EN 300 328 RF Test Report (Conducted Test)

Report No.:	RE160104C01
Test Model:	Type1GC
Received Date:	Jan. 04, 2016
Test Date:	Feb. 18 ~ Mar. 17, 2016
Issued Date:	Mar. 24, 2016
Applicant:	Murata Manufacturing Co., Ltd.
Address:	10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555, Japan
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan, R.O.C.
Test Location:	No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.)

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Release Control Record

Issue No.	Description	Date Issued
RE160104C01	Original release.	Mar. 24, 2016

1 Certificate of Conformity

Product: Communication Module

Brand: MURATA

Test Model: Type1GC

Sample Status: Engineering sample

Applicant: Murata Manufacturing Co., Ltd.

Test Date: Feb. 18 ~ Mar. 17, 2016

Standards: EN 300 328 V1.9.1 (2015-02)

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by :  , **Date:** Mar. 24, 2016

Polly Chien / Specialist

Approved by :  , **Date:** Mar. 24, 2016

Ken Liu / Senior Manager

2 Summary of Test Results

The EUT has been tested according to the following specifications:

EN 300 328 V1.9.1		
Clause	**Test Parameter**	**Results**
	Transmitter Parameters	
4.3.2.2	RF Output Power	Pass
4.3.2.3	Power Spectral Density (Modulations other than FHSS equipment)	Pass
4.3.2.4	Duty cycle, Tx-sequence, Tx-gap (Non-adaptive equipment)	Not Applicable
4.3.2.5	Medium Utilisation (Non-Adaptive Equipment)	Not Applicable
4.3.2.6	Adaptivity (Adaptive Equipment)	Pass
4.3.2.7	Occupied Channel Bandwidth	Pass
4.3.2.8	Transmitter Unwanted Emissions in the OOB Domain	Pass
4.3.2.9	Transmitter Unwanted Emissions in the Spurious Domain	Refer to Note
	Receiver Parameters	
4.3.2.10	Receiver Spurious Emissions	Refer to Note
4.3.2.11	Receiver Blocking (Only for Adaptive equipment)	Pass
4.3.2.12	Geo-location capability	Not Applicable

Note: For spurious emissions test was recorded in Report No.: RE160104C01-3.

2.1 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Spectrum Analyzer Agilent	N9030A	MY54490617	Jul. 14, 2015	Jul. 13, 2016
Spectrum Analyzer Rohde & Schwarz	FSV40	101042	Sep. 23, 2015	Sep. 22, 2016
Vector signal generator Agilent	E4438C	MY47271120	Sep. 24, 2015	Sep. 23, 2016
Open Switch and Control Unit Rohde & Schwarz	OSP120	B157-100898	Jan. 08, 2016	Jan. 07, 2017
Vector Signal Generator Rohde & Schwarz	SMJ 100A	101943	Dec. 03, 2015	Dec. 02, 2016
RF and Microwave Signal Generator Rohde & Schwarz	SMB100A	177994	Dec. 25, 2015	Dec. 24, 2016
BILOG Antenna SCHWARZBECK	VULB 9168	9168-158	Jan. 18, 2016	Jan. 17, 2017
HORN Antenna ETS	3117	00034128	Jan. 20, 2016	Jan. 19, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170243	Jan. 20, 2016	Jan. 19, 2017
Preamplifier Agilent	8449B	3008A01963	Aug. 22, 2015	Aug. 21, 2016
Preamplifier Agilent	8447D	2944A10627	Aug. 22, 2015	Aug. 21, 2016
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-RF1-03 (274397-4)	Nov. 02, 2015	Nov. 01, 2016
RF signal cable HUBER+SUHNER	CA3501-3501-G.90 (3m) & CA3501-3501-F.90 (2m)	NF090 (3m)*2 & TCF427S (2m)*1	Apr. 07, 2015	Apr. 06, 2016
Software ADT	ADT_Radiated_ V7.6.15.9.4	NA	NA	NA
Antenna Tower Max-Full	MFA-440H	9707	NA	NA
Turn Table ADT	NA	SN40303	NA	NA
Controller Max-Full	MF-7802	MF7802093	NA	NA
Temperature & Humidity chamber TERCHY	MHU-225AU	920842	Jun. 18, 2015	Jun. 17, 2016

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa RF Chamber 1.
3. The horn antenna and HP preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.

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
Radio frequency	±1.06 x 10^{-8}
Total RF power, conducted	1.371 dB
RF power density, conducted	2.889 dB
All emissions, radiated	±3.0127dB
Temperature	±0.23 °C
Humidity	±0.3 %
DC and low frequency voltages	±0.3 %

2.3 Maximum Measurement Uncertainty

For the test methods, according to ETSI 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
Radio frequency	±1 x 10^{-5}
Total RF power, conducted	±1.5 dB
RF power density, conducted	±3 dB
All emissions, radiated	± 6.0 dB
Temperature	± 1 °C
Humidity	± 5.0 %
DC and low frequency voltages	± 3.0 %
Time	±5 %

2.4 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Communication Module
Brand	MURATA
Test Model	Type1GC
Status of EUT	Engineering sample
Nominal Voltage	3.6Vdc (host)
Voltage Operation Range	3.6Vdc
Temperature Operating Range	-40~85℃
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: 11.0/ 5.5/ 2.0/ 1.0Mbps 802.11g: 54.0/ 48.0/ 36.0/ 24.0/ 18.0/ 12.0/ 9.0/ 6.0Mbps 802.11n (HT20): up to 65Mbps
Operating Frequency	2412 ~ 2472MHz
Number of Channel	802.11b, 802.11g, 802.11n (HT20): 13
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)	18.95dBm
Antenna Type	Monopole pattern antenna with 1.2dBi gain
Antenna Connecter	NA
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. The EUT provides one completed transmitter and one receiver.

Modulation Mode	TX Function
802.11b	1TX
802.11g	1TX
802.11n (HT20)	1TX

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

13 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency	Channel	Frequency
1	2412 MHz	8	2447 MHz
2	2417 MHz	9	2452 MHz
3	2422 MHz	10	2457 MHz
4	2427 MHz	11	2462 MHz
5	2432 MHz	12	2467 MHz
6	2437 MHz	13	2472 MHz
7	2442 MHz		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to						Description
	ROP	PSD	AD	OCB	EOB	RB	
-	√	√	√	√	√	√	-

Where ROP: RF Output Power
PSD: Power Spectral Density
AD: Adaptivity (Channel Access Mechanism)
OCB: Occupied Channel Bandwidth
EOB: Transmitter unwanted emissions in the out-of-band domain
RB: Receiver Blocking

Note: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-plane.**

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.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11b	1 to 13	1, 7, 13	DSSS	DBPSK	1.0
-	802.11g	1 to 13	1, 7, 13	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 13	1, 7, 13	OFDM	BPSK	6.5

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.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11b	1 to 13	1, 7, 13	DSSS	DBPSK	1.0
-	802.11g	1 to 13	1, 7, 13	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 13	1, 7, 13	OFDM	BPSK	6.5

Adaptivity 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.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11b	1 to 13	1, 13	DSSS	DBPSK	1.0
-	802.11g	1 to 13	1, 13	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 13	1, 13	OFDM	BPSK	6.5

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.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11b	1 to 13	1, 13	DSSS	DBPSK	1.0
-	802.11g	1 to 13	1, 13	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 13	1, 13	OFDM	BPSK	6.5

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.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11b	1 to 13	1, 13	DSSS	DBPSK	1.0
-	802.11g	1 to 13	1, 13	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 13	1, 13	OFDM	BPSK	6.5

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.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11b	1 to 13	1, 13	DSSS	DBPSK	1.0
-	802.11g	1 to 13	1, 13	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 13	1, 13	OFDM	BPSK	6.5

Test Condition:

Applicable to	Environmental Conditions	Input Power (System)	Tested by
ROP	24deg. C, 64%RH	230Vac, 50Hz	Match Tsui
PSD	24deg. C, 64%RH	230Vac, 50Hz	Match Tsui
AD	24deg. C, 64%RH	230Vac, 50Hz	Match Tsui
OCB	24deg. C, 64%RH	230Vac, 50Hz	Match Tsui
EOB	24deg. C, 64%RH	230Vac, 50Hz	Match Tsui
RB	24deg. C, 64%RH	230Vac, 50Hz	Match Tsui

3.3 Description of Support Units

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

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Notebook	DELL	E5430	FKKCYW1	FCC DoC Approved	-
B.	Power Supply	TOPWARD	6303D	802236	NA	-
C.	Jig board	NA	NA	NA	NA	Provided by manufacturer

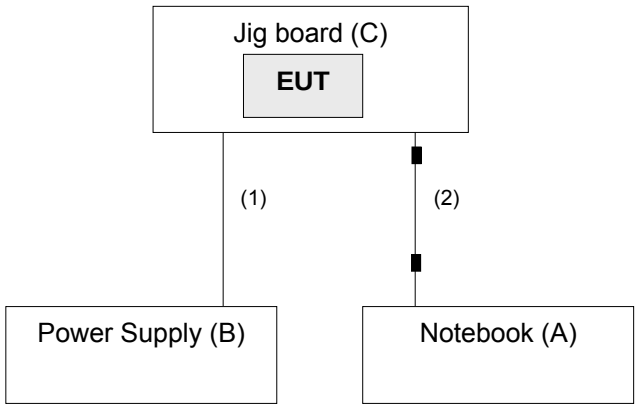
Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Items A, B acted as communication partners to transfer data and under test table during test.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	DC power cable	4	1.8	-	0	-
2.	USB cable	1	1.8	Y	2	Provided by manufacturer

NOTE: The core(s) is(are) originally attached to the cable(s).

3.3.1 Configuration of System under Test



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:

ETSI EN 300 328 V1.9.1 (2015-02)

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

4 Test Procedure and Results

Transmitter Parameters

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 5.3.2.2 of ETSI EN 300 328 V1.9.1.

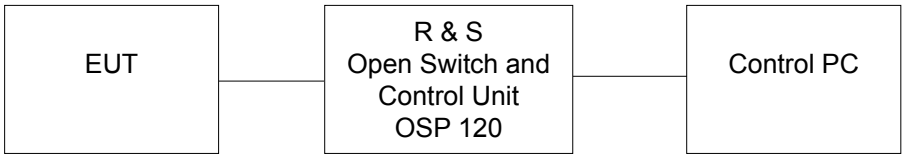
Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

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. Controlling software (provided by manufacturer) has been activated to set the EUT on specific channel and power level.



4.1.5 Test Results

Test Condition			EIRP Power (dBm)		
			(CH1) 2412 MHz	(CH7) 2442 MHz	(CH13) 2472 MHz
802.11b					
T_{nom}(℃)	+25	V_{nom}(v)	18.26	18.20	18.28
T_{min}(℃)	-40	V_{nom}(v)	18.91	18.94	**18.95**
T_{max}(℃)	+85	V_{nom}(v)	18.24	18.18	18.25
802.11g					
T_{nom}(℃)	+25	V_{nom}(v)	14.26	14.20	14.35
T_{min}(℃)	-40	V_{nom}(v)	14.94	14.94	15.04
T_{max}(℃)	+85	V_{nom}(v)	14.23	14.17	14.31
802.11n (HT20)					
T_{nom}(℃)	+25	V_{nom}(v)	13.46	13.58	13.21
T_{min}(℃)	-40	V_{nom}(v)	14.16	14.26	13.96
T_{max}(℃)	+85	V_{nom}(v)	13.44	13.55	13.17

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 5.3.3.2 of ETSI EN 300 328 V1.9.1.

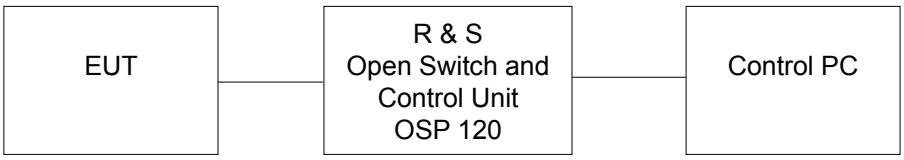
Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

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. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator. The power spectral density as defined in EN 300 328 clause 4.3.2.3 shall be measured and recorded. Controlling software (provided by manufacturer) has been activated to set the EUT on specific status.



4.3 Test Results

802.11b

Channel	Channel Frequency (MHz)	Power Density (dBm/1MHz) (EIRP)	Limit (dBm/1MHz) (EIRP)	Pass/Fail
1	2412	9.90	10	Pass
7	2442	9.86	10	Pass
13	2472	9.92	10	Pass

802.11g

Channel	Channel Frequency (MHz)	Power Density (dBm/1MHz) (EIRP)	Limit (dBm/1MHz) (EIRP)	Pass/Fail
1	2412	3.95	10	Pass
7	2442	3.88	10	Pass
13	2472	4.03	10	Pass

802.11n (HT20)

Channel	Channel Frequency (MHz)	Power Density (dBm/1MHz) (EIRP)	Limit (dBm/1MHz) (EIRP)	Pass/Fail
1	2412	1.53	10	Pass
7	2442	1.68	10	Pass
13	2472	2.61	10	Pass

4.4 Adaptive (Channel Access Mechanism)

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.

4.4.1 Limit of Adaptive

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

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

NOTE 1: The CCA time used by the equipment shall be declared by the supplier.
NOTE 2:Load Based Equipment may implement an LBT based spectrum sharing mechanism based on the Clear Channel Assessment (CCA) mode using energy detect, as described in IEEE 802.11™-2012 clause 9, clause 10, clause 16,clause 17, clause 19 and clause 20, or in IEEE 802.15.4™-2011 [i.4], clause 4, clause 5 and clause 8
NOTE 3: The Idle Period in between transmissions is considered to be the CCA or the Extended CCA check as there are no transmissions during this period.
NOTE 4: Adaptive equipment may or may not have Short Control Signalling Transmissions

Maximum transmit power (P_H) EIRP dBm	Threshold level (TL) (see notes 1 and 2)
20	-70 dBm / MHz

NOTE 1: TL = -70 dBm/MHz +[20 - P_H (assuming a 0dBi receive antenna and P_H specified in dBm e.i.r.p.)]/1MHz.
NOTE 2: transmitter the CCA threshold level (TL) shall be equal or lower than -70 dBm/MHz at the input to the receiver (assuming a 0 dBi receive antenna).

4.4.2 Test Procedure

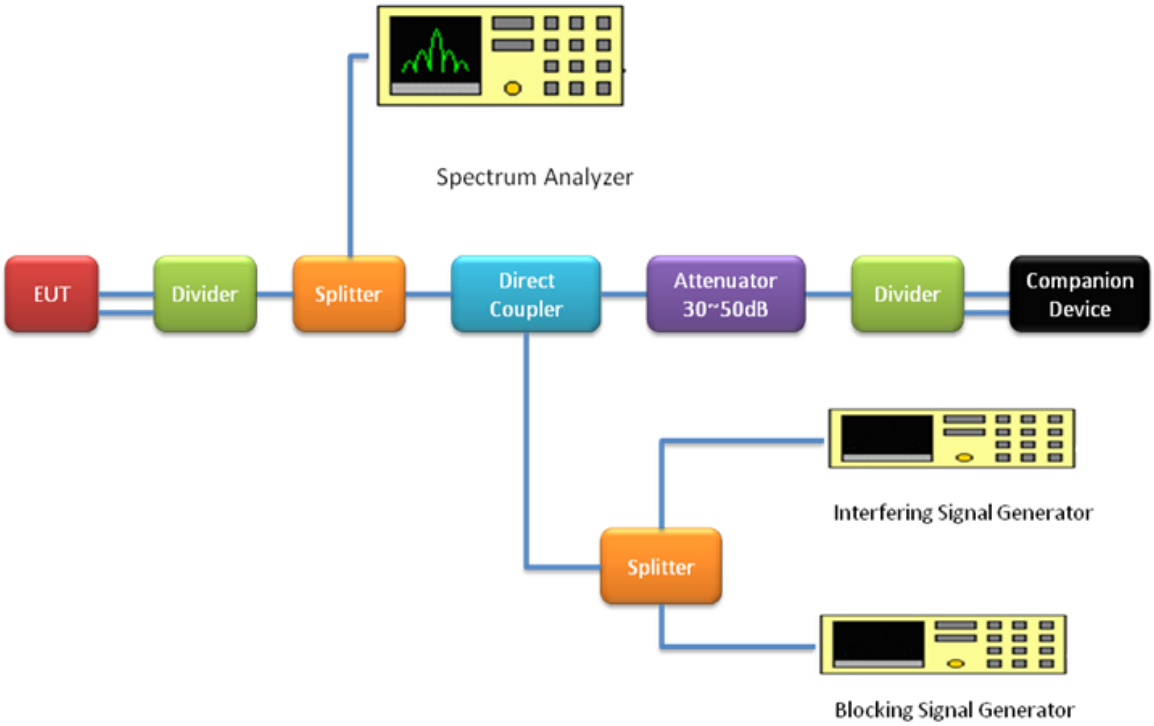
Refer to chapter 5.3.7.2 of ETSI EN 300 328 V1.9.1.

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

4.4.3 Deviation from Test Standard

No deviation.

4.4.4 Test Setup Configuration



UUT Software and Firmwave Version

Product	Brand	Model No.	Software/Firmware Version
Communication Module	MURATA	Type1GC	WLAN Firmware : wl0 Oct 20 2015 123035 Version : 7.15.168.5

Companion Device information

Product	Brand	Model No.	Software/Firmware Version
Wireless AP	D-Link	DIR-810L	Firmware Version: 1.01

4.4.5 List of Measurements

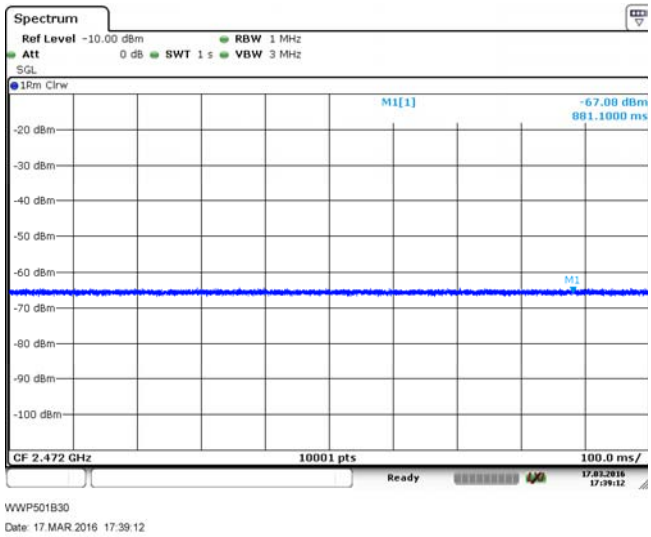
UUT Operational Mode	Applicable	Limit	
		The Maximum Channel Occupancy Time	The Minimum idle Period
Frame Based Equipment		meet in 1ms ~ 10ms	>5% x channel occupancy time
Load Based Equipment (CCA using 'energy detect')		Follow IEEE 802.11 Less than _____ms	Follow IEEE 802.11 More than _____ms
	v	13ms	18us
Load Based Equipment (CCA not using any of the mechanisms referenced)		13ms	18us

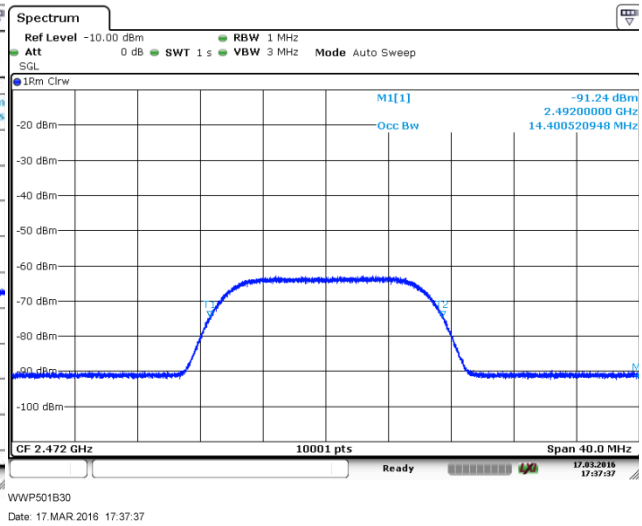
Clause	Test Parameter	Remarks	Pass/Fail
4.3.2.6.3.2.2	Adaptive (Frame Based Equipment)	Not Applicable	NA
4.3.2.6.3.2.3	Adaptive (Load Based Equipment)	Applicable	Pass
4.3.2.6.4	Short Control Signalling Transmissions	Applicable	Pass

4.4.6 Interference Threshold Level

802.11b

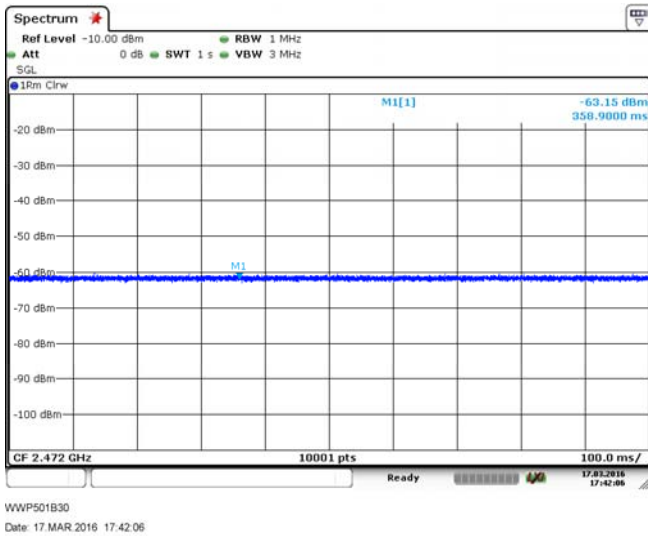
Detection Threshold Level
The maximum EIRP (Vnom) power is 18.28dBm and antenna gain is 1.2dBi. Detection Threshold level= -70dBm/MHz + 20 – Pout EIRP(18.28dBm) + G (1.2dBi) = -67.08dBm/MHz . The interference signal level to the UUT is -67.08dBm/MHz

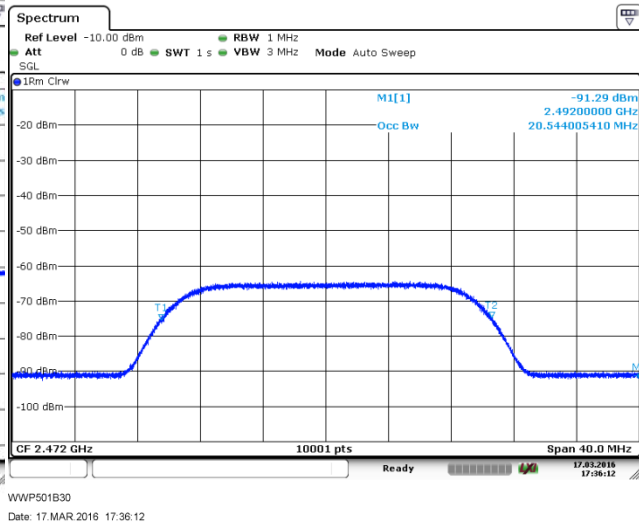




802.11g

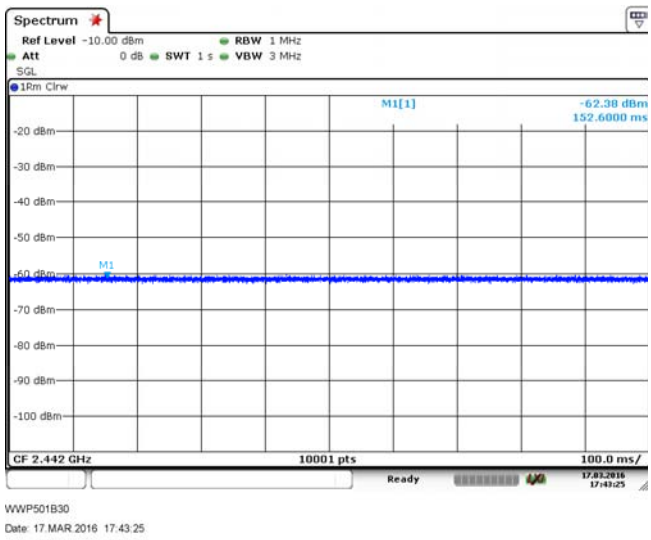
Detection Threshold Level
The maximum EIRP (Vnom) power is 14.35dBm and antenna gain is 1.2dBi. Detection Threshold level= -70dBm/MHz + 20 – Pout EIRP(14.35dBm) + G (1.2dBi) = -63.15dBm/MHz . The interference signal level to the UUT is -63.15dBm/MHz

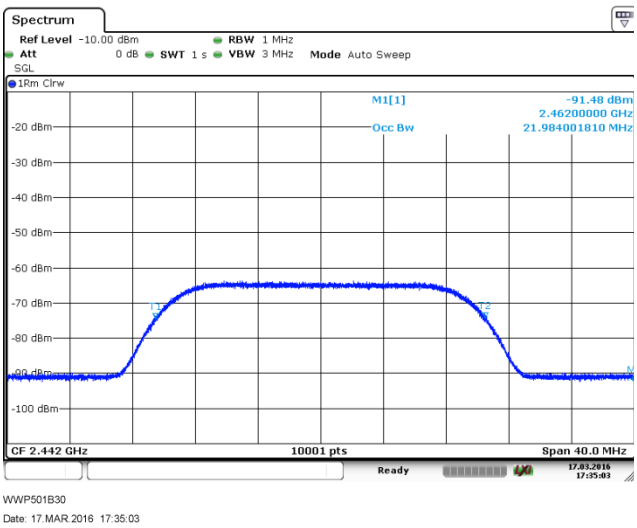




802.11n (HT20)

Detection Threshold Level
The maximum EIRP (Vnom) power is 13.58dBm and antenna gain is 1.2dBi. Detection Threshold level= -70dBm/MHz + 20 – Pout EIRP(13.58dBm) + G (1.2dBi) = -62.38dBm/MHz . The interference signal level to the UUT is -62.38dBm/MHz





4.4.7 Test Result

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

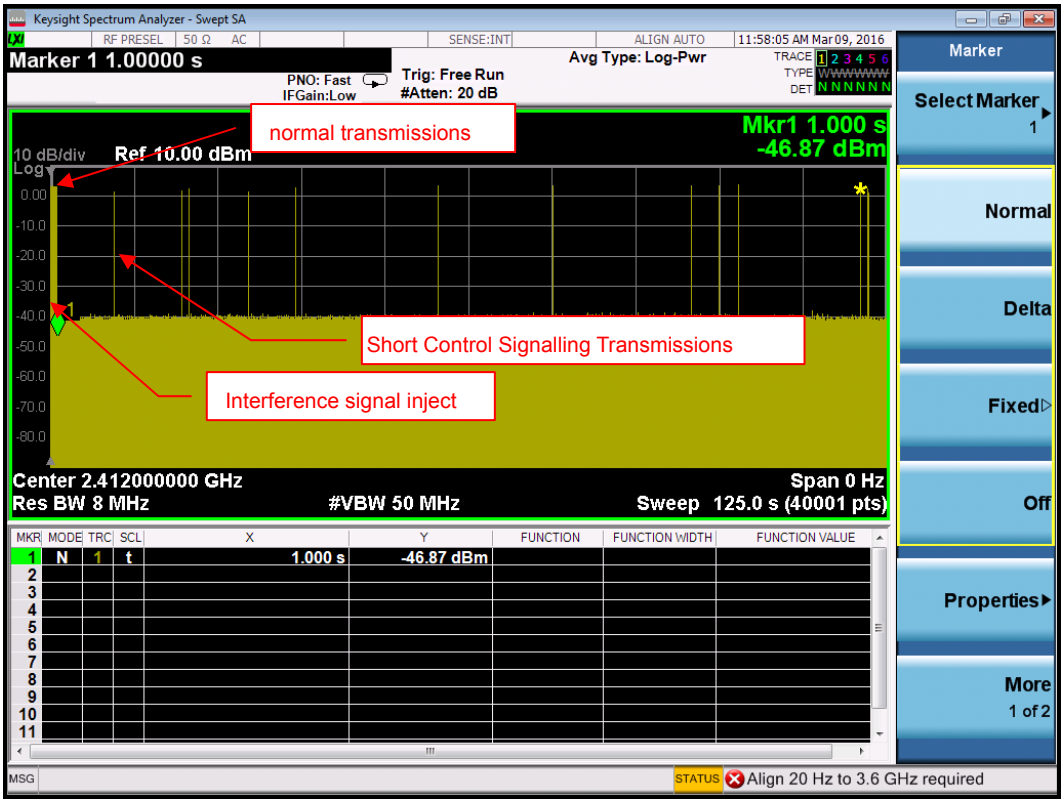
4.4.7.1 Adaptive Result

Operating Frequency Bands and Mode of EUT

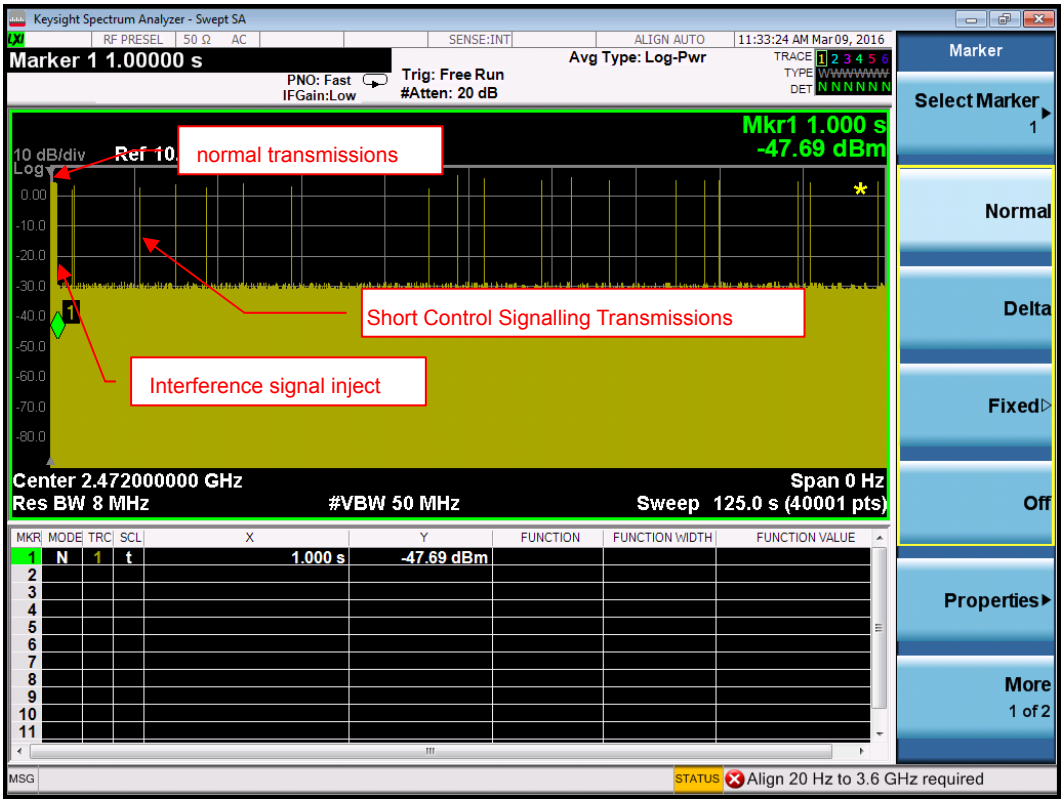
Operational Mode	Operating Frequency (Low Channel, MHz)	Operating Frequency (High Channel, MHz)	Test Result
802.11b	2412	2472	Pass
802.11g	2412	2472	Pass
802.11n (HT20)	2412	2472	Pass
802.11n (HT40)	2422	2462	Pass

802.11b

2412 MHz

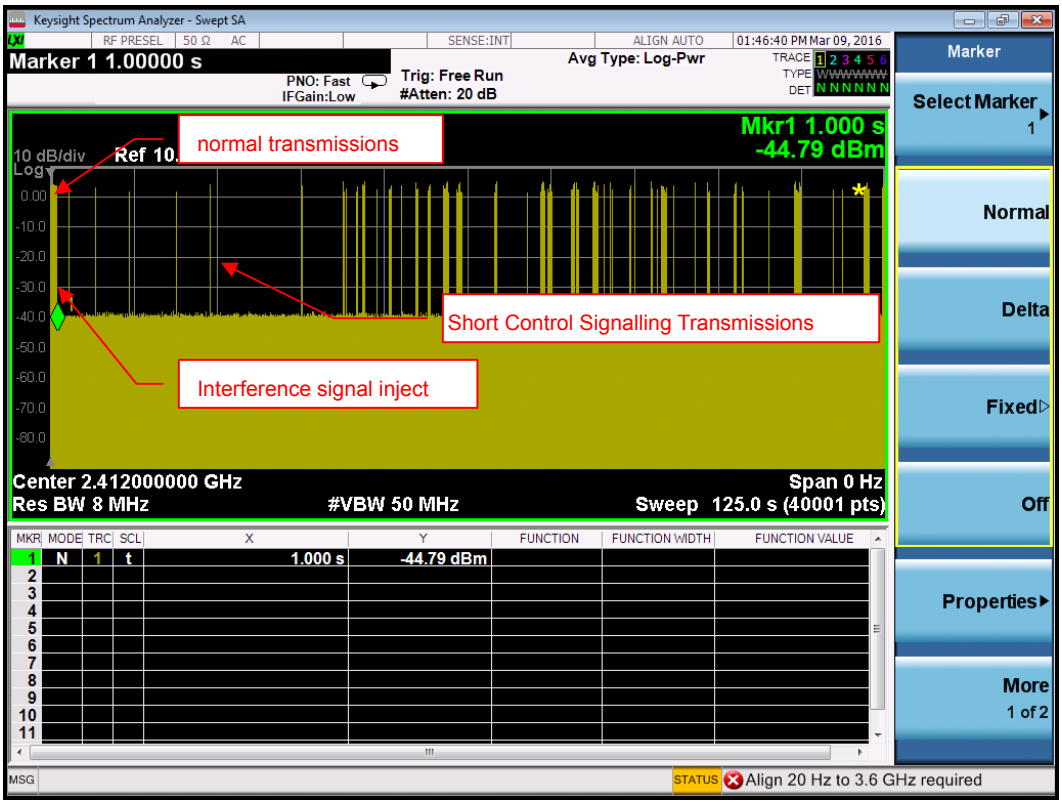


2472 MHz

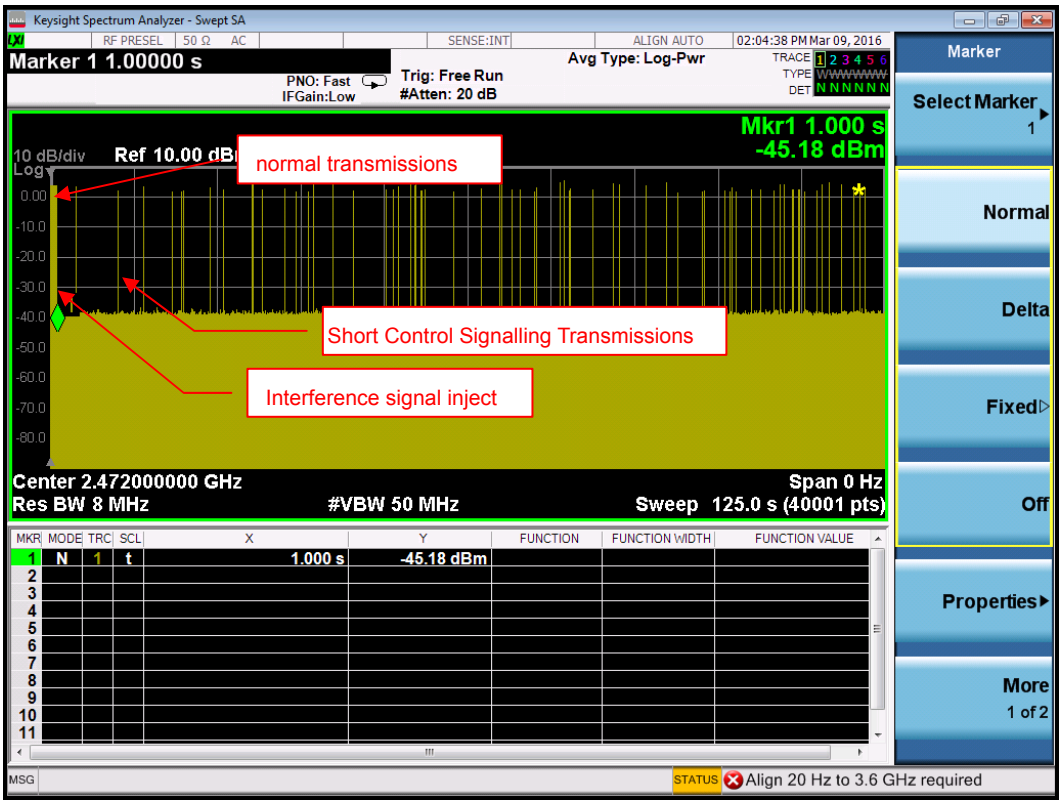


802.11g

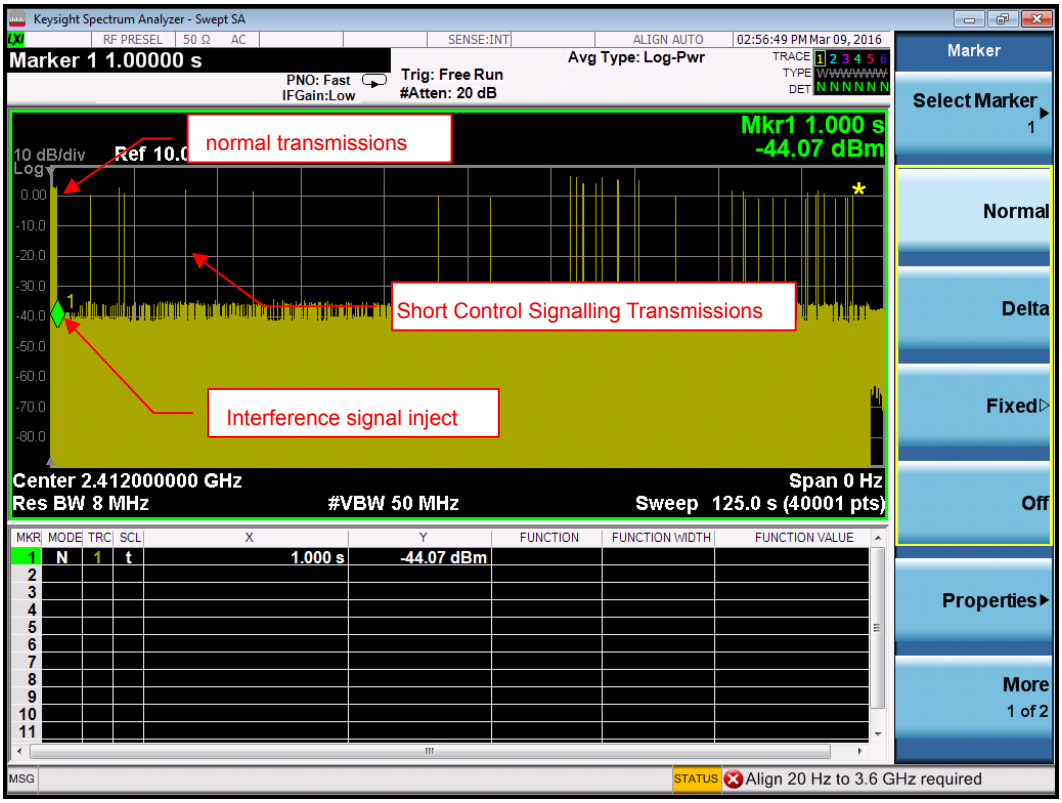
2412 MHz



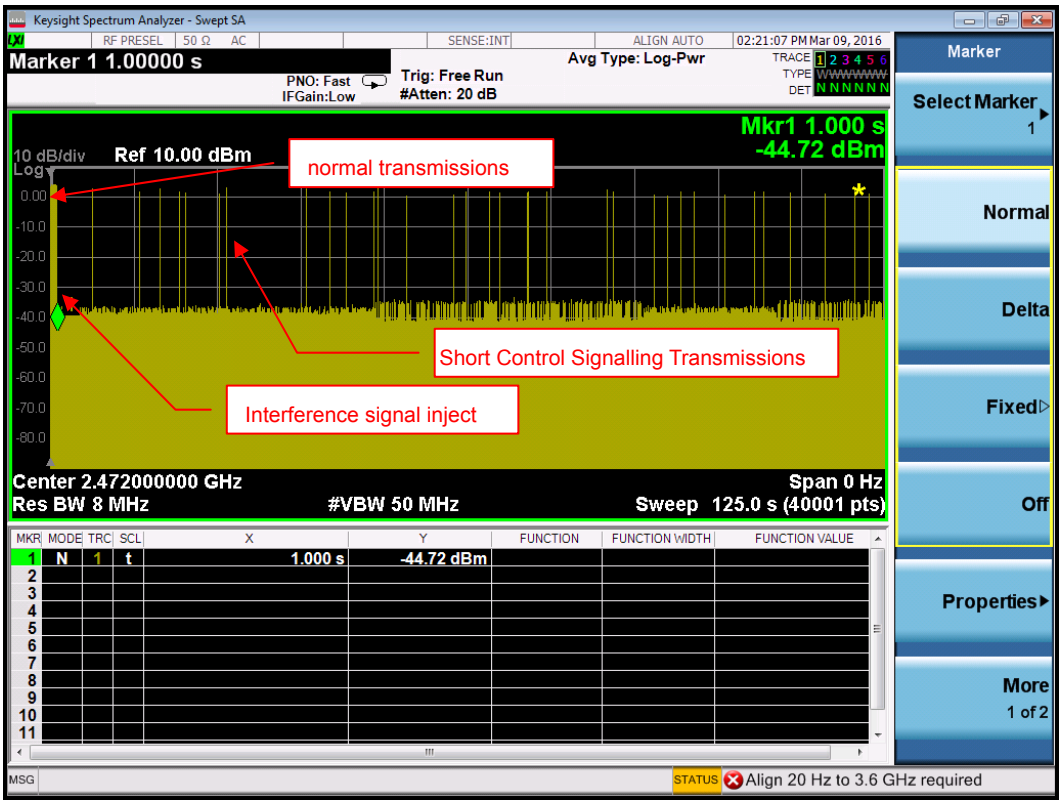
2472 MHz



802.11n (HT20)
2412 MHz



2472 MHz

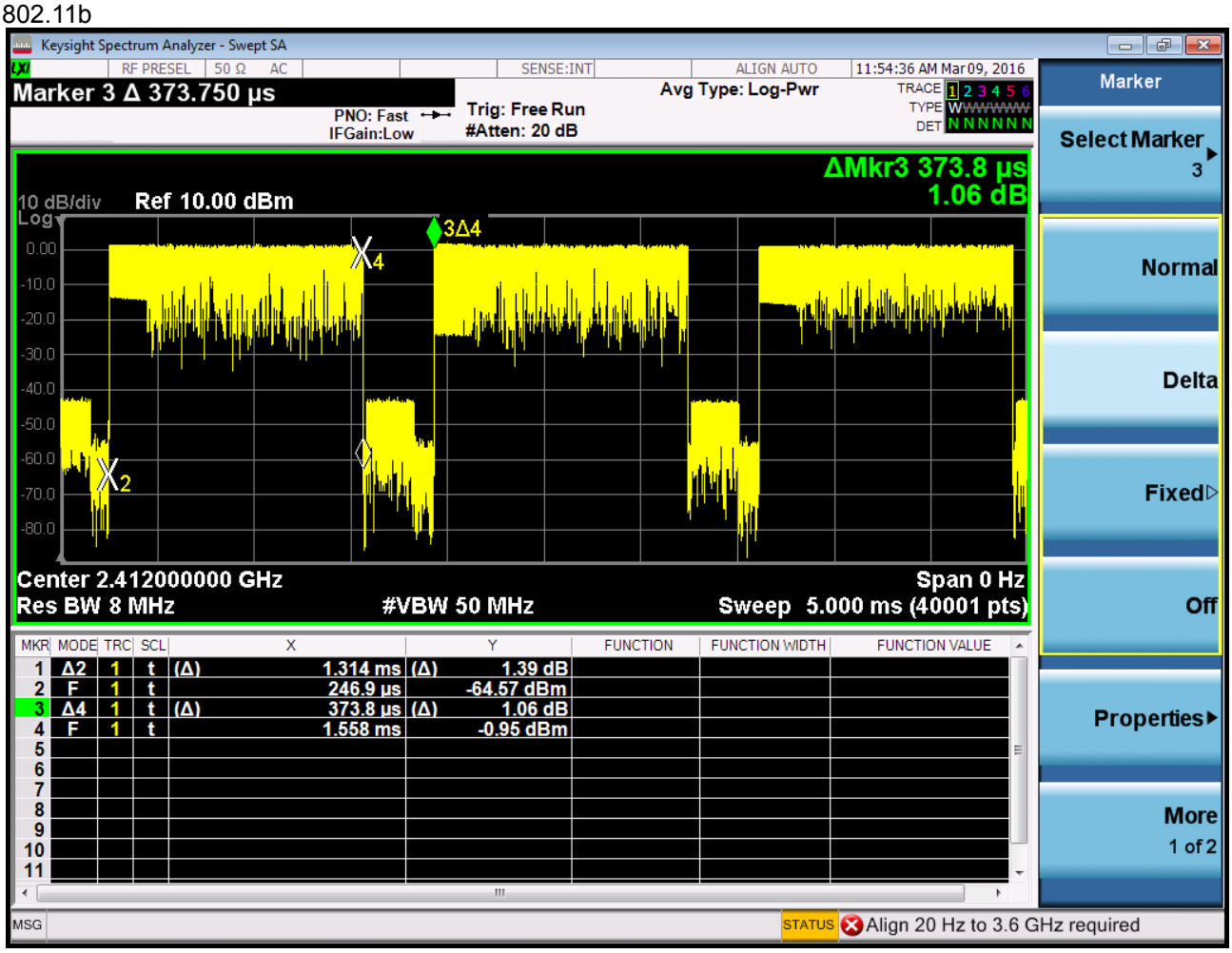


4.4.7.2 The Channel Occupancy Time Result

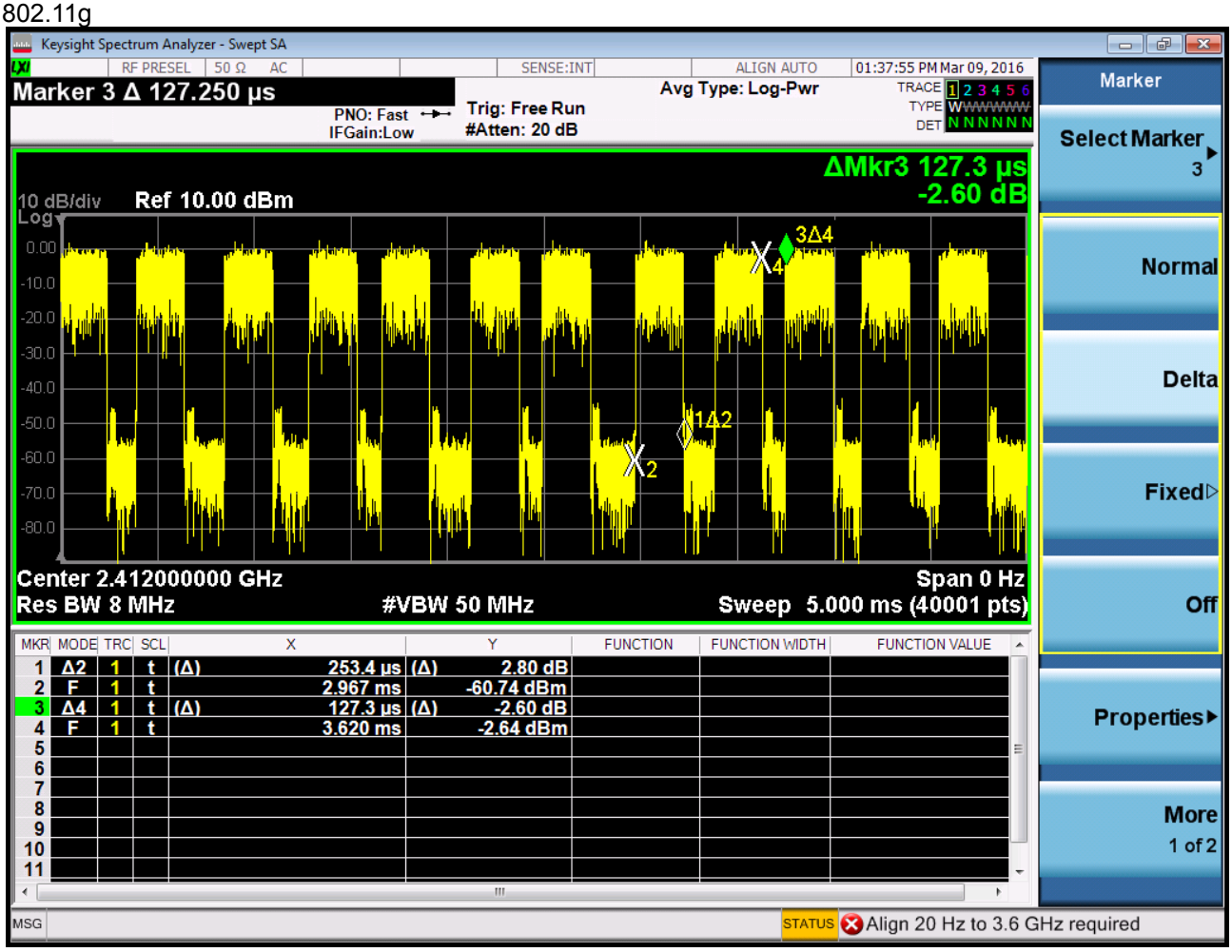
Operating Frequency Bands and Mode of EUT

Operational Mode	Operating Frequency Low Channel (MHz)	The Channel Occupancy Time (ms)	Minimum Idle Period (ms)	Test Result
802.11b	2412	1.314	0.3738	Pass
802.11g	2412	0.2534	0.1273	Pass
802.11n (HT20)	2412	0.7249	0.06775	Pass

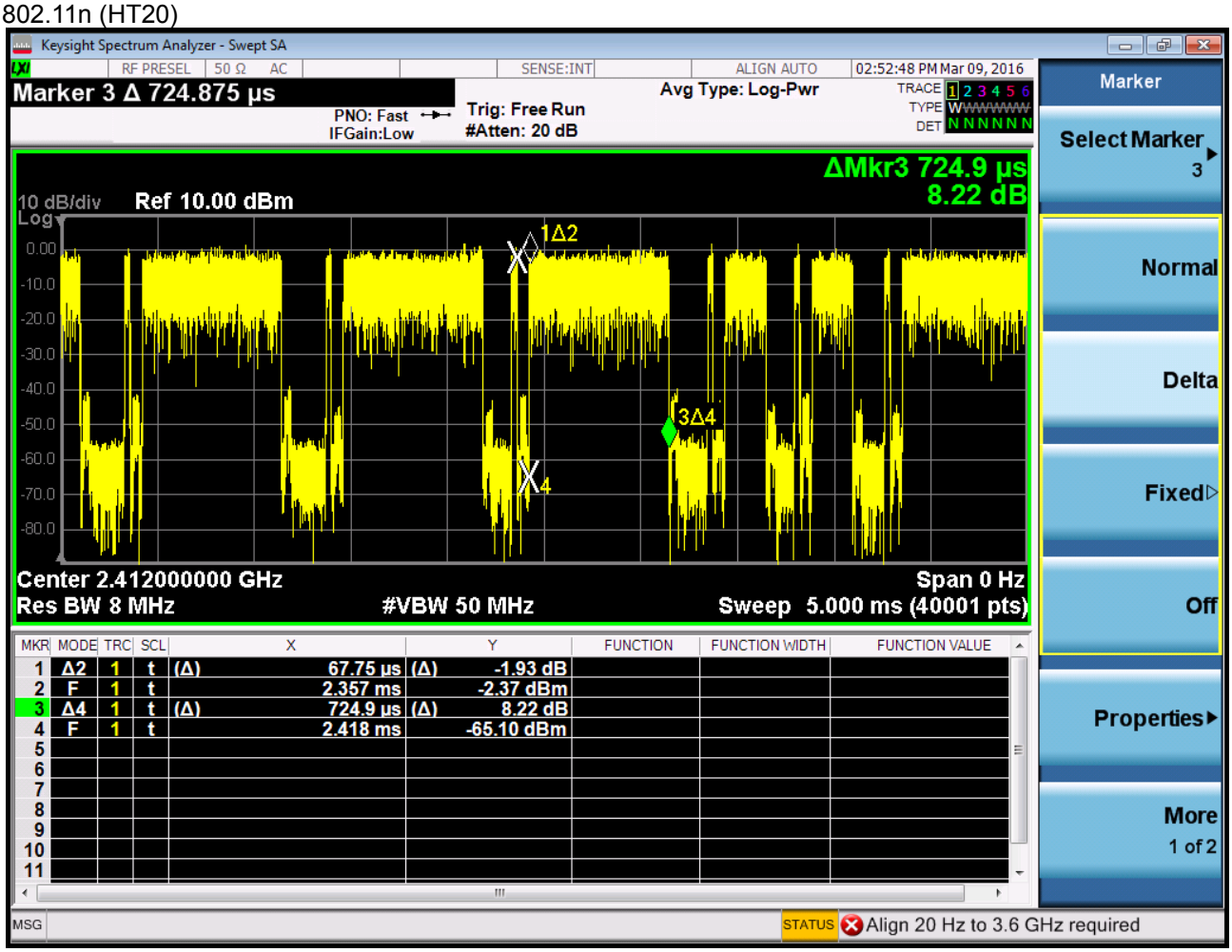
802.11b


Keysight Spectrum Analyzer - Swept SA
RF PRESEL
50 Ω AC
SENSE:INT
ALIGN AUTO
11:54:36 AM Mar 09, 2016
Marker 3 Δ 373.750 µs
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE W
DET N N N N N
ΔMkr3 373.8 µs
1.06 dB
10 dB/div
Log
Ref 10.00 dBm
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
3Δ4
X4
X2
Center 2.412000000 GHz
Res BW 8 MHz
#VBW 50 MHz
Span 0 Hz
Sweep 5.000 ms (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 Δ2 1 t (Δ) 1.314 ms (Δ) 1.39 dB
2 F 1 t 246.9 µs -64.57 dBm
3 Δ4 1 t (Δ) 373.8 µs (Δ) 1.06 dB
4 F 1 t 1.558 ms -0.95 dBm
5
6
7
8
9
10
11
Marker
Select Marker 3
Normal
Delta
Fixed
Off
Properties
More 1 of 2
MSG
STATUS
Align 20 Hz to 3.6 GHz required

