FCC CFR47 PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

2.4 GHz DSSS low power radio transceiver

MODEL NUMBER: STD-502-R

FCC ID: V9X-STD502R

REPORT NUMBER: 33IE0022-SH-A

ISSUE DATE: May 22, 2013

Prepared for

CIRCUIT DESIGN, INC.
7557-1 HOTAKA, AZUMINO,
NAGANO, 399-8303, JAPAN

Prepared by

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JAB Accreditation No. : RTL02610

JAB Testing RTL02610

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/22/13	Initial Issue	K. Adachi

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	CIRCUIT DESIGN, INC. 7557-1, HOTAKA, AZUMINO, NAGANO, 399-8303, JAPAN
EUT DESCRIPTION:	2.4 GHz DSSS low power radio transceiver
MODEL:	STD-502-R
SERIAL NUMBER:	S0000003 (for Conducted emissions and Radiated test), S0000002 (for Bandwidth and Power spectral density) S0000001 (for Output power, Average power and Conducted Spurious emissions),
DATE TESTED:	April 17 to May 13, 2013

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass

UL Japan Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Japan, Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Japan, Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Japan, Inc. will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by any government agency.

Approved & Released For UL Japan, Inc. By:

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN.

UL Japan is accredited by JAB, Laboratory Code RTL02610. The full scope of accreditation can be viewed at
http://www.jab.or.jp/cgi-bin/jab_exam_proof_j.cgi?page=2&authorization_number=RTL02610

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER		UNCERTAINTY
Power Line Conducted Emission	150kHz-30MHz	+/- 3.6 dB
Radiated Emission	30MHz-300MHz	+/- 5.1 dB
	300MHz-1000MHz	+/- 5.2 dB
	1000MHz-15GHz	+/- 4.9 dB
	15GHz-18GHz	+/- 5.6 dB
	18GHz-26.5GHz	+/- 4.3 dB

Uncertainty figures are valid to a confidence level of 95% using a coverage factor k=2.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Radio Module.
The radio module is manufactured by CIRSUIT DESIGN, INC.

GENERAL INFORMATION

Power Requirements	DC 3.3V to DC 5.5V (Typical 5.0V)
List of frequencies generated or used by the EUT	16MHz, 26MHz

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402.5 - 2478.5	19.2kbps	5.73	3.74

(narrow band mode)

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

This EUT uses the antenna below.
1. Sleeve antenna : 2dBi
2. Loop PCB antenna : 1.89dBi
3. Coaxial antenna : 1.67dBi

5.4. SOFTWARE AND FIRMWARE

The test utility Firmware used during testing was STD-502, rev.2.0.

All test was conducted with the evaluation board, TB-STD-502-R, manufactured by Circuit Design.

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5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power.

All final tests in the Transmitting Mode were made at 19.2kbps.

The fundamental and spurious was measured in three different orientations X, Y and Z to find worst-case orientation, and final testing for radiated emissions was performed with EUT in following orientation.

	Sleeve antenna			
	Module		Antenna	
	Horizontal	Vertical	Horizontal	Vertical
Carrier	X	Y	X	Y
30M-1GHz	X	Z	X	Y
1G-15GHz	Y	X	X	X
15-26GHz	X	X	X	X

	Loop PCB antenna			
	Module		Antenna	
	Horizontal	Vertical	Horizontal	Vertical
Carrier	Z	Z	X	Y
30M-1GHz	X	Z	X	X
1G-15GHz	Y	X	Y	Y
15-26GHz	X	X	X	X

	Coaxial antenna			
	Module		Antenna	
	Horizontal	Vertical	Horizontal	Vertical
Carrier	Y	Z	X	Y
30M-1GHz	X	Z	X	X
1G-15GHz	Y	X	X	X
15-26GHz	X	X	X	X

The worst-case channel is determined as the channel with the highest output power, power line conducted emissions were performed with the EUT set to the channel with highest output power,
and used highest output power antenna.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
D: Jig	CIRCUIT DESIGN, INC.	TB-STD-502-R	N/A	N/A

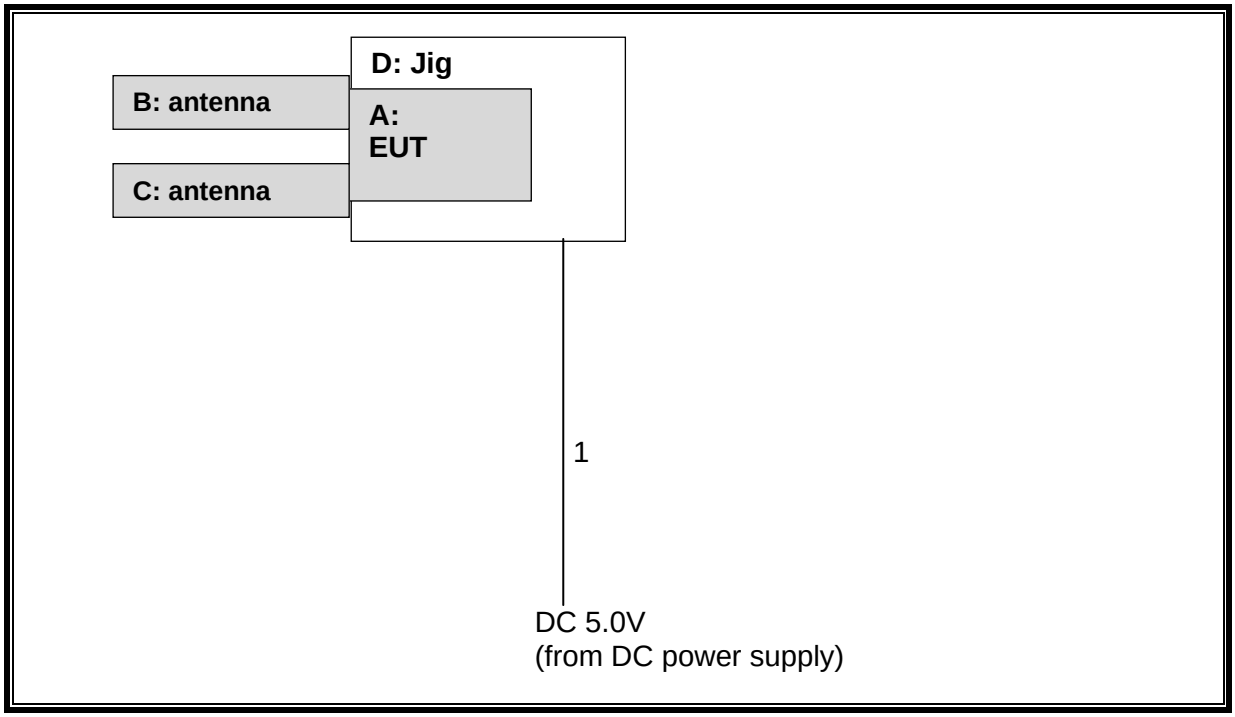
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identica Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	DC	1	DC	Un-shielded	2	N/A

TEST SETUP

The EUT is a stand alone unit. Test jig exercised the radio unit.

SETUP DIAGRAM FOR TESTS



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6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SPM-06	Power Meter	Anritsu	ML2495A	850009	AT	2013/04/09 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	917063	AT	2013/04/09 * 12
SSA-03	Spectrum Analyzer	Agilent	E4448A	MY48250152	AT	2013/01/08 * 12
SAT10-10	Attenuator	Weinschel Corp.	54A-10	37584	AT	2013/04/09 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2013/03/16 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2013/03/07 * 12
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2012/09/21 * 12
SAF-06	Pre Amplifier	TOYO Corporation	TPA0118-36	1440491	RE	2012/07/18 * 12
SCC-G03	Coaxial Cable	Suhner	SUCOFLEX 104A	46499/4A	RE	2013/04/11 * 12
SCC-G23	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	RE	2012/05/22 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2012/08/17 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2013/02/27 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2013/03/28 * 12
SJM-11	Measure	PROMART	SEN1935	-	RE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI,MF)	-	RE, CE	-
SAT20-01	Attenuator(above1GHz)	Agilent	8493C-020	74889	RE	2012/12/18 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	51	RE	2012/12/18 * 12
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	RE	2012/09/21 * 12
SHA-02	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	RE	2012/08/17 * 12
SCC-G02	Coaxial Cable	Suhner	SUCOFLEX 104A	46498/4A	RE	2013/04/09 * 12
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2013/03/19 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2012/05/22 * 12
SSA-01	Spectrum Analyzer	Agilent	N9010A-526	MY48031482	RE	2013/04/09 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2013/02/27 * 12
SJM-02	Measure	KOMELON	KMC-36	-	RE, CE	-
SHA-05	Horn Antenna	ETS LINDGREN	3160-09	LM4210	RE	2013/03/14 * 12
SAF-09	Pre Amplifier	TOYO Corporation	HAP18-26W	18	RE	2013/03/19 * 12
SCC-G18	Coaxial Cable	Suhner	SUCOFLEX 104A	46292/4A	RE	2013/03/16 * 12

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Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2012/11/18 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2013/02/12 * 12
SLA-02	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0893	RE	2012/11/18 * 12
KAT3-11	Attenuator	JFW IND. INC.	50HF-003N	-	RE	2012/08/07 * 12
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2013/02/12 * 12
SCC-B1/B3/B5/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2013/04/03 * 12
SCC-B2/B4/B6/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2013/04/03 * 12
STR-02	Test Receiver	Rohde & Schwarz	ESCI	100575	RE, CE	2012/09/03 * 12
SCC-B12/B13/SRSE-02	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-270(RF Selector)	CE	2013/04/03 * 12
SLS-03	LISN	Rohde & Schwarz	ENV216	100513	CE	2013/02/22 * 12
SAT3-06	Attenuator	JFW	50HF-003N	-	CE	2013/02/12 * 12
SOS-04	Humidity Indicator	A&D	AD-5681	4061512	CE	2013/03/07 * 12

The expiration date of the calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.
Test Item:
CE: Conducted emission,
RE: Radiated emission,
AT: Antenna terminal conducted tests

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7. ANTENNA PORT TEST RESULTS

7.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402.5	0.51	0.5
Middle	2440.5	0.51	0.5
High	2478.5	0.51	0.5

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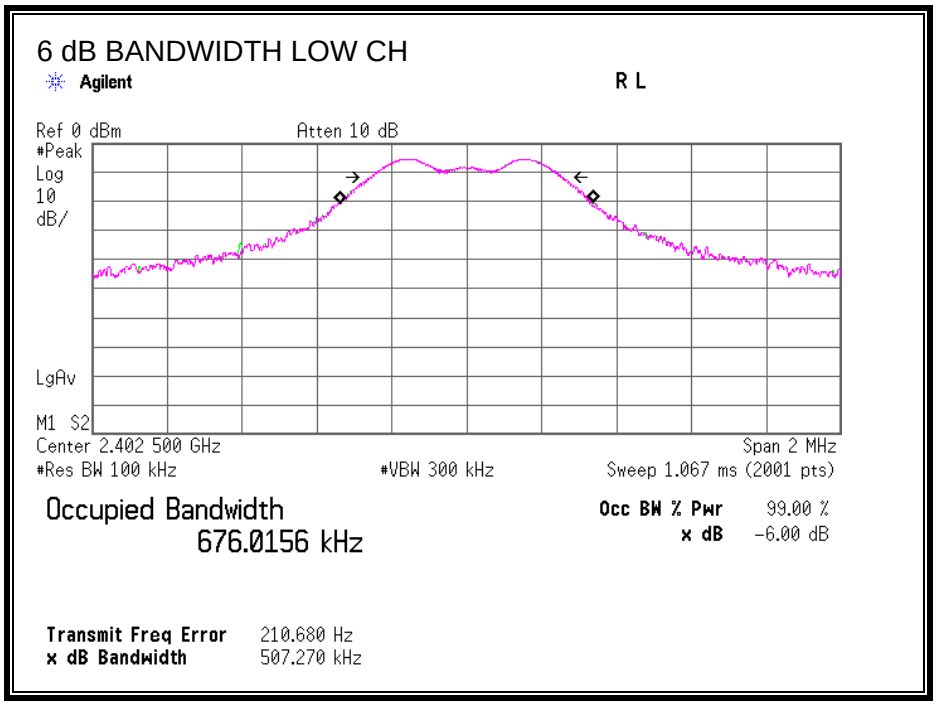
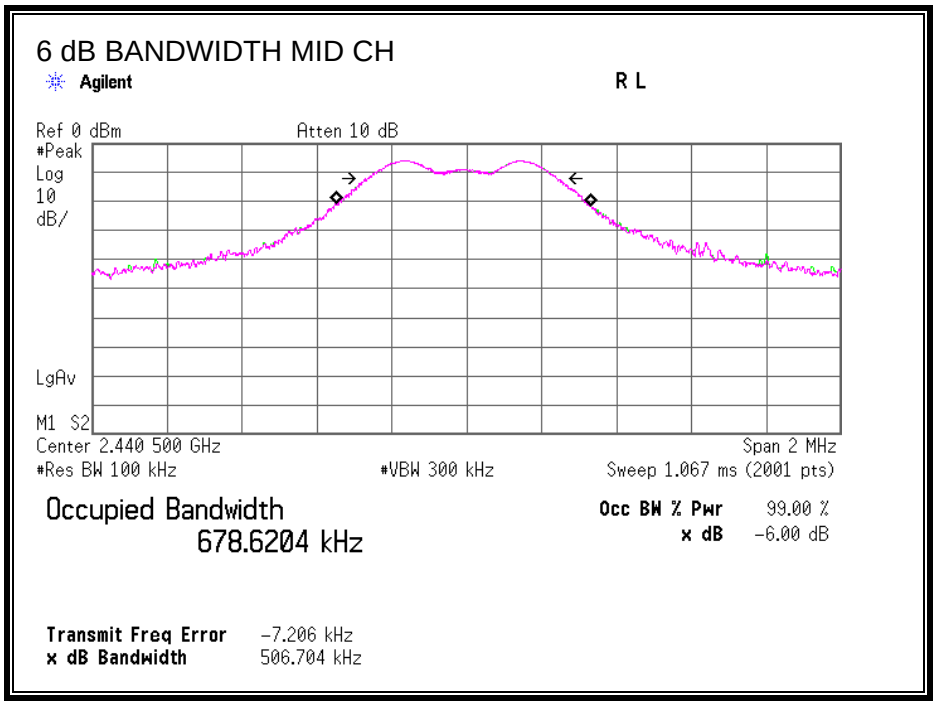
6 dB BANDWIDTH





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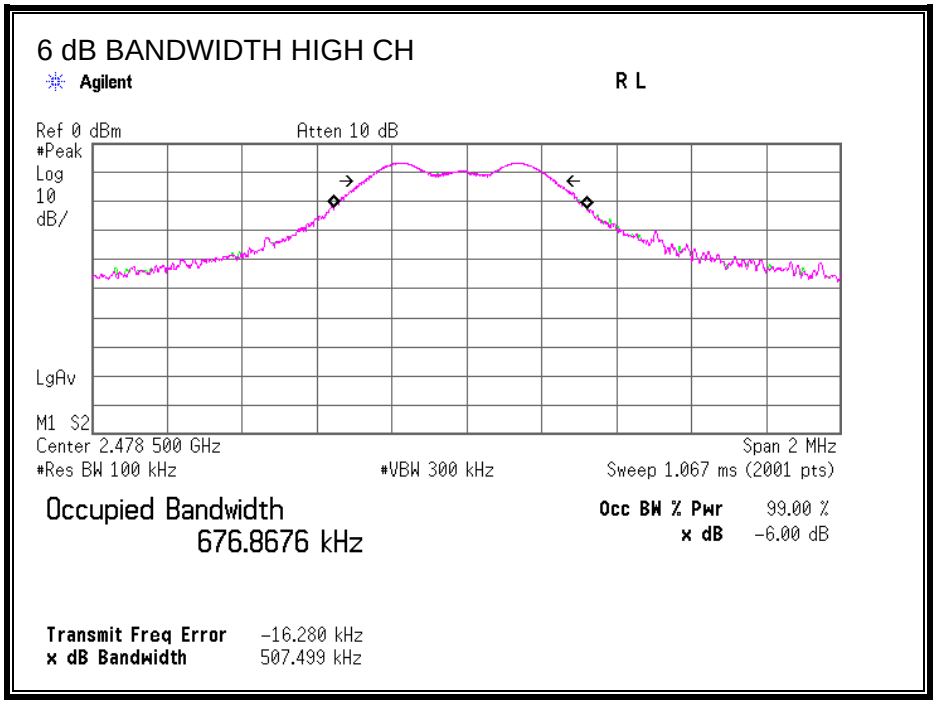

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7.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402.5	0.59287
Middle	2440.5	0.59245
High	2478.5	0.59286

