ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name:	**ZigBee module**
Brand Name:	**N/A**
Model No.:	**DFZM-TS210-DT0R, DFZM-TS211-DT0R**
Model Difference:	**DFZM-TS210-DT0R use external antenna & DFZM-TS211-DT0R use build-in antenna**
FCC ID:	**H79DFZM-TS210**
Report No.:	**ER/2013/80008**
Issue Date:	**Oct. 04, 2013**
FCC Rule Part:	**§15.247, Cat: DTS**
Prepared for:	**Delta Electronics, Inc. 252 Shangying Road, Guishan Industrial Zone, Taoyuan County 33341, Taiwan, R.O.C.**
Prepared by:	**SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803**

Testing Laboratory
0513

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VERIFICATION OF COMPLIANCE

Applicant:	Delta Electronics, Inc. 252 Shangying Road, Guishan Industrial Zone, Taoyuan County 33341, Taiwan, R.O.C.
Product Name:	ZigBee module
Brand Name:	N/A
Model No.:	DFZM-TS210-DT0R, DFZM-TS211-DT0R
Model Difference:	DFZM-TS210-DT0R use external antenna & DFZM-TS211-DT0R use build-in antenna
FCC ID:	H79DFZM-TS210
File Number:	ER/2013/80008
Date of test:	Aug. 02, 2013 ~ Sep. 18, 2013
Date of EUT Received:	Aug. 02, 2013

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4:2009 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247.
The test results of this report relate only to the tested sample identified in this report.

Test By:	Marcus Tseng	***Date***	Oct. 04, 2013
	Marcus Tseng / Engineer		
Prepared By:	Violetta Tang	***Date***	Oct. 04, 2013
	Violetta Tang / Clerk		
Approved By:	Jim Chang	***Date***	Oct. 04, 2013
	Jim Chang / Supervisor		

Version

Version No.	Date	Description
00	Oct. 04, 2013	Initial creation of document

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1 GENERAL INFORMATION

1.1 Product description

General:

Product Name:	ZigBee module
Brand Name:	N/A
Model No.:	DFZM-TS210-DT0R, DFZM-TS211-DT0R
Model Difference:	DFZM-TS210-DT0R use external antenna & DFZM-TS211-DT0R use build-in antenna
Hardware Version:	N/A
Software Version:	N/A
Power Supply:	3.0Vdc from Test Kit
Operation Frequency:	2405~2480MHz
Channel number:	16 channels
Channel Spacing:	5MHz
Modulation Type:	DSSS
Rated Power:	20.27dBm (Peak)
Antenna Designation:	External Dipole Antenna: 2.00dBi, P/N: AR007WSW01A03, for DFZM-TS210-DT0R Multilayer Ceramic Antenna: 2.00dBi, P/N: RFANT3216120A5T, for DFZM-TS211-DT0R

The EUT is in compliance with FCC §15.247.

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: H79DFZM-TS210** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system (digital device) is compliance with Subpart B under the DoC procedure.

1.3 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4:2009. Radiated testing was performed at an antenna to EUT distance 3 meters.

Tested in accordance with Apr 2013 KDB558074 D01 V03 for compliance to FCC 47CFR 15.247 requirements.

1.4 Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, Wuku Industrial Zone, Taipei County, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4:2009. FCC Registration Number is: 990257. Canada Registration Number: 4620A-4.

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No. 29, Pau-Tou-Tsuo Valley Chia-Pau Tsuen, Linkou Hsiang, Taipei county, which is constructed and calibrated to meet the CISPR 22/EN 55022 requirements. SGS Site No. 1(3 &10 meters) and FCC Registration Number: 94644.

1.5 Special Accessories

There are no special accessories used while test was conducted.

1.6 Equipment Modifications

There was no modification incorporated into the EUT.

2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

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

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the general criterion in Section 7.1 of ANSI C63.4:2009.Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz, and the measurement procedure 7.3 in ANSI 63.4:2009 is followed to carry out the test. The CISPR Quasi-Peak and Average detector mode is employed according to §15.107

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna. according to the requirements in Section 8 and 13 and of ANSI C63.4:2009,

2.4 Configuration of Tested System

Fig. 2-1 Radiated Emission & Conducted (Antenna Port) Configuration

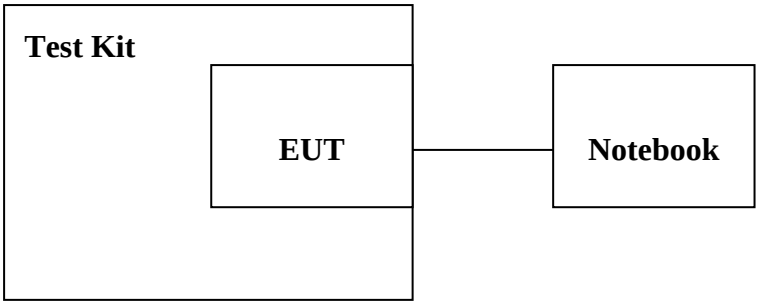


Fig. 2-2 AC Power Line Conducted Emission

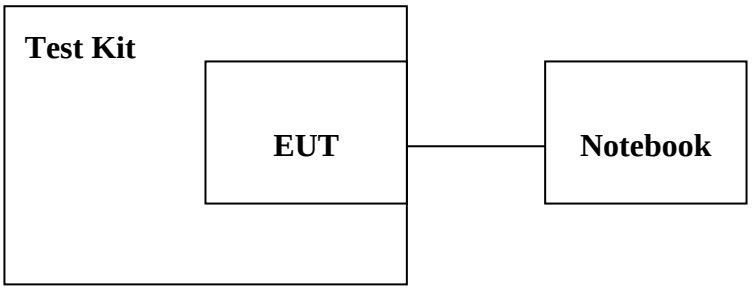


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Test Software	SmartRF Studio 7	1.9.1	N/A	N/A	N/A
2.	Notebook	Lenovo	R400	7440AV6	N/A	N/A
3.	Test Kit	N/A	N/A	N/A	N/A	N/A

3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(a)(2)	6dB Bandwidth	Compliant
§15.247(d)	100 KHz Bandwidth Of Frequency Band Edges	Compliant
§15.247(d)	Spurious Emission	Compliant
§15.247(e)	Peak Power Density	Compliant
§15.203	Antenna Requirement	Compliant

4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition.
Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low (2405MHz)、mid (2440MHz) and high (2480MHz) with highest data rate are chosen for full testing.

5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 1.55dB (for Spectrum) +/- 1.42 dB (for Power Meter)
6dB Bandwidth	+/- 123.36 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 1.55 dB
Peak Power Density	+/- 1.55 dB
Temperature	+/- 0.8 °C
Humidity	+/- 4.7 %
DC / AC Power Source	DC= +/- 1%, AC=+/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : **Vertical**)	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : **Horizontal**)	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

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

6 CONDUCTED EMISSION TEST

6.1 Standard Applicable:

According to §15.207, frequency range within 150KHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

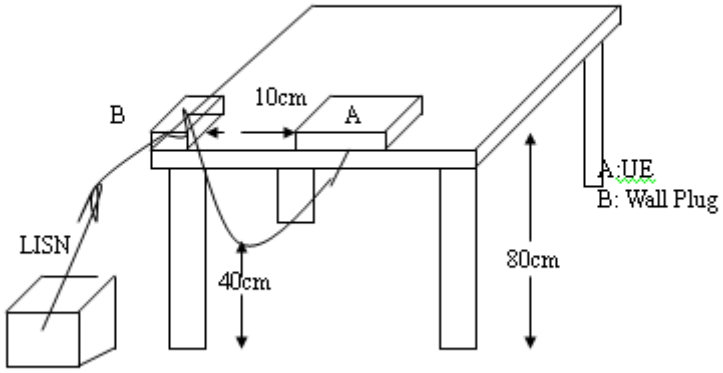
6.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
EMI Test Receiver	R&S	ESCI7	100759	02/08/2013	02/07/2014
EMI Receiver	R&S	ESCS 30	828985/004	09/23/2012	09/22/2013
LISN	Rolf-Heine	NNB-2/16Z	99012	03/23/2013	03/22/2014
LISN	FCC	FCC-LISN-50/250-25-2-01	04034	03/23/2013	03/22/2014
Coaxial Cables	N/A	WK CE Cable	N/A	01/05/2013	01/04/2014

6.3 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4:2009.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

6.6 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit

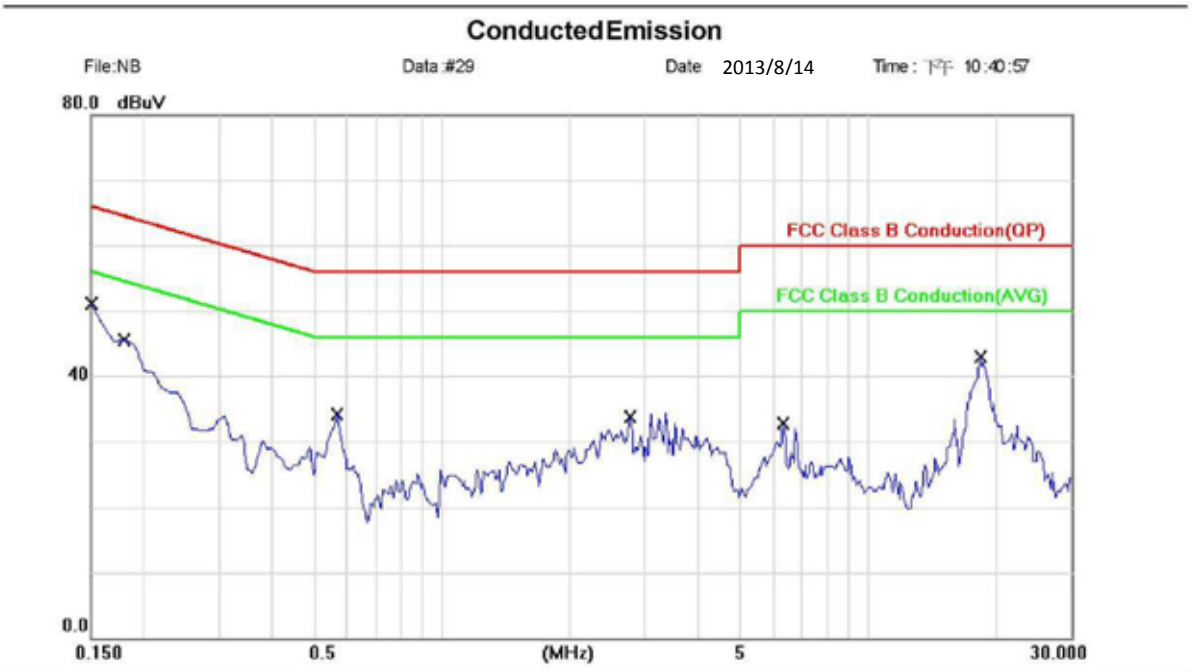
AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode			Test Date:	Aug. 14, 2013
Temperature:	26 ℃	Humidity:	60 %	Test By:	Marcus

Site ConductionRoom
Limit: FCC Class B Conduction(QP)
EUT: ZigBeemodule
M/N: DFZM-TS210-DT0R,DFZM-TS211-DT0R
Note:

Phase: L1
Power: AC 120V/60Hz
Distance:
Mode: Operationmode

Temperature: 26 ℃
Humidity: 60%

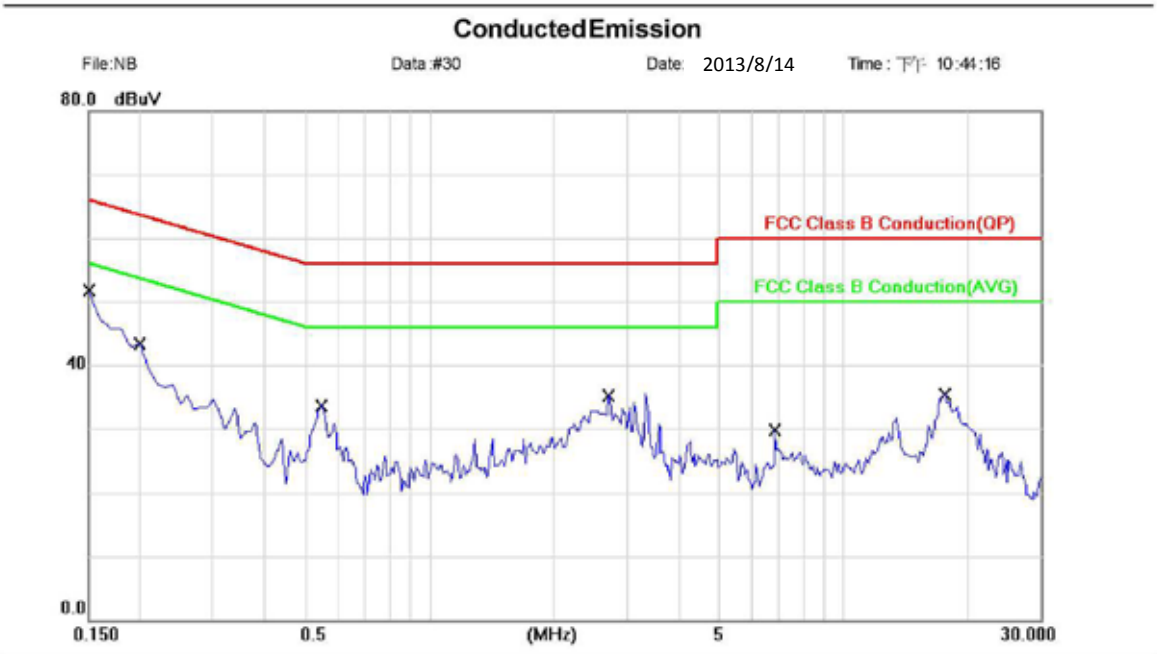


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1500	51.04	0.16	51.20	66.00	-14.80	QP	
2		0.1800	45.39	0.16	45.55	64.49	-18.94	QP	
3		0.5700	33.88	0.17	34.05	56.00	-21.95	QP	
4		2.7700	33.54	0.23	33.77	56.00	-22.23	QP	
5		6.3400	32.40	0.30	32.70	60.00	-27.30	QP	
6		18.3600	42.58	0.42	43.00	60.00	-17.00	QP	

Site ConductionRoom
Limit: FCC Class B Conduction(QP)
EUT: ZigBeemodule
M/N: DFZM-TS210-DT0R,DFZM-TS211-DT0R
Note:

Phase: N
Power: AC 120V/60Hz
Distance:
Mode: Operationmode

Temperature: 26 ℃
Humidity: 60%



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1500	51.58	0.18	51.76	66.00	-14.24	QP	
2		0.2000	43.19	0.19	43.38	63.61	-20.23	QP	
3		0.5500	33.39	0.21	33.60	56.00	-22.40	QP	
4		2.7200	34.87	0.27	35.14	56.00	-20.86	QP	
5		6.8600	29.43	0.36	29.79	60.00	-30.21	QP	
6		17.6400	34.82	0.53	35.35	60.00	-24.65	QP	

7 PEAK OUTPUT POWER MEASUREMENT

7.1 Standard Applicable:

According to §15.247 (b)

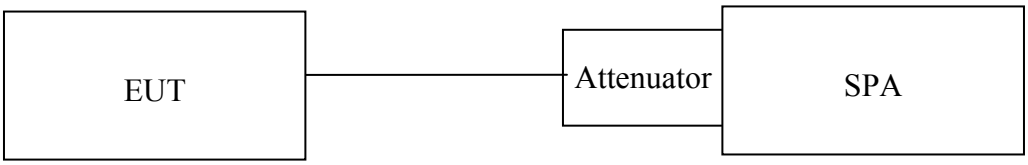
(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined 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.

(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.

7.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
Power Meter	Anritsu	ML2495A	1005007	02/08/2012	02/07/2014
Power Sensor	Anritsu	MA2411B	917032	02/08/2012	02/07/2014
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/30/2013	05/29/2014
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/15/2013	03/14/2014
DC Block	Mini-Circuits	BLK-18-S+	1	02/28/2013	02/27/2014
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/05/2013	01/04/2014
Attenuator	Mini-Circuit	BW-S10W2+	002	02/28/2013	02/27/2014
Splitter	Agilent	11636B	N/A	02/28/2013	02/27/2014

7.3 Test Set-up:



7.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (**Peak power setting on Spectrum:** Channel power function, RBW = 1MHz, VBW = 3MHz, Span: 30/60MHz, Detector =peak, Sweep = Auto. Setting on spectrum is adjusted based on the mandatory procedure in 9.1.2 of the KDB558074). Power Meter is used as the auxiliary test equipment to conduct the output power measurement. 9.1.3 in KDB558074 is followed.
   (**Avg. power setting on Spectrum:** Channel power function, RBW = 1MHz, VBW = 3MHz, Span: 30/60MHz, Detector =Avg., Trace avg =100, Sweep = Auto, Setting on spectrum is adjusted based on the mandatory procedure in 9.2.2.4 of the KDB558074). Power Meter is used as the auxiliary test equipment to conduct the output power measurement. 9.2.3, option 3 in KDB558074 is followed.
3. Record the max. Reading as observed from Spectrum or Power Meter.
4. Repeat above procedures until all frequency of interest measured was complete.
5. For MIMO operation, measurement is done per chain basis, and then sum the simultaneous transmitting output in linear.

Pre-anaysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle. All duty cycle is pre-scanned, resulted as obtained below, and showed only the most representative ones
Tabular results as indicates below entails the results of duty factor for all supported modes.

Formula:

Duty Cycle = Ton / (Ton+Toff)

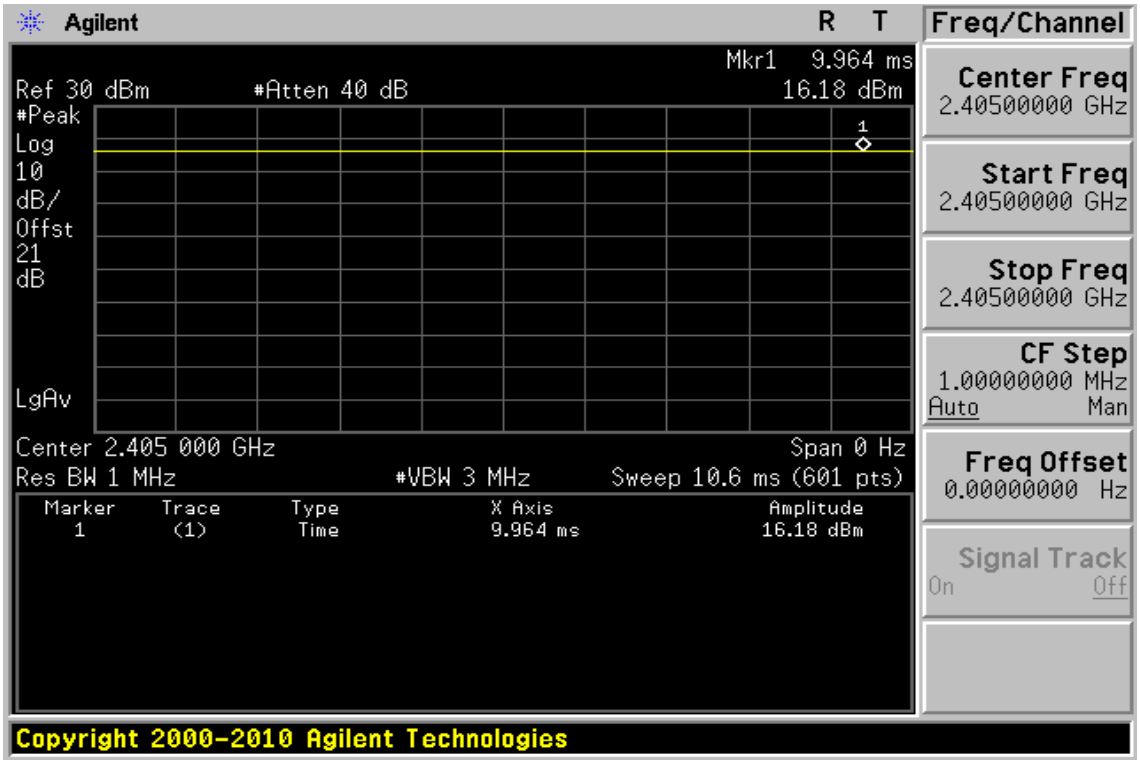
Test Procedure:

Set span = 0, RBW = 1MHz, VBW = 3MHz, Detector = Peak

Duty Cycle:

Duty Cycle	Duty Factor (dBm)
0.9964	0

Duty Factor:

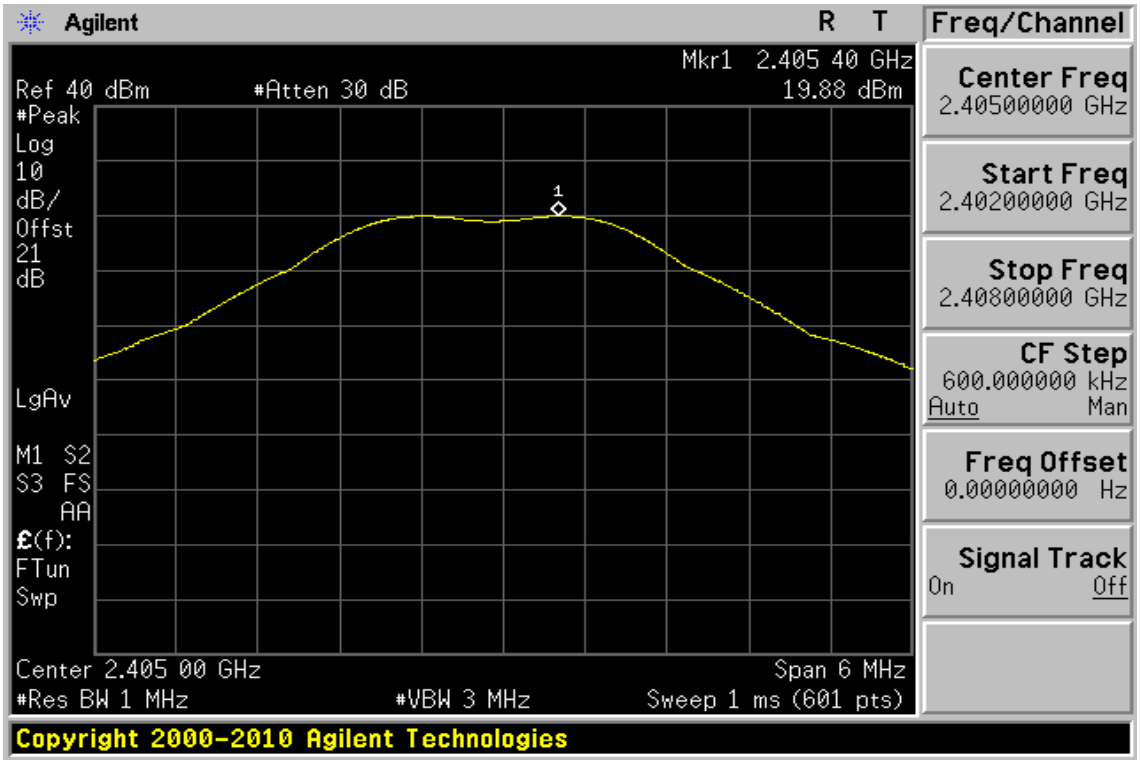


7.5 Measurement Result:

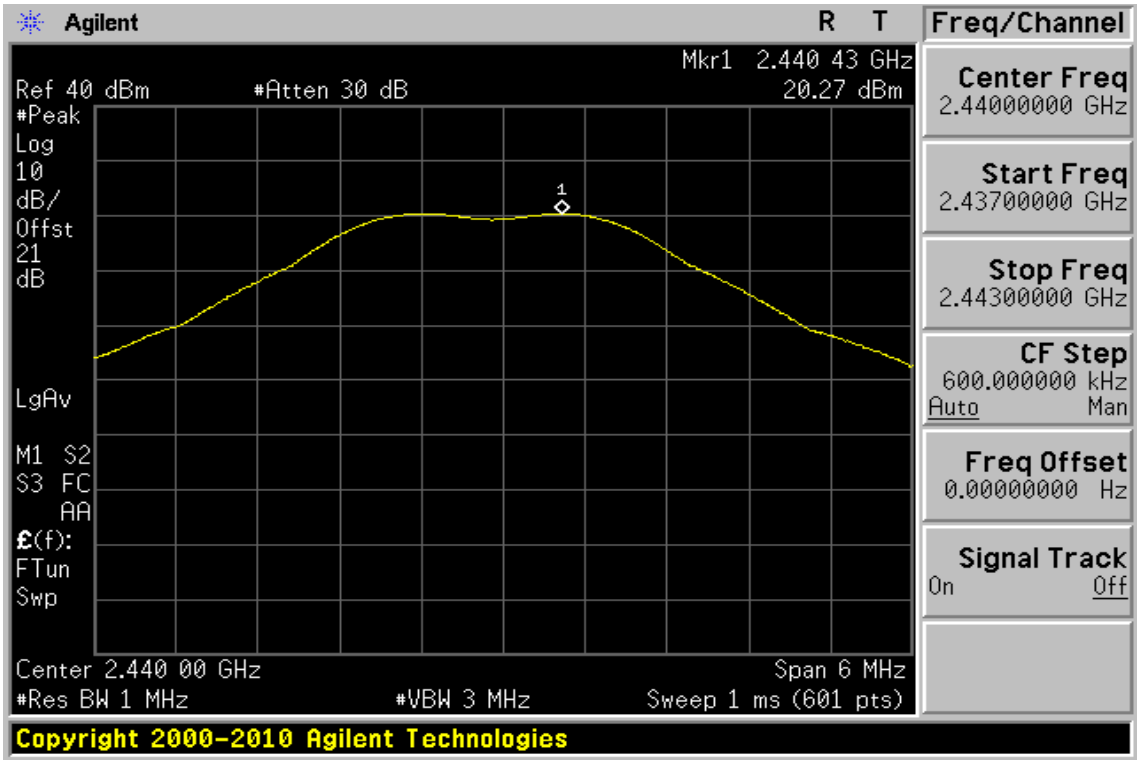
Frequency (MHz)	Peak Power Output (dBm)	Required Limit
2405	19.88	1 Watt = 30 dBm
2440	20.27	1 Watt = 30 dBm
2480	11.98	1 Watt = 30 dBm

**** Note: The duty cycle factor is compensated back to obtain the maximum value of the measurement in average.***

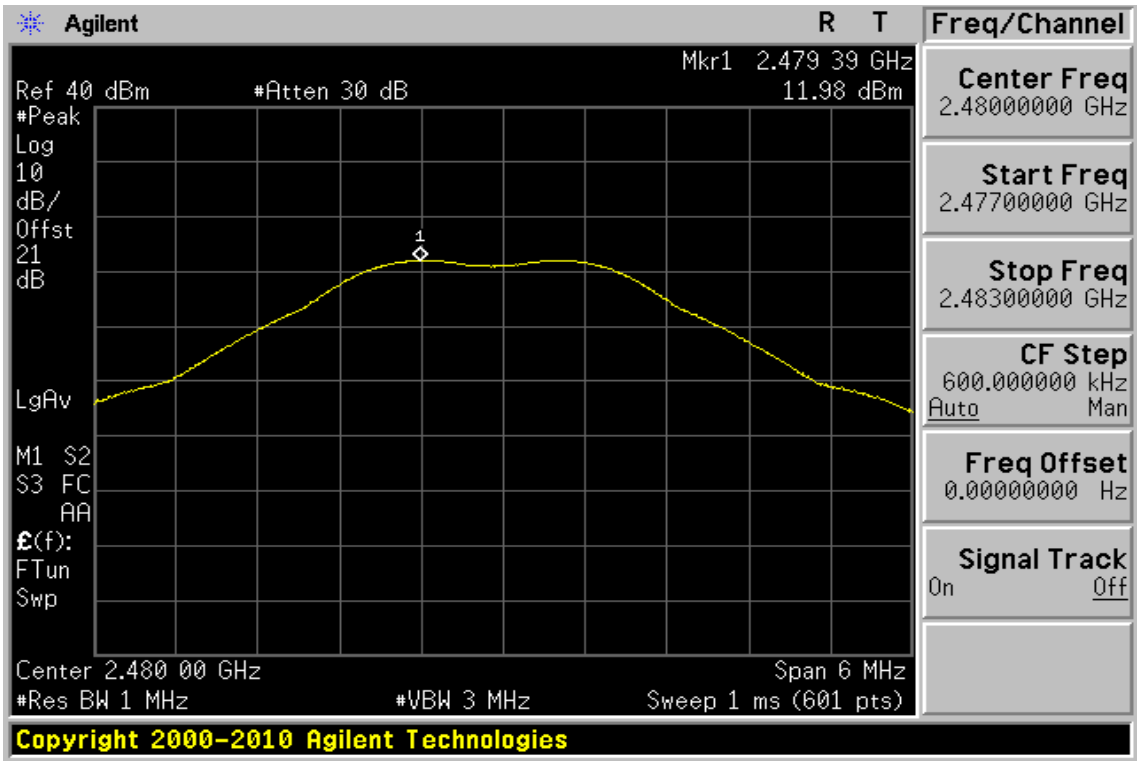
Peak Output Power Test Data CH-Low



Peak Output Power Test Data CH-Mid



Peak Output Power Test Data CH-High



8 6dB BANDWIDTH

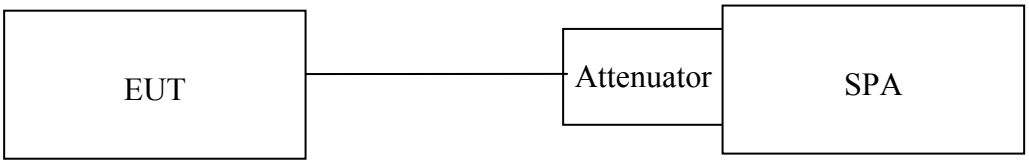
8.1 Standard Applicable:

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 6 dB bandwidth shall be at least 500kHz.

8.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
Power Meter	Anritsu	ML2495A	1005007	02/08/2012	02/07/2014
Power Sensor	Anritsu	MA2411B	917032	02/08/2012	02/07/2014
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/30/2013	05/29/2014
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/15/2013	03/14/2014
DC Block	Mini-Circuits	BLK-18-S+	1	02/28/2013	02/27/2014
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/05/2013	01/04/2014
Attenuator	Mini-Circuit	BW-S10W2+	002	02/28/2013	02/27/2014
Splitter	Agilent	11636B	N/A	02/28/2013	02/27/2014

8.3 Test Set-up:



8.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 100 kHz, VBW = 3*RBW, Span = 10M, Detector=Peak, Sweep=auto, the setting on spectrum is adjusted based on the procedure as guide in 8.1 option 1 of KDB558074.
4. Mark the peak frequency and –6dB (upper and lower) frequency.
5. Repeat above procedures until all frequency of interest measured was complete.

8.5 Measurement Result:

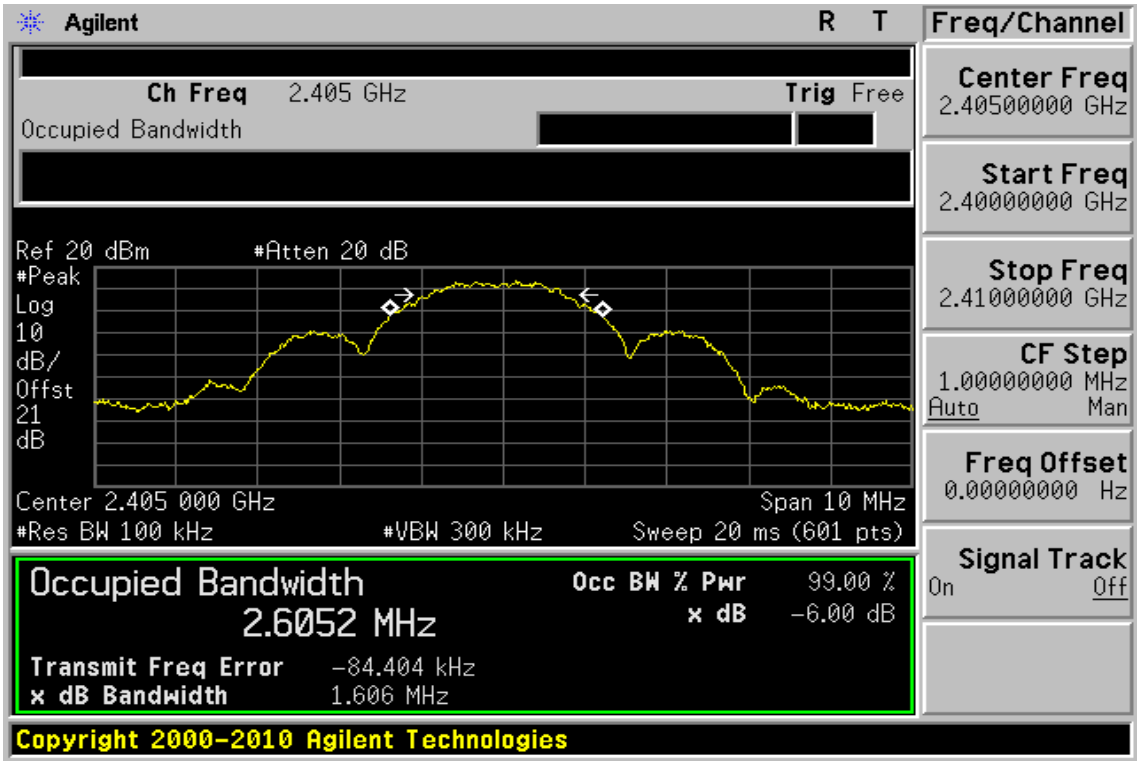
Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Result
2405	1606	> 500	PASS
2440	1580	> 500	PASS
2480	1620	> 500	PASS