802.11g


Keysight Spectrum Analyzer - Swept SA
RF PRESEL
50 Ω AC
SENSE:INT
ALIGN AUTO
01:37:55 PM Mar 09, 2016
Marker 3 Δ 127.250 µs
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE W
DET N N N N N
ΔMkr3 127.3 µs
-2.60 dB
10 dB/div
Log
Ref 10.00 dBm
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
3Δ4
1Δ2
Center 2.412000000 GHz
Res BW 8 MHz
#VBW 50 MHz
Span 0 Hz
Sweep 5.000 ms (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 Δ2 1 t (Δ) 253.4 µs (Δ) 2.80 dB
2 F 1 t 2.967 ms -60.74 dBm
3 Δ4 1 t (Δ) 127.3 µs (Δ) -2.60 dB
4 F 1 t 3.620 ms -2.64 dBm
5
6
7
8
9
10
11
Marker
Select Marker 3
Normal
Delta
Fixed
Off
Properties
More 1 of 2
MSG
STATUS
Align 20 Hz to 3.6 GHz required

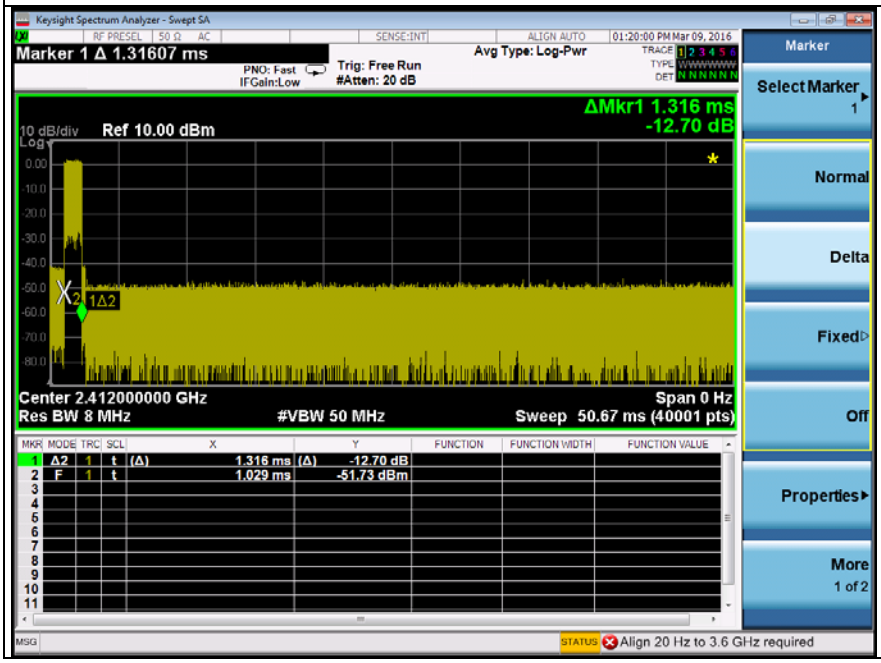
802.11n (HT20)


Keysight Spectrum Analyzer - Swept SA
RF PRESEL
50 Ω AC
SENSE:INT
ALIGN AUTO
02:52:48 PM Mar 09, 2016
Marker 3 Δ 724.875 µs
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE W
DET N N N N N
ΔMkr3 724.9 µs
8.22 dB
10 dB/div
Log
Ref 10.00 dBm
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
1Δ2
3Δ4
Center 2.412000000 GHz
Res BW 8 MHz
#VBW 50 MHz
Span 0 Hz
Sweep 5.000 ms (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 Δ2 1 t (Δ) 67.75 µs (Δ) -1.93 dB
2 F 1 t 2.357 ms -2.37 dBm
3 Δ4 1 t (Δ) 724.9 µs (Δ) 8.22 dB
4 F 1 t 2.418 ms -65.10 dBm
5
6
7
8
9
10
11
Marker
Select Marker 3
Normal
Delta
Fixed
Off
Properties
More 1 of 2
MSG
STATUS
Align 20 Hz to 3.6 GHz required

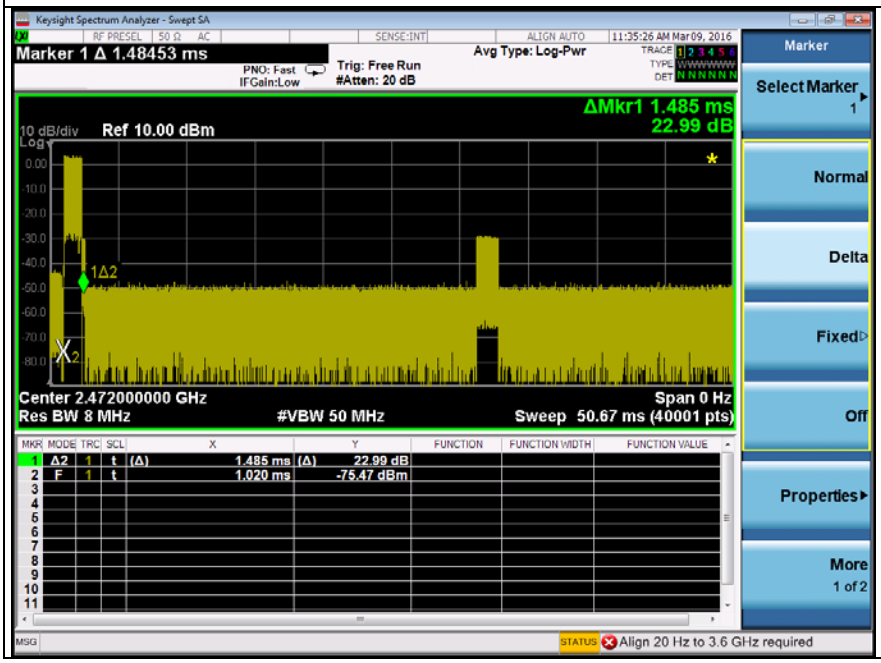
4.4.7.3 Short Control Signaling Transmissions Result

802.11b

2412MHz

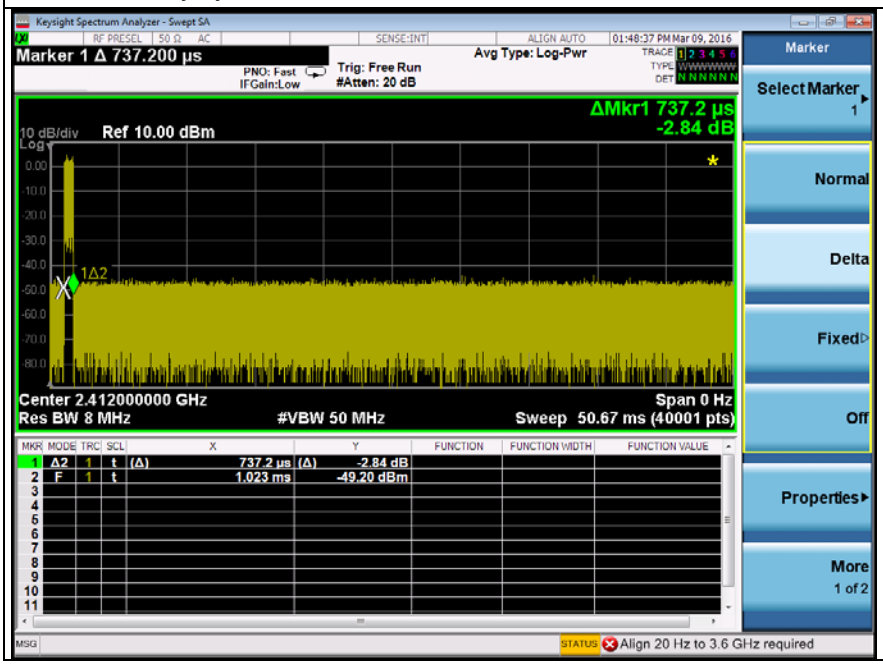
Short Control Signalling Transmission Result
The SCST on time is 1.316ms
The SCST Duty cycle = 1.316ms / 50ms = 2.63% < 10%


2472MHz

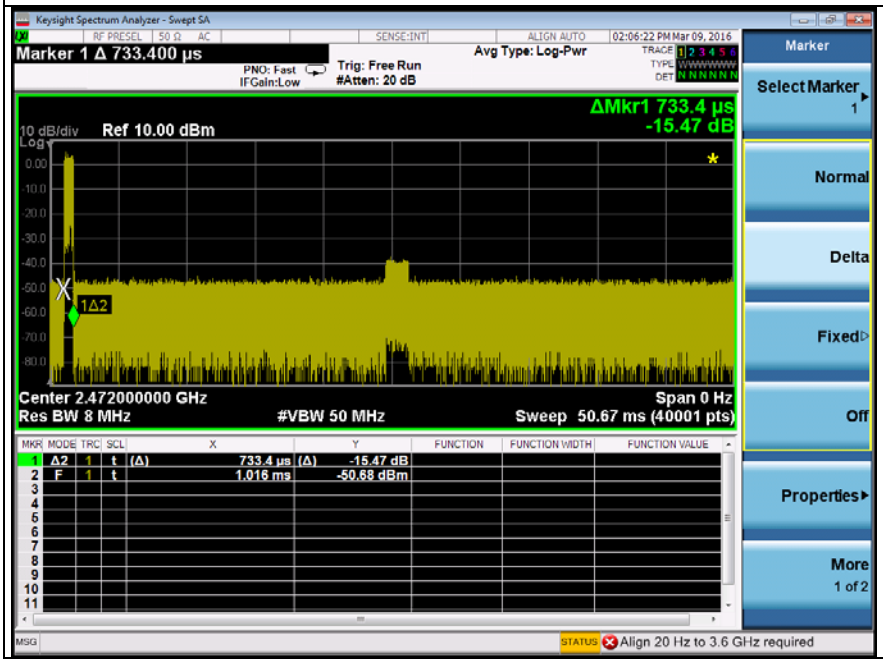
Short Control Signalling Transmission Result
The SCST on time is 1.485ms
The SCST Duty cycle = 1.485ms / 50ms = 2.97% < 10%


802.11g

2412MHz

Short Control Signalling Transmission Result
The SCST on time is 0.07372ms
The SCST Duty cycle = 0.07372ms / 50ms = 1.47 % < 10%


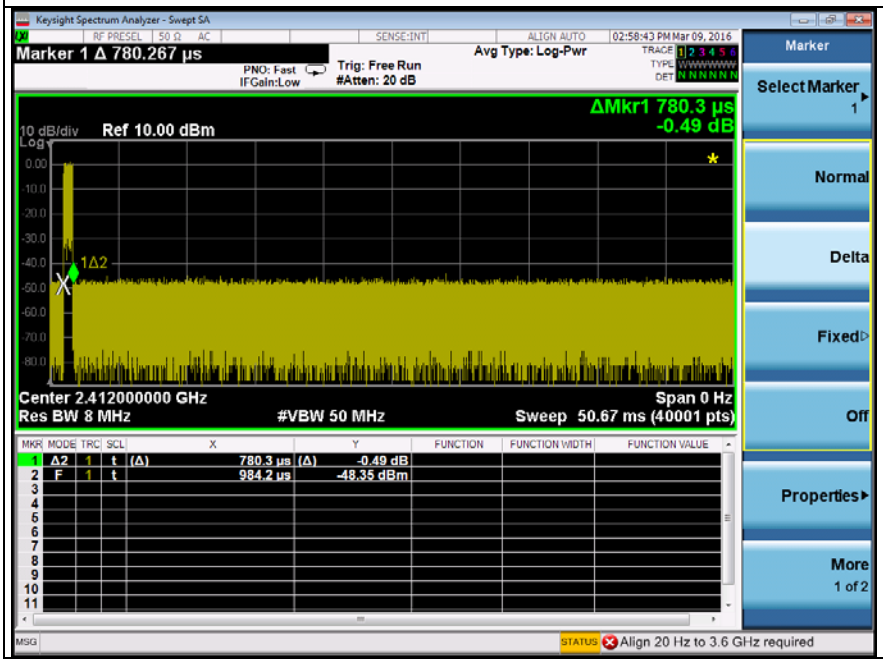
2472MHz

Short Control Signalling Transmission Result
The SCST on time is 0.7334ms
The SCST Duty cycle = 0.7334ms / 50ms = 1.47% < 10%


802.11n (HT20)

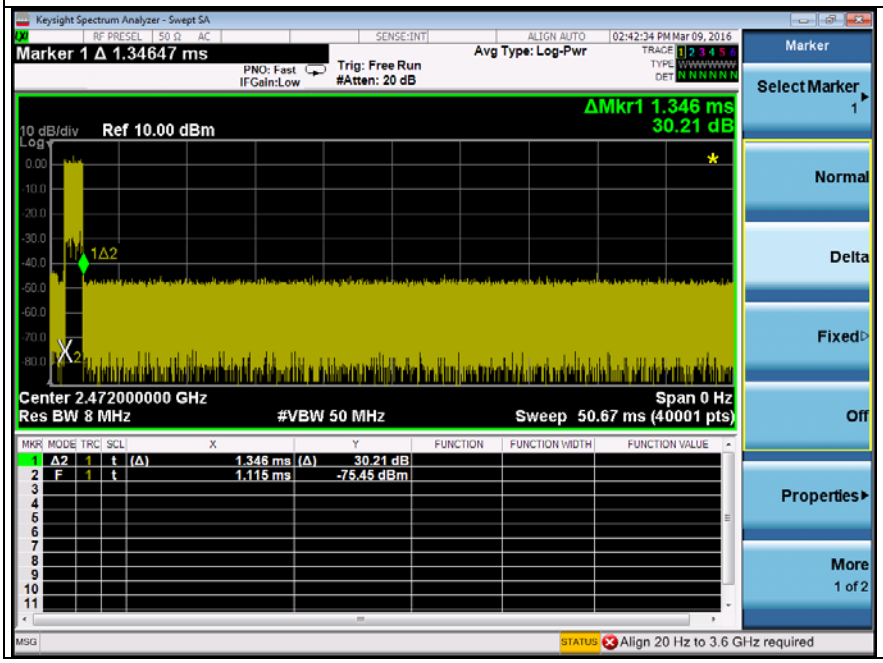
2412MHz

Short Control Signalling Transmission Result
The SCST on time is 0.7803ms
The SCST Duty cycle = 0.7803ms / 50ms = 1.56% < 10%



2472MHz

Short Control Signalling Transmission Result
The SCST on time is 1.346ms
The SCST Duty cycle = 1.346ms / 50ms = 2.69% < 10%



4.5 Occupied Channel Bandwidth

4.5.1 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

4.5.2 Test Procedure

Refer to chapter 5.3.8.2 of ETSI EN 300 328 V1.9.1.

Measurement	
☐ Conducted measurement	☒ Radiated measurement

4.5.3 Deviation from Test Standard

No deviation.

4.5.4 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. Controlling software (provided by manufacturer) has been activated to set the EUT on specific status.

4.5.5 Test Results

802.11b

Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	Measured Frequencies		Limit	Pass/Fail
			F_L (MHz)	F_H (MHz)		
1	2412	18.32	2402.80	2421.12	F_L > 2400 MHz and F_H < 2483.5 MHz	Pass
13	2472	18.24	2462.88	2481.12		Pass

802.11g

Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	Measured Frequencies		Limit	Pass/Fail
			F_L (MHz)	F_H (MHz)		
1	2412	17.12	2403.44	2420.56	F_L > 2400 MHz and F_H < 2483.5 MHz	Pass
13	2472	17.12	2463.44	2480.56		Pass

802.11n (HT20)

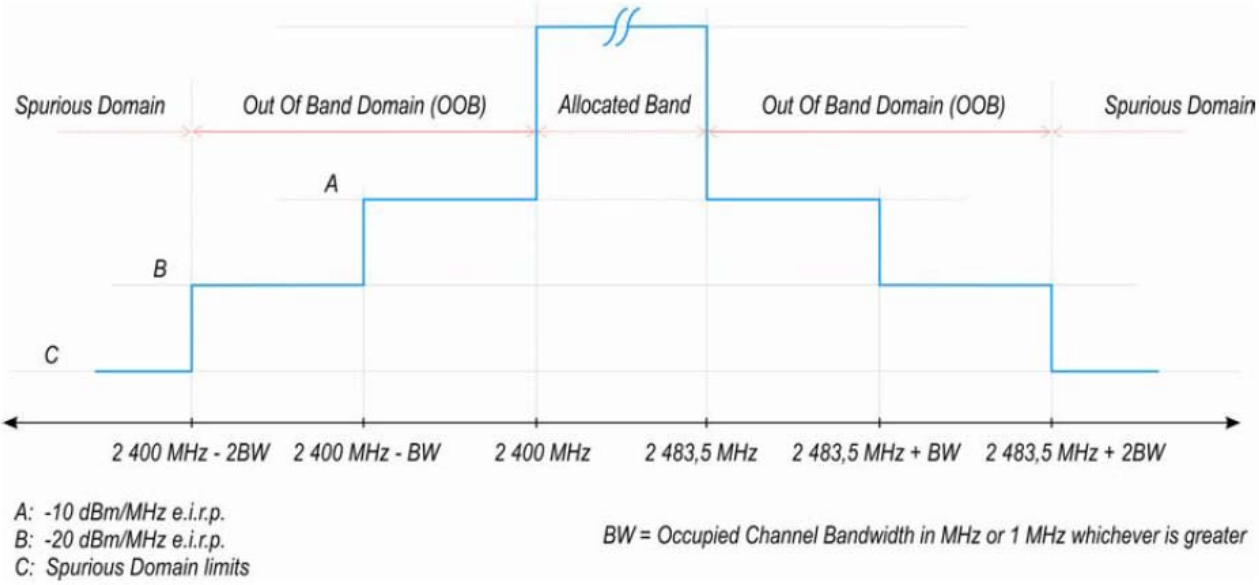
Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	Measured Frequencies		Limit	Pass/Fail
			F_L (MHz)	F_H (MHz)		
1	2412	18.32	2402.80	2421.12	F_L > 2400 MHz and F_H < 2483.5 MHz	Pass
13	2472	18.24	2462.88	2481.12		Pass

Note: FL is the lowest frequency of the 99% occupied bandwidth of power envelope.
FH is the highest frequency of the 99% occupied bandwidth of power envelope.

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

4.6.1 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.



4.6.2 Test Procedure

Refer to chapter 5.3.9.2 of ETSI EN 300 328 V1.9.1.

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

4.6.3 Deviation from Test Standard

No deviation

4.6.4 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.

4.6.5 Test Results

802.11b

Channel Frequency		2412MHz				2472MHz			
Test Condition		OOB Emission (MHz)				OOB Emission (MHz)			
		2381.68 ~ 2400		2363.36 ~ 2381.68		2483.5 ~ 2501.74		2501.74 ~ 2519.98	
		Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)
Tnom 25℃	Vnom(v)	2398.50	-29.64	2386.50	-51.67	2486.00	-29.05	2496.00	-52.14
Tmin -40℃	Vnom(v)	2398.50	-29.63	2386.50	-51.56	2486.00	-29.23	2496.00	-52.10
Tmax 85℃	Vnom(v)	2398.50	-29.65	2386.50	-51.75	2486.00	-29.00	2496.00	-52.08
Limit (dBm/MHz)		-10.00		-20.00		-10.00		-20.00	
Pass/Fail		Pass		Pass		Pass		Pass	

802.11g

Channel Frequency		2412MHz				2472MHz			
Test Condition		OOB Emission (MHz)				OOB Emission (MHz)			
		2382.88 ~ 2400		2365.76 ~ 2382.88		2483.5 ~ 2500.62		2500.62 ~ 2517.74	
		Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)
Tnom 25℃	Vnom(v)	2399.50	-37.23	2382.50	-51.81	2484.00	-35.40	2501.00	-52.14
Tmin -40℃	Vnom(v)	2399.50	-37.40	2382.50	-51.83	2484.00	-35.24	2501.00	-52.24
Tmax 85℃	Vnom(v)	2399.50	-37.12	2382.50	-51.86	2484.00	-35.48	2501.00	-51.97
Limit (dBm/MHz)		-10.00		-20.00		-10.00		-20.00	
Pass/Fail		Pass		Pass		Pass		Pass	

802.11n (HT20)

Channel Frequency		2412MHz				2472MHz			
Test Condition		OOB Emission (MHz)				OOB Emission (MHz)			
		2381.68 ~ 2400		2363.36 ~ 2381.68		2483.5 ~ 2501.74		2501.74 ~ 2519.98	
		Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)	Freq. (MHz)	Power (dBm/ MHz)
Tnom 25℃	Vnom(v)	2399.50	-38.35	2381.50	-52.52	2484.00	-35.35	2502.00	-52.56
Tmin -40℃	Vnom(v)	2399.50	-38.31	2381.50	-52.39	2484.00	-35.54	2502.00	-52.68
Tmax 85℃	Vnom(v)	2399.50	-38.52	2381.50	-52.68	2484.00	-35.42	2502.00	-52.71
Limit (dBm/MHz)		-10.00		-20.00		-10.00		-20.00	
Pass/Fail		Pass		Pass		Pass		Pass	

4.7 Receiver Blocking

4.7.1 Limit of Receiver Blocking

Adaptive equipment using wide band modulations other than FHSS, shall comply with the requirements defined in non-LBT based DAA or LBT based DAA in the presence of a blocking signal with characteristics as provided in below table.

