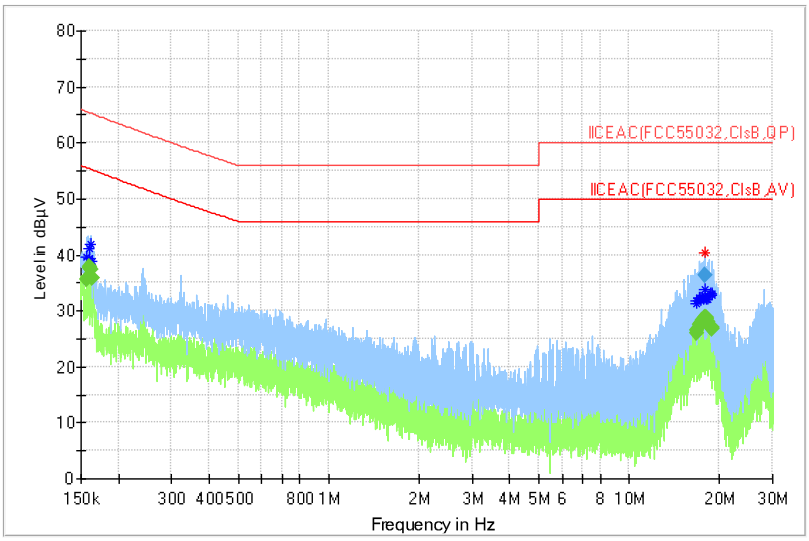
  No modifications required for this test.

- **Result:**

  The EUT complies with the applicable standard.

Measurement Data

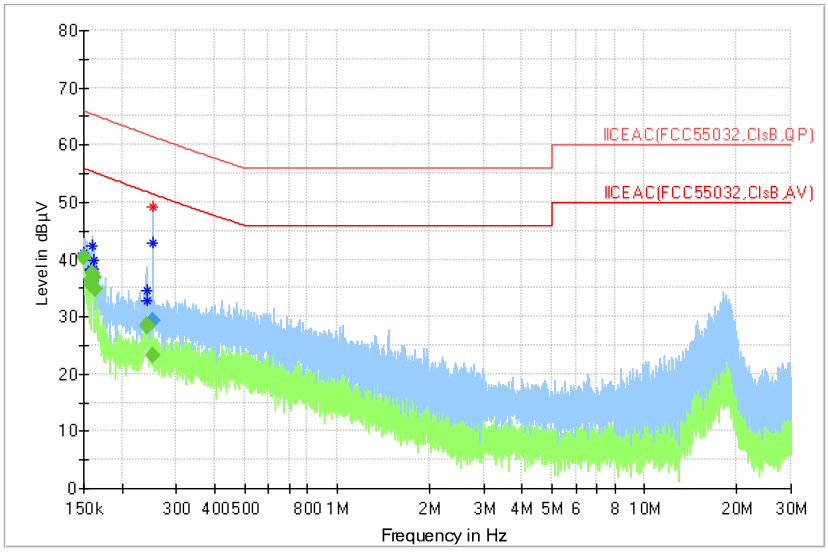
Only data for settings yielding the worst case presented.
Setting: Both cables attached and powered, lower cable through LISN.



Line 1:

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)
0.157400	---	35.62	55.56	19.95	1000.0	9.000	GND	10.3
0.159400	---	37.53	55.45	17.92	1000.0	9.000	GND	10.3
0.160000	---	37.89	55.41	17.52	1000.0	9.000	GND	10.3
0.161600	---	37.38	55.32	17.94	1000.0	9.000	GND	10.3
0.163200	---	35.75	55.23	19.48	1000.0	9.000	GND	10.3
16.678000	---	26.00	50.00	24.00	1000.0	9.000	GND	10.7
16.840000	---	26.45	50.00	23.55	1000.0	9.000	GND	10.7
17.172000	---	27.46	50.00	22.54	1000.0	9.000	GND	10.7
17.244000	---	27.83	50.00	22.17	1000.0	9.000	GND	10.7
17.318000	---	27.47	50.00	22.53	1000.0	9.000	GND	10.7
17.484000	---	28.26	50.00	21.74	1000.0	9.000	GND	10.7
17.642000	---	28.17	50.00	21.83	1000.0	9.000	GND	10.7
17.814000	---	28.64	50.00	21.36	1000.0	9.000	GND	10.7
17.886000	---	28.75	50.00	21.25	1000.0	9.000	GND	10.7
17.886000	36.35	---	60.00	23.65	1000.0	9.000	GND	10.7
17.972000	---	28.75	50.00	21.25	1000.0	9.000	GND	10.7
18.130000	---	28.57	50.00	21.43	1000.0	9.000	GND	10.7
18.288000	---	28.04	50.00	21.96	1000.0	9.000	GND	10.7
18.606000	---	27.13	50.00	22.87	1000.0	9.000	GND	10.7
18.772000	---	27.08	50.00	22.92	1000.0	9.000	GND	10.7
18.932000	---	26.71	50.00	23.29	1000.0	9.000	GND	10.7

