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Prüfbericht - Nr.: *Test Report No.:*	**12606813 001**	**Seite 1 von 55** *Page 1 of 55*

Auftraggeber: *Client:*	**TESSERA TECHNOLOGY INC.** 4F, 2710-1 Noborito, Tama-ku, Kawasaki-shi, Kanagawa 214-0014, Japan
Gegenstand der Prüfung: *Test Item:*	**ZigBee RF4CE Module Board**
Bezeichnung: *Identification:*	**MB-RF8058**
Serien-Nr.: *Serial No.:*	**Lot: 0990340, Serial: 040B**
Wareneingangs-Nr.: *Receipt No.:*	**PT0213099431-1-7**
Eingangsdatum: *Date of Receipt:*	**2010-02-24**
Prüfort: *Testing Location:*	**TÜV Rheinland Japan Ltd. - Global Technology Assessment Center** 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan
Prüfgrundlage: *Test Specification:*	**FCC 47 CFR Part 15, Subpart C, Section 15.247 (October 1, 2009)** ANSI C63.4-2003 Measurement of Digital Transmission Systems Operating under Section 15.247 (March 23, 2005)
Prüfergebnis: *Test Result:*	**Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).** *The test item passed the test specification(s).*
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland Japan Ltd. - Global Technology Assessment Center** 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
2010-04-14	T. Sauter / Inspector		2010-04-14	J. Taylor / Reviewer	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges / *Other Aspects:*

This test report deals only with the intentional radiator portion of the tested product. Unintentional radiator aspects are covered by test report 12606813 003.

Abkürzungen:				*Abbreviations:*			
P(ass)	=	*entspricht Prüfgrundlage*		*P(ass)*	=	*passed*	
F(ail)	=	*entspricht nicht Prüfgrundlage*		*F(ail)*	=	*failed*	
N/A	=	*nicht anwendbar*		*N/A*	=	*not applicable*	
N/T	=	*nicht getestet*		*N/T*	=	*not tested*	

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.
This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.

TEST SUMMARY

3.2.1 VOLTAGE REQUIREMENTS, FCC 15.31(E)
RESULT: PASS

3.2.2 ANTENNA REQUIREMENTS, FCC 15.203 AND FCC 15.204
RESULT: PASS

5.1.1 CONDUCTED OUTPUT POWER, FCC 15.247(B)(3)
RESULT: PASS

5.1.2 6DB BANDWIDTH, FCC 15.247(A)(2)
RESULT: PASS

5.1.3 CONDUCTED SPURIOUS EMISSION, FCC 15.247(D)
RESULT: PASS

5.1.4 PEAK POWER SPECTRAL DENSITY, FCC 15.247(E)
RESULT: PASS

6.1.1 AC POWER LINE CONDUCTED EMISSION OF TRANSMITTER, FCC 15.207
RESULT: PASS

6.2.1 AC POWER LINE CONDUCTED EMISSION OF RECEIVER, FCC 15.107
RESULT: PASS

7.1.1 BAND EDGE RADIATED EMISSION, FCC 15.247(D)
RESULT: Pass

7.1.2 RADIATED SPURIOUS EMISSION OF TRANSMITTER, FCC 15.247(D), FCC 15.205 AND FCC 15.209
RESULT: PASS

7.2.1 RADIATED SPURIOUS EMISSION OF RECEIVER, FCC 15.109
RESULT: PASS

Contents

1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report.

This applies especially to the following document:

(1) Maximum Duty Ratio of the MB-RF8058 Module in IEEE 802.15.4 by NEC Electronics Corp.

2. Test Sites

2.1 Test Facilities

TÜV Rheinland Japan Ltd. - Global Technology Assessment Center
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The Federal Communications Commission has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance with the requirements of section 2.948 of the FCC rules. The description of the test facility is listed under FCC registration number 299054.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2005. TÜV Rheinland Japan Ltd. is accredited by the Federal Communications Commission as a Conformity Assessment Body under Designation Number JP0017 and Test Firm Registration Number 386498.

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equipment ID	Calibrated until
For Antenna Port Conducted Emission					
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	2010-12
For AC Power Line Conducted Emission					
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	2011-02
LISN	Rohde & Schwarz	ENV216	100276	RF-0016	2010-05
LISN	Schwarzbeck Mess-Electronik	NSLK 8128 (4X32/50A)	8128-239	RF-0017	2010-05
For Radiated Emission					
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	2011-02
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	2010-12
RF Selector (10m)	Toyo Corporation	NS4900	0703-182	RF-0029	2010-05
3dB Attenuator 50Ohm	Tamagawa Electronics Co., Ltd.	CFA-01	-	RF-0265	2010-05
Low Noise Pre-Amplifier	TSJ	MLA-10K01-B01-35	1370750	RF-0253	2010-05
Microwave Pre-Amplifier, 1-8GHz	Toyo Corporation	TPA0108-40	0634	RF-0052	2010-11
Band Reject Filter	Nitsuki	NF-49BT	027	RF-0131	2010-11
Loop Antenna with power supply, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	2011-02
Trilog Antenna, 30-1000MHz	Schwarzbeck	VULB9168	0245	RF-0019	2010-05
Biconical Antenna, 30-300MHz	EMCO	3110B	9603-2379	RF-0207	2011-02
Horn Antenna, 1-10GHz	Schwarzbeck	BBHA9120B	419	RF-0050	2010-05
Horn Antenna with Pre-Amplifier, 2-18GHz	Toyo Corporation	HAP06-18W	00000025	RF-0065	2010-05
Horn Antenna with Pre-Amplifier, 18-26.5GHz	Toyo Corporation	HAP18-26N	00000010	RF-0070	2010-05
Constant Voltage Constant Frequency Stabilizers					
CVCF (Shielded Room)	NF Corporation	ESU2000S	9075612	RF-0210	N/A
CVCF Booster (Shielded Room)	NF Corporation	ESU2000B	9074403	RF-0211	N/A
CVCF (10m chamber)	NF Corporation	ESU2000S	9067307	RF-0212	N/A
CVCF Booster (10m chamber)	NF Corporation	ESU2000B	9074408	RF-0213	N/A

2.3 Measurement Uncertainty

Table 2: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
AC Power Line Conducted Emission	150kHz - 30MHz	±3.0dB
Antenna Port Conducted Emission	< 1GHz	±0.39dB
	> 1GHz	±0.68dB
Radiated Emission	30MHz - 1GHz	±4.7dB
	> 1GHz	±4.5dB

3. General Product Information

3.1 Product Function and Intended Use

The EUT (Equipment Under Test) MB-RF8058 is a ZigBee RF4CE Module Board that can be installed in various kinds of host equipment, including portable equipment.

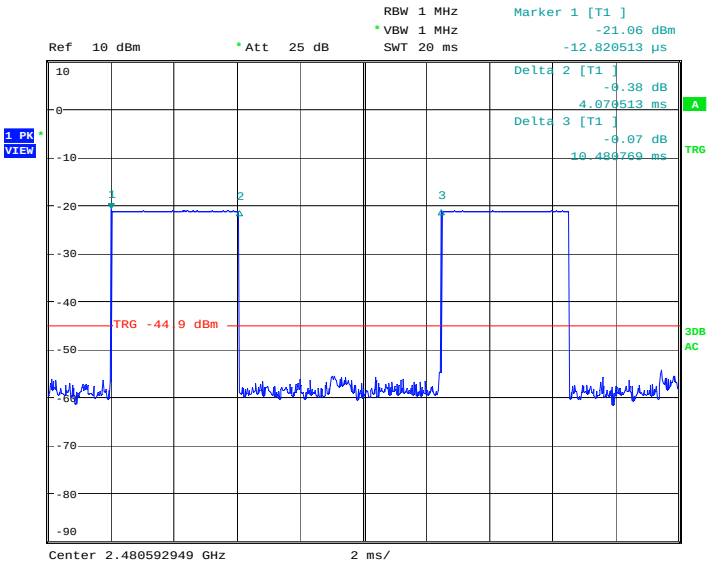
3.2 System Details

Radio standard:	IEEE 802.15.4 (ZigBee)
Specified output power:	0dBm
Antenna gain:	2.0dBi
Antenna type:	Hinge antenna
Antenna mounting type:	External
Frequency range:	2405 – 2480MHz
Number of channels:	16
Channel spacing:	5MHz
Modulation type:	DSSS, OQPSK
Maximum duty cycle:	38.8% (in normal use) – see note below
FCC classification:	DTS
Emission designator:	G1D
Rated voltage:	DC 3V
Rated current:	30mA
Protection class:	III
Test voltage:	DC 3V via Support Board

Notes:

The customer declares that the maximum duty cycle of the equipment that may be achieved in normal use is 38.8%. A sample spectrum showing the maximum duty cycle is given here below. Refer to the attached document: “Maximum Duty Ratio of the MB-RF8058 Module in IEEE 802.15.4” by NEC Electronics Corp. for more details.

Figure 1: Maximum Duty Cycle



Maximum duty cycle
Date: 13.APR.2010 21:12:35

Note: The above spectrum shows that the transmitter on-time is about 4.07ms and a pulse train is about 10.48ms. Therefore, the maximum duty cycle is 4.07/10.48 = 38.8%.

3.2.1 Voltage Requirements, FCC 15.31(e)

RESULT: **PASS**

The EUT has an internal voltage regulator to supply the RF circuit. Hence it complies with the power supply requirements.

3.2.2 Antenna Requirements, FCC 15.203 and FCC 15.204

RESULT: **PASS**

The EUT has an external antenna with SMA connector which has to be professionally installed. Hence it complies with the applicable requirements.

3.3 Independent Operation Modes

The EUT was tested on a stand-alone basis (only attached to the test jig) and the test system was configured in a typical fashion (as a customer would normally use it).

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.4:2003. Testing was performed at the lowest operating frequency (2405MHz), at the operating frequency in the middle of the specified frequency band (2440MHz) and at the highest operating frequency (2480MHz).

The basic operation modes used for testing purpose are:

A. EUT transmits (TX mode), with full power, at lowest channel (2405MHz), a continuous modulated signal streaming with 100% duty cycle.

B. EUT transmits (TX mode), with full power, at middle channel (2440MHz), a continuous modulated signal streaming with 100% duty cycle.

C. EUT transmits (TX mode), with full power, at highest channel (2480MHz), a continuous modulated signal streaming with 100% duty cycle.

D. EUT receives (RX mode), at middle channel (2440MHz), continuously.

3.4 Noise Generating and Suppressing Parts

Refer to schematics.

3.5 Submitted Documents

A document describing the maximum duty cycle in normal use of the EUT: “Maximum Duty Ratio of the MB-RF8058 Module in IEEE 802.15.4” from NEC Electronics Corp. was provided by the customer. It is attached to this test report.

4. Test Set-up and Operation Modes

4.1 Test Methodology

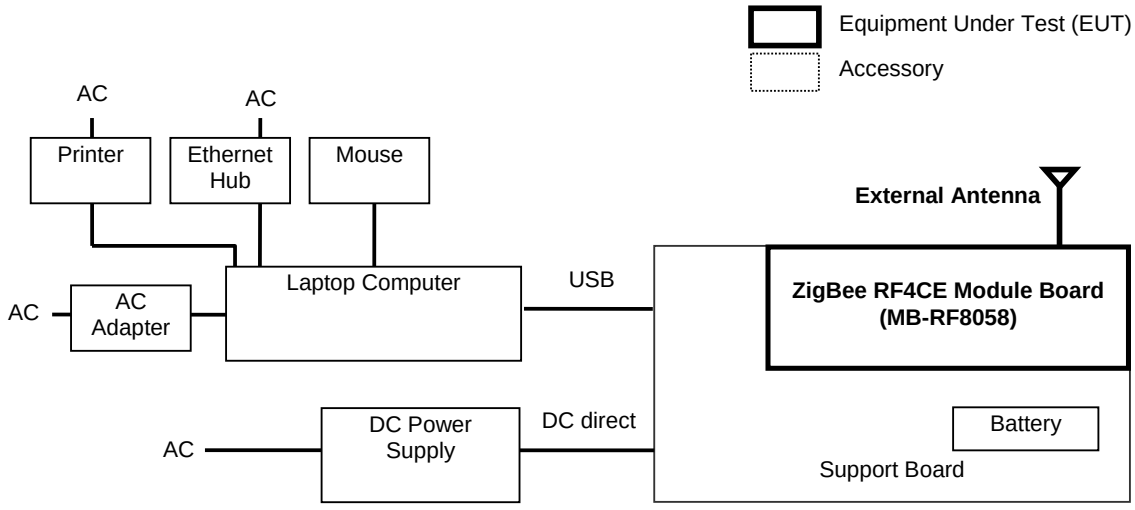
The test methodology used is based on the requirements of 47 CFR Part 15, Sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209 and Measurement of Digital Transmission Systems Operating under Section 15.247.

