FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

Keyboard

Model: KBBT9881

Trade Name: Primax

Issued to

Primax Electronics LTD.
No. 669, Ruey Kuang Road, Neihu Taipei, Taiwan, R.O.C.

Issued by

Compliance Certification Services Inc.
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Testing Laboratory
0363

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Revision History

Rev.		Issue Date		Revisions	Effect Page	Revised By
00		May 28, 2014		Initial Issue	ALL	Iren Wang

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1 TEST RESULT CERTIFICATION

Applicant:	**Primax Electronics LTD.** No. 669, Ruey Kuang Road, Neihu Taipei, Taiwan, R.O.C.
Manufacturer:	**Primax Electronics LTD.** No. 669, Ruey Kuang Road, Neihu Taipei, Taiwan, R.O.C.
Equipment Under Test:	Keyboard
Trade Name:	Primax
Model:	KBBT9881
Date of Test:	May 16 ~ 26, 2014

APPLICABLE STANDARDS	
STANDARD	**TEST RESULT**
FCC 47 CFR Part 15 Subpart C	No non-compliance noted

We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:

Stan Lin
Section Manager

Reviewed by:

Angel Hu
Section Manager

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2 EUT DESCRIPTION

Product	Keyboard
Trade Name	Primax
Model Number	KBBT9881
Model Name Discrepancy	N/A
EUT Power Rating	5VDC from PC / 3.7VDC from Battery
Operating Frequency Range	2402 ~ 2480 MHz
Transmit Power	-1.28dBm (0.0007W)
Modulation Technique	GFSK
Transmit Data Rate	1Mbps
Number of Channels	79 Channels
Antenna Specification	PCB Antenna / Gain: 1.46dBi

Remark:

1. *The sample selected for test was production product and was provided by manufacturer.*
2. *This submittal(s) (test report) is intended for FCC ID: **EMJKKBBT9881** filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.*

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3 TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4 (2009), DA00-705 and FCC CFR 47 15.207, 15.209 and 15.247.

3.1. EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2. EUT EXERCISE

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3. GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.4.

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3.4. FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]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
6.215 - 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 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	([2])
13.36 - 13.41	322 - 335.4		

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

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3.5. DESCRIPTION OF TEST MODES

The EUT (model: KBBT9881) had been tested under operating condition and had been reported as worst case on this test report.

Test program used to control the EUT for staying in continuous transmitting mode was programmed.

Following channel(s) was (were) selected for the final test as listed below.

Tested Channel	Modulation Type	Packet Type	Date Rate
Low, Mid, High	GFSK	DH 5	1

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in normal link mode only.

Channel Low (2402MHz), Mid (2441MHz) and High (2480MHz) with 1Mbps data rate was chosen for full testing.

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4 INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

4.1. MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

Conducted Emissions Test Site				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	Agilent	E4446A	MY48250064	01/01/2015
Spectrum Analyzer	Agilent	N9010A	MY52220817	03/20/2015
Spectrum Analyzer	R&S	FSL	100837	11/11/2014
Power meter	Anritsu	ML2495A	1033009	09/29/2014
Power Sensor	Anritsu	MA2411B	0917221	09/29/2014

3M Semi Anechoic Chamber				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	Agilent	E4446A	MY48250064	01/01/2015
Spectrum Analyzer	R&S	FSL	100837	11/11/2014
Pre-Amplifier	HP	8447D	2944A06530	05/02/2015
Pre-Amplifier	EMEC	EM01M26G	060570	07/25/2014
Pre-Amplifier	MITEQ	AMF-6F-260400-40-8P	985646	08/08/2014
Pre-Amplifier	Agilent	8449B	3008A01738	08/10/2014
EMI Test Receiver	SCHAFFNER	SCR 3501	430	03/30/2015
Loop Antenna	EMCO	6502	2356	06/12/2014
Bilog Antenna	TESEQ	CBL 6112D	35378	09/11/2014
Horn Antenna	EMCO	3115	00022250	08/04/2014
Horn Antenna	EMCO	3116	00026370	12/29/2014
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R
Test S/W	EZ-EMC			

NOTE: *1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.*
2. N.C.R = No Calibration Request.

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Powerline Conducted Emissions Test Site #3				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
EMI Test Receiver	R&S	ESCI	101300	09/06/2014
LISN	R&S	ENV216	100069	06/16/2014
LISN	FCC	FCC-LISN-50/250-16-2-07	06013	11/20/2014
ISN	TESEQ	ISN-T8	30842	08/09/2014
Current Probe	FCC	F-35	506	07/19/2014
ISN	FCC	FCC-TLISN-T4-02	20396	06/28/2014
Test S/W	EZ-EMC			

NOTE: *1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.*
2. N.C.R = No Calibration Request.

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4.2. MEASUREMENT UNCERTAINTY

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028-1 [2] and shall correspond to an expansion factor (coverage factor) k = 1,96 or k = 2 (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Table 6 is based on such expansion factors.

Table 6: Maximum measurement uncertainty

Parameter	Uncertainty
Powerline Conducted Emission	±2.1876
3M Semi Anechoic Chamber / 30MHz ~ 200MHz	±3.5921
3M Semi Anechoic Chamber / 200MHz ~ 1GHz	±3.5657
3M Semi Anechoic Chamber / 1 ~ 8GHz	±2.5873
3M Semi Anechoic Chamber / 8 ~ 18GHz	±2.6646
3M Semi Anechoic Chamber / 18 ~ 26GHz	±2.9617
3M Semi Anechoic Chamber / 26 ~ 40GHz	±3.4250

Remark: *This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.*

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5 FACILITIES AND ACCREDITATIONS

5.1. FACILITIES

All measurement facilities used to collect the measurement data are located at

☐ No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.
Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029

☐ No.11, Wugong 6th Rd., Wugu Industrial Park, Taipei Hsien 248, Taiwan
Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045

☒ No.81-1, Lane 210, Bade 2nd Rd., Lujhu Township, Taoyuan County 33841,Taiwan, R.O.C.
Tel: 886-3-324-0332 / Fax: 886-3-324-5235

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

5.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

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5.3. TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	A2LA	CFR 47, FCC Part15/18, CISPR 22, EN 55022, ICES-003, AS/NZS CISPR 22, VCCI V-3, EN 55011, CISPR 11, IEC/EN 61000-4-2/3/4/5/6/8/11, EN 61000-6-1/2/3/4, EN 55024, CISPR 24, AS/NZS CISPR 24, AS/NZS 61000.6.2, EN 55014-1/-2, ETSI EN 300 386 v1.3.2/v1.3.3, IEC/EN 61000-3-2, AS/NZS 61000.3.2, IEC/EN 61000-3-3, AS/NZS 61000.3.3	ACCREDITED TESTING CERT #0824.01
USA	FCC MRA	3 meter Open Area Test Sites to perform FCC Part 15/18 measurements	TW1026
Japan	VCCI	3/10 meter Open Area Test Sites and conducted test sites to perform radiated/conducted measurements	VCCI R-2882/2541/2798/725/1868 C-402/747/912 T-1930/1646
Taiwan	TAF	EN 55014-1, CISPR 14, CNS 13781-1, EN 55013, CISPR 13, CNS 13439, EN 55011, CISPR 11, CNS 13803, PLMN09, IS2045-0, LP0002 FCC Part 27/90, Part 15B/C/D/E, RSS-192/193/210/310 ETSI EN 300 328/ 300 220-1/ 300 220-2/ 301 893/ 301 489-01/ 301 489-03/ 301 489-07 / 301 489-17/ 300 440-1/ 300 440-2 AS/NZS 4268, AS/NZS 4771 CISPR 22, EN 55022, CNS 13438, AS/NZS CISPR 22, VCCI, IEC/EN 61000-4-2/3/4/5/6/8/11, CNS 14676-2/3/4/5/6/8, CNS 14934-2/3, CNS 13783-1, CNS 13439, CNS 13803	ilac-MRA TAF Testing Laboratory 0363
Taiwan	BSMI	CNS 13438, CNS 13783-1, CNS 13439, CNS 14115	SL2-IS-E-0014 / IN-E-0014 /A1-E-0014 /R1-E-0014 /R2-E-0014 /L1-E-0014
Canada	Industry Canada	RSS-Gen Issue 3	Canada IC 2324C-5

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6 SETUP OF EQUIPMENT UNDER TEST

6.1. SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

6.2. SUPPORT EQUIPMENT

For Conducted & Radiated Emission measurement (Above 1GHz):							
No.	**Device Type**	**Brand**	**Model**	**Series No.**	**FCC ID**	**Data Cable**	**Power Cord**
1	Test Jig	N/A	N/A	N/A	N/A	N/A	N/A
2	Notebook PC	LEO	M285	NU2503544	FCC DoC	Comport Cable: Unshielded, 1.8m USB Cable: Shielded, 1.2m	AC I/P: Unshielded, 1.8m DC O/P: Unshielded, 1.8m with a core

For Power line conducted emission measurement:							
No.	**Device Type**	**Brand**	**Model**	**Series No.**	**FCC ID**	**Data Cable**	**Power Cord**
1	LCD Monitor	DELL	2407WFPb	CN-0FC255-466 33-660-045S	FCC DoC	HDMI Cable: Shielded, 1.8m	Unshielded, 1.8m
2	USB External HDD	TeraSys	F12-U	A0100214-43b00 01	FCC DoC	Shielded, 1.2m	N/A
3	USB Mouse	M100	N/A	N/A	FCC DoC	Unshielded, 1.8m	N/A
4	Multimedia Headset	Logitech	ClearChat	N/A	FCC DoC	Unshielded, 1.2m	N/A

Remark: *Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*

For Radiated Emission (Below 1GHz):							
No.	**Device Type**	**Brand**	**Model**	**Series No.**	**FCC ID**	**Data Cable**	**Power Cord**
	N/A						

****No any support equipment during the test.**

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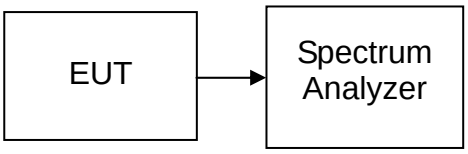
7 FCC PART 15.247 REQUIREMENTS

7.1. 20DB BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST CONFIGURATION



TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=10kHz, VBW = 30kHz, Span = 3MHz, Sweep = auto.
4. Mark the peak frequency and 20dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

TEST RESULTS

No non-compliance noted

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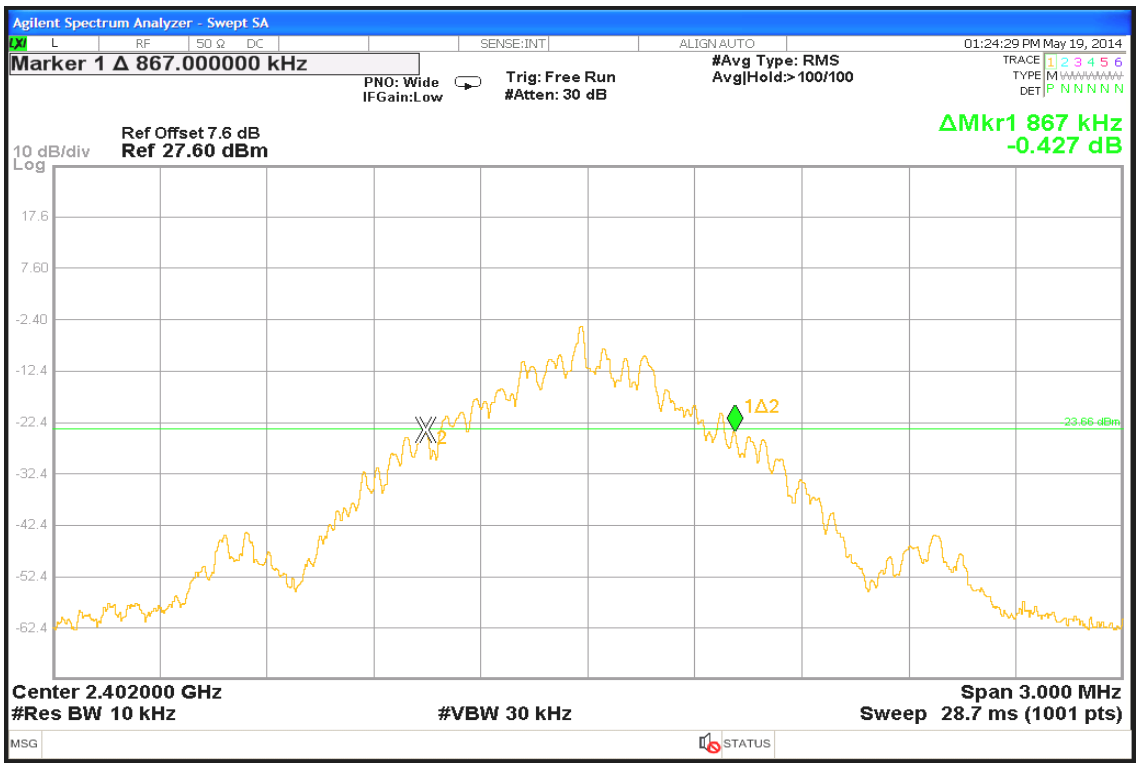
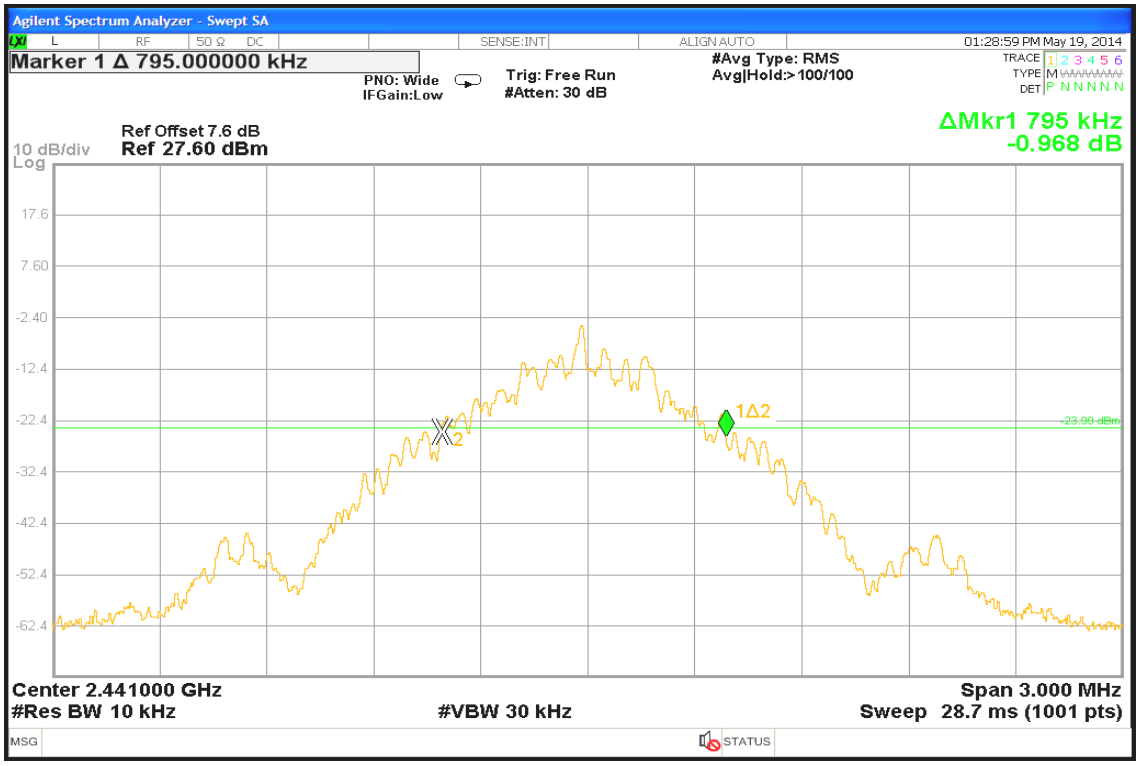
Test Plot

