

CFR 47 FCC Part 15.231

TEST REPORT

Product : Water System Control Panel

Trade Name :



Model Number : VHS-1050

FCC ID : 2AD4D-1050

Prepared for

Vital Home Systems LLC

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Prepared by

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The test result in the report is only subjected to the test sample.

Statement of Compliance

Applicant: Vital Home Systems LLC

Manufacturer: Nutek Corporation

Product: Water System Control Panel

Model No.: VHS-1050

Tested Power Supply: DC 3.7V (For Battery) ; 120Vac, 60Hz (For Adapter)

Date of Final Test: Mar. 29, 2016

Configuration of Measurements and Standards Used :

FCC Rules and Regulations Part 15 Subpart C

1. The result of the testing report relate only to the item tested.
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Report Issued: 2016/03/30

Project Engineer: 
Elli Chang

Approved: 
Jerry Liu

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1 Summary of Measurement

Report Clause	Test Parameter	Reference Document CFR47 Part15	Results
4	Timing requirement	§15.231(a)	Pass
4	Radiated Emission	§15.231(b), 15.209	Pass
5	Emission Bandwidth	§15.231(c)	Pass
6	AC Power Line Conducted Emission test	§15.207	Pass

2 General Information

2.1 Description of Equipment Under Test

Product	: Water System Control Panel
Model Number	: VHS-1050
Applicant	: Vital Home Systems LLC 2266 Tigereye Place Carlsbad, CA 92009 United States
Manufacturer	: Nutek Corporation No.167, Lane 235, Bauchiau Rd., Shindian City, Taipei Country 23145, Taiwan
Power Supply	: DC 3.7V (For Battery) ; 120Vac, 60Hz (For Adapter)
Operating Frequency	: 433.92MHz
Type of Modulation	: ASK
Antenna Description	: This device uses Helix Antenna. The antenna is integral to the device, thereby meeting the requirement of FCC 15.203.
Measurement Software	: e3; Ver: 8.120803a7-2
Date of Test	: Mar. 18 ~ 29, 2016
Product information	: <u>Adapter</u> Manufacturer: Y&L Electronics Model Number: DSA-5PFK-05 FUS 050055a Input: 100-240 Vac, 50/60 Hz, 0.2A Output: DC 5V, 0.55A Output cable: Shielded, Detachable, 1.0m, w/o core <u>Battery:</u> Output: 3.7V, 560mAh
Additional Description	: 1) The Model Number “ VHS-1050 ” is representative selected in the test and included in this report. 2) For more detail specification about EUT, please refer to the user’s manual.

2.2 Test Facility

- Site Description** : ☒ Chamber 3 ☒ Conducted 1
- Name of Firm** : Interocean EMC Technology Corp.
- Company web** : <http://www.ietc.com.tw>
- Location** : No. 5-2, Lin 1, Tin-Fu, Lin-Kou Dist., New Taipei City, Taiwan 244, R.O.C.
- Site Filing** :
- Federal Communication Commissions – USA
Registration No.: 96399 (OATS 1, 2, 3 & Chamber 3)
Designation No.: TW1020
 - Industry Canada (IC)
OUR FILE: 46405-4437
Registration No. (OATS 1): Site# 4437A-1
Registration No. (OATS 3): Site# 4437A-3
Registration No. (Chamber 3): Site# 4437A-5
Registration No. (OATS 5): Site# 4437A-6
 - Voluntary Control Council for Interference by Information Technology Equipment (VCCI) – Japan
Member No.: 1349
Registration No. (Conducted Room): C-1094
Registration No. (Conducted Room): T-1562
Registration No. (OATS 1): R-1040; G-274
- Site Accreditation** :
- Bureau of Standards and Metrology and Inspection (BSMI) – Taiwan, R.O.C.
Accreditation No.:
SL2-IN-E-0026 for CNS13438 / CISPR 22
SL2-IN-E-0026 for CNS14757-2 / IEC 62040-2
SL2-R1-E-0026 for CNS13439 / CISPR 13
SL2-R2-E-0026 for CNS13439 / CISPR 13
SL2-A1-E-0026 for CNS13783-1 / CISPR 14-1
SL2-L1-E-0026 for CNS 14115 / CISPR 15
 - Taiwan Accreditation Foundation (TAF)
Accreditation No.: 1113
 - Vehicle Safety Certification Center (VSCC)
Approval No.: TW16-11-0
 - TÜV NORD
Certificate No: TNTW0801R-04
 - Nemko
Authorisation No: ELA 181

3 Test Specifications

3.1 Test Standard

The EUT was performed according to FCC Part 15 Subpart C Section 15.231 procedure and setup followed by ANSI C63.10, 2013 requirements.

3.2 Test Step of EUT

- 3.2.1 Setup the fixture to EUT for power supplying.
- 3.2.2 Turn on the power of all equipment.
- 3.2.3 Let the EUT continuous transmission. Executed the test.

