EMI – TEST REPORT

- FCC Part 15.249, RSS210 -

Type / Model Name	:	Type 2761B
Product Description	:	Remote control with Bluetooth 4.0 Low Energy
Applicant	:	ruwido austria gmbh
Address	:	Köstendorfer Strasse 8
		5202 NEUMARKT, AUSTRIA
Manufacturer	:	ruwido austria gmbh
Address	:	Köstendorfer Strasse 8
		5202 NEUMARKT, AUSTRIA
Licence holder	:	ruwido austria gmbh
Address	:	Köstendorfer Strasse 8
		5202 NEUMARKT, AUSTRIA

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

Test Report No. : T40428-00-02GK	18. December 2015 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.

Contents

1 TEST STANDARDS 3

2 EQUIPMENT UNDER TEST 4

2.1 Photo documentation of the EUT 4
2.2 Equipment category 4
2.3 Short description of the equipment under test (EUT) 4
2.4 Variants of the EUT 4
2.5 Operation frequency and channel plan 5
2.6 Transmit operating modes 5
2.7 Antenna 5
2.8 Power supply system utilised 6
2.9 Peripheral devices and interface cables 6
2.10 Determination of worst case conditions for final measurement 6

3 TEST RESULT SUMMERY 7

3.1 Final assessment 7

4 TEST ENVIRONMENT 8

4.1 Address of the test laboratory 8
4.2 Environmental conditions 8
4.3 Statement of the measurement uncertainty 8
4.4 Measurement protocol for FCC and IC 9

5 TEST CONDITIONS AND RESULTS 10

5.1 AC power line conducted emissions 10
5.2 Field strength of fundamental 11
5.3 Out-of-band emission, radiated 13
5.4 EBW and OBW 20
5.5 Correction for pulse operation (duty cycle) 23
5.6 Antenna application 24

6 USED TEST EQUIPMENT AND ACCESSORIES 25

Attachment B as separate supplement

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2015)

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, 2015)

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: 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 B

2.2 Equipment category

Bluetooth Low Energy device, portable equipment.

2.3 Short description of the equipment under test (EUT)

The EUT is a Bluetooth Low Energy wireless remote control system. The EUT is compatible with the standard 802.15.1. It supports the 2.4 GHz frequency band. A single PCB antenna is used within the system. The modulation used by the EUT is GFSK with a data rate of 1 Mbits which means worst case for testing. The EUT has only one integrated antenna, no temporary connector and no external antenna can be connected.

Number of tested samples	:	1 (emission test)	1 (CPC measurement)
Serial number	:	Pre-production sample	Pre-production sample
Firmware version	:	V 0.15.55	V 0.15.55

Items	Description
BT type	4.0 Low Energy
BT chipset type	Texas Instruments CC2541
Modulation	GFSK
Frequency range	2400 MHz to 2483.5 MHz
Channel numbers	40
Data rate (kbps)	1000
Antenna type	PCB

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

2.4 Variants of the EUT

None

2.5 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
37	2402	9	2422	18	2442	28	2462
0	2404	10	2424	19	2444	29	2464
1	2406	38	2426	20	2446	30	2466
2	2408	11	2428	21	2448	31	2468
3	2410	12	2430	22	2450	32	2470
4	2412	13	2432	23	2452	33	2472
5	2414	14	2434	24	2454	34	2474
6	2416	15	2436	25	2456	35	2476
7	2418	16	2438	26	2458	36	2478
8	2420	17	2440	27	2460	39	2480

Note: the marked frequencies are determined for final testing.

2.6 Transmit operating modes

The EUT uses GFSK and provide following data rate:

1000 kbps (kbps = *kilobits per second)*

2.7 Antenna

The following antenna shall be used with the EUT:

Frequency (MHz)	Characteristic	Certification name	Plug	Frequency range (GHz)	Gain (dBi)
2402	Omni	PCB antenna	none	2.4 - 2.4835	-1.4
2450	Omni	PCB antenna	none	2.4 - 2.4835	-0.35
2480	Omni	PCB antenna	none	2.4 - 2.4835	0.4

Calculation of gain:

Peak measurement				
Power setting : 0 dBm		Test results		
		max. P_{EIRP} (dBm)	$P_{conducted}$ (dBm)	Calculated gain (dBi)
CH37				
T_{nom}	V_{nom}	-0.8	0.6	-1.4
CH22				
T_{nom}	V_{nom}	-0.4	-0.1	-0.3
CH39				
T_{nom}	V_{nom}	-0.4	-0.8	0.4
Measurement uncertainty		±6 dB		

Note: For test instruments and accessories used see section 6 Part CPC 3.

2.8 Power supply system utilised

Power supply voltage, V_{nom} : 3 VDC battery powered (2 x LR03 Size AAA)

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 X position with the following settings:

BT 4.0 LE	Available channels	Tested channels	Power setting	Modulation	Data rate
802.15.1	00 to 39	37, 22, 39	0 dBm	GFSK	1000 kbps

1000 kbps, GFSK with TX continuous modulated.