20dB Bandwidth (CH Low)



20dB Bandwidth (CH Mid)



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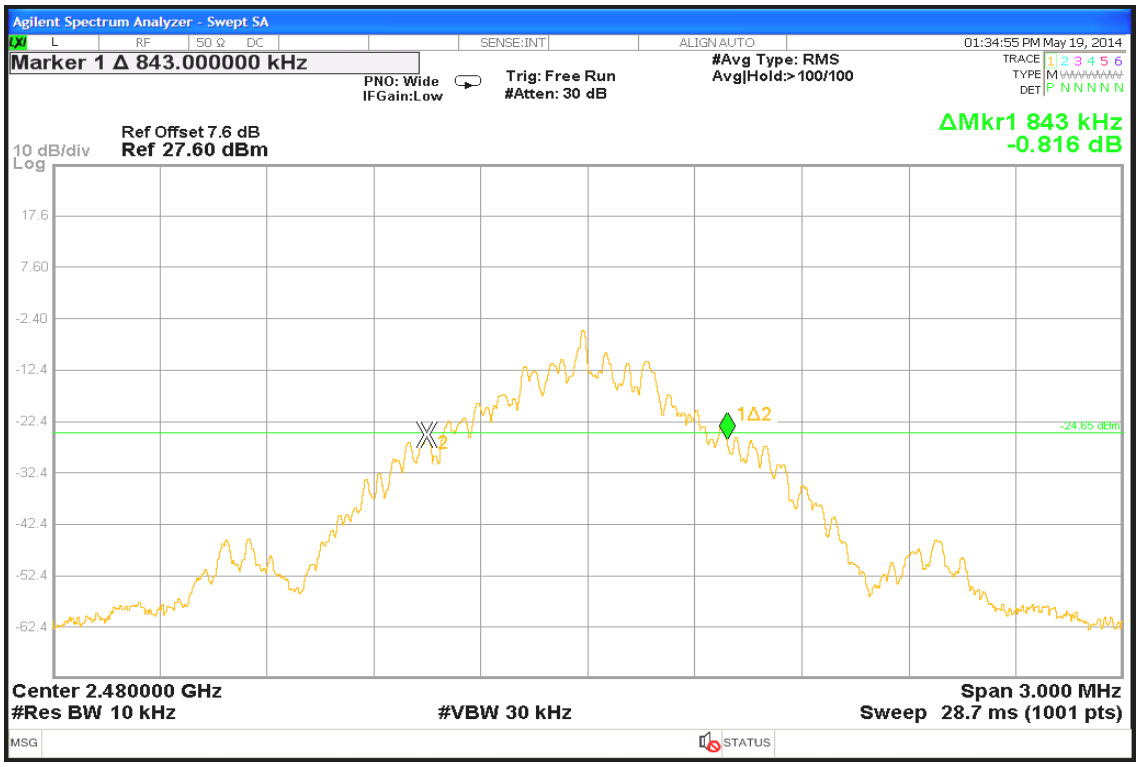
20dB Bandwidth (CH High)



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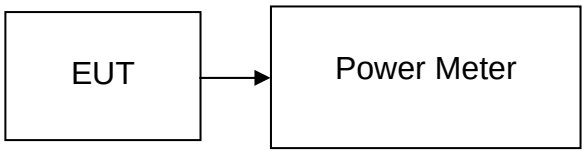
7.2. PEAK POWER

LIMIT

According to §15.247, the maximum peak output power of the intentional radiator shall not exceed the following:

1. According to §15.247(b)(1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt.
2. According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
3. According to §15.247(b) (4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output is connected to the Power Meter. The Power Meter is set to the peak power detection.

TEST RESULTS

No non-compliance noted

TEST DATA

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Test Result
Low	2402	-1.28	0.0007	0.125	PASS
Mid	2441	-1.73	0.0007		PASS
High	2480	-2.43	0.0006		PASS

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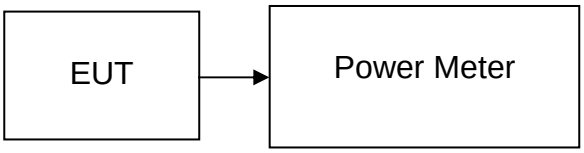
7.3. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output is connected to the Power Meter. The Power Meter is set to the average power detection.

TEST RESULTS

No non-compliance noted

TEST DATA

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2402	-2.73	0.0005
Mid	2441	-3.21	0.0005
High	2480	-3.88	0.0004

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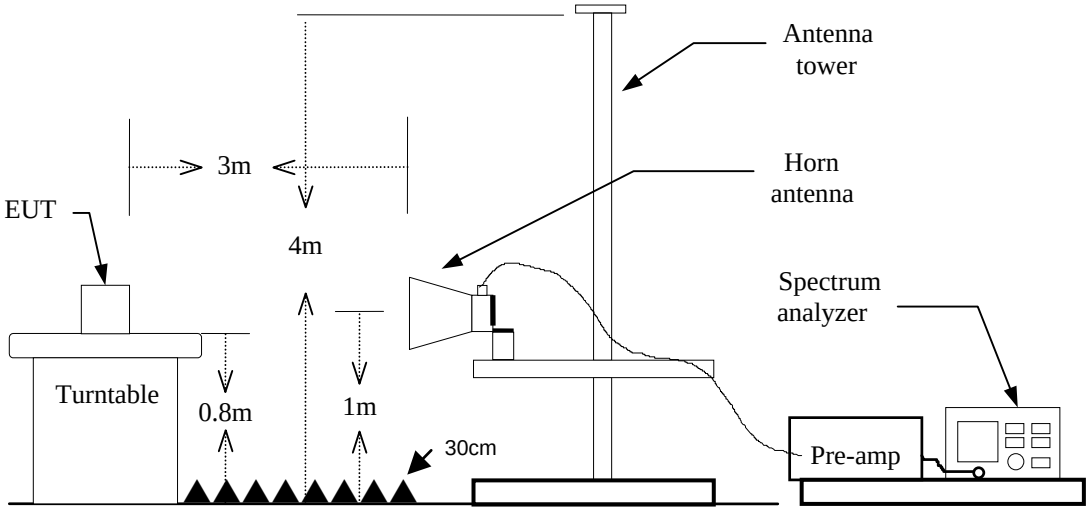
7.4. BAND EDGES MEASUREMENT

LIMIT

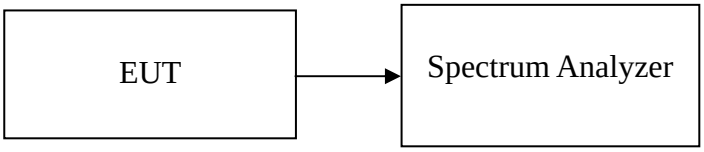
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of thsnder this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, 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 CONFIGURATION

For Radiated



For Conducted



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TEST PROCEDURE

For Radiated

1. The EUT is placed on a turntable, which is 0.8m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
   (a) PEAK: RBW=1MHz/VBW=3MHz / Sweep=100ms
   (b) AVERAGE: RBW=1MHz / VBW=360Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

For Conducted

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

TEST RESULTS

No non-compliance noted

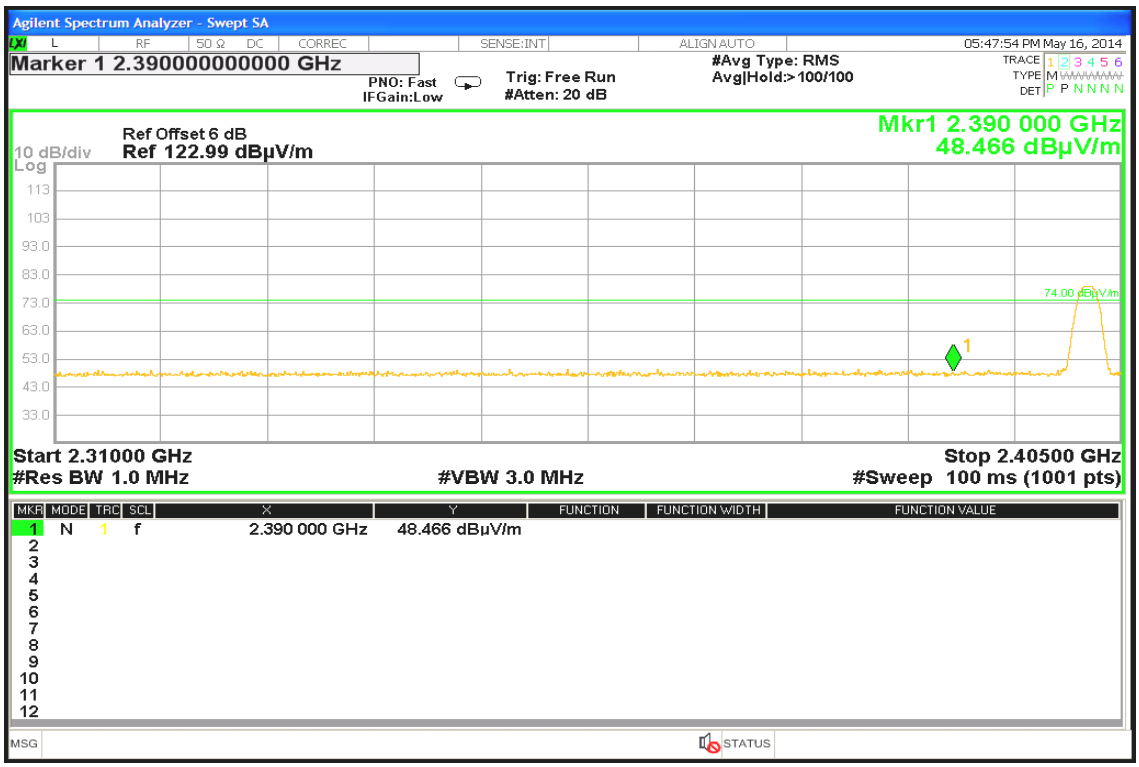
TEST DATA

Refer to attach spectrum analyzer data chart.

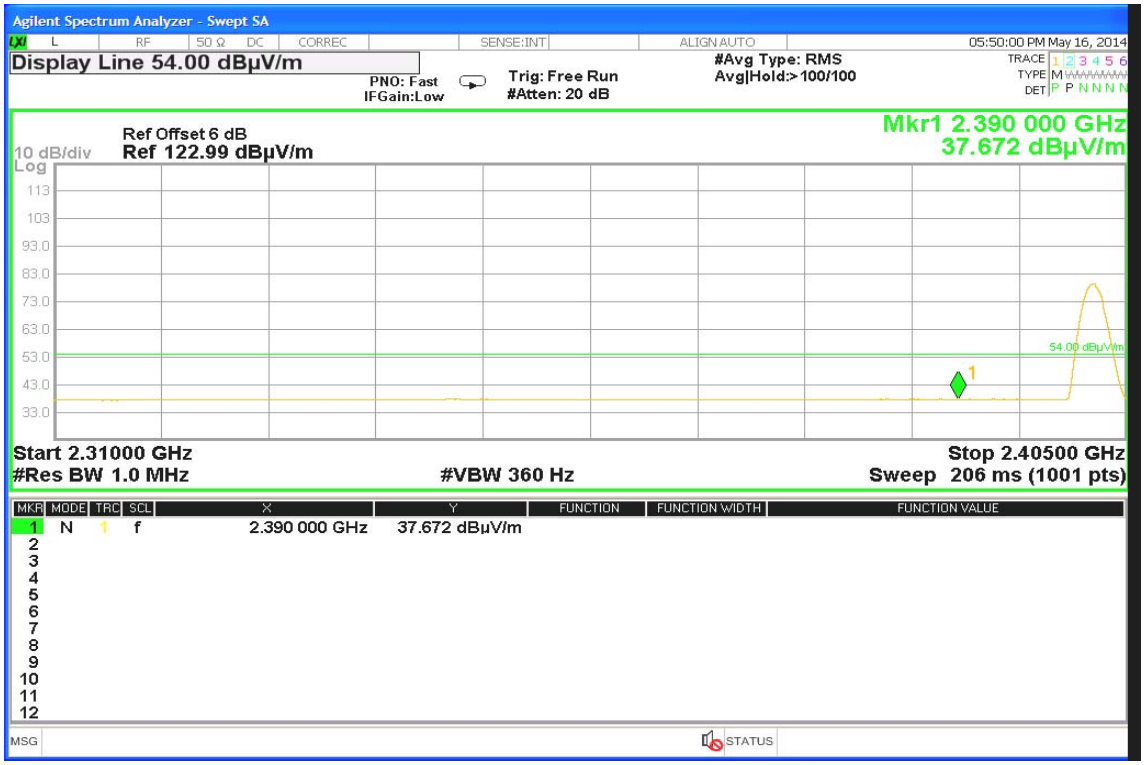
This report shall not be reproduced except in full, without the written approval of Compliance Certification Services.

