Element Materials Technology Denver-Longmont A.K.A. NTS Labs, LLC Test Report for Electromagnetic Interference (EMI) Testing of the SMARTMATIC VSR1 2.1 BMD + BR1500M2 UPS

Prepared For
Pro V&V, Inc | 1736 Vista View Drive | Longmont, CO 80504

Prepared By
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Revision History

Rev.	Description	Issue Date
0	Initial Release	12/13/2023

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1.0 Introduction

This document presents the test procedures used and the results obtained during the performance of an Electromagnetic Interference (EMI) test program at Element Materials Technology Denver-Longmont (hereafter referred to as "Element"). The test program was conducted to assess the ability of the specified Equipment Under Test (EUT) to successfully satisfy the requirements defined in the test specification.

2.0 References

The following references listed below form a part of this document to the extent specified herein.

- Test Specification: FCC Part 15 Class B
- Pro V&V, Inc Purchase Order 2023-009 dated 03/17/2023.
- Element Quotation OP0636249 dated 03/16/2023.
- ISO/IEC 17025:2017(E) *General Requirements for the Competence of Testing and Calibration Laboratories,* dated 11/2017.

3.0 Product Selection and Description

Pro V&V, Inc selected and provided the following test sample(s) to be used as the Equipment Under Test.

Table 3.0-1: Product Identification – Equipment Under Test (EUT)

Item	Qty.	Name/Description	Part Number	Serial Number
1	2	SMARTMATIC VSR1 2.1 BMD + BR1500M2 UPS	VSR1 2.1 BMD	BDUBMDBRC4000 0006, UPS - 352223X14214, UPS - 5B2339T92762

3.1 Security Classification

Non-classified

4.0 General Test Requirements

4.1 Test Equipment

The instrumentation used in the performance of these tests is periodically calibrated and standardized within manufacturer's rated accuracies and are traceable to the National Institute of Standards and Technology. The calibration procedures and practices are in accordance with ISO 17025:2017. Certification of calibration is on file subject to inspection by authorized personnel.

4.2 Measurement Uncertainties

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below were calculated using the approach described in CISPR 16-4-2:2003 using a coverage factor of k=2, which gives a level of confidence of approximately 95%. The levels were found to be below levels of CISPR and therefore no adjustment of the data for measurement uncertainty is required.

Table 4.2-1: Measurement Uncertainties (Emissions)

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
Conducted Emissions	dBuA	150kHz to 30MHz	.+/- 3.75 dB
Radiated Emissions	dBuV/m	30MHz to 1GHz	.+/- 6.32 dB
		1GHz to 6GHz	.+/- 9.59 dB
		6GHz to 18GHz	.+/- 7.58 dB
		18GHz to 40GHz	.+/- 6.08 dB

5.0 Test Description and Results

Table 5.0-1: Summary of Test Information & Results

Section	Test	Specification	Test Facility	Test Date	Part #	Serial #	Test Result
5.1	Radiated Emissions, 30 MHz - 1 GHz (4.1.2.9)	FCC Part 15 Class B	Longmont	12/01/2023 - 12/05/2023	VSR1 2.1 BMD	BDUBMDBRC40000006, UPS - 5B2339T92762	Passed. A test deviation occurred. See NOD
5.2	Conducted Emissions, 150 kHz - 30 MHz (4.1.2.9)	FCC Part 15 Class B	Longmont	12/06/2023	VSR1 2.1 BMD	BDUBMDBRC40000006, UPS - 5B2339T92762	Passed

The decision rule for Test Results was based on the Test Specification used for testing.

5.1 Radiated Emissions, 30 MHz - 1 GHz (4.1.2.9)

5.1.1 Test Procedure

The EUT was tested in accordance with FCC Part 15 Class B

5.1.2 Test Result

The EUT passed the defined requirements. A test deviation occurred. For details, refer to Notice of Deviation (NOD) NOD # 1.

5.1.3 Notice of Deviation (NOD)

NTS

NOTICE OF DEVIATION

Client:	Pro V&V	Job #:	PR170750	NOD #:	1
P. O. #:	2023-009	Date of Deviation:	12-1-2023	CAR #:	N/A
Notification Made To: *(Client Contact)*	Michael Walker	Notification Made By:	Mike Tidquist		
If notification was not made, provide justification:	N/A				
Date:	12-6-2023	Via:	Verbal		
Test:	Radiated Emissions	Test Item:	Smartmatic VSR1 2.1 BMD		
Specification:	FCC Part 15 Class B	Model or P/N:	VSR1 2.1 BMD		
Revision/Date:	N/A	Serial Number:	BDUBMCBRC4000008		

REQUIREMENTS: *(Reference paragraph or section of specification)*

FCC Part 15 Class B limits

DESCRIPTION OF DEVIATION

EUT Failed Radiated Emissions over class B limits
Client was using wrong model of UPS

DISPOSITIONS/COMMENTS/RECOMMENDATIONS:

Client added ferrite to Power cord and also swapped UPS for correct model

Client Disposition Authorization	12/6/23 Date	Kerry Martin NTS Quality Representative	12/6/2023 Date
NTS Project Manager	12/6/23 Date	N/A Government QAR (if applicable)	N/A Date

NOTE: IT IS THE CLIENT'S RESPONSIBILITY TO ANALYZE AND DISPOSITION DEVIATIONS ON CLIENT TEST PROGRAMS.

