Electromagnetic Compatibility
Test Report

Test Report No: NLK 260114
Issued on: January 26, 2014

Product Name
NGL System-
Smeller Unit

Tested According to
FCC 47 CFR, Part 15B & C

Tests Performed for
Nleak Technologies Ltd.
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Electrical Testing

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Test Report Details:

Test commencement date:	01.01.2014
Test completion date:	21.01.2014
Customer's representative:	Menachem Liberman
Issued on:	26.01.2014

Assessment Information:

This report contains an assessment of the EUT against Electromagnetic Compatibility based upon tests carried out on the samples submitted. The results contained in this report relate only to the items tested. Manufactured products will not necessarily give identical results due to production and measurement tolerances. QualiTech, EMC Lab does not assume responsibility for any conclusion and generalization drawn from the test results with regards to other specimens or samples of type of the equipment represented by test item.

The EUT was setup and exercised using the configuration, modes of operation and arrangements defined in this report only.

Modifications:

Modifications made to the EUT

None

Modifications made to the Test Standard

None

Summary of Compliance Status:

FCC Part 15, Subpart C Part 15.231 – Intentional Radiators

Test Spec. Clause	Test Case	Remarks
FCC Part 15, Subpart B and C – Unintentional and Intentional Radiators		
47 CFR §15.231(b)	Field Strength of Fundamental and Spurious emission	Pass
47 CFR §15.109	Radiated Emission, Unintentional Radiator	Pass
47 CFR §15.107, §15.207	Conducted Emissions	Pass
47 CFR §15.203	Antenna Connector requirement	Pass
47 CFR §15.231(c)	Occupied bandwidth	Pass

Table of Contents

1. General Description

1.1. Description of the EUT /test Item:

Product name:Smeller Unit

FCC ID: AFOINGLSM

EUT Description-GAS DETECTOR UNIT

Triple+ NGL™ detectors are capable of detecting LPG and Natural Gas. Triple+ NGL™ housing is a molded shell made of fire safety approved reinforced nylon. Each detector includes an external power adaptor, an on board controller, and a primary RF communication layer. Triple+ NGL™ detectors are rated IPX2D. Gas detectors must be connected to an electrical power source at all times. The detectors set off an audio-visual alarm, and wirelessly transmit a signal to the Shut off Unit, consequently shutting off the gas flow at the main gas valve.

Detector Specifications

Calibration GAS	LPG- Butane, NG- Methan
Dimensions [mm]	Ø 101x 40
Weight	175gr
Operating Voltage	5V
External Power Supply	Input 110 -240 V AC
Nominal operating current	500mA

RF Specifications	
Internal Clock	32 MHz
Operation Frequency	433.85 MHz
Bandwidth	100 KHz
Transmit duration	3 ms
Transmit interval	5 sec

2. Method of Measurements

2.1. Radiated Emissions Measurements in the restricted bands:

For radiated emissions, which fall in the restricted bands the spectrum from 30MHz to 12.7 GHz was investigated following the guidelines in ANSI C63.4-2003

Measurements were performed with peak detector and repeated averaged with VBW=10Hz for frequencies above 1GHz, and quasi-peak detector below 1GHz.

2.2. Radiated Field Strength Measurements:

During the testing process, the EUT was controlled via dedicated software. The EUT was operated at maximum power, continuous transmission and FSK data modulation.

The EUT was placed in an anechoic chamber, on a non-metallic table/support, 0.8m above the turntable, at 3 meter from the receive antenna, and its position where the maximum antenna gain occurs was identified. The peak and average readings of emissions were measured and recorded.

2.3. Conducted Measurement:

The transmitter output was connected to the Spectrum Analyzer via an RF attenuator, and peak output power was measured.

2.4. Radiated Emission measurements:

During the testing process, the EUT was controlled via dedicated software. The EUT was operated at in receive mode.

Measurements were performed at a 3-meter measurement distance in the semi-anechoic chamber in order to evaluate the radiated electromagnetic interference characteristics of the EUT. The EUT was placed on a non-metallic table/support, 0.8m above the turntable, was configured, arranged and operated in a manner consistent with typical application and load conditions.
An appropriate antenna depending upon the frequency range, per ANSI C63.4-2003 clause 4.1.5 was used. While the turntable was being rotated, the height of the antenna was varied from 1 to 4m for the frequency range of 30 MHz to 12.7 GHz. The highest radiated emission was detected by manipulating the system cables to the worst-case position. This process was repeated for both antenna polarizations.
The amplitudes of worst-case emission were measured with the detector modes and resolution bandwidths over various frequency ranges according to the requirements of ANSI C63.4-2003 clause 4.2.

3. Report of Measurements and Examinations

3.1. Field Strength Emission of Fundamental and Spurious Emission

Reference document:	**47 CFR §15.231(b)**		
Test Requirements:	In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the values given in Table 3.1.1. Compliance with the provisions of §15.205 shall be demonstrated. Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c).		
Test setup:	See sec 2.1	Pass	
Method of testing:	Radiated		
Operating conditions:	Under normal test conditions		
S.A. Settings:	f <1GHz: RBW: 120kHz,VBW**:** 300kHz f >1GHz: RBW: 1MHz, VBW**:** 3MHz		
Mode of operation:	worse case result of intentional & unintentional transmission (max hold trace)		
Environment conditions:	Ambient Temperature: 21.0 °C	Relative Humidity: 54.4%	Atmospheric Pressure: hPa
Test Result:	See below	See Plot 3.1.1 – Plot 3.1.18	

Table 3.1.1 Radiated emission limit according to FCC Part 15, Section 231(b)

Fundamental frequency, MHz	Field strength of fundamental, dBuV/m		Field strength of spurious emissions, dBuV/m	
	Peak	AVG	Peak	AVG
433.85	100.6	80.6	80.6	60.6

Table 3.1.2 Radiated emission limit according to FCC Part 15, Section 209(for emission in Restricted Bands, see §15.231(b.2) and §15.205)

Frequency, MHz	Radiated emissions limit		
	Peak	QP	AVG
0.009 – 0.090	148.5 – 128.5[1]	NA	128.5 – 108.5[1]
0.090 – 0.110	NA	108.5 – 106.8[1]	NA
0.110 – 0.490	126.8 – 113.8[1]	NA	106.8 – 93.8[1]
0.490 – 1.705	NA	73.8 – 63.0[1]	NA
1.705 – 30.0		69.5	
30 – 88		40.0	
88 – 216		43.5	
216 – 960		46.0	
960 - 1000		54.0	
1000 – 10th harmonic	74.0	NA	54.0

[1]Linear interpolation

Test Results:

Table 3.1.3 Field Strength of Fundamental measurements results

Frequency, MHz	Peak			AVG			Duty Cycle factor***	Antenna polarization	Pass/Fail
	Measured emission, dB(μV/m)	Limit, dB(μV/m)*	Delta, [dB]	Calculated emission, dB(μV/m)**	Limit, dB(μV/m)	Delta, [dB]			
Gas Detector unit transmit mode									
433.050	93.45	100.60	-7.15	62.95	80.60	-17.65	-30.50	V	Pass
433.050	99.60	100.60	-1.00	69.10	80.60	-11.50	-30.50	H	Pass

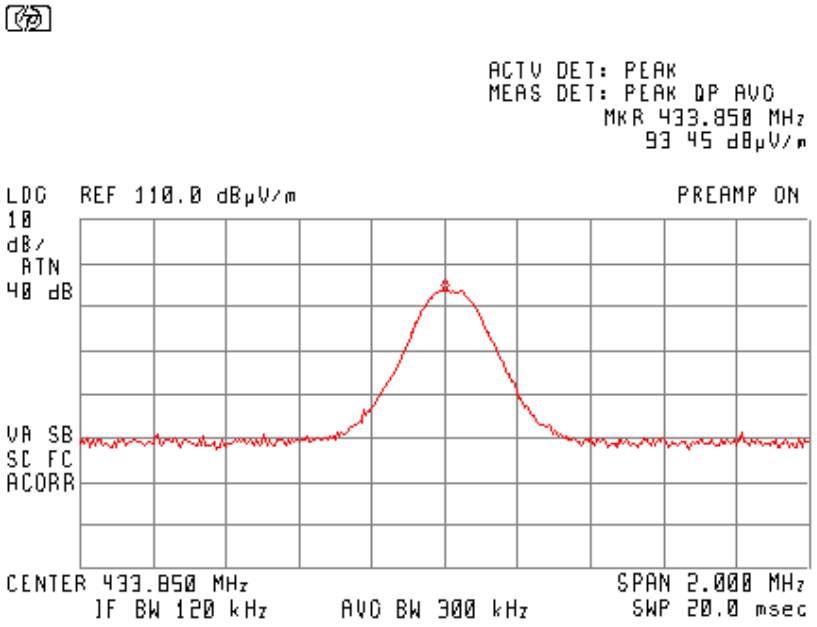
*Peak Limit = AVG Limit + 20dB
**AVG calculated emission = Peak measured emission + Duty cycle factor
***Duty Cycle factor= 20 × (Pulse duration ÷ Pulse period × Number of pulses within pulse train) = 20 ×log (3msec ÷ 100msec) = -30.5 dB

