EMI – TEST REPORT

- FCC Part 15.249, RSS210 -

Type / Model Name	:	MWR-XX-S/T/TA
Product Description	:	Mechatronic wrench with integrated radio module
Applicant	:	SALTUS Industrial Technique GmbH
Address	:	Schaberger Strasse 49-53
		42659 SOLINGEN; GERMANY
Manufacturer	:	Enics Schweiz AG
Address	:	Austraße
		5300 TURGI; SWITZERLAND
Licence holder	:	SALTUS Industrial Technique GmbH
Address	:	Schaberger Strasse 49-53
		42659 SOLINGEN; GERMANY

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

Test Report No. : T41241-00-00KJ	03. May 2017 Date of issue

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

Contents

Attachment A and B as separatly supplement

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2016)

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, 2016)

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 15.209	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: 2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
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: 2013	Uncertainty in EMC measurement
CISPR 22: 2008 EN 55022: 2010	Information technology equipment

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – Detailed photos see attachment A

2.2 Short description of the equipment under test (EUT)

The EUT is a 900 MHz – transceiver unit for low power data transmission in 8 channels of the operating band of 902 MHz to 928 MHz.
The MWR-25TA is a mechatronic wrench and is equipt with a radio interface for wireless communication with Focus 60 / Focus 61.

Number of tested samples:	1
Tested version:	MWR-25TA
Serial number:	A7400007
Firmware version:	v2.2.7

The whole measurements where performed on the MWR-25TA, because there are no differences on the PCB and RF Part for all variants. Additional this variant has the most features included (torque and angle measurement). Please see also point 2.4 of this test report.

2.3 Equipment category

DXT: Part 15 Low Power Transceiver; RX Verfied

Range: 902 MHz – 928 MHz

2.4 Variants of the EUT

- **Focus 60**
  - 1 MWR
  - Same Hardware as Focus61, but without the MPC PCB

- **Focus 61**
  - Up to 10 MWR
  - Same Hardware as Focus60 with additional MPC PCB
  - Same Radio Transmission Board for Focus60/61

MWR xx S

- Only Clickdetection

MWR xx T

- Torque Measurement

MWR xx T/A

- Torque and Angle Measurement

- Focus61 has an additional Network interface (MPC PCB)
- MPC handles data output / protocols
- No additional differences between Focus60 and Focus61 regarding Hardware

MWR xx S

- MWR 25 S
- MWR 50 S
- MWR 85 S

MWR xx T

- MWR 25 T
- MWR 50 T
- MWR 85 T

MWR xx T/A

- MWR 25 TA
- MWR 50 TA
- MWR 85 TA

- The MWR PCB is the same for all 3 Models (S/T/TA)

2.5 Operation frequency and channel plan

Channel plan:

Channel	Frequency [MHz]
1	902.265
2	902.791
3	903.318
4	903.845
5	904.371
6	904.898
7	905.425
8	905.951
9	906.478
10	907.004
11	907.531
12	908.058
13	908.584
14	909.111
15	909.638
16	910.164
17	910.691
18	911.217
19	911.744
20	912.271
21	912.797
22	913.324
23	913.851
24	914.377
25	914.904

Channel	Frequency [MHz]
26	915.430
27	915.957
28	916.484
29	917.010
30	917.537
31	918.064
32	918.590
33	919.117
34	919.643
35	920.170
36	920.697
37	921.223
38	921.750
39	922.277
40	922.803
41	923.330
42	923.857
43	924.383
44	924.910
45	925.436
46	925.963
47	926.490
48	927.016
49	927.543

	available channels
X	tested channels (lower = 2 / middle = 20 / highest = 46)

2.6 Transmit operating modes

The EUT use FSK and provide following data rate:

38400 bps (bps = *bits per second)*

2.7 Antenna

The following antennas shall be used with the EUT:

Number	Characteristic	Model number	Plug	Frequency range (MHz)	Gain (dBi)	Cable loss (dB)
1	PCB antenna	-	-	868 - 915	0	-

2.8 Power supply system utilised

Power supply voltage, V_{nom} : 1.2 V Battery powered (rechargeable)

2.9 Peripheral devices and interface cables

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

- _____ Model : _____
- _____ Model : _____
- _____ Model : _____

2.10 Determination of worst case conditions for final measurement

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 horizontal position.

2.10.1 Test jig

No Test jig was used.

2.10.2 Test software

The system was supervised and programmed over standard terminal programm.

3 TEST RESULT SUMMARY

Operating in the 902 MHz – 928 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.35(c)	RSS-Gen, 6.10	Pulsed operation	passed
15.203	RSS Gen, 8.3	Antenna requirement	passed
15.204	RSS Gen, 8.2	External radio frequency power amplifiers	passed
15.205(a)	RSS Gen, 8.1	Emissions in restricted bands	passed
15.207(a)	RSS Gen, 8.8	AC power line conducted emissions	not applicable
15.215(c)	-	EBW	passed
-	RSS-Gen, 6.6	OBW	passed
15.249(a)	RSS-210, B10(a)	Field strength of fundamental	passed
15.249(d)	RSS-210, B10(b)	Out-of-band emission, radiated	passed
-	RSS-Gen, 6.11	Transmitter frequency stability	not applicable

The mentioned RSS Rule Parts in the above table are related to:
RSS Gen, Issue 4, November 2014
RSS 210, Issue 9, August 2016

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 : 27 January 2017

Testing concluded on : 04 April 2017

Checked by:

Klaus Gegenfurtner
I confirm the correctness and
Integrity of this document
2017.05.04 07:56:53 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Josef Knab
I'm the autor of this document
2017.05.03 14:23:00 +02'00'

Josef Knab
Radio Team

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%	± 2.5 x 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 ISED

4.4.1 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 210 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

4.4.2 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.

4.4.2.1 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.

4.4.2.1.1 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

4.4.2.1.2 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: NONE

5.1.2 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.

5.1.3 Test result

Remarks: This test is not applicable, because the system is battery powere.

5.2 Field strength of fundamental

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

5.2.1 Description of the test location

Test location: OATS 1
Test distance: 3 m

5.2.2 Photo documentation of the test set-up

5.2.3 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.

5.2.4 Description of Measurement

The radiated emission of the fundamental wave from the EUT is measured using a tuned EMI-receiver. The set up of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 6.5. The EUT is measured in TX mode under normal conditions.
EMI test receiver settings:
30 MHz – 1000 MHz: RBW: 120 kHz

5.2.5 Test result

Frequency (MHz)	Level QP (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Corrected level dB(µV/m)	Limit dB(µV/m)	Delta (dB)
902.791	53.0	120	30.7	83.7	94.0	-10.3
912.271	54.0	120	30.8	84.8	94.0	-9.2
925.963	54.4	120	30.7	85.1	94.0	-8.9

Note: The correction factor includes cable loss and antenna factor.

