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

Prepared For
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Revision History

Rev.	Description	Issue Date
0	Initial Release	03/21/2024

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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: See Table 5.0-1
- Pro V&V, Inc Purchase Order 2023-008,2024-001 dated 03/17/2023,02/12/2024.
- Element Quotation OP0636252 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	1	SMARTMATIC VSR1 2.1 PCOS	A4-800	GESA481A01000165

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	03/11/2024 - 03/12/2024	A4-800	GESA481A0100 0165	Passed
5.2	Conducted Emissions, 150 kHz - 30 MHz (4.1.2.9)	FCC Part 15B, Subpart B, Class B	Longmont	03/12/2024	A4-800	GESA481A0100 0165	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 SMARTMATIC VSR1 2.1 PCOS was tested in accordance with FCC Part 15. Class B

5.1.2 Test Result

The EUT passed the defined requirements.

5.1.3 Test Datasheets

Element Materials Technology

Radiated Emissions, FCC Part 15

Standard Referenced:	FCC Part 15, Class A	Date:	3/11/2024
Temperature:	18˚C Humidity: 14%	Pressure:	833 mb
Input Voltage:	120Vac/60Hz	Pretest & Linearity Check:	Pass
Configuration of Unit:	Normal Operation	Sweep Time Check:	Ok
Test Engineer / Technician:	T. Wittig		

Date	Time	Log Entries	Initials	Result
3/11/2024		Performed RE pre-test verification and ambient scans in 10 M #1	MT	Complete
	1200	Client arrived, setting up EUT	TW	Complete
		Begin Radiated Emissions, 30 MHz - 1 GHz. FCC Part 15. Class B	TW	---
	1400	EUT would not operate properly	TW	---
	1600	Done for the day	TW	---
3/12/2024	0730	Performed RE pre-test verification and ambient scans in 10 M #2	TW	---
	0810	Begin Radiated Emissions, 30 MHz - 1 GHz. FCC Part 15. Class B	TW	---
	1031	Completed RE testing	TW	Pass

Element Materials Technology			
Radiated Emissions, FCC Part 15			
Standard Referenced:	FCC Part 15, Class A	Date:	3/11/2024
Temperature:	18˚C Humidity: 14%	Pressure:	833 mb
Input Voltage:	120Vac/60Hz	Pretest & Linearity Check:	Pass
Configuration of Unit:	Normal Operation	Sweep Time Check:	Ok
Test Engineer / Technician:	T. Wittig		

"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.)

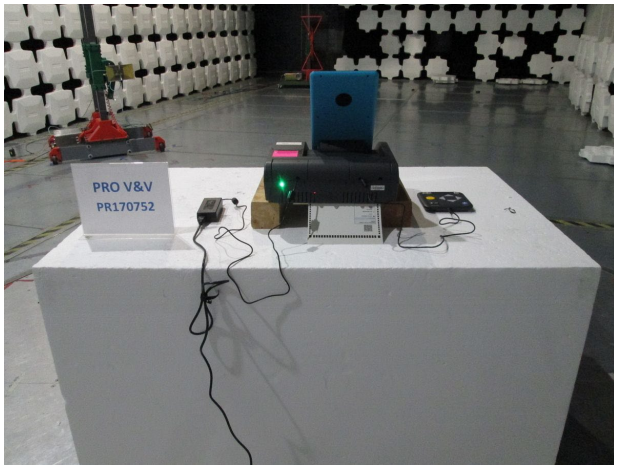
The "Azm/Pol/Hgt" indicates the turn-table azimuth, the antenna polarity, and the antenna height where the maximum emissions level was measured.

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.

