Electromagnetic Compatibility Test Report

Tests Performed on a SMART Temps, LLC

Smart Link DTS, Model L2013

Radiometrics Document RP-7558

ACCREDITED
TESTING CERT #1495.01

Product Detail: FCC ID: 2AAHTL2013 IC: 11068A-L2013 Equipment type: 2.4 GHz Digital Transmission System
Test Standards: US CFR Title 47, Chapter I, FCC Part 15 Subpart C FCC Part 15 CFR Title 47: 2012 Industry Canada RSS-210, Issue 8: 2010 as required for Category I Equipment This report concerns: Original Grant for Certification FCC Part 15.247

Tests Performed For:	*Test Facility:*
SMART Temps, LLC 435 Park Place Circle Mishawaka, IN 46545	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446 (815) 293-0772

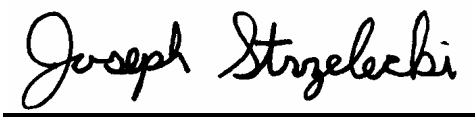
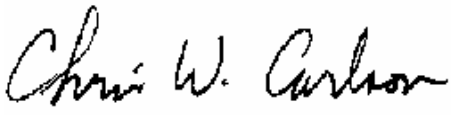
Test Date(s): (Month-Day-Year)
April 1 thru May 6, 2013

Document RP-7558 Revisions:

Rev.	Issue Date	Affected Sections	Revised By
0	May 21, 2013		
1	June 6, 2013	All	Joseph Strzelecki
2	June 10, 2013	10.1, 10.5.1	Joseph Strzelecki
3	June 14, 2013	Cover	Joseph Strzelecki

Table of Contents

1 ADMINISTRATIVE DATA

Equipment Under Test: A SMART Temps, LLC, SMART Link DTS Model: L2013 Serial Number: None This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) April 1, 2013	*Test Date(s): (Month-Day-Year)* April 1 thru May 6, 2013
Test Report Written By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* The tests were not witnessed by SMART Temps, LLC
Radiometrics' Personnel Responsible for Test:  Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Report Approved By*  Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a SMART Link DTS, Model L2013, manufactured by SMART Temps, LLC. The detailed test results are presented in a separate section. The following is a summary of the test results.

Test Results

Environmental Phenomena	Frequency Range	FCC Section	RSS- Section	Test Result
RF AC Mains Conducted Emissions	0.15 - 30 MHz	15.207	GEN; 7.2.2	Pass
RF Radiated Emissions (Unintential Radiation Receive mode)	30-25,000 MHz	15.209	GEN; 7.2.5	Pass
6 dB Bandwidth Test	2400 to 2483 MHz	15.247 a	210; A8.1 (4)	Pass
20 dB Bandwidth Test	2400 to 2483 MHz	15.247 a	210; A8.1 (4)	Pass
Peak Output Power	2400 to 2483 MHz	15.247 b	210; A8.1 (1)	Pass
Band-edge Compliance of RF Conducted Emissions	2400 to 2483 MHz	15.247 d	210; A8.4 (2)	Pass
Spurious Radiated Emissions	30 MHz to 25 GHz	15.247 d	210; A8.5	Pass
Power Spectral Density	2400 to 2483 MHz	15.247 e	210; A8.2 (1)	Pass

Note: The RSS-210 specification is not currently covered in Radiometrics' Scope of Accreditation. This is technically very similar to FCC, CFR 47 Part 15 which is on Radiometrics scope.

2.1 RF Exposure Compliance Requirements

Since the EUT is not handheld and the power output is 100 mW, the EUT meets the FCC requirement for RF exposure, and it is exempt from RSS-102 SAR and RF exposure evaluations. There are no power level adjustments and the antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a SMART Link DTS, Model L2013, manufactured by SMART Temps, LLC. The EUT was in good working condition during the tests, with no known defects.

The EUT receives data from a SMART shield or SMART Guards and sends them bi-directionally to and from a SMART Command Center website.

3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The Antenna directly connects to the PCB with a unique connector that is not readily available to the general public; therefore it meets the FCC 15.203 Requirements.

3.2 Related Submittals

SMART Temps, LLC is not submitting any other products simultaneously for equipment authorization related to the EUT.

4 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations. Power was supplied at 115 VAC, 60 Hz single-phase to its external power supply.

The identification for all equipment, plus descriptions of all cables used in the tested system, are:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	SMART Link DTS	E	SMART Temps, LLC	L2013	None
2	Power Adaptor	E	Cincon Electronics Co., Ltd.	TRG1505-A	JET2850-61010-2036
3	Thinkpad PC	H	Lenovo	2842-F7U (PC) 42T4418 (AC adaptor)	LR-LGXYE 10/09 11S42T4418Z1ZGW G07R9PZ

* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

List of System Cables

QTY	Length (m)	Cable Description	Connected to	Shielded?
1	1.8	DC Cord	Power input from AC adaptor	No
1	1.8	USB cable	From EUT to Laptop	Yes
1	2.0	Ethernet	From EUT to Laptop	No
1	10	Ethernet	From EUT to Ethernet Hub	No

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2012	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-2009	2009	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-210 Issue 8	2010	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment
IC RSS-Gen Issue 3	2010	General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)

The test procedures used are in accordance with the Industry Canada RSS-GEN and ANSI document C63.4, "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2005 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber E: Is a custom made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber. The floor has a 9' x 9' section of microwave absorber for testing above 1 GHz.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC3124A-1.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification and the data contained herein was taken with calibrated test equipment. The results relate only to the EUT listed herein.

9 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	01/15/13
AMP-20	Avantek	Pre-amplifier	SF8-0652	15221	8-18GHz	12 Mo	01/15/13
AMP-22	Anritsu	Pre-amplifier	MH648A	M23969	0.1-1200MHz	12 Mo.	01/16/13
AMP-29	HP / Agilent	Amplifier	11975A	2304A00158	2-8 GHz	12 Mo.	11/06/12
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	12/05/12
ANT-44	Impossible Machine	Super Log Antenna	SL-20M2G	1002	20-2000MHz	24 Mo.	12/14/11
ANT-48	RMC	Std Gain Horn	HW2020	1001	18-26 GHz	24 Mo.	04/05/12
ANT-53	EMCO	Loop Antenna	6507	1453	1 kHz-30 MHz	24 Mo	10/26/11
HPF-01	Solar	High Pass Filter	7930-100	HPF-1	0.15-30MHz	24 Mo.	01/24/12
LSN-01	Electrometrics	50 uH LISN	FCC/VDE 50/2	1001	0.01-30MHz	24 Mo.	06/14/11
LSN-03	Farnell	50 uH LISN	1EXLSN30B	000314	0.01-30MHz	24 Mo.	06/14/11
MXR-02	HP / Agilent	Harmonic Mixer	11970K	2332A00489	18-26.5GHz	12 Mo.	11/06/12
REC-01	Hewlett Packard	Spectrum Analyzer	8566A	2106A02115, 2209A01349	30Hz-22GHz	24 Mo.	11/21/12
REC-03	Anritsu	Spectrum Analyzer	MS2601B	MT94589	0.01-2200MHz	12 Mo.	04/08/13
REC-07	Anritsu	Spectrum Analyzer	MS2601A	MT53067	0.01-2200MHz	12 Mo.	05/21/12
REC-08	Hewlett Packard	Spectrum Analyzer	8566B	2648A13481 2209A01436	30Hz-22GHz	24 Mo.	10/28/11
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	12 Mo.	05/25/12

Note: All calibrated equipment is subject to periodic checks.

10 TEST SECTIONS

10.1 AC Conducted Emissions

The tests and limits are in accordance with FCC section 15.207 and RSS Gen section 7.2.2.

A computer-controlled analyzer was used to perform the conducted emissions measurements. The frequency range was divided into 500 subranges equally spaced on a logarithmic scale. The computer recorded the peak of each subrange. This data was then plotted on semi-log graph paper generated by the computer and plotter. Adjusting the positions of the cables and orientation of the test system then maximizes the highest emissions.

Mains Conducted emission measurements were performed using a 50 Ohm/50 uH Line Impedance Stabilization Network (LISN) as the pick-up device. Measurements were repeated on both leads within the power cord. If the EUT power cord exceeded 80 cm in length, the excess length of the power cord was made into a 30 to 40 cm bundle near the center of the cord. The LISN was placed on the floor at the base of the test platform and electrically bonded to the ground plane.

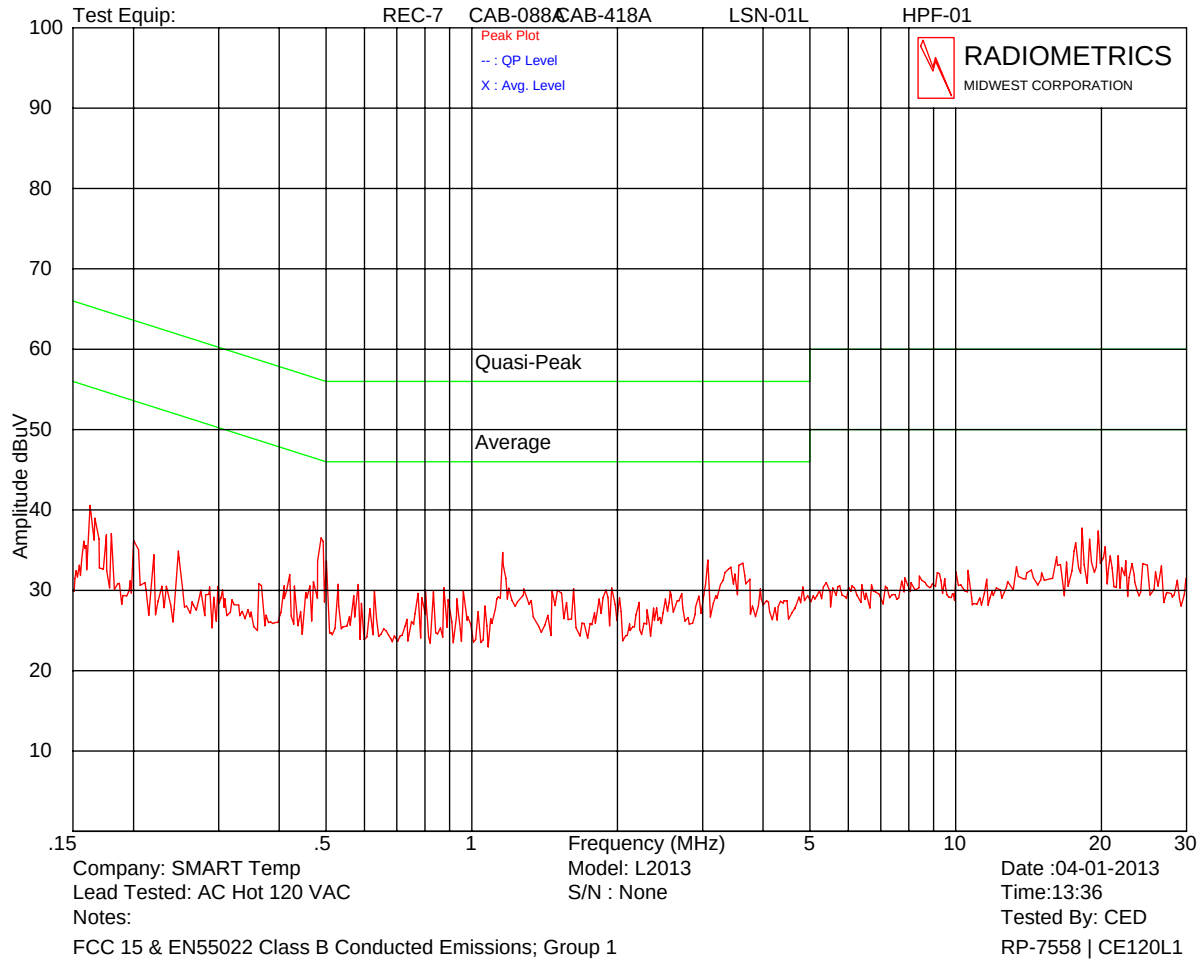
FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBuV)	
	Quasi-Peak	Average
0.150 - 0.50*	66 - 56	56 - 46
0.5 – 5.0	56	46
5.0 - 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

The initial step in collecting conducted data is a peak detector scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from the host computer (with the EUT connected) power cord, after testing all modes of operation.