Table 3.1.4 Radiated emission measurements results

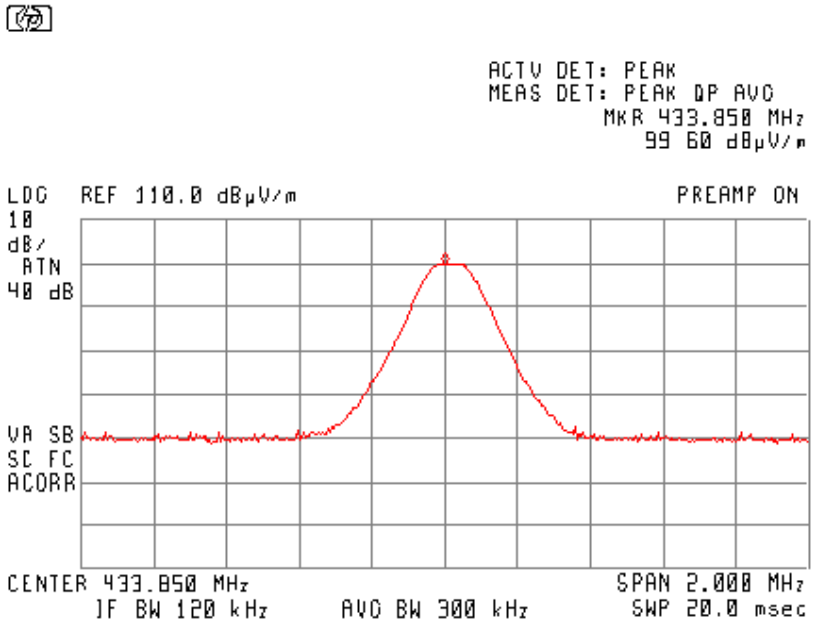
Frequency [MHz]	Peak emission, dB(μV/m)	Quasi Peak			Antenna polarization	Antenna height, m	Turn-table position,[°]	Pass/Fail
		Radiated Emission dB(μV/m)	Limit, dB(μV/m)	Delta, [dB]				
Gas Detector unit transmit mode								
30.00	36.5	30.9	40.0	-9.1	V	1.0	25	Pass
37.90	31.7	25.8	40.0	-14.2	V	1.0	0	Pass
46.20	33.1	27.7	40.0	-12.3	V	1.3	30	Pass
92.40	33.9	28.5	43.5	-15.0	V	1.0	0	Pass
142.800	33.4	28.1	43.5	-15.4	H	1.1	0	Pass
144.000	34.9	30.2	43.5	-13.3	V	1.1	10	Pass
867.700	41.4	40.2	46.0	-5.8	V	1.0	330	Pass
867.700	47.8	47.2	60.6*	-13.4	H	1.0	330	Pass*

Note: Radiated Emission [dBμV/m] = measured [dBμV] + Correction-factor [dB(1/m)]
Correction Factor = Antenna factor + Cable Loss
* According to FCC Part 15, Section 231(b) the spurious emission limit is 60.6 dB(μV/m), not in the Restricted Band (15.205)

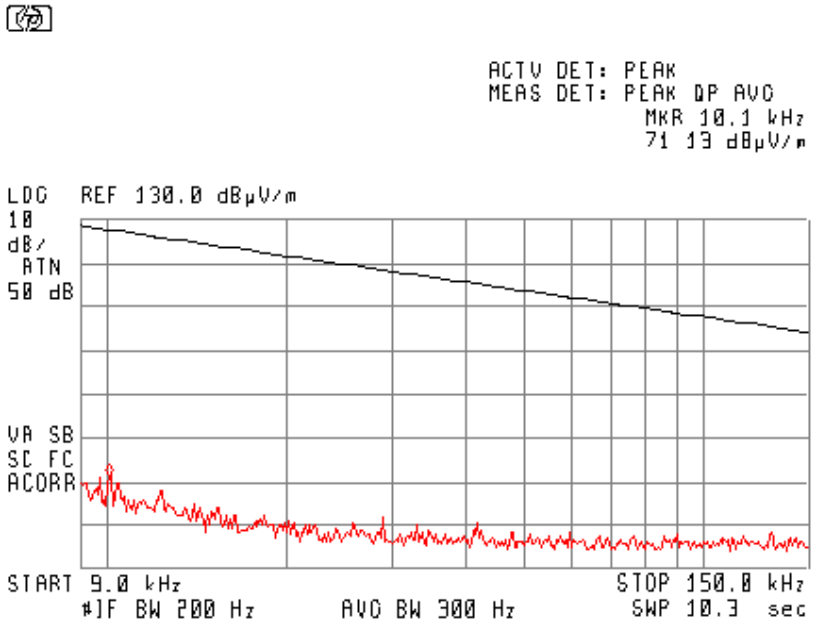
Plot 3.1.1 Field Strength of Fundamental measurements, vertical polarization



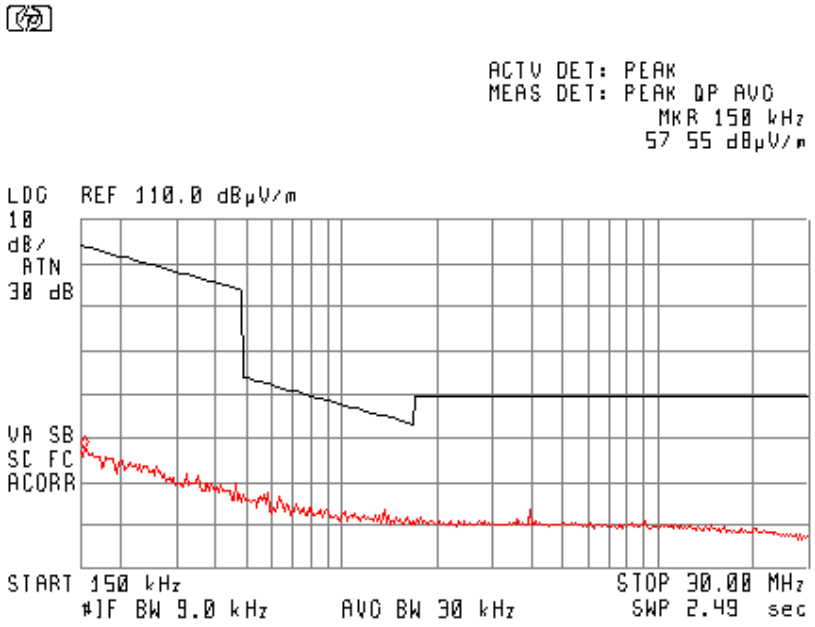
Plot 3.1.2 Field Strength of Fundamental measurements, horizontal polarization



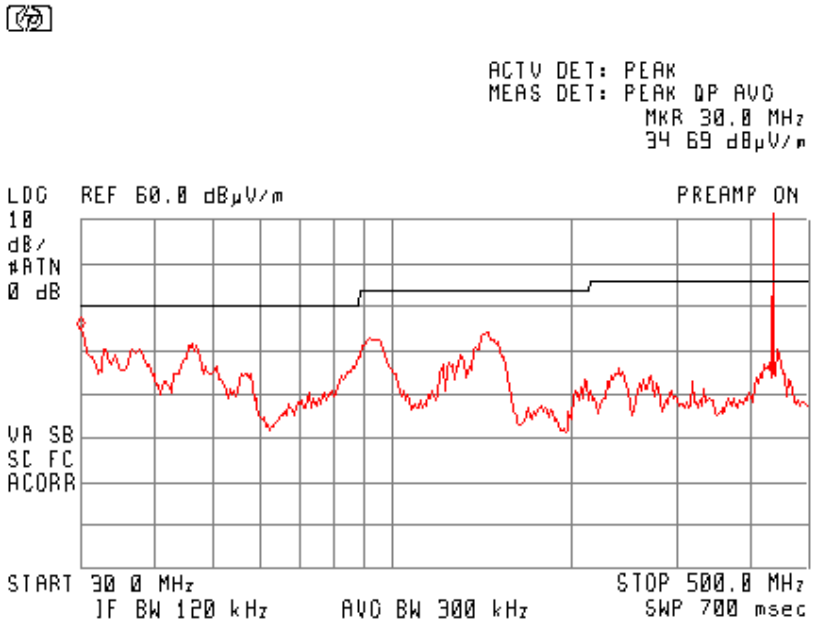
Plot 3.1.3 Radiated emission measurements in 9 – 150 kHz range, vertical polarization



