



Nemko Test Report: 10240453RUS1 Rev2

Applicant: Texas Instruments, Inc.
12500 TI Boulevard
Dallas TX 75243

**Equipment Under Test:
(E.U.T.)** GASSENSOREVM

FCC ID#: Z64-GASSENSOREVM
IC ID#: 4511- GASSENSOREV

In Accordance With: **FCC Part 15, Subpart C, 15.247 and
Industry Canada RSS-210, Issue 8**
Digital Transmission Systems

Tested By: Nemko USA, Inc.
802 N. Kealy
Lewisville, Texas 75057-3136

TESTED BY:

A handwritten signature in black ink, appearing to read 'David Light'.

David Light, Senior Wireless Engineer

DATE: 12 April 2013

APPROVED BY:

A handwritten signature in black ink, appearing to read 'Mike Cantwell'.

Mike Cantwell, Reviewer

DATE: 14 June 2013

Number of Pages: 35

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EQUIPMENT: GASSENSOREVM

Section 1. Summary of Test Results

Manufacturer: Texas Instruments, Inc.

Model No.: GASSENSOREVM

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 and Industry Canada RSS-210, Issue 8 for Digital Transmission Systems. Tests were conducted in accordance with ANSI C63.4-2003 and FCC KDB publication 558074 v03r01. Radiated emissions are made in a semi-anechoic chamber. A description of the test facility is on file with the FCC and Industry Canada.



New Submission



Production Unit



Class II Permissive Change



Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST
SPECIFICATIONS HAVE BEEN MADE.

See " Summary of Test Data".



NVLAP Lab Code 100426-0

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EQUIPMENT: GASSENSOREVM**Summary Of Test Data**

NAME OF TEST	PARA. NO.	RESULT
Powerline Conducted Emissions	15.207(a) / RSS-Gen 7.2.4	NA
Minimum 6 dB Bandwidth	15.247(a)(2) / A8.2(a)	Complies
Maximum Peak Power Output	15.247(b)(3) / A8.4(4)	Complies
Spurious Emissions (Antenna Conducted)	15.247(d) / A8.5	Complies
Spurious Emissions (Restricted Bands)	15.247(d)/15.209(a) / RSS-Gen 7.2.2	Complies
Peak Power Spectral Density	15.247(e) / A8.2(b)	Complies

Footnotes:

The EUT is battery powered.

EQUIPMENT: GASSENSOREVM

Section 2. Equipment Under Test (E.U.T.)

General Equipment Information

Frequency Band (MHz):	902-928	2400-2483.5	5725-5850
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Operating Frequency of Test Sample: 2402 to 2480 MHz

Channel Spacing: 1 MHz

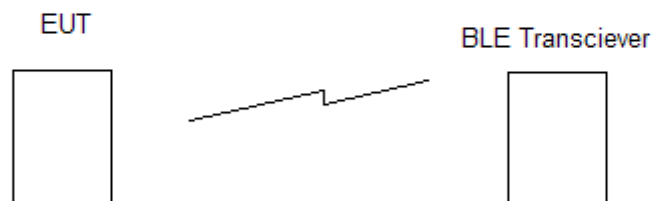
User Frequency Adjustment: Software controlled

EQUIPMENT: GASSENSOREVM

Description of EUT

The system is a small, simple wireless gas sensor application. The radio is as per Bluetooth Low Energy standard communicating to an IOS or an Android device

System Diagram



EQUIPMENT: GASSENSOREVM

Section 3. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(2)/A8.2(a)
TESTED BY: David Light	DATE: 08 February 2013

Test Results: Complies.

Measurement Data: See 6 dB BW plot
Measured 6 dB bandwidth: 717 kHz
Channel Separation: 1 MHz

Test Conditions: 45 %RH
23 °C

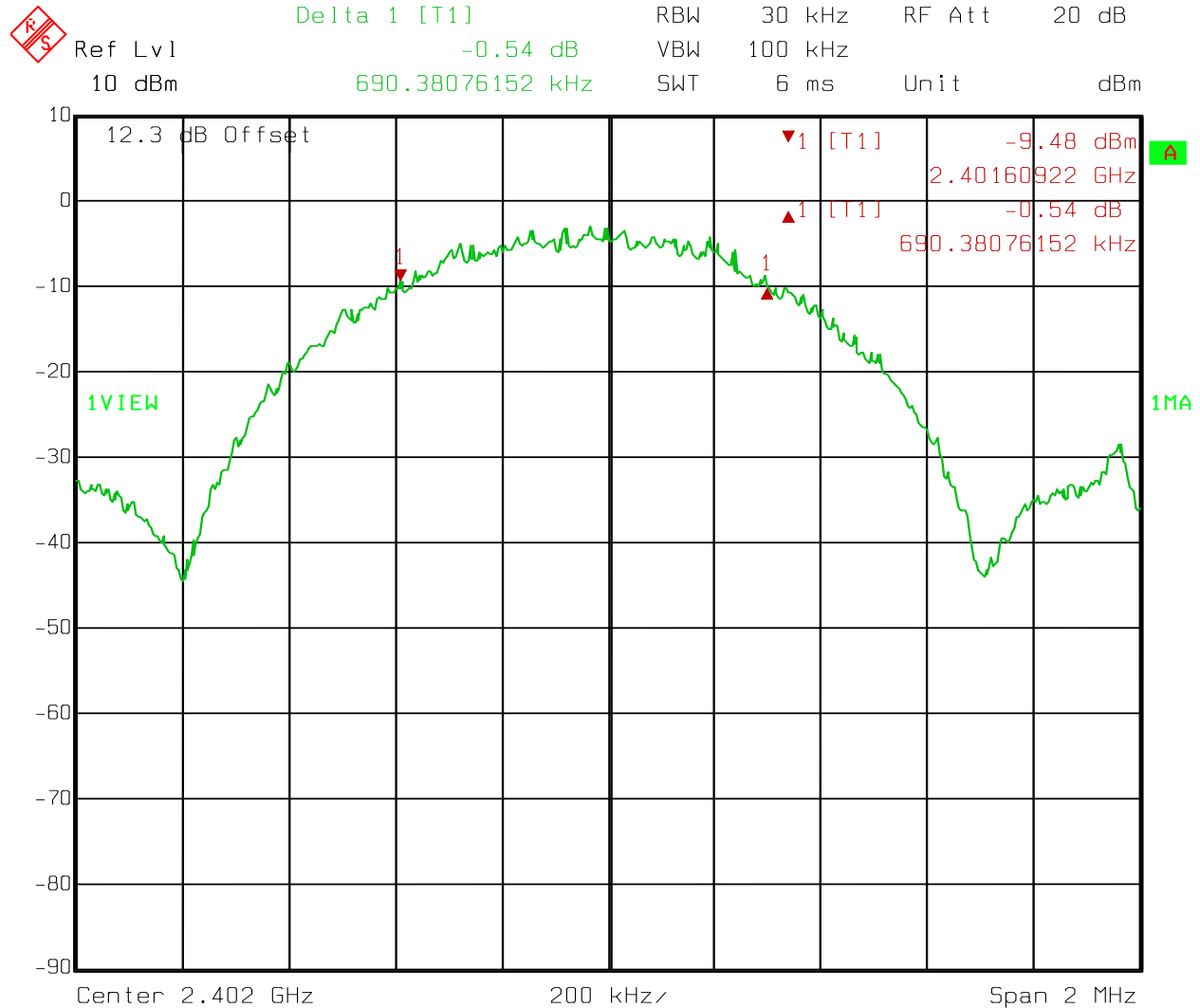
Measurement Uncertainty: $\pm 1 \times 10^{-7}$ ppm

