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Test Report

Report Number:

F191168E2

Equipment under Test (EUT):

Track&Trace - Marker

Applicant:

TRUMPF Werkzeugmaschinen GmbH + Co. KG

Manufacturer:

TRUMPF Werkzeugmaschinen GmbH + Co. KG





References

- [1] ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- [2] FCC CFR 47 Part 15, Radio Frequency Devices
- [3] 393764 D01 UWB FAQ v02, ULTRA-WIDEBAND (UWB) DEVICES FREQUENTLY ASKED QUESTIONS

TEST RESULT

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test.

The complete test results are presented in the following.

Tested and written by:	Thomas KÜHN	76	07.07.2020
	Name	Signature	Date
Reviewed and approved by:	Bernd STEINER	B.Ster	07.07.2020
	Name	Signature	Date

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1 Identification

1.1 Applicant

Name:	TRUMPF Werkzeugmaschinen GmbH + Co. KG		
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Applicant represented during the test by the following person:			

1.2 Manufacturer

Name:	TRUMPF Werkzeugmaschinen GmbH + Co. KG		
Address:	Johann-Maus-Str. 2, 71254 Ditzingen		
Country:	Germany		
Name for contact purposes:	Mr. Sebastian Ochs		
Phone:	+49 71 56 303 - 35 927		
Fax:	+49 71 56 303 – 93 59 27		
eMail Address:	sebastian.ochs@de.trumpf.com		
Manufacturer represented during the test by the following person:			

1.3 Test laboratory

The tests were carried out at:

PHOENIX TESTLAB GmbH Königswinkel 10 32825 Blomberg Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-05 and D-PL-17186-01-06, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623.



Test object: *	Track&Trace - Marker for indoor localization		
Model name: *	Track&Trace - Marker Mat. No. 2564360		
Serial number: *	204579377		
FCC ID: *	2AVYV-2564360-01		
PCB identifier: *	1901154A001032B8		
Hardware version: *	Rev D		
Software version: *	2.17.9		
Lowest / highest internal frequency: *	32.768 kHz / 4500 MHz		

1.4 EUT (Equipment Under Test)

*: Declared by the applicant.

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical data of equipment

Channel 1	$f_{\rm C}$ = 3.575 GHz, 500 MHz bandwidth
Channel 4	f_{C} = 4.000 GHz, 500 MHz bandwidth
Channel 3	f_{C} = 4.500 GHz, 500 MHz bandwidth
Channel 4	$f_{\rm C}$ = 4.000 GHz, 1000 MHz bandwidth

Rated rf-output power: *	-41.3 dBm (e.i.r.p.)					
Antenna type: *	Internal PC	Internal PCB antenna only				
Antenna connector: *	None					
Supply voltage EUT: *	Unom= VDC Umin= VDC Umax= VDC			VDC		
Temperature range: *	-10 °C to 39 °					
Ancillary used for test:	Samsung S9 mobile phone with the app nRF Connect V4.24.1, wireless charger.					

* declared by the applicant.

Identification		Connector			Length *
		EUT		Ancillary	
- No.1		ines connectable to the ELIT] -	-
-			1	_	-

*: Length during the test if not otherwise specified.

1.6 Dates

Date of receipt of test sample:	07.05.2020
Start of test:	17.06.2020
End of test:	29.06.2020



2 Operational states

The EUT is a mobile UWB transceiver device, which is intended to be used as indoor locating device.

All measurements were carried out with an unmodified test sample mounted with a test software.

The UWB operation mode could be selected via a Bluetooth connection to a mobile phone with the app nRF Connect V4.24.1. After the operation mode is selected, the Bluetooth operation of the EUT was switched off with placing it on a charging station. Placing the device on the charger again will switch on the Bluetooth operation of the EUT.

During all measurements the EUT was supplied by a fully charged internal battery, which could be charged with wireless power transfer.

Because the EUT has no connector, all measurements were carried out radiated.

The transmit power level could be adjusted with the test software on the mobile phone. The following power levels were used to reach the documented results:

Channel No.	Power setting		
1	0		
2	-1		
3	-2		
4	0		

3 Additional information

It was agreed between the applicant and the laboratory to test the EUT as handheld device according to FCC 47 CFR Part 15.519. After testing was completed it was clarified by the FCC, that the device can be certified as indoor device according to FCC 47 CFR Part 15.517. The limits in the final test results were changed accordingly but the limits shown in the plots at the more stringent limits of the FCC 47 CFR Part 15.519.

The EUT was not labeled as required by FCC.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	Status	Refer page
10 dB bandwidth	3100 - 10600	15.517 (b)	Passed	7 et seq.
Peak level of transmission	3100 - 10600	15.517 (e)	Passed	11 et seq.
Radiated emissions (transmitter)	0.009 - 40000	15.517 (c) 15.517 (d) 15.205 (a) 15.209 (a)	Passed	14 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	Not applicable *1	-
Antenna requirement	-	15.517 (2)	Passed *2	-

*1: Battery supplied device without any connector, the battery will be charged wireless.

*2: As declared by the applicant, the EUT is intended to be used with the internal PCB antenna only. No external antennas should be connected to the EUT. The internal UFL-connector is intended for test purposes only. Therefore, the antenna requirement could be regarded as fulfilled.



5 Test results

5.1 10 dB bandwidth

5.1.1 Method of measurement (10 dB bandwidth)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be switched on and the hopping function has to be disabled, the transmitter shall work with its maximum data rate.

The following spectrum analyser settings according to [1] shall be used:

- Span: App. 2 to 5 times the 10 dB bandwidth.
- Resolution bandwidth: 1 MHz.
- Video bandwidth: \geq the RBW.
- Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation.
- Sweep time: 1 ms / sweep point.
- Detector function: Peak.
- Trace mode: Max hold.

After trace stabilization the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 10 dB below the first line (or the peak marker). The frequency lines shall be set on the intersection points between the second display line and the measured curve.

Test set-up:





5.1.2 Test results (10 dB bandwidth)

Ambient temperature	22 °C	Relative humidity	60 %
			·I

191168_1.png: 10 dB bandwidth on channel 1:

MultiView B	Spectrum	Re	eiver 🔅	x)					
RefLevel -30 Att Input TDE Input1 "311	00 dBm 0 dD ● SW 1 AC PS 5A HORIZONTA	● RBW T 3.01 s ● VBW OF Notch 3M 35DB PREAM	1 MHz 3 MHz Mode 1 Off P''	: Auto Sweep			Fr	equency 3.6	338900 GHz
L Frequency Sv	veep								1Pk Max
					41			M2[1]	-44.06 dBm
	A 10,000 d2		100		A WAY MAN THIS IS NOT			mol 1	2 022020 011-
-40 dBm			total	N MARTIN COMPANY	THE REAL PROPERTY OF				3.023030 GH2
- TO UD I		10 43 00	. Marting and			M3		MI[1]	33.86 dBm
		-12 -43.90	U dBm			Str. Schullenne	A STATISTICS AND AND	A SHARE WERE AND A PARTY AND A	3.635890 GHz
-51 d82-		United the				"The low fitter	and shares of the second		nipupingi
	- white	Wenner					8		and the second second
-50'dB*	مستحم مراولتا بالمطفا المتلجا								
7⊃ dBγ									
-30 dBr		× ~ ~						-	
-JJ dBY									
-100 d3m									
110 d3m									
-120 d3 n									
CF 3.63389 GH	z		3001 pt	s	15	0.0 MHz/			Span 1.5 GHz
2 Marker Table					8				
Typc Ret M1 M2 M3	Trc 1 1 1	X Value 3.63589 GH: 3.3175 GH: 3.82383 GH:	z -:	Y Value 33.86 dBm 14.06 dBm 14.96 dBm		Function		Function R	csult

191168_3.png: 10 dB bandwidth on channel 2:

MultiView 8	Spectrum	Recei	ver 🗵					
Ref Level -30 Att Input TDE Input 1 "311"	00 dBm 0 dB ● SWT 0 1 AC PS 54 HORIZONTAL 36	 RBW 1 .01 s • VBW 3 Of Notch 4 35PB PREAME" 	MHZ MHZ Mode Auto Off	Sweep		Fre	equency 4.0	569900 GHz
1 Frequency Sw	/eep	1000011Ko-Mil					7	1Pk Max
	H1 -33,300 dPm			141	c		M3[1]	-43.50 dBm
	A 10, JUU 18		with an unit Andre 18	יויייייייייייייייייייייייייייייייייייי	When.			4.298410 GHz
-40 dBr		M2 M	Wildings a summer and		WWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWW		MILLI	33.17 dBm
			m —		With Vine	and support for the state of the	AN MAN AND AND AND AND AND AND AND AND AND A	4.056990 GHz
-STURT-	an a manufacture and a second second	www.W				Sauce and a second s	and the second se	when we all so was
70 dBr								
-30 dBr								
-JJ dBY								
-100 d3m								
110 d3m								
-120 d3 n								
CF 4.05699 GH:	2		3001 pts		150.0 MHz/			Span 1.5 GHz
2 Marker Table Type Ret M1 M2 M3	Trc 1 4.0 1 3 1 4.1	X Valuc 5699 GHz .7131 GHz 29841 GHz	-33.1 -43.7 -43.5	/aluc 7 dBm 7 dBm 0 dBm	Function		Function R	Result



191168_5.png: 10 dB bandwidth on channel 3:



191168 7.png: 10 dB bandwidth on channel 4:

MultiView 8	Spectrum	Re	ceiver	x)					▼
RefLevel -30 Att Input TDF Input1 "311:	00 dBm 0 dD ● SW 1 AC PS 5A HORIZONTAL	● RBW ● 4.01 s ● VBW OF Note 3M 35CB PREAM	1 IVHz 3 Milz Mode h Off 4P''	: Auto Sweep			Fo	equency 4.16	640500 GHz
I Frequency Sw	/eep								IPk Max
				9	10			M3[1]	-47.83 dBm
	H1 -37,500 dB	n							4.554910 GHz
-40 dBY	A 10,000 13	(MAKAN)	AND THE OWNER OF THE OWNER OWNER OF THE OWNER OWN	and the second se	The state of the s	2		MILLI	27 F2 d0m
CELECTED TWO	M2	JATS WALKS	- Difference - Second	100025000 L 000L L 00	and a many	Water Water Man		WILLI	4.164050 GHz
-51 dB2	and the second se	-12 -47.50	00 dBm			A CONTRACTOR OF THE OWNER OF THE	Department of the second		
	and the second states of the						and in the line is a set of the set	as adjugging country any fisher	A DESCRIPTION OF THE PARTY OF
-50 dBr						-			
70 dB.m									
15 001									
-30 dBr									
-#J dB7									
-100 d3m									
110 d3m									
-120 d3 n						e			
CF 4.16405 GH:	2		4001 pt	s	20	0.0 MHz/			Span 2.0 GHz
2 Marker Table					0				
Type Ret	Trc	X Value		Y Value	2	Function		Function Re	sult
M1	1	4.16405 GH	z -	37.52 dBm					
M2	1	3.53743 GH	z -	48. 19 dB m					
MB	1	4.5 5491 GH	z -	47.83 dBm					



Channel number	Higher frequency f _H [MHz]	Lower frequency f _L [MHz]	10 dB bandwidth f _H -f∟ [GHz]	Center frequency (f _{H+} f _L)/2 [MHz]	Fractional bandwidth	
1	3823.830	3317.500	0.50633	3570.665	0.142	
2	4298.410	3713.100	0.58531	4005.755	0.146	
3	4737.990	4117.690	0.62030	4427.840	0.140	
4	4554.910	3537.430	1.01748	4046.170	0.251	
Mea	surement uncertai	nty	+0.66 dB / -0.72 dB			

Test: Passed

Test equipment used (refer clause 6):

11 – 13, 17, 19, 26



5.2 Peak level of transmission

5.2.1 Method of measurement (peak level of transmission)

Because the EUT has no antenna connector, which presents the power delivered to the antenna, the peak value of the field strength was measured. The method of measurement is described under clause 5.3.1 (final measurement (1 GHz to 26.5 GHz)) of this test report with the exception that a peak detector and a resolution bandwidth of 50 MHz within a 50 MHz span centered at highest detected average emission level.

5.2.2 Test results (peak level of transmission)

Ambient temperature 22 °C Relative numidity 60	Ambient temperature	22 °C	Relative humidity	60 %
--	---------------------	-------	-------------------	------

<u>191168_2.png: Peak level of transmission on channel 1:</u>

MultiView 🖽 S	pectrum 🖾	Receiver	x)					
Ref Level 0.00 dB Att 0 c Input 1 A DE Input 1 "3115A b	m • RBM IB • SWT 1.01 s VBV .C PS Off Not HORIZONTAL 3M 35CB PE	W 5017Hz W 5017Hz Mode ch Off FAMP"	Auto Sweep			Fre	equency 3.6	358900 GHz
L Frequency Swee	D						//	1Pk Max
							MILLI	-16.75 dBm
								3.6265990 GHz
								UNDERGO DO UNE
-1J dBY		- 100 CT						
		Ma						
DD db u								
-2J UB1								
-30 dBx								
55 451								
-40 dBr								
6030660								
-51 dBr-								-
5D dBγr								
0.000								
-70 dBr-								
22.40.4								
-51087-								
-20 dBx-								
22.401								
J J J J J J J J J J J J J J J J J J J		1001 DB	5	5	U MI IZ7			Span JU, U MI IZ



191168_4.png: Peak level of transmission on channel 2:

MultiView 🔠 Spectrum	Receiver X		
Ref Level 0.00 dBm Att 0 dB = SWT 1 Input 1 AC PS TDE Input 11 "3115A HORIZONTAL Input 2000 AD	RBW 5017Hz S017Hz Mode Auto Sweep Off Notch Off Motch Off M 35CB RB=AMP"		Frequency 4.0569900 GHz
1 Frequency Sweep	3413300110141		1Pk Max
			M1[1] -16.36 dBm 4.0638330 GHz
-10 dBr		MI	
-20 dBm			
-30 dB r			
-4J dBY			
-51 dBr			
50 dBm			
-73 dBr			
-31 dB1			
-77 4B			
55 001			
CE 4.05699 GUz	1001 pts	5.0 MUz/	Span 50.0 MUz

191168 6.png: Peak level of transmission on channel 3:

MultiView	Spectrum	🖾 Rec	eiver	x)					
Ref Level 0.0 Att Input TDE Inc. t1 "31:	0 dBm 0 dB ● SWT 1 AC PS	RBW 5 1.01 s VBW 5 Off Notch 3M 35CB DEAM	OIMHZ OMIIZ Mode Off	Auto Sweep			Fre	quency 4.42	225900 GHz
L Frequency St	ween	SIN 3566 FREMI							1Pk Max
								м1[1]	-16.42 dBm
-10 dB7									
	MI.								
-20 dBr									
-30 dB r						r			
-40 d8m									
-45 081									
-57 dBr	5								
50 dBr									
-70 dB~	6								
22 dbw									
	4.								
-90 dBr									
CF 4.42259 GI	z		1001 pt	5	5	.0 MHz/			Span 50.0 MHz



|--|

MultiView 😁 Spectrum	X Receiver		\bigtriangledown
Ref Level 0.00 dBm ● Att 0 dB ● SWT 1.01s Input 1 AC PS 0ff TDE Input 13115A HORIZONTAL 3M 35 M355 M355	 RBW 501/Hz VBW 501/Hz Notch Off CB DREAME" 		Frequency 4.1640500 GHz
1 Frequency Sweep			IPk Max
			M1[1] -20.28 dBm 4.1815820 GHz
-11 dBr			
			V1
-30 dBr			
-+D uBr			
-50 dBY			
-50 dBY			
70 dBY			
-30 dBr			
-90 dB v			
CF 4.16405 GHz	1001 pts	5.0 MI Iz/	Span 50.0 MHz

Channel No.	Channel frequency [GHz]	Frequency of max. level [GHz]	Bandwidth [kHz]	Height [cm]	Turn table [deg]	Turn device [deg]	Pol.	Peak level (EIRP) [dBm]	Limit [dBm]	Margin [dB]
1	3575	3626.699	50000	150	88	6	Hor.	-16.8	0.0	16.9
2	4000	4063.833	50000	150	89	8	Hor.	-16.4	0.0	16.4
3	4500	4407.560	50000	150	89	10	Hor.	-16.4	0.0	16.4
4	4000	4181.582	50000	150	84	15	Hor.	-20.3	0.0	20.3
	Measurement uncertainty						±5.5 dB			

Test: Passed

Test equipment used (refer clause 6):



5.3 Radiated emissions

5.3.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into five stages.

- A preliminary measurement carried out inside a semi anechoic chamber with various antenna heights in the frequency range 9 kHz to 1 GHz.
- A final measurement carried out on an outdoor test site without reflecting ground plane and fixed antenna height in the frequency range 9 kHz to 30 MHz.
- A final measurement carried out inside a semi anechoic chamber with reflecting ground plane and various antenna height in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with fixed antenna distance and height in the frequency range above 1 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range above 1 GHz.

The frequency range 9 kHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to find the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	300 Hz
150 kHz to 30 MHz	10 kHz





Preliminary measurement procedure:

Prescans were performed in the frequency range 9 kHz to 30 MHz.

The following procedure will be used:

- 1) Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
- 2) Manipulate the system cables within the range to produce the maximum level of emission.
- 3) Rotate the EUT by 360 ° to maximize the detected signals.
- 4) Make a hardcopy of the spectrum.
- 5) Measure the frequencies of highest detected emission with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
- 6) Repeat steps 1) to 5) with the other orthogonal axes of the EUT.
- 7) Rotate the measuring antenna and repeat steps 1) to 5).

Final measurement (9 kHz to 30 MHz):

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m and 30 m whichever is appropriate. In the case where larger measuring distances were required the results will be extrapolated based on the values measured on the closer distances according to [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak.

On the during the preliminary measurement detected frequencies the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum value is found.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz





Final measurement procedure:

The following procedure will be used:

- 1) Monitor the frequency range with the measuring antenna at vertical orientation parallel to the EUT at an azimuth of 0 °.
- 2) Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
- 3) Rotate the measuring antenna to find the maximum and note the value.
- 4) Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
- 5) Repeat steps 1) to 4) with the other orthogonal axes of the EUT (only if the EUT is a module or is used in a handheld application).

Preliminary and final measurement (30 MHz to 1 GHz)

The EUT is measured in the frequency range from 30 MHz to 1 GHz inside a semi anechoic chamber with a metal ground plane, which has been validated to the requirements of [1]. It is placed on a 3D-positioner to allow different positions at a distance of 3 meters from the receiving antenna. Both polarizations (vertical and horizontal) have been evaluated and the turn table has been turned to 360° to maximize the emissions. The receiving antenna is raised from 1 to 4 m.

Procedure preliminary measurement:

The following procedure is used:

- 1. Set the measurement antenna to 1 m height.
- 2. Monitor the frequency range at vertical polarization and a EUT azimuth of 0 °.
- 3. Rotate the EUT by 360° to maximize the detected signals in two axes.
- 4. Repeat 1) to 2) with the horizontal polarization of the measuring antenna.
- 5. Increase the height of the antenna for 0.5 m and repeat steps 2 4 until the final height of 4 m is reached (30 MHz to 1 GHz only).
- 6. The highest values for each frequency will be saved by the software, including the antenna height, measurement antenna polarization and turntable azimuth for that value.

Procedure final measurement:

The following procedure is used:

- 1. Select the highest frequency peaks to the limit for the final measurement.
- 2. The software will determine the exact peak frequencies by doing a partial scan with reduced RBW with +/- 10 times the RBW of the pre-scan of the selected peaks.
- 3. If the EUT is portable or ceiling mounted, find the worst case EUT position (x, y, z) for the final test.
- 4. The worst measurement antenna height is found by the measurement software by varying the measurement antenna height by +/- 0.5 m from the value obtained in the preliminary measurement, and to monitor the emission level.
- 5. The worst azimuth turntable position is found by varying the turntable azimuth by +/- 25° from the value obtained in the preliminary measurement, and to monitor the emission level.
- 6. The final measurement is performed at the worst-case antenna height and the worst case turntable azimuth
- 7. Steps 2 6 will be repeated for each frequency peak selected in step 1.
- 8. For frequencies above 960 MHz the measured field strength is converted to an EIRP value

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	100 kHz



Test setup for measurements below 1 GHz

Preliminary and final measurement (1 GHz to 26.5 GHz)

This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a nonconducting turn device at a height of 1.5 m. The set-up of the Equipment under test will be in accordance with [1].

Procedure preliminary measurement:

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30 ° steps according 6.6.5.4 in [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 26.5 GHz	1 MHz



Prescans were performed in the frequency range 1 to 26.5 GHz.

The following procedure will be used:

- 1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 ° with peak or RMS detector of the spectrum analyser (depending of the noise floor and the applicable limit).
- 2. Rotate the EUT by 360° to maximize the detected signals.
- 3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
- 4. Make a hardcopy of the spectrum.
- 5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) according to 6.6.5.4 in [1].
- 6. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
- 7. The measurement antenna polarisation, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

Procedure final measurement:

The measurements were performed in the frequency range 1 GHz to 26.5 GHz.

The following procedure will be used:

- 1) Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
- 3) Set the spectrum analyser to EMI mode with peak and RMS average detector activated.
- 4) Rotate the turntable from 0° to 360° to find the EUT angle that produces the highest emissions.
- 5) Note the highest displayed peak and average values
- 6) Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.
- 7) Replace the EUT by a substitution antenna, which is fed by a signal generator.
- 8) Carry out a substitution for each frequency detected during the steps 5) to 6).
- 9) Calculate the EIRP values with the help of the final measurement and the substitution results.



Test setup for measurements from 1 GHz to 26.5 GHz



Preliminary and final measurement (26.5 GHz to 40 GHz)

The measurement will be performed in horizontal and vertical polarisation of the measuring antenna, the antenna close to the EUT and while moving the antenna over all sides of the EUT.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
26.5 GHz to 40 GHz	1 MHz

Procedure of measurement:

The following procedure will be used:

- 1) Monitor the frequency range at horizontal polarisation and move the antenna over all sides of the EUT (if necessary, move the EUT to another orthogonal axis).
- 2) Change the antenna polarisation and repeat 1) with vertical polarisation.
- 3) Make a hardcopy of the spectrum.
- 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
- 5) Change the analyser mode to Clear / Write and found the cone of emission.
- 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3 m and the antenna will be still inside the cone of emission.
- Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarisation and azimuth and the peak and RMS average detector, which causes the maximum emission.
- 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.
- 9) Replace the EUT by a substitution antenna, which is fed by a signal generator.
- 10) Carry out a substitution for each frequency detected during the steps 5) to 6).
- 11) Calculate the EIRP values with the help of the final measurement and the substitution results.

Step 1) to 6) are defined as preliminary measurement.



Test setup for measurements from 26.5 GHz to 40 GHz



5.3.2 Test results (radiated emissions)

5.3.2.1 Preliminary radiated emission measurement (9 kHz to 10 GHz)

Ambient temperature		21 °C		Relative humidity	55 %				
Position of EUT: The EUT was set-up on a turn device of a height of 1.5 m. The dis between EUT and antenna was 3 m (9 kHz to 1 GHz), 1 m (1 GHz to 26.5 GHz) and 0.3 m (26.5 GHz to 40 GHz).									
Cable guide:	For de report	For detail information of test set-up refer to the pictures in annex A of this test report.							
Test record:	All res	sults are shown	in the follow	ving.					
Supply voltage:	During	g all measureme	ents the EU	T was supplied by a fully cha	rged battery.				
Frequency range:	The p 40 G⊦	reliminary meas Iz according to	urement wa [2].	as carried out in the frequenc	y range 9 kHz to				
Remark:	As the mease	e measurements urement system	have show were emitte	/n, no emissions above the n ed by the EUT below 1 GHz.	oise floor of the				
It was agreed between the applicant and the laboratory to test the EUT as handheld device according to FCC 47 CFR Part 15.519. After testing was completed it was clarified by the FCC, that the device can be certified as indoor device according to FCC 47 CFR Part 15.517. So, the limits in the on the following pages showing the more stringent limits of the FCC 47 C Part 15.519.									

Transmitter independent emissions below 1 GHz:

191168_11_mag: Spurious emissions from 9 kHz to 30 MHz (operation mode 1):

Remark: In the shown plot a distance correction factor was added to the measurement results to account for the different measuring distances according to standard (9 kHz to 490 kHz @ 300 m; 490 kHz to 30 MHz @ 30 m).



All emissions are more the 20 dB from the limit, so no final measurement was performed.

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F191168E2
19-111168
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801 70 60 §15.209 & RSS-GEN 30-1000 MHz QP 3m 50 Level in dBµV/m 40 30 20 10 0 -10 30M 50 60 80 100M 200 300 400 500 800 1G Frequency

191168_11_SAC: Spurious emissions from 30 MHz to 1 GHz (operation mode 1):

The emissions in this frequency range were caused by the camera system of the semi anechoic chamber and not by the EUT.

The following frequency was found in the frequency range 960 MHz to 1 GHz:

- 962.975 MHz (highest peak, noise floor of the measuring system).

On this frequency a final measurement has to be carried out. The result is presented in the following.

Transmitter operates on channel 1 (operation mode 1):

<u>191168_13.png: Transmitter spurious emissions from 1 GHz to 1.61 GHz (operation mode 1):</u>

MultiView B	Spectrum	L						
Ref Level -50 Att Input	00 dBm 0 dD ● SWT 1.2 1 AC PS	• RBW 1 MH 23 s • VBW 3 MH OF Notch O	z z Mode Auto Sweep ff	0		Free	uency 1.3	111000 GHz
1 Frequency Sw	veep							
-50 dBr								
-70 dBr								
-30 dB 1	TL 75.00 dum							
menone.								
-90 dBr								
-110 d&m								
110 42 -								
110 03/8								
-120 d3m								
-130 d3m								
-140 d3 m		Ĩ						
CE 1.3111 GUz			1221 pts	6	1.0 MHz/		S	pan 610.0 MI Iz

All emissions were below -82.7 dBm. This peak value is already below the rms AV-limit of -75.3 dBm.



MultiView 🔠 Spectrum ∇ ■ RBW 1 MHz SWT 1.01 ms ■ VBW 3 MHz PS Cff Notch Of Ref Level Att Input -50 00 dBm 0 dD 1 AC Frequency 1.8000000 GHz Mode Auto Sweep "3115F I Frequency Sweep 1Pk Max 70 dB1 white a course Ma a a march the main man marken mouth and see we and mound month and sold und same 3D di -⊋⊃ dB eh or i 110 d3m -120 d31 eb ne i 140 d3 1001 pts 38.0 MI Iz/ 1.99 GI Iz 1.61 GHz

191168_14.png: Transmitter spurious emissions from 1.61 GHz to 1.99 GHz (operation mode 1):

All emissions were below -70.1 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -53.3 dBm.

<u>191168</u> 15.png: Transmitter spurious emissions from 1.99 GHz to 3.1 GHz (operation mode 1):

MultiView 88	Spectrum								
Ref Level -50 00 Att Input TDF Input1 "3115PA	dEm 0dE SWT 2 1AC PS A1V"	23 ms = RBW Cff Note	1 MHz 1 3 MHz Mod h 011	e Auto Sweep			Fo	equency 2.5	450000 GHz
1 Frequency Swee	ер								1Pk Max
-50 dBr									
	H1 -61,500 dBm					the second second	he are added to have been and	or the and the principal of the second se	and a sub-station of the second
upper and the second	an town what the solution of the	shalowayayayay	win-bankersonaktion of the	and the state of the second second	an south of the second and the second	ANT A MAR AND A MAR			
221 M									
-30 dB r									
-20 dBr		3							
-100 dam									-
110 d3m									
100.43m									
-120 05 11									
12									
-130 d3m		3							
-140 d3m									
1.99 GHz			2221 pt	5	11	1.0 MHz/	ļ	ļ	3.1 GHz

The following frequencies were found:

1996.799 MHz and 3009.011 MHz.

On these frequencies a final measurement has to be carried out. The result is presented in the following. All other emissions were below -68.1 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm.

_



MultiView 🖽 Spectrum Receiver X ∇ Ref Level Att Input -30 00 dBm 0 dD 1 AC 3115A HORIZ RBW 1 MHz
SWT 30 ms
 VBW 3 Milz
PS Cff Notch Of
ONTAL 3M 35CB PREAMP" Mode Auto Sweep Frequency 6.8500000 GHz "3115A I Frequency Sweep 1Pk Max 70 dB h ce 90 dB1 -100 da i in di -120 d3 3.1 GI Iz 15001 pts 750.0 MHz/ 10.6 GHz

191168_9.png: Transmitter spurious emissions from 3.1 GHz to 10.6 GHz (operation mode 1):

The following frequencies were found:

3633.890MHz (wanted signal) and 4139.870 MHz.

On this frequency a final measurement has to be carried out. The result is presented in the following. All other emissions were below -49.8 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -41.3 dBm.

<u>191168</u> 33.png: Transmitter spurious emissions from 10.6 GHz to 12 GHz (operation mode 1):

MultiView 88	Spectrum								
RefLevel -30 Att Input TDF Input1 "1624	00 dBm 0 dB SWT 1 AC PS 40 1m 35 dB'	5.6 ms • VBW Or Notch	1 MHz 3 MHz Mode 1 Off	Sweep			Free	uency 11.30	0000 00 GHz
1 Frequency Sw	veep								IPk Max
-47 dBr									6
55 db4									
-50 dBr	H2 -61.300 dBr	m							
nam stift estates see (me dates in a string	والمراهد والمدارية والمراسات والم	much with latin bon bong	millionoryamous	read adjust special de sua	here, highlige and a star	ومهاطوروا الهرمانية ومناور والإعرا	and a stand in a low providence of	الموسا ويوقد سادي ورواد استديووه	-
-70 dB'r									
->- ab rc-									
55 461									
-90 dBr									
~									
130 d3m									
-110 d3m									
-120 d3 m									
10.6 GI Iz		а — а	2801 pt	5	14	0.0 MHz/			12.0 GI Iz

All emissions were below -65.4 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



 MultiView
 Spectrum

 Reflevel -30 00 ddm
 RBW 1 MHz

 Att
 00 SWT 24 ms V3W 3 Milz

 Input
 1A2
 PS on Notch of

 TFloat 1"1020"
 01 Notch of
 ∇ Frequency 15.000000 GHz Input 1 A "DF Input1 "18240" I Frequency Sweep 1Pk Max 40 dB -50 dBr SD dB r -70 dB~ RD dB1 ∋0 dBγ -100 d31 EL IOL da -120 d31 600.0 MHz/ 18.0 GI Iz 12.0 GI Iz 12001 pts

191168_37.png: Transmitter spurious emissions from 12 GHz to 18 GHz (operation mode 1):

All emissions were below -62.4 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.

191168	_38.png:	Transmitter	spurious	emissions	from 1	18 GHz te	o 26.5	GHz	(operation	mode	1):



All emissions were below -62.8 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



MultiView 🔠 Spectrum ∇ Ref Level Att Input ■ RBW 1 MHz SWT 54 ms ■ VBW 3 MHz PS On Notch Of cersion 30 cm to 1 m" -30 00 dBm 0 dD 1 AC Frequency 33.2500000 GHz Mode Sweep 1 Frequency Sweep 1Pk Max 40 d 50 dB1 SD de an de ∋0 dBγ -100 da -LID da -120 d3 40.0 GI Iz 26.5 GHz 27001 pts 1.35 GHz/

191168_45.png: Transmitter spurious emissions from 26.5 GHz to 40 GHz (operation mode 1):

All emissions were below -66.9 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



191168_16.png: Transmitter spurious emissions from 1.164 GHz to 1.240 GHz (operation mode 1):

All emissions were below -92.9 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -85.3 dBm. Therefore, no final measurement was carried out in this frequency range.



⊽ MultiView 😁 Spectrum
 Ref Level
 -50 00 dBm

 Att
 0 dD

 Input
 1 AC

 TDF Input
 "3115PA1H"
 RBW : kHz
 SWT 5.1 s ● VBW 3 kHz
 PS Off Notch Off Frequency 1.5845000 GHz Input 1 A TDF Input1 "3115PA1H I Frequency Sweep 1Pk Max 50 di 70 dB1 30 dB -90 dB1 Eb nr i 110 d3m -120 d3m Eb OF I -140 d3 1.559 GHz 51001 pts 5.1 MHz/ 1.61 GHz

191168_17.png: Transmitter spurious emissions from 1.559 GHz to 1.610 GHz (operation mode 1):

All emissions were below -95.1 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -85.3 dBm. Therefore, no final measurement was carried out in this frequency range.

Transmitter operates on channel 2 (operation mode 2):

191168_18.png: Transmitter spurious emissions from 1 GHz to 1.61 GHz (operation mode 2):

MultiView Spectrum Ref Level -50 00 dBm	• RBW 1 MHz				 	
Input I AC PS C TDF Input1 "3115PA1H"	of Notch Off	эмаср			 quency 1.5	
1 Frequency Sweep						●1Rm Max
-52 dBr					 	
-75 dBr						
-30 dB r					 	
->> dBr						
-100 dBm						
110 dJm						
-120 d3m-						
-130 dam						
-140 d3 n						
1.0 GI Iz	1221 pts	5	61	.0 MHz/		1.61 GHz

All emissions were below -82.6 dBm. This peak value is already below the rms AV-limit of -75.3 dBm.



~ MultiView 🖽 Spectrum Ref Level -50 00 dBm Att 0 dD Input 1 AC TDF Input1 "3115PA1H" ● RBW 1 MHz SWT 1.01 ms ● VBW 3 MHz Mode Sweep PS Cff Notch Of Frequency 1.8000000 GHz Input 1 A TDF Input1 "3115PA1H I Frequency Sweep 1Pk Max -73 dBTmolth and an when we we N. And by Sugar manual manufation 3D di -ƏD dB -inn da 110 d3m -120 d31 eb ne i 140 d3 1001 pts 38.0 MHz/ 1.99 GI Iz 1.61 G |z

191168_19.png: Transmitter spurious emissions from 1.61 GHz to 1.99 GHz (operation mode 2):

All emissions were below -70.3 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -53.3 dBm.

191168_20.png: Transmitter spurious emissions from 1.99 GHz to 3.1 GHz (ope	peration mode 2):
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MultiView 88	Spectrum								
RefLevel -500 Att Input TDF Input1 "3115	DU dEm D dE SWT 1 AC PS SPA1H'	= RB¥ 2.23 ms = ¥B¥ Cff Note	V 1MHz V 3MHz Mod ch OŤ	e Sweep			Fre	equency 2.	5450000 GHz
1 Frequency Sw	eep								😑 IPk Max
-51 dBr	H1 -61,500 dBr								
70 dBr aphilochurghy surphander	hoursessestimaterative	weather and the second second	a district recording when	ungselterklikklikkningen	uninductions where	knathankakakana	white the second because of	and the second second	shi ha dynamid deviet britani mar
-30 dBr									
-90 dBr									
-100 d3m									
100 00 0									
-110 d3m									
120 d3m									
-130 d3m									
-140 d3 11									
1.99 GHz			2221 pt	S	11	1.0 MHz/		1	3.1 GHz

The following frequency was found:

- 1996.799 MHz.

On this frequency a final measurement has to be carried out. The result is presented in the following. All other emissions were below -66.3 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm.



MultiView 😁 Spectrum Receiver X ∇ BBW 1 MHz
 SWT 30 ms • VBW 3 Milz
 PS Cff Notch Of
 ONTAL 3M 35CB PREAMP" RefLevel Att Input -30 00 dBm 0 dD 1 AC Mode Auto Sweep Frequency 6.8500000 GHz DRC I Frequency Sweep 1Pk Max 50 dB 70 dB th ce 90 dB1 -100 da -LID da -120 d3 3.1 GI Iz 15001 pts 750.0 MI Iz/ 10.6 GI Iz

191168_10.png: Transmitter spurious emissions from 3.1 GHz to 10.6 GHz (operation mode 2):

The following frequency was found:

4055.990 MHz (wanted signal).

On this frequency a final measurement has to be carried out. The result is presented in the following. All other emissions were below -47.4 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -41.3 dBm.

191168_34.png: Transmitter spurious emissions from 10.6 GHz to 12 GHz (operation mode 2):

MultiView	Spectrum								
Ref Level -30 Att Input TDF Input1 "16	000 dBm 0 dB SWT 1 AC PS 240 1m 35 dB'	S.6 ms VBW Or Notch	1 MHz 3 MHz Mode 1 Off	Sweep			Free	quency 11.30	0000 00 GHz
1 Frequency S	weep								IPk Max
-47 dBr									
50 dB7									
-50 dBr	H2 -61,300 dB	m							
under webbenhowhere	arawin's prostations	cause have been a second	of a state of the	uppersonal advantages	matherestration	and the second	adam of subflets by sealor	or dearranges as well the second	and the strands the works
75 001									
-30 dBr	<i></i>								
-90 dBr									
100 d3m									
-110 d3m									
-120 d3 n									
10.6 GI Iz	i0/	**	2801 pt	ŝ	14	0.0 MI Iz/		× .	12.0 GHz

All emissions were below -65.7 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



 Bits
 Spectrum

 Reflevel-3000/ddm
 BBW 1.MHz

 Toput
 0d0
 SWT 24 ms
 VBW 3.MHz

 Triput
 200
 SWT 24 ms
 VBW 0.000

 TF ing it "10200"
 PS
 3n Noteh
 Of

</tabular ∇ Frequency 15.0000000 GHz Mode Sweep Input 1 A TDF Input1 "18240" I Frequency Sweep 1Pk Max 40 di -50 dB1 SO dB1 -70 dB1 Rh CF ∋0 dBγ -100 da -LID da -120 d3 18.0 GI Iz 12.0 GI Iz 12001 pts 600.0 MHz/

191168_40.png: Transmitter spurious emissions from 12 GHz to 18 GHz (operation mode 2):

All emissions were below -63.2 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.

 ∇ MultiView 🖂 Spectrum
 Ref Level -30 00 dbm
 RBW 1 MHz

 Att
 0 db
 SWT 34 ms
 VBW 3 MHz

 Input
 1 AC
 PS
 0n
 Notch
 04'

 DF Inout1 "20240'
 1 Frequency Sweep
 1
 Frequency Sweep
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 Frequency 22.2500000 GHz Mode Sweep IPk M 4n dB 50 dBm 50 dB1 61.300 c 70 dB -30 dB ∋⊃ dB 100 d3m -110 d3 -120 d3 17001 pts 18.0 GI Iz 850.0 MHz/ 26.5 GHz

191168_39.png: Transmitter spurious emissions from 18 GHz to 26.5 GHz (operation mode 2):

All emissions were below -63.1 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



MultiView 🔠 Spectrum ∇ Ref Level Att Input ■ RBW 1 MHz SWT 54 ms ■ VBW 3 MHz PS On Notch Of version 30 cm to 1 m" -30 00 dBm 0 dD 1 AC Frequency 33.2500000 GHz Mode Sweep 1 Frequency Sweep 1Pk Max 40 di 50 dB1 SD dB ah ce ∋0 dBγ -100 da -LID da -120 d3 40.0 GI Iz 26.5 GHz 27001 pts 1.35 GHz/

191168_46.png: Transmitter spurious emissions from 26.5 GHz to 40 GHz (operation mode 2):

All emissions were below -67.3 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.

191168 21.png: Transmitter spurious emissions from 1.164 GHz to 1.240 GHz (operation mode 2):



All emissions were below -93.5 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -85.3 dBm. Therefore, no final measurement was carried out in this frequency range.



⊽ MultiView 😁 Spectrum
 Ref Level
 -50 00 dBm

 Att
 0 dD

 Input
 1 AC

 TDF Input
 "3115PA1H"
 ● RBW : kHz SWT 5.1 s ● VBW 3 kHz PS Off Notch Off Frequency 1.5845000 GHz Input 1 A TDF Input1 "3115PA1H I Frequency Sweep 1Pk Max 50 d 70 dB1 30 dB -90 dB1 Ph nr 110 d3m -120 d31 eb ne i -140 d3 1.559 GHz 51001 pts 5.1 MHz/ 1.61 GHz

191168_22.png: Transmitter spurious emissions from 1.559 GHz to 1.610 GHz (operation mode 2):

All emissions were below -94.9 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -85.3 dBm. Therefore, no final measurement was carried out in this frequency range.

Transmitter operates on channel 3 (operation mode 3):

191168_25.png: Transmitter spurious emissions from 1 GHz to 1.61 GHz (operation mode 3):

MultiView 🖽 Spectrum	٦						
Ref Level -50 00 dBm ● Att 0 dD ● SWT 1.2 Input 1 AC PS TDE Logit1 "3115PA1H" 1	● RBW 1 MHz 3 s ● VBW 3 MHz Mode OF Notch Off	Sweep			Freq	uency 1.30	50000 GHz
1 Frequency Sweep							💷 🔍 1Rm Max
-50 dBr							
-70 dBr							
-30 dB r							
	·						
-20 dBr							
- I TO dam				-			
110 d3m							
-120 d3m							
- 130 dam							
-140 d3 n							
1.0 GI Iz	1221 pts	i	61	.0 MHz/		>	1.61 GHz

All emissions were below -82.7 dBm. This peak value is already below the rms AV-limit of -75.3 dBm.



~ MultiView 😁 Spectrum
 Ref Level
 -50 00 dBm

 Att
 0 dD

 Input
 1 AC

 TDF Input
 "3115PA1H"
 ● RBW 1 MHz SWT 1.01 ms ● VBW 3 MHz Mode Sweep PS Cff Notch Of Frequency 1.8000000 GHz Input 1 A TDF Input1 "3115PA1H I Frequency Sweep 1Pk Max TO dBY with a shall be a would be deally an application of the Ash drive have al marken the 3D di -⊋⊃ dB -inn da 110 d3m -120 d3: eb ne i 140 d3 1001 pts 38.0 MHz/ 1.99 GI Iz 1.61 G |z

191168_26.png: Transmitter spurious emissions from 1.61 GHz to 1.99 GHz (operation mode 3):

All emissions were below -69.9 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -53.3 dBm.

<u>19116_27.png: Transmitter spurious emissions from 1.99 GHz to 3.1 GHz (operation mode</u>
--

MultiView 😁 Spectrum	\neg						
Ref Level -50 00 dBm Att 0 dB SWT 2 Input 1 AC PS "DF Input1"3115PA1H"	■ RBW 1 MHz 2.23 ms ■ VBW 3 MHz Mode Off Notch Of	: Sweep			Fre	equency 2.5	5450000 GHz
1 Frequency Sweep							🕒 IPk Max
-51 dBr							
170 dBr ปกรีประเทศสาราชการเป็นเกิดเป็นเราเป็นเกิดที่เห	were and the state of the second state of the	a filmeridenselves	ah dhantar a saasa ahaybara hada	en manghering her high	and the advector of the second	ner an total work and	ulphranese interview
-30 dB~							
-90 UB1							
-100 d3m				<u>.</u>			
-110 d3m							
120 d)m							
-130 d3m							
-140 d3 n							
1.90 GUz				1.0 MUz/			21615

The following frequency was found:

- 1996.799 MHz.

On this frequency a final measurement has to be carried out. The result is presented in the following. All other emissions were below -66.8 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm.



MultiView 8	Spectrum	Re	ceiver 🔅	x					▼
RefLevel -30 Att Input TDF Input1 "311!	00 dBm 0 dD SWT 1 AC PS 5A HORIZONTAL	● RBW 30 ms ● VBW Cff Notch 3M 35DB PREAM	1 MHz 3 MHz Mode 01 1P''	Auto Sweep			Fn	equency 6.8	500000 GHz
1 Frequency Sw	/eep				2				IPk Max
-4ጋ dBγ	H) 225.200 dB								
-50 dBr						Jay and Decident fields	المرد المرد والمرد المرد	and the stand of the stand of the stand	Made And State State State State
and the state of the second		V N	and a state of the	and the state of the local state of the	- Laborate Milling In				
~5J dB 1									
-70 dB~									
-31 dBm									
∋D dBrr									
-130 d3m									
-1 IO d3m									-
-120 d5 h									
3.1 GI Iz		,,	15 0 01 p	l s	75	0.0 MHz/		5	10.6 GHz

191168_11.png: Transmitter spurious emissions from 3.1 GHz to 10.6 GHz (operation mode 3):

The following frequencies were found:

4423.600 MHz (wanted signal) and 5027.120 MHz.

On these frequencies a final measurement has to be carried out. The results are presented in the following. All other emissions were below -50.3 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -41.3 dBm.

191168 35.png: Transmitter spurious emissions from 10.6 GHz to 12 GHz (operation mode 3):

MultiView	Spectrum								
RefLevel -30 Att Input TDF Input1 "163	000 dBm 0 dE SWT 1 AC PS 240 1m 35 dB'	● RBW 5.6 ms ● VBW Or Notch	1 MHz 3 MHz Mode 1 Off	Sweep			Free	quency 11.30	000000 GHz
1 Frequency S	weep								🖲 IPk Max
-47 dBY									
50 dBr									
-5J dBr		m							
-70 UBT	ren-terrenter-terrenter-terretert	longton and a strate of the state	uput share when we	e phase and an	wooddan Abhan Isaa	an a had a share of the state of the state of the	and the second	الجيافيار اليدرير خل عدريالل فرو	Adhrenologiante
10/10/1									
-3D dBr	-								
-90 dBY									
100 d3m									
-110 d3m									
-120 d3 m									
10.6 GI Iz	62 	* *	2801 pts	5	14	0.0 MHz/		×	12.0 GHz

All emissions were below -65.1 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



 MultiView
 Spectrum

 Ref Level -30 00 dbm
 RBW 1 MHz

 Att
 0 db
 SWT 24 ms
 VBW 3 MHz

 Input
 1A2
 PS
 Dn
 Notch
 Of

 DF Input "1920"
 1A2
 PS
 Dn
 Notch
 Of
 ∇ Frequency 15.000000 GHz Mode Sweep Input 1 A TDF Input1 "18240" I Frequency Sweep 1Pk Max 40 di -50 dB1 SD dB1 -70 dB1 Rh CF ∋0 dBγ -100 d3--LID da -120 d3 600.0 MHz/ 18.0 GI Iz 12.0 GI Iz 12001 pts

191168_41.png: Transmitter spurious emissions from 12 GHz to 18 GHz (operation mode 3):

All emissions were below -62.9 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.

191168	42.png:	Transmitter si	ourious	emissions fr	rom 18	GHz to 26.5	5 GHz (operation mode	3):
							· • · · - ·		• .



All emissions were below -62.4 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



MultiView 🔠 Spectrum ∇ Ref Level Att Input ■ RBW 1 MHz SWT 54 ms ■ VBW 3 MHz PS On Notch Of cersion 30 cm to 1 m" -30 00 dBm 0 dD 1 AC Frequency 33.2500000 GHz Mode Sweep 1 Frequency Sweep 1Pk Max 40 d 50 dB1 SD de ah ce ∋0 dBγ -100 da -LID da -120 d3 40.0 GI Iz 26.5 GHz 27001 pts 1.35 GHz/

191168_47.png: Transmitter spurious emissions from 26.5 GHz to 40 GHz (operation mode 3):

All emissions were below -67.1 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



191168_24.png: Transmitter spurious emissions from 1.164 GHz to 1.240 GHz (operation mode 3):

All emissions were below -93.2 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -85.3 dBm. Therefore, no final measurement was carried out in this frequency range.



⊽ MultiView 😁 Spectrum
 Ref Level
 -50 00 dBm

 Att
 0 dD

 Input
 1 AC

 TDF Input
 "3115PA1H"
 ● RBW : kHz SWT 5.1 s ● VBW 3 kHz PS Off Notch Off Frequency 1.5845000 GHz Input 1 A TDF Input1 "3115PA1H I Frequency Sweep 1Pk Max 50 d 70 dB1 30 dB -90 dB1 t n da 110 d3m -120 d3m eb ne i -140 d3 1.559 GHz 51001 pts 5.1 MHz/ 1.61 GHz

191168_23.png: Transmitter spurious emissions from 1.559 GHz to 1.610 GHz (operation mode 3):

All emissions were below -95.0 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -85.3 dBm. Therefore, no final measurement was carried out in this frequency range.

Transmitter operates on channel 4 (operation mode 4):

<u>191168_30.png: Transmitter spurious emissions from 1 GHz to 1.61 GHz (operation mode 4):</u>

MultiView 🖽 Spectrum			
Ref Level -50 00 dbm Att 0 db • SWT 1.23 s Input 1 A5 PS 0F DE Input 1 A5 PS 0F	RBW 11MHz VBW 31MHz Mode Auto Sweep Notch Off		Frequency 1.3050000 GHz
1 Frequency Sweep			● 1Rm Max
-50 dBr	~		
-70 dBY			
-90 dB m			
-90 dBr			
- Inn dam			
110 d3m			
-120 d3m-			
- 130 dam			
-140 d3 m			
1.0 GI Iz	1221 pts	61.0 MI Iz/	1.61 GI Iz

All emissions were below -82.7 dBm. This peak value is already below the rms AV-limit of -75.3 dBm.



MultiView 🕄 Spectrum ∇
 Ref Level
 -50 00 dBm

 Att
 0 dD

 Input
 1 AC

 TDF Input1
 "3115PA1H"
 RBW 1 MHz
 SWT 1.01 ms • VBW 3 MHz
 PS Cff Notch Of Frequency 1.8000000 GHz Mode Auto Sweep TDF Input 1 A TDF Input1 "3115PA1H I Frequency Sweep 1Pk Max 50 di -70 dBT-la al-. fue Marchahmen mound M. A. March march ada and she 3D di -⊋⊃ dB -inn da 110 d3m -120 d3: eb ne i 140 d3 1001 pts 38.0 MHz/ 1.99 GI Iz 1.61 GHz

191168_29.png: Transmitter spurious emissions from 1.61 GHz to 1.99 GHz (operation mode 4):

All emissions were below -69.1 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -53.3 dBm.

19116_28.png: Transmitter spurious emissions from 1.99 GHz to 3.1 GHz (operation mode 4):

MultiView	Spectrum								
RefLevel -50 Att Input TDE Input1 "31	000 dBm 0 dB SWT 2 1 AC PS 15PA1H'	2.23 ms = RBW Off Note	1 MHz 3 MHz Mod h 이커	e Sweep			Fre	equency 2.5	450000 GHz
1 Frequency S	weep								IPk Max
-57 dBr									
, 70 dBm	H1 -6: 500 dem	11.20	a ka analata wa shi	tan announal Marsha	stilles, intaction differen	iku wa chikuka wa Mi	risher which exceed a personal	maninalateristerist	new where where the second state
-BD dBr	algene skielder der fenske van bekenen. Nation	adagan Waadan Ugang Karantalan Product	All and a sure of the second o						
-90 dBr									
-130 d3m									
-110 d3m									
120 dJm									
-130 d3m									
-140 d3 m									
1.99 GI Iz	L. L.	9	2221 pt	5	11	1.0 MI Iz/			3.1 GHz

The following frequency was found:

- 1996.799 MHz.

On this frequency a final measurement has to be carried out. The result is presented in the following. All other emissions were below -66.4 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm.



MultiView 🖽 Spectrum Receiver X ∇ Ref Level Att Input -30 00 dBm 0 dD 1 AC "3115A HORIZ RBW 1 MHz
SWT 30 ms
 VBW 3 Milz
PS Cff Notch Of
ONTAL 3M 35CB PREAMP" Mode Auto Sweep Frequency 6.8500000 GHz I Frequency Sweep 1Pk Max 50 di 70 dB b ce 90 dB1 -100 da -LID da -120 d3 3.1 GI Iz 15001 pts 750.0 MHz/ 10.6 GI Iz

19116_12.png: Transmitter spurious emissions from 3.1 GHz to 10.6 GHz (operation mode 4):

The following frequency was found:

4171.380 MHz (wanted signal).

On this frequency a final measurement has to be carried out. The result is presented in the following. All other emissions were below -49.7 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -41.3 dBm.

191168 36.png: Transmitter spurious emissions from 10.6 GHz to 12 GHz (operation mode 4):

MultiView 😁 Spectrum			
Ref Level 30 00 dBm RB Att 0 dE SWT 5.6 ms VB Input 1 AC PS Or No DF Input1 16240 Im 35 dB' DF No	W 1 MHz W 3 MHz Mode Sweep tch Off	Fre	quency 11.3000000 GHz
1 Frequency Sweep			IPk Max
-41 dBr			
50 dDm			
-50 dBr			
when we are and the other stores and a way the	war illustration and the state of the second states of	and a present start and a president second sources and as a survey of the descention of the second	an a
-70 dB r			
-30 dBr			
-90 dBm-	-		
100 d3m			
110 10 1			
-110 05 %			
~			
-120 d3 n			
10.6 GHz	2801 pts	140.0 MHz/	12.0 GI Iz

All emissions were below -65.6 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



MultiView 🔠 Spectrum ∇ Ref Level Att Input -30 00 dBm BBW 1 MHz 0 dD SWT 24 ms • VBW 3 Milz 1 AC PS 3n Notch Of Frequency 15.0000000 GHz Mode Sweep TDF Input 14 TDF Input1 "18240" I Frequency Sweep 1Pk Max 40 di 50 dB1 50 dB -70 dB1 Rh CF ∋0 dBγ -100 da -LID da -120 d3 18.0 GI Iz 12.0 GI Iz 12001 pts 600.0 MHz/

191168_44.png: Transmitter spurious emissions from 12 GHz to 18 GHz (operation mode 4):

All emissions were below -62.7 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.

191168_43.png: Transmitter spu	urious emissions from 1	18 GHz to 26.5 GHz	(operation mode 4):
MultiView 😂 Spectrum			



All emissions were below -62.4 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



MultiView 🔠 Spectrum ∇ Ref Level Att Input ■ RBW 1 MHz SWT 54 ms ■ VBW 3 MHz PS On Notch Of cersion 30 cm to 1 m" -30 00 dBm 0 dD 1 AC Frequency 33.2500000 GHz Mode Sweep 1 Frequency Sweep 1Pk Max 40 d 50 dB1 SD de ah ce ∋0 dBγ -100 da -LIO da -120 d3 40.0 GI Iz 26.5 GHz 27001 pts 1.35 GHz/

191168_48.png: Transmitter spurious emissions from 26.5 GHz to 40 GHz (operation mode 4):

All emissions were below -66.9 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -51.3 dBm. Therefore, no final measurement was carried out in this frequency range.



191168_32.png: Transmitter spurious emissions from 1.164 GHz to 1.240 GHz (operation mode 4):

All emissions were below -96.6 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -85.3 dBm. Therefore, no final measurement was carried out in this frequency range.



 MultiView
 Spectrum

 RefLevel -50 00 dtm
 • RBW 1 kHz

 Att
 0 dt • SWT 5.1 s • VBW 3 kHz

 Input
 1.AZ

 DF Input "315PA1H"

 1 Frequency sweep
 V Frequency 1.5845000 GHz IPk Max sh de 70 dBγ 30 dB -90 dBr -130 d3 . dan -110 d3m 120 d3m -130 d3 140 d3 1.559 GHz 51001 pts 1.61 GHz 5.1 MHz/

191168_31.png: Transmitter spurious emissions from 1.559 GHz to 1.610 GHz (operation mode 4):

All emissions were below -95.0 dBm (measured with peak detector). This peak value is already below the rms AV-limit of -85.3 dBm. Therefore, no final measurement was carried out in this frequency range.

Test equipment used (refer clause 6):



Ambient temperature		22 °C	Relative humidity	42 %				
Position of EUT:	The E betwe	UT was set-up on a en EUT and antenn	turn device of a height of 1.5 m. ∃ a was 3 m.	The distance				
Cable guide:	For de report	etail information of te	est set-up refer to the pictures in a	nnex A of this test				
Test record:	All res	All results are shown in the following.						
Supply voltage:	During	g all measurements	the EUT was supplied by a fully c	harged battery.				
Test results:	The te the fol	est results from abov lowing formula:	ve 960 MHz and below 1 GHz wer	e calculated with				
	Resul + 6 dE	t [dBµV/m] = reading 3 (used attenuator) -	g [dBµV] + correction [dB] (cable - 95.2 dB (according to 15.503 (k)	oss antenna factor) [2])				

5.3.2.2 Final radiated emission measurement (30 MHz to 1 GHz)

The results of the standard subsequent measurement inside a semi anechoic chamber are indicated in the table below. The limits as well as the measured results (levels) refer to the above-mentioned standard while taking account of the specified requirements for a 3 m measuring distance.

The measurement time with the final detector is 1 second.

Result measured with the RMS detector above 960 MHz and below 1 GHz:

Frequency [MHz]	Result [dBm]	Limit [dBm]	Margin [dB]	Readings [dBµV]	Correction [dB]	Conversion from dBµV/m to dBm	Height [cm]	Azimuth	Pol.
962.975 *	-76.9	-75.3	1.6	-21.7	34.0	95.2	263	157	Hor.
	Measure	ement uncer	taintv		+5.5 dB				

*: Highest peak (noise floor of the measuring system) with in the frequency range 960 MHz to 1 GHz.

Test: Passed

Test equipment used (refer clause 6):



5.3.2.3 Final radiated emission measurement (1 GHz to 40 GHz)

			_		
Ambient temperature		22 °C		Relative humidity	57 %
Position of EUT:	The E betwe (26.5	UT was set-up o en EUT and ante GHz to 40 GHz).	n a turn de enna was 1	vice of a height of 1.5 m. The m (1 GHz to 26.5 GHz) and	e distance 0.3 m
Cable guide:	For detail information of test set-up refer to the pictures in annex A of this test report.				
Test record:	All res	sults are shown ir	n the follow	ving.	

Supply voltage: During all measurements the EUT was supplied by a fully charged battery.

Transmit on channel 1							
Frequency [MHz]	RMS average [dBm]	Limit [dBm]	Margin [dB]	Bandwidth * [kHz]	Pol.	Azimuth [deg]	Elevation [deg]
1996.799	-74.1	-51.3	22.8	1000	Hor.	181	30
3009.011	-71.3	-51.3	20.0	1000	Hor.	88	8
3633.890	-41.7	-41.3	0.4	1000	Hor.	88	6
4139.870	-52.2	-41.3	10.9	1000	Hor.	88	6
			Transmit or	n channel 2			
Frequency [MHz]	RMS average [dBm]	Limit [dBm]	Margin [dB]	Bandwidth * [kHz]	Pol.	Azimuth [deg]	Elevation [deg]
1996.799	-74.1	-51.3	22.8	1000	Hor.	181	30
4055.990	-41.5	-41.3	0.2	1000	Hor.	89	8
Transmit on channel 3							
Frequency [MHz]	RMS average [dBm]	Limit [dBm]	Margin [dB]	Bandwidth * [kHz]	Pol.	Azimuth [deg]	Elevation [deg]
1996.799	-74.1	-51.3	22.8	1000	Hor.	181	30
4423.600	-42.0	-41.3	0.7	1000	Hor.	89	10
5027.120	-54.0	-41.3	12.9	1000	Hor.	89	10
			Transmit or	n channel 4			
Frequency [MHz]	RMS average [dBm]	Limit [dBm]	Margin [dB]	Bandwidth * [kHz]	Pol.	Azimuth [deg]	Elevation [deg]
1996.799	-74.1	-51.3	22.8	1000	Hor.	181	30
4171.380	-45.3	-41.3	4.0	1000	Hor.	84	15
	Measurement u	uncertainty			±4.7	′ dB	

*: The measuring receiver bandwidth

Test: Passed

Test equipment used (refer clause 6):

11 – 13, 15 – 19, 21 – 31



6 Test equipment and ancillaries used for tests

No.	Test equipment	Туре	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
1	Semi anechoic chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138- 10-0006	483227	Calibration not necessary	
2	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration n	ot necessary
3	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
4	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
5	Positioner	TG1.5-10kg	Maturo	110/2648.01	483042	Calibration not necessary	
6	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration n	ot necessary
7	System software EMC32 M276	EMC32	Rohde & Schwarz	100970	482972	Calibration n	ot necessary
8	Ultralog Antenna	HL562E	Rohde & Schwarz	101079	482978	07.08.2019	08.2022
9	EMI Test receiver ESW	ESW44	Rohde & Schwarz	101828	482979	12.04.2019	04.2021
10	Cable C417	Sucoflex 118	Huber+Suhner	500654/118	-	Calibration n	ot necessary
11	Fully anechoic chamber M20	B83117-E2439- T232	Albatross Projects	103	480303	Calibration n	ot necessary
12	EMI Receiver / Spectrum Analyser	FSW43	Rohde & Schwarz	100586 & 100926	481720	04.03.2020	03.2022
13	Antenna (Horn)	3115	EMCO	9609-4918	480183	05.02.2018	02.2021
14	Antenna (Horn)	3115	EMCO	6761	480368	06.02.2020	02.2023
15	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration n	ot necessary
16	Swept CW generator	83650L	Agilent	3844A00554	480333	18.02.2020	02.2021
17	RF-cable No.3	Sucoflex 106B	Suhner	0563/6B	480670	Calibration n	ot necessary
18	RF-cable No.36	Sucoflex 106B	Suhner	0587/6B	480865	Calibration n	ot necessary
19	RF-cable 40	Sucoflex 106B	Suhner	0708/6B	481330	Calibration n	ot necessary
20	Standard gain horn antenna	14240-20	Flann	209388	481596	Calibration n	ot necessary
21	Standard gain horn antenna	16240-20	Flann	135671	480513	Calibration n	ot necessary
22	Standard gain horn antenna	18240-20	Flann	483	480294	Calibration n	ot necessary
23	Standard gain horn antenna	18240-20	Flann	482	480295	Calibration n	ot necessary
24	Standard gain horn antenna	20240-20	Flann	411	480297	Calibration not necessary	
25	Standard gain horn antenna	22240-20	Flann	469	480299	Calibration n	ot necessary
26	Preamplifier 100 MHz – 16 GHz	AFS6- 00101600-23- 10P-6-R	MITEQ	2011215	482333	13.02.2020	02.2022
27	Preamplifier 12 GHz - 18 GHz	JS3-12001800- 16-5A	MITEQ	571667	480343	13.02.2020	02.2022
28	Preamplifier 18 GHz - 26 GHz	JS4-18002600- 20-5A	MITEQ	658697	480342	13.02.2020	02.2022
29	Preamplifier 26 GHz - 40 GHz	JDM2- 26004000-25- 10P	MITEQ	128746	482806	17.02.2020	02.2022



No.	Test equipment	Туре	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
30	RF-cable 1 m	Insulated Wire Inc.	Insulated Wire	KPS-1533-400-KPS	480300	Calibration n	ot necessary
31	RF-cable 2m	Insulated Wire Inc.	Insulated Wire	KPS-1533-800-KPS	480302	Calibration n	ot necessary

7 Test site Validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA	ANSI C63.4-2014	19.09.2019	18.09.2021
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	13.07.2018	12.07.2021

8 Report history

Report Number	Date	Comment
F191168E2	07.07.2020	Document created

9 List of annexes

Annex A Test setup photos

6 pages