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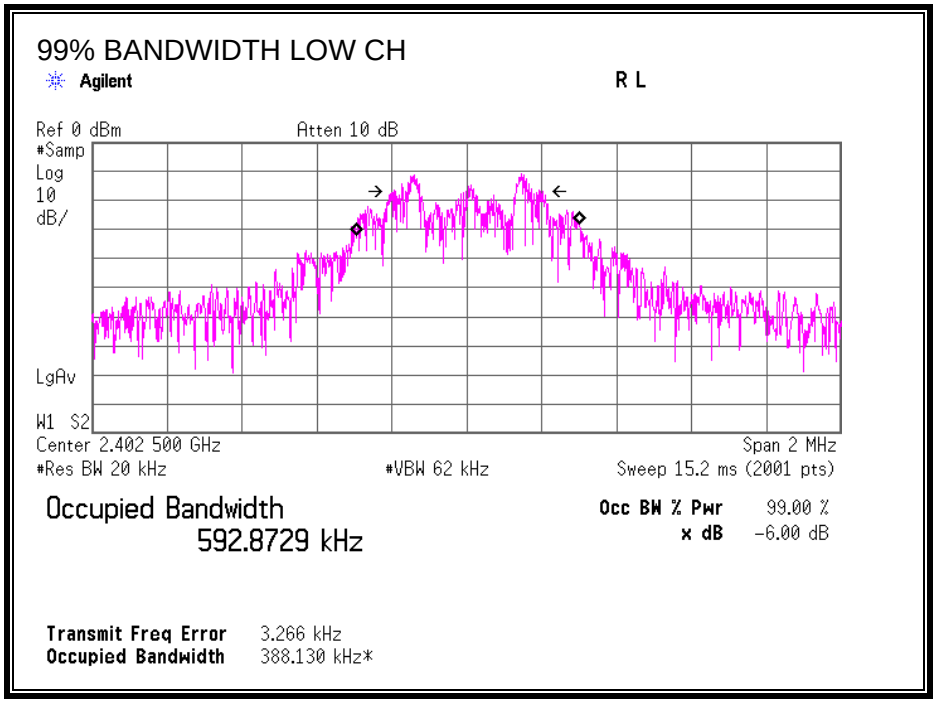
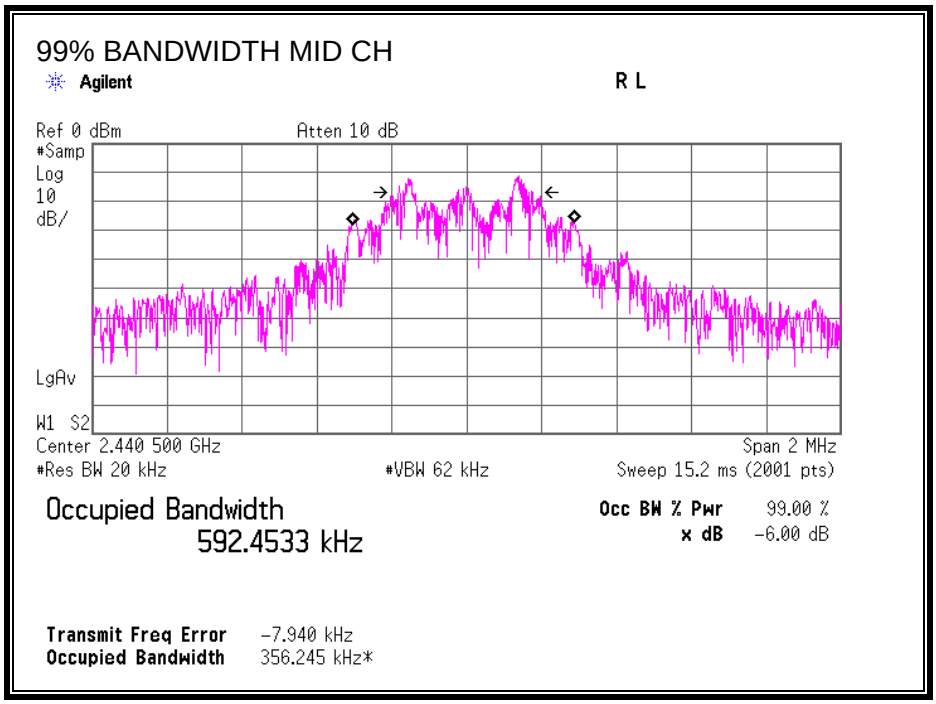
99% BANDWIDTH





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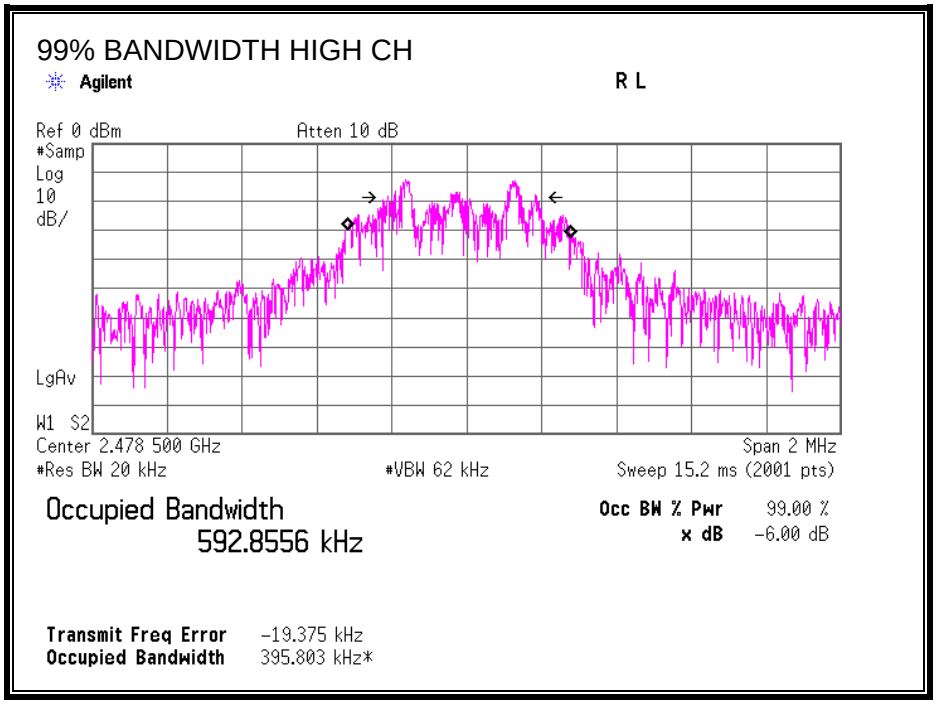

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7.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.26dB to 11.28 dB (including 9.98 dB attenuator and 1.28 dB to 1.30 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Output Power Reading (dBm)	factor (cable ,ATT) (dB)	Output Power Result (dBm)	Limit (dBm)	Margin (dB)
Low	2402.5	-5.53	11.26	5.73	30.00	24.27
Middle	2440.5	-6.29	11.27	4.98	30.00	25.02
High	2478.5	-7.14	11.28	4.14	30.00	25.86

Sample calculation: Output Power Reading [dBm] + factor [dB]

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7.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.26dB to 11.28 dB (including 9.98 dB attenuator and 1.28 dB to 1.30 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Output Power Reading (dBm)	factor (cable ,ATT) (dB)	Output Power Result (dBm)
Low	2402.5	-5.72	11.26	5.54
Middle	2440.5	-6.55	11.27	4.72
High	2478.5	-7.32	11.28	3.96

Sample calculation: Output Power Reading [dBm] + factor [dB]

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7.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST PROCEDURE

Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Method PKPSD in accordance with FCC document “Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating under Section 15.247”, April 9, 2013.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402.5	-0.05	8	-8.05
Middle	2440.5	-0.73	8	-8.73
High	2478.5	-1.45	8	-9.45

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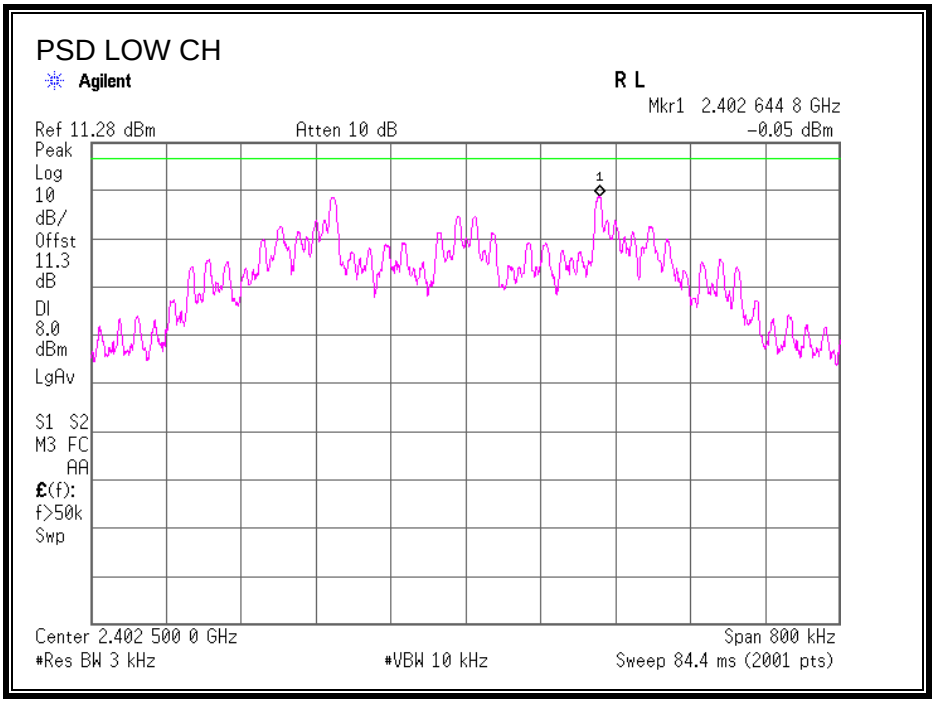
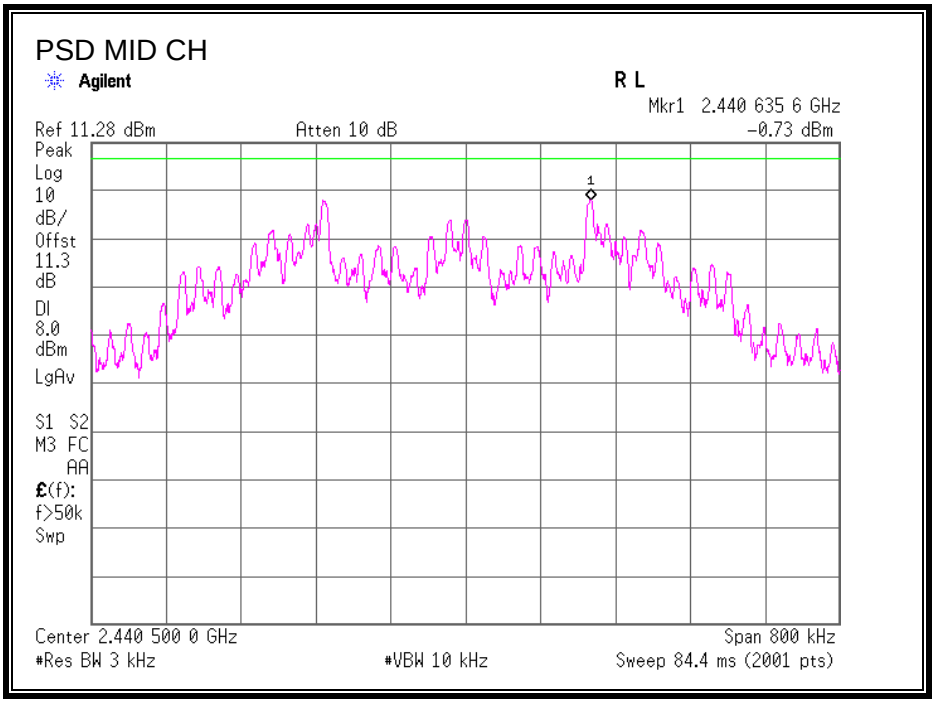
POWER SPECTRAL DENSITY

PSD LOW CH



PSD MID CH



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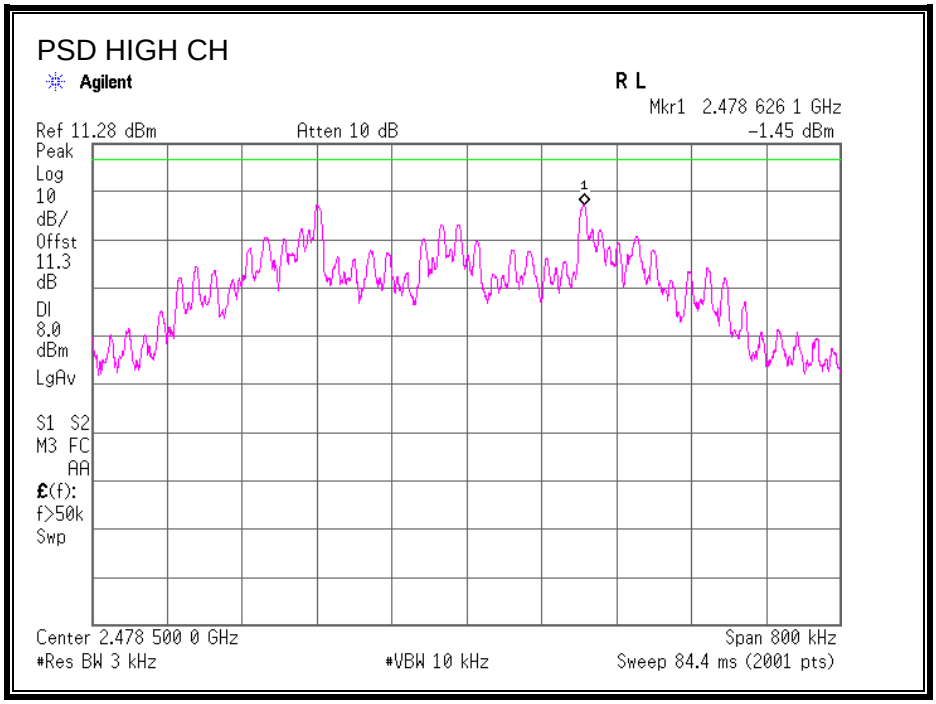

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7.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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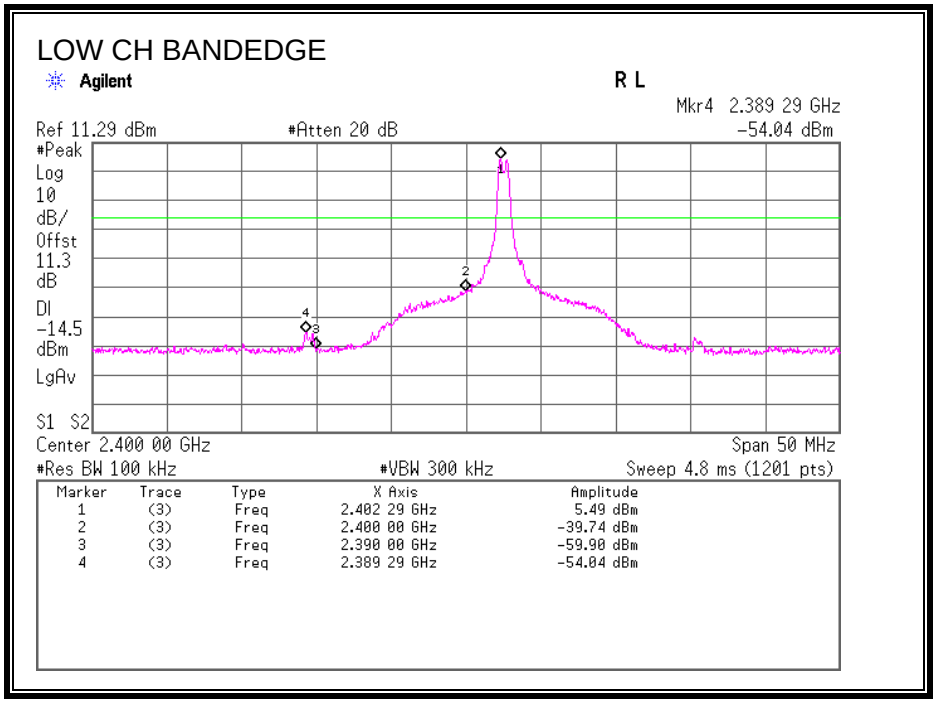
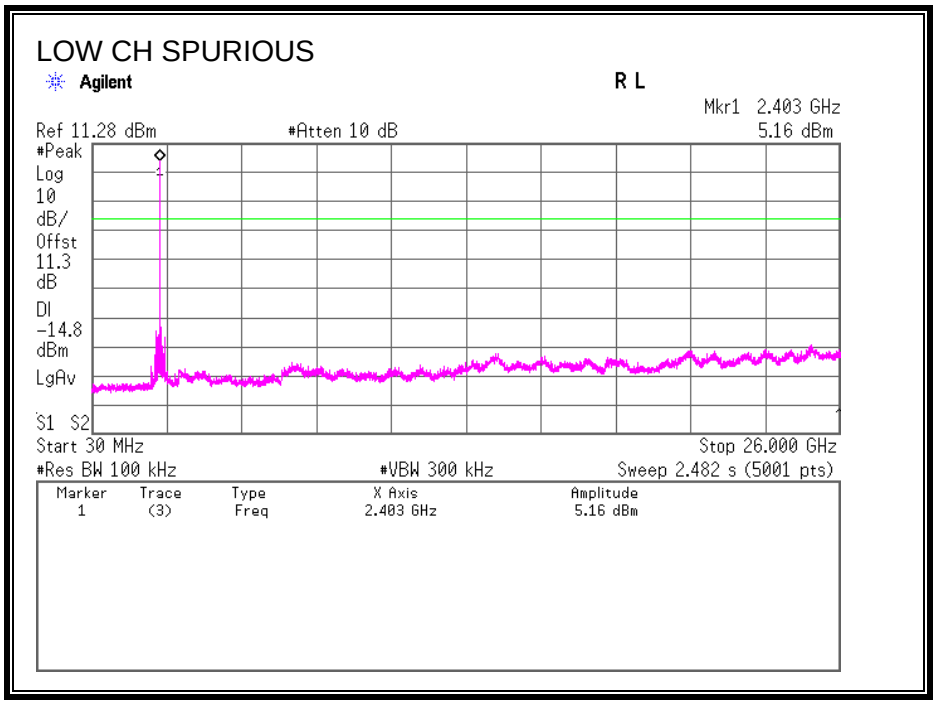
RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL





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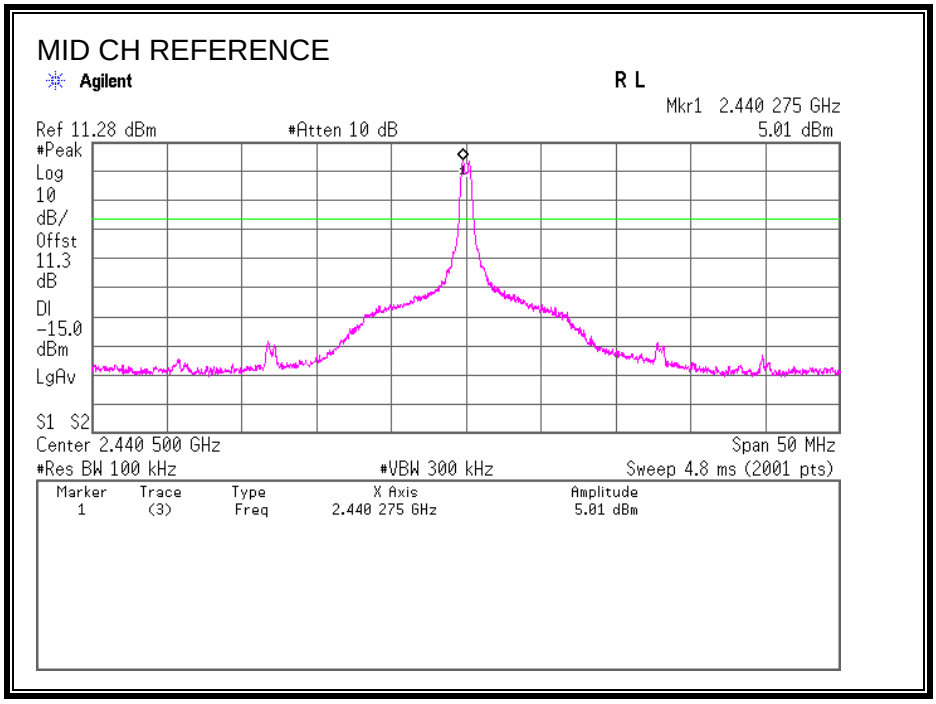
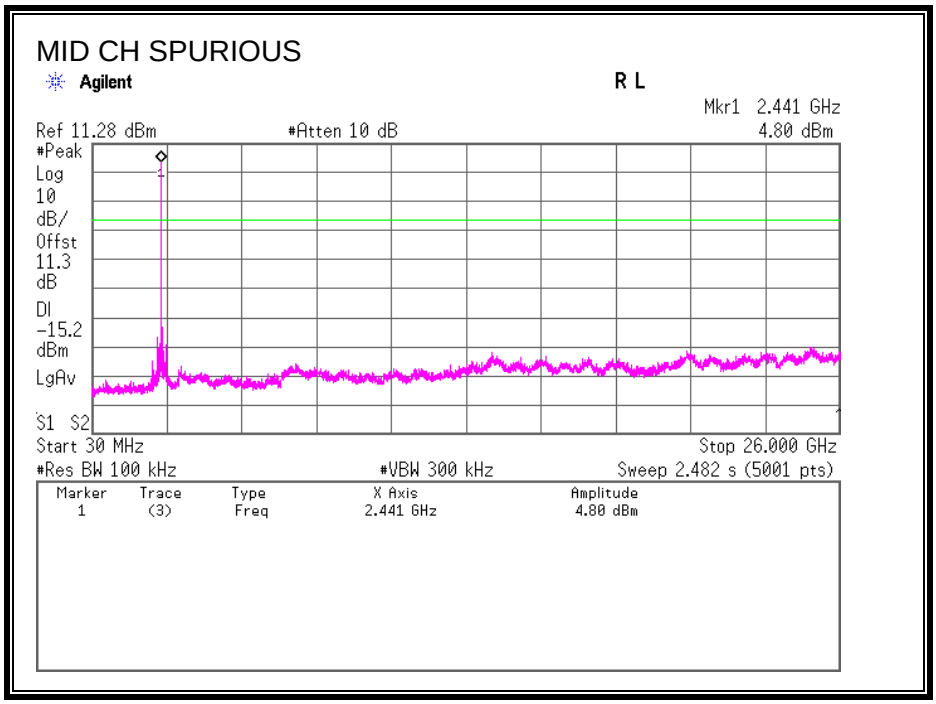
SPURIOUS EMISSIONS, MID CHANNEL





