Report on the Testing of the

McIntosh Laboratory Inc.
MC1502

In accordance with:
EN 55035: 2017
EN 55032: 2015 Class B
EN 61000-3-2: 2014 (<16A)
EN 61000-3-3: 2013 (<16A)

Prepared for: McIntosh Laboratory Inc.
2 Chambers Street
Binghamton, NY 13903-2699

America

Add value.
Inspire trust.

COMMERCIAL-IN-CONFIDENCE

Document Number: NC72162304.1 | Issue: 1

SIGNATURE			
			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Brad A Reasoner	EMC Test Engineer	**Authorized Signatory**	17 September 2020

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD America, Inc. document control rules.

TÜV SÜD America's New Brighton Lab maintain A2LA accreditation to ISO/IEC 17025 for the specific tests listed in A2LA Certificate #2955.11 as Electrical Testing Laboratories and are recognized by the National RRA under Phase I of the APEC Tel MRA Identification Number US0080.

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with the standards listed above.

A2LA Cert. No. 2955.11

ACCREDITATION
Our A2LA Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our A2LA Accreditation.

TÜV SÜD America Inc
141 14th St NW
New Brighton, MN 55112 USA

Phone: 651-631-2487
www.tuv-sud-america.com

Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Table 1.1-1 – Modification Record

Issue	Description of Change	Date of Issue
1	First Issue	17 September 2020
2	Updated 1.3-1 to include base standard reference years	17 September 2020

1.2 Introduction

Applicant	McIntosh Laboratory Inc.
Manufacturer	McIntosh Laboratory Inc.
Applicant's Email Address	LSavidge@mcintoshlabs.com
Model Number(s)	MC1502
Serial Number(s)	AJB1057
Number of Samples Tested	1
Test Specification/Issue/Date	EN 55035: 2017 EN 55032: 2015 EN 61000-3-2: 2014 (<16A) EN 61000-3-3: 2013 (<16A)
Order Number	72162304
Date of Receipt of EUT	10 September 2020
Condition of EUT	Normal - No Damage
Start of Test	10 September 2020
Finish of Test	16 September 2020

1.3 Summary of Test Results

A brief summary of the tests carried out in accordance with the specifications shown below.

Table 1.3-1 – Summary of Tests

Section	Specification Clause	Test Description	Accreditation	Base Standard
2.1	EN 55035 / 4.2.1	Electrostatic discharges (ESD)	A2LA	EN 61000-4-2:2009
2.2	EN 55035 / 4.2.2.2	Continuous RF electromagnetic field disturbances	A2LA	EN 61000-4-3:2006 +A1:2008 +A2:2010
2.3	EN 55035 / 4.2.2.3	Continuous induced RF disturbances	A2LA	EN 61000-4-6:2014
2.4	EN 55035 / 4.2.3	Power frequency magnetic field	A2LA	EN 61000-4-8:2010
2.5	EN 55035 / 4.2.4	Electrical fast transients/burst (EFT/B)	A2LA	EN 61000-4-4:2012
2.6	EN 55035 / 4.2.5	Surges	A2LA	EN 61000-4-5:2014
2.7	EN 55035 / 4.2.6	Voltage dips and interruptions	A2LA	EN 61000-4-11:2004
2.8	EN 55035 / A.2	Radiated Emissions	A2LA	EN 55016-2-3
2.9	EN 55035 / A.3	Conducted Emissions at Mains Power Ports	A2LA	EN 55016-2-1
2.10	EN 55035 / A.3	Conducted Emissions at Communication Ports	A2LA	EN 55016-2-1
2.11	7	Harmonic current emissions	A2LA	EN 61000-3-2
2.12	5	Voltage fluctuations and flicker	A2LA	EN 61000-3-3

Table 1.3-2 – Test results

Test Description	Name of tester(s)	Result
Electrostatic discharges (ESD)	Greg Jakubowski	Pass
Continuous RF electromagnetic field disturbances	Greg Jakubowski	Pass
Continuous induced RF disturbances	Greg Jakubowski	Pass
Power frequency magnetic field	Greg Jakubowski	Pass
Electrical fast transients/burst (EFT/B)	Greg Jakubowski	Pass
Surges	Greg Jakubowski	Pass
Voltage dips and interruptions	Greg Jakubowski	Pass
Radiated Emissions	Greg Jakubowski	Pass
Conducted Emissions at Mains Power Ports	Greg Jakubowski	Pass
Conducted Emissions at Communication Ports	n/a	n/a
Harmonic current emissions	n/a	n/a
Voltage fluctuations and flicker	Greg Jakubowski	Pass

1.4 Declaration of Build Status

EQUIPMENT DESCRIPTION	
Model Name/Number	MC1502
Part Number	MC1502
Hardware Version	n/a
Software Version	n/a
Technical Description (Please provide a brief description of the intended use of the equipment)	2-Channel Vacuum Tube Audio Amplifier. 150 Watts per Channel. Unity Coupled Circuit Output Transformers. (8) KT88, (4) 12AX7A and (4) 12AT7 vacuum tubes.

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	< 108MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	n/a
Class A Digital Device (Use in commercial, industrial or business environment) ☐ Class B Digital Device (Use in residential environment only) ☒	

Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
	☒	☐	230V / 50Hz
External DC	Nominal Voltage		Maximum Current
	n/a		
Battery	Nominal Voltage		Battery Operating End Point Voltage
	n/a		n/a

EXTREME CONDITIONS					
Maximum temperature	n/a*	°C	Minimum temperature	n/a*	°C

Ancillaries

* Not provided

1.5 Product Information

1.5.1 Technical Description

The Equipment Under Test (EUT) was a 2-Channel vacuum tube audio amplifier.
A full description and detailed product specification details are available from the manufacturer.

Photo 1.5-1 –Front view of the EUT

Photo 1.5-2 –Rear view of the EUT

Table 1.5-1 – Cable Descriptions

Cable/Port	Description
Cable/Port 1	Balanced input R
Cable/Port 2	Balanced input L
Cable/Port 3	Unbalanced input L
Cable/Port 4	Unbalanced input R
Cable/Port 5	Power control in
Cable/Port 6	Power control out
Cable/Port 7	R output com (-)
Cable/Port 8	R output 2Ω (+)
Cable/Port 9	R output 4Ω (+)
Cable/Port 10	R output 8Ω (+)
Cable/Port 11	L output com (-)
Cable/Port 12	L output 2Ω (+)
Cable/Port 13	L output 4Ω (+)
Cable/Port 14	L output 8Ω (+)

Table 1.5-2 – Support Equipment Descriptions

Make/Model	Description
HP / 33120A	Audio source. Arbitrary waveform generator
Agilent Technologies / E4440A	Output monitor. Spectrum Analyzer
Fluke / 70/73	Output monitor. Digital Multimeter
Keysight Technologies / MSO-X 3104T	Output monitor. Oscilloscope, 4-CH
Memcor / R-300	Load simulator. 0-10Ω 300W
Dale / NH2502R000FE01	Load simulator. 2Ω

1.5.2 Modes of Operation

The tested mode of operation for conducted and radiated immunity was to set the initial reference level and then use the method of measurement per CISPR 35 Annex G. For other testing, a 1kHz sinewave input was applied. Amplitude adjusted to produce ½ rated output (~75W per channel).

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test program. The modifications incorporated during each test are recorded on the appropriate test pages.

Table 1.7-1 – Modification Record

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	Initial State		

1.8 Test Location

TÜV SÜD conducted the following tests at our New Brighton, MN test laboratory.

Office address:
TÜV SÜD America
141 14th St NW
New Brighton, MN 55112 USA

2 Test Details

Criteria A:

During and after the test the EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed below a minimum performance level specified by the manufacturer when the EUT 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 EUT if used as intended.

Criteria B:

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

During the test, degradation of performance is allowed. However, no change of operating state or stored data is allowed to persist after the test.

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 EUT if used as intended.

Criteria C:

During and after testing, a temporary loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls or cycling of the power to the EUT by the user in accordance with the manufacturer's instructions.

Functions, and/or information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

2.1 Electrostatic Discharges (ESD)

2.1.1 Specification Reference

EN 61000-4-2 per EN 55035: 2017

2.1.2 Equipment Under Test and Modification State

As shown in §1.5 with modification state “0”, as noted in §1.7

2.1.3 Test Voltage / Frequency

230V / 50Hz

2.1.4 Date of Test

16 September 2020

2.1.5 Test Method

The equipment under test including associated cabling was configured on but insulated from, using a 0.5mm isolator, a horizontal coupling plane fitted to the top of a 0.8 m non-conductive table for table-top equipment; and on a 0.1 m insulated support for floor standing equipment; above a ground reference plane all within a test laboratory.

Using the air discharge method for non-metallic parts, contact discharge method for metallic parts with both vertical and horizontal couple plane discharge methods for the sides of the equipment under test, the required electrostatic discharge voltage levels in both voltage polarities were applied at the detailed pulse repetition rate.

During this testing any anomalies in the equipment under test’s performance were recorded.

2.1.6 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	23 °C
Relative Humidity	50 %
Atmospheric Pressure	98.5 kPa

2.1.7 Test Results

Table 2.1-1 – Requirements

Required Test Levels				Performance Criteria
Discharge type	Discharge Level (kV)		Number of discharges per location (each polarity)	
	Positive	Negative		
Air – Direct	8	8	10	B
Contact – Direct	4	4	10	B
Contact – Indirect	4	4	10	B

Table 2.1-2 – Observations

Test Point Location	Discharge Type		4 kV Reps		8 kV Reps		Complies		Criteria Met	Remarks
	Direct/ Indirect	Contact/ Air	+	-	+	-	Yes	No		
HCP	Indirect	Contact	10	10			✓		A	
VCP	Indirect	Contact	10	10			✓		A	Four sides tested
1	Direct	Contact	10	10			✓		A	
2	Direct	Contact	10	10			✓		A	
3	Direct	Contact	10	10			✓		A	
4	Direct	Contact	10	10			✓		A	
5	Direct	Contact	10	10			✓		A	
6	Direct	Contact	10	10			✓		A	
7	Direct	Air			10	10	✓		A	
8	Direct	Contact	10	10			✓		A	
9	Direct	Contact	10	10			✓		A	
10	Direct	Contact	10	10			✓		A	
11	Direct	Contact	10	10			✓		A	
12	Direct	Contact	10	10			✓		A	
13	Direct	Contact	10	10			✓		A	
14	Direct	Contact	10	10			✓		A	
15	Direct	Air			10	10	✓		A	
16	Direct	Air			10	10	✓		A	
17	Direct	Air			10	10	✓		A	
18	Direct	Contact	10	10			✓		A	
19	Direct	Contact	10	10			✓		A	
20	Direct	Contact	10	10			✓		A	
21	Direct	Contact	10	10			✓		A	

Test Summary: EUT operated as intended before, during, and after testing.

