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FCC TEST REPORT

FCC 47 CFR Part 15C
Industry Canada RSS-247

Frequency hopping systems operating within the 2400 – 2483.5 MHz band

Report Reference No. ..... :	G0M-1507-4918-TFC247BT-V01
Testing Laboratory ..... :	Eurofins Product Service GmbH
Address ..... :	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation ..... :	A2LA Accredited Testing Laboratory, Certificate No.: 1983.01 FCC Filed Test Laboratory, Reg.-No.: 96970 IC OATS Filing assigned code: 3470A
Applicant's name ..... :	ABB Oy, Drives and Controls
Address ..... :	Hiomotie 13 00380 Helsinki FINLAND
Test specification:	
Standard..... :	47 CFR Part 15C RSS-247, Issue 1, 2015-05 RSS-Gen, Issue 4, 2014-11 ANSI C63.10:2013 ANSI C63.4:2014
Test scope…….. ..... :	complete Radio compliance test
Equipment under test (EUT):	
Product description	Assistant control panel with Bluetooth interface
Model No.	ACS-AP-W
Additional Model(s)	ACH-AP-W
Brand Name(s)	ABB
Hardware version	C
Firmware / Software version	v 4.90
	FCC-ID: 2AFNGAPWSERIES IC: 20555-APWSERIES
Test result	**Passed**

Possible test case verdicts:	
- neither assessed nor tested ..... :	N/N
- required by standard but not appl. to test object ..... :	N/A
- required by standard but not tested ..... :	N/T
- not required by standard for the test object ..... :	N/R
- test object does meet the requirement ..... :	P (Pass)
- test object does not meet the requirement ..... :	F (Fail)

Testing:		
Test Lab Temperature ..... :	20 – 23 °C	
Test Lab Humidity ..... :	32 – 38 %	
Date of receipt of test item ..... :	2015-06-24	
Date (s) of performance of tests ..... :	2015-07-16 – 2015-07-24	
Compiled by ..... :	Wilfried Treffke	
Tested by (+ signature) ..... : (Responsible for Test)	Wilfried Treffke	W. Treffke
Approved by (+ signature) ..... : (Head of Lab)	Christian Weber	C. Weber
Date of issue ..... :	2015-10-23	
Total number of pages ..... :	79	

General remarks:

The test results presented in this report relate only to the object tested.

The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.

Additional comments:

"First" model: ACS-AP-W

"Second" model: ACH-AP-W

The "second" variant is called “HVAC assistant control panel with Bluetooth interface”. The most important difference is that HVAC markets require different start-stop logic for controlling the frequency converter. In HVAC variant, the logic is Hand – Auto – Off, while normal industrial modes has only On – Off.

The Bluetooth part and PCB are exactly similar:

- layout : no changes - schematic: no changes
- RF part: no changes
- Bluetooth profiles, QDID: no changes
- plastic covers: different printings on push-buttons, different colors of plastics

Full Test was performed on the version ACS-AP-W

Version History

Version	Issue Date	Remarks	Revised by
01	2015-10-23	Initial Release	

REPORT INDEX

1 Equipment (Test item) Description

Description	Assistant control panel with Bluetooth interface	
Model	ACS-AP-W	
Additional Model(s)	ACH-AP-W	
Brand Name(s)	ABB	
Serial number	None	
Hardware version	C	
Software / Firmware version	v 4.90	
FCC-ID	2AFNGAPWSERIES	
IC	20555-APWSERIES	
Equipment type	End product	
Radio type	Transceiver	
Radio technology	Bluetooth	
Operating frequency range	2402 - 2480 MHz	
Assigned frequency band	2400 - 2483.5 MHz	
Main test frequencies	F_{LOW}	2402 MHz
	F_{MID}	2441 MHz
	F_{HIGH}	2480 MHz
Spreading	FHSS	
Modulations	GFSK, PI/4-DQPSK, 8-PSK	
Number of channels	79 hopping channels at all	
Channel spacing	1 MHz	
Number of antennas	1	
Antenna	Type	integrated
	Model	PCB F-antenna
	Manufacturer	unspecified
	Gain	1.7
Manufacturer	ABB Oy, Drives and Controls Hiomotie 13 00380 Helsinki FINLAND	
Power supply	V_{NOM}	24.0 VDC
	V_{MIN}	15.0 VDC
	V_{MIN}	26.4 VDC
AC/DC-Adaptor	Model	NONE
	Vendor	NONE
	Input	NONE
	Output	NONE

1.5 Supporting Equipment Used During Testing

Product Type*	Device	Manufacturer	Model No.	Comments
SIM	Communication tester	Rohde & Schwarz	CBT	Signaling

***Note:** Use the following abbreviations:

AE : Auxiliary/Associated Equipment, or

SIM : Simulator (Not Subjected to Test)

CABL : Connecting cables

1.6 Test Modes

Mode #	Description	
DH5-Sngl	General conditions:	EUT powered by laboratory power supply.
	Radio conditions:	Mode = standalone transmit Spreading = Hopping stopped (single hopping channel) Modulation = GFSK Packet type = DH5 Data rate = 1 Mbps Duty cycle = 77 % Power level = Maximum
2DH5-Sngl	General conditions:	EUT powered by laboratory power supply.
	Radio conditions:	Mode = standalone transmit Spreading = Hopping stopped (single hopping channel) Modulation = π/4-DQPSK Packet type = 2DH5 Data rate = 2 Mbps Duty cycle = 77 % Power level = Maximum
3DH5-Sngl	General conditions:	EUT powered by laboratory power supply.
	Radio conditions:	Mode = standalone transmit Spreading = Hopping stopped (single hopping channel) Modulation = 8-DPSK Packet type = 3DH5 Data rate = 3 Mbps Duty cycle = 77 % Power level = Maximum
DH5-Hop	General conditions:	EUT powered by laboratory power supply.
	Radio conditions:	Mode = standalone transmit Spreading = Hopping Modulation = GFSK Packet type = DH5 Data rate = 1 Mbps Duty cycle = 77 % Power level = Maximum

2DH5-Hop	General conditions:	EUT powered by laboratory power supply.
	Radio conditions:	Mode = standalone transmit Spreading = Hopping Modulation = π/4-DQPSK Packet type = 2DH5 Data rate = 2 Mbps Duty cycle = 77 % Power level = Maximum
3DH5-Hop	General conditions:	EUT powered by laboratory power supply.
	Radio conditions:	Mode = standalone transmit Spreading = Hopping Modulation = 8-DPSK Packet type = 3DH5 Data rate = 3 Mbps Duty cycle = 77 % Power level = Maximum
Receive	General conditions:	EUT powered by laboratory power supply.
	Radio conditions:	Mode = standalone receive Spreading = Hopping
AC-Powerline	General conditions:	EUT powered by commercial AC/DC-Adapter
	Radio conditions:	Mode = standalone transmit Spreading = Hopping Power level = Maximum

1.7 Test Equipment Used During Testing

Measurement Software			
Description	Manufacturer	Name	Version
EMC Test Software	Dare Instruments	Radimation	2014.1.15

20dB Bandwidth					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSP 30	EF00312	2015-02	2016-02

Number of hopping frequencies					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSP 30	EF00312	2015-02	2016-02

Time of occupancy					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSP 30	EF00312	2015-02	2016-02

Maximum peak conducted power					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSP 30	EF00312	2015-02	2016-02

Band edge compliance					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSP 30	EF00312	2015-02	2016-02

Conducted spurious emissions					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSP 30	EF00312	2015-02	2016-02

Radiated spurious emissions					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Semi-anechoic chamber	Frankonia	AC 1	EF00062	-	-
Spectrum Analyzer	R&S	FSIQ26	EF00242	2015-04	2016-04
Biconical Antenna	R&S	HK 116	EF00012	2013-02	2016-02
LPD Antenna	R&S	HL 223	EF00187	2014-03	2017-03
LPD Antenna	R&S	HL 025	EF00327	2013-02	2016-02

AC powerline conducted emissions					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
AMN	R&S	ESH2-Z5	EF00182	2014-11	2016-11
EMI Test Receiver	R&S	ESCS 30	EF00295	2014-10	2015-10

1.8 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dBµV. Any external preamplifiers used are taken into account through internal analyzer settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

Reading on Analyzer (dBµV) + A.F. (dB) = Net field strength (dBµV/m)

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBµV/m). The FCC limits are given in units of µV/m. The following formula is used to convert the units of µV/m to dBµV/m:

Limit (dBµV/m) = 20*log (µV/m)

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

Reading	+	AF	=	Net Reading	:	Net reading - FCC limit	= Margin
21.5 dBµV	+	26 dB	=	47.5 dBµV/m	:	47.5 dBµV/m - 57.0 dBµV/m	= -9.5 dB

2 Result Summary

FCC 47 CFR Part 15C, IC RSS-247				
Product Specific Standard Section	**Requirement – Test**	**Reference Method**	**Result**	**Remarks**
RSS-Gen 6.6	Occupied Bandwidth	ANSI C63.10	N/R	Informational only
FCC § 15.247(a)(1) IC RSS-247 § 5.1	20 dB Bandwidth	ANSI C63.10	PASS	
FCC § 15.247(a)(1)(iii) IC RSS-247 § 5.1	Number of hopping frequencies	ANSI C63.10	PASS	
FCC § 15.247(a)(1) IC RSS-247 § 5.1	Frequency hopping channel separation	ANSI C63.10	PASS	
FCC § 15.247(a)(1)(iii) IC RSS-247 § 5.1	Time of occupancy (Dwell time)	ANSI C63.10	PASS	
FCC § 15.247(b)(1) IC RSS-247 § 5.4	Maximum peak conducted power	ANSI C63.10	PASS	
47 CFR 15.207 IC RSS-247 § 3.1	AC power line conducted emissions	ANSI C63.4	PASS	
FCC § 15.247(d) IC RSS-247 § 5.5	Band edge compliance	ANSI C63.10	PASS	
FCC § 15.247(d) IC RSS-247 § 5.5	Conducted spurious emissions	ANSI C63.10	PASS	
FCC § 15.247(d) FCC § 15.209 IC RSS-247 § 5.5	Transmitter radiated spurious emissions	ANSI C63.10	PASS	
IC RSS-247 § 3.1	Receiver radiated spurious emissions	ANSI C63.10	PASS	
Remarks:				

3 Test Conditions and Results

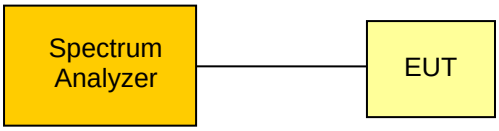
3.1 Test Conditions and Results – Occupied Bandwidth

Occupied Bandwidth acc. to IC RSS-Gen	**Verdict: PASS**
Test according to measurement reference	Reference Method
	ANSI C63.10
Test frequency range	Tested frequencies
	F_{LOW} / F_{MID} / F_{HIGH}

Limits

None (Informational only)

Test setup



Test procedure

1. EUT set to test mode (Communication tester is used if needed)
2. Span set to at least twice the emission spectrum
3. Resolution bandwidth set to 1 % of span
4. Occupied Bandwidth (99 %) measurement with spectrum analyzer built in measurement function

Test results

Channel	Frequency [MHz]	Mode	Occupied Bandwidth [kHz]
F_{LOW}	2402	DH5-Sngl	922.5
F_{MID}	2441	DH5-Sngl	928.8
F_{HIGH}	2480	DH5-Sngl	926.2
F_{LOW}	2402	2DH5-Sngl	1228.8
F_{MID}	2441	2DH5-Sngl	1226.2
F_{HIGH}	2480	2DH5-Sngl	1228.8
F_{LOW}	2402	3DH5-Sngl	1237.5
F_{MID}	2441	3DH5-Sngl	1241.2
F_{HIGH}	2480	3DH5-Sngl	1240.0

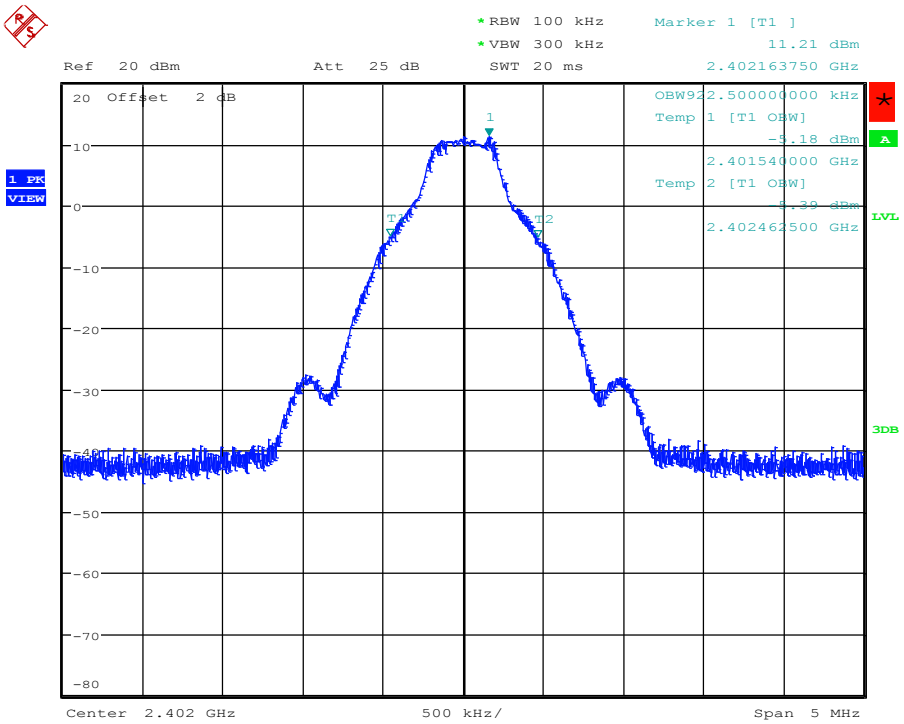
Comments:

Occupied Bandwidth – DH5-Sngl F_{LOW}

Occupied Bandwidth acc. to RSS-Gen

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, GFSK, 2402 MHz, modulated
Test Date:	2015-07-23
Verdict:	NONE (INFORMATION ONLY)
Note 1:	A spectrum analyzer with an integrated 99% power bandwidth function is used
Note 2:	conducted measurement



Occupied bandwidth: 922.5 KHz

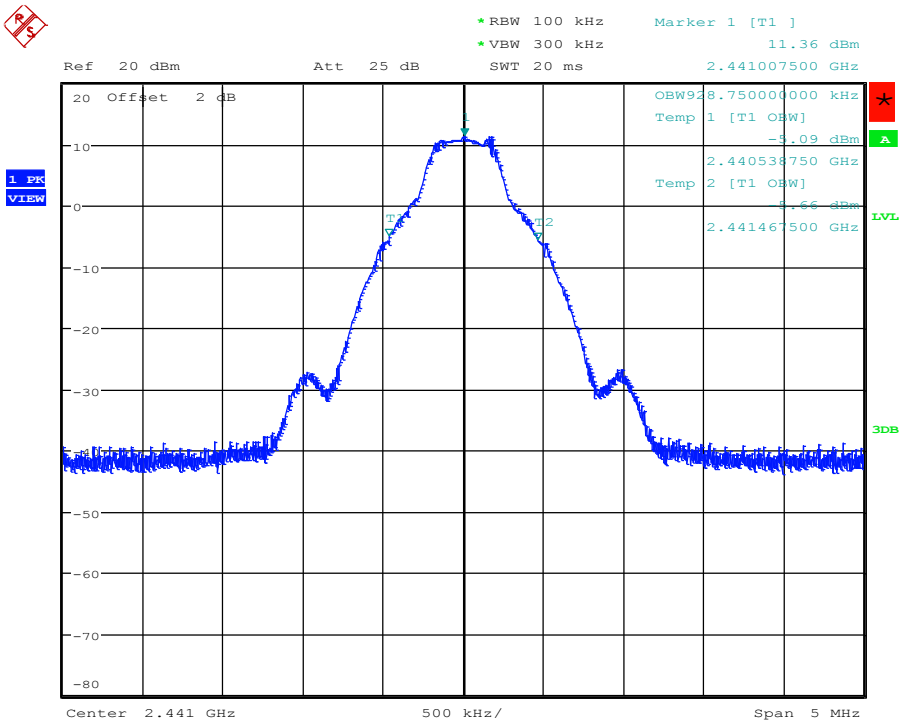
Date: 23.JUL.2015 15:23:00

Occupied Bandwidth – DH5-Sngl F_{MID}

Occupied Bandwidth acc. to RSS-Gen

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, GFSK, 2441 MHz, modulated
Test Date:	2015-07-23
Verdict:	NONE (INFORMATION ONLY)
Note 1:	A spectrum analyzer with an integrated 99% power bandwidth function is used
Note 2:	conducted measurement



Occupied bandwidth: 928.8 KHz

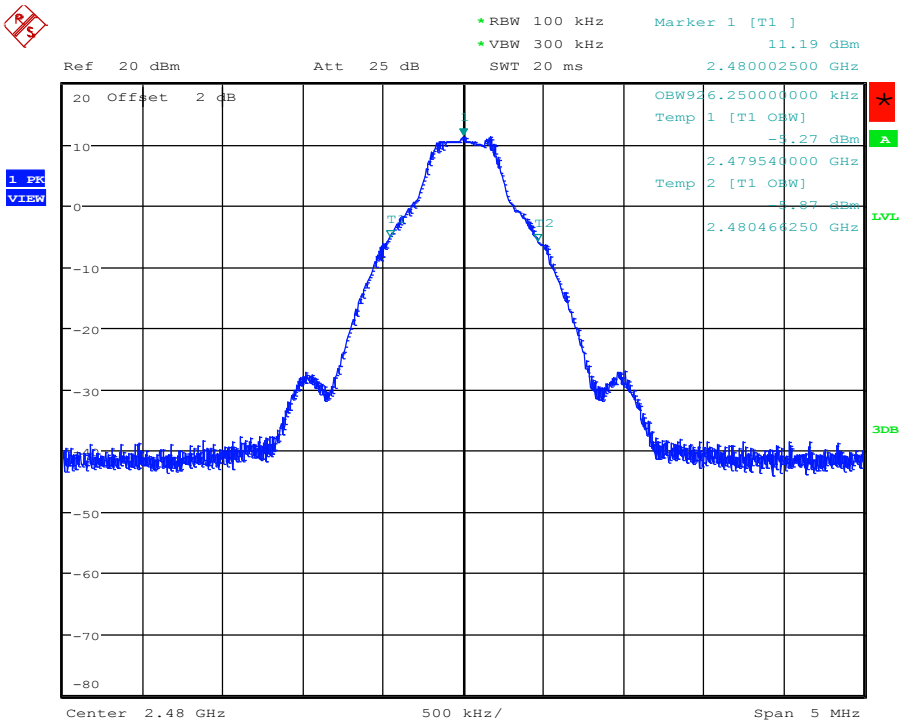
Date: 23.JUL.2015 15:26:23

Occupied Bandwidth – DH5-Sngl F_{HIGH}

Occupied Bandwidth acc. to RSS-Gen

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, GFSK, 2480 MHz, modulated
Test Date:	2015-07-23
Verdict:	NONE (INFORMATION ONLY)
Note 1:	A spectrum analyzer with an integrated 99% power bandwidth function is used
Note 2:	conducted measurement



