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Project No.:	**11CA49640**
File No.:	**TC8316**
Report No.:	**08CA48859-FCCP15C-A2**
Date:	**Mar.10, 2012**
Model No.:	**XT DUAL**

Bluetooth RF Test Report

Satellite/GSM Mobile Hand Held Terminal
Model : XT DUAL

For

Asia Pacific Satellite Industries Co., Ltd.

9FL, Lotte IT Castle 2-Dong,
#550-1,Gasan-Dong, GeumCheon-Gu,
Seoul, Korea, 153-768

Report Directory

Appendix
Annex 1. Test Setup Photos

Revision History

Revision	Issue Date	Revision Details	Revised By
Original	July 31, 2009	Original Report issued	KY Kim
A1	Nov.15, 2011	1. Model name change 2. Brand logo change	KY Kim
A2	Mar.10, 2012	1. Typo correction 2. Add Radiated Band edge measurement data	KY Kim

Test Report Details

Tests Performed By:	UL Korea Ltd. 33rd FL. GFC Center, 737 Yeoksam-dong, Kangnam-ku, Seoul, 135-984, Korea
Test Site:	Chungbuk Technopark EMC Center 685-3 Yangcheong-ri, Ochang-eub, Cheongwon-kun, Chungbuk-province, Republic of Korea.
Applicant:	Asia Pacific Satellite Industries Co., Ltd. 9FL, Lotte IT Castle 2-Dong, #550-1,Gasan-Dong, GeumCheon-Gu, Seoul, Korea, 153-768
Applicant Contact:	WonJae Jung
Title:	Manager of R&D Center
Phone:	+82 2-2026-7780
Fax:	+82 2-2026-7771
E-mail:	jwjung@apsat.co.kr
Equipment Class:	DSS – Part 15 Spread Spectrum Transmitter
Product Type:	SAT/GSM Mobile Hand Held Terminal
Model Number:	XT DUAL
FCC ID:	TZ5XTDUAL
Sample Serial Number:	N/A
Test standards:	FCC Part 15 Subpart C Section 15.247 Radio Frequency devices – Intentional Radiators operation within the bands 2400 – 2483.5 MHz
Sample Serial Number:	Prototype
Sample Receive Date:	2008-08-20
Testing Date:	2008-08-20 ~ 09-25
Test Report Date:	2009-07-10
Report Reissue Date:	2012-03-10
Overall Results:	Pass

1. Summary of Testing

The following tests were performed on a sample submitted for evaluation of compliance with 47 CFR Part 15 Subpart C Section 15.247_2008 Radio Frequency devices – Intentional Radiators operation within the bands 2400 – 2483.5 MHz

No	Reference Clause No.	Conformance Requirements	Result Verdict	Remark
1	15.247(a)(1)	Carrier Frequency Separation	Complied	
2	15.247(a)(1)(iii)	Minimum Number of Hopping Channels	Complied	
3	15.247(a)(1)	20dB Bandwidth		Note 1
3	15.247(a)(1)(iii)	Average Time of Occupancy	Complied	
5	15.247(b)(1)	Maximum Peak Conducted Output Power	Complied	
6	15.247(d)	Conducted Spurious Emissions : Band edge & Restricted band	Complied	
7	15.209	Radiated Spurious Emissions	Complied	
8	15.207	AC Mains Conducted Emissions	Complied	
9	15.203	Antenna Requirement	Complied	

Note 1 : No Compliance limit. Just Reporting purpose.

Conclusion:

The tests listed in the Summary of Testing section of this report have been performed and the results recorded by UL Korea Ltd. in accordance with the procedures stated in each test requirement and specification. The test list was determined by the Applicant as being applicable to the Equipment Under Test. As a result, the subject product has been verified to comply or not comply as noted in the Summary of Testing with each test specification. The test results relate only to the items tested.

Tested by
Sung Hoon Baek, Project Engineer
Conformity Assessment Services – 3014ASEO
UL Korea Ltd.

Reviewed by
Jeawoon, Choi, Senior Project Engineer
Conformity Assessment Services – 3014ASEO
UL Korea Ltd.

2. General Product Information

2.1 Equipment Description

XT Pro is the Satellite/GSM Mobile Hand Held Terminal for Thuraya satellite mobile communication service and GSM networks providing various services such as voice, circuit data, packet data and fax etc. Its is reflected in having three integrated technologies in one handset: satellite (SAT), GSM/GPS and Bluetooth wireless.

2.2 Details of Test Equipment (EUT)

- Equipment Type : Satellite/GSM Mobile Hand Held Terminal
- Model No. : XT DUAL
- Trade name : Thuraya
- Type of test Equipment : Portable Equipment
- Operating characteristic : Frequency Hopping Spread Spectrum Transmitters operation Within the bands 2400 – 2483.5 MHz
- Manufacturer : Asia Pacific Satellite Industries Co., Ltd. 9FL, Lotte IT Castle 2-Dong, #550-1, Gasan-dong, Geumcheon-gu, Seoul, Korea, 153-768
- Bluetooth module used : BT module BC02 - BTEZ1702SA (Samsung Electro-Mechanics) BT module BC04 – UGNZ9-F03A (ALPS Electric Co.,Ltd)

2.3 Equipment Configuration

The EUT is consisted of the following component provided by the manufacturer.

No.	Product Type	Manufacturer	Model	Comments
1	Satellite/GSM Mobile Terminal	Asia Pacific Satellite Industries Co., Ltd.	XT DUAL	EUT
2	Travel Charger	Phihong Technology Co Ltd.	PSC11R-050	EUT
3	Ear Set	Cresin	EMB-ATS 106TKA	EUT

2.4 Technical Data of Bluetooth

Specification	
Compatibility	BC02 - BTEZ1702SA BT Specification v1.1 BC04 - UGNZ9-F03A BT Specification v2.0+EDR
Frequency Ranges	2,402 ~ 2,480 MHz
Channel spacing	1 MHz
Output power	Max. 4.0 dBm , Typical : 1.0 dBm
Kind of modulation (s)	BC02 : GFSK BC04 : 1Mbps(GFSK) , 2Mbps(π/4-DQPSK) , 3Mbps(8DPSK)
Hopping channel	79 channel, 1600 hops/sec
Symbol rate	1 Mbps
Rx Sensitivity	Typ. -83.0 dBm (BER < 0.1%)
Baseband crystal OSC	26 MHz
Antenna Gain	ALA621C4 : Max. 3.5 dBi
Working temperature	-20℃ ~ 60℃
Supply Voltage	DC 1.8 ~ 3.3V

Note ;
1. All the technical data described above were provided by the manufacturer.

[2)] antenna was provided by the manufacturer

Antenna Information

Antenna Type : Multilayer Chip Antenna
Manufacturer : AMOTECH Co., Ltd.
Transmit Gain dBi : Max. 3.5 dBi , Avg. -1.7 dBi
Azimuth Beam Pattern : Omni-directional
Installation : Permanently installed on the PCB / Inside EUT

Equipment Type :

☐ Radio and ancillary equipment for fixed or semi-fixed use
☐ Radio and ancillary equipment for vehicular mounted use
☒ Radio and ancillary equipment for portable or handheld use

☒ Stand alone ☐ Host connected ☐ Host connected
☒ Self contained single unit ☐ Module with associated connection or interface

2.5 Technical descriptions and documents

The following documents was provided by the manufacturer.

No.	Document Title and Description
1	APSI, Satellite/GSM Hand Held Terminal Technical Description
2	Samsung BT module approval specification, BTEZ1702SA
3	AMOTECH Antenna specification ALA621C4

2.6 Equipment Marking Plate

2.7 Test Specification

The following test specifications and standards have been applied and used for testing.

1) **FCC 47 CFR Part 15: Radio frequency devices**

§15.207(a) Conducted limits
§15.209(a) Radiated emission limits
§15.247 Intentional Radiator operated in the band 2400 – 2483.5 MHz

2) ANSI C63.4-2003

American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

3) FCC Public Notice DA 00-705-2003

Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

3. Test Conditions

3.1 Equipment Used During Test

Use*	Product Type	Manufacturer	Model	Comments
EUT	Sat/GSM Mobile phone	Asia Pacific Satellite Industries Co., Ltd.	XT DUAL	Main Unit
EUT	BT Module	Samsung Electro-Mechanics Co., Ltd.	BTEZ1702SA	Incorporated in Main Unit
AE	Travel Charger	Phihong Technology Co Ltd.	PSC11R-050	Connected to AC mains
SIM	Universal Radio communication Tester	Rohde & Schwarz	CMU200	

Note:
* EUT - Equipment Under Test, AE - Auxiliary/Associated Equipment, or SIM - Simulator (Not Subjected to Test)

3.2 Input/Output Ports

No	Port Name	Type*	Cable Max. >3m (Y/N)	Cable Shielded (Y/N)	Comments
0	Enclosure	-	-	-	Non-metal enclosure
1	Travel Charger	DC	< 3m	Unshielded	Connected to DC input port of EUT
2	UDC port	I/O	< 3m	Shield	Connected to Satellite simulator
3	Ear set	I/O	< 3m	Unshield	Connected to Mono Ear set

Note:
-. All the interface cables and Power Cable have been provided by the manufacturer
-. UDC port is not user interface port for data download purpose only.

*AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
TP = Telecommunication Ports

3.3 Power Interface

Mode #	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
Rated	3.7 V	-	-	DC	-	Internal Battery Rating
1	3.7 V	-	-	DC	-	Normal operating voltage (Charger was connected to the ac mains)
2	3.5 V	-	-	DC	-	Battery End Point
3	4.2 V	-	-	DC	-	Battery Full charged voltage

3.4 Operation Modes

Mode #	Description
1	BT Module : BC02 3 hopping channels @ GFSK modulation -. Low : 2402 MHz / CH = 1 -. Mid : 2441 MHz / CH = 40 -. Top : 2480 MHz / CH= 79
2	BT Module : BC04 3 hopping channels @ GFSK, π/4-DQPSK , 8DPSK -. Low : 2402 MHz / CH = 1 -. Mid : 2441 MHz / CH = 40 -. Top : 2480 MHz / CH= 79

Note :

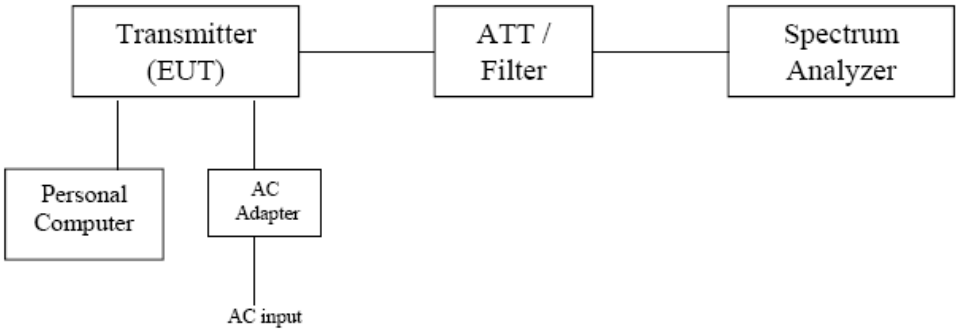
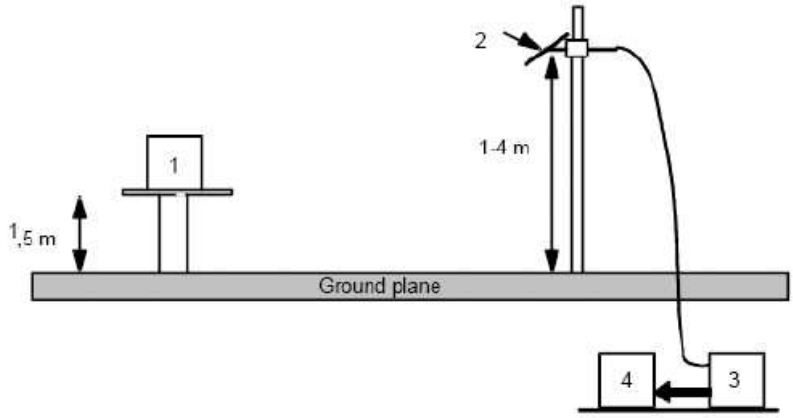
1. Test program used to control the EUT for establishing the continuous transmitting mode was programmed.
2. After verification, all the tests were carried out with the worst case test modes as shown in the below except the radiated spurious emissions below 1 GHz and ac power line conducted emissions below 30 MHz, which worst case was in normal mode only.
3. During the preliminary test, GFSK, π/4-DQPSK, 8DPSK with DH1 were pre-tested and found that 8DPSK was the highest power. Then tests were carried out with DH3 & DH5 to compare DH1. The DH5 emit the highest output power. Therefore the worst case operating mode was determined.
4. The carrier and noise level were confirmed at each position of X, Y, Z axis of EUT to see the position of maximum level in preliminary testing and found the Z axis (EUT vertical position) was the worst case.
5. Following channels were selected for the radiated emission testing only.

Tested channel	Modulation	Packet type	Data Rate	Axis
L, M, H	GFSK	DH5	1 MHz	Z
L, M, H	8DPSK	DH5	3 MHz	Z

3.5 Environment Conditions

Parameters	Normal condition	Extreme condition
Temperature	+ 15℃ ~ +35℃	N/A
Humidity	20% ~ 75%	N/A
Supply voltage	3.7Vdc (Rated nominal voltage)	N/A
Note.		

3.6 Test Configurations

Mode #	Description
1	Test Configuration of Conducted Measurement 
2	Test Configuration of Radiated Measurement  1) equipment under test; 2) test antenna; 3) high pass filter (if necessary); 4) spectrum analyzer or measuring receiver.

3.7 List of Test Equipment

No	Description	Manufacturer	Model	Identifier	Cal. Due
1	Spectrum Analyzer	Agilent Technologies	E4440A	MY46186519	2009.03.29
2	RF Power Meter	Agilent Technologies	E4418B	MY45105913	2009.03.29
3	Power Sensor	Agilent Technologies	8481H	MY41092319	2009.03.29
4	Coaxial Attenuator	Agilent Technologies	8491B	90466	2009.03.29
5	High Pass Filter	Wainwright	WHK3.3/18G-10EF	10Z	2009.08.20
6	Programmable DC Power Supply	GW Instek	PSH-2050A	EH160824	2009.03.30
7	Temp & Humid Test Chamber	Climats	EX2213-HA	7558	2009.06.23
8	Test Receiver	Rohde & Schwarz	ESIB26	100359	2009.05.26
9	Signal generator	Agilent Technologies	E4438C	MY45094697	2009.03.29
10	Dipole Antenna	Schwarzbeck	UHA9105	9105-2371	2010.04.18
11	BiconiLog ANT	Schaffner	CBL6112D	22022	2009.04.21
12	Horn Antenna	Schwarzbeck	BBHA9120D	BBHA9120D	2009.03.24
13	Antenna Mast	Inn-co	MA 4000	-	-
14	Turntable	Inn-co	DT 3000	-	-

4. Overview of Technical requirements

47 CFR Part 15 Subpart C Section 15.247_2008 Radio Frequency devices – Intentional Radiators operation within the bands 2400 – 2483.5 MHz			Reported
Reference Clause No.	Essential technical requirements	Test method Clause No.	
15.247(a)(1)	Carrier Frequency Separation		[X]
15.247(a)(1)(iii)	Minimum Number of Hopping Channels		N/A Note 1
15.247(a)(1)(iii)	Average Time of Occupancy		[X]
15.247(a)(1)	20dB Bandwidth		[X]
15.247(b)(1)	Maximum Peak Conducted Output Power		[X]
15.247(d)	Radiated Emission in the Restricted Band		[X]
15.247(d)	Conducted Spurious Emissions		[X]
15.209	Radiated Emissions		[X]
15.207	Conducted Emissions		[X] Note 2
15.203	Antenna Requirement		

5. Test Results

5.1 Hopping Frequency Separation

	TEST: FHSS - Carrier frequency Separation	
Method	The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled. After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.	
Reference Clause	15.247(a)(1)	
Parameters required prior to the test	Laboratory Ambient Temperature	10 to 40 °C
	Relative Humidity	10 to 90 %
Parameters recorded during the test	Laboratory Ambient Temperature	25 °C
	Relative Humidity	42 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	2,402 MHz – 2,480 MHz	Antenna terminal

Configuration Settings

Power Interface Mode # (See Section 3.3)	Test Configurations Mode # (See Section 3.6)	EUT Operation Mode # (See 3.4)
1	1	1, 2
Supplementary information: -. Normal condition only.		

Limits

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Equipment Used

No. used in the List of Test equipment table	1

Test Result of Carrier Frequency Separation

Measurement method : ☐ Radiated ☒ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Each modulation condition
Power setting : Max. Power condition declared by the manufacturer
Duty cycle(x) : BC02 (0.338), BC04(0.337)
Antenna Gain : Max. 3.5 dBi

BT Module : BC02

Channel condition	Mark #1 (MHz)	Mark #2 (MHz)	Carrier Separation (MHz)	Limit (MHz)	Result
GFSK (1Mbps)	2441	2442	1.0	≥ 20dB BW or ≥ Two-Thirds of 20dB BW	Comply

BT Module : BC04

Channel condition	Mark #1 (MHz)	Mark #2 (MHz)	Carrier Separation (MHz)	Limit (MHz)	Result
GFSK (1Mbps)	2441	2442	1.0	≥ 20dB BW or ≥ Two-Thirds of 20dB BW	Comply
π/4-DQPSK (2Mbps)	2441	2442	1.0		Comply
8DPSK (3Mbps)	2441	2442	1.0		Comply

Supplementary information:
-. Spectrum analyzer was set to the following conditions :
- Span = wide enough to capture the peaks of two adjacent channels
- Resolution (or IF) Bandwidth (RBW) = 1% of the span
- Video (or Average) Bandwidth (VBW) = RBW
- Sweep = auto, Detector function = peak , Trace = max hold

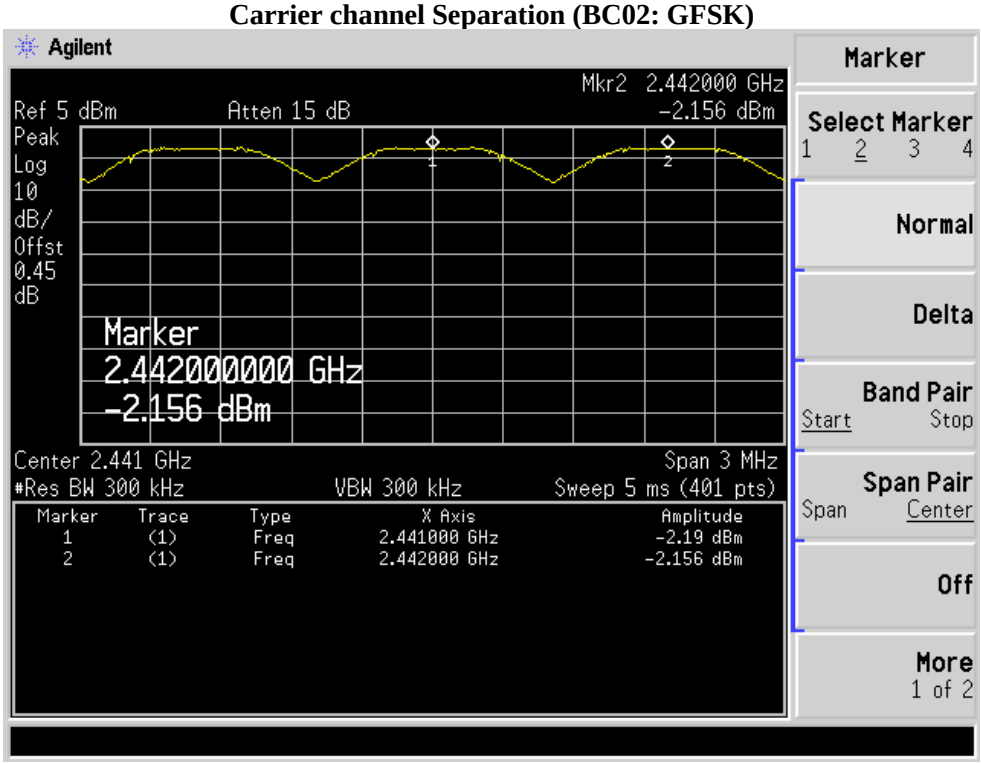
Measurement Plots : Worst case plots are provided.

