FCC RF TEST REPORT

Test Laboratory:
SK Tech Co., Ltd.
820-2, Wolmoon-ri, Wabu-up,
Namyangju-si, Kyunggi-do
472-905 South Korea
TEL: +82-31-576-2204
FAX: +82-31-576-2205

Test Report Number: SKTRFC-130408-004

Date of issue: April 8, 2013

Applicant:	**KYUNGWOO SYSTECH INC.** #401, Daeryung Post Tower 5, Gasan-dong, Geumcheon-gu, Seoul, 153-702 South Korea
Manufacturer:	**KYUNGWOO SYSTECH INC.** #401, Daeryung Post Tower 5, Gasan-dong, Geumcheon-gu, Seoul, 153-702 South Korea
Product:	SMART KEY TAG
Model:	**A232** (please see P5 for all the model numbers)
FCC ID:	**ZE8-A232A**
File number:	SKTEU13-0304
EUT received:	March 8, 2013
Applied standards:	ANSI C63.10-2009 and ANSI C63.4-2009, KDB 558074 D01 DTS Meas Guidance v02
Rule parts:	FCC Part 15 Subpart C - Intentional radiators
Equipment Class:	DTS - Part 15 Digital Transmission System
Remarks to the standards:	None

The above equipment has been tested by SK Tech Co., Ltd., and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product or system, which was tested.

Jungtae Kim / **Testing Engineer**

Jongsoo Yoon / **Technical Manager**

Revision History of Report

Rev.	Revisions	Effect page	Reviewed by	Date
-	Initial issue	All	Jongsoo Yoon	April 8, 2013

TABLE OF CONTENTS

1 Summary of test results

Requirement	CFR 47 Section	Result
Antenna Requirement	15.203, 15.247(b)(4)	Meets the requirements
6dB Bandwidth	15.247(a)(2)	Meets the requirements
Maximum Peak Output Power	15.247(b)(3), (4)	Meets the requirements
Spurious Emission, Band Edge, and Restricted bands	15.247(d), 15.205(a), 15.209(a)	Meets the requirements
Peak Power Spectral Density	15.247(e)	Meets the requirements
AC power line Conducted emissions	15.207(a)	N/A (NOTE)
RF Exposure	15.247(i), 1.1307(b)(1),	Meets the requirements

Note: *The EUT uses a lithium battery with DC 3 V.*

2 Description of equipment under test (EUT)

Product:	SMART KEY TAG
Model:	A232
Serial number:	None (prototype)

Model differences:

Model name	Difference	Tested (checked)
A232	Original	☒

Note: *All the differences were compared with the test sample.*

Technical data:

Power source	DC 3.0 V lithium battery (type CR2032)	
Local Oscillator or X-Tal	32 MHz	
Transmit Frequency	2405 MHz to 2480 MHz (16 CH)	125 kHz RFID (only receiver)
Antenna Type	Integral chip antenna	Resonance coil
Type of Modulation	OQPSK	ASK
RF Output power	4.39 dBm (measured conducted RF power)	-
External Ports	none	

I/O port	Type	Q'ty	Remark
none			

Equipment Modifications

none

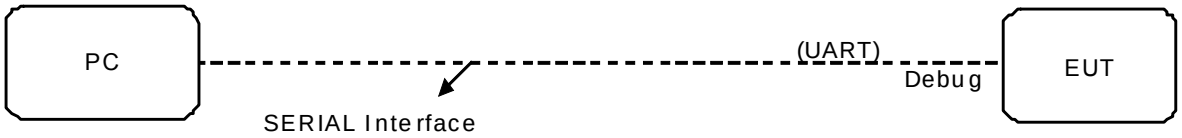
Submitted Documents

Block diagram
Schematic diagram
Antenna Specification
Part List
User manual

3 Test and measurement conditions

3.1. Test configuration (arrangement of EUT)

The measurements were taken in continuous transmitting mode provided by the applicant.



3.2. Description of support units (accessory equipment)

The following support units or accessories were used to form a representative test configuration during the tests.

#	Equipment	Manufacturer	Model No.	Serial No.
1	Notebook PC	DELL	INSPIRION	14791079949
2	Adaptor(for Notebook PC)	DELL	LA65NS0-00	CN-0DF263-71615-6BT-81A8

Note: *1) For control of the RF module via UART interface at the Debug port in the EUT. For radiated spurious emission measurements, the measurements were performed without PC after setting the radio module to TEST MODE.*

3.3. Interconnection and I/O cables

The following support units or accessories were used to form a representative test configuration during the tests.

#	Start		End		Cable	
	Name	I/O port	Name	I/O port	length (m)	shielded (Y/N)

Note: *1) All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
2) Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

3.4. Measurement Uncertainty (*U*)

Measurement Item	Combined Standard Uncertainty *Uc*	Expanded Uncertainty $U = k \times Uc$ ($k = 2$)
Conducted RF power	±1.49 dB	±2.98 dB
Radiated disturbance	±2.30 dB	±4.60 dB
Conducted disturbance	±1.96 dB	±3.92 dB

3.5. Test date

Date Tested	March 27, 2013 – April 4, 2013

4 Facilities and accreditations

4.1. Facilities

All of the measurements described in this report were performed at SK Tech Co., Ltd
Site I: 820-2, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, Korea
Site II: 688-8, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, Korea

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-4. The sites comply with the Normalized Site Attenuation requirements given in ANSI C63.4, and site VSWR requirements specified in CISPR 16-1-4. The measuring apparatus and ancillary equipment conform to CISPR 16-1 series.

4.2. Accreditations

The laboratory has been also notified to FCC by RRA as a Conformity Assessment Body, and designated to perform compliance testing on equipment subject to Declaration of Conformity (DOC) and Certification under Parts 15 and 18 of the FCC Rules.

Designation No. KR0007

4.3. List of test and measurement instruments

No	Description	Model	Manufacturer	Serial No.	Cal. due	Use
1	Spectrum Analyzer	Agilent	E4405B	US40520856	2014.03.07	
2	Spectrum Analyzer	Agilent	E4440A	MY46186322	2014.03.18	☒
3	EMC Spectrum Analyzer	Agilent	E7405A	US40240203	2013.07.09	
4	EMI Test Receiver	Rohde&Schwarz	ESPI7	101206	2014.07.10	☒
5	EMI Test Receiver	Rohde&Schwarz	ESHS10	835871/002	2013.09.18	☒
6	Artificial Mains Network	Rohde&Schwarz	ESH3-Z5	834549/011	2013.07.09	☒
7	Pre-amplifier	HP	8447F	3113A05153	2013.07.10	☒
8	Pre-amplifier	MITEQ	AFS44	1116321	2013.12.15	
9	Pre-amplifier	MITEQ	AFS44	1116322	2014.03.08	☒
10	Power Meter	Agilent	E4417A	MY45100426	2013.07.10	
11	Power Meter	Agilent	E4418B	US39402176	2013.07.10	
12	Power Sensor	Agilent	E9327A	MY44420696	2013.07.10	
13	Power Sensor	Agilent	8485A	3318A13916	2013.07.10	
14	Attenuator (10dB)	HP	8491B	38072	2013.07.09	☒
15	High Pass Filter	Wainwright	WHKX3.0/18G	8	2013.07.09	☒
16	VHF Precision Dipole Antenna (TX/RX)	Schwarzbeck	VHAP	1014 / 1015	2013.10.04	
17	UHF Precision Dipole Antenna (TX/RX)	Schwarzbeck	UHAP	989 / 990	2013.10.04	
18	Loop Antenna	Schwarzbeck	HFH2-Z2	863048/019	2013.12.22	☒
19	TRILOG Broadband Antenna	Schwarzbeck	VULB9168	189	2013.05.31	☒
20	Horn Antenna	AH Systems	SAS-200/571	304	N/A	
21	Horn Antenna	EMCO	3115	00040723	2014.03.26	☒
22	Horn Antenna	EMCO	3115	00056768	2013.08.13	
23	Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170318	2013.09.28	☒
24	Vector Signal Generator	Agilent	E4438C	MY42080359	2013.07.10	
25	PSG analog signal generator	Agilent	E8257D-520	MY45141255	2013.07.10	
26	DC Power Supply	HP	6622A	3348A03223	2013.07.10	
27	Hygro/Thermo Graph	SATO	PC-5000TRH-II	-	2013.07.18	☒
28	Temperature/Humidity Chamber	All Three	ATM-50M	20030425	2014.03.08	

5 Test and measurements

5.1. Antenna requirement

5.1.1 Regulation

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And 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.

5.1.2 Result: PASS

The transmitter has the integral chip antenna. The directional gain of the antenna is 3.0 dBi.

5.2. 6 dB bandwidth

5.2.1 Regulation

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

5.2.2 Test Procedure(Measurement Procedure Option1)

1. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
2. Set the spectrum analyzer as follows:

1) Set resolution bandwidth (RBW) = 1-5% or DTS BW, not to exceed 100 kHz.
2) Set the video bandwidth (VBW) ≥ 3 x RBW.
3) Detector = Peak.
4) Trace mode = max hold.
5) Sweep = auto couple.
6) Allow the trace to stabilize.
7) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

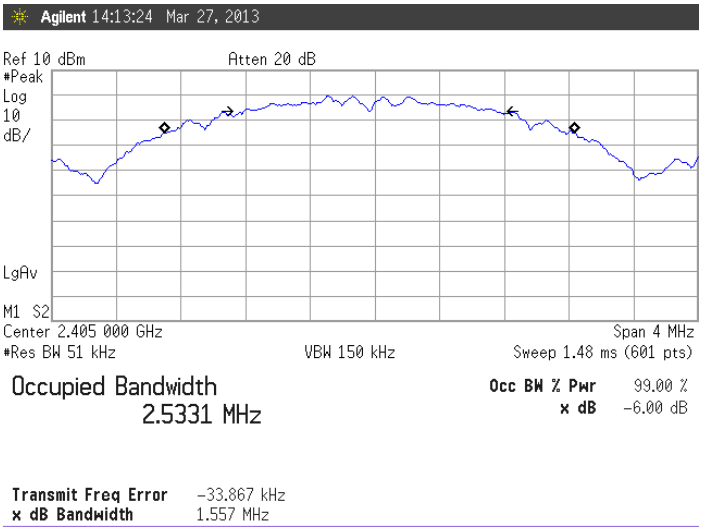
5.2.3 Test Results: PASS

Table 1: Measured values of the 6dB Bandwidth

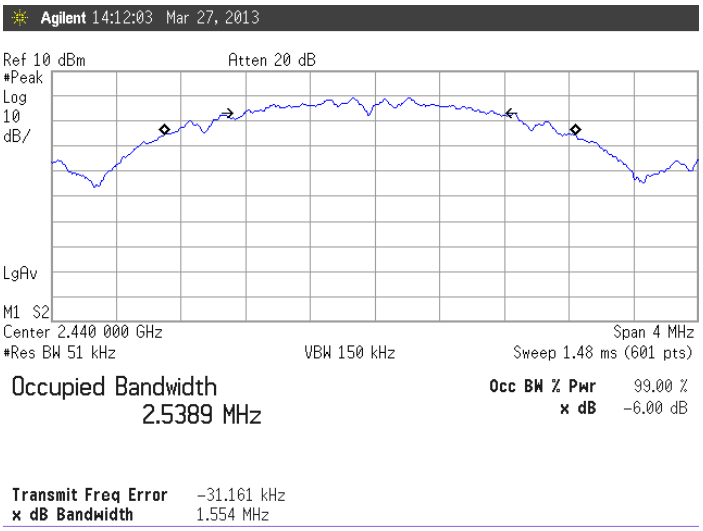
Operating frequency	Occupied Bandwidth (99 %)	6 dB Bandwidth	Limit
2405 MHz	2.5331 MHz	1.557 MHz	≥ 500 kHz
2440 MHz	2.5389 MHz	1.554 MHz	≥ 500 kHz
2480 MHz	2.5368 MHz	1.551 MHz	≥ 500 kHz

Figure 1. Plot of the 6dB Bandwidth

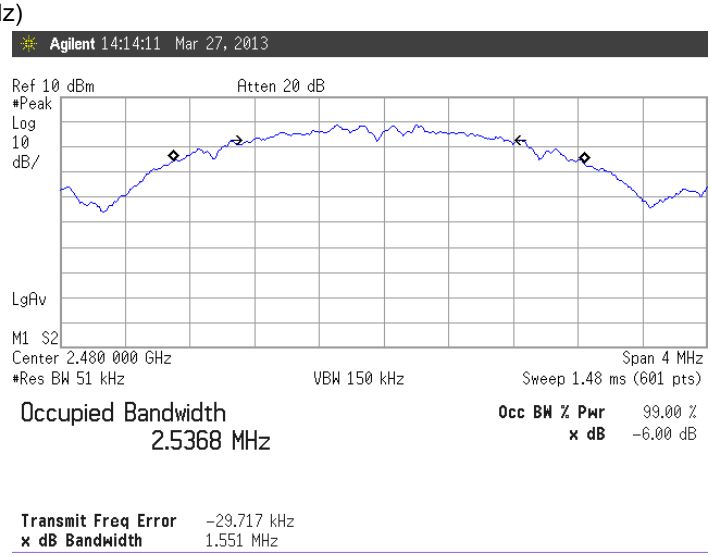
Lowest Channel (2405 MHz)



Middle Channel (2440 MHz)



Highest Channel (2480 MHz)



5.3. Maximum peak output power

5.3.1 Regulation

According to §15.247(b)(3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

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.

5.3.2 Test Procedure(Measurement Procedure Option2)

1. Set the RBW = maximum available (at least 1 MHz).
2. Set the VBW = 3 x RBW or maximum available setting (must be ≥ RBW).
3. Set the span to fully encompass the DTS bandwidth.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the spectrum analyzer's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some analyzers, this may require a manual override to ensure use of peak detector). If the spectrum analyzer does not have a band power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS channel bandwidth.

5.3.3 Test Results: PASS

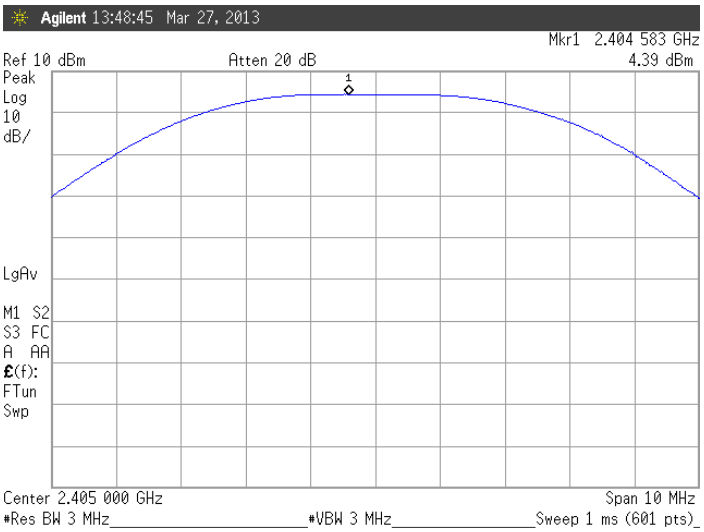
Table 2: Measured values of the Maximum Peak Conducted Output Power

Operating frequency	PEAK POWER		Limit
	[dBm]	[W]	
2405 MHz	4.39	0.002 75	1 W
2440 MHz	4.12	0.002 58	1 W
2480 MHz	3.69	0.002 34	1 W

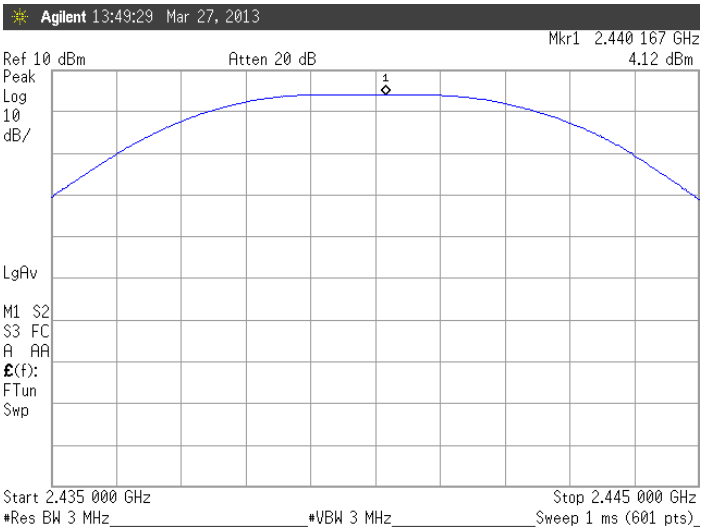
NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

Figure 2. Plot of the Maximum Peak Conducted Output Power

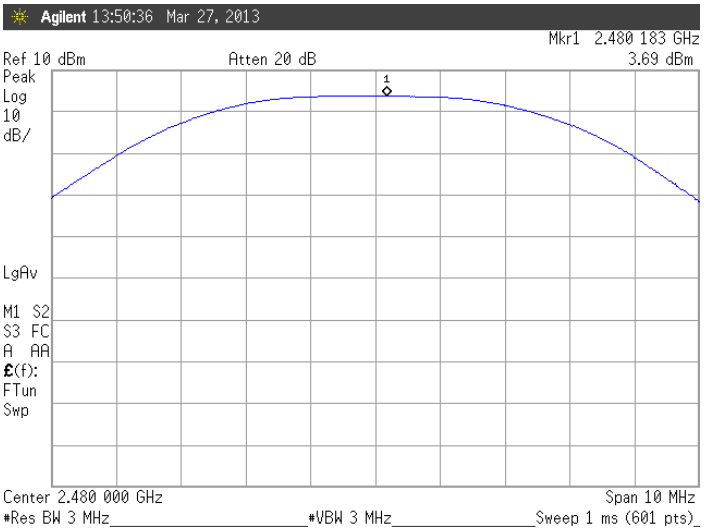
Lowest Channel (2405 MHz)



Middle Channel (2440 MHz)



Highest Channel (2480 MHz)



5.4. Spurious emissions, Band edge, and Restricted bands

5.4.1 Regulation

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 the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under 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)).
According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field strength (μV/m @ 3m)	Field strength (dBμV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

5.4.2 Test Procedure

1) Band-edge Compliance of RF Conducted Emissions

1. Set the spectrum analyzer as follows:
   Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters for above 30 MHz, and at 1 meter / 3 meter distance for below 30 MHz.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360˚.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, from 30 to 1000 MHz using the Trilog broadband antenna, and from 1 GHz to tenth harmonic of the highest fundamental frequency using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8. If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative “marker-delta” method may be employed.

4) Marker-Delta Method at the edge of the authorized band of operation:

1. Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function as the above Spurious Radiated Emissions test procedure.
2. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.
3. Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.
4. The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two “standard” bandwidths must be measured as the above Spurious Radiated Emissions test procedure.

5.4.3 Test Results: PASS

Band-edge compliance of RF conducted/radiated emissions was shown in the Figure 3 and 4.
Spurious RF conducted emissions were shown in the Figure 5.
Emission plot for the preliminary radiated measurements were shown in the Figure 6.

NOTE 1: for conducted measurement, we took the insertion loss of the cable loss into consideration within the measuring instrument. And for radiated measurement, the results were calibrated to the field strength within the measuring instrument; Table 3 contains the correction factors at the operating frequencies such as antenna factor, cable loss, etc.

NOTE 2: The preliminary radiated measurements were performed in the anechoic chamber in order to find the frequency, which falls in the restricted bands as defined in Section 15.205, and the results for the final measurements were indicated in the Table 3.

Table 3: Measured values of the Field strength of spurious emission (Radiated)

BELOW 1 GHz

Frequency	Receiver Bandwidth	Pol.	Antenna Height	Turn Table	Reading	Amp Gain	ATT	AF	CL	Actual	Limit	Margin
[MHz]	[kHz]	[V/H]	[m]	[degree]	[dB(μV)]	[dB]	[dB]	dB(1/m)	[dB]	[dB(μV/m)]	[dB(μV/m)]	[dB]
Average/Peak/Quasi-peak data, emissions below 30 MHz												
Quasi-peak data, emissions below 1000 MHz												

No Spurious Radiated Emissions Found

No Spurious Radiated Emissions Found

Margin (dB) = Limit – Actual
[Actual = Reading – Amp Gain + Attenuator + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss
NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

Table 3: Measured values of the Field strength of spurious emission (Radiated) *(continued)*

ABOVE 1 GHz

Frequency	Receiver Bandwidth	Pol.	Antenna Height	Turn Table	Reading	Amp Gain	ATT	AF	CL	Actual	Limit	Margin
[MHz]	[kHz]	[V/H]	[m]	[degree]	[dB(μV)]	[dB]	[dB]	dB(1/m)	[dB]	[dB(μV/m)]	[dB(μV/m)]	[dB]
PEAK data, emissions above 1000 MHz												
2404.4	1000	H	1.70	173	---	48.46	10.15	28.16	6.51	94.04	Not Applicable	
2404.4	1000	V	1.17	185	---	48.46	10.15	28.16	6.51	91.37		
2341.6	1000	H	1.70	173	---	48.44	10.15	27.96	6.41	62.16	74.00	11.84
2345.2	1000	V	1.17	185	---	48.44	10.15	27.97	6.41	63.87	74.00	10.13
2439.5	1000	H	1.66	163	---	48.48	10.14	28.27	6.56	92.43	Not Applicable	
2439.5	1000	V	1.10	188	---	48.48	10.14	28.27	6.56	89.93		
2479.6	1000	H	1.68	150	---	48.49	10.14	28.40	6.61	91.08	Not Applicable	
2480.4	1000	V	1.09	167	---	48.49	10.14	28.40	6.61	89.22		
2483.6	1000	H	1.68	150	---	48.50	10.14	28.41	6.62	55.80	74.00	18.20
2483.6	1000	V	1.09	167	---	48.50	10.14	28.41	6.62	56.17	74.00	17.83

Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization
2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss
3. '---' in Reading [dB(μV)] value means that the Actual [dB(μV/m)] value containing all the correction factors were directly taken from the measurement instrument.

Table 3: Measured values of the Field strength of spurious emission (Radiated) *(continued)*												
ABOVE 1 GHz												
Frequency	Receiver Bandwidth	Pol.	Antenna Height	Turn Table	Reading	Amp Gain	ATT	AF	CL	Actual	Limit	Margin
[MHz]	[kHz]	[V/H]	[m]	[degree]	[dB(μV)]	[dB]	[dB]	dB(1/m)	[dB]	[dB(μV/m)]	[dB(μV/m)]	[dB]
AVERAGE data, emissions above 1000 MHz												
2404.4	1000	H	1.70	173	---	48.46	10.15	28.16	6.51	89.46	Not Applicable	
2404.4	1000	V	1.17	185	---	48.46	10.15	28.16	6.51	86.77		
2341.6	1000	H	1.70	173	---	48.44	10.15	27.96	6.41	44.75	54.00	9.25
2345.2	1000	V	1.17	185	---	48.44	10.15	27.97	6.41	46.06	54.00	7.94
2439.5	1000	H	1.66	163	---	48.48	10.14	28.27	6.56	88.51	Not Applicable	
2439.5	1000	V	1.10	188	---	48.48	10.14	28.27	6.56	85.76		
2479.6	1000	H	1.68	150	---	48.49	10.14	28.40	6.61	87.06	Not Applicable	
2480.4	1000	V	1.09	167	---	48.49	10.14	28.40	6.61	85.12		
2483.6	1000	H	1.68	150	---	48.50	10.14	28.41	6.62	43.88	54.00	10.12
2483.6	1000	V	1.09	167	---	48.50	10.14	28.41	6.62	45.06	54.00	8.94

Margin (dB) = Limit – Actual

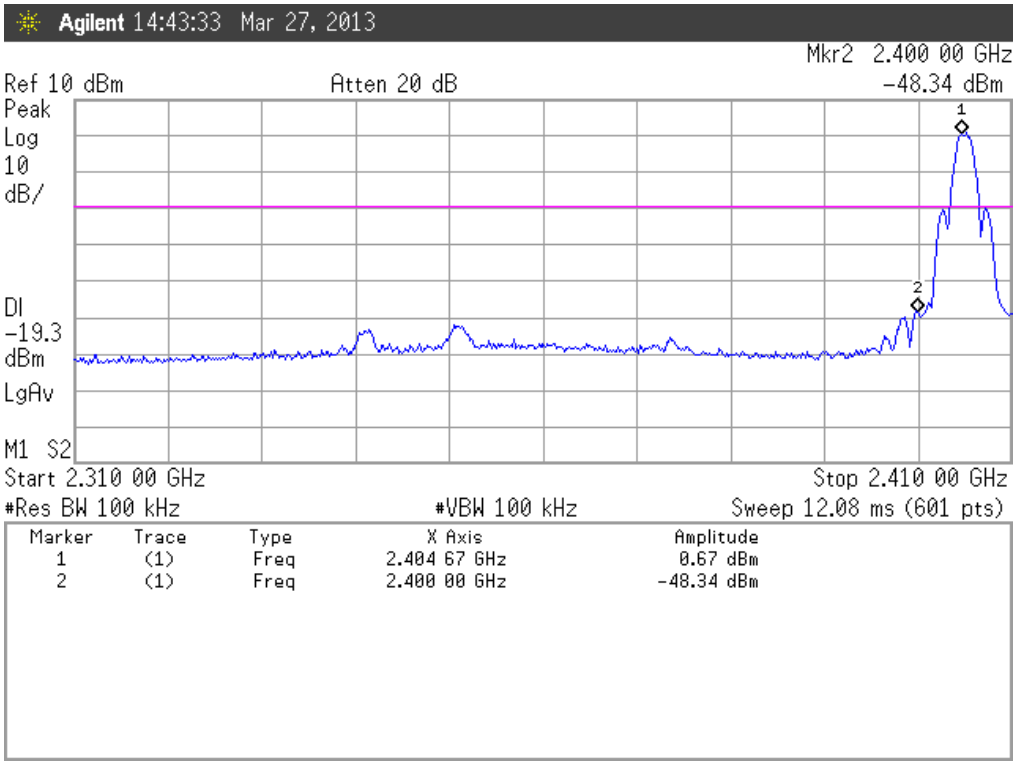
[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization
2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss
3. '---' in Reading [dB(μV)] value means that the Actual [dB(μV/m)] value containing all the correction factors were directly taken from the measurement instrument.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

Figure 3. Plot of the Band Edge (Conducted)

Lowest Channel (2405 MHz)



Highest Channel (2480 MHz)

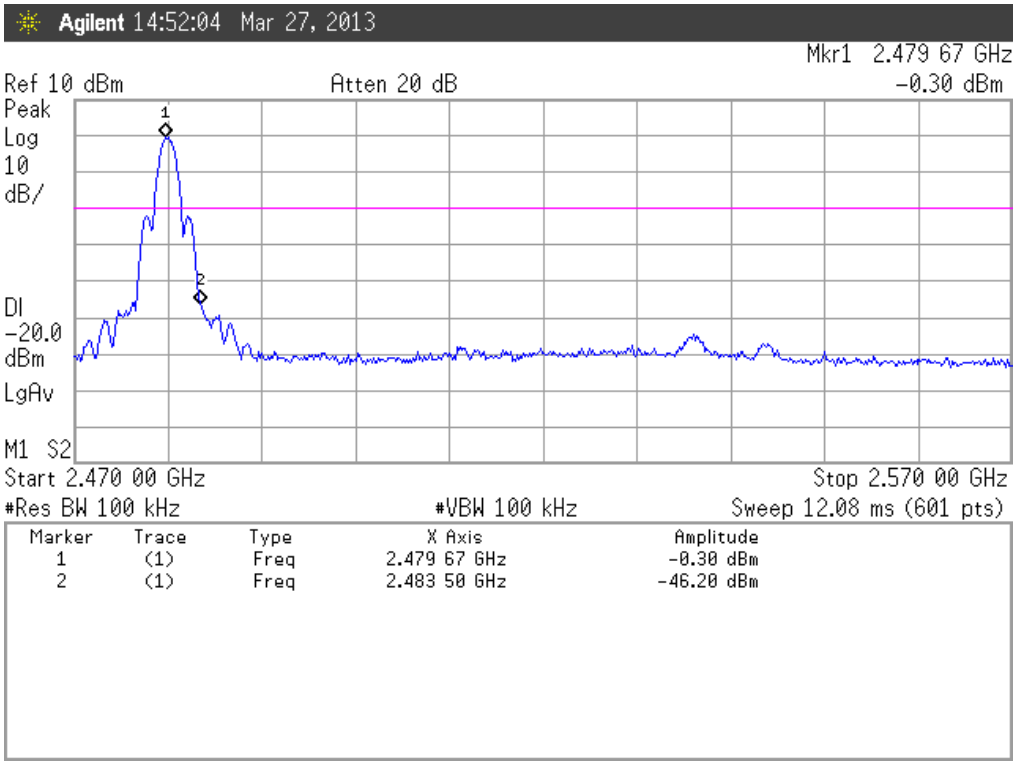
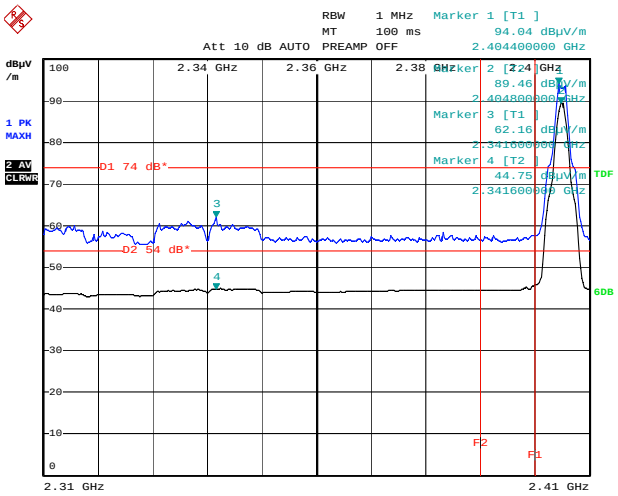


Figure 4. Plot of the Band Edge (Radiated)

Lowest Channel (2405 MHz)

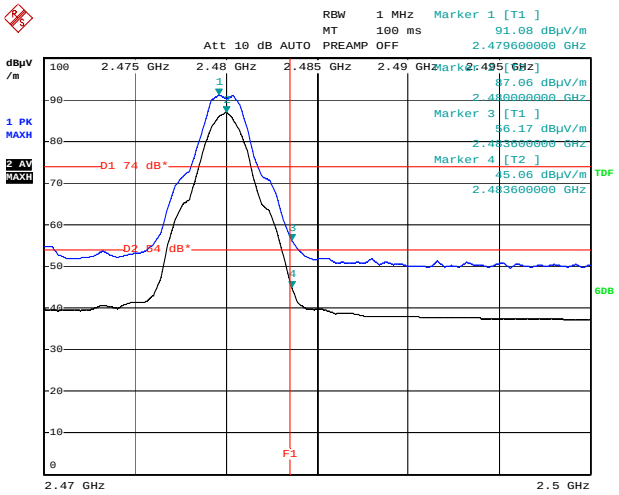
Horizontal



Date: 4.APR.2013 15:50:04

Highest Channel (2480 MHz)

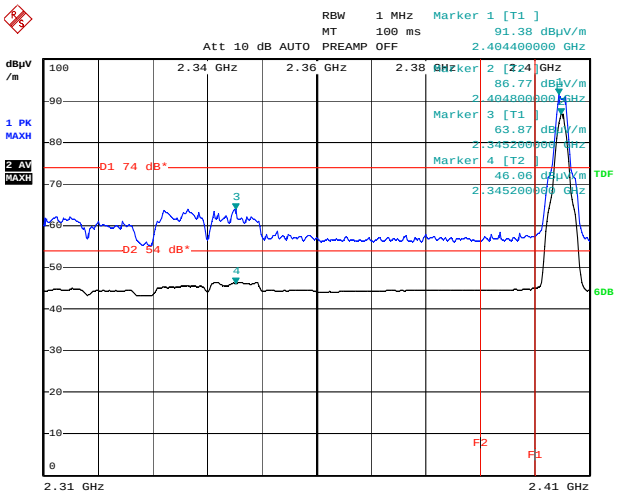
Horizontal



Date: 4.APR.2013 16:31:01

Lowest Channel (2405 MHz)

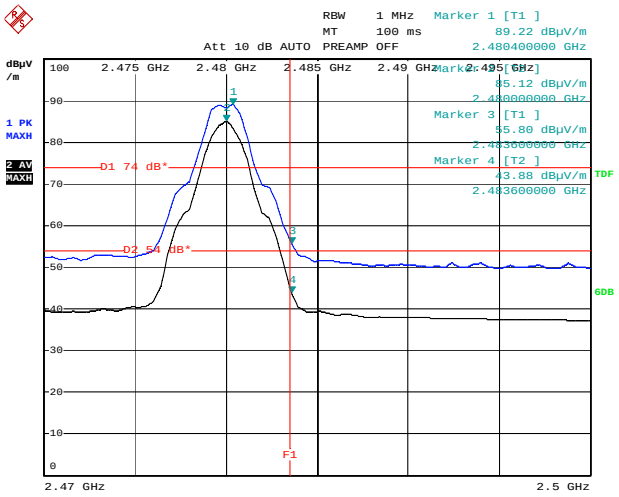
Vertical



Date: 4.APR.2013 15:42:45

Highest Channel (2480 MHz)

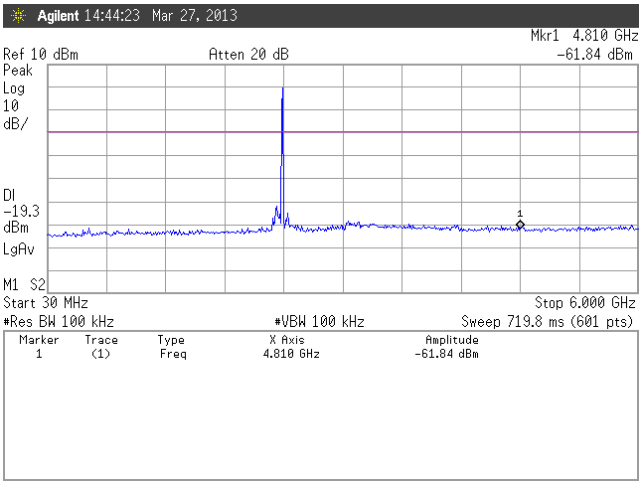
Vertical



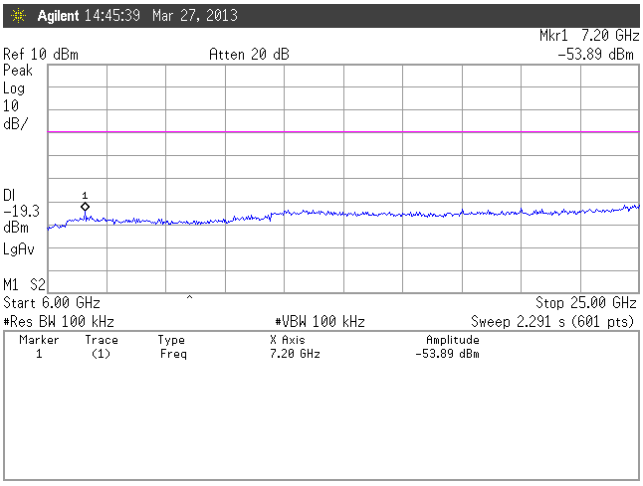
Date: 4.APR.2013 16:25:00

Figure 5. Spurious RF conducted emissions

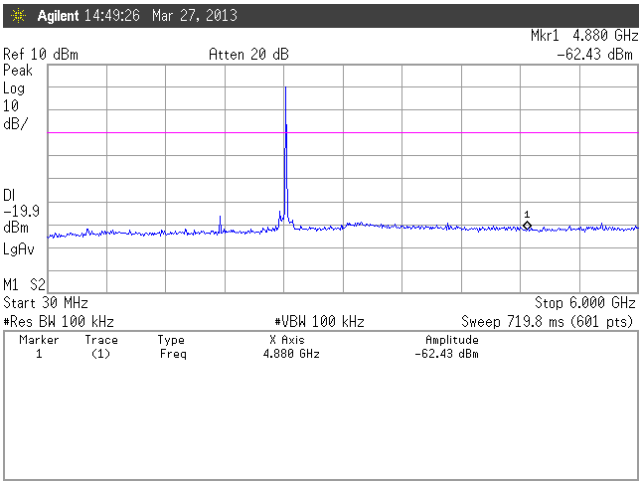
Lowest Channel(2405 MHz): 30 MHz ~ 6 GHz



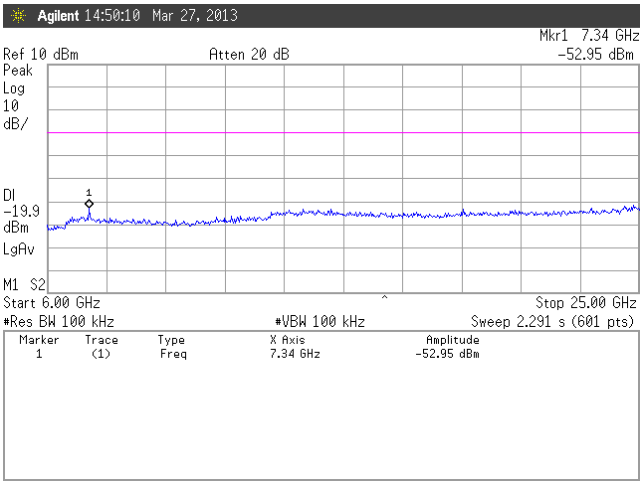
Lowest Channel (2405 MHz): 6 GHz ~ 25 GHz



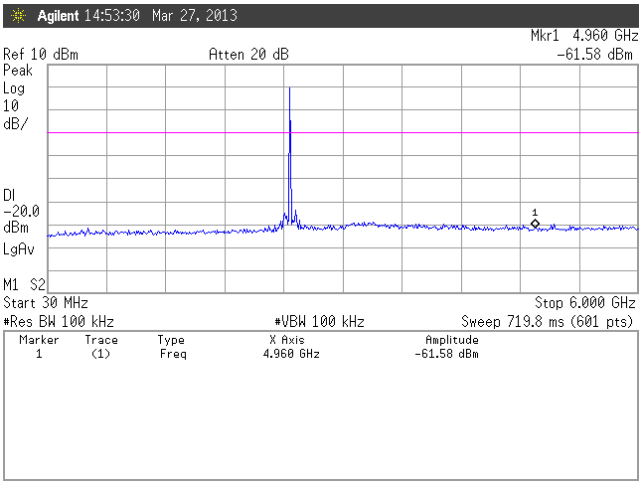
Middle Channel (2440 MHz): 30 MHz ~ 6 GHz



Middle Channel (2440 MHz): 6 GHz ~ 25 GHz



Highest Channel(2480 MHz): 30 MHz ~ 6 GHz



Highest Channel(2480 MHz): 6 GHz ~ 25 GHz

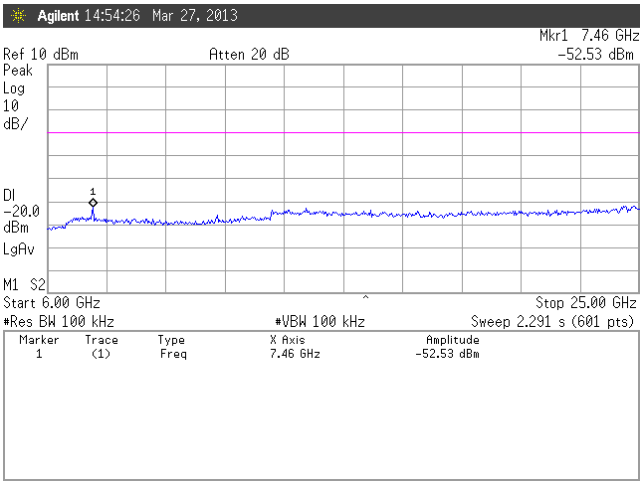
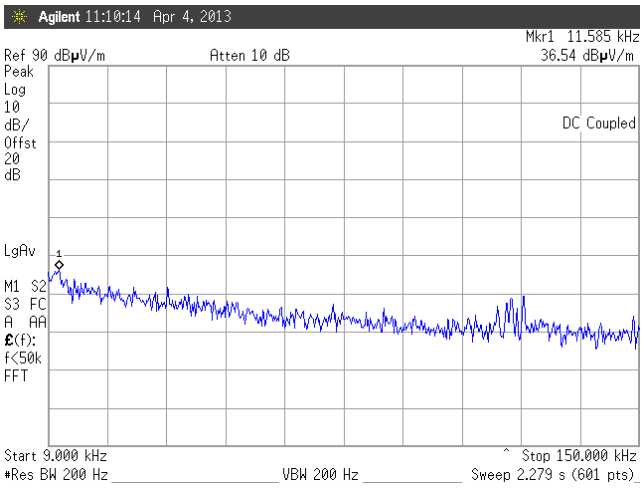
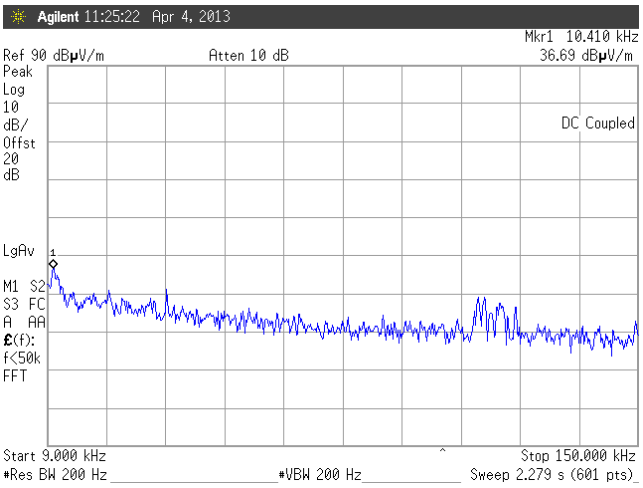


Figure 6. Emission plot for the preliminary radiated measurements

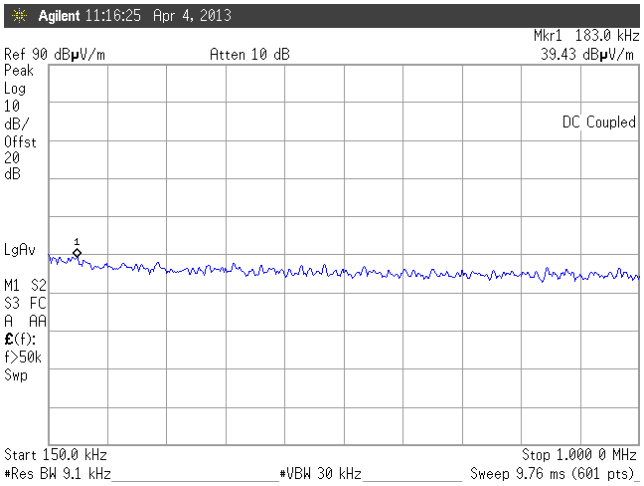
Operating at 2405 MHz: 9 kHz ~ 150 kHz (@ 3-m distance)



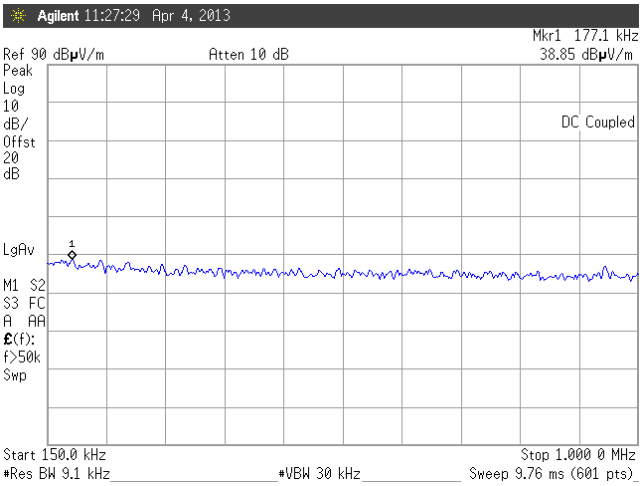
Operating at 2480 MHz: 9 kHz ~ 150 kHz (@ 3-m distance)



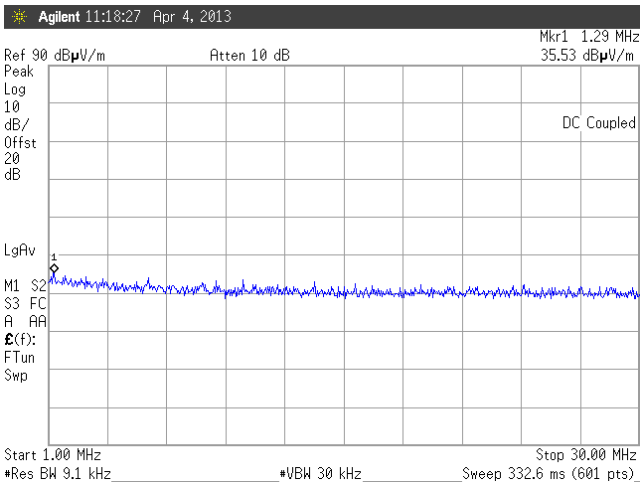
Operating at 2405 MHz: 150 kHz ~ 1 MHz (@ 3-m distance)



Operating at 2480 MHz: 150 kHz ~ 1 MHz (@ 3-m distance)



Operating at 2405 MHz: 1 MHz ~ 30 MHz (@ 3-m distance)



Operating at 2480 MHz: 1 MHz ~ 30 MHz (@ 3-m distance)

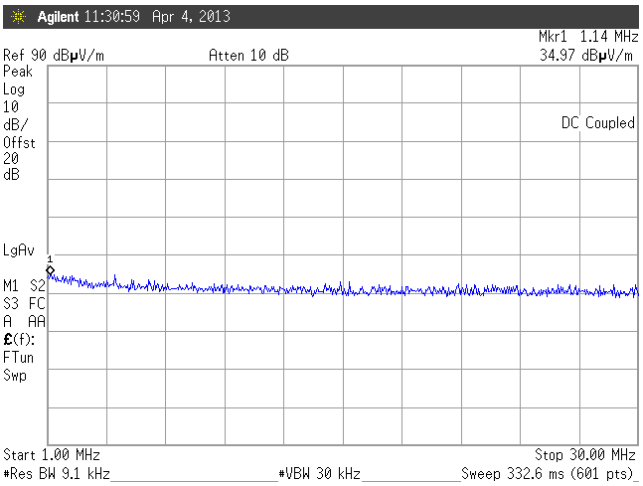
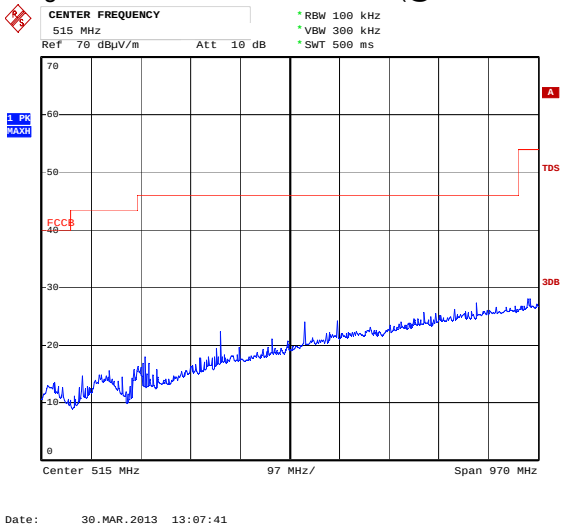
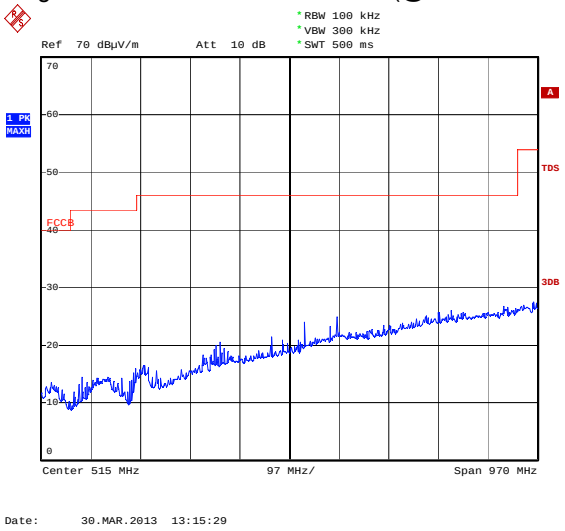


Figure 6. Emission plot for the preliminary radiated measurements *(continued)*

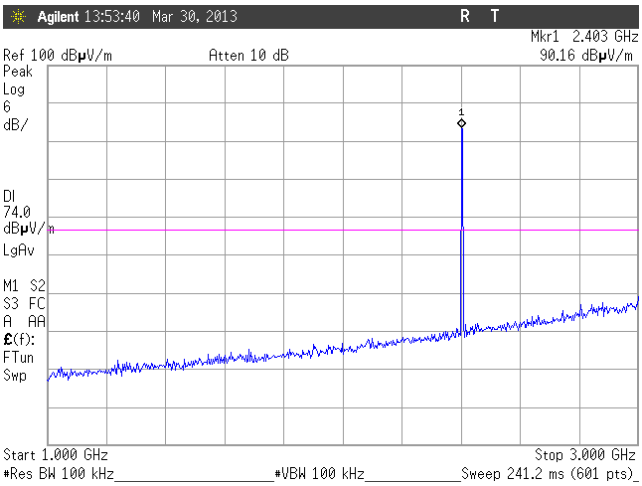
Operating at 2405 MHz: 30 MHz ~ 1 GHz (@ 3-m distance)



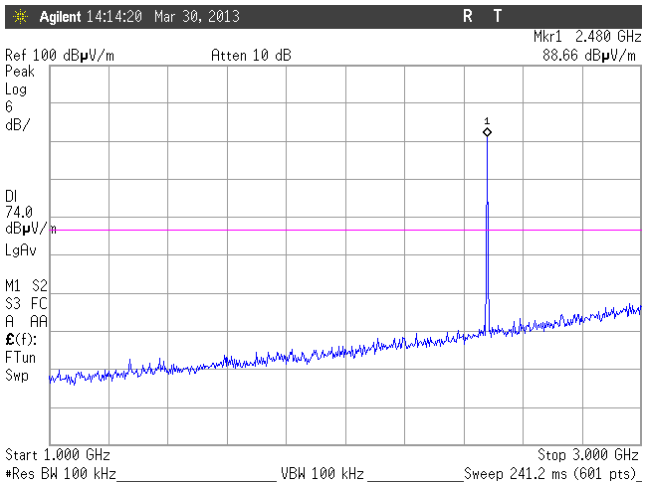
Operating at 2480 MHz: 30 MHz ~ 1 GHz (@ 3-m distance)



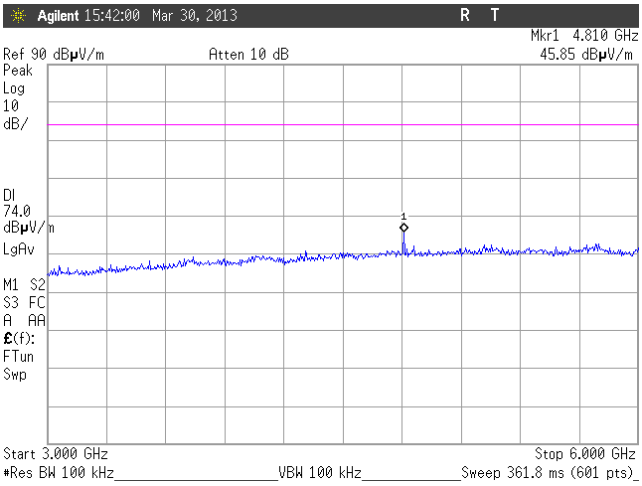
Operating at 2405 MHz: 1 GHz ~ 3 GHz (@ 3-m distance)



Operating at 2480 MHz: 1 GHz ~ 3 GHz (@ 3-m distance)



Operating at 2405 MHz: 3 GHz ~ 6 GHz (@ 3-m distance)



Operating at 2480 MHz: 3 GHz ~ 6 GHz (@ 3-m distance)

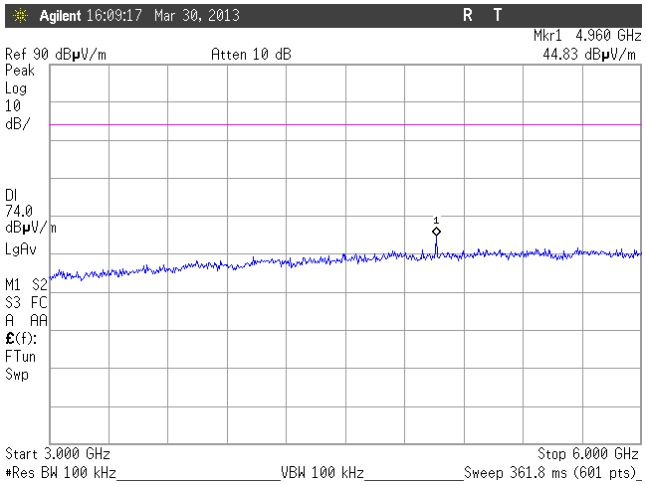
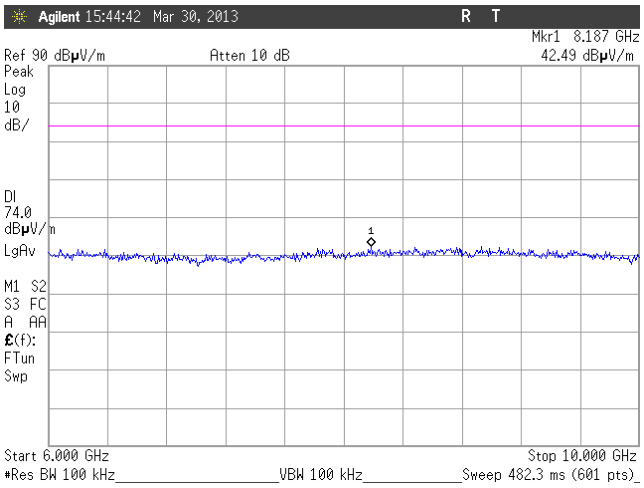
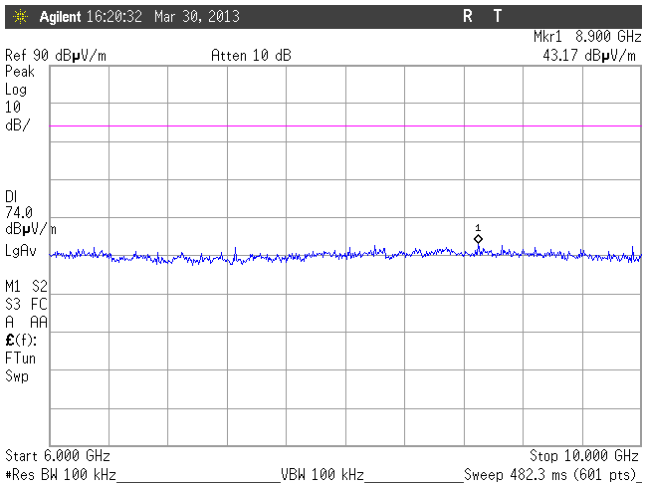


Figure 6. Emission plot for the preliminary radiated measurements *(continued)*

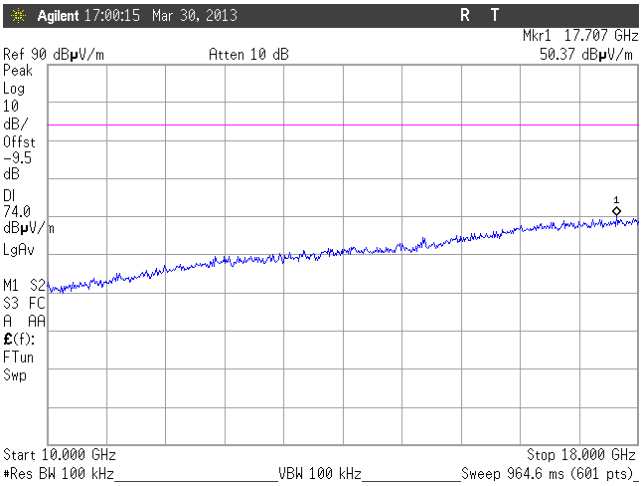
Operating at 2405 MHz: 6 GHz ~ 10 GHz (@ 3-m distance)



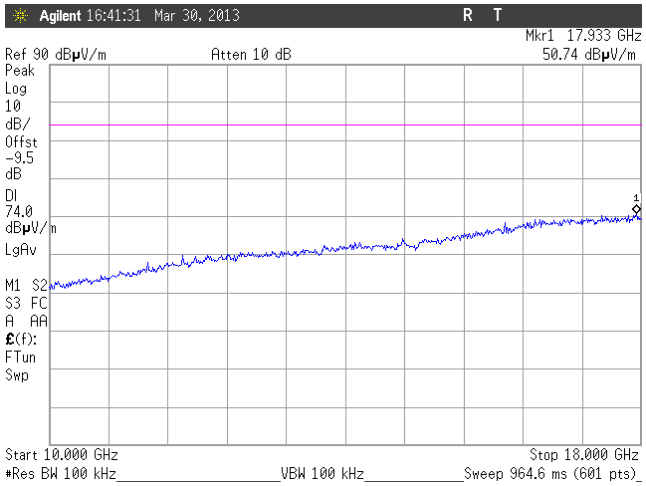
Operating at 2480 MHz: 6 GHz ~ 10 GHz (@ 3-m distance)



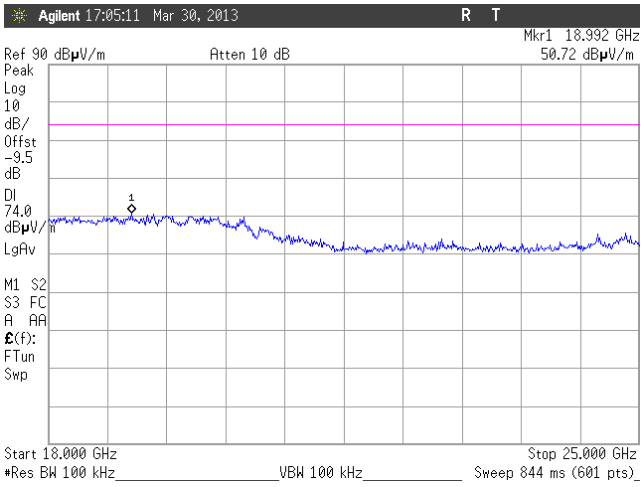
Operating at 2405 MHz: 10 GHz ~ 18 GHz (@ 1-m distance)



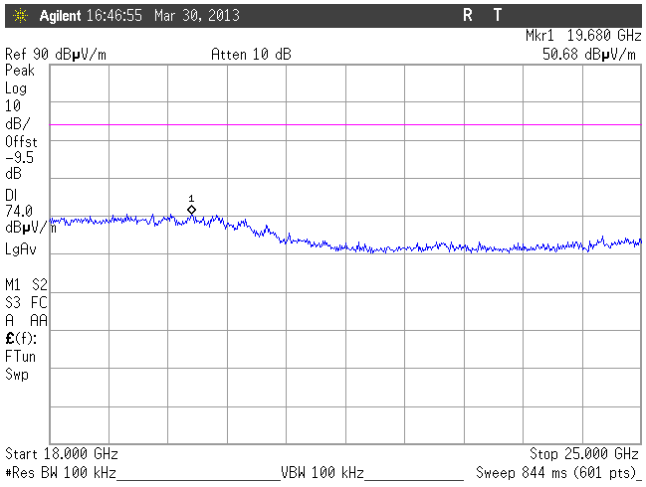
Operating at 2480 MHz: 10 GHz ~ 18 GHz (@ 1-m distance)



Operating at 2405 MHz: 18 GHz ~ 25 GHz (@ 1-m distance)



Operating at 2480 MHz: 18 GHz ~ 25 GHz (@ 1-m distance)



5.5. Peak power spectral density

5.5.1 Regulation

According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

5.5.2 Test Procedure(Measurement Procedure PKPSD, Option 1)

Set the spectrum analyzer as follows:

1. Set analyzer center frequency to DTS channel center frequency.
2.Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW ≥ 3 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.5.3 Test Results: PASS

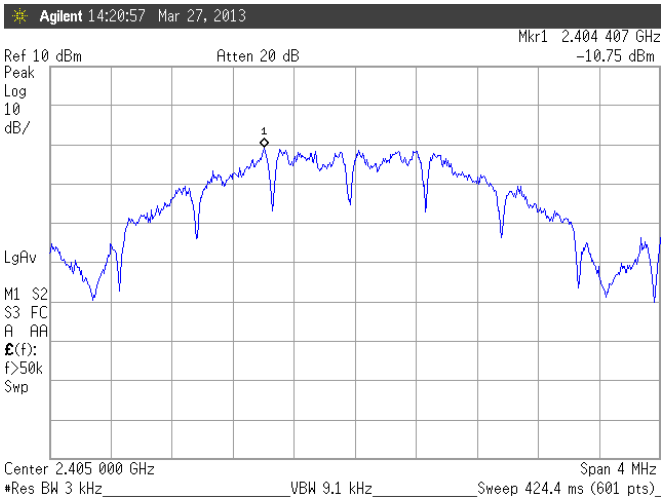
Table 4: Measured values of the Peak Power Spectral Density (Conducted)

Operating frequency	Measured Value (PPSD)	Limit
2405 MHz	-10.75	8.0 dBm
2440 MHz	-10.87	8.0 dBm
2480 MHz	-11.27	8.0 dBm

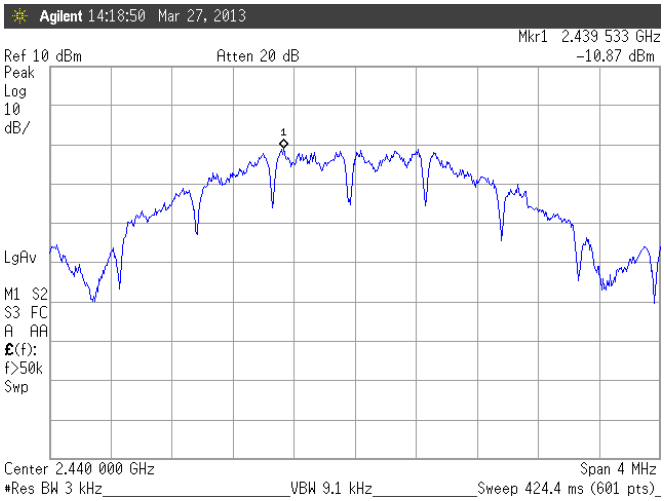
NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

Figure 7. Plot of the Peak Power Spectral Density

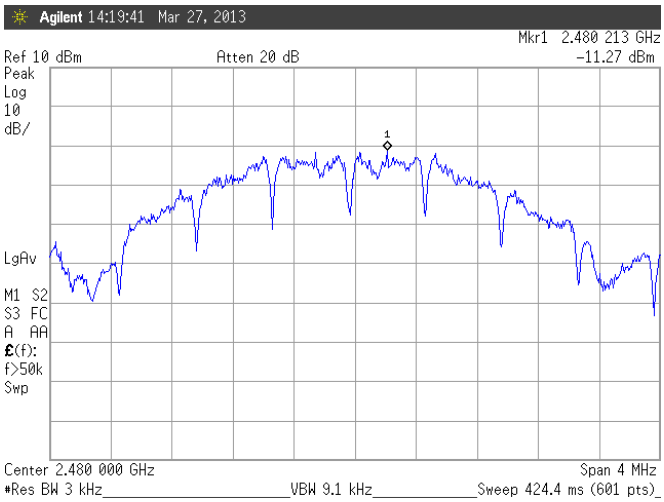
Lowest Channel (2405 MHz)



Middle Channel (2440 MHz)



Highest Channel (2480 MHz)



5.6. RF Exposure

5.6.1 Regulation

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

5.6.2 RF Exposure Compliance Issue

The test exclusion criteria of KDB447498 was applied and the documentation for RF Exposure test exclusion was separately submitted.