

EMI – TEST REPORT

- FCC Part 15.247, RSS247 -

Type / Model Name : mURM ver. 2.0

Product Description : UHF RFID Reader

Applicant : TSS COMPANY s.r.o.

Address : Pod Rovnicami 41

84104 Bratislava

SLOVAKIA

Manufacturer : TSS COMPANY s.r.o.

Address : Pod Rovnicami 41

84104 Bratislava

SLOVAKIA

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

POSITIVE

Test Report No. : **T42777-00-00JP**

02. October 2018

Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

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 (May 2018)

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (May 2018)

Part 15, Subpart C, Section 15.207

Part 15, Subpart C, Section 15.209

Part 15, Subpart C, Section 15.247

Conducted limits

Radiated emission limits, general requirements

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

RSS-Gen Issue 5, Apr 2018

General Requirements for Compliance of Radio Apparatus

RSS-247 Issue 2, Feb 2017

Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices

ANSI C63.10: 2013

Testing Unlicensed Wireless Devices

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT

Detailed photos see T42777-00-00JP attachment B and T42777-00-00JP attachment C.

2.2 Short description of the equipment under test (EUT)

The mURM module is an UHF RFID reader OEM module intended to be used in systems working with UHF RFID passive tags. Frequency hopping is used.

Number of tested samples: 1
 Serial number: none
 Firmware version: 1.20f

2.3 Operation frequency and channel plan

The operating frequency range is 902 – 928 MHz.

Following hopping channels are used:

CH 01	902,75 MHz	CH 18	911,25 MHz	CH 35	919,75 MHz
CH 02	903,25 MHz	CH 19	911,75 MHz	CH 36	920,25 MHz
CH 03	903,75 MHz	CH 20	912,25 MHz	CH 37	920,75 MHz
CH 04	904,25 MHz	CH 21	912,75 MHz	CH 38	921,25 MHz
CH 05	904,75 MHz	CH 22	913,25 MHz	CH 39	921,75 MHz
CH 06	905,25 MHz	CH 23	913,75 MHz	CH 40	922,25 MHz
CH 07	905,75 MHz	CH 24	914,25 MHz	CH 41	922,75 MHz
CH 08	906,25 MHz	CH 25	914,75 MHz	CH 42	923,25 MHz
CH 09	906,75 MHz	CH 26	915,25 MHz	CH 43	923,75 MHz
CH 10	907,25 MHz	CH 27	915,75 MHz	CH 44	924,25 MHz
CH 11	907,75 MHz	CH 28	916,25 MHz	CH 45	924,75 MHz
CH 12	908,25 MHz	CH 29	916,75 MHz	CH 46	925,25 MHz
CH 13	908,75 MHz	CH 30	917,25 MHz	CH 47	925,75 MHz
CH 14	909,25 MHz	CH 31	917,75 MHz	CH 48	926,25 MHz
CH 15	909,75 MHz	CH 32	918,25 MHz	CH 49	926,75 MHz
CH 16	910,25 MHz	CH 33	918,75 MHz	CH 50	927,25 MHz
CH 17	910,75 MHz	CH 34	919,25 MHz		

Note: the green marked frequencies were tested.

2.4 Tested operating modes

- Continuous transmit mode on defined frequencies (CH01, CH26 and CH50)
- Hopping mode (all 50 Channels are used)

2.5 Antenna

The following antennas were tested with the EUT:

Model	Type of antenna	Gain
DAE915R7865AGDZ1-T	Patch antenna	4.5 dBi
DAE915R3540CGDD3-T	Patch antenna	1.5 dBi

2.6 Power supply system utilised

Power supply voltage, V_{nom} : 3 – 3,5V DC

2.7 Peripheral devices and interface cables

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

- Host board _____ Model : mURM Evaluation Board V 1.1
- Laptop _____ Model : Lifebook E751, Fujitsu Siemens
- TAG _____ Model : Supplied by client

2.8 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes and the settings of the EUT are 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 X position.

The tests are carried out in the following frequency band:

2.8.1 Test software

Test software was used to set the module in specific operation modes. The test software was supplied by client.

Used software:

- mURM_Test_Application_x64_FCC.exe

3 TEST RESULT SUMMARY

The EuT is a frequency hopping system.

FCC Rule Part	RSS Rule Part	Description	Result
15.207	RSS Gen, 8.8	AC power line conducted emissions	passed
15.209	RSS Gen, 8.9	Radiated Emission Limits, General Limits	passed
15.247(a)(1)(i)	RSS Gen, 6.6 RSS-247, 5.1c	Occupied bandwidth	passed
15.247(a)(1)	RSS-247, 5.1b	Hopping frequency separation	passed
15.247(a)(1)(i)	RSS-247, 5.1c	Number of hopping channels	passed
15.247(a)(1)(i)	RSS-247, 5.1c	Average time of occupancy	passed
15.247(b)(2)	RSS-247, 5.4a	Peak conducted output power	passed
15.247(d)	RSS-247, 5.5	Spurious RF conducted emission	passed

3.1 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 : 24 July 2017

Testing concluded on : 08 May 2018

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Jürgen Pessinger

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
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. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern 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 and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
EBW and OBW	2400 MHz to 3000 MHz	95%	$\pm 2.5 \times 10^{-7}$
Maximum peak conducted output power	2400 MHz to 3000 MHz	95%	± 0.62 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB
Conducted Spurious Emissions	10000 MHz to 40000 MHz	95%	± 3.47 dB
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	± 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	± 3.71 dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	± 2.34 dB
Field strength of the fundamental	100 kHz to 100 MHz	95%	± 3.53 dB

4.4 Measurement protocol for FCC and ISCED

4.4.1 General information

4.4.1.1 Test methodology

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

IC 3009A-1

The Anechoic chamber is a listed test site under the Canadian Test-Sites File-No:

IC 3009A-2

In compliance with RSS 247 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.10.

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 General Standard information

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 C63.10 and applying the CISPR 22 limits.

4.4.1.3.1 Radiated emission (electrical field 30 MHz - 1 GHz)

Description of measurement

Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.

The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:

30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency	Level	+	Factor	=	Level	-	CISPR Limit	=
Delta								
(MHz)	(dBµV)		(dB)		(dBµV/m)		(dBµV/m)	(dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	= -2.4

4.4.1.3.2 Radiated emission (electrical field 1 GHz - 40 GHz)Description of measurement

Radiated emissions from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table, 1.5 metre above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyzer set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

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: Shielded Room S2

5.1.2 Photo documentation of the test set-up

For test setup photos see T42777-00-00JP ATTACHMENT A

5.1.3 Applicable standard

FCC Part 15, Section 15.207 and RSS-Gen 8.8:

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin 13.09 dB at 0.5385 MHz

Limit according to FCC Part 15, Section 15.207(a) and RSS-GEN 8.8 Table 4:

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

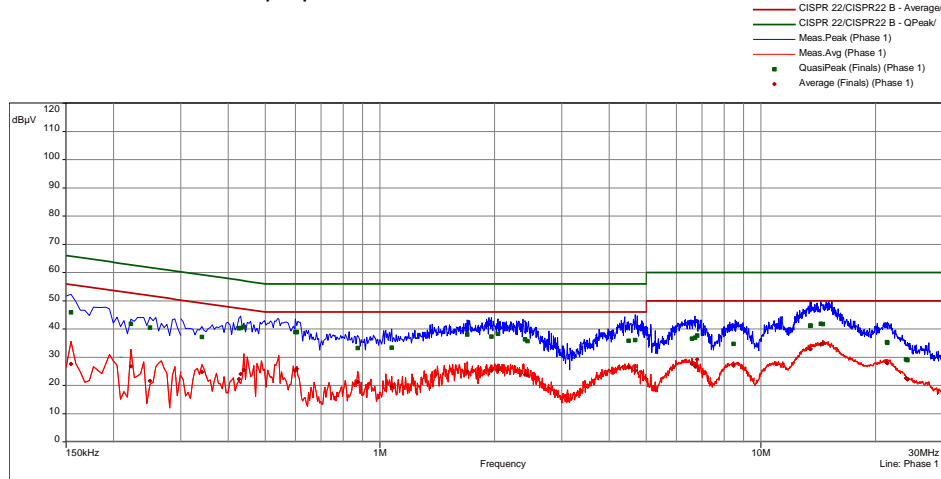
* Decreases with the logarithm of the frequency

The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocols. The measurement was performed
on the AC input of the used Laptop which is acting as power supply.

5.1.6 Test protocol

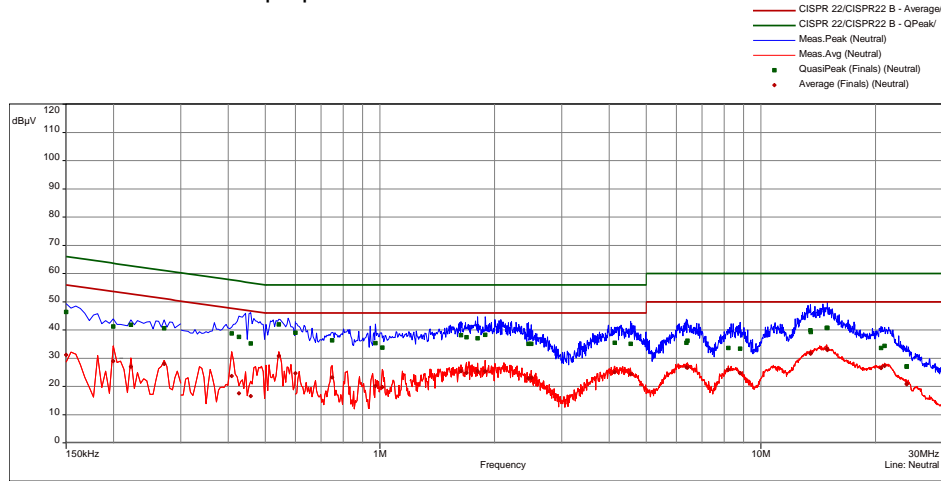
Test point L1 Result: passed
 Operation mode: Hopping mode (all 50 Channels are used) – Antenna
 DAE915R7865AGDZ1-T connected
 Remarks: Measurement was performed at the AC input of the
 connected Laptop



Frequency (MHz)	QuasiPeak (dBµV)	QP Margin (dB)	QP Limit (dBµV)	Average (dBµV)	AV Margin (dB)	AV Limit (dBµV)	Line	Correction (dB)
0.1545	45.85	19.90	65.75	27.60	28.15	55.75	Phase 1	9.83
0.222	41.84	20.91	62.74	26.74	26.00	52.74	Phase 1	9.81
0.249	40.51	21.28	61.79	21.60	30.19	51.79	Phase 1	9.81
0.3405	37.17	22.02	59.19	24.79	24.40	49.19	Phase 1	9.80
0.426	40.22	17.11	57.33	22.22	25.11	47.33	Phase 1	9.80
0.4305	40.39	16.85	57.24	24.12	23.12	47.24	Phase 1	9.80
0.4395	40.76	16.31	57.07	25.55	21.52	47.07	Phase 1	9.80
0.6	38.86	17.14	56.00	25.33	20.67	46.00	Phase 1	9.80
0.6045	38.93	17.07	56.00	25.93	20.07	46.00	Phase 1	9.80
0.8745	33.31	22.69	56.00	21.20	24.80	46.00	Phase 1	9.80
1.0725	33.37	22.63	56.00	19.61	26.39	46.00	Phase 1	9.80
1.695	37.99	18.01	56.00	24.90	21.10	46.00	Phase 1	9.78
1.9605	37.29	18.71	56.00	25.29	20.71	46.00	Phase 1	9.80
2.0415	38.29	17.71	56.00	25.69	20.31	46.00	Phase 1	9.80
2.4045	36.29	19.71	56.00	23.82	22.18	46.00	Phase 1	9.79
2.436	35.73	20.27	56.00	23.75	22.25	46.00	Phase 1	9.79
4.497	35.81	20.19	56.00	26.40	19.60	46.00	Phase 1	9.81
4.6725	36.02	19.98	56.00	25.25	20.75	46.00	Phase 1	9.82
6.5955	36.54	23.46	60.00	27.62	22.38	50.00	Phase 1	9.84
6.7215	36.99	23.01	60.00	26.80	23.20	50.00	Phase 1	9.84
6.798	37.69	22.31	60.00	29.24	20.76	50.00	Phase 1	9.84
8.4675	34.76	25.24	60.00	27.05	22.95	50.00	Phase 1	9.86
13.4835	41.06	18.94	60.00	32.85	17.15	50.00	Phase 1	10.04
13.497	41.29	18.71	60.00	32.91	17.09	50.00	Phase 1	10.04
14.361	41.90	18.10	60.00	34.55	15.45	50.00	Phase 1	10.09
14.5275	41.77	18.23	60.00	34.73	15.27	50.00	Phase 1	10.10
21.414	35.35	24.65	60.00	28.04	21.96	50.00	Phase 1	10.34
21.486	35.15	24.85	60.00	27.82	22.18	50.00	Phase 1	10.34
24.033	29.18	30.82	60.00	22.63	27.37	50.00	Phase 1	10.35
24.258	28.91	31.09	60.00	22.04	27.96	50.00	Phase 1	10.35

Test point: N
 Operation mode: Hopping mode (all 50 Channels are used) – Antenna
 DAE915R7865AGDZ1-T connected
 Remarks: Measurement was performed at the AC input of the
 connected Laptop

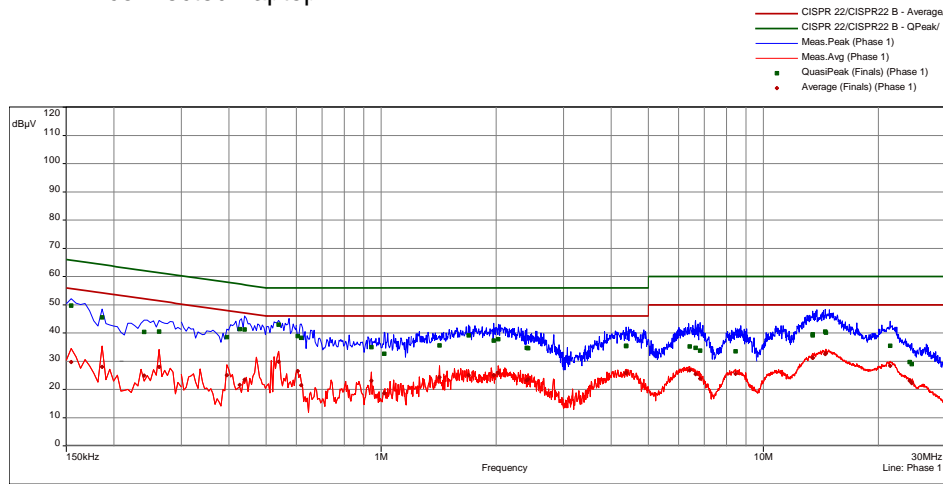
Result: passed



Frequency (MHz)	QuasiPeak (dBµV)	QP Margin (dB)	QP Limit (dBµV)	Average (dBµV)	AV Margin (dB)	AV Limit (dBµV)	Line	Correction (dB)
0.15	46.41	19.59	66.00	31.20	24.80	56.00	Neutral	9.83
0.1995	41.25	22.38	63.63	29.01	24.62	53.63	Neutral	9.84
0.222	41.87	20.87	62.74	27.04	25.71	52.74	Neutral	9.83
0.2715	40.64	20.43	61.07	27.98	23.10	51.07	Neutral	9.81
0.408	38.77	18.92	57.69	23.65	24.04	47.69	Neutral	9.80
0.426	37.61	19.72	57.33	17.61	29.72	47.33	Neutral	9.80
0.4575	35.20	21.54	56.74	16.56	30.18	46.74	Neutral	9.80
0.543	41.96	14.04	56.00	30.85	15.15	46.00	Neutral	9.81
0.6	39.06	16.94	56.00	24.67	21.33	46.00	Neutral	9.80
0.7485	36.35	19.65	56.00	23.16	22.84	46.00	Neutral	9.79
0.9735	35.33	20.67	56.00	20.10	25.90	46.00	Neutral	9.80
1.014	33.76	22.24	56.00	19.81	26.19	46.00	Neutral	9.80
1.632	38.21	17.79	56.00	25.40	20.60	46.00	Neutral	9.78
1.686	37.44	18.56	56.00	24.82	21.18	46.00	Neutral	9.78
1.803	37.09	18.91	56.00	25.41	20.59	46.00	Neutral	9.79
1.8885	38.24	17.76	56.00	25.43	20.57	46.00	Neutral	9.79
2.454	35.05	20.95	56.00	22.79	23.21	46.00	Neutral	9.78
2.4945	35.14	20.86	56.00	23.06	22.94	46.00	Neutral	9.78
4.1325	35.44	20.56	56.00	25.08	20.92	46.00	Neutral	9.80
4.5465	35.07	20.93	56.00	24.35	21.65	46.00	Neutral	9.81
6.3795	35.46	24.54	60.00	26.74	23.26	50.00	Neutral	9.81
6.42	36.23	23.77	60.00	26.67	23.33	50.00	Neutral	9.81
8.2065	33.67	26.33	60.00	25.92	24.08	50.00	Neutral	9.82
8.8185	33.44	26.56	60.00	24.63	25.37	50.00	Neutral	9.82
13.488	39.91	20.09	60.00	31.72	18.28	50.00	Neutral	9.90
13.5015	39.23	20.77	60.00	31.61	18.39	50.00	Neutral	9.90
14.874	40.74	19.26	60.00	33.38	16.62	50.00	Neutral	9.94
14.946	40.77	19.23	60.00	32.93	17.07	50.00	Neutral	9.94
20.667	33.60	26.40	60.00	26.54	23.46	50.00	Neutral	10.10
21.0855	34.42	25.58	60.00	27.22	22.78	50.00	Neutral	10.09
24.114	26.96	33.04	60.00	20.79	29.21	50.00	Neutral	9.97
24.15	27.15	32.85	60.00	20.95	29.05	50.00	Neutral	9.97

Test point L1
 Operation mode: Hopping mode (all 50 Channels are used) – Antenna
 DAE915R3540CGDD3-T connected
 Remarks: Measurement was performed at the AC input of the
 connected Laptop

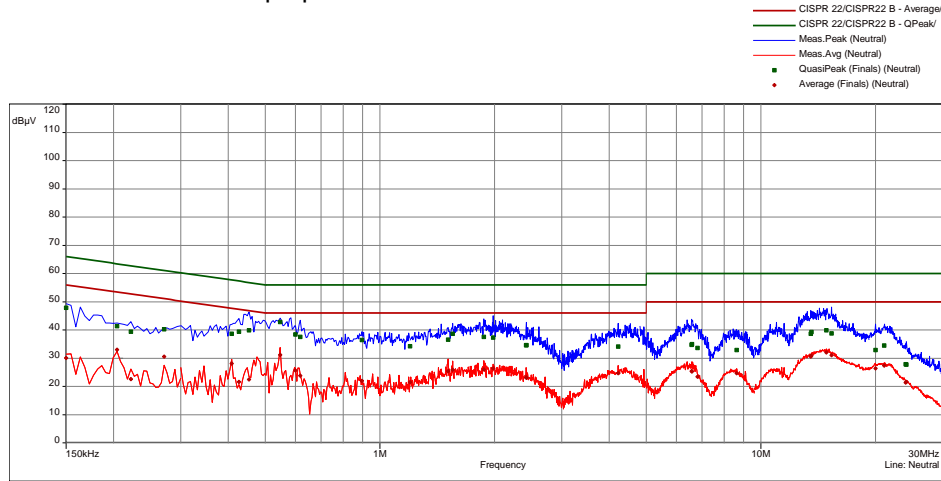
Result: passed



Frequency (MHz)	QuasiPeak (dBμV)	QP Margin (dB)	QP Limit (dBμV)	Average (dBμV)	AV Margin (dB)	AV Limit (dBμV)	Line	Correction (dB)
0.1545	49.72	16.04	65.75	29.68	26.08	55.75	Phase 1	9.83
0.186	45.55	18.66	64.21	27.94	26.27	54.21	Phase 1	9.82
0.24	40.43	21.67	62.10	24.97	27.13	52.10	Phase 1	9.81
0.2625	40.55	20.80	61.35	27.98	23.37	51.35	Phase 1	9.81
0.3945	38.54	19.43	57.97	25.02	22.95	47.97	Phase 1	9.80
0.426	41.36	15.97	57.33	21.62	25.71	47.33	Phase 1	9.80
0.4395	41.20	15.87	57.07	23.49	23.58	47.07	Phase 1	9.80
0.5385	42.91	13.09	56.00	29.78	16.22	46.00	Phase 1	9.81
0.6045	38.94	17.06	56.00	26.53	19.47	46.00	Phase 1	9.80
0.618	38.29	17.71	56.00	21.53	24.47	46.00	Phase 1	9.80
0.942	34.99	21.01	56.00	23.04	22.96	46.00	Phase 1	9.80
1.0185	32.63	23.37	56.00	18.70	27.30	46.00	Phase 1	9.80
1.4205	35.62	20.38	56.00	24.26	21.74	46.00	Phase 1	9.78
1.695	39.09	16.91	56.00	25.06	20.94	46.00	Phase 1	9.78
1.9695	37.37	18.63	56.00	25.10	20.90	46.00	Phase 1	9.80
2.0235	37.80	18.20	56.00	25.94	20.06	46.00	Phase 1	9.80
2.4045	34.77	21.23	56.00	23.16	22.84	46.00	Phase 1	9.79
2.4225	34.62	21.38	56.00	23.54	22.46	46.00	Phase 1	9.79
4.371	35.48	20.52	56.00	25.82	20.18	46.00	Phase 1	9.81
4.3755	35.41	20.59	56.00	26.00	20.00	46.00	Phase 1	9.81
6.4155	35.24	24.76	60.00	26.76	23.24	50.00	Phase 1	9.84
6.6405	34.70	25.30	60.00	25.42	24.58	50.00	Phase 1	9.84
6.825	33.69	26.31	60.00	23.87	26.13	50.00	Phase 1	9.84
8.4495	33.47	26.53	60.00	25.48	24.52	50.00	Phase 1	9.86
13.4565	39.52	20.48	60.00	31.15	18.85	50.00	Phase 1	10.04
13.461	39.14	20.86	60.00	31.23	18.77	50.00	Phase 1	10.04
14.505	40.45	19.55	60.00	32.51	17.49	50.00	Phase 1	10.10
14.5725	40.14	19.86	60.00	32.75	17.25	50.00	Phase 1	10.10
21.4815	35.43	24.57	60.00	28.33	21.67	50.00	Phase 1	10.34
24.1455	29.74	30.26	60.00	23.06	26.94	50.00	Phase 1	10.35
24.4245	28.92	31.08	60.00	22.18	27.82	50.00	Phase 1	10.35

Test point: N
 Operation mode: Hopping mode (all 50 Channels are used) – Antenna
 DAE915R3540CGDD3-T connected
 Remarks: Measurement was performed at the AC input of the
 connected Laptop

Result: passed



Frequency (MHz)	QuasiPeak (dBμV)	QP Margin (dB)	QP Limit (dBμV)	Average (dBμV)	AV Margin (dB)	AV Limit (dBμV)	Line	Correction (dB)
0.15	47.81	18.19	66.00	30.03	25.97	56.00	Neutral	9.83
0.204	41.36	22.08	63.45	32.98	20.46	53.45	Neutral	9.83
0.222	39.45	23.30	62.74	22.63	30.12	52.74	Neutral	9.83
0.2715	40.24	20.83	61.07	30.54	20.53	51.07	Neutral	9.81
0.408	38.62	19.07	57.69	28.17	19.52	47.69	Neutral	9.80
0.426	39.46	17.88	57.33	21.61	25.72	47.33	Neutral	9.80
0.453	39.84	16.98	56.82	22.46	24.36	46.82	Neutral	9.80
0.5475	42.81	13.19	56.00	31.12	14.88	46.00	Neutral	9.81
0.6	38.36	17.64	56.00	25.61	20.39	46.00	Neutral	9.80
0.618	37.54	18.46	56.00	23.81	22.19	46.00	Neutral	9.80
0.897	36.49	19.51	56.00	21.99	24.01	46.00	Neutral	9.80
1.2	34.28	21.72	56.00	21.53	24.47	46.00	Neutral	9.79
1.5105	36.53	19.47	56.00	25.47	20.53	46.00	Neutral	9.77
1.551	38.66	17.34	56.00	25.90	20.10	46.00	Neutral	9.77
1.875	37.56	18.44	56.00	25.99	20.01	46.00	Neutral	9.79
1.983	37.32	18.68	56.00	26.37	19.63	46.00	Neutral	9.80
2.418	34.60	21.40	56.00	23.22	22.78	46.00	Neutral	9.78
2.4225	34.60	21.40	56.00	23.10	22.90	46.00	Neutral	9.78
4.2225	34.14	21.86	56.00	24.64	21.36	46.00	Neutral	9.80
6.5775	34.74	25.26	60.00	25.41	24.59	50.00	Neutral	9.82
6.5865	35.00	25.00	60.00	25.34	24.66	50.00	Neutral	9.82
6.8115	33.60	26.40	60.00	23.42	26.58	50.00	Neutral	9.81
8.643	32.93	27.07	60.00	24.69	25.31	50.00	Neutral	9.82
13.515	38.63	21.37	60.00	30.62	19.38	50.00	Neutral	9.90
13.5555	39.32	20.68	60.00	30.96	19.04	50.00	Neutral	9.90
14.838	39.90	20.10	60.00	32.06	17.94	50.00	Neutral	9.94
15.333	38.75	21.25	60.00	31.11	18.89	50.00	Neutral	9.95
19.992	32.86	27.14	60.00	26.44	23.56	50.00	Neutral	10.13
21.0765	34.48	25.52	60.00	27.35	22.65	50.00	Neutral	10.09
24.006	27.83	32.17	60.00	21.39	28.61	50.00	Neutral	9.97
24.0825	27.72	32.28	60.00	21.63	28.37	50.00	Neutral	9.97

5.2 Occupied bandwidth

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

5.2.1 Description of the test location

Test location: AREA4

5.2.2 Photo documentation of the test set-up

For test setup photos see T42777-00-00JP ATTACHMENT A

5.2.3 Applicable standard

FCC Part 15, Section 15.247(a)(1)(i), RSS-Gen 6.6 and RSS-247 5.1c:

5.2.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10.

Spectrum analyser settings: refer to attached plots

5.2.5 Test result

20dB bandwidth			
Operating frequency [MHz]	Bandwidth [kHz]	limit [kHz]	Result
902.75	86.4	500	Pass
915.25	85.6	500	Pass
927.25	85.6	500	Pass

99% bandwidth			
Operating frequency [MHz]	Bandwidth [kHz]	limit [kHz]	Result
902.75	117.6	None defined	NA
915.25	121.6	None defined	NA
927.25	106.4	None defined	NA

Bandwidth limit according to FCC Part15C, Section 15.247(a)(1)(i) and RSS-247 5.1c:

Frequency (MHz)	Limit -20 dB bandwidth (kHz)
902-928	≤ 500

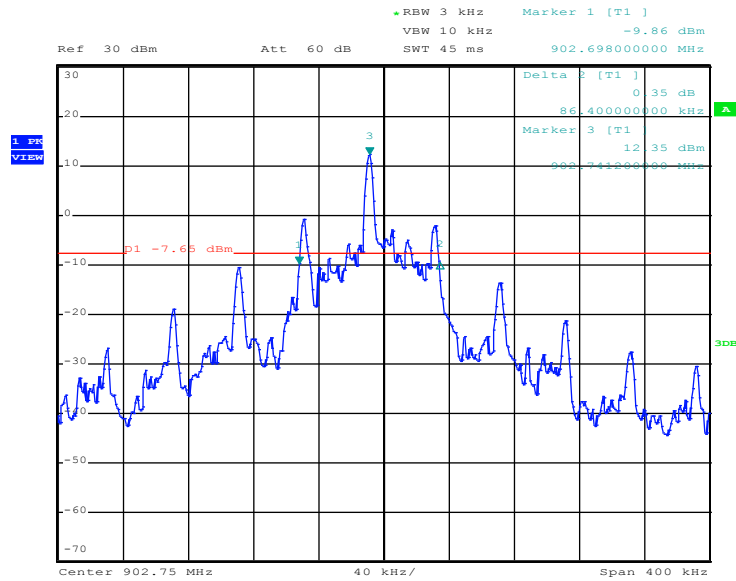
The requirements are **FULFILLED**.

Remarks: For detailed test results please refer to attached test protocols.

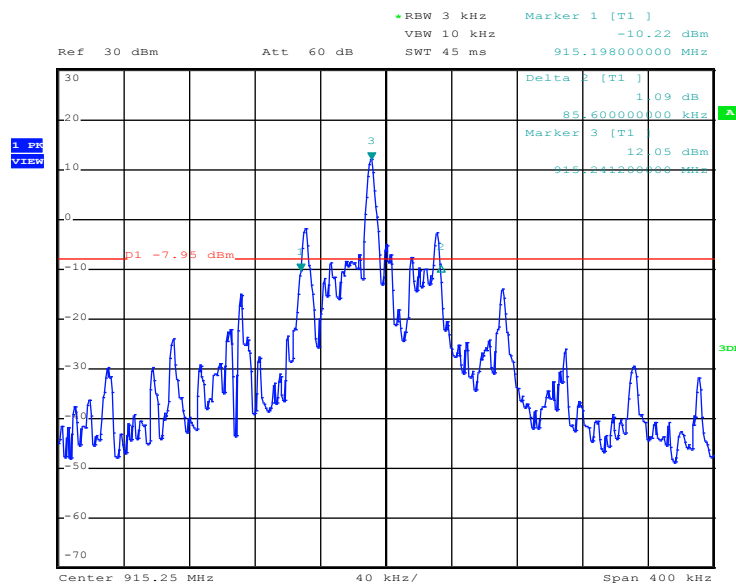
Measurement was made conducted at the antenna port.

5.2.6 Test protocols – 20dB bandwidth

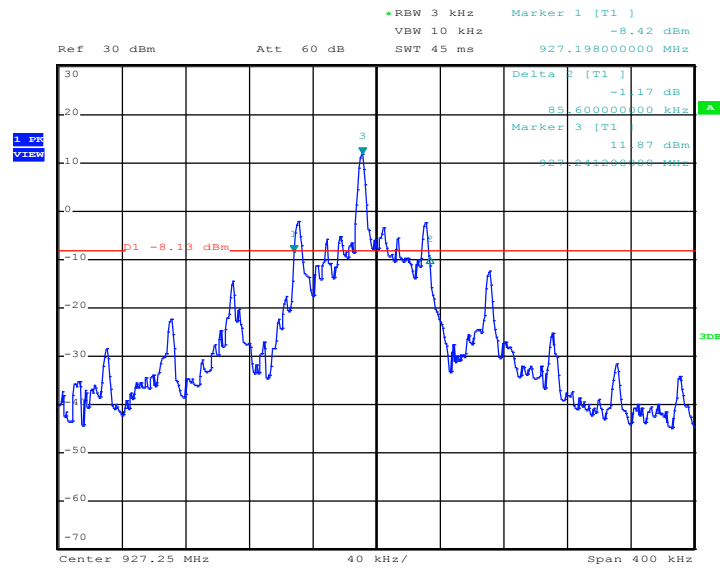
CH01, 902.75MHz



CH26, 915.25MHz

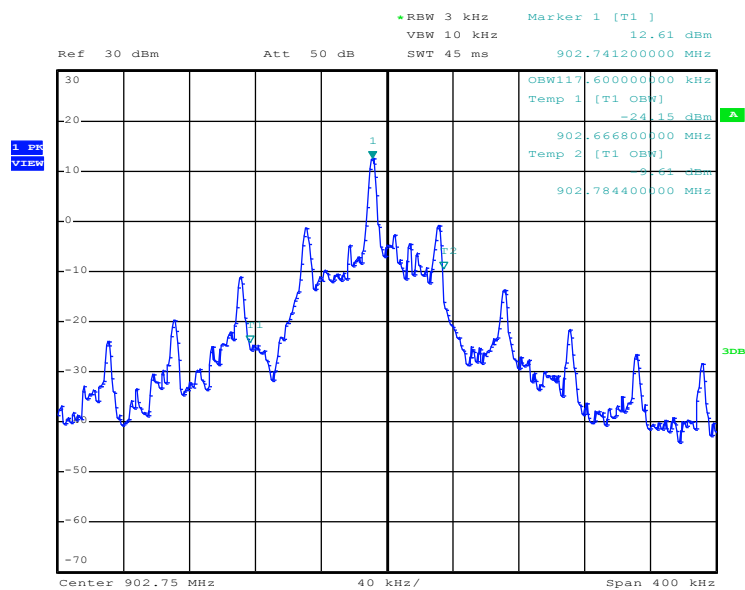


CH50, 927.25MHz

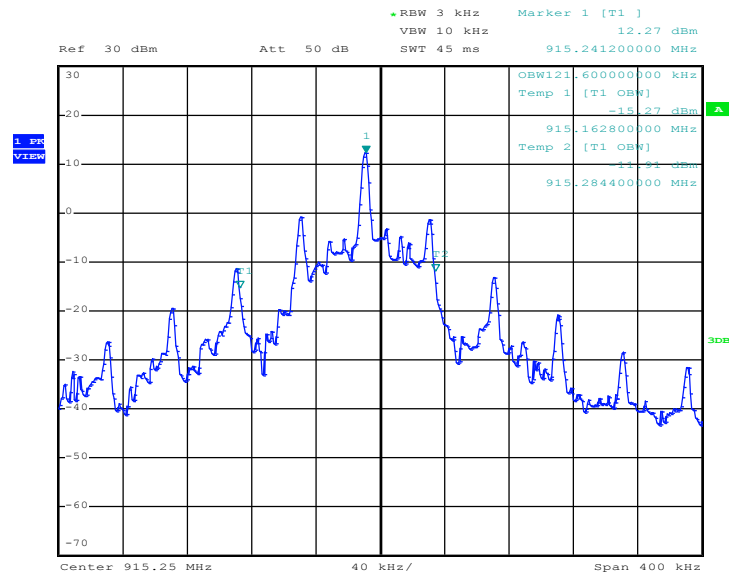


5.2.7 Test protocols – 99% bandwidth

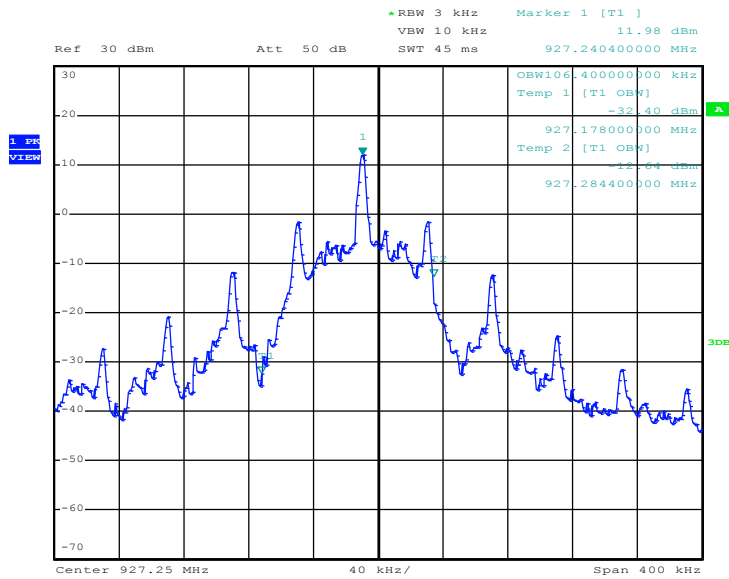
CH01, 902.75MHz



CH26, 915.25MHz



CH50, 927.25MHz



5.3 Maximum peak conducted output power

For test instruments and accessories used see section 6 Part **CPC 2**.

5.3.1 Description of the test location

Test location: AREA4

5.3.2 Photo documentation of the test set-up

For test setup photos see T42777-00-00JP ATTACHMENT A

5.3.3 Applicable standard

FCC Part 15, Section 15.247(b)(2) and RSS-247 5.4a:

5.3.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10.

Spectrum analyser settings:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Trace Mode: Max hold, Span: 1 MHz

5.3.5 Test result

Maximum peak conducted power						
Operating frequency [MHz]	Measured value [dBm]	Correction factor* [dB]	Conducted power [dBm]	Conducted power limit [dBm]	Delta [dB]	Result
902.75	12.3	0.8	13.1	30	-16.9	Pass
915.25	12.0	0.7	12.7	30	-17.3	Pass
927.25	11.7	0.8	12.5	30	-17.5	Pass

*measurement cable attenuation

Equivalent isotropically radiated power						
Operating frequency [MHz]	Conducted power [dBm]	Antenna gain* [dBi]	Resulting e.i.r.p. power [dBm]	e.i.r.p. limit [dBm]	Delta [dB]	Result
902.75	13.1	4.5	17.6	36	-18.4	Pass
915.25	12.7	4.5	17.2	36	-18.8	Pass
927.25	12.5	4.5	17.0	36	-19.0	Pass

*Antenna with maximum gain: DAE915R7865AGDZ1-T

Maximum peak conducted power limit according to FCC Part 15, Section 15.247(b)(2) and RSS-247 5.4a:

Frequency (MHz)	Peak conducted Power Limit	
	(dBm)	(Watt)
902-928	30*	1.0*

Equivalent isotropically radiated power limit according to RSS-247 5.4a:

Frequency (MHz)	e.i.r.p. limit	
	(dBm)	(Watt)
902-928	36*	4.0*

*Applicable for equipment with 50 or more hopping channels.

The requirements are **FULFILLED**.

Remarks: Antenna gain of dedicated antenna <6dBi.

5.4 Hopping frequency separation

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

For test setup photos see T42777-00-00JP ATTACHMENT A

5.4.3 Applicable standard

FCC Part 15, Section 15.247(a)(1) and RSS-247 5.1b:

5.4.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10.

Spectrum analyser settings: refer to attached plots

5.4.5 Test result

Reference channel CH26 [MHz]	Channel separation to CH25 [kHz]	Channel separation to CH27 [kHz]	Applied limit [kHz]
902.25	501	501	86.4

Limit according to FCC Part 15, Section 15.247(a)(1) and RSS-247 5.1b:

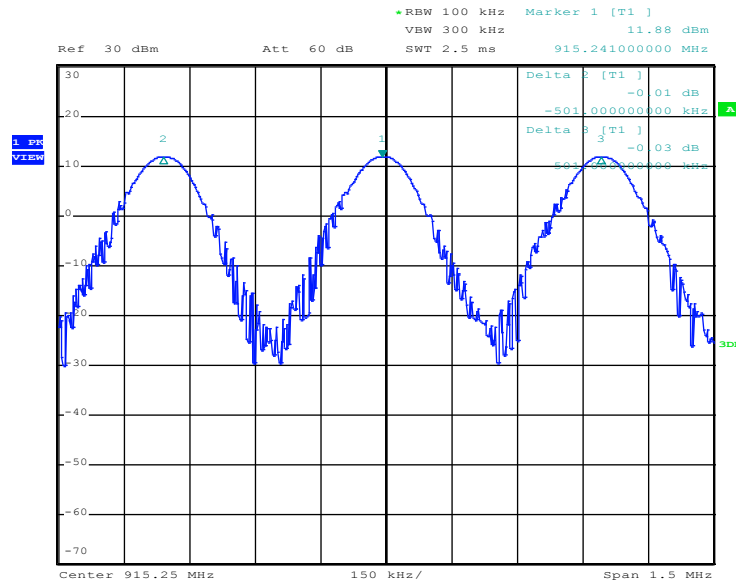
Frequency (MHz)	Limit channel separation (kHz)
All systems	> 25 kHz or 20 dB bandwidth, whichever is greater

The requirements are **FULFILLED**.

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

5.4.1 Test protocol

Channel separation



5.5 Number of hopping channels

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

5.5.1 Description of the test location

Test location: AREA4

5.5.2 Photo documentation of the test set-up

For test setup photos see T42777-00-00JP ATTACHMENT A

5.5.3 Applicable standard

FCC Part 15, Section 15.247(a)(1)(i) and RSS-247 5.1c:

5.5.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10.

Spectrum analyser settings: refer to attached plots

5.5.5 Test result

Hopping channel frequency range	Quantity of hopping channels value	Quantity of hopping channels minimum limit
902.75-927.25 MHz	50	50

Limit according to FCC Part 15, Section 15.247(a)(1)(i) and RSS-247 5.1c:

Frequency range (MHz)	minimum Quantity of Hopping Channels	
	20dB Bandwidth < 250kHz	20dB Bandwidth > 250kHz
902 - 928	50	25

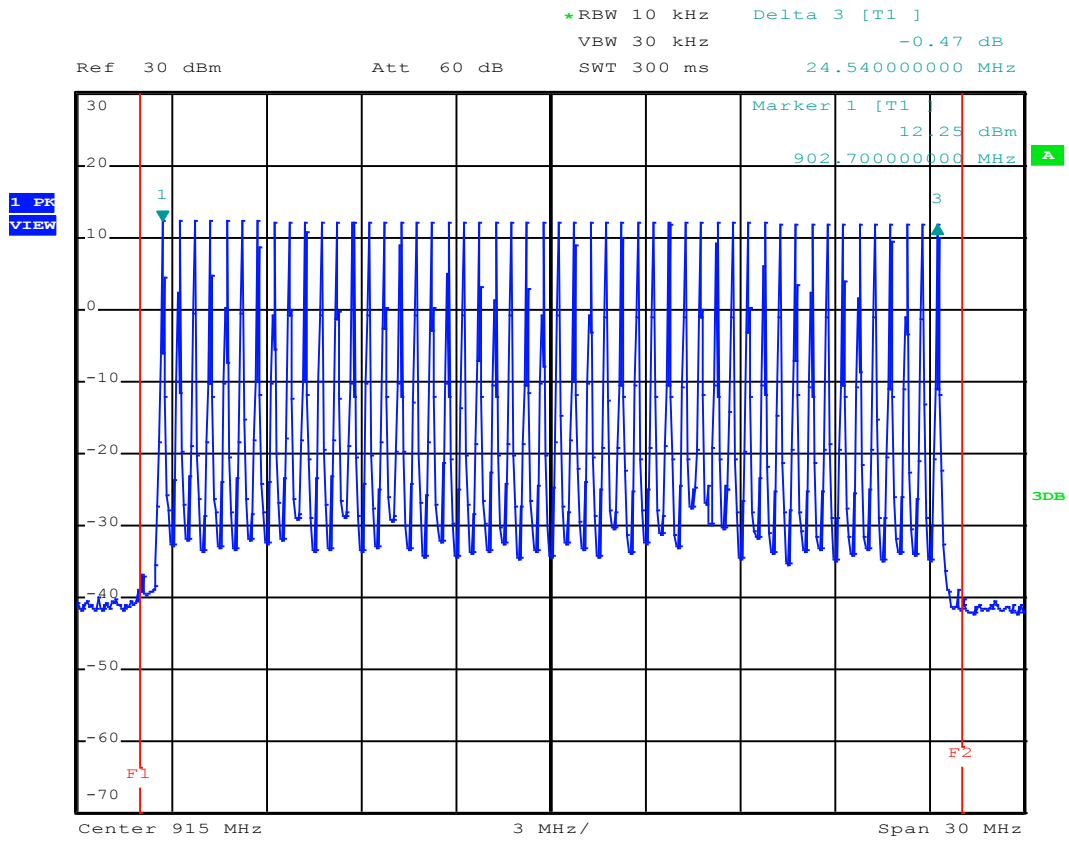
The requirements are **FULFILLED**.

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

--

5.5.6 Test protocol

Number of hopping channels



5.6 Average time of occupancy

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

5.6.1 Description of the test location

Test location: AREA4

5.6.2 Photo documentation of the test set-up

For test setup photos see T42777-00-00JP ATTACHMENT A

5.6.3 Applicable standard

FCC Part 15, Section 15.247(a)(1)(i), RSS-Gen 6.6 and RSS-247 5.1c:

5.6.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10.

Spectrum analyser settings: refer to attached plots

5.6.5 Test result

Channel frequency (MHz)	Pulse Time (ms)	Number of Bursts (in 1 time period)	Dwell time (pulse time x number of bursts) (ms)
902.75	17.1	18	307.8
915.25	16.9	18	304.2
927.25	17.2	18	309.6

Limit according to FCC Part 15, Section 15.247(a)(1)(i) and RSS-247 5.1c:

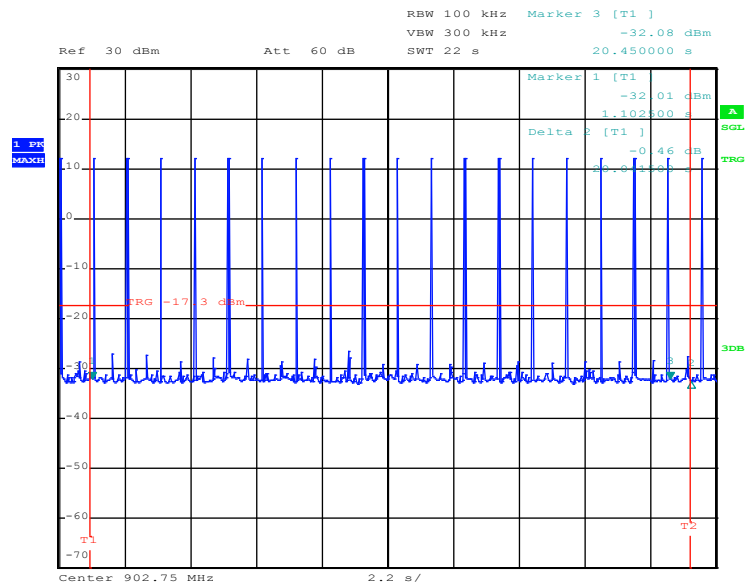
Frequency band (MHz)	Hopping channels	time of one period (s)	Limit dwell time, AV (ms)
902-928	≥ 50	20	< 400

The requirements are **FULFILLED**.

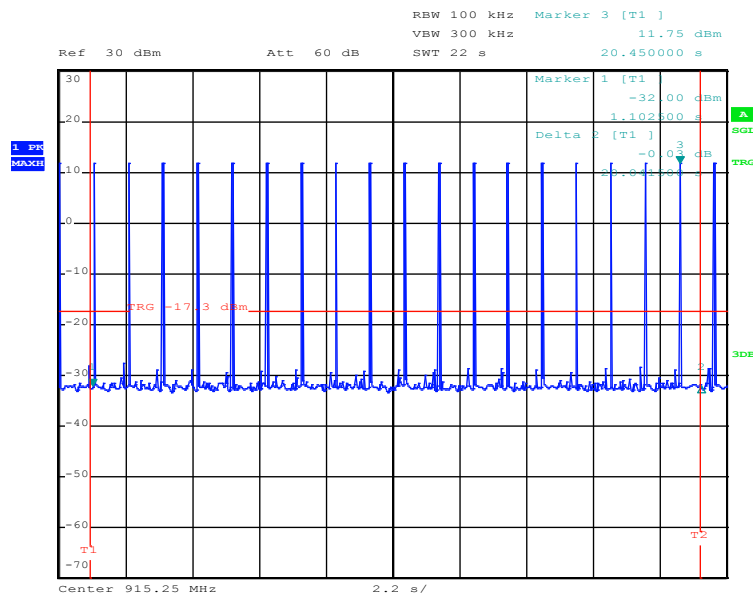
Remarks: For detailed test results please refer to following test protocols.

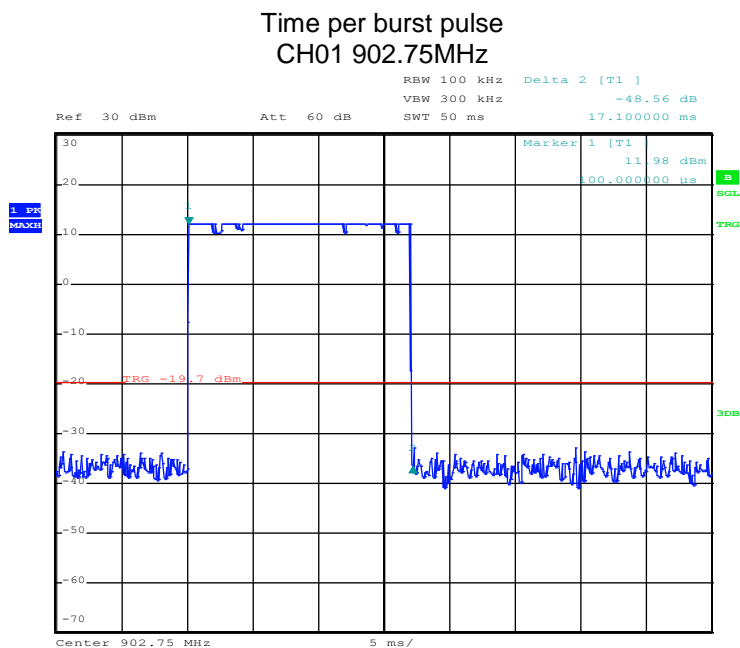
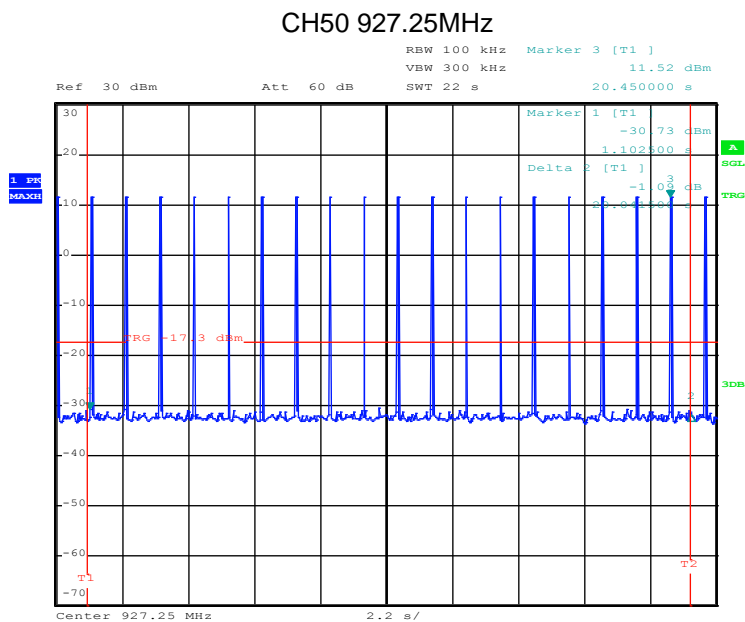
5.6.6 Test protocol

No of burst per time period
CH01 902.75MHz

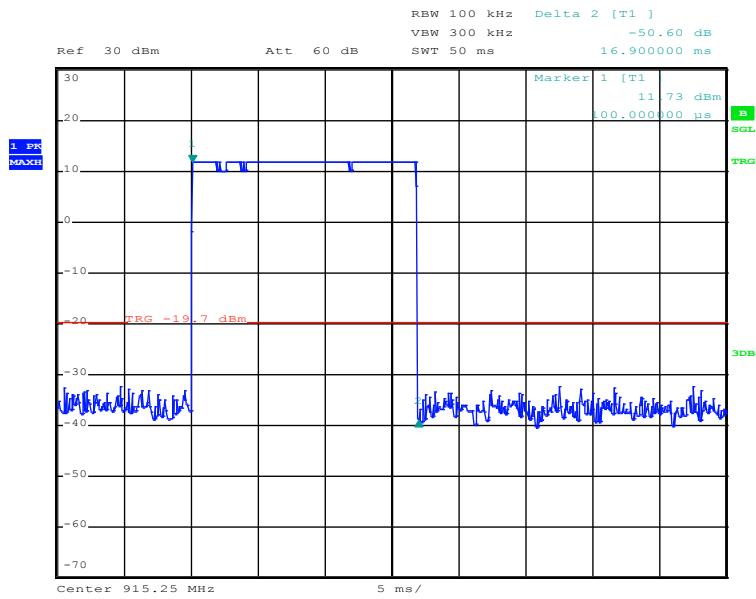


CH26 915.25MHz

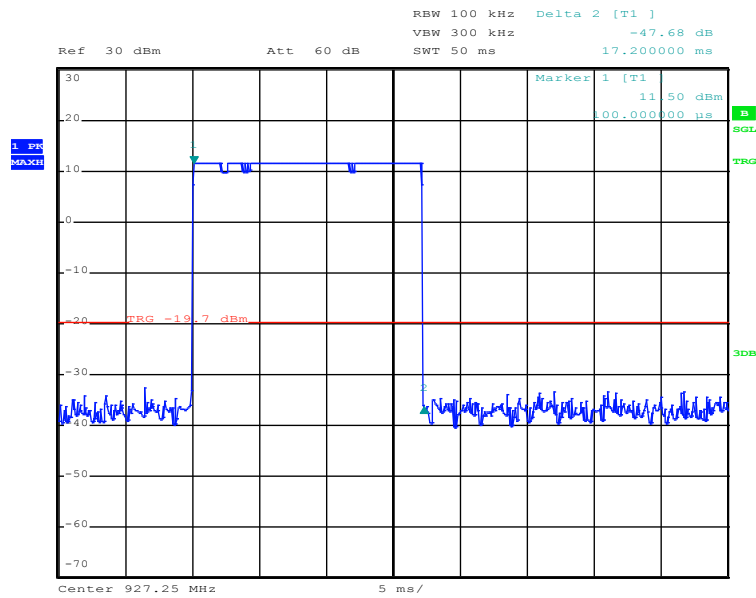




CH26 915.25MHz



CH50 927.25MHz



5.7 Unwanted emissions, conducted

For test instruments and accessories used see section 6 Part **SEC 1**, **SEC 2** and **SEC 3**.

5.7.1 Description of the test location

Test location: AREA4

5.7.2 Photo documentation of the test set-up

For test setup photos see T42777-00-00JP ATTACHMENT A

5.7.3 Applicable standard

According to FCC Part 15, Section 15.247(d) and RSS-247 5.5:

5.7.4 Description of measurement

The measurements are performed following the procedures set out in ANSI C63.10.
Spectrum analyser settings: refer to attached plots

5.7.5 Test result

All emissions are below the limit. Details can be found in the attached test plots.

Limit according to FCC Part 15, Section 15.247(d) and RSS-247 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB.

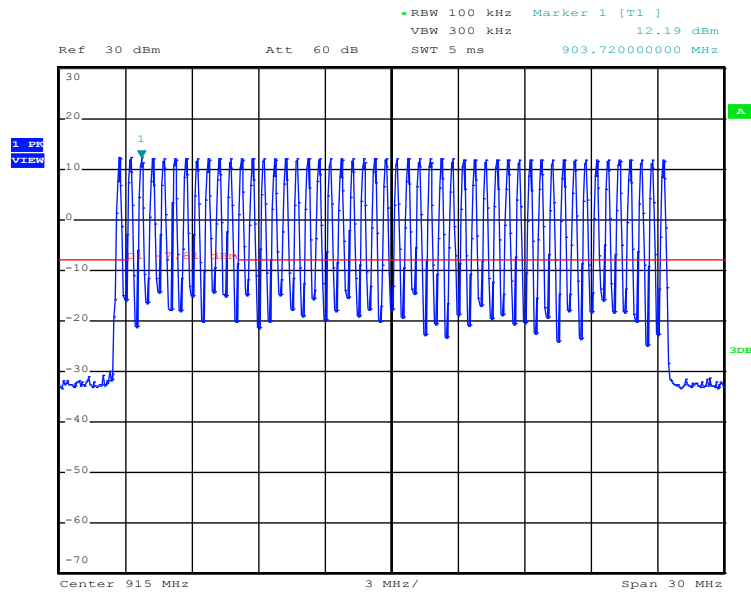
The requirements are **FULFILLED**.

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

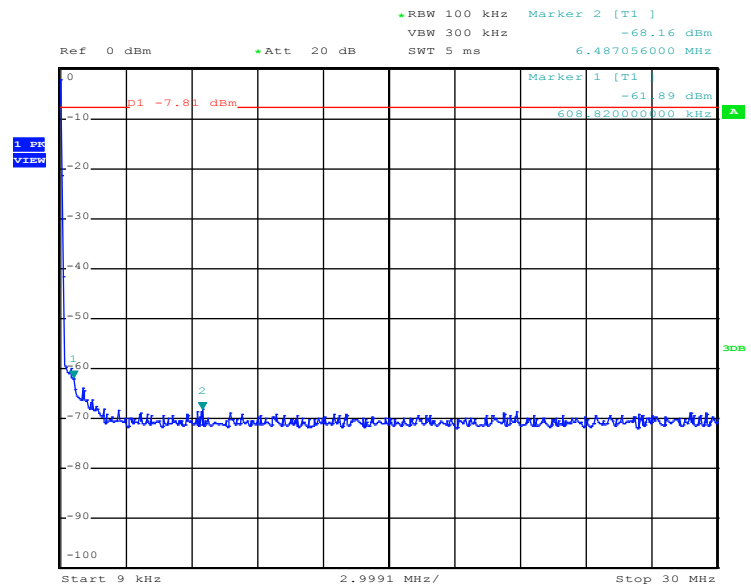
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5.7.6 Test protocols

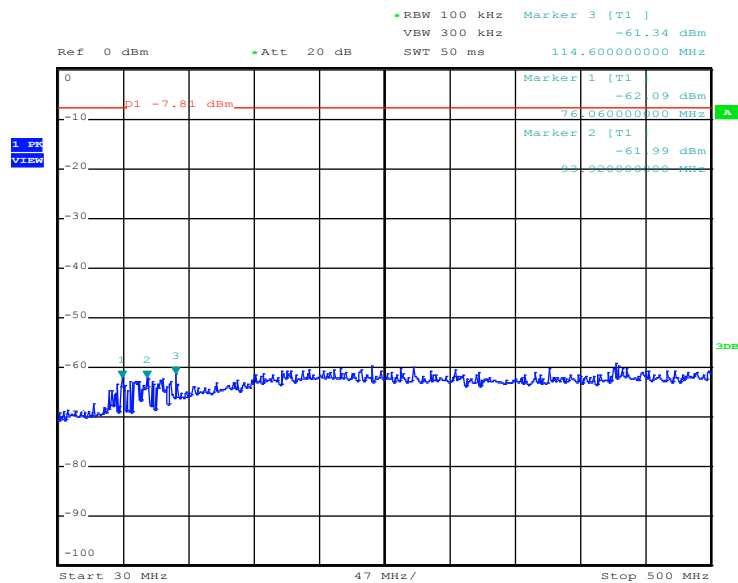
Determination of the reference level and limit



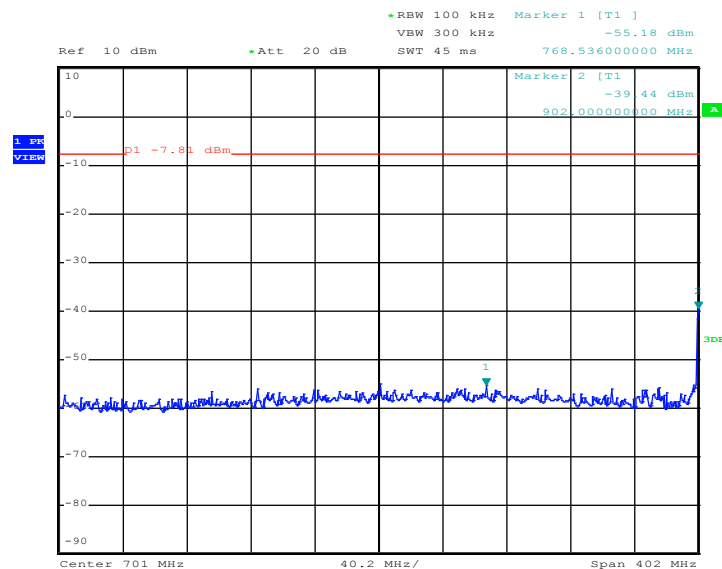
Spurious emissions conducted from 9 kHz to 30 MHz



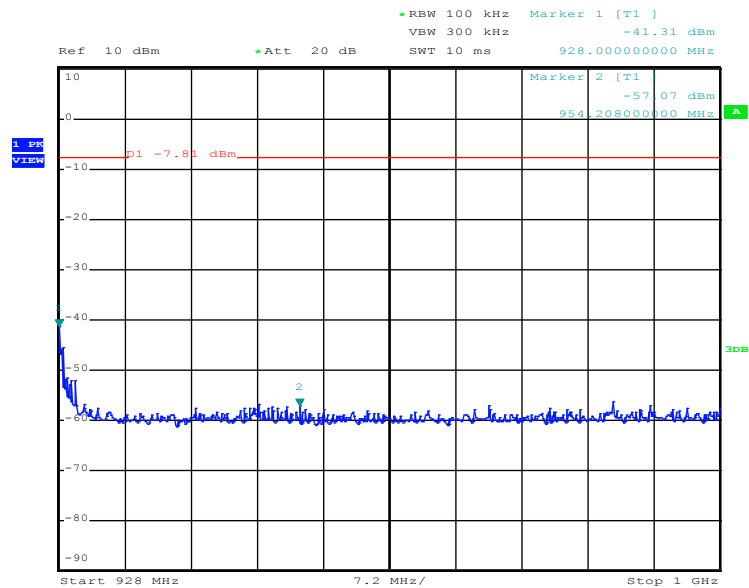
Spurious emissions conducted from 30 MHz to 500 MHz



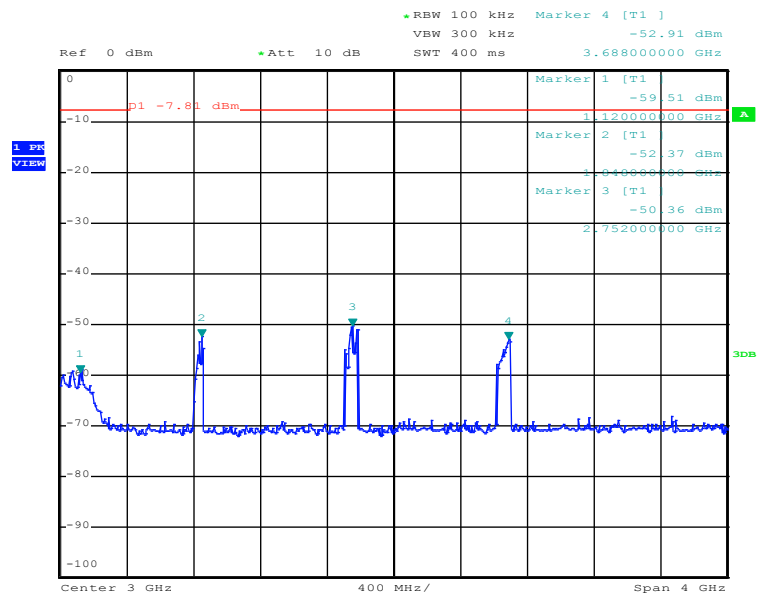
Spurious emissions conducted from 500 MHz to 902 MHz



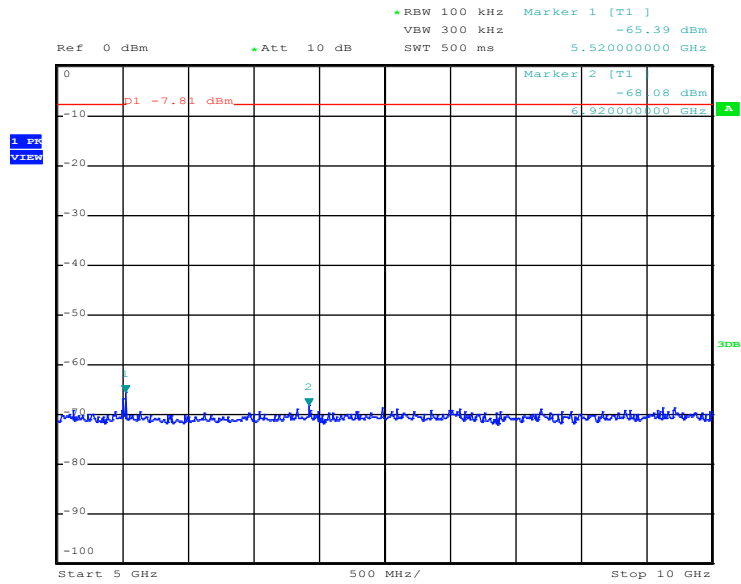
Spurious emissions conducted from 928 MHz to 1 GHz



Spurious emissions conducted from 1 GHz to 5 GHz



Spurious emissions conducted from 5 GHz to 10 GHz



5.8 Band edge compliance

For test instruments and accessories used see section 6 Part **SEC 2**.

5.8.1 Description of the test location

Test location: AREA4

5.8.2 Photo documentation of the test set-up

For test setup photos see T42777-00-00JP ATTACHMENT A

5.8.3 Applicable standard

According to FCC Part 15, Section 15.247(d) and RSS-247 5.5:

5.8.4 Description of measurement

The measurements are performed following the procedures set out in ANSI C63.10.
Spectrum analyser settings: refer to attached plots

5.8.5 Test result

All emissions are below the limit. Details can be found in the attached test plots.

Limit according to FCC Part 15, Section 15.247(d) and RSS-247 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB.

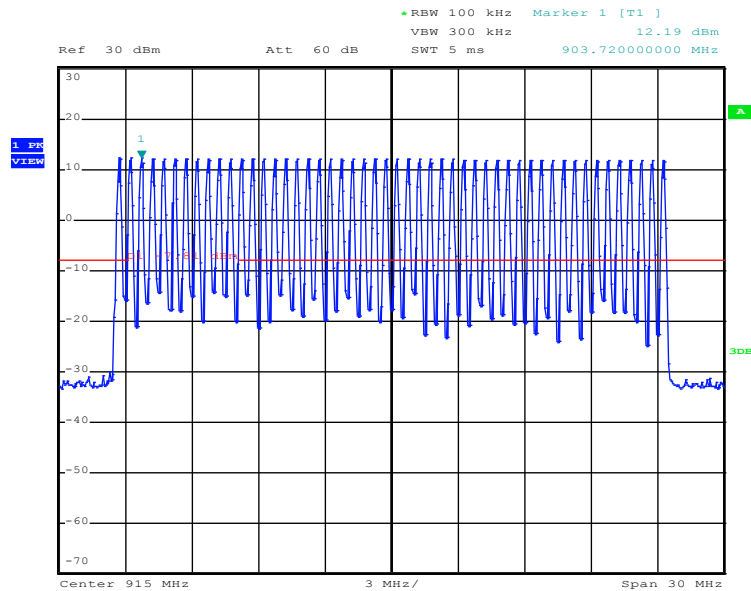
The requirements are **FULFILLED**.

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

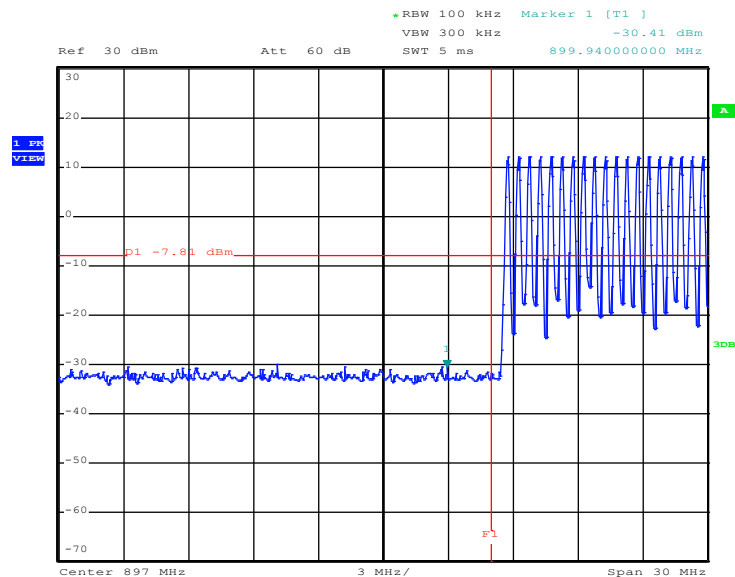
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5.8.6 Test protocol

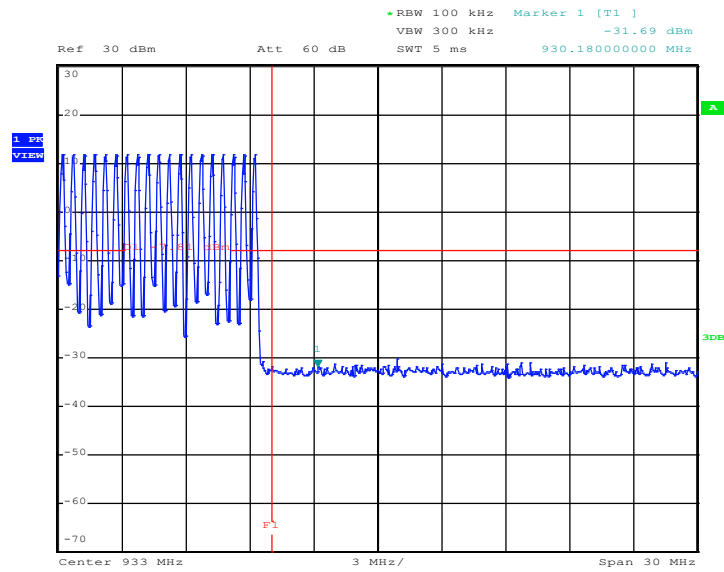
Determination of the reference level and limit



Band edge low



Band edge high



5.10 Unwanted emissions, radiated

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

5.10.1 Description of the test location

Test location: OATS 1
 Test location: Anechoic chamber 1
 Test distance: 3 m

5.10.2 Photo documentation of the test set-up

For test setup photos see T42777-00-00JP ATTACHMENT A

5.10.3 Applicable standard

According to FCC Part 15, Section 15.209 and RSS-GEN 8.9

5.10.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10.

Spectrum analyser settings:

30 MHz – 1000 MHz: RBW: 120 kHz

1000 MHz – 25 GHz: RBW: 1 MHz, VBW: 3 MHz, Sweep: Auto, Detector function: Peak

5.10.5 Test result 30 MHz < f < 1 GHz

Hopping mode (all 50 Channels are used) – Antenna DAE915R7865AGDZ1-T connected

Frequency (MHz)	Reading Vert. QP (dBµV)	Reading Hor. QP (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. QP (dBµV/m)	Level Hor. QP (dBµV/m)	Limit QP (dBµV/m)	Dlimit (dB)
35,80	12,0	4,1	14,0	12,8	26,0	16,9	40,0	-14,0
80,15	20,0	12,1	11,0	10,8	31,0	22,9	40,0	-9,0
83,80	12,5	5,0	10,2	10,3	22,7	15,3	40,0	-17,3
265,90	8,3	4,8	14,8	14,8	23,1	19,6	46,0	-22,9
461,26	10,3	5,4	21,5	21,2	31,8	26,6	46,0	-14,2

Hopping mode (all 50 Channels are used) – Antenna DAE915R3540CGDD3-T connected

Frequency (MHz)	Reading Vert. QP (dBµV)	Reading Hor. QP (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. QP (dBµV/m)	Level Hor. QP (dBµV/m)	Limit QP (dBµV/m)	Dlimit (dB)
35,80	12,3	3,8	14,0	12,8	26,3	16,6	40,0	-13,7
80,15	20,5	12,1	11,0	10,8	31,5	22,9	40,0	-8,5
83,80	12,6	4,9	10,2	10,3	22,8	15,2	40,0	-17,2
265,90	8,4	4,9	14,8	14,8	23,2	19,7	46,0	-22,8
461,26	9,6	5,6	21,5	21,2	31,1	26,8	46,0	-14,9

5.10.1 Test result 1GHz < f < 10 GHz

Hopping mode (all 50 Channels are used) – Antenna DAE915R7865AGDZ1-T connected

Frequency (MHz)	Reading PK Vert. (dBµV)	Reading PK Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit AV (dBµV/m)	Dlimit (dB)
1818,50	60,3	69,5	-17,3	-17,3	43,0	52,1	54,0	-1,9
2746,00	63,4	--	-13,2	--	50,2	--	54,0	-3,8
2782,00	--	63,4	--	-13,3	--	50,0	54,0	-4,0
3628,00	--	56,7	--	-13,0	--	43,7	54,0	-10,3
3694,00	62,3	--	-12,6	--	49,7	--	54,0	-4,3

Note: Peak values are below average value. Therefore no average measurement was performed.

Hopping mode (all 50 Channels are used) – Antenna DAE915R3540CGDD3-T connected

Frequency (MHz)	Reading PK Vert. (dBµV)	Reading PK Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. PK (dBµV/m)	Level Hor. PK (dBµV/m)	Limit AV (dBµV/m)	Dlimit (dB)
1810,00	64,1	65,1	-17,6	-17,6	46,5	47,5	54,0	-6,5
2758,00	67,0	--	-13,1	--	53,9	--	54,0	-0,1
2780,00	--	62,5	--	-13,3	--	49,1	54,0	-4,9
3628,00	--	59,4	--	-13,0	--	46,4	54,0	-7,6
3634,00	63,0	--	-13,0	--	50,0	--	54,0	-4,0

Note: Peak values are below average value. Therefore no average measurement was performed.

Radiated limits according to FCC Part 15 Section 15.209(a):

Frequency (MHz)	Field strength of spurious emissions		Measurement distance
	($\mu\text{V/m}$)	dB($\mu\text{V/m}$)	(metres)
0.009-0.490	2400/F (kHz)		300
0.490-1.705	24000/F (kHz)		30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Radiated limits according to RSS-GEN 8.9 Table 5:

Frequency (MHz)	Field strength of spurious emissions		Measurement distance
	($\mu\text{V/m}$)	dB($\mu\text{V/m}$)	(metres)
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

The requirements are **FULFILLED**.

Remarks: The measurement was performed in the frequency range 30 MHz to 10 GHz.

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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	BAT-EMC 3.16.0.73	01-02/68-13-001				
	ESCI	02-02/03-15-001	31/05/2018	31/05/2017		
	ESH 2 - Z 5	02-02/20-05-004	25/10/2019	25/10/2017	30/10/2018	30/04/2018
	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	18/11/2019	18/11/2016	07/11/2018	07/05/2018
CPC 2	FSP 30	02-02/11-05-001	04/10/2018	04/10/2017		
MB	FSP 30	02-02/11-05-001	04/10/2018	04/10/2017		
SEC 1-3	FSP 30	02-02/11-05-001	04/10/2018	04/10/2017		
SER 2	ESVS 30	02-02/03-05-006	03/07/2018	03/07/2017		
	VULB 9168	02-02/24-05-005	18/04/2019	18/04/2018	21/09/2018	21/03/2018
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSP 30	02-02/11-05-001	04/10/2018	04/10/2017		
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	3117	02-02/24-05-009	10/05/2018	10/05/2017		
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11N/11N/1500MM	02-02/50-13-015				