Measurement of RF Emissions from an Industrial Scientific Corporation Vaughan Aspirated Portable Gas Monitor

For	Industrial Scientific Corporation 7848 Steubenville Pike Oakdale, PA 15071
P.O. Number	400250906
Date Tested	October 2, 2015 through October 7, 2015
Test Personnel	Mark Longinotti
Test Specification	FCC "Code of Federal Regulations" Title 47 Part15, Subpart C, §225 Industry Canada RSS-210 Industry Canada RSS-Gen

Test Report By: MARK E. LONGINOTTI

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Requested By: Adam Platek
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REVISION HISTORY

Revision	Date	Description
—	12 OCT 2015	Initial release

Measurement of RF Emissions from an Industrial Scientific Corporation Vaughan Aspirated Portable Gas Monitor

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on an Industrial Scientific Corporation Vaughan Aspirated Portable Gas Monitor, Serial No. 15072EK-045, hereinafter referred to as the Equipment Under Test (EUT). The EUT was designed to transmit at approximately 13.56MHz using an internal antenna. The EUT was manufactured and submitted for testing by Industrial Scientific Corporation located in Oakdale, PA.

1.2. Purpose

The test series was performed to determine if the EUT meets the conducted RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Section 107 for digital devices and the radiated RF emission requirements of Subpart C, Section 225 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2014.

The test series was also performed to determine if the EUT meets the conducted RF emission requirements of the Industry Canada Radio Standards Specification RSS-Gen Section 8.8 for digital devices and the radiated RF emission requirements of RSS-210 Annex 2 for transmitters. Testing was performed in accordance with ANSI C63.4-2014.

1.3. Deviations, Additions and Exclusions

There were no deviations, additions to, or exclusions from the test specification during this test series.

1.4. EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by The American Association for Laboratory Accreditation (A2LA). A2LA Certificate Number: 1786.01.

1.5. Laboratory Conditions

The temperature at the time of the test was 23^{o}C and the relative humidity was 45%.

2. APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 2014
- ANSI C63.4-2014, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
- Industry Canada Radio Standards Specification, RSS-210, “Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment”, Issue 8, December 2010
- Industry Canada Radio Standards Specification, RSS-Gen, “General Requirements for Compliance of Radio Apparatus”, Issue 4, November 2014

3. EUT Setup and Operation

3.1. General Description

The EUT is an Industrial Scientific Corporation Vaughan Aspirated Portable Gas Monitor, A block diagram of the EUT setup is shown as Figure 1. A photograph of the EUT is shown as Figure 2.

3.1.1. Power Input

The EUT obtained 6.2VDC from an internal Li-Ion battery pack, P/N: 17134453-01.

3.1.2. Peripheral Equipment

The following peripheral equipment was submitted with the EUT:

Item	Description
Battery Charger	Industrial Scientific Ventis MX4 Charger/Datalink 18108209. The charger received 12VDC from the Industrial Scientific AC adapter, P/N: 17151382. The charger was connected to the AC adapter via a 1.5 meter long 2 wire power cable. (The charger was only used for power line conducted emissions tests.)

3.1.3. Signal Input/Output Leads

The EUT was submitted for testing with no signal leads.

3.1.4. Grounding

The EUT was not grounded during the tests.

3.2. Software

For all tests the EUT had Firmware Version 01.00.81 BLv 00.00.06 loaded onto the device to provide correct load characteristics.

3.3. Operational Mode

For all tests the EUT was placed on an 80cm high non-conductive stand. The EUT and all peripheral equipment were energized. For all tests, except power line conducted emissions, the EUT was programmed so that once it was powered up, it would start transmitting at 13.56MHz.

For power line conducted emissions tests, the EUT was placed in the Industrial Scientific Ventis MX4 Charger/Datalink 18108209. When placed in the charger, the EUT was operating in the charging mode.

3.4. EUT Modifications

No modifications were required for compliance.

4. Test Facility and Test Instrumentation

4.1. Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

4.2. Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1.

Conducted and radiated emission measurements were performed with a spectrum analyzer. This receiver

allows measurements with the bandwidths and detector functions specified in the requirements.

4.3. Calibration Traceability

Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.4. Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty for these tests is presented below:

Conducted Emissions Measurements		
Combined Standard Uncertainty	1.06	-1.06
Expanded Uncertainty (95% confidence)	2.12	-2.12

Radiated Emissions Measurements		
Combined Standard Uncertainty	2.09	-2.09
Expanded Uncertainty (95% confidence)	4.19	-4.19

5. TEST PROCEDURES

5.1. Powerline Conducted Emissions

5.1.1.Requirements

All radio frequency voltages on the power lines of a Class B digital device shall be below the values shown below when using a quasi-peak detector:

CONDUCTED LIMITS FOR CLASS B DEVICE

Frequency MHz	RFI Voltage dBuV(QP)	RFI Voltage dBuV(Average)
0.15-0.5	66 decreasing with logarithm of frequency to 56	56 decreasing with logarithm of frequency to 46
0.5-5	56	46
5-30	60	50

Note 1: The lower limit shall apply at the transition frequencies.
Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the EUT is considered to have met both requirements and measurements do not need to be performed using the Average detector.

5.1.2.Procedures

The interference on each power lead of the EUT was measured by connecting the measuring equipment to the appropriate meter terminal of the Line Impedance Stabilization Network (LISN). The meter terminal of the LISN not under test was terminated with 50 ohms.

a) The EUT was operated in the Charging mode.

b) Measurements were first made on the 115V, 60Hz high line of the Industrial Scientific Ventis MX4 Charger/Datalink.

c) The frequency range from 150 kHz to 30 MHz was broken up into smaller frequency sub-bands.

d) Conducted emissions measurements were taken on the first frequency sub-band using a peak detector.

e) The data thus obtained was then searched by the computer for the highest levels. Any emissions levels that were within 10dB of the average limit were then measured again using both a quasi-peak detector and an average detector. (If no peak readings were within 10dB of the average limit, quasi-peak and average readings were taken on the highest emissions levels measured during the peak detector scan.)

f) Steps (d) and (e) were repeated for the remainder of the frequency sub-bands until the entire frequency range from 150kHz to 30MHz was investigated. The peak trace was automatically plotted. The plot also shows quasi-peak and average readings that were taken on discrete frequencies. A table showing the quasi-peak and average readings was also generated. This tabular data compares the quasi-peak and average conducted emissions to the applicable conducted emissions limits. The resultant voltage level (VL) is a summation in decibels (dB) of the receiver meter reading (MTR) and the cable loss factor (CF).

Formula 1: VL (dBuV) = MTR (dBuV) + CF (dB)

g) Steps (c) through (f) were repeated on the 115V, 60Hz return line of the Industrial Scientific Ventis MX4 Charger/Datalink.

5.1.3. Results

The plots and tabular data of the peak, quasi-peak, and average conducted voltage levels acquired from each input power line with the EUT operated in the Charging mode are shown on pages 19 through 22. All power line conducted emissions measured from the EUT were within the specification limits. Photographs of the test configuration which yielded the highest or worst case, conducted emission levels are shown on Figure 3.

5.2. Radiated Measurements

5.2.1. Requirements

The EUT must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.225.

