InterLab®

FCC Measurement/Technical Report on

Transceiver Module
Smart Controller

FCC ID: YQVHHH002
IC CN: 9199A-HHH002

Report Reference: MDE_HORST_1001_FCCa

Test Laboratory:

DGA-PL-192/99-02

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Note:
The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the testing laboratory.

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0 Summary

0.1 Technical Report Summary

Type of Authorization
Certification for an Intentional Radiator (Digital Transmission Systems DTS).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (10-1-09 Edition) and 15 (10-1-09 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.215 Additional provisions to the general radiated emission limitations.

§ 15.249 Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

Note:
Additionally the following Public Notice was considered:
"Measurement of radiated emissions at the edge of the band for a Part 15 RF Device"
Publication Number KDB913591

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.

0.2 Measurement Summary

FCC Part 15, Subpart C		**§ 15.207**	
Conducted emissions (AC power line)			
The measurement was performed according to ANSI C63.4			2003
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1	Setup_c01	AC Port (power line)	passed *
FCC Part 15, Subpart C		**§ 15.215 (c)**	
Occupied bandwidth			
The measurement was performed according to FCC § 15.31			10-1-09
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1	Setup_a01	Enclosure	passed
op-mode 2	Setup_a01	Enclosure	passed
FCC Part 15, Subpart C		**§ 15.249 (a)**	
Peak power output			
The measurement was performed according to FCC § 15.31			10-1-09
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1	Setup_a01	Enclosure	passed
op-mode 2	Setup_a01	Enclosure	passed
FCC Part 15, Subpart C		**§ 15.249 (a)(d), § 15.35 (b), § 15.209**	
Spurious radiated emissions			
The measurement was performed according to ANSI C63.4			2003
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1	Setup_a01	Enclosure	passed
op-mode 2	Setup_a01	Enclosure	passed
FCC Part 15, Subpart C		**§ 15.249**	
Band edge compliance			
The measurement was performed according to FCC § 15.31 / ANSI C63.4			10-1-09 / 2003
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1	Setup_a01	Enclosure	passed
op-mode 2	Setup_a01	Enclosure	passed

* The module is DC powered, but to show compliance in regards to conducted emissions at AC power line the module was tested with a representative AC/DC adaptor.

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Responsible for Accreditation Scope: _____ Responsible for Test Report: _____

1 Administrative Data

1.1 Testing Laboratory

Company Name:	7 Layers AG
Address	Borsigstr. 11 40880 Ratingen Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716.

The test facility is also accredited by the following accreditation organisation:

- Deutscher Akkreditierungs Rat	DAR-Registration no. DGA-PL-192/99-02
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Thomas Hoell Dipl.-Ing. Andreas Petz
Report Template Version:	2010-09-03

1.2 Project Data

Responsible for testing and report:	Dipl.-Ing. Robert Machulec
Date of Test(s):	2010-08-11 to 2010-09-15
Date of Report:	2010-09-15

1.3 Applicant Data

Company Name:	Dipl.-Ing. H. Horstmann GmbH
Address:	Humboldtstraße 2 D-42579 Heiligenhaus Germany
Contact Person:	Mr. Frank Langenberg

1.4 Manufacturer Data

Company Name:	please see applicant data
Address:	
Contact Person:	

2 Test object Data

2.1 General EUT Description

Equipment under Test:	Transceiver Module
Type Designation:	Smart Controller
Kind of Device:	
(optional)	
Voltage Type:	DC
Voltage level:	5 V

General product description:

The Transceiver is operating in the 2.4 GHz ISM band at carrier frequencies 2400.5 and 2482.5 MHz. Modulation: MSK, Data Rate: 250 kbps

Specific product description for the EUT:

The Smart Controller is designed as a printed circuit board that integrates into a host application. The interface between both consists of a power supply and a serial port. The Smart Controller communicates over a bidirectional short-range radio link with up to 12 Smart Navigators (overhead fault circuit indicators). The Smart Navigators transmit measurement and status data to the Smart Controller in the event of an overhead line fault or within pre-defined periods to the Smart Controller. The Smart Controller temporarily stores this data and communicates it via the serial port to the host application.

The EUT provides the following ports:

Ports
Enclosure
Permanent antenna connector
System connector incl. power supply

The main components of the EUT are listed and described in Chapter 2.2.

2.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A (Code: UN010a01)	Transceiver Module	Smart Controller	-	B	ID266	2010-08-11
Remark: EUT A is equipped with an external antenna (max. gain = 2.5 dBi).						

NOTE: The short description is used to simplify the identification of the EUT in this test report.

2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
					–	–

2.4 Auxiliary Equipment

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
–	–	–	–	–	–	–

2.5 EUT Setups

This chapter describes the combination of EUTs and ancillary equipment used for testing.

Setup No.	Combination of EUTs	Description
Setup_a01	EUT A	setup for radiated measurements
Setup_c01	EUT A + AC charger	setup for ac mains: The module (Smart Controller) is connected via an representative AC/DC adapter to AC mains. Details: AC/DC adaptor: Manufacturer: ZTE Model: STC-A22O50U8-A S/N: 100810110888893

2.6 Operating Modes

This chapter describes the operating modes of the EUTs used for testing.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1	TX/RX-mode, the EUT transmits and receives on the lowest channel (2400.5 MHz).	TX/RX Ratio 3:1.
op-mode 2	TX/RX-mode, the EUT transmits and receives on the highest channel (2482.5 MHz).	TX/RX Ratio 3:1.

2.7 Product labelling

2.7.1 FCC ID label

Please refer to the documentation of the applicant.

2.7.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

3 Test Results

3.1 Conducted emissions (AC power line)

Standard FCC Part 15, 10-1-09 Edition Subpart C

The test was performed according to: ANSI C 63.4, 2003

3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50µH || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.

The measurement procedure consists of two steps. It is implemented into the EMI test software ES-K1 from R&S.

Step 1: Preliminary scan
Intention of this step is, to determine the conducted EMI-profile of the EUT.
EMI receiver settings:
- Detector: Peak - Maxhold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF–Bandwidth: 9 kHz
- Measuring time / Frequency step: 20 ms
- Measurement on phase + neutral lines of the power cords

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2: Final measurement
Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.
EMI receiver settings:
- Detector: Quasi-Peak
- IF - Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:
1) Neutral lead - reference ground (PE grounded)
2) Phase lead - reference ground (PE grounded)
3) Neutral lead - reference ground (PE floating)
4) Phase lead - reference ground (PE floating)

The highest value is reported.

3.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

Frequency Range (MHz)	QP Limit (dBµV)	AV Limit (dBµV)
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

Used conversion factor: Limit (dBµV) = 20 log (Limit (µV)/1µV).

3.1.3 Test Protocol

Temperature: 28 °C
Air Pressure: 1006 hPa
Humidity: 38 %

Op. Mode	Setup	Port
op-mode 1	Setup_c01	AC Port (power line)

Power line	Frequency MHz	Measured value dBµV	Delta to limit dBµV	Remarks
L1	0.360	48.00	9.9	QP detector
L1	0.505	44.80	10.0	QP detector
N	0.820	39.20	10.1	QP detector
L1	1.610	41.20	10.0	QP detector
L1	2.750	38.50	10.1	QP detector
L1	0.370	39.20	9.9	AV detector

Remark: Please see annex for the measurement plot.

