



Test Report

FCC Part 15, Subpart C, Section 15.247 Industry Canada RSS-210, Issue 7

Report Number: CWD6671-Cert

Model: CWD6671

FCC ID: EROCWD6671
IC: 5683C-CWD6671

Date: April 18, 2009 (Revised April 28, 2009)

Prepared by: Grace Lin Date: Apr. 18, 2009
Grace Lin, Sr. Compliance Engineer

Reviewed by: Wayne Owens Date: Apr. 18, 2009
Wayne Owens, Director of Program Management



Table of Contents

1. GENERAL DESCRIPTION.....	3
1.1 PRODUCT DESCRIPTION	3
1.2 TEST METHODOLOGY	3
1.3 TEST FACILITY.....	3
1.4 TEST EQUIPMENT.....	4
1.5 EVALUATION SUMMARY	4
2. SYSTEM TEST CONFIGURATION.....	5
2.1 JUSTIFICATION	5
2.2 BLOCK DIAGRAM.....	5
2.3 EUT EXERCISE SOFTWARE AND MODE(S) OF OPERATION	6
2.4 CABLES.....	6
2.5 SPECIAL ACCESSORIES.....	6
2.6 SUPPORT EQUIPMENT	6
2.7 EQUIPMENT MODIFICATIONS	6
3. EVALUATION	7
3.1 ANTENNA REQUIREMENTS.....	7
3.2 MODULAR TRANSMITTER	8
3.3 6 dB BANDWIDTH	9
3.3 99% BANDWIDTH	11
3.4 POWER OUTPUT	13
3.5 BAND EDGE	17
3.6 CONDUCTED SPURIOUS EMISSIONS.....	21
3.7 POWER SPECTRAL DENSITY	25
3.8 RF SAFETY	27
3.9 POWER LINE CONDUCTED EMISSIONS.....	28
3.10 RADIATED EMISSIONS AND RADIATED SPURIOUS EMISSIONS	30
4. TEST SETUP PHOTOS.....	34
APPENDIX A ANTENNA SPECIFICATIONS.....	37



1. General Description

1.1 Product Description

The equipment under test (EUT) is a Crestron 2.4GHz two-way RF transceiver module, model: CWD6671, serial number: CNA6332589.

1.2 Test Methodology

Measurements were performed according to the following procedures and standards:

- ANSI C63.4: 2003
- FCC procedure, "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005
- Industry Canada RSS-Gen Issue 2
- Industry Canada RSS-210 Issue 7
- Industry Canada ICES-003 Issue 4

All measurements were performed in a 3-meter semi-anechoic chamber and the control room.

1.3 Test Facility

The 3-meter semi-anechoic chamber used to collect conducted and radiated emission data is located at 22 Link Drive, Rockleigh, New Jersey. This test facility has been placed on file with the FCC, Registration Number: 412871, and Industry Canada, File: 46405-5683.



1.4 Test Equipment

Description	Model	Serial No.	Frequency Range	Calibration Date
R&S EMI Receiver	ESU40	100076	20 Hz – 40 GHz	Dec. 12, 2008
Teseq Bilog Antenna	CBL 6112D	25231	30 MHz – 2 GHz	Jan. 12, 2009
ETS-Lindgren Double Ridge Horn Antenna	3117	00092366	1 GHz – 18 GHz	Aug. 14, 2008
R&S Preamplifier	TS-PR18	100044	30 MHz – 18 GHz	Feb. 11, 2009
ETS-Lindgren Standard Gain Horn Antenna	3160-09	00078911	18 GHz – 26.5 GHz	Apr. 3, 2009
R&S Preamplifier	TS-PR26	100030	18 GHz – 26.5 GHz	Jan. 21, 2009
Solar Electronics LISN	9252-50-R-24-N	068545	10 kHz – 50 MHz	Feb. 16, 2009

1.5 Evaluation Summary

Rule Section		Description/Parameters	Results
FCC	IC		
§15.203	N/A	Antenna Requirement	Complies
§15.212(a)(1)	§7.1.1 of RSS-Gen	Single Modular Transmitter	Complies
§15.247(a)(2)	§A8.2(a) of RSS-210	6 dB bandwidth, 500 kHz	Complies
N/A	§4.6.1 of RSS-Gen	99% Occupied Bandwidth	Complies
§15.247(b)(3)	§A8.4(4) of RSS-210	Power output, conducted, 1 Watt (30dBm)	Complies
§15.247(d)	§A8.5 of RSS-210	Band edge	Complies
§15.247(d)	§A8.5 of RSS-210	Conducted spurious emissions, 20 dBc	Complies
§15.247(e)	§A8.2(b) of RSS-210	Power spectral density (PSD), 8 dBm in any 3 kHz band.	Complies
§15.247(i)	§5.5 of RSS-Gen	RF safety	Complies
§15.107, §15.207	Table 2 of RSS-Gen	Power line conducted emissions	Complies
§15.209, §15.247(d)	Table 2 of RSS-210	Radiated emissions and radiated spurious emissions	Complies
§15.109	§4.8 of RSS-Gen	Receiver Spurious Emission	Complies

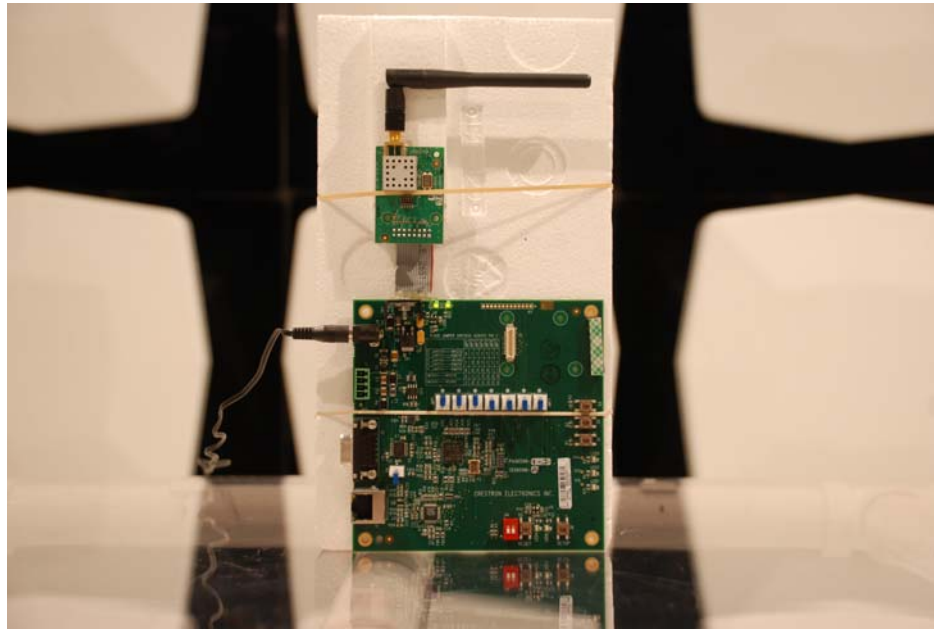
Note:

The channels selected for test were 11, 18, and 26.

2. System Test Configuration

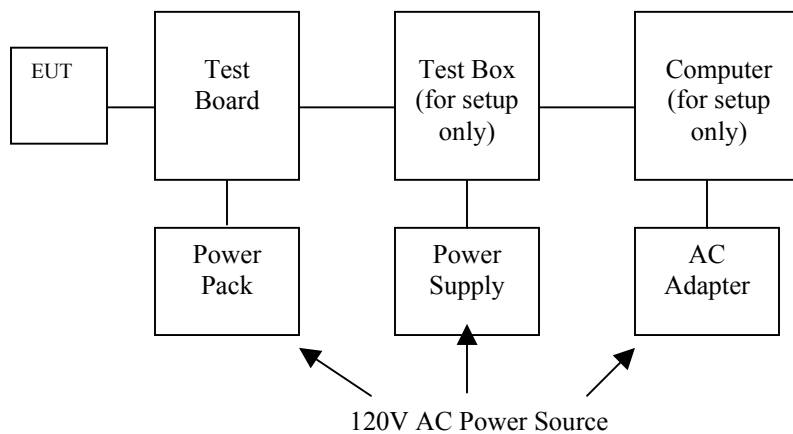
2.1 Justification

The EUT was connected to a test board. A power adapter supplied power to the EUT through the test board. A computer supplied test commands through the test box.



2.2 Block Diagram

Block diagram is shown below.





2.3 *EUT Exercise Software and Mode(s) of Operation*

The EUT was configured to transmit continuously. Channels 11 (2405 MHz), 18 (2440 MHz), and 26 (2480 MHz) were selected for test.

2.4 *Cables*

Qty	Description	Length (m)	From - To	Shielded/ Unshielded
1	Power Cord	1.5	Power Source – Computer	Unshielded
1	Cat 5e	2.2	Computer – Test Box	Shielded
1	10-conductor Flat Cable	0.3	Test Box – Test Board	Unshielded

2.5 *Special Accessories*

There are no special accessories for compliance of this EUT.

2.6 *Support equipment*

No	Description	Manufacturer	Model No	Serial No
1	Computer	DELL	PP02X	11109700981
2	AC Adapter	DELL	LA90PS0-00	CN-0DF266-71615-68A-2AB1
3	Test Box	ember	Not Labeled	ember05
4	Power Supply	CUI	3A-161WP12	Not Labeled
5	Test Board	Crestron	PA06598-1-2	CNA6239429
6	Power Pack	Crestron	PW-1205	Not Labeled

2.7 *Equipment Modifications*

There were no modifications installed during compliance measurements.



3. Evaluation

3.1 *Antenna Requirements*

This module is validated with a dipole antenna from two sources:

- ACE Technology, model: ACE-2400NF
- Z&Y Excellence, model: C047-RF-002

ACE-2400NF and C047-RF-002 antennas have the same electric specifications with a reverse polarity SMA (RP-SMA) male connector. Detail specifications are included in Appendix A.

The antennas' connectors are unique in the sense of complying with FCC §15.203, §15.204(b), and §15.204(c).