Test Result: Pass

2.1.8 Test Set-up & Discharge Points

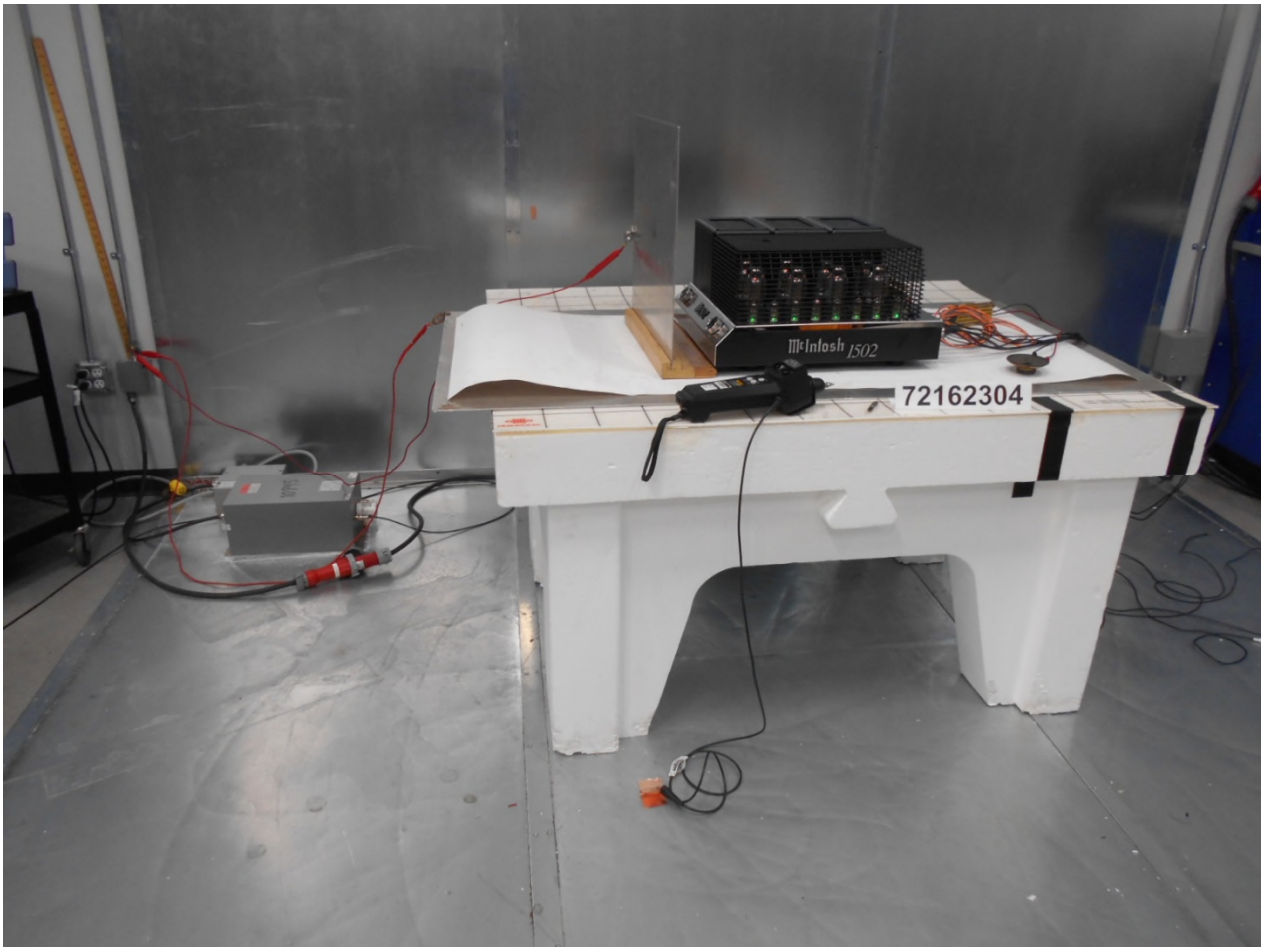


Photo 2.1-1 – ESD Test Set-up

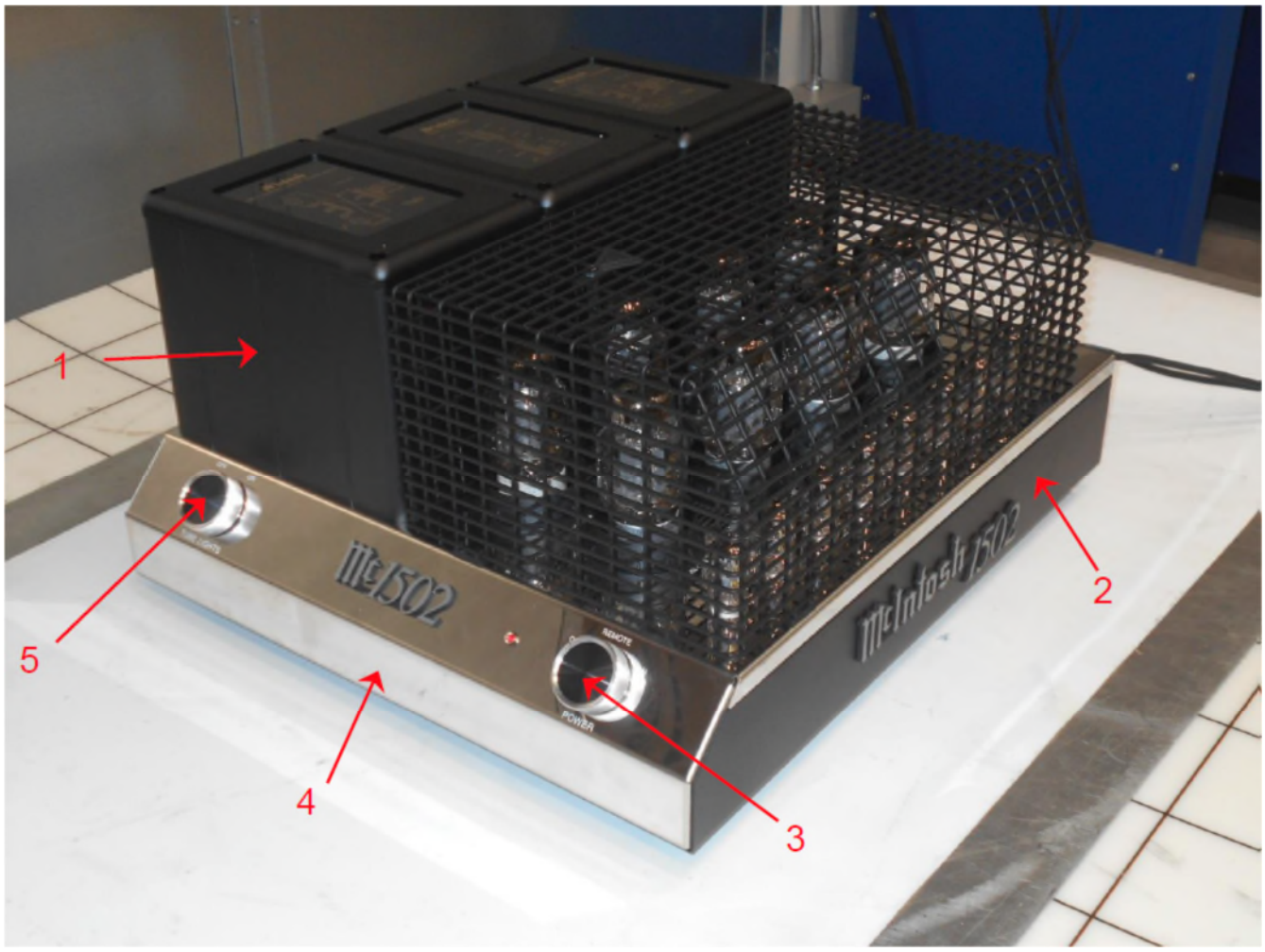


Photo 2.1-2 – Discharge Points

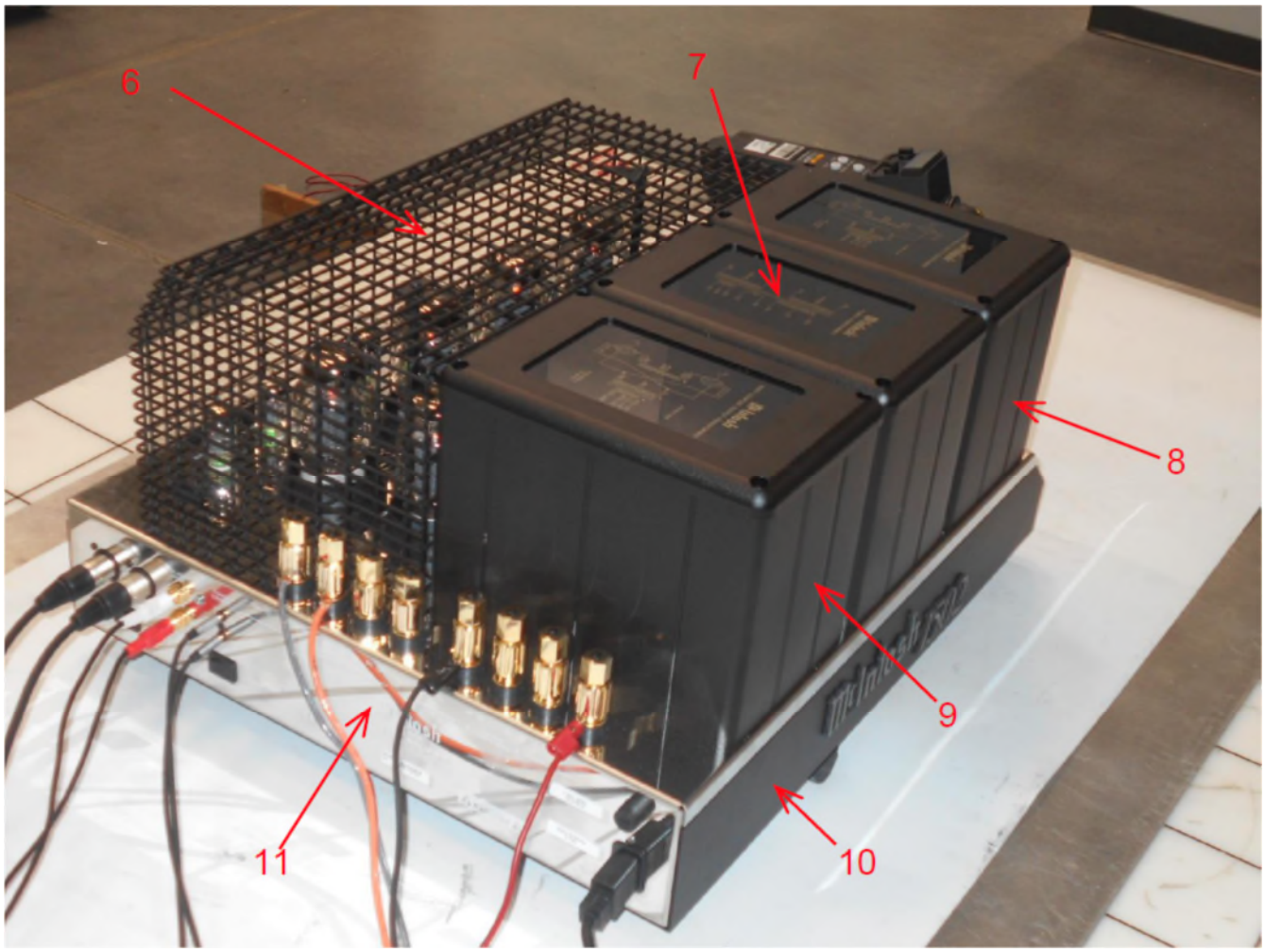


Photo 2.1-3 – Discharge Points

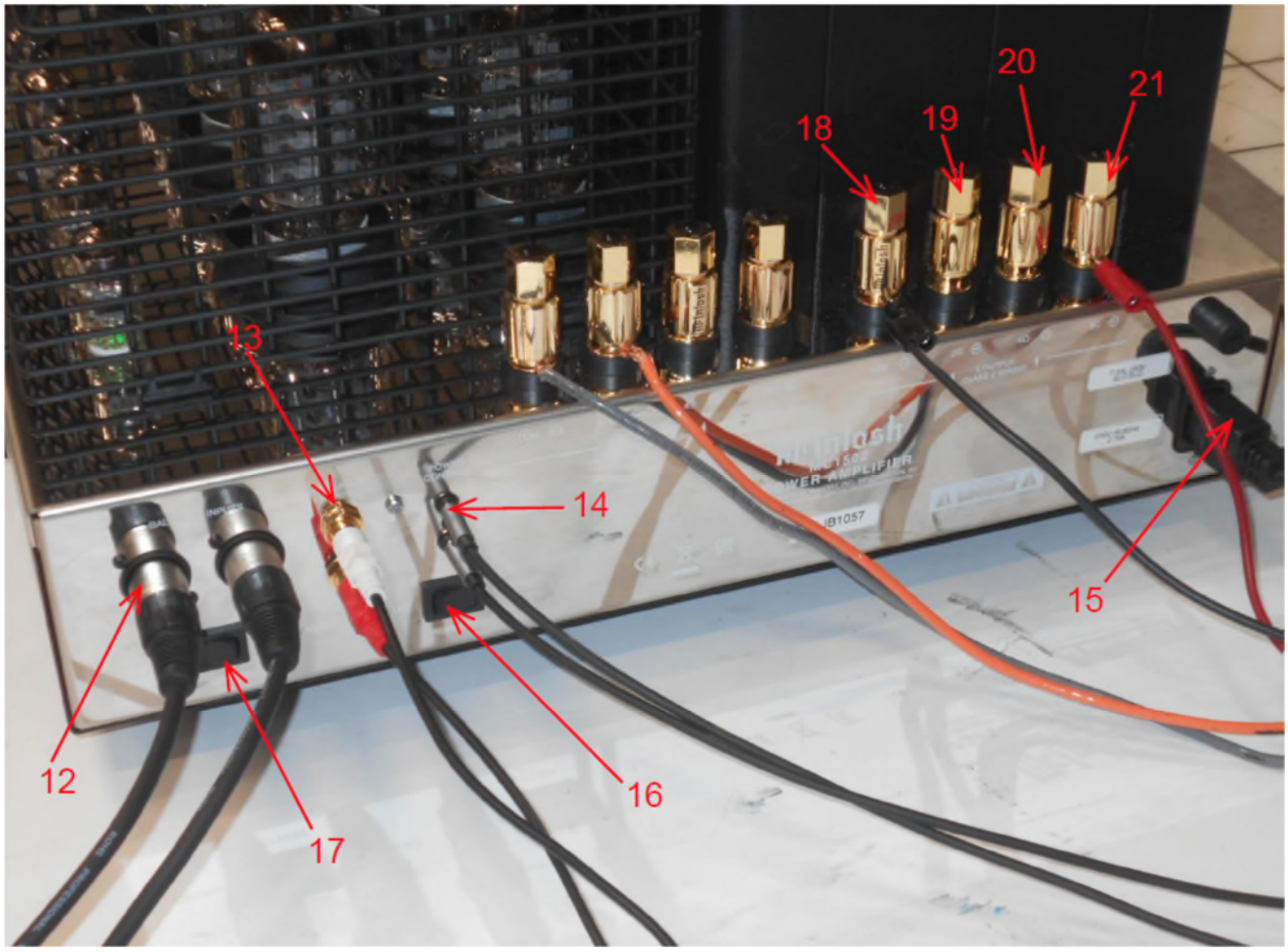


Photo 2.1-4 – Discharge Points

2.1.9 Test Location and Test Equipment Used

This test was carried out in New Brighton, MN.
Test Area: GRP2

Table 2.1-3 – Electrostatic Discharge Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE11154	KeyTek	ESD MiniZap	MZ-15EC	9809460	B	06/02/2020	06/02/2021
NBLE11157	Fluke	Temp/Humidity Meter	971	12001009	G	05/28/2020	05/28/2021
NBLE11220	ThermoKeytek	TPC-2A, Omni Tip	TPC-2A	1406191	B	06/02/2020	06/02/2021
WRLE11445	TÜV SÜD	Vertical Coupling Plane	n/a	n/a	Y	n/a	n/a
None	TÜV SÜD	Horizontal Coupling Plane	None	None	Y	N/A	N/A

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

2.2 Continuous RF Electromagnetic Field Disturbances

2.2.1 Specification Reference

EN 61000-4-3 per EN 55035: 2017

2.2.2 Equipment Under Test and Modification State

As shown in §1.5 with modification state “0”, as noted in §1.7

2.2.3 Test Voltage / Frequency

230V / 50Hz

2.2.4 Date of Test

11 & 14 September 2020

2.2.5 Test Method

The equipment under test including associated cabling was configured, on a 0.8 m non-conductive table for table-top equipment and on a 0.05 to 0.15 m insulated support for floor standing equipment; with a pre-calibrated semi anechoic chamber.

All four sides of the equipment under test were subjected to the required RF field strength, modulated as described, swept over the frequency range of test with the antenna positioned in both horizontal and vertical polarizations.

During this testing any anomalies in the equipment under test’s performance was recorded.

2.2.6 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

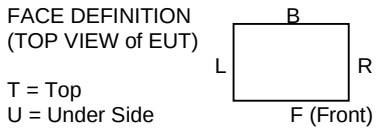
2.2.7 Test Results

Table 2.2-1 – Requirements

Required Test Levels					Performance Criteria
Frequency Range (MHz)	Level (V/m)	Modulation	Step Size (%)	Dwell (s)	
80 to 1000	3	AM (80 %,1 kHz, sine wave)	1 %	3	A
1800 2600 3500 5000	3	AM (80 %,1 kHz, sine wave)	-	10	A
Supplementary information: Note 1. EUT powered at one of the Nominal input voltages and frequencies					

Table 2.2-2 – Observations

Actual Test Levels					Performance Criteria
Frequency Range (MHz)	Level (V/m)	Modulation	Step Size (%)	Dwell (s)	
80 to 1000	3	AM (80 %,1 kHz, sine wave)	1 %	3	A
1800 2600 3500 5000	3	AM (80 %,1 kHz, sine wave)	-	10	A
Supplementary information: Note 1: EUT powered at one of the Nominal input voltages and frequencies Note 2: EUT was tested on all four sides (Front, Left, Back, Right).					



Test Summary: EUT operated as intended before, during, and after testing.