3.3 Test Equipment

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSP40	100478	2016/06/03
EMI Test Spectrum Analyzer & Receiver	Rohde & Schwarz	ESI7	830154/002	2016/09/24
Preamplifier	Burgeon	BPA-530	100216	2016/06/30
Preamplifier	Mini-Circuits	ZVA-213-S+	491801136	2016/08/25
Preamplifier	Agilent	8449B	3008A01434	2016/09/21
Preamplifier	Agilent	83050A	3950M00225	2016/09/21
Bilog Antenna	Schwarzbeck	VULB 9163	113	2016/07/26
Horn Antenna	Schwarzbeck	BBHA 9120	9120D-583	2016/09/29
Horn Antenna	Schwarzbeck	BBHA 9170	213	2016/07/19
RF Cable	HARBOUR	27478LL142	CBL22	2017/03/22
RF Cable	Jye Bao	N30N30-5006	CBL53	2016/03/30
RF Cable	HARBOUR	27478LL142	CBL65	2017/03/22
EMI Test Receiver	Rohde & Schwarz	ESCS 30	100127	2016/10/25
RF Cable	HARBOUR	RG58/U	CBL48	2016/07/27
L.I.S.N.	Schwarzbeck	NNLK8121	8121417	2017/03/20
L.I.S.N.	Schaffner	MN2050D	1598	2016/08/27

Note: The above equipments are within the valid calibration period.

4 Radiated Emission Test

4.1 Limits

According to FCC 15.231(b) requirement:

In addition to the provisions of §15.205, the field strength of emissions from intentional radiator operated under this section shall not exceed the following:

Fundamental and Harmonics Emission Limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(μ V/m@3m)	(dB μ V/m@3m)	(μ V/m@3m)	(dB μ V/m@3m)
433.92	10996	80.8	1099.6	60.8

General Radiated Emission Limit

Spurious Emission tested through until 10th harmonic. Radiated emissions, which fall in the restricted bands, as defined in §15.205 (a), comply with the radiated emission limits specified in §15.209 (a).

Frequency (MHz)	15.209 Limits	
	(μ V/m@3m)	(dB μ V/m@3m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

Remark :

1. The table above tighter limit applies at the band edges.
2. The measurement distance in meters, which that between form closest point of EUT to instrument antenna.

4.2 Calculation of Average Factor

The output field strengths of specification in accordance with the FCC rules specify measurements with an average detector. During the test, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The duty cycle is measured in 100 ms or the repetition cycle period, whichever is a shorter time frame. The duty cycle is measured by placing the spectrum analyzer to set zero span at 100kHz resolution bandwidth.

Averaging factor in dB = $20 \log (\text{duty cycle})$

The duration of one cycle = 111.76ms

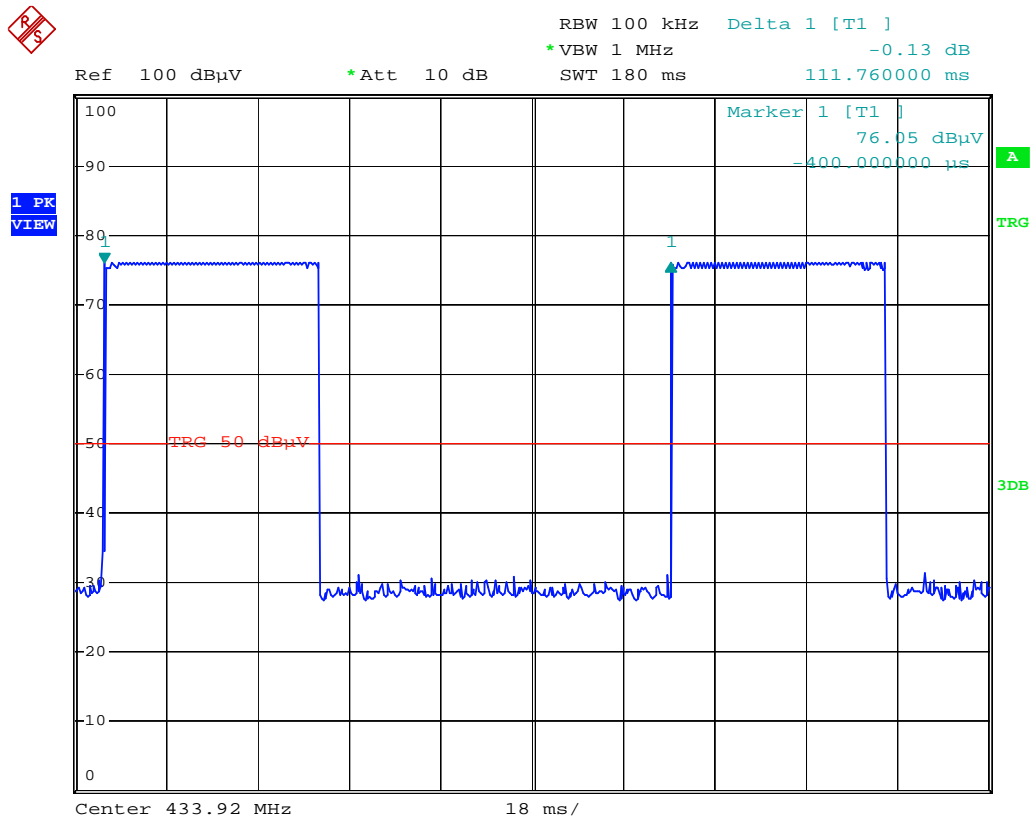
The duty cycle is simply the on-time divided by 100ms

Duty Cycle = $(1.04\text{ms} \times 2 + 0.24\text{ms} \times 58) / 100\text{ms} = 16 \text{ ms} / 100\text{ms}$