** Note: Offset 21dB*

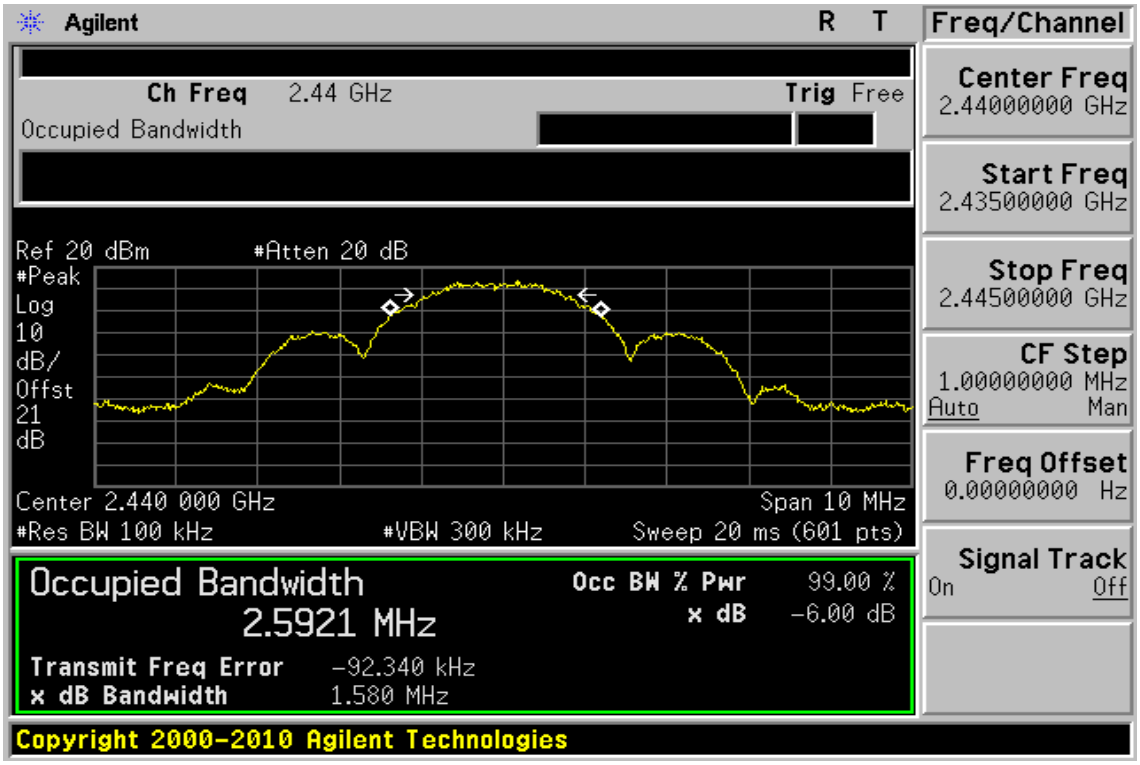
** Note: The diamond reveals X decibel level*

**Refer to next page for plots.*

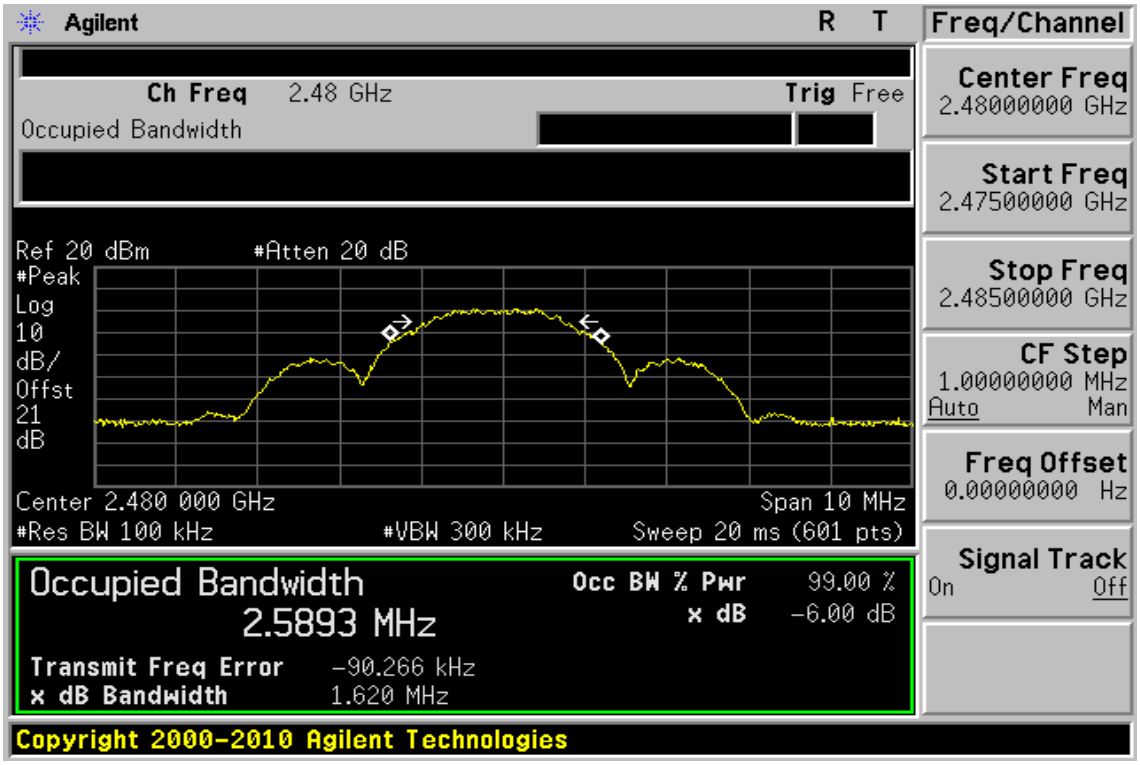
6dB Band Width Test Data CH-Low



6dB Band Width Test Data CH-Mid



6dB Band Width Test Data CH-High



9 BAND EDGES MEASUREMENT

9.1 Standard Applicable:

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in15.209(a).

9.2 Measurement Equipment Used:

9.2.1 Conducted Emission at antenna port:

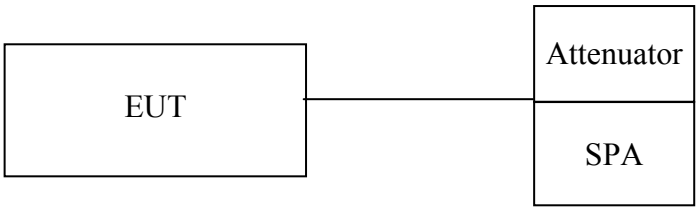
Refer to section 7.2 for details.

9.2.2 Radiated emission:

966 Chamber					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
EMI Test Receiver	R&S	ESCI7	100759	02/08/2013	02/07/2014
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/30/2013	05/29/2014
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	02/06/2013	02/07/2014
Spectrum Analyzer	R&S	FSV-30	101398	10/18/2011	10/17/2013
Bilog Antenna	SCHWAZBECK	VULB9168	378	01/10/2012	01/09/2014
Horn antenna	ETS.LINDGREN	3117	123995	05/31/2013	05/30/2014
Horn Antenna	Schwarzbeck	BBHA9170	184	01/17/2012	01/16/2014
Pre-Amplifier	Agilent	8447D	2944A07676	01/04/2013	01/03/2014
Pre-Amplifier	EMC Instruments Corp.	EMC0126530	980038	01/04/2013	01/03/2014
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M2	02/28/2013	02/28/2014
5725-5875 Band Reject Filter	Micro-Tronics	BRM50705	1	01/04/2013	01/03/2014
Attenuator	Mini-Circuit	BW-S10W2+	004	02/28/2013	02/27/2014
Attenuator	Mini-Circuit	BW-S10W2+	004	02/28/2013	02/27/2014
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	HD	MA240-N	240/657	N.C.R	N.C.R
Controller	HD	HD100	N/A	N.C.R	N.C.R
Low Loss Cable	Huber Suhner	966_Rx	9	01/04/2013	01/03/2014
3m Site NSA	SGS	966 chamber	N/A	07/15/2013	07/14/2014

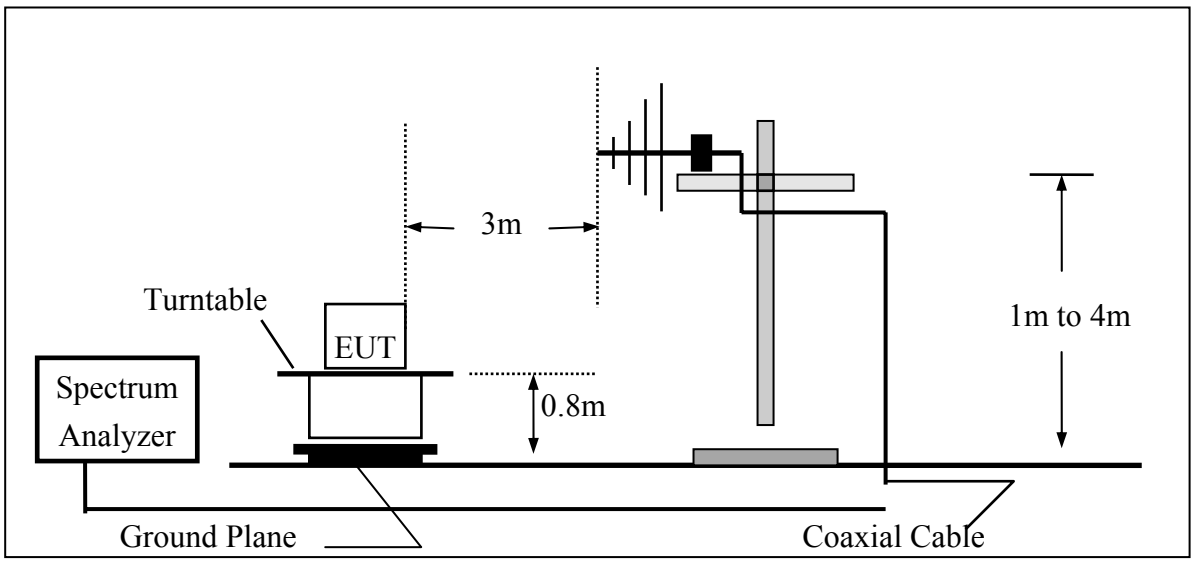
9.3 Test SET-UP:

9.3.1 Conducted Emission at antenna port:

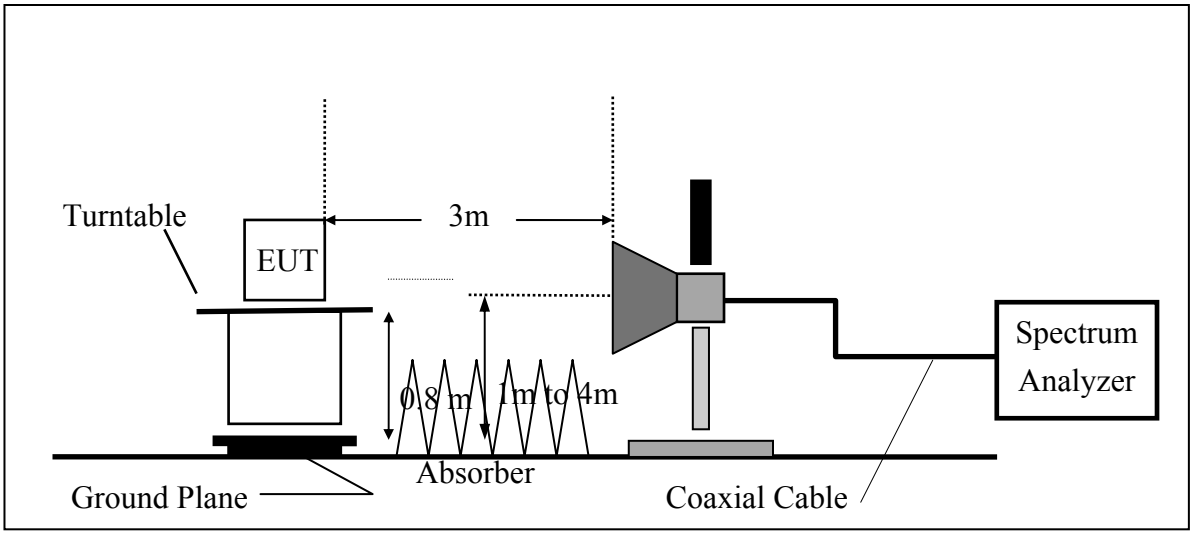


9.3.2 Radiated emission:

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-UP Frequency Over 1 GHz



9.4 Measurement Procedure:

Unwanted Emissions into Non-Restricted Frequency Bands, Measurement Procedure followed by 11.1 of KDB558074 D01

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
4. Set the spectrum analyzer as RBW, VBW=300KHz, Detector = Peak, Sweep = auto
5. Mark the highest reading of the emission as the reference level measurement.
6. Set DL as the limit = reading on marker 1 – 20dBm
7. Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 KHz immediately outside the authorized (2400~2483.5) be attenuated by 20dB at least relative to the maximum emission of power.
8. Repeat above procedures until all default test channel (low, middle, and high) was complete.