FOR NTS QA USE:	Tracking Code: 5
	Risk Level: Low

Tracking Codes:

1. Employee Error - Training	2. Employee Error - Process	3. Test Equipment Problem	4. Equipment Limitations	5. Customer Item Problem	6. Other

Risk Levels:

Low	Medium	High

COR 16.0, REV. 7

5.1.4 Test Datasheets

Element Materials Technology

Radiated Emissions, FCC Part 15, Class B

Standard Referenced: **FCC Part 15, Class B**

Date: 12/1/2023

Temperature: 26˚C Humidity: 11%

Pressure: 829 mb

Input Voltage: 120Vac, 60Hz

Pretest & Linearity Check: Pass

Configuration of Unit: Normal Operation Scanning Ballots

Sweep Time Check: Yes

Test Engineer / Technician: Mike Tidquist

Date	Time	Log Entries	Initials	Result
12/1/23	0900-1100	Radiated Emissions: 30 MHz - 1 GHz. FCC Part 15. Class B. 120 VAC / 60 Hz Client will determine next steps	MT	Fail
12/4/23	0800-1200	Troubleshoot FCC RE	ED	Fail
12/5/23	1200-1300	Troubleshoot FCC RE	ED	Continue
Client changed UPS to new Model number (BR1500M2). Added Ferrite to PC (Wurth 742-715-1) rerun scan				
12/5/23	1400-1600	Radiated Emissions: 30 MHz - 1 GHz. FCC Part 15. Class B. 120 VAC / 60 Hz	MT	Pass

Element Materials Technology			
Radiated Emissions, FCC Part 15, Class B			
Standard Referenced:	FCC Part 15, Class B	Date:	12/1/2023
Temperature:	26˚C Humidity: 11%	Pressure:	829 mb
Input Voltage:	120Vac, 60Hz	Pretest & Linearity Check:	Pass
Configuration of Unit:	Normal Operation Scanning Ballots	Sweep Time Check:	Yes
Test Engineer / Technician:	Mike Tidquist		

"Type" refers to the type of measurement performed. The type of measurement made is based on the requirements of the particular standard:

PK = Peak Measurement: RBW is 120kHz, VBW is 3 MHz
QP = Quasi-Peak Measurement: RBW is 120kHz, VBW is 3 MHz, and QP Detection is ENABLED
AV = Video Average Measurement: RBW is 1 MHz, VBW is 10 Hz

The "field strength" (FS) emissions level is attained by adding the received amplitude measured (RA), Antenna factor (AF), and cable factor (CF) minus the amplifier gain (AG). FS = RA + AF + CF – AG .Final measurements are made with the Azimuth, Polarity, Height, and EUT Cables positioned for maximum radiation. If applicable, cables positions are noted in the test log.
(Sample Calculation: 49.6 dBuV + 11.4 dB/m – 28.8 dB (CF/AG) = 32.2 dBuV/m. Important Note: This is a sample calculation only for the purpose of demonstration, and does not reflect data in this report.)

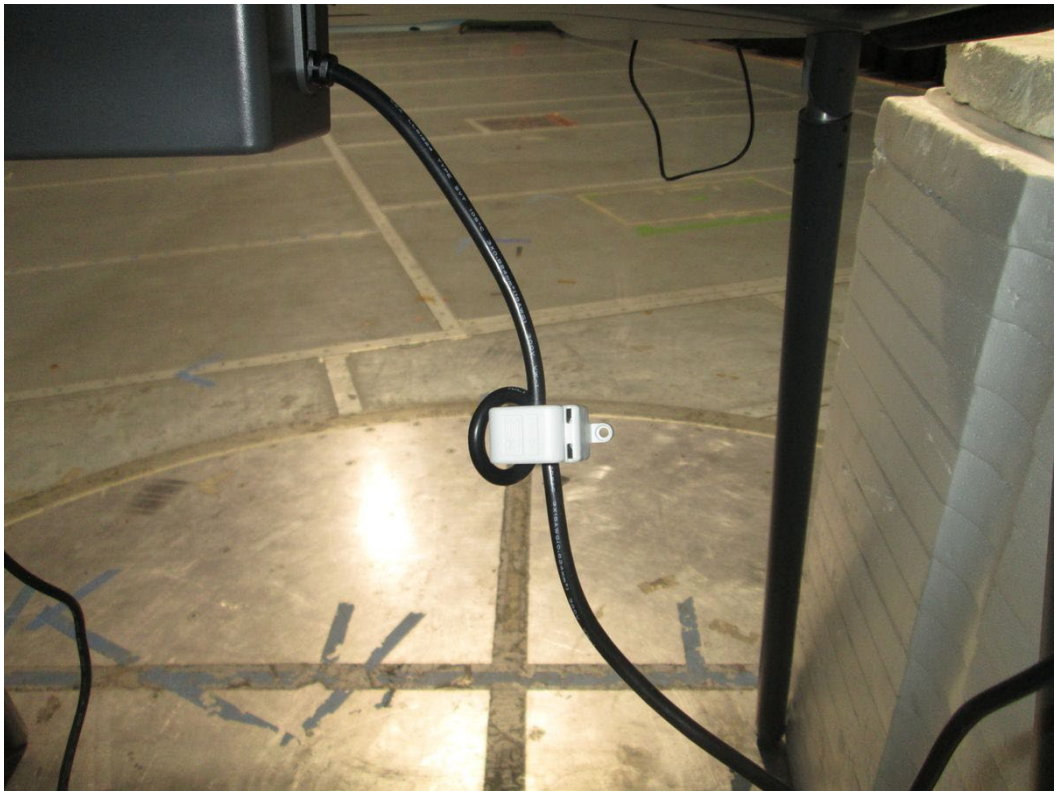
The "Azm/Pol/Hgt" indicates the turn-table azimuth, the antenna polarity, and the antenna height where the maximum emissions level was measured.

The "Margin" is with reference to the emissions limit. A positive number indicates that the emission measurement is below the limit. A negative number indicates that the emission measurement exceeds the limit.