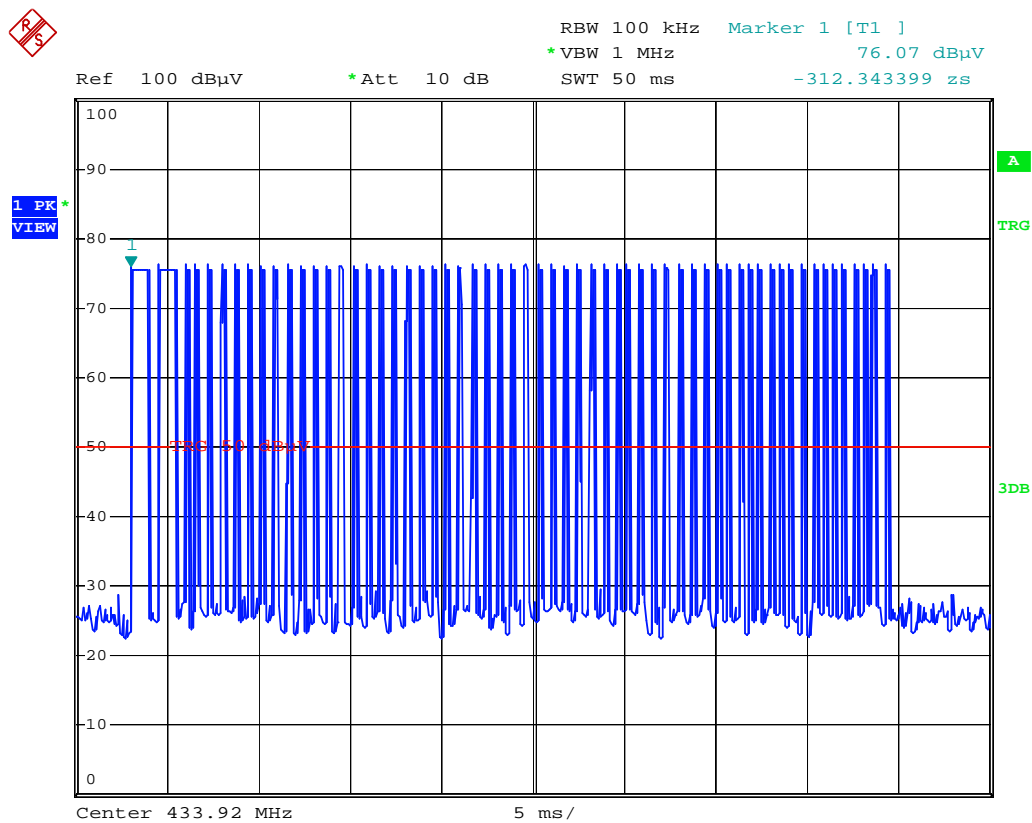
Therefore, the averaging factor is found by $20 \log 0.16 = -15.92 \text{ dB}$

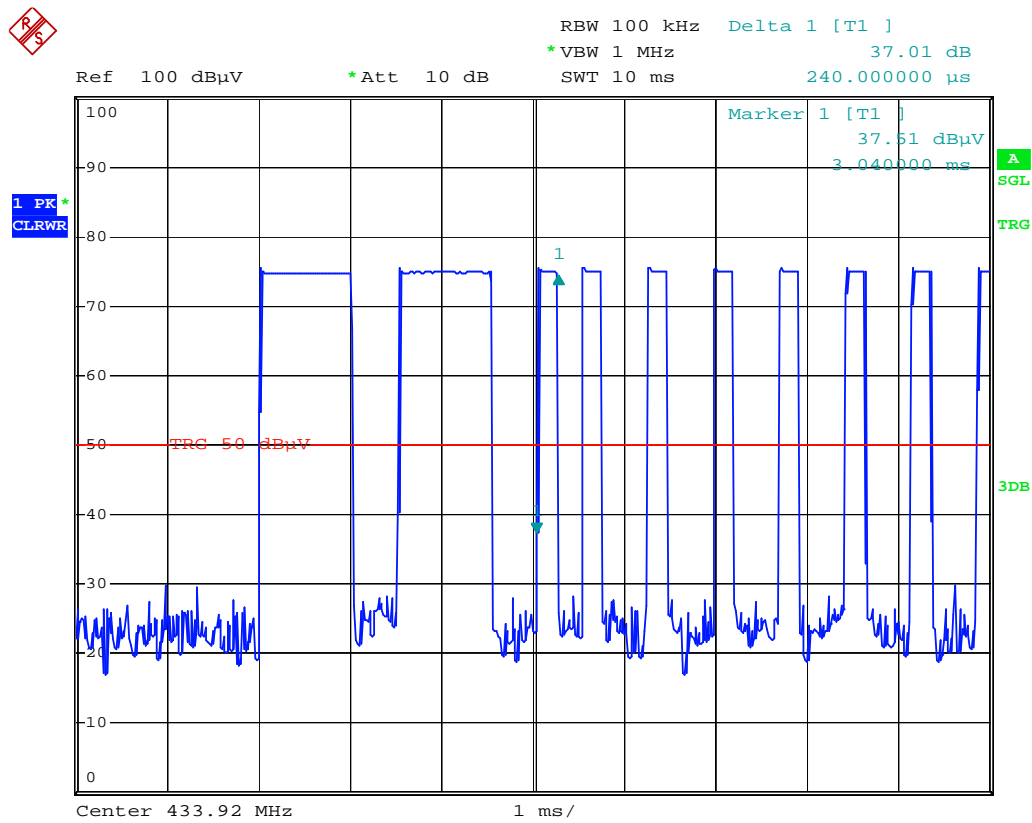
Please see the diagrams below.

