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TEST REPORT For FCC

Test Report No.	:	2011120035
Date of Issue	:	December 12, 2011
FCC ID	:	A5R-EMU11A
Model/Type No.	:	Wi-GEM
Kind of Product	:	Energy Meter Unit
Applicant	:	KEPID AMSTECH CO., LTD.
Applicant Address	:	SK VENTIUM, 522 DANGJEONG-DONG, GUNPO-SHI, GYEONGGI-DO, KOREA
Manufacturer	:	KEPID AMSTECH CO., LTD.
Manufacturer Address	:	SK VENTIUM, 522 DANGJEONG-DONG, GUNPO-SHI, GYEONGGI-DO, KOREA
Contact Person	:	BYUNG JUN NA / Member
Telephone	:	+82-31-466-0386
Received Date	:	December 5, 2011
Test period	:	Start : December 5, 2011 End : December 9, 2011
Test Results	:	☒ In Compliance ☐ Not in Compliance

The test results presented in this report relate only to the object tested.

Tested by

Y. T. Lee

Young-taek Lee
Test Engineer
Date: December 12, 2011

Reviewed by

Y. J. Park

Young-Joon, Park
Technical Manager
Date: December 12, 2011

REPORT REVISION HISTORY

Date	Revision	Page No
December 12, 2011	Issued (2011120035)	All

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1.0 General Product Description

Equipment model name	: Wi-GEM
Serial number	: Prototype
EUT condition	: Pre-production, not damaged
Antenna type	: Chip antenna Gain 2.26 dBi
Frequency Range	: 2405 MHz – 2480 MHz (DSSS)
RF output power	: 13.585 dBm Peak Conducted
Number of channels	: 16
Type of Modulation	: OQPSK
Rated Channel spacing	: 5 MHz
Power Source	: AC 57 - 277 V

1.1 Tested Frequency

	LOW	MID	HIGH
Frequency (MHz)	2405	2445	2480

1.2 Model Differences

Not applicable

1.3 Device Modifications

The following modifications were necessary for compliance:

Not applicable

1.4 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.	FCC ID or DoC
-	-	-	-	-

1.5 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

1.6 Test Facility

The measurement facility is located at 386-1, Ho-dong, Cheoin-gu, Yongin-si, Gyeonggi-do, 449-100, Korea. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

1.7 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Logo
USA	**FCC**	3 & 10 meter Open Area Test Sites and one conducted site to perform FCC Part 15/18 measurements.	805871
JAPAN	**VCCI**	10 meter Open Area Test Site and one conducted site.	R-948, C-986, T-1843
KOREA	**KCC**	EMI (10 meter Open Area Test Site and two conducted sites) EMS (ESD, RS, EFT/Burst, Surge, CS, Magnetic, Dips and interruptions)	No. 51, KR0025
International	**KOLAS**	EMC	

2.0 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	6 dB Bandwidth	> 500 kHz	Conducted	C
15.247(b)	Maximum Output Power	< 1 Watt		C
15.247(d)	Conducted Spurious emission	> 20 dBc		C
15.247(d)	Band Edge	> 20 dBc		C
15.247(e)	Transmitter Power Spectral Density	< 8 dBm @ 3 kHz		C
				C
15.209	Field Strength of Harmonics	15.209(a)	Radiated	C
15.207	AC Conducted Emissions	15.207(a)	Line Conducted	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

The sample was tested according to the following specification:
- FCC Part 15.247, ANSI C63.4-2003

2.1 Technical Characteristic Test

2.1.1 6dB Bandwidth

Procedure:

The bandwidth at 6dB below the highest in-band spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate frequencies.

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 6dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 6 dB bandwidth of the emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

VBW = 100 kHz (VBW ≥ RBW)

Trace = Max hold

Span = 10 MHz

Sweep = auto

Detector function = peak

Measurement Data:

Test mode : Continuous modulated carrier

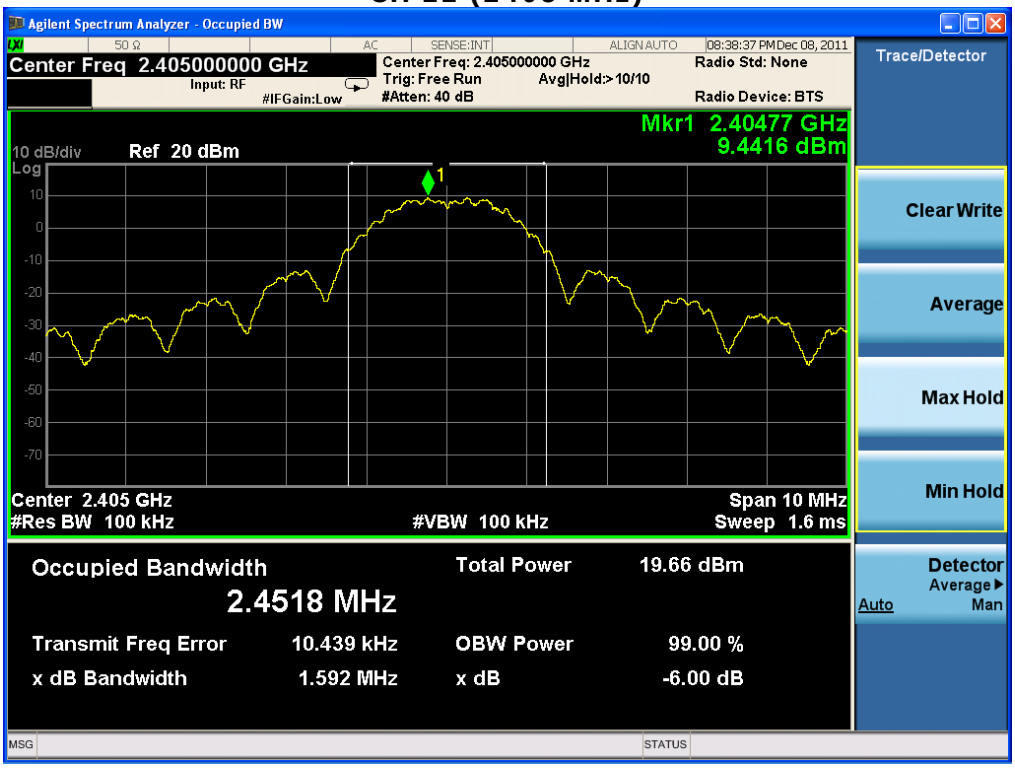
Frequency (MHz)	Channel No.	Test Results	
		Measured Bandwidth (MHz)	Result
2405	11	1.592	Complies
2445	19	1.596	Complies
2480	26	1.606	Complies

Minimum Standard:

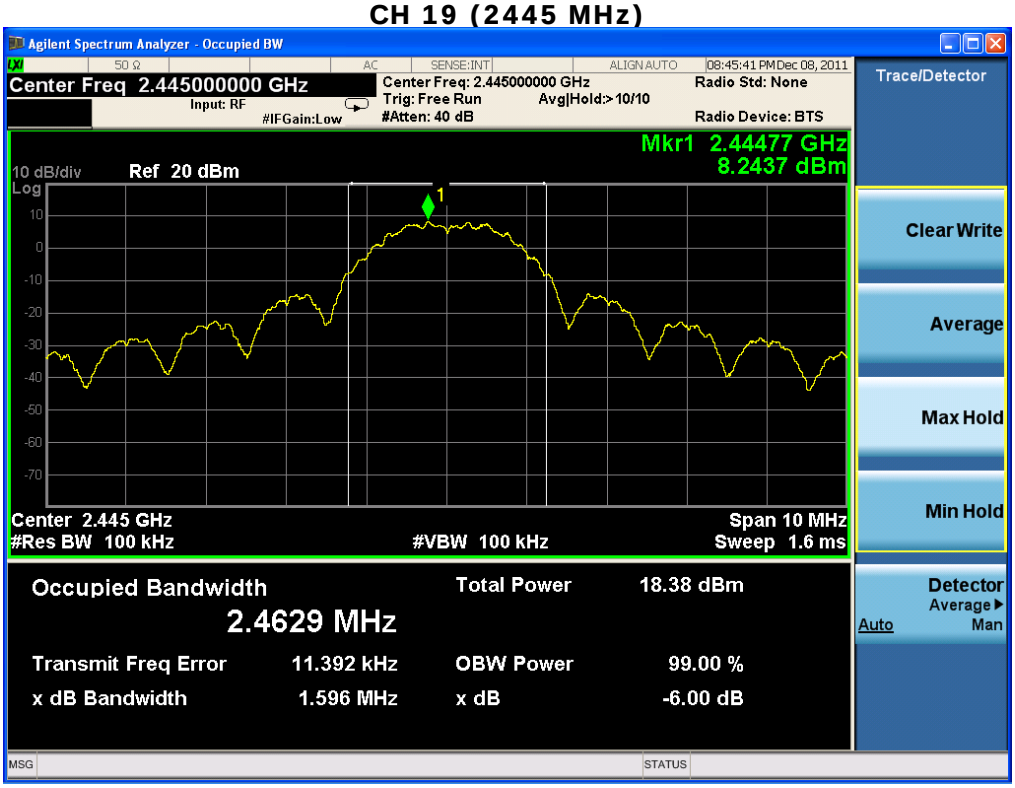
6 dB Bandwidth > 500kHz

See next pages for actual measured spectrum plots.

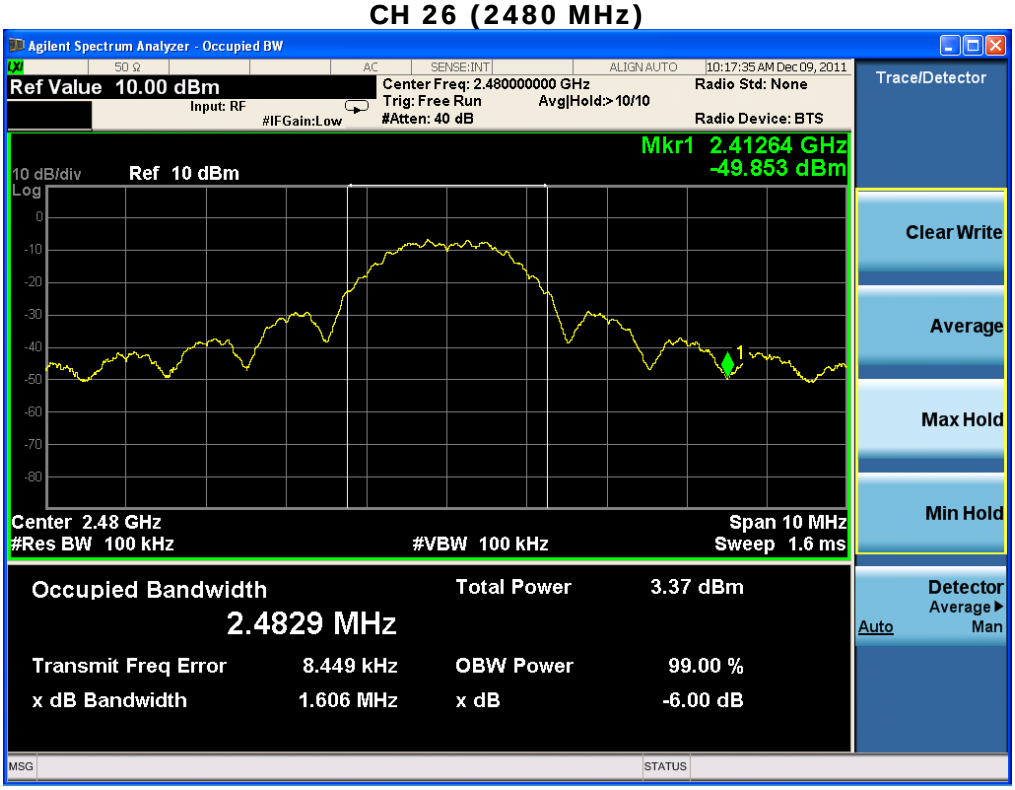
CH 11 (2405 MHz)



CH 19 (2445 MHz)



CH 26 (2480 MHz)



2.1.2 Maximum peak Conducted Output Power

Test Location

RF Test Room

Test Procedures

- Conducted measurement with peak detector, detection of maximum values via "Max Hold" function
- Test at mains power supply via external power supply
- Measurement at the channels 11, 19 and 26

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 1 MHz

VBW = 1 MHz (VBW ≥ RBW)