Line 2:



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)
0.150400	---	40.41	55.98	15.57	1000.0	9.000	GND	10.3
0.157600	---	35.58	55.55	19.96	1000.0	9.000	GND	10.3
0.158200	---	36.32	55.52	19.20	1000.0	9.000	GND	10.3
0.159800	---	37.54	55.42	17.89	1000.0	9.000	GND	10.3
0.162000	---	36.87	55.30	18.43	1000.0	9.000	GND	10.3
0.162400	---	36.79	55.28	18.49	1000.0	9.000	GND	10.3
0.163600	---	34.77	55.21	20.44	1000.0	9.000	GND	10.3
0.240000	---	28.51	51.86	23.35	1000.0	9.000	GND	10.2
0.241400	---	28.35	51.81	23.46	1000.0	9.000	GND	10.2
0.252200	29.38	---	61.48	32.10	1000.0	9.000	GND	10.2
0.252400	---	23.31	51.44	28.13	1000.0	9.000	GND	10.2

3.3 Harmonic Current Emissions

Date Performed: January 31, 2020

Test Method: EN 61000-3-2:2018

Test Voltage: 120V 60Hz & 230 VAC/50 Hz

Test Requirement:
For Class A equipment, the harmonics of the input current shall not exceed the maximum permissible values given in Table One, multiplied by a factor of 1.5.

Test Set-up:
The equipment was set-up using a power analyzer, and a filtered power source, and the harmonic contents measured.
Class A equipment.

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

Result:
The EUT complies with the applicable standard.

Power Line Harmonic Limits:

1 Harmonic Limits for Class A equipment

Harmonic order n	Maximum permissible harmonic current A
Odd Harmonics	
3 5 7 9 11 13 $15 \leq n \leq 39$	2.30 1.14 0.77 0.40 0.33 0.21 $0.15 \frac{15}{n}$
Even harmonics	
2 4 6 $8 \leq n \leq 40$	1.08 0.43 0.30 $0.23 \frac{8}{n}$

2 Harmonic Limits for Class C equipment

Harmonic order N	Maximum permissible harmonic current expressed as a percentage of the input current at the fundamental frequency %
2 3 5 7 9 $11 \leq n \leq 39$ (odd harmonics only)	2 $30 \cdot \aleph$ (1) 10 7 5 3
(1) $\aleph$ is the circuit power factor	

3 Harmonic Limits for Class D equipment

Harmonic order n	Maximum permissible harmonic current per watt mA/W	Maximum permissible harmonic current A
3 5 7 9 11 $13 \leq n \leq 39$ (odd harmonics only)	3.4 1.9 1.0 0.5 0.35 $\frac{3.85}{n}$	2.30 1.14 0.77 0.40 0.33 See Class A

Measurement Data:
Only data for settings yielding the worst case presented.
Setting: 230V 50 Hz, High-Power Mode