The test methods, which have been used, are based on ANSI C63.4-2003.

For details, see under each test item.

4.2 Physical Configuration for Testing

Figure 2: Block Diagram



Notes:

The EUT was directly attached to a Support Board for testing purpose. The used Support Board had several DC power input capabilities: via USB cable (DC 5V), via external DC power supply (DC 1.8-3.6V), via one AA-type battery (DC 1.5V) or via two AA-type batteries (DC 3V). The interfaces present on the Support Board are given in the table below

For antenna conducted measurements, the antenna was removed and a spectrum analyzer was connected directly to the antenna connector via an RF cable.

The DC power supply was removed from the set-up when the EUT was powered via USB or battery.

The printer and the Ethernet hub were only used for AC power line conducted emission and radiated emission measurements. The printer was used for the operation mode D (receive mode) only.

For more details, refer to section: Photographs of the Test Set-Up.

Table 3: Interfaces present on the Support Board

No.	Interface	Cable Length for Testing, Shielding	Interface Classification
1.	USB Cable	1.5m, shielded	Signal port
2.	DC Input	2.2m, un-shielded	DC power port

4.3 Test Operation and Test Software

Software used for testing: HyperTerminal version 5.1 by Microsoft.

This software was running on the laptop computer connected to the EUT. It was used to enable the test operation modes listed in section 3.3 as appropriate.

4.4 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. Product: Laptop computer
   Manufacturer: IBM
   Model: X41 (2525-5AE)
   Rated Voltage: DC 16V
   Input Current: 3.5 A
   Serial Number: LV-D6940 05/10

2. Product: AC Adapter for Laptop Computer
   Manufacturer: IBM
   Model: 02K6810
   Rated Voltage: AC 100-240V
   Input Current: 1.5A
   Frequency: 50/60Hz
   Serial Number: 11S02K6810Z1Z3BJ59G1JH

3. Product: Laptop Computer
   Manufacturer: Toshiba
   Model: PM0 12X 256M 4C, Dynabook SS S8/210LNS
   Rated Voltage: DC 15V
   Input Current: 3.0A
   Serial Number: -

4. Product: AC Adapter for Laptop Computer
   Manufacturer: Toshiba
   Model: PA3241U-1ACA
   Rated Voltage: AC 100-240V
   Input Current: 0.6A
   Frequency: 50/60Hz
   Serial Number: 0308 A 0141359G

5. Product: Ethernet Hub
   Manufacturer: Buffalo
   Model: Giga Switching Hub, LSW3-GT-5NS(D1)
   Rated Voltage: AC 100V
   Input Power: 5W
   Frequency: 50/60Hz
   Serial Number: 16485784211186

6. Product: Mouse
   Manufacturer: Kokuyo
   Model: EAM-8D
   Rated Voltage: DC 5V
   Serial Number: 90501524

7. Product: Printer
   Manufacturer: Hewlett Packard
   Model: C4224A
   Rated Voltage: AC 100-127V
   Input Current: 3.0A
   Frequency: 50/60Hz
   Serial Number: USDG022308

8. Product: DC Power Supply
   Manufacturer: Elpa
   Model: TSA9-050120WU
   Rated Voltage: AC 100-240V
   Input Current: 0.12A
   Frequency: 50/60Hz
   Serial Number: 0749

9. Product: DC Power Supply
   Manufacturer: L.T.E.
   Model: GFP101U-A320
   Rated Voltage: AC 100-120V
   Input Current: 0.2A
   Frequency: 50/60Hz
   Serial Number: 0507-0005208

10. Product: Support Board
    Manufacturer: Tessera Technology Inc.
    Model: SB-UD
    Rated Voltage: Refer to section 3.2
    Serial Number: 0991620-001

Note:

The accessories were used for testing as shown in the table below.

Table 4: Repartition of Accessories for Testing

Accessory No.	Test
1, 2	All tests except Conducted Output Power
3, 4	Conducted Output Power only
5	AC Power line Conducted Emission and Radiated Emission (all operation modes)
6	All tests except Conducted Output Power
7	AC Power line Conducted Emission and Radiated Emission (mode D only)
8	AC Power line Conducted Emission only
9	Conducted Output Power only
10	All tests

5. Test Results of Conducted Measurements at Antenna Port

5.1.1 Conducted Output Power, FCC 15.247(b)(3)

RESULT: **PASS**

Date of testing: 2010-03-08

Ambient temperature: 20°C
Relative humidity: 42%
Atmospheric pressure: 1025hPa

Requirements:

For systems using digital modulation in the 2400-2483.5MHz band, the maximum peak output power is 1W (30dBm).

Test procedure:

ANSI C63.4-2003 and Measurement of Digital Transmission Systems Operating under Section 15.247.

The maximum peak output power (conducted) was measured at the antenna connector with a power meter. The final measurement takes into account the loss generated by all the involved cables.

Since the Support Board accepts several power input methods, the conducted output power was measured for each of those methods and the results are given here below. For the DC direct power input method, the voltage was DC 3.3V.

Table 5: Conducted Output Power, Mode A (2405MHz)

DC Input Method	Reading [dBm]	Correction Factor [dB]	Output Power [dBm]	Output Power [mW]	Limit [dBm]	Limit [mW]	Margin [dB]
DC direct	0.71	0.54	1.25	1.33	30.00	1000	28.75
USB	0.68	0.54	1.22	1.32	30.00	1000	28.78
1 battery	0.67	0.54	1.21	1.32	30.00	1000	28.79
2 batteries	0.80	0.54	1.34	1.36	30.00	1000	28.66

Notes: Output power = Reading + Correction factor
Correction factor = Total cable loss
mW = 10 ^ (dBm/10), dBm = 10 x log(mW)

Table 6: Conducted Output Power, Mode B (2440MHz)

DC Input Method	Reading [dBm]	Correction Factor [dB]	Output Power [dBm]	Output Power [mW]	Limit [dBm]	Limit [mW]	Margin [dB]
DC direct	0.15	0.52	0.67	1.17	30.00	1000	29.33
USB	0.06	0.52	0.58	1.14	30.00	1000	29.42
1 battery	0.08	0.52	0.60	1.15	30.00	1000	29.40
2 batteries	0.27	0.52	0.79	1.20	30.00	1000	29.21

Notes: Output power = Reading + Correction factor
Correction factor = Total cable loss
mW = 10 ^ (dBm/10), dBm = 10 x log(mW)

Table 7: Conducted Output Power, Mode C (2480MHz)

DC Input Method	Reading [dBm]	Correction Factor [dB]	Output Power [dBm]	Output Power [mW]	Limit [dBm]	Limit [mW]	Margin [dB]
DC direct	-0.84	0.51	-0.33	0.93	30.00	1000	30.33
USB	-0.96	0.51	-0.45	0.90	30.00	1000	30.45
1 battery	-0.99	0.51	-0.48	0.89	30.00	1000	30.48
2 batteries	-0.71	0.51	-0.20	0.95	30.00	1000	30.20

Notes: Output power = Reading + Correction factor
Correction factor = Total cable loss
mW = 10 ^ (dBm/10), dBm = 10 x log(mW)

Remark:

The above results show that the worst case output power is found when the Support Board is powered by two batteries. Therefore, all the other measurements for the evaluation of the radio properties of the EUT have been performed using this power input method (except AC Power Line Conducted Emission).

5.1.2 6dB Bandwidth, FCC 15.247(a)(2)

RESULT: **PASS**

Date of testing: 2010-03-25

Ambient temperature: 25°C
Relative humidity: 30%
Atmospheric pressure: 998hPa

Requirements:

For systems using digital modulation in the 2400-2483.5MHz band, the minimum 6dB bandwidth shall be at least 500kHz.

Test procedure:

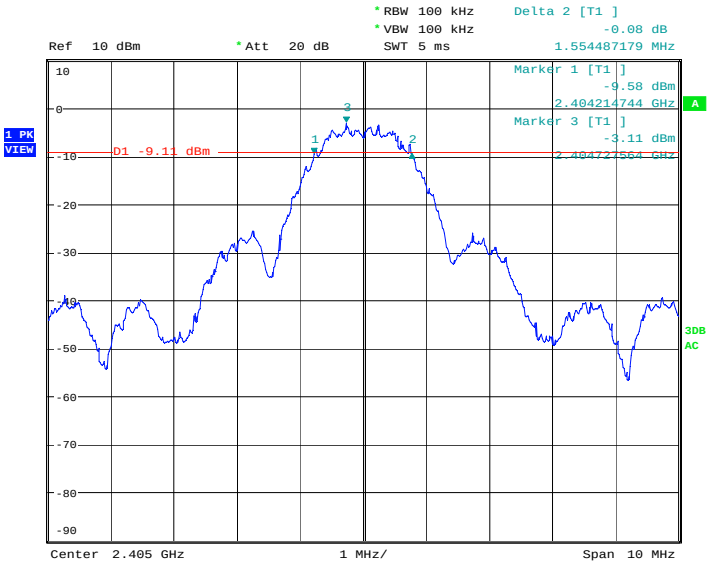
ANSI C63.4-2003 and Measurement of Digital Transmission Systems Operating under Section 15.247.

A spectrum analyzer was connected to the antenna port of the EUT. The spectrum analyzer resolution bandwidth was set to 100kHz and the span to 10MHz.

Table 8: 6dB Bandwidth

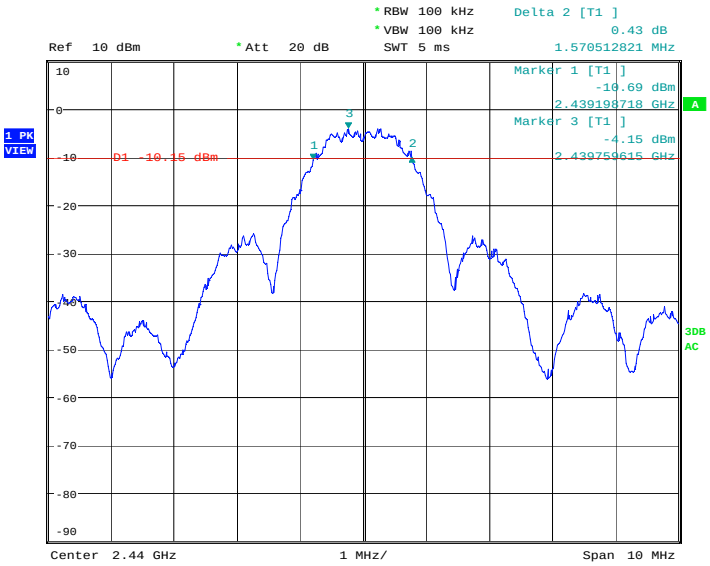
Operating Frequency [MHz]	6dB Bandwidth [kHz]	Limit [kHz]
2405	1554.49	500
2440	1570.51	500
2480	1586.54	500

Figure 3: 6dB Bandwidth, Mode A (2405MHz)



6dB bandwidth, mode A
Date: 25.MAR.2010 23:05:27

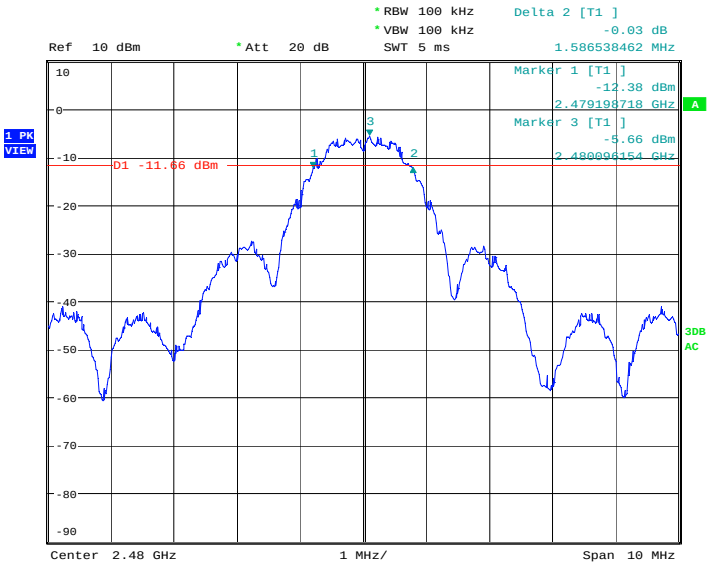
Figure 4: 6dB Bandwidth, Mode B (2440MHz)



6dB bandwidth, mode B

Date: 25.MAR.2010 23:08:46

Figure 5: 6dB Bandwidth, Mode C (2480MHz)



6dB bandwidth, mode C

Date: 25.MAR.2010 23:11:04

5.1.3 Conducted Spurious Emission, FCC 15.247(d)

RESULT: **PASS**

Date of testing: 2010-03-25

Ambient temperature: 25°C
Relative humidity: 30%
Atmospheric pressure: 998hPa

Requirements:

In any 100kHz bandwidth outside the frequency band, the RF power shall be at least 20dB below that of the maximum in-band 100kHz emission.

Test procedure:

ANSI C63.4-2003 and Measurement of Digital Transmission Systems Operating under Section 15.247.

A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 100kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 30MHz to 25GHz (10^{th} harmonics).

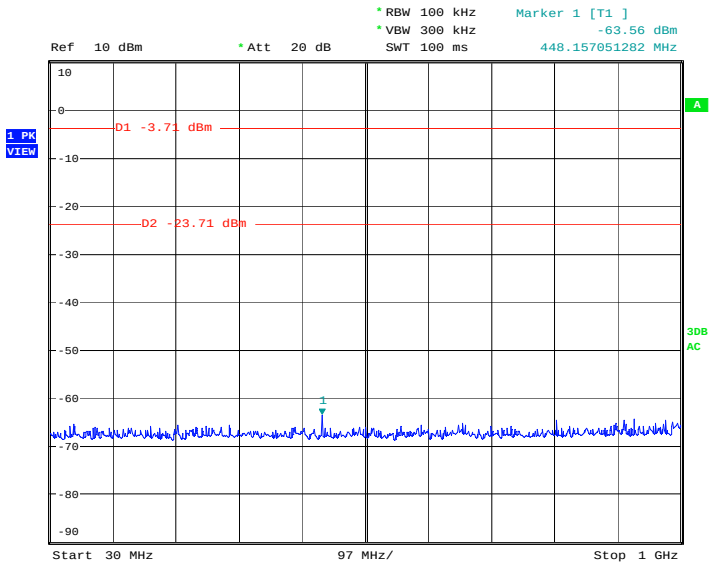
The final measurement takes into account the loss generated by all the involved cables.

Table 9: Conducted Spurious Emission, Mode A (2405MHz)

Frequency [MHz]	Reading [dBm]	Correction Factor [dB]	Emission Level [dBm]	Limit [dBm]	Margin [dB]
Fundamental	-3.71	0.54	-3.17	N/A	N/A
448.2	-63.56	0.21	-63.35	-23.17	40.18
2307.7	-57.13	0.51	-56.62	-23.17	33.45
2371.8	-57.42	0.47	-56.95	-23.17	33.78
4814.1	-52.93	0.77	-52.16	-23.17	28.99
7211.5	-60.09	0.81	-59.28	-23.17	36.11
10945.5	-64.42	1.08	-63.34	-23.17	40.17
21730.8	-64.07	1.60	-62.47	-23.17	39.30

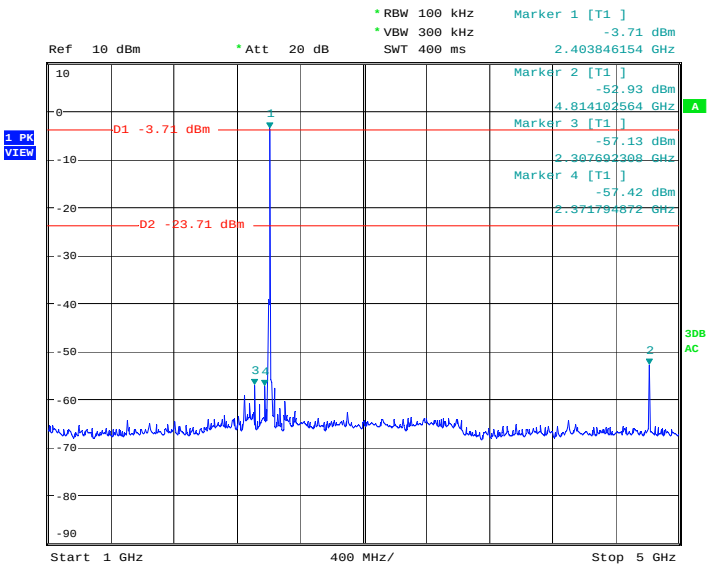
Notes: Limit = Reading of fundamental + Correction factor – 20dB
Emission level = Reading + Correction factor
Correction factor = Total cable loss

Figure 6: Spurious Emission from 30MHz to 1GHz, Mode A (2405MHz)



Antenna conducted spurious emission, mode A
Date: 26.MAR.2010 00:01:37

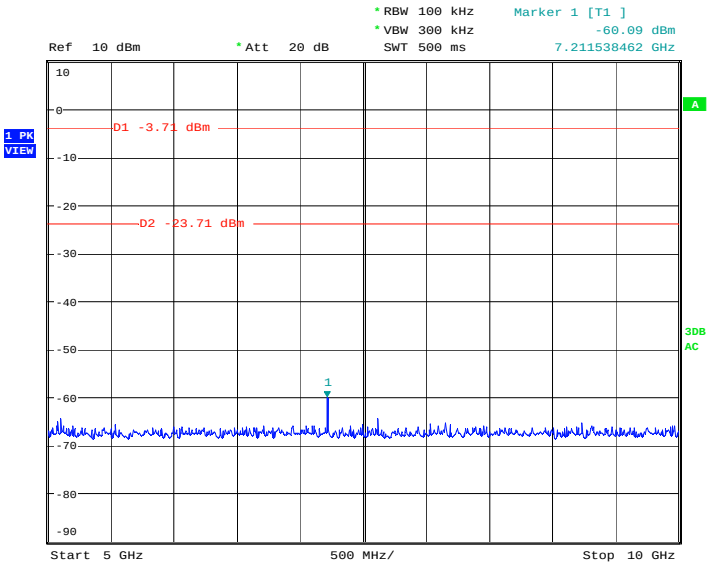
Figure 7: Spurious Emission from 1 to 5GHz, Mode A (2405MHz)



Antenna conducted spurious emission, mode A

Date: 26.MAR.2010 00:00:48

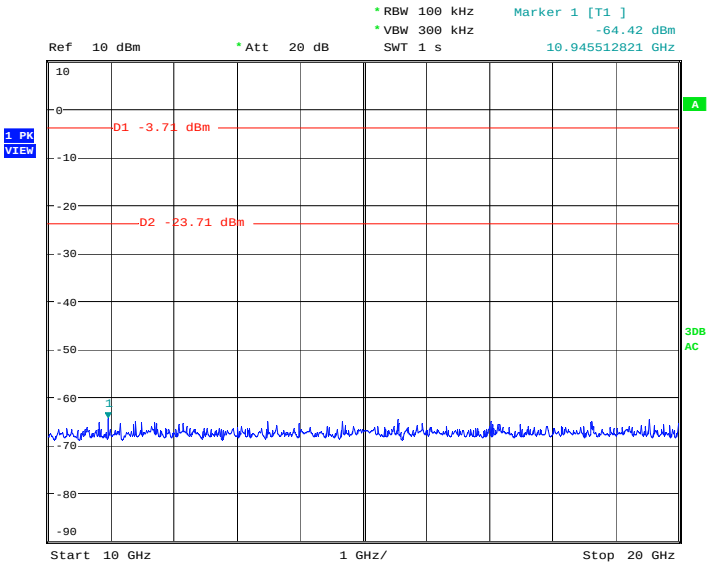
Figure 8: Spurious Emission from 5 to 10GHz, Mode A (2405MHz)



Antenna conducted spurious emission, mode A

Date: 26.MAR.2010 00:02:17

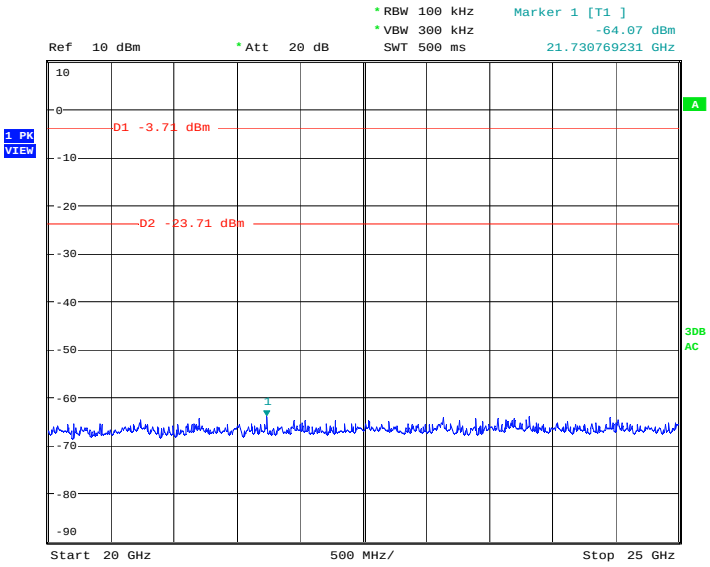
Figure 9: Spurious Emission from 10 to 20GHz, Mode A (2405MHz)



Antenna conducted spurious emission, mode A

Date: 26.MAR.2010 00:02:49

Figure 10: Spurious Emission from 20 to 25GHz, Mode A (2405MHz)



Antenna conducted spurious emission, mode A

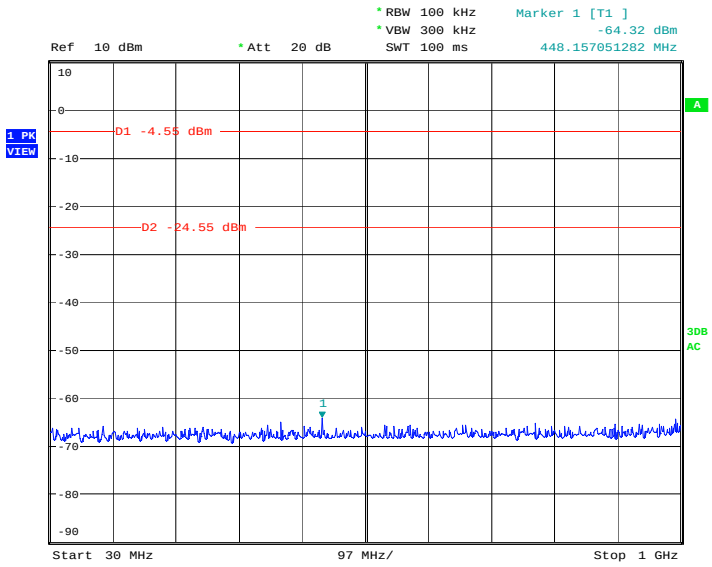
Date: 26.MAR.2010 00:15:18

Table 10: Conducted Spurious Emission, Mode B (2440MHz)

Frequency [MHz]	Reading [dBm]	Correction Factor [dB]	Emission Level [dBm]	Limit [dBm]	Margin [dB]
Fundamental	-4.55	0.52	-4.03	N/A	N/A
448.2	-64.32	0.21	-64.11	-24.03	40.09
2275.6	-56.09	0.50	-55.59	-24.03	31.56
2346.2	-56.02	0.49	-55.53	-24.03	31.51
4884.6	-52.71	0.70	-52.01	-24.03	27.98
7323.7	-59.20	0.86	-58.34	-24.03	34.32
15993.6	-64.91	1.29	-63.62	-24.03	39.59
22956.7	-64.14	1.65	-62.49	-24.03	38.46

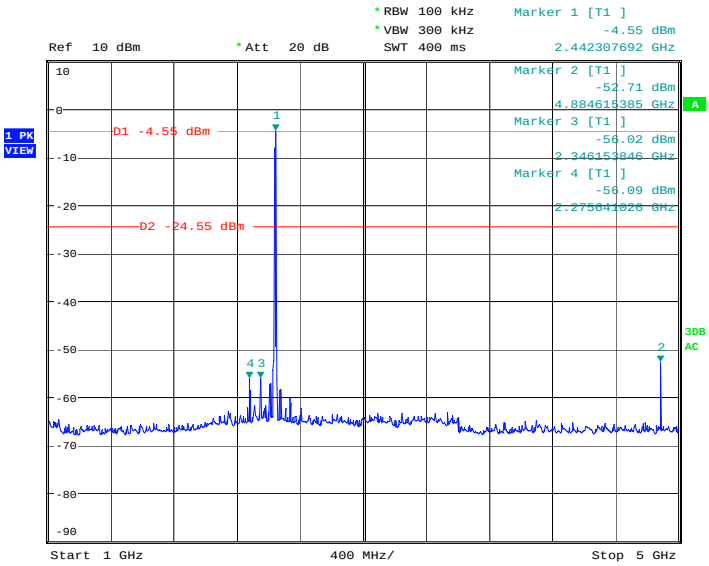
Notes: Limit = Reading of fundamental + Correction factor – 20dB
Emission level = Reading + Correction factor
Correction factor = Total cable loss

Figure 11: Spurious Emission from 30MHz to 1GHz, Mode B (2440MHz)