Remarks : None

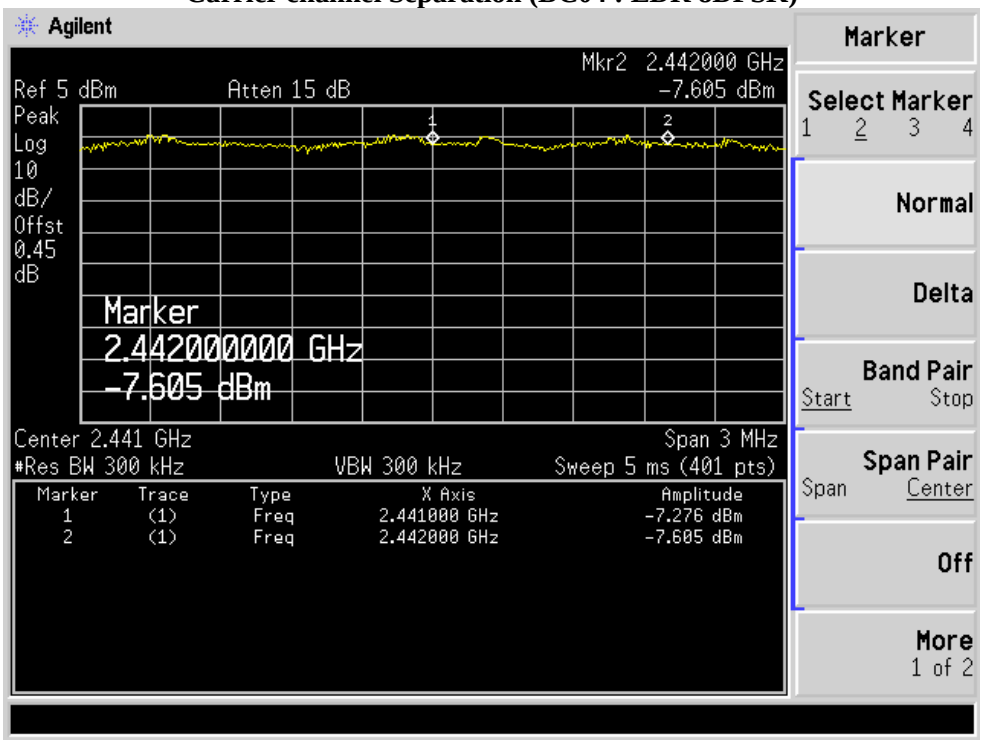
Result of test
In accordance with Technical requirement of Clause 15.247(a)(1)

☒ Complied ☐ Failed

Carrier channel Separation (BC02: GFSK)



Carrier channel Separation (BC04 : EDR 8DPSK)



5.2 Number of Hopping Frequencies

	TEST: Hopping Channels	
Method	Measurements were made in the laboratory environment. Conducted measurement was used with using a direct connection between RF output of the EUT and spectrum analyzer through RF attenuator. The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.	
Reference Clause	§15.247(a)(1)(iii)	
Parameters required prior to the test	Laboratory Ambient Temperature	10 to 40 °C
	Relative Humidity	10 to 90 %
Parameters recorded during the test	Laboratory Ambient Temperature	25 °C
	Relative Humidity	42 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	2,400 MHz – 2483.5 MHz	Antenna terminal port

Configuration Settings

Power Interface Mode # (See Section 3.3)	Test Configurations Mode # (See Section 3.6)	EUT Operation Mode # (See 3.4)
1	1	1, 2
Supplementary information: None		

Limits

§15.247(a)(1)(iii) : Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Equipment Used

No. used in the List of Test equipment table	1

Test Result of Number of Hopping Channel

Measurement method : ☐ Radiated ☒ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Low, Mid, High Channel with modulation
Power setting : Max. Power condition declared by the manufacturer
Duty cycle(x) : BC02 (0.338), BC04(0.337)
Antenna Gain : Max. 3.5 dBi
Environment Condition : Normal condition

Temp. 25 °C Humidity 42 %RH Supply voltage : 3.7 Vdc

BT Module : BC02

Operating condition	Measurement Result	Limit
GFSK (1Mbps)	79	≥ 15

BT Module : BC04

Operating condition	Measurement Result	Limit
GFSK (1Mbps)	79	≥ 15
π/4-DQPSK (2Mbps)	79	
8DPSK (3Mbps)	79	

Supplementary information:
-. Spectrum analyzer settings
- Span = the frequency band of operation
- RBW = 1% of the span
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

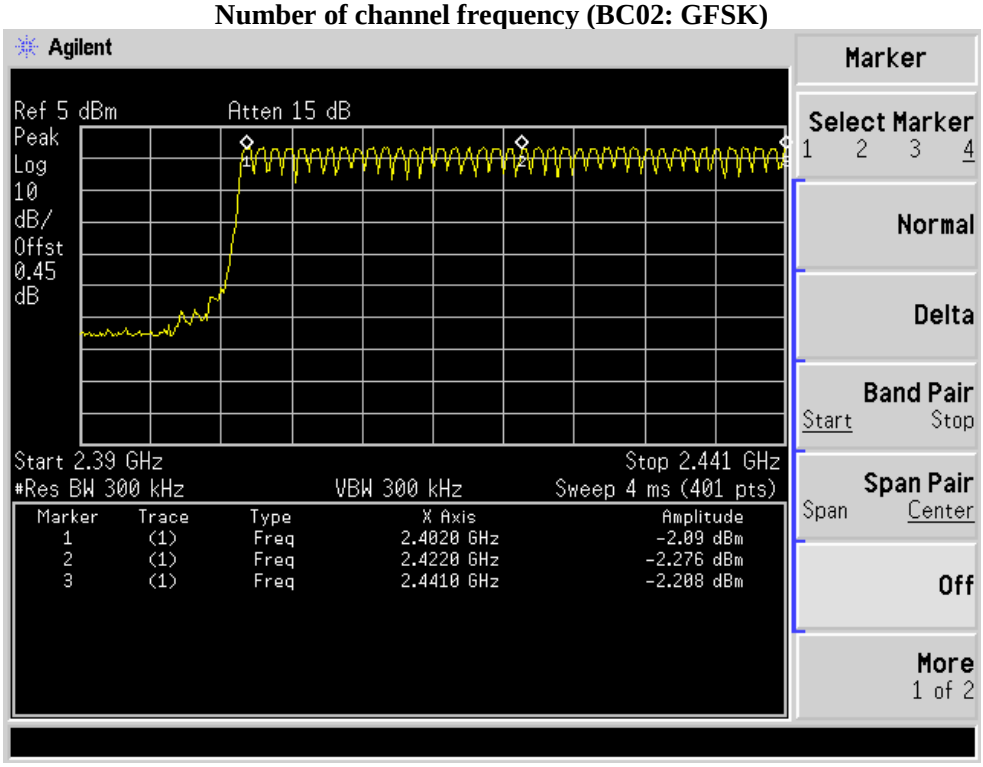
Measurement Plots : Measurement plots provided.

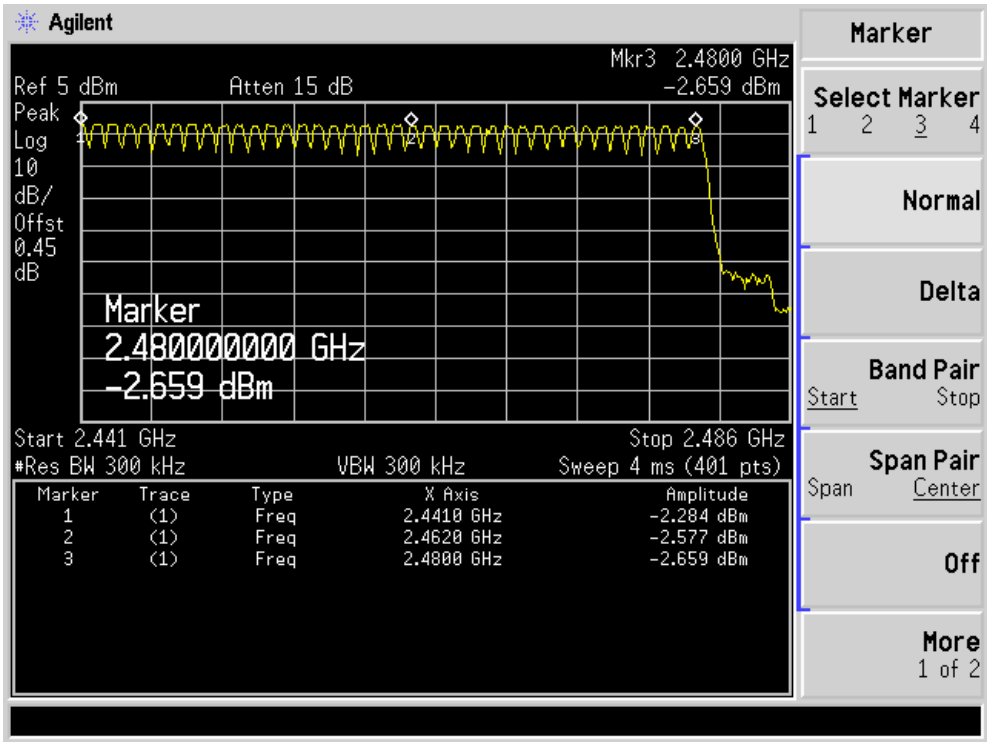
Remarks : None

Result of test
In accordance with Technical requirement of Clause §15.247(a)(1)(iii)

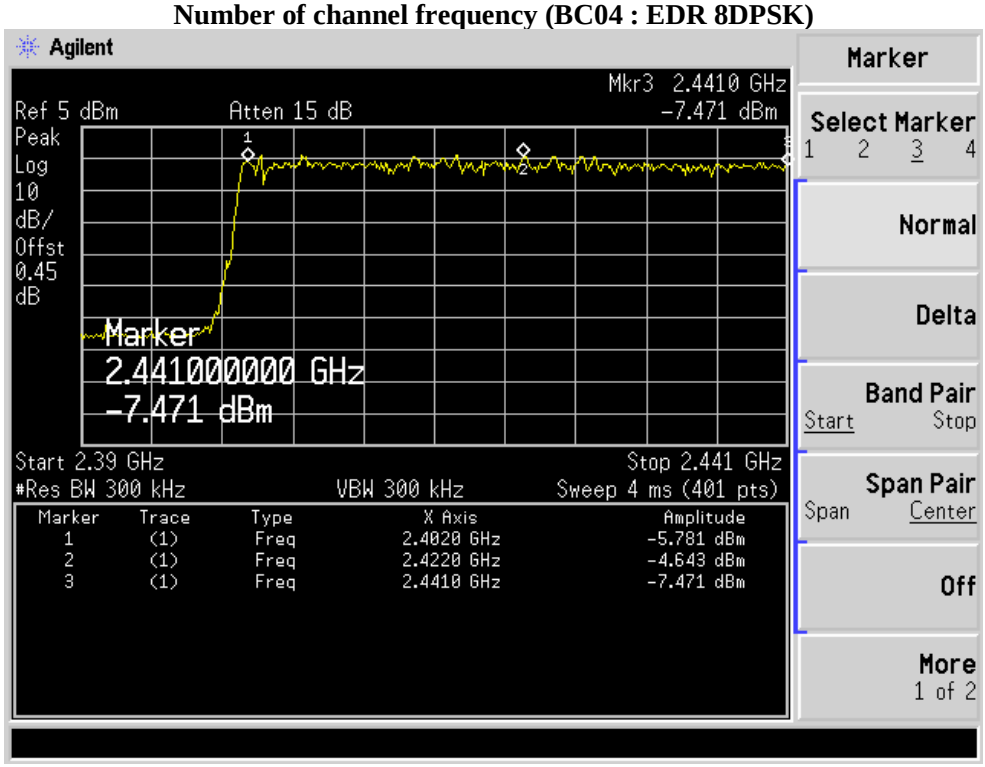
☒ Complied ☐ Failed

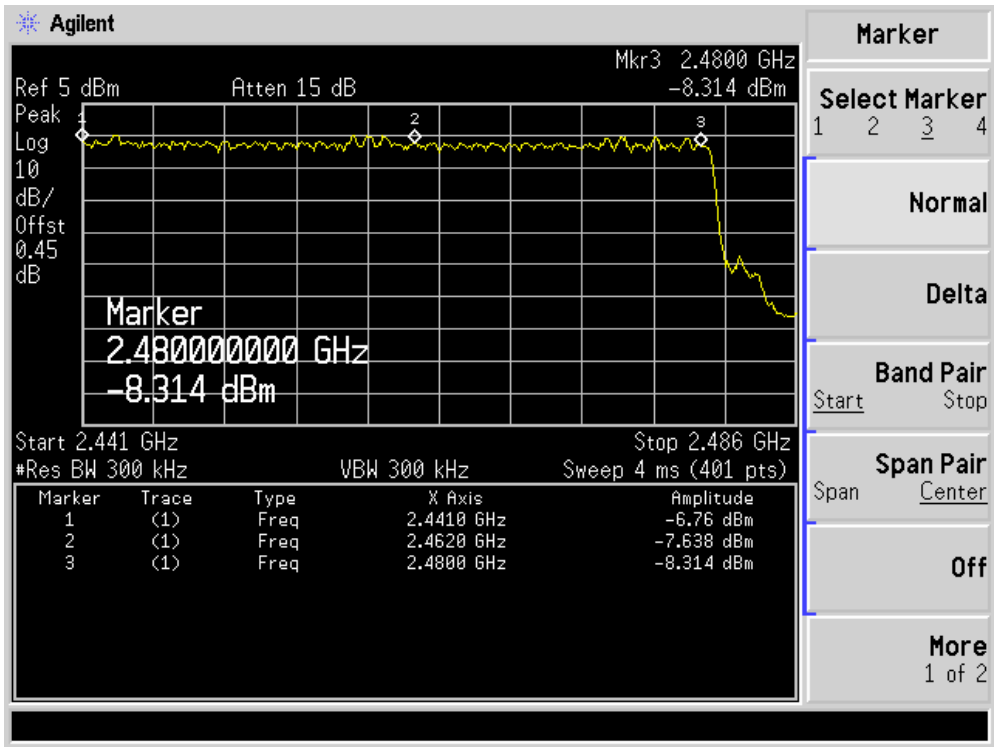
Number of channel frequency (BC02: GFSK)





Number of channel frequency (BC04 : EDR 8DPSK)





5.3 20 dB Bandwidth

	TEST: 20 dB Bandwidth Measurement	
Method	The bandwidth at 20 dB below the highest in-band spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.. After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.	
Reference Clause	§15.247(a)(1)	
Parameters required prior to the test	Laboratory Ambient Temperature	10 to 40 °C
	Relative Humidity	10 to 90 %
Parameters recorded during the test	Laboratory Ambient Temperature	25 °C
	Relative Humidity	42 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	2402 MHz, 2441 MHz, 2480 MHz	Antenna port

Configuration Settings

Power Interface Mode # (See Section 3.3)	Test Configurations Mode # (See Section 3.6)	EUT Operation Mode # (See 3.4)
1	1	1, 2
Supplementary information: None		

Limits

§15.247(a)(1) : No limit apply.

Test Equipment Used

No. used in the List of Test equipment table	1

Test Result of 20dB Bandwidth

Measurement method : ☐ Radiated ☒ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Low, Mid, High Channel with modulation
Power setting : Max. Power condition declared by the manufacturer
Duty cycle(x) : BC02 (0.338), BC04(0.337)
Antenna Gain : Max. 3.5 dBi
Environment Condition : Normal condition

BT Module : BC02

Operating condition	Measurement Frequency	20dB Bandwidth
GFSK (1Mbps)	2402 MHz	926.614 kHz
	2441 MHz	971.917 kHz
	2480 MHz	946.546 kHz

BT Module : BC04

Operating condition	Measurement Frequency	20dB Bandwidth
8DPSK (3Mbps)	2402 MHz	1.316 MHz
	2441 MHz	1.353 MHz
	2480 MHz	1.312 MHz

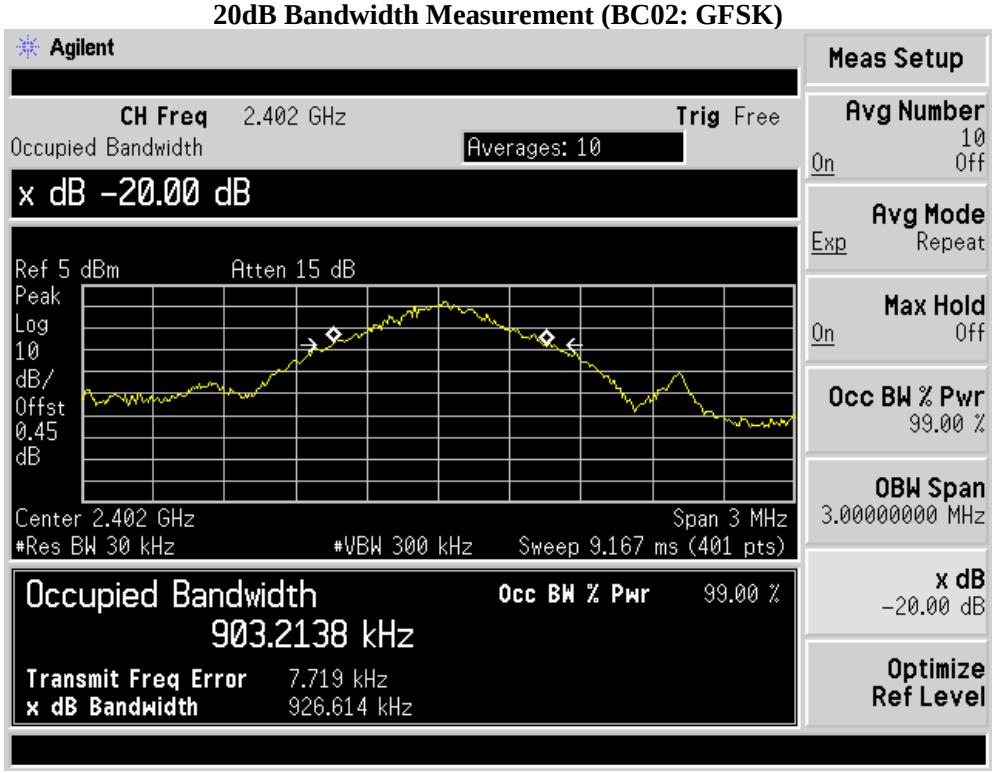
Supplementary information:
-. Spectrum analyzer settings

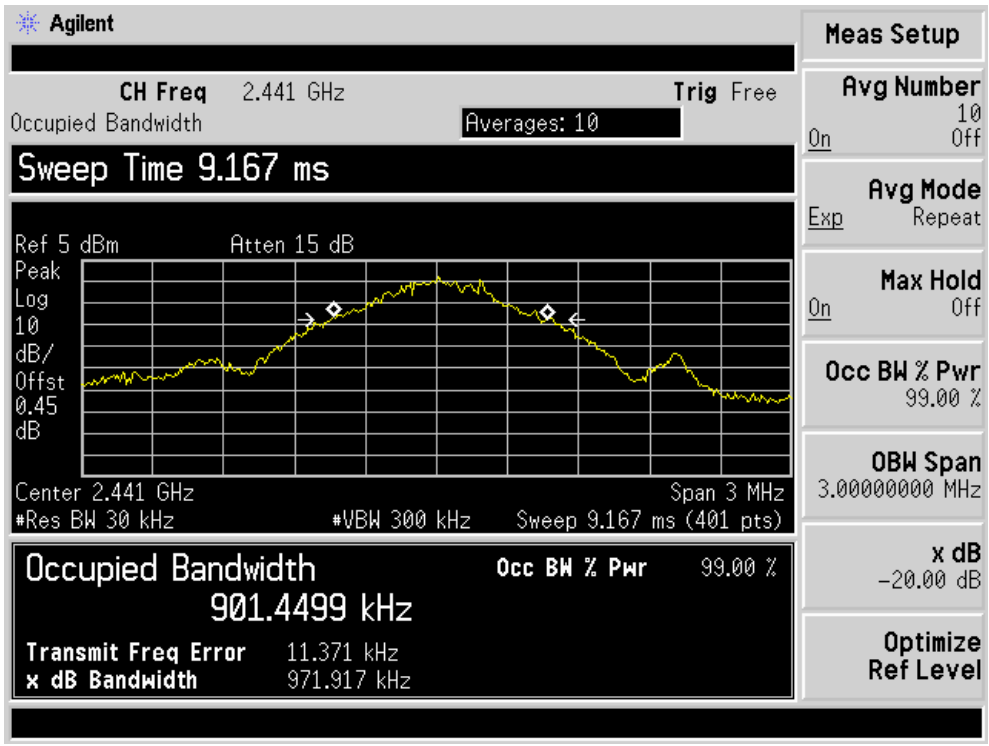
- Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
- RBW = 1% of the 20 dB bandwidth
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

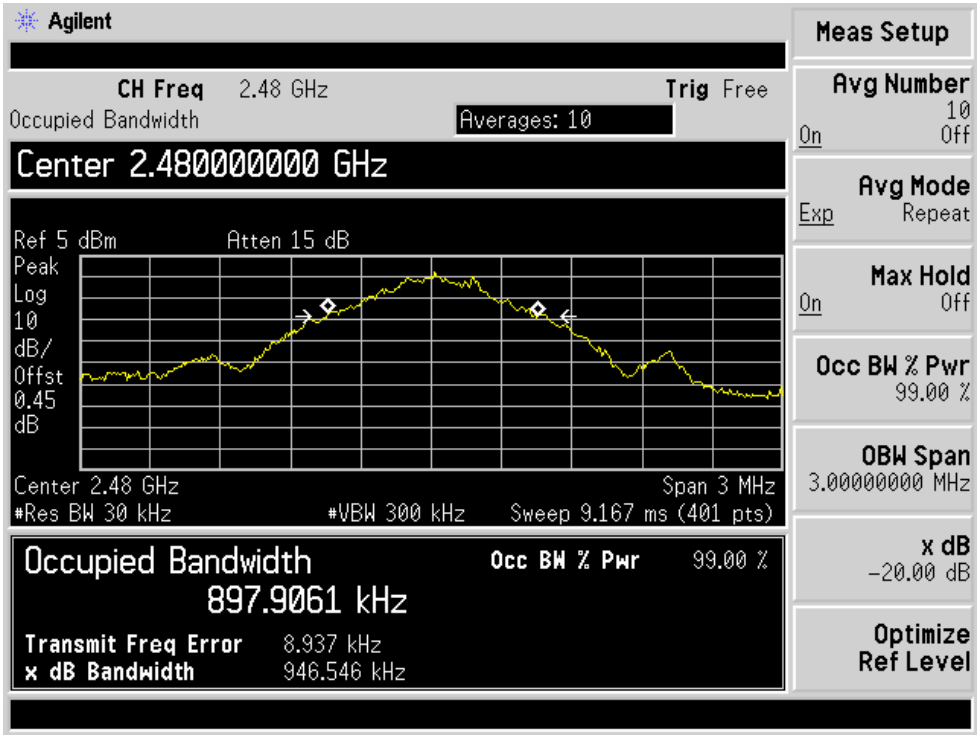
Measurement Plots : Measurement plots provided.