Occupied bandwidth: 926.2 KHz

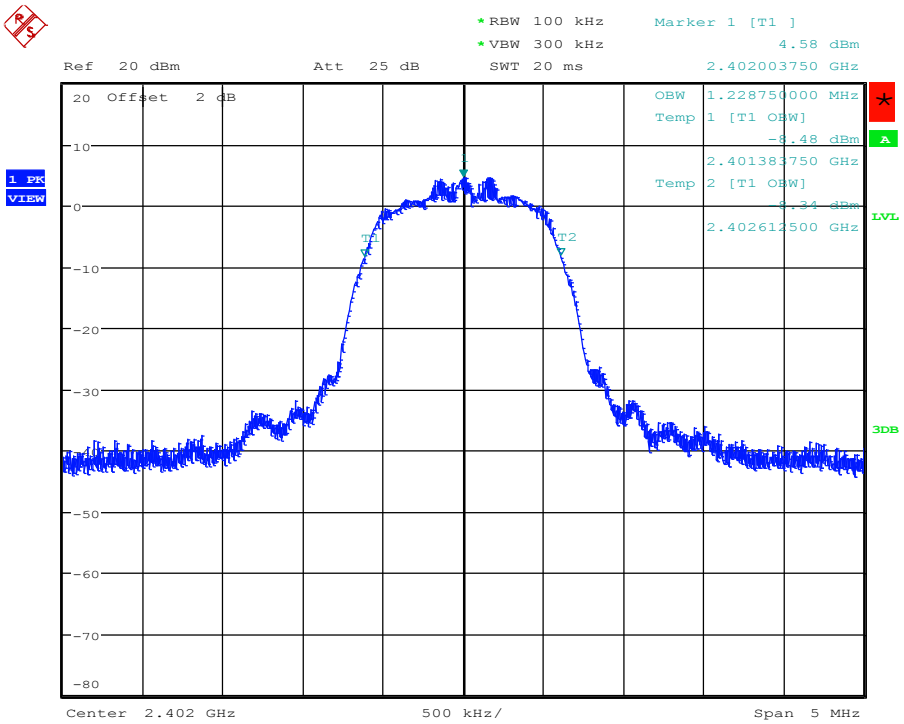
Date: 23.JUL.2015 15:28:21

Occupied Bandwidth – 2-DH5-Sngl F_{LOW}

Occupied Bandwidth acc. to RSS-Gen

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5, 2402 MHz
Test Date:	2015-07-23
Verdict:	NONE (INFORMATION ONLY)
Note 1:	A spectrum analyzer with an integrated 99% power bandwidth function is used
Note 2:	conducted measurement



Occupied bandwidth: 1228.8 KHz

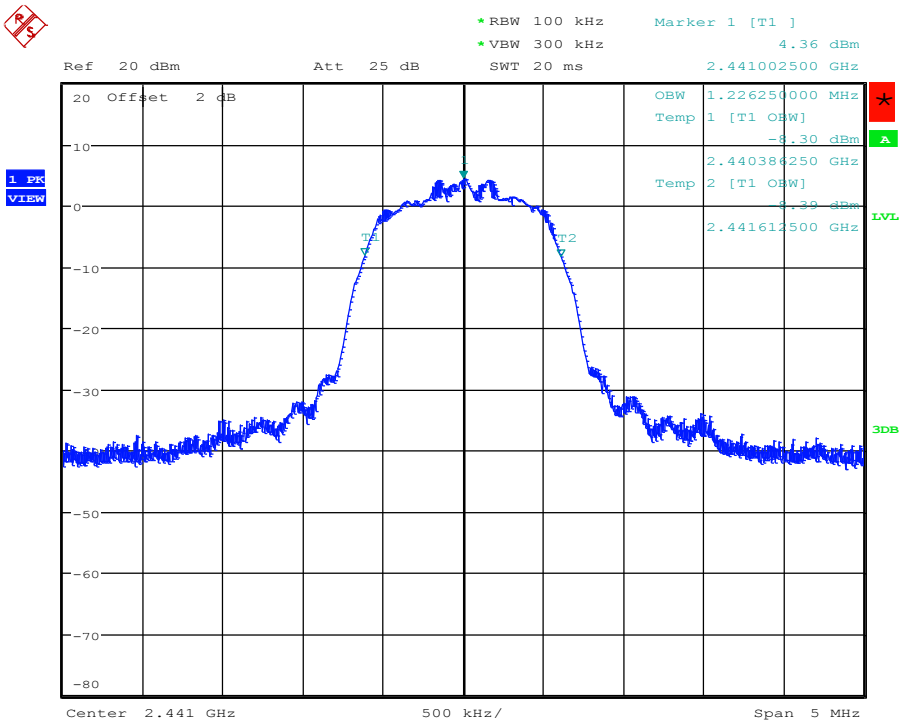
Date: 23.JUL.2015 15:32:34

Occupied Bandwidth – 2-DH5-Sngl F_{MID}

Occupied Bandwidth acc. to RSS-Gen

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5, 2441 MHz
Test Date:	2015-07-23
Verdict:	NONE (INFORMATION ONLY)
Note 1:	A spectrum analyzer with an integrated 99% power bandwidth function is used
Note 2:	conducted measurement



Occupied bandwidth: 1226.2 KHz

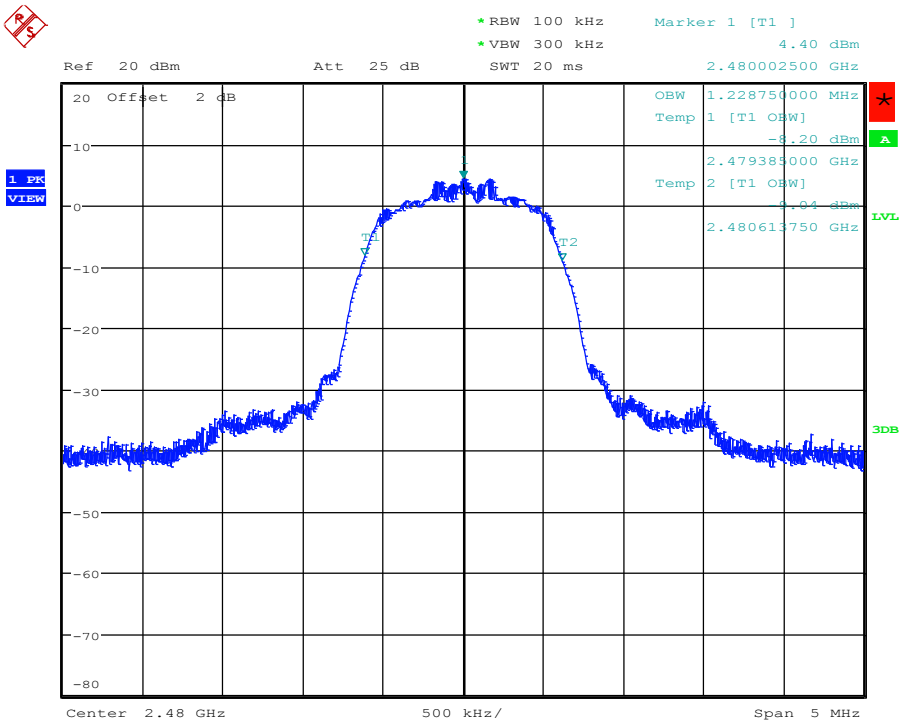
Date: 23.JUL.2015 15:34:55

Occupied Bandwidth – 2-DH5-Sngl F_{HIGH}

Occupied Bandwidth acc. to RSS-Gen

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5, 2480 MHz
Test Date:	2015-07-23
Verdict:	NONE (INFORMATION ONLY)
Note 1:	A spectrum analyzer with an integrated 99% power bandwidth function is used
Note 2:	conducted measurement



Occupied bandwidth: 1228.8 KHz

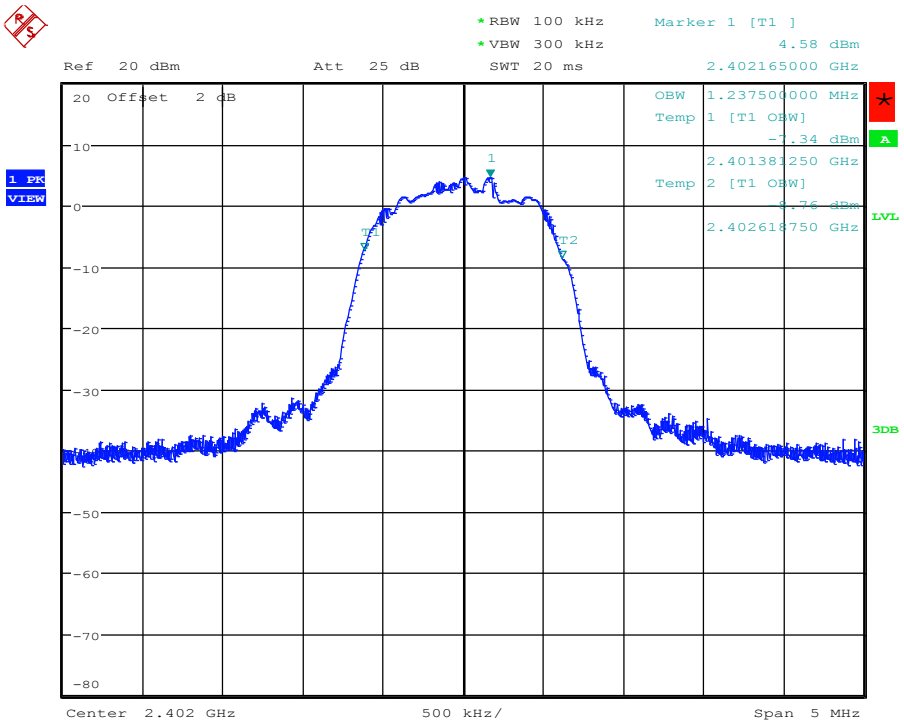
Date: 23.JUL.2015 15:37:16

Occupied Bandwidth – 3-DH5-Sngl F_{LOW}

Occupied Bandwidth acc. to RSS-Gen

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5, 2402 MHz
Test Date:	2015-07-23
Verdict:	NONE (INFORMATION ONLY)
Note 1:	A spectrum analyzer with an integrated 99% power bandwidth function is used
Note 2:	conducted measurement



Occupied bandwidth: 1237.5 KHz

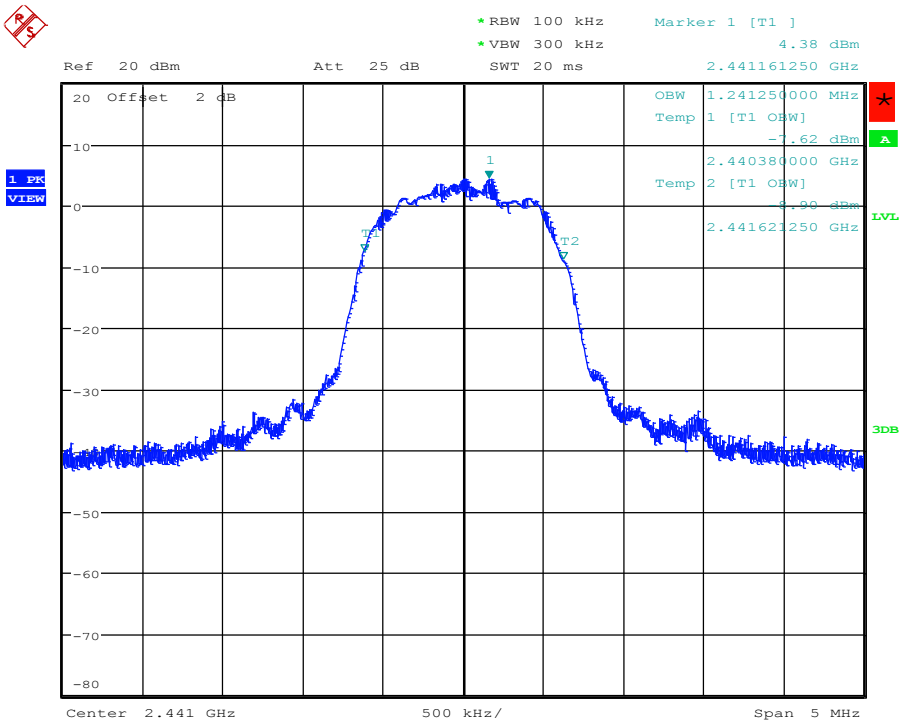
Date: 23.JUL.2015 15:39:54

Occupied Bandwidth – 3-DH5-Sngl F_{MID}

Occupied Bandwidth acc. to RSS-Gen

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5, 2441 MHz
Test Date:	2015-07-23
Verdict:	NONE (INFORMATION ONLY)
Note 1:	A spectrum analyzer with an integrated 99% power bandwidth function is used
Note 2:	conducted measurement



Occupied bandwidth: 1241.2 KHz

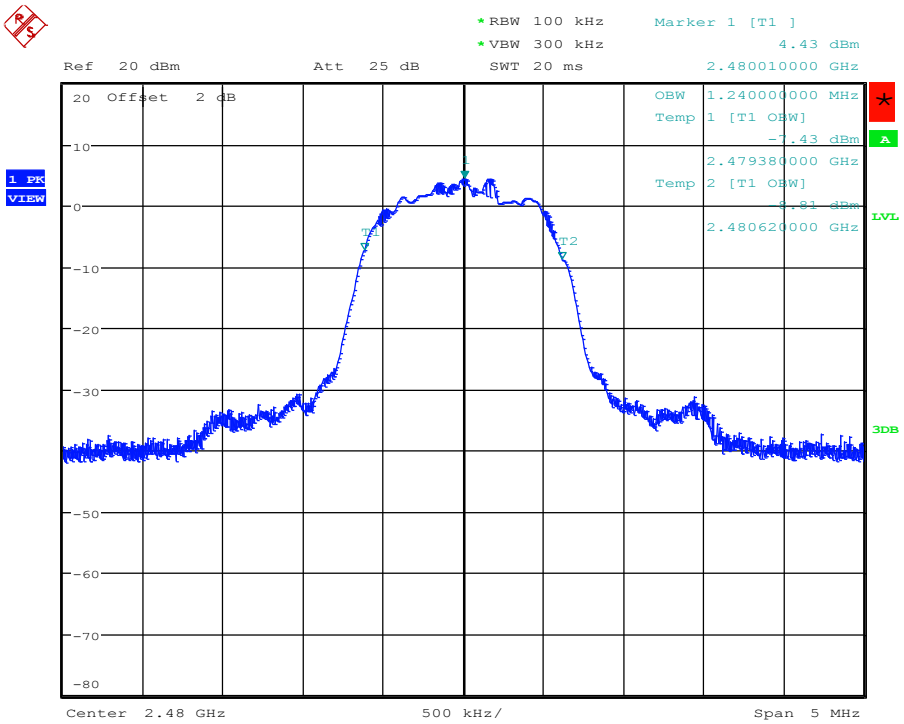
Date: 23.JUL.2015 15:41:48

Occupied Bandwidth – 3-DH5-Sngl F_{HIGH}

Occupied Bandwidth acc. to RSS-Gen

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5, 2480 MHz
Test Date:	2015-07-23
Verdict:	NONE (INFORMATION ONLY)
Note 1:	A spectrum analyzer with an integrated 99% power bandwidth function is used
Note 2:	conducted measurement



Occupied bandwidth: 1240 KHz

Date: 23.JUL.2015 15:44:25

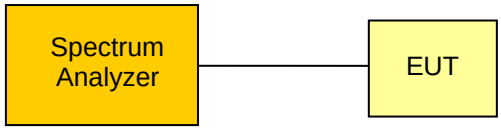
3.2 Test Conditions and Results – 20 dB Bandwidth

20 dB Bandwidth acc. to FCC 15.247 / IC RSS-247	**Verdict: PASS**
EUT requirement rule parts and clause	Reference
	FCC 15.247(a)(1) / IC RSS-247 5.1
Test according to measurement reference	Reference Method
	ANSI C63.10
Test frequency range	Tested frequencies
	F_{LOW} / F_{MID} / F_{HIGH}

Limits

Limit	Condition
1.5 · Carrier spacing	Output power ≤ 125 mW / 21 dBm
1.0 · Carrier spacing	125 mW / 21 dBm < Output power ≤ 1 W / 30 dBm

Test setup



Test procedure

1. EUT set to test mode (Communication tester is used if needed)
2. Span set to at least twice the emission spectrum
3. Detector set to peak and max hold
4. Envelope peak value of emission spectrum is selected
5. Marker on envelope of spectrum is set to level of -20 dB to the left of the peak
6. Marker on envelope of spectrum is set to level of -20 dB to the right of the peak
7. 20dB Bandwidth is determined by marker frequency separation

Test results

Channel	Frequency [MHz]	Mode	20 dB Bandwidth [MHz]	Limit [MHz]	Result
F_{LOW}	2402	DH5-Sngl	0.919	1.5	PASS
F_{MID}	2441	DH5-Sngl	0.920	1.5	PASS
F_{HIGH}	2480	DH5-Sngl	0.919	1.5	PASS
F_{LOW}	2402	2DH5-Sngl	1.315	1.5	PASS
F_{MID}	2441	2DH5-Sngl	1.313	1.5	PASS
F_{HIGH}	2480	2DH5-Sngl	1.318	1.5	PASS
F_{LOW}	2402	3DH5-Sngl	1.279	1.5	PASS
F_{MID}	2441	3DH5-Sngl	1.309	1.5	PASS
F_{HIGH}	2480	3DH5-Sngl	1.315	1.5	PASS

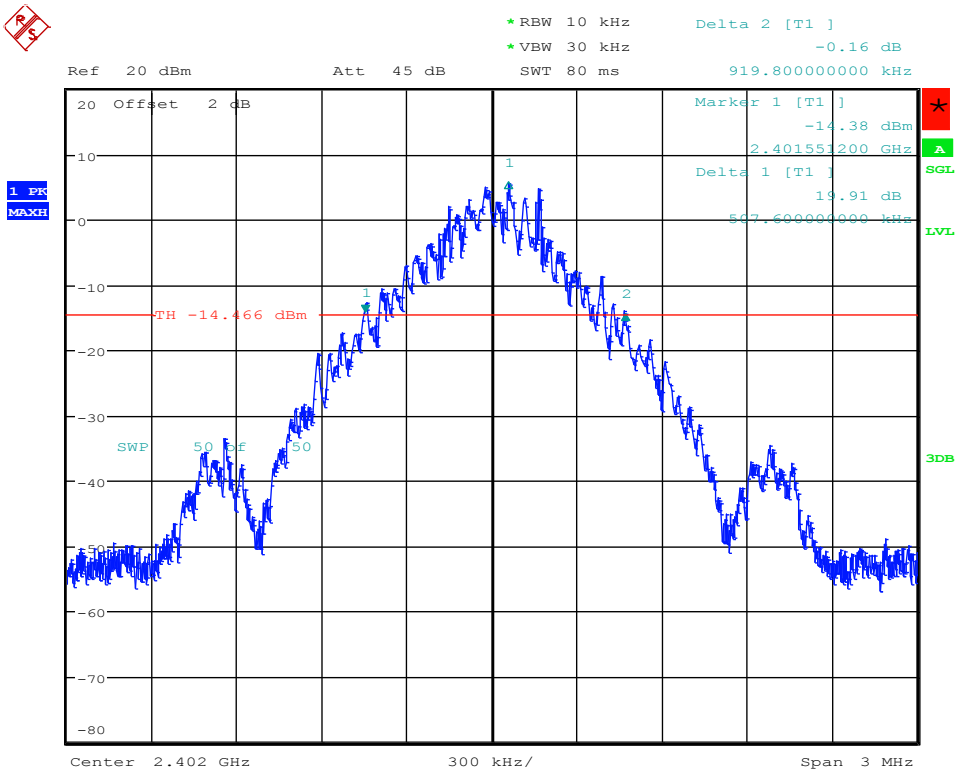
Comments:

20 dB Bandwidth – DH5-Sngl F_{LOW}

20 dB Bandwidth acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, BR, DH5, 2402 MHz
Test Date:	2015-07-23
Verdict:	PASS
Note 1:	FCC part 15 section 247 (a)



