

EMI – TEST REPORT

- FCC Part 15.247, RSS-247 -

Type / Model Name	e : AudioLink (market name), Wireless Relay (internal development name)					
Product Description	: Audio streaming accessory for MED-EL audio processors including a 2.4 GHz proprietary transceiver					
Applicant : MED-EL Elektromedizinische Geraete GmbH						
Address : Fuerstenweg 77a						
	6020 INNSBRUCK, AUSTRIA					
Manufacturer	: MED-EL Elektromedizinische Geraete GmbH					
Address	: Fuerstenweg 77a					
	6020 INNSBRUCK, AUSTRIA					

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

Test Report No	T44784-00-00KS	27. May 2019	
		Date of issue	



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 Part 15, Subpart A, Section 15.31	: A - General (March, 2019) 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 Part 15, Subpart C, Section 15.203	C - Intentional Radiators (March, 2019) 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 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
ETSI TR 100 028 V1.3.1: 2001-03	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2
KDB 558074 D01 v05	Guidance for compliance measurements on DTS; FHSS and hybrid system devices operating under Section 15.247 of the FCC rules, August 24, 2018.



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2 EQUIPMENT UNDER TEST

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

2.2 General remarks

The EUT contains a 2.4 GHz transceiver with integral antenna. The transceiver operates in the frequency band 2.400 GHz - 2.4835 GHz.

2.3 Equipment type

2.4 GHz transceiver

2.4 Short description of the equipment under test (EUT)

The AudioLink is a multifunctional battery powered body worn accessory to the MED-EL CI System that provides wireless connectivity options for MED-EL CI systems. It communicates over a proprietary low power 2.4 GHz link to supported MED-EL audio processors (e.g. SONNET & SONNET 2) and has a Bluetooth classic module integrated for connectivity to common mobile devices. From such Bluetooth devices the AudioLink can receive audio signals which are streamed to the MED-EL audio processor or control data like remote control commands e.g. from the FineTuner App. It also provides a user interface, a USB charging connector and an audio jack.

Test samples:

SN EUT	CBA	RF Transceiver FW	Main Controller FW	Tests
#1	AL-000066	rev. 1.0.0	rev. 1.0.0	Conducted measurements MB, CPC, SEC
#2	AL-000077	rev. 1.0.0	rev. 1.0.0	Conducted measurements MB, CPC, SEC
#3	AL-000080	rev. 1.0.0	rev. 1.0.0	Radiated measurements MB, SER3, SER2, DC
#4	AL-000081	rev. 1.0.0	rev. 1.0.0	Radiated measurements MB, SER3, SER2, DC

Note: The specially prepared sample #1 for conducted tests and has been used for testing. Sample #2 is a replacement to #1. Sample #3 has been used for radiated tests. Sample #4 is a replacement to #3.

2.5 Variants of the EUT

None.



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2.6 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan:

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

Note: the marked frequencies are determined for final testing.

2.7 EUT operation modes

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

- Cont. TX at CH1, CH19 and CH39 (the EUT uses GFSK and provides following data rate: 2 Mbps)



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2.8 Antenna

The following antenna shall be used with the EUT:

Number	Characteristic	Туре	Plug	Frequency range (GHz)	Gain (dBi)
1	Omni	PCB	None	2.4	1.0

2.9 Power supply system utilised

Power supply voltage, V _{nom}	:	3.2 VDC - 4.2 VDC Battery powered
Power supply voltage (alternative)	:	5 VDC USB powered

2.10 Peripheral devices and interface cables

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

-	Power supply	Model :	Supplied by manufacturer
-	FTDI-USB cable	Model :	FTDI FT2232H Mini Module
-		Model :	

2.11 Determination of worst case conditions for final measurement

Measurements have been made in all three orthogonal axes of the EUT to locate at which position the EUT produces the maximum of the emissions.

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

Standard	Available channels	Tested channels	Power setting	Modulation	Modulation Type	Data rate
Proprietary	1 to 39	1, 19, 39	-4 dBm	DSSS	GFSK	2 Mbps

2.11.1 Test jig

No test jig is used.

2.11.2 Test software

The test software for the EUT provides the special test modes continuous TX unmodulated (CW), continuous TX modulated (bursts) and the channel settings.



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TEST RESULT SUMMARY 3

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS-Gen, 8.8	AC power line conducted emissions	passed
15.247(a)(2)	RSS-247, 5.2(a)	-6 dB EBW	passed
15.247(b)(3)	RSS-247, 5.4(d)	Maximum peak conducted output power	passed
15.247(b)(4)	RSS-247, 5.4(d)	Defacto limit	passed
15.247(d)	RSS-247, 5.5	Unwanted emission, radiated	passed
15.247(d)	RSS-Gen, 8.10	Emissions in restricted bands	passed
15.247(e)	RSS-247, 5.2(b)	PSD	passed
15.35(c)	RSS-Gen, 6.10	Pulsed operation	passed
15.203	-	Antenna requirement	passed
-	RSS-Gen, 6.11	Transmitter frequency stability	not applicable
-	RSS-Gen, 6.6	99 % Bandwidth	passed

The mentioned RSS Rule Parts in the above table are related to: RSS-Gen, Issue 5, April 2018 RSS-247, Issue 2, February 2017

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

: 01 February 2019

Testing concluded on

: 08 March 2019

Checked by:

Tested by:

Klaus Gegenfurtner Teamleader Radio

Hermann Smetana Radio Team



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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 %

86-106 kPa

Atmospheric pressure:



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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 30000 MHz	95%	± 2.5 x 10 ⁻⁷
Output power ERP, radiated	1000 MHz to 7000 MHz	95%	± 2.71 dB
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	± 2.71 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	± 2.15 dB
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	± 3.47 dB
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	± 3.53 dB
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	± 4.44 dB
Spurious Emissions, radiated	1000 MHz to 30000 MHz	95%	± 2.34 dB
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	± 5.13 dB



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4.4 Measurement protocol for FCC and ISED

4.4.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011 ISED: DE0009

4.4.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

4.4.2.1 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.

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

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 nonconducting 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 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 -	Limit	=
Delta							
(MHz)	(dBµV)		(dB)		(dBµV/m)	(dBµV/m)	(dB)
719.0	75.0	+	32.6	=	107.6 -	110.0	= -2.4



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4.4.2.3 Radiated emission (electrical field 1 GHz - 40 GHz)

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.



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5 TEST CONDITIONS AND RESULTS

5.1 AC power line conducted emissions

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

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up



5.1.3 Applicable standard

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

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits under FCC 15.207(a).