Remarks : For reporting purpose only.

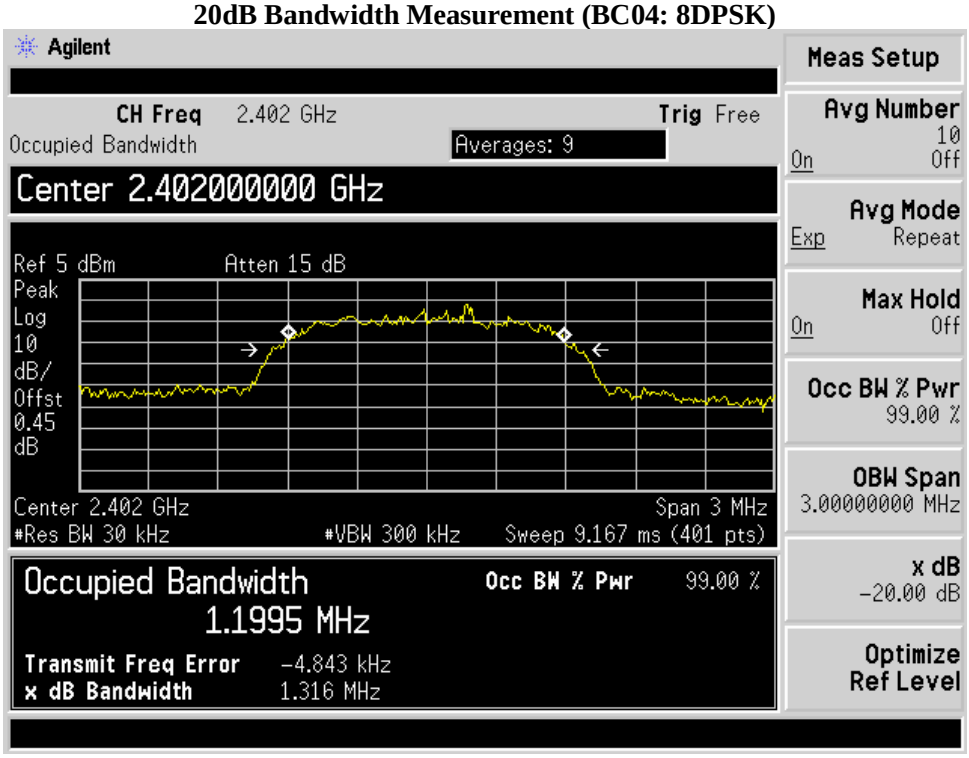
20dB Bandwidth Measurement (BC02: GFSK)

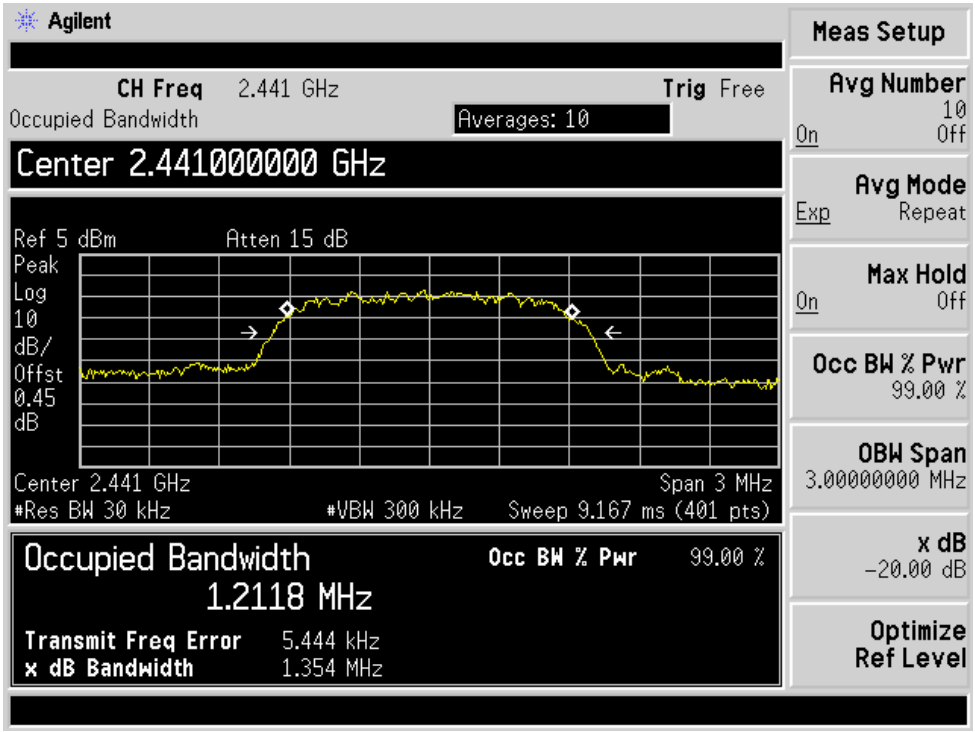


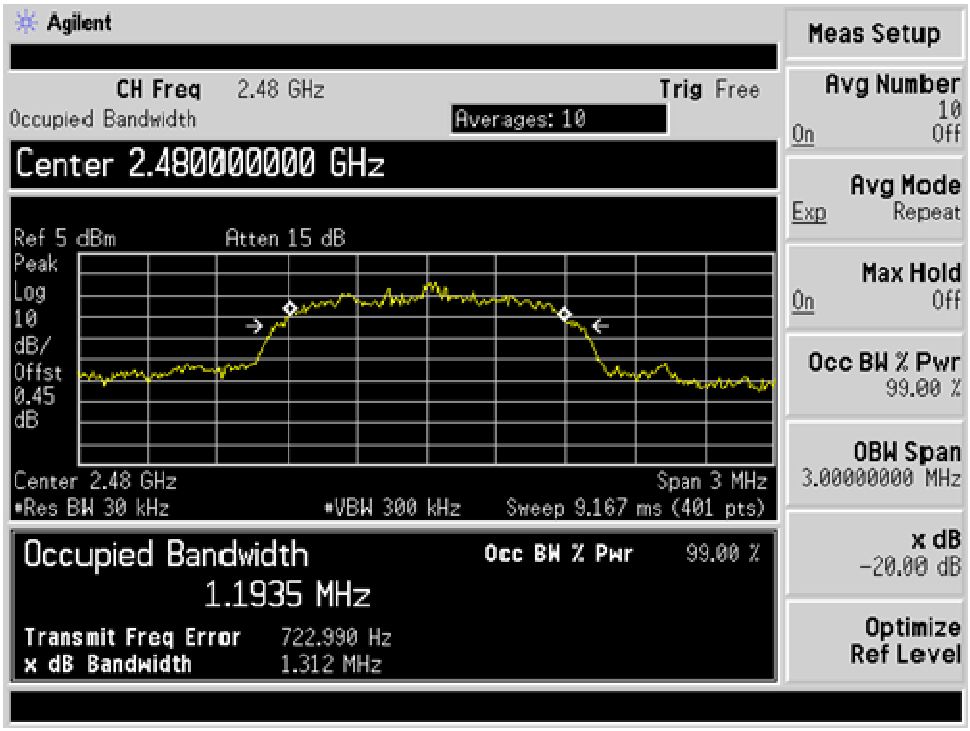



Agilent
Meas Setup
CH Freq 2.48 GHz
Trig Free
Occupied Bandwidth
Averages: 10
Avg Number
10
On Off
Center 2.480000000 GHz
Avg Mode
Exp Repeat
Ref 5 dBm
Atten 15 dB
Peak
Log
10
dB/
Offst
0.45
dB
Max Hold
On Off
Occ BW % Pwr
99.00 %
Center 2.48 GHz
Span 3 MHz
#Res BW 30 kHz
#VBW 300 kHz
Sweep 9.167 ms (401 pts)
OBW Span
3.00000000 MHz
Occupied Bandwidth
Occ BW % Pwr 99.00 %
897.9061 kHz
x dB
-20.00 dB
Transmit Freq Error 8.937 kHz
x dB Bandwidth 946.546 kHz
Optimize
Ref Level

20dB Bandwidth Measurement (BC04: 8DPSK)






Agilent
Meas Setup
CH Freq 2.48 GHz
Trig Free
Occupied Bandwidth
Averages: 10
Avg Number
10
On Off
Center 2.480000000 GHz
Avg Mode
Exp Repeat
Ref 5 dBm
Atten 15 dB
Peak
Log
10
dB/
Offst
0.45
dB
Max Hold
On Off
Occ BW % Pwr
99.00 %
Center 2.48 GHz
Span 3 MHz
#Res BW 30 kHz
#VBW 300 kHz
Sweep 9.167 ms (401 pts)
OBW Span
3.00000000 MHz
Occupied Bandwidth
Occ BW % Pwr 99.00 %
1.1935 MHz
x dB
-20.00 dB
Transmit Freq Error 722.990 Hz
x dB Bandwidth 1.312 MHz
Optimize
Ref Level

5.4 Time of Occupancy (Dwell Time)

	TEST: Time of Occupancy Measurement	
Method	The testing follows FCC Public Notice DA 00-705 Measurement Guidelines. The RF output of EUT was connected to the spectrum analyzer by a low loss cable. The EUT should be transmitting at its maximum data rate as the worst cases. The EUT must have its hopping function enabled. Use the marker-delta function to calculate the dwell time.	
Reference Clause	§15.247(a)(1)	
Parameters required prior to the test	Laboratory Ambient Temperature	10 to 40 °C
	Relative Humidity	10 to 90 %
Parameters recorded during the test	Laboratory Ambient Temperature	25 °C
	Relative Humidity	42 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	2402 MHz, 2441 MHz, 2480 MHz	Antenna port

Configuration Settings

Power Interface Mode # (See Section 3.3)	Test Configurations Mode # (See Section 3.6)	EUT Operation Mode # (See 3.4)
1	1	1, 2
Supplementary information: None		

Limits

§15.247(a)(1) (iii) : For Frequency hopping systems in the 2400–2483.5 MHz band, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Equipment Used

No. used in the List of Test equipment table	1

Test Result of Dwell Time

Measurement method : ☐ Radiated ☒ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Low, Mid, High Channel with modulation
Power setting : Max. Power condition declared by the manufacturer
Duty cycle(x) : BC02 (0.338), BC04(0.337)
Antenna Gain : Max. 3.5 dBi
Environment Condition : Normal condition

BT Module : BC02

Operating condition	Packet Type	Burst On Time (ms)	Hops per second	Period (sec)	Dwell Time (ms)	Limit (ms)
GFSK (1Mbps)	DH1	0.435	10.13	31.6	139.24	400
	DH3	1.768	5.06	31.6	282.70	400
	DH5	2.881	3.38	31.6	307.71	400

BT Module : BC04

Operating condition	Packet Type	Burst On Time (ms)	Hops per second	Period (sec)	Dwell Time	Limit (ms)
8DPSK (3Mbps)	DH1	0.470	10.13	31.6	150.45	400
	DH3	1.739	5.06	31.6	278.06	400
	DH5	2.987	3.38	31.6	319.04	400

Supplementary information:
-. Spectrum analyzer settings
- Span = zero span, centered on a hopping channel
- RBW = 1 MHz
- VBW = RBW
- Sweep = as necessary to capture the entire dwell time per hopping channel
- Detector function = peak
- Trace = max hold

-. Dwell time calculation
- Dwell time = Pulse time x Hops per second within channel x Period time
- Hops per second within channel = 1600 hops/slot/no of channels
  DH1 = 1600/2/79(10.13), DH3 = 1600/4/79(5.06), DH5 = 1600/6/79(3.38)
- Period time = 0.4 sec x 79 channel = 31.6 sec

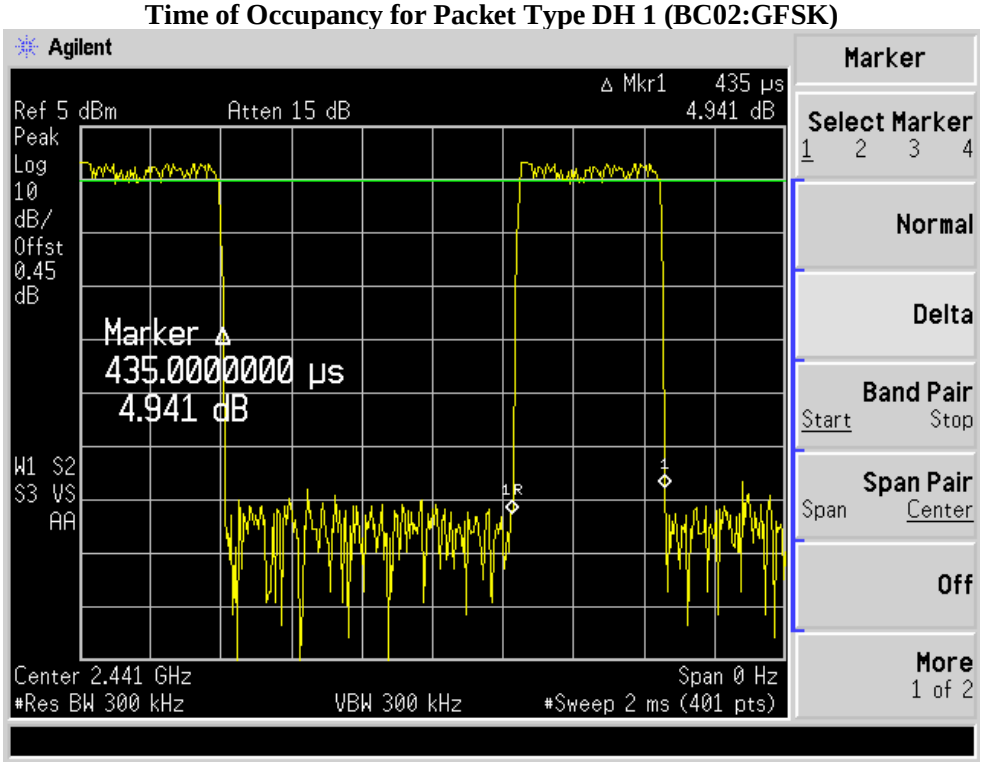
Measurement Plots : Measurement plots provided.

Remarks : None

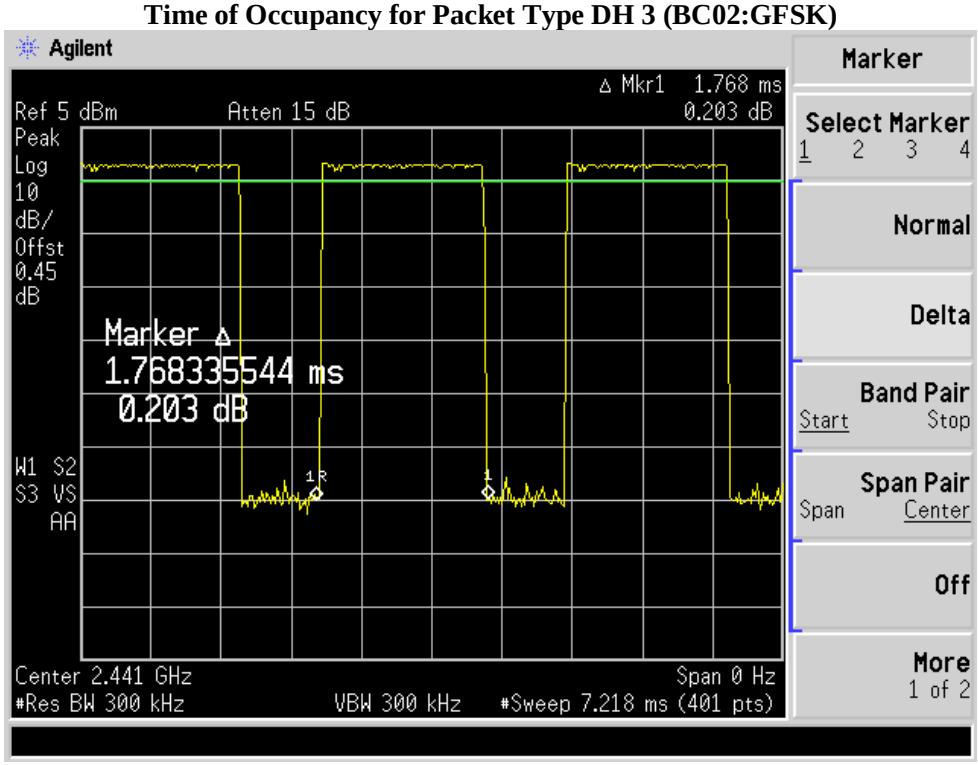
Result of test
In accordance with Technical requirement of Clause 15.247(a)(1)

☒ Complied ☐ Failed

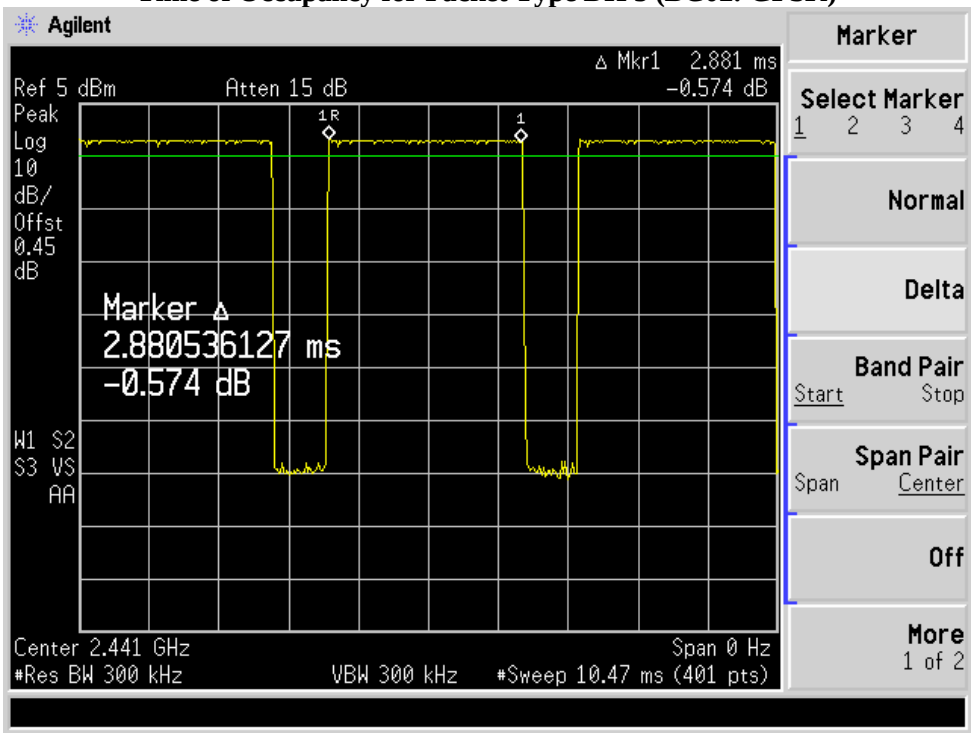
Time of Occupancy for Packet Type DH 1 (BC02:GFSK)