3.1.4 Test result: Conducted emissions (AC power line)

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed

3.2 Occupied bandwidth

Standard FCC Part 15, Subpart C
The test was performed according to: FCC §15.31

3.2.1 Test Description

The Equipment Under Test (EUT) was setup in a shielded room to perform the occupied bandwidth measurements.
The results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth.
The EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:
- Resolution Bandwidth (RBW): 50 kHz
- Video Bandwidth (VBW): 50 kHz
- Span: 2 MHz

3.2.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.215 (c)
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. …

3.2.3 Test Protocol

Temperature: 26 °C
Air Pressure: 1008 hPa
Humidity: 38 %

Op. Mode	Setup	Port
op-mode 1	Setup_a01	Enclosure

20 dB bandwidth MHz	Remarks
0.782	The 99% bandwidth is 770 MHz

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 2	Setup_a01	Enclosure

20 dB bandwidth MHz	Remarks
0.792	The 99% bandwidth is 798 MHz

Remark: Please see annex for the measurement plot.

3.2.4 Test result: Occupied bandwidth

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed

3.3 Peak power output

Standard FCC Part 15, Subpart C
The test was performed according to: FCC §15.31

3.3.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the anechoic chamber. The measurement distance was reduced to 1 m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements, inverse linear-distance squared for the power reference level measurements).

3.3.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.249 (a)
Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/ meter)	Field strength of fundamental (dBµV/m)
2400-2483.5 MHz	50	94

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

3.3.3 Test Protocol

Temperature: 26 °C
Air Pressure: 1015 hPa
Humidity: 42 %

Op. Mode	Setup	Port
op-mode 1	Setup_a01	Enclosure

Output power PK dBµV/m	Output power AV dBµV/m	Remarks
91.30	77.09	-

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 2	Setup_a01	Enclosure

Output power PK dBµV/m	Output power AV dBµV/m	Remarks
93.34	79.13	-

Remark: Please see annex for the measurement plot.

3.3.4 Test result: Peak power output

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed

3.4 Spurious radiated emissions

Standard FCC Part 15, Subpart C
The test was performed according to: ANSI C 63.4, 2003

3.4.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna.
The radiated emissions measurements were made in a typical installation configuration.
The measurement procedure is implemented into the EMI test software ES-K1 from R&S.

1. Measurement up to 30 MHz
The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.
The radiated emissions measurements were made in a typical installation configuration.
The measurement procedure is implemented into the EMI test software ES-K1 from R&S.
The Loop antenna HFH2-Z2 is used.
Step 1: pre-measurement
- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 - 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF–Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.
Step 2: final measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.
- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 200 Hz - 10 kHz
- Measuring time / Frequency step: 100 ms

2. Measurement above 30 MHz and up to 1 GHz
Step 1: Preliminary scan
Preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 µs
- Turntable angle range: –180 to 180°
- Turntable step size: 90°
- Height variation range: 1 – 3 m

- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: second measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: –180 to 180°
- Turntable step size: 45°
- Height variation range: 1 – 4 m
- Height variation step size: 0.5 m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):

- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:

- Azimuth value (of turntable): 45°
- Antenna height: 0.5 m

Step 3: final measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will be slowly varied by +/- 22.5° around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by +/- 25 cm around the antenna height determined. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: –22.5° to + 22.5 ° around the determined value
- Height variation range: –0.25 m to + 0.2 5m around the determined value

Step 4: final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

3. Measurement above 1 GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:
The measurement distance was reduced to 1 m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements, inverse linear-distance squared for the power reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18-25 GHz) are used, the steps 2-4 are omitted. Step 1 was performed with one height of the receiving antenna only.
EMI receiver settings:
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.
For mode b or g the test is performed as worst-case-check in order to verify that emissions have a comparable level as found at the other data rate. Typically, the measurement for this mode is performed in the frequency range 1 to 8 GHz but it depends on the emissions found during the test for the other data rate. Please refer to the results for the used frequency range.

4. Verification of band edge emissions

In making radiated band edge measurements, there can be a problem obtaining meaningful data since a measurement instrument that is tuned to a band edge frequency may also capture some in-band signals when using the resolution bandwidth (RBW) as specified by measurement procedure ANSI C63.4-1992, unless precautions are followed.

In this case the technique described in the public notice "Measurement of radiated emissions at the edge of the band for a Part 15 RF Device" Publication Number KDB913591 was used.

3.4.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.249 (a) (d)

Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of harmonics (microvolts/ meter)	Field strength of harmonics (dBµV/m)
2400-2483.5 MHz	500	54

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

3.4.3 Test Protocol

Temperature: 24 °C
Air Pressure: 1011 hPa
Humidity: 36 %

3.4.3.1 Measurement up to 30 MHz

Op. Mode	Setup	Port
op-mode 1	Setup_a01	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
0°	-	-	-	-	-	-	-	-	-
90°	-	-	-	-	-	-	-	-	-

Remark: No relevant spurious emissions in the range 20 dB below the limit found therefore step 2 was not performed.

3.4.3.2 Measurement above 30 MHz

Op. Mode	Setup	Port
op-mode 1	Setup_a01	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Vertical + horizontal	4801		51.17	46.81		74	54	22.83	7.19
Vertical + horizontal	9602		48.50	34.91		74	54	25.50	19.09

Remark: No (further) spurious emissions in the range 20 dB below the limit found.
The measurements were performed up to 26 GHz.

Op. Mode	Setup	Port
op-mode 2	Setup_a01	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Vertical + horizontal	4965		52.65	47.57		74	54	21.35	6.43
Vertical + horizontal	7448		54.45	39.12		74	54	19.55	14.88

Remark: No (further) spurious emissions in the range 20 dB below the limit found.
The measurements were performed up to 26 GHz.

3.4.3.3 Verification of band edge emissions

Radiated measurement (Marker-Delta Method)

Lower band edge

Temperature: 27 °C
Air Pressure: 996 hPa
Humidity: 46 %

Op. Mode	Setup	Port
op-mode 1	Setup_a01	Enclosure

Marker-Delta Method Step 1: Fundamental emission level radiated in dBµV/m (RBW = 1 MHz)		Marker-Delta Method Step 2: Delta between fundamental and max. band-edge emission in the range 2483.5 to 2485.5 MHz in dBµV/m (RBW = 50 kHz)
Peak	AV	Peak
91.30	77.09	23.92

Step 1 and Step 2

Frequency MHz	Polarisation	Corrected value dBµV/m		Limit Peak dBµV/m	Limit AV dBµV/m	Delta to Peak limit/dB	Delta to AV limit dB
		Peak	AV				
2400	Vertical + horizontal	67.38	53.17	74	54	6.62	0.83

Step 3: Corrected value of max. band-edge emission in the range 2483.5 to 2485.5 MHz.
Corrected value = Fundamental emission (step1) – Delta emission (step2)

Frequency MHz	Polarisation	Corrected value dBµV/m		Limit Peak dBµV/m	Limit AV dBµV/m	Delta to Peak limit/dB	Delta to AV limit dB
		Peak	AV				
2400.5-2 = 2398.5	Vertical + horizontal	68.09	33.29	74	54	5.91	20.71

Step 4: Radiated emissions at 2 MHz from the band-edge

Remark: Please see annex for the measurement plot.