Band Edges (CH Low)

Detector mode: Peak **Polarity: Vertical**



Detector mode: Average **Polarity: Vertical**



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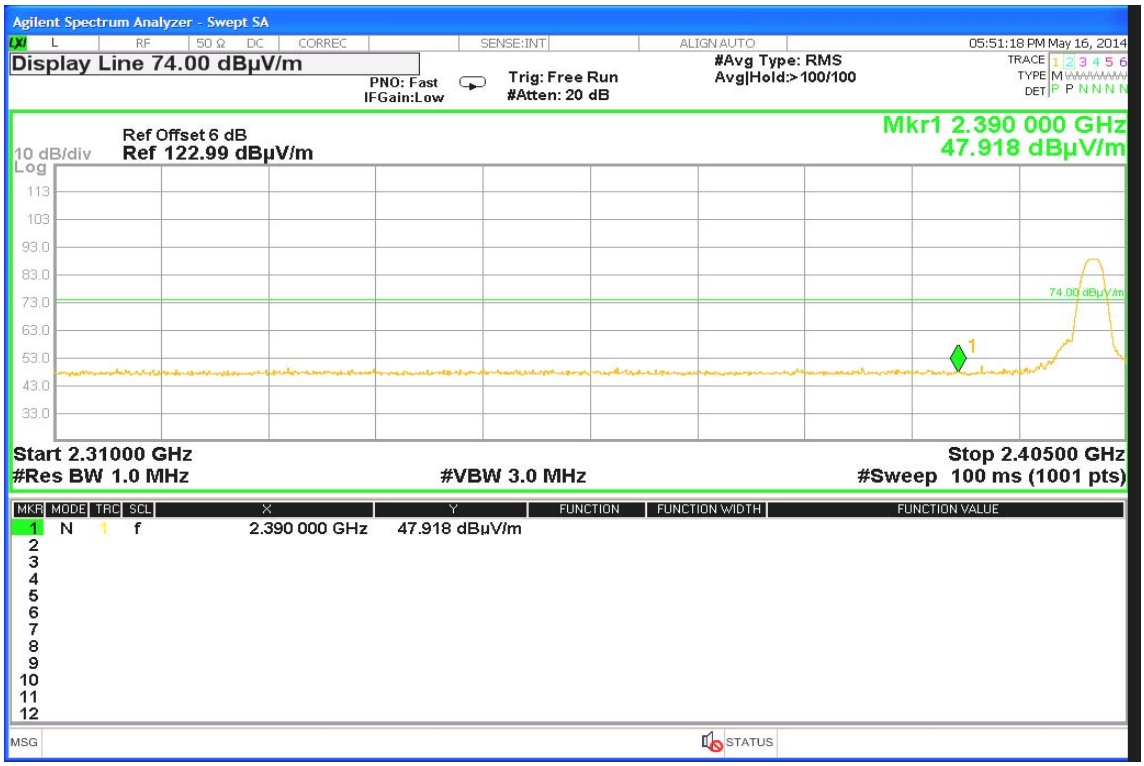
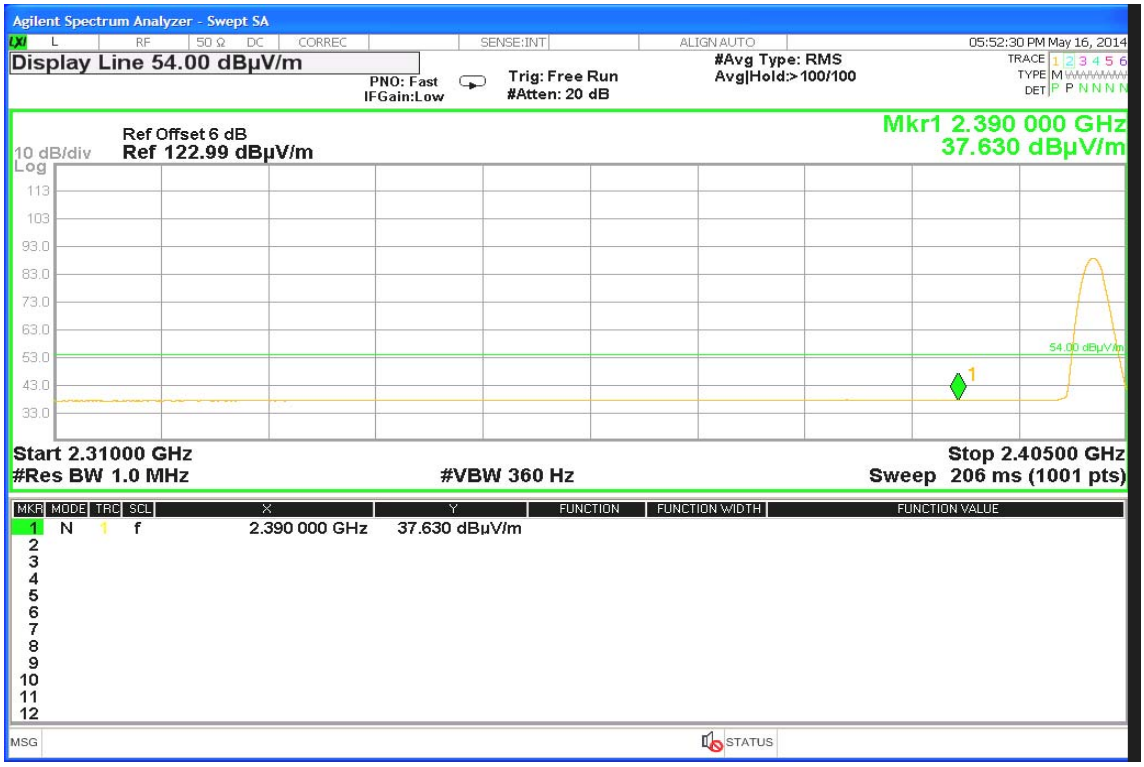
Detector mode: Peak **Polarity: Horizontal**



Detector mode: Average **Polarity: Horizontal**



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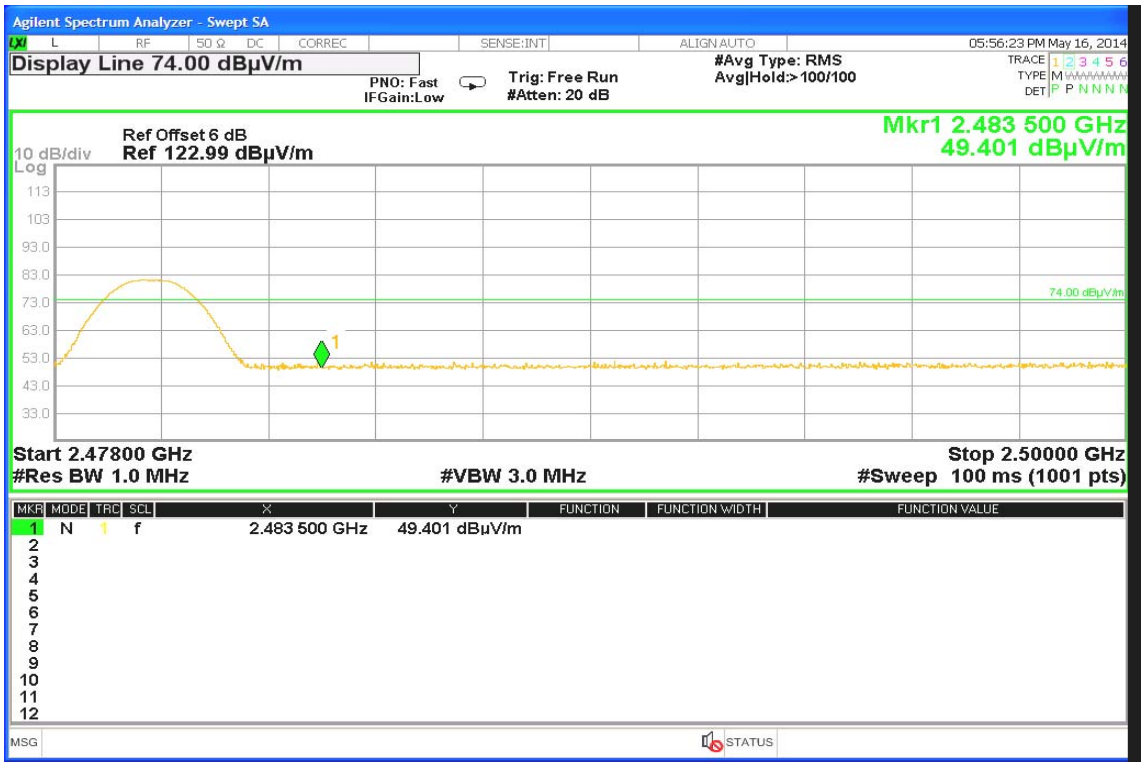
Band Edges (CH High)

Detector mode: Peak **Polarity: Vertical**



Detector mode: Average **Polarity: Vertical**

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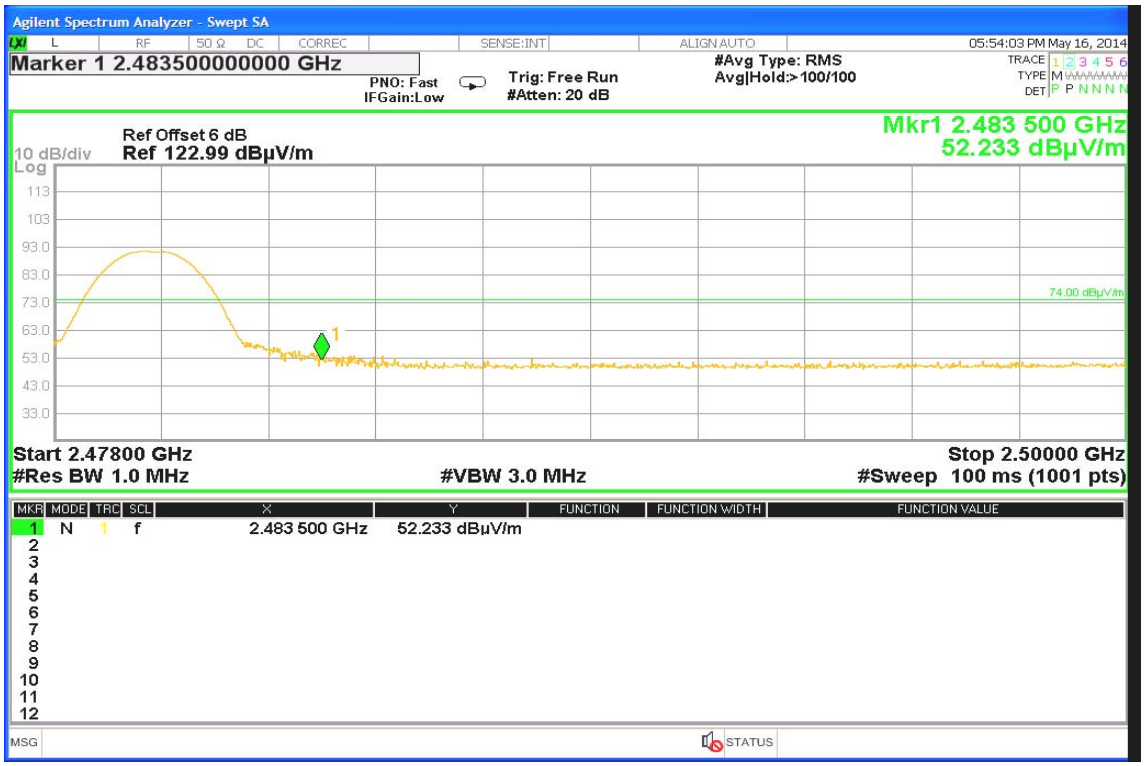
Detector mode: Peak **Polarity: Horizontal**



Detector mode: Average **Polarity: Horizontal**

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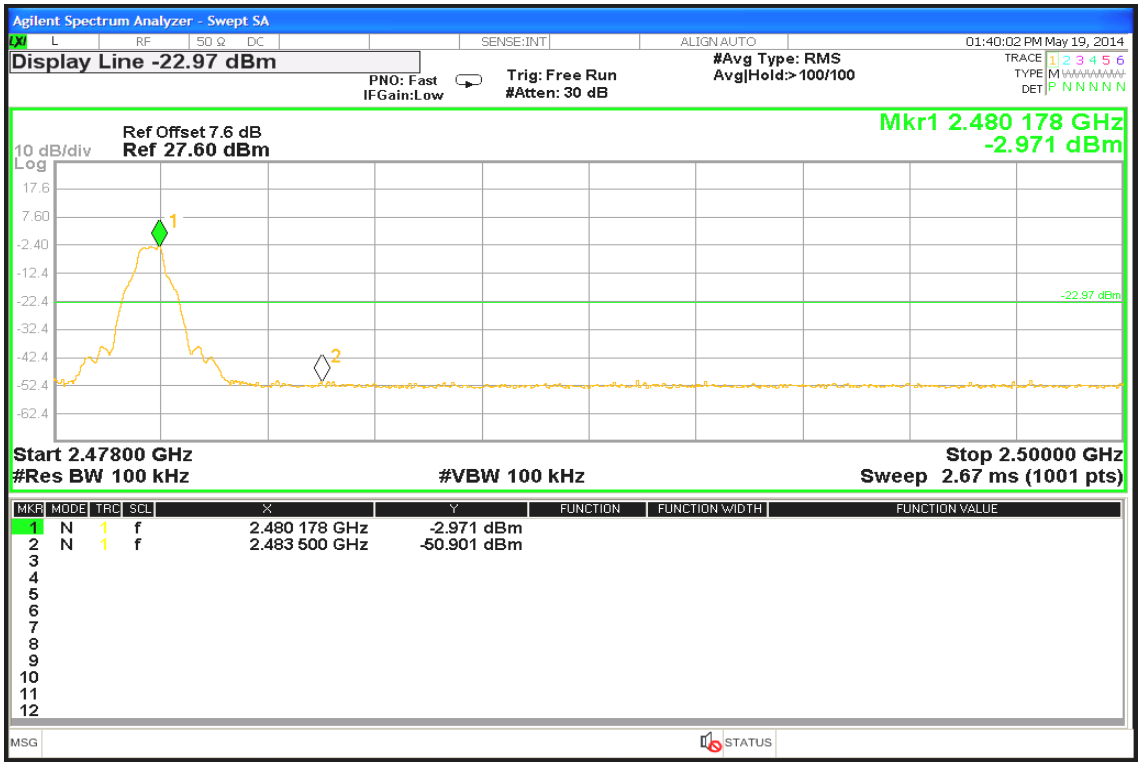
Conducted band-edge