Test Result: Pass

2.2.8 Test Set-up Photos

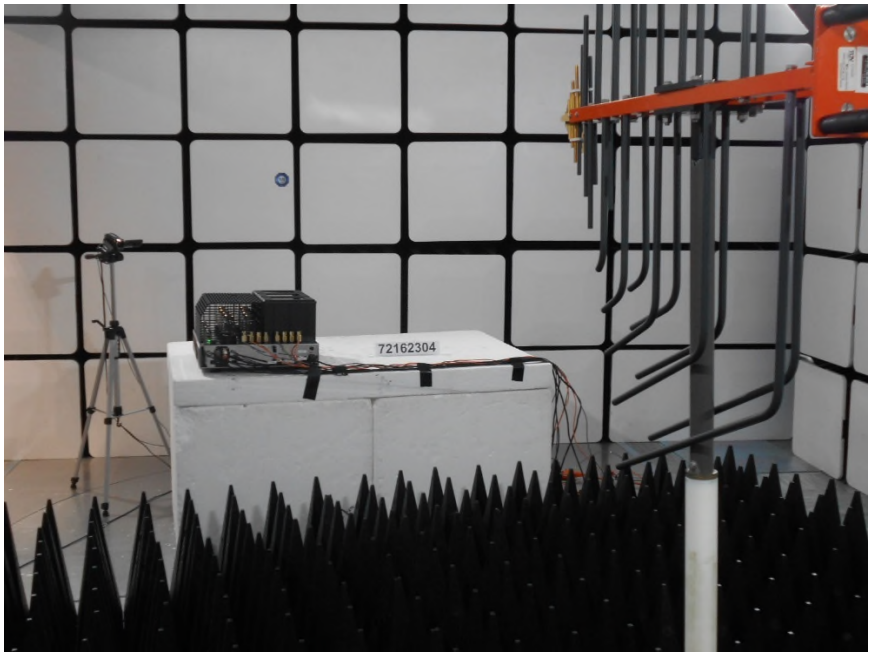


Photo 2.2-1 – Swept frequencies 80-1000MHz

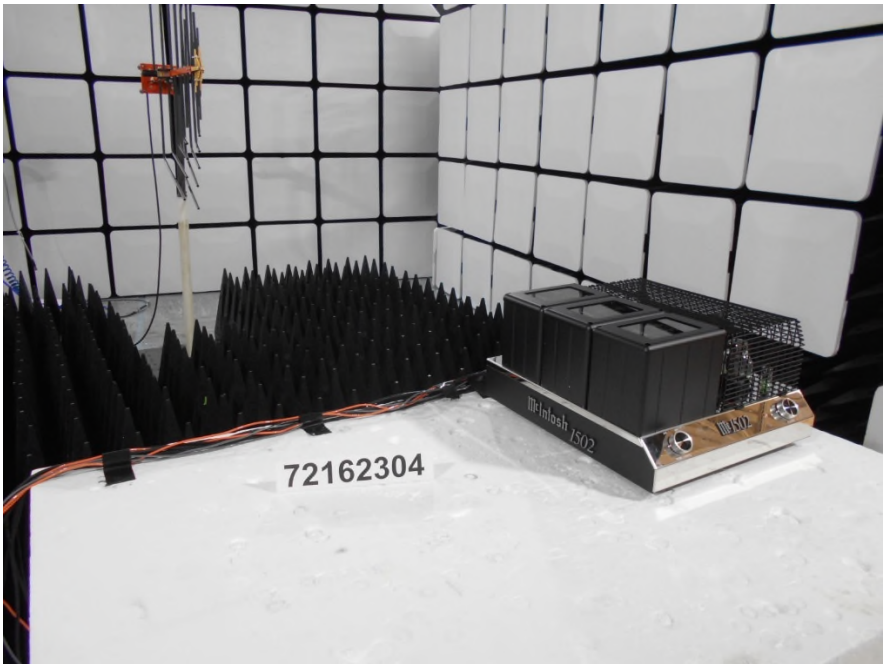


Photo 2.2-2 – Swept frequencies 80-1000MHz

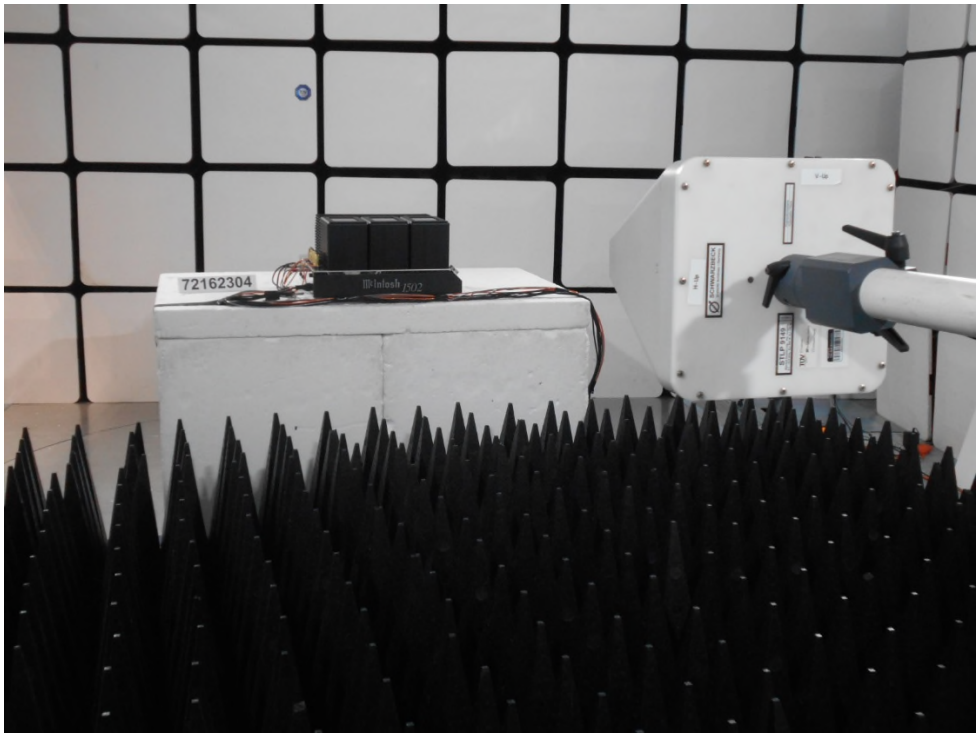


Photo 2.2-3 – Spot frequencies >1GHz

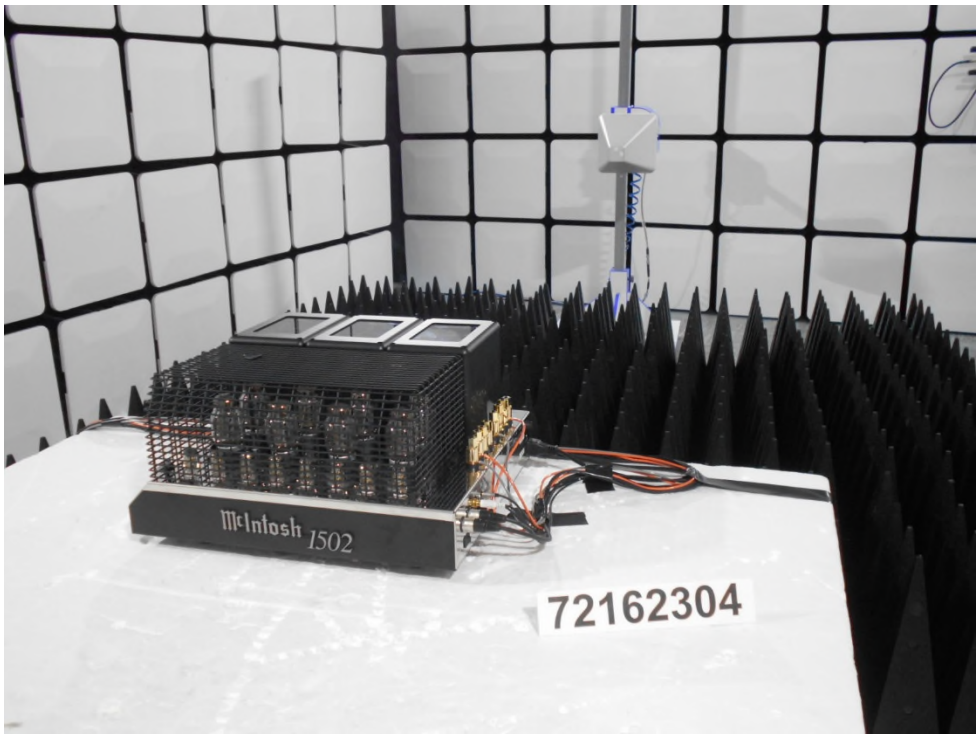


Photo 2.2-4 – Spot frequencies >1GHz

2.2.9 Test Location and Test Equipment Used

This test was carried out in New Brighton, MN.
Test Area: SAC1

Table 2.2-3 – Electromagnetic Field Immunity Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE10513	Amplifier Research	Antenna, Biconilog Periodic .08-5GHz	AT5080M1	0323557	Y	N/A	N/A
NBLE11376	Werlatone	Coupler, 40dB 700 MHz-6 GHz	C10117-10	108786	B	02/27/2020	02/27/2021
NBLE11512	Amplifier Research	Amplifier, 80-1000 MHz	150W1000M3	AMP3MCH00003	Y	N/A	N/A
NBLE11514	Rohde & Schwarz	EMS Test Panel / Power Input	TS-RSP/1153.800.31	MSCEMCH00014 / PWR3MCH0016	Y	N/A	N/A
NBLE11521	Schwarzbeck	Antenna, Stacked Dbl Log Per, 0.7-10.5 GHz	STLP 9149	9149-003	Y	N/A	N/A
NBLE11533	Rohde & Schwarz	Signal Generator, 9 kHz-6 GHz	SMA 100A	101540	G	08/18/2020	08/18/2021
NBLE11622	Amplifier Research	Coupler, 60dB 80-1000 MHz	DC6180	300965	B	02/27/2020	02/27/2021
NBLE11624	Rohde & Schwarz	Spectrum Analyzer, 9 kHz-30 GHz	FSP30	100884	G	02/13/2020	02/13/2021
NBLE11685	Milmega	Amplifier, 100W, 0.8-6 GHz	AS0860-100	1086694	Y	N/A	N/A

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

2.3 RF Continuous Conducted Disturbances

2.3.1 Specification Reference

EN 61000-4-6 per EN 55035: 2017

2.3.2 Equipment Under Test and Modification State

As shown in §1.5 with modification state “0”, as noted in §1.7

2.3.3 Test Voltage / Frequency

230V / 50Hz

2.3.4 Date of Test

14-15 September 2020

2.3.5 Test Method

The equipment under test was configured, on but insulated from, using a 0.1 m isolator, above a ground reference plane all within a test laboratory.

Using CDNs or current clamps as appropriate, the power ports and applicable signal and control ports were subjected to the required, pre-calibrated RF injected signal strength, modulated as described, swept over the frequency range of test.

During this testing any anomalies in the equipment under test’s performance were recorded.

2.3.6 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.3.7 Test Results

Table 2.3-1 – Requirements for AC Mains Power Ports & Analogue / Digital Data Ports

Environmental Phenomenon	Test specification		Units	Basic standard	Performance criteria
Continuous induced RF disturbance	Frequency Ranges Test level See Figure 2.3-2	0,15 to 10 3	MHz V	EN 61000-4-6	A
		10 to 30 3 to 1	MHz V		
		30 to 80 1	MHz V		
Supplementary information: Note 1: EUT powered at one of the Nominal input voltages and frequencies. Note 2: Only applicable to DC Network Power and Analogue / Digital Data Ports which, according to the manufacturer's specification, are greater than 3m.					

The test level specified is the rms voltage level of the unmodulated signal.
The disturbance test signal shall be 80 % amplitude modulated by a sine wave, preferably having a frequency of 1 kHz. A frequency other than 1 kHz may be used where permitted.
The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised and to be able to respond. However, the dwell time should not exceed 5 s at each of the frequencies during the scan.
When testing an EUT with a radio reception function, the radio reception function is not expected to operate normally when the test frequency is within the band where the radio reception function is designed to operate.

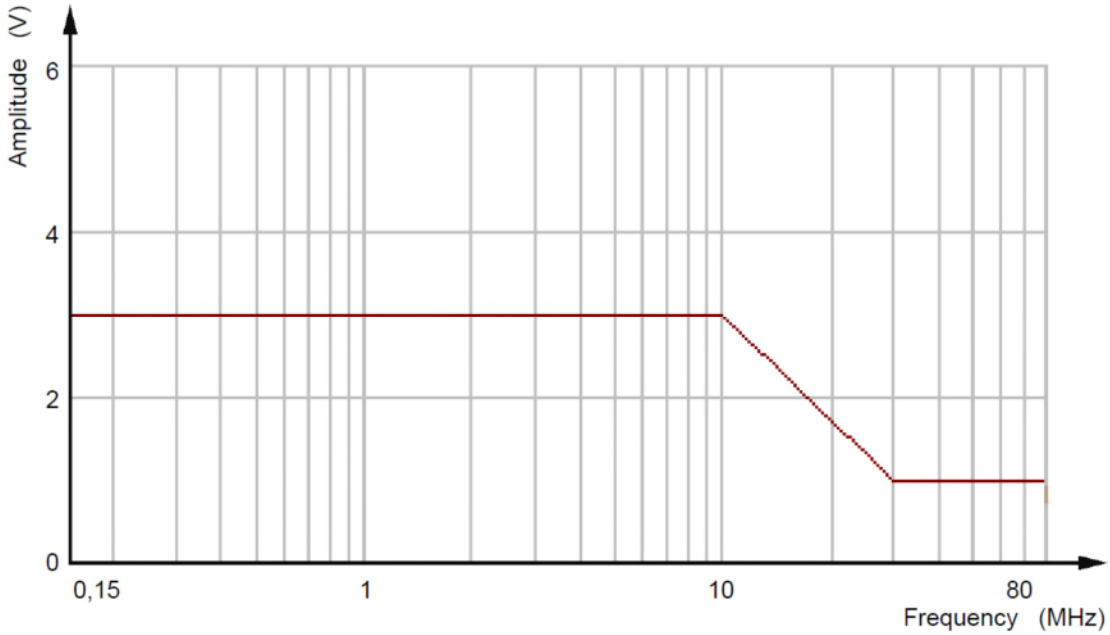


Figure 2.3-2 – Continuous induced RF disturbances levels

Table 2.3-3 – Observations

Test Frequency (MHz)	Test Level (Volts)	Modulation Type (See Key)	Injection Method	Lead Description (Type)	Step Size (%)	Dwell Time (sec.)	Complies		Criteria Met	Remarks
							Yes	No		
0.15 - 80	*	1	CDN	AC Mains	1	3	✓		A	
0.15 - 80	*	1	EM Clamp	L Balanced input	1	3	✓		A	
0.15 - 80	*	1	EM Clamp	L Unbalanced input	1	3	✓		A	
0.15 - 80	*	1	EM Clamp	Power control in	1	3	✓		A	
0.15 - 80	*	1	EM Clamp	Power control out	1	3	✓		A	
0.15 - 80	*	1	EM Clamp	L Output com (-)	1	3	✓		A	
0.15 - 80	*	1	EM Clamp	L Output 8ohm (+)	1	3	✓		A	
0.15 - 80	*	1	EM Clamp	L Output 4ohm (+)	1	3	✓		A	
0.15 - 80	*	1	EM Clamp	L Output 2ohm (+)	1	3	✓		A	

* Test level per Figure 2.3-2

Test Summary: EUT operated as intended before, during, and after testing.