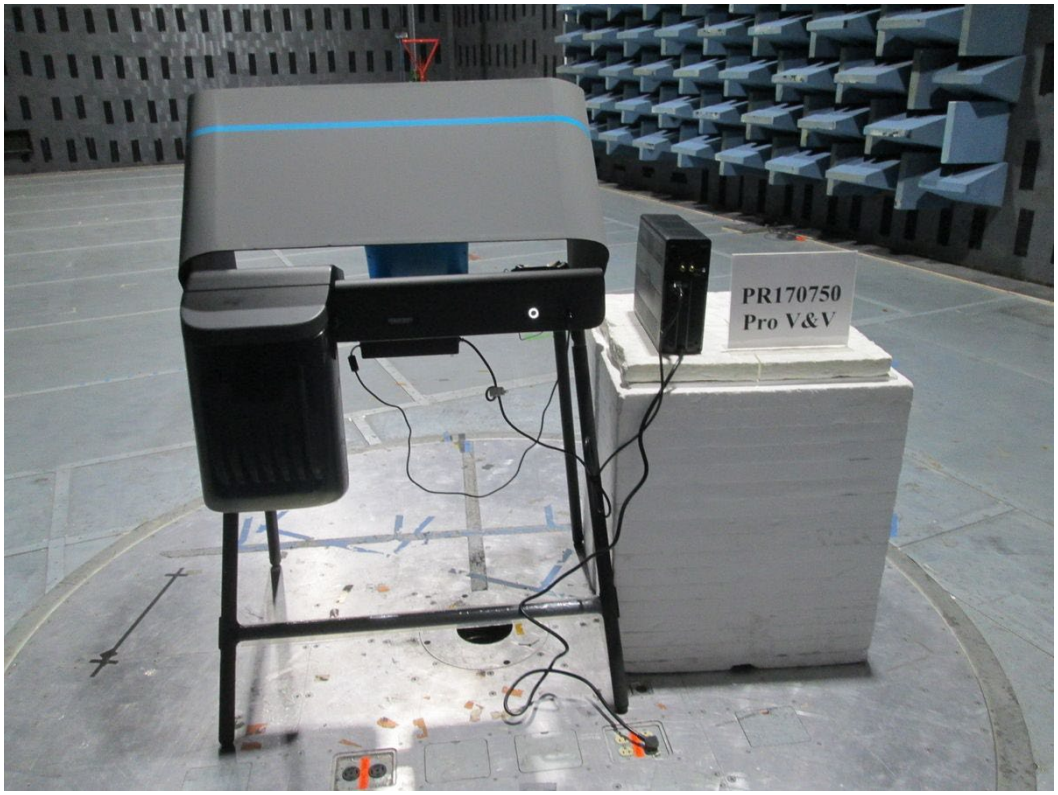
The PRESCAN is a peak measurement and is performed with the RBW set to 120 kHz, VBW set to 3 MHz (30 MHz to 1 GHz), and the RBW set to 1 MHz, VBW set to 3MHz (> 1 GHz)

The Antenna setup for >1GHz should match the setup that was used to meet SVSWR requirements. Refer to the SVSWR report storred in the calibration records for the chamber being used.