GFSK / CH Low

GFSK / CH High



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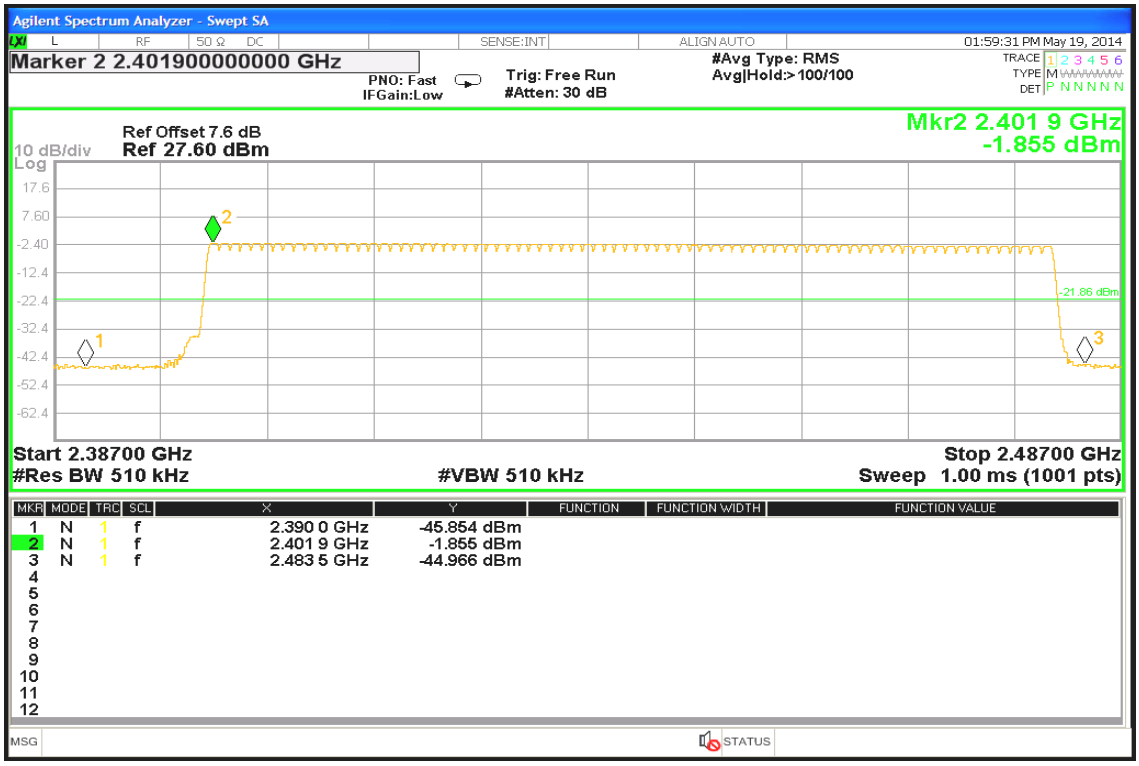
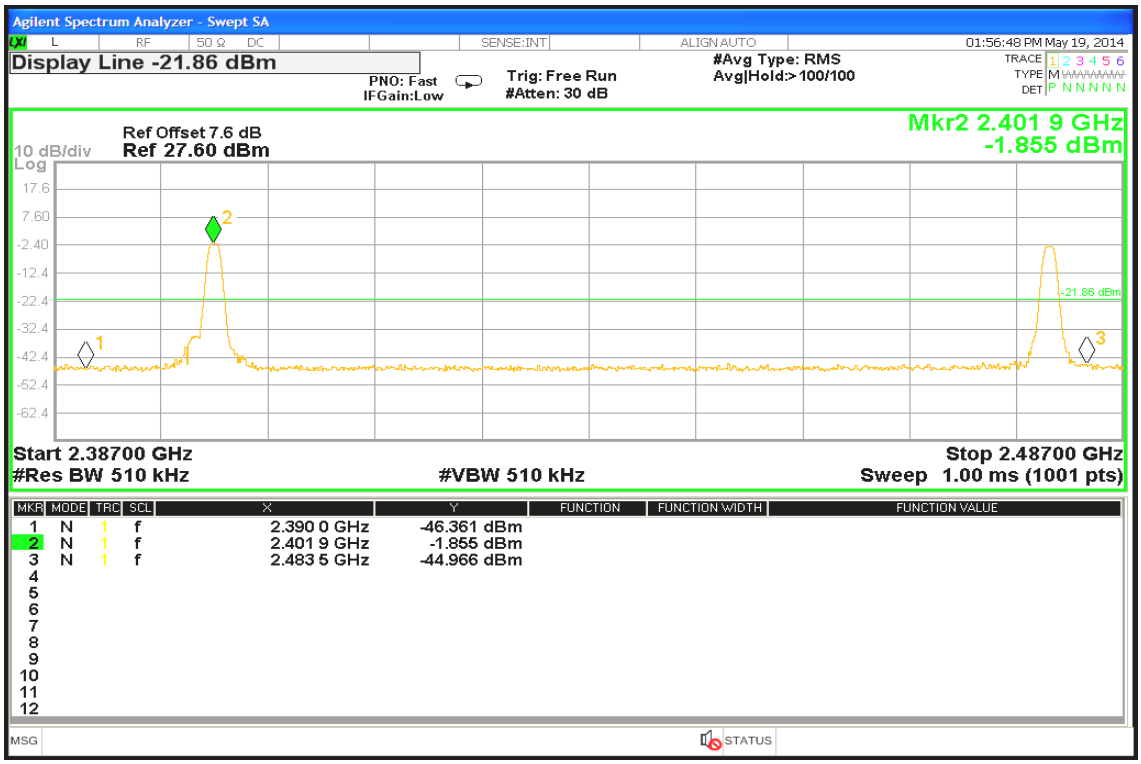
GFSK / Hopping On



GFSK / Hopping Off



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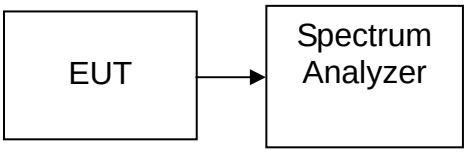
7.5. FREQUENCY SEPARATION

LIMIT

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

TEST CONFIGURATION



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as RBW = 30kHz, VBW = 100kHz, Span = 3MHz, Sweep = auto.
5. Max hold, mark 3 peaks of hopping channel and record the 3 peaks frequency.

TEST RESULTS

No non-compliance noted

TEST DATA

GFSK

Channel Separation (MHz)	two-thirds of the 20 dB bandwidth	Channel Separation Limit	Result
1.00	578	> 20dB Bandwidth or two-thirds of the 20 dB bandwidth	Pass

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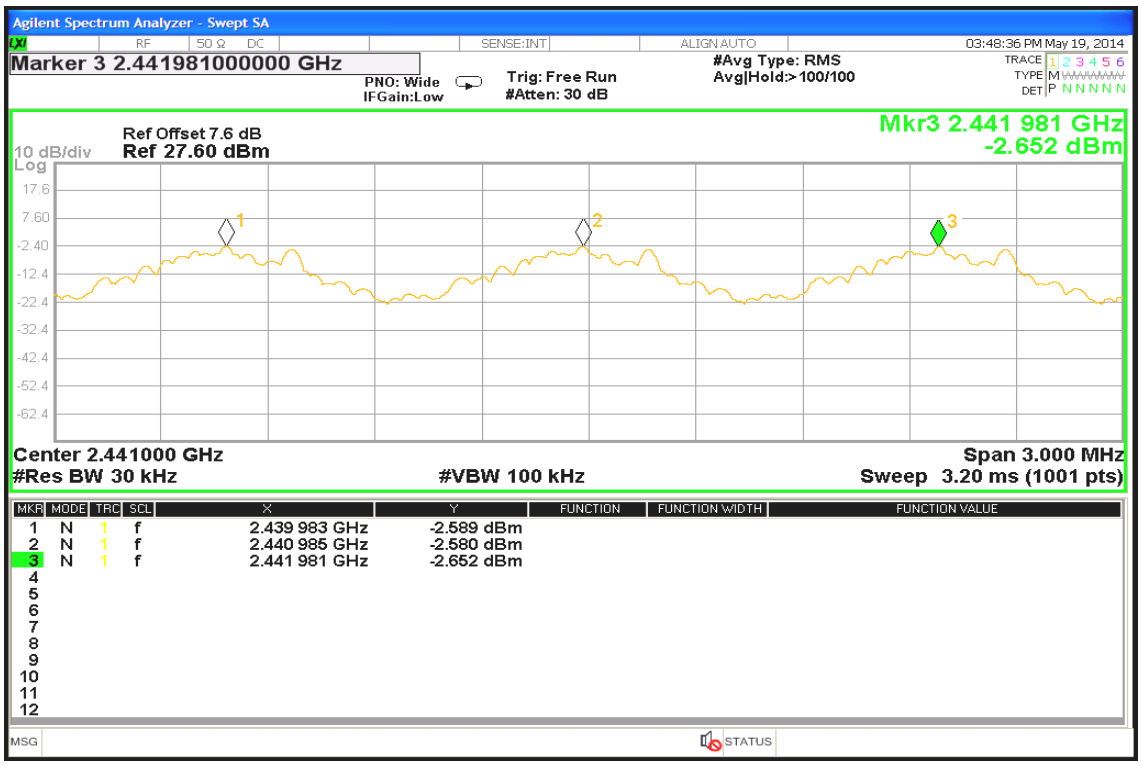
Test Plot

Measurement of Channel Separation



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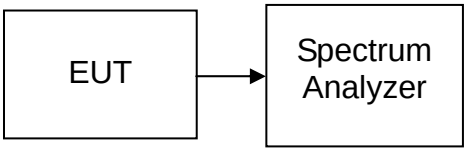
7.6. NUMBER OF HOPPING FREQUENCY

LIMIT

According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

TEST CONFIGURATION



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2441.5MHz, Sweep = auto and Start=2441.5MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW, VBW=510kHz.
5. Max hold, view and count how many channel in the band.

TEST RESULTS

No non-compliance noted

TEST DATA

Result (No. of CH)	Limit (No. of CH)	Result
79	>15	PASS

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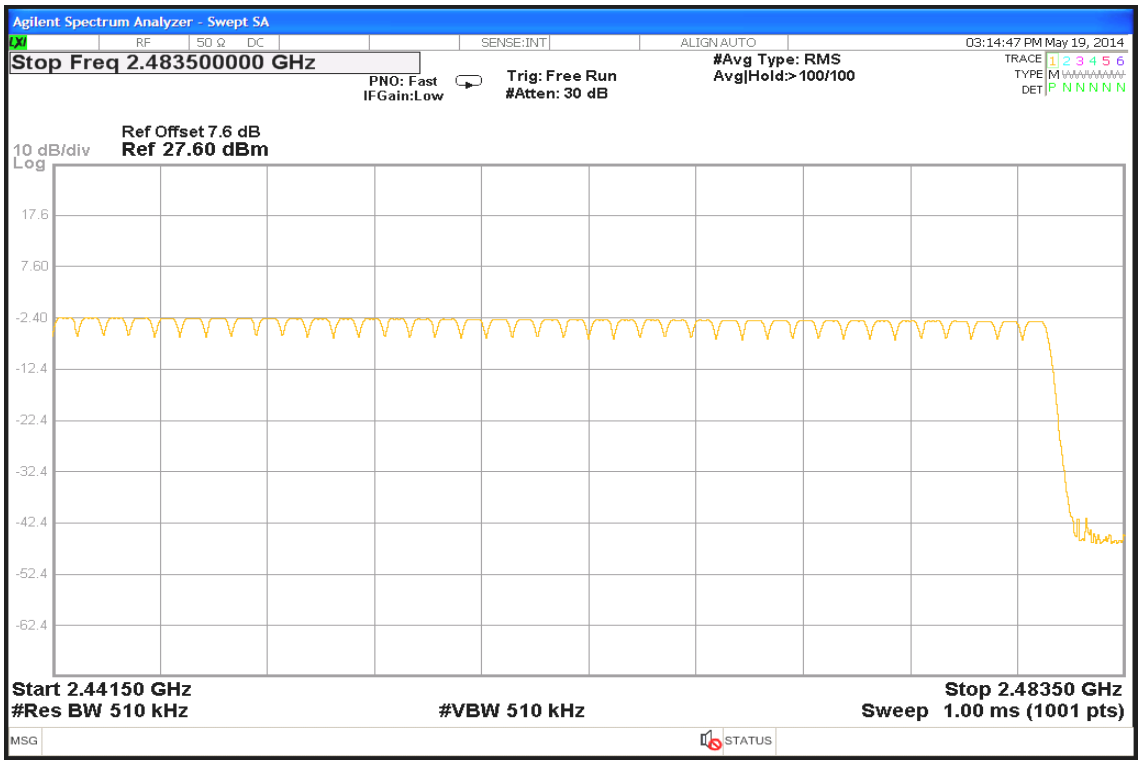
Test Plot

Channel Number

2.4 GHz – 2.4415 GHz

2.4415 GHz – 2.4835 GHz



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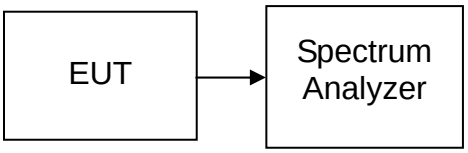
7.7. TIME OF OCCUPANCY (DWELL TIME)

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

TEST CONFIGURATION



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=1MHz, Span = 0Hz, Sweep = 10ms.
5. Repeat above procedures until all frequency measured were complete.

TEST RESULTS

No non-compliance noted

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TEST DATA

DH 1

CH Low: 0.45 * (1600/2)/79 * 31.60 = 144.00 (ms)
CH Mid: 0.44 * (1600/2)/79 * 31.60 = 140.80 (ms)
CH High: 0.45 * (1600/2)/79 * 31.60 = 144.00 (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	0.45	144.00	31.60	400.00	PASS
Mid	0.44	140.80	31.60		PASS
High	0.45	144.00	31.60		PASS

DH 3

CH Low: 1.71 * (1600/4)/79 * 31.6 = 273.60 (ms)
CH Mid: 1.71 * (1600/4)/79 * 31.6 = 273.60 (ms)
CH High: 1.70 * (1600/4)/79 * 31.6 = 272.00 (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	1.71	273.60	31.60	400.00	PASS
Mid	1.71	273.60	31.60		PASS
High	1.70	272.00	31.60		PASS

DH 5

CH Low: 2.95 * (1600/6)/79 * 31.6 = 314.67 (ms)
CH Mid: 2.95 * (1600/6)/79 * 31.6 = 314.67 (ms)
CH High: 2.95 * (1600/6)/79 * 31.6 = 314.67 (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	2.95	314.67	31.60	400.00	PASS
Mid	2.95	314.67	31.60		PASS
High	2.95	314.67	31.60		PASS