Equipment Type (LBT / Non- LBT)	Wanted signal Mean Power from Companion Device	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm)	Type of Interfering Signal
LBT	sufficient to maintain the link (see note 2)	2 395 or 2 488.5 (see note 1)	-35	CW
Non-LBT	-30 dBm			
NOTE 1: The highest blocking frequency shall be used for testing the lowest operating hopping frequency, while the lowest blocking frequency shall be used for testing the highest hopping frequency. NOTE 2: A typical value which can be used in most cases is -50 dBm/MHz.				

4.7.2 Test Procedure

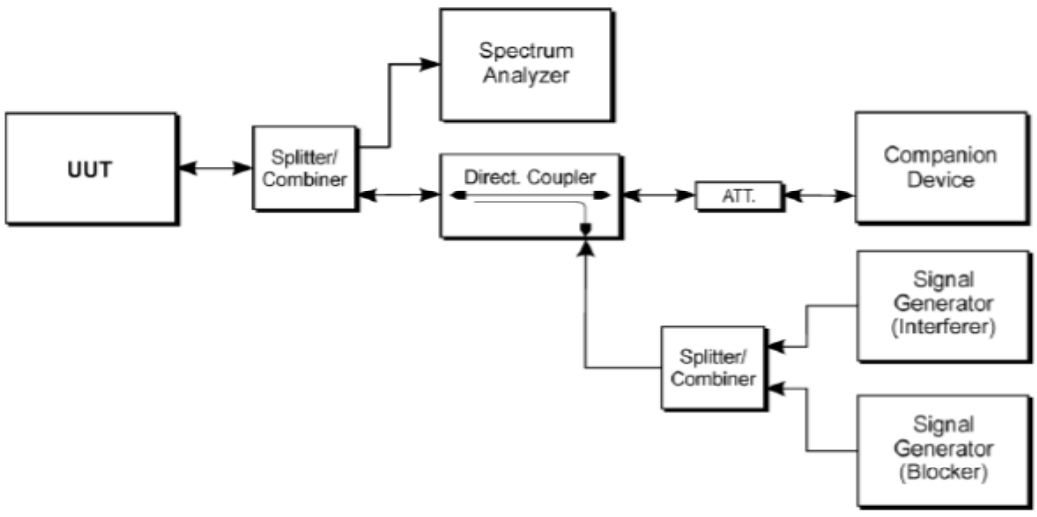
Refer to chapter 5.3.7.2.1. of ETSI EN 300 328 V1.9.1.

Measurement Method	
☒ Conducted measurement	☐ Radiated measurement

4.7.3 Deviation from Test Standard

No deviation.

4.7.4 Test Setup Configuration



4.7.5 Test Results

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

802.11b

Channel	Channel Frequency (MHz)	Wanted Signal Mean Power from Companion Device (dBm/MHz)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm)	Pass/Fail
1	2412	-50	2488.5	-35	Pass
13	2472	-50	2395.0	-35	Pass

802.11g

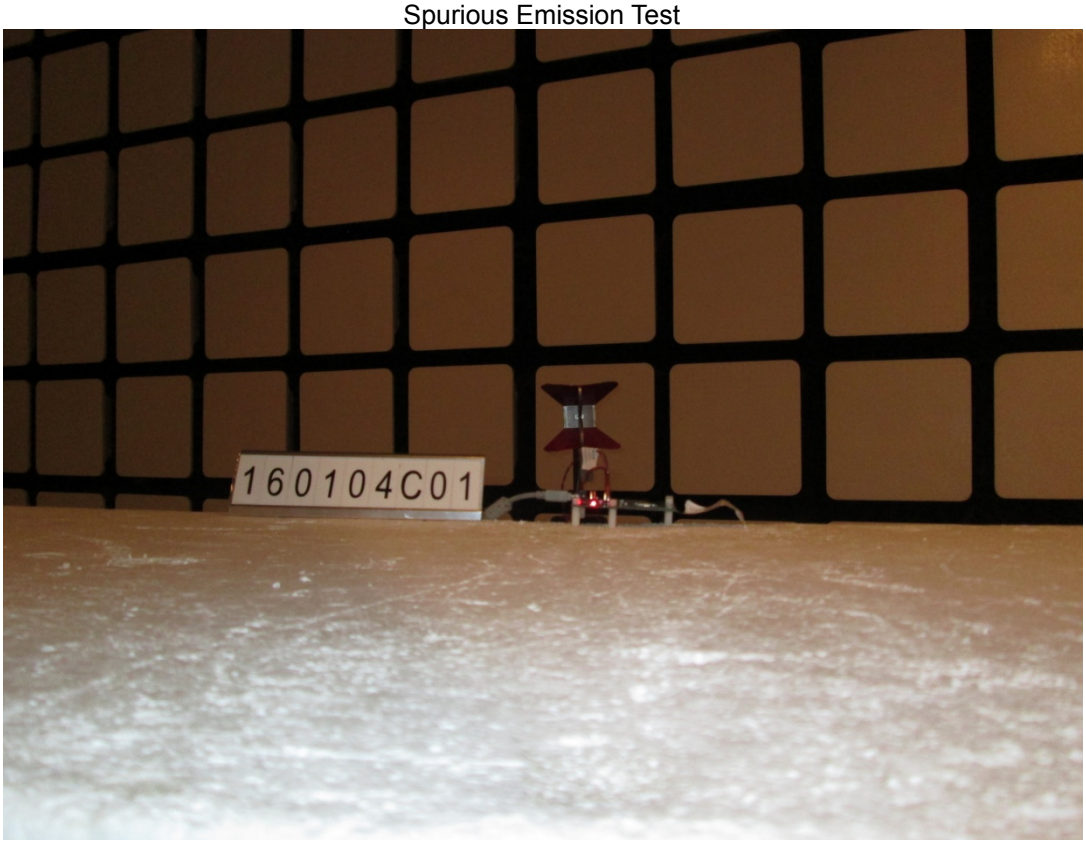
Channel	Channel Frequency (MHz)	Wanted Signal Mean Power from Companion Device (dBm/MHz)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm)	Pass/Fail
1	2412	-50	2488.5	-35	Pass
13	2472	-50	2395.0	-35	Pass

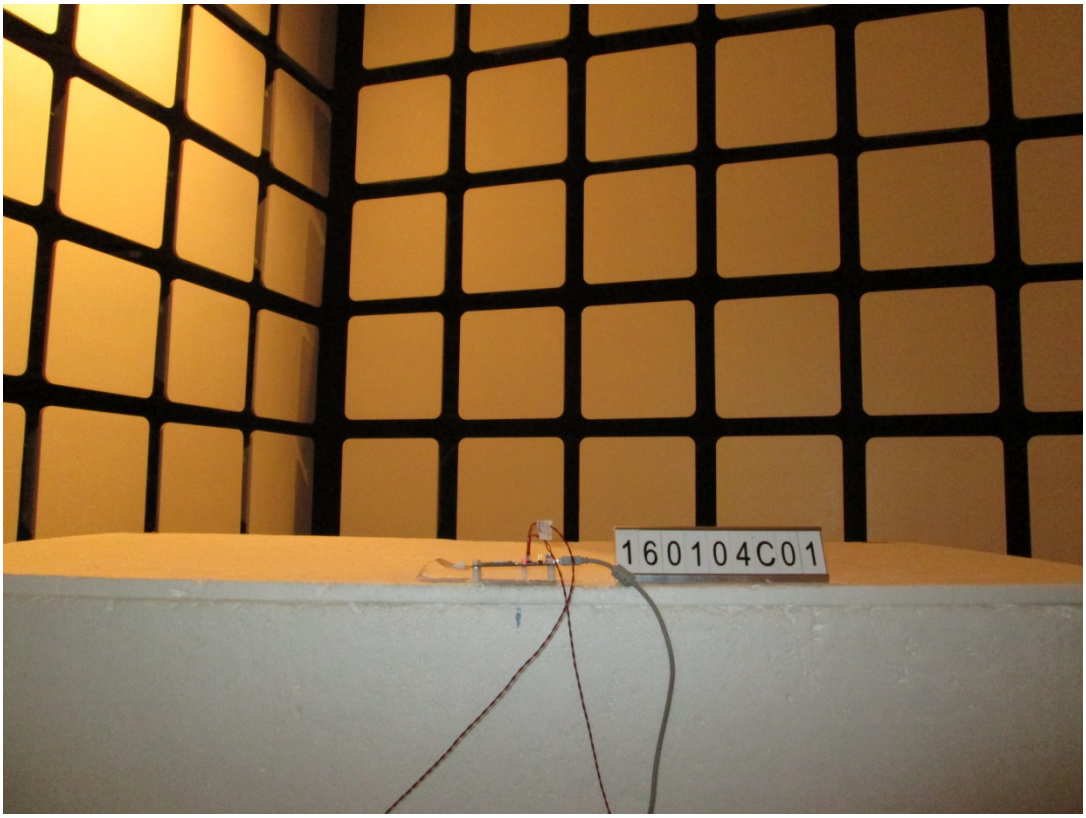
802.11n (HT20)

Channel	Channel Frequency (MHz)	Wanted Signal Mean Power from Companion Device (dBm/MHz)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm)	Pass/Fail
1	2412	-50	2488.5	-35	Pass
13	2472	-50	2395.0	-35	Pass

5 Photographs of the Test Configuration

Spurious Emission Test






160104C01

Appendix - Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Linko EMC/RF Lab
Tel: 886-2-26052180
Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab
Tel: 886-3-6668565
Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab
Tel: 886-3-3183232
Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com
Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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