Test Result: Pass

2.3.8 Test Set-up Photos

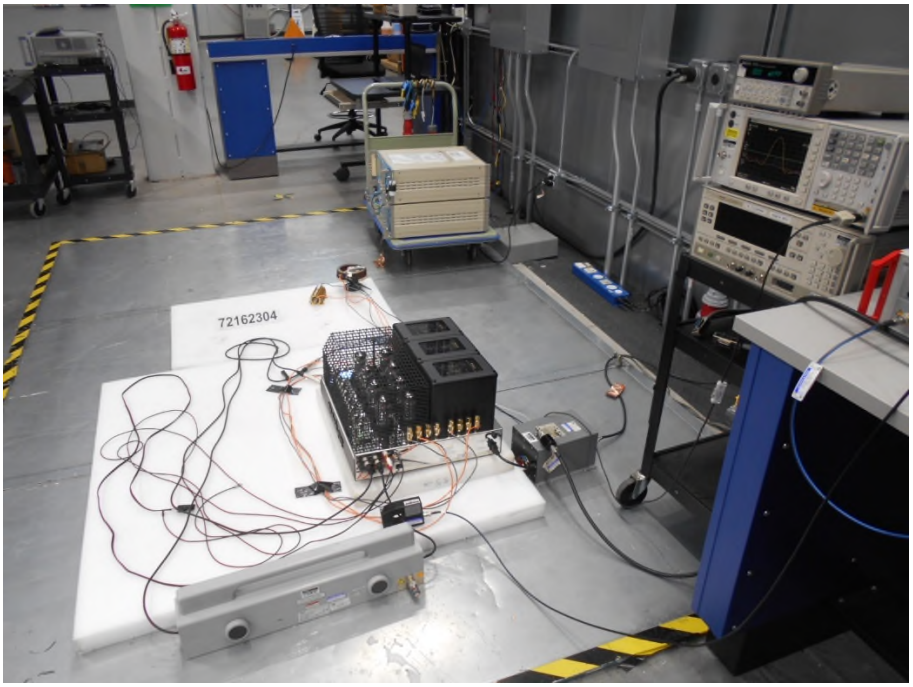


Photo 2.3-1 – RF Continuous Conducted Test Setup – AC Mains

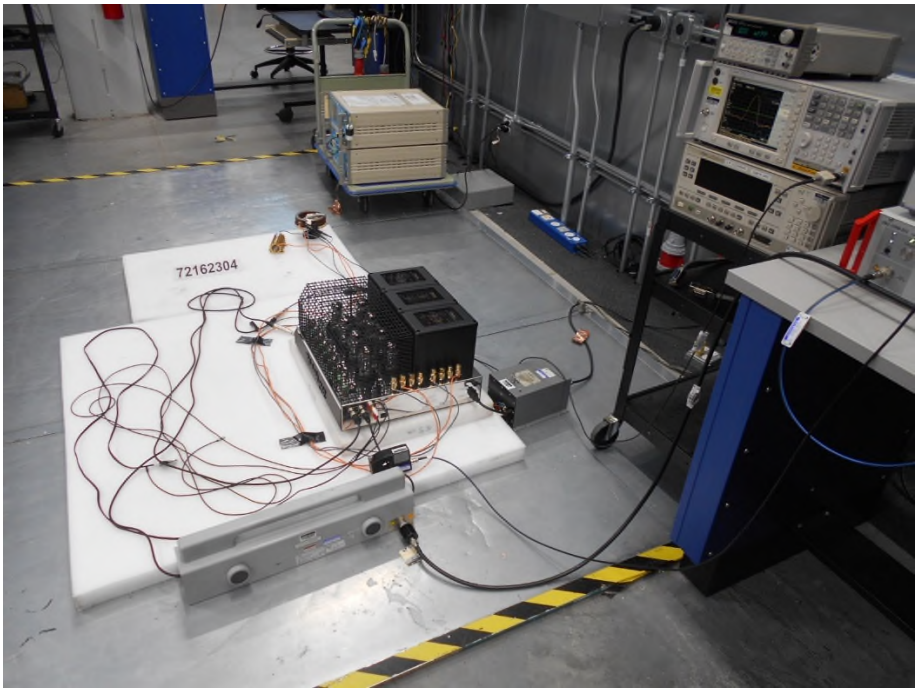


Photo 2.3-2 – RF Continuous Conducted Test Setup – I/O Clamp Injection

2.3.9 Test Location and Test Equipment Used

This test was carried out in New Brighton, MN.
Test Area: GRP1

Table 2.3-4 – Conducted Immunity Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE02645	Fischer Custom Comm.	CDN, M3	FCC-801-M3-25	83	G	07/17/2020	07/17/2021
NBLE02777	Hewlett-Packard	Spectrum Analyzer, 9kHz-1.8GHz	8591E	3501A03603	G	11/25/2019	11/25/2020
NBLE02850	Tektronix	Scope Probe, 100:1	P5100	202150	G	01/21/2020	01/21/2021
NBLE02893	Hewlett-Packard	Power Meter	437B	3125U15333	G	10/21/2019	10/21/2020
NBLE10997	Werlatone	Coupler, 30dB 10 kHz-1 GHz	C6934-10	99177	B	10/15/2019	10/15/2020
NBLE11000	Agilent Technologies	Spectrum Analyzer	E4440A-M75	MY44303856	G	01/23/2020	01/23/2021
NBLE11010	Rohde & Schwarz	Signal Generator, 10 Hz-2 GHz	SMY02	843810023	G	05/19/2020	05/19/2021
NBLE11044	Fischer Custom Comm.	EM Injection Clamp	F-2031-32MM	130269	B	07/17/2019	01/17/2021
NBLE11290	Agilent Technologies	Power Sensor	8482A	3318A29955	G	05/19/2020	05/19/2021
NBLE11292	Solar	Current Probe, 10 kHz-108 MHz	6741-1	6741141201	B	11/06/2019	11/06/2020
NBLE11380	Teseq	Amplifier	CBA 230M-022	T44482	Y	N/A	N/A
WRLE03000	Hewlett-Packard	Function Generator, Arb	33120A	US36020798	G	01/23/2020	01/23/2021

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

2.4 Power Frequency Magnetic Field

2.4.1 Specification Reference

EN 61000-4-8 per EN 55035: 2017

2.4.2 Equipment Under Test and Modification State

As shown in §1.5 with modification state “0”, as noted in §1.7

2.4.3 Test Voltage / Frequency

230V / 50Hz

2.4.4 Date of Test

16 September 2020

2.4.5 Test Method

The equipment under test including associated cabling was configured on a non-conductive support in the 3dB test volume of the inductive coil. A pre-calibrated input level was then applied to magnetic inductive coil at the detailed frequency and level for the required test period.

The EUT was retested with the magnetic field applied in all 3 orthogonal planes of the EUT.

During this testing, any anomalies in the equipment under tests performance was recorded.

2.4.6 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.4.7 Test Results

Table 2.4-1 – Requirements

Environmental Phenomenon	Test specification		Units	Basic standard	Performance criteria
Power frequency magnetic field	Frequency Field strength	50 or 60 1	Hz A/m	EN 61000-4-8	A

Table 2.4-2 – Observations

Actual Test Levels					
Orientation	Operating Frequency	Test Frequency	Test Level	Duration	Performance Criteria Met
X, Y, Z	50 & 60 Hz	50 & 60 Hz	1 A/m	60 s	A

Test Summary: EUT operated as intended before, during, and after testing.

Test Result: Pass

2.4.8 Test Set-up Photo

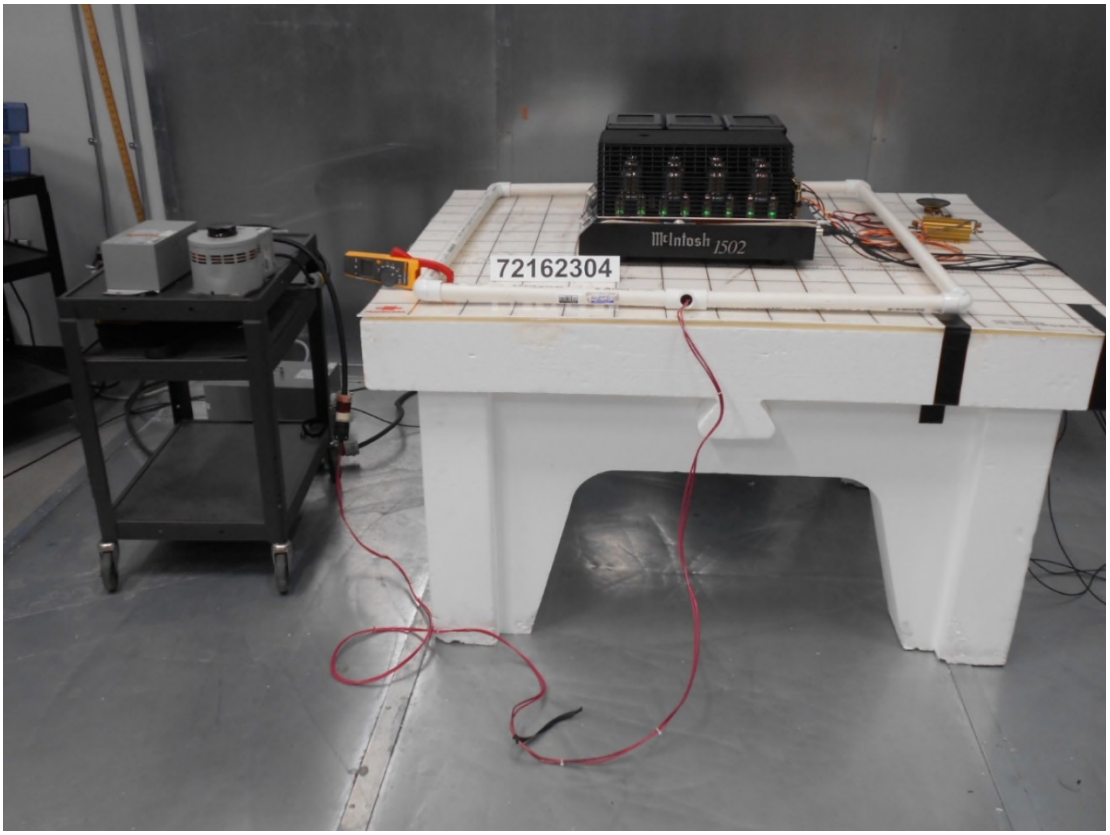


Photo 2.4-1 – Power-frequency Magnetic Field Immunity Set-up

2.4.9 Test Location and Test Equipment Used

This test was carried out in New Brighton, MN.
Test Area: ESD1

Table 2.4-3 – Magnetic Field Immunity Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE10983	Fluke	Clamp Meter	376	19160040	G	01/21/2020	01/21/2021
NBLE11024	Pearson Electronics	Antenna, Loop 1mx1m	1m Loop	4	B	04/17/2020	04/17/2021
NBLE11027	Jefferson Electric	10:1 Transformer	416-1141-000	84	Y	N/A	N/A
NBLE11043	Staco Energy	Variable Transformer	3PN1520B	11043	Y	N/A	N/A
NBLE11402	Behlman	AC Power Supply	BL+30-3-C1-3M	10408	Y	N/A	N/A

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

2.5 Electrical Fast Transients / Burst (EFT/B)

2.5.1 Specification Reference

EN 61000-4-4 per EN 55035: 2017

2.5.2 Equipment Under Test and Modification State

As shown in §1.5 with modification state “0”, as noted in §1.7

2.5.3 Test Voltage / Frequency

230V / 50Hz

2.5.4 Date of Test

16 September 2020

2.5.5 Test Method

The equipment under test including associated cabling was configured on but insulated from, using a 0.1m isolator, above a ground reference plane all within a test laboratory.

Using a CDN for power ports, capacitive coupling clamp for signal and control ports and a 33nF coupling capacitor for earth ports, the required fast transient burst voltage levels in both voltage polarities were applied at the detailed pulse repetition rate and duration of test.

During this testing any anomalies in the equipment under test’s performance were recorded.

2.5.6 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.5.7 Test Results

Table 2.5-1 – Requirements

Required Test Levels					Performance Criteria
Line Under Test	Level (kV)	Repetition Rate (kHz)	Test Duration	Coupling Method	
AC Power Port [2]	± 1	5	1 min per polarity	Direct	B
DC Power Port [1]	± 0.5	5	1 min per polarity	Direct	B
Signal / Control Port [1]	± 0.5	5	1 min per polarity	Capacitive Clamp	B

Notes:

1. Only applicable to DC Network Power and Analogue / Digital Data Ports which, according to the manufacturer’s specification, are greater than 3m.

2. EUT powered at one of the Nominal input voltages and frequencies

Table 2.5-2 – Observations

Test Level (kV)	Test Time (Seconds)	Polarity +	Polarity -	PE	N	L1	L2	L3	Coupl. Clamp	Complies Yes	Complies No	Criteria Met	Remarks
0.5	60	+							X	✓		B*	Balanced input L
0.5	60		-						X	✓		↓	
0.5	60	+							X	✓		B*	Unbalanced input L
0.5	60		-						X	✓		↓	
0.5	60	+							X	✓		B*	Power control in
0.5	60		-						X	✓		↓	
0.5	60	+							X	✓		B*	Power control out
0.5	60		-						X	✓		↓	
0.5	60	+							X	✓		A	L output com (-)
0.5	60		-						X	✓		↓	
0.5	60	+							X	✓		↓	L output 2Ω (+)
0.5	60		-						X	✓		↓	
0.5	60	+							X	✓		↓	L output 4Ω (+)
0.5	60		-						X	✓		↓	
0.5	60	+							X	✓		↓	L output 8Ω (+)
0.5	60		-						X	✓		↓	
													AC Mains
1.0	60	+				X				✓		B*	
1.0	60	+			X					✓		B*	
1.0	60	+		X						✓		B*	
1.0	60	+		X	X	X				✓		B*	
1.0	60		-			X				✓		B*	
1.0	60		-		X					✓		B*	
1.0	60		-	X						✓		B*	
1.0	60		-	X	X	X				✓		B*	

Test Summary: *EFT interference detected on outputs. EUT resumes normal operation when interference is removed. Otherwise, EUT operated as intended before, during, and after testing.