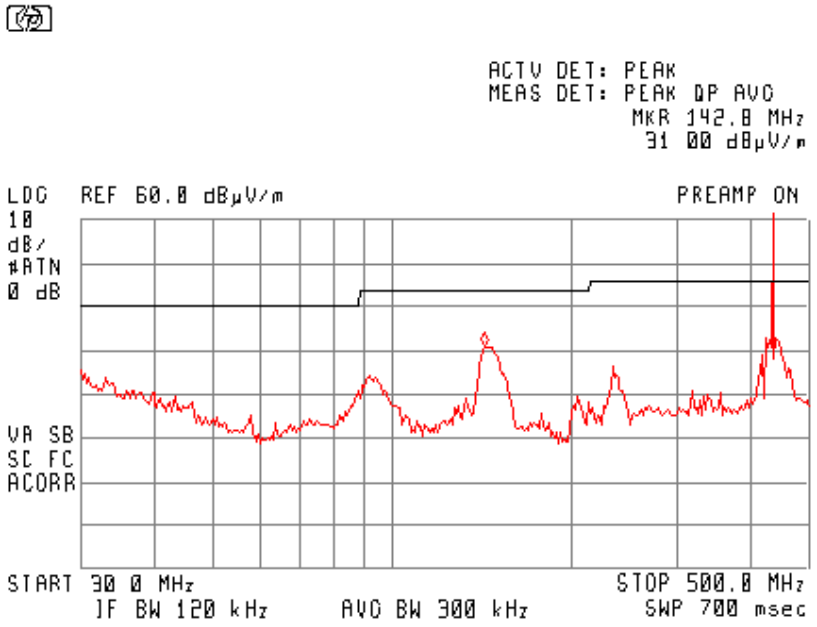
Plot 3.1.4 Radiated emission measurements in 150 kHz – 30 MHz range, horizontal polarization



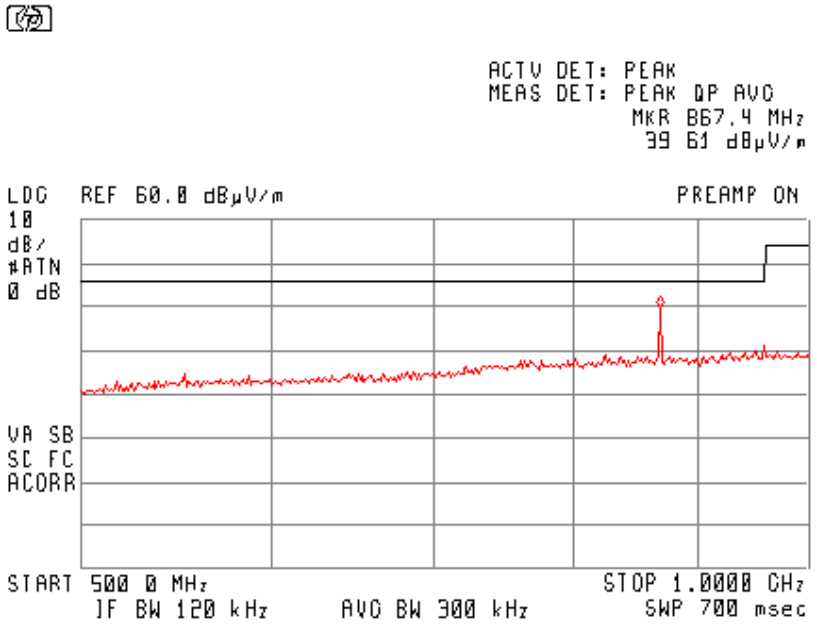
Plot 3.1.5 Radiated emission measurements in 30– 500 MHz range, vertical polarization



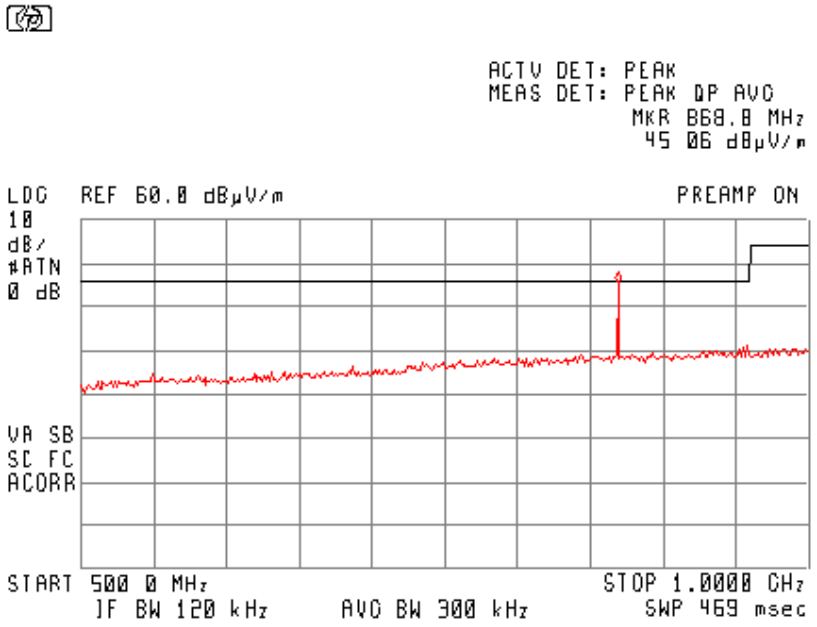
Plot 3.1.6 Radiated emission measurements in 30– 500 MHz range, horizontal polarization



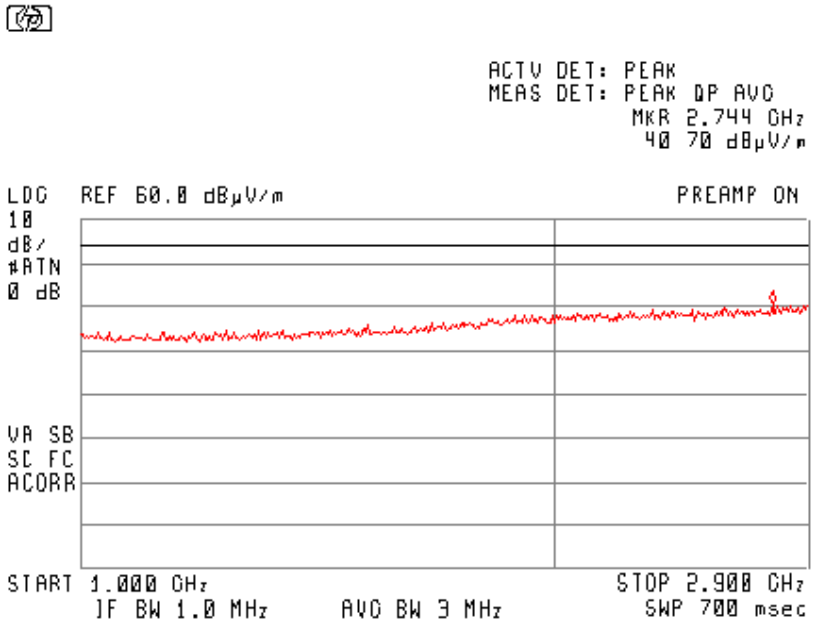
Plot 3.1.7 Radiated emission measurements in 500– 1000 MHz range, vertical polarization



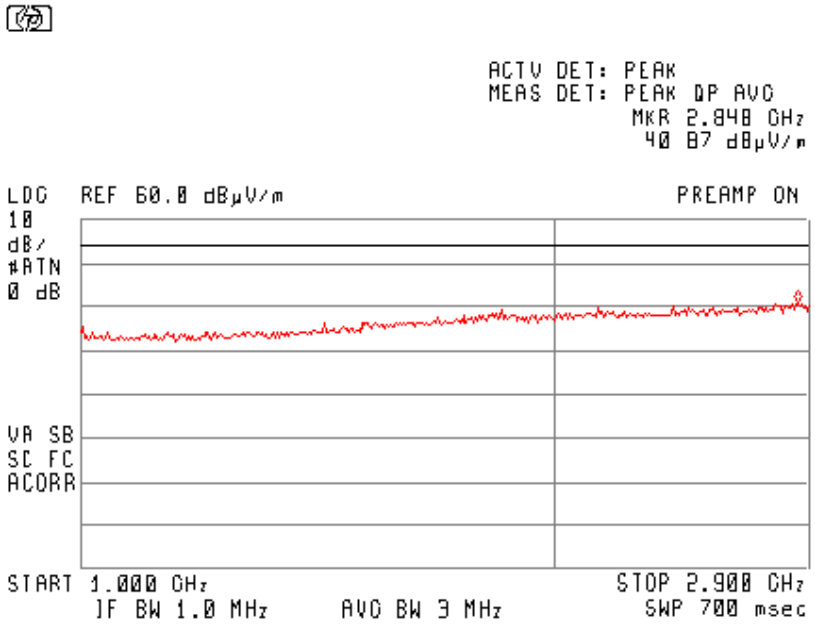
Plot 3.1.8 Radiated emission measurements in 500– 1000 MHz range, horizontal polarization



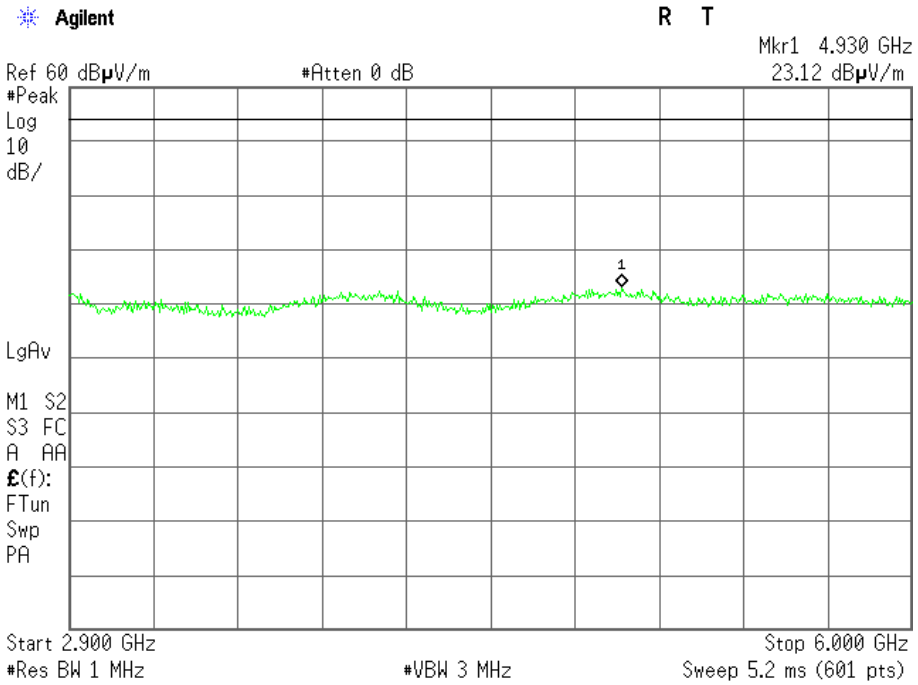
Plot 3.1.9 Radiated emission measurements in 1– 2.9 GHz range, vertical polarization



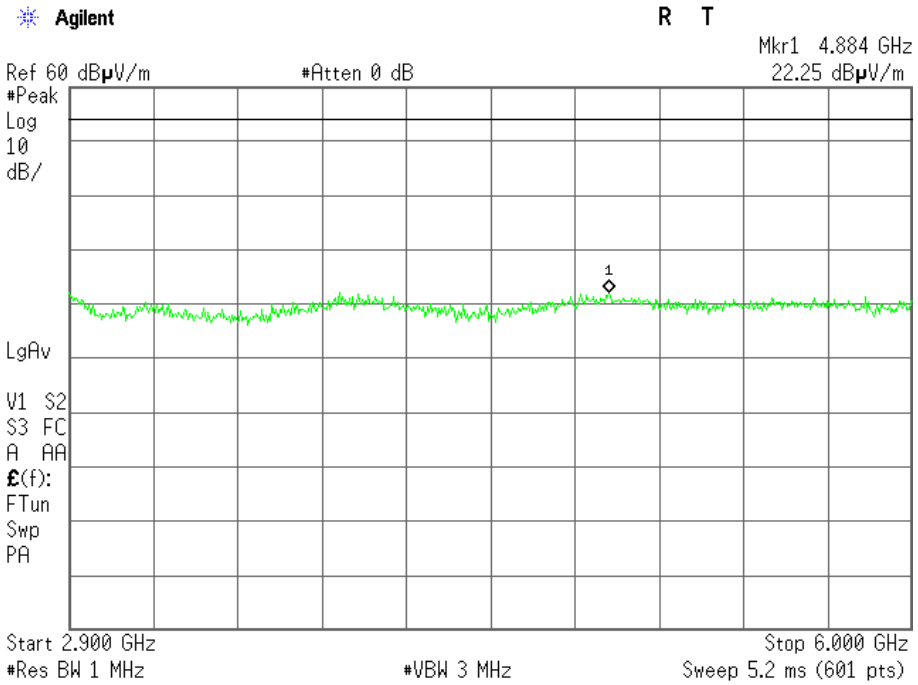
Plot 3.1.10 Radiated emission measurements in 1– 2.9 GHz range, horizontal polarization



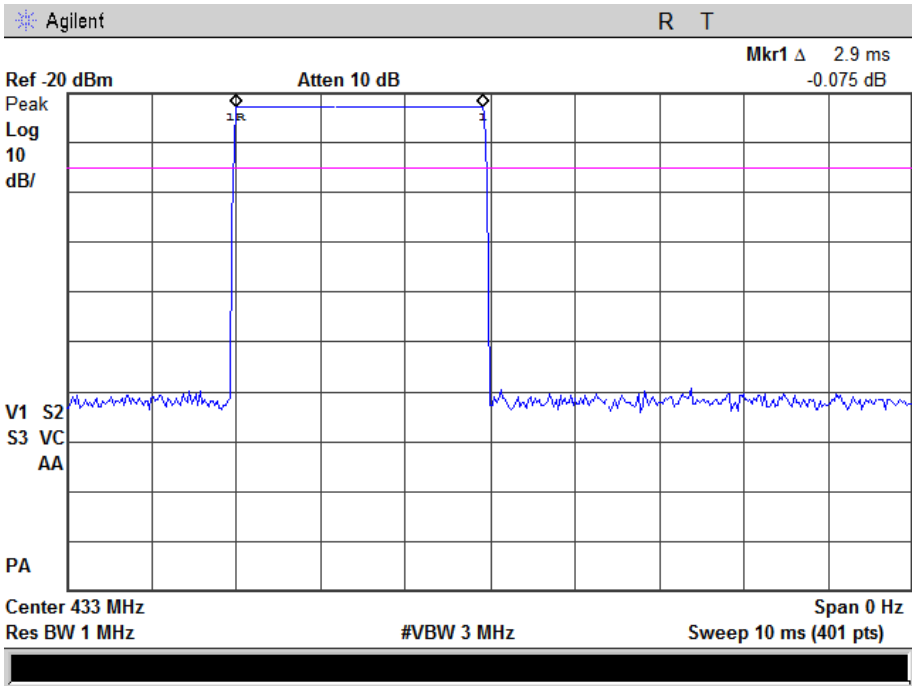
Plot 3.1.11 Radiated emission measurements in 2.9– 6.0 GHz range, vertical polarization



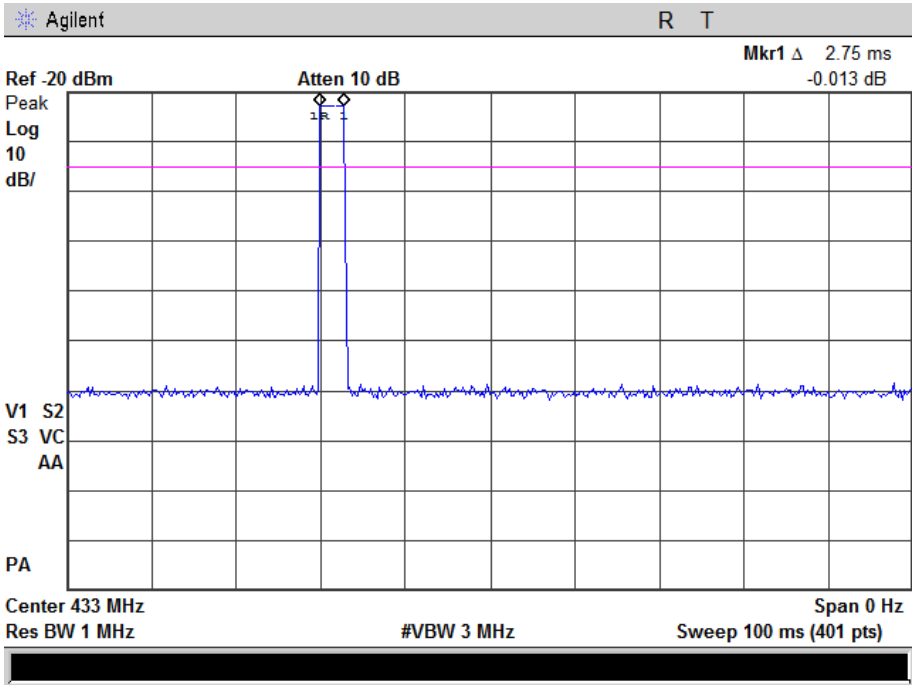
Plot 3.1.12 Radiated emission measurements in 2.9– 6.0 GHz range, horizontal polarization