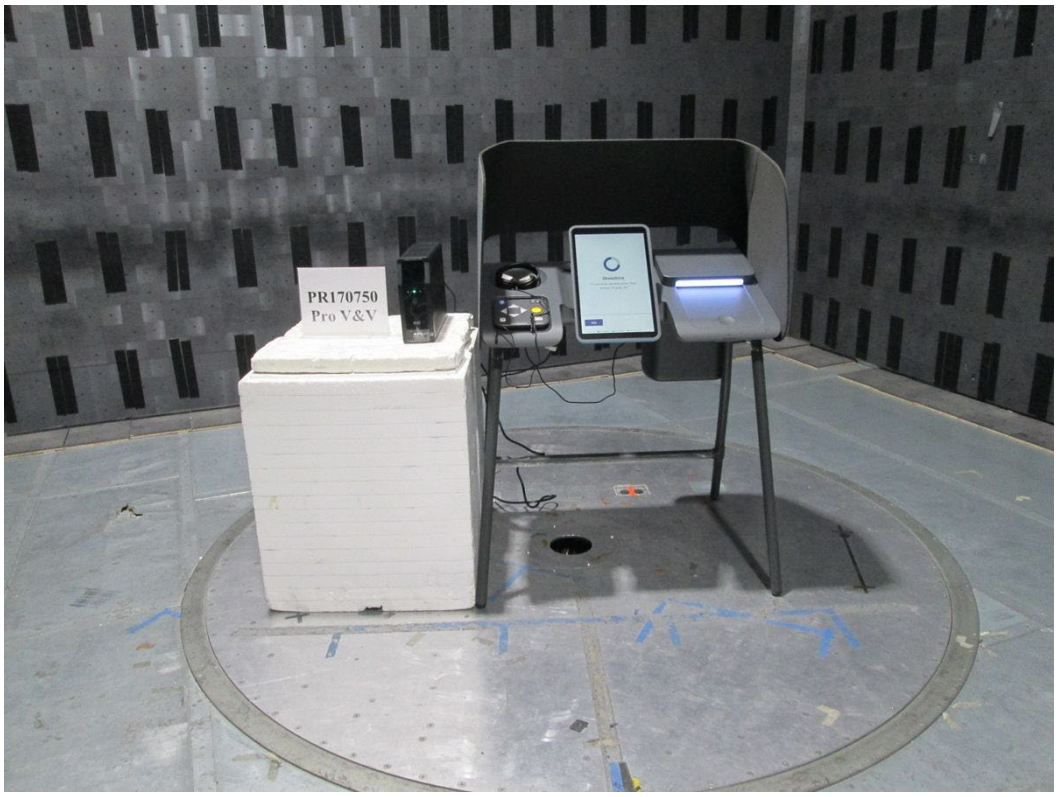
5.1.5 Test Photographs



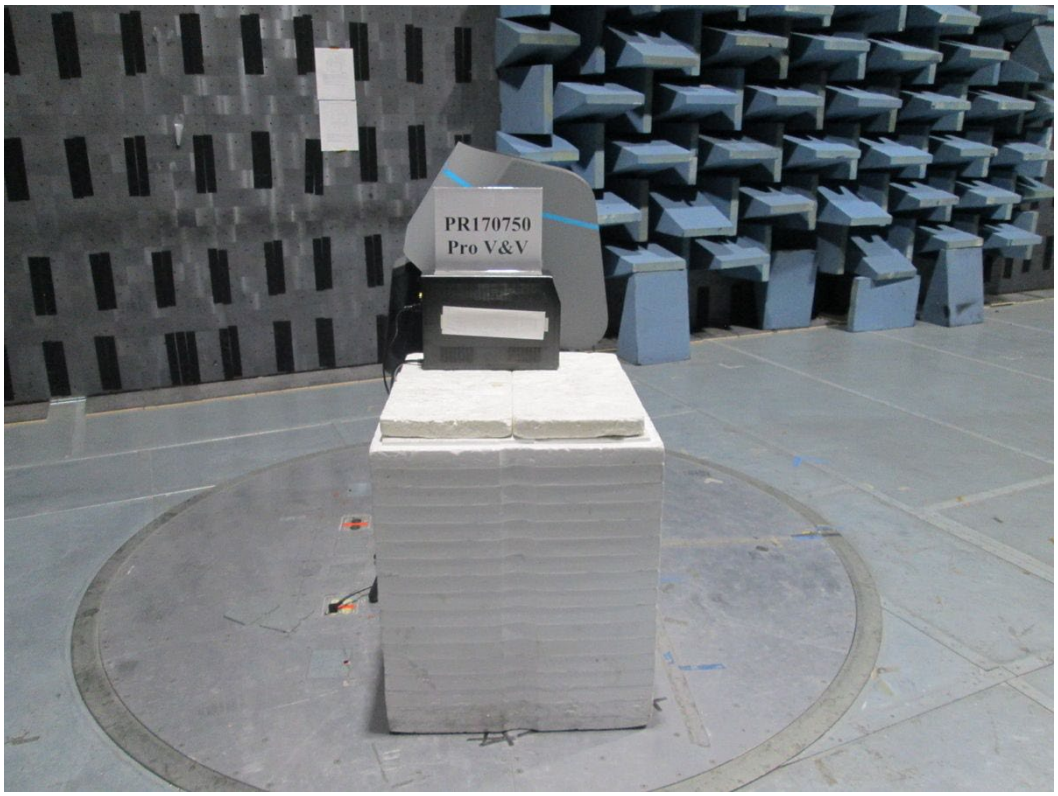
Radiated Emissions Ferrite Placement



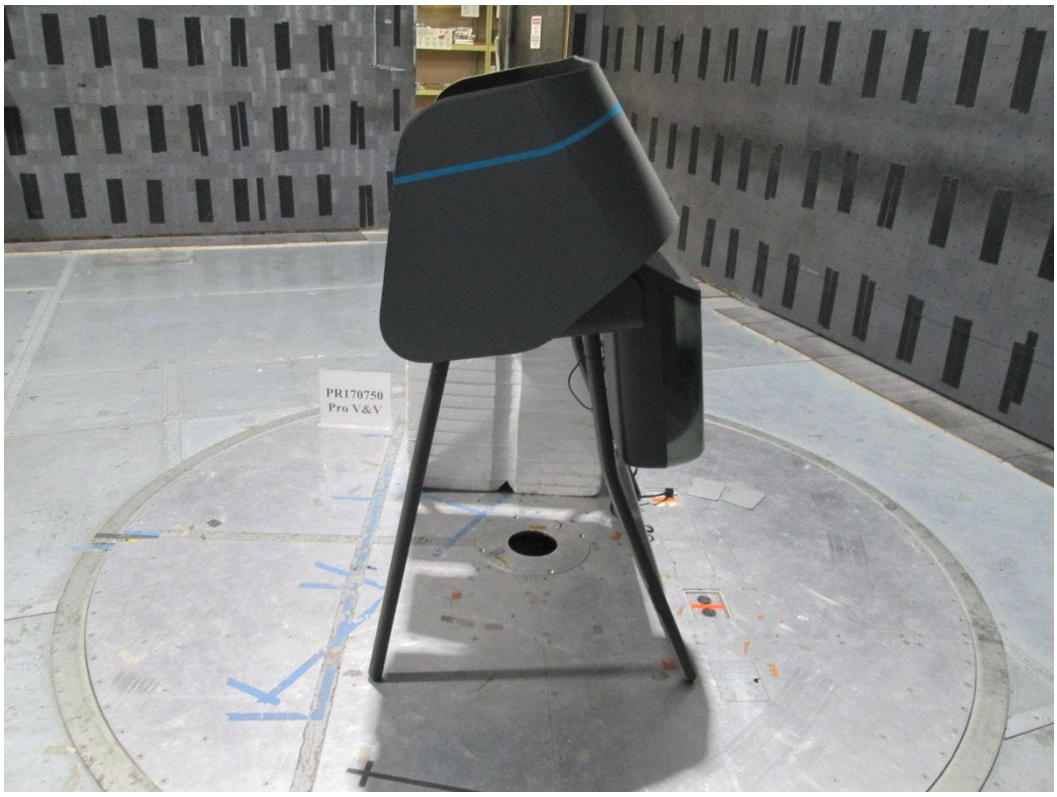
Radiated Emissions Back



Radiated Emissions Front

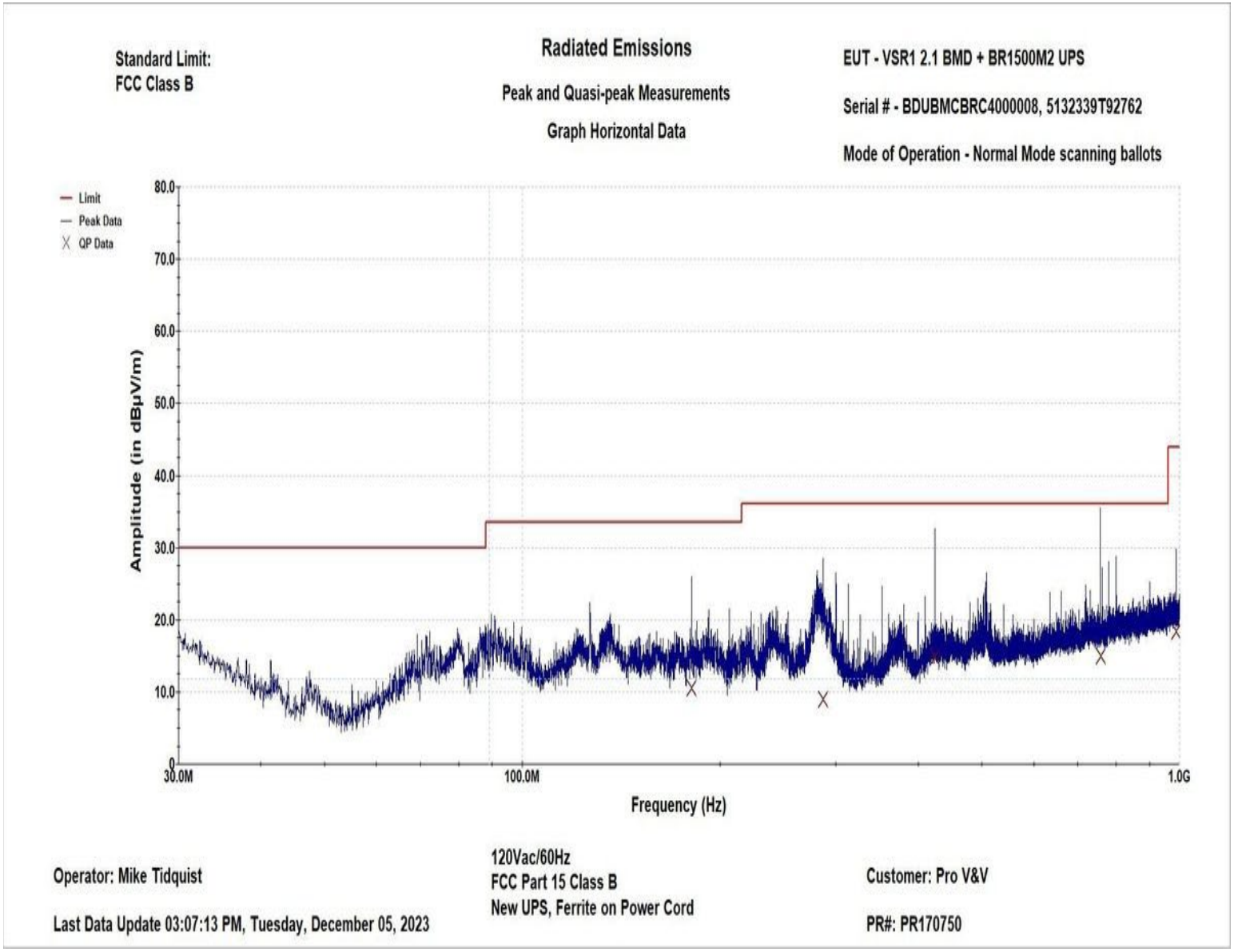


Radiated Emissions Left



Radiated Emissions Right

5.1.6 Test Data

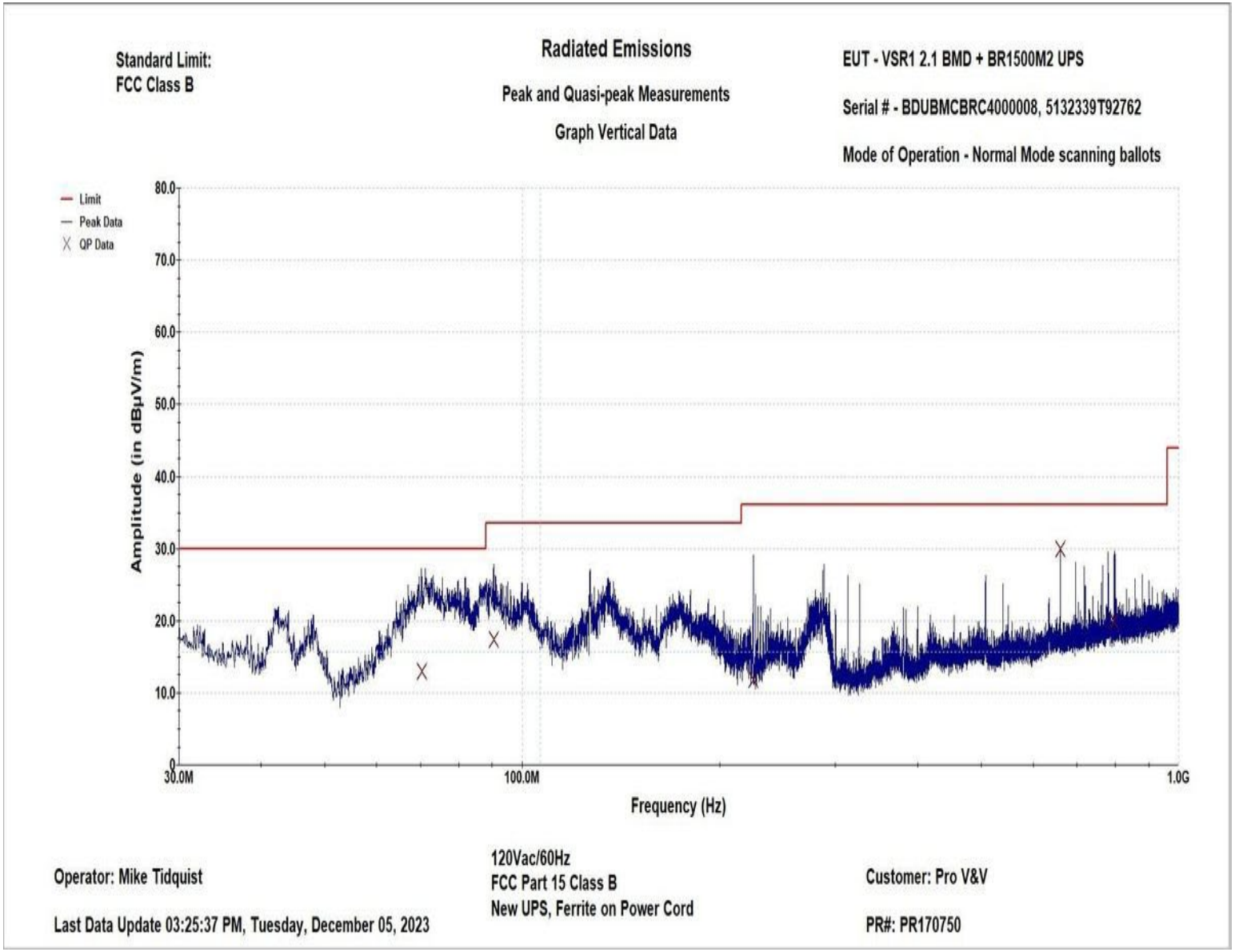


Radiated Emissions
Table: Horizontal Quasi-Peaks below 1 GHz

Operator: Mike Tidquist

EUT: VSR1 2.1 BMD + BR1500M2 UPS
PR#: PR170750
Customer: Pro V&V

Frequency (MHz)	QP (in dBuV)	Delta QP to Limit (in dBuV)	Height (in cm)	Azimuth (in Degrees)
181.036 MHz	10.513	-23.007	212	169
286.760 MHz	8.901	-27.119	282	2
424.729 MHz	14.776	-21.244	177	199
757.730 MHz	14.941	-21.079	331	69
988.361 MHz	18.440	-25.540	282	51
Standard Limit:				
FCC Class B				


