



TEST REPORT N°: KSK-ESH-P24071264B-2

EN 300 328 RF Test Report

Applicant:	K-tronics (Suzhou) Technology Co., Ltd.
Address:	No.1088, Dajing Road, Economic and Technological Development Zone, Wujiang District, Suzhou, Jiangsu Province, 215200, P.R. China
Manufacturer:	i3-TECHNOLOGIES NV
Address:	Nijverheidslaan 60, 8540 Deerlijk, BELGIUM
This document includes : 58 pages	

Product Name:	Interactive Flat Panel	
Model Number:	i3TOUCH V-ONE 86, i3TOUCH V-ONE 86xxxxxxx (x=0-9, A-Z, a-z, +, - (hyphen), /, \ or blank)	
Brand:	i3TOUCH	
Rated Voltage/Power	100-240V~, 50/60Hz, 4.8A	
Received Date:	Jul.15, 2024	
Test Date:	Jul.15 to Sep.03, 2024	
Applicable Standards:	EN 300 328 V2.2.2(2019-07)	
Clause Examined :	All Clauses Relevant	

Test Location: Building C, No. 829, Xin Zhuan Road, Shanghai, CHINA

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Test done by:

Approved by:

Yuan Zhang

Sean Yu

Name: Yuan ZHANG
Title: Project Engineer
Date: Sep.06, 2024

Name: Sean YU
Title: RF Supervisor
Date: Sep.06, 2024

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Release Control Record

Issue No.	Description	Date Issued
KSK-ESH-P24071264B-2	Original release	Sep.06, 2024

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1 Summary of Test Results

The EUT has been tested according to the following specifications:

EN 300 328 V2.2.2		
Clause	Test Parameter	Results
4.3.2.2	RF Output Power	Pass
4.3.2.3	Power Spectral Density	Pass
4.3.2.6	Adaptivity (Adaptive Equipment using modulation other than FHSS)	Not Applicable (Note 1)
4.3.2.7	Occupied Channel Bandwidth	Pass
4.3.2.8	Transmitter Unwanted Emissions in the out-of-band Domain	Pass
4.3.2.9	Transmitter Unwanted Emissions in the Spurious Domain	Pass
4.3.2.10	Receiver Spurious Emissions	Pass
4.3.2.11	Receiver Blocking	Pass
4.3.2.12	Geo-location capability	Not Applicable (Note 2)

Note1: These requirements do not apply for equipment with a maximum declared RF Output power of less than 10 dBm EIRP or for equipment when operating in a mode where the RF Output power is less than 10 dBm EIRP.

Note2: This product has no Geo-location capability, so the test is not applicable.

Special Comments: None.

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1.1 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Double Ridged Broadband Horn (30MHz-1.5GHz)	Schwarzbeck	VULB9168	E1A1012	Aug.17,23	Aug.16,25
Horn Antenna (1GHz -18GHz)	Schwarzbeck	BBHA9120D	E1A1041	Apr.11,23	Apr.10,25
Pre-Amplifier(9kHz-1GHz)	Tonscend	TAP9K3G40	E1A2012	Apr.19,23	Apr.18,25
Pre-Amplifier(1GHz-18GHz)	Tonscend	TAP01018050	E1A2013	Mar.01,24	Feb.28,25
Pre-Amplifier(18GHz-40GHz)	Tonscend	TAP18040048	E1A2014	May.24,24	May.23,25
Pre-Amplifier(9kHz-1GHz)	SONOMA	11909A(310)	E1A2007	Feb.18,24	Feb.17,25
Pre-Amplifier(1GHz-26.5GHz)	Agilent	8449B	E1A2002	Feb.18,24	Feb.17,25
Signal Generator	Keysight	N5171B	E1S9016	Feb.19,24	Feb.18,25
Signal Generator	Keysight	N5182B	E1S9017	Feb.19,24	Feb.18,25
Wireless Connectivity Tester	R&S	CMW270	E1S9021	Oct.28,22	Oct.26,24
Spectrum Analyzer	R&S	FSQ	E1S1005	Aug.12,24	Aug.11,25
Spectrum Analyzer	Keysight	N9030B	E1S1003	Sep.14,23	Sep.13,24
Spectrum Analyzer	Keysight	N9020A	E1S1004	Mar.01,24	Feb.28,25
RF Control Unit	Toscend	JS0806-2	E1C5003	NCR	NCR
DC Power supply	Chroma	62024p-80-60	S1S1009	Mar.21,24	Mar.20,25
Humidity&Temp Programmable Tester	ESPEC	SE TH-Z-042U	C1TH002	Jun.06,24	Jun.05,25
Test Software	Toscend	JS1120-3	N/A	N/A	N/A
Test Software	Toscend	JS36-RSE	N/A	N/A	N/A



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1.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Parameter	Uncertainty
Occupied Channel Bandwidth	$\pm 1.132 \times 10^{-4} \%$
RF output power, conducted	$\pm 1.017 \text{ dB}$
Power Spectral Density, conducted	$\pm 1.017 \text{ dB}$
Unwanted Emissions, conducted	$\pm 2.855 \text{ dB}$
All emissions, radiated	$\pm 2.855 \text{ dB}$
Temperature	$\pm 0.7^\circ \text{C}$
Supply voltages	$\pm 0.04 \%$
Time	$\pm 5 \%$

1.3 Maximum Measurement Uncertainty

For the test methods, according to EN 300 328 standard, the measurement uncertainty figures shall be calculated in accordance with ETR 100 028-1 [4] and shall correspond to an expansion factor (coverage factor) $k = 1,96$ or $k = 2$ (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Maximum measurement uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	$\pm 5 \%$
RF output power, conducted	$\pm 1,5 \text{ dB}$
Power Spectral Density, conducted	$\pm 3 \text{ dB}$
Unwanted Emissions, conducted	$\pm 3 \text{ dB}$
All emissions, radiated	$\pm 6 \text{ dB}$
Temperature	$\pm 1^\circ \text{C}$
Supply voltages	$\pm 3 \%$
Time	$\pm 5 \%$

1.4 Modification Record

There were no modifications required for compliance.

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2 General Information

2.1 General Description of EUT

Product	Interactive Flat Panel
Brand	i3TOUCH
Model	i3TOUCH V-ONE 86, i3TOUCH V-ONE 86xxxxxxx (x=0-9, A-Z, a-z, +, - (hyphen), /, \ or blank)
Model difference	All models are identical to each other except for different model name.
Nominal Voltage	100-240V~, 50/60Hz, 4.8A
Temperature Operating Range	+0deg.c to +40deg.c
Modulation Type	GFSK
Modulation Technology	Bluetooth Low Energy
Operating Frequency	2402-2480MHz
Number of Channel	40
Adaptive/Non-Adaptive	☐ non-adaptive Equipment ☒ adaptive Equipment without the possibility to switch to a non-adaptive mode ☐ adaptive Equipment which can also operate in a non-adaptive mode
EIRP Power (Measured Max. Average)	8.65dBm
Antenna Type	External Antenna
Antenna Gain	2.80dBi
Data Cable Supplied	--

Note:

1. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.
2. The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.
3. The EUT contains two wireless modules.
The wireless module of model WCT1DR2201D supports BT/WIFI function.
The wireless module of model WC0NR2201 supports WIFI function.
The two wireless modules can work at the same time.



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2.2 Description of Test Modes

40 channels are provided for Bluetooth LE.

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



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2.2.1 Test Mode Applicability:

EUT Configure Mode	Applicable to								Description
	ROP	PSD	AD	OCB	EOB	SE< 1G	SE> 1G	RB	
-	--	--	--	--	--	√	√	--	-

Where **ROP**: RF Output Power **PSD**: Power Spectral Density
DC/TS/TG: Duty Cycle/ Tx-Sequence / Tx-gap **MU**: Medium Utilization
AD: Adaptivity (Channel Access Mechanism) **OCB**: Occupied Channel Bandwidth
EOB: Transmitter unwanted emissions in the out-of-band domain **SE<1G**: Unwanted Emissions in the Spurious Domain below 1 GHz
SE> 1G: Unwanted Emissions in the Spurious Domain above 1 GHz **RB**: Receiver Blocking

2.2.2 Test Condition:

Applicable to	Normal Environmental Conditions	Normal Input Power	Extreme Temperature conditions
ROP	25deg. C, 60%RH	AC 230V	√
PSD	25deg. C, 60%RH	AC 230V	-
AD	25deg. C, 60%RH	-	-
OCB	25deg. C, 60%RH	AC 230V	-
EOB	25deg. C, 60%RH	AC 230V	-
SE<1G	25deg. C, 60%RH	AC 230V	-
SE>1G	25deg. C, 60%RH	AC 230V	-
RB	25deg. C, 60%RH	AC 230V	-

Extreme Temperature conditions	
Tmin	0deg. C
Tmax	+40deg. C

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2.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND/Manufacturer	MODEL NO.
1	PC	ThinkPad	L470

2.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

EN 300 328 V2.2.2 (2019-07)

All relaxed test items have been performed and recorded as per the above standard.



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3 Test Procedure and Results

3.1 RF Output Power

3.1.1 Limits of RF Output Power

Condition	Frequency Band	Limit (e.i.r.p)
Under all test conditions	2400 ~ 2483.5 MHz	AV: 20dBm

3.1.2 Test Procedures

Refer to chapter 5.4.2.2 of EN 300 328 V2.2.2.

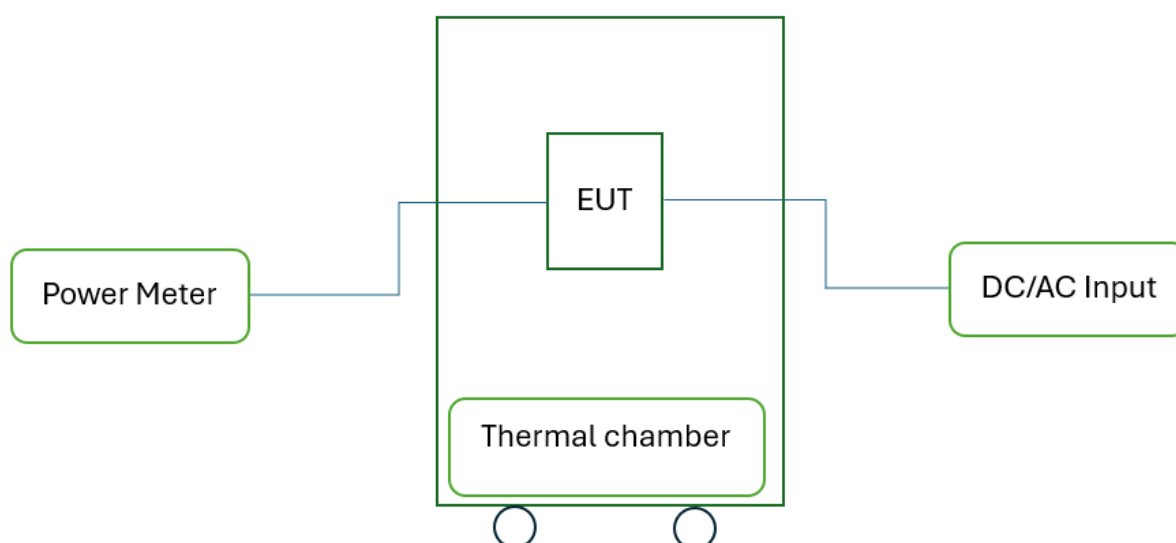
Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

3.1.3 Deviation from Test Standard

No deviation.

3.1.4 Test Setup

The measurements for RF output power was performed at both normal environmental conditions and at the extremes of the operating temperature. The measurement was performed at the lowest, the middle, and the highest channel.





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3.1.5 Test Results

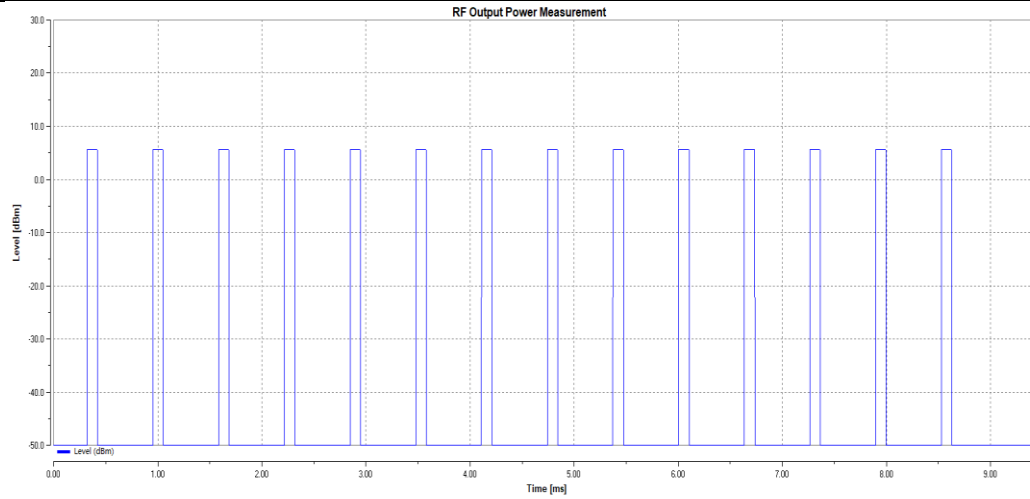
Test Condition	Test Mode	Antenna	Freq [MHz]	EIRP [dBm]	Limit [dBm]	Verdict
NTNV	BLE_1M	Ant1	2402	8.49	20	PASS
			2440	8.57	20	PASS
			2480	8.65	20	PASS
	BLE_2M	Ant1	2402	7.99	20	PASS
			2440	8.06	20	PASS
			2480	8.14	20	PASS
LTVN	BLE_1M	Ant1	2402	8.56	20	PASS
			2440	8.60	20	PASS
			2480	8.64	20	PASS
	BLE_2M	Ant1	2402	8.00	20	PASS
			2440	8.08	20	PASS
			2480	8.19	20	PASS
HTNV	BLE_1M	Ant1	2402	8.49	20	PASS
			2440	8.58	20	PASS
			2480	8.65	20	PASS
	BLE_2M	Ant1	2402	8.00	20	PASS
			2440	8.03	20	PASS
			2480	8.15	20	PASS



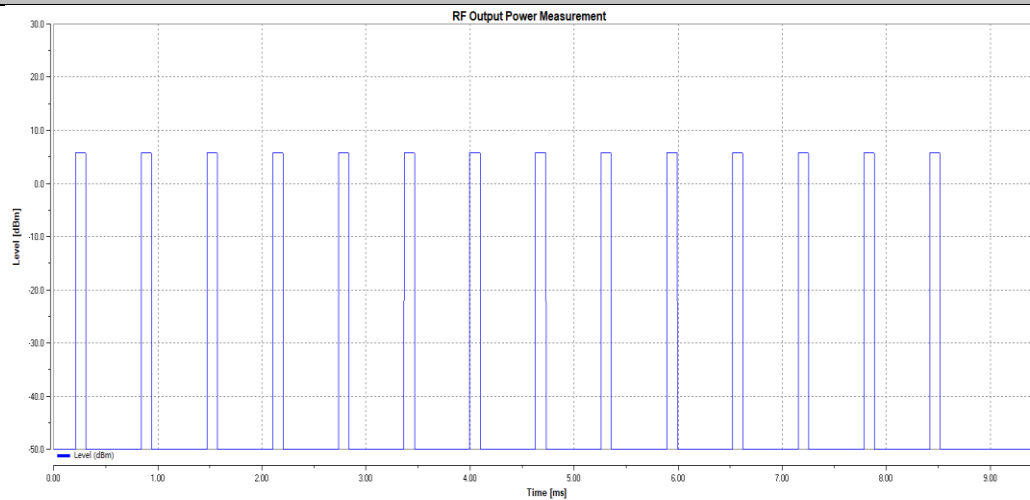
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3.1.6 Test Graphs

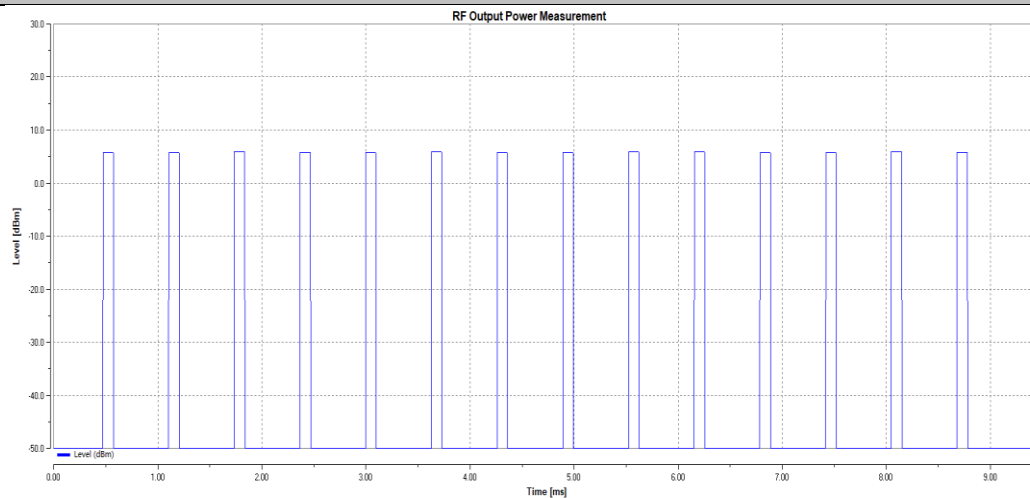
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NTNV_BLE_1M_Ant1_2440



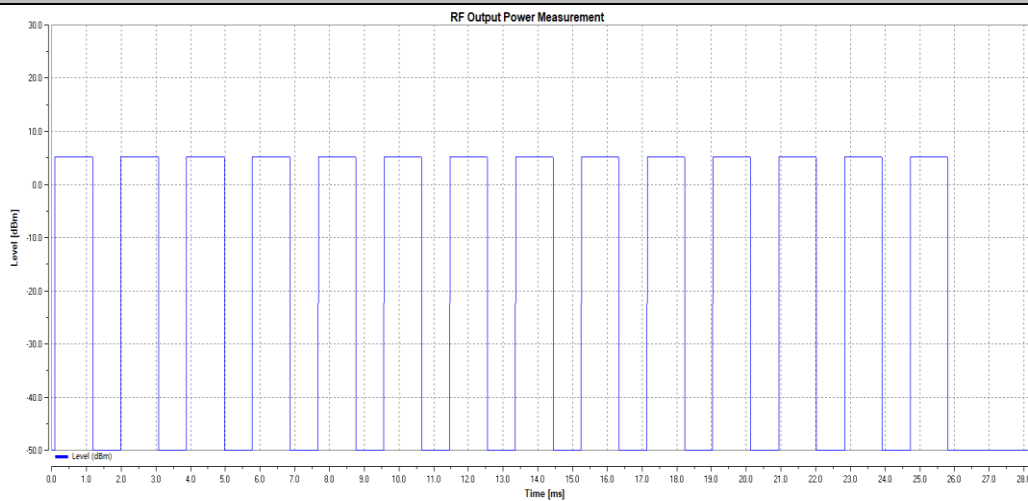
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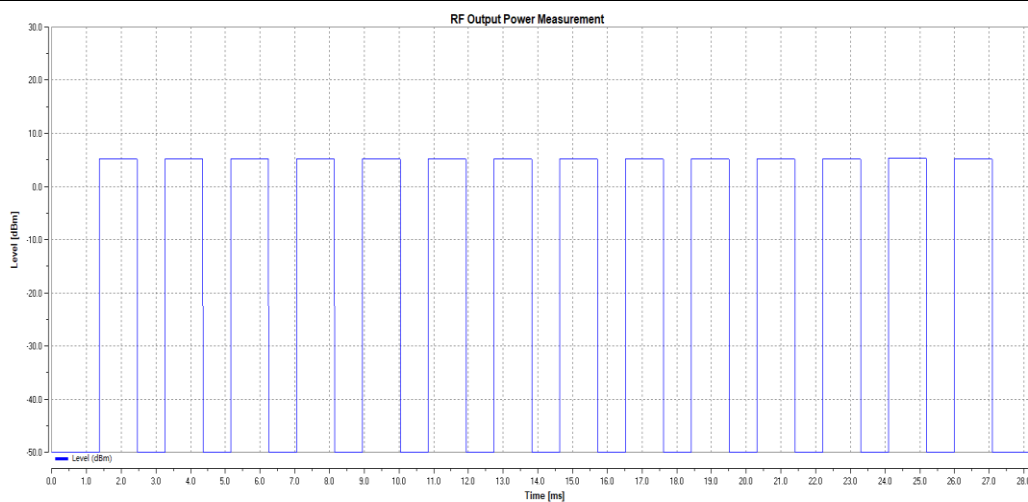


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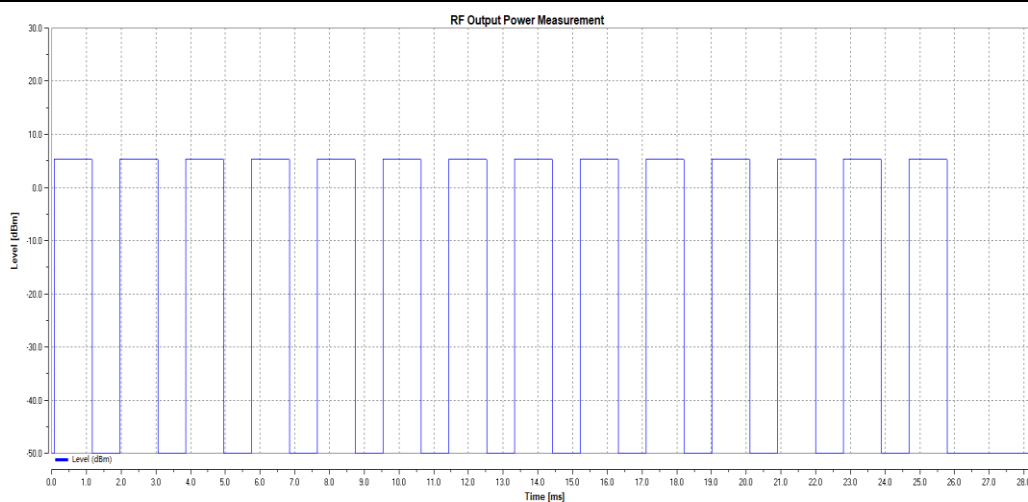
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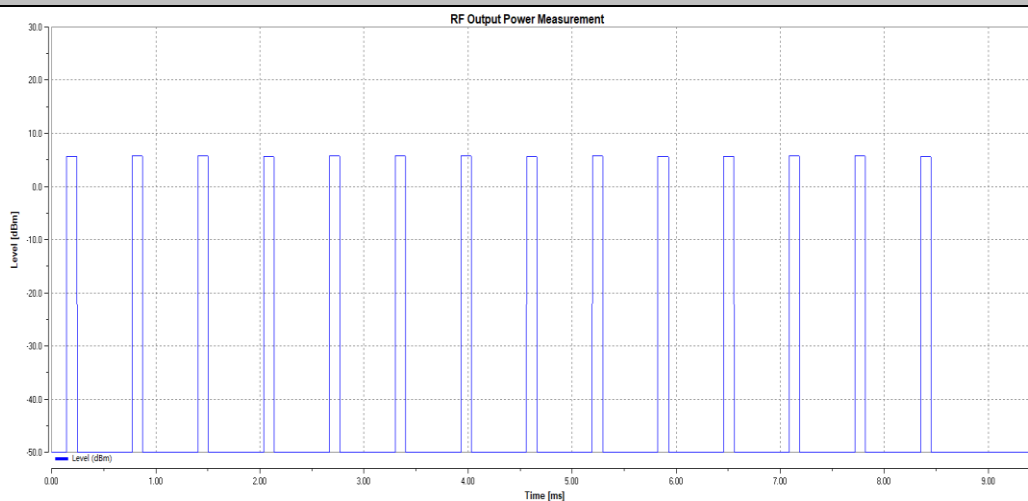
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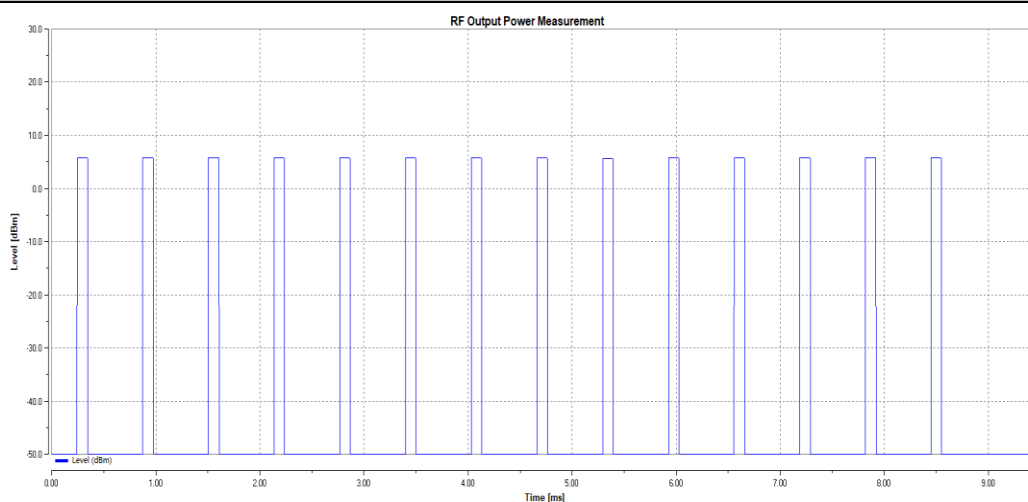


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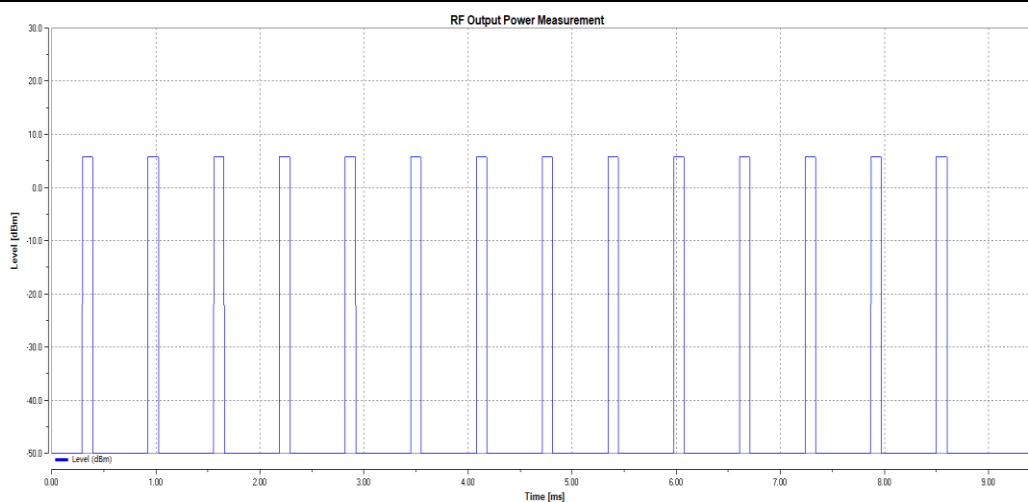
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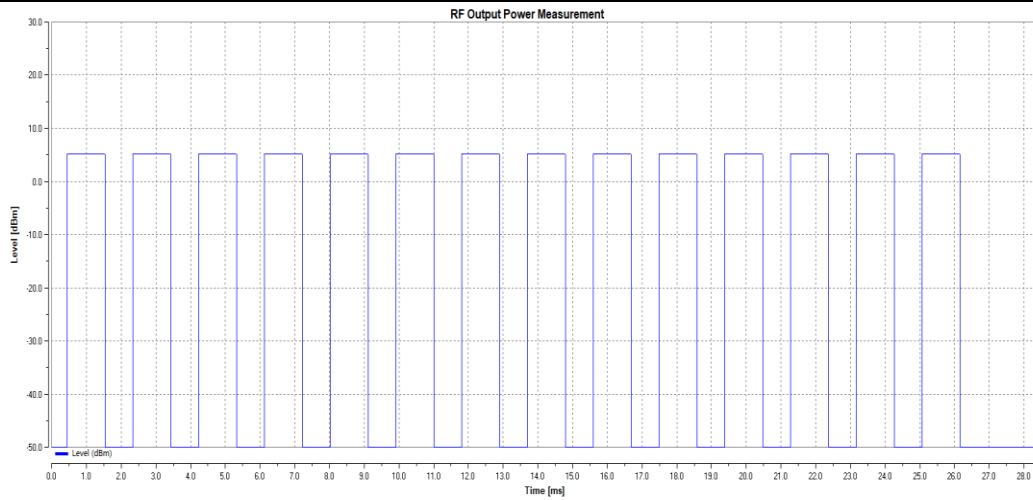
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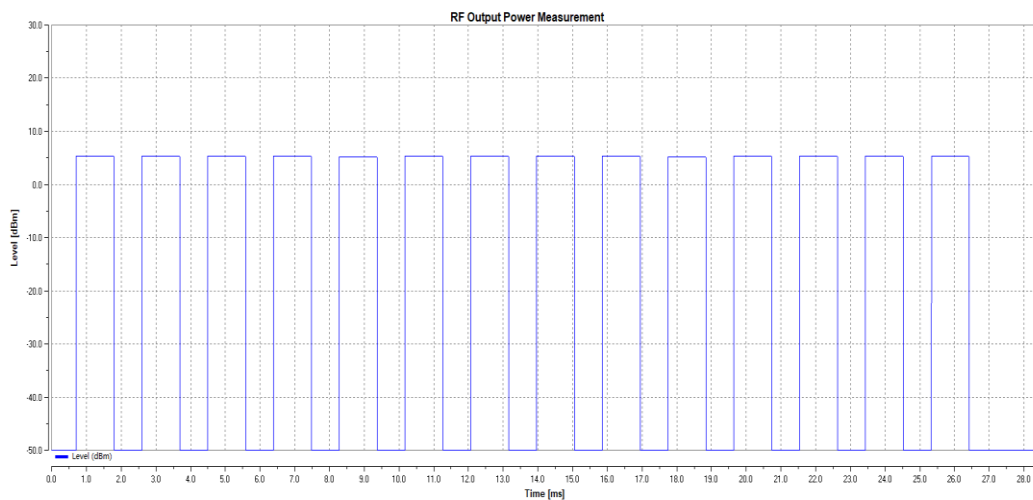


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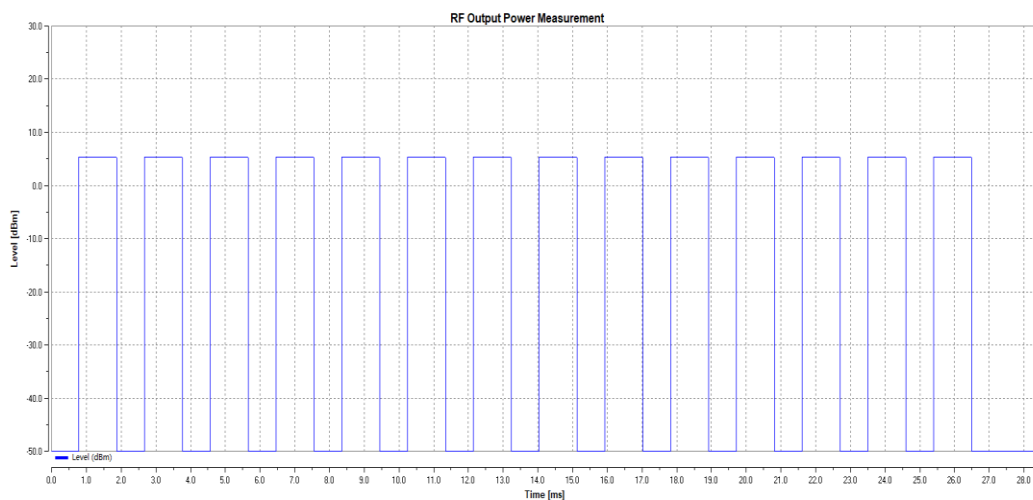
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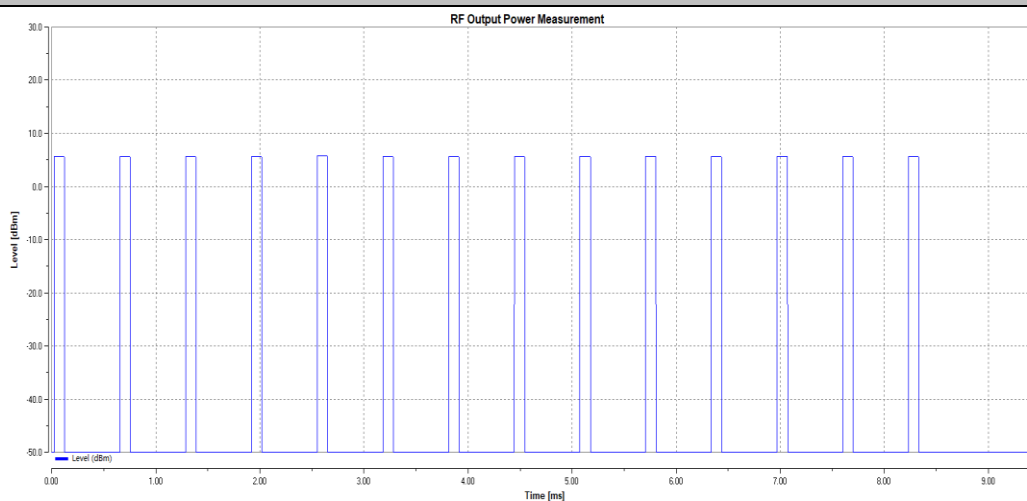
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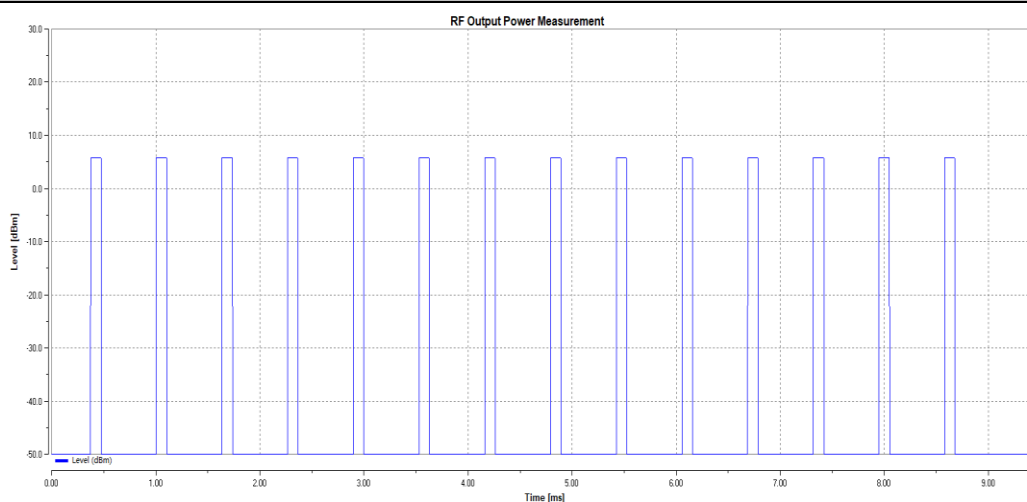


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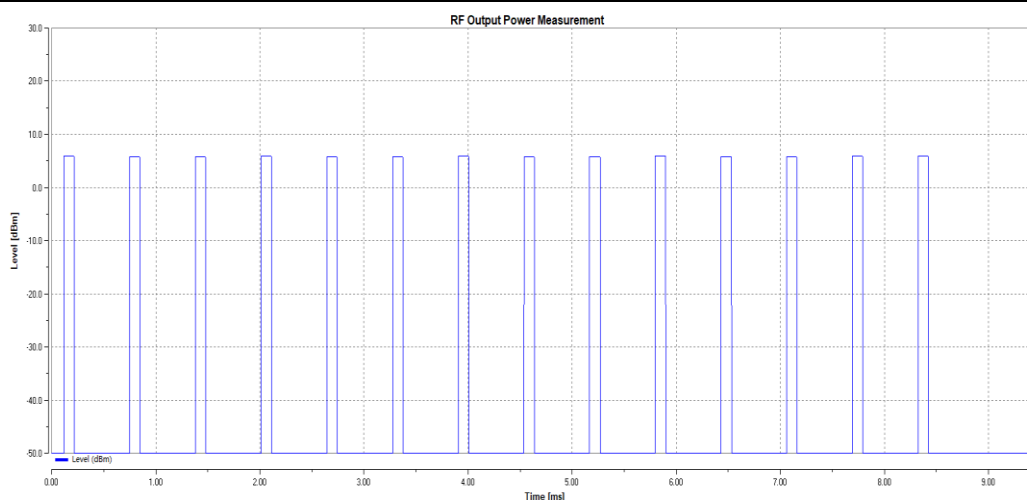
HTNV_BLE_1M_Ant1_2402



HTNV_BLE_1M_Ant1_2440



HTNV_BLE_1M_Ant1_2480



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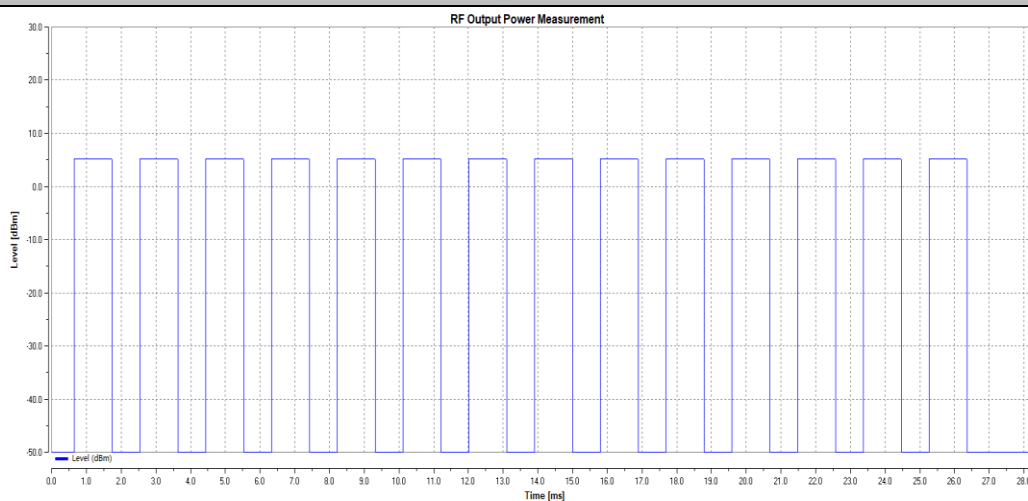
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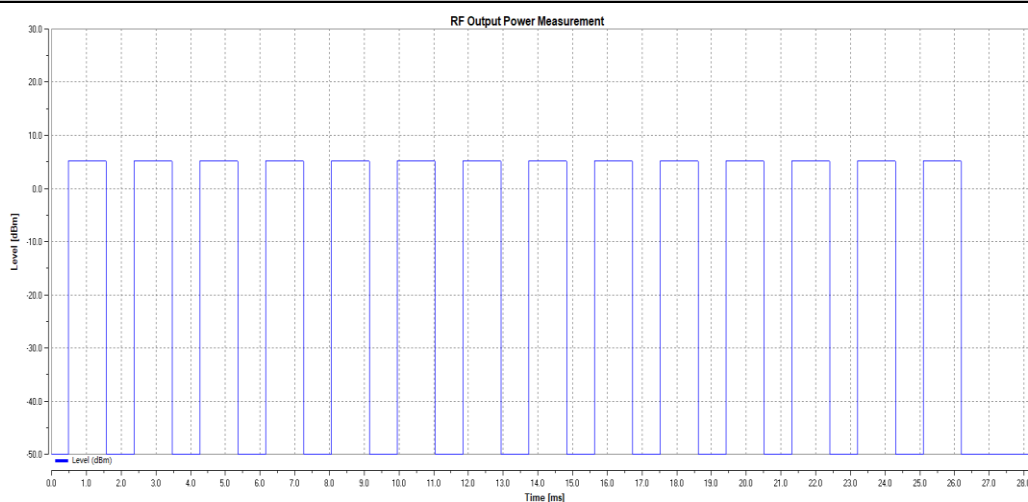


TEST REPORT N°: KSK-ESH-P24071264B-2

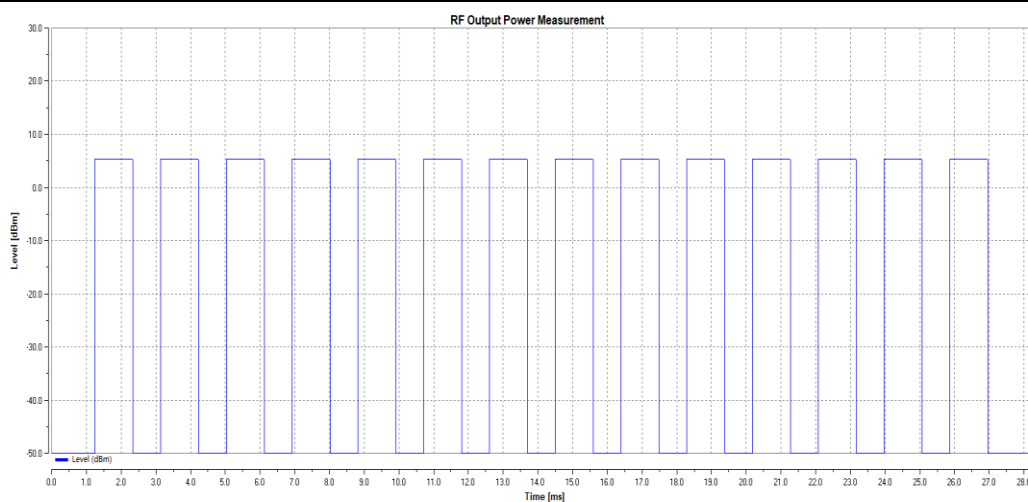
HTNV_BLE_2M_Ant1_2402



HTNV_BLE_2M_Ant1_2440



HTNV_BLE_2M_Ant1_2480



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TEST REPORT N°: KSK-ESH-P24071264B-2

3.2 Power Spectral Density

3.2.1 Limit of Power Spectral Density

Condition	Frequency Band	Limit (e.i.r.p.)
Under normal conditions	2400 ~ 2483.5 MHz	10dBm / 1MHz

3.2.2 Test Procedures

1. Refer to chapter 5.4.3.2 of EN 300 328 V2.2.2.
2. These measurements shall only be performed at normal test conditions.
3. The measurement shall be repeated for the equipment being configured to operate at the lowest, the middle, and the highest frequency of the stated frequency range.
4. The test procedure shall be as follows:

Step 1:

Connect the UUT to the spectrum analyzer and use the following settings:

Start Frequency : 2400MHz
Stop Frequency : 2483.5MHz
Resolution BW : 10kHz
Video BW : 30kHz
Sweep Points : 8350
Detector : RMS
Trace Mode : Max Hold
Sweep time : 10 sec

Step 2:

For conducted measurements on smart antenna systems using either operating mode 2 or operating mode 3 (see clause 5.3.2.2), repeat the measurement for each of the transmit ports. For each sampling point (frequency domain), add up the coincident power values (in mW) for the different transmit chains and use this as the new data set.

Step 3:

Add up the values for power for all the samples in the file using the formula below.

$$P_{Sum} = \sum_{n=1}^k P_{sample}(n)$$

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Step 4:

Normalize the individual values for power (in dBm) so that the sum is equal to the RF Output Power (e.i.r.p.)

Step 5:

Starting from the first sample PSamplecorr(n) (lowest frequency), add up the power (in mW) of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to sample #100). This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded.

Step 6:

Shift the start point of the samples added up in step 5 by one sample and repeat the procedure in step 5 (i.e. sample #2 to sample #101).

Step 7:

Repeat step 6 until the end of the data set and record the Power Spectral Density values for each of the 1 MHz segments.

From all the recorded results, the highest value is the maximum Power Spectral Density (PSD) for the UUT. This value, which shall comply with the limit given in clause 4.3.2.3.3, shall be recorded in the test report.

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement
☒ Option 1: For equipment with continuous and non-continuous transmissions	
☐ Option 2: For equipment with continuous transmission capability or for equipment operating (or with the capability to operate) with a constant duty cycle (e.g. Frame Based equipment)	

3.2.3 Deviation of Test Standard

No deviation.

3.2.4 Test Setup

The test setup has been constructed as the normal test condition. The measurement was performed at the lowest, the middle, and the highest channel.





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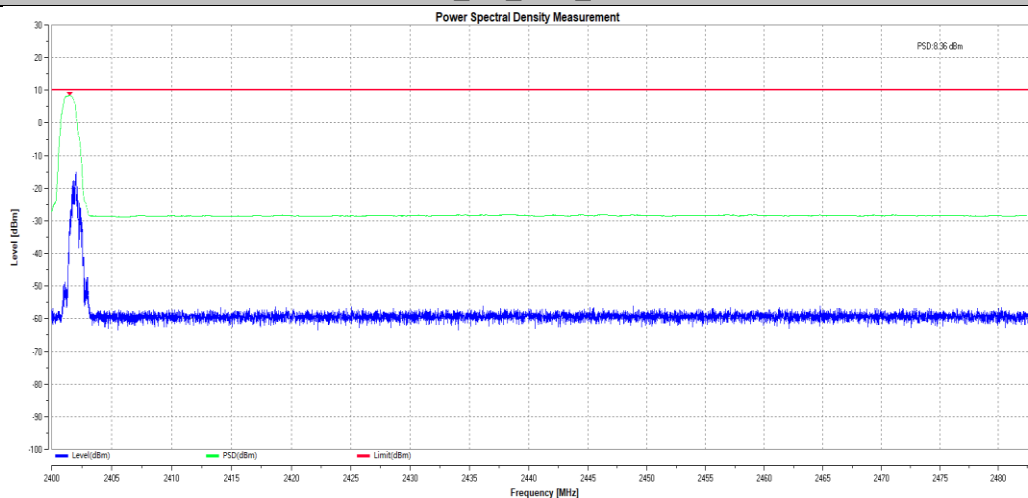
3.2.5 Test Results

Test Mode	Antenna	Freq(MHz)	PSD[dBm/MHz]	Limit[dBm/MHz]	Verdict
BLE_1M	Ant1	2402	8.36	10	PASS
		2440	8.45	10	PASS
		2480	8.53	10	PASS
BLE_2M	Ant1	2402	6.80	10	PASS
		2440	6.88	10	PASS
		2480	6.95	10	PASS

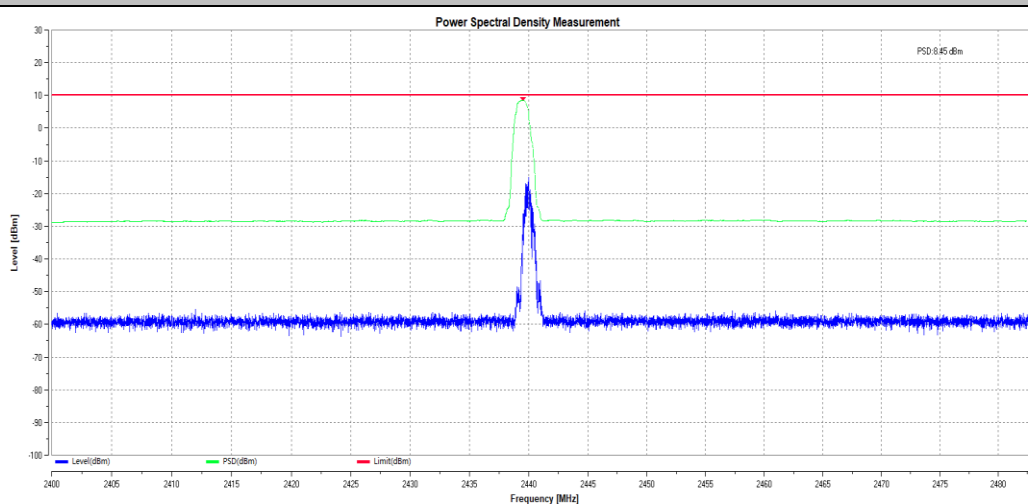
TEST REPORT N°: KSK-ESH-P24071264B-2

3.2.6 Test Graphs

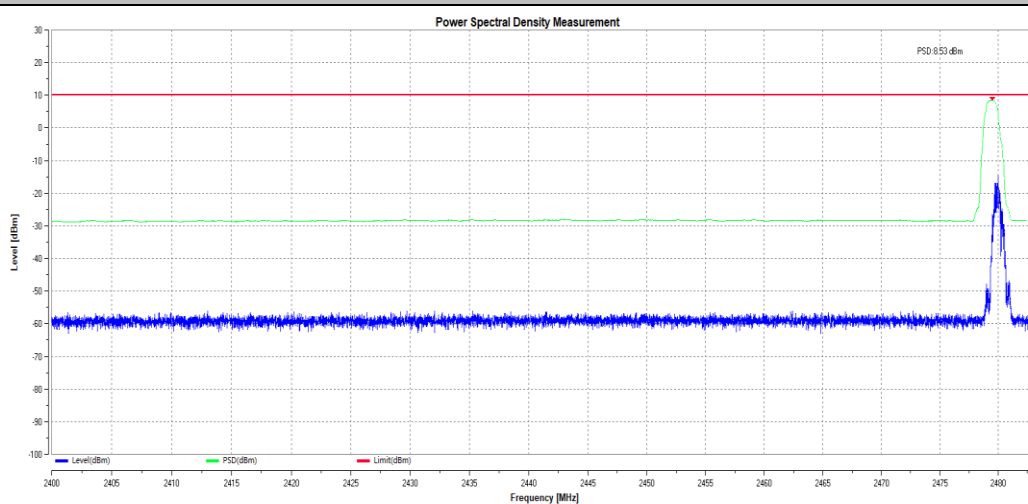
BLE_1M_Ant1_2402



BLE_1M_Ant1_2440



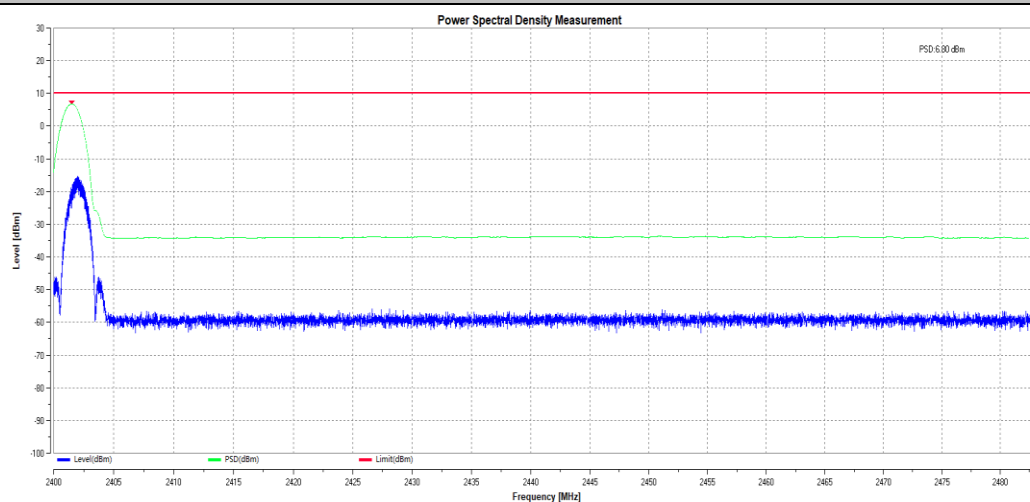
BLE_1M_Ant1_2480



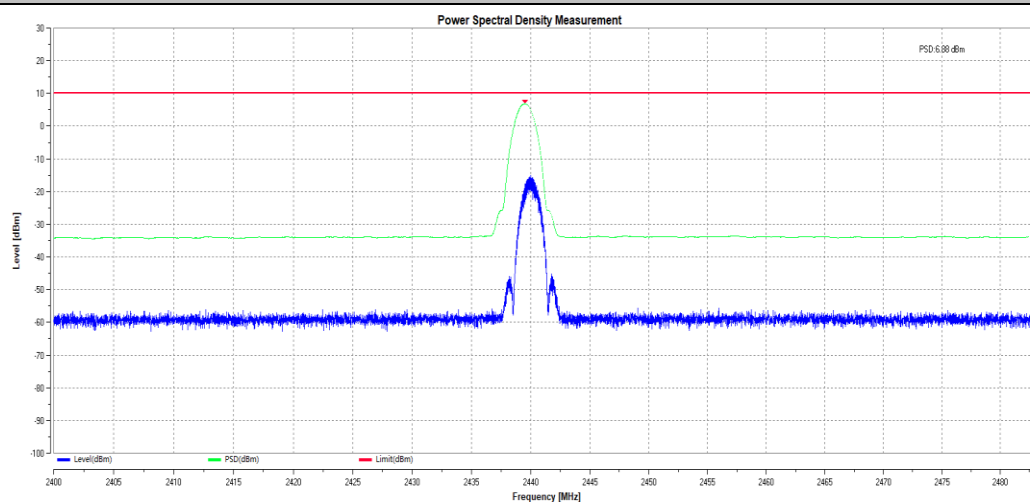


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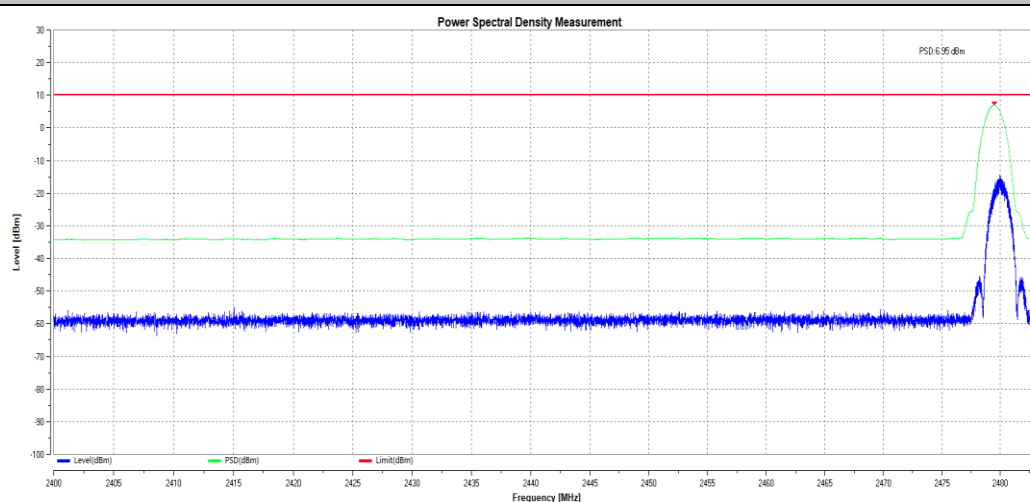
BLE_2M_Ant1_2402



BLE_2M_Ant1_2440



BLE_2M_Ant1_2480



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3.3 Adaptivity (adaptive equipment using modulations other than FHSS)

This requirement does not apply to non-adaptive equipment or adaptive equipment operating in a non-adaptive mode providing the equipment complies with the requirements and/or restrictions applicable to non-adaptive equipment.

In addition, this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.

3.3.1 Limit of Adaptive

Applicability of adaptive requirements and limit for wide band modulation techniques Interference threshold level

Requirement	Operational Mode			
	Non-LBT based Detect and Avoid	LBT based Detect and Avoid		
		Frame Based Equipment	Load Based Equipment (Base on 'Spectrum Sharing' mechanisms)	Load Based Equipment (Not using any of the mechanisms referenced)
Minimum Clear Channel Assessment (CCA) Time	NA	18 us (see note 1)	(see note 2)	18 us (see note 1)
Maximum Channel Occupancy (COT) Time	40 ms	1 ms to 10 ms	(see note 2)	13ms
Minimum Idle Period	5us	5% of COT	(see note 2)	18us (see note 3)
Extended CCA check	NA	NA	(see note 2)	18us~160us
Short Control Signalling Transmissions	Maximum duty cycle of 10 % within an observation period of 50 ms (see note 4)			

NOTE 1: The CCA time used by the equipment shall be declared by the supplier.

NOTE 2: Load Based Equipment may implement an LBT based spectrum sharing mechanism based on the Clear Channel Assessment (CCA) mode using energy detect, as described in IEEE 802.11™-2012 clause 9, clause 10, clause 16, clause 17, clause 19 and clause 20, or in IEEE 802.15.4™-2011 [i.4], clause 4, clause 5 and clause 8.

NOTE 3: The Idle Period in between transmissions is considered to be the CCA or the Extended CCA check as there are no transmissions during this period.

NOTE 4: Adaptive equipment may or may not have Short Control Signalling Transmissions



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Threshold Level for Non-LBT based Detect and Avoid	
Maximum transmit power (P _H) EIRP dBm	Threshold level (TL) (see notes 1 and 2)
20	-70 dBm / MHz
NOTE 1: For a 20 dBm e.i.r.p. transmitter the detection threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G) NOTE 2: For power levels less than 20 dBm e.i.r.p., the detection threshold level may be relaxed to: $TL = -70 \text{ dBm/MHz} + 10 \times \log_{10} (100 \text{ mW} / P_{out}) ; (P_{out} \text{ in mW e.i.r.p.})$	

Unwanted signal parameters for Non-LBT based Detect and Avoid		
Wanted signal mean power from companion device (dBm)	Unwanted signal frequency (MHz)	Unwanted CW signal power (dBm)
-30	2 395 or 2 488,5 (see note 1)	-35 (see note 2)
NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. NOTE 2: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.		

Threshold Level for LBT based Detect and Avoid (Frame Based Equipment)	
Maximum transmit power (P _H) EIRP dBm	Threshold level (TL) (see notes 1 and 2)
20	-70 dBm / MHz
NOTE 1: For a 20 dBm e.i.r.p. transmitter the CCA threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G) NOTE 2: For power levels less than 20 dBm e.i.r.p. the CCA threshold level may be relaxed to: $TL = -70 \text{ dBm/MHz} + 10 \times \log_{10} (100 \text{ mW} / P_{out}) ; (P_{out} \text{ in mW e.i.r.p.})$	

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Unwanted signal parameters for LBT based Detect and Avoid (Frame Based Equipment)		
Wanted signal mean power from companion device	Unwanted signal frequency (MHz)	Unwanted signal power (dBm)
sufficient to maintain the link (see note 2)	2 395 or 2 488,5 (see note 1)	-35 (see note 3)
NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. See clause 5.4.6.1. NOTE 2: A typical value which can be used in most cases is -50 dBm/MHz. NOTE 3: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.		

Threshold Level for LBT based Detect and Avoid (Load Based Equipment)	
Maximum transmit power (P _H) EIRP dBm	Threshold level (TL) (see notes 1 and 2)
20	-70 dBm / MHz
NOTE 1: For a 20 dBm e.i.r.p. transmitter the CCA threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G) NOTE 2: For power levels less than 20 dBm e.i.r.p. the CCA threshold level may be relaxed to: $TL = -70 \text{ dBm/MHz} + 10 \times \log_{10} (100 \text{ mW} / P_{out}) ; (P_{out} \text{ in mW e.i.r.p.})$	

Unwanted signal parameters for LBT based Detect and Avoid (Load Based Equipment)		
Wanted signal mean power from companion device	Unwanted signal frequency (MHz)	Unwanted signal power (dBm)
sufficient to maintain the link (see note 2)	2 395 or 2 488,5 (see note 1)	-35 (see note 3)
NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. See clause 5.4.6.1. NOTE 2: A typical value which can be used in most cases is -50 dBm/MHz. NOTE 3: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.		

3.3.2 Test Procedure

Refer to chapter 5.4.6.2 of EN 300 328 V2.2.2.

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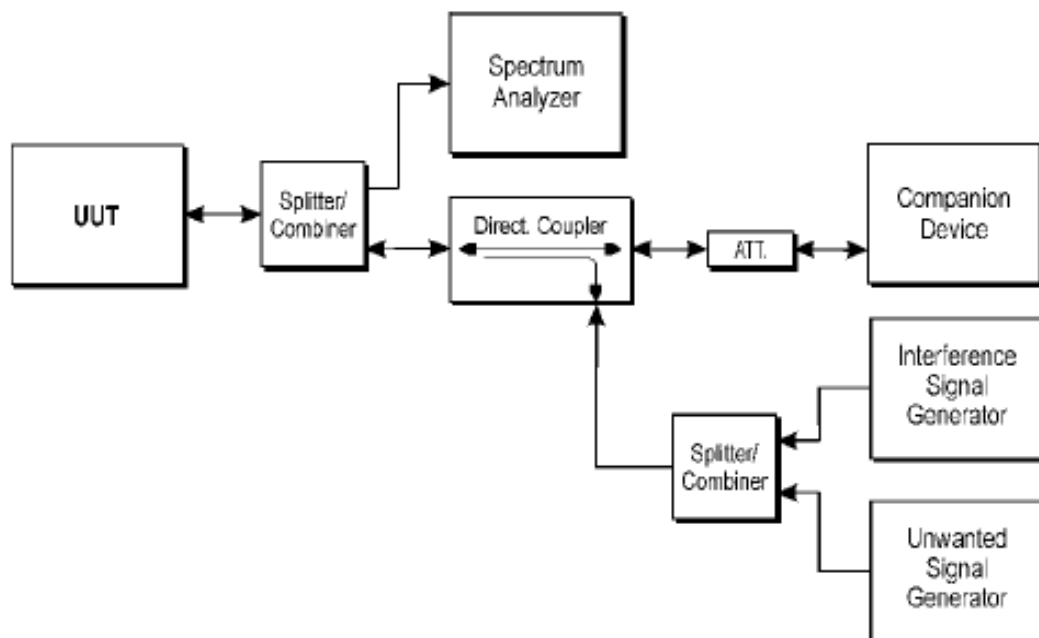
TEST REPORT N°: KSK-ESH-P24071264B-2

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

3.3.3 Deviation from Test Standard

No deviation.

3.3.4 Test Setup Configuration





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3.3.5 List of Measurements

Clause	Test Parameter	Remarks	Pass/Fail
4.3.2.6.3.2.3	Adaptive (Load Based Equipment)	Applicable	Pass
4.3.2.6.4	Short Control Signalling Transmissions	Applicable	Pass

3.3.6 Test Result

☐ Not applicable to non-adaptive equipment or adaptive equipment operating in a non-adaptive mode
☒ Not applicable to equipment with RF output power is less than 10 dBm e.i.r.p.
☐ Refer to below test result

3.3.6.1 Adaptive Result

☐ Not applicable to non-adaptive equipment or adaptive equipment operating in a non-adaptive mode
☒ Not applicable to equipment with RF output power is less than 10 dBm e.i.r.p.
☐ Refer to below test result



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3.4 Occupied Channel Bandwidth

3.4.1 Limit of Occupied Channel Bandwidth

Condition		Limit
All types of equipment		Shall fall completely within the band 2400 to 2483.5 MHz.
Additional requirement	For non-adaptive using wide band modulations other than FHSS system and e.i.r.p >10dBm.	Less than 20MHz
	For non-adaptive Frequency Hopping system and e.i.r.p >10dBm.	Less than 5MHz

3.4.2 Test Procedure

1. Refer to chapter 5.4.7.2 of EN 300 328 V2.2.2.
2. The measurement shall be performed only on the lowest and the highest frequency within the stated frequency range.
3. The test procedure shall be as follows:

Step 1:

Connect the EUT to the spectrum analyzer and use the following settings:

Center Frequency	: Channel under test
Resolution BW	: 1 % of the span
Video BW	: 3 × RBW
Frequency Span	: 2 × Nominal Channel Bandwidth
Detector	: RMS
Trace Mode	: Max Hold
Sweep Time	: 1 s

Step 2:

Save the trace data to a file for further analysis by a computing device using an appropriate software application or program.

Step 3:

Use the 99 % bandwidth function of the spectrum analyzer to measure the Occupied Channel Bandwidth of the EUT.

Measurement	
☒ Conducted measurement	☐ Radiated measurement

3.4.3 Deviation from Test Standard

No deviation.

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3.4.4 Test Setup

These measurements only were performed at normal test conditions. The measurement shall be performed only on the lowest and the highest frequency within the stated frequency range. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator.



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3.4.5 Test Results

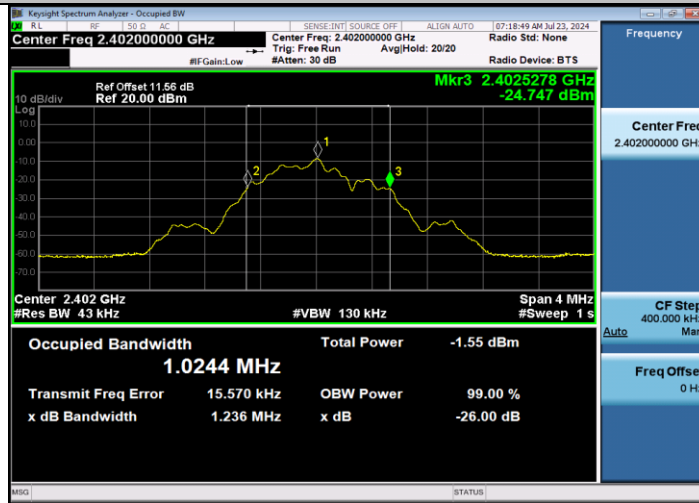
Test Mode	Antenna	Freq[MHz]	OCB[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.0244	2401.5034	2402.5278	2400 to 2483.5	PASS
		2440	1.0245	2439.5030	2440.5275	2400 to 2483.5	PASS
		2480	1.0247	2479.5030	2480.5277	2400 to 2483.5	PASS
BLE_2M	Ant1	2402	2.0655	2400.9689	2403.0344	2400 to 2483.5	PASS
		2440	2.0663	2438.9683	2441.0346	2400 to 2483.5	PASS
		2480	2.0668	2478.9680	2481.0348	2400 to 2483.5	PASS



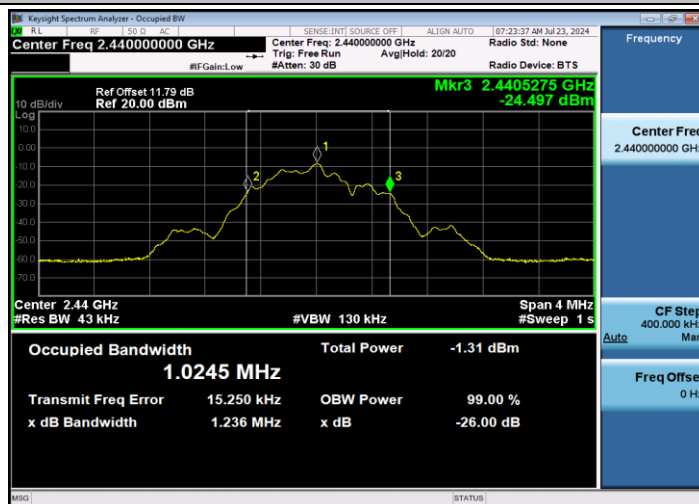
TEST REPORT N°: KSK-ESH-P24071264B-2

3.4.6 Test Graphs

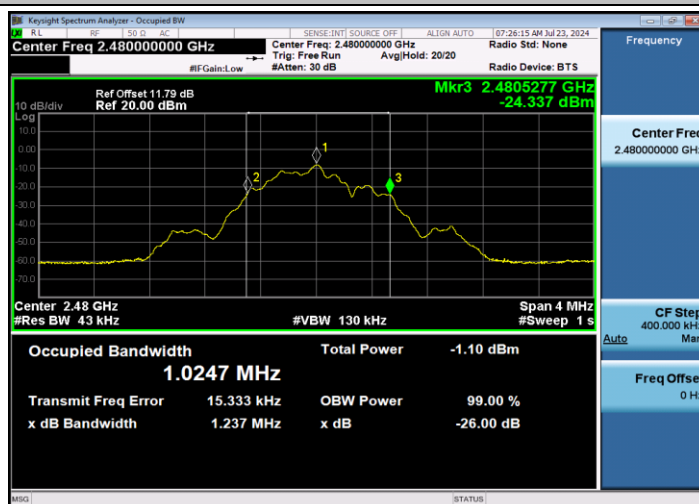
BLE_1M_Ant1_2402



BLE_1M_Ant1_2440



BLE_1M_Ant1_2480



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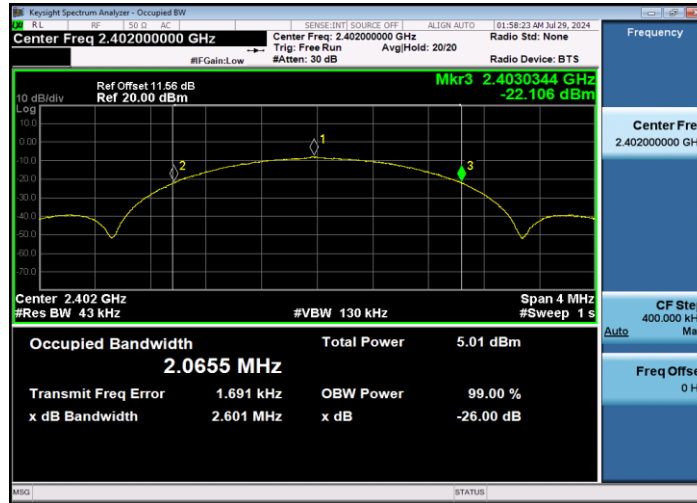
No.829,Xin Zhuan Road,Song Jiang
District,Shanghai,China

Tel: +86 21 6195 7000
Fax: +86 21 6195 7001
Email: contact@cn.bureauveritas.com

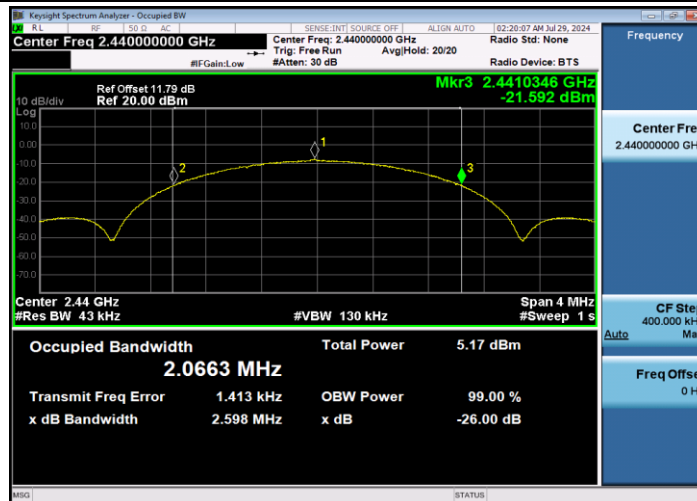


TEST REPORT N°: KSK-ESH-P24071264B-2

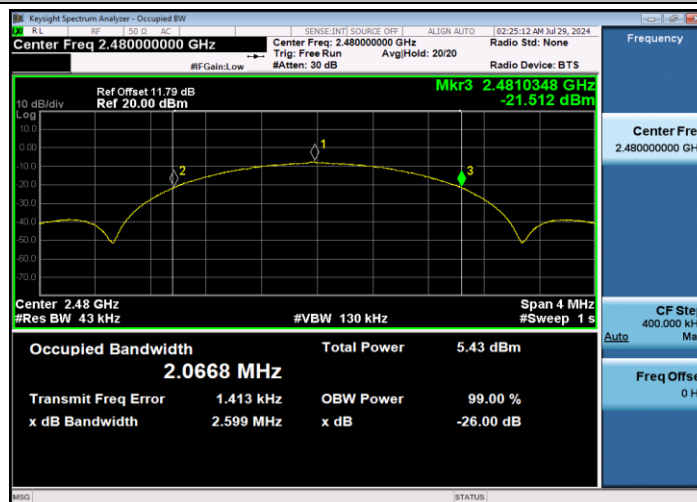
BLE_2M_Ant1_2402



BLE_2M_Ant1_2440



BLE_2M_Ant1_2480



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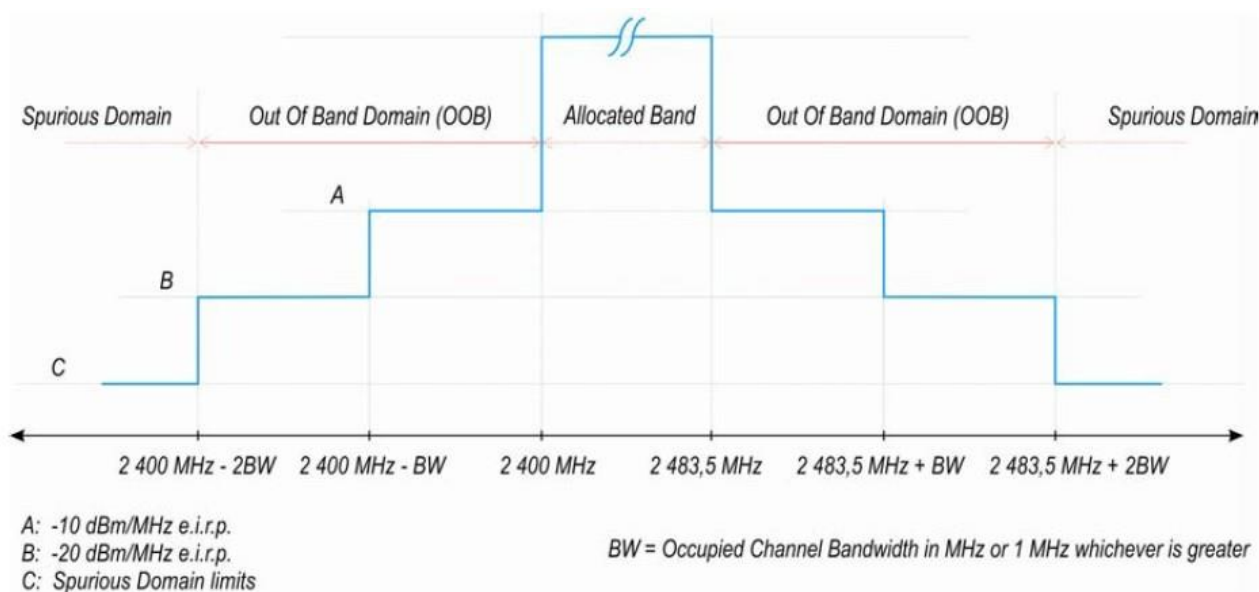
Tel: +86 21 6195 7000
Fax: +86 21 6195 7001
Email: contact@cn.bureauveritas.com

TEST REPORT N°: KSK-ESH-P24071264B-2

3.5 Transmitter Unwanted Emissions in the Out-of-band Domain

3.5.1 Limits of Transmitter Unwanted Emissions in the Out-of-band Domain

Condition	Limit
Under all test conditions	The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in below figure.



3.5.2 Test Procedure

1. Refer to chapter 5.4.8.2 of EN 300 328 V2.2.2.
2. These measurements shall only be performed at normal test conditions.
3. For conducted measurements on devices with multiple transmit chains using the results for each of the transmit chains for the corresponding 1 MHz segments shall be added and compared with the transmit mask limit.
4. These measurements shall only be performed at normal test conditions.
5. For conducted measurements on devices with multiple transmit chains using the results for each of the transmit chains for the corresponding 1 MHz segments shall be added and compared with the transmit mask limit.

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

3.5.3 Deviation from Test Standard

No deviation



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3.5.4 Test Setup

The measurements were performed at normal environmental conditions and shall be repeated at the extremes of the operating temperature. The measurement was performed at the lowest and the highest channel on which the equipment can operate. The equipment was configured to operate under its worst case situation with respect to output power. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator. The frequency has to be recorded for the right and left end above threshold of highest and lowest channel respectively.



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3.5.5 Test Results

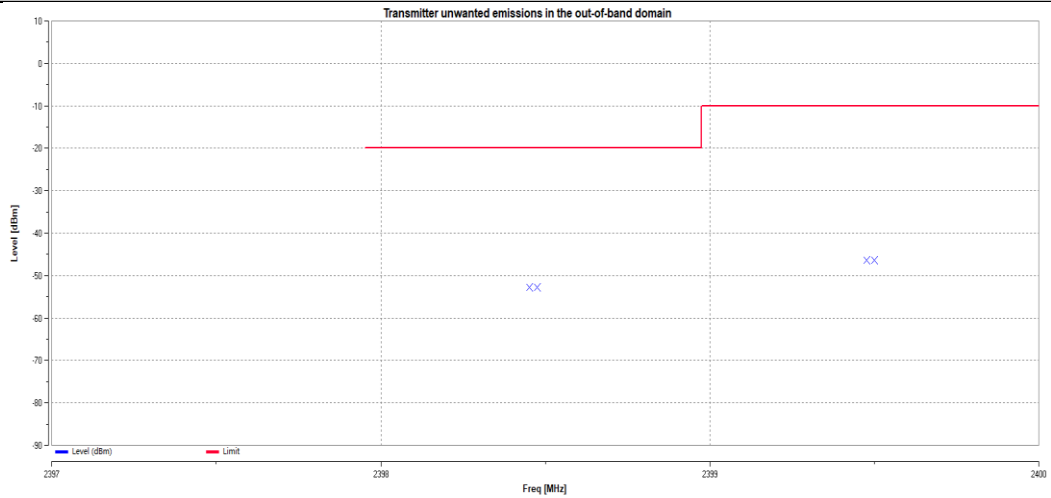
Test Mode	Antenna	Channel	Freq. [MHz]	Level[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	2398.48	-52.71	-20.00	PASS
			2399.5	-46.36	-10.00	PASS
			2484.02	-53.29	-10.00	PASS
			2485.05	-53.28	-20.00	PASS
		2480	2398.48	-53.73	-20.00	PASS
			2399.5	-53.71	-10.00	PASS
			2484	-48.02	-10.00	PASS
			2485.02	-52.84	-20.00	PASS
BLE_2M	Ant1	2402	2397.43	-51.65	-20.00	PASS
			2399.5	-29	-10.00	PASS
			2484	-53.22	-10.00	PASS
			2487.13	-53.22	-20.00	PASS
		2480	2396.43	-53.68	-20.00	PASS
			2399.5	-53.63	-10.00	PASS
			2484	-48.37	-10.00	PASS
			2486.07	-50.39	-20.00	PASS



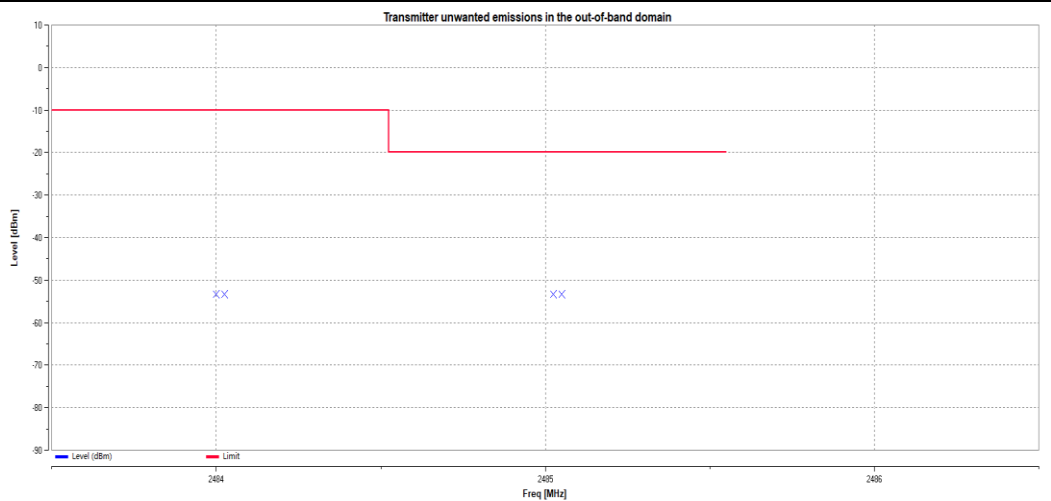
TEST REPORT N°: KSK-ESH-P24071264B-2

3.5.6 Test Graphs

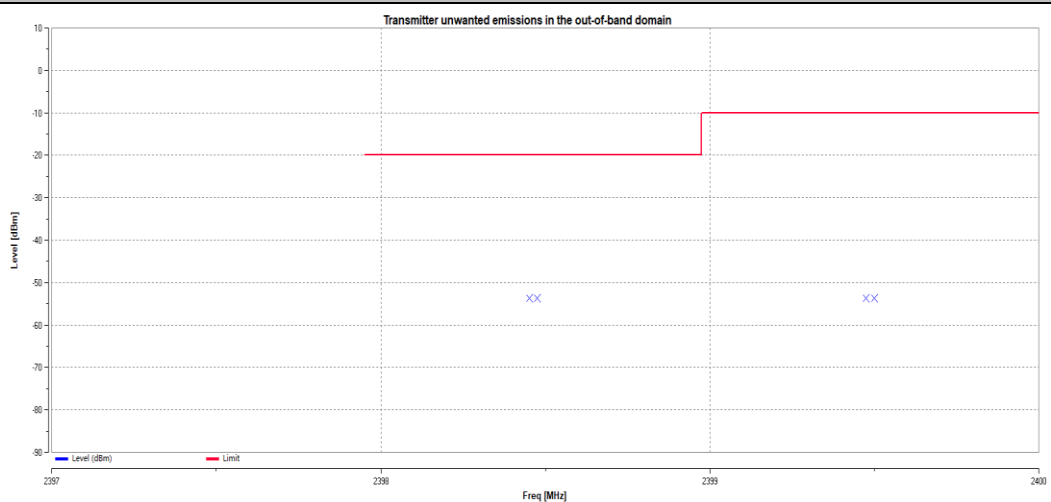
BLE_1M_Ant1_2402_2400MHz-2BW to 2400MHz



BLE_1M_Ant1_2402_2483.5MHz to 2483.5MHz+2BW



BLE_1M_Ant1_2480_2400MHz-2BW to 2400MHz



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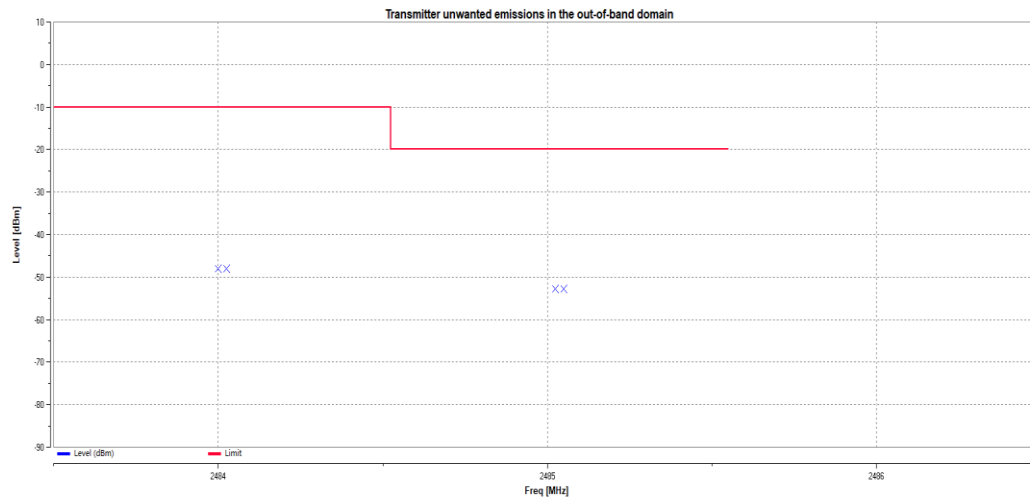
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Tel: +86 21 6195 7000
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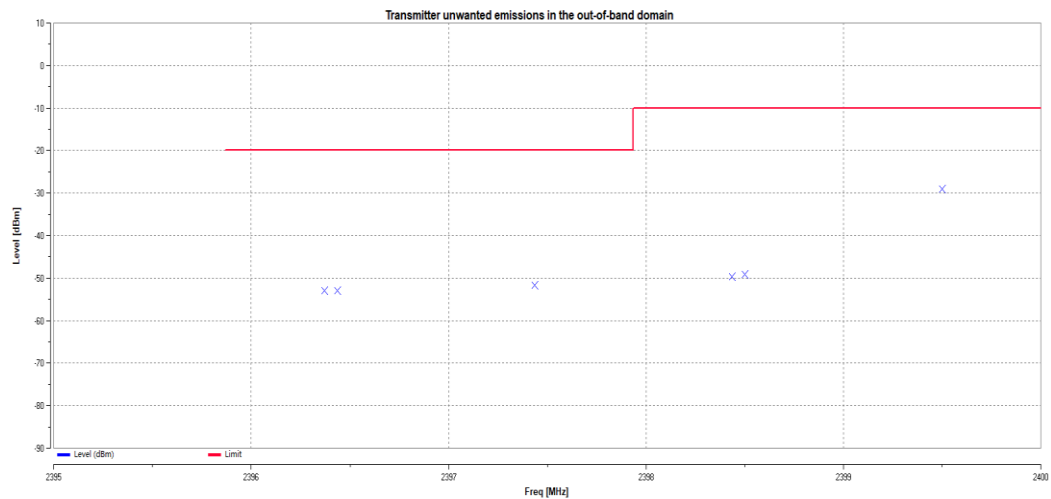


TEST REPORT N°: KSK-ESH-P24071264B-2

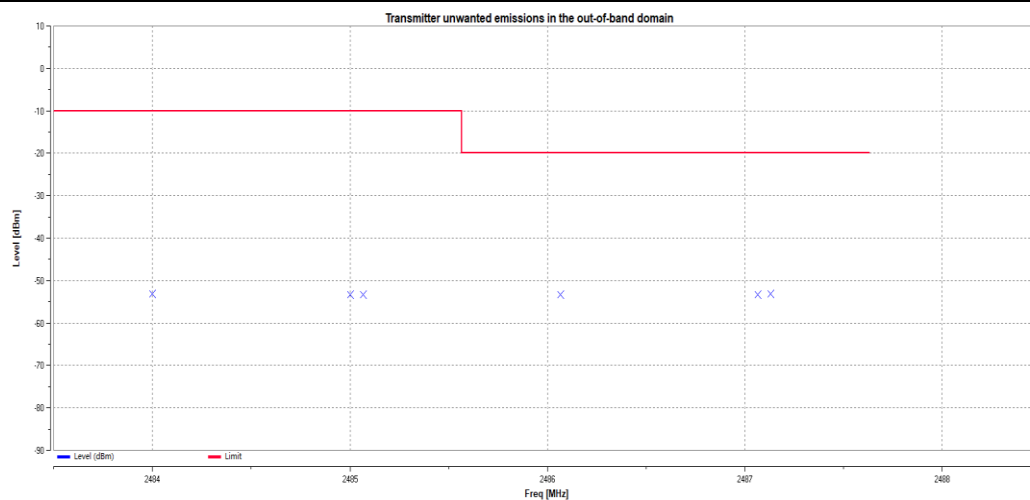
BLE_1M_Ant1_2480_2483.5MHz to 2483.5MHz+2BW



BLE_2M_Ant1_2402_2400MHz-2BW to 2400MHz



BLE_2M_Ant1_2402_2483.5MHz to 2483.5MHz+2BW



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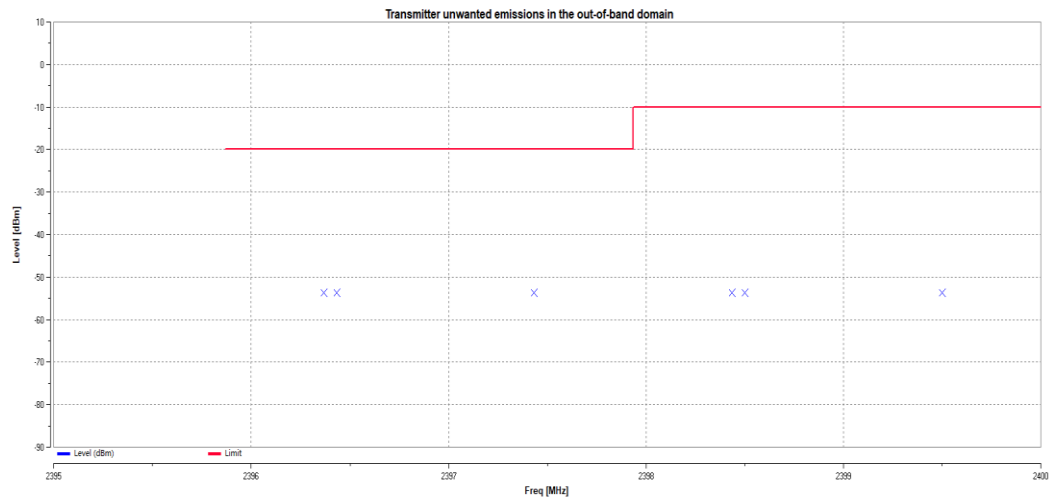
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Email: contact@cn.bureauveritas.com

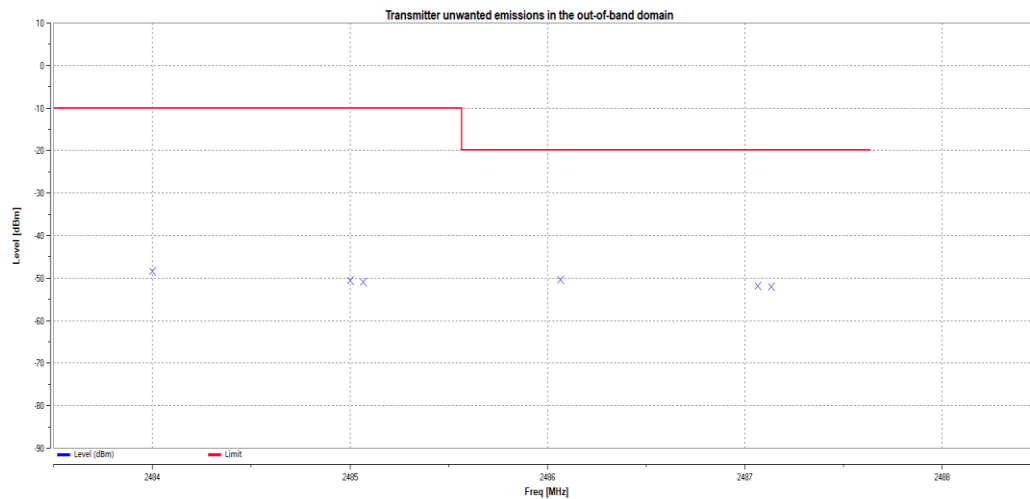


TEST REPORT N°: KSK-ESH-P24071264B-2

BLE_2M_Ant1_2480_2400MHz-2BW to 2400MHz



BLE_2M_Ant1_2480_2483.5MHz to 2483.5MHz+2BW





TEST REPORT N°: KSK-ESH-P24071264B-2

3.6 Transmitter Spurious Emissions in the spurious domain

3.6.1 Limits of Transmitter Spurious Emissions

Frequency Range	Maximum Power Limit	Bandwidth
30 MHz to 47 MHz	-36dBm	100kHz
47 MHz to 74 MHz	-54dBm	100kHz
74 MHz to 87,5 MHz	-36dBm	100kHz
87,5 MHz to 118 MHz	-54dBm	100kHz
118 MHz to 174 MHz	-36dBm	100kHz
174 MHz to 230 MHz	-54dBm	100kHz
230 MHz to 470 MHz	-36dBm	100kHz
470 MHz to 694 MHz	-54dBm	100kHz
694 MHz to 1 GHz	-36dBm	100kHz
1GHz ~ 12.75GHz	-30dBm	1MHz

Note: These limits are e.r.p. for emissions up to 1 GHz and as e.i.r.p. for emissions above 1 GHz.

3.6.2 Test Procedure

1. Refer to chapter 5.4.9 of EN 300 328 V2.2.2.
2. The EUT was placed on a turntable with 1.5m height.
3. The test distance between the receiving antenna and the EUT is 3meter below 1GHz frequency range, and 3 meter which is in far field test condition for measured frequency above 1GHz, while the receiving (test) antenna is kept at 1.5 meter height.
4. Set EUT in continuous transmitting with maximum output power.
5. The table was rotated from 0 to 360 degree to search the highest radiated emission.

Measurement Method	
☐ Conducted measurement	☒ Radiated measurement
<u>For Conducted measurement:</u> The level of unwanted emissions shall be measured as their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation).	
<u>Conducted measurement (For equipment with multiple transmit chains):</u> ☐ Option 1: The results for each of the transmit chains for the corresponding 1MHz segments shall be added and compared with the limits. ☐ Option 2: The results for each of the transmit chains shall be individually compared with the limits after these limits have been reduced by 10 x log (N) (number of active transmit chains)	

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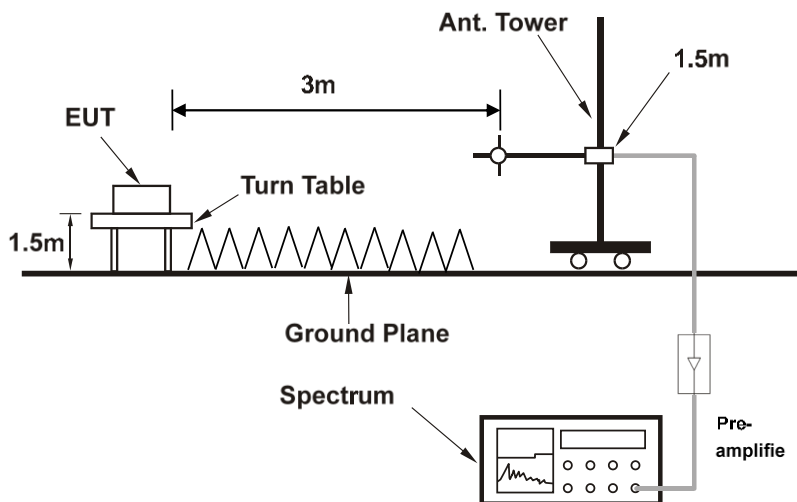
3.6.3 Deviation from Test Standard

No deviation.

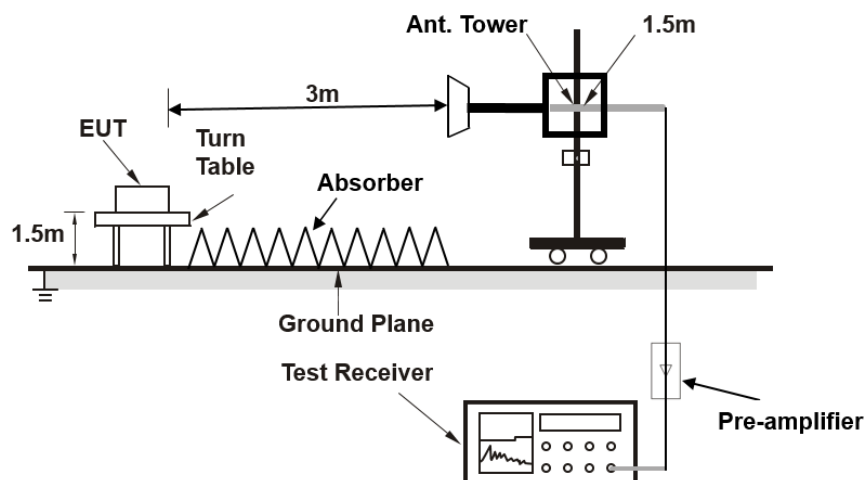
3.6.4 Test Setup

1. For the actual test configuration, please refer to the related Item in this test report (Photographs of the Test Configuration).
2. The equipment was configured to operate under its worst case situation with respect to output power.
3. The test setup has been constructed as the normal use condition.

< Frequency Range 30MHz~1GHz >



<Frequency Range above 1GHz>





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3.6.5 Test Results

Below 1GHz Worst-case Data

Frequency Range	30 MHz ~ 1 GHz	Operating Channel	0
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Spurious Emission Level				
Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
52.12	H	-56.89	-54.00	2.89
57.33	H	-59.34	-54.00	5.34
66.05	H	-59.18	-54.00	5.18
91.82	H	-55.86	-54.00	1.86
187.69	H	-57.67	-54.00	3.67
499.95	H	-65.46	-54.00	11.46
57.54	V	-67.24	-54.00	13.24
88.26	V	-60.65	-54.00	6.65
101.64	V	-62.78	-54.00	8.78
193.95	V	-70.35	-54.00	16.35
500.24	V	-63.14	-54.00	9.14
568.84	V	-66.56	-54.00	12.56



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Above 1GHz Worst-case Data

BLE_1M

Frequency Range	1GHz ~ 12.75GHz	Operating Channel	0, 39
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Spurious Emission Level					
Channel	Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
0	4804.00	H	-64.75	-30.00	34.75
	7206.00	H	-59.14	-30.00	29.14
	4804.00	V	-63.56	-30.00	33.56
	7206.00	V	-60.22	-30.00	30.22
39	4960.00	H	-65.07	-30.00	35.07
	7440.00	H	-59.36	-30.00	29.36
	4960.00	V	-64.28	-30.00	34.28
	7440.00	V	-59.54	-30.00	29.54

BLE_2M

Frequency Range	1GHz ~ 12.75GHz	Operating Channel	0, 39
-----------------	-----------------	-------------------	-------

Spurious Emission Level					
Channel	Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
0	4804.00	H	-65.17	-30.00	35.17
	7206.00	H	-58.84	-30.00	28.84
	4804.00	V	-63.35	-30.00	33.35
	7206.00	V	-60.42	-30.00	30.42
39	4960.00	H	-64.51	-30.00	34.51
	7440.00	H	-59.86	-30.00	29.86
	4960.00	V	-63.57	-30.00	33.57
	7440.00	V	-59.46	-30.00	29.46



TEST REPORT N°: KSK-ESH-P24071264B-2

3.7 Receiver Spurious Emissions

3.7.1 Limit of Receiver Spurious Radiation

Frequency Range	Maximum Power Limit	Bandwidth
30 MHz ~ 1 GHz	-57dBm	100 kHz
1 GHz ~ 12.75 GHz	-47dBm	1 MHz

Note: These limits are e.r.p. for emissions up to 1 GHz and as e.i.r.p. for emissions above 1 GHz.

3.7.2 Test Procedure

1. Refer to chapter 5.4.10 of EN 300 328 V2.2.2.
2. The test distance between the receiving antenna and the EUT is 3meter below 1GHz frequency range, and 3 meter which is in far field test condition for measured frequency above 1GHz, while the receiving (test) antenna is kept at 1.5 meter height.
3. Set EUT in receiving mode.
4. The table was rotated from 0 to 360 degree to search the highest radiated emission.

Measurement Method	
☐ Conducted measurement	☒ Radiated measurement
<u>For Conducted measurement:</u> The level of unwanted emissions shall be measured as their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation).	
<u>Conducted measurement (For equipment with multiple transmit chains):</u> ☐ Option 1: The results for each of the transmit chains for the corresponding 1MHz segments shall be added and compared with the limits. ☐ Option 2: The results for each of the transmit chains shall be individually compared with the limits after these limits have been reduced by $10 \times \log(N)$ (number of active transmit chains)	

3.7.3 Deviation from Test Standard

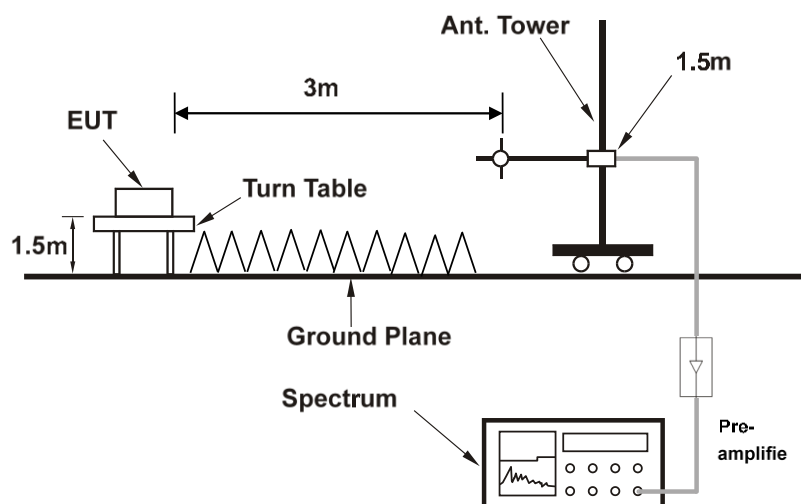
No deviation.

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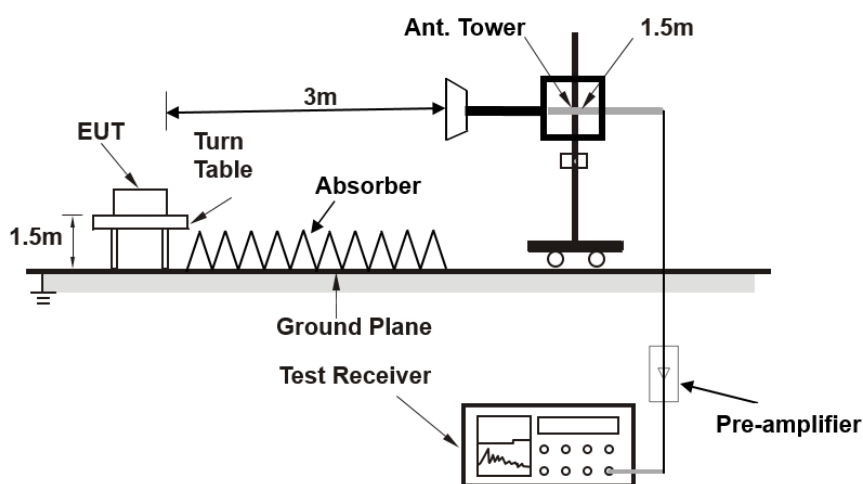
3.7.4 Test Setup

1. For the actual test configuration, please refer to the related Item in this test report (Photographs of the Test Configuration).
2. Testing was performed when the equipment was in a receive-only mode.
3. The test setup has been constructed as the normal use condition.

< Frequency Range 30MHz~1GHz >



<Frequency Range above 1GHz>





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3.7.5 Test Results

RX Worst-case Data

Frequency Range	30 MHz ~ 1 GHz	Operating Channel	Receiver mode
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Spurious Emission Level				
Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
60.62	H	-59.49	-57.00	2.49
144.28	H	-61.67	-57.00	4.67
166.55	H	-59.25	-57.00	2.25
200.76	H	-58.57	-57.00	1.57
240.24	H	-61.32	-57.00	4.32
499.95	H	-65.18	-57.00	8.18
73.62	V	-60.84	-57.00	3.84
89.54	V	-60.66	-57.00	3.66
122.17	V	-65.62	-57.00	8.62
263.52	V	-67.07	-57.00	10.07
500.25	V	-63.68	-57.00	6.68
569.19	V	-66.34	-57.00	9.34

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RX above 1GHz Worst-case Data

Frequency Range	1 GHz ~ 12.75 GHz	Operating Channel	Receiver mode
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Spurious Emission Level					
Channel	Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
39	1708.54	H	-53.77	-47.00	6.77
	2342.68	H	-53.25	-47.00	6.25
	3520.58	H	-53.65	-47.00	6.65
	4998.47	H	-59.84	-47.00	12.84
	6570.69	H	-59.81	-47.00	12.81
	7800.96	H	-58.54	-47.00	11.54
	2365.35	V	-48.57	-47.00	1.57
	3008.72	V	-55.65	-47.00	8.65
	3560.42	V	-53.28	-47.00	6.28
	5467.00	V	-54.47	-47.00	7.47
	6829.57	V	-56.68	-47.00	9.68
	10385.50	V	-53.54	-47.00	6.54

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3.8 Receiver Blocking

3.8.1 Limit of Receiver Blocking

This requirement applies to all receiver categories.

Receiver Category		
☐ Category 1	☒ Category 2	☐ Category 3
Minimum performance criterion	☒ PER $\leq 10\%$	
	☐ Alternative performance criteria (See note)	
Note: The manufacturer was declared performance criteria is x% for the intended use of the equipment.		

Receiver Category 1 Equipment			
Wanted signal mean power from companion device (dBm)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm) (See note 2)	Type of blocking signal
(-133 dBm + 10 × log ₁₀ (OCBW)) or -68 dBm whichever is less (see note 2)	2 380	-34	CW
	2 504		
(-139 dBm + 10 × log ₁₀ (OCBW)) or -74 dBm whichever is less (see note 3)	2 300		
	2 330		
	2 360		
	2 524		
	2 584		
	2 674		

NOTE 1: OCBW is in Hz.

NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

NOTE 3: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 20 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

NOTE 4: The level specified is the level at the UUT receiver input assuming a 0dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

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Receiver Category 2 Equipment			
Wanted signal mean power from companion device (dBm)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm) (See note 2)	Type of blocking signal
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}) + 10 \text{ dB})$ or $(-74 \text{ dBm} + 10 \text{ dB})$ whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to $P_{\min} + 26 \text{ dB}$ where $P_{\min}$ is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

Receiver Category 3 Equipment			
Wanted signal mean power from companion device (dBm)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm) (See note 2)	Type of blocking signal
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}) + 20 \text{ dB})$ or $(-74 \text{ dBm} + 20 \text{ dB})$ whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to $P_{\min} + 30 \text{ dB}$ where $P_{\min}$ is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna			

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3.8.2 Test Procedure

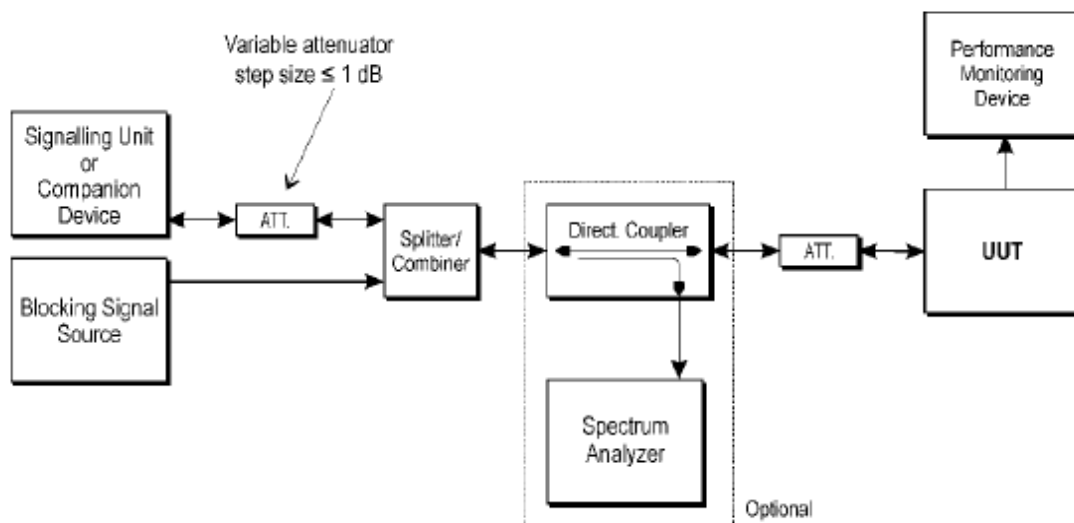
1. Refer to chapter 5.4.11.2 of EN 300 328 V2.2.2.
2. For systems using multiple receive chains only one chain (antenna port) need to be tested.

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

3.8.3 Deviation from Test Standard

No deviation.

3.8.4 Test Setup Configuration





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3.8.5 Test Results

Receiver Category 2 Equipment

Receiver blocking performance when operating at the lowest operating channel	
The actual blocking signal power(Note1)	antenna gain(G) :2.8dBi
	☒ at the antenna connector
	☐ in front of the antenna
Note1: For the conducted measurements , the level shall be corrected as follows: the actual blocking signal power = blocking signal power + G	

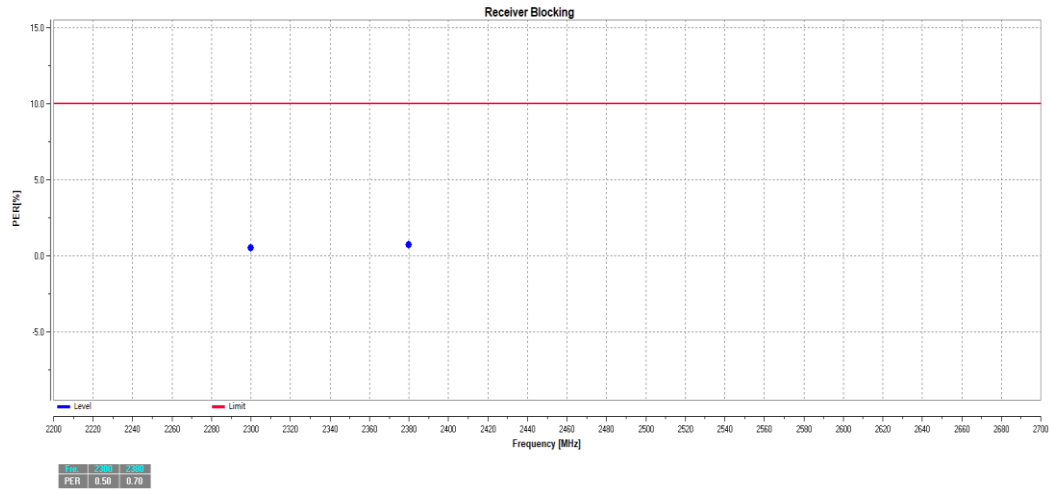
Test Mode	Antenna	Freq[MHz]	Wanted signal [dBm]	Freq. [MHz]	CW [dBm]	PER [%]	Limit [%]	Verdict
BLE_1M	Ant1	2402	-66.10	2300	-31.2	0.50	≤10	PASS
			-66.10	2380	-31.2	0.70	≤10	PASS
		2480	-66.09	2504	-31.2	0.80	≤10	PASS
			-66.09	2584	-31.2	0.60	≤10	PASS



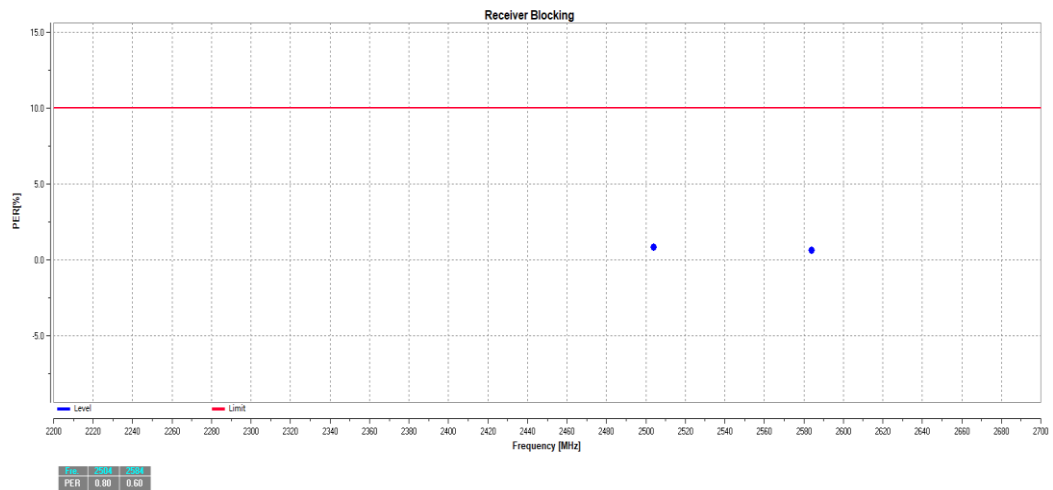
TEST REPORT N°: KSK-ESH-P24071264B-2

3.8.6 Test Graphs

BLE_1M_Ant1_2402

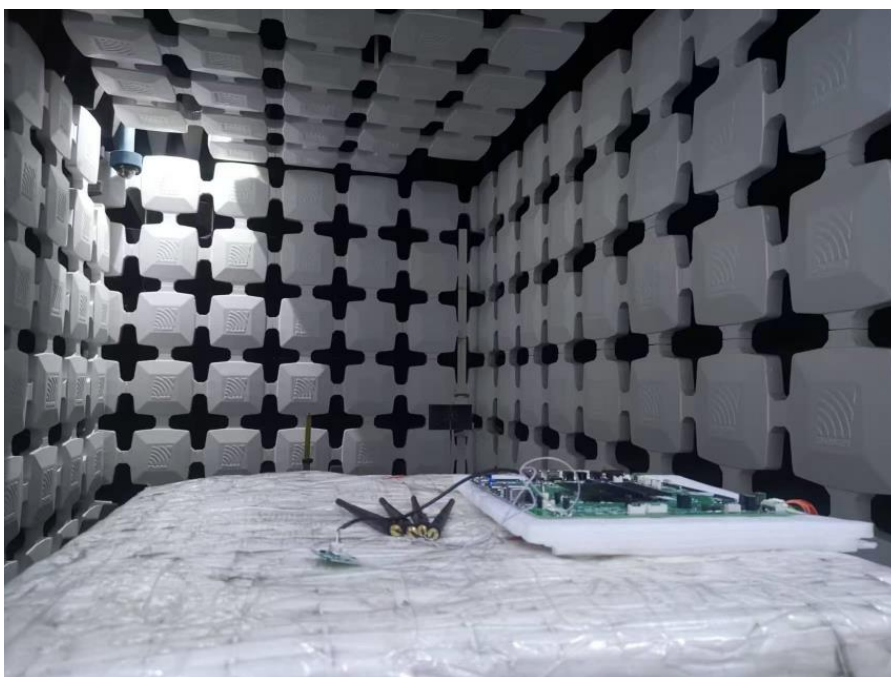
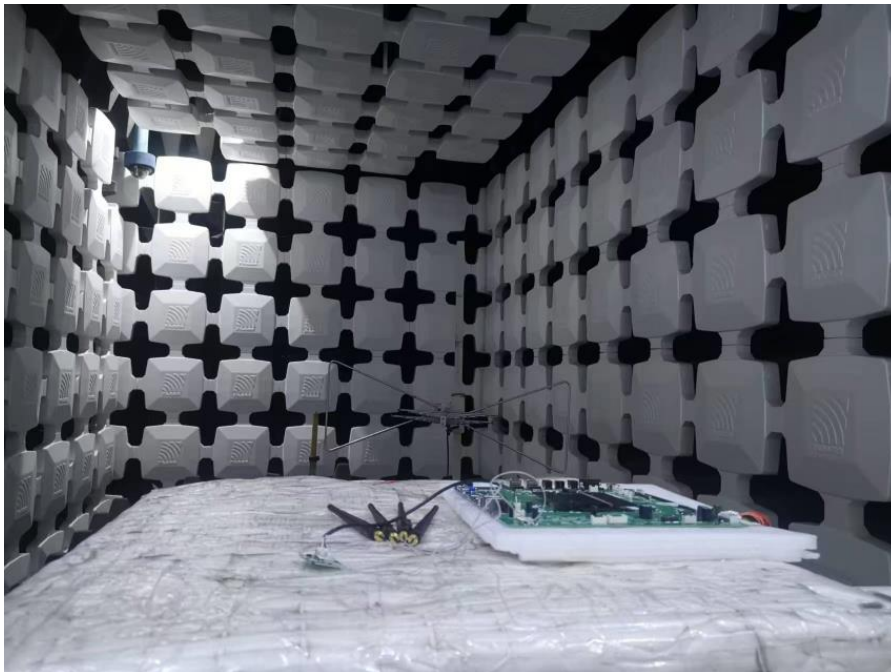


BLE_1M_Ant1_2480



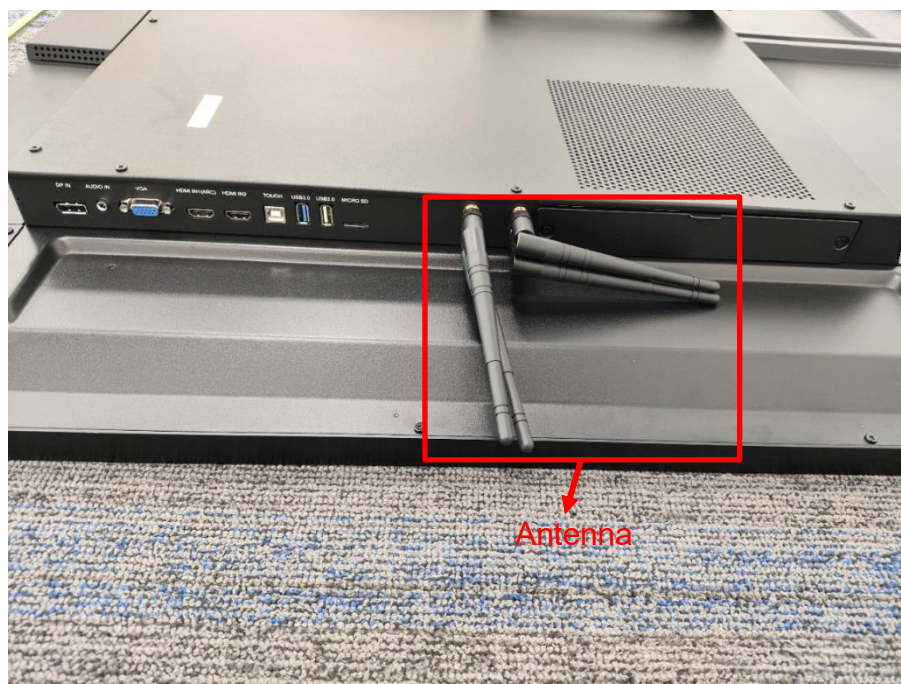
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4 Photographs of the Test Configuration

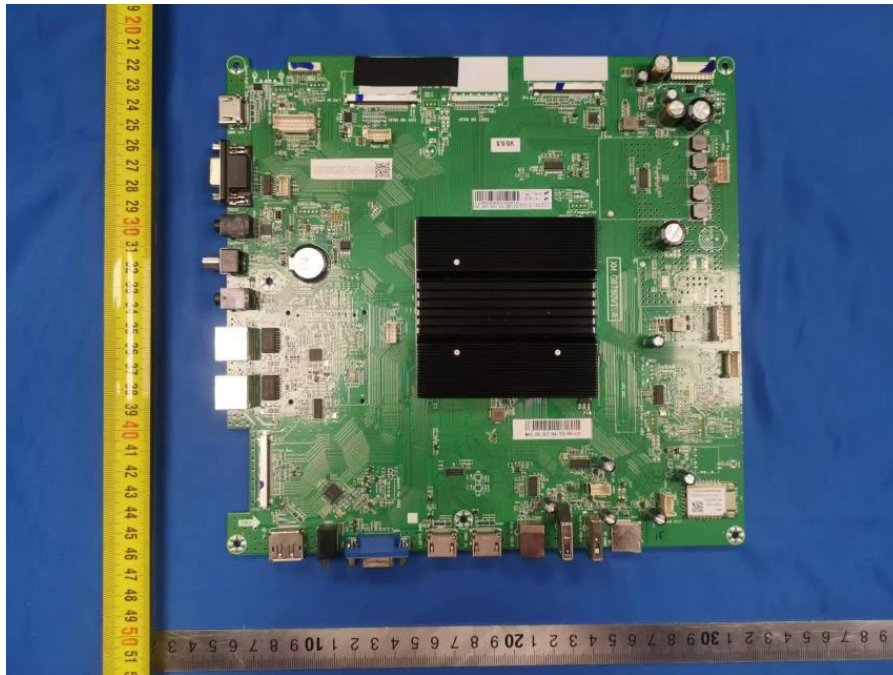


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5 Photographs of the EUT



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APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications were made to the EUT by the lab during the test.

----- **END** -----

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