InterLab®

Final Report on

N-Com B5
FCC ID Y6MNCOM8
IC: 9455A-NCOM8

Report Reference:	MDE_REDOX_1403_FCCa acc. Title 47 CFR chapter I part 15 subpart C
Date:	February 27, 2015

Test Laboratory:
7 layers AG
Borsigstrasse 11
40880 Ratingen
Germany

DAkkS
Deutsche
Akkreditierungsstelle
D-PL-12140-01-01

1 Administrative Data

1.1 Project Data

Project Responsible:	Imad Hjije
Date Of Test Report:	2015/02/27
Date of first test:	2014/02/09
Date of last test:	2014/12/12

1.2 Applicant Data

Company Name: Nolangroup s.p.a.

Street:	via Terzi di S.Agata 2
City:	24030 Brembate di sopra
Country:	Italy

Contact Person: Mr. Claudio Corollo

Phone:	+39 035 602 285
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E-Mail:	c.corollo@nolan.it

1.3 Test Laboratory Data

The following list shows all places and laboratories involved for test result generation:

7 layers DE

Company Name :	7 layers AG
Street :	Borsigstrasse 11
City :	40880 Ratingen
Country :	Germany
Contact Person :	Mr. Michael Albert
Phone :	+49 2102 749 201
Fax :	+49 2102 749 444
E Mail :	Michael.Albert@7Layers.com

Laboratory Details

Lab ID	*Identification*	*Responsible*	*Accreditation Info*
Lab 1	Conducted Emissions	Mr. Andreas Petz Mr. Wolfgang Richter	DAkkS-Registration no. D-PL-12140-01-01
Lab 2	Radiated Emissions	Mr. Marco Kullik Mr. Robert Machulec	DAkkS-Registration no. D-PL-12140-01-01
Lab 3	Regulatory Bluetooth RF Test Solution	Mr. Jimmy Chatheril Mr. Sören Berentzen	DAkkS-Registration no. D-PL-12140-01-01

1.4 Signature of the Testing Responsible

Imad Hjije

Imad Hjije
responsible for tests performed in: Lab 1, Lab 2, Lab 3

7 layers AG, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

1.5 Signature of the Accreditation Responsible

B. Retka [B. RETKA]

Accreditation scope responsible person
responsible for Lab 1, Lab 2, Lab 3

7 layers AG, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

2 Test Object Data

2.1 General OUT Description

The following section lists all OUTs (Object's Under Test) involved during testing.

OUT: Internal PCB

Type / Model / Family:	N-Com B5 FCC ID Y6MNCOM8 IC: 9455A-NCOM8
Manufacturer:	
Company Name:	Please see applicant data
Contact Person:	-

Parameter List:

Parameter name	*Value*
AC Power Supply	120 (V)
Antenna Gain	0 (dBi)
DC Power Supply	3.7 (V)
highest channel (BT)	2480 (MHz)
lowest channel (BT)	2402 (MHz)
mid channel (BT)	2441 (MHz)

OUT: N-Com B5

Type / Model / Family:	N-Com B5 FCC ID Y6MNCOM8 IC: 9455A-NCOM8

Parameter List:

Parameter name	*Value*
AC Power Supply	120 (V)
Antenna Gain	0 (dBi)
DC Power Supply	3.3 (V)
highest channel (BT)	2480 (MHz)
lowest channel (BT)	2402 (MHz)
mid channel (BT)	2441 (MHz)

2.2 Detailed Description of OUT Samples

Sample : aa01

OUT Identifier	N-Com B5		
Sample Description	Standard sample		
HW Status	1.0		
SW Status	1.0		
Low Voltage	3.3 V	*Low Temp.*	-20 °C
High Voltage	4.2 V	*High Temp.*	60 °C
Nominal Voltage	3.7 V	*Normal Temp.*	20 °C

Parameter List:

Parameter Description	*Value*
Parameter for Scope FCC_v2	
Antenna Gain	0 (dBi)
Frequency_high	2480 (MHz)
Frequency_low	2402 (MHz)
Frequency_mid	2441 (MHz)

Sample : ab01

OUT Identifier	N-Com B5		
Sample Description	Standard sample		
HW Status	1.0		
SW Status	1.0		
Low Voltage	3.3 V	*Low Temp.*	-20 °C
High Voltage	4.2 V	*High Temp.*	60 °C
Nominal Voltage	3.7 V	*Normal Temp.*	20 °C

Parameter List:

Parameter Description	*Value*
Parameter for Scope FCC_v2	
Antenna Gain	0 (dBi)
Frequency_high	2480 (MHz)
Frequency_low	2402 (MHz)
Frequency_mid	2441 (MHz)

Sample : ac01

OUT Identifier	Internal PCB		
Sample Description	Conducted sample		
HW Status	1.0		
SW Status	1.0		
Low Voltage	3.3 V	*Low Temp.*	-20 °C
High Voltage	4.2 V	*High Temp.*	60 °C
Nominal Voltage	3.7 V	*Normal Temp.*	20 °C

Parameter List:

Parameter Description	*Value*
Parameter for Scope FCC_v2	
Antenna Gain	0 (dBi)
Frequency_high	2480 (MHz)
Frequency_low	2402 (MHz)
Frequency_mid	2441 (MHz)

2.3 OUT Features

Features for OUT: Internal PCB

Designation	*Description*	*Allowed Values*	*Supported Value(s)*
Features for scope: FCC_v2			
AC	The OUT is powered by or connected to AC Mains		
BT	EUT supports Bluetooth data rate of 1 Mbps with GFSK modulation in the band 2400 MHz - 2483.5 MHz		
BTLE	Support of Bluetooth Low Energy		
DC	The OUT is powered by or connected to DC		
EDR2	EUT supports Bluetooth using data rate of 2 Mbps with PI/4 DQPSK modulation in the band 2400 MHz - 2483.5 MHz		
EDR3	EUT supports Bluetooth using data rate of 3 Mbps with 8DPSK modulation in the band 2400 MHz - 2483.5 MHz		
TantC	temporary antenna connector, which may be only built-in for testing, designed as an example part of the equipment		

Features for OUT: N-Com B5

Designation	*Description*	*Allowed Values*	*Supported Value(s)*
Features for scope: FCC_v2			
AC	The OUT is powered by or connected to AC Mains		
BT	EUT supports Bluetooth data rate of 1 Mbps with GFSK modulation in the band 2400 MHz - 2483.5 MHz		
BTLE	Support of Bluetooth Low Energy		
DC	The OUT is powered by or connected to DC		
EDR2	EUT supports Bluetooth using data rate of 2 Mbps with PI/4 DQPSK modulation in the band 2400 MHz - 2483.5 MHz		
EDR3	EUT supports Bluetooth using data rate of 3 Mbps with 8DPSK modulation in the band 2400 MHz - 2483.5 MHz		
Iant	Integral Antenna: permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment		

2.4 Auxiliary Equipment

AE No.	*Type Designation*	*Serial No.*	*HW Status*	*SW Status*	*Description*
AE AUX4	CHERRY RS 6000 USB ON	G 0000273 2P28			EMC KEYBOARD 1
AE AUX2	Fujitsu LIFEBOOK E Series E781	DSCK013817			Laptop RE
AE AUX1	LG L17NB-3	504WAHS3J991			EMC TFT 2
AE AUX3	Logitech M-BT58	HC60915A2XC			EMC MOUSE 1
AE AUX5	SED100P2-19.0	07Y17323A			AC Adapter 2 Laptop RE

2.5 Setups used for Testing

For each setup a relation is given to determine if and which samples and auxiliary equipment is used. The left side list all OUT samples and the right side lists all auxiliary equipment for the given setup.

Setup No.	*List of OUT samples*		*List of auxiliary equipment*	
	Sample No.	*Sample Description*	*AE No.*	*AE Description*
Setup_aa01	**(Setup for radiated measurments)**			
	Sample: aa01	Standard sample		
Setup_ab01	**(Setup for radiated measurments)**			
	Sample: ab01	Standard sample	AE AUX4	EMC KEYBOARD 1
			AE AUX2	Laptop RE
			AE AUX1	EMC TFT 2
			AE AUX3	EMC MOUSE 1
			AE AUX5	AC Adapter 2 Laptop RE
Setup_ac01	**(Setup for conducted measurments)**			
	Sample: ac01	Conducted sample		

3 Results

3.1 General

Documentation of tested devices: Available at the test laboratory.

Interpretation of the test results: The results of the inspection are described on the following pages, where 'Conformity' or 'Passed' means that the certification criteria were verified and that the tested device is conform to the applied standard.

In cases where 'Declaration' is printed, the required documents are available in the manufacturers product documentation.

In cases where 'not applicable' is printed, the test case requirements are not relevant to the specific equipment implementation.

Note:

1. All tests are performed under environmental conditions within the requirements of the specifications. Environmental conditions are available at the laboratory.

2. The device is a hands-free kit containing a BT and BTLE Transceiver operating in the 2.4 GHz ISM band.

3. This report focuses only on the BT part using Frequency Hopping Spread Spectrum (FHSS) Modulation

3.2 List of the Applicable Body

(Body for Scope: FCC_v2)

Designation	*Description*
FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES	Subpart C - Intentional Radiators; 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

3.3 List of Test Specification

Test Specification:	**FCC part 2 and 15**
Version	10-1-13 Edition
Title:	PART 2 - GENERAL RULES AND REGULATIONS PART 15 - RADIO FREQUENCY DEVICES

3.4 Summary

Test Case Identifier / Name Test (condition)	*Result*	*Date of Test*	*Lab Ref.*	*Setup*
15c.1 Conducted emissions (AC power line) §15.207				
15c.1; Mode = transmit	Passed	2014/11/13	Lab 1	Setup_ab01
15c.2 Spurious radiated emissions §15.247 (d), §15.35 (b), §15.209				
15c.2; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation, Channel = low	Passed	2014/12/12	Lab 2	Setup_aa01
15c.2; Frequency = 2402, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed footnote: 1	2014/12/12	Lab 2	Setup_aa01
15c.2; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation, Channel = mid	Passed	2014/12/12	Lab 2	Setup_aa01
15c.2; Frequency = 2441, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed footnote: 1	2014/12/12	Lab 2	Setup_aa01
15c.2; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation, Channel = highest	Passed	2014/12/12	Lab 2	Setup_aa01
15c.2; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed footnote: 1	2014/12/12	Lab 2	Setup_aa01
15c.3 Occupied bandwidth §15.247 (a) (1)				
15c.3; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.3; Frequency = 2402, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.3; Frequency = 2402, Mode = BT transmit using 3 Mbps with 8DPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.3; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.3; Frequency = 2441, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.3; Frequency = 2441, Mode = BT transmit using 3 Mbps with 8DPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.3; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.3; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.3; Frequency = 2480, Mode = BT transmit using 3 Mbps with 8DPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01

Test Case Identifier / Name *Test (condition)*	*Result*	*Date of Test*	*Lab Ref.*	*Setup*
15c.4 Peak power output §15.247 (b) (1)				
15c.4; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.4; Frequency = 2402, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.4; Frequency = 2402, Mode = BT transmit using 3 Mbps with 8DPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.4; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.4; Frequency = 2441, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.4; Frequency = 2441, Mode = BT transmit using 3 Mbps with 8DPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.4; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.4; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.4; Frequency = 2480, Mode = BT transmit using 3 Mbps with 8DPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.5 Spurious RF conducted emissions §15.247 (d)				
15c.5; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.5; Frequency = 2402, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.5; Frequency = 2402, Mode = BT transmit using 3 Mbps with 8DPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.5; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.5; Frequency = 2441, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.5; Frequency = 2441, Mode = BT transmit using 3 Mbps with 8DPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.5; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.5; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.5; Frequency = 2480, Mode = BT transmit using 3 Mbps with 8DPSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01

Test Case Identifier / Name Test (condition)	Result	Date of Test	Lab Ref.	Setup
15c.6 Band edge compliance §15.247 (d)				
15c.6; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation, Method = conducted, band edge = 2400 MHz	Passed	2014/12/09	Lab 3	Setup_ac01
15c.6; Frequency = 2402, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation, Method = conducted, band edge = 2400 MHz	Passed	2014/12/09	Lab 3	Setup_ac01
15c.6; Frequency = 2402, Mode = BT transmit using 3 Mbps with 8DPSK modulation, Method = conducted, band edge = 2400 MHz	Passed	2014/12/09	Lab 3	Setup_ac01
15c.6; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation, Method = conducted, band edge = 2483.5 MHz	Passed	2014/12/09	Lab 3	Setup_ac01
15c.6; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation, Method = radiated	Passed	2014/12/12	Lab 2	Setup_aa01
15c.6; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation, Method = conducted, band edge = 2483.5 MHz	Passed	2014/12/09	Lab 3	Setup_ac01
15c.6; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation, Method = radiated	Passed	2014/12/12	Lab 2	Setup_aa01
15c.6; Frequency = 2480, Mode = BT transmit using 3 Mbps with 8DPSK modulation, Method = conducted, band edge = 2483.5 MHz	Passed	2014/02/09	Lab 3	Setup_ac01
15c.6; Frequency = 2480, Mode = BT transmit using 3 Mbps with 8DPSK modulation, Method = radiated	Passed	2014/12/12	Lab 2	Setup_aa01
15c.7 Dwell time §15.247 (a) (1) (iii)				
15c.7; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.8 Channel separation §15.247 (a) (1)				
15c.8; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01
15c.9 Number of hopping frequencies §15.247 (a) (1) (iii)				
15c.9; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation	Passed	2014/12/09	Lab 3	Setup_ac01

3.5 Detailed Footnotes

No.	Description
1	PSK modulation was tested using a reduced frequency range of 1-18GHz as no spurious emissions have been found outside this frequency range during pre-measurements

3.6 Detailed Results

3.6.1 15c.1 Conducted emissions (AC power line) §15.207

Test: 15c.1; Mode = transmit

Result:	Passed
Setup No.:	Setup_ab01
Date of Test:	2014/11/13 18:04
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

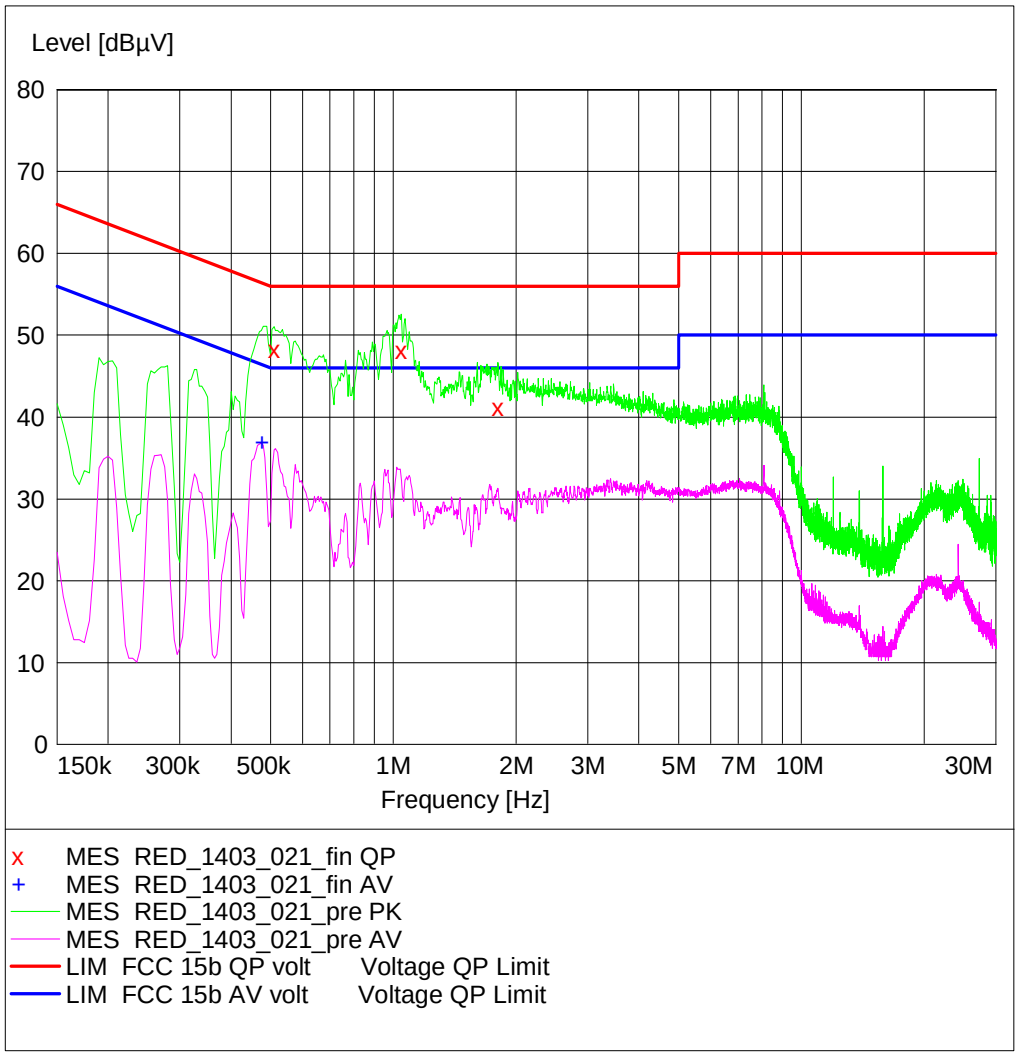
Detailed Results:

AC MAINS CONDUCTED

```
EUT:                 (DE1056002ab01)
Manufacturer:        REDOX
Operating Condition: FM Radio on; USB data traffic
Test Site:           7 layers Ratingen
Operator:            URO
Test Specification:  ANSI C63.4; FCC 15.107 / 15.207
Comment:             computer peripheral setup, 120V/60Hz
Start of Test:       13.11.2014 / 21:37:49
```

SCAN TABLE: "FCC Voltage"

Short Description:			FCC Voltage			
Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak Average	20.0 ms	9 kHz	ESH3-Z5



MEASUREMENT RESULT: "RED_1403_021_fin QP"

13.11.2014 21:43

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.510000	48.30	10.1	56	7.7	L1	FLO
1.045000	48.20	10.1	56	7.8	L1	FLO
1.805000	41.20	10.1	56	14.8	L1	GND

MEASUREMENT RESULT: "RED_1403_021_fin AV"

13.11.2014 21:43

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.475000	36.90	10.1	46	9.5	L1	GND

3.6.2 15c.2 Spurious radiated emissions §15.247 (d), §15.35 (b), §15.209

Test: 15c.2; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation, Channel = low

Result: Passed

Setup No.: Setup_aa01

Date of Test: 2014/12/12 22:09

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

Traffic Mode FCC 15.247 (15.35b,15.209) TX on 2402 MHz 1-DH1

Frequency range 30 MHz - 1 GHz

Ant. Polar.	Limit QPK [dBµV]	Frequency [MHz]	Corrected value QPK [dBµV]	Margin QPK [dB]	Result
Ver + Hor					Passed

Frequency range 1 GHz - 25 GHz

Ant. Polar.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	Corrected value PK [dBµV]	Corrected value AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
Ver + Hor	74	54	2246	49.40	37.70	24.60	16.30	Passed
Ver + Hor	74	54	2272	49.40	38.00	24.60	16.00	Passed
Ver + Hor	74	54	2298	48.80	37.30	25.20	16.70	Passed
Ver + Hor	74	54	4808	50.60	39.60	23.40	14.40	Passed

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Test: 15c.2; Frequency = 2402, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result: Passed

Setup No.: Setup_aa01

Date of Test: 2014/12/12 22:15

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

Traffic Mode FCC 15.247 (15.35b,15.209) TX on 2402 MHz 2-DH1

Frequency range 1 GHz - 8 GHz

Ant. Polar.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	Corrected value PK [dBµV]	Corrected value AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
Ver + Hor	74	54						Passed

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Test: 15c.2; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation, Channel = mid

Result: Passed

Setup No.: Setup_aa01

Date of Test: 2014/12/12 22:11

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

Traffic Mode FCC 15.247 (15.35b,15.209) TX on 2441 MHz 1-DH1

Frequency range 9 kHz - 1 GHz

Ant. Polar.	Limit QPK [dBµV]	Frequency [MHz]	Corrected value QPK [dBµV]	Margin QPK [dB]	Result
Ver + Hor					Passed

Frequency range 1 GHz - 25 GHz

Ant. Polar.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	Corrected value PK [dBµV]	Corrected value AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
Ver + Hor	74	54	2285	50.40	39.20	23.60	14.80	Passed
Ver + Hor	74	54	2311	49.80	38.80	24.20	15.20	Passed
Ver + Hor	74	54	2337	48.70	37.50	25.30	16.50	Passed
Ver + Hor	74	54	4882	48.20	37.10	25.80	16.90	Passed

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Test: 15c.2; Frequency = 2441, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result: Passed

Setup No.: Setup_aa01

Date of Test: 2014/12/12 22:16

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

Traffic Mode FCC 15.247 (15.35b,15.209) TX on 2480 MHz 2-DH1

Frequency range 1 GHz - 8 GHz

Ant. Polar.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	Corrected value PK [dBµV]	Corrected value AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
Ver + Hor	74	54						Passed

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Test: 15c.2; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation, Channel = highest

Result: Passed

Setup No.: Setup_aa01

Date of Test: 2014/12/12 22:14

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

Traffic Mode FCC 15.247 (15.35b,15.209) TX on 2480 MHz 1-DH1

Frequency range 30 MHz - 1 GHz

Ant. Polar.	Limit QPK [dBµV]	Frequenc y [MHz]	Corrected value QPK [dBµV]	Margin QPK [dB]	Result
Ver + Hor					Passed

Frequency range 1 GHz - 25 GHz

Ant. Polar.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	Corrected value PK [dBµV]	Corrected value AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
Ver + Hor	74	54	2324	50.60	39.30	23.40	14.70	Passed
Ver + Hor	74	54	2350	50.50	39.10	23.50	14.90	Passed
Ver + Hor	74	54	2376	49.50	37.90	24.50	16.10	Passed
Ver + Hor	74	54	4960	44.00	33.20	30.00	20.80	Passed

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Test: 15c.2; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result:	Passed
Setup No.:	Setup_aa01
Date of Test:	2014/12/12 22:16
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Traffic Mode FCC 15.247 (15.35b,15.209) TX on 2480 MHz 2-DH1

Frequency range 1 GHz - 8 GHz

Ant. Polar.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	Corrected value PK [dBµV]	Corrected value AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
Ver + Hor	74	54						Passed