Test Result: Pass

2.5.8 Test Set-up Photos

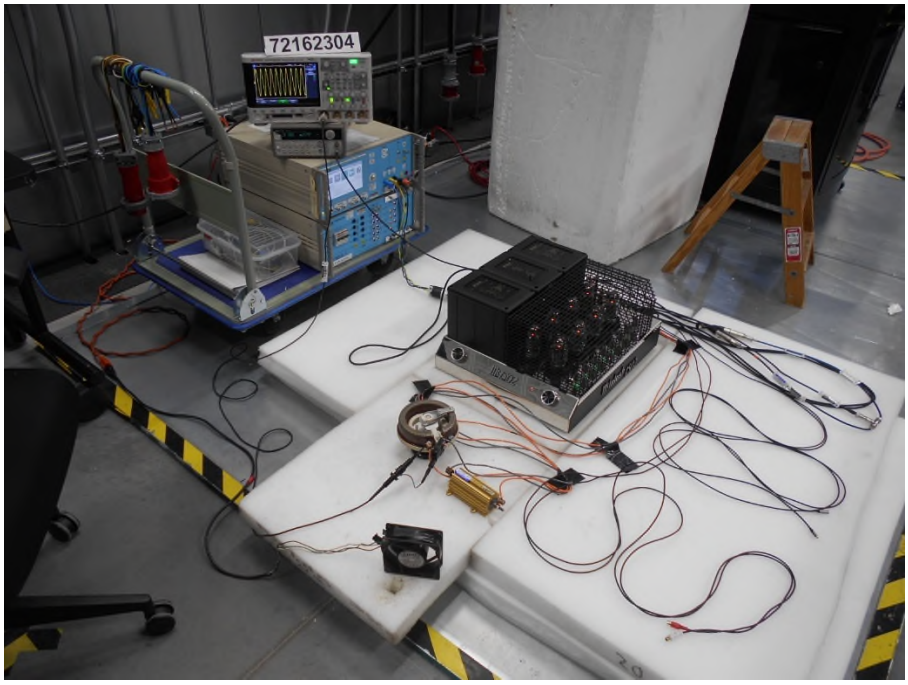


Photo 2.5-1 – EFT Test Setup, AC Power Ports

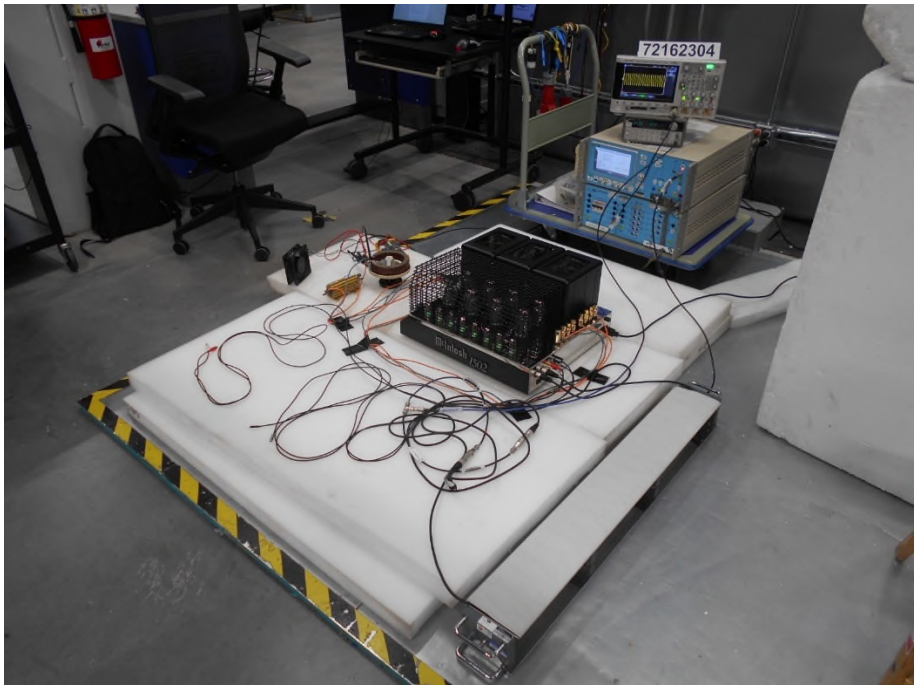


Photo 2.5-2– EFT Test Setup. Analogue / Digital Data Ports

2.5.9 Test Location and Test Equipment Used

This test was carried out in New Brighton, MN.
Test Area: GRP1

Table 2.5-3 – Electrical Fast Transient Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE11381	EMC-Partner	IMU4000-F-S-D-V Test System	106767	1533	G	08/17/2020	08/17/2021
NBLE11464	EMC-Partner	CN-EFT1000	103468	1650	B	10/25/2019	10/25/2020

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

2.6 Surges

2.6.1 Specification Reference

EN 61000-4-5 per EN 55035: 2017

2.6.2 Equipment Under Test and Modification State

As shown in §1.5 with modification state “0”, as noted in §1.7

2.6.3 Test Voltage / Frequency

230V / 50Hz

2.6.4 Date of Test

15 September 2020

2.6.5 Test Method

Using CDNs for power ports and appropriate coupling methods for applicable signal and control ports, the required number of surges was applied for each surge voltage level using both positive and negative surge voltage polarities. Surges were applied at the power line frequency phase angles and repetition rates detailed.

During this testing any anomalies in the equipment under test’s performance were recorded.

2.6.6 Environmental Conditions

The EUT was evaluated within the temperature and humidity range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient temperature range of 20°C to 40°C and humidity range of 30% to 80%.

2.6.7 Test Results

Table 2.6-1 – Requirements for AC Mains Power Ports

Table clause	Environmental phenomenon	Test specification		Units	Basic standard	Remarks	Performance criteria
4.4	Surges	Apply between line and line			EN 61000-4-5	See (a) Test shall be performed with protection measures in place, if specified by the manufacturer.	B
		Test level Tr/Th	1 1,2/50 (8/20)	kV µs			
		Apply between line and earth (ground)					
		Test level Tr/Th	2 1,2/50 (8/20)	kV µs			
Supplementary Information: The number of pulses applied shall be as follows: • Five positive pulses line-to-neutral at 90° phase • Five negative pulses line-to-neutral at 270° phase The following additional pulses are required only if the EUT has an earth connection or if the EUT is earthed via any AE. • Five positive pulses line-to-earth at 90° phase • Five negative pulses line-to-earth at 270° phase • Five negative pulses neutral-to-earth at 90° phase • Five positive pulses neutral-to-earth at 270° phase For multiple-phase systems, where a neutral conductor is present, the test is applied (as defined above) to a single phase unless the other phases are connected to significantly different circuit arrangements. For multiple-phase systems, where a neutral conductor is not present, the test is applied as defined in the basic standard.							

Table 2.6-2 – Requirements for Analogue / Digital Data Ports

Table clause	Environmental phenomenon	Test specification		Units	Basic standard	Remarks	Performance criteria
2.4	Surges	Port type: unshielded symmetrical Apply: lines to ground			EN 61000-4-5	.	B
		Test level Tr/Th	1.0 and 4 10/700 (5/320)	kV µs			
		Port type: coaxial or shielded Apply: shield to ground					
		Test level Tr/Th	0.5 and 4 1,2/50 (8/20)	kV µs			
Supplementary Information: Applicable only to ports which, according to the manufacturer's specification, support cable lengths greater than 3 m.							

Table 2.6-3 – Requirements for DC Network Power Ports

Table clause	Environmental phenomenon	Test specification		Units	Basic standard	Remarks	Performance criteria
3.2	Surges	Surges are applied line to reference ground for each individual line			EN 61000-4-5		B
		Test level Tr/Th	0.5 1,2/50 (8/20)	kV µs			
Supplementary Information: Applicable only to ports which, according to the manufacturer's specification, support cable lengths greater than 3 m and connect to outdoor cables.							

Table 2.6-4 – Observations

Test Level (kV)	Phase Angle (Degrees)	# of Surges (+)	# of Surges (-)	PE	N	L1	L2	L3	Complies Yes	Complies No	Criteria Met	Remarks
												Differential mode
1	90	5			X	X			✓		A	
1	270		5		X	X			✓		A	
												Common mode
2	90	5		X		X			✓		A	
2	270		5	X		X			✓		A	
2	90	5		X	X				✓		A	
2	270		5	X	X				✓		A	

Test Summary: EUT operated as intended before, during, and after testing.

Test Result: Pass

2.6.8 Test Set-up Photos

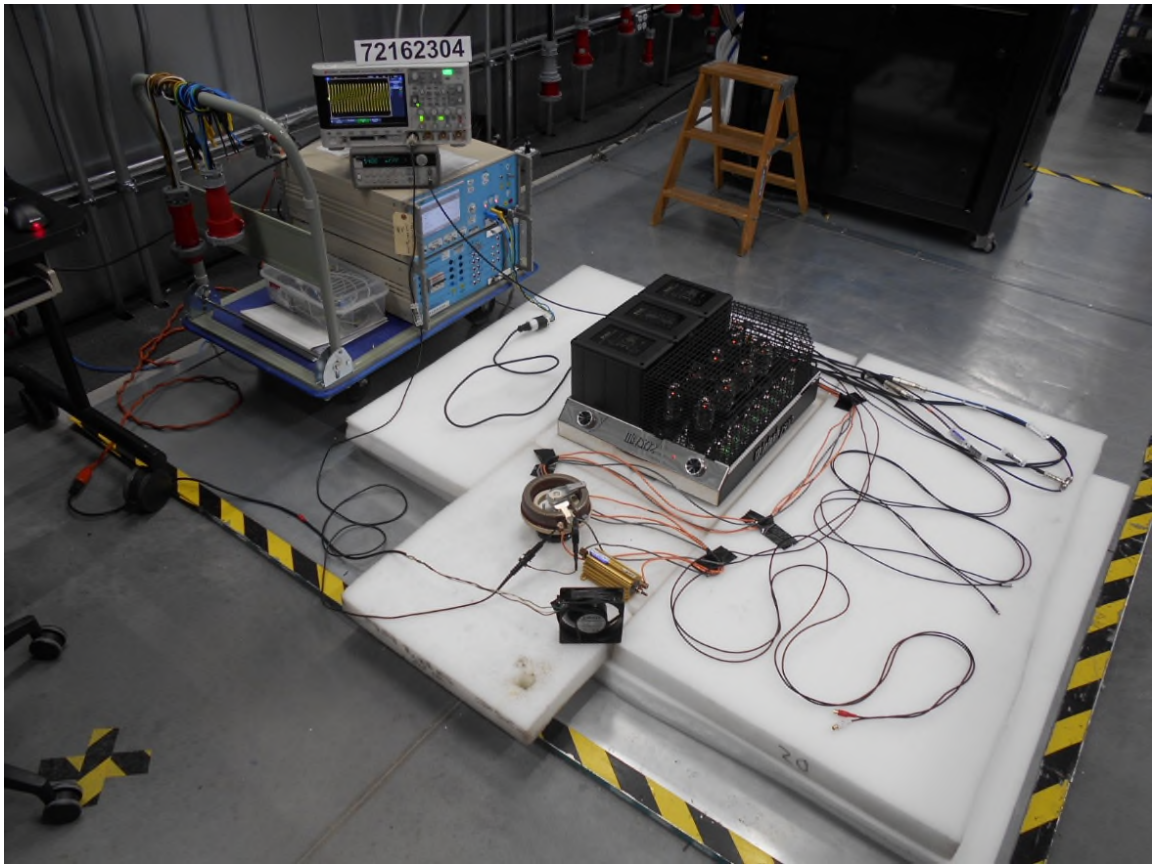


Photo 2.6-1 – Surge Test Setup, AC Power Port

2.6.9 Test Location and Test Equipment Used

This test was carried out in New Brighton, MN.
Test Area: GRP1

Table 2.6-5 – Surge Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE11381	EMC-Partner	IMU4000-F-S-D-V Test System	106767	1533	G	08/17/2020	08/17/2021

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

2.7 AC Voltage Dips and Interruptions

2.7.1 Specification Reference

EN 61000-4-11 per EN 55035: 2017

2.7.2 Equipment Under Test and Modification State

As shown in §1.5 with modification state “0”, as noted in §1.7

2.7.3 Test Voltage / Frequency

230V / 50Hz

2.7.4 Date of Test

15 September 2020

2.7.5 Test Method

Using a voltage dip tester, the equipment under test was subjected to the detailed supply voltage dips and interruptions. The required supply phase synchronization and test repetition rate, detailed, was controlled by the voltage dip tester.

During this testing any anomalies in the equipment under test’s performance were recorded.

2.7.6 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.7.7 Test Results

Table 2.7-1 – Requirements

Environmental phenomenon	Test specification		Units	Basic standard	Remarks	Performance criteria
Voltage dips	Residual voltage Number of cycles	< 5 0,5	%	EN 61000-4-11	See (a) Apply at only one supply frequency of the MME.	B
	Residual voltage Number of cycles	70 25 for 50 Hz 30 for 60 Hz	%			C
Voltage Interruptions	Residual voltage Number of cycles	< 5 250 for 50 Hz 300 for 60 Hz	%	EN 61000-4-11	See (a) Apply at only one supply frequency of the MME.	C
Supplementary Information: (a) Changes to occur at 0 degrees crossover point of the voltage waveform. If the EUT does not demonstrate compliance when tested with 0 degrees 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.						

Table 2.7-2 – Observations

Test Level (Nominal Voltage)	% Reduction	Phase Angle (Degrees)	Repetitions	Duration (cycles)	Complies Yes	Complies No	Criteria Met	Remarks
230	100	0	3	0.5	✓		A	
230	100	180	3	0.5	✓		A	
230	100	0	3	1	✓		A	
230	30	0	3	25	✓		A	
230	100	0	3	250	✓		B	EUT shuts down, returns to normal
								operation without user intervention

Test Summary: EUT operated as intended before, during, and after testing.

Test Result: Pass

2.7.8 Test Set-up Photographs

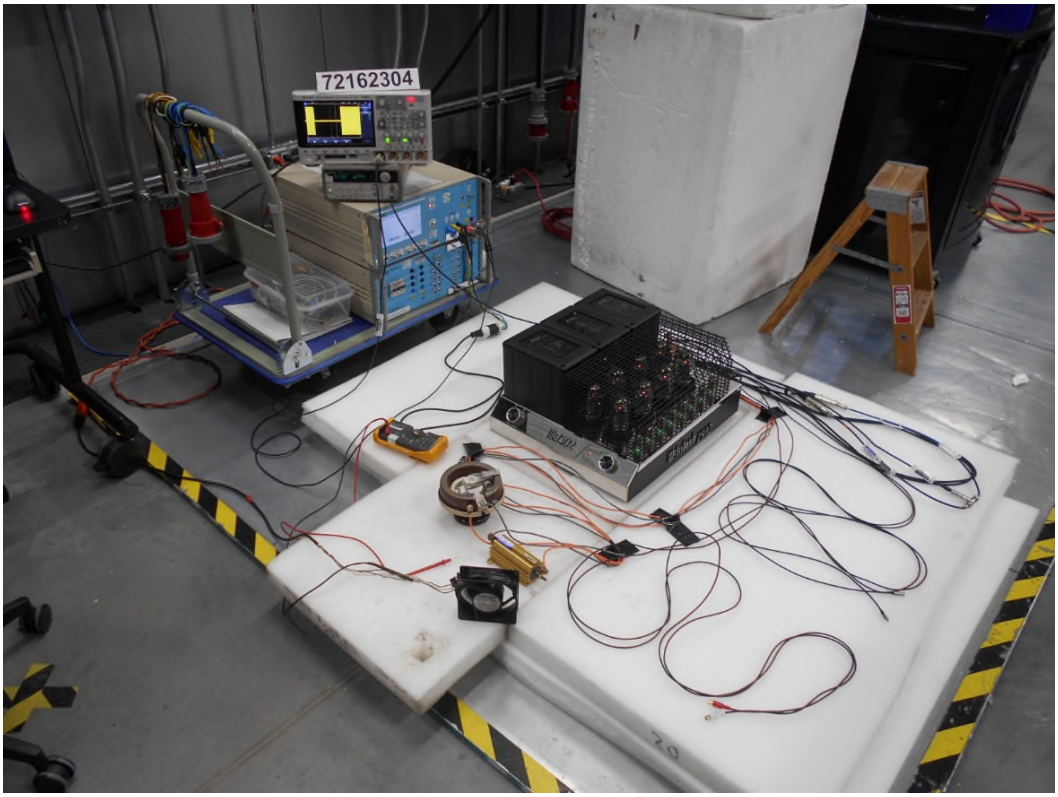


Photo 2.7-1 –Test Setup for the Voltage Dips and Interruptions

2.7.9 Test Location and Test Equipment Used

This test was carried out in New Brighton, MN.
Test Area: GRP1

Table 2.7-3 – Voltage Dips and Interruptions Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE02850	Tektronix	Scope Probe, 100:1	P5100	202150	G	01/21/2020	01/21/2021
NBLE11381	EMC-Partner	IMU4000-F-S-D-V Test System	106767	1533	G	08/17/2020	08/17/2021
NBLE11428	Keysight Technologies	Oscilloscope, 4-CH	MSO-X 3104T	MY55440833	G	05/18/2020	05/18/2021
WRLE03000	Hewlett-Packard	Function Generator, Arb	33120A	US36020798	G	01/23/2020	01/23/2021
WRLE03232	Fluke	Digital Multimeter	70/73	73800099	Y	N/A	N/A

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

2.8 Radiated Emissions

2.8.1 Specification Reference

EN 55032: 2015

2.8.2 Equipment Under Test and Modification State

As shown in §1.5 with modification state “0”, as noted in §1.7

2.8.3 Test Voltage / Frequency

230V / 50Hz

2.8.4 Date of Test

10 September 2020

2.8.5 Test Method

30-1000 MHz - The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive support 0.8 m above a reference ground plane using a measurement distance of 10 m.

A pre-scan of the EUT emissions profile was made while varying the antennae-to-EUT azimuth and antennae-to-EUT polarization using a peak detector; measurements were taken at a 10 m distance. Using the pre-scan list of the highest emissions detected, their bearing and associated antenna polarization, the EUT was then formally measured using Quasi-Peak detector. The readings were maximized by adjusting the antenna height, polarization and turntable azimuth, in accordance with the specification.

The EUT was assessed against the Class B limits at 230V / 50Hz input power. Maximized measurements were performed on the worst-case voltage.

2.8.6 Environmental Conditions

The EUT was evaluated within the temperature and humidity range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient temperature range of 20°C to 40°C and humidity range of 30% to 80%.

2.8.7 Additional Observations

EN 55032: The frequency range investigated was 30 MHz to 1GHz. The highest frequency to which the DUT was measured was determined in accordance with Table 2.8-1 below.

Table 2.8-1 - Highest Measured Frequency

Highest Internal Frequency (F_x)	Highest Measured Frequency
$F_x \leq 108$ MHz	1 GHz
108 MHz < $F_x \leq 500$ MHz	2 GHz
500 MHz < $F_x \leq 1$ GHz	5 GHz
$F_x > 1$ GHz	5 X F_x up to a maximum of 6 GHz

Measurements up to 1 GHz were done using BAT-EMC (V3.18) automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.8.8 for sample computation.

2.8.8 Sample Computation (Radiated Emissions)

Table 2.8-2 - Sample Computation

Measuring equipment raw measurement (dBµV) @ 30 MHz			20.0
Correction Factor (dB/m)	Cable 2	0.24	18.94
	TEMC00011 (antenna)	18.70	
Reported Quasi-peak Final Measurement (dBµV/m) @ 30MHz			38.94

2.8.9 Test Results

Test Summary: EUT emissions generated during testing remained under the limit.

Test Result: Pass

See data below for detailed results.

Highest frequency generated or used within the EUT: < 108MHz
Which necessitates an upper frequency test limit of: 1 GHz
Measurement distance used for < 1GHz measurements: 10 m

RE 30M-1GHz

Frequency Range	Polarity	Antenna Distance	RBW	Step Size	Sweep Time
30MHz- 1GHz	Vertical	10m	120kHz	18001Pts	Auto
30MHz- 1GHz	Horizontal	10m	120kHz	18001Pts	Auto

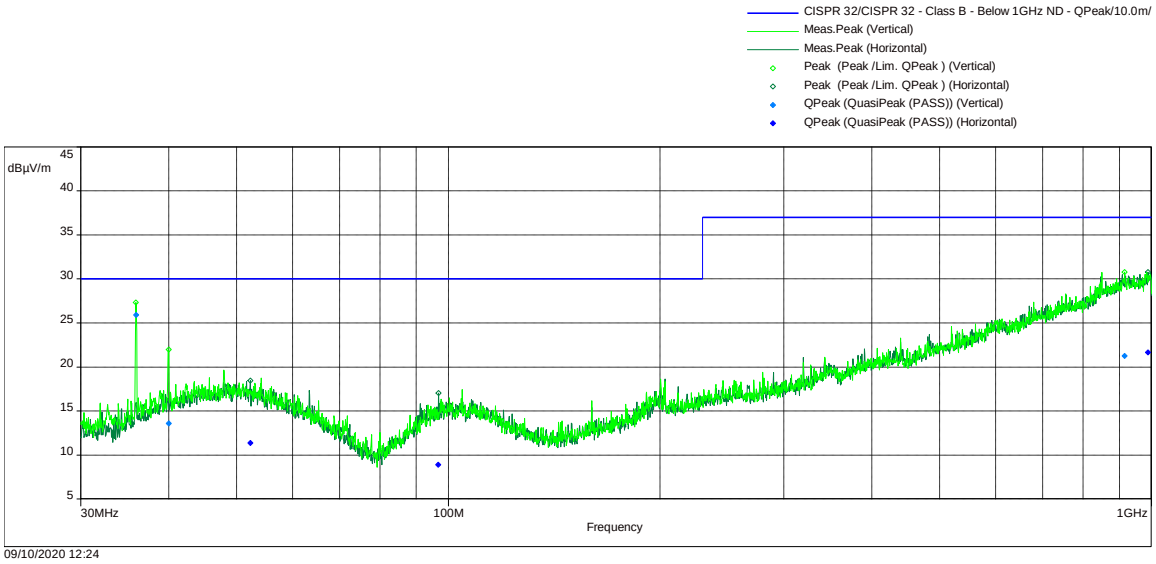


Figure 2-1 – Graphical Results 30 MHz to 1 GHz – H & V Polarity

Table 2.8-3 – Electromagnetic Radiation Disturbance Data – 30 MHz to 1 GHz

Frequency	QP Level (dBuV/m)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (º)	Height (m)	Polarity	Result
35.958387MHz	25.91	30.00	-4.09	291.00	1.06	Vertical	Pass
39.998814MHz	13.60	30.00	-16.40	21.00	2.83	Vertical	Pass
52.278867MHz	11.37	30.00	-18.63	282.00	1.34	Horizontal	Pass
96.788248MHz	8.90	30.00	-21.10	218.00	3.11	Horizontal	Pass
915.7157MHz	21.28	37.00	-15.72	312.00	3.70	Vertical	Pass
988.62175MHz	21.66	37.00	-15.34	148.00	1.03	Horizontal	Pass

2.8.10 Radiated Emissions Test Set-up Photos

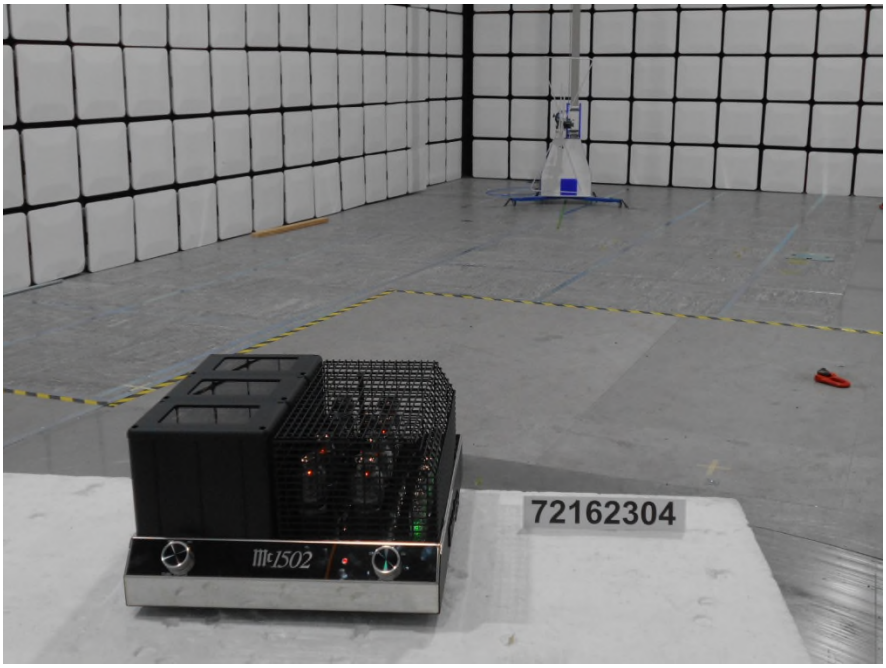


Photo 2.8-1 – Front View of the Test Setup below 1 GHz

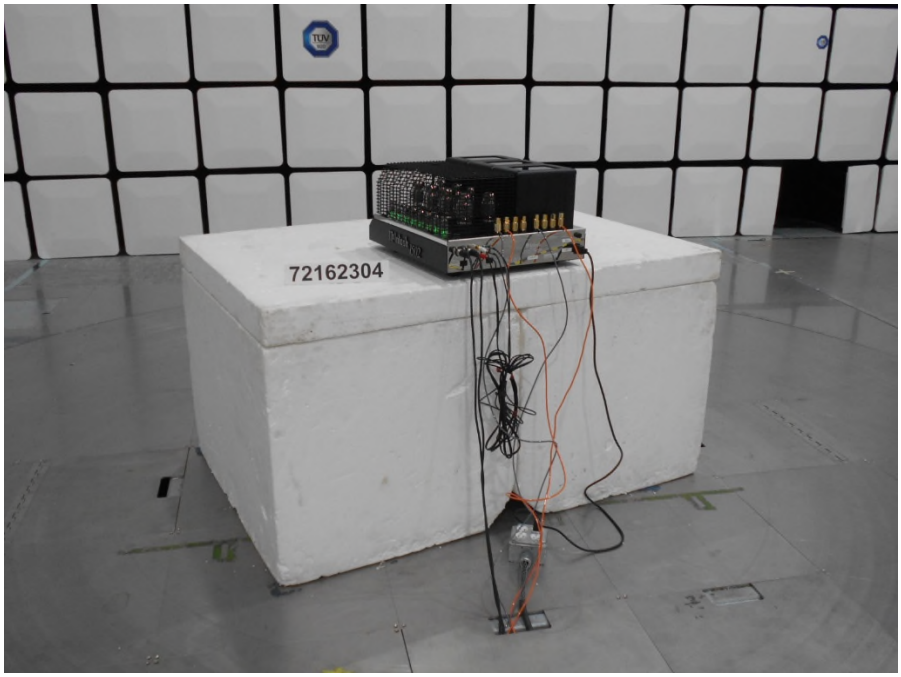


Photo 2.8-2 – Rear View of the Test Setup below 1 GHz

2.8.11 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: LTS

Table 2.8-4 – Radiated Emissions Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
WRLE10998	Rohde & Schwarz	Receiver, 20 Hz-26.5 GHz	ESU 26	100379	G	08/15/2019	02/15/2021
NBLE11573	Schwarzbeck	Preamplifier, 10 MHz-6 GHz	BBV 9743 B	00075	G	08/08/2020	08/08/2021
NBLE11579	Schwarzbeck	Antenna, Broadband Trilog	VULB 9162	9162-196	G	11/20/2018	11/20/2020

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

2.9 Conducted Emissions

2.9.1 Specification Reference

EN 55032: 2015

2.9.2 Equipment Under Test and Modification State

As shown in §1.5 with modification state “0”, as noted in §1.7

2.9.3 Test Voltage / Frequency

230V / 50Hz

2.9.4 Date of Test

10 September 2020

2.9.5 Test Method

The EUT was placed on a non-conductive table 0.8 m above a reference ground plane and 0.4 m away from a vertical coupling plane.

All power was connected to the EUT through an Artificial Mains Network (AMN). Conducted disturbance voltage measurements on mains lines were made at the output of the AMN. The AMN was placed 0.8 m from the boundary of the EUT and bonded to the reference ground plane.

The EUT was assessed against the Class B limits.

2.9.6 Environmental Conditions

The EUT was evaluated within the temperature and humidity range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient temperature range of 20°C to 40°C and humidity range of 30% to 80%.

2.9.7 Additional Observations

Measurements were performed using BAT-EMC (v3.18) automated software. The reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.9.8 for a sample computation.

