

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name: iCalc Bluetooth Calculator Keypad

Brand Name: SMK-Link

Model No.: VP6274

Model Difference: N/A

FCC ID: IE3VP627X13

Report No.: EF/2012/C0018

Issue Date: Jan. 09, 2013

FCC Rule Part: §15.247, Cat: DSS

SMK-LINK ELECTRONICS CORP

Prepared for:
3601-B Calle Tecate, Camarillo, California
93012, United States

Prepared by:
SGS Taiwan Ltd.
Electronics & Communication Laboratory
No.134, Wu Kung Road, New Taipei Industrial
Park, Wuku District, New Taipei City, Taiwan
24803



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CERTIFICATION OF COMPLIANCE

Applicant: SMK-LINK ELECTRONICS CORP
3601-B Calle Tecate, Camarillo, California 93012, United States

Product Name: iCalc Bluetooth Calculator Keypad

Brand Name: SMK-Link

Model No.: VP6274

Model Difference: N/A

FCC ID: IE3VP627X13

File Number: EF/2012/C0018

Date of test: Dec.20, 2012~ Dec. 28, 2012

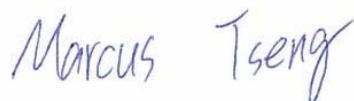
Date of EUT Received: Dec.20, 2012

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. 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, 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:

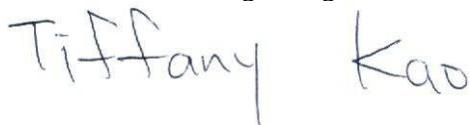


Date:

Jan. 09, 2013

Marcus Tseng / Engineer

Prepared By:



Date:

Jan. 09, 2013

Tiffany Kao / Clerk

Approved By:



Date:

Jan. 09, 2013

Jim Chang / Supervisor

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台灣檢驗科技股份有限公司

t (886-2) 2299-3279

f (886-2) 2298-0488

www.tw.sgs.com

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Version

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1. GENERAL INFORMATION

1.1. Product Description

General:

Product Name:	iCalc Bluetooth Calculator Keypad
Brand Name:	SMK-Link
Model No.:	VP6274
Model difference:	N/A
Hardware Version:	Keyboard:1.0
Software Version:	Keyboard:1.0
Power Supply	3.0Vdc from AAA batteries*2

Bluetooth:

Bluetooth Version:	V3.0 (GFSK)
Channel number:	79 channels
Modulation type:	GFSK
Transmit Power:	-3.27dBm (Peak)
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	<= 0.4s
Operating Mode:	Point-to-Point
Antenna Designation:	Printed Antenna / antenna gain: 2.78dBi.

This test report applies for Bluetooth function.

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1.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: IE3VP627X13** 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 is authorized under a Doc procedure.

1.3. Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2009 and RSS-Gen: 2010. Radiated testing was performed at an antenna to EUT distance 3 meters.

Tested in accordance with FCC Public Notice DA 00-705

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. No. 134, Wu Kung Rd., Wuku Industrial Zone, Taipei Country, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 2009. FCC Registration Number are: 990257 and 236194, Canada Registration Number: 4620A-4.

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. 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

Not available for this EUT intended for grant.

1.6. Equipment Modifications

Not available for this EUT intended for grant.

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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

The EUT (Transmitter) was tested with a test program to fix the TX/RX frequency that was for the purpose of the measurements. For more information please see test data and APPENDIX 1 for set-up photographs.

2.3. Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. According to the requirements in Section 7.3.1 of ANSI C63.4:2009. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and Average detector mode.

2.3.2 Radiated Emissions

The EUT is placed on a 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 of ANSI C63.4:2009 and DA 00-705.

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2.4. Configuration of Tested System

Fig. 2-1 Configuration of Tested System



Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Notebook	Dell	E5400	3704625136	shielding	Un-shielding
2.	Test Kit	N/A	N/A	N/A	N/A	N/A
3.	Test Software	BlueTool	v1.0.0.6	N/A	N/A	N/A

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3. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power line Conducted Emission	Compliant
§15.247(b)(1)	Peak Output Power	Compliant
§15.247(d)	100 KHz Bandwidth Of Frequency Band Edges	Compliant
§15.247(c)	Spurious Emission	Compliant
§15.247(a)(1)	Frequency Separation	Compliant
§15.247(a)(1)(iii)	Number of hopping frequency	Compliant
§15.247(a)(1)(iii)	Time of Occupancy	Compliant
§15.247(a)(1)	20dB Bandwidth	Compliant
§15.203, §15.247(b)(4)(i)	Antenna Requirement	Compliant

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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, Mid and High with DH5 highest rated data rate were chosen as worst case for full testing.

The field strength of spurious radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth Transmitter for channel Low, Mid and High the worst case E2 position was reported.

5. MEASUREMENT UNCERTAINTY FOR FIELD STRENGTH OF

SPURIOUS RADIATION

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

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6. CONDUCTED EMISSION TEST

6.1. Standard Applicable:

According to §15.207, frequency range within 150 KHz 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	05/20/2011	05/19/2013
EMI Receiver	R&S	ESCS 30	828985/004	09/23/2012	09/22/2013
LISN	Rolf-Heine	NNB-2/16Z	99012	03/23/2012	03/22/2013
LISN	FCC	FCC-LISN-50/250-25 -2-01	04034	03/23/2012	03/22/2013
Coaxial Cables	N/A	WK CE Cable	N/A	01/05/2013	01/04/2014

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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 EUT was plug-in the AC/DC Power adapter. The host system was placed on the center of the back edge on the test table. The peripherals was placed on the side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
3. The spacing between the peripherals was 10 centimeters.
4. External I/O cables were draped along the edge of the test table and bundle when necessary.
5. The host system was connected with 120Vac/60Hz power source.

6.4. 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 frequency measured were complete.

6.5. Measurement Result:

N/A. EUT powered from AAA batteries.

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7. PEAK OUTPUT POWER MEASUREMENT

7.1. Standard Applicable:

According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: 0.125 Watts.

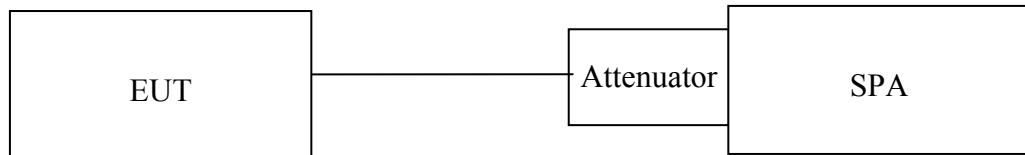
7.2. Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Sensor	Anritsu	ML2495A	1005007	02/08/2012	02/07/2014
Power Meter	Anritsu	MA2411B	917032	02/08/2012	02/07/2014
Spectrum Analyzer	Agilent	E4446A	MY51100003	04/15/2011	04/14/2013
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/17/2012	03/16/2014
DC Block	Mini-Circuits	BLK-18-S+	1	02/28/2012	02/27/2013
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/05/2013	01/04/2014
Attenuator	Mini-Circuit	BW-S10W2+	002	02/28/2012	02/27/2013
Splitter	Agilent	11636B	N/A	02/28/2012	02/27/2013

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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. (Max peak function, >20dB bandwidth, >=RBW)
3. Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

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7.5. Measurement Result:

BDR mode (GFSK):

Frequency (MHz)	Reading Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)
2402.00	-3.27	-3.27	0.00047	1
2441.00	-3.31	-3.31	0.00047	1
2480.00	-4.31	-4.31	0.00037	1

*Note: offset 3.7dB

Note: Refer to next page for plots.

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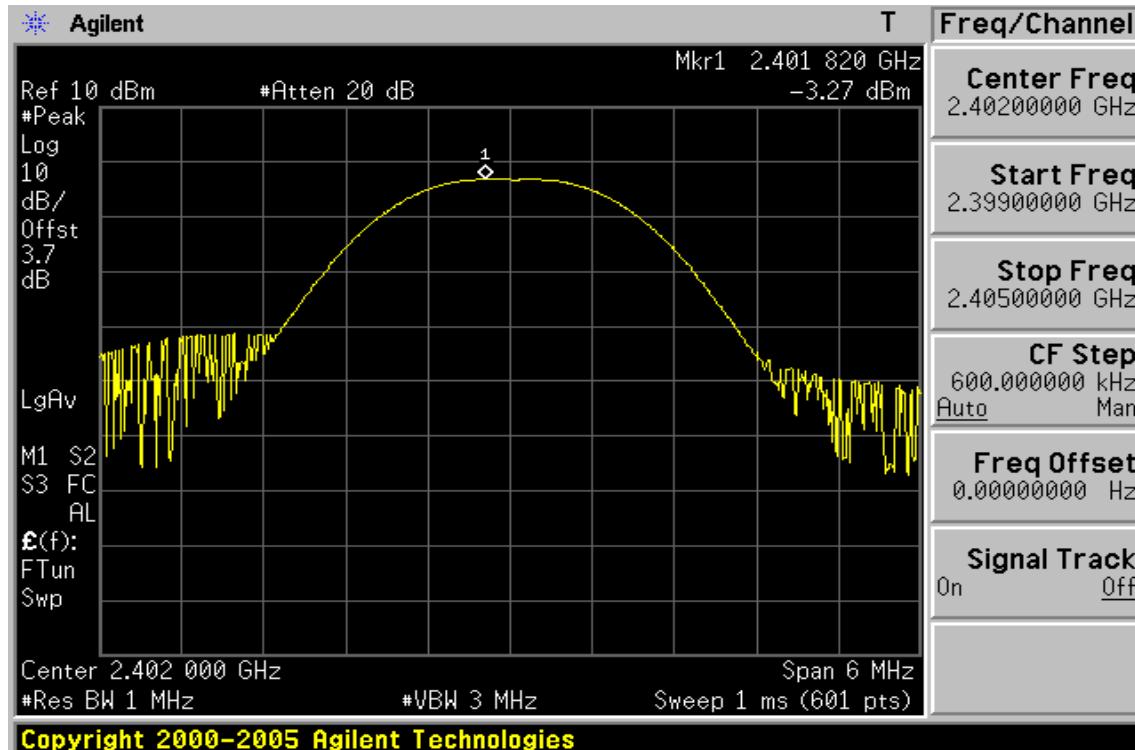
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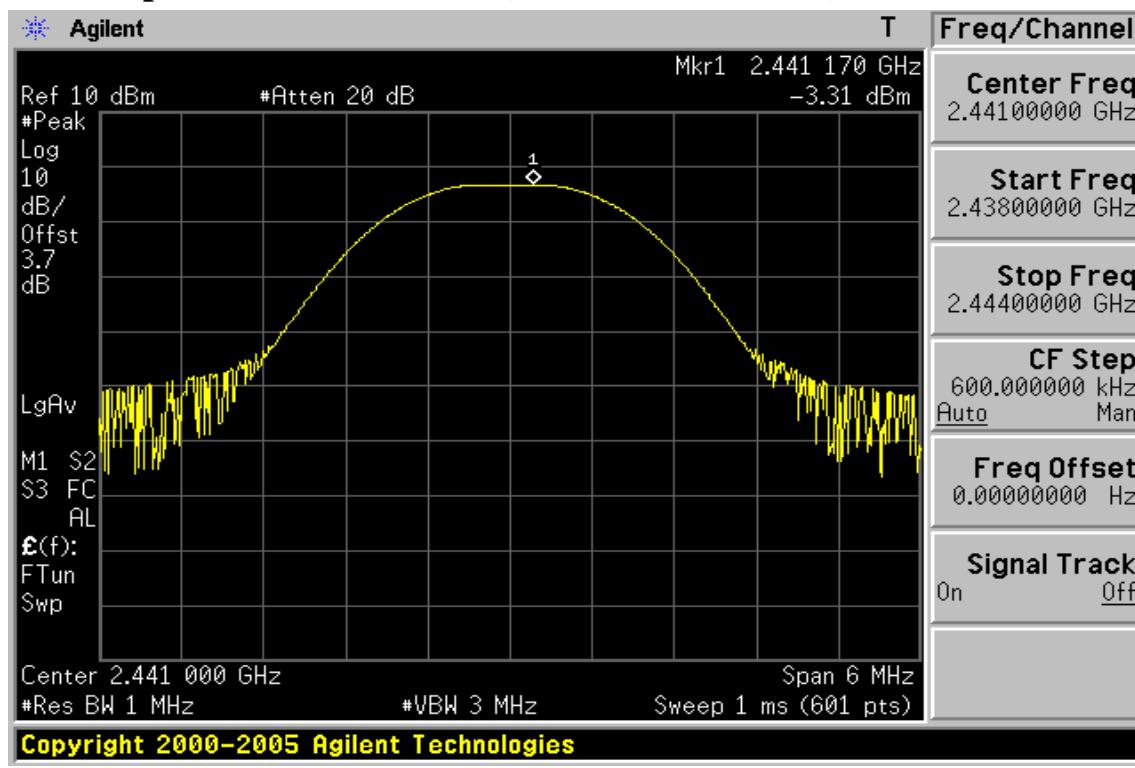
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Peak Power Output Data Plot (CH Low) (BDR mode GFSK)



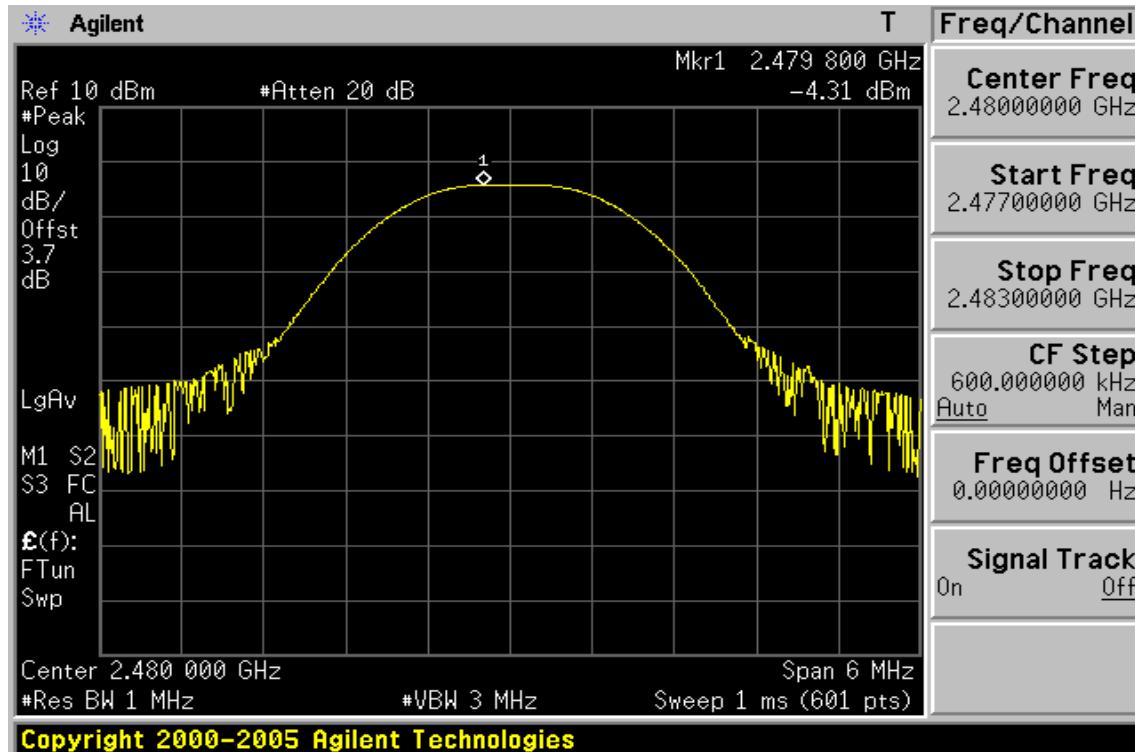
Peak Power Output Data Plot (CH Mid) (BDR mode GFSK)



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Peak Power Output Data Plot (CH High) (BDR mode GFSK)

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8. 100 KHz BANDWIDTH OF BAND EDGES MEASUREMENT

8.1 Standard Applicable:

According to §15.247(d), in any 100 KHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz 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 in 15.209(a).