Duty Cycle



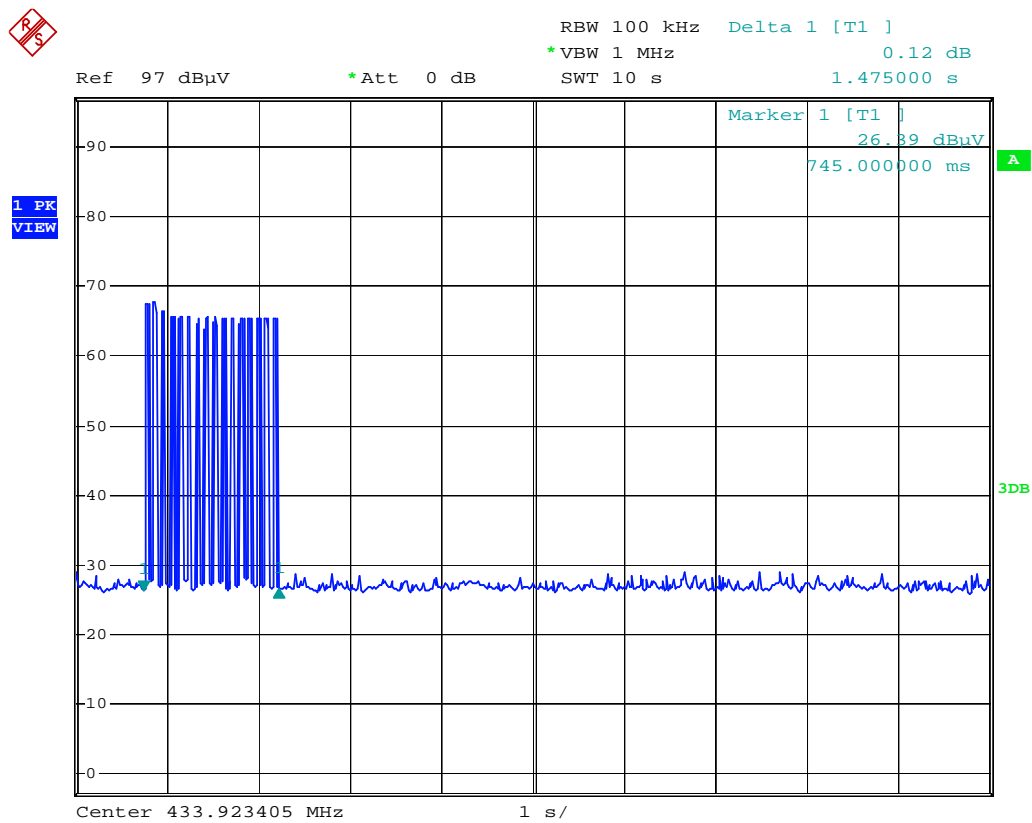
Time Slot





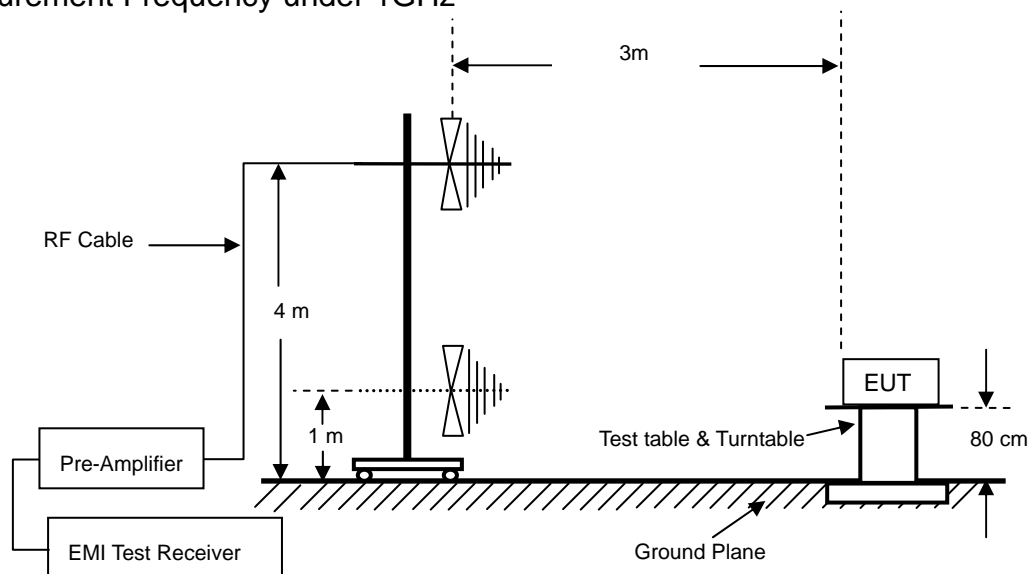
Time Slot 2

The EUT was complied with the requirement of FCC 15.231 (a)(1), which employed a switch that will automatically deactivate the transmitter within less than 5 seconds of being released.