5.1.4 Test Photographs



RE Test Setup - Back

RE Test Setup - Front

RE Test Setup - Left

RE Test Setup - Right

5.1.5 Test Data

Standard Limit:
FCC Part 15. Class B
120Vac/60Hz

Radiated Emissions

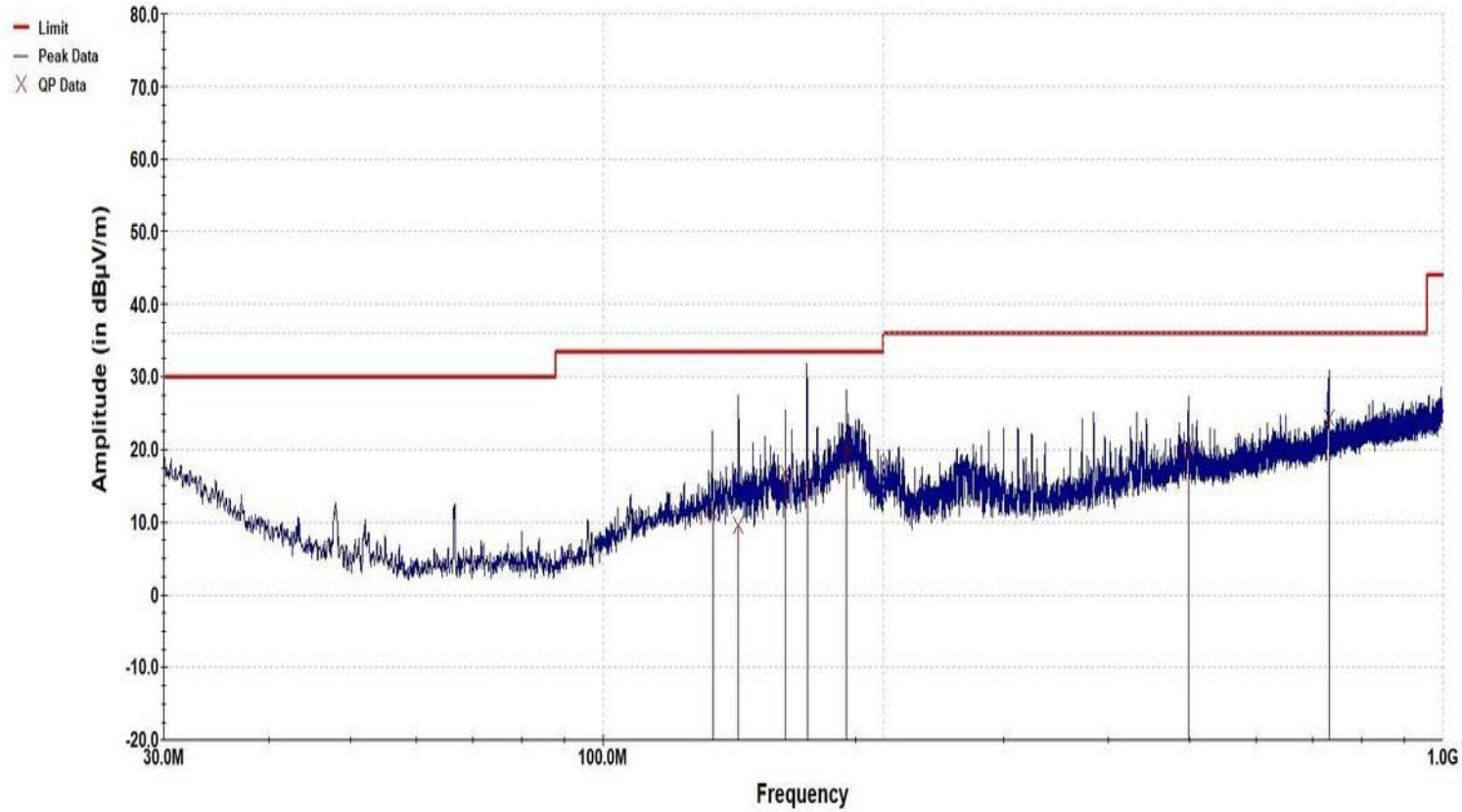
Peak and Quasi-peak Measurements

Graph Horizontal Data

EUT - SMARTMATIC VSR1 2.1 PCOS

Serial # - GESA481A01000165

Mode of Operation - Shoeshine Mode



Operator: T. Wittig

Last Data Update 09:25:57 AM, Tuesday, March 12, 2024

Customer: PRO V&V

PR#: PR170752

Standard Limit:
FCC Part 15. Class B
120Vac/60Hz

Radiated Emissions

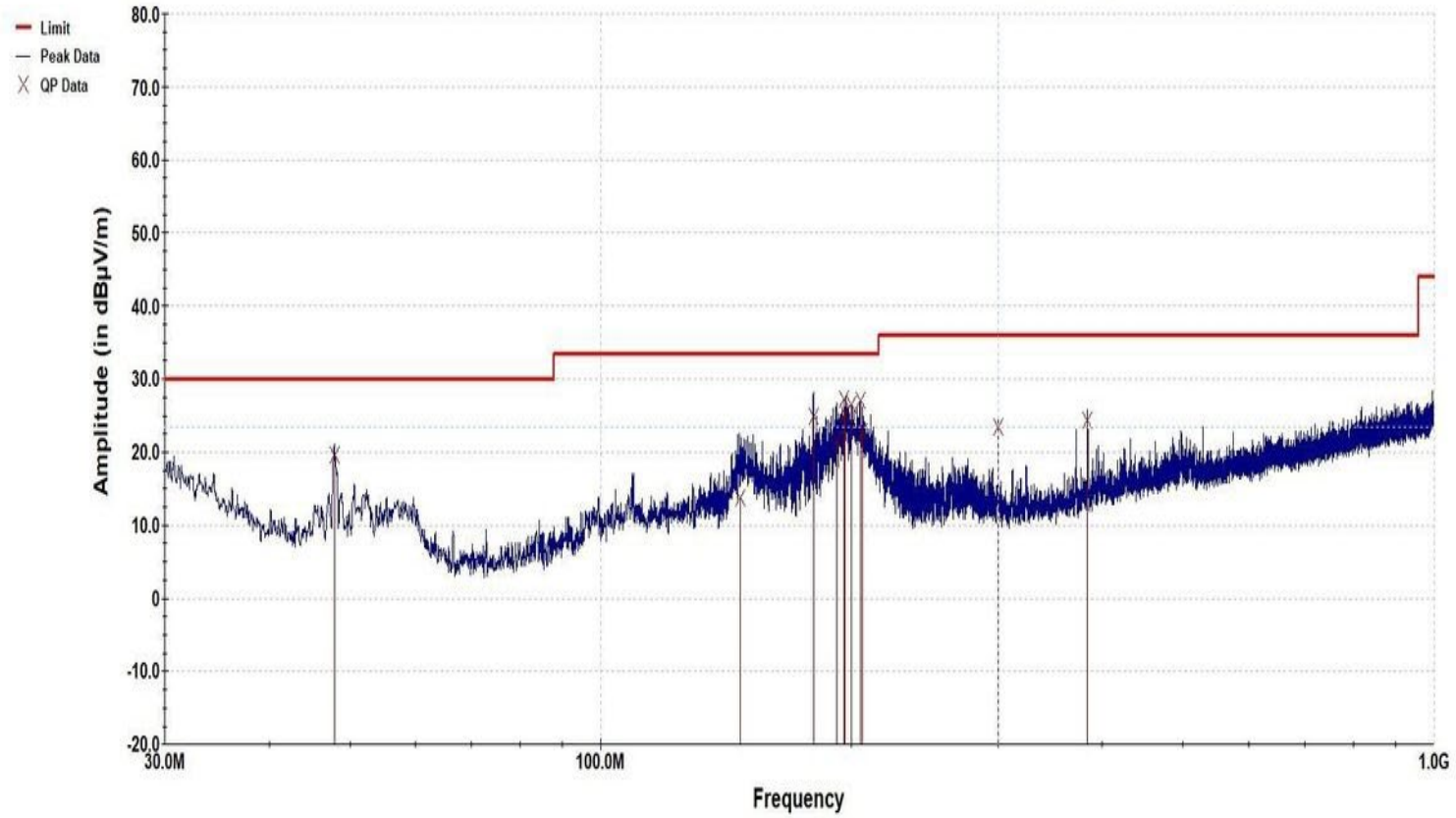
Peak and Quasi-peak Measurements

Graph Vertical Data

EUT - SMARTMATIC VSR1 2.1 PCOS

Serial # - GESA481A01000165

Mode of Operation - Shoeshine Mode



Operator: T. Wittig

Last Data Update 10:27:42 AM, Tuesday, March 12, 2024

Customer: PRO V&V

PR#: PR170752

Radiated Emissions
Quasi-peak Measurements
Table: Horizontal Quasi-peaks below 1 GHz

Operator: T. Wittig

EUT: SMARTMATIC VSR1 2.1 PCOS
PR#: PR170752
Customer: PRO V&V

Frequency (MHz)	QP (in dBuV)	Delta QP to Limit (in dBuV)	Height (in cm)	Azimuth (in Degrees)
135.170 MHz	11.365	-22.155	275	229
145.040 MHz	9.561	-23.959	144	212
164.870 MHz	16.736	-16.784	342	264
175.170 MHz	15.045	-18.475	374	104
194.920 MHz	20.383	-13.137	370	54
498.930 MHz	20.120	-15.900	177	213
732.570 MHz	24.396	-11.624	190	30

Standard Limit:
FCC Part 15. Class B
120Vac/60Hz

Radiated Emissions
Quasi-peak Measurements
Table: Vertical Quasi-peaks below 1 GHz

Operator: T. Wittig

EUT: SMARTMATIC VSR1 2.1 PCOS
PR#: PR170752
Customer: PRO V&V

Frequency (MHz)	QP (in dBuV)	Delta QP to Limit (in dBuV)	Height (in cm)	Azimuth (in Degrees)
47.940 MHz	19.664	-10.336	98	239
147.130 MHz	13.731	-19.789	135	281
180.000 MHz	24.897	-8.623	232	169
191.800 MHz	21.613	-11.907	138	204
195.980 MHz	27.266	-6.254	125	175
196.650 MHz	25.251	-8.269	138	178
200.090 MHz	26.610	-6.910	98	178
204.890 MHz	27.079	-6.441	104	158
206.130 MHz	22.624	-10.896	105	165
300.135 MHz	23.441	-12.579	120	210
383.960 MHz	24.273	-11.747	320	158
Standard Limit:				
FCC Part 15. Class B				
120Vac/60Hz				

5.1.6 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
WC059425	Power Supply (AC)	Pacific Power Source	3060-MS/M93235	NCR	NCR
WC059431	Controller (System)	Sunol Sciences	SC110V	NCR	NCR
WC059439	Meter (Digital Multimeter)	Fluke	85	08/28/2023	08/28/2024
WC059452	Generator (Signal)	Com-Power	CGO - 505	08/27/2014	NCR
WC059550	Amplifier (Pre/RF/Low Noise)	Ciao Wireless	1-18 GHZ	06/01/2023	06/01/2024
WC059739	Antenna (Biconilog)	Sunol Sciences	JB1	05/18/2021	05/11/2024
WC076859	Receiver	Rohde & Schwarz	ESW44	01/31/2024	01/31/2025
WC076925	Cable (Test)	Teledyne-taber	3 M RF Coax Cable	06/01/2023	06/01/2024
WC076928	Cable (Test)	Teledyne-taber	RF Coaxial Cable (1 meter)	07/05/2023	07/05/2024
WC078490	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	02/19/2024	02/28/2025
WC080805	Cable (Test)	Micro-Coax	UFA210A-0-0180-300300	06/05/2023	06/05/2024

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 SMARTMATIC VSR1 2.1 PCOS EUT was tested in accordance with FCC Part 15B, Subpart B, 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

Standard Referenced:	FCC Part 15, Class A	Date:	3/12/2024
Temperature:	18˚C Humidity: 14%	Pressure:	832 mb
Input Voltage:	120Vac/60Hz	LISN Bonding:	1.3 milliohms
Configuration of Unit:	Normal Operation	Sweep Time Check:	Yes
Test Engineer:	T. Wittig		

Date	Time	Log Entries	Initials	Result
3/12/2024		Performed CE pre-test verification and ambient scans	TW	Complete
	1100	Begin Conducted Emissions, 150 kHz - 30 MHz. FCC Part 15. Class B	TW	---
	1141	Completed CE testing	TW	Pass

Element Materials Technology			
Conducted Emissions, FCC Part 15			
Standard Referenced:	FCC Part 15, Class A	Date:	3/12/2024
Temperature:	18˚C Humidity: 14%	Pressure:	832 mb
Input Voltage:	120Vac/60Hz	LISN Bonding:	1.3 milliohms
Configuration of Unit:	Normal Operation	Sweep Time Check:	Yes
Test Engineer:	T. Wittig		

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

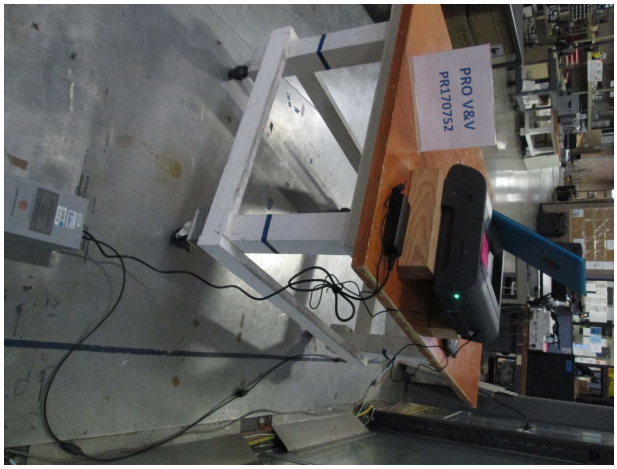
PK = Peak Measurement: RBW is 9 kHz, VBW is 3 MHz
QP = Quasi-Peak Measurement: RBW is 9 kHz, VBW is 3 MHz, and QP Detection is ENABLED
AV = Video Average Measurement: RBW is 9 kHz, VBW is 10 Hz

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



CE Test Setup - Back

CE Test Setup - Front

CE Test Setup - Left

CE Test Setup - Right

5.2.5 Test Data

Conducted Emissions
Average Data Table

Operator: T. Wittig
11:15:33 AM, Tuesday, March 12, 2024

EUT: SMARTMATIC VSR1 2.1 PCOS
PR#: PR170752
Client: PRO V&V

Frequency (MHz)	Amplitude (in dBµV)	Average Limit (in dBµV)	Delta to Average Limit (in dB)
198.87 KHz	23.83	54.60	-30.78
382.94 KHz	15.87	49.34	-33.47
646.88 KHz	11.34	46.00	-34.66
707.77 KHz	10.58	46.00	-35.42
3.71 MHz	0.48	46.00	-45.52
23.68 MHz	26.82	50.00	-23.18
AC LINE 1			
120Vac/60Hz			
Shoeshine Mode			

3

Conducted Emissions
Average Data Table

Operator: T. Wittig
11:36:58 AM, Tuesday, March 12, 2024

EUT: SMARTMATIC VSR1 2.1 PCOS
PR#: PR170752
Client: PRO V&V

Frequency (MHz)	Amplitude (in dBµV)	Average Limit (in dBµV)	Delta to Average Limit (in dB)
173.75 KHz	28.39	55.32	-26.93
235.10 KHz	21.97	53.57	-31.59
357.56 KHz	17.70	50.07	-32.37
610.75 KHz	12.15	46.00	-33.85
2.10 MHz	1.30	46.00	-44.70
3.78 MHz	0.29	46.00	-45.71
23.71 MHz	27.63	50.00	-22.37
AC Neutral			
120Vac/60Hz			
Shoeshine Mode			

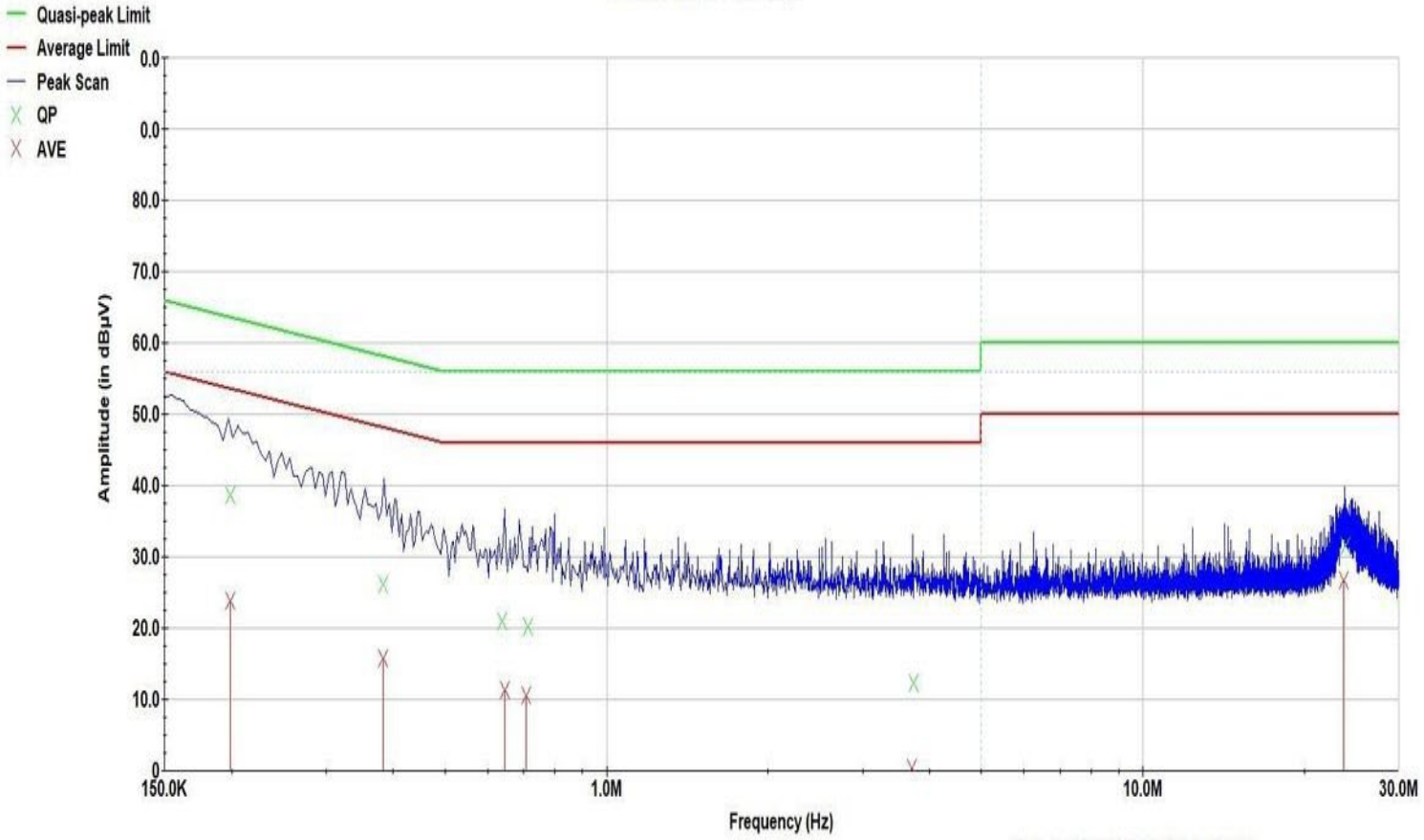
AC LINE 1
120Vac/60Hz
Shoeshine Mode

Conducted Emissions

Peak, Quasi-peak and Average Measurements

Conducted Emissions Graph

FCC Part 15. Class B
Voltage Measurement at LISN



EUT: SMARTMATIC VSR1 2.1 PCOS

Operator: T. Wittig

Client: PRO V&V

Conducted Emissions Test line 1 3-11-2024.til

PR#: PR170752

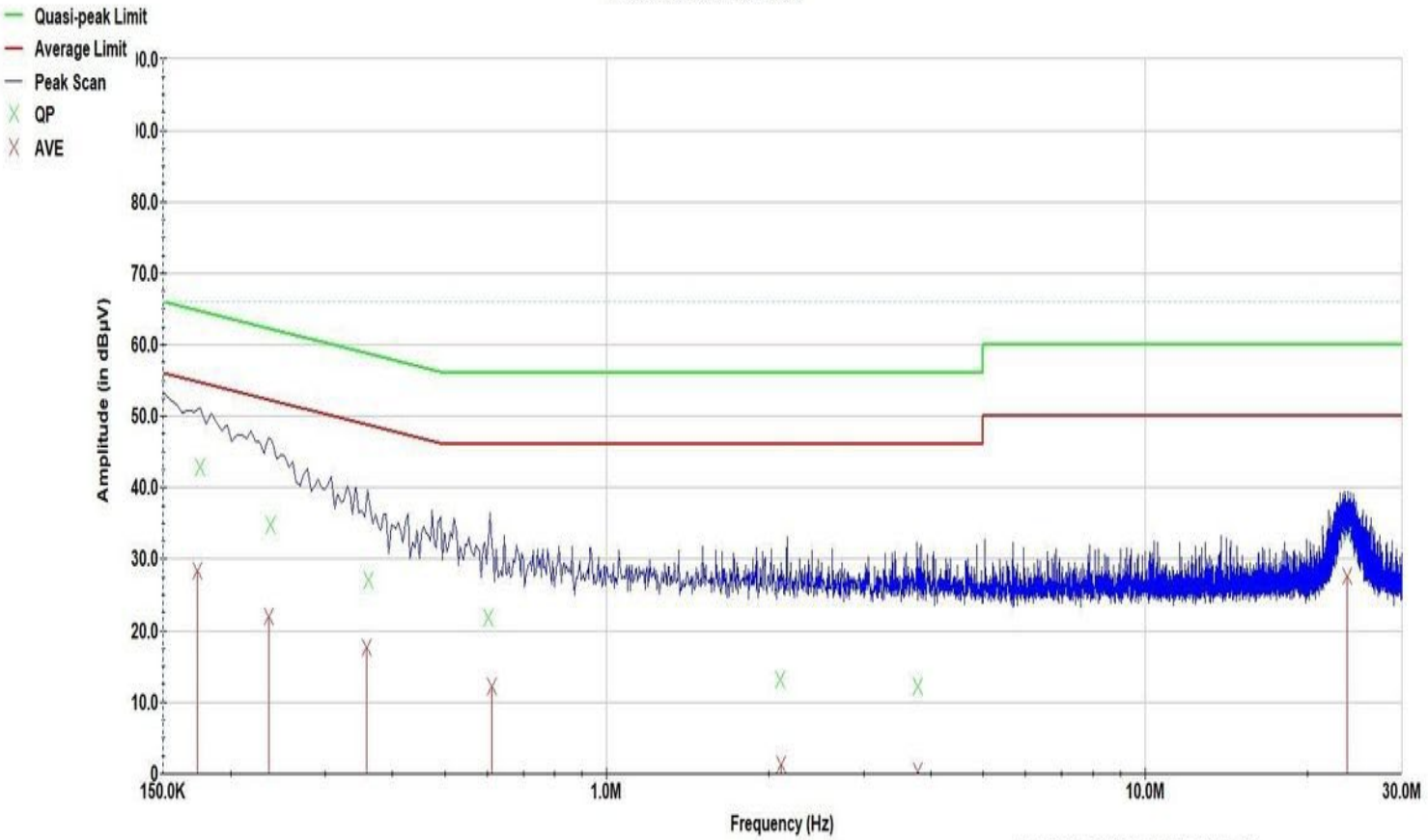
AC Neutral
120Vac/60Hz
Shoeshine Mode

Conducted Emissions

Peak, Quasi-peak and Average Measurements

Conducted Emissions Graph

FCC Part 15. Class B
Voltage Measurement at LISN



EUT: SMARTMATIC VSR1 2.1 PCOS

Operator: T. Wittig

Client: PRO V&V

Conducted Emissions Test Neutral 3-11-2024.til

PR#: PR170752

Conducted Emissions
Quasi-Peak Data Table

Operator: T. Wittig
11:13:32 AM, Tuesday, March 12, 2024

EUT: SMARTMATIC VSR1 2.1 PCOS
PR#: PR170752
Client: PRO V&V

Frequency (MHz)	Amplitude (in dBµV)	Quasi-peak Limit (in dBµV)	Delta to Quasi-peak Limit (in dB)
198.87 KHz	38.66	64.60	-25.94
382.94 KHz	26.19	59.34	-33.16
638.22 KHz	21.01	56.00	-34.99
712.60 KHz	20.25	56.00	-35.75
3.73 MHz	12.32	56.00	-43.68
23.84 MHz	31.61	60.00	-28.39
AC LINE 1			
120Vac/60Hz			
Shoeshine Mode			

Conducted Emissions
Quasi-Peak Data Table

Operator: T. Wittig
11:34:41 AM, Tuesday, March 12, 2024

EUT: SMARTMATIC VSR1 2.1 PCOS
PR#: PR170752
Client: PRO V&V

Frequency (MHz)	Amplitude (in dBµV)	Quasi-peak Limit (in dBµV)	Delta to Quasi-peak Limit (in dB)
175.50 KHz	42.85	65.27	-22.42
237.34 KHz	34.69	63.50	-28.81
361.15 KHz	26.97	59.97	-33.00
602.47 KHz	21.75	56.00	-34.25
2.10 MHz	13.13	56.00	-42.87
3.78 MHz	12.23	56.00	-43.77
23.70 MHz	33.23	60.00	-26.77
AC Neutral			
120Vac/60Hz			
Shoeshine Mode			

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
WC059439	Meter (Digital Multimeter)	Fluke	85	08/28/2023	08/28/2024
WC059729	Power Supply (AC)	Pacific Power Source	TMX 140	NCR	NCR
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	01/01/1900	NCR
WC078471	Cable (Test)	National Technical Systems	BNC Coaxial Cable	09/20/2023	09/20/2024
WC078487	Meter (Hydrometer)	Extech Instruments	Datalogger 42270	07/25/2023	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