8.2. Measurement Equipment Used:

8.2.1. Conducted Emission at antenna port:

Refer to section 7.2 for details.

8.2.2. Radiated emission:

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100759	05/20/2011	05/19/2013
Spectrum Analyzer	Agilent	E4446A	MY51100003	04/15/2011	04/14/2013
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	02/15/2011	02/14/2013
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	05/19/2011	05/18/2013
Horn Antenna	Schwarzbeck	BBHA9170	185	07/11/2011	07/10/2013
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	02/28/2012	02/28/2013
Attenuator	Mini-Circuit	BW-S10W2+	004	02/28/2012	02/27/2013
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	07/15/2012	07/14/2013

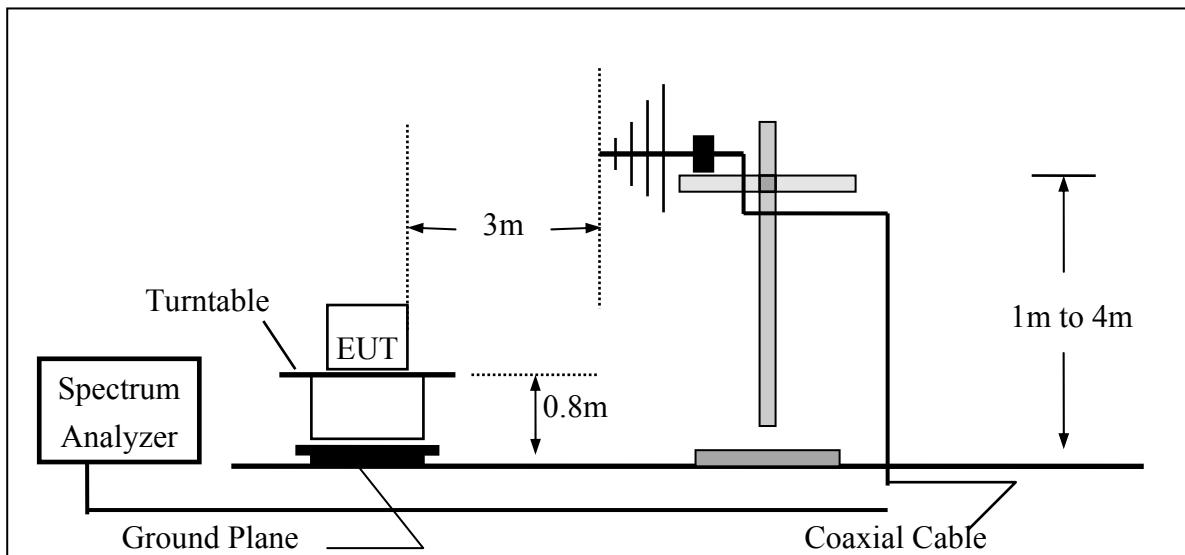
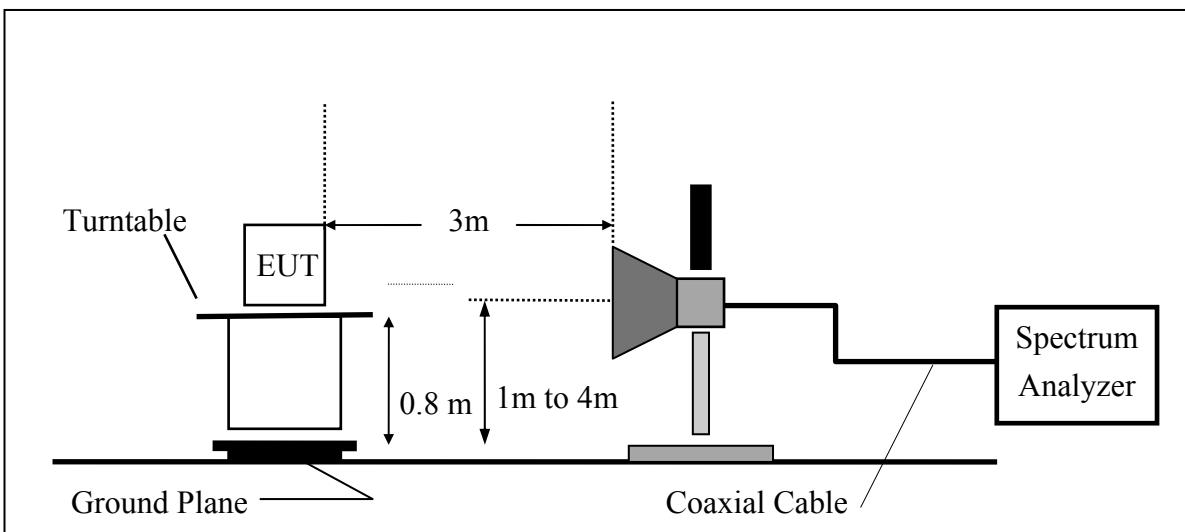
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Test SET-UP:**8.3.1. Conducted Emission at antenna port:**

Refer to section 7.3 for details.

8.3.2. Radiated emission:**(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz****(B) Radiated Emission Test Set-UP Frequency Over 1 GHz**

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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 center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=100KHz, Span=25MHz, Sweep = auto
5. Mark Peak, 2.390GHz and 2.4835GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.
7. Radiated Emission refers to section 9.

8.5. 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:

$$FS = RA + AF + CL - AG$$

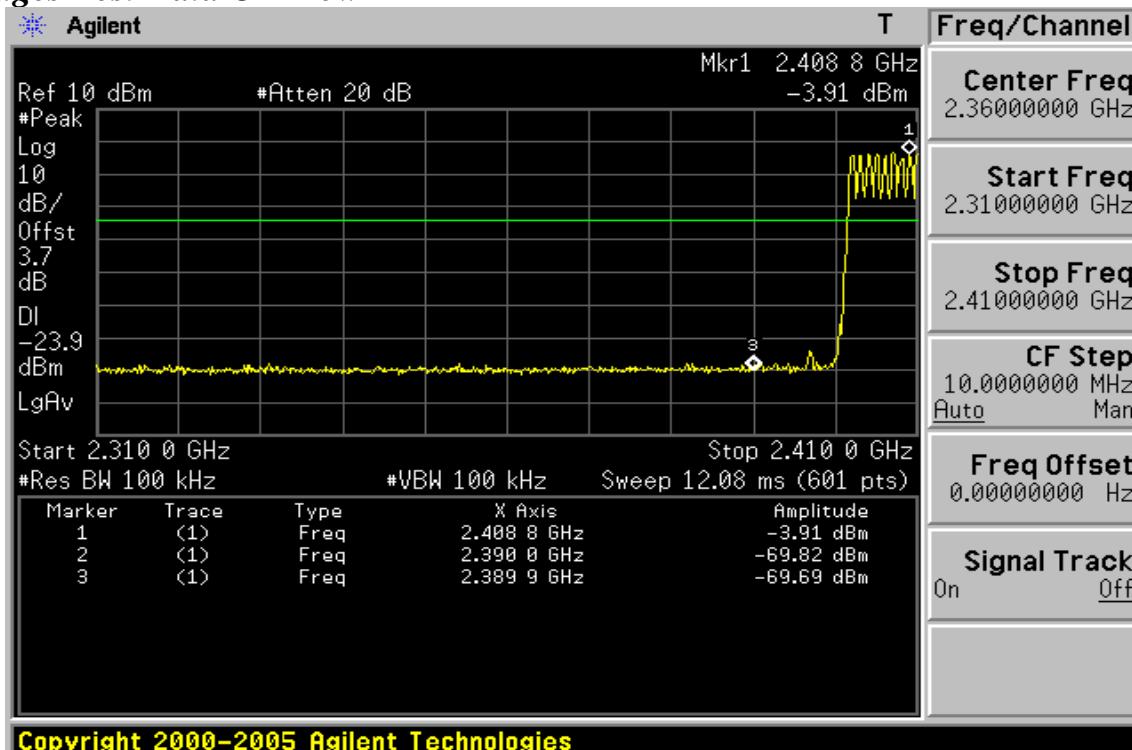
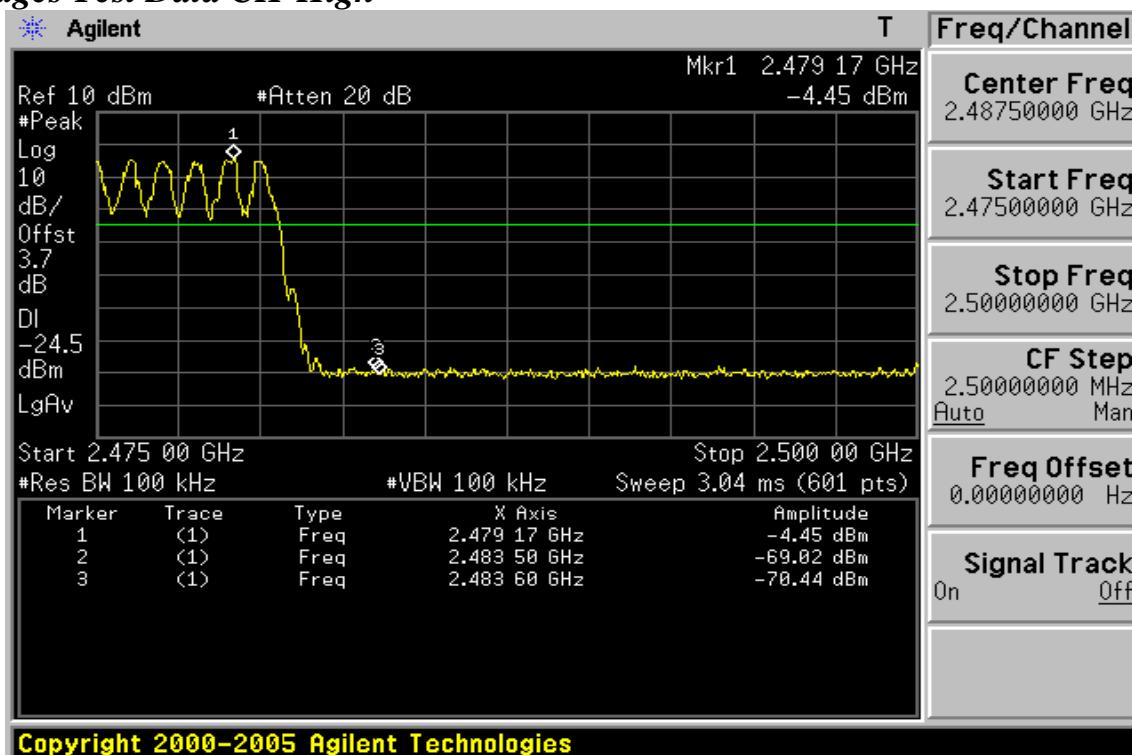
Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

8.6. Measurement Result:

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

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BDR Mode**Band Edges Test Data CH-Low****Band Edges Test Data CH-High**

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Radiated Emission: (BDR mode)

Operation Band	:BDR	Test Date	:2012-12-28
Fundamental Frequency	:2402 MHz	Temp./Humi.	:26.2 deg_C / 62 RH
Operation Mode	:BANDEDGE LOW	Engineer	:Marcus
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
			PK/QP/AV	Reading Level dB μ V				
2390.00	E	Average		40.10	2.12	42.22	54.00	-11.78
2390.00	E	Peak		51.30	2.12	53.42	74.00	-20.58

Operation Band	:BDR	Test Date	:2012-12-28
Fundamental Frequency	:2402 MHz	Temp./Humi.	:26.2 deg_C / 62 RH
Operation Mode	:BANDEDGE LOW	Engineer	:Marcus
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
			PK/QP/AV	Reading Level dB μ V				
2390.00	E	Average		40.03	2.74	42.77	54.00	-11.23
2390.00	E	Peak		52.06	2.74	54.80	74.00	-19.20

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

Factor(dB) = Antenna Factor(dB μ V/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.

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

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Operation Band :BDR
 Fundamental Frequency :2480 MHz
 Operation Mode :BANDEDGE HIGH
 EUT Pol. :E2 Plan

Test Date :2012-12-28
 Temp./Humi. :26.2 deg_C / 62 RH
 Engineer :Marcus
 Measurement Antenna Pol. :VERTICAL

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
						FS dB μ V/m	
2483.50	E	Average	39.97	2.53	42.50	54.00	-11.50
2483.50	E	Peak	50.76	2.53	53.29	74.00	-20.71

Operation Band :BDR
 Fundamental Frequency :2480 MHz
 Operation Mode :BANDEDGE HIGH
 EUT Pol. :E2 Plan

Test Date :2012-12-28
 Temp./Humi. :26.2 deg_C / 62 RH
 Engineer :Marcus
 Measurement Antenna Pol. :HORIZONTAL

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
						FS dB μ V/m	
2483.50	E	Average	39.94	3.56	43.50	54.00	-10.50
2483.50	E	Peak	50.25	3.56	53.81	74.00	-20.19

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

Factor(dB) = Antenna Factor(dB μ V/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.

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

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9. SPURIOUS EMISSION TEST

9.1. Standard Applicable:

According to §15.247(c), all other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). 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.

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:

Refer to section 8.2.2 for details.

9.3. Test SET-UP:

9.3.1. Conducted Emission at antenna port:

Refer to section 7.3 for details.

9.3.2. Radiated emission:

Refer to section 8.3.2 for details.

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9.4. 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.
7. Repeat above procedures until all frequency measured were complete.

Conducted Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. Set RBW = 100K & VBW = 100K 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.
4. Via Software, combine 5 spans of frequency range into one plot.

