

FCC ID: YJKSE6X

IC ID: 11148A-SE6X

EMI - TEST REPORT

- FCC Part 15.249, RSS210 -

**Test Report No. :** T36611-00-01HS

31. July 2013

Date of issue

Type / Model Name : SE660**Product Description** : Transceiver unit 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.

ANSI C95.1:2005

IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

CISPR 16-4-2: 2003

Uncertainty in EMC measurement

CISPR 22: 2005
EN 55022: 2006

Information technology equipment

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2 SUMMARY**IC ID: 11148A-SE6X****2.1 GENERAL REMARKS:**

The EUT is a 2.4 GHz – transceiver unit for low power data transmission in 16 channels of the operating band of 2.4 GHz to 2.4835 GHz. The transceiver unit stays in contact to the installed touch probe and acknowledge every successful received data frame. The transceiver unit use for diversity four parallel transceiver trees with identically RF parts, 2 PCB antennas and 2 dedicated antennas. Special test software is used for setting the test modes.

Variants of the EUT

There are no variants.

Antennas

The following integrated antennas are used with the EUT:

- PCB meander antenna for transceiver unit and touch probe .
- Dedicated antenna for transceiver unit (flagpole antenna).

The antennas cannot be unattached by the user.

Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel No	<i>f</i>
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	passed
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	passed
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 Senior 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 : 12 VDC

3.3 Short description of the equipment under test (EUT)

The EUT is a 2.4 GHz – transceiver unit for low power data transmission in 16 channels of the operating band of 2.4 GHz to 2.4835 GHz.

Number of tested samples: 1
Serial number: 40762031

EUT operation mode:

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

- TX continuous mode

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:

- AC/DC adapter, FW75550/12	Model : Heidenhain 894 312-01, M7
- Power supply and control line, 5 m	Model : Heidenhain, Nr 663631-03
-	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

Exploratory measurements:

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 with the following settings:

The EUT has four parallel transceiver legs are looking always for a valuable signal from their touch probes. They receive parallel but transmission is only with the leg has the best received signal. This diversity method shall assure that the touch probe data are always received. Measurement of all legs shows that the leg with PCB-antenna has less power than the legs with flagpole antenna. Therefore a leg with flagpole antenna is selected for measurement as representative for all legs. The premise is the same chipset and the same devices for all legs.

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

The frequency range was scanned from 25 MHz to 10 times carrier frequency (25000 MHz).

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5 TEST CONDITIONS AND RESULTS

5.1 AC power line conducted emissions

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

5.1.1 Description of the test location

Test location: AREA4

5.1.2 Photo documentation of the test set-up



5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.4 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin -23.1 dB at 0.68 MHz

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Limit according to FCC Part 15, Section 15.207(a):

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

The requirements are **FULFILLED**.**Remarks:** For detailed test result please see the following test protocols.

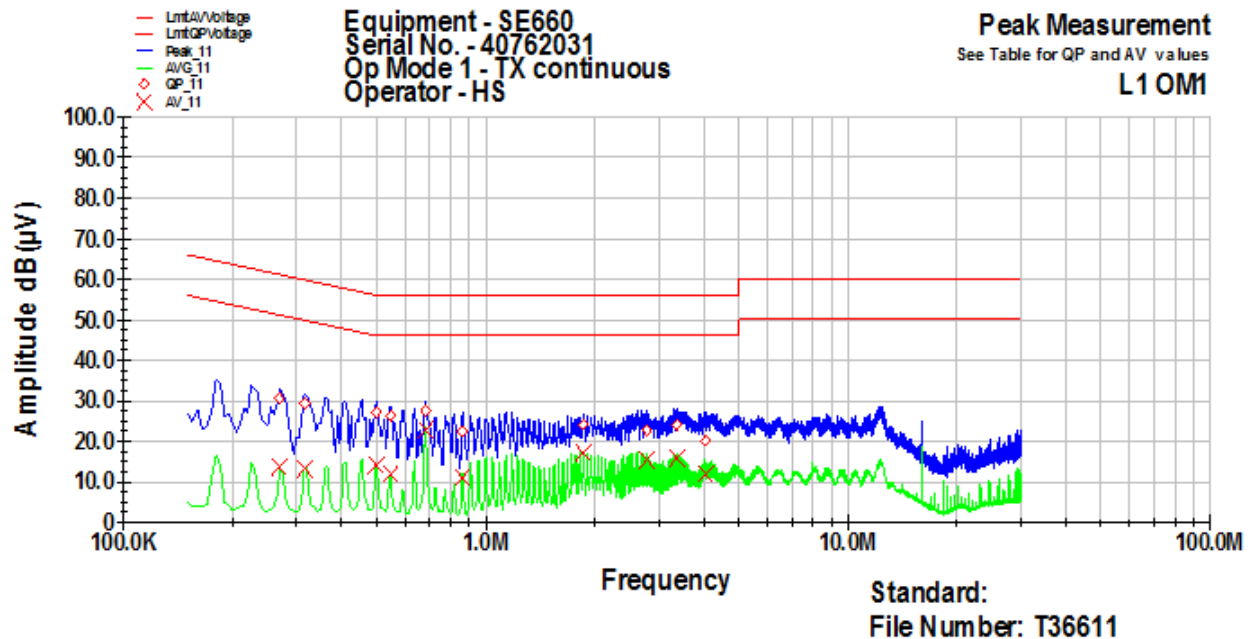
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5.1.6 Test protocol

Test point L1
Operation mode: TX continuous mode
Remarks:

Result: passed



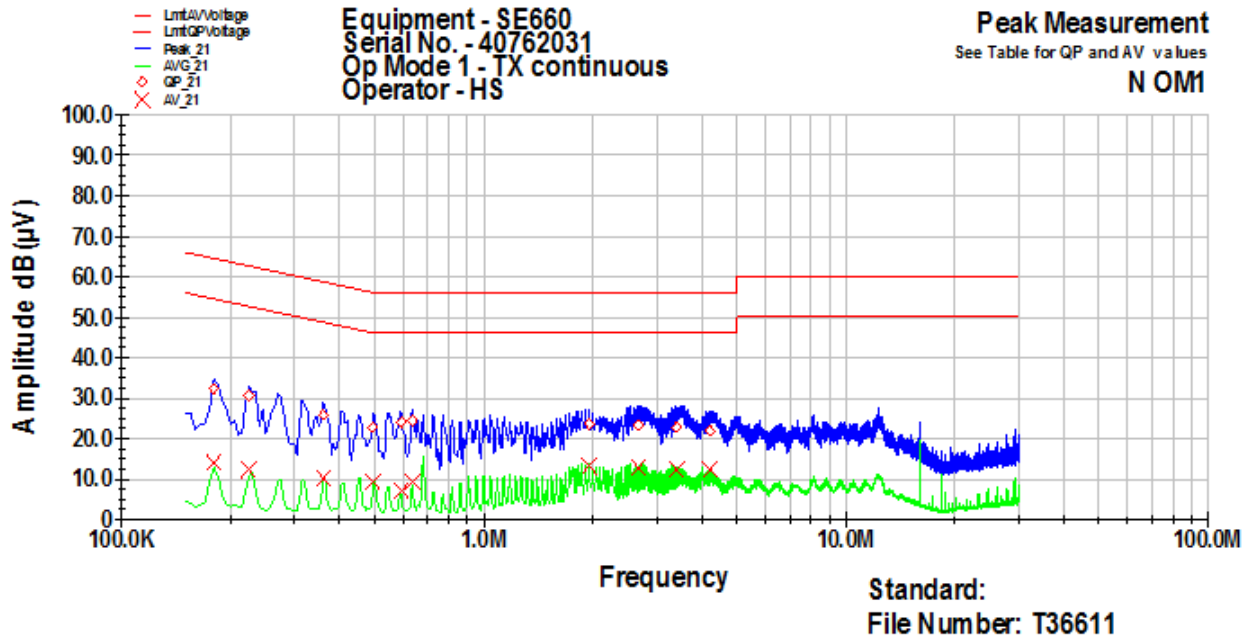
Frequency MHz	QP Level dB(μV)	QP Margin dB	QP Limit dB	AV Level dB(μV)	AV Margin dB	AV Limit dB
0.27	30.5	-30.6	61.1	13.8	-37.4	51.1
0.315	29.4	-30.4	59.8	13.2	-36.6	49.8
0.5	27.1	-28.9	56.0	14.0	-32.0	46.0
0.545	26.2	-29.8	56.0	11.7	-34.3	46.0
0.68	27.4	-28.6	56.0	22.9	-23.1	46.0
0.865	22.5	-33.5	56.0	11.0	-35.0	46.0
1.86	23.9	-32.1	56.0	17.1	-28.9	46.0
2.77	22.9	-33.1	56.0	15.5	-30.5	46.0
3.36	24.2	-31.8	56.0	15.9	-30.1	46.0
4.05	20.1	-35.9	56.0	12.1	-33.9	46.0