2.10.1 Test jig

No Test jig was used for test.

2.10.2 Test software

The device for emission test uses a special firmware that allows enabling a continuous modulated output signal.

3 TEST RESULT SUMMERY

Operating in the 2400 MHz – 2483.5 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	passed
15.215(c)	-	EBW	passed
-	RSS-Gen, 6.6	OBW	passed
15.249(a)	RSS-210, A2.9(a)	Field strength of fundamental	passed
15.249(d)	RSS-210, A2.9(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 8, December 2010

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 : 12 November 2015

Testing concluded on : 23 November 2015

Checked by:

Klaus Gegenfurtner
I confirm the correctness and Integrity of this document
2015.12.18 11:44:23 +01'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Konrad Graßl
I am the author of this document
2015.12.18 10:59:23 +01'00'

Konrad Graßl
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.

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.

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

Remarks: Not applicable, the EUT is battery powered and has no externally connectable cables.

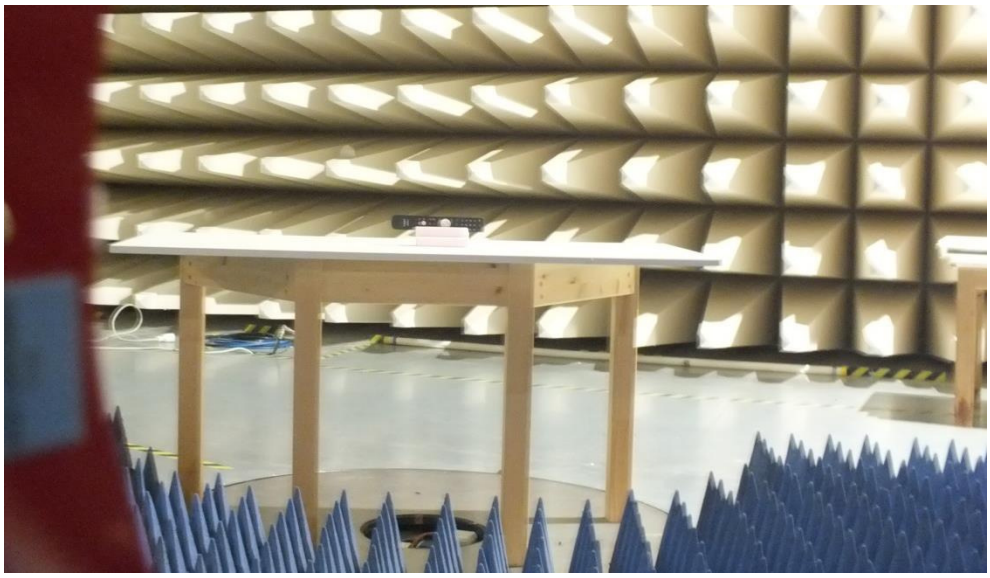
5.2 Field strength of fundamental

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

5.2.1 Description of the test location

Test location: Anechoic chamber 1
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 emissions from intentional radiators operated within these frequency bands shall comply with the effective limits.

5.2.2 Description of Measurement

The radiated emission of the fundamental wave from the EUT is measured using a spectrum analyser and appropriate linear polarized antennas. 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 continuous mode modulated under normal conditions.

Analyser settings:
Peak measurement: RBW: 3 MHz VBW: 10 MHz Detector: Max peak

5.2.3 Test result

Frequency	Level PK	Limit PK	Margin PK	Level AV	Limit AV	Margin AV
(MHz)	dB(µV/m)	dB(µV/m)	(dB)	dB(µV/m)	dB(µV/m)	(dB)
2402	94.4	114.0	-19.6	69.8	94.0	-24.1
2450	94.8	114.0	-19.2	70.2	94.0	-23.7
2480	94.8	114.0	-19.2	70.2	94.0	-23.7

Note: The correction factor includes cable loss and antenna factor.
Additional the peak values are corrected with the duty cycle of -24.6 dB to get the average value.

Average-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

Peak-Limit according to FCC Part 15C, Section 15.249(e):
However the peak fieldstrength shall not exceed the maximum permitted average limit by more than 20 dB.