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:

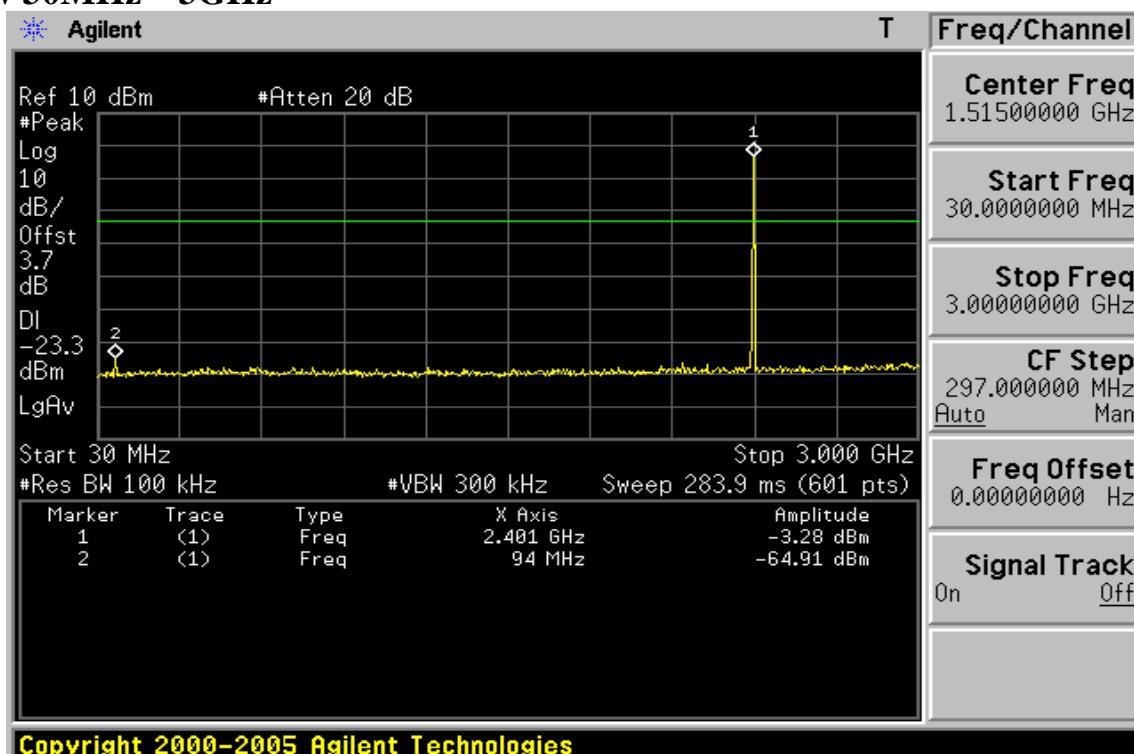
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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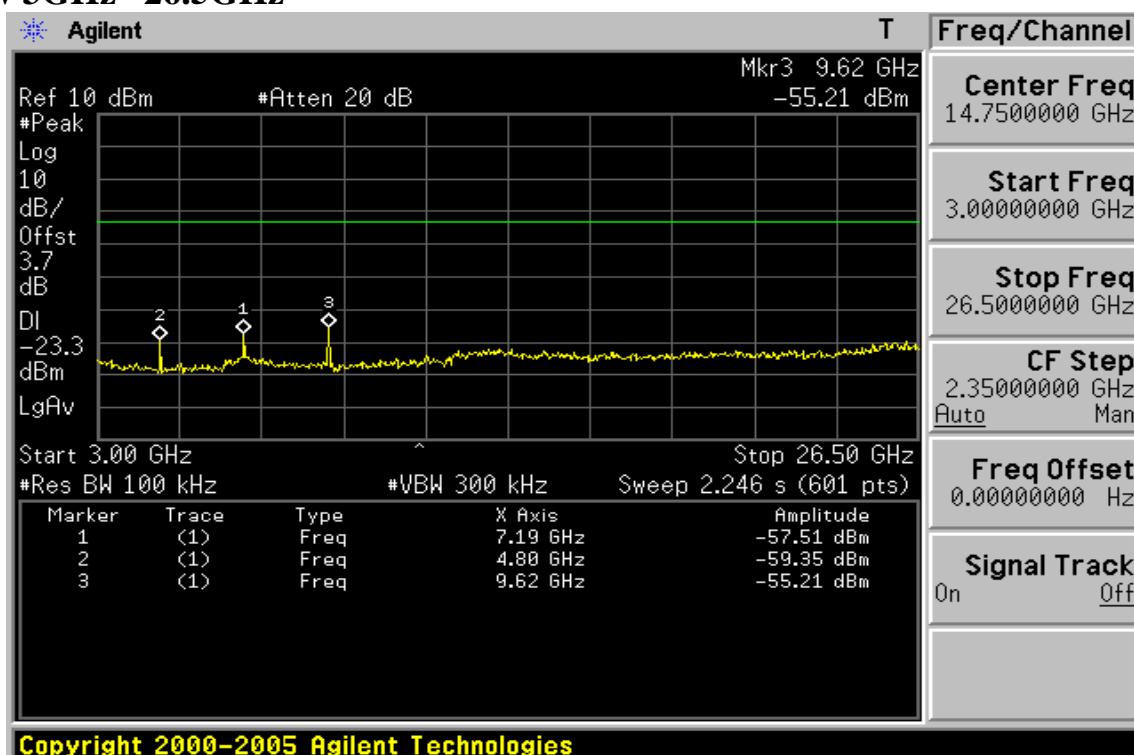
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Conducted Spurious Emission Measurement Result (BDR Mode)

Ch Low 30MHz – 3GHz



Ch Low 3GHz – 26.5GHz

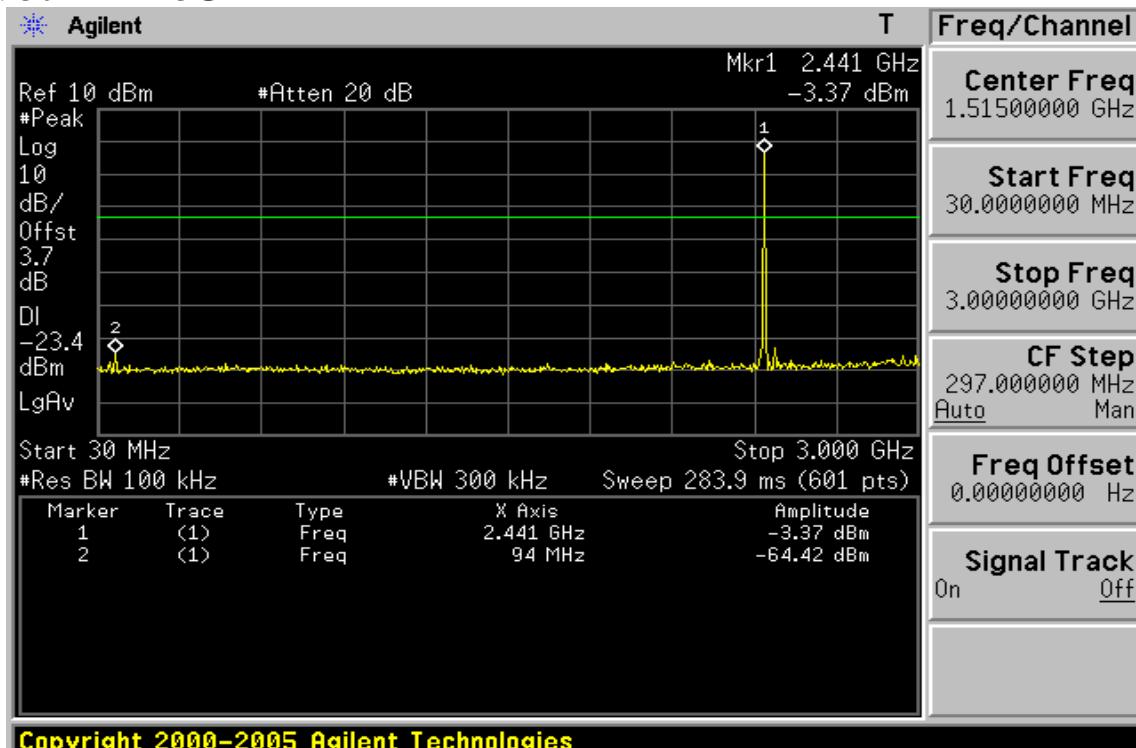


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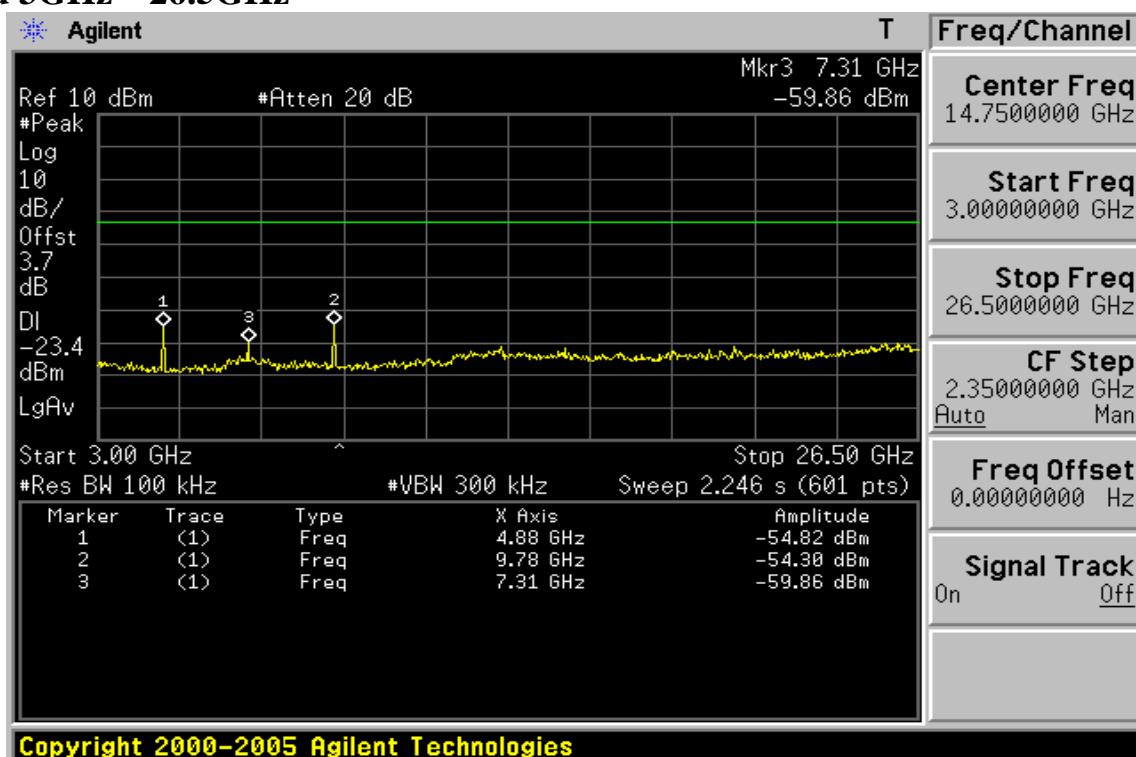
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Ch Mid 30MHz – 3GHz



Ch Mid 3GHz – 26.5GHz

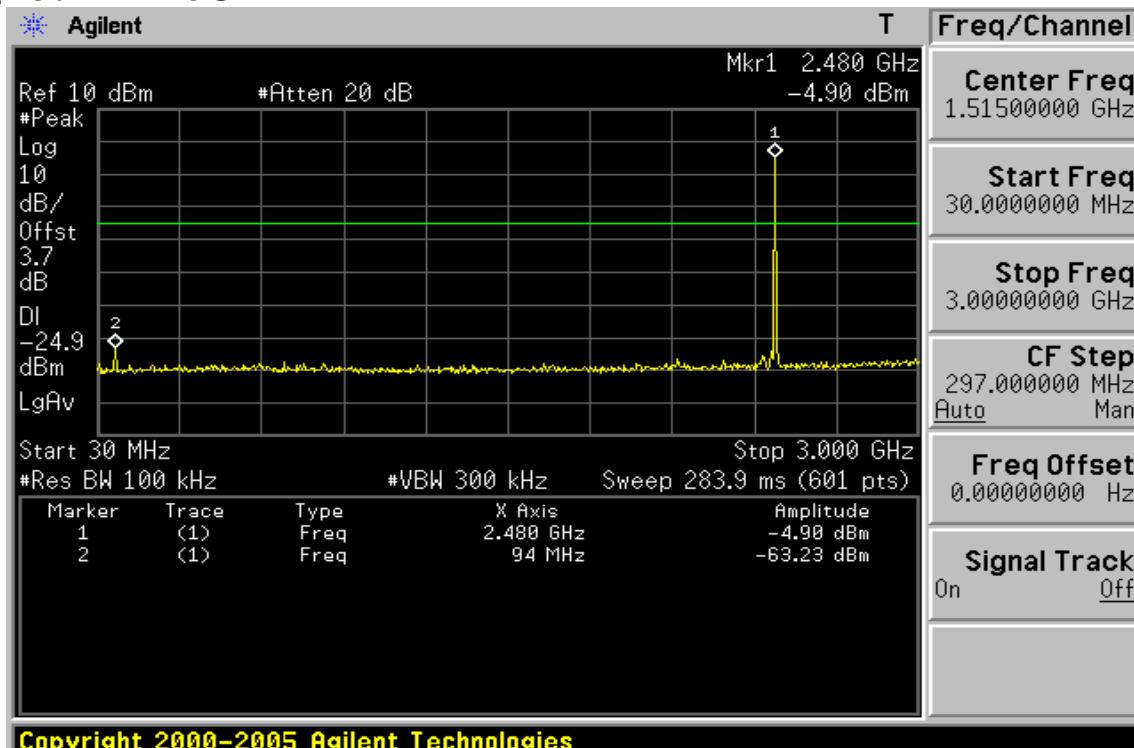


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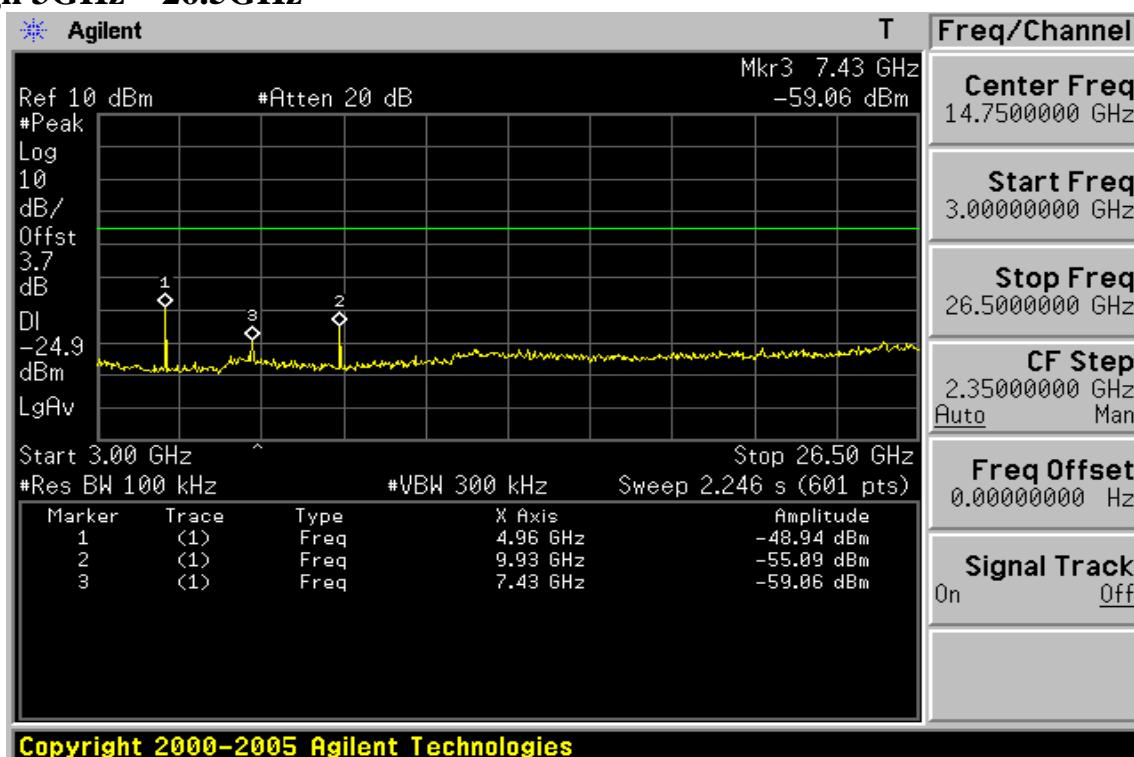
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Ch High 30MHz – 3GHz



Ch High 3GHz – 26.5GHz



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t (886-2) 2299-3279

f (886-2) 2298-0488

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Radiated Spurious Emission Measurement Result (BDR mode)

Operation Band	:BDR	Test Date	:2012-12-28
Fundamental Frequency	:2402 MHz	Temp./Humi.	:26.2 deg_C / 62 RH
Operation Mode	:TX LOW	Engineer	:Allen
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

