

# National Technical Systems Test Report for Electromagnetic Interference (EMI) Testing of the FVS

**Prepared For**

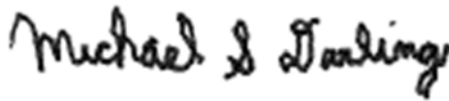
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Karen Norton  
Preparer

A handwritten signature in black ink, appearing to read "Michael Darling", written over a horizontal line.

Michael Darling  
EMI Department Manager



This report and the information contained herein represents the results of testing of only those articles/products identified in this document and selected by the client. The tests were performed to specifications and/or procedures approved by the client. National Technical Systems ("NTS") makes no representations expressed or implied that such testing fully demonstrates efficiency, performance, reliability, or any other characteristic of the articles being tested, or similar products. This report should not be relied upon as an endorsement or certification by NTS of the equipment tested, nor does it present any statement whatsoever as to the merchantability or fitness of the test article or similar products for a particular purpose. This document shall not be reproduced except in full without written approval from NTS.



### Revision History

Rev.	Description	Issue Date
0	Initial Release	07/09/2021

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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 test program. The test program was conducted to assess the ability of the specified Equipment Under Test (EUT) to successfully satisfy the requirements listed in Section 2.0.

### 2.0 References

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

- Pro V&V, Inc. Purchase Order(s) 2020-005,2020-007,Signed COS, dated 07/02/2020,10/21/2020,02/11/2021
- National Technical Systems (NTS) Quote(s) OP0565856, dated 10/22/2020
- NTS Corporate Quality Policy Manual, Revision 9, dated 9/20/2018
- ISO/IEC 17025:2017(E) *General Requirements for the Competence of Testing and Calibration Laboratories*, dated 11/1/2017
- Test Specification: FCC Part 15

### 3.0 Product Selection and Description

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

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

Item	Qty.	Name/Description	Part Number	Serial Number
1	1	FVS	FVS	VST 100 115

### 3.1 Security Classification

Non-classified

### 4.0 General Test Requirements

#### 4.1 Test Equipment

NTS-provided equipment is calibrated according to ISO/IEC 17025:2017(E) and calibration is traceable to the National Institute of Standards and Technology (NIST). Calibration records are maintained on file at NTS.

#### 4.2 Measurement Uncertainties

Measurement uncertainty data is available upon request.

#### 4.3 Notice of Deviation

In accordance with NTS' quality procedures, when the EUT is observed to exceed or display susceptibility, a Notice of Deviation (NOD) document is generated by the technician performing the test. This NOD documents the requirement, how the EUT deviated from the requirement, and allows room for resolution of the deviation.

This document is reviewed and approved by the NTS Program Manager or Engineer and the NTS Quality Assurance Representative, and then forwarded to the customer contact. Once mitigated (or passed over), the steps taken to correct the deviation (or simply instruction from the customer to continue testing) are recorded in the NOD and a copy of the NOD is integrated into the body of the report, in the appropriate location.

### 5.0 Test Descriptions 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	FCC Part 15	Longmont	01/19/2021	FVS	VST 100 115	Complied
5.2	Conducted Emissions, 150 kHz - 30 MHz	FCC Part 15	Longmont	01/15/2021	FVS	VST 100 115	Complied

\*The decision rule used to state compliance is in accordance with the test specification used for testing. Unless otherwise noted, testing was performed in accordance with the latest published version of test specification at time of test.