Standard Limit:
FCC Class B
Radiated Emissions
Peak and Quasi-peak Measurements
Graph Vertical Data
EUT - VSR1 2.1 BMD + BR1500M2 UPS
Serial # - BDUBMCBRC4000008, 5132339T92762
Mode of Operation - Normal Mode scanning ballots
Limit
Peak Data
QP Data
Amplitude (in dBµV/m)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
30.0M
100.0M
1.0G
Frequency (Hz)
Operator: Mike Tidquist
Last Data Update 03:25:37 PM, Tuesday, December 05, 2023
120Vac/60Hz
FCC Part 15 Class B
New UPS, Ferrite on Power Cord
Customer: Pro V&V
PR#: PR170750

Radiated Emissions
Table: Vertical Quasi-Peaks below 1 GHz

Operator: Mike Tidquist

EUT: VSR1 2.1 BMD + BR1500M2 UPS
PR#: PR170750
Customer: Pro V&V

Frequency (MHz)	QP (in dBuV)	Delta QP to Limit (in dBuV)	Height (in cm)	Azimuth (in Degrees)
70.365 MHz	12.922	-17.078	241	74
90.650 MHz	17.437	-16.083	204	148
224.946 MHz	11.798	-24.222	363	344
660.065 MHz	29.906	-6.114	240	184
797.188 MHz	19.876	-16.144	352	20
Standard Limit:				
FCC Class B				

5.1.7 Test Equipment List

Table 5.1-1: Radiated Emissions, 30 MHz - 1 GHz (4.1.2.9) Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059736	Chamber (EMI, Semi-Anechoic)10 Meter	CIR Enterprises	10M1	04/03/2022	04/03/2024
WC059432	Antenna (Biconilog)	Sunol Sciences	JB1	09/27/2022	08/23/2025
WC059439	Meter (Digital Multimeter)	Fluke	85	08/28/2023	08/28/2024
WC059748	Controller (System)	Sunol Sciences	SC104V	NCR	NCR
WC059822	Receiver	Keysight Technologies	N9038A	09/28/2023	09/28/2024
WC076938	Cable (Test)	National Technical Systems	RF Coax Cable	08/18/2023	08/18/2024
WC078465	Amplifier (Pre/RF/Low Noise)	Pasternack Enterprises	PE15A1013	10/05/2023	10/05/2024
WC078470	Software	ETS-Lindgren	C47213	NCR	NCR
WC078487	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	07/25/2023	07/31/2024
WC080772	Cable (Test)	National Technical Systems	10 Meter #1 Test Cable	08/18/2023	08/18/2024

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

5.2 Conducted Emissions, 150 kHz - 30 MHz (4.1.2.9)

5.2.1 Test Procedure

The EUT was tested in accordance with FCC Part 15 Class B

5.2.2 Test Result

The EUT passed the defined requirements.

5.2.3 Test Datasheets

Element Materials Technology

Conducted Emissions, FCC Part 15, Class B

Standard Referenced:	FCC Part 15, Class B	Date:	12/6/2023
Temperature:	24°C Humidity: 15%	Pressure:	841 mb
Input Voltage:	120Vac/60Hz	LISN Bonding:	1.3 mΩ
Configuration of Unit:	Normal Operation scanning ballots	Sweep Time Check:	Yes
Test Engineer:	Mike Tidquist		

Date	Time	Log Entries	Initials	Result
12/6/23	0830-0930	Conducted Emissions: 150 kHz – 30 MHz. FCC Part 15. Class B. 120 VAC / 60 Hz	MT	Pass

Element Materials Technology			
Conducted Emissions, FCC Part 15, Class B			
Standard Referenced:	FCC Part 15, Class B	Date:	12/6/2023
Temperature:	24˚C Humidity: 15%	Pressure:	841 mb
Input Voltage:	120Vac/60Hz	LISN Bonding:	1.3 mΩ
Configuration of Unit:	Normal Operation scanning ballots	Sweep Time Check:	Yes
Test Engineer:	Mike Tidquist		

"Type" refers to the type of measurement performed. The type of measurement made is based on the requirements of the particular standard:

PK = Peak Measurement: RBW is 9 kHz, VBW is 3 MHz
QP = Quasi-Peak Measurement: RBW is 9 kHz, VBW is 3 MHz, and QP Detection is ENABLED
AV = Video Average Measurement: RBW is 9 kHz, VBW is 10 Hz

The "CE Level" is attained by adding the conducted amplitude measured (CA), Attenuation Cal factor (ACF), cable factor (CF) plus the LISN Cal Factor (LCF). CE Level = CA + ACF + CF + LCF . If applicable, cables positions are noted in the test log. (Sample Calculation: -7.5 dBuV + 20.2 dB + 1.5 dB + 23.8 dB= 38 dBuV. **Important Note:** This is a sample calculation only for the purpose of demonstration, and does not reflect data in this report.)

The "TestPoint" indicates which AC or DC input power line or which I/O cable the measurement was made on.

The "Margin" is with reference to the emissions limit. A positive number indicates that the emission measurement is below the limit. A negative number indicates that the emission measurement exceeds the limit.