Higher band edge

Temperature: 27 °C
Air Pressure: 996 hPa
Humidity: 46 %

Op. Mode	Setup	Port
op-mode 2	Setup_a01	Enclosure

Marker-Delta Method Step 1: Fundamental emission level radiated in dBµV/m (RBW = 1 MHz)		Marker-Delta Method Step 2: Delta between fundamental and max. band-edge emission in the range 2483.5 to 2485.5 MHz in dBµV/m (RBW = 50 kHz)
Peak	AV	Peak
93.34	79.13	33.14

Step 1 and Step 2

Frequency MHz	Polarisation	Corrected value dBµV/m		Limit Peak dBµV/m	Limit AV dBµV/m	Delta to Peak limit/dB	Delta to AV limit dB
		Peak	AV				
2483.56	Vertical + horizontal	60.20	45.99	74	54	13.80	8.01

Step 3: Corrected value of max. band-edge emission in the range 2483.5 to 2485.5 MHz.
Corrected value = Fundamental emission (step1) – Delta emission (step2)

Frequency MHz	Polarisation	Corrected value dBµV/m		Limit Peak dBµV/m	Limit AV dBµV/m	Delta to Peak limit/dB	Delta to AV limit dB
		Peak	AV				
2483.5+2 = 2485.5	Vertical + horizontal	70.08	35.89	74	54	3.92	18.11

Step 4: Radiated emissions at 2 MHz from the band-edge

Remark: Please see annex for the measurement plot.

3.4.4 Test result: Spurious radiated emissions

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed

4 Test Equipment

The calibration, hardware and software states are shown for the testing period.

Test Equipment Anechoic Chamber

Lab ID:	**Lab 2**		
Manufacturer:	Frankonia		
Description:	Anechoic Chamber for radiated testing		
Type:	10.58x6.38x6		
	IC renewal	2009/01/21	2011/01/20
	FCC renewal	2009/01/07	2011/01/06

Single Devices for Anechoic Chamber

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Air compressor	none	-	Atlas Copco	
Anechoic Chamber	10.58 x 6.38 x 6	none	Frankonia	
	Calibration Details		*Last Execution*	*Next Exec.*
	FCC listing 96716 3m Part15/18		2009/01/07	2011/01/06
	ANSI C64.3 NSA		2009/01/21	2011/01/20
Controller Innco 2000	CO 2000	CO2000/328/12470 406/L	Innco innovative constructions GmbH	
EMC camera	CE-CAM/1	-	CE-SYS	
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi	
Filter ISDN	B84312-C110-E1		Siemens&Matsushita	
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita	

Test Equipment Auxiliary Equipment for Conducted emissions

Lab ID:	**Lab 1**
Manufacturer:	Rohde & Schwarz GmbH & Co.KG
Description:	EMI Conducted Auxiliary Equipment

Single Devices for Auxiliary Equipment for Conducted emissions

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber&Suhner	
Coupling-Decoupling-Network	CDN ENY41	100002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2008/03/06	2011/03/05
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG	
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	DKD calibration		2008/10/13	2011/10/12

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID:	**Lab 2**
Description:	Equipment for emission measurements
Serial Number:	see single devices

Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Antenna mast	AS 620 P		HD GmbH	
Biconical dipole	VUBA 9117	9117108	Schwarzbeck	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2008/10/27	2013/10/26
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq	
	Path Calibration		2010/05/10	2010/11/09
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq	
	Path Calibration		2010/05/10	2010/11/09
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq	
	Path Calibration		2010/05/10	2010/11/09
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01-2	Kabel Kusch	
	Path Calibration		2010/05/10	2010/11/09
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02-2	Rosenberger Micro-Coax	
	Path Calibration		2010/05/10	2010/11/09
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2009/04/16	2012/04/15
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2009/04/28	2012/04/27
Dreheinheit	DE 325		HD GmbH	
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic	
	Path Calibration		2010/05/10	2010/11/09
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic	
	Path Calibration		2010/05/10	2010/11/09
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic	
	Path Calibration		2010/05/10	2010/11/09
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2009/05/27	2012/05/26
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	DKD calibration		2008/10/07	2011/10/06
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH	
Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH	

Test Equipment Auxiliary Test Equipment

Lab ID:	**Lab 2**
Manufacturer:	see single devices
Description:	Single Devices for various Test Equipment
Type:	various
Serial Number:	none

Single Devices for Auxiliary Test Equipment

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates
Digital Multimeter 01 (Multimeter)	Voltcraft M-3860M	IJ096055	Conrad Electronics
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
	Standard calibration		2009/10/07 2011/10/06
Digital Oscilloscope [SA2] (Aux)	TDS 784C	B021311	Tektronix GmbH
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorenwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	DKD calibration		2008/10/06 2011/10/05
Vector Signal Generator	SMIQ B3	832492/061	

Test Equipment Digital Signalling Devices

Lab ID:	**Lab 1, Lab 2**
Description:	Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Bluetooth Signalling Unit CBT	CBT	100589	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2008/08/14	2011/08/13
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2008/10/07	2010/10/06
Digital Radio Test Set	6103E	2359	Racal Instruments, Ltd.	
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2009/02/16	2012/02/15
	HW/SW Status		*Date of Start*	*Date of End*
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 ---		2007/07/16	
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2008/12/01	2011/11/30
	HW/SW Status		*Date of Start*	*Date of End*
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 ---		2007/01/02	
	SW: K62, K69		2008/11/03	
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2008/10/28	2011/10/27

Test Equipment Emission measurement devices

Lab ID:	**Lab 1, Lab 2**
Description:	Equipment for emission measurements
Serial Number:	see single devices

Single Devices for Emission measurement devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Personal Computer	Dell	30304832059	Dell	
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2007/12/05	2010/12/04
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG	
	Standard Calibration		2009/12/03	2011/12/02

Test Equipment Multimeter 12

Lab ID:	**Lab 3, Lab 4**
Description:	Ex-Tech 520
Serial Number:	05157876

Single Devices for Multimeter 12

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Digital Multimeter 12 (Multimeter)	EX520	05157876	Extech Instruments Corp.	
	Standard calibration		2009/10/07	2010/10/06
	Standard calibration		2009/10/07	2011/10/06

Test Equipment Regulatory Bluetooth RF Test Solution

Lab ID:	**Lab 3**
Description:	Regulatory Bluetooth RF Tests
Type:	Bluetooth RF
Serial Number:	001