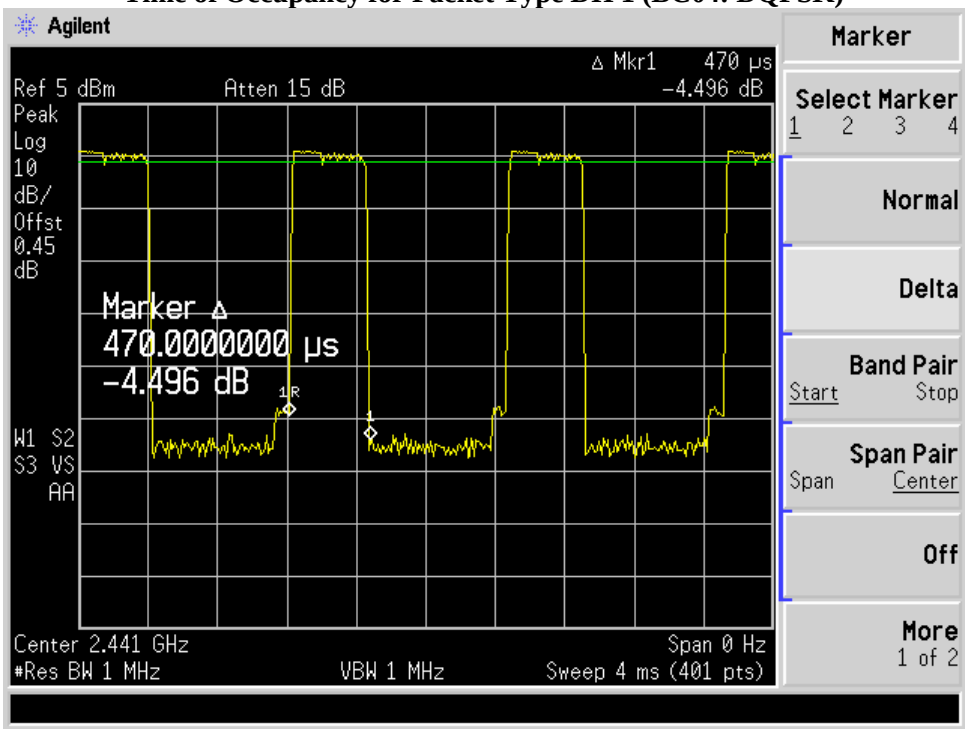
Time of Occupancy for Packet Type DH 3 (BC02:GFSK)



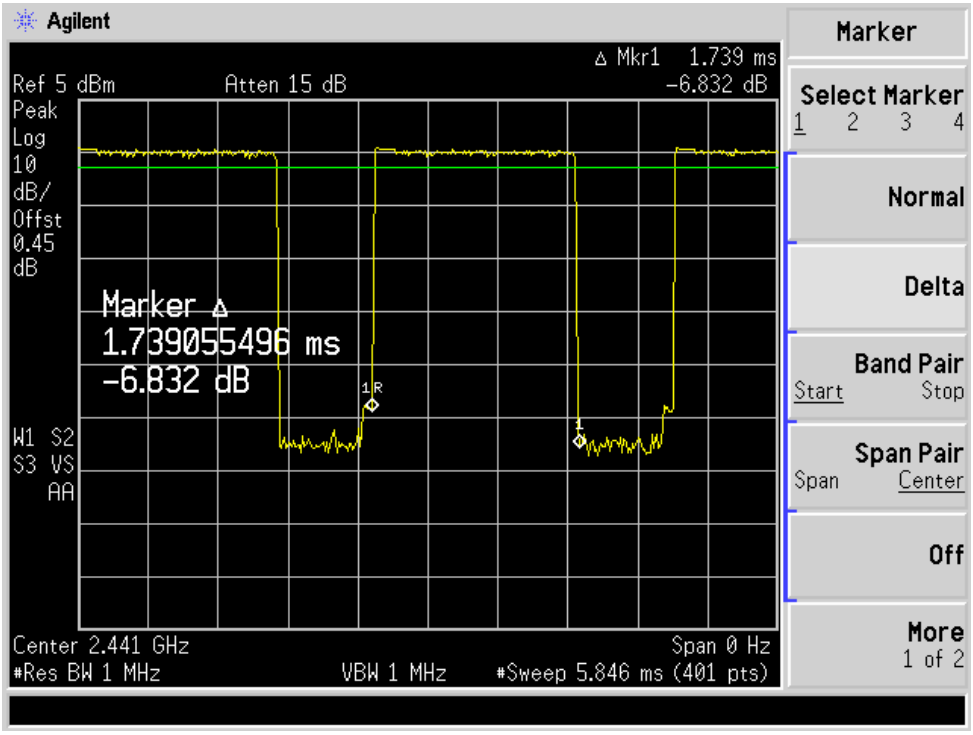
Time of Occupancy for Packet Type DH 5 (BC02: GFSK)



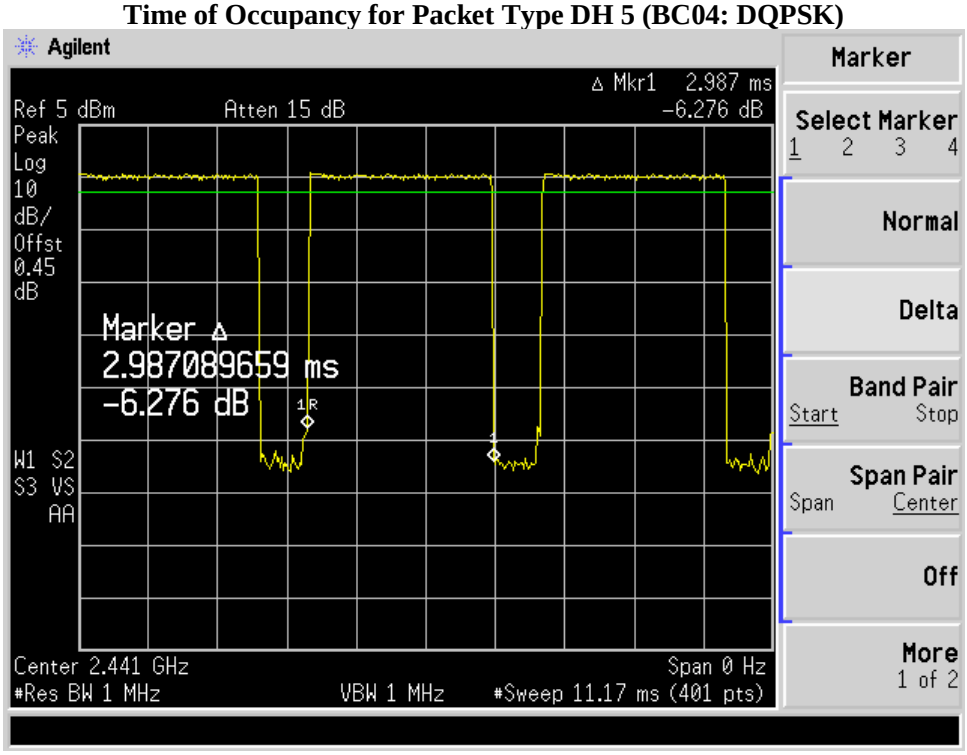
Time of Occupancy for Packet Type DH 1 (BC04: DQPSK)



Time of Occupancy for Packet Type DH 3 (BC04: DQPSK)



Time of Occupancy for Packet Type DH 5 (BC04: DQPSK)



5.5 Maximum Peak Output Power

	TEST: Peak Output Power	
Method	Measurements were made in the laboratory environment. Conducted measurement was used. The transmitter was connected to the measuring equipment via a suitable attenuator. The RF power as defined as the maximum isotropic radiated power of the equipment was measured and recorded. The measurement was performed using normal operation of the equipment with the test modulation applied. The measurement was repeated at the lowest, the middle, and the highest frequency of the stated frequency range. The FHSS equipment shall be made to hop continuously to each of these three frequencies.	
Reference Clause	15.247(b)(1) Maximum Peak Output Power	
Parameters required prior to the test	Laboratory Ambient Temperature	10 to 40 °C
	Relative Humidity	10 to 90 %
Parameters recorded during the test	Laboratory Ambient Temperature	25 °C
	Relative Humidity	42 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	2402 MHz, 2441 MHz, 2480 MHz	Antenna port

Configuration Settings

Power Interface Mode # (See Section 3.3)	Test Configurations Mode # (See Section 3.6)	EUT Operation Mode # (See 3.4)
1	1	1, 2
Supplementary information: None		

Limits

Equipment Class	Frequency band [2)]	Peak Power Limit
FHSS	2400 – 2483.5 MHz	1 W
FHSS-AFH	2400 – 2483.5 MHz	125 mW

*Note
1) FCC Public Notice DA 00-705 Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems Released on March 30, 2000.
2) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels : 1 watt.

Test Equipment Used

No. used in the List of Test equipment table	1

Test Result of Maximum Peak Output Power

Measurement method : ☐ Radiated ☒ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Low, Mid, High Channel with modulation
Power setting : Max. Power condition declared by the manufacturer
Antenna Gain : Max. 3.5 dBi

BT Module : BC02

Channel condition		Measured Power (dBm)	Cable Loss Factor (dB)	Output Power (dBm)	Limit (dBm)	Result
GFSK (1Mbps)						
2402 MHz	V_{NOM} 3.7 Vdc	3.01	0.5	3.51	21	Pass
2442 MHz	V_{NOM} 3.7 Vdc	2.73	0.5	3.23	21	Pass
2480 MHz	V_{NOM} 3.7 Vdc	1.91	0.5	2.41	21	Pass

BT Module : BC04

Channel condition		Measured Power (dBm)	Cable Loss Factor (dB)	Output Power (dBm)	Limit (dBm)	Result
8DPSK (3Mbps)						
2402 MHz	V_{NOM} 3.7 Vdc	1.36	0.5	1.86	21	Pass
2442 MHz	V_{NOM} 3.7 Vdc	1.09	0.5	1.59	21	Pass
2480 MHz	V_{NOM} 3.7 Vdc	0.29	0.5	0.79	21	Pass

Supplementary information:
-. Measured Power is the peak output power of the transmitter and compensated with ext. attenuator and cable loss as an offset value
-. Power Output = Measured power + cable/Loss
-. Spectrum Condition
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured, VBW = RBW
Sweep = auto, Detector function = peak , Trace = max hold

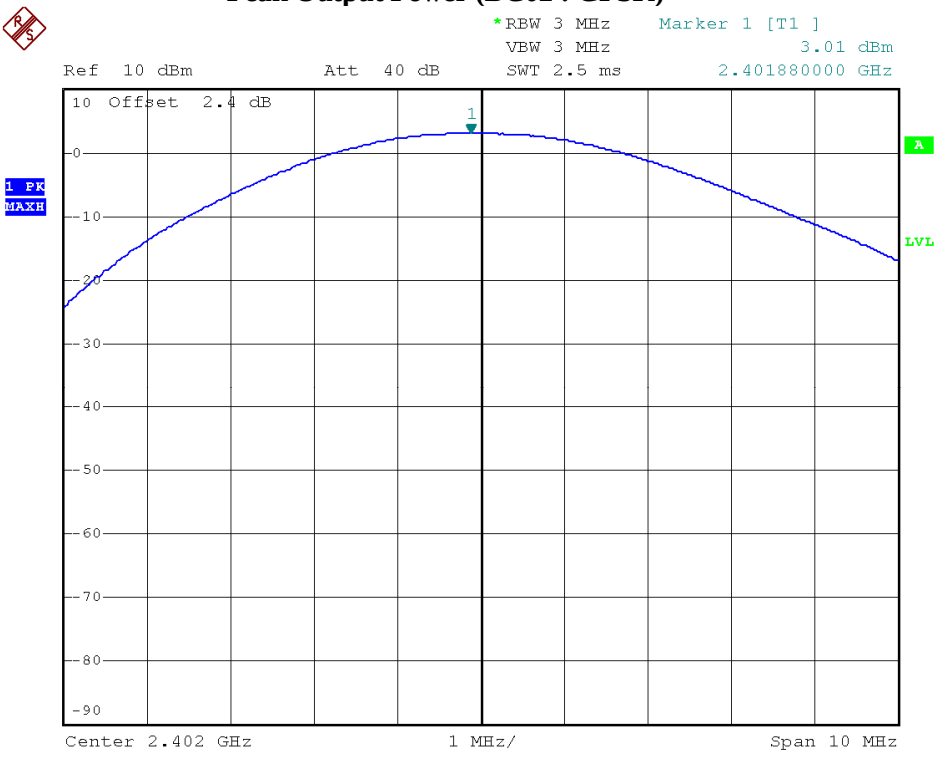
Measurement Plots : Measurement plots provided.

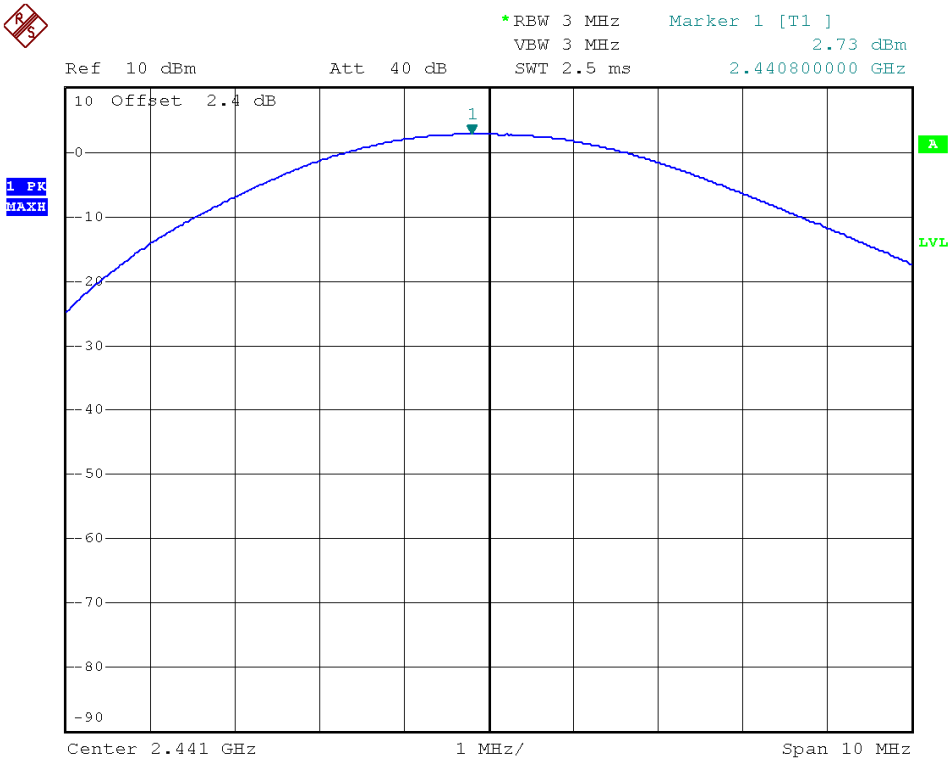
Remarks : None

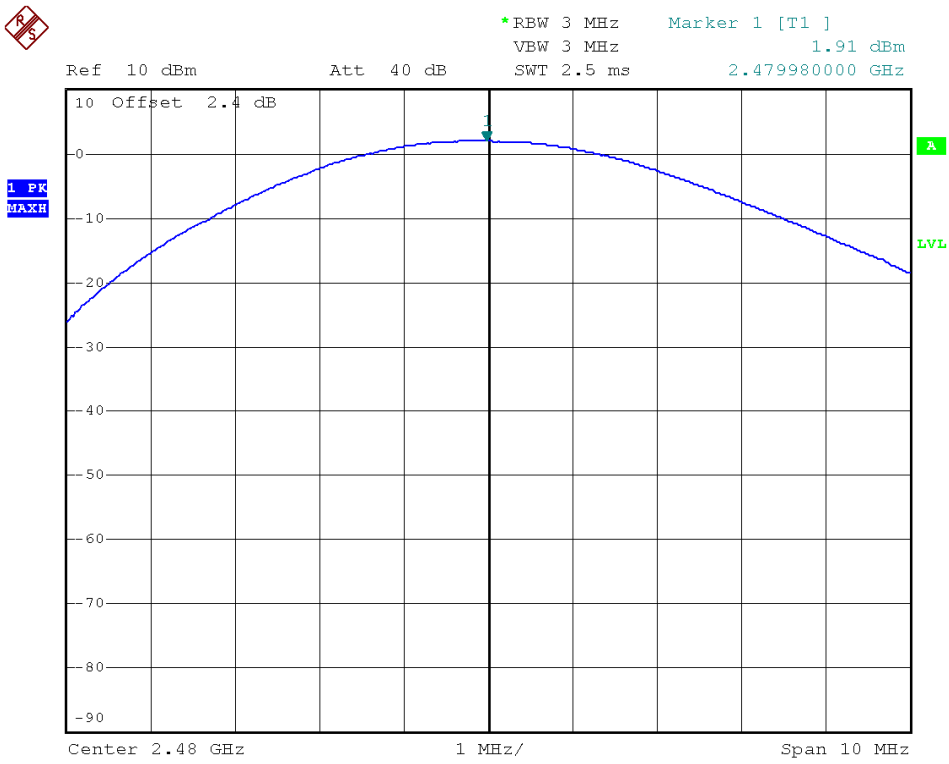
Result of test
In accordance with Technical requirement of Clause 15.247(b)(1)

☒ Complied ☐ Failed

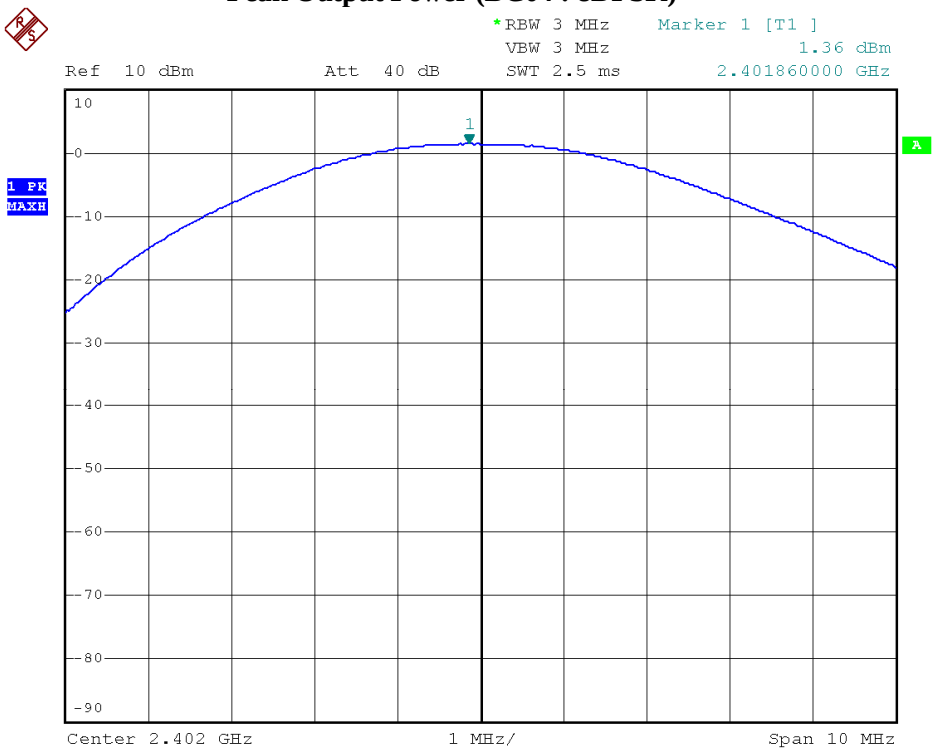
Peak Output Power (BC02 : GFSK)