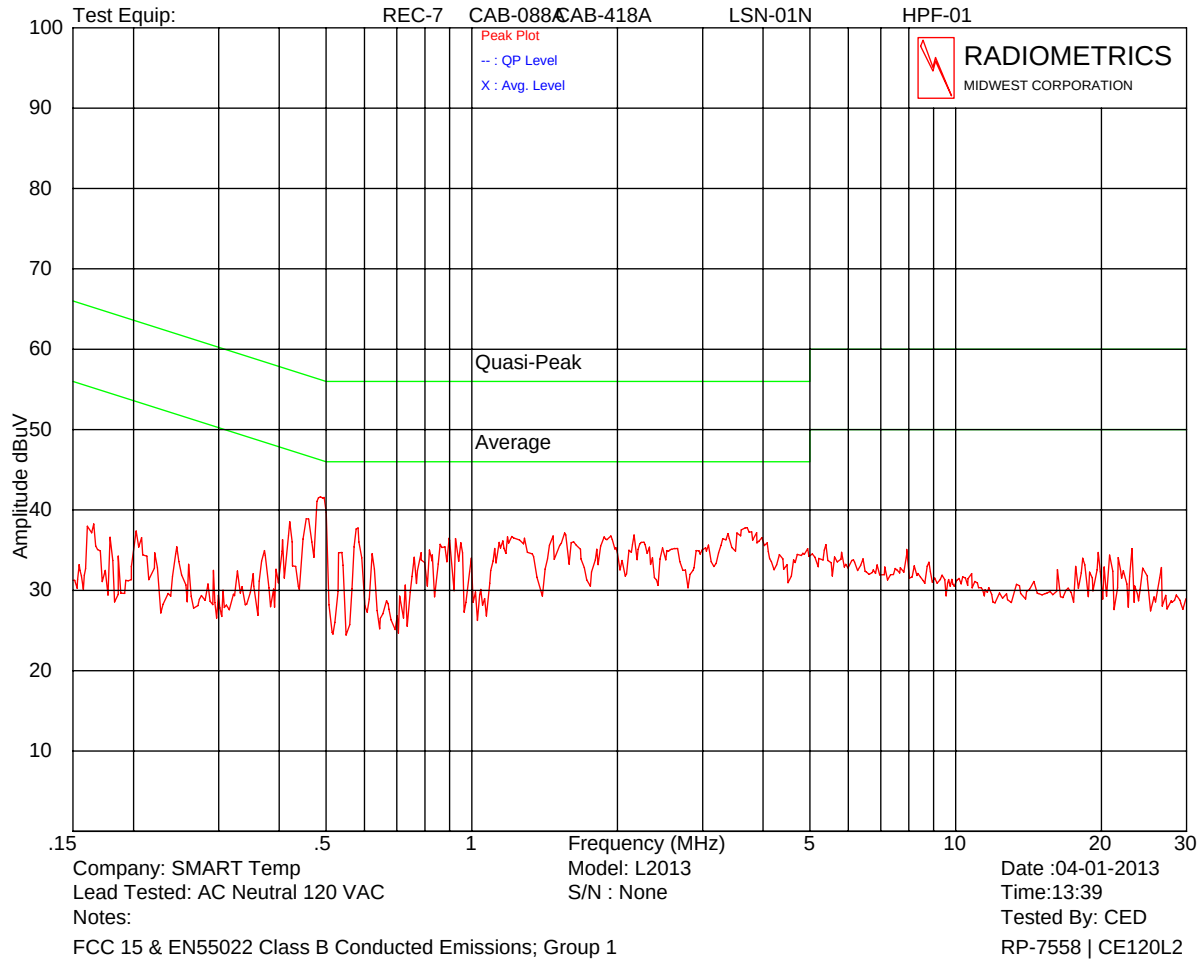
Test Date : April 1 thru May 6, 2013
The Amplitude is the final corrected value with cable and LISN Loss.

Judgment: Passed by at least 3 dB



MHz	Peak dBuV	Average Limit	Margin
0.4882	36.52	46.2	9.7
0.4931	36.07	46.1	10.0
1.159	34.7	46.0	11.3
3.0758	33.75	46.0	12.3
18.24	37.74	50.0	12.3
0.5007	33.66	46.0	12.3
19.704	37.38	50.0	12.6
3.6336	33.37	46.0	12.6
0.4801	33.64	46.3	12.7
1.1612	33.19	46.0	12.8
3.5632	33.1	46.0	12.9
3.4312	32.88	46.0	13.1
3.3912	32.64	46.0	13.4
18.908	36.35	50.0	13.7
3.336	32.2	46.0	13.8

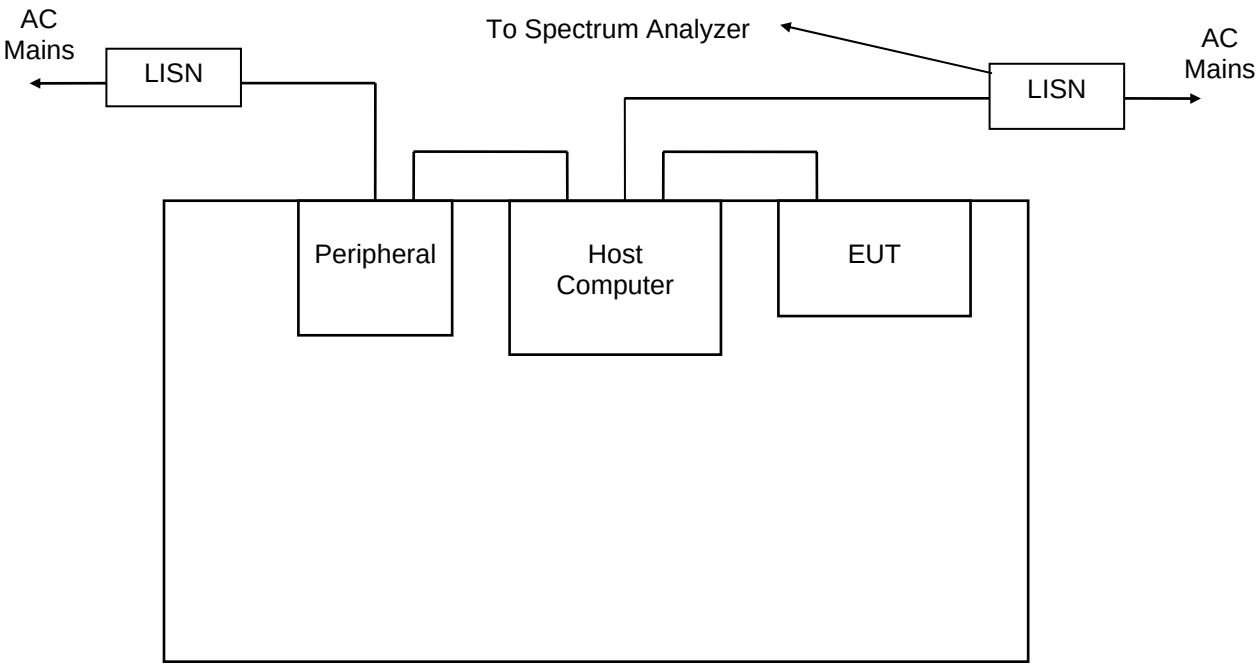
Above is the tabulated list of the 15 highest readings relative to the limit. Since the peak detector data passed the average (lowest) limit, no additional detector functions are required.



MHz	Peak dBuV	Average Limit	Margin
0.4956	41.55538	46.1	4.5
0.4869	41.64	46.2	4.6
0.4924	41.46	46.1	4.7
0.4821	41.50231	46.3	4.8
0.4786	41.06	46.4	5.3
0.5005	39.69	46.0	6.3
0.4601	38.87	46.7	7.8
0.455	38.9	46.8	7.9
0.455	38.9	46.8	7.9
3.7088	37.8	46.0	8.2
3.6736	37.77	46.0	8.2
0.5822	37.76	46.0	8.2
0.5768	37.63	46.0	8.4
3.6048	37.51	46.0	8.5
3.7872	37.28	46.0	8.7

Above is the tabulated list of the 15 highest readings relative to the limit. Since the peak detector data passed the average (lowest) limit, no additional detector functions are required.

Figure 1. Conducted Emissions Test Setup



Notes:
- LISN's at least 80 cm from EUT chassis
- Vertical conductive plane 40 cm from rear of table top
- EUT power cord bundled

10.2 Peak Output Power

The EUT antenna port was connected to the Spectrum analyzer Via a low loss coaxial cable.

The power output option 2; Method #3 from FCC rules 558074 was used for this test. The spectrum analyzer was set to the following settings:

Span = 2 MHz
RBW = 1 MHz
VBW = 3 MHz
Sweep = auto
Detector function = peak
Trace = max hold

The trace was allowed to stabilize. The marker-to-peak function was used to measure the peak of the emission. The indicated level is the peak output power. The BW correction factor is 10*Log(BW). Note 30 dBm = 1 watt. Since the gain of the antenna is always less than 6 dB, the limit is not reduced.