2.9.8 Sample Computation (Conducted Emission)

Table 2.9-1 - Sample Computation

Measuring equipment raw measurement (dBµV) @ 150kHz			30.0
Correction Factor (dB)	TEMC00002 - LISN	0.03	10.53
	Cable 1	10.50	
Reported Quasi-peak Final Measurement (dBµV) @ 150kHz			40.53

2.9.9 Test Results

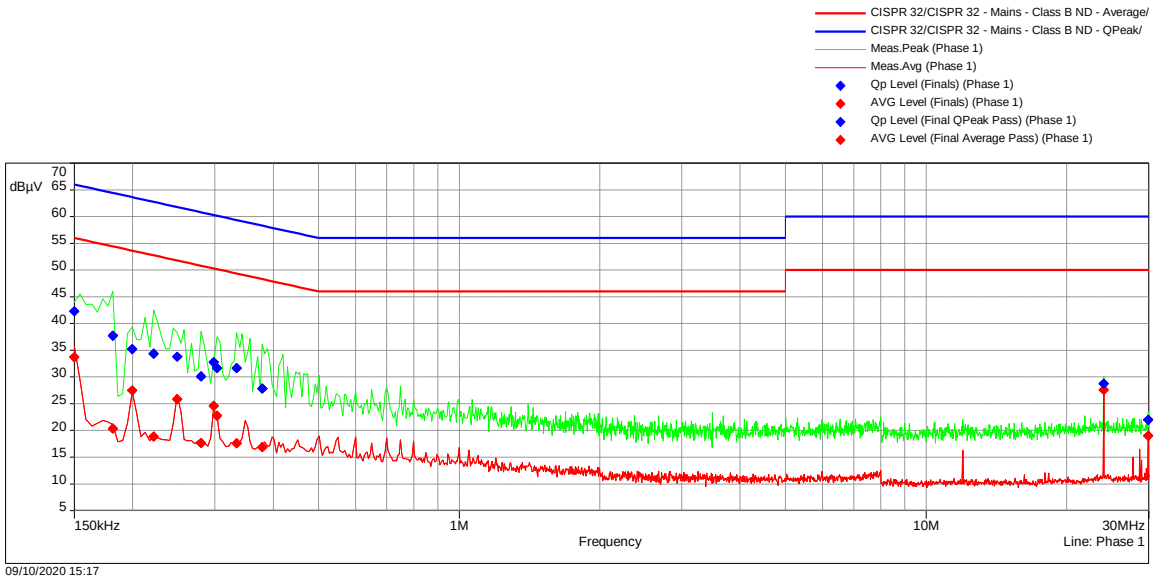
Test Summary: EUT emissions generated during testing remained under the limit.

Test Result: Pass

See data below for detailed results.

230V-50Hz L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150kHz- 30MHz	L1	9kHz	4.5kHz	2000 ms/MHz



Test Notes: ~1/2 power. 25Vrms^2/8ohm=78W. 12Vrms^2/2ohm=72W

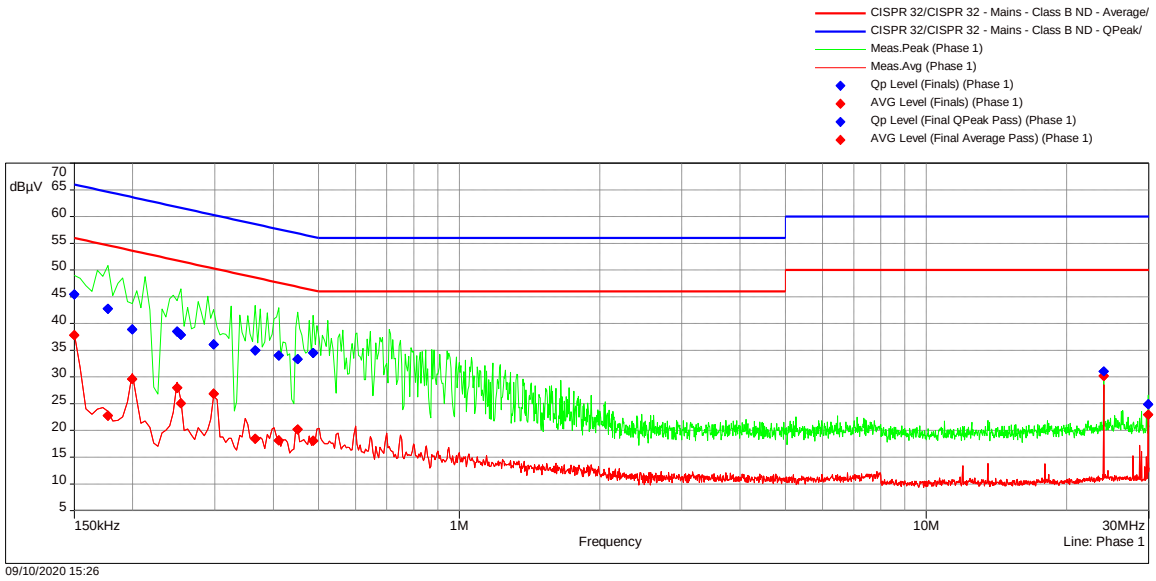
Figure 2-2 – Graphical Results - AC Mains L1 Plot

Table 2.9-2 – Conducted Emissions Results on the AC Power Port L1

Frequency	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
150kHz	33.74	56.00	-22.26	42.27	66.00	-23.73	Pass
181.5kHz	20.36	54.42	-34.06	37.78	64.42	-26.64	Pass
199.5kHz	27.53	53.63	-26.10	35.20	63.63	-28.43	Pass
222kHz	18.84	52.74	-33.91	34.37	62.74	-28.37	Pass
249kHz	25.83	51.79	-25.96	33.78	61.79	-28.01	Pass
280.5kHz	17.67	50.80	-33.13	30.08	60.80	-30.72	Pass
298.5kHz	24.62	50.28	-25.66	32.77	60.28	-27.51	Pass
303kHz	22.77	50.16	-27.39	31.71	60.16	-28.45	Pass
334.5kHz	17.57	49.34	-31.77	31.72	59.34	-27.62	Pass
379.5kHz	16.92	48.29	-31.38	27.80	58.29	-30.49	Pass
23.991MHz	27.60	50.00	-22.40	28.74	60.00	-31.26	Pass
29.904MHz	18.99	50.00	-31.01	21.98	60.00	-38.02	Pass

230V-50Hz L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150kHz- 30MHz	L2	9kHz	4.5kHz	2000 ms/MHz



Test Notes: ~1/2 power. 25Vrms^2/8ohm=78W. 12Vrms^2/2ohm=72W

Figure 2-3 – Graphical Results - AC Mains L2 Plot

Table 2.9-3 – Conducted Emissions Results on the AC Power Port N

Frequency	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
150kHz	37.83	56.00	-18.17	45.47	66.00	-20.53	Pass
177kHz	22.76	54.63	-31.87	42.76	64.63	-21.86	Pass
199.5kHz	29.62	53.63	-24.01	38.93	63.63	-24.70	Pass
249kHz	27.98	51.79	-23.81	38.56	61.79	-23.23	Pass
253.5kHz	25.05	51.64	-26.60	37.94	61.64	-23.71	Pass
298.5kHz	26.85	50.28	-23.43	36.12	60.28	-24.16	Pass
366kHz	18.42	48.59	-30.17	34.96	58.59	-23.63	Pass
411kHz	18.14	47.63	-29.49	34.08	57.63	-23.55	Pass
451.5kHz	20.17	46.85	-26.68	33.32	56.85	-23.52	Pass
487.5kHz	18.06	46.21	-28.15	34.51	56.21	-21.70	Pass
23.991MHz	30.18	50.00	-19.82	31.04	60.00	-28.96	Pass
29.904MHz	22.92	50.00	-27.08	24.93	60.00	-35.07	Pass

2.9.10 Conducted Emissions Test Set-up Photos

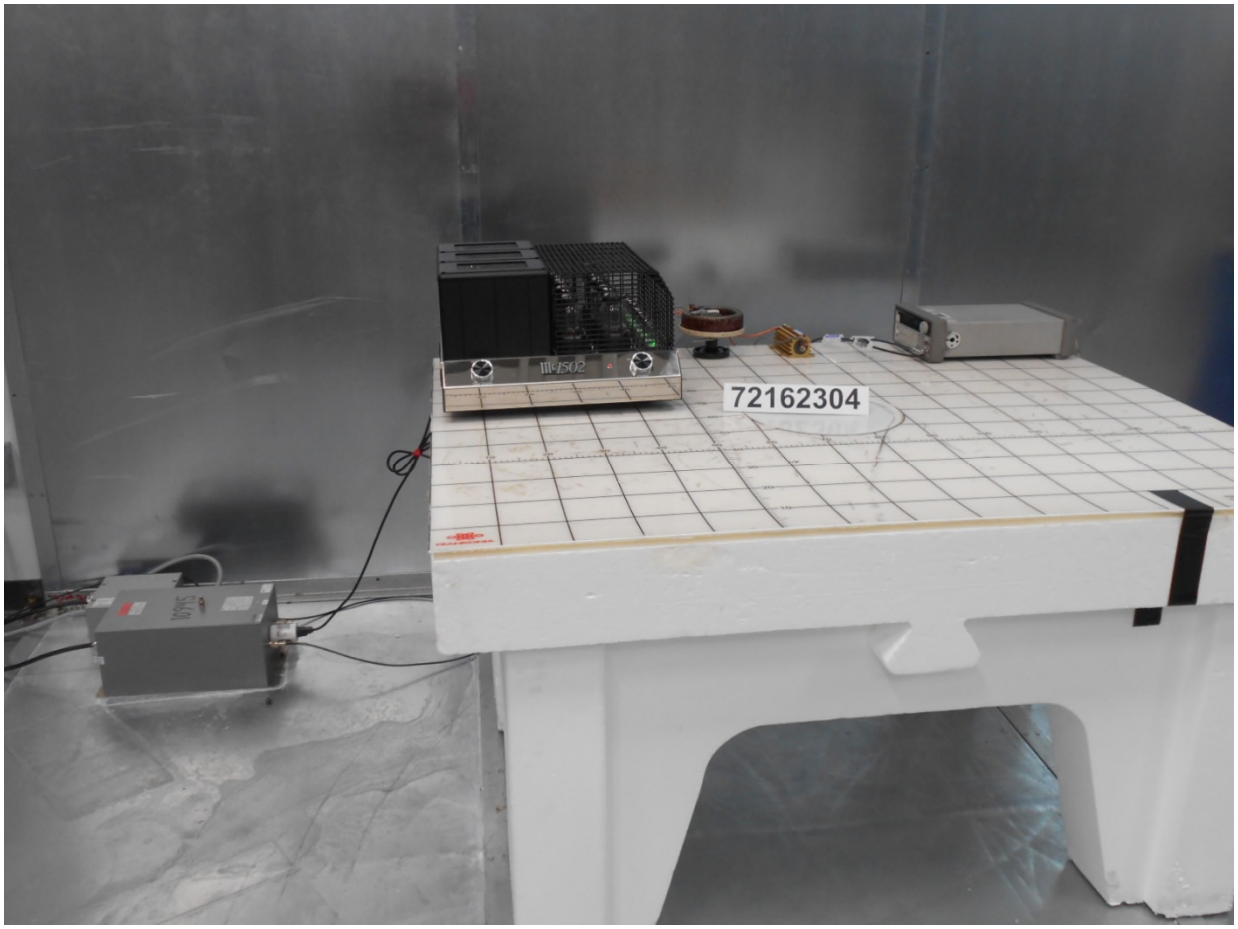


Photo 2.9-1 – Front View of the Test Setup

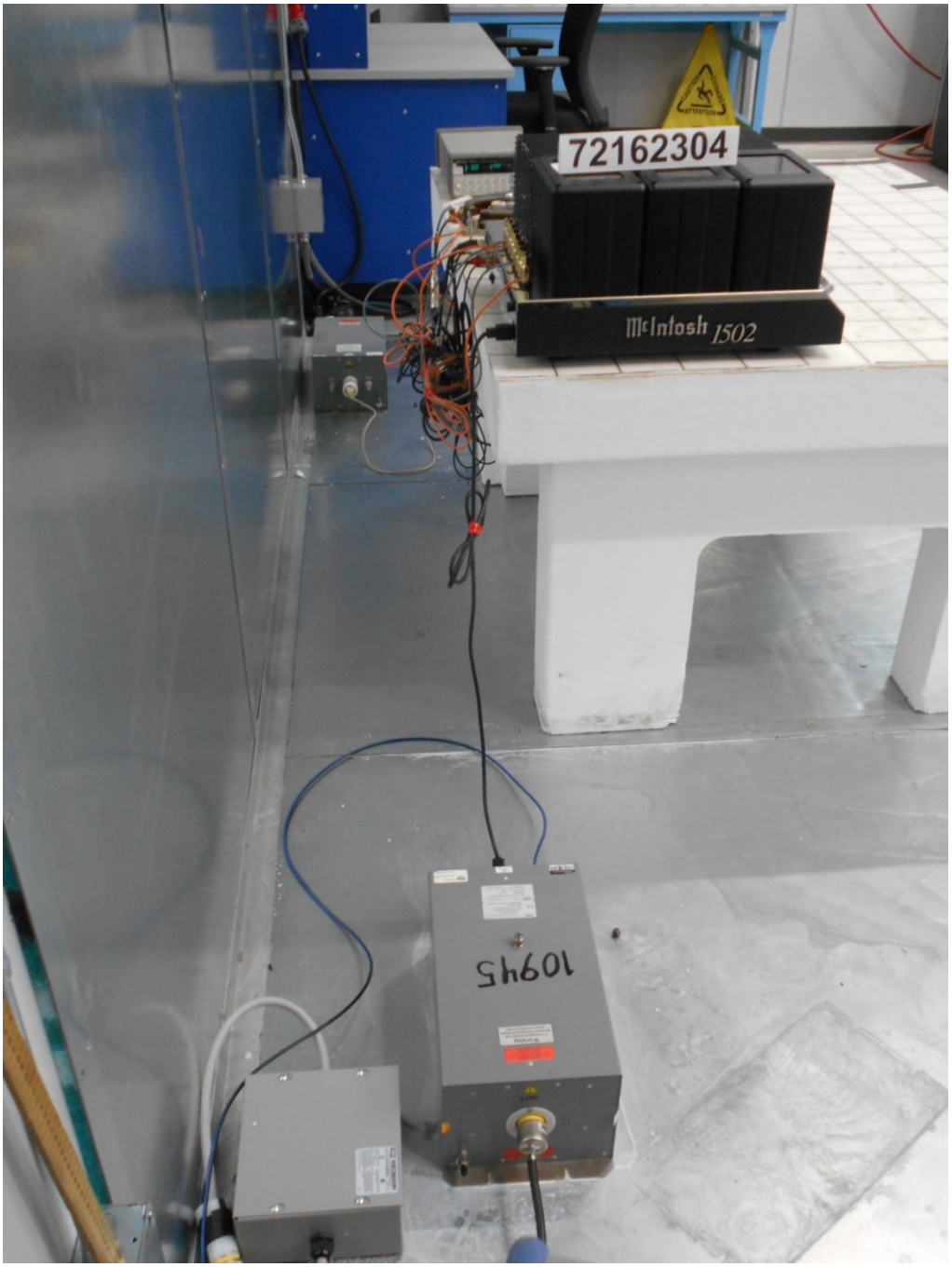


Photo 2.9-2 – Side View of the Test Setup

2.9.11 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: GRP2

Table 2.9-4 – Conducted Emissions Test Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE10466	Weinschel	Attenuator, 20dB	34-20-34	BR2651	B	11/01/2019	11/01/2020
WRLE10945	Fischer Custom Comm.	LISN	FCC-LISN-50-25-2-10	120309	G	08/08/2020	08/08/2021
WRLE10998	Rohde & Schwarz	Receiver, 20 Hz-26.5 GHz	ESU 26	100379	G	08/15/2019	02/15/2021

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

2.10 Harmonic current emissions

2.10.1 Specification Reference

EN 61000-3-2: 2014

Note: Results only relevant if EUT is connected to public low-voltage distribution system.