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

Factor(dB) = Antenna Factor(dB μ V/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. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level		Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
			PK/QP/AV	dB μ V				
60.07	S	Peak	47.86	-14.59	33.27	40.00	-6.73	
143.49	S	Peak	49.53	-12.82	36.71	43.50	-6.79	
240.49	S	Peak	54.37	-14.19	40.18	46.00	-5.82	
288.02	S	Peak	52.83	-12.86	39.97	46.00	-6.03	
384.05	S	Peak	46.93	-11.23	35.70	46.00	-10.30	
719.67	S	Peak	42.25	-5.44	36.81	46.00	-9.19	
4804.00	H	Average	39.81	6.98	46.79	54.00	-7.21	
4804.00	H	Peak	45.22	6.98	52.20	74.00	-21.80	
7206.00	H	---						
9608.00	H	---						
12010.00	H	---						
14412.00	H	---						
16814.00	H	---						
19216.00	H	---						
21618.00	H	---						
24020.00	H	---						

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Operation Band :BDR
Fundamental Frequency :2402 MHz
Operation Mode :TX LOW
EUT Pol. :E2 Plan
Test Date :2012-12-28
Temp./Humi. :26.2 deg_C / 62 RH
Engineer :Allen
Measurement Antenna Pol. :HORIZONTAL

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

Factor(dB) = Antenna Factor(dB μ V/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. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
143.49	S	Peak	50.17	-12.82	37.35	43.50	-6.15
240.49	S	Peak	53.39	-14.19	39.20	46.00	-6.80
288.02	S	Peak	52.23	-12.86	39.37	46.00	-6.63
720.64	S	Peak	43.61	-5.43	38.18	46.00	-7.82
816.67	S	Peak	41.03	-4.02	37.01	46.00	-8.99
864.20	S	Peak	39.43	-3.47	35.96	46.00	-10.04
4804.00	H	Average	39.46	7.04	46.50	54.00	-7.50
4804.00	H	Peak	44.59	7.04	51.63	74.00	-22.37
7206.00	H	---					
9608.00	H	---					
12010.00	H	---					
14412.00	H	---					
16814.00	H	---					
19216.00	H	---					
21618.00	H	---					
24020.00	H	---					

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Operation Band	:BDR	Test Date	:2012-12-28
Fundamental Frequency	:2441 MHz	Temp./Humi.	:26.2 deg_C / 62 RH
Operation Mode	:TX MID	Engineer	:Allen
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

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

Factor(dB) = Antenna Factor(dB μ V/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. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level	Factor dB	Actual FS dB μ V	Limit @3m dB μ V/m	Margin dB
			PK/QP/AV				
47.46	S	Peak	48.64	-13.85	34.79	40.00	-5.21
95.96	S	Peak	51.85	-17.13	34.72	43.50	-8.78
143.49	S	Peak	50.53	-12.82	37.71	43.50	-5.79
288.02	S	Peak	52.15	-12.86	39.29	46.00	-6.71
384.05	S	Peak	47.75	-11.23	36.52	46.00	-9.48
720.64	S	Peak	41.18	-5.43	35.75	46.00	-10.25
4882.00	H	Average	39.61	7.16	46.77	54.00	-7.23
4882.00	H	Peak	44.90	7.16	52.06	74.00	-21.94
7323.00	H	---					
9764.00	H	---					
12205.00	H	---					
14646.00	H	---					
17087.00	H	---					
19528.00	H	---					
21969.00	H	---					
24410.00	H	---					

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Operation Band	:BDR	Test Date	:2012-12-28
Fundamental Frequency	:2441 MHz	Temp./Humi.	:26.2 deg_C / 62 RH
Operation Mode	:TX MID	Engineer	:Allen
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

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

Factor(dB) = Antenna Factor(dB μ V/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. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level	Factor dB	Actual FS dB μ V/m	Limit @3m	Margin
						dB μ V/m	dB
60.07	S	Peak	48.73	-14.59	34.14	40.00	-5.86
143.49	S	Peak	50.45	-12.82	37.63	43.50	-5.87
240.49	S	Peak	55.16	-14.19	40.97	46.00	-5.03
288.02	S	Peak	53.60	-12.86	40.74	46.00	-5.26
384.05	S	Peak	50.80	-11.23	39.57	46.00	-6.43
719.67	S	Peak	44.49	-5.44	39.05	46.00	-6.95
4882.00	H	Average	37.98	7.10	45.08	54.00	-8.92
4882.00	H	Peak	44.82	7.10	51.92	74.00	-22.08
7323.00	H	---					
9764.00	H	---					
12205.00	H	---					
14646.00	H	---					
17087.00	H	---					
19528.00	H	---					
21969.00	H	---					
24410.00	H	---					

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Operation Band	:BDR	Test Date	:2012-12-28
Fundamental Frequency	:2480 MHz	Temp./Humi.	:26.2 deg_C / 62 RH
Operation Mode	:TX HIGH	Engineer	:Allen
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL

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

Factor(dB) = Antenna Factor(dB μ V/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. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level	Factor dB	Actual FS dB μ V	Limit @3m dB μ V/m	Margin dB
			dB μ V				
47.46	S	Peak	48.06	-13.85	34.21	40.00	-5.79
95.96	S	Peak	53.75	-17.13	36.62	43.50	-6.88
191.99	S	Peak	53.49	-15.76	37.73	43.50	-5.77
288.02	S	Peak	52.63	-12.86	39.77	46.00	-6.23
384.05	S	Peak	47.38	-11.23	36.15	46.00	-9.85
719.67	S	Peak	41.63	-5.44	36.19	46.00	-9.81
4960.00	H	Average	38.36	7.16	45.52	54.00	-8.48
4960.00	H	Peak	45.18	7.16	52.34	74.00	-21.66
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

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Operation Band	:BDR	Test Date	:2012-12-28
Fundamental Frequency	:2480 MHz	Temp./Humi.	:26.2 deg_C / 62 RH
Operation Mode	:TX HIGH	Engineer	:Allen
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL

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

Factor(dB) = Antenna Factor(dB μ V/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. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level	Factor dB	Actual FS dB μ V	Limit @3m dB μ V/m	Margin dB
			dB μ V				
60.07	S	Peak	49.14	-14.59	34.55	40.00	-5.45
95.96	S	Peak	54.78	-17.13	37.65	43.50	-5.85
239.52	S	Peak	54.58	-14.21	40.37	46.00	-5.63
287.05	S	Peak	53.11	-12.87	40.24	46.00	-5.76
720.64	S	Peak	43.22	-5.43	37.79	46.00	-8.21
815.70	S	Peak	41.24	-4.02	37.22	46.00	-8.78
4960.00	H	Average	38.31	7.01	45.32	54.00	-8.68
4960.00	H	Peak	44.63	7.01	51.64	74.00	-22.36
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

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10. FREQUENCY SEPARATION

10.1. Standard Applicable:

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the $2/3 \times 20\text{dB}$ bandwidth of the hopping channel, whichever is greater.

10.2. Measurement Equipment Used:

Refer to section 7.2 for details.

10.3. Test Set-up:

Refer to section 7.3 for details.

10.4. 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 center frequency of spectrum analyzer = middle of hopping channel .
4. Set the spectrum analyzer as RBW,VBW=100KHz, Adjust Span to 3.0 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

10.5. Measurement Result:

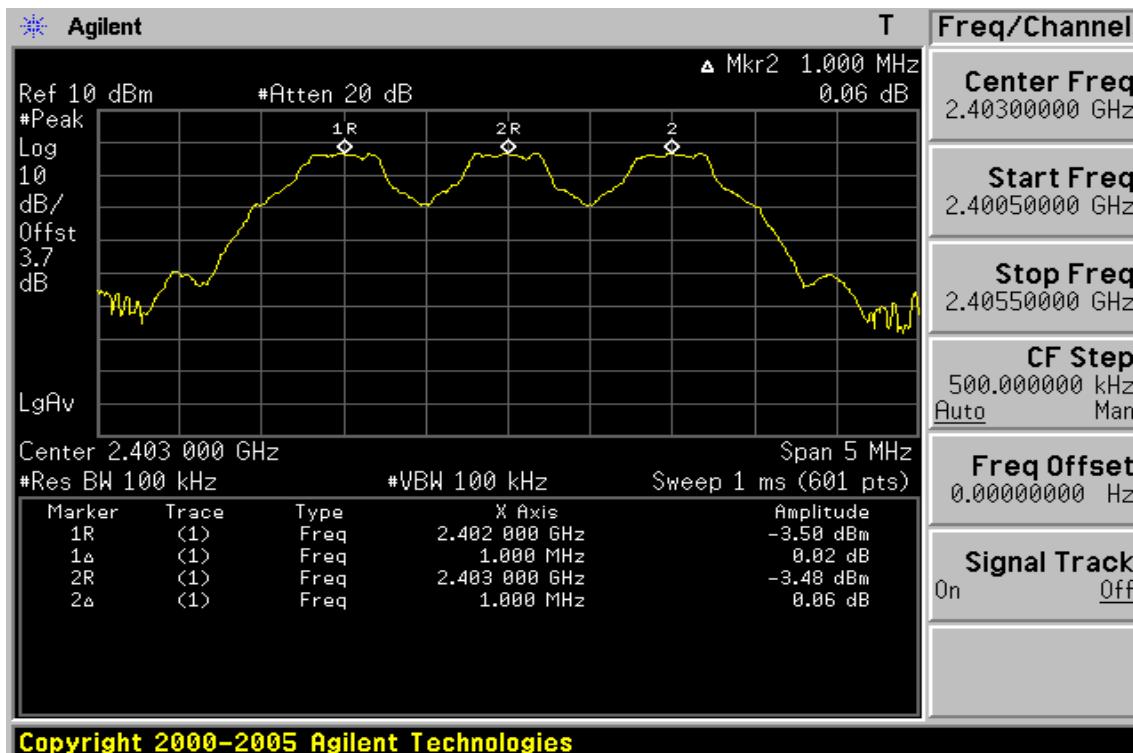
Channel separation (MHz)	Limit	Result
1	$\geq 25\text{KHz}$ or $2/3$ times 20dB bandwidth	PASS

Note: Refer to next page for plots.

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Frequency Separation Test Data



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11. NUMBER OF HOPPING FREQUENCY

11.1. Standard Applicable:

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

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:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW=430KHz, VBW=1.5MHz,
5. Max hold, view and count how many channel in the band.

11.5. Measurement Result:

Note: Refer to next page for plots.

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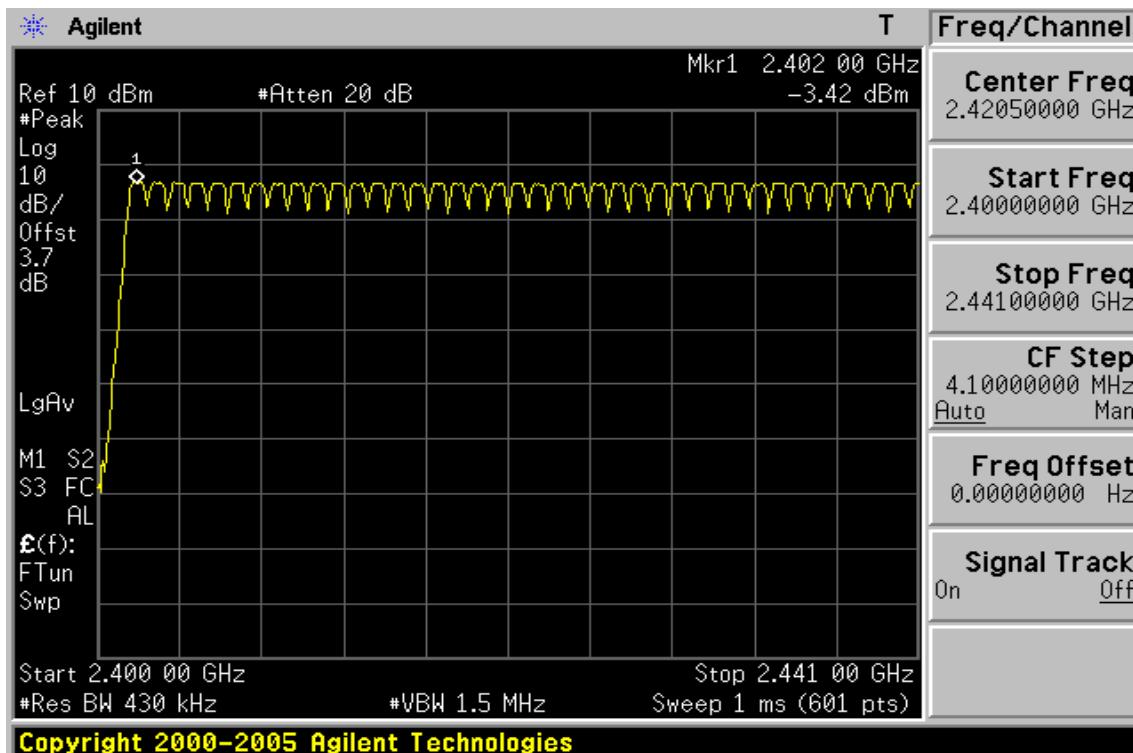
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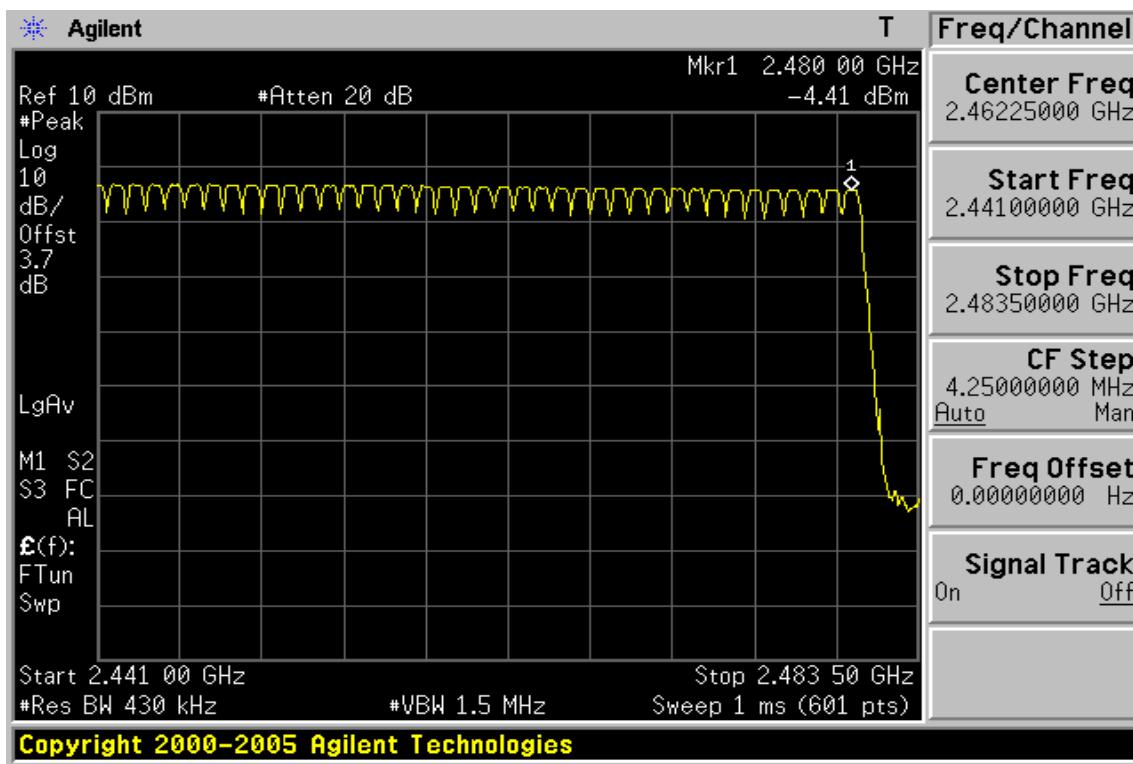
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Channel Number

2.4 GHz – 2.441GHz



2.441 GHz – 2.4835GHz



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12. TIME OF OCCUPANCY (DWELL TIME)

12.1. Standard Applicable:

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

12.2. Measurement Equipment Used:

Refer to section 7.2 for details.