The requirements are **FULFILLED.**

Remarks: _____

_____

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

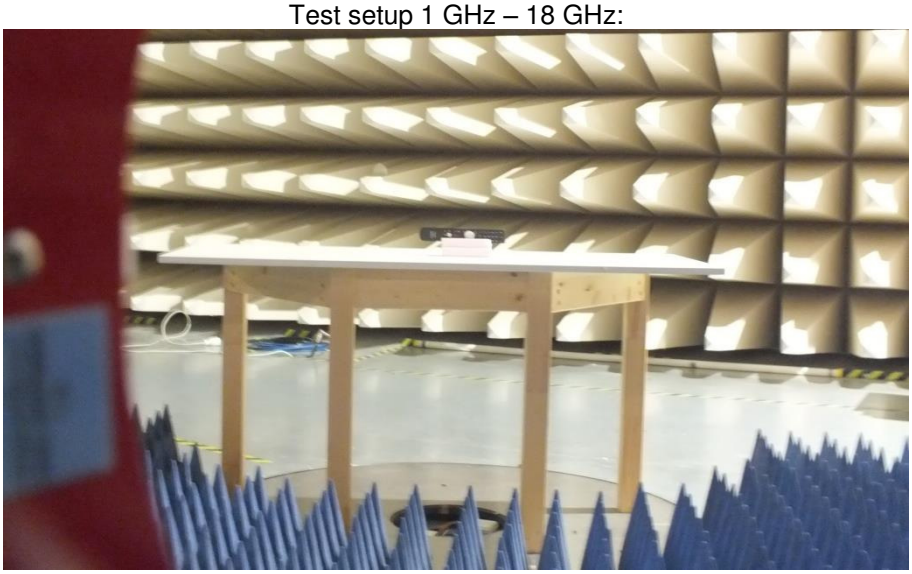
Test location: OATS 1
Test location: Anechoic chamber 1

Test distance: 3 m

5.3.2 Photo documentation of the test set-up

Test setup 30 MHz – 1000 MHz:

Test setup 1 GHz – 18 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 modulated under normal conditions.

Instrument settings:

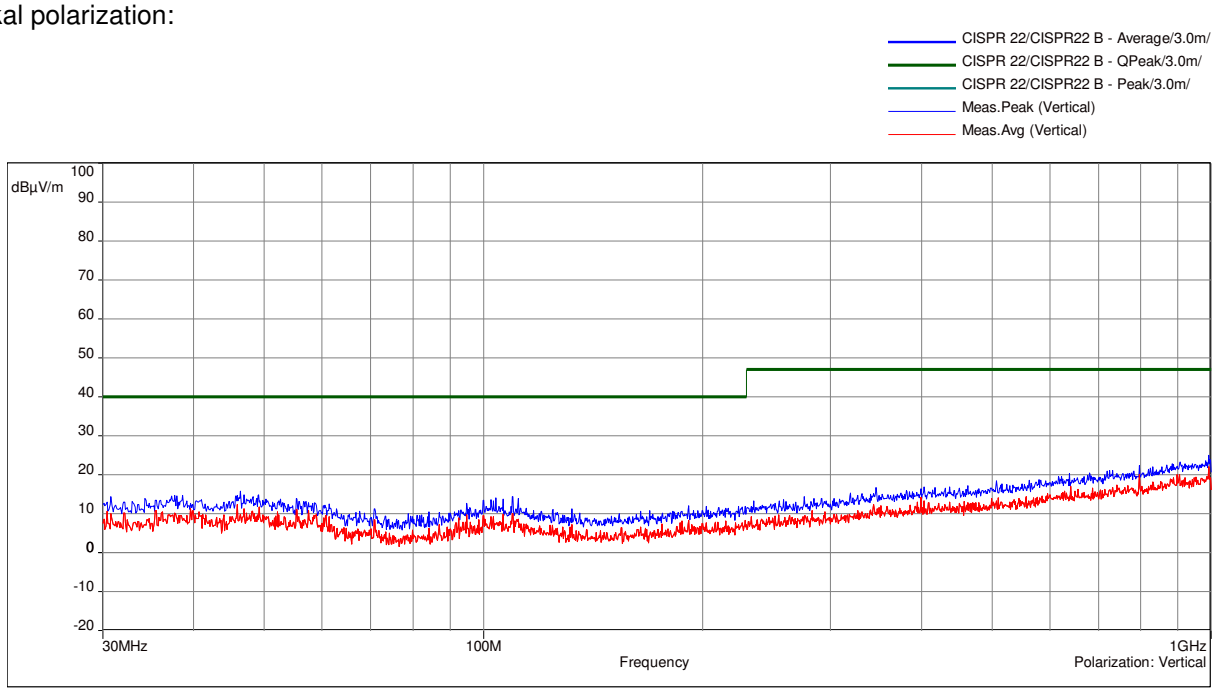
9 kHz – 150 kHz	RBW:	200 Hz
150 kHz - 30 MHz	RBW:	9 kHz
30 MHz – 1000 MHz:	RBW:	120 kHz
1000 MHz – 25 GHz	RBW:	1 MHz