## 5.1 Radiated Emissions, 30 MHz - 1 GHz

### Radiated Emissions, FCC Part 15, Class B

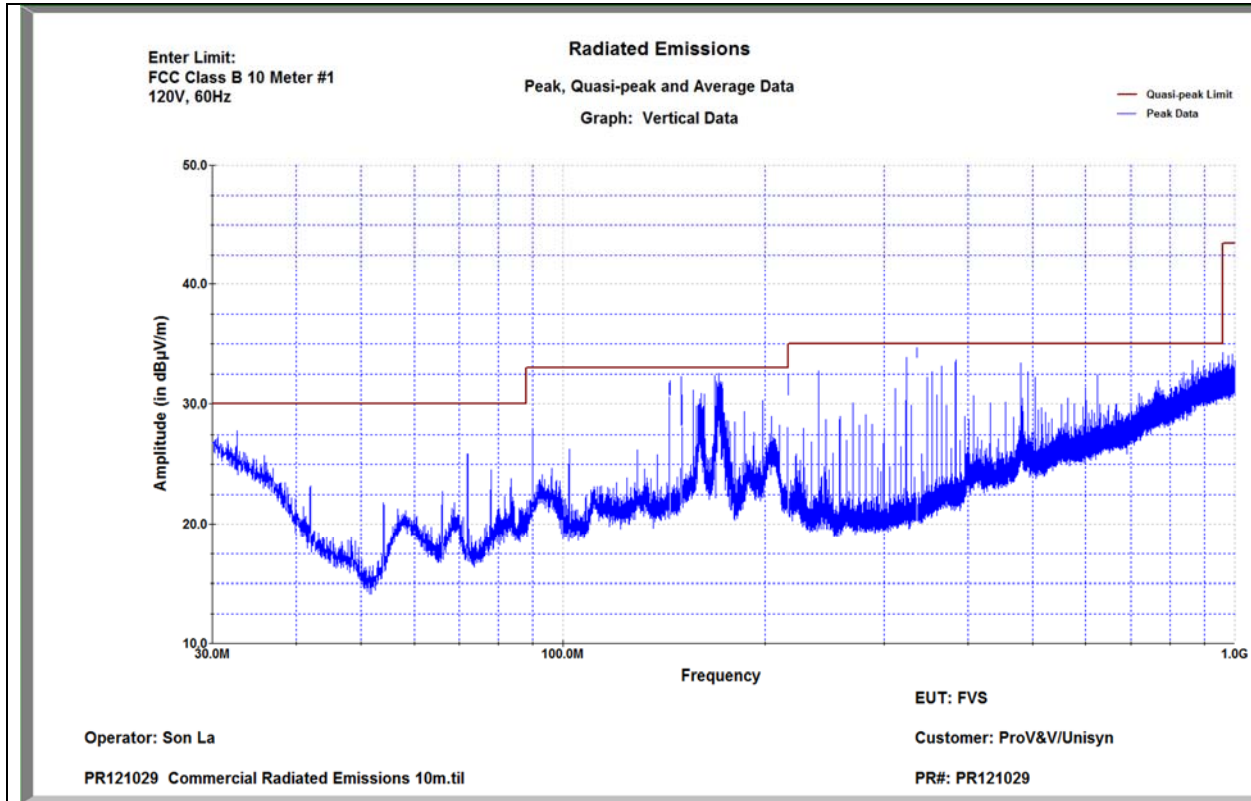
Manufacturer:	ProV&V/Unisyn	Project Number:	PR121029
Customer Representative:	Michael Walker	Test Area:	10m #1
Model:	FVS	S/N:	VST 100 115
Standard Referenced:	FCC PART 15, CLASS B	Date:	January 19, 2021
Temperature:	28.2°C	Humidity:	22%
Input Voltage:	120Vac/60Hz	Pressure:	847mb
Configuration of Unit:	Normal Operating Mode		
Test Engineer:	Son La		

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The highest emission measured was at **384.0 MHz**, which was **0.4 dB** below the limit.