3.2 *Modular Transmitter*

Rule Sections		Description
FCC Part 15	IC RSS-Gen	
§15.212 (a)	§7.1.1 (a)	This module is a single modular transmitter consists of a completely self-contained RF transmitter device that is typically incorporated into another product, host, or device.
§15.212 (a)(1)(i)	§7.1.1 (b)	The module has integral RF shielding to isolate it from surrounding equipment and the large environment in general.
§15.212 (a)(1)(ii)	§7.1.1 (c)	All inputs are processed as data by the radio control element. The outside user has no direct control of transmit modulation.
§15.212 (a)(1)(iii)	§7.1.1 (d)	The radio front end contains a linear regulator to regulate device operation over voltage variations and to limit the output power under high voltage conditions.
§15.212 (a)(1)(iv)	§7.1.1(e)	This module is validated with a dipole antenna. The reverse polarity SMA antenna connector is unique in the sense of complying with FCC §15.203, §15.204(b), and §15.204(c).
§15.212 (a)(1)(v)	§7.1.1	The module was tested in a stand-alone configuration. It complies with the AC line conducted requirements found in FCC §15.207 and IC RSS-Gen Table 2 requirements.
§15.212 (a)(1)(vi)	§5.2	An ID label is affixed to each unit at the time of manufacture. Information is also clearly presented in the user guide about labeling requirements for the final assembly.
§15.212 (a)(1)(vii)	§7.1.1	This module is compliant with FCC §15.247 and IC RSS-Gen/RSS-210 rules. Installation and other requirements are presented in the user guide to allow the unit to be correctly installed.
§15.212 (a)(1)(viii)	§5.5	This module is compliant with the RF exposure requirements of FCC Parts §15.247, §15.1091, §15.1093, and IC RSS-Gen §5.5.



3.3 6 dB Bandwidth

Performance Criterion: The 6 dB bandwidth shall be at least 500 kHz.

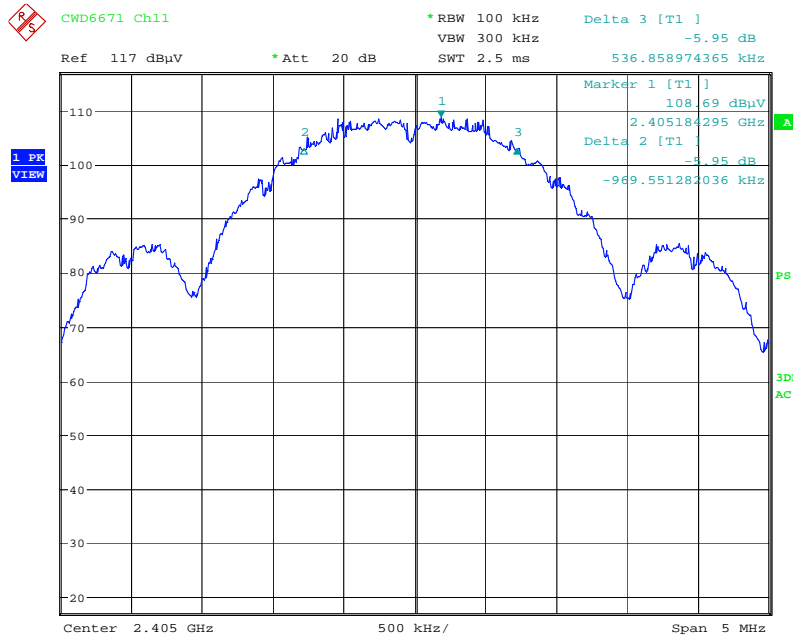
Test Results: Complies

Test Details: Refers to the following table and receiver screen captures. The EUT was tested in a continuous transmit mode with power level of 3 in boost mode.

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)
11	2405	1506.5
18	2440	1498.4
26	2480	1466.4

Note: The RF level in the plots is relative and is not the indication of RF output power.

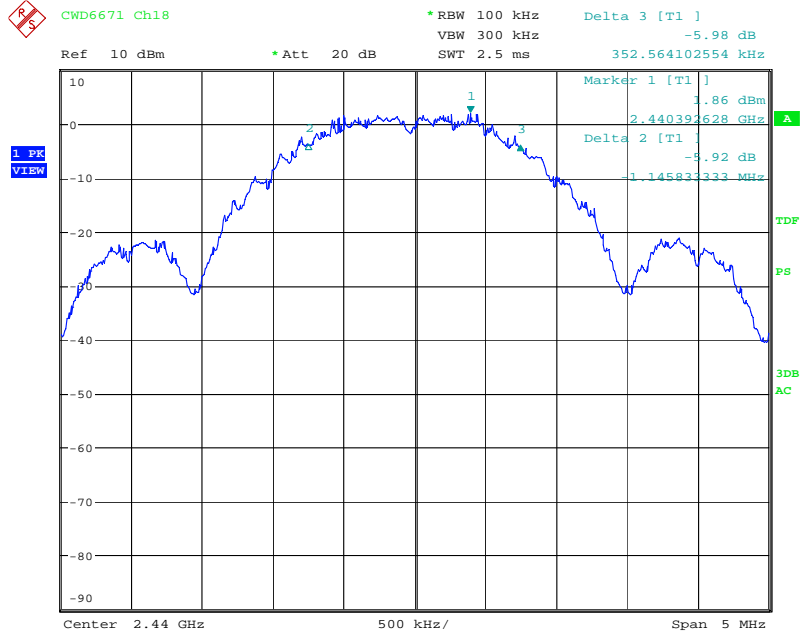
Channel 11:



Date: 13.APR.2009 14:42:12

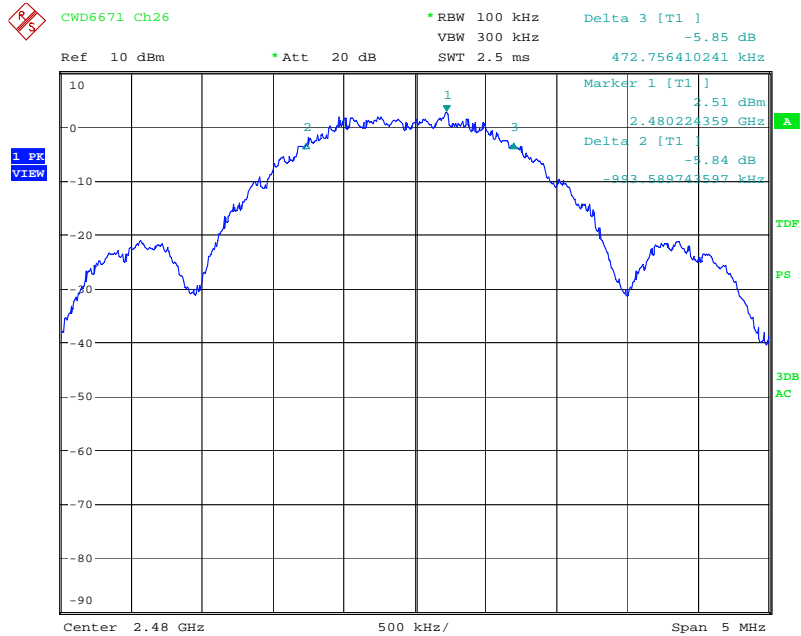


Channel 18:



Date: 13.APR.2009 14:55:14

Channel 26:



Date: 13.APR.2009 14:57:38



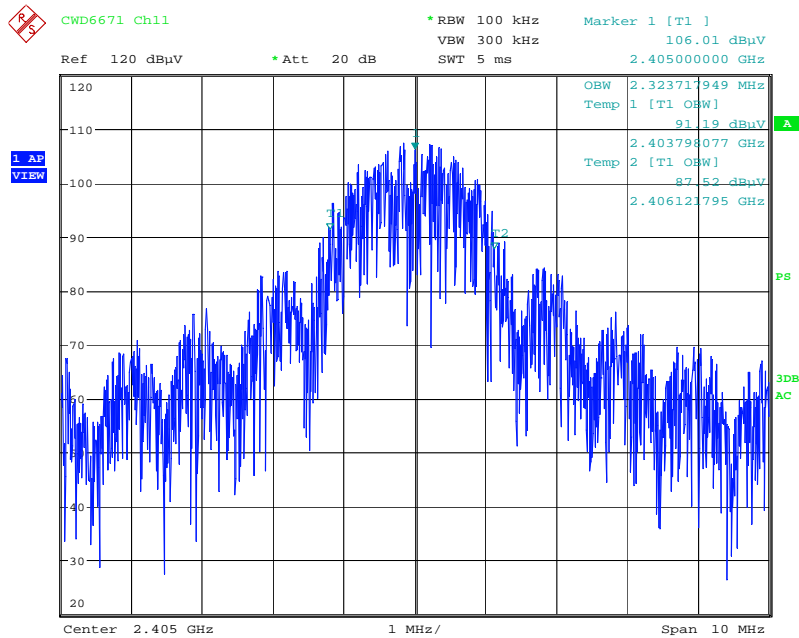
3.3 99% Bandwidth

Test Details: Refers to the following table and receiver screen captures. The EUT was tested in a continuous transmit mode with power level of 3 at boost mode.

Channel	Frequency (MHz)	99% Bandwidth (MHz)
11	2405	2.324
18	2440	2.308
26	2480	2.484

Note: The RF level in the plots is relative and is not the indication of RF output power.

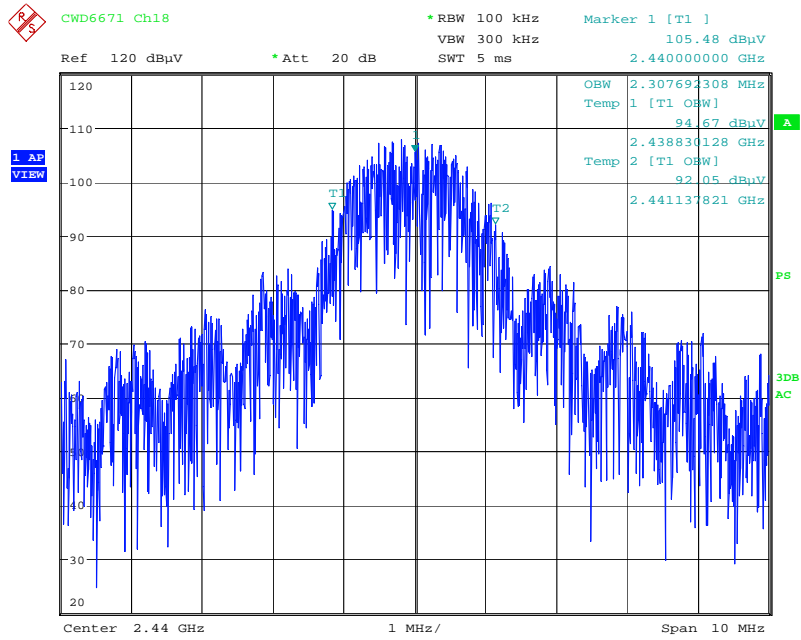
Channel 11:



Date: 13.APR.2009 15:42:13

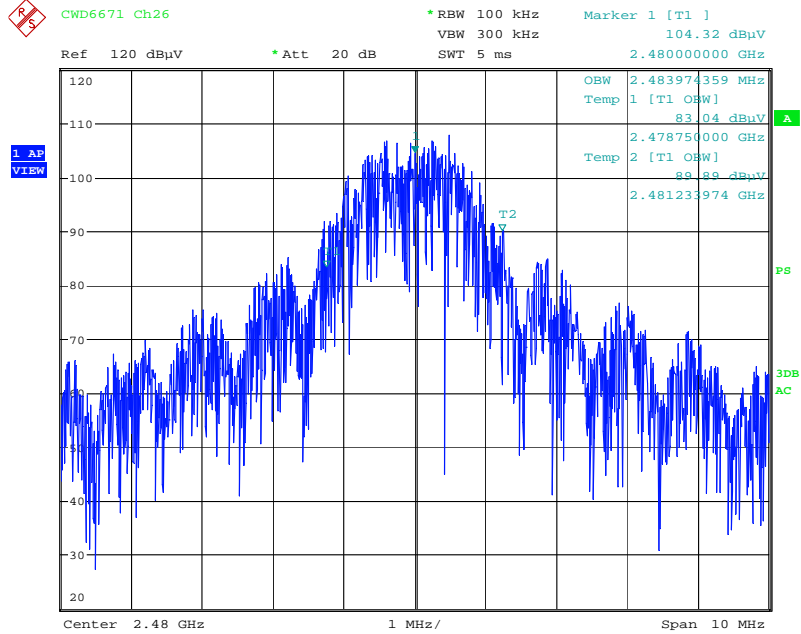


Channel 18:



Date: 13.APR.2009 15:40:57

Channel 26:



Date: 13.APR.2009 15:39:22



3.4 Power Output

Performance Criterion: The maximum peak conducted output power shall not exceed 1 Watt.

Test Results: Complies

Test Details: The available power settings of the processor are listed below.

Power Settings (decimal, signed)	Power Settings (decimal, unsigned)
+3	3
+2	2
+1	1
0	0
-1	255
-2	254
-3	253
-4	252
-5	251
-6	250
-7	249
-8	248
-9	247
-11	245
-12	244
-14	242
-17	239
-20	236
-26	230
-43	213

The maximum output power settings of the EUT are listed below. The factory will set these maximum settings. The integrators and end users have no access to change these settings

Channel	Power Settings (decimal, unsigned)
11-25	3
26	252

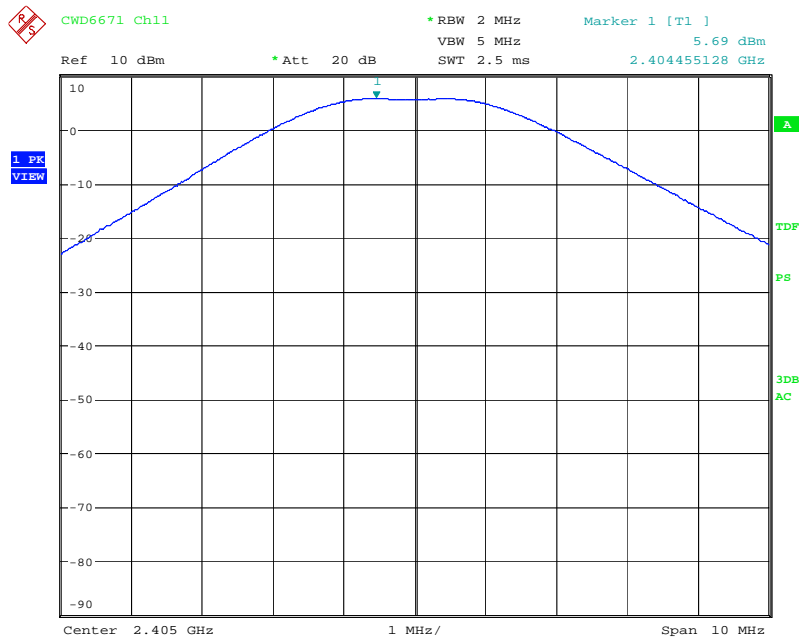


The EUT was tested in a continuous transmit mode. Refers to the following data table and receiver screen captures.

Channel	Frequency (MHz)	Power Level	Power	
			dBm	mW
11	2405	3	5.69	3.71
18	2440	3	5.84	3.84
25	2475	3	5.76	3.76
26	2480	252	-0.75	0.84

Note: The insertion loss was compensated for in the receiver.

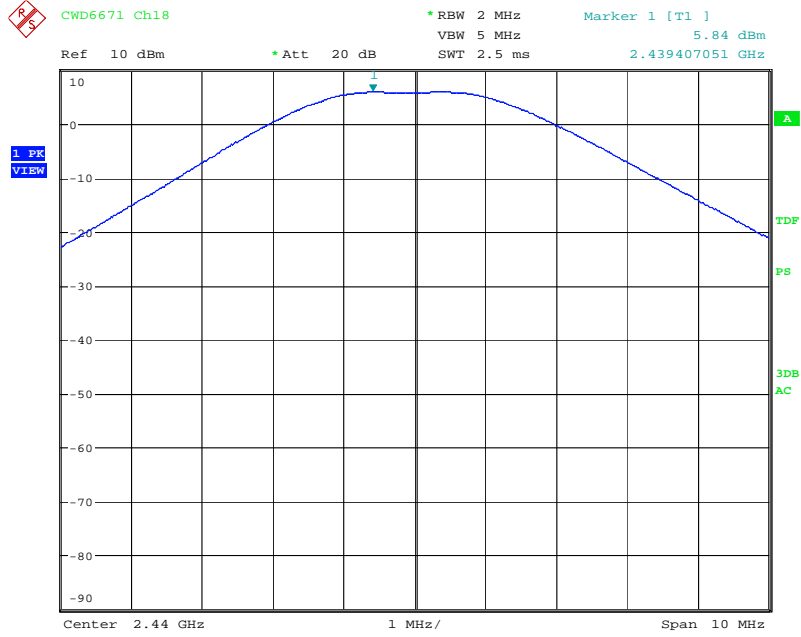
Channel 11:



Date: 13.APR.2009 14:48:27

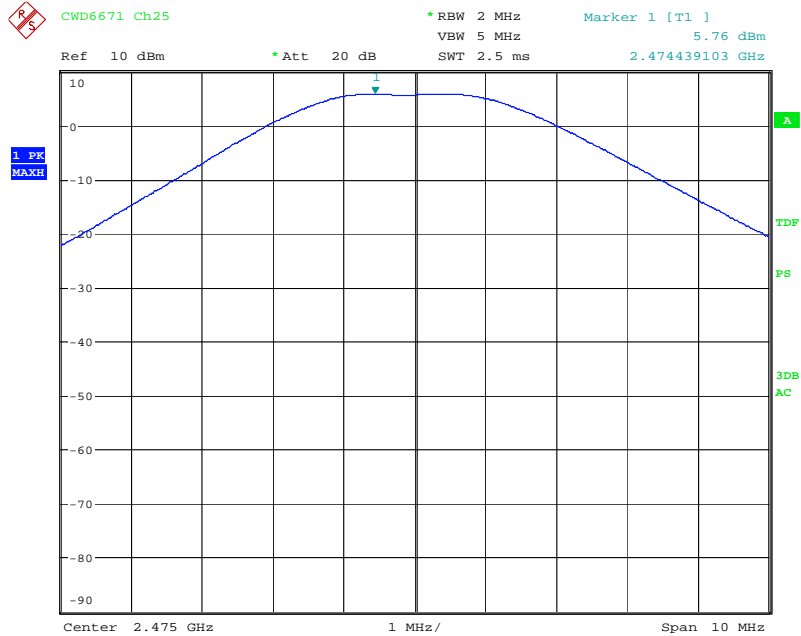


Channel 18:



Date: 13.APR.2009 14:52:03

Channel 25:



Date: 18.APR.2009 16:07:28



Channel 26:



CWD6671 Ch26 P=252

* RBW 2 MHz

Marker 1 [T1]

VBW 5 MHz

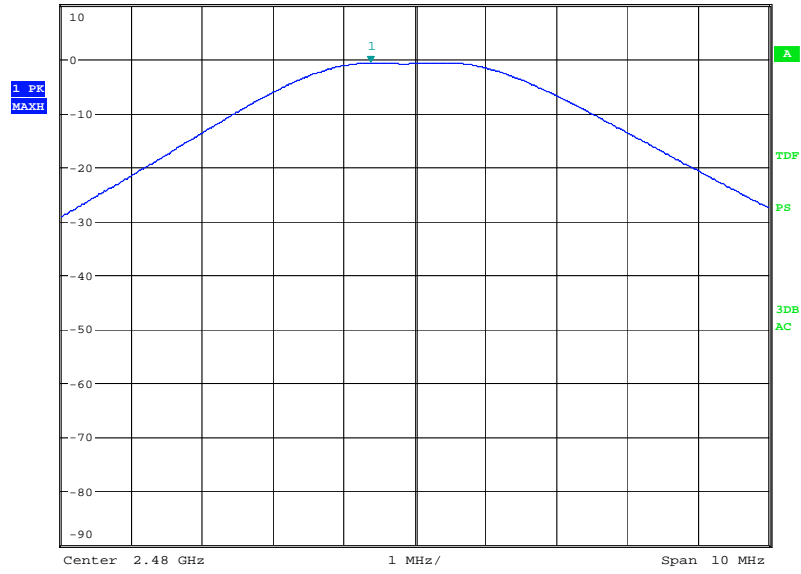
-0.75 dBm

Ref 10 dBm

* Att 20 dB

SWT 2.5 ms

2.479375000 GHz



Date: 18.APR.2009 16:03:46



3.5 *Band Edge*

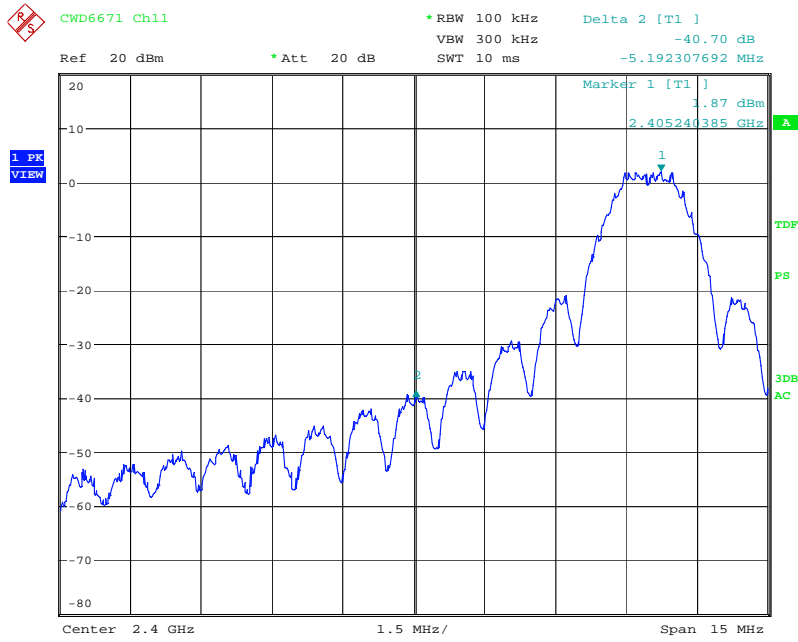
Performance Criterion: In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

Test Results: Complies

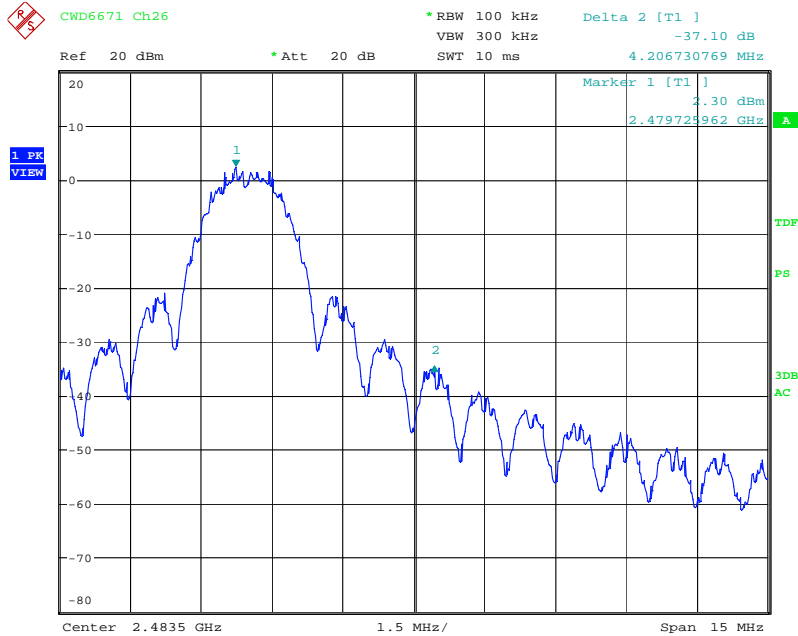
Test Details: Refers to the following receiver screen captures



Band Edge, Conducted:



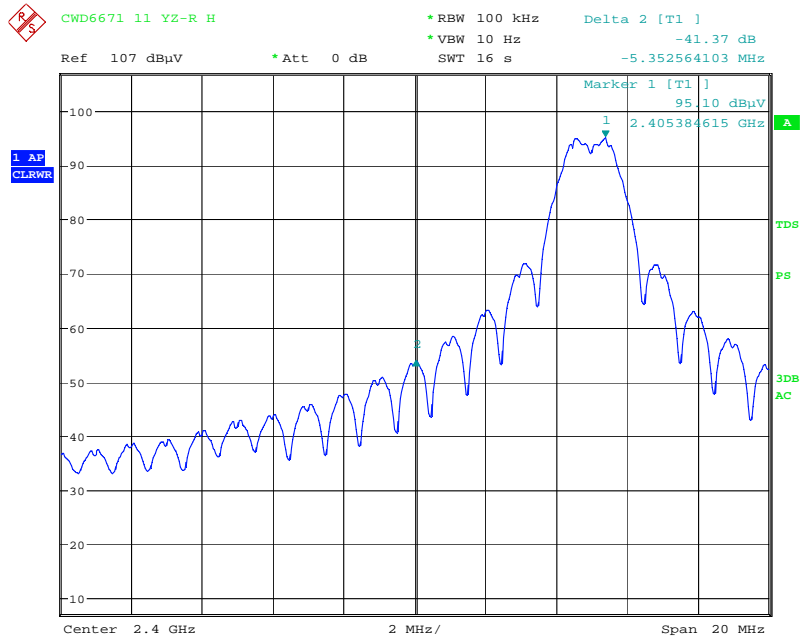
Date: 14.APR.2009 10:52:45



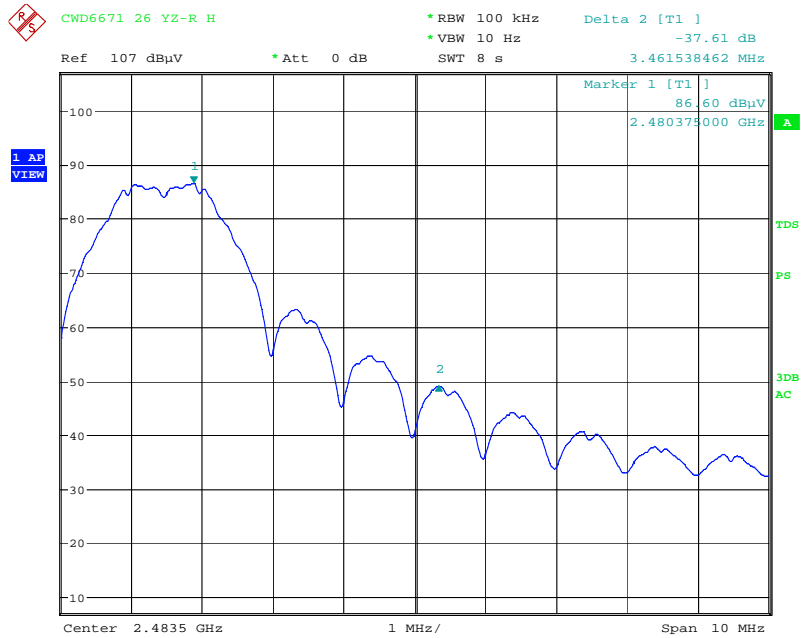
Date: 14.APR.2009 10:54:51



Band Edge, Radiated



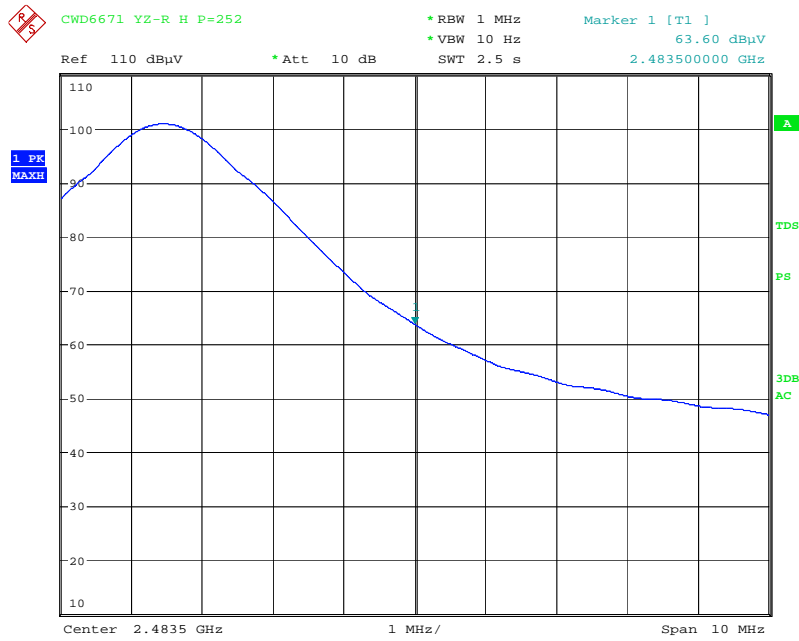
Date: 18.APR.2009 12:02:28



Date: 18.APR.2009 09:49:13



Band Edge, Radiated



Date: 18.APR.2009 10:31:02

NOTE: Antenna factor and cable loss were compensated for in the receiver. Calculation of duty cycle correction factor (11 dB) is attached in a separate file.



3.6 *Conducted Spurious Emissions*

Performance Criterion: In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

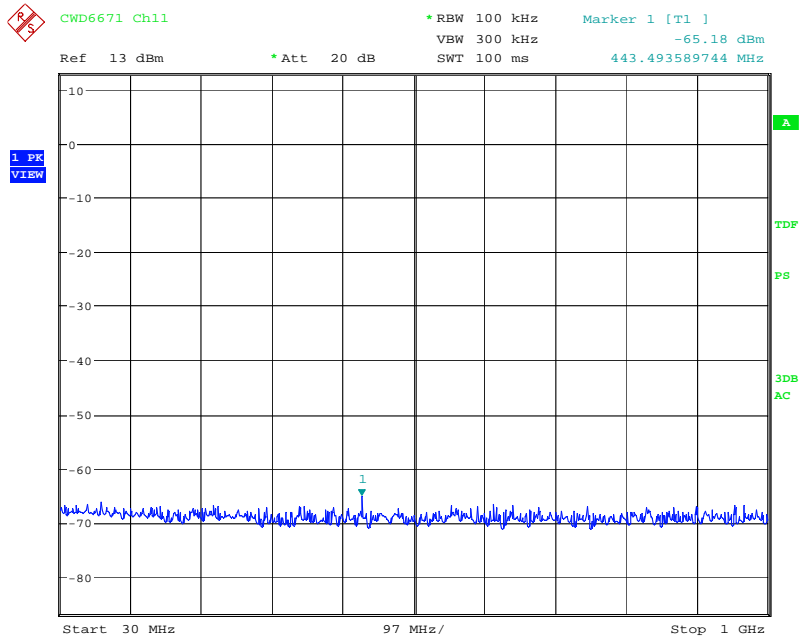
Test Results: Complies

Test Details: Refers to the following receiver screen captures

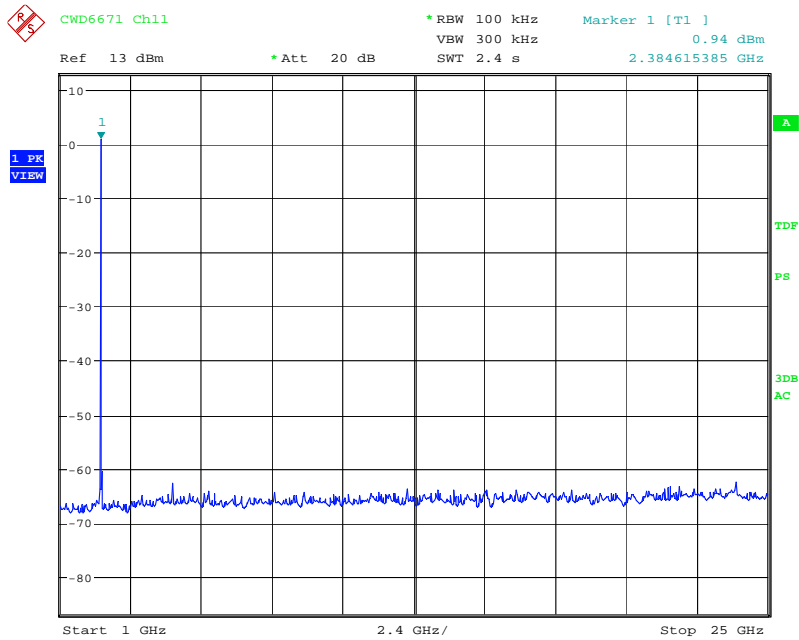
Note: The EUT was tested in a continuous transmit mode with maximum power level of 3. The RF level in the screen captures is relative and is not the indication of RF output power. The insertion loss was compensated for in the receiver.



Conducted Spurious Emission – Channel 11



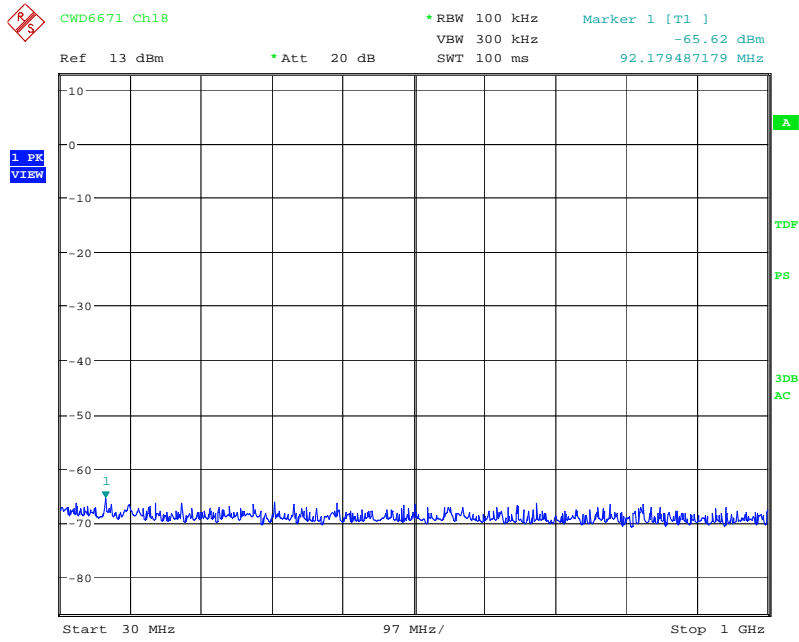
Date: 14.APR.2009 11:19:33



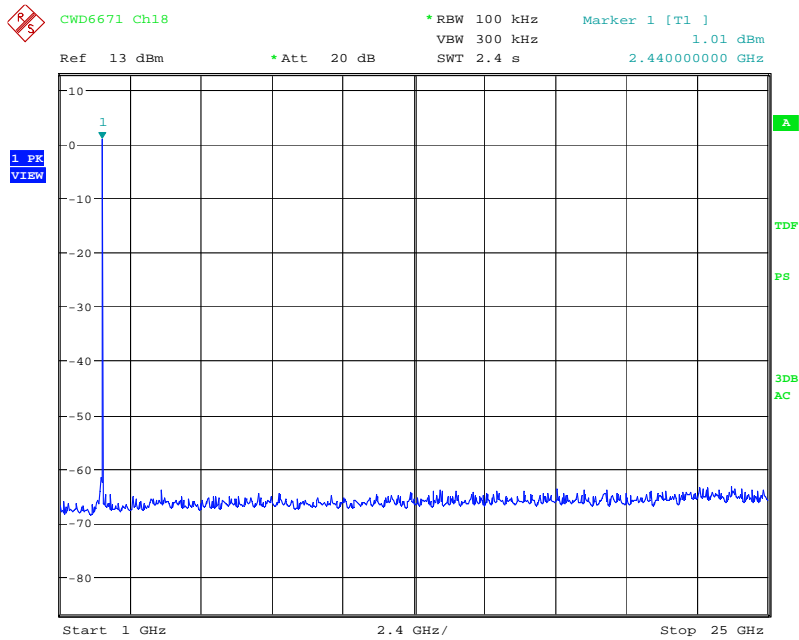
Date: 14.APR.2009 11:16:08



Conducted Spurious Emission – Channel 18



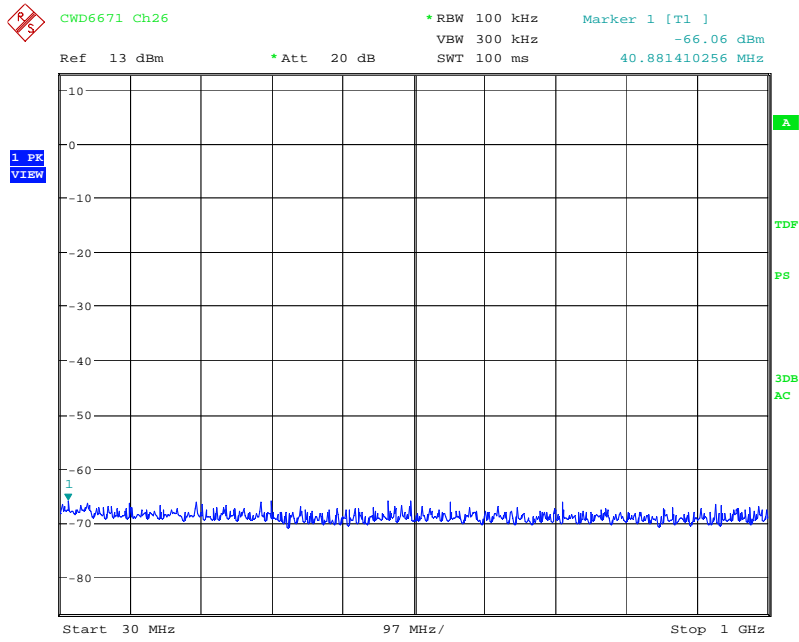
Date: 14.APR.2009 11:23:15



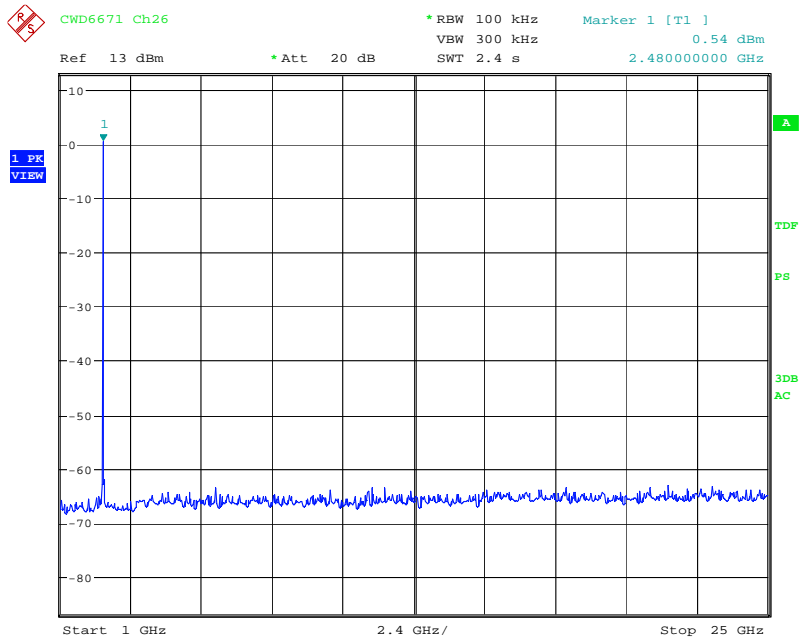
Date: 14.APR.2009 11:22:41



Conducted Spurious Emission – Channel 26



Date: 14.APR.2009 11:27:27



Date: 14.APR.2009 11:26:46



3.7 Power Spectral Density

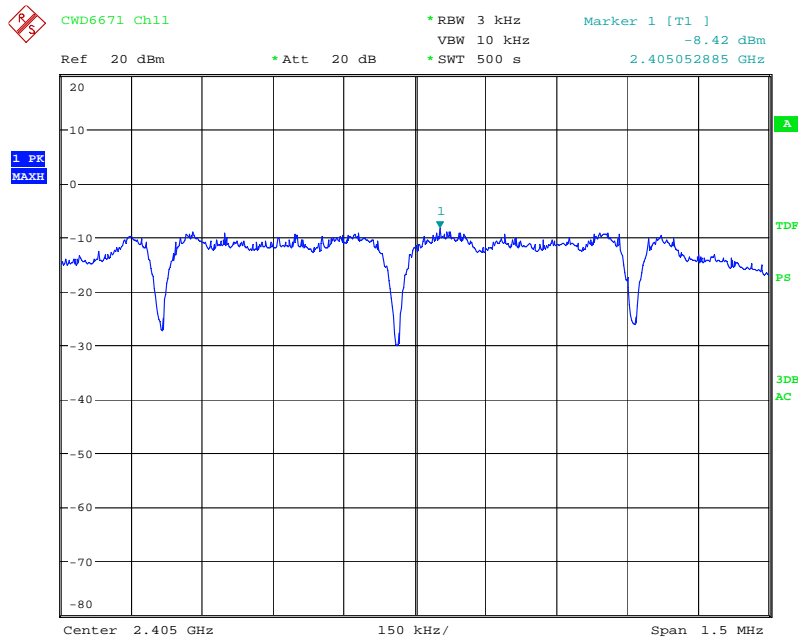
Performance Criterion: The power spectral density shall not be greater than 8 dBm in any 3 kHz band.