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

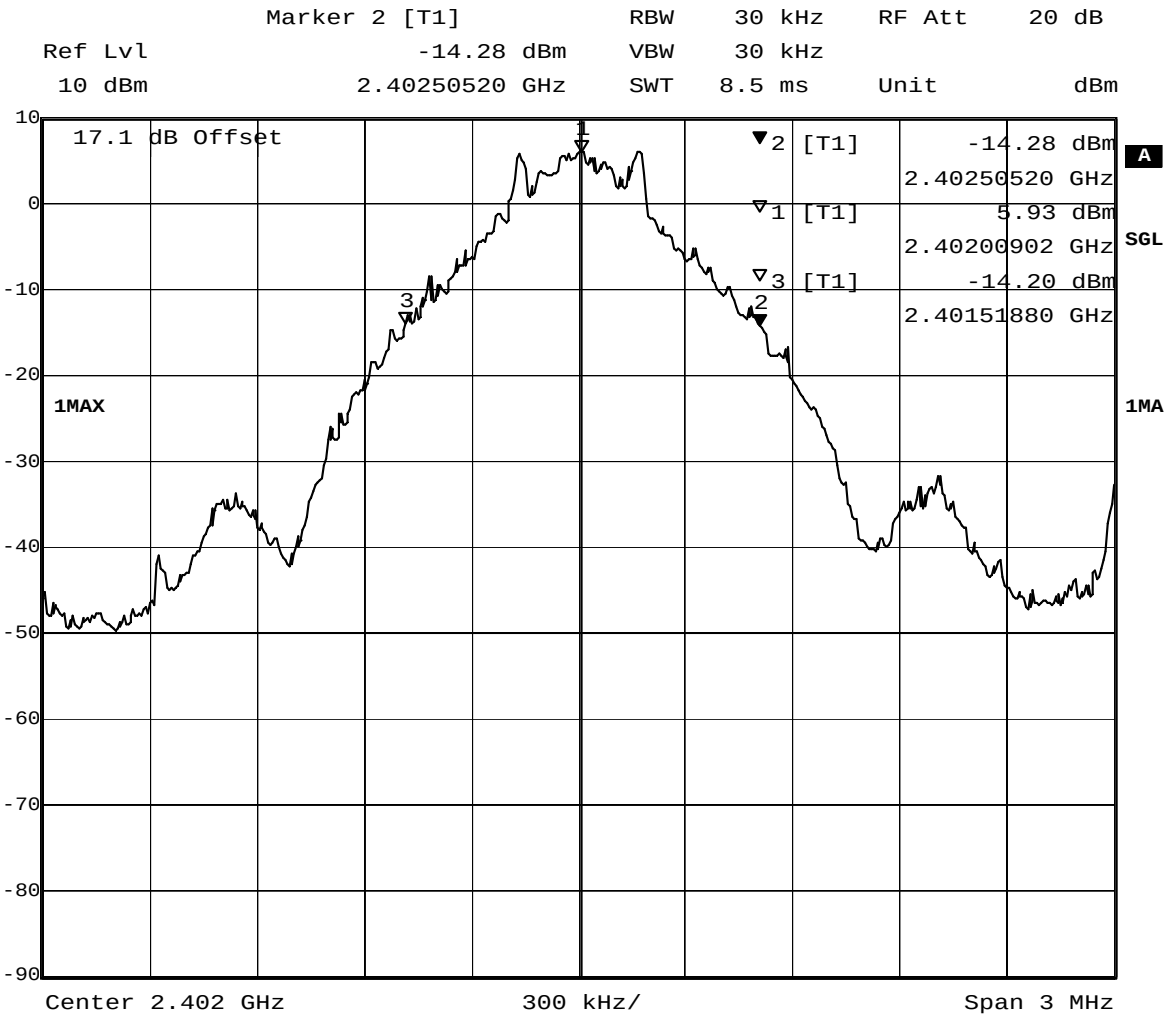
3.6.3 15c.3 Occupied bandwidth §15.247 (a) (1)

Test: 15c.3; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 15:41
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

20 dB bandwidth MHz
0.986



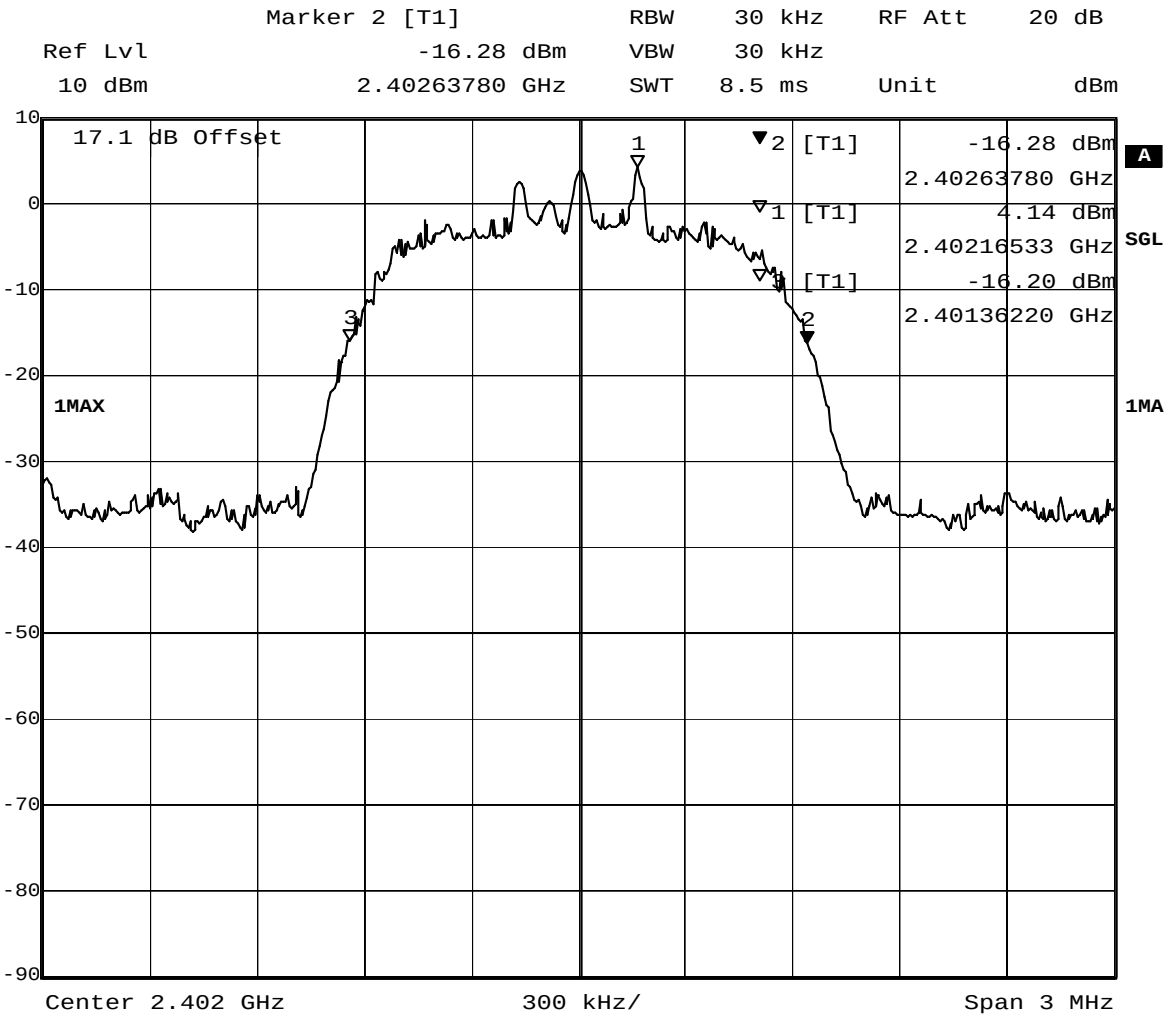
Title: 20dB Bandwidth
Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):986.4
Date: 17.SEP.2014 08:51:46

Test: 15c.3; Frequency = 2402, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:31
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

20 dB bandwidth MHz
1.276



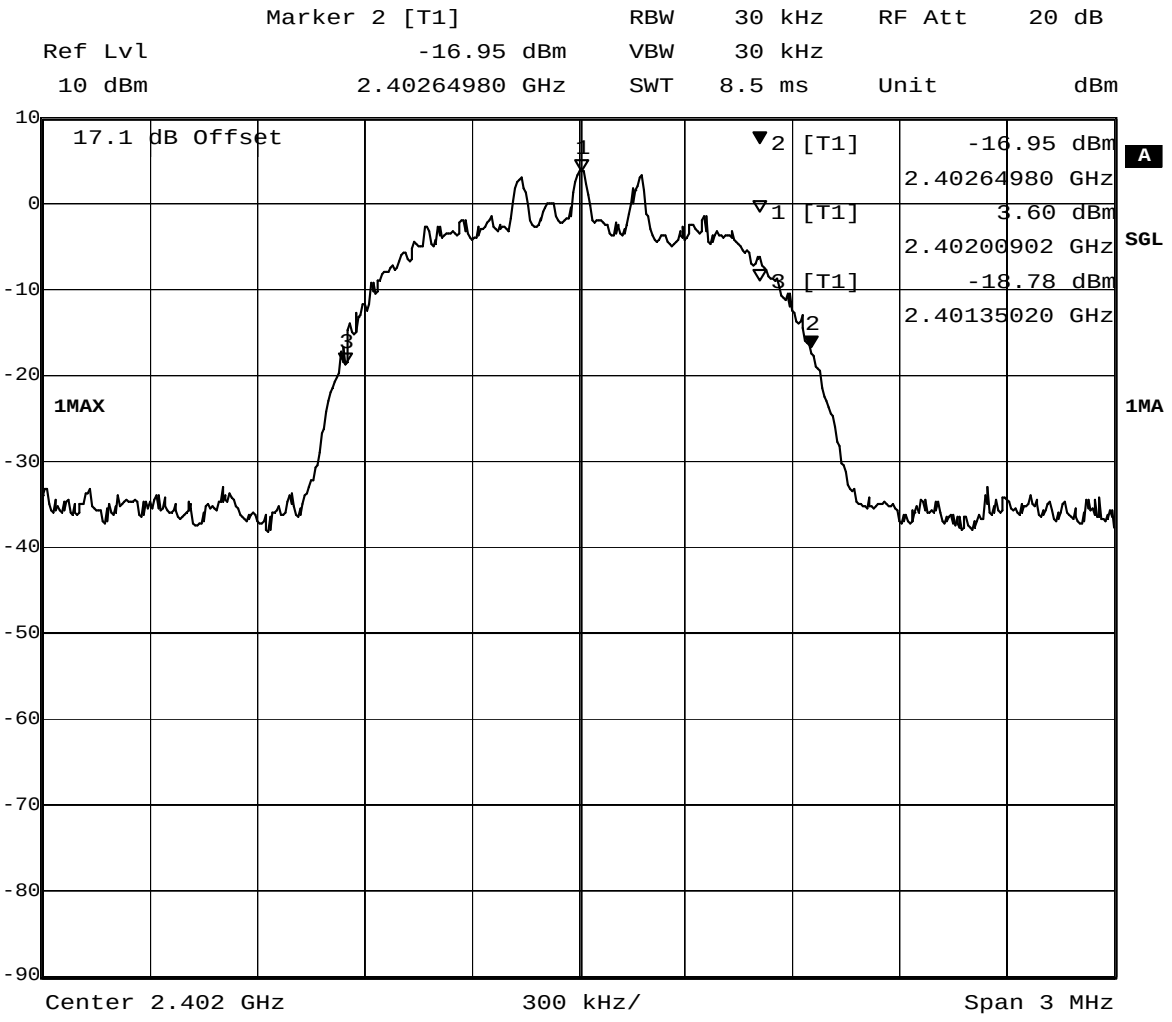
Title: 20dB Bandwidth
Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):1275.6
Date: 17.SEP.2014 09:17:54

Test: 15c.3; Frequency = 2402, Mode = BT transmit using 3 Mbps with 8DPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:35
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

20 dB bandwidth MHz
1.300



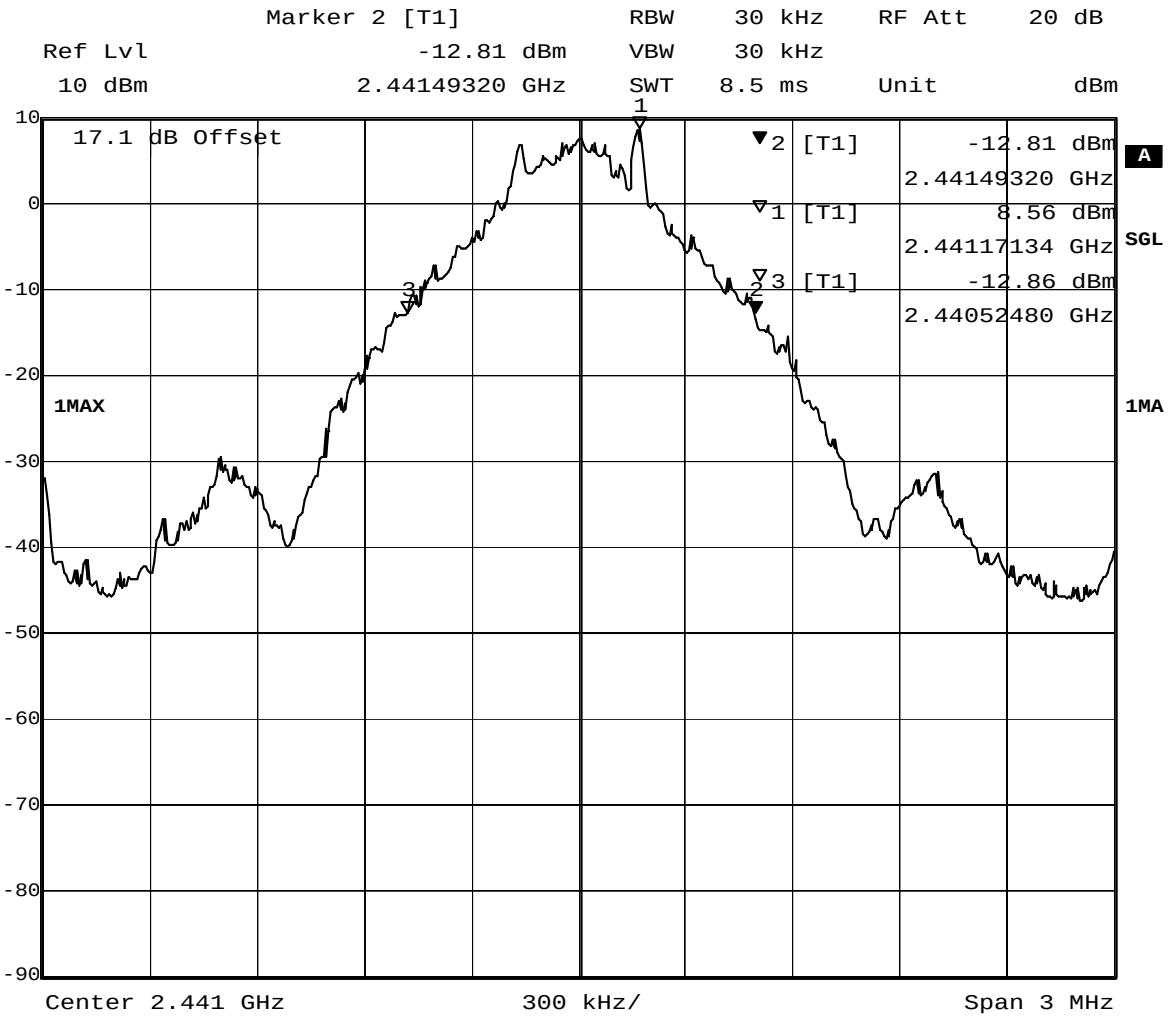
Title: 20dB Bandwidth
Comment A: CH B: 2402 MHz; 20dB bandwidth (kHz):1299.6
Date: 17.SEP.2014 09:42:59

Test: 15c.3; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:22
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

20 dB bandwidth MHz
0.968



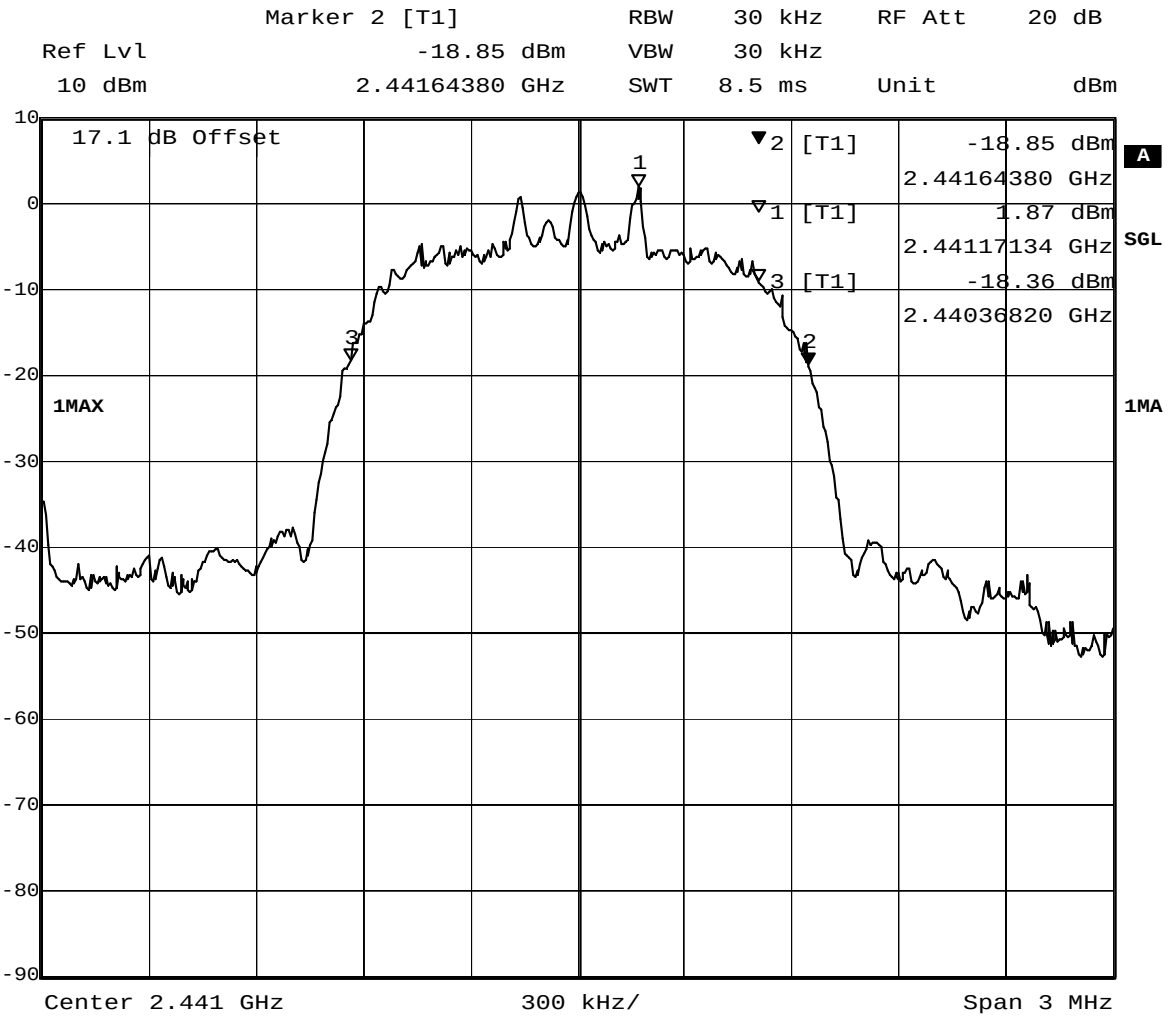
Title: 20dB Bandwidth
Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):968.4
Date: 17.SEP.2014 13:24:05

Test: 15c.3; Frequency = 2441, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:38
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

20 dB bandwidth MHz
1.276



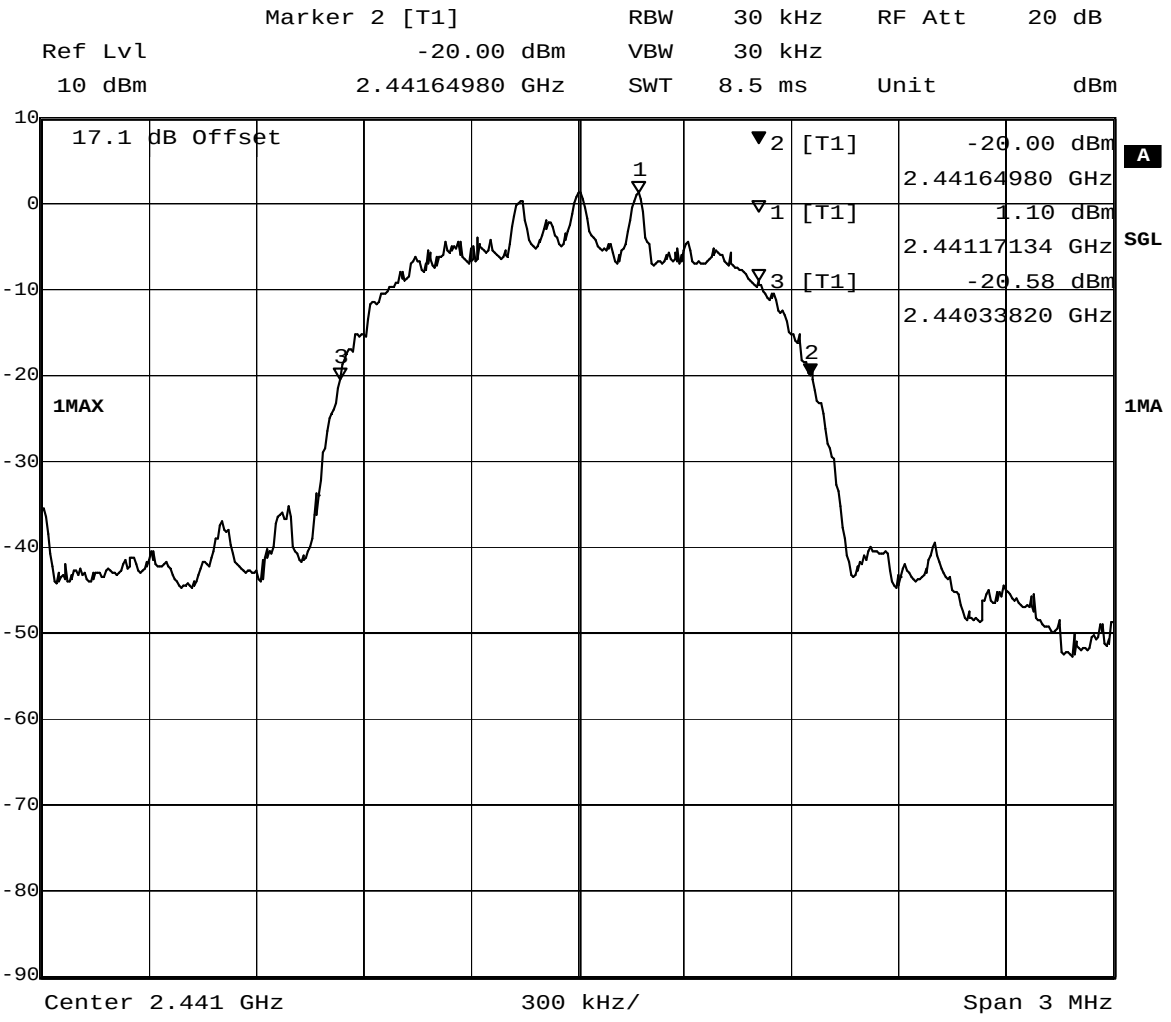
Title: 20dB Bandwidth
Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):1275.6
Date: 17.SEP.2014 11:22:21

Test: 15c.3; Frequency = 2441, Mode = BT transmit using 3 Mbps with 8DPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:40
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

