

FCC ID: YJKTSX6TTX6

IC: 11148A-TSX6TTX6

EMI - TEST REPORT

- FCC Part 15.249, RSS210 -

**Test Report No. :** T36611-00-03HS

31. July 2013

Date of issue

Type / Model Name : TS460, TS462, TT460**Product Description** : Touch probe 2.4 GHz**Applicant** : Dr. Johannes Heidenhain GmbH

Address : Dr. Johannes-Heidenhain-Str. 5

83301 TRAUNREUT

Manufacturer : Dr. Johannes Heidenhain GmbH

Address : Dr. Johannes-Heidenhain-Str. 5

83301 TRAUNREUT

Licence holder : Dr. Johannes Heidenhain GmbH

Address : Dr. Johannes-Heidenhain-Str. 5

83301 TRAUNREUT

Test Result according to the
standards listed in clause 1 test
standards:**POSITIVE**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test results
without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2012)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September, 2012)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.249	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz

ANSI C63.4: 2003	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
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ANSI C95.1:2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
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CISPR 16-4-2: 2003	Uncertainty in EMC measurement
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CISPR 22: 2005 EN 55022: 2006	Information technology equipment
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2 SUMMARY

2.1 GENERAL REMARKS:

The EUT is a 2.4 GHz – transceiver for low power data transmission in the operating band of 2.4 GHz to 2.4835 GHz supporting 16 channels. Special test software is used for setting the test modes.

Variants of the EUT

Type	Comment
TS460	Touch probe
TS462	Touch probe
TT460	Touch probe

For testing the TS460 was used.

Antennas

The following integrated antenna is used with the EUT:

- PCB meander antenna.

Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel No	f
0	2405
1	2410
2	2415
3	2420
4	2425
5	2430
6	2435
7	2440
8	2445
9	2450
10	2455
11	2460
12	2465
13	2470
14	2475
15	2480

Transmit operating modes

The EUT use O-QPSK and provide following data rate:

250 kbps

(kbps = *kilobits per second*)

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2.1 Test result summary

Operating in the 2400 MHz – 2483.5 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.35(c)	RSS-Gen, 4.5	Pulsed operation	not applicable
15.203	RSS Gen, 7.1.2	Antenna requirement	passed
15.204	RSS Gen, 7.1.1	External radio frequency power amplifiers	passed
15.205(a)	RSS-Gen, 7.2.2	Emissions in restricted bands	passed
15.207(a)	RSS Gen, 7.2.4	AC power line conducted emissions	not applicable
15.215(c)		EBW	passed
	RSS-Gen, 4.6.1	OBW	passed
15.249(a)	RSS-210, A2.9(a)	Field strength of fundamental	passed
15.249(d)	RSS Gen, 7.2.5	Out-of-band emission, radiated	passed
	RSS-Gen, 7.2.6	Transmitter frequency stability	not applicable

The mentioned RSS Rule Parts in the above table are related to:

RSS Gen, Issue 3, December 2010

RSS 210, Issue 8, December 2010

RSS 102, Issue 4, March 2010

2.2 FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 4 March 2013

Testing concluded on : 3 June 2013

Checked by:

Tested by:

Klaus Gegenfurtner
Dipl.-Ing.(FH)
Manager: Radio Group

Hermann Smetana
Dipl.-Ing.(FH)
Radio Expert

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3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Please see attachment A

3.2 Power supply system utilised

Power supply voltage : 3.6 VDC lithium battery (TS460, TS462 and TT460)

3.3 Short description of the equipment under test (EUT)

The EUT is a touch probe for the 2.4 GHz band and works together with the transceiver unit SE660 after pairing.

Number of tested samples: 1
Serial number: 40960018

EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- TX continuous mode, unmodulated

EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

The following peripheral devices and interface cables were connected during the measurements:

-	-	Model :	-
-		Model :	
-		Model :	
-		Model :	

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4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**mikes-testingpartners gmbh
Ohmstrasse 2-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader may notice that tolerances within the calibration of the equipment and facilities may cause additional uncertainty. The measurement uncertainty is calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurement“ and documented in the mikes-testingpartners gmbh quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, mikes-testingpartners gmbh, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component diversity and modifications in production processes may result in additional deviation. If necessary, refer to the test lab for the actual measurement uncertainty for specific tests. The manufacturer has the sole responsibility of continued compliance of the EUT.

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4.4 Measurement protocol for FCC and IC

4.4.1 General information

4.4.1.1 Test methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A-1

In compliance with RSS 210 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.4.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.1.3 Details of test procedures

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.5 Determination of worst case measurement conditions

Measurements have been made in all three orthogonal axes and the settings of the EUT were changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in Y position.

As worst case the following channels and test modes are selected for the final test:

Standard	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
Proprietary	0 to 15	0, 7, 15	max	O-QPSK	digital	250 kbps

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5 TEST CONDITIONS AND RESULTS

5.1 Conducted emissions

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

Test location: NONE

Remarks: Not applicable, the EUT is battery powered only.

5.2 Radiated emission of the fundamental wave

For test instruments and accessories used see section 6 Part CPR 3.

5.2.1 Description of the test location

Test location: Anechoic chamber 2

Test distance: 3 m

5.2.2 Photo documentation of the test set-up



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5.2.1 Applicable standard

According to FCC Part 15C, Section 15.249(a):

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the effective limits.

5.2.2 Description of Measurement

The radiated emission of the fundamental wave from the EUT is measured using a spectrum analyser and appropriate linear polarized antennas.

Analyser settings:

Peak measurement: RBW: 1 MHz

VBW: 1 MHz

Detector: Max peak

5.2.3 Test result

Frequency (MHz)	Level PK dB(μV/m)	Limit PK dB(μV/m)	Margin PK (dB)	Level AV dB(μV/m)	Limit AV dB(μV/m)	Margin AV (dB)
2405	88.0	114.0	-26.0	74.5	94.0	-19.5
2440	89.9	114.0	-24.1	76.4	94.0	-17.6
2480	86.9	114.0	-27.1	73.4	94.0	-20.6

Note: The correction factor 13.5 dB is used to calculate the AV level.

Average-Limit according to FCC Part 15C, Section 15.249(a):

Frequency (MHz)	Field strength of fundamental	
	(mV/m)	dB(μV/m)
902 - 928	50	94
2400 - 2483.5	50	94
5725-5875	50	94
24000 - 24250	250	108

Peak-Limit according to FCC Part 15C, Section 15.249(e):

However the peak fieldstrength shall not exceed the maximum permitted average limit by more than 20 dB.

The requirements are **FULFILLED**.