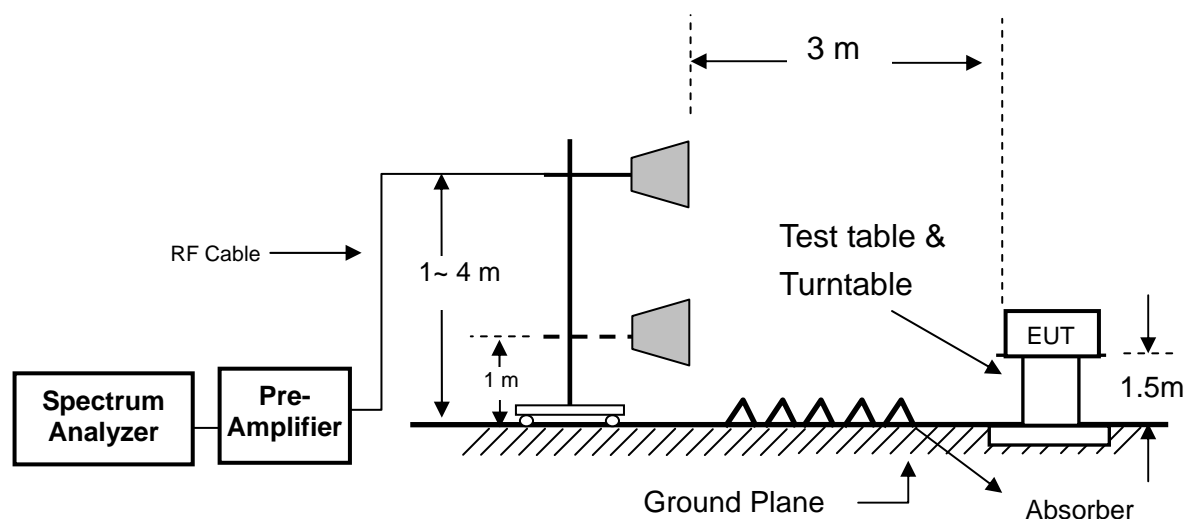


4.3 Configuration of Measurement

Measurement Frequency under 1GHz



Measurement Frequency above 1GHz



4.4 Test Procedure

Radiated emission measurements frequency range were performed from 30MHz to 5GHz. Spectrum Analyzer Resolution Bandwidth set to 100kHz or greater for frequencies from 30MHz to 1GHz, and set 1MHz Resolution Bandwidth for frequencies above 1GHz.

The EUT is place on non-conductive turntable for the test. If peripheral devices apply to the EUT, the peripheral devices will be connected to EUT and whole system. During the emission test, the signal is maximized through rotation and all cables were present worst-case emissions. The height of antenna and polarization is constantly changed for exploring maximum signal reading. The height of antenna can be up form reference ground to 4 meter and down to 1 meter.

4.5 Test Result

PASS.

The final test emission data is shown as following tables.

Radiated Emission Below 1GHz

ASK Modulation

Frequency	Antenna	Reading	Preamp	Correction Factor	Corrected Level	Limits	Margin	Det
(MHz)	Polarization	(dBuV)	(dB)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	Mode
34.00	H	47.25	31.67	13.06	28.64	40.00	-11.36	PK
125.39	H	41.50	31.42	10.37	20.45	43.50	-23.05	PK
208.75	H	39.29	31.23	12.57	20.63	43.50	-22.87	PK
256.10	H	41.46	31.22	14.54	24.78	46.00	-21.22	PK
372.30	H	38.29	31.30	18.04	25.03	46.00	-20.97	PK
569.56	H	35.29	31.34	21.64	25.59	46.00	-20.41	PK
35.61	V	45.10	31.67	13.29	26.72	40.00	-13.28	PK
146.23	V	46.03	31.36	9.73	24.40	43.50	-19.10	PK
216.77	V	42.59	31.23	13.03	24.39	46.00	-21.61	PK
288.91	V	41.08	31.22	15.89	25.75	46.00	-20.25	PK
372.28	V	48.21	31.30	18.04	34.95	46.00	-11.05	PK
560.20	V	33.52	31.33	21.42	23.61	46.00	-22.39	PK

Remark : Corrected Level = Reading + Correction Factor – Preamp
Correction Factor = Antenna Factor + Cable Loss

