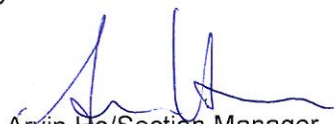


Produkte
Products

Prüfbericht - Nr.: 10040507 001			Seite 1 von 34		
<i>Test Report No.:</i>			<i>Page 1 of 34</i>		
Auftraggeber: AAC Technologies Pte Ltd					
<i>Client:</i>			10 Ang Mo Kio Street 65, #01-08, Tech Point, 569059 Singapore		
Gegenstand der Prüfung: Zigbee module (802.15.4/2.4G)					
<i>Test item:</i>					
Bezeichnung: AT357HP		Serien-Nr.: N/A			
<i>Identification:</i>		<i>Serial No.:</i>			
Wareneingangs-Nr.: TPE79267		Eingangsdatum: 13 Dec. 2012			
<i>Receipt No.:</i>		<i>Date of receipt:</i>			
Zustand des Prüfgegenstandes bei Anlieferung:			The sample is ok for testing and not damaged		
<i>Condition of test item at delivery:</i>					
Prüfört: TÜV Rheinland Taiwan Ltd.					
<i>Testing location:</i>			11F., No.758, Sec. 4, Bade Rd., Songshan Dist., Taipei City 105 Taiwan		
			FCC Registration No.: 365730		
Prüfgrundlage: FCC CFR47 Part 15: Subpart C Section 15.247					
<i>Test specification:</i>					
Prüfergebnis: Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).					
<i>Test Result:</i>			<i>The test item passed the test specification(s).</i>		
Prüflaboratorium: TÜV Rheinland Taiwan Ltd.					
<i>Testing Laboratory:</i>			11F., No.758, Sec. 4, Bade Rd., Songshan Dist., Taipei City 105, Taiwan, R.O.C.		
geprüft/ tested by:			kontrolliert/ reviewed by:		
 2013-04-08 Arvin Ho/Section Manager			 2013-04-08 Rene Charton/Senior Project Manager		
Datum	Name/Stellung	Unterschrift	Datum	Name/Stellung	Unterschrift
<i>Date</i>	<i>Name/Position</i>	<i>Signature</i>	<i>Date</i>	<i>Name/Position</i>	<i>Signature</i>
Sonstiges/ Other Aspects:					
Abkürzungen: P(ass) = entspricht Prüfgrundlage F(ail) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet			Abbreviations: P(ass) = passed F(ail) = failed N/A = not applicable 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. <i>This test report relates to the a. m. test item. 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.</i>					

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT

RESULT: Passed

5.1.2 PEAK OUTPUT POWER

RESULT: Passed

5.1.3 6dB BANDWIDTH

RESULT: Passed

5.1.4 POWER DENSITY

RESULT: Passed

5.1.5 CONDUCTED SPURIOUS EMISSIONS AND FREQUENCY BAND EDGE MEASURED IN 100KHz BANDWIDTH

RESULT: Passed

5.1.6 SPURIOUS EMISSION

RESULT: Passed

6.1.1 ELECTROMAGNETIC FIELDS

RESULT: Passed

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1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix P: Photo

(File:APPENDIX P)

Appendix D: Test Result of Radiated Emissions

(File:APPENDIX D)

Test Specifications

The following standards were applied (in bold: product standards, otherwise: basic standards).

Table 1: Applied Standard and Test Levels

Radio
FCC CFR47 Part 15: Subpart C Section 15.247
ANSI C63.10:2009, KDB558074 D01 DTS Meas Guidance v02

2. Test Sites

2.1 Test Facilities

TUV Rheinland Taiwan Ltd.

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

FCC Registration No.: 365730
TAF Accredited NCC Test Lab. No.:0759
TAF ISO17025 Certification effective periods: 2010-Jul-1st to 2013-Jun-30th



Testing Laboratory
0759

2.2 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Type	S/N	Calibrated until
EMI Test Receiver	R&S	ESCI 7	1166.5950K07-100797-Pt	20-Dec-13
Bilog Antenna	TESEQ	CBL6111D	29802	29-Jun-13
Pre-Amplifier	HP	8447F	2805A03335	14-Sep-13
Spectrum Analyzer	R&S	FSV 40	100921	13-Dec-13
Horn Antenna (1GHz~18GHz)	COM-POWER	AHA118	701251	28-Sep-13
Horn Antenna (18GHz~40GHz)	COM-POWER	AH840	101031	2-Nov-13
Preamplifier (30MHz -1GHz)	HP	8447F	2805A03335	14-Sep-13
Preamplifier (18 GHz -40 GHz)	COMPOWER	PAM-840	461257	17-Sep-13
Power meter	R&S	NRVD	100439	27-Mar-13
Power sensor	R&S	NRV-Z1	100013	27-Mar-13
Temp. & Humid. Chamber	Giant Force	GCT-099-40-S	MAF0103-007	13-May-13
Signal Generator	R&S	SMU200	104260	13-Aug-13
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	28-Sep-13

2.3 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements are $\pm 3\text{dB}$.

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-7}$
RF power, conducted	$\pm 1 \text{ dB}$
Adjacent channel power	$\pm 3 \text{ dB}$
Radiated emission of transmitter, valid up to 26 GHz	$\pm 6 \text{ dB}$
Radiated emission of receiver, valid up to 26 GHz	$\pm 6 \text{ dB}$
Temperature	$\pm 2 \text{ }^{\circ}\text{C}$
Humidity	$\pm 10 \text{ \%}$

3. General Product Information

3.1 Product Function and Intended Use

The tested sample is a “Zigbee module (802.15.4/2.4G)” with an external antenna.
For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 Ratings and System Details

Table 4: Technical Specification of EUT

Technical Specification	Value
Kind of Equipment	Zigbee module (802.15.4/2.4G)
Brand Name	AAC Technologies Pte Ltd
FCC ID	S2J-357HP
Type Designation	AT357HP
Operating Frequencies	2405MHz~2480MHz
Channel Spacing	5 MHz
Channel number	16
Operation Voltage	3.3
Modulation	DSSS (O-QPSK)
Antenna gain	2.4dBi (External)

Table 5: Channel Table

Channel No.	Frequency
11	2405
12	2410
13	2415
14	2420
15	2425
16	2430
17	2435
18	2440
19	2445
20	2450
21	2455
22	2460
23	2465
24	2470
25	2475
26	2480

Channel 25 uses a 10 dB power reduction to ensure bandedge compliance.
Channel 26 uses a 57 dB power reduction to ensure bandedge compliance.

3.3 Independent Operation Modes

Basic operation modes are:

- A. Transmitting
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. Receiving
- C. Standby
- D. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- | | |
|-------------------------|----------------------|
| - Bill of Material | - Circuit Diagram |
| - PCB Layout | - Instruction Manual |
| - Photo Document | - Rating Label |
| - Technical Description | |

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Setup for testing: Test mode controlled through data interface

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

Full test was applied on all test modes, but only worst case was shown.

4.3 Special Accessories and Auxiliary Equipment

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

Kind of Equipment	Manufacturer	Model Name	S/N
Laptop	MSI	MS-1453	MX-233TWK1008000096

4.4 Countermeasures to achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Constructional Data Form or the Technical Construction File. No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test