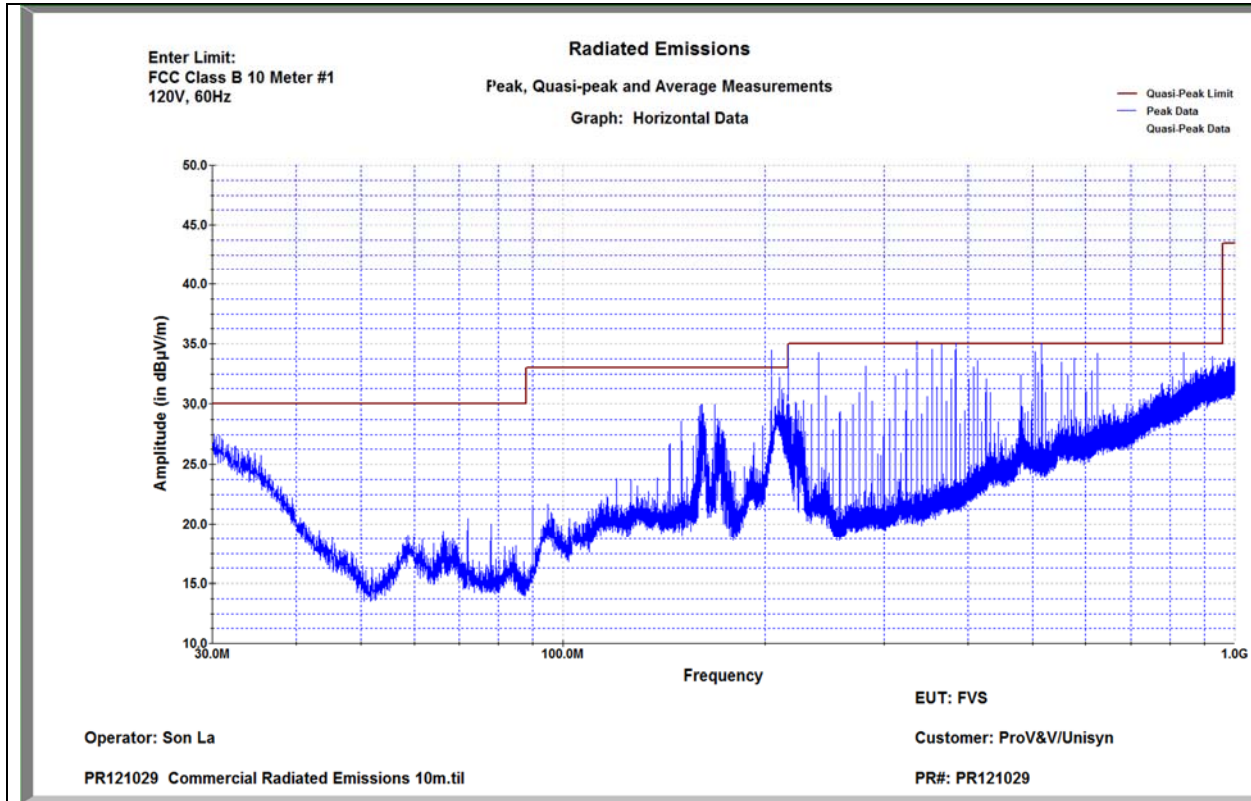
- “Type” refers to the type of measurement performed. The type of measurement made is based on the requirements of the particular standard:
  - PK = Peak Measurement: RBW is 120kHz, VBW is 3 MHz
  - QP = Quasi-Peak Measurement: RBW is 120kHz, VBW is 3 MHz, and QP Detection is ENABLED
  - AV = Video Average 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:  $49.6 \text{ dBuV} + 11.4 \text{ dB/m} - 28.8 \text{ dB (CF/AG)} = 32.2 \text{ dBuV/m}$ . **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 100 kHz (> 1 GHz)



Radiated Emissions-Quasi-Peak Data Table  
Vertical

Frequency (MHz)	Amplitude (in dBµV/m)	Quasi-peak Limit (in dBµV/m)	Delta to Limit (in dB)	EUT Azimuth (in degrees)	Antenna Height (in cm)
144.000	30.6	33.0	-2.4	327	156
149.956	28.2	33.0	-4.8	44	106
170.650	25.4	33.0	-7.6	250	106
216.000	30.6	33.0	-2.4	63	102
336.002	33.8	35.0	-1.2	192	102
338.985	15.6	35.0	-19.4	263	400