Freq. (MHz)	Reading (dBm)	Cable & Attenuator Loss (dB)	Total Power (dBm)		Limit (dBm)	Margin (dB)
			dBm	Watts		
2405	-0.9	20.6	19.7	0.093	30.0	10.3
2440	-0.6	20.6	20.0	0.100	30.0	10.0
2470	-0.9	20.6	19.7	0.093	30.0	10.3

Judgment: Pass by 10 dB

10.3 Power Spectral Density

PSD option 1 was used for this test. The spectrum analyzer was set to the following settings:

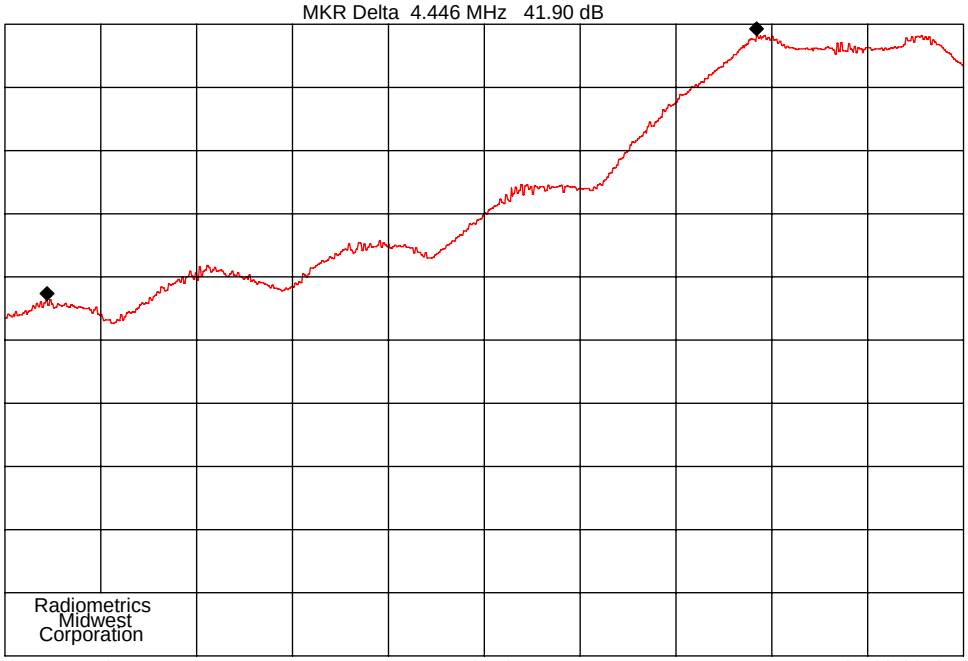
Span = 500 kHz
RBW = 3 kHz
VBW = 10 kHz
Sweep = 167 seconds
Detector function = Peak

Frequency (MHz)	Reading dBm	Cable & Attenuator Loss (dB)	3 kHz Spectral Density (dBm)	Limit (dBm)	Margin (dB)
2405	-16.4	20.6	4.2	8.0	3.8
2440	-16.9	20.6	3.7	8.0	4.3
2470	-17.4	20.6	3.2	8.0	4.8

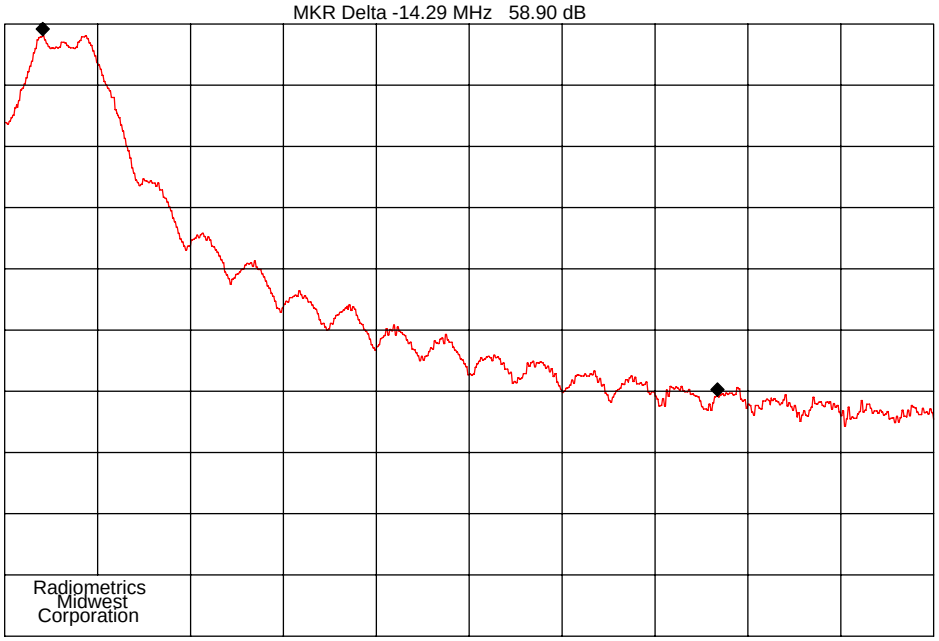
Judgment: Passed by 3.8 dB

10.4 Band-edge Compliance of RF Conducted Emissions

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation at the band-edge, with the EUT set to the lowest frequency. The trace was allowed to stabilize.



Company: SMART Temp
CENTER 2.402 73 GHz
RES BW 300 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 14:11
Date : 05-03-2013
SPAN 6.00 MHz
ATTEN 20 dB
SWP 20.0 msec
Notes: Model L2013 Zigbee @ 2405 MHz, Lower Band Edge measurement @ 2400 MHz. File: 2400LE

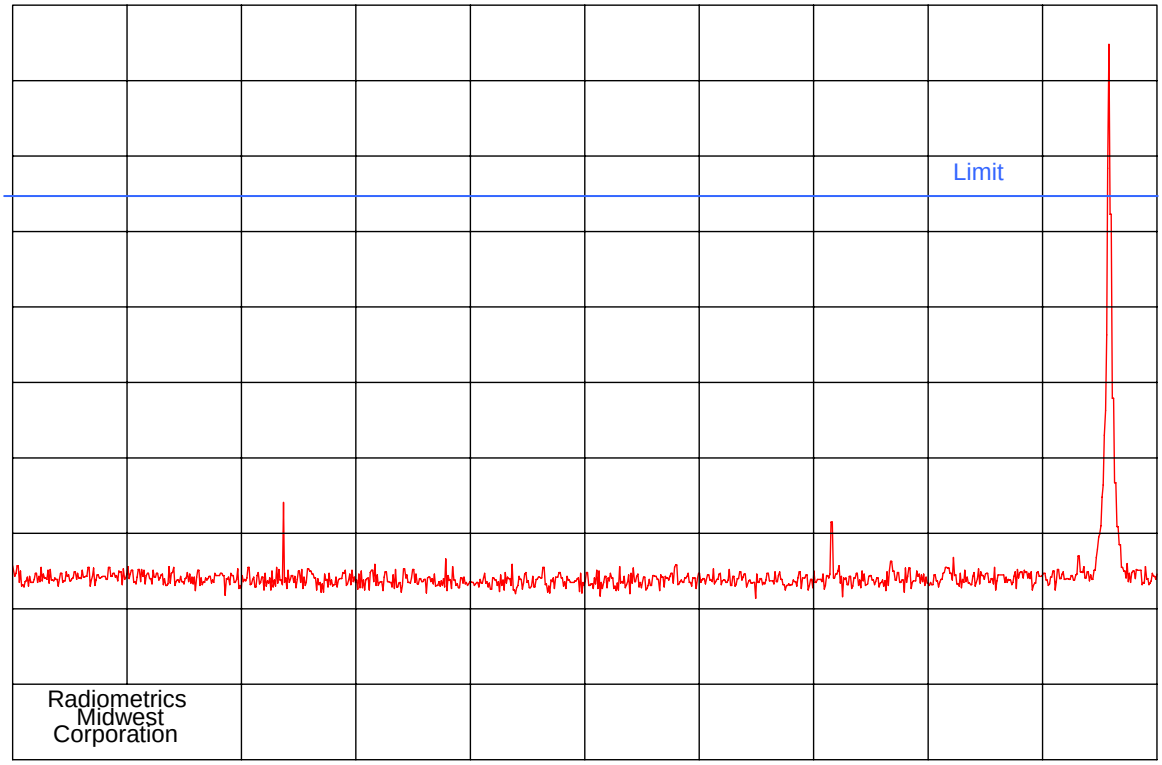


Company: SMART Temp
CENTER 2.478 6 GHz
RES BW 300 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 13:58
Date : 05-03-2013
SPAN 19.7 MHz
ATTEN 20 dB
SWP 20.0 msec
Notes: Model L2013 Zigbee @ 2470 MHz, Upper Band edge measurement @ 2483.5 MHz. File: 2483UE

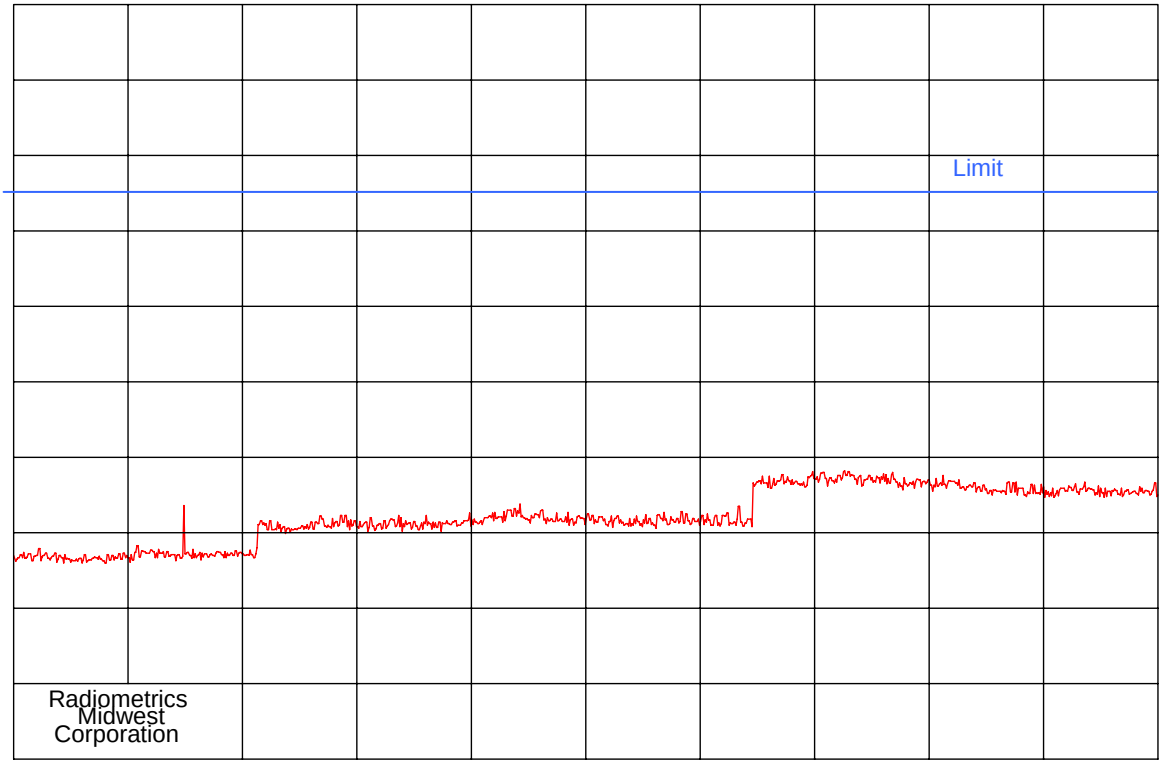
Channel	Reading at Band Edge		Minimum Allowed
	Freq. (MHz)	Delta (dB)	dB
2405 Lower Band edge	2400	41.9	20
2470 Upper Band edge	2483.5	58.9	20