Fundamental and Harmonics Emissions

Freq.	Antenna	Reading	Preamp	Correction Factor	Average Factor	Corrected Level	Limits	Margin	Det
(MHz)	Polarization	(dBuV)	(dB)	(dB/m)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Mode
433.92	H	74.56	0.00	19.30	--	93.86	100.8	-6.94	PK
433.92	H	74.56	0.00	19.30	-15.92	77.94	80.8	-2.86	AV
867.84	H	74.85	31.27	26.07	--	69.65	80.8	-11.15	PK
867.84	H	74.85	31.27	26.07	-15.92	53.73	60.8	-7.07	AV
1301.76	H	63.34	36.31	32.76	--	59.79	74.0	-14.21	PK
1301.76	H	63.34	36.31	32.76	-15.92	43.87	54.0	-10.13	AV
1735.68	H	60.12	35.95	33.67	--	57.84	80.8	-22.96	PK
1735.68	H	60.12	35.95	33.67	-15.92	41.92	60.8	-18.88	AV
2169.60	H	64.73	35.88	33.02	--	61.87	80.8	-18.93	PK
2169.60	H	64.73	35.88	33.02	-15.92	45.95	60.8	-14.85	AV
2603.52	H	71.03	36.04	34.70	--	69.69	80.8	-11.11	PK
2603.52	H	71.03	36.04	34.70	-15.92	53.77	60.8	-7.03	AV
3037.44	H	59.91	36.27	36.19	--	59.83	80.8	-20.97	PK
3037.44	H	59.91	36.27	36.19	-15.92	43.91	60.8	-16.89	AV
3471.36	H	73.31	36.30	37.07	--	74.08	80.8	-6.72	PK
3471.36	H	73.31	36.30	37.07	-15.92	58.16	60.8	-2.64	AV
3905.28	H	66.11	35.98	38.25	--	68.38	74.0	-5.62	PK
3905.28	H	66.11	35.98	38.25	-15.92	52.46	54.0	-1.54	AV
4339.20	H	58.00	36.06	39.90	--	61.84	74.0	-12.16	PK
4339.20	H	58.00	36.06	39.90	-15.92	45.92	54.0	-8.08	AV
433.92	V	65.12	0.00	19.30	--	84.42	100.8	-16.38	PK
433.92	V	65.12	0.00	19.30	-15.92	68.50	80.8	-12.30	AV
867.84	V	58.96	31.27	26.07	--	53.76	80.8	-27.04	PK
867.84	V	58.96	31.27	26.07	-15.92	37.84	60.8	-22.96	AV
1301.76	V	58.94	36.31	32.76	--	55.39	74.0	-18.61	PK
1301.76	V	58.94	36.31	32.76	-15.92	39.47	54.0	-14.53	AV
1735.68	V	62.53	35.95	33.67	--	60.25	80.8	-20.55	PK
1735.68	V	62.53	35.95	33.67	-15.92	44.33	60.8	-16.47	AV
2169.60	V	63.10	35.88	33.02	--	60.24	80.8	-20.56	PK
2169.60	V	63.10	35.88	33.02	-15.92	44.32	60.8	-16.48	AV
2603.52	V	66.59	36.04	34.70	--	65.25	80.8	-15.55	PK
2603.52	V	66.59	36.04	34.70	-15.92	49.33	60.8	-11.47	AV
3037.44	V	66.95	36.27	36.19	--	66.87	80.8	-13.93	PK
3037.44	V	66.95	36.27	36.19	-15.92	50.95	60.8	-9.85	AV
3471.36	V	68.73	36.30	37.07	--	69.50	80.8	-11.30	PK
3471.36	V	68.73	36.30	37.07	-15.92	53.58	60.8	-7.22	AV
3905.28	V	61.83	35.98	38.25	--	64.10	74.0	-9.90	PK
3905.28	V	61.83	35.98	38.25	-15.92	48.18	54.0	-5.82	AV
4339.20	V	53.70	36.06	39.90	--	57.54	74.0	-16.46	PK
4339.20	V	53.70	36.06	39.90	-15.92	41.62	54.0	-12.38	AV

Remark : Corrected Level = Reading + Correction Factor – Preamp

Correction Factor = Antenna Factor + Cable Loss

“ * ” Mark indicated Background Noise Level

5 Emission Bandwidth

5.1 Limits

According to FCC 15.231(c) requirement:

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating between 70 MHz to 900 MHz. Those devices operating above 900 MHz, the emission spurious shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

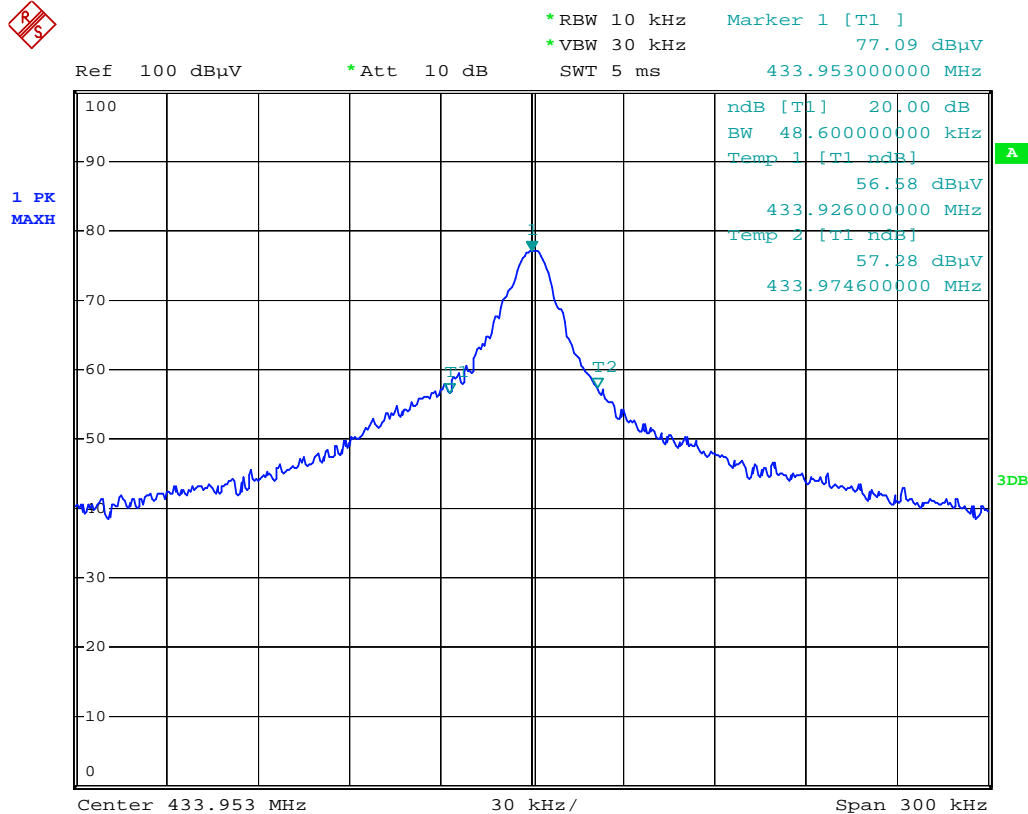
B.W (20dBc) Limit = $0.25\% * f(\text{MHz}) = 0.25\% * 433.92\text{MHz} = 1084.8\text{kHz}$

5.2 Test Result

PASS.