Trace = Max hold

Span = 20 MHz

Sweep = auto

Detector function = peak

Limit

< 1 W

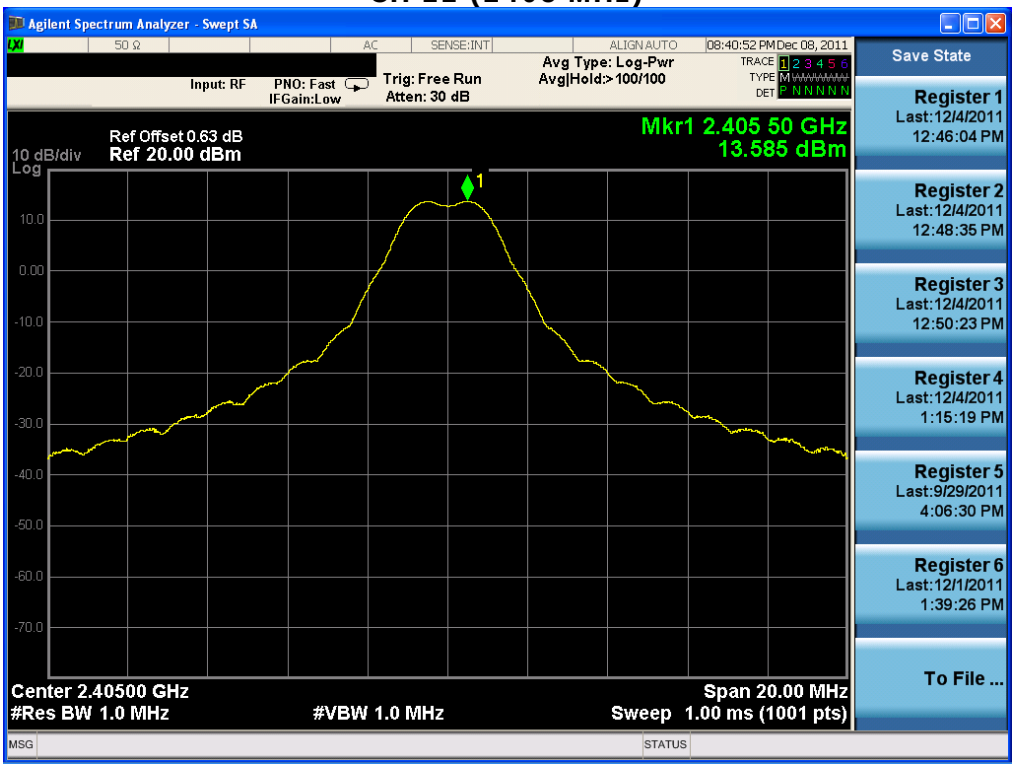
Test Results

Test mode : Continuous modulated carrier

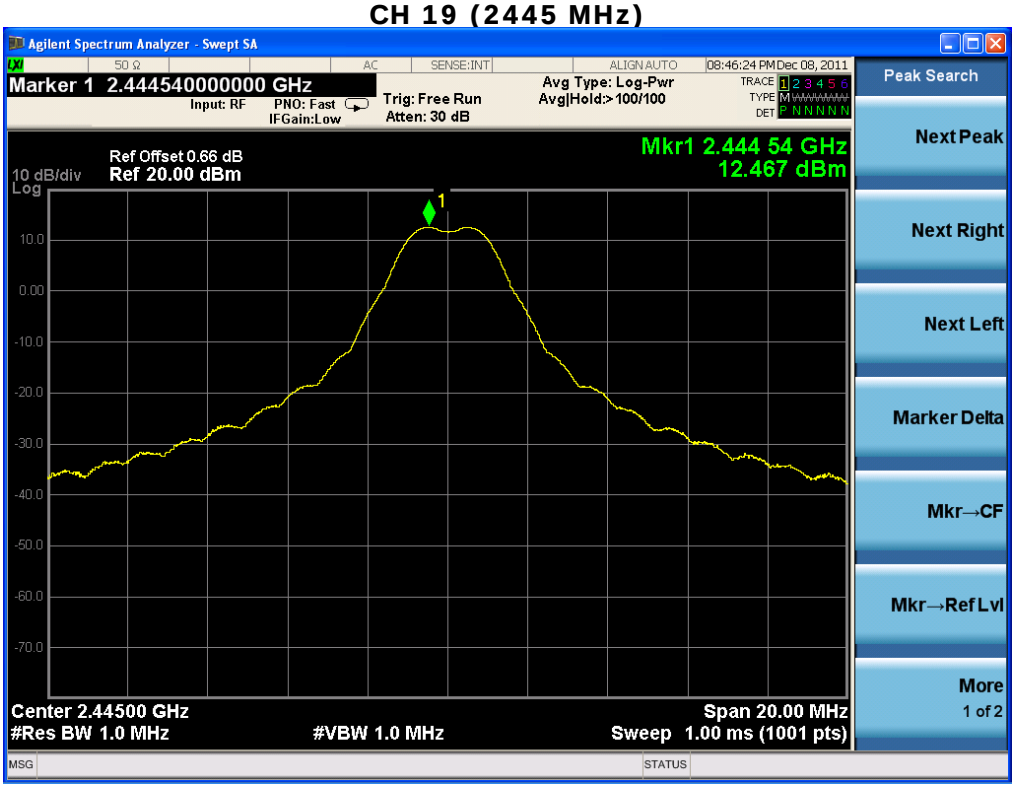
Frequency (MHz)	Channel No.	Peak output power(dBm)	Limit	Result
2405	11	13.585	30dBm	Complies
2445	19	12.467	30dBm	Complies
2480	26	-2.336	30dBm	Complies

See next pages for actual measured spectrum plots.

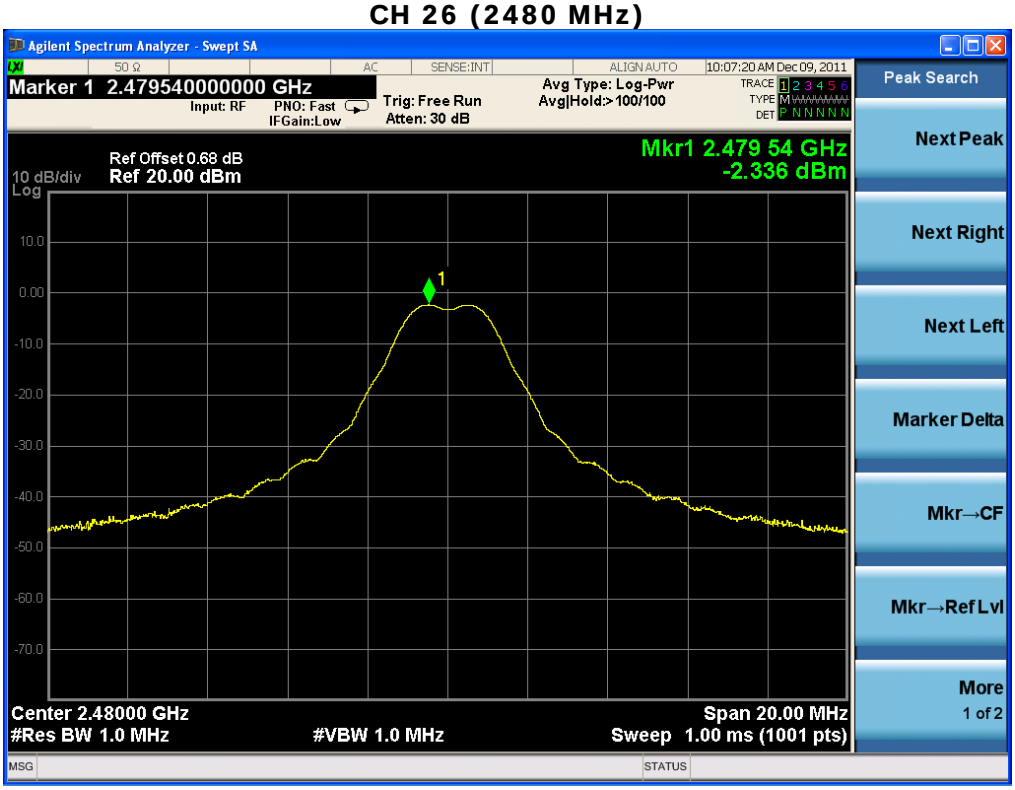
CH 11 (2405 MHz)



CH 19 (2445 MHz)



CH 26 (2480 MHz)



2.1.3 Power Spectral Density

Procedure:

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The spectrum analyzer is set to:

RBW = 3 kHz	VBW = (VBW ≥ RBW)
Sweep = 100 s (Span/3 kHz)	Span = 300 kHz
Detector function = peak	Trace = Max hold

Test mode : Continuous modulated carrier

Frequency (MHz)	Ch.	Test Results	
		dBm	Result
2405	11	-1.144	Complies
2445	19	-2.114	Complies
2480	26	-17.469	Complies

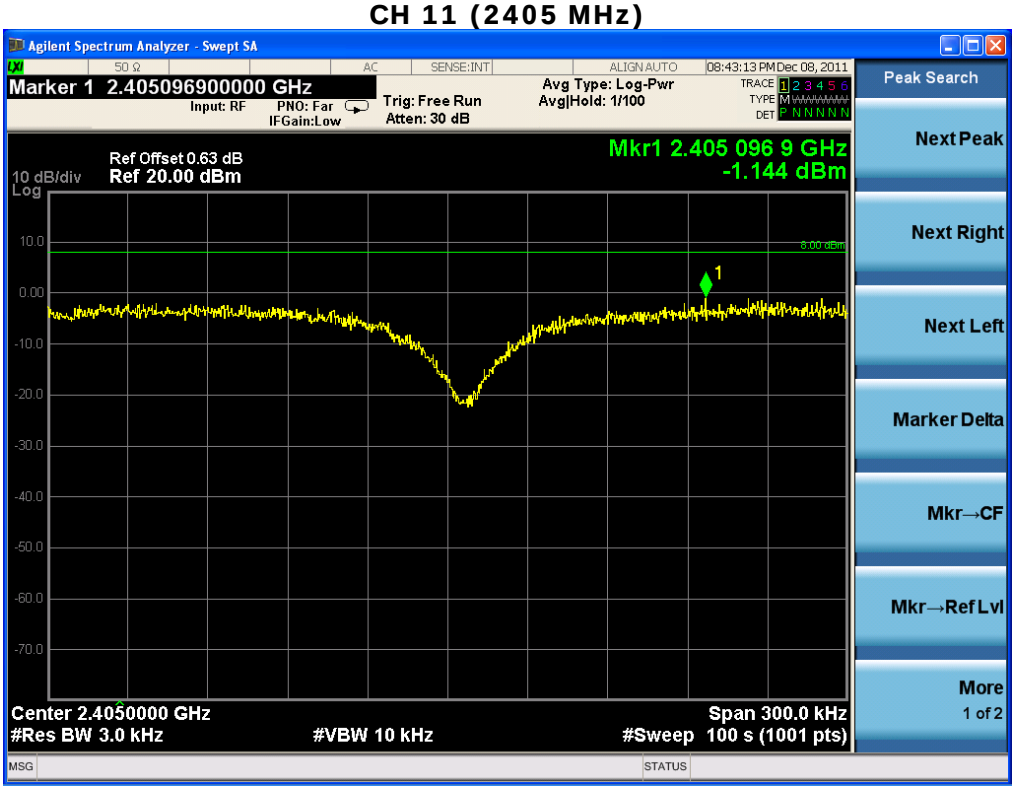
Minimum Standard:

Power Spectral Density	< 8dBm @ 3 kHz BW

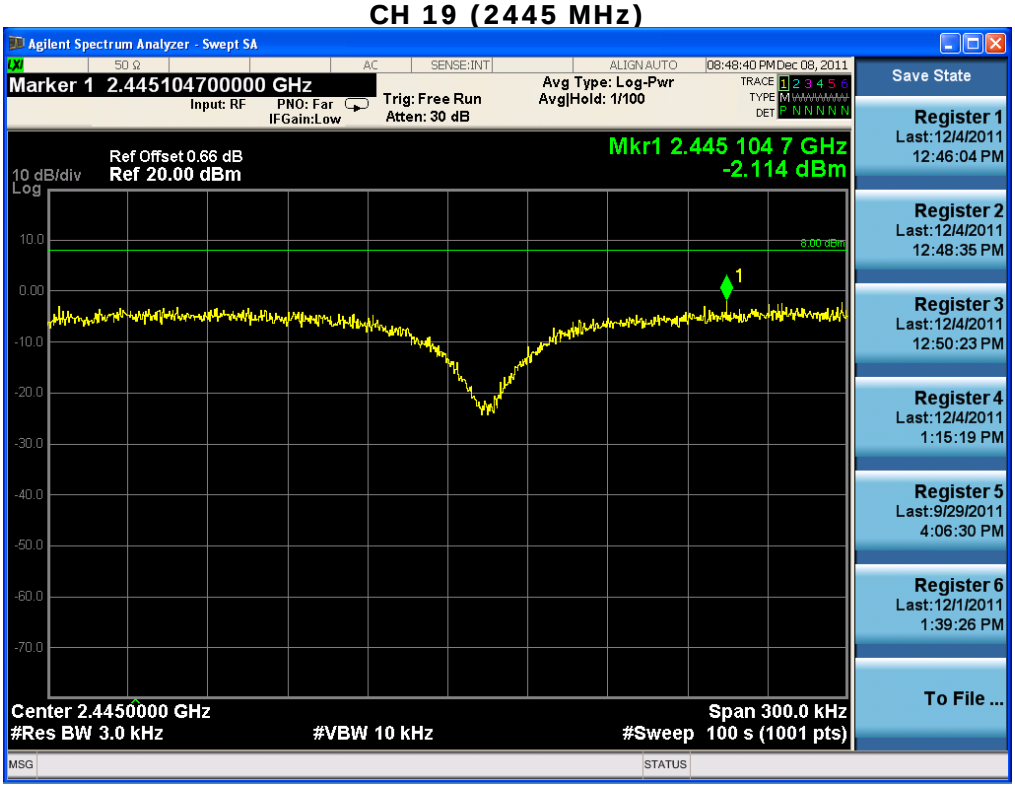
See next pages for actual measured spectrum plots.

Power Density Measurement

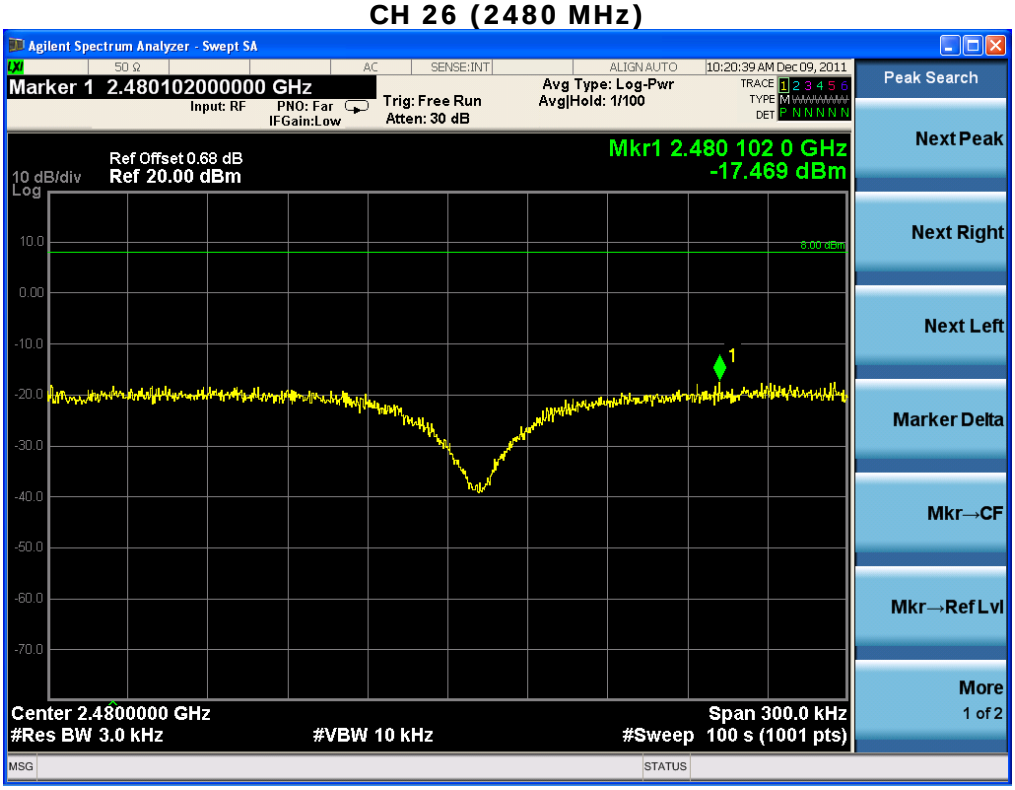
CH 11 (2405 MHz)



CH 19 (2445 MHz)



CH 26 (2480 MHz)



2.1.4 Band - edge

Procedure:

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate frequencies.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz	VBW = 100 kHz
Span = 20 MHz	Detector function = peak
Trace = Max hold	Sweep = auto

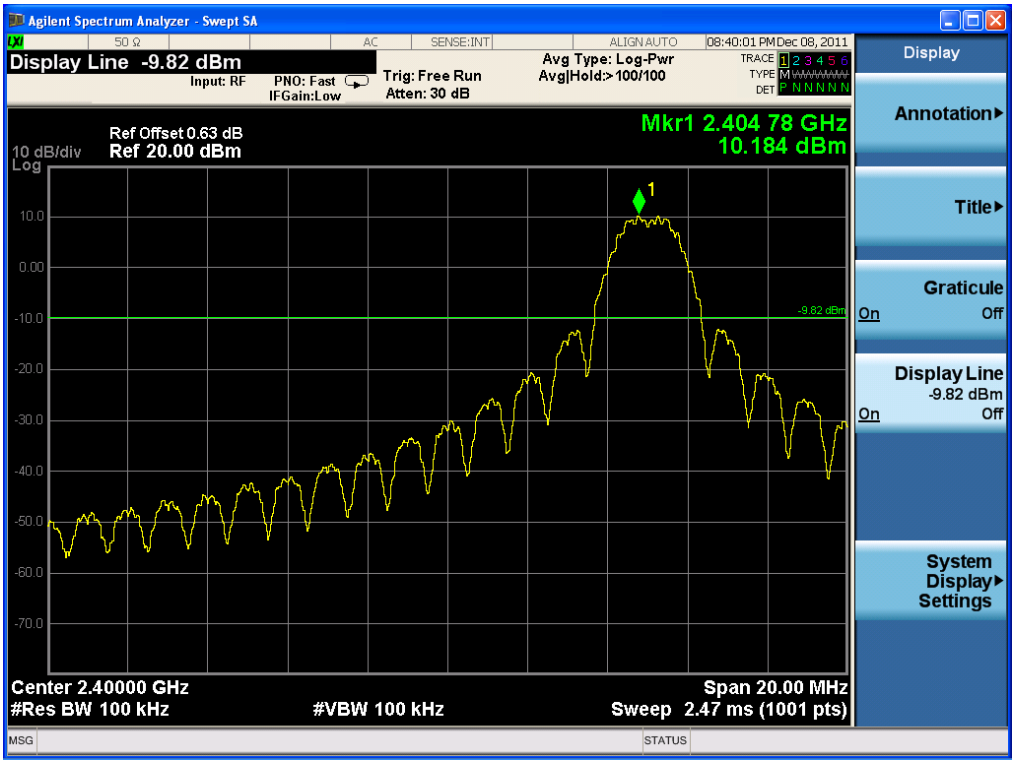
Measurement Data: Complies

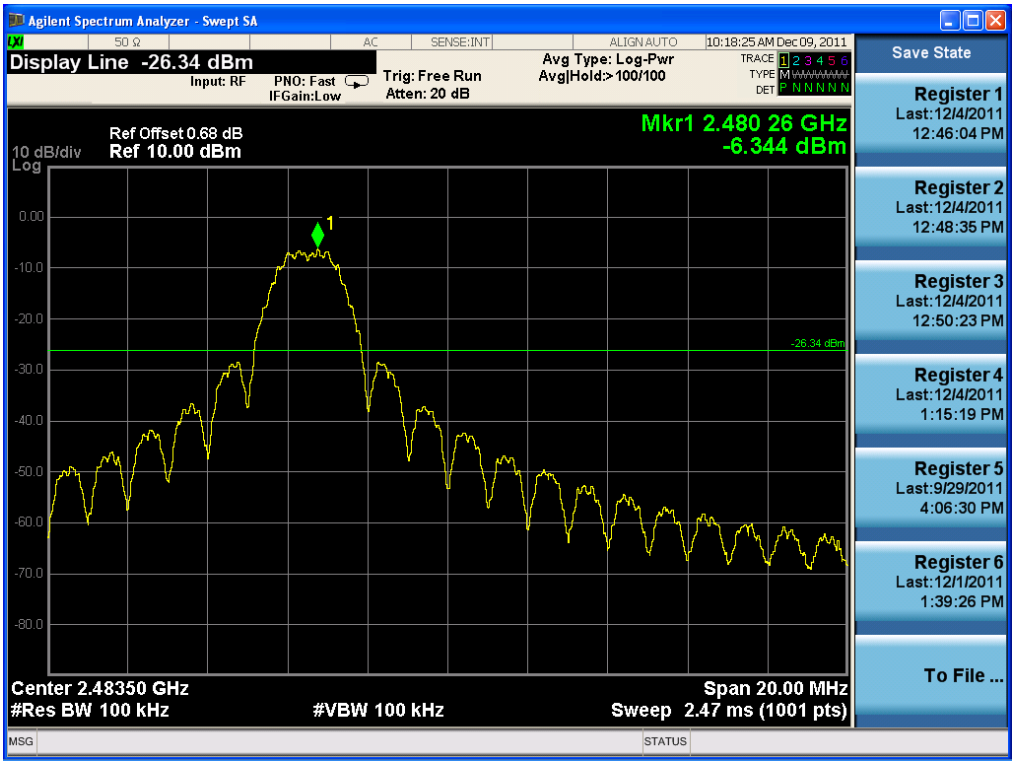
- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.

Minimum Standard:	> 20 dBc

See next pages for actual measured spectrum plots.