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Test point: N
Operation mode: TX continuous mode
Remarks:

Result: passed



Frequency MHz	QP Level dB(µV)	QP Margin dB	QP Limit dB	AV Level dB(µV)	AV Margin dB	AV Limit dB
0.18	32.4	-32.1	64.5	14.2	-40.3	54.5
0.225	30.5	-32.2	62.6	12.5	-40.2	52.6
0.36	25.9	-32.9	58.7	10.2	-38.5	48.7
0.495	22.6	-33.5	56.1	9.2	-36.9	46.1
0.59	24.2	-31.8	56.0	7.3	-38.7	46.0
0.635	24.3	-31.7	56.0	9.1	-36.9	46.0
1.95	23.7	-32.3	56.0	13.2	-32.8	46.0
2.67	23.0	-33.0	56.0	12.6	-33.4	46.0
3.395	22.8	-33.3	56.0	12.4	-33.6	46.0
4.215	22.0	-34.0	56.0	12.3	-33.7	46.0

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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**5.2.1 Applicable standard**

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

The field strength of emission from intentional radiators operated within these frequency bands shall comply with the limit in the table.

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. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.4, Item 8.3. The EUT is measured in TX continuous mode unmodulated under normal conditions.

Analyser settings:

Peak measurement: RBW: 1 MHz

VBW: 1 MHz

Detector: Max peak

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5.2.3 Test result

ANT0 (PCB antenna):

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	97.6	114.0	-16.4	83.9	94.0	-10.1
2440	98.8	114.0	-15.2	85.1	94.0	-8.9
2480	98.9	114.0	-15.1	85.2	94.0	-8.8

Note: The correction factor 13.7 dB is used to calculate the AV level.

ANT3 (Flagpole antenna):

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	100.7	114.0	-13.3	87.0	94.0	-7.0
2440	100.8	114.0	-13.2	87.1	94.0	-6.9
2480	98.5	114.0	-15.5	84.8	94.0	-9.2

Note: The correction factor 13.7 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 field strength shall not exceed the maximum permitted average limit by more than 20 dB.

The requirements are **FULFILLED**.

Remarks: ANT0, ANT3 means in the position for the EUT the highest output level of all outputs.

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5.3 Out-of-band emission, 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 setup

Test setup 9 kHz – 30 MHz:



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Test setup 30 MHz – 1000 MHz:



Test setup 1 GHz – 18 GHz:



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Test setup 18 GHz – 25 GHz:



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 setup of the EUT and the measurement procedure is in accordance to ANSI C63.4, Item 8.3. 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 testing is stopped and peak values will be reported, otherwise, the emission is measured in average mode again and reported. The EUT is measured in TX continuous mode unmodulated under normal conditions.

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 – 25 GHz	RBW:	1 MHz

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5.3.5 Test result f < 30 MHz

For emission test the transmission leg of highest power level is choosen.

Frequency (MHz)	Reading PK dB(μV)	D factor dB(μV/m)	Level PK dB(μV/m)	Limit AV dB(μV/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

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

5.3.6 Test result f < 1 GHz

Note: The emissions are caused by the internal FPGA and are no transmitter emissions, therefore it doesn't matter which channel is set. Only the table for CH0 is shown.

Channel 0

Frequency (MHz)	Level QP dB(μV/m)	Limit QP dB(μV/m)	Delta (dB)
280	31.9	46.0	-14.1
320	20.9	46.0	-25.1
360	23.5	46.0	-22.5
600	30.5	46.0	-15.5
666	22.5	46.0	-23.5
680	34.9	46.0	-11.1
720	33.8	46.0	-12.2
760	39.0	46.0	-7.0
920	41.0	46.0	-5.0

5.3.7 Test result f > 1 GHz

Channel 0

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)
1079	47.3	-	74.0	-26.7	54.0	-
1239	40.0	-	74.0	-34.0	54.0	-
1684	47.7	-	74.0	-26.3	54.0	-
1708	40.1	-	74.0	-33.9	54.0	-
1993	46.9	-	74.0	-27.1	54.0	-
4810	64.9	51.2	74.0	-9.1	54.0	-2.8

Note: Average values for harmonics are calculated with peak values minus duty cycle correction factor.

Channel 7

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)
1079	47.7	-	74.0	-26.3	54.0	-
1240	47.5	-	74.0	-26.5	54.0	-
1684	46.8	-	74.0	-27.2	54.0	-
1708	47.1	-	74.0	-26.9	54.0	-
3023	46.9	-	74.0	-27.1	54.0	-
4880	62.3	48.6	74.0	-11.7	54.0	-5.4

Note: Average values for harmonics are calculated with peak values minus duty cycle correction factor.

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Channel 15

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)
1079	47.4	-	74.0	-26.6	54.0	-
1240	47.1	-	74.0	-26.9	54.0	-
2627	49.5	-	74.0	-24.5	54.0	-
3293	47.5	-	74.0	-26.5	54.0	-
3764	47.1	-	74.0	-26.9	54.0	-
4960	61.9	48.2	74.0	-12.1	54.0	-5.8

Note: Average values for harmonics are calculated with peak values minus duty cycle correction factor.

Limit according to FCC Part 15C, Section 15.209:

Frequency (MHz)	15.209 Limits (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	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	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

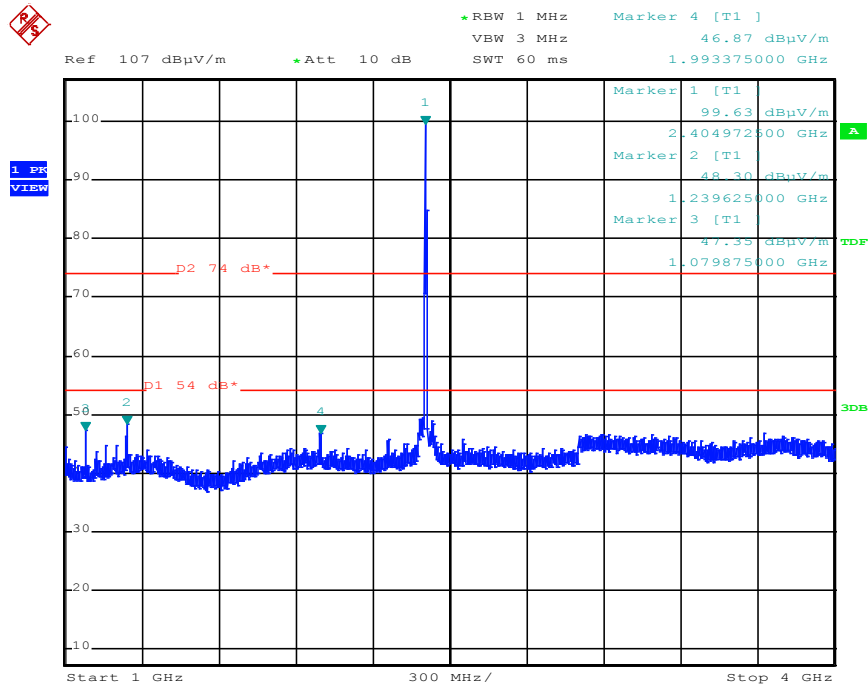
The requirements are **FULFILLED**.

Remarks: The measurement is performed up to the 10th harmonic (25000 MHz). For detailed test result
please see the following test protocols.