Test Results: Complies

Test Details: The EUT was tested in a continuous transmit mode with maximum power level of 3. Refers to the following table and receiver screen captures. The insertion loss was compensated for in the receiver.

Channel	Frequency (MHz)	Power Spectral Density (dBm)
11	2405	-8.42
18	2440	-8.21
26	2480	-8.34

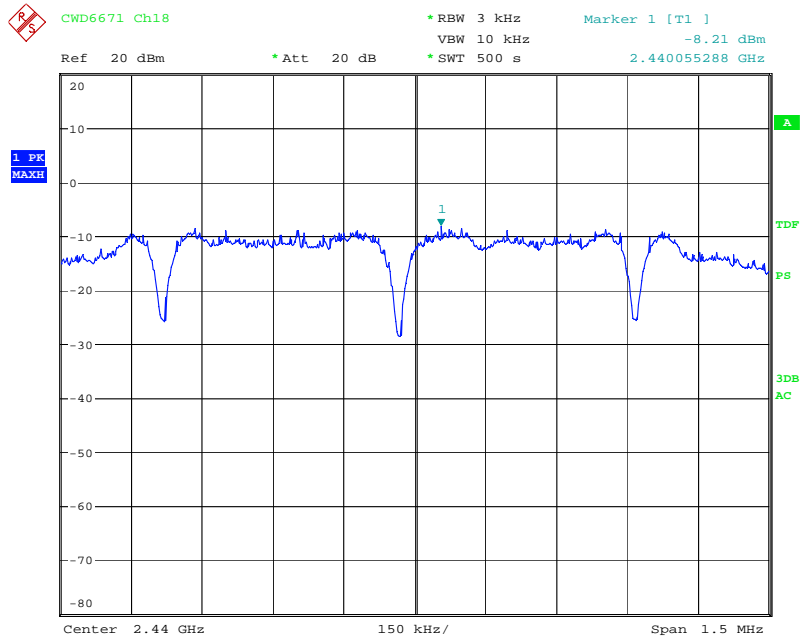
Channel 11:



Date: 14.APR.2009 10:17:34

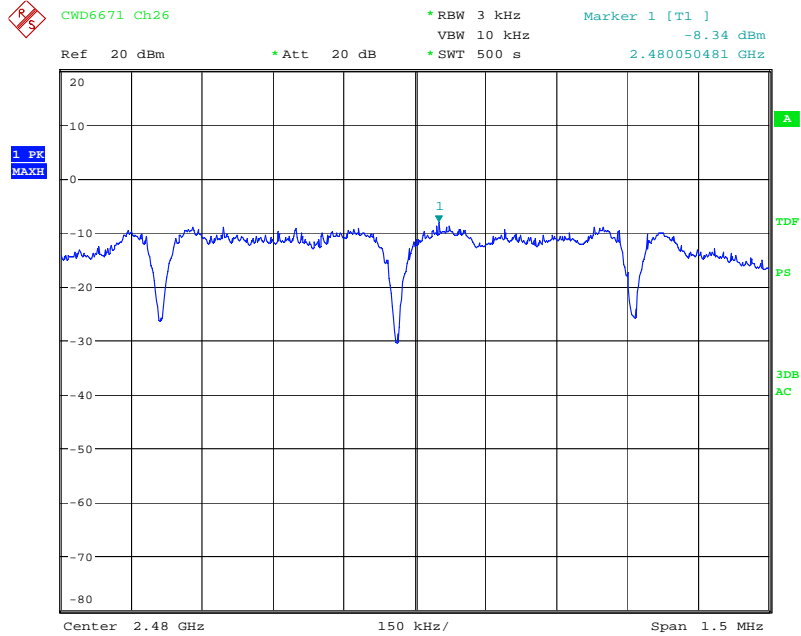


Channel 18:



Date: 14.APR.2009 10:27:52

Channel 26:



Date: 14.APR.2009 10:39:03



3.8 *RF Safety*

Performance Criterion: The human RF exposure limit is 1 mW/cm².

Test Results: Complies

Details: The maximum permissible exposure (MPE) is predicted by using Equation (3) of Section 2 of FCC OET Bulletin 65, Edition 97-01:

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

where: S = power density (in appropriate units, e.g. mW/cm²)
P = power input to the antenna (in appropriate units, e.g., mW)
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 (appropriate units, e.g., cm)

P = 3.84 mW (5.84 dBm), G = 1.585 (2 dBi), R = 20 cm

$$S = 0.0012 \text{ mW/cm}^2 = 0.0484 \text{ W/m}^2$$

MPE limit for uncontrolled exposure at prediction frequency: 1 mW/cm²

Maximum allowable antenna gain: 31.1694dBi

Margin of Compliance at 20 cm = **29.2 dB**



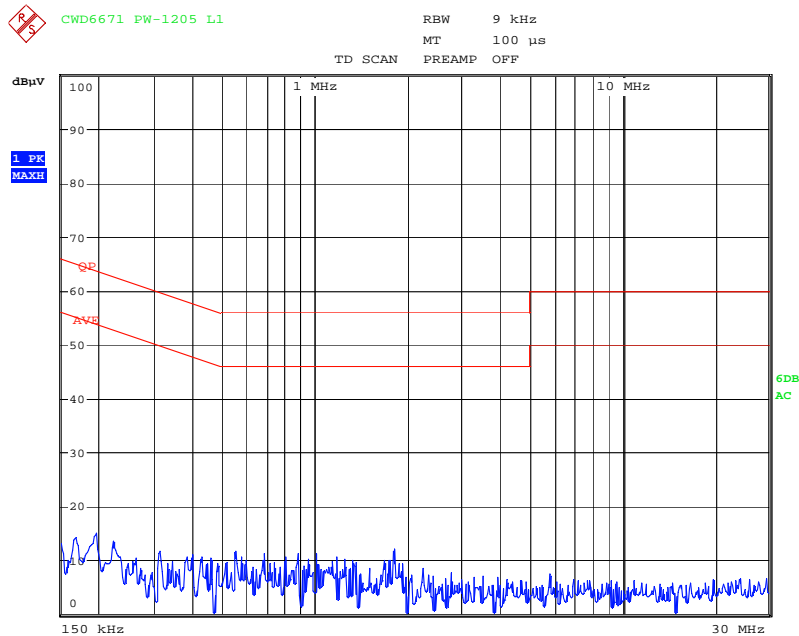
3.9 Power Line Conducted Emissions

Performance Criterion: AC power line conducted emissions shall not exceed the limits specified in FCC § 15.207 and Table 2 of IC RSS-Gen.

Test Results: Complies.

Test Details: Refers to the following receiver screen captures. The screen captures represent Peak emissions.

Line 1:

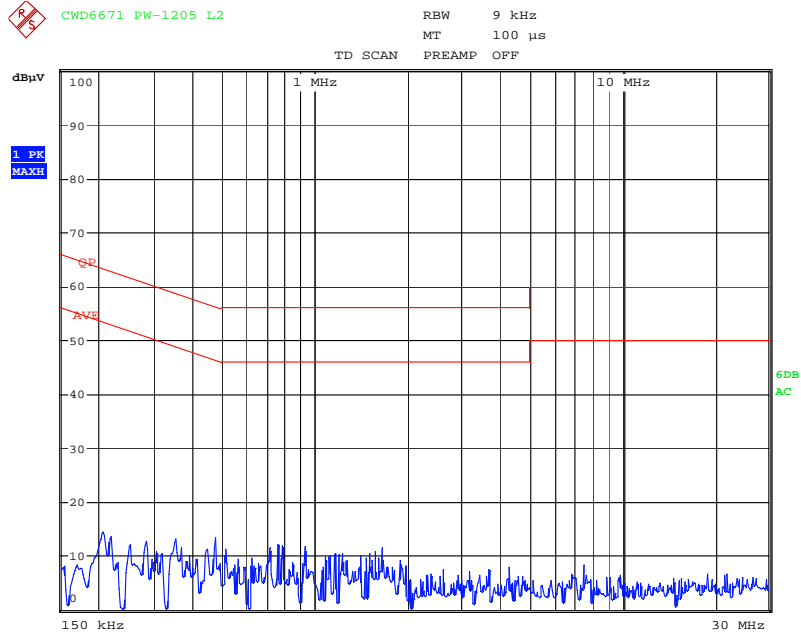


Date: 14.APR.2009 14:36:36



Power Line Conducted Emissions

Line 2:



Date: 14.APR.2009 14:38:43

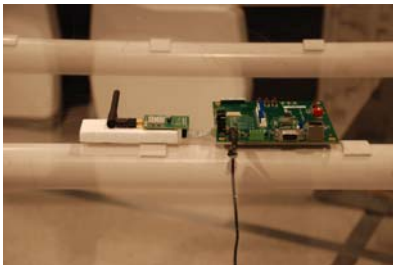
3.10 Radiated Emissions and Radiated Spurious Emissions

Performance Criterion: In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band. Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified in FCC § 15.209(a) and Table 2 of IC RSS-210.