Remarks:

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5.3 Spurious emissions radiated

For test instruments and accessories used see section 6 Part **SER1, SER 2, SER 3.**

5.3.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 2

Test distance: 3 m

5.3.2 Photo documentation of the test set-up



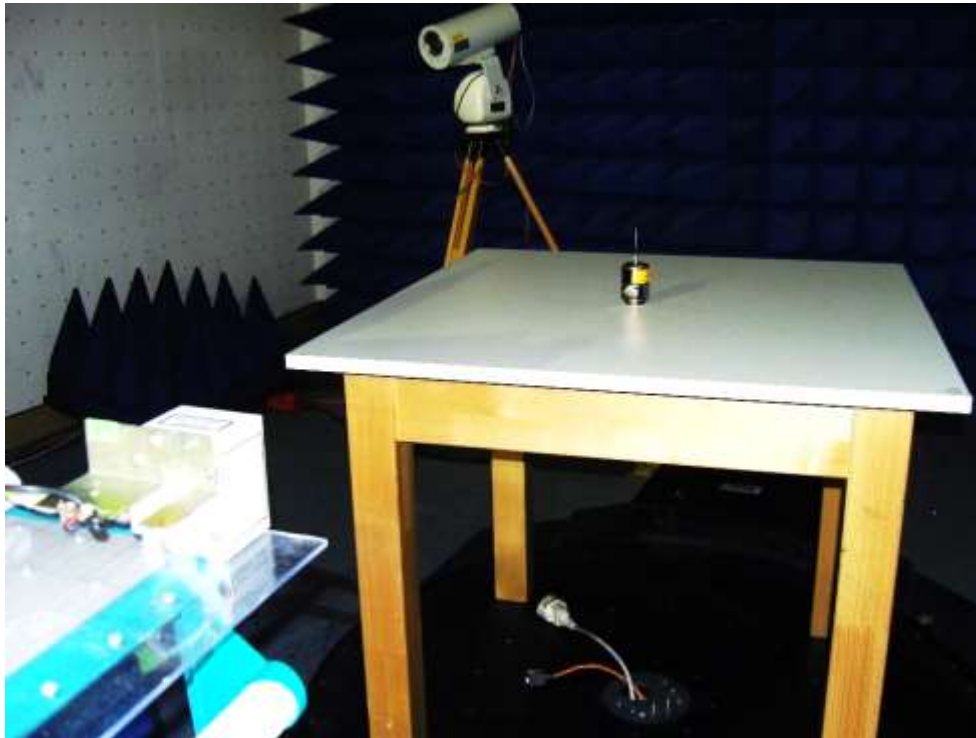
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5.3.3 Applicable standard

According to FCC Part 15C, Section 15.249 (d):

Emission radiated outside of the specified frequency bands, except harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limit in FCC Part 15C, Section 15.209, whichever is the lesser attenuation.

5.3.4 Description of Measurement

The radiated emissions from the EUT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The set up of the EUT will be in accordance to ANSI C63.4. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. If the emission level in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported. During the test, the EUT was set into continuous transmitting mode modulated.

Instrument settings:

9 kHz – 150 kHz	RBW:	200 Hz
150 kHz - 30 MHz	RBW:	9 kHz
30 MHz – 1000 MHz:	RBW:	120 kHz
1000 MHz – 40 GHz	RBW:	1 MHz

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5.3.1 Test result $f < 30$ MHz

Note: In the frequency range 9 kHz to 30 MHz no emission could be detected. The frequencies in the table mention the noise level. The measurement results from distance 3 m are extrapolated (D factor) to the specified distance.

Frequency (MHz)	Reading PK dB(μ V)	D factor dB(μ V/m)	Level PK dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.047	52.0	-80.0	-28.0	34.2	-62.2
1.5	51.0	-40.0	11.0	24.1	-13.1
18.2	39.0	-40.0	-1.0	29.5	-30.5

5.3.2 Test result $f < 1$ GHz

Note: In the frequency range 30 MHz to 1000 MHz no emission could be detected. The noise level is independent of the channel setting. Therefore only the table for CH0 is shown.

CH0

Frequency (MHz)	Level QP dB(μ V/m)	Limit QP dB(μ V/m)	Delta (dB)
280	18.0	46.0	-28.0
600	25.2	46.0	-20.8
920	27.3	46.0	-18.7

5.3.3 Test result $f > 1$ GHz

CH0

Frequency (MHz)	Level PK dB(μ V/m)	Level AV dB(μ V/m)	Limit PK dB(μ V/m)	Margin PK (dB)	Limit AV dB(μ V/m)	Margin AV (dB)
3023	46.3	-	74.0	-27.7	54.0	-
3871	47.7	-	74.0	-26.3	54.0	-
4810	50.2	-	74.0	-23.8	54.0	-
7215	48.9	-	74.0	-25.1	54.0	-
17847	52.5	-	74.0	-21.5	54.0	-
24920	53.6	-	74.0	-20.4	54.0	-

CH7

Frequency (MHz)	Level PK dB(μ V/m)	Level AV dB(μ V/m)	Limit PK dB(μ V/m)	Margin PK (dB)	Limit AV dB(μ V/m)	Margin AV (dB)
1310	44.6	-	74.0	-29.4	54.0	-
3810	47.9	-	74.0	-26.1	54.0	-
4880	52.8	-	74.0	-21.2	54.0	-
7320	48.6	-	74.0	-25.4	54.0	-
17907	53.5	-	74.0	-20.5	54.0	-
24753	53.9	-	74.0	-20.1	54.0	-

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CH15

Frequency (MHz)	Level PK dB(μV/m)	Level AV dB(μV/m)	Limit PK dB(μV/m)	Margin PK (dB)	Limit AV dB(μV/m)	Margin AV (dB)
1266	44.6	-	74.0	-29.4	54.0	-
3890	48.0	-	74.0	-26.0	54.0	-
4960	53.5	-	74.0	-20.5	54.0	-
7440	48.8	-	74.0	-25.2	54.0	-
17847	52.5	-	74.0	-21.5	54.0	-
24944	53.8	-	74.0	-20.2	54.0	-

Limit according to FCC Part 15C, Section 15.209:

Frequency (MHz)	15.209 Limits dB(μV/m)	Measurement distance (m)
0.009 - -0.49	2400/f(kHz)	300
0.49 – 1.705	24000/f(kHz)	30
1.705 – 30.0	30	30
30-88	40	3
88-216	43,5	3
216-960	46	3
Above 960	54	3

Average limit according to FCC Part 15C, Section 15.249(a):

Fundamental frequency (MHz)	Field strength of harmonics	
	(μV/m)	dB(μV/m)
902 - 928	500	54
2400 - 2483.5	500	54
5725-5875	500	54
24000 - 24250	2500	68

The requirements are **FULFILLED**.

Remarks: The measurement is performed up to the 10th harmonic (25000 MHz). For detailed test result
please refer to following test protocols. Only the worst case plots are listed.