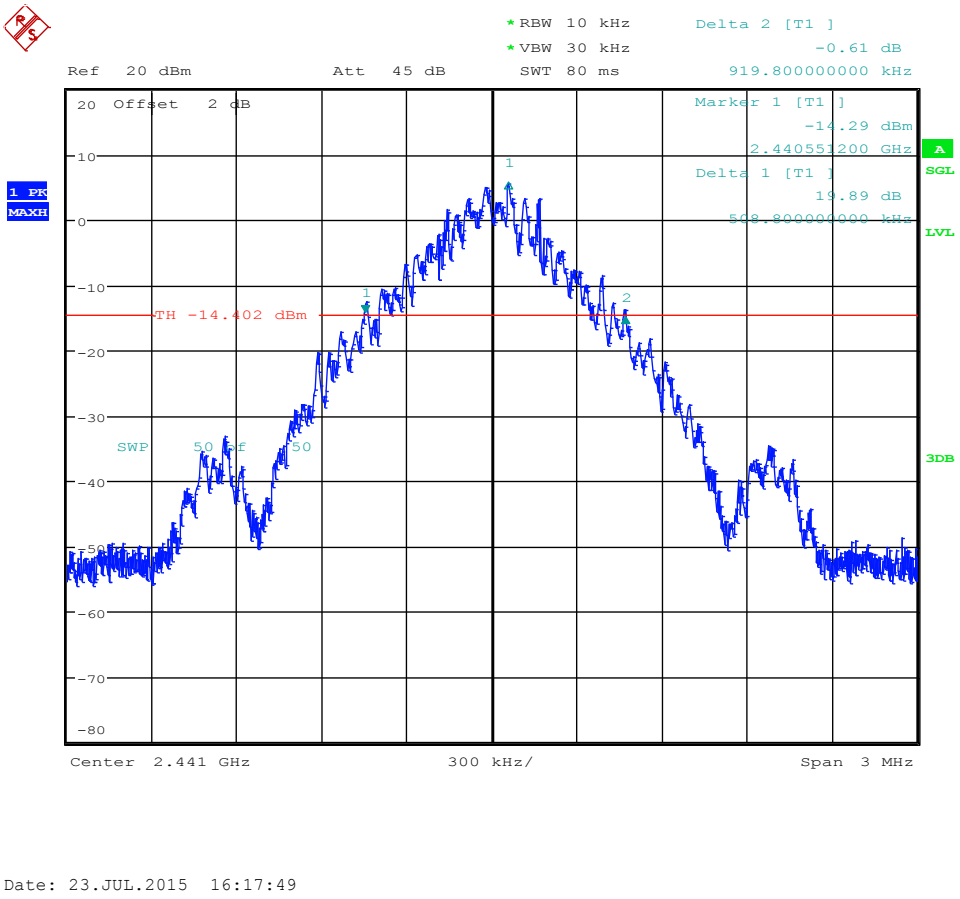
Date: 23.JUL.2015 16:15:24

20 dB Bandwidth – DH5-Sngl F_{MID}

20 dB Bandwidth acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, BR, DH5, 2441 MHz
Test Date:	2015-07-23
Verdict:	PASS
Note 1:	FCC part 15 section 247 (a)

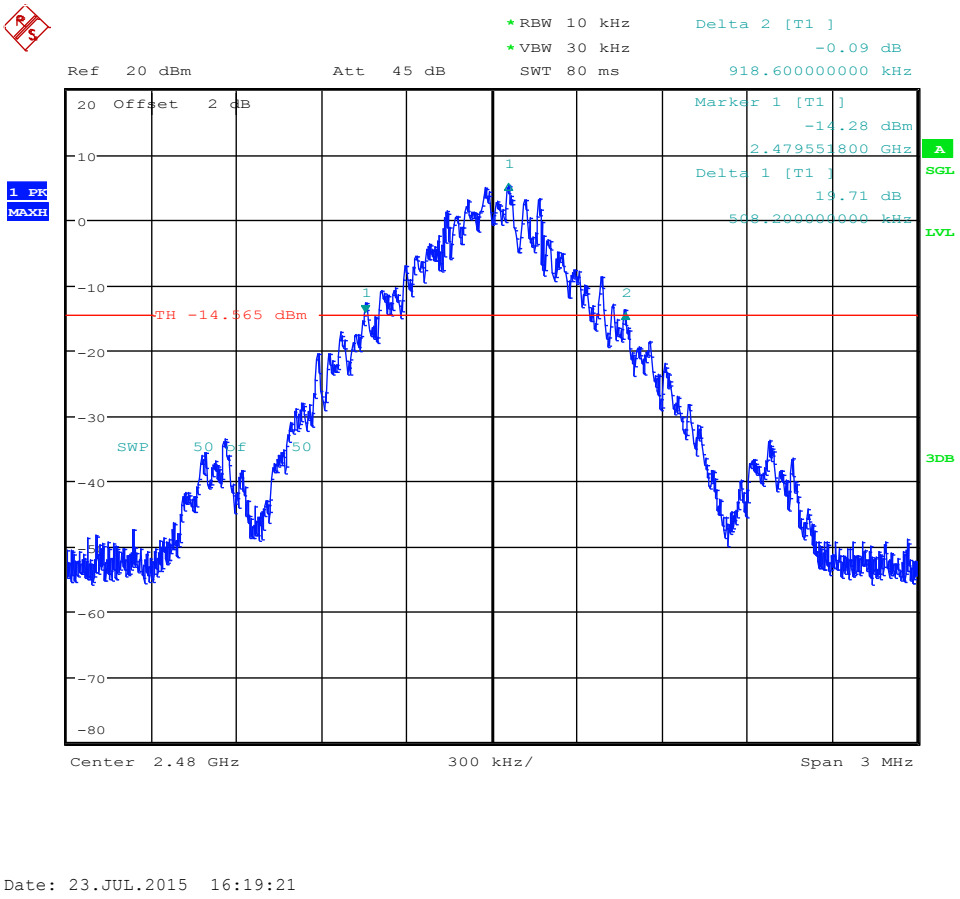


20 dB Bandwidth – DH5-Sngl F_{HIGH}

20 dB Bandwidth acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, BR, DH5, 2480 MHz
Test Date:	2015-07-23
Verdict:	PASS
Note 1:	FCC part 15 section 247 (a)

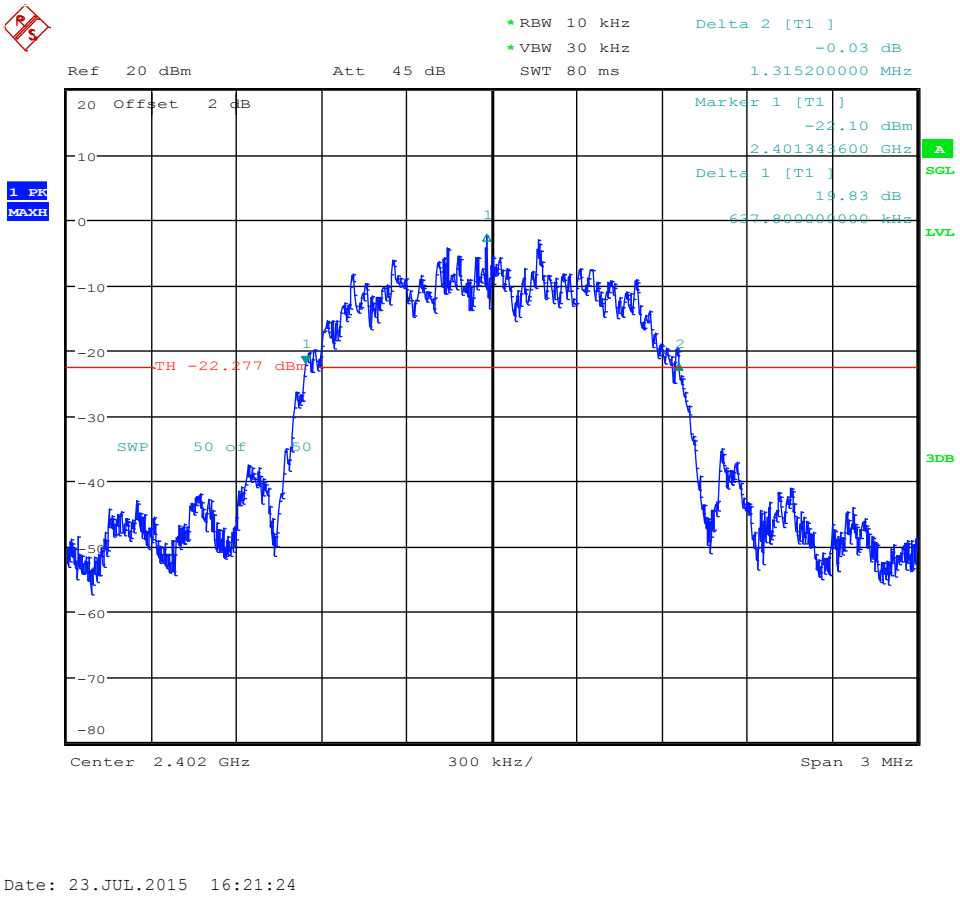


20 dB Bandwidth – 2-DH5-Sngl F_{LOW}

20 dB Bandwidth acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5, 2402 MHz
Test Date:	2015-07-23
Verdict:	PASS
Note 1:	FCC part 15 section 247 (a)

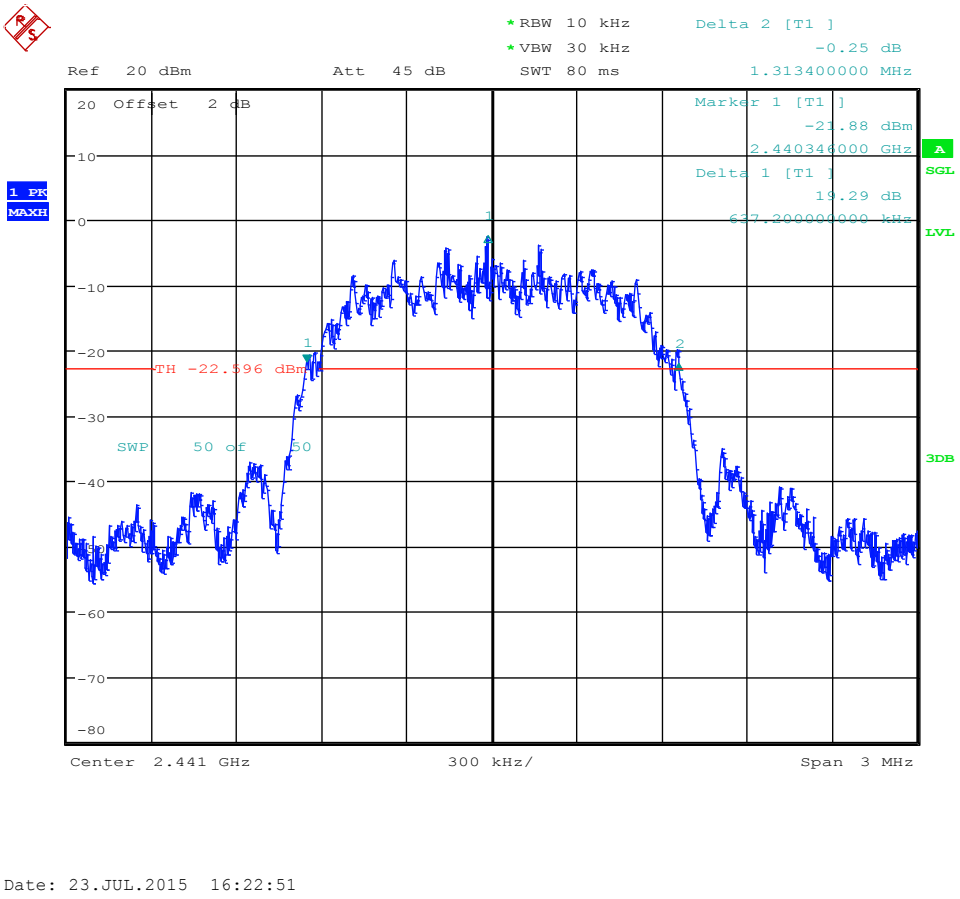


20 dB Bandwidth – 2-DH5-Sngl F_{MID}

20 dB Bandwidth acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5, 2441 MHz
Test Date:	2015-07-23
Verdict:	PASS
Note 1:	FCC part 15 section 247 (a)

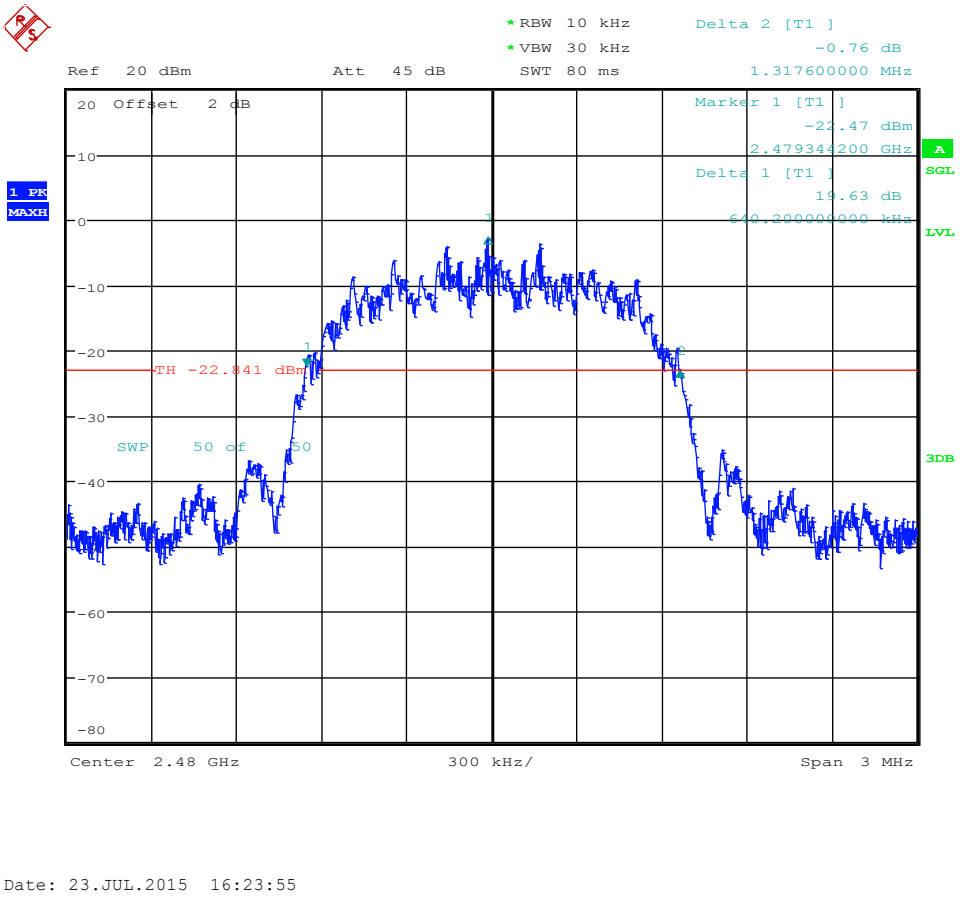


20 dB Bandwidth – 2-DH5-Sngl F_{HIGH}

20 dB Bandwidth acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5, 2480 MHz
Test Date:	2015-07-23
Verdict:	PASS
Note 1:	FCC part 15 section 247 (a)

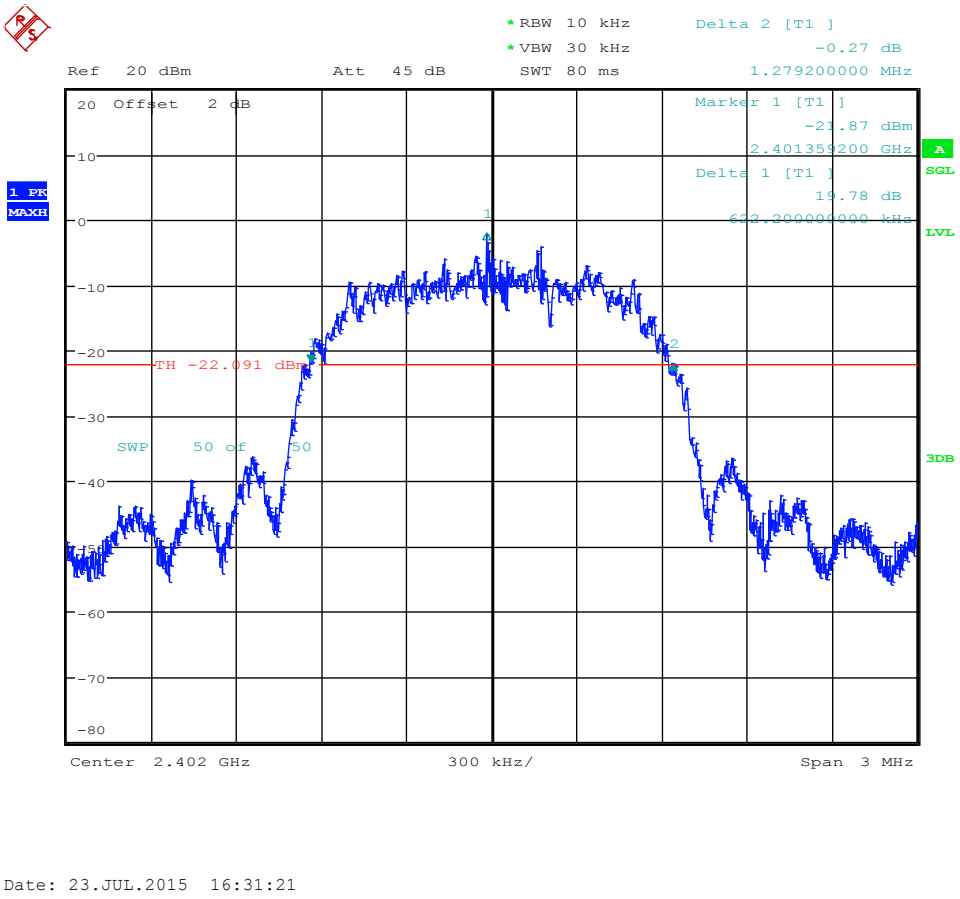


20 dB Bandwidth – 3-DH5-Sngl F_{LOW}

20 dB Bandwidth acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5, 2402 MHz
Test Date:	2015-07-23
Verdict:	PASS
Note 1:	FCC part 15 section 247 (a)

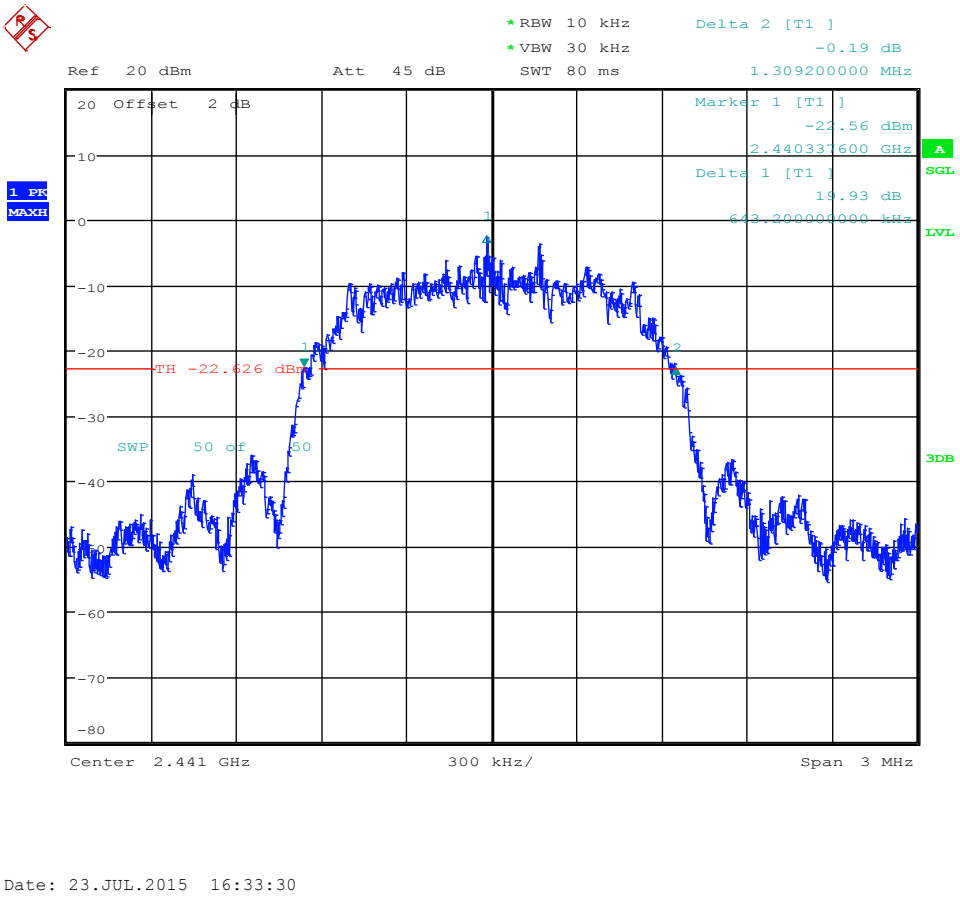


20 dB Bandwidth – 3-DH5-Sngl F_{MID}

20 dB Bandwidth acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5, 2441 MHz
Test Date:	2015-07-23
Verdict:	PASS
Note 1:	FCC part 15 section 247 (a)

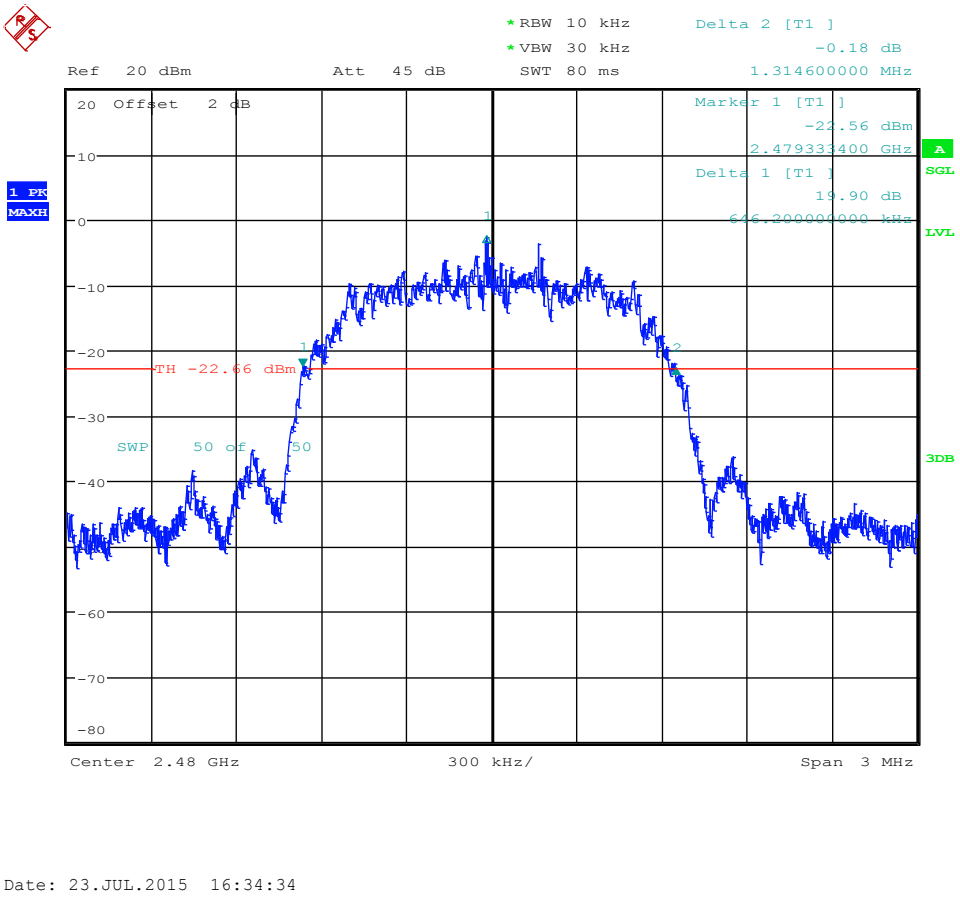


20 dB Bandwidth – 3-DH5-Sngl F_{HIGH}

20 dB Bandwidth acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5, 2480 MHz
Test Date:	2015-07-23
Verdict:	PASS
Note 1:	FCC part 15 section 247 (a)



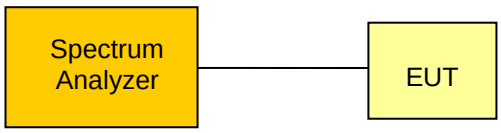
3.3 Test Conditions and Results – Number of hopping frequencies

Number of hopping frequencies acc. to FCC 15.247 / IC RSS-247	**Verdict: PASS**
EUT requirement rule parts and clause	Reference
	FCC 15.247(a)(1)(iii) / IC RSS-247 5.1
Test according to measurement reference	Reference Method
	ANSI C63.10
Test frequency range	Tested frequencies
	F_{LOW} - F_{HIGH}
EUT test mode	DH5-Hop

Limits

Limit	Condition
Number of hopping channels ≥ 15	Output power ≤ 125 mW / 21 dBm
Number of hopping channels ≥ 75	125 mW / 21 dBm < Output power ≤ 1 W / 30 dBm

Test setup



Test procedure

1. EUT set to test mode (Communication tester is used if needed)
2. Span set to measurement frequency range
3. Detector set to peak and max hold
4. Resolution bandwidth is set small enough to resolve hopping channel emission spectra
5. The number of peaks is counted to determine number of hopping frequencies

Test results

Number of hopping frequencies	Limit	Result
79	≥ 15	PASS

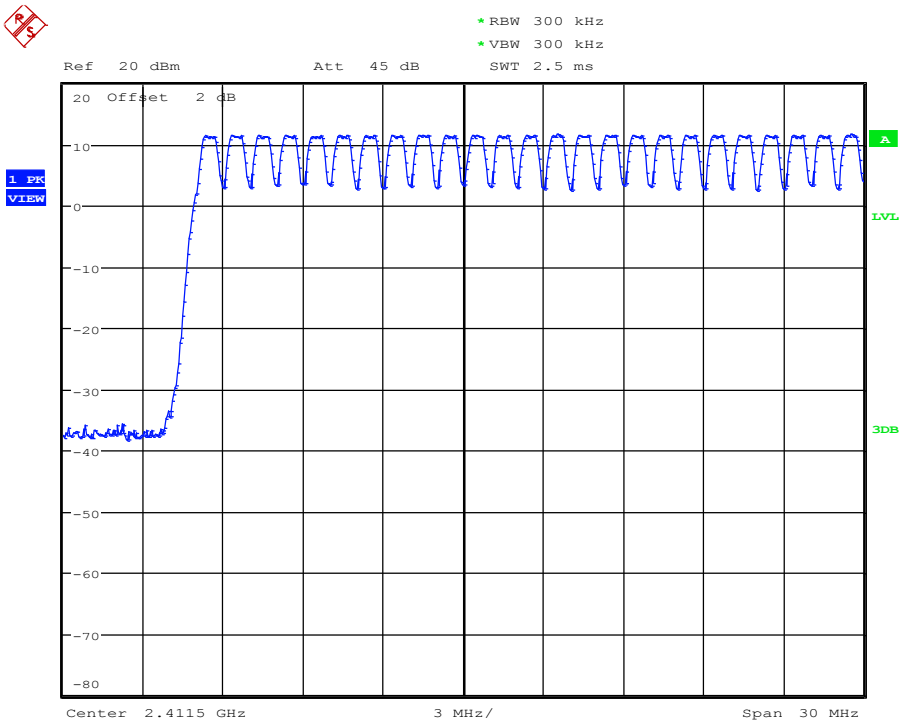
Comments:

Number of hopping frequencies - Range A

Number of Hopping Frequencies acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, GFSK, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Number of Hopping Frequencies (ANSI C63.10)
Note 2:	conducted measurement, channel 0-24

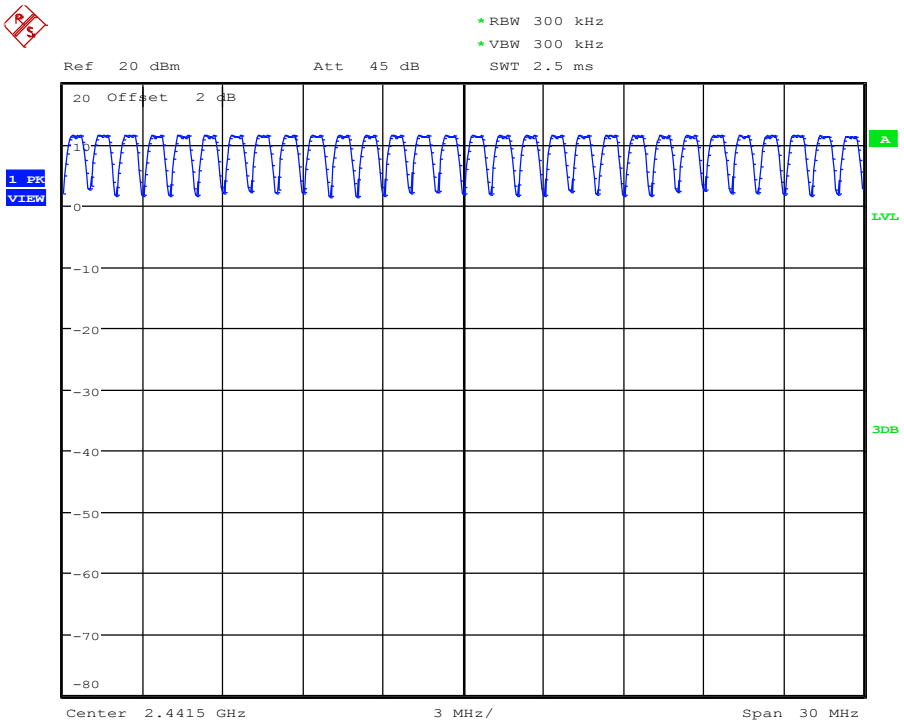


Number of hopping frequencies - Range B

Number of Hopping Frequencies acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, GFSK, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Number of Hopping Frequencies (ANSI C63.10)
Note 2:	conducted measurement, channel 25-53



Number of hopping frequencies

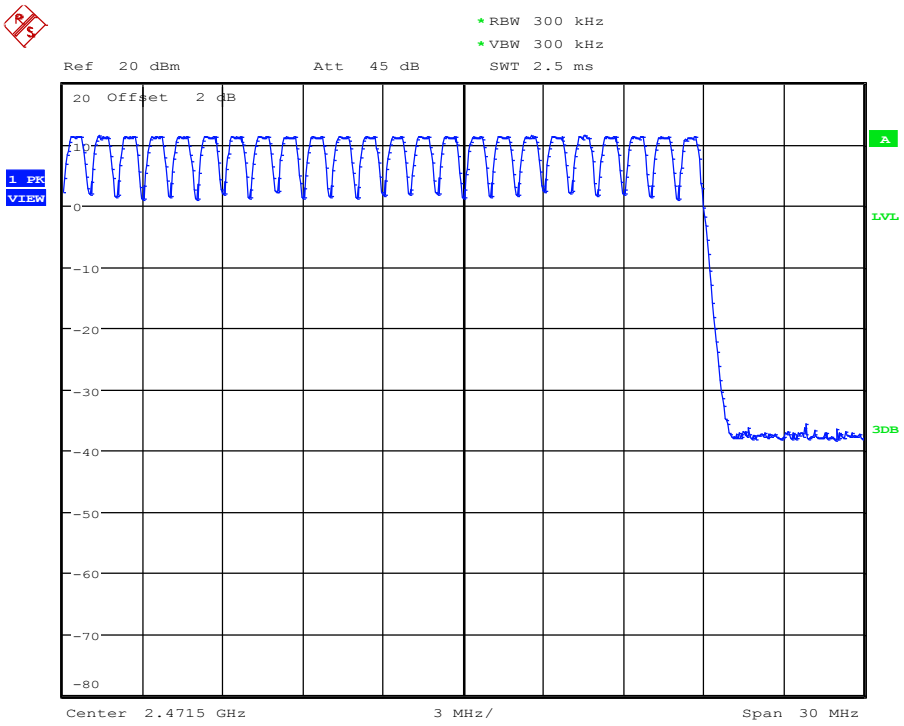
Date: 24.JUL.2015 08:38:06

Number of hopping frequencies - Range C

Number of Hopping Frequencies acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, GFSK, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Number of Hopping Frequencies (ANSI C63.10)
Note 2:	conducted measurement, channel 55-78



Number of hopping frequencies

Date: 24.JUL.2015 08:39:48

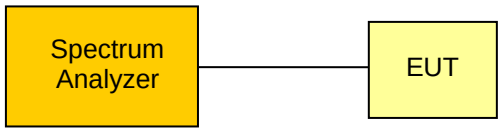
3.4 Test Conditions and Results – Frequency hopping channel separation

Frequency hopping channel separation acc. to FCC 15.247 / IC RSS-247	**Verdict: PASS**
EUT requirement rule parts and clause	Reference
	FCC 15.247(a)(1) / IC RSS-247 5.1
Test according to measurement reference	Reference Method
	ANSI C63.10
Test frequency range	Tested frequencies
	2441 & 2442 MHz
EUT test mode	DH5-Hop

Limits

Limit	Condition
≥ 25 kHz or ⅔ of 20 dB bandwidth	Output power ≤ 125 mW / 21 dBm
≥ 25 kHz or 20 dB bandwidth	125 mW / 21 dBm < Output power ≤ 1 W / 30 dBm

Test setup



Test procedure

1. EUT set to test mode (Communication tester is used if needed)
2. Span set to measurement frequency range
3. Detector set to peak and max hold
4. Resolution bandwidth is set small enough to resolve hopping channel emission spectra
5. The two adjacent channel peaks are marked
6. Channel separation is determined from frequency separation of markers

Test results

Channel separation [kHz]	Limit [kHz]	Result
1008.3	≥ ⅔ · 920. 0 = 613.33	PASS

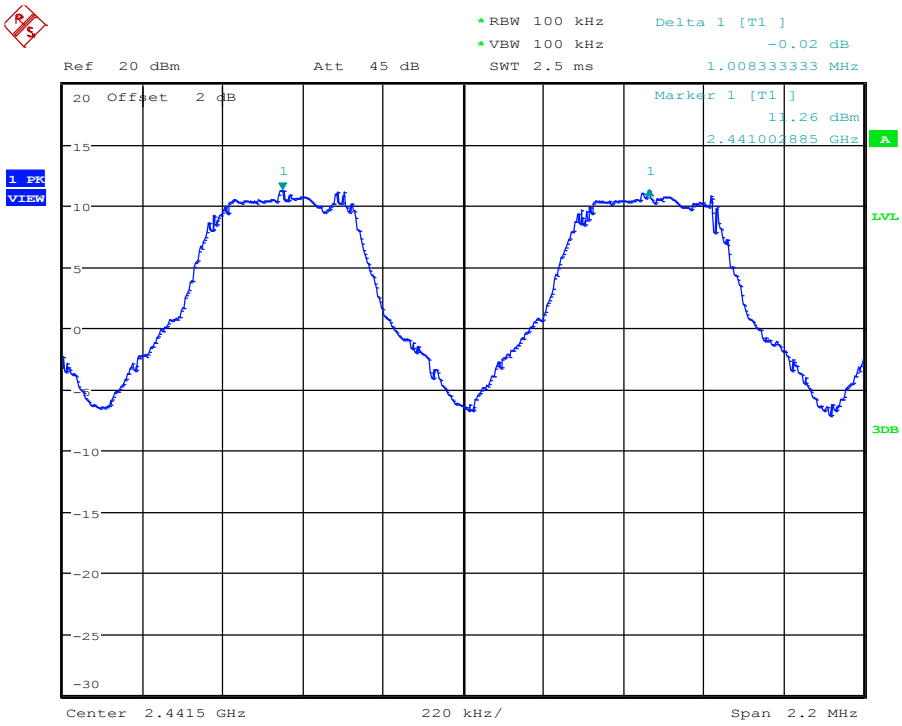
Comments:

Frequency hopping channel separation

Carrier Frequency Separation acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, GFSK, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Carrier Frequency Separation (ANSI C63.10)
Note 2:	conducted measurement



Limit: > two-thirds of the 20 dB bandwidth ; Result: Pass

Date: 24.JUL.2015 08:58:06

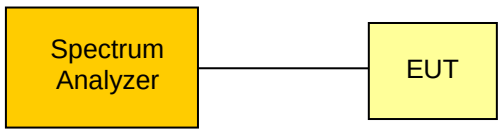
3.5 Test Conditions and Results – Time of occupancy (Dwell Time)

Time of occupancy (Dwell time) acc. to FCC 15.247 / IC RSS-247	**Verdict: PASS**
EUT requirement rule parts and clause	Reference
	FCC 15.247(a)(1)(iii) / IC RSS-247 5.1
Test according to measurement reference	Reference Method
	ANSI C63.10
Test frequency range	Tested frequencies
	2441 MHz
EUT test mode	DH5-Hop

Limits

Limit
Time of occupancy ≤ 0.4 s within 0.4 s · Number of hopping channels

Test setup



Test procedure

1. EUT set to test mode (Communication tester is used if needed)
2. Center frequency set to test channel center frequency
3. Span set to zero span and detector to peak and max hold
4. Resolution bandwidth is set to 100kHz and sweep time to observation period
5. Time of occupancy determined from number of peaks multiplied by single hop dwell time

Test results

Observation period [s]	No. of hops	Dwell time/hop [s]	Time of occupancy [s]	Limit [s]	Result
31.6	117	0.002897	0.339	≤ 0.4	PASS

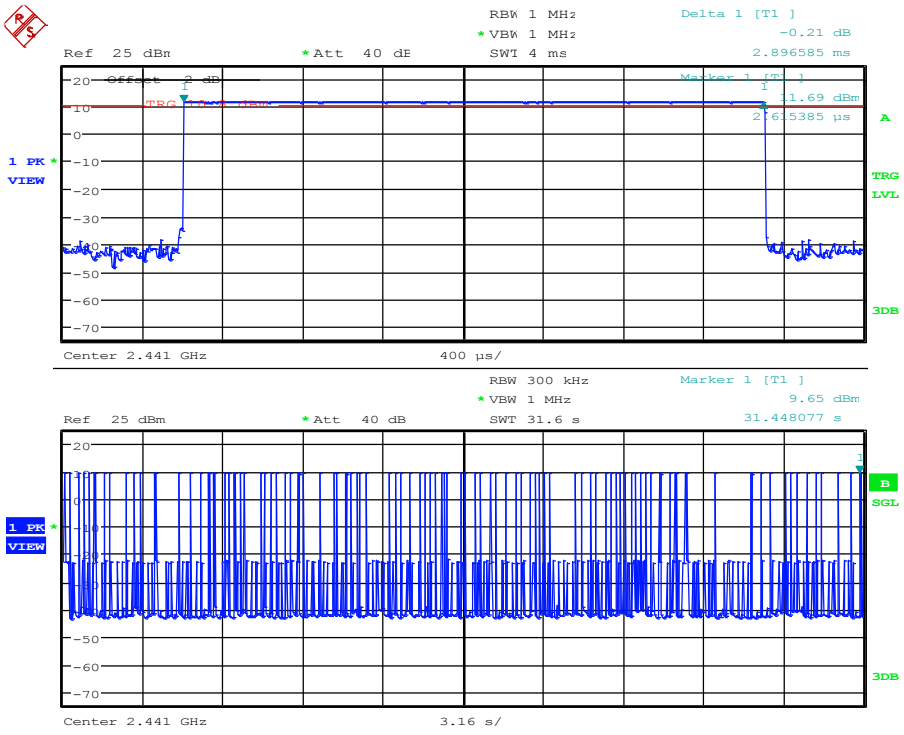
Comments:

Time of occupancy

Time of Occupancy acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, GFSK, channel 2441MHz, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	117 events * 2.897ms; Result:0.339ms Limit<0.4s
Note 2:	conducted measurement, (ANSI C63.10)