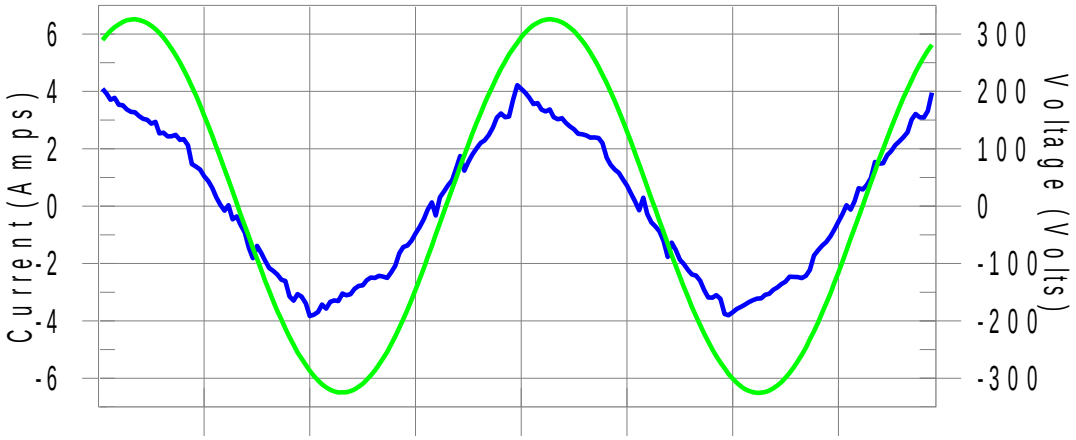
Harmonics – Class-A (Run time)

EUT: Talon-LRU
Test category: Class-A per Ed. 3.2 (2009) (European limits)
Test date: 1/31/2020 Start time: 8:33:16 AM
Test duration (min): 3 Data file name: H-000526.cts_data
Comment: 2 x
Customer: NRC

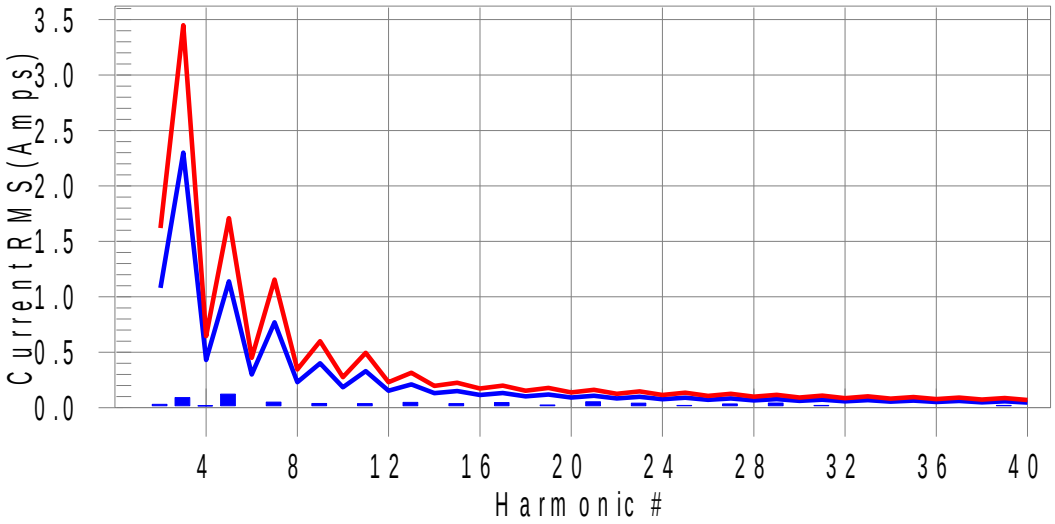
Tested by: MK
Test Margin: 100
End time: 8:36:38 AM

Test Result: Pass Source qualification: Normal

Current & voltage wavef



Harmonics and Class A limit line European Limits



Test result: Pass Worst harmonic was #29 with 42.96% of the limit.

Current Test Result Summary (Run time)

EUT: Talon-LRU Tested by: MK
Test category: Class-A per Ed. 3.2 (2009) (European limits) Test Margin: 100
Test date: 1/31/2020 Start time: 8:33:16 AM End time: 8:36:38 AM
Test duration (min): 3 Data file name: H-000526.cts_data
Comment: 2 x
Customer: NRC

Test Result: Pass Source qualification: Normal
THC(A): 0.20 I-THD(%): 8.03 POHC(A): 0.076 POHC Limit(A): 0.251
Highest parameter values during test:

V_RMS (Volts):	230.13	Frequency(Hz):	50.00
I_Peak (Amps):	4.431	I_RMS (Amps):	2.488
I_Fund (Amps):	2.477	Crest Factor:	1.790
Power (Watts):	558.3	Power Factor:	0.976