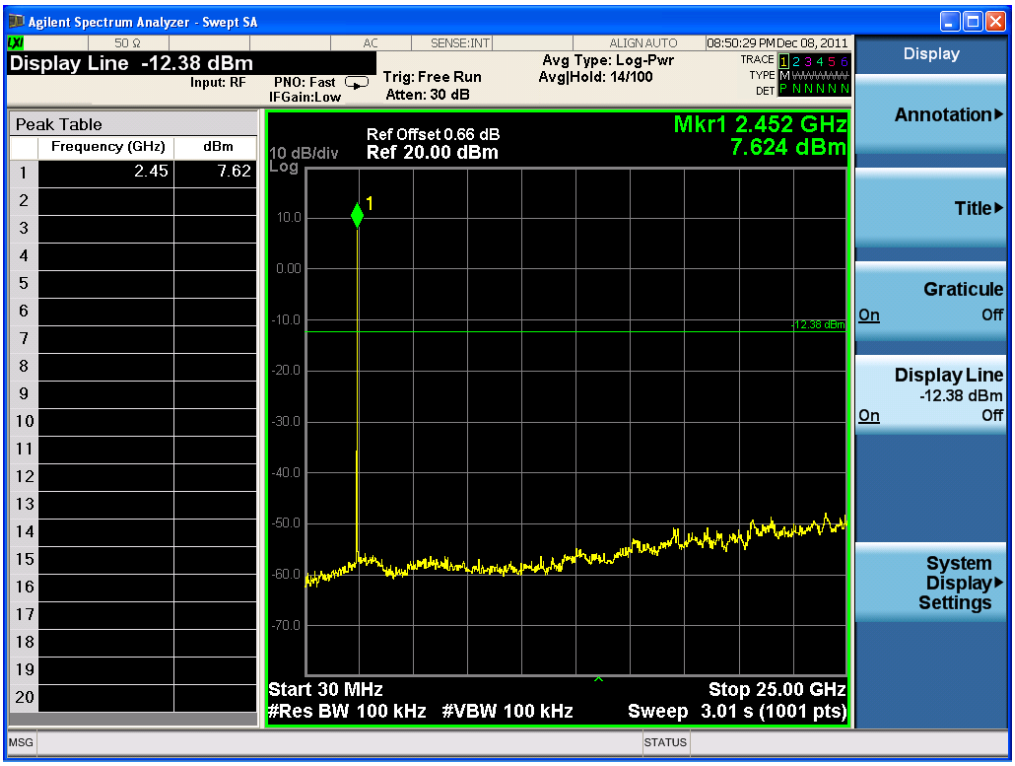
Band-edge Measurements



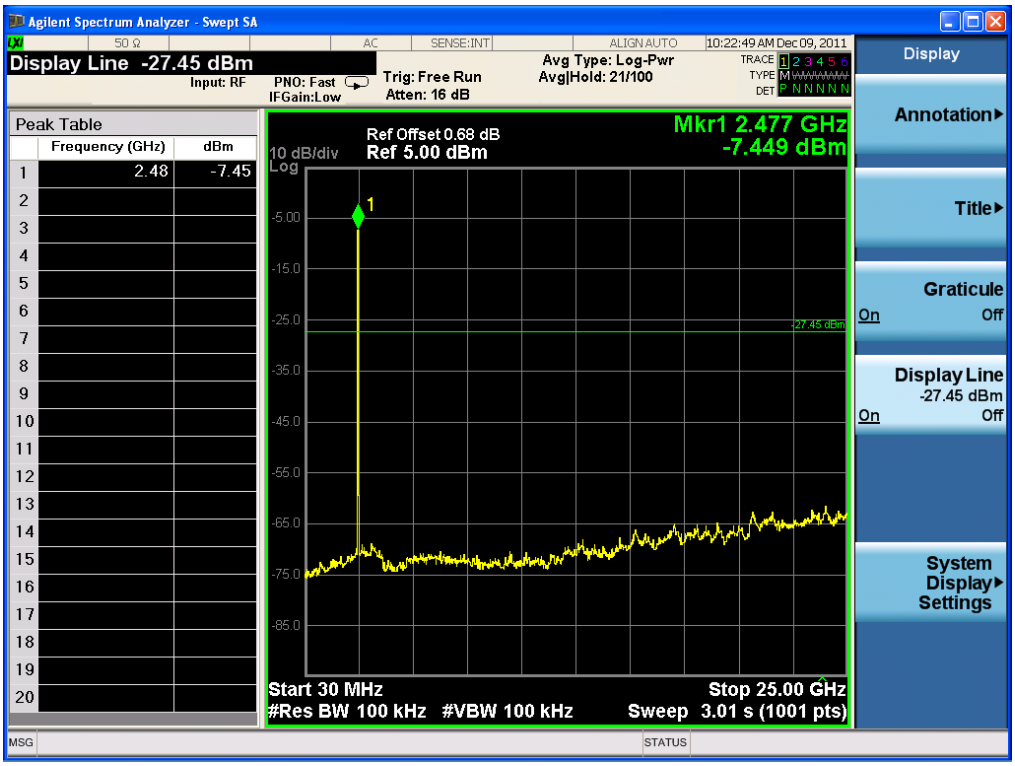


Band – edge (at 20 dB blow) – Low channel(11)
Frequency Range = 30 MHz ~ 10th harmonic

Band – edge (at 20 dB blow) – Mid channel(19)
Frequency Range = 30 MHz ~ 10th harmonic



Band – edge (at 20 dB blow) – High channel(26)
Frequency Range = 30 MHz ~ 10th harmonic



2.1.5 Field Strength of Emissions

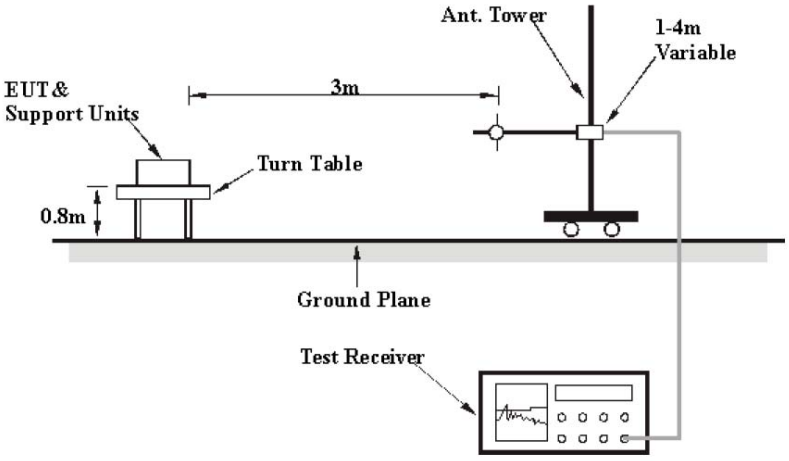
Test Location

☒ Testing was performed at a test distance of 3 meter Open Area Test Site

Test Procedures

The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity. The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

The spectrum analyzer is set to:
Center frequency = the worst channel
Frequency Range =30 MHz ~ 10th harmonic
RBW = 120 kHz (30 MHz ~ 1 GHz) VBW ≥ RBW
= 1 MHz (1 GHz ~ 10th harmonic)
Span = 100 MHz Detector function = Quasi-peak
Trace = max hold



Limit

- **15.209(a)**

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

** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Test Results

Test mode : Continuous modulated carrier

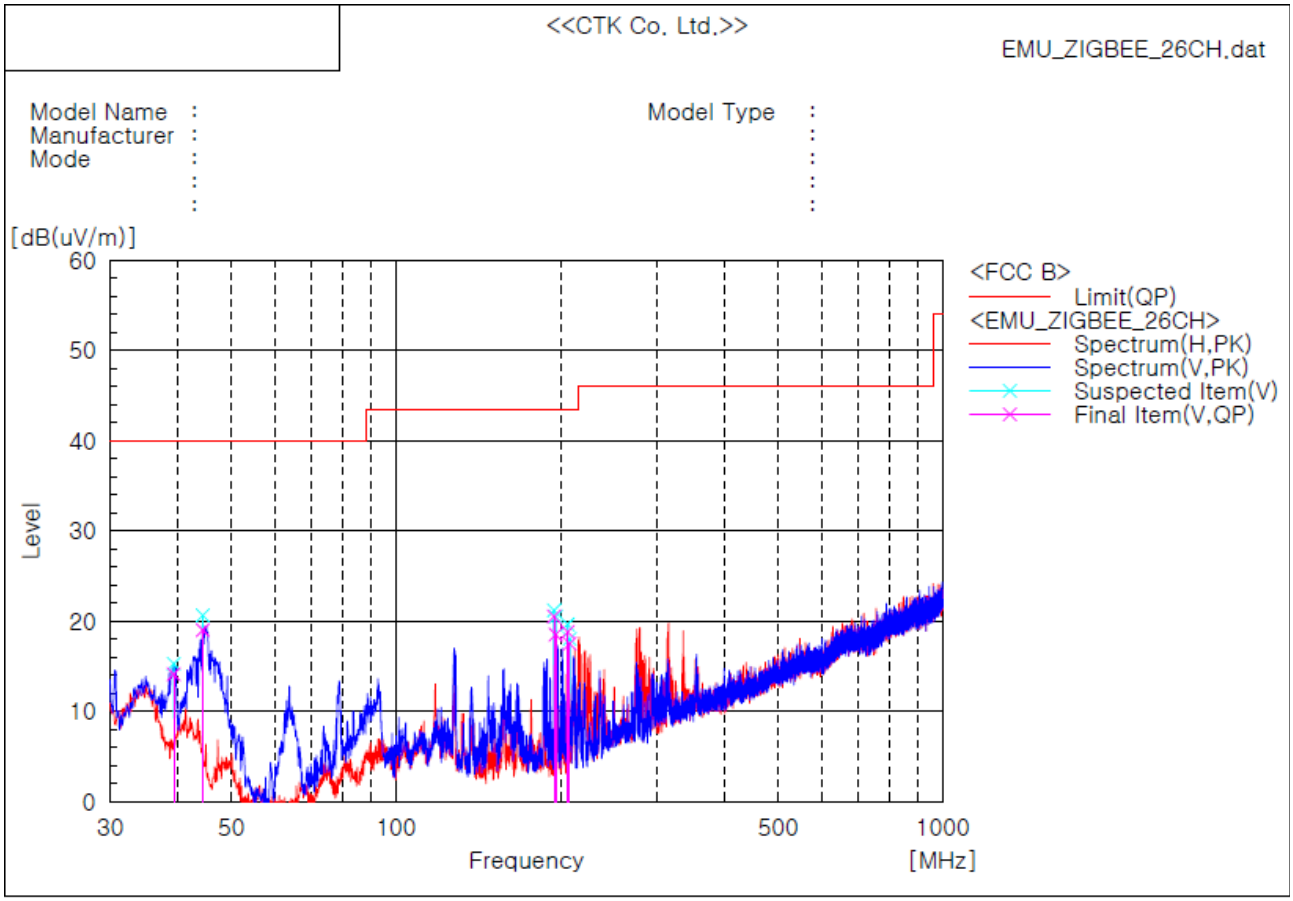
EUT	Energy Meter Unit	Measurement Detail	
Model	Wi-GEM	Frequency Range	Below 1000MHz
Mode	Continuous modulated carrier	Detector function	Quasi-Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
44.308	19.0	21.0	Quasi-peak

Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	39.215	V	29.1	-15.0	14.1	40.0	25.9	100.0	181.0	
2	44.308	V	36.8	-17.8	19.0	40.0	21.0	100.0	144.0	
3	194.536	V	40.4	-19.9	20.5	43.5	23.0	100.0	70.0	
4	195.870	V	38.4	-19.9	18.5	43.5	25.0	100.0	107.0	
5	206.055	V	38.7	-19.9	18.8	43.5	24.7	100.0	219.0	
6	207.753	V	37.4	-19.9	17.5	43.5	26.0	100.0	219.0	

Test Results

EUT	Energy Meter Unit	Measurement Detail	
Model	Wi-GEM	Frequency Range	1-25GHz
Channel	Channel 11 (2405 MHz)	Detector function	Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
4809	51.2	2.8	Average

Test Data

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Height [m]	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
4809.00	42.0	49.1	H	1.5	32.7	34.9	11.4	54.0	74.0	51.2	58.3	2.8	15.7

Restricted band edge test data

Measured frequency range : 2310-2390 MHz, 2483.5-2500 MHz

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Height [m]	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2390.00	48.5	55.8	H	1.5	28.2	35.3	7.4	54.0	74.0	48.8	56.1	5.2	17.9

Test Results

EUT	Energy Meter Unit	Measurement Detail	
Model	Wi-GEM	Frequency Range	1-25GHz
Channel	Channel 19 (2445 MHz)	Detector function	Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
4889	45.8	8.2	Average

Test Data

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Height [m]	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
4889.00	36.6	44.4	H	1.5	32.7	34.9	11.4	54.0	74.0	45.8	53.6	8.2	20.4

Test Results

EUT	Energy Meter Unit	Measurement Detail	
Model	Wi-GEM	Frequency Range	1-25GHz
Channel	Channel 26 (2480 MHz)	Detector function	Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
2483.5	50.5	3.5	Average

Test Data

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Height [m]	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
4959.10	33.3	42.1	H	1.4	32.7	34.9	11.4	54.0	74.0	42.5	51.3	11.5	22.7

Restricted band edge test data

Measured frequency range : 2310-2390 MHz, 2483.5-2500 MHz

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Height [m]	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2483.50	50.2	56.1	H	1.5	28.2	35.3	7.4	54.0	74.0	50.5	56.4	3.5	17.6

2.1.6 AC Conducted Emissions

Test Location
Shielded Room

Frequency Range of Measurement
150 kHz to 30 MHz

Instrument Settings
IF Band Width: 9 kHz

Test Procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.
Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

- **15.207(a)**

Frequency (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 Results
The requirements are:

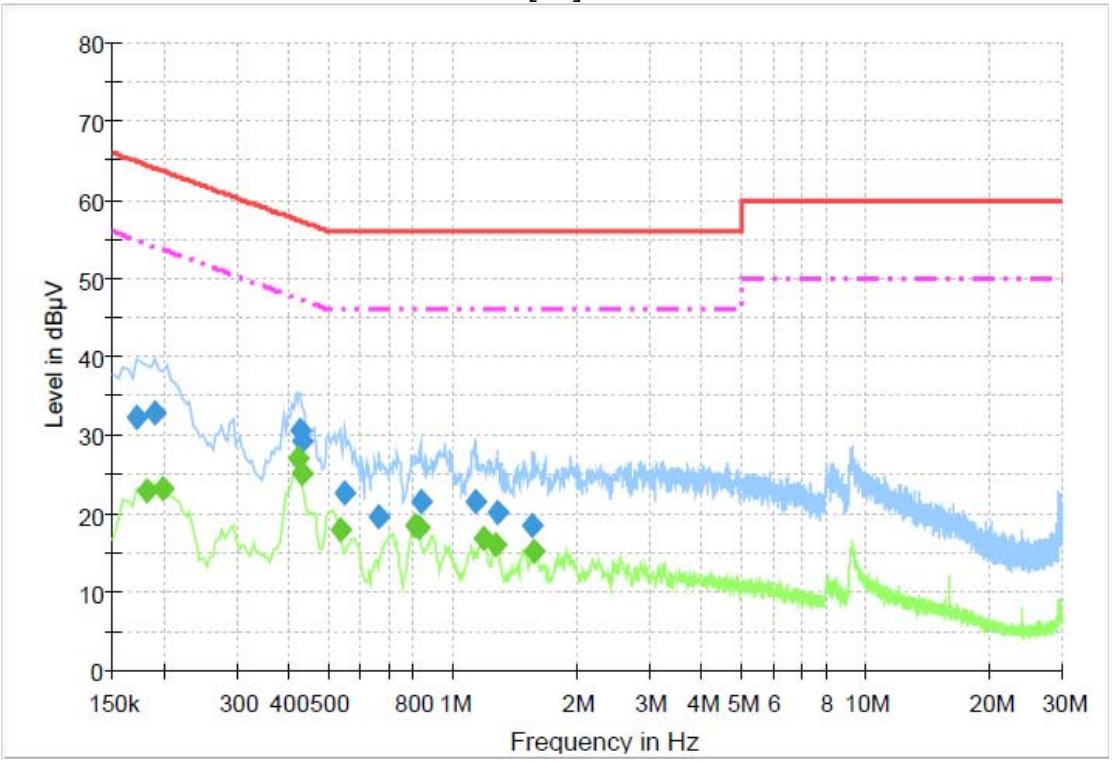
☒ Complies

Test mode : Continuous modulated carrier

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
0.420	29.2	18.2	Average

Test Data

[L1]



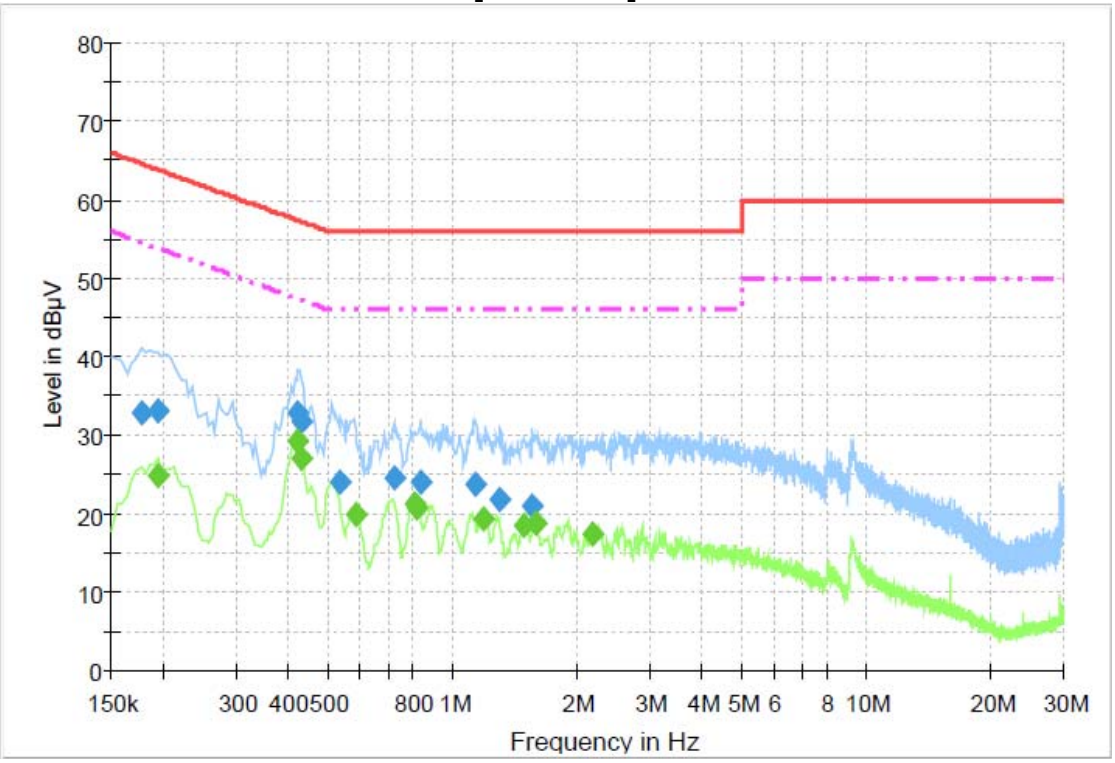
Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.172500	32.2	1000.0	9.000	On	L1	9.9	32.6	64.8
0.190500	33.0	1000.0	9.000	On	L1	10.0	31.1	64.0
0.429000	30.6	1000.0	9.000	On	L1	10.0	26.6	57.3
0.433500	29.3	1000.0	9.000	On	L1	10.0	27.8	57.2
0.546000	22.7	1000.0	9.000	On	L1	10.0	33.3	56.0
0.663000	19.6	1000.0	9.000	On	L1	10.1	36.4	56.0
0.834000	21.5	1000.0	9.000	On	L1	10.1	34.5	56.0
1.131000	21.6	1000.0	9.000	On	L1	10.0	34.4	56.0
1.288500	20.1	1000.0	9.000	On	L1	10.0	35.9	56.0
1.554000	18.6	1000.0	9.000	On	L1	9.9	37.4	56.0

Final Result 2

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.181500	23.0	1000.0	9.000	On	L1	10.0	31.4	54.4
0.199500	23.1	1000.0	9.000	On	L1	10.1	30.6	53.6
0.420000	27.1	1000.0	9.000	On	L1	10.0	20.3	47.4
0.433500	25.2	1000.0	9.000	On	L1	10.0	22.0	47.2
0.537000	17.8	1000.0	9.000	On	L1	10.0	28.2	46.0
0.811500	18.5	1000.0	9.000	On	L1	10.1	27.5	46.0
0.825000	18.1	1000.0	9.000	On	L1	10.1	27.9	46.0
1.185000	16.8	1000.0	9.000	On	L1	10.0	29.2	46.0
1.270500	15.9	1000.0	9.000	On	L1	10.0	30.1	46.0
1.572000	15.2	1000.0	9.000	On	L1	9.9	30.8	46.0

[NEUTRAL]



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.177000	32.9	1000.0	9.000	On	N	10.0	31.7	64.6
0.195000	33.2	1000.0	9.000	On	N	10.2	30.6	63.8
0.424500	32.9	1000.0	9.000	On	N	10.0	24.4	57.4
0.433500	31.6	1000.0	9.000	On	N	9.9	25.5	57.2
0.537000	24.1	1000.0	9.000	On	N	9.9	31.9	56.0
0.721500	24.5	1000.0	9.000	On	N	10.1	31.5	56.0
0.838500	24.0	1000.0	9.000	On	N	10.1	32.0	56.0
1.140000	23.7	1000.0	9.000	On	N	10.0	32.3	56.0
1.306500	21.9	1000.0	9.000	On	N	10.0	34.1	56.0
1.558500	20.9	1000.0	9.000	On	N	9.9	35.1	56.0

Final Result 2

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.195000	24.8	1000.0	9.000	On	N	10.2	29.0	53.8
0.420000	29.2	1000.0	9.000	On	N	10.0	18.3	47.4
0.433500	27.1	1000.0	9.000	On	N	9.9	20.1	47.2
0.582000	19.8	1000.0	9.000	On	N	10.0	26.2	46.0
0.807000	21.1	1000.0	9.000	On	N	10.1	24.9	46.0
0.820500	20.7	1000.0	9.000	On	N	10.1	25.3	46.0
1.189500	19.4	1000.0	9.000	On	N	10.0	26.6	46.0
1.491000	18.5	1000.0	9.000	On	N	9.9	27.5	46.0
1.590000	18.7	1000.0	9.000	On	N	9.9	27.3	46.0
2.184000	17.3	1000.0	9.000	On	N	9.9	28.7	46.0

APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Due Date
1	Signal Analyzer	Agilent	N9020A	MY48011598	2012-11-10
2	Spectrum Analyzer	Rohde & Schwarz	FSP-30	100994	2012-11-10
3	EMI Test Receiver	Rohde & Schwarz	ESVS30	826638/008	2012-07-07
4	ULTRA Broadband Antenna	Rohde & Schwarz	HL562	100203	2013-07-05
5	LOOP ANTENNA	EMCO	6502	9107-2652	2012-10-29
6	Attenuator	HP	8498A	1801A06913	2012-11-14
7	EPM Series Power Meter	HP	E4418A	GB38272734	2012-11-10
8	Power Sensor	HP	8487A	3318A03524	2012-07-07
9	Audio Analyzer	HP	8903B	2747A03432	2012-11-10
10	ESG-D Series Signal Generator	Agilent	E4432B	US40054094	2012-11-21
11	SYNTHESIZED SWEEPER	HP	8341B	2819A01563	2012-11-10
12	Modulation Analyzer	HP	8901B	3438A05228	2012-11-18
13	Attenuator	HP	8494A	3308A33351	2012-11-14
14	Temp&Humi Chamber	Kunpoong	KP-1000	2002KP050041	2012-01-14
15	DC POWER SUPPLY	Agilent	E3632A	MY40011638	2012-11-10
16	EMC Analyzer	Agilent	E7405A	MY45110859	2012-02-11
17	Horn Antenna	ETS-Lindgren	3115	00078894	2013-03-22
18	Horn Antenna	ETS-Lindgren	3115	00078895	2013-03-22
19	Antenna(Biconical)	EMCO	3110	9202-1510	2012-06-10
20	Antenna(Log Periodic)	EMCO	3146	9607-4567	2012-06-10
21	OPT H64 AMPLIFIER	HP	8447F	3113A06814	2012-03-31
22	PREAMPLIFIER	Agilent	8449B	3008A02307	2012-11-17
23	Radio Communication Tester	Rohde & Schwarz	CMU200	106765	2012-02-09
24	EMI Test Receiver	Rohde & Schwarz	ESHS30	862024/001	2012-03-24
25	EMI Test Receiver	Rohde & Schwarz	ESHS30	829673/015	2012-02-09
26	LISN	Rohde & Schwarz	ENV216	101151	2012-02-10
27	DC POWER SUPPLY	Agilent	E3632A	MY40011638	2012-11-10
28	EMI Test Receiver	Rohde & Schwarz	ESCI3	100032	2012-02-09
29	AC Power Source	California Instruments	2001RP	08770	2012-02-09