12.3. Test Set-up:

Refer to section 7.3 for details.

12.4. 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 center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW:1MHz, VBW=3MHz, Span = 0Hz , Adjust Sweep = 2~7ms.
5. Repeat above procedures until all frequency measured were complete.

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12.5. Measurement Result:

A period time = 0.4 (sec) * 79 = 31.6 (s)

CH Low: DH1 time slot = 0.423 (ms) * (1600/(2*79)) * 31.6 = 135.36 (ms)
DH3 time slot = 1.683 (ms) * (1600/(4*79)) * 31.6 = 269.28 (ms)
DH5 time slot = 2.933 (ms) * (1600/(6*79)) * 31.6 = 312.85 (ms)

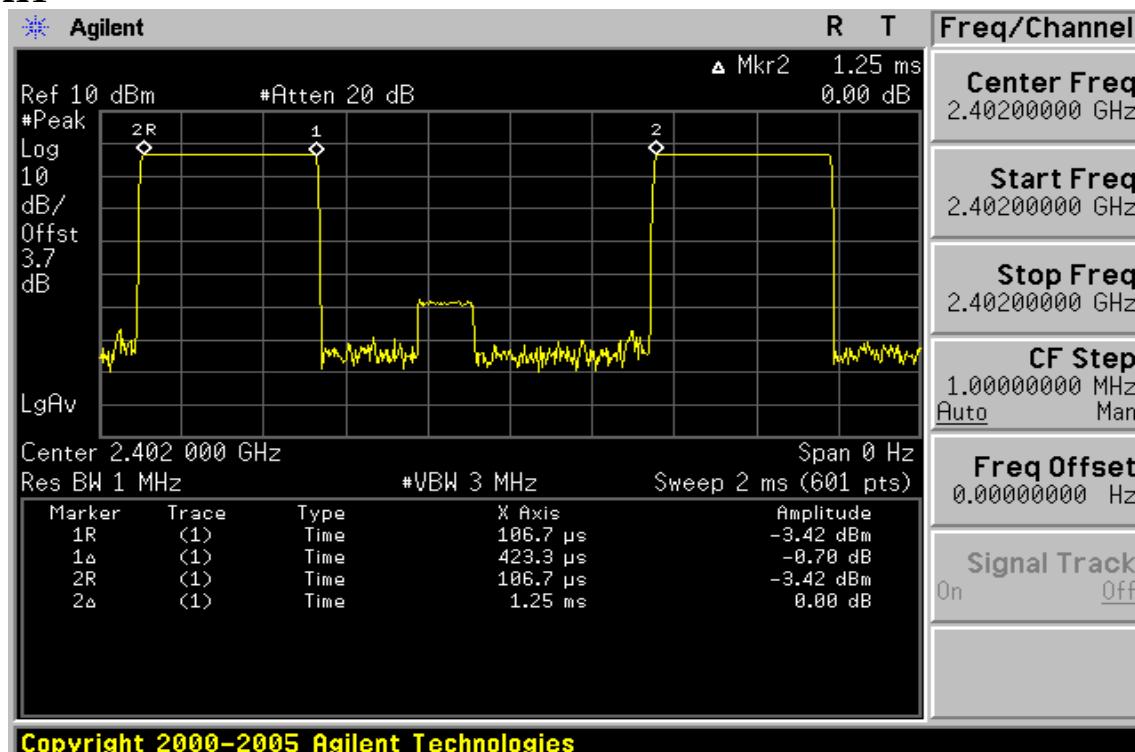
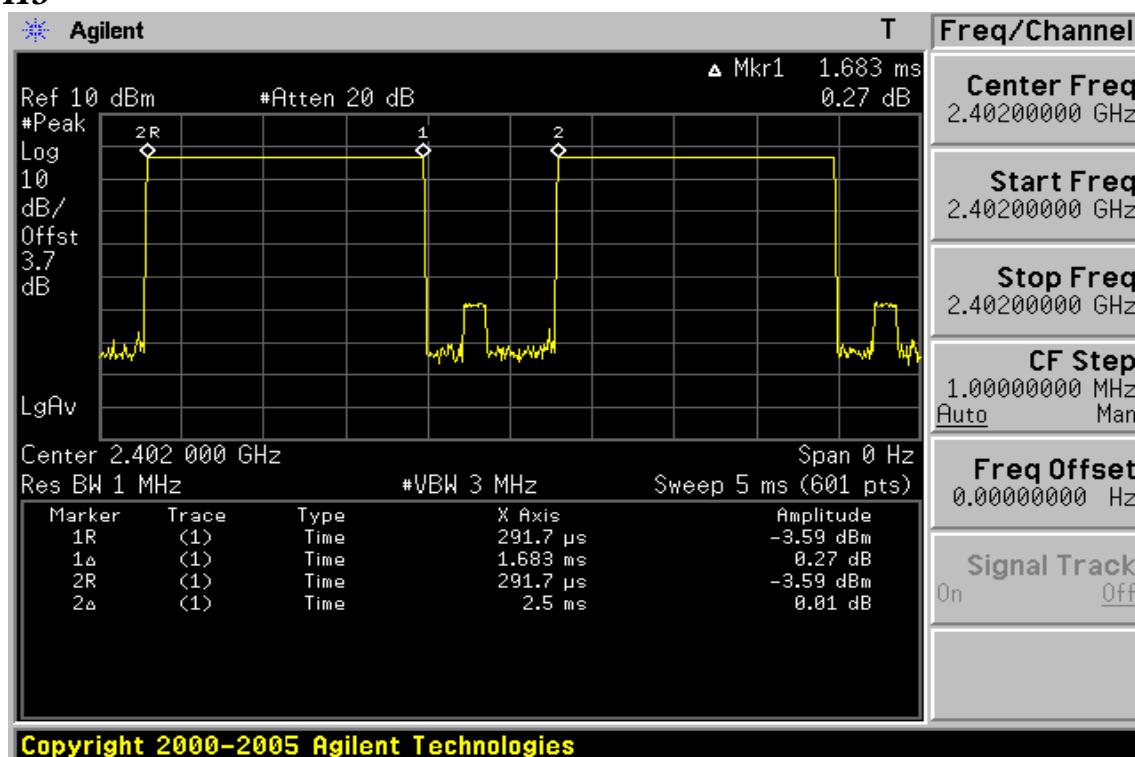
CH Mid: DH1 time slot = 0.423 (ms) * (1600/(2*79)) * 31.6 = 135.36 (ms)
DH3 time slot = 1.683 (ms) * (1600/(4*79)) * 31.6 = 269.28 (ms)
DH5 time slot = 2.933 (ms) * (1600/(6*79)) * 31.6 = 312.85 (ms)

CH High: DH1 time slot = 0.423 (ms) * (1600/(2*79)) * 31.6 = 135.36 (ms)
DH3 time slot = 1.683 (ms) * (1600/(4*79)) * 31.6 = 269.28 (ms)
DH5 time slot = 2.933 (ms) * (1600/(6*79)) * 31.6 = 312.85 (ms)

Note: Refer to next page for plots.

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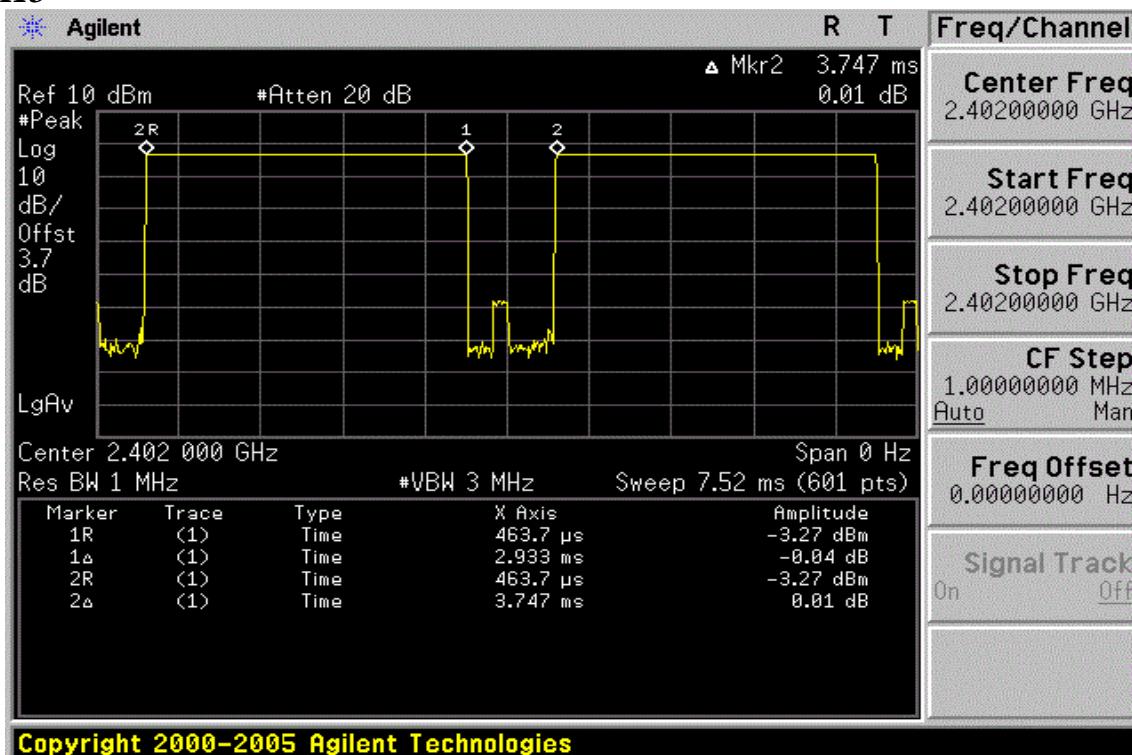
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CH-Low
DH1

DH3


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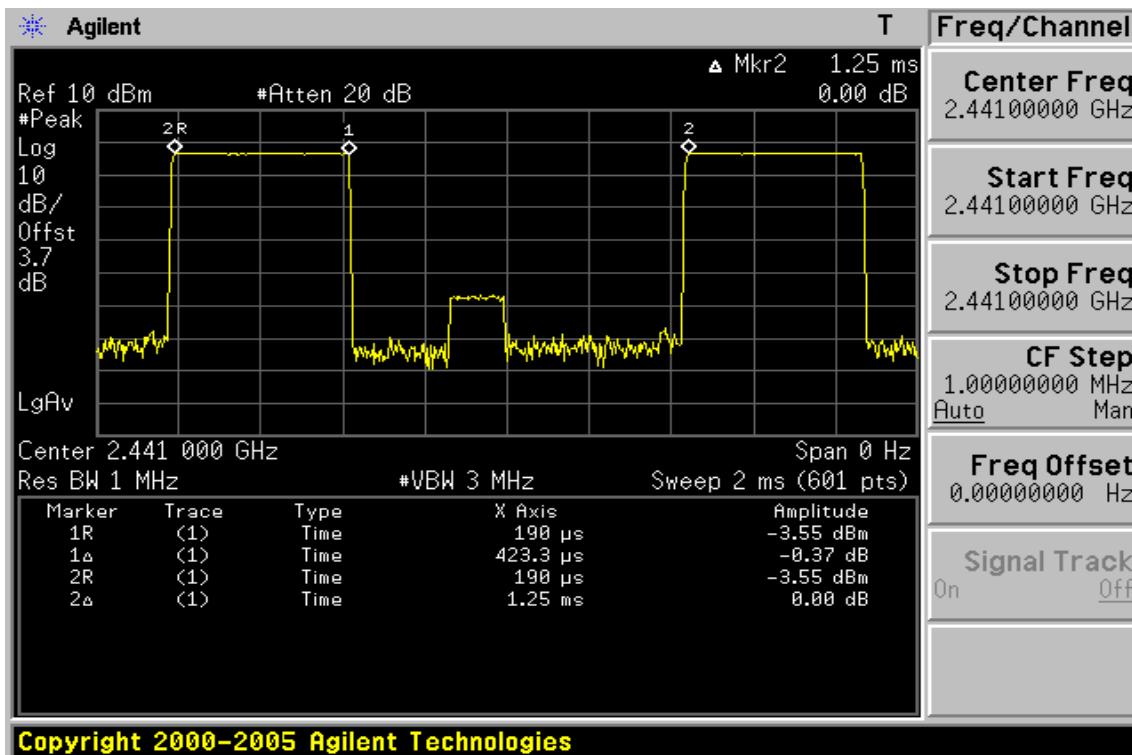
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DH5



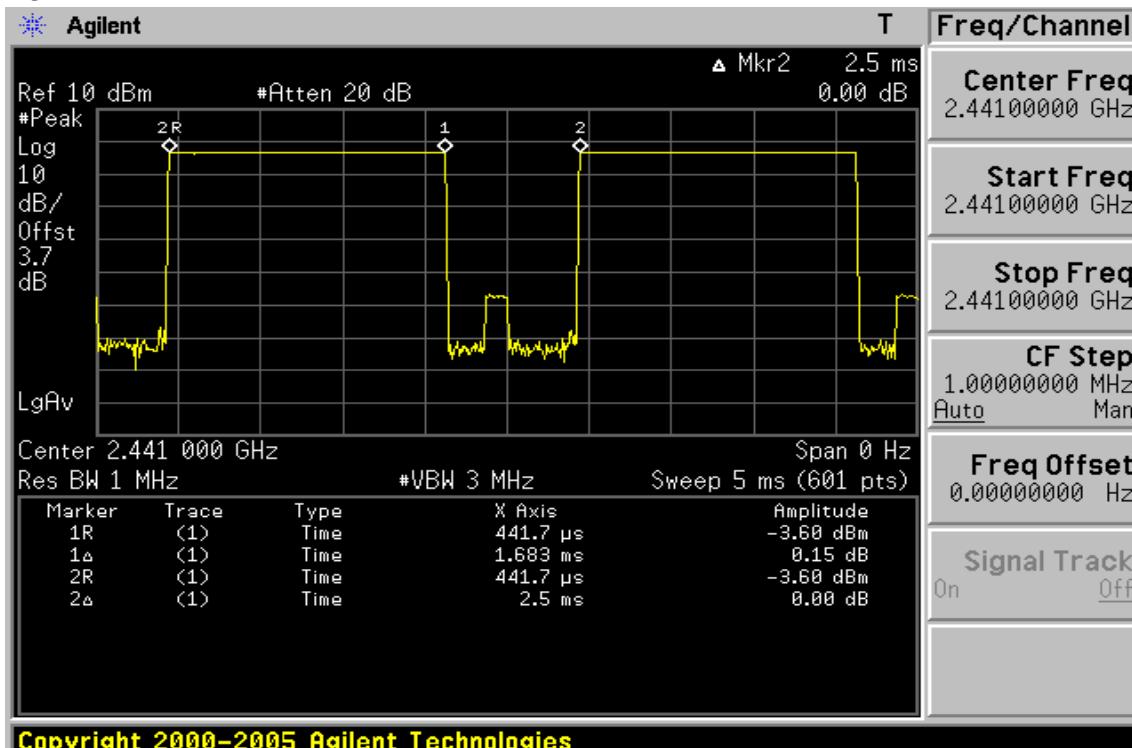
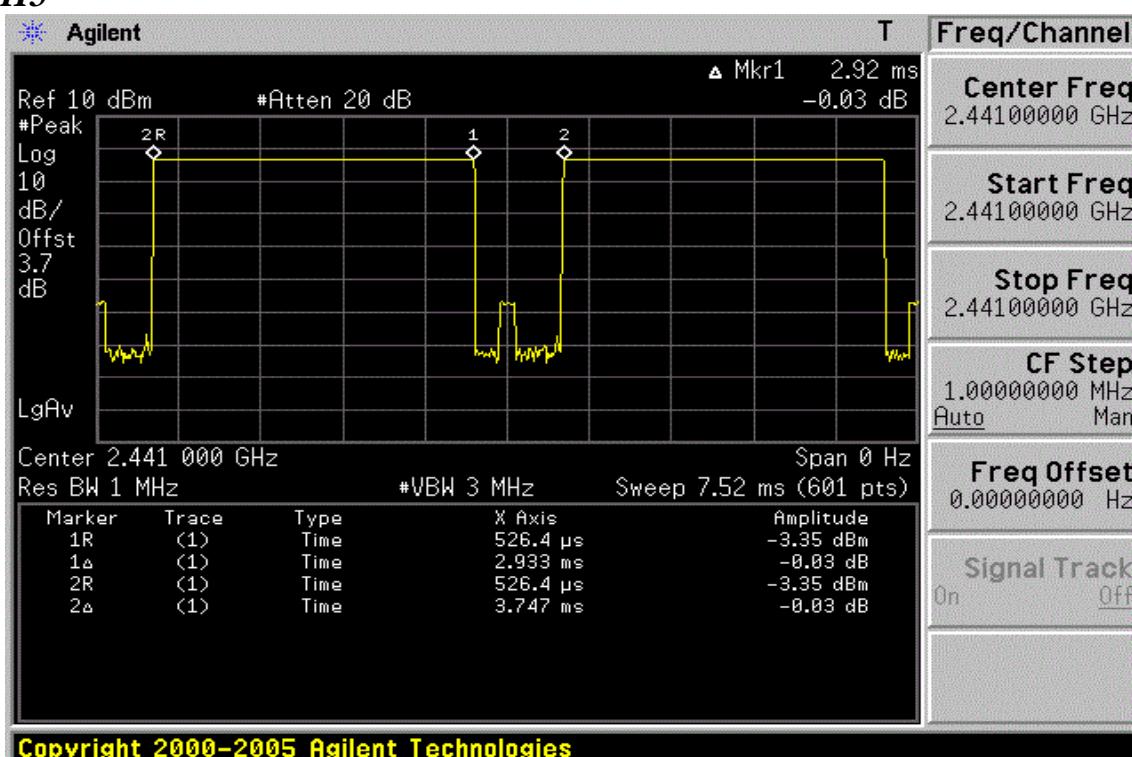
CH-Mid

DH1



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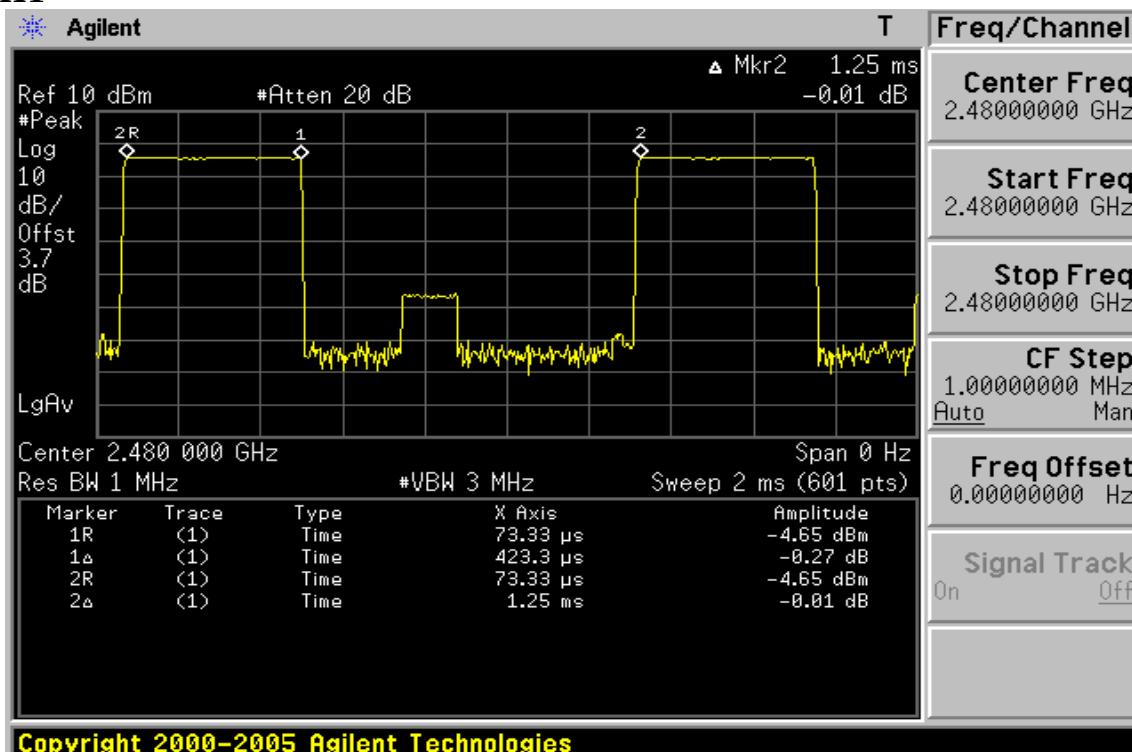
DH3

DH5


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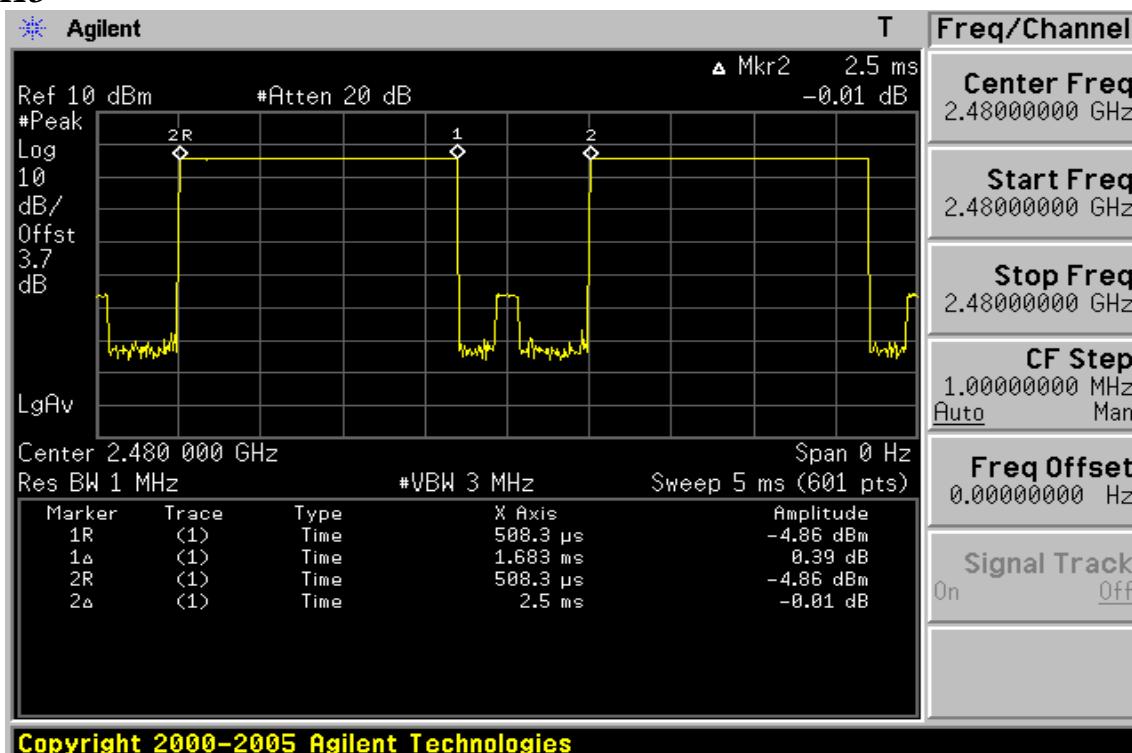
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CH-High *DH1*

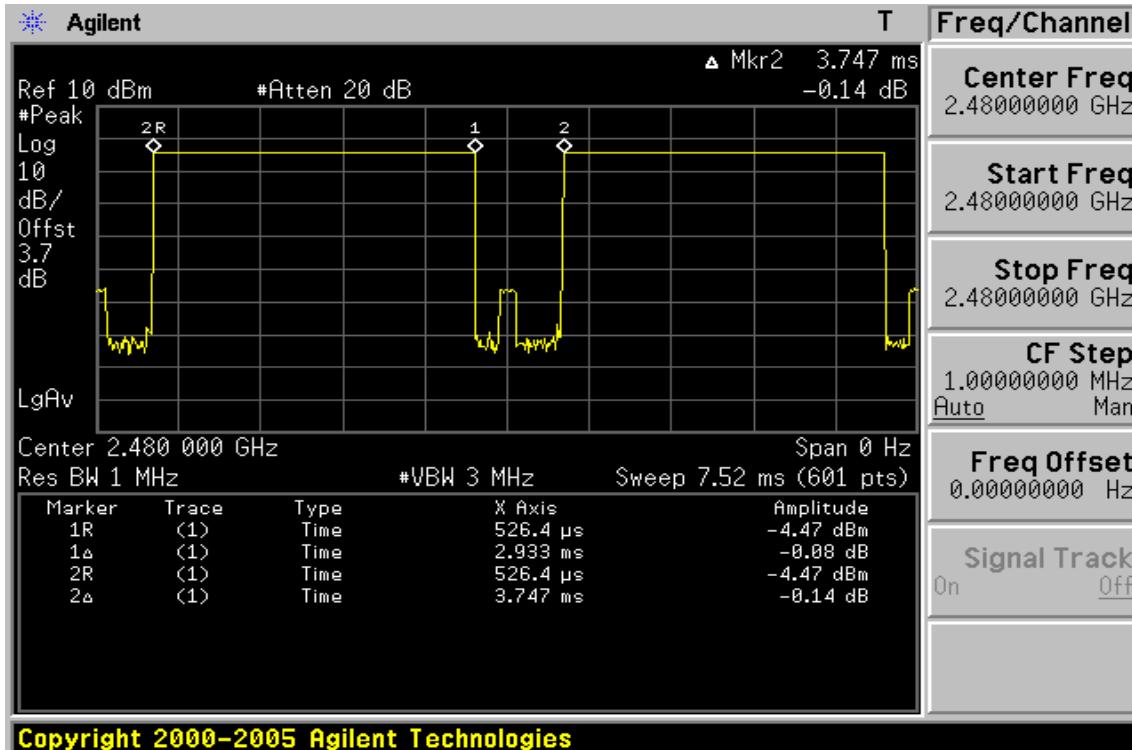


DH3



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13. 20DB BANDWIDTH

13.1. Standard Applicable:

For 20 dB Bandwidth

According to §15.247 (a)(1) for frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB bandwidth.

13.2. Measurement Equipment Used:

Refer to section 7.2 for details.

13.3. Test Set-up:

Refer to section 7.3 for details.

13.4. 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=10KHz (1 % of Bandwidth.), Span= 3MHz, Sweep=auto for 20dB Bandwidth test.
4. Mark the peak frequency and -20dB (upper and lower) frequency and Turn on the 99% bandwidth function, max reading..
5. Repeat above procedures until all frequency measured were complete.

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13.5. Measurement Result:

20dB Bandwidth:

BDR mode (GFSK):

CH	Bandwidth (kHz)
Lower	961.346
Mid	964.259
Higher	880.252

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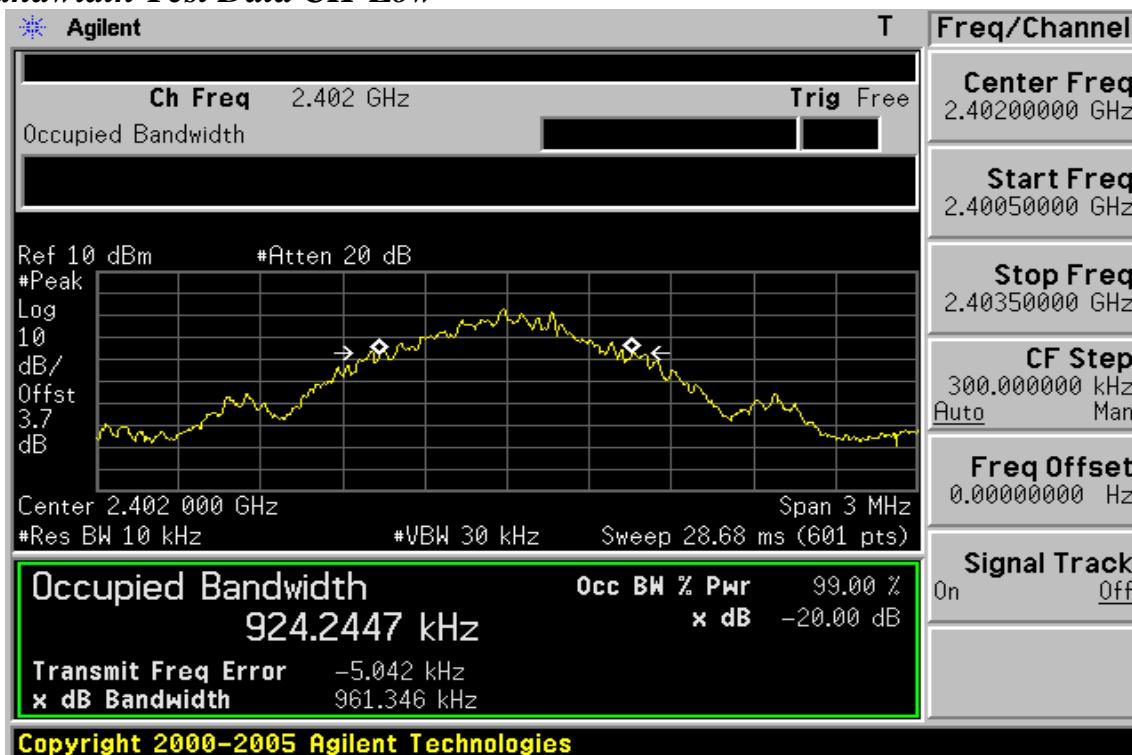
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BDR Mode (GFSK)

20dB Bandwidth Test Data CH-Low



20dB Bandwidth Test Data CH-Mid



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20dB Bandwidth Test Data CH-High

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14. ANTENNA REQUIREMENT

14.1. 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.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

14.2. Antenna Connected Construction:

The directional gains of antenna used for transmitting is 2.78dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

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15. RF Exposure

15.1. 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 Portable device with its physical nature to be used nearby.

As per KDB 447498 D01 §4.3.1, The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$

*$f(\text{GHz})$ is the RF channel transmit frequency in GHz
Power and distance are rounded to the nearest mW and mm before calculation*

15.2. Measurement Result:

This is a portable device and the Max peak output power is (0.47mW) lower than the threshold given and derived as above, where

$$=0.47/5 * \sqrt{2.441} = 0.146863 < 3.0$$

So that RF exposure generating from Bluetooth transmitter can be excluded.

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15.3. Standard Applicable:

As per RSS-102, any transmitter shall be compliant with applicable RF exposure prior to being market.

In §2.5.2, while the operative frequency range is “*above 2.2 GHz and up to 3 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use*”

15.4. Measurement Result:

Power	Gain	Radiated Power (mW)
-3.27	2.78	0.893305484

0.89mW < 20mW

So that RF exposure generating from Bluetooth transmitter can be excluded based on RSS-102

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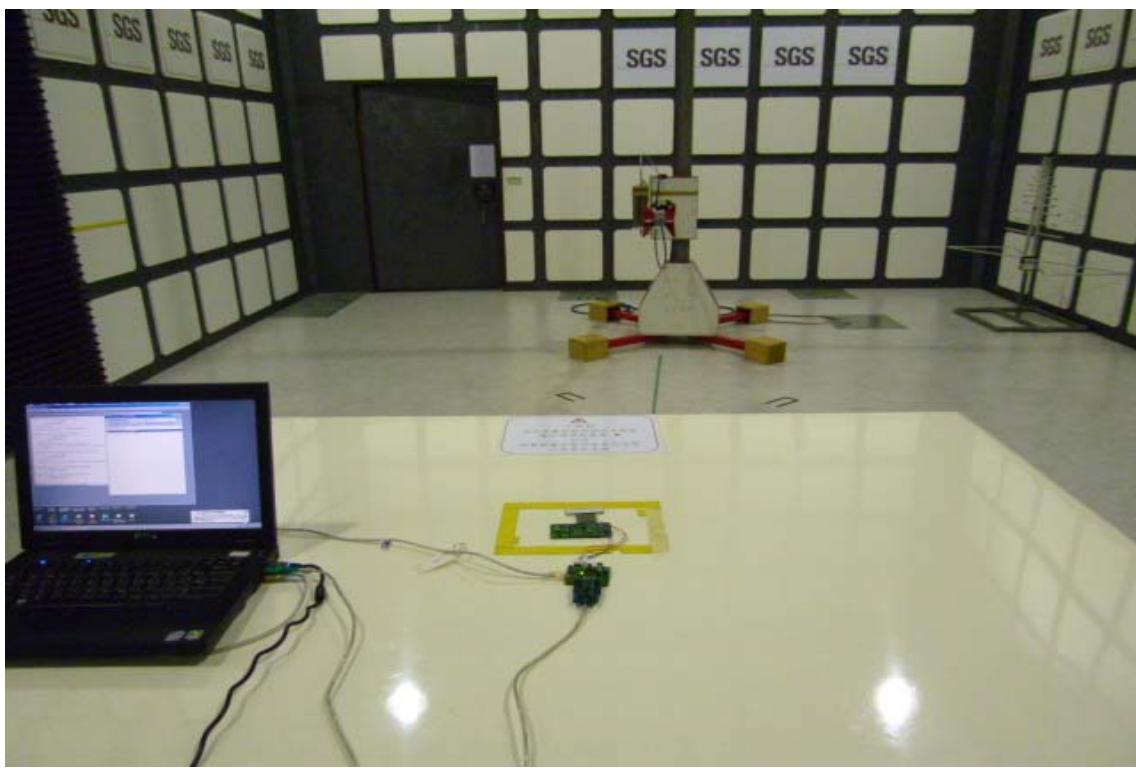
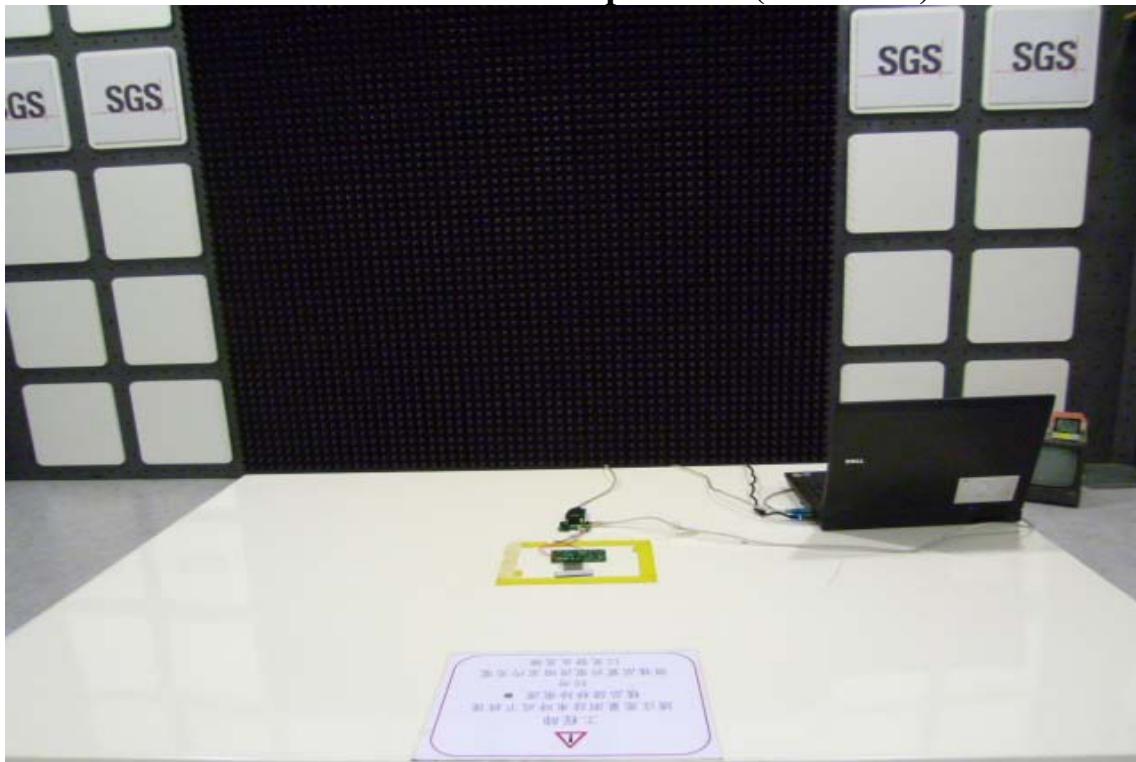
APPENDIX 1

PHOTOGRAPHS OF SETUP

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Radiated Emission Set up Photos (E2 PLAN)

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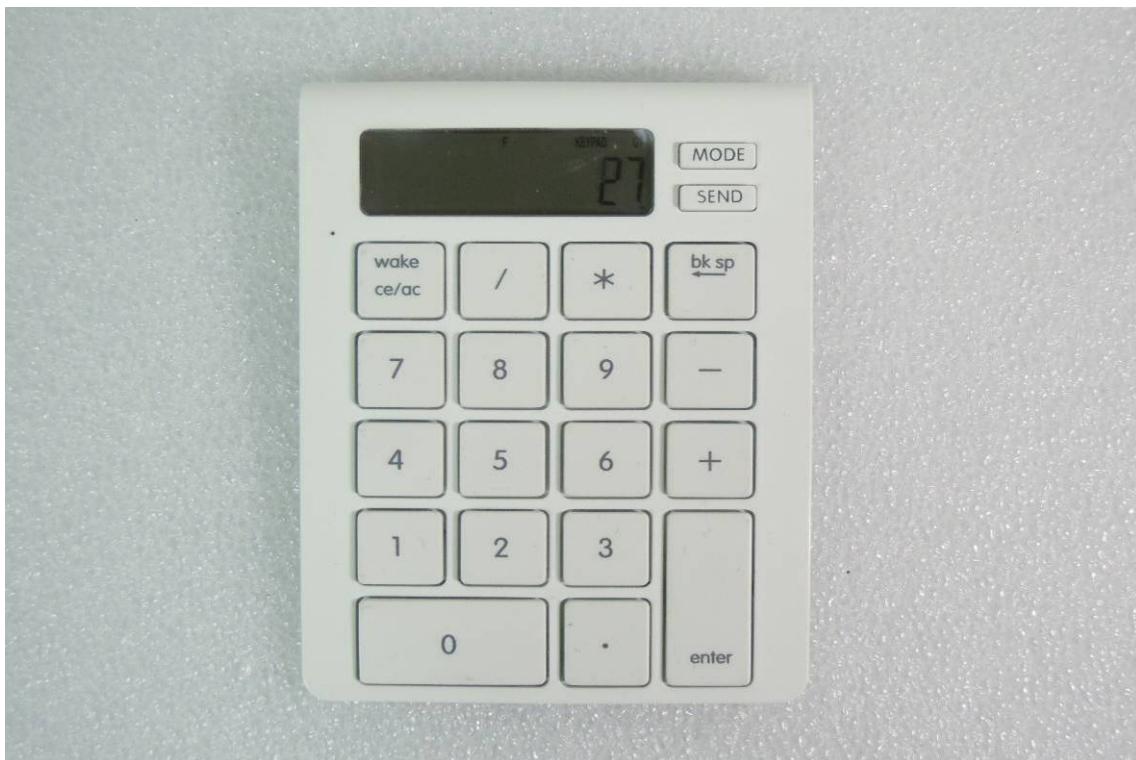
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APPENDIX 2

PHOTOGRAPHS OF EUT

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Front View of EUT - 1*Back View of EUT*

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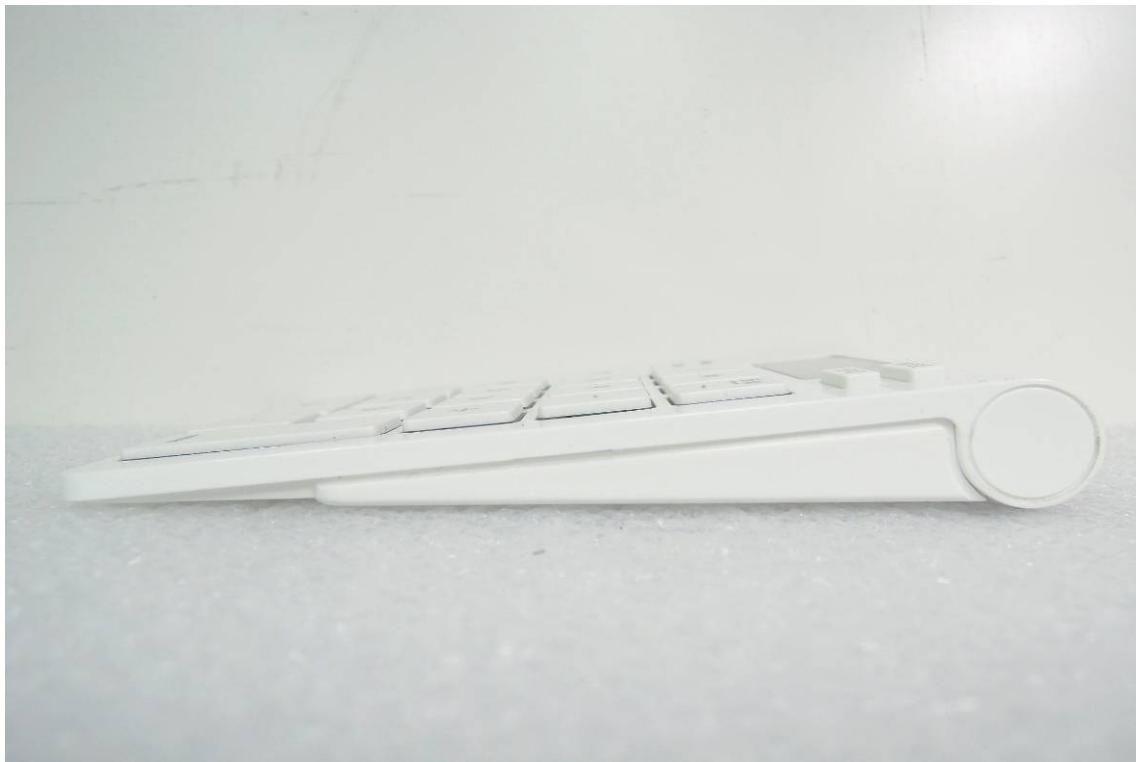
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Side View of EUT -1*Side View of EUT - 2*

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Side View of EUT – 3*Side View of EUT – 4*