Single Devices for Regulatory Bluetooth RF Test Solution

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
ADU 200 Relay Box 7	Relay Box	A04380	Ontrak Control Systems Inc.	
Bluetooth Signalling Unit CBT	1153.9000.35	100302	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2009/08/06	2010/08/05
	Standard Calibration		2010/06/23	2011/06/22
Power Meter NRVD	857.8008.02	832025/059		
	Standard Calibration		2010/06/21	2011/06/20
Power Sensor NRV Z1 A	828.3018.03	832279/013		
	Standard Calibration		2010/06/22	2011/06/21
Power Supply	NGSM 32/10	2725		
Rubidium Frequency Normal MFS	828.3018.03	002	Datum GmbH	
	Standard Calibration		2010/07/05	2011/07/04
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG	
	Standard Calibration		2009/06/24	2011/06/23
Signal Generator	SMP03	833680/003	Rohde & Schwarz GmbH & Co.KG	
	Standard Calibration		2009/06/23	2012/06/22
Vector Signal Generator SMIQ03B B	1125.5555.03	832870/017		
	Standard Calibration		2010/06/23	2013/06/20

Test Equipment Shielded Room 02

Lab ID:	**Lab 1**
Manufacturer:	Frankonia
Description:	Shielded Room for conducted testing
Type:	12 qm
Serial Number:	none

Test Equipment Shielded Room 07

Lab ID:	**Lab 3, Lab 4**
Description:	Shielded Room 4m x 6m

Test Equipment T/H Logger 04

Lab ID:	**Lab 3, Lab 4**
Description:	Lufft Opus10
Serial Number:	7481

Single Devices for T/H Logger 04

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoHygro Datalogger 04 (Environ)	Opus10 THI (8152.00)	7481	Lufft Mess- und Regeltechnik GmbH

Calibration Details	*Last Execution*	*Next Exec.*
Standard calibration	2009/01/23	2011/01/22

Test Equipment Temperature Chamber 01

Lab ID:	**Lab 3, Lab 4**
Manufacturer:	see single devices
Description:	Temperature Chamber KWP 120/70
Type:	Weiss
Serial Number:	see single devices

Single Devices for Temperature Chamber 01

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Temperature Chamber Weiss 01	KWP 120/70	59226012190010	Weiss Umwelttechnik GmbH
	Specific calibration		2010/03/16 2011/03/15

Test Equipment WLAN RF Test Solution

Lab ID:	**Lab 4**
Manufacturer:	7 layers AG
Description:	Regulatory WLAN RF Tests
Type:	WLAN RF
Serial Number:	001

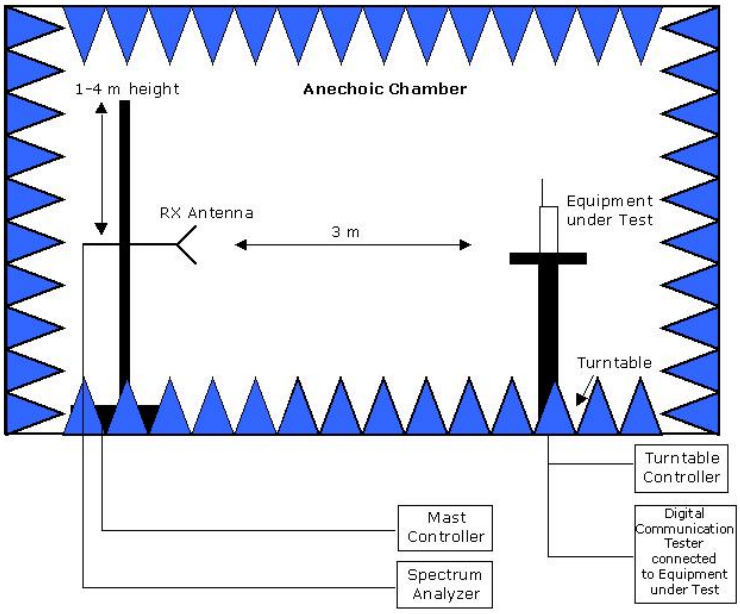
Single Devices for WLAN RF Test Solution

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Arbitrary Waveform Generator	TGA12101	284482		
Power Meter NRVD	857.8008.02	832025/059		
	Standard Calibration		2010/06/21	2011/06/20
Power Sensor NRV Z1 A	828.3018.03	832279/013		
	Standard Calibration		2010/06/22	2011/06/21
Power Supply	NGSM 32/10	2725		
Rubidium Frequency Normal MFS	828.3018.03	002	Datum GmbH	
	Standard Calibration		2010/07/05	2011/07/04
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG	
	Standard Calibration		2009/06/24	2011/06/23
Signal Generator	SMP03	833680/003	Rohde & Schwarz GmbH & Co.KG	
	Standard Calibration		2009/06/23	2012/06/22
TOCT Switching Unit	Switching Unit	030106	7 layers, Inc.	
Vector Signal Generator SMIQ03B B	1125.5555.03	832870/017		
	Standard Calibration		2010/06/23	2013/06/20

5 Photo Report

Please see Annex I: Photo Report

6 Setup Drawings



Remark: Depending on the frequency range suitable antenna types, attenuators or preamplifiers are used.

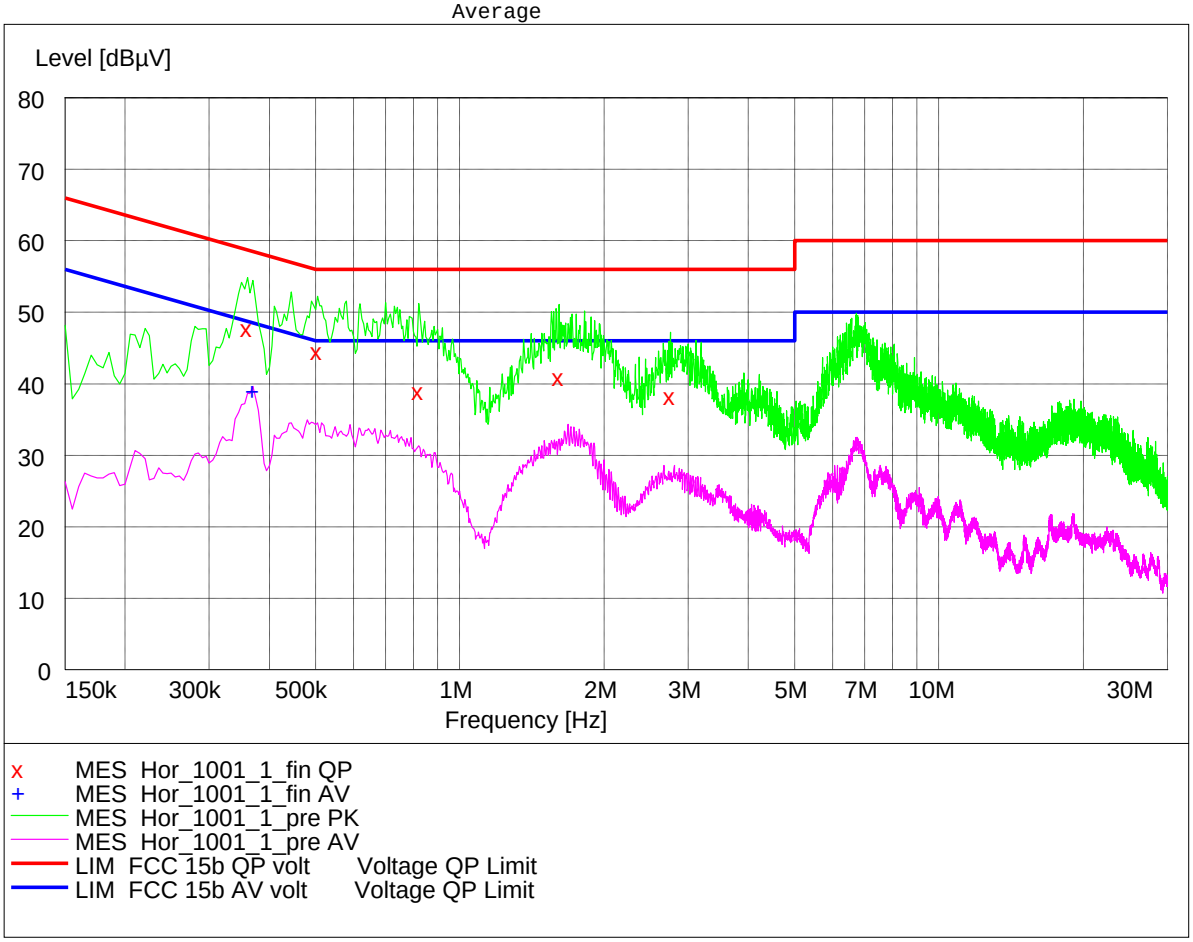
Drawing 1: Setup in the Anechoic chamber:
Measurements below 1 GHz: Semi-anechoic, conducting ground plane.
Measurements above 1 GHz: Fully-anechoic, absorbers on all surfaces

7 Annex measurement plots

7.1 AC Mains conducted

Op. Mode 1

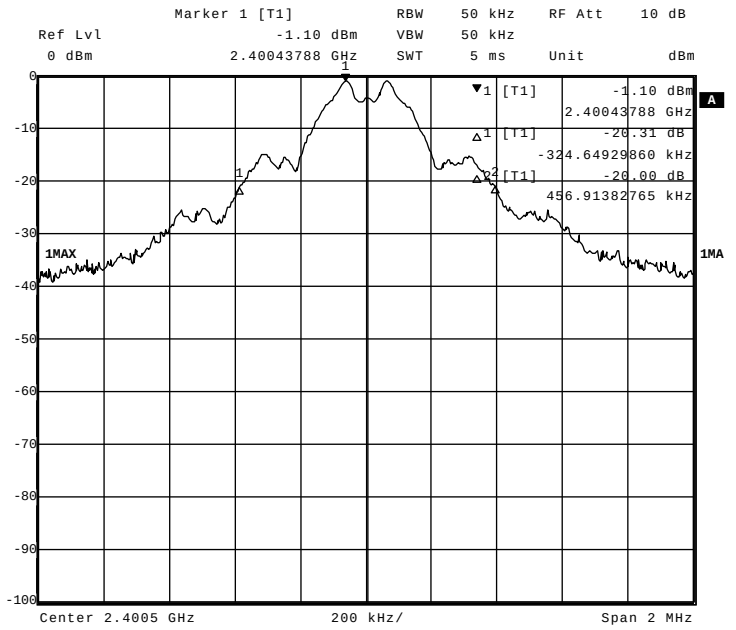
Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak Average	20.0 ms	9 kHz	ESH3-Z5