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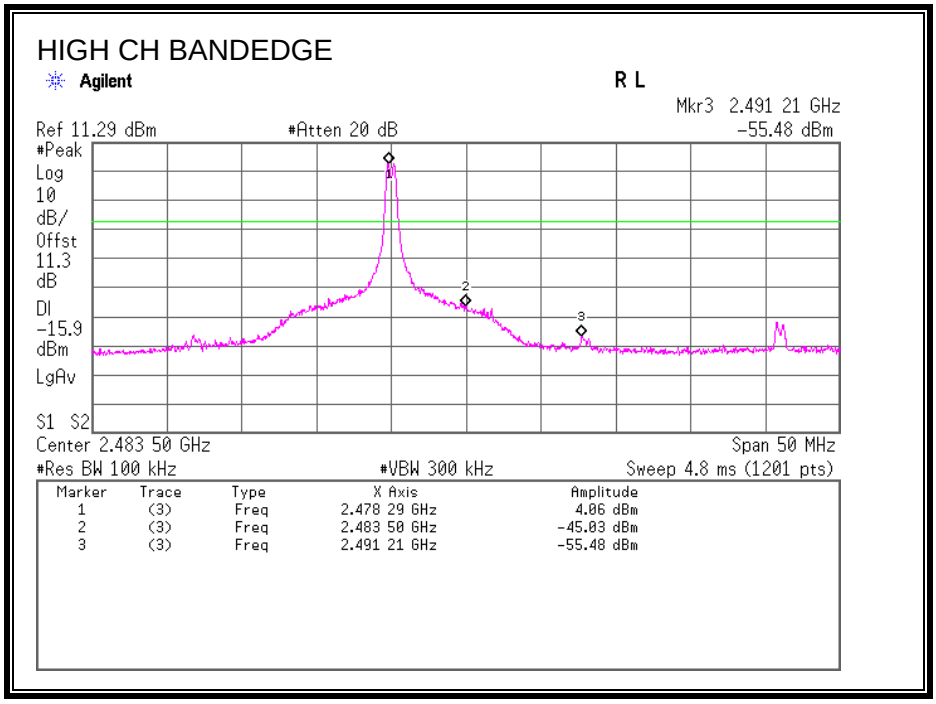
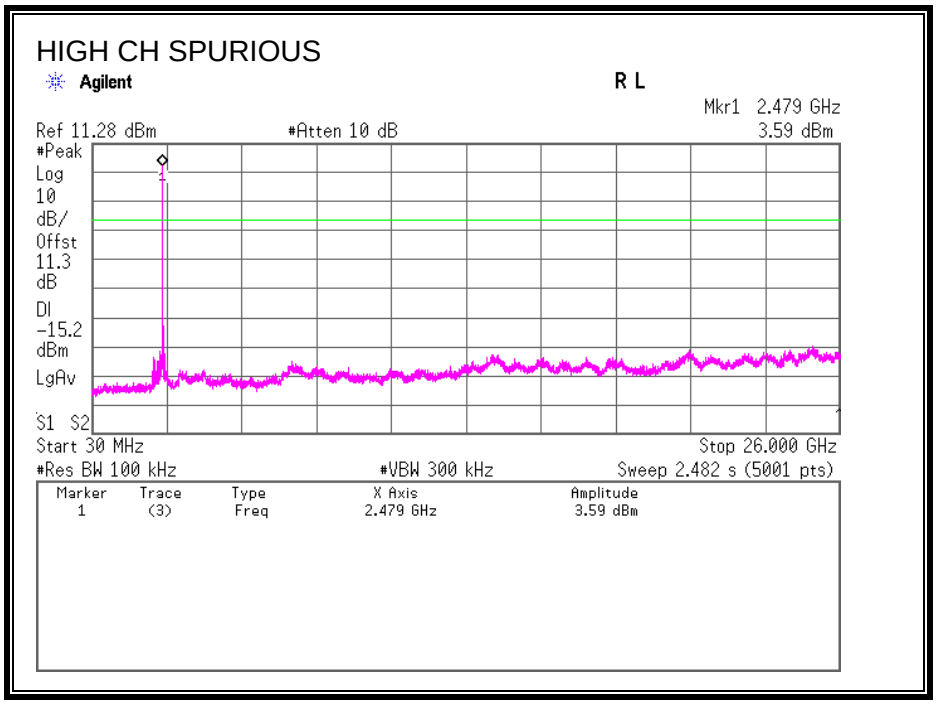
SPURIOUS EMISSIONS, HIGH CHANNEL





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8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

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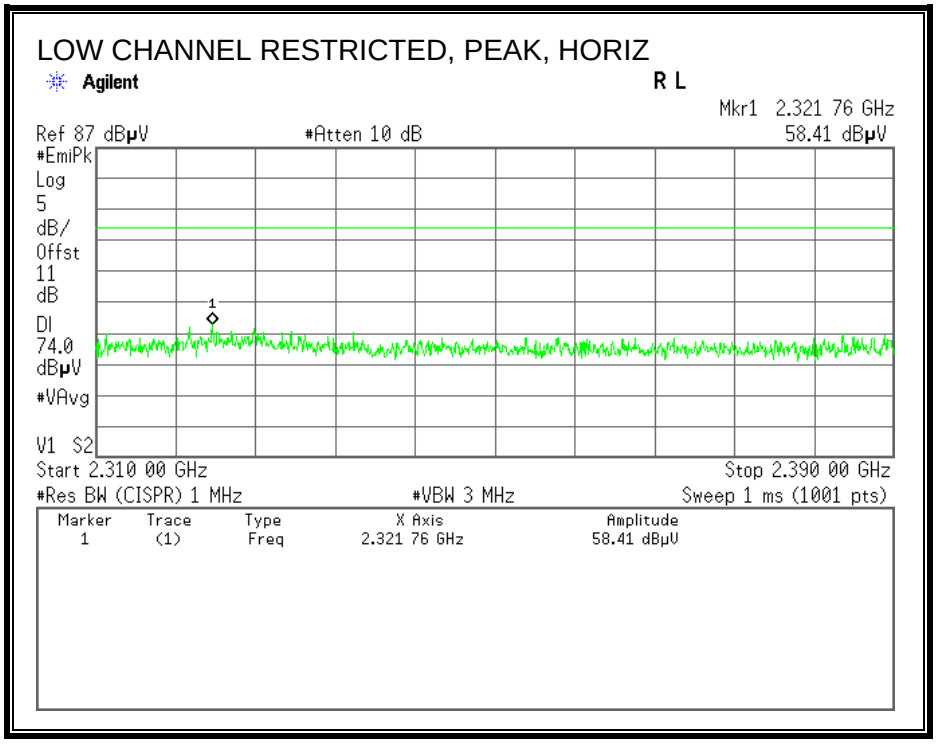
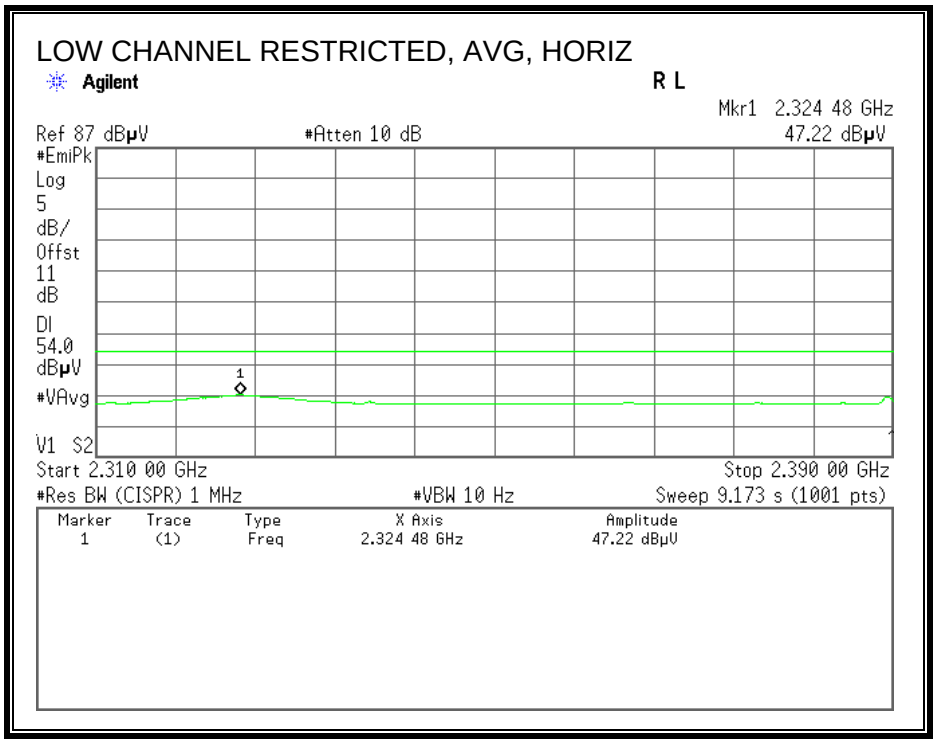
8.2. TRANSMITTER

8.2.1. Sleeve antenna

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





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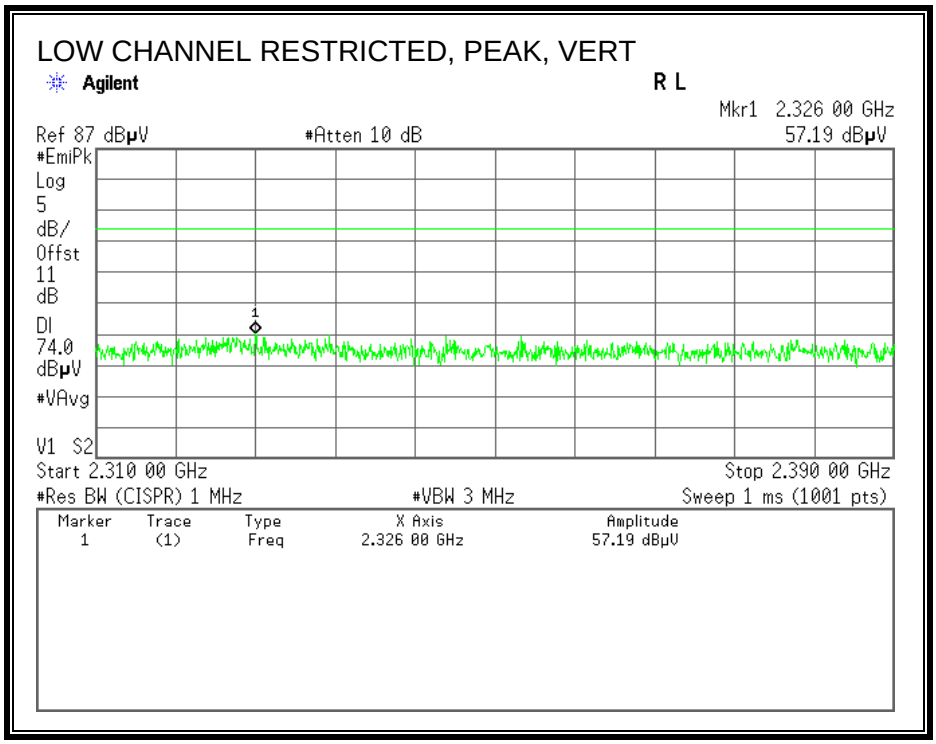
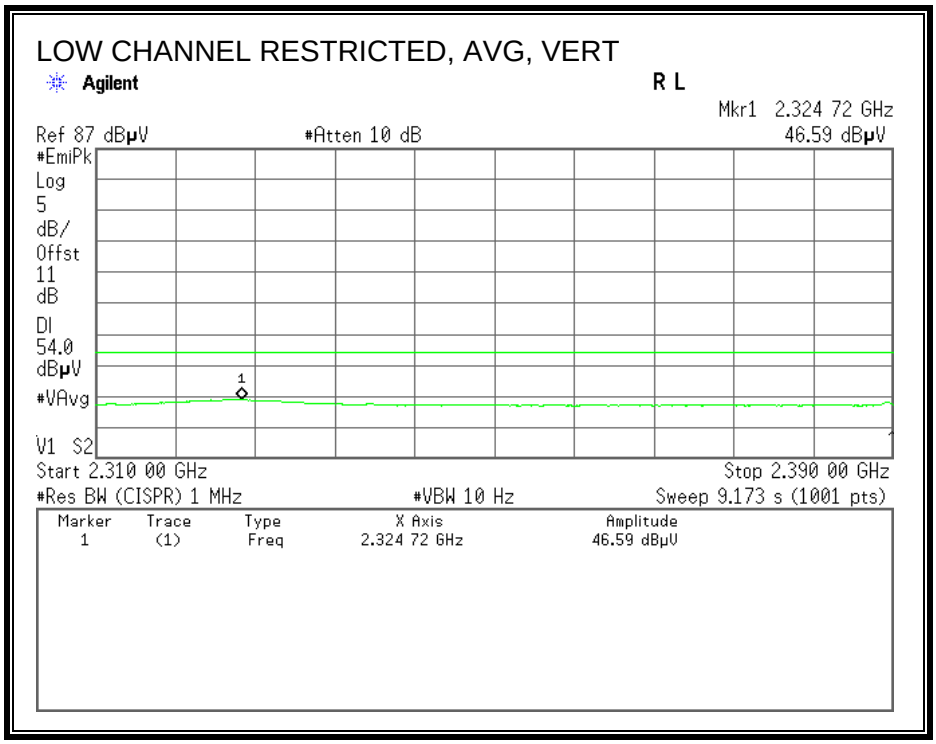
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





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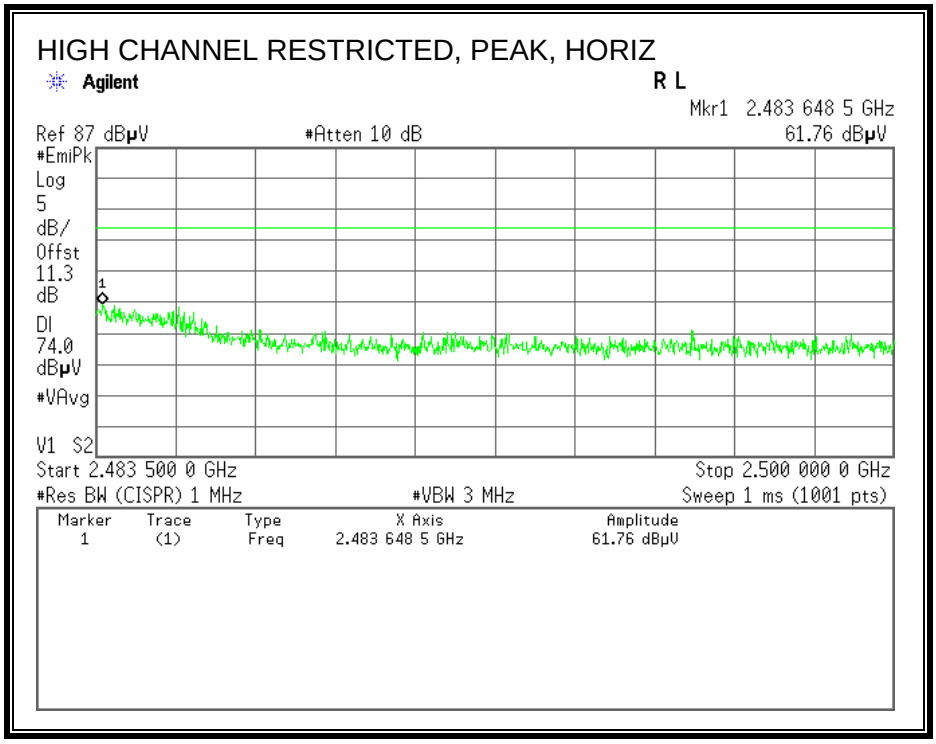
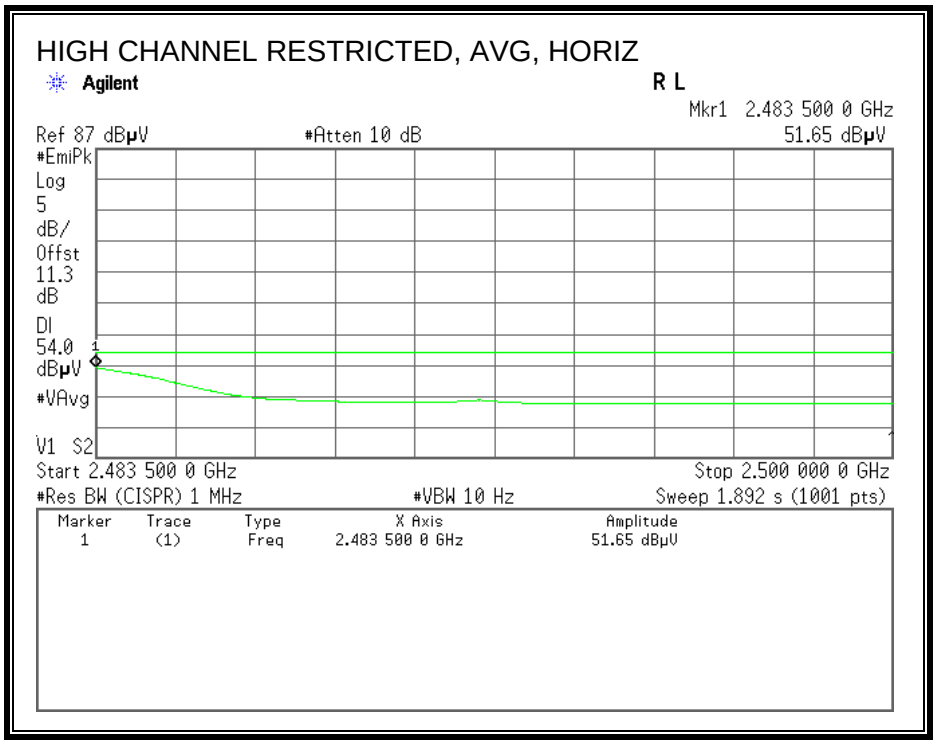
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





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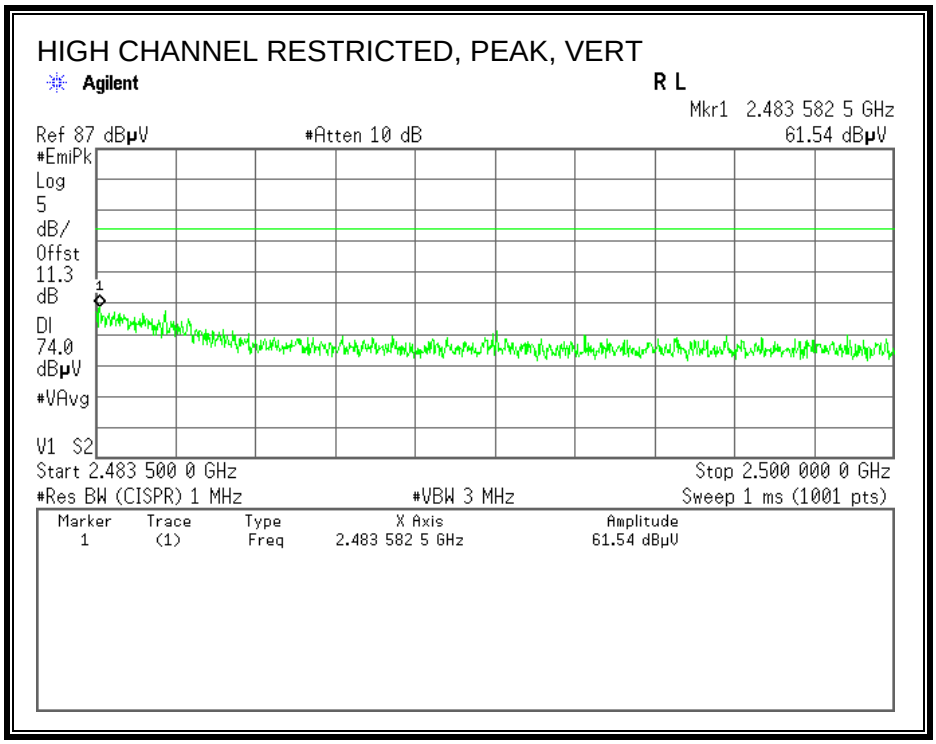
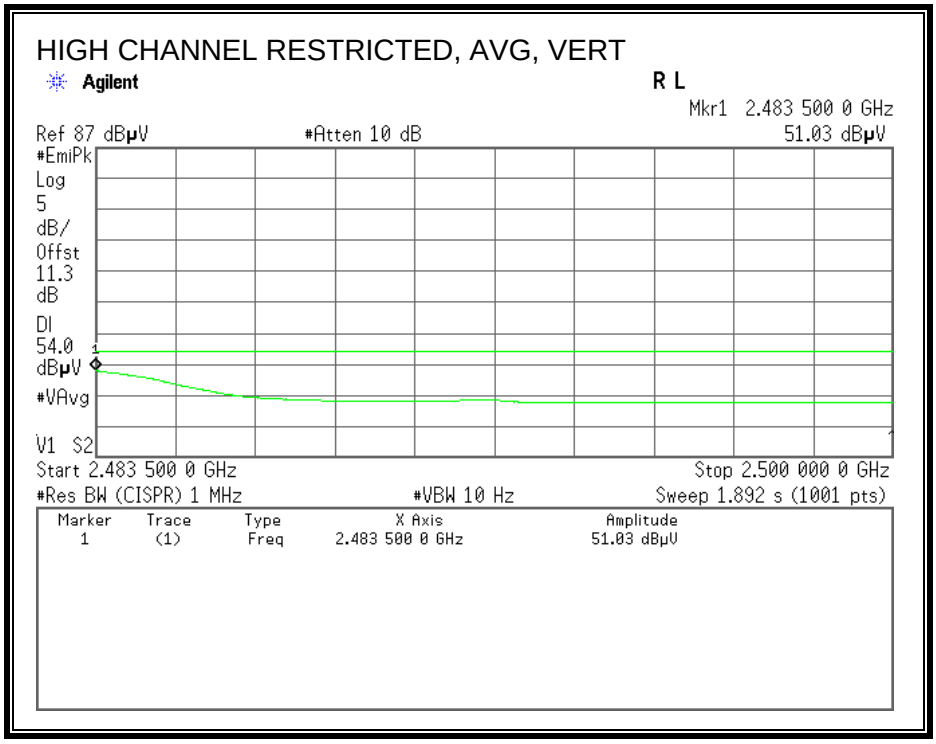
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





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HARMONICS AND SPURIOUS EMISSIONS

Radiated Emission

Test place	No.3 Semi Anechoic Chamber (1G - 15GHz),		No.2 Semi Anechoic Chamber (15G - 26GHz, 30M - 1GHz)	
Date	April 19, 2013,	April 19, 2013,	April 22, 2013,	April 23, 2013
Temperature / Humidity	25deg.C / 36%RH,	25deg.C / 36%RH,	23deg.C / 27%RH,	23deg.C / 28%RH
Engineer	Akio Hayashi,	Tatsuya Arai,	Kenichi Adachi,	Kenichi Adachi
Mode	Tx, 2402.5 MHz			
	with Sleeve antenna			

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	159.999	QP	23.8	15.4	9.0	31.8	16.4	43.5	27.1	206	59	
Hori.	527.999	QP	38.5	18.1	8.6	31.7	33.5	46.0	12.5	189	95	
Hori.	591.999	QP	37.0	19.0	8.9	31.6	33.3	46.0	12.7	162	271	
Hori.	623.999	QP	37.9	19.4	9.0	31.6	34.7	46.0	11.3	145	124	
Hori.	4805.000	PK	52.2	31.1	7.6	41.2	49.7	73.9	24.2	118	79	
Hori.	7207.500	PK	47.9	36.6	9.1	41.4	52.2	73.9	21.7	104	356	
Hori.	24025.000	PK	51.6	39.8	-1.9	46.5	43.0	73.9	30.9	100	0	noise floor level
Hori.	4805.000	AV	44.5	31.1	7.6	41.2	42.0	53.9	11.9	118	79	
Hori.	7207.500	AV	36.9	36.6	9.1	41.4	41.2	53.9	12.7	104	356	
Hori.	24025.000	AV	38.5	39.8	-1.9	46.5	29.9	53.9	24.0	100	0	noise floor level
Vert.	63.999	QP	27.7	7.7	7.0	31.9	10.5	40.0	29.5	100	309	
Vert.	463.999	QP	41.4	17.3	8.3	31.6	35.4	46.0	10.6	130	109	
Vert.	495.999	QP	40.0	17.7	8.4	31.6	34.5	46.0	11.5	118	112	
Vert.	527.999	QP	39.0	18.1	8.6	31.7	34.0	46.0	12.0	100	63	
Vert.	559.999	QP	39.8	18.5	8.8	31.7	35.4	46.0	10.6	100	122	
Vert.	591.999	QP	40.2	19.0	8.9	31.6	36.5	46.0	**9.5**	100	141	
Vert.	4805.000	PK	51.3	31.1	7.6	41.2	48.8	73.9	25.1	110	128	
Vert.	7207.500	PK	48.5	36.6	9.1	41.4	52.8	73.9	21.1	100	359	
Vert.	24025.000	PK	51.6	39.8	-1.9	46.5	43.0	73.9	30.9	100	0	noise floor level
Vert.	4805.000	AV	43.1	31.1	7.6	41.2	40.6	53.9	13.3	110	128	
Vert.	7207.500	AV	37.0	36.6	9.1	41.4	41.3	53.9	12.6	100	359	
Vert.	24025.000	AV	38.6	39.8	-1.9	46.5	30.0	53.9	23.9	100	0	noise floor level

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

20dBc Data Sheet **(RBW 100kHz, VBW 300kHz)**

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2402.500	PK	95.3	27.4	25.0	41.4	106.3	-	-	100	277	Carrier
Hori.	2400.000	PK	50.1	27.4	25.0	41.4	61.1	86.3	25.2	100	277	
Vert.	2402.500	PK	92.1	27.4	25.0	41.4	103.1	-	-	103	314	Carrier
Vert.	2400.000	PK	47.2	27.4	25.0	41.4	58.2	83.1	24.9	103	314	

Result = Reading + Ant.Fac. + Loss(Cable+Attenuator+Filter) - Gain(Amplifier)

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Radiated Emission

Test place	No.3 Semi Anechoic Chamber (1G - 15GHz),		No.2 Semi Anechoic Chamber (15G - 26GHz, 30M - 1GHz)	
Date	April 19, 2013,	April 19, 2013,	April 22, 2013,	April 23, 2013
Temperature / Humidity	25deg.C / 36%RH,	25deg.C / 36%RH,	23deg.C / 27%RH,	23deg.C / 28%RH
Engineer	Akio Hayashi,	Tatsuya Arai,	Kenichi Adachi,	Kenichi Adachi
Mode	Tx, 2440.5 MHz with Sleeve antenna			

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	159.999	QP	23.7	15.1	9.0	31.8	16.3	43.5	27.2	203	63	
Hori.	527.999	QP	38.3	18.1	8.6	31.7	33.3	46.0	12.7	186	97	
Hori.	591.999	QP	36.8	19.0	8.9	31.6	33.1	46.0	12.9	161	274	
Hori.	623.999	QP	37.7	19.4	9.0	31.6	34.5	46.0	11.5	147	121	
Hori.	4881.000	PK	53.1	31.3	7.7	41.1	51.0	73.9	22.9	100	135	
Hori.	7321.500	PK	48.2	36.6	9.2	41.4	52.6	73.9	21.3	100	359	
Hori.	24405.000	PK	52.0	39.7	-1.8	46.7	43.2	73.9	30.7	100	0	noise floor level
Hori.	4881.000	AV	46.2	31.3	7.7	41.1	44.1	53.9	9.8	100	135	
Hori.	7321.500	AV	36.1	36.6	9.2	41.4	40.5	53.9	13.4	100	359	
Hori.	24405.000	AV	39.1	39.7	-1.8	46.7	30.3	53.9	23.6	100	0	noise floor level
Vert.	63.999	QP	27.8	7.7	7.0	31.9	10.6	40.0	29.4	100	312	
Vert.	463.999	QP	41.2	17.3	8.3	31.6	35.2	46.0	10.8	127	110	
Vert.	495.999	QP	40.1	17.7	8.4	31.6	34.6	46.0	11.4	120	114	
Vert.	527.999	QP	38.9	18.1	8.6	31.7	33.9	46.0	12.1	100	65	
Vert.	559.999	QP	39.6	18.5	8.8	31.7	35.2	46.0	10.8	100	118	
Vert.	591.999	QP	40.0	19.0	8.9	31.6	36.3	46.0	**9.7**	100	138	
Vert.	4881.000	PK	52.3	31.3	7.7	41.1	50.2	73.9	23.7	100	134	
Vert.	7321.500	PK	47.3	36.6	9.2	41.4	51.7	73.9	22.2	100	357	
Vert.	24405.000	PK	52.1	39.7	-1.8	46.7	43.3	73.9	30.6	100	0	noise floor level
Vert.	4881.000	AV	45.0	31.3	7.7	41.1	42.9	53.9	11.0	100	134	
Vert.	7321.500	AV	36.2	36.6	9.2	41.4	40.6	53.9	13.3	100	357	
Vert.	24405.000	AV	39.2	39.7	-1.8	46.7	30.4	53.9	23.5	100	0	noise floor level

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

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Radiated Emission

Test place	No.3 Semi Anechoic Chamber (1G - 15GHz),		No.2 Semi Anechoic Chamber (15G - 26GHz, 30M - 1GHz)	
Date	April 19, 2013,	April 19, 2013,	April 22, 2013,	April 23, 2013
Temperature / Humidity	25deg.C / 36%RH,	25deg.C / 36%RH,	23deg.C / 27%RH,	23deg.C / 28%RH
Engineer	Akio Hayashi,	Tatsuya Arai,	Kenichi Adachi,	Kenichi Adachi
Mode	Tx, 2478.5 MHz with Sleeve antenna			

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	159.999	QP	23.5	15.4	9.0	31.8	16.1	43.5	27.4	204	61	
Hori.	527.999	QP	38.6	18.1	8.6	31.7	33.6	46.0	12.4	188	93	
Hori.	591.999	QP	37.1	19.0	8.9	31.6	33.4	46.0	12.6	164	273	
Hori.	623.999	QP	37.8	19.4	9.0	31.6	34.6	46.0	11.4	144	118	
Hori.	4957.000	PK	50.7	31.6	7.7	41.0	49.0	73.9	24.9	100	135	
Hori.	7435.500	PK	47.0	36.7	9.2	41.5	51.4	73.9	22.5	100	357	
Hori.	24785.000	PK	53.0	39.7	-1.6	46.7	44.4	73.9	29.5	100	0	noise floor level
Hori.	4957.000	AV	41.8	31.6	7.7	41.0	40.1	53.9	13.8	100	135	
Hori.	7435.500	AV	35.7	36.7	9.2	41.5	40.1	53.9	13.8	100	357	
Hori.	24785.000	AV	39.5	39.7	-1.6	46.7	30.9	53.9	23.0	100	0	noise floor level
Vert.	63.999	QP	27.6	7.7	7.0	31.9	10.4	40.0	29.6	100	299	
Vert.	463.999	QP	41.3	17.3	8.3	31.6	35.3	46.0	10.7	126	111	
Vert.	495.999	QP	40.2	17.7	8.4	31.6	34.7	46.0	11.3	116	110	
Vert.	527.999	QP	39.2	18.1	8.6	31.7	34.2	46.0	11.8	100	59	
Vert.	559.999	QP	39.7	18.5	8.8	31.7	35.3	46.0	10.7	100	120	
Vert.	591.999	QP	40.1	19.0	8.9	31.6	36.4	46.0	**9.6**	100	139	
Vert.	4957.000	PK	50.7	31.6	7.7	41.0	49.0	73.9	24.9	109	132	
Vert.	7435.500	PK	46.9	36.7	9.2	41.5	51.3	73.9	22.6	100	358	
Vert.	24785.000	PK	53.1	39.7	-1.6	46.7	44.5	73.9	29.4	100	0	noise floor level
Vert.	4957.000	AV	42.3	31.6	7.7	41.0	40.6	53.9	13.3	109	132	
Vert.	7435.500	AV	35.7	36.7	9.2	41.5	40.1	53.9	13.8	100	358	
Vert.	24785.000	AV	39.6	39.7	-1.6	46.7	31.0	53.9	22.9	100	0	noise floor level

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

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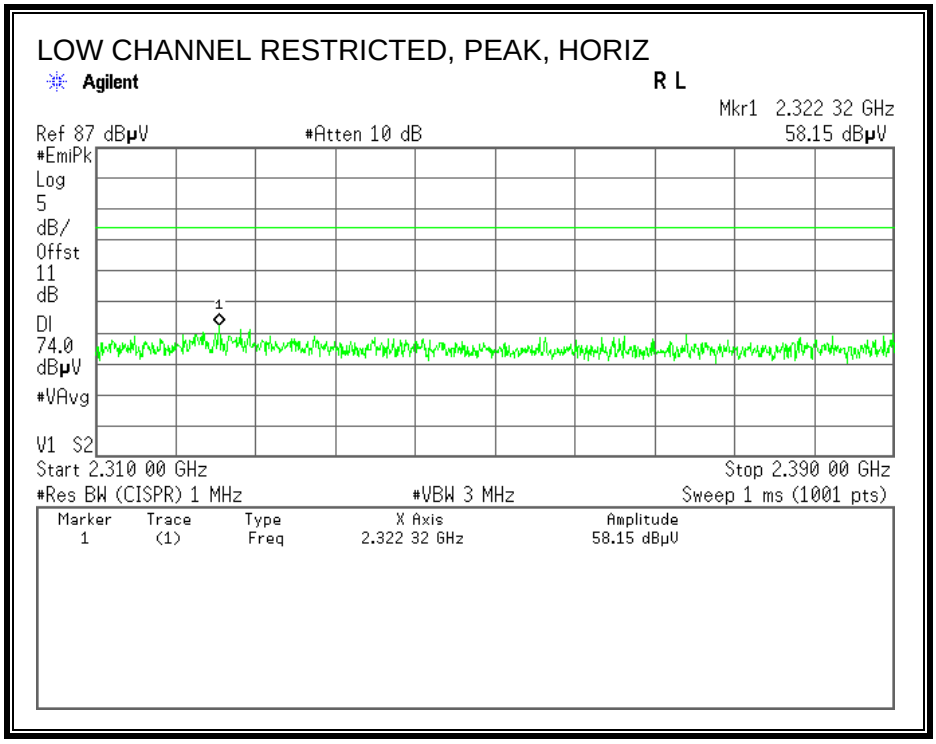
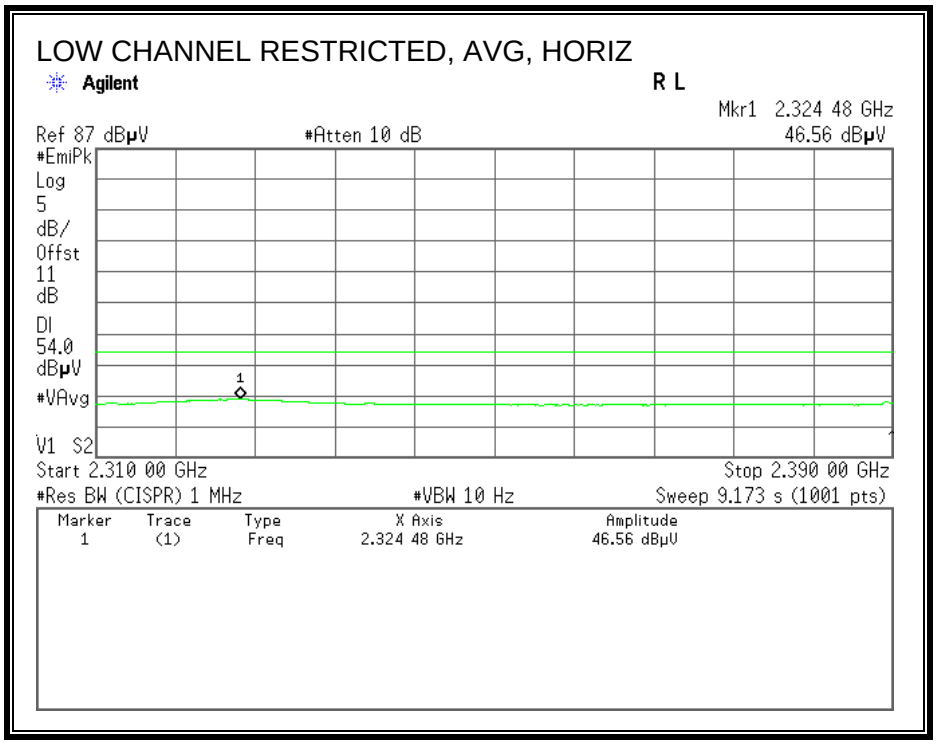
8.2.2. Loop PCB antenna

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





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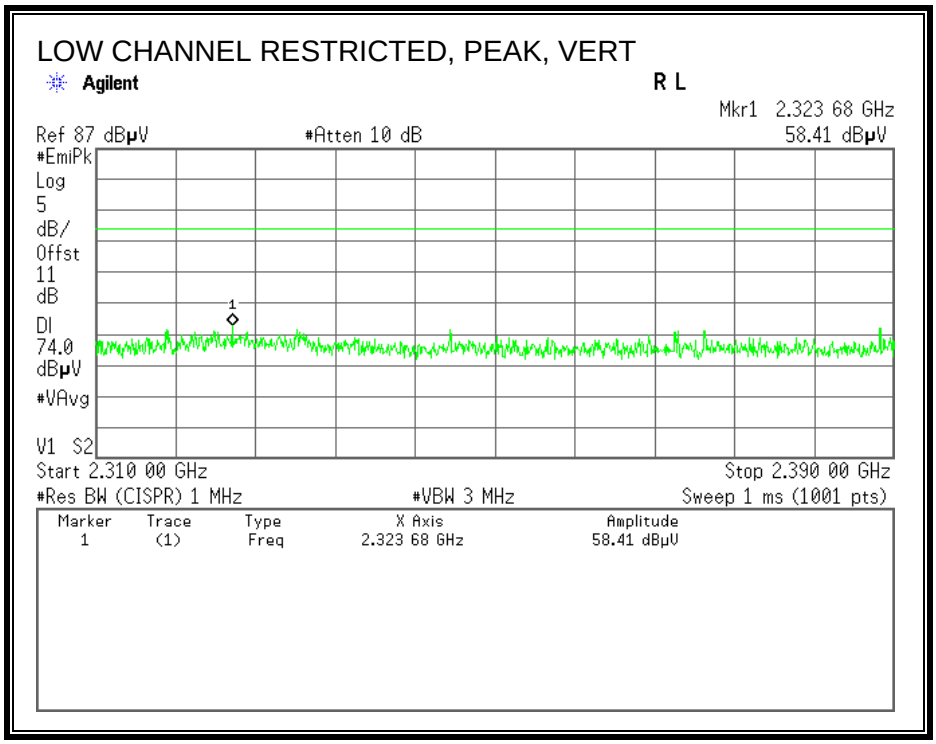
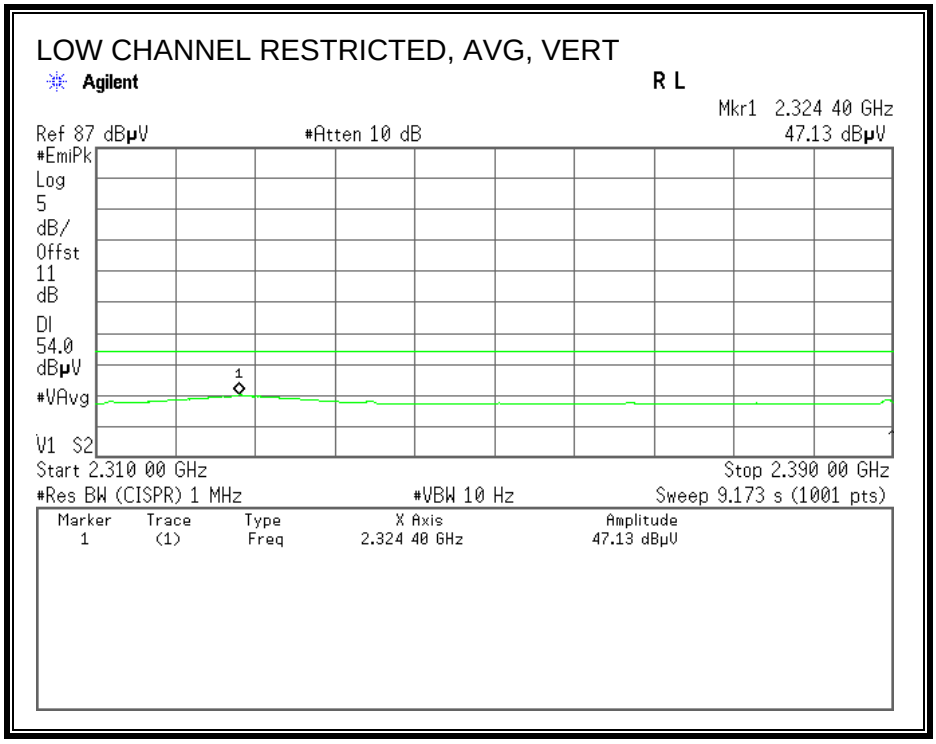
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





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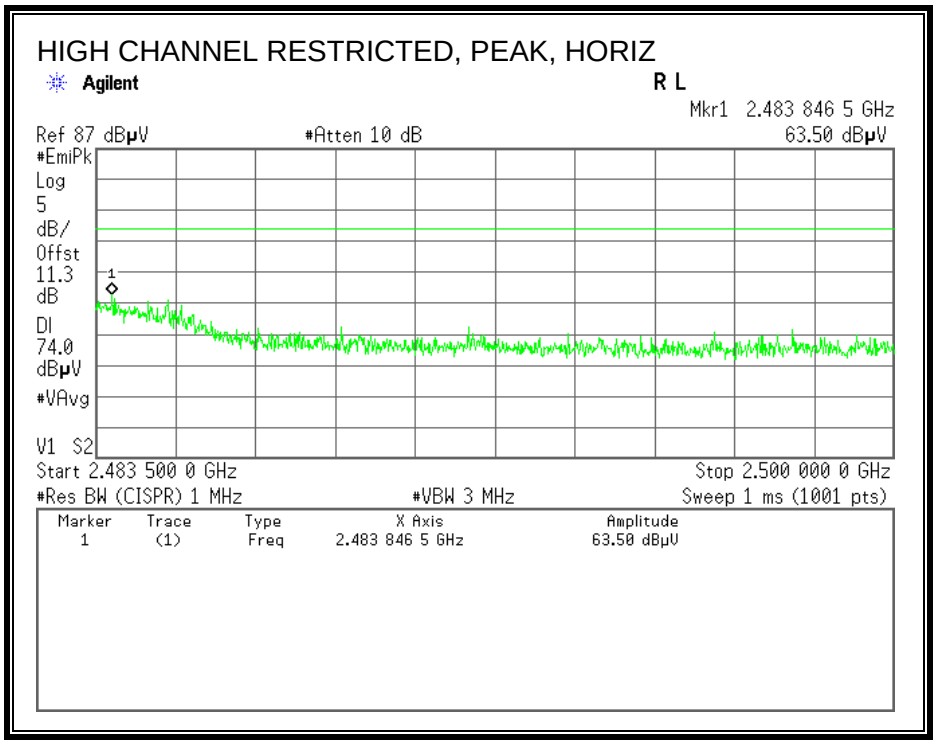
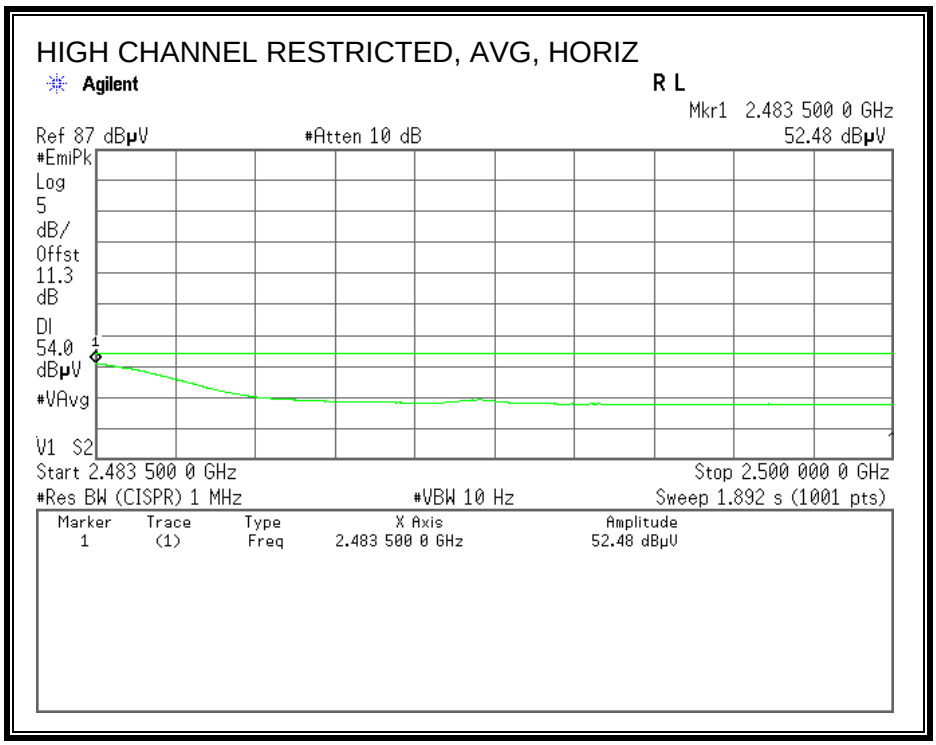
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





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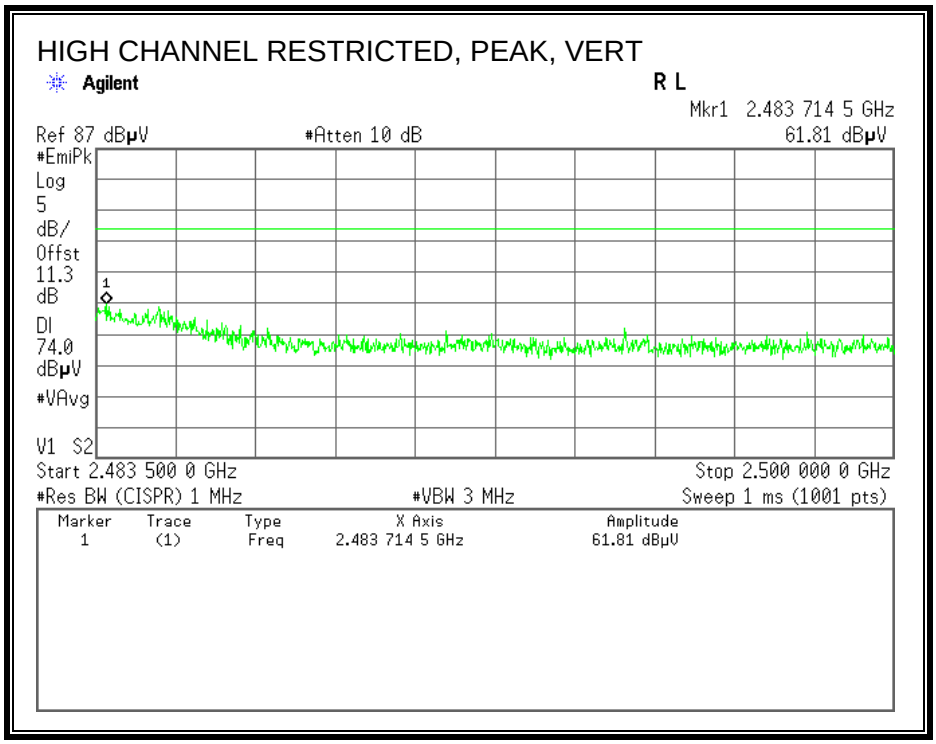
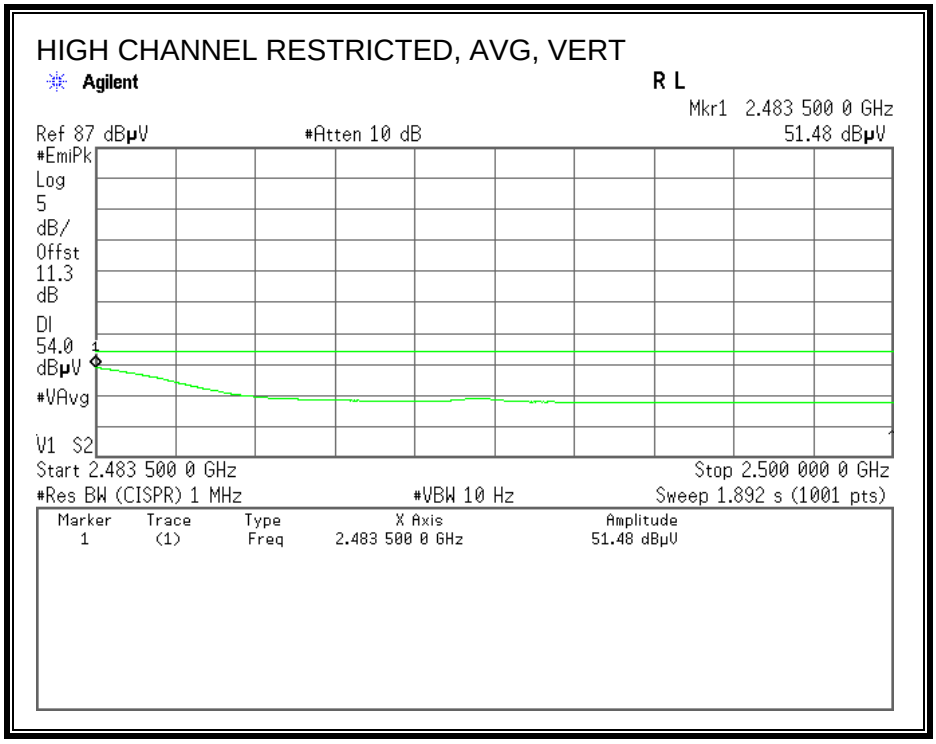
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





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HARMONICS AND SPURIOUS EMISSIONS

Radiated Emission

Test place	No.3 Semi Anechoic Chamber (1G - 15GHz),		No.2 Semi Anechoic Chamber (15G - 26GHz, 30M - 1GHz)
Date	April 19, 2013,	April 22, 2013,	April 23, 2013
Temperature / Humidity	25deg.C / 36%RH,	23deg.C / 27%RH,	23deg.C / 28%RH
Engineer	Tatsuya Arai,	Kenichi Adachi,	Kenichi Adachi
Mode	Tx, 2402.5 MHz		
	with Loop PCB antenna		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	144.000	QP	30.4	14.9	8.8	31.8	22.3	43.5	21.2	235	52	
Hori.	431.999	QP	35.2	17.0	8.2	31.6	28.8	46.0	17.2	100	343	
Hori.	463.999	QP	35.0	17.3	8.3	31.6	29.0	46.0	17.0	100	302	
Hori.	495.999	QP	34.2	17.7	8.4	31.6	28.7	46.0	17.3	202	332	
Hori.	559.999	QP	35.1	18.5	8.8	31.7	30.7	46.0	15.3	178	350	
Hori.	4805.000	PK	52.8	31.1	7.6	41.2	50.3	73.9	23.6	100	130	
Hori.	7207.500	PK	48.5	36.6	9.1	41.4	52.8	73.9	21.1	100	263	
Hori.	24025.000	PK	51.6	39.8	-1.9	46.5	43.0	73.9	30.9	100	0	noise floor level
Hori.	4805.000	AV	44.6	31.1	7.6	41.2	42.1	53.9	**11.8**	100	130	
Hori.	7207.500	AV	36.7	36.6	9.1	41.4	41.0	53.9	12.9	100	263	
Hori.	24025.000	AV	38.6	39.8	-1.9	46.5	30.0	53.9	23.9	100	0	noise floor level
Vert.	63.999	QP	35.0	7.7	7.0	31.9	17.8	40.0	22.2	100	22	
Vert.	527.999	QP	38.0	18.1	8.6	31.7	33.0	46.0	13.0	104	209	
Vert.	559.999	QP	36.7	18.5	8.8	31.7	32.3	46.0	13.7	105	152	
Vert.	591.999	QP	36.0	19.0	8.9	31.6	32.3	46.0	13.7	100	155	
Vert.	623.999	QP	35.4	19.4	9.0	31.6	32.2	46.0	13.8	100	170	
Vert.	4805.000	PK	51.0	31.1	7.6	41.2	48.5	73.9	25.4	100	136	
Vert.	7207.500	PK	47.2	36.6	9.1	41.4	51.5	73.9	22.4	100	358	
Vert.	24025.000	PK	51.5	39.8	-1.9	46.5	42.9	73.9	31.0	100	0	noise floor level
Vert.	4805.000	AV	42.8	31.1	7.6	41.2	40.3	53.9	13.6	100	136	
Vert.	7207.500	AV	36.4	36.6	9.1	41.4	40.7	53.9	13.2	100	358	
Vert.	24025.000	AV	38.5	39.8	-1.9	46.5	29.9	53.9	24.0	100	0	noise floor level

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

20dBc Data Sheet **(RBW 100kHz, VBW 300kHz)**

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2402.500	PK	93.0	27.4	25.0	41.4	104.0	-	-	103	85	Carrier
Hori.	2400.000	PK	47.8	27.4	25.0	41.4	58.8	84.0	25.2	103	85	
Vert.	2402.500	PK	93.2	27.4	25.0	41.4	104.2	-	-	100	201	Carrier
Vert.	2400.000	PK	48.3	27.4	25.0	41.4	59.3	84.2	24.9	100	201	

Result = Reading + Ant.Fac. + Loss(Cable+Attenuator+Filter) - Gain(Amplifier)

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Radiated Emission

Test place	No.3 Semi Anechoic Chamber (1G - 15GHz),		No.2 Semi Anechoic Chamber (15G - 26GHz, 30M - 1GHz)
Date	April 19, 2013,	April 22, 2013,	April 23, 2013
Temperature / Humidity	25deg.C / 36%RH,	23deg.C / 27%RH,	23deg.C / 28%RH
Engineer	Tatsuya Arai,	Kenichi Adachi,	Kenichi Adachi
Mode	Tx, 2440.5 MHz		
	with Loop PCB antenna		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	144.001	QP	30.2	14.9	8.8	31.8	22.1	43.5	21.4	231	54	
Hori.	431.999	QP	35.0	17.0	8.2	31.6	28.6	46.0	17.4	100	347	
Hori.	463.999	QP	34.9	17.3	8.3	31.6	28.9	46.0	17.1	100	299	
Hori.	495.999	QP	34.3	17.7	8.4	31.6	28.8	46.0	17.2	201	328	
Hori.	559.999	QP	35.0	18.5	8.8	31.7	30.6	46.0	15.4	173	354	
Hori.	4881.000	PK	51.7	31.3	7.7	41.1	49.6	73.9	24.3	100	129	
Hori.	7321.500	PK	47.3	36.6	9.2	41.4	51.7	73.9	22.2	100	355	
Hori.	24405.000	PK	51.9	39.7	-1.8	46.7	43.1	73.9	30.8	100	0	noise floor level
Hori.	4881.000	AV	44.1	31.3	7.7	41.1	42.0	53.9	**11.9**	100	129	
Hori.	7321.500	AV	35.9	36.6	9.2	41.4	40.3	53.9	13.6	100	355	
Hori.	24405.000	AV	39.1	39.7	-1.8	46.7	30.3	53.9	23.6	100	0	noise floor level
Vert.	63.999	QP	34.8	7.7	7.0	31.9	17.6	40.0	22.4	100	25	
Vert.	527.999	QP	37.8	18.1	8.6	31.7	32.8	46.0	13.2	103	203	
Vert.	559.999	QP	36.6	18.5	8.8	31.7	32.2	46.0	13.8	106	151	
Vert.	591.999	QP	35.8	19.0	8.9	31.6	32.1	46.0	13.9	100	159	
Vert.	623.999	QP	35.2	19.4	9.0	31.6	32.0	46.0	14.0	100	168	
Vert.	4881.000	PK	51.8	31.3	7.7	41.1	49.7	73.9	24.2	100	138	
Vert.	7321.500	PK	47.6	36.6	9.2	41.4	52.0	73.9	21.9	100	358	
Vert.	24405.000	PK	52.0	39.7	-1.8	46.7	43.2	73.9	30.7	100	0	noise floor level
Vert.	4881.000	AV	43.2	31.3	7.7	41.1	41.1	53.9	12.8	100	138	
Vert.	7321.500	AV	35.9	36.6	9.2	41.4	40.3	53.9	13.6	100	358	
Vert.	24405.000	AV	39.1	39.7	-1.8	46.7	30.3	53.9	23.6	100	0	noise floor level

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)

Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

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Radiated Emission

Test place	No.3 Semi Anechoic Chamber (1G - 15GHz),	No.2 Semi Anechoic Chamber (15G - 26GHz, 30M - 1GHz)	
Date	April 19, 2013,	April 22, 2013,	April 23, 2013
Temperature / Humidity	25deg.C / 36%RH,	23deg.C / 27%RH,	23deg.C / 28%RH
Engineer	Tatsuya Arai,	Kenichi Adachi,	Kenichi Adachi
Mode	Tx, 2478.5 MHz with Loop PCB antenna		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	144.001	QP	30.3	14.9	8.8	31.8	22.2	43.5	21.3	229	55	
Hori.	431.999	QP	35.3	17.0	8.2	31.6	28.9	46.0	17.1	100	346	
Hori.	463.999	QP	34.8	17.3	8.3	31.6	28.8	46.0	17.2	100	301	
Hori.	495.999	QP	34.0	17.7	8.4	31.6	28.5	46.0	17.5	199	333	
Hori.	559.999	QP	35.2	18.5	8.8	31.7	30.8	46.0	15.2	169	353	
Hori.	4957.000	PK	50.8	31.6	7.7	41.0	49.1	73.9	24.8	100	124	
Hori.	7435.500	PK	47.0	36.7	9.2	41.5	51.4	73.9	22.5	100	358	
Hori.	24785.000	PK	52.9	39.7	-1.6	46.7	44.3	73.9	29.6	100	0	noise floor level
Hori.	4957.000	AV	42.5	31.6	7.7	41.0	40.8	53.9	13.1	100	124	
Hori.	7435.500	AV	35.4	36.7	9.2	41.5	39.8	53.9	14.1	100	358	
Hori.	24785.000	AV	39.4	39.7	-1.6	46.7	30.8	53.9	23.1	100	0	noise floor level
Vert.	63.999	QP	35.1	7.7	7.0	31.9	17.9	40.0	22.1	100	24	
Vert.	527.999	QP	37.9	18.1	8.6	31.7	32.9	46.0	13.1	106	202	
Vert.	559.999	QP	36.8	18.5	8.8	31.7	32.4	46.0	13.6	104	151	
Vert.	591.999	QP	35.9	19.0	8.9	31.6	32.2	46.0	13.8	100	153	
Vert.	623.999	QP	35.5	19.4	9.0	31.6	32.3	46.0	13.7	100	173	
Vert.	4957.000	PK	51.0	31.6	7.7	41.0	49.3	73.9	24.6	100	137	
Vert.	7435.500	PK	48.0	36.7	9.2	41.5	52.4	73.9	21.5	100	358	
Vert.	24785.000	PK	53.0	39.7	-1.6	46.7	44.4	73.9	29.5	100	0	noise floor level
Vert.	4957.000	AV	42.6	31.6	7.7	41.0	40.9	53.9	**13.0**	100	137	
Vert.	7435.500	AV	35.5	36.7	9.2	41.5	39.9	53.9	14.0	100	358	
Vert.	24785.000	AV	39.5	39.7	-1.6	46.7	30.9	53.9	23.0	100	0	noise floor level

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

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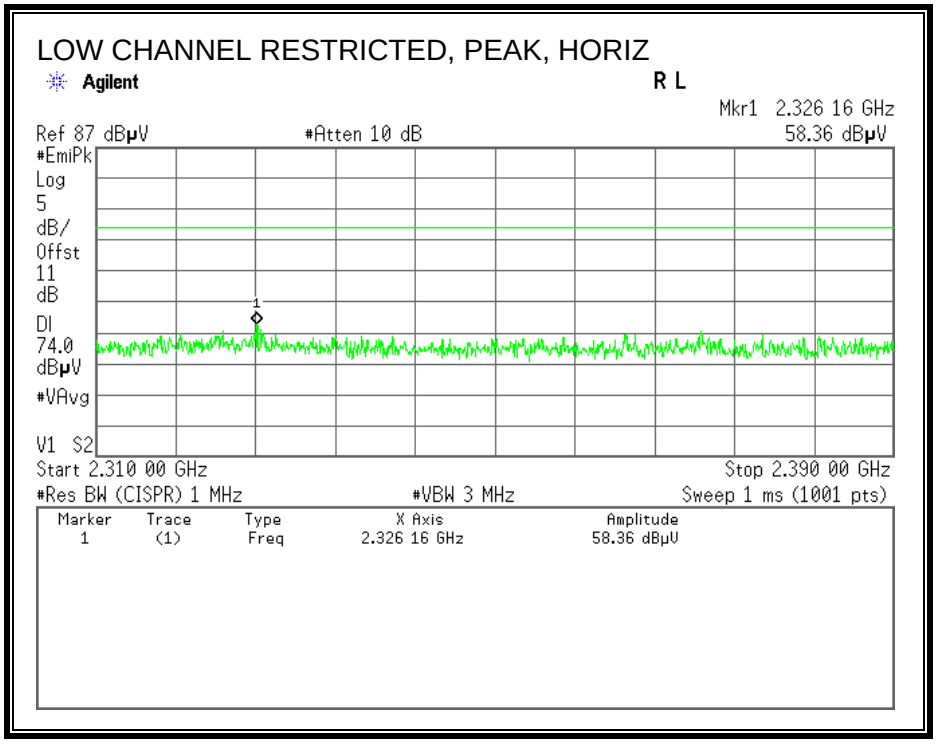
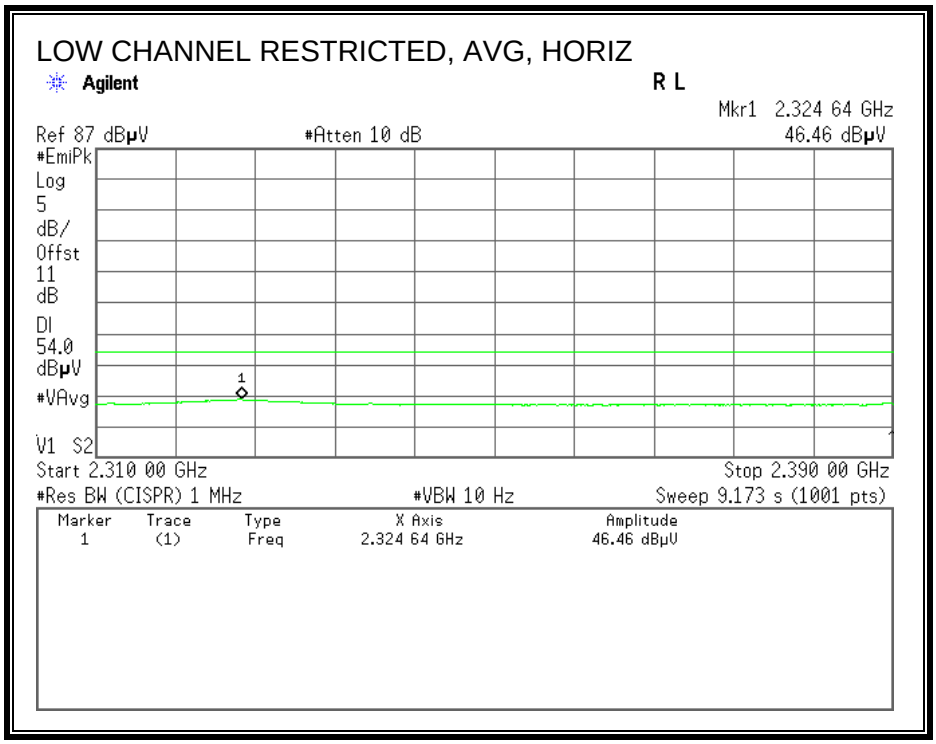
8.2.3. Coaxial antenna

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





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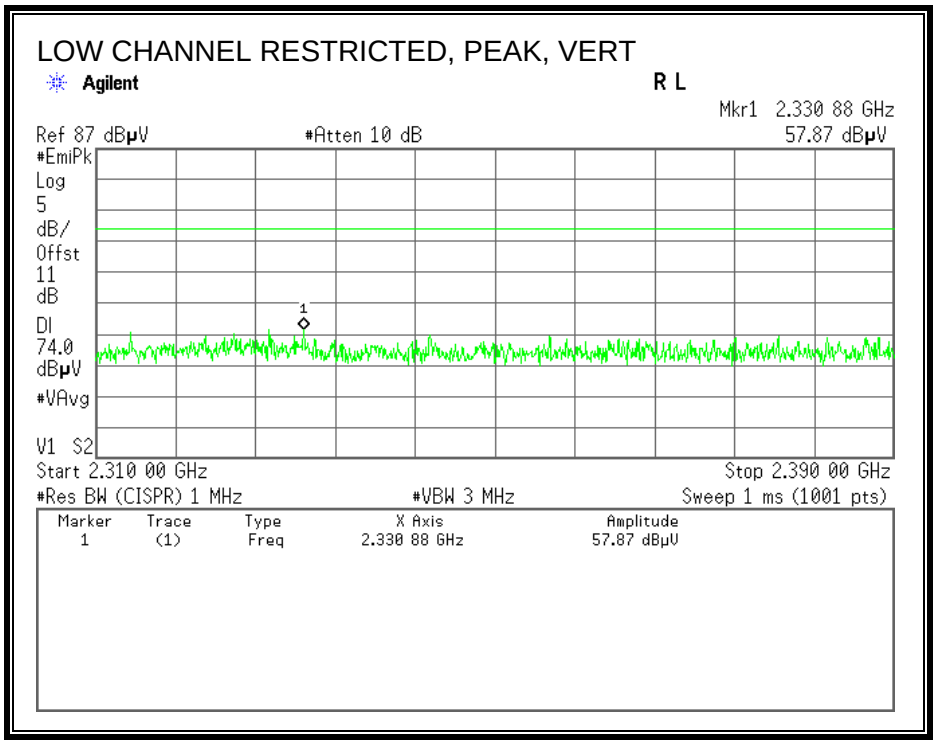
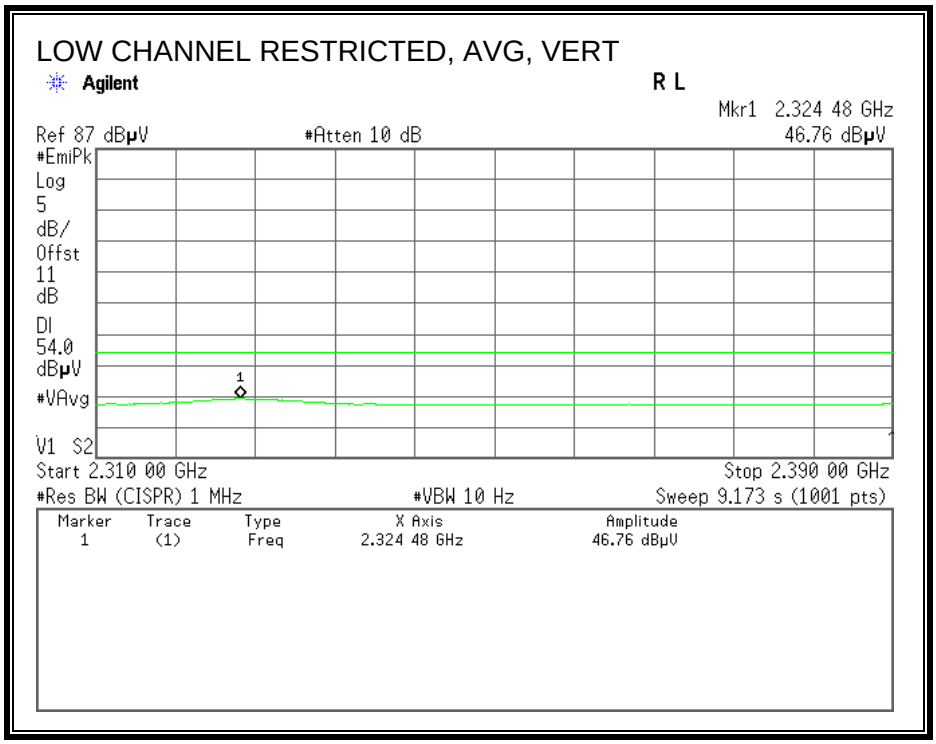
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





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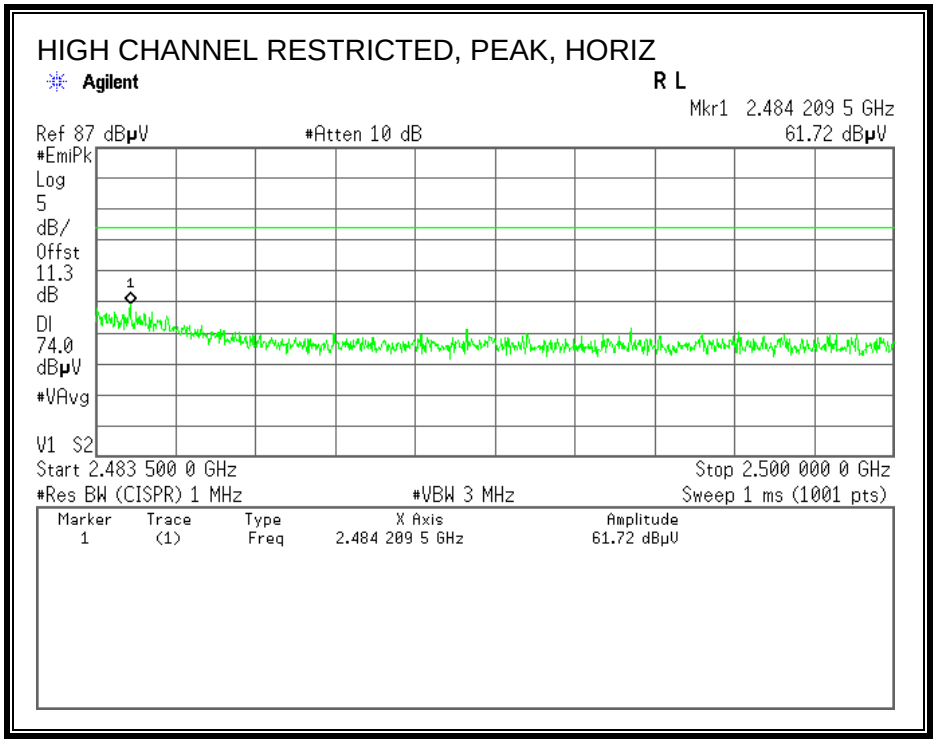
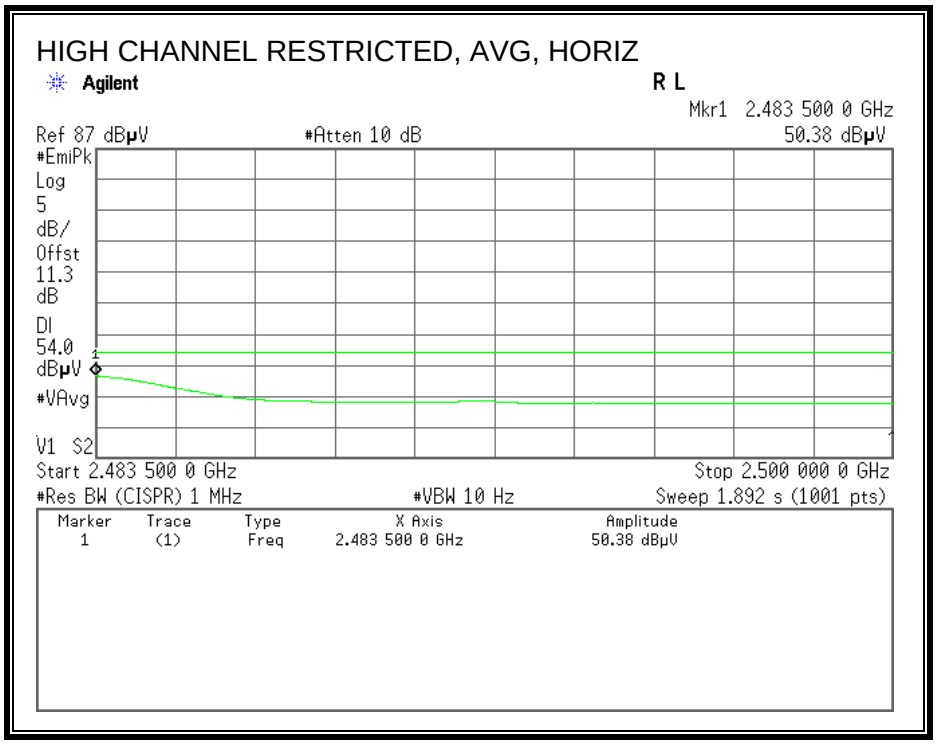
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