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

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

The requirements are **FULFILLED.**

Remarks: _____

_____

5.3 Out-of-band emission, radiated

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

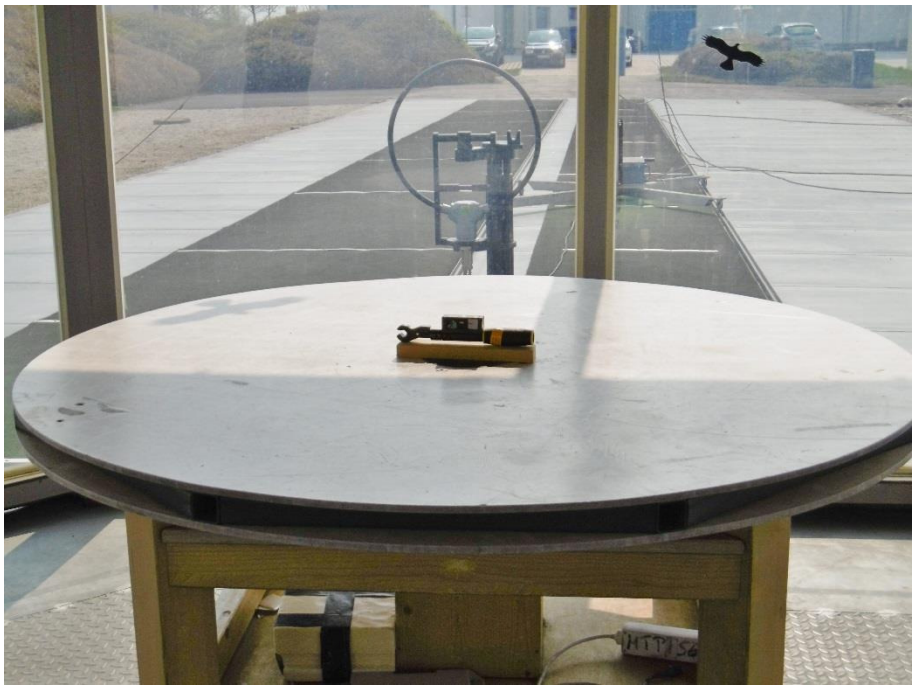
5.3.1 Description of the test location

Test location: OATS 1 / Anechoic chamber 1

Test distance: 3 m

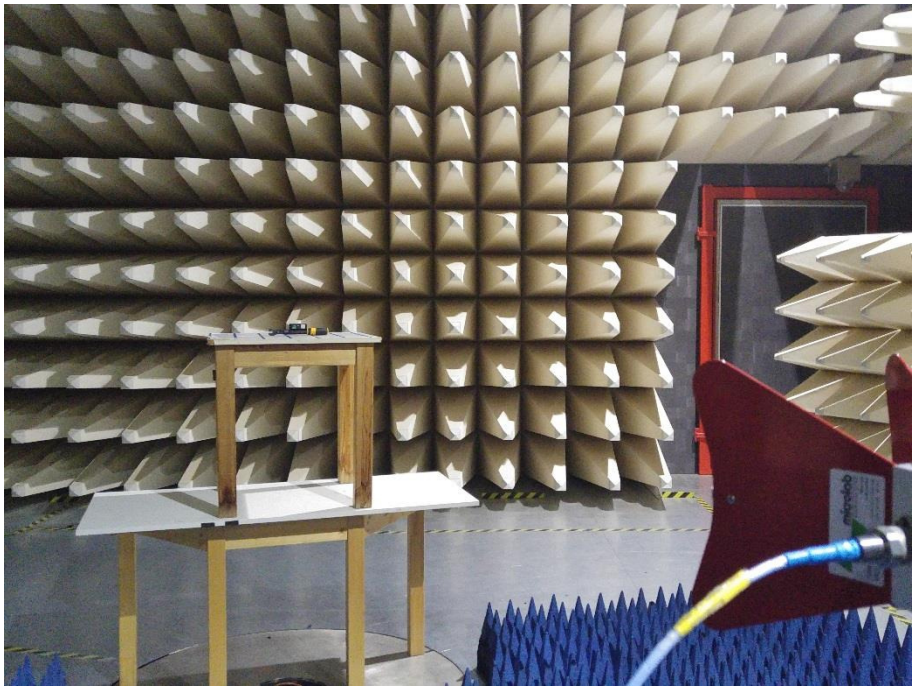
5.3.2 Photo documentation of the test set-up

Test setup 9 kHz – 30 MHz:



Test setup 30 MHz – 1000 MHz:

Test setup 1 GHz – 10 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 C63.10, Item 6.3. 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 – 10 GHz	RBW:	1 MHz

5.3.5 Test result f < 30 MHz

Channel 20

Frequency (MHz)	Reading QP dB(µV/m)	D factor (dB)	Level QP dB(µV/m)	Limit QP dB(µV/m)	Delta (dB)
0.1	24.3	-80.0	-55.7	27.6	-83.3
0.5	31.6	-40.0	-8.4	33.6	-42.0
1.0	24.7	-40.0	-15.3	27.6	-42.9
5.0	24.5	-40.0	-15.5	29.5	-45.0
10.0	23.6	-40.0	-16.4	29.5	-45.9
20.0	20.4	-40.0	-19.6	29.5	-49.1

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

Channel 20

Frequency (MHz)	Level QP (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Corrected level QP dB(µV/m)	Limit QP dB(µV/m)	Delta (dB)
30.0	6.2	120.0	14.1	20.3	40.0	-19.7
200.0	-1.3	120.0	11.3	10.0	40.0	-30.0
400.0	1.0	120.0	19.8	20.8	40.0	-19.2
600.0	-2.1	120.0	25.5	23.4	40.0	-16.6
800.0	-0.7	120.0	29.5	28.8	42.9	-14.1
1000.0	0.2	120.0	32.4	32.6	42.9	-10.3

Note: The correction factor includes cable loss and antenna factor. In the frequency range 30 MHz to 1000 MHz no emission could be detected. The frequencies mention the noise level. The measurement results are from distance of 3 m.

5.3.7 Test result f > 1 GHz

Channel 2

Frequency (MHz)	Level Pk (dBµV)	Duty Cycle correction (kHz)	Level AV (dBµV)	Correct. factor (dB)	Corrected level PK (dBµV/m)	Corrected level AV (dBµV/m)	Limit PK (dBµV/m)	Limit AV (dBµV/m)	Delta (dB)
1805.6	84.4	-13.0	71.4	-17.6	66.8	53.8	74.0	54.0	-0.2
2708.4	70.1	-13.0	57.1	-13.0	57.1	44.1	74.0	54.0	-9.9
3611.2	55.8	-13.0	42.8	-13.0	42.8	29.8	74.0	54.0	-24.2
4514.0	49.2	-13.0	36.2	1.4	1.4	37.6	74.0	54.0	-16.4

*) Average values were calculated from the subtraction of peak values minus correction duty cycle factor.

Channel 20

Frequency (MHz)	Level Pk (dBµV)	Duty Cycle correction (kHz)	Level AV (dBµV)	Correct. factor (dB)	Corrected level PK (dBµV/m)	Corrected level AV (dBµV/m)	Limit PK (dBµV/m)	Limit AV (dBµV/m)	Delta (dB)
1824.6	83.9	-13.1	70.8	-17.3	66.6	53.5	74.0	54.0	-0.5
2736.8	63.2	-13.1	50.1	-13.2	50.0	36.9	74.0	54.0	-17.1
3649.1	55.5	-13.1	42.4	-13.0	42.5	29.4	74.0	54.0	-24.6
4561.4	48.0	-13.1	34.9	1.9	49.9	36.8	74.0	54.0	-17.2

*) Average values were calculated from the subtraction of peak values minus correction duty cycle factor.