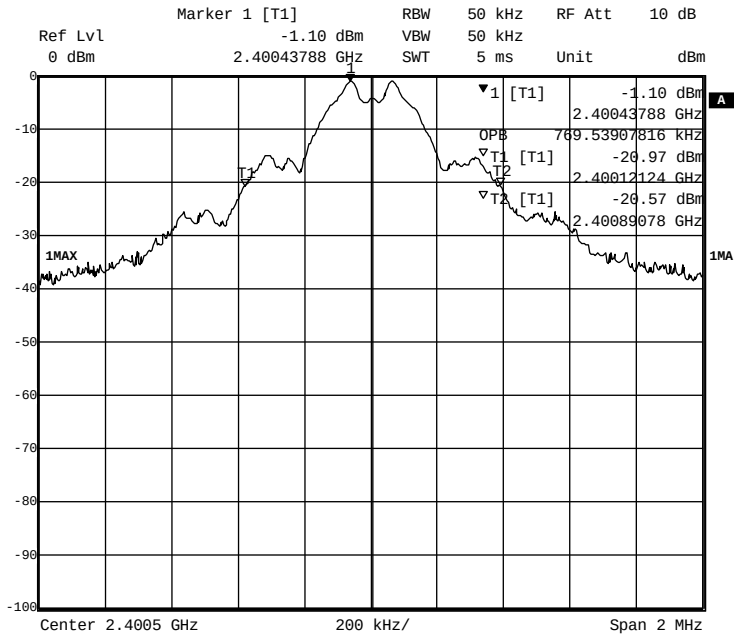


7.2 Occupied bandwidth

7.2.1 Occupied bandwidth operating mode 1

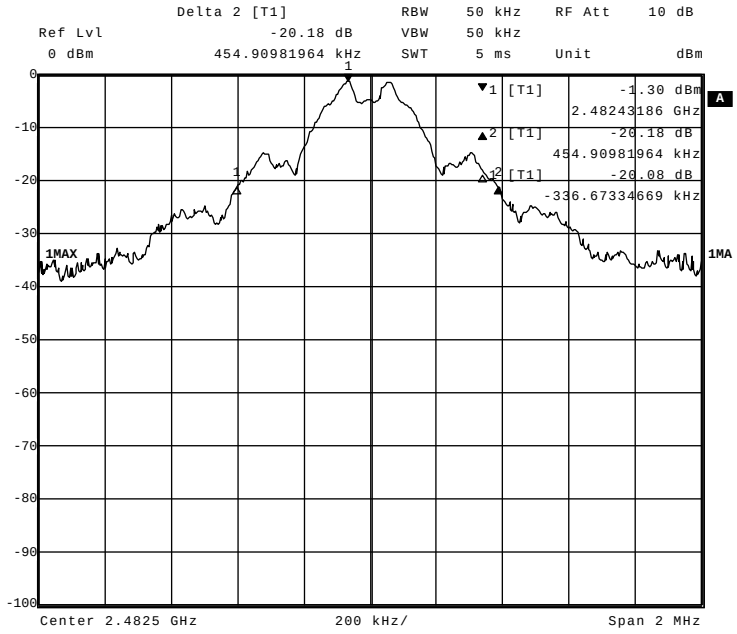
Op. Mode 2

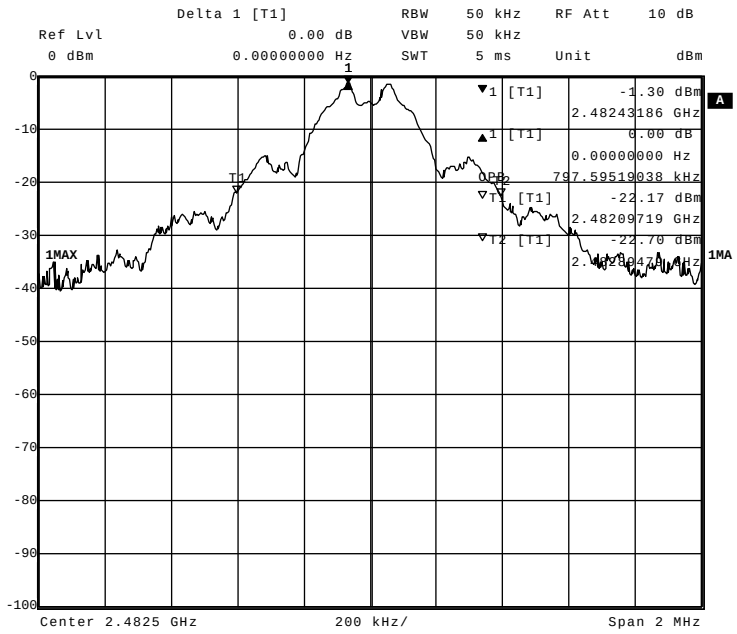




7.2.2 Occupied bandwidth operating mode 2

Op. Mode 2

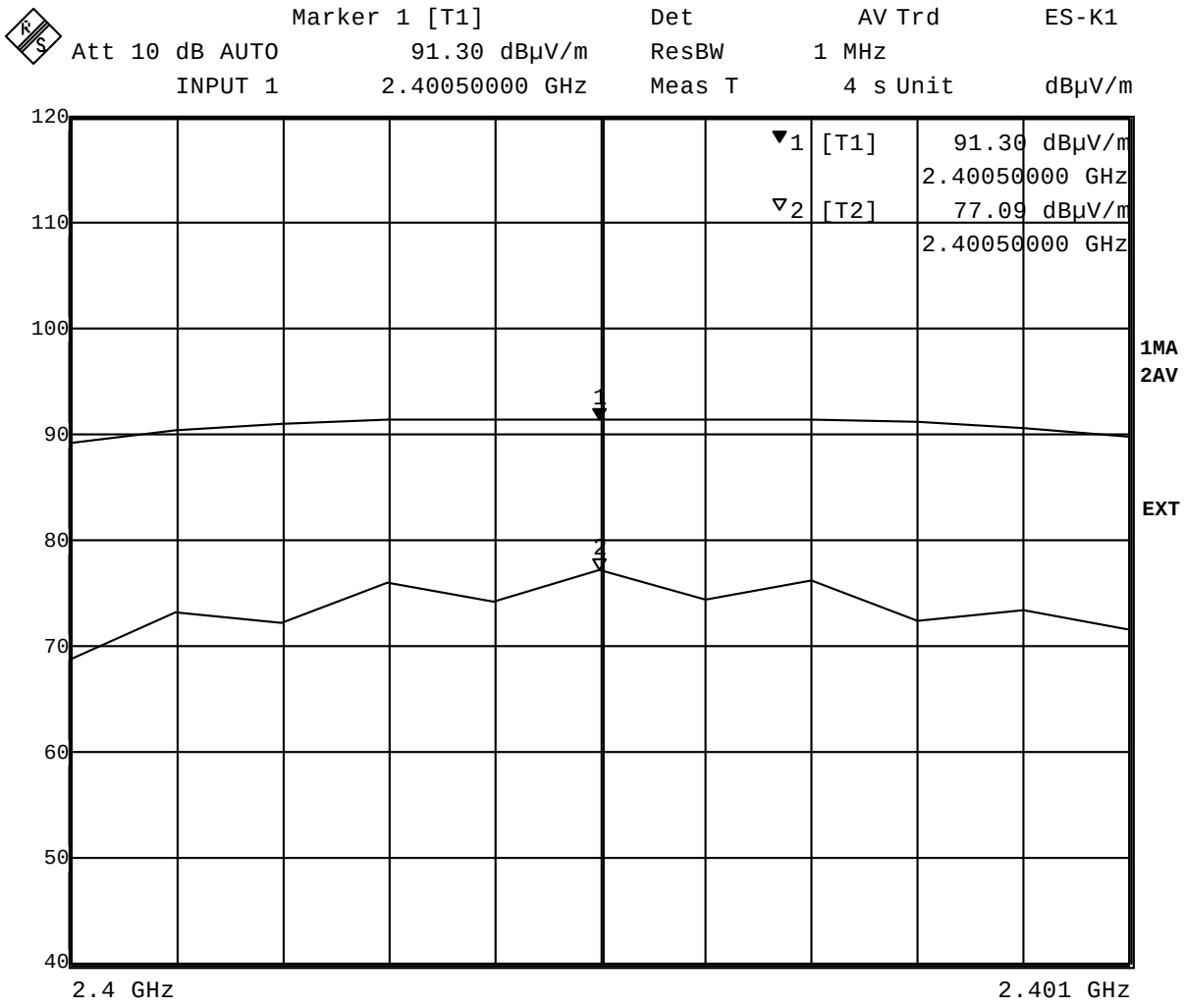




7.3 Peak power output

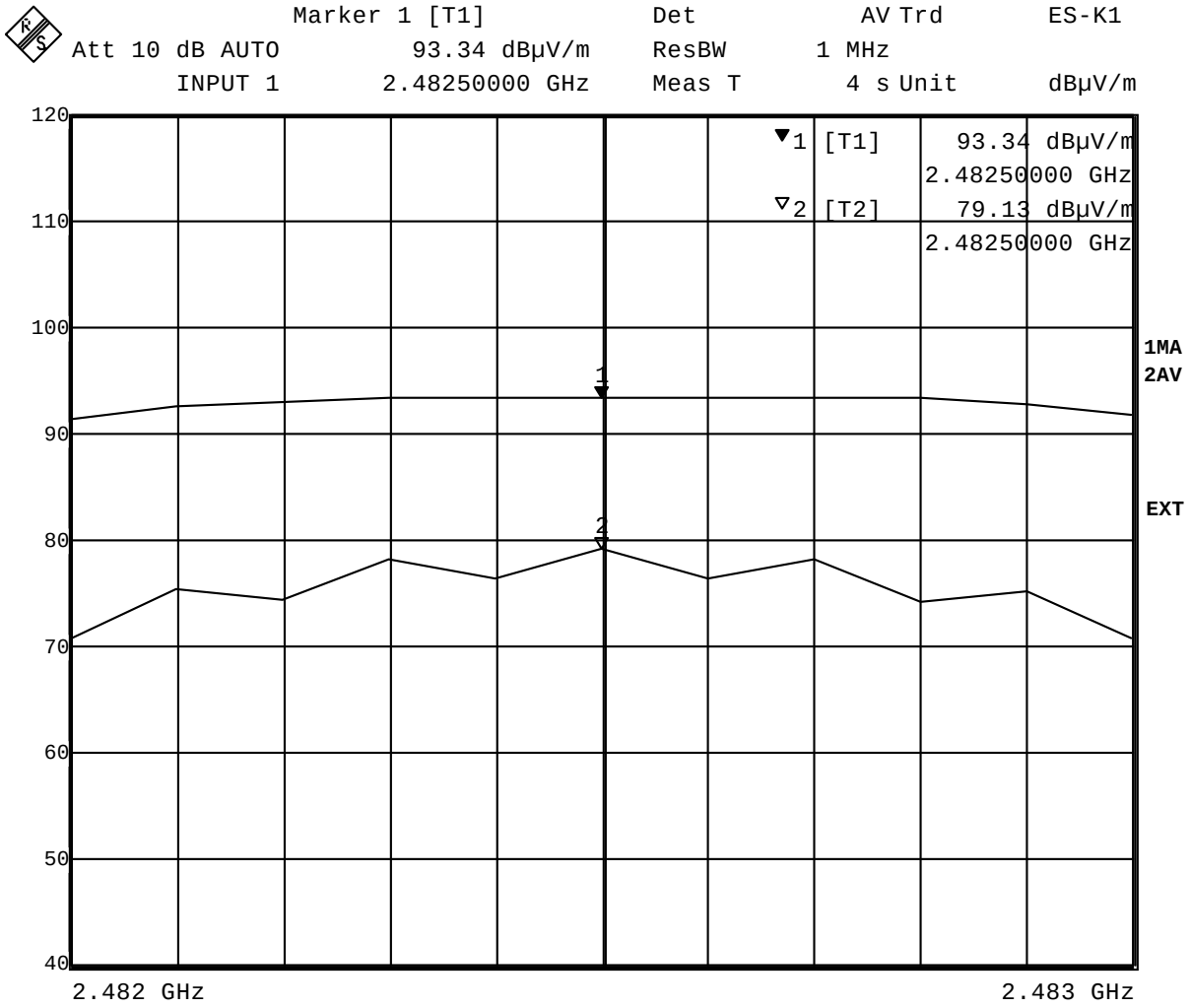
7.3.1 Peak power output operating mode 1