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

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5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin

-19.5 dB at 0.290 MHz

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

Frequency of Emission	Conducted Limit (dBµV)			
(MHz)	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



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5.1.6 Test protocol



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.150	1	38.0	-28.0	66.0	20.5	-35.5	56.0	Phase 1	10
0.155	1	37.4	-28.3	65.8	19.7	-36.0	55.8	Phase 1	10
0.245	1	31.5	-30.5	61.9	17.0	-35.0	51.9	Phase 1	10
0.290	1	31.2	-29.4	60.5	23.9	-26.7	50.5	Phase 1	10
0.300	2	30.2	-30.0	60.2	17.8	-32.5	50.2	Phase 1	10
0.444	2	18.3	-38.7	57.0	12.8	-34.2	47.0	Phase 1	10
0.614	3	18.2	-37.8	56.0	11.3	-34.7	46.0	Phase 1	10
0.663	3	15.5	-40.5	56.0	8.9	-37.1	46.0	Phase 1	10
0.951	3	16.7	-39.3	56.0	10.2	-35.8	46.0	Phase 1	10
0.978	3	16.4	-39.6	56.0	10.4	-35.6	46.0	Phase 1	10
1.322	4	17.2	-38.8	56.0	10.0	-36.0	46.0	Phase 1	10
1.331	4	15.6	-40.5	56.0	9.7	-36.3	46.0	Phase 1	10
2.015	4	16.7	-39.4	56.0	9.0	-37.0	46.0	Phase 1	10
2.397	4	13.7	-42.3	56.0	7.7	-38.4	46.0	Phase 1	10
2.414	5	14.7	-41.3	56.0	7.1	-38.9	46.0	Phase 1	10
2.679	5	17.3	-38.7	56.0	7.2	-38.8	46.0	Phase 1	10
3.552	5	17.5	-38.5	56.0	7.4	-38.6	46.0	Phase 1	10
4.002	5	14.7	-41.3	56.0	5.4	-40.6	46.0	Phase 1	10
5.084	6	15.1	-44.9	60.0	6.3	-43.7	50.0	Phase 1	10
5.997	6	16.1	-43.9	60.0	7.0	-43.0	50.0	Phase 1	11
6.884	6	15.9	-44.1	60.0	7.3	-42.7	50.0	Phase 1	11
8.477	6	14.8	-45.2	60.0	8.6	-41.4	50.0	Phase 1	11
11.855	7	15.5	-44.5	60.0	9.0	-41.0	50.0	Phase 1	11
13.713	7	8.8	-51.2	60.0	1.8	-48.3	50.0	Phase 1	11
17.282	7	8.6	-51.4	60.0	2.5	-47.5	50.0	Phase 1	11
21.648	8	10.3	-49.7	60.0	2.6	-47.5	50.0	Phase 1	12
23.043	8	10.5	-49.5	60.0	3.8	-46.2	50.0	Phase 1	12
24.420	8	10.1	-49.9	60.0	4.4	-45.6	50.0	Phase 1	12
24.740	8	9.4	-50.6	60.0	3.7	-46.3	50.0	Phase 1	12

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freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.150	9	37.2	-28.8	66.0	19.8	-36.2	56.0	Neutral	10
0.285	9	33.5	-27.2	60.7	30.8	-19.9	50.7	Neutral	10
0.290	9	33.5	-27.0	60.5	31.0	-19.5	50.5	Neutral	10
0.300	10	29.8	-30.4	60.2	23.7	-26.5	50.2	Neutral	10
0.440	10	21.6	-35.5	57.1	18.3	-28.7	47.1	Neutral	10
0.618	11	20.1	-35.9	56.0	16.7	-29.3	46.0	Neutral	10
0.794	11	20.4	-35.6	56.0	17.2	-28.8	46.0	Neutral	10
1.136	11	20.3	-35.7	56.0	16.6	-29.4	46.0	Neutral	10
1.140	11	20.1	-35.9	56.0	16.5	-29.5	46.0	Neutral	10
1.326	12	19.5	-36.5	56.0	16.2	-29.8	46.0	Neutral	10
1.524	12	17.4	-38.6	56.0	15.2	-30.8	46.0	Neutral	10
1.848	12	18.9	-37.1	56.0	15.0	-31.0	46.0	Neutral	10
1.853	12	18.7	-37.3	56.0	15.0	-31.0	46.0	Neutral	10
2.553	13	18.1	-37.9	56.0	14.1	-31.9	46.0	Neutral	10
2.580	13	16.1	-39.9	56.0	13.6	-32.4	46.0	Neutral	10
3.408	13	17.7	-38.3	56.0	11.5	-34.5	46.0	Neutral	10
3.647	13	13.8	-42.2	56.0	9.7	-36.3	46.0	Neutral	10
4.895	14	11.4	-44.6	56.0	6.7	-39.3	46.0	Neutral	10
4.967	14	14.9	-41.1	56.0	7.7	-38.3	46.0	Neutral	10
6.915	14	11.5	-48.5	60.0	3.9	-46.1	50.0	Neutral	11
7.244	14	10.6	-49.5	60.0	2.9	-47.2	50.0	Neutral	11
11.855	15	11.4	-48.6	60.0	5.7	-44.3	50.0	Neutral	11
17.880	15	7.5	-52.5	60.0	0.2	-49.8	50.0	Neutral	11
18.461	15	7.7	-52.3	60.0	-0.3	-50.3	50.0	Neutral	11
20.258	16	7.1	-52.9	60.0	-0.5	-50.5	50.0	Neutral	11
23.880	16	7.9	-52.1	60.0	2.1	-47.9	50.0	Neutral	11
24.033	16	7.5	-52.5	60.0	2.0	-48.0	50.0	Neutral	11
25.293	16	8.0	-52.0	60.0	3.2	-46.8	50.0	Neutral	11

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5.2 EBW and OBW

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



5.2.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(2):

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.



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5.2.4 Description of Measurement

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitter at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. An alternative is to use the bandwidth measurement of the analyser.

Spectrum analyser settings for EBW: RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Span: 4 MHz; Spectrum analyser settings for OBW:

RBW: 1-5% OBW, VBW: 3 RBW, Detector: Max peak, Span: 2 OBW;

5.2.5 Test result

Channel	Centre frequency	6 dB bandwidth	99% OBW	Minimum limit
	(MHz)	(MHz)	(MHz)	(MHz)
1	2404	0.810	1.657	0.5
19	2440	0.814	1.666	0.5
39	2480	0.824	1.672	0.5

The requirements are **FULFILLED**.

Remarks: For detailed test results please refer to following test protocols. The RSS Gen defines no limit for

the occupied bandwidth!



5.2.6 Test protocols EBW

Ref Level 132.	.00 dBµV	● RBV	V 100 kHz						
Att	35 dB SWI	2.01 ms 🖷 VBV	✔ 300 kHz Mo	de Sweep					
1 Erequency Sy	ween								●1Pk Max
130 dBµV	исер							M3[1]	109.06 dBuV
				1				2.	40443580 GHz
120 dBµV				ļ	641		ļ!	M1[1]	115.07 dBµV
l · · · · · · · · · · · · · · · · · · ·								2.	40404600 GHz
110 dBuV	11 100 070 dp.w/			<u>₩ ~~~</u>	$\sim \sim \sim$	M3		·	
	11 109.070 upp-			P		~			
100 dBuV						$\square \frown$		<u> </u>	
100 0001			í I	1				l	
00. dBuV								L	
90 000 *									
en deux				L					
80 ubµv-								~~	
29 de.u.				l				I	
70 ubµv-									
60 dpuv				l				I	
00 uopv-									
co doute				1			'		
50 ashA									
			l I	1					
40 авµv									
25.0.404.0115			2001 pt	Ĺ	40		!	L	2
CF 2,404 GHz			2001 pe	ŝ	40	.0.0 кHz/			Span 4.0 MITZ
Z Marker Table	; Trc	X-Value		V-Value		Supetion		Euroction Re	scult
M1	1	2.404046 GI	Hz 11	5.07 dBµV		Tuncton		Tunctorrite	suit
M2	i 2	.4036262 GI	Hz 10)9.04 dBµV					
M3	1 2	.4044358 GI	HZ 10	J9.06 dBµV					

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Ref Level 132 Att	.00 dBµV 35 dB SW 1	● RB\ F 2.01 ms ● VBV	V 100 kHz V 300 kHz Mo	de Sweep					
1 Frequency S	weep								⊜1Pk Max
130 dBµV								M2[1]	—107.95 dBµ∀ 43961620 GHz
120 dBuV								M1[1]	114.06 dBµV
				M2///	M1	мз		2.	44008800 GHz
110 dBµV	H1 108.060 dBµV			y	`				
100 40.41									
100 0804			~				~~~~		
90 dBµV							<u>```</u>	M.	
80 dBµV								- North Contraction of the second sec	
70 dBµV									
60 dBµV									
50 dBuV									
, i									
40 dBµV									
CE 2.44 GHz			2001 nt	<u> </u>	40]0.0 kHz/			Span 4.0 MHz
2 Marker Table	e		2001 pt			551516127			
Type Ref	Trc	X-Value		Y-Value		Function		Function Re	esult
M1 M2 M3	1 1 2 1 2	2.440088 G .4396162 G .4404298 G	Hz 11 Hz 10 Hz 10	14.06 dBμV)7.95 dBμV)7.98 dBμV					



	F	CC ID: V	/NP-AL			IC: 1198	6A-AL		
DofLoyal 12	2.00 dB/V		100 ku-						
Att	2.00 UDDV 35 dr SWT	⊂ RD1 201 ms = VBV	V 300 kHz Mo	de Sween					
TDF	55 GD 5111	2.01 113 - 001	000 KHZ 100	de oweep					
1 Frequency S	Sweep								⊖1Pk Max
130 dBµV								M1[1]	—113.15 dBµ∀
								2.	47969820 GHz
120 dBµ∨								M2[1]	—107,08 dBµV
								2.	47960820 GHz
110 dBµ∨				12/~~~~	$ \sim \sim$	МЗ			
	H1 107.150 dBµV			·		K			
100 dBuV			\sim			\rightarrow			
			~			· ·	\sim		
oo deuv.									
90 dop (کسر					~	\sim	
00.40.00		Ĩ						~~	
80 dBhA	and the second sec							and the second sec	
70 dBµ∨									
60 dBµ∨									
50 dBµ∨									
40 dBµV									
CF 2.48 GHz			2001 pt	s	4	00.0 kHz/			Span 4.0 MHz
2 Marker Tab	le					- ,			
Type Re	f Trc	X-Value		Y-Value		Function		Function Re	esult
M1	1 2	.4796982 G	Hz 11	L3.15 dBµV					
M2	1 2	.4796082 G	HZ 10	07.08 dBµV					
M3	1 2	.4004316 6	nz 10	νισμ ν					

5.2.7 Test protocols OBW



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5.3 Maximum peak conducted output power

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

5.3.1 Description of the test location

Test location: AREA4

5.3.2 Photo documentation of the test set-up



5.3.3 Applicable standard

According to FCC Part 15, Section 15.247(b)(3):

For systems using digital modulation in the 2400 – 2483.5 MHz band, the maximum peak output power of the transmitter shall not exceed 1 Watt. The limit is based on transmitting antennas of directional gain that do not exceed 6 dBi.

5.3.4 Description of Measurement

The maximum peak conducted output power is measured using a peak power meter following the procedure set out in KDB 558074, item 8.3.1. The EUT is set in TX continuous mode while measuring.

Analyser settings: RBW: 3 MHz,

VBW ≥ RBW,

Detector: Max peak,

Trace: Max hold,

Sweep time: auto



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5.3.5 Test result

Tost results cor	ductod	A [Pmax]	Limit	Margin
Test results cor	luucieu	(dBm)	(dBm)	(dB)
Lowest frequenc	y: CH1			
T _{nom}	V _{nom}	7.6	30.0	-22.4
Middle frequency	/: CH19			
T _{nom}	V _{nom}	6.2	30.0	-23.8
Highest frequency: CH39				
T _{nom}	Vnom	5.6	30.0	-24.4

Peak Power Limit according to FCC Part 15, Section 15.247(b)(3):

Frequency	Peak Pov	/er Limit		
(MHz)	(dBm)	(Watt)		
902-928	30	1.0		
2400-2483.5	30	1.0		
5725-5850	30	1.0		

The requirements are **FULFILLED.**

Remarks:



5.4 Power spectral density

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

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 15.247(e):

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

5.4.4 Description of Measurement

The measurement is performed using the procedure 8.4 set out in KDB-558074. The power measurement was done as peak power measurement. Therefore, the PKPSD is measured. The max peak was located and with the spectrum analyser and a marker set to peak.

Spectrum analyser settings: RBW: 3 kHz, VBW: 10 kHz,

Detector: Peak,

Sweep time: auto

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5.4.5 Test result

Toot regulate	conductod	PD [Pmax]	Limit	Margin
rescresults	conducted	(dBm/3kHz)	(dBm/3kHz)	(dB)
Lowest freque	ency: CH1			
T _{nom}	V _{nom}	-6.7	8.0	-14.7
Middle frequency: CH19				
T _{nom}	V _{nom}	-7.6	8.0	-15.6
Highest frequ	ency: CH39			
T _{nom}	V _{nom}	-8.4	8.0	-16.4

Power spectral density limit according to FCC Part 15, Section 15.247(e):

Frequency	Power spectral density limit			
(MHz)	(dBm/3 kHz)			
2400 - 2483.5	8			

The requirements are FULFILLED.

Remarks: The antenna gain of 1 dBi was added to the test result.

For detailed test results please refer to following test protocols.

5.4.6 Power spectral density plots









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5.5 Unwanted emissions, conducted

For test instruments and accessories used see section 6 Part SEC 1-3.

5.5.1 Description of the test location

Test location: AREA4

5.5.2 Photo documentation of the test set-up



5.5.3 Applicable standard

According to FCC Part 15, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator 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 an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a) (see Section 15.205(c)).

5.5.4 Description of measurement

The spurious emissions are measured conducted using a spectrum analyser in a test setup following the procedures set out in KDB 558074 for DTS equipment. The transmitter is set to the lowest operating frequency, the middle and to the highest operating frequency. The frequency spectrum outside from the operating frequency range (2400 - 2483.5 MHz) is scanned for emissions that exceed the limit. The measurement is performed at normal test conditions in modulated TX continuous mode.

Spectrum analyser search setting: RBW: 100 kHz, VBW: 300 kHz,

Detector: Max peak, Trace Mode: Max hold

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5.5.5 Test result

Determination of the reference level and limit



Highest level of the desired power: 94.16 dBµV

Limit according to FCC Part 15, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency band 2400 – 2483.50 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator 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. Attenuation below the general limits specified in Section 15.209(a) is not required.

Frequency	Spurious emission limit
(MHz)	
Below 960	20 dB below the highest level of the desired power
Above 960	20 dB below the highest level of the desired power

The requirements are FULFILLED.