Channel 46

Frequency (MHz)	Level Pk (dBµV)	Duty Cycle correction (kHz)	Level AV (dBµV)	Correct. factor (dB)	Corrected level PK (dBµV/m)	Corrected level AV (dBµV/m)	Limit PK (dBµV/m)	Limit AV (dBµV/m)	Delta (dB)
1851.9	83.6	-13.0	70.6	-16.8	66.8	53.8	74.0	54.0	-0.2
2777.9	67.9	-13.0	54.9	-13.4	54.5	41.5	74.0	54.0	-12.5
3703.9	56.2	-13.0	43.2	-12.5	43.7	30.7	74.0	54.0	-23.3
4629.8	49.8	-13.0	36.8	2.3	52.1	39.1	74.0	54.0	-14.9
6481.8	39.8	-13.0	26.8	6.4	46.2	33.2	74.0	54.0	-20.8

*) Average values were calculated from the subtraction of peak values minus correction duty cycle 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	Field strength of harmonics	
(MHz)	(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 was performed up to the 10th harmonic (10000 MHz). For detailed test result please refer to following test protocols.

Radiated emission below 1 GHz only performend at CH 20, because there are no differences between CH 2 and CH 46.

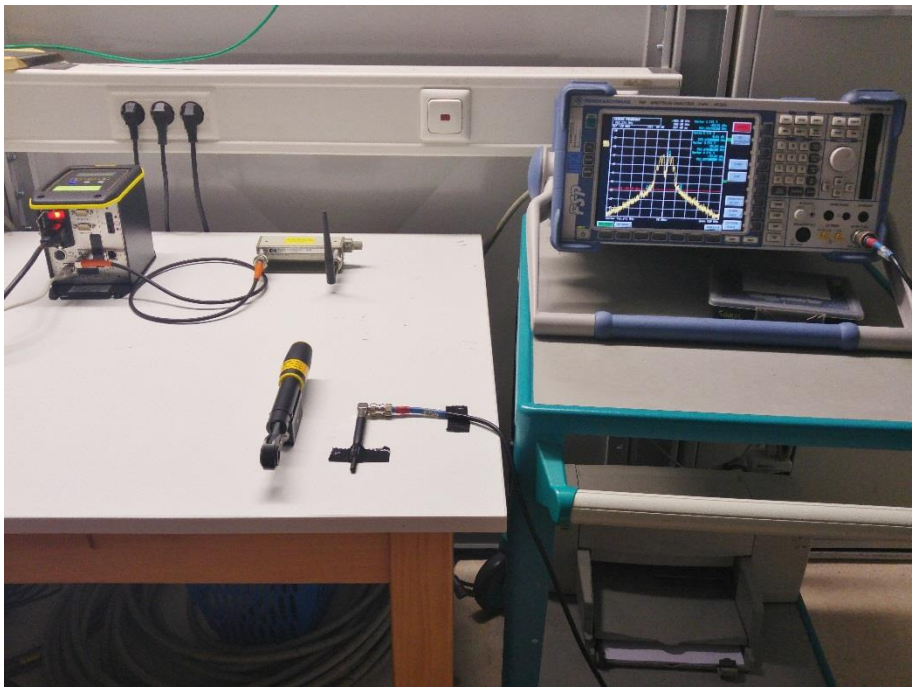
5.4 EBW and OBW

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

5.4.1 Description of the test location

Test location: Shielded Room S4

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: 10 kHz, VBW: 30 kHz, Span: 750 kHz, Trace mode: max. hold, Detector: max. peak;

5.4.5 Test result

Operating frequency band	20 dB Bandwidth		
	CH 2	CH 20	CH 46
f_{low} > 902 MHz	f_{low} = 902.7041 MHz	f_{low} = 912.1156 MHz	f_{low} = 925.8322 MHz
f_{high}< 928 MHz	f_{high} = 902.8900 MHz	f_{high} = 912.4240 MHz	f_{high} = 926.1018 MHz
20 dB BW	185.9 kHz	308.4 kHz	269.5 kHz

Operating frequency band	99 % Bandwidth		
	CH 2	CH 20	CH 46
f_{low} > 902 MHz	f_{low} = 902.6697 MHz	f_{low} = 912.0822 MHz	f_{low} = 925.7817 MHz
f_{high}< 928 MHz	f_{high} = 902.9152 MHz	f_{high} = 912.4685 MHz	f_{high} = 926.1473 MHz
99 % BW	245.5 kHz	386.3 kHz	365.6 kHz

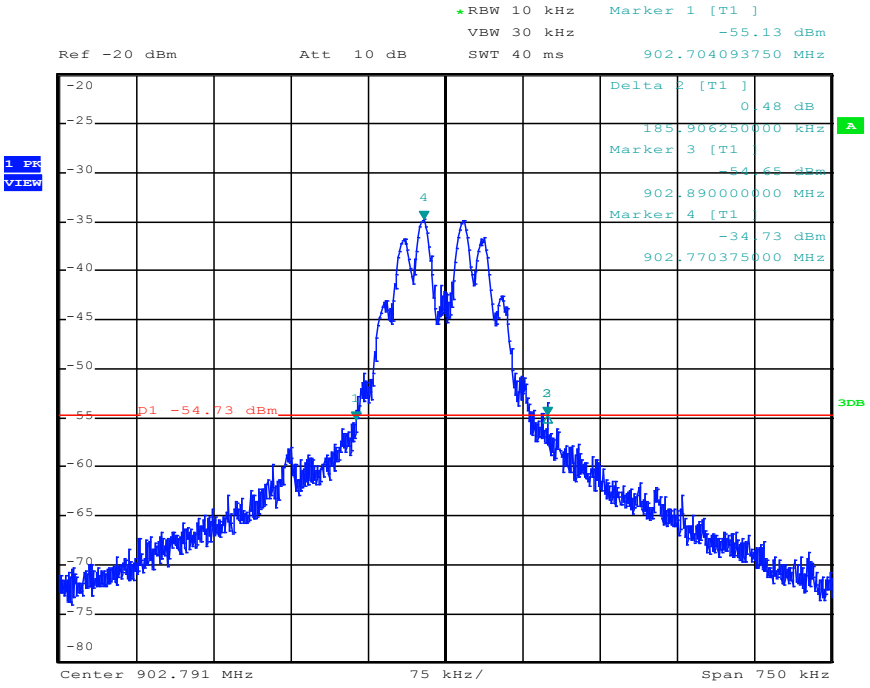
The requirements are **FULFILLED.**

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

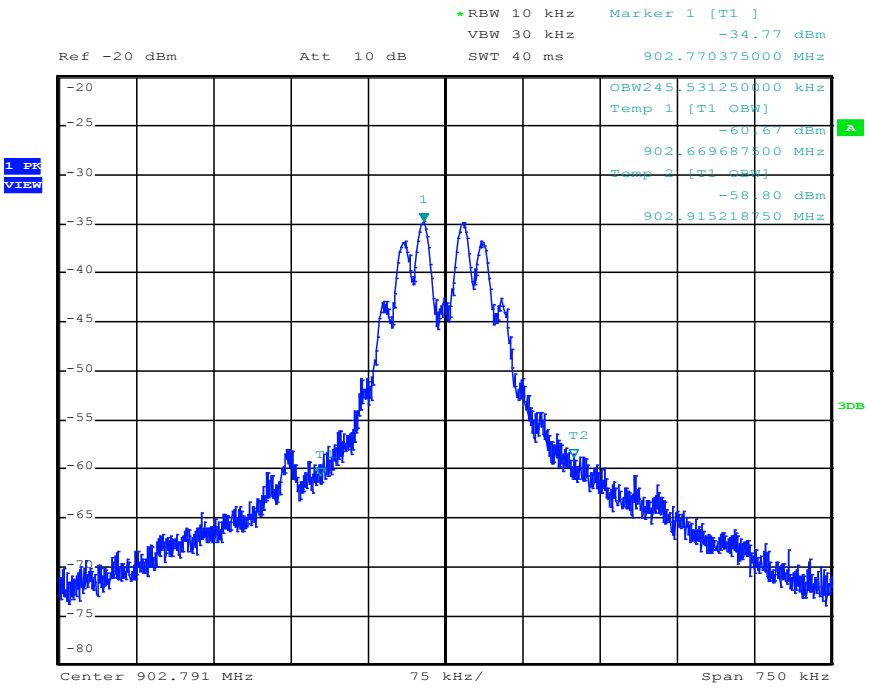
The OBW99 is measured for RSS only.