Paragraph 15.225 has the following radiated emission limits:

(a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

5.2.2. Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed

over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

5.2.2.1 10MHz to 30MHz Frequency Range

A preliminary radiated emissions test was performed to determine the emission characteristics of the EUT. For the preliminary test, an active loop measuring antenna was positioned at a 3 meter distance from the EUT. The entire frequency range from 10MHz to 30MHz was investigated using a peak detector function.

The final open field emission tests were then manually performed over the frequency range of 10MHz to 30MHz using an active loop antenna. All significant broadband and narrowband signals were measured and recorded using a quasi-peak detector with a 9kHz bandwidth.

To ensure that maximum or worst case, emission levels were measured, the following steps were taken:

1) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
2) The active loop antenna was placed at a height of 1 meter.
3) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
4) With the loop antenna in the vertical polarization, the loop antenna was rotated through 360 degrees.

The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external pre-amplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total. (Per 15.231(f)(2), at frequencies below 30MHz, measurements may be made at a distance closer than that specified. When performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by using the square of an inverse linear distance extrapolation factor (40 dB/decade).)

Formula 1: FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

Formula 2: FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

5.2.2.2 30MHz to 200MHz Frequency Range

Since a quasi-peak detector requires long integration times, it is not practical to automatically sweep through the quasi-peak levels. Therefore, radiated emissions from the EUT were first scanned using a peak detector and automatically plotted. The frequencies where significant emission levels were noted were then remeasured using the quasi-peak detector.

The broadband measuring antenna was positioned at a 3 meter distance from the EUT. The frequency range from 30MHz to 200MHz was investigated using a peak detector function with the bilog antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The maximum levels for each antenna polarization were plotted. The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external pre-amplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

Formula 1: FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

Formula 2: FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

Final radiated emissions were performed on all significant broadband and narrowband emissions found in the preliminary sweeps using the following methods:

1) Measurements from 30MHz to 200MHz were made using a quasi-peak detector and a broadband bilog antenna.

2) To ensure that maximum or worst case, emission levels were measured, the following steps were taken:

    a) The EUT was rotated so that all of its sides were exposed to the receiving antenna.

    b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

    c) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

5.2.3. Results

The preliminary plots, with the EUT transmitting at 13.56MHz, are presented on data pages 23 through 26. The plots are presented for a reference only, and are not used to determine compliance.

The final radiated levels, with the EUT transmitting at 13.56MHz, are presented on data page 27. As can be seen from the data, all emissions measured from the EUT were within the specification limits. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 4 and Figure 5.

5.3. Frequency Stability

5.3.1. Requirement

Per 15.225(e), the frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.3.2. Procedures

The EUT was placed inside a temperature chamber. A near-field loop antenna was placed next to the EUT. The near-field loop antenna was connected to a frequency counter.

a) The nominal frequency of the transmitter was measured and recorded.

b) The temperature chamber was then set to -20ºC.

c) Once the temperature had reached -20ºC the EUT was allowed to soak for 30 minutes.

d) After soaking at -20ºC for thirty minutes the EUT was turned on and the transmit frequency was measured and recorded.

e) Steps (b) through (d) were repeated for each temperature in 10ºC steps from -10ºC to +50ºC.

f) The temperature chamber was then set to +20ºC and the EUT was allowed to soak for 30 minutes.

5.3.3. Results

The frequency stability measurements are presented on page 28. As can be seen from the data the test frequency deviation was within the ±0.01% limit. A photograph of the test set-up is shown in Figure 6.

6. OTHER TEST CONDITIONS

6.1. Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated.

6.2. Disposition of the EUT

The EUT and all associated equipment were returned to Industrial Scientific Corporation upon completion of the tests.

7. CONCLUSIONS

It was determined that the Industrial Scientific Corporation Vaughan Aspirated Portable Gas Monitor, Serial No. 15072EK-045, did fully meet the conducted emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Section 107 for digital devices and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 225 for Intentional Radiators, when tested per ANSI C63.4-2014:

It was also determined that the Industrial Scientific Corporation Vaughan Aspirated Portable Gas Monitor, Serial No. 15072EK-045, did fully meet the conducted emission requirements of RSS-Gen Section 8.8 for digital devices and radiated emission requirements of RSS-210 Annex 2 for transmitters when tested per ANSI C63.4-2014:

8. CERTIFICATION

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the EUT at the test date. Any electrical or mechanical modification made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the Federal Government.

9. EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
CDX8	COMPUTER	ELITE	WORKSTATION			N/A	
CDY0	WORKSTATION	ELITE	WORKSTATION		WINDOWS 7	N/A	
CMA1	Controllers	EMCO	2090	9701-1213	---	N/A	
ETD0	ENV Chambers For Auto Dept Use Only	Thermotron	S-8	15461	-70 to 150 degrees C	NOTE 1	
ETDA	HONEYWELL CHART RECORDER	HONEYWELL	DR45AT-1100	0825Y878133300009	PROGRAMMABLE	12	
ETDC	CONTROLLER	THERMOTRON	2800	753726	PROGRAMABLE	NOTE 1	
NLS0	24" ACTIVE LOOP ANTENNA	EMCO	6502	89979	10KHZ-30MHZ	7/7/2014	7/7/2016
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHz	3/27/2015	3/27/2016
PHA0	MAGNETIC FIELD PROBE	ELECTRO-METRICS	EM-6882	134	22-230MHZ	NOTE 1	
PLF1	CISPR16 50UH LISN	ELITE	CISPR16/70A	001	.15-30MHz	5/20/2015	5/20/2016
PLF3	CISPR16 50UH LISN	ELITE	CISPER16/70A	003	.15-30MHz	5/20/2015	5/20/2016
RBA0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100145	20HZ-26.5GHZ	3/3/2015	3/3/2016
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	2/13/2015	2/13/2016
T1E5	10DB 25W ATTENUATOR	WEINSCHEL	46-10-34	BG3492	DC-18GHZ	7/6/2015	7/6/2016

I/O: Initial Only
N/A: Not Applicable
Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

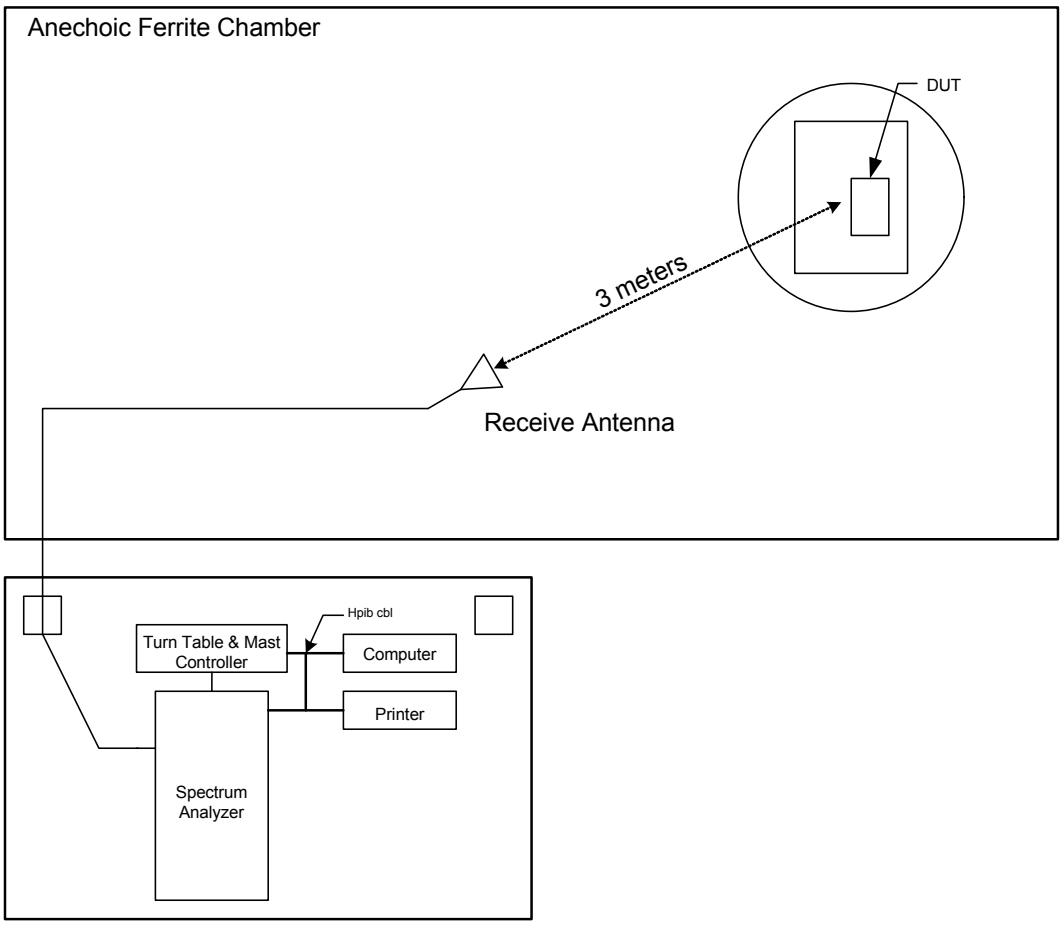
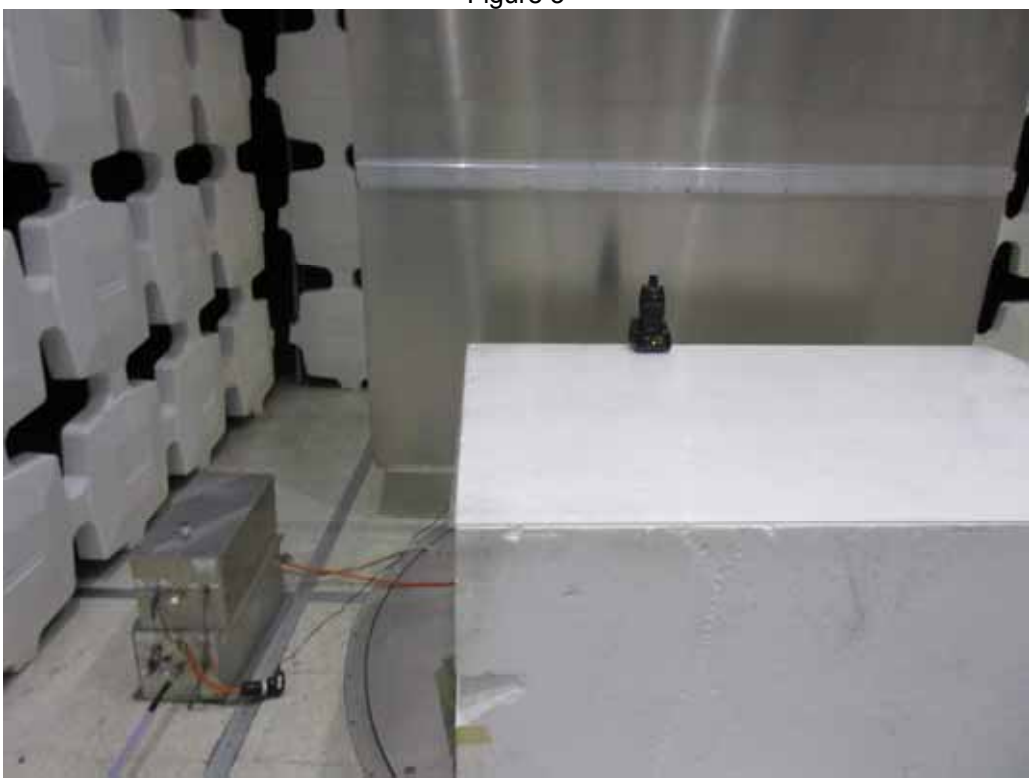


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 2

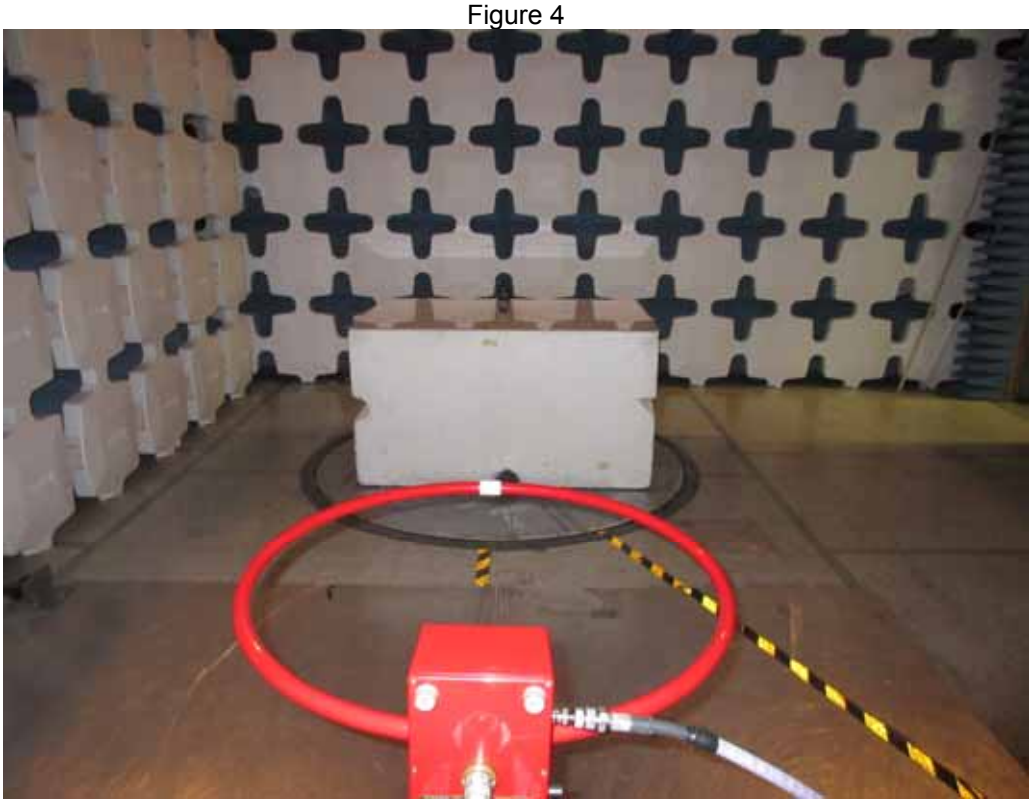
Photograph of the EUT

Figure 3



Test Setup for Power Line Conducted Emissions Tests

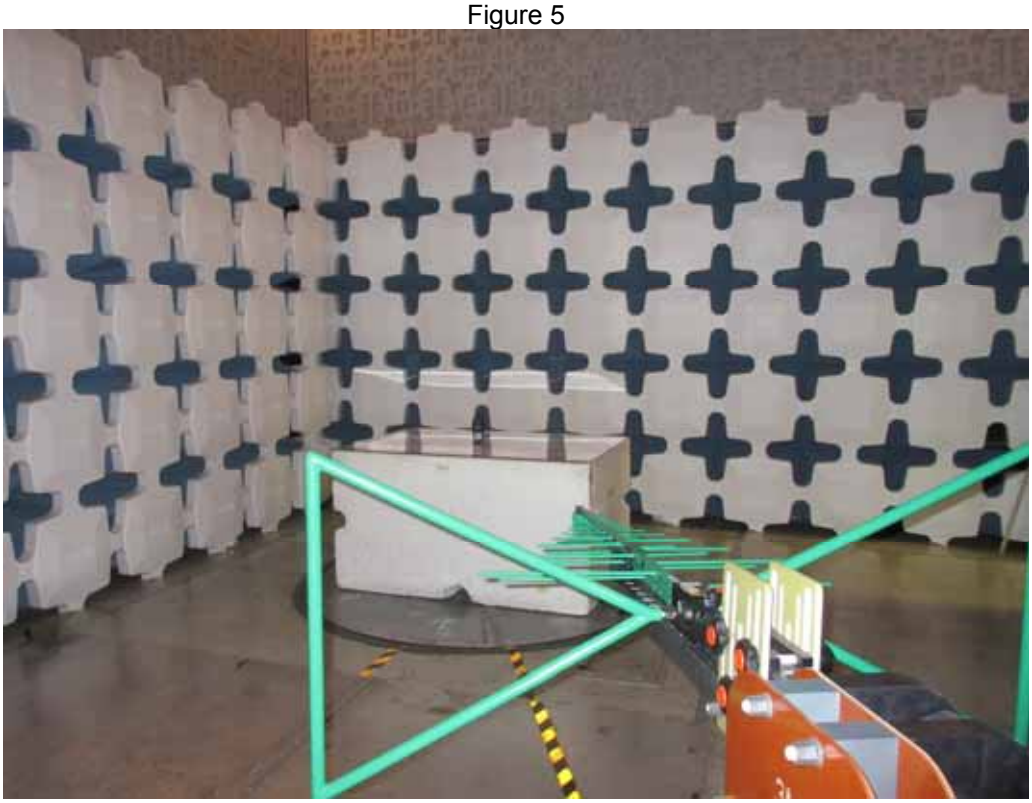
Figure 4



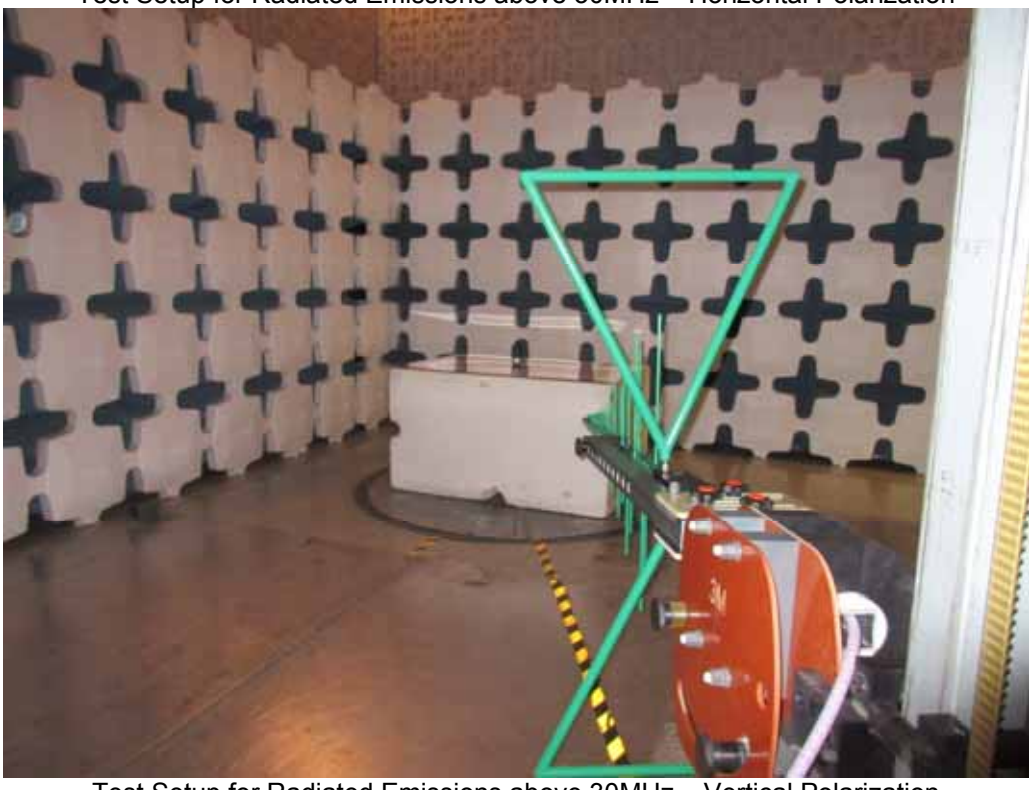
Test Setup for Radiated Emissions below 30MHz – Horizontal Polarization

Test Setup for Radiated Emissions below 30MHz – Vertical Polarization

Figure 5



Test Setup for Radiated Emissions above 30MHz – Horizontal Polarization



Test Setup for Radiated Emissions above 30MHz – Vertical Polarization

Figure 6

Test Setup for Frequency Stability Tests

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 03/04/2015

Manufacturer	:	INDUSTRIAL SCIENTIFIC
Model	:	VENTIS MX4 CHARGER/DATALINK 18108209
DUT Revision	:	
Serial Number	:	
DUT Mode	:	CHARGING VAUGHAN ASPIRATED (15072EK-045)
Line Tested	:	115V, 60Hz HIGH
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Oct 06, 2015 10:04:49 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 6 dB margin below limit

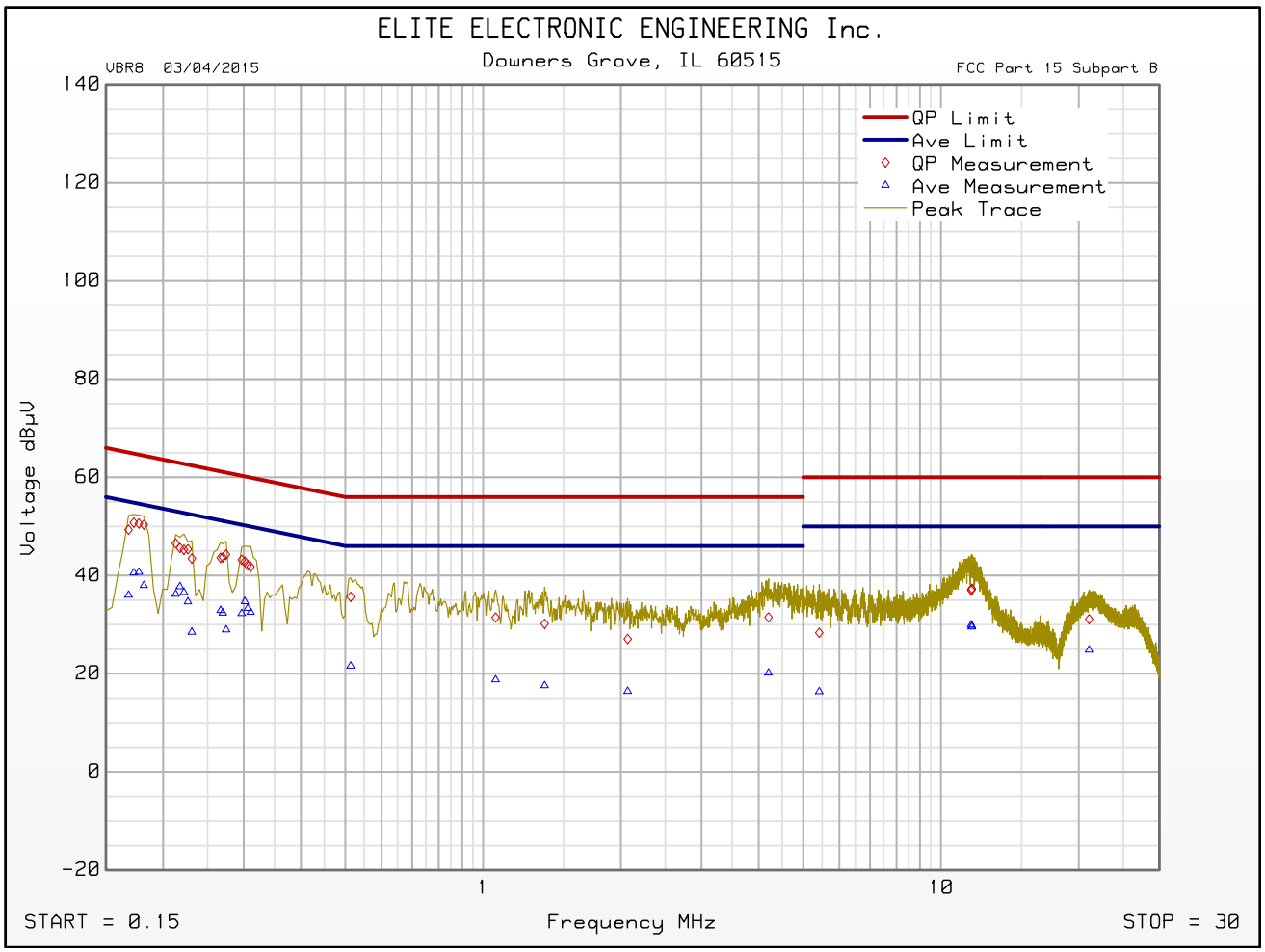
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.177	50.6	64.6		40.7	54.6	
0.275	44.3	61.0		29.0	51.0	
0.514	35.7	56.0		21.6	46.0	
1.065	31.5	56.0		18.8	46.0	
1.363	30.2	56.0		17.6	46.0	
2.070	27.1	56.0		16.4	46.0	
4.202	31.5	56.0		20.2	46.0	
5.423	28.3	60.0		16.4	50.0	
11.678	37.3	60.0		29.5	50.0	
21.074	31.1	60.0		24.8	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VBR8 03/04/2015

Manufacturer	:	INDUSTRIAL SCIENTIFIC
Model	:	VENTIS MX4 CHARGER/DATALINK 18108209
DUT Revision	:	
Serial Number	:	
DUT Mode	:	CHARGING VAUGHAN ASPIRATED (15072EK-045)
Line Tested	:	115V, 60Hz HIGH
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Oct 06, 2015 10:04:49 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 03/04/2015

Manufacturer	:	INDUSTRIAL SCIENTIFIC
Model	:	VENTIS MX4 CHARGER/DATALINK 18108209
DUT Revision	:	
Serial Number	:	
DUT Mode	:	CHARGING VAUGHAN ASPIRATED (15072EK-045)
Line Tested	:	115V, 60Hz RETURN
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Oct 06, 2015 09:57:56 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 6 dB margin below limit

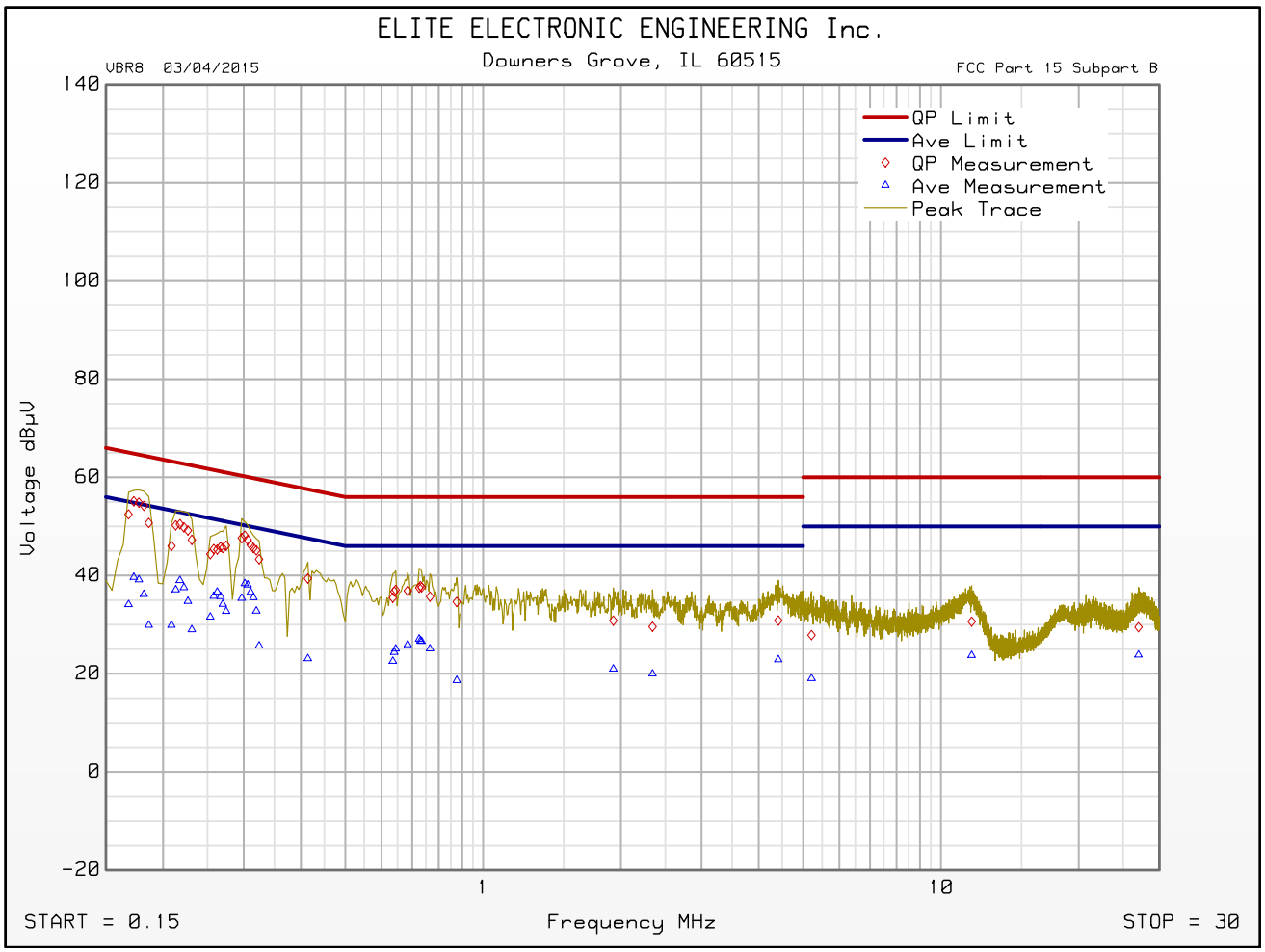
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.173	55.1	64.8		39.6	54.8	
0.302	48.1	60.2		38.4	50.2	
0.730	37.9	56.0		26.7	46.0	
0.876	34.6	56.0		18.6	46.0	
1.925	30.8	56.0		21.0	46.0	
2.345	29.6	56.0		20.0	46.0	
4.414	30.8	56.0		22.9	46.0	
5.216	27.9	60.0		19.0	50.0	
11.673	30.6	60.0		23.7	50.0	
27.010	29.5	60.0		23.8	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

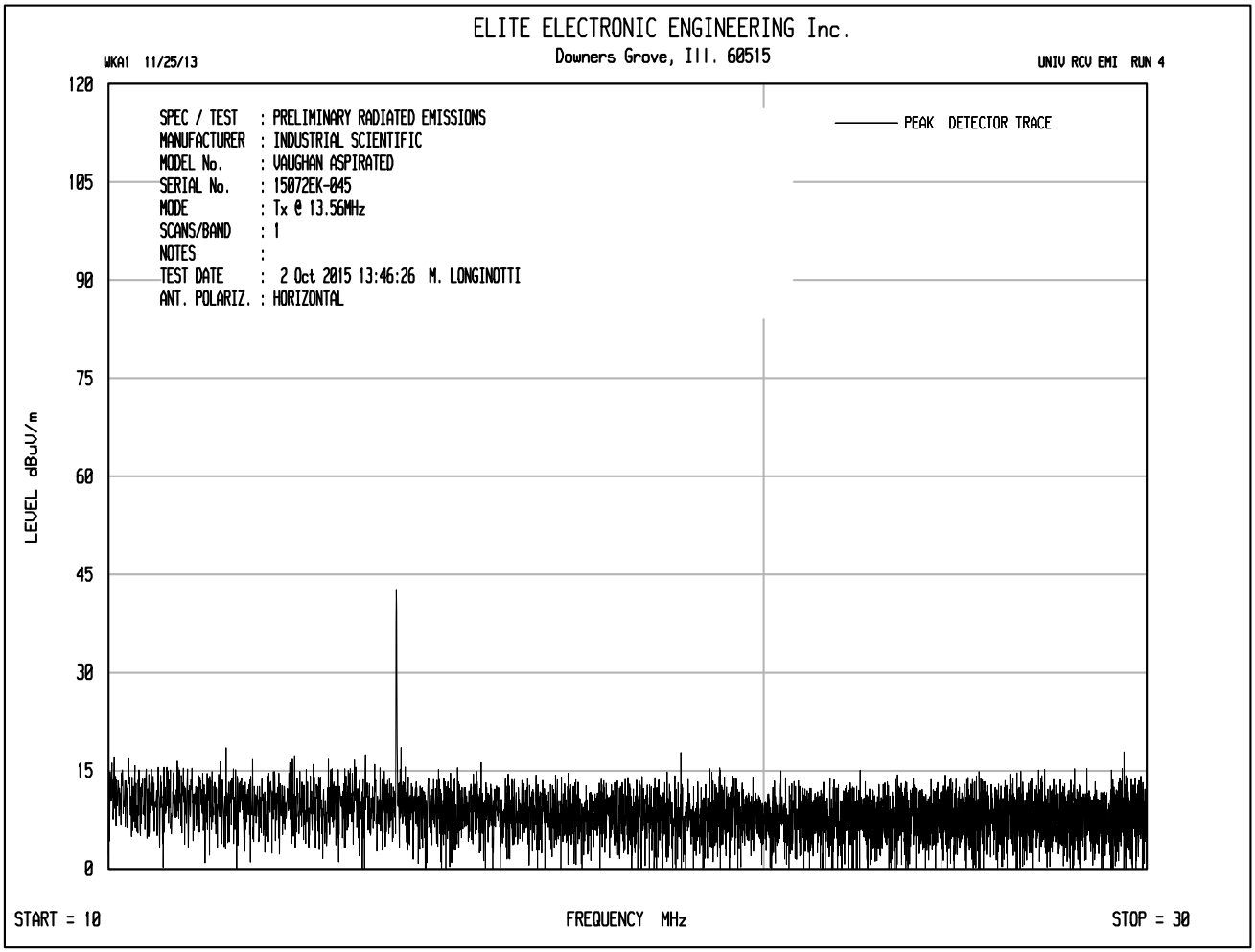
Cumulative Data

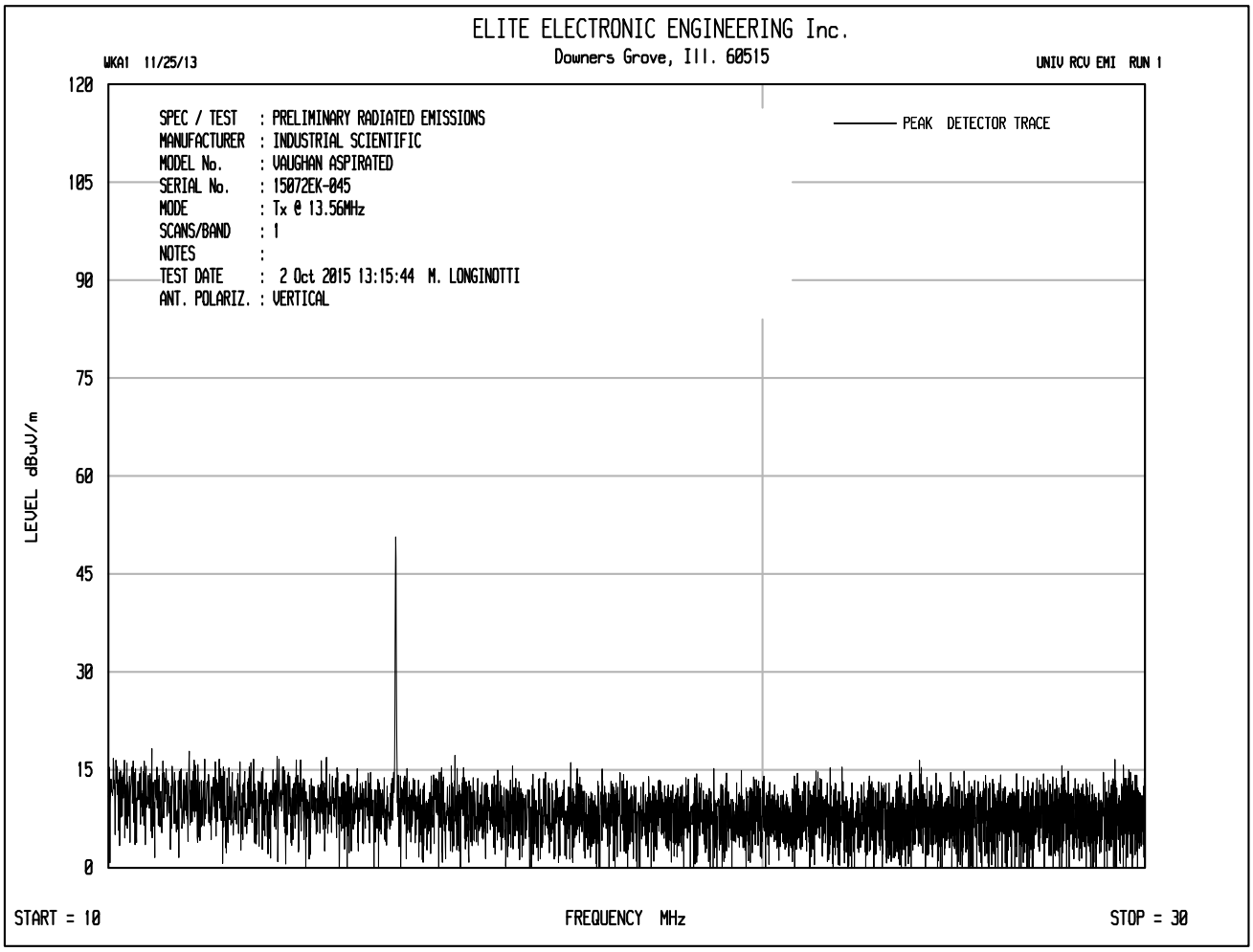
VBR8 03/04/2015

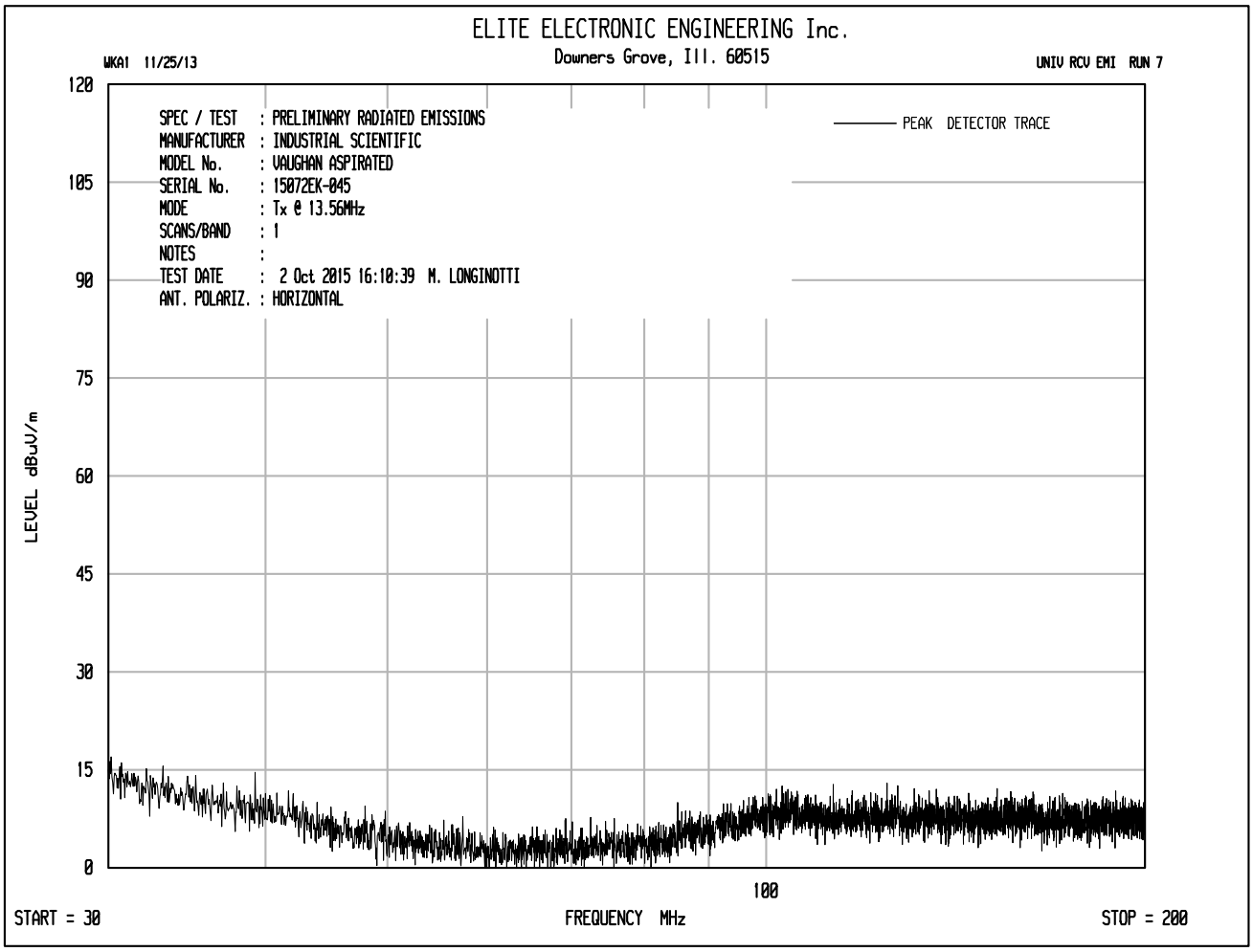
Manufacturer	:	INDUSTRIAL SCIENTIFIC
Model	:	VENTIS MX4 CHARGER/DATALINK 18108209
DUT Revision	:	
Serial Number	:	
DUT Mode	:	CHARGING VAUGHAN ASPIRATED (15072EK-045)
Line Tested	:	115V, 60Hz RETURN
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Oct 06, 2015 09:57:56 AM