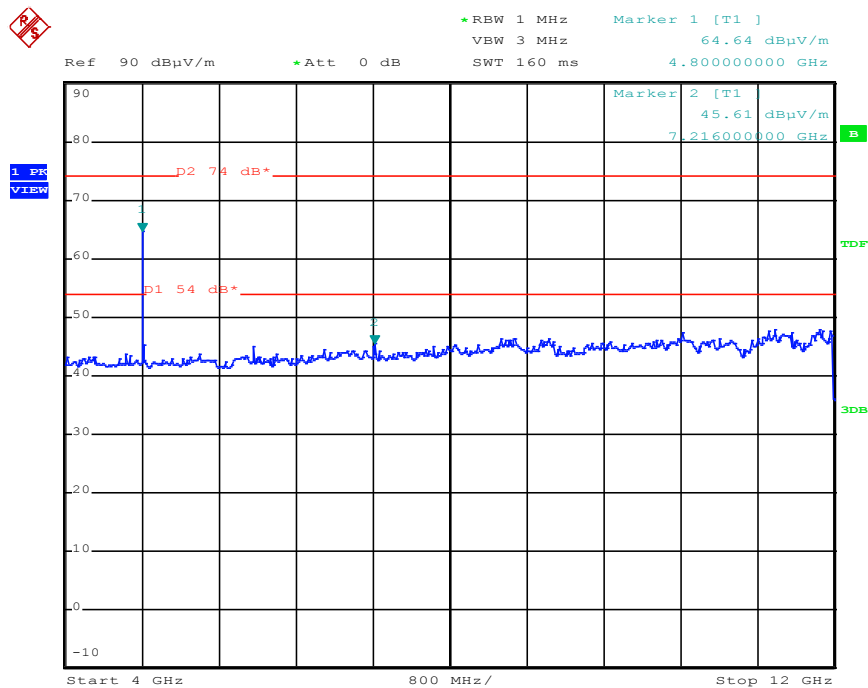
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5.3.8 Test protocols
CH0:

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



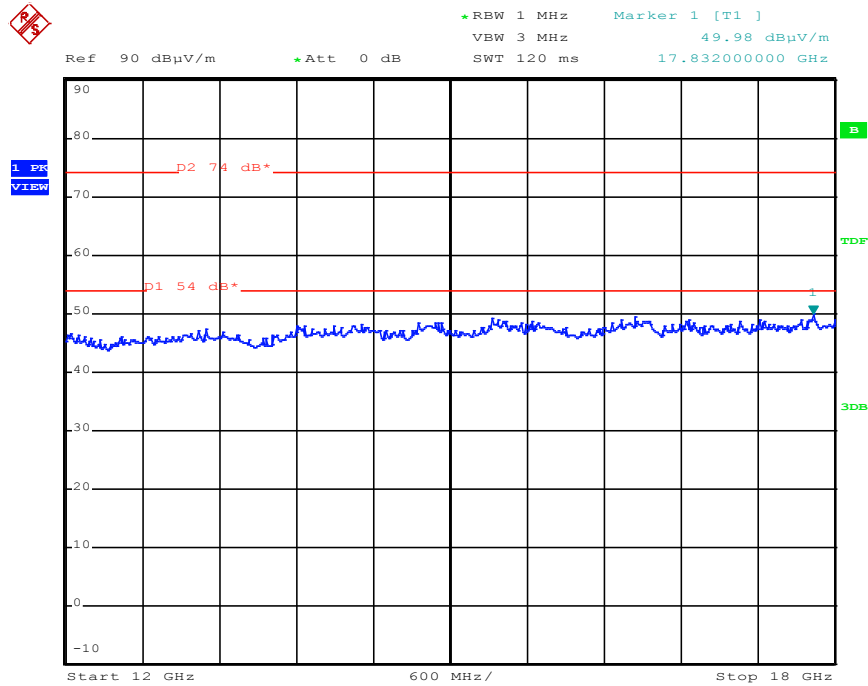
Spurious emissions from 4 to 12 GHz



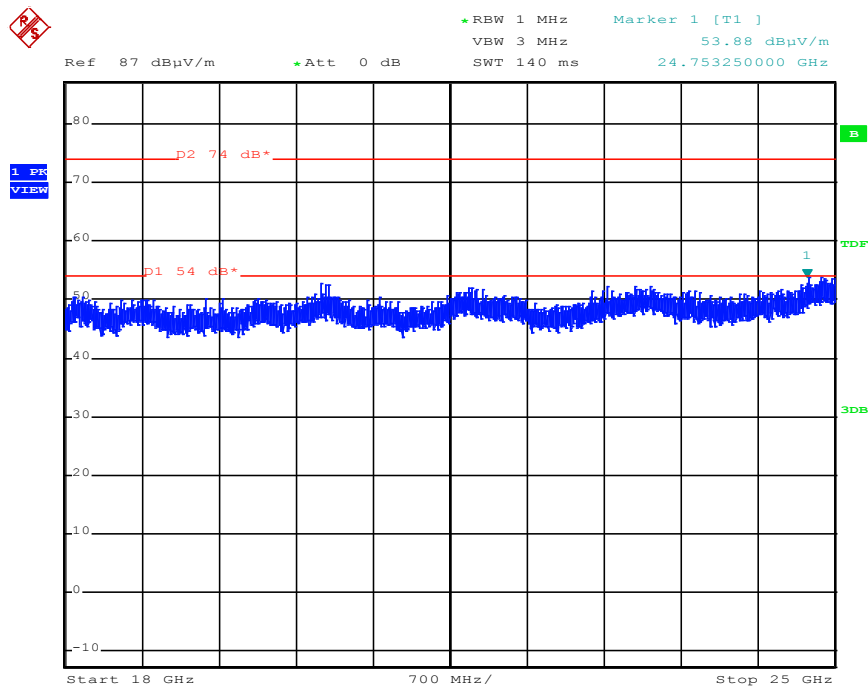
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Spurious emissions from 12 to 18 GHz



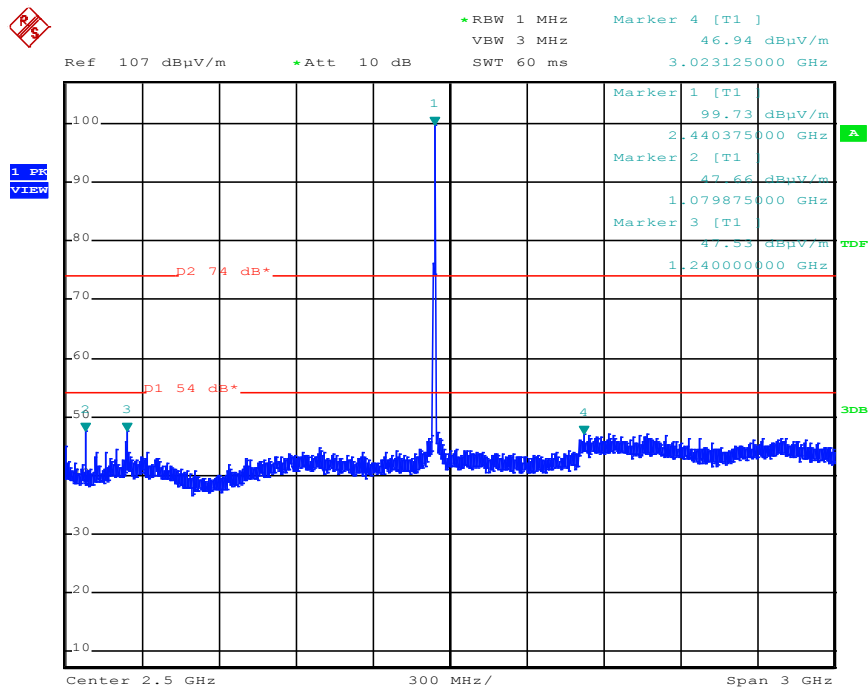
Spurious emissions from 18 to 25 GHz



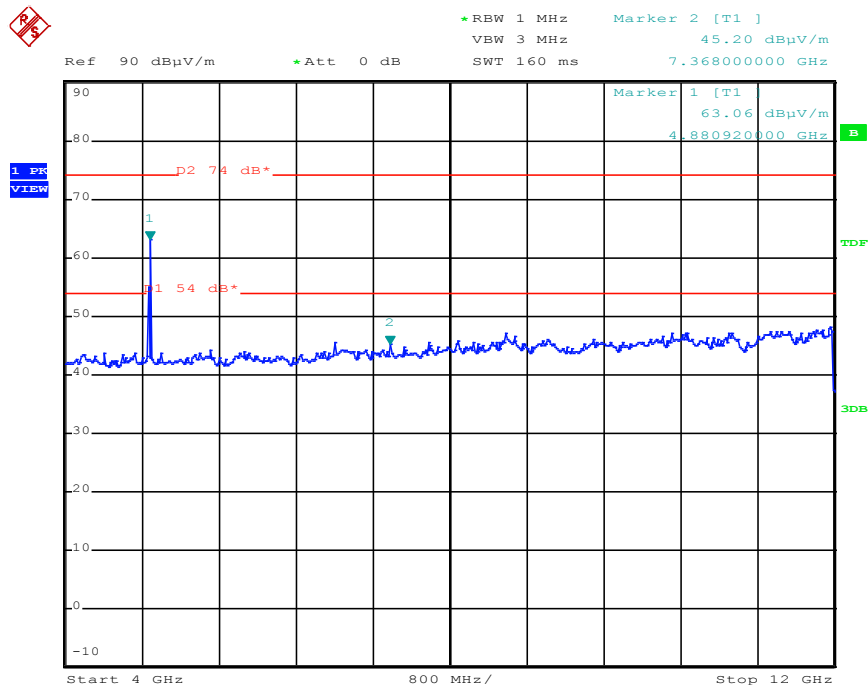
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CH7:

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



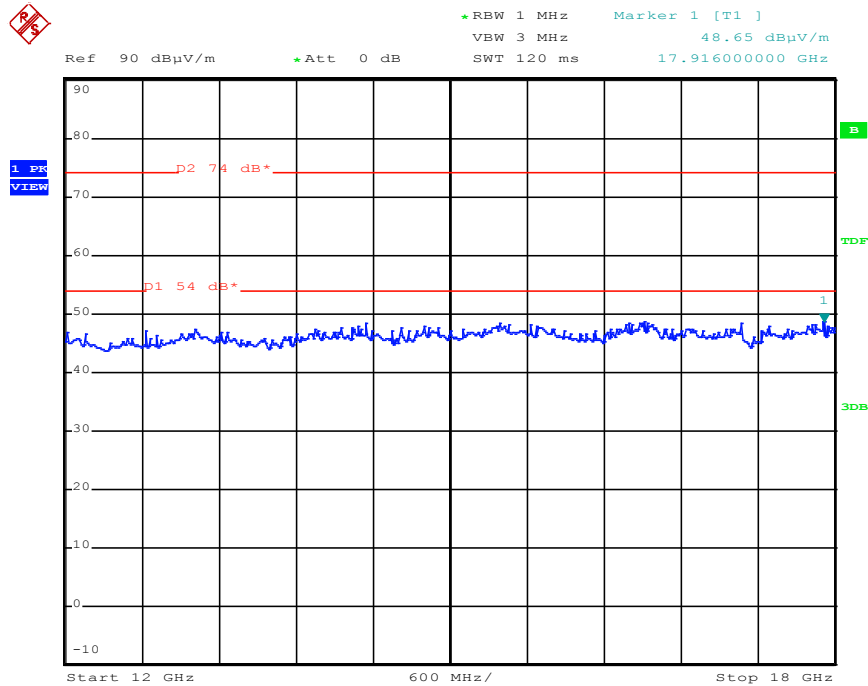
Spurious emissions from 4 to 12 GHz



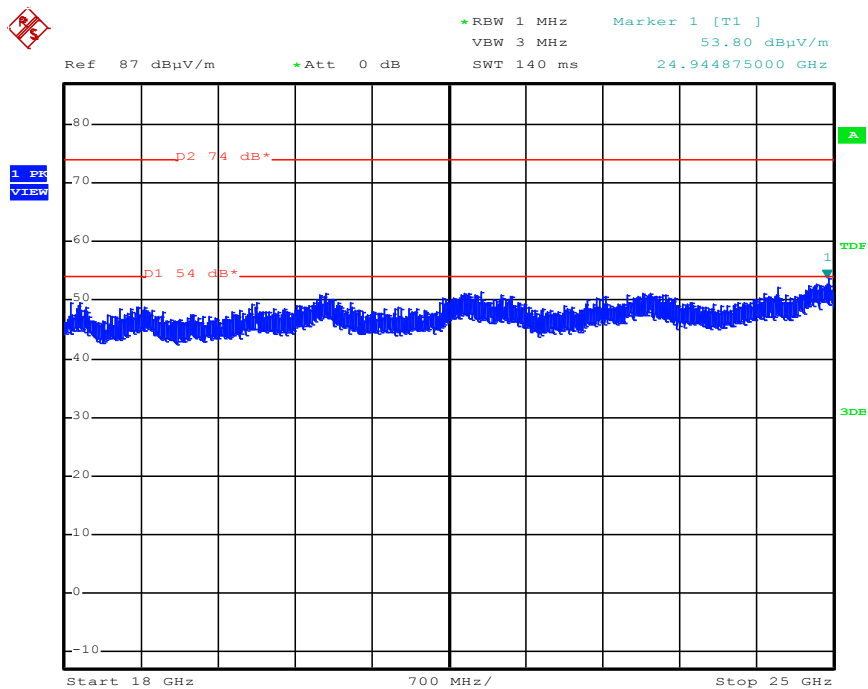
FCC ID: YJKSE6X

IC ID: 11148A-SE6X

Spurious emissions from 12 to 18 GHz



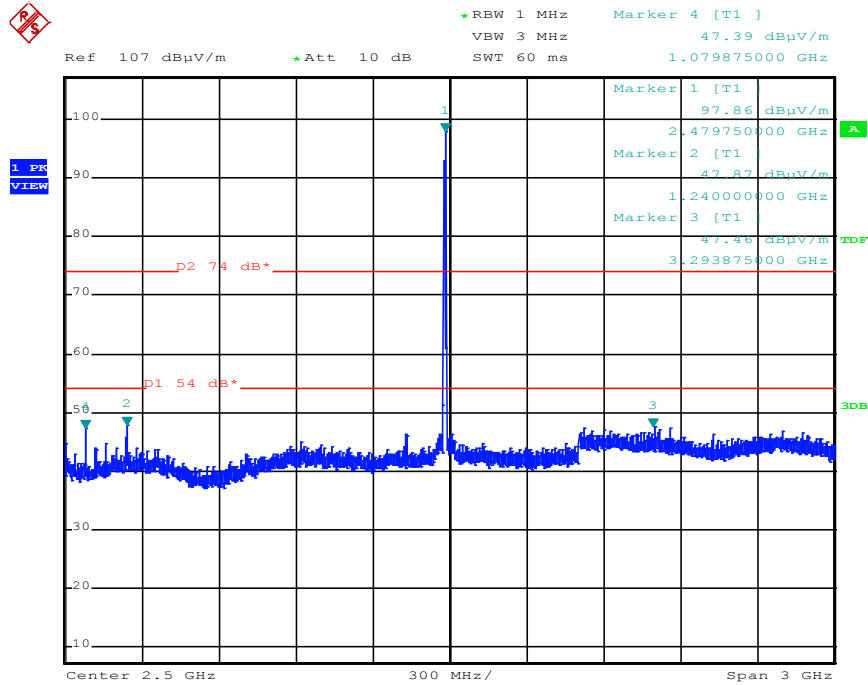
Spurious emissions from 18 to 25 GHz



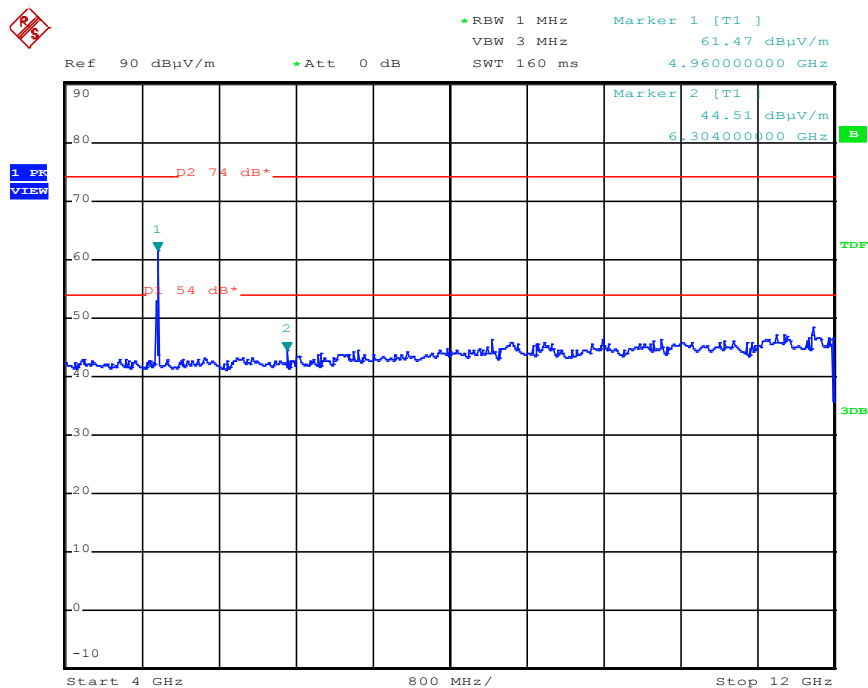
FCC ID: YJKSE6X
CH15:

IC ID: 11148A-SE6X

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



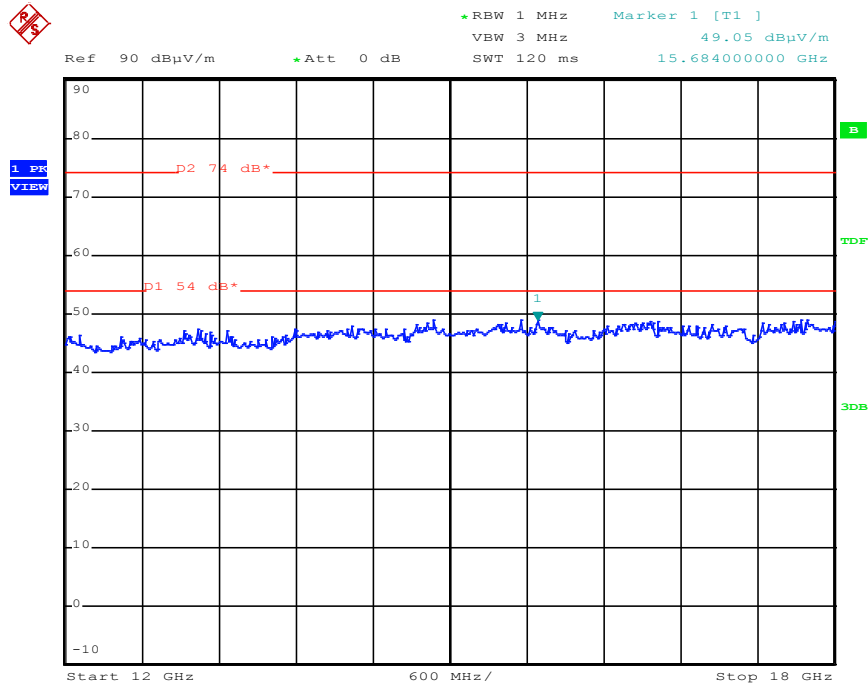
Spurious emissions from 4 to 12 GHz



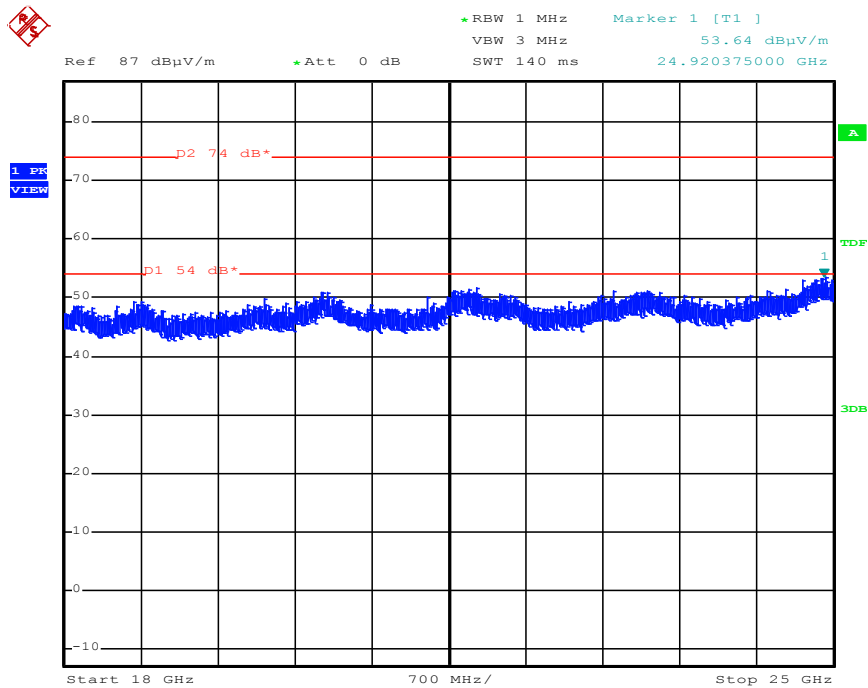
FCC ID: YJKSE6X

IC ID: 11148A-SE6X

Spurious emissions from 12 to 18 GHz



Spurious emissions from 18 to 25 GHz



FCC ID: YJKSE6X

IC ID: 11148A-SE6X

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 (99%). The x-dB-down (OBW) function of the analyser is used. The measurement is performed with normal modulation in TX continuous mode.

Spectrum analyser settings:

RBW: 30 kHz, VBW: 100 kHz, Span: 6 MHz, Trace mode: max. hold, 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)
2404.994	2403.692	2406.296	2.604
2439.988	2438.692	2441.284	2.592
2480.000	2478.716	2481.284	2.568

Centre f (MHz)	99% bandwidth f_1	99% bandwidth f_2	Measured OBW (MHz)
2404.976	2403.728	2406.224	2.496
2440.000	2438.752	2441.248	2.496
2480.006	2478.764	2481.248	2.484

Operating frequency band (MHz)	20 dB Bandwidth (MHz)
$f_{low} > 2400$	$f_{low} = 2403.692$
$f_{high} < 2483.5$	$f_{high} = 2481.284$

Channel bandwidth	5.000 MHz
80% bandwidth of the permitted channel:	4.000 MHz
20 dB bandwidth CH0	2.604 MHz
20 dB bandwidth CH7	2.592 MHz
20 dB bandwidth CH15	2.568 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. Due to the channelizing of the operating band into 16 channels with channel bandwidth of 5 MHz the limit central 80% of the permitted band cannot be applied. Therefore the stability of the EUT will be shown staying within the central 80% of the operating channel.

The requirements are **FULFILLED**.

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

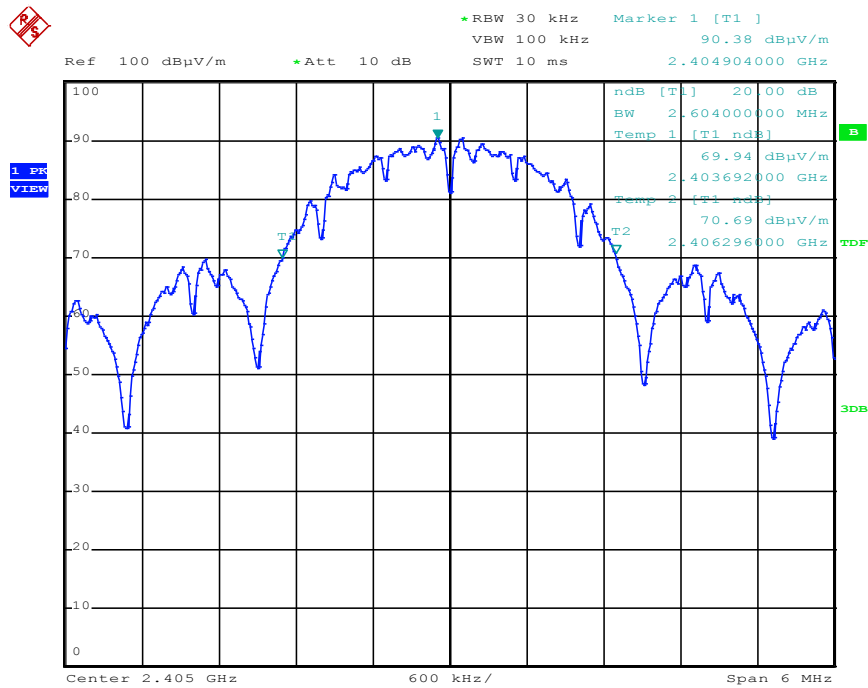
The OBW99 is measured for RSS only.

FCC ID: YJKSE6X
5.4.6 Test protocols

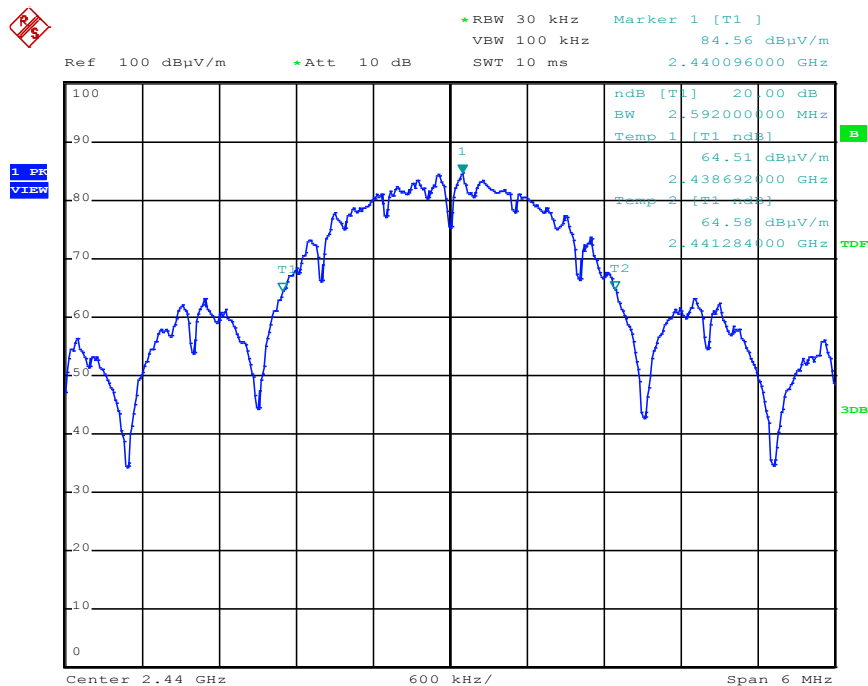
IC ID: 11148A-SE6X

20 dB bandwidth

CH0:

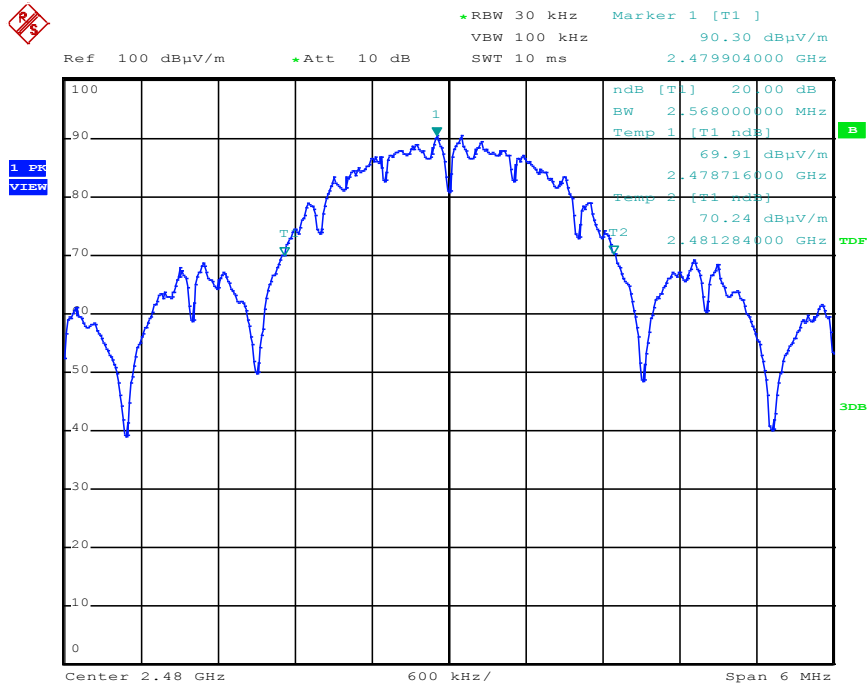


CH7:



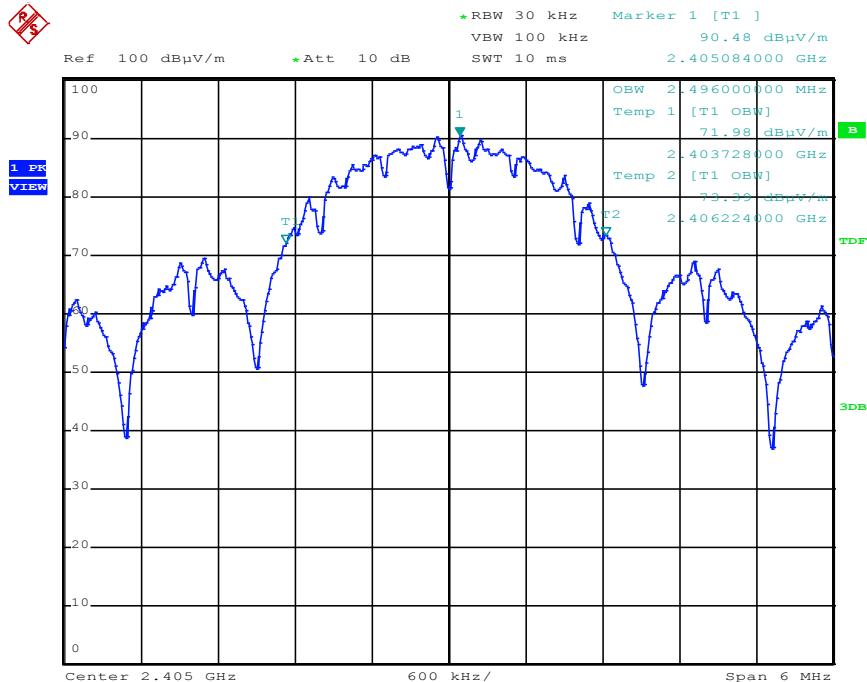
FCC ID: YJKSE6X
CH15:

IC ID: 11148A-SE6X



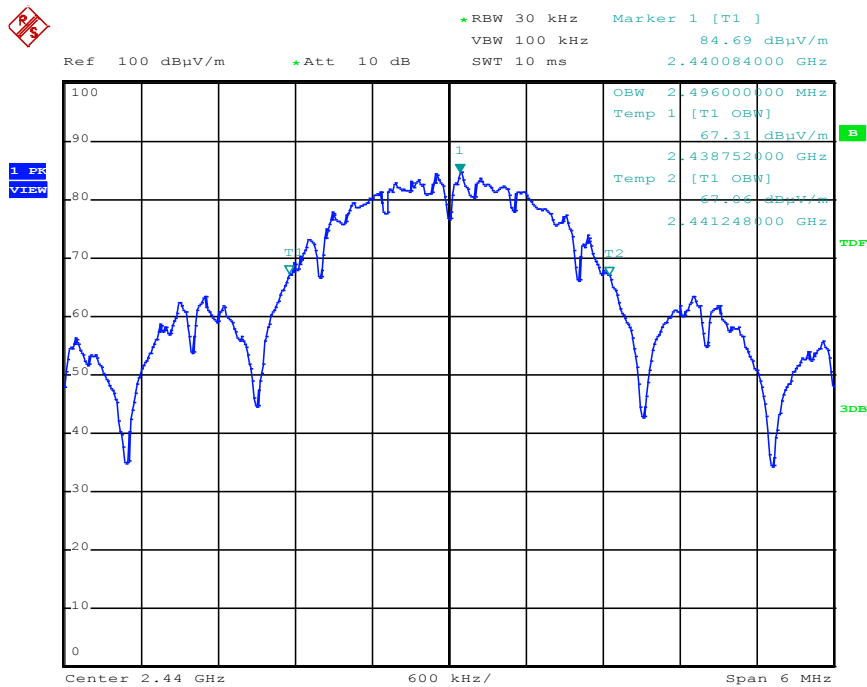
OBW 99%

CH0:

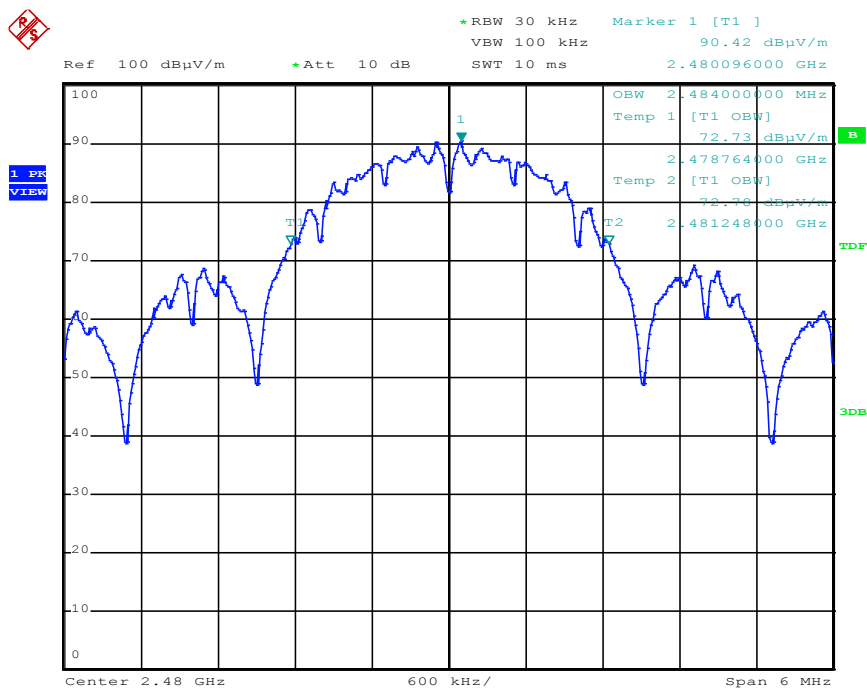


FCC ID: YJKSE6X
CH7:

IC ID: 11148A-SE6X



CH15:



FCC ID: YJKSE6X

IC ID: 11148A-SE6X

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

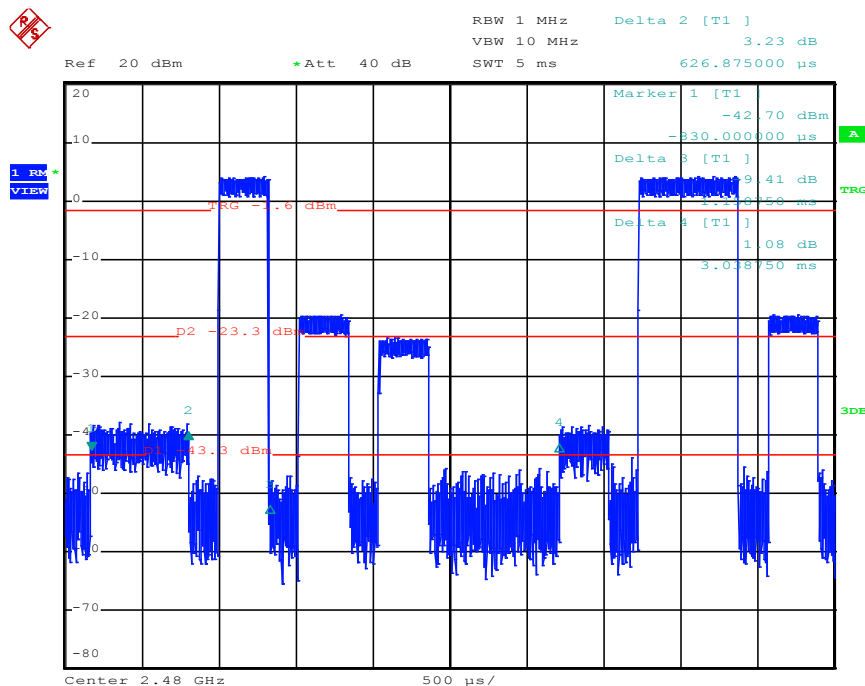
Total length of period	3.038 ms
Max. On time Port4	0.627 ms
DC	0.21
Correction factor	-13.7 dB

Note: The duty cycle for port4 is the max On-time for port4 till it is again transmitting. In the meantime port1, port2 and port3 are permitted to hold the communication with its client.

Remarks: For detailed results, please see the test protocol below.

5.5.6 Test protocol

Correction for Pulse Operation (Duty Cycle) FCC Part 15A, Section 15.35(c)



FCC ID: YJKSE6X**IC ID: 11148A-SE6X****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 at two RF-legs integrated PCB antennas and at the other two RF-legs dedicated antennas. The dedicated antennas are fixed at the SMA-connector with glue, that the antennas are not detachable. The glue is necessary because the connection has to be oil tight. 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.

FCC ID: YJKSE6X
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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.
A 4	ESHS 30	02-02/03-05-002	11/07/2013	11/07/2012		
	ESH 2 - Z 5	02-02/20-05-004	12/05/2013	12/05/2011	23/07/2013	23/01/2013
	EMV D 30000/PAS	02-02/30-05-006				
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	02/04/2013	02/10/2012		
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				
DC	Sucoflex N-2000-SMA	02-02/50-05-075				
	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	02-02/17-05-005				
	Sucoflex N-1000-SMA	02-02/50-05-072				
MB	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	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	02-02/17-05-005				
SER 1	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				
	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				
SER 2	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
	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				
SER 3	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	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		
SER 3	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				

FCC ID: YJKSE6X
Attachment A

IC ID: 11148A-SE6X

Transceiver unit SE 660

External view:



FCC ID: YJKSE6X

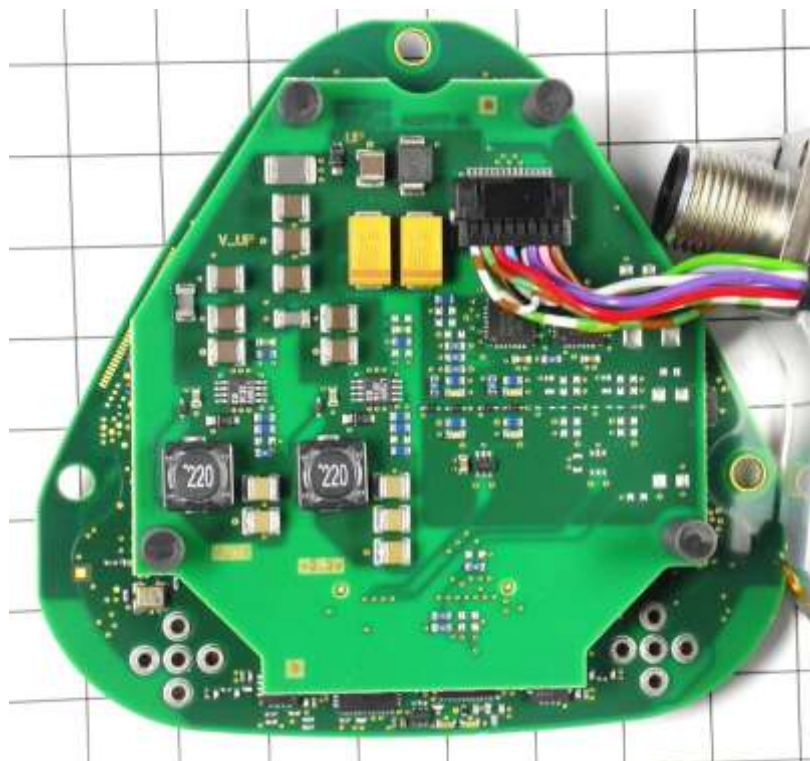
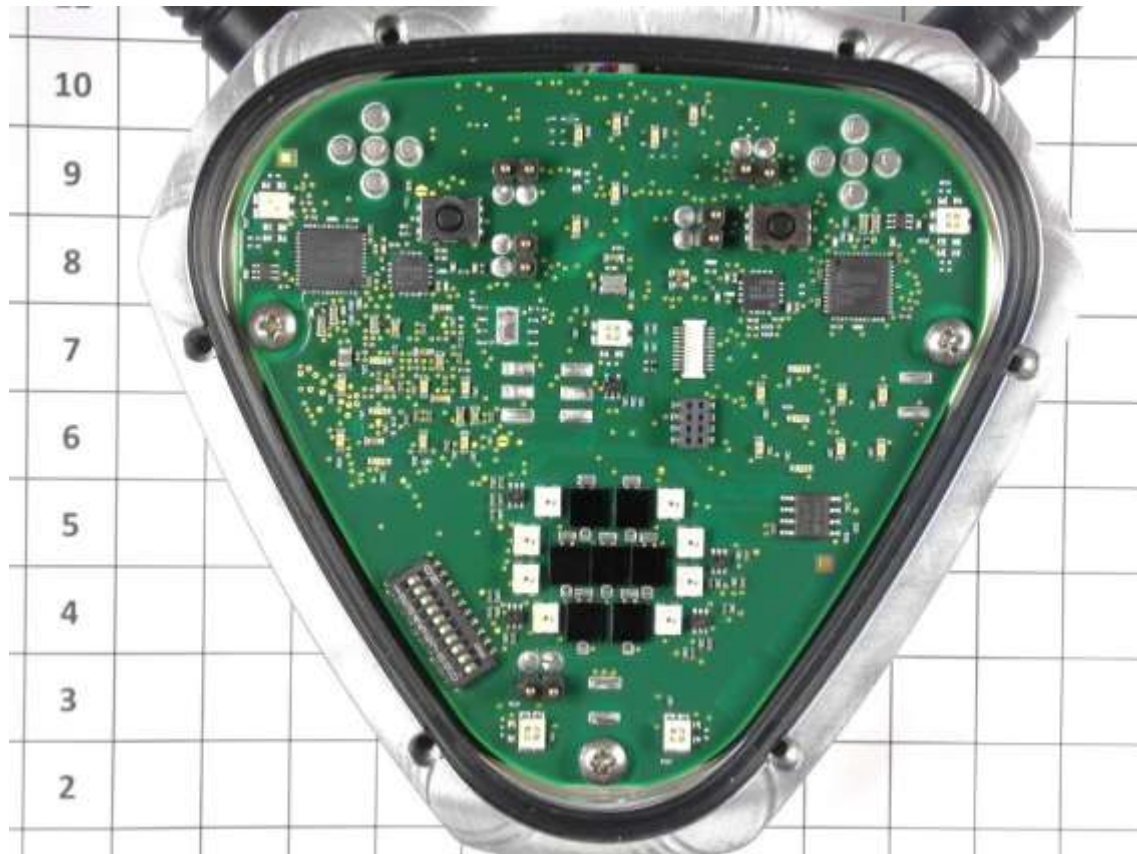
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Internal view:



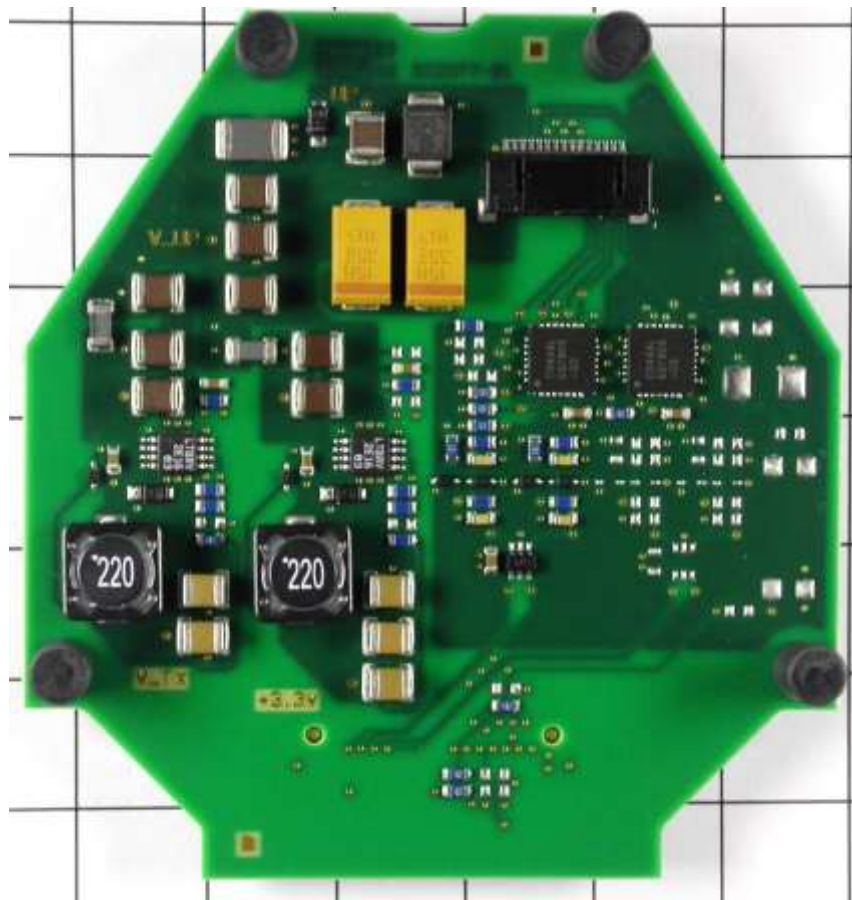
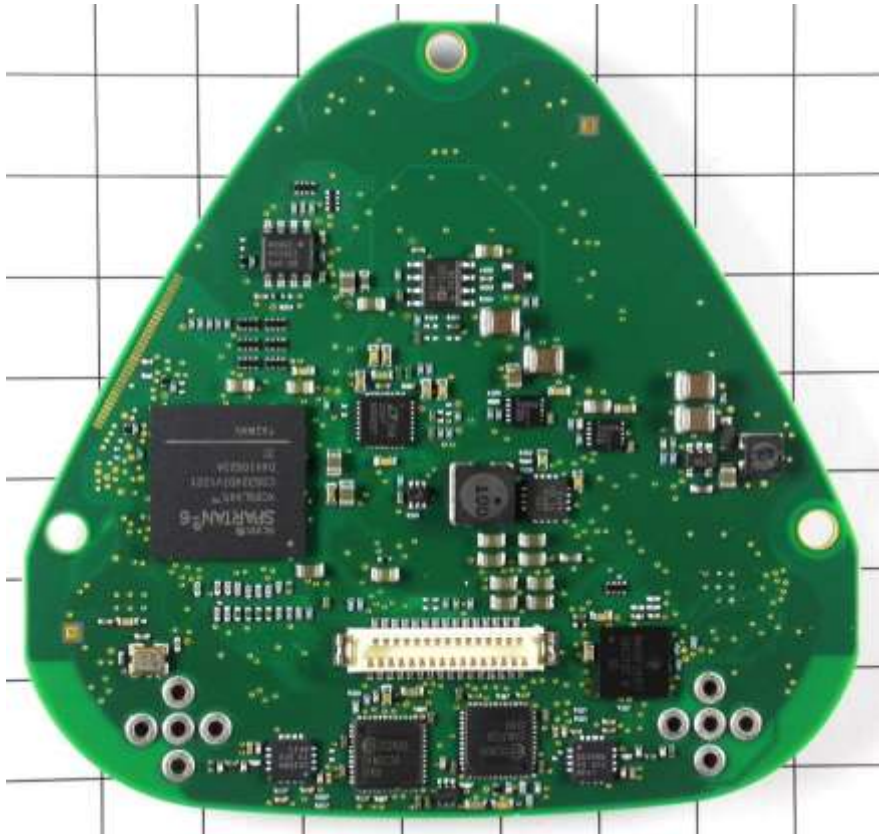
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