Plot 3.1.13 Transmission pulse duration



Plot 3.1.14 Number of pulses in 100ms period



Duty Cycle correction factor for AVG = 20*LOG(3/100) = -30.5 dB

Figure 3.1.1 Radiated emission measurements below 30 MHz test setup

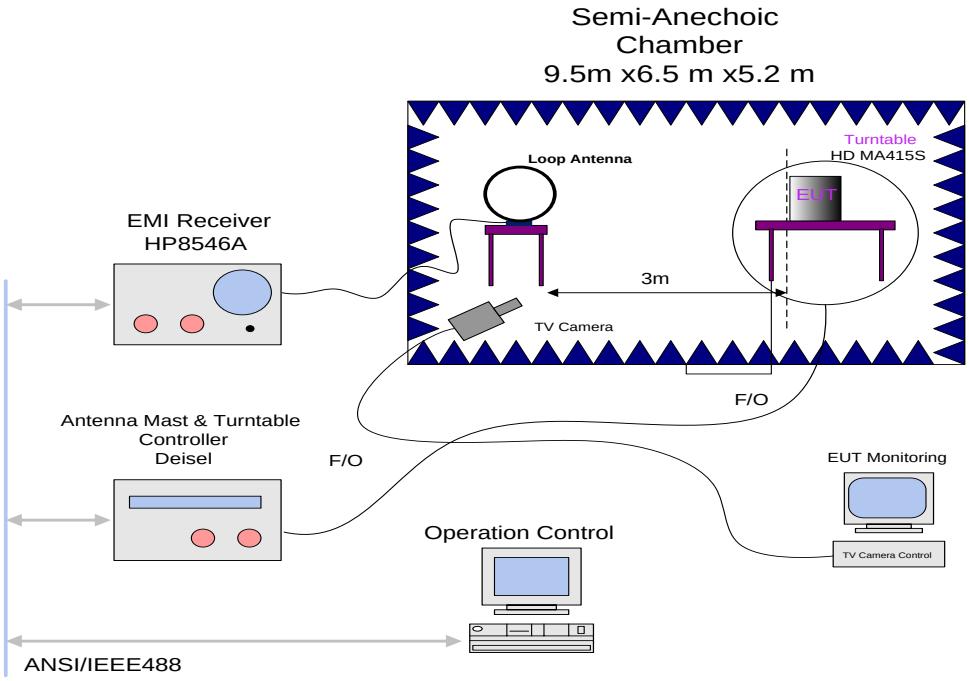
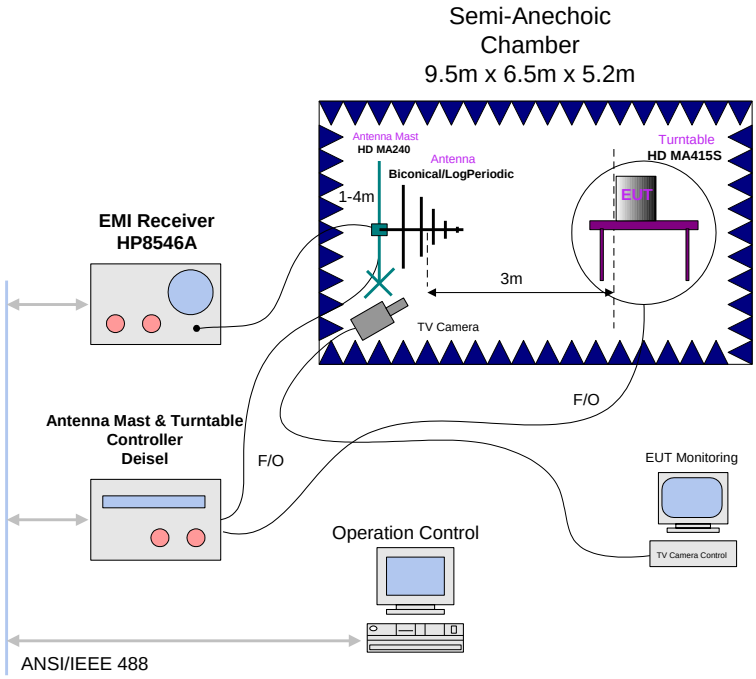


Figure 3.1.2 Radiated emission measurements above 30 MHz test setup



3.2. Radiated Emission, Unintentional Radiator

Reference document:	**47 CFR §15.109, Class B**		
Test Requirements:	The field strength of radiated emissions from unintentional radiators at a distance of 3m shall not exceed the values given in Table 3.2.1		
Test setup:	See sec 2.1	Pass	
Method of testing:	Radiated		
Operating conditions:	Under normal test conditions		
S.A. Settings:	f <1GHz: RBW: 120kHz,VBW**:** 300kHz f >1GHz: RBW: 1MHz, VBW**:** 3MHz		
Mode of operation:	worse case result of intentional & unintentional transmission (max hold trace)		
Environment conditions:	Ambient Temperature: 21.0 °C	Relative Humidity: 54.4%	Atmospheric Pressure: hPa
Test Result:	See below	See Plot 3.1.1 – Plot 3.1.18	

Table 3.2.1 Radiated emission limits

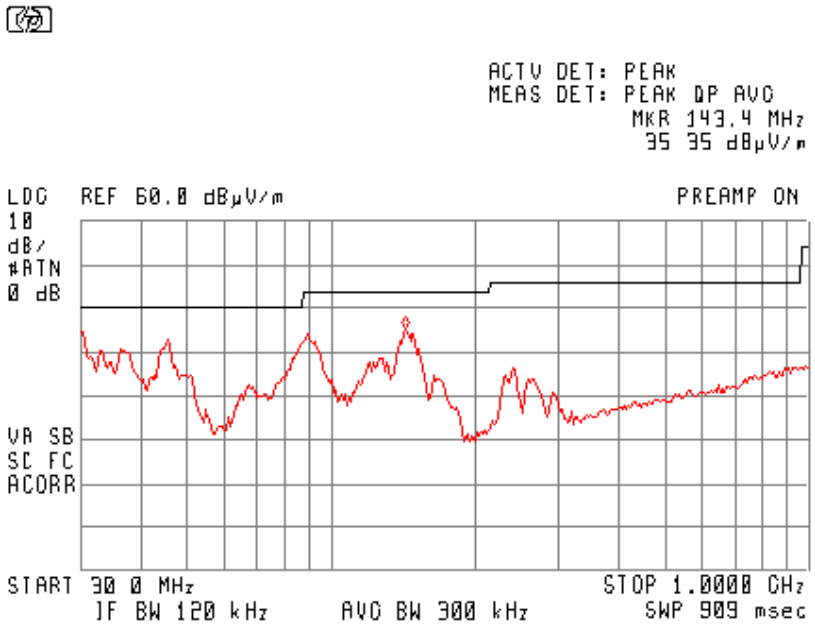
Frequency, MHz	**Radiated emissions limit**					
	Class A			**Class B**		
	Peak	**QP**	**AVG**	**Peak**	**QP**	**AVG**
30 - 88	NA	49.5	NA	NA	40.0	NA
88 - 216		54.0			43.5	
216 - 960		56.9			46.0	
960 - 1000		60.0			54.0	
1000 - 5th harmonic	80.0	NA	60.0	74.0	NA	54.0

Table 3.2.2 Radiated emission measurements results

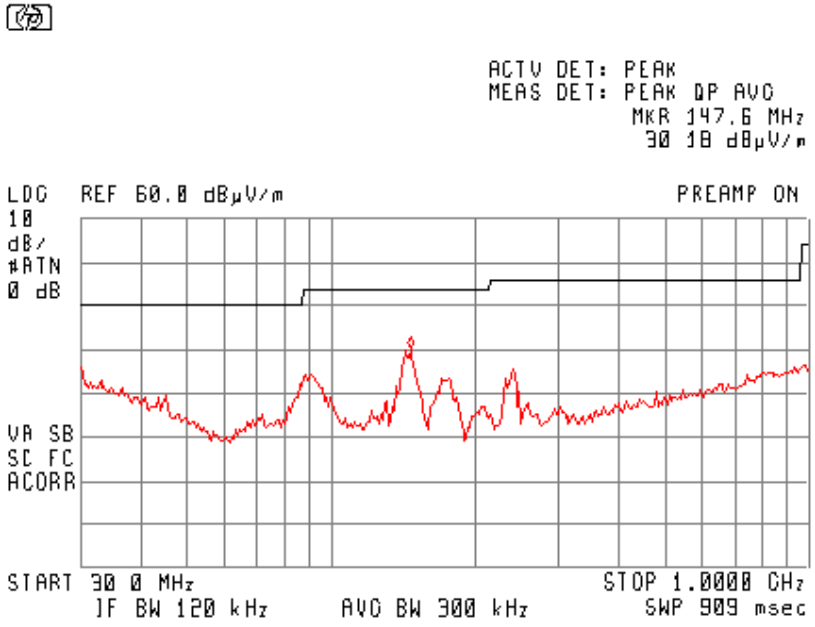
Frequency [MHz]	**Peak emission, dB(µV/m)**	**Quasi Peak**			**Antenna polarization**	**Antenna height, m**	**Turn-table position,[°]**	**Pass/Fail**
		Radiated Emission dB(µV/m)	**Limit, dB(µV/m)**	**Delta, [dB]**				
Gas Detector unit and Gas Shut OFF unit in receive mode								
30.360	35.80	30.00	40.00	-10.00	V	1.0	0	Pass
45.700	33.90	27.80	40.00	-12.20	V	1.3	30	Pass
89.400	35.10	29.80	43.50	-13.70	V	1.0	0	Pass
143.400	36.00	30.10	43.50	-13.40	V	1.1	0	Pass
147.600	31.40	25.60	43.50	-17.90	H	1.1	10	Pass

Note: Radiated Emission [dBµV/m] = measured [dBµV] + Correction-factor [dB(1/m)]
Correction Factor = Antenna factor + Cable Loss

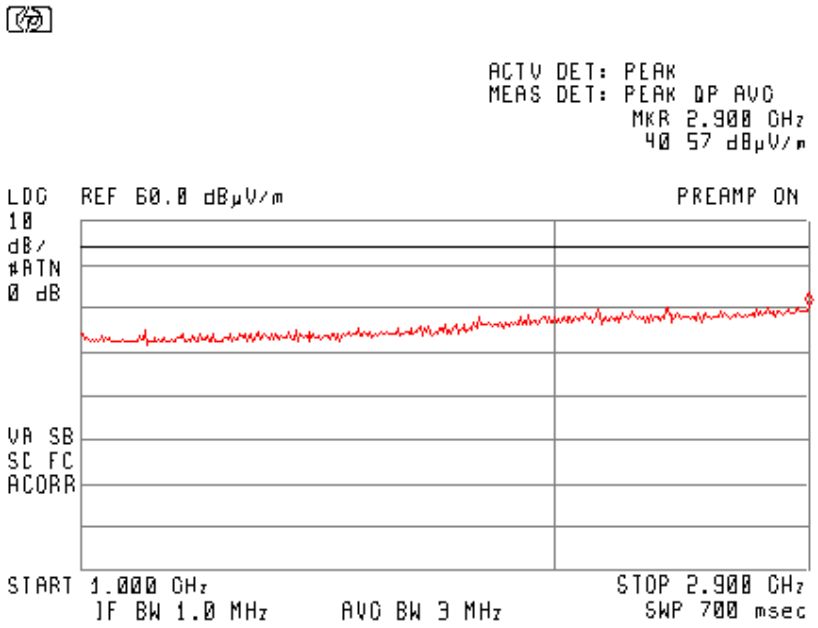
Plot 3.2.1 Radiated emission measurements in 30– 1000 MHz range, vertical antenna Gas Detector unit + Shut OFF unit, receive mode



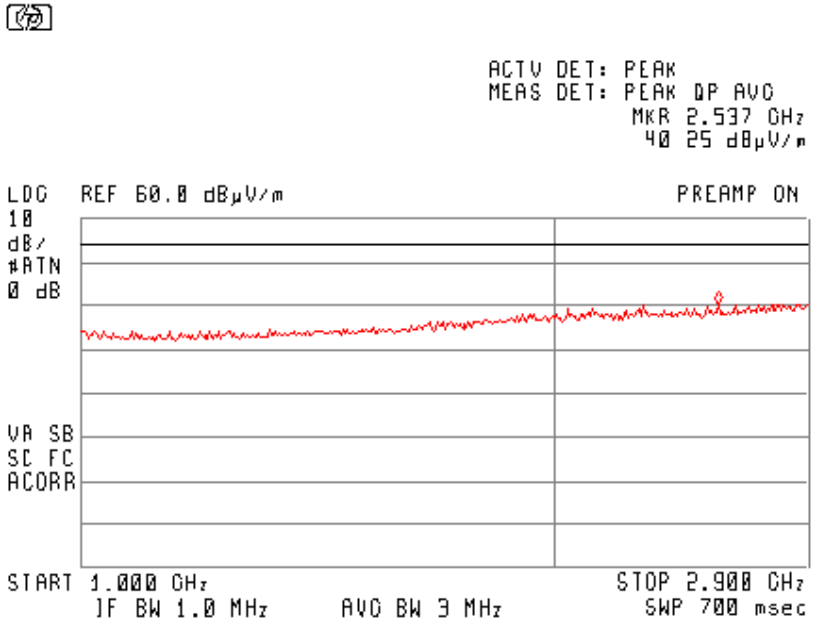
Plot 3.2.2 Radiated emission measurements in 30– 1000 MHz range, horizontal antenna Gas Detector unit + Shut OFF unit, receive mode



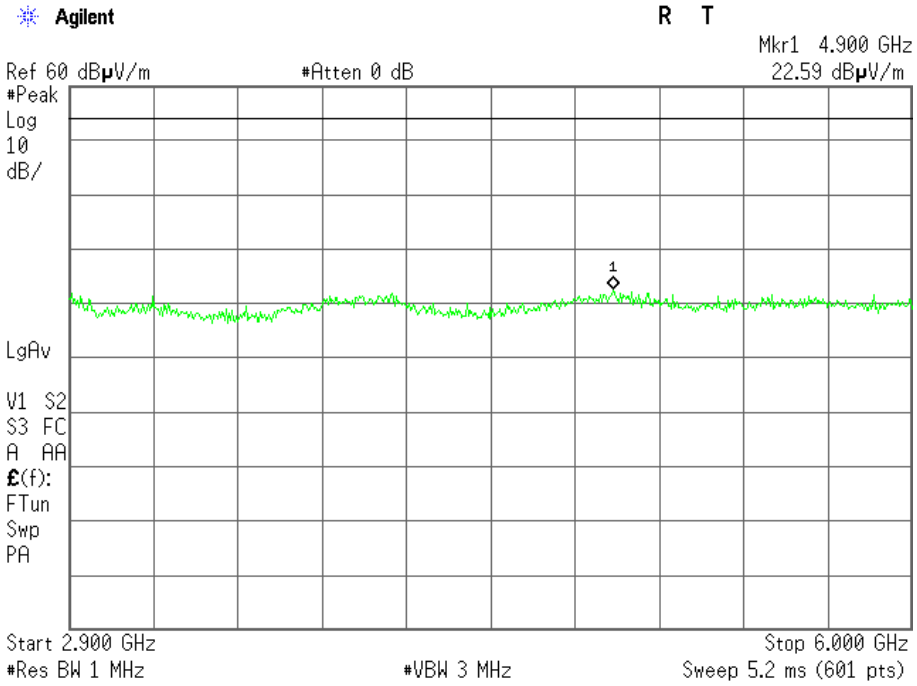
Plot 3.2.3 Radiated emission measurements in 1.0– 2.9 GHz range, vertical antenna Gas Detector unit + Shut OFF unit, receive mode



Plot 3.2.4 Radiated emission measurements in 1.0– 2.9 GHz range, horizontal antenna Gas Detector unit + Shut OFF unit, receive mode



Plot 3.2.5 Radiated emission measurements in 2.9– 6.0 GHz range, vertical antenna Gas Detector unit + Shut OFF unit, receive mode



Plot 3.2.6 Radiated emission measurements in 2.9– 6.0 GHz range, horizontal antenna Gas Detector unit + Shut OFF unit, receive mode

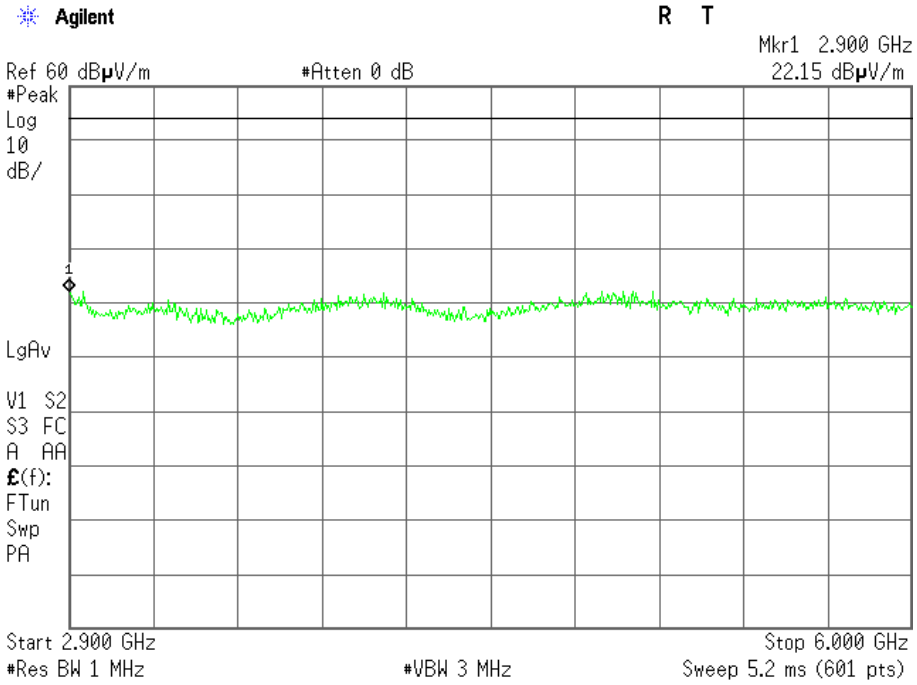
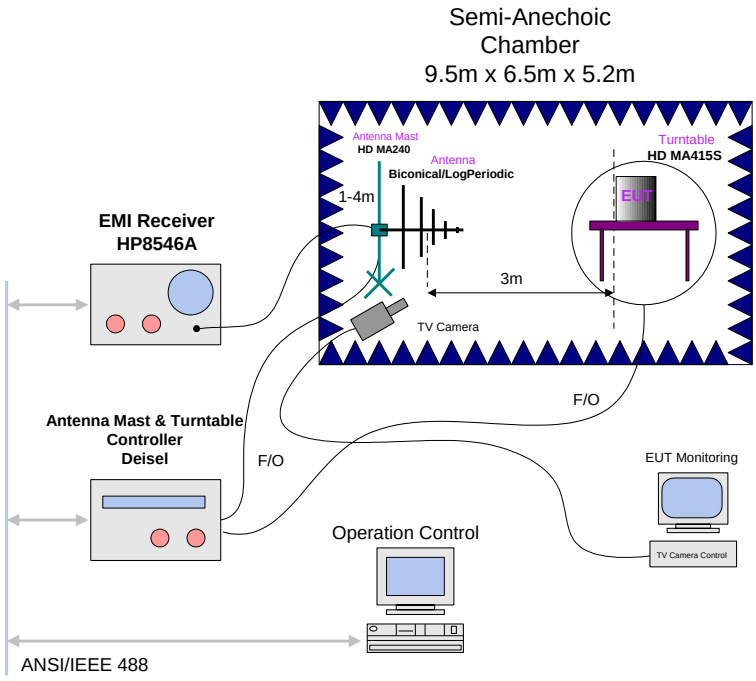


Figure 3.2.1 Radiated emission measurements 30 MHz – 6GHz test setup



3.3. Conducted Emissions measurements

Reference document:	**47 CFR §15.107, §15.207**		
Test Requirements:	Any devices using an AC power line are required to comply with the conducted limits set forth in Sec.15.107 and Sec.15.207, Class B		
Test setup:	See Sec. 2.2	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted Emissions		
S.A. Settings:	RBW: 9kHz, VBW:30kHz		
Mode of operation:	Worse case result of intentional & unintentional transmission (max hold trace)		
Environment conditions:	Ambient Temperature: 21°c	Relative Humidity: 48%	Atmospheric Pressure: hPa
Test Result:	See below	See Plot 3.2.1 - Plot 3.2.4	

Table 3.2.1 Limits for conducted emissions according to FCC Part 15, Section 107 / 207

Frequency [MHz]	**Limits Class B [dBµV]**	
	QP	**Average**
0.15÷0.5	66 to 56[1]	56 to 46[1]
0.5÷5	56	46
5÷30	60	50

[1]Linear interpolation

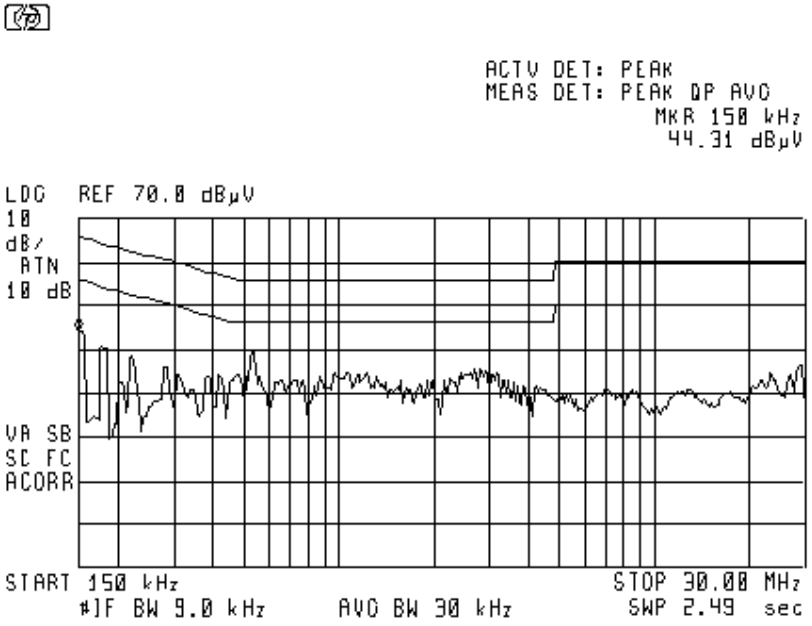
Test Results:

Table 3.2.1 Conducted emission test results

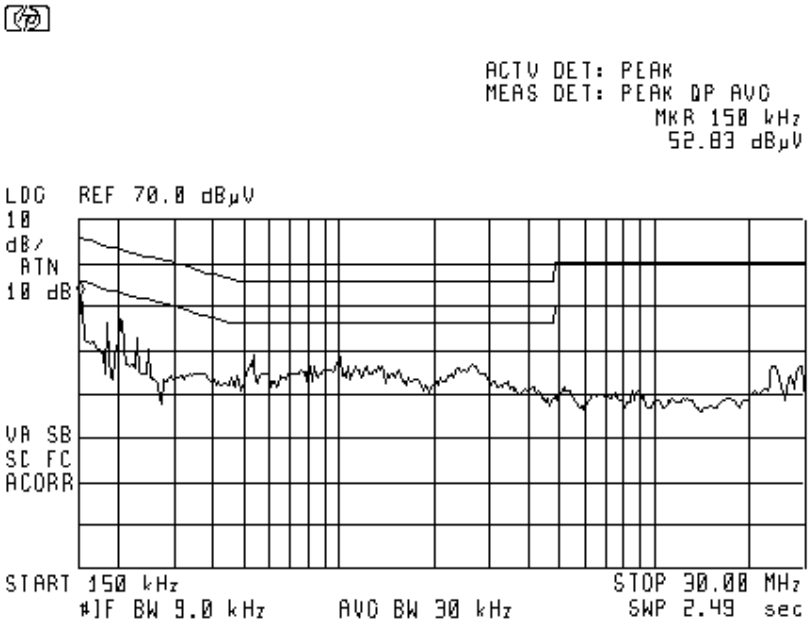
Frequency [MHz]	**Measured Emission [dBµV]**		**Limit [dBµV]**		**Delta* [dB]**		**Pass/Fail**
	QP	**AVR**	**QP**	**AVR**	**QP**	**AVR**	
Phase line							
0.150000	41.50	23.80	66.00	56.00	-24.50	-32.20	Pass
0.166600	43.80	31.50	65.10	55.10	-21.30	-23.60	Pass
0.504360	33.20	27.90	56.00	46.00	-22.80	-18.10	Pass
Neutral line							
0.150000	43.30	27.40	66.00	56.00	-22.70	-28.60	Pass
0.198050	51.10	21.90	63.70	53.70	-25.60	-31.80	Pass

*Delta = Measured emission - Limit

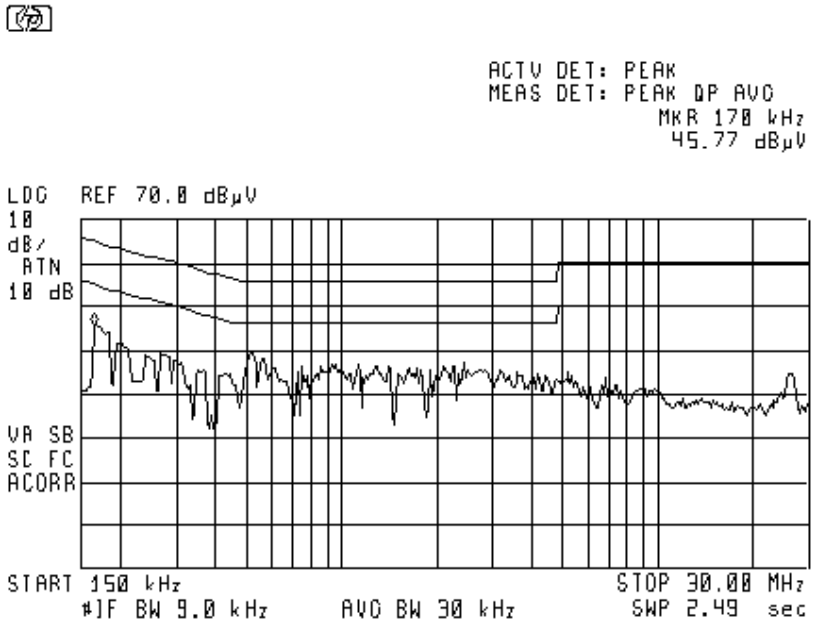
Plot 3.2.1 Conducted emission measurements, Phase lead, transmit mode



Plot 3.2.2 Conducted emission measurements, Neutral lead, transmit mode



Plot 3.2.3 Conducted emission measurements, Phase lead, receive mode



Plot 3.2.4 Conducted emission measurements, Neutral lead, receive mode

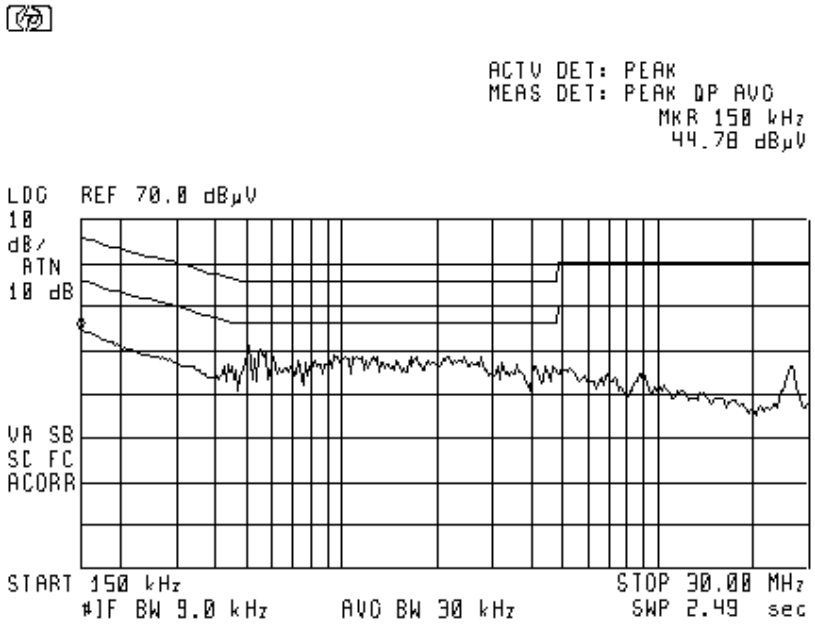
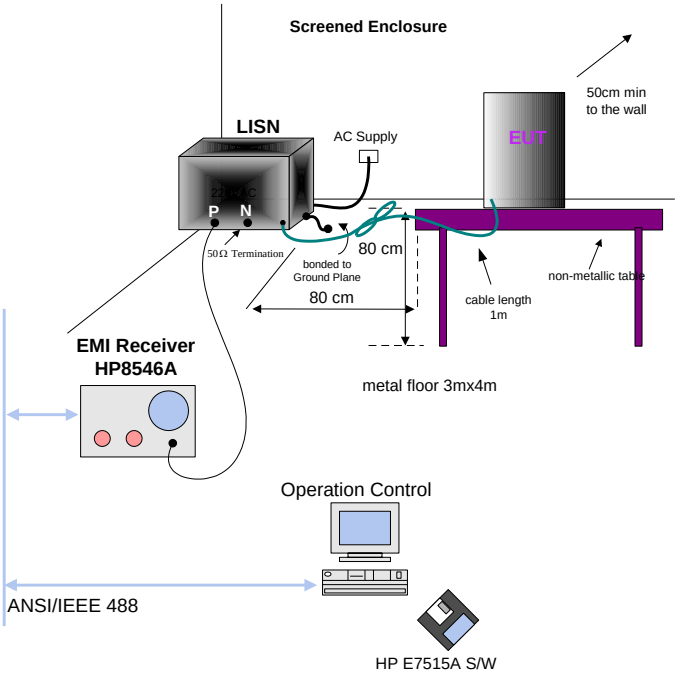


Figure 3.2.1 Conducted emission measurements test setup, table-top equipment



3.4. Antenna Connector Requirements

Reference document:	**47 CFR §15.203**	
Test Requirements:	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with provisions of this section.	
Test Result:	The EUT has an integral antenna.	

3.5. Occupied bandwidth

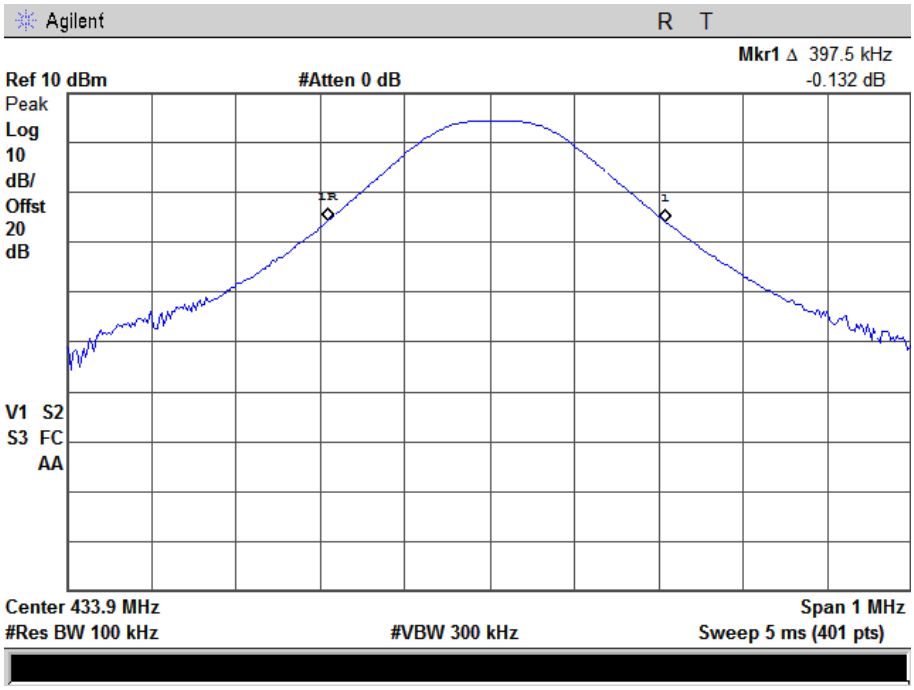
Reference document:	**47 CFR §15.231(c)**		
Test Requirements:	**Devices operating in 70MHz – 900MHz range** - the bandwidth of the emission shall be no wider than 0.25% of the center frequency. **Devices operating above 900MHz -** the bandwidth of the emission shall be no wider than 0.25% of the center frequency. **Bandwidth** is determined at the points 20dB down from the modulated carrier		
Test setup:	Figure 3.5.1	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted		
S.A. Settings:	RBW: 100kHz, VBW: 300kHz RBW: 10kHz, VBW: 300kHz		
Environment conditions:	Ambient Temperature: 20.7 °c	Relative Humidity: 55.4 %	Atmospheric Pressure: hPa
Test Result:	See below	Plot 3.5.1	

Test results:

Fundamental Frequency, MHz	Emission Bandwidth, kHz	Bandwidth Limit, kHz	Delta*, kHz	Pass/Fail
Gas detector				
433.85	397.50	1084.63	-687.13	Pass

*Delta = Emission Bandwidth - Bandwidth Limit

Plot 3.5.1 Occupied Bandwidth



4. Appendix

Appendix A: List of Measuring Equipment used:

Equipment	Manufacturer	Model No.	Serial No.	Calibration Due Date
CISPR16 EMI Receiver	HP	8546A	3710A00392	14.05.2014
Bilog Antenna	Teseq	CBL 6141B	34119	03.07.2015
Double Ridge Guide Horn antenna	A.R.A	DRG-118/A	17188	22.01.2015
LISN	Fischer	50/250-25-2	9705	26.05.2014
Transient Limiter	Agilent	11947A	3107A04121	14.04.2014

Appendix B: Accreditation Certificate

ilac-MRA A2LA American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

QUALITECH

Petach-Tikva, Israel

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 7th day of December 2012.

President & CEO
For the Accreditation Council
Certificate Number 1633.01
Valid to September 30, 2014

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

End of the Test Report