Unwanted Emission falling into Restricted Frequency Bands, Measurement Procedure followed by 12.1 of KDB558074 D01

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. On spectrum, following 8.1.2, and RBW = 1MHz, VBW = 3MHz, & Marker 2390MHz, and 2483.5MHz (Peak Measurement). Average Measurement: following 8.2 with the modification span to 1MHz, &RBW = 1MHz, VBW = 3MHz and peak marker function to obtain the highest reading on 2390, and 2483.5MHz.
8. Repeat above procedures until all default test channel (low, middle, and high) was complete

9.5 Field Strength Calculation:

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

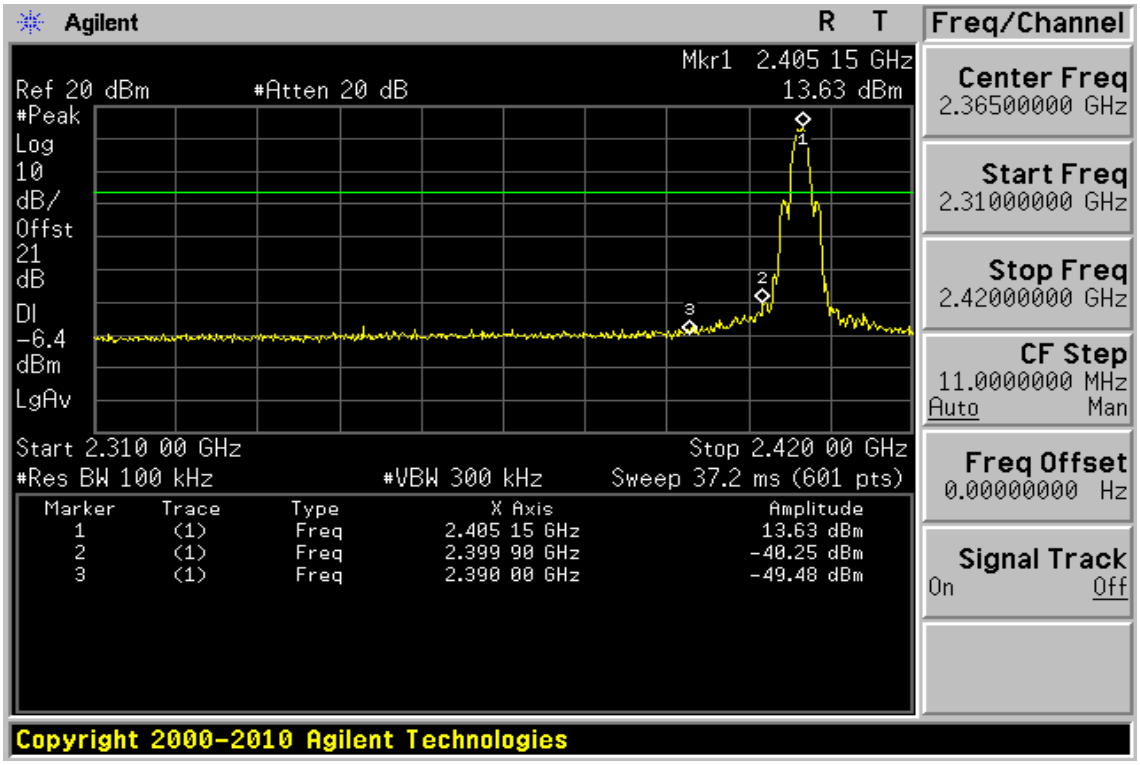
Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

9.6 Measurement Result:

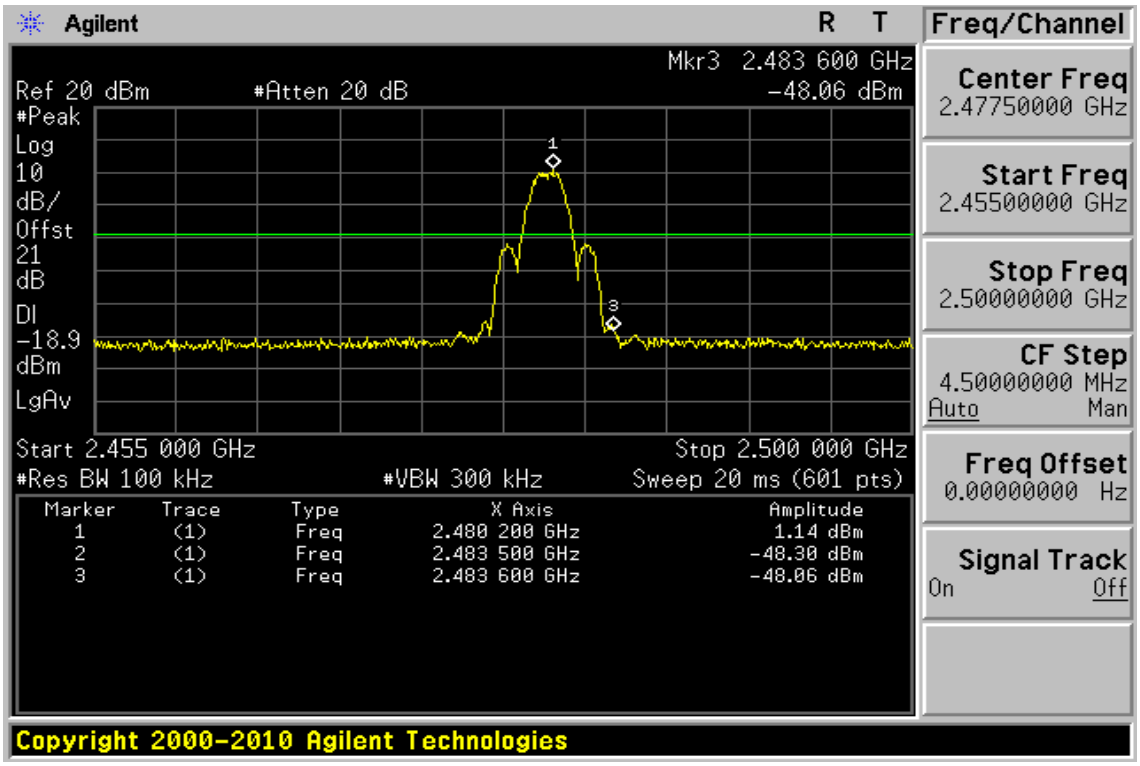
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

Unwanted Emissions into Non-Restricted Frequency Bands

Band Edges Test Data CH-Low



Band Edges Test Data CH-High



Radiated Emission:

(Unwanted Emissions into Restricted Frequency Bands)-Internal Antenna-DFZM-TS211-DT0R

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:Bandedge LOW	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2390.00	E	Average	27.16	2.51	29.67	54.00	-24.33
2390.00	E	Peak	61.24	2.51	63.75	74.00	-10.25

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:Bandedge LOW	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2390.00	E	Average	27.21	3.13	30.34	54.00	-23.66
2390.00	E	Peak	61.18	3.13	64.31	74.00	-9.69

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2475 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:Bandedge HIGH	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2483.50	E	Average	26.86	2.80	29.66	54.00	-24.34
2483.50	E	Peak	59.53	2.80	62.33	74.00	-11.67

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2475 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:Bandedge HIGH	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2483.50	E	Average	27.51	3.83	31.34	54.00	-22.66
2483.50	E	Peak	52.57	3.83	56.40	74.00	-17.60

Radiated Emission:

(Unwanted Emissions into Restricted Frequency Bands)-External Antenna-DFZM-TS210-DT0R

Operation Band	:2.4G ZigBee	Test Date	:2013-08-29
Fundamental Frequency	:2405 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:Bandedge LOW	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2390.00	E	Average	27.34	2.51	29.85	54.00	-24.15
2390.00	E	Peak	65.84	2.51	68.35	74.00	-5.65

Operation Band	:2.4G ZigBee	Test Date	:2013-08-29
Fundamental Frequency	:2405 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:Bandedge LOW	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2390.00	E	Average	26.99	3.13	30.12	54.00	-23.88
2390.00	E	Peak	63.46	3.13	66.59	74.00	-7.41

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:Bandedge HIGH	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2483.50	E	Average	27.17	2.80	29.97	54.00	-24.03
2483.50	E	Peak	68.97	2.87	71.84	74.00	-2.16

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:Bandedge HIGH	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2483.50	E	Average	26.48	3.83	30.31	54.00	-23.69
2483.50	E	Peak	69.45	3.83	73.28	74.00	-0.72

10 SPURIOUS EMISSION TEST

10.1 Standard Applicable

According to §15.247(d),

Emission at antenna port:

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.

Radiated Spurious Emission

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

10.2 Measurement Equipment Used:

10.2.1 Conducted Emission at antenna port:

Refer to section 7.2 for details.

10.2.2 Radiated emission:

Refer to section 9.2.2 for details.

10.3 Test SET-UP:

10.3.1 Conducted Emission at antenna port:

Refer to section 7.3 for details.

10.3.2 Radiated emission:

Refer to section 9.3.2 for details.

10.4 Measurement Procedure:

Radiated Emission:

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
7. Repeat above procedures until all default test channel measured were complete.

Conducted Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. Set RBW = 100K & VBW = 300K on Spectrum.
3. Sweep the frequency to determine spurious emission as seen on spectrum from span of 30 to 3G, 3G to 8G, 8G to 13G, 13G to 18G and 18G to 26.5GHz, 18G to 40GHz (applicable if operation mode is 5GHz)
4. Via Software, combine 5 spans of frequency range into one plot
5. Repeat above procedures until all default test channel measured were complete.

10.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

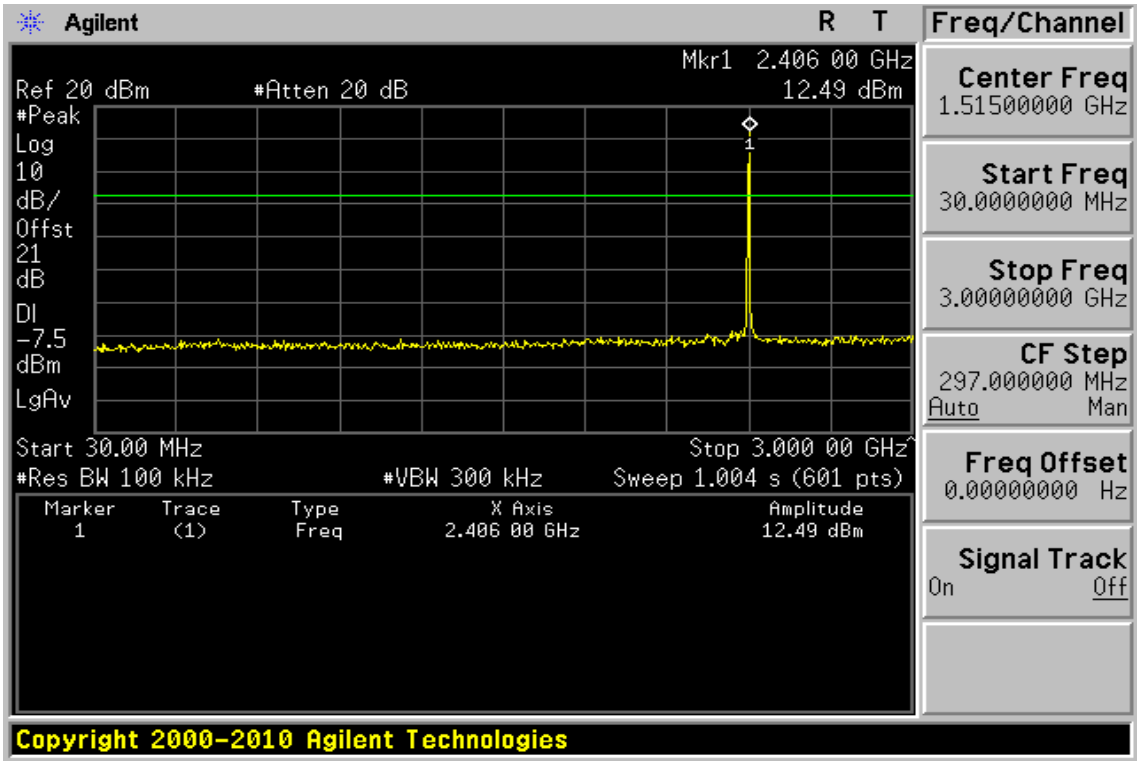
Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