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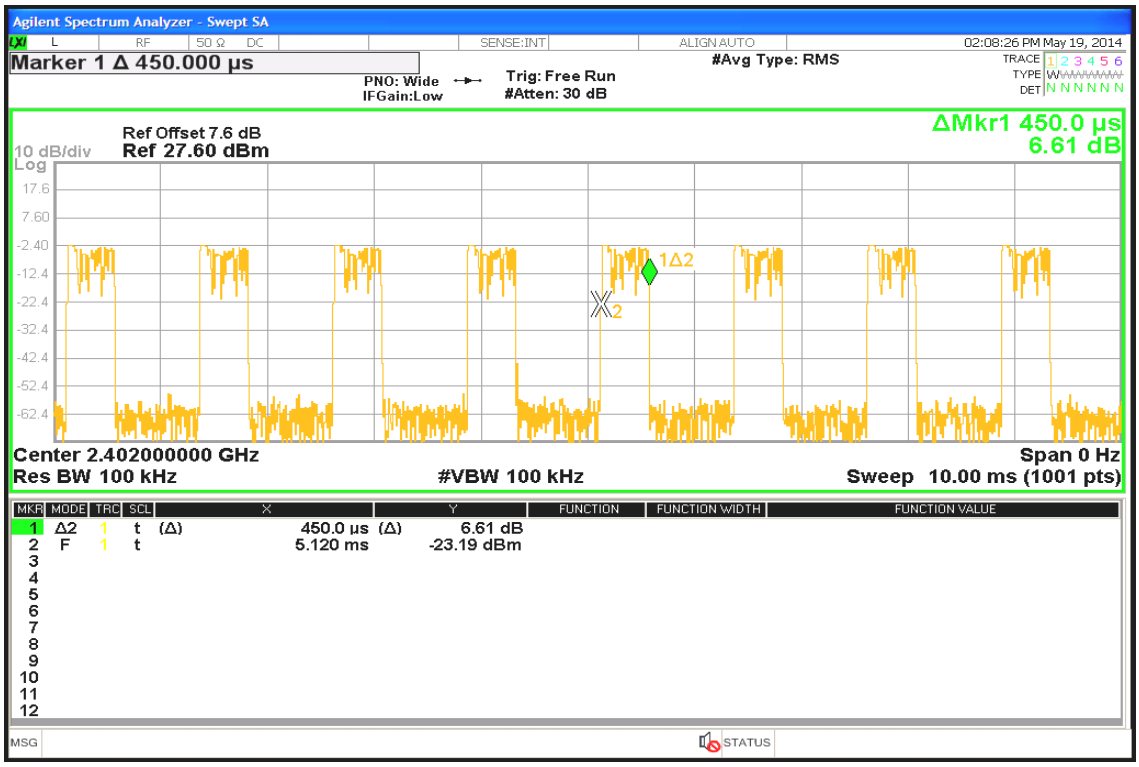
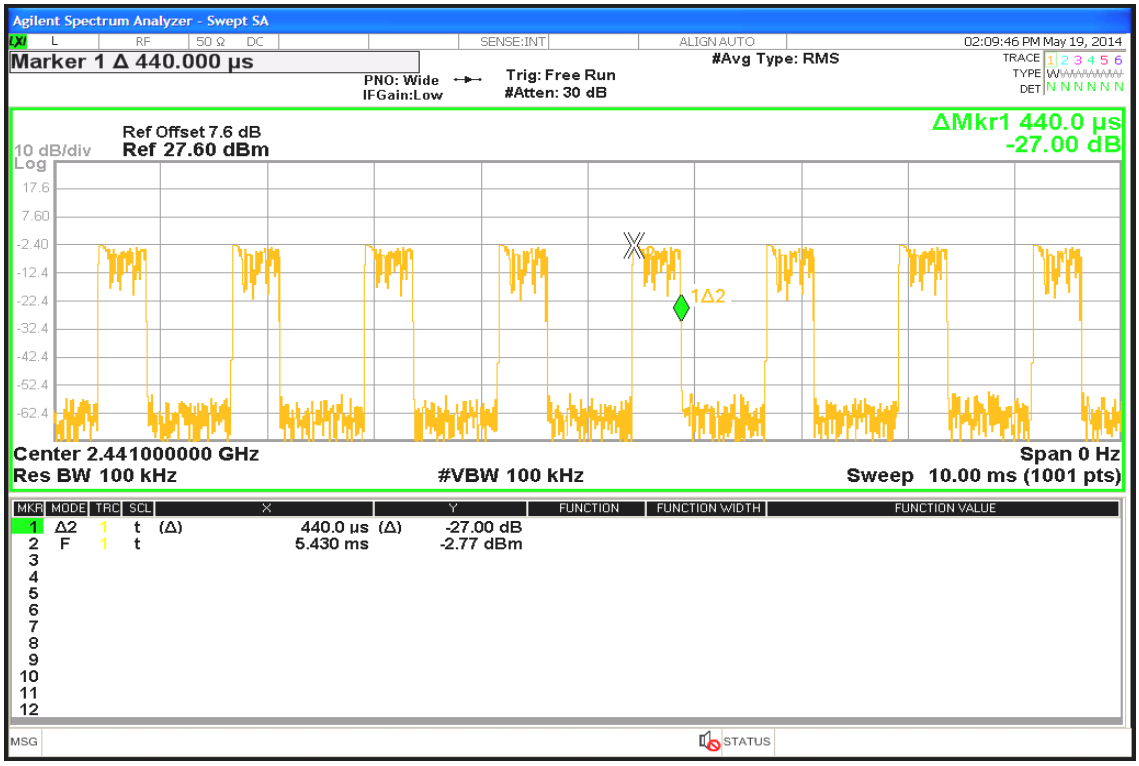
Test Plot

DH 1

(CH Low)

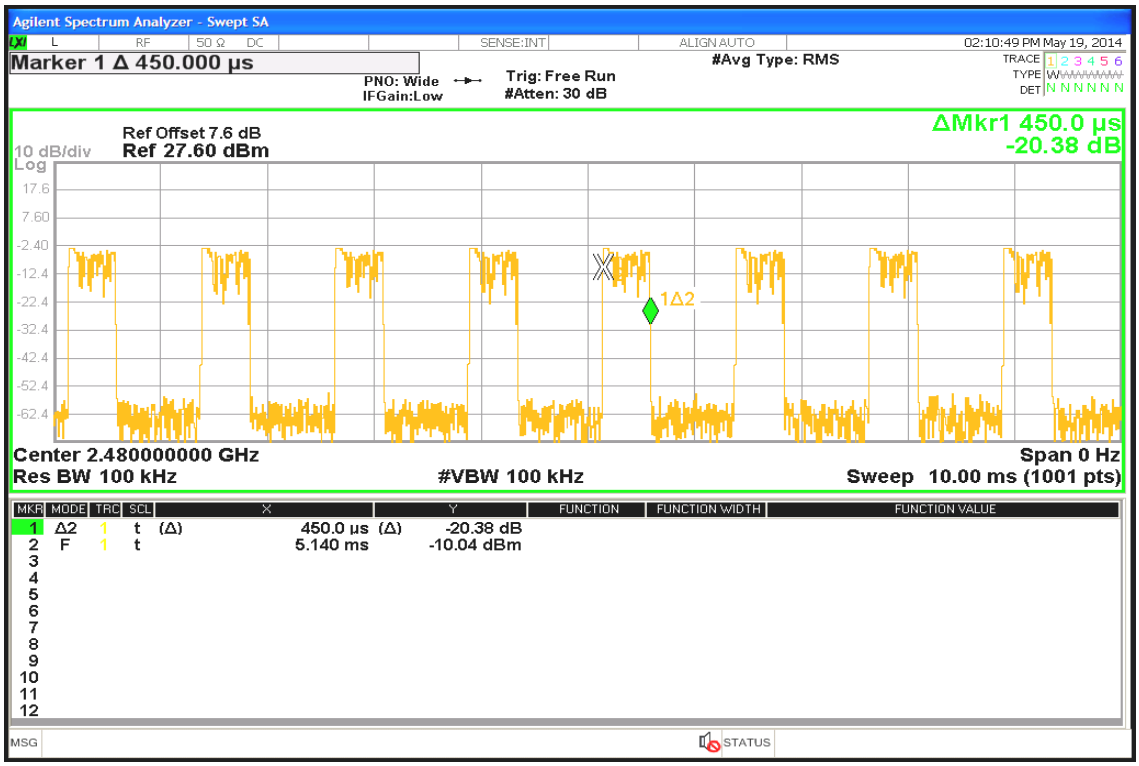


(CH Mid)



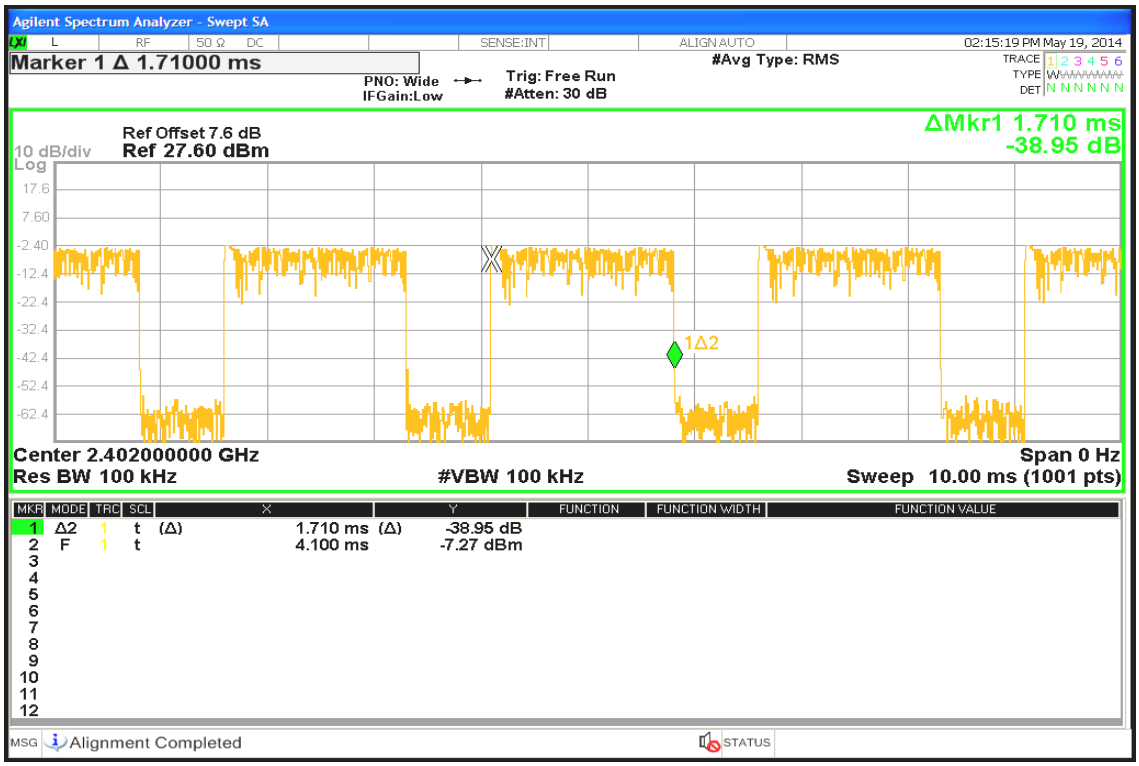
This report shall not be reproduced except in full, without the written approval of Compliance Certification Services.

(CH High)



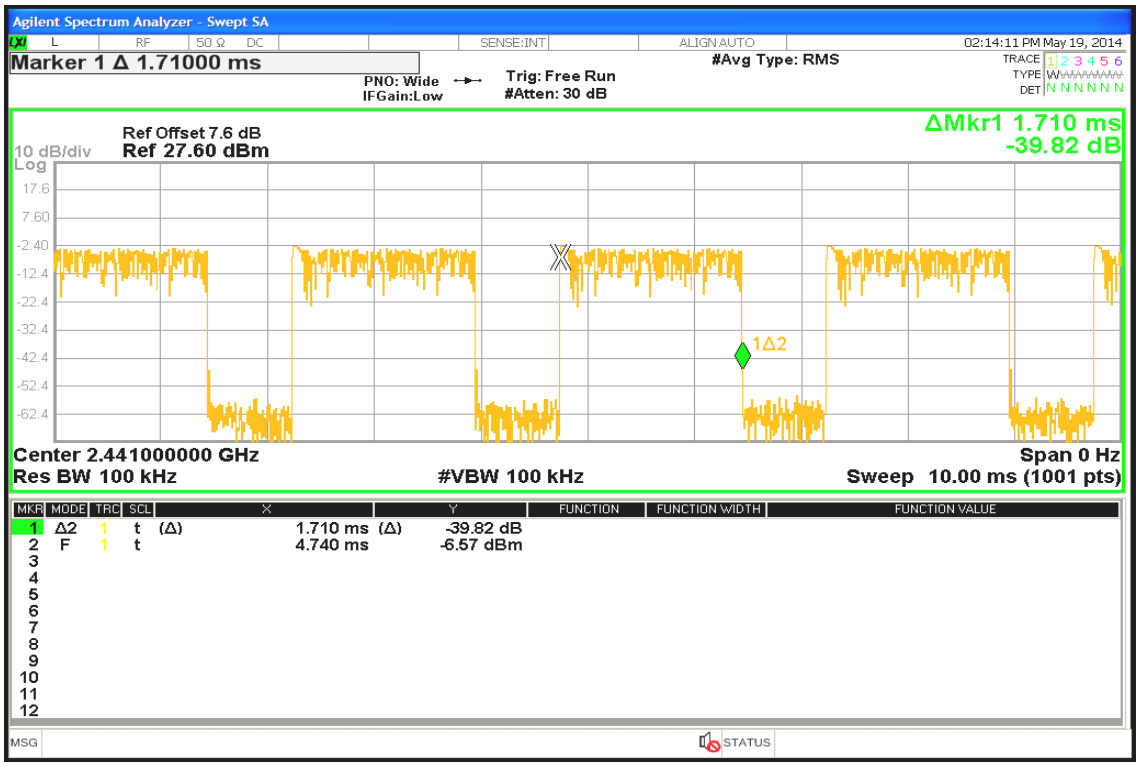
DH 3

(CH Low)

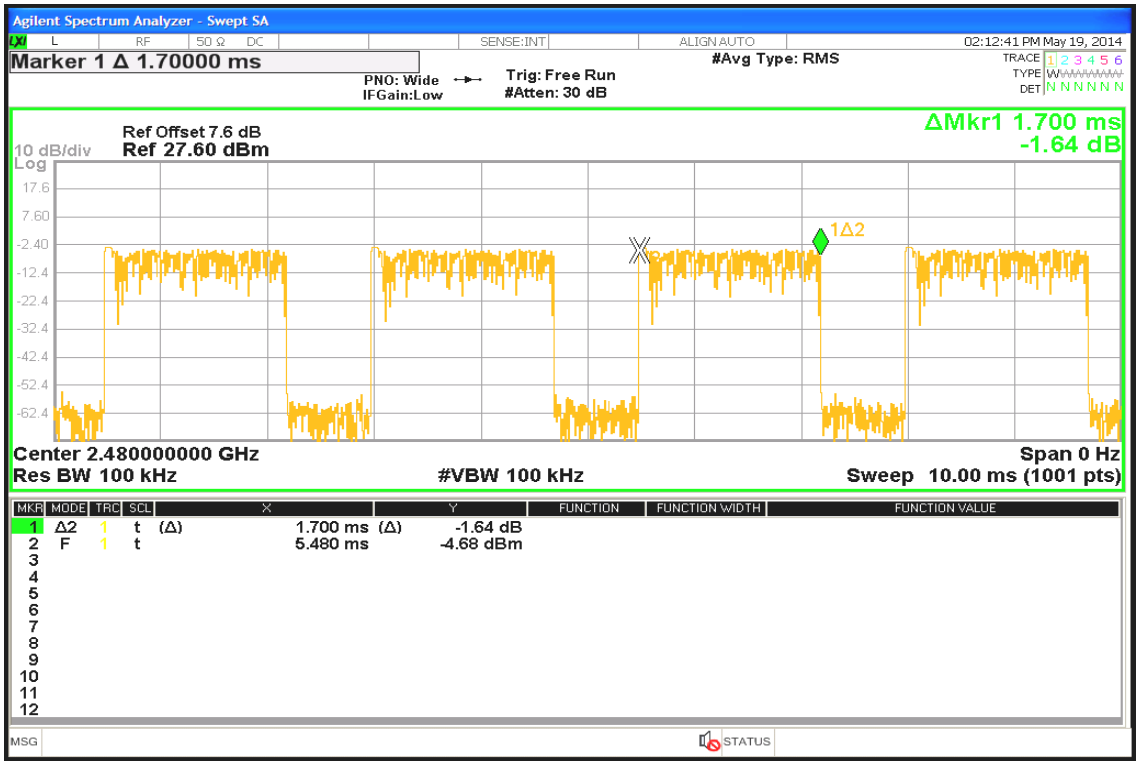


This report shall not be reproduced except in full, without the written approval of Compliance Certification Services.