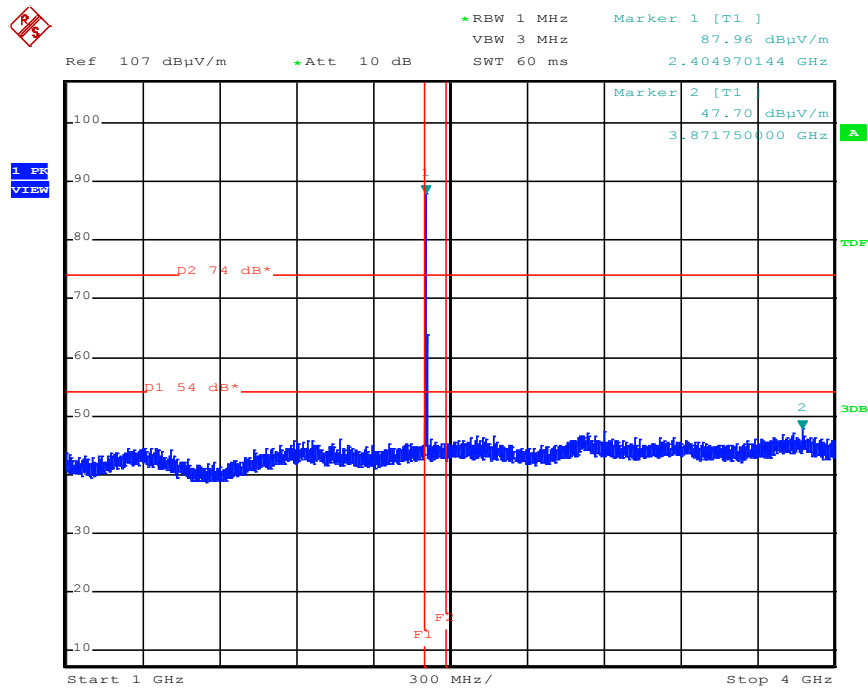
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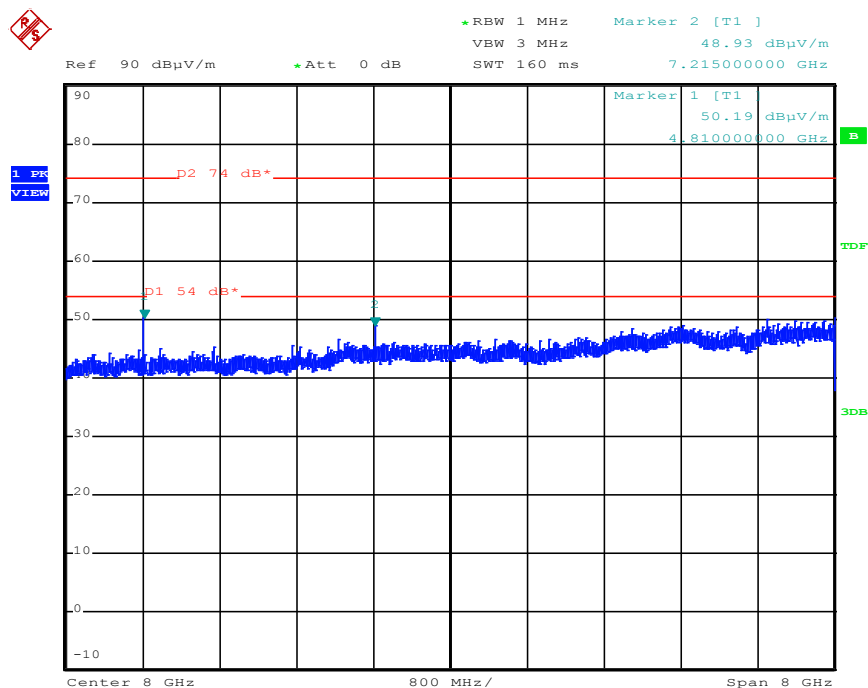
5.3.4 Test protocols

CH0:

Spurious emissions from 1 to 4 GHz
(incl. Fundamental carrier)



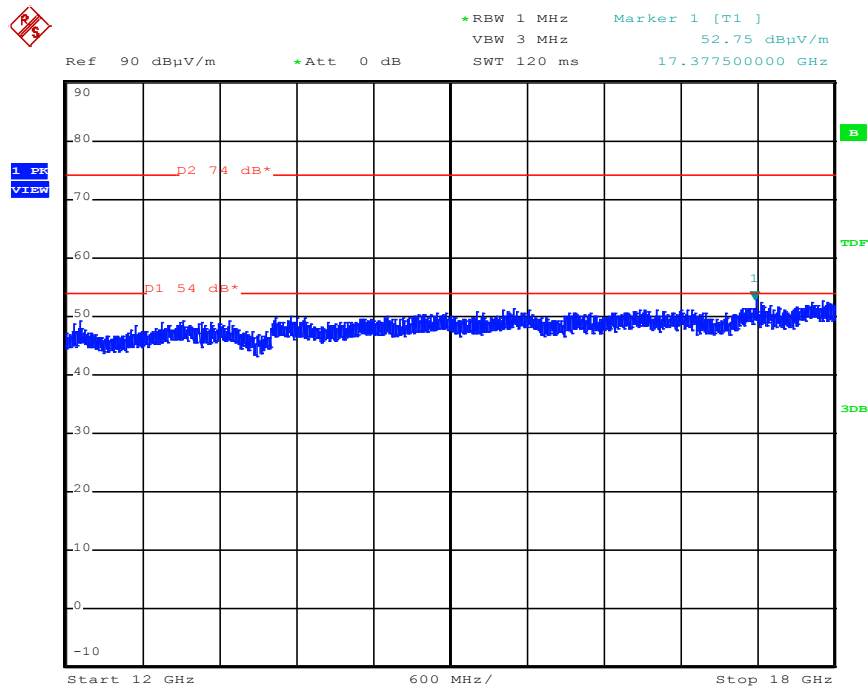
Spurious emissions from 4 to 12 GHz



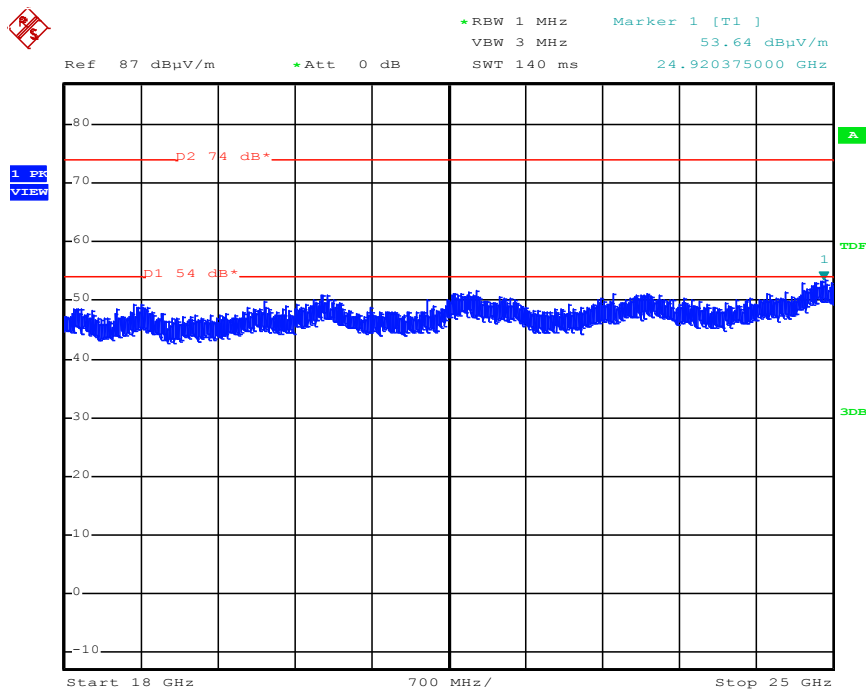
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Spurious emissions from 12 to 18 GHz