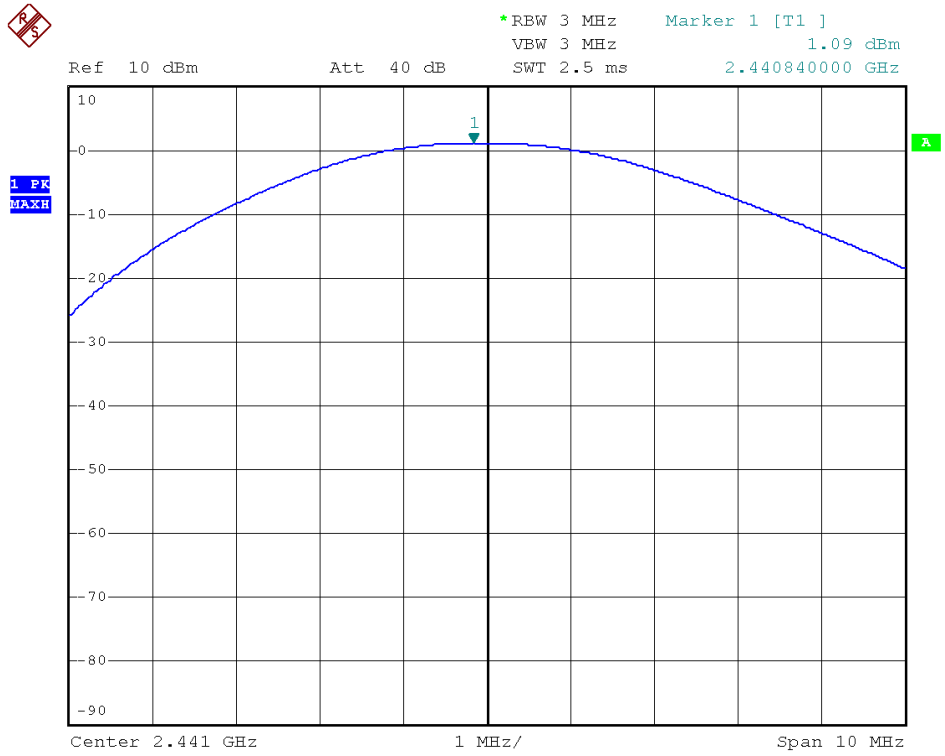


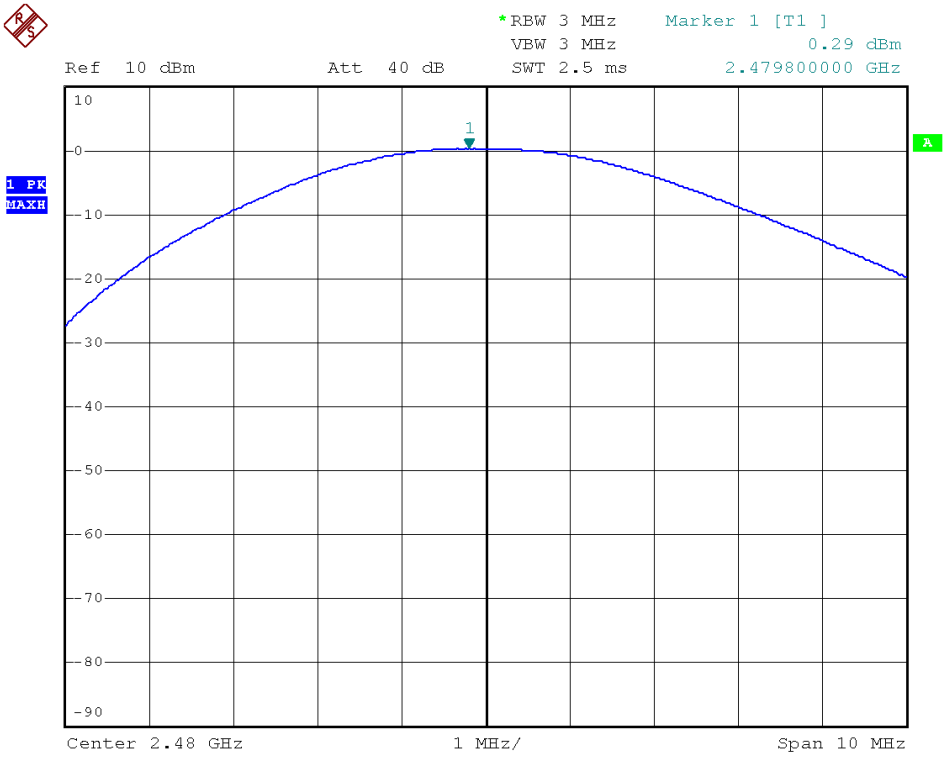




Peak Output Power (BC04 : 8DPSK)




*RBW 3 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
1.09 dBm
2.440840000 GHz
Ref 10 dBm
Att 40 dB
1 PK
MAXH
A
Center 2.441 GHz
1 MHz/
Span 10 MHz


*RBW 3 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
0.29 dBm
2.479800000 GHz
Ref 10 dBm
Att 40 dB
1 PK
MAXH
A
Center 2.48 GHz
1 MHz/
Span 10 MHz

5.6 Conducted Spurious Emissions

	TEST: Conducted emissions at Antenna port	
Method	Measurements were made in the laboratory environment. Conducted measurement was used by using a direct connection between RF output of the EUT and spectrum analyzer through RF attenuator. The bandwidth at 20dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels. After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.	
Reference Clause	§15.247(d)	
Parameters required prior to the test	Laboratory Ambient Temperature	10 to 40 °C
	Relative Humidity	10 to 90 %
Parameters recorded during the test	Laboratory Ambient Temperature	25 °C
	Relative Humidity	42 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30 MHz – 26 GHz	Antenna port

Configuration Settings

Power Interface Mode # (See Section 3.3)	Test Configurations Mode # (See Section 3.6)	EUT Operation Mode # (See 3.4)
1	1	1, 2
Supplementary information: None		

Limits of spurious emissions

§15.247(d) : In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Equipment Used

No. used in the List of Test equipment table	1

Test Result of Conducted Spurious Emissions

Measurement method : ☐ Radiated ☒ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Low, Mid, High Channel with modulation
Power setting : Max. Power condition declared by the manufacturer
Duty cycle(x) : BC02 (0.338), BC04(0.337)
Antenna Gain : Max. 3.5 dBi
Environment Condition : Normal condition

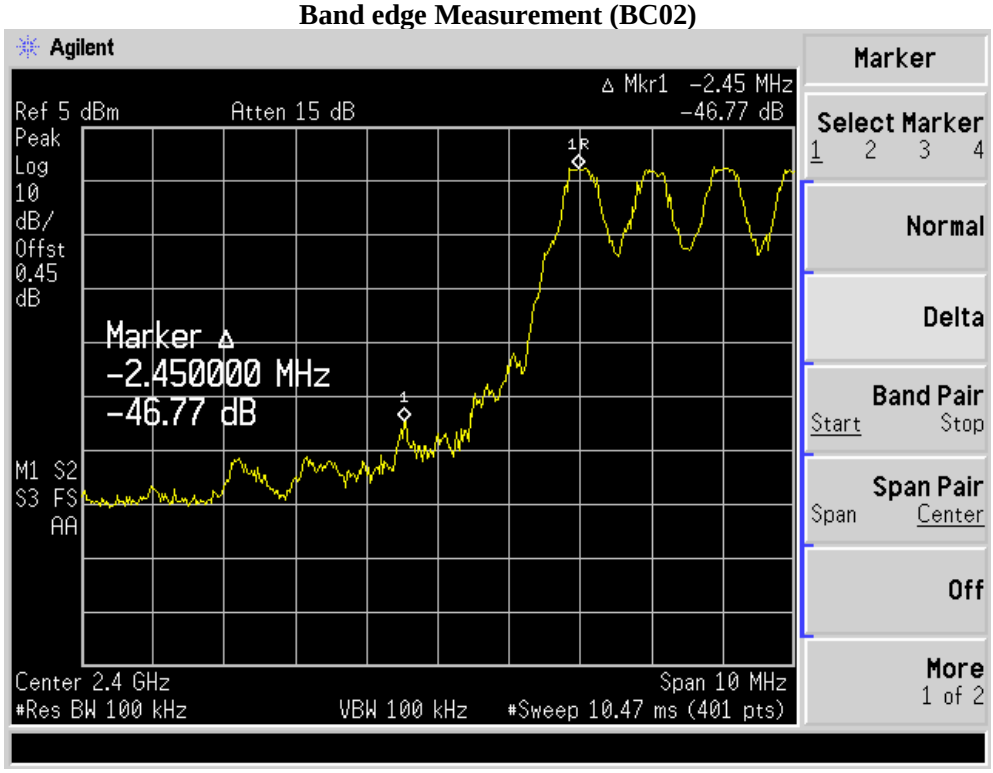
Supplementary information:
-. Measured Power is compensated with ext. ATT + cable loss as offset value
-. The emissions that exceed the limit values or that come to within 6 dB below the limit were reported.
-. Spectrum analyzer was set to the following conditions :
- Resolution BW: 100 kHz
- Video BW: 300 kHz
- Detector mode: Positive peak.
- Averaging: Off.
- Sweep time: Auto.

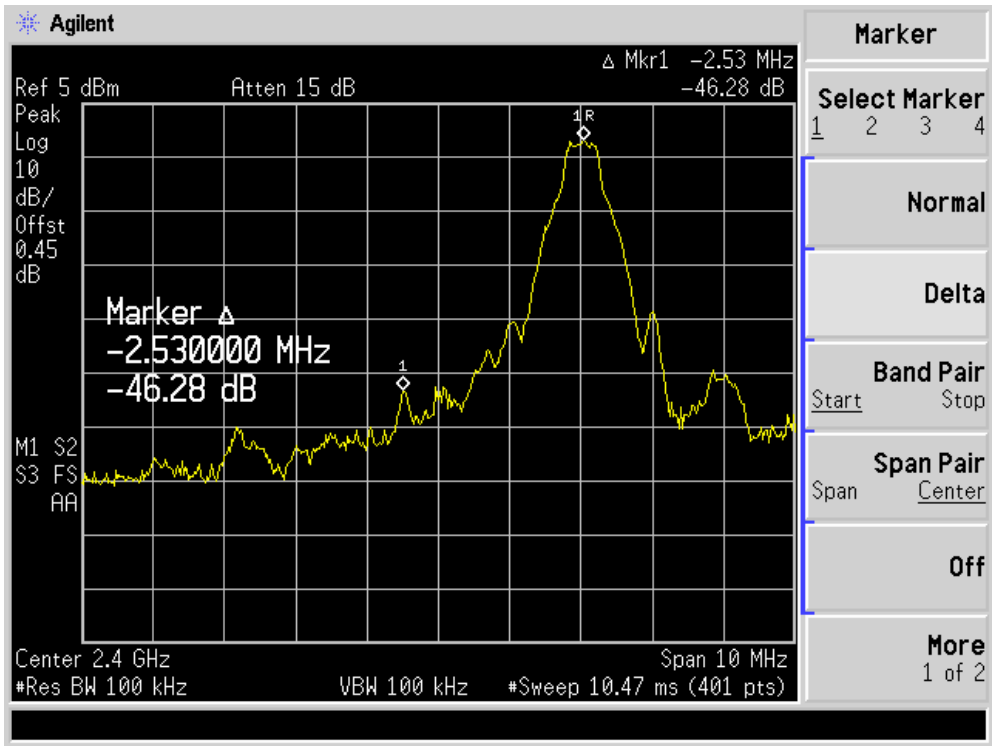
Measurement Plots : Measurement plots provided.

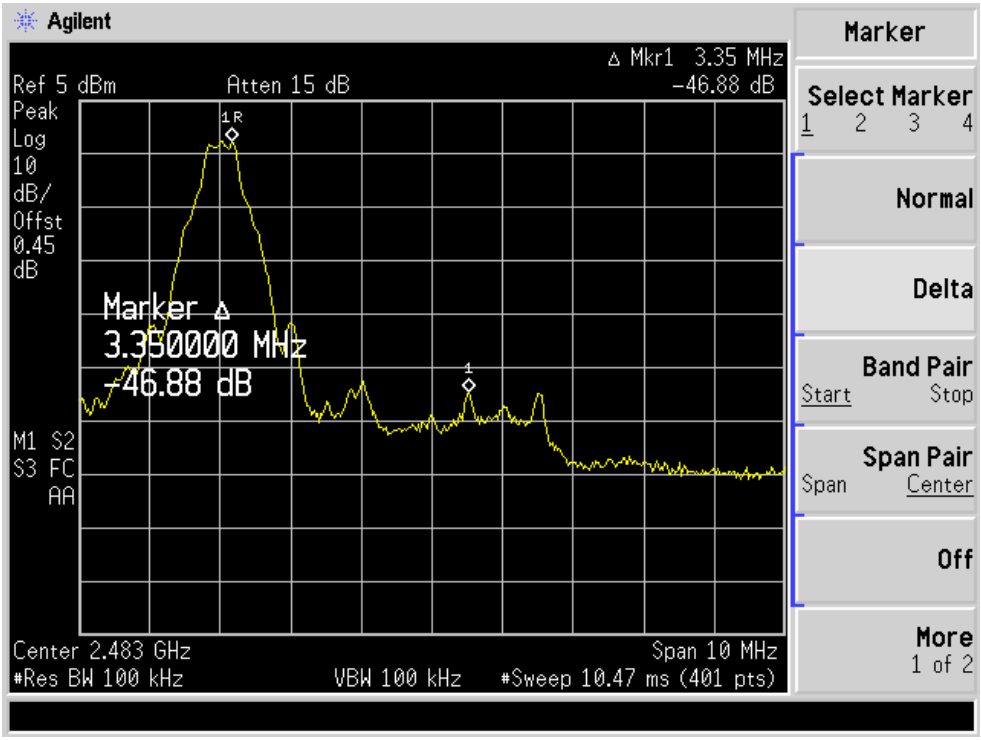
Remarks : No emissions detected which exceed the 20 dB below the specified limit

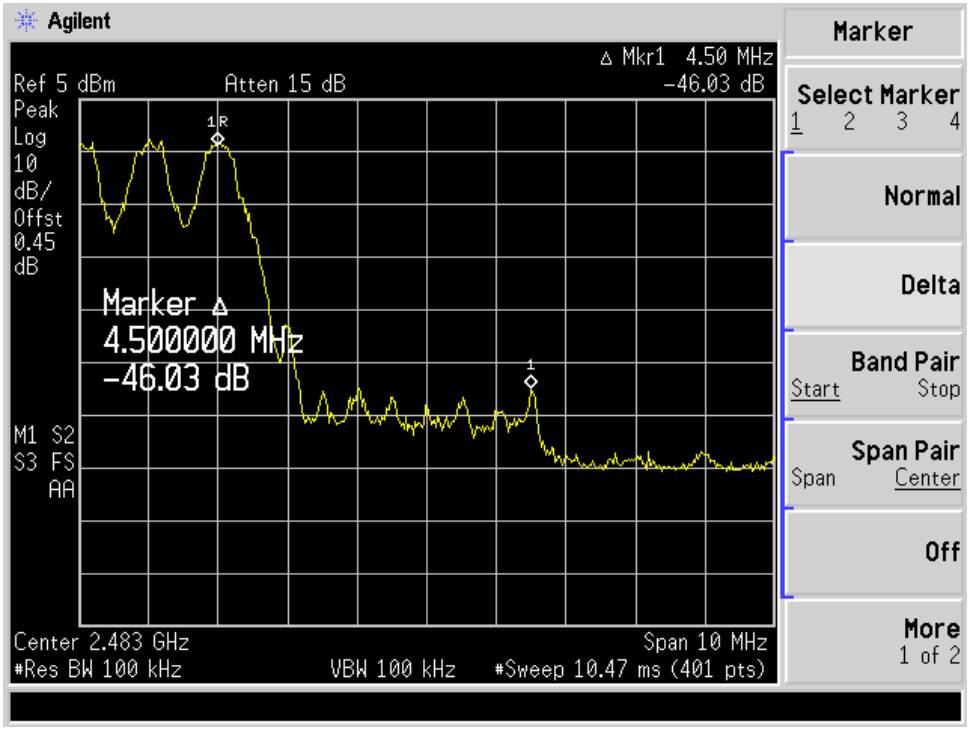
Result of test
In accordance with Technical requirement of Clause §15.247(d)
☒ Complied ☐ Failed

Band edge Measurement (BC02)

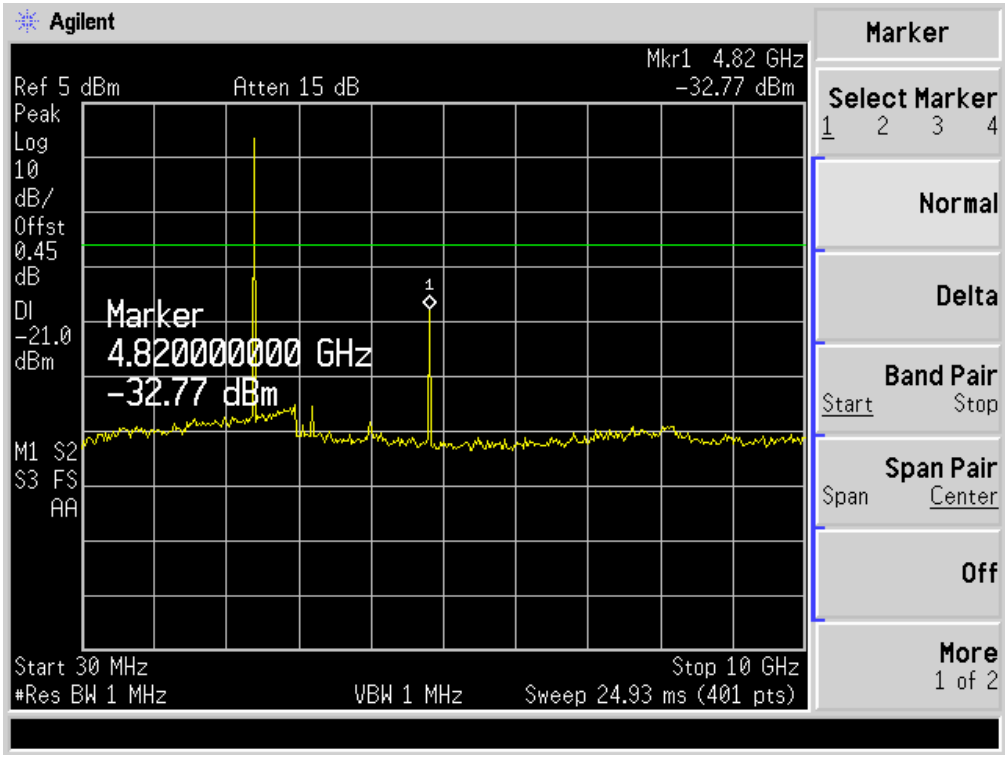


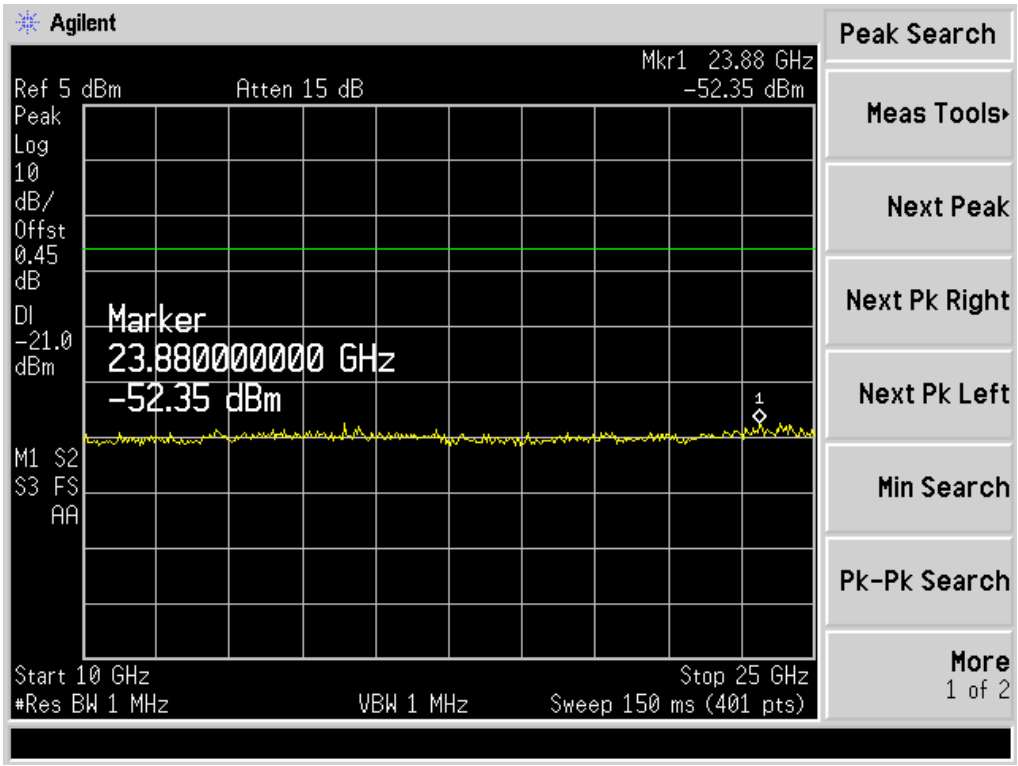


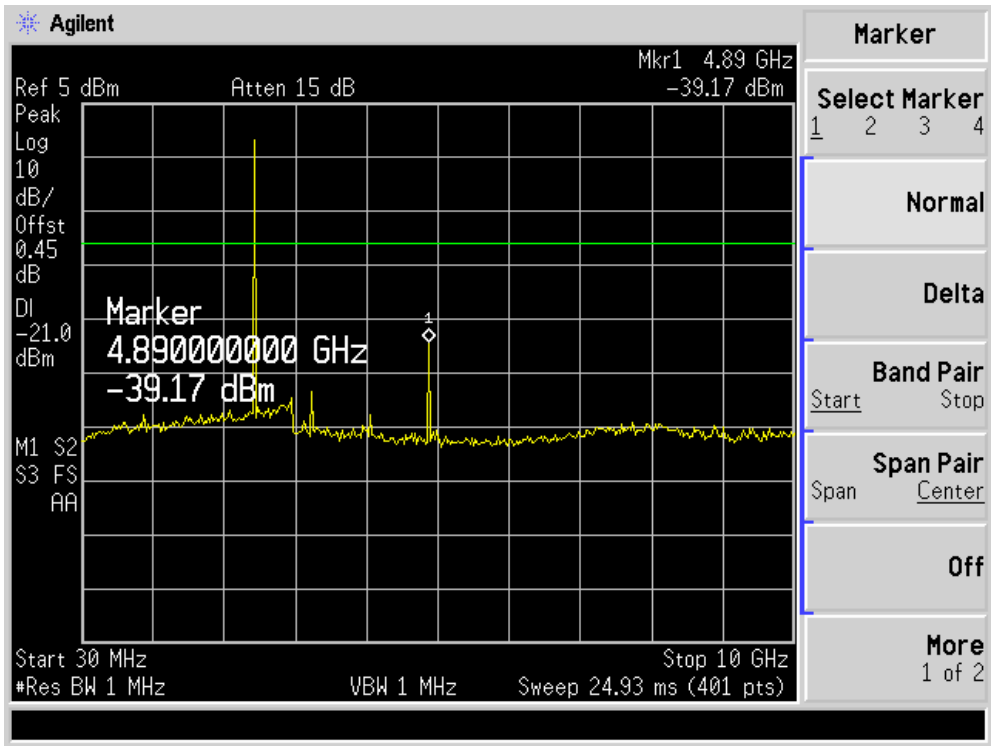


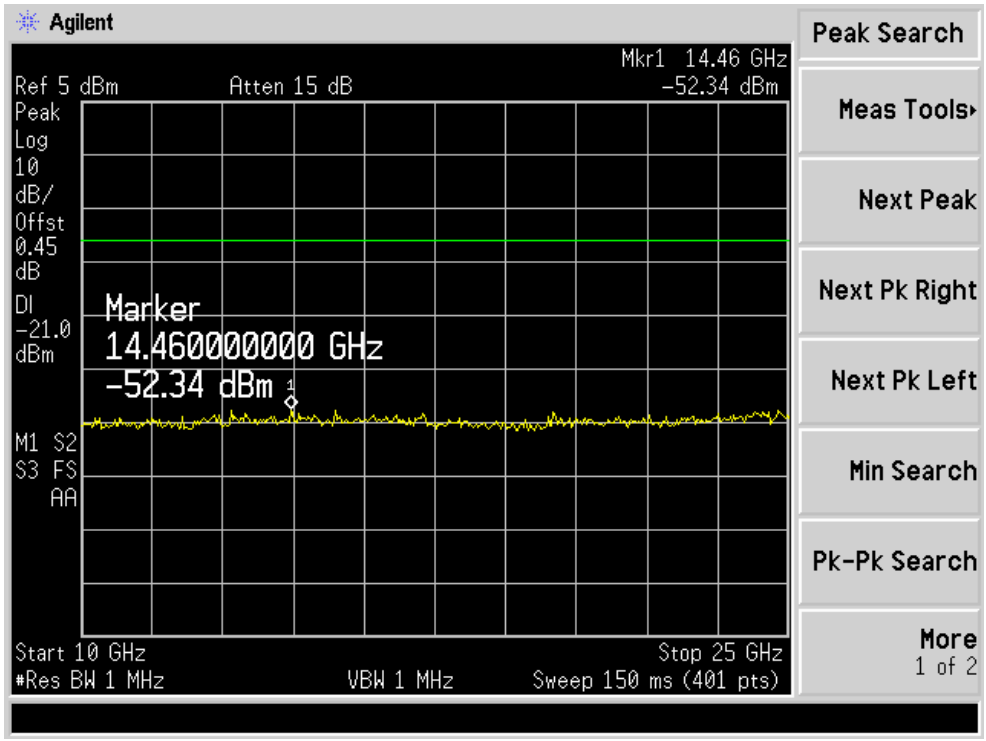


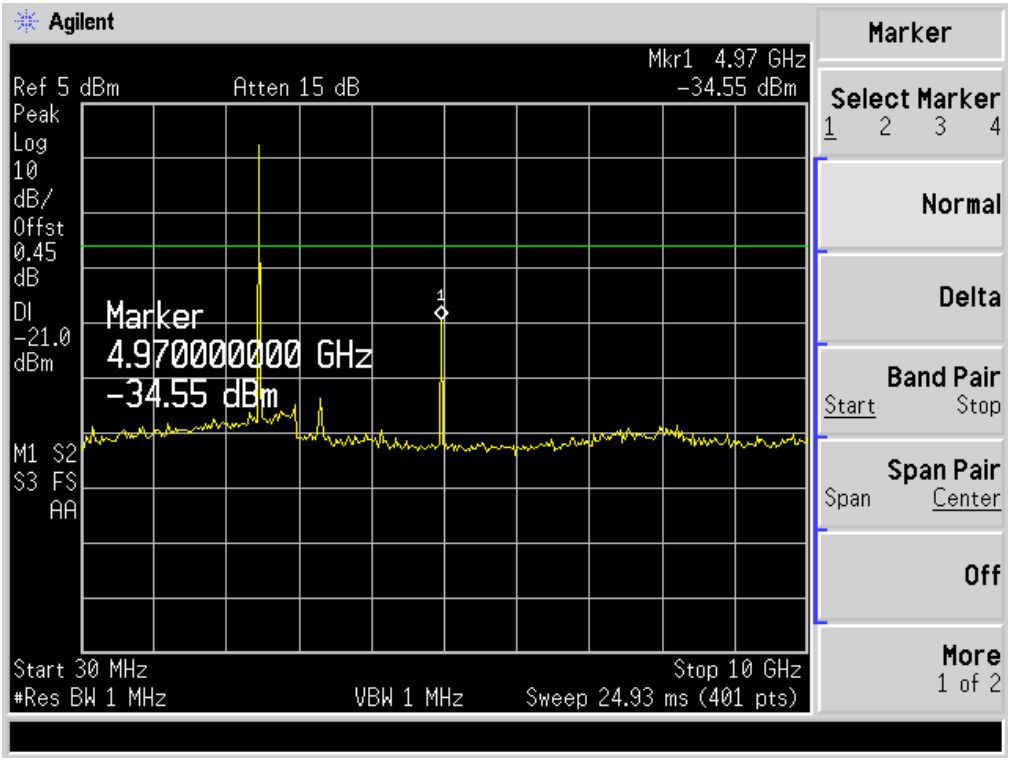
Spurious Emission Measurement (BC02)

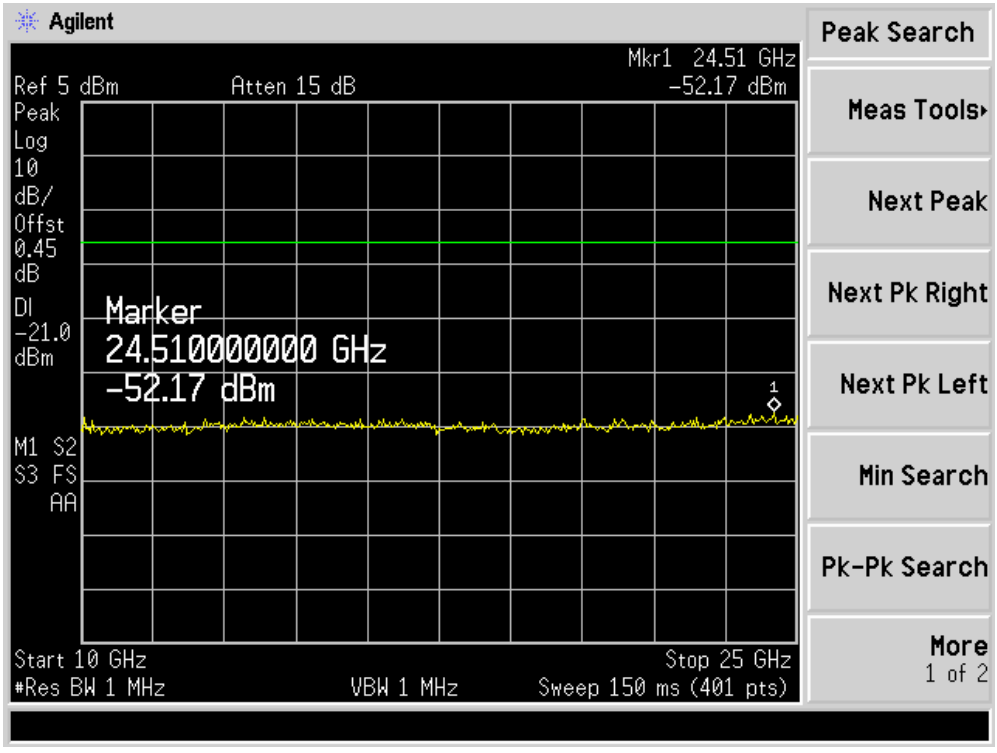

Agilent
Marker
Mkr1 4.82 GHz
Ref 5 dBm
Atten 15 dB
-32.77 dBm
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
4.820000000 GHz
-32.77 dBm
M1 S2
S3 FS
AA
Start 30 MHz
#Res BW 1 MHz
VBW 1 MHz
Stop 10 GHz
Sweep 24.93 ms (401 pts)
Select Marker
1 2 3 4
Normal
Delta
Band Pair
Start Stop
Span Pair
Span Center
Off
More
1 of 2


Agilent
Peak Search
Mkr1 23.88 GHz
Ref 5 dBm
Atten 15 dB
-52.35 dBm
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
23.880000000 GHz
-52.35 dBm
M1 S2
S3 FS
AA
Start 10 GHz
#Res BW 1 MHz
VBW 1 MHz
Stop 25 GHz
Sweep 150 ms (401 pts)
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

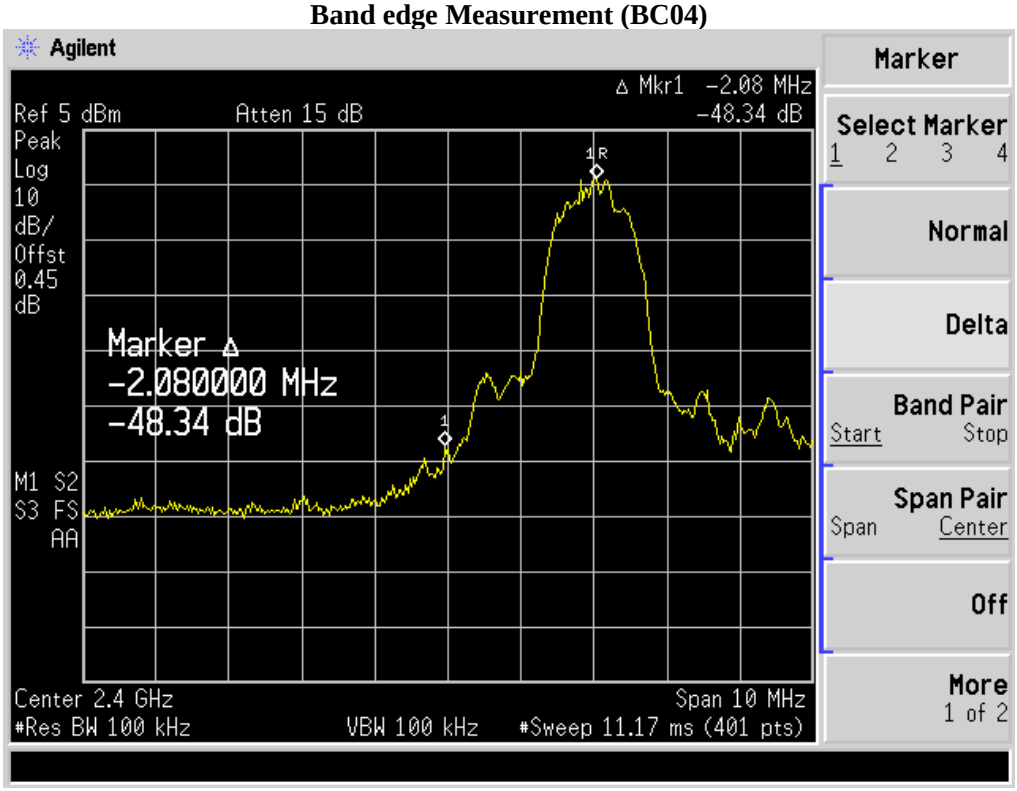

Agilent
Marker
Mkr1 4.89 GHz
Ref 5 dBm
Atten 15 dB
-39.17 dBm
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
4.890000000 GHz
-39.17 dBm
M1 S2
S3 FS
AA
Start 30 MHz
#Res BW 1 MHz
VBW 1 MHz
Stop 10 GHz
Sweep 24.93 ms (401 pts)
Select Marker
1 2 3 4
Normal
Delta
Band Pair
Start Stop
Span Pair
Span Center
Off
More
1 of 2

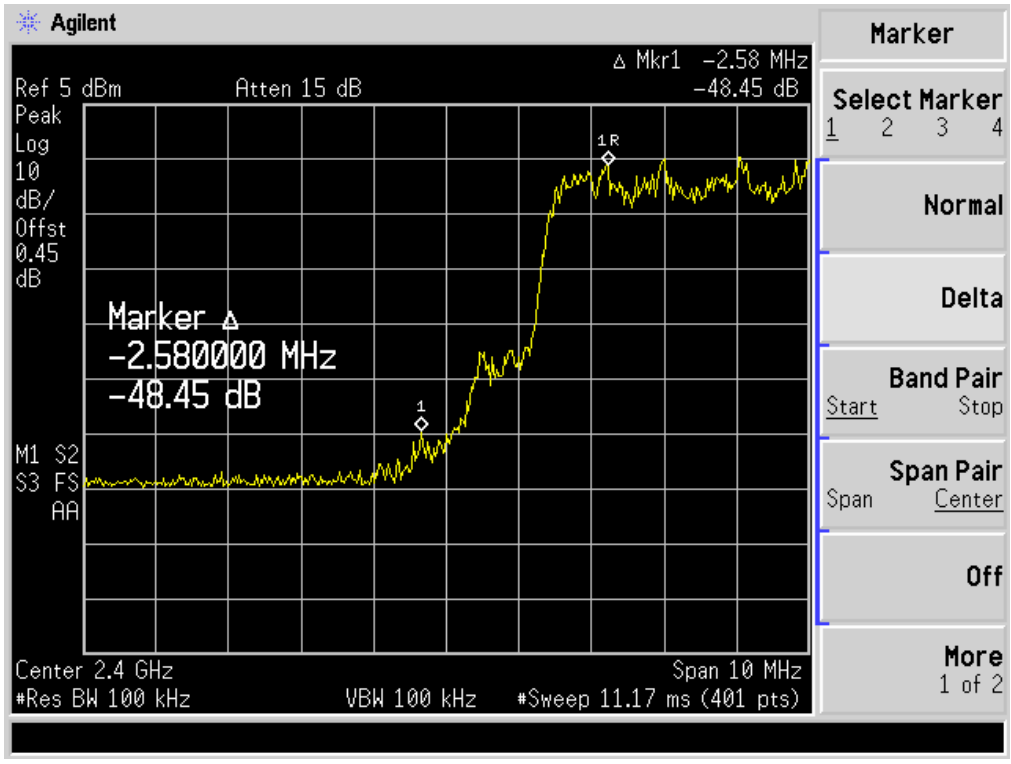

Agilent
Peak Search
Mkr1 14.46 GHz
Ref 5 dBm
Atten 15 dB
-52.34 dBm
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
14.460000000 GHz
-52.34 dBm
M1 S2
S3 FS
AA
Start 10 GHz
#Res BW 1 MHz
VBW 1 MHz
Stop 25 GHz
Sweep 150 ms (401 pts)
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

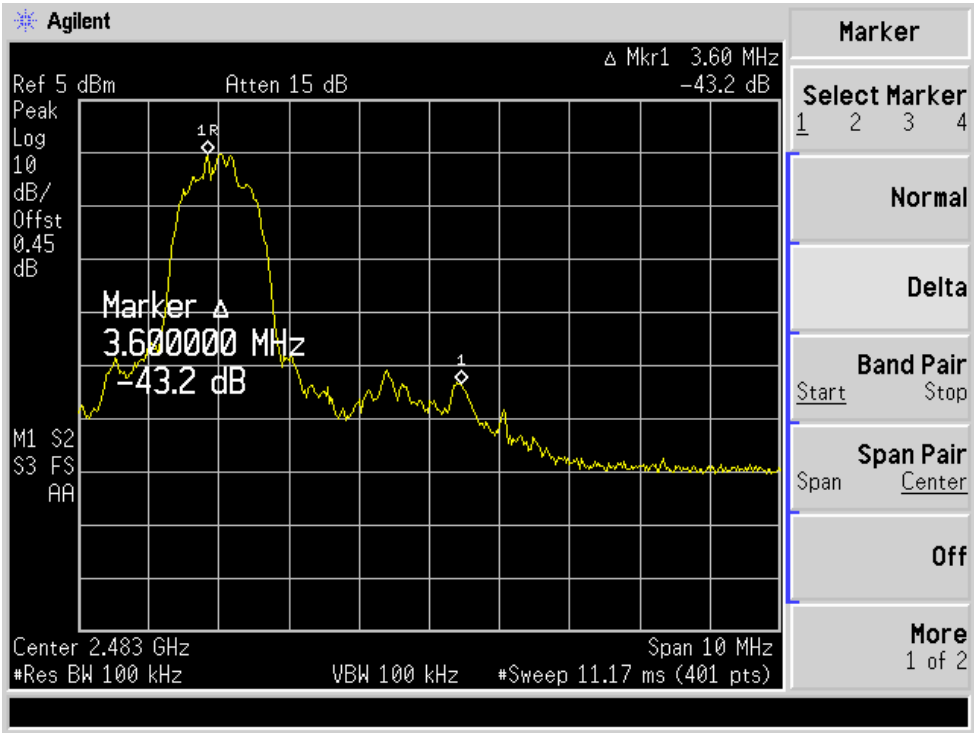

Agilent
Mkr1 4.97 GHz
Ref 5 dBm
Atten 15 dB
-34.55 dBm
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
4.970000000 GHz
-34.55 dBm
M1 S2
S3 FS
AA
Start 30 MHz
#Res BW 1 MHz
VBW 1 MHz
Stop 10 GHz
Sweep 24.93 ms (401 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Band Pair
Start Stop
Span Pair
Span Center
Off
More
1 of 2

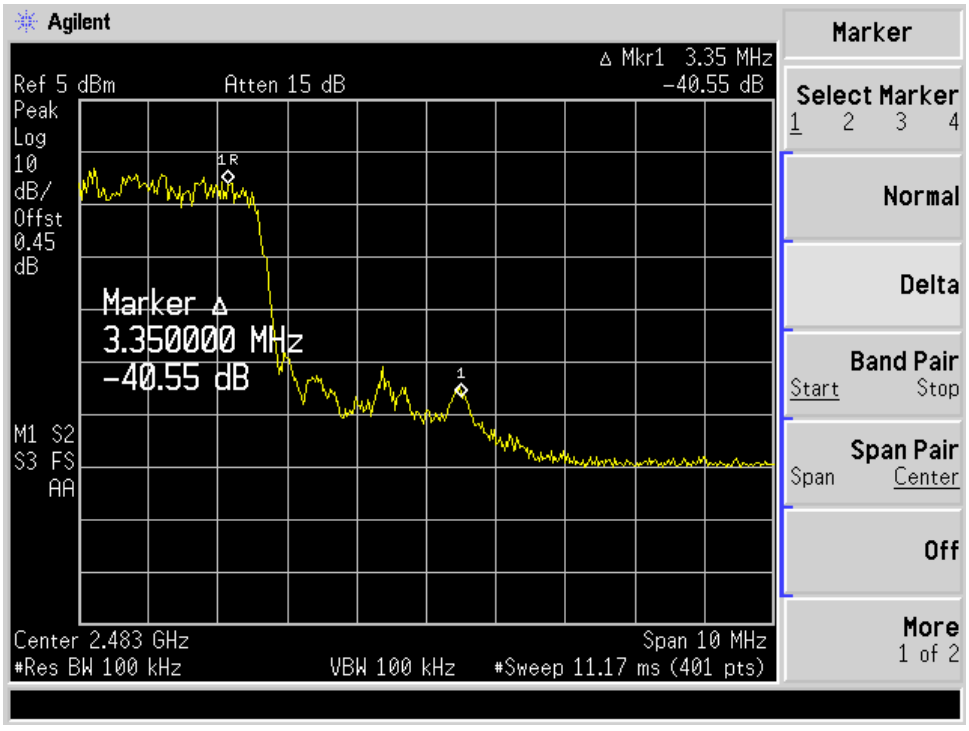

Agilent
Mkr1 24.51 GHz
Ref 5 dBm
Atten 15 dB
-52.17 dBm
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
24.510000000 GHz
-52.17 dBm
M1 S2
S3 FS
AA
Start 10 GHz
#Res BW 1 MHz
VBW 1 MHz
Stop 25 GHz
Sweep 150 ms (401 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

Band edge Measurement (BC04)

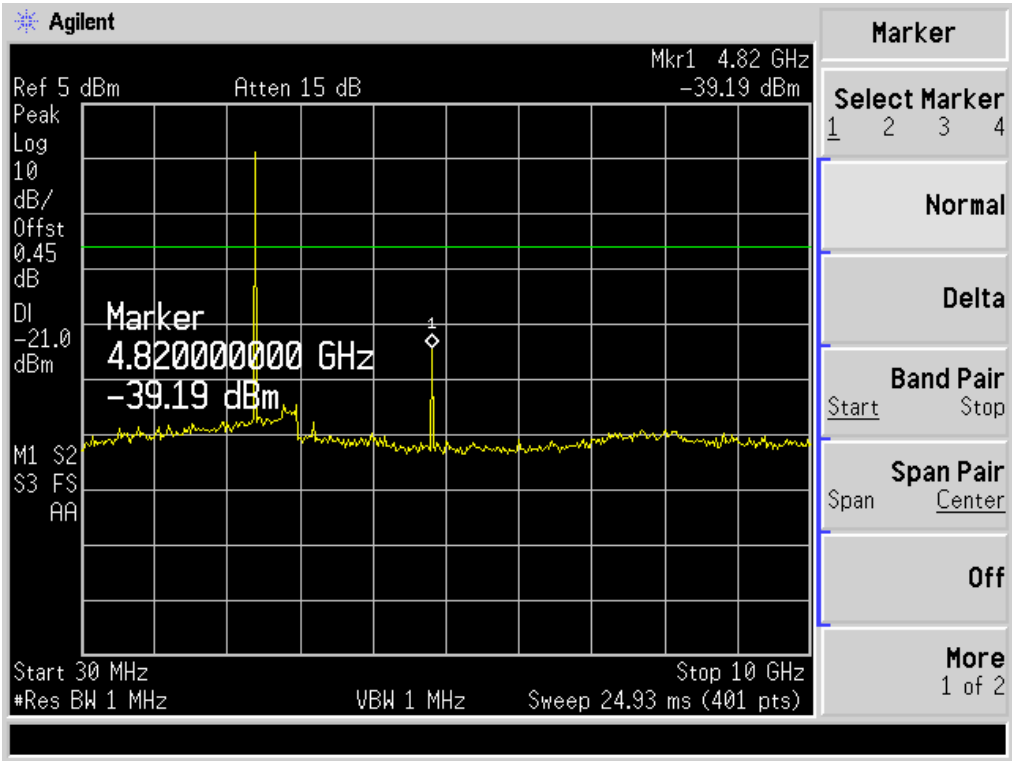


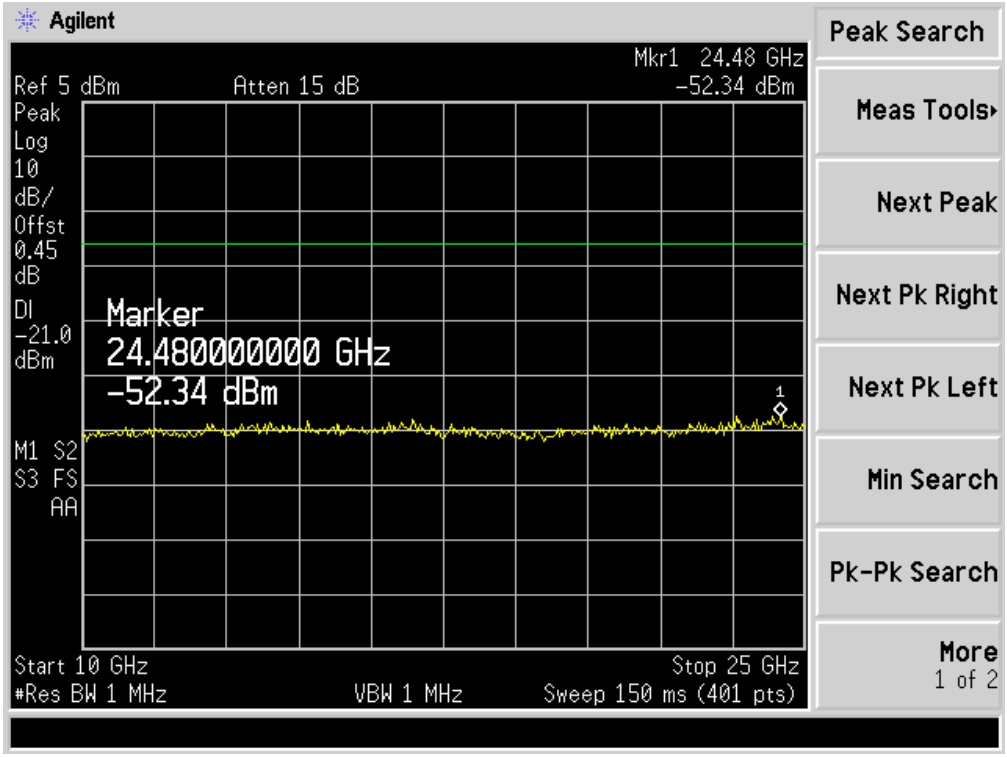


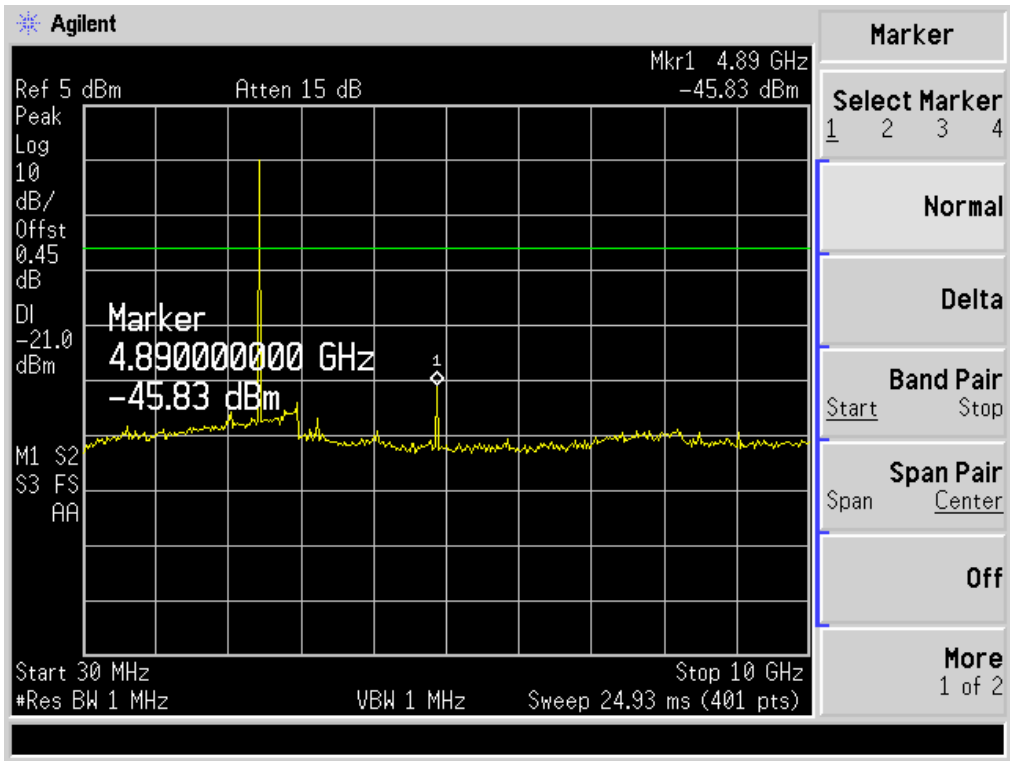


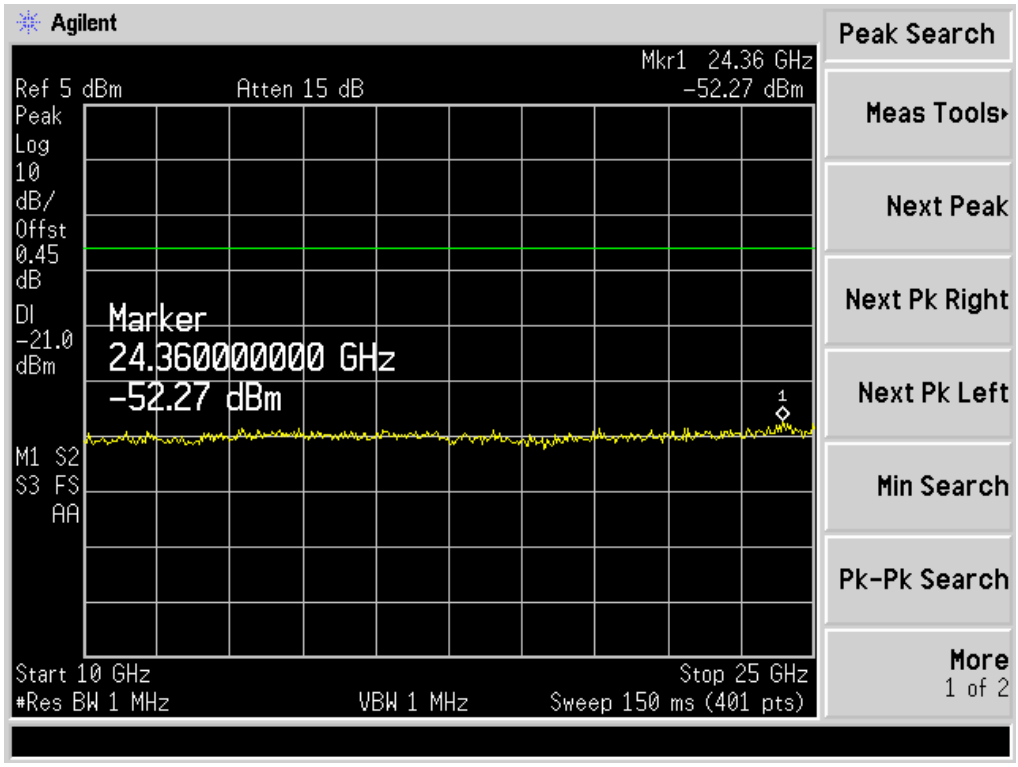


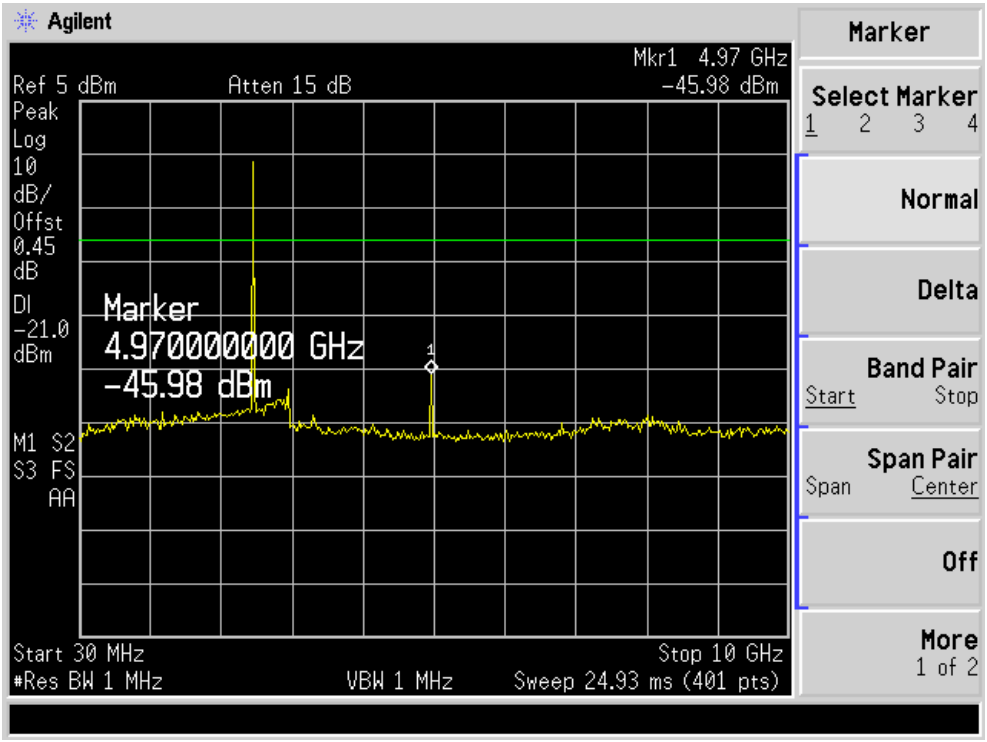
Spurious Emission Measurement (BC04)

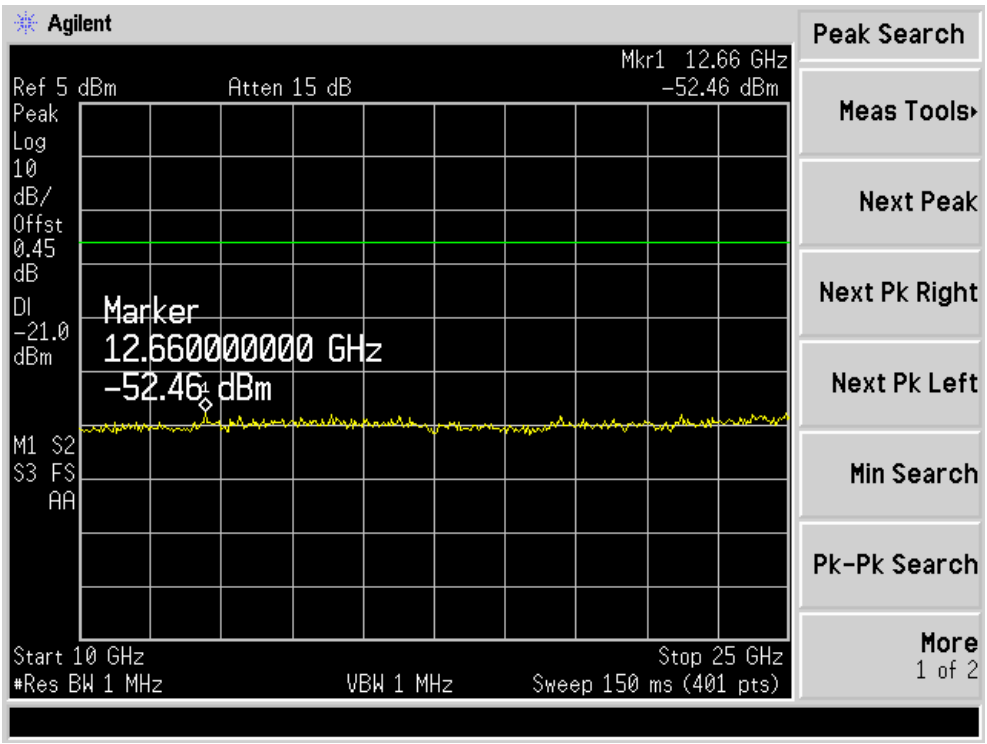

Agilent
Marker
Mkr1 4.82 GHz
-39.19 dBm
Ref 5 dBm
Atten 15 dB
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
4.820000000 GHz
-39.19 dBm
M1 S2
S3 FS
AA
Start 30 MHz
#Res BW 1 MHz
VBW 1 MHz
Stop 10 GHz
Sweep 24.93 ms (401 pts)
Select Marker
1 2 3 4
Normal
Delta
Band Pair
Start Stop
Span Pair
Span Center
Off
More
1 of 2


Agilent
Peak Search
Mkr1 24.48 GHz
-52.34 dBm
Ref 5 dBm
Atten 15 dB
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
24.480000000 GHz
-52.34 dBm
M1 S2
S3 FS
AA
Start 10 GHz
#Res BW 1 MHz
VBW 1 MHz
Stop 25 GHz
Sweep 150 ms (401 pts)
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2


Agilent
Marker
Mkr1 4.89 GHz
-45.83 dBm
Ref 5 dBm
Atten 15 dB
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
4.890000000 GHz
-45.83 dBm
M1 S2
S3 FS
AA
Start 30 MHz
#Res BW 1 MHz
VBW 1 MHz
Stop 10 GHz
Sweep 24.93 ms (401 pts)
Select Marker
1 2 3 4
Normal
Delta
Band Pair
Start Stop
Span Pair
Span Center
Off
More
1 of 2


Agilent
Peak Search
Mkr1 24.36 GHz
-52.27 dBm
Ref 5 dBm
Atten 15 dB
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
24.360000000 GHz
-52.27 dBm
M1 S2
S3 FS
AA
Start 10 GHz
#Res BW 1 MHz
VBW 1 MHz
Stop 25 GHz
Sweep 150 ms (401 pts)
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2


Agilent
Mkr1 4.97 GHz
Ref 5 dBm
Atten 15 dB
-45.98 dBm
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
4.970000000 GHz
-45.98 dBm
M1 S2
S3 FS
AA
Start 30 MHz
#Res BW 1 MHz
VBW 1 MHz
Stop 10 GHz
Sweep 24.93 ms (401 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Band Pair
Start Stop
Span Pair
Span Center
Off
More
1 of 2


Agilent
Mkr1 12.66 GHz
Ref 5 dBm
Atten 15 dB
-52.46 dBm
Peak
Log
10
dB/
Offst
0.45
dB
Dl
-21.0
dBm
Marker
12.660000000 GHz
-52.46 dBm
M1 S2
S3 FS
AA
Start 10 GHz
#Res BW 1 MHz
VBW 1 MHz
Stop 25 GHz
Sweep 150 ms (401 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

5.7 Radiated Spurious Emissions

	TEST: Spurious Radiated Emissions	
Method	Measurements were made at semi anechoic chamber that correlated with standard open field test site complies to CISPR 16/ANSI C63.4. The EUT was positioned on a non-metallic table at a height of 0.8m .The test antenna was placed at a distance of 3 m from the EUT. The center of the antenna shall be at least 1,5 m above the ground plane. The E-field antenna only shall be adjusted in height of the measuring antenna above the ground over a range of 1 m to 4 m and rotated to give horizontal and vertical polarization, one being parallel to the ground, in order to determine the maximum emission level. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.	
Reference Clause	§15.247(d)	
Parameters required prior to the test	Laboratory Ambient Temperature	10 to 40 °C
	Relative Humidity	10 to 90 %
Parameters recorded during the test	Laboratory Ambient Temperature	25 °C
	Relative Humidity	42 %
	Frequency range	Measurement Distance
Fully configured sample scanned over the following frequency range	30 MHz – 25 GHz	3 meter

Configuration Settings

Power Interface Mode # (See Section 3.3)	Test Configurations Mode # (See Section 3.7)	EUT Operation Mode # (See 3.5)
1	2	1, 2
Supplementary information: None		

Limits of spurious emissions

§15.247(d) : In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Equipment Used

No. used in the List of Test equipment table	1, 8, 9, 11, 12, 13, 14

Test Result of Radiated Emissions

Measurement method : ☒ Radiated ☐ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Hopping disabled with modulation
Power setting : Max. Power condition declared by the manufacturer
Measurement Frequency Range : 30 MHz - 25 GHZ

Table 7a. Radiated Emissions Data (BC02, Z-Axis, GFSK, Fundamental tuned @ 2402 MHz)

Frequency Reading (MHz)	Reading (dBuV/m)	Polarization	Ant. Factor (dB)	Cable Loss (dB)	Limit (dBuV/m)	Emission Level (dBuV/m)	Margin (dB)
53.33	3.80	V	6.80	1.10	40.00	11.70	18.30
84.01	10.60	H	7.60	1.40	40.00	19.60	10.40
150.00	11.70	H	10.40	1.90	43.50	24.00	6.00
244.42	4.36	V	12.80	2.50	46.00	19.66	17.34
373.75	5.12	H	15.40	3.20	46.00	23.72	13.28
447.94	9.50	H	16.50	3.50	46.00	29.50	7.50
-	-	-	-	-	-	-	-

Band edge

Frequency Reading (MHz)	Reading (dBuV/m)	Ant. Pol.	Detector	Ant. Factor (dB)	Amp. Gain (dB)	Cable Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2390.0	57.2	H	Peak	25.7	41.3	2.3	43.9	74.0	30.1
2390.0	43.6	H	AV	25.7	41.3	2.3	30.3	54.0	23.7
-	-	-		-		-	-	-	-

Supplementary information:
-. Below 1 GHz, the emissions that exceed the limit values or that come to within 20 dB below the limit were reported.
Above 1 GHz, no emissions or harmonics were detected at a level exceed 20dB below the limit.
-. Spectrum analyzer was set to the following conditions :
- Resolution BW: 100 kHz (Below 1 GHz), 1 MHz (Above 1 GHz)
- Video BW: ≥ RBW (Below 1 GHz) , 10 Hz (Above 1GHz)
- Detector mode: Peak (Below 1 GHz), Average (Above 1 GHz)
- Trace : Max Hold
- Sweep time: Auto

Measurement Plots : No measurement plots provided.

Remarks : No emissions detected which exceed the 20 dB below the specified limit.

Result of test
In accordance with Technical requirement of Clause §15.209(a) and in §15.247(d).

☒ Complied ☐ Failed

Test Result of Radiated Emissions

Measurement method : ☒ Radiated ☐ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Hopping disabled with modulation
Power setting : Max. Power condition declared by the manufacturer
Measurement Frequency Range : 30 MHz - 25 GHZ

Table 7a. Radiated Emissions Data (BC02, Z-Axis, GFSK, Fundamental tuned @ 2441 MHz)

Frequency Reading (MHz)	Reading (dBuV/m)	Polarization	Ant. Factor (dB)	Cable Loss (dB)	Limit (dBuV/m)	Emission Level (dBuV/m)	Margin (dB)
84.43	10.30	H	8.00	1.40	40.00	19.70	10.30
151.48	9.10	H	10.40	1.90	43.50	21.40	8.60
232.16	5.70	H	12.30	2.40	46.00	20.40	16.60
298.26	4.00	H	13.80	2.80	46.00	20.60	16.40
373.60	6.80	H	15.40	3.20	46.00	25.40	11.60
447.94	7.60	H	16.50	3.50	46.00	27.60	9.40
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Supplementary information:
-. Below 1 GHz, the emissions that exceed the limit values or that come to within 20 dB below the limit were reported.
Above 1 GHz, no emissions or harmonics were detected at a level exceed 20dB below the limit.
-. Spectrum analyzer was set to the following conditions :
- Resolution BW: 100 kHz (Below 1 GHz), 1 MHz (Above 1 GHz)
- Video BW: ≥ RBW (Below 1 GHz) , 10 Hz (Above 1GHz)
- Detector mode: Peak (Below 1 GHz), Average (Above 1 GHz)
- Trace : Max Hold
- Sweep time: Auto

Measurement Plots : No measurement plots provided.

Remarks : No emissions detected which exceed the 20 dB below the specified limit.

Result of test
In accordance with Technical requirement of Clause §15.209(a) and in §15.247(d).

☒ Complied ☐ Failed

Test Result of Radiated Emissions

Measurement method : ☒ Radiated ☐ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Hopping disabled with modulation
Power setting : Max. Power condition declared by the manufacturer
Measurement Frequency Range : 30 MHz - 25 GHZ

Table 7a. Radiated Emissions Data (BC02, Z-Axis, GFSK, Fundamental tuned @ 2480 MHz)

Frequency Reading (MHz)	Reading (dBuV/m)	Polarization	Ant. Factor (dB)	Cable Loss (dB)	Limit (dBuV/m)	Emission Level (dBuV/m)	Margin (dB)
84.43	10.70	H	8.00	1.40	40.00	20.10	9.90
151.36	9.26	H	10.40	1.90	43.50	21.56	8.44
228.28	5.90	H	12.10	2.40	46.00	20.40	9.60
298.26	8.40	H	13.80	2.80	46.00	25.00	12.00
374.07	3.90	H	15.40	3.20	46.00	22.50	14.50
463.12	8.35	H	16.50	3.70	46.00	28.55	8.45
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Band edge

Frequency Reading (MHz)	Reading (dBuV/m)	Ant. Pol.	Detector	Ant. Factor (dB)	Amp. Gain (dB)	Cable Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.5	60.2	H	Peak	25.5	41.5	2.5	46.7	74.0	27.3
2483.5	42.3	H	AV	25.5	41.5	2.5	28.8	54.0	25.2
-	-	-		-		-	-	-	-

Supplementary information:
-. Below 1 GHz, the emissions that exceed the limit values or that come to within 20 dB below the limit were reported.
Above 1 GHz, no emissions or harmonics were detected at a level exceed 20dB below the limit.
-. Spectrum analyzer was set to the following conditions :
- Resolution BW: 100 kHz (Below 1 GHz), 1 MHz (Above 1 GHz)
- Video BW: ≥ RBW (Below 1 GHz) , 10 Hz (Above 1GHz)
- Detector mode: Peak (Below 1 GHz), Average (Above 1 GHz)
- Trace : Max Hold
- Sweep time: Auto

Measurement Plots : No measurement plots provided.

Remarks : No emissions detected which exceed the 20 dB below the specified limit.

Result of test
In accordance with Technical requirement of Clause §15.209(a) and in §15.247(d).

☒ Complied ☐ Failed

Test Result of Radiated Emissions

Measurement method : ☒ Radiated ☐ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Hopping disabled with modulation
Power setting : Max. Power condition declared by the manufacturer
Measurement Frequency Range : 30 MHz - 25 GHZ

Table 7a. Radiated Emissions Data (BC04, Z-Axis, 8DPSK, Carrier tuned @ 2402 MHz)

Frequency Reading (MHz)	Reading (dBuV/m)	Polarization	Ant. Factor (dB)	Cable Loss (dB)	Limit (dBuV/m)	Emission Level (dBuV/m)	Margin (dB)
109.96	5.60	H	11.15	1.60	30.00	18.35	11.65
149.99	10.60	V	10.40	1.90	30.00	22.90	7.10
231.78	7.81	V	9.60	2.40	37.00	19.81	17.19
299.98	12.88	V	12.80	2.90	37.00	28.58	8.42
488.75	0.97	H	17.10	3.70	37.00	21.77	15.23
499.99	9.87	V	17.20	3.80	37.00	30.87	6.13
-	-	-	-	-	-	-	-

Band edge

Frequency Reading (MHz)	Reading (dBuV/m)	Ant. Pol.	Detector	Ant. Factor (dB)	Amp. Gain (dB)	Cable Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2390.0	56.8	H	Peak	25.7	41.3	2.3	43.5	74.0	30.5
2390.0	41.6	H	AV	25.7	41.3	2.3	38.3	54.0	25.7
-	-	-		-		-	-	-	-

Supplementary information:
-. Below 1 GHz, the emissions that exceed the limit values or that come to within 20 dB below the limit were reported.
Above 1 GHz, no emissions or harmonics were detected at a level exceed 20dB below the limit.
-. Spectrum analyzer was set to the following conditions :
- Resolution BW: 100 kHz (Below 1 GHz), 1 MHz (Above 1 GHz)
- Video BW: ≥ RBW (Below 1 GHz) , 10 Hz (Above 1GHz)
- Detector mode: Peak (Below 1 GHz), Average (Above 1 GHz)
- Trace : Max Hold
- Sweep time: Auto

Measurement Plots : No measurement plots provided.

Remarks : No emissions detected which exceed the 20 dB below the specified limit.

Result of test
In accordance with Technical requirement of Clause §15.209(a) and in §15.247(d).

☒ Complied ☐ Failed

Test Result of Radiated Emissions

Measurement method : ☒ Radiated ☐ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Hopping disabled with modulation
Power setting : Max. Power condition declared by the manufacturer
Measurement Frequency Range : 30 MHz - 25 GHZ

Table 7a. Radiated Emissions Data (BC04, Z-Axis, 8DPSK, Carrier tuned @ 2441 MHz)

Frequency Reading (MHz)	Reading (dBuV/m)	Polarization	Ant. Factor (dB)	Cable Loss (dB)	Limit (dBuV/m)	Emission Level (dBuV/m)	Margin (dB)
109.96	10.90	H	8.00	1.40	40.00	20.30	19.70
129.14	7.40	H	11.70	1.80	40.00	20.90	19.10
160.24	10.90	H	10.30	1.90	40.00	23.10	16.90
230.22	9.70	H	12.20	2.40	47.00	24.30	22.70
411.00	8.70	H	16.00	3.40	47.00	28.10	18.90
447.94	9.60	H	16.50	3.50	47.00	29.60	17.40
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Supplementary information:
-. Below 1 GHz, the emissions that exceed the limit values or that come to within 20 dB below the limit were reported.
Above 1 GHz, no emissions or harmonics were detected at a level exceed 20dB below the limit.
-. Spectrum analyzer was set to the following conditions :
- Resolution BW: 100 kHz (Below 1 GHz), 1 MHz (Above 1 GHz)
- Video BW: ≥ RBW (Below 1 GHz) , 10 Hz (Above 1GHz)
- Detector mode: Peak (Below 1 GHz), Average (Above 1 GHz)
- Trace : Max Hold
- Sweep time: Auto

Measurement Plots : No measurement plots provided.

Remarks : No emissions detected which exceed the 20 dB below the specified limit.

Result of test
In accordance with Technical requirement of Clause §15.209(a) and in §15.247(d).

☒ Complied ☐ Failed

Test Result of Radiated Emissions

Measurement method : ☒ Radiated ☐ Conducted
Measurement procedure : ANSI C63.4 & FCC Public Notice DA 00-705
Mode of operation : Hopping disabled with modulation
Power setting : Max. Power condition declared by the manufacturer
Measurement Frequency Range : 30 MHz - 25 GHZ

Table 7a. Radiated Emissions Data (BC04, Z-Axis, 8DPSK, Carrier tuned @ 2480 MHz)

Frequency Reading (MHz)	Reading (dBuV/m)	Polarization	Ant. Factor (dB)	Cable Loss (dB)	Limit (dBuV/m)	Emission Level (dBuV/m)	Margin (dB)
109.96	9.40	H	8.00	1.40	40.00	18.80	21.20
131.08	5.10	H	11.60	1.80	40.00	18.50	21.50
157.49	9.96	H	10.40	1.90	40.00	22.26	17.74
241.88	6.20	V	12.80	2.50	47.00	21.50	25.50
374.07	1.70	H	15.40	3.20	47.00	20.30	26.70
447.94	8.90	H	16.50	3.50	47.00	28.90	18.10
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Band edge

Frequency Reading (MHz)	Reading (dBuV/m)	Ant. Pol.	Detector	Ant. Factor (dB)	Amp. Gain (dB)	Cable Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.5	58.8	H	Peak	25.5	41.5	2.5	45.3	74.0	28.7
2483.5	38.6	H	AV	25.5	41.5	2.5	25.1	54.0	28.9
-	-	-		-		-	-	-	-

Supplementary information:
-. Below 1 GHz, the emissions that exceed the limit values or that come to within 20 dB below the limit were reported.
Above 1 GHz, no emissions or harmonics were detected at a level exceed 20dB below the limit.
-. Spectrum analyzer was set to the following conditions :
- Resolution BW: 100 kHz (Below 1 GHz), 1 MHz (Above 1 GHz)
- Video BW: ≥ RBW (Below 1 GHz) , 10 Hz (Above 1GHz)
- Detector mode: Peak (Below 1 GHz), Average (Above 1 GHz)
- Trace : Max Hold
- Sweep time: Auto

Measurement Plots : No measurement plots provided.

Remarks : No emissions detected which exceed the 20 dB below the specified limit.

Result of test
In accordance with Technical requirement of Clause §15.209(a) and in §15.247(d).

☒ Complied ☐ Failed

5.8 AC Mains Conducted Emissions

TEST: Limits of mains terminal disturbance voltage				
Method	Measurements were made on a ground plane that extends 1-meter minimum beyond all sides of the system under test. All power was connected to the system through Artificial Mains Network (AMN). Conducted voltage measurements on mains lines were made at the output of the AMN.			
Basic Standard		ANSI C63.4:2003		
Parameters recorded during the test		Laboratory Ambient Temperature	27.4 °C	
		Relative Humidity	48.0 %	
-		Frequency range on each side of line	Measurement Point	
Fully configured sample scanned over the following frequency range		150 kHz to 30 MHz	AC Input port	

Limits - Class B				
Frequency (MHz)	Limit (dBµV)			
	Quasi-Peak	Result	Average	Result
0.15 to 0.50	66 to 56	**Pass**	56 to 46	**Pass**
0.50 to 5	56	**Pass**	46	**Pass**
5 to 30	60	**Pass**	50	**Pass**

Conducted Emissions EUT Configuration Settings:		
Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See 3.6)	EUT Configurations Mode # (See Section 3.4)
1	2	1,2

Conducted Emissions Test Equipment used:				
Description	Manufacturer	Model	Identifier	Cal. Due
Test Receiver	Rohde & Schwarz	ESIB26	100359	2009.05.26
LISN	Rohde & Schwarz	ESH2-Z5	100146	2009.03.28
Attenuator (10 dB)	BIRD	150-A-FFN-06	57578	2009.03.28

Test Result of AC Line Conducted Emissions

Conducted Emissions Data Table of Low Channel – BC02

Test Frequency (MHz)	Correction Factor		Reading value (dBuV)		Line	Level (dBuV)		Limit (dBuV)		Margin (dB)	
	Cable	LISN	QP	AV		QP	AV	QP	AV	QP	AV
0.17	0.04	0.06	36.20	27.00	N	36.30	27.10	65.20	53.40	28.90	26.30
0.53	0.10	0.10	41.10	33.10	H	41.30	33.30	56.00	46.00	14.70	12.70
1.04	0.17	0.13	29.80	26.10	H	30.10	26.40	56.00	46.00	25.90	19.60
1.29	0.16	0.14	23.90	17.20	N	24.20	17.50	56.00	46.00	31.80	28.50
1.33	0.16	0.14	30.70	26.00	H	31.00	26.30	56.00	46.00	25.00	19.70
1.97	0.13	0.17	30.60	26.10	H	30.90	26.40	56.00	46.00	25.10	19.60
2.03	0.13	0.17	23.00	17.00	N	23.30	17.30	56.00	46.00	32.70	28.70
2.10	0.13	0.17	29.90	25.40	H	30.20	25.70	56.00	46.00	25.80	20.30
2.85	0.16	0.24	24.10	19.20	N	24.50	19.60	56.00	46.00	31.50	26.40
3.66	0.22	0.28	23.80	17.60	N	24.30	18.10	56.00	46.00	31.70	27.90
8.11	0.22	0.38	35.20	28.00	H	35.80	28.60	60.00	50.00	24.20	21.40

Measurement Plots : Measurement plots provided.

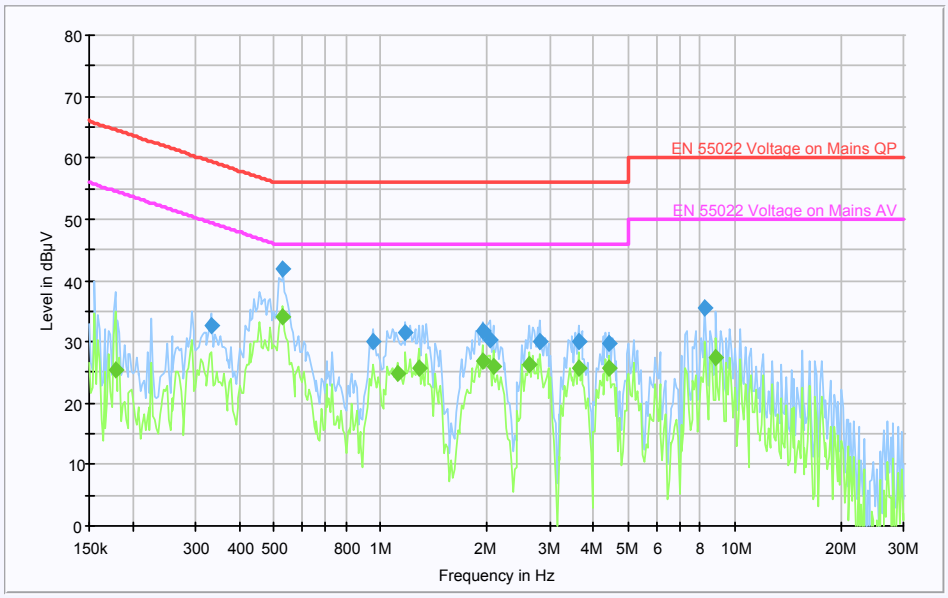
Remarks : Measurement was performed at the input of the battery charger.

Result of test
In accordance with Technical requirement of Clause §15.209(a)

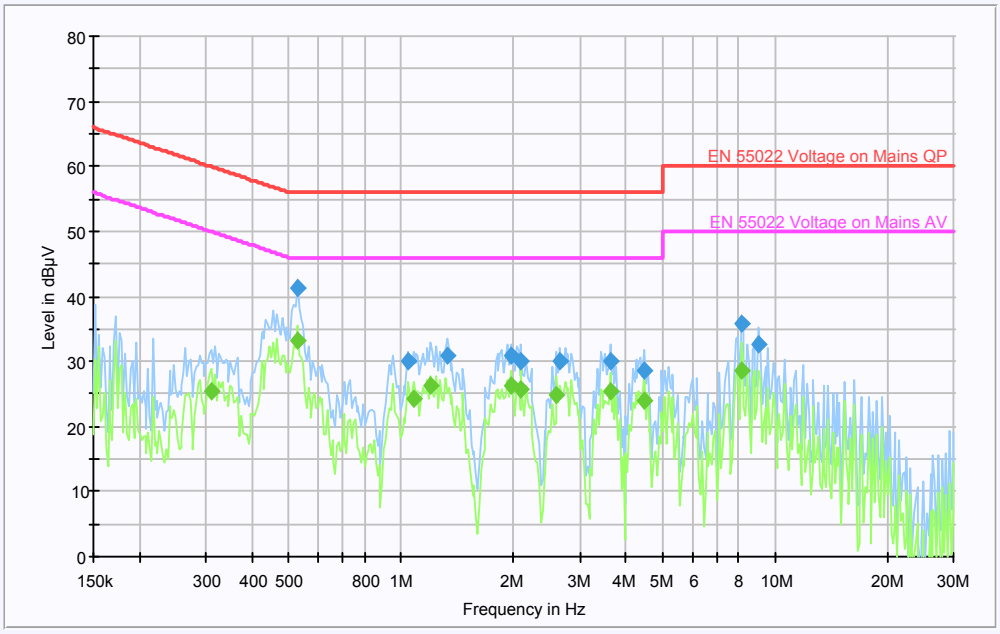
☒ Complied ☐ Failed

Conducted Emissions Graph of Hopping Mode - BC02

Live Line



Neutral Line



Conducted Emissions Data Table for Hopping mode – BC04

Test Frequency (MHz)	Correction Factor		Reading value (dBuV)		Line	Level (dBuV)		Limit (dBuV)		Margin (dB)	
	Cable/ 10dB Atten	LISN	QP	AV		QP	AV	QP	AV	QP	AV
0.18	10.06	0.08	26.56	6.46	N	36.70	16.60	64.60	54.60	27.9	38.0
0.21	10.06	0.08	24.16	4.56	N	34.30	14.70	63.10	53.10	28.8	38.4
0.46	10.09	0.08	24.53	18.03	H	34.70	28.20	56.70	46.70	22	18.5
7.87	10.37	0.24	22.59	14.89	H	33.20	25.50	60.00	46.00	26.8	20.5
8.61	10.41	0.24	25.05	17.45	H	35.70	28.10	60.00	46.00	24.3	17.9
Note: If no frequencies are specified in the tables, no measurement for quasi-peak or average was necessary.											

Measurement Plots : Measurement plots provided.

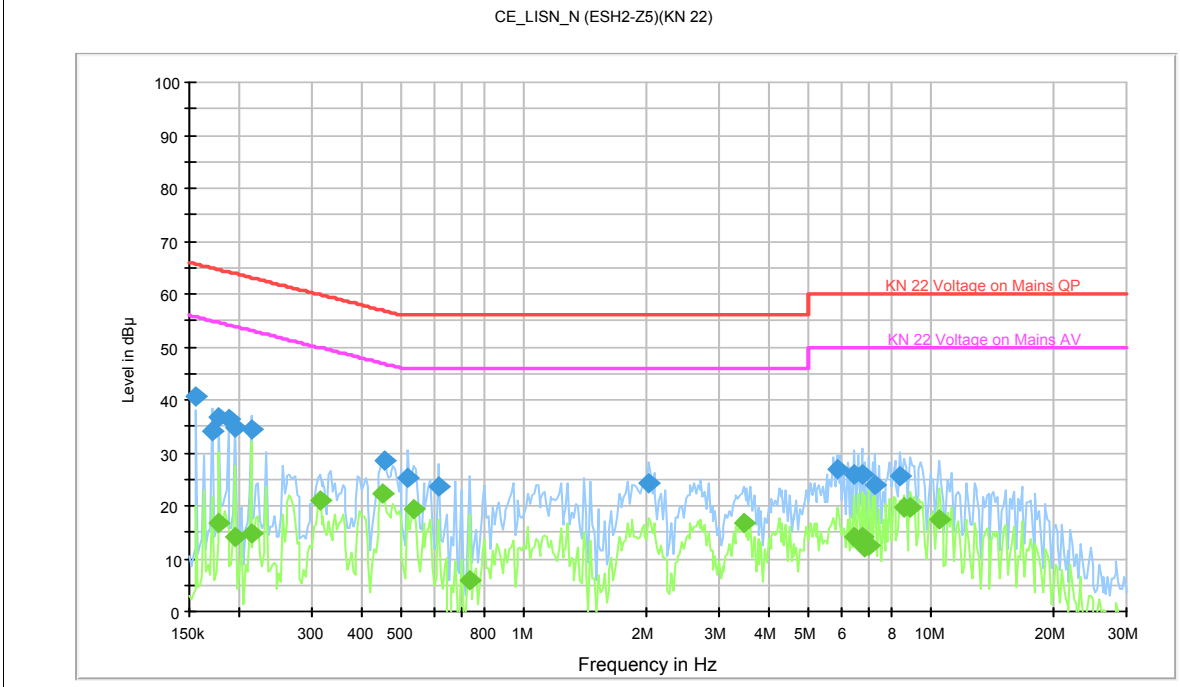
Remarks : None

Result of test
In accordance with Technical requirement of Clause §15.209(a)

☒ Complied ☐ Failed

Conducted Emissions Graph for Hopping mode - BC04

Live Line



Neutral Line