(CH Mid)



(CH High)



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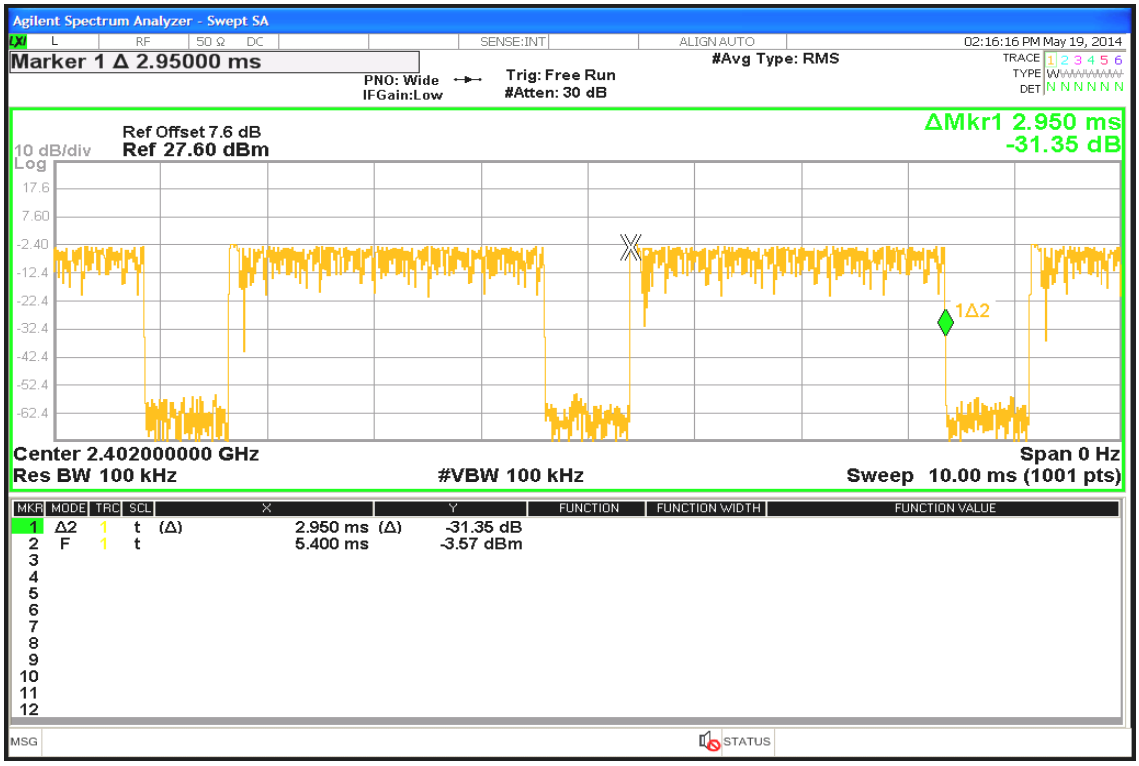
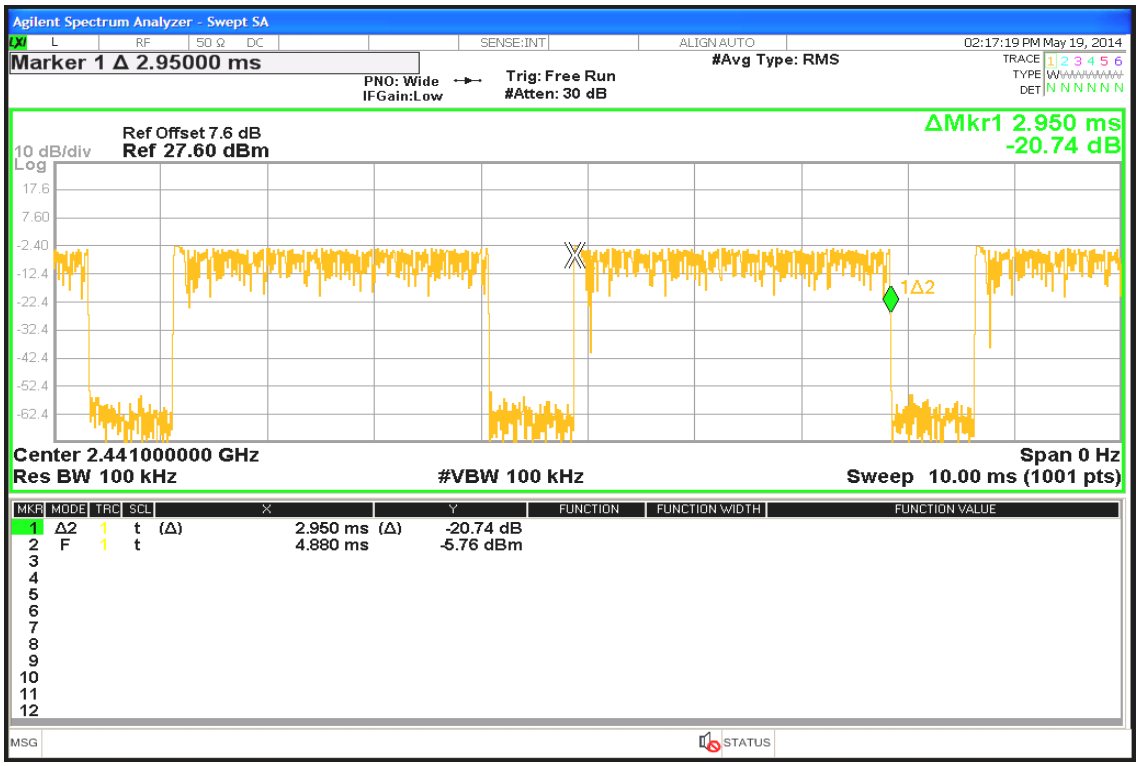
DH 5

(CH Low)

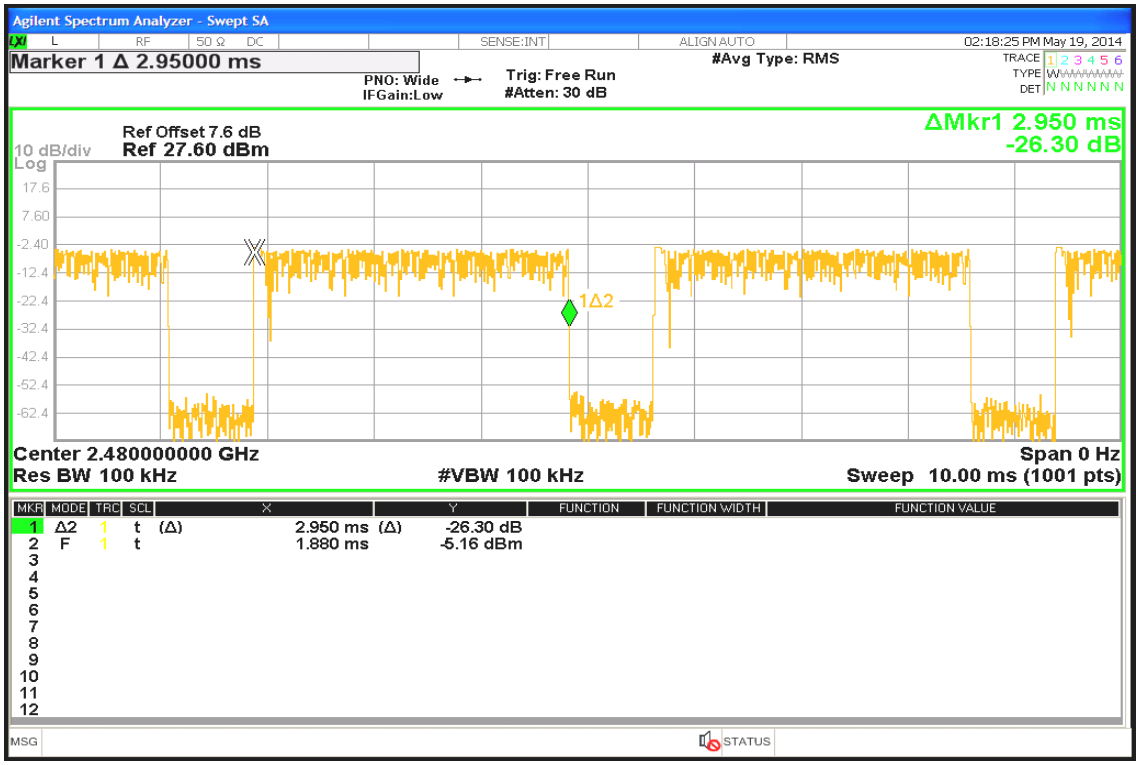


(CH Mid)



This report shall not be reproduced except in full, without the written approval of Compliance Certification Services.

(CH High)



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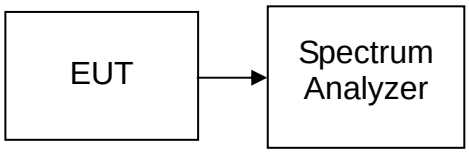
7.8. SPURIOUS EMISSIONS

7.8.1 Conducted Measurement

LIMIT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, 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 CONFIGURATION



TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

Measurements are made over the 30MHz to 26GHz range with the transmitter set to the lowest, middle, and highest channels.

TEST RESULTS

No non-compliance noted

TEST DATA

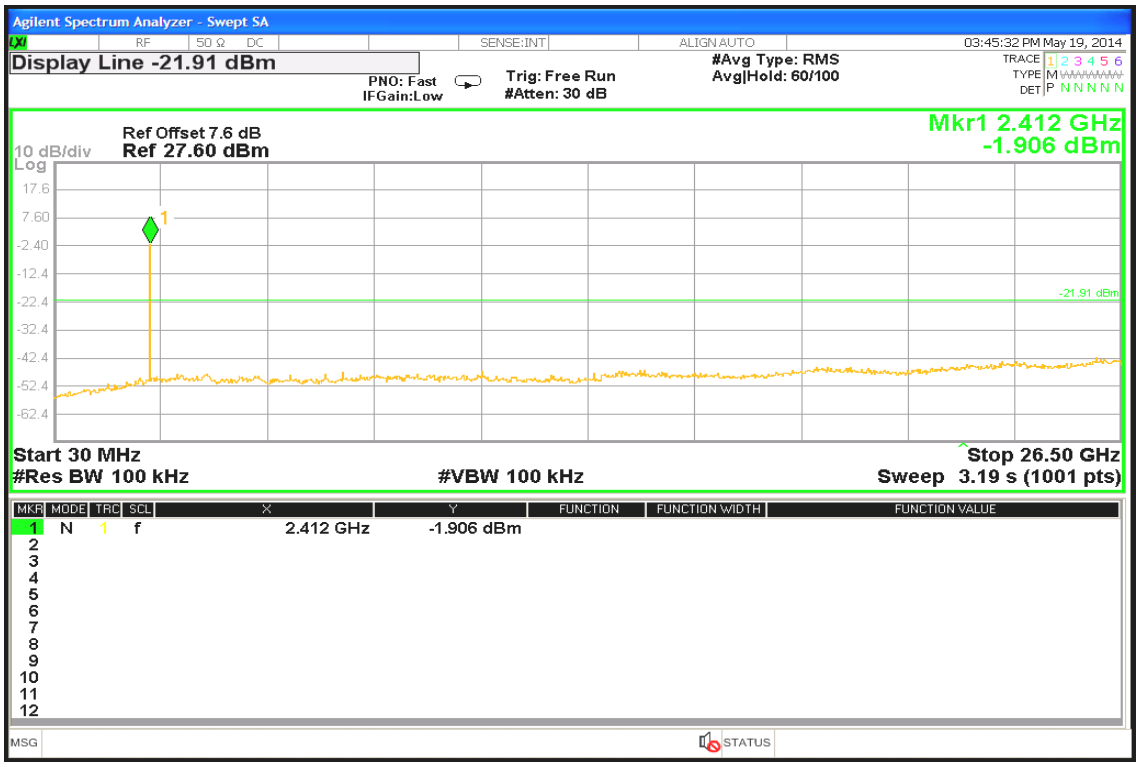
Refer to attach spectrum analyzer data chart.

This report shall not be reproduced except in full, without the written approval of Compliance Certification Services.

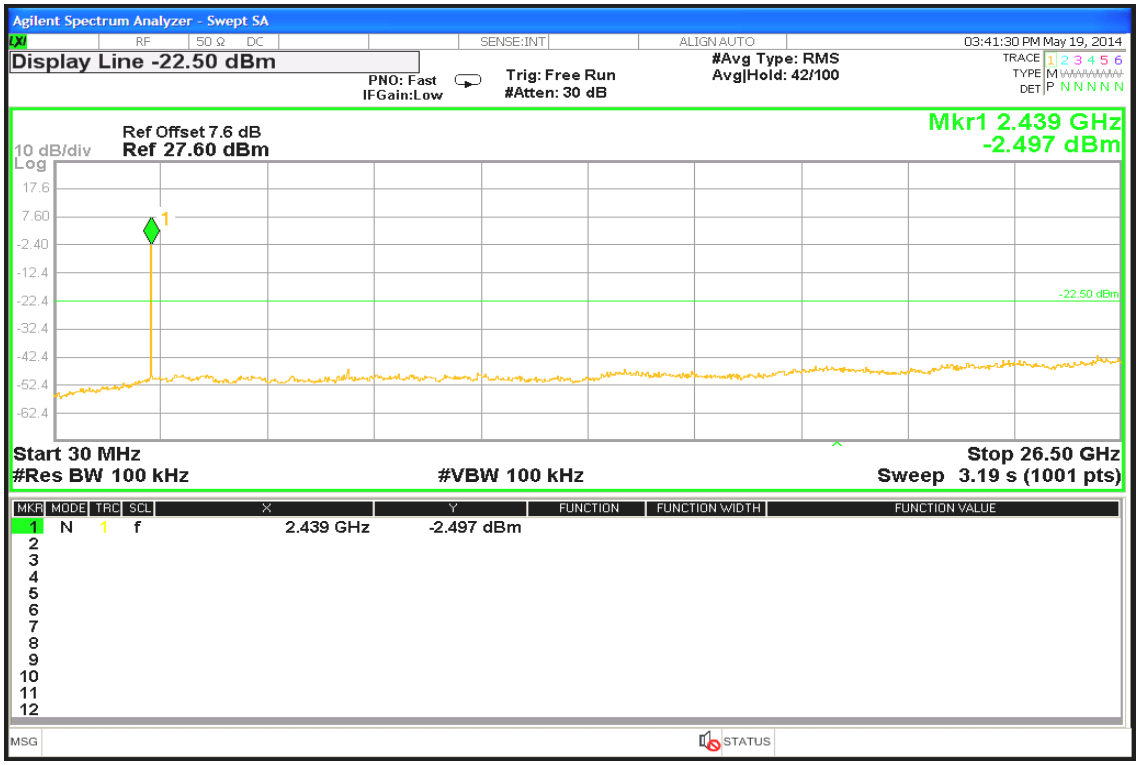
Test Plot

Spurious Emissions

GFSK / CH Low



GFSK / CH Mid



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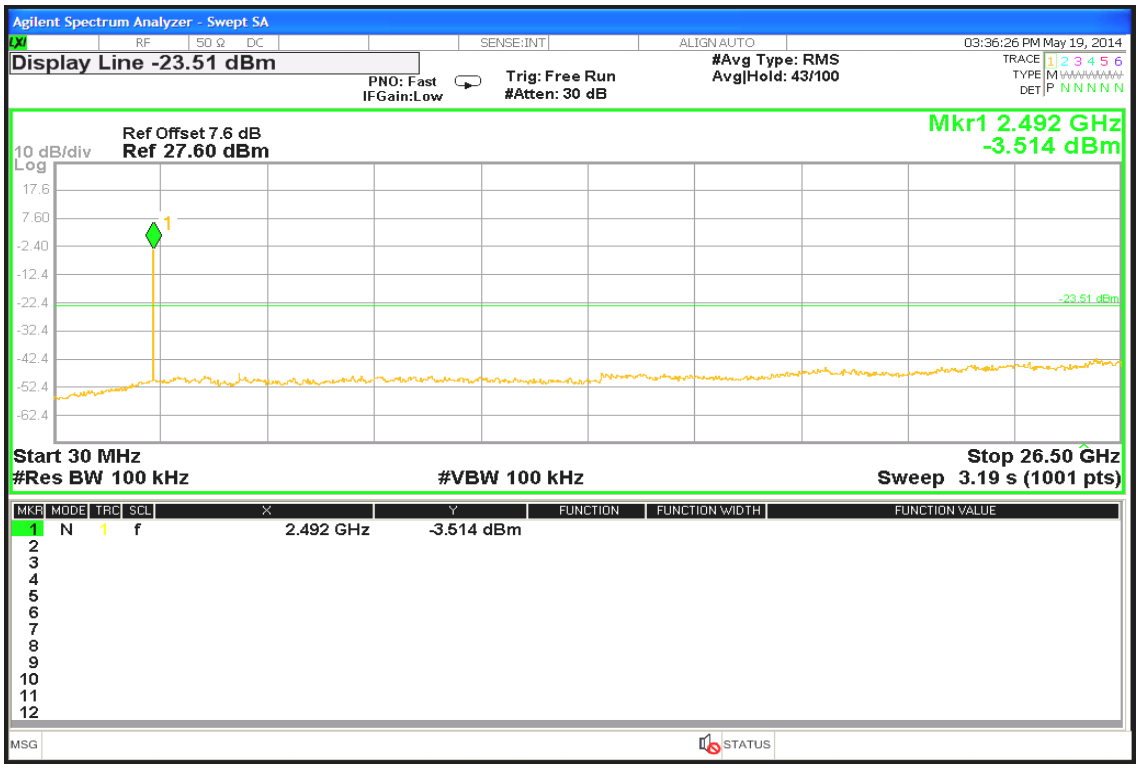
GFSK / CH High



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7.8.2 RADIATED EMISSIONS

LIMIT

1. According to §15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100*	3
88-216	150*	3
216-960	200*	3
Above 960	500	3

Remark: *Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.*

2. In the emission table above, the tighter limit applies at the band edges.

Frequency (Hz)	Field Strength (µV/m at 3-meter)	Field Strength (dBµV/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

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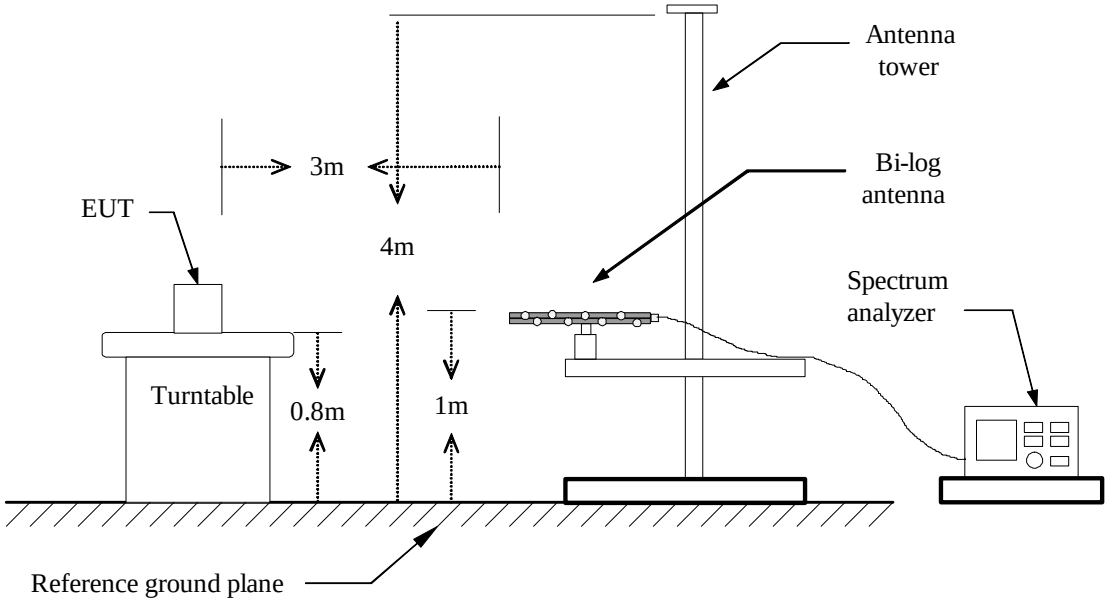
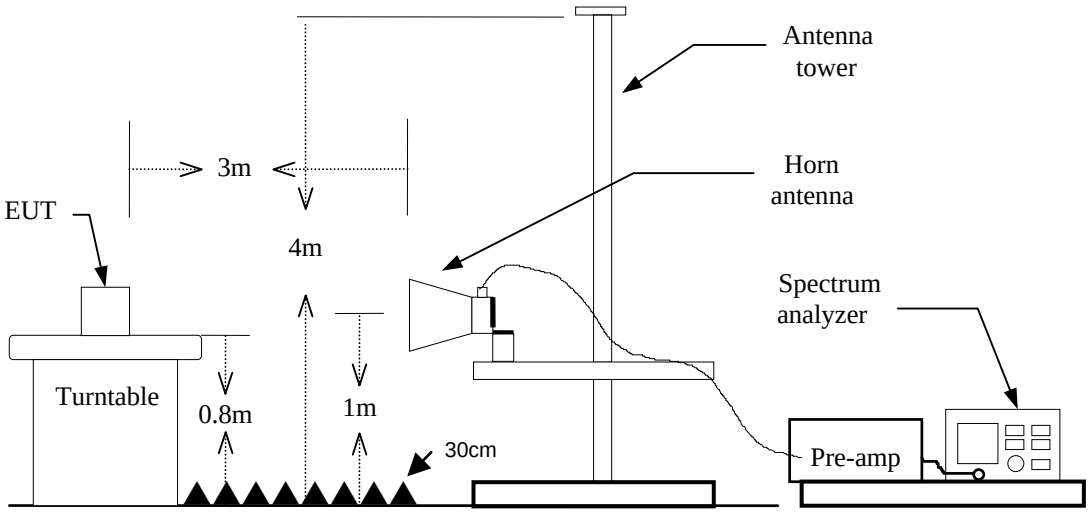
TEST CONFIGURATION

Below 1 GHz



Above 1 GHz



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TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:

   Below 30MHz

   RBW=10kHz / VBW=30kHz / Sweep=AUTO

   30 ~ 1000MHz:

   RBW=100kHz / VBW=300KHz / Sweep=AUTO

   Above 1GHz:

   a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
   b) AVERAGE: RBW=1MHz / VBW=360Hz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.

In case the emission is lower than 30MHz. loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case

TEST RESULTS

Below 1 GHz (9kHz ~ 30MHz)

No emission found between lowest internal used/generated frequency to 30MHz

Below 1 GHz (30 ~ 1000MHz)

No non-compliance noted

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TEST DATA

Below 1 GHz

Operation Mode:	Transmitting	**Test Date:**	2014/5/23
Temperature:	26℃	**Tested by:**	Louis Shen
Humidity:	56 % RH	**Polarity:**	Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant. Pol. (H/V)	Remark
57.1599	40.17	-20.77	19.40	40.00	-20.60	V	QP
132.8199	30.95	-15.50	15.45	43.50	-28.05	V	QP
159.9799	30.69	-16.68	14.01	43.50	-29.49	V	QP
599.3899	30.69	-7.91	22.78	46.00	-23.22	V	QP
756.5299	30.22	-5.99	24.23	46.00	-21.77	V	QP
870.9900	30.00	-4.22	25.78	46.00	-20.22	V	QP
133.7899	29.58	-15.53	14.05	43.50	-29.45	H	QP
234.6700	32.22	-14.79	17.43	46.00	-28.57	H	QP
338.4600	30.50	-11.43	19.07	46.00	-26.93	H	QP
552.8300	29.96	-8.29	21.67	46.00	-24.33	H	QP
741.9800	31.05	-6.20	24.85	46.00	-21.15	H	QP
870.9900	27.59	-4.22	23.37	46.00	-22.63	H	QP

Remark:

1. *No emission found between lowest internal used / generated frequency to 30 MHz. (9kHz ~ 30MHz)*
2. *Measuring frequencies from 30 MHz to the 1GHz.*
3. *Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak detector mode.*
4. *Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
5. *The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.*

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Above 1 GHz

GFSK

Operation Mode:	TX / CH Low	**Test Date:**	2014/5/16
Temperature:	26℃	**Tested by:**	Francis Lee
Humidity:	56% RH	**Polarity:**	Ver. / Hor.

Freq. (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant. Pol H/V	Remark
1496.000	52.48	-5.31	47.17	74.00	-26.83	V	peak
1684.000	58.22	-5.50	52.72	74.00	-21.28	V	peak
1684.000	57.10	-5.50	51.60	54.00	-2.40	V	AVG
1870.000	52.95	-3.58	49.37	74.00	-24.63	V	peak
2650.000	50.87	-1.82	49.05	74.00	-24.95	V	peak
3640.000	39.28	2.75	42.03	74.00	-31.97	V	peak
5685.000	38.45	5.94	44.39	74.00	-29.61	V	peak
7525.000	37.19	11.63	48.82	74.00	-25.18	V	peak
1406.000	49.61	-7.03	42.58	74.00	-31.42	H	peak
1684.000	54.21	-7.94	46.27	74.00	-27.73	H	peak
2174.000	49.28	-3.62	45.66	74.00	-28.34	H	peak
2882.000	47.26	-1.86	45.40	74.00	-28.60	H	peak
4805.000	43.49	5.54	49.03	74.00	-24.97	H	peak
6370.000	39.50	7.84	47.34	74.00	-26.66	H	peak
7315.000	36.83	11.74	48.57	74.00	-25.43	H	peak

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.*
3. *Average test would be performed if the peak result were greater than the average limit or as required by the applicant.*
4. *Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
5. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
6. *Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).*

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Operation Mode:	TX / CH Mid	**Test Date:**	2014/5/16
Temperature:	26℃	**Tested by:**	Francis Lee
Humidity:	56% RH	**Polarity:**	Ver. / Hor.

Freq. (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant. Pol H/V	Remark
1496.000	53.08	-5.31	47.77	74.00	-26.23	V	peak
1684.000	59.07	-5.50	53.57	74.00	-20.43	V	peak
1684.000	57.23	-5.50	51.73	54.00	-2.27	V	AVG
1988.000	49.14	-1.49	47.65	74.00	-26.35	V	peak
2650.000	50.11	-1.82	48.29	74.00	-25.71	V	peak
3770.000	38.96	3.32	42.28	74.00	-31.72	V	peak
5430.000	37.52	6.34	43.86	74.00	-30.14	V	peak
7485.000	36.89	11.50	48.39	74.00	-25.61	V	peak
1404.000	49.32	-6.98	42.34	74.00	-31.66	H	peak
1682.000	53.16	-7.98	45.18	74.00	-28.82	H	peak
2366.000	46.72	-6.35	40.37	74.00	-33.63	H	peak
2858.000	47.28	-2.04	45.24	74.00	-28.76	H	peak
4880.000	40.91	6.81	47.72	74.00	-26.28	H	peak
5910.000	37.76	9.18	46.94	74.00	-27.06	H	peak
7315.000	37.45	11.74	49.19	74.00	-24.81	H	peak

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.*
3. *Average test would be performed if the peak result were greater than the average limit or as required by the applicant.*
4. *Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
5. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
6. *Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).*

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Operation Mode:	TX / CH High	**Test Date:**	2014/5/16
Temperature:	26℃	**Tested by:**	Francis Lee
Humidity:	56% RH	**Polarity:**	Ver. / Hor.

Freq. (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant. Pol H/V	Remark
1496.000	52.37	-5.31	47.06	74.00	-26.94	V	peak
1682.000	59.19	-5.49	53.70	74.00	-20.30	V	peak
1682.000	57.16	-5.49	51.67	54.00	-2.33	V	AVG
2660.000	51.58	-1.75	49.83	74.00	-24.17	V	peak
2920.000	48.00	-0.79	47.21	74.00	-26.79	V	peak
3625.000	40.02	2.82	42.84	74.00	-31.16	V	peak
5385.000	38.52	6.22	44.74	74.00	-29.26	V	peak
7580.000	37.14	11.84	48.98	74.00	-25.02	V	peak
1396.000	50.15	-7.00	43.15	74.00	-30.85	H	peak
1682.000	53.40	-7.98	45.42	74.00	-28.58	H	peak
2198.000	48.47	-3.56	44.91	74.00	-29.09	H	peak
2816.000	48.19	-2.36	45.83	74.00	-28.17	H	peak
4305.000	38.25	7.62	45.87	74.00	-28.13	H	peak
5880.000	38.45	8.73	47.18	74.00	-26.82	H	peak
7385.000	37.29	11.39	48.68	74.00	-25.32	H	peak

Remark:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.*
3. *Average test would be performed if the peak result were greater than the average limit or as required by the applicant.*
4. *Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
5. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
6. *Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).*

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7.9. POWERLINE CONDUCTED EMISSIONS

LIMIT

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBµV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

TEST CONFIGURATION

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

TEST RESULTS

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

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TEST DATA

Operation Mode:	Normal Link	**Test Date:**	2014/5/26
Temperature:	25°C	**Tested by:**	Francis Lee
Humidity:	57% RH	**Test**	

Freq. (MHz)	QP Reading	AV Reading	Corr. factor	QP Result	AV Result	QP Limit	AV Limit	QP Margin	AV Margin	Note
0.1702	33.46	11.61	9.77	43.23	21.38	64.95	54.95	-21.72	-33.57	L1
0.2592	34.40	15.08	9.72	44.12	24.80	61.45	51.46	-17.33	-26.66	L1
0.4783	16.11	2.84	9.75	25.86	12.59	56.37	46.37	-30.51	-33.78	L1
1.3771	8.47	-2.35	9.75	18.22	7.40	56.00	46.00	-37.78	-38.60	L1
5.9179	8.74	-1.38	9.91	18.65	8.53	60.00	50.00	-41.35	-41.47	L1
19.6818	12.15	4.91	10.08	22.23	14.99	60.00	50.00	-37.77	-35.01	L1
0.2025	36.11	18.22	9.72	45.83	27.94	63.50	53.51	-17.67	-25.57	L2
0.2542	34.62	15.43	9.71	44.33	25.14	61.62	51.62	-17.29	-26.48	L2
0.3125	29.49	11.23	9.71	39.20	20.94	59.90	49.90	-20.70	-28.96	L2
0.3766	23.75	6.08	9.73	33.48	15.81	58.35	48.35	-24.87	-32.54	L2
5.6401	6.64	-0.95	9.88	16.52	8.93	60.00	50.00	-43.48	-41.07	L2
17.4169	-0.84	-5.50	10.11	9.27	4.61	60.00	50.00	-50.73	-45.39	L2

Remark:

1. *Measuring frequencies from 0.15 MHz to 30MHz.*
2. *The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-peak detector and average detector.*
3. *"---" denotes the emission level was or more than 2dB below the Average limit*
4. *The IF bandwidth of SPA between 0.15MHz to 30MHz was 10kHz; the IF bandwidth of Test Receiver between 0.15MHz to 30MHz was 9kHz;*
5. *L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)*