Spurious emissions from 18 to 25 GHz

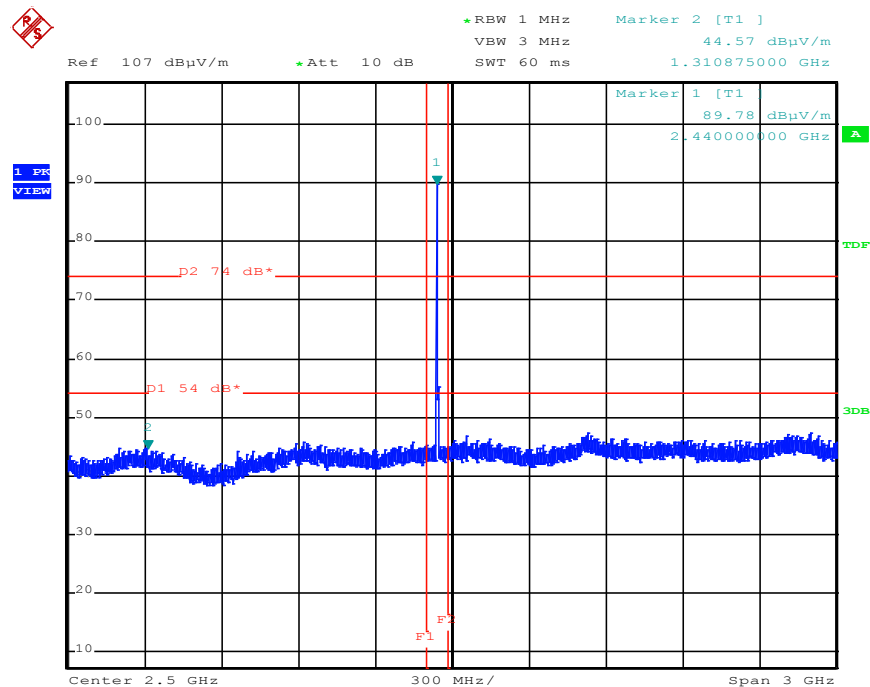


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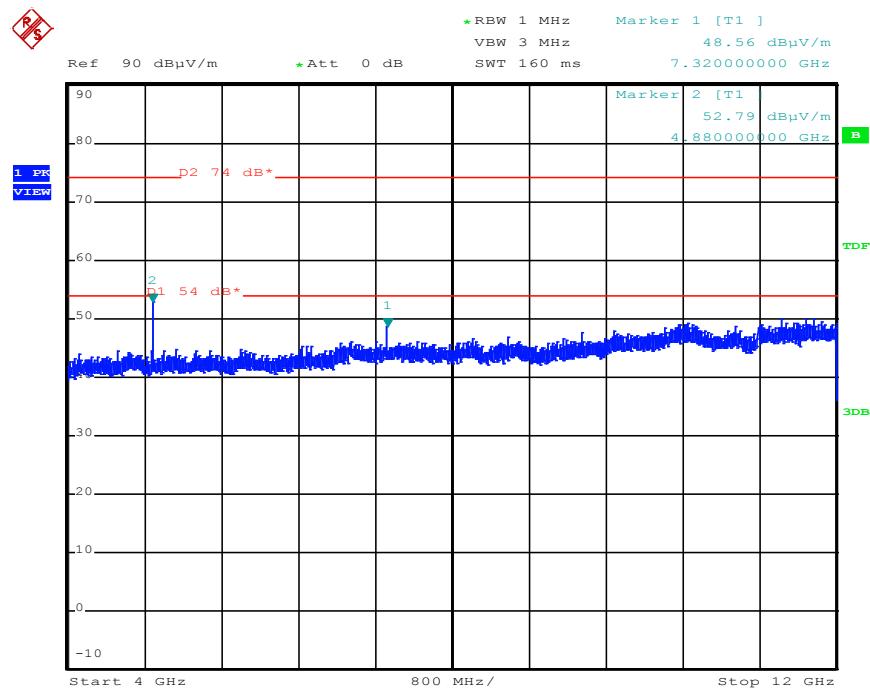
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CH7:

Spurious emissions from 1 to 4 GHz
(incl. Fundamental carrier)



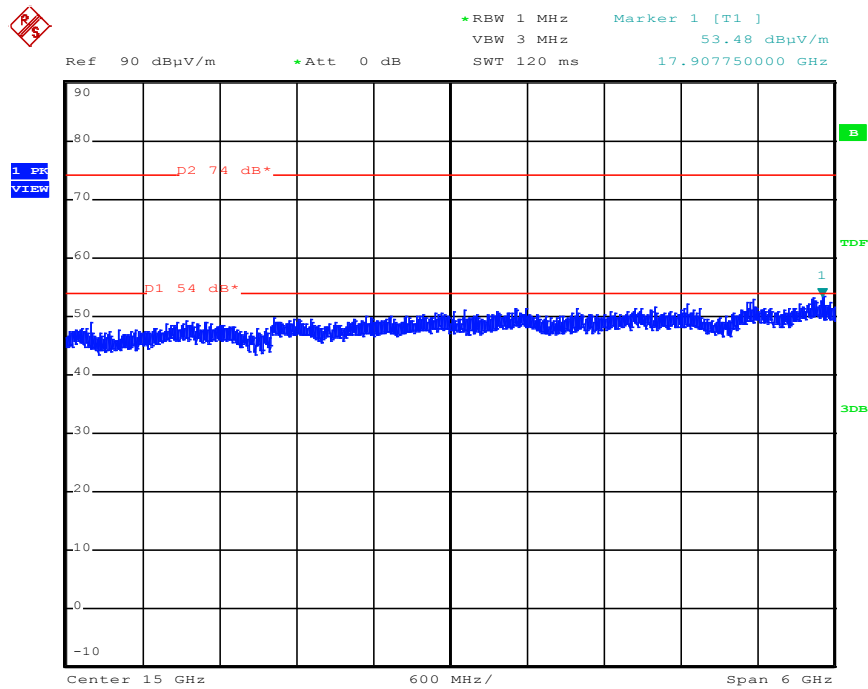
Spurious emissions from 4 to 12 GHz



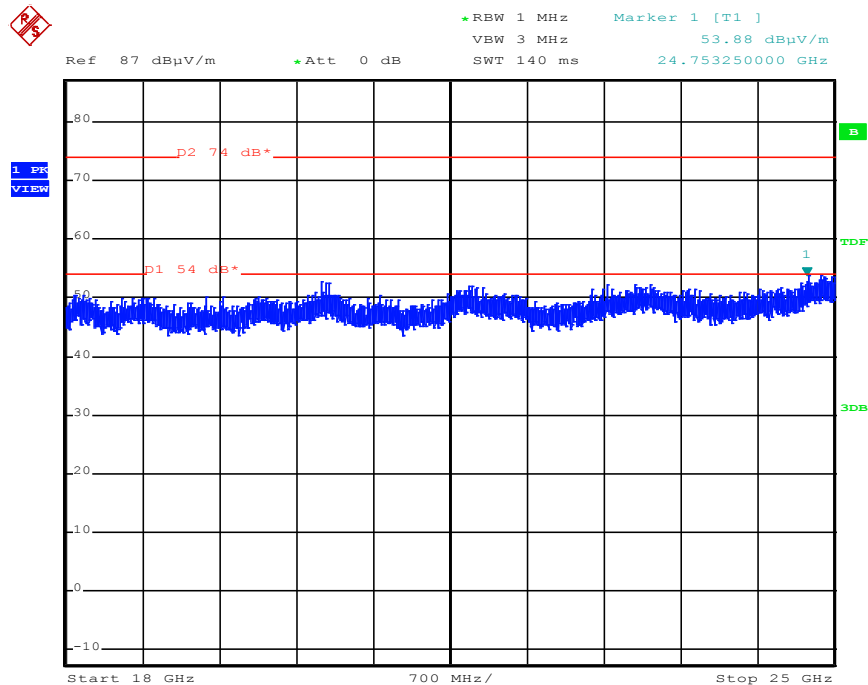
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Spurious emissions from 12 to 18 GHz