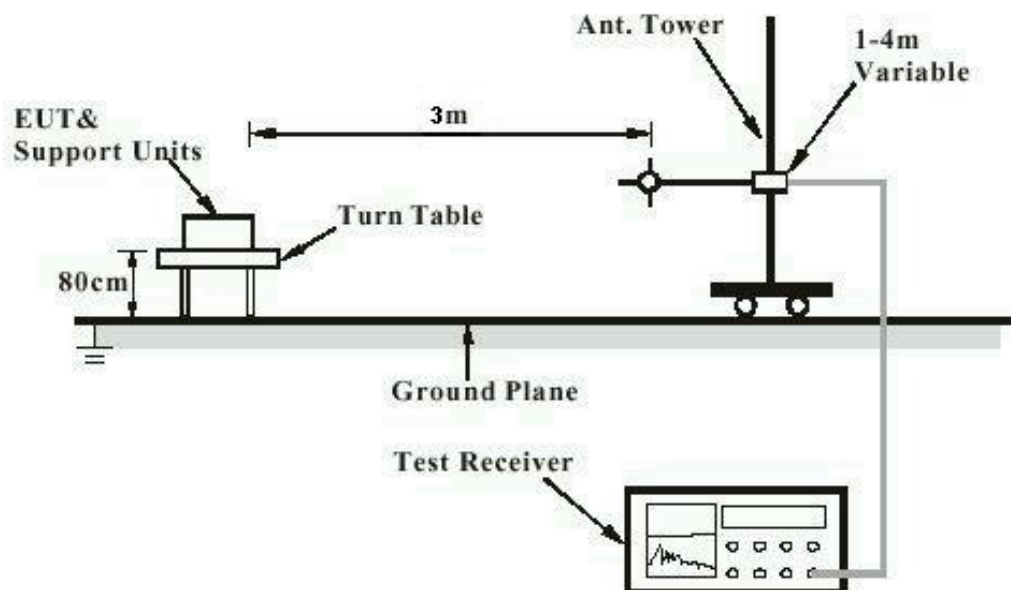


Diagram of Measurement Equipment Configuration for Mains Conduction Measurement (if applicable)

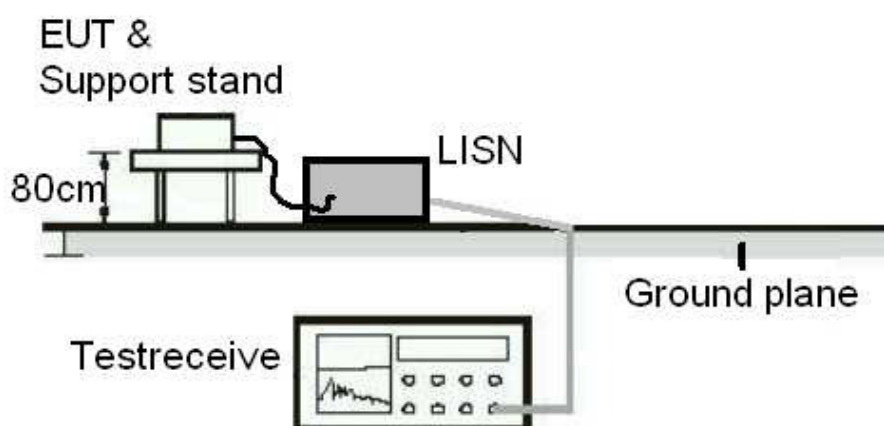
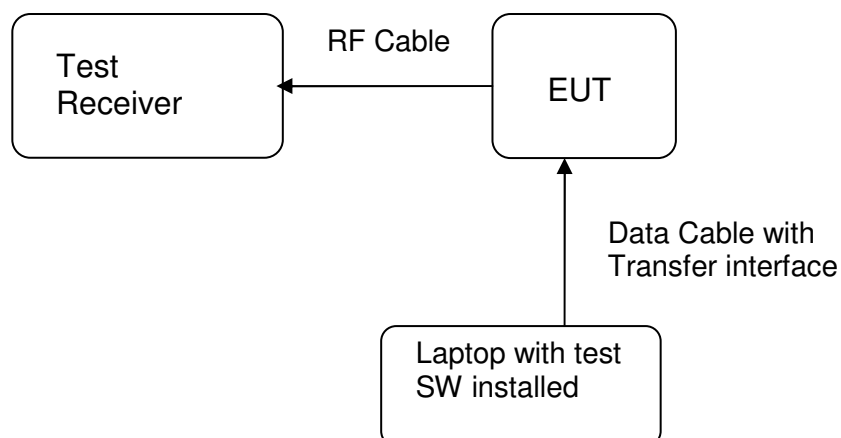


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Passed**

Test date	:	2012-12-12
Test standard	:	FCC Part 15.247(b)(4), Part 15.203
Limit	:	the use of antennas with directional gains that do not exceed 6 dBi

According to the manufacturer declaration, the EUT will be supplied with an external antenna with an directional gain of 2.1 dBi (External).

The antenna is connected through an Hirose connector . This is not a standard connector .

Therefore, the EUT is considered to comply the provision.

Refer to EUT photo for details.

5.1.2 Peak Output Power

RESULT:
Passed

Test standard : FCC Part 15.247(b)(1)
 Basic standard : ANSI C63.10:2009, KDB558074
 Limit : 1 Watt
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A

 Ambient temperature : 20-24 °C
 Relative humidity : 50-65 %
 Atmospheric pressure : 100-103 kPa

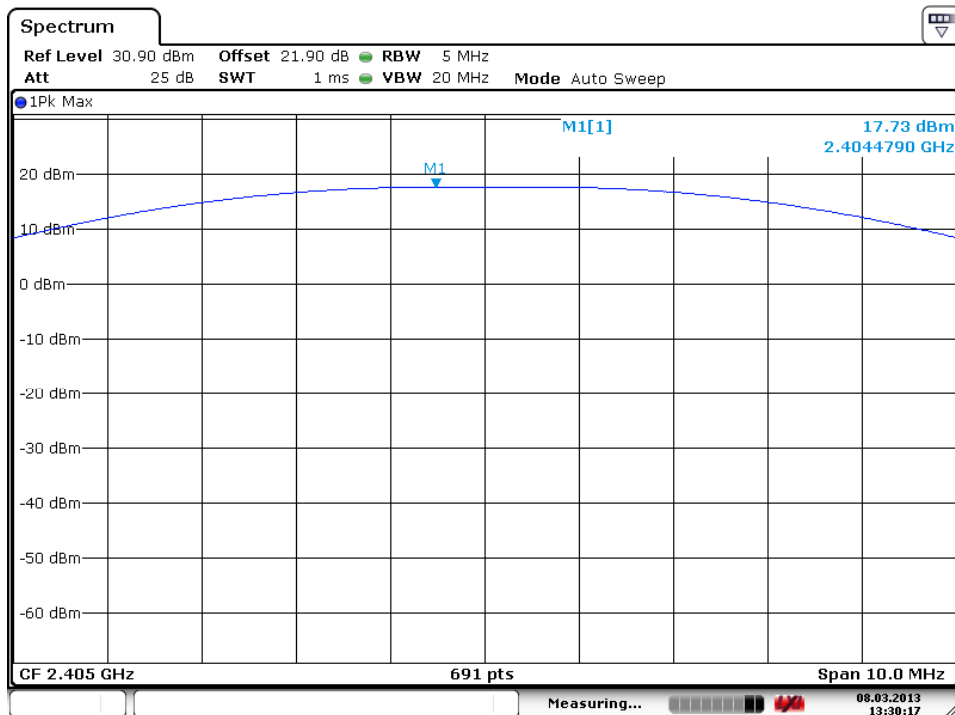
Table 6: Test result of Peak Output Power

Channel	Channel Frequency (MHz)	Peak Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2405	17.73	0.059	1
Mid Channel	2445	17.26	0.053	1
High Channel	2475	6.9	0.005	1
High Channel	2480	-39.44	0.0000001	1

Pmax: 59 mW

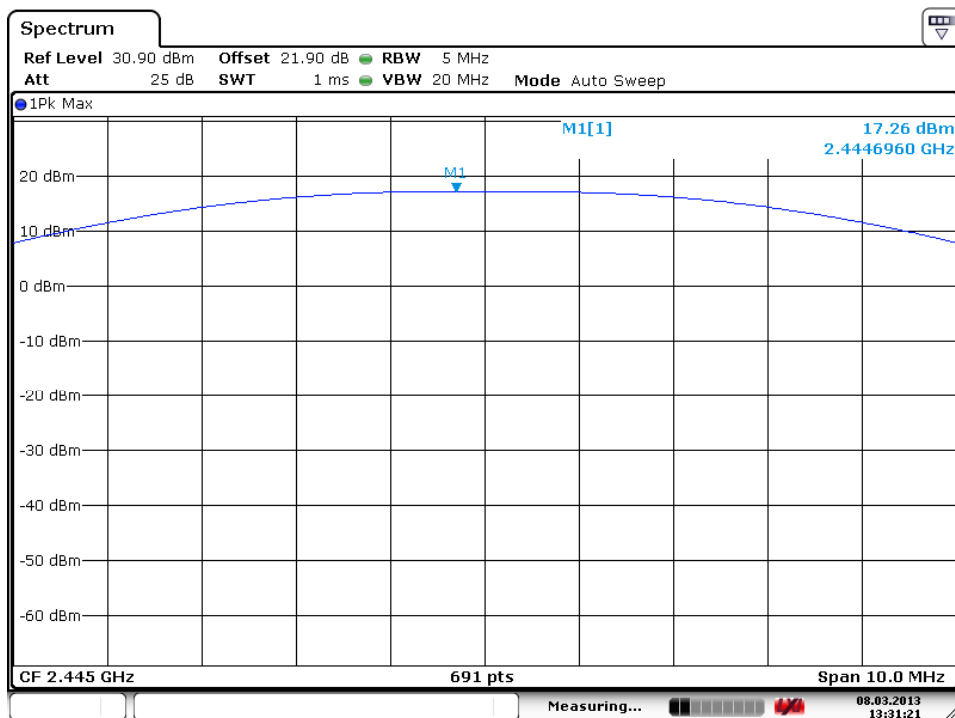
Test Plot of Peak Output Power

Low Channel



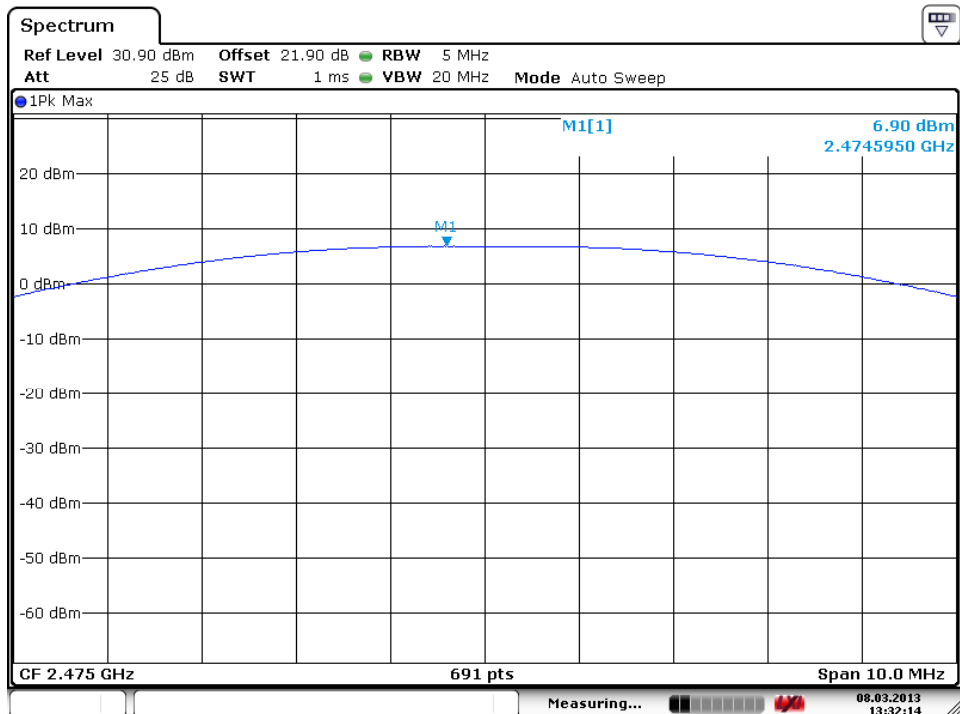
Date: 8.MAR.2013 13:30:17

Middle Channel



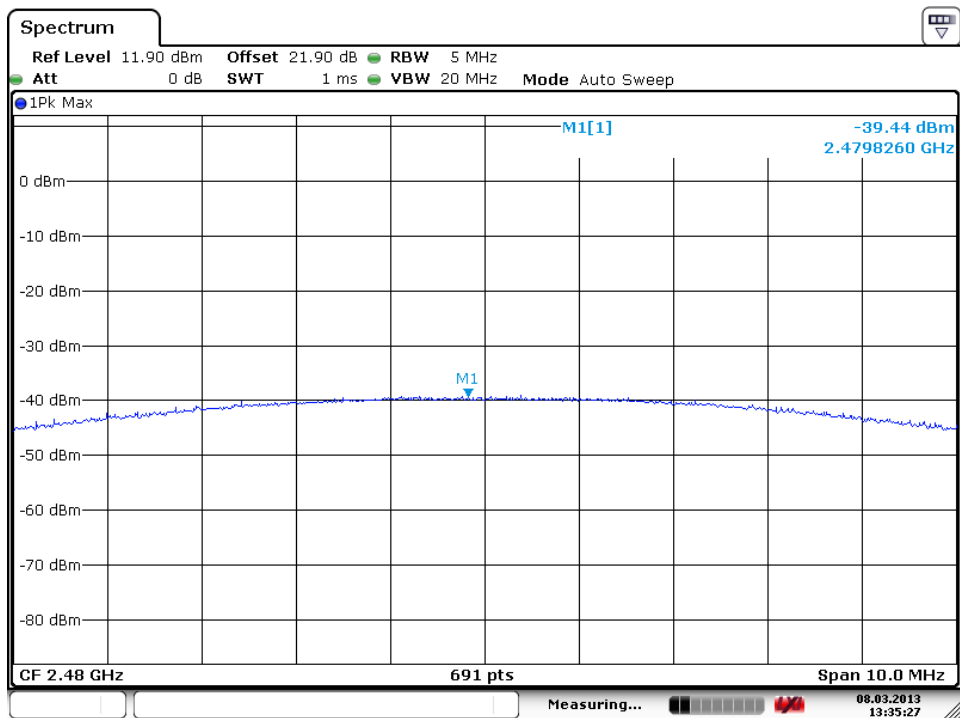
Date: 8.MAR.2013 13:31:21

High Channel 2475



Date: 8.MAR.2013 13:32:14

High Channel 2480



Date: 8.MAR.2013 13:35:27

5.1.3 6dB Bandwidth

RESULT:**Passed**

Test standard : FCC Part 15.247(a)(1)
Basic standard : ANSI C63.10:2009, KDB558074
Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
Operation Mode : A

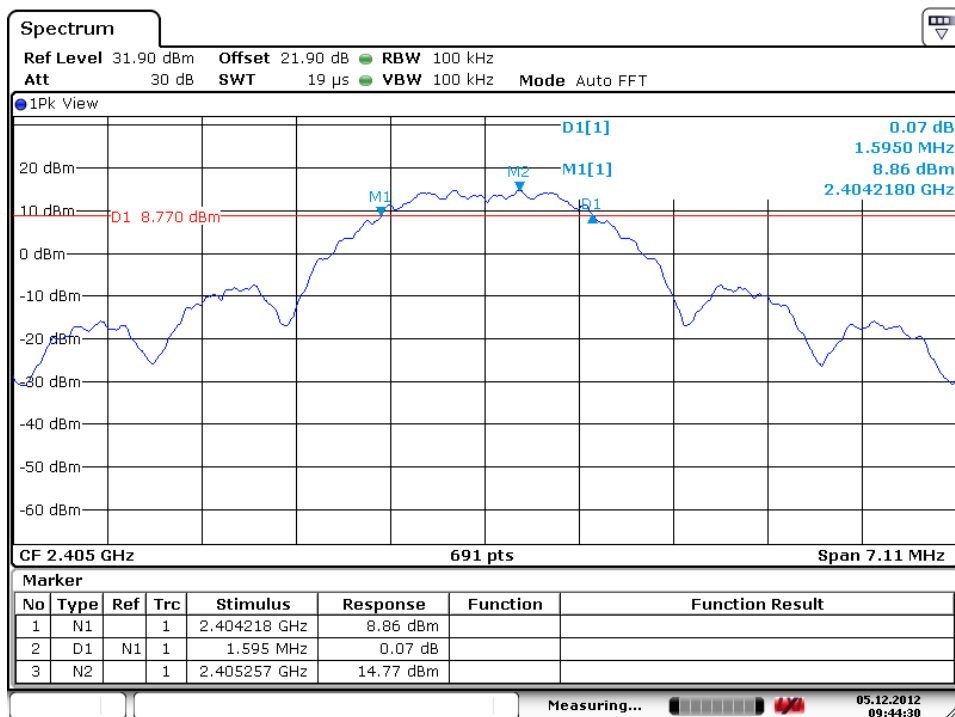
Ambient temperature : 20-24 °C
Relative humidity : 50-65 %
Atmospheric pressure : 100-103 kPa

Table 7: Test result of 6 dB Bandwidth

Channel	Channel Frequency (MHz)	6 dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2405	1.595	> 500	Pass
Mid Channel	2445	1.585	> 500	Pass
High Channel	2480	1.595	> 500	Pass

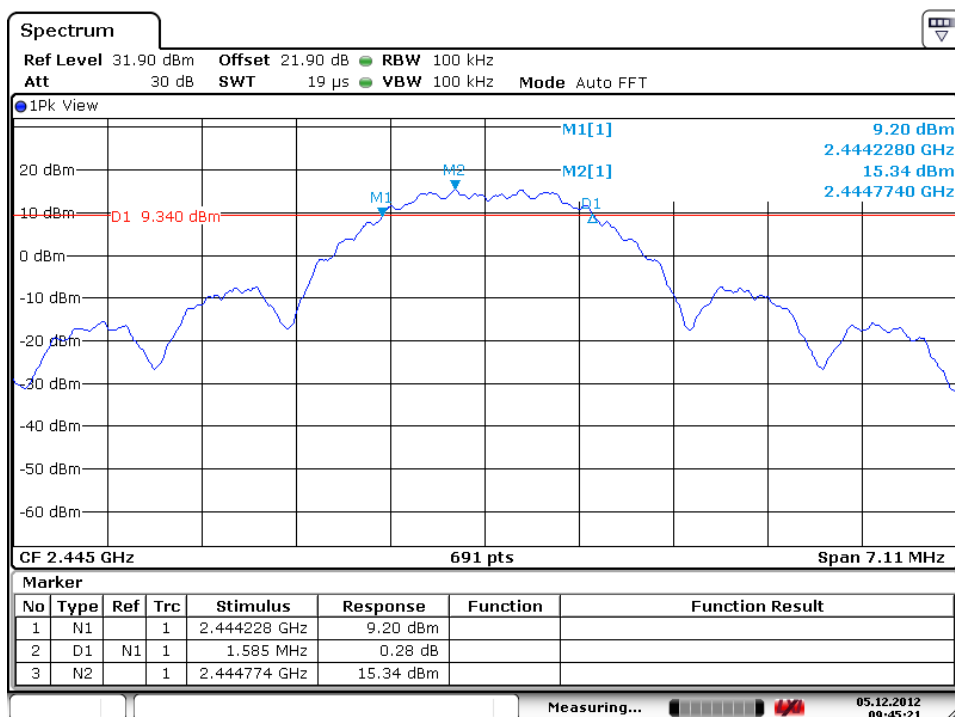
Test Plot of 6dB Bandwidth

Low Channel



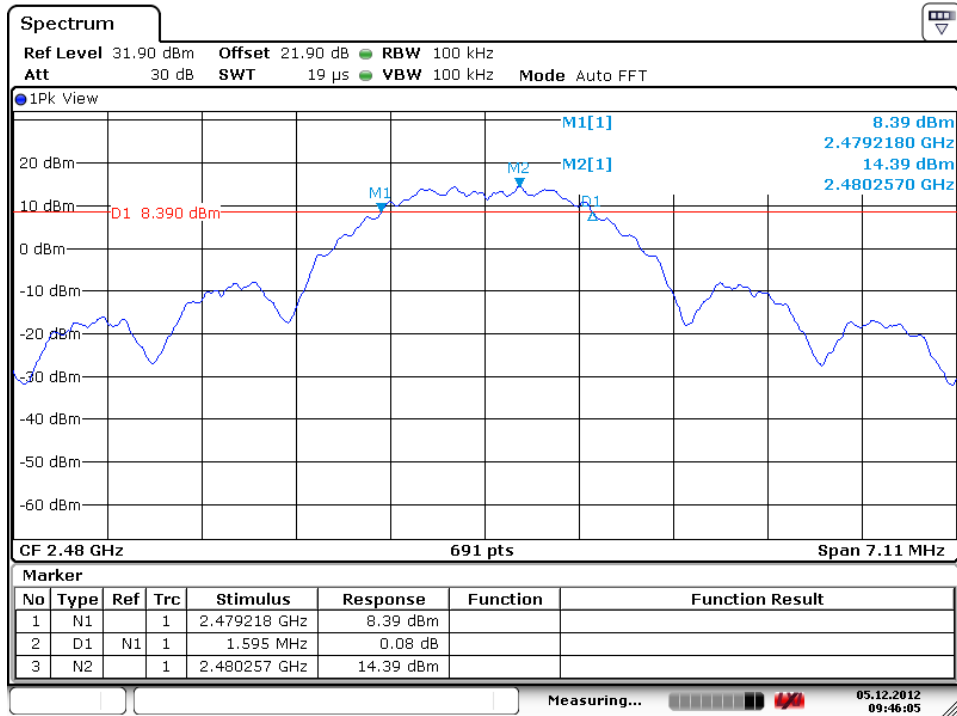
Date: 5.DEC.2012 09:44:29

Middle Channel



Date: 5.DEC.2012 09:45:21

High Channel



Date: 5.DEC.2012 09:46:05

5.1.4 Power Density

RESULT:**Passed**

Test standard : FCC Part 15.247(e)
Basic standard : ANSI C63.10:2009, KDB558074
Kind of test site : Shielded room

Test setup

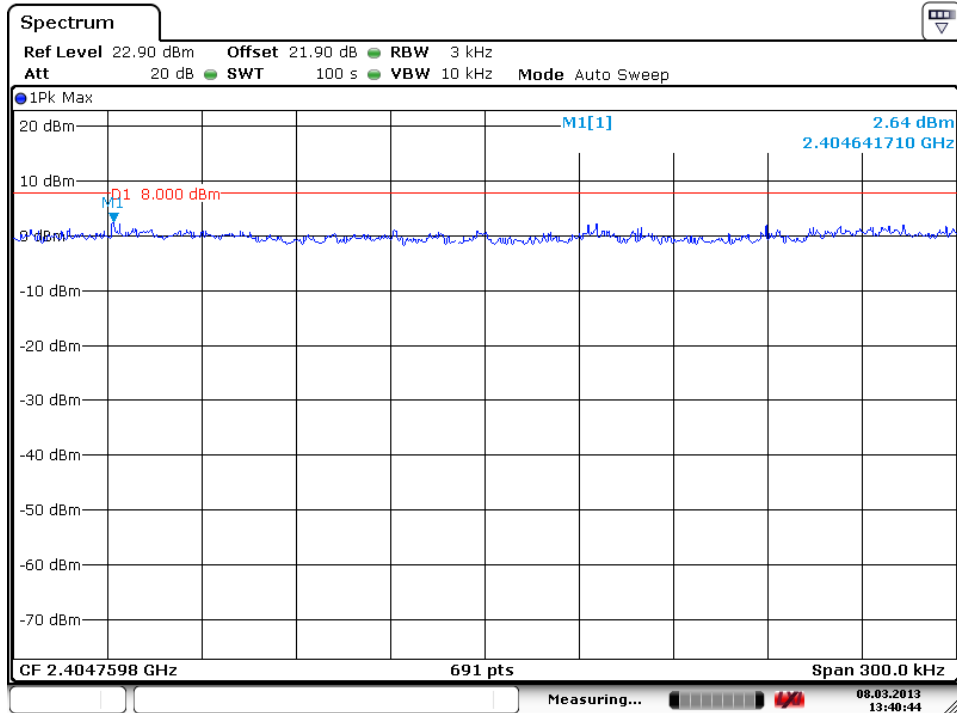
Test Channel : Low/ Middle/ High
Operation Mode : A
Ambient temperature : 18-22 °C
Relative humidity : 50-65 %
Atmospheric pressure : 100-103 kPa

Table 8: Test result of Power Density

Channel	Channel Frequency (MHz)	Peak Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
Low Channel	2405	2.64	8	Pass
Mid Channel	2445	2.77	8	Pass
High Channel	2475	-7.66	8	Pass
High Channel	2480	-57.47	8	Pass

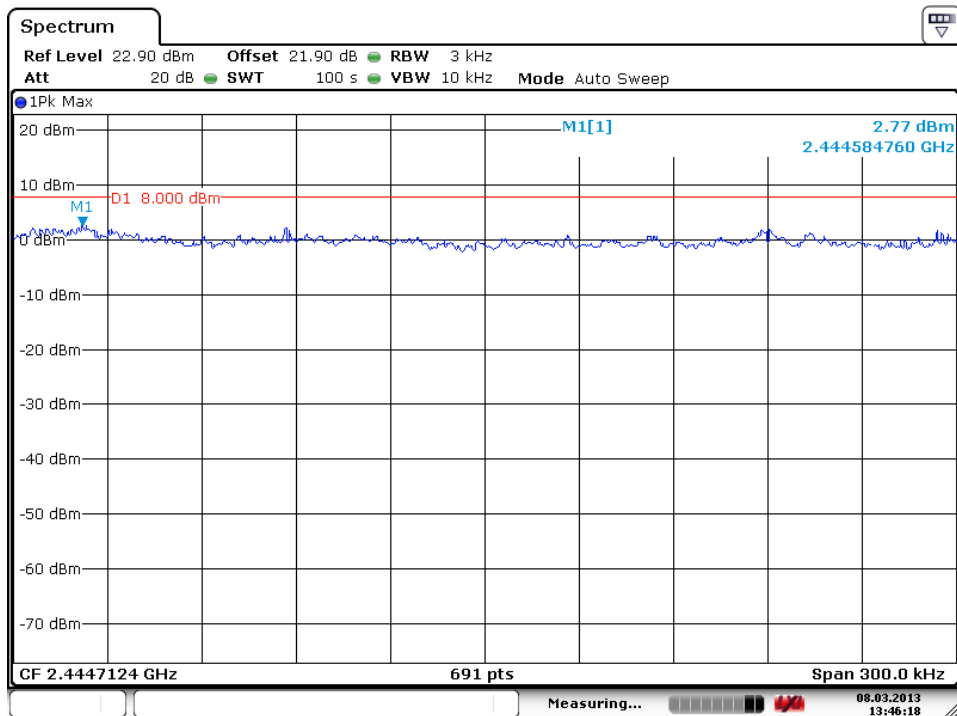
Test Plot of Power Density

Low Channel



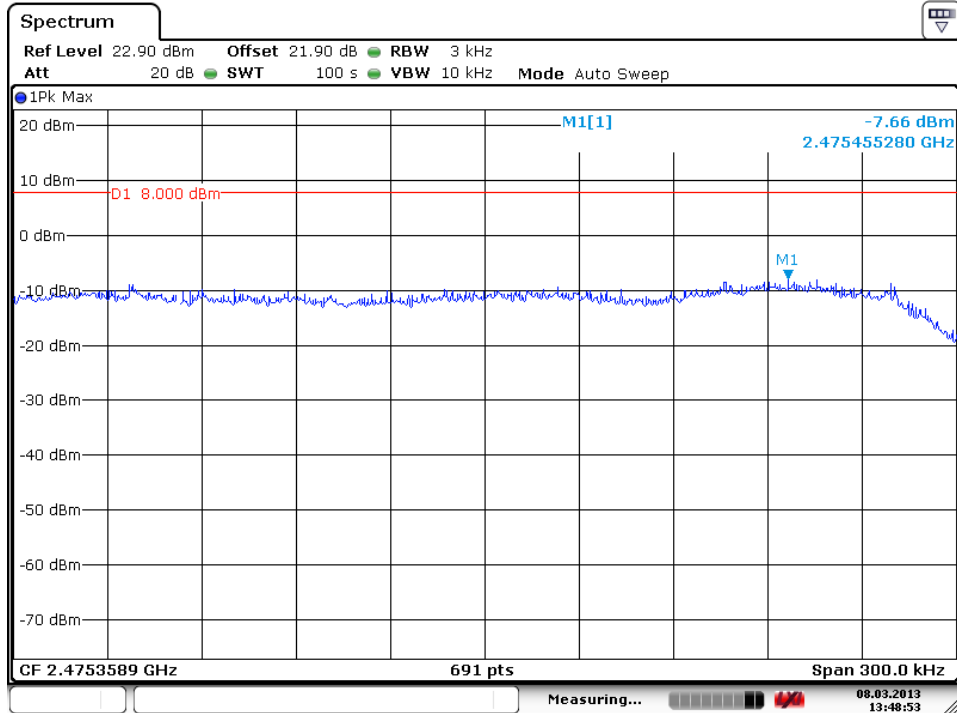
Date: 8.MAR.2013 13:40:44

Middle Channel



Date: 8.MAR.2013 13:46:17

High Channel 2475



Date: 8.MAR.2013 13:48:54

5.1.5 Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth

RESULT:**Passed**

Test standard	:	FCC part 15.247(d)
Basic standard	:	ANSI C63.10:2009, KDB558074
Limit	:	20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power)
Kind of test site	:	Shielded room

Test setup

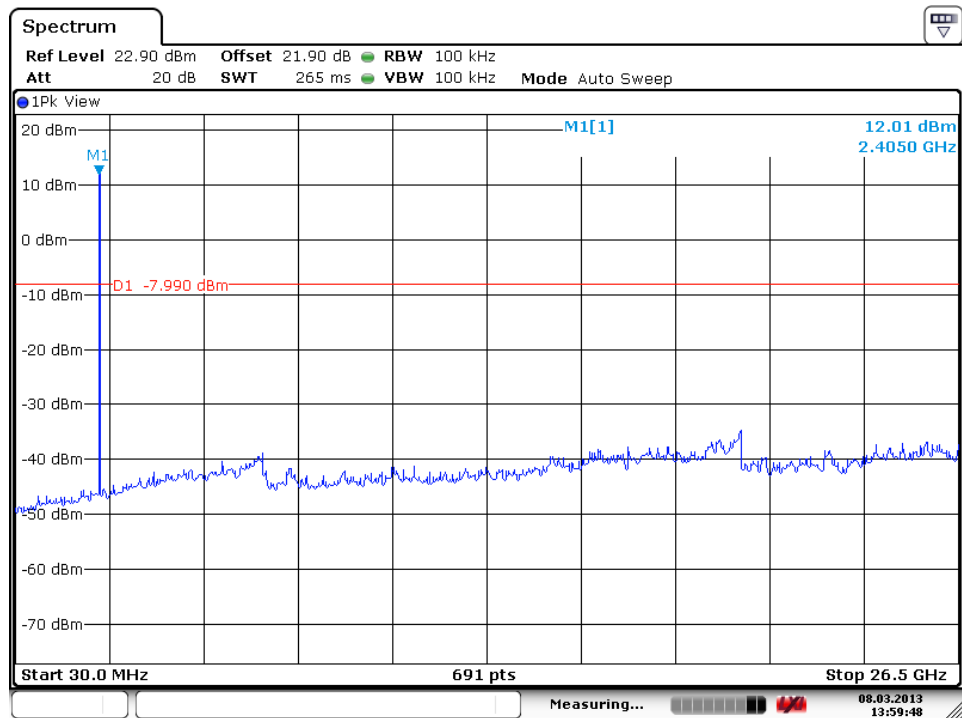
Test Channel	:	Low/ High
Operation mode	:	A
Ambient temperature	:	20-24 °C
Relative humidity	:	50-65 %
Atmospheric pressure	:	100-103 kPa

All emissions are more than 20dB below fundamental, details refer to following test plot, and compliance is achieved as well.

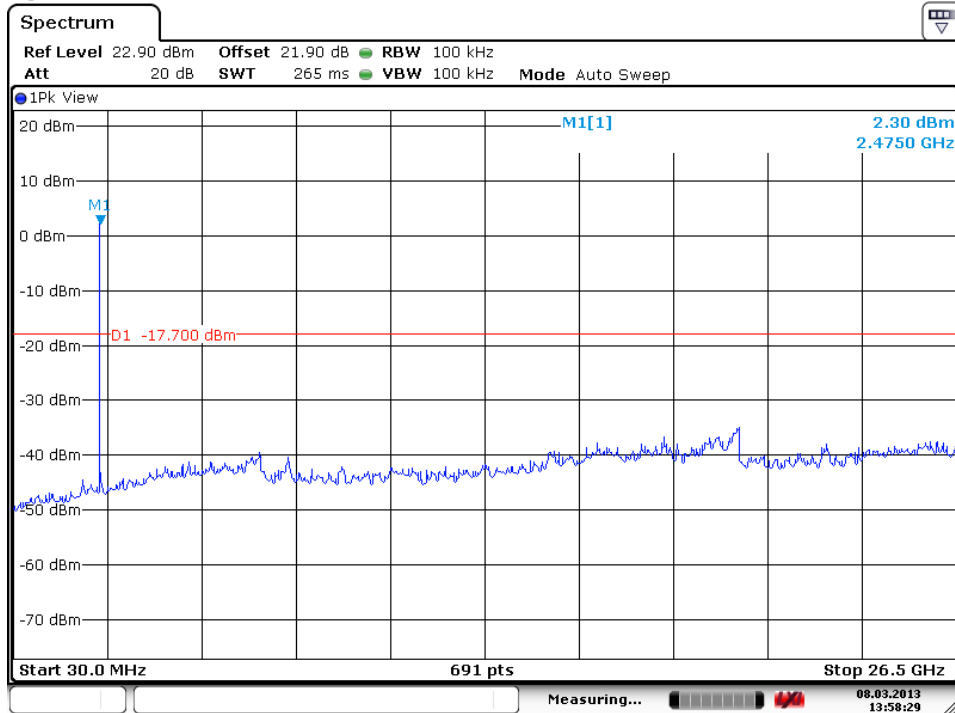
Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.

Test Plot of 100kHz Conducted Emissions

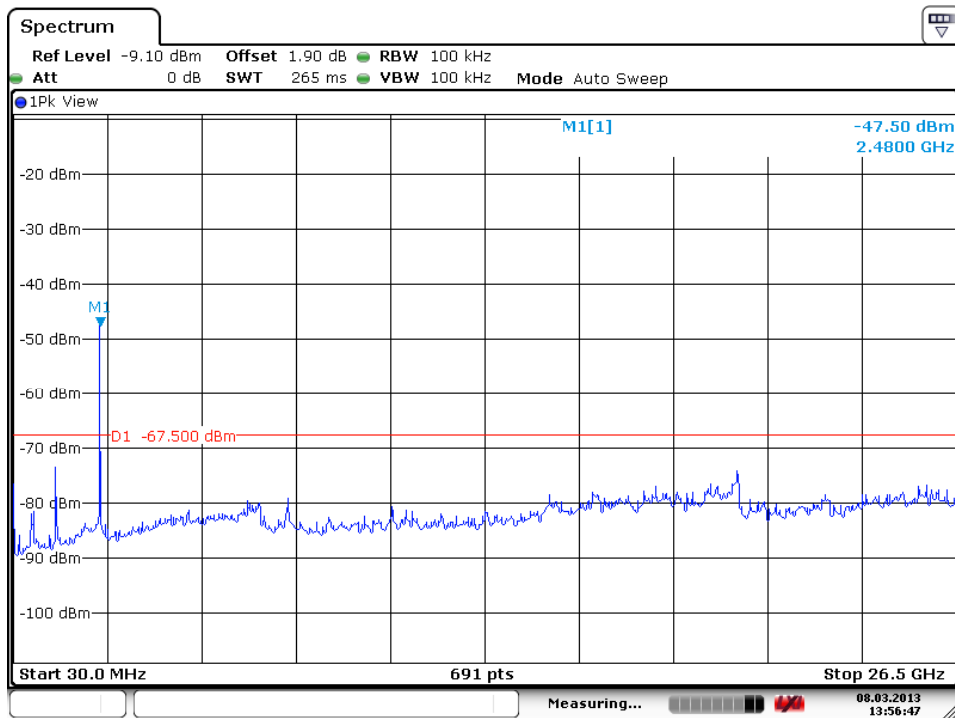
Low Channel



Date: 8.MAR.2013 13:59:49

High Channel (2475/2480)


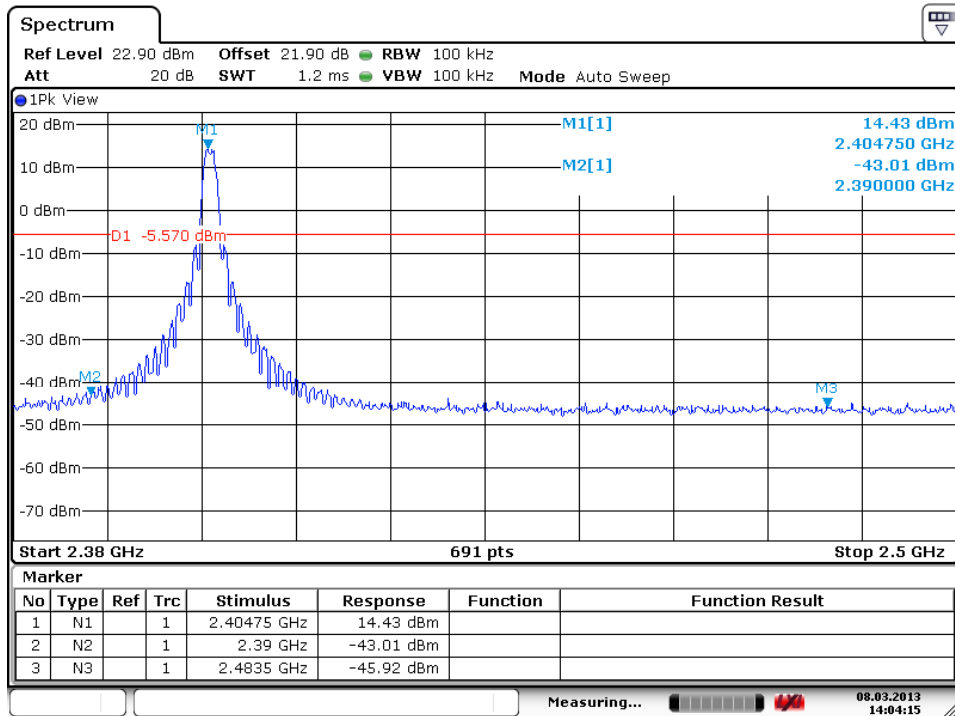
Date: 8.MAR.2013 13:58:30



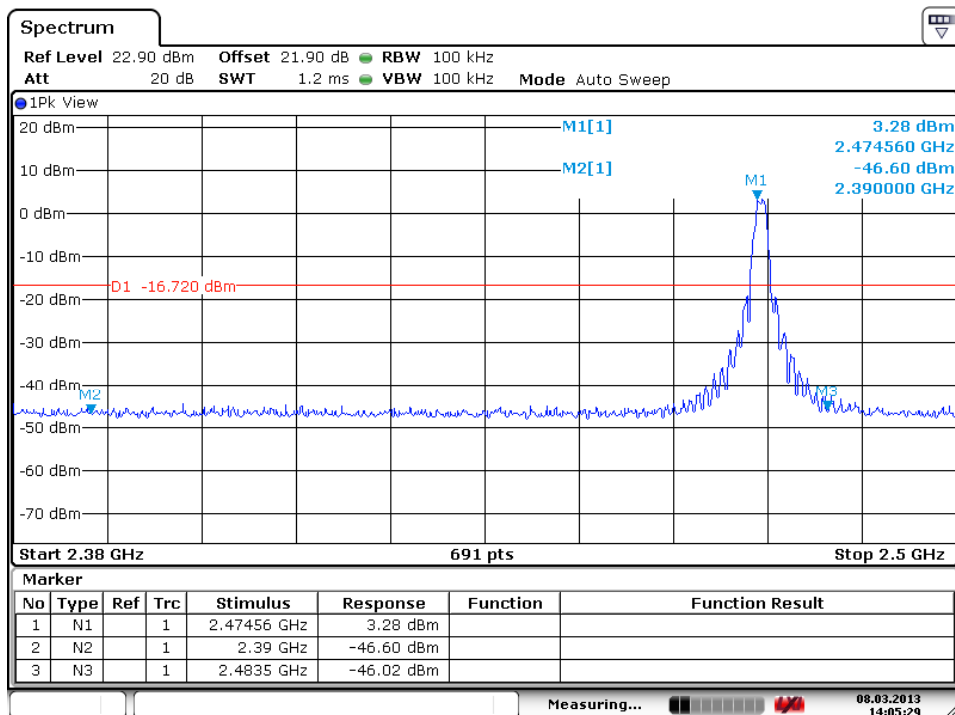
Date: 8.MAR.2013 13:56:47

Test Plot of 100kHz Bandwidth of Frequency Band Edge

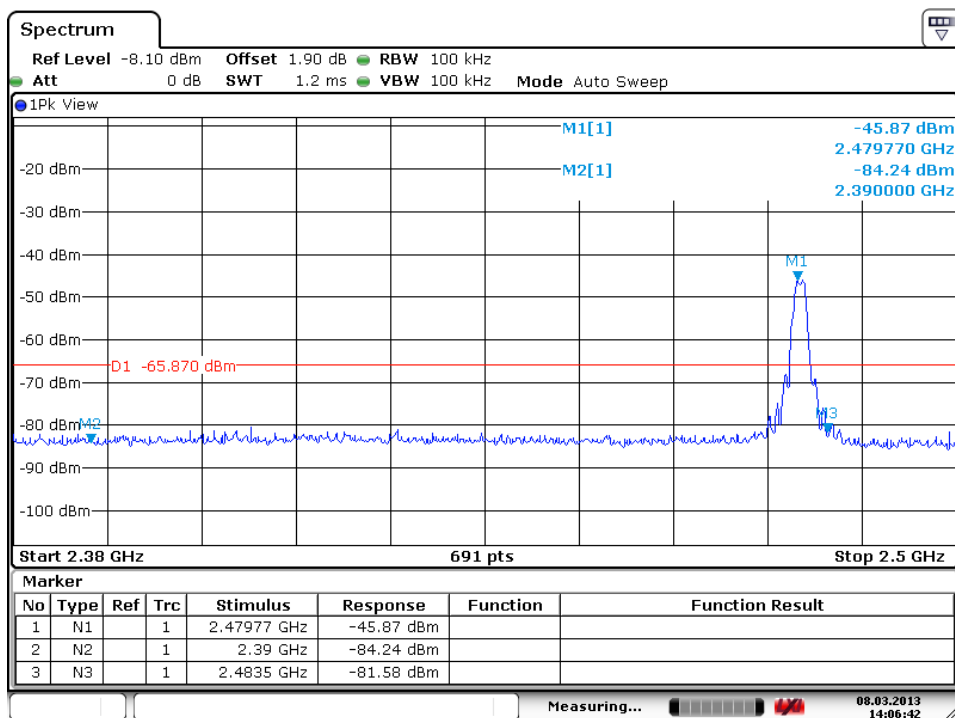
Low Channel



Date: 8.MAR.2013 14:04:16

High Channel (2475/2480)


Date: 8.MAR.2013 14:05:28



Date: 8.MAR.2013 14:06:43

5.1.6 Spurious Emission

RESULT:**Passed**

Test standard	:	FCC part 15.247(d), FCC 15.205, FCC 15.209
Basic standard	:	ANSI C63.10: 2009
Limits	:	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). Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in FCC 15.209(a) and FCC 15.249(a).
Kind of test site	:	3m Semi-Anechoic Chamber

Test setup

Test Channel	:	Low/ Middle/ High
Operation mode	:	A, C

Remark: Testing was carried out within frequency range 30MHz to the tenth harmonic.

For details refer to Appendix D.

The Radiated Emissions testing was performed in the X, Y and Z axis orientation. The X Axis orientation is the worst-case and recorded in this test report. Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.

6. Safety Human exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:**Passed**

Test standard : FCC KDB Publication 447498

The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The gain of the antennas used in the product is extracted from the Antenna data sheets provided and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

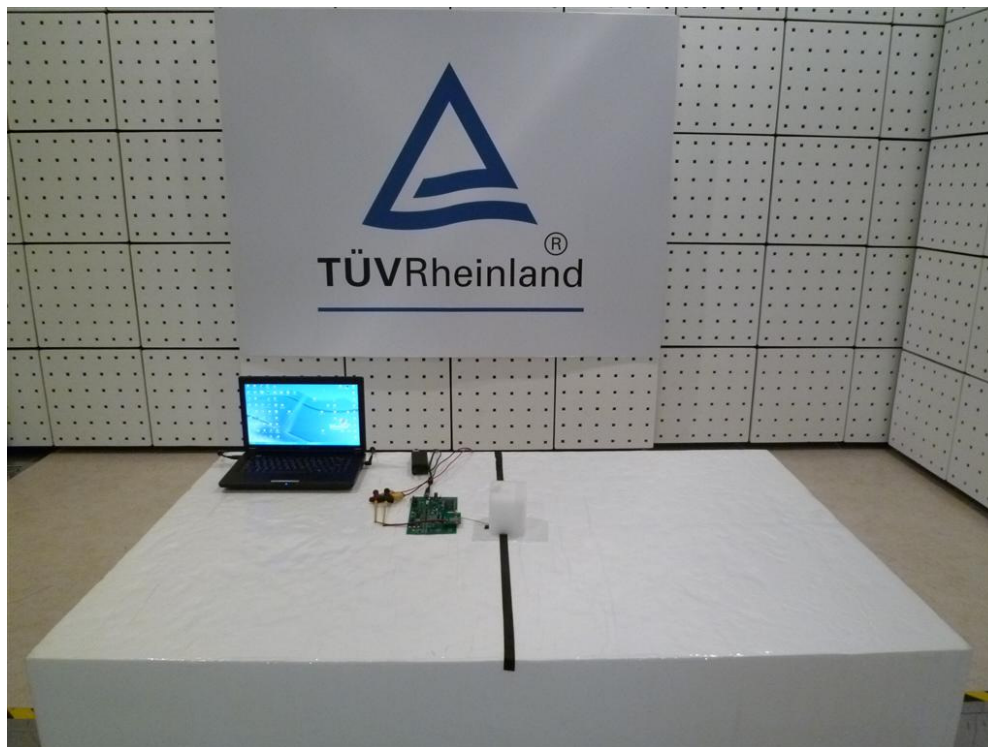
Frequency Band: 2400-2483.5 MHz

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

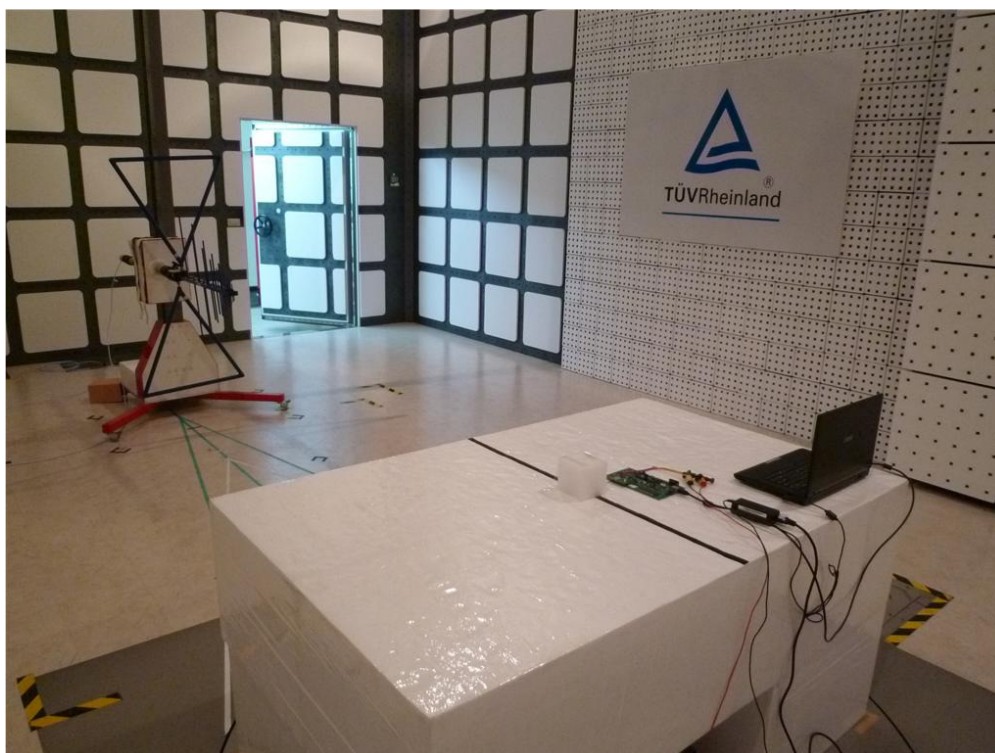
Max Power to Antenna (mW)	Antenna Gain (dBi)	Antenna Gain (numeric)	Power Density at 20cm (mW/cm ²)	Limit (mW/cm ²)	Result
59	2.4	1.738	0.020	1	Pass

7. Photographs of the Test Set-Up

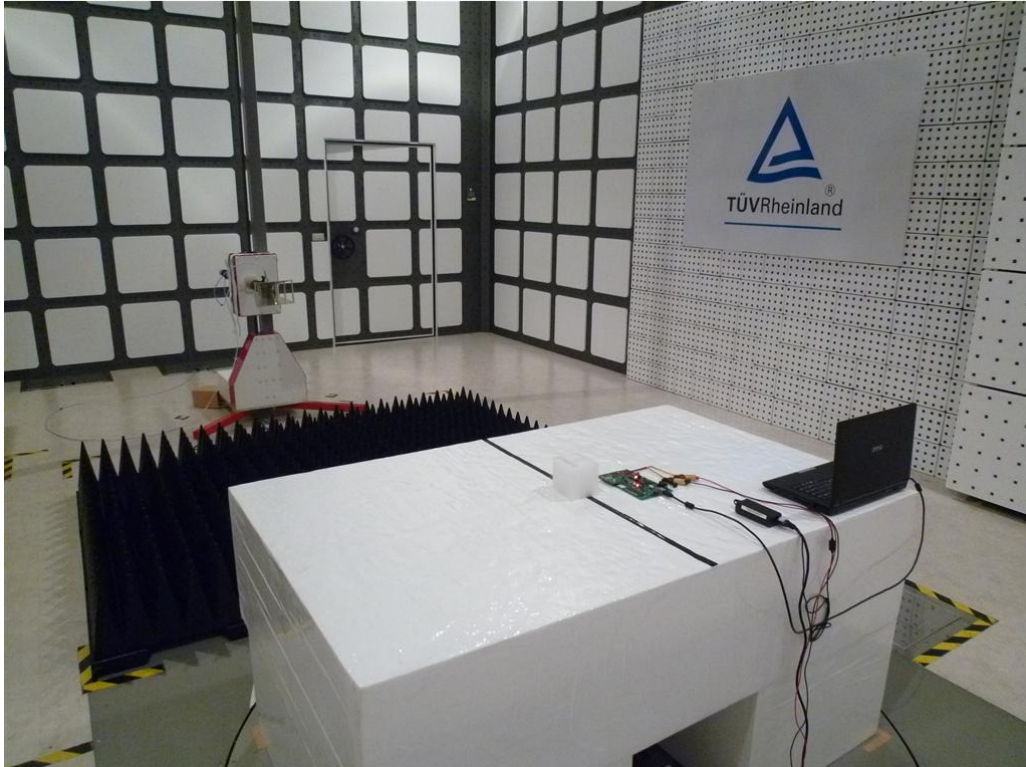
Photograph 1: Set-up for Spurious Emissions (Front View)



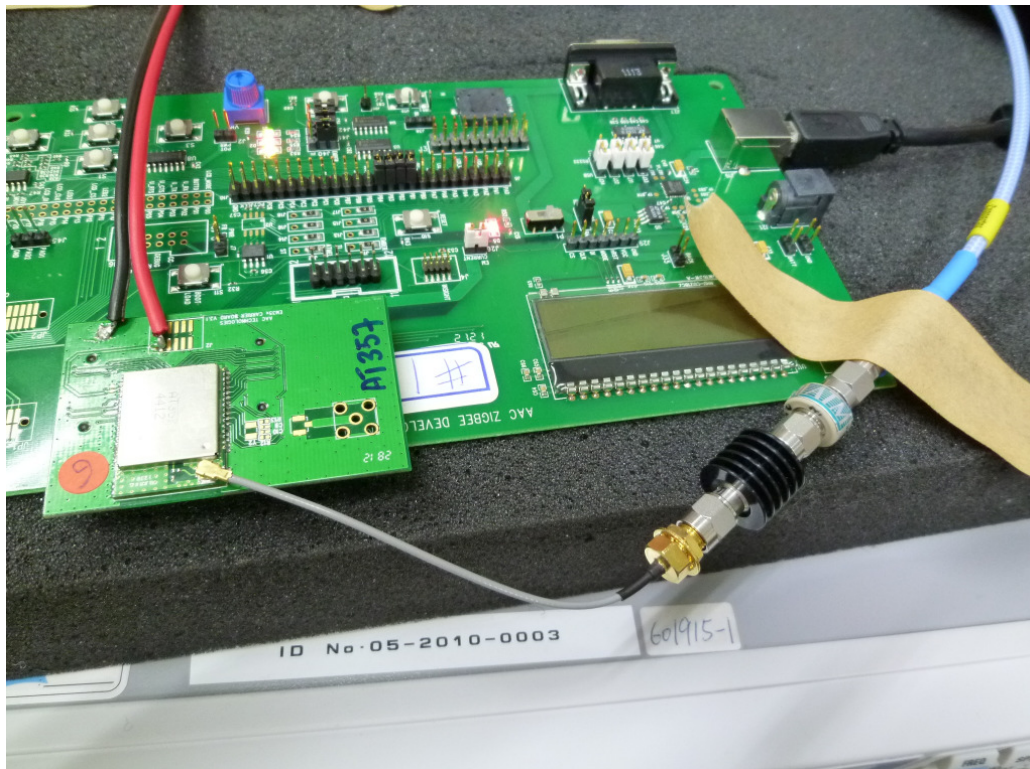
Photograph 2: Set-up for Spurious Emissions (Back View 1)



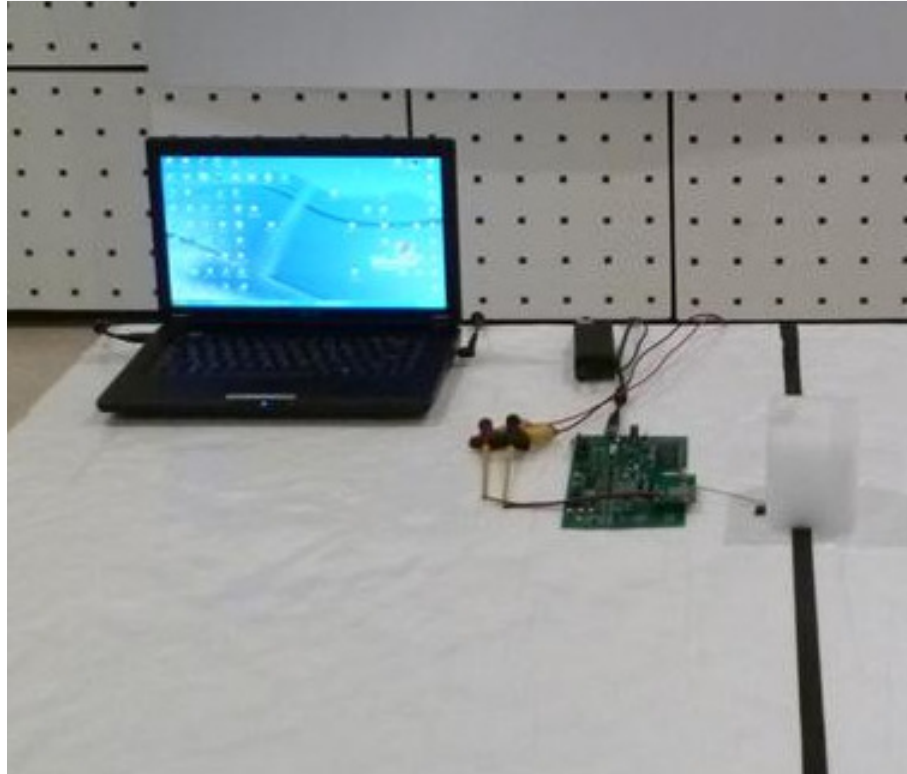
Photograph 3: Set-up for Spurious Emissions (Back View 2)



Photograph 4: Set-up for Conducted testing



Photograph 5: Set-up for Radiated testing of Module



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