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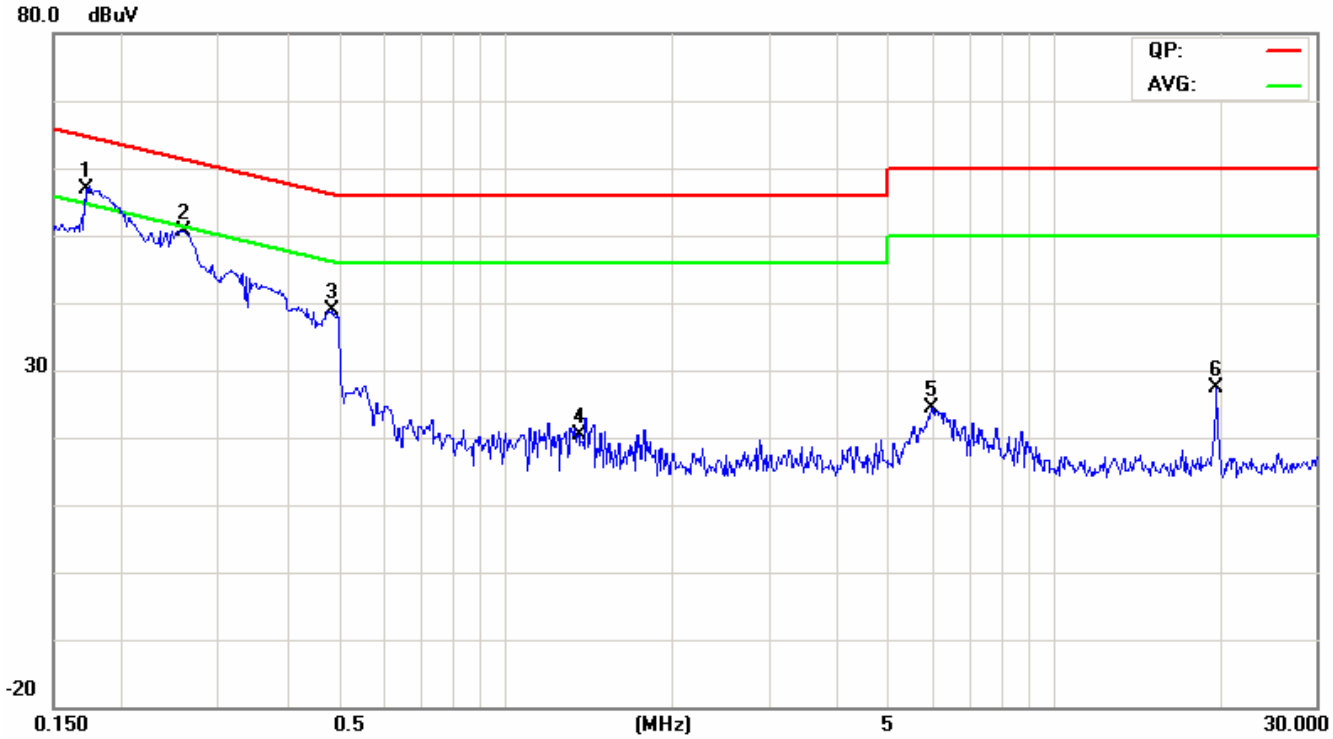
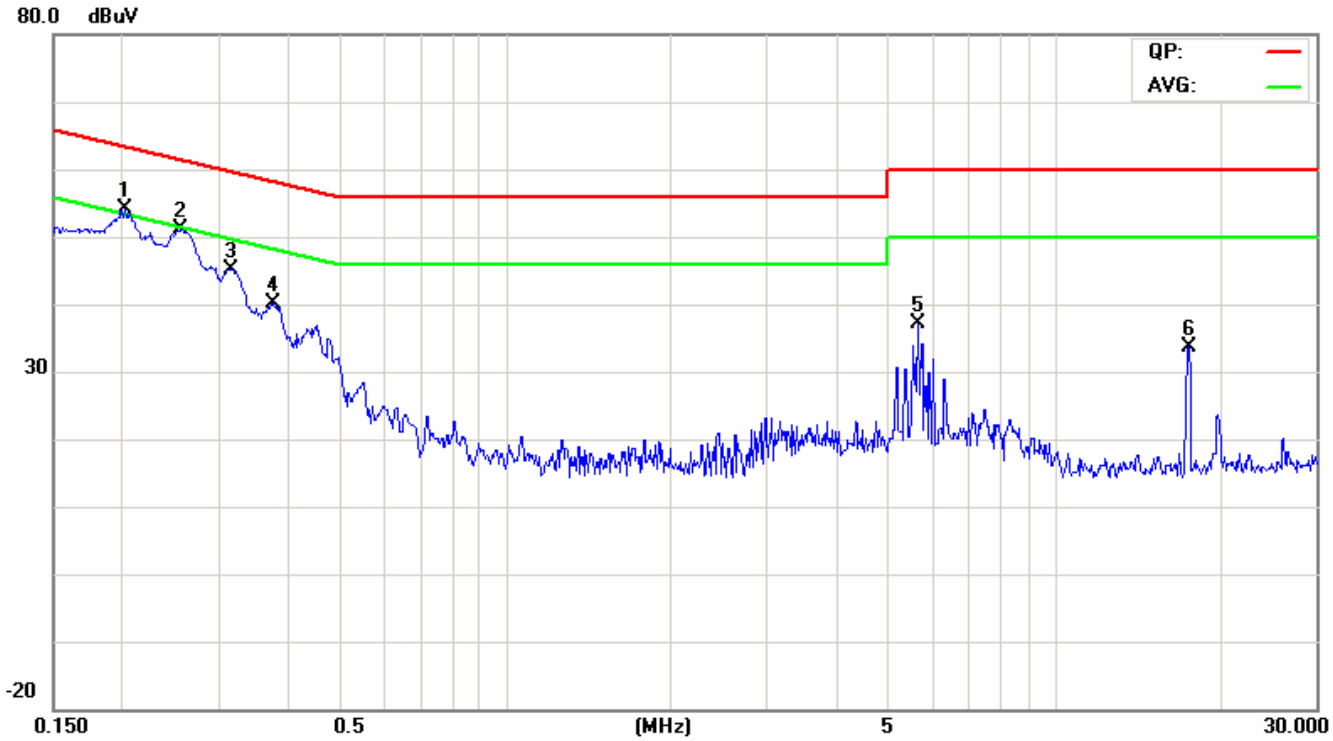
Test Plots

Conducted emissions (Line 1)



Conducted emissions (Line 2)



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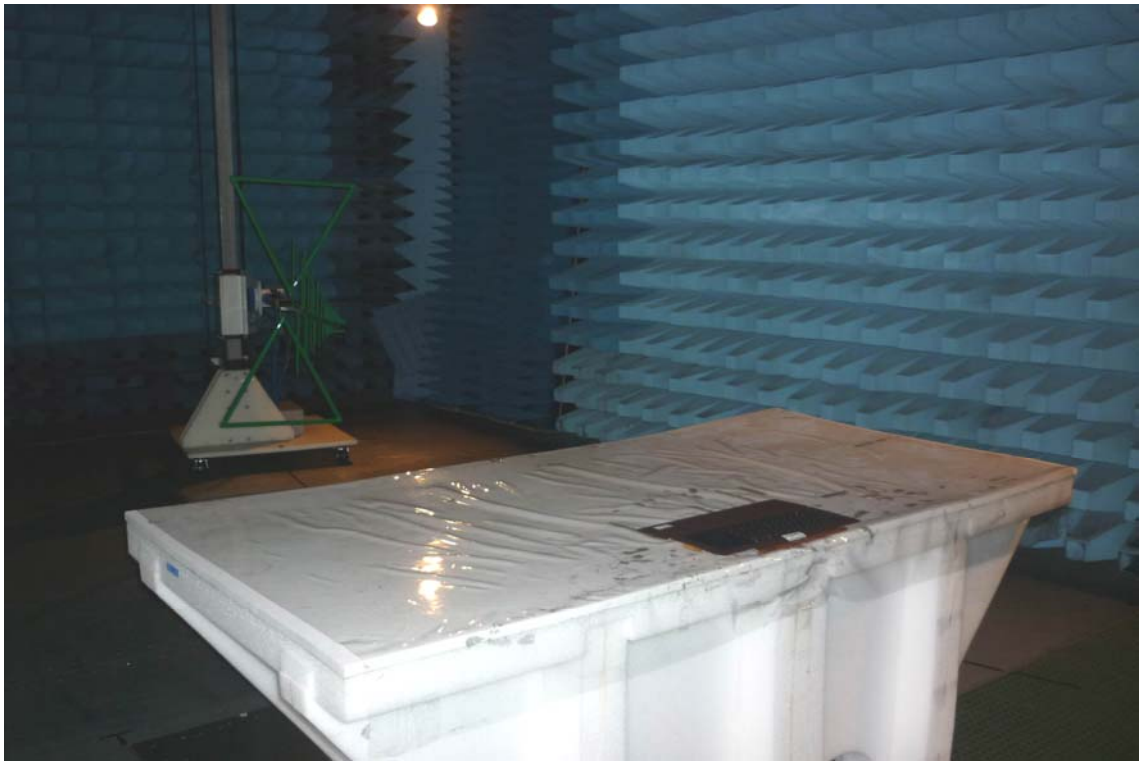
8 PHOTOGRAPHS OF TEST SETUP

Below 1GHz



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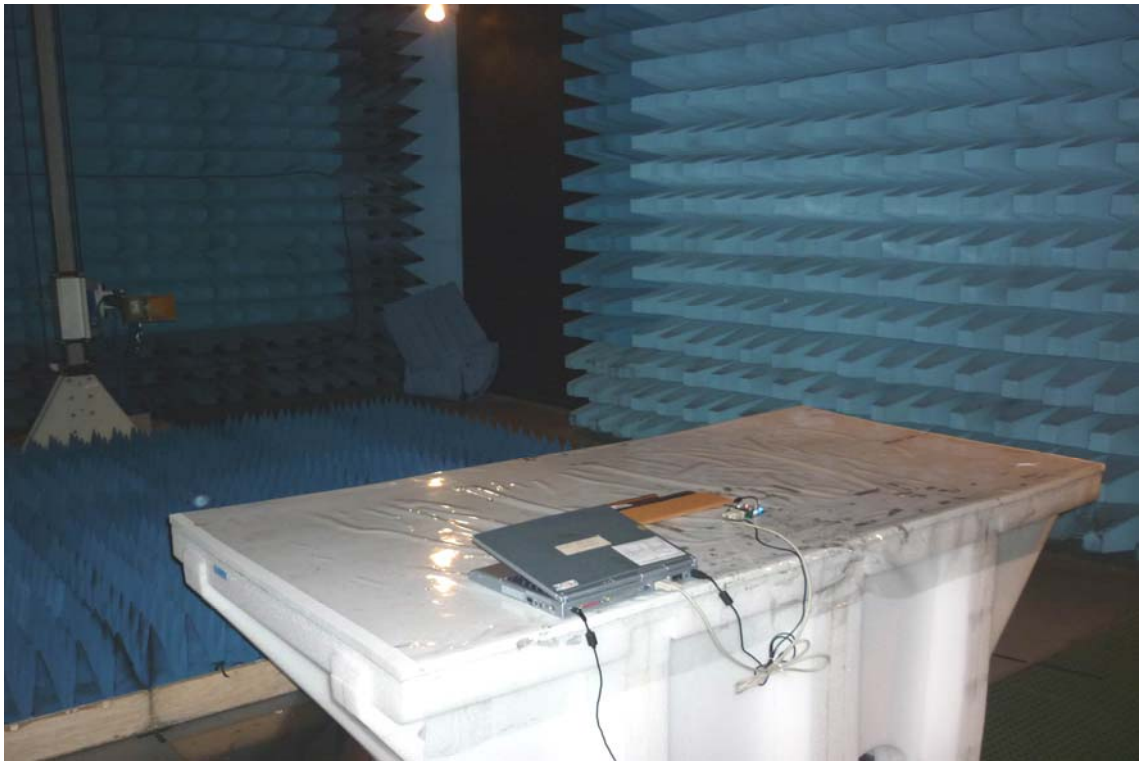
Above 1GHz



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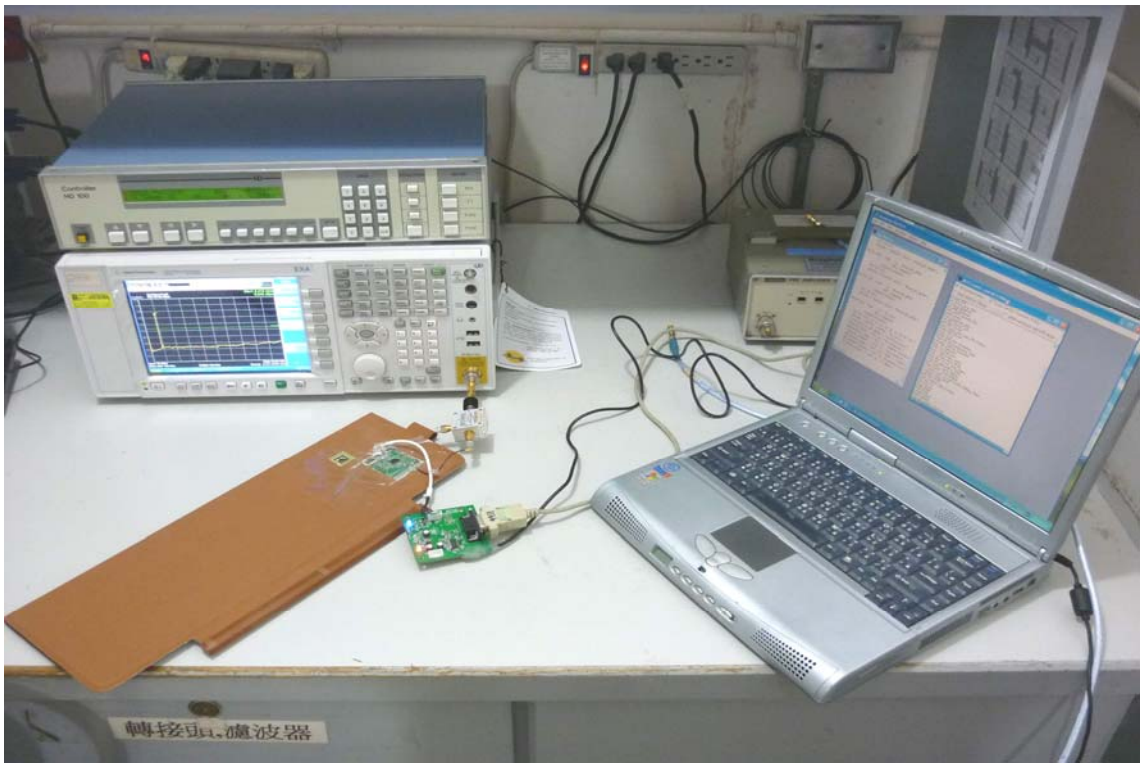
Conducted Emission Setup Photo



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Power Line Conducted Emissions Setup Photos

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APPENDIX 1: PHOTOGRAPHS OF EUT

Refer to T140516L03 External Photographs.

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