Spurious emissions from 18 to 25 GHz

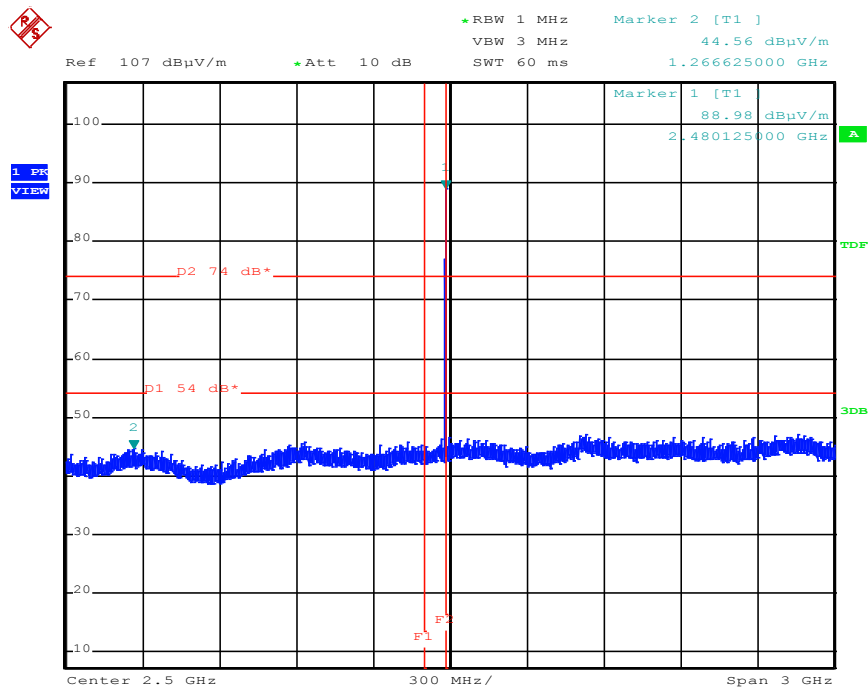


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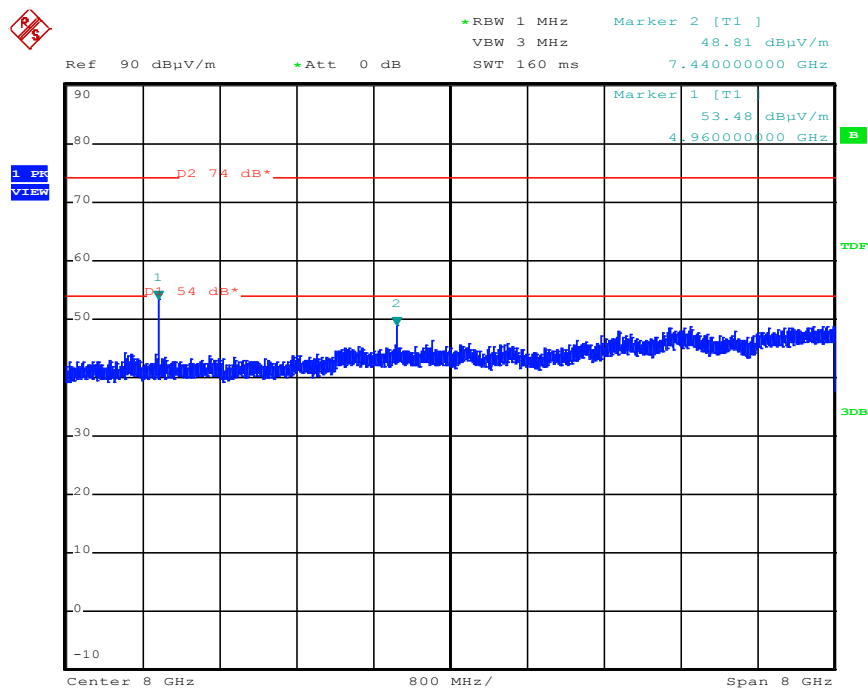
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CH15:

Spurious emissions from 1 to 4 GHz
(incl. Fundamental carrier)



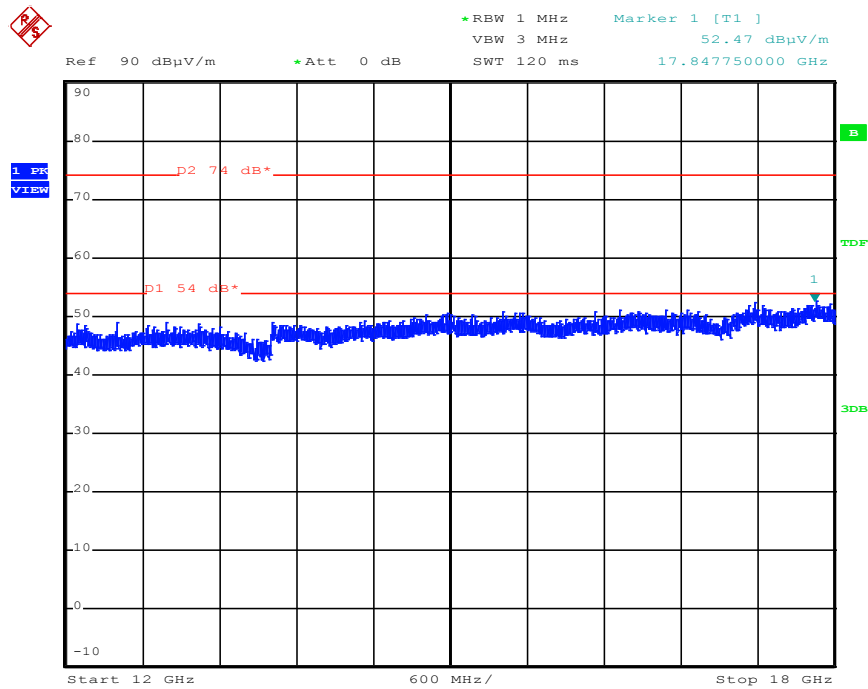
Spurious emissions from 4 to 12 GHz



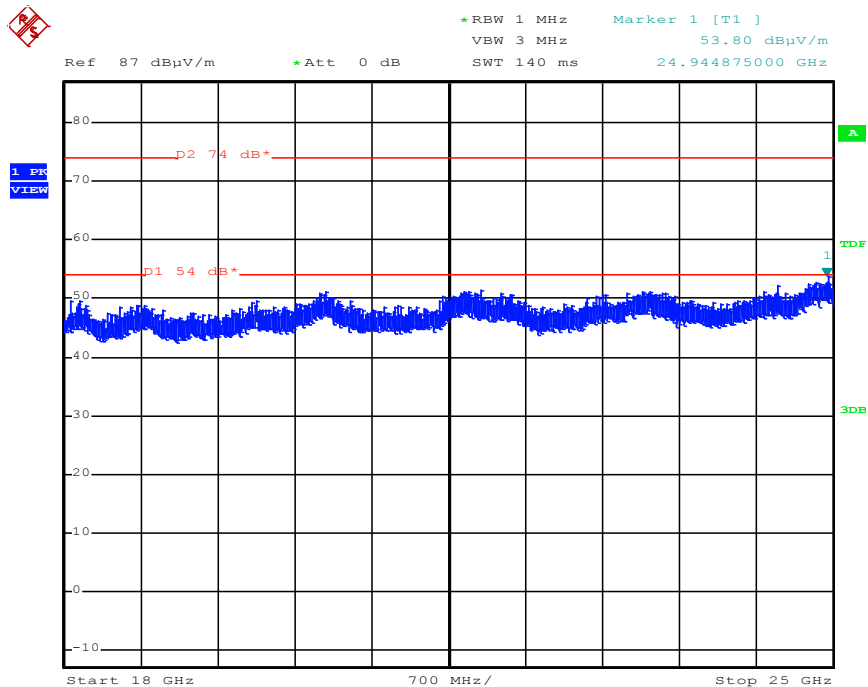
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Spurious emissions from 12 to 18 GHz



Spurious emissions from 18 to 25 GHz



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5.4 EBW and OBW

For test instruments and accessories used see section 6 Part MB.

5.4.1 Description of the test location

Test location: AREA4

5.4.2 Photo documentation of the test set-up



5.4.3 Applicable standard

According to FCC Part 15, Section 15.215(c):

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in Section 15.217 through Section 15.257, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated.

5.4.4 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -20 dB. The reference level is the level of the highest signal amplitude observed from the transmitter at the fundamental frequency. Alternative is the x-dB-down function of the analyser used. The EBW is then directly shown in the marker display. The measurement is performed with normal modulation and a transfer rate means the worst case.