Op. Mode 1 Field strength of fundamental (peak, average)



Peak power output operating mode 2

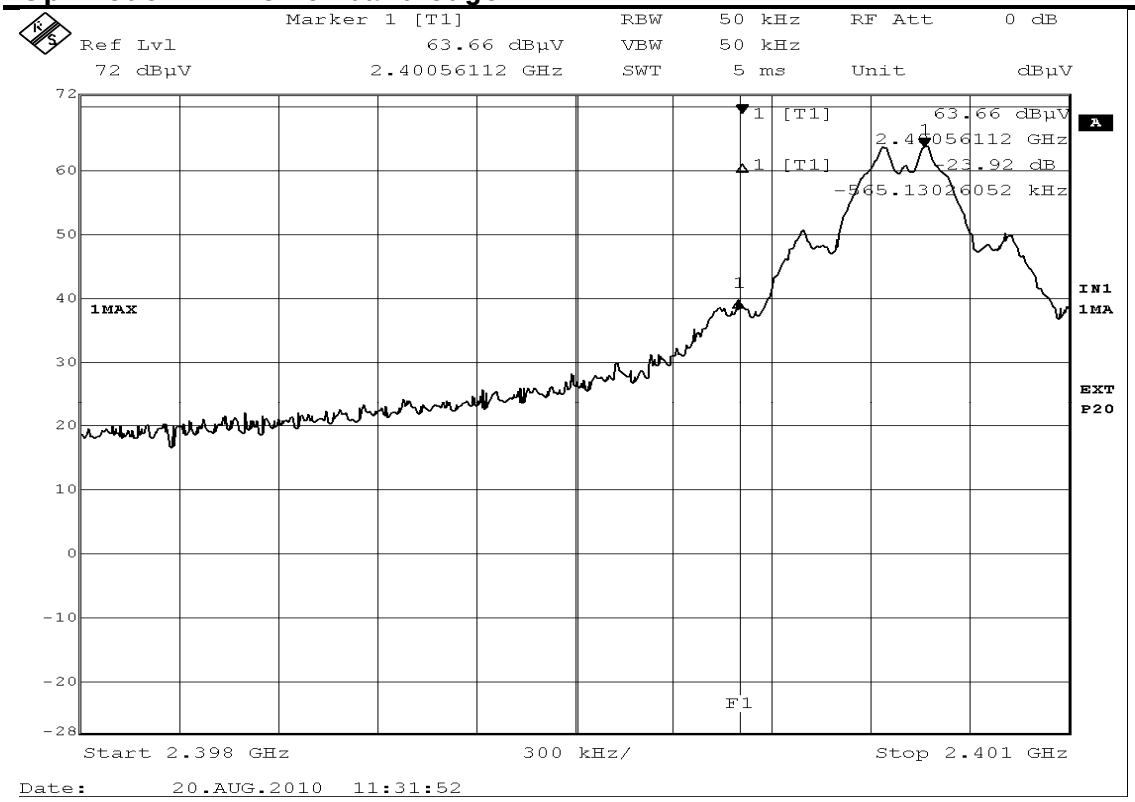
Op. Mode 2 Field strength of fundamental (peak, average)