Antenna conducted spurious emission, mode B
Date: 26.MAR.2010 00:06:04

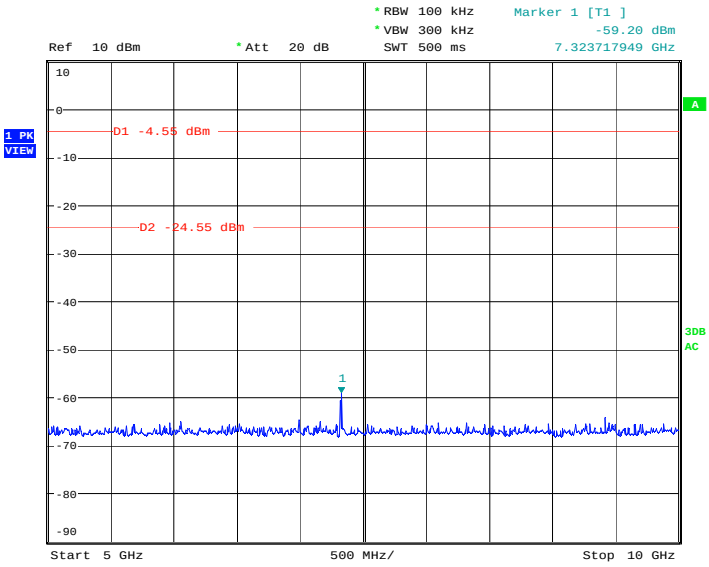
Figure 12: Spurious Emission from 1 to 5GHz, Mode B (2440MHz)



Antenna conducted spurious emission, mode B

Date: 26.MAR.2010 00:05:27

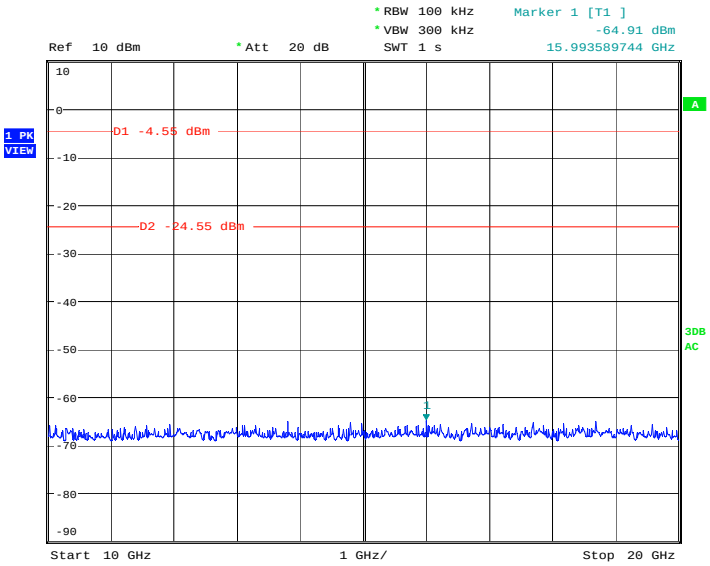
Figure 13: Spurious Emission from 5 to 10GHz, Mode B (2440MHz)



Antenna conducted spurious emission, mode B

Date: 26.MAR.2010 00:06:35

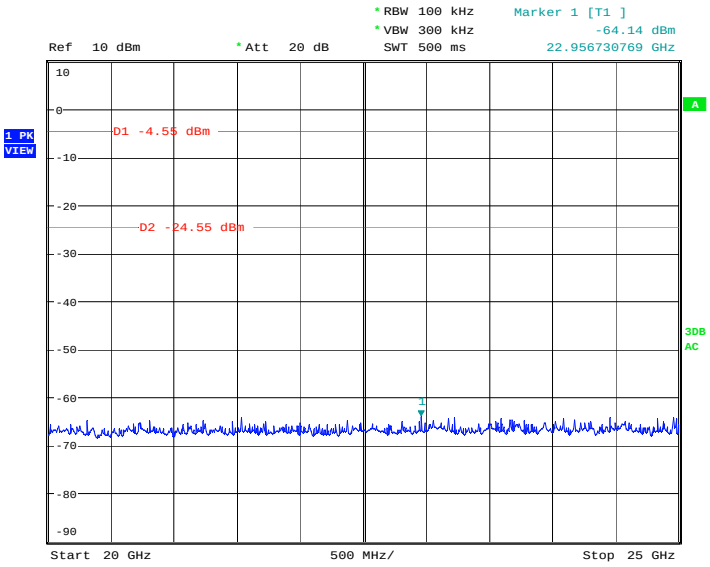
Figure 14: Spurious Emission from 10 to 20GHz, Mode B (2440MHz)



Antenna conducted spurious emission, mode B

Date: 26.MAR.2010 00:07:03

Figure 15: Spurious Emission from 20 to 25GHz, Mode B (2440MHz)



Antenna conducted spurious emission, mode B

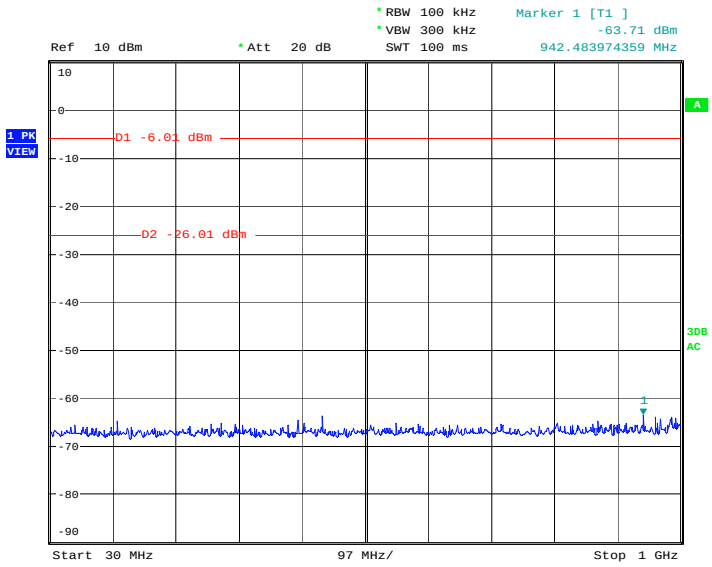
Date: 26.MAR.2010 00:07:31

Table 11: Conducted Spurious Emission, Mode C (2480MHz)

Frequency [MHz]	Reading [dBm]	Correction Factor [dB]	Emission Level [dBm]	Limit [dBm]	Margin [dB]
Fundamental	-6.01	0.51	-5.50	N/A	N/A
942.5	-63.71	0.34	-63.37	-25.50	37.87
2384.6	-56.25	0.53	-55.72	-25.50	30.22
2512.8	-57.49	0.52	-56.97	-25.50	31.46
4961.5	-56.48	0.79	-55.69	-25.50	30.18
7443.9	-63.94	0.95	-62.99	-25.50	37.48
15689.1	-64.71	1.27	-63.44	-25.50	37.93
24535.3	-63.54	1.71	-61.83	-25.50	36.32

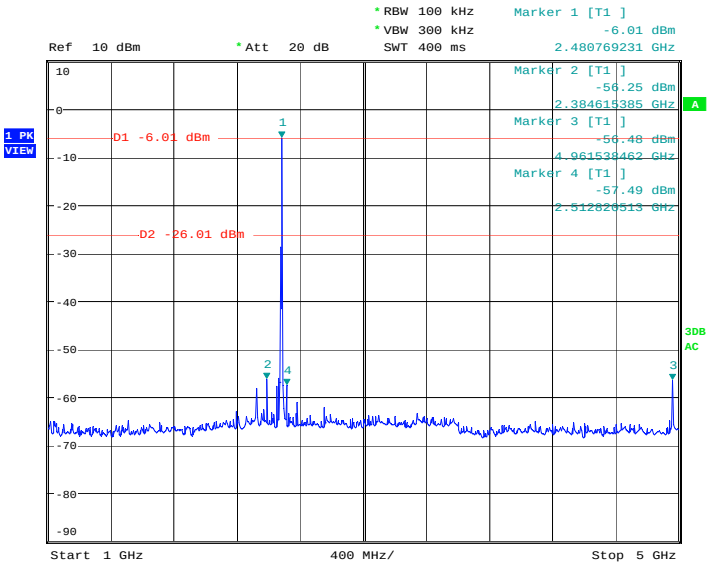
Notes: Limit = Reading of fundamental + Correction factor – 20dB
Emission level = Reading + Correction factor
Correction factor = Total cable loss

Figure 16: Spurious Emission from 30MHz to 1GHz, Mode C (2480MHz)



Antenna conducted spurious emission, mode C
Date: 26.MAR.2010 00:10:16

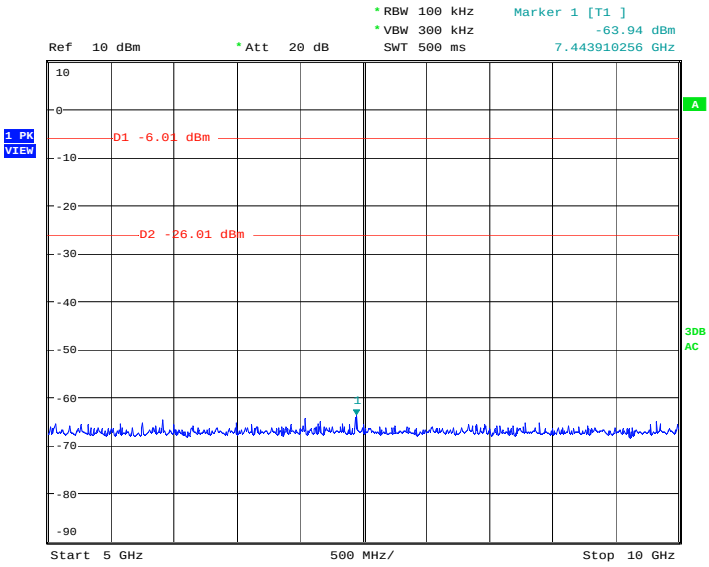
Figure 17: Spurious Emission from 1 to 5GHz, Mode C (2480MHz)



Antenna conducted spurious emission, mode C

Date: 26.MAR.2010 00:09:27

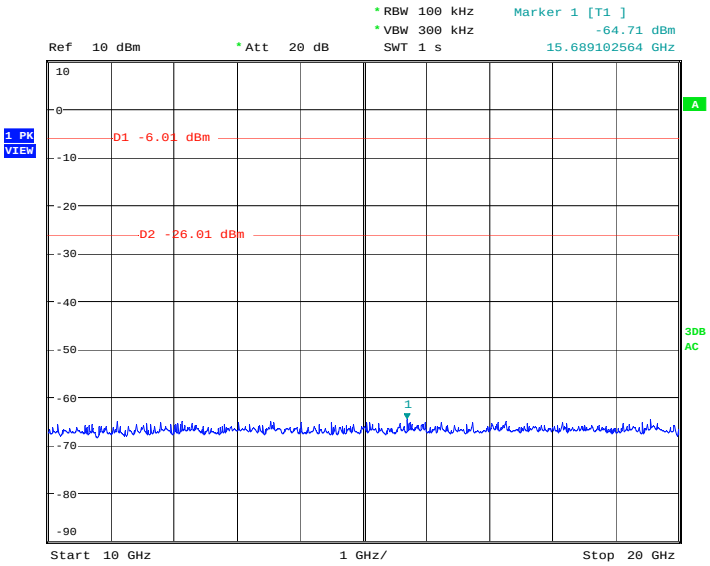
Figure 18: Spurious Emission from 5 to 10GHz, Mode C (2480MHz)



Antenna conducted spurious emission, mode C

Date: 26.MAR.2010 00:10:50

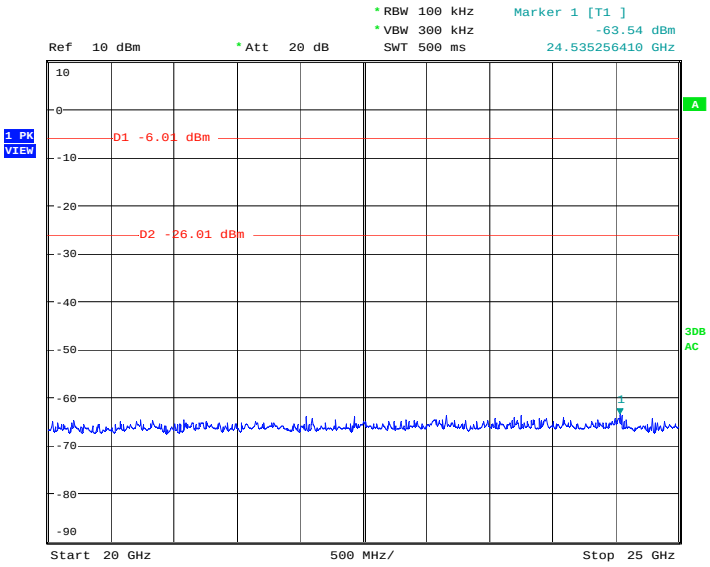
Figure 19: Spurious Emission from 10 to 20GHz, Mode C (2480MHz)



Antenna conducted spurious emission, mode C

Date: 26.MAR.2010 00:11:31

Figure 20: Spurious Emission from 20 to 25GHz, Mode C (2480MHz)



Antenna conducted spurious emission, mode C

Date: 26.MAR.2010 00:12:17

5.1.4 Peak Power Spectral Density, FCC 15.247(e)

RESULT: **PASS**

Date of testing: 2010-03-25

Ambient temperature: 25°C
Relative humidity: 30%
Atmospheric pressure: 998hPa

Requirements:

For digitally modulated systems, the power spectral density (PSD) conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

Test procedure:

ANSI C63.4-2003 and Measurement of Digital Transmission Systems Operating under Section 15.247.

A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 3kHz and the video bandwidth was set to 10kHz. The sweep time was set to 500s.

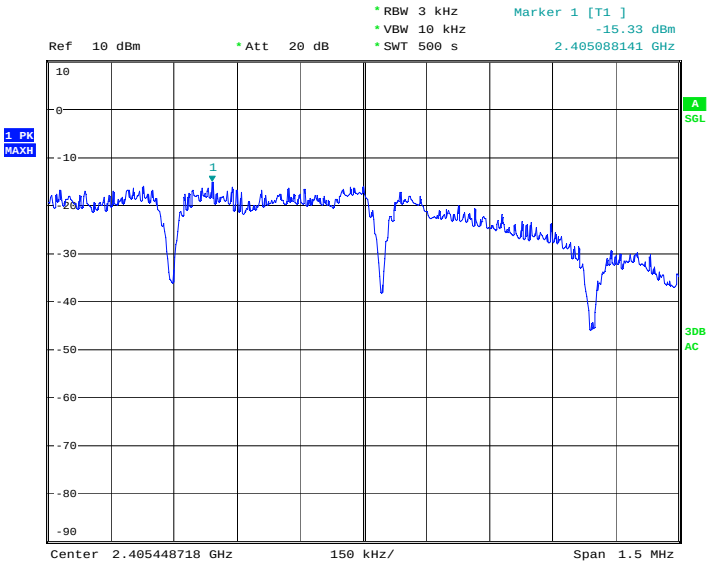
The final measurement takes into account the loss generated by all the involved cables.

Table 12: Peak Power Spectral Density

Operating Frequency [MHz]	Max PSD Frequency [MHz]	Reading [dBm]	Correction Factor [dB]	Max PSD [dBm]	Limit [dBm]	Margin [dB]
2405	2405.09	-15.33	0.54	-14.79	8.00	22.79
2440	2440.09	-15.86	0.52	-15.34	8.00	23.34
2480	2480.09	-17.13	0.51	-16.62	8.00	24.62

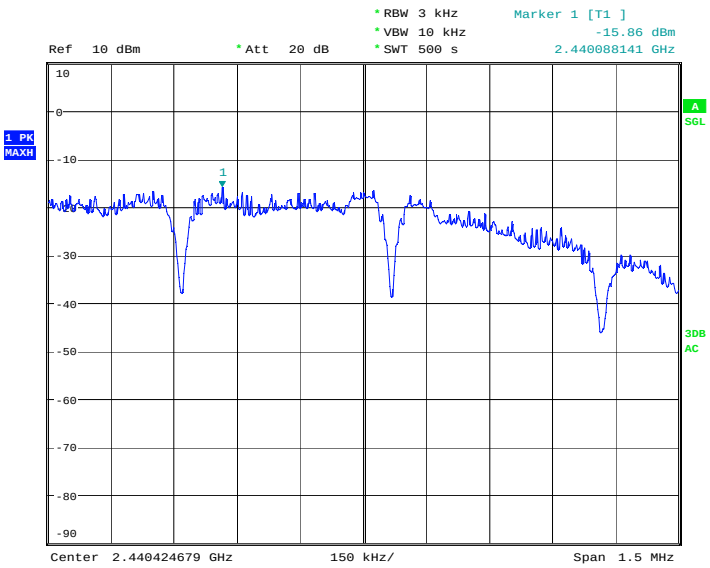
Notes: Power density = Reading + Correction factor
Correction factor = Total cable loss

Figure 21: Power Spectral Density, Mode A (2405MHz)



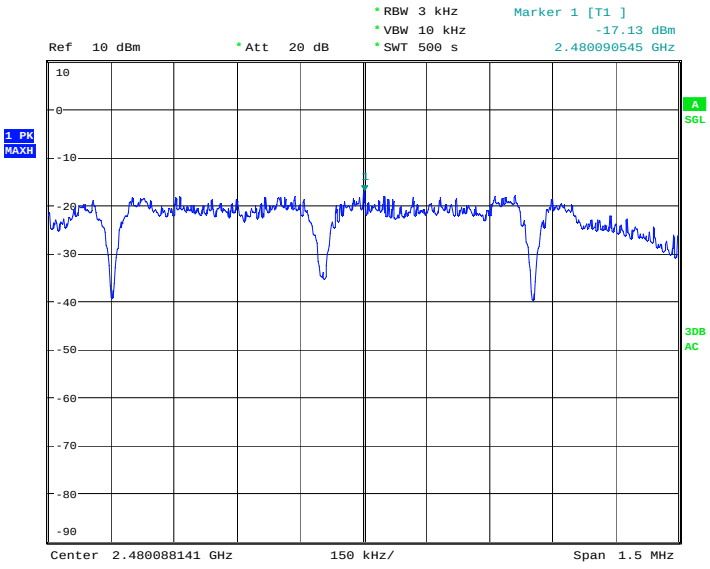
Peak power spectral density, mode A
Date: 25.MAR.2010 23:57:08

Figure 22: Power Spectral Density, Mode B (2440MHz)



Peak power spectral density, mode B
Date: 25.MAR.2010 23:43:16

Figure 23: Power Spectral Density, Mode C (2480MHz)



Peak power spectral density, mode C
Date: 25.MAR.2010 23:33:06

6. Test Results of AC Power Line Conducted Measurements

6.1 AC Power Line Conducted Emission of Transmitter

6.1.1 AC Power Line Conducted Emission of Transmitter, FCC 15.207

RESULT: **PASS**

Date of testing:	2010-03-25
Ambient temperature:	25°C
Relative humidity:	30%
Atmospheric pressure:	998hPa
Frequency range:	0.15 – 30MHz
Kind of test site:	Shielded Room
Supply voltage during testing:	AC 120V, 60Hz for DC power supply

Requirements:

The AC power line conducted emission on any frequency within the band 150 kHz to 30MHz shall not exceed the limits specified in FCC 15.207.

Test procedure:

ANSI C63.4-2003.

The EUT was placed on a wooden table raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT. The Support Board was powered via an external DC power supply (input voltage: AC 120V, 60Hz, output voltage: DC 3V) which was connected to a Line Impedance Stabilization Network (LISN).

The physical arrangement of the test system and associated cabling was varied to determine the effect on the EUT's emissions in amplitude and frequency in order to ensure that maximum emission amplitudes were attained.

The measurements were performed with the spectrum analyzer operating in the CISPR quasi-peak and average detection modes. The analyzer’s 6 dB bandwidth was set to 9kHz. No video filter less than 10 times the resolution bandwidth was used.

Disturbances other than those mentioned are small or not detectable.

Table 13: AC Power Line Conducted Emission, Quasi Peak and Average Data, 0.15 - 30MHz, Phase N (N) and L1 (L), Mode A (2405MHz)

Freq. [MHz]	Phase	Reading QP [dBµV]	Reading AV [dBµV]	Factor [dB]	Level QP [dBµV]	Level AV [dBµV]	Limit QP [dBµV]	Limit AV [dBµV]	Margin QP [dB]	Margin AV [dB]
0.28375	N	28.9	15.8	9.7	38.6	25.5	60.7	50.7	22.1	25.2
0.38000	N	31.7	17.9	9.7	41.4	27.6	58.3	48.3	16.9	20.7
0.42956	N	36.0	23.7	9.7	45.7	33.4	57.3	47.3	11.6	13.9
0.57641	N	26.0	11.7	9.7	35.7	21.4	56.0	46.0	20.3	24.6
3.70892	N	20.9	6.6	9.8	30.7	16.4	56.0	46.0	25.3	29.6
0.20385	L1	27.4	15.1	9.7	37.1	24.8	63.5	53.5	26.4	28.7
0.86157	L1	26.8	18.6	9.7	36.5	28.3	56.0	46.0	19.5	17.7
1.23649	L1	26.5	13.3	9.7	36.2	23.0	56.0	46.0	19.8	23.0
2.18595	L1	20.8	14.8	9.8	30.6	24.6	56.0	46.0	25.4	21.4

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

Table 14: AC Power Line Conducted Emission, Quasi Peak and Average Data, 0.15 - 30MHz, Phase N (N) and L1 (L), Mode B (2440MHz)

Freq. [MHz]	Phase	Reading QP [dBµV]	Reading AV [dBµV]	Factor [dB]	Level QP [dBµV]	Level AV [dBµV]	Limit QP [dBµV]	Limit AV [dBµV]	Margin QP [dB]	Margin AV [dB]
0.26739	N	29.7	16.7	9.7	39.4	26.4	61.2	51.2	21.8	24.8
0.37063	N	34.3	20.2	9.7	44.0	29.9	58.5	48.5	14.5	18.6
0.43204	N	36.5	24.1	9.7	46.2	33.8	57.2	47.2	11.0	13.4
1.22964	N	26.4	11.2	9.7	36.1	20.9	56.0	46.0	19.9	25.1
1.97757	N	24.3	10.6	9.7	34.0	20.3	56.0	46.0	22.0	25.7
3.71351	N	21.7	7.6	9.8	31.5	17.4	56.0	46.0	24.5	28.6
0.19849	L1	28.7	14.4	9.7	38.4	24.1	63.7	53.7	25.3	29.6
0.58079	L1	27.3	19.6	9.7	37.0	29.3	56.0	46.0	19.0	16.7
0.85885	L1	27.4	17.7	9.7	37.1	27.4	56.0	46.0	18.9	18.6
1.34311	L1	23.4	11.7	9.7	33.1	21.4	56.0	46.0	22.9	24.6
2.29469	L1	21.0	9.2	9.8	30.8	19.0	56.0	46.0	25.2	27.0

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

Table 15: AC Power Line Conducted Emission, Quasi Peak and Average Data, 0.15 - 30MHz, Phase N (N) and L1 (L), Mode C (2480MHz)

Freq. [MHz]	Phase	Reading QP [dBµV]	Reading AV [dBµV]	Factor [dB]	Level QP [dBµV]	Level AV [dBµV]	Limit QP [dBµV]	Limit AV [dBµV]	Margin QP [dB]	Margin AV [dB]
0.28226	N	30.7	16.7	9.7	40.4	26.4	60.7	50.7	20.3	24.3
0.37197	N	34.1	20.5	9.7	43.8	30.2	58.5	48.5	14.7	18.3
0.42981	N	36.3	24.0	9.7	46.0	33.7	57.3	47.3	11.3	13.6
0.75729	N	27.0	13.0	9.7	36.7	22.7	56.0	46.0	19.3	23.3
0.86029	N	28.5	14.0	9.7	38.2	23.7	56.0	46.0	17.8	22.3
1.23640	N	26.4	11.8	9.7	36.1	21.5	56.0	46.0	19.9	24.5
2.56689	N	23.1	8.5	9.8	32.9	18.3	56.0	46.0	23.1	27.7
0.57890	L1	27.4	19.8	9.7	37.1	29.5	56.0	46.0	18.9	16.5
1.34027	L1	24.7	16.7	9.7	34.4	26.4	56.0	46.0	21.6	19.6
1.88455	L1	20.8	14.4	9.7	30.5	24.1	56.0	46.0	25.5	21.9

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

6.2 AC Power Line Conducted Emission of Receiver

6.2.1 AC Power Line Conducted Emission of Receiver, FCC 15.107

RESULT: **PASS**

Date of testing:	2010-03-25
Ambient temperature:	25°C
Relative humidity:	30%
Atmospheric pressure:	998hPa
Frequency range:	0.15 – 30MHz
Kind of test site:	Shielded Room

Requirements:

The AC power line on any frequency within the band 150 kHz to 30MHz shall not exceed the limits specified in FCC 15.107(a).

Test procedure:

ANSI C63.4-2003.

The EUT was placed on a wooden table raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT. The Support Board was powered via an external DC power supply (input voltage: AC 120V, 60Hz, output voltage: DC 3V) which was connected to a Line Impedance Stabilization Network (LISN).

The physical arrangement of the test system and associated cabling was varied to determine the effect on the EUT's emissions in amplitude and frequency in order to ensure that maximum emission amplitudes were attained.

The measurements were performed with the spectrum analyzer operating in the CISPR quasi-peak and average detection modes. The analyzer’s 6 dB bandwidth was set to 9kHz. No video filter less than 10 times the resolution bandwidth was used.

Disturbances other than those mentioned are small or not detectable.

Table 16: AC Power Line Conducted Emission, Quasi Peak and Average Data, 0.15 – 30MHz, Phase N (N) and L1 (L), Mode D (Receive at 2440MHz)

Freq. [MHz]	Phase	Reading QP [dBµV]	Reading AV [dBµV]	Factor [dB]	Level QP [dBµV]	Level AV [dBµV]	Limit QP [dBµV]	Limit AV [dBµV]	Margin QP [dB]	Margin AV [dB]
0.26922	N	32.8	19.0	9.7	42.5	28.7	61.1	51.1	18.6	22.4
0.36900	N	35.7	21.3	9.7	45.4	31.0	58.5	48.5	13.1	17.5
0.43178	N	42.7	27.9	9.7	52.4	37.6	57.2	47.2	4.8	9.6
0.59534	N	31.8	15.7	9.7	41.5	25.4	56.0	46.0	14.5	20.6
0.68387	N	34.5	18.3	9.7	44.2	28.0	56.0	46.0	11.8	18.0
0.92358	N	42.4	21.9	9.7	52.1	31.6	56.0	46.0	3.9	14.4
1.02541	N	35.6	16.5	9.7	45.3	26.2	56.0	46.0	10.7	19.8
0.81785	L1	40.0	26.3	9.7	49.7	36.0	56.0	46.0	6.3	10.0

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

7. Test Results of Radiated Measurements

7.1 Radiated Emission of Transmitter

7.1.1 Band Edge Radiated Emission, FCC 15.247(d)

RESULT: **Pass**

Date of testing:	2010-03-10
Ambient temperature:	20°C
Relative humidity:	37%
Atmospheric pressure:	996hPa
Measurement distance:	3m
Kind of test site:	Semi Anechoic Chamber

Requirements:

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a), must comply with the radiated emission limits specified in FCC 15.209(a).

Test procedure:

ANSI C63.4-2003 and Measurement of Digital Transmission Systems Operating under Section 15.247.

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Measurements were made at 3m distance. The EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level.

Measurements were taken using both horizontal and vertical antenna polarizations for 3 EUT orientations (X, Y and Z).

Measurements were performed using a spectrum analyzer with a suitable span to encompass the peak of the fundamental and using the following settings: Peak: RBW & VBW = 1MHz, Average: RBW = 1MHz, VBW = 10Hz.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Note:

Measurements were performed while the EUT was operating on a single channel (low middle or high) with full power and 100% duty cycle. These operation modes are only used for testing purpose and do not correspond to real use conditions since the EUT is to be operated in practice by sending data packets. Therefore, the average level of the band edge needs to be corrected by a duty cycle correction factor in order to obtain a value which corresponds to normal use conditions.

The following principle has been applied regarding the duty cycle correction factor:

(1) If the carrier level at band edge did not meet the average limit with 100% duty cycle, then this level was adjusted to the normal operation level using the duty cycle correction factor described below, as permitted by FCC 15.35(c). In this case, both values with and without duty cycle correction factor are displayed in the table here below.

(2) If the carrier level at band edge met the average limit with 100% duty cycle, it would meet the limit in normal operation as well and no further calculation was performed. Only the value for 100% duty cycle is displayed in the table here below.

The duty cycle correction factor is calculated using the following formula:

Duty cycle correction factor (in dB)
= 20 * log (pulse duration / min [pulse train duration, 100ms])

The customer declares that the maximum duty cycle corresponds to a pulse duration of 4.064ms with a pulse train duration of 10.468ms, which represents a 38.8% ratio. Hence we obtain:

Duty cycle correction factor = 20 * log (4.064 / 10.468) = -8.2dB

Refer to the attached document: “Maximum Duty Ratio of the MB-RF8058 Module in IEEE 802.15.4” by NEC Electronics Corp. for more details regarding the maximum duty cycle.

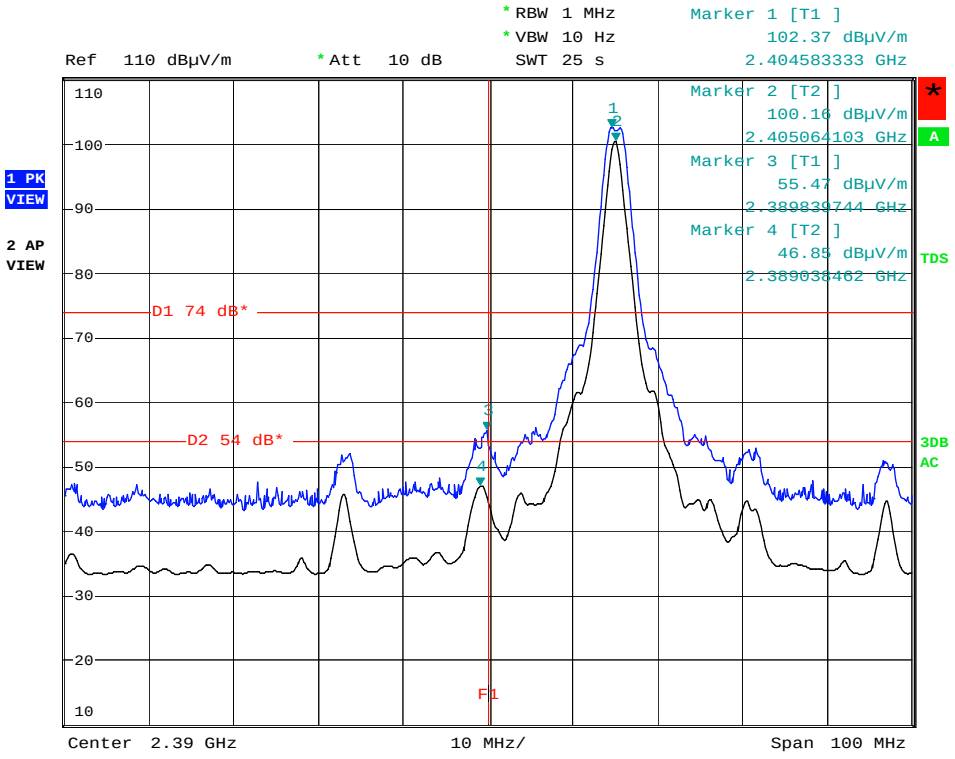
Table 17: Band Edge Radiated Emission

Operating Frequency [MHz]	EUT / Antenna Orient.	Average Value [dBµV/m]	Peak Value [dBµV/m]	Average Limit [dBµV/m]	Peak Limit [dBµV/m]	Average Margin [dB]	Peak Margin [dB]
2405	Z / H	46.9	55.5	54.0	74.0	7.1	18.5
2480	Z / H	59.9 / 51.7*	65.4	54.0	74.0	-5.9 / 2.3*	8.6

Notes: * Value without / with duty cycle correction factor. (The result with correction factor is below the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a high probability that the tested product complies with the specification limit.)

All other correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

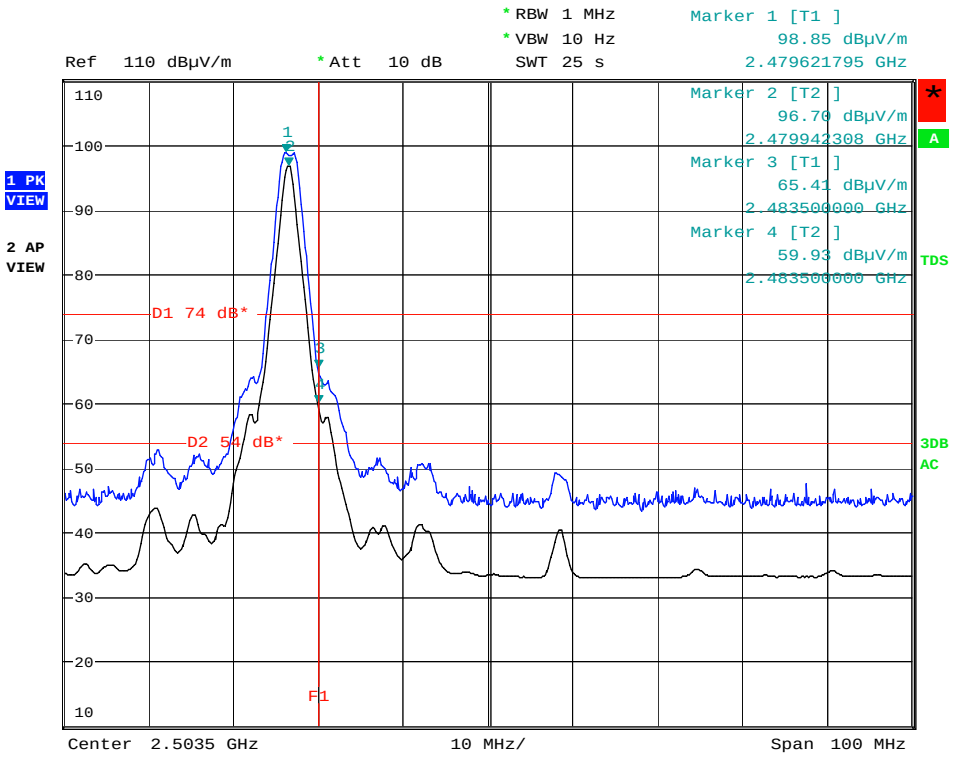
Figure 24: Band Edge Radiated Emission, Spectral Diagram, Mode A (2405MHz)



Band Edge (Lo), Hor, Mode A, Position Z
Direct/Fundamental
Date: 10.MAR.2010 13:10:09

Note: The upper trace shows the peak value and the lower trace shows the average value.

Figure 25: Band Edge Radiated Emission, Spectral Diagram, Mode C (2480MHz)



Band Edge (Hi), Hor, Mode C, Position Z
Direct/Fundamental
Date: 10.MAR.2010 13:16:11

Note: The upper trace shows the peak value and the lower trace shows the average value.

7.1.2 Radiated Spurious Emission of Transmitter, FCC 15.247(d), FCC 15.205 and FCC 15.209

RESULT: **PASS**

Date of testing:	2010-03-08 to 2010-03-25
Ambient temperature:	20 to 21°C
Relative humidity:	43 to 42%
Atmospheric pressure:	996 to 1025hPa
Frequency range:	9kHz – 25GHz
Measurement distance:	3m
Kind of test site:	Semi Anechoic Chamber

Requirements:

The emissions from the intentional radiator shall not exceed the field strength specified in FCC 15.209(a).

Test procedure:

ANSI C63.4-2003 and Measurement of Digital Transmission Systems Operating under Section 15.247.

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

Final radiated emission measurements were made at 3m distance. The spectrum was examined from 9kHz to the 10th harmonic of the highest fundamental transmitter frequency (25GHz).

At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

For frequencies between 30MHz and 1GHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1GHz, measurements were performed using the following settings: Peak: RBW & VBW = 1MHz, Average: RBW = 1MHz, VBW = 10Hz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

Note:

No spurious emission was found in the range 9kHz – 30MHz.

Table 18: Radiated Emission, Quasi Peak Data, 30MHz – 1GHz, Horizontal and Vertical Antenna Orientations, Mode A (2405MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
166.845	Y / H	56.2	-22.5	33.7	43.5	9.8	190	100
294.481	Y / H	50.5	-14.6	35.9	46.0	10.1	116	43
901.640	X / H	31.2	-10.3	20.9	46.0	25.1	101	200
30.408	Y / V	54.2	-23.3	30.9	40.0	9.1	100	196
55.457	Y / V	53.3	-27.5	25.8	40.0	14.2	100	79
65.458	Y / V	55.9	-27.6	28.3	40.0	11.7	101	253
73.582	Y / V	59.5	-27.3	32.2	40.0	7.8	104	206
500.064	X / V	55.2	-15.4	39.8	46.0	6.2	132	154

Note: Level QP = Reading QP + Factor

Table 19: Radiated Emission, Average and Peak Data, 1GHz – 25GHz, Horizontal and Vertical Antenna Orientations, Mode A (2405MHz)

Freq. [MHz]	EUT / Antenna Orientation	Level AV [dBµV/m]	Level PK [dBµV/m]	Limit AV [dBµV/m]	Limit PK [dBµV/m]	Margin AV [dB]	Margin PK [dB]
1623.439	X / V	33.9	40.9	54.0	74.0	20.1	33.1
4809.711	X / V	44.0	51.6	54.0	74.0	10.0	22.4

Note: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

Table 20: Radiated Emission, Quasi Peak Data, 30MHz – 1GHz, Horizontal and Vertical Antenna Orientations, Mode B (2440MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
167.533	Y / H	56.3	-22.5	33.8	43.5	9.7	199	94
287.998	Y / H	53.1	-15.1	38.0	46.0	8.0	115	329
30.983	Y / V	53.8	-23.4	30.4	40.0	9.6	100	212
35.516	Y / V	52.0	-24.4	27.6	40.0	12.4	104	82
73.648	Y / V	59.8	-27.3	32.5	40.0	7.5	100	221
449.986	Y / V	36.1	-16.4	19.7	46.0	26.3	137	41
500.066	Y / V	53.8	-15.4	38.4	46.0	7.6	131	150
901.555	Y / V	31.9	-10.5	21.4	46.0	24.6	295	181

Note: Level QP = Reading QP + Factor

Table 21: Radiated Emission, Average and Peak Data, 1GHz – 25GHz, Horizontal and Vertical Antenna Orientations, Mode B (2440MHz)

Freq. [MHz]	EUT / Antenna Orientation	Level AV [dBµV/m]	Level PK [dBµV/m]	Limit AV [dBµV/m]	Limit PK [dBµV/m]	Margin AV [dB]	Margin PK [dB]
2343.975	X / V	45.0	49.2	54.0	74.0	9.0	24.8
4879.886	X / V	40.3	49.4	54.0	74.0	13.7	24.6
14809.322	Y / H	31.2	45.7	54.0	74.0	22.8	28.3
19501.564	X / H	26.6	40.7	54.0	74.0	27.4	33.3

Note: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

Table 22: Radiated Emission, Quasi Peak Data, 30MHz – 1GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
184.005	X / H	55.0	-21.5	33.5	43.5	10.0	186	226
295.235	X / H	52.2	-14.6	37.6	46.0	8.4	110	175
901.897	X / H	35.2	-10.3	24.9	46.0	21.1	202	318
30.350	X / V	53.9	-23.3	30.6	40.0	9.4	100	174
47.582	X / V	51.7	-26.8	24.9	40.0	15.1	100	206
57.144	X / V	53.0	-27.6	25.4	40.0	14.6	100	187
74.219	X / V	60.2	-27.3	32.9	40.0	7.1	102	243
164.795	X / V	53.5	-22.1	31.4	43.5	12.1	102	105
500.075	X / V	54.7	-15.4	39.3	46.0	6.7	136	157

Note: Level QP = Reading QP + Factor

Table 23: Radiated Emission, Average and Peak Data, 1GHz – 25GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)

Freq. [MHz]	EUT / Antenna Orientation	Level AV [dBµV/m]	Level PK [dBµV/m]	Limit AV [dBµV/m]	Limit PK [dBµV/m]	Margin AV [dB]	Margin PK [dB]
2319.978	Z / H	43.9	49.2	54.0	74.0	10.1	24.8
1493.930	Z / V	23.6	37.6	54.0	74.0	30.4	36.4
1623.470	Z / V	36.9	42.1	54.0	74.0	17.1	31.9
4959.927	Z / V	41.5	49.4	54.0	74.0	12.5	24.6

Note: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

7.2 Radiated Emission of Receiver

7.2.1 Radiated Spurious Emission of Receiver, FCC 15.109

RESULT: **PASS**

Date of testing:	2010-03-08, 2010-03-09, 2010-03-10
Ambient temperature:	20, 20, 20°C
Relative humidity:	42, 36, 37%
Atmospheric pressure:	1025, 1024, 996hPa
Frequency range:	30MHz – 12.5GHz
Measurement distance:	3m
Kind of test site:	Semi Anechoic Chamber

Requirements:

The emissions from the unintentional radiator shall not exceed the field strength specified in 15.109(a).

Test procedure:

ANSI C63.4-2003.

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

Final radiated emission measurements were made at 3m distance. The spectrum was examined from 30MHz to the 5th harmonic of the highest fundamental transmitter frequency (12.5GHz).

At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

For frequencies between 30MHz and 1GHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1GHz, measurements were performed using the following settings: Peak: RBW & VBW = 1MHz, Average: RBW = 1MHz, VBW = 10Hz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

Table 24: Radiated Emission, Quasi Peak Data, 30MHz – 1GHz, Horizontal and Vertical Antenna Orientations, Mode D (Receive at 2440MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
296.490	Y / H	48.9	-14.5	34.4	46.0	11.6	112	240
443.093	Z / H	53.1	-17.3	35.8	46.0	10.2	100	19
901.859	Z / H	31.3	-10.3	21.0	46.0	25.0	250	138
35.386	Y / V	57.0	-24.3	32.7	40.0	7.3	100	197
48.517	Y / V	60.7	-26.9	33.8	40.0	6.2	102	229
72.869	Y / V	58.4	-27.3	31.1	40.0	8.9	109	115
163.230	Y / V	51.1	-22.2	28.9	43.5	14.6	100	98
500.065	Z / V	54.3	-15.4	38.9	46.0	7.1	125	188

Note: Level QP = Reading QP + Factor

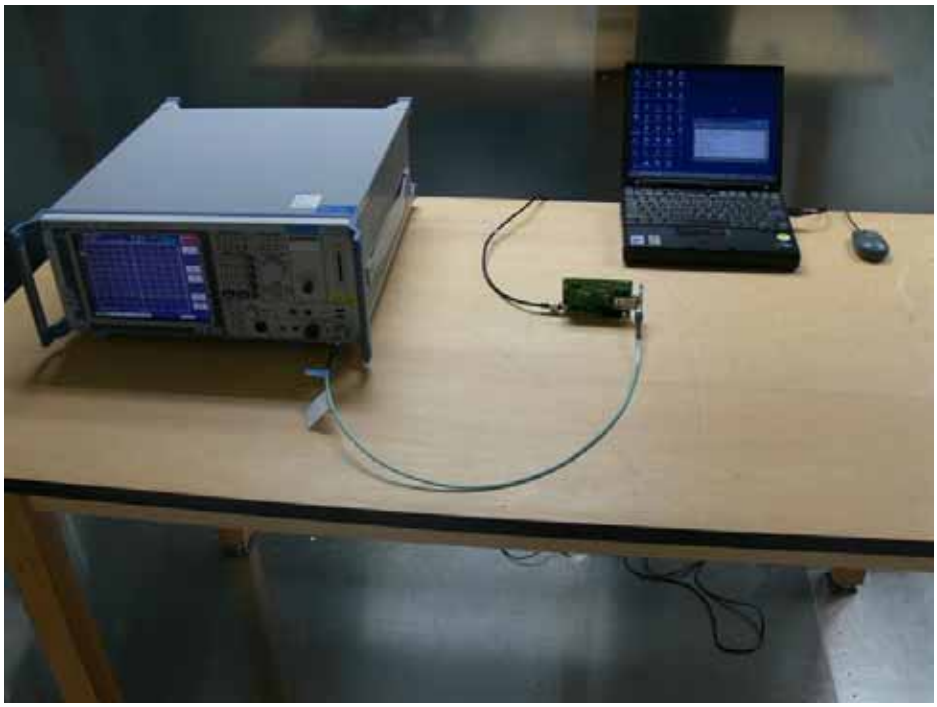
Table 25: Radiated Emission, Average and Peak Data, 1GHz – 13.5GHz, Horizontal and Vertical Antenna Orientations, Mode D (Receive at 2440MHz)

Freq. [MHz]	EUT / Antenna Orientation	Level AV [dBµV/m]	Level PK [dBµV/m]	Limit AV [dBµV/m]	Limit PK [dBµV/m]	Margin AV [dB]	Margin PK [dB]
2067.748	X / H	38.1	43.0	54.0	74.0	15.9	31.0
11960.682	X / H	29.7	44.6	54.0	74.0	24.3	29.4

Note: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

8. Photographs of the Test Setup

Photograph 1: Set-up for Conducted Emissions at Antenna Port



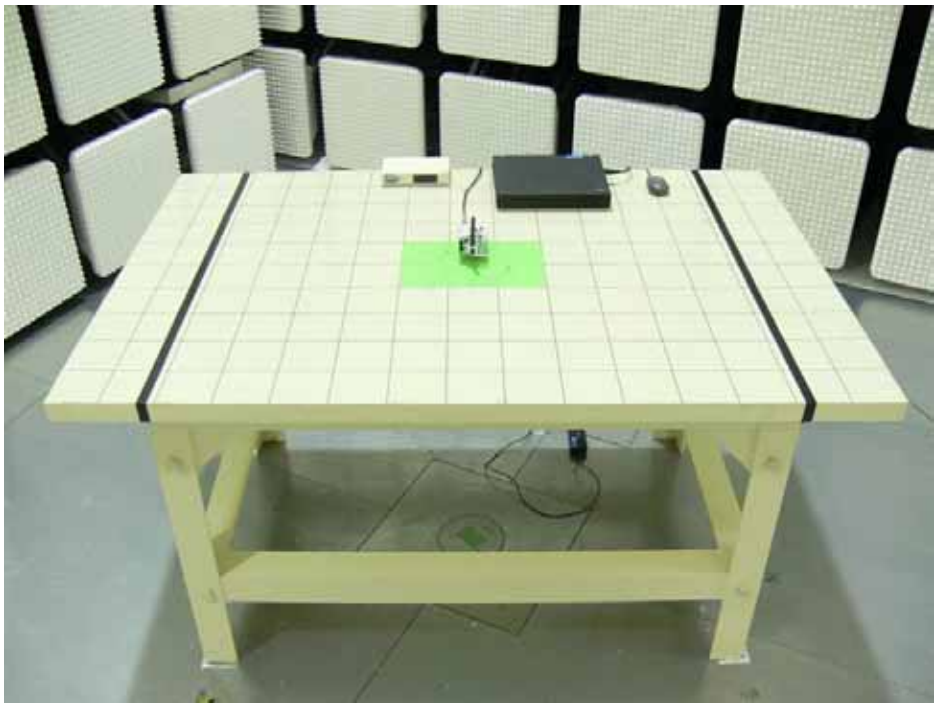
Photograph 2: Set-up for AC Power Line Conducted Emission of Transmitter, Front View

Photograph 3: Set-up for AC Power Line Conducted Emission of Transmitter, Rear View

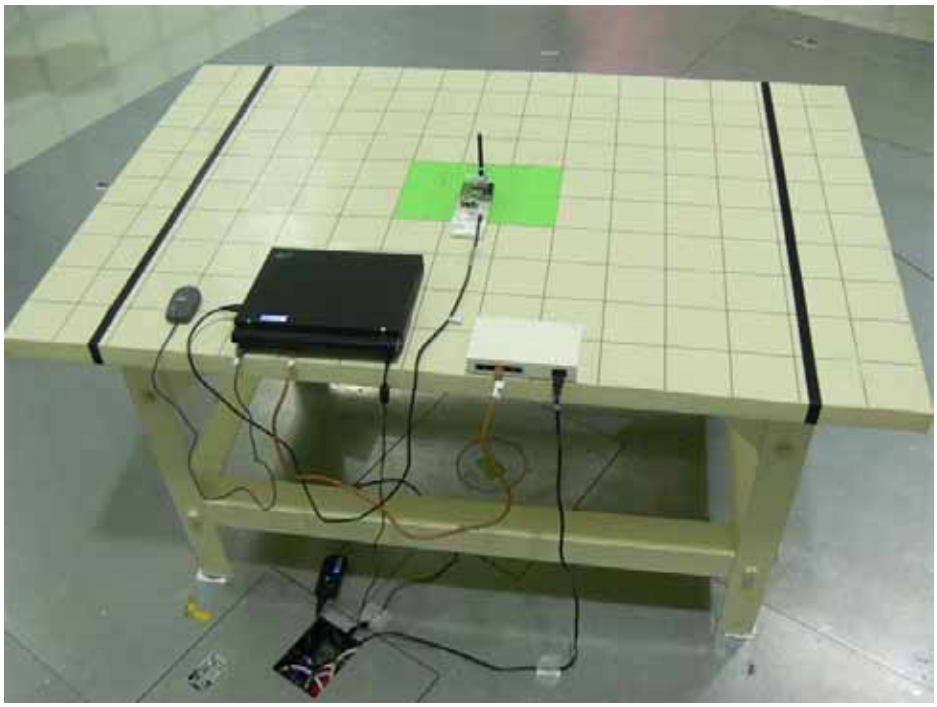
Photograph 4: Set-up for AC Power Line Conducted Emission of Receiver, Front View