Spectrum analyser settings:

RBW: 30 kHz, VBW: 100 kHz, Span: 6 MHz, Sweep time: auto, Detector: max. peak;

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5.4.5 Test result

Centre f (MHz)	20dB bandwidth f_1	20dB bandwidth f_2	Measured EBW (MHz)
2405.229	2403.580	2406.877	3.297
2439.989	2438.093	2441.885	3.792
2479.956	2478.568	2481.343	2.775

Centre f (MHz)	99% bandwidth f_1	99% bandwidth f_2	Measured OBW (MHz)
2404.994	2403.608	2406.380	2.772
2439.918	2438.467	2441.368	2.901
2479.917	2478.512	2481.321	2.809

Operating frequency band (MHz)	20 dB Bandwidth (MHz)
$f_{\text{low}} > 2400$	$f_{\text{low}} = 2403.580$
$f_{\text{high}} < 2483.5$	$f_{\text{high}} = 2481.343$

Channel bandwidth	5.000 MHz
80% bandwidth of the permitted channel:	4.000 MHz
20 dB bandwidth CH0	3.297 MHz
20 dB bandwidth CH7	3.792 MHz
20 dB bandwidth CH15	2.775 MHz

Limit according to FCC Part 15C, Section 15.215(c):

If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocols.

The OBW99 is measured for RSS only.

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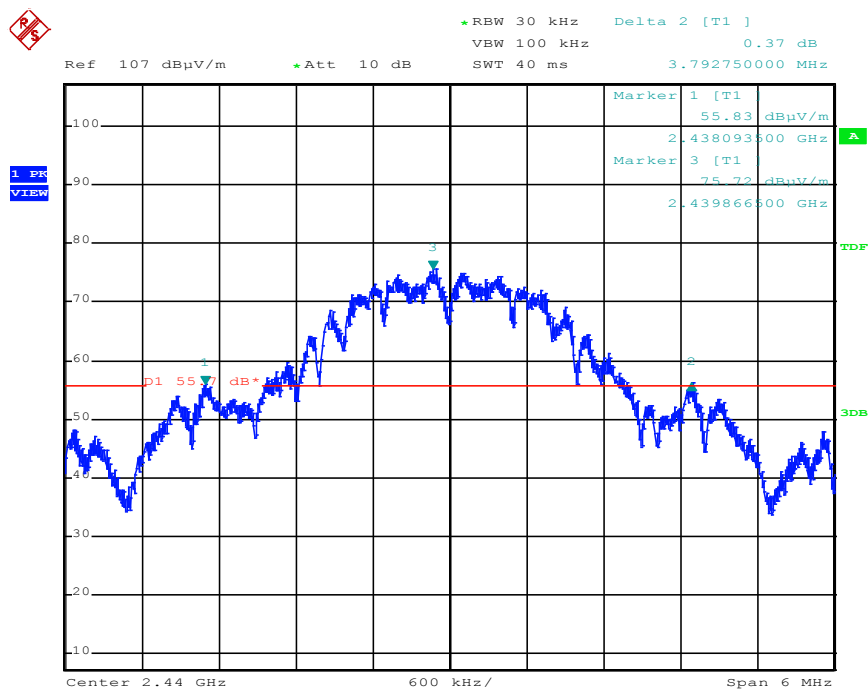
5.4.6 Test protocols

20 dB bandwidth

CH0



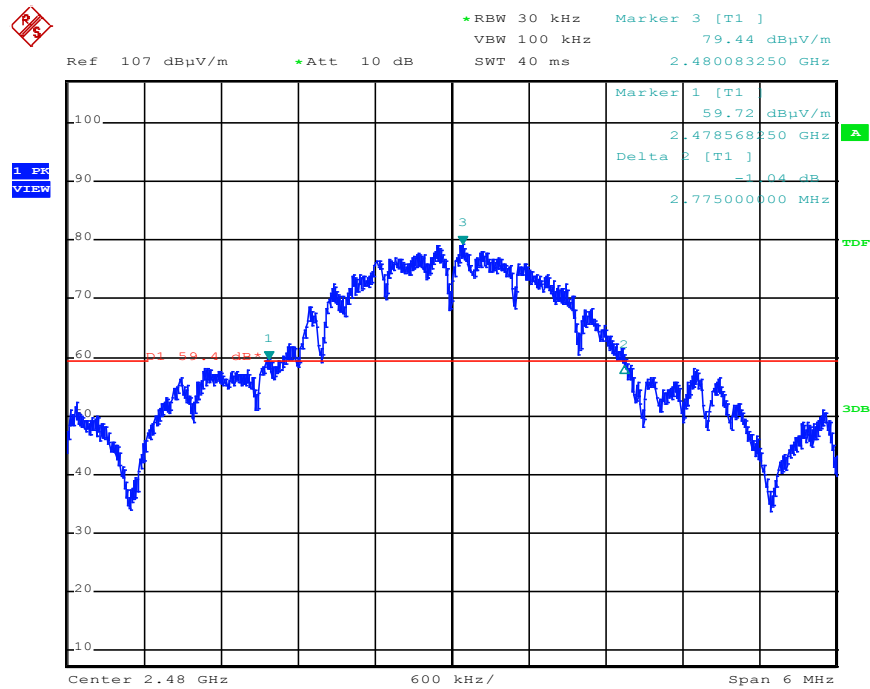
CH7



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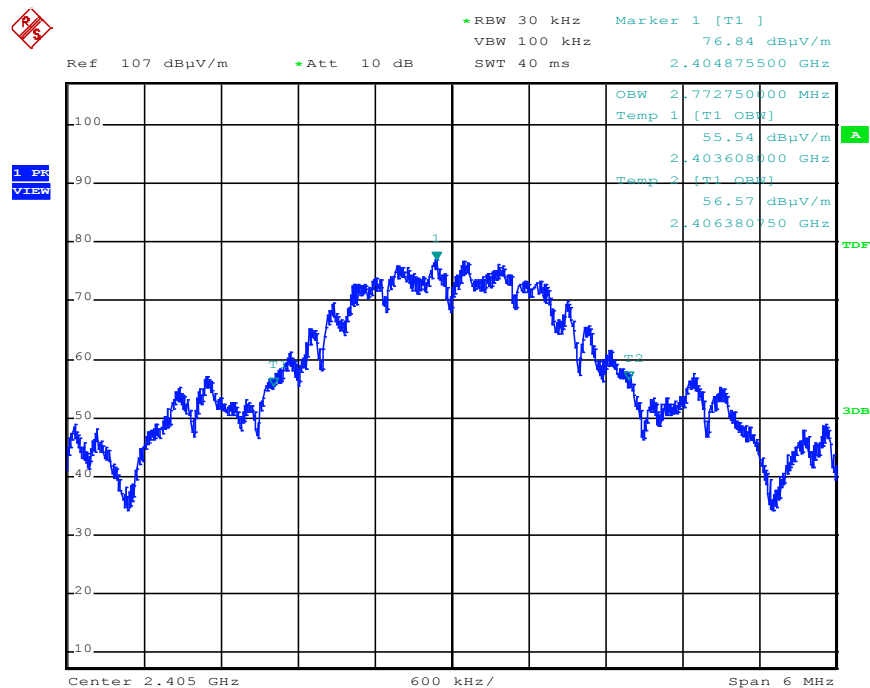
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CH15



