

## Test Report

<b>Product</b>	Electronic Control Unit for vehicle Integration		
<b>Name and address of the applicant</b>	CPAC Systems AB Bergskroken 3, 431 37 Mölndal, Sweden		
<b>Name and address of the manufacturer</b>	CPAC Systems AB Bergskroken 3, 431 37 Mölndal, Sweden		
<b>Model</b>	SID 2.0		
<b>Rating</b>	24VDC		
<b>Trademark</b>	CPAC Systems AB		
<b>Serial number</b>	See page 3		
<b>Additional information</b>	This test report covers Bluetooth Low Energy. (The radio module is from Alps UGCZ1 containing Qualcomm QCA6175A)		
<b>Tested according to</b>	<b>ETSI EN 300 328 v2.2.2 (2019-07)</b> Wideband transmission systems; Data transmission equipment operating in the 2.4 GHz band; Harmonised Standard for access to radio spectrum		
<b>Order number</b>	PRJ0024292		
<b>Tested in period</b>	2023-02-24 to 2023-03-16		
<b>Issue date</b>	2023-05-15		
<b>Name and address of the testing laboratory</b>	Nemko Scandinavia AS Instituttveien 6, 2007 Kjeller, Norway		
<b>An accredited technical test executed under the Norwegian accreditation scheme</b>			
 Prepared by [G.Suhanthakumar]		 Approved by [Jan G Eriksen]	
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## Revision history

Revision #	Date	sign	Order #	Description
A	2023-05-15	gns	PRJ0024292	First issued



**THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.**

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

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## 1 GENERAL INFORMATION

### 1.1 Test Information

Name	CPAC Systems AB
Model/version	SID 2.0
Serial number	23040034
Hardware identity and/or version	P-01
Software identity and/or version	Hydra_BTSW_1.0
Adaptivity	N/A (Output Power $\leq$ 10 dBm)
Frequency Range	2402 - 2480 MHz
Number of Channels	40
Channel BW	2 MHz
Operating Mode	Transceiver
Type of Modulation	GFSK
Rated Output Power	$\leq$ +10 dBm (max)
Power supply	24VDC
Antenna Connector	FAKRA
Number of Antennas	See cl.1.3 of this report
Antenna gain	See cl.1.3 of this report
Antenna Diversity Supported	No
Smart Antenna System	No
Receiver	Yes, Catogory 2
Geo-Location capability	Not implemented

#### Description of Test Item

Electronic Control Unit for vehicle Integration

### 1.2 Model Variants

According to the manufacturer the following models have same RF parts and RF modules.

Model/type	LTE Module mounted	Superseal 26	Tested
SID 2.0 (tested at Nemko)	Yes	version 1	<input checked="" type="checkbox"/>
SID 2.0M	No (Marine commercial)	version 2	
SID 2.0MLTE	Yes (Marine leisure)	version 2	
SID 2.0X (EU only)	Yes	version 1	

### 1.3 Antenna types

Declared by the manufacturer.

Name	P/N	Max gain (dBi)	Function
2J 2x 4G/3G/2G MIMO, 2x 2.4/5.0 GHz MIMO and GNSS	2J #2J4A50PCFa	3.7	2.4GHz Wifi+BT
2J 2x 4G/3G/2G MIMO, 2x 2.4/5.0 GHz MIMO and GNSS	2J #2J4A50PCFa	4	2G+3G+4G
TE ANTENNA BASE FULL FEAT	Volvo #23311779	7	2.4GHz Wifi+BT
TE ANTENNA BASE FULL FEAT	Volvo #23311779	7	2G+3G+4G
TE ANTENNA INTERIOR PHONE	Volvo #23311714	3	2G+3G+4G
TE ANTENNA INTERIOR WLAN	Volvo #23311706	3.5	2.4GHz Wifi+BT

### 1.4 Normal test condition

Temperature:	20.0 – 23.0 °C
Relative humidity:	20.0 – 44.0 %
Normal test voltage:	24 V DC

The values are the limit registered during the test period.

## 1.5 Extreme test conditions

	Voltage	Temperature
Minimum	8 VDC	-40 °C
Maximum	32 VDC	+85 °C

Extreme test conditions were defined by the manufacturer.

## 1.6 Test Engineer

G. Suhanthakumar

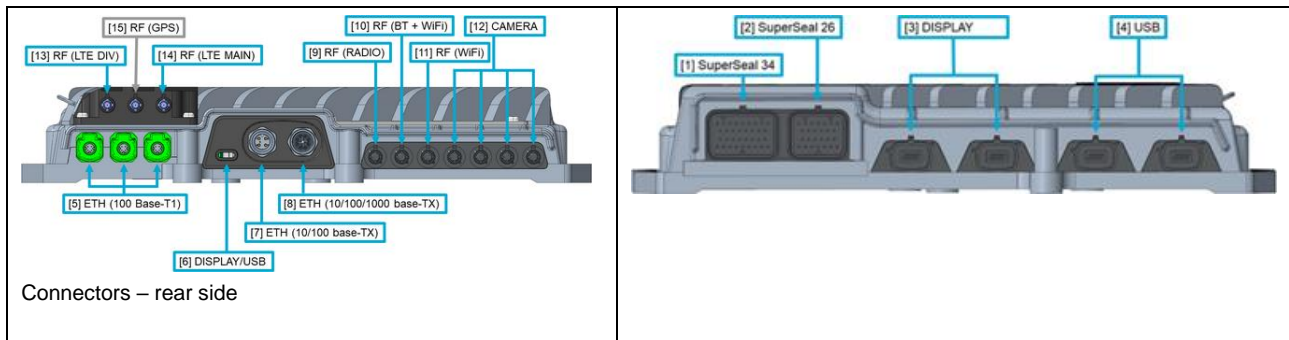
## 1.7 Test Equipment

See list of test equipment in clause 8.

## 1.8 Test Configuration

Channel nr	Frequency (MHz)	Datarate	Modulation
0	2402	1 Mbit/s	GFSK
17	2440	1 Mbit/s	GFSK
39	2480	1 Mbit/s	GFSK

Note: /



## 1.9 Other Comments

The EUT has been tested to ETSI EN 300 328 and all relevant tests are passed.  
All radiated measurements and conducted RF measurements are done with DC power supply.

## 2 TEST REPORT SUMMARY

### 2.1 General

The tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with **EN 300 328 V2.2.2 (2019-07)**:

Wideband Transmission systems; Data transmission equipment operating in the 2.4 GHz ISM band; Harmonised Standard for access to radio spectrum.

The test methods have been in accordance with TM-NO-WLS-500, TM-NO-WLS-204A and EN 300 328 where applicable.

Radiated emissions are performed in 3m anechoic chamber.