Burst length=2.89658 ms

Date: 24.JUL.2015 09:20:12

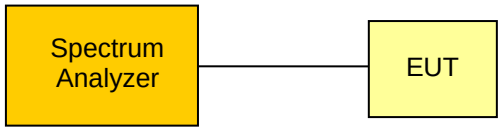
3.6 Test Conditions and Results – Maximum peak conducted power

Maximum peak conducted power acc. to FCC 15.247 / IC RSS-210	**Verdict: PASS**
EUT requirement rule parts and clause	Reference
	FCC 15.247(b)(1) / IC RSS-247 5.4
Test according to measurement reference	Reference Method
	ANSI C63.10
Test frequency range	Tested frequencies
	F_{LOW} / F_{MID} / F_{HIGH}
Measurement mode	Peak
Maximum antenna gain	1.7 dBi ⇒ Limit correction = 0 dB

Limits	
Limit	Condition
1 W (30 dBm)	Number of hopping channels ≥ 75
0.125 W (21 dBm)	75 > Number of hopping channels ≥ 15

The conducted output power limit specified above is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in the table, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test setup



Test procedure

1. EUT set to test mode (Communication tester is used if needed)
2. Center frequency set to test channel center frequency
3. Span set to twice the 20 dB bandwidth and detector to peak and max hold
4. Resolution bandwidth is set to 3 MHz
5. Peak conducted power is determined from peak of spectrum envelope

Test results								
Channel	Frequency [MHz]	Voltage	Mode	Peak power [dBm]	Peak power [W]	Limit [dBm]	Margin [dB]	Result
F_{LOW}	2402	24.0 VDC	DH5-Sngl	11.72	0.015	30	-18.28	PASS
F_{MID}	2441	24.0 VDC	DH5-Sngl	11.77	0.015	30	-18.23	PASS
F_{HIGH}	2480	24.0 VDC	DH5-Sngl	11.65	0.015	30	-18.35	PASS
F_{LOW}	2402	24.0 VDC	2DH5-Sngl	7.38	0.005	30	-22.62	PASS
F_{MID}	2441	24.0 VDC	2DH5-Sngl	7.34	0.005	30	-22.66	PASS
F_{HIGH}	2480	24.0 VDC	2DH5-Sngl	7.32	0.005	30	-22.68	PASS
F_{LOW}	2402	24.0 VDC	3DH5-Sngl	7.95	0.006	30	-22.05	PASS
F_{MID}	2441	24.0 VDC	3DH5-Sngl	7.95	0.006	30	-22.05	PASS
F_{HIGH}	2480	24.0 VDC	3DH5-Sngl	7.98	0.006	30	-22.02	PASS
Comments:								

3.7 Test Conditions and Results – AC power line conducted emissions

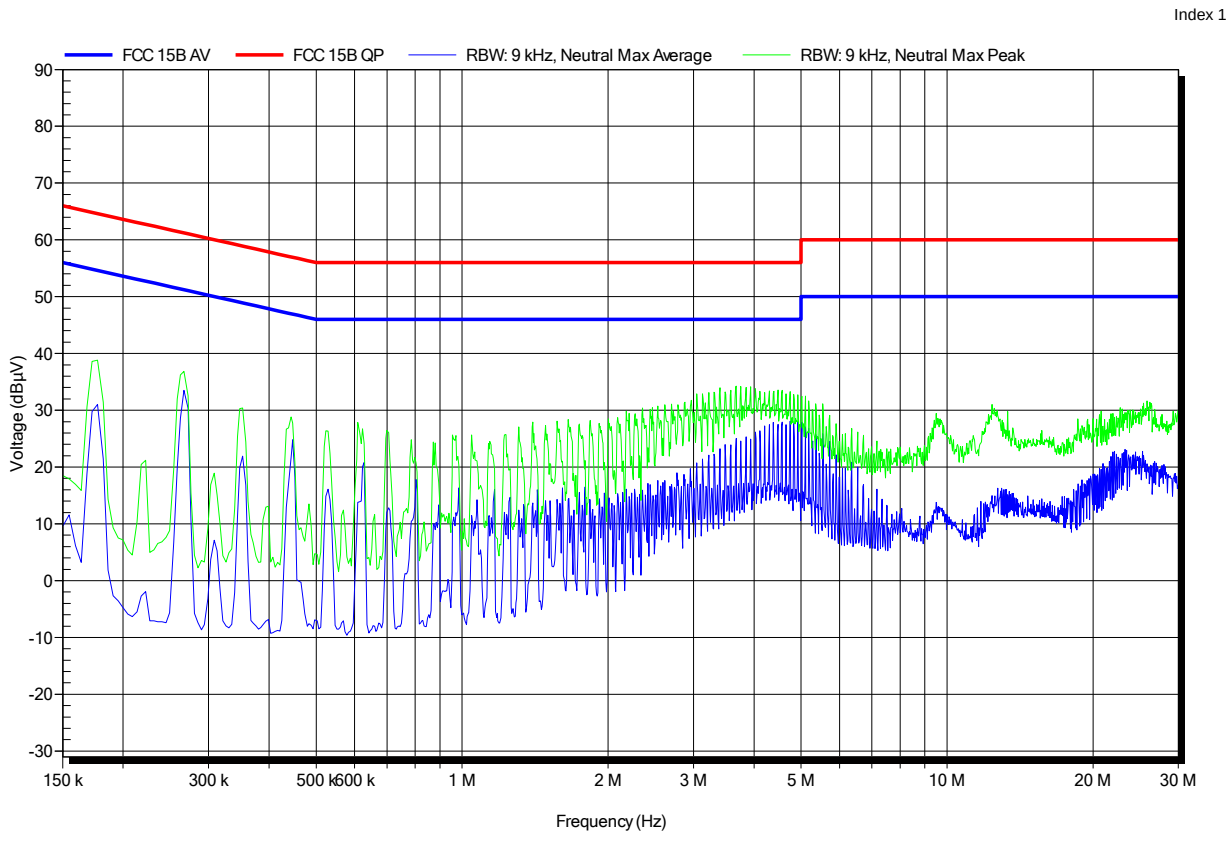
Power line conducted emissions acc. to FCC 47 CFR 15.207 / IC RSS-Gen				**Verdict: PASS**
Test according referenced standards	Reference Method			
	ANSI C63.10			
Fully configured sample scanned over the following frequency range	Frequency range			
	0.15 MHz to 30 MHz			
Points of Application	Application Interface			
AC Mains	LISN			
EUT test mode	AC-Powerline			
Limits and results				
Frequency [MHz]	Quasi-Peak [dBµV]	Result	Average [dBµV]	Result
0.15 to 5	66 to 56*	PASS	56 to 46*	PASS
0.5 to 5	56	PASS	46	PASS
5 to 30	60	PASS	50	PASS
Comments: * Limit decreases linearly with the logarithm of the frequency.				

Conducted Emissions 1

EMI voltage test in the ac-mains according to FCC 15B

Project number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Yu
Test Conditions:	Tnom: 27°C, Unom: 24VDC
LISN:	ESH2-Z5 N
Mode:	1
Test Date:	2015-10-02
Note:	

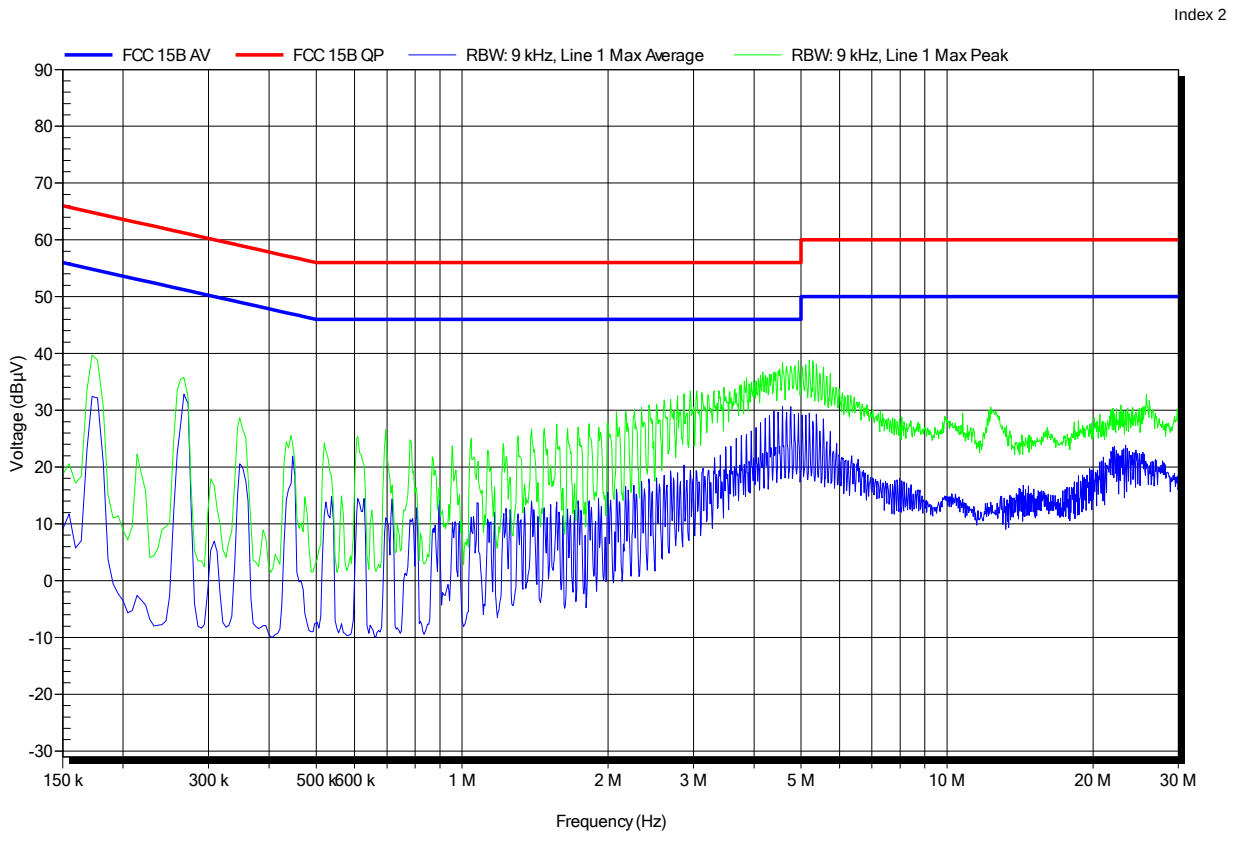


Conducted Emissions 2

EMI voltage test in the ac-mains according to FCC 15B

Project number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Yu
Test Conditions:	Tnom: 27°C, Unom: 24VDC
LISN:	ESH2-Z5 L
Mode:	1
Test Date:	2015-10-02
Note:	



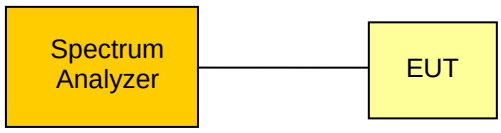
3.8 Test Conditions and Results – Band edge compliance

Band-edge compliance acc. to FCC 15.247 / IC RSS-247	**Verdict: PASS**
EUT requirement rule parts and clause	Reference
	FCC 15.247(d) / IC RSS-247 5.5
Test according to measurement reference	Reference Method
	ANSI C63.10
Test frequency range	Tested frequencies
	F_{LOW} / F_{HIGH}
Measurement mode	Peak

Limits

Limit	Condition
≤ -20 dB/100 kHz	Peak power measurement detector = Peak
≤ -30 dB/100 kHz	Peak power measurement detector = RMS

Test setup



Test procedure

1. EUT set to test mode (Communication tester is used if needed)
2. Span set around lower band edge and detector is set to peak and max hold
3. Resolution bandwidth is set to 100 kHz
4. Markers are set to peak emission levels within frequency band and outside frequency band
5. Band edge attenuation is determined from level difference

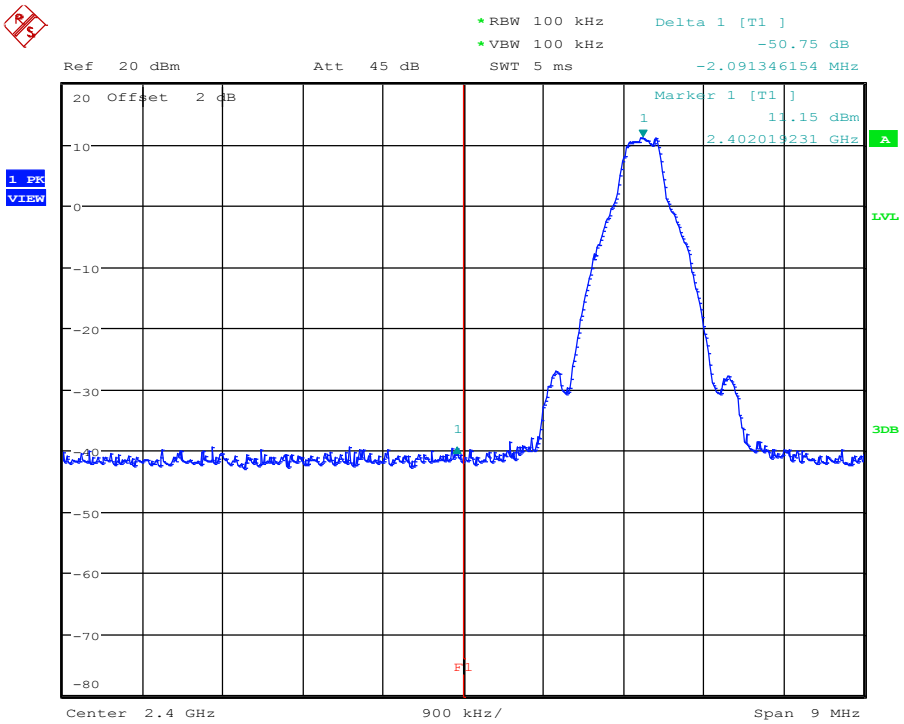
Test results						
Channel	Frequency [MHz]	Mode	Level [dBc]	Limit [dBc]	Margin [dB]	Result
F_{LOW}	2402	DH5-Sngl	-50.8	-20	-30.80	PASS
F_{HIGH}	2480	DH5-Sngl	-51.4	-20	-31.40	PASS
F_{LOW}	2402	2DH5-Sngl	-45.5	-20	-25.50	PASS
F_{HIGH}	2480	2DH5-Sngl	-44.2	-20	-24.20	PASS
F_{LOW}	2402	3DH5-Sngl	-42.6	-20	-22.60	PASS
F_{HIGH}	2480	3DH5-Sngl	-45.8	-20	-25.80	PASS
F_{LOW}	2402	DH5-Hop	-51.2	-20	-31.20	PASS
F_{HIGH}	2480	DH5-Hop	-51.3	-20	-31.30	PASS
F_{LOW}	2402	2DH5-Hop	-44.5	-20	-24.50	PASS
F_{HIGH}	2480	2DH5-Hop	-42.5	-20	-22.50	PASS
F_{LOW}	2402	3DH5-Hop	-41.7	-20	-21.70	PASS
F_{HIGH}	2480	3DH5-Hop	-41.5	-20	-21.50	PASS
Comments:						

Band-edge compliance – DH5-Sngl F_{LOW}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, GFSK, 2402 MHz, single frequency
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	lower Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

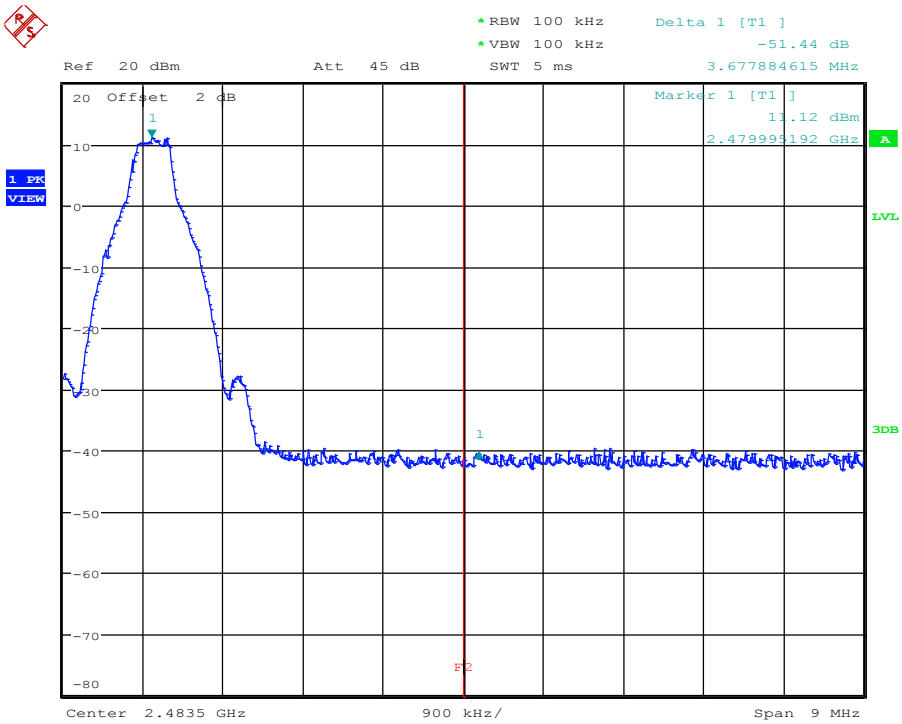
Date: 24.JUL.2015 10:05:13

Band-edge compliance – DH5-Sngl F_{HIGH}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, GFSK, 2480 MHz, single frequency
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	upper Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

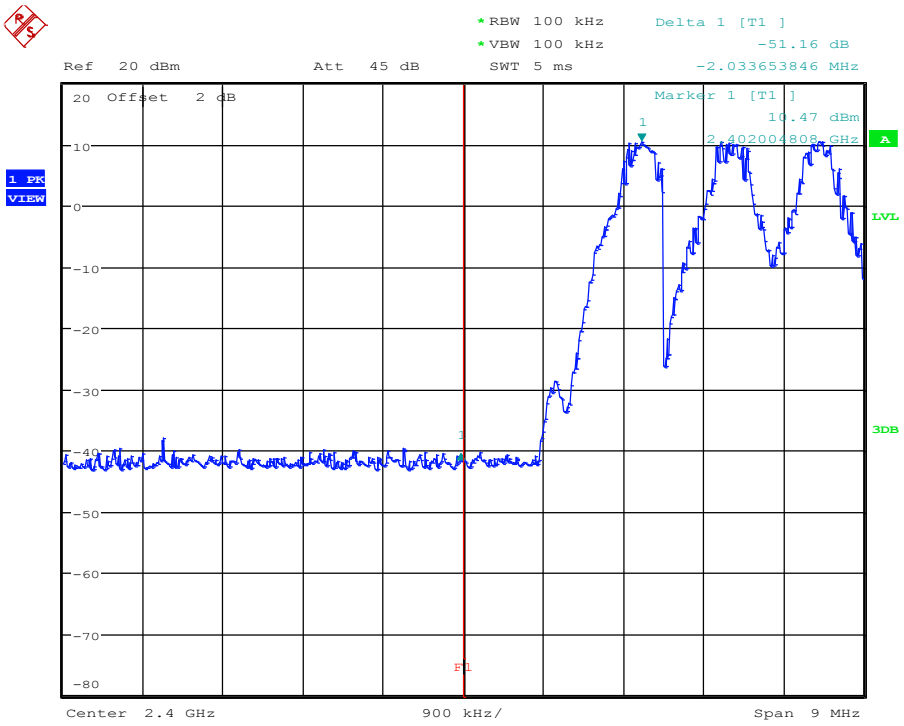
Date: 24.JUL.2015 10:14:10

Band-edge compliance – DH5-Hop F_{LOW}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx,BR, DH5, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	lower Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

