Test Report

TEST Reg. no. 19

Radio parameter test of CSN V2 Bluetooth Low Energy 4.2 Sensor Node according to FCC specifications

Performed for Pirelli Tyre LLC

DANAK-19/18660
Project no.: 117-28082-7

12 December 2017

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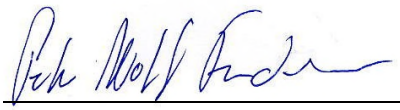
Title	Radio parameter test of CSN V2 Bluetooth Low Energy 4.2 Sensor Node according to FCC specifications
Test object	CSN V2 Bluetooth Low Energy 4.2 Sensor Node according to FCC specifications
Report no.	DANAK-19/18660
Project no.	117-28082-7
Test period	20 to 21 November 2017
Client	Pirelli Tyre LLC 100 Pirelli Drive Rome Georgia 30161-7000, USA Tel.: 1-800-PIRELLI (800-747-3554)
Contact person	Stephanie Dattilo E-mail: Stephanie.dattilo@pirelli.com
Manufacturer	Pirelli Tyre S.p.A
Specifications	47 CFR Part 15, Subpart C (Specific rule part §15.249)
Results	The test object was found to be in compliance with the specifications
Test personnel	Peter Wolf Frandsen
Test site	Venlighedsvej 4, 2970 Hørsholm, Denmark

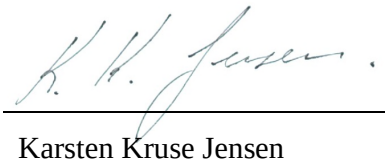
Date 12 December 2017

Project Manager



Peter Wolf Frandsen
Specialist, EMC
FORCE Technology

Responsible



Karsten Kruse Jensen
Head of Department
FORCE Technology

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1. Summary of tests

Tests	Test methods	Rule Section	Results
Measurement of radiated emission / field strength of harmonics	ANSI C63.10:2013	47 CFR Part 15.249	Passed
Measurement of field strength of fundamental	ANSI C63.10:2013	47 CFR Part 15.249	Passed
Measurement of band edge compliance	ANSI C63.10:2013	47 CFR Part 15.249	Passed
Measurement of 20 dB bandwidth	ANSI C63.10:2013	47 CFR Part 15.215(c)	Passed

The given result is based on a shared risk principle with respect to the measurement uncertainty.

Conclusion

The test objects mentioned in this report meet the requirements of the standard stated below, with respect to the tests listed above.

- 47 CFR Part 15, Subpart C (Specific rule part §15.249)

The test results relate only to the objects tested.

2. Test object and auxiliary equipment

2.1 Test object

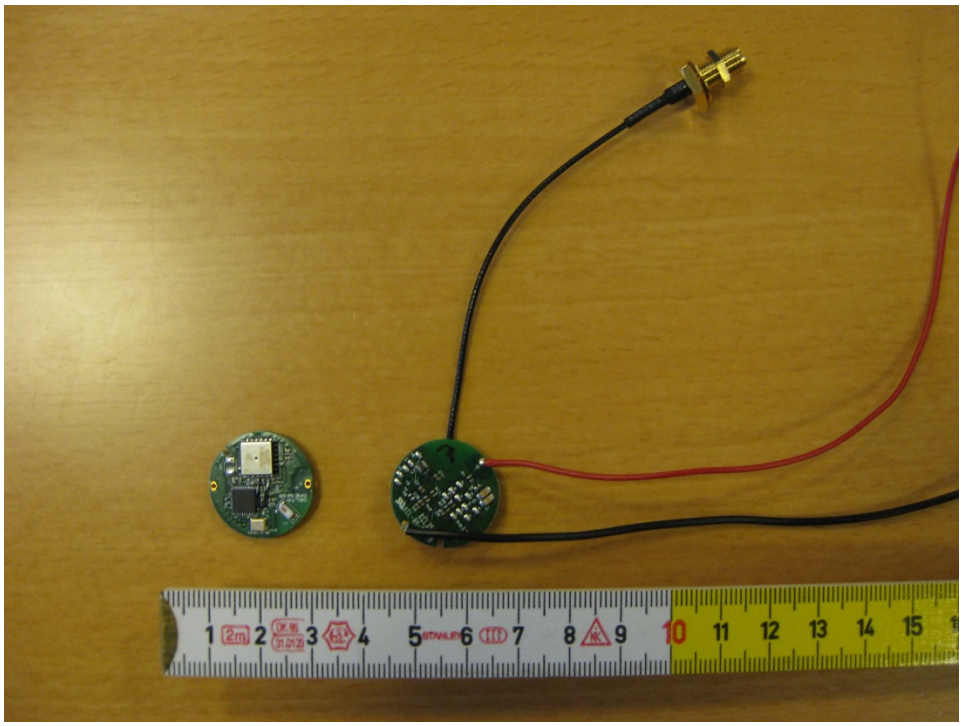


Photo 2.1.1 Test object.

Test object 2.1.1

Name of test object	CSN V2
Model / type	Bluetooth Low Energy 4.2 Sensor Node
Part no.	-
Serial no.	TX_LOW (4), TX_MID (6) and TX_HIGH (8)
FCC ID	2ANX7CCSN2
Manufacturer	Pirelli Tyre S.p.A.
Supply voltage	3 VDC
Software version	6.0
Hardware version	Special SRD version
Cycle time	< 1 ms
Highest frequency generated or used	2483,5 MHz
Comment	3 different test objects hardwired for low, mid, and high Tx frequency
Received	Date: 20 November 2017. Status: Test object sampled and provided by customer.

Test object 2.1.2

Name of test object	CSN V2
Model / type	Bluetooth Low Energy 4.2 Sensor Node
Part no.	-
Serial no.	TX_LOW (5), TX_MID (7) and TX_HIGH (8)
FCC ID	2ANX7CCSN2
Manufacturer	Pirelli Tyre S.p.A.
Supply voltage	3 VDC
Software version	6.0
Hardware version	M103431_DME303_585
Cycle time	< 1 ms
Highest frequency generated or used	2483,5 MHz
Comment	Antenna replaced by SMA connector. Battery replaced by external PSU. 3 different test objects hardwired for low, mid, and high Tx frequency.
Received	Date: 21 November 2017. Status: Test object sampled and provided by customer.

3. General test conditions

3.1 Test setup during test

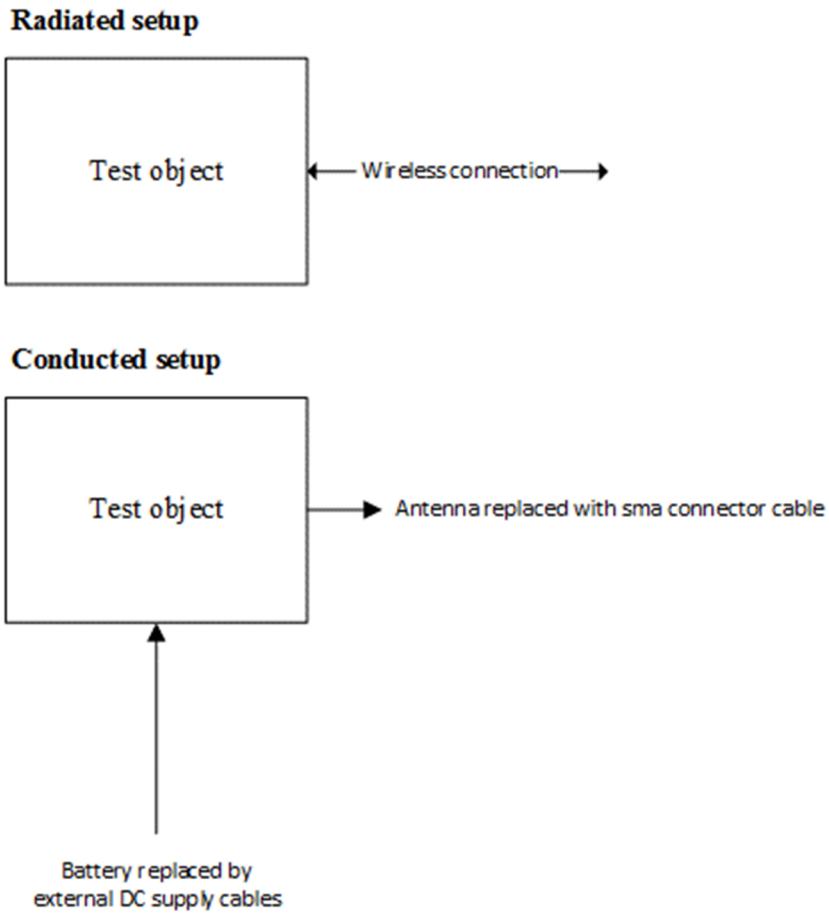


Figure 3.1.1 Block diagram of test objects with cables and auxiliary equipment.

3.1.1 Description of test setup

Two different test setups were used:

- Radiated setup: Wireless connection with continuous transmission (low, mid or high channel).
- Conducted setup: Antenna replaced with a SMA connector and continuous transmission (low, mid or high channel).

3.1.2 Description and intended use of test object

The product is:

- Tyre Pressure Monitoring System Sensor (TPMS sensor)
- Located on a vehicle tyre, permanently attached to the inner lining
- A radio transceiver, operating on the 2.4 GHz Bluetooth low energy band

The real software, CSN V2 4.0, operates in a discontinuous state, only transmitting periodically depending on the mode/state (e.g. 30 seconds, 6 seconds). When a connection is made with a control unit, the transmission rates is up to 0.5 seconds.

3.1.3 Test modes during emission tests

Test software was implemented to operate at worst case (continuous transmission cycle), conditions for the low, mid and high bands.

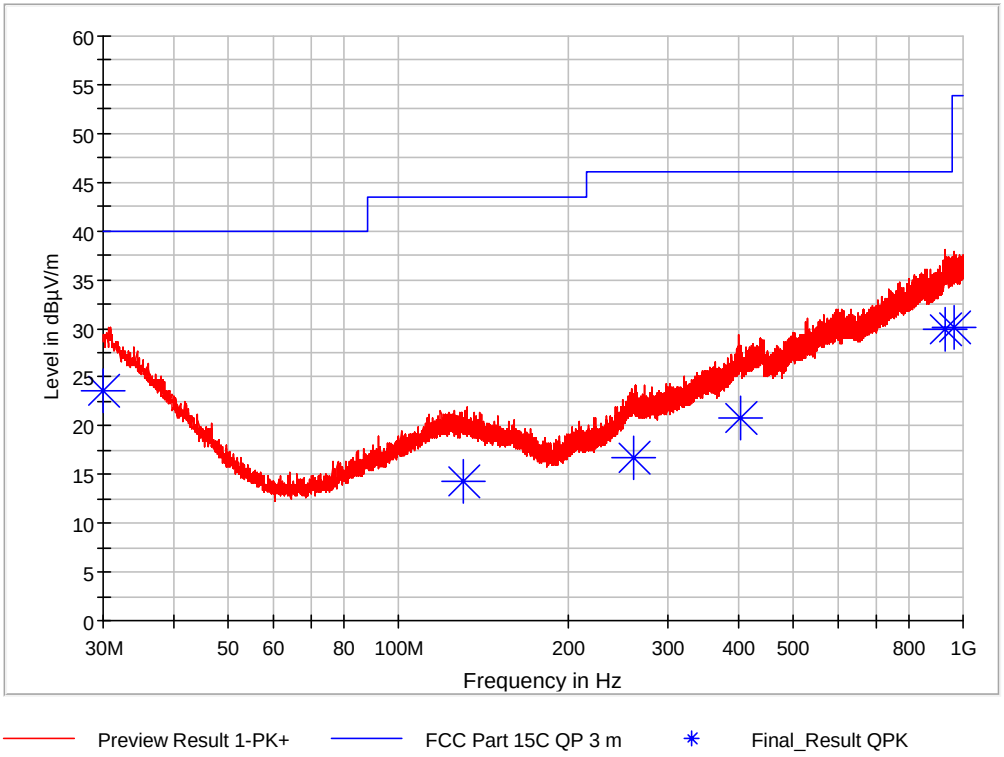
4. Test results

4.1 Measurement of radiated emission (below 1 GHz)

Test object	CSN V2	Sheet	RE_Spur-1
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (4), TX_MID (6) and TX_HIGH (8)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	30-1000 MHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m	Temperature Humidity	22 °C 32 % RH
Detector	Peak and quasi peak	Bandwidth	120 kHz
Test equipm.	EMI room Hørsholm 49704 49590 49817 49999 49807 49154 49900	Uncertainty	5.0 dB

Full Spectrum



Comments Continuous Tx - normal modulation - hopping off

Test object	CSN V2	Sheet	RE_Spur-2
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (4), TX_MID (6) and TX_HIGH (8)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	30-1000 MHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m	Temperature Humidity	23 °C 32 % RH
Detector	Quasi peak	Bandwidth	120 kHz
Test equipm.	EMI room Hørsholm 49704 49590 49817 49999 49807 49154 49900	Uncertainty	5.0 dB

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band width (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.00	23.56	40.00	16.44	15000.0	120.0	208.0	H	6	26.8
130.11	14.34	43.50	29.16	15000.0	120.0	200.0	H	84	20.1
260.76	16.66	46.00	29.34	15000.0	120.0	352.0	H	201	22.5
403.17	20.75	46.00	25.25	15000.0	120.0	178.0	H	51	26.1
929.67	29.96	46.00	16.04	15000.0	120.0	400.0	H	84	35.5
964.71	30.14	53.90	23.76	15000.0	120.0	296.0	H	57	35.9

Test result	The measured field strengths are below the limit
Test Port	Enclosure
Test frequency	2402, 2442 and 2480 MHz
Test mode	Continuous Tx - normal modulation - hopping off
Condition	Normal
Compliant	Yes
Comments	Final maximal measurements by variation of turntable azimuth, antenna height, and antenna polarisation. Test voltage: Internal battery 3 VDC.

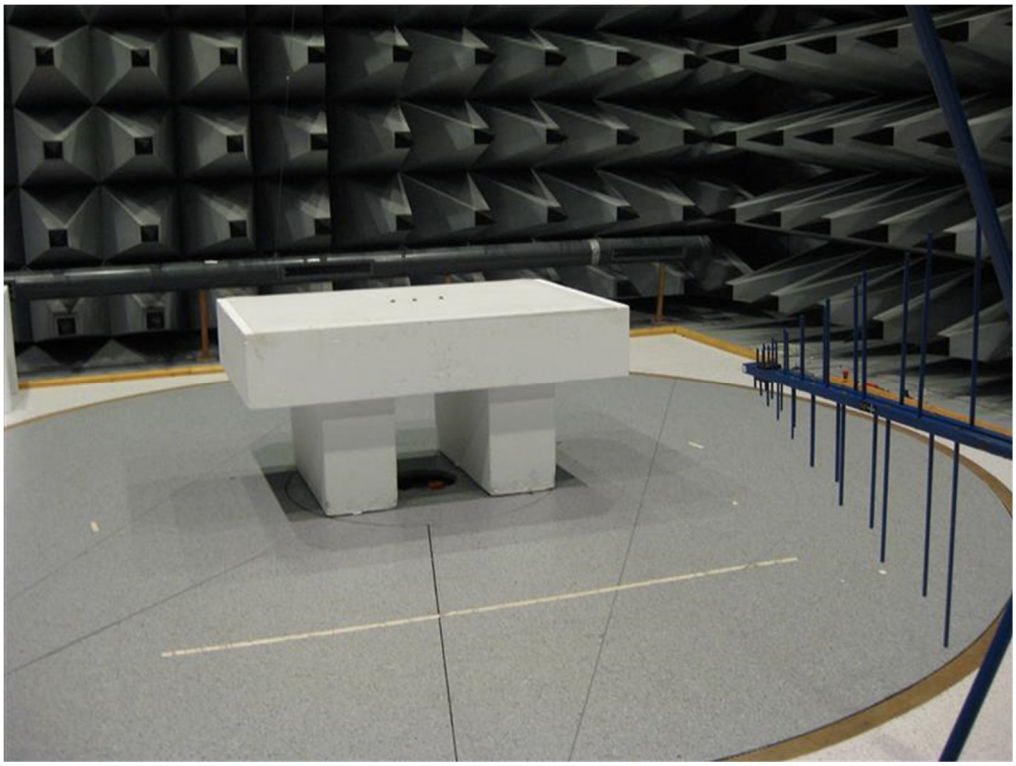


Photo 4.1.1 Test setup regarding measurement of radiated emission (below 1 GHz).

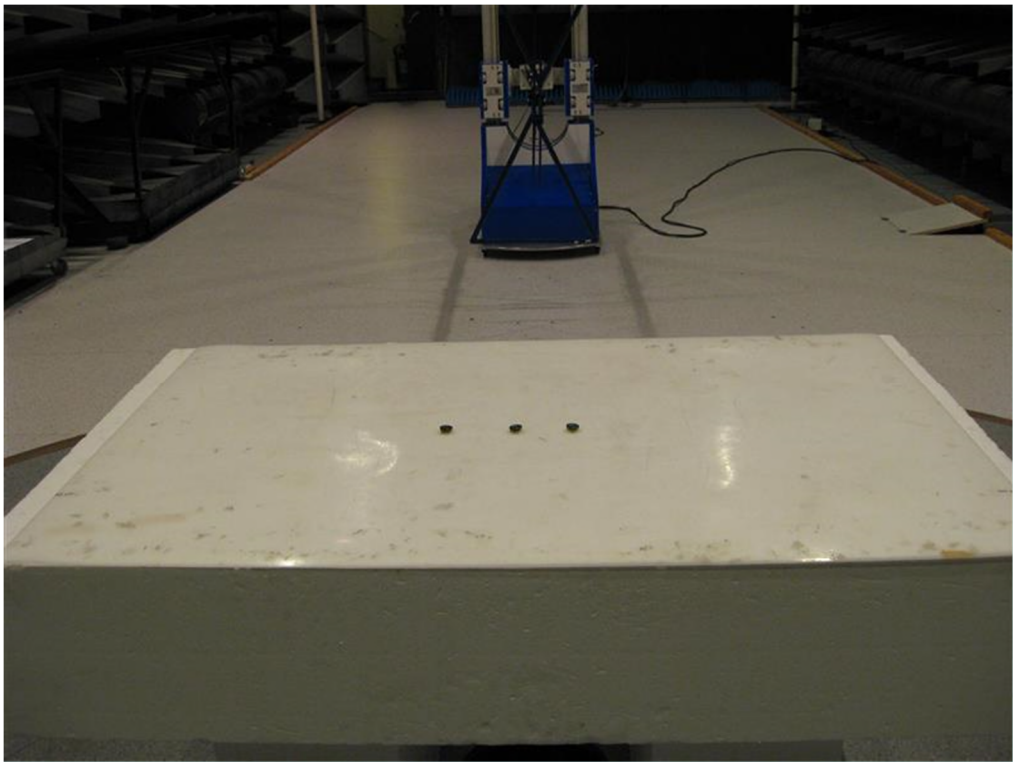
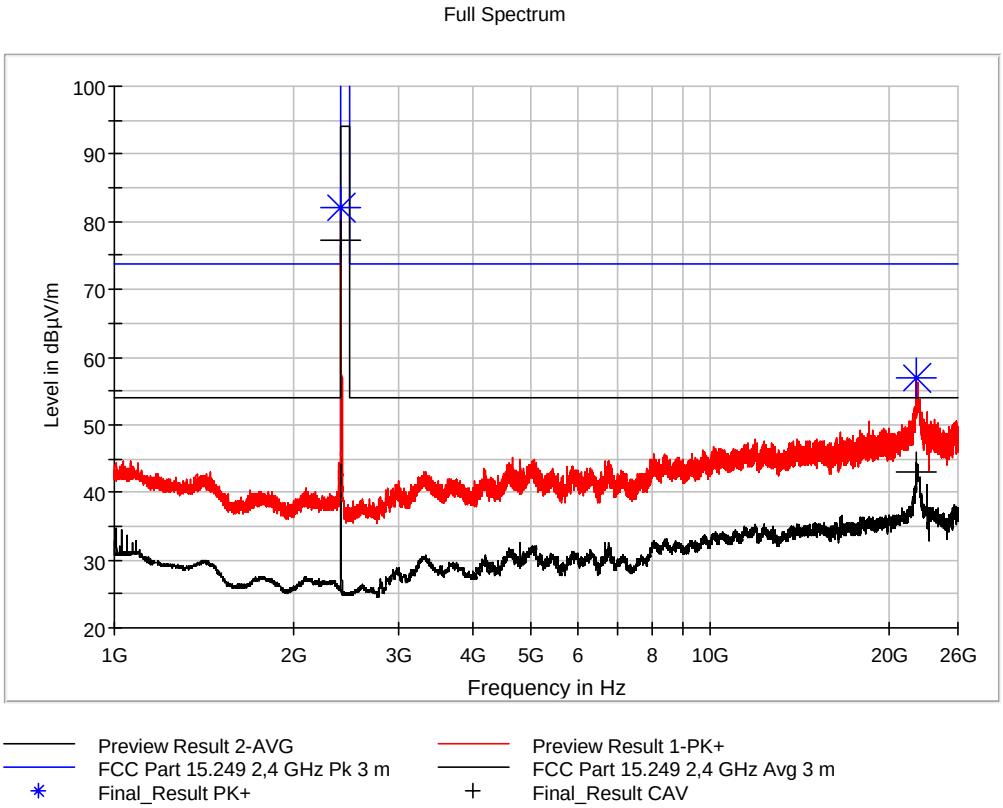


Photo 4.1.2 Test setup regarding measurement of radiated emission (below 1 GHz).

4.2 Measurement of radiated emission (above 1 GHz), LOW

Test object	CSN V2	Sheet	RE_Spur-3
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (4)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	1-26 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB



Polarization Vertical and horizontal peak measurements

Comments Continuous Tx - normal modulation - hopping off.