- Production Unit
- Pre-production Unit

### 3.1 Abbreviations

The following abbreviations are used in the test summary:

- N/A** Not applicable. The testcase is not applicable for the tested equipment.
- N/T** Not tested. The testcase is not covered by this test report.
- U** Unconditional.
- C** Conditional.

### 3.2 Test Summary

Harmonized Standard EN 300 328					
Relationship between the present document and the essential requirements of Directive 2014/53/EU					
Technical Requirement reference		Technical Requirement Conditionality		Test Specification	
Description	Reference Clause No	U/C	Condition	Reference Clause No	Verdict
RF Output Power	4.3.1.2 or 4.3.2.2	U		5.4.2	Pass
Power Spectral Density	4.3.2.3	C	Only for modulations other than FHSS	5.4.3	N/A <sup>1</sup>
Duty cycle, Tx-Sequence, Tx-gap	4.3.1.3 or 4.3.2.4	C	Only for non-adaptive equipment	5.4.2	N/A
Accumulated Transmit time, Frequency Occupation & Hopping Sequence	4.3.1.4	C	Only for FHSS	5.4.4	N/A
Hopping Frequency Separation	4.3.1.5	C	Only for FHSS	5.4.5	N/A
Medium Utilisation	4.3.1.6 or 4.3.2.5	C	Only for non-adaptive equipment	5.4.2	N/A
Adaptivity	4.3.1.7 or 4.3.2.6	C	Only for adaptive equipment	5.4.6	N/A <sup>1</sup>
Occupied Channel Bandwidth	4.3.1.8 or 4.3.2.7	U		5.4.7	Pass
Transmitter unwanted emissions in the Out-of-Band domain	4.3.1.9 or 4.3.2.8	U		5.4.8	Pass
Transmitter unwanted emissions in the spurious domain	4.3.1.10 or 4.3.2.9	U		5.4.9	Pass
Receiver spurious emissions	4.3.1.11 or 4.3.2.9	U		5.4.10	Pass
Receiver Blocking	4.3.1.12 or 4.3.2.11	U		5.4.11	Pass
Geo-Location capability	4.3.1.13 or 4.3.2.12	C	If Implemented	X	N/A <sup>2</sup>

<sup>1</sup>: The e.i.r.p is less than 10 dBm

<sup>2</sup>: Not implemented

## 4 Test Results

### 4.1 RF Output Power (Radiated)

#### ETSI EN 300 328 subclause 4.3.2.2

Conducted RF measurements done with maximum antenna gain to get eirp. Standard FAKRA RF connector is provided for 2 types of detachable antenna.

1Mbps

DUT Frequency (MHz)	Duty cycle (%)	Max Burst RMS power (dBm)	Antenna gain (dBi)	Cable loss (dB)	Max Burst e.i.r.p (dBm)	Limit (dBm)
2402.000	66.7	-1.4	7	0	5.6	≤ 10
2440.000	66.7	-0.5	7	0	6.5	≤ 10
2480.000	66.8	-0.9	7	0	6.1	≤ 10

Nominal conditions - RF output power

#### Limits: Clause 4.3.2.2.3

Maximum Effective Radiated Power shall be less than or equal to 100 mW (20 dBm) e.i.r.p.

Test Equipment Used: 7,8,9,10

## 4.2 RF output power (Conducted)

### ETSI EN 300 328 subclause 4.3.2.2

1Mbit/s

DUT Frequency (MHz)	Duty cycle (%)	Max Burst RMS power (dBm)	Antenna gain (dBi)	Cable loss (dB)	Max e.i.r.p (dBm)	Limit (dBm)
2402.000	66.6	-0.2	7.0	0	6.8	≤ 10
2440.000	66.6	+0.2	7.0	0	7.2	≤ 10
2480.000	66.6	0.0	7.0	0	7.0	≤ 10

8Vdc, -40°C - RF output power

DUT Frequency (MHz)	Duty cycle (%)	Max Burst RMS power (dBm)	Antenna gain (dBi)	Cable loss (dB)	Max e.i.r.p (dBm)	Limit (dBm)
2402.000	66.7	1.8	7.0	0	8.8	≤ 10
2440.000	66.6	1.2	7.0	0	8.2	≤ 10
2480.000	66.7	0.3	7.0	0	7.3	≤ 10

32Vdc, -40°C - RF output power

DUT Frequency (MHz)	Duty cycle (%)	Max Burst RMS power (dBm)	Antenna gain (dBi)	Cable loss (dB)	Max e.i.r.p (dBm)	Limit (dBm)
2402.000	66.7	-2.6	7.0	0	4.4	≤ 10
2440.000	66.7	-1.8	7.0	0	5.2	≤ 10
2480.000	66.8	-2.1	7.0	0	4.9	≤ 10

8Vdc, +85°C - RF output power

DUT Frequency (MHz)	Duty cycle (%)	Max Burst RMS power (dBm)	Antenna gain (dBi)	Cable loss (dB)	Max e.i.r.p (dBm)	Limit (dBm)
2402.000	66.7	-2.9	7.0	0	4.1	≤ 10
2440.000	66.8	-0.6	7.0	0	6.4	≤ 10
2480.000	66.8	-1.3	7.0	0	5.7	≤ 10

32Vdc, +85°C - RF output power

### Limits: Clause 4.3.2.2

Maximum Equivalent Isotropic Radiated Power shall be less than or equal to 100 mW (20 dBm)

Test Equipment Used: 1,2, 3, 6,15,16,17

## 4.3 Power Spectral Density

ETSI EN 300 328 subclause 4.3.2.3

This requirement does not apply for equipment with maximum declared RF output power level less than 10 dBm e.i.r.p.

### Limits: Clause 4.3.2.3.3

The maximum power spectral density is limited to 10 dBm per MHz

## 4.4 Duty Cycle, TX-Sequence, TX-gap

ETSI EN 300 328 subclause 4.3.2.4

This requirement is not applicable for using FHSS and using DSSS with RF output power less than 10 dBm e.i.r.p. But applicable to non adaptive equipment or to adaptive equipment when operating in a non-adaptive mode.

### Limits: Clause 4.3.2.4.3

The Duty cycle shall be equal to or less than the maximum value declared by the supplier.  
The TX- sequence time shall be equal to or less than 10ms. The minimum Tx-gap time following a Tx-sequence shall be equal to the duration of that proceeding Tx-sequence with minimum of 3.5ms.

## 4.5 Medium Utilisation (MU) factor

ETSI EN 300 328 subclause 4.3.2.5

This requirement is not applicable for Adaptive Equipments, using FHSS and RF output power less than 10 dBm e.i.r.p.

### Limits: Clause 4.3.2.5.3

For non-adaptive equipment using wide band modulations other than FHSS, the maximum Medium Utilisation factor shall be 10 %.

## 4.6 Occupied Channel Bandwidth

ETSI EN 300 328 subclause 4.3.2.7

### 1Mbit/s - 99 % Bandwidth

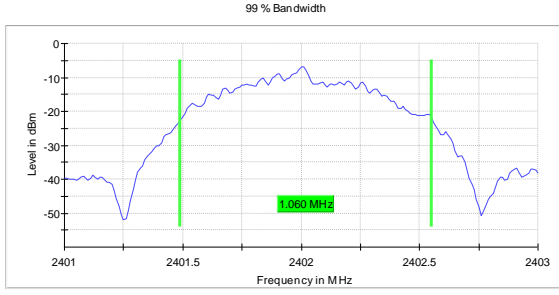
DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000	1.060	---	---	2401.49	2402.55
2440.000	1.060	---	---	2439.49	2440.55
2480.000	1.060	---	---	2479.49	2480.55

### Limits: Clause 4.3.2.7.3

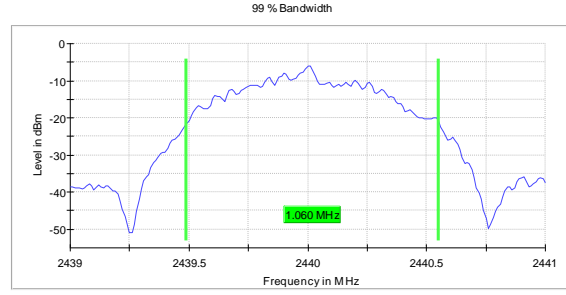
The Occupied Channel Bandwidth shall fall completely within the 2400 – 2483.5 MHz band.  
 In addition, for non-adaptive systems using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz

**Test Equipment Used:** 1,2,3,6,15,16,17

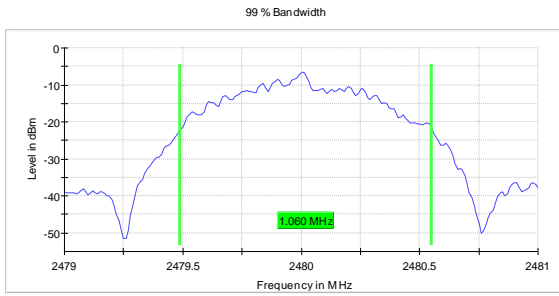
1Mbit/s:



**Low Frequency**

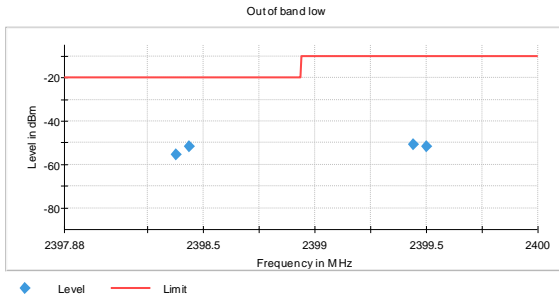


**Middle Frequency**

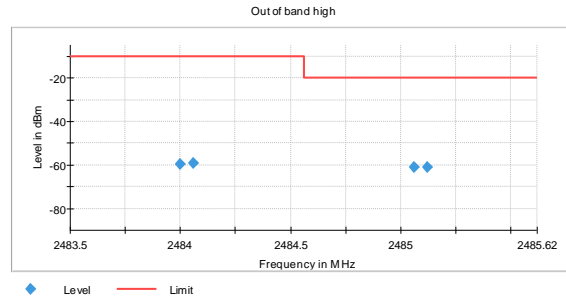


**High Frequency**

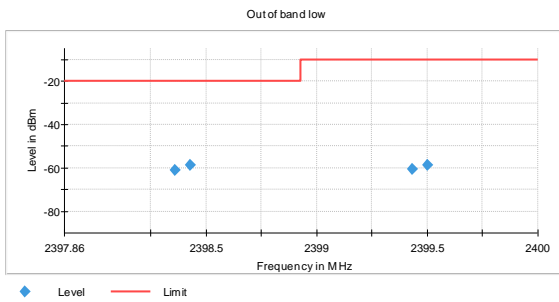




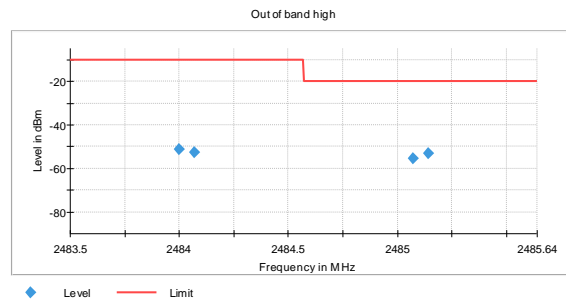
**Low Frequency (1Mbit/s)**



**Low Frequency (1Mbit/s)**



**High Frequency (1Mbit/s)**



**High Frequency (1Mbit/s)**

#### 4.8 Transmitter spurious emissions – Radiated and conducted (Operating)

ETSI EN 300 328 subclause 4.3.2.9

Frequency (MHz)	Detector	Polarization	Spurious Emission Level (dBm)
120.05	rms	HP	-57.11
30 – 1000 ( all others)	PK	VP/HP	< -54
1000 – 12750 (all others)	PK	VP/HP	< -36

Measured with 50 ohm termination at antenna port 10, according to the cl. 5.4.9.1 a) in EN300 328 v2.2.2.

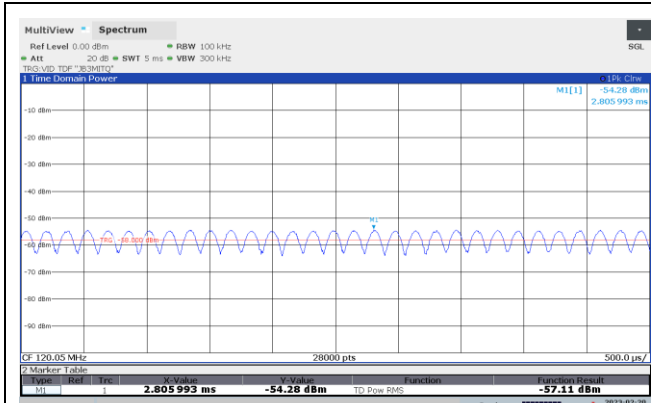
Below 1 GHz measured with base antenna.

Also measured conducted.

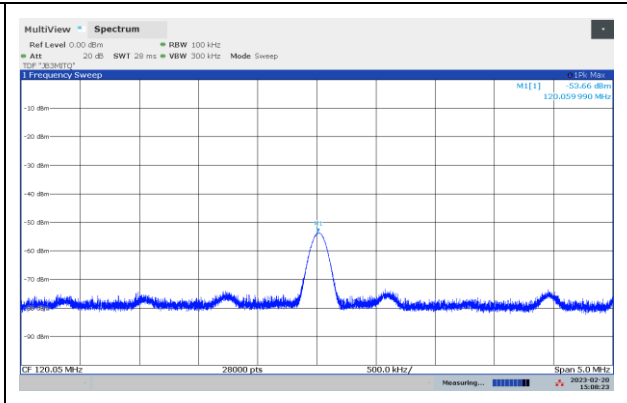
#### Limits: Clause 4.3.2.9.3

Frequency Range	Maximum power e.r.p. ( $\leq$ 1 GHz) e.i.r.p (> 1 GHz)	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87.5 MHz	-36 dBm	100 kHz
87.5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 694 MHz	-54 dBm	100 kHz
694 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12.75 GHz	-30 dBm	1 MHz

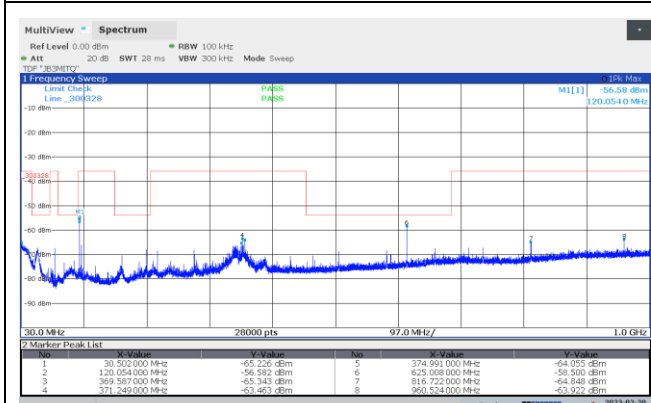
Test Equipment Used: 7,8,9,10,13,14



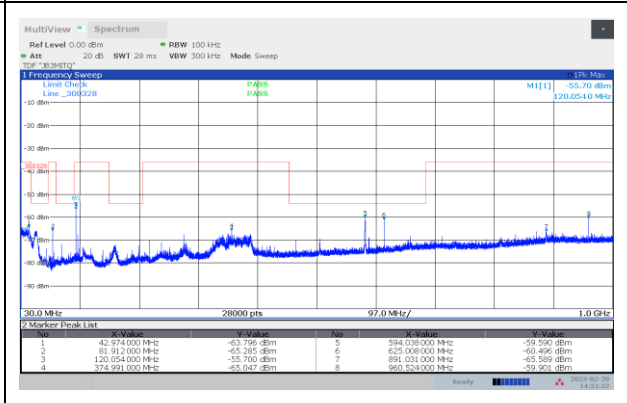
120.05MHz,HP, rms



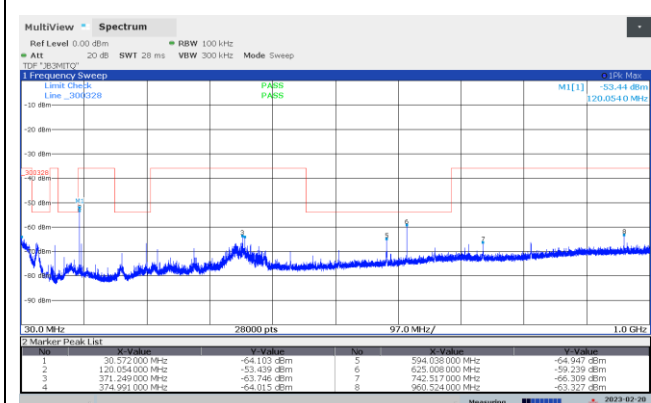
120.05MHz,HP, PK



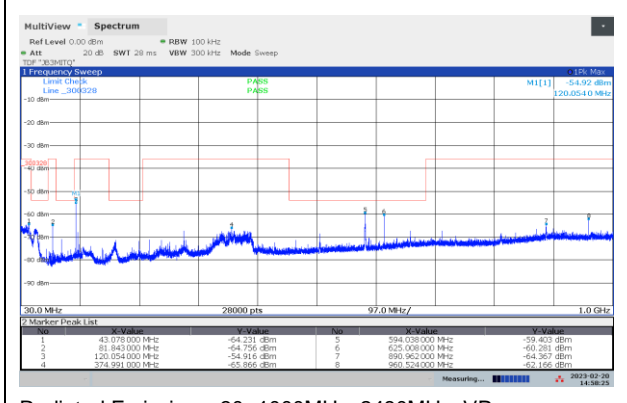
Radiated Emissions, 30 -1000MHz, 2402MHz, HP



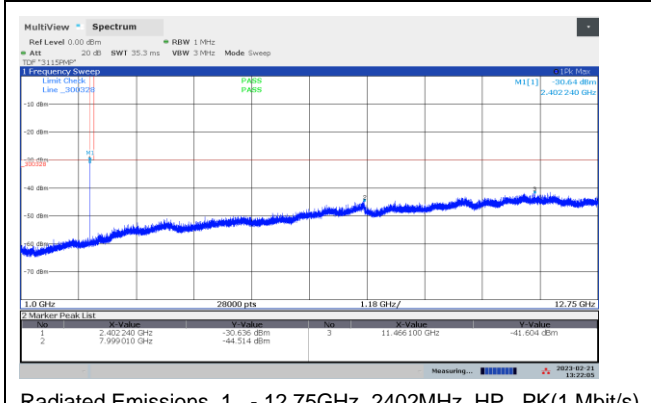
Radiated Emissions, 30 -1000MHz, 2402MHz, VP



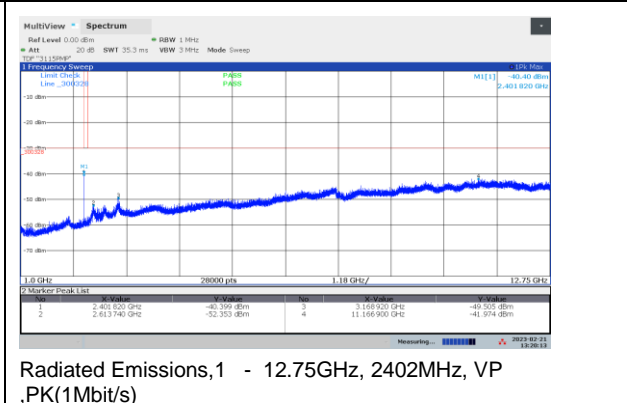
Radiated Emissions, 30 -1000MHz, 2480MHz, HP



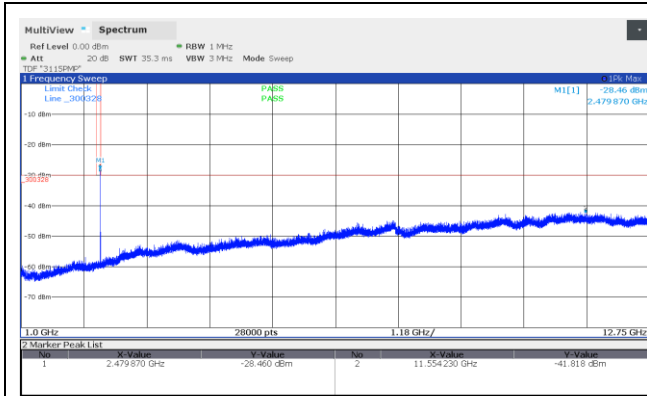
Radiated Emissions, 30 -1000MHz, 2480MHz, VP



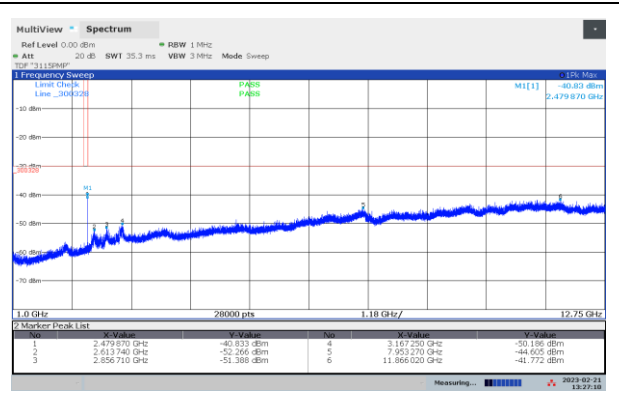
Radiated Emissions, 1 - 12.75GHz, 2402MHz, HP , PK(1Mbit/s)



Radiated Emissions, 1 - 12.75GHz, 2402MHz, VP ,PK(1Mbit/s)

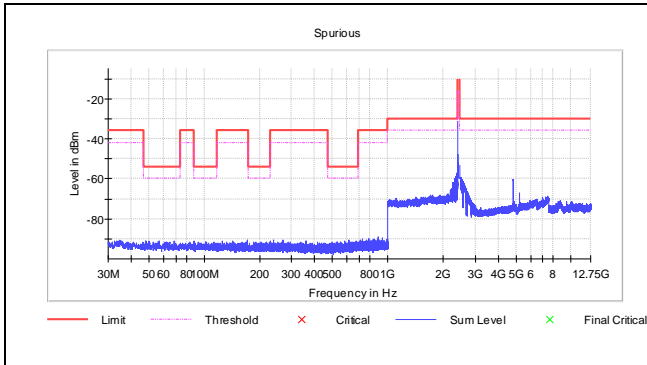


Radiated Emissions, 1 - 12.75GHz, 2480MHz, HP,PK (1Mbit/s)

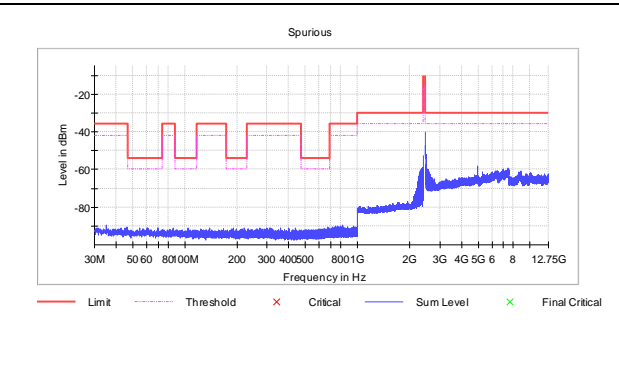


Radiated Emissions, 1 - 12.75GHz, 2480MHz, VP,PK (1Mbit/s)

Conducted TX emissions.



Conducted TX spurious emissions, ch2402MHz, (1Mbit/s)



Conducted TX spurious emissions, ch2480MHz, (1Mbit/s)

## 4.9 Receiver spurious emissions – Radiated and conducted

ETSI EN 300 328 subclause 4.3.2.10

Frequency (MHz)	Detector	Polarization	Spurious Emission Level (dBm)
120	rms	HP	-57.11
30 – 1000 (all others)	PK	VP/HP	< -63
1000 – 12750 (all others)	PK	VP/HP	< -53

Measured with 50 ohm termination at antenna port 10, according to the cl. 5.4.9.1 a) in EN300 328 v2.2.2.

Below 1 GHz measured with base antenna.

Also measured conducted.

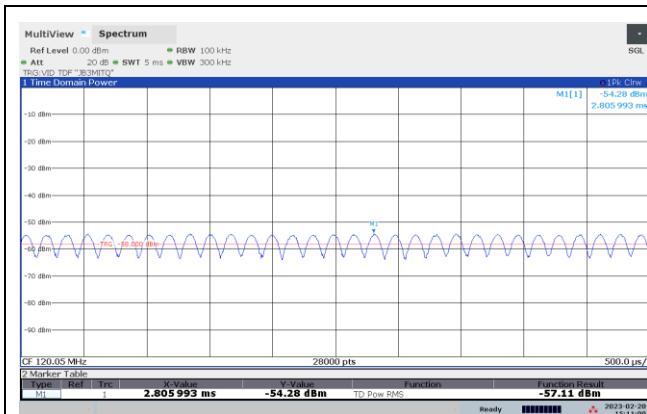
The 847 MHz emission is not from the EUT.

RBW of 100 kHz is used above 1 GHz to reduce the noise level. None detected above 1 GHz.

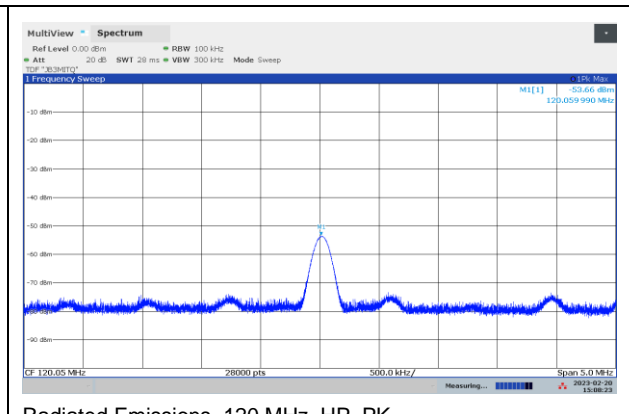
### Limits: Clause 4.3.2.10.3

Frequency Range	Limit
30 MHz to 1 GHz	-57 dBm
above 1 GHz to 12,75 GHz	-47 dBm

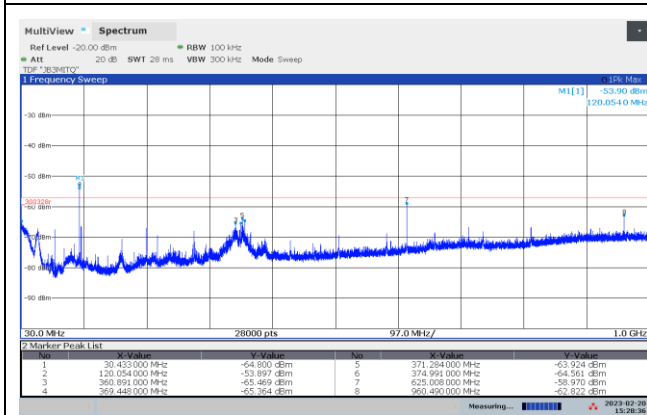
**Test Equipment Used:** 7,9,10,14



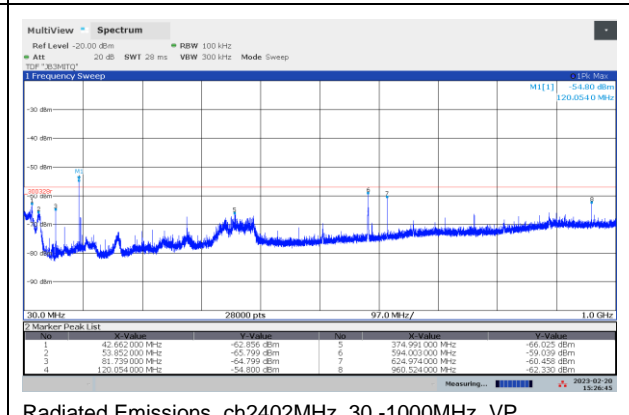
Radiated Emissions, 120 MHz, HP, rms



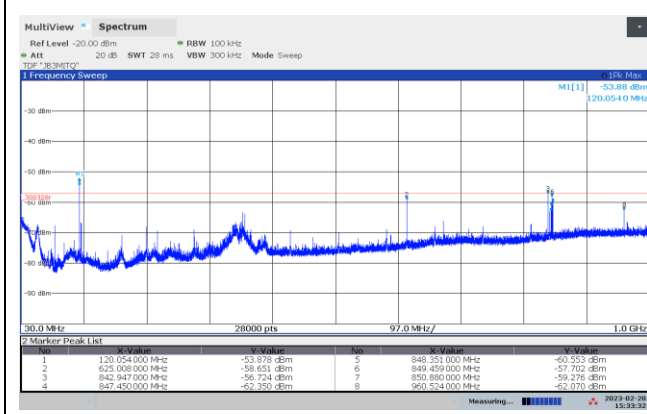
Radiated Emissions, 120 MHz, HP, PK



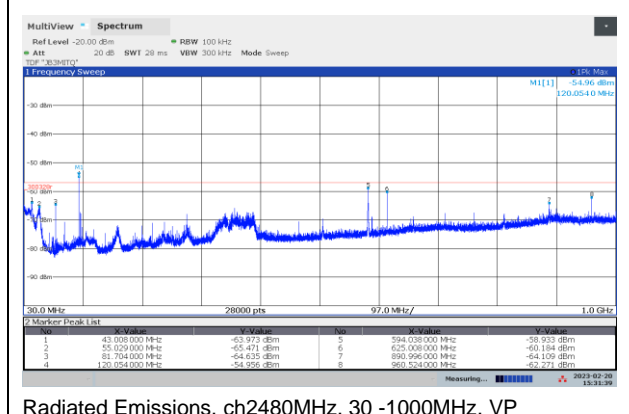
Radiated Emissions, ch2402MHz,30 -1000MHz, HP



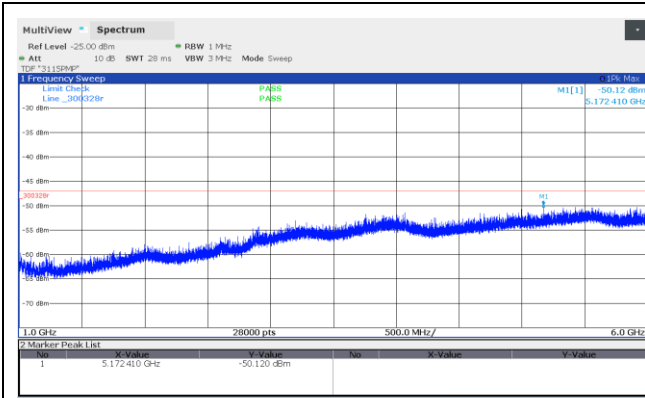
Radiated Emissions, ch2402MHz, 30 -1000MHz, VP



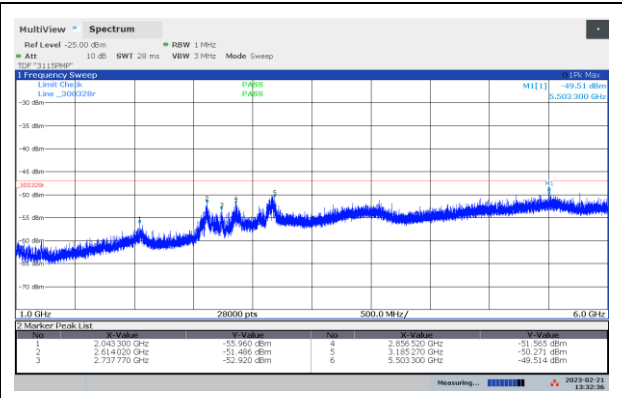
Radiated Emissions, ch2480MHz,30 -1000MHz, HP



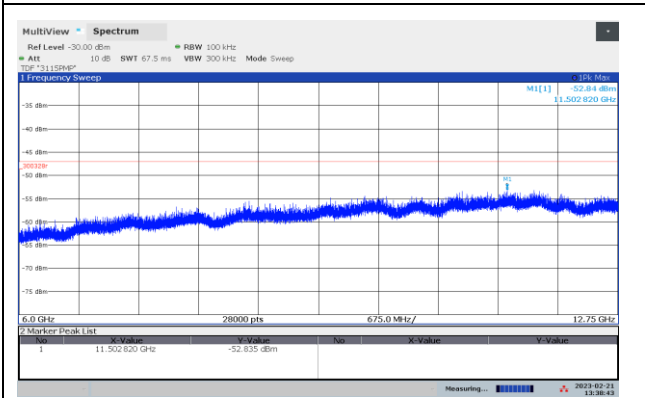
Radiated Emissions, ch2480MHz, 30 -1000MHz, VP



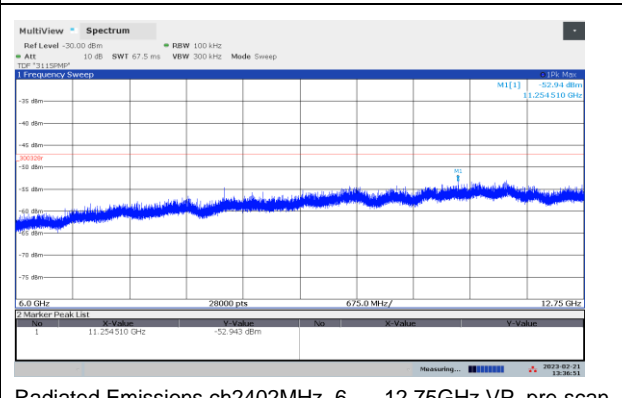
Radiated Emissions, ch2402MHz, 1 - 6GHz, HP , pre-scan



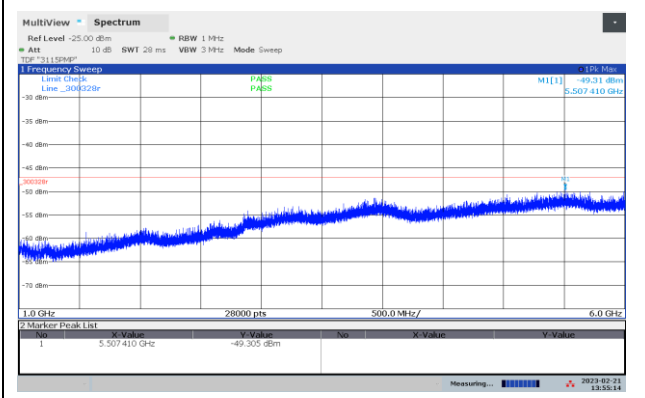
Radiated Emissions, ch2402MHz, 1 - 6GHz,VP, pre-scan



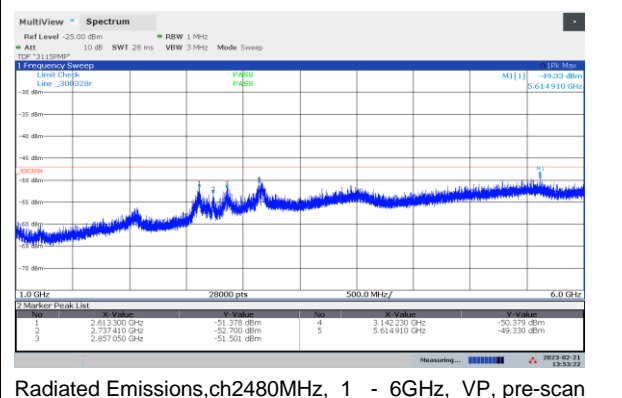
Radiated Emissions, ch2402MHz, 6 - 12.75GHz, HP, pre-scan



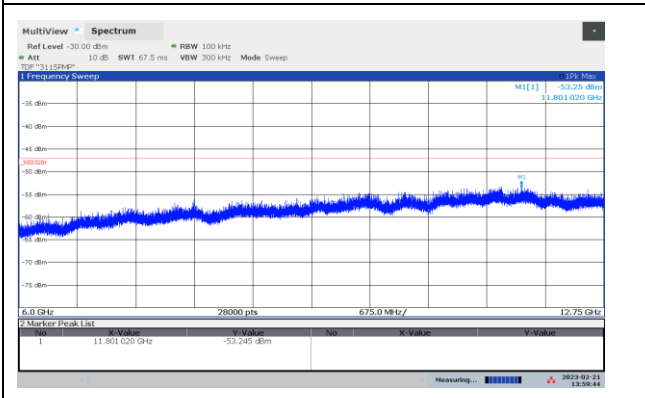
Radiated Emissions, ch2402MHz, 6 - 12.75GHz,VP, pre-scan



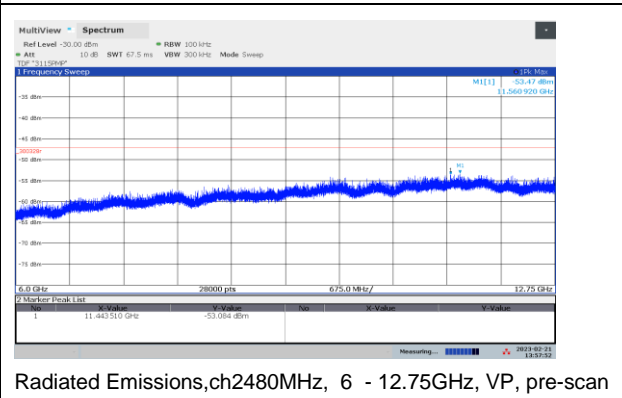
Radiated Emissions, ch2480MHz, 1 - 6GHz, HP, pre-scan



Radiated Emissions, ch2480MHz, 1 - 6GHz, VP, pre-scan

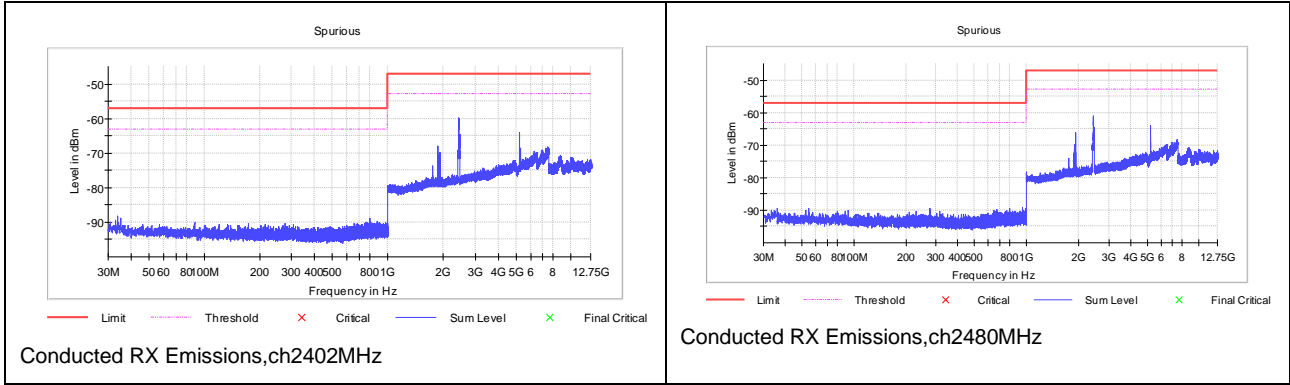


Radiated Emissions, ch2480MHz, 6 - 12.75GHz, HP, pre-scan



Radiated Emissions, ch2480MHz, 6 - 12.75GHz, VP, pre-scan

Conducted RX spurious emissions Measurements



## 4.10 Receiver Blocking

ETSI EN 300 328 subclause 4.3.2.11

Conducted measurements: Modulation type GFSK, data rate : 1Mbit/s

Wanted signal (dBm) §	Channel (Mhz)	Blocking signal frequency [MHz]	Blocking signal power* [dBm]	Observed PER (%)
-75.1	2402	2 300	-32.19	< 4
-75.1		2 380	-32.19	< 4
-75.1	2480	2 504	-32.19	< 4
-75.1		2 584	-32.19	< 4

100 packets were sent for each test. The PER was monitored on laptop with manufacturer supplied SW. Transmission signal was sent from a vector generator.

Ch2402MHz and Ch2480 MHz

OCBW = 1.06 MHz

§:  $-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}) + 10 \text{ dB} = -62.75 \text{ dBm}$

\*Blocking signal power with antenna gain of 7 dBi is used for ch2402MHz and for ch2480MHz.

### Limits: Clause 4.3.2.11.4.3

#### Receiver Category 2

Wanted signal mean power from companion device	Blocking signal frequency [MHz]	Blocking signal power [dBm]	Type of blocking signal	Performance criteria
(-139 dBm + 10 x log <sub>10</sub> (OCBW) + 10 dB) or (-74 dBm + 10 dB), whichever is less	2380	-34	CW	≤ 10%
	2504			
	2300			
	2584			
OCBW is in Hz Note 3: Level above is assuming antenna gain of 0 dBi, the above level have to be corrected for antenna gain in case of conducted measurements				

Test Equipment Used: 5,7,18,19,20,21,22

#### 4.11 Geo-Location capability

##### ETSI EN 300 328 subclause 4.3.2.12

Description	Yes/NO
Geo-location capability implemented	NO
Accessible to user	NO

#### Requirements: Clause 4.3.2.12.3

The geographical location determined by the equipment as defined in cl. 4.3.2.12.2 shall not be accessible to the user.

## 5 Measurement Uncertainty

Measurement Uncertainty Values $U_{95}$		
Test Item		Uncertainty
Conducted Output Power		< 1 dB
Power Spectral Density		< 1 dB
Out of Band Emissions, Conducted	< 1 GHz	< 1 dB
	> 1 GHz	< 1 dB
Spurious Emissions, Radiated	30 – 80MHz	±4.23 dB
	80 – 180 MHz	±2.80 dB
	180 – 1000 MHz	±2.54 dB
	1 – 18 GHz	±2.23 dB
Occupied Bandwidth		< 2%
Timing/Duty cycle		< 1%

Conducted measurements are given by the manufacturer (R&S TS8997)

## 6 Test Setups



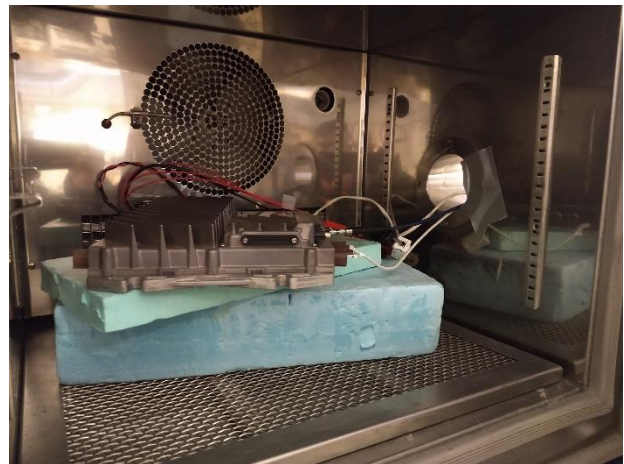
Radiated measurements with 50ohm termination



Radiated measurements with antenna type Interior WLAN






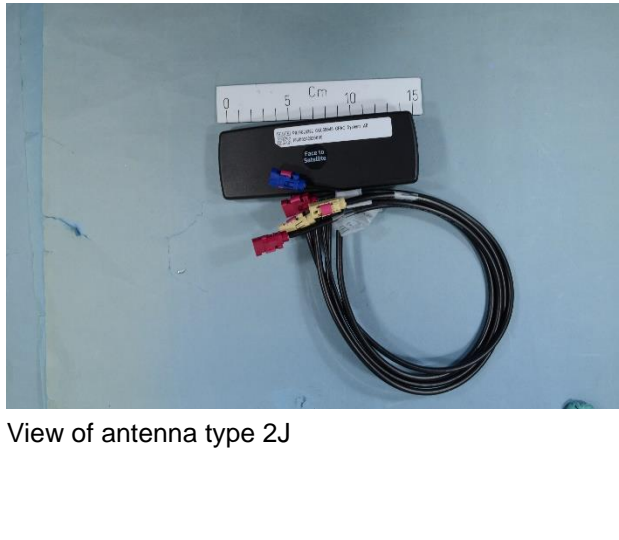


Radiated measurements with antenna type 2J



Climatic tests

## 7 PHOTOGRAPHS OF THE EUT

External photos	
	
<p>View from above</p>	<p>View from rear</p>
	
<p>View of antenna ports</p>	<p>View of power port</p>
	
<p>View of antenna type Interior WLAN</p>	<p>View of antenna type 2J</p>



Power connector



Audio connector



FAKRA to SMA RF connector for conducted test



Display- rear side



Display front side



Display cable

## 8 Test Equipment Used

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the testhouse.

No	Ref. No	Description	Manufacturer	Type	Cal. date	Cal. due
1.	LR 1808	Spectrum Analyzer	Rohde & Schwarz	FSVA3044	08.2022	08.2023
2.	LR 1806	Power meter	Rohde & Schwarz	OSP220	08.2022	08.2023
3.	LR 1793	Power Meter	Rohde & Schwarz	OSP-B157W8Plus	08.2022	08.2023
4.	LR 1807	Vector Signal generator	Rohde & Schwarz	SMW200A	08.2022	08.2023
5.	LR 1656	Signal generator	Rohde & Schwarz	SMB100A	01.2023	01.2024
6.	-	EMC 32, TS8997 (Soft ware)	Rohde & Schwarz	11.40.00	N/A	
7.	LR 1640	Spectrum Analyzer	Rohde & Schwarz	FSW26	01.2023	01.2024
8.	LR 1673	Attenuator	NARDA	4768-10	Cal b4 use	
9.	LR 1747	Pre-Amplifier	Miteg	JS4	08.2022	08.2023
10.	LR 1330	Double Ridged Horn Antenna	EMCO	3115	11.2022	11.2026
11.	LR 1614	Highpass Filter	Trilithic	6HC3000/18000	Cal b4 use	
12.	LR 1615	Highpass Filter	Trilithic	6HC2500/18000	Cal b4 use	
13.	LR 1785	Notch filter	Microwave circuits	NO324415	Cal b4 use	
14.	N-4525	Biconical-Log hybrid	Sunol Sciences	JB3	07.2022	07.2024
15.	LR 1083	Climatic Chamber	ACS	TY 80	03.2022	03.2023
16.	LR 1713	Power Supply	TTi	CPX400S	Cal b4 use	
17.	LT 5218	Multimeter, Digital	Fluke	46	03.2022	03.2023
18.	LR 1528	Hybrid	NARDA	4356B	Cal b4 use	
19.	LR1526	Directional coupler	Agilent	87300C	Cal b4 use	
20.	LR1627	Cable			Cal b4 use	
21.	LR1634	Cable			Cal b4 use	
22.	LR 1743	Vector Signal generator	Rohde & Schwarz	SMW200A	01.2022	01.2024