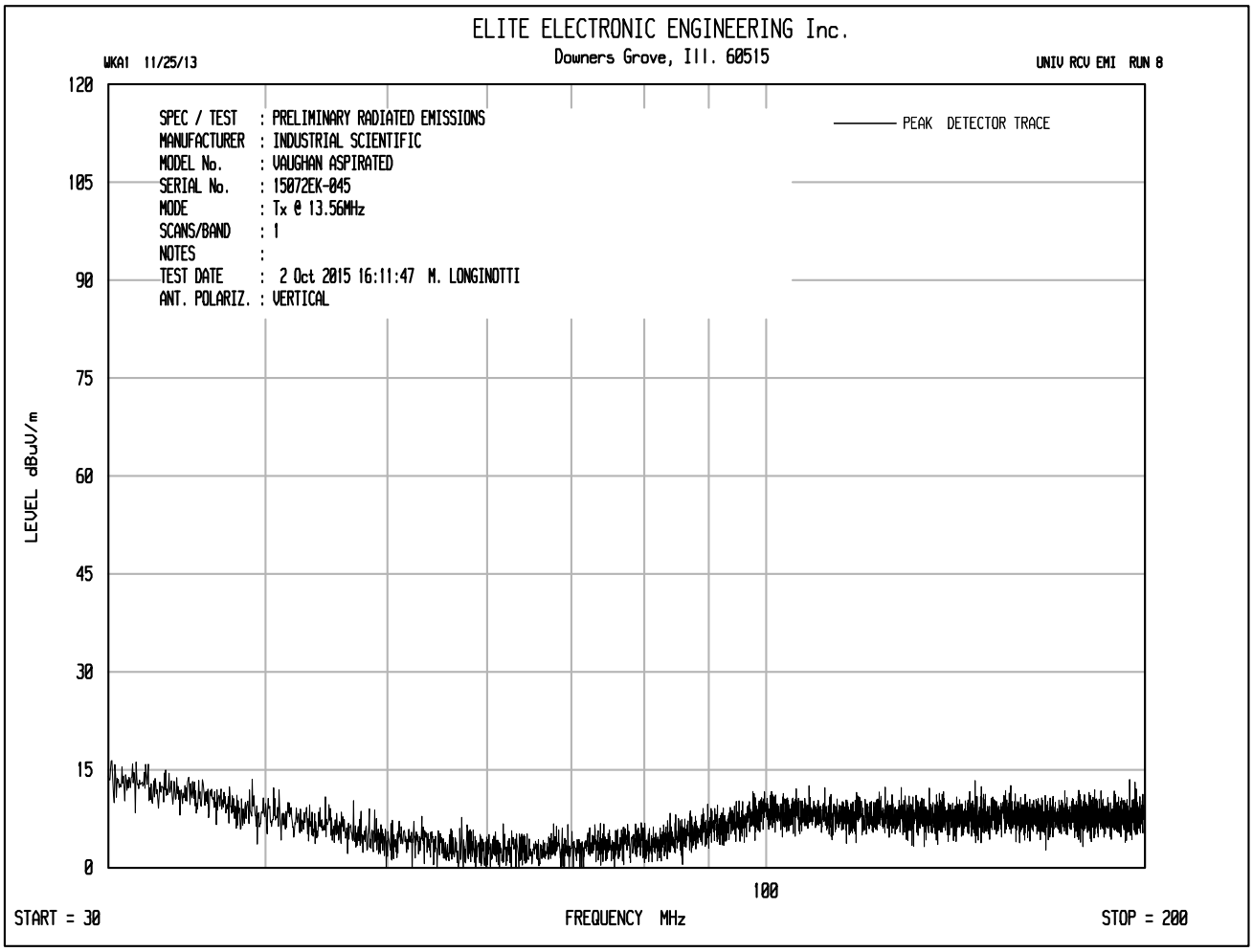


Emissions Meet QP Limit
Emissions Meet Ave Limit


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 4
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : INDUSTRIAL SCIENTIFIC
MODEL No. : VAUGHAN ASPIRATED
SERIAL No. : 15072EK-045
MODE : Tx @ 13.56MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 2 Oct 2015 13:46:26 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 10
FREQUENCY MHz
STOP = 30


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 1
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : INDUSTRIAL SCIENTIFIC
MODEL No. : VAUGHAN ASPIRATED
SERIAL No. : 15072EK-045
MODE : Tx @ 13.56MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 2 Oct 2015 13:15:44 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 10
FREQUENCY MHz
STOP = 30


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 7
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : INDUSTRIAL SCIENTIFIC
MODEL No. : VAUGHAN ASPIRATED
SERIAL No. : 15072EK-045
MODE : Tx @ 13.56MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 2 Oct 2015 16:10:39 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 200


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 8
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : INDUSTRIAL SCIENTIFIC
MODEL No. : VAUGHAN ASPIRATED
SERIAL No. : 15072EK-045
MODE : Tx @ 13.56MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 2 Oct 2015 16:11:47 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 200

Manufacturer: Industrial Scientific Corporation
Model No.: Vaughan Aspirated Portable Gas Monitor
Serial no.: 15072EK-045
Test Mode: Tx @ 13.56MHz
Test Date: October 2, 2015
Test Distance: 3 meters
Test Performed: FCC 15.225 Radiated Emissions

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Dist. Corr. (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Specified Test Distance (meters)	Margin (dB)
13.560	H	32.1		0.3	10.6	0.0	-40.0	3.0	1.41405	15848.0	30.0	-81.0
13.560	V	40.1		0.3	10.6	0.0	-40.0	11.0	3.55195	15848.0	30.0	-73.0
27.120	H	9.6	Ambient	0.4	9.0	0.0	-40.0	-21.0	0.08865	30.0	30.0	-50.6
27.120	V	10.1	Ambient	0.4	9.0	0.0	-40.0	-20.5	0.09390	30.0	30.0	-50.1
40.680	H	2.1	Ambient	0.4	12.9	0.0	0.0	15.5	5.93403	100.0	3.0	-24.5
40.680	V	3.8	Ambient	0.4	12.9	0.0	0.0	17.2	7.21688	100.0	3.0	-22.8
54.240	H	3.2	Ambient	0.5	7.7	0.0	0.0	11.4	3.69822	100.0	3.0	-28.6
54.240	V	3.4	Ambient	0.5	7.7	0.0	0.0	11.6	3.78436	100.0	3.0	-28.4
67.800	H	2.9	Ambient	0.6	6.8	0.0	0.0	10.2	3.24621	100.0	3.0	-29.8
67.800	V	3.3	Ambient	0.6	6.8	0.0	0.0	10.6	3.39920	100.0	3.0	-29.4
81.360	H	3.4	Ambient	0.6	7.7	0.0	0.0	11.8	3.87348	100.0	3.0	-28.2
81.360	V	3.2	Ambient	0.6	7.7	0.0	0.0	11.6	3.78531	100.0	3.0	-28.4
94.920	H	3.2	Ambient	0.7	10.1	0.0	0.0	14.0	4.99464	150.0	3.0	-29.6
94.920	V	3.4	Ambient	0.7	10.1	0.0	0.0	14.2	5.11098	150.0	3.0	-29.4
108.480	H	3.7	Ambient	0.7	11.7	0.0	0.0	16.1	6.37695	150.0	3.0	-27.4
108.480	V	4.0	Ambient	0.7	11.7	0.0	0.0	16.4	6.60105	150.0	3.0	-27.1
122.040	H	3.5	Ambient	0.8	12.3	0.0	0.0	16.6	6.72847	150.0	3.0	-27.0
122.040	V	3.4	Ambient	0.8	12.3	0.0	0.0	16.5	6.65145	150.0	3.0	-27.1
135.600	H	3.6	Ambient	0.8	11.8	0.0	0.0	16.2	6.49167	150.0	3.0	-27.3
135.600	V	4.2	Ambient	0.8	11.8	0.0	0.0	16.8	6.95595	150.0	3.0	-26.7

Manufacturer: Industrial Scientific Corporation
Model No.: Vaughan Aspirated Portable Gas Monitor
Serial no.: 15072EK-045
Test Mode: Tx @ 13.559MHz
Test Date: October 6 and October 7, 2015
Test Performed: Frequency Stability vs. temperature

Temperature °C	Input Voltage	Nominal Frequency Hz	Measured Frequency Hz	Frequency Variation in %			Pass/Fail
				Lower Limit %	Measured Variation %	Upper Limit %	
-20	6.2	13,560,000	13,560,701	-0.010000000	0.005169617	0.010000000	Pass
-10	6.2	13,560,000	13,560,501	-0.010000000	0.003694690	0.010000000	Pass
0	6.2	13,560,000	13,560,902	-0.010000000	0.006651917	0.010000000	Pass
+10	6.2	13,560,000	13,560,701	-0.010000000	0.005169617	0.010000000	Pass
+20	6.2	13,560,000	13,560,301	-0.010000000	0.002219764	0.010000000	Pass
+30	6.2	13,560,000	13,560,701	-0.010000000	0.005169617	0.010000000	Pass
+40	6.2	13,560,000	13,560,501	-0.010000000	0.003694690	0.010000000	Pass
+50	6.2	13,560,000	13,560,100	-0.010000000	0.000737463	0.010000000	Pass