5.4.6 Test protocols – CH 2

20 dB bandwidth

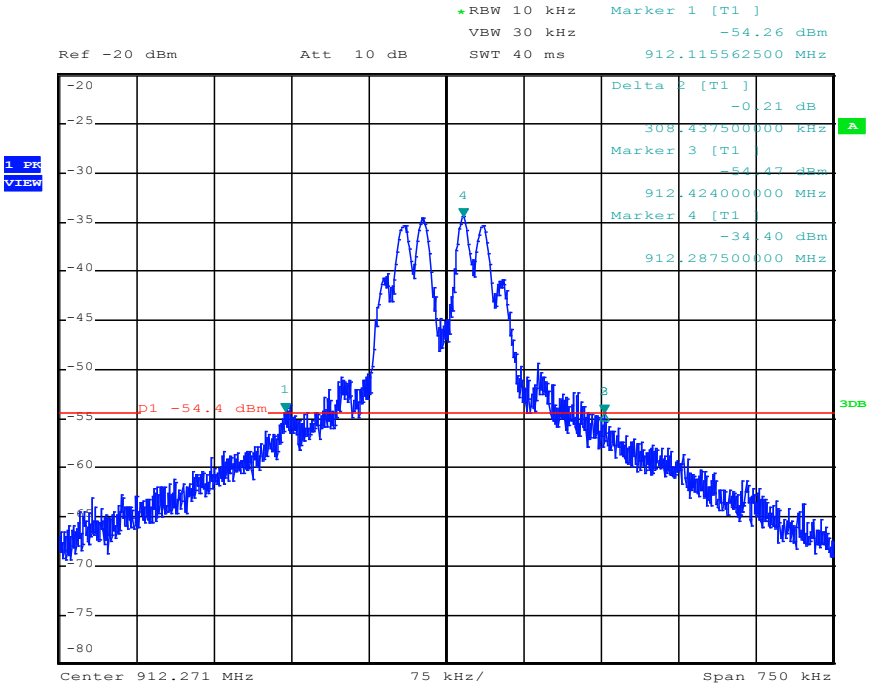


OBW 99%

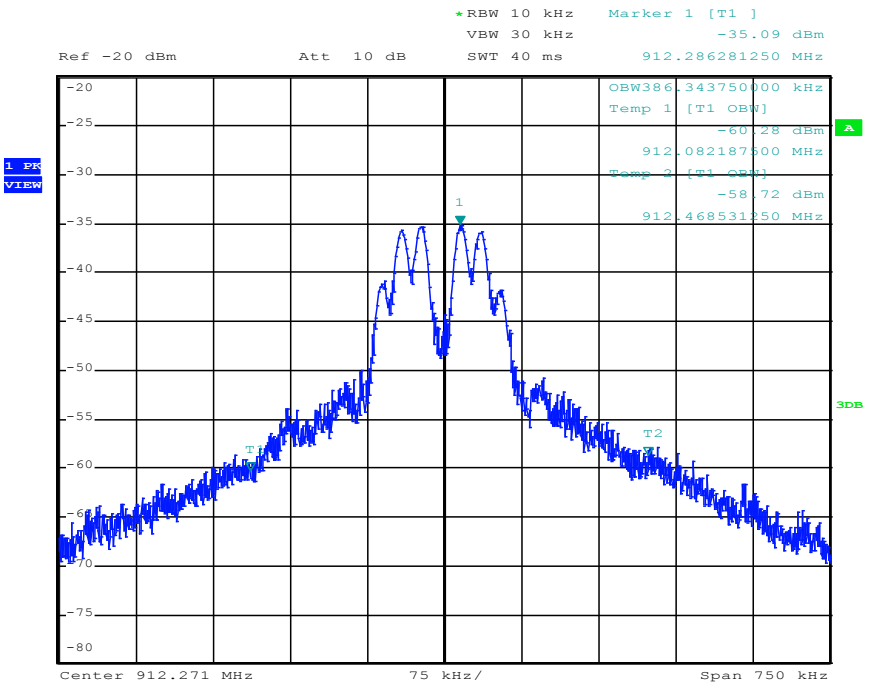


5.4.7 Test protocols – CH 20

20 dB bandwidth

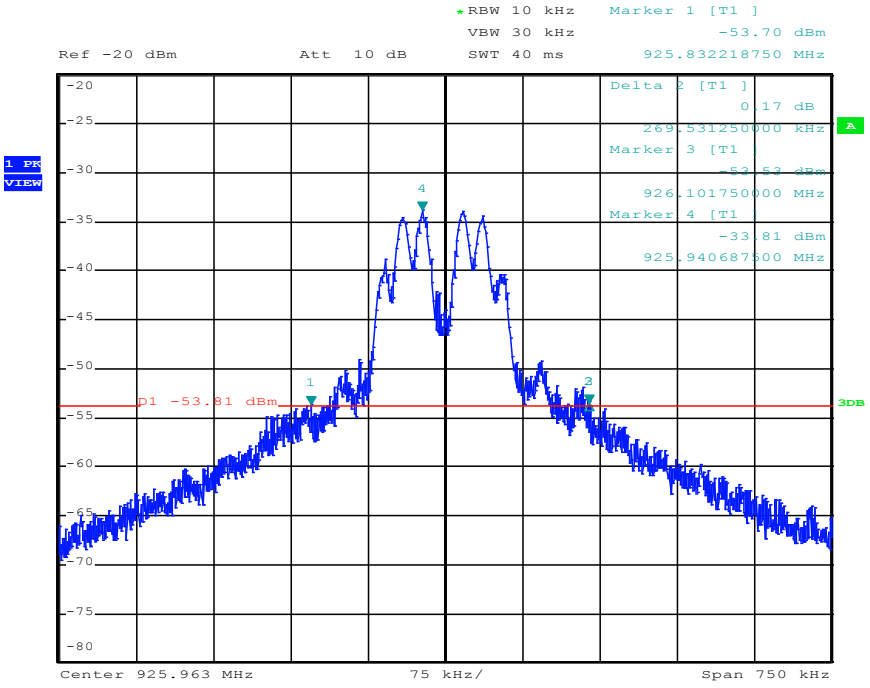


OBW 99%

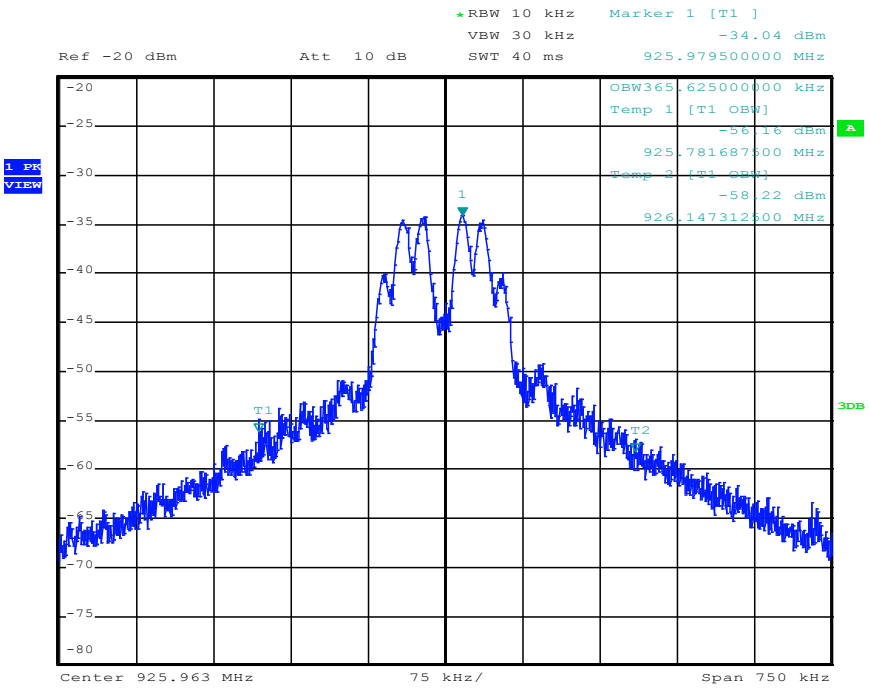


5.4.8 Test protocols – CH 46

20 dB bandwidth



OBW 99%



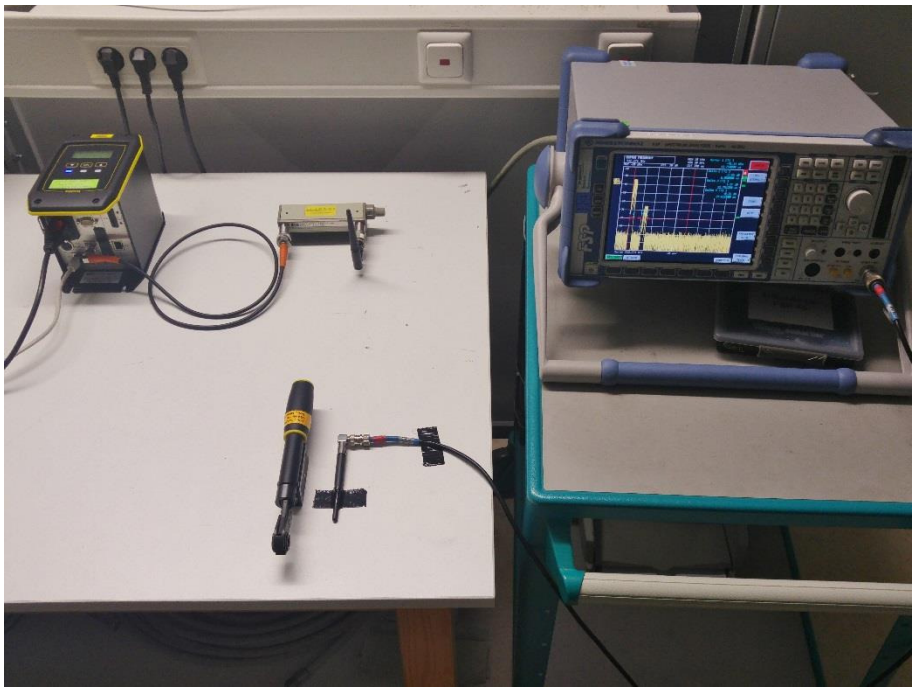
5.5 Correction for pulse operation (duty cycle)

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

5.5.1 Description of the test location

Test location: Shielded Room S4

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:

$$K_E = 20 \log ((t_{iB})/100)$$

K_E:	pulse operation correction factor	(dB)
t_{iB}	pulse duration for one pulse	(ms)

Spectrum analyser settings:
RBW: 10 kHz, VBW: 30 kHz, Span: zero span, Trace mode: clear write (single), Detector: max. peak;

5.5.5 Test result

Idle mode:

CH	t_{iB} (ms)	K_E (dB)
2	6.9	-23.2
20	6.9	-23.2
46	6.9	-23.2

Data transmission:

CH	t_{iB} (ms)	K_E (dB)
2	22.4	-13.0
20	22.1	-13.1
46	22.3	-13.0

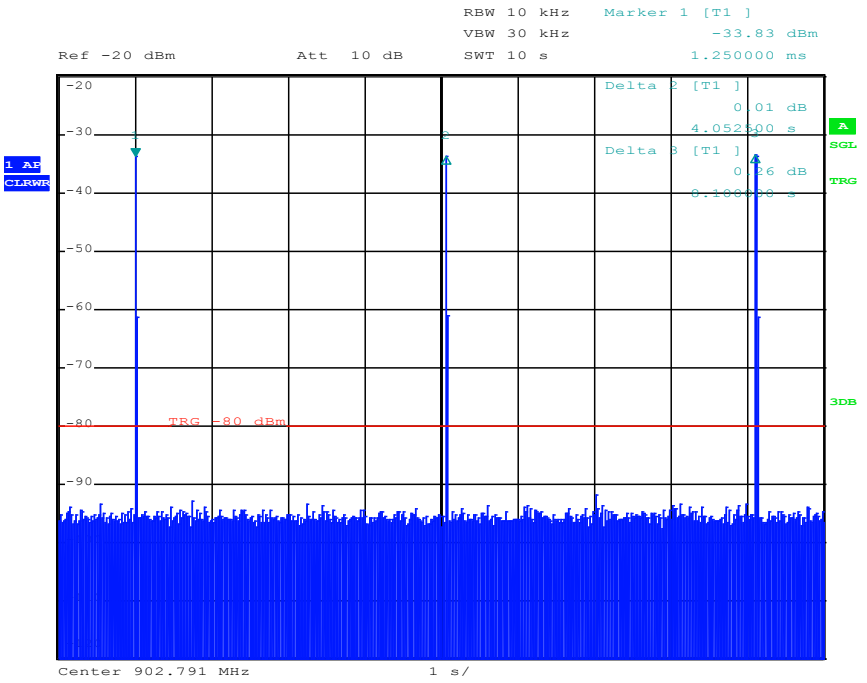
Remarks: The pulse train (*Tw*) exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulse widths over the 100 ms with the highest average value.

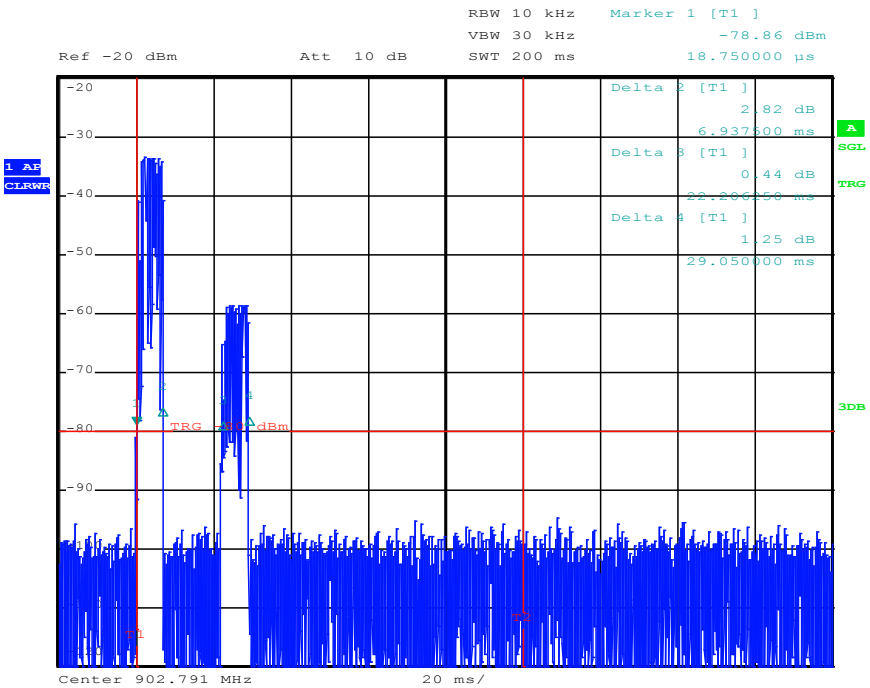
For detailed results, please see the test protocol below.

5.5.6 Test protocols – CH 2

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

Idle mode

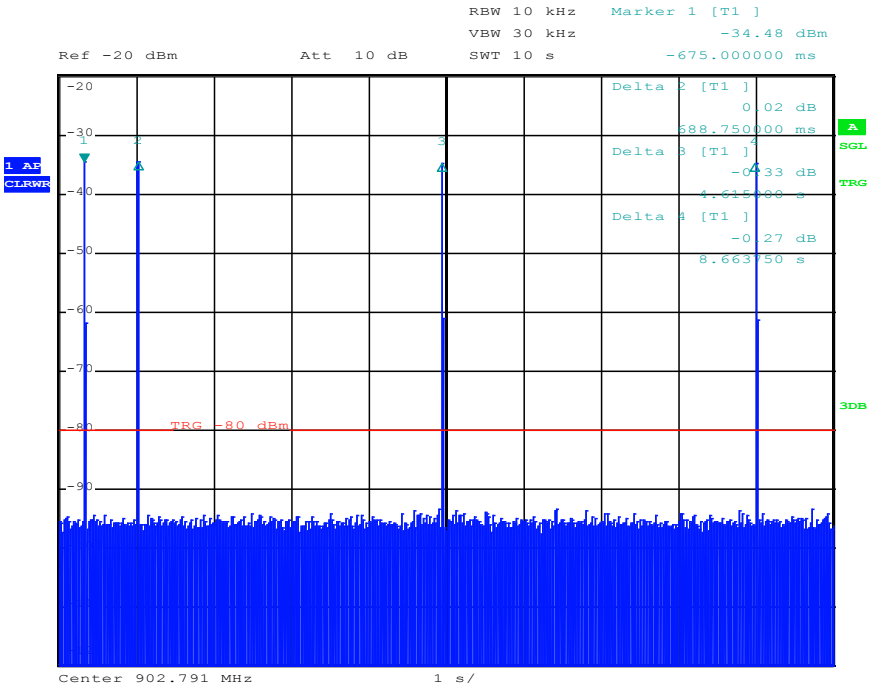


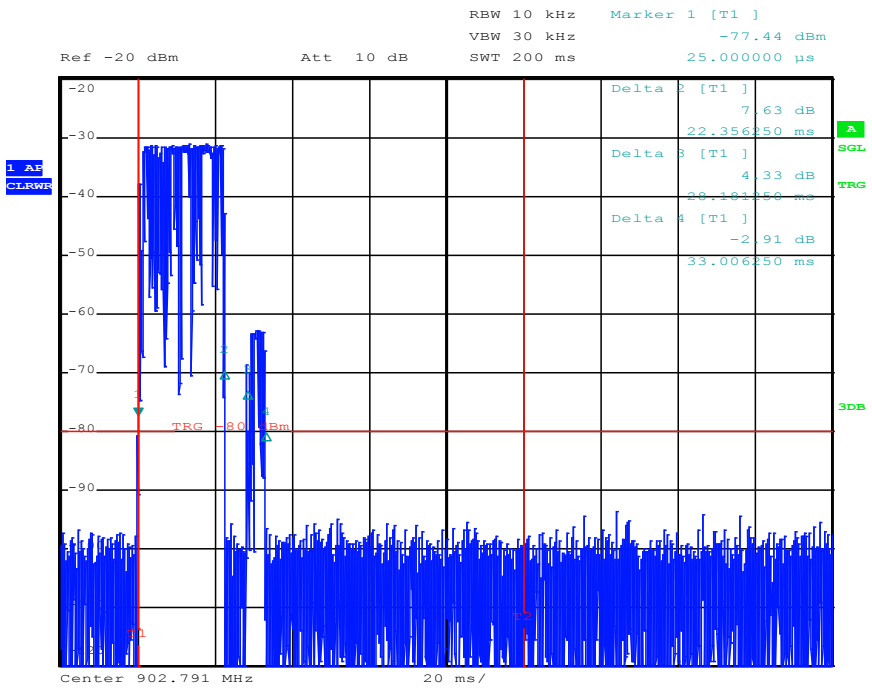


Note: The higher packets emitted from the EuT (the lower are emitted from the Focus 61)

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

Data transmission



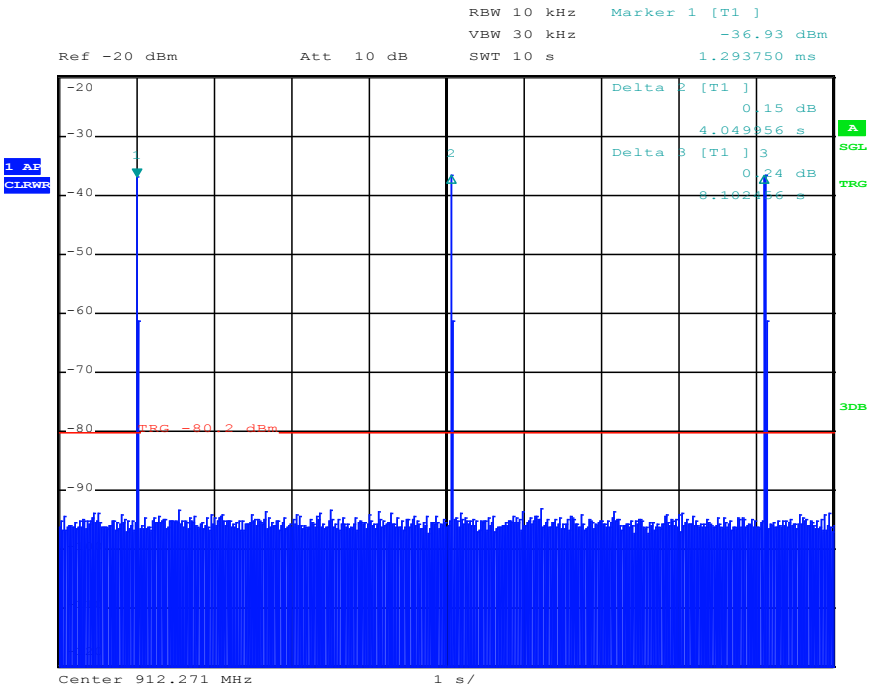


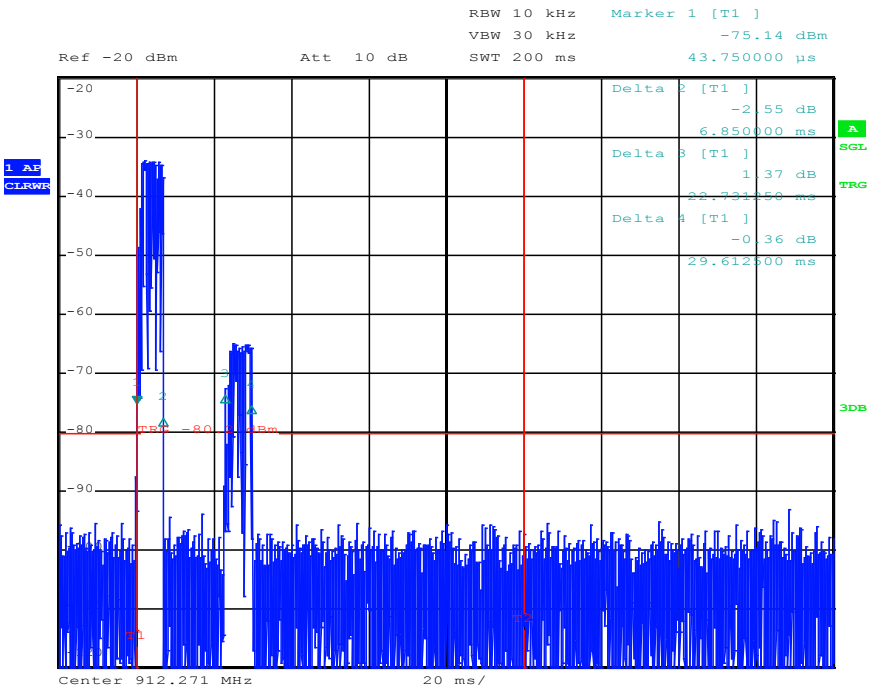
Note: The higher packets emitted from the EuT (the lower are emitted from the Focus 61)

5.5.7 Test protocols – CH 20

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

Idle mode

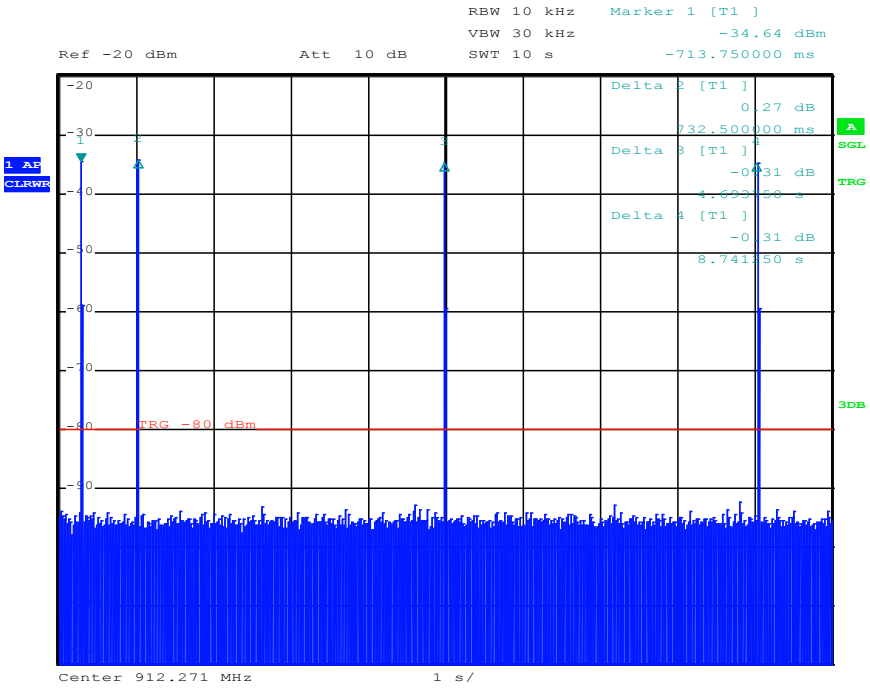


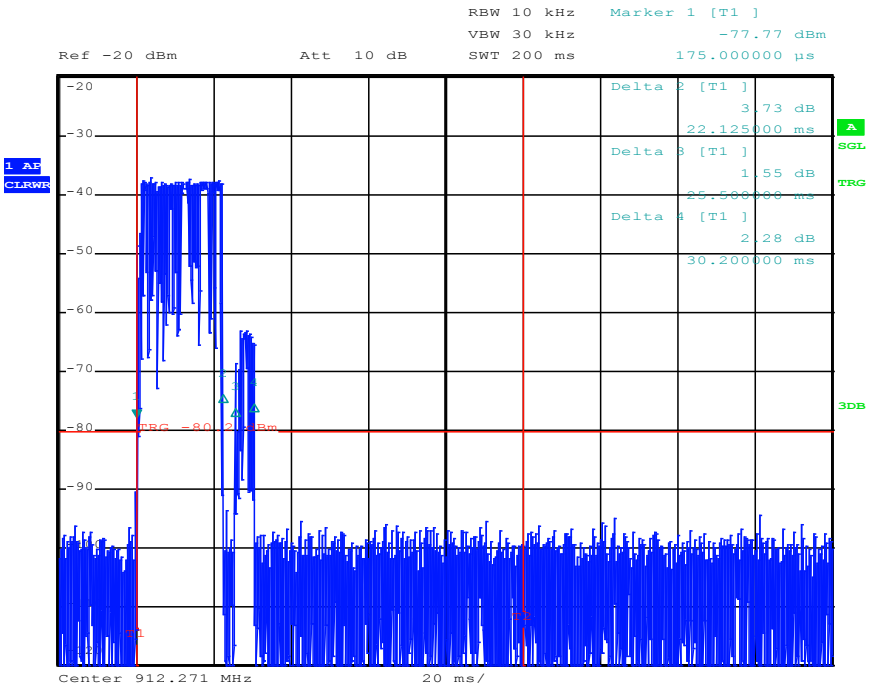


Note: The higher packets emitted from the EuT (the lower are emitted from the Focus 61)

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

Data transmission



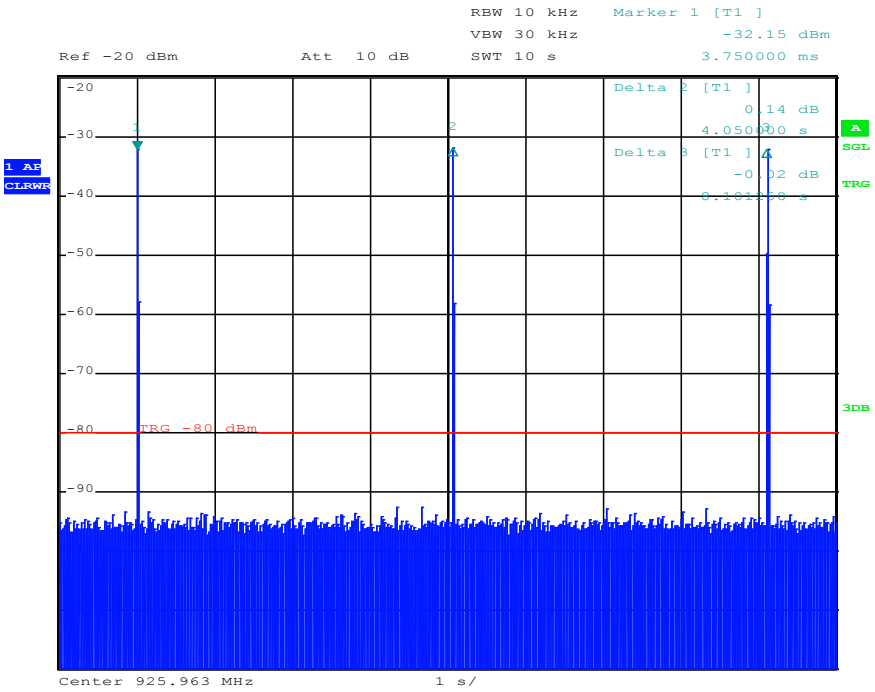


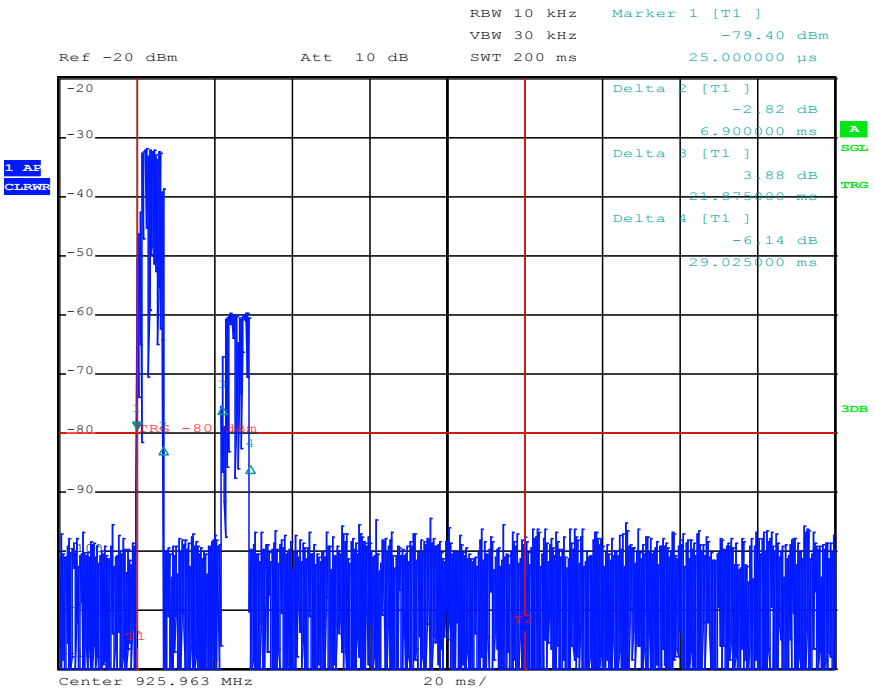
Note: The higher packets emitted from the EuT (the lower are emitted from the Focus 61)

5.5.8 Test protocols – CH 46

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

Idle mode

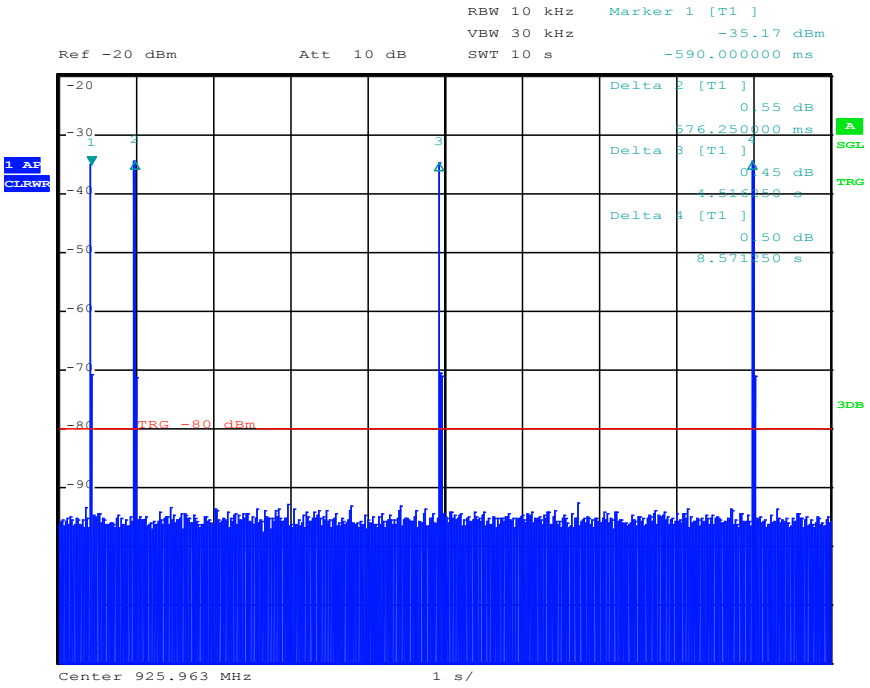


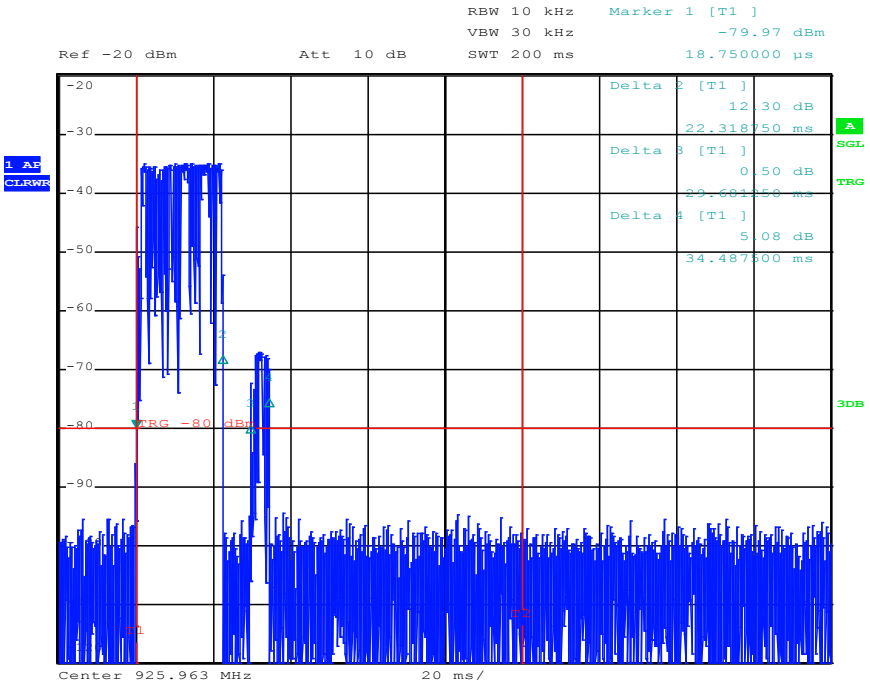


Note: The higher packets emitted from the EuT (the lower are emitted from the Focus 61)

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

Data transmission





Note: The higher packets emitted from the EuT (the lower are emitted from the Focus 61)

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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

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.

The requirements are **FULFILLED.**

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 2	ESVS 30	02-02/03-05-003	08/07/2017	08/07/2016		
	VULB 9168	02-02/24-05-005	20/04/2017	20/04/2016	30/09/2017	30/03/2017
	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				
DC	FSP 40	02-02/11-11-001	13/10/2017	13/10/2016		
	RF Antenna	02-02/24-05-032				
	8469B / 0 - 110 dB	02-02/50-05-066				
MB	FSP 40	02-02/11-11-001	13/10/2017	13/10/2016		
	RF Antenna	02-02/24-05-032				
	8469B / 0 - 110 dB	02-02/50-05-066				
SER 1	ESCI	02-02/03-05-005	12/12/2017	12/12/2016		
	HFH 2 - Z 2	02-02/24-15-001	23/03/2018	23/03/2017	23/09/2017	23/03/2017
	NW-2000-NB	02-02/50-05-113				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	ANT1010A	02-02/50-16-034				
SER 2	ESVS 30	02-02/03-05-003	08/07/2017	08/07/2016		
	VULB 9168	02-02/24-05-005	20/04/2017	20/04/2016	30/09/2017	30/03/2017
	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	06/10/2017	06/10/2016		
	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	24/05/2017	24/05/2016		
	WHJS 1000-10EE	02-02/50-05-070				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11N/11N/1500MM	02-02/50-13-015				