Graph 1. Vertical Scan



Radiated Emissions-Quasi-Peak Data Table  
Horizontal

Frequency (MHz)	Amplitude (in dBµV/m)	Quasi-peak Limit (in dBµV/m)	Delta to Limit (in dB)	EUT Azimuth (in degrees)	Antenna Height (in cm)
30.776	19.8	30.0	-10.2	150	196
204.018	32.3	33.0	-0.7	244	375
215.949	30.1	33.0	-2.9	7	400
336.000	34.4	35.0	-0.6	45	240
384.000	34.6	35.0	-0.4	76	187
515.970	32.1	35.0	-2.9	54	132

Graph 2. Horizontal Scan

### Radiated Emissions, FCC Part 15, Class B

Manufacturer:	ProV&V/Unisyn	Project Number:	PR121029
Customer Representative:	Michael Walker	Test Area:	10m #1
Model:	FVS	S/N:	VST 100 115
Standard Referenced:	FCC PART 15, CLASS B	Date:	January 19, 2021

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Figure A1. Radiated Emissions Test Setup (Front).



Figure A1. Radiated Emissions Test Setup (Back).





**Radiated Emissions, FCC Part 15, Class B**

Manufacturer:	ProV&V/Unisyn	Project Number:	PR121029
Customer Representative:	Michael Walker	Test Area:	10m #1
Model:	FVS	S/N:	VST 100 115
Standard Referenced:	FCC PART 15, CLASS B	Date:	January 19, 2021

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**Test Equipment List**

ID Number	Manufacturer	Model #	Serial #	Description	Cal Date	Cal Due
1038	Fluke	85	66180455	Multimeter/Frequency Meter	05/26/2020	05/26/2021
1219	Mini-Circuits	ZKL-2	062905	Preamp, 10 - 2000 MHz, 30 dB	05/20/2020	05/20/2021
1232	Sunol Sciences	JB1	A071605-2	Bilog Antenna, 30 MHz to 2.0 GHz	09/25/2019	09/25/2021
1233	Sunol Sciences	SC104V	110305-1	Positioning Controller	NA	NA
1323	Rohde&Schwarz	SMT03	100204	Signal Generator, 5 kHz to 3 GHz	05/05/2020	05/05/2021
1584	IFR	2023B	202303/034	Signal Generator 9 kHz - 2.05 GHz (WC059597)	09/24/2020	09/24/2021
1901	EXTECH	445703	0617	Hygrometer-Thermometer (WC059899)	06/29/2020	06/29/2021
1945	ROHDE & SCHWARZ	ESW26	101441	EMI Test Receiver (WC076849)	11/18/2020	11/18/2021

**5.2 Conducted Emissions, 150 kHz - 30 MHz**

**Conducted Emissions, FCC Part 15, Class B**

Manufacturer:	ProV&V/Unisyn	Project Number:	PR121029
Customer Representative:	Michael Walker	Test Area:	GP #10m1
Model:	FVS	S/N:	VST 100 115
Standard Referenced:	FCC PART 15, CLASS B	Date:	January 15, 2021
Temperature:	19.01°C	Humidity:	22%
Input Voltage:	120V, 60Hz	Pressure:	840mb
Configuration of Unit:	Normal Operating Mode		
Test Engineer:	Son La		

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**Conducted Emissions-Quasi-Peak/ Average Data Table - L1**

Frequency	Amplitude (dBμV)	Quasi-peak Limit (dBμV)	Delta to Quasi-peak Limit (dB)	Average Limit (dBμV)	Delta to Average Limit (dB)
206.82 KHz	54.07	64.38	-10.30	54.38	-0.30
210.63 KHz	54.16	64.27	-10.11	54.27	-0.11
210.75 KHz	53.74	64.26	-10.52	54.26	-0.52
212.89 KHz	54.16	64.20	-10.04	54.20	-0.04
213.42 KHz	54.04	64.19	-10.14	54.19	-0.14
224.24 KHz	53.32	63.88	-10.56	53.88	-0.56