2.10.2 Equipment Under Test and Modification State As listed in Section 1.2

As shown in §1.5 with modification state “0”, as noted in §1.7

2.10.3 Test Voltage / Frequency

230V / 50Hz

2.10.4 Date of Test

n/a

2.10.5 Test Method

Harmonic current test should be conducted with the user's operation control or automatic programs set to the mode expected to produce the maximum total harmonic current under normal operating conditions.

Specific test conditions for the measurement of harmonic currents associated with some types of equipment are given in EN 61000-3-2 Annex C.

2.10.6 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.10.7 Test Results

Test Summary: Testing was not performed. Per the customer, the EUT can draw more than 1kW and is therefore exempt.

Test Result: n/a

2.11 Voltage fluctuations and flicker

2.11.1 Specification Reference

EN 61000-3-3: 2013

Note: Results only relevant if EUT is connected to public low-voltage distribution system.

2.11.2 Equipment Under Test and Modification State

As shown in §1.5 with modification state “0”, as noted in §1.7

2.11.3 Test Voltage / Frequency

230V / 50Hz

2.11.4 Date of Test

11 September 2020

2.11.5 Test Method

The object of this standard is to establish a common reference for measuring the effects of voltage fluctuations and flicker impressed on the public low-voltage system.

2.11.6 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.11.7 Test Results

Test Summary: EUT emissions generated during testing remained under the limit.

Test Result: Pass

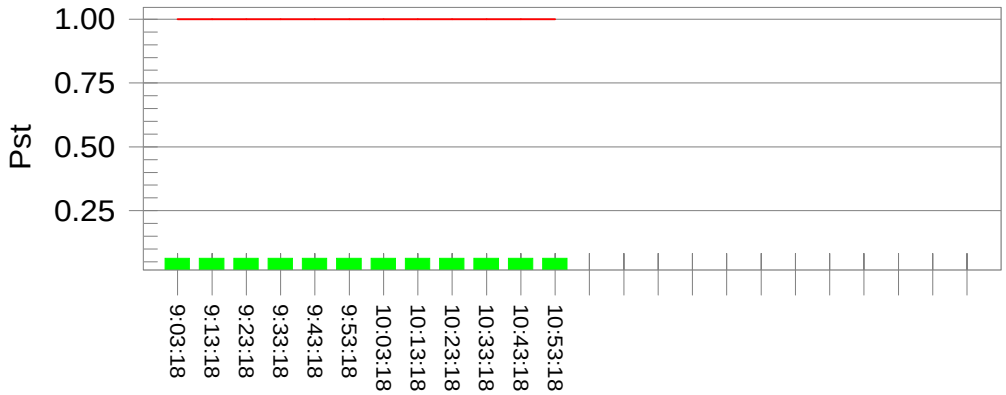
See data below for detailed results.

Table 2.11-1 – Flicker Test Results

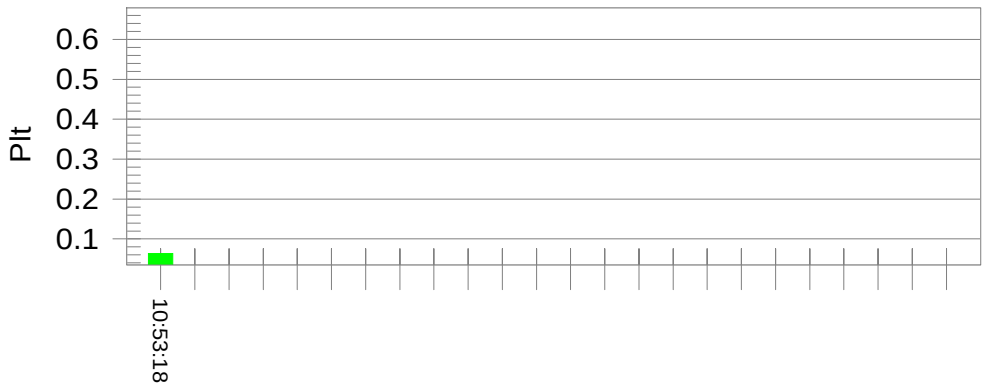
EUT: MC1502. 2-Channel Vacuum Tube Amplifier **Tested by: Greg Jakubowski**
Test category: All parameters (European limits) **Test Margin: 100**
Test date: 9/11/2020 **Start time: 8:52:57 AM** **End time: 10:53:19 AM**
Test duration (min): 120 **Data file name: F-000558.cts_data**
Comment: 72162304
Customer: McIntosh

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):	**229.10**			
Highest dt (%):	**0.00**	**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 (%):	**0.00**	**Test limit (%):**	**4.00**	**Pass**
Highest Pst (10 min. period):	**0.064**	**Test limit:**	**1.000**	**Pass**
Highest Plt (2 hr. period):	**0.064**	**Test limit:**	**0.650**	**Pass**

2.11.8 Test Set-up Photographs

Photo 2.11-1 – Flicker Test Set-up

2.11.9 Test Location and Test Equipment Used

This test was carried out in New Brighton, MN.
Test Area: GRP1

Table 2.11.9-2.11-2 – Flicker Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE02098	California Instruments	AC Power System 20 - 800 Hz	15003iX	57218	G	01/20/2020	01/20/2022

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

3 Diagram of Test Set-ups

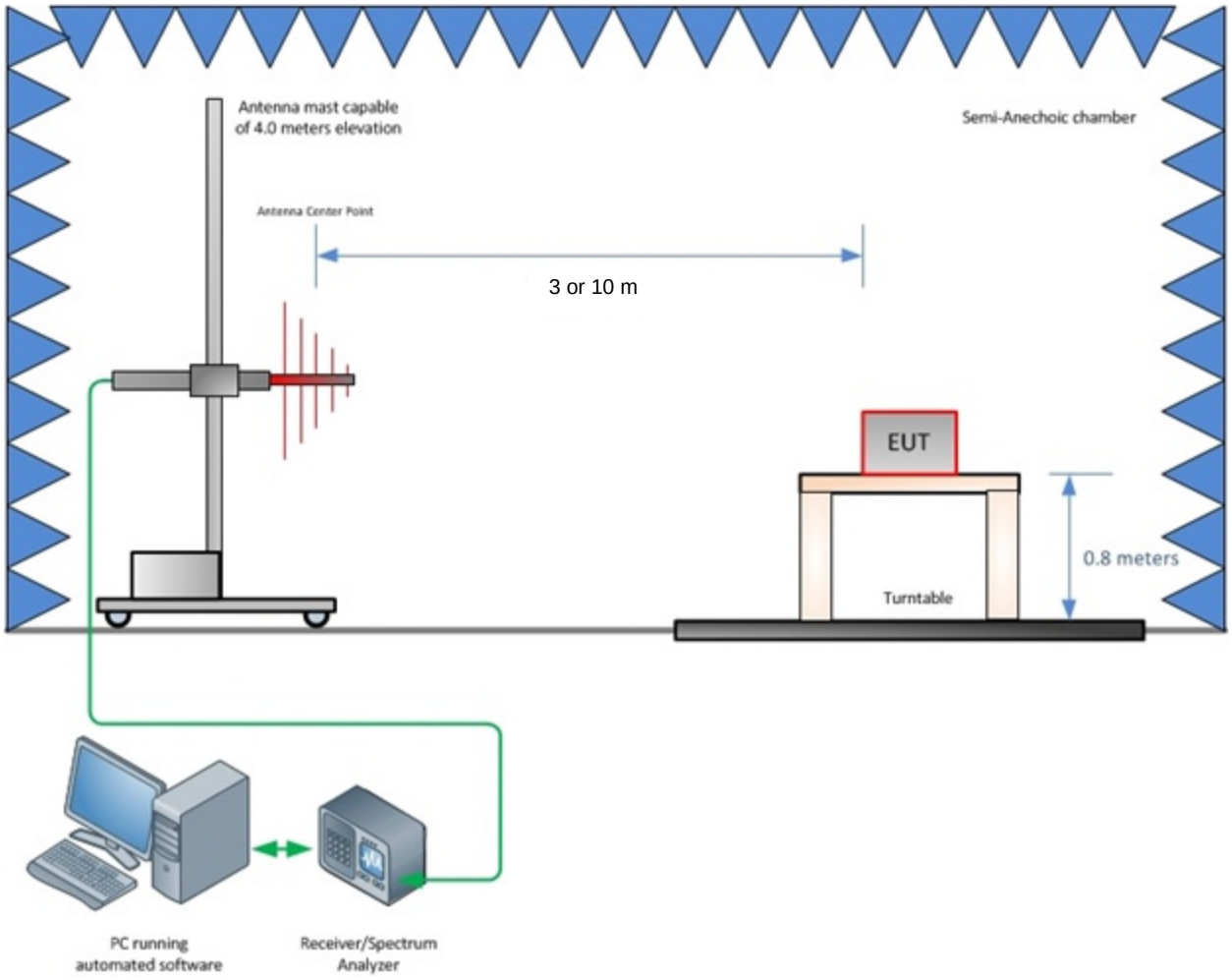


Figure 3-1 - Radiated Emissions Test Setup up to 1 GHz

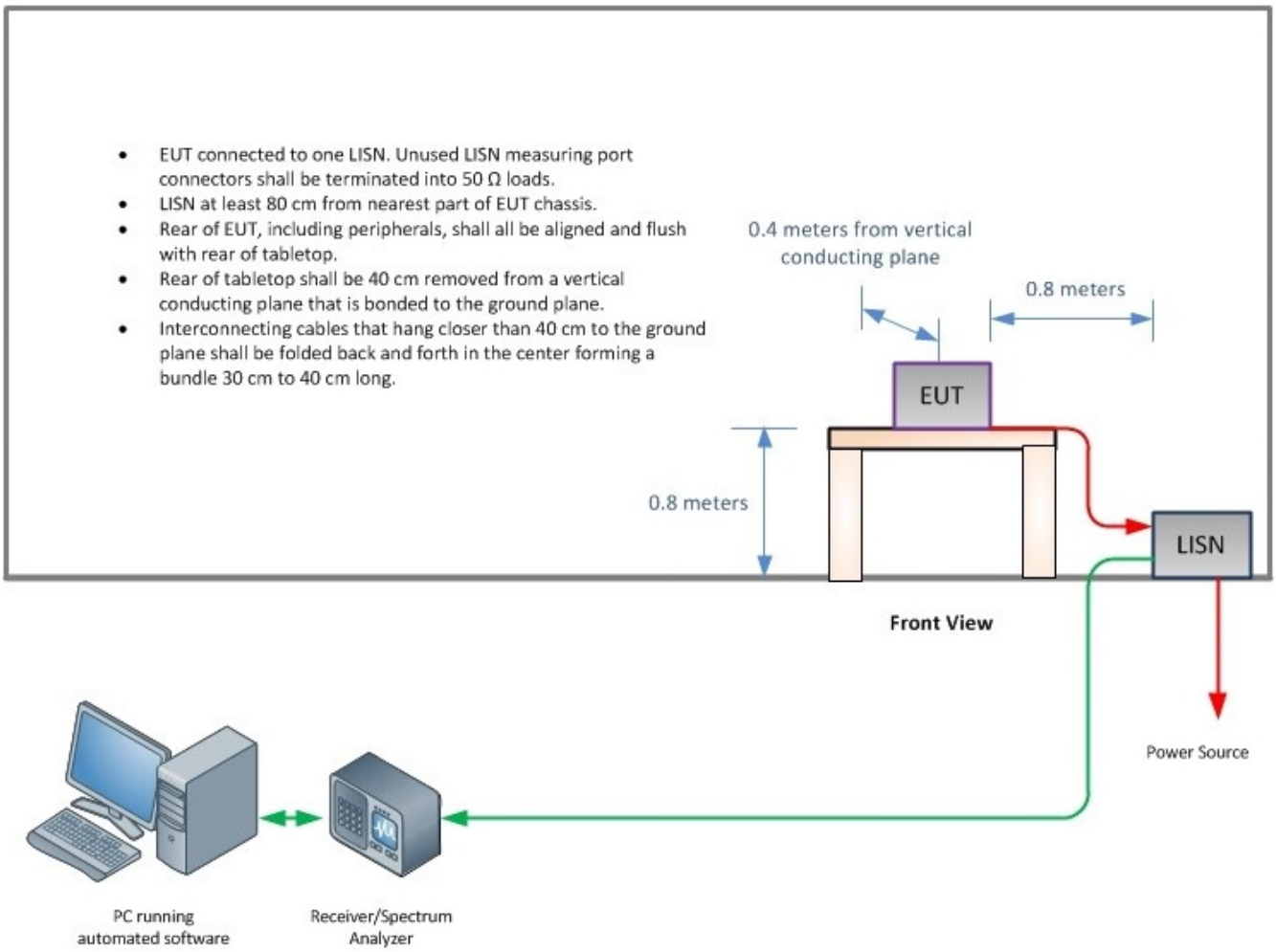


Figure 3-2 - Conducted Emissions Test Setup

4 Accreditation, Disclaimers and Copyright

TÜV SÜD America Inc.'s reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. TÜV SÜD America, Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD America, Inc.'s issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and TÜV SÜD America, Inc., extracts from the test report shall not be reproduced, except in full without TÜV SÜD America, Inc.'s written approval.

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal government.

STATEMENT OF MEASUREMENT UNCERTAINTY – Immunity

The data and results referenced in this document are accurate. The reader is cautioned that there is some measurement variability due to the tolerances of the test equipment that can contribute to a nominal product measurement uncertainty. Furthermore, component differences and manufacturing process variability of production units similar to that tested may result in additional product uncertainty. If necessary, refer to the test lab for the actual measurement uncertainty for specific tests.

STATEMENT OF MEASUREMENT UNCERTAINTY – Emissions

The test system for conducted emissions is defined as the LISN, tuned receiver or spectrum analyzer, and coaxial cable. This test system has a measurement uncertainty of ±3.30 dB. The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. This test system for 30 MHz – 1000 MHz has a measurement uncertainty of ±5.88 dB and above 1 GHz a measurement uncertainty of ±4.47 dB. The measurement uncertainty values for conducted and radiated emissions meet the requirements as expressed in CISPR 16-4-2. The equipment comprising the test systems is calibrated on an annual basis.

TEST EQUIPMENT

All measurement instrumentation is traceable to the National Institute of Standards and Technology and is calibrated to meet test method standard requirements and/or manufacturer's specifications

5 Appendix A – Manufacturer Test Plan / Product Information

None provided