5.3.1 Test result

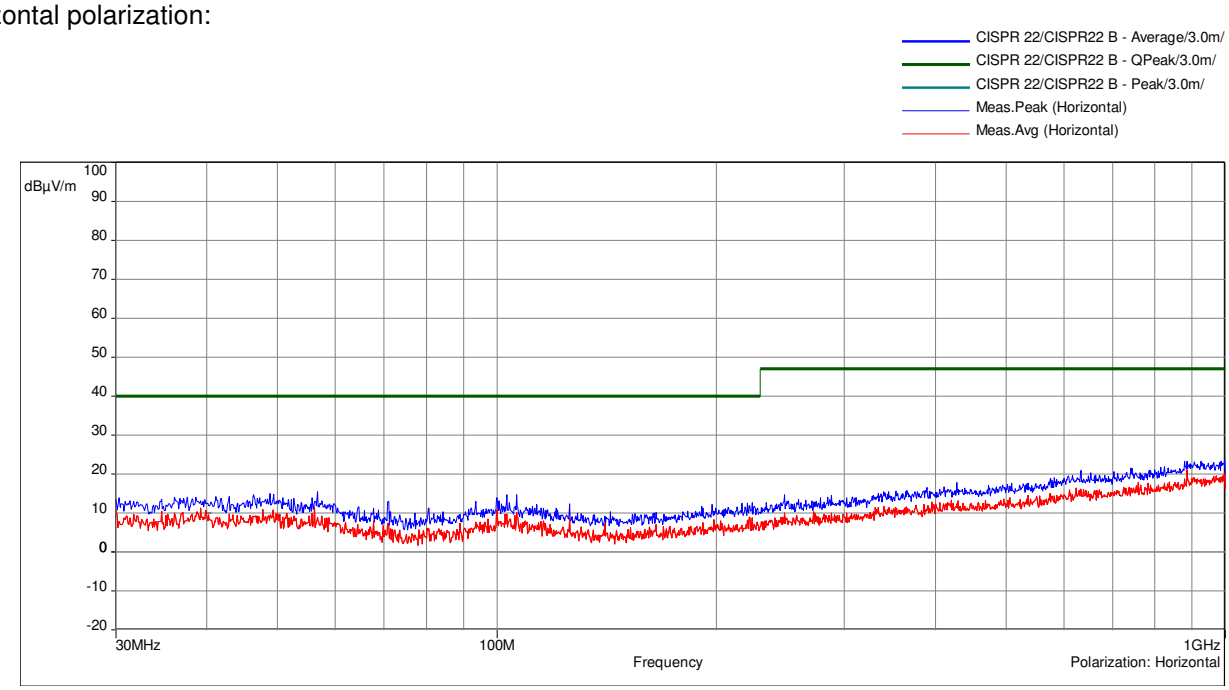
Note:
Pre-measurements were performed in the frequency range 9 kHz to 30 MHz, 30 MHz to 1000 MHz and 18 GHz to 25 GHz. The EUT showed no detectable suspects.

Only for reference the plots of the pre-measurement in TX mode at 2402 MHz

Vertikal polarization:



Horizontal polarization:



5.3.2 Test result f 30 MHz - 1000 MHz

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
33.80	5.0	3.8	13.6	12.3	18.6	16.1	40.0	-21.4
45.00	4.4	3.5	14.4	13.7	18.8	17.2	40.0	-21.2
68.00	5.8	4.6	13.8	13.1	19.6	17.7	40.0	-20.4
77.00	5.8	4.3	11.6	11.3	17.4	15.6	40.0	-22.6
108.60	4.9	4.8	9.9	11.0	14.8	15.8	43.5	-27.7
210.00	5.8	5.6	11.5	12.0	17.3	17.6	43.5	-25.9
350.00	5.7	5.5	18.2	17.7	23.9	23.2	46.0	-22.1
455.80	5.8	5.9	21.1	20.8	26.9	26.7	46.0	-19.1
540.40	5.7	5.1	23.5	23.2	29.2	28.3	46.0	-16.8
613.00	5.6	6.2	25.5	25.0	31.1	31.2	46.0	-14.8
715.40	5.4	5.2	27.4	26.8	32.8	32.0	46.0	-13.2
824.20	7.2	7.4	29.6	29.0	36.8	36.4	46.0	-9.2
964.60	7.5	7.2	31.6	31.0	39.1	38.2	54.0	-14.9

Note:
The correction factor includes cable loss and antenna factor. No emission difference could be detected for the intentional radiated frequencies 2402 MHz, 2450 MHz and 2480 MHz within the frequency range from 30 MHz to 1000 MHz. The values show only the noise floor of the OATS 1, but there were no values measureable belonging to the EUT.

5.3.3 Test result f > 1 GHz

Note: Pre-measurements have shown that the highest emissions occur, if the EUT is in Y-axis and the measurement antenna is in vertical polarization.

2402 MHz

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Average Limit (dBµV/m)	Dlimit (dB)	EUT
2400.00	84.0		-14.7		69.3		54.0		Peak
4804.00	50.8		2.8		53.6		54.0	-0.4	Peak
16494.00	48.0		4.6		52.6		54.0	-1.4	Peak

Apart of the value at 2400 MHz all peak values fulfil the average limit, therefore an average measurement is not required.
Calculation of the average value at 2400 MHz: peak value – DC = average value
69.3 dBµV/m – 24.6 dB = 44.7 dBµV/m

Frequency	Reading PK	D factor	Level PK	Limit AV	Delta
(MHz)	dB(µV)	dB(µV/m)	dB(µV/m)	dB(µV/m)	(dB)
2400	69.3	-24.6	44.7	54.0	-9.3

2450 MHz

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Average Limit (dBµV/m)	Dlimit (dB)	EUT
2400.00	62.9		-14.7		48.2		54.0	-5.8	Peak
2483.50	63.3		-14.4		48.9		54.0	-5.1	Peak
4899.80	43.7		2.9		46.6		54.0	-7.4	Peak
15807.00	47.9		3.7		51.5		54.0	-2.5	Peak

Note: All peak values fulfil the average limit, therefore an average measurement is not required.

2480 MHz

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)	EUT
2483.50	66.3		-14.4		51.9		54.0	-2.1	Peak
4960.00	41.2		3.2		44.4		54.0	-9.6	Peak
16541.00	48.3		4.4		52.7		54.0	-1.3	Peak

Note: All peak values fulfil the average limit, therefore an average measurement is not required.

Note: 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

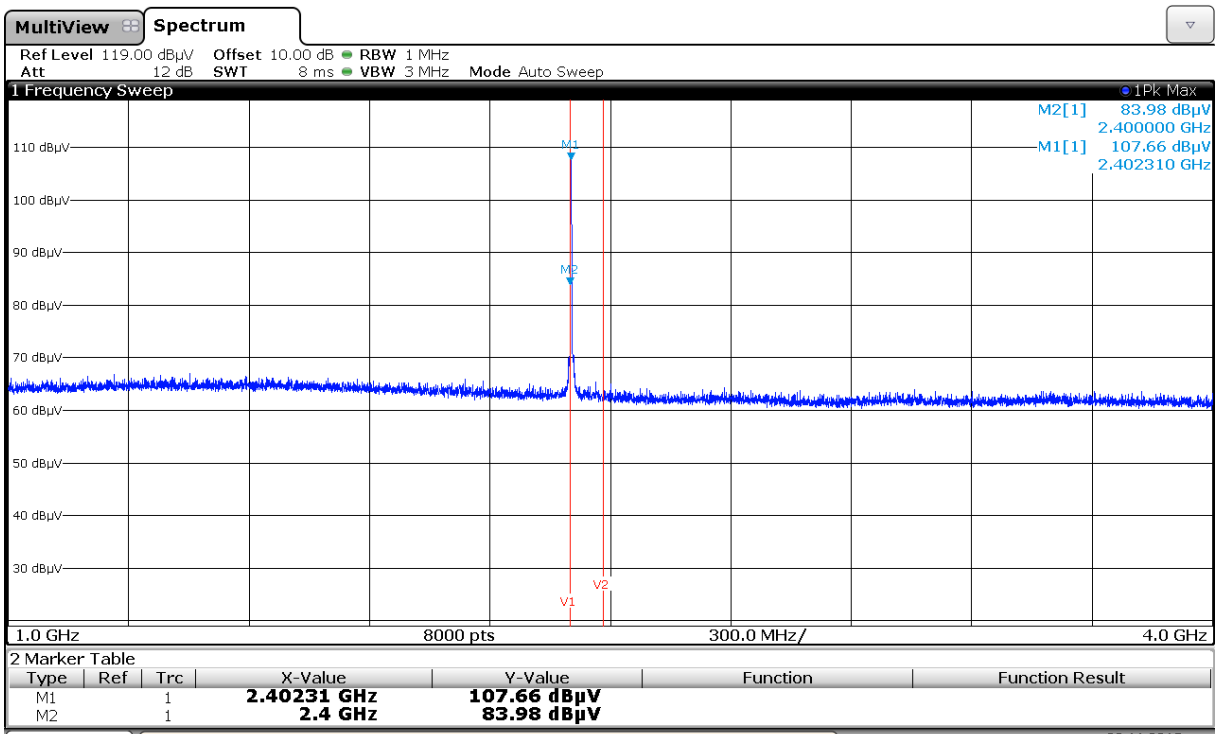
The requirements are **FULFILLED.**

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

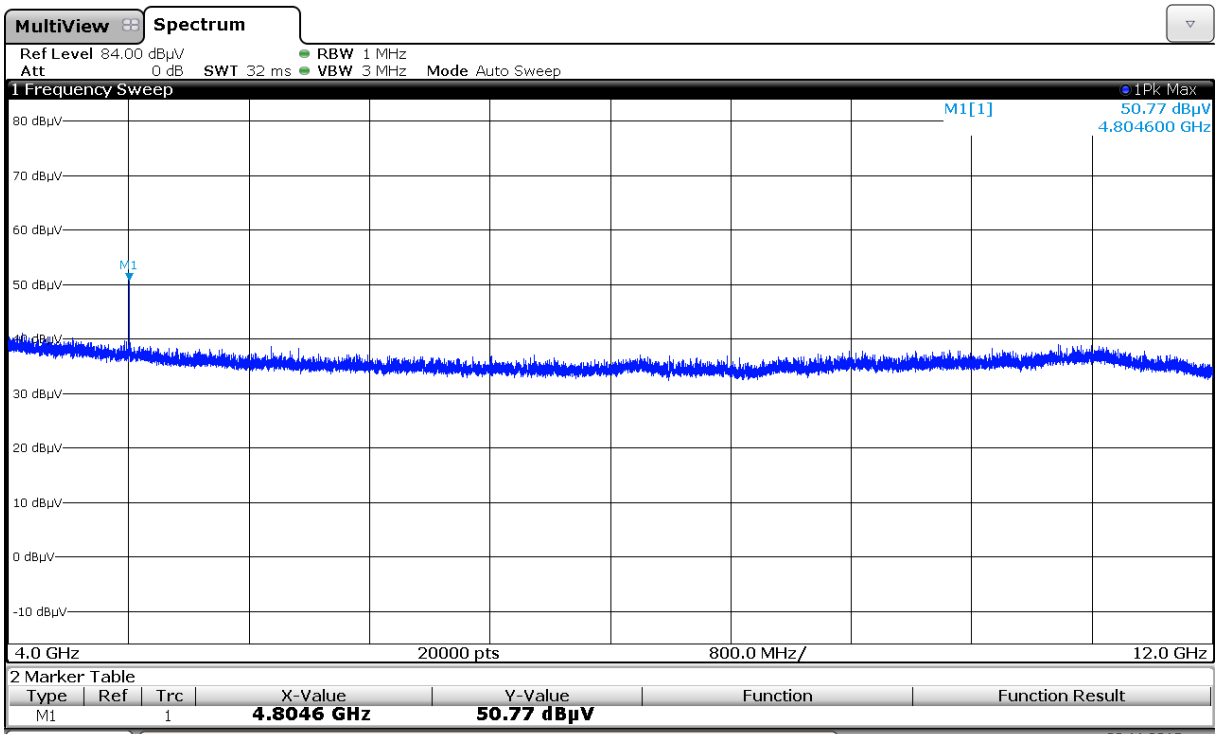
5.3.4 Test protocols

For reference the plots from 1 GHz up to 18 GHz (only raw data) at TX 2402 MHz

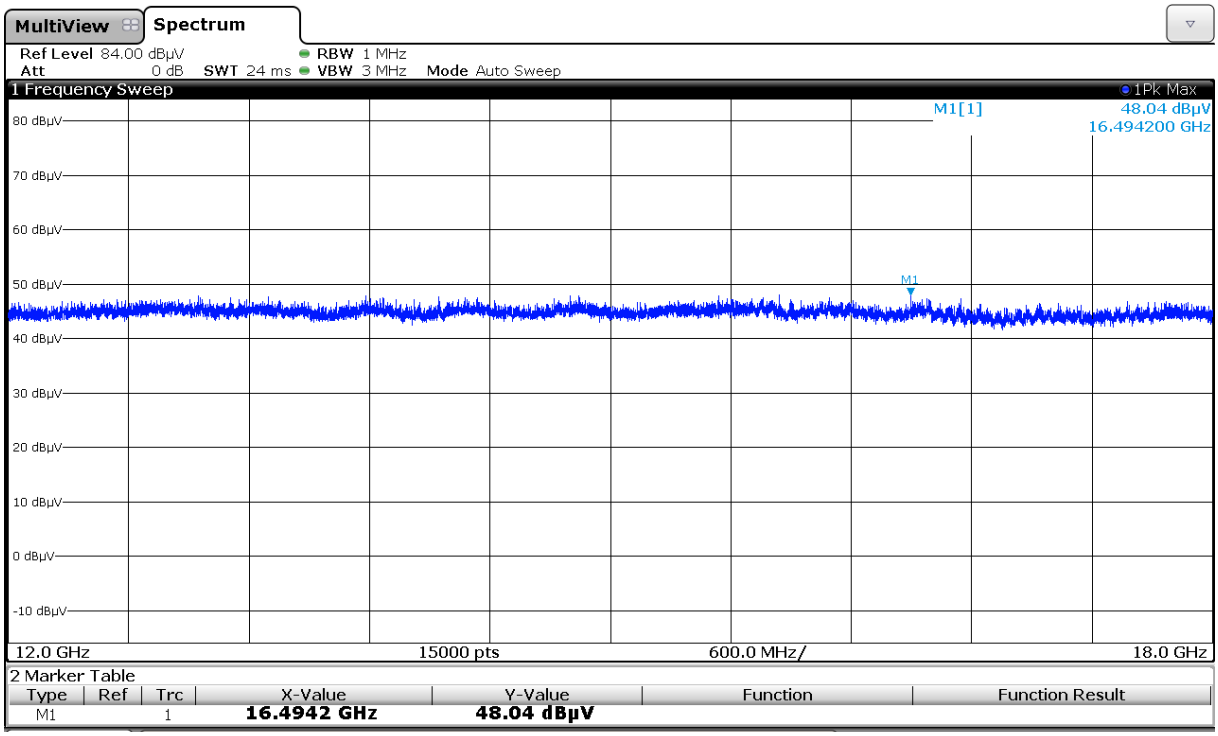
1-4 GHz



4-12 GHz



12-18 GHz


MultiView
Spectrum
Ref Level 84.00 dBµV
RBW 1 MHz
Att 0 dB SWT 24 ms VBW 3 MHz Mode Auto Sweep
1 Frequency Sweep
1Pk Max
M1[1]
48.04 dBµV
16.494200 GHz
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
0 dBµV
-10 dBµV
M1
12.0 GHz
15000 pts
600.0 MHz/
18.0 GHz
2 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 16.4942 GHz 48.04 dBµV

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: 3 MHz, Trace mode: max. hold, Detector: max. peak;

5.4.5 Test result

Centre *f*	20dB bandwidth	20dB bandwidth	Measured EBW
(MHz)	f_1	f_2	(MHz)
2402.035250	2401.433	2402.637500	1.204500
2450.018750	2449.4135	2450.624000	1.210500
2480.024000	2479.4285	2480.619500	1.191000

Centre *f*	99% bandwidth	99% bandwidth	Measured OBW
(MHz)	f_1	f_2	(MHz)
2402.036750	2401.5065	2402.567000	1.060500
2450.019500	2449.4885	2450.550500	1.062000
2480.021750	2479.4915	2480.552000	1.060500

Operating frequency band	20 dB Bandwidth
(MHz)	(MHz)
f_{low} > 2400	f_{low} = 2401.43300
f_{high}< 2483.5	f_{high} = 2480.61950
Operating Band occupancy	79.19

Operating channel occupancy percentage	60.52 %

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 channelising of the operating band into 39 channels with 20 dB channel bandwidth of 1.22 MHz within a channel pattern of 2 MHz the limit central 80% of the permitted band can not be applied. Therefore the stability of the EUT will be shown staying within the central 80% of the operating channel.

The requirements are **FULFILLED.**

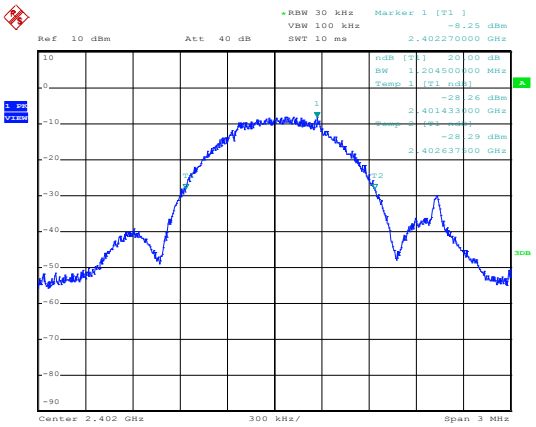
Remarks: For detailed test result please refer to following test protocols.

The OBW99 is measured for RSS only.

5.4.6 Test protocols

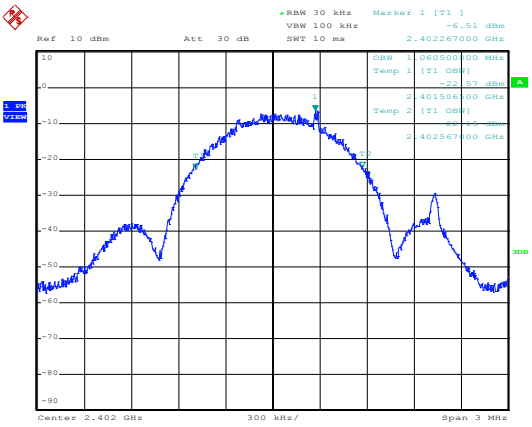
20 dB bandwidth

2402 MHz

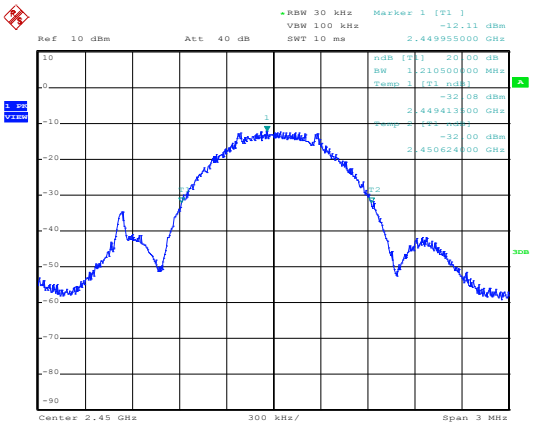


OBW 99%

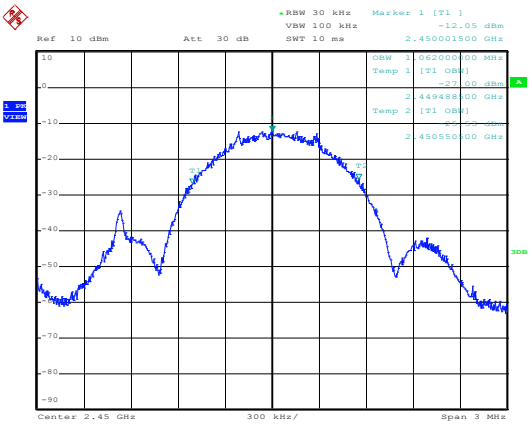
2402 MHz



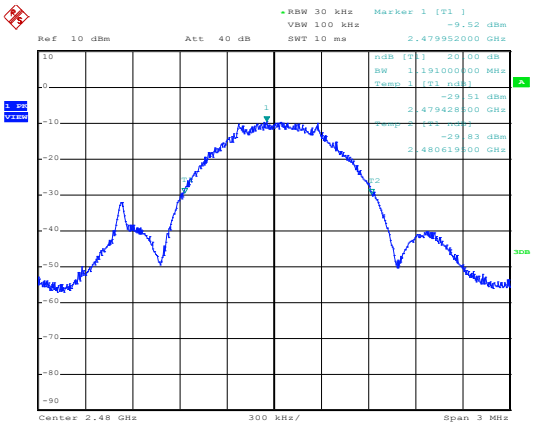
2450 MHz



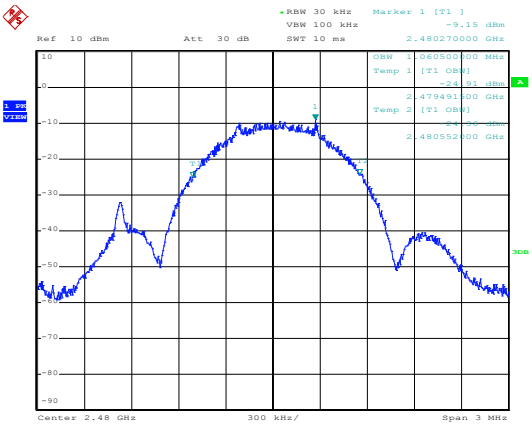
2450 MHz



2480 MHz



2480 MHz



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: NONE

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:

$$K_E = 20 \log \left((t_{iw}/T_w) * (t_{iB}/T_B) \right)$$

K_E: pulse operation correction factor
t_{iw} pulse duration for one complete pulse track
t_{iB} pulse duration for one pulse
T_w a period of the pulse track
T_B a period of one pulse

5.5.5 Test result

Declaration of the manufacturer:

The worst case TX conditions in the BLE remote are when the device is in a connection and continously sending data and when it is advertising to form a connection.

When a BLE connection exists a maximum number of 8 packets are transmitted on one channel in a 100ms time period. A packet with the maximum payload is 376us. So the maximum duty cycle is 8*376us / 100ms = 3.01%.

When the device is advertising it continously sends packets with a length of 176us and a gap of 2973us on each advertisement channel. Hence the maximum duty cycle is 176us/2973us = 5.92%

The advertising mode has the highest duty cycle with 5.92%

Note:
According to the manufacturer declaration the frequency occupation within one transmission frequency is summed up to 5920 µs (max. number of transmission retries) within 100 ms transmit time. The worst case results a 5.92% frequency occupation. This means a worst case duty cycle correction factor of -24.6 dB .
The manufacturer has performed the measurements by means of the software “Frontline Sniffer”.

Remarks: The Duty Cycle was declared by the manufacturer.

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 uses an integrated PCB antenna. No other antenna than the 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:

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.
CPC 3	FSP 40	02-02/11-11-001	28/10/2016	28/10/2015		
	HM 8143	02-02/50-10-016				
	KK-SF104-11SMA-11N-2M	02-02/50-14-006				
CPR 3	FSP 40	02-02/11-11-001	28/10/2016	28/10/2015		
	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	12/05/2016	12/05/2015		
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11N/11N/1500MM	02-02/50-13-015				
MB	FSP 40	02-02/11-11-001	28/10/2016	28/10/2015		
	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	12/05/2016	12/05/2015		
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11N/11N/1500MM	02-02/50-13-015				
SER 2	ESVS 30	02-02/03-05-003	09/07/2016	09/07/2015		
	VULB 9168	02-02/24-05-005	17/04/2016	17/04/2015	29/02/2016	31/08/2015
	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	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
	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	12/05/2016	12/05/2015		
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11N/11N/1500MM	02-02/50-13-015				