10.5 Spurious RF Conducted Emissions

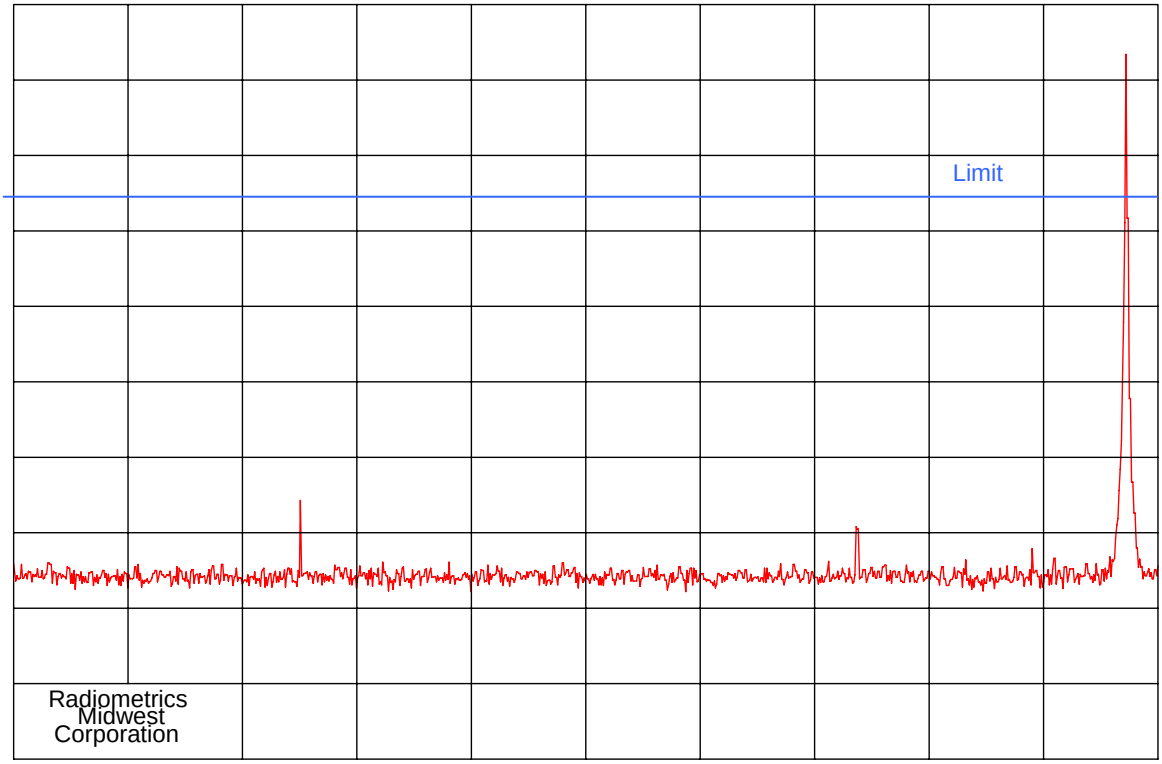
The spectrum analyzer was set to the MAX HOLD mode to record all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic. The trace was allowed to stabilize. The first two plots were made while stepping through three frequencies (Low middle and high). Each frequency was on for 30 seconds.



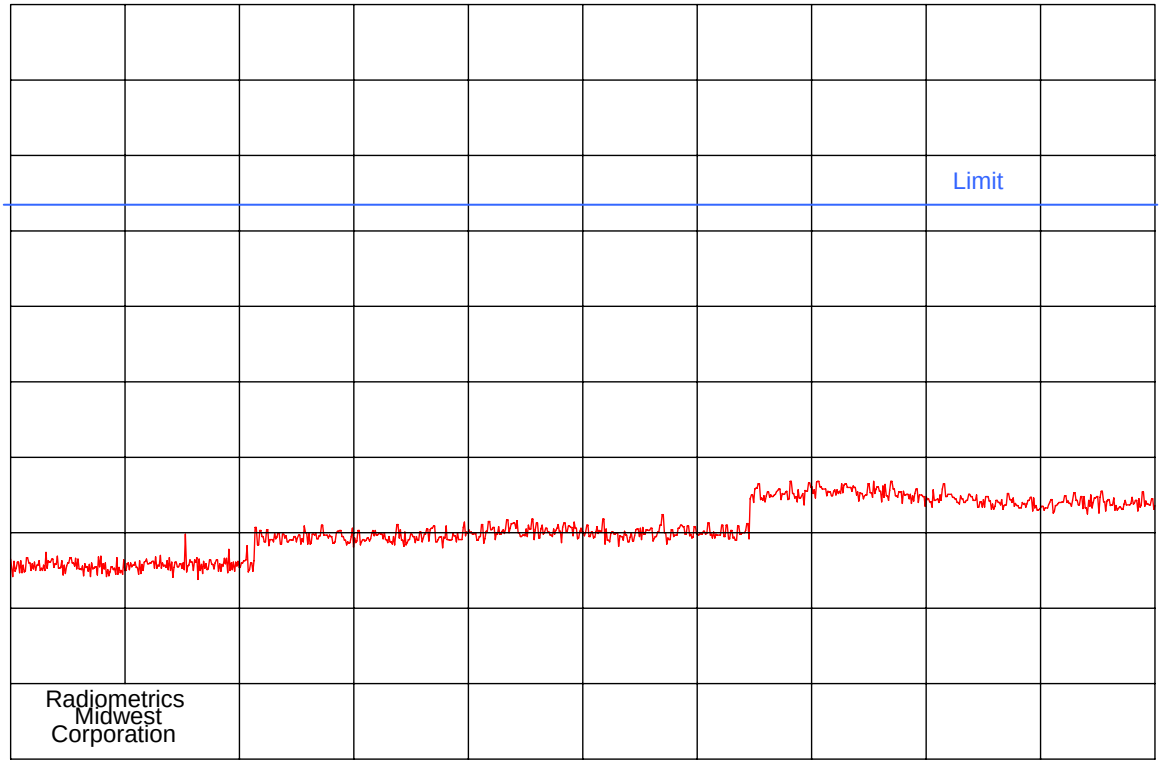
Company: SMART Temp
START 1 MHz
RES BW 100 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 14:56
Date : 05-06-2013
STOP 2.50 GHz
ATTEN 10 dB
SWP 750 msec
Notes: Conducted Spurious test., EUT @ 2405 MHz . Used Att-38
File: 2405CSR1



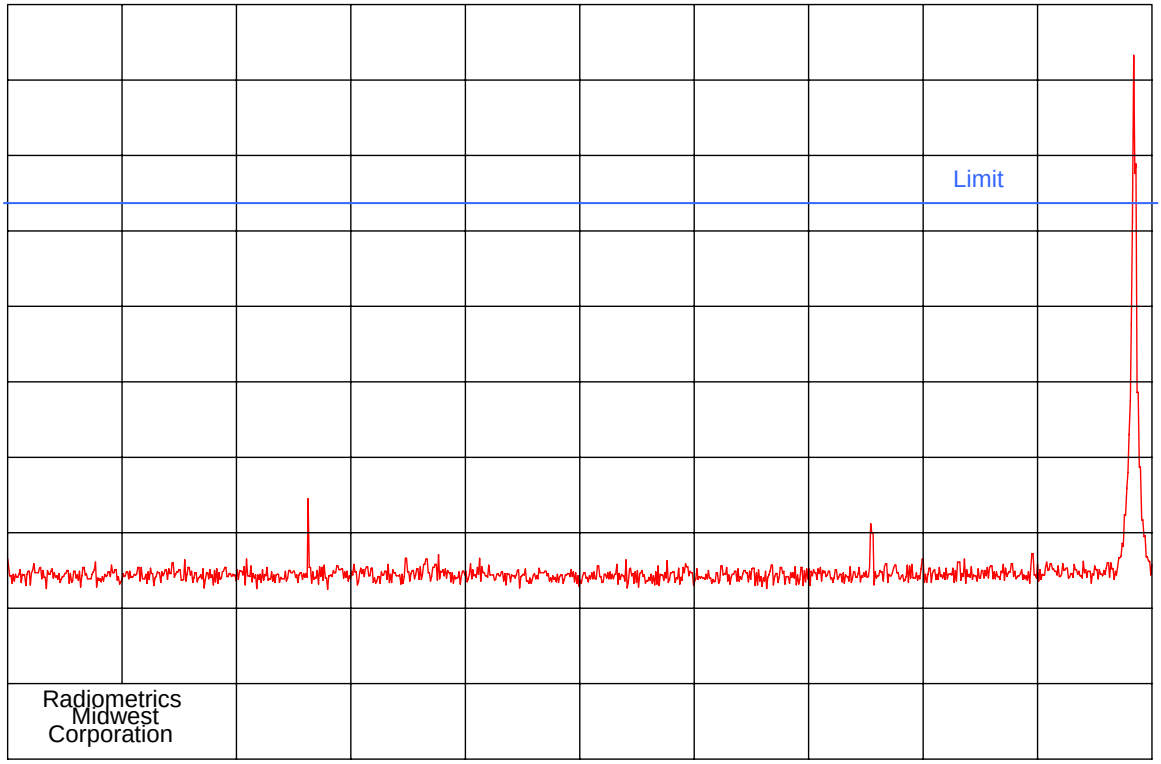
Company: SMART Temp
START 2.5 GHz
RES BW 100 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 14:53
Date : 05-06-2013
STOP 18.0 GHz
ATTEN 10 dB
SWP 4.65 sec
File: 2405CSR2
Notes: Conducted Spurious test., EUT @ 2405 MHz . Used Att-38



Company: SMART Temp
START 1 MHz
RES BW 100 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 15:03
Date : 05-06-2013
STOP 2.50 GHz
ATTEN 10 dB
SWP 750 msec
Notes: Conducted Spurious test., EUT @ 2440 MHz. Used ATT-38
File: 2440CSR1



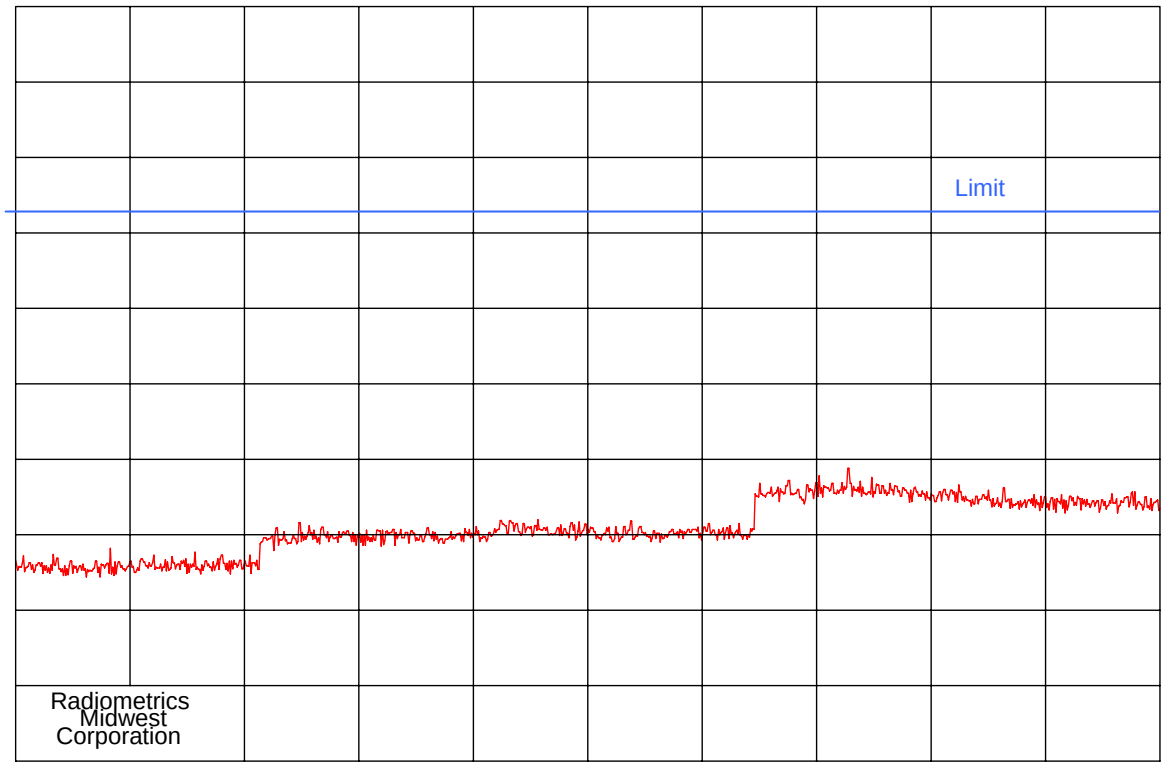
Company: SMART Temp
START 2.5 GHz
RES BW 100 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 15:05
Date : 05-06-2013
STOP 18.0 GHz
ATTEN 10 dB
SWP 4.65 sec
Notes: Conducted Spurious test., EUT @ 2440 MHz. Used ATT-38
File: 2440CSR2



Company: SMART Temp
START 1 MHz
RES BW 100 kHz
10 dB/
Notes: Conducted Spurious test., EUT @ 2470 MHz.Used Att-38

ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 15:09

Date : 05-06-2013
STOP 2.50 GHz
ATTEN 10 dB
SWP 750 msec
File: 2470CSR1



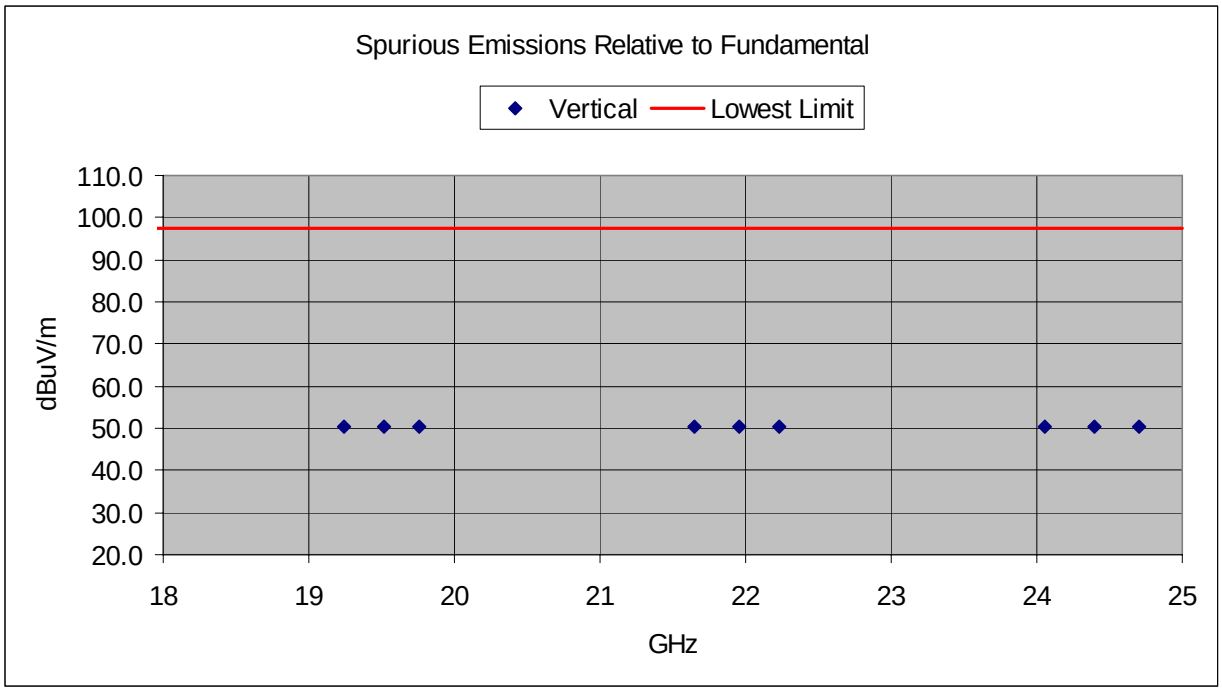
Company: SMART Temp
START 2.5 GHz
RES BW 100 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 15:11
Date : 05-06-2013
STOP 18.0 GHz
ATTEN 10 dB
SWP 4.65 sec
Notes: Conducted Spurious test., EUT @ 2470 MHz. Used ATT-38
File: 2470CSR2

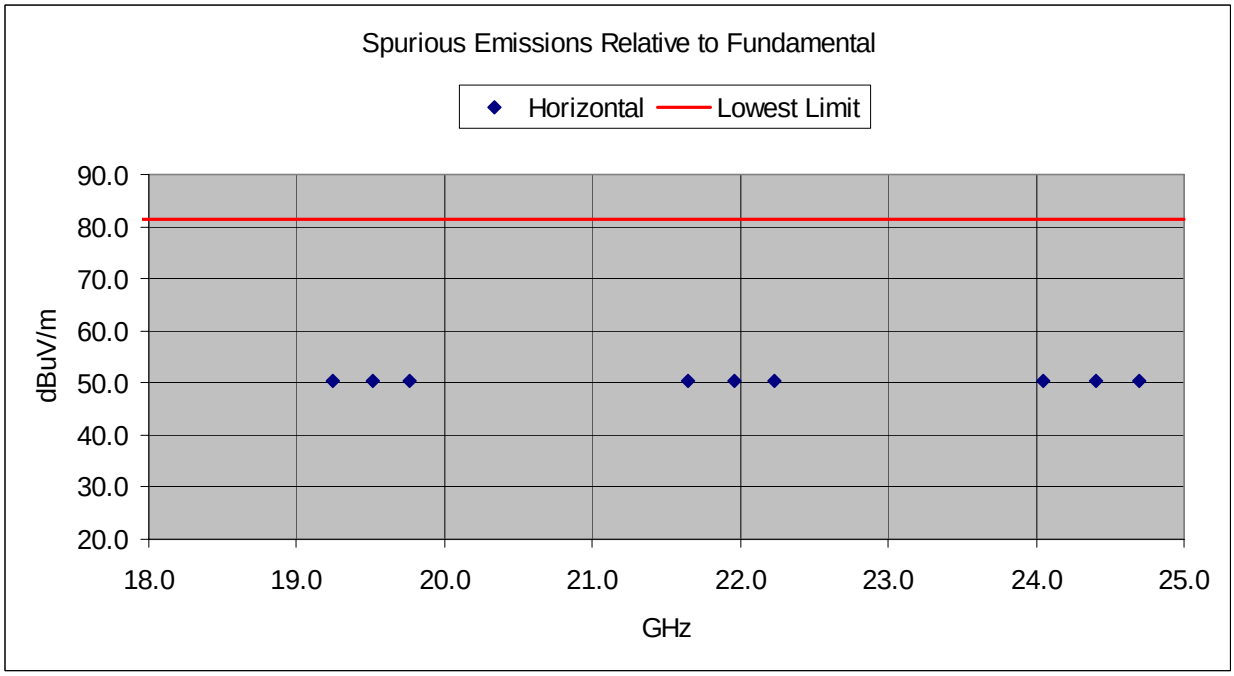
Judgement: Pass by at least 10 dB from 1 MHz to 18 GHz

10.5.1 Spurious RF Emissions; Radiated Method (18 - 25 GHz)

Radiated tests were performed to show compliance with the conducted spurious requirement from 18 to 25 GHz since the previous Section stopped at 18 GHz.

The EUT was tested in continous mode and peak readings were made from 2.5 GHz up through the 10th harmonic. The limit is 20 dB lower than the peak of the lowest fundamental. The data is shown graphically.
Test Date: 05/02/13





Judgement: Pass by at least 10 dB

10.6 Duty Cycle Calculation

The Peak to average factor is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is 20 * Log(Duty cycle/100).

The transmitter operates for a maximum duration of 47.5 ms in any 100 ms interval for a **47.5%** maximum duty cycle:

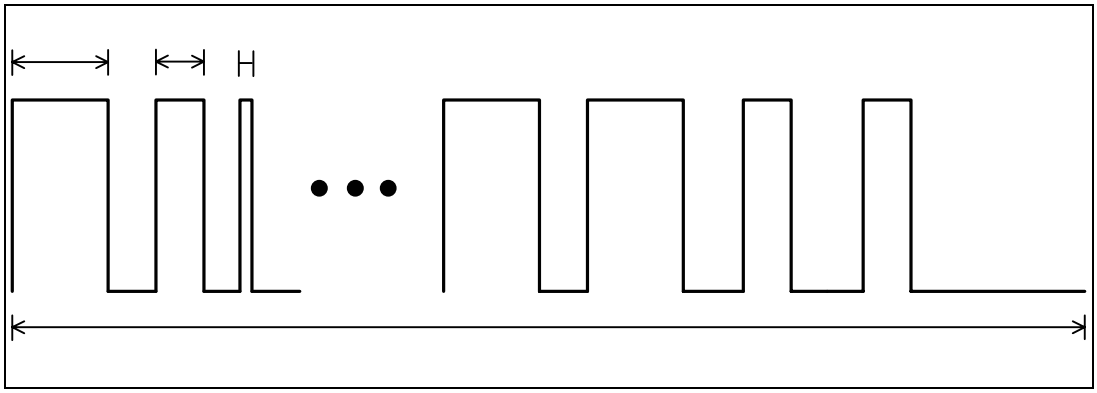


Figure 2. Transmitter Duty Cycle

20 Log*(47.5mSec/100mSec) = -6.5 dB Peak to average Correction factor.

4 ms 2 ms 0

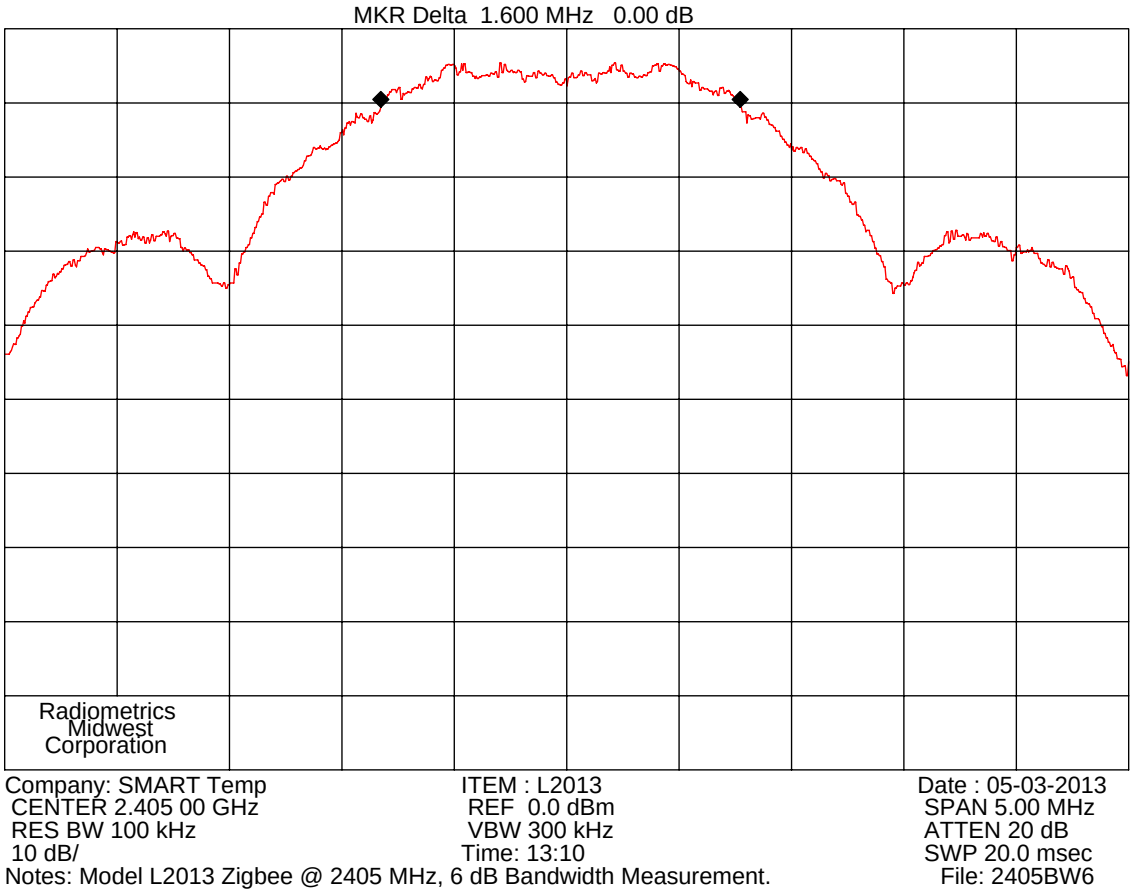
10.7 Occupied Bandwidth

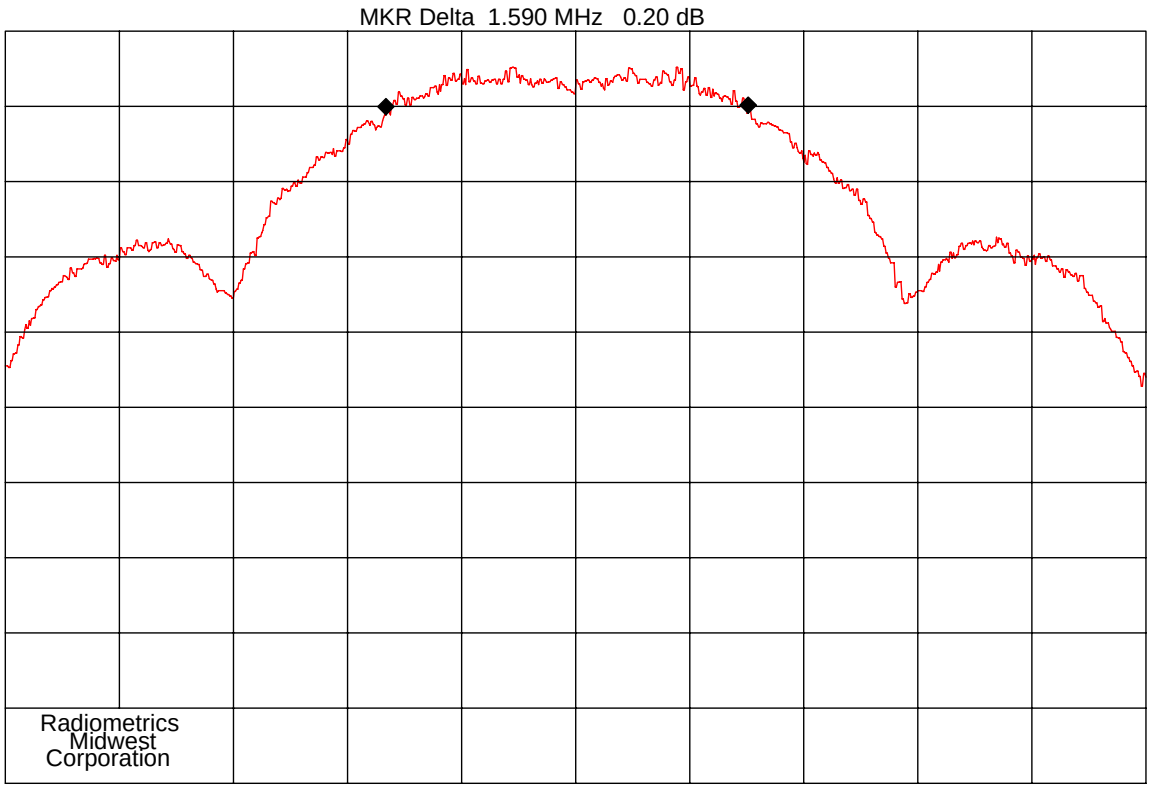
The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize.

The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 6 or 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the bandwidth of the emission.

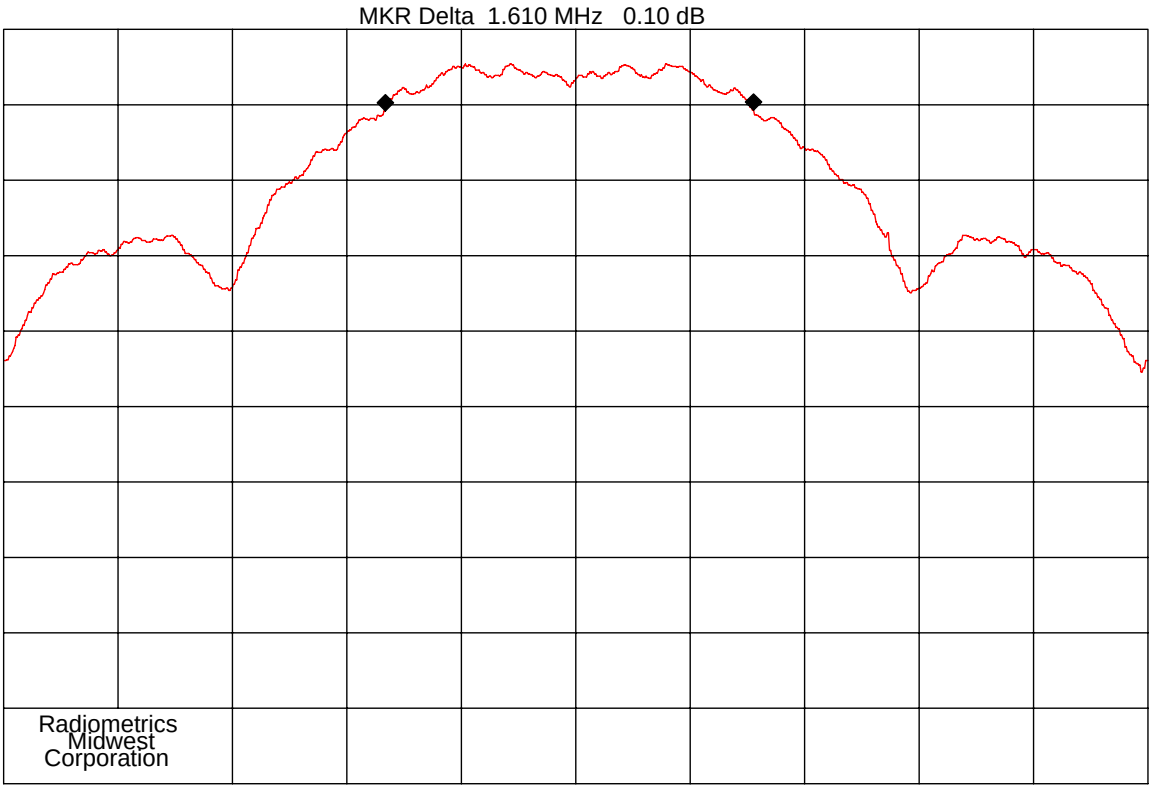
Channel	6 dB EBW MHz	20 dB EBW MHz
2405	1.6	2.67
2440	1.59	2.65
2470	1.61	2.66