20 dB bandwidth MHz
1.312



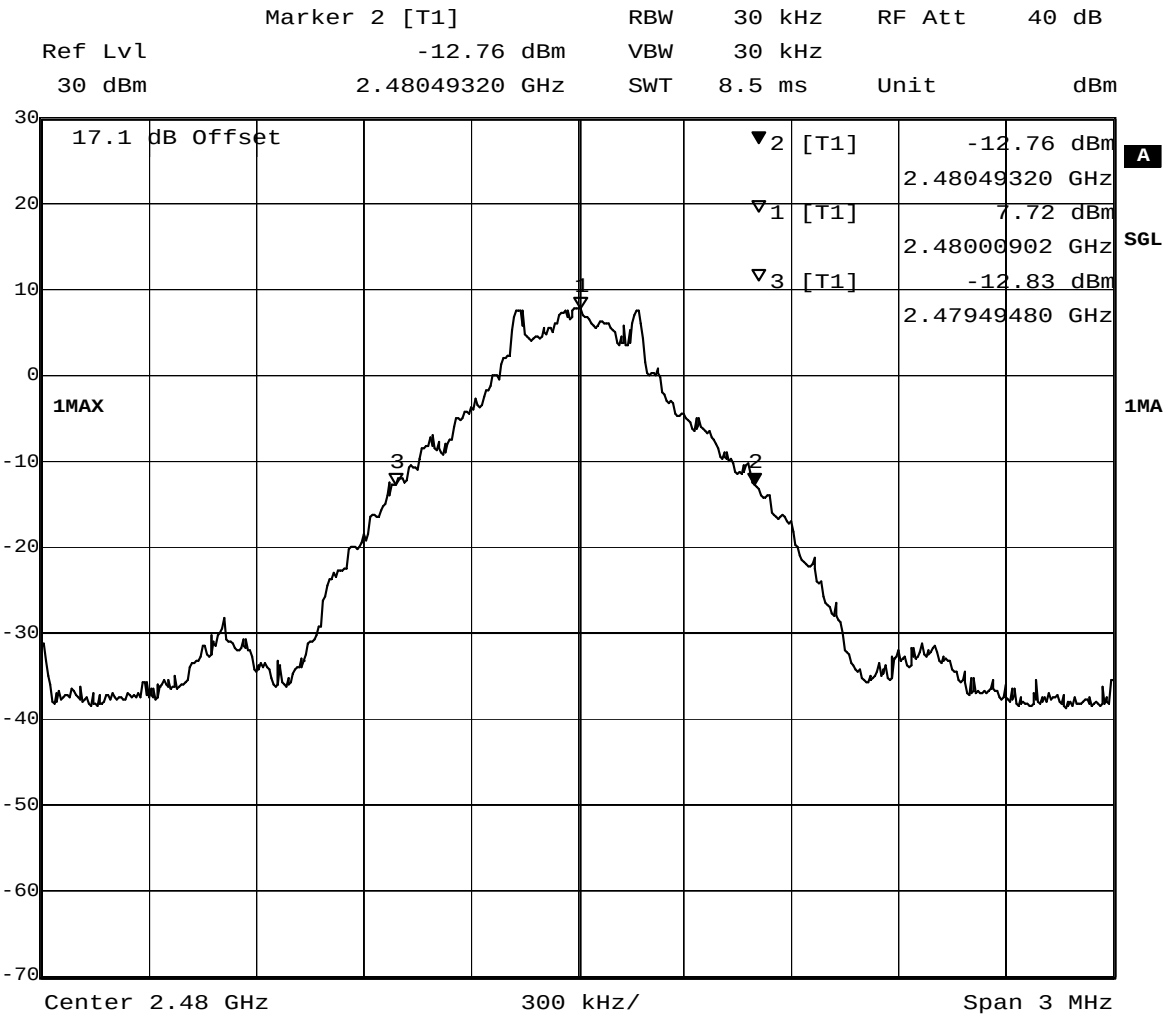
Title: 20dB Bandwidth
Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):1311.6
Date: 17.SEP.2014 11:14:10

Test: 15c.3; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:24
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

20 dB bandwidth MHz
0.998



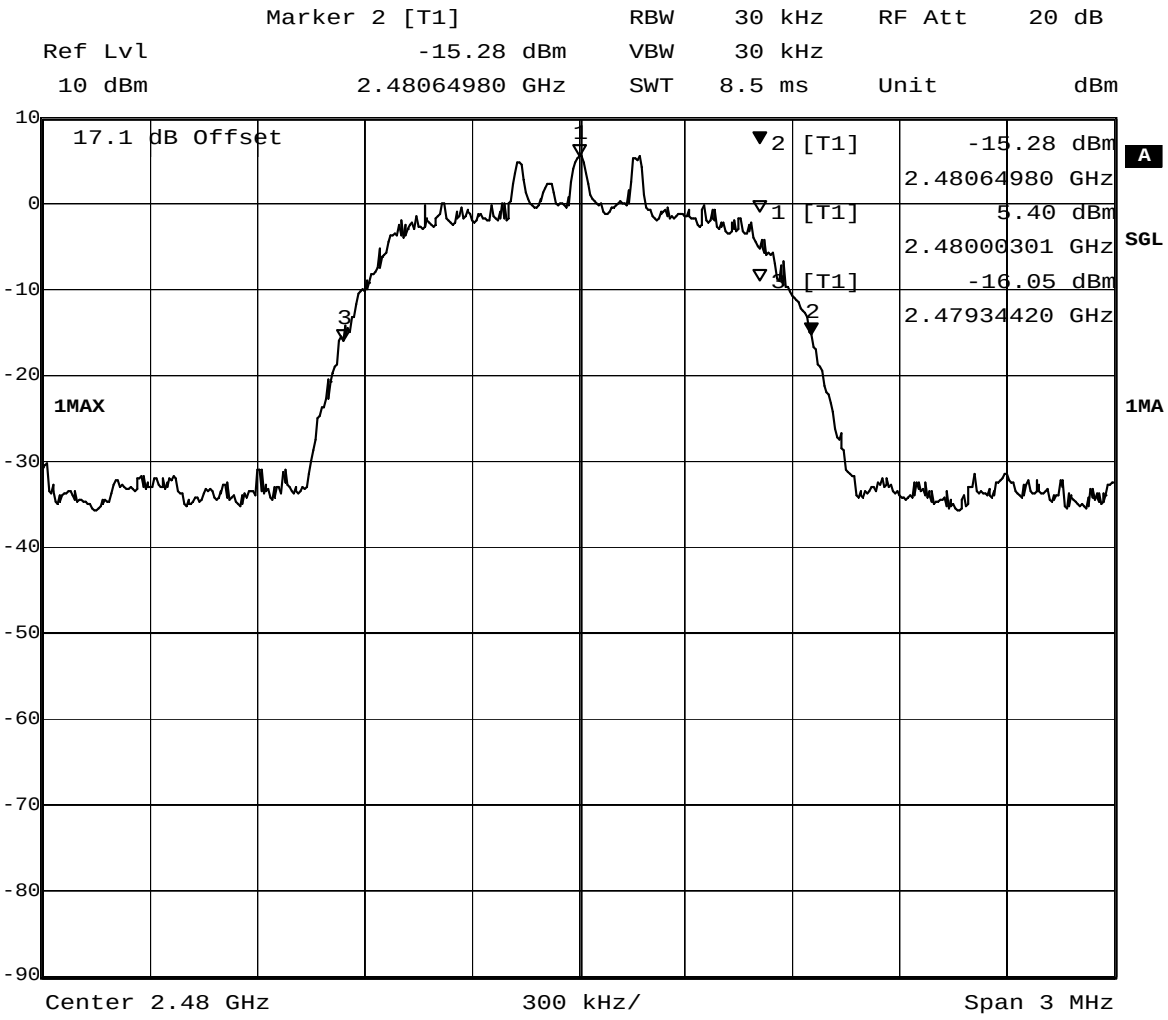
Title: 20dB Bandwidth
Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):998.4
Date: 17.SEP.2014 13:50:17

Test: 15c.3; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:42
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

20 dB bandwidth MHz
1.306



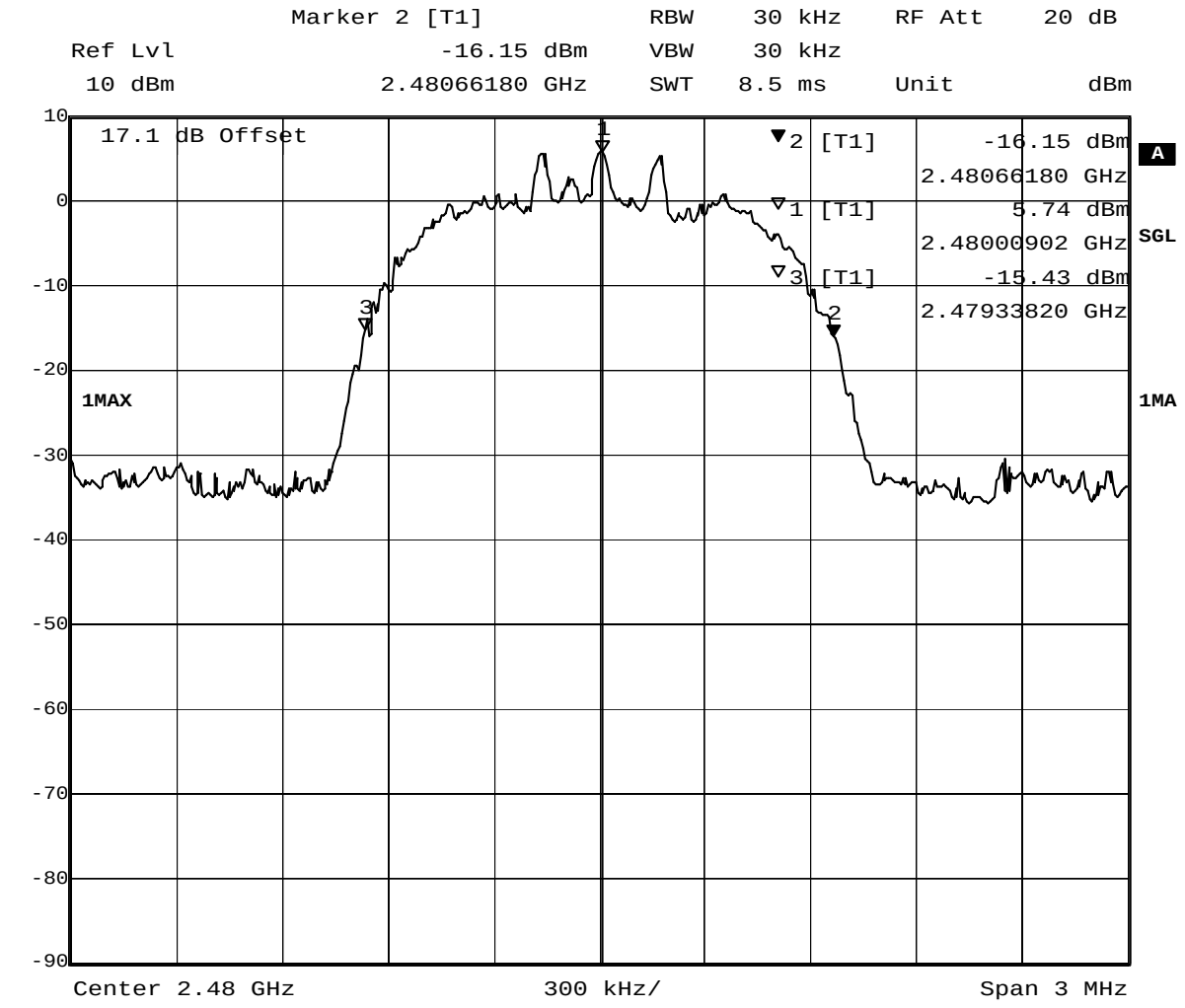
Title: 20dB Bandwidth
Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):1305.6
Date: 17.SEP.2014 14:10:46

Test: 15c.3; Frequency = 2480, Mode = BT transmit using 3 Mbps with 8DPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:44
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

20 dB bandwidth MHz
1.324



Title: 20dB Bandwidth
Comment A: CH T: 2480 MHz; 20dB bandwidth (kHz):1323.6
Date: 17.SEP.2014 14:58:28

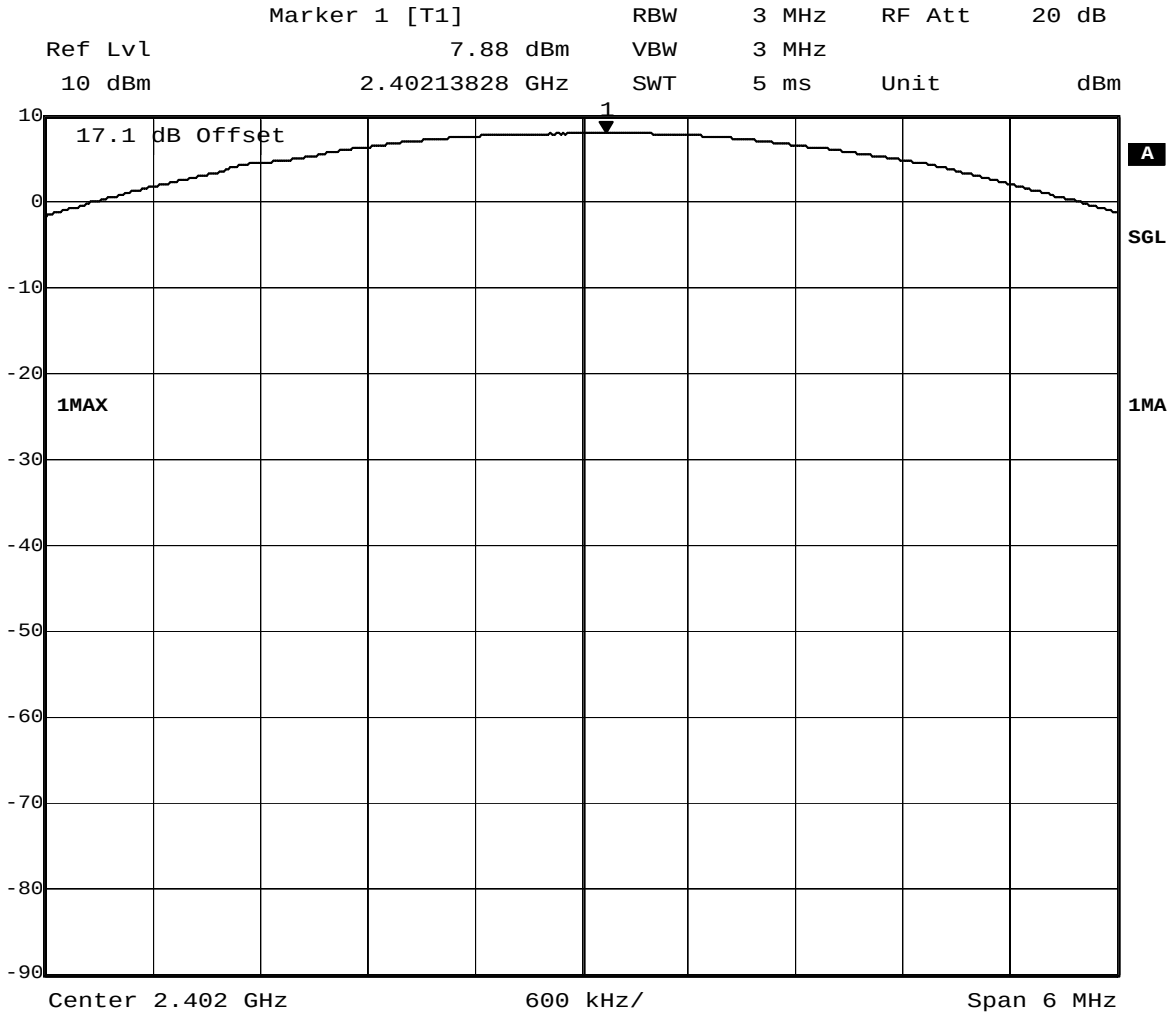
3.6.4 15c.4 Peak power output §15.247 (b) (1)

Test: 15c.4; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:48
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
7.88	0.00	7.88

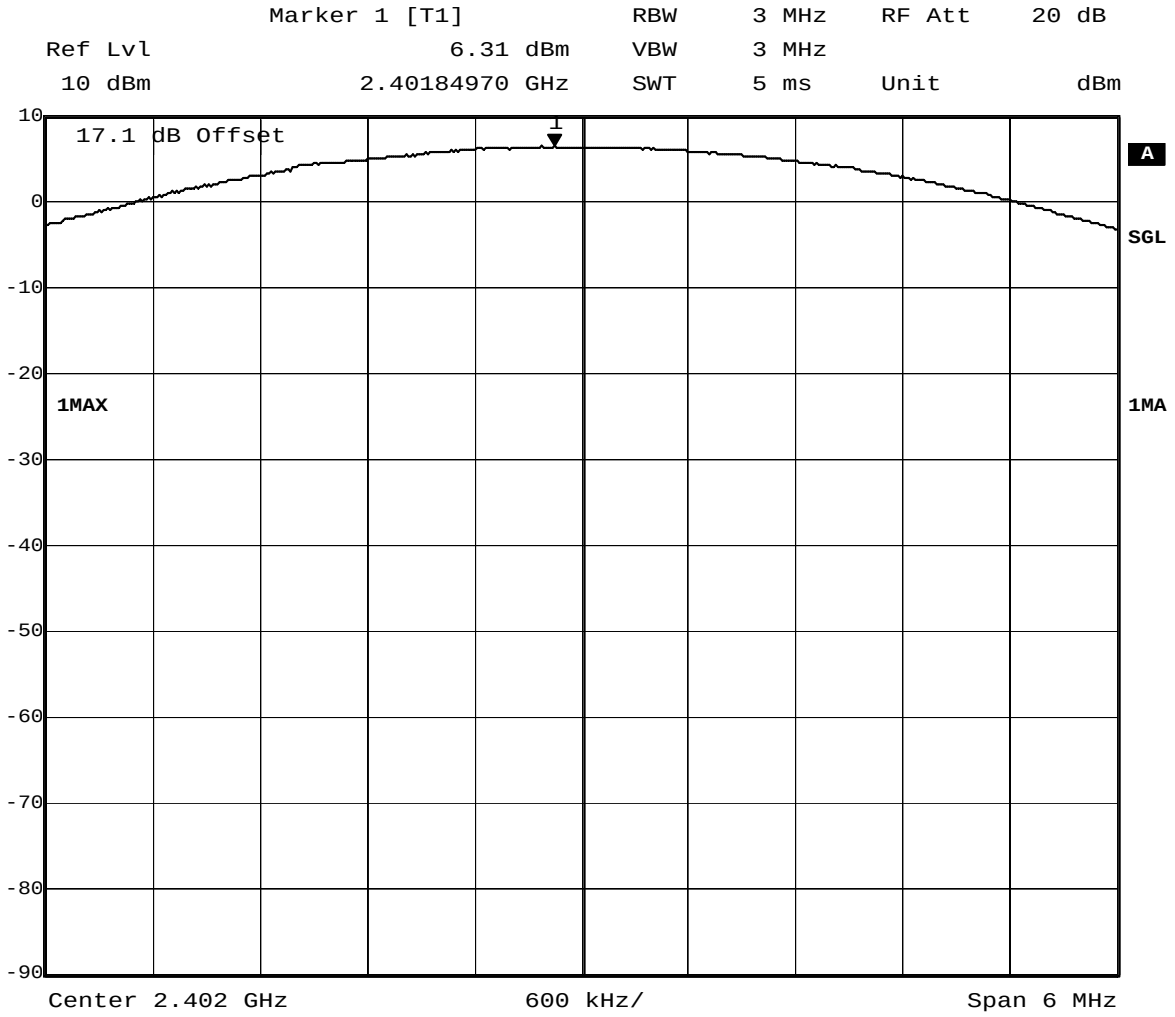


Test: 15c.4; Frequency = 2402, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:58
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
6.31	0.00	6.31

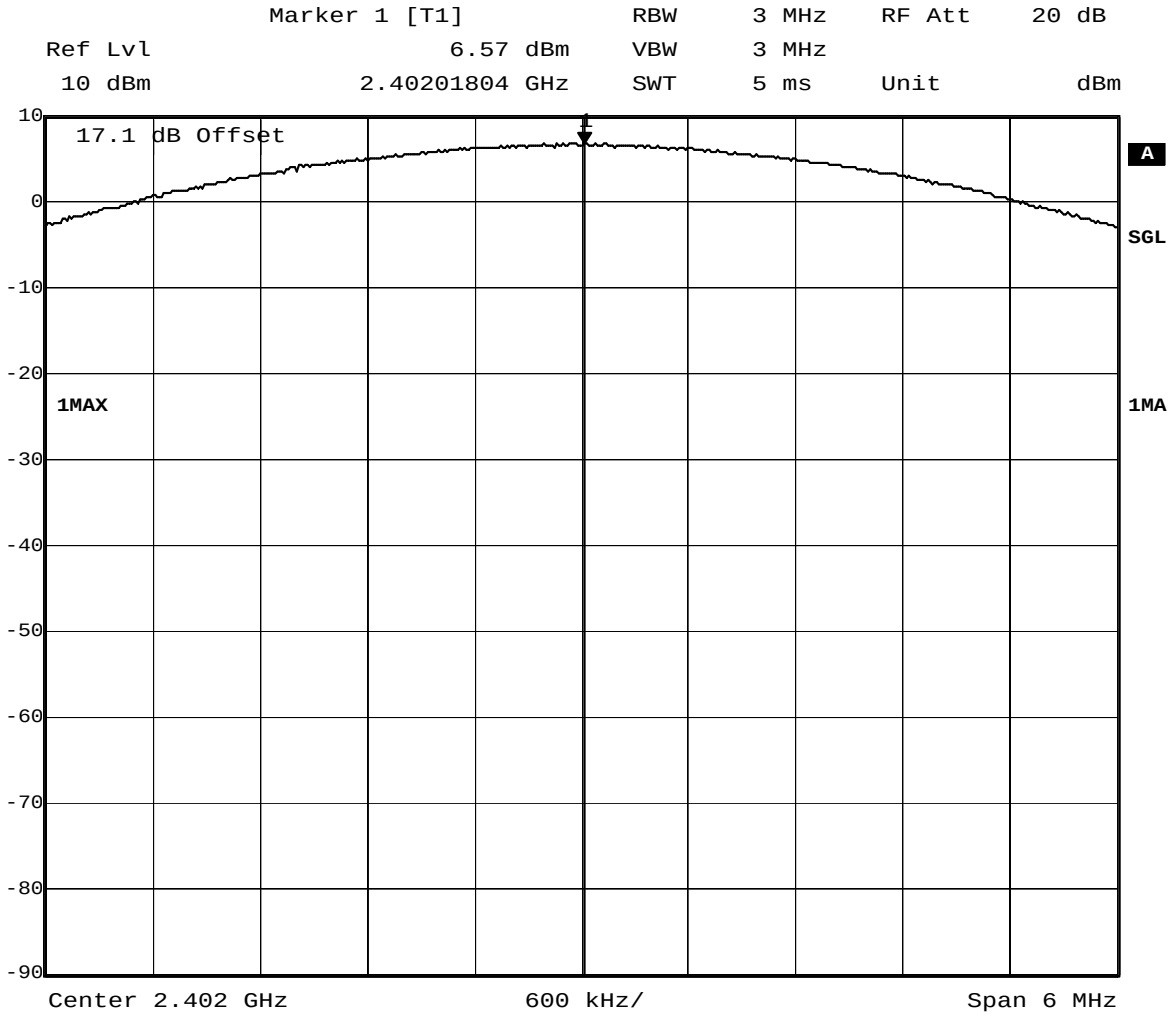


Test: 15c.4; Frequency = 2402, Mode = BT transmit using 3 Mbps with 8DPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:15
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
6.57	0.00	6.57