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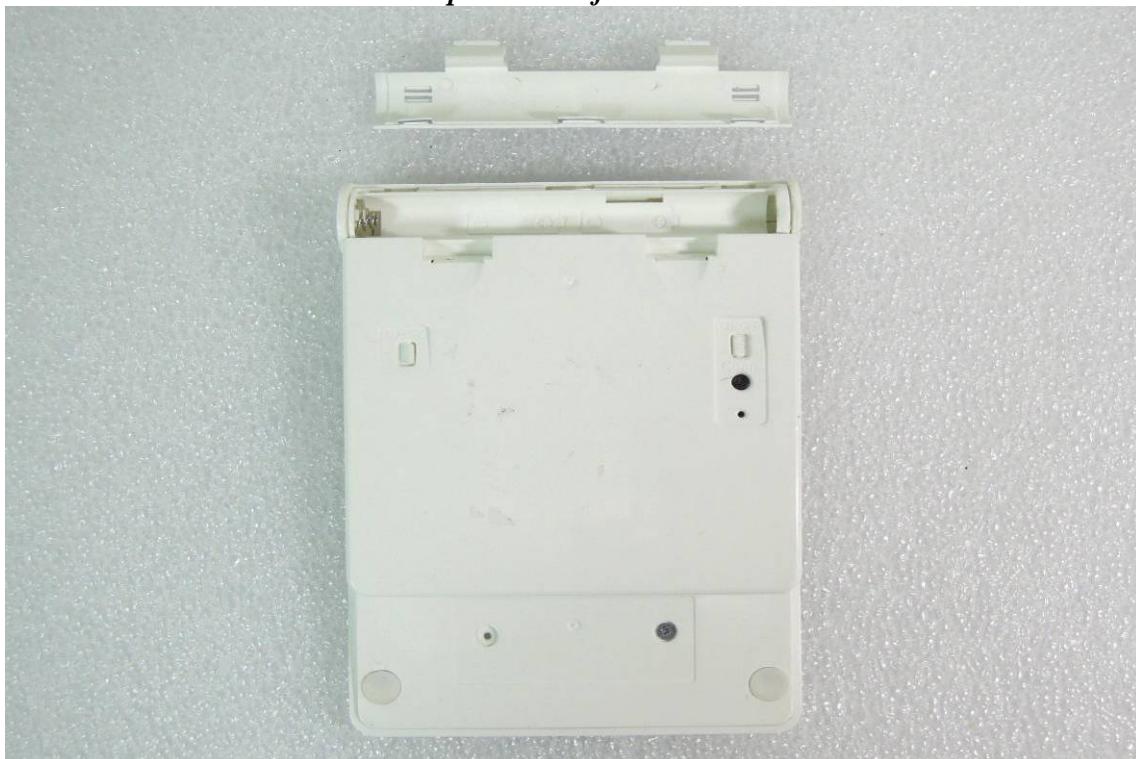
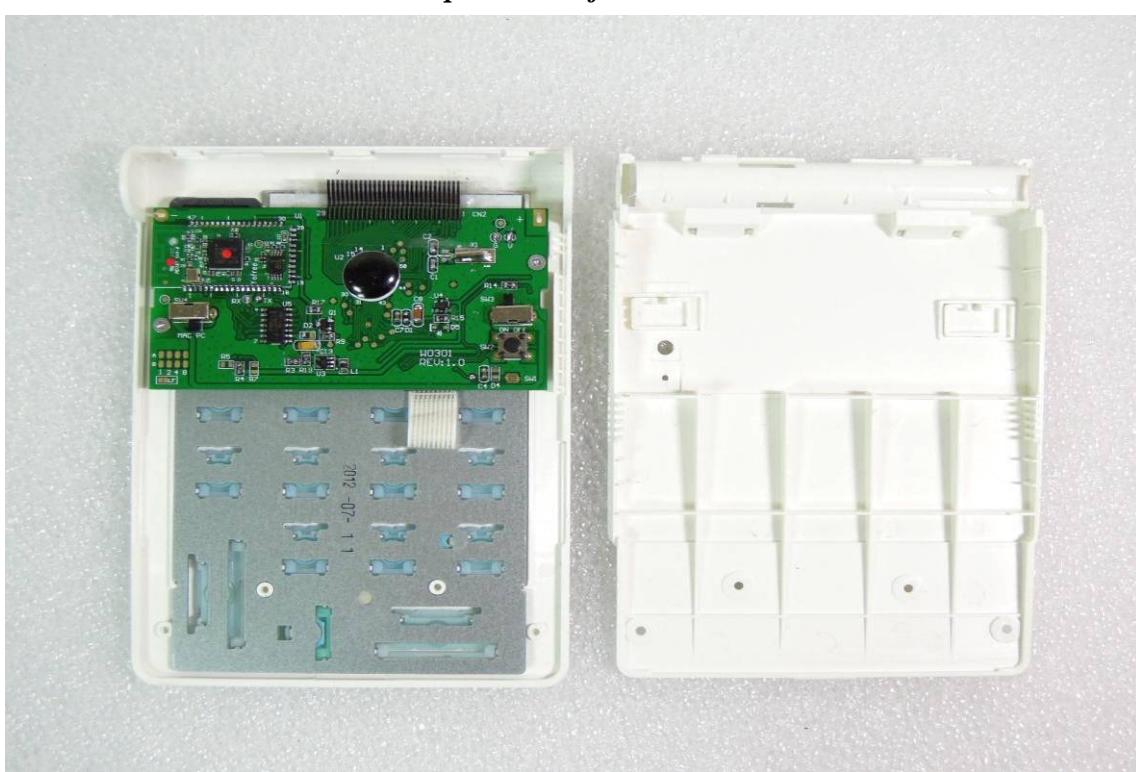
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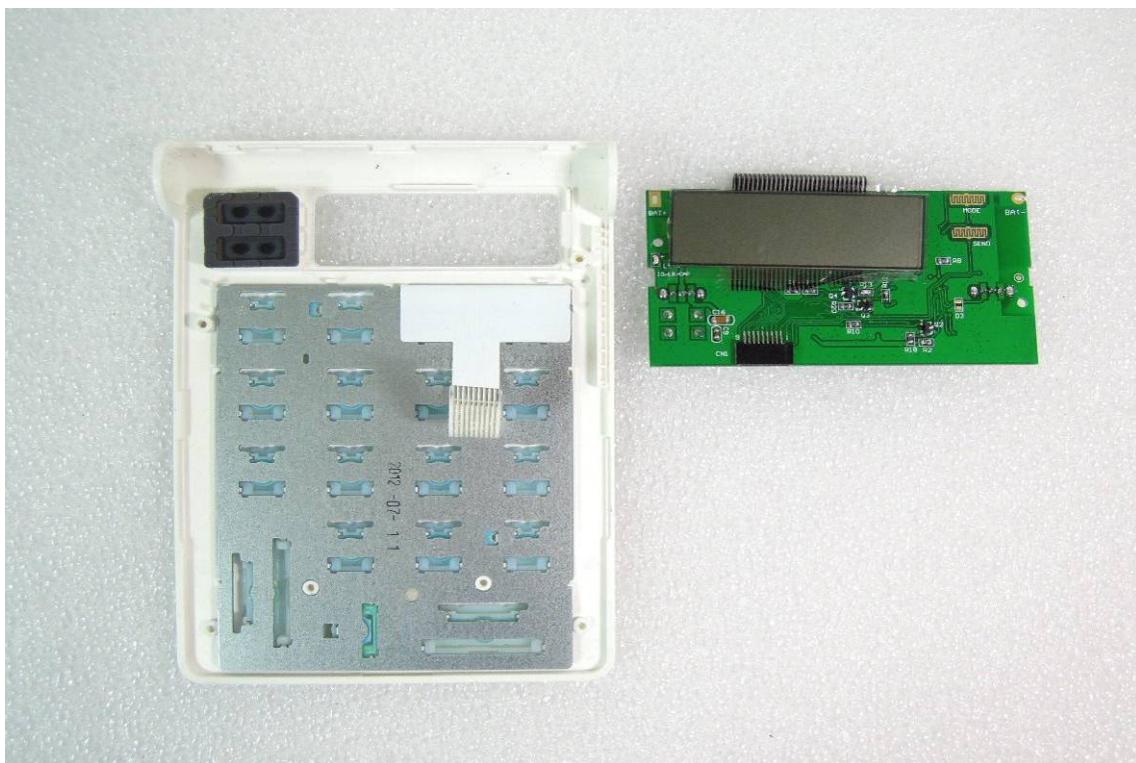
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Open View of EUT - 3*Open View of EUT - 4*

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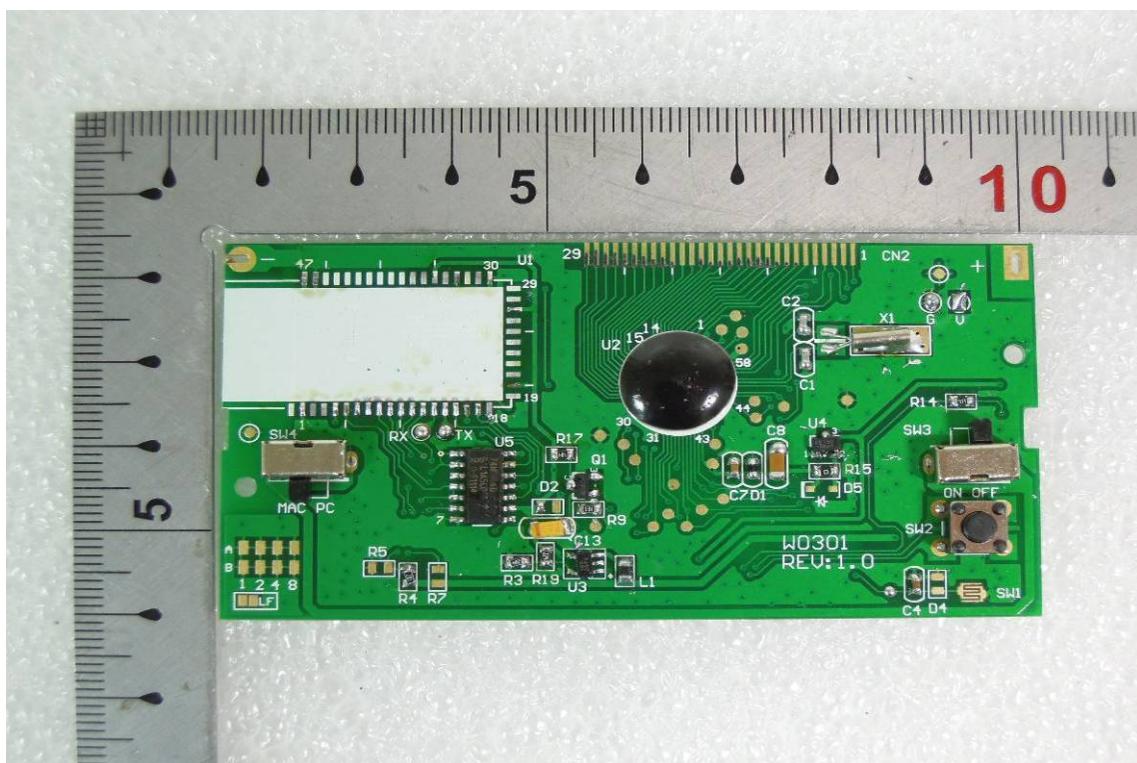
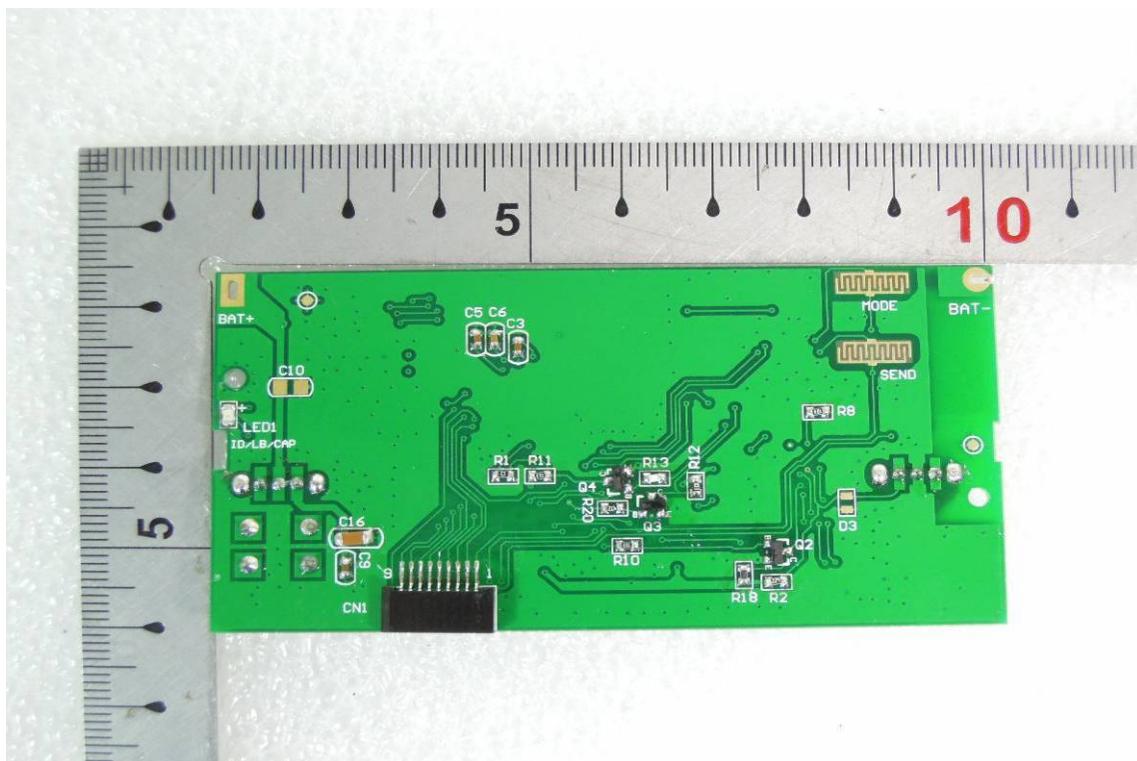
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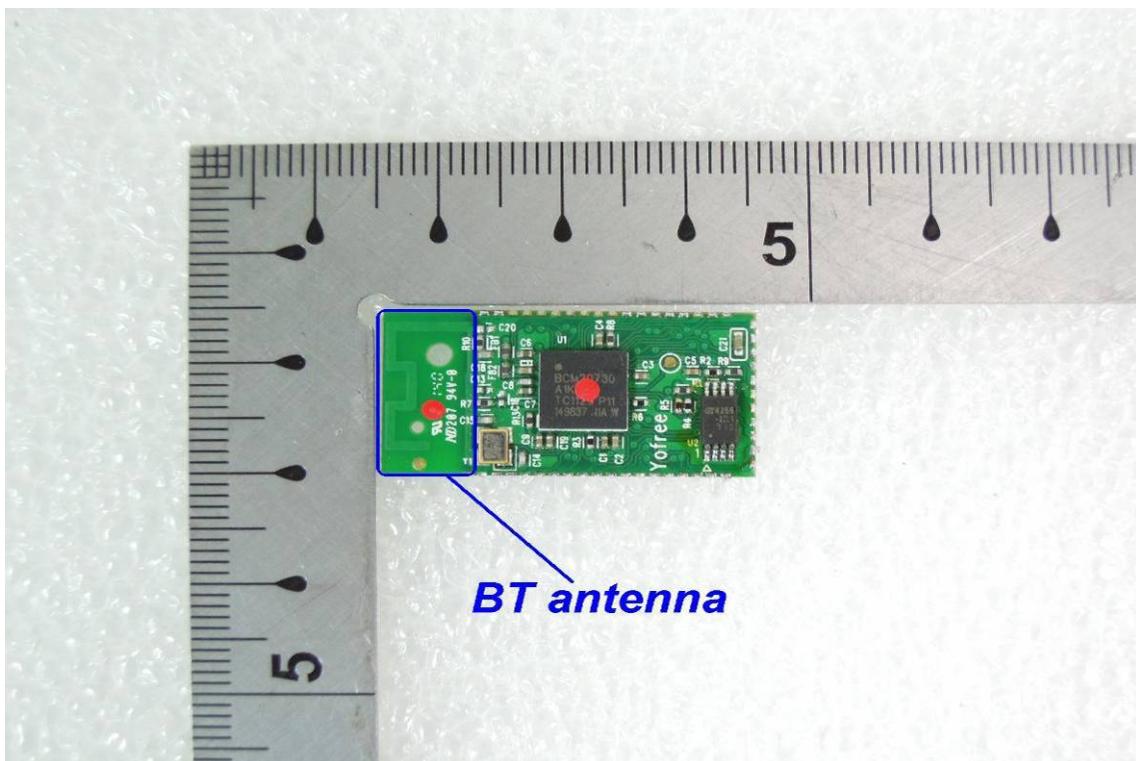
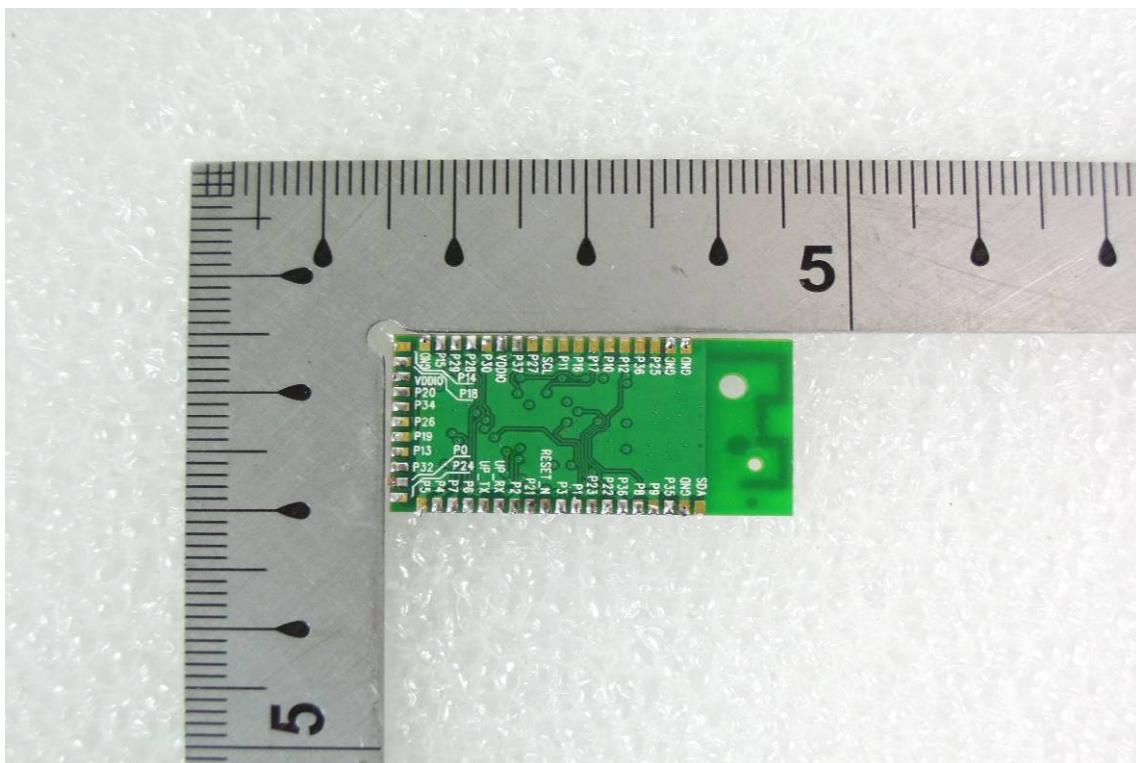
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Internal View of EUT - 5*Internal View of EUT - 6**~ End of Report*

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