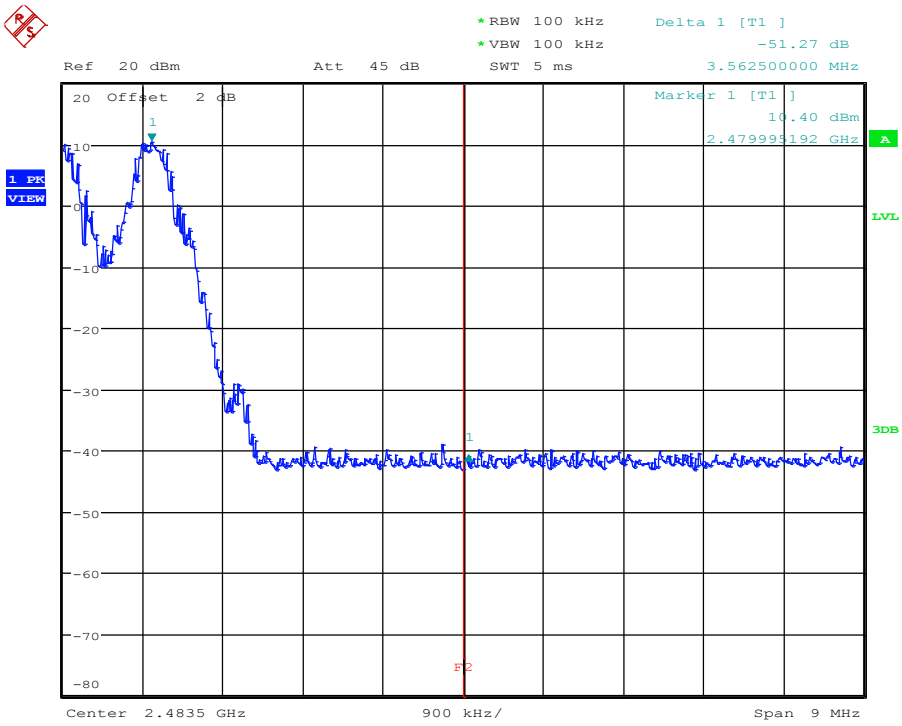
Date: 24.JUL.2015 11:05:10

Band-edge compliance – DH5-Hop F_{HIGH}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx,BR, DH5, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	upper Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

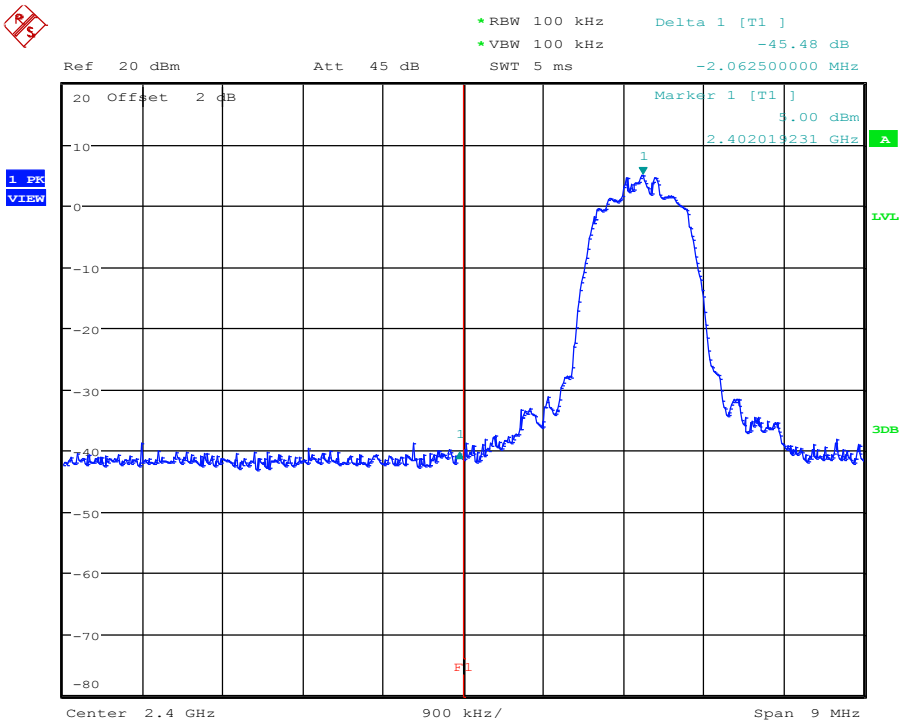
Date: 24.JUL.2015 11:06:22

Band-edge compliance – 2-DH5-Sngl F_{LOW}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5; 2402 MHz, single frequency
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	lower Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

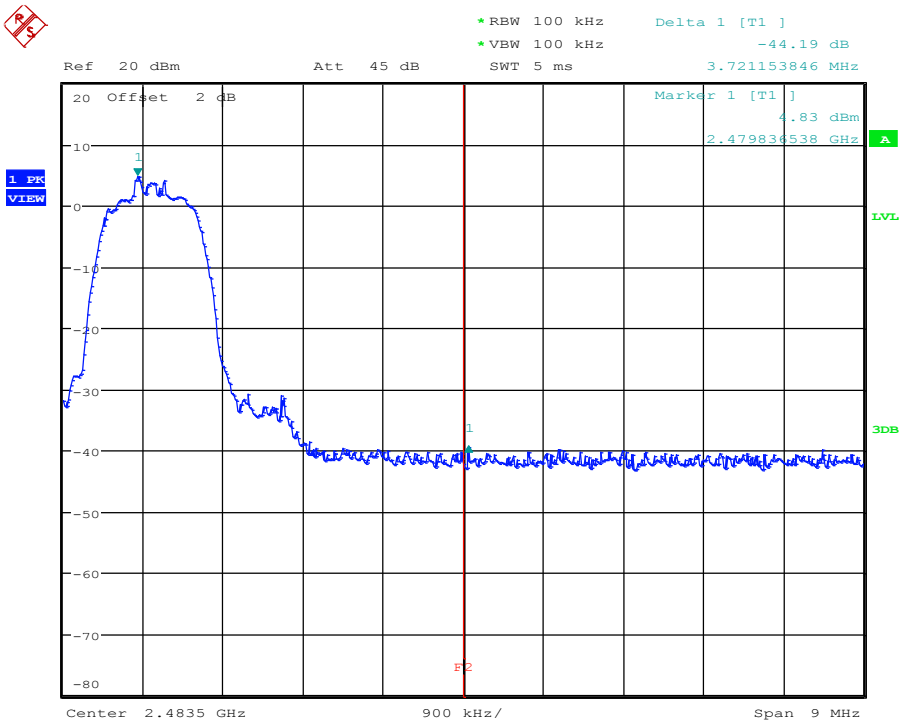
Date: 24.JUL.2015 10:20:04

Band-edge compliance – 2-DH5-Sngl F_{HIGH}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5; 2480 MHz, single frequency
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	upper Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

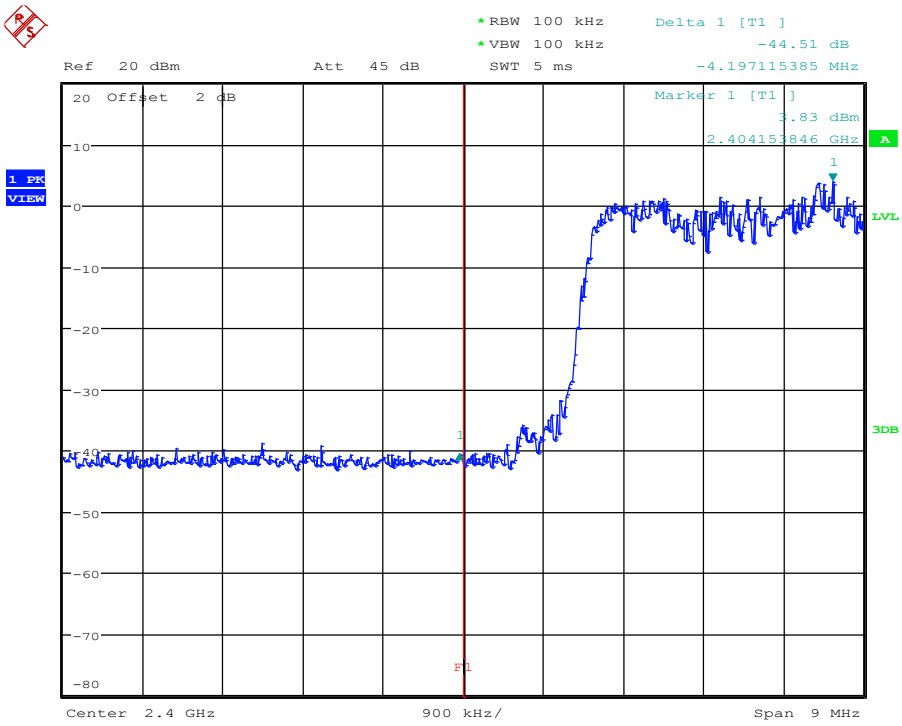
Date: 24.JUL.2015 10:17:07

Band-edge compliance – 2-DH5-Hop F_{LOW}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx,EDR, 2DH5, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	lower Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

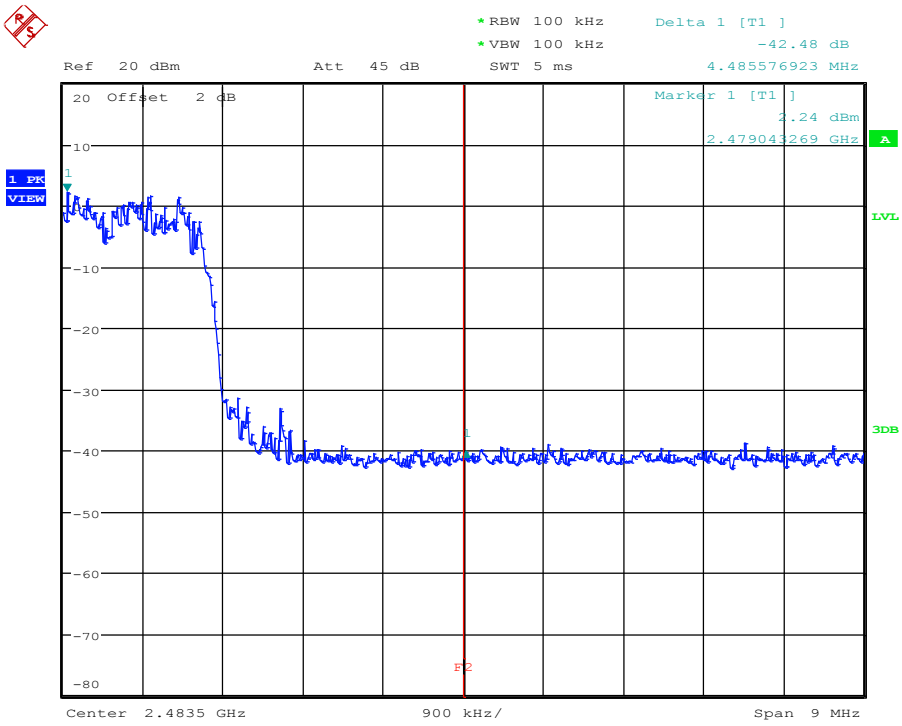
Date: 24.JUL.2015 11:07:54

Band-edge compliance – 2-DH5-Hop F_{HIGH}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx,EDR, 2DH5, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	upper Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

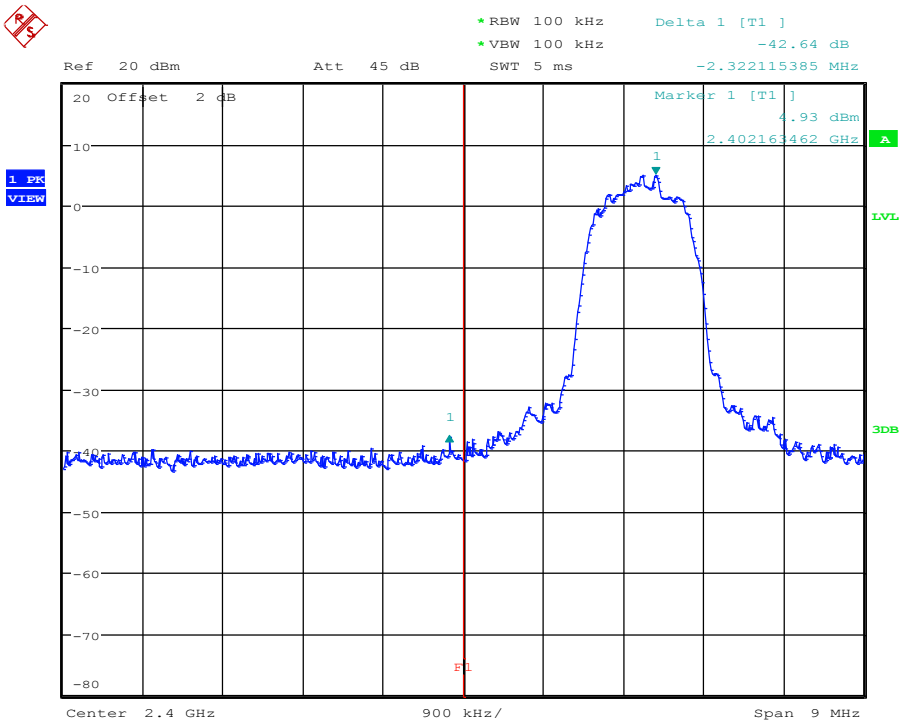
Date: 24.JUL.2015 11:09:18

Band-edge compliance – 3-DH5-Sngl F_{LOW}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5; 2402 MHz, single frequency
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	lower Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

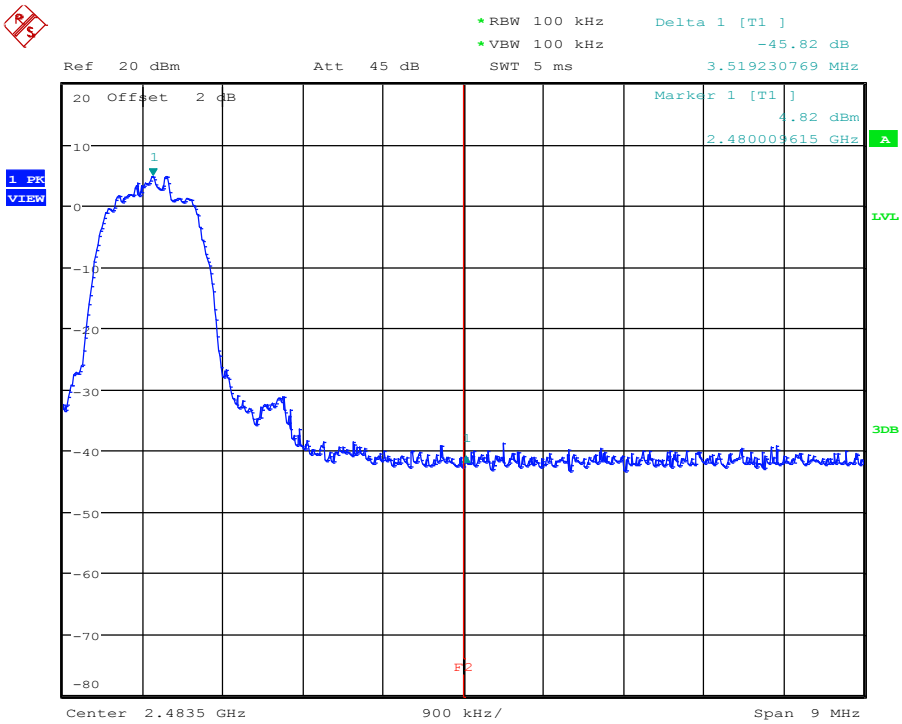
Date: 24.JUL.2015 10:52:29

Band-edge compliance – 3-DH5-Sngl F_{HIGH}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5; 2480 MHz, single frequency
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	upper Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

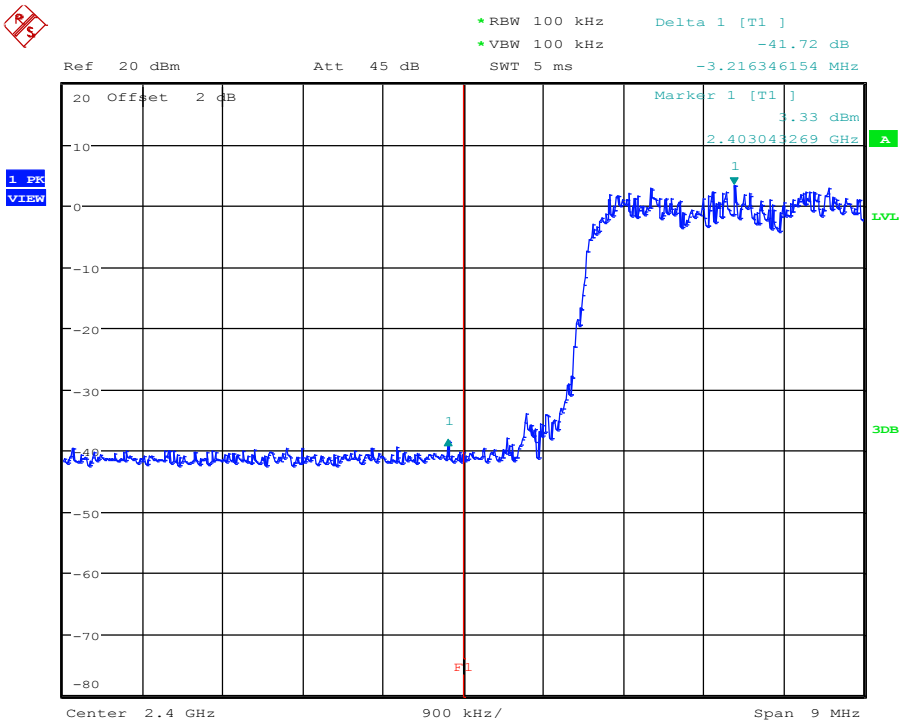
Date: 24.JUL.2015 10:53:55

Band-edge compliance – 3-DH5-Hop F_{LOW}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx,EDR, 3DH5, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	lower Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

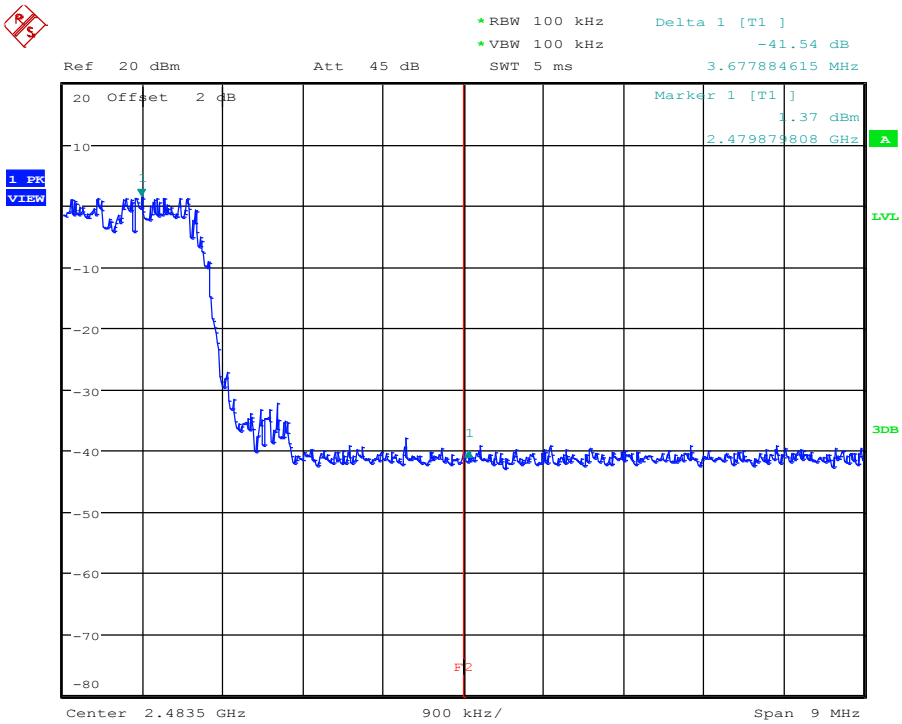
Date: 24.JUL.2015 11:11:22

Band-edge compliance – 3-DH5-Hop F_{HIGH}

Band-edge compliance acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx,EDR, 3DH5, hopping mode
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Marker-delta method (ANSI C63.10)
Note 2:	upper Band-edge, conducted measurement