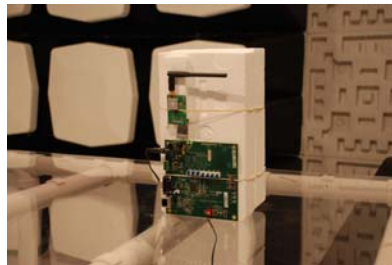
Test Results: Complies

Test Details: For each scan of radiated and radiated spurious emission measurement, the procedures for maximizing emissions were followed. The EUT was rotated and antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. All radiated and radiated spurious emission measurements, up to 18 GHz, were performed at 3-meter distance between an antenna and the EUT. Above 18 GHz, radiated spurious emission measurement was performed at 1-meter distance. For the frequency range 30-1000MHz, measurement was made using a quasi-peak detector with a 120 kHz bandwidth. For the frequency range above 1 GHz, measurement was made using a peak detector with a 1 MHz bandwidth.

EUT was tested in three orthogonal orientations (XY, YZ, and ZX planes). EUT antenna was tested in three orthogonal orientations (Horizontal, Vertical, and Right).



EUT = XY



EUT = YZ



EUT = ZX



EUT Antenna = Horizontal



EUT Antenna = Vertical



EUT Antenna = Right



Refers to the following table and receiver screen captures for test data. Antenna factor, cable loss, and preamplifier gain were compensated for in the receiver. Calculation of duty cycle correction factor is included in a separate file.

CWD6671 Radiated Spurious EmissionsI, Boost Mode s/n: CNA6332589

Antenna Polarization	Frequency (MHz)	Channel No.	Power Setting	EUT Orientation	EUT Antenna Orientation	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turntable Degree
H	2483.5	26	252	YZ	R	73.61	74	0.39	224.9	0
H	2483.5	25	3	YZ	R	64.36	74	9.64	224.9	0
H	4960	26	252	YZ	R	55.24	74	18.76	117.4	0
H	7440	26	252	YZ	R	58.35	74	15.65	118	0
H	4880	18	3	YZ	H	68.74	74	5.26	109.6	273.2
V	7320	18	3	XY	V	61.61	74	12.39	104.8	2.6
H	2390	11	3	YZ	R	52.24	74	21.76	123.4	187.7
H	2400	11	3	YZ	R	70.4	74	3.6	123.4	187.7
H	4810	11	3	YZ	R	65.11	74	8.89	121.5	189.9

RBW=1MHz, VBW=3MHz Dates of Test: April 28, 2009

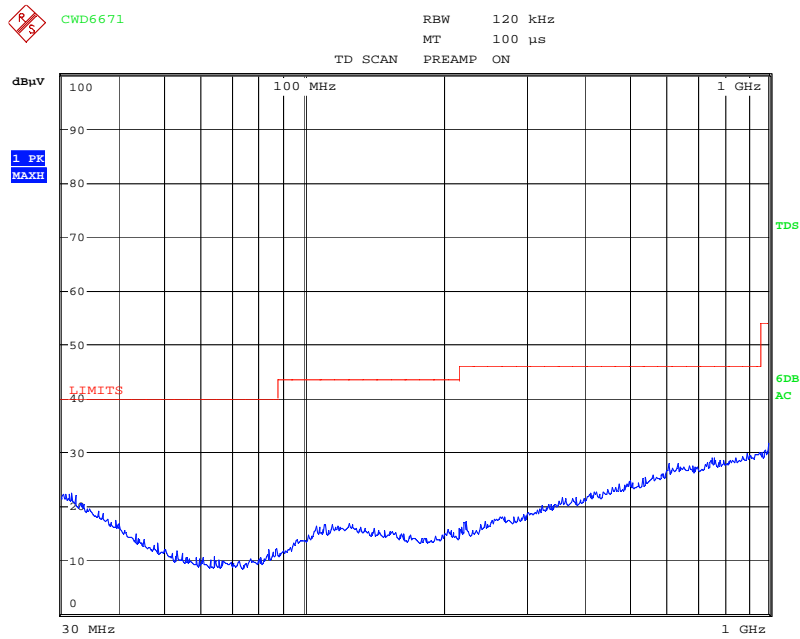
CWD6671 Radiated Spurious EmissionsI, Boost Mode s/n: CNA6332589 Tested by: Grace Lin

Antenna Polarization	Frequency (MHz)	Channel No.	Power Setting	EUT Orientation	EUT Antenna Orientation	Measured Data (dBuV/m)	Duty Cycle Correction Factor (dB)	Corrected Data	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turntable Degree
H	2483.5	26	252	YZ	R	63.6	11	52.6	54	1.4	216.6	3.9
H	2483.5	25	3	YZ	R	51.63	11	40.63	54	13.37	216.6	2.9
H	4960	26	252	YZ	R	46.54	11	35.54	54	18.46	216.2	0
H	7440	26	252	YZ	R	48.01	11	37.01	54	16.99	216.4	0
H	12400	26	252 (NF)	YZ	R	42.21	11	31.21	54	22.79	-	-
H	19840	26	252 (NF)	YZ	R	42.11	11	31.11	54	22.89	-	-
H	22320	26	252 (NF)	YZ	R	43.22	11	32.22	54	21.78	-	-
H	4880	18	3	YZ	H	49.53	11	38.53	54	15.47	110.6	4.5
V	7320	18	3	XY	V	51.81	11	40.81	54	13.19	155.6	0
V	12200	18	3 (NF)	YZ	V	42.31	11	31.31	54	22.69	-	-
H	19520	18	3 (NF)	YZ	R	41.73	11	30.73	54	23.27	-	-
H	2390	11	3	YZ	R	44.37	11	33.37	54	20.63	117.9	187.7
H	2400	11	3	YZ	R	60.93	11	49.93	54	4.07	115.4	187.4
H	4810	11	3	YZ	R	51.92	11	40.92	54	13.08	114.7	188.3
H	12025	11	3 (NF)	YZ	R	43.16	11	32.16	54	21.84	-	-
H	19240	11	3 (NF)	YZ	R	41.81	11	30.81	54	23.19	-	-

NF: Noise Floor Dates of Test: April 15-18, 2009



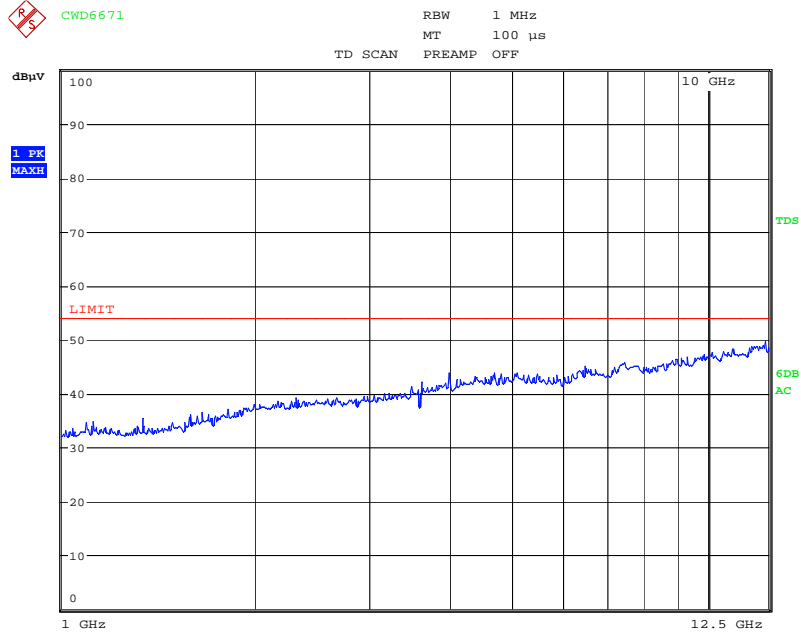
Radiated Emission, 30MHz-1GHz:



Date: 18.APR.2009 15:14:12

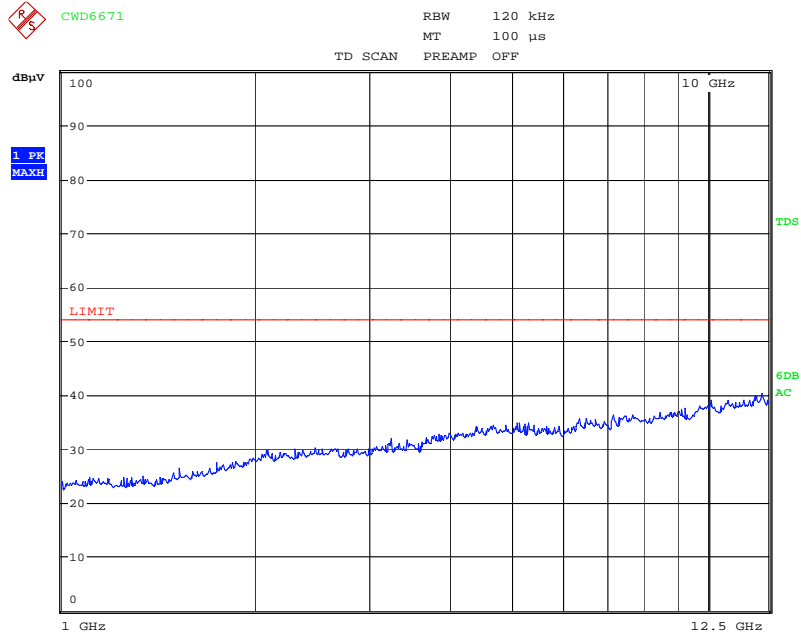


Radiated Emission, 1-12.5GHz, RBW=1MHz:



Date: 18.APR.2009 14:25:57

Radiated Emission, 1-12.5GHz, RBW=120kHz:

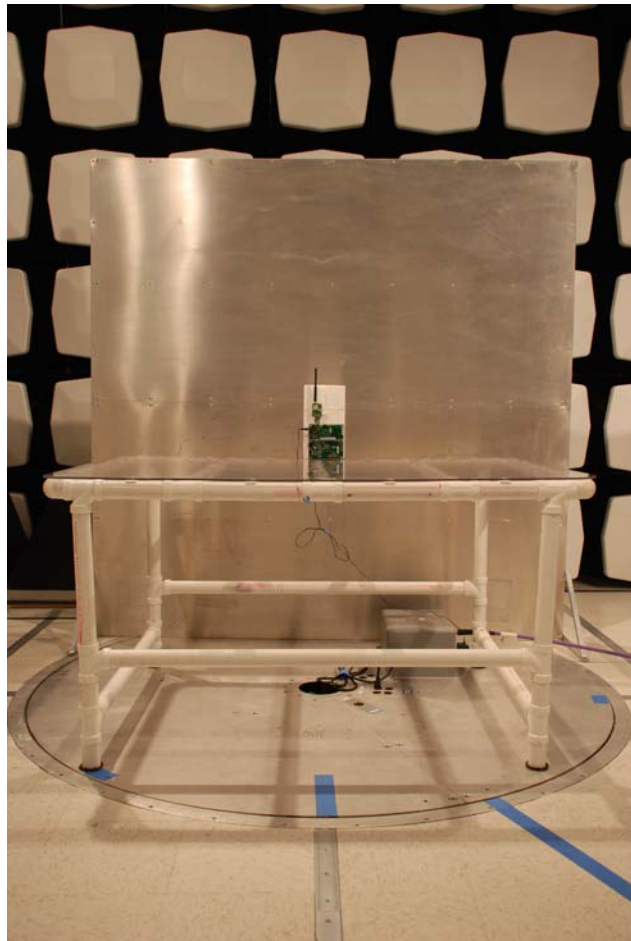


Date: 18.APR.2009 14:28:39

4. Test Setup Photos

Conducted Emission Configuration Photographs

Worst-case conducted emission, front view



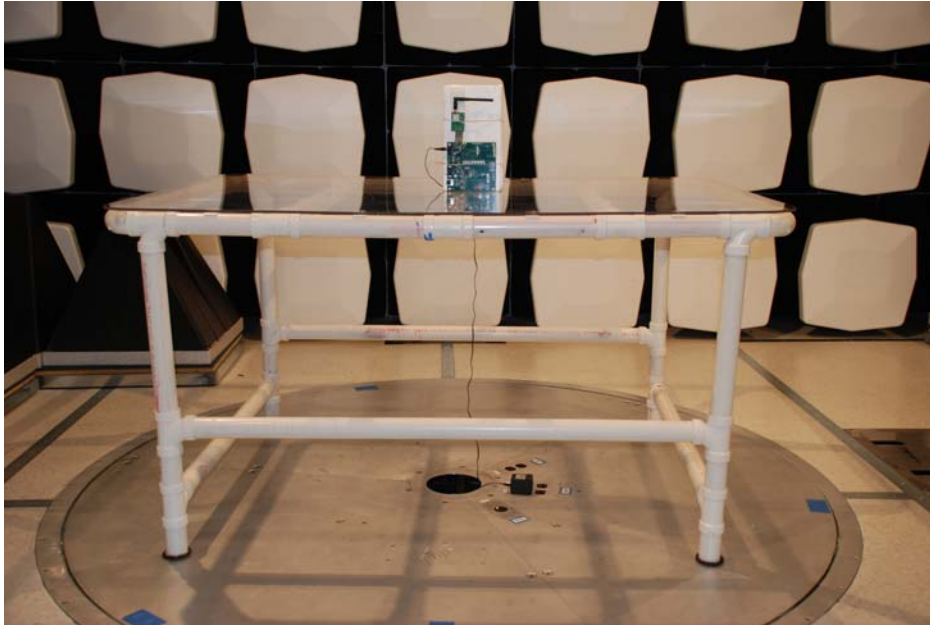
Conducted Emission Configuration Photographs

Worst-case conducted emission, side view



Radiated Emission Configuration Photographs

Worst-case radiated emission, front view



Worst-case radiated emission, side view





Appendix A Antenna Specifications



ANTENNA SPECIFICATIONS

GENERAL SPECIFICATIONS

MODEL	ACE-2400NF
ANTENNA TYPE	SLEEVE DIPOLE ANTENNA

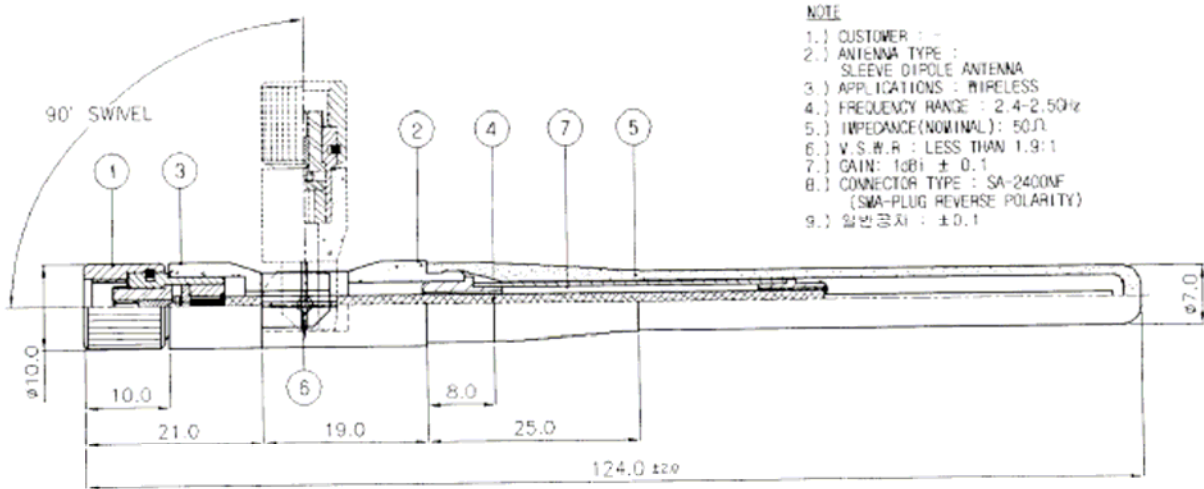
ELECTRICAL SPECIFICATIONS

FREQUENCY	2.4 ~ 2.5 GHz
IMPEDANCE	50 Ω (NOMINAL)
V.S.W.R.	$\leq 1.9: 1$
GAIN	2.0 ± 0.5 dBi
RADIATION PATTERN	OMNI-DIRECTIONAL
POLARIZATION	VERTICAL

MECHANICAL SPECIFICATIONS

LENGTH	124.0 ± 2.0 mm
PULLING STRENGTH	≥ 3 Kgf
SWIVEL TORQUE	≥ 3 Kgf
OPERATING TEMP.	-30 °C ~ $+60$ °C
CONNECTOR TYPE	SMA PLUG REVERSE POLARITY

ACE-2400NF Sleeve Dipole Antenna:



Z&Y Excellence Dipole Antenna:



深圳市卓越发展世纪有限公司

SHENZHEN SHI EXCELLENCE DEVELOPMENT WORLD CO.LTD

Antenna Specification

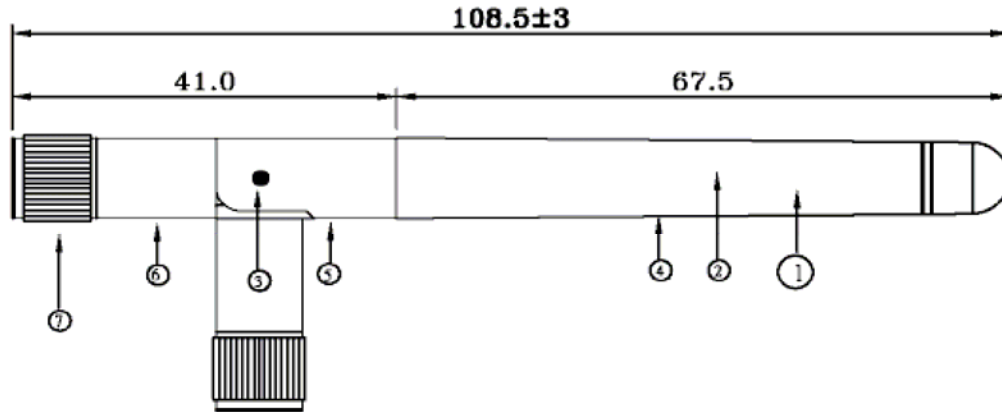
1. Electrical Properties

- 1.1 Operating Frequency..... 2.4 - 2.5 GHz
- 1.2 characteristic impedance..... 50 ohm (Nominal)
- 1.3 VSWR..... MAX 1.9: 1
- 1.4 Return Loss..... -10dBi Max
- 1.5 Polarization..... Vertical
- 1.6 Gain (Peak)..... 2dBi +/- 0.5
- 1.7 Radiation..... Omni-directional

2. Physical Properties:

- 2.1 Cable..... RG178 Coaxial Cable
- 2.2 Antenna Cover..... TPEE
- 2.3 Antenna Base-1..... PBT+PC
- 2.4 Antenna Base-2..... PBT+PC
- 2.5 temperature..... -20 ºC - + 70 ºC
- 2.6 Storage temperature..... -30 ºC - +80 ºC
- 2.7 Color..... BLACK
- 2.8 Connector..... SMA MALE Reverse Polarity

Z&Y Excellence Dipole Antenna:



Note:

1. Superscript "@" that focus on test size;
2. 1PC/PE bags,
3. 20 PCS / PE bags;
4. 1-desiccant / 20PCS ;
5. Electrical Properties :
 - 5.1 Operating Frequency :2.4 - 2.5 GHz
 - 5.2 characteristic impedance:50 ohm(Nominal)
 - 5.3 VSWR: MAX 1.9: 1;
 - 5.4 Return Loss:-10dBi Max;
 - 5.5 Polarization: Vertical;
 - 5.6 Gain: 2dBi ± 0.5;
 - 5.7 Radiation: Omni-directional
6. Mechanical properties:
 - 6.1: temperature: -20 º - + 70º
 - 6.2: Storage temperature:-30º - +80 º
7. Use environment protect material (RoSH compliant)