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.029	1.080	2.7	0.031	1.620	1.91	Pass
3	0.089	2.300	3.9	0.091	3.450	2.64	Pass
4	0.016	0.430	3.7	0.017	0.645	2.61	Pass
5	0.119	1.140	10.5	0.122	1.710	7.15	Pass
6	0.015	0.300	5.0	0.016	0.450	3.61	Pass
7	0.047	0.770	6.1	0.050	1.155	4.35	Pass
8	0.008	0.230	3.4	0.009	0.345	2.54	Pass
9	0.036	0.400	8.9	0.038	0.600	6.29	Pass
10	0.008	0.184	4.5	0.010	0.276	3.45	Pass
11	0.034	0.330	10.3	0.037	0.495	7.40	Pass
12	0.006	0.153	4.1	0.007	0.230	3.17	Pass
13	0.044	0.210	21.1	0.048	0.315	15.30	Pass
14	0.009	0.131	6.9	0.011	0.197	5.80	Pass
15	0.032	0.150	21.4	0.037	0.225	16.46	Pass
16	0.011	0.115	9.4	0.012	0.173	6.82	Pass
17	0.035	0.132	26.8	0.046	0.199	23.04	Pass
18	0.010	0.102	9.4	0.012	0.153	7.73	Pass
19	0.022	0.118	18.7	0.025	0.178	14.00	Pass
20	0.010	0.092	10.5	0.011	0.138	7.73	Pass
21	0.042	0.107	39.4	0.053	0.161	32.92	Pass
22	0.004	0.084	4.6	0.006	0.125	4.96	Pass
23	0.039	0.098	39.8	0.041	0.147	27.80	Pass
24	0.009	0.077	11.2	0.009	0.115	8.10	Pass
25	0.016	0.090	17.4	0.020	0.135	14.67	Pass
26	0.004	0.071	5.6	0.006	0.106	5.25	Pass
27	0.028	0.083	34.1	0.033	0.125	26.59	Pass
28	0.003	0.066	4.2	0.003	0.099	3.28	Pass
29	0.033	0.078	43.0	0.042	0.116	36.63	Pass
30	0.004	0.061	6.1	0.005	0.092	5.07	Pass
31	0.019	0.073	26.0	0.020	0.109	18.72	Pass
32	0.003	0.058	5.7	0.004	0.086	4.44	Pass
33	0.012	0.068	17.6	0.013	0.102	12.77	Pass
34	0.004	0.054	7.7	0.005	0.081	6.19	Pass
35	0.006	0.064	9.8	0.013	0.096	13.15	Pass
36	0.007	0.051	13.8	0.008	0.077	10.27	Pass
37	0.011	0.061	17.5	0.013	0.091	13.98	Pass
38	0.009	0.048	17.8	0.009	0.073	12.69	Pass
39	0.015	0.058	25.9	0.020	0.087	23.07	Pass
40	0.007	0.046	14.3	0.008	0.069	11.36	Pass

Voltage Source Verification Data (Run time)

EUT: Talon-LRU
Test category: Class-A per Ed. 3.2 (2009) (European limits)
Test date: 1/31/2020
Test duration (min): 3
Comment: 2 x
Customer: NRC

Tested by: MK
Test Margin: 100
Start time: 8:33:16 AM
End time: 8:36:38 AM
Data file name: H-000526.cts_data

Test Result: Pass
Source qualification: Normal

Highest parameter values during test:

Voltage (Vrms):	230.13	Frequency(Hz):	50.00
I_Peak (Amps):	4.431	I_RMS (Amps):	2.488
I_Fund (Amps):	2.477	Crest Factor:	1.790
Power (Watts):	558.3	Power Factor:	0.976