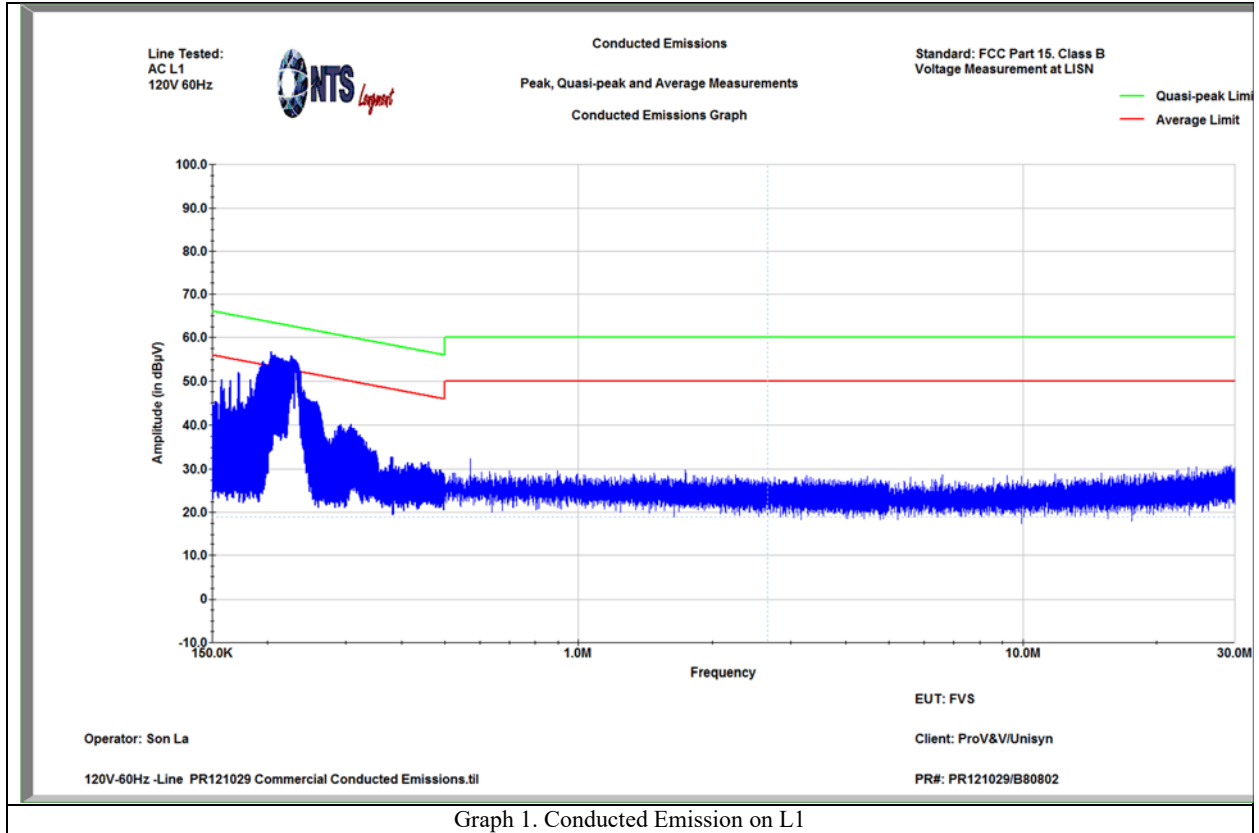
**Conducted Emissions-Quasi-Peak/ Average Data Table - L2**

Frequency	Amplitude (dBμV)	Quasi-peak Limit (dBμV)	Delta to Quasi-peak Limit (dB)	Average Limit (dBμV)	Delta to Average Limit (dB)
228.81 KHz	53.71	63.75	-10.04	53.75	-0.04
229.04 KHz	53.52	63.74	-10.22	53.74	-0.22
229.32 KHz	53.63	63.73	-10.10	53.73	-0.10
229.33 KHz	53.67	63.73	-10.06	53.73	-0.06
230.16 KHz	53.47	63.71	-10.24	53.71	-0.24
232.06 KHz	53.50	63.66	-10.16	53.66	-0.16