The final test data is shown as following.

Channel Frequency (MHz)	Measured 20dB Bandwidth (kHz)	Limit (kHz)	Result
433.92	48.6	1084.8	PASS



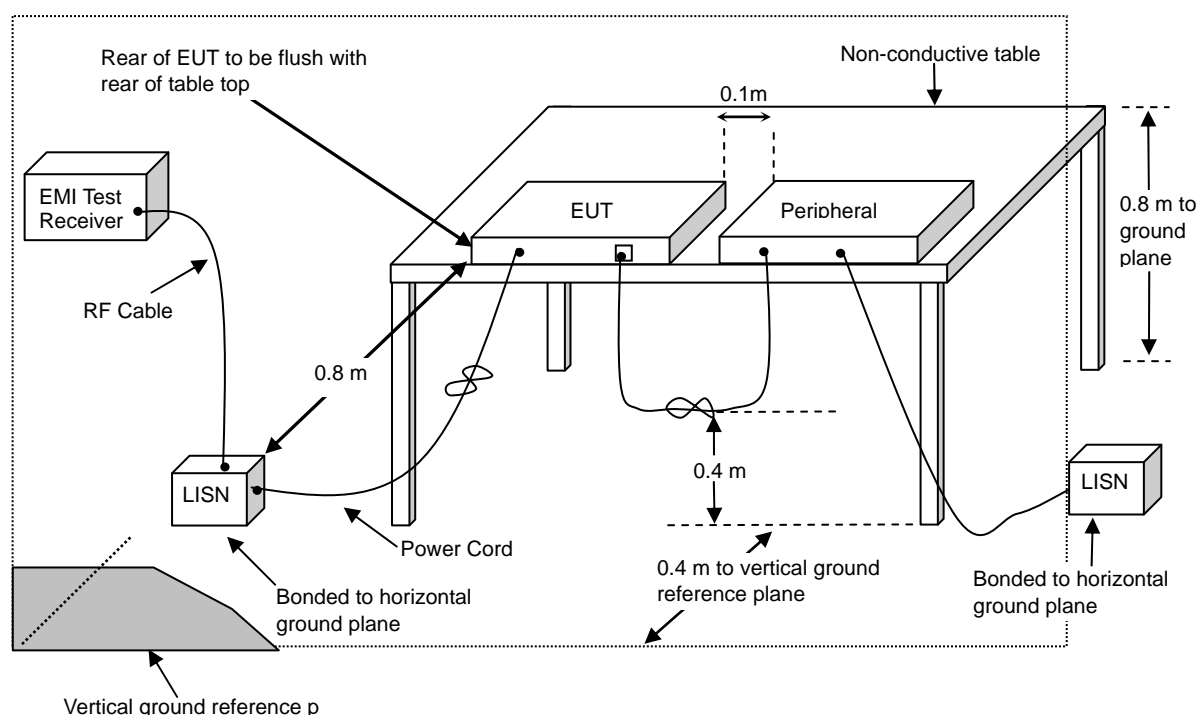
6 AC Power Line Conducted Emission test

6.1 Limits

Frequency (MHz)	Quasi-Peak (dB μ V)	Average (dB μ V)
0.15 to 0.5	66 to 56	56 to 46
> 0.5 to 5	56	46
> 5 to 30	60	50

NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 30 MHz.

6.2 Configuration of Measurement



6.3 Test Procedures

The EUT was setup to ANSI C63.10, 2013; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

- 1) The EUT was placed 80cm height above ground on a non-conductive table and vertical conducting plane located 40cm to the rear of the EUT.
- 2) The EUT was connected to the main power through Line Impedance Stabilization Networks (LISN). This setup provided a 50ohm/50mH coupling impedance for the measuring equipment. The auxiliary equipment will place in secondary LISN.
- 3) Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10, 2013 on conducted measurement.

6.4 Test Result

PASS.

The final test data is shown as following pages.