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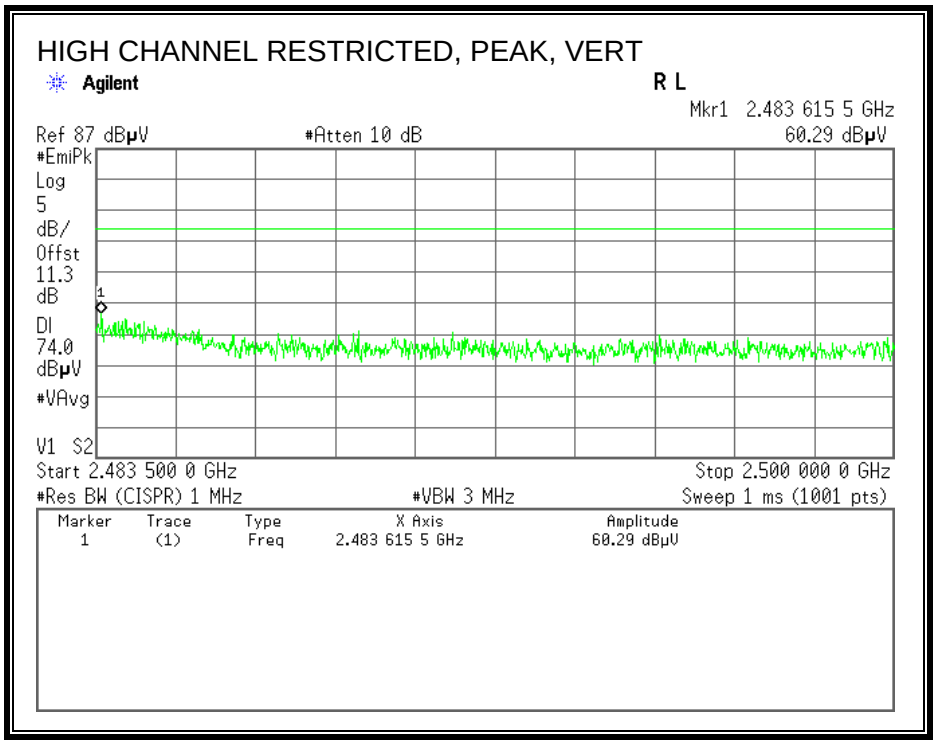
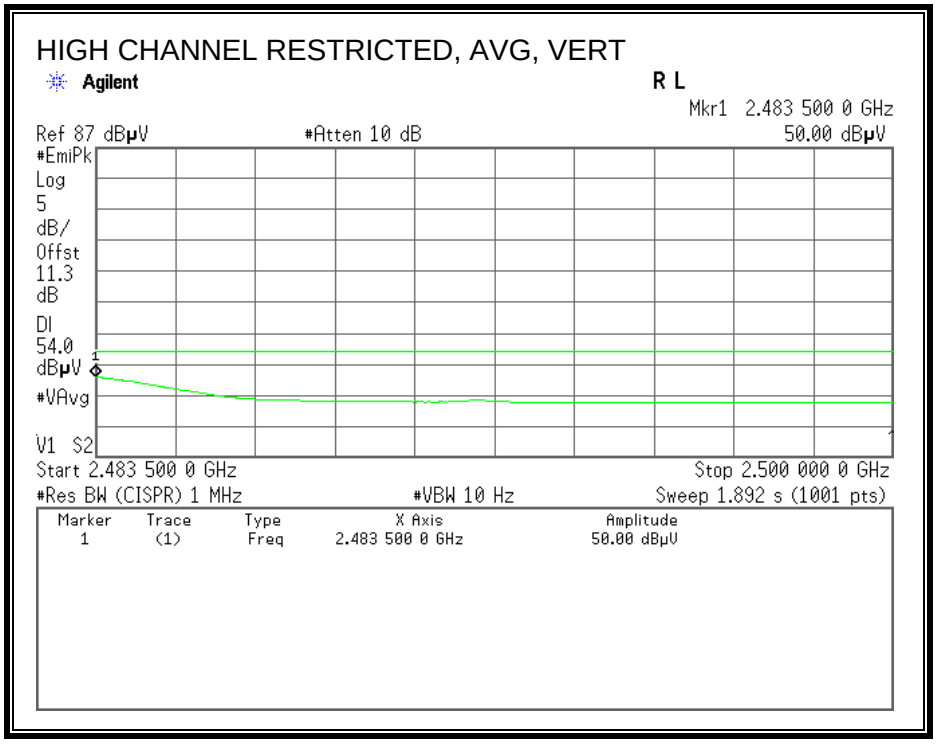
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





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HARMONICS AND SPURIOUS EMISSIONS

Radiated Emission

Test place	No.3 Semi Anechoic Chamber (1G - 15GHz),		No.2 Semi Anechoic Chamber (15G - 26GHz, 30M - 1GHz)
Date	April 19, 2013,	April 22, 2013,	April 23, 2013
Temperature / Humidity	25deg.C / 36%RH,	23deg.C / 27%RH,	23deg.C / 28%RH
Engineer	Tatsuya Arai,	Kenichi Adachi,	Kenichi Adachi
Mode	Tx, 2402.5 MHz		
	with Coaxial antenna		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	144.001	QP	28.5	14.9	8.8	31.8	20.4	43.5	23.1	227	219	
Hori.	431.999	QP	34.4	17.0	8.2	31.6	28.0	46.0	18.0	100	353	
Hori.	559.999	QP	36.3	18.5	8.8	31.7	31.9	46.0	14.1	176	170	
Hori.	591.999	QP	33.8	19.0	8.9	31.6	30.1	46.0	15.9	159	180	
Hori.	623.999	QP	33.1	19.4	9.0	31.6	29.9	46.0	16.1	153	177	
Hori.	687.999	QP	33.0	20.4	9.3	31.6	31.1	46.0	14.9	132	184	
Hori.	4805.000	PK	54.6	31.1	7.6	41.2	52.1	73.9	21.8	100	133	
Hori.	7207.500	PK	48.8	36.6	9.1	41.4	53.1	73.9	20.8	100	357	
Hori.	24025.000	PK	51.6	39.8	-1.9	46.5	43.0	73.9	30.9	100	0	noise floor level
Hori.	4805.000	AV	48.2	31.1	7.6	41.2	45.7	53.9	**8.2**	100	133	
Hori.	7207.500	AV	36.5	36.6	9.1	41.4	40.8	53.9	13.1	100	357	
Hori.	24025.000	AV	38.6	39.8	-1.9	46.5	30.0	53.9	23.9	100	0	noise floor level
Vert.	63.999	QP	33.9	7.7	7.0	31.9	16.7	40.0	23.3	100	4	
Vert.	463.999	QP	36.2	17.3	8.3	31.6	30.2	46.0	15.8	118	223	
Vert.	495.999	QP	36.7	17.7	8.4	31.6	31.2	46.0	14.8	112	63	
Vert.	527.999	QP	37.3	18.1	8.6	31.7	32.3	46.0	13.7	100	46	
Vert.	559.999	QP	35.5	18.5	8.8	31.7	31.1	46.0	14.9	100	157	
Vert.	591.999	QP	34.5	19.0	8.9	31.6	30.8	46.0	15.2	100	167	
Vert.	4805.000	PK	53.2	31.1	7.6	41.2	50.7	73.9	23.2	100	133	
Vert.	7207.500	PK	48.1	36.6	9.1	41.4	52.4	73.9	21.5	100	358	
Vert.	24025.000	PK	51.7	39.8	-1.9	46.5	43.1	73.9	30.8	100	0	noise floor level
Vert.	4805.000	AV	46.0	31.1	7.6	41.2	43.5	53.9	10.4	100	133	
Vert.	7207.500	AV	36.7	36.6	9.1	41.4	41.0	53.9	12.9	100	358	
Vert.	24025.000	AV	38.7	39.8	-1.9	46.5	30.1	53.9	23.8	100	0	noise floor level

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB
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20dBc Data Sheet **(RBW 100kHz, VBW 300kHz)**

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2402.500	PK	90.7	27.4	25.0	41.4	101.7	-	-	100	208	Carrier
Hori.	2400.000	PK	45.5	27.4	25.0	41.4	56.5	81.7	25.2	100	208	
Vert.	2402.500	PK	90.2	27.4	25.0	41.4	101.2	-	-	117	233	Carrier
Vert.	2400.000	PK	45.3	27.4	25.0	41.4	56.3	81.2	24.9	117	233	

Result = Reading + Ant.Fac. + Loss(Cable+Attenuator+Filter) - Gain(Amplifier)

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Radiated Emission

Test place	No.3 Semi Anechoic Chamber (1G - 15GHz),		No.2 Semi Anechoic Chamber (15G - 26GHz, 30M - 1GHz)
Date	April 19, 2013,	April 22, 2013,	April 23, 2013
Temperature / Humidity	25deg.C / 36%RH,	23deg.C / 27%RH,	23deg.C / 28%RH
Engineer	Tatsuya Arai,	Kenichi Adachi,	Kenichi Adachi
Mode	Tx, 2440.5 MHz		
	with Coaxial antenna		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	144.000	QP	28.3	14.9	8.8	31.8	20.2	43.5	23.3	225	224	
Hori.	431.999	QP	34.2	17.0	8.2	31.6	27.8	46.0	18.2	100	355	
Hori.	559.999	QP	36.2	18.5	8.8	31.7	31.8	46.0	14.2	174	172	
Hori.	591.999	QP	33.7	19.0	8.9	31.6	30.0	46.0	16.0	162	182	
Hori.	623.999	QP	33.0	19.4	9.0	31.6	29.8	46.0	16.2	154	175	
Hori.	687.999	QP	32.6	20.4	9.3	31.6	30.7	46.0	15.3	151	179	
Hori.	4881.000	PK	52.8	31.3	7.7	41.1	50.7	73.9	23.2	100	130	
Hori.	7321.500	PK	47.1	36.6	9.2	41.4	51.5	73.9	22.4	100	357	
Hori.	24405.000	PK	52.1	39.7	-1.8	46.7	43.3	73.9	30.6	100	0	noise floor level
Hori.	4881.000	AV	45.1	31.3	7.7	41.1	43.0	53.9	**10.9**	100	130	
Hori.	7321.500	AV	35.9	36.6	9.2	41.4	40.3	53.9	13.6	100	357	
Hori.	24405.000	AV	39.2	39.7	-1.8	46.7	30.4	53.9	23.5	100	0	noise floor level
Vert.	63.999	QP	33.8	7.7	7.0	31.9	16.6	40.0	23.4	100	358	
Vert.	463.999	QP	36.0	17.3	8.3	31.6	30.0	46.0	16.0	116	226	
Vert.	495.999	QP	36.6	17.7	8.4	31.6	31.1	46.0	14.9	111	65	
Vert.	527.999	QP	37.2	18.1	8.6	31.7	32.2	46.0	13.8	100	44	
Vert.	559.999	QP	35.3	18.5	8.8	31.7	30.9	46.0	15.1	100	159	
Vert.	591.999	QP	34.3	19.0	8.9	31.6	30.6	46.0	15.4	100	165	
Vert.	4881.000	PK	51.2	31.3	7.7	41.1	49.1	73.9	24.8	100	135	
Vert.	7321.500	PK	47.3	36.6	9.2	41.4	51.7	73.9	22.2	100	358	
Vert.	24405.000	PK	52.0	39.7	-1.8	46.7	43.2	73.9	30.7	100	0	noise floor level
Vert.	4881.000	AV	42.5	31.3	7.7	41.1	40.4	53.9	13.5	100	135	
Vert.	7321.500	AV	36.0	36.6	9.2	41.4	40.4	53.9	13.5	100	358	
Vert.	24405.000	AV	39.1	39.7	-1.8	46.7	30.3	53.9	23.6	100	0	noise floor level

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

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Radiated Emission

Test place	No.3 Semi Anechoic Chamber (1G - 15GHz),		No.2 Semi Anechoic Chamber (15G - 26GHz, 30M - 1GHz)
Date	April 19, 2013,	April 22, 2013,	April 23, 2013
Temperature / Humidity	25deg.C / 36%RH,	23deg.C / 27%RH,	23deg.C / 28%RH
Engineer	Tatsuya Arai,	Kenichi Adachi,	Kenichi Adachi
Mode	Tx, 2478.5 MHz		
	with Coaxial antenna		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	144.001	QP	28.4	14.9	8.8	31.8	20.3	43.5	23.2	229	222	
Hori.	431.999	QP	34.2	17.0	8.2	31.6	27.8	46.0	18.2	100	351	
Hori.	559.999	QP	36.1	18.5	8.8	31.7	31.7	46.0	14.3	172	168	
Hori.	591.999	QP	33.6	19.0	8.9	31.6	29.9	46.0	16.1	157	178	
Hori.	623.999	QP	33.0	19.4	9.0	31.6	29.8	46.0	16.2	153	173	
Hori.	687.999	QP	32.7	20.4	9.3	31.6	30.8	46.0	15.2	136	186	
Hori.	4957.000	PK	48.1	31.6	7.7	41.0	46.4	73.9	27.5	100	85	
Hori.	7435.500	PK	46.5	36.7	9.2	41.5	50.9	73.9	23.0	100	359	
Hori.	24785.000	PK	53.0	39.7	-1.6	46.7	44.4	73.9	29.5	100	0	noise floor level
Hori.	4957.000	AV	37.3	31.6	7.7	41.0	35.6	53.9	18.3	100	85	
Hori.	7435.500	AV	35.5	36.7	9.2	41.5	39.9	53.9	14.0	100	359	
Hori.	24785.000	AV	39.4	39.7	-1.6	46.7	30.8	53.9	23.1	100	0	noise floor level
Vert.	63.999	QP	33.8	7.7	7.0	31.9	16.6	40.0	23.4	100	6	
Vert.	463.999	QP	36.1	17.3	8.3	31.6	30.1	46.0	15.9	115	231	
Vert.	495.999	QP	36.5	17.7	8.4	31.6	31.0	46.0	15.0	110	59	
Vert.	527.999	QP	37.1	18.1	8.6	31.7	32.1	46.0	**13.9**	100	45	
Vert.	559.999	QP	35.4	18.5	8.8	31.7	31.0	46.0	15.0	100	162	
Vert.	591.999	QP	34.4	19.0	8.9	31.6	30.7	46.0	15.3	100	169	
Vert.	4957.000	PK	48.2	31.6	7.7	41.0	46.5	73.9	27.4	100	134	
Vert.	7435.500	PK	46.1	36.7	9.2	41.5	50.5	73.9	23.4	100	358	
Vert.	24785.000	PK	52.9	39.7	-1.6	46.7	44.3	73.9	29.6	100	0	noise floor level
Vert.	4957.000	AV	38.2	31.6	7.7	41.0	36.5	53.9	17.4	100	134	
Vert.	7435.500	AV	35.4	36.7	9.2	41.5	39.8	53.9	14.1	100	358	
Vert.	24785.000	AV	39.4	39.7	-1.6	46.7	30.8	53.9	23.1	100	0	noise floor level

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

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8.3. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

ANSI C63.4

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RESULTS

Sleeve antenna

DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2013/04/24

Company	: Circuit Design, Inc.	Mode	: Transmitting 2402.5MHz
Kind of EUT	: 2.4 GHz DSSS low power radio transceiv	Order No.	: 33IE0022-SH
Model No.	: STD-502-R	Power	: DC 5V (DC supply: AC120V/60Hz)
Serial No.	: S0000003	Temp./Humi.	: 24deg.C. / 42%RH
Remarks	: (Sleeve antenna)		

Limit1 : FCC 15C(15.207) QP
Limit2 : FCC 15C(15.207) AV

Engineer : Kenichi Adachi

<< QP/AV DATA >>

No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	21.0	-5.6	12.6	33.6	7.0	66.0	56.0	32.4	49.0	N	
2	0.28136	17.4	-5.9	12.6	30.0	6.7	60.7	50.7	30.7	44.0	N	
3	0.50001	12.9	-9.6	12.6	25.5	3.0	56.0	46.0	30.5	43.0	N	
4	1.83475	0.8	-13.2	12.8	13.6	-0.4	56.0	46.0	42.4	46.4	N	
5	7.66503	-9.3	-14.0	13.2	3.9	-0.8	60.0	50.0	56.1	50.8	N	
6	19.66351	5.9	3.0	14.2	20.1	17.2	60.0	50.0	39.9	32.8	N	
7	0.15000	20.8	-5.7	12.6	33.4	6.9	66.0	56.0	32.6	49.1	L1	
8	0.28136	17.5	-6.3	12.6	30.1	6.3	60.7	50.7	30.6	44.4	L1	
9	0.50001	12.8	-9.9	12.6	25.4	2.7	56.0	46.0	30.6	43.3	L1	
10	1.83475	1.1	-13.1	12.8	13.9	-0.3	56.0	46.0	42.1	46.3	L1	
11	7.66503	-9.7	-14.0	13.2	3.5	-0.8	60.0	50.0	56.5	50.8	L1	
12	19.66351	1.9	-1.0	14.2	16.1	13.2	60.0	50.0	43.9	36.8	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN:SLS-03

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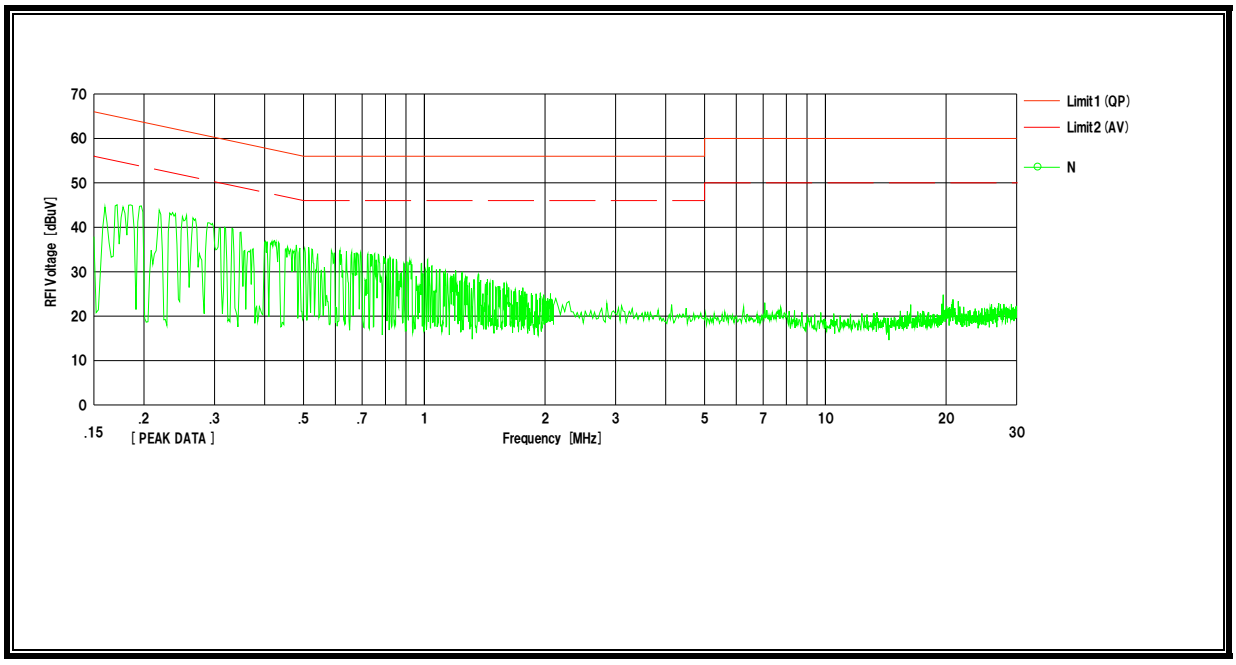
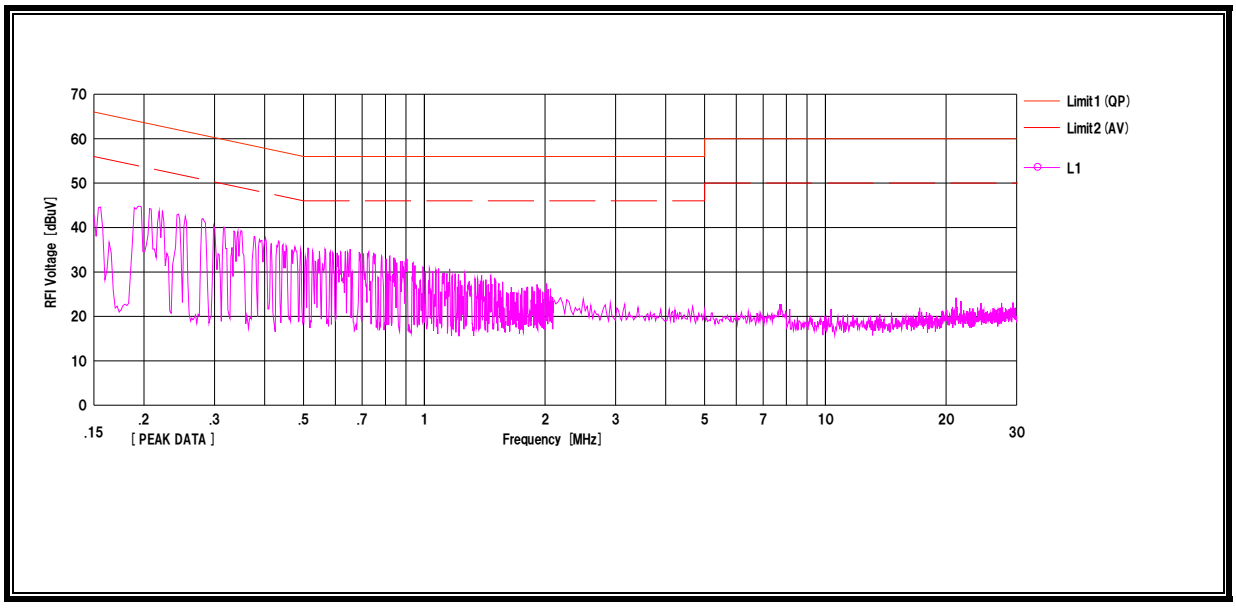
LINE 1 RESULTS

Sleeve antenna



LINE 2 RESULTS

Sleeve antenna



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RESULTS

Loop PCB antenna

DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2013/04/24

Company	: Circuit Design, Inc.	Mode	: Transmitting 2402.5MHz
Kind of EUT	: 2.4 GHz DSSS low power radio transceiv	Order No.	: 33IE0022-SH
Model No.	: STD-502-R	Power	: DC 5V (DC supply: AC120V/60Hz)
Serial No.	: S0000003	Temp./Humi.	: 24deg.C. / 42%RH
Remarks	: (Loop antenna)		

Limit1 : FCC 15C(15.207) QP
Limit2 : FCC 15C(15.207) AV

Engineer : Kenichi Adachi

<< QP/AV DATA >>

No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	21.1	-5.5	12.6	33.7	7.1	66.0	56.0	32.3	48.9	N	
2	0.28145	17.5	-5.8	12.6	30.1	6.8	60.7	50.7	30.6	43.9	N	
3	0.50001	12.9	-9.5	12.6	25.5	3.1	56.0	46.0	30.5	42.9	N	
4	1.83488	0.9	-13.9	12.8	13.7	-1.1	56.0	46.0	42.3	47.1	N	
5	7.66511	-9.2	-13.9	13.2	4.0	-0.7	60.0	50.0	56.0	50.7	N	
6	19.66338	9.9	7.1	14.2	24.1	21.3	60.0	50.0	35.9	28.7	N	
7	0.15000	20.9	-5.6	12.6	33.5	7.0	66.0	56.0	32.5	49.0	L1	
8	0.28145	17.6	-6.2	12.6	30.2	6.4	60.7	50.7	30.5	44.3	L1	
9	0.50001	12.9	-9.7	12.6	25.5	2.9	56.0	46.0	30.5	43.1	L1	
10	1.83488	1.2	-13.0	12.8	14.0	-0.2	56.0	46.0	42.0	46.2	L1	
11	7.66511	-9.6	-13.9	13.2	3.6	-0.7	60.0	50.0	56.4	50.7	L1	
12	19.66338	5.8	3.0	14.2	20.0	17.2	60.0	50.0	40.0	32.8	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN:SLS-03

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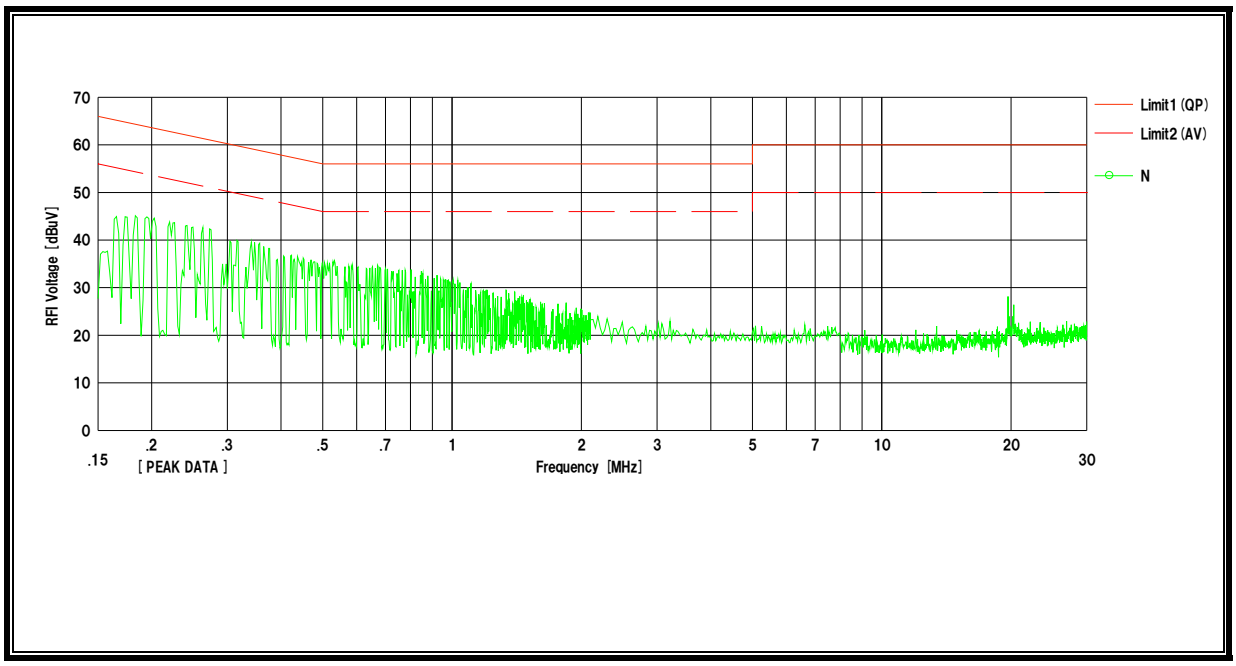
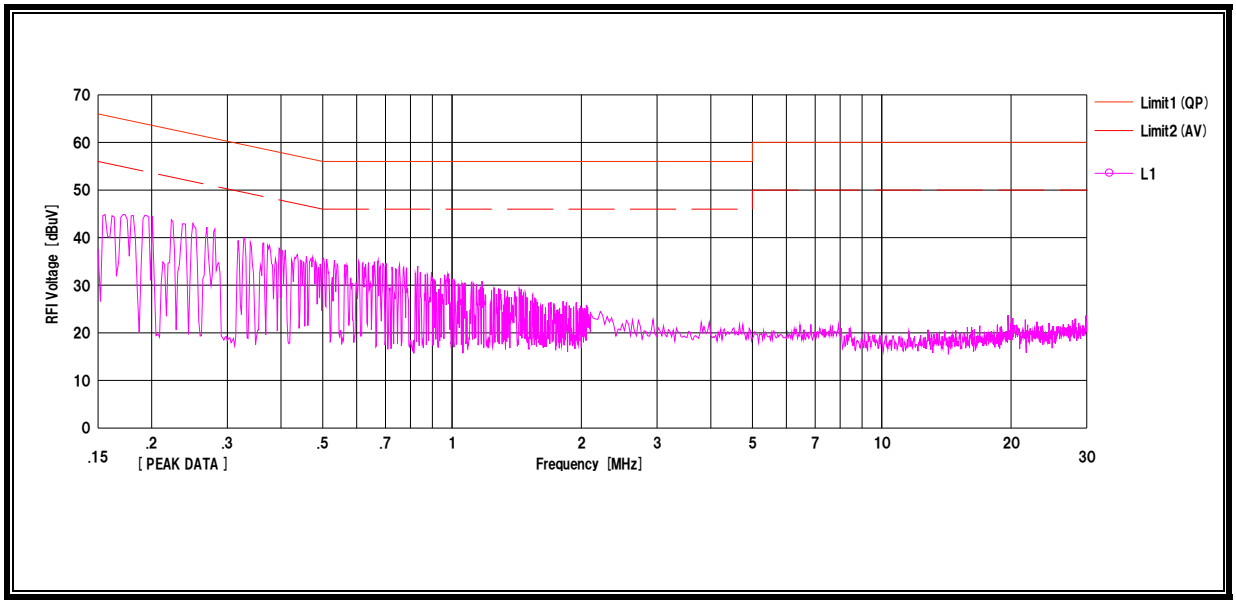
LINE 1 RESULTS

Loop PCB antenna



LINE 2 RESULTS

Loop PCB antenna



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RESULTS

Coaxial antenna

DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2013/04/24

Company	: Circuit Design, Inc.	Mode	: Transmitting 2402.5MHz
Kind of EUT	: 2.4 GHz DSSS low power radio transceiv	Order No.	: 33IE0022-SH
Model No.	: STD-502-R	Power	: DC 5V (DC supply: AC120V/60Hz)
Serial No.	: S0000003	Temp./Humi.	: 24deg.C. / 42%RH
Remarks	: (Coaxial antenna)		

Limit1 : FCC 15C(15.207) QP
Limit2 : FCC 15C(15.207) AV

Engineer : Kenichi Adachi

<< QP/AV DATA >>

No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	20.9	-5.7	12.6	33.5	6.9	66.0	56.0	32.5	49.1	N	
2	0.28168	17.3	-6.0	12.6	29.9	6.6	60.7	50.7	30.8	44.1	N	
3	0.50001	12.8	-9.7	12.6	25.4	2.9	56.0	46.0	30.6	43.1	N	
4	1.83528	0.8	-13.3	12.8	13.6	-0.5	56.0	46.0	42.4	46.5	N	
5	7.66489	-9.4	-14.1	13.2	3.8	-0.9	60.0	50.0	56.2	50.9	N	
6	19.66349	5.8	2.9	14.2	20.0	17.1	60.0	50.0	40.0	32.9	N	
7	0.15000	20.8	-5.8	12.6	33.4	6.8	66.0	56.0	32.6	49.2	L1	
8	0.28168	17.4	-6.4	12.6	30.0	6.2	60.7	50.7	30.7	44.5	L1	
9	0.50001	12.7	-9.9	12.6	25.3	2.7	56.0	46.0	30.7	43.3	L1	
10	1.83528	1.0	-13.1	12.8	13.8	-0.3	56.0	46.0	42.2	46.3	L1	
11	7.66489	-9.6	-14.0	13.2	3.6	-0.8	60.0	50.0	56.4	50.8	L1	
12	19.66349	2.0	-0.9	14.2	16.2	13.3	60.0	50.0	43.8	36.7	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN:SLS-03

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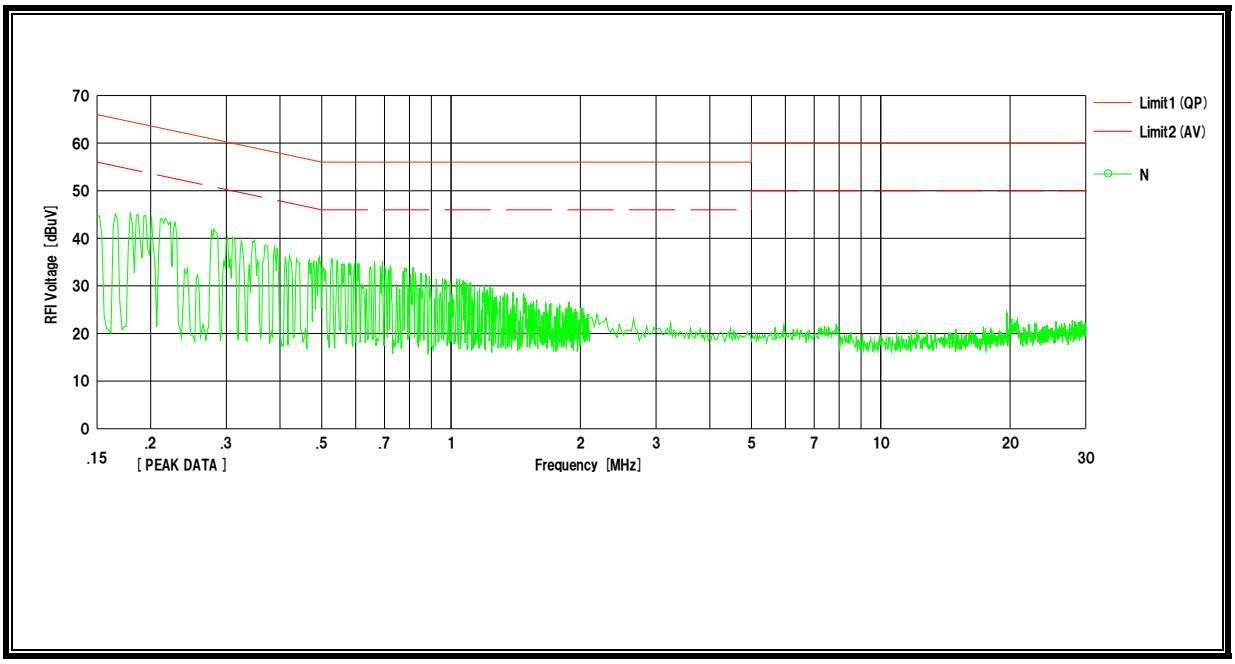
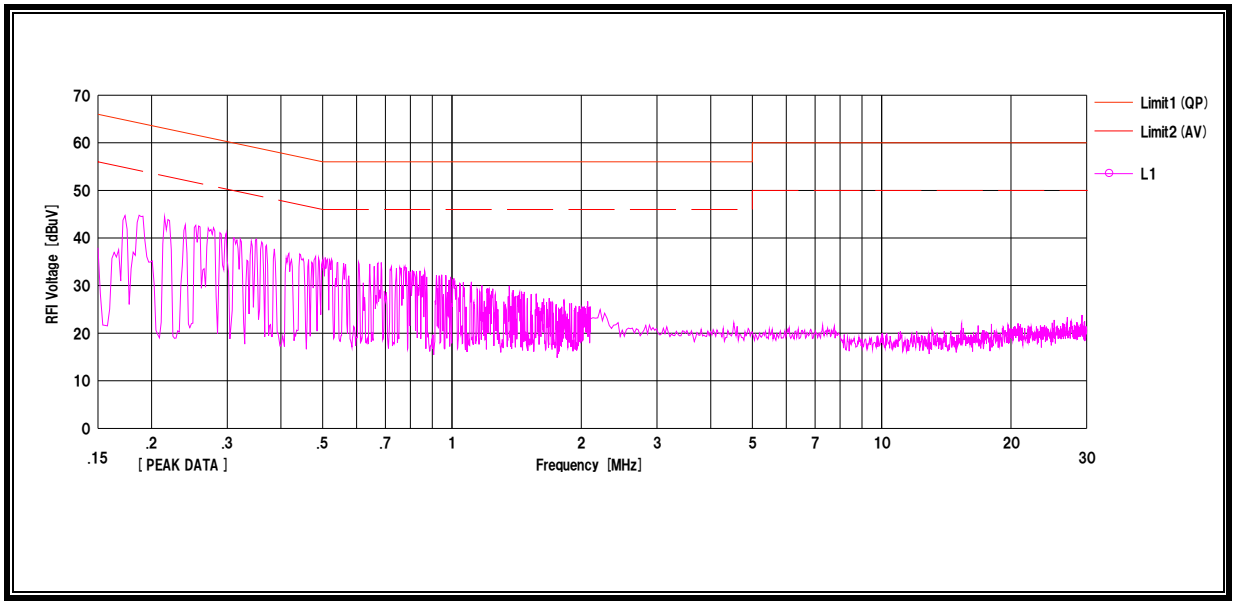
LINE 1 RESULTS

Coaxial antenna



LINE 2 RESULTS

Coaxial antenna



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