Test object	CSN V2	Sheet	RE_Spur-4
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (4)	Date	11 Sep. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	1-26 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Corr (dB)	Azimuth (deg)
2402.00	---	77.15	94.00	16.85	15000	156.0	V	-15.2	137
2402.25	82.12	---	114.00	31.88	15000	206.0	V	-15.2	163
22196.00	---	42.99	53.90	10.91	15000	102.0	V	-1.7	37
22200.75	56.79	---	73.90	17.11	15000	229.0	H	-1.5	256

Test result — The measured peak field strengths are below the peak limit

Test Port — Enclosure

Test frequency — 2402 MHz

Test mode — Continuous Tx - normal modulation - hopping off

Condition — Normal

Compliant — Yes

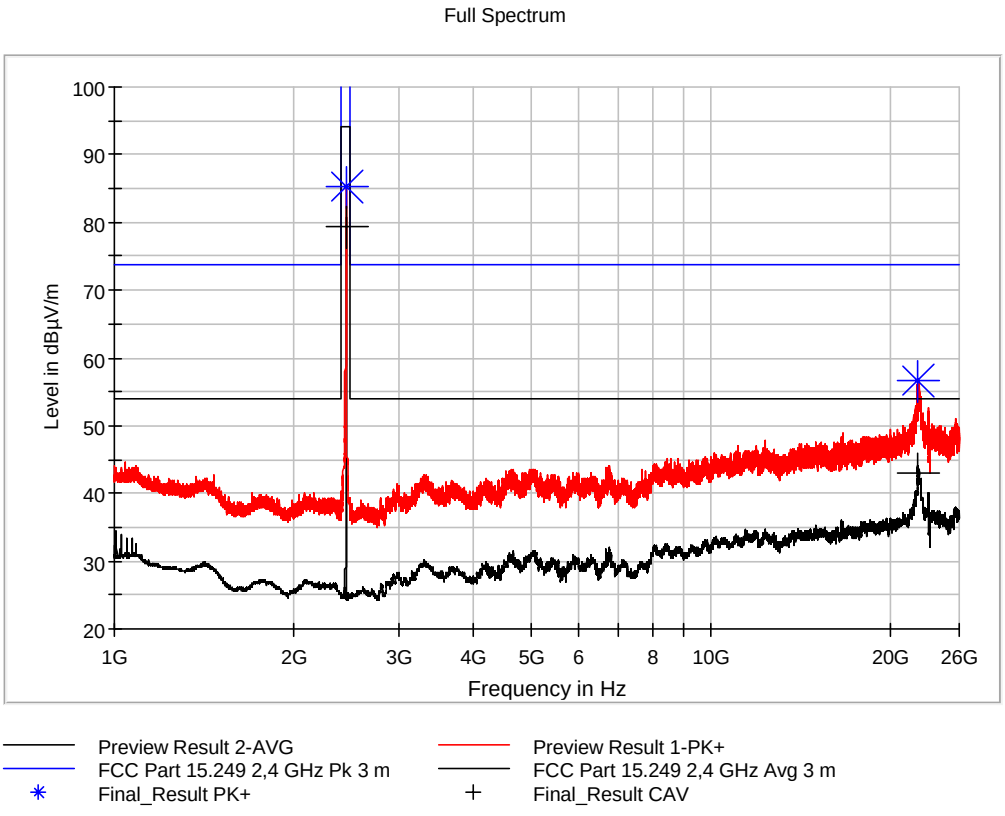
Comments — Final maximal measurements by variation of turntable azimuth, antenna height and antenna polarization.

Test voltage: Internal battery 3 VDC.

4.3 Measurement of radiated emission (above 1 GHz), MID

Test object	CSN V2	Sheet	RE_Spur-5
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_MID (6)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	1-26 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB



Polarization Vertical and horizontal peak measurements

Comments Continuous Tx - normal modulation - hopping off.

Test object	CSN V2	Sheet	RE_Spur-6
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_MID (6)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	1-26 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Corr (dB)	Azimuth (deg)
2442.00	---	79.48	94.00	14.52	15000.0	203.0	V	-15.0	178
2442.25	85.25	---	114.00	28.75	15000.0	212.0	V	-15.0	171
22196.25	56.55	---	73.90	17.35	15000.0	107.0	V	-1.7	130
22197.50	---	42.93	53.90	10.97	15000.0	100.0	V	-1.6	41

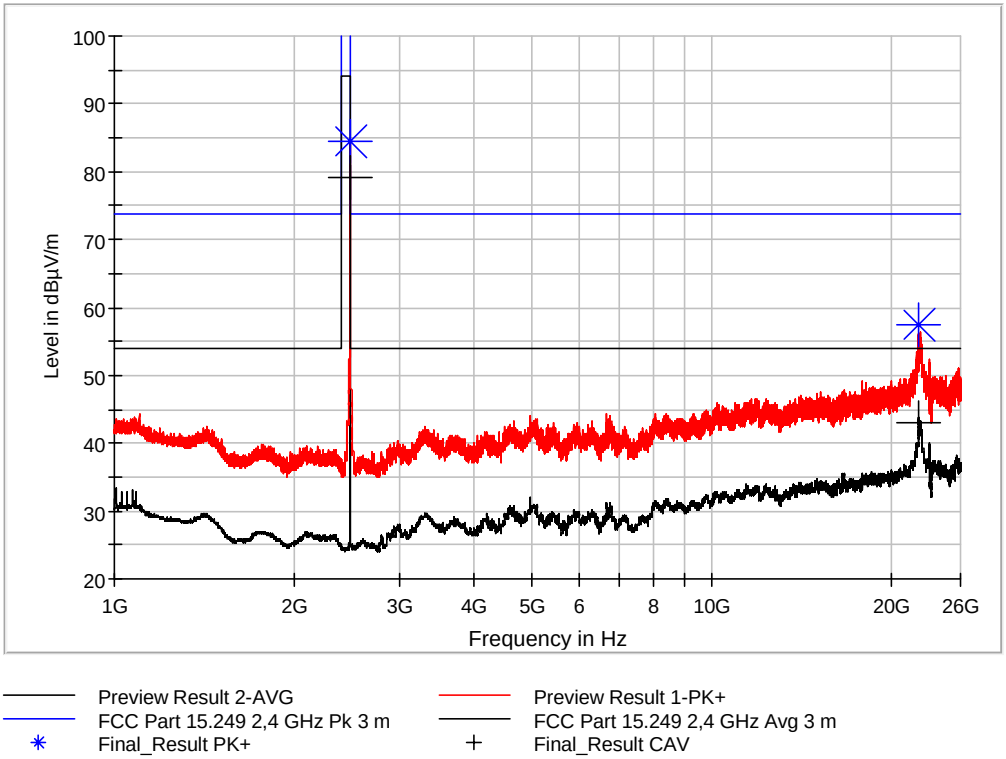
Test result	The measured peak field strengths are below the peak and average limits
Test Port	Enclosure
Test frequency	2442 MHz
Test mode	Continuous Tx - normal modulation - hopping off
Condition	Normal
Compliant	Yes
Comments	Final maximal measurements by variation of turntable azimuth, antenna height and antenna polarization. Test voltage: Internal battery 3 VDC.

4.4 Measurement of radiated emission (above 1 GHz), HIGH

Test object	CSN V2	Sheet	RE_Spur-7
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_HIGH (8)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	1-26 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB

Full Spectrum



Polarization Vertical and horizontal peak measurements

Comments Continuous Tx - normal modulation - hopping off.

Test object	CSN V2	Sheet	RE_Spur-8
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_HIGH (8)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	1-26 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Corr (dB)	Azimuth (deg)
2479.75	**84.50**	**---**	**114.00**	**29.50**	**15000.0**	**100.0**	**V**	**-15.1**	**-5**
2480.00	**---**	**79.13**	**94.00**	**14.87**	**15000.0**	**102.0**	**V**	**-15.1**	**-8**
22197.50	**---**	**42.92**	**53.90**	**10.98**	**15000.0**	**109.0**	**V**	**-1.6**	**23**
22198.50	**57.41**	**---**	**73.90**	**16.49**	**15000.0**	**400.0**	**V**	**-1.6**	**288**

Test result — The measured peak field strengths are below the peak and average limits

Test Port — Enclosure

Test frequency — 2480 MHz

Test mode — Continuous Tx - normal modulation - hopping off

Condition — Normal

Compliant — Yes

Comments — Final maximal measurements by variation of turntable azimuth, antenna height and antenna polarization.

Test voltage: Internal battery 3 VDC.

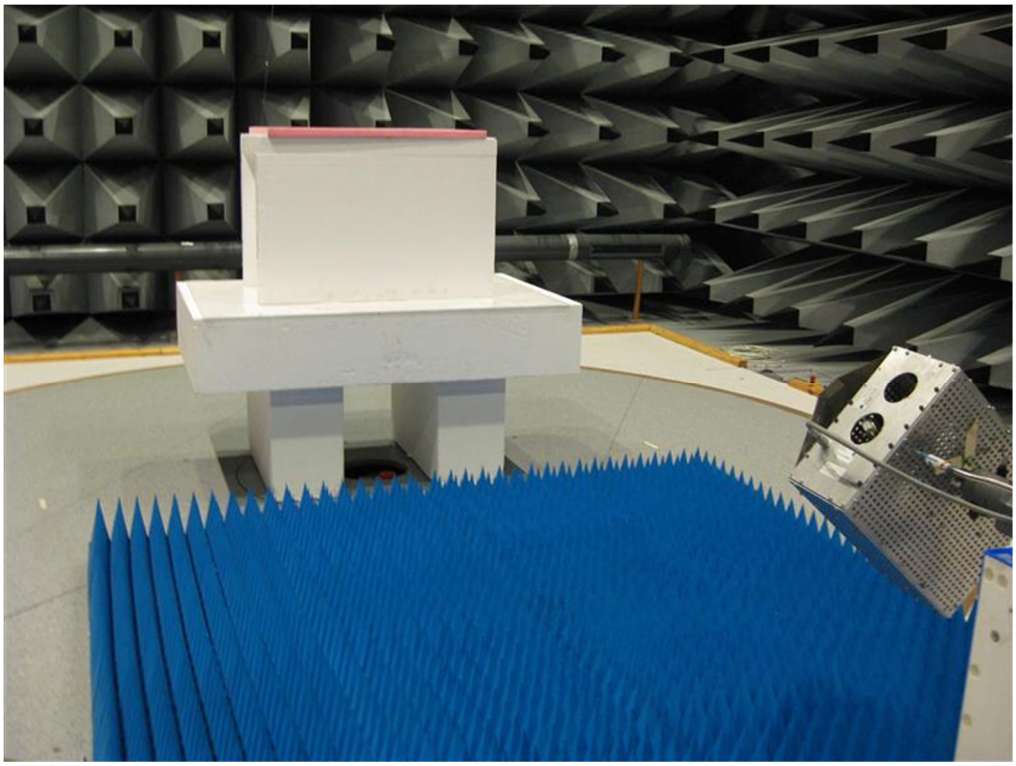


Photo 4.4.1 Test setup regarding measurement of radiated emission (above 1 GHz).

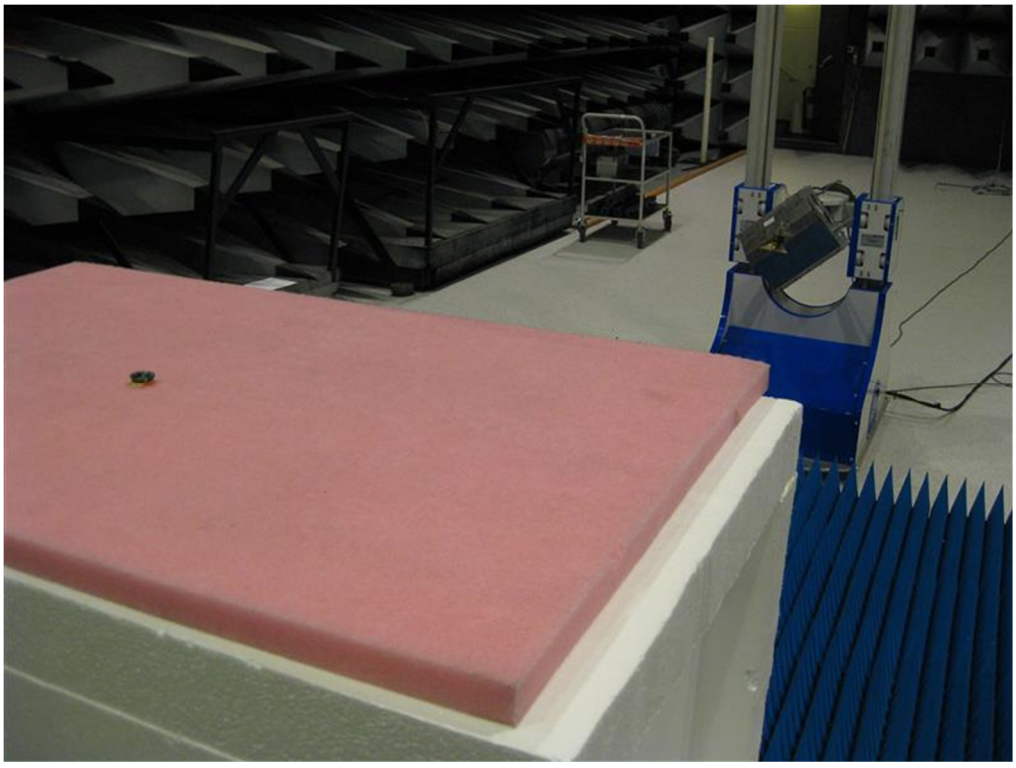
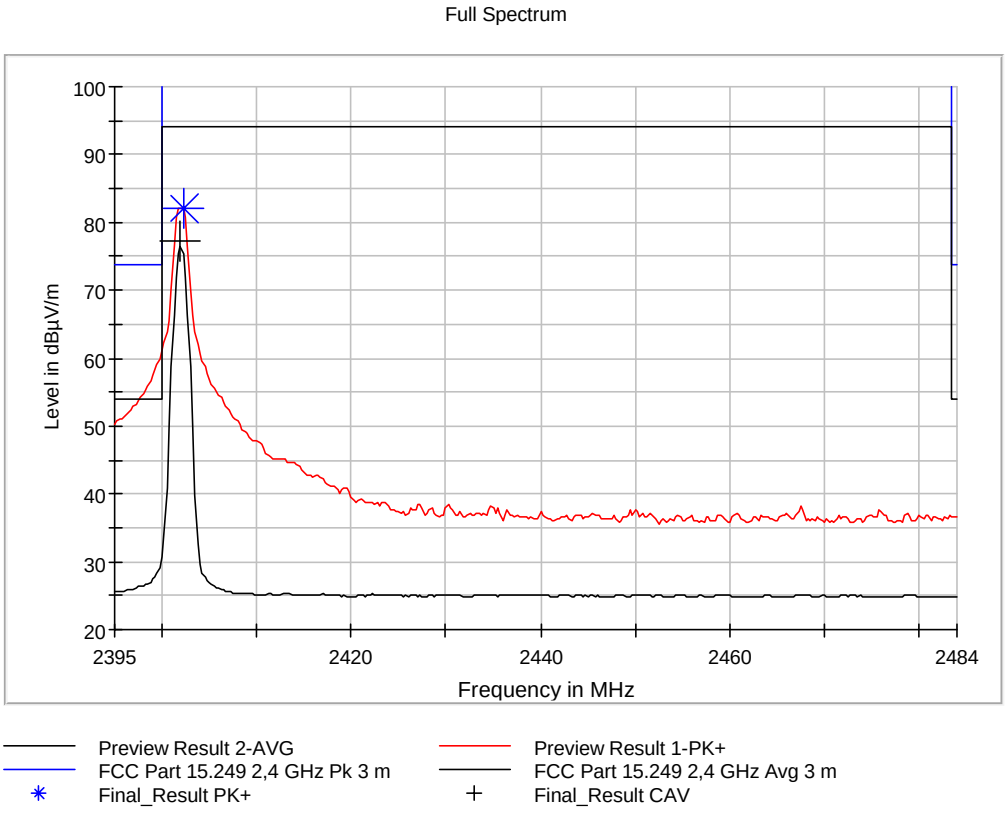


Photo 4.4.2 Test setup regarding measurement of radiated emission (above 1 GHz).

4.5 Measurement of field strength of fundamental, LOW

Test object	CSN V2	Sheet	RE_Spur-9
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (4)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	2.402 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB



Polarization	Vertical and horizontal peak measurements
Comments	Continuous Tx - normal modulation - hopping off.

Test object	CSN V2	Sheet	RE_Spur-10
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (4)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	2.402 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB

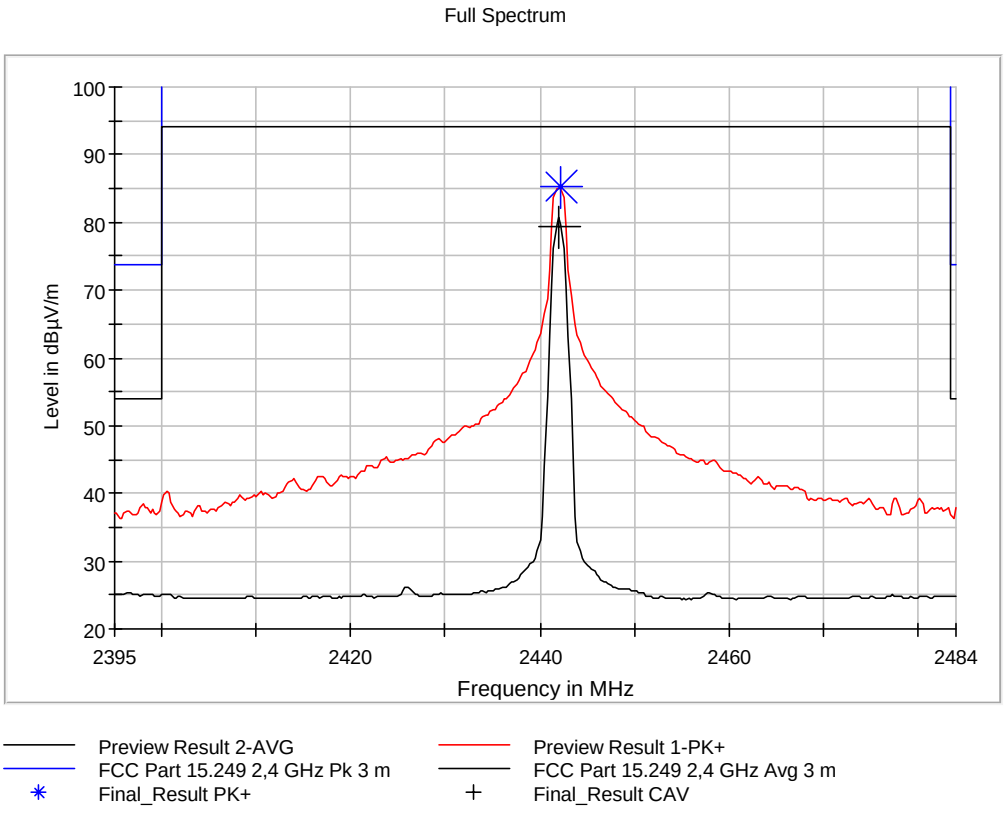
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Corr. (dB)	Pol	Azimuth (deg)
2402.00	---	77.15	94.00	16.85	15000.0	156.0	-15.2	V	137
2402.25	82.12	---	114.00	31.88	15000.0	206.0	-15.2	V	163

Test result	The measured peak field strengths are below the peak and average limits
Test Port	Enclosure
Test frequency	2402 MHz
Test mode	Continuous Tx - normal modulation - hopping off
Condition	Normal
Compliant	Yes
Comments	Final maximal measurements by variation of turntable azimuth, antenna height and antenna polarization. Test voltage: Internal battery 3 VDC.

4.6 Measurement of field strength of fundamental, MID

Test object	CSN V2	Sheet	RE_Spur-11
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_MID (6)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	2.442 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB



Polarization Vertical and horizontal peak measurements

Comments Continuous Tx - normal modulation - hopping off.

Test object	CSN V2	Sheet	RE_Spur-12
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_MID (6)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	2.442 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB

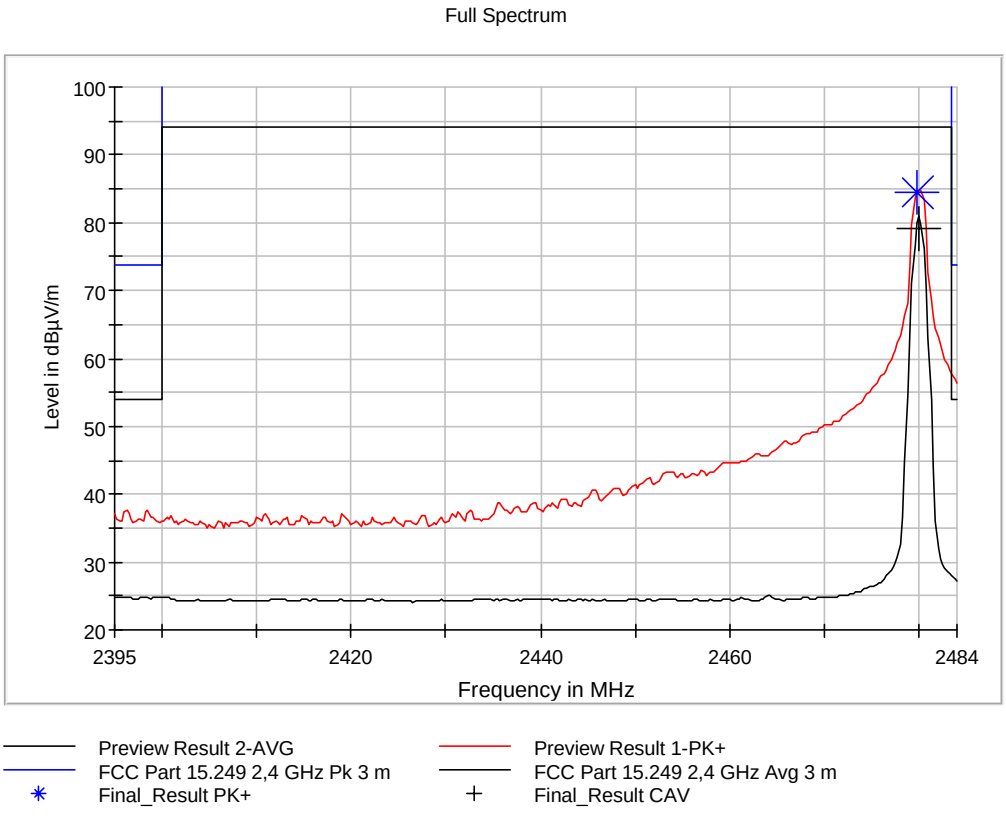
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Corr (dB)	Azimuth (deg)
2442.00	---	79.48	94.00	14.52	15000.0	203.0	V	-15.0	178
2442.25	85.25	---	114.00	28.75	15000.0	212.0	V	-15.0	171

Test result	The measured peak field strengths are below the peak and average limits
Test Port	Enclosure
Test frequency	2442 MHz
Test mode	Continuous Tx - normal modulation - hopping off
Condition	Normal
Compliant	Yes
Comments	Final maximal measurements by variation of turntable azimuth, antenna height and antenna polarization. Test voltage: Internal battery 3 VDC.

4.7 Measurement of field strength of fundamental, HIGH

Test object	CSN V2	Sheet	RE_Spur-13
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_HIGH (8)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	2.480 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB



Polarization	Vertical and horizontal peak measurements
Comments	Continuous Tx - normal modulation - hopping off.

Test object	CSN V2	Sheet	RE_Spur-14
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_HIGH (8)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)	Frequency	2.480 GHz

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m	Temperature Humidity	23 °C 30 % RH
Detector	Peak and average	Bandwidth	1 MHz
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Corr (dB)	Azimuth (deg)
2479.75	84.50	---	114.00	29.50	15000.0	100.0	V	-15.1	-5
2480.00	---	79.13	94.00	14.87	15000.0	102.0	V	-15.1	-8

Test result	The measured peak field strengths are below the peak and average limits
Test Port	Enclosure
Test frequency	2480 MHz
Test mode	Continuous Tx - normal modulation - hopping off
Condition	Normal
Compliant	Yes
Comments	Final maximal measurements by variation of turntable azimuth, antenna height and antenna polarization. Test voltage: Internal battery 3 VDC.

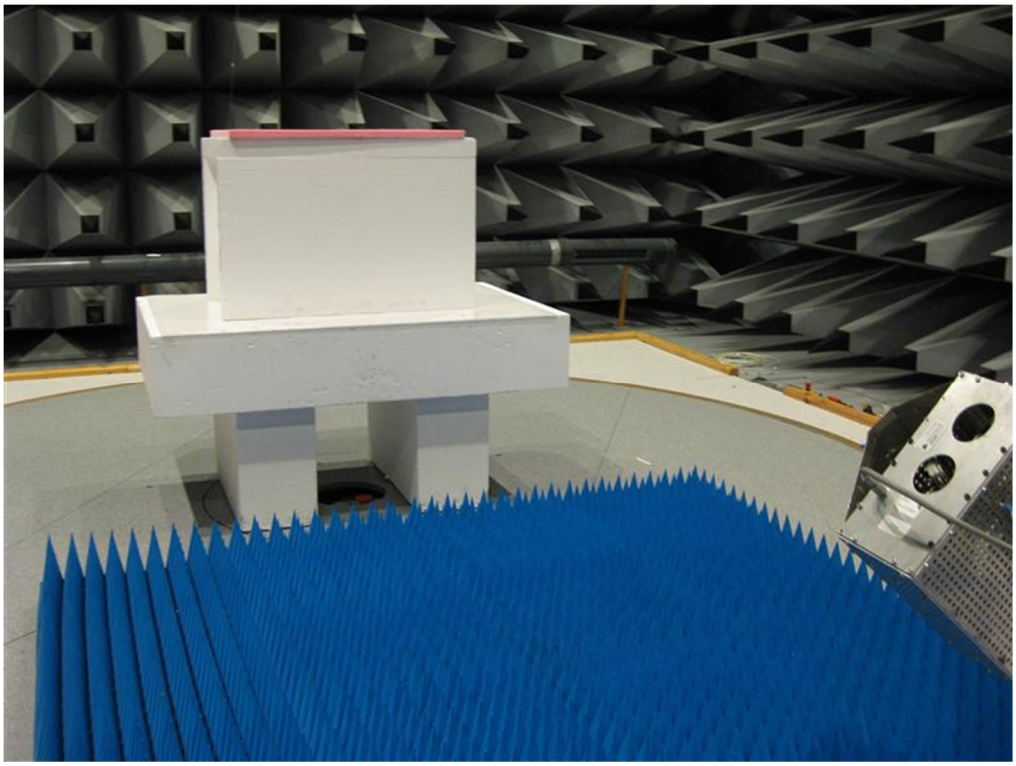


Photo 4.7.1 Test setup regarding measurement of field strength of fundamental.

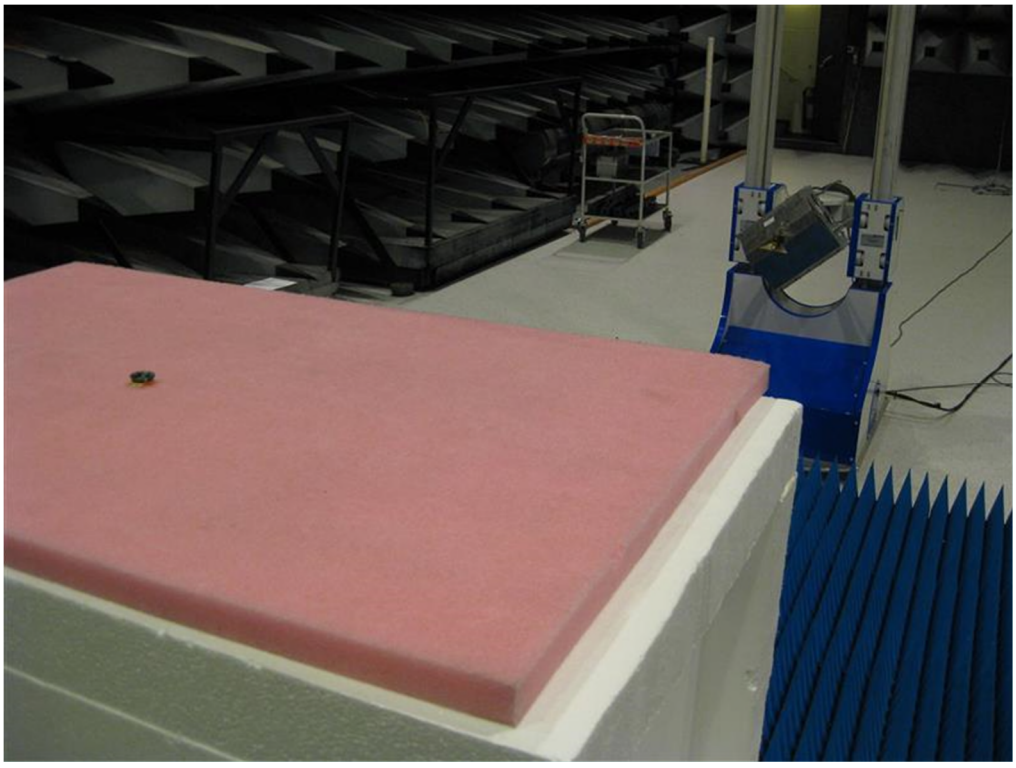


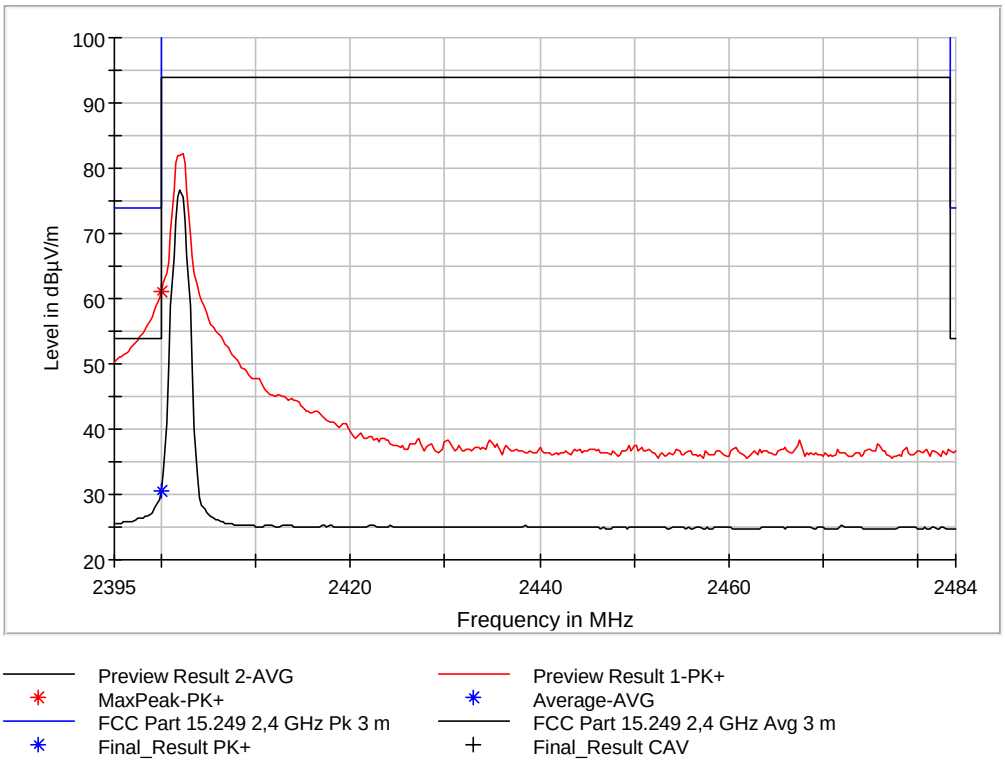
Photo 4.7.2 Test setup regarding measurement of field strength of fundamental.

4.8 Measurement of band edge compliance

Test object	CSN V2	Sheet	PROF-1
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (4) and TX_HIGH (8)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)		

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB
Detector	Peak and average	Bandwidth	1 MHz

Full Spectrum

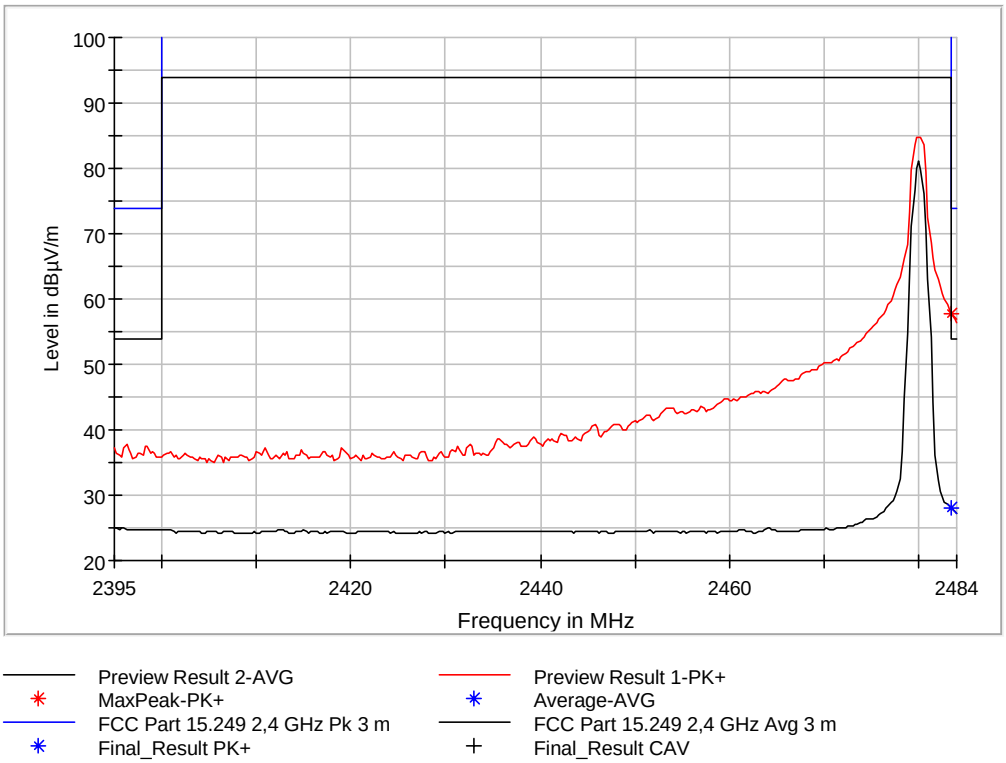


Comments Operating frequency: 2402 MHz.

Test object	CSN V2	Sheet	PROF-2
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (4) and TX_HIGH (8)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)		

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB
Detector	Peak and average	Bandwidth	1 MHz

Full Spectrum



Comments Operating frequency: 2480 MHz.

Test object	CSN V2	Sheet	PROF-3
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (4) and TX_HIGH (8)	Date	20 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)		

Test method Characteristics	ANSI C63.10:2013 Complete search, antenna distance 3 m.	Temperature Humidity	23 °C 30 % RH
Test equipm.	EMI room Hørsholm 49900 49624 49625 49622 49623 49999	Uncertainty	4.9 dB
Detector	Peak and average	Bandwidth	1 MHz

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)
2400.00	---	30.62	94.00	63.38	200.0	V	180
2400.00	61.14	---	114.00	52.86	200.0	V	180
2483.50	---	27.98	53.90	25.92	100.0	V	0
2483.50	57.66	---	73.90	16.24	100.0	V	90

Band edge criteria	The measured field strengths were within the limit of the band edge
Test port	Enclosure
Test frequency	2402 and 2480 MHz
Test mode	Continuous Tx - normal modulation - hopping off
Condition	Normal
Compliant	Yes
Comments	Test voltage: Internal battery 3 VDC.

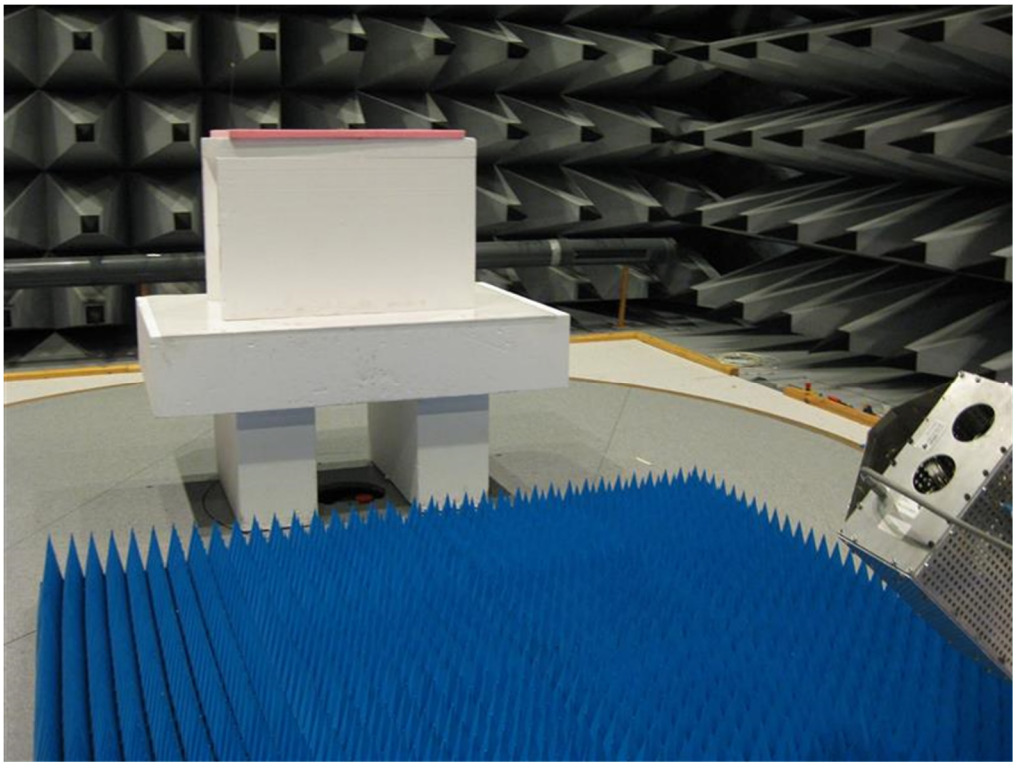


Photo 4.8.1 Test setup regarding measurement of band edge compliance.