5.2.4 Test Photographs

Conducted Emissions Back

Conducted Emissions Front

Conducted Emissions Left

Conducted Emissions Right

5.2.5 Test Data

Conducted Emissions
Average Data Table

Operator: Mike Tidquist
08:42:48 AM, Wednesday, December 06, 2023

EUT: Smartmatic VSR1 2.1 BMD + UPS
PR#: PR177050
Client: Pro V&V

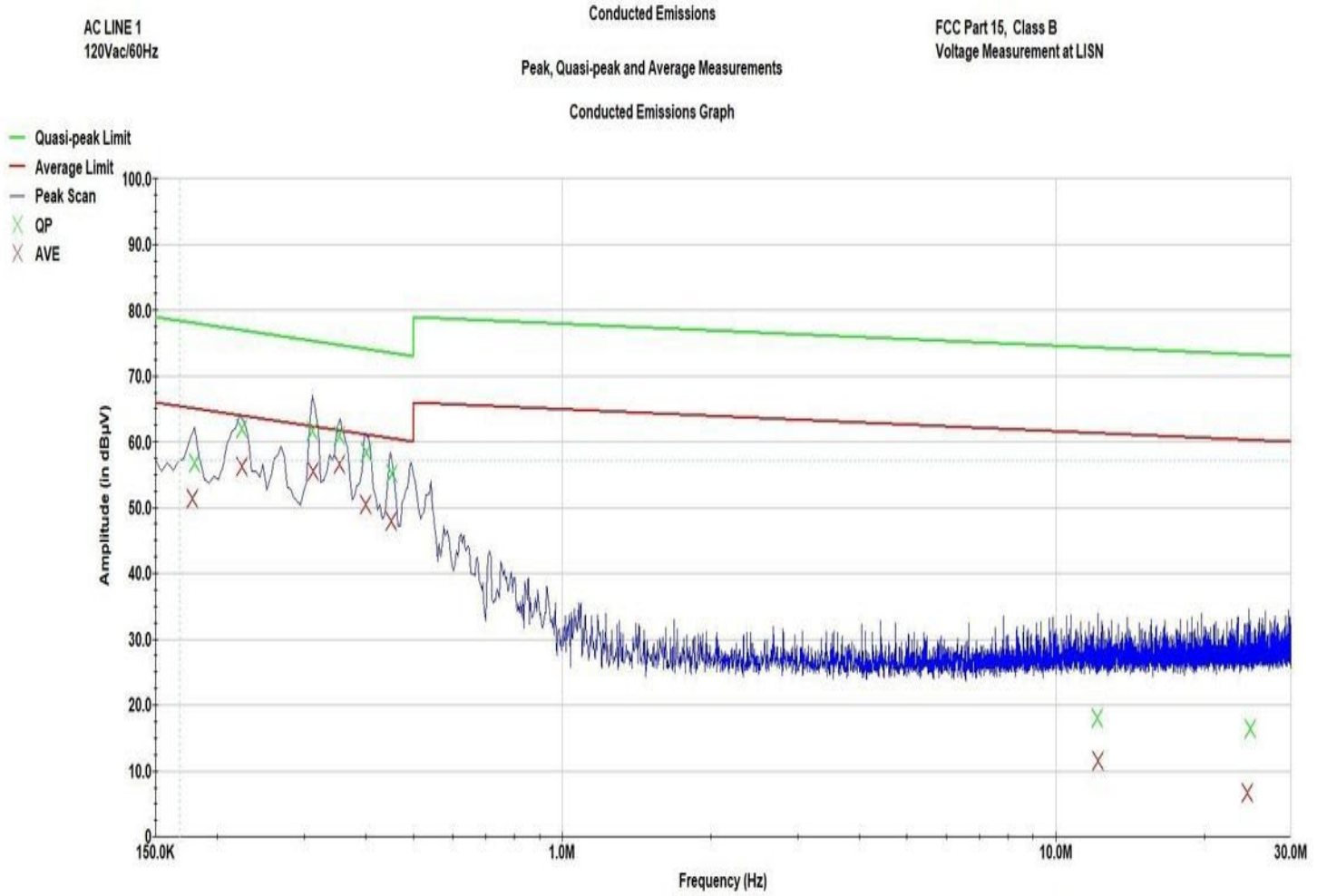
Frequency (MHz)	Amplitude (in dBµV)	Average Limit (in dBµV)	Delta to Average Limit (in dB)
178.06 KHz	51.31	65.52	-14.21
224.72 KHz	56.22	64.72	-8.50
313.42 KHz	55.56	63.20	-7.64
353.40 KHz	56.62	62.51	-5.89
400.36 KHz	50.53	61.71	-11.18
450.74 KHz	47.90	60.84	-12.95
12.19 MHz	11.59	63.62	-52.04
24.43 MHz	6.68	61.13	-54.45
AC LINE 1			
120Vac/60Hz			