Limit: Marker Delta value >20 dB

Date: 24.JUL.2015 11:12:34

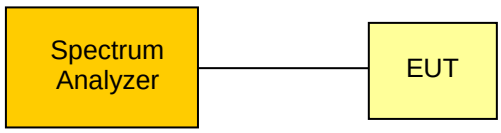
3.9 Test Conditions and Results – Conducted spurious emissions

Conducted spurious emissions acc. to FCC 15.247 / IC RSS-247	**Verdict: PASS**
EUT requirement rule parts and clause	Reference
	FCC 15.247(d) / IC RSS-247 5.5
Test according to measurement reference	Reference Method
	ANSI C63.10
Test frequency range	Tested frequencies
	10 MHz – 10th Harmonic
Measurement mode	Peak

Limits

Limit	Condition
≤ -20 dB/100 kHz	Peak power measurement detector = Peak
≤ -30 dB/100 kHz	Peak power measurement detector = RMS

Test setup



Test procedure

1. EUT set to test mode (Communication tester is used if needed)
2. Span it set according to measurement range
3. Resolution bandwidth is set to 100 kHz and detector to peak and max hold
4. Markers are set to peak emission levels within frequency band
5. Emission level is determined by second marker on emission peak
6. Attenuation is determined from level difference

Test results

Channel	Frequency [MHz]	Mode	Emission [MHz]	Emission Level [dbm]	Peak power [dBm]	Limit [dBm]	Margin [dB]	Result
F_{LOW}	2402	DH5-Sngl	4804	-45.7	10.6	-9.4	-36.30	PASS
F_{MID}	2441	DH5-Sngl	4883	-42.6	10.5	-9.5	-33.10	PASS
F_{HIGH}	2480	DH5-Sngl	4961	-40.1	10.5	-9.5	-30.60	PASS
F_{LOW}	2402	2DH5-Sngl	4804	-52.8	2.3	-17.7	-35.10	PASS
F_{MID}	2441	2DH5-Sngl	4883	-51.9	1.8	-18.2	-33.70	PASS
F_{HIGH}	2480	2DH5-Sngl	2385	-45.2	2.8	-17.2	-28.00	PASS
F_{LOW}	2402	3DH5-Sngl	2385	-44.1	3.8	-16.2	-27.90	PASS
F_{MID}	2441	3DH5-Sngl	2385	-47.0	2.5	-17.5	-29.50	PASS
F_{HIGH}	2480	3DH5-Sngl	2340	-40.9	2.9	-17.1	-23.80	PASS

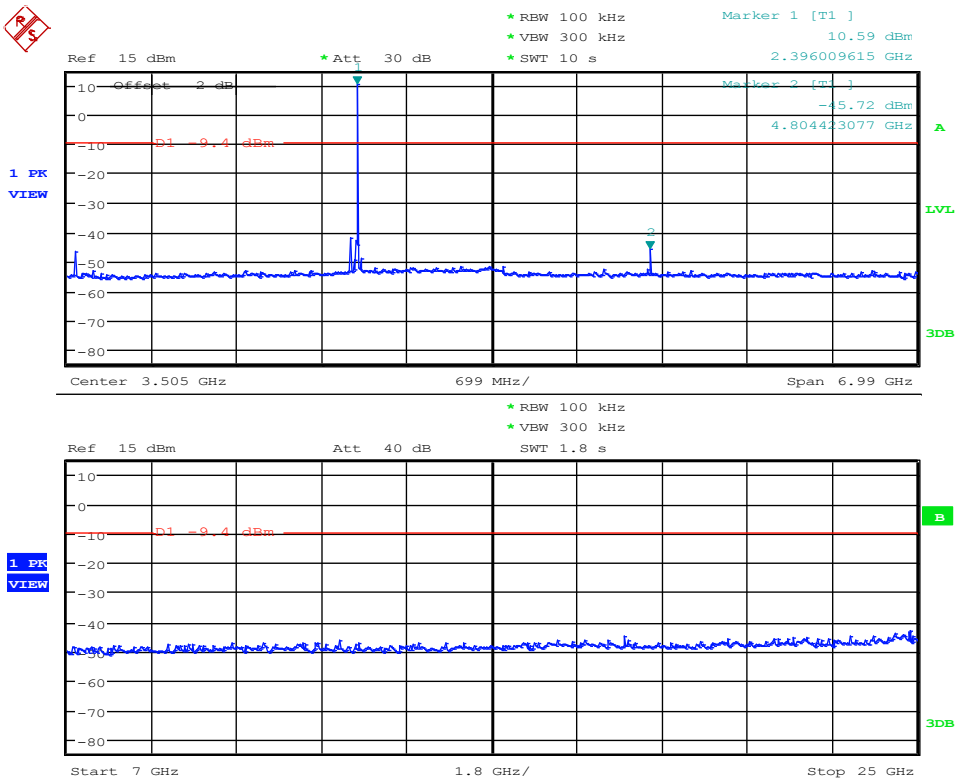
Comments:

Conducted spurious emissions – DH5-Sngl F_{LOW}

Spurious Emissions acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, BR, DH5, 2402 MHz
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Spurious in non-restricted frequency bands (ANSI C63.10)
Note 2:	conducted measurement



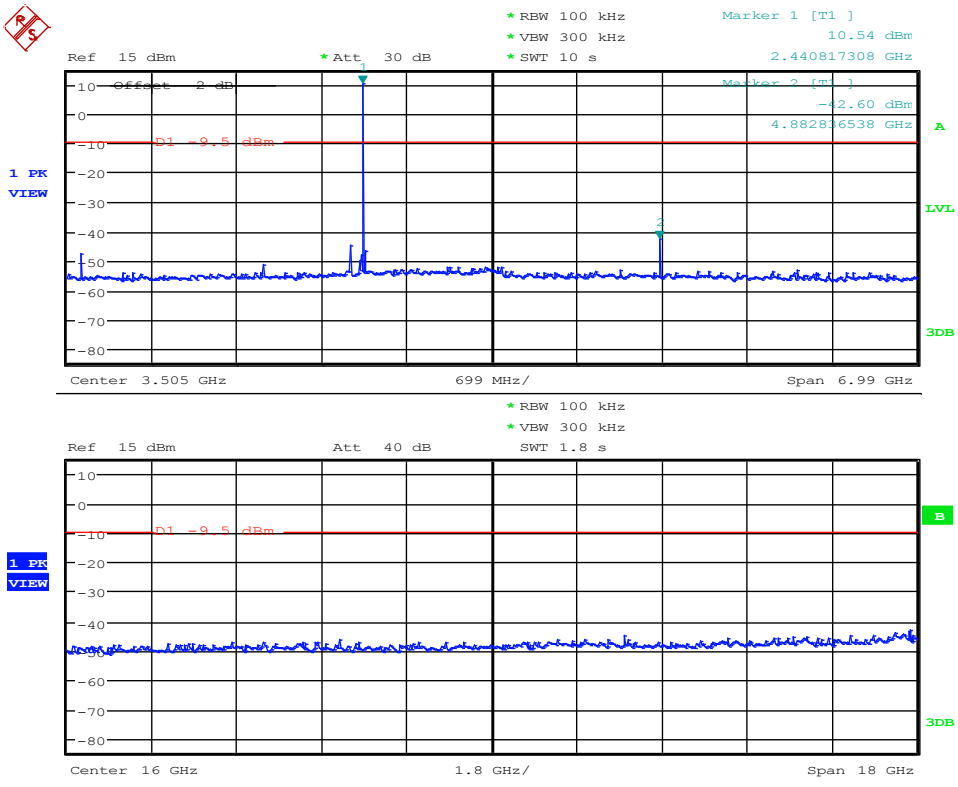
Date: 24.JUL.2015 11:27:51

Conducted spurious emissions – DH5-Sngl F_{MID}

Spurious Emissions acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, BR, DH5, 2441 MHz
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Spurious in non-restricted frequency bands (ANSI C63.10)
Note 2:	conducted measurement



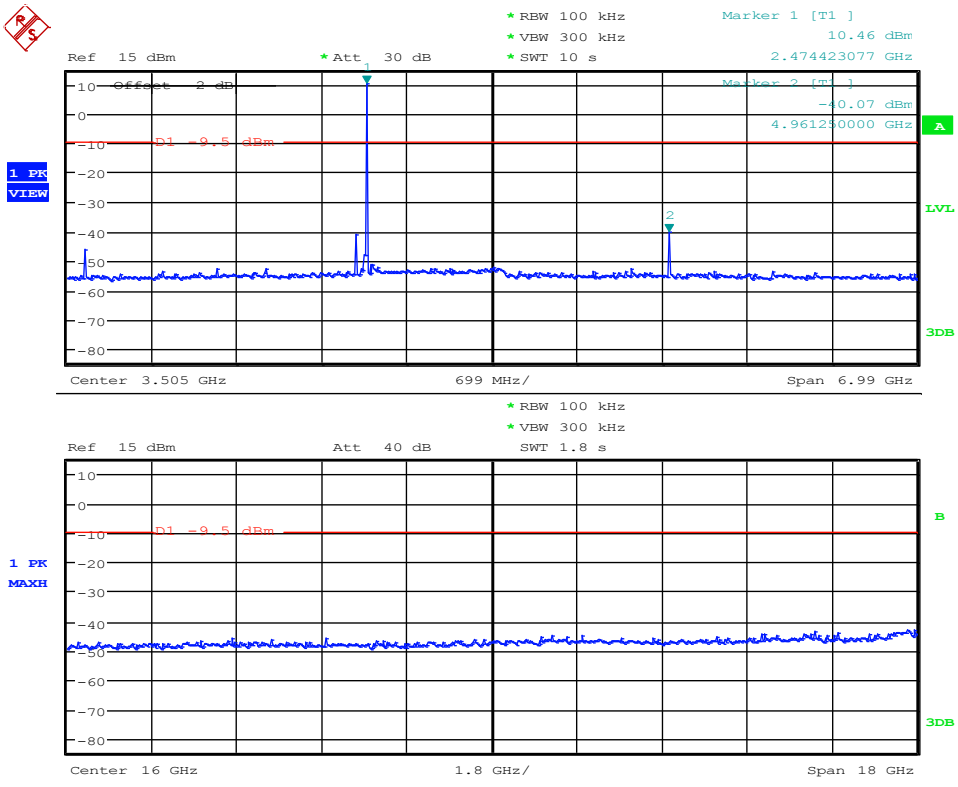
Date: 24.JUL.2015 11:31:09

Conducted spurious emissions – DH5-Sngl F_{HIGH}

Spurious Emissions acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, BR, DH5, 2480 MHz
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Spurious in non-restricted frequency bands (ANSI C63.10)
Note 2:	conducted measurement



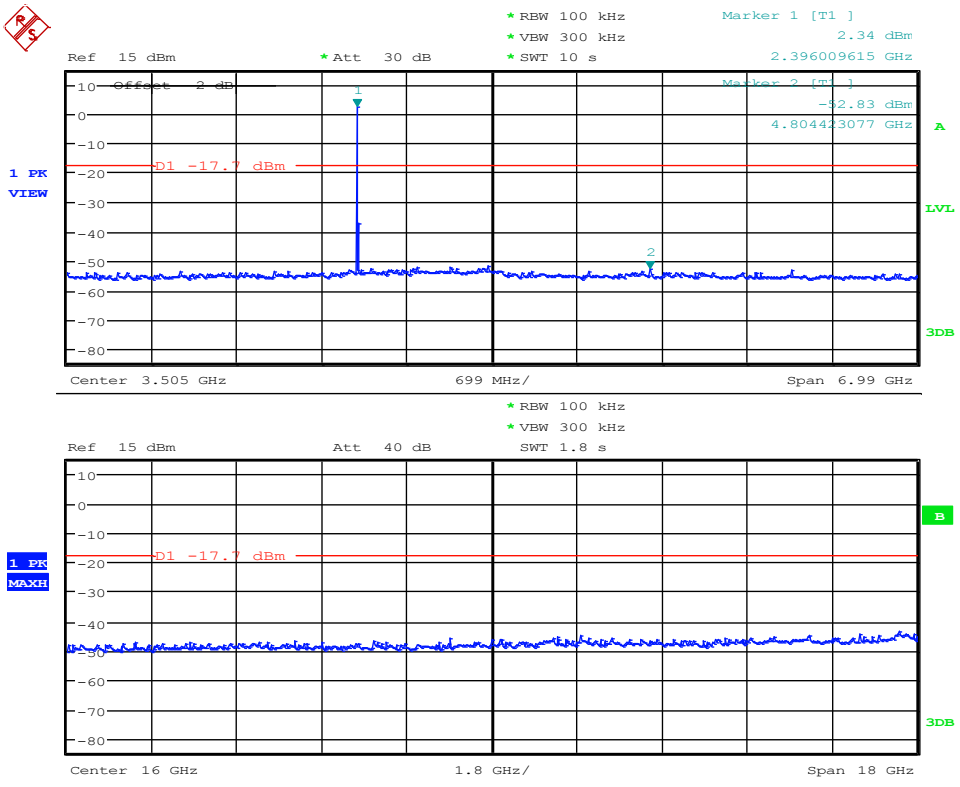
Date: 24.JUL.2015 11:36:45

Conducted spurious emissions – 2-DH5-Sngl F_{LOW}

Spurious Emissions acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5, 2402 MHz
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Spurious in non-restricted frequency bands (ANSI C63.10)
Note 2:	conducted measurement



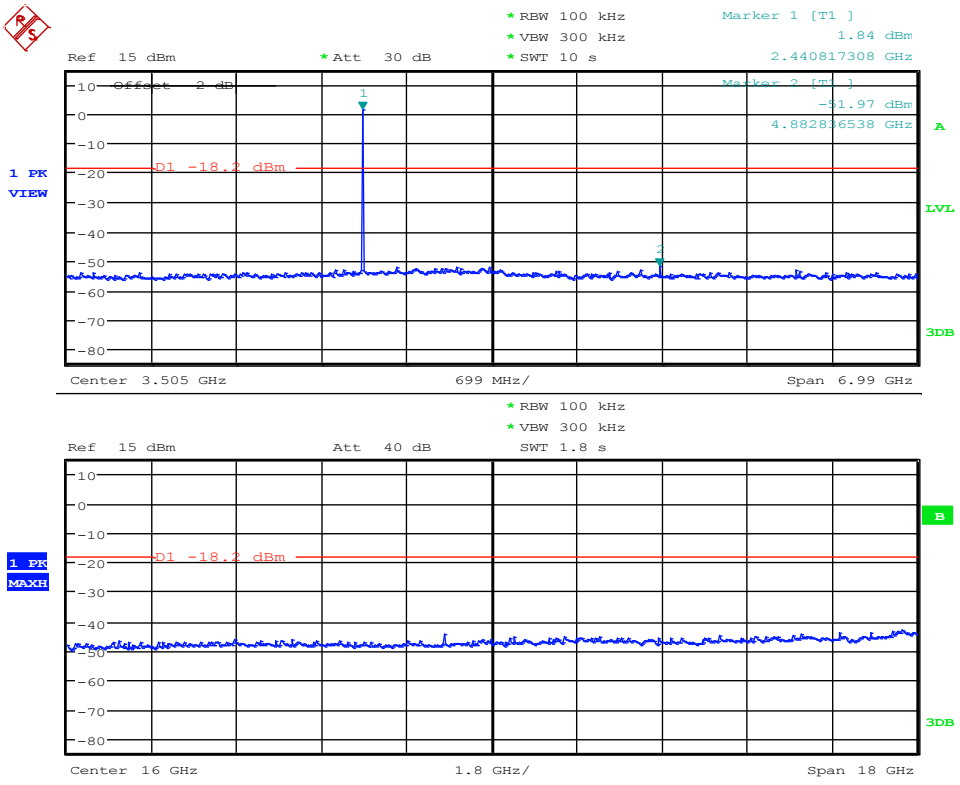
Date: 24.JUL.2015 11:44:27

Conducted spurious emissions – 2-DH5-Sngl F_{MID}

Spurious Emissions acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5, 2441 MHz
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Spurious in non-restricted frequency bands (ANSI C63.10)
Note 2:	conducted measurement



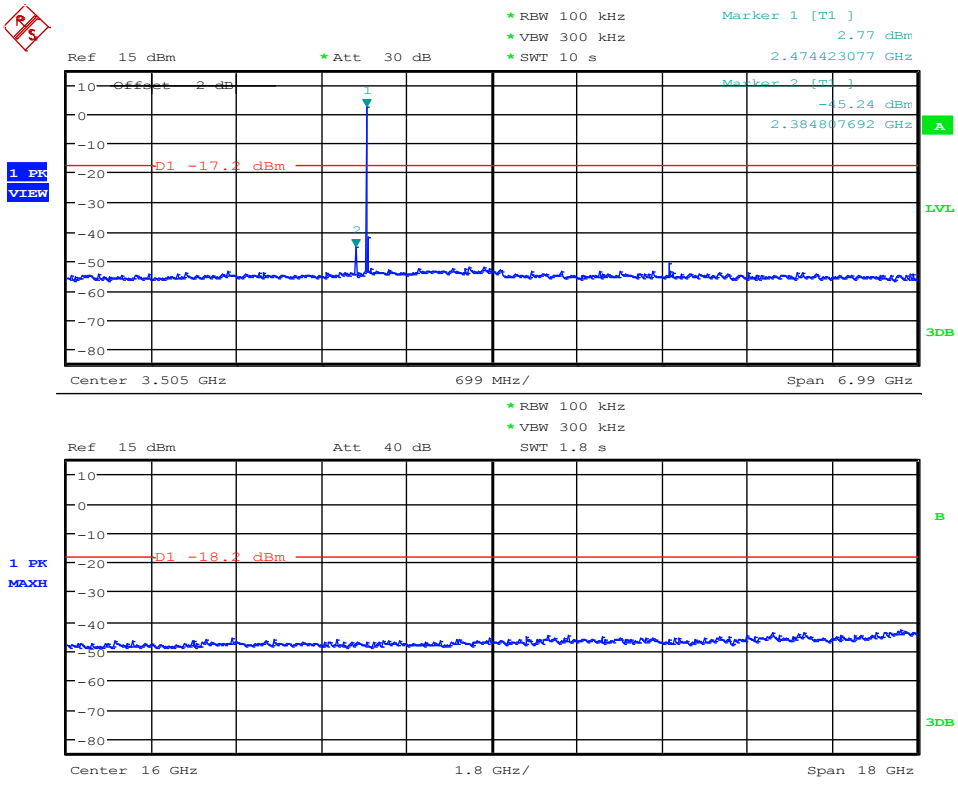
Date: 24.JUL.2015 11:47:18

Conducted spurious emissions – 2-DH5-Sngl F_{HIGH}

Spurious Emissions acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 2DH5, 2480 MHz
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Spurious in non-restricted frequency bands (ANSI C63.10)
Note 2:	conducted measurement



