TEST REPORT

of

RE Directive (2014/53/EU)
ETSI EN 300 328

Product:	**ESP32 WROOM-32 module**
Brand:	**Fanstel**
Model:	**ESP32M4; ESP32E4; ESP32M16; ESP32E16; ESP32F16; ESP32F4**
Model Difference:	**Memory, Antenna . Please see page 5 for detail**
Applicant:	**Fanstel Corporation, Taipei**
Address:	**10F-10, No. 79, Sec. 1, Hsin Tai Wu Rd., Hsi-Chih, New Taipei City 221 Taiwan**

Test Performed by:

International Standards Laboratory Corp.
<LT Lab.>
*Address:
No. 120, Lane 180, Hsin Ho Rd.
Lung-Tan Dist., Tao Yuan City 325, Taiwan
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Report No.: **ISL-20LR045E328**

Issue Date : **2020/03/30**

Testing laboratory
0997

VERIFICATION OF COMPLIANCE

Applicant:	Fanstel Corporation, Taipei
Equipment Under Test:	ESP32 WROOM-32 module
Brand Name:	Fanstel
Model Number:	ESP32M4; ESP32E4; ESP32M16; ESP32E16; ESP32F16; ESP32F4
Model Different:	Memory , Antenna. Please see page 5 for detail
Date of Test:	2020/02/20 ~ 2020/03/27
Date of EUT Received:	2020/02/20

APPLICABLE STANDARDS	
STANDARD	**TEST RESULT**
ETSI EN 300 328 V2.1.1	Complied

The above equipment was tested by International Standards Laboratory Corp. for compliance with the requirements set forth in the European Standard ETSI EN 300 328 V2.1.1. under article 3.2 of RE Directive 2014/53/EU. The results of testing in this report apply to the product/system that was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Test By:	Weitin Chen	***Date:***	2020/03/30
	Weitin Chen / Senior Engineer		
Prepared By:	Gigi yeh	***Date:***	2020/03/30
	Gigi Yeh / Senior Engineer		
Approved By:	Jerry Liu	***Date:***	2020/03/30
	Jerry Liu / Technical Manager		

Version

Version No.	Date	Description
00	2020/03/30	Initial creation of document

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1. Description of Equipment under Test (EUT)

General:

Product Name:	ESP32 WROOM-32 module
Brand Name:	Fanstel
Model Name:	ESP32M4; ESP32E4; ESP32M16; ESP32E16; ESP32F16; ESP32F4
Model Difference:	Antenna. Please see table below for detail.
Type of Equipment:	Stand-alone equipment
Temperature Range:	-40°C to + 105°C
Simultaneous transmissions:	Yes
Geo-location capability:	No
Power Supply	5Vdc by USB port

Model Summaries

module	ESP32M4	ESP32F4.	ESP32E4.	ESP32M16	ESP32F16	ESP32E16.
SoC	ESP32-D0WD	ESP32-D0WD	ESP32-D0WD	ESP32-D0WD	ESP-D0WD	ESP32-D0WD
Flash memory	4MB, IS25LP032-JBLE	4MB, IS25LP032-JBLE	4MB, IS25LP032-JBLE	16MB, IS25LP128-JBLE	16MB, IS25LP128-JBLE	16MB, IS25LP128-JBLE
Size	18x25.5	18x25.5	18x25.5	18x25.5	20x29.5	18x25.5
WIFI Antenna	PCB trace	PCB trace	u.FL	PCB trace	PCB trace	u.FL
Max TX						
Operating temp.	-40ºC to +105ºC	-40ºC to +105ºC	-40ºC to +105ºC	-40ºC to +105ºC	-40ºC to +105ºC	-40ºC to +105ºC
Price at 1K pcs	$3.46			$4.33		$4.49
Availability				Sample 03/2020		Sample 03/2020

2.4GHz WLAN: 1TX/1RX SISO

Frequency Range:	2412MHz–2472MHz
Channel number:	802.11b/g: 13channels 802.11n_HT20: 13 channels 802.11n_HT40: 11 channels
Transmit Power (EIRP):	802.11b:17.92dBm 802.11g:19.82 dBm 802.11n_HT20:19.92 dBm 802.11n_HT40:19.92 dBm
Modulation Technology:	DSSS, OFDM
Antenna Designation:	PCB Antenna ESP32M : 2.22 dBi ESP32F: 1.70 dBi Dipole Antenna ESP32E : 0dBi
Modulation type:	CCK, DQPSK, DBPSK for DSSS 256QAM.64QAM. 16QAM, QPSK, BPSK for OFDM
TPC feature:	No
DFS operation mode:	N/A
Ad-hoc mode:	No.
Occupied Channel Bandwidth:	Within 2400-2483.5MHz,
Duty Cycle:	N/A
Adaptive/ Non-Adaptive:	Adaptive
LBT based Detect and Avoid:	Load Based Equipment
Antenna Beamforming:	No

The EUT is compliance with IEEE 802.11 b/g/n Standard.

This test report applies for WLAN 802.11b/g/n.

2. Description of Test Modes

The EUT has been tested under Operating condition. To control the EUT for staying in continuous transmitting and receiving mode is programmed.

802.11 b: Lowest (2412MHz), Mid (2437MHz) and Highest (2472MHz) with 1 Mbps

802.11 g: Lowest (2412MHz, Mid (2437MHz) and Highest (2472MHz) with 6 Mbps

802.11 n_20MHz: Lowest (2412MHz), Mid (2437MHz) and Highest (2472MHz) with 6.5Mbps

802.11 n_40MHz: Lowest (2422MHz), Mid (2437MHz) and Highest (2462MHz) with 13.5Mbps

The worst case of Radiated Spurious Emission was report:
1. 802.11 n_20MHz: Lowest (2412MHz), Mid (2437MHz) and Highest (2472MHz)

Normal test conditions :
Refer to section 5.1.1.2 of EN 300 328
Temperature : -20°C to + 70°C
Relative humidity: 20 % to 75 %

Normal Voltage: 5Vdc

Extreme test conditions :
Refer to section 5.1.1.3 of EN 300 328

Where tests at extreme temperatures are required, measurements shall be made over the extremes of the operating temperature range as declared by the manufacturer.

Extreme temperatures: -40°C to + 105°C

3. General Description of Applied Standards

The EUT According to the Specifications, it must comply with the requirements of the following standards:

ETSI EN 300 328 V2.1.1: 2016 – Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU

4. Test Facility

International Standards Laboratory Corp.
<LT Lab.>
No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan

A fully anechoic chamber was used for the radiated spurious emissions test.

TAF Accreditation Lab. Lab number: 0997

5. Block Diagram of Test Setup

5.1 EUT Configuration

Fig. 1 Configuration of Tested System

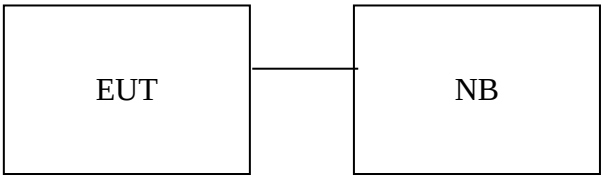


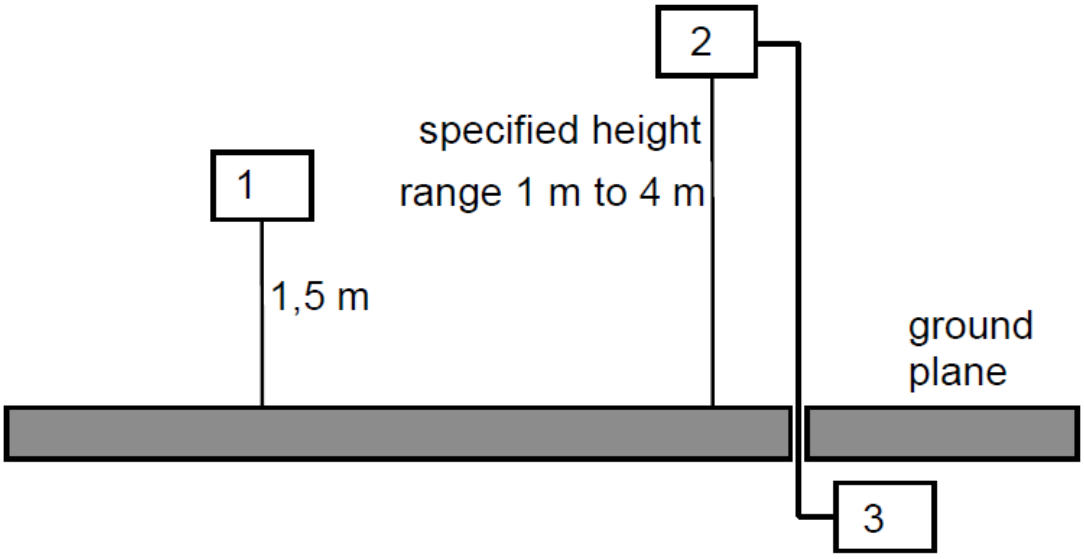
Table 1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1	NB	Lenovo	X220i	NA	Non-Shielding	Non-Shielding

5.2 Test Setup for ERP/EIRP Measurement

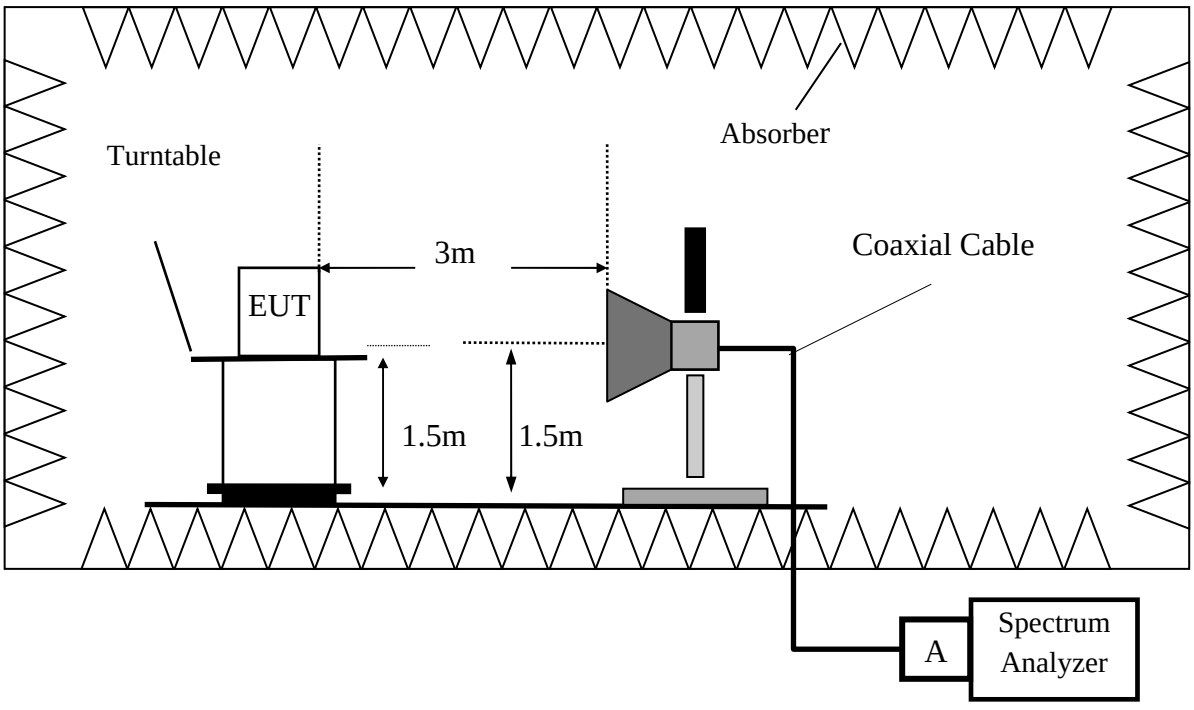
5.2.1 Step 1. Field Strength Measurement

OATS or SAR test Site

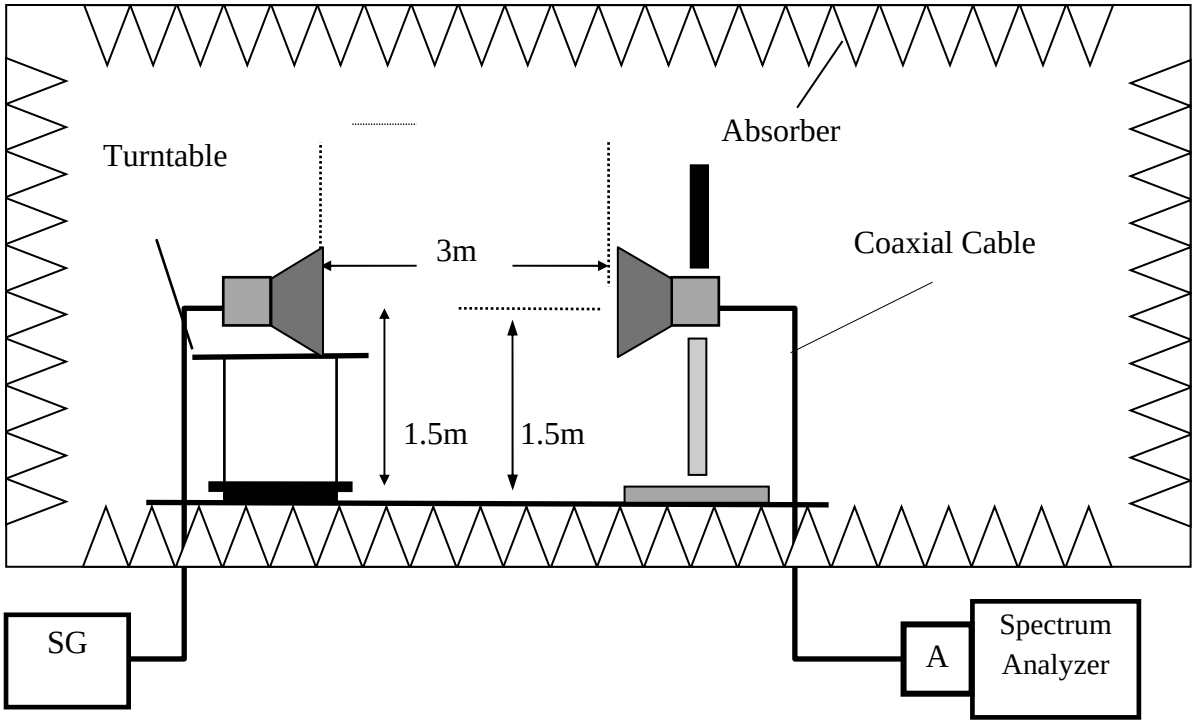


1) UUT
2) Measurement antenna
3) Measurement equipment

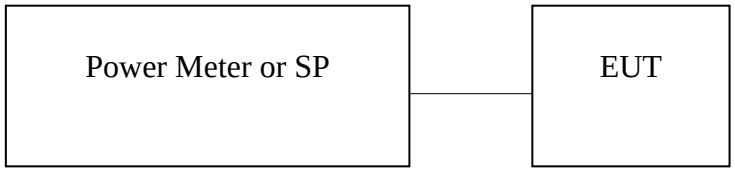
FAR Test Site



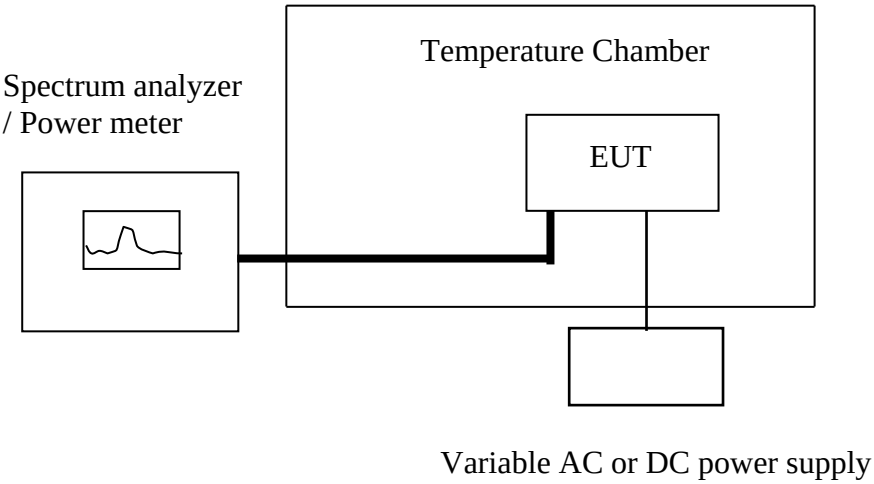
Step 2. SUBSTITUTION METHOD:



5.3 Test Setup for Conducted Measurement



5.4 Test Setup for Extreme test



5.5 Test Setup for verifying the adaptivity of an equipment

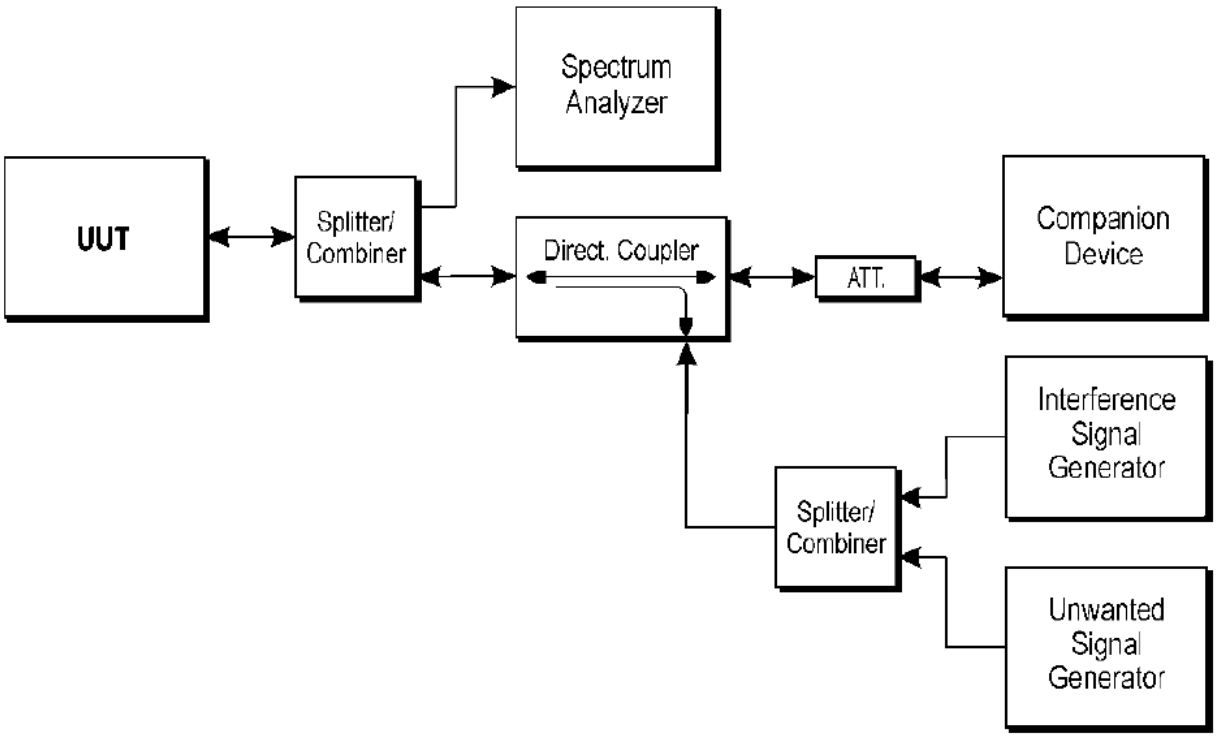


Figure 5: Test set-up for verifying the adaptivity of an equipment

5.6 Test Setup for verifying the receiver blocking of an equipment

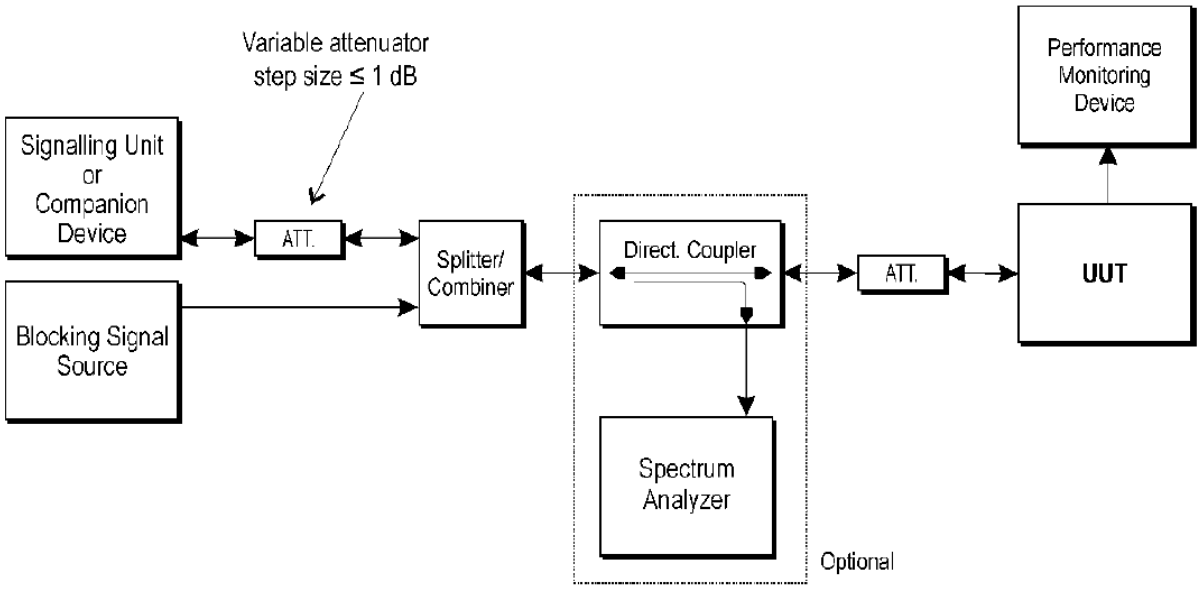


Figure 6: Test Set-up for receiver blocking

5.7 Measurement Equipment Used:

Location	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Chamber 16	Spectrum Analyzer (26.5GHz)	Agilent	N9010A	MY52100117	09/05/2019	09/05/2020
Chamber 16	Dipole antenna	Schwarzbeck	VHAP,30-300	919	05/15/2019	05/15/2021
Chamber 16	Dipole antenna	Schwarzbeck	UHAP,300-1000	1195	05/15/2019	05/15/2021
Chamber 16	Loop Antenna	EM	EM-6879	271	05/31/2019	05/31/2020
Chamber 16	Bilog Antenna	Schaffner	9168	9168-495	10/03/2019	10/03/2020
Chamber 16	Horn antenna (1GHz - 18GHz)	EM	EM-AH-10180	2011090207	03/25/2020	03/25/2021
Chamber 16	Horn antenna (18GHz - 26GHz)	Com-power	AH-826	81001	11/25/2019	11/25/2020
Chamber 16	Horn antenna (26GHz - 40GHz)	Com-power	AH-640	100A	03/29/2019	03/29/2021
Chamber 16	Preamplifier (9kHz - 1.3GHz)	HP	8447F	3113A04621	06/26/2019	06/26/2020
Chamber 16	Preamplifier (1GHz - 26GHz)	EM	EM01M26G	NA	05/06/2019	05/06/2020
Chamber 16	Preamplifier (26GHz - 40GHz)	MITEQ	JS4-26004000-27-5A	818471	05/06/2019	05/06/2020
Chamber 16	Cable (9kHz-18GHz)	HUBER SUHNER	Sucoflex 104A	1166 cable 001	01/14/2020	01/14/2021
Chamber 16	Cable (9kHz-18GHz)	HUBER SUHNER	Sucoflex 104A	1166 cable 002	12/28/2019	12/28/2020
Chamber 16	Cable (18GHz-40GHz)	HUBER SUHNER	Sucoflex 102	27963/2&37421/2	11/21/2019	11/21/2020
Chamber 16	Signal Generator	Anritsu	MG3692A	20311	01/09/2020	01/09/2021
Chamber 16	Test Software	Audix	E3 Ver:6.12023	N/A	N/A	N/A

Location Conducted	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Conducted	Power Meter	Anritsu	ML2495A	1116010	10/04/2019	10/04/2020
Conducted	Power Sensor	Anritsu	MA2411B	34NKF50	10/04/2019	10/04/2020
Conducted	Power Sensor	DARE	RPR3006W	13I00030SNO33	01/11/2020	01/11/2021
Conducted	Power Sensor	DARE	RPR3006W	14I00889SNO35	06/27/2019	06/27/2020
Conducted	Power Sensor	DARE	RPR3006W	14I00889SNO36	06/27/2019	06/27/2020
Conducted	Temperature Chamber	KSON	THS-B4H100	2287	02/19/2020	02/19/2021
Conducted	DC Power supply	ABM	8185D	N/A	01/10/2020	01/10/2021
Conducted	AC Power supply	EXTECH	CFC105W	NA	N/A	N/A
Conducted	Spectrum analyzer	Keysight	N9010A	MY56070257	10/05/2019	10/05/2020
Conducted	Spectrum analyzer	R&S	FSP40	100116	01/10/2020	01/10/2021
Conducted	Test Software	DARE	Radiation Ver:2013.1.23	NA	NA	NA
Conducted	Test Software	R&S	CMUGO Ver:2.0.0	N/A	N/A	N/A
Conducted	Radio Communication Analyzer	R&S	CMU200	111968	10/29/2019	10/29/2020
Conducted	Radio Communication Analyzer	R&S	CMW500	1201.002K50108 793-JG	10/11/2019	10/11/2020
Conducted	BT Simulator	Agilent	N4010A	MY48100200	NA	NA
Conducted	GPS Simulator	Welnavigate	GS-50	701523	NA	NA
Conducted (DFS)	Signal Generator	Agilent	E4438C	MY49071550	01/16/2020	01/16/2021
Conducted (DFS)	Signal Generator	Keysight	N5182B	MY53052399	01/09/2020	01/09/2021
Conducted (DFS)	Spectrum analyzer	Keysight	N9010A	MY56070257	10/05/2019	10/05/2020
Conducted (DFS)	AP Router	ASUS	RTAC66U	FTX1220905D	NA	NA
Conducted (DFS)	USB Adapter	D-Link	DWA-182	QBYS1D800007 3	NA	NA
Conducted (DFS)	Test Box	Keysight	AD211A	NA	NA	NA
Conducted (DFS)	Test Box	Keysight	AD191A	NA	NA	NA
Conducted (DFS)	Direction Coupler	Krytar	1821S	1461	NA	NA
Conducted (DFS)	Splitter	Mini-Circuits	ZN2PD-63-S	UU97201111	NA	NA
Conducted (DFS)	Attenuator	Woken	Watt-65m3502	11051601	NA	NA
Conducted (DFS)	Software	Agilent	Adaptive TEST	NA	NA	NA
Conducted (DFS)	Cable	Draka	NA	NA	NA	NA
Conducted (DFS)	Test Software	Keysight	N9607B DFS Radar Profiles	NA	NA	NA
Conducted (DFS)	Test Software	Keysight	ETSI Standard test system	NA	NA	NA

6. Frequency Hopping Equipment Measurement (FHSS)

6.1 ETSI EN 300 328 SUB-CLAUSE 4.3.1.2 RF Output Power

This requirement applies to all types of Frequency Hopping equipment

6.1.1 Limit: Sub-Clause 4.3.1.2.3

The maximum RF output power for adaptive Frequency Hopping equipment shall be equal to or less than 20 dBm.

The maximum RF output power for non-adaptive Frequency Hopping equipment, shall be declared by the supplier. The maximum RF output power for this equipment shall be equal to or less than the value declared by the supplier. This declared value shall be equal to or less than 20 dBm.

This limit shall apply for any combination of power level and intended antenna assembly.

6.1.2 Test Procedure:

See Sub-Clause 5.4.2.1 of ETSI EN 300 328 for the test conditions
See Sub-Clause 5.4.2.2 of ETSI EN 300 328 for the test method

6.1.3 Test Result:

N/A

6.2 ETSI EN 300 328 SUB-CLAUSE 4.3.1.3 Duty Cycle, Tx-sequence, Tx-gap

These requirements apply to non-adaptive equipment or to adaptive equipment when operating in a non-adaptive mode. The equipment is using wide band modulations other than FHSS.

These requirements do 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.

6.2.1 Limit: Sub-Clause 4.3.1.3.3

For non-adaptive FHSS equipment, the Duty Cycle shall be equal to or less than the maximum value declared by the manufacturer. In addition, the maximum Tx-sequence time shall be 5 ms while the minimum Tx-gap time shall be 5 ms.

6.2.2 Test Procedure:

See Sub-Clause 5.4.2.1 of ETSI EN 300 328 for the test conditions
See Sub-Clause 5.4.2.2 of ETSI EN 300 328 for the test method

6.2.3 Test Result:

N/A, this is adaptive device.

6.3 ETSI EN 300 328 SUB-CLAUSE 4.3.1.4 Accumulated Transmit Time, Frequency Occupation and Hopping Sequence

These requirements apply to all types of frequency hopping equipment

6.3.1 Limit: Sub-Clause 4.3.1.4.3

Non-adaptive frequency hopping systems

The Accumulated Transmit Time on any hopping frequency shall not be greater than 15 ms within any observation period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use. Adaptive frequency hopping systems

Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.

The hopping sequence(s) shall contain at least N hopping frequencies where N is either 5 or the result of 15 MHz divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater. According to clause 4.3.1.5.3.1 the minimum Hopping Frequency Separation for non-adaptive equipment is equal to the Occupied Channel Bandwidth with a minimum of 100 kHz.

Adaptive frequency hopping equipment

Adaptive Frequency Hopping equipment shall be capable of operating over a minimum of 70 % of the band specified in table 1.

The Accumulated Transmit Time on any hopping frequency shall not be greater than 400 ms within any observation period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.

Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.

The hopping sequence(s) shall contain at least N hopping frequencies at all times, where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

Other Requirements
For non-Adaptive Frequency Hopping equipment, from the N hopping frequencies defined in clause 4.3.1.4.3.1 above, the equipment shall transmit on at least one hopping frequency while other hopping frequencies are blacklisted.

For equipment that blacklists one or more hopping frequencies, these blacklisted frequencies are considered as active transmitting for the calculation of the MU factor of the equipment. See also clause 5.3.2.2.1.3 step 3, second bullet item and clause 5.3.2.2.1.4 step 3, note 2.

For Adaptive Frequency Hopping equipment, from the N hopping frequencies defined in clause 4.3.1.4.3.2 above, the equipment shall consider at least one hopping frequency for its transmissions. Providing that there is no interference present on this frequency with a level above the detection threshold defined in clause 4.3.1.7.2.2 point 5 or clause 4.3.1.7.3.2 point 5, then the equipment shall have transmissions on this frequency.

For non-Adaptive Frequency Hopping equipment, when not transmitting on a hopping frequency, the equipment has to occupy that frequency for the duration of the typical dwell time (see also definition for blacklisted frequency in clause 3.1).

For Adaptive Frequency Hopping equipment using LBT based DAA, if a signal is detected during the CCA, the equipment may jump immediately to the next frequency in the hopping sequence (see clause 4.3.1.7.2.2 point 2) provided the limit for maximum dwell is respected.

6.3.2 Test Procedure:
See Sub-Clause 5.4.4.1 of ETSI EN 300 328 for the test conditions
See Sub-Clause 5.4.4.2 of ETSI EN 300 328 for conducted method.

6.3.3 Test Result:
N/A

6.4 ETSI EN 300 328 SUB-CLAUSE 4.3.1.5 Hopping Frequency Separation

This requirement applies to all types of frequency hopping equipment.

6.4.1 Limit: Sub-Clause 4.3.1.5.3

Non-adaptive frequency hopping systems

For non-adaptive Frequency Hopping equipment, the Hopping Frequency Separation shall be equal or greater than the Occupied Channel Bandwidth (see clause 4.3.1.8), with a minimum separation of 100 kHz.

For equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for non-adaptive Frequency Hopping equipment operating in a mode where the RF Output power is less than 10 dBm e.i.r.p. only the minimum Hopping Frequency Separation of 100 kHz applies.

Adaptive frequency hopping systems

The minimum Hopping Frequency Separation shall be 100 kHz.

Adaptive Frequency Hopping equipment, which for one or more hopping frequencies, has switched to a non-adaptive mode because interference was detected on all these hopping positions with a level above the threshold level defined in clause 4.3.1.7.2.2 or clause 4.3.1.7.3.2, is allowed to continue to operate with a minimum Hopping Frequency Separation of 100 kHz on these hopping frequencies as long as the interference is present on these frequencies. The equipment shall continue to operate in an adaptive mode on other hopping frequencies.

Adaptive Frequency Hopping equipment which decided to operate in a non-adaptive mode on one or more hopping frequencies without the presence of interference, shall comply with the limit in clause 4.3.1.5.3.1 for these hopping frequencies as well as with all other requirements applicable to non-adaptive frequency hopping equipment.

6.4.2 Test Procedure:

See Sub-Clause 5.4.5.1 of ETSI EN 300 328 for the test conditions
See Sub-Clause 5.4.5.2 of ETSI EN 300 328 for conducted method.

6.4.3 Test Result:

N/A

6.5 ETSI EN 300 328 SUB-CLAUSE 4.3.1.6 Medium Utilisation (MU) factor

This requirement does not apply to adaptive equipment unless operating in a non-adaptive mode.

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.

6.5.1 Limit: Sub-Clause 4.3.1.6.3

The maximum Medium Utilisation factor for non-adaptive Frequency Hopping equipment shall be 10 %.

The Medium Utilisation (MU) factor is a measure to quantify the amount of resources (Power and Time) used by non-adaptive equipment. The Medium Utilisation factor is defined by the formula:

MU = (P/100 mW) × DC,

where: MU is Medium Utilisation factor in %.
P is the RF output power as defined in clause 4.3.1.1.1 expressed in mW.
DC is the Duty Cycle as defined in clause 4.3.1.2.1 expressed in %.

6.5.2 Test Procedure:

See Sub-Clause 5.4.2.1 of ETSI EN 300 328 for the test conditions
See Sub-Clause 5.4.2.2 of ETSI EN 300 328 for conducted method.

6.5.3 Test Result:

N/A, RF Output power level of less than 10 dBm e.i.r.p.

6.6 ETSI EN 300 328 SUB-CLAUSE 4.3.1.7 Adaptivity (Adaptive Frequency Hopping)

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.

Adaptive Frequency Hopping equipment is allowed to operate in a non-adaptive mode providing it complies with the requirements applicable to non-adaptive frequency hopping equipment. See also clause 4.3.1.5.3.2.

Adaptive Frequency Hopping equipment is allowed to have Short Control Signalling Transmissions (e.g. ACK/NACK signals, etc.) without sensing the frequency for the presence of other signals. See clause 4.3.1.7.4.

Adaptive Frequency Hopping (AFH) equipment uses a Detect And Avoid (DAA) mechanism which allows an equipment to adapt to its radio environment by identifying frequencies that are being used by other equipment.

Adaptive Frequency Hopping equipment shall implement either of the DAA mechanisms provided in clause 4.3.1.7.2 or clause 4.3.1.7.3.

Adaptive equipment is allowed to switch dynamically between different adaptive modes.

6.6.1 Limit:

ETSI EN 300 328 SUB-CLAUSE 4.3.1.7.2 Adaptive Frequency Hopping using LBT based DAA Refer to section ETSI EN 300 328 SUB-CLAUSE 4.3.1.7.2.2 Requirements & Limits

ETSI EN 300 328 SUB-CLAUSE 4.3.1.7.3 Adaptive Frequency Hopping using other forms of DAA (non-LBT based) Refer to section ETSI EN 300 328 SUB-CLAUSE 4.3.1.7.3.2 Requirements & Limits

ETSI EN 300 328 SUB-CLAUSE 4.3.1.7.4 Short Control Signaling Transmissions Refer to section ETSI EN 300 328 SUB-CLAUSE 4.3.1.7.4.2 Requirements & Limits

6.6.2 Test Procedure:

See Sub-Clause 5.4.6.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.6.2 of ETSI EN 300 328 for conducted method.

6.6.3 Test Result:

N/A, the RF Output power level of less than 10 dBm e.i.r.p

6.7 ETSI EN 300 328 SUB-CLAUSE 4.3.1.8 Occupied Channel Bandwidth

This requirement applies to all types of frequency hopping equipment

6.7.1 Limit: Sub-Clause 4.3.1.8.3

The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band given in table 1.

For non-adaptive Frequency Hopping equipment with e.i.r.p. greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the Nominal Channel Bandwidth declared by the manufacturer. See clause 5.4.1 j). This declared value shall not be greater than 5 MHz.

6.7.2 Test Procedure:

See Sub-Clause 5.4.7.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.7.2 of ETSI EN 300 328 for conducted method.

6.7.3 Test Result:

N/A

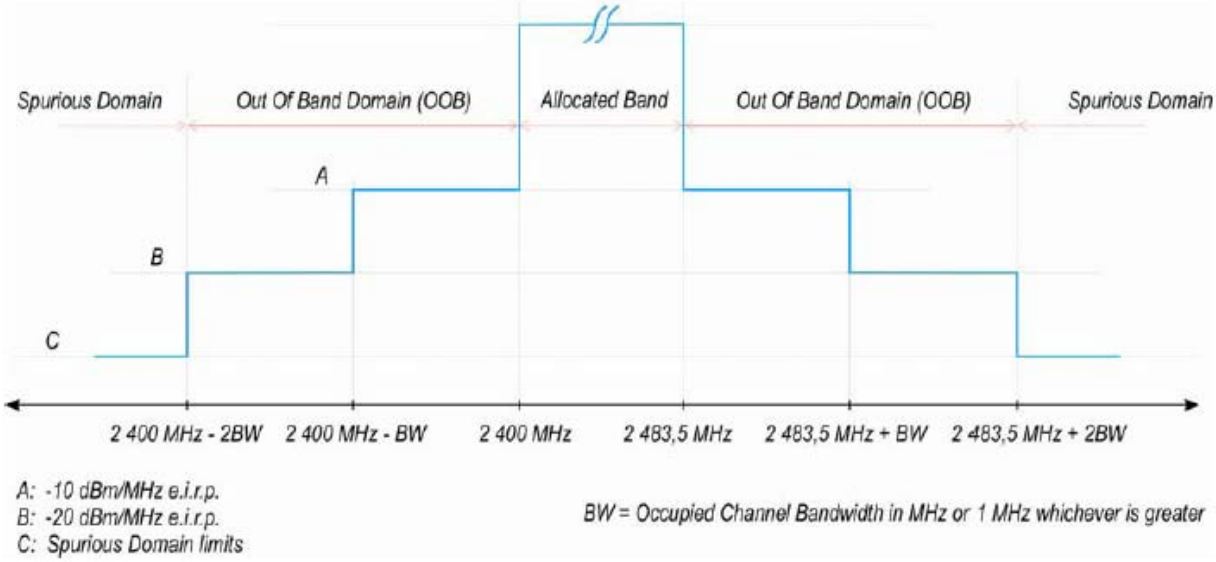
6.8 ETSI EN 300 328 SUB-CLAUSE 4.3.1.9 Transmitter Unwanted Emissions in the out-of-band Domain

This requirement applies to all types of frequency hopping equipment

6.8.1 Limit: Sub-Clause 4.3.1.9.3

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 figure 1.

Within the band specified in table 1, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.1.8.



Transmit mask

6.8.2 Test Procedure:

Conducted test method

See Sub-Clause 5.4.8.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.8.2 of ETSI EN 300 328 for conducted method.

6.8.3 Test Result:

N/A

6.9 ETSI EN 300 328 SUB-CLAUSE 4.3.1.10 Transmitter Unwanted Emissions in the Spurious Domain

This requirement applies to all types of frequency hopping equipment.

6.9.1 Limit: Sub-Clause 4.3.1.10.3

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table

In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Table 12: Transmitter limits for spurious emissions

Frequency range	Maximum power	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 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

6.9.2 Test Procedure:

See Sub-Clause 5.4.9.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.9.2 and 5.4.9.2.2 of ETSI EN 300 328 for Conducted Pre-Scan test method.

See Sub-Clause 5.4.9.2.2 of ETSI EN 300 328 for final Radiated test method.

6.9.3 Test Result:

N/A

6.10 ETSI EN 300 328 SUB-CLAUSE 4.3.1.11 Receiver Spurious Emissions

This requirement applies to all types of frequency hopping equipment.

6.10.1 Limit: Sub-Clause 4.3.1.11.3

The spurious emissions of the receiver shall not exceed the values given in table.

In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Table 13: Spurious emission limits for receivers

Frequency range	Maximum power	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

6.10.2 Test Procedure:

See Sub-Clause 5.4.10.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.10.2 and 5.4.10.2.2 of ETSI EN 300 328 for Conducted Pre-Scan test method.

See Sub-Clause 5.4.10.2.2 of ETSI EN 300 328 for final Radiated test method.

6.10.3 Test Result:

N/A

6.11 ETSI EN 300 328 SUB-CLAUSE 4.3.1.12 Receiver Blocking

This requirement applies to all receiver categories below.

Receiver categories

Receiver category 1
Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p. shall be considered as receiver category 1 equipment.

Receiver category 2
Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of 10 dBm e.i.r.p. shall be considered as receiver category 2 equipment.

Receiver category 3
Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p. shall be considered as receiver category 3 equipment.

6.11.1 Limit: Sub-Clause 4.3.1.12.4

While maintaining the minimum performance criteria as defined in clause 4.3.1.12.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 6, table 7 or table 8.

Table 6: Receiver Blocking parameters for 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
P_{min} + 6 dB	2 380 2 503,5	-53	CW
P_{min} + 6 dB	2 300 2 330 2 360	-47	CW
P_{min} + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW
NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Table 7: Receiver Blocking parameters 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
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Table 8: Receiver Blocking parameters 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
P_{min} + 12 dB	2 380 2 503,5	-57	CW
P_{min} + 12 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

6.11.2 Test Procedure:

See Sub-Clause 5.4.11.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.11.2 of ETSI EN 300 328 for conducted method.

6.11.3 Test Result:

N/A

6.12 ETSI EN 300 328 SUB-CLAUSE 4.3.1.13 Geo-location capability

This requirement only applies to equipment with geo-location capability as defined in ETSI EN 300 328 clause 4.3.1.13.2 below

Geo-location capability is a feature of the equipment to determine its geographical location with the purpose to configure itself according to the regulatory requirements applicable at the geographical location where it operates.

The geo-location capability may be present in the equipment or in an external device (temporary) associated with the equipment operating at the same geographical location during the initial power up of the equipment. The geographical location may also be available in equipment already installed and operating at the same geographical location.

6.12.1 Requirement: Sub-Clause 4.3.1.13.3

The geographical location determined by the equipment as defined in clause 4.3.2.13.2 shall not be accessible to the user.

6.12.2 Result:

N/A, the device doesn’t have Geo-location capability.

7. Other Types of Wide Band Modulation Equipment

7.1 ETSI EN 300 328 SUB-CLAUSE 4.3.2.2 RF Output Power

This requirement applies to all types of equipment using wide band modulations other than FHSS.

7.1.1 Limit: Sub-Clause 4.3.2.2.3

For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm.

The maximum RF output power for non-adaptive equipment shall be declared by the supplier and shall not exceed 20 dBm. See clause 5.3.1 m). For non-adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be equal to or less than the value declared by the supplier.

This limit shall apply for any combination of power level and intended antenna assembly.

7.1.2 Test Procedure:

See Sub-Clause 5.4.2.1 of ETSI EN 300 328 for the test conditions
See Sub-Clause 5.4.2.2 of ETSI EN 300 328 for the test method

7.1.3 Test Result :

Example Calculation:

RF Conducted Power (A) = Reading + Cable Loss

EIRP (P) = A+G+Y

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

Test Mode: 802.11 b

antenna assembly gain "G" in dBi	2.22 dBi
beamforming gain "Y" in dB	0.00 dB
Cable Loss=	21.00 dB

TEST CONDITIONS	TRANSMITTER POWER (dBm)		
	Lowest Frequency	Middle Frequency	Highest Frequency
Temp -40 °C	P 16.12 dBm A 13.90 dBm Reading -7.10 dBm	P 16.42 dBm A 14.20 dBm Reading -6.80 dBm	P 17.92 dBm A 15.70 dBm Reading -5.30 dBm
Temp 25 °C	P 11.72 dBm A 9.50 dBm Reading -11.50 dBm	P 11.72 dBm A 9.50 dBm Reading -11.50 dBm	P 13.42 dBm A 11.20 dBm Reading -9.80 dBm
Temp 105 °C	P 11.72 dBm A 9.50 dBm Reading -11.50 dBm	P 11.72 dBm A 9.50 dBm Reading -11.50 dBm	P 13.42 dBm A 11.20 dBm Reading -9.80 dBm
Limit(P)	20dBm		
Measurement uncertainty	+ 0.28dB / - 0.30dB		

Test Mode: 802.11 g

antenna assembly gain "G" in dBi 2.22 dBi

beamforming gain "Y" in dB 0.00 dB

Cable Loss= 21.00 dB

TEST CONDITIONS	TRANSMITTER POWER (dBm)		
	Lowest Frequency	Middle Frequency	Highest Frequency
Temp -40 °C	P 19.82 dBm A 17.60 dBm Reading -3.40 dBm	P 19.72 dBm A 17.50 dBm Reading -3.50 dBm	P 19.52 dBm A 17.30 dBm Reading -3.70 dBm
Temp 25 °C	P 15.72 dBm A 13.50 dBm Reading -7.50 dBm	P 15.92 dBm A 13.70 dBm Reading -7.30 dBm	P 15.52 dBm A 13.30 dBm Reading -7.70 dBm
Temp 105 °C	P 15.72 dBm A 13.50 dBm Reading -7.50 dBm	P 15.92 dBm A 13.70 dBm Reading -7.30 dBm	P 15.52 dBm A 13.30 dBm Reading -7.70 dBm
Limit(P)	20dBm		
Measurement uncertainty	+ 0.28dB / - 0.30dB		

Test Mode: 802.11n HT20

antenna assembly gain "G" in dBi 2.22 dBi

beamforming gain "Y" in dB 0.00 dB

Cable Loss= 21.00 dB

TEST CONDITIONS	TRANSMITTER POWER (dBm)		
	Lowest Frequency	Middle Frequency	Highest Frequency
Temp -40 °C	P 19.72 dBm A 17.50 dBm Reading -3.50 dBm	P 19.92 dBm A 17.70 dBm Reading -3.30 dBm	P 19.42 dBm A 17.20 dBm Reading -3.80 dBm
Temp 25 °C	P 15.52 dBm A 13.30 dBm Reading -7.70 dBm	P 15.72 dBm A 13.50 dBm Reading -7.50 dBm	P 15.32 dBm A 13.10 dBm Reading -7.90 dBm
Temp 105 °C	P 15.52 dBm A 13.30 dBm Reading -7.70 dBm	P 15.72 dBm A 13.50 dBm Reading -7.50 dBm	P 15.32 dBm A 13.10 dBm Reading -7.90 dBm
Limit(P)	20dBm		
Measurement uncertainty	+ 0.28dB / - 0.30dB		

Test Mode: 802.11n HT40

antenna assembly gain "G" in dBi 2.22 dBi

beamforming gain "Y" in dB 0.00 dB

Cable Loss= 21.00 dB

TEST CONDITIONS	TRANSMITTER POWER (dBm)		
	Lowest Frequency	Middle Frequency	Highest Frequency
Temp -40 °C	P 19.82 dBm	P 19.92 dBm	P 19.62 dBm
	A 17.60 dBm	A 17.70 dBm	A 17.40 dBm
	Reading -3.40 dBm	Reading -3.30 dBm	Reading -3.60 dBm
Temp 25 °C	P 16.02 dBm	P 15.82 dBm	P 15.62 dBm
	A 13.80 dBm	A 13.60 dBm	A 13.40 dBm
	Reading -7.20 dBm	Reading -7.40 dBm	Reading -7.60 dBm
Temp 105 °C	P 16.02 dBm	P 15.82 dBm	P 15.62 dBm
	A 13.80 dBm	A 13.60 dBm	A 13.40 dBm
	Reading -7.20 dBm	Reading -7.40 dBm	Reading -7.60 dBm
Limit(P)	20dBm		
Measurement uncertainty	+ 0.28dB / - 0.30dB		

7.2 ETSI EN 300 328 SUB-CLAUSE 4.3.2.3 Power Spectral Density

This requirement applies to all types of equipment using wide band modulations other than FHSS.

6.12.3 Limit: Sub-Clause 4.3.2.3.3

For equipment using wide band modulations other than FHSS, the maximum Power Spectral Density is limited to 10 dBm per MHz.

7.2.1 Test Procedure:

See Sub-Clause 5.4.3.1 of ETSI EN 300 328 for the test conditions
See Sub-Clause 5.4.3.2 of ETSI EN 300 328 for the test method

7.2.2 Test Result:

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

Test Mode: 802.11 b

measured power density Reading (value "A" in dBm)

antenna assembly gain "G" in dBi 2.22 dBi

beamforming gain "Y" in dB 0.00 dB

Cable Loss= 0.00 dB

Maximum Power Spectrum Density =A+G+Y

TEST CONDITIONS	Power Density Measurement		
	Ch Low dBm/1MHz	Ch Mid dBm/1MHz	Ch High dBm/1MHz
Measured power density Reading	7.72	7.41	7.26
Maximum Power Spectrum Density	9.94	9.63	9.48
Limit	10 dBm/1MHz		
Measurement Uncertainty	+ 1.5dB/ - 1.4dB		

Test Mode: 802.11 g

measured power density Reading (value "A" in dBm)

antenna assembly gain "G" in dBi 2.22 dBi

beamforming gain "Y" in dB 0.00 dB

Cable Loss= 0.00 dB

Maximum Power Spectrum Density =A+G+Y

TEST CONDITIONS	Power Density Measurement		
	Ch Low dBm/1MHz	Ch Mid dBm/1MHz	Ch High dBm/1MHz
Measured power density Reading	7.73	7.21	5.46
Maximum Power Spectrum Density	9.95	9.43	7.68
Limit	10 dBm/1MHz		
Measurement Uncertainty	+ 1.5dB/ - 1.4dB		

Test Mode: 802.11n HT20

measured power density Reading (value "A" in dBm)

antenna assembly gain "G" in dBi 2.22 dBi

beamforming gain "Y" in dB 0.00 dB

Cable Loss= 0.00 dB

Maximum Power Spectrum Density =A+G+Y

TEST CONDITIONS	Power Density Measurement		
	Ch Low dBm/1MHz	Ch Mid dBm/1MHz	Ch High dBm/1MHz
Measured power density Reading	7.74	7.19	5.51
Maximum Power Spectrum Density	9.96	9.41	7.73
Limit	10 dBm/1MHz		
Measurement Uncertainty	+ 1.5dB/ - 1.4dB		

Test Mode: 802.11n HT40

measured power density Reading (value "A" in dBm)

antenna assembly gain "G" in dBi 2.22 dBi

beamforming gain "Y" in dB 0.00 dB

Cable Loss= 0.00 dB

Maximum Power Spectrum Density =A+G+Y

TEST CONDITIONS	Power Density Measurement		
	Ch Low dBm/1MHz	Ch Mid dBm/1MHz	Ch High dBm/1MHz
Measured power density Reading	5.51	5.15	3.98
Maximum Power Spectrum Density	7.73	7.37	6.20
Limit	10 dBm/1MHz		
Measurement Uncertainty	+ 1.5dB/ - 1.4dB		

7.3 ETSI EN 300 328 SUB-CLAUSE 4.3.2.4 Duty Cycle, Tx-sequence, Tx-gap

These requirements apply to non-adaptive equipment or to adaptive equipment when operating in a non-adaptive mode.

The equipment is using wide band modulations other than FHSS.
These requirements do 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.

7.3.1 Limit: Sub-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 10 ms. The minimum Tx-gap time following a Tx-sequence shall be equal to the duration of that proceeding Tx-sequence with a minimum of 3,5 ms.

7.3.2 Test Procedure:

See Sub-Clause 5.4.2.1 of ETSI EN 300 328 for the test conditions
See Sub-Clause 5.4.2.2 of ETSI EN 300 328 for conducted method.

7.3.3 Test Result:

N/A, this is adaptive device without non-adaptive mode.

7.4 ETSI EN 300 328 SUB-CLAUSE 4.3.2.5 Medium Utilization (MU) factor

This requirement does not apply to adaptive equipment unless operating in a non-adaptive mode.

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.

7.4.1 Limit: Sub-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 %.

The Medium Utilisation (MU) factor is a measure to quantify the amount of resources (Power and Time) used by non-adaptive equipment. The Medium Utilisation factor is defined by the formula:

MU = (P/100 mW) × DC,

where: MU is Medium Utilisation factor in %.

P is the RF output power as defined in clause 4.3.1.1.1 expressed in mW.

DC is the Duty Cycle as defined in clause 4.3.1.2.1 expressed in %.

7.4.2 Test Procedure:

See Sub-Clause 5.4.5.1 of ETSI EN 300 328 for the test conditions
See Sub-Clause 5.4.5.2 of ETSI EN 300 328 for conducted method.

7.4.3 Test Result:

N/A, this is adaptive device without non-adaptive mode.

7.5 ETSI EN 300 328 SUB-CLAUSE 4.3.2.6 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.

Adaptive equipment using modulations other than FHSS is allowed to operate in a non-adaptive mode providing it complies with the requirements applicable to non-adaptive equipment.

An adaptive equipment using modulations other than FHSS is equipment that uses a mechanism by which it can adapt to its radio environment by identifying other transmissions present within its Occupied Channel Bandwidth.

Adaptive equipment using modulations other than FHSS shall implement either of the Detect and Avoid mechanisms provided in clause 4.3.2.6.2 or clause 4.3.2.6.3.

Adaptive equipment is allowed to switch dynamically between different adaptive modes.

7.5.1 Requirements & Limit:

Frame Based Equipment: refer to ETSI EN 300 328 SUB-CLAUSE 4.3.2.6.2.2 Requirements & Limits

$$TL = -70\ \text{dBm/MHz} + 10 \times \log_{10}(100\ \text{mW} / \text{Pout}) \qquad (\text{Pout in mW e.i.r.p.})$$

Table 9: Unwanted Signal parameters

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. See clause 5.4.6.1.		
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.		

Load Based Equipment: refer to ETSI EN 300 328 SUB-CLAUSE 4.3.2.6.3.2.3 Requirements & Limits

$$TL = -70\ dBm/MHz + 10 \times \log_{10}(100\ mW / Pout) \qquad (Pout\ in\ mW\ e.i.r.p.)$$

Table 10: Unwanted Signal parameters

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.		

Short Control Signaling Transmissions: refer to ETSI EN 300 328 SUB-CLAUSE 4.3.2.6.4 Limits

If implemented, Short Control Signalling Transmissions of adaptive equipment using wide band modulations other than
FHSS shall have a maximum TxOn / (TxOn + TxOff) ratio of 10 % within any observation period of 50 ms.
NOTE: Duty Cycle is defined in clause 4.3.2.4.2.

7.5.2 Test Procedure:

See Sub-Clause 5.4.6.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.6.2 of ETSI EN 300 328 for conducted method.

7.5.3 Test Result: N/A

7.6 ETSI EN 300 328 SUB-CLAUSE 4.3.2.7 Occupied Channel Bandwidth

This requirement applies to all types of equipment using wide band modulations other than FHSS.

7.6.1 Limit: Sub-Clause 4.3.2.7.3

The Occupied Channel Bandwidth shall fall completely within the band given in clause 1.

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.

7.6.2 Test Procedure:

See Sub-Clause 5.4.7.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.7.2 of ETSI EN 300 328 for conducted method.

7.6.3 Test Result :

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

Test Mode: 802.11 b

Occupied Channel Bandwidth		
	Channel Low	**Channel High**
Occupied Bandwidth (MHz)	12.92	12.89
Lowest/Highest Frequency (MHz)	2405.4480	2468.7400
Limit (Operating in the band)	2400~2483.5 MHz	
Measurement Uncertainty	+/- 120kHz	

Test Mode: 802.11 g

Occupied Channel Bandwidth		
	Channel Low	**Channel High**
Occupied Bandwidth (MHz)	17.21	17.25
Lowest/Highest Frequency (MHz)	2403.4200	2470.4800
Limit (Operating in the band)	2400~2483.5 MHz	
Measurement Uncertainty	+/- 120kHz	

Test Mode: 802.11 20n

Occupied Channel Bandwidth		
	Channel Low	**Channel High**
Occupied Bandwidth (MHz)	17.55	17.54
Lowest/Highest Frequency (MHz)	2403.2320	2480.7110
Limit (Operating in the band)	2400~2483.5 MHz	
Measurement Uncertainty	+/- 120kHz	

Test Mode: 802.11 40n

Occupied Channel Bandwidth		
	Channel Low	**Channel High**
Occupied Bandwidth (MHz)	35.49	35.89
Lowest/Highest Frequency (MHz)	2404.4060	2480.0750
Limit (Operating in the band)	2400~2483.5 MHz	
Measurement Uncertainty	+/- 120kHz	

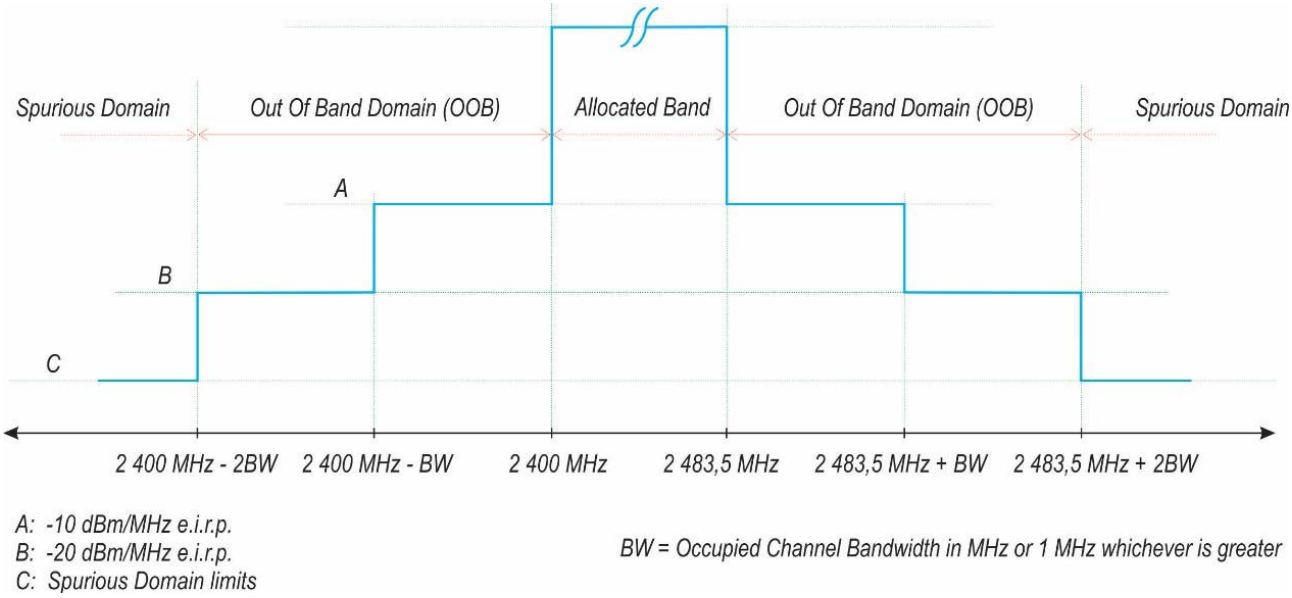
7.7 ETSI EN 300 328 SUB-CLAUSE 4.3.2.8 Transmitter Unwanted Emissions in the out-of-band Domain

This requirement applies to all types of equipment using wide band modulations other than FHSS.

7.7.1 Limit: Sub-Clause 4.3.2.8.3

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 figure 3.

Within the band specified in table 1, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.2.7.



Transmit mask

7.7.2 Test Procedure:

Conducted test method

See Sub-Clause 5.4.8.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.8.2 of ETSI EN 300 328 for conducted method.

7.7.3 Test Result:

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

802.11b

antenna assembly gain "G" in dBi 2.22 dBi

beamforming gain "Y" in dB 0 dB

Cable Loss= 0 dB

Out of Band Domain Emission				
Test condition	2400 ~ 2400-BW	2400-BW ~ 2400-2BW	2483.5 ~ 2483.5+BW	2483.5+BW ~ 2483.5+2BW
Temp -40 °C	-44.16	-33.08	-33.91	-42.14
Temp 25 °C	-41.89	-33.21	-35.02	-41.66
Temp 105 °C	-43.15	-35.51	-34.64	-44.34
Limit(dBm/MHz)	**-10**	**-20**	**-10**	**-20**
Measurement Uncertainty	+/- 2.45dB			

802.11g

antenna assembly gain "G" in dBi 2.22 dBi

beamforming gain "Y" in dB 0 dB

Cable Loss= 0 dB

Out of Band Domain Emission				
Test condition	2400 ~ 2400-BW	2400-BW ~ 2400-2BW	2483.5 ~ 2483.5+BW	2483.5+BW ~ 2483.5+2BW
Temp -40 °C	-42.34	-33.11	-33.83	-44.84
Temp 25 °C	-43.84	-34.67	-36.8	-44.48
Temp 105 °C	-42.92	-36.04	-34.83	-42.26
Limit(dBm/MHz)	**-10**	**-20**	**-10**	**-20**
Measurement Uncertainty	+/- 2.45dB			

802.11n HT20

antenna assembly gain "G" in dBi 2.2 dBi

beamforming gain "Y" in dB 0 dB

Cable Loss= 0 dB

Out of Band Domain Emission				
Test condition	2400 ~ 2400-BW	2400-BW ~ 2400-2BW	2483.5 ~ 2483.5+BW	2483.5+BW ~ 2483.5+2BW
Temp -40 °C	-40.23	-34.12	-30.72	-41.66
Temp 25 °C	-42.71	-35.05	-30.39	-40.74
Temp 105 °C	-42.09	-35.95	-31.61	-42.32
Limit(dBm/MHz)	**-10**	**-20**	**-10**	**-20**
Measurement Uncertainty	+/- 2.45dB			

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antenna assembly gain "G" in dBi 2.2 dBi

beamforming gain "Y" in dB 0 dB

Cable Loss= 0 dB

Out of Band Domain Emission				
Test condition	2400 ~ 2400-BW	2400-BW ~ 2400-2BW	2483.5 ~ 2483.5+BW	2483.5+BW ~ 2483.5+2BW
Temp -40 °C	-44.50	-35.87	-32.67	-44.12
Temp 25 °C	-40.29	-35.87	-32.37	-41.76
Temp 105 °C	-40.02	-30.14	-31.73	-43.30
Limit(dBm/MHz)	**-10**	**-20**	**-10**	**-20**
Measurement Uncertainty	+/- 2.45dB			

7.8 ETSI EN 300 328 SUB-CLAUSE 4.3.2.9 Transmitter Unwanted Emissions in the Spurious Domain

This requirement applies to all types of equipment using wide band modulations other than FHSS.

7.8.1 Limit: Sub-Clause 4.3.2.9.3

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table

In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Table 12: Transmitter limits for spurious emissions

Frequency range	Maximum power	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 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

7.8.2 Test Procedure:

See Sub-Clause 5.4.9.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.9.2 and 5.4.9.2.2 of ETSI EN 300 328 for Conducted Pre-Scan test method.

See Sub-Clause 5.4.9.2.2 of ETSI EN 300 328 for final Radiated test method.

7.8.3 Test Result:

Dipole Ant:

Test Mode: 802.11n_HT20 mode, TX CH Low

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	30.00	-72.01	8.27	-63.74	-40.00	-23.74	VERTICAL
2	96.93	-66.49	-0.23	-66.72	-40.00	-26.72	VERTICAL
3	571.26	-81.51	9.45	-72.06	-40.00	-32.06	VERTICAL
4	739.07	-82.47	13.75	-68.72	-40.00	-28.72	VERTICAL
5	809.88	-82.69	13.72	-68.97	-40.00	-28.97	VERTICAL
6	933.07	-82.42	17.39	-65.03	-40.00	-25.03	VERTICAL
7	4804.00	-79.43	15.71	-63.72	-40.00	-23.72	VERTICAL
8	6299.00	-77.19	19.19	-58.00	-40.00	-18.00	VERTICAL
1	30.97	-77.33	10.48	-66.85	-40.00	-26.85	HORIZONTAL
2	106.63	-73.57	1.11	-72.46	-40.00	-32.46	HORIZONTAL
3	476.20	-81.68	8.39	-73.29	-40.00	-33.29	HORIZONTAL
4	595.51	-82.70	11.13	-71.57	-40.00	-31.57	HORIZONTAL
5	671.17	-81.68	12.03	-69.65	-40.00	-29.65	HORIZONTAL
6	741.98	-82.65	14.01	-68.64	-40.00	-28.64	HORIZONTAL
7	4804.00	-79.18	15.63	-63.55	-40.00	-23.55	HORIZONTAL
8	6481.00	-78.67	23.69	-54.98	-40.00	-14.98	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm)+Aux(dB)
5. Measurement Range upto 12.75GHz.

Test Mode: 802.11n_HT20 mode, TX CH High

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	90.14	-66.05	0.59	-65.46	-40.00	-25.46	VERTICAL
2	205.57	-73.07	1.98	-71.09	-40.00	-31.09	VERTICAL
3	528.58	-81.98	8.93	-73.05	-40.00	-33.05	VERTICAL
4	640.13	-82.24	11.71	-70.53	-40.00	-30.53	VERTICAL
5	718.70	-82.14	13.82	-68.32	-40.00	-28.32	VERTICAL
6	833.16	-81.10	14.39	-66.71	-40.00	-26.71	VERTICAL
7	4960.00	-76.22	16.40	-59.82	-40.00	-19.82	VERTICAL
8	7545.00	-79.24	23.35	-55.89	-40.00	-15.89	VERTICAL
1	70.74	-75.08	4.38	-70.70	-40.00	-30.70	HORIZONTAL
2	200.72	-72.47	1.28	-71.19	-40.00	-31.19	HORIZONTAL
3	480.08	-80.38	8.39	-71.99	-40.00	-31.99	HORIZONTAL
4	583.87	-82.05	10.86	-71.19	-40.00	-31.19	HORIZONTAL
5	679.90	-81.56	12.18	-69.38	-40.00	-29.38	HORIZONTAL
6	784.66	-81.78	14.20	-67.58	-40.00	-27.58	HORIZONTAL
7	4960.00	-78.64	16.15	-62.49	-40.00	-22.49	HORIZONTAL
8	6404.00	-77.97	22.98	-54.99	-40.00	-14.99	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm)+Aux(dB)
5. Measurement Range upto 12.75GHz.

PCB Ant:

Test Mode: 802.11n_HT20 mode, TX CH Low

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	90.14	-72.53	0.59	-71.94	-40.00	-31.94	VERTICAL
2	251.16	-75.91	4.86	-71.05	-40.00	-31.05	VERTICAL
3	514.03	-80.05	8.94	-71.11	-40.00	-31.11	VERTICAL
4	612.00	-80.61	10.62	-69.99	-40.00	-29.99	VERTICAL
5	766.23	-81.13	13.62	-67.51	-40.00	-27.51	VERTICAL
6	883.60	-83.10	16.16	-66.94	-40.00	-26.94	VERTICAL
7	4804.00	-75.28	15.71	-59.57	-40.00	-19.57	VERTICAL
8	7013.00	-79.40	21.94	-57.46	-40.00	-17.46	VERTICAL
1	90.14	-66.00	0.70	-65.30	-40.00	-25.30	HORIZONTAL
2	573.20	-81.13	10.61	-70.52	-40.00	-30.52	HORIZONTAL
3	657.59	-81.39	11.79	-69.60	-40.00	-29.60	HORIZONTAL
4	773.02	-81.36	14.22	-67.14	-40.00	-27.14	HORIZONTAL
5	893.30	-82.38	15.64	-66.74	-40.00	-26.74	HORIZONTAL
6	944.71	-81.68	16.91	-64.77	-40.00	-24.77	HORIZONTAL
7	4804.00	-70.08	15.71	-54.37	-40.00	-14.37	HORIZONTAL
8	6278.00	-78.09	19.15	-58.94	-40.00	-18.94	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm)+Aux(dB)
5. Measurement Range upto 12.75GHz.

Test Mode: 802.11n_HT20 mode, TX CH High

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	96.93	-65.62	-0.23	-65.85	-40.00	-25.85	VERTICAL
2	478.14	-78.78	8.99	-69.79	-40.00	-29.79	VERTICAL
3	572.23	-81.79	9.47	-72.32	-40.00	-32.32	VERTICAL
4	653.71	-80.93	12.22	-68.71	-40.00	-28.71	VERTICAL
5	811.82	-82.03	13.78	-68.25	-40.00	-28.25	VERTICAL
6	911.73	-81.76	17.00	-64.76	-40.00	-24.76	VERTICAL
7	2001.00	-64.13	4.63	-59.50	-40.00	-19.50	VERTICAL
8	4960.00	-77.57	16.40	-61.17	-40.00	-21.17	VERTICAL
1	106.63	-73.31	1.11	-72.20	-40.00	-32.20	HORIZONTAL
2	282.20	-74.45	3.99	-70.46	-40.00	-30.46	HORIZONTAL
3	399.57	-78.71	6.86	-71.85	-40.00	-31.85	HORIZONTAL
4	577.08	-82.02	10.70	-71.32	-40.00	-31.32	HORIZONTAL
5	677.96	-82.08	12.15	-69.93	-40.00	-29.93	HORIZONTAL
6	796.30	-82.34	14.17	-68.17	-40.00	-28.17	HORIZONTAL
7	4960.00	-74.05	16.40	-57.65	-40.00	-17.65	HORIZONTAL
8	7664.00	-79.43	23.76	-55.67	-40.00	-15.67	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm)+Aux(dB)
5. Measurement Range upto 12.75GHz.

7.9 ETSI EN 300 328 SUB-CLAUSE 4.3.2.10 Receiver Spurious Emissions

This requirement applies to all types of equipment using wide band modulations other than FHSS.

7.9.1 Limit: Sub-Clause 4.3.2.10.3

The spurious emissions of the receiver shall not exceed the values given in table

In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Table 13: Spurious emission limits for receivers

Frequency range	Maximum power	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

7.9.2 Test Procedure:

See Sub-Clause 5.4.10.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.10.2 and 5.4.10.2.2 of ETSI EN 300 328 for Conducted Pre-Scan test method.

See Sub-Clause 5.4.10.2.2 of ETSI EN 300 328 for final Radiated test method.

7.9.3 Test Result:

Dipole Ant:

Test Mode: 802.11n_HT20 mode, RX CH Low (Worst case)

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	30.97	-72.32	7.94	-64.38	-54.82	-9.56	VERTICAL
2	90.14	-68.37	0.59	-67.78	-54.82	-12.96	VERTICAL
3	226.91	-73.07	3.44	-69.63	-54.82	-14.81	VERTICAL
4	422.85	-78.51	7.52	-70.99	-54.82	-16.17	VERTICAL
5	588.72	-80.77	9.87	-70.90	-54.82	-16.08	VERTICAL
6	751.68	-80.53	13.70	-66.83	-54.82	-12.01	VERTICAL
7	3268.00	-72.77	8.41	-64.36	-44.84	-19.52	VERTICAL
8	7160.00	-78.69	22.33	-56.36	-44.84	-11.52	VERTICAL
1	30.97	-75.95	10.48	-65.47	-54.82	-10.65	HORIZONTAL
2	106.63	-73.37	1.11	-72.26	-54.82	-17.44	HORIZONTAL
3	167.74	-73.46	3.25	-70.21	-54.82	-15.39	HORIZONTAL
4	372.41	-79.52	5.98	-73.54	-54.82	-18.72	HORIZONTAL
5	532.46	-81.38	9.49	-71.89	-54.82	-17.07	HORIZONTAL
6	705.12	-81.71	12.71	-69.00	-54.82	-14.18	HORIZONTAL
7	4955.00	-74.29	16.13	-58.16	-44.84	-13.32	HORIZONTAL
8	7034.00	-79.44	23.55	-55.89	-44.84	-11.05	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm)+Aux(dB)
5. Measurement Range upto 12.75GHz.

Test Mode: 802.11n_HT20 mode, RX CH High (Worst case)

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	30.97	-73.45	7.94	-65.51	-54.82	-10.69	VERTICAL
2	90.14	-66.31	0.59	-65.72	-54.82	-10.90	VERTICAL
3	154.16	-79.06	5.76	-73.30	-54.82	-18.48	VERTICAL
4	399.57	-79.08	6.14	-72.94	-54.82	-18.12	VERTICAL
5	512.09	-81.36	8.94	-72.42	-54.82	-17.60	VERTICAL
6	741.98	-82.48	13.74	-68.74	-54.82	-13.92	VERTICAL
7	4955.00	-75.02	16.38	-58.64	-44.84	-13.80	VERTICAL
8	7503.00	-80.15	23.20	-56.95	-44.84	-12.11	VERTICAL
1	30.00	-76.53	10.91	-65.62	-54.82	-10.80	HORIZONTAL
2	106.63	-72.56	1.11	-71.45	-54.82	-16.63	HORIZONTAL
3	246.31	-75.14	4.38	-70.76	-54.82	-15.94	HORIZONTAL
4	399.57	-79.66	6.86	-72.80	-54.82	-17.98	HORIZONTAL
5	567.38	-81.50	10.47	-71.03	-54.82	-16.21	HORIZONTAL
6	754.59	-81.75	14.27	-67.48	-54.82	-12.66	HORIZONTAL
7	4955.00	-74.19	16.13	-58.06	-44.84	-13.22	HORIZONTAL
8	6670.00	-79.31	23.76	-55.55	-44.84	-10.71	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm)+Aux(dB)
5. Measurement Range upto 12.75GHz.

PCB Ant:

Test Mode: 802.11n_HT20 mode, RX CH Low (Worst case)

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	30.97	-72.10	7.94	-64.16	-54.82	-9.34	VERTICAL
2	90.14	-67.38	0.59	-66.79	-54.82	-11.97	VERTICAL
3	201.69	-72.77	1.69	-71.08	-54.82	-16.26	VERTICAL
4	469.41	-78.90	9.01	-69.89	-54.82	-15.07	VERTICAL
5	673.11	-82.81	12.93	-69.88	-54.82	-15.06	VERTICAL
6	772.05	-82.05	13.58	-68.47	-54.82	-13.65	VERTICAL
7	4955.00	-75.44	16.38	-59.06	-44.84	-14.22	VERTICAL
8	6999.00	-78.71	21.91	-56.80	-44.84	-11.96	VERTICAL
1	31.94	-76.39	7.61	-68.78	-54.82	-13.96	HORIZONTAL
2	144.46	-78.95	5.57	-73.38	-54.82	-18.56	HORIZONTAL
3	246.31	-73.81	4.66	-69.15	-54.82	-14.33	HORIZONTAL
4	381.14	-80.47	5.91	-74.56	-54.82	-19.74	HORIZONTAL
5	547.01	-81.51	8.91	-72.60	-54.82	-17.78	HORIZONTAL
6	767.20	-82.72	13.61	-69.11	-54.82	-14.29	HORIZONTAL
7	2008.00	-70.75	4.81	-65.94	-44.84	-21.10	HORIZONTAL
8	4955.00	-74.67	16.13	-58.54	-44.84	-13.70	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm)+Aux(dB)
5. Measurement Range upto 12.75GHz.

Test Mode: 802.11n_HT20 mode, RX CH High (Worst case)

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

No	Freq MHz	Reading dBm	Aux dB	Level dBm	Limit dBm	Margin dB	Pol V/H
1	30.97	-71.68	7.94	-63.74	-54.82	-8.92	VERTICAL
2	90.14	-67.18	0.59	-66.59	-54.82	-11.77	VERTICAL
3	184.23	-73.82	2.89	-70.93	-54.82	-16.11	VERTICAL
4	316.15	-78.01	4.68	-73.33	-54.82	-18.51	VERTICAL
5	422.85	-77.07	7.52	-69.55	-54.82	-14.73	VERTICAL
6	630.43	-82.06	11.34	-70.72	-54.82	-15.90	VERTICAL
7	1994.00	-66.06	4.60	-61.46	-44.84	-16.62	VERTICAL
8	2239.00	-70.34	5.23	-65.11	-44.84	-20.27	VERTICAL
9	4955.00	-77.51	16.38	-61.13	-44.84	-16.29	VERTICAL
10	5809.00	-78.86	18.33	-60.53	-44.84	-15.69	VERTICAL
1	30.00	-76.68	10.91	-65.77	-54.82	-10.95	HORIZONTAL
2	90.14	-72.92	0.70	-72.22	-54.82	-17.40	HORIZONTAL
3	167.74	-75.58	3.25	-72.33	-54.82	-17.51	HORIZONTAL
4	251.16	-75.20	4.59	-70.61	-54.82	-15.79	HORIZONTAL
5	516.94	-81.06	8.99	-72.07	-54.82	-17.25	HORIZONTAL
6	833.16	-80.65	14.70	-65.95	-54.82	-11.13	HORIZONTAL
7	1931.00	-71.02	4.48	-66.54	-44.84	-21.70	HORIZONTAL
8	4955.00	-73.83	16.13	-57.70	-44.84	-12.86	HORIZONTAL

Measurement uncertainty	30MHz - 80MHz: 5.04dB
	80MHz -1000MHz: 3.76dB
	1GHz - 26GHz: 4.45dB

Remark:

1. The emission behaviors belong to narrowband spurious emission.
2. Remark " --- " means that the emission level is too low to be measured
3. Aux: Field strength to EIRP correction factor
4. Level (dBm) = Reading (dBm)+Aux(dB)
5. Measurement Range upto 12.75GHz.

7.10 ETSI EN 300 328 SUB-CLAUSE 4.3.2.11 Receiver Blocking

This requirement applies to all receiver categories below.

Receiver categories

Receiver category 1
Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p. shall be considered as receiver category 1 equipment.

Receiver category 2
Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of 10 dBm e.i.r.p. shall be considered as receiver category 2 equipment.

Receiver category 3
Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p. shall be considered as receiver category 3 equipment.

7.10.1 Limit: Sub-Clause 4.3.2.11.3

While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 14, table 15 or table 16.

Table 14: Receiver Blocking parameters for 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
P_{min} + 6 dB	2 380 2 503,5	-53	CW
P_{min} + 6 dB	2 300 2 330 2 360	-47	CW
P_{min} + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Table 15: Receiver Blocking parameters 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
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Table 16: Receiver Blocking parameters 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
P_{min} + 12 dB	2 380 2 503,5	-57	CW
P_{min} + 12 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

7.10.2 Test Procedure:

See Sub-Clause 5.4.11.1 of ETSI EN 300 328 for the test conditions

See Sub-Clause 5.4.11.2 of ETSI EN 300 328 for conducted method.

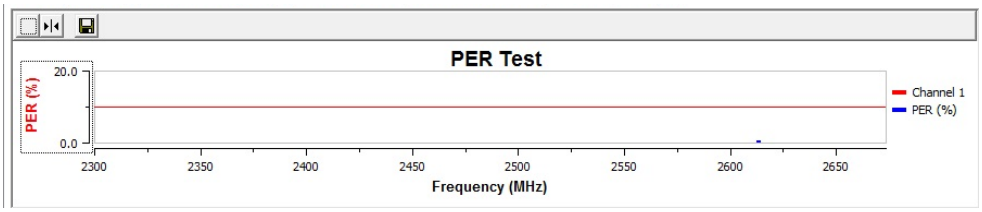
7.10.3 Test Result::

Ambient temperature: 25℃ Relative humidity: 60% Test Date: 2020/03/22

WiFi mode:

Test Detail - Receiver Blocking Test

Blocking Freq (MHz)	PER (%)	Limit (%)	Status
2300	0	10	Pass
2330	0	10	Pass
2360	0.1487362	10	Pass
2380	0	10	Pass
2503.5	0	10	Pass
2523.5	0.1988373	10	Pass
2553.5	0	10	Pass
2583.5	0	10	Pass
2613.5	0.5827362	10	Pass
2643.5	0	10	Pass
2673.5	0	10	Pass



7.11 ETSI EN 300 328 SUB-CLAUSE 4.3.2.12 Geo-location capability

This requirement only applies to equipment with geo-location capability as defined in ETSI EN 300 328 clause 4.3.1.12.2 below

Geo-location capability is a feature of the equipment to determine its geographical location with the purpose to configure itself according to the regulatory requirements applicable at the geographical location where it operates.

The geo-location capability may be present in the equipment or in an external device (temporary) associated with the equipment operating at the same geographical location during the initial power up of the equipment. The geographical location may also be available in equipment already installed and operating at the same geographical location.

7.11.1 Requirement: Sub-Clause 4.3.2.12.3

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

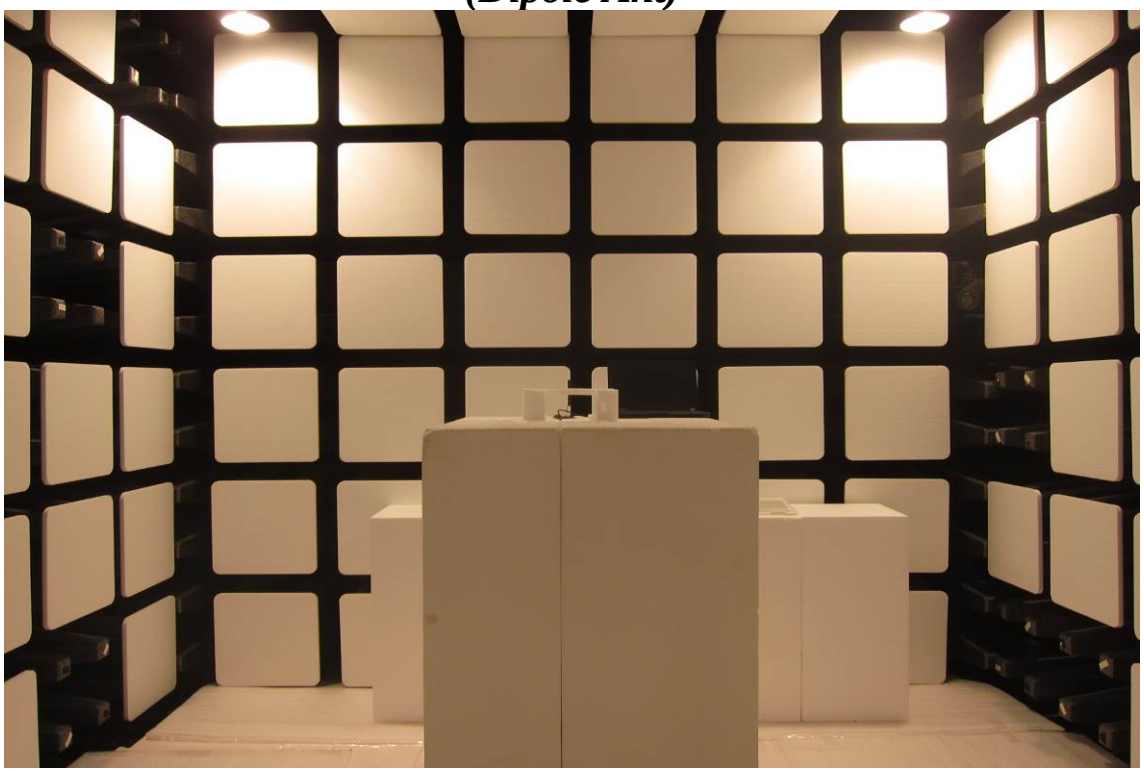
7.11.2 Result:

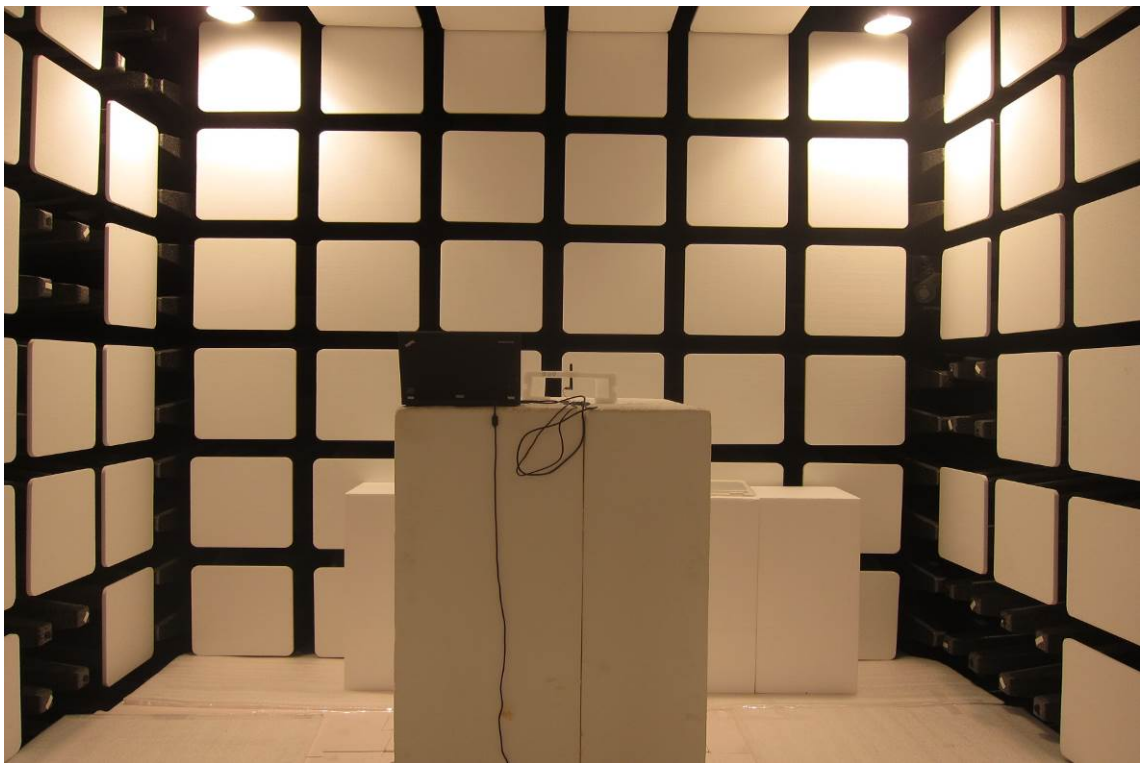
PASS, the device has Geo-location capability, but this function will not be accessible to the user.

APPENDIX 1

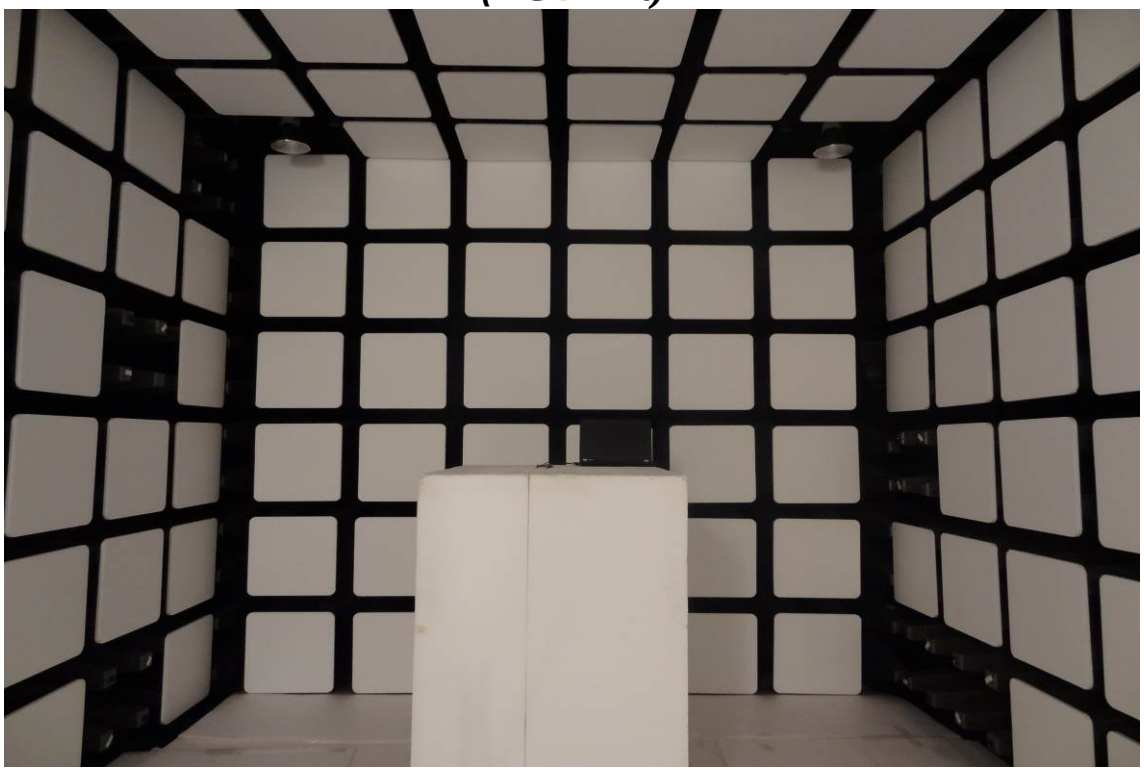
PHOTOGRAPHS OF SET UP

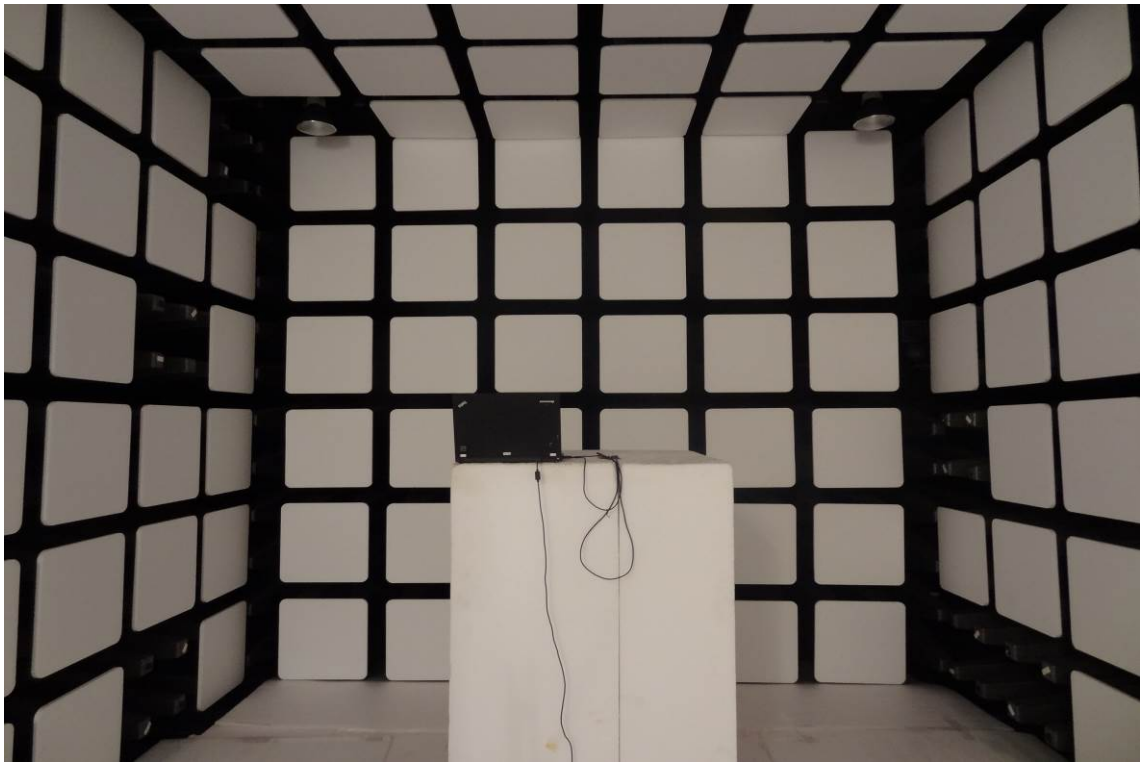
Wifi mode
(Dipole Ant)





(PCB Ant)

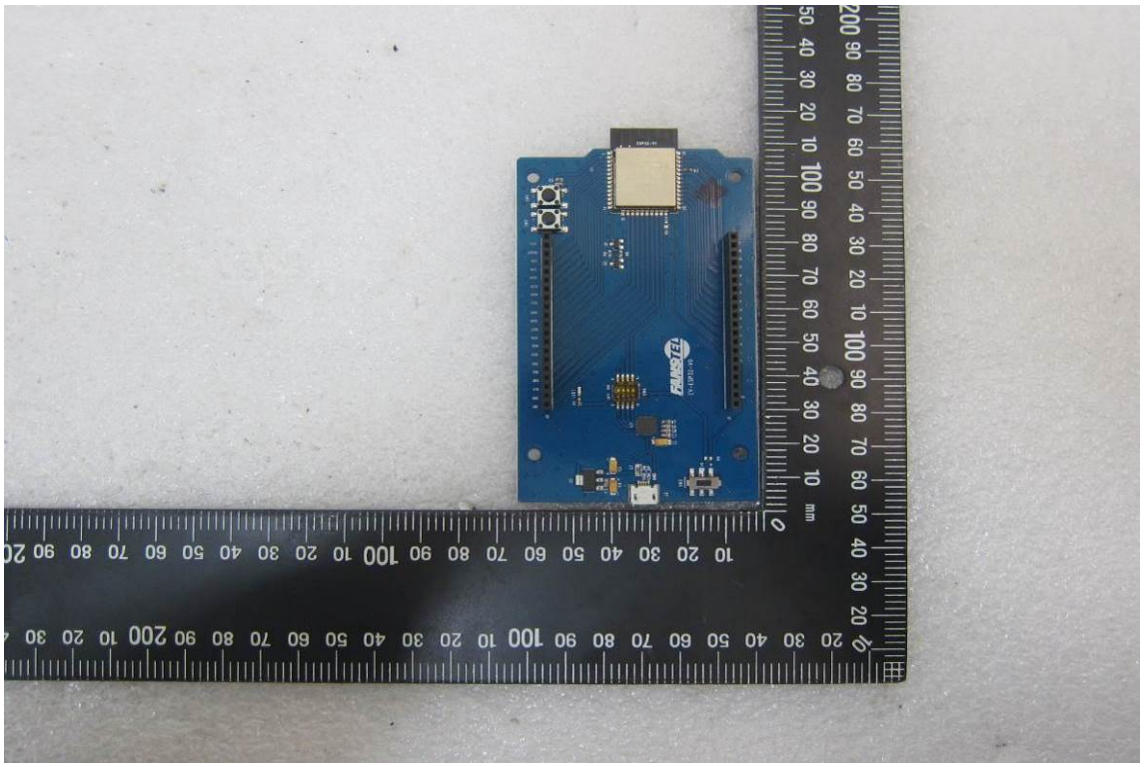




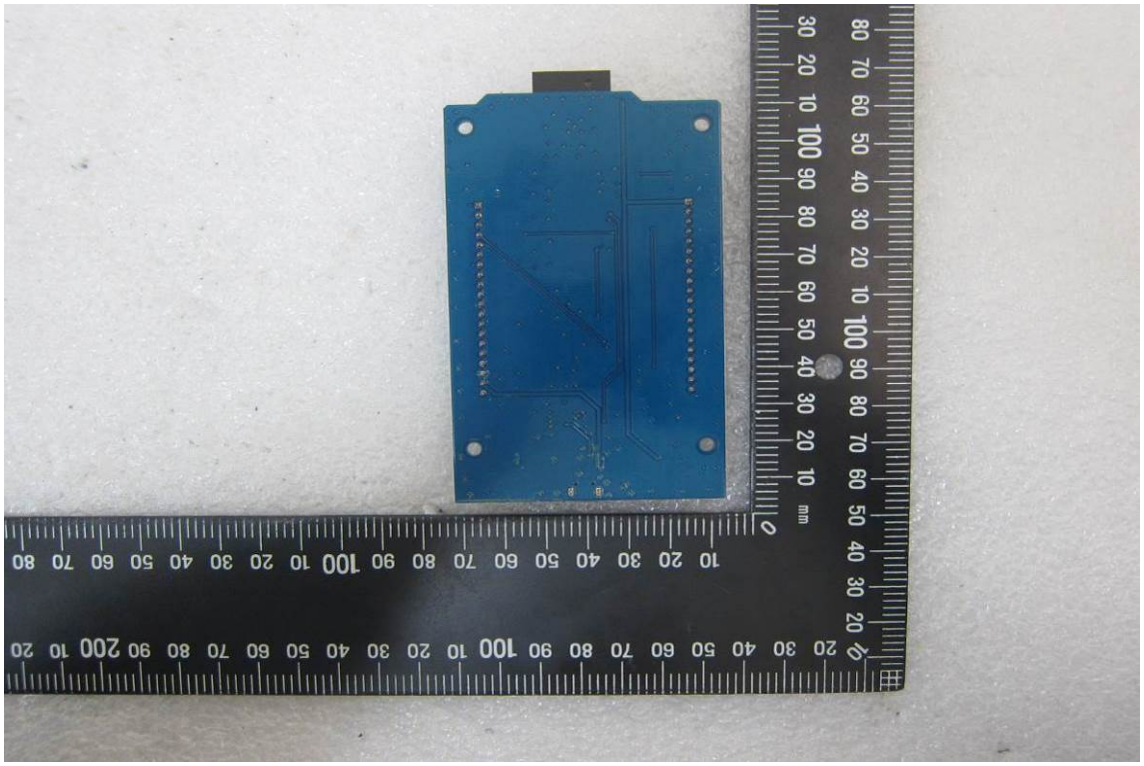
APPENDIX 2

PHOTOGRAPHS OF EUT

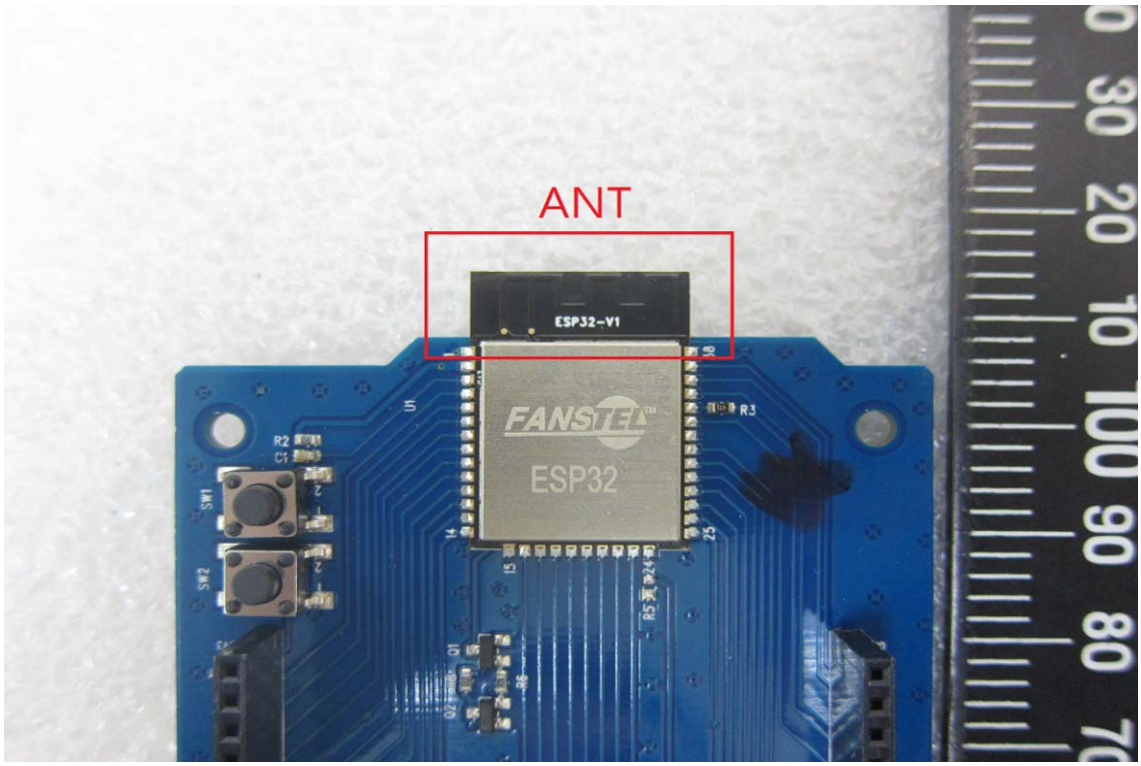
EUT 1



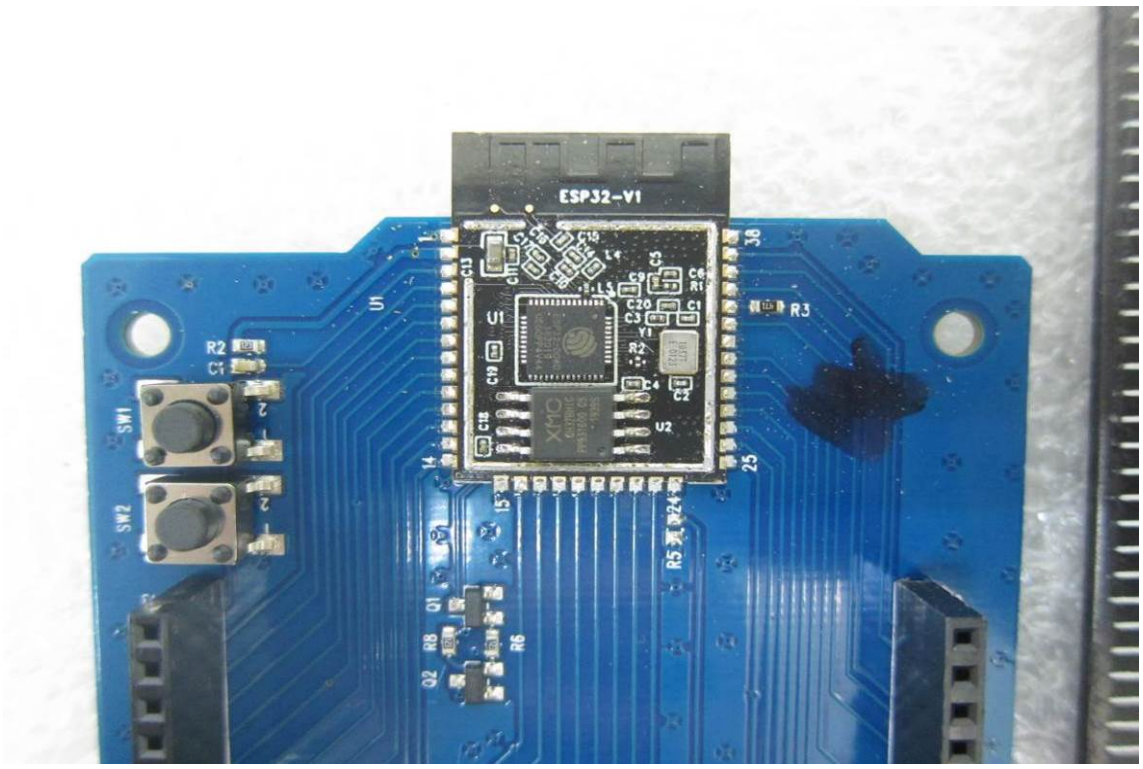
EUT 2 ESP32



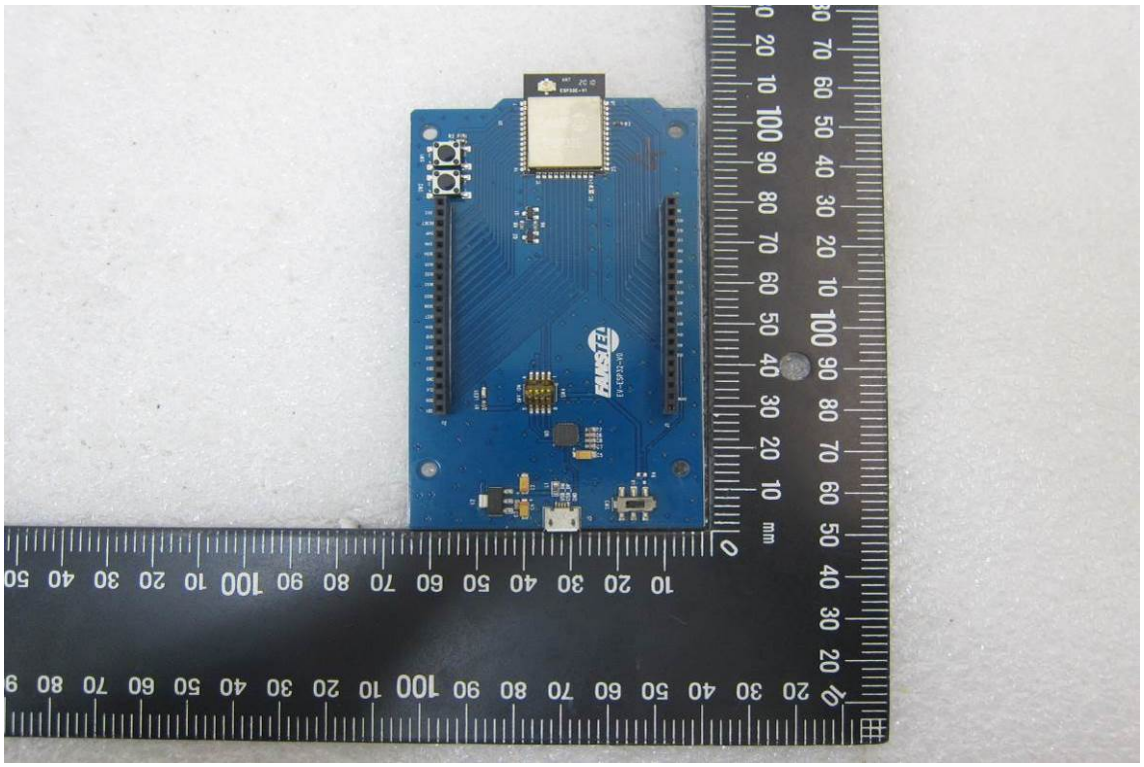
EUT 3 ESP32



EUT 4 ESP32



EUT 5 ESP32E



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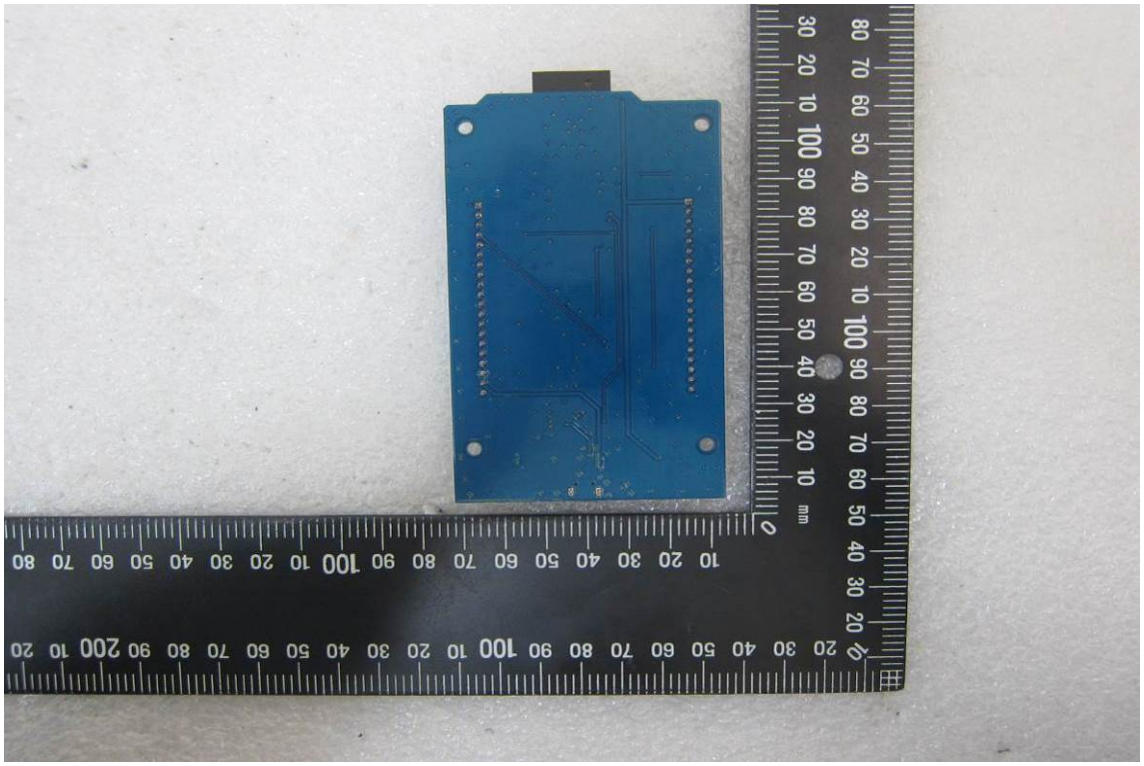
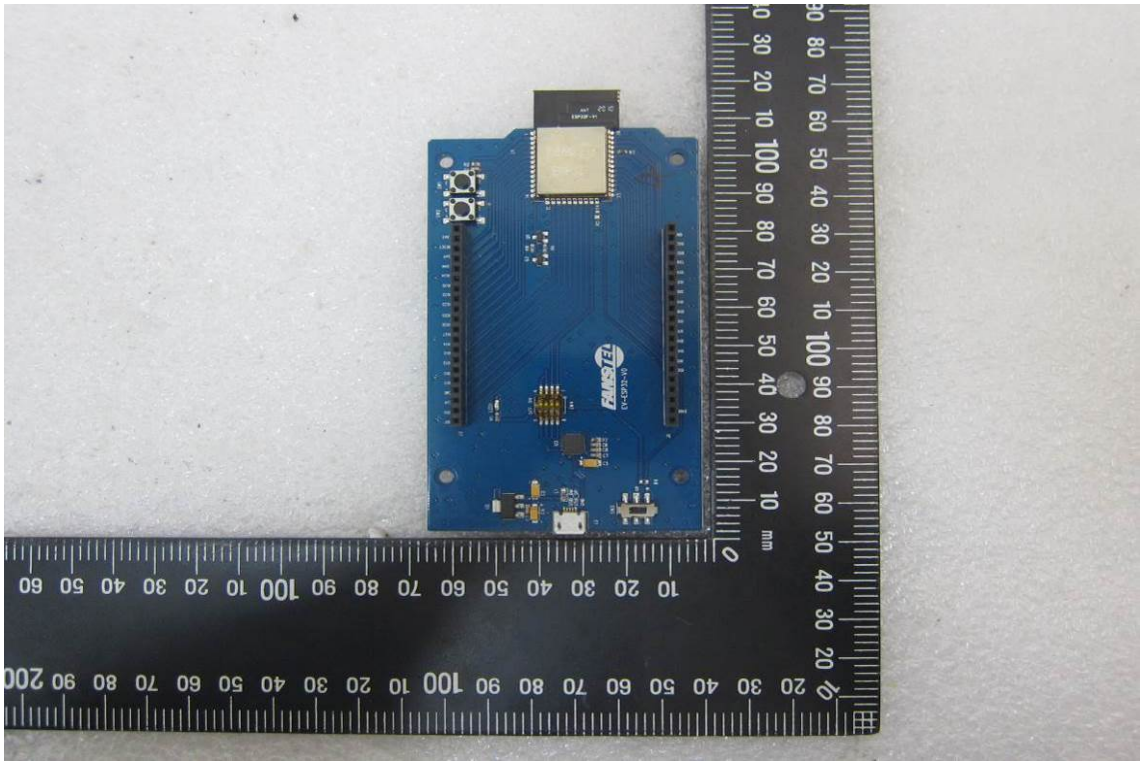


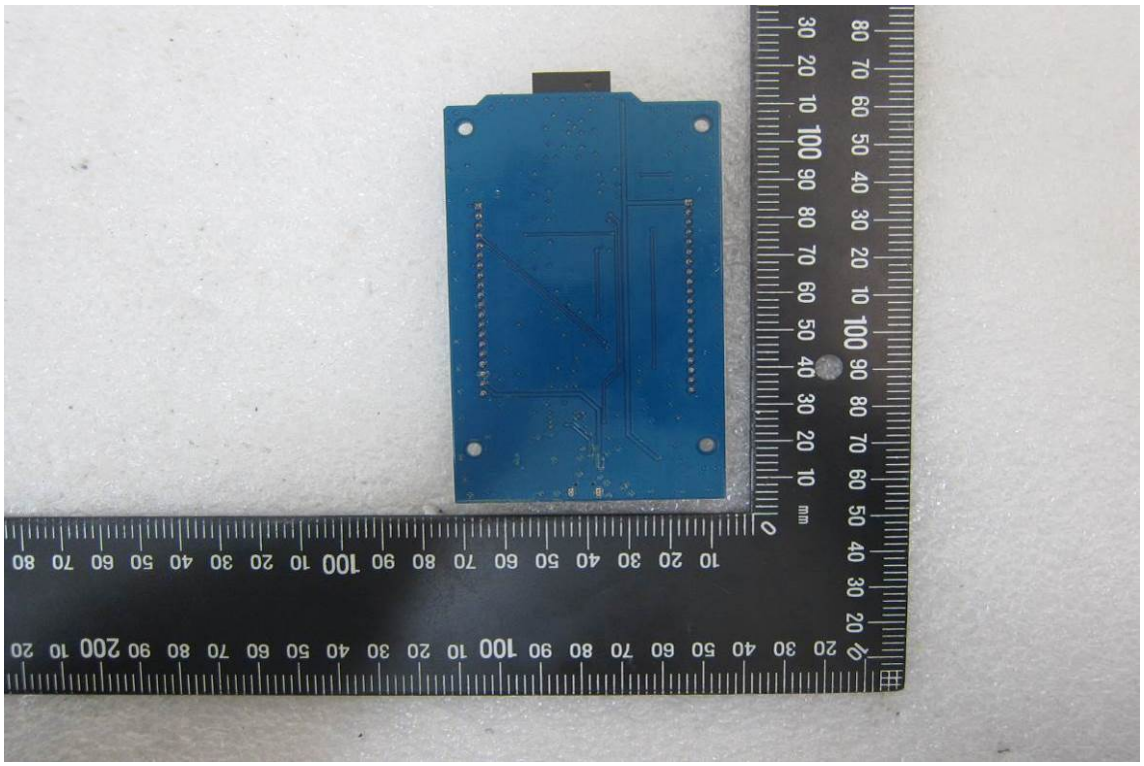
EUT 7 ESP32E

EUT 8 ESP32E

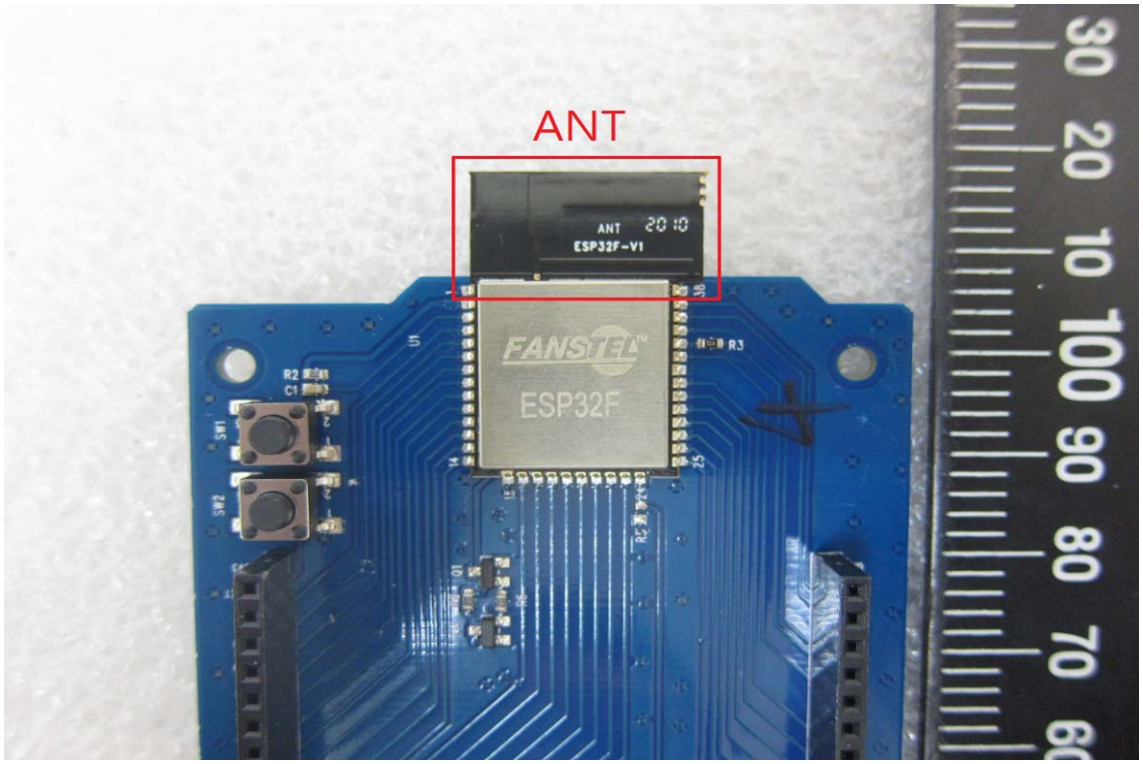
EUT 9 ESP32F



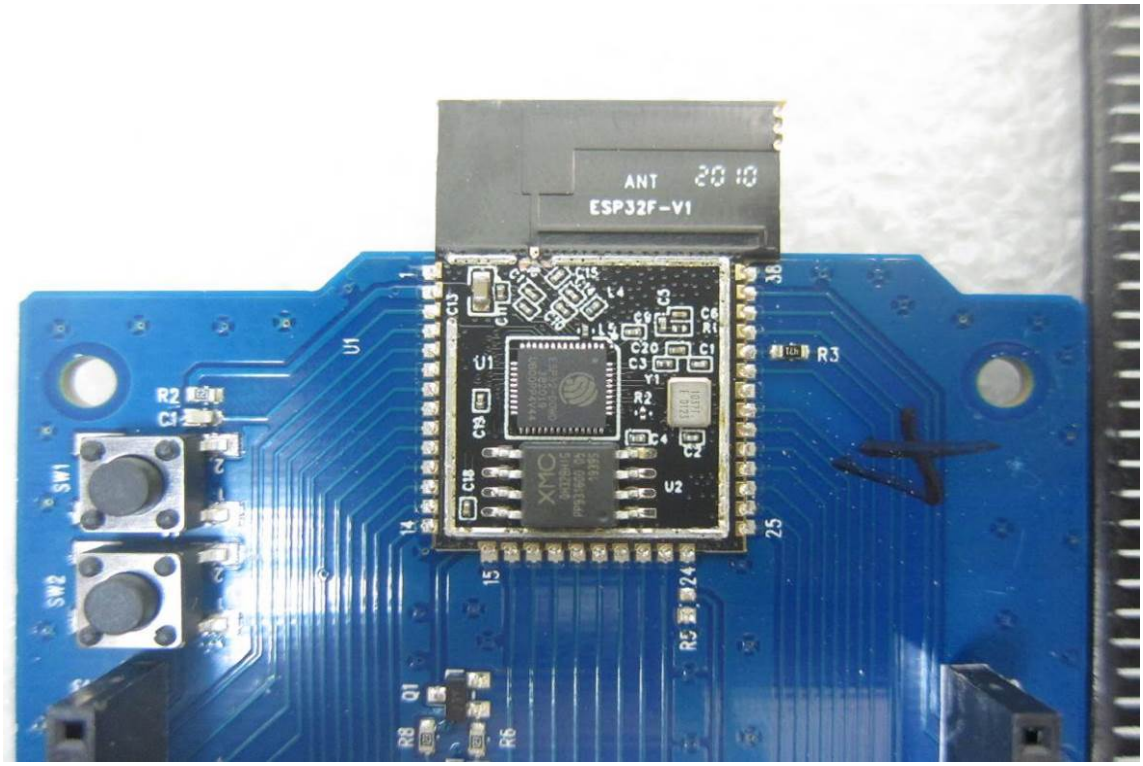
EUT 10 ESP32F



EUT 11 ESP32F



EUT 12 ESP32F



~ End of Report ~