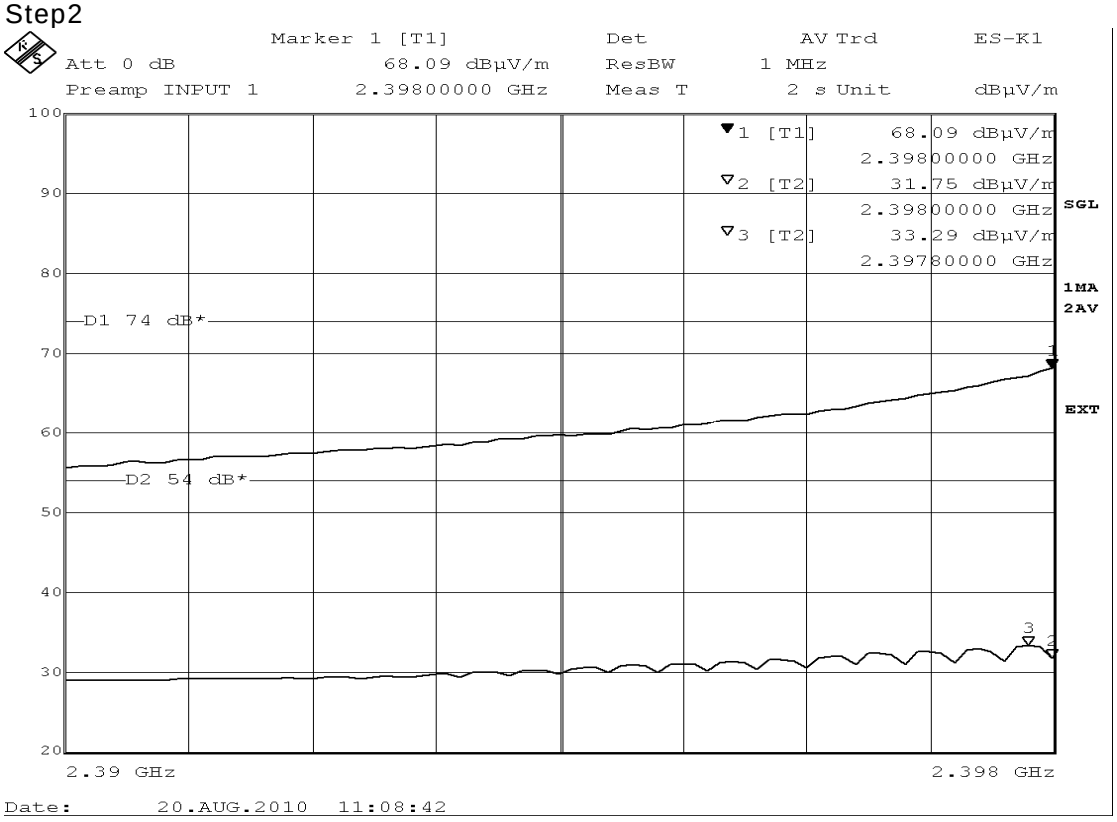
7.4 Verification of band edge emissions

7.4.1 Band edge compliance radiated

Op. Mode 1 Lower band edge



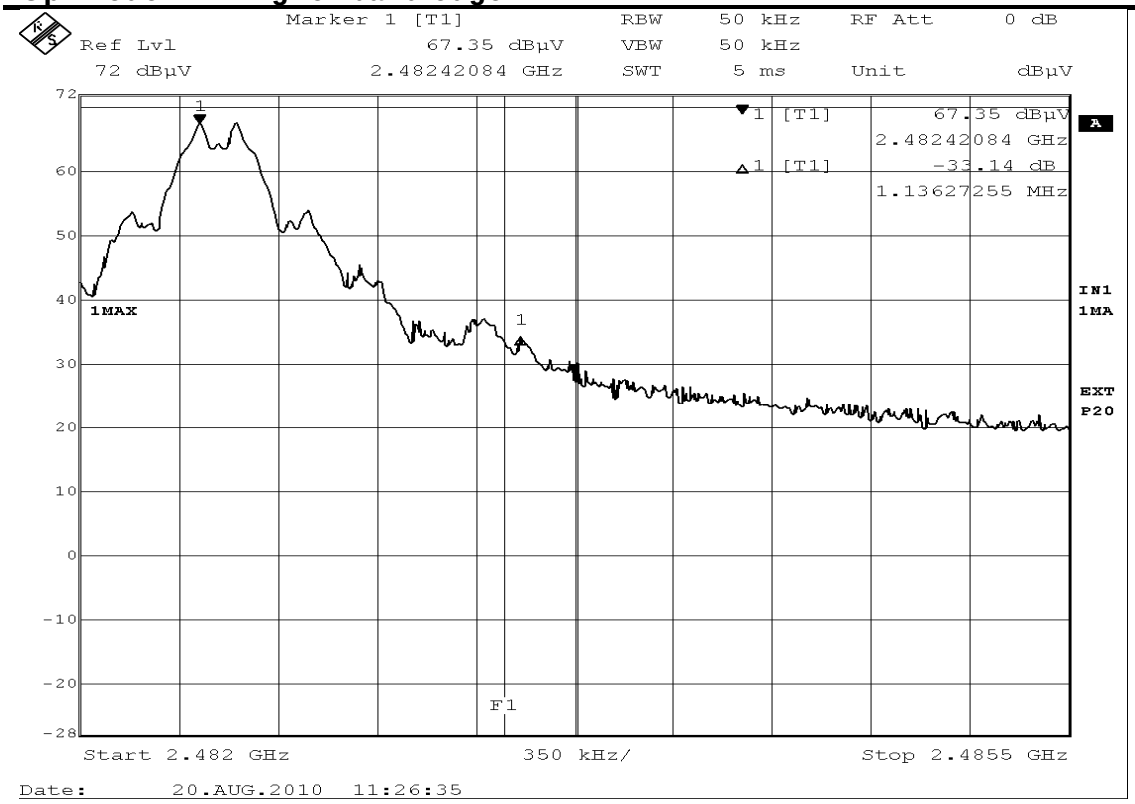
Step2



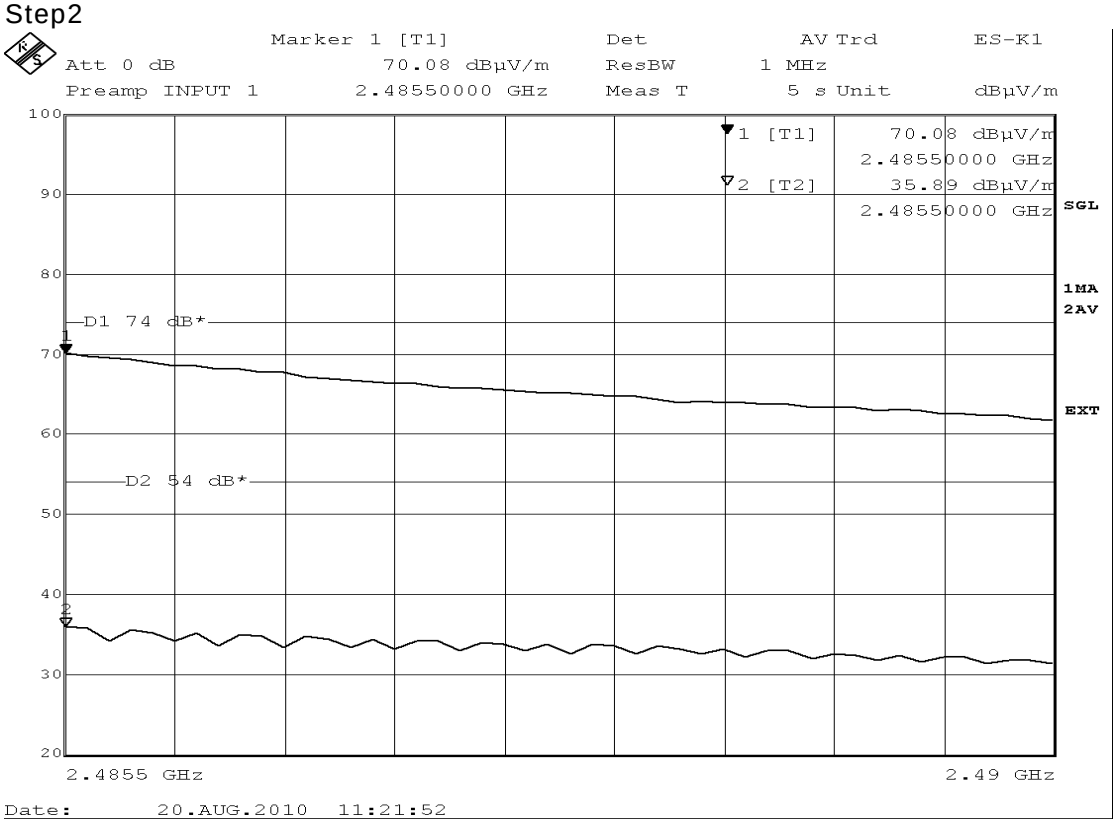
Step4

7.4.2 Band edge compliance radiated

Op. Mode 2 higher band edge



Step2



Step4