OBW bandwidth

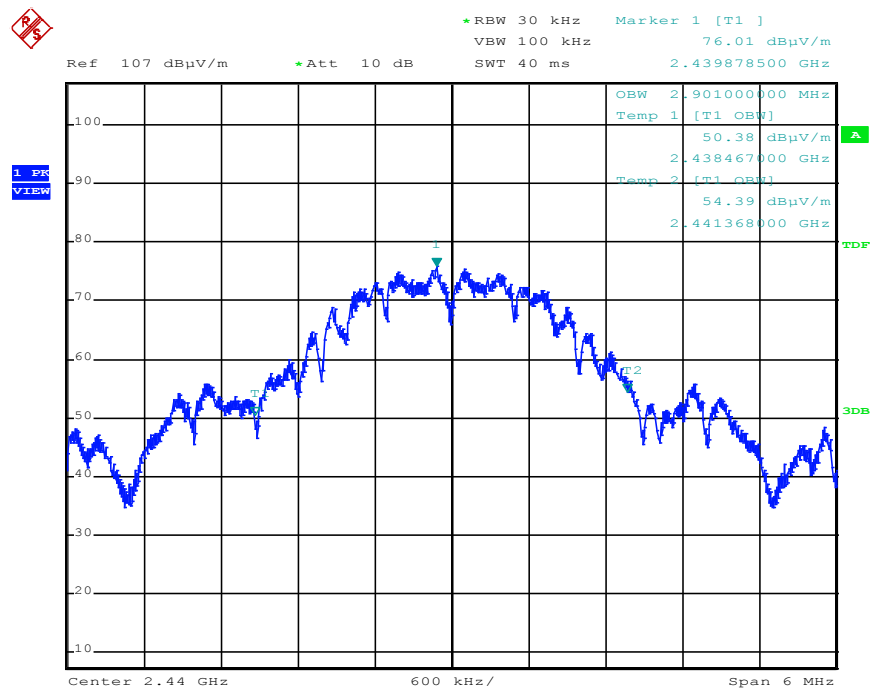
CH0



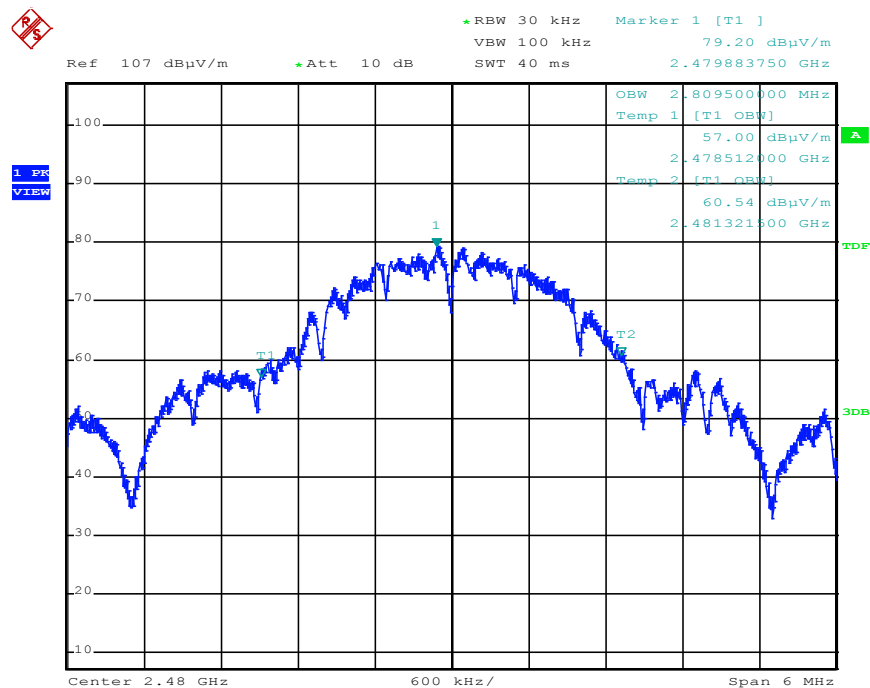
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CH7



CH15



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5.5 Correction for pulse operation (duty cycle)

For test instruments and accessories used see section 6 Part DC.

5.5.1 Description of the test location

Test location: AREA4

5.5.2 Photo documentation of the test set-up



5.5.3 Applicable standard

According to FCC Part 15A, Section 15.35(c):

When the radiated emission limits are expressed in terms of average value and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete puls train, including blanking intervals, as long as the pulse train does not exceed 0.1s. In cases where the puls train exceeds 0.1s, the measured field strength shall be determined from the average absolute voltage during a 0.1s interval during which the field strength is at its maximum. The exact method of calculating the average field strength shall be submitted.

5.5.4 Description of Measurement

The duty cycle factor (dB) is calculated applying the following formula:

$$KE = 20 \log (\max \text{ On-time}/T_w);$$

KE : pulse operation correction factor
 T_w a period of the pulse track

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5.5.5 Test result

Total length of period	3.039 ms
Max. On time Port4	0.640 ms
DC	0.21
Correction factor	-13.5 dB

Remarks:

5.6 Antenna application**5.6.1 Applicable standard**

According to FCC Part 15C, Section 15.203(a):

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

5.6.2 Result

The EUT use an integrated PCB antenna. No other antenna than that furnished by the responsible party or external power amplifier can be applied by a customer.

The antenna of the EUT meets the requirement of FCC Part 15C, Section 15.203 and 15.204.

Remarks:

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6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPR 3	FSP 30	02-02/11-05-001	18/10/2013	18/10/2012		
	AFS4-01000400-10-10P-4	02-02/17-05-003				
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	3117	02-02/24-05-009	18/12/2013	18/12/2012		
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
DC	FSP 30	02-02/11-05-001	18/10/2013	18/10/2012		
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	3117	02-02/24-05-009	18/12/2013	18/12/2012		
	Sucoflex N-1000-SMA	02-02/50-05-072				
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
MB	FSP 30	02-02/11-05-001	18/10/2013	18/10/2012		
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	3117	02-02/24-05-009	18/12/2013	18/12/2012		
	Sucoflex N-1000-SMA	02-02/50-05-072				
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
SER 1	FMZB 1516	01-02/24-01-018	14/02/2014	14/02/2013		
	ESCI	02-02/03-05-005	03/12/2013	03/12/2012		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 2	ESVS 30	02-02/03-05-006	26/06/2013	26/06/2012		
	VULB 9168	02-02/24-05-005	16/03/2013	16/03/2012	08/04/2013	08/10/2012
	S10162-B	02-02/50-05-031				
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
SER 3	FSP 30	02-02/11-05-001	18/10/2013	18/10/2012		
	AFS4-01000400-10-10P-4	02-02/17-05-003				
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	3117	02-02/24-05-009	18/12/2013	18/12/2012		
	R1 _ 18 - 40 GHz	02-02/30-09-002	08/01/2014	08/01/2013		
	Sucoflex N-1000-SMA	02-02/50-05-072				
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				

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Attachment A

Touch probe TS460

External view:



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Internal view:



FCC ID: YJKTSX6TTX6

IC: 11148A-TSX6TTX6



FCC ID: YJKTSX6TTX6

IC: 11148A-TSX6TTX6



Touch probe TT460

External view:

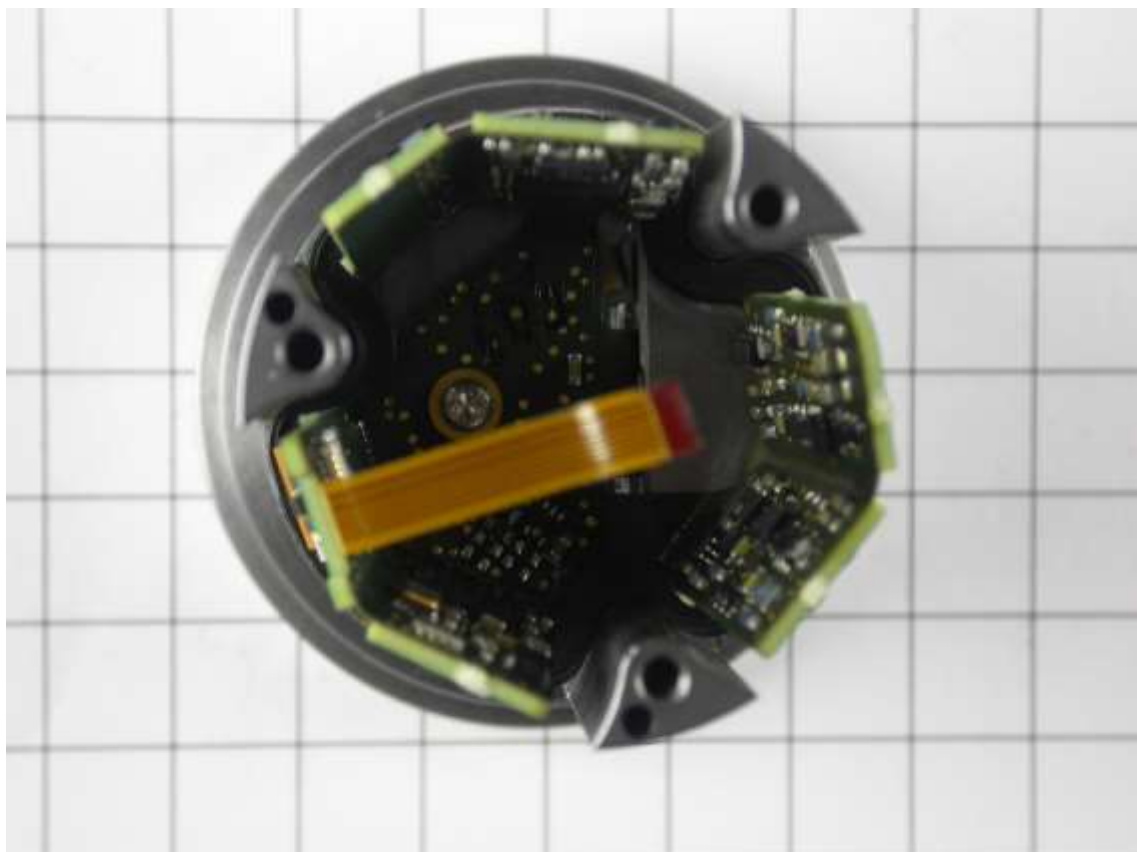


FCC ID: YJKTSX6TTX6

IC: 11148A-TSX6TTX6



Internal view:



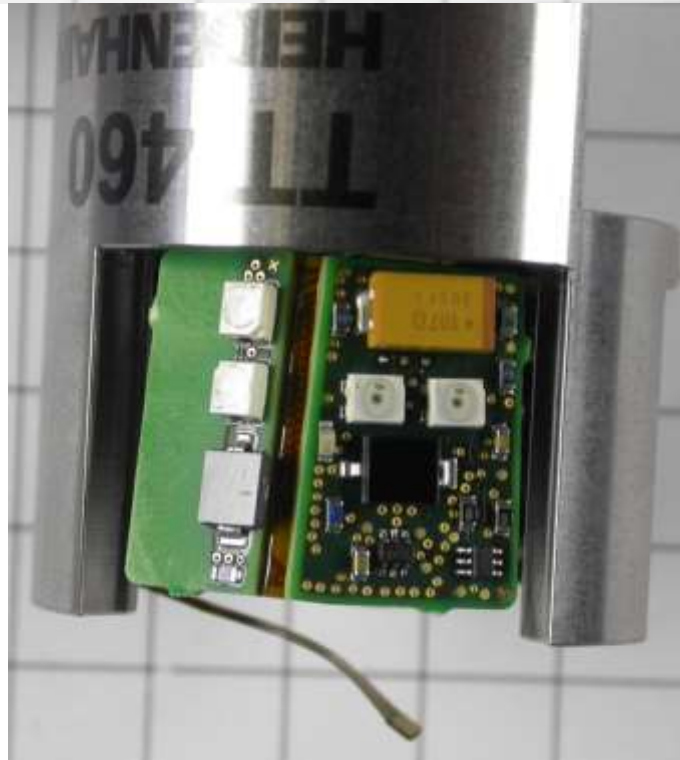
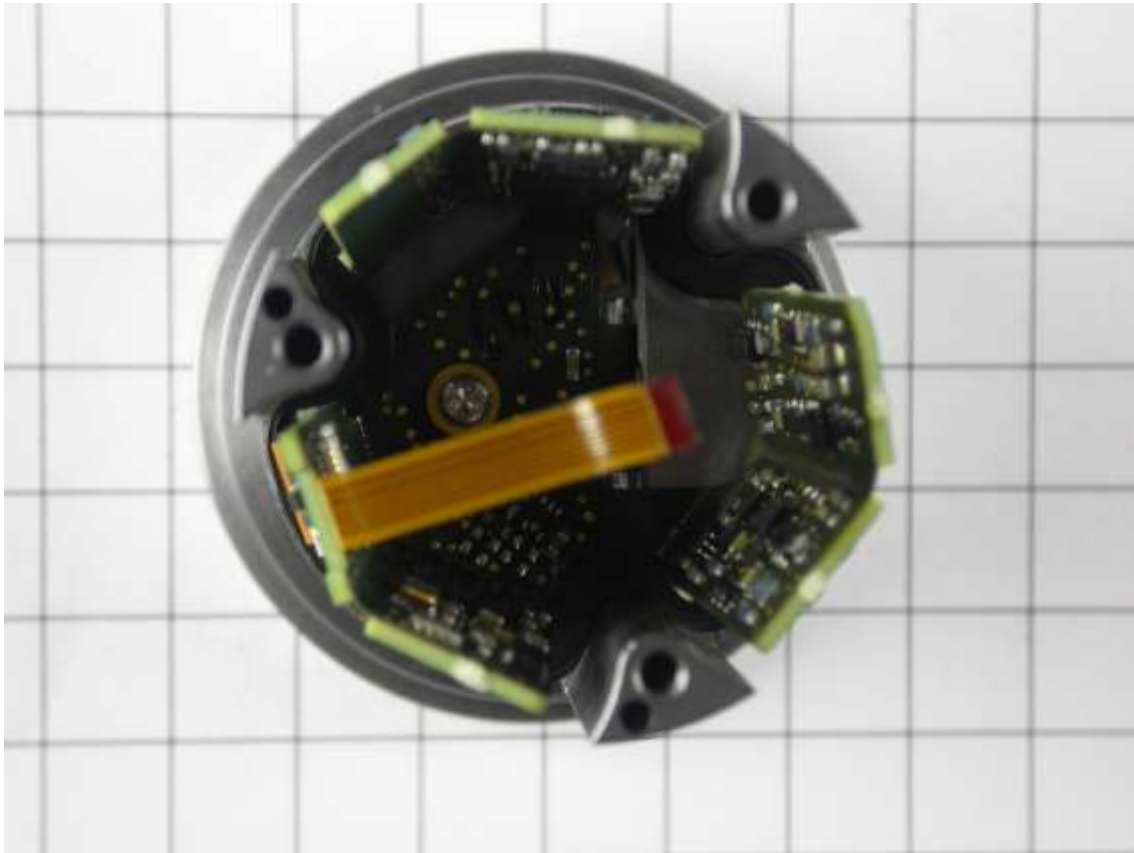
FCC ID: YJKTSX6TTX6

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FCC ID: YJKTSX6TTX6

IC: 11148A-TSX6TTX6



FCC ID: YJKTSX6TTX6

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