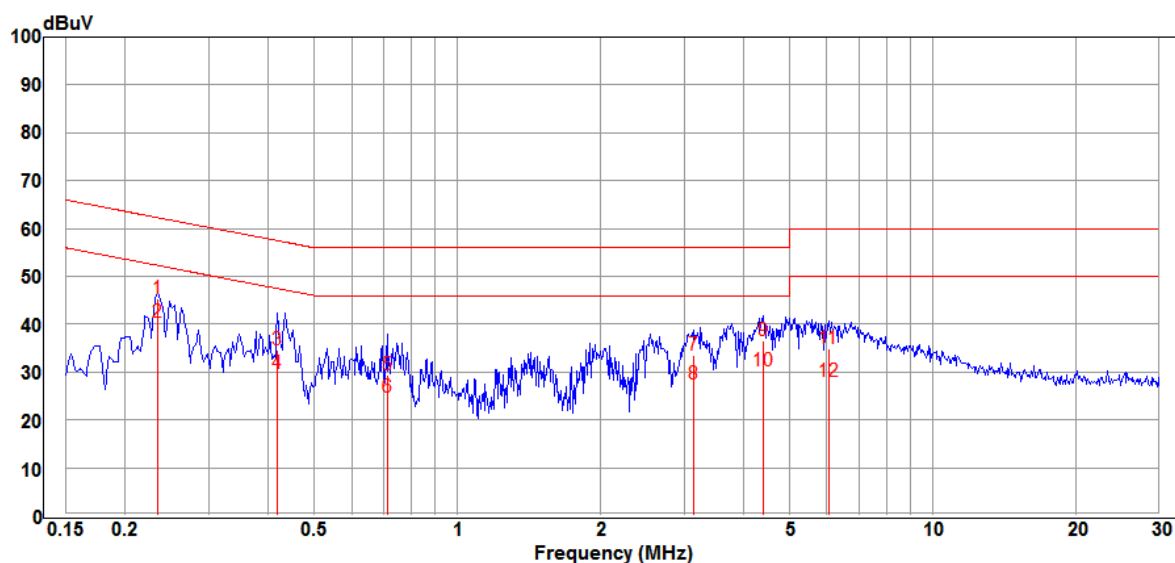
Power Line Conducted Test Data

CLIENT: Vital Home Systems LLC
EUT: Water System Control Panel
MODEL: VHS-1050
RATING: 120Vac, 60Hz (For Adapter)
COMMENT: working mode

OPERATOR: Elli
TEST SITE: Conducted 1
POLARIZATION: Line
TEMP/HUM: 16.3°C / 60%

Data:1

2016-03-25



Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	0.235	45.00	0.26	45.26	62.26	-17.00	QP
2	0.235	40.05	0.26	40.31	52.26	-11.95	Average
3	0.419	34.49	0.26	34.75	57.46	-22.71	QP
4	0.419	29.36	0.26	29.62	47.46	-17.84	Average
5	0.712	29.18	0.27	29.45	56.00	-26.55	QP
6	0.712	24.37	0.27	24.64	46.00	-21.36	Average
7	3.156	33.28	0.35	33.63	56.00	-22.37	QP
8	3.156	27.12	0.35	27.47	46.00	-18.53	Average
9	4.407	36.14	0.38	36.52	56.00	-19.48	QP
10	4.407	29.74	0.38	30.12	46.00	-15.88	Average
11	6.056	34.46	0.42	34.88	60.00	-25.12	QP
12	6.056	27.48	0.42	27.90	50.00	-22.10	Average

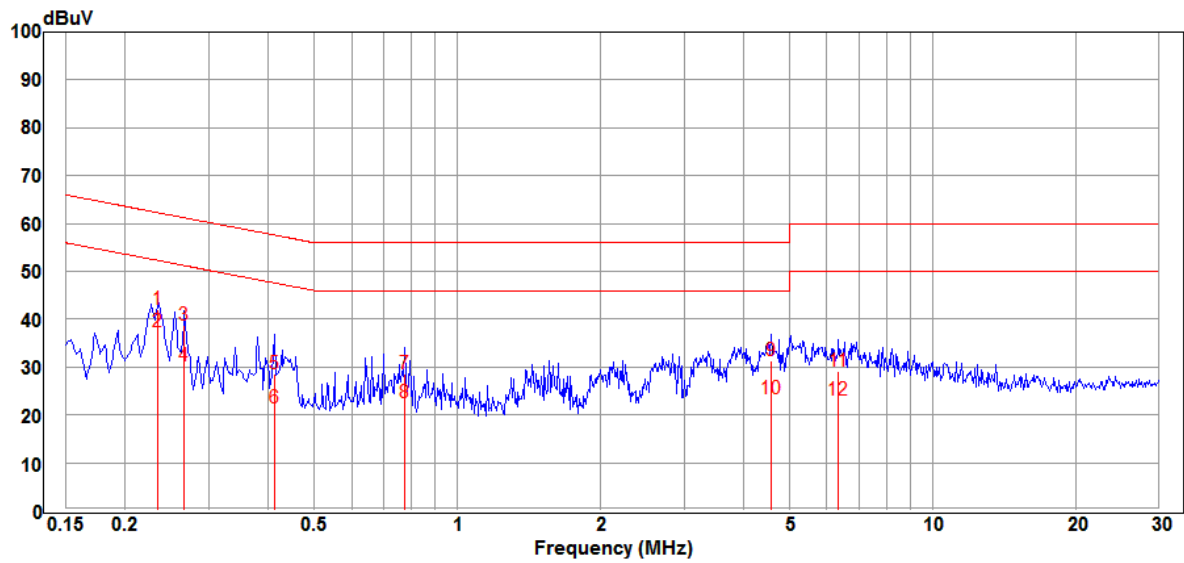
Power Line Conducted Test Data

CLIENT: Vital Home Systems LLC
EUT: Water System Control Panel
MODEL: VHS-1050
RATING: 120Vac, 60Hz (For Adapter)
COMMENT: working mode

OPERATOR: Elli
TEST SITE: Conducted 1
POLARIZATION: Neutral
TEMP/HUM: 16.3°C / 60%

Data:2

2016-03-25



Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	0.235	41.86	0.24	42.10	62.26	-20.16	QP
2	0.235	37.09	0.24	37.33	52.26	-14.93	Average
3	0.267	38.44	0.24	38.68	61.20	-22.52	QP
4	0.267	30.10	0.24	30.34	51.20	-20.86	Average
5	0.413	28.31	0.25	28.56	57.59	-29.03	QP
6	0.413	21.30	0.25	21.55	47.59	-26.04	Average
7	0.775	28.30	0.26	28.56	56.00	-27.44	QP
8	0.775	22.37	0.26	22.63	46.00	-23.37	Average
9	4.574	30.87	0.39	31.26	56.00	-24.74	QP
10	4.574	22.88	0.39	23.27	46.00	-22.73	Average
11	6.352	28.60	0.43	29.03	60.00	-30.97	QP
12	6.352	22.58	0.43	23.01	50.00	-26.99	Average