10.6 Measurement Result:

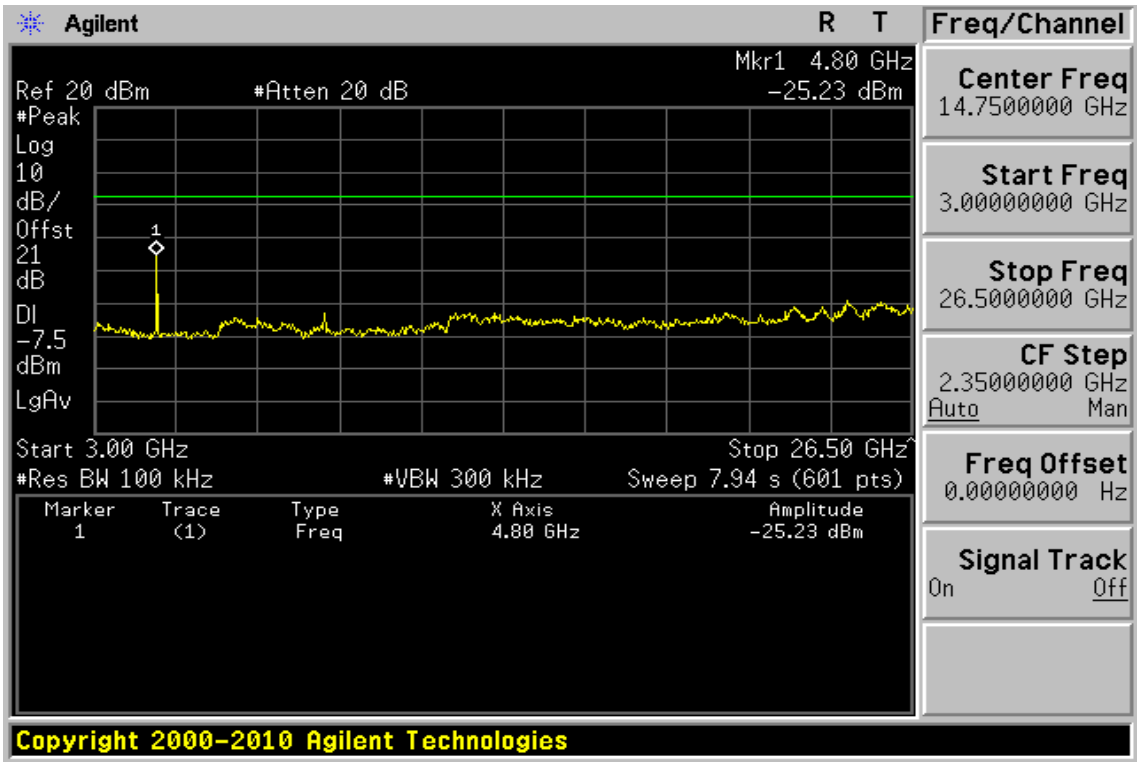
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

Conducted Spurious Emission Measurement Result

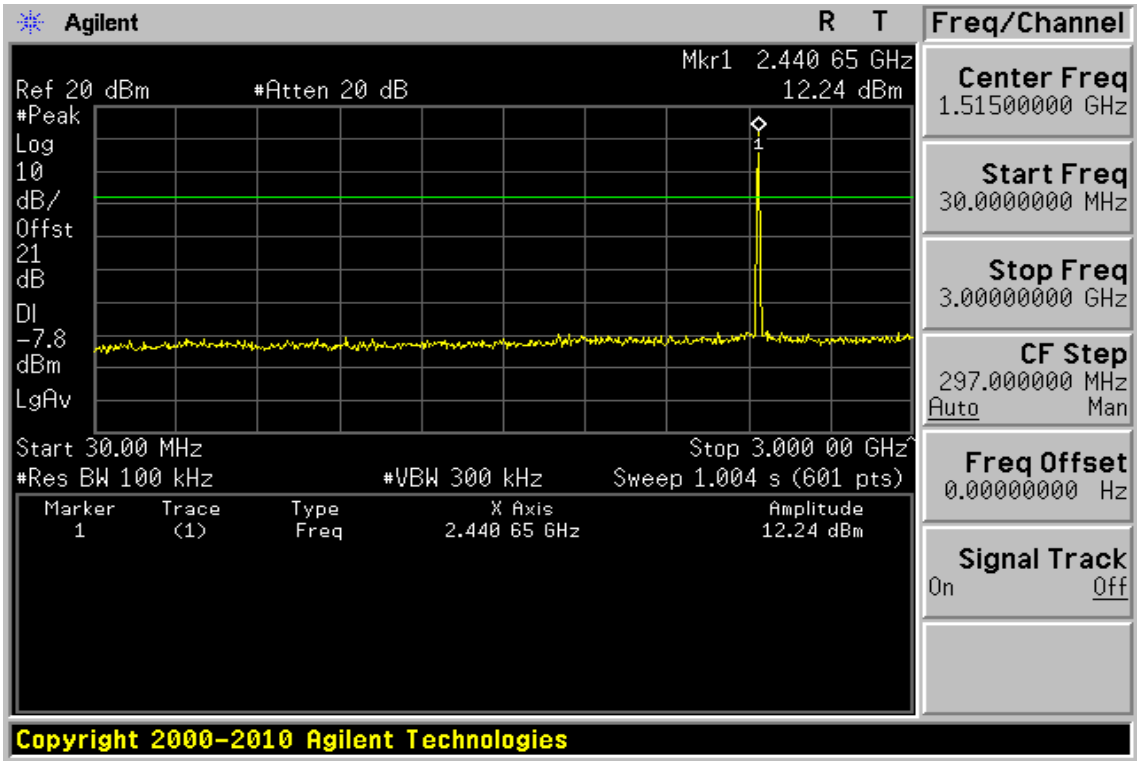
Ch Low 30MHz – 3GHz



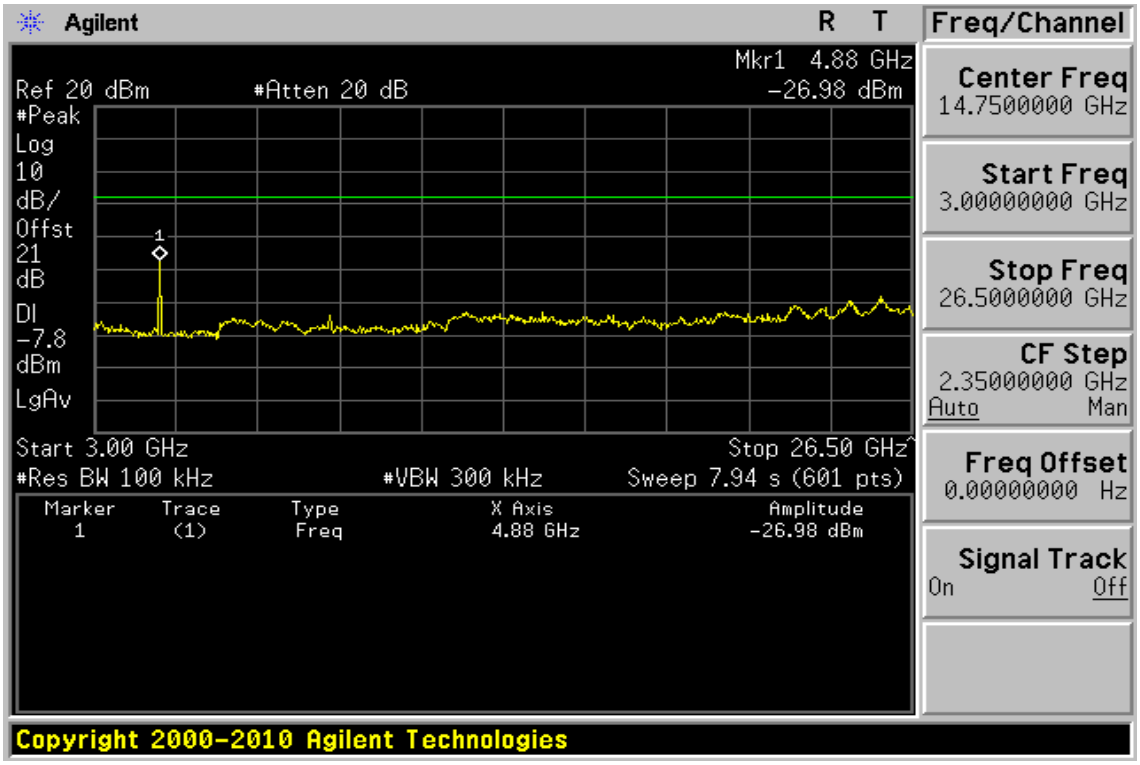
Ch Low 3GHz – 26.5GHz



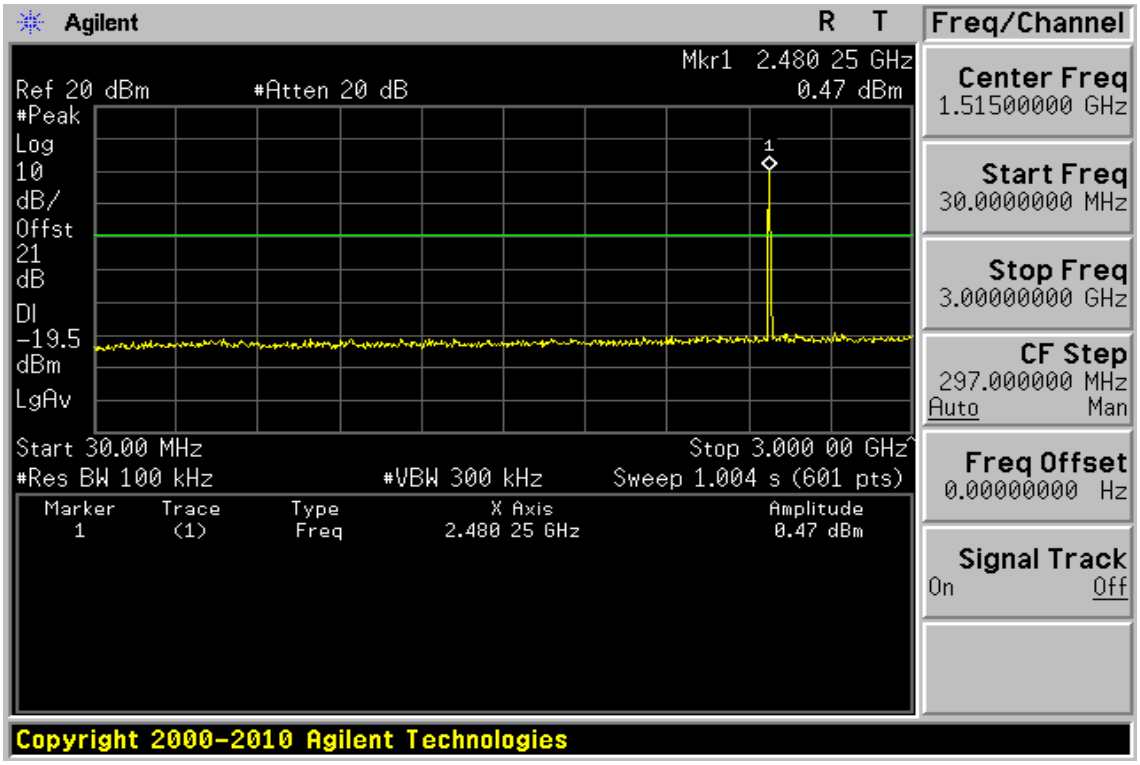
Ch Mid 30MHz – 3GHz



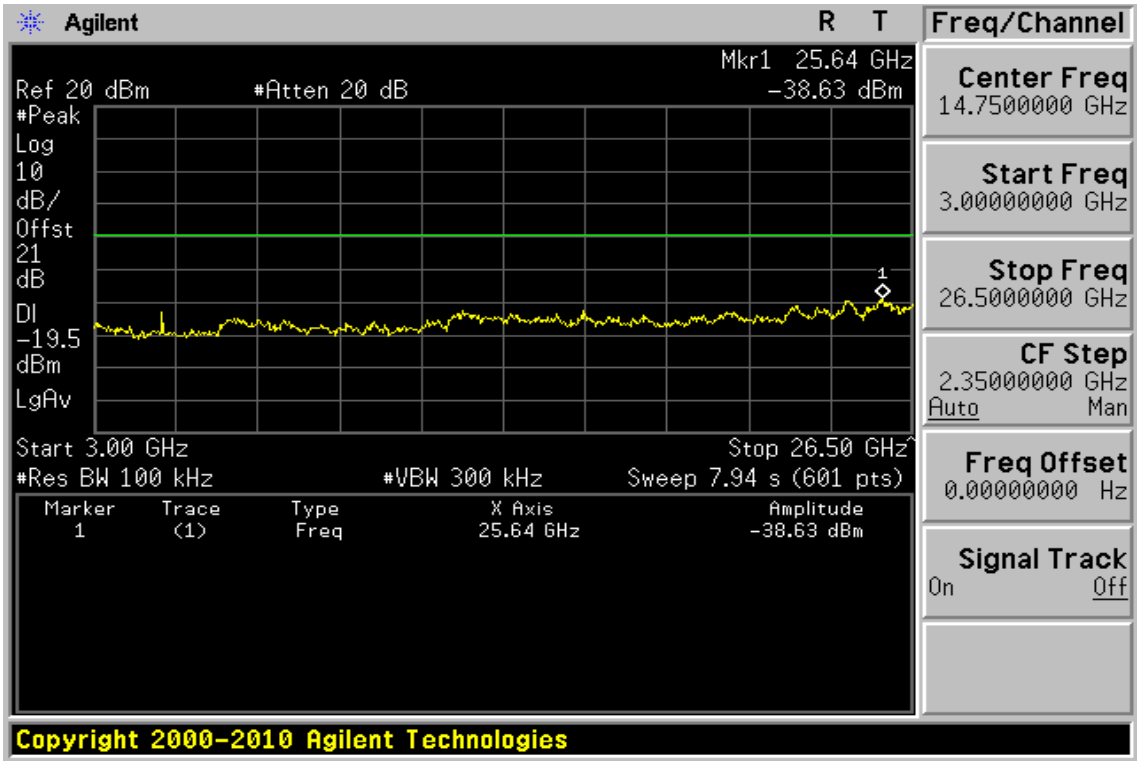
Ch Mid 3GHz – 26.5GHz



Ch High 30MHz – 3GHz



Ch High 3GHz – 26.5GHz



Radiated Spurious Emission Measurement Result-Internal Antenna-DFZM-TS211-DT0R

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX LOW	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
48.43	S	Peak	50.65	-13.63	37.02	40.00	-2.98
126.03	S	Peak	55.07	-13.84	41.23	43.50	-2.27
291.90	S	Peak	41.36	-12.50	28.86	46.00	-17.14
521.79	S	Peak	32.62	-8.48	24.14	46.00	-21.86
647.89	S	Peak	29.42	-5.66	23.76	46.00	-22.24
823.46	S	Peak	27.47	-3.51	23.96	46.00	-22.04
4810.00	H	Average	25.85	7.25	33.10	54.00	-20.90
4810.00	H	Peak	49.96	7.25	57.21	74.00	-16.79
7215.00	H	---					
9620.00	H	---					
12025.00	H	---					
14430.00	H	---					
16835.00	H	---					
19240.00	H	---					
21645.00	H	---					
24050.00	H	---					

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX LOW	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
95.96	S	Peak	47.62	-16.89	30.73	43.50	-12.77
159.01	S	Peak	50.86	-11.96	38.90	43.50	-4.60
292.87	S	Peak	47.21	-12.47	34.74	46.00	-11.26
465.53	S	Peak	37.71	-9.38	28.33	46.00	-17.67
686.69	S	Peak	28.20	-5.02	23.18	46.00	-22.82
862.26	S	Peak	28.51	-3.06	25.45	46.00	-20.55
4810.00	H	Average	26.32	7.28	33.60	54.00	-20.40
4810.00	H	Peak	58.97	7.28	66.25	74.00	-7.75
7215.00	H	---					
9620.00	H	---					
12025.00	H	---					
14430.00	H	---					
16835.00	H	---					
19240.00	H	---					
21645.00	H	---					
24050.00	H	---					

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2440 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX MID	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
48.43	S	Peak	50.94	-13.63	37.31	40.00	-2.69
127.00	S	Peak	55.06	-13.78	41.28	43.50	-2.22
287.05	S	Peak	41.02	-12.62	28.40	46.00	-17.60
536.34	S	Peak	32.64	-8.14	24.50	46.00	-21.50
692.51	S	Peak	28.77	-4.93	23.84	46.00	-22.16
800.18	S	Peak	28.10	-3.75	24.35	46.00	-21.65
4880.00	H	Average	25.15	7.47	32.62	54.00	-21.38
4880.00	H	Peak	49.23	7.47	56.70	74.00	-17.30
7320.00	H	---					
9760.00	H	---					
12200.00	H	---					
14640.00	H	---					
17080.00	H	---					
19520.00	H	---					
21960.00	H	---					
24400.00	H	---					

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2440 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX MID	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
95.96	S	Peak	47.74	-16.89	30.85	43.50	-12.65
158.04	S	Peak	50.82	-11.96	38.86	43.50	-4.64
295.78	S	Peak	47.02	-12.38	34.64	46.00	-11.36
380.17	S	Peak	41.01	-11.01	30.00	46.00	-16.00
612.97	S	Peak	27.68	-6.35	21.33	46.00	-24.67
807.94	S	Peak	27.68	-3.67	24.01	46.00	-21.99
4880.00	H	Average	25.36	7.42	32.78	54.00	-21.22
4880.00	H	Peak	53.33	7.42	60.75	74.00	-13.25
7320.00	H	---					
9760.00	H	---					
12200.00	H	---					
14640.00	H	---					
17080.00	H	---					
19520.00	H	---					
21960.00	H	---					
24400.00	H	---					

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX HIGH	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
48.43	S	Peak	50.94	-13.63	36.31	40.00	-2.69
132.82	S	Peak	54.69	-13.34	41.35	43.50	-2.15
289.96	S	Peak	41.36	-12.55	28.81	46.00	-17.19
531.49	S	Peak	32.08	-8.25	23.83	46.00	-22.17
672.14	S	Peak	29.40	-5.24	24.16	46.00	-21.84
819.58	S	Peak	27.82	-3.56	24.26	46.00	-21.74
4960.00	H	Average	25.03	7.64	32.67	54.00	-21.33
4960.00	H	Peak	49.82	7.64	57.46	74.00	-16.54
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX HIGH	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
95.96	S	Peak	47.73	-16.89	30.84	43.50	-12.66
157.07	S	Peak	50.81	-11.96	38.85	43.50	-4.65
289.96	S	Peak	47.64	-12.55	35.09	46.00	-10.91
468.44	S	Peak	37.02	-9.35	27.67	46.00	-18.33
669.23	S	Peak	27.90	-5.30	22.60	46.00	-23.40
800.18	S	Peak	31.29	-3.75	27.54	46.00	-18.46
4960.00	H	Average	25.09	7.49	32.58	54.00	-21.42
4960.00	H	Peak	50.30	7.49	57.79	74.00	-16.21
7440.00	H	---					
9920.00	H	Average	22.85	14.06	36.91	54.00	-17.09
9920.00	H	Peak	28.25	14.06	42.31	74.00	-31.69
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

Radiated Spurious Emission Measurement Result-External Antenna-DFZM-TS210-DT0R

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX LOW	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
48.43	S	Peak	50.97	-13.63	37.34	40.00	-2.66
124.09	S	Peak	55.60	-13.97	41.63	43.50	-1.87
258.92	S	Peak	42.49	-13.57	28.92	46.00	-17.08
531.49	S	Peak	32.60	-8.25	24.35	46.00	-21.65
714.82	S	Peak	27.69	-4.62	23.07	46.00	-22.93
859.35	S	Peak	27.49	-3.10	24.39	46.00	-21.61
4810.00	H	Average	26.97	7.26	34.23	54.00	-19.77
4810.00	H	Peak	65.38	7.26	72.64	74.00	-1.36
7215.00	H	---					
9620.00	H	---					
12025.00	H	---					
14430.00	H	---					
16835.00	H	---					
19240.00	H	---					
21645.00	H	---					
24050.00	H	---					

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX LOW	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
159.01	S	Peak	50.94	-11.96	38.98	43.50	-4.52
291.90	S	Peak	47.06	-12.50	34.56	46.00	-11.44
382.11	S	Peak	41.86	-10.99	30.87	46.00	-15.13
631.40	S	Peak	28.51	-5.95	22.56	46.00	-23.44
788.54	S	Peak	26.83	-3.82	23.01	46.00	-22.99
856.44	S	Peak	27.39	-3.15	24.24	46.00	-21.76
4810.00	H	Average	24.55	7.28	31.83	54.00	-22.17
4810.00	H	Peak	57.20	7.28	64.48	74.00	-9.52
7215.00	H	---					
9620.00	H	---					
12025.00	H	---					
14430.00	H	---					
16835.00	H	---					
19240.00	H	---					
21645.00	H	---					
24050.00	H	---					

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2440 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX MID	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
128.94	S	Peak	54.90	-13.66	41.24	43.50	-2.26
256.98	S	Peak	42.17	-13.63	28.54	46.00	-17.46
522.76	S	Peak	32.27	-8.45	23.82	46.00	-22.18
692.51	S	Peak	27.88	-4.93	22.95	46.00	-23.05
821.52	S	Peak	27.70	-3.53	24.17	46.00	-21.83
915.61	S	Peak	27.04	-2.19	24.85	46.00	-21.15
4880.00	H	Peak	63.97	7.38	71.35	74.00	-2.65
4880.00	H	Peak	26.66	7.38	34.04	74.00	-39.96
7320.00	H	---					
9760.00	H	---					
12200.00	H	---					
14640.00	H	---					
17080.00	H	---					
19520.00	H	---					
21960.00	H	---					
24400.00	H	---					

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2440 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX MID	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
157.07	S	Peak	50.93	-11.96	38.97	43.50	-4.53
288.99	S	Peak	47.23	-12.58	34.65	46.00	-11.35
380.17	S	Peak	41.68	-11.01	30.67	46.00	-15.33
465.53	S	Peak	37.76	-9.38	28.38	46.00	-17.62
644.98	S	Peak	28.78	-5.70	23.08	46.00	-22.92
860.32	S	Peak	27.66	-3.09	24.57	46.00	-21.43
4880.00	H	Average	24.88	7.42	32.30	54.00	-21.70
4880.00	H	Peak	54.94	7.42	62.36	74.00	-11.64
7320.00	H	---					
9760.00	H	---					
12200.00	H	---					
14640.00	H	---					
17080.00	H	---					
19520.00	H	---					
21960.00	H	---					
24400.00	H	---					

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX HIGH	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
124.09	S	Peak	54.67	-13.97	40.70	43.50	-2.80
252.13	S	Peak	42.68	-13.76	28.92	46.00	-17.08
521.79	S	Peak	32.52	-8.48	24.04	46.00	-21.96
686.69	S	Peak	28.13	-5.02	23.11	46.00	-22.89
825.40	S	Peak	27.60	-3.49	24.11	46.00	-21.89
907.85	S	Peak	27.59	-2.35	25.24	46.00	-20.76
4960.00	H	Average	25.60	7.64	33.24	54.00	-20.76
4960.00	H	Peak	54.30	7.64	61.94	74.00	-12.06
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

Operation Band	:2.4G ZigBee	Test Date	:2013-09-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:22.6 deg_C / 70 RH
Operation Mode	:TX HIGH	Engineer	:Louis
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV / m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
159.01	S	Peak	50.85	-11.96	38.89	43.50	-4.61
293.84	S	Peak	47.40	-12.44	34.96	46.00	-11.04
377.26	S	Peak	41.22	-11.04	30.18	46.00	-15.82
463.59	S	Peak	37.25	-9.39	27.86	46.00	-18.14
649.83	S	Peak	27.39	-5.62	21.77	46.00	-24.23
827.34	S	Peak	27.60	-3.47	24.13	46.00	-21.87
4960.00	H	Average	24.49	7.49	31.98	54.00	-22.02
4960.00	H	Peak	42.73	7.49	50.22	74.00	-23.78
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

11 PEAK POWER SPECTRAL DENSITY

11.1 Standard Applicable:

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 8dBm 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.

11.2 Measurement Equipment Used:

Refer to section 7.2 for details.

11.3 Test Set-up:

Refer to section 7.3 for details.

11.4 Measurement Procedure (following the measurement procedure 10.2 of KDB558074):

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.

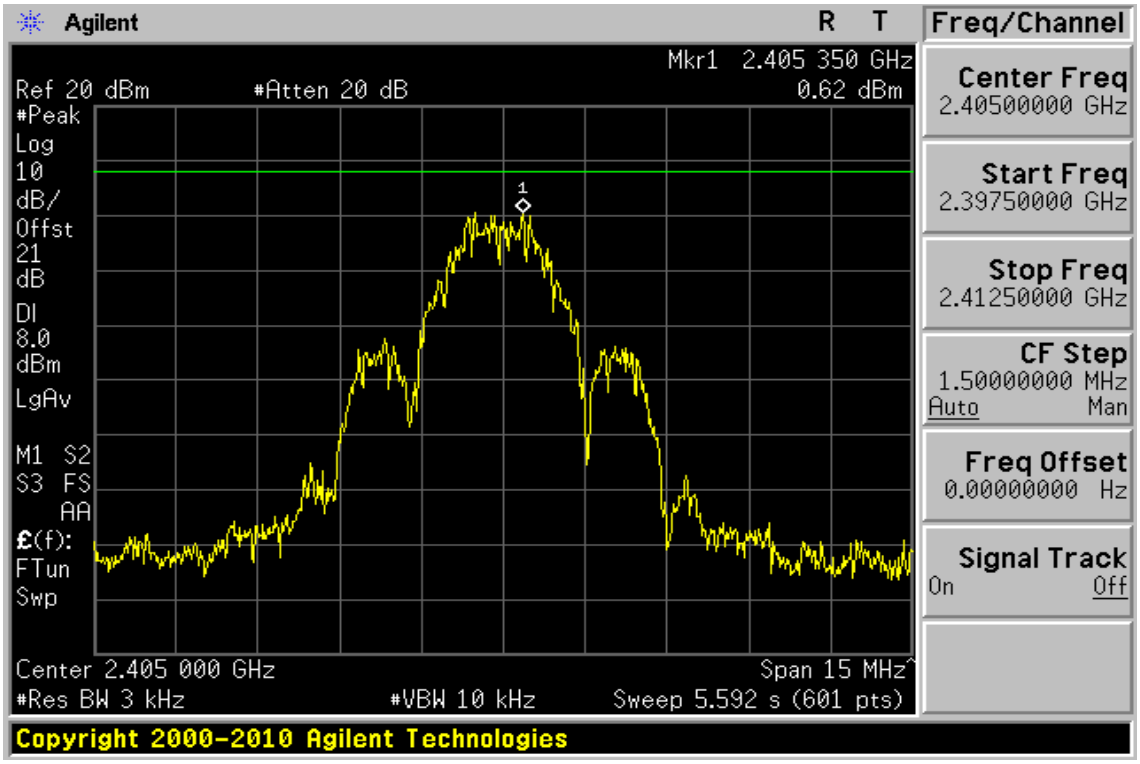
11.5 Measurement Result:

Frequency MHz	RF Power Density Reading (dBm)	Maximum Limit (dBm)
2405	0.62	8
2440	0.20	8
2480	-11.85	8

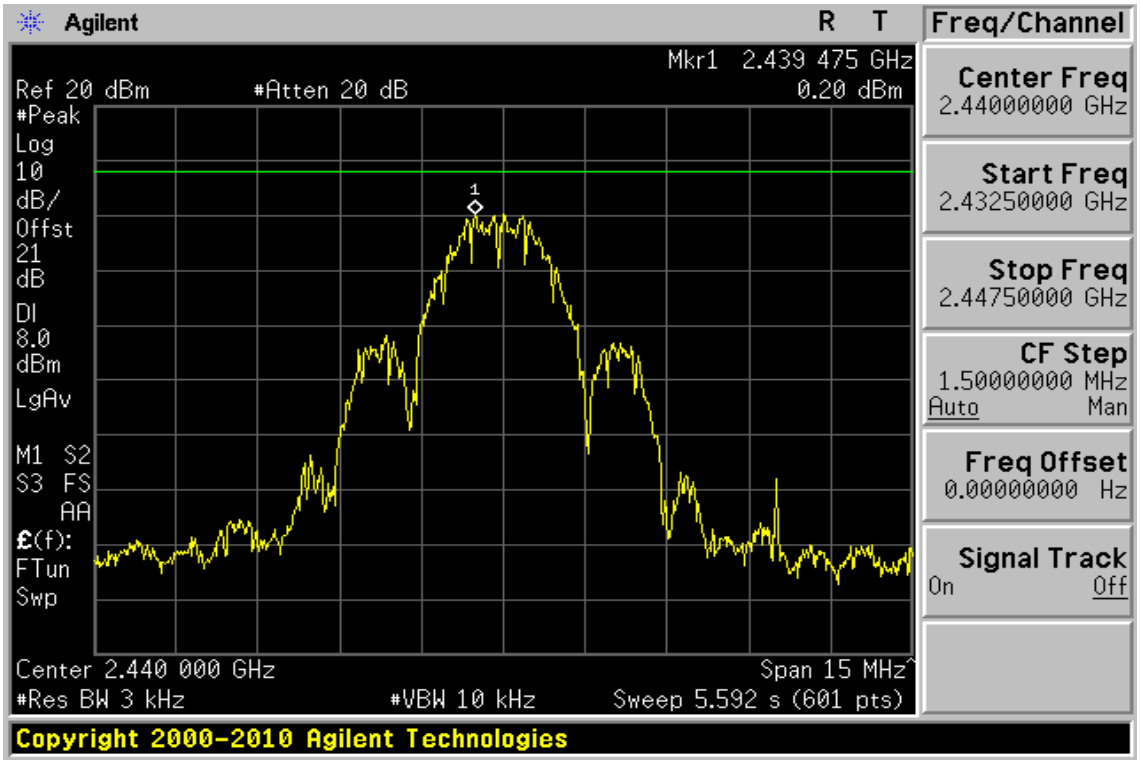
** Note: Offset 21dB*

**Refer to next page for plots*

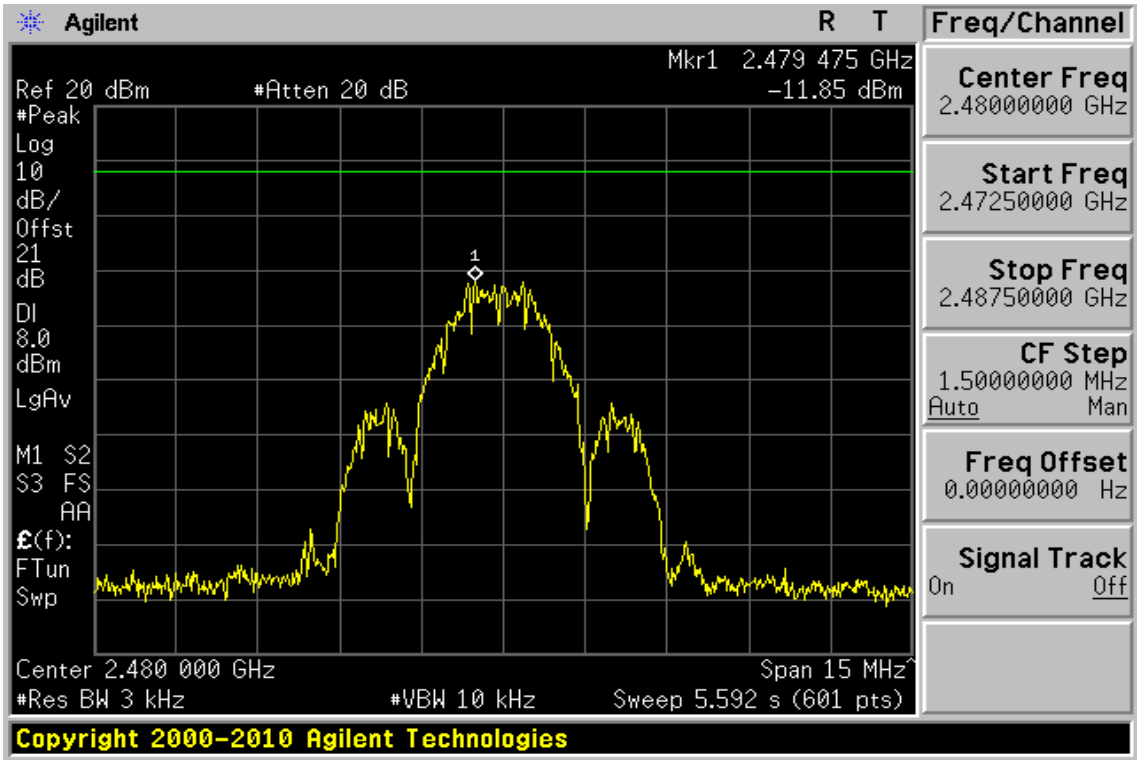
Power Spectral Density Test Plot (CH-Low)



Power Spectral Density Test Plot (CH-Mid)



Power Spectral Density Test Plot (CH-High)



12 ANTENNA REQUIREMENT

12.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

According to RSS-GEN 7.1.2, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in RSS-210 or RSS-310 for devices of RF output powers of 10 milliwatts or less. For devices of output powers greater than 10 milliwatts, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

12.2 Antenna Connected Construction:

The directional gains of antenna used for transmitting is 2.00dBi. In addition, the antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

13 Maximum Permissible Exposure (MPE) Evaluation

13.1 Standard Applicable

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Mobile device, the MPE is required.

According to §1.1310 and §2.1093 RF exposure is calculated.

Limits for Maximum Permissive Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-15000	/	/	1.0	30

F = frequency in MHz

* = Plane-wave equipment power density

13.2 Maximum Permissible Exposure (MPE) Evaluation

Frequency (MHz)	Peak Power Output (dBm)	Required Limit
2405	19.88	**1 Watt = 30 dBm**
2440	**20.27**	**1 Watt = 30 dBm**
2480	11.98	**1 Watt = 30 dBm**

**Note: Measured by power meter, cable loss as 21dB that offsets on the power meter.*

MPE Prediction

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	20.27	(dBm)
Maximum peak output power at antenna input terminal:	106.414302	(mW)
Duty cycle:	99.64	(%)
Maximum Pav :	106.03121	(mW)
Antenna gain (typical):	2	(dBi)
Maximum antenna gain:	1.58489319	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2440	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.033449	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.033449mW/cm^2. This is below the uncontrolled exposure limit of 1mW/cm^2 at 2440MHz.

~ End of Report ~