



Accredited testing-laboratory

DAR registration number: DGA-PL-176/94-D1

**Federal Motor Transport Authority (KBA)
DAR registration number: KBA-P 00070-97**

Recognized by the Federal Communications Commission

Anechoic chamber registration no.: 90462 (FCC)

Anechoic chamber registration no.: 3462C-1 (IC)

Certification ID: DE 0001

Accreditation ID: DE 0002

Accredited Bluetooth® Test Facility (BQTF)

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Test report no. : 1-2029-02-05/10
Type identification : SB100
Applicant : E-Senza Technologies GmbH
FCC ID : YBSSB100
Test standards : 47 CFR Part 15

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1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 3.1.1. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

This test report is electronically signed and valid without handwriting signature. For verification of the electronical signatures, the public keys can be requested at the testing laboratory.

Test laboratory manager:

2010-06-02 **Meheza Kpelou Walla**

Date Name Signature

Technical responsibility for area of testing:

2010-06-02 **Jakob Reschke**

Date Name Signature

1.2 Testing laboratory

CETECOM ICT Services GmbH

Untertürkheimer Straße 6 - 10

66117 Saarbrücken

Germany

Phone: + 49 681 5 98 - 0

Fax: + 49 681 5 98 - 9075

e-mail: info@ICT.cetecom.de

Internet: http://www.cetecom-ict.de

State of accreditation: The test laboratory (area of testing) is accredited according to
DIN EN ISO/IEC 17025
DAR registration number: DGA-PL-176/94-D1

Accredited by: Federal Motor Transport Authority (KBA)
DAR registration number: KBA-P 00070-97

Testing location, if different from CETECOM ICT Services GmbH:

Name :
Street :
Town :
Country :
Phone :
Fax :

1.3 Details of applicant

Name:	E-Senza Technologies GmbH
Street:	Bücklestrasse 82b
Town:	78467 Konstanz
Country:	Germany
Telephone:	+49 (0) 7531 36599-10
Fax:	+49 7531 36599 -29
Contact:	Johannes Bleuel
E-mail:	Johannes.Bleuel@e-senza.de
Telephone:	+49 7531 36599 -22

1.4 Application details

Date of receipt of order:	2010-04-19
Date of receipt of test item:	2010-04-21
Date of start test:	2010-04-21
Date of end test	2010-06-02
Persons(s) who have been present during the test:	-/-

2 Test standard/s

47 CFR Part 15	2009-10	Title 47 of the Code of Federal Regulations; Chapter I- Federal Communications Commission subchapter A - general, Part 15-Radio frequency devices
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3 Technical tests

3.1 Details of manufacturer

Name:	E-Senza Technologies GmbH
Street:	Bücklestrasse 82b
Town:	78467 Konstanz
Country:	Germany

3.1.1 Test item

Kind of test item	:	2.4 GHz radio module with hopping system
Type identification	:	SB100
S/N serial number	:	-/-
HW hardware status	:	-/-
SW software status	:	-/-
Frequency Band [MHz]	:	ISM 2.400 - 2.483,5
Type of Modulation	:	GFSK
Number of channels	:	16
Antenna	:	4 external rod antennas (for more information, please take a look at the sub clause 8 – Photos of the EUT)
Power Supply	:	2*1.5 V DC Lithium battery or MW3N06GS switching power supply
Temperature Range	:	-20 °C to +55 °C

Max. power radiated: +5.60 dBm (with antenna A)

Max. power conducted: +0.66 dBm

FCC ID: YBSSB100

3.1.2 EUT operating modes

EUT operating mode no. *)	Description of operating modes	Additional information
Op. 0	Normal mode	Normal temperature and power source conditions
Op. 1		low temperature, low power source conditions
Op. 2		low temperature, high power source conditions
Op. 3		high temperature, low power source conditions
Op. 4		high temperature, high power source conditions

*) EUT operating mode no. is used to simplify the test plan

3.1.3 Extreme conditions testing values

Description	Shortcut	Unit	Value
Nominal Temperature	T _{nom}	°C	23
Nominal Humidity	H _{nom}	%	42
Nominal Power Source	V _{nom}	V	3.00

Type of power source: **V DC Lithium battery or MW3N06GS switching power supply**

Deviations from these values are reported in chapter 2

4 Summary of Measurement Results and list of all performed test cases

- ☒ No deviations from the technical specifications were ascertained
- ☐ There were deviations from the technical specifications ascertained

TC identifier	Description	verdict	date	Remark
RF-Testing	FCC Part 15 §15.247	PASS	2010-06-02	-/-

Test Specification Clause	Test Case	Pass	Fail	Not applicable	Not performed
None	Antenna Gain	Yes			
§15.247(a1)	Carrier frequency separation	Yes			
§15.247(a1)	Number of hopping channels	Yes			
§15.247(a)(1)(iii)	Time of occupancy (dwell time)	Yes			
§15.247(e)	Power Spectral density (Hybrid system in Inquiry mode/Page scan)			Yes	
§15.247(a)(1)	Spectrum Bandwidth of a FHSS System / 20dB Bandwidth	Yes			
§ 15.247 (b)(1)	Maximum output power (conducted)	Yes			
§ 15.247 (b)(1)	Max. peak output power (radiated)	Yes			
§ 15.247 (d)	Band-edge compliance of conducted emissions	Yes			
§ 15.205	Band-edge compliance of radiated emissions	Yes			
§ 15.247 (d)	Spurious Emission - conducted (Transmitter)	Yes			
§ 15.247 (d)	Spurious Emission - radiated (Transmitter) >30 MHz	Yes			
§ 15.209	Spurious Emissions - radiated (Transmitter) <30 MHz	Yes			
§ 15.107/207	Conducted Emissions <30 MHz	Yes			

5 RF measurement testing

5.1 Description of test set-up

5.1.1 Radiated measurements

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 25 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63.2-1996 clause 15 and ANSI C63.4-2003 clause 4.1.5. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63-4-2003 clause 4.2. Antennas are confirmed with ANSI C63.2-1996 item 15.

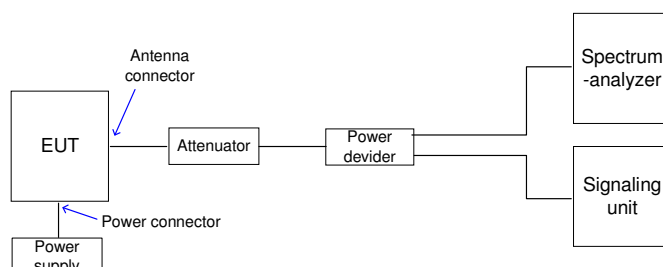
9 kHz - 150 kHz: Quasi Peak measurement, 200 Hz Bandwidth, passive loop antenna.
150 kHz - 30 MHz: Quasi Peak measurement, 9 kHz Bandwidth, passive loop antenna.
30 MHz - 200 MHz: Quasi Peak measurement, 120 kHz Bandwidth, bi-conical antenna
200MHz - 1GHz: Quasi Peak measurement, 120 kHz Bandwidth, log periodic antenna
>1GHz: Average, RBW 1MHz, VBW 10 Hz, waveguide horn

All measurements are done in accordance with the Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems DA 00-705 and Appendix A "BLUETOOTH APPROVALS"

The EUT is powered by an external power supply with nominal voltage. The signalling is performed from outside the chamber with a signalling unit (CMU200 or other) by air link using signalling antenna.

5.1.2 Conducted measurements

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The signal is first 10dB attenuated before it is power divided (~6dB loss per branch). One of the signal paths is connected to the communication base Station (CMU200 or other), the other one is connected to the spectrum analyzer. The specific losses for both signal paths are first checked within a calibration. The measurement readings on the signalling unit/spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signalling unit and the spectrum analyzer are impedance matched on 50 Ohm.



5.2 Referenced documents

None

5.3 Additional comments

The radiated spurious emissions were performed with 4 different external rod antennas (reverse on SMA):

- Antenna A



- Antenna B



- Antenna C



- Antenna D



5.4 Antenna gain

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Antenna A:

	low channel 2405 MHz	mid channel 2445 MHz	high channel 2480 MHz
Conducted power [dBm] Measured, GFSK modulation	+0.44	+0.66	-0.92
Radiated power [dBm] Measured, GFSK modulation	+5.50	+5.60	+3.90
Gain [dBi] Calculated	+5.06	+4.94	+4.82

Antenna B:

	low channel 2405 MHz	mid channel 2445 MHz	high channel 2480 MHz
Conducted power [dBm] Measured, GFSK modulation	+0.44	+0.66	-0.92
Radiated power [dBm] Measured, GFSK modulation	+5.30	+5.40	+3.50
Gain [dBi] Calculated	+4.86	+4.74	+4.42

Antenna C:

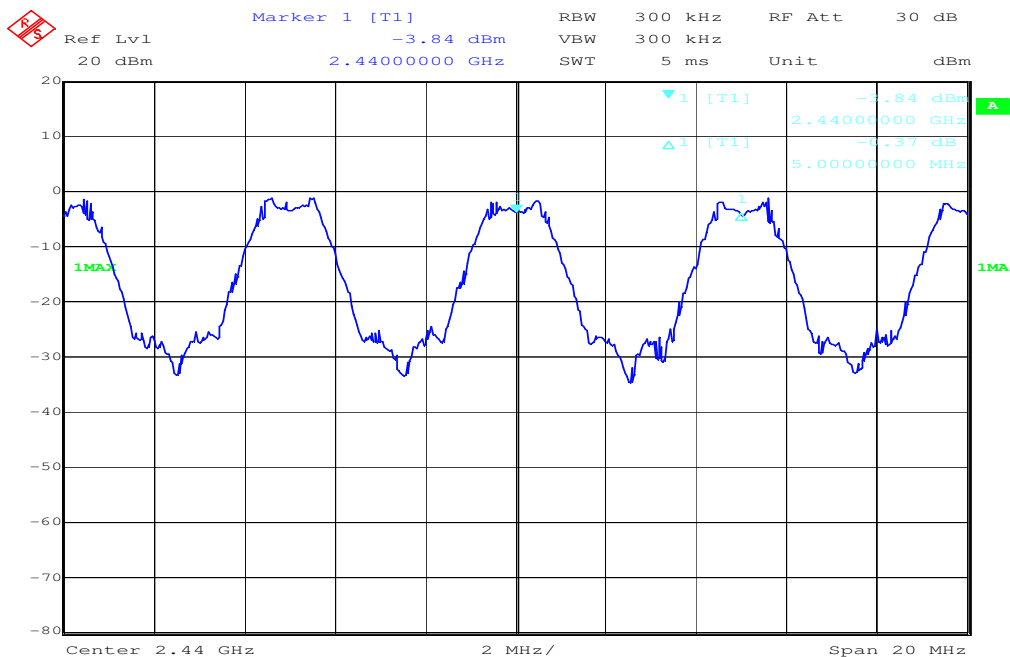
	low channel 2405 MHz	mid channel 2445 MHz	high channel 2480 MHz
Conducted power [dBm] Measured, GFSK modulation	+0.44	+0.66	-0.92
Radiated power [dBm] Measured, GFSK modulation	+5.00	+4.80	+3.00
Gain [dBi] Calculated	+4.56	+4.14	+3.92

Antenna D:

	low channel 2405 MHz	mid channel 2445 MHz	high channel 2480 MHz
Conducted power [dBm] Measured, GFSK modulation	+0.44	+0.66	-0.92
Radiated power [dBm] Measured, GFSK modulation	+4.85	+4.65	+4.00
Gain [dBi] Calculated	+4.45	+3.99	+4.92

5.5 Carrier frequency separation §15.247(a)(1)

Plot 1 of 1:



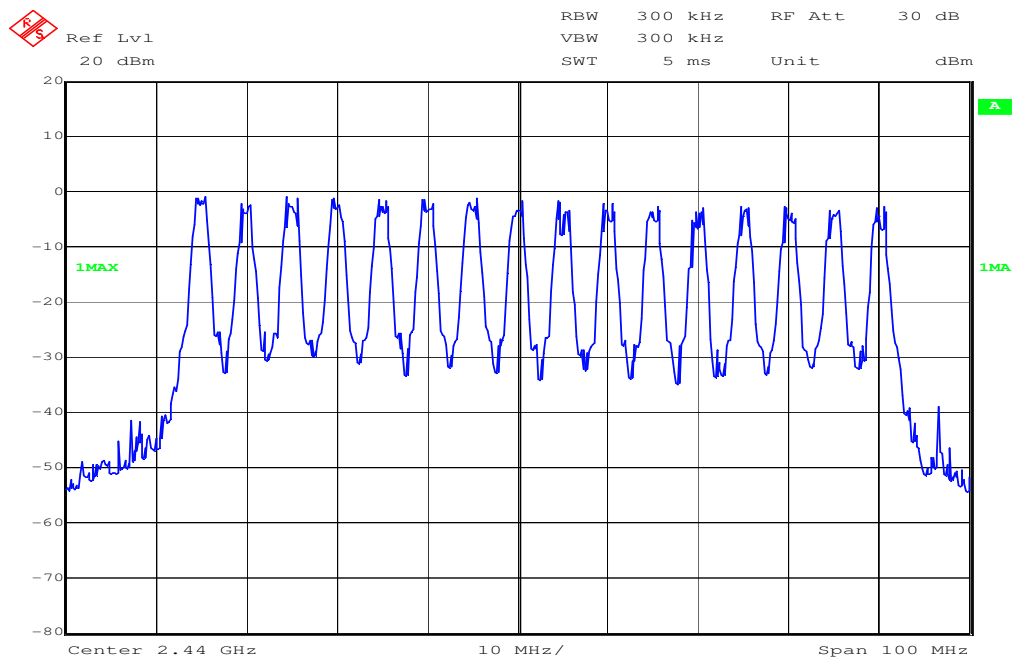
Result: Channel separation is: 5 MHz

Limits:

Under normal test conditions only	Minimum 25 kHz or 20 dB Bandwidth of the hopping system
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5.6 Number of hopping channels §15.247(a) (1)

Plot 1 of 1:



Result: The number of hopping channels is: 16

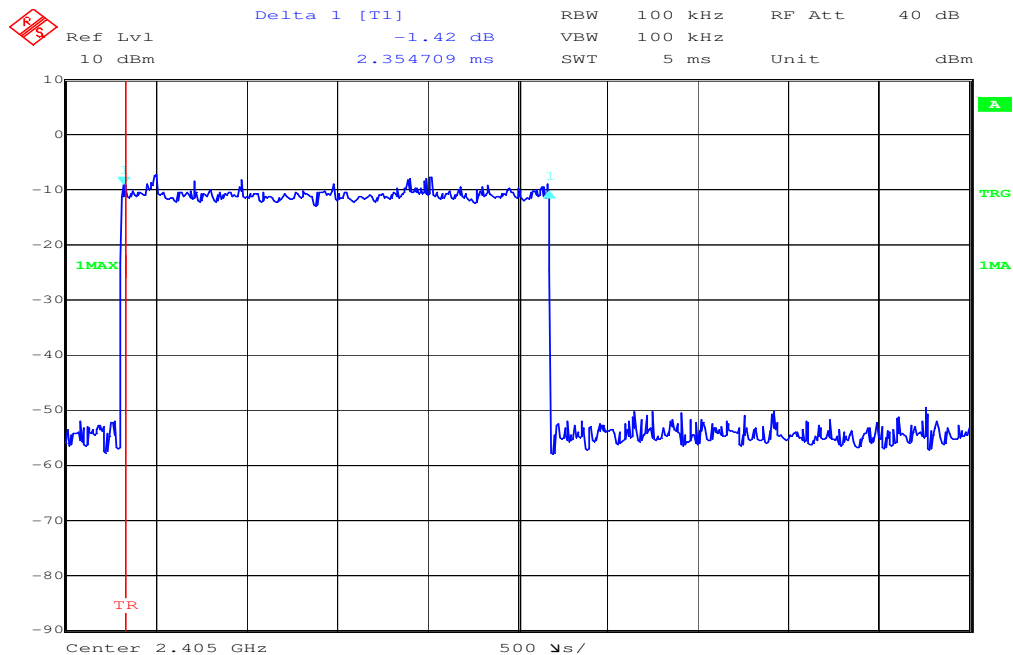
Limits:

Under normal test conditions only	at least 15 non-overlapping channels
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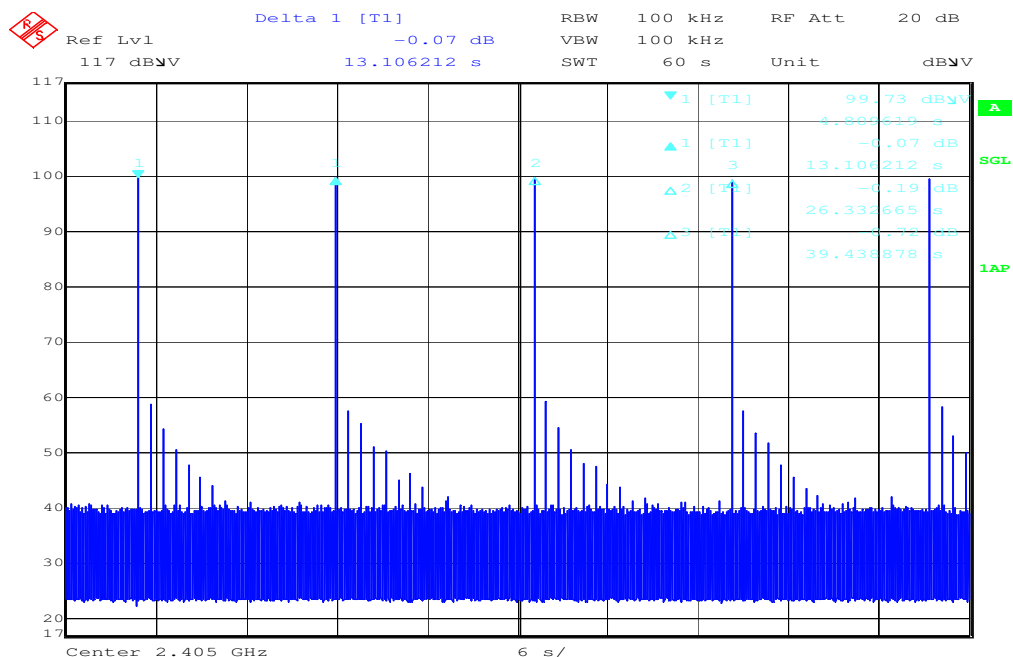
5.7 Time of occupancy (dwell time) §15.247(a)(1)(iii)

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Plot 1:



Plot 2:



The calculation for a 16 * 0.4 second period is as follows:

Dwell time = time slot length * hop rate / number of hopping channels * 6.4

Dwell time = 2.35 ms * 1.22 / 16 * 6.4 s

According to plot 2, the hope rate per second is calculated with $1\text{ s} * 16 / 13.10 = 1.22$

→ Dwell time = 1.15 ms < 0.4 s (in a 6.4 s period)

**5.8 Power Spectral density (Hybrid system in Inquiry mode/Page scan)
§15.247(e)**

Not applicable!

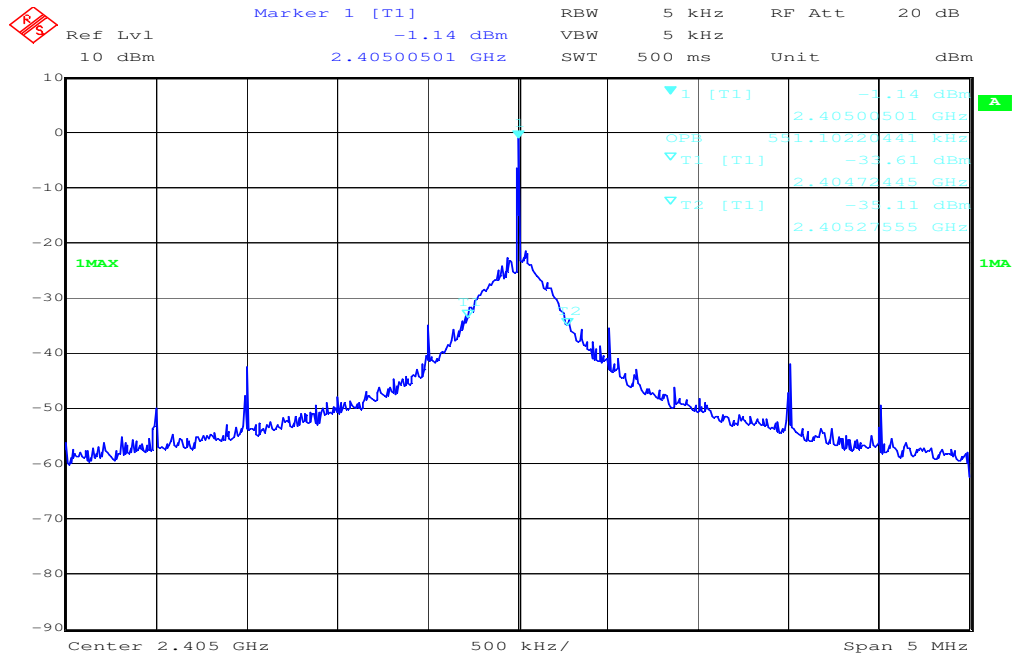
Result: Power density: - dBm/Hz = - dBm / 3 kHz
Correction factor from dBm/Hz to dBm / 3 kHz is +34.8 dB

Limits:

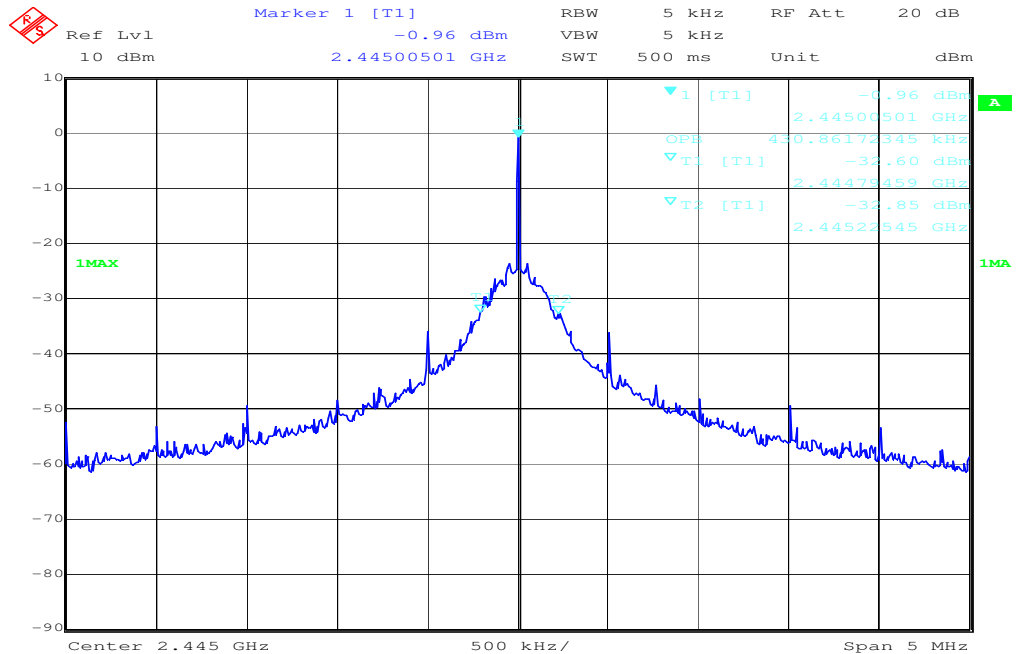
Under normal test conditions only	For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission
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5.9 Spectrum Bandwidth of a FHSS System / 20dB Bandwidth §15.247(a)(1)

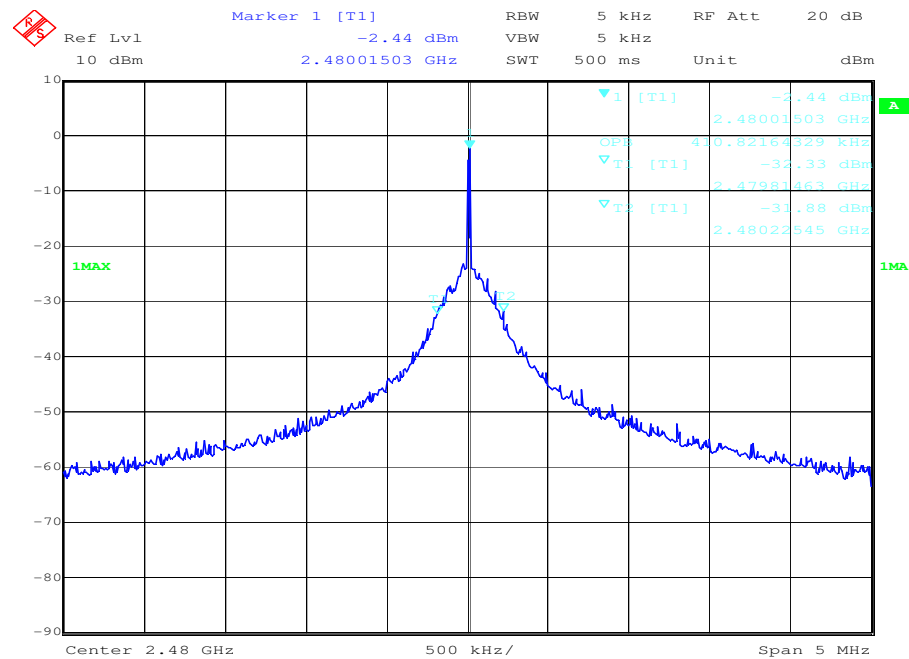
Plot 1 of 3



Plot 2 of 3



Plot 3 of 3



Result:

Test conditions		20 dB BANDWIDTH [kHz]		
Frequency [MHz]		2405	2445	2480
T_{nom}	V_{nom}	551	431	411
Measurement uncertainty		± 5 kHz		

RBW / VBW as provided in the „Measurement Guidelines“ (DA 00-705, March 30, 2000)

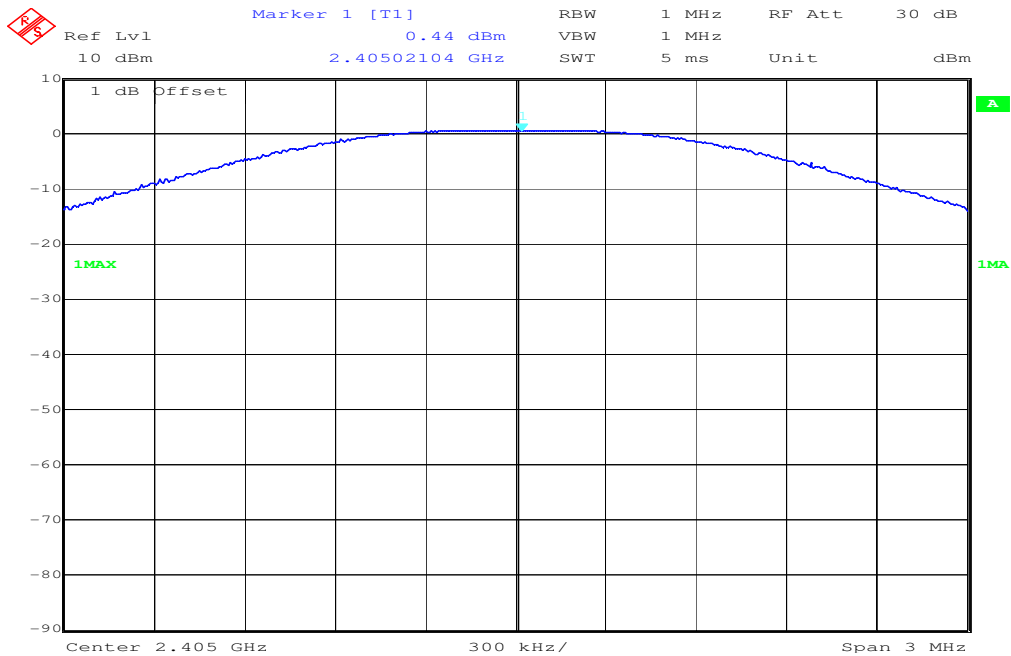
RBW: 5 kHz / VBW 5 kHz

Limits:

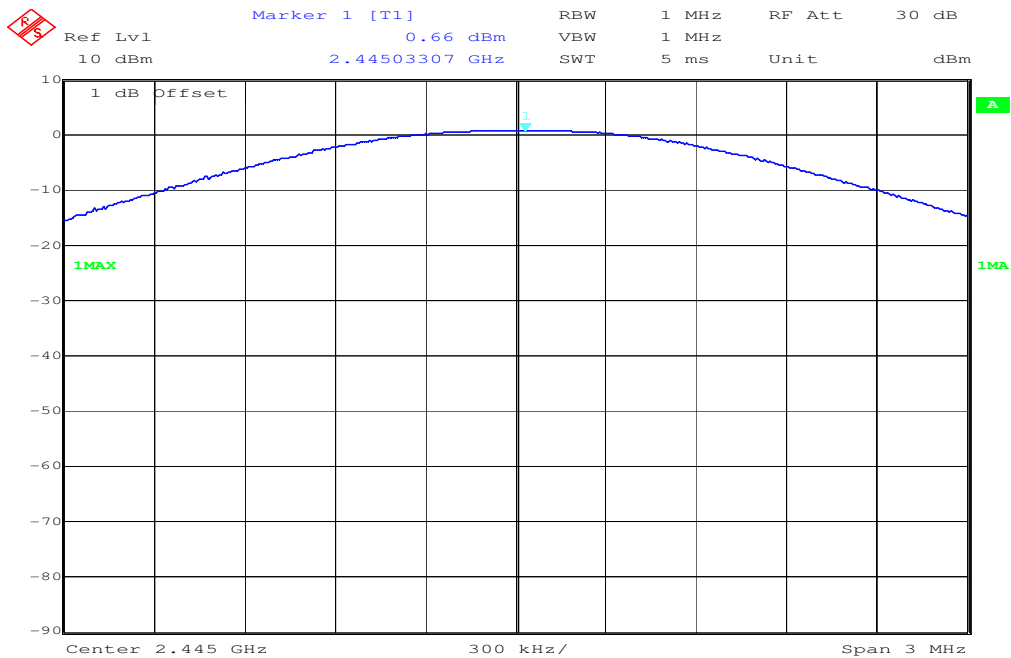
Under normal test conditions only	< 1000 kHz
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5.10 Maximum output power (conducted) § 15.247 (b) (1)

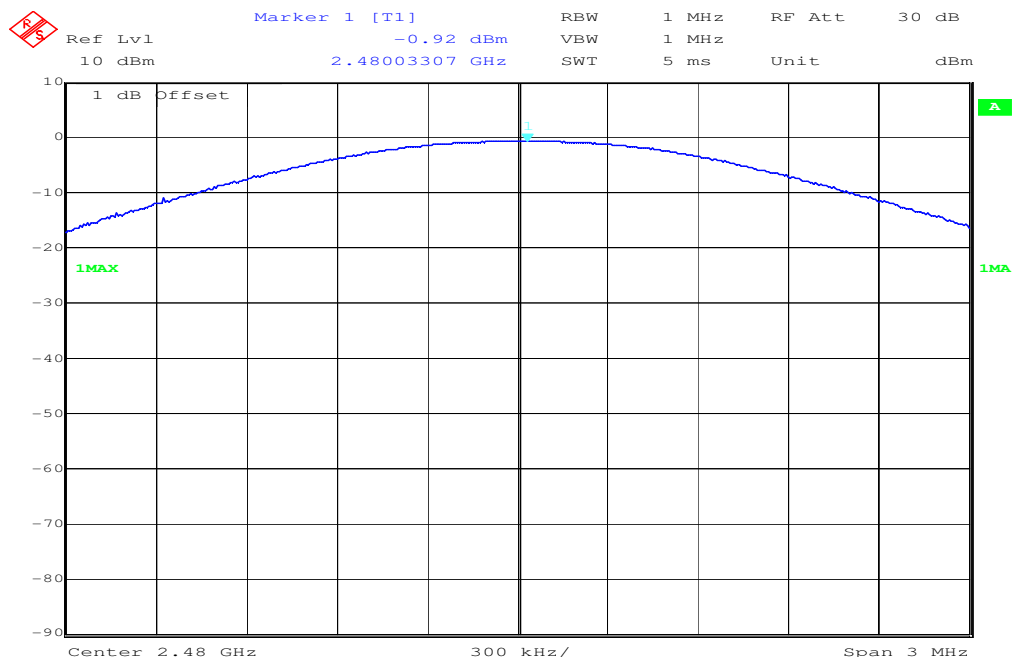
Plot 1 of 3



Plot 2 of 3



Plot 3 of 3



Results:

Test conditions		Max. peak output power [dBm]					
Frequency [MHz]		2405		2445		2480	
T _{nom}	V _{nom}	PK	+0.44	PK	+0.66	PK	-0.92
Measurement uncertainty		±3dB					

RBW / VBW: 1 MHz

Limits:

Under normal test conditions only, for frequency range 2400-2483.5 MHz	Max. 1.0 Watt
--	---------------

5.11 Max. peak output power (radiated) § 15.247 (b)(1)

Antenna A:

Test conditions		Max. peak output power EIRP [dBm]		
Frequency [MHz]		2405	2445	2480
T _{nom}	V _{nom}	5.50	5.60	3.90
Measurement uncertainty		±3dB		

RBW / VBW: 1 MHz

Measured at a distance of 3m

Antenna B:

Test conditions		Max. peak output power EIRP [dBm]		
Frequency [MHz]		2405	2445	2480
T _{nom}	V _{nom}	5.30	5.40	3.50
Measurement uncertainty		±3dB		

RBW / VBW: 1 MHz

Measured at a distance of 3m

Antenna C:

Test conditions		Max. peak output power EIRP [dBm]		
Frequency [MHz]		2405	2445	2480
T _{nom}	V _{nom}	5.00	4.80	3.00
Measurement uncertainty		±3dB		

RBW / VBW: 1 MHz

Measured at a distance of 3m

Antenna D:

Test conditions		Max. peak output power EIRP [dBm]		
Frequency [MHz]		2405	2445	2480
T _{nom}	V _{nom}	4.85	4.65	4.00
Measurement uncertainty		±3dB		

RBW / VBW: 1 MHz

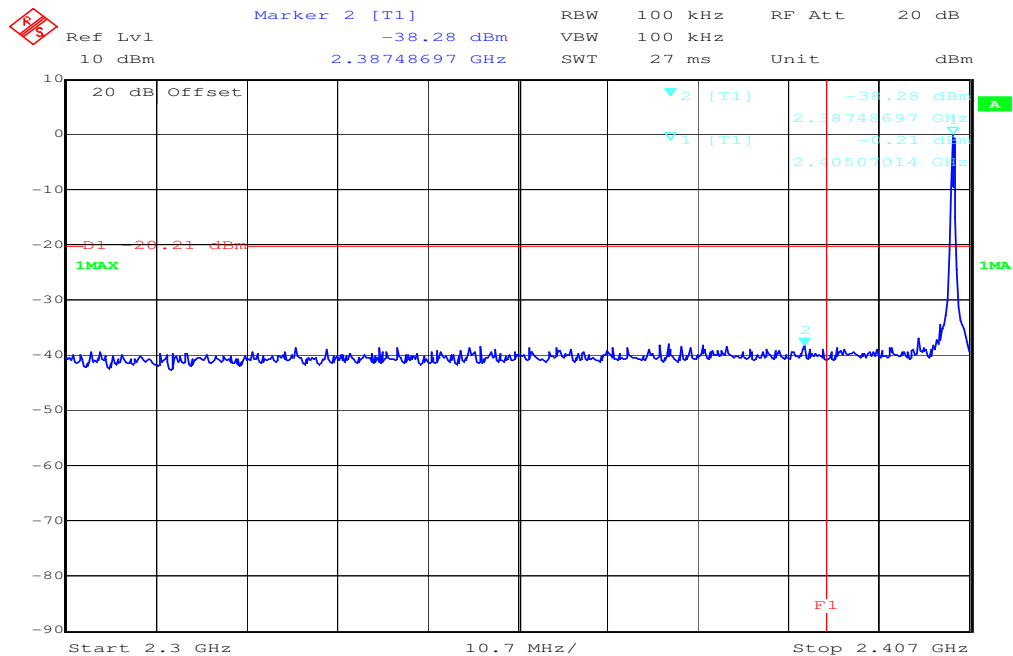
Measured at a distance of 3m

Limits:

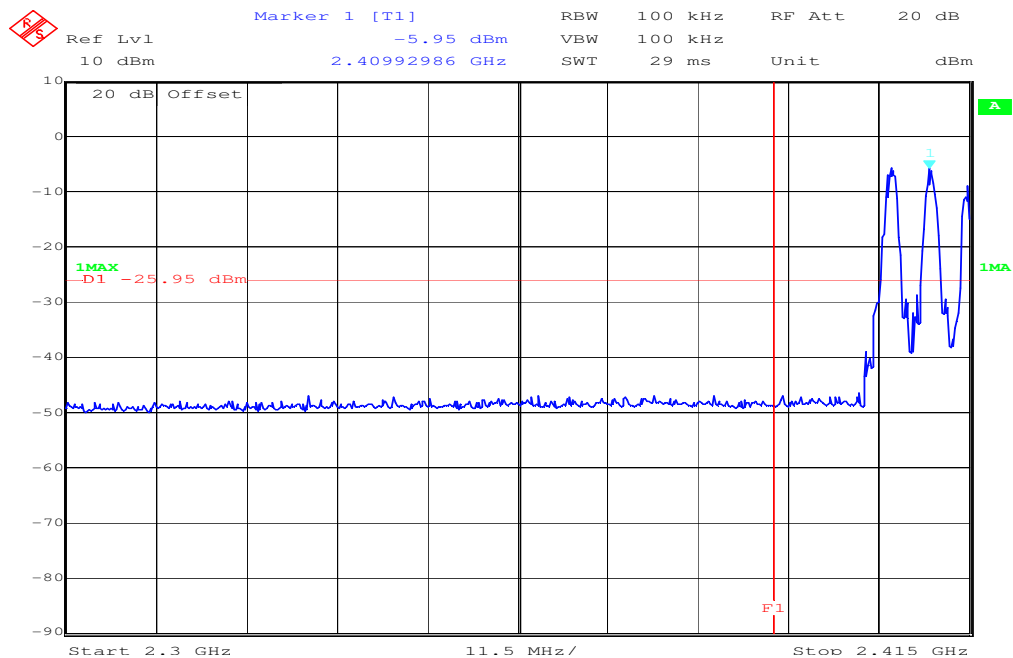
Under normal test conditions only, for frequency range 2400-2483.5 MHz	Max. 1.0 Watt
--	---------------

5.12 Band-edge compliance of conducted emissions §15.247 (d)

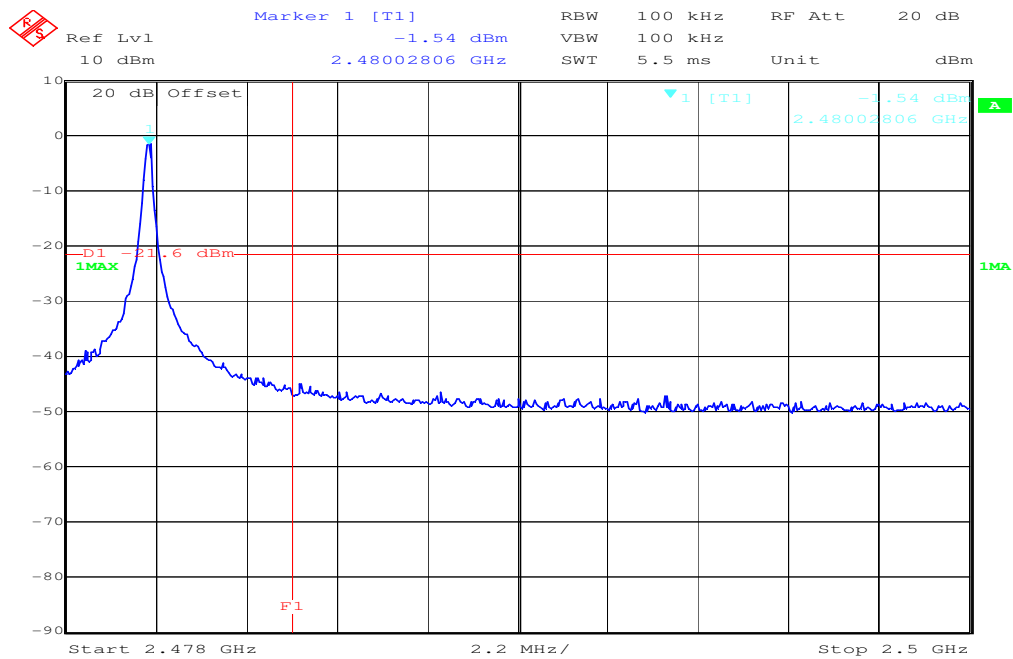
Plot 1 of 4 (hopping off, lowest frequency):



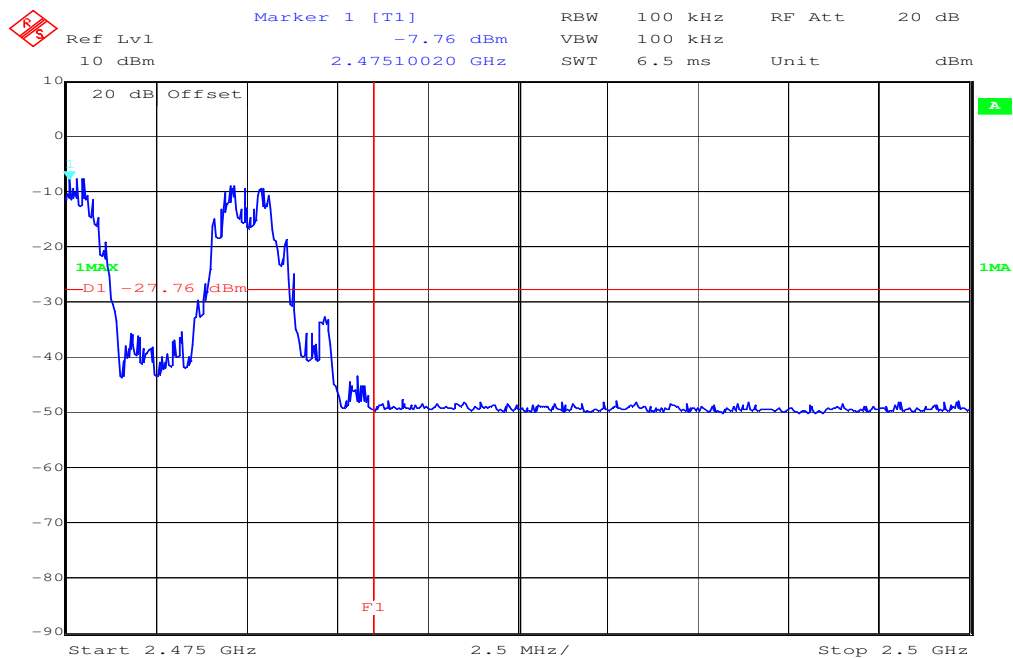
Plot 2 of 4 (hopping on, lowest frequency):



Plot 3 of 4 (hopping off, highest frequency):



Plot 4 of 4 (hopping on, highest frequency):



Results:

SZENARIO	DELTA VALUE [DB]
hopping off, lowest frequency	> 20 dB
hopping on, lowest frequency	> 20 dB
hopping off, highest frequency	> 20 dB
hopping on, highest frequency	> 20 dB
Measurement uncertainty	±1,5dB

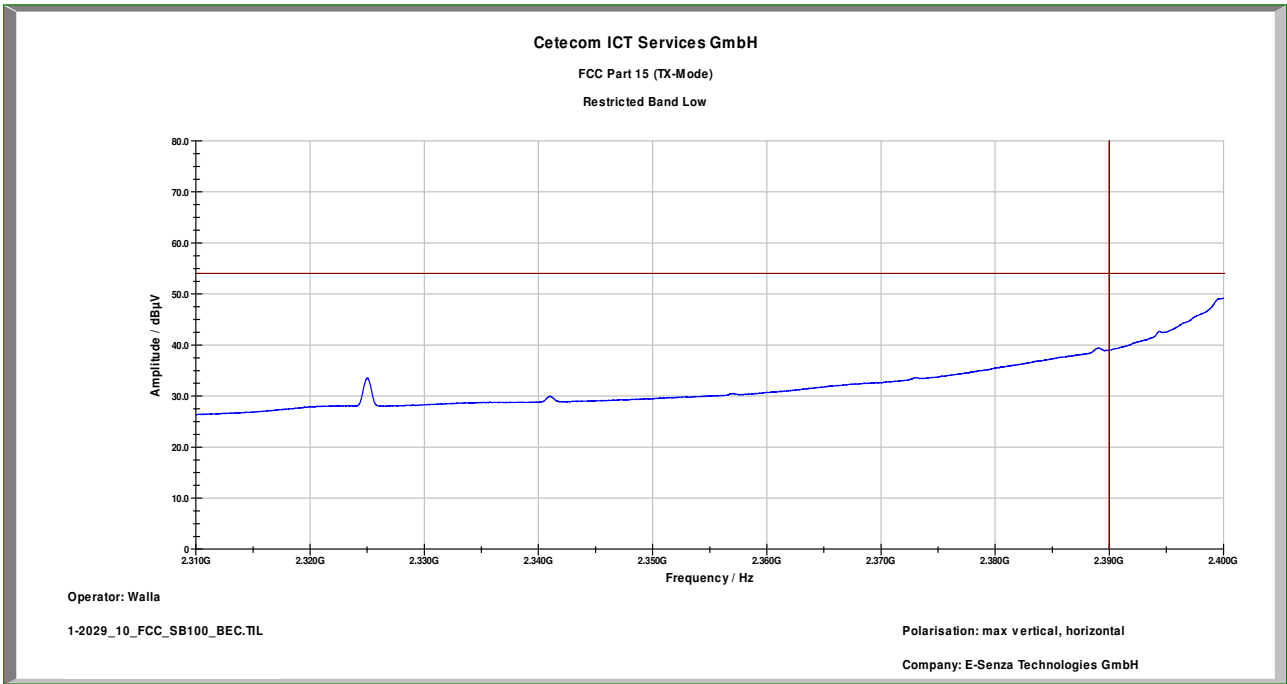
Limits:

Under normal test conditions only	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).
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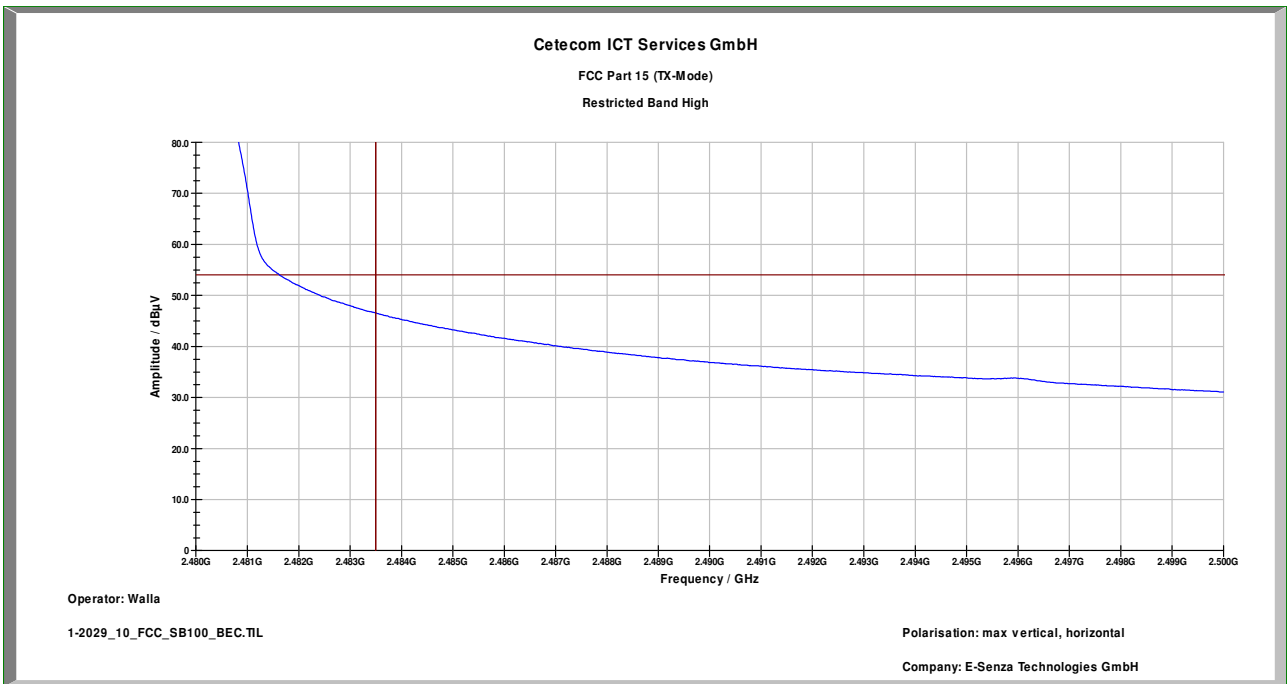
5.13 Band-edge compliance of radiated emissions §15.205

Antenna A:

Plot 1: Lowest Channel



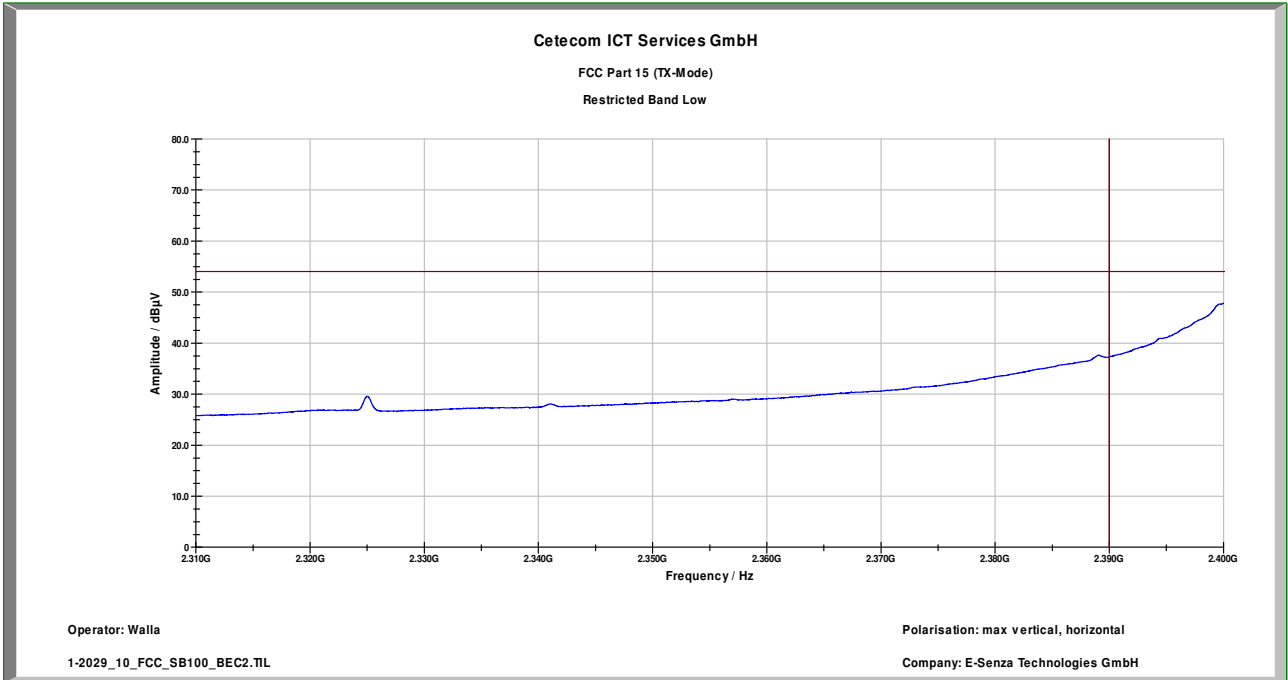
Plot 2: Highest Channel



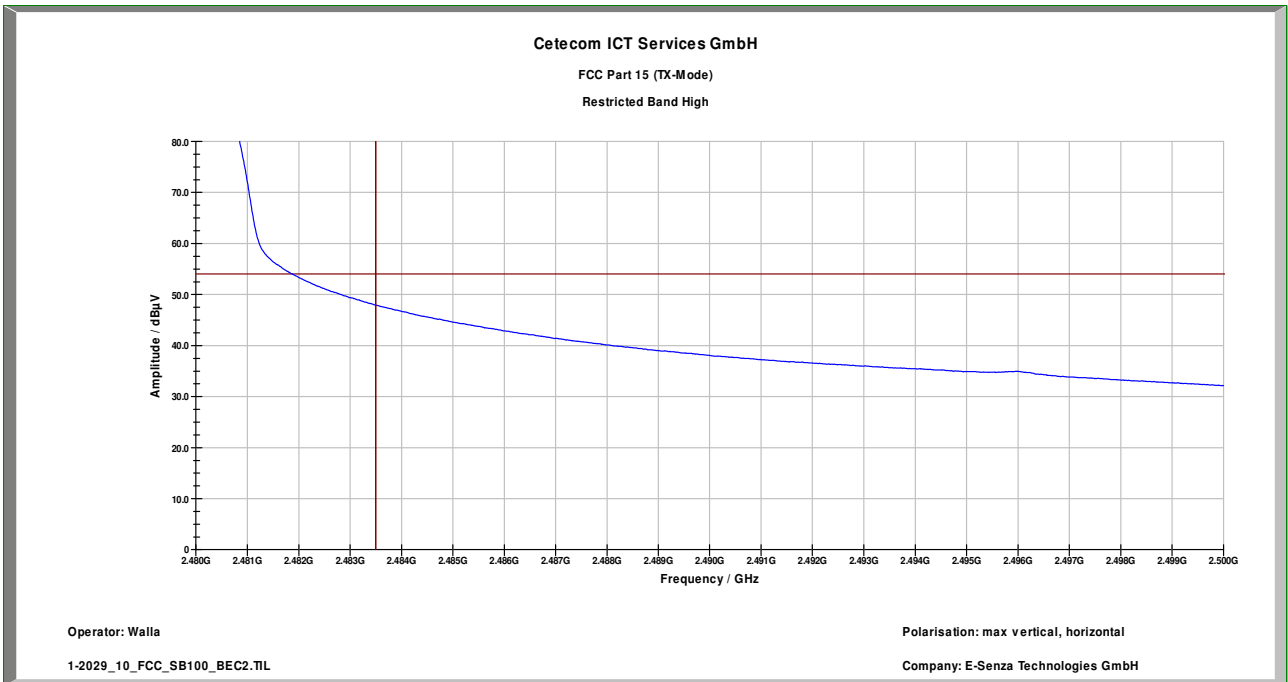
Limit: 54 dBµV/m		Complies
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Antenna B:

Plot 3: Lowest Channel



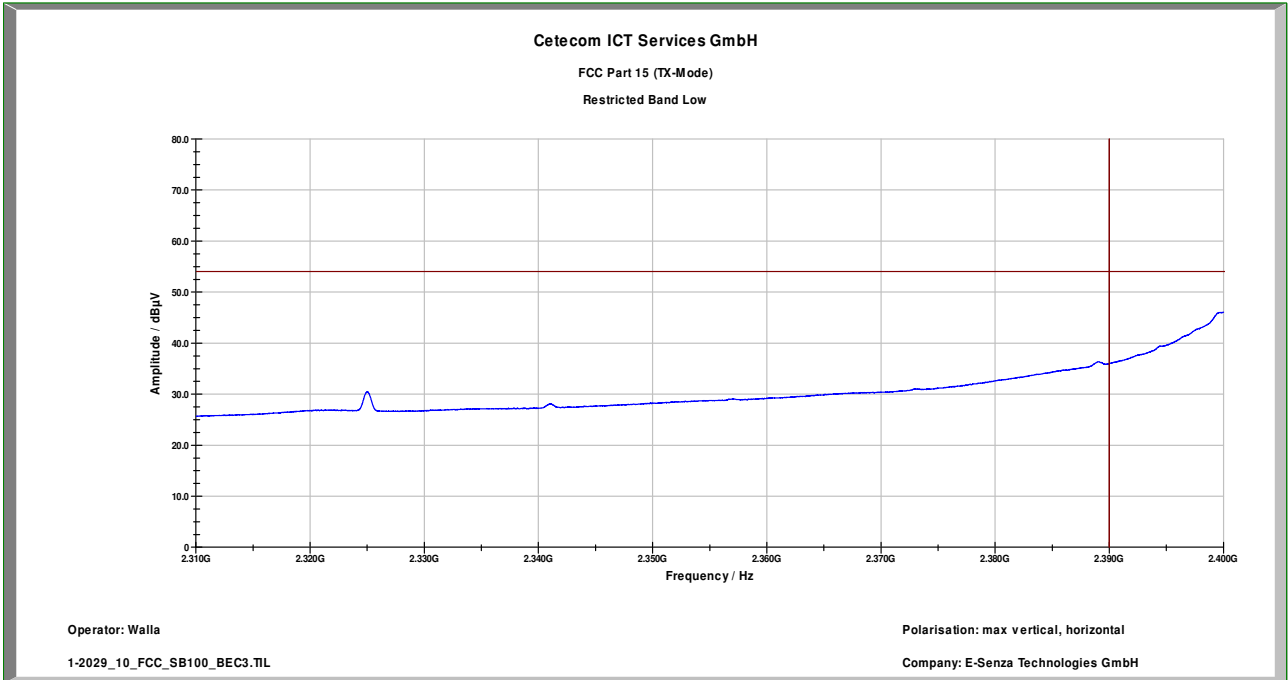
Plot 4: Highest Channel



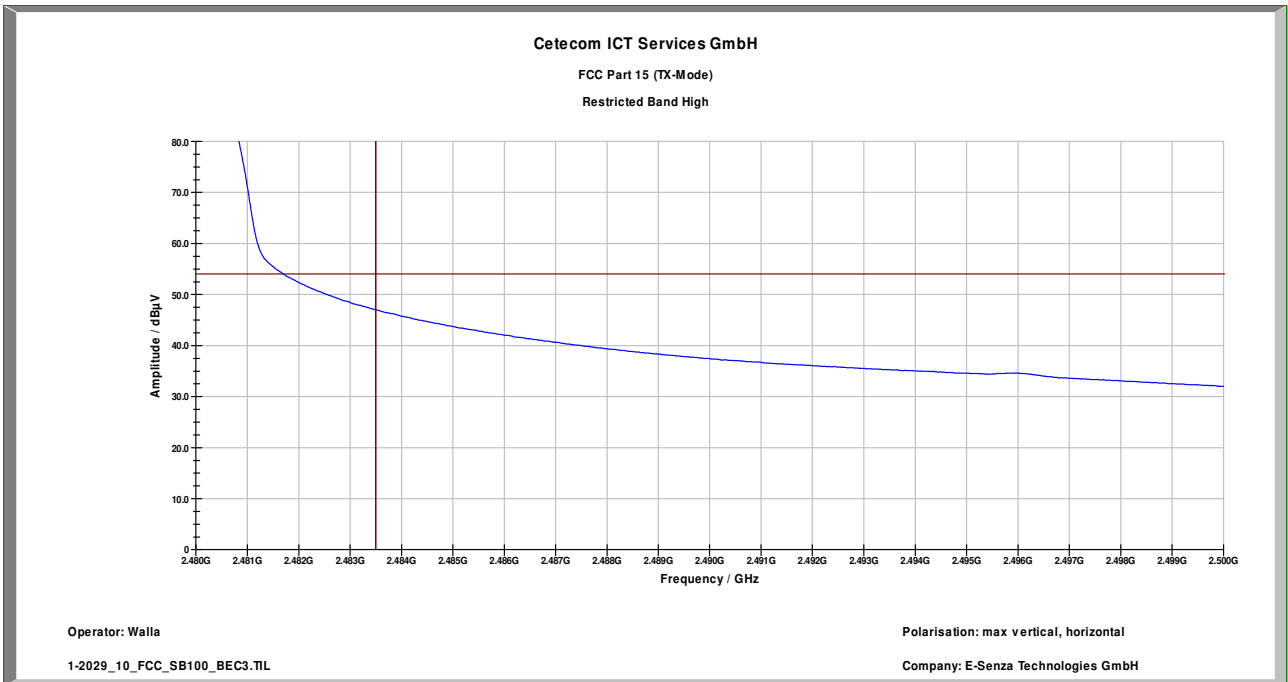
Limit: 54 dBµV/m		Complies
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Antenna C:

Plot 5: Lowest Channel



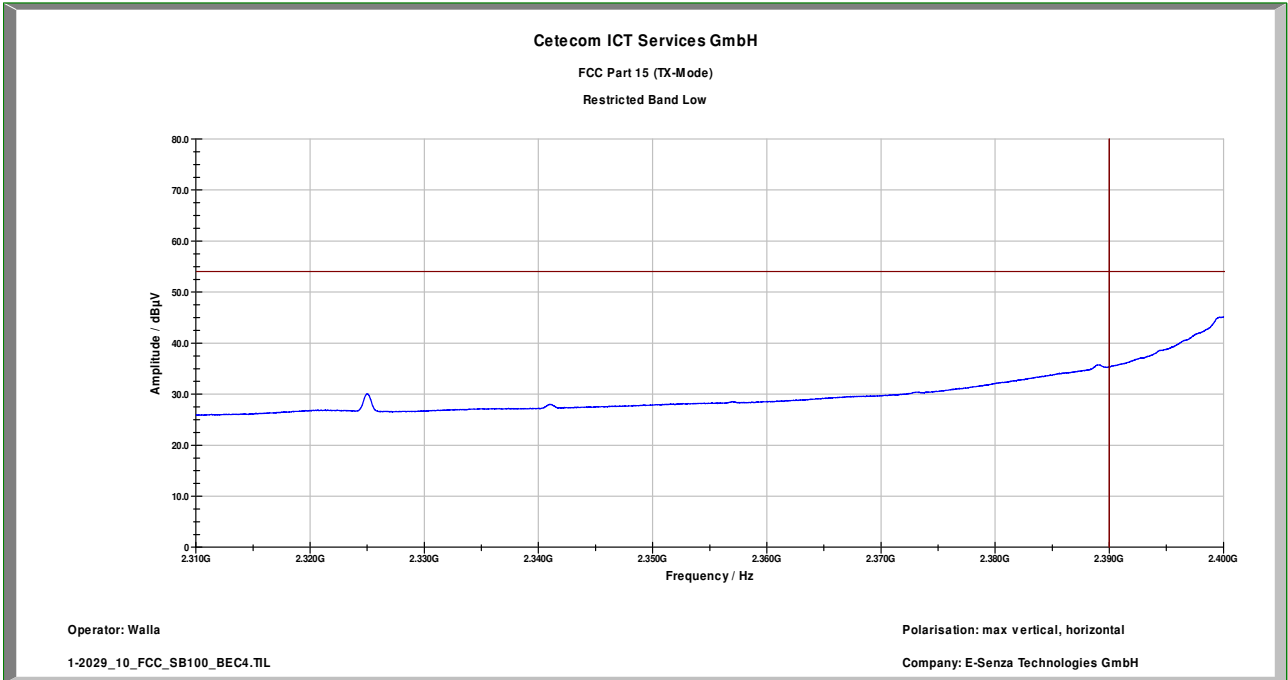
Plot 6: Highest Channel



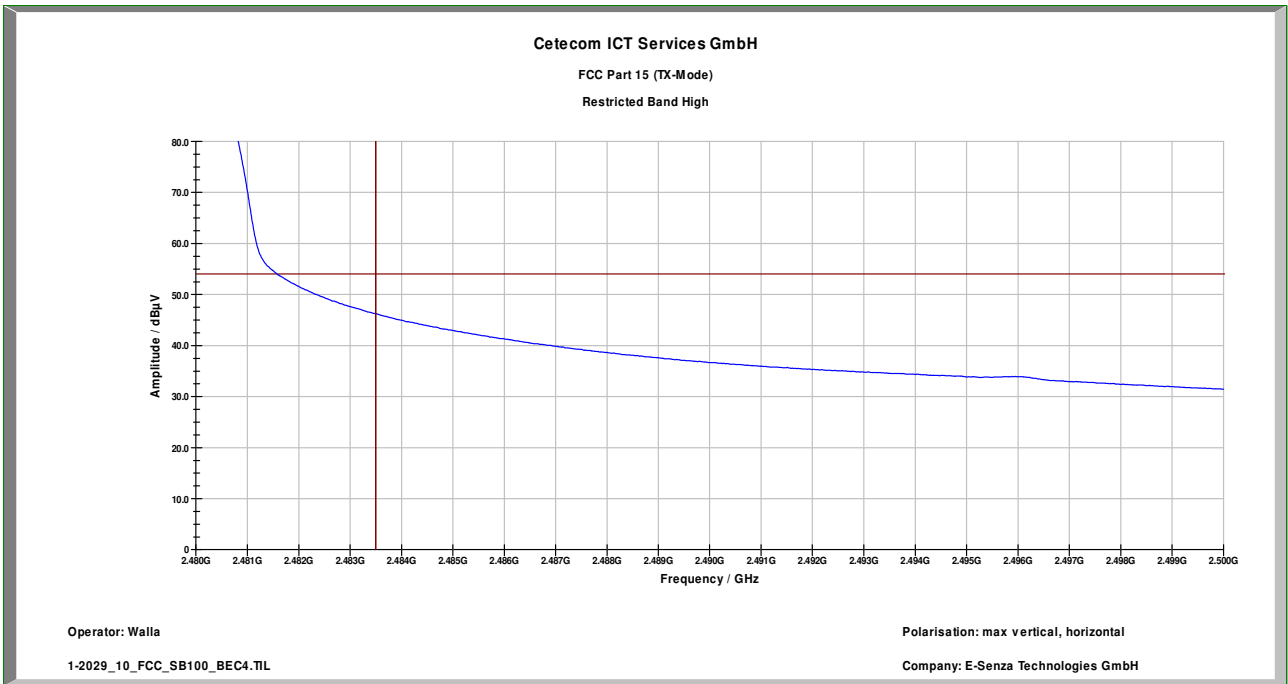
Limit: 54 dBµV/m		Complies
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Antenna D:

Plot 7: Lowest Channel



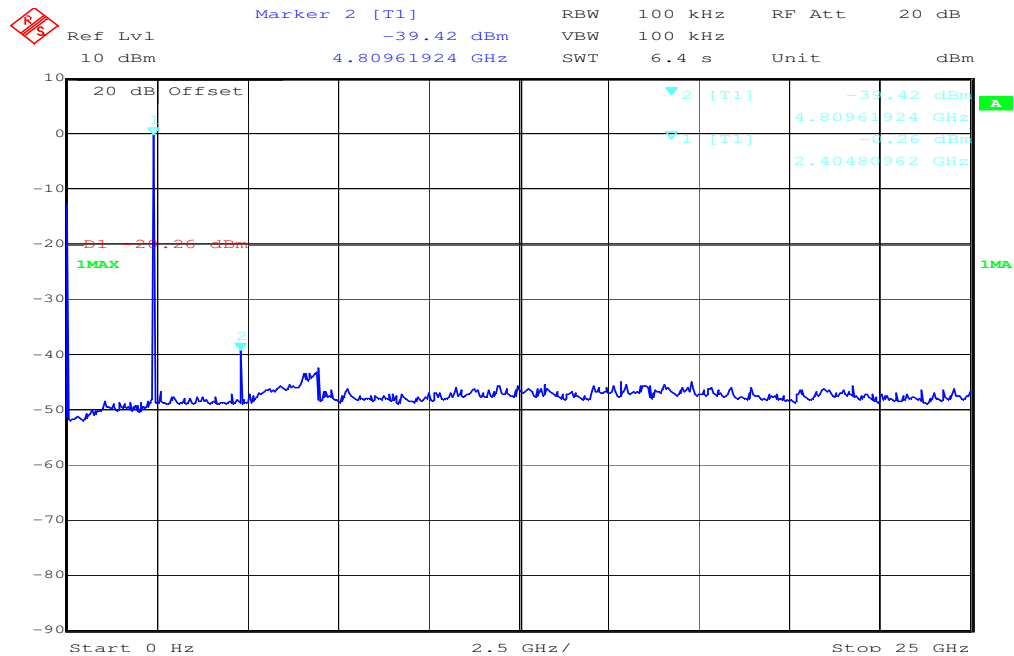
Plot 8: Highest Channel



Limit: 54 dBµV/m		Complies
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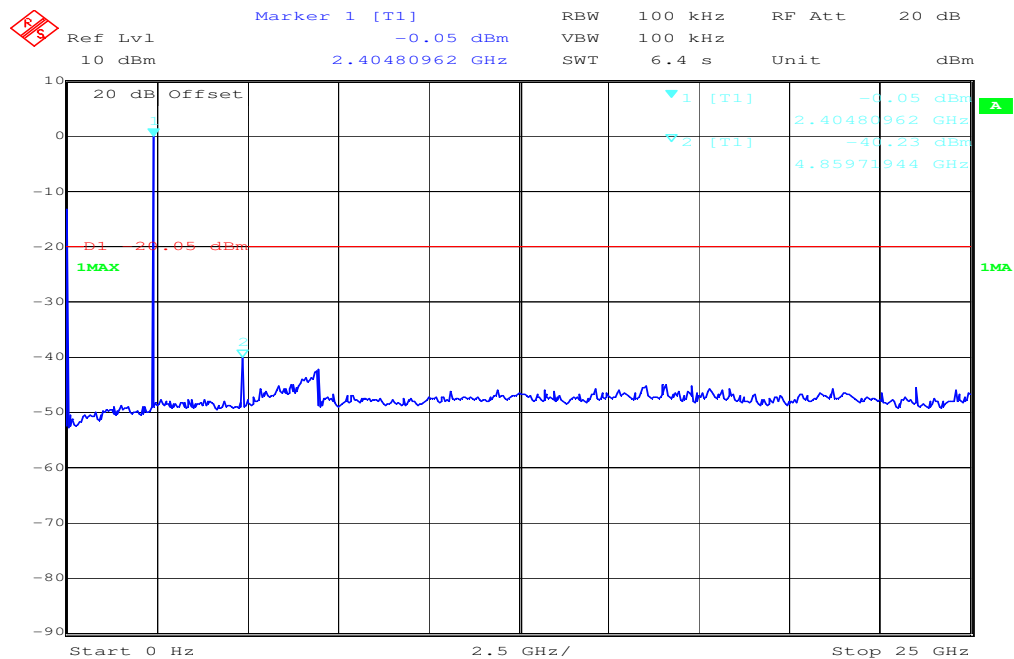
5.14 Spurious Emissions - conducted (Transmitter) § 15.247 (c) (1)

Plot 1 of 3: lowest channel



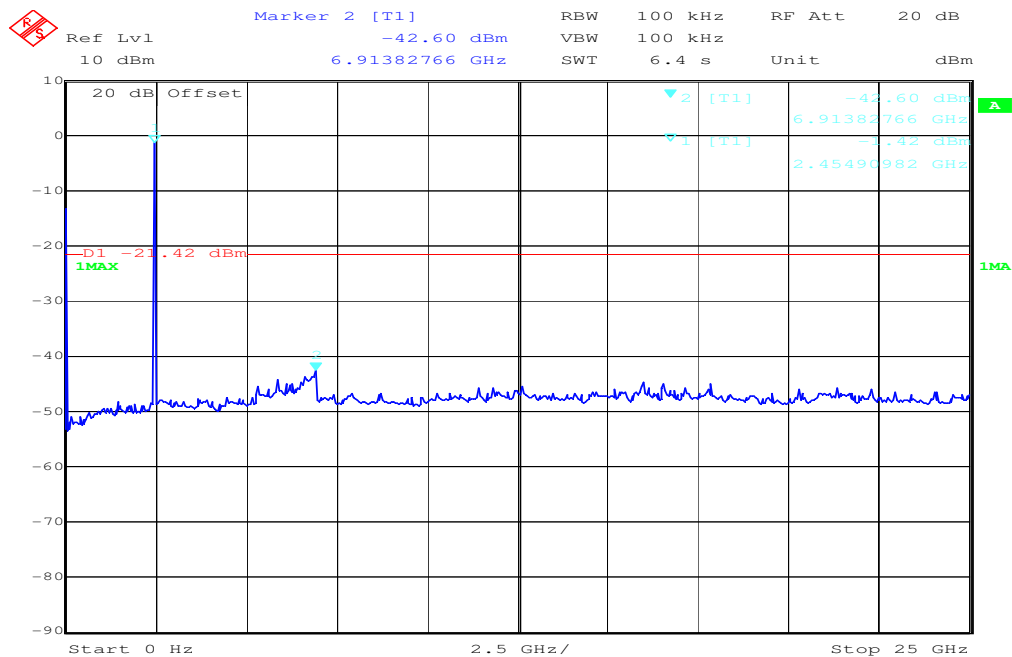
The peak at the left site of the plot is the local oscillator from the spectrum analyzer and not a spurious emission.

Plot 2 of 3: middle channel



The peak at the left site of the plot is the local oscillator from the spectrum analyzer and not a spurious emission.

Plot 3 of 3: highest channel



The peak at the left site of the plot is the local oscillator from the spectrum analyzer and not a spurious emission.

Result & Limits:

Emission Limitation					
Frequency [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2405		-0.26	30 dBm		Operating frequency
No critical peaks found!			-20 dBc		
2445		-0.05	30 dBm		Operating frequency
No critical peaks found!			-20 dBc		
2480		-1.42	30 dBm		Operating frequency
No critical peaks found!			-20 dBc		
Measurement uncertainty		± 3dB			

F < 1 GHz: RBW: 100 kHz VBW: 100 kHz
 F > 1 GHz: RBW: 1 MHz VBW: 1 MHz

Under normal test conditions only	In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
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Note: For emissions that fall into restricted bands you find the radiated emissions later in the report.

5.15 Spurious Emissions > 30 MHz- radiated (Transmitter) § 15.247 (c)(1)

Worst case scenario: Antenna A

Plot 1: 0.03 - 1 GHz, antenna vertical/horizontal (lowest channel)

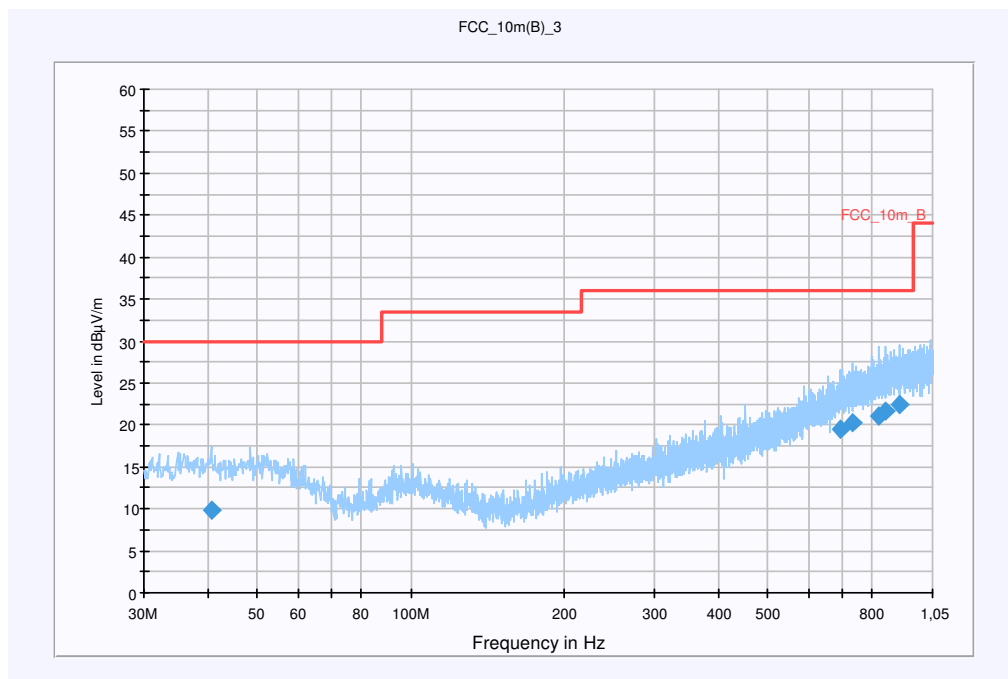
Information

EUT:	SB100
Serial Number:	Prototyp
Test Description:	FCC Part 15 @ 10m
Operating Conditions:	TX Mode Channel 11
Operator Name:	HNA
Comment:	3V DC

Scan Setup: FCC_Fin [EMI radiated]

Hardware Setup:	Electric Field (NOS)
Level Unit:	dBμV/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30 MHz - 1 GHz	QuasiPeak	120 kHz	15 s	Receiver



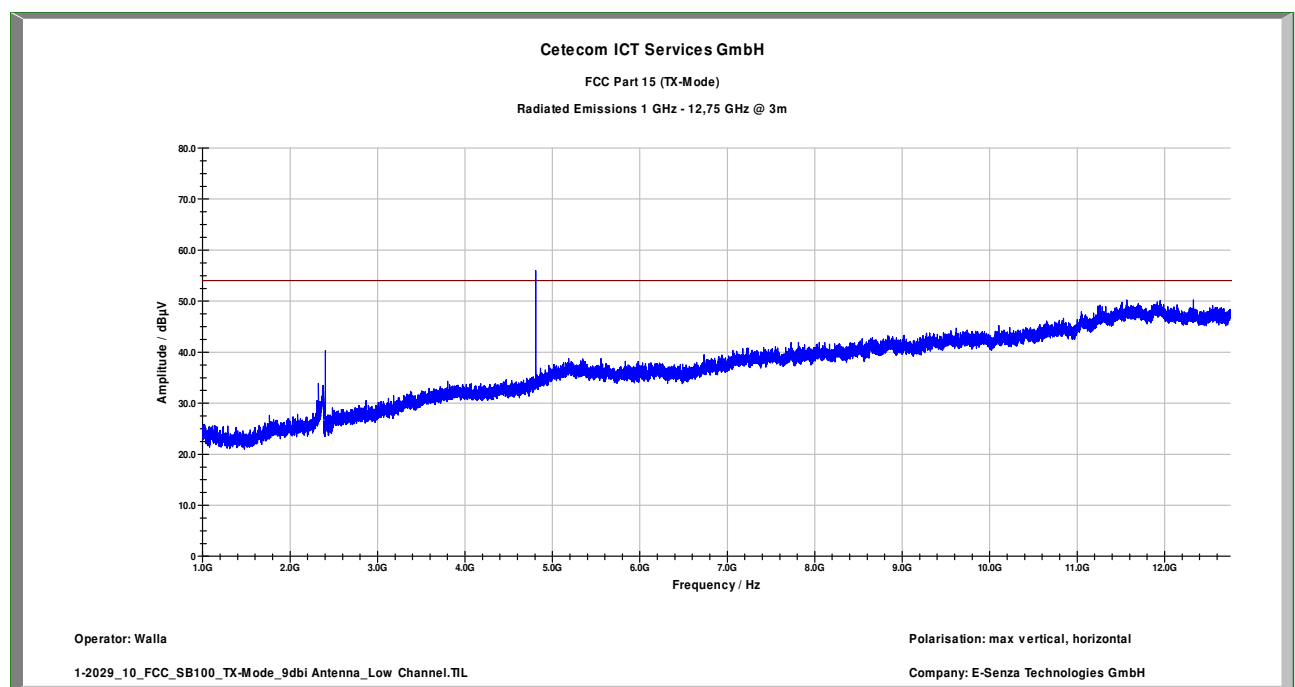
Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
40.845300	9.8	15000.000	120.000	109.0	H	87.0	13.4	20.2	30.0
694.926750	19.4	15000.000	120.000	174.0	H	13.0	22.4	16.6	36.0
730.109850	20.2	15000.000	120.000	220.0	V	278.0	23.2	15.8	36.0
826.419600	21.1	15000.000	120.000	128.0	H	181.0	24.2	14.9	36.0
852.194550	21.6	15000.000	120.000	220.0	H	90.0	24.6	14.4	36.0
906.444150	22.4	15000.000	120.000	220.0	V	167.0	25.2	13.6	36.0

Hardware Setup: EMI radiated\Electric Field (NOS) - [EMI radiated]

Subrange 1	
Frequency Range:	30 MHz - 2 GHz
Receiver:	Receiver [ESCI 3] @ GPIB0 (ADR 20), SN 100083/003, FW 3.32, CAL 07.01.2009
Signal Path:	without Notch FW 1.0
Antenna:	VULB 9163 SN 9163-295, FW ---, CAL 08.04.2010 Correction Table (vertical): VULP6113 Correction Table (horizontal): VULP6113 Correction Table: Cabel with switch (0908)
Antenna Tower:	Tower [EMCO 2090 Antenna Tower] @ GPIB0 (ADR 8), FW REV 3.12
Turntable:	Turntable [EMCO Turntable] @ GPIB0 (ADR 9), FW REV 3.12

EMC 32 Version 6.30.10 + Service Pack 2

Plot 2: 1 - 12 GHz, antenna vertical/horizontal (lowest channel)



Carrier suppressed with a rejection filter.

Plot 4: 0.03 - 1 GHz, antenna vertical/horizontal (middle channel)

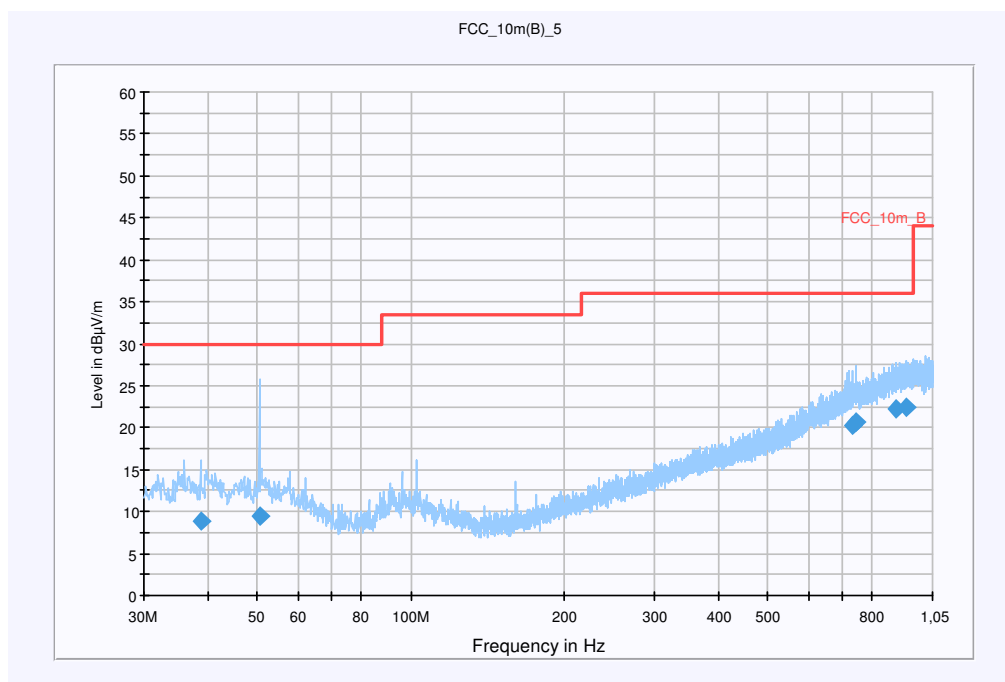
Information

EUT:	SB100
Serial Number:	Prototyp
Test Description:	FCC Part 15 @ 10m
Operating Conditions:	TX Mode Channel 19
Operator Name:	HNA
Comment:	3V DC

Scan Setup: FCC_Fin [EMI radiated]

Hardware Setup:	Electric Field (NOS)
Level Unit:	dB μ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30 MHz - 1 GHz	QuasiPeak	120 kHz	15 s	Receiver



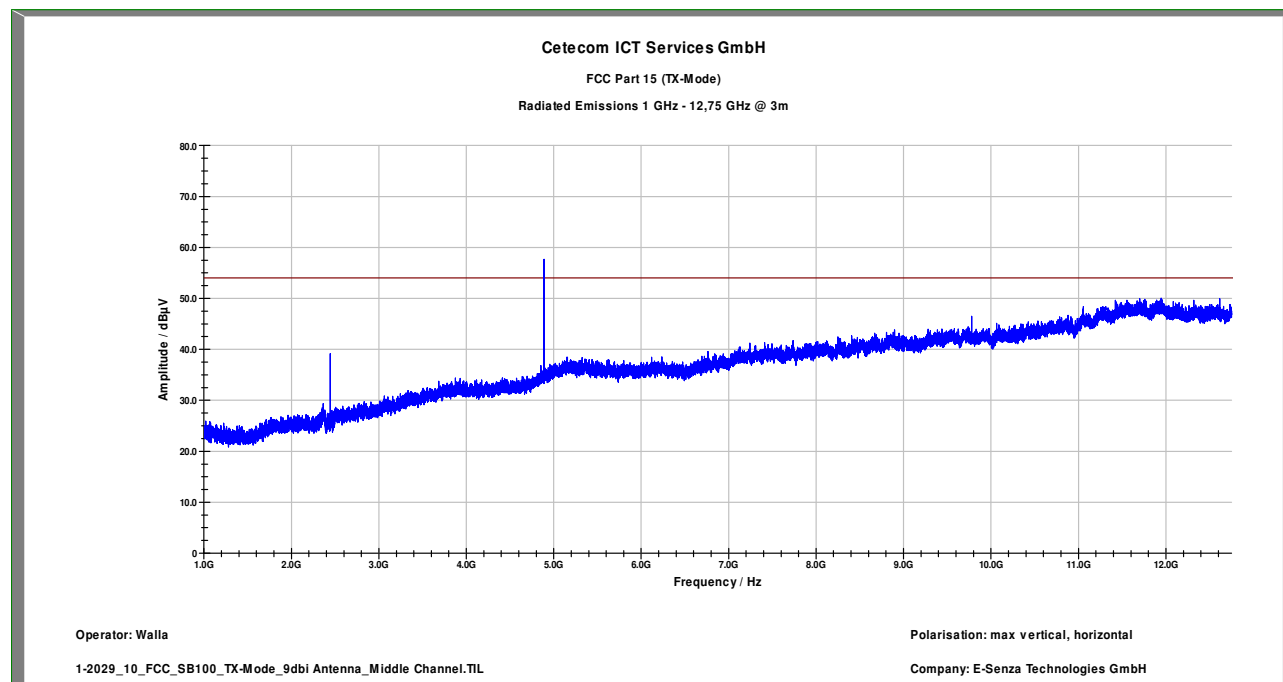
Frequency (MHz)	QuasiPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
38.760000	8.8	15000.000	120.000	165.0	V	235.0	13.3	21.2	30.0
50.520000	9.5	15000.000	120.000	220.0	V	-1.0	13.3	20.5	30.0
735.000000	20.3	15000.000	120.000	166.0	H	235.0	23.3	15.7	36.0
744.480000	20.6	15000.000	120.000	220.0	H	12.0	23.5	15.4	36.0
892.200000	22.2	15000.000	120.000	165.0	H	112.0	25.1	13.8	36.0
933.720000	22.4	15000.000	120.000	208.0	V	54.0	25.3	13.6	36.0

Hardware Setup: EMI radiated\Electric Field (NOS) - [EMI radiated]

Subrange 1	
Frequency Range:	30 MHz - 2 GHz
Receiver:	Receiver [ESCI 3] @ GPIB0 (ADR 20), SN 100083/003, FW 3.32, CAL 07.01.2009
Signal Path:	without Notch FW 1.0
Antenna:	VULB 9163 SN 9163-295, FW ---, CAL 08.04.2010
	Correction Table (vertical): VULP6113
	Correction Table (horizontal): VULP6113
	Correction Table: Cabel with switch (0908)
Antenna Tower:	Tower [EMCO 2090 Antenna Tower] @ GPIB0 (ADR 8), FW REV 3.12
Turntable:	Turntable [EMCO Turntable] @ GPIB0 (ADR 9), FW REV 3.12

EMC 32 Version 6.30.10 + Service Pack 2

Plot 5: 1 - 12 GHz, antenna vertical/horizontal (middle channel)



Carrier suppressed with a rejection filter.

Plot 6: 0.03 - 1 GHz, antenna vertical/horizontal (highest channel)

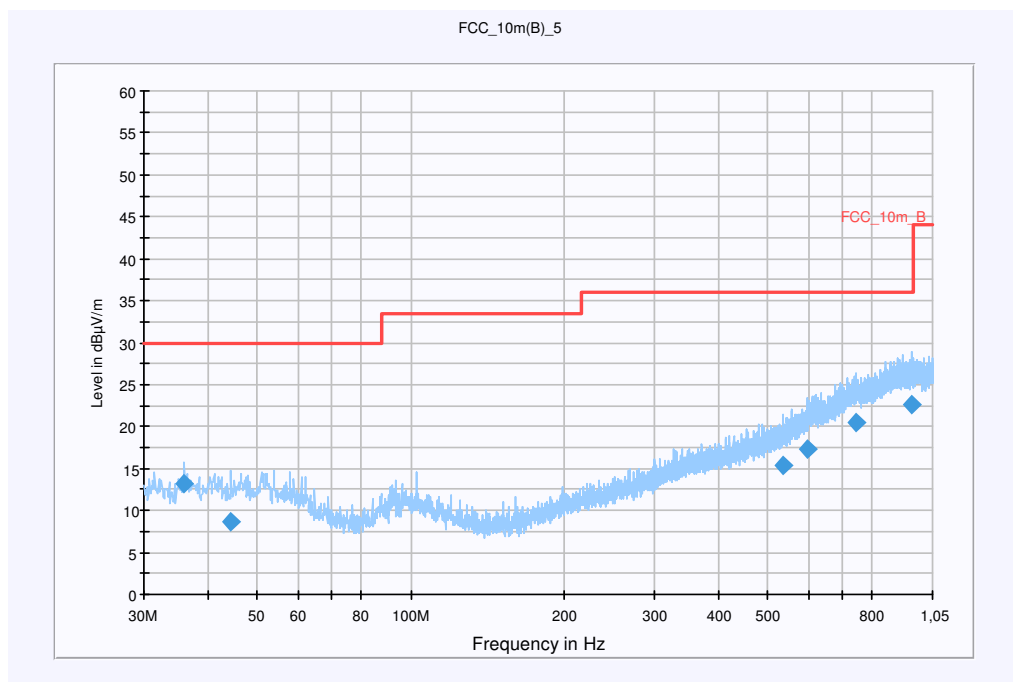
Information

EUT:	SB100
Serial Number:	Prototyp
Test Description:	FCC Part 15 @ 10m
Operating Conditions:	TX Mode Channel 26
Operator Name:	HNA
Comment:	3V DC

Scan Setup: FCC_Fin [EMI radiated]

Hardware Setup:	Electric Field (NOS)
Level Unit:	dB μ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30 MHz - 1 GHz	QuasiPeak	120 kHz	15 s	Receiver



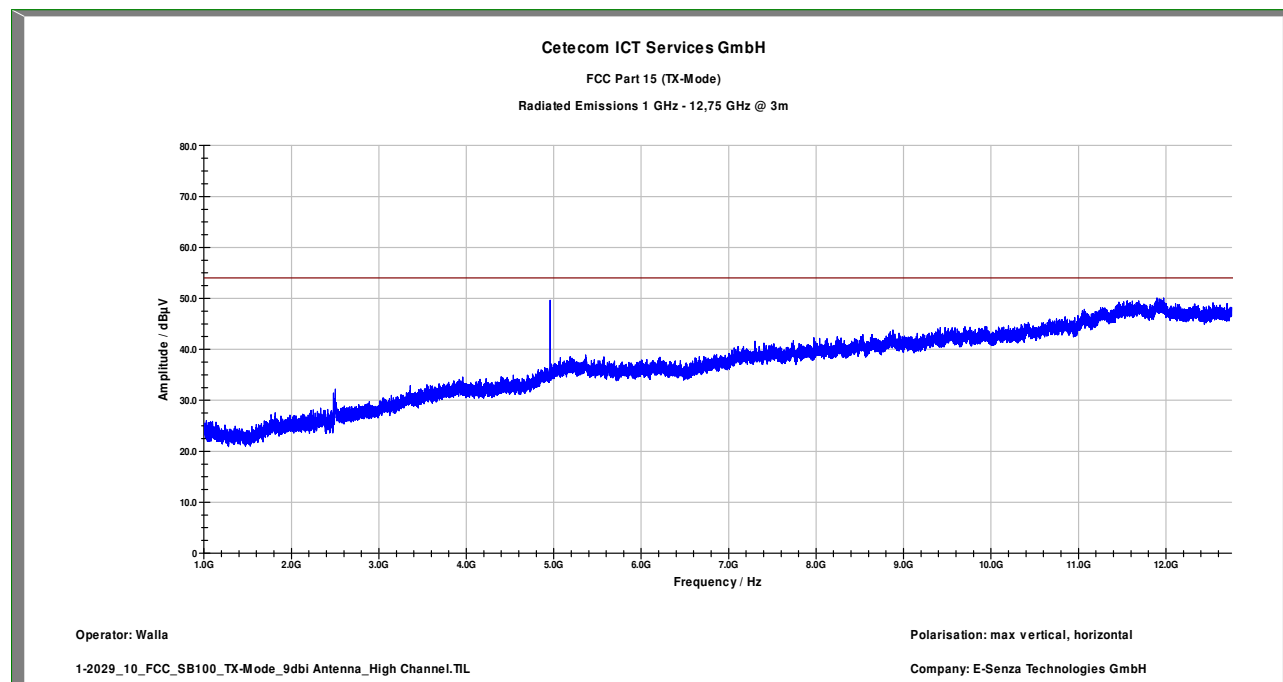
Frequency (MHz)	QuasiPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
36.000000	13.1	15000.000	120.000	213.0	V	66.0	13.1	16.9	30.0
44.400000	8.6	15000.000	120.000	220.0	V	-2.0	13.3	21.4	30.0
534.240000	15.4	15000.000	120.000	220.0	H	250.0	19.2	20.6	36.0
596.160000	17.3	15000.000	120.000	220.0	V	284.0	20.7	18.7	36.0
741.360000	20.5	15000.000	120.000	220.0	V	332.0	23.5	15.5	36.0
952.680000	22.6	15000.000	120.000	220.0	H	110.0	25.4	13.4	36.0

Hardware Setup: EMI radiated\Electric Field (NOS) - [EMI radiated]

Subrange 1	
Frequency Range:	30 MHz - 2 GHz
Receiver:	Receiver [ESCI 3] @ GPIB0 (ADR 20), SN 100083/003, FW 3.32, CAL 07.01.2009
Signal Path:	without Notch FW 1.0
Antenna:	VULB 9163 SN 9163-295, FW ---, CAL 08.04.2010 Correction Table (vertical): VULP6113 Correction Table (horizontal): VULP6113 Correction Table: Cabel with switch (0908)
Antenna Tower:	Tower [EMCO 2090 Antenna Tower] @ GPIB0 (ADR 8), FW REV 3.12
Turntable:	Turntable [EMCO Turntable] @ GPIB0 (ADR 9), FW REV 3.12

EMC 32 Version 6.30.10 + Service Pack 2

Plot 7: 1 - 12 GHz, antenna vertical/horizontal (highest channel)

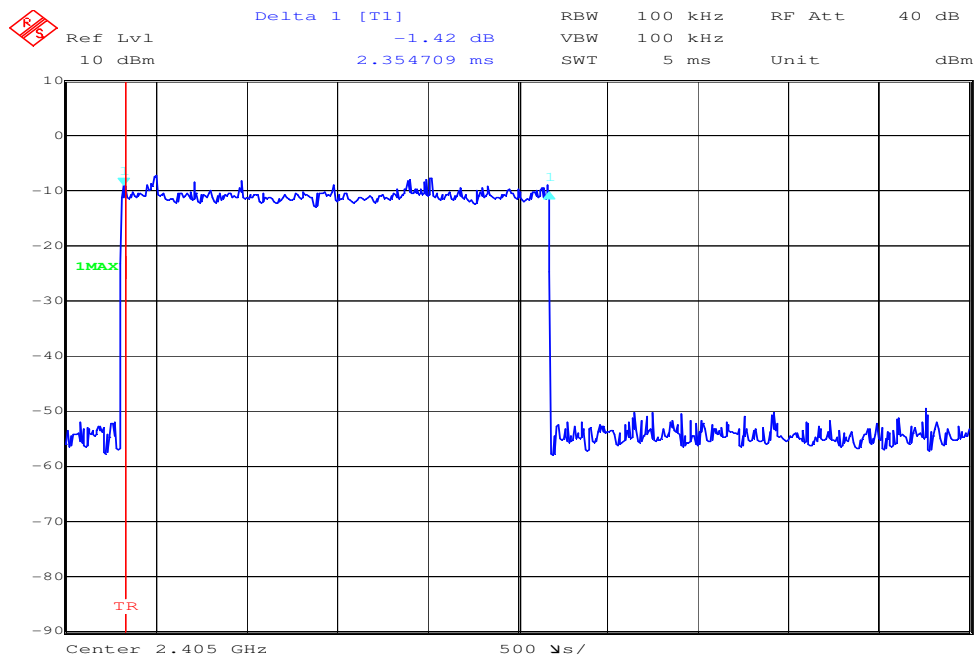


Carrier suppressed with a rejection filter.

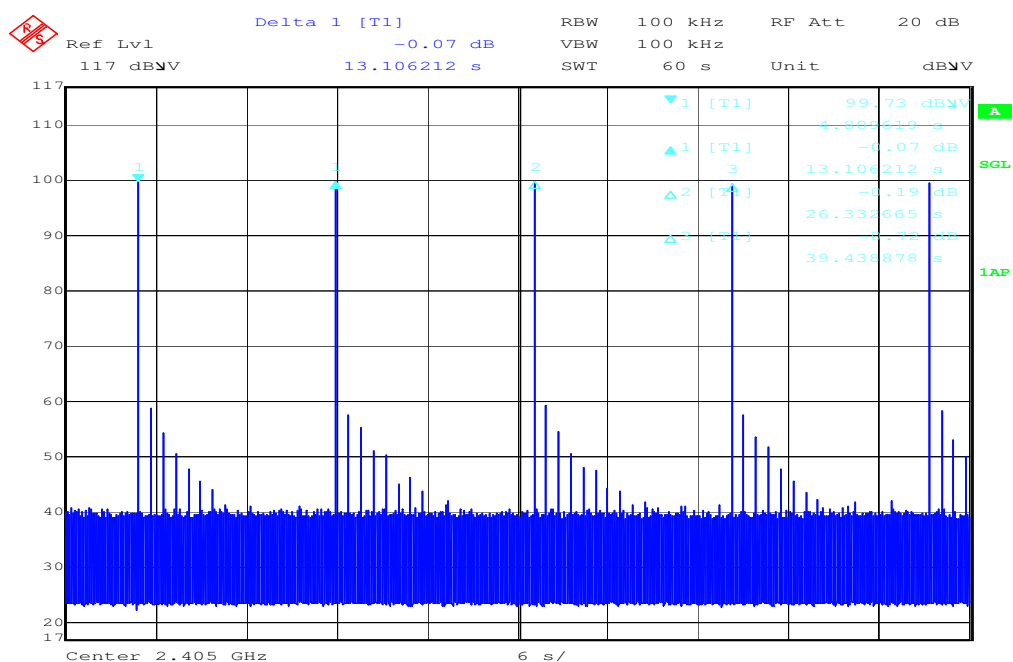
Results:

For radiated spurious emission the limits of 15.209 applies for all frequencies mentioned in 15.205. The average emission shall be determined by using Video averaging (VBW=10 Hz). If the dwell time of the hopping signal is less than 100 ms (per channel), the VBW=10 Hz reading may be adjusted by a factor $F = 20\log(\text{dwell time}/100 \text{ ms})$. In a period of 100 ms, we have a maximum of 1 transmission and that gives the correction factor for spurious measurement $F = 20\log(1 * 2.35 / 100) = -32.57 \text{ dB}$

Plot 8:



Plot 9:



- Antenna A

SPURIOUS EMISSIONS LEVEL [dB μ V/m]								
2405 MHz			2445 MHz			2480 MHz		
Frequency [MHz]	Detector	Level [dB μ V/m]	Frequency [MHz]	Detector	Level [dB μ V/m]	Frequency [MHz]	Detector	Level [dB μ V/m]
4810	*Avg	32.78	4890	*Avg	32.08	4960	*Avg	31.52
9620	Average	47.80	9780	Average	46.55	9920	Average	45.42
Measurement uncertainty			± 3 dB					

f < 1 GHz : RBW/VBW: 100 kHz

f \geq 1GHz : RBW/VBW: 1 MHz***Avg:** Detector Average (RBW = 1 MHz; VBW = 10 Hz) corrected with the correction factor F = -32.57 dB.**Average:** Detector Average (RBW = 1 MHz; VBW = 10 Hz).

- Antenna B

SPURIOUS EMISSIONS LEVEL [dB μ V/m]								
2405 MHz			2445 MHz			2480 MHz		
Frequency [MHz]	Detector	Level [dB μ V/m]	Frequency [MHz]	Detector	Level [dB μ V/m]	Frequency [MHz]	Detector	Level [dB μ V/m]
4810	*Avg	31.35	4890	*Avg	30.45	4960	*Avg	30.05
9620	Average	43.53	9780	Average	43.29	9920	Average	43.36
Measurement uncertainty			± 3 dB					

f < 1 GHz : RBW/VBW: 100 kHz

f \geq 1GHz : RBW/VBW: 1 MHz***Avg:** Detector Average (RBW = 1 MHz; VBW = 10 Hz) corrected with the correction factor F = -32.57 dB.**Average:** Detector Average (RBW = 1 MHz; VBW = 10 Hz).

- Antenna C

SPURIOUS EMISSIONS LEVEL [dB μ V/m]								
2405 MHz			2445 MHz			2480 MHz		
Frequency [MHz]	Detector	Level [dB μ V/m]	Frequency [MHz]	Detector	Level [dB μ V/m]	Frequency [MHz]	Detector	Level [dB μ V/m]
4810	*Avg	27.45	4890	*Avg	27.57	4960	*Avg	27.21
9620	Average	42.42	9780	Average	42.12	9920	Average	41.95
Measurement uncertainty			± 3 dB					

f < 1 GHz : RBW/VBW: 100 kHz

f \geq 1GHz : RBW/VBW: 1 MHz***Avg:** Detector Average (RBW = 1 MHz; VBW = 10 Hz) corrected with the correction factor F = -32.57 dB.**Average:** Detector Average (RBW = 1 MHz; VBW = 10 Hz).

- Antenna D

SPURIOUS EMISSIONS LEVEL [dB μ V/m]								
2405 MHz			2445 MHz			2480 MHz		
Frequency [MHz]	Detector	Level [dB μ V/m]	Frequency [MHz]	Detector	Level [dB μ V/m]	Frequency [MHz]	Detector	Level [dB μ V/m]
4810	*Avg	24.55	4890	*Avg	24.38	4960	*Avg	24.75
9620	Average	40.25	9780	Average	40.32	9920	Average	40.45
Measurement uncertainty			± 3 dB					

f < 1 GHz : RBW/VBW: 100 kHz

f \geq 1GHz : RBW/VBW: 1 MHz***Avg:** Detector Average (RBW = 1 MHz; VBW = 10 Hz) corrected with the correction factor F = -32.57 dB.**Average:** Detector Average (RBW = 1 MHz; VBW = 10 Hz).**Limits:**

§ 15.35 (b)

Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see Sec. Sec. 15.250, 15.252, 15.255, and 15.509-15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

Limits:

§ 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Limits:

§ 15.209

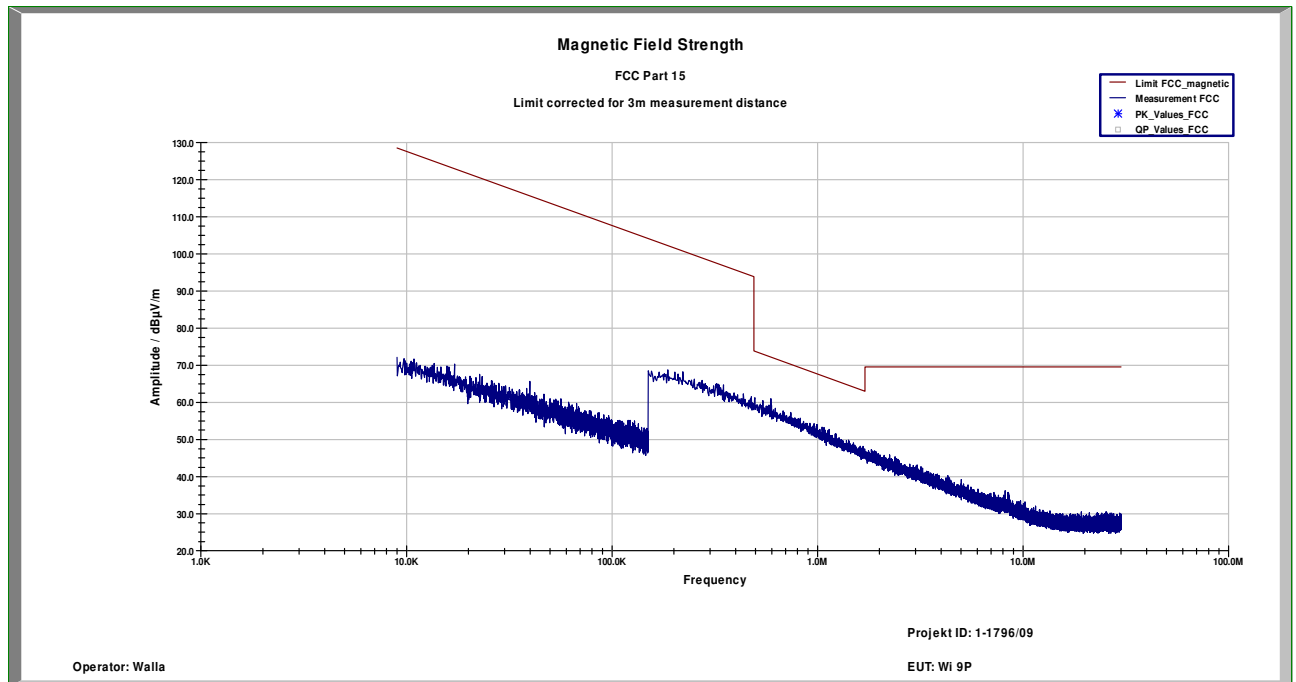
Frequency [MHz]	Field strength [μ V/m]	Measurement distance (m)
30 - 88	100 (40 dB μ V/m)	3
88 - 216	150 (43.5 dB μ V/m)	3
216 - 960	200 (46 dB μ V/m)	3
above 960	500 (54 dB μ V/m)	3

5.16 Spurious Emissions < 30 MHz - Transmitter radiated § 15.209

Measured at 3 m distance.

Values recalculated with 40 dB/decade according to FCC rules.

Plot 10: TX – Mode

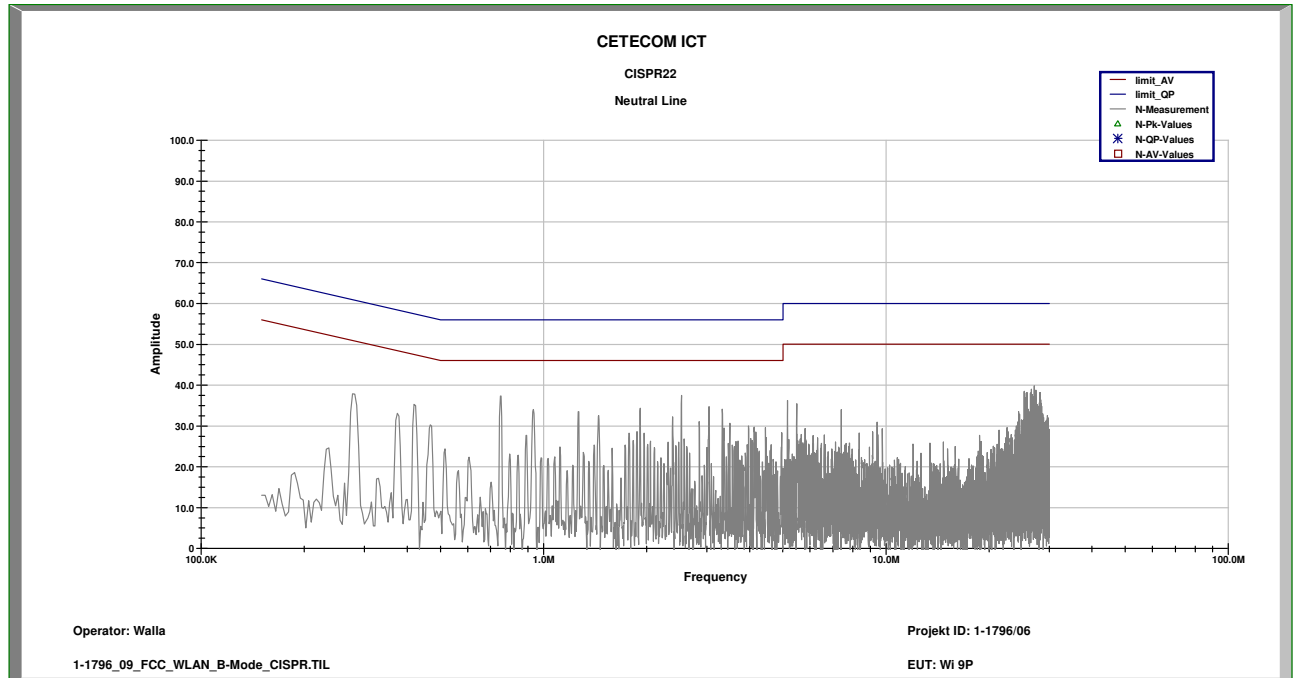


Limits:

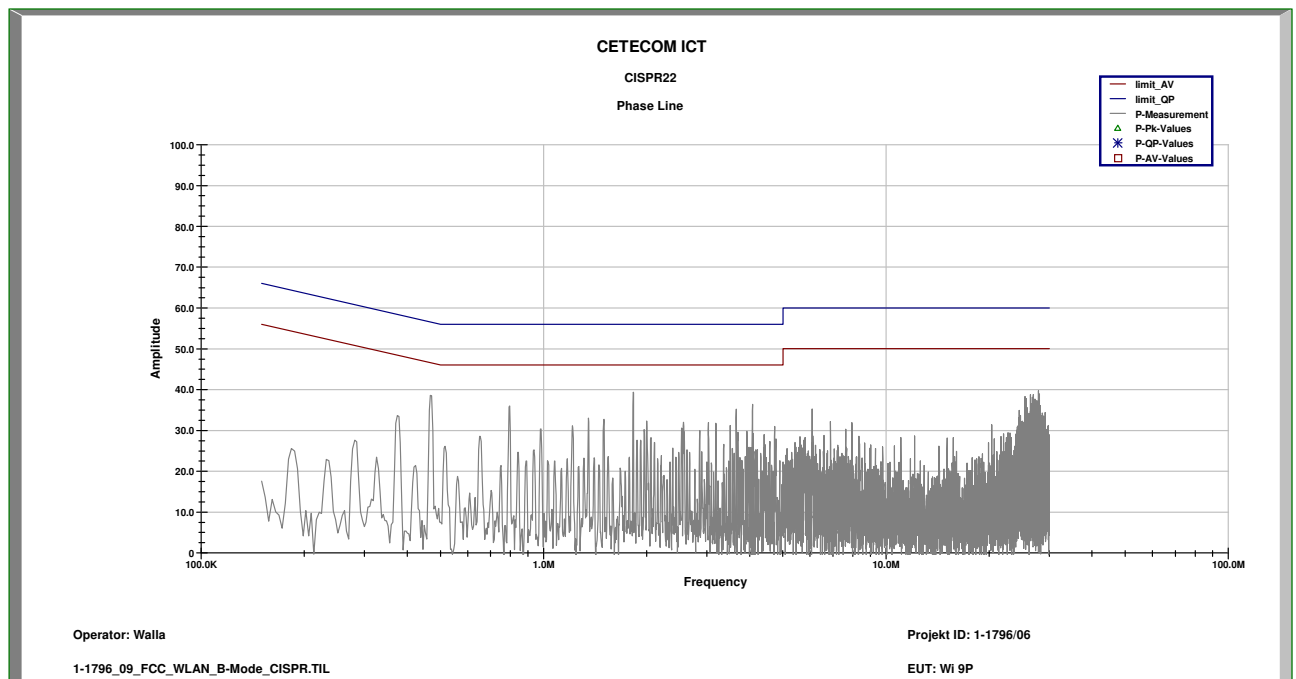
Frequency (MHz)	Field strength (μV/m)	Measurement distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30 / 29.5 dBμV/m	30
30 - 88	100 / 40 dBμV/m	3
88 - 216	150 / 43.5 dBμV/m	3
216 - 960	200 / 46 dBμV/m	3
above 960	54 dBμV/m	3

5.17 Conducted Emissions <30 MHz § 15.107/207

Plot 11: TX – Mode, Neutral line



Plot 12: TX – Mode, Phase line



Limits:

Under normal test conditions only	See plots
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6 Test equipment and ancillaries used for tests

In order to simplify the identification of the equipment used at each specific test, each item of test equipment and ancillaries are provided with an identifier or number in the equipment list below.

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, rf-generating and signalling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

No.	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Last Calibration	Next Calibration
1	System Autoranging DC power supply, 60Vdc, 50A, 1200 W	6032A	HP Meßtechnik	2818A03450	300001040	08.01.2009	08.01.2012
2	PowerAttenuator	8325	Byrd	1530	300001595		
3	Double-Ridged Waveguide Horn Antenna 1- 26.5GHz	3115	EMCO	8812-3088	300001032	05.03.2009	05.03.2011
4	Active Loop Antenna	6502	EMCO	2210	300001015		
5	Anechoic chamber		MWB	87400/02	300000996		
6	System rack for EMI measurement solution	85900	HP I.V.	*	300000222		
7	Artificial Mains 9 kHz to 30 MHz, 4 x 25 Ampere	ESH3-Z5	R&S	828576/020	300001210	06.01.2010	06.01.2012
8	Relais Matrix	3488A	HP Meßtechnik	2719A15013	300001156		
9	Relais Matrix	PSU	R&S	890167/024	300001168		
10	Isolating Transformer	RT5A	Grundig	9242	300001263		
11	Three-Way Power Splitter, 50 Ohm	11850C	HP Meßtechnik		300000997		
12	Switch / Control Unit	3488A	HP	2605e08770	300001443		
13	Band Reject filter	WRCG1855/1910-1835/1925-40/8SS	Wainwright	7	300003350		
14	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351		
15	TILE-Software Emission	Quantum Change, Modell TILE-ICS/FULL	EMCO	none	300003451		
16	Highpass Filter	WHKX2.9/18G-12SS	Wainwright	1	300003492		
17	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255		
18	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789		
19	PSA Spectrum Analyzer 3 Hz - 26.5 GHz	E4440A	Agilent Vertr. Bad Hom	MY48250080	300003812	05.08.2008	05.08.2010
20	MXG Microwave Analog Signal Generator	N5183A	Agilent Vertr. Bad Hom	MY47420220	300003813	06.08.2008	06.08.2010
21	RF Filter Section 9kHz - 1GHz	N9039A	Agilent Vertr. Bad Hom	MY48260003	300003825	19.08.2008	19.08.2010
22	TRILOG Super Breitband Antenne	VULB9163	Schwarzbeck	371	300003854	17.12.2008	17.12.2010
23	DC Power Supply 0 – 32V	1108-32	Heiden	1802	300001383	13.05.2007	13.05.2010

24	Signal Analyzer 20Hz-26,5GHz- 150 to + 30 DBM	FSiQ26	R&S	835111/0004	300002678	06.01.2009	06.01.2011
25	Switch-Unit	3488A	HP Meßtechnik	2719A14505	300000368		
26	Netzgerät	6032A	HP Meßtechnik	2920A04466	300000580	06.01.2009	06.01.2011
27	EMI- Messempfänger	ESCI 1166.5950.03	R&S	100083	300003312	08.01.2010	08.01.2012
28	Amplifier	JS42-00502650-28- 5A	MITEQ	1084532	300003379		
29	Antennenmast	Model 2175	ETS- LINDGREN	64762	300003745		
30	Steuergerät	Model 2090	ETS- LINDGREN	64672	300003746		
31	Interface-Box für Drehtisch	Model 105637	ETS- LINDGREN	44583	300003747		
32	Breitbandantenne	VULB9163	Schwarzbeck	295	300003787	01.04.2010	01.04.2012
33	Spectrum- Analyzer	FSU26	R&S	200809	300003874	08.01.2010	08.01.2012

7 Photographs of the Test Set-up

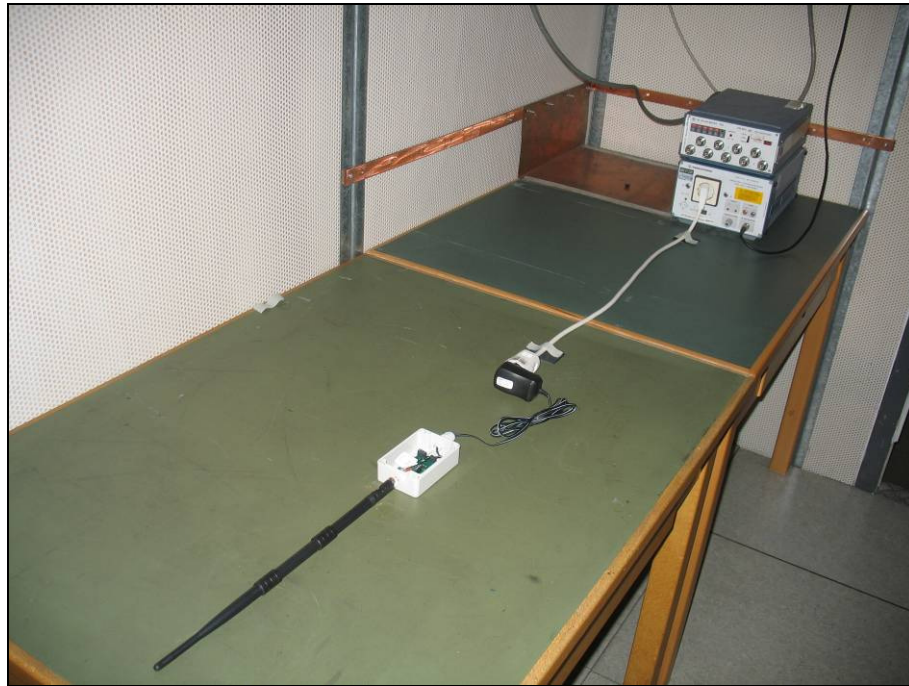
Photo 1:



Photo 2:



Photo 3:



8 Photographs of the EUT

Photo 4: Antenna A



Photo 5: Antenna B



Photo 6: Antenna C



Photo 7: Antenna D



Photo 8:



Photo 9:

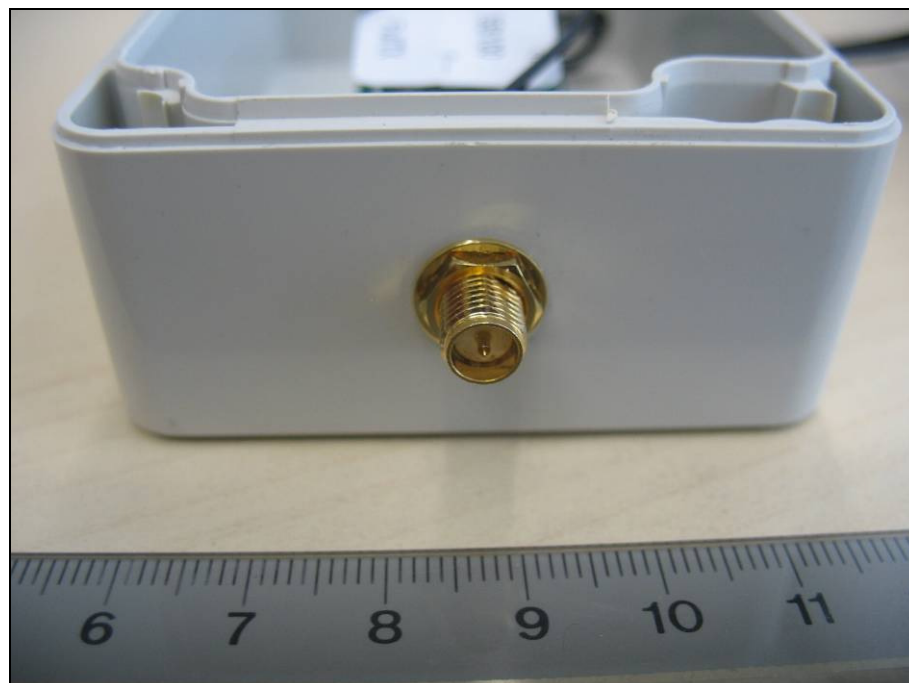


Photo 10:

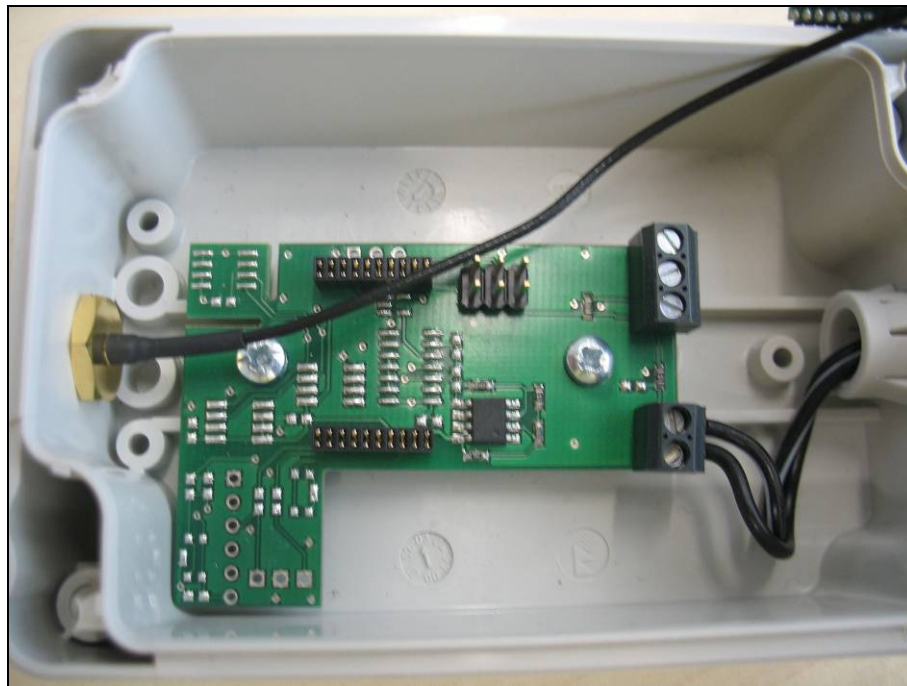


Photo 11:



Photo 12:

