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Emissions testing of the GoConex Wireless Light Switch model S1, in accordance with FCC Part 15.249:

Operation in the band 902 - 928 MHz.

Test Personnel: David Raynes

Prepared for: Levven Automation Inc.

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REVISION RECORD

ISSUE	DATE	REVISIONS
DRAFT1	2014-09-17	Initial DRAFT
Release 1	2014-09-19	Released for distribution
Release 2	2015-01-06	Peak, Duty Cycle and Band Edge data added. EUT name & model # updated.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 SCOPE

The purpose of this report is to present the findings and results of compliance testing performed in accordance with CFR Title 47 FCC Part 15.249, Operation within the band 902 - 928 MHz.

1.2 APPLICANT

This test report has been prepared for Levven Automation Inc., located in Edmonton, Alberta, Canada.

1.3 APPLICABILITY

All test procedures, limits, and results defined in this document apply to the Levven Automation GoConex S1 wireless light switch, referred to herein as the Equipment Under Test (EUT).

The results contained in this report relate only to the item tested.

This report does not imply product endorsement by A2LA or the Canadian or US governments.

1.4 TEST SAMPLE DESCRIPTION

The test sample provided for testing was a GoConex S1 wireless light switch:

Product Type:	Wireless light switch
Model Number:	GoConex S1
Serial Number:	N/A
Cables:	none
Power Requirements:	Internal CR-2032 lithium battery
Peripheral Equipment:	none

1.5 GENERAL TEST CONDITIONS AND ASSUMPTIONS

The EUT was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Where relevant, the EUT was only tested using the monitoring methods and test criteria defined in this report.

Environmental conditions are recorded for each test.

1.6 SCOPE OF TESTING

Testing was performed in accordance with FCC Part 15 Subpart C, and ANSI C63.4 (2003).

1.6.1 Variations in Test Methods

There were no variations from the test procedures outlined above.

1.6.2 Marginal Emissions Measurements

As noted in Section 4, some emissions were measured to be within -6 dB of the specified limit:

1.6.3 Test Sample Configuration & Modifications

The unit under test, GoConex S1 wireless light switch, was set up as shown in the photographs which are submitted separately.

Special test firmware permitted the EUT to be configured to transmit continuously.

The EUT met the requirements without modifications.

2.0 ACRONYMS

AP -Average Peak
CE -Conducted Emissions
E -Field - Electric Field
H -Field - Magnetic Field
N/T -Not Tested
N/A -Not Applicable
PK -Peak
QP -Quasi Peak
RE -Radiated Emissions

3.0 MEASUREMENT UNCERTAINTY

For Radiated E-Field Emissions and Conducted Emissions, the uncertainties in the measurements were calculated using the methods outlined in the NAMAS document, NIS81: May 1984.

Frequency	= ± 1 kHz
Amplitude (RE)	= ± 4.01 dB
Amplitude (CE)	= ± 3.25 dB

4.0 TEST CONCLUSION

STATEMENT OF COMPLIANCE

The client equipment referred to in this report was found to comply with the requirements as stated below.

The EUT was subjected to the following tests. Compliance status is reported as **PASS** or **FAIL**. Test conditions that are not applicable to the EUT are marked **N/A**. If testing was not performed at this time, the appropriate field is marked **N/T**.

The following table summarizes the test results in terms of the specification and class or level applied, the unique test sample identification, the EUT modification state, and configuration as applicable.

TEST CASE	TEST TYPE	SPECIFICATION	TEST SAMPLE	MOD. STATE	CONFIGURATION	RESULT
§4.1	Conducted Emissions on AC Power Lines	FCC Part 15.107	GoConex S1 wireless light switch	nil	See § 1.6.3	**N/A**
§4.2	Conducted Emissions at Antenna Port	FCC Part 15	GoConex S1 wireless light switch	nil	See § 1.6.3	**N/A**
§4.3a	Spurious Radiated Emissions (Sleep Mode)	FCC Part 15.109	GoConex S1 wireless light switch	nil	See § 1.6.3	**PASS**
§4.3b	Spurious Radiated Emissions (Tx Mode)	FCC Part 15.249	GoConex S1 wireless light switch	nil	See § 1.6.3	**PASS**
§4.4	Radiated Emissions (Tx Mode)	FCC Parts 15.205, 15.209 and 15.249	GoConex S1 wireless light switch	nil	See § 1.6.3	**PASS**
§4.4	Frequency Stability (Tx Mode)	FCC Parts 15.249	GoConex S1 wireless light switch	nil	See § 1.6.3	**N/A**

4.1 CONDUCTED EMISSIONS ON AC POWER LINES

Test Lab: Electronics Test Centre (Airdrie) Test Personnel: n/a Test Date: n/a	Product: GoConex S1 wireless light switch
Test Result, GoConex S1 wireless light switch itch: **Not Applicable**	
The EUT is powered only by an internal CR-2032 lithium battery. There is no connection to the AC mains.	

4.2 CONDUCTED EMISSIONS MEASURED AT ANTENNA PORT

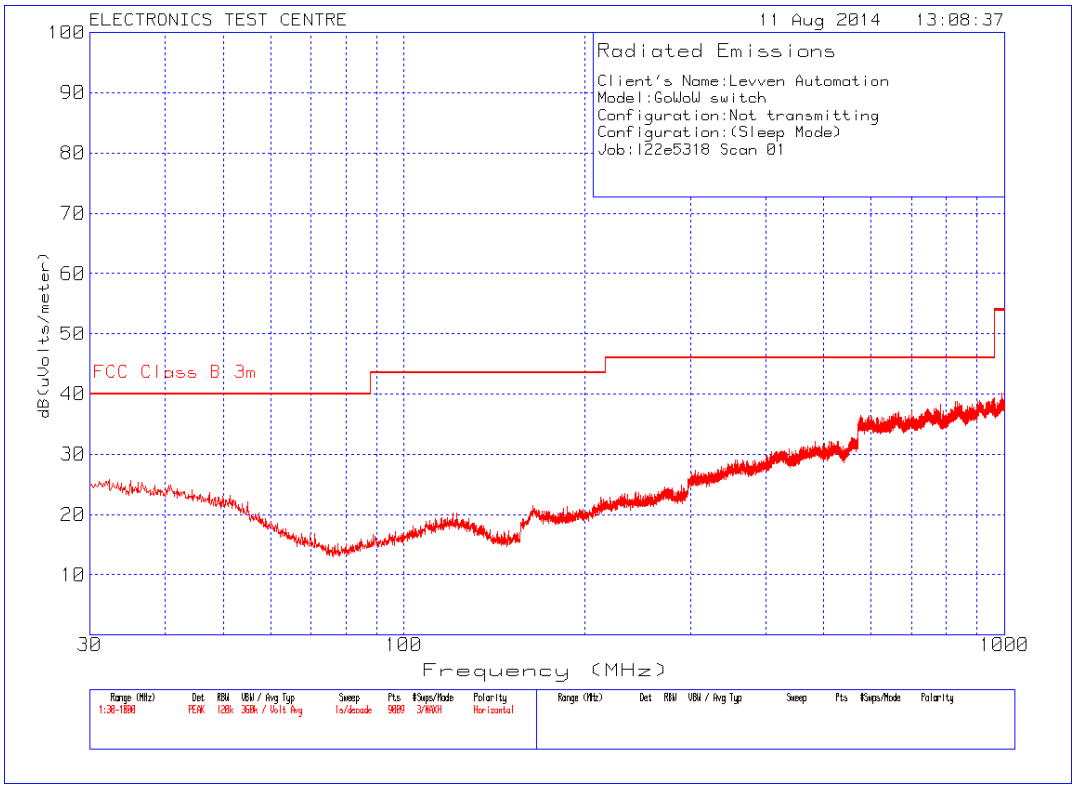
Test Lab: Electronics Test Centre (Airdrie) Test Personnel: n/a Test Date: n/a	Product: GoConex S1 wireless light switch
Test Result, GoConex S1 wireless light switch: **Not Applicable**	
The EUT antenna is integral to the printed circuit board. There is no connection access to the RF output.	

4.3 SPURIOUS RADIATED EMISSIONS

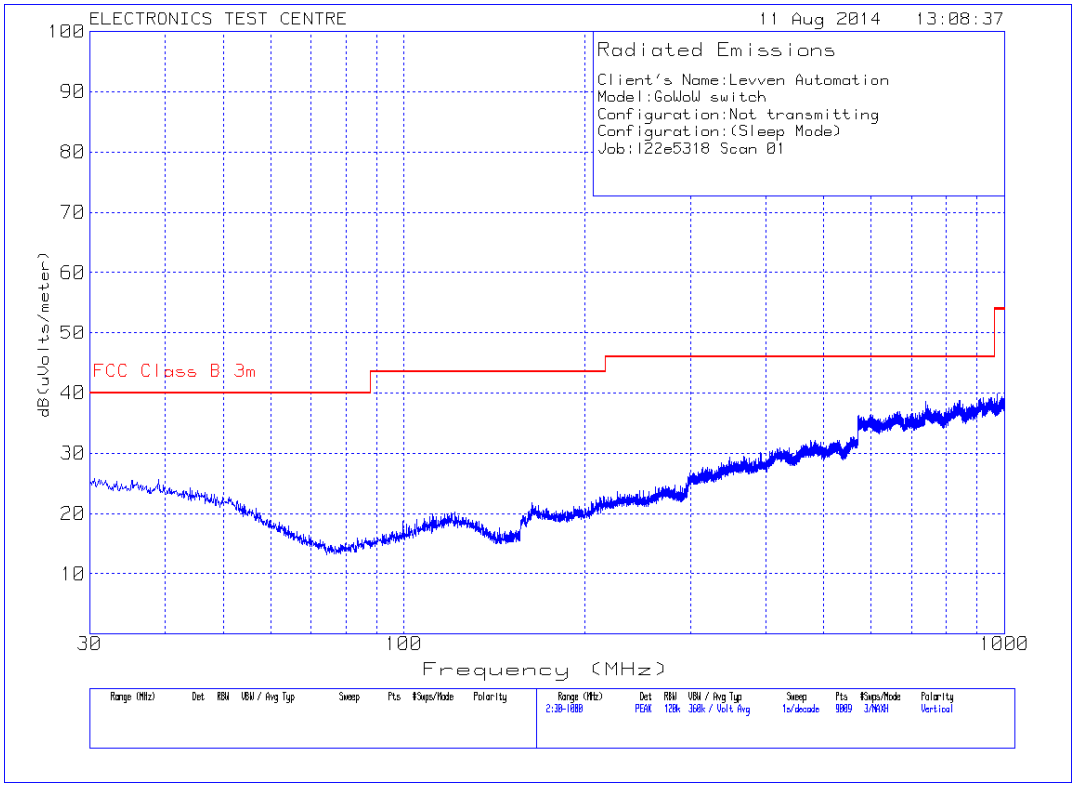
4.3a Sleep Mode

Test Lab: MPB Technologies Inc. Airdrie Test Personnel: David Raynes Test Date: 12 August 2014	Product: GoConex S1 wireless light switch
Test Result, GoConex S1 wireless light switch: **PASS**	
Objectives/Criteria The Radiated E-Field emissions produced by a system or sub-system, measured at a distance of 3m from the EUT, shall not exceed the limits for the specifications as stated. Temperature = 25.5 °C Humidity = 41.3 %	Specification: FCC Part 15.109 Class B Frequency Limit [MHz] QP @ 3m 30 – 88 40.00 88 – 216 43.52 216 – 960 46.02 above 960 53.98
There were no spurious emissions measured within -6 dB of the specified limit. Refer to the test data and plots for more detail.	

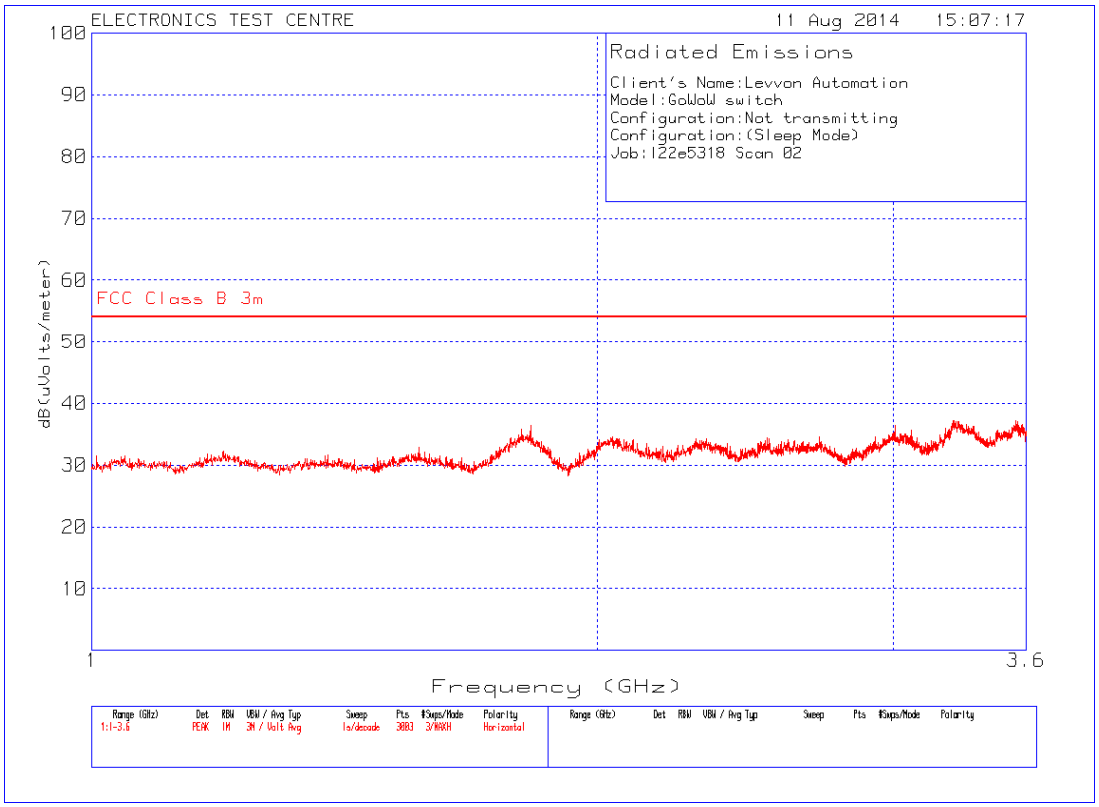
Plot of Radiated Emissions:



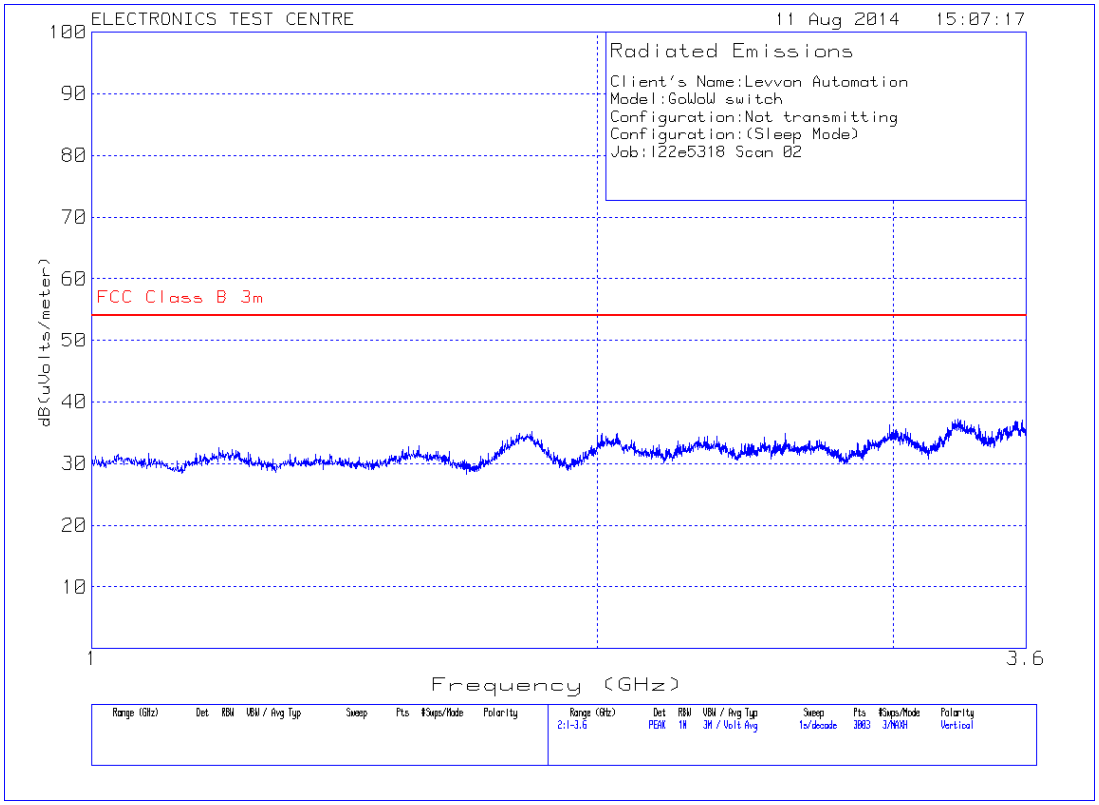
Plot of Radiated Emissions:



Plot of Radiated Emissions:



Plot of Radiated Emissions:



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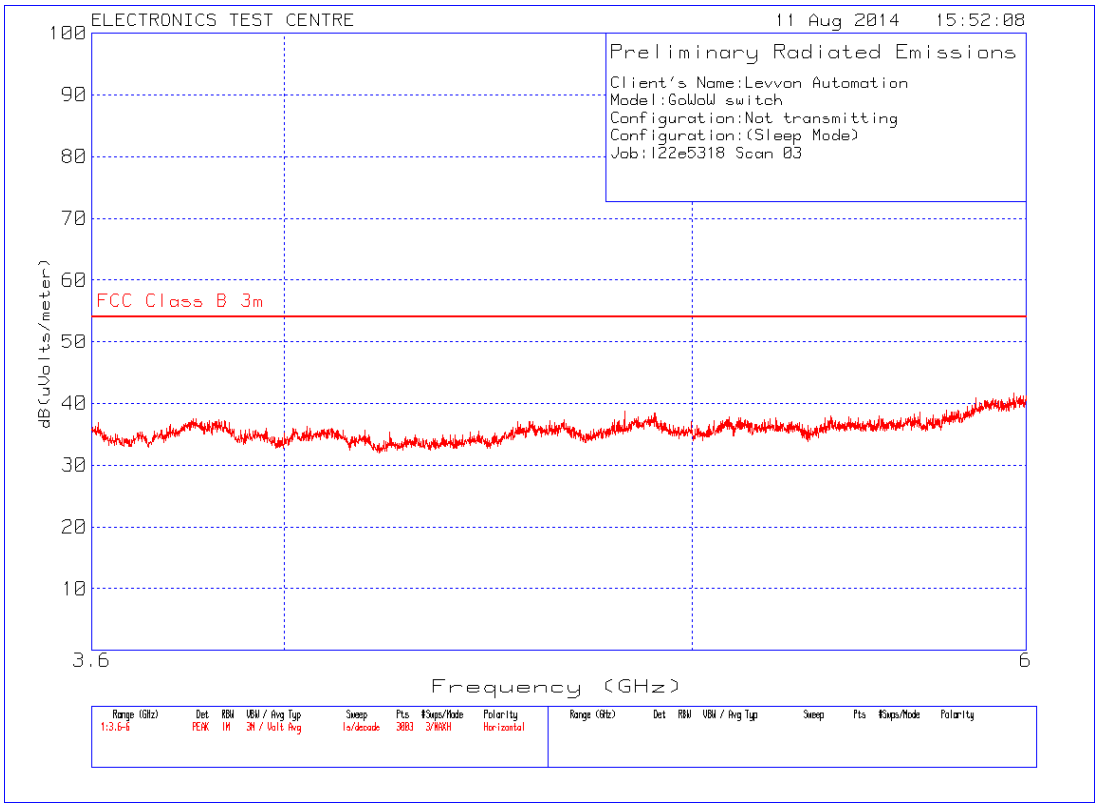
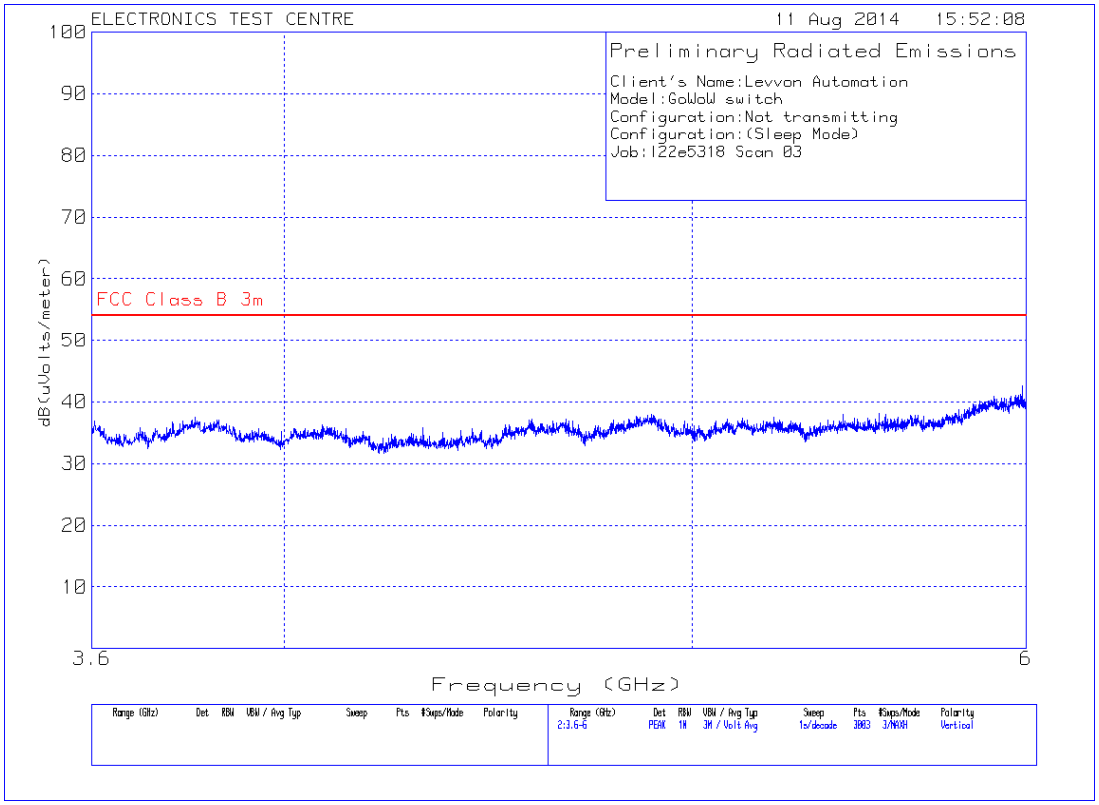


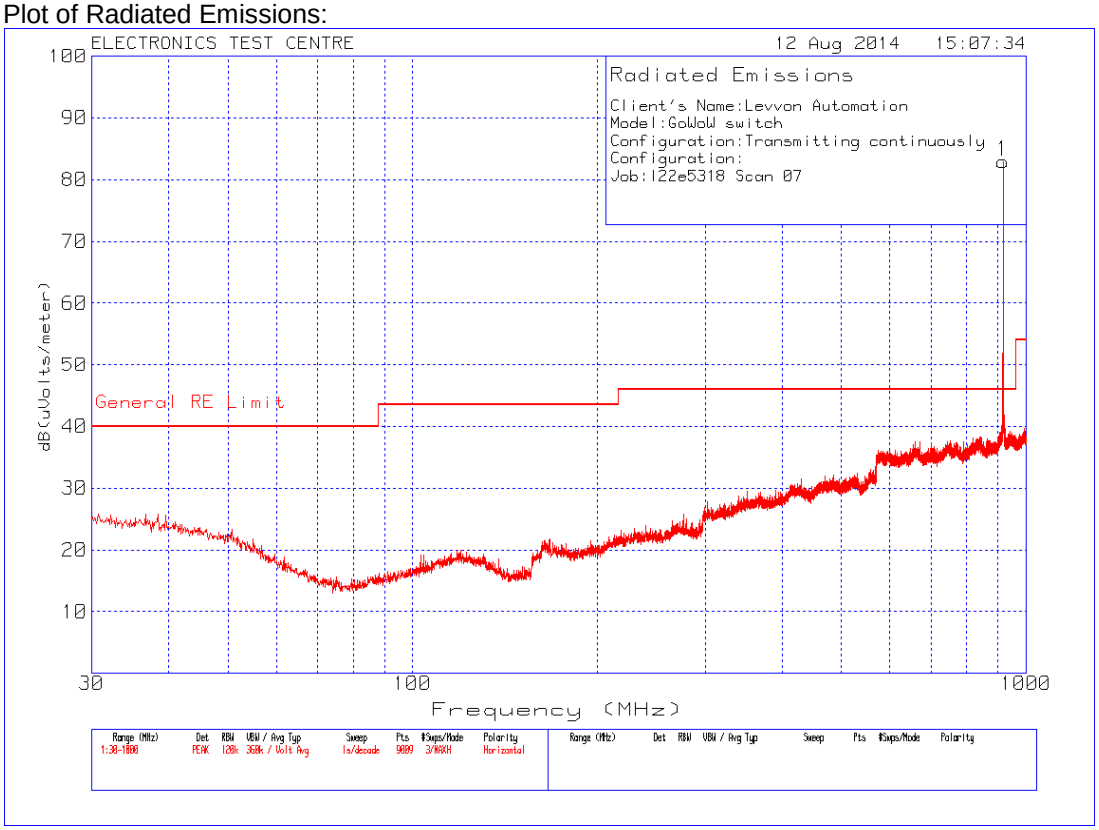
Plot of Radiated Emissions:



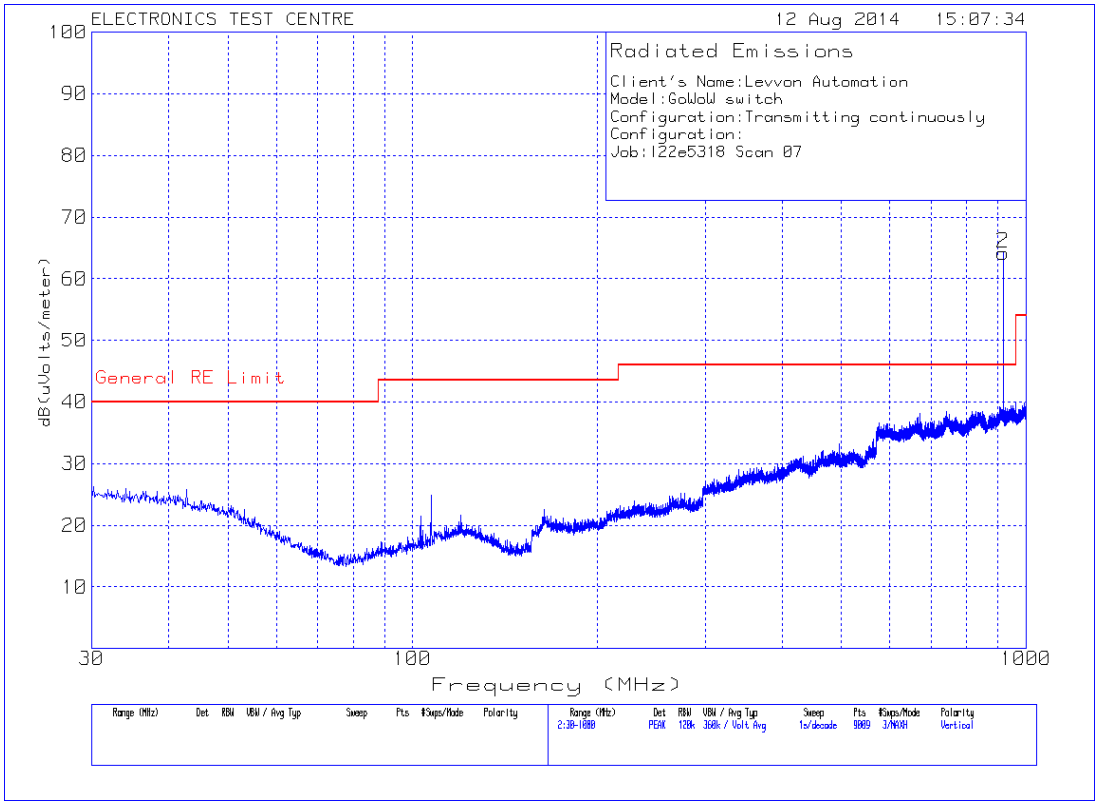
4.3b Transmit Mode

Test Lab: MPB Technologies Inc. Airdrie Test Personnel: David Raynes Test Date: 12 August 2014	Product: GoConex S1 wireless light switch
Test Result, GoConex S1 wireless light switch: **PASS**	
Objectives/Criteria The Radiated E-Field emissions produced by a system or sub-system, measured at a distance of 3m from the EUT, shall not exceed the limits for the specifications as stated. Temperature = 25.5 °C Humidity = 41.3 %	Specification: FCC Part 15.209 Carrier: Not more than 93.98 dBµV/m Frequency General RE Limit [MHz] QP @ 3m 30 – 88 40.00 88 – 216 43.52 216 – 960 46.02 above 960 53.98
There were no spurious emissions measured within -6 dB of the specified limit. Data for the Carrier and Harmonics are contained in section 4.4 of this report. Data for the Carrier ERP and EIRP are contained in section 4.5 of this report.	

Plot of Radiated Emissions:



Plot of Radiated Emissions:



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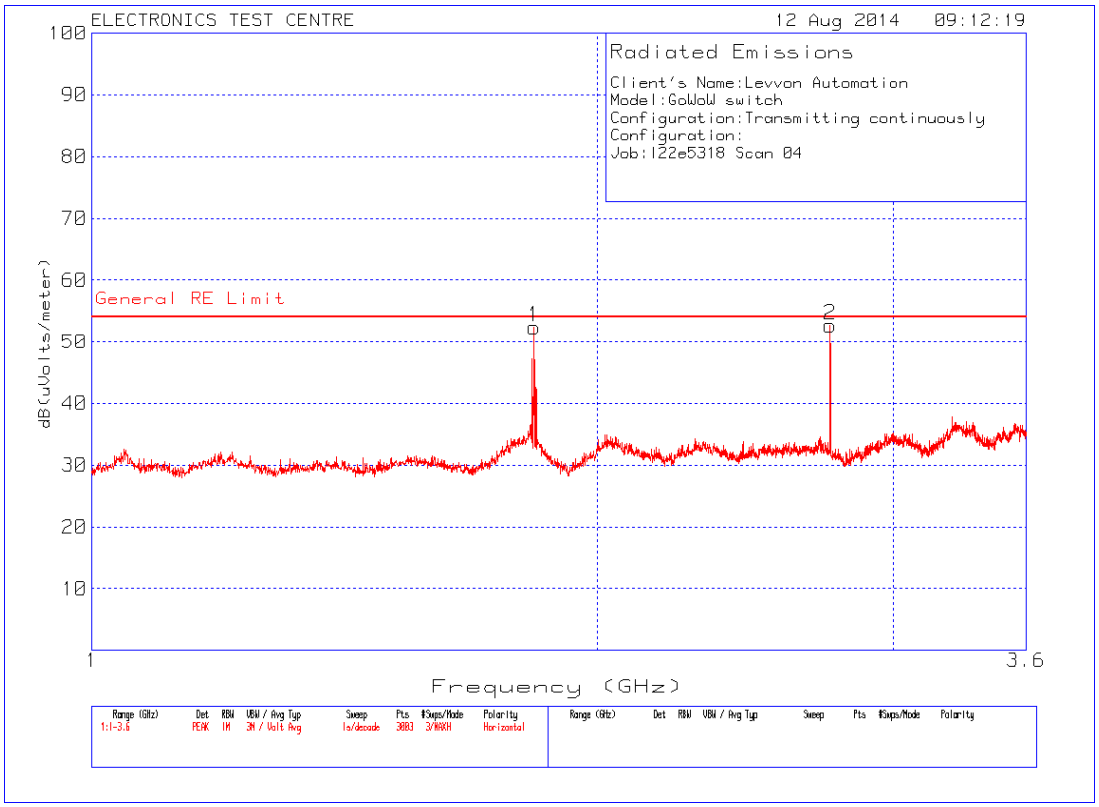
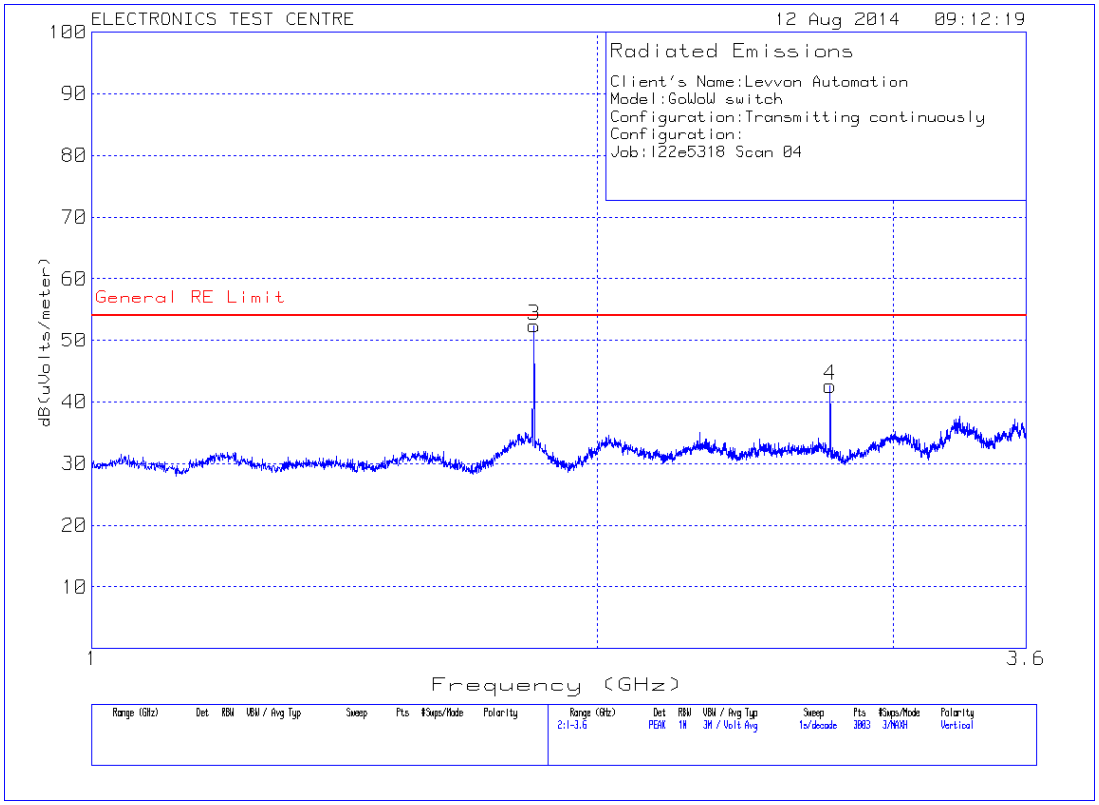
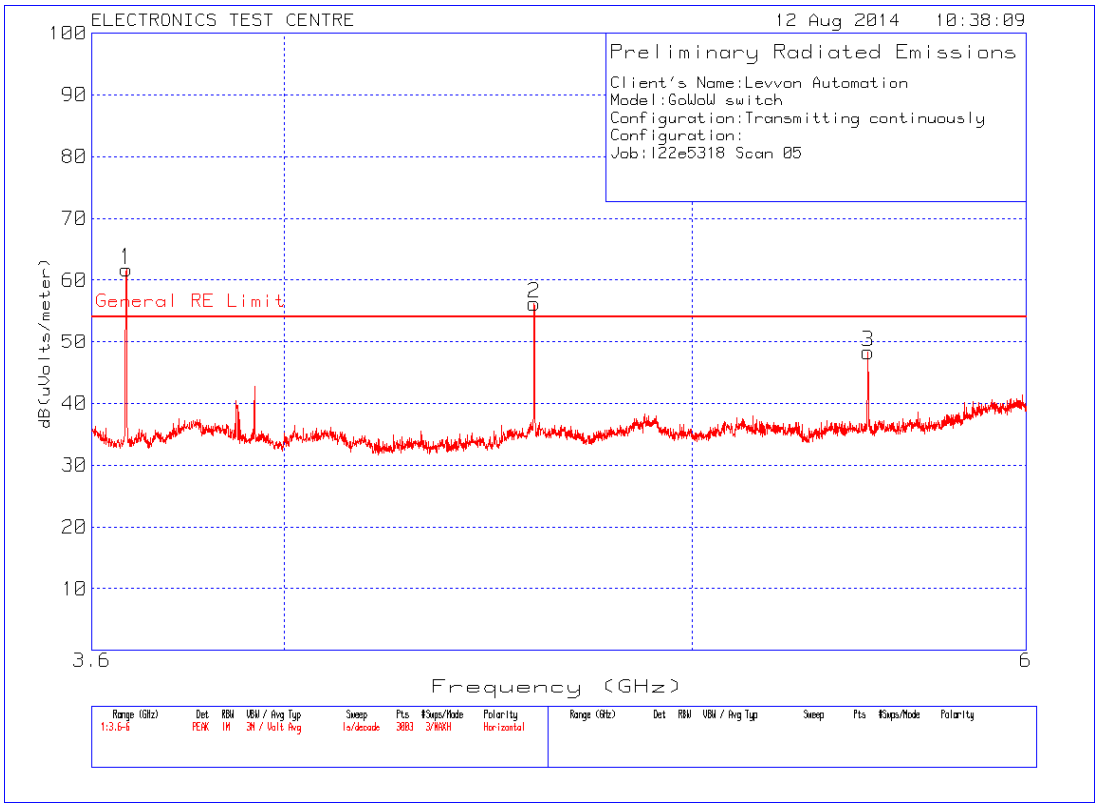


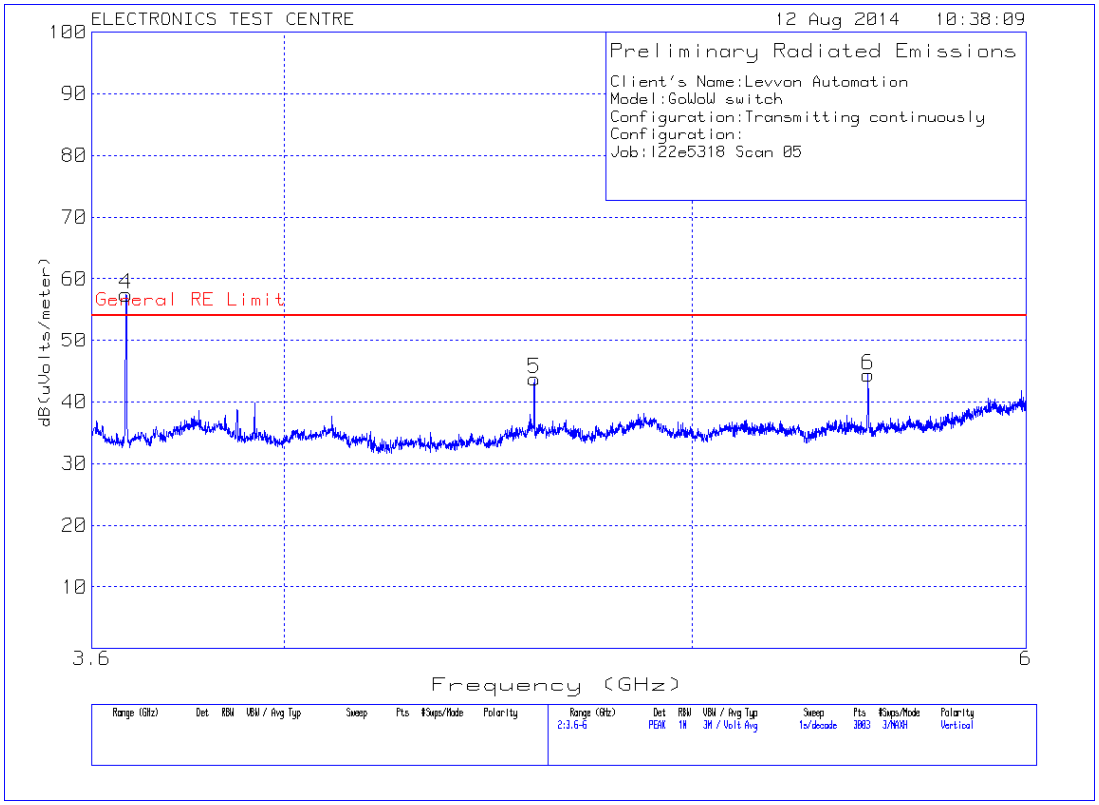
Plot of Radiated Emissions:



Plot of Radiated Emissions:



Plot of Radiated Emissions:



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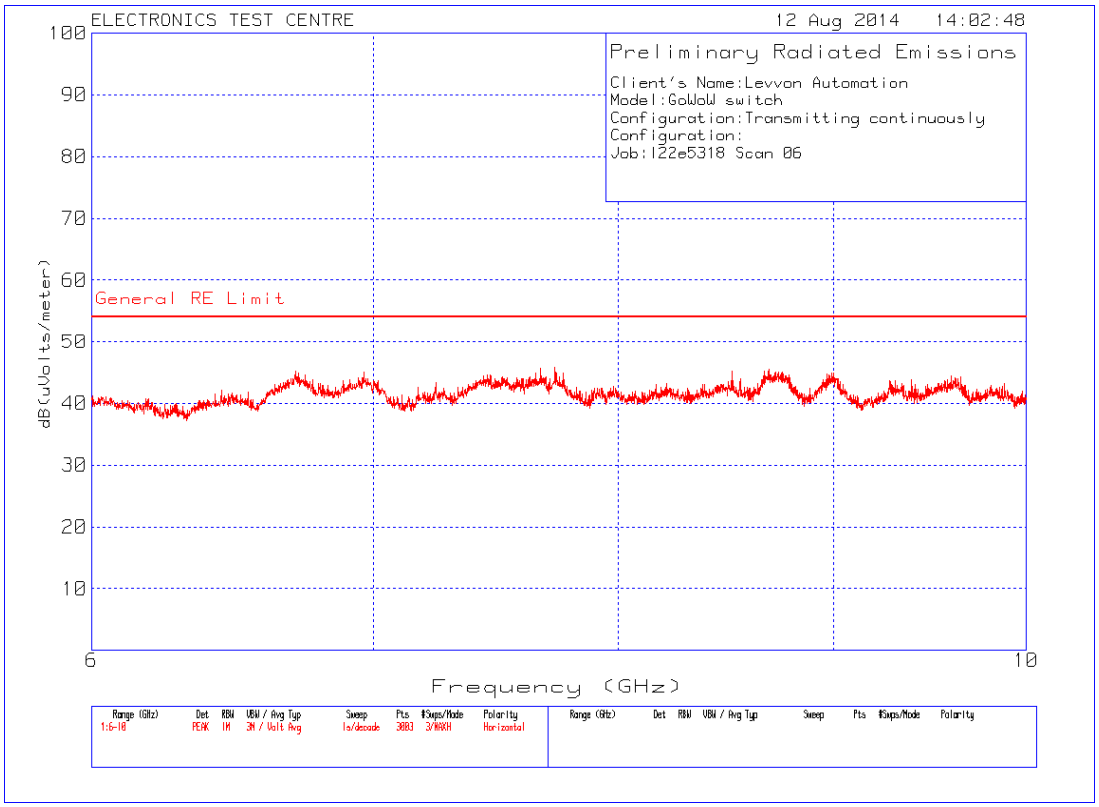

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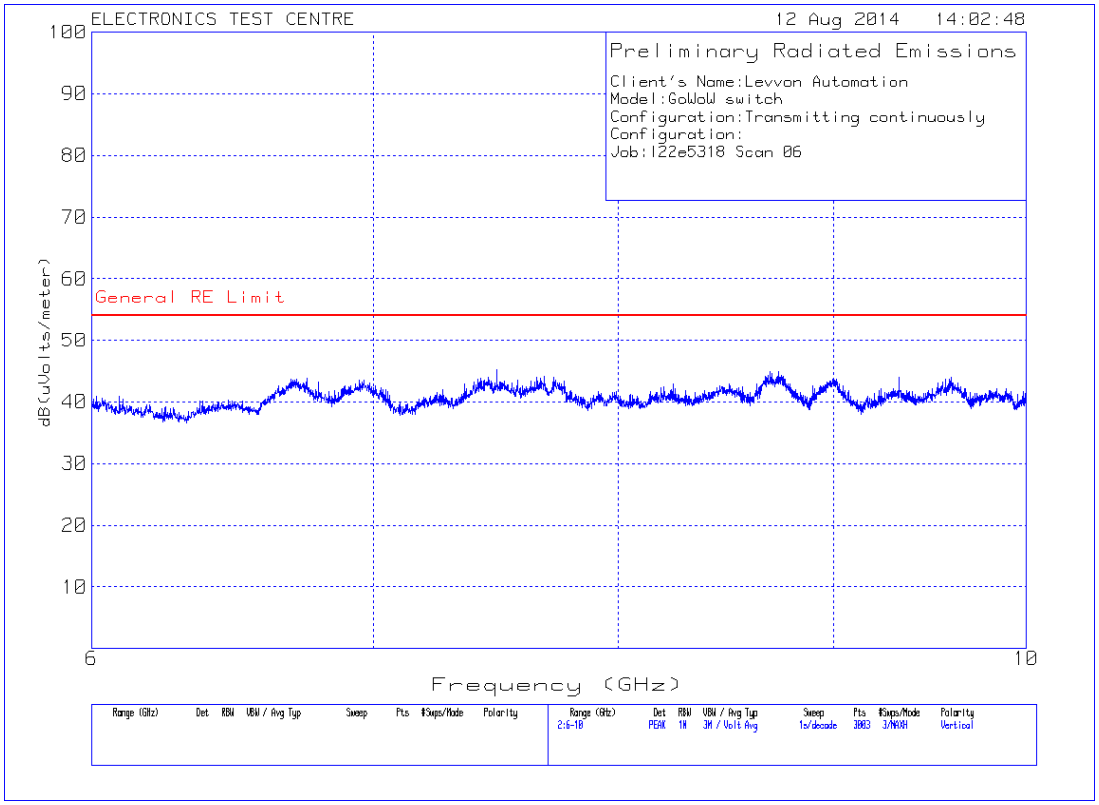
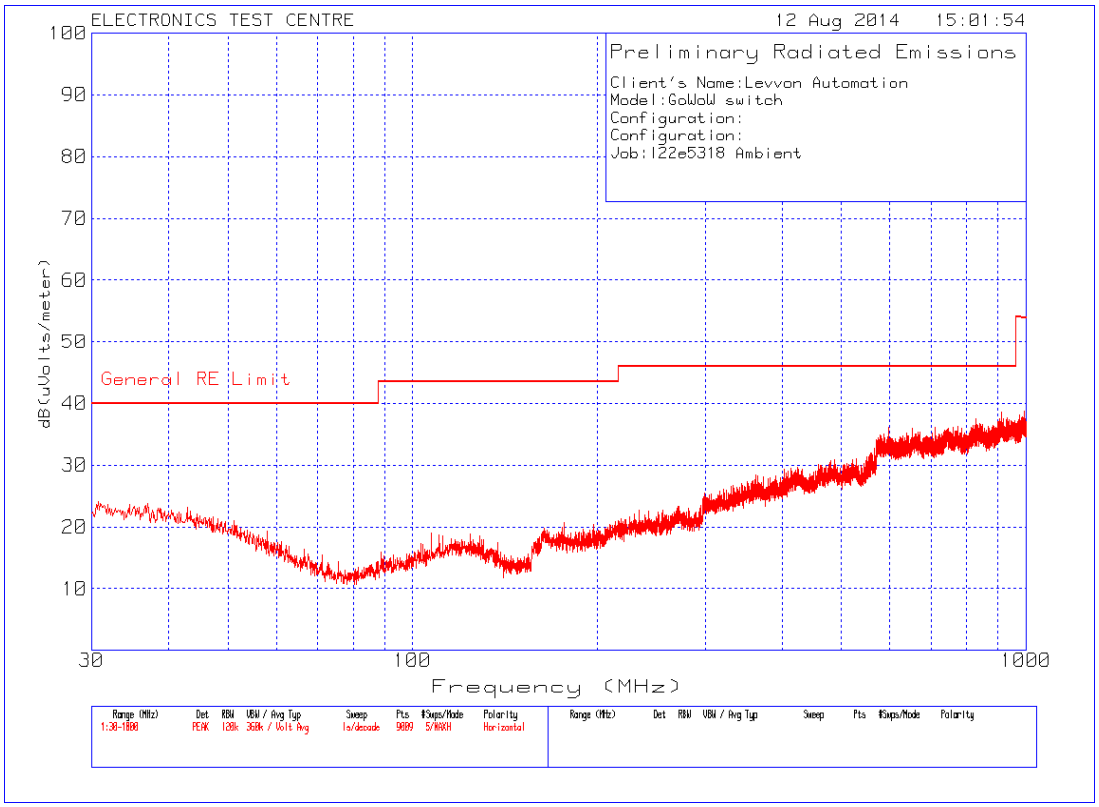
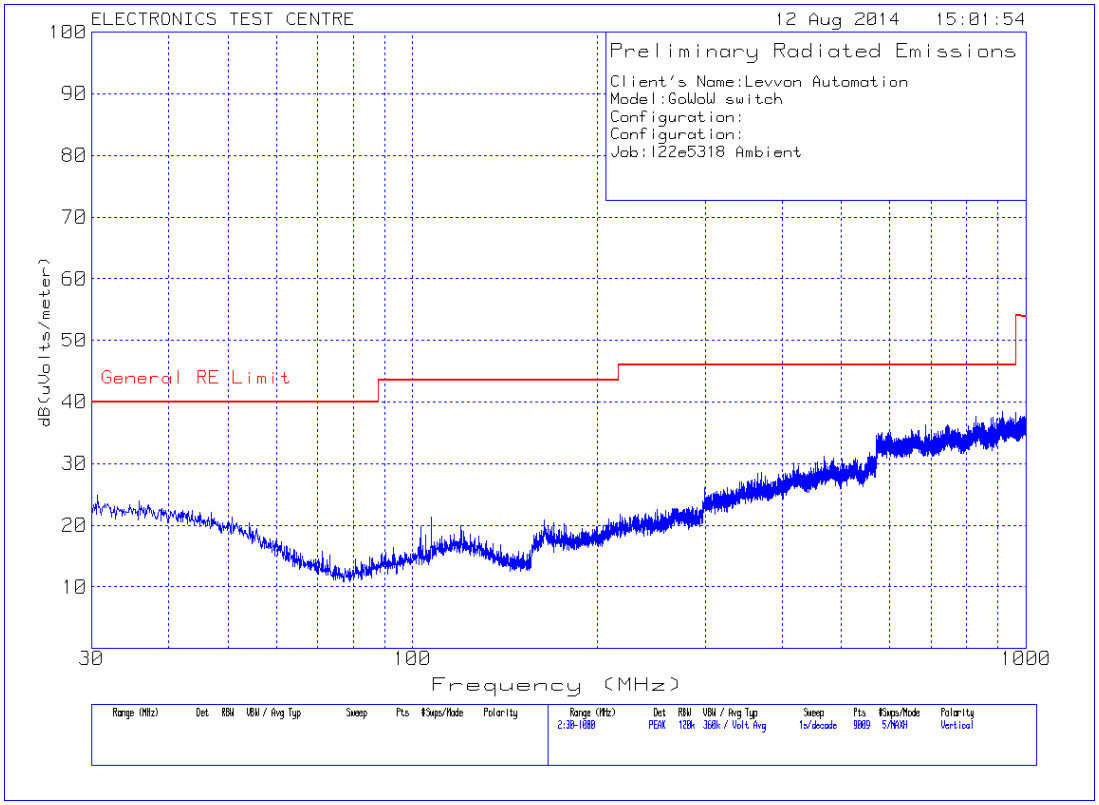


Plot of Radiated Emissions Test Chamber Ambient:



Plot of Radiated Emissions Test Chamber Ambient:



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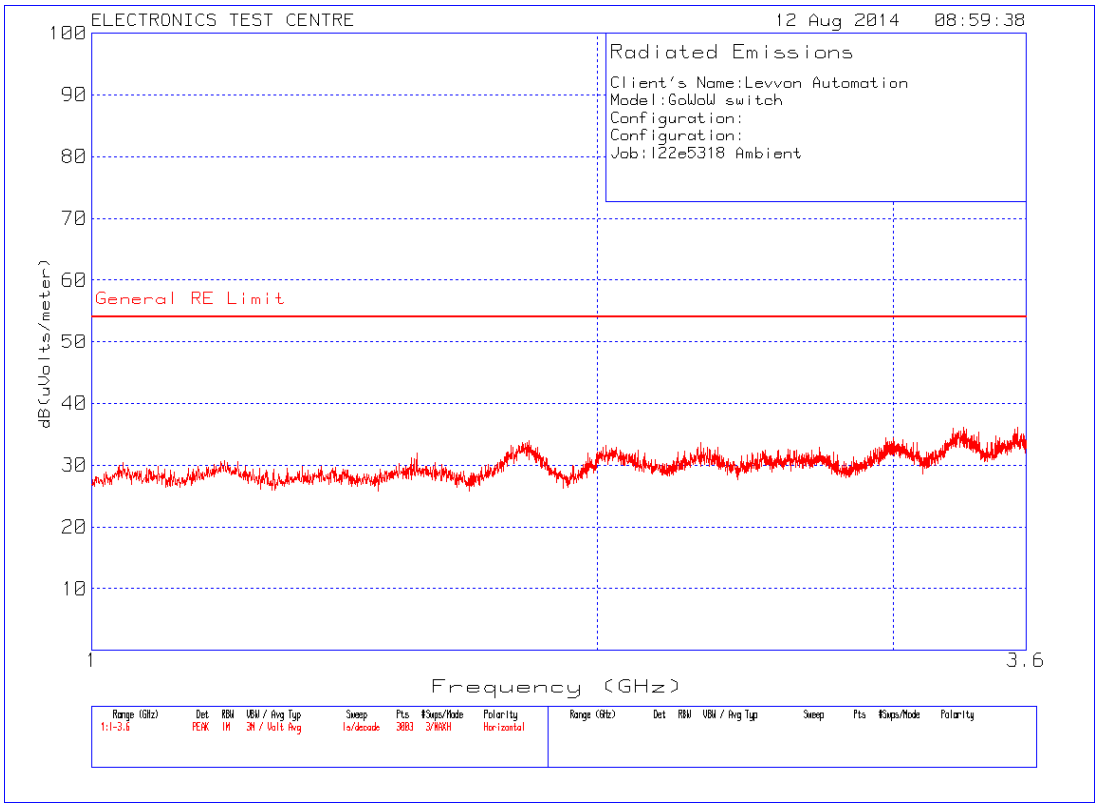
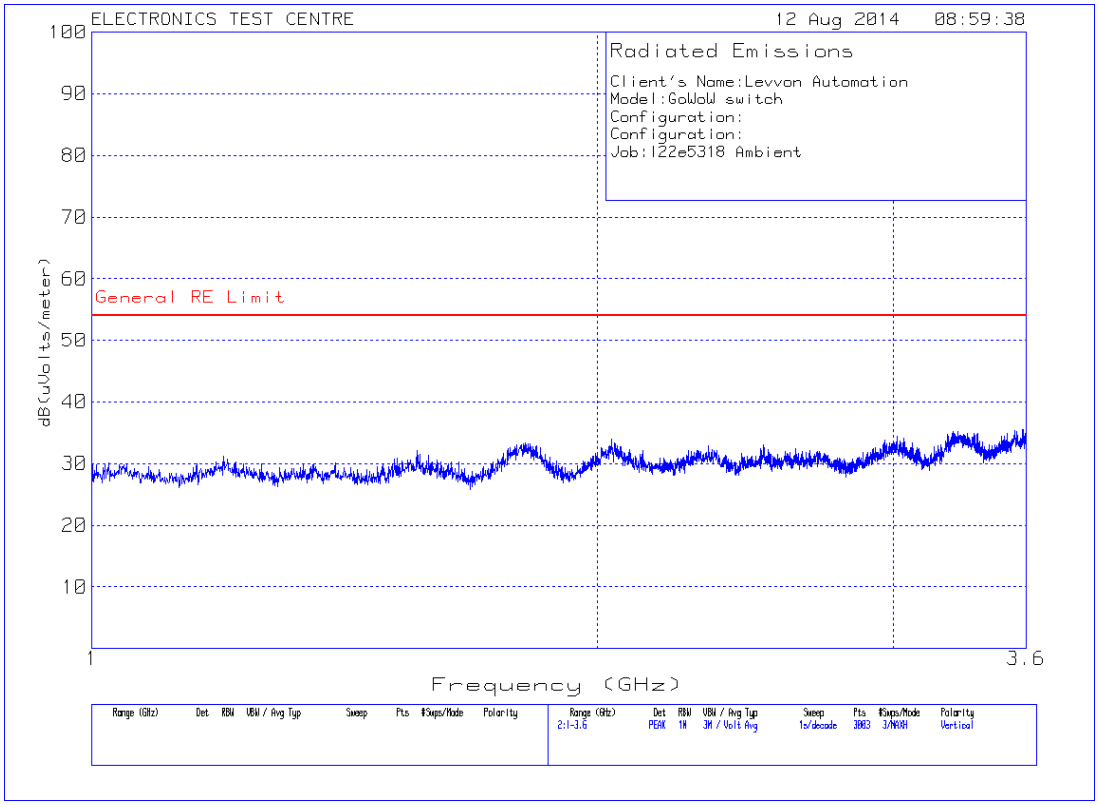
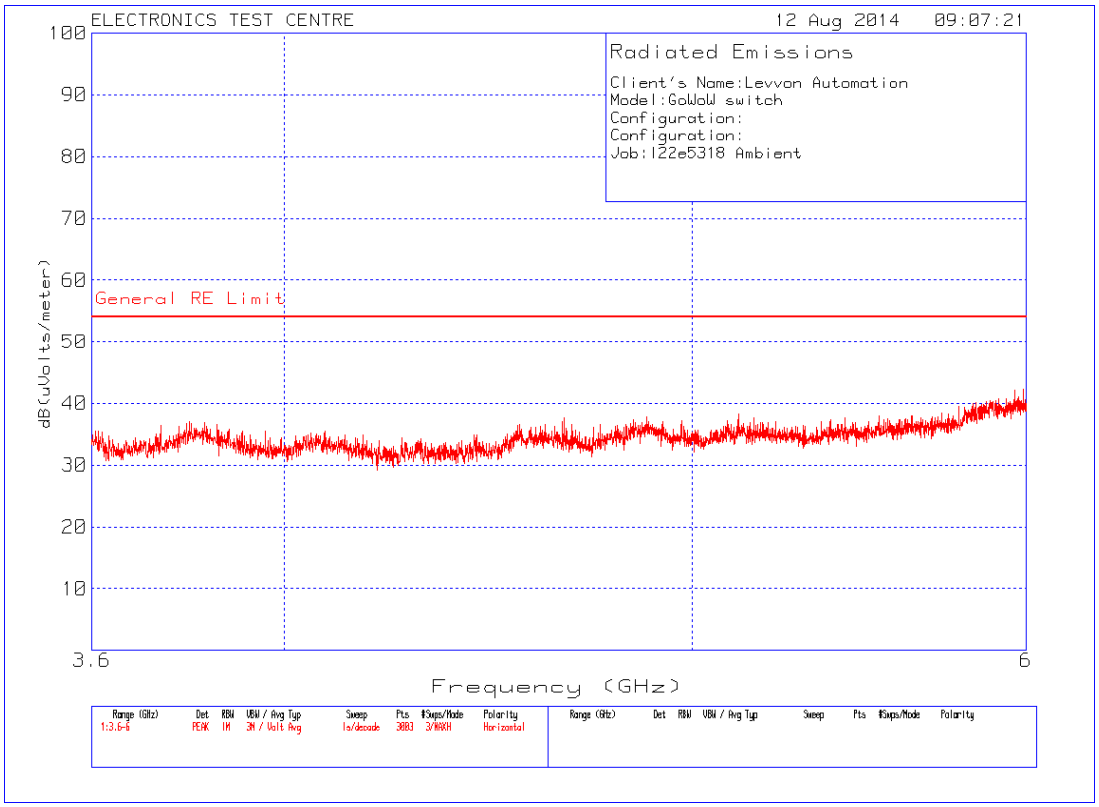


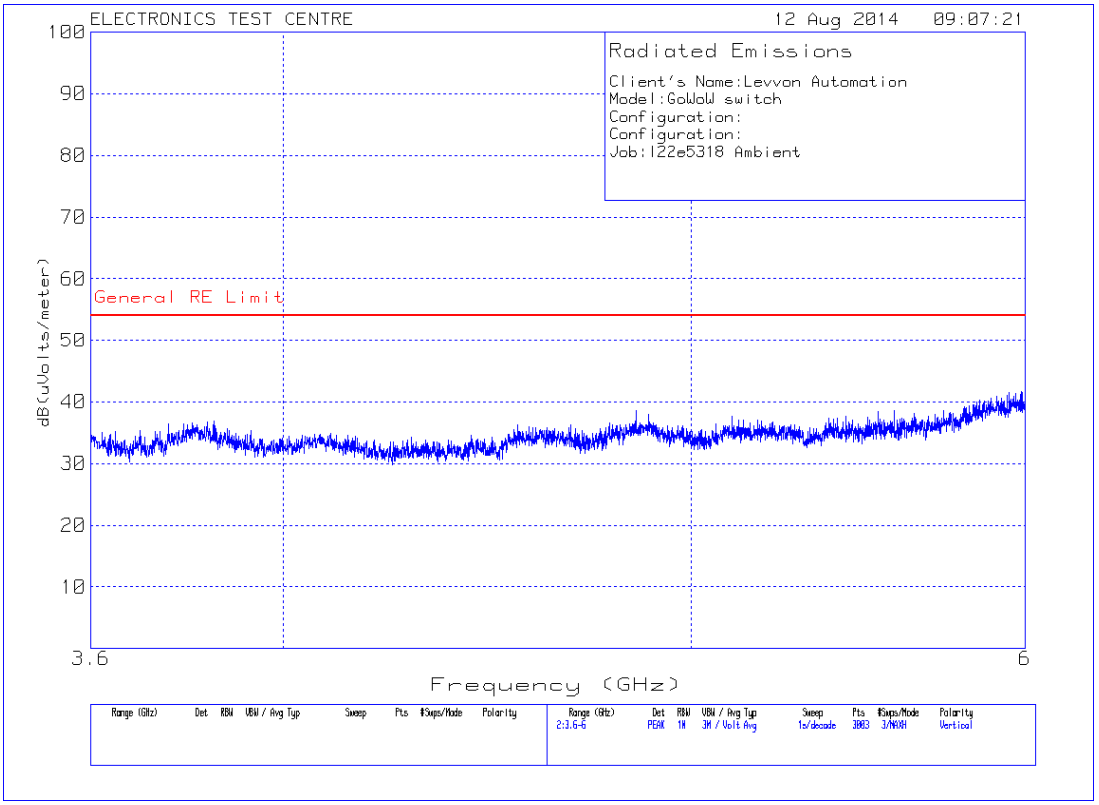
Plot of Radiated Emissions Test Chamber Ambient:



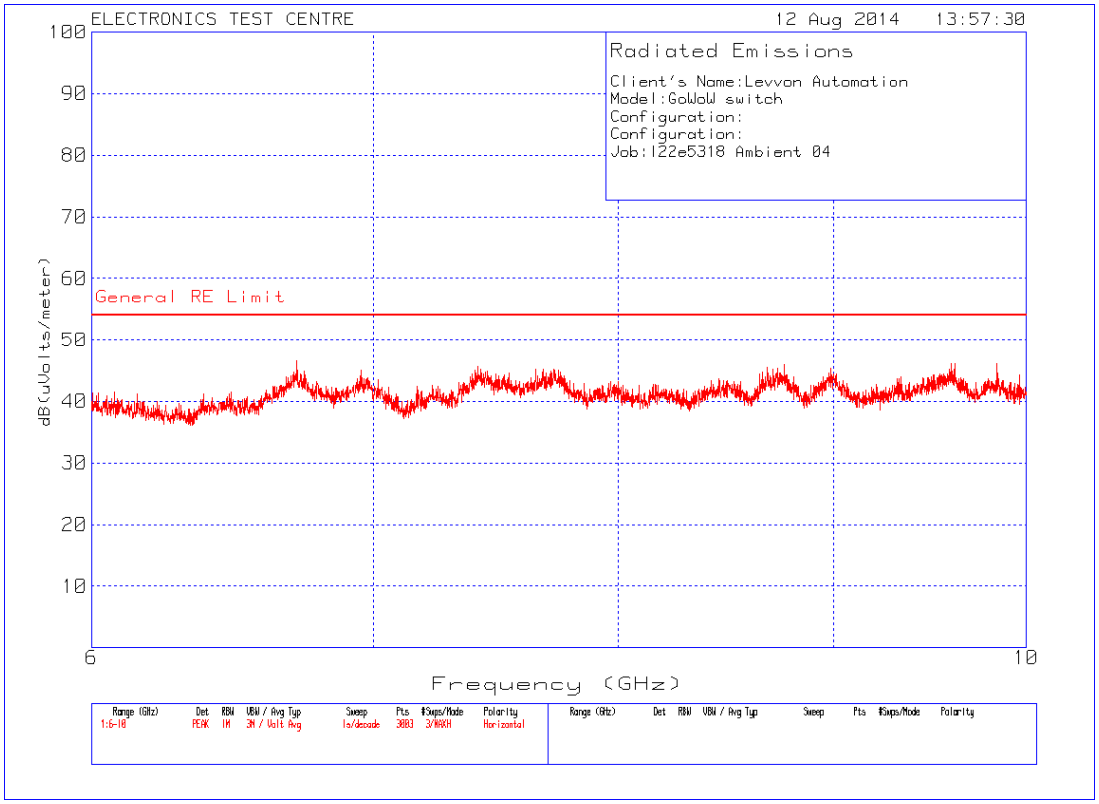
Plot of Radiated Emissions Test Chamber Ambient:



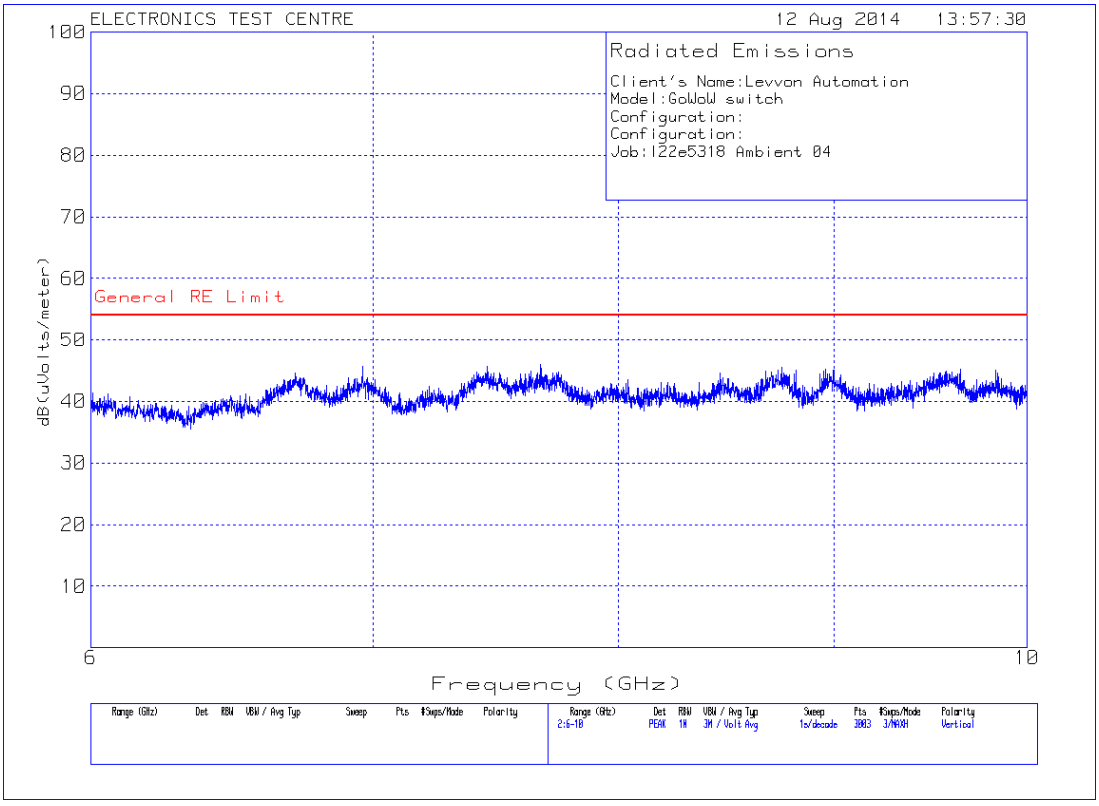
Plot of Radiated Emissions Test Chamber Ambient:



Plot of Radiated Emissions Test Chamber Ambient:



Plot of Radiated Emissions Test Chamber Ambient:



4.4 RADIATED EMISSIONS INCLUDING RESTRICTED BANDS OF OPERATION

Test Lab: MPB Technologies Inc. Airdrie Test Personnel: David Raynes Test Date: 12 August 2014	Product: GoConex S1 wireless light switch
Test Result, GoConex S1 wireless light switch: **PASS**	
The Radiated E-Field emissions produced by EUT, measured at a distance of 3m, shall not exceed these limits within the restricted bands of operation. Any emissions lying outside these bands shall be at least 20 dB down from the level of the fundamental. Attenuation below the limits of 15.209 is not required. Temperature = 25.5 °C Humidity = 41.3 %	Specification: FCC Part 15.249 Carrier: Not more than 93.98 dBµV/m Frequency General RE Limit [MHz] QP @ 3m 30 – 88 40.00 88 – 216 43.52 216 – 960 46.02 above 960 53.98

Horizontal:			**Vertical:**		
Frequency [MHz]	Field Strength [dBµV/m]	Delta [dB from limit]	Frequency [MHz]	Field Strength [dBµV/m]	Delta [dB from limit]
917.185	82.47	-11.51	917.173	68.71	-25.27
1833.9	53.30	-0.68	1834.4	51.63	-2.35
3668.7*	49.47	-4.51	3667.8*	46.55	-7.43

There were no more emissions measured within -6 dB of the specified limit.
Refer to the test data and plots for more detail.

* Within a Restricted Band

Restricted Bands of Operation per Part 15.205:

MHz	MHz	MHz	MHz	MHz	GHz	GHz
0.0900000 – 0.1100000	8.2910000 - 8.2940000	16.804250 - 16.804750	162.01250 - 167.17000 *	1660.0000 – 1710.0000	3.6000000 – 4.4000000	14.470000 – 14.500000
0.4950000 - 0.5050000 *	8.3620000 - 8.3660000	25.500000 - 25.670000	167.72000 - 173.20000 *	1718.8000 – 1722.2000	4.5000000 – 5.1500000	15.350000 – 16.200000
2.1735000 - 2.1905000	8.3762500 - 8.3867500	37.500000 - 38.250000	240.00000 – 285.00000	2200.0000 – 2300.0000	5.3500000 – 5.4600000	17.700000 – 21.400000
4.1250000 - 4.1280000	8.4142500 - 8.4147500	73.000000 - 74.600000	322.00000 - 335.40000	2310.0000 – 2390.0000	7.2500000 – 7.7500000	22.010000 – 23.120000
4.1772500 - 4.1777500	12.290000 - 12.293000	74.800000 - 75.200000	399.90000 – 410.00000	2483.5000 – 2500.0000 *	8.0250000 – 8.5000000	23.600000 – 24.000000
4.2072500 - 4.2077500	12.519750 - 12.520250	108.00000 - 121.94000 **	608.00000 – 614.00000	2655.0000 – 2900.0000	9.0000000 – 9.2000000	31.200000 – 31.800000
5.6770000 - 5.6830000	12.576750 - 12.577250	123.00000 - 138.00000 **	960.00000 – 1240.0000 ***	3260..0000 – 3267.0000	9.3000000 – 9.5000000	36.430000 – 36.500000
6.2150000 - 6.2180000	13.360000 - 13.410000	149.90000 - 150.05000 *	1300.0000 – 1427.0000 ***	3332.0000 – 3339.0000	10.600000 – 12.700000	Above 38.600000
6.2677500 - 6.2682500	16.420000 - 16.423000	156.52475- 156.52525	1435.0000 – 1626.5000	3345.8000 – 3358.0000	13.250000 – 13.400000	
6.3117500 - 6.3122500	16.694750 - 16.695250	156.70000 - 156.90000	1645.5000 – 1646.5000	3500.0000 – 3600.0000 ****		

* US only ** Canada 108 – 138 MHz *** Canada 960 – 1427 MHz **** Canada only

Radiated Emissions Data:

The emissions data is presented in tabular form, showing the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value(s) of limit at the frequency measured, and the margin between the result and the limit.

Freq. Marker	Test Freq. [MHz]	Meter reading [dBµV]	Det	Antenna Factor [dB/m]	Cable Loss [dB]	Corrected Value [dBµV/m]	15.249 Limit [dBµV/m]	Margin [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	917.185	53.07	Pk	22.6	6.8	82.47	93.98	-11.51	270	100	Horizontal
2	917.173	39.31	Pk	22.6	6.8	68.71	93.98	-25.27	9	286	Vertical
1	1833.9	85.32	Pk	27.3	-48.1	64.52	73.98	-9.46	281	103	Horizontal
2	2751.6	74.24	Pk	29.3	-48.8	54.74	73.98	-19.24	256	174	Horizontal
3	1834.4	83.07	Pk	27.3	-48.1	62.27	73.98	-11.71	332	357	Vertical
4	2751.6	60.44	Pk	29.2	-48.8	40.84	73.98	-33.14	133	388	Vertical
1	3668.7	75.94	Pk	32.0	-46.2	61.74	73.98	-12.24	35	108	Horizontal
2	4585.9	66.73	Pk	32.5	-43.0	56.23	73.98	-17.75	266	103	Horizontal
3	5503.0	56.54	Pk	34.4	-42.6	48.34	73.98	-25.64	197	105	Horizontal
4	3667.8	71.76	Pk	31.9	-46.2	57.46	73.98	-16.52	97	339	Vertical
5	4584.6	54.28	Pk	32.5	-43.0	43.78	73.98	-30.2	302	290	Vertical
6	5503.6	52.82	Pk	34.2	-42.6	44.42	73.98	-29.56	45	256	Vertical

Meter Reading in dBµV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dbµV/m.

Note: When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.

Negative margin indicates PASS.

Periodic Operation:

The Duty Cycle Correction Factor is determined according to the following equation:

Duty Cycle Correction Factor (dB) = 20 * $\log_{10}$(Duty Cycle)

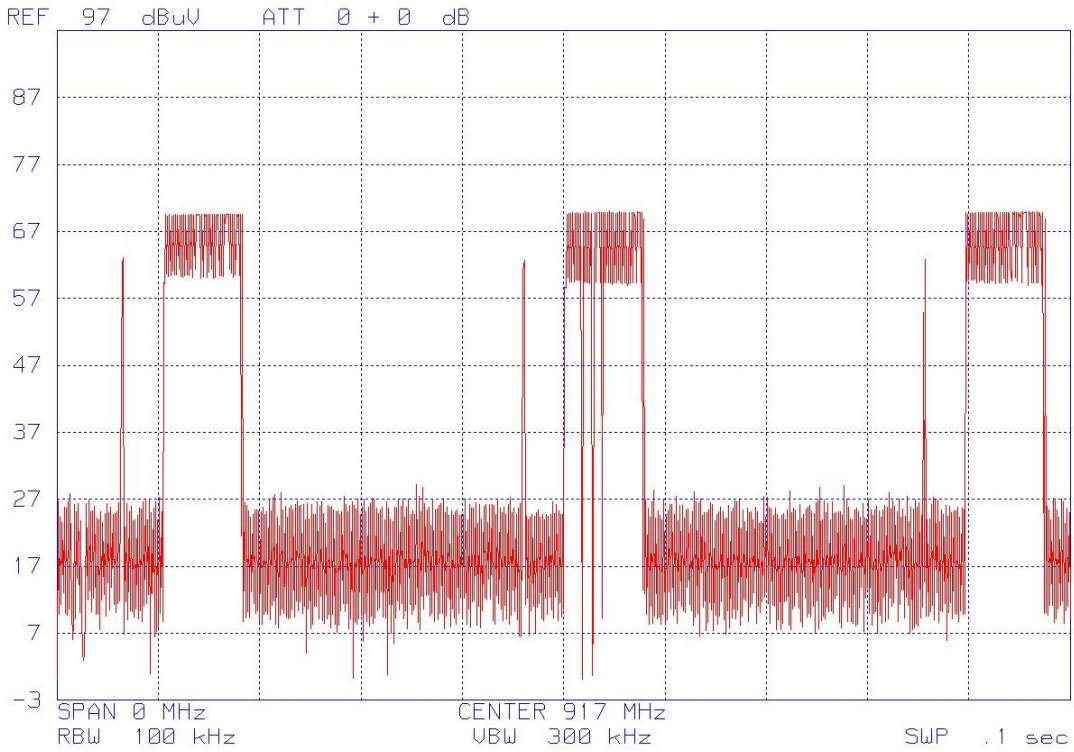
The Duty Cycle is defined as the 'On' time during a 0.1 second interval.

Duty Cycle = (7.8 * 3) / 100 = 0.234

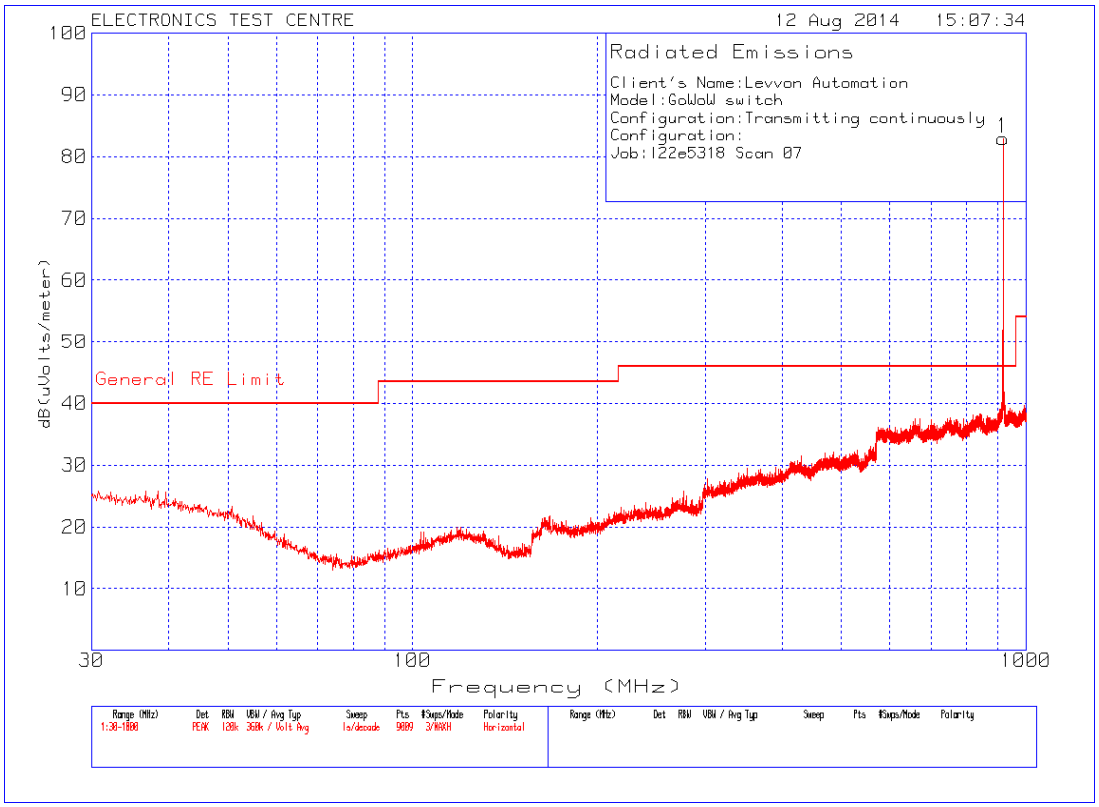
DCCF = 20 * $\log_{10}$(0.234) = -12.62 dB

Freq. Marker	Test Freq. [MHz]	Peak [dBµV/m]	DCCF	Corrected Value [dBµV/m]	15.35/15.249 Limit [dBµV/m]	Margin [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	917.185	82.47	-12.62	69.85	93.98	-24.13	270	100	Horizontal
2	917.173	68.71	-12.62	56.09	93.98	-37.89	9	286	Vertical
1	1833.9	64.52	-12.62	51.90	53.98	-2.08	281	103	Horizontal
2	2751.6	54.74	-12.62	42.12	53.98	-11.86	256	174	Horizontal
3	1834.4	62.27	-12.62	49.65	53.98	-4.33	332	357	Vertical
4	2751.6	40.84	-12.62	28.22	53.98	-25.76	133	388	Vertical
1	3668.7	61.74	-12.62	49.12	53.98	-4.86	35	108	Horizontal
2	4585.9	56.23	-12.62	43.61	53.98	-10.37	266	103	Horizontal
3	5503.0	48.34	-12.62	35.72	53.98	-18.26	197	105	Horizontal
4	3667.8	57.46	-12.62	44.84	53.98	-9.14	97	339	Vertical
5	4584.6	43.78	-12.62	31.16	53.98	-22.82	302	290	Vertical
6	5503.6	44.42	-12.62	31.80	53.98	-22.18	45	256	Vertical

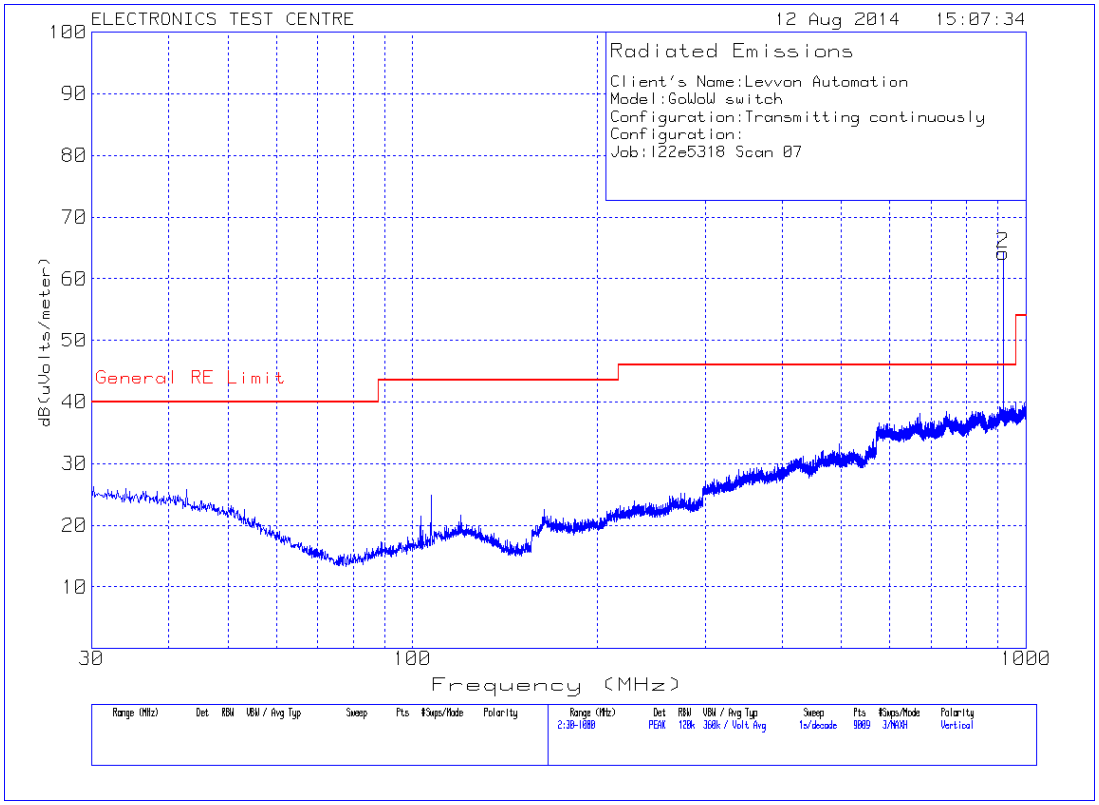
Each pulse is 7.8 ms long



Plot of Radiated Emissions:



Plot of Radiated Emissions:



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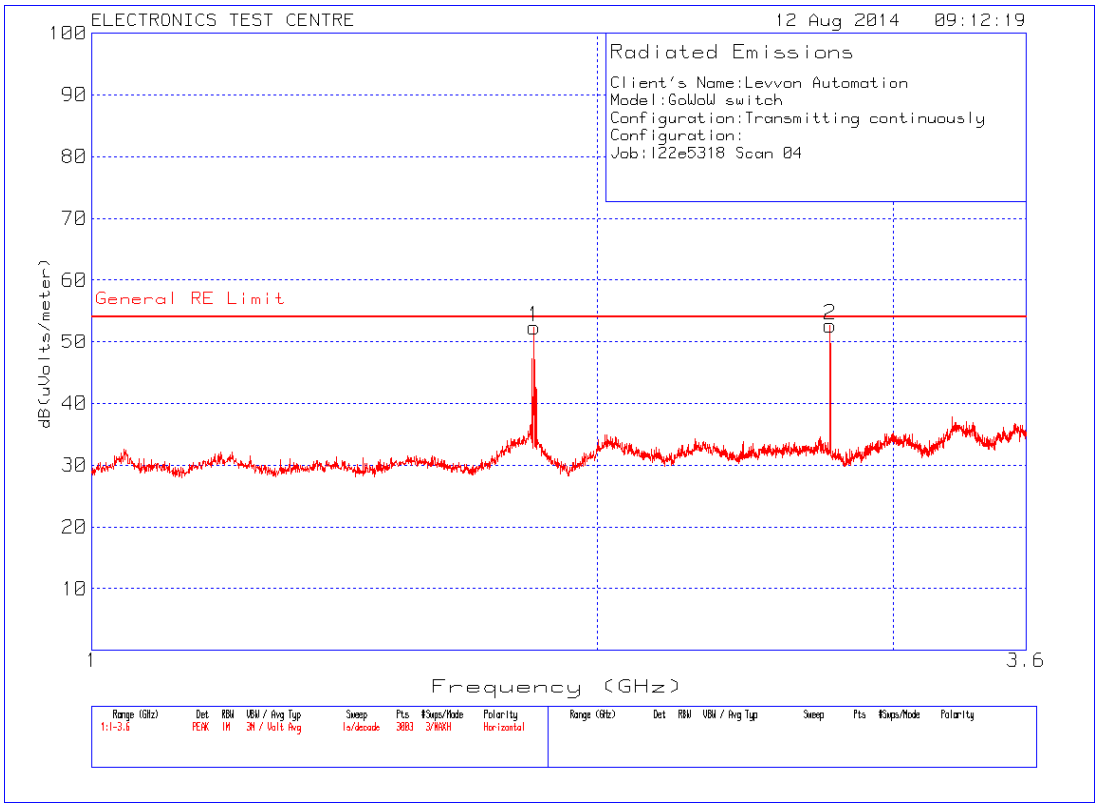

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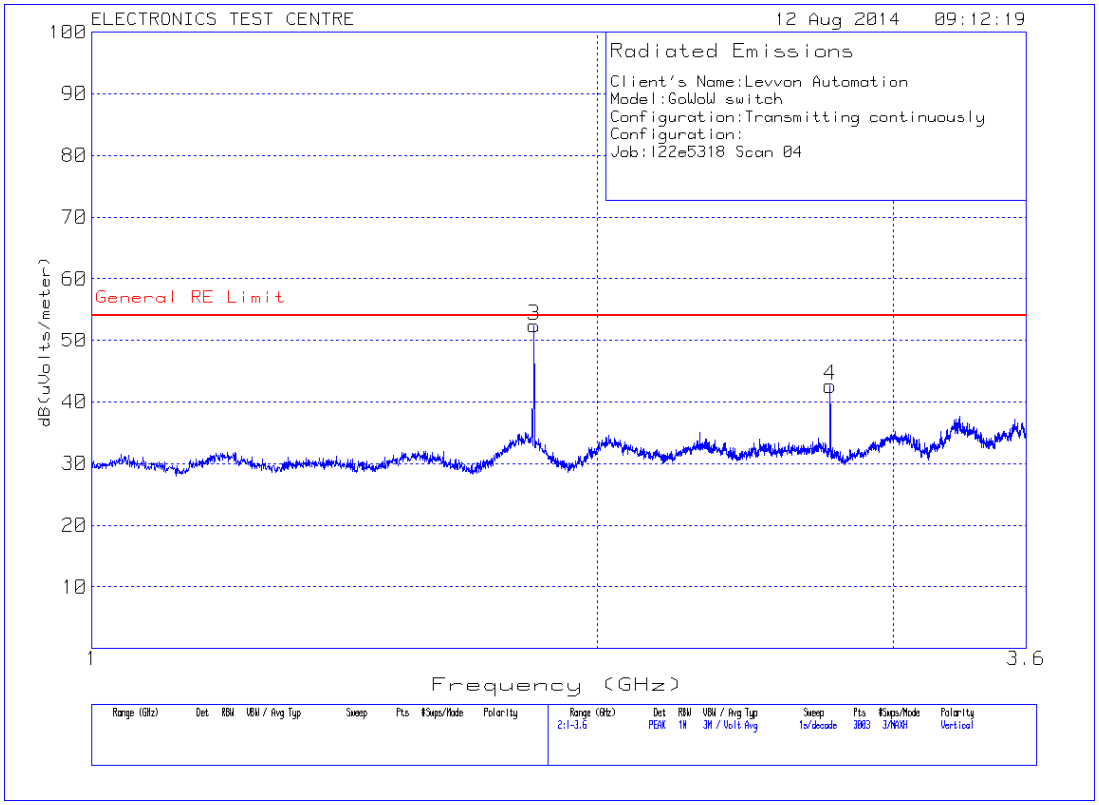

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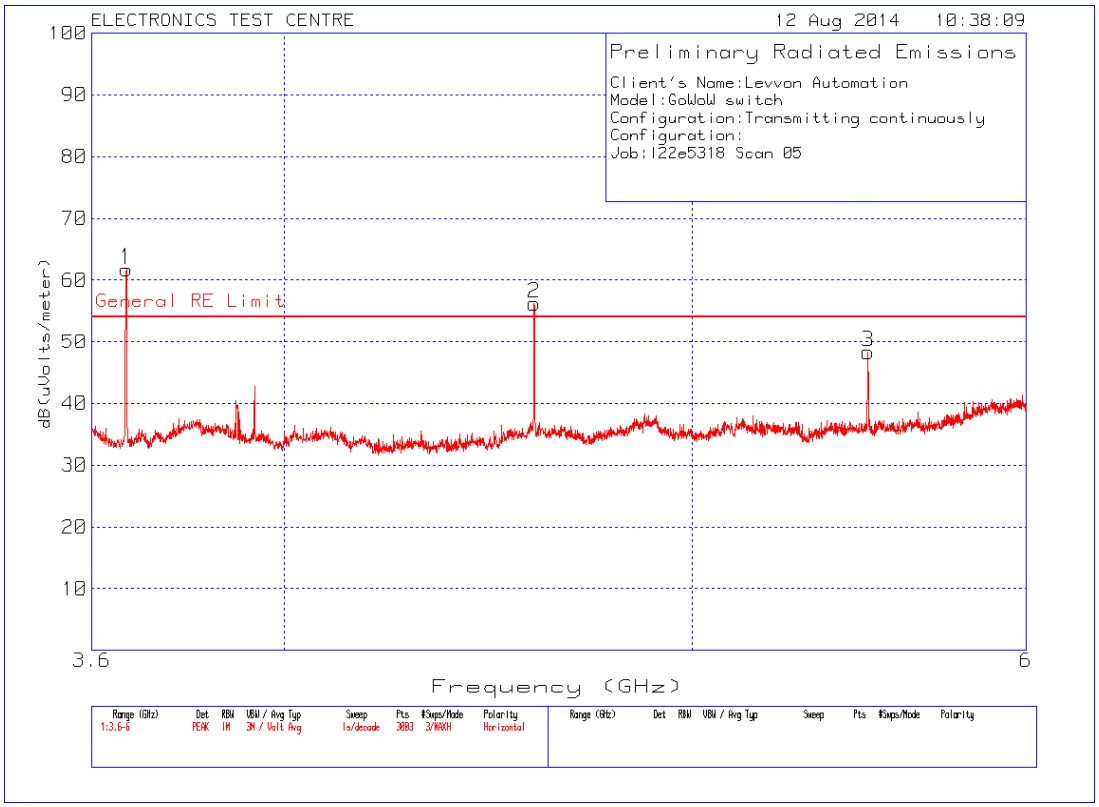
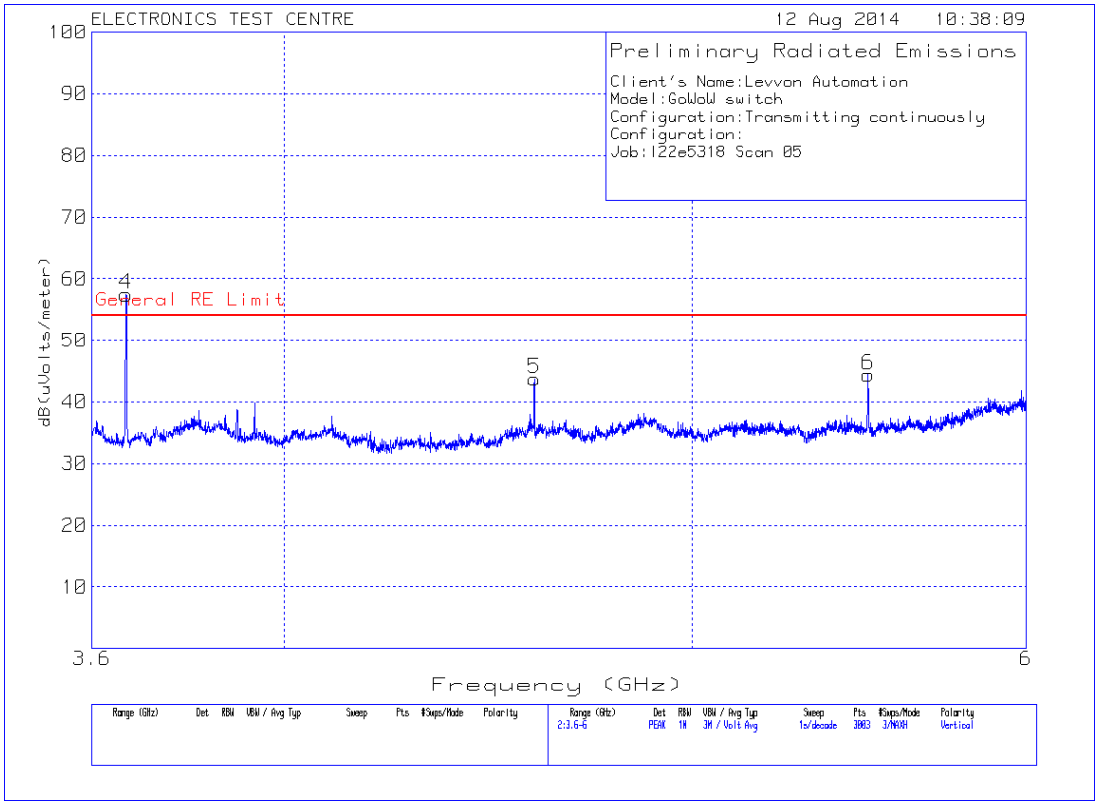
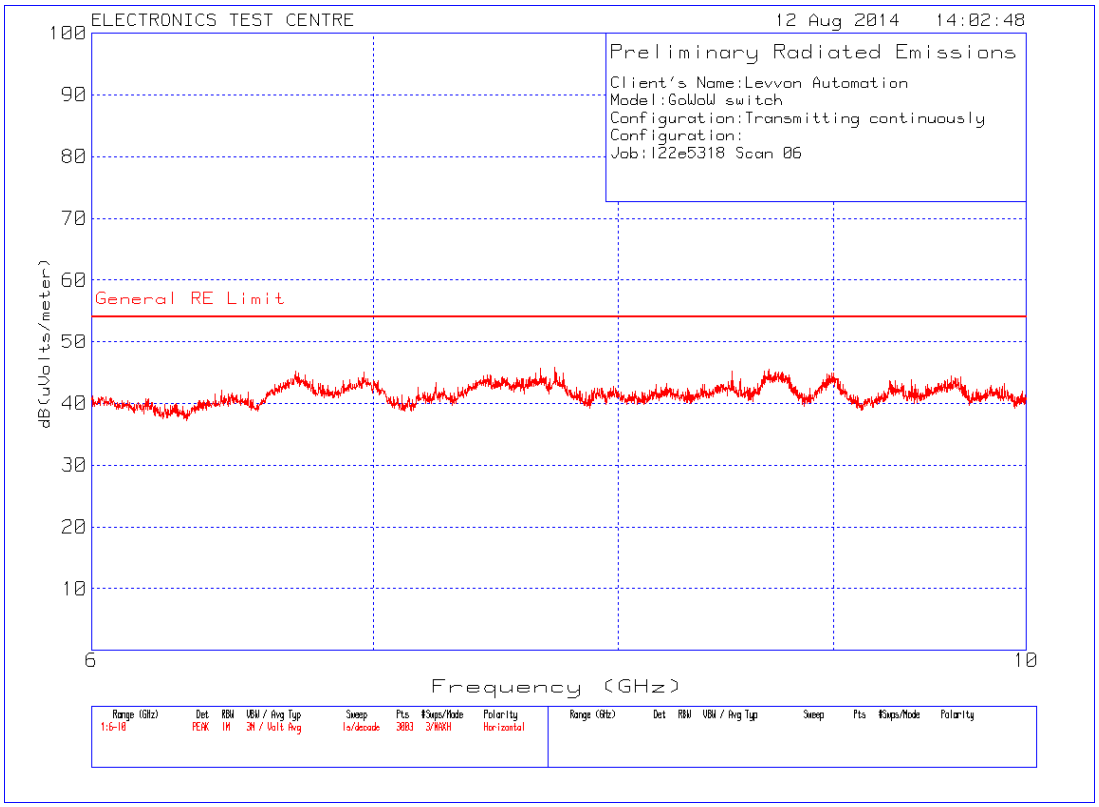


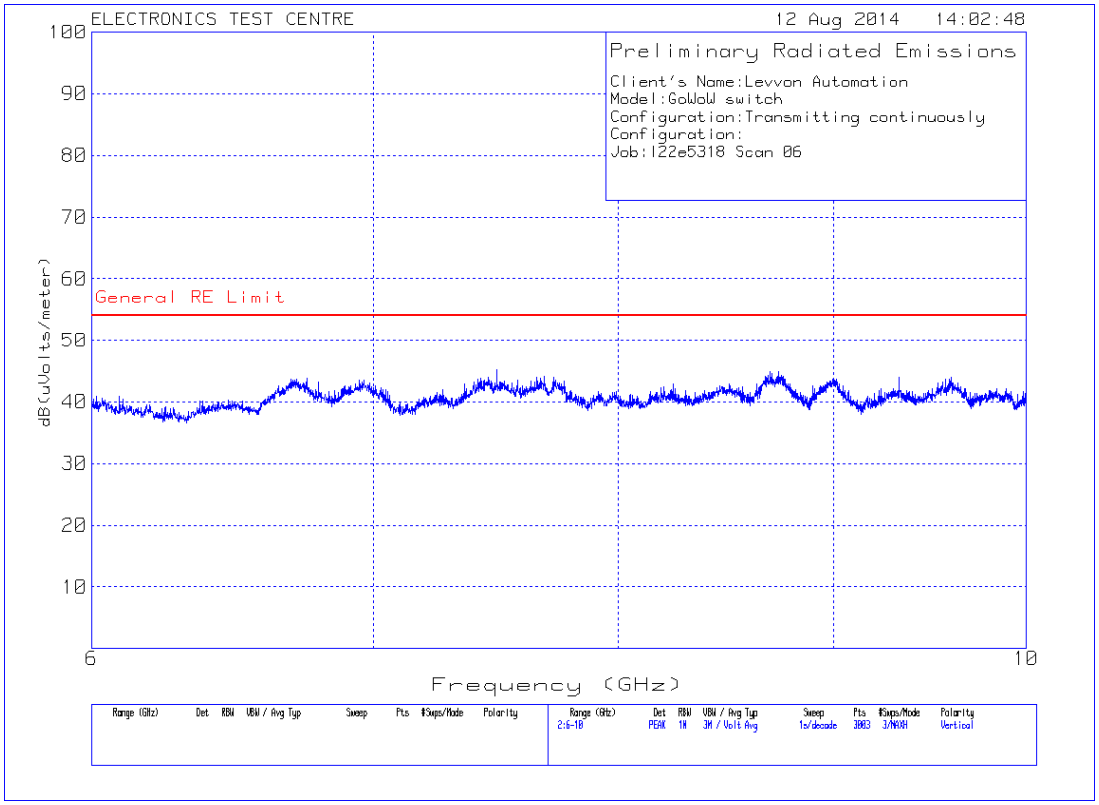
Plot of Radiated Emissions:



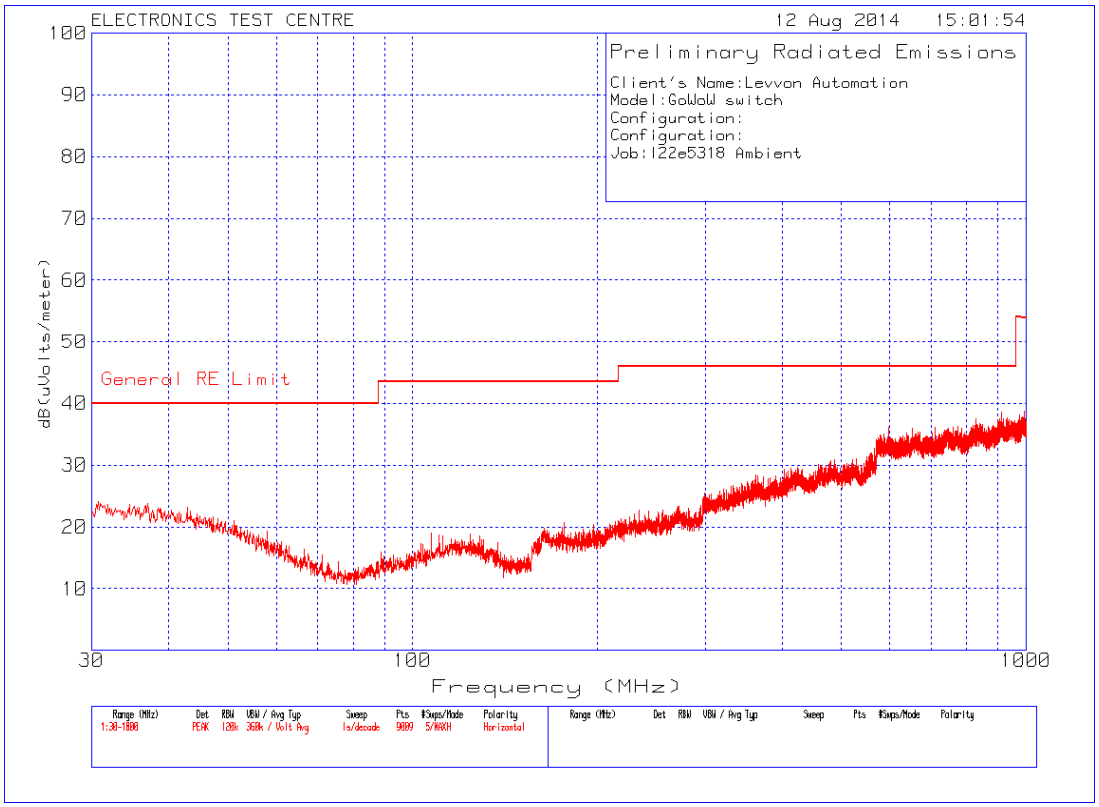
Plot of Radiated Emissions Test Chamber Ambient:



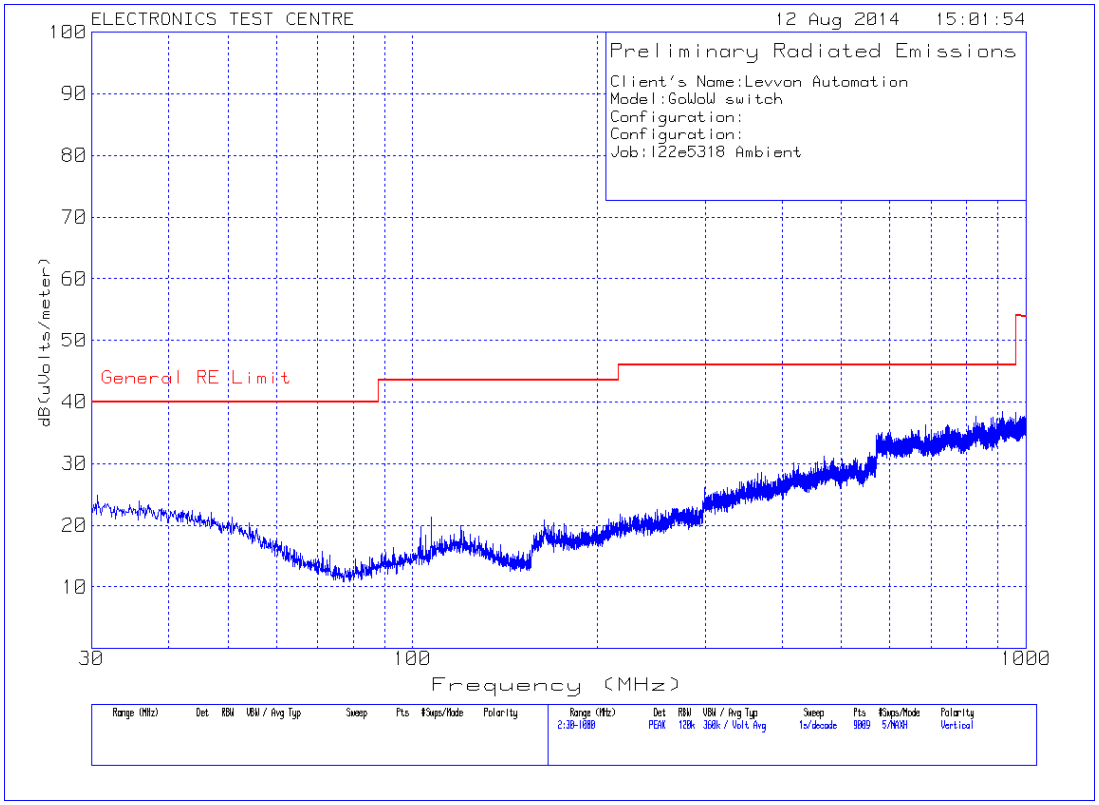
Plot of Radiated Emissions Test Chamber Ambient:



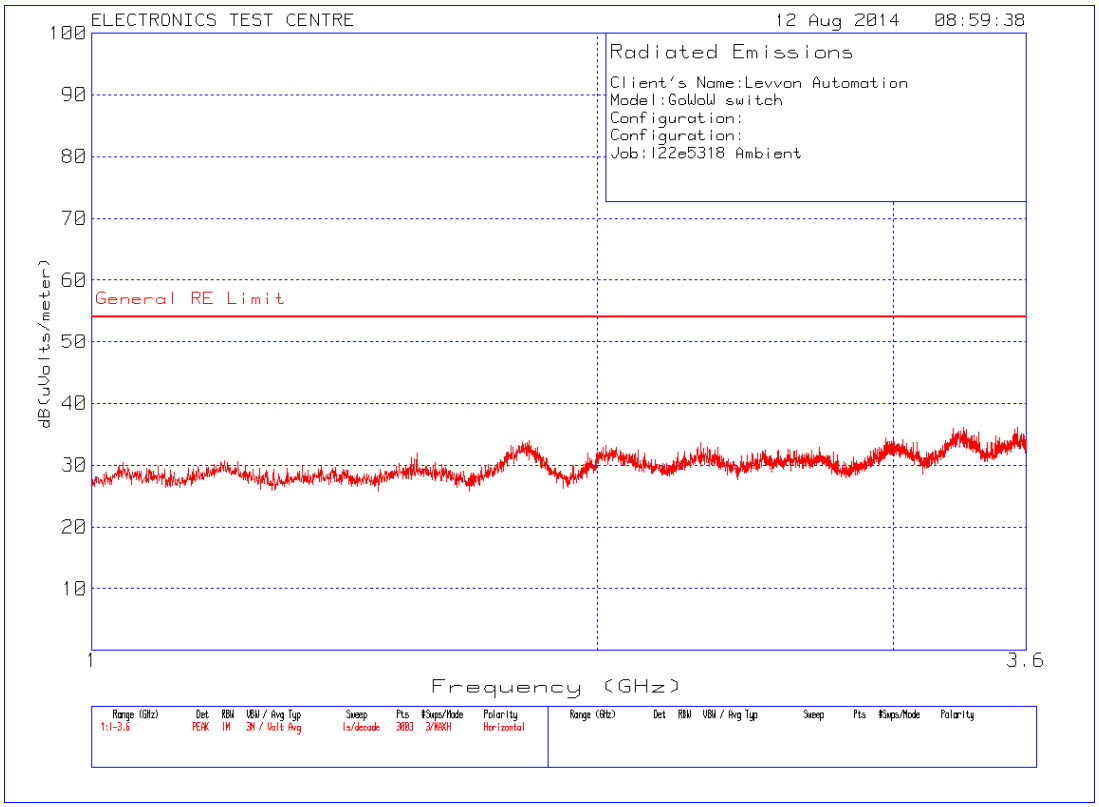
Plot of Radiated Emissions Test Chamber Ambient:



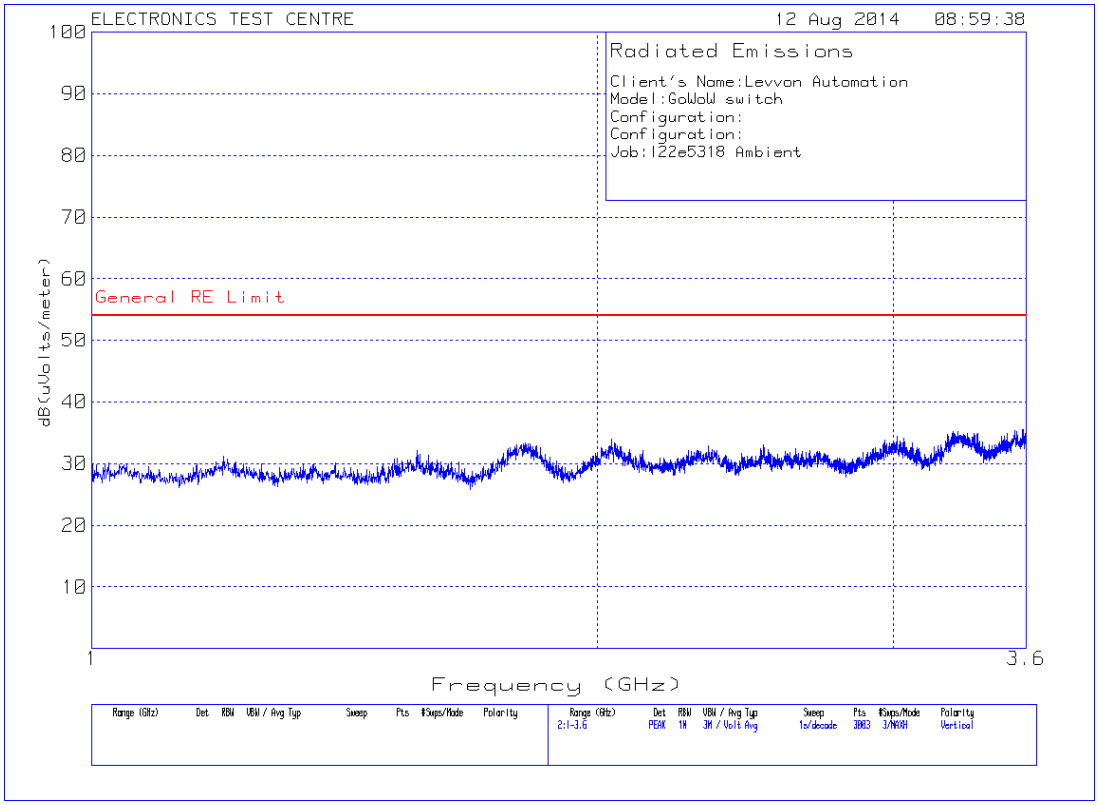
Plot of Radiated Emissions Test Chamber Ambient:



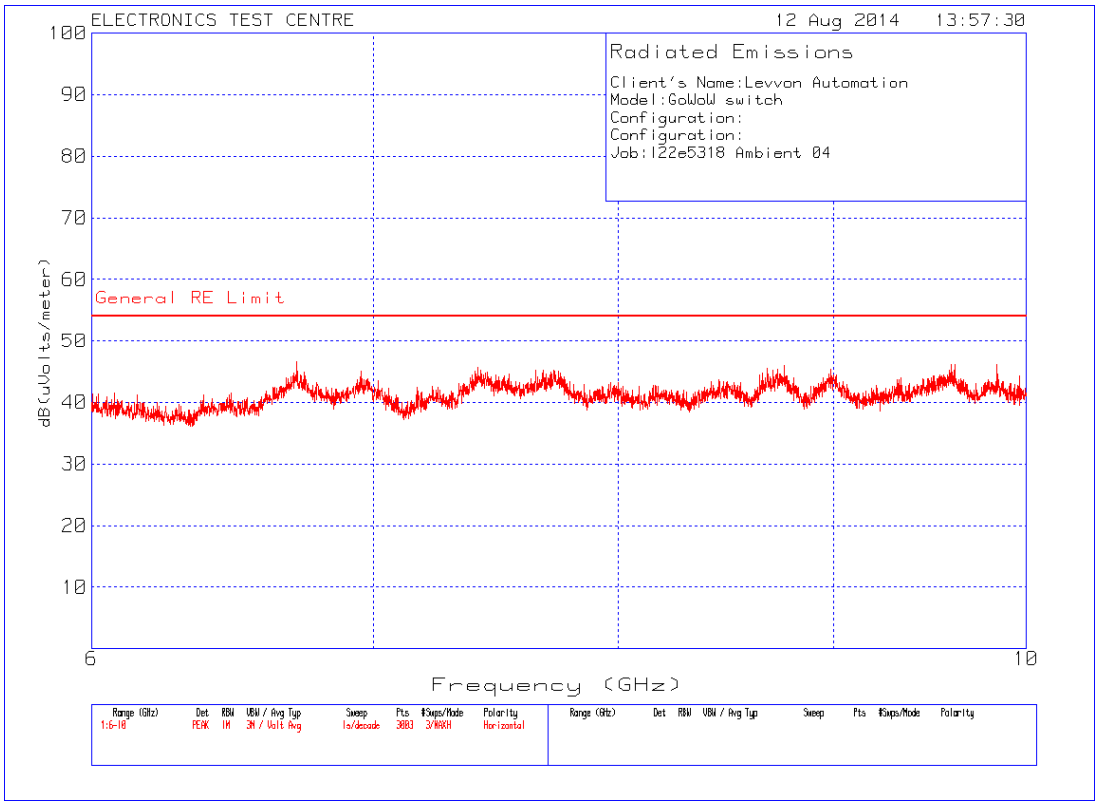
Plot of Radiated Emissions Test Chamber Ambient:



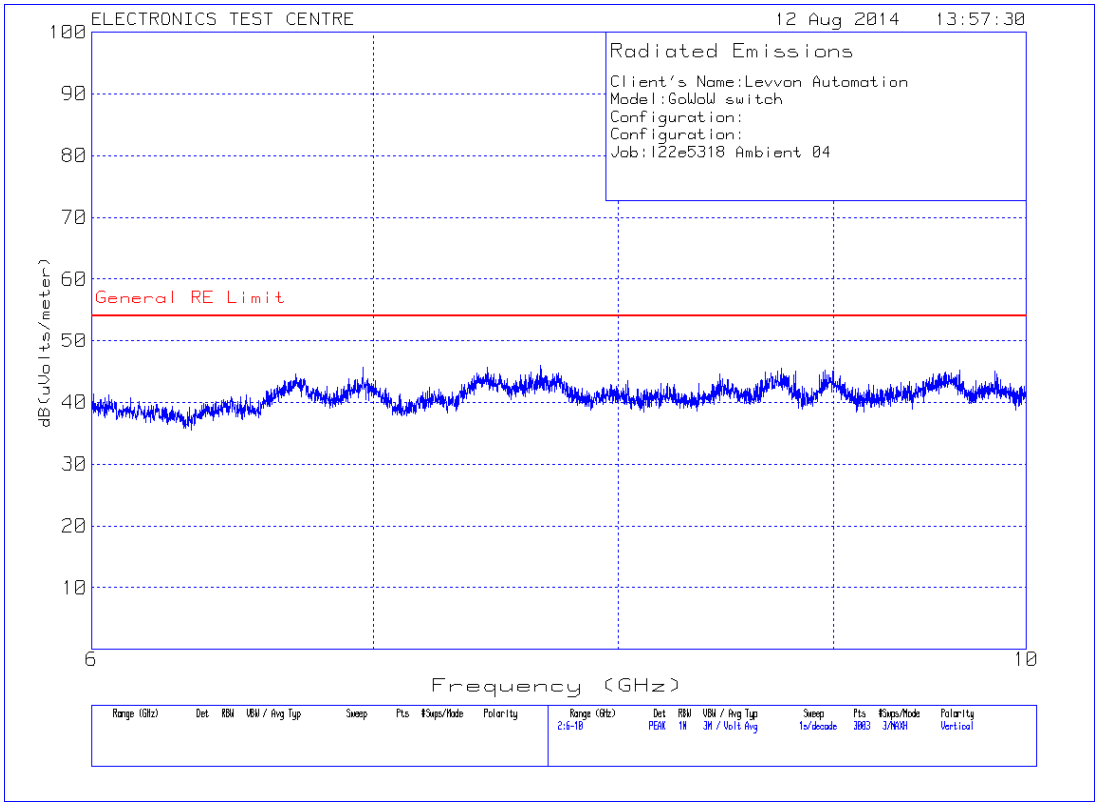
Plot of Radiated Emissions Test Chamber Ambient:



Plot of Radiated Emissions Test Chamber Ambient:



Plot of Radiated Emissions Test Chamber Ambient:



4.5 EFFECTIVE RADIATED POWER

Test Lab: Electronics Test Centre (Airdrie) Test Personnel: Imran Akram Test Date: 15 September 2014	Product: GoConex S1 wireless light switch
Test Result, GoConex S1 wireless light switch:	
The ERP/EIRP was measured using the Substitution Method.	

EUT Peak Reading (dBµV/m)	Substitute Peak Reading (dBµV/m)	Adjustment (dBm)	Sig Gen O/P (dBm)	Tx Cable Loss	Tx Antenna Gain (dBi)	EIRP (dBm)	ERP (dBm)
53.07	53.05	+0.02	-17.50	4.87	7.9	-14.35	-16.50

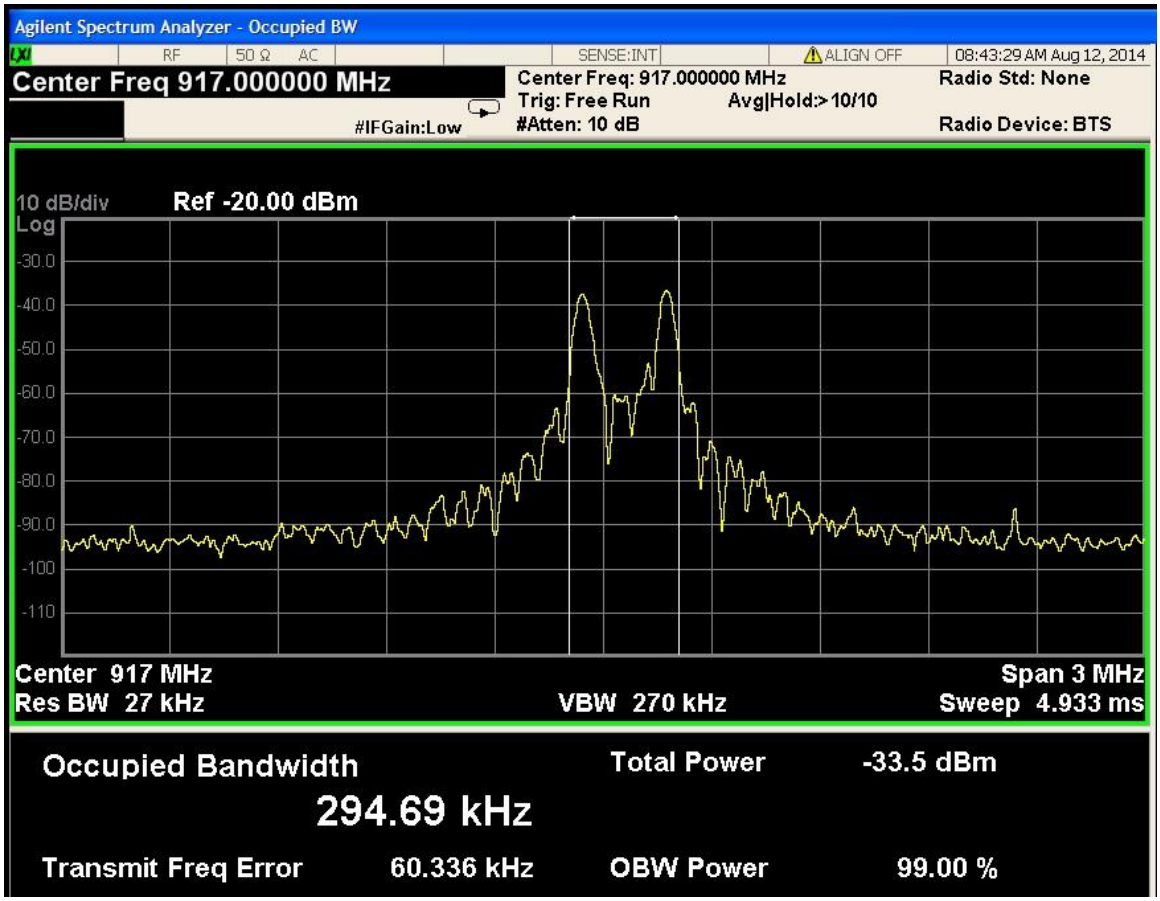
4.6 99% OCCUPIED BANDWIDTH & BAND EDGE

Test Lab: Electronics Test Centre (Airdrie) Test Personnel: David Raynes Test Date: August 12, 2014	Product: GoConex S1 wireless light switch
Test Result, GoConex S1 wireless light switch: **294.69 kHz**	

The wireless light switch applies FSK radio modulation on the frequency 917MHz. Lower frequency is 916.86MHz, while upper frequency is 917.14MHz. Frequency tolerance is ±150 ppm. Below 915.5 MHz, and above 918.5 MHz, the carrier is attenuated by more than 50 dB.

The GoWoW GoConex S1 wireless light switch was not tested for frequency stability at this time.

The EUT is specified for fixed point-to-point operation at 917 MHz only, indoors only.



4.7 FREQUENCY STABILITY (§ 15.249)

Test Lab: Electronics Test Centre (Airdrie) Test Personnel: n/a Test Date: n/a	Product: GoConex S1 wireless light switch
Test Result, GoConex S1 wireless light switch itch: **Not Tested**	
The GoWoW Wireless Switch was not tested for frequency stability at this time. The EUT is specified for fixed point-to-point operation at 917 MHz only, indoors only.	

5.0 TEST FACILITY

5.1 LOCATION

The EUT was tested for Electromagnetic Compatibility at the Electronics Test Centre, located in Airdrie, Alberta, Canada.

The RF Anechoic Chamber (RFAC) is identified as Chamber 1, located in the main building complex at the Electronics Test Centre. Its usable working space measures 10.6 m long x 7.3 m wide x 6.5 m high.

This test site is listed with the FCC under Registration Number 99541. Measurements taken at this site are accepted by Industry Canada per file number IC 2046-1.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in two shielded vestibules located at the side of the main room. Cables are routed through bulkhead panels between the rooms as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

5.2 GROUNDING PLAN

The EUT was located on a Styrofoam table 80 cm above the ground plane.

In accordance with Levven Automation specifications, the EUT was not grounded.

5.3 POWER

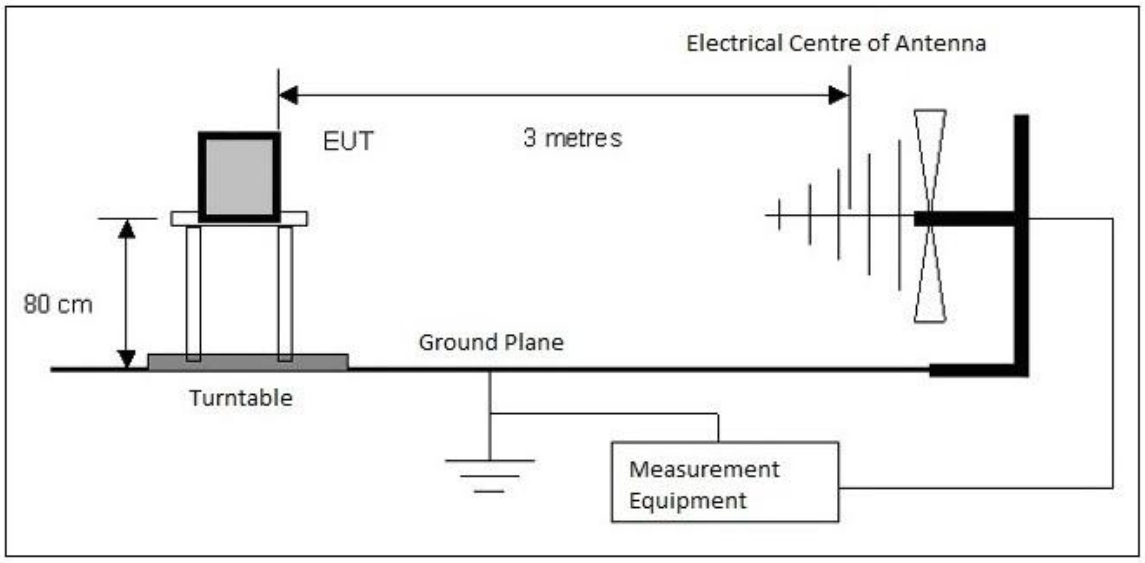
No external power was utilized by the EUT.

5.4 AMBIENT EMISSIONS PROFILE

Ambient radiated electromagnetic emission profiles were generated throughout the tests and are included in the test data.

5.5 TEST CONFIGURATION

The following diagram illustrates the configuration of the EUT test and measurement equipment for Radiated Emissions testing of tabletop equipment.



6.0 TEST EQUIPMENT

The following equipment was used for this procedure. All measurement devices are calibrated annually, traceable to NIST.

6.1 RADIATED EMISSIONS

a) EMI receiver
b) Power Isolation Transformers
c) Biconilog antenna (20 MHz to 2 GHz)
d) DRG horn antenna (1 – 18 GHz)
e) Low noise preamplifier
f) Antenna mast positioner and controller
g) Flush-mounted turntable and controller
h) Personal Computer and EMC software

6.2 CONDUCTED EMISSIONS

a) EMI receiver
b) Line Impedance Stabilization Network, 50 μH
c) Power Isolation Transformers
d) Personal Computer and EMC software

6.3 CALIBRATION

All measurement instrumentation conforms to ANSI C63.2. Calibration is maintained in accordance with manufacturer recommendations. Each measurement device is labeled with its ETC asset number and calibration due date.

6.3.1 Calibration Accuracy

Test equipment used to provide quantitative measurements are calibrated with standards traceable to the National Research Council, National Institute of Standards and Technology or other national standards. Instrumentation systems for emissions measurements have the following accuracies:

Frequency = ± 1 kHz
Amplitude (RE) = ± 4.01 dB
Amplitude (CE) = ± 3.25 dB

6.3.2 Test Equipment Description

The equipment used in the tests was selected from the following list.

Instrument	Manufacturer	Model No.	Asset No.	Calibration Due
EMI Receiver	Agilent	N9038A	6130	17 June 2015
Measurement System Software	Underwriters Laboratories	Version 9.5	ETC-SW-EMC 2.1	n/a
RF Power Meter	Hewlett Packard	HP 437B	4423	19 March 2015
Power Sensor	Hewlett Packard	HP 8481A	4424	19 March 2015
Biconilog Antenna	ARA	LPB-2520/A	4318	7 February 2015
Biconilog Antenna	ARA	LPB-2520/A	4281	23 July 2015
Dual Ridged Guide Antenna	Tensor	4105	9588	7 February 2015
Low Noise Amplifier	MITEQ	JS43-01001800-21-5P	4354	Monitored

Appendix A

GoConex S1 wireless light switch

Test Sample Description
(from data provided by Levven Automation Inc.)

Product Application	**Product Category**
Commercial ✗ Military o	Telecommunications o Information Technology o Surface Transportation o Aerospace o Test & Measurement o Other ✗: Commercial & Residential lighting
Product Name	GoWoW (changed to GoConex S1 wireless light switch)
Part/Model No.	Switch
Serial Number	n/a
Power Requirements: **(Voltage, AC/DC, Hz, Current)**	1 Internal CR-2032 lithium battery
Typical Installation Instructions or Configuration	Wireless light switch
Ground Connection **(in addition to power cord)**	nil
Internally Generated Frequencies	917 MHz
Peripheral Support Equipment	nil
Description and number of interconnecting Leads & Cables	nil
Brief Functional Description	Wireless light switch

END OF DOCUMENT