Test Equipment Used: 1036-1082-1469

EQUIPMENT: GASSENSOREVM

Test Data – Occupied Bandwidth

Low Channel

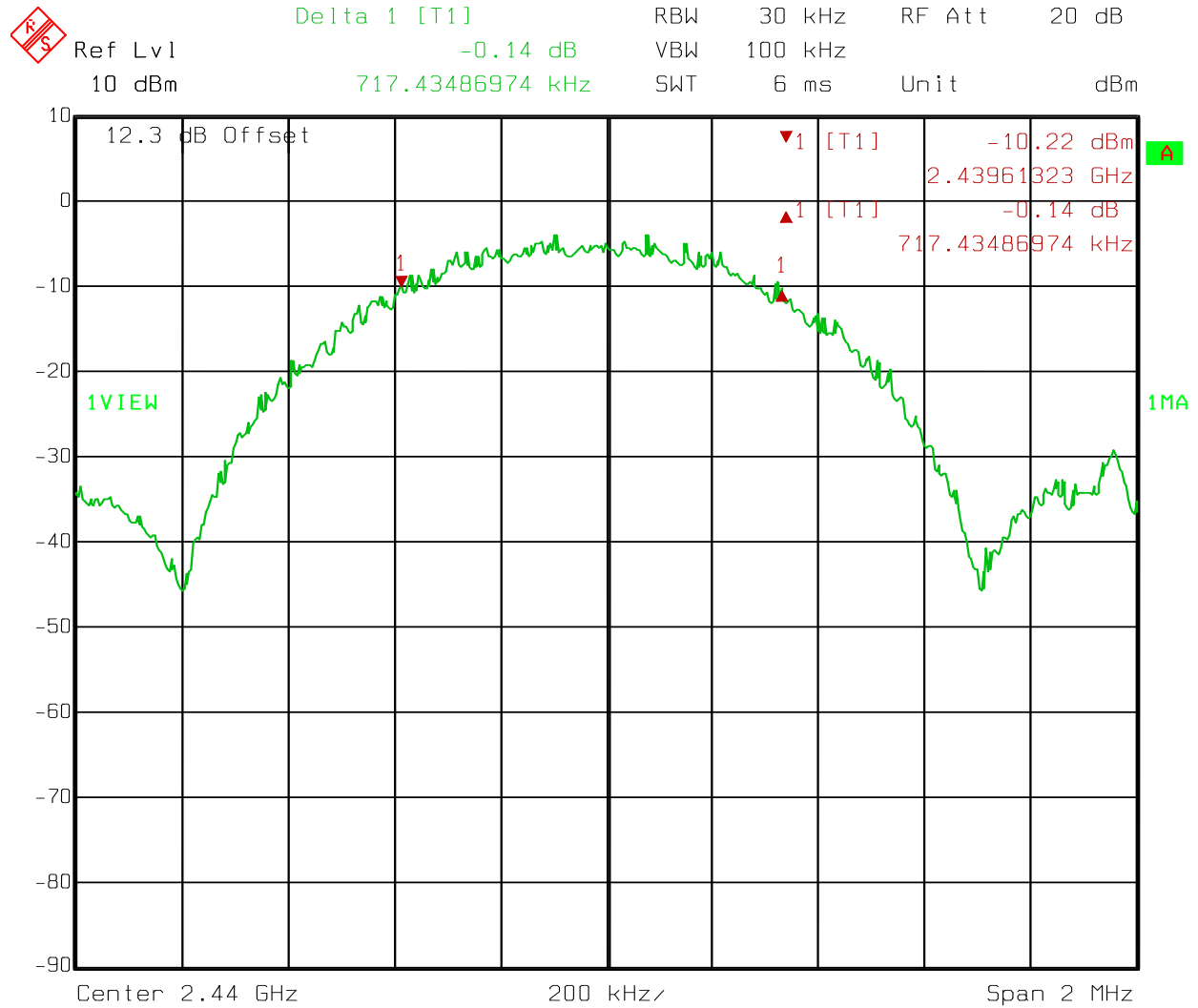


Date: 08.APR.2013 11:16:58

EQUIPMENT: GASSENSOREVM

Test Data – Occupied Bandwidth

Middle Channel

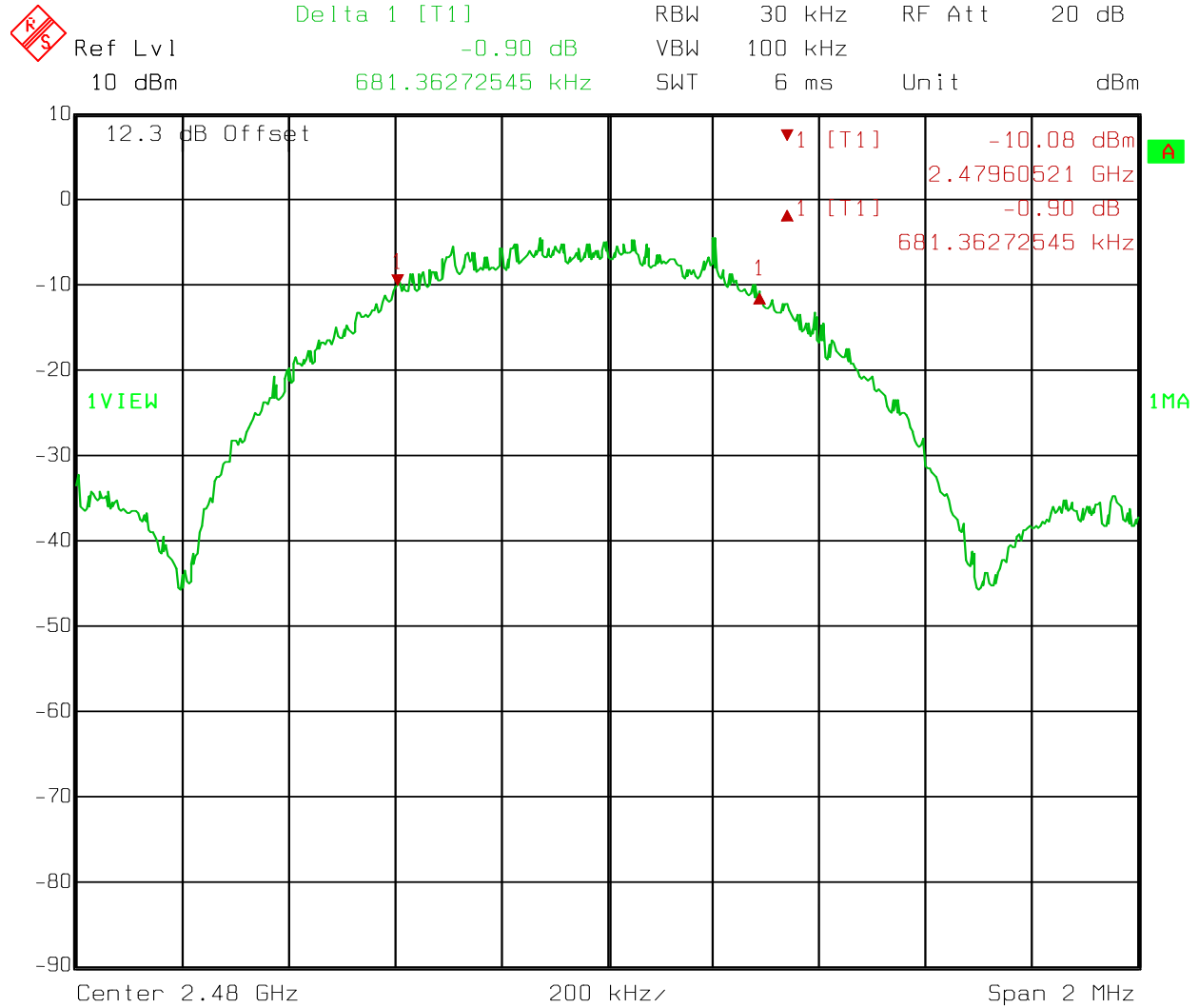


Date: 08.APR.2013 11:18:23

EQUIPMENT: GASSENSOREVM

Test Data – Occupied Bandwidth

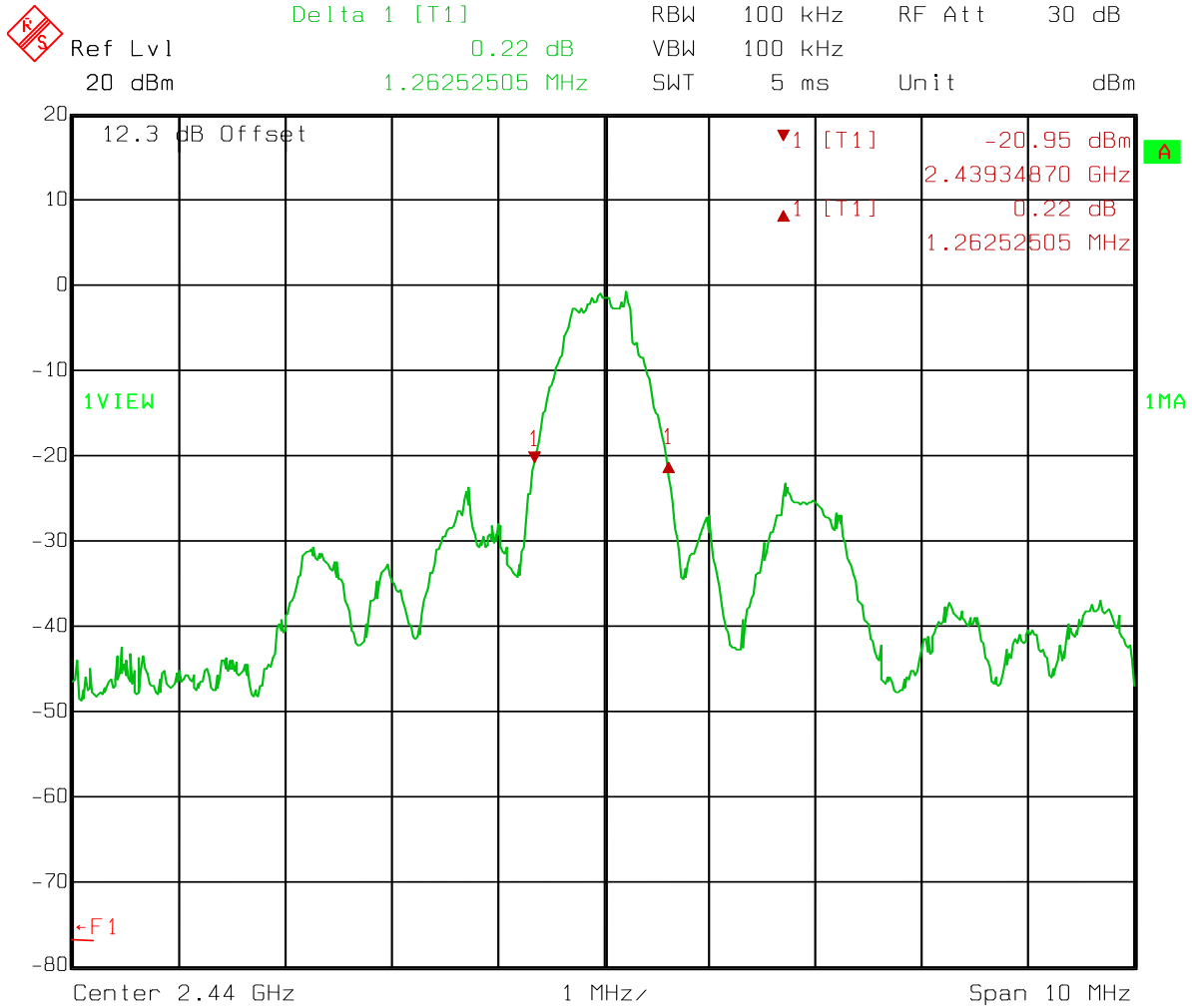
High Channel



Date: 08.APR.2013 11:19:32

EQUIPMENT: GASSENSOREVM

Test Data – 20 dB Bandwidth



Date: 10.APR.2013 12:14:06

EQUIPMENT: GASSENSOREVM

Section 4. Maximum Peak Output Power

NAME OF TEST: Maximum Peak Output power	PARA. NO.: 15.247(b)(3)/A8.4(4)
TESTED BY: David Light	DATE: 08 April 2013

Test Results: Complies.

Measurement Data: Refer to attached data

Test Conditions: 40 %RH
23 °C

Measurement Uncertainty: +/-1.7 dB

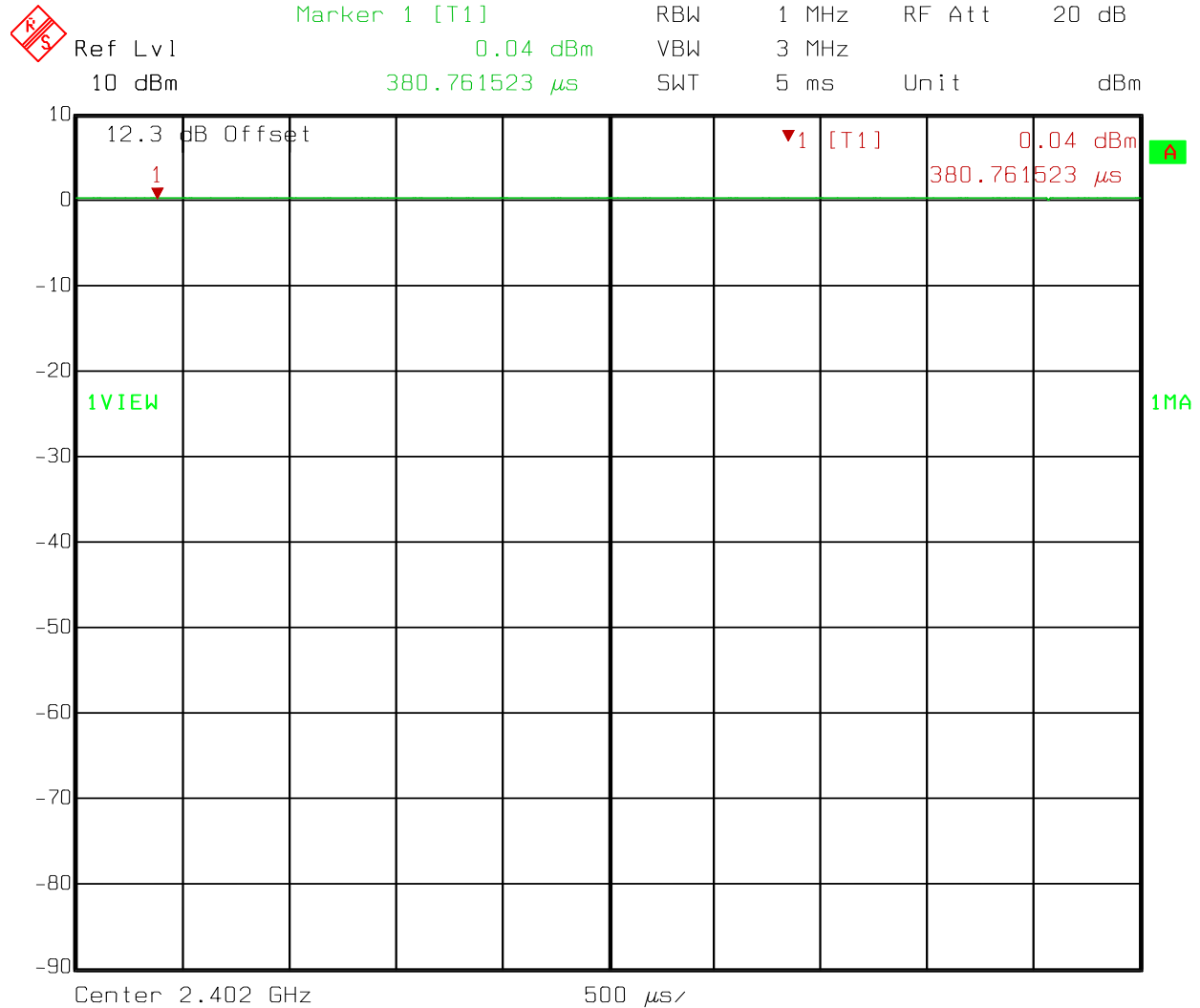
Test Equipment Used: 1036-1082-1469

- ☐ This device was tested at +/- 15% input power per 15.31(e), with no variation in output power.
- ☒ For battery powered equipment, the device was tested with a fresh battery per 15.31(e).
- ☒ The device was tested on three channels per 15.31(l).
- ☐ This test was performed radiated.

EQUIPMENT: GASSENSOREVM

Test Data – Peak Power

Low Channel

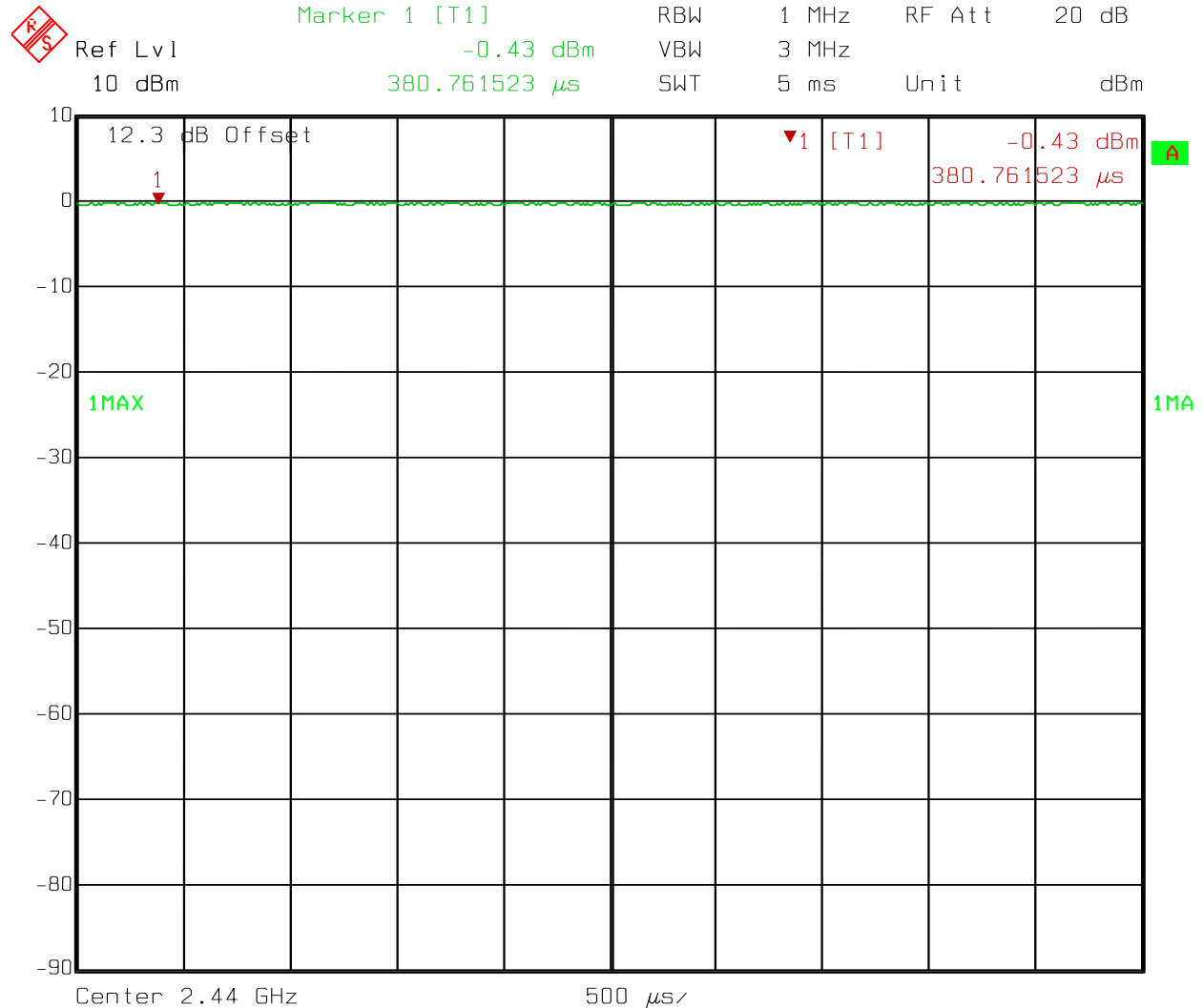


Date: 08.APR.2013 11:04:37

EQUIPMENT: GASSENSOREVM

Test Data – Peak Power

Mid Channel

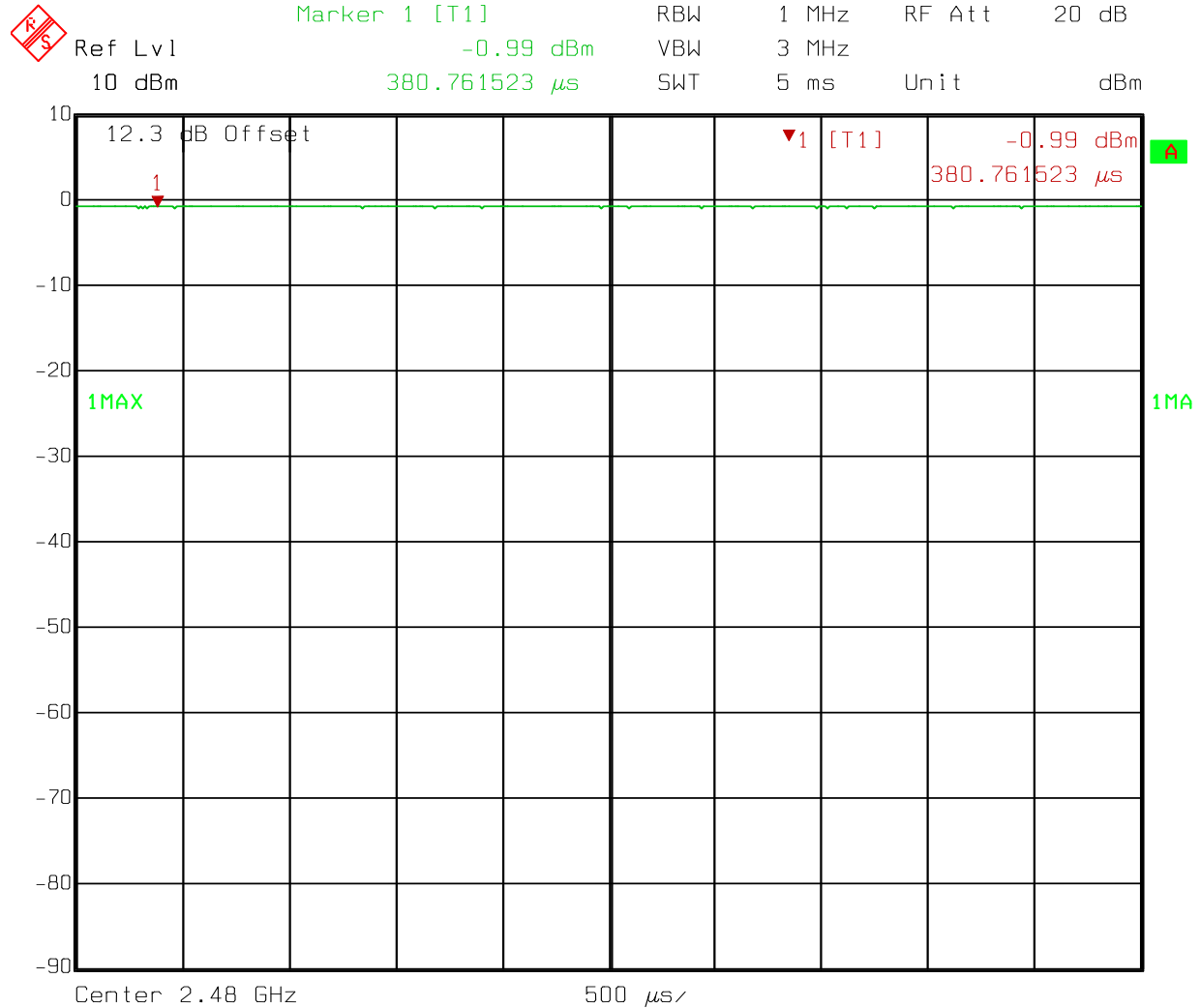


Date: 08.APR.2013 11:04:02

EQUIPMENT: GASSENSOREVM

Test Data – Peak Power

High Channel



Date: 08.APR.2013 11:05:34

Section 5 Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions at Antenna Terminals	PARA. NO.: 15.247 (d) A8.5
TESTED BY: David Light	DATE: 08 April 2013

Test Results: Complies.

Measurement Data: See attached plots.

Test Conditions: 40 %RH
 23 °C

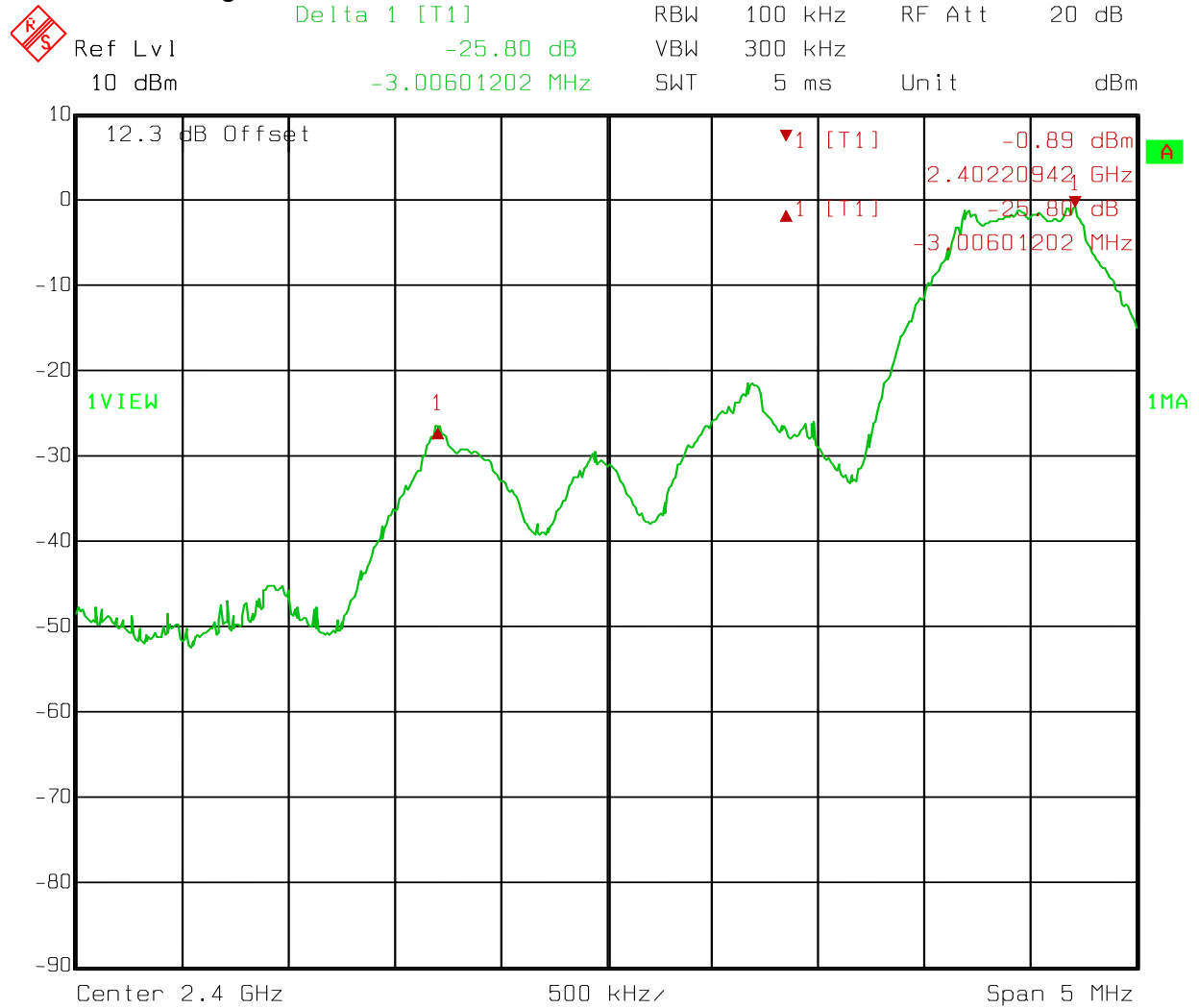
Measurement Uncertainty: +/-1.7 dB

Test Equipment Used: 1036-1082-1469

EQUIPMENT: GASSENSOREVM

Test Data – Spurious Emissions at Antenna Terminals

Lower Band Edge

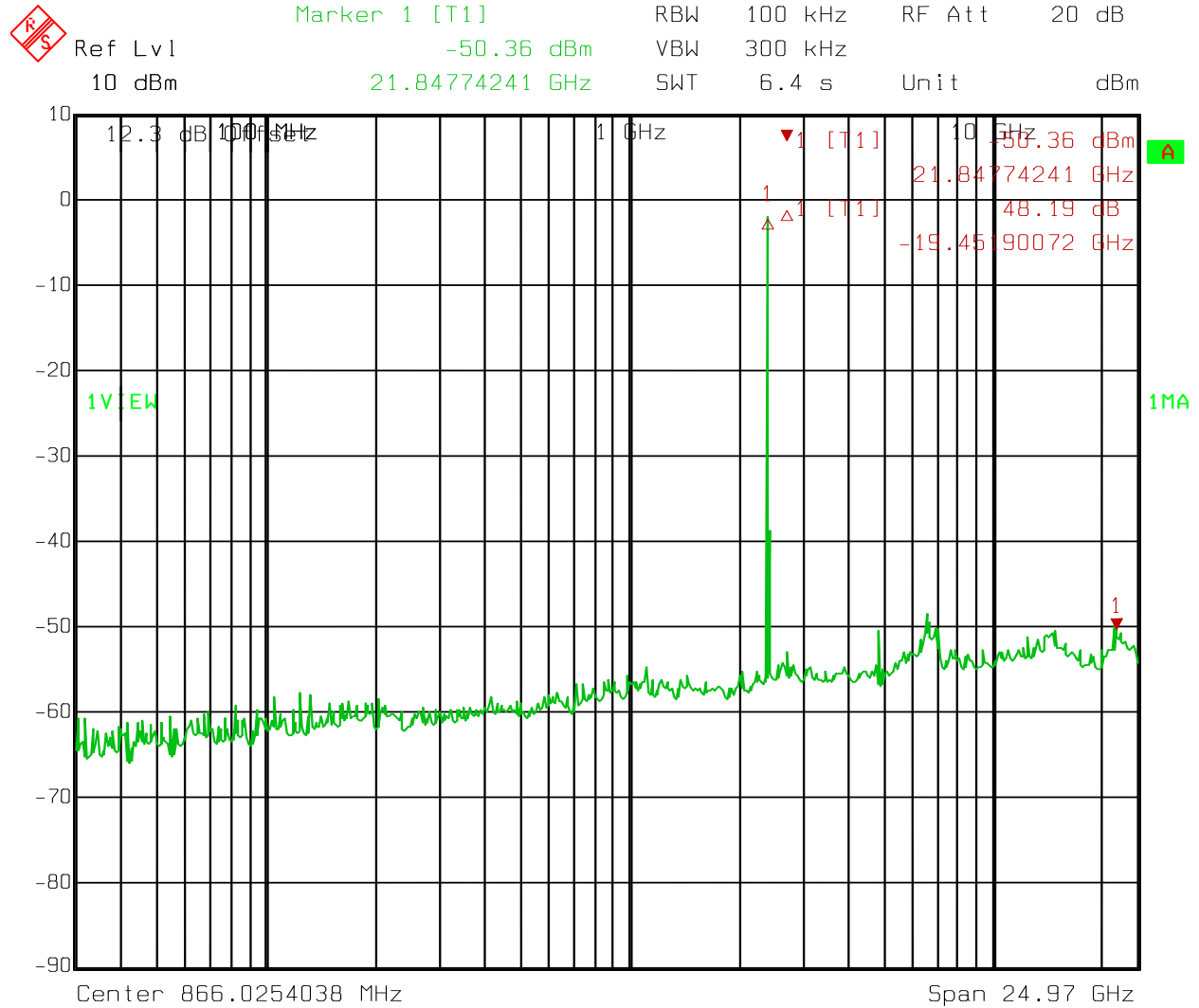


Date: 08.APR.2013 11:07:26

EQUIPMENT: GASSENSOREVM

Test Data – Spurious Emissions at Antenna Terminals

Low Channel

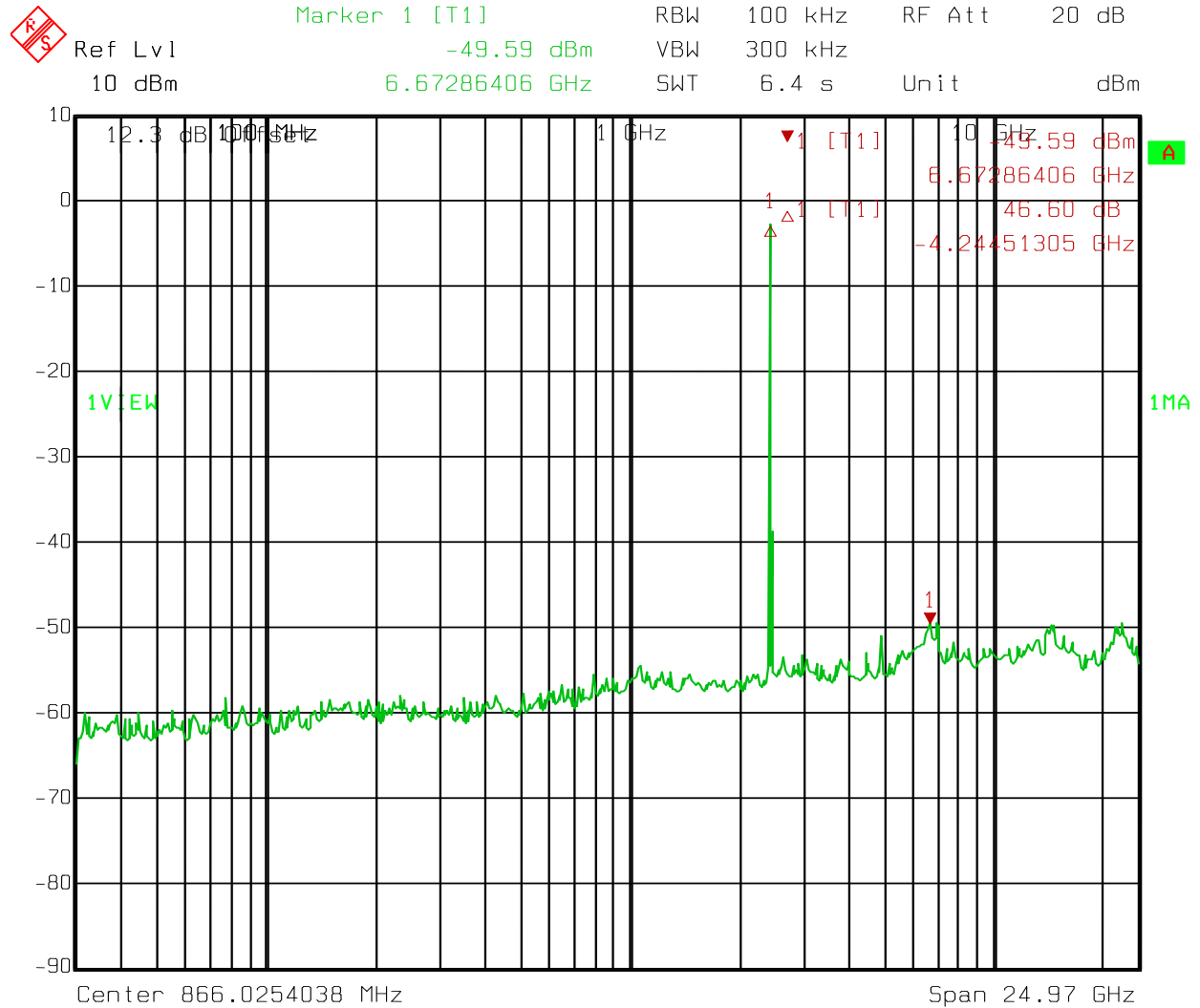


Date: 08.APR.2013 11:08:31

EQUIPMENT: GASSENSOREVM

Test Data – Spurious Emissions at Antenna Terminals

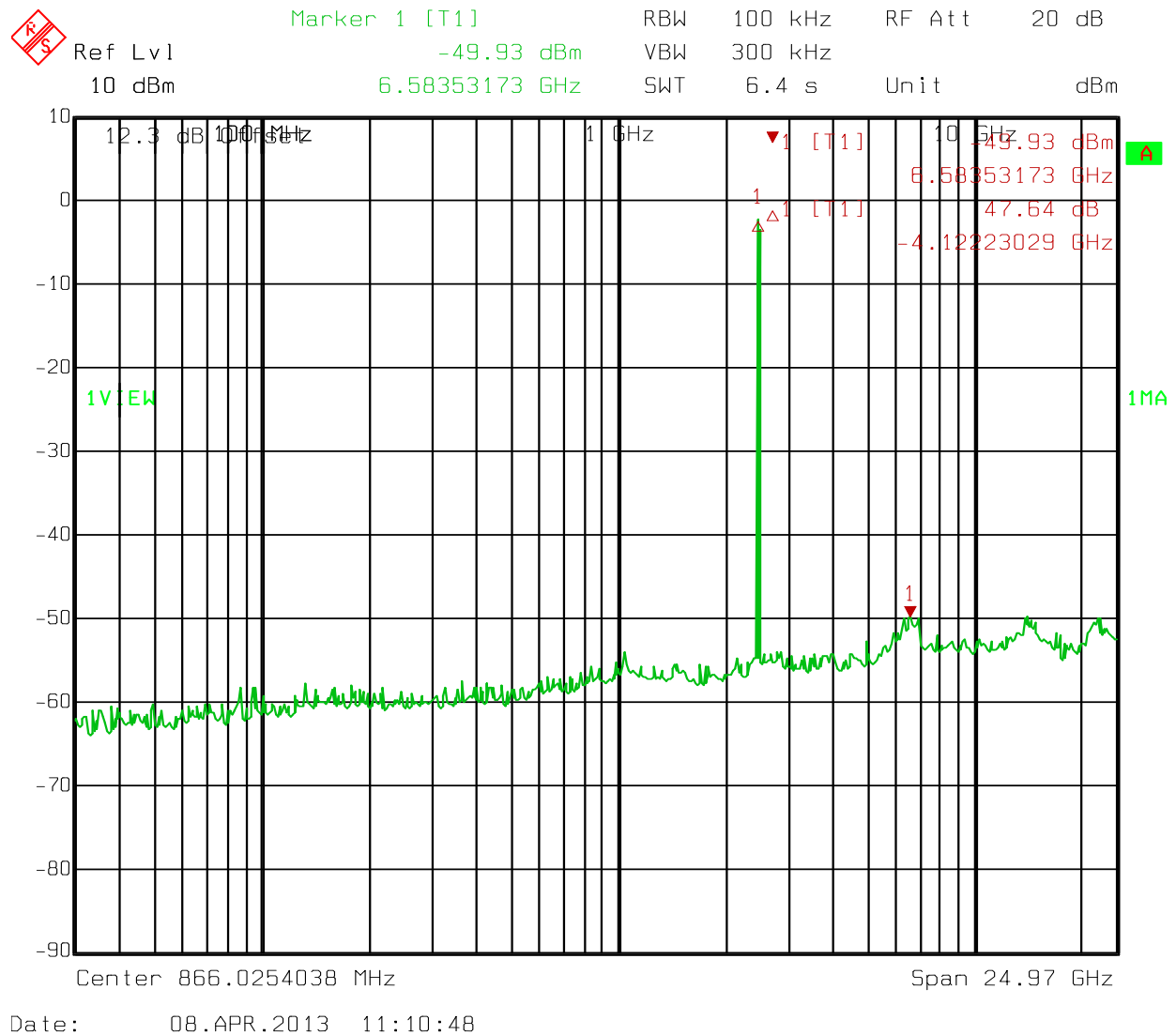
Mid Channel



Date: 08.APR.2013 11:09:38

Test Data – Spurious Emissions at Antenna Terminals

Upper Channel



EQUIPMENT: GASSENSOREVM

Section 6. Radiated Emissions

NAME OF TEST: Radiated Emissions	PARA. NO.: 15.247 (d)/RSS-Gen 7.2.2
TESTED BY: David Light	DATE: 09 April 2013

Test Results: Complies.**Measurement Data:** See attached table.

Test Conditions: 42 %RH
21 °C

Measurement Uncertainty: +/-1.7 dB**Test Equipment Used:** 1763-1783-1767-1785-1304

Notes:

- ☒ The EUT was tested on three orthogonal axis'
- ☒ The device was tested from 30 MHz to the tenth harmonic of the highest fundamental frequency per 15.33
- ☒ The device was tested on three channels per 15.31(l).
- ☒ No emissions were detected within 20 dB of the specification limit therefore none are reported per 15.31(o). Band edge data is presented below.

RBW=VBW=100 kHz below 1000 MHz

RBW=VBW=1 MHz above 1000 MHz (Peak)

RBW= 1 MHz VBW=10Hz (Average)

Meas. Freq. (MHz)	Ant. Pol. (H/V)	Duty Cycle (dB)	Meter Reading (dBuV)	Antenna Factor (dB)	Path Loss (dB)	RF Gain (dB)	Corrected Reading (dBuV/m)	Spec. limit (dBuV/m)	CR/SL Diff. (dB)	Pass Fail Unc.	Comment
											TX @ 2480 MHz (High)
2483.5	V	0	47.9	29	3.4	33.0	47.3	54.0	-6.7	Pass	Peak measurement
2483.5	H	0	51.7	29	3.7	33.0	51.4	54.0	-2.6	Pass	Peak measurement

EQUIPMENT: GASSENSOREVM

Section 7. Peak Power Spectral Density

NAME OF TEST: Peak Power Spectral Density	PARA. NO.: 15.247(e)/A8.2(b)
TESTED BY: David Light	DATE: 08 April 2013

Test Results: Complies.

Measurement Data: See attached data..

Test Conditions: 40 %RH
23 °C

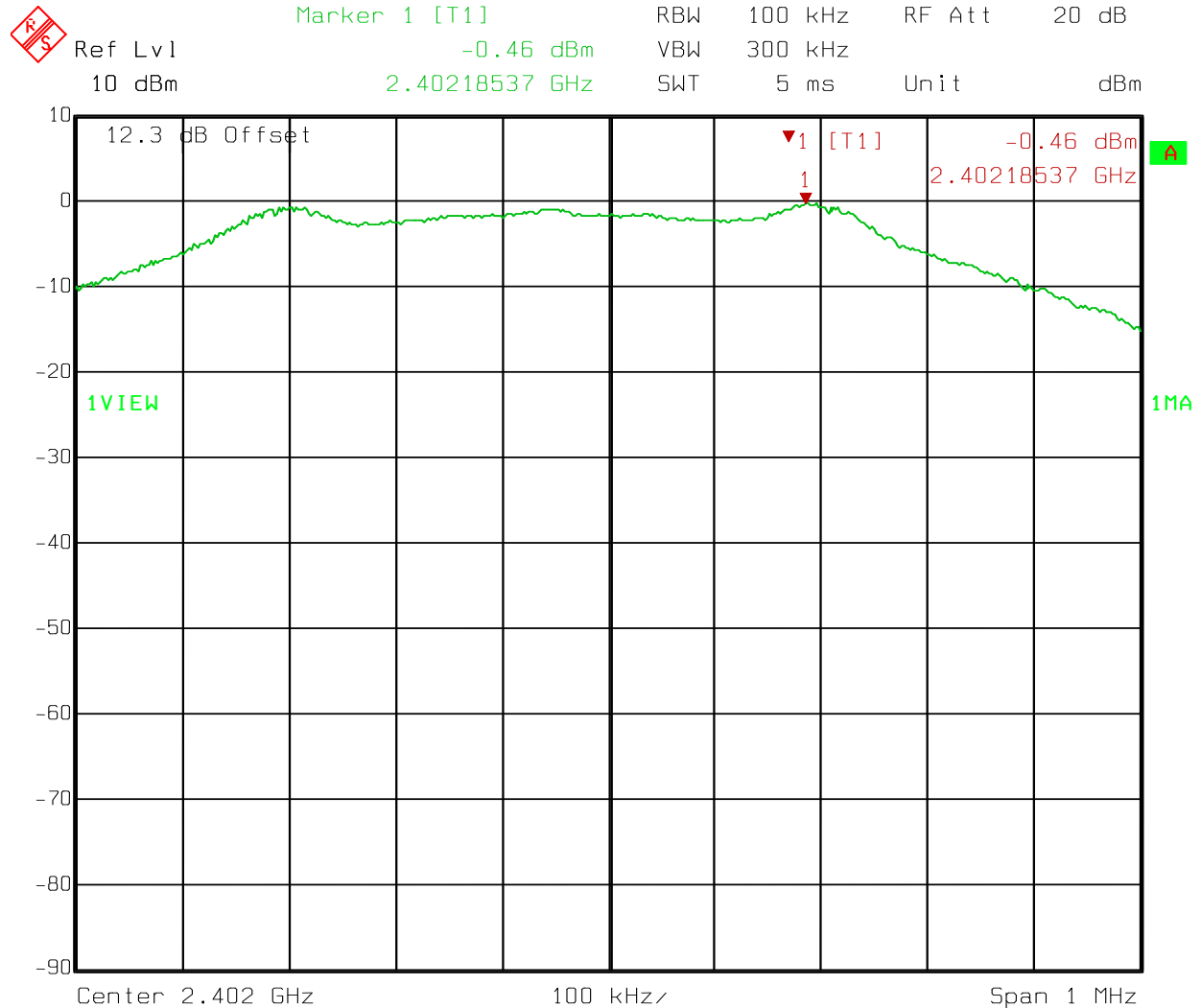
Measurement Uncertainty: +/-1.7 dB

Test Equipment Used: 1036-1082-1469

EQUIPMENT: GASSENSOREVM

Peak Power Spectral Density

Lower Channel



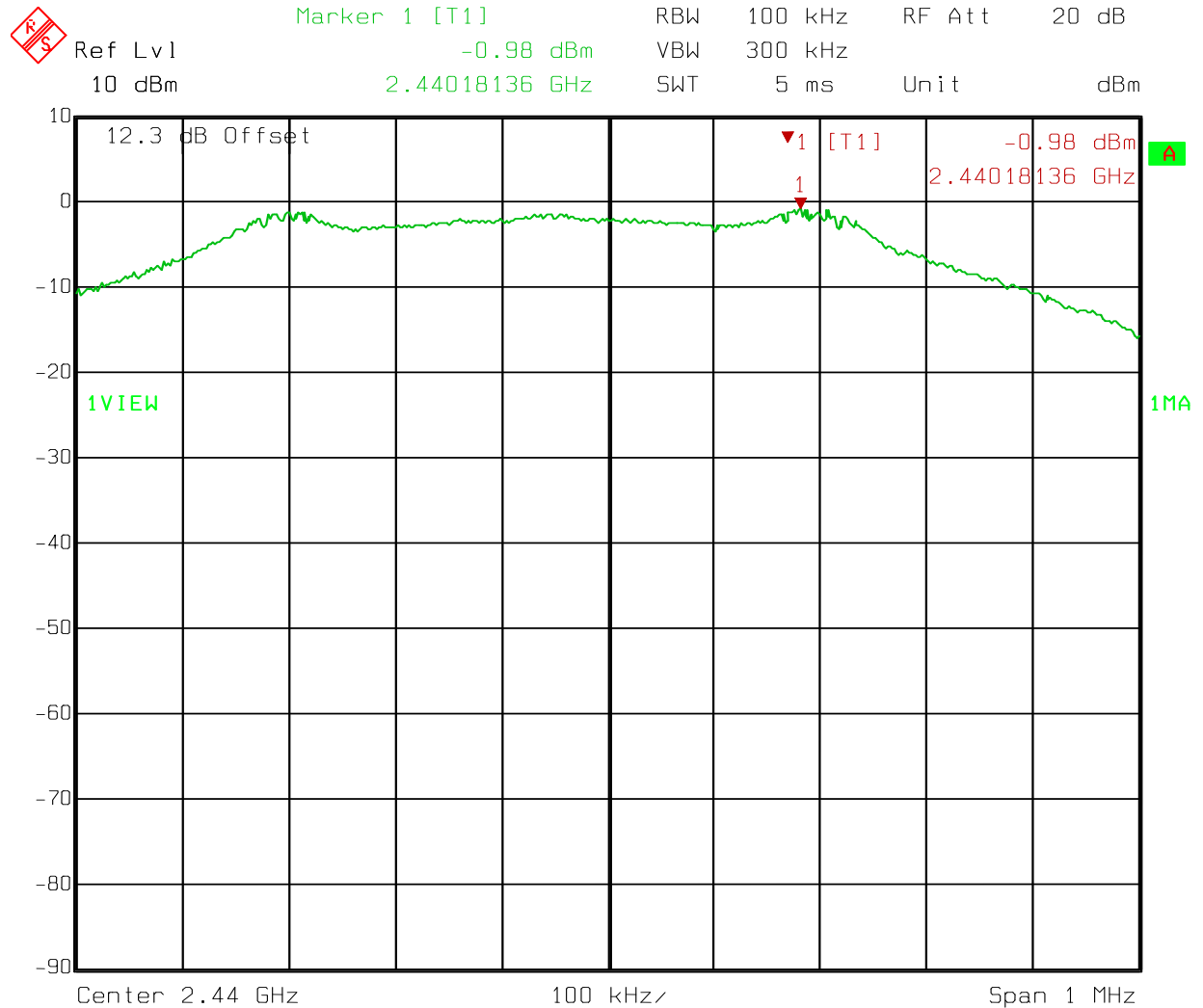
Date: 08.APR.2013 11:22:01

$$\text{Density} = -0.46 \text{ dBm} - 15.2 \text{ dB} = -15.66 \text{ dBm}$$

EQUIPMENT: GASSENSOREVM

Peak Power Spectral Density

Mid Channel



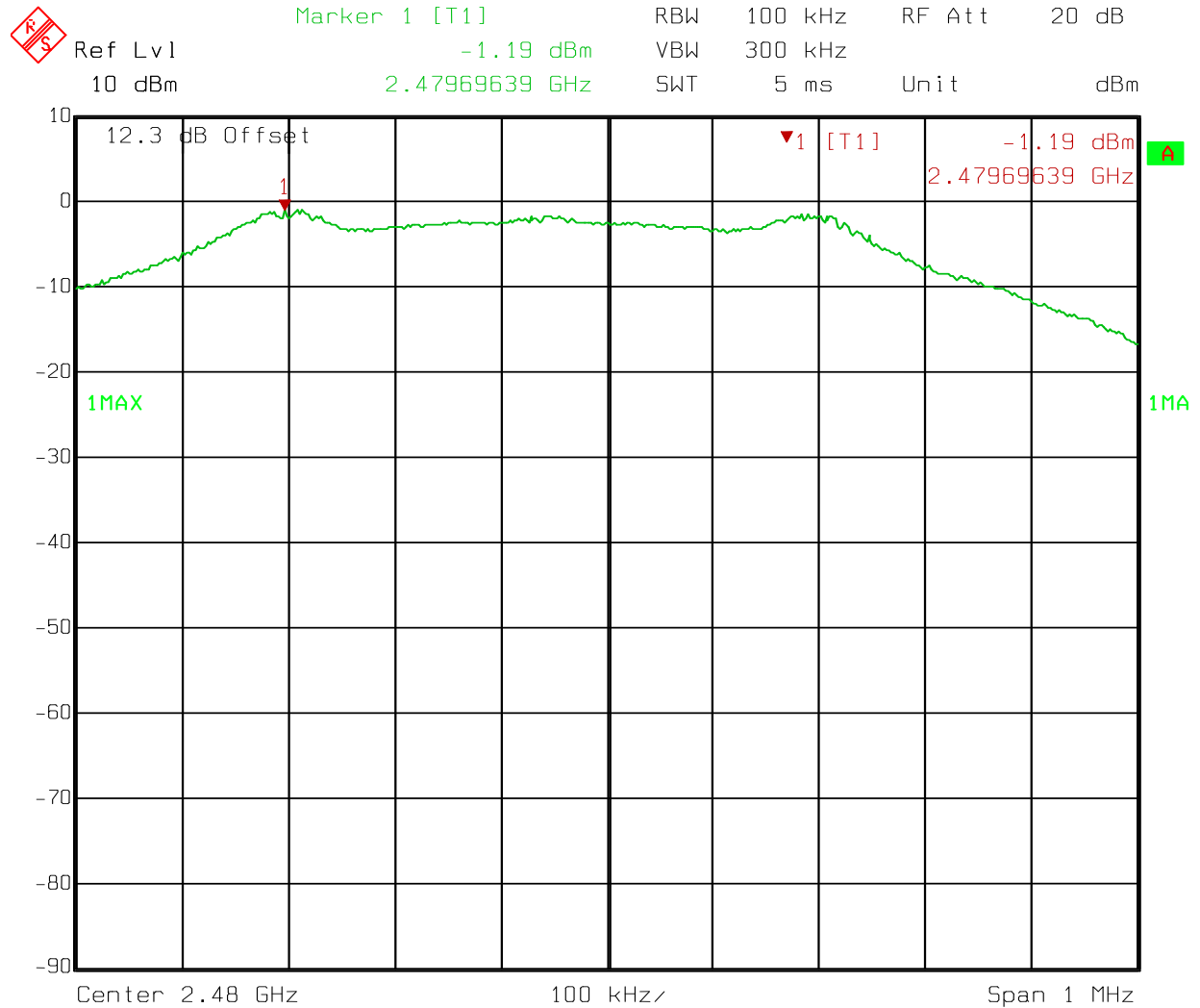
Date: 08.APR.2013 11:24:13

Density - -0.98 dBm – 15.2 dB = -16.18 dBm

EQUIPMENT: GASSENSOREVM

Peak Power Spectral Density

Upper Channel



Date: 08.APR.2013 11:26:09

Density = -1.19 dBm – 15.2 dB = -16.39 dBm

EQUIPMENT: GASSENSOREVM

Section 8. Test Equipment List

Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
1036	Spectrum Analyzer	Rohde & Schwartz	FSEK30	830844/006	23-Dec-2011	23-Dec-2013
1082	Cable, 2m	Astrolab	32027-2-29094-72TC		N/R	
1304	Antenna, Horn	Electro Metrics	RGA-60	6151	24-Nov-2010	24-Nov-2012
1469	Attenuator, 10 db, DC 18 Ghz	MCL Inc.	BW-S10W2 10db-2WDC		N/R	
1763	Antenna, Bilog	Schaffner	CBL 6111D	22926	07-Mar-2013	07-Mar-2014
1767	Receiver, EMI Test 20Hz - 26.5 GHz - 150 - +30 dBm LCD	Rohde & Schwartz	ESIB26	837491/0002	19-Dec-2012	19-Dec-2013
1783	Cable Assy, 3m Chamber	Nemko	Chamber		26-Sep-2012	26-Sep-2013
1785	Preamplifier	A.H. Systems	PAM-0126	143	09-Jan-2013	09-Jan-2014

ANNEX A - TEST DETAILS

EQUIPMENT: GASSENSOREVM

NAME OF TEST: Maximum Peak Output Power PARA. NO.: 15.247(b)(3)/A8.4(4)

Minimum Standard: The maximum peak output power shall not exceed 1 watt.

If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point to point operation may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceed 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operation may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Direct Measurement Method For Detachable Antennas:

1. This procedure requires availability of a spectrum analyzer resolution bandwidth that is \geq EBW.
2. Set the RBW \geq EBW.
3. Set VBW \geq 3 x RBW.
4. Set span = zero.
5. Sweep time = auto couple.
6. Detector = peak.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use peak marker function to determine the peak amplitude level within the fundamental emission.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

EQUIPMENT: GASSENSOREVM

NAME OF TEST: Occupied Bandwidth

PARA. NO.: 15.247(a)(2)/A8.2(a)

Minimum Standard:

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Method Of Measurement:

EBW Measurement Procedure:

1. Set resolution bandwidth (RBW) = 1-5 % of the emission bandwidth (EBW).
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1-5 %.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

EQUIPMENT: GASSENSOREVM

NAME OF TEST: Spurious Emissions(conducted)

PARA. NO.: 15.247(d)(A8.5)

Minimum Standard:

In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM IS SEARCHED TO THE 10th HARMONIC OF THE HIGHEST FREQUENCY GENERATED IN THE EUT.

Method Of Measurement:

30 MHz - 10th harmonic plot

RBW: 100 kHz

VBW: 300 kHz

Sweep: Auto

Display line: -20 dBc

Lower Band Edge

RBW: At least 1% of span/div.

VBW: >RBW

Span: As necessary to display any spurious at band edge.

Sweep: Auto

Center Frequency: 902 MHz, 2400 MHz, or 5725 MHz

Marker: Peak of fundamental emission

Marker Δ : Peak of highest spurious level below center frequency.

Upper Band Edge

RBW: At least 1% of span/div.

VBW: >RBW

Span: As necessary to display any spurious at band edge.

Sweep: Auto

Center Frequency: 928 MHz, 2483.5 MHz, or 5850 MHz

Marker: Peak of fundamental emission

Marker Δ : Peak of highest spurious level above center frequency.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Radiated Spurious Emissions PARA. NO.: 15.247(c)/RSS-Gen 7.2.2

Minimum Standard: In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits:

Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC

15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41	1718		

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Transmitter Power Density

PARA. NO.: 15.247(d)/A8.2(b)

Minimum Standard: The transmitted power density averaged over any 1 second interval shall not be greater than +8 dBm in any 3 kHz bandwidth.

Method Of Measurement:

Measurement Procedure PKPSD:

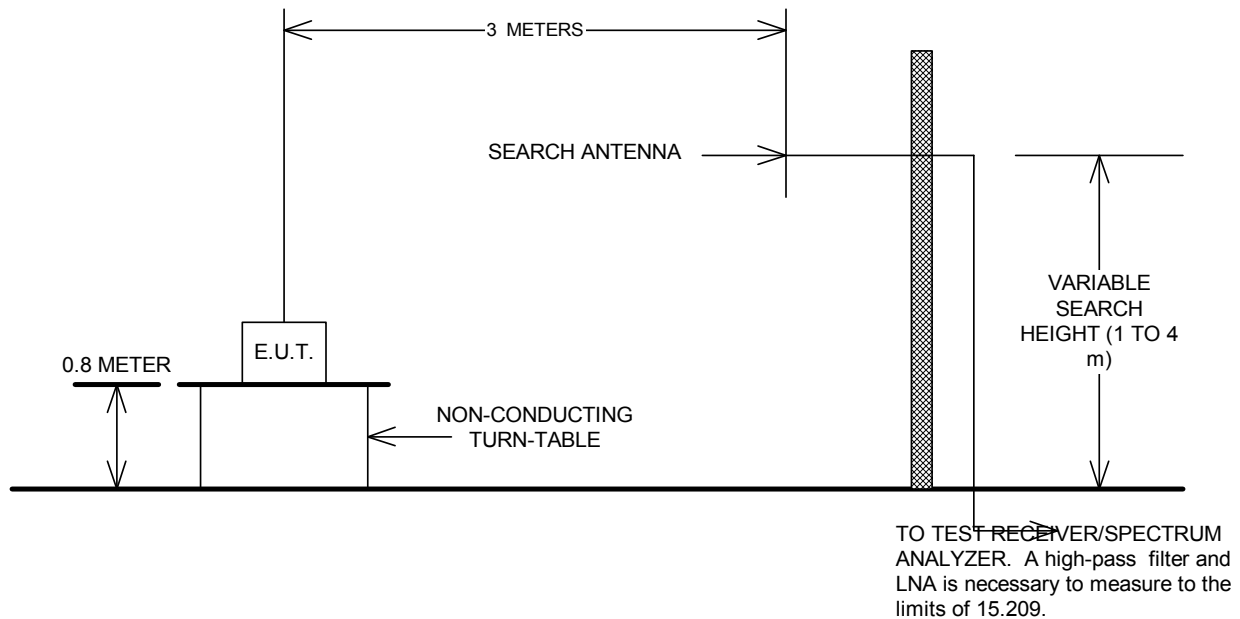
1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 100 kHz.
3. Set the VBW \geq 300 kHz.
4. Set the span to 5-30 % greater than the EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
10. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where $BWCF = 10\log(3\text{ kHz}/100\text{ kHz} = -15.2\text{ dB})$.
11. The resulting peak PSD level must be $\leq 8\text{ dBm}$.

Number of channels tested:

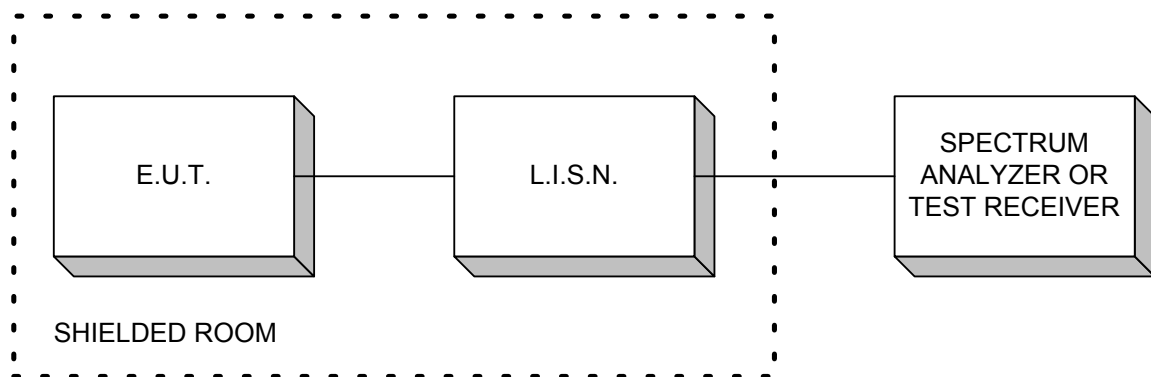
Tuning Range	Number Of Channels Tested	Channel Location In Band
1 MHz or Less	1	Middle
1 to 10 MHz	2	Top And Bottom
More Than 10 MHz	3	Top, Middle, Bottom

ANNEX B - TEST DIAGRAMS

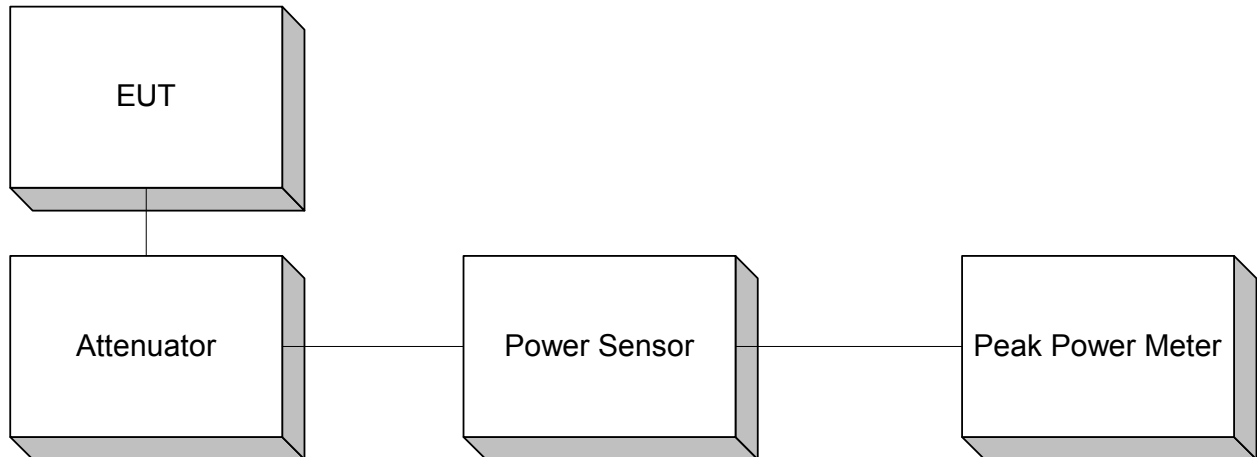
Test Site For Radiated Emissions



Conducted Emissions



Peak Power At Antenna Terminals



Note: A spectrum analyzer may be substituted for Peak Power Meter given that the measurement bandwidth is sufficient to capture the 60 dB bandwidth of the transmitter.

**Minimum 6 dB Bandwidth
Peak Power Spectral Density
Spurious Emissions (conducted)**