Photograph 5: Set-up for AC Power Line Conducted Emission of Receiver, Rear View

Photograph 6: Set-up for Radiated Emission of Transmitter, Front View

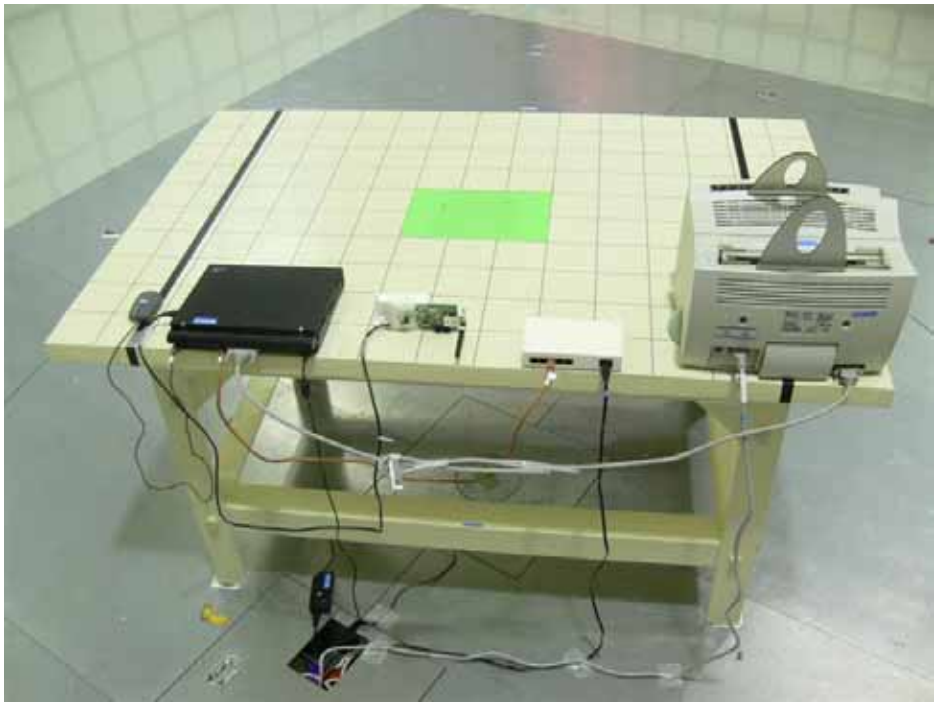


Photograph 7: Set-up for Radiated Emission of Transmitter, Rear View



Photograph 8: Set-up for Radiated Emission of Receiver, Front View

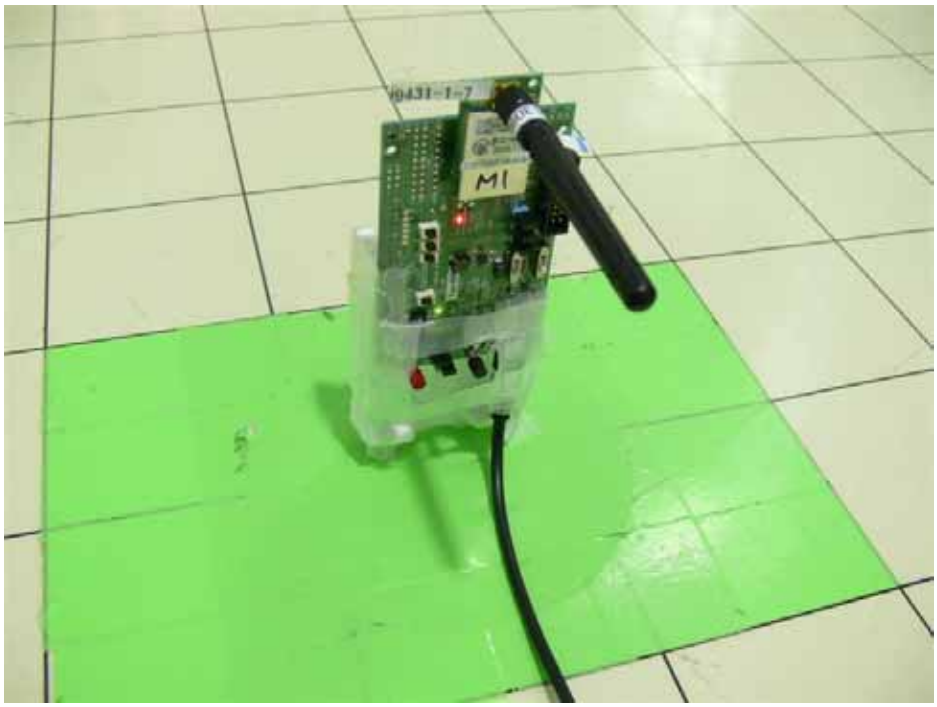
Photograph 9: Set-up for Radiated Emission of Receiver, Rear View



Photograph 10: Set-up for Radiated Emission, EUT Configuration X-Axis

Photograph 11: Set-up for Radiated Emission, EUT Configuration Y-Axis

Photograph 12: Set-up for Radiated Emission, EUT Configuration Z-Axis



9. List of Tables

10. List of Figures

11. List of Photographs

12. Attachment: Maximum Duty Ratio of the MB-RF8058 Module in IEEE 802.15.4 by NEC Electronics Corp.

6 pages following

NEC

Maximum Duty Ratio of the MB-RF8058 module in IEEE 802.15.4

March 23, 2010

NEC Electronics Corp.

Summary of the evaluation

To figure out the maximum duty ratio on an implementation of the IEEE 802.15.4 radio connections, an evaluation was carried out using a pair of the MB-RF8058 module.

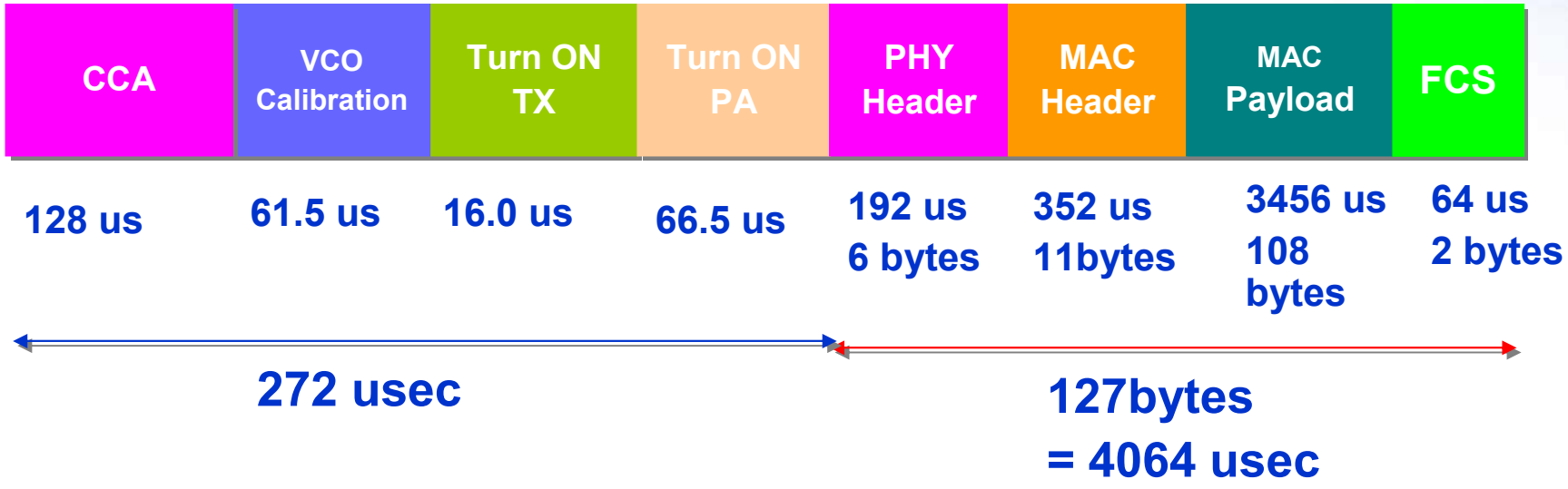
The duty cycle was measured as an interval between the time A, one module starts storing the payload to TxFIFO, setting up the packet, and sending out the packet of 127 byte long, and the time B, the module recognizes an acknowledgement from the other module.

The cycle time measured was 10468 usec, while “on-time” to send out 127 bytes of a packet is 4064 usec.

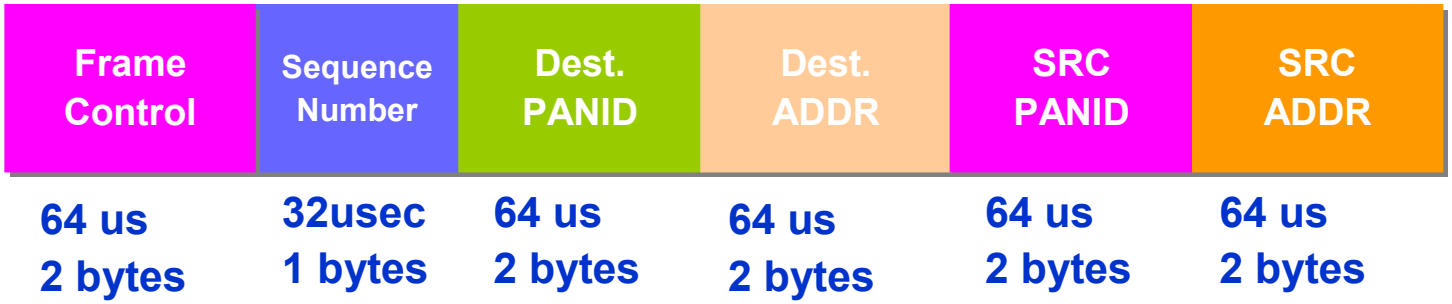
The duty ratio is calculated as 4064/10468 = 38.8 %.

CSMA-CA was inactivated to learn the minimum cycle time.

PHY setup and packet configuration in 78F8058

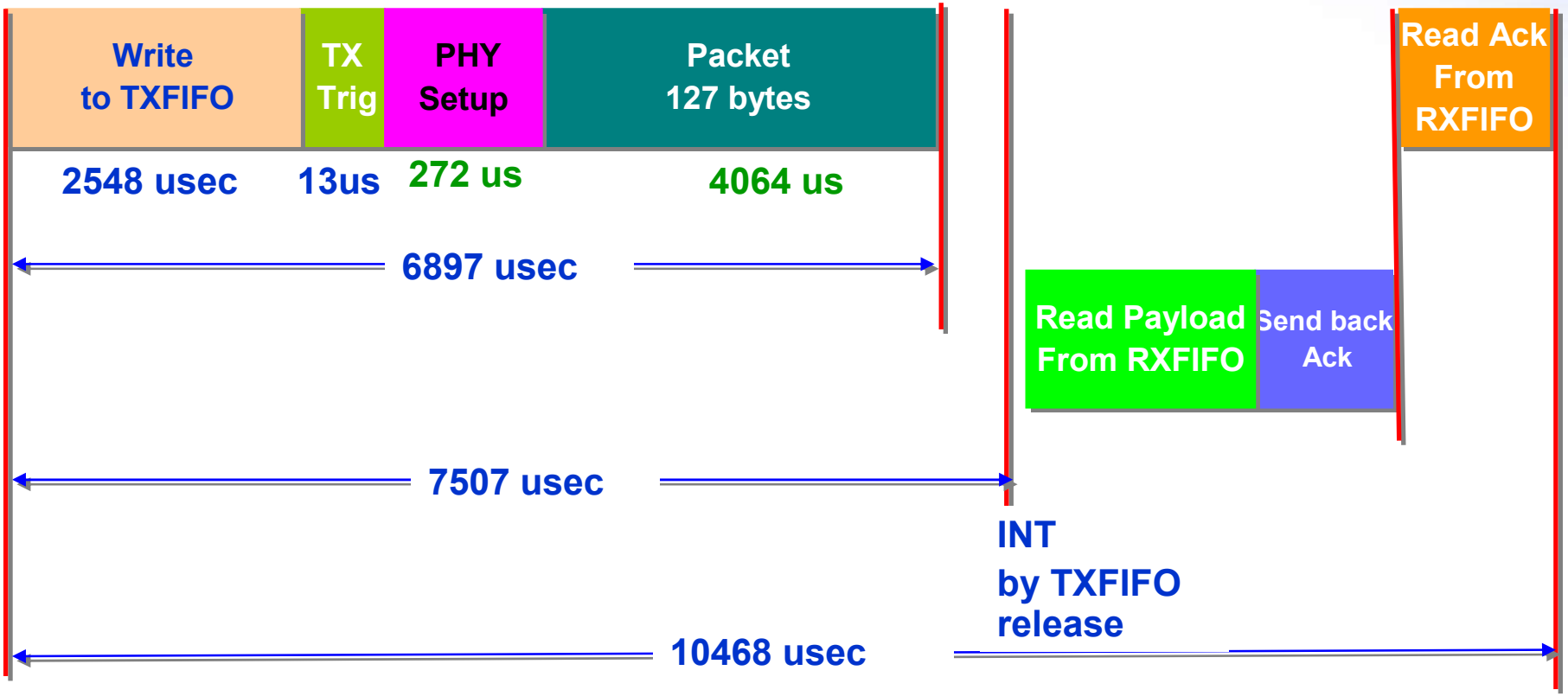


MAC Header



Control Frame of 8821 was employed.
The control frame of 8821 defines 11 bytes of the MAC header.

Cycle time till confirming Ack in application



Duty ratio is,
4064/10468 = 38.8%


NEC
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