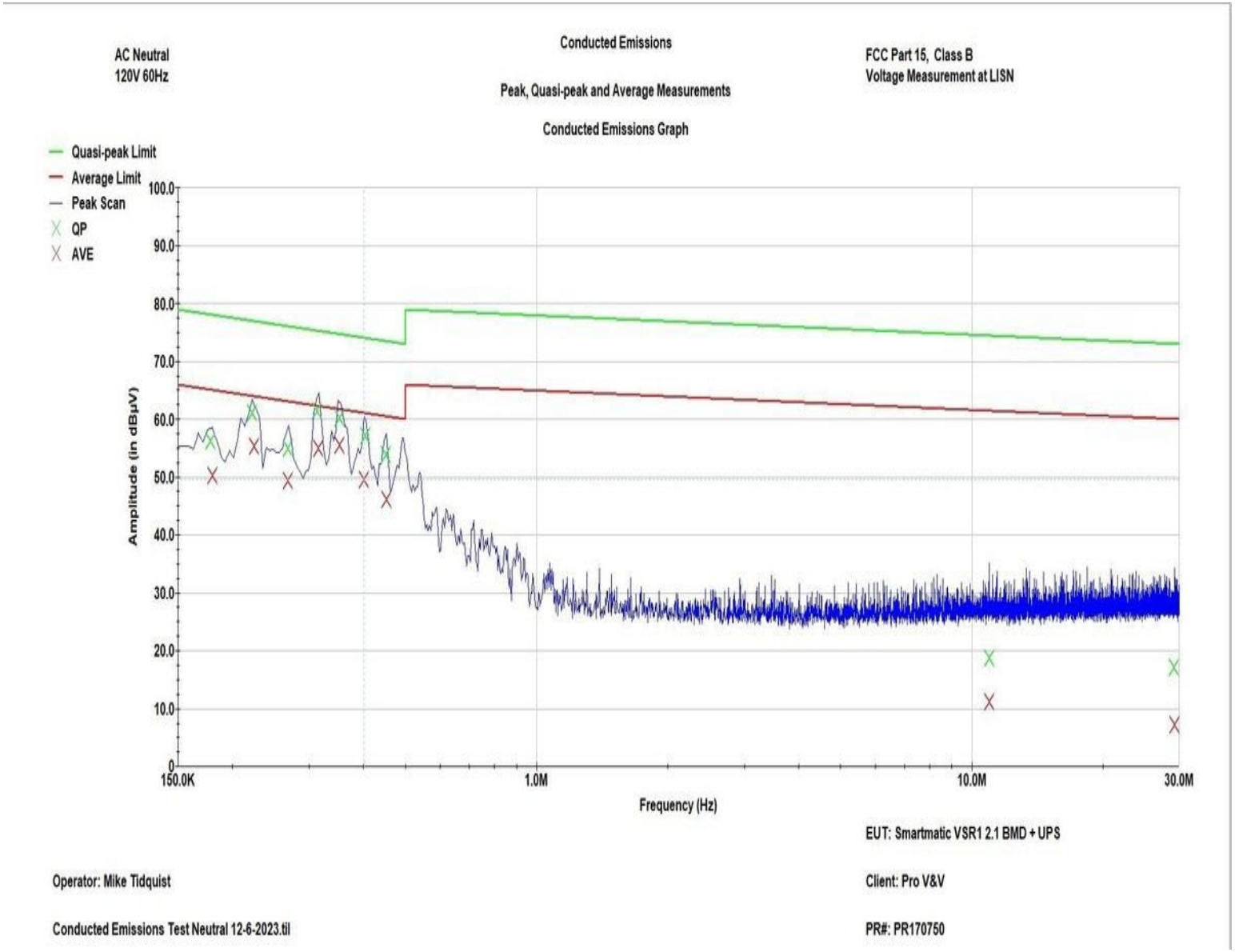
Conducted Emissions
Average Data Table

Operator: Mike Tidquist
09:02:25 AM, Wednesday, December 06, 2023

EUT: Smartmatic VSR1 2.1 BMD + UPS
PR#: PR170750
Client: Pro V&V

Frequency (MHz)	Amplitude (in dBµV)	Average Limit (in dBµV)	Delta to Average Limit (in dB)
179.84 KHz	50.29	65.49	-15.19
224.72 KHz	55.29	64.72	-9.43
268.71 KHz	49.32	63.97	-14.64
315.32 KHz	54.84	63.17	-8.32
352.66 KHz	55.49	62.53	-7.04
401.58 KHz	49.54	61.69	-12.15
452.74 KHz	46.11	60.81	-14.70
10.97 MHz	11.19	63.87	-52.68
29.23 MHz	7.09	60.16	-53.07
AC Neutral			
120V 60Hz			


AC LINE 1
120Vac/60Hz
Conducted Emissions
Peak, Quasi-peak and Average Measurements
Conducted Emissions Graph
FCC Part 15, Class B
Voltage Measurement at LISN
Quasi-peak Limit
Average Limit
Peak Scan
QP
AVE
Amplitude (in dBµV)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
150.0K
1.0M
10.0M
30.0M
Frequency (Hz)
EUT: Smartmatic VSR1 2.1 BMD + UPS
Operator: Mike Tidquist
Client: Pro V&V
Conducted Emissions Test line 1 12-6-2023.til
PR#: PR177050


AC Neutral
120V 60Hz
Conducted Emissions
Peak, Quasi-peak and Average Measurements
Conducted Emissions Graph
FCC Part 15, Class B
Voltage Measurement at LISN
Quasi-peak Limit
Average Limit
Peak Scan
QP
AVE
Amplitude (in dBµV)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
150.0K
1.0M
10.0M
30.0M
Frequency (Hz)
EUT: Smartmatic VSR1 2.1 BMD + UPS
Operator: Mike Tidquist
Client: Pro V&V
Conducted Emissions Test Neutral 12-6-2023.til
PR#: PR170750

Conducted Emissions
Quasi-Peak Data Table

Operator: Mike Tidquist
08:40:15 AM, Wednesday, December 06, 2023

EUT: Smartmatic VSR1 2.1 BMD + UPS
PR#: PR177050
Client: Pro V&V

Frequency (MHz)	Amplitude (in dBµV)	Quasi-peak Limit (in dBµV)	Delta to Quasi-peak Limit (in dB)
179.84 KHz	56.71	78.49	-21.78
224.72 KHz	62.03	77.72	-15.69
312.03 KHz	61.55	76.22	-14.67
353.40 KHz	60.91	75.51	-14.60
402.10 KHz	58.28	74.68	-16.40
452.99 KHz	55.09	73.81	-18.72
12.13 MHz	17.94	76.63	-58.70
24.79 MHz	16.42	74.06	-57.64
AC LINE 1			
120Vac/60Hz			

Conducted Emissions
Quasi-Peak Data Table

Operator: Mike Tidquist
08:59:33 AM, Wednesday, December 06, 2023

EUT: Smartmatic VSR1 2.1 BMD + UPS
PR#: PR170750
Client: Pro V&V

Frequency (MHz)	Amplitude (in dBµV)	Quasi-peak Limit (in dBµV)	Delta to Quasi-peak Limit (in dB)
178.06 KHz	56.13	78.52	-22.39
222.49 KHz	60.97	77.76	-16.78
268.71 KHz	54.93	76.97	-22.03
313.07 KHz	61.38	76.20	-14.83
352.66 KHz	60.08	75.53	-15.44
403.83 KHz	57.08	74.65	-17.57
450.49 KHz	53.89	73.85	-19.96
10.97 MHz	18.65	76.87	-58.22
29.17 MHz	17.05	73.17	-56.12
AC Neutral			
120V 60Hz			

5.2.6 Test Equipment List

Table 5.2-1: Conducted Emissions, 150 kHz - 30 MHz (4.1.2.9) Test Equipment List

Asset Number	Asset Type	Manufacturer	Model	Calibrated	Due
WC059736	Chamber (EMI, Semi-Anechoic)10 Meter	CIR Enterprises	10M1	04/03/2022	04/03/2024
WC059439	Meter (Digital Multimeter)	Fluke	85	08/28/2023	08/28/2024
WC059822	Receiver	Keysight Technologies	N9038A	09/28/2023	09/28/2024
WC076847	Network (LISN)	Solar Electronics	8012-50-R-25-BNC	01/23/2023	10/11/2024
WC078470	Software	ETS-Lindgren	C47213	NCR	NCR
WC078471	Cable (Test)	National Technical Systems	BNC Coaxial Cable	09/20/2023	09/20/2024
WC078486	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	07/26/2023	07/31/2024
WC078542	Meter (Milliohm)	Extech Instruments	380460	11/03/2023	11/03/2024
WC084270	Attenuator (Coaxial)	Pasternack Enterprises	PE7002-6	09/20/2023	09/20/2024

Calibration Abbreviations
CAL: Calibration
NCR: No Calibration Required

End of Test Report