Figure 3. Occupied Bandwidth Plot

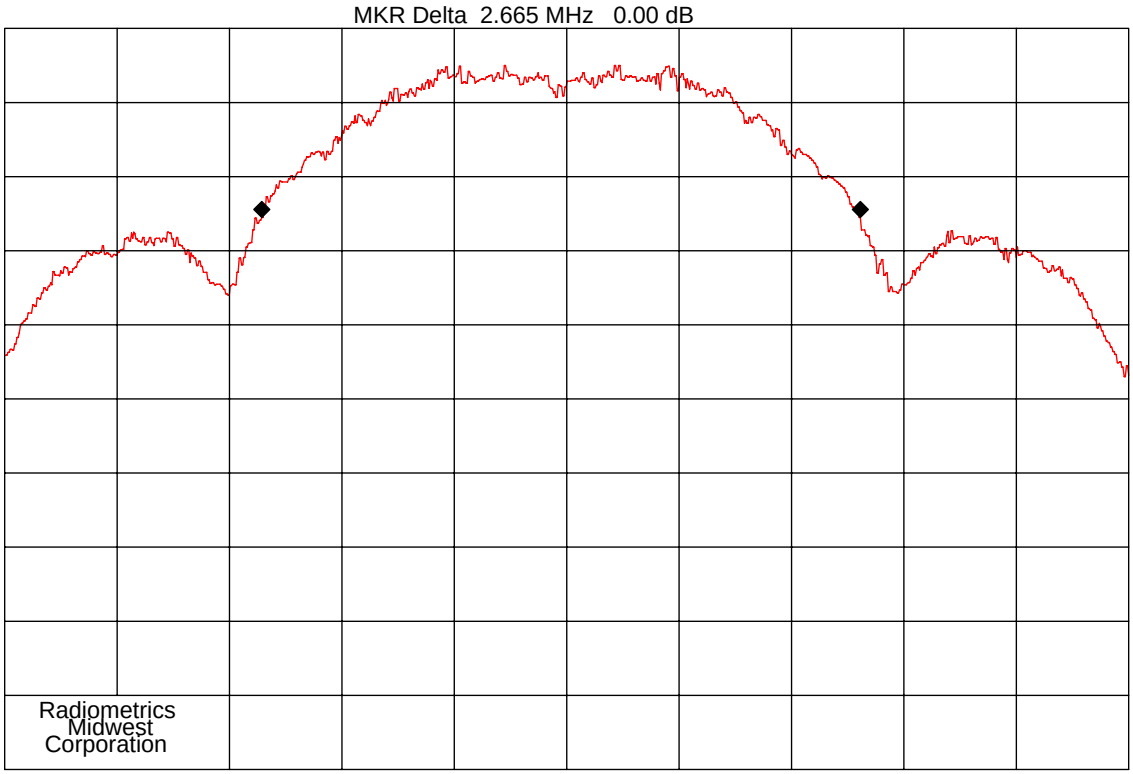




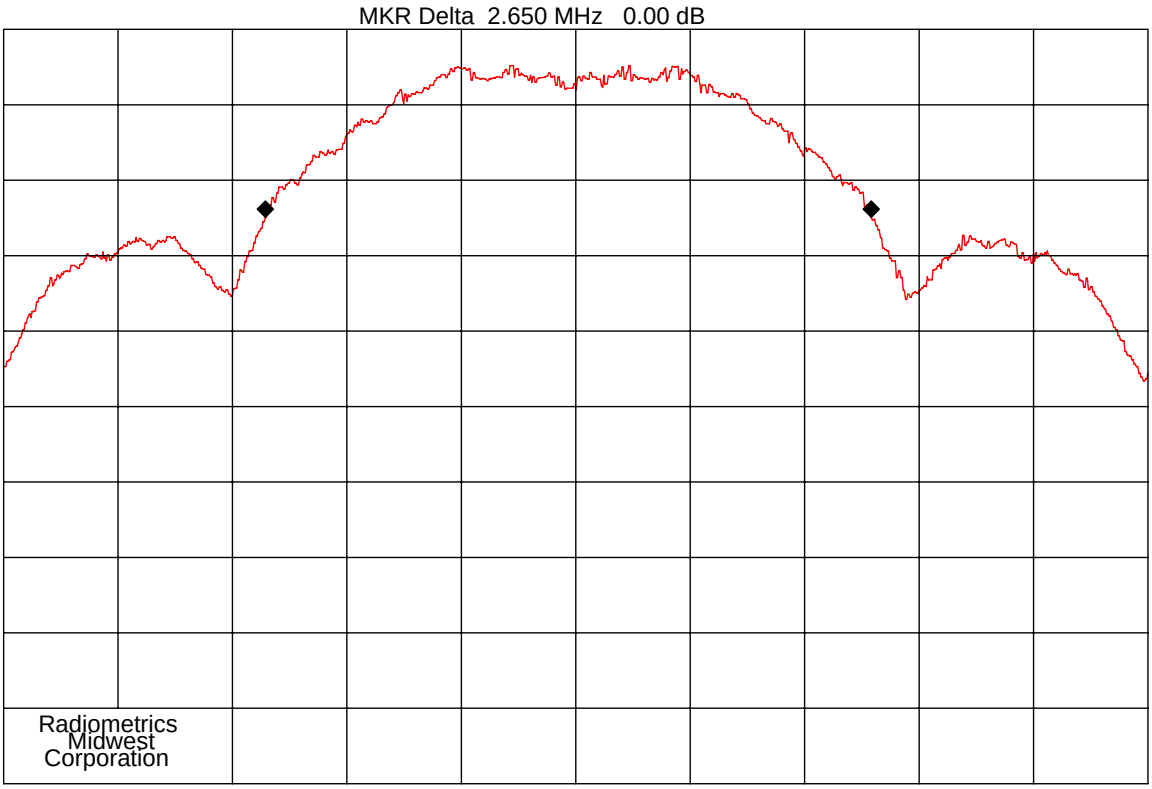
Company: SMART Temp
CENTER 2.440 00 GHz
RES BW 100 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 13:23
Date : 05-03-2013
SPAN 5.00 MHz
ATTEN 20 dB
SWP 20.0 msec
File: 2440BW6
Notes: Model L2013 Zigbee @ 2440 MHz, 6 dB Bandwidth measurement



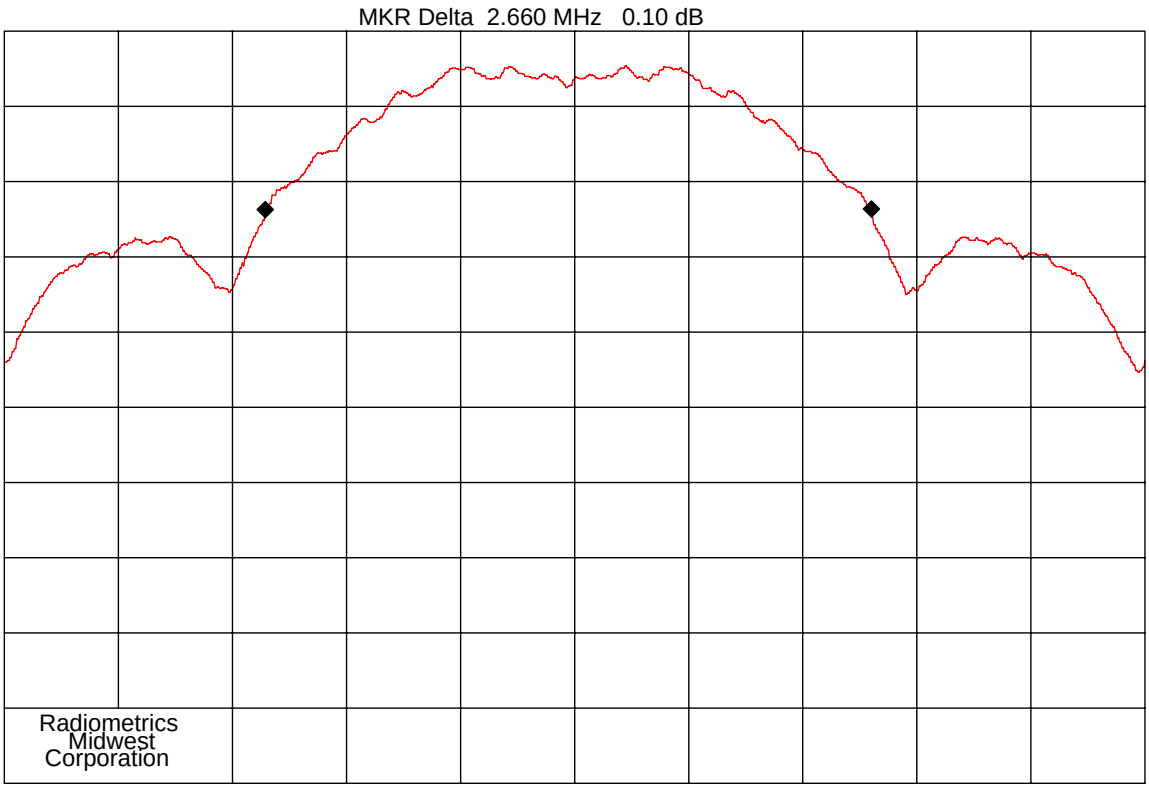
Company: SMART Temp
CENTER 2.470 00 GHz
RES BW 100 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 13:38
Date : 05-03-2013
SPAN 5.00 MHz
ATTEN 20 dB
SWP 20.0 msec
File: 2470BW6
Notes: Model L2013 Zigbee @ 2470 MHz, 6 dB Bandwidth



Company: SMART Temp
CENTER 2.405 00 GHz
RES BW 100 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 13:17
Date : 05-03-2013
SPAN 5.00 MHz
ATTEN 20 dB
SWP 20.0 msec
Notes: Model L2013 Zigbee @ 2405 MHz, 20 dB Bandwidth measurement
File: 2405BW20



Company: SMART Temp
CENTER 2.440 00 GHz
RES BW 100 kHz
10 dB/
ITEM : L2013
REF 0.0 dBm
VBW 300 kHz
Time: 13:30
Date : 05-03-2013
SPAN 5.00 MHz
ATTEN 20 dB
SWP 20.0 msec
File: 2440BW20
Notes: Model L2013 Zigbee @ 2440 MHz, 20 dB Bandwidth



10.8 Radiated RF Emissions

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 1000 MHz, an Anritsu spectrum analyzer was used. For tests from 1 to 25 GHz, an HP 8566 spectrum analyzer was used. For tests from 1 to 10 GHz, a high pass filter was used to reduce the fundamental emission. A harmonic mixer was used from 18 to 25 GHz. Figure 4 herein lists the details of the test equipment used during radiated emissions tests. In addition, a high pass filter was used to reduce the fundamental emission.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 25000 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

10.8.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF - AG + HPF + PKA

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
HPF = High pass Filter Loss
PKA = Peak to Average Factor (This is zero for non-average measurements)

The Peak to average factor is used when average measurements are required. It is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is 20 * Log(Duty cycle/100).

10.8.2 Radiated Emissions Test Results

Test Dates	May 1 and 2, 2013

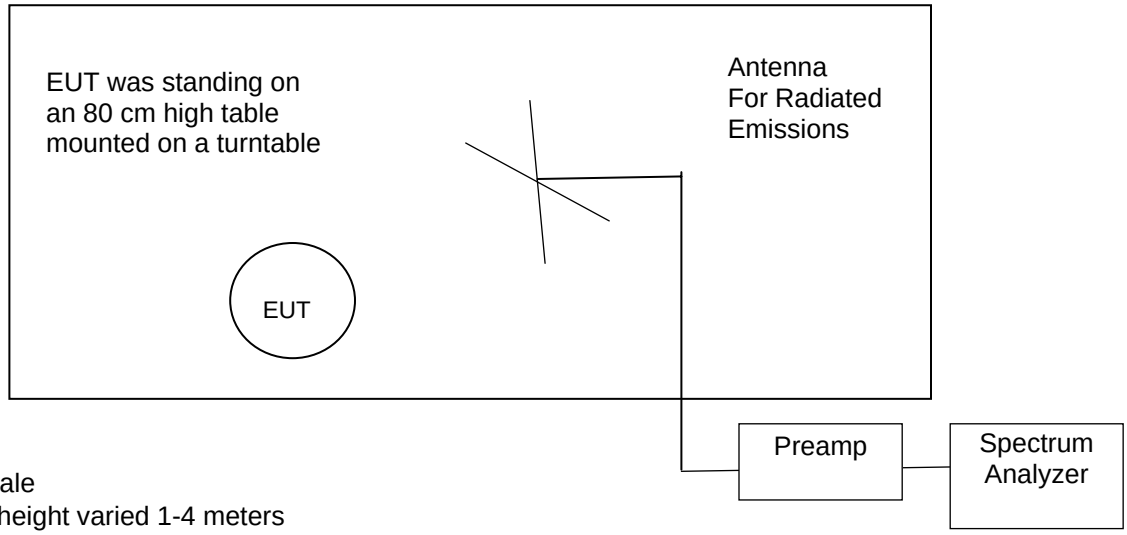
hrm #	Tx Freq MHz	Spectrum Analyzer Readings in dBuV				Corr. Fact dB	Emission Freq MHz	Field Strength				Margin Under Limit
		Vertical Pol.		Horizontal Pol.				EUT		Limit		
		Peak	Ave	Peak	Ave			dBuV/m				
1	2405	116.1	109.6	103.7	97.2	2.3	2405	118.4	111.9	125.0	125.0	6.6
BE	2405	55.4	48.9	0.0	-6.5	2.3	2390	57.7	51.2	74.0	54.0	2.8
2	2405	43.1	36.6	37.0	30.5	11.0	4810	54.1	47.6	74.0	54.0	6.4
3	2405	39.4	32.9	39.8	33.3	11.5	7215	51.3	44.8	74.0	54.0	9.2
4	2405	48.2	41.7	45.7	39.2	3.9	9620	52.1	45.6	81.5	81.5	29.4
5	2405	43.6	37.1	42.5	36.0	4.0	12025	47.6	41.1	74.0	54.0	12.9
6	2405	45.6	39.1	45.8	45.3	8.1	14430	53.9	53.4	81.5	81.5	27.6
7	2405	44.4	37.9	45.3	38.8	6.7	16835	52.0	45.5	81.5	81.5	29.5
1	2440	114.8	108.3	99.0	92.5	2.5	2440	117.3	110.8	125.0	115.0	4.2
2	2440	36.1	29.6	34.9	28.4	10.7	4880	46.8	40.3	74.0	54.0	13.7
3	2440	40.9	34.4	39.3	32.8	11.8	7320	52.7	46.2	74.0	54.0	7.8
4	2440	46.9	40.4	44.3	37.8	4.2	9760	51.1	44.6	81.5	81.5	30.4
5	2440	44.2	37.7	42.7	36.2	3.6	12200	47.8	41.3	74.0	54.0	12.7
6	2440	45.7	39.2	46.4	39.9	7.8	14640	54.2	47.7	81.5	81.5	27.3
7	2440	44.4	37.9	44.8	38.3	7.7	17080	52.5	46.0	81.5	81.5	29.0
1	2470	116.2	109.7	104.6	98.1	2.5	2470	118.7	112.2	125.0	125.0	6.3
BE	2470	55.9	49.4	51.9	45.4	2.5	2483.5	58.4	51.9	74.0	54.0	2.1
2	2470	34.3	27.8	32.9	26.4	10.6	4940	44.9	38.4	74.0	54.0	15.6
3	2470	40.0	33.5	39.9	33.4	12.1	7410	52.1	45.6	74.0	54.0	8.4
4	2470	48.2	41.7	45.9	39.4	4.6	9880	52.8	46.3	81.5	81.5	28.7
5	2470	43.4	36.9	42.5	36.0	3.4	12350	46.8	40.3	74.0	54.0	13.7
6	2470	45.1	38.6	44.9	38.4	7.4	14820	52.5	46.0	81.5	81.5	29.0
7	2470	44.8	38.3	44.3	37.8	8.9	17290	53.7	47.2	81.5	81.5	27.8