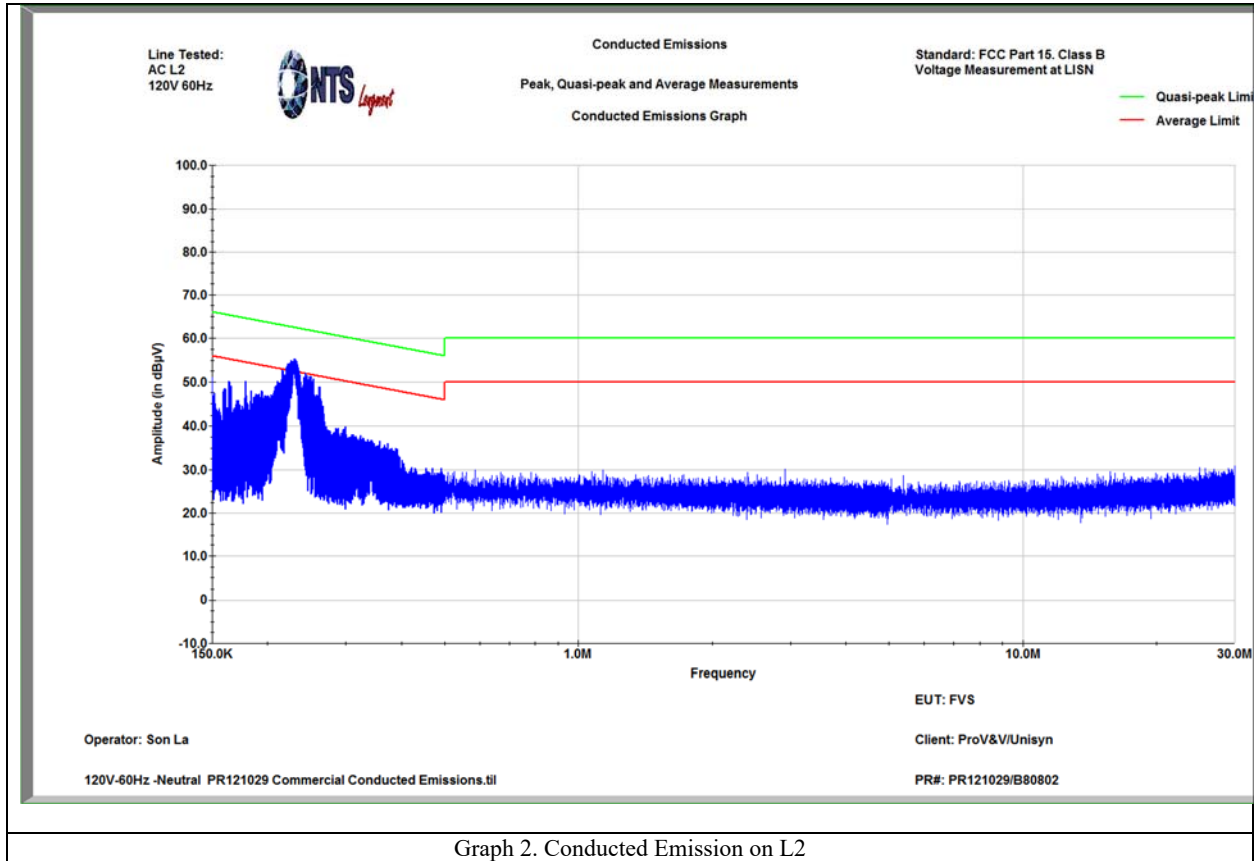
The highest emission measured was at **0.228 MHz**, which was **0.04 dB** below the limit.