Remarks:

For detailed test results please refer to following test protocols.

The unwanted emissions conducted have only been performed in the non-resticted frequency

range 2390 MHz to 2400 MHz. For all other emissions, please refer to chapter 5.7.

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5.5.6 Test protocols

Plots of spurious emissions conducted out of operating frequency bands (-20 dBc)

2404 MHz

Spurious emissions conducted from 2.39 GHz – 2.40 GHz including the lower bandedge

Ref Level 113	.00 dBµV	● RB¥	V 100 kHz							
Att	16 dB SWT	2.01 ms 🖷 VBV	y 300 kHz Mo	de Sweep						
TDF										
1 Frequency S	weep									●1Pk Max
110 dBμV									M1[1]	67.49 dBµV
									2.	40000000 GHz
100 dBµV										
	H1 94,160 dBuV									
90 dBuV										
en deux										
00 dbp v										
70.40.41								M	1	
ло авру									and the second designed and the second designed and the second designed and the second designed and the second	
60 dBµV					and a second and a s	And and a second se				
			a a water and a start of the st	and the second s						
50 dBUV	www.weither	and the second s	,,,,,=							
40 dBµV										
30 dBµV										
20 dBuV										
									1	
2.39 GHz	1	1	2001 pt	s	1	.2 MHz/				2.402 GHz
2 Marker Peak	List					•				
No	X-Valu	e	Y-Va	lue	No	X-Value	2		Y-Va	ue
1	2.401997 (GHz	75.036 0	dBµV						
L										

2440 MHz

Spurious emissions conducted from 2.39 GHz – 2.40 GHz including the lower bandedge

Reflevel 1	07.00.dBuV	• RF	W 100 kHz							
 Att 	0 dB SW 1	I 2.01 ms 🖷 VB	W 300 kHz M	de Sween						
TDF	0 40 011	. 2102 110 - 10		and official						
1 Frequency	Sweep									●1Pk Max
									M1[1]	30.65 dBµV
100 dBµV									2.	40000000 GHz
	—H1 94.160 dBµV —									
90 dBµ∨										
80 dBµV										
70 авµ∨										
eo douv										
оо авру										
FO dBuV	1									
50 ubµv										
40 dBµV	www.	2 Jahny Mary	~		m					
Marrian	-0		mu han	an and a dealer	Manager	1		M	1	No. AN
30 dBµV			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	on van www	100 10000000	frage of the second second second	and Arana and Aran and	, engana	^{مر} کرونی	Wall and and and and
20 dBµV										
10 dBµV									1	
2.39 GHz			2001 pt	\$	1	.2 MHz/				2.402 GHz
2 Marker Pea	ak List	A	V Vo	hua	No	V Value		_	V Vo	luo
	2,392072 (GHz	50,618 (dBuV	2	2,396036 0	;Hz		38,359 (dBuV

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2480 MHz

Spurious emissions conducted from 2.39 GHz – 2.40 GHz including the lower bandedge





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5.6 Band edge compliance

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

5.6.1 Description of the test location

Test location:AREA4Test location:Anechoic chamber 1Test distance:3 m

5.6.2 Photo documentation of the test set-up

Conducted measurement lower bandedge



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Radiated measurement upper bandedge



5.6.3 Applicable standard

According to FCC Part 15C, Section 15.247(d):

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

5.6.4 Description of Measurement

A spectrum analyser is connected to the output of the transmitter via a suitable attenuator while EUT was operating in transmit mode at the assigned frequency according to ANSI C63.10.

Spectrum analyser	pectrum analyser settings non-restricted band:											
RBW: 100 kHz,	VBW: 300 kHz,	Detector: Max peak,	Trace: Max hold,	Sweep: auto								
Spectrum analyser	settings restricted bar	nd:										
RBW: 1 MHz,	VBW: 3 MHz,	Detector: Max peak,	Trace: Max hold,	Sweep: auto								



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5.6.5 Test result

Lower bandedge measurement channel 1

Ref Level 113.0)0 dBµV	● RB¥	✔ 100 kHz							
Att	16 dB SWI	2.01 ms 🖷 VBW	/ 300 kHz Mod	de Sweep						
1 Frequency Sw	eep									⊜1Pk Max
110 dBµV				'	·'	'			M1[1]	67.49 dBµV
		, I	i 1	1	1 '	1 '			2.	40000000 GHz
100 dBµ∨	+	·+	·+	t'	t'	·'				
P	. 94.160 dBμV —	 	·	t'	t'	├ ─────┘				
90 dBµV		ı †	i ————————————————————————————————————	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·				
		, I	i 1	1	1 '	1				
80 dBµV		,†	1	· · · · ·	· · · · · · · · · · · · · · · · · · ·	,				
70 dBuV			!	L'	L'	<u> </u>		м	1	
76 dbpv	I	I	i I	<u> </u>	ſ '	['		F		
60 dBµV		<u>لــــــ</u>	<u>ا</u> ا	Ļ'	L'					
		, I	1	Low mand	In the second se	1 '				
50 dBUV	where the second second	hard a second se	mont	<u> </u>	t'	↓ '				
		, I	i I	1	1 '	1 /				
40 dBµV		·+	·	t'	t'	+'				
		, I	i 1	1	1 '	1 /				
30 dBµV		ı †	i †	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·				
		, I	i 1	1	1 '	1 /				
20 авµ∨		,	1	· · · · ·	· · · · · · · · · · · · · · · · · · ·	,				
2.39 GHz	L			.s	·1		11	T	-	2.402 GHz
2 Marker Peak I	List									
No	X-Value		Y-Val	lue	No	X-Value	2		Y-Va	ue
1	2.401997 G	JHZ	/5.036 0	18hA	l.					
				ļ	l.					
				ļ	1					

Upper bandedge measurement channel 39

RefLevel 11 Att	7.00 dBµV/m 20 dB 🖷 S	● RE WT 50 ms ● VE	3W 1 MHz 3W 3 MHz Mo	de Sweep					
1 Frequency	Sweep							o 1Pk M	ax 🛛 2Rm Max
110 dBµV/m								M3[2]	51.70 dBµV/m 48350000 GHz
								M1[1]	94.14 dBµV/m
100 dBµV/m M1								2.	48100250 GHz.
-90_dBµV/m	~-								
on deuty/m									
		dBuV/m		l.	2				
70 dBµV/m	112 77.000				L				
60 dBµ∨/m									
	-H1 54.000 dBµV/m		and a star and a star and a star and a star a sta	10	3				
50 dBµ∨/m					~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		m		
40 dBµV/m									
30 dBµV/m									
20 dBµV/m				v	1				
CF 2.4835 GH	İz		1001 pt	Ś	51	0.0 kHz/	•		Span 5.0 MHz
2 Marker Tab	f Trc	X-Value		V-Value		Eunction		Eupction R	eult
M1 M2 M3	1 2 .	4810025 G 2.4835 G 2.4835 G	Hz 94 Hz 71 Hz 51	.14 dBμV/m .28 dBμV/m .70 dBμV/m		randon		- ancuorrice	Source



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Limit according to FCC Subpart 15.247(d):

-

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limit specified in §15.209(a) (see §15.205(c)).

The requirements are **FULFILLED**.

Remarks:



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5.7 Unwanted emissions, radiated

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

5.7.1 Description of the test location

Test location:OATS 1Test location:Anechoic chamber 1

Test distance:

3 m

5.7.2 Photo documentation of the test set-up

Open area test site

Test setup 9 kHz - 30 MHz



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Test setup 30 MHz – 1 GHz



Anechoic chamber

Test setup 1 GHz - 18 GHz



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Test setup 18 GHz – 26 GHz



According to FCC Part 15, Section 15.205(a):

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

5.7.3 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

Spectrum analyser 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,	VBW: 3 MHz,	Sweep: Auto,	Detector function: Peak



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5.7.4 Test result f < 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)
43.40	6.7	5.5	14.0	12.8	20.7	18.3	40.0	-19.3
55.94	6.8	6.3	14.0	13.0	20.8	19.3	40.0	-19.2
80.00	8.2	6.4	10.4	10.1	18.6	16.5	40.0	-21.4

Note: In the frequency range 9 kHz to 1000 MHz no emission could be detected. The frequencies mention the noise level. No difference could be detected between the operating frequencies.

5.7.5 Test result f > 1 GHz

2404 MHz

Frequency	Level PK	Level AV	Limit PK	Margin PK	Limit AV	Margin AV
(MHz)	dB(µV/m)	dB(µV/m)	dB(µV/m)	(dB)	dB(µV/m)	(dB)
1440.18	41.0	-	74.0	-33.0	54.0	-
4808.72	47.7	-	74.0	-26.3	54.0	-
7211.64	46.4	-	74.0	-27.6	54.0	-
9615.05	56.9	46.0	74.0	-17.1	54.0	-7.9
12018.96	50.0	-	74.0	-24.0	54.0	-
14422.38	54.4	43.6	74.0	-19.6	54.0	-10.4
16826.29	51.3	40.5	74.0	-22.7	54.0	-13.5
19235.16	58.9	-	84.0	-25.1	64.0	-
21633.49	57.0	-	84.0	-27.0	64.0	-

Note: only when the peak value exceeds the average value, an average measurement is necessary. The AV value is calculated with the duty cycle correction factor -10.8 dB.

2440 MHz

Frequency	Level PK	Level AV	Limit PK	Margin PK	Limit AV	Margin AV
		dB(µV/m)	dB(µV/m)	(dB)	dB(µV/m)	(dB)
1440.18	40.8	-	74.0	-33.2	54.0	-
4879.72	42.5	-	74.0	-31.5	54.0	-
7319.13	47.6	-	74.0	-26.3	54.0	-
9759.04	51.1	-	74.0	-22.9	54.0	-
12198.46	50.5	-	74.0	-23.5	54.0	-
14639.37	48.8	-	74.0	-25.2	54.0	-
19521.64	56.6	-	84.0	-27.4	64.0	-
21957.47	56.7	-	84.0	-27.3	64.0	-

Note: only when the peak value exceeds the average value, an average measurement is necessary. The AV value is calculated with the duty cycle correction factor -10.8 dB.



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2480 MHz

Frequency	Level PK	Level AV	Limit PK	Margin PK	Limit AV	Margin AV
(MHz)	dB(µV/m)	dB(µV/m)	dB(µV/m)	(dB)	dB(µV/m)	(dB)
1439.68	46.2	-	74.0	-27.8	54.0	-
4960.72	42.6	-	74.0	-31.3	54.0	-
7440.63	48.0	-	74.0	-25.9	54.0	-
9918.54	50.3	-	74.0	-23.7	54.0	-
12400.45	51.8	-	74.0	-22.2	54.0	-
19838.62	54.1	-	84.0	-29.9	64.0	-
22320.44	55.3	-	84.0	-28.7	64.0	-

Note: only when the peak value exceeds the average value, an average measurement is necessary. The AV value is calculated with the duty cycle correction factor -10.8 dB.



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Radiated limits according to FCC Part 15 Section 15.209(a) for spurious emissions which fall in restricted bands:

Frequency	Field strength of sp	ourious emissions	Measurement distance		
(MHz)	(µV/m)	dB(µV/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		

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 - 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 - 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 - 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 - 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 - 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 - 3267	23.6 - 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 - 12.52025	240 – 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 – 335.4	3600 - 4400	Above 38.6

RSS-Gen, Table 6 - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	12.57675 - 12.57725	399.9 - 410	7.250 - 7.750
0.495 - 0.505	13.36 - 13.41	608 - 614	8.025 - 8.500
2.1735 - 2.1905	16.42 - 16.423	960 - 1427	9.0 - 9.2
3.020 - 3.026	16.69475 - 16.69525	1435 - 1626.5	9.3 - 9.5
4.125 - 4.128	16.80425 - 16.80475	1645.5 - 1646.5	10.6 - 12.7
4.17725 - 4.17775	25.5 - 25.67	1660 - 1710	13.25 - 13.4
4.20725 - 4.20775	37.5 - 38.25	1718.8 - 1722.2	14.47 - 14.5
5.677 - 5.683	73 - 74.6	2200 - 2300	15.35 - 16.2
6.215 - 6.218	74.8 - 75.2	2310 - 2390	17.7 - 21.4
6.26775 - 6.26825	108 – 138	2483.5 - 2500	22.01 - 23.12
6.31175 - 6.31225	149.9 - 150.05	2655 - 2900	23.6 - 24.0
8.291 - 8.294	156.52475 - 156.52525	3260 - 3267	31.2 - 31.8
8.362 - 8.366	156.7 - 156.9	3332 - 3339	36.43 - 36.5
8.37625 - 8.38675	162.0125 - 167.17	3345.8 - 3358	Above 38.6
8.41425 - 8.41475	167.72 - 173.2	3500 - 4400	
12.29 - 12.293	240 – 285	4500 - 5150	
12.51975 - 12.52025	322 - 335.4	5350 - 5460	



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The requirements are FULFILLED.

 Remarks:
 The measurement was performed up to the 10th harmonic. For detailed test results please see to

following test protocol.

5.7.6 Test protocol

2440 MHz only for reference

Ref Level 11	0.00 dBµV/m	 RBW 1 MHz 						
Att	13 dB 🖷 SWT 1	50 ms 🖷 VBW 3 MHz 🛛 Mo	de Auto Sweep					
TDF								
1 Frequency	Sweep	1					●1Pk M	ax 🛛 2Rm Max
			M1				M2[2]	35.23 dBµV/m
100 -00-01/								1.440180 GHz
100 08h4/ш							M1[1] 1	01.07 dBµV/m
								2.439510 GHz
90 dBµV/m								
80 dBµV/m								
	H2 74.000 dBuV/	/m						
70 dBµV/m								
60 dBuV/m								
00 000000								
so dout for	-H1 54.000 dBμV/m							
50 dBµV/m								
	1		J (16					
40 dBµV/m	M2	At the second state of the	Charles and the second state	المجلوبان التواجة المتحاط المحاط وتجرب	مرابلي بالمحاجم والدر ويواد الم	وبيديها والمعامة المعير والربيان الما	والمادة بالمعرجين ومناده والم	
الملاقع المراري والمتعالية المتعادية	والمالية المالية المالية المراجع المحافظ المراجع المحافظ المراجع المحافظ المحاف	A CONTRACTOR OF						
30 dBµ∨/m		and the second s	W Websteins	Non of the other states of the		• دليا ويو روي در جازم، مواديا و موادون ماه «	<u>ۇ</u> ئەرەبىلەر بىرىن يەرەپىرىكە ئەرەپىرىكە ئەرەپىرىكە ئەرەپىرىكە ئەرەپىرىكە ئەرەپىرىكە ئەرەپىرىكە ئەرەپىرىكە ئەرەپى	ديد الديونيين روانيارين مياد الديدورين
- marken water	where a second in the second sec	and a state of the						
20 dBuV/m								
				2				
			V1					
1.0 GHz		6001 pts	ş	3	00.0 MHz/			4.0 GHz
3 Marker Pea	ik List							
No	X-Value	Y-Val	ue	No	X-Value	:	Y-Va	lue
1	1.440180 GHz	40.788 dt	3µV/m	3	2.460010 G	Hz	46.246 d	BµV/m
2	2.439310 GHZ	101.069 de	эµилп					
				1				

1 GHz to 4 GHz



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4 GHz to 18 GHz



18 GHz to 25 GHz

	7.00 dBµV/m	•	RBW 1 MHz						
Att	10 dB 😑 S	WT 100 ms 👄	VBW 3 MHz M	ode Auto Sweep					
1 Erequency 1	Sween							o 1 Pk Ma	ax ⊜2Rm Max
								M1[1]	55.53 dBµV/m
100 dBµV/m──								2	1.957470 GHz
90 dBµV/m									
	H1 84.000 dBµV/m								
80 dBµV/m									
70. dBuV/m									
70 dbp 97m	110.64.000	a dibu di Mar							
60 dBµV/m	H2 64.000) авµv/m ———			M1				
Discussion of the second			and the second states of the	alla denna den	Total	والمقعاطة ويعجز فروي	alatadaalidikki, maxaa oo sabbali	and the second secon	A shirt of a south states
50 dBµV/m									and had a set of the set
intering a little with the second	بيبنوب المتشاه مترجب والمتالية	and the second	i di kalingi kang dari kang da	فالمال برجي وبالأأث فادانا الارجان و	ووالله مغمر المتناو المتحم وفاعت المتح		in a historical second seco	and the state of the	
40 dBµV/m									
30 dBµV/m——									
30 dBµV/m									
30 dBµV/m 20 dBµV/m									
30 dBµV/m 20 dBµV/m									
30 dBµV/m 20 dBµV/m 10 dBµV/m 18.0 GHz			14001 pt	S	70	0.0 MHz/			25.0 GHz
30 dBµV/m 20 dBµV/m 10 dBµV/m 18.0 GHz 2 Marker Pea	ik List		14001 pt	ts	70	0.0 MHz/			25.0 GHz
30 dBµV/m 20 dBµV/m 10 dBµV/m 18.0 GHz 2 Marker Pea No	ik List X-Valu	e	14001 pt	is lue		0.0 MHz/	2	V-Val	25.0 GHz
30 dBµV/m 20 dBµV/m 10 dBµV/m 18.0 GHz 2 Marker Pea No 1	k List X-Valu 19.521640	e GHz	14001 pt Y-Va 56.611 dt	ts lue βμV/m	70 No 2	0.0 MHz/ X-Value 24.773770 (e GHz	V-Val 57.671 dB	25.0 GHz μV/m
30 dBµV/m 20 dBµV/m 10 dBµV/m 18.0 GHz 2 Marker Pea No 1	k List 7Valu 19.521640	e GHz	14001 p 7-Va 56.611 de	ts Jue βμV/m	70 No 2	0.0 MHz/ X-Valut 24.773770 (s l	Y-Val 57.671 dB	<u>25.0 GHz</u> μV/m

Remark: All peak emissions were below the limits of part 15.209. The measurement distance was changed to 1 m for this frequency range, therefore the limit line has to be adjusted and was increased by 10 dB.



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5.8 Antenna application

5.8.1 Applicable standard

According to FCC Part 15C, Section 15.203:

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 EUT has an integrated antenna. No other antenna can be used with the device.

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

5.8.2 Antenna requirements

According to FCC Part 15C, Section 15.247(b)(4):

The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Remarks: No power reduction results from the defacto limit.



5.9 Correction for pulse operation (duty cycle)

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

5.9.1 Description of the test location

Test location: AREA4

5.9.2 Photo documentation of the test set-up



5.9.3 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.



5.9.4 Description of Measurement

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

$$KE = 20 \log (t_{iw} / 0.1s)$$

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KE: pulse operation correction factor

tiw pulse duration for one complete pulse track

The pulse train exceeds 0.1s. Thus, the field strength is determined during a 100 ms interval.





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5.9.5 Test result

Ref Level -3.0 Att Input TRG:VID	00 dBm 7 dB ● SWT 1 1 AC PS	● RBW 100 ms ● VBW Off Notch	3 MHz 10 MHz Off				sgl Fi	requency	2.4040000 G	GHz
1 Time Domai	in Power								⊜1Rm Cli	rw
								M:	1[1] -80.52 d	dBm
-10 dBm-									100,0000	-1115-
-20 dBm										
1 1 \$ d hallow 1 1 1 1 1 1 1 1 1	<u>, 1 , , , , , , , , , , , , , , , , , ,</u>			<u>.</u> 						H H I
						1444444444				
-40 d2m										
-\$0/d3m										
	+TBG -56.000 dBm +								1111	
-6C car										
-70 c5m										
							14.1.1.1.1.1			
ไปอยังสรีสามาร์เรา										ЩЩ
								,		
-90 dBm										
-100 dBm										
CE 2.404 GHz				200	l nts				10.0 n	ns/
2 Marker Tabl	le			200	r pts				101011	1157
Type Ref	f Trc	X-Value		Y-Value		Function		Functio	on Result	
M1	1	100.0 ms	-8	80.52 dBm	TD Pow RM	1S		-33.2	20 dBm	
Ref Level -3.0 Att Input	00 dBm 7 dB ● SWT 1 1 AC PS	● RBW 10 ms ● VBW Off Notch	3 MHz 10 MHz Off				sgl Fi	requency	2.4040000 @	GHz
Ref Level -3.(Att Input TRG:VID 1 Time Domain -20 dBm-2 -4p dBm-4	00 dBm 7 dB • SWT 1 1 AC • PS	10 ms PRW Off VBW Notch	3 MHz 10 MHz Off				SGL Fi	M:	2.4040000 G Image: Image: Ima	GHz rw dBm) ms
Ref Level -3.(Att Input TRG:VID 1 Time Domain -20 dBm -40 dBm	00 dBm 7 dB • SWT 1 1 AC • PS in Power -TRG -56.000 dBm	10 ms PRW Off VBW Notch	3 MHz 10 MHz Off				SGL Fi	M:	2.4040000 G Image: Image: Ima	GHz rw dBm) ms
Ref Level -3.(Att Input TRG:VID 1 Time Domain -20 dBm -40 dBm -60 dBm	00 dBm 7 dB • SWT 1 1 AC • PS in Power 3 • • • • • • • • • • • • • • • • • • •	10 ms PRW Off VBW Notch	3 MHz 10 MHz Off				SGL FI	M:	2.4040000 G Image: Image: Ima	GHz nw dBm 0 ms
Ref Level -3.(Att Input TRG:VID 1 Time Domain -20 dBm -40 dBm	00 dBm 7 dB • SWT 1 1 AC • PS	10 ms PRW Off VBW Notch	3 MHz 10 MHz Off		9 10		SGL FI	M:	2.4040000 G 111] -65.91 c 100.00000 15 16 100.00000	GHz dBm) ms
Ref Level -3.(Att Input TRG:VID 1 Time Domai -20 dBm -40 dBm -60 dBm	00 dBm 7 dB • SWT 1 1 AC • PS in Power 	PRW Off VBW Notch	3 MHz 10 MHz Off		9 10		SGL Fi	M:	2.4040000 G 111] -65.91 c 100.00000 15 16 100.00000	GHz rw dBm) ms M1
Ref Level -3.(Att Input TRG:VID 1 Time Domai -20 dBm -40 dBm -60 dBm	00 dBm 7 dB • SWT 1 1 AC • PS in Power	PRW Off VBW Notch	3 MHz 10 MHz Off		9 10		SGL Fi	M:	2.4040000 G	GHz rw ddBm) ms M1
Ref Level -3.(Att Input TRG:VID 1 Time Domai -20 dBm -40 dBm -60 dBm -80W#RMWW	00 dBm 7 dB • SWT 1 1 AC • PS in Power	PRW Off VBW Notch	3 MHz 10 MHz Off		9 10 1 10 1 10 1 10 1 10 1 10 1 10 1 10		SGL Fi	M:	2.4040000 G	GHz dBm) ms
Ref Level -3.0 Att Input TRG:VID Time Domain -20 dBm -40 dBm -60 dBm -8644644444 -100 dBm CF 2,404 GHz	00 dBm 7 dB • SWT 1 1 AC • PS • PS • POWER • TRG -56.000 dBm • TRG -56.000 dBm	PRW Off VBW Notch	3 MHz 10 MHz Off	200	9 10 1 10 1 10 1 10 1 10 1 10 1 10 1 10		SGL 2 13 2 13 13 13 13 14 14 14 14 14 14 14 14 14 14	requency in the second	2.4040000 G	GHz dBm 0 ms
Ref Level -3.(Att Input TRG:VID 1 Time Domai -20 dBm -40 dBm -60 dBm -86W#6WWW// -100 dBm CF 2.404 GHz 2 Marker Tabl	00 dBm 7 dB • SWT 1 1 AC • PS • PS • POWER • FRG -56.000 dBm • VWV • V • V • V • V • V • V • V • V •	PRW Off VBW Notch	3 MHz 10 MHz Off	200	2 10 10 10 10 10 10 10 10 10 10 10 10 10 1		SGL Fi	requency in the second	2.4040000 G	GHz Iw D ms M1
Ref Level -3.(Att Input TRG:VID 1 Time Domai -20 dBm -40 dBm -60 dBm -860 dBm -100 dBm CF 2.404 GHz 2 Marker Tabl Type	00 dBm 7 dB • SWT 1 1 AC • PS n Power 	Notch	3 MHz 10 MHz Off	200 Y-Value 55 91 dBm		Function	SGL	requency :	2.4040000 G	GHz Itw dBm) ms ms/
Ref Level -3.(Att Input TRG:VID Time Domai -20 dBm -40 dBm -60 dBm -60 dBm -60 dBm CF 2.404 GHz 2 Marker Tabl Type Ref 2 Marker Doci	00 dBm 7 dB • SWT 1 1 AC • PS n Power 	RBW Off VBW Notch	3 MHz 10 MHz Off	200 V-Value 55.91 dBm	9 10 1	Function	SGL	requency ()	2.4040000 G 1[1] -65.91 c 100.00000 15 16 10 10 10 10 10 10 10 10 10 10	GHz rw dBm 0 ms 0 ms
Ref Level -3.1 Att Input TRG:VID -20 dBm -20 dBm -40 dBm -60 dBm -60 dBm -60 dBm CF 2.404 GHz 2 Marker Tabl Type Ref M1 3 Marker Peak No	00 dBm 7 dB • SWT 1 1 AC • PS n Power 	RBW Off VBW Notch	3 MHz 10 MHz Off	200 Y-Value 55.91 dBm	2 10 10 10 10 10 10 10 10 10 10	Function X-Value	SGL P 13 13 13 14 14 14 14 14 14 14 14 14 14	requency (۲۰۰۰) ۲۰۰۰ (۲۰۰۰) ۲۰۰۰ (۲۰۰۰) ۲۰۰۰ (۲۰۰۰) ۲۰۰۰ (۲۰۰۰)	2.4040000 G	GHz dBm) ms Mi ms/
Ref Level -3.1 Att Input TRG:VID 1 Time Domai -20 dBm -40 dBm -60 dBm -60 dBm CF 2.404 GHz 2 Marker Tabl Type Ref M1 3 Marker Peal No 1	00 dBm 7 dB • SWT 1 1 AC • PS n Power 	Notch	3 MHz 10 MHz Off	200 Y-Value 55.91 dBm Jen	9 10 10 10 10 10 10 10 10 10 10	Function 5.730000 m 5.730000 m	SGL Fi	Functic -32.4	2.4040000 G	GHz dBm) ms ms/
Ref Level -3.1 Att Input TRG:VID 1 Time Domai -20 dBm -40 dBm -60 dBm -60 dBm -100 dBm CF 2.404 GHz 2 Marker Tabl Type Ref M1 3 Marker Peal No 1 2 3	00 dBm 7 dB • SWT 1 1 AC • PS n Power 	RBW Off VBW Notch 5 5 6 7	3 MHz 10 MHz Off	200 Y-Value 65.91 dBm	9 10 10 10 10 10 11 12	Function 5.730000 m 6.265000 m	SGL 2 13 14 14 14 14 14 14 14 14 14 14	Function -26.92 -26.91 -26.91	2.4040000 G	GHz dBm 0 ms MI ms/
Ref Level -3.(Att Input TRG:VID 1 Time Domai -20 dBm -40 dBm -60 dBm -80W#6wgwgr -100 dBm CF 2.404 GHz 2 Marker Table Type Rel M1 3 Marker Peal No 1 2 3 4	00 dBm 7 dB • SWT 1 1 AC • PS n Power - TRG -56.000 dBm - TRG -56.000 dBm - TRG -56.000 dBm - TRG - 56.000 00000000000000000000000000000000	RBW Off VBW Off Notch X-Value 100.0 ms ************************************	3 MHz 10 MHz Off	200 Y-Value 65.91 dBm	9 10 1 10 1 11 1 12 1 3	Function 5.73000 m 6.96500 m 7.515000 m	SGL 2 13 14 14 14 14 14 15 15 15 15 15	Function -26.92 -26.95 -26.85	2.4040000 G 111] -65.91 c 100.0000 15 16 16 10 10 10 10 10 10 10 10 10 10	GHz dBm 0 ms 0 ms
Ref Level -3.1 Att Input TRG:VID 1 Time Domai -20 dBm -40 dBm -60 dBm -80/45/45/45/45/45/45/45/45/45/45/45/45/45/	00 dBm 7 dB • SWT 1 1 AC • PS in Power 	RBW Off VBW Notch	3 MHz 10 MHz Off	200 Y-Value 65.91 dBm Bm Bm Bm Bm Bm Bm Bm	9 10 9 10 1 10 1 10 1 11 12 13 14 15	Function 5.730000 m 6.265000 m 7.515000 m 8.235000 m 8.235000 m	SGL 2 13 2 13 4 1 4 1 5 15 15 1	Eunction Function -26.92 -26.95 -26.85 -27.85 -2	2.4040000 G	GHz rw dBm ms ms/ ms/
Ref Level -3.1 Att Input TRG:VID Time Domain -20 dBm -40 dBm -60 dBm -60 dBm -100 dBm CF 2.404 GHz 2 Marker Table Type Ref No 1 2 3 4 5 6 7	00 dBm 7 dB • SWT 1 1 AC • PS n Power 	RBW Off VBW Notch	3 MHz 10 MHz Off 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	V-Value 65.91 dBm Bm Bm Bm Bm Bm Bm Bm Bm Bm	9 10 9 10 10 10 10 10 11 12 13 14 15 16	Function 5.730000 m 6.265000 m 7.515000 m 8.235000 m 8.235000 m 8.235000 m 8.235000 m 8.235000 m	SGL	Pequency (1) 14 14 14 14 14 14 14 14 14 14	2.4040000 G 1[1] -65.91 c 100.00000 15 16 100.00000 15 16 100.00000 15 26 100.00000 15 26 100.00000 15 16 100.00000 15 16 100.00000 100.00000 100.00000 100.00000 100.000000 100.000000 100.0000 100.0000 100.00000 100.00000 100.00000 100.0000 100.0000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.00000 100.000000 100.000000 100.00000 100.00000 100.000000 100.000000 100.0000000000	GHz rw dBm oms ms/
Ref Level -3.(Att Input TRG:VID Time Domai -20 dBm -40 dBm -60 dBm -60 dBm -80W#WWW -100 dBm CF 2.404 GHz 2 Marker Tabl Type 1 2 3 Marker Peal No 1 2 3 4 5 6 7 8	00 dBm 7 dB • SWT 1 1 AC PS n Power 	Notch	3 MHz 10 MHz Off 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	200 V-Value 65.91 dBm Bm B	2 10 2 10 1 10 1 10 1 10 1 11 1 2 1 3 1 4 1 5 1 6 1 7	Function 15 Function 15 X-Value 5.730000 m 6.265000 m 6.265000 m 7.515000 m 8.235000 m 8.235000 m 9.485000 m 9.485000 m	SGL 2 13 2 13 4 14 5 15 15 15 1	Equency M: 14 14 14 14 14 14 14 14 14 14	2.4040000 G 1[1] -65.91 c 100.00000 15 16 100.00000 15 16 100.00000 15 10 100.00000 15 10 100.0000 100.00000 100.00000 100.00000 100.0000 100.0	GHz dBm) ms ms/ ms/



		FCC ID:	VNP-AL		l.	C: 1198	6A-AL		
Ref Level Att Input TRG:VID	-3.00 dBm 7 dB ● 9 1 AC	● RBW SWT 250 µs ● VBW PS Off Noto	3 MHz 10 MHz h Off				SGL	Frequency	2.4040000 GHz
1 Time Do	main Power								⊙1Rm Clrw
								D	2[1] -0.14 dB
-10 dBm									179.125 μs
								M	1[1] -49.08 dBm
-20 dBm									0.000000000 s
				++					
-30 dBm									
-40 dBm									
	M1							D2	
-50 dBm									
	TRG -56.00	0 dBm							
-60 dBm									
. An work	Mmm								
ANA CENT	PHY 7 PT								
ηv,									triand . I. take
-80 dBm									<u>. In the second s</u>
									, ANN AN TANK IN AN TANK
-90 dBm								111	
								- ' 'I	
-100 dBm	TRG								
CF 2.404 0	GHz		1	2001	pts			I	25.0 μs/
2 Marker	Table								
Туре	Ref Trc	X-Value		Y-Value		Function		Funct	on Result
M1 D2	1 M1 1	0.0 با 179.125	s - s	49.08 dBm -0.14 dB	TD Pow RMS	; 		-28.:	11 dBm

 $K_E = 20 \log (28.8 \text{ ms} / 100 \text{ ms}) = -10.8 \text{ dB}$

Total length of period	100 ms
Max. On time	28.800 ms
DC	0.2880
Correction factor	-10.8 dB

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.
CPC 3	ESW26 KK-SF104-11SMA-11N-2M	02-02/03-17-002 02-02/50-14-002	13/12/2019	13/12/2018		
DC	ESW26 RF Antenna	02-02/03-17-002 02-02/24-05-032	13/12/2019	13/12/2018		
MB	ESW26 KK-SF104-11SMA-11N-2M	02-02/03-17-002 02-02/50-14-002	13/12/2019	13/12/2018		
SEC 1-3	ESW26 KK-SF104-11SMA-11N-2M	02-02/03-17-002 02-02/50-14-002	13/12/2019	13/12/2018		
SER 1	ESCI HFH 2 - Z 2 NW-2000-NB KK-EF393/U-16N-21N20 m KK-SD_7/8-2X21N-33,0M ANT1010A	02-02/03-15-001 02-02/24-05-020 02-02/50-05-113 02-02/50-12-018 02-02/50-15-028 02-02/50-16-034	11/06/2019 09/08/2020	11/06/2018 09/08/2017	15/01/2020	15/01/2019
SER 2	ESVS 30 VULB 9168 NW-2000-NB KK-EF393/U-16N-21N20 m KK-SD_7/8-2X21N-33,0M	02-02/03-05-006 02-02/24-05-005 02-02/50-05-113 02-02/50-12-018 02-02/50-15-028	06/06/2019 18/04/2019	06/06/2018 18/04/2018		
SER 3	FSW43 JS4-18004000-30-5A AMF-6D-01002000-22-10P	02-02/11-15-001 02-02/17-05-017 02-02/17-15-004	19/03/2019	19/03/2018		
	3117 BBHA 9170 KMS102-0.2 m 18N-20 NMS111-GL200SC01-NMS BAM 4.5-P NCD	02-02/24-05-009 02-02/24-05-014 02-02/50-11-020 02-02/50-17-003 1102-02/50-17-012 02-02/50-17-024 02-02/50-17-025	08/05/2019 12/06/2021	08/05/2018 12/06/2018	12/12/2019	12/12/2018
MB	KK-SF106-2X11N-6,5M FSW43 JS4-18004000-30-5A AMF-6D-01002000-22-10P	02-02/11-15-001 02-02/17-05-017 02-02/17-15-004	19/03/2019	19/03/2018		
	3117 BBHA 9170 KMS102-0.2 m 18N-20 NMS111-GL200SC01-NMS BAM 4.5-P NCD	02-02/24-05-009 02-02/24-05-014 02-02/50-11-020 02-02/50-17-003 1102-02/50-17-012 02-02/50-17-024 02-02/50-17-025	08/05/2019 12/06/2021	08/05/2018 12/06/2018	12/12/2019	12/12/2018
	KK-SF106-2X11N-6.5M	02-02/50-18-016				

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