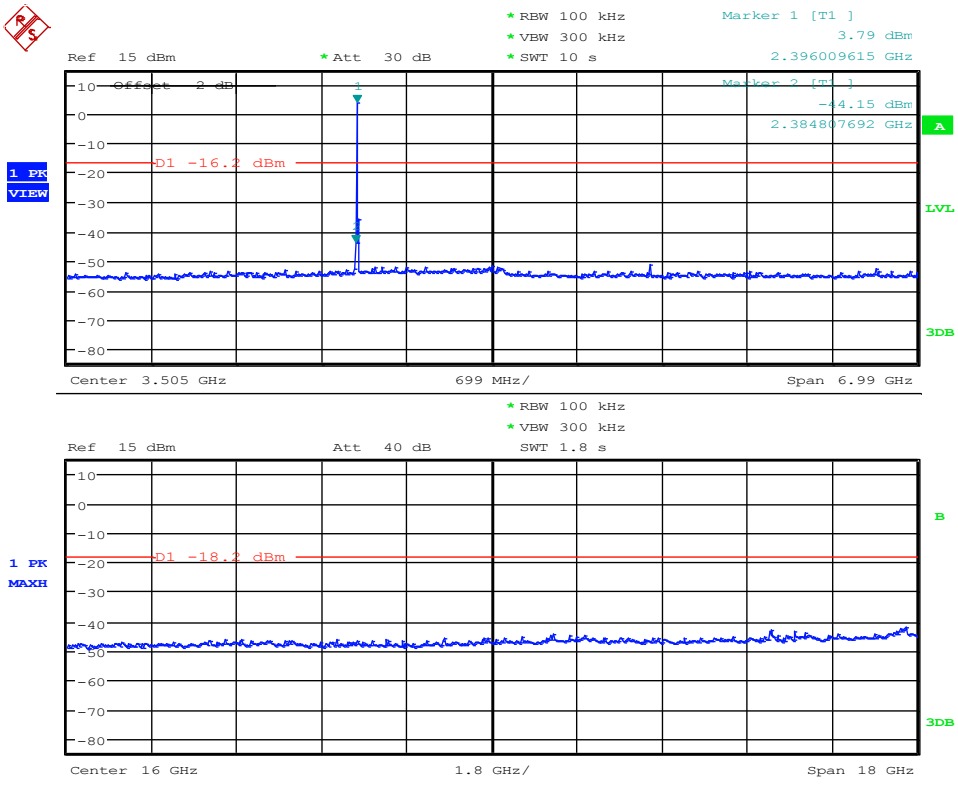
Date: 24.JUL.2015 11:51:05

Conducted spurious emissions – 3-DH5-Sngl F_{LOW}

Spurious Emissions acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5, 2402 MHz
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Spurious in non-restricted frequency bands (ANSI C63.10)
Note 2:	conducted measurement



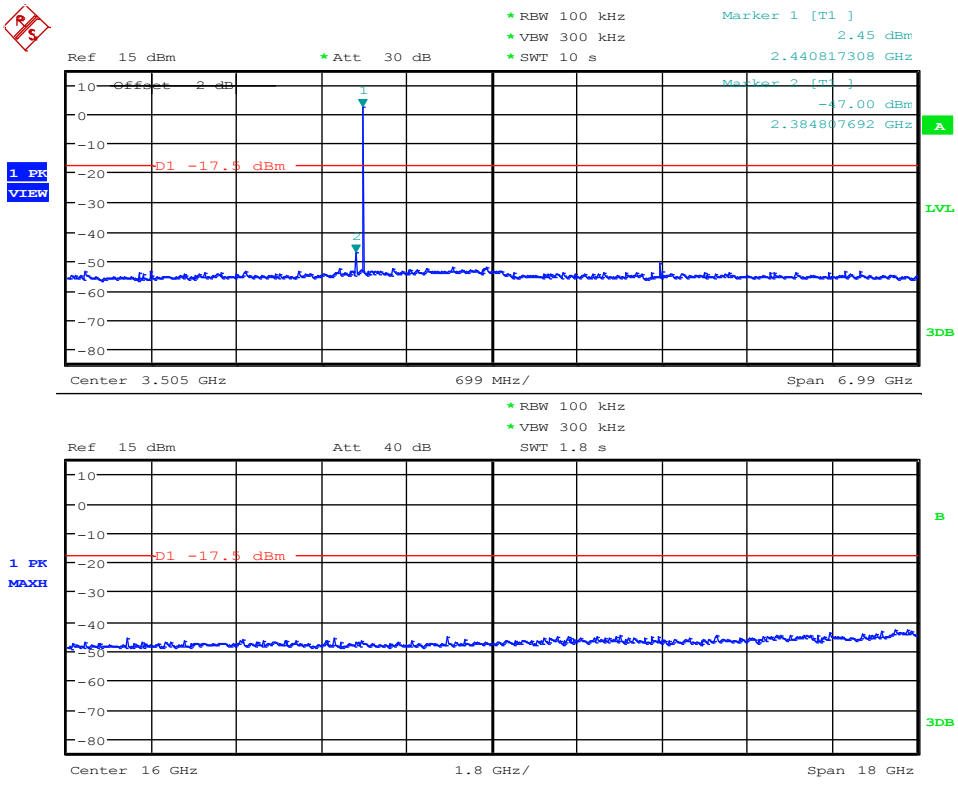
Date: 24.JUL.2015 11:54:30

Conducted spurious emissions – 3-DH5-Sngl F_{MID}

Spurious Emissions acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5, 2441 MHz
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Spurious in non-restricted frequency bands (ANSI C63.10)
Note 2:	conducted measurement



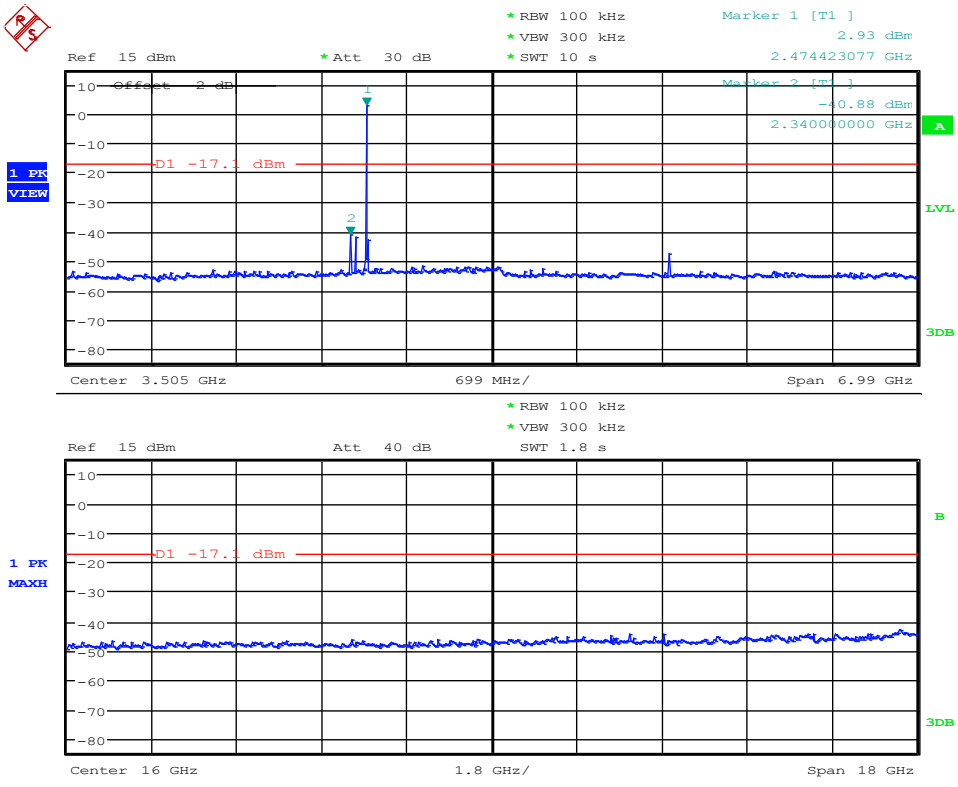
Date: 24.JUL.2015 11:57:34

Conducted spurious emissions – 3-DH5-Sngl F_{HIGH}

Spurious Emissions acc. to FCC 15.247

Project Number: G0M-1507-4918

Applicant:	ABB Oy, Drives and Controls
EUT Name:	Assistant control panel with Bluetooth interface
Model:	ACS-AP-W
Test Site:	Eurofins Product Service GmbH
Operator:	Wilfried Treffke
Test Conditions:	Tnom / Vnom
Mode:	Tx, EDR, 3DH5, 2480 MHz
Test Date:	2015-07-24
Verdict:	PASS
Note 1:	Spurious in non-restricted frequency bands (ANSI C63.10)
Note 2:	conducted measurement



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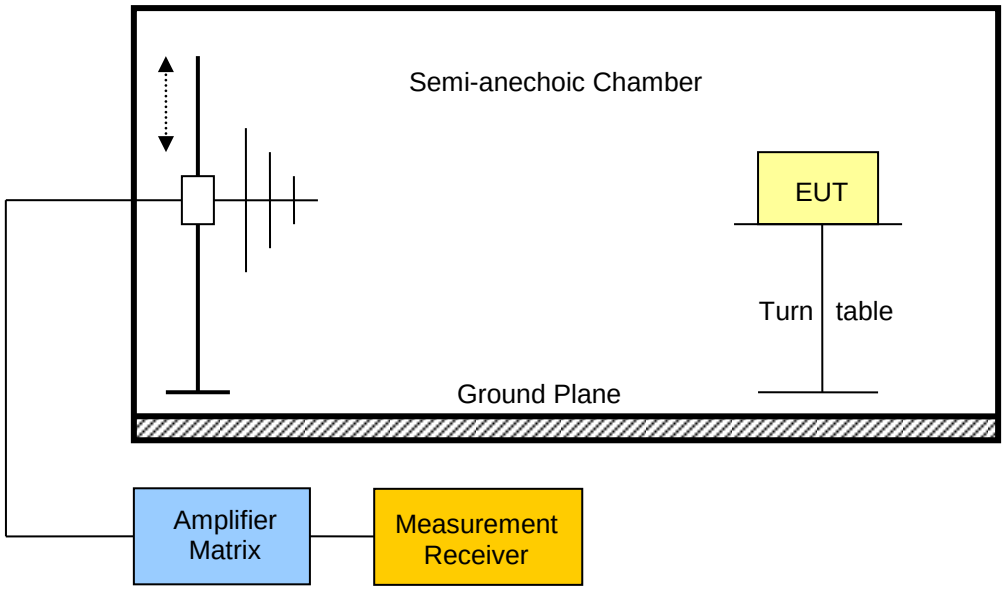
3.10 Test Conditions and Results – Transmitter radiated emissions

Transmitter radiated emissions acc. to FCC 47 CFR 15.247 / IC RSS-247				**Verdict: PASS**
Test according referenced standards		Reference Method		
		FCC 15.247(d) / IC RSS-247 5.5		
Test according to measurement reference		Reference Method		
		ANSI C63.10		
Test frequency range		Tested frequencies		
		30 MHz – 10th Harmonic		
Limits				
Frequency range [MHz]	Detector	Limit [µV/m]	Limit [dBµV/m]	Limit Distance [m]
30 – 88	Quasi-Peak	100	40	3
88 – 216	Quasi-Peak	150	43.5	3
216 – 960	Quasi-Peak	200	46	3
960 – 1000	Quasi-Peak	500	54	3
> 1000	Average	500	54	3
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)). When average radiated emission measurements are specified, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.				
Test setup				



Test procedure
1. EUT set to test mode (Communication tester is used if needed) 2. Span it set according to measurement range 3. Resolution bandwidth below 1 GHz is set according to CISPR 16 with peak/quasi-peak detector and RBW of 1 MHz with peak/average detector is used above 1 GHz 4. Markers are set to peak emission levels within restricted bands

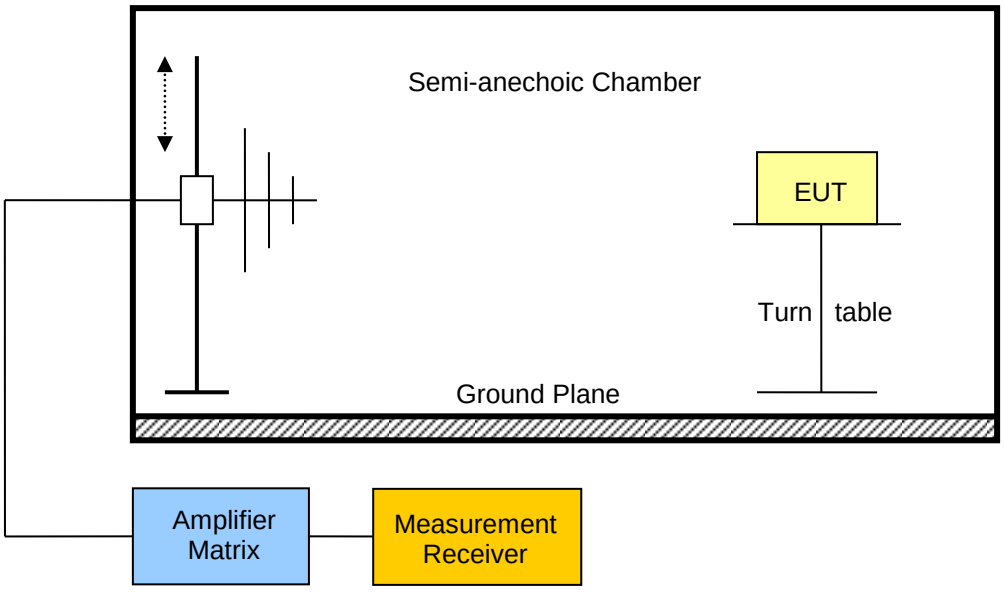
Test results

Channel	Frequency [MHz]	Mode	Emission [MHz]	Level [dbµV/m]	Det.	Pol.	Limit [dbµV/m]	Limit dist. [m]*	Margin [dB]
F_{LOW}	2402	DH5-Sngl	2337	54.50	pk	ver	74.00	3	-19.50
F_{LOW}	2402	DH5-Sngl	2337	36.56	RMS	ver	54.00	3	-17.44
F_{LOW}	2402	DH5-Sngl	2338	56.48	pk	hor	74.00	3	-17.52
F_{LOW}	2402	DH5-Sngl	2338	36.57	RMS	hor	54.00	3	-17.43
F_{LOW}	2402	DH5-Sngl	2376	58.48	pk	hor	74.00	3	-15.52
F_{LOW}	2402	DH5-Sngl	2376	37.81	RMS	hor	54.00	3	-16.19
F_{LOW}	2402	DH5-Sngl	2377	57.72	pk	ver	74.00	3	-16.28
F_{LOW}	2402	DH5-Sngl	2377	37.81	RMS	ver	54.00	3	-16.19
F_{MID}	2441	DH5-Sngl	2370.4	54.23	pk	hor	74.00	3	-19.77
F_{MID}	2441	DH5-Sngl	2370.4	30.14	avg	hor	54.00	3	-23.86
F_{MID}	2441	DH5-Sngl	7323	57.18	pk	hor	74.00	1	-16.82
F_{MID}	2441	DH5-Sngl	7323	53.30	avg	hor	54.00	1	-00.70
F_{HIGH}	2480	DH5-Sngl	2380	55.93	pk	ver	74.00	3	-18.07
F_{HIGH}	2480	DH5-Sngl	2380	31.84	avg	ver	54.00	3	-22.16
F_{HIGH}	2480	DH5-Sngl	2381	55.75	pk	hor	74.00	3	-18.25
F_{HIGH}	2480	DH5-Sngl	2381	31.72	avg	hor	54.00	3	-22.28
F_{HIGH}	2480	DH5-Sngl	2483.5	59.70	pk	hor	74.00	3	-14.30
F_{HIGH}	2480	DH5-Sngl	2483.5	52.56	RMS	hor	54.00	3	-01.44
F_{HIGH}	2480	DH5-Sngl	2483.5	59.53	pk	ver	74.00	3	-14.47
F_{HIGH}	2480	DH5-Sngl	2483.5	51.86	RMS	ver	54.00	3	-02.14
F_{HIGH}	2480	DH5-Sngl	2503	55.85	pk	ver	95.00	3	-39.15
F_{HIGH}	2480	DH5-Sngl	2506	59.25	pk	hor	95.00	3	-35.75
F_{HIGH}	2480	DH5-Sngl	4960	52.74	pk	ver	74.00	1	-21.26
F_{HIGH}	2480	DH5-Sngl	7440	55.80	pk	hor	74.00	1	-18.20
F_{HIGH}	2480	DH5-Sngl	7440	52.16	avg	hor	54.00	1	-01.84
F_{LOW}	2402	3DH5-Sngl	2337	55.65	pk	hor	74.00	3	-18.35
F_{LOW}	2402	3DH5-Sngl	2337	36.56	RMS	hor	54.00	3	-17.44
F_{LOW}	2402	3DH5-Sngl	2338	53.04	pk	ver	74.00	3	-20.96
F_{LOW}	2402	3DH5-Sngl	2338	36.56	RMS	ver	54.00	3	-17.44

F_{LOW}	2402	3DH5-Sngl	2379	56.91	pk	hor	74.00	3	-17.09
F_{LOW}	2402	3DH5-Sngl	2379	37.83	RMS	hor	54.00	3	-16.17
F_{LOW}	2402	3DH5-Sngl	2379	54.86	pk	ver	74.00	3	-19.14
F_{LOW}	2402	3DH5-Sngl	2379	36.92	RMS	ver	54.00	3	-17.08
F_{LOW}	2402	3DH5-Sngl	2388	55.29	pk	hor	74.00	3	-18.71
F_{LOW}	2402	3DH5-Sngl	2388	37.91	RMS	hor	54.00	3	-16.09
F_{LOW}	2402	3DH5-Sngl	2388	54.03	pk	ver	74.00	3	-19.97
F_{LOW}	2402	3DH5-Sngl	2388	36.99	RMS	ver	54.00	3	-17.01
F_{MID}	2441	3DH5-Sngl	7323	55.84	pk	hor	74.00	1	-18.16
F_{MID}	2441	3DH5-Sngl	7323	51.17	avg	hor	54.00	1	-02.83
F_{HIGH}	2480	3DH5-Sngl	2483.5	57.28	pk	hor	74.00	3	-16.72
F_{HIGH}	2480	3DH5-Sngl	2483.5	47.18	RMS	hor	54.00	3	-06.82
F_{HIGH}	2480	3DH5-Sngl	2483.5	57.44	pk	ver	74.00	3	-16.56
F_{HIGH}	2480	3DH5-Sngl	2483.5	46.67	RMS	ver	54.00	3	-07.33
F_{HIGH}	2480	3DH5-Sngl	7440	56.48	pk	hor	74.00	1	-17.52
F_{HIGH}	2480	3DH5-Sngl	7440	51.27	avg	hor	54.00	1	-02.73
Comments: * Physical distance between EUT and measurement antenna.									

3.11 Test Conditions and Results – Receiver radiated emissions

Receiver radiated emissions acc. to IC RSS-247				**Verdict: PASS**
Test according referenced standards	Reference Method			
	IC RSS-247 3.1			
Test according to measurement reference	Reference Method			
	ANSI C63.10			
Test frequency range	Tested frequencies			
	30 MHz – 5th Harmonic			
EUT test mode	Receive			
Limits				
Frequency range [MHz]	Detector	Limit [µV/m]	Limit [dBµV/m]	Limit Distance [m]
30 – 88	Quasi-Peak	100	40	3
88 – 216	Quasi-Peak	150	43.5	3
216 – 960	Quasi-Peak	200	46	3
960 – 1000	Quasi-Peak	500	54	3
> 1000	Average	500	54	3
Test setup				



Test procedure
1. EUT set to receive mode (Communication tester is used if needed) 2. Span it set according to measurement range 3. Resolution bandwidth below 1 GHz is set according to CISPR 16 with peak/quasi-peak detector and RBW of 1 MHz with peak/average detector is used above 1 GHz 4. Markers are set to peak emission levels

Test results

Channel	Frequency [MHz]	Emission [MHz]	Emission Level [dbµV/m]	Det.	Pol.	Limit [dBµV/m]	Margin [dB]
F_{scan}	2402-2480	430.4	23.11	pk	ver	46.00	-22.89
F_{scan}	2402-2480	883.2	25.78	pk	ver	46.00	-20.22
F_{scan}	2402-2480	3892	39.90	pk	ver	53.98	-14.08
F_{scan}	2402-2480	7560	48.36	pk	hor	53.98	-5.62
F_{scan}	2402-2480	7944	49.04	pk	ver	53.98	-4.94
F_{scan}	2402-2480	12365	42.75	pk	hor	53.98	-11.23

Comments: