EN 300 328 RF Test Report

Report No.: ARFR-ESH-P2004211472B-3-A2

Product: Smart Zigbee Gateway

Model: THP10-Z

Received Date: Jul.09, 2020

Test Date: Jul.09, 2020

Issued Date: Feb.21, 2023

Applicant: Hangzhou Tuya Information Technology Co., Ltd

Address: Room701, Building3, More Center,No.87 GuDun Road, Hangzhou, Zhejiang, China

Manufacturer: Hangzhou Tuya Information Technology Co., Ltd

Address: Room701, Building3, More Center,No.87 GuDun Road, Hangzhou, Zhejiang, China

Issued By: LCIE China Co., Ltd.

Lab Address: Building C, No. 829, Xinzhuan Road, Shanghai, P.R.China (201612)

This report is governed by, and incorporates by reference, the Conditions of Testing as posted at the date of issuance of this report at http://www.bureauveritas.com/home/about-us/our-business/cps/about-us/terms-conditions/ and is intended for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. Measurement uncertainty is only provided upon request for accredited tests. Statements of conformity are based on simple acceptance criteria without taking measurement uncertainty into account, unless otherwise requested in writing. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence or if you require measurement uncertainty; provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents.

Table of Contents

Release Control Record 4

1 Test Program 5

2 Summary of Test Results 6

2.1 Test Instruments 7
2.2 Measurement Uncertainty 8
2.3 Maximum Measurement Uncertainty 8
2.4 Modification Record 8

3 General Information 9

3.1 General Description of EUT 9
3.2 Description of Test Modes 10
3.2.1 Test Mode Applicability: 11
3.3 Description of Support Units 14
3.4 General Description of Applied Standards 14

4 Test Procedure and Results 15

4.1 RF Output Power 15
4.1.1 Limits of RF Output Power 15
4.1.2 Test Procedures 15
4.1.3 Deviation from Test Standard 15
4.1.4 Test Setup 15
4.1.5 Test Results 16
4.2 Power Spectral Density 17
4.2.1 Limit of Power Spectral Density 17
4.2.2 Test Procedures 17
4.2.3 Deviation of Test Standard 17
4.2.4 Test Setup 17
4.2.5 Test Results 18
4.3 Adaptivity (adaptive equipment using modulations other than FHSS) 19
4.3.1 Limit of Adaptive 19
4.3.2 Test Procedure 21
4.3.3 Deviation from Test Standard 21
4.3.4 Test Setup Configuration 21
4.3.5 List of Measurements 21
4.3.6 Test Result 22
4.4 Occupied Channel Bandwidth 23
4.4.1 Limit of Occupied Channel Bandwidth 23
4.4.2 Test Procedure 23
4.4.3 Deviation from Test Standard 23
4.4.4 Test Setup 23
4.4.5 Test Results 24
4.5 Transmitter Unwanted Emissions in the Out-of-band Domain 25
4.5.1 Limits of Transmitter Unwanted Emissions in the Out-of-band Domain 25
4.5.2 Test Procedure 25
4.5.3 Deviation from Test Standard 25
4.5.4 Test Setup 25
4.5.5 Test Results 26
4.6 Transmitter Spurious Emissions in the spurious domain 27
4.6.1 Limits of Transmitter Spurious Emissions 27
4.6.2 Test Procedure 27
4.6.3 Deviation from Test Standard 27
4.6.4 Test Setup 27
4.6.5 Test Results 28
4.7 Receiver Spurious Emissions 29
4.7.1 Limit of Receiver Spurious Radiation 29

4.7.2 Test Procedure 29
4.7.3 Deviation from Test Standard 29
4.7.4 Test Setup 29
4.7.5 Test Results 30
4.8 Receiver Blocking 31
4.8.1 Limit of Receiver Blocking 31
4.8.2 Test Procedure 32
4.8.3 Deviation from Test Standard 32
4.8.4 Test Setup Configuration 33
4.8.5 Test Results 34
5 Photographs of the Test Configuration 35
6 Photographs of the EUT 36
APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB 39

Release Control Record

Issue No.	Description	Date Issued
ARFR-ESH-P2004211472B-3	Original release	May.28, 2020
ARFR-ESH-P2004211472B-3-A1	Add new adaptors, refer to special comment in chapter 2 for details	Jul.29, 2020
ARFR-ESH-P2004211472B-3-A2	Update standard	Feb.21, 2023

1 Test Program

Product: Smart Zigbee Gateway

Brand: --

Model: THP10-Z

Applicant: Hangzhou Tuya Information Technology Co., Ltd

Test Date: Jul.09, 2020

Standards: EN 300 328 V2.2.2 (2019-07)

The above equipment has been tested by **LCIE China Co., Ltd.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Unit Under Test (UUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** Feb.21, 2023

Yan ZHOU

Project Engineer

Approved by : _____ , **Date:** Feb.21, 2023

Sean YU

RF Supervisor

2 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: 1.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.

Special Comment: This report is updated report based on history report ARFR-ESH-P2004211472B-3-A1 for updating standards. After evaluation, no necessary test needed. All test results can refer to history report ARFR-ESH-P2004211472B-3-A1.

2.1 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Double Ridged Broadband Horn (30MHz-1.5GHz)	Schwarzbeck	VULB9168	E1A1036	Feb.08,20	Feb.07,21
Horn Antenna (1GHz -18GHz)	Schwarzbeck	BBHA9120D	E1A1017	Aug.26,17	Aug.25,20
Antenna (18GHz-40GHz)	Schwarzbeck	AH-840	E1A1040	Jun.28.20	Jun.27.21
Pre-Amplifier(9kHz-1GHz)	SONOMA	11909/310	E1A2007	Oct.16,20	Oct.15,21
Pre-Amplifier(1GHz-26.5GHz)	Agilent	8449B	E1A2002	Mar.25,20	Mar.24,21
Pre-Amplifier(18GHz-40GHz)	EMCI		E1A2008	Jun.11.20	Jun.10.21
Signal Generator	Keysight	N5171B	E1S9016	Jun.11.20	Jun.10.21
Signal Generator	Keysight	N5182B	E1S9017	Jun.11.20	Jun.10.21
Spectrum Analyzer	R&S	FSP30	E1S1002	Jul.23,20	Jul.22,21
Spectrum Analyzer	Keysight	N9030B	E1S1003	Jul.23,20	Jul.22,21
Power Meter	BOOTON	4232A	E1P5001	Dec.04,19	Dec.03,20
DC Power supply	Chroma	62024p-80-60	S1S1009	Mar.25,20	Mar.24,21
Humidity&Temp Programmable Tester	Testo	608-H1	E1H1022	Apr.03,20	Apr.02,21
Test Software	TOYO	JS36-RSE V2.5.0.0	N/A	N/A	N/A
Test Software	Keysight	V1.01.10	N/A	N/A	N/A

2.2 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	±1.132x10^{-4} %
RF output power, conducted	±1.017dB
Power Spectral Density, conducted	±1.017dB
Unwanted Emissions, conducted	±2.855dB
All emissions, radiated	±2.855dB
Temperature	±0.7°C
Supply voltages	±0.04%
Time	±5 %

2.3 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	±5 %
RF output power, conducted	±1,5 dB
Power Spectral Density, conducted	±3 dB
Unwanted Emissions, conducted	±3 dB
All emissions, radiated	±6 dB
Temperature	±1 °C
Supply voltages	±3 %
Time	±5 %

2.4 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Smart Zigbee Gateway
Model	THP10-Z
Trade Mark	--
Nominal Voltage	5VDC/1.0A with adaptor 100-240V~,50/60Hz
Temperature Operating Range	-10deg.c to +55deg.c
Modulation Type	DSSS
Modulation Technology	O-QPSK
Operating Frequency	2405MHz to 2480MHz
Number of Channel	16
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)	9.80dBm
Antenna Type	FPC Antenna
Antenna Gain	1.47dBi
Data Cable Supplied	NA

Note:

1. The above EUT built in a Zigbee wireless module and model TYZS4-IPEX. The detail as described above.
2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Description of Test Modes

16 channels are provided for 802.15.4.

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
11	2405 MHz	19	2445 MHz
12	2410 MHz	20	2450 MHz
13	2415 MHz	21	2455 MHz
14	2420 MHz	22	2460 MHz
15	2425 MHz	23	2465 MHz
16	2430 MHz	24	2470 MHz
17	2435 MHz	25	2475 MHz
18	2440 MHz	26	2480 MHz

3.2.1 Test Mode Applicability:

EUT Configure Mode	Applicable to								Description
	ROP	PSD	AD	OCB	EOB	SE< 1G	SE≥ 1G	RB	
A	√	√	-	√	√	√	√	√	By USB

Where **ROP:** RF Output Power **PSD:** Power Spectral Density

AD: Adaptivity (Channel Access Mechanism) **OCB:** Occupied Channel Bandwidth

OOB: 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

RF Output Power Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
11 to 26	11,18, 26	DSSS	OQPSK	250kbps

Power Spectral Density Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
11 to 26	11,18, 26	DSSS	OQPSK	250kbps

Occupied Channel Bandwidth Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
11 to 26	11, 26	DSSS	OQPSK	250kbps

Transmitter Unwanted Emissions in the Out-of-band Domain Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
11 to 26	11, 26	DSSS	OQPSK	250kbps

Spurious Emissions Test (Below 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
11 to 26	11	DSSS	OQPSK	250kbps

Spurious Emissions Test (above 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
11 to 26	11, 26	DSSS	OQPSK	250kbps

Receiver Blocking test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
11 to 26	11, 26	DSSS	OQPSK

Test Condition:

Applicable to	Environmental Conditions	Input Power
ROP	25deg. C, 60%RH	By USB
PSD	25deg. C, 60%RH	By USB
AD	N/A	N/A
OCB	25deg. C, 60%RH	By USB
OOB	25deg. C, 60%RH	By USB
SE<1G	23deg. C, 53%RH	By USB
SE≥1G	23deg. C, 53%RH	By USB
RB	N/A	N/A

3.3 Description of Support Units

The EUT has been tested as an independent unit together without other necessary accessories or support units.

3.4 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 related test items have been performed and recorded as per the above standard.

4 Test Procedure and Results

4.1 RF Output Power

4.1.1 Limits of RF Output Power

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

4.1.2 Test Procedures

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

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

4.1.3 Deviation from Test Standard

No deviation.

4.1.4 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.

4.1.5 Test Results

Refer to the test result in history report ARFR-ESH-P2004211472B-3.

Test Condition		EIRP Power (dBm)		
		(CH11) 2405 MHz	(CH18) 2440 MHz	(CH26) 2480 MHz
Tnom	Vnom	9.80	8.91	9.04
Tmin	Vnom	9.33	8.69	8.58
Tmax	Vnom	9.06	8.35	8.09

4.2 Power Spectral Density

4.2.1 Limit of Power Spectral Density

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

4.2.2 Test Procedures

Refer to chapter 5.4.3.2 of EN 300 328 V2.2.2.

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 Basedequipment)	

4.2.3 Deviation of Test Standard

No deviation.

4.2.4 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.

4.2.5 Test Results

Refer to the test result in history report ARFR-ESH-P2004211472B-3.

CHANNEL	CHANNEL FREQUENCY (MHz)	Power Density (dBm/1MHz) (EIRP)	Limit (dBm/1MHz) (EIRP)	PASS/FAIL
11	2405	8.30	10	Pass
18	2440	7.30	10	Pass
26	2480	7.72	10	Pass

4.3 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.

4.3.1 Limit of Adaptive

Applicability of adaptive requirements and limit for wide band modulation techniquesInterference 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 ChannelAssessment (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

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 dBm/MHz + 10 × $\log_{10}$ (100 mW / Pout) ; (Pout 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 dBm/MHz + 10 × $\log_{10}$ (100 mW / Pout) ; (Pout in mW e.i.r.p.)	

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 dBm/MHz + 10 × $\log_{10}$ (100 mW / Pout) ; (Pout 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.		

4.3.2 Test Procedure

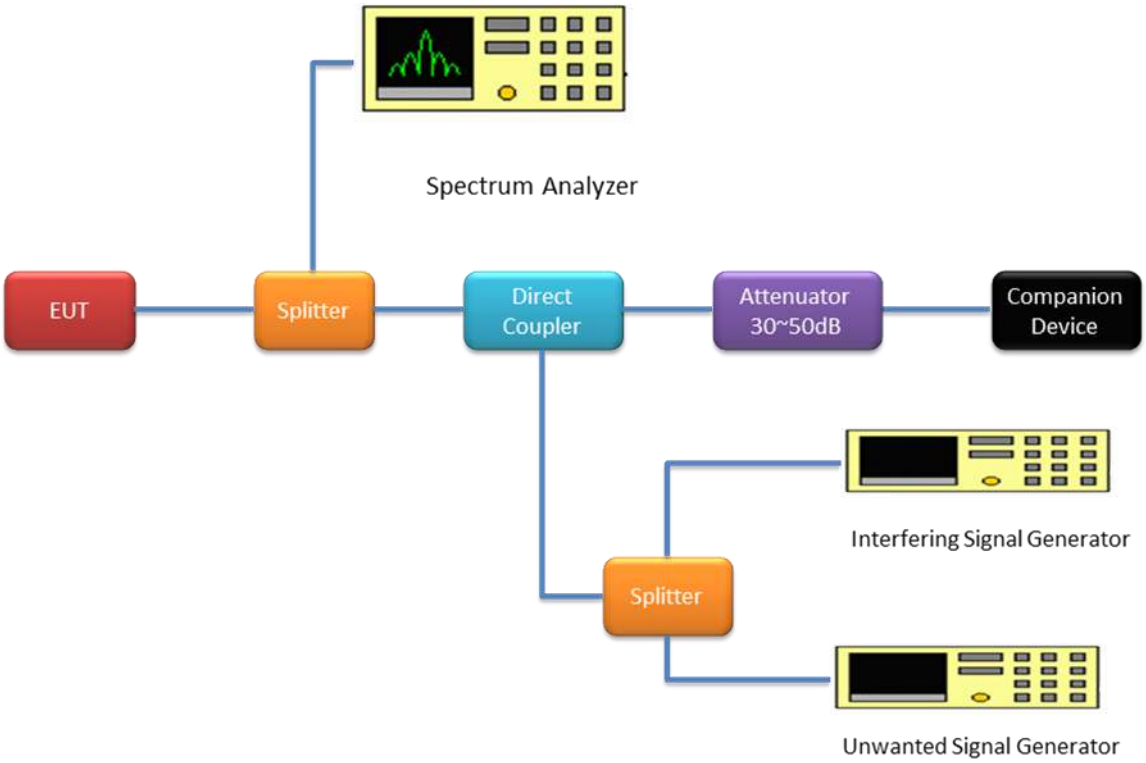
Refer to chapter 5.4.6.2 of EN 300 328 V2.2.2.

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

4.3.3 Deviation from Test Standard

No deviation.

4.3.4 Test Setup Configuration



4.3.5 List of Measurements

Clause	Test Parameter	Remarks	Pass/Fail
4.3.2.6.3.2.2	Adaptive (Frame Based Equipment)	Not Applicable	N/A
4.3.2.6.3.2.3	Adaptive (Load Based Equipment)	Applicable	N/A
4.3.2.6.4	Short Control Signalling Transmissions	Applicable	N/A

4.3.6 Test Result

Refer to the test result in history report ARFR-ESH-P2004211472B-3.

☐	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

4.4 Occupied Channel Bandwidth

4.4.1 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

4.4.2 Test Procedure

Refer to chapter 5.4.7.2 of EN 300 328 V2.2.2.

Measurement	
☒ Conducted measurement	☐ Radiated measurement

4.4.3 Deviation from Test Standard

No deviation.

4.4.4 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.

4.4.5 Test Results

Refer to the test result in history report ARFR-ESH-P2004211472B-3.

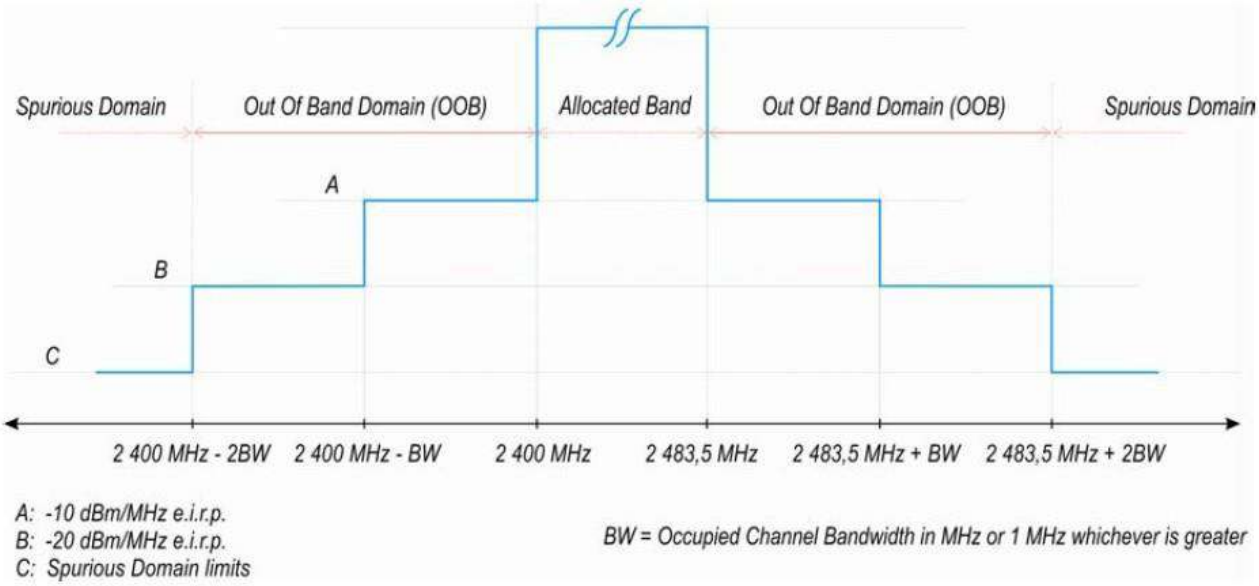
Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	Measured Frequencies		Limit	Pass/Fail
			F_L (MHz)	F_H (MHz)		
11	2405	2.261	2403.87	--	F_L > 2400 MHz and F_H < 2483.5 MHz	Pass
26	2480	2.260	--	2481.13		Pass

Note: F_L is the lowest frequency of the 99% occupied bandwidth of power envelope.
F_H is the highest frequency of the 99% occupied bandwidth of power envelope.

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

4.5.1 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.



4.5.2 Test Procedure

Refer to chapter 5.4.8.2 of EN 300 328 V2.2.2.

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

4.5.3 Deviation from Test Standard

No deviation

4.5.4 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.

4.5.5 Test Results

Refer to the test result in history report ARFR-ESH-P2004211472B-3.

Channel Frequency		2405 MHz				2480 MHz			
Test Condition		OOB Emission (MHz)				OOB Emission (MHz)			
		2400-BW ~ 2400		2400-2*BW ~ 2400-BW		2483.5 ~ 2483.5+BW		2483.5+BW ~ 2483.5+2*BW	
		Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)
Tnom	Vnom	2399.500	-36.88	2397.24	-43.77	2484	-34.26	2486.26	-44.79
Limit (dBm/MHz)		-10.00		-20.00		-10.00		-20.00	
Pass/Fail		Pass		Pass		Pass		Pass	

4.6 Transmitter Spurious Emissions in the spurious domain

4.6.1 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.

4.6.2 Test Procedure

Refer to chapter 5.4.9 of EN 300 328 V2.2.2.

Measurement Method	
☐ Conducted measurement	☒ Radiated measurement
For Conducted measurement: 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).	
Conducted measurement (For equipment with multiple transmit chains): ☐ 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)	

4.6.3 Deviation from Test Standard

No deviation.

4.6.4 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.

4.6.5 Test Results

Refer to the test result in history report ARFR-ESH-P2004211472B-3.

Below 1GHz Worst-case Data

Frequency Range	30 MHz ~ 1 GHz	Operating Channel	11

Spurious Emission Level				
Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
53.2800	H	-63.79	-54.00	-9.79
192.1113	H	-62.02	-54.00	-8.02
480.4438	H	-60.14	-54.00	-6.14
575.1400	H	-62.48	-54.00	-8.48
599.1475	H	-66.58	-54.00	-12.58
625.0950	H	-61.60	-54.00	-7.60
58.9788	V	-61.10	-54.00	-7.10
191.3838	V	-65.29	-54.00	-11.29
224.9700	V	-68.00	-54.00	-14.00
479.3525	V	-63.38	-54.00	-9.38
573.9275	V	-65.56	-54.00	-11.56
625.0950	V	-65.04	-54.00	-11.04

Above 1GHz Worst-case Data

Frequency Range	1GHz ~ 12.75GHz	Operating Channel	11 and 26

Spurious Emission Level					
Channel	Frequency (MHz)	Antenna Polarization	Level (dBm)	Limit (dBm)	Margin (dB)
11	4808.4688	H	-45.56	-30.00	-15.56
	6942.5625	H	-44.09	-30.00	-14.09
	4808.4688	V	-46.77	-30.00	-16.77
	7449.2813	V	-43.81	-30.00	-13.81
26	4961.2188	H	-46.12	-30.00	-16.12
	7384.6563	H	-44.58	-30.00	-14.58
	4958.2813	V	-46.77	-47.23	-16.77
	7374.3750	V	-42.85	-44.26	-12.85

4.7 Receiver Spurious Emissions

4.7.1 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.

4.7.2 Test Procedure

Refer to chapter 5.4.10 of EN 300 328 V2.2.2.

Measurement Method	
☐ Conducted measurement	☒ Radiated measurement
For Conducted measurement: 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).	
Conducted measurement (For equipment with multiple transmit chains): ☐ 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)	

4.7.3 Deviation from Test Standard

No deviation.

4.7.4 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.

4.7.5 Test Results

Refer to the test result in history report ARFR-ESH-P2004211472B-3.

Below 1GHz Worst-case Data

Frequency Range	30 MHz ~ 1 GHz	Operating Channel	11

Spurious Emission Level					
Channel	**Frequency (MHz)**	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
11	143.9750	H	-67.24	-57.00	-10.24
	312.0275	H	-69.66	-57.00	-12.66
	408.0575	H	-67.62	-57.00	-10.62
	583.6275	H	-68.39	-57.00	-11.39
	662.9250	H	-67.67	-57.00	-10.67
	821.6413	H	-65.96	-57.00	-8.96
	143.9750	V	-67.32	-57.00	-10.32
	233.3363	V	-70.64	-57.00	-13.64
	312.0275	V	-73.08	-57.00	-16.08
	525.3063	V	-64.31	-57.00	-7.31
	661.2275	V	-68.67	-57.00	-11.67
	756.0450	V	-67.12	-57.00	-10.12

Above 1GHz Worst-case Data

Frequency Range	1 GHz ~ 12.75 GHz	Operating Channel	11

Spurious Emission Level					
Channel	**Frequency (MHz)**	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
11	143.4900	H	-63.92	-47.00	-6.92
	294.8100	H	-67.18	-47.00	-10.18
	334.8225	H	-63.43	-47.00	-6.43
	502.2688	H	-67.34	-47.00	-10.34
	575.2613	H	-63.02	-47.00	-6.02
	781.2650	H	-63.94	-47.00	-6.94
	191.3838	V	-65.11	-47.00	-8.11
	287.6563	V	-65.48	-47.00	-8.48
	468.8038	V	-67.40	-47.00	-10.40
	574.0488	V	-66.00	-47.00	-9.00
	625.0950	V	-64.68	-47.00	-7.68
	684.5075	V	-64.98	-47.00	7.98

4.8 Receiver Blocking

4.8.1 Limit of Receiver Blocking

This requirement applies to all receiver categories.

Receiver Category		
☐**Category 1**	☒**Category 2**	☐**Category 3**
Minimum performance criterion	☒PER ≦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 × log10(OCBW)) or -68 dBm whichever is less (see note 2)	2 380 2 504	-34	CW
(-139 dBm + 10 × log10(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 Pmin + 26 dB where Pmin 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 Pmin + 20 dB where Pmin 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.

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 dBm + 10 × log10(OCBW) + 10 dB) or (-74 dBm + 10 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 Pmin + 26 dB where Pmin 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 dBm + 10 × log10(OCBW) + 20 dB) or (-74 dBm + 20 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 the test may be performed using a wanted signal up to Pmin + 30 dB where Pmin 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			

4.8.2 Test Procedure

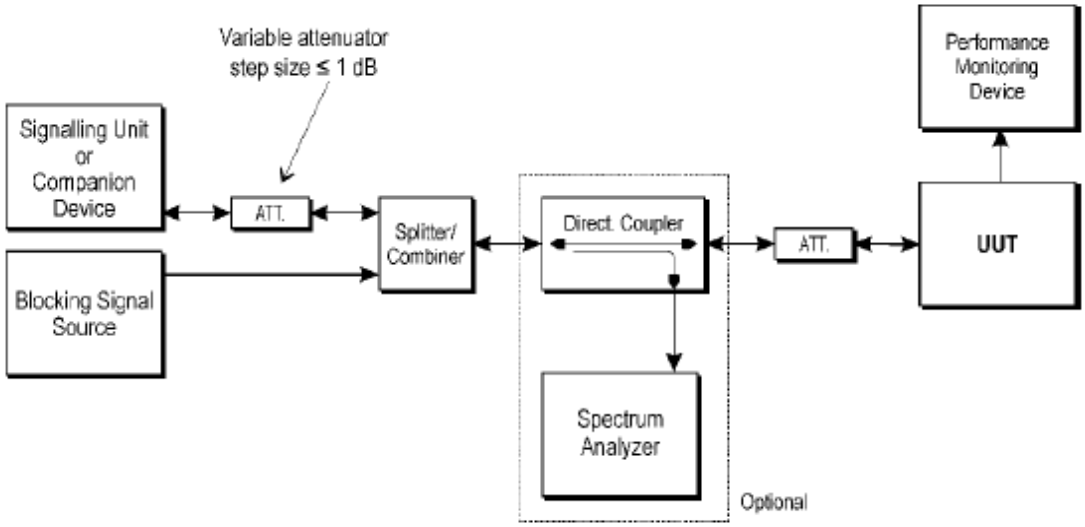
Refer to chapter 5.4.11.2 of EN 300 328 V2.2.2.

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

4.8.3 Deviation from Test Standard

No deviation.

4.8.4 Test Setup Configuration



4.8.5 Test Results

Refer to the test result in history report ARFR-ESH-P2004211472B-3.

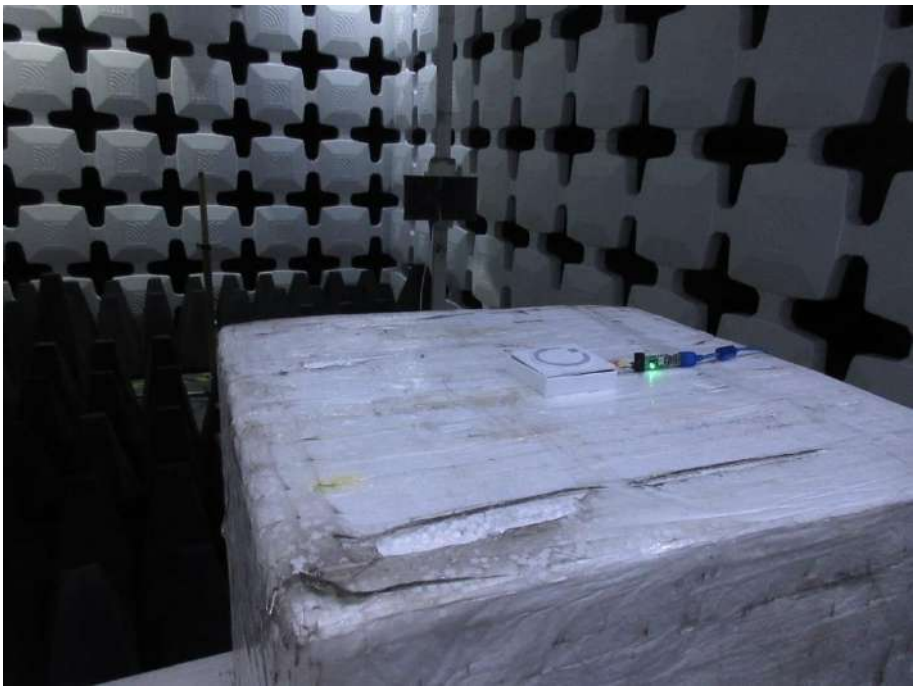
Receiver Catergory2 Equipment

Receiver blocking performance when operating at the lowest operating channel					
The actual blocking signal power (Note1)				antenna gain(G) : 1.47dBi ☒ 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					
Operation Mode	**Channel**	**Wanted signal mean power from companion device (dBm)**	**Blocking signal frequency (MHz))**	**The actual blocking signal power (dBm)**	**Pass/Fail**
Zigbee	11	-65.48	2380	-32.53	Pass
			2504	-32.53	Pass
			2300	-32.53	Pass
			2584	-32.53	Pass

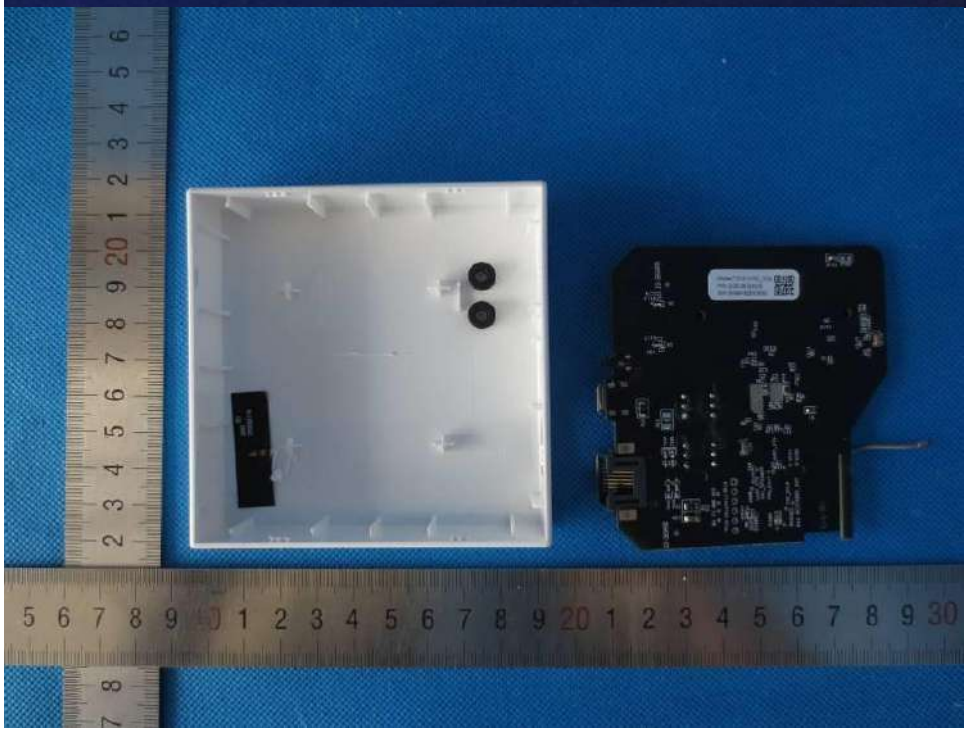
Receiver blocking performance when operating at the lowest operating channel					
The actual blocking signal power (Note1)				antenna gain(G) :2dBi ☒ at the antenna connector ☐ in front of the antenna	
Note1: For the conducted measurements , the level shall be corrected as follows: the actual blocking signal power = blocking signal power + G					
Operation Mode	**Channel**	**Wanted signal mean power from companion device (dBm)**	**Blocking signal frequency (MHz))**	**The actual blocking signal power (dBm)**	**Pass/Fail**
Zigbee	26	-65.49	2380	-32.53	Pass
			2504	-32.53	Pass
			2300	-32.53	Pass
			2584	-32.53	Pass

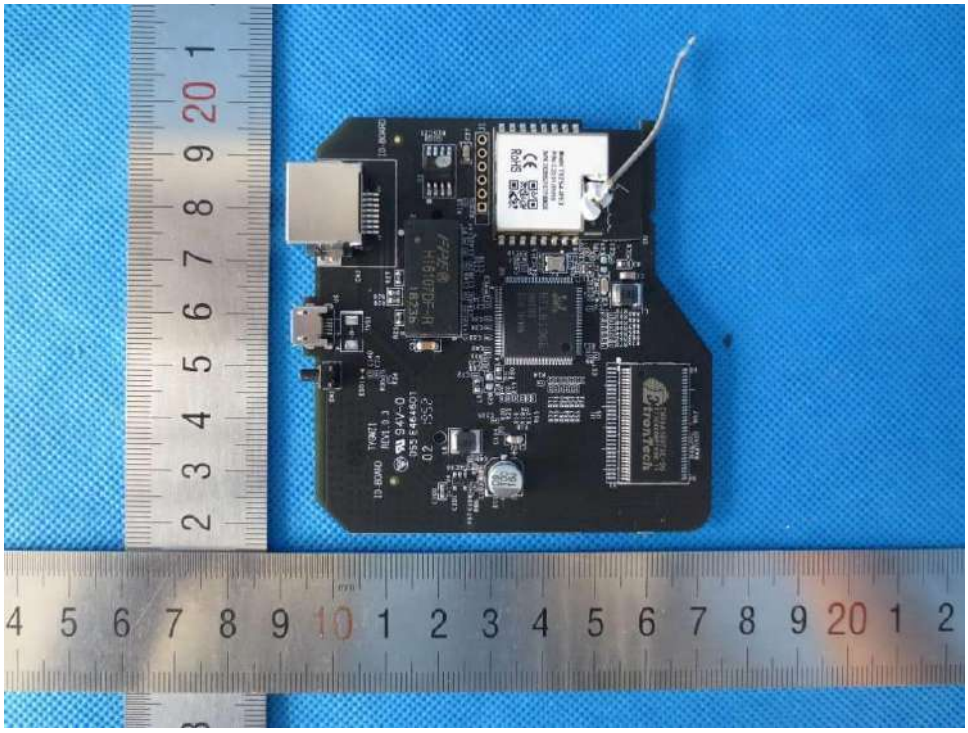
5 Photographs of the Test Configuration

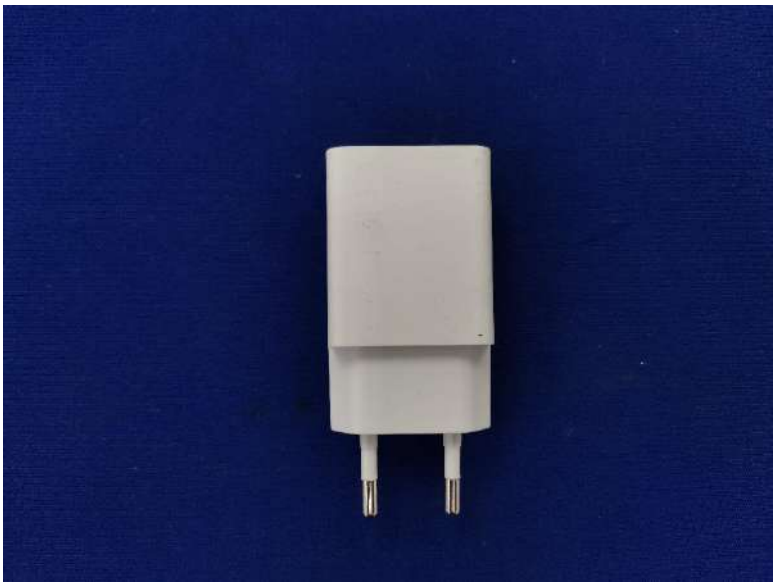
TX / RX SPURIOUS EMISSION TEST



6 Photographs of the EUT







Model: KA06E-0501000EU

Model: KA06C-0501000BS

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 ---