Harm#	Harmonics V-rms	Limit V-rms	% of Limit	Status
2	0.155	0.460	33.67	OK
3	0.350	2.071	16.88	OK
4	0.028	0.460	6.05	OK
5	0.118	0.920	12.86	OK
6	0.027	0.460	5.84	OK
7	0.086	0.690	12.44	OK
8	0.023	0.460	5.08	OK
9	0.060	0.460	13.12	OK
10	0.019	0.460	4.04	OK
11	0.059	0.230	25.60	OK
12	0.026	0.230	11.13	OK
13	0.046	0.230	20.18	OK
14	0.050	0.230	21.88	OK
15	0.035	0.230	15.23	OK
16	0.018	0.230	7.74	OK
17	0.049	0.230	21.19	OK
18	0.016	0.230	6.89	OK
19	0.043	0.230	18.82	OK
20	0.017	0.230	7.19	OK
21	0.044	0.230	19.24	OK
22	0.039	0.230	16.96	OK
23	0.066	0.230	28.59	OK
24	0.019	0.230	8.10	OK
25	0.021	0.230	9.14	OK
26	0.013	0.230	5.57	OK
27	0.032	0.230	14.03	OK
28	0.028	0.230	12.21	OK
29	0.035	0.230	15.36	OK
30	0.023	0.230	10.21	OK
31	0.044	0.230	18.93	OK
32	0.020	0.230	8.56	OK
33	0.037	0.230	15.95	OK
34	0.027	0.230	11.56	OK
35	0.033	0.230	14.35	OK
36	0.028	0.230	12.22	OK
37	0.045	0.230	19.50	OK
38	0.020	0.230	8.63	OK
39	0.046	0.230	20.13	OK
40	0.035	0.230	15.11	OK

3.4 Voltage Fluctuations and Flicker

Date Performed: January 31, 2020

Test Method: EN 61000-3-3:2013+A1:2017

Test Voltage: 230 VAC/50 Hz

Test Requirement:

The relative voltage change characteristic shall be obtained from a histogram of U(t) . The limits shall be applicable to voltage fluctuations and flicker at the supply terminals of the EUT, measured or calculated according to clause 4 under test conditions described in clause 6 and Annex A of standard. Tests made to prove compliance with the limits are considered to types tests. The following limits apply:

- The value of P_{st} shall not be greater than 1.0;
- The value of P_{lt} shall not be greater than 0.65;

Test Set-up:

The equipment was set-up using a power analyzer, and a filtered power source, and short-term (Pst) and the long (Plt) flicker was measured.

Modifications:

No modification was required to comply for this test.

Result:

The EUT complies with the applicable standard.

Measurement Data:

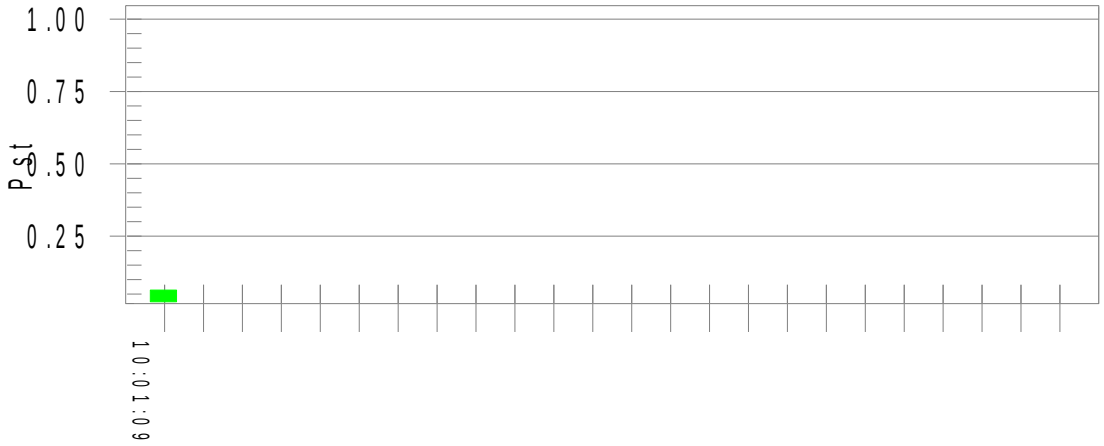
Flicker Test Summary per EN/IEC61000-3-3 (Run time)

EUT: Talon-LRU
Test category: All parameters (European limits)
Test date: 1/31/2020 Start time: 9:50:49 AM End time: 10:03:10 AM
Test duration (min): 12 Data file name: F-000535.cts_data
Comment: HP 230V 50Hz
Customer: NRC

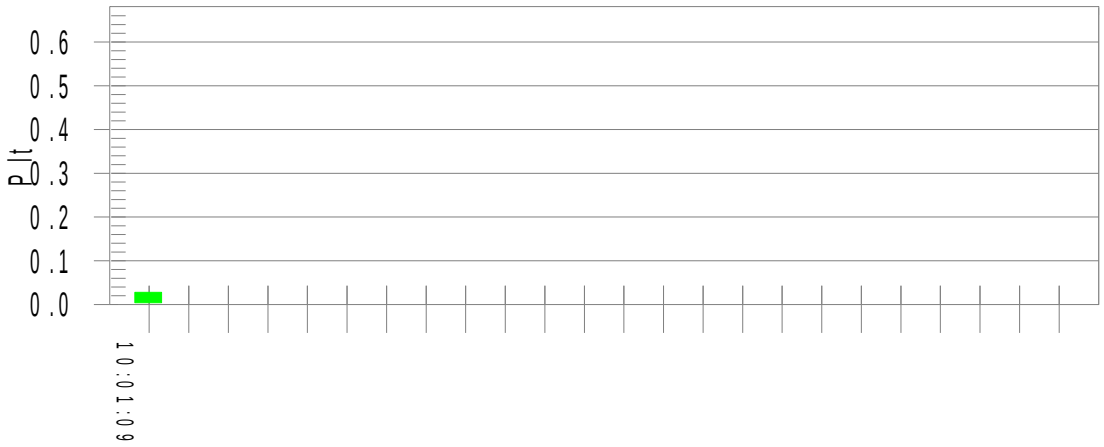
Tested by: MK
Test Margin: 100

Test Result: Pass Status: Test Completed

Pst_i and limit line European Limits



Plt and limit line



Parameter values recorded during the test:

Vrms at the end of test (Volt):	229.92			
Highest dt (%):	0.20	Test limit (%):	3.30	Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.07	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.064	Test limit:	1.000	Pass
Highest Plt (2 hr. period):	0.028	Test limit:	0.650	Pass

3.5 Inrush Current

Date Performed: January 31, 2020

Test Method: EN 61000-3-3:2013+A1:2017 – Annex B, procedure B.2

Test Voltage: 230 VAC/50 Hz

Test Requirement:

For voltage changes caused by manual switching, equipment is deemed to comply without further testing if the maximum r.m.s. input current (including inrush current) evaluated over each 10 ms half-period between zero-crossings does not exceed 20 A, and the supply current after inrush is within a variation band of 1,5 A.

Test Set-up:

The equipment was set-up using a power analyzer, and a filtered power source, and maximum relative voltage change d(max) was measured.

Modifications:

No modification was required to comply for this test.

Result:

The EUT complies with the applicable standard.

Measurement Data:

Inrush Current Test Summary per EN/IEC61000-3-3 (Run time)

EUT: Talon-LRU
Test category: InRush Current Test
Test date: 1/31/2020 Start time: 10:17:40 AM End time: 10:25:17 AM
Test duration (min): 5 Data file name: F-000539.cts_data
Comment: HP 230V 50Hz Inrush
Customer: NRC

Tested by: MK
Test Margin: 100

Test Result: Pass Status: Test Aborted

European Limits

Parameter values recorded during the test:

Vrms at the end of test (Volt):	230.29		
Highest dmax (%):	0.00	Test limit (%):	4.00
InRush Current(Amps-rms):	2.538	Test limit:	< 20A

QAI: # of trials: 9

IMMUNITY TEST RESULTS

4.1 Voltage Dips & Interruptions

- **Date Performed:** January 31, 2020
- **Test Standard:** EN 55035:2016
- **Test Method:** EN 61000-4-11:2004+A2:2017
- **Test Voltage:** 230VAC, 50 Hz
- **Test Requirement:**

  Compliance is checked by the following tests and determined during and after the tests in accordance with EN61000-4-11.

- **Test Set-up:**
  The EUT was connected to the test voltage using the provided AC power adapter. The required voltage Dips and Interruptions were applied as per the table below.

Test Performed	Test Specifications	Required Criteria	EUT
Voltage Dips	0% during 0.5 Cycle	B	A
	0% during 1 Cycle	B	A
	70% during 25 cycles	C	A
Voltage Interruptions	0% during 250 Cycles	C	C

- **Modifications:**

  No modification was required to comply for this test.

- **Result:**

  The EUT complies with the standard.

Appendix A: Test Set-up Photos

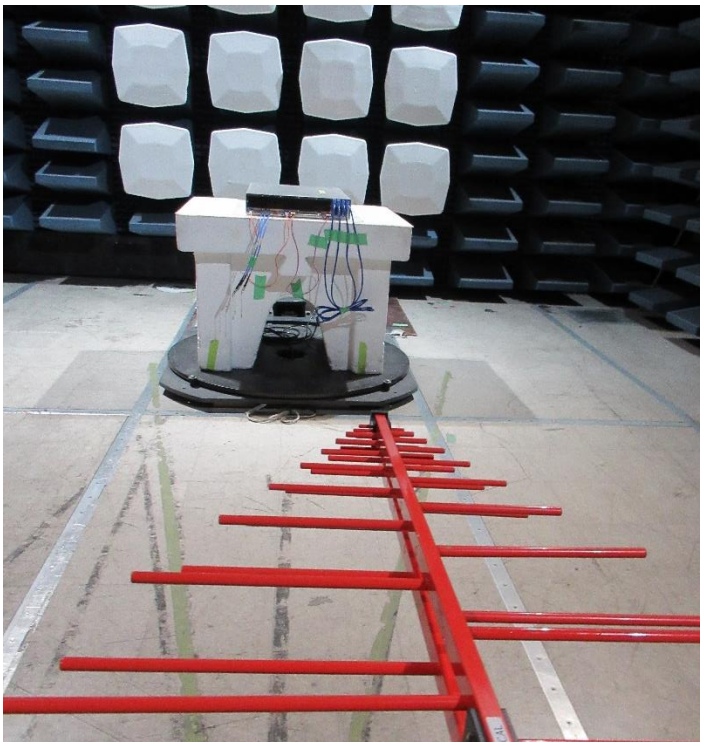


Figure 1: Radiated Emissions (30 MHz – 1 GHz) – 3.1.1

Figure 2: Radiated Emissions (1 – 18 GHz) – 3.1.1

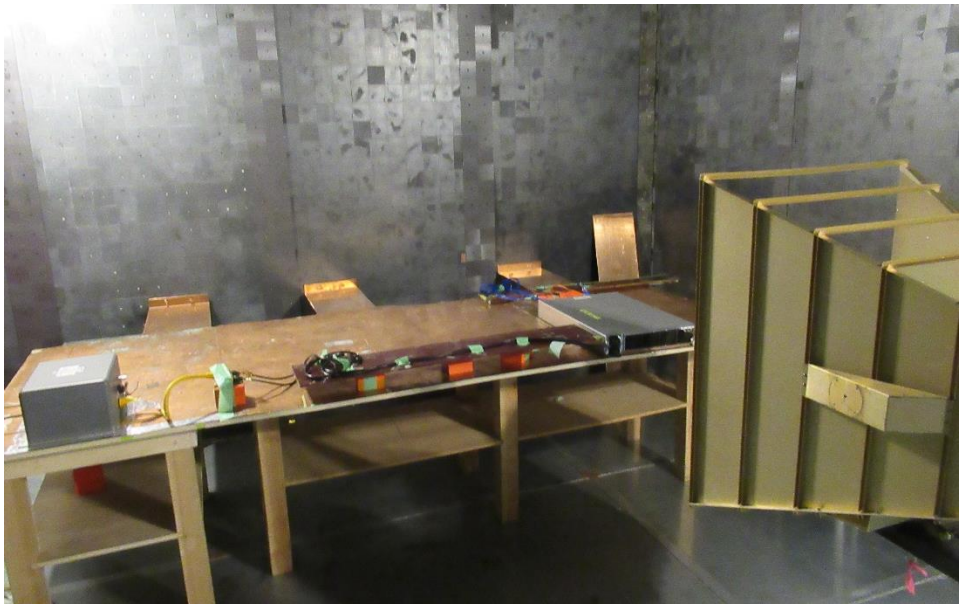


Figure 3: Radiated Emissions (200 MHz – 1 GHz) – 3.1.2 iii

Figure 4: Radiated Emissions (1-18 GHz) – 3.1.2 v

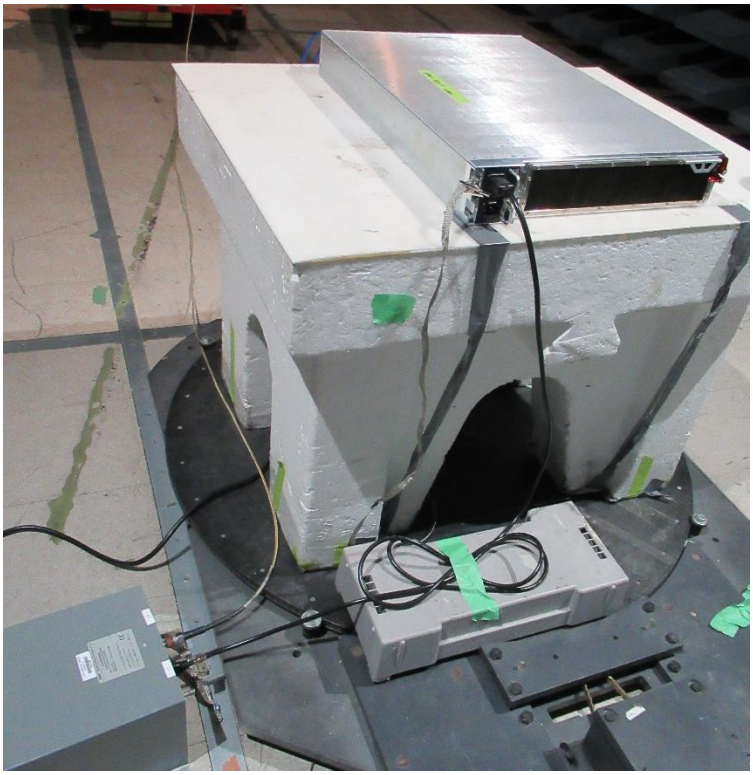


Figure 5: Conducted Emissions – 3.2

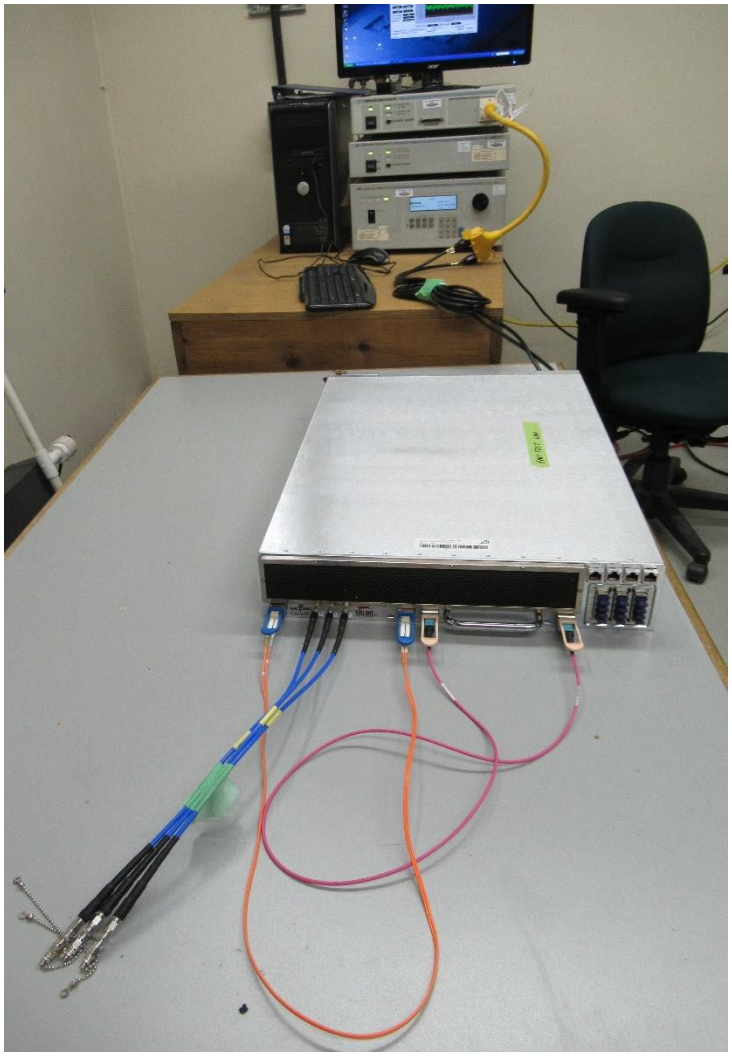


Figure 6: Harmonics, Flicker & Inrush Current

Appendix B: ABBREVIATIONS

Abbreviation	Definition
AC	Alternating Current
AM	Amplitude Modulation
BW	Bandwidth
CE	European Conformity
CISPR	Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference)
CW	Continuos Wave
DC	Direct Current
EFT	Electrical Fast Transient
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FCC	Federal Communications Commission
FW	Firmware
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

END OF REPORT