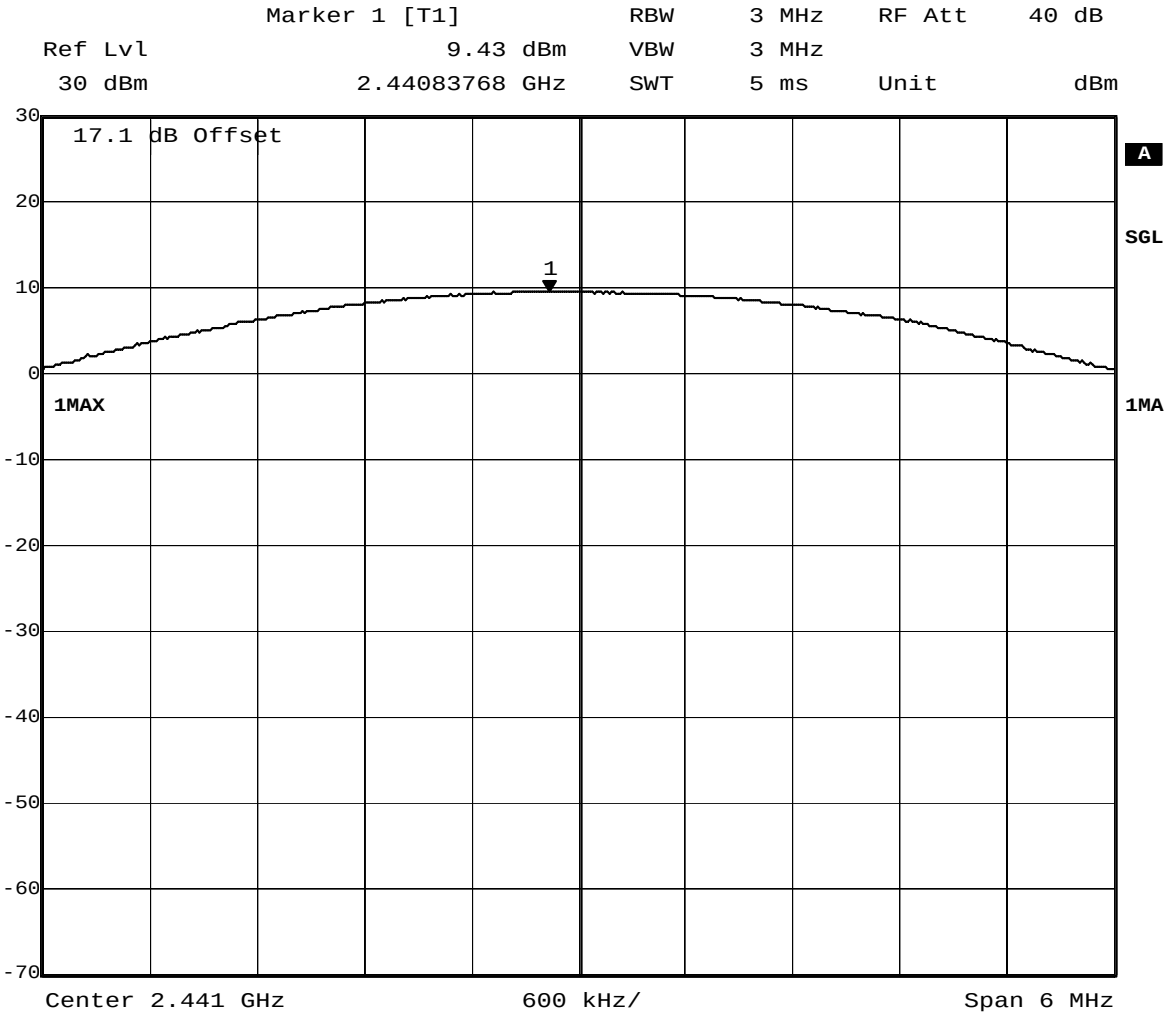
Title: Peak outputpower Power
Comment A: CH B: 2402 MHz
Date: 17.SEP.2014 09:43:37

Test: 15c.4; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:50
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
9.43	0.00	9.43



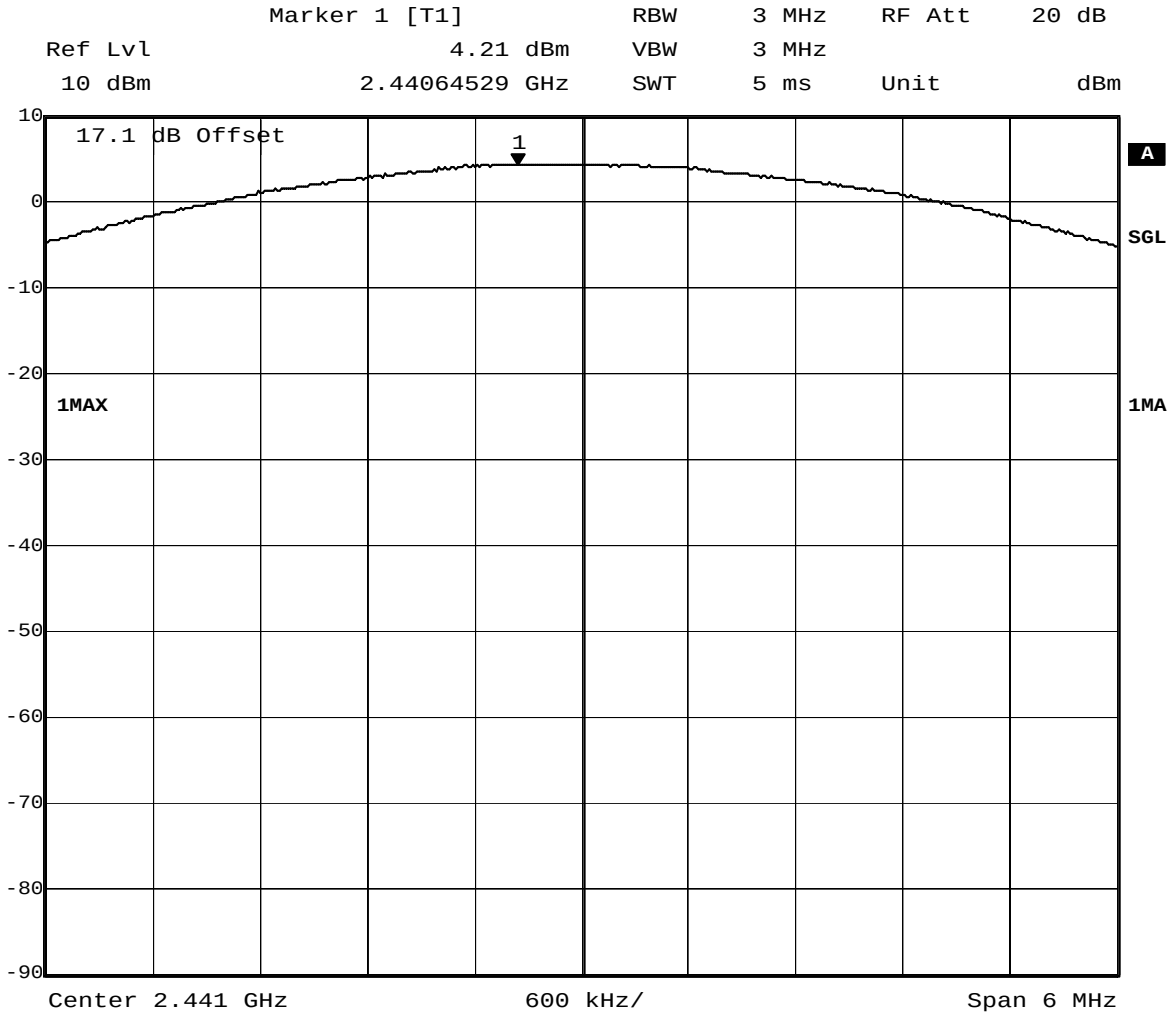
Title: Peak outputpower Power
Comment A: CH M: 2441 MHz
Date: 17.SEP.2014 13:32:13

Test: 15c.4; Frequency = 2441, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:17
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
4.21	0.00	4.21



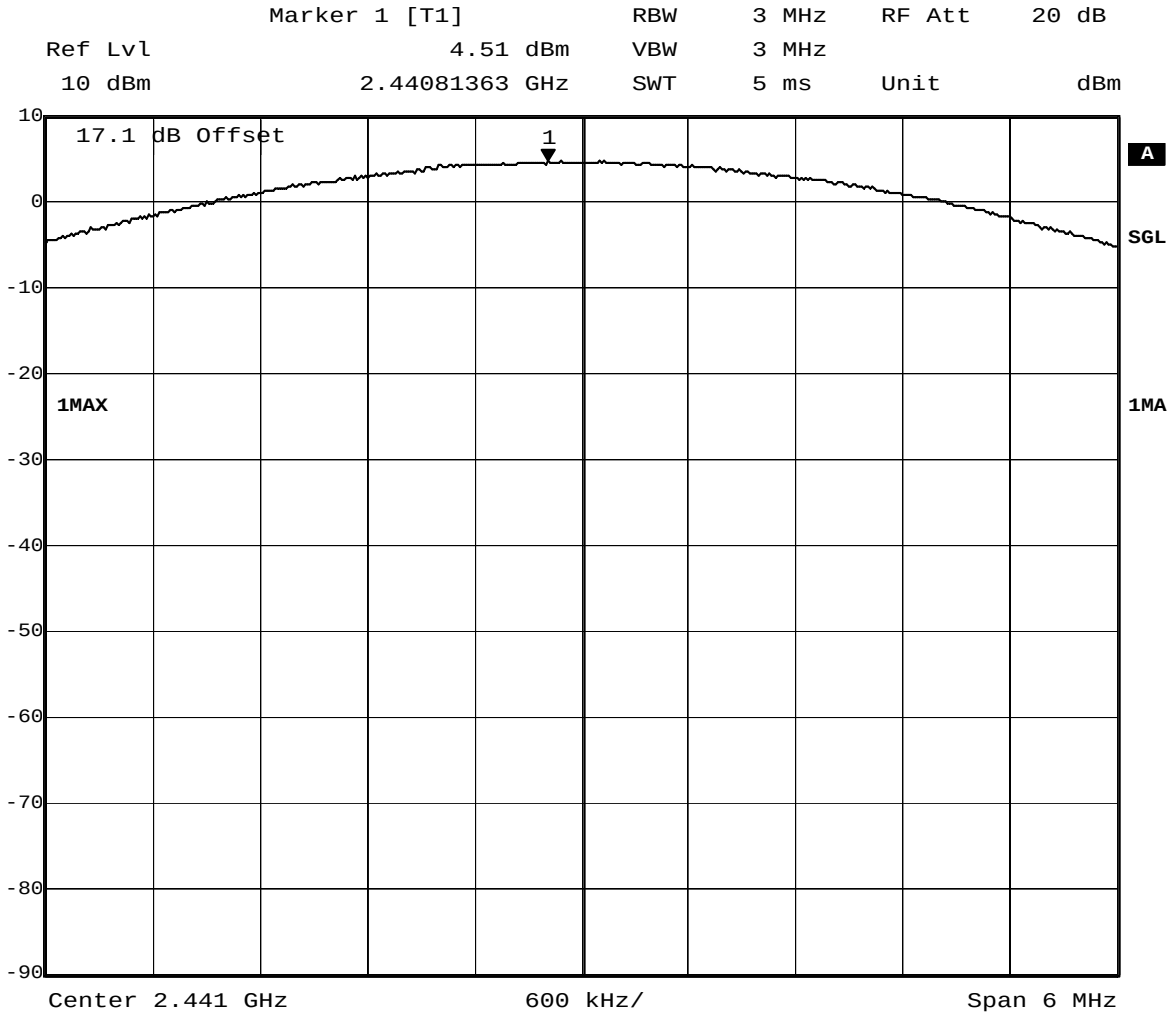
Title: Peak outputpower Power
Comment A: CH M: 2441 MHz
Date: 17.SEP.2014 11:22:59

Test: 15c.4; Frequency = 2441, Mode = BT transmit using 3 Mbps with 8DPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:19
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
4.51	0.00	4.51



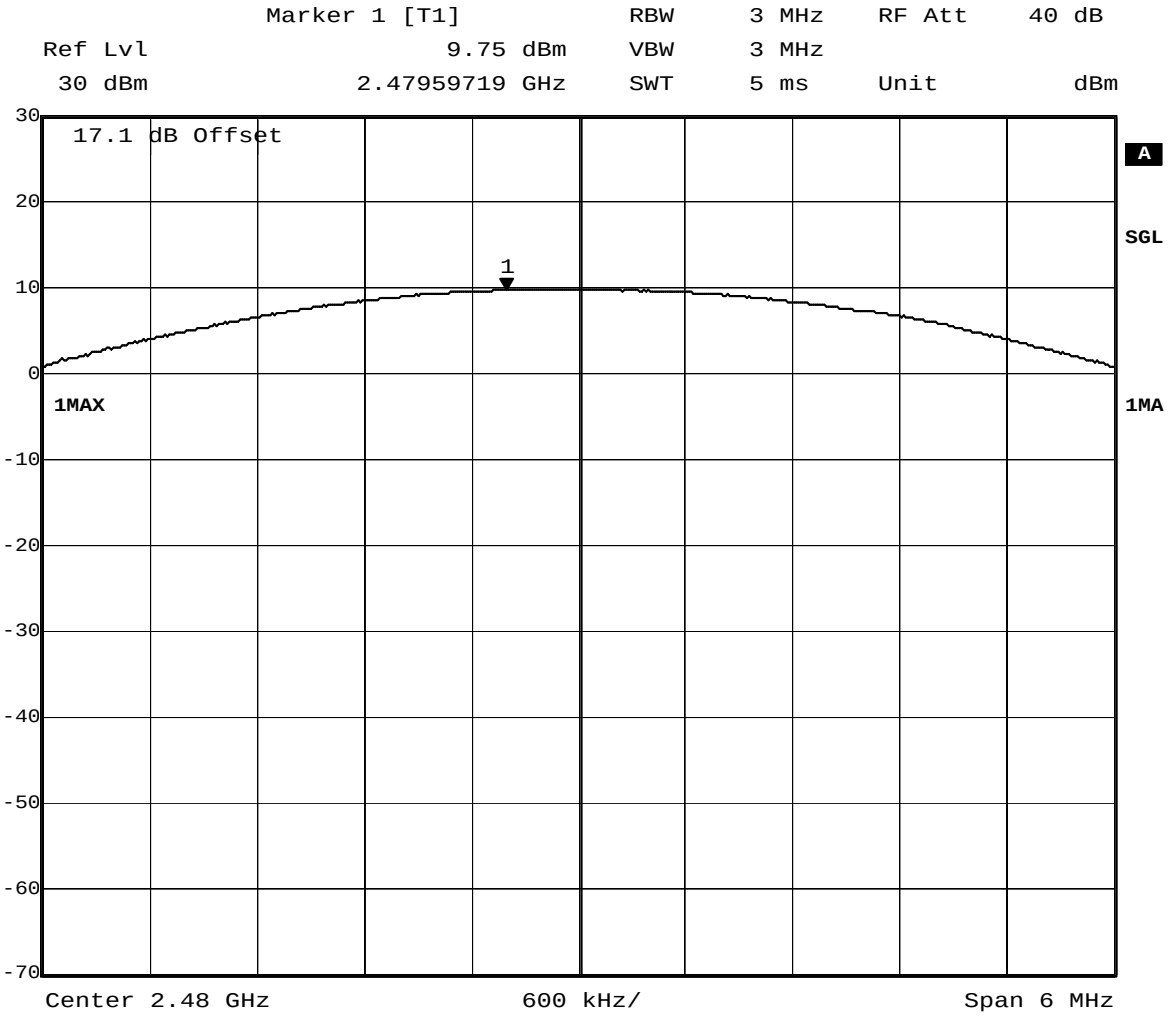
Title: Peak outputpower Power
Comment A: CH M: 2441 MHz
Date: 17.SEP.2014 11:14:48

Test: 15c.4; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 16:53
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
9.75	0.00	9.75



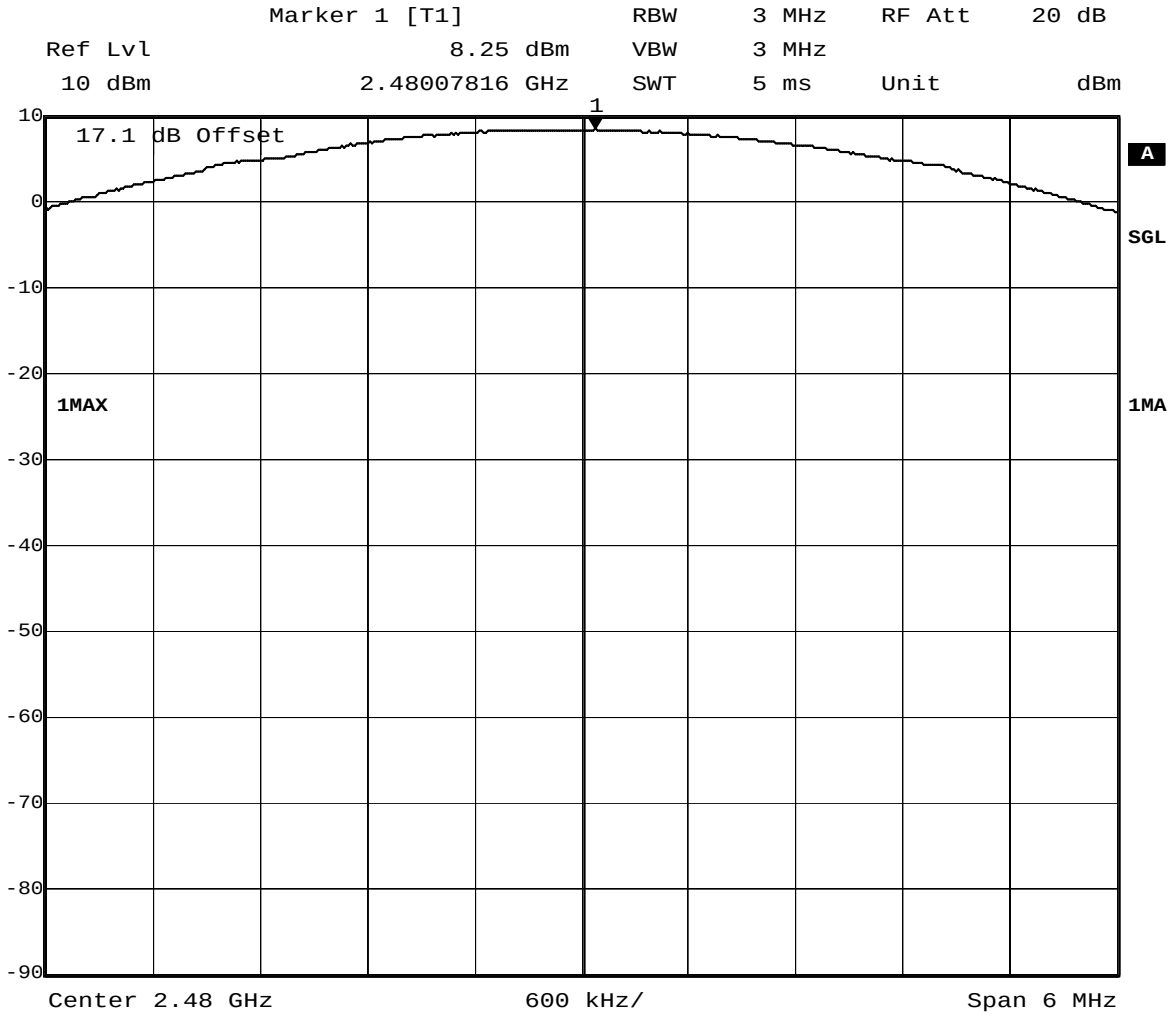
Title: Peak outputpower Power
Comment A: CH T: 2480 MHz
Date: 17.SEP.2014 13:50:56

Test: 15c.4; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:21
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
8.25	0.00	8.25

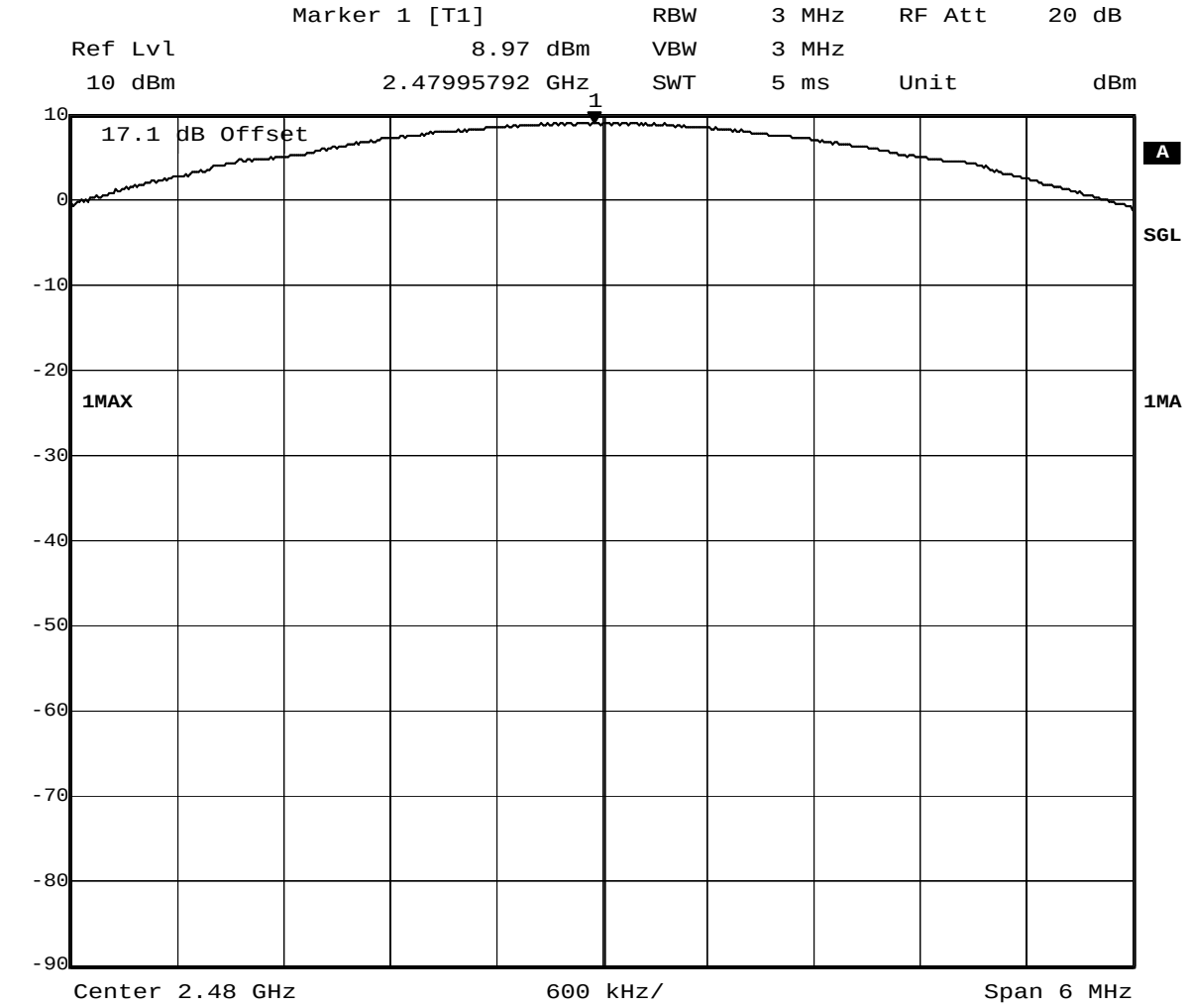


Test: 15c.4; Frequency = 2480, Mode = BT transmit using 3 Mbps with 8DPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:23
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

conducted peak output power value /dBm	Antenna gain / dBi	peak value EIRP /dBm
8.97	0.00	8.97



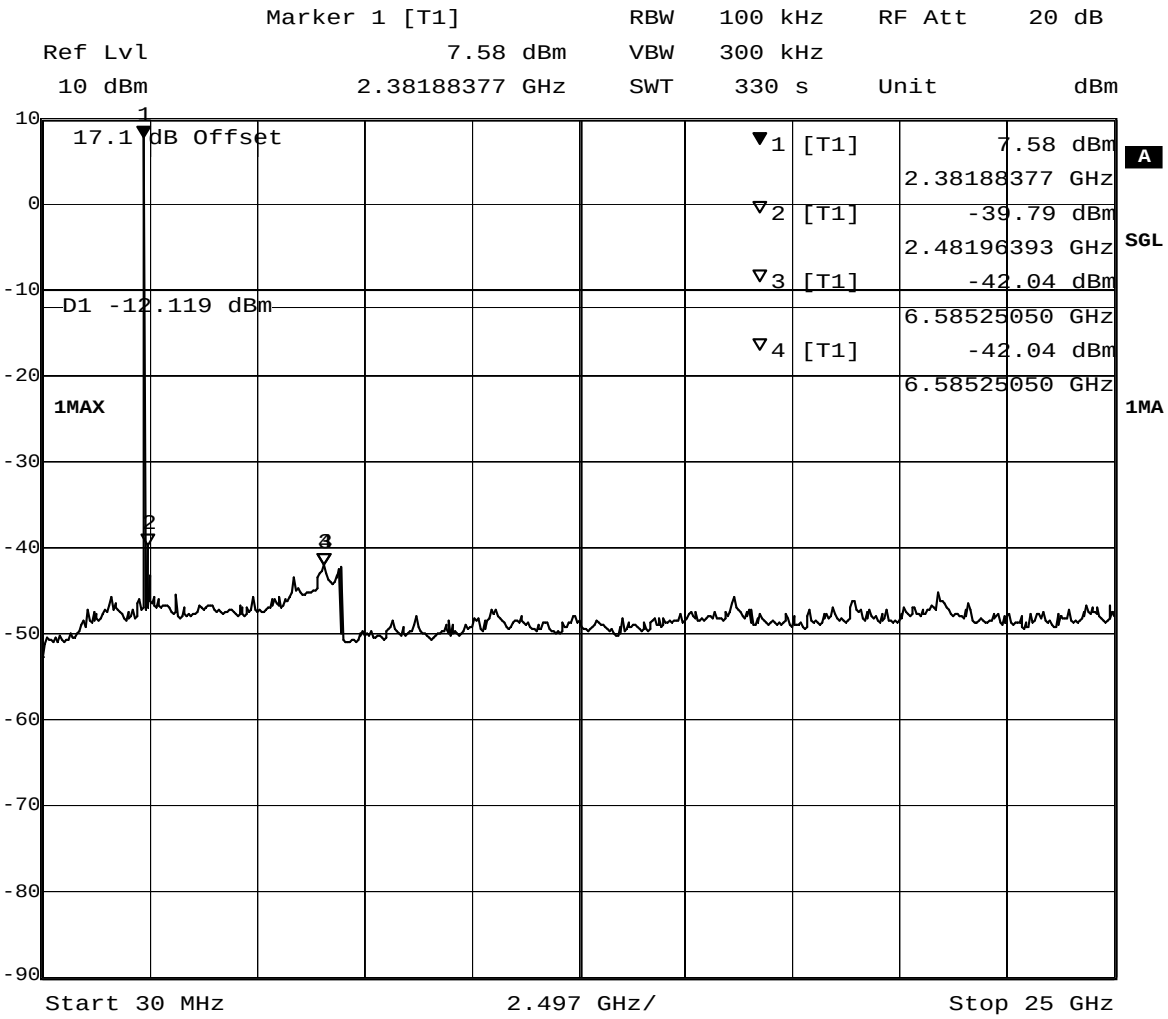
Title: Peak outputpower Power
Comment A: CH T: 2480 MHz
Date: 17.SEP.2014 14:59:07

3.6.5 15c.5 Spurious RF conducted emissions §15.247 (d)

Test: 15c.5; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:25
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:



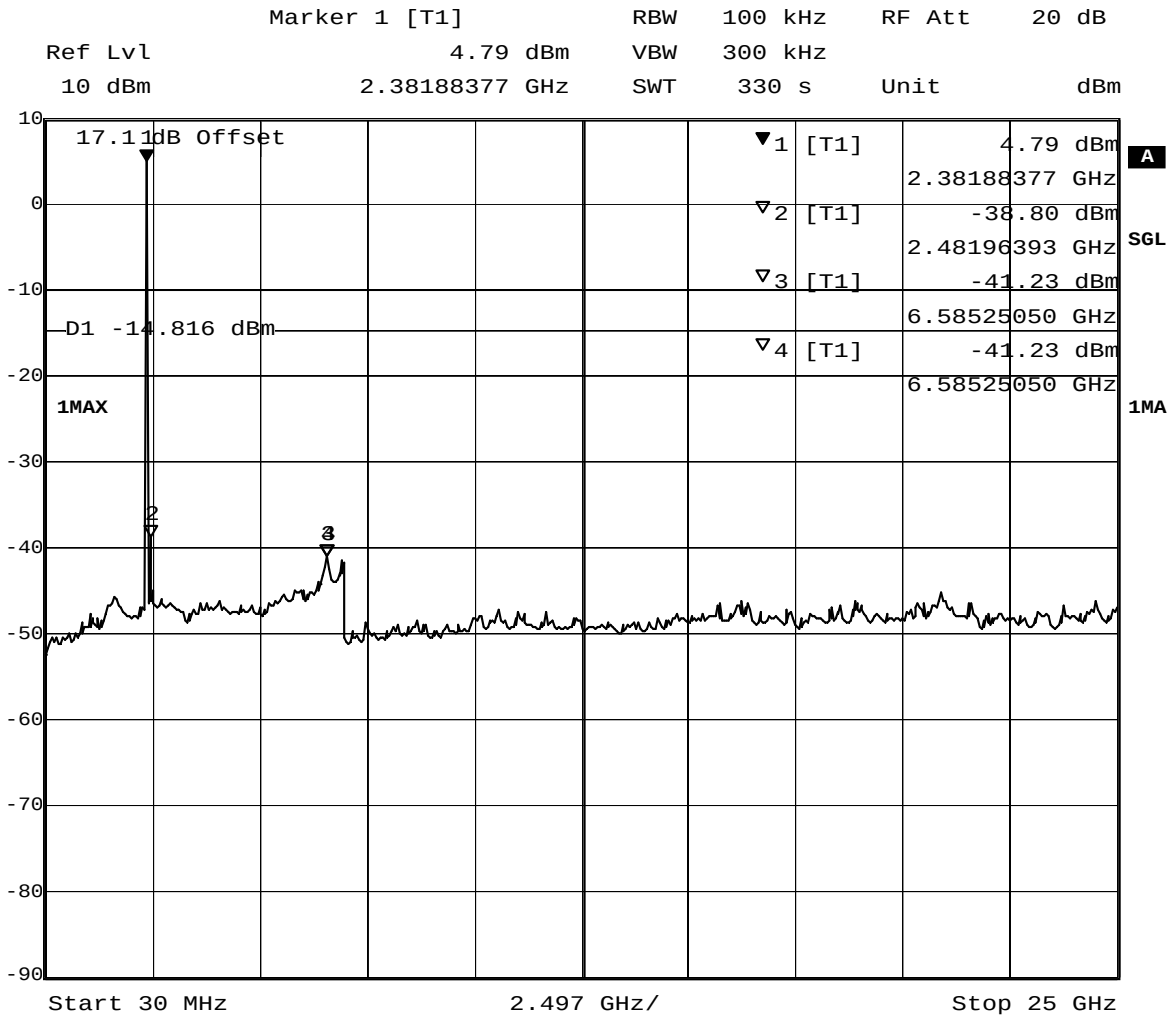

```
Title:      spurious emissions
Comment A:  CH B: 2402 MHz
Date:      17.SEP.2014  09:09:42
```

No futher peaks found within 20 dB of the limit line

Test: 15c.5; Frequency = 2402, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:30
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:



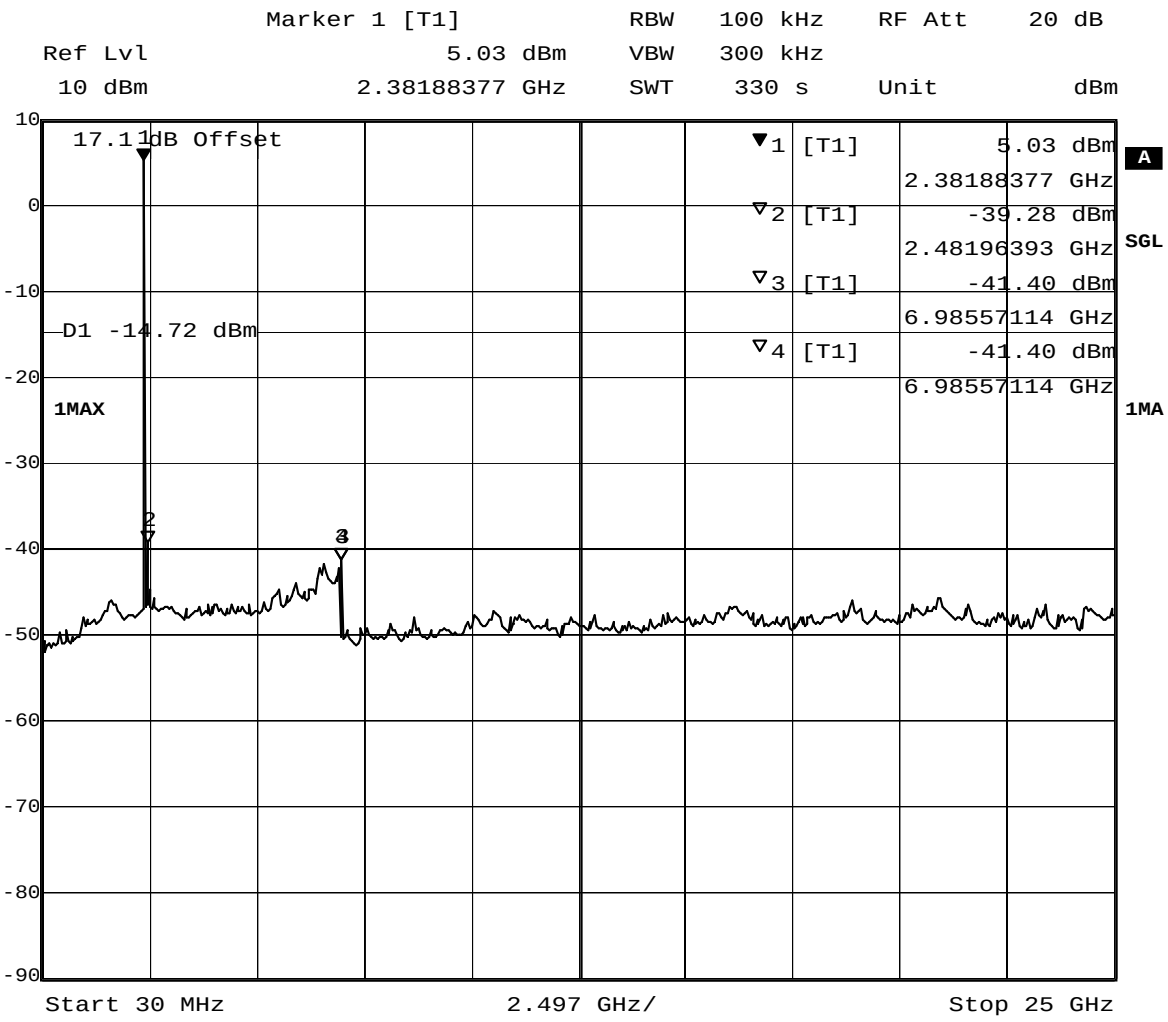
Title: spurious emissions
Comment A: CH B: 2402 MHz
Date: 17.SEP.2014 09:39:20

No futher peaks found within 20 dB of the limit line

Test: 15c.5; Frequency = 2402, Mode = BT transmit using 3 Mbps with 8DPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:32
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:



Title: spurious emissions
Comment A: CH B: 2402 MHz
Date: 17.SEP.2014 10:24:24

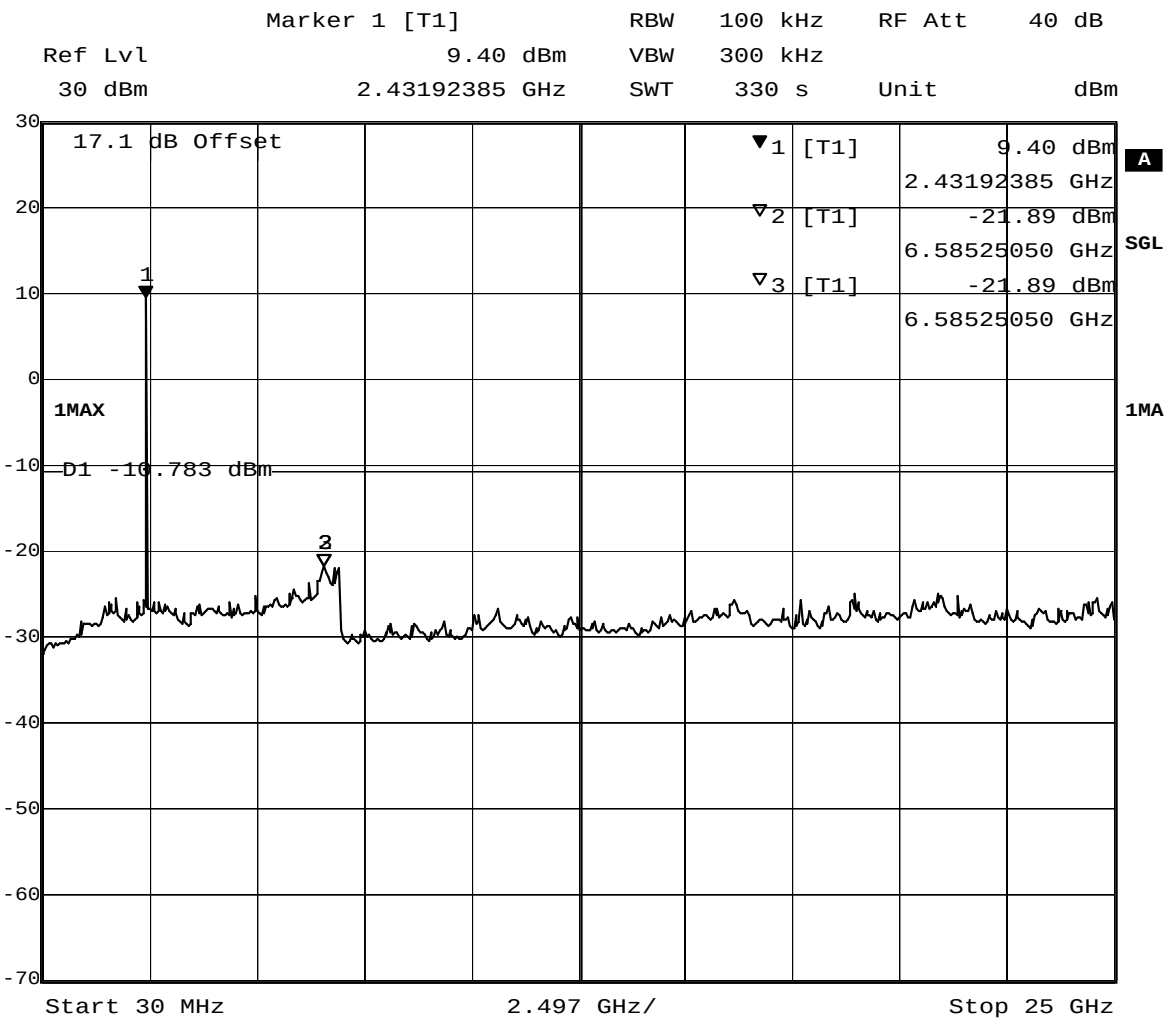
No futher peaks found within 20 dB of the limit line

Test: 15c.5; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:27
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2441		9.22		



Title: spurious emissions
Comment A: CH M: 2441 MHz
Date: 17.SEP.2014 13:44:47

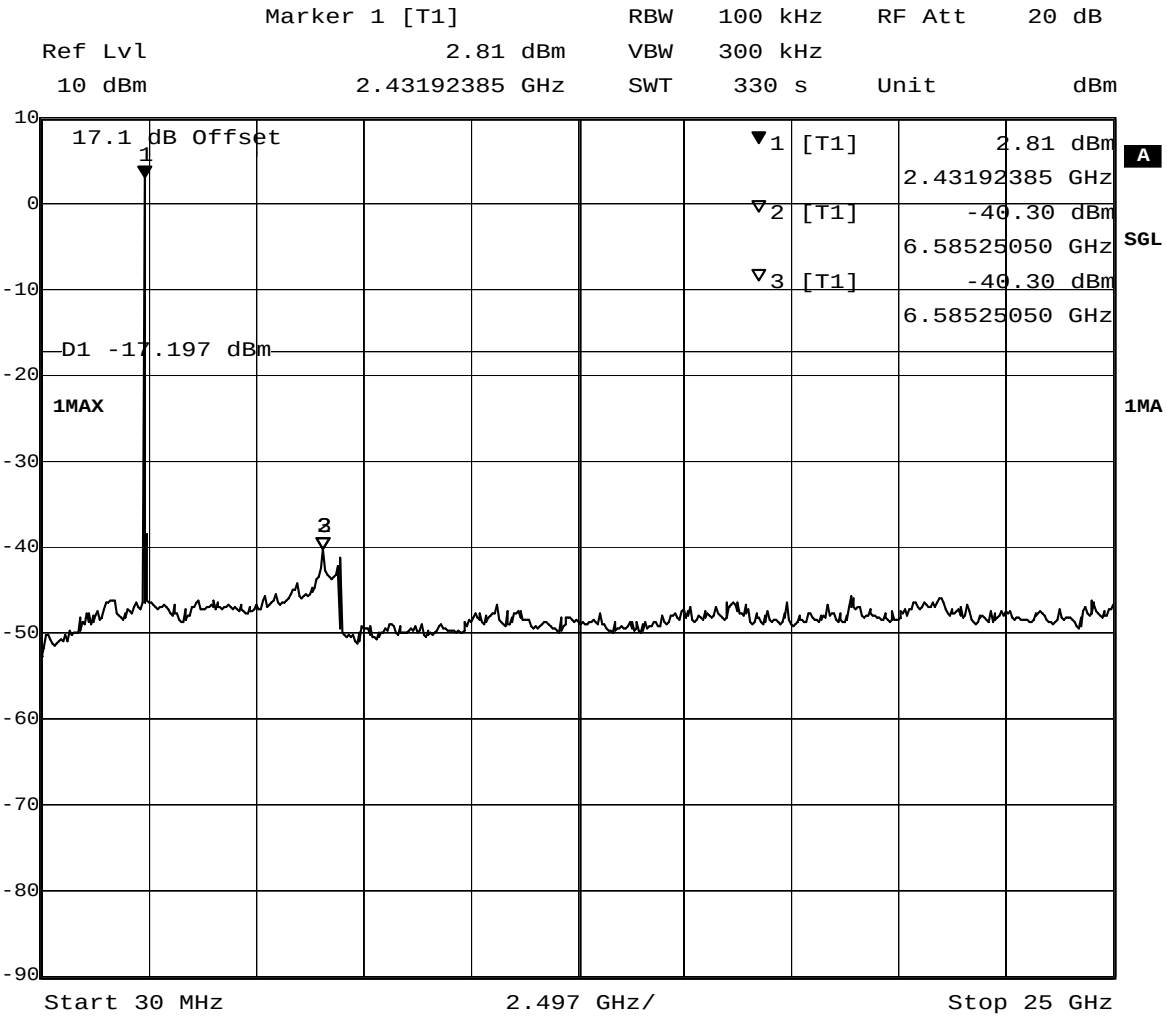
No futher peaks found within 20 dB of the limit line

Test: 15c.5; Frequency = 2441, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:35
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2441		2.80		



Title: spurious emissions
Comment A: CH M: 2441 MHz
Date: 17.SEP.2014 13:19:15

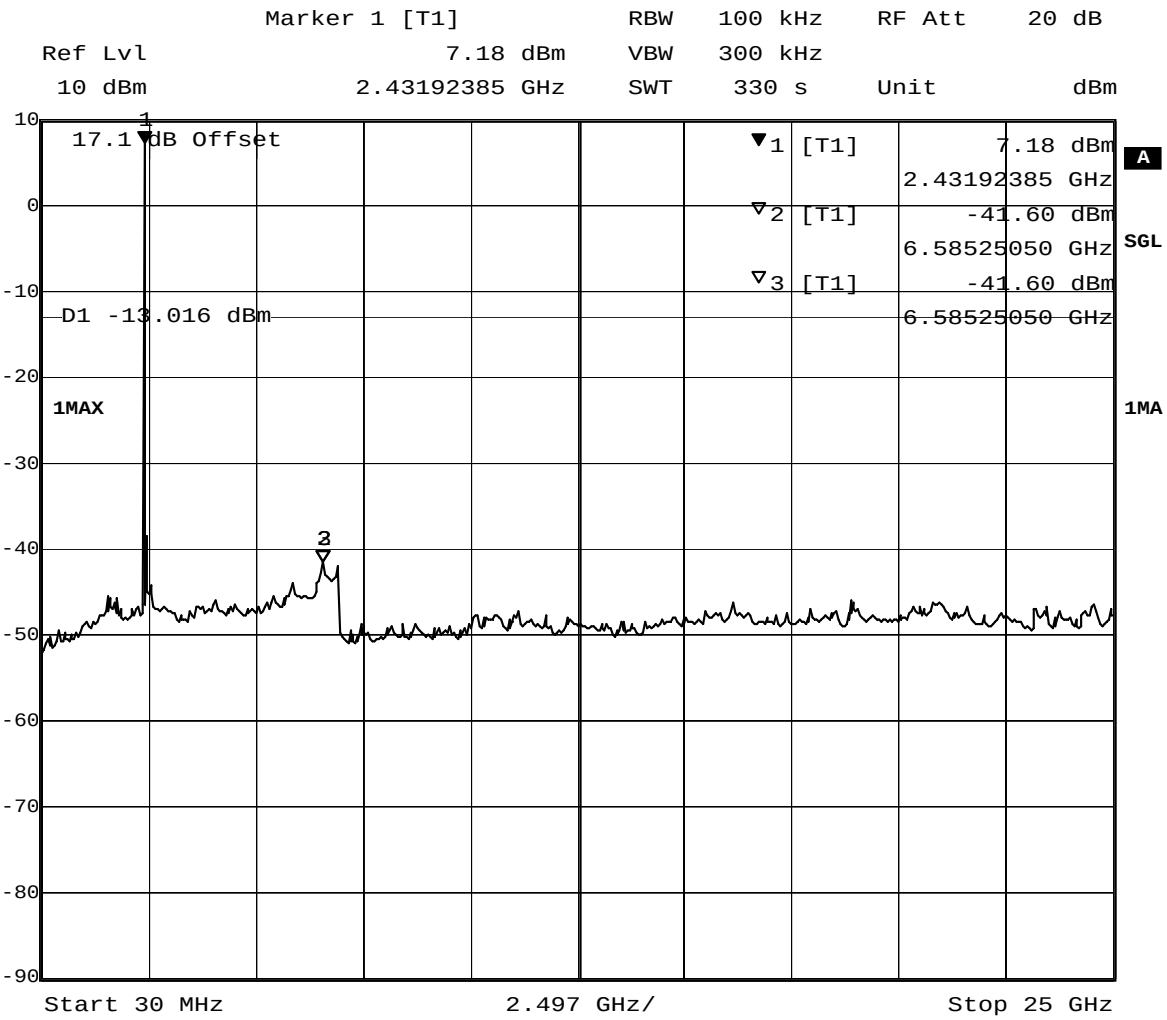
No futher peaks found within 20 dB of the limit line

Test: 15c.5; Frequency = 2441, Mode = BT transmit using 3 Mbps with 8DPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:38
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2441		6.98		



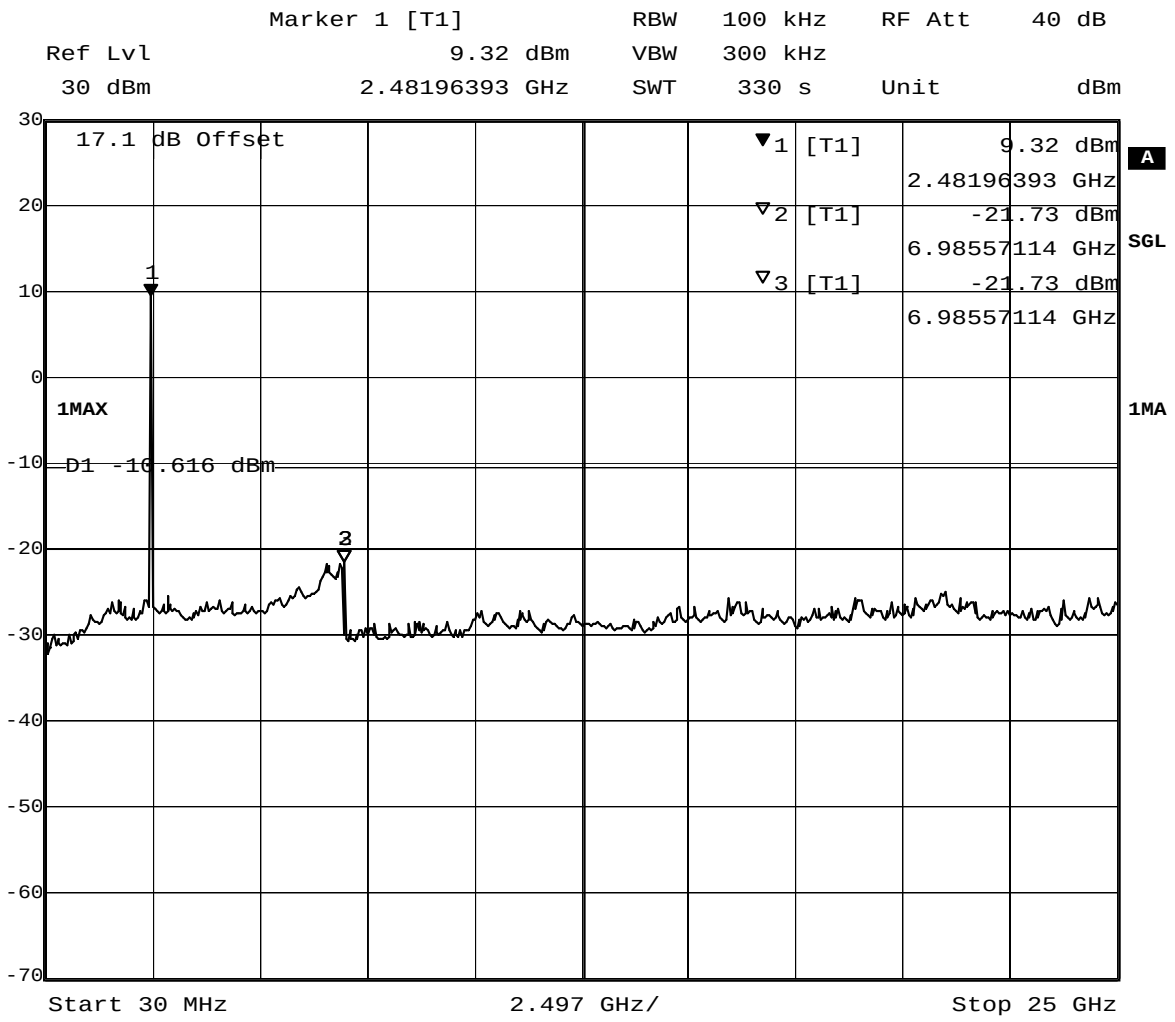
Title: spurious emissions
Comment A: CH M: 2441 MHz
Date: 17.SEP.2014 10:49:27

No futher peaks found within 20 dB of the limit line

Test: 15c.5; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:29
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:



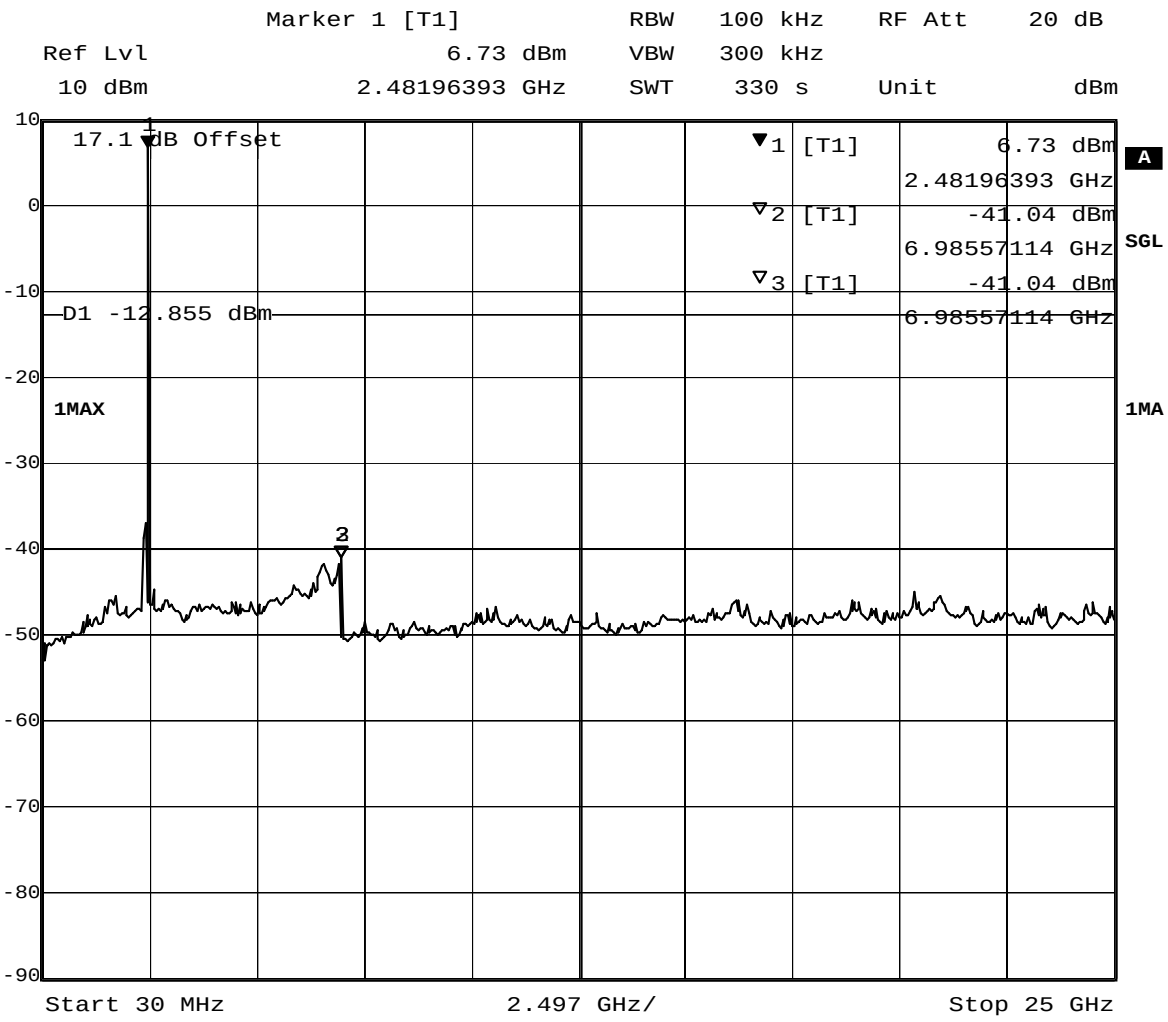
Title: spurious emissions
Comment A: CH T: 2480 MHz
Date: 17.SEP.2014 14:04:42

No futher peaks found within 20 dB of the limit line

Test: 15c.5; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:40
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:



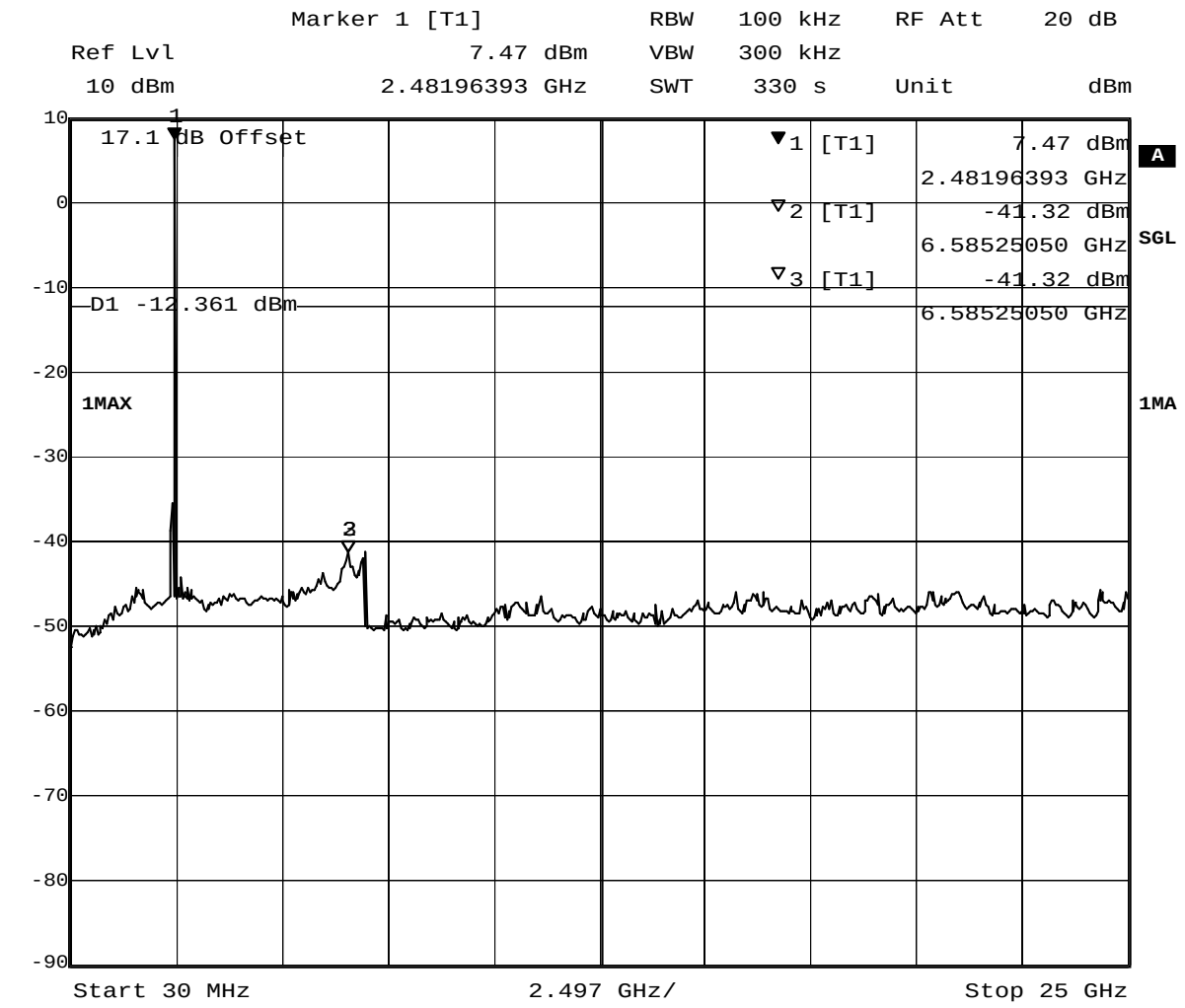
Title: spurious emissions
Comment A: CH T: 2480 MHz
Date: 17.SEP.2014 14:27:35

No futher peaks found within 20 dB of the limit line

Test: 15c.5; Frequency = 2480, Mode = BT transmit using 3 Mbps with 8DPSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:41
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:



Title: spurious emissions
Comment A: CH T: 2480 MHz
Date: 17.SEP.2014 15:50:27

No futher peaks found within 20 dB of the limit line

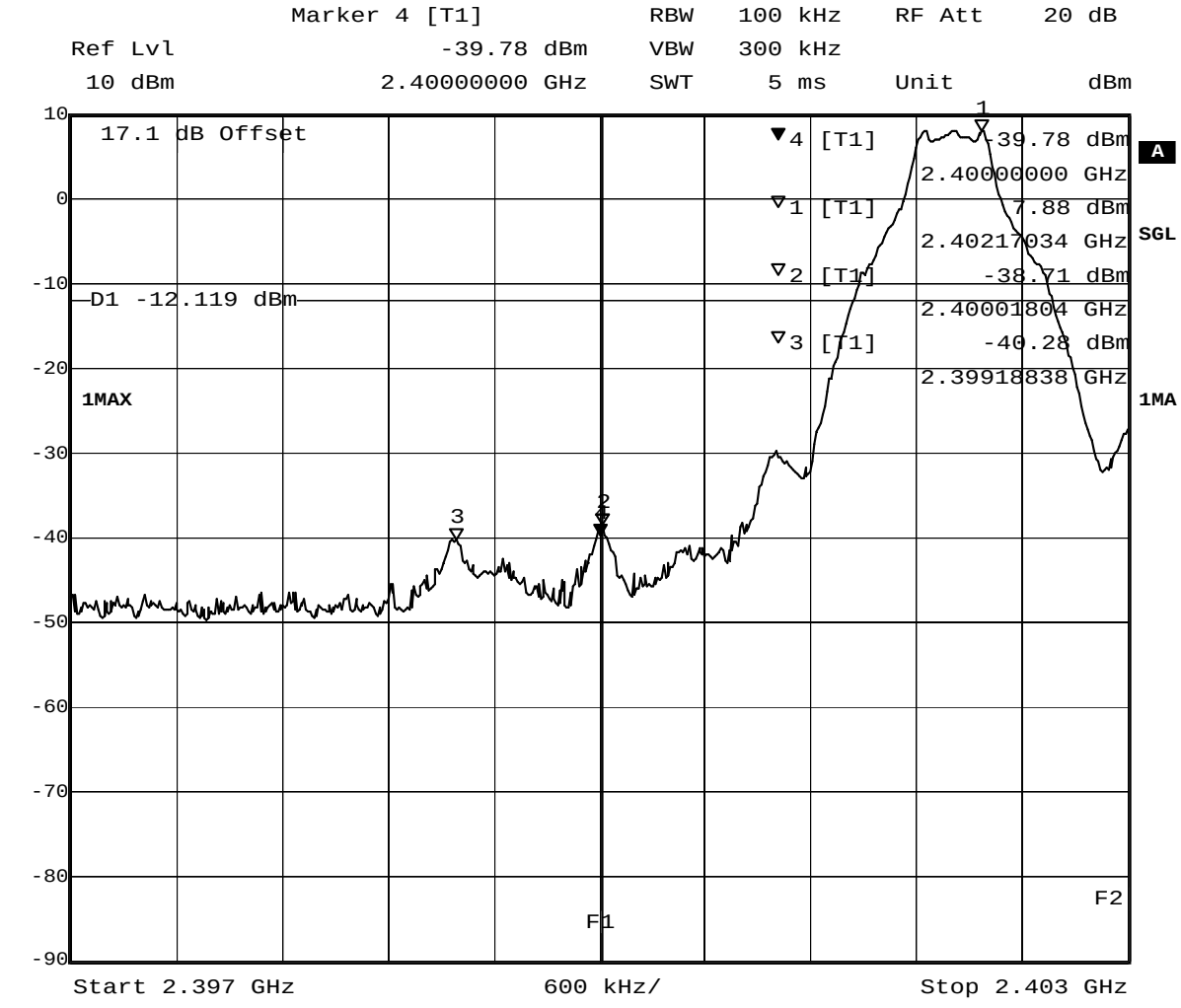
3.6.6 15c.6 Band edge compliance §15.247 (d)

Test: 15c.6; Frequency = 2402, Mode = BT transmit using 1 Mbps with GFSK modulation, Method = conducted, band edge = 2400 MHz

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:47
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2400	-39.78	7.88	-12.12	27.66

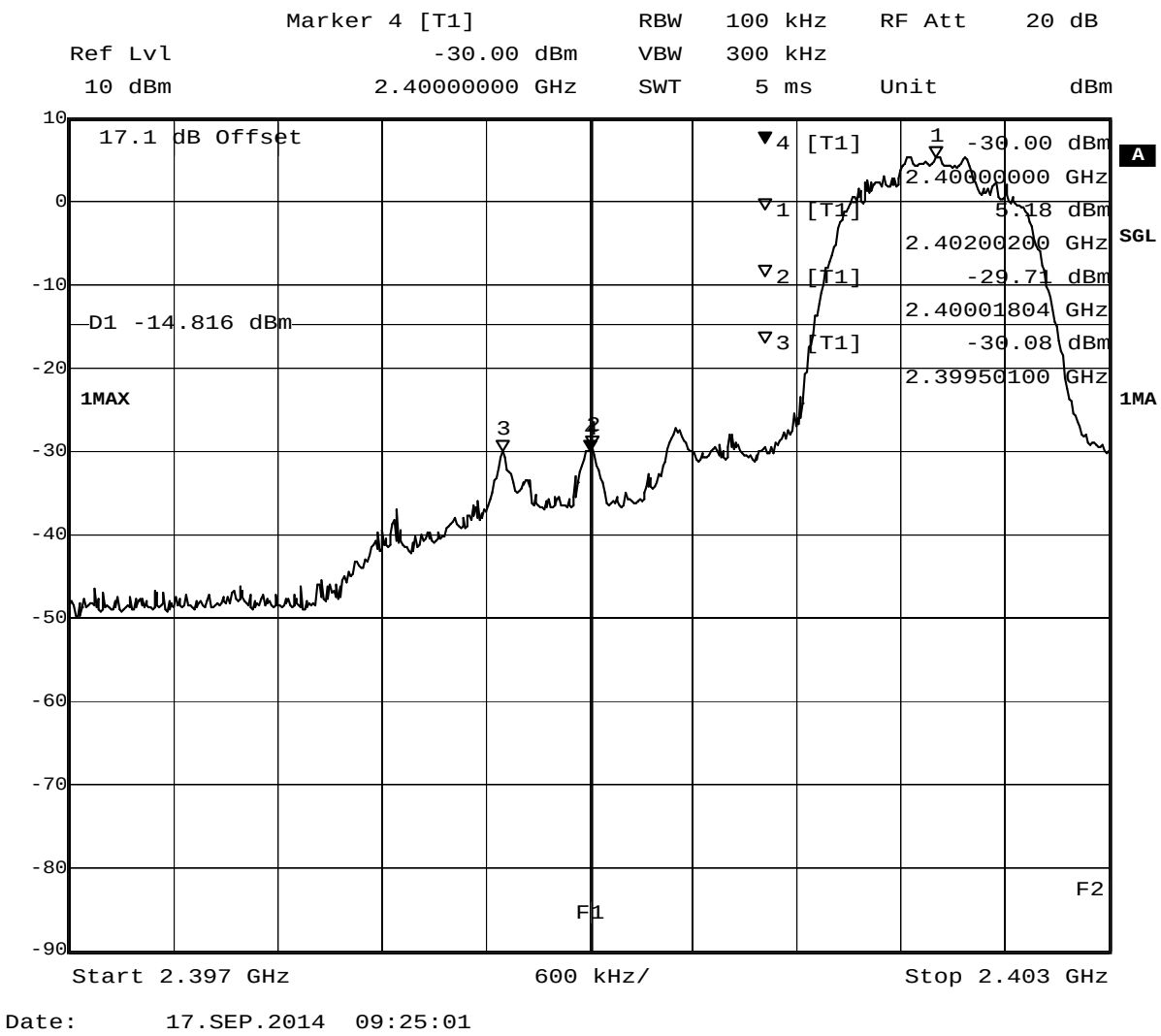


Test: 15c.6; Frequency = 2402, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation, Method = conducted, band edge = 2400 MHz

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:50
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2400	-30.00	5.18	-14.82	15.19

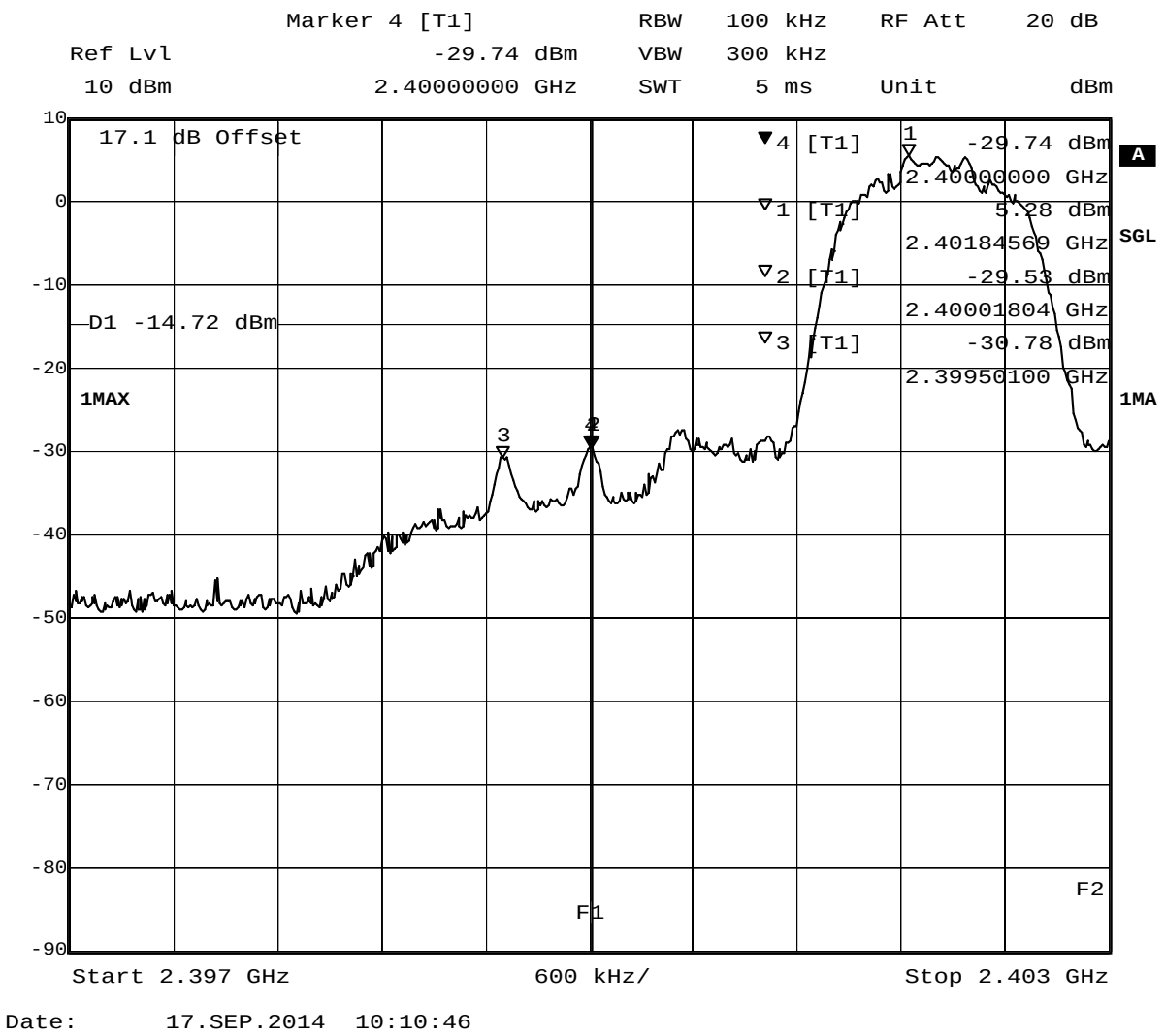


Test: 15c.6; Frequency = 2402, Mode = BT transmit using 3 Mbps with 8DPSK modulation, Method = conducted, band edge = 2400 MHz

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:52
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2400	-29.74	5.28	-14.72	15.02

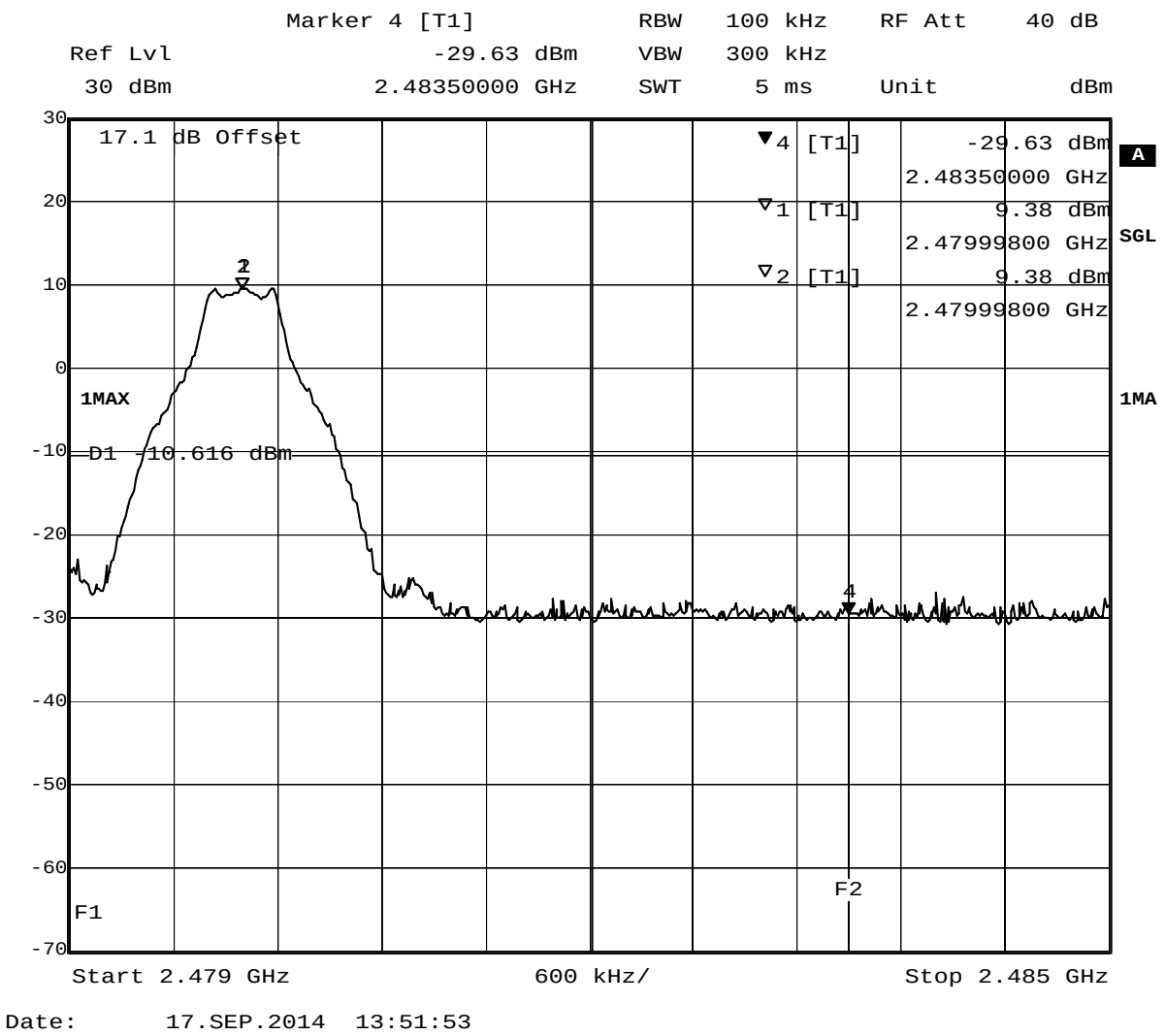


Test: 15c.6; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation, Method = conducted, band edge = 2483.5 MHz

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:48
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2484	-29.63	9.38	-10.62	19.02



Test: 15c.6; Frequency = 2480, Mode = BT transmit using 1 Mbps with GFSK modulation, Method = radiated

Result: Passed

Setup No.: Setup_aa01

Date of Test: 2014/12/12 19:45

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

TX on	Ant. Polar.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	Corrected value PK [dBµV]	Corrected value AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
2480 MHz	Ver + Hor	74	54	2483.5	51.20	37.40	22.80	16.60	Passed

Test: 15c.6; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation, Method = conducted, band edge = 2483.5 MHz

Result: Passed

Setup No.: Setup_ac01

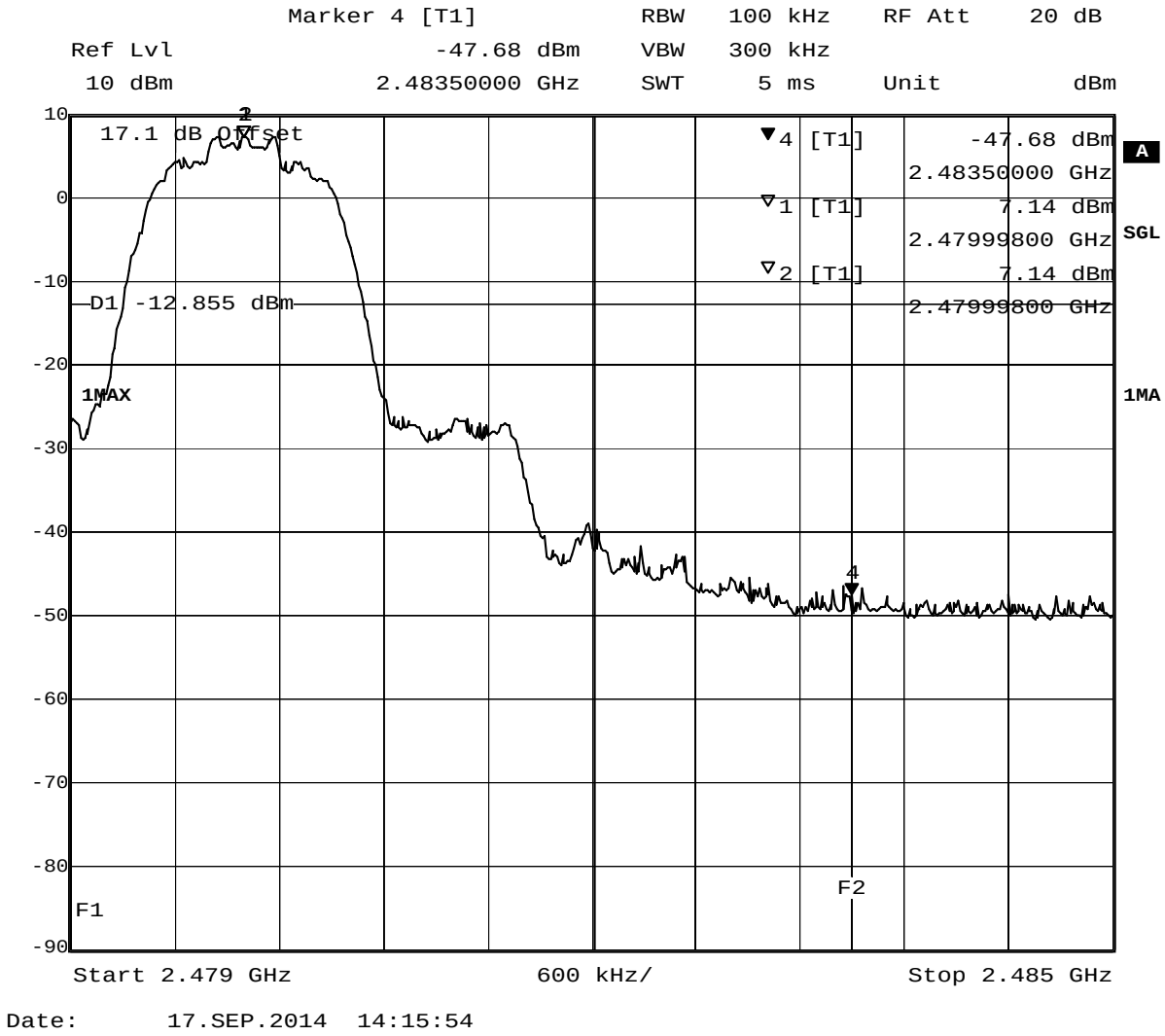
Date of Test: 2014/12/09 17:54

Body: FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES

Test Specification: FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2484	-47.68	7.14	-12.86	34.82



Test: 15c.6; Frequency = 2480, Mode = BT transmit using 2 Mbps with PI/4 DQPSK modulation, Method = radiated

Result:	Passed
Setup No.:	Setup_aa01
Date of Test:	2014/12/12 19:49
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

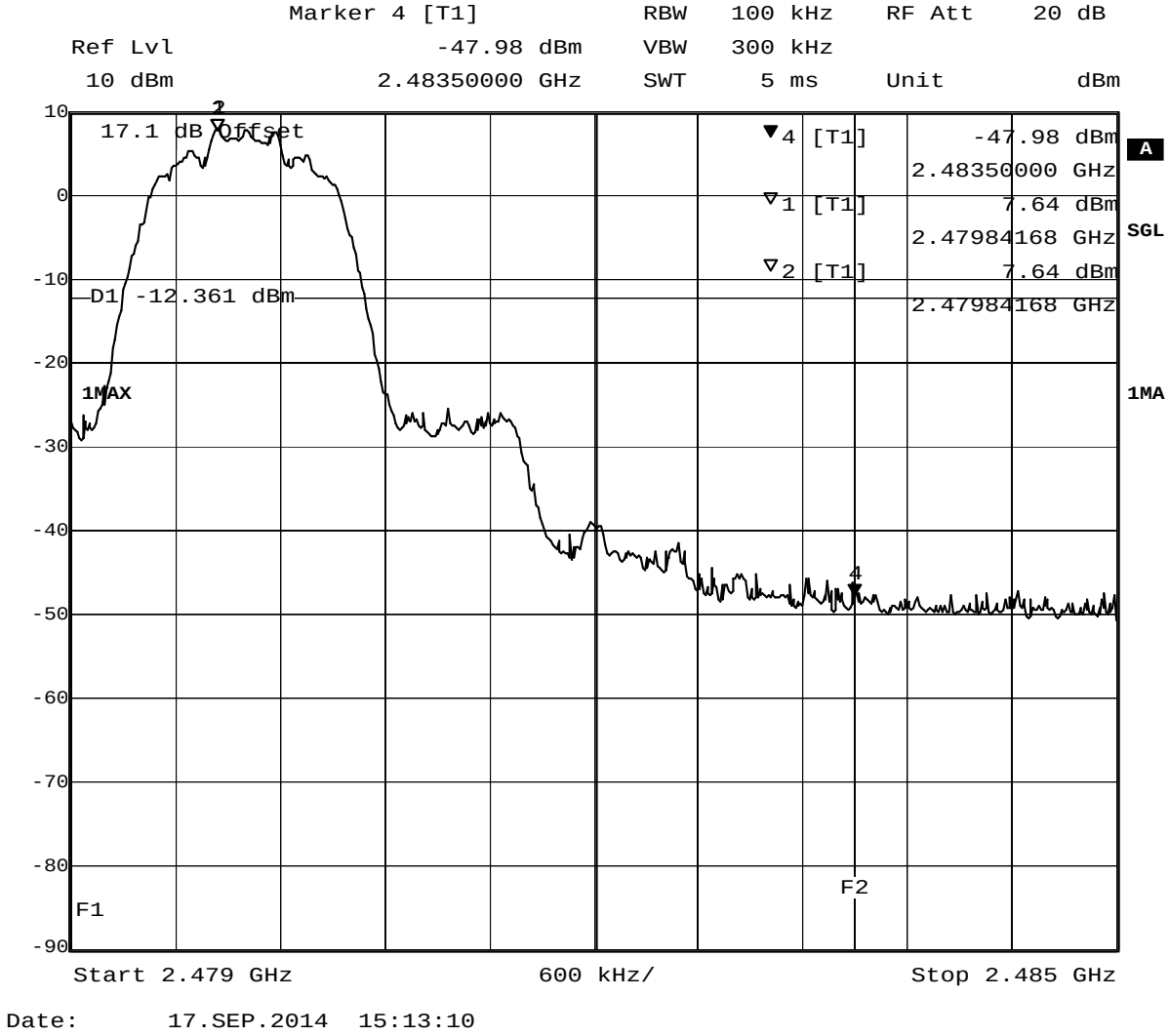
TX on	Ant. Polar.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	Corrected value PK [dBµV]	Corrected value AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
2480 MHz	Ver + Hor	74	54	2483.5	49.10	36.00	24.90	18.00	Passed

Test: 15c.6; Frequency = 2480, Mode = BT transmit using 3 Mbps with 8DPSK modulation, Method = conducted, band edge = 2483.5 MHz

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/02/09 17:56
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Frequency MHz	Measured value dBm	Reference value dBm	Limit dBm	Margin to limit dB
2484	-47.98	7.64	-12.36	35.62



Test: 15c.6; Frequency = 2480, Mode = BT transmit using 3 Mbps with 8DPSK modulation, Method = radiated

Result:	Passed
Setup No.:	Setup_aa01
Date of Test:	2014/12/12 19:50
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

TX on	Ant. Polar.	Limit PK [dBµV]	Limit AV [dBµV]	Frequency [MHz]	Corrected value PK [dBµV]	Corrected value AV [dBµV]	Margin PK [dB]	Margin AV [dB]	Result
2480 MHz	Ver + Hor	74	54	2483.5	49.80	36.80	24.20	17.20	Passed

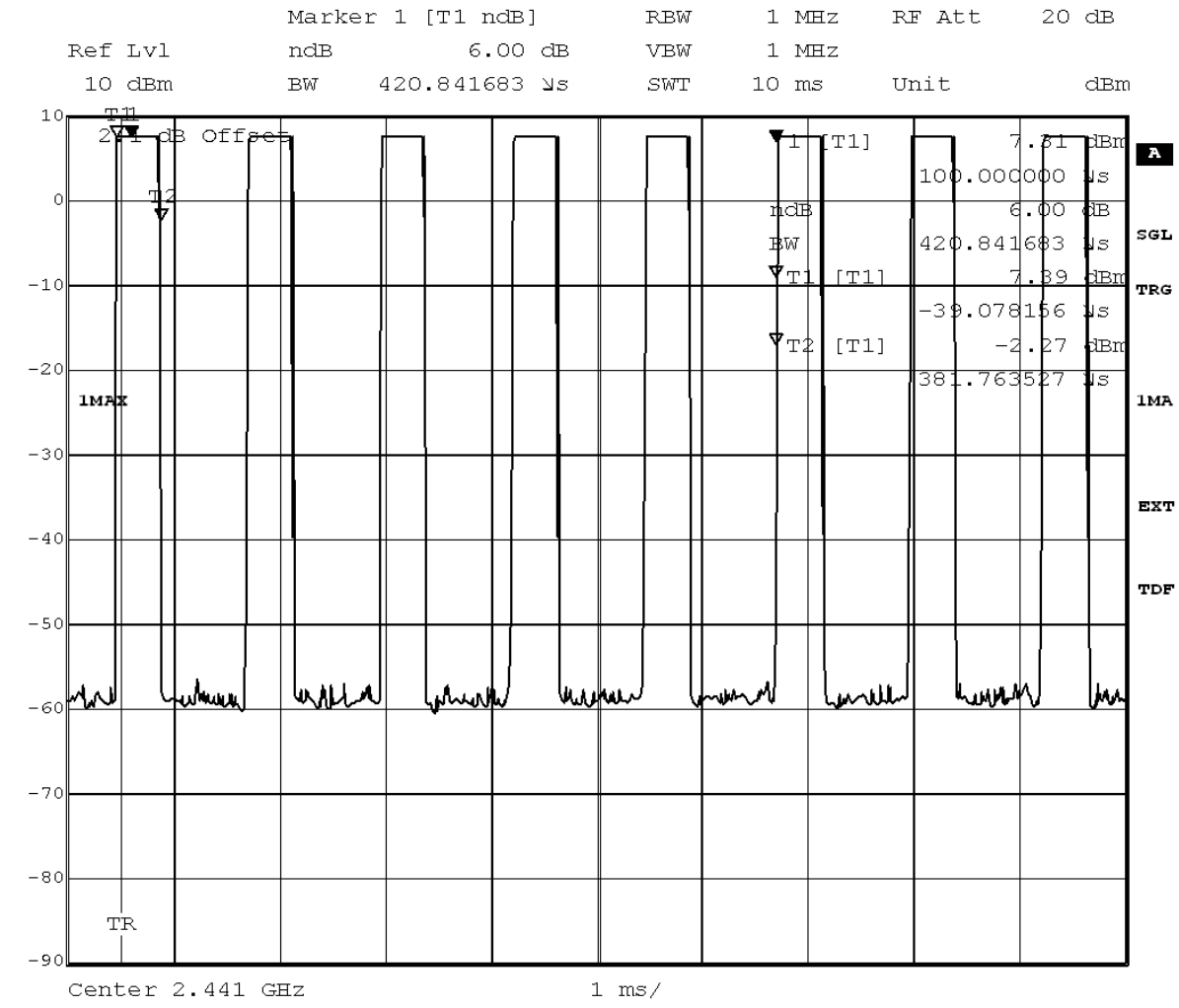
3.6.7 15c.7 Dwell time §15.247 (a) (1) (iii)

Test: 15c.7; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 17:58
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Packet type	Time slot length	Dwell time	Dwell time ms
DH1	0.42	time slot length * 1600/5 /79 * 31.6	53.87



Title: Dwell time
Comment A: CH M: 2441 MHz
Date: 18.SEP.2014 14:13:33

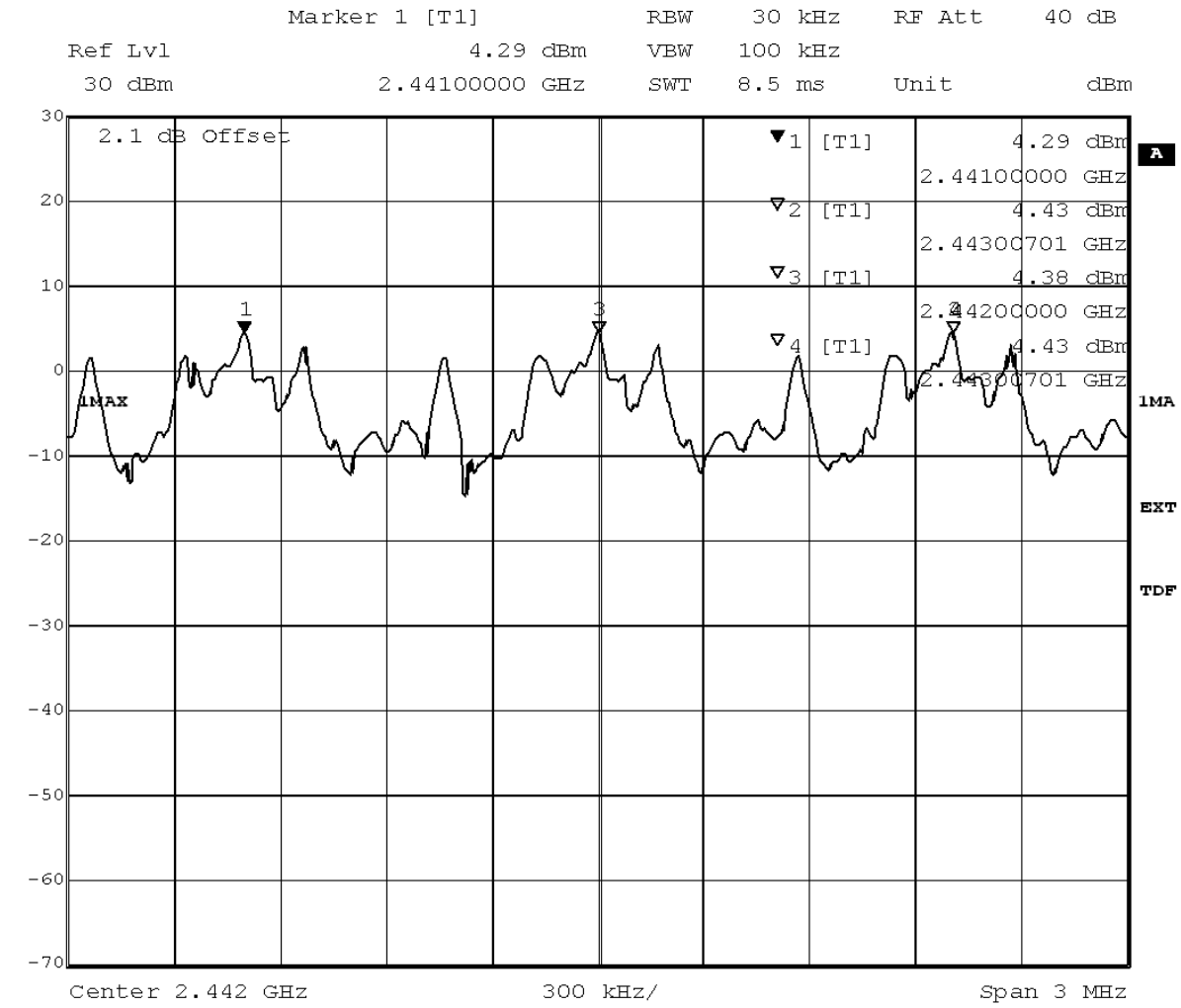
3.6.8 15c.8 Channel separation §15.247 (a) (1)

Test: 15c.8; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 18:00
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Channel separation / MHz
1.000



Title: Channel separation
Comment A: CH H: Hopping
Date: 18.SEP.2014 15:16:03

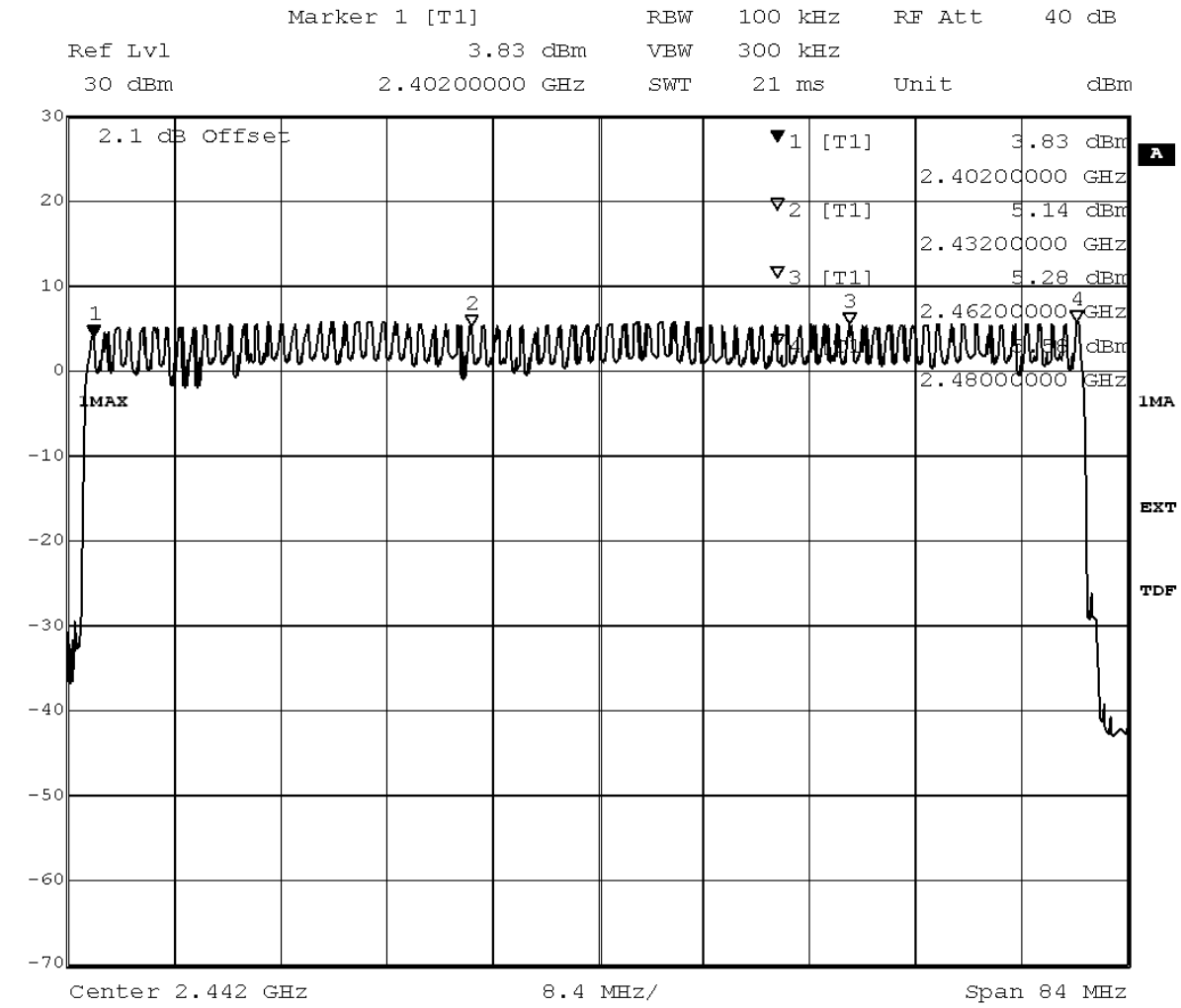
3.6.9 15c.9 Number of hopping frequencies §15.247 (a) (1) (iii)

Test: 15c.9; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation

Result:	Passed
Setup No.:	Setup_ac01
Date of Test:	2014/12/09 18:02
Body:	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

Detailed Results:

Number of Hopping Frequencies
79



Title: Number of hopping frequencies
Comment A: CH H: Hopping
Date: 18.SEP.2014 15:24:10

4 Test Equipment Details

4.1 List of Used Test Equipment

The calibration, hardware and software states are shown for the testing period.

Test Equipment Anechoic Chamber

Lab ID:	**Lab 2**
Manufacturer:	Frankonia
Description:	Anechoic Chamber for radiated testing
Type:	10.58x6.38x6.00 m³

Calibration Details	*Last Execution*	*Next Exec.*
NSA (FCC)	2014/01/09	2017/01/09

Single Devices for Anechoic Chamber

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m³	none	Frankonia
	Calibration Details		*Last Execution* *Next Exec.*
	FCC listing 96716 3m Part15/18		2014/01/09 2017/01/08
Controller Maturo	MCU	961208	Maturo GmbH
EMC camera	CE-CAM/1	-	CE-SYS
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1		Siemens&Matsushita
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita

Test Equipment Auxiliary Equipment for Conducted emissions

Lab ID:	**Lab 1**
Manufacturer:	Rohde & Schwarz GmbH & Co.KG
Description:	EMI Conducted Auxiliary Equipment

Single Devices for Auxiliary Equipment for Conducted emissions

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber&Suhner	
Impedance Stabilization Network	ISN T800	36159	Teseq GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2014/02/06	2016/02/28
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ENY41	100002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/03/01	2015/03/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ST08	36292	Teseq GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2014/01/10	2016/01/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN T8-Cat6	32187	Teseq GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2014/01/08	2016/01/31
One-Line V-Network	ESH 3-Z6	100489	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	standard calibration		2014/06/18	2017/11/30
One-Line V-Network	ESH 3-Z6	100570	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2013/11/25	2016/11/24
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standart Calibration		2013/03/01	2015/02/28
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2013/03/01	2015/02/28

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID: **Lab 2**
Description: Equipment for emission measurements
Serial Number: see single devices

Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Antenna mast	AM 4.0	AM4.0/180/11920513	Maturo GmbH	
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2009/06/04	2014/06/03
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2012/01/18	2015/01/17
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq	
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq	
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq	
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01-2	Kabel Kusch	
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02-2	Rosenberger Micro-Coax	
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2012/05/18	2015/05/17
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2012/06/26	2015/06/25
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic	
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic	
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic	
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright	
Horn Antenna Schwarzbeck 15-26 GHz BBHA 9170	BBHA 9170	BBHA9170262		
Log.-per. Antenna	HL 562 Ultralog	100609	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2012/12/18	2015/12/17
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG	
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	DKD Calibration		2014/11/27	2017/11/27
	Standard calibration		2011/10/27	2014/10/26

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Standard Gain / Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH
Standard Gain / Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5-10kg/024/3790709	Maturo GmbH

Test Equipment Auxiliary Test Equipment

Lab ID:	**Lab 2**
Manufacturer:	see single devices
Description:	Single Devices for various Test Equipment
Type:	various
Serial Number:	none

Single Devices for Auxiliary Test Equipment

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
	Calibration Details		*Last Execution* *Next Exec.*
	Customized calibration		2013/12/04 2015/12/03
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorenwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Signal Analyzer	FSV30	103005	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard		2014/02/10 2016/02/09
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard		2012/06/13 2015/06/12
	DKD calobration		2014/11/24 2017/11/23
Spectrum Analyser	FSU26	200418	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2013/07/29 2014/07/28
	Standard calibration		2014/07/29 2015/07/28
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

Test Equipment Digital Signalling Devices

Lab ID: **Lab 1, Lab 2**
Description: Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Bluetooth Signalling Unit CBT	CBT	100589	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2011/11/24 2014/11/23
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2014/01/27 2016/01/26
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2011/11/28 2014/11/27
	DKD calibration		2014/12/02 2017/12/01
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG
	HW/SW Status		*Date of Start* *Date of End*
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 ---		2007/07/16
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2011/12/07 2014/12/06
	DKD calibration		2014/12/03 2017/12/02
	HW/SW Status		*Date of Start* *Date of End*
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 ---		2007/01/02
	SW: K62, K69		2008/11/03
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG

Test Equipment Emission measurement devices

Lab ID:	**Lab 1, Lab 2**
Description:	Equipment for emission measurements
Serial Number:	see single devices

Single Devices for Emission measurement devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Personal Computer	Dell	30304832059	Dell	
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/05/03	2014/05/02
	Standard calibration		2014/05/13	2015/05/12
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/04/30	2014/04/29
	Standard calibration		2014/05/13	2015/05/12
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	standard calibration		2011/05/12	2014/05/11
	Standard Calibration		2014/06/24	2017/06/23
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2014/01/07	2016/01/31
	HW/SW Status		*Date of Start*	*Date of End*
	Firmware-Update 4.34.4 from 3.45 during calibration		2009/12/03	

Test Equipment Multimeter 12

Lab ID:	**Lab 3**
Description:	Ex-Tech 520
Serial Number:	05157876

Single Devices for Multimeter 12

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Digital Multimeter 12 (Multimeter)	EX520	05157876	Extech Instruments Corp.	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2013/12/04	2015/12/03

Test Equipment Regulatory Bluetooth RF Test Solution

Lab ID:	**Lab 3**
Description:	Regulatory Bluetooth RF Tests
Type:	Bluetooth RF
Serial Number:	001

Single Devices for Regulatory Bluetooth RF Test Solution

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
ADU 200 Relay Box 7	Relay Box	A04380	Ontrak Control Systems Inc.	
Bluetooth Signalling Unit CBT	CBT	100302	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/08/28	2014/08/27
	Standard calibration		2014/08/29	2015/08/28
Power Meter NRVD	NRVD	832025/059		
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/08/26	2014/08/25
	Standard calibration		2014/08/29	2015/08/28
Power Sensor NRV Z1 A	PROBE	832279/013		
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/08/28	2014/08/27
	Standard calibration		2014/08/28	2015/08/27
Power Supply	NGSM 32/10	2725		
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/06/20	2015/06/19
Rubidium Frequency Normal MFS	Datum MFS	002	Datum GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/08/27	2014/08/26
	Standard calibration		2014/08/29	2015/08/28
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG	
Vector Signal Generator SMIQ03B	SMIQ03B	832870/017		
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/06/21	2016/06/20

Test Equipment Shielded Room 02

Lab ID:	**Lab 1**
Manufacturer:	Frankonia
Description:	Shielded Room for conducted testing
Type:	12 qm
Serial Number:	none

Test Equipment Shielded Room 07

Lab ID:	**Lab 3**
Description:	Shielded Room 4m x 6m

Test Equipment T/A Logger 13

Lab ID:	**Lab 1, Lab 2**
Description:	Lufft Opus10 TPR
Type:	Opus10 TPR
Serial Number:	13936

Single Devices for T/A Logger 13

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoAirpressure Datalogger 13 (Environ)	Opus10 TPR (8253.00)	13936	Lufft Mess- und Regeltechnik GmbH

Calibration Details	*Last Execution*	*Next Exec.*
Customized calibration	2013/02/07	2015/02/06

Test Equipment T/H Logger 02

Lab ID:	**Lab 1**
Description:	Lufft Opus10
Serial Number:	7489

Single Devices for T/H Logger 02

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoHygro Datalogger 02 (Environ)	Opus10 THI (8152.00)	7489	Lufft Mess- und Regeltechnik GmbH

Calibration Details	*Last Execution*	*Next Exec.*
Customized calibration	2013/02/07	2015/02/06

Test Equipment T/H Logger 12

Lab ID:	**Lab 2**
Description:	Lufft Opus10
Serial Number:	12482

Single Devices for T/H Logger 12

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoHygro Datalogger 12 (Environ)	Opus10 THI (8152.00)	12482	Lufft Mess- und Regeltechnik GmbH

Calibration Details	*Last Execution*	*Next Exec.*
Customized calibration	2013/01/07	2015/02/24

Test Equipment T/H Logger 15

Lab ID:	**Lab 3**
Description:	Lufft Opus10
Serial Number:	13985

Single Devices for T/H Logger 15

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoHygro Datalogger 15 (Environ)	Opus10 THI (8152.00)	13985	Lufft Mess- und Regeltechnik GmbH

Calibration Details	*Last Execution*	*Next Exec.*
Customized calibration	2013/01/07	2015/02/24

Test Equipment Temperature Chamber 01

Lab ID:	**Lab 3**
Manufacturer:	see single devices
Description:	Temperature Chamber KWP 120/70
Type:	Weiss
Serial Number:	see single devices

Single Devices for Temperature Chamber 01

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Temperature Chamber Weiss 01	KWP 120/70	59226012190010	Weiss Umwelttechnik GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2012/03/12	2014/03/11
	Customized calibration		2014/03/12	2016/03/11

5 Annex

5.1 Additional Information for Report

Summary of Test Results

The EUT complied with all performed tests as listed in the summary section of this report.

Technical Report Summary

Type of Authorization :

Certification for an Intentional Radiator (Frequency Hopping Spread Spectrum).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15. The following subparts are applicable to the results in this test report

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

additional documents

The tests were selected and performed with reference to the FCC Public Notice DA 00-705, released March 30, 2000. Instead of applying ANSI C63.4-1992 which is referenced in the FCC Public Note, the newer ANSI C63.4-2009 is applied.

Description of Methods of Measurements

Conducted emissions (AC power line)

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C 63.4,

Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4.

The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50µH || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads. The measurement procedure consists of two steps. It is implemented into the EMI test software ES-K1 from R&S.

Step 1: Preliminary scan
Intention of this step is, to determine the conducted EMI-profile of the EUT.
EMI receiver settings:
- Detector: Peak - Maxhold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF–Bandwidth: 9 kHz
- Measuring time / Frequency step: 20 ms
- Measurement on phase + neutral lines of the power cords

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2: Final measurement
Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.
EMI receiver settings:
- Detector: Quasi-Peak
- IF - Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:
1) Neutral lead - reference ground (PE grounded)
2) Phase lead - reference ground (PE grounded)
3) Neutral lead - reference ground (PE floating)
4) Phase lead - reference ground (PE floating)

The highest value is reported.

Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

Frequency Range (MHz)	QP Limit (dBµV)	AV Limit (dBµV)
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

Used conversion factor: Limit (dBµV) = 20 log (Limit (µV)/1µV).

Occupied bandwidth

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

Test Description

The Equipment Under Test (EUT) was setup to perform the occupied bandwidth measurements.
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.
The results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth. The resolution bandwidth for measuring the reference level and the occupied bandwidth was 30 kHz.
The EUT was connected to the spectrum analyzer via a short coax cable.

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1)
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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Implication by the test laboratory:
Since the Bluetooth technology defines a fixed channel separation of 1 MHz this design parameter defines the maximum allowed occupied bandwidth depending on the EUT's output power:
1. Under the provision that the system operates with an output power not greater than 125 mW (21.0 dBm) : Implicit Limit: Max. 20 dB BW = 1.0 MHz / 2/3 = 1.5 MHz
2. If the system output power exceeds 125 mW (21.0 dBm): Implicit Limit: Max. 20 dB BW = 1.0 MHz

Used conversion factor: Output power (dBm) = 10 log (Output power (W) / 1mW)

The measured output power of the system is below 125 mW (21.0 dBm). For the results, please refer to the related chapter of this report. Therefore the limit is determined as 1.5 MHz.

Peak power output

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

Test Description

The Equipment Under Test (EUT) was set up to perform the output power measurements. The resolution bandwidth for measuring the output power was set to 3 MHz. The reference level of the spectrum analyzer was set higher than the output power of the EUT. The EUT was connected to the spectrum analyzer via a short coax cable with a known loss.

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (b) (1)
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW)
==> Maximum Output Power: 30 dBm

Spurious RF conducted emissions

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

Test Description

The Equipment Under Test (EUT) was set up to perform the spurious emissions measurements.
The EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:
- Detector: Peak-Maxhold
- Frequency range: 30 – 25000 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: 330 s
The reference value for the measurement of the spurious RF conducted emissions is determined during the

test "band edge compliance" (cf. chapter 3.6). This value is used to calculate the 20 dBc limit.

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (c)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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

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Spurious radiated emissions

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C 63.4,

Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4–2009.
The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.
The test was performed at the distance of 3 m between the EUT and the receiving antenna. The measurement procedure is implemented into the EMI test software ES-K1 from R&S. The radiated emissions measurements were made in a typical installation configuration. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is performed at 2 axes. A pre-check is also performed while the EUT is powered from both AC and DC (battery) power in order to find the worst-case operating condition.

1. Measurement up to 30 MHz
The test set-up was made in accordance to the general provisions of ANSI C63.4.
The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.
The radiated emissions measurements were made in a typical installation configuration.
The measurement procedure is implemented into the EMI test software ES-K1 from R&S.
The Loop antenna HFH2-Z2 is used.
Step 1: pre-measurement
- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 – 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF–Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.
Step 2: final measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.
- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 200 Hz – 10 kHz
- Measuring time / Frequency step: 100 ms

2. Measurement above 30 MHz and up to 1 GHz
Step 1: Preliminary scan
Preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 µs (BT Timing 1.25 ms)
- Turntable angle range: –180 to +180°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.
Step 2: second measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: –180 to +180°
- Turntable step size: 45°
- Height variation range: 1 – 4 m
- Height variation step size: 0.5 m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):
- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:
- Azimuth value (of turntable): 45°
- Antenna height: 0.5 m

Step 3: final measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will be slowly varied by +/–22.5° around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by +/–25 cm around the antenna height determined. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: –22.5° to +22.5° around the determined value
- Height variation range: –0.25 m to +0.25 m around the determined value

Step 4: final measurement with QP detector
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

3. Measurement above 1 GHz
The following modifications apply to the measurement procedure for the frequency range above 1 GHz:
The measurement distance was reduced to 1 m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements, inverse linear-distance squared for the power reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18–25 GHz) are used, the steps 2–4 are omitted.
Step 1 was performed with one height of the receiving antenna only.
EMI receiver settings:
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.
For the enhanced data rate packets the test is performed as worst-case-check in order to verify that emissions have a comparable level as found at basic data rate. Typically, the measurement for these packets is performed in the frequency range 1 to 8 GHz but it depends on the emissions found during the test for the basic data rate. Please refer to the results for the used frequency range.

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)
... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit(dBµV/m @10m)
0.009 – 0.49	2400/F(kHz)	300	Limit (dBµV/m)+30dB
0.49 – 1.705	24000/F(kHz)	30	Limit (dBµV/m)+10dB
1.705 - 30	30	30	Limit (dBµV/m)+10dB

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
30 - 88	100	3	40.0
88 - 216	150	3	43.5
216 - 960	200	3	46.0
above 960	500	3	54.0

§15.35(b)
..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

Band edge compliance

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C 63.4, FCC §15.31

Test Description

The procedure to show compliance with the band edge requirement is divided into two measurements: 1. Show compliance of the lower band edge by a conducted measurement and 2. show compliance of the higher band edge by a radiated and conducted measurement.

For the first measurement the EUT is set to transmit on the lowest channel (2402 MHz). The lower band edge is 2400 MHz.
Analyzer settings:
- Detector: Peak
- RBW= 100 kHz
- VBW= 300 kHz

For the second measurement the EUT is set to transmit on the highest channel (2480 MHz). The higher band edge is 2483.5 MHz.
Analyzer settings for conducted measurement:
- Detector: Peak
- RBW= 100 kHz
- VBW= 300 kHz
EMI receiver settings:
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

Test Requirements / Limits

FCC Part 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c))."

For the measurement of the lower band edge the RF power at the band edge 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..."

For the measurement of the higher band edge the limit is "specified in Section 15.209(a)".

Dwell time

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

Test Description

The Equipment Under Test (EUT) was set up to perform the dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

Dwell time = time slot length * hop rate / number of hopping channels * 31.6 s

with:
- hop rate = 1600 * 1/s for DH1 packets = 1600 s-1
- hop rate = 1600/3 * 1/s for DH3 packets = 533.33 s-1
- hop rate = 1600/5 * 1/s for DH5 packets = 320 s-1
- number of hopping channels = 79
- 31.6 s = 0.4 seconds multiplied by the number of hopping channels = 0.4 s * 79

The highest value of the dwell time is reported.

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1) (iii)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. 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. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6 seconds.

Channel separation

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

Test Description

The Equipment Under Test (EUT) was set up to perform the channel separation measurements. The channel separation is independent from the modulation pattern.
The EUT was connected to spectrum analyzer via a short coax cable.
Analyzer settings:
- Detector: Peak-Maxhold
- Span: 3 MHz
- Centre Frequency: a mid frequency of the 2.4 GHz ISM band
- Resolution Bandwidth (RBW): 30 kHz
- Video Bandwidth (VBW): 100 kHz
- Sweep Time: Coupled

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1)
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. The system shall hop to

channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Number of hopping frequencies

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

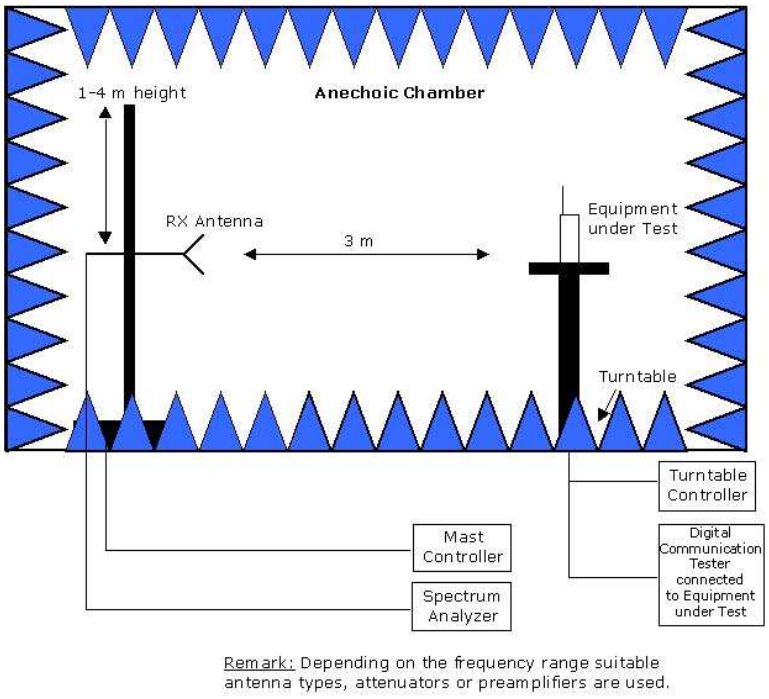
Test Description

The Equipment Under Test (EUT) was set up to perform the number of hopping frequencies measurement.
The number of hopping frequencies is independent from the modulation pattern.
The EUT was connected to spectrum analyzer via a short coax cable.
Analyzer settings:
- Detector: Peak-Maxhold
- Centre frequency: 2442 MHz
- Frequency span: 84 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: Coupled

Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (iii)
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Setup Drawings



Remark: Depending on the frequency range suitable antenna types, attenuators or preamplifiers are used.

Setup in the Anechoic chamber:
Measurements below 1 GHz: Semi-anechoic, conducting ground plane.
Measurements above 1 GHz: Fully-anechoic, absorbers on all surfaces

November, 2014

To Whom This May Concern

Correlation of measurement requirements for FHSS (e.g. Bluetooth®) equipment from FCC and IC

FHSS equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 4: 8.8
Occupied bandwidth	§ 15.247 (a) (1)	RSS-210 Issue 8: A8.1 (b)
Peak conducted output power	§ 15.247 (b) (1), (4)	RSS-210 Issue 8: A8.4 (2)
Transmitter spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen Issue 4: 6.13/8.9/8.10; RSS-210 Issue 8: A8.5
Transmitter spurious radiated emissions	§ 15.247 (d); § 15.209 (a)	RSS-Gen Issue 4: 6.13 / 8.9/8.10; RSS-210 Issue 8: A8.5
Band edge compliance	§ 15.247 (d)	RSS-210 Issue 8: A8.5
Dwell time	§ 15.247 (a) (1) (iii)	RSS-210 Issue 8: A8.1 (d)
Channel separation	§ 15.247 (a) (1)	RSS-210 Issue 8: A8.1 (b)
No. of hopping frequencies	§ 15.247 (a) (1) (iii)	RSS-210 Issue 8: A8.1 (d)
Hybrid systems (only)	§ 15.247 (f); § 15.247 (e)	RSS-210 Issue 8: A8.3
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 4: 8.3
Receiver spurious emissions	–	RSS-210 Issue 8: 2.3; RSS Gen Issue 4: 5 / 7 *)

*) Receivers are exempted from certification besides if operating in stand-alone mode in the frequency range 30–960 MHz or if these are scanner receivers.

6 Index