- “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 “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:  $49.6 \text{ dB}\mu\text{V} + 11.4 \text{ dB/m} - 28.8 \text{ dB (CF/AG)} = 32.2 \text{ dB}\mu\text{V/m}$ . **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.
- The PRESCAN is a peak measurement and is performed with the RBW set to 9 kHz, and the VBW set to 3 MHz

### Conducted Emissions, FCC PART 15, CLASS B



Graph 1. Conducted Emission on L1



Graph 2. Conducted Emission on L2

### Conducted Emissions, FCC PART 15, CLASS B

Manufacturer:	Unisyn/Pr0V&V	Project Number:	PR121029
Customer Representative:	Michael Walker	Test Area:	GP #10m1
Model:	FVS	S/N:	VST 100 115
Standard Referenced:	FCC PART 15, CLASS B	Date:	January 15, 2021
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Figure A1. Conducted Emissions Test Setup (Front).



Figure A2. Conducted Emissions Test Setup (Side).

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### Conducted Emissions, FCC PART 15, CLASS B

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Manufacturer:	Unisyn/Pr0V&V	Project Number:	PR121029
Customer Representative:	Michael Walker	Test Area:	GP #10m1
Model:	FVS	S/N:	VST 100 115
Standard Referenced:	FCC PART 15, CLASS B	Date:	January 15, 2021

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Figure A3. Conducted Emissions Test Setup (Back).



**Conducted Emissions, FCC PART 15, CLASS B**

Manufacturer:	Unisyn/Pr0V&V	Project Number:	PR121029
Customer Representative:	Michael Walker	Test Area:	GP #10m1
Model:	FVS	S/N:	VST 100 115
Standard Referenced:	FCC PART 15, CLASS B	Date:	January 15, 2021
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**Test Equipment List**

ID Number	Manufacturer	Model #	Serial #	Description	Cal Date	Cal Due
1017	Pacific Power	TMX 140	0256	4 kVA, 50 Hz Power Source	NA	NA
1038	Fluke	85	66180455	Multimeter/Frequency Meter	05/26/2020	05/26/2021
1200	Agilent Technology	11947A	3107A03807	Transient Limiter, 9 kHz to 200 MHz	04/24/2020	04/24/2021
1323	Rohde&Schwarz	SMT03	100204	Signal Generator, 5 kHz to 3 GHz	05/05/2020	05/05/2021
1901	EXTECH	445703	0617	Hygrometer-Thermometer (WC059899)	06/29/2020	06/29/2021
1938	SOLAR ELECTRONICS	8012-50-R-25-BNC	SN221373-1A	150kHz to 30MHz LISN	11/10/2020	11/10/2021
1945	ROHDE & SCHWARZ	ESW26	101441	EMI Test Receiver (WC076849)	11/18/2020	11/18/2021



**6.0 Test Log**

**EMI Test Log**

Manufacturer:	ProV&V/Unisyn	Project Number:	PR121029/B80802
Model:	FVS	S/N:	FVS- 001
Customer Representative:	Michael Walker		
Standard Referenced:	FCC PART 15, CLASS B		

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**10m Emissions**

Test	Test Code	Date	Event	O T	Time (hrs)	Result	Initials
		January 11, 2021 0800	Setup/downtime		---	---	TW
4-11		0900	Begin Voltage Dips and Interruptions (Inc./Red. of Nom. Voltage) Electric power increases of 7.5% and reductions of 12.5% of nominal specified power., 120/60 VAC		---	Pass	TW
4-11			Voltage Dips and Interruptions (Surge of +/- 15%) Surge of +/- 15% line variation of nominal line voltage 120/60 VAC		---	Pass	TW
		1600	Done for the day		8.0	---	TW
4-11		January 12, 2021 0800	Resumed 4-11 testing		---	---	TW
		1030	Completed 4-11 testing		---	---	TW
CE		January 15, 2021	Conducted emissions 150KHz -30MHz FCC Part 15. Class B, 120V, 60Hz			-	-
CE		9:15	FCC Part 15. Class B, Line - LISN			Pass	SL
CE		11:00	FCC Part 15. Class B, Neutral - LISN			Pass	SL





**End of Report**