Judgment: Passed by 2.1 dB
No other emissions were detected from the transmitter between 30 MHz to 25 GHz within 10 dB of the limits.

Notes on Columns:
Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected Vertical readings from the spectrum analyzer
Column #4. Raw Average reading; The average reading was converted from the peak reading. Ave = Peak – Dwell time correction factor from section 10.3.2 herein.
Column #5. Uncorrected Horizontal readings from the spectrum analyzer
Column #6. Raw Average reading; The average reading was converted from the peak reading. Ave = Peak – Dwell time correction factor from section 10.3.2 herein.
Column #7. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #8. Frequency of Tested Emission
Column #9. Highest peak field strength at listed frequency.
Column #10. Highest Average field strength at listed frequency.
Column #11. Peak Limit. All limits set to 74 dBuV/m. Non restricted band limit is 81.5 dBuV/m since this is the worst case limit
Column #12. Average Limit. All limits set to 54 dBuV/m. Non restricted band limit is 81.5 dBuV/m since this is the worst case limit. There is no average limit for this band.
Column #13. The margin (last column) is the worst case margin under the peak or average limits for that row.

Figure 4. Drawing of Radiated Emissions Setup

Chamber E, anechoic



Notes:
- Not to Scale
- Antenna height varied 1-4 meters
- Distance from antenna to tested system is 3 meters
- AC cords not shown. They are connected to AC outlet with low-pass filter on turntable

Frequency Range	Receive Antenna	Pre-Amplifier	Spectrum Analyzer	High Pass Filter
0.01 to 30 MHz	ANT-53	None	REC-03	None
30 to 1000 MHz	ANT-44	AMP-22	REC-03	None*
1 to 10 GHz	ANT-13	AMP-05	REC-01	HPF-03
10 to 18 GHz	ANT-13	AMP-20	REC-01	None*
18 to 25 GHz	ANT-48	AMP-29	REC-08; MXR-01	None*

* A high pass filter was not needed since the fundamental frequency was outside of the amplifiers pass band.

10.9 Unintentional Emissions (Receive Mode)

Manufacturer	SMART Temps	Specification	FCC Part 15.247 & RSS-210
Model	L2013	Test Date	04/01/2013
Serial Number	none	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain – Duty Cycle Factor + HP Filter Loss		
Configuration	Receive mode		

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
48.0	42.4	P	14.6	H/44	-28.1	28.9	40.0	11.1
69.2	45.3	P	7.9	H/44	-27.8	25.4	40.0	14.6

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
98.5	54.1	Q	9.1	H/44	-27.5	35.7	43.5	7.8
147.6	47.9	P	9.8	H/44	-26.9	30.8	43.5	12.7
161.2	45.5	P	10.3	H/44	-26.7	29.1	43.5	14.4
183.2	50.8	P	9.2	H/44	-26.4	33.6	43.5	9.9
189.2	49.8	P	9.7	H/44	-26.4	33.1	43.5	10.4
198.8	47.1	P	9.8	H/44	-26.3	30.6	43.5	12.9
228.4	45.1	P	11.6	H/44	-26.0	30.7	46.0	15.3
250.2	49.9	P	12.7	H/44	-27.4	35.2	46.0	10.8
271.5	49.3	P	13.0	H/44	-27.3	35.0	46.0	11.0
300.6	43.8	P	12.9	H/44	-27.3	29.4	46.0	16.6
349.9	36.9	P	14.6	H/44	-27.3	24.2	46.0	21.8
375.1	51.5	P	15.3	H/44	-27.2	39.6	46.0	6.4
396.4	50.1	P	15.4	H/44	-27.2	38.3	46.0	7.7
448.4	43.5	P	16.6	H/44	-26.9	33.2	46.0	12.8
497.2	43.7	P	17.3	H/44	-26.6	34.4	46.0	11.6
538.0	33.2	P	18.5	H/44	-26.4	25.3	46.0	20.7
598.0	34.2	P	19.3	H/44	-26.4	27.1	46.0	18.9
625.0	38.2	P	19.8	H/44	-26.4	31.6	46.0	14.4
661.0	41.9	P	20.4	H/44	-26.3	36.0	46.0	10.0
717.0	31.5	P	20.6	H/44	-26.0	26.1	46.0	19.9
750.0	45.6	P	20.3	H/44	-25.9	40.0	46.0	6.0
800.0	32.1	P	20.2	H/44	-25.5	26.8	46.0	19.2
875.0	43.7	P	21.3	H/44	-25.2	39.8	46.0	6.2
925.0	32.8	P	21.8	H/44	-24.9	29.7	46.0	16.3
960.0	31.4	P	21.9	H/44	-24.6	28.7	54.0	25.3
50.6	47.2	Q	13.9	V/44	-28.1	33.0	40.0	7.0
69.1	51.3	Q	7.9	V/44	-27.8	31.4	40.0	8.6
99.0	56.1	Q	9.2	V/44	-27.5	37.8	43.5	5.7
125.0	49.4	Q	14.6	V/44	-27.2	36.8	43.5	6.7
148.1	52.9	Q	9.7	V/44	-26.9	35.7	43.5	7.8
184.4	52.4	P	9.2	V/44	-26.4	35.2	43.5	8.3
185.2	48.5	Q	9.3	V/44	-26.4	31.4	43.5	12.1
204.4	49.6	P	9.8	V/44	-26.3	33.1	43.5	10.4
255.8	53.2	P	12.9	V/44	-27.4	38.7	46.0	7.3
310.7	36.3	P	13.4	V/44	-27.3	22.4	46.0	23.6
352.1	40.6	P	14.7	V/44	-27.3	28.0	46.0	18.0
375.0	55.9	Q	15.3	V/44	-27.2	44.0	46.0	2.0
566.0	39.1	P	19.1	V/44	-26.4	31.8	46.0	14.2
661.0	41.3	P	20.4	V/44	-26.3	35.4	46.0	10.6
716.0	34.7	P	20.6	V/44	-26.1	29.2	46.0	16.8
750.0	41.2	P	20.3	V/44	-25.9	35.6	46.0	10.4
819.0	40.7	P	21.5	V/44	-25.3	36.9	46.0	9.1
875.0	37.7	P	21.3	V/44	-25.2	33.8	46.0	12.2
925.0	37.8	P	21.8	V/44	-24.9	34.7	46.0	11.3
983.0	36.0	P	22.9	V/44	-24.1	34.8	54.0	19.2
1045.0	40.4	P	24.5	H/13	-26.7	38.2	54.0	15.8

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
1102.0	39.5	P	24.9	H/13	-26.6	37.8	54.0	16.2
1199.0	40.5	P	25.4	H/13	-26.4	39.5	54.0	14.5
1275.0	37.6	P	25.4	H/13	-26.3	36.7	54.0	17.3
1367.0	39.3	P	25.4	H/13	-26.3	38.4	54.0	15.6
1411.0	38.6	P	25.3	H/13	-26.3	37.6	54.0	16.4
1599.0	35.9	P	25.6	H/13	-26.1	35.4	54.0	18.6
1693.0	34.8	P	26.3	H/13	-26.0	35.1	54.0	18.9
1800.0	30.9	P	26.9	H/13	-25.9	31.9	54.0	22.1
1921.0	34.0	P	27.4	H/13	-25.4	36.0	54.0	18.0
1982.0	30.8	P	27.5	H/13	-25.2	33.1	54.0	20.9
1045.0	38.2	P	24.5	V/13	-26.7	36.0	54.0	18.0
1087.0	36.9	P	24.8	V/13	-26.7	35.0	54.0	19.0
1126.0	35.7	P	25.1	V/13	-26.4	34.4	54.0	19.6
1200.0	38.0	P	25.4	V/13	-26.4	37.0	54.0	17.0
1214.0	36.1	P	25.4	V/13	-26.4	35.1	54.0	18.9
1251.0	36.6	P	25.3	V/13	-26.3	35.6	54.0	18.4
1364.0	36.6	P	25.4	V/13	-26.3	35.7	54.0	18.3
1391.0	36.4	P	25.3	V/13	-26.3	35.4	54.0	18.6
1461.0	34.1	P	25.5	V/13	-26.2	33.4	54.0	20.6
1526.0	32.9	P	25.6	V/13	-26.2	32.3	54.0	21.7
1600.0	33.5	P	25.6	V/13	-26.1	33.0	54.0	21.0
1621.0	34.5	P	25.7	V/13	-26.1	34.1	54.0	19.9
1664.0	31.4	P	26.0	V/13	-26.1	31.3	54.0	22.7
1720.0	31.2	P	26.5	V/13	-26.0	31.7	54.0	22.3
1797.0	31.8	P	26.9	V/13	-25.9	32.8	54.0	21.2
1835.0	31.5	P	27.2	V/13	-25.8	32.9	54.0	21.1
1897.0	30.9	P	27.4	V/13	-25.6	32.7	54.0	21.3
1952.0	30.5	P	27.4	V/13	-25.5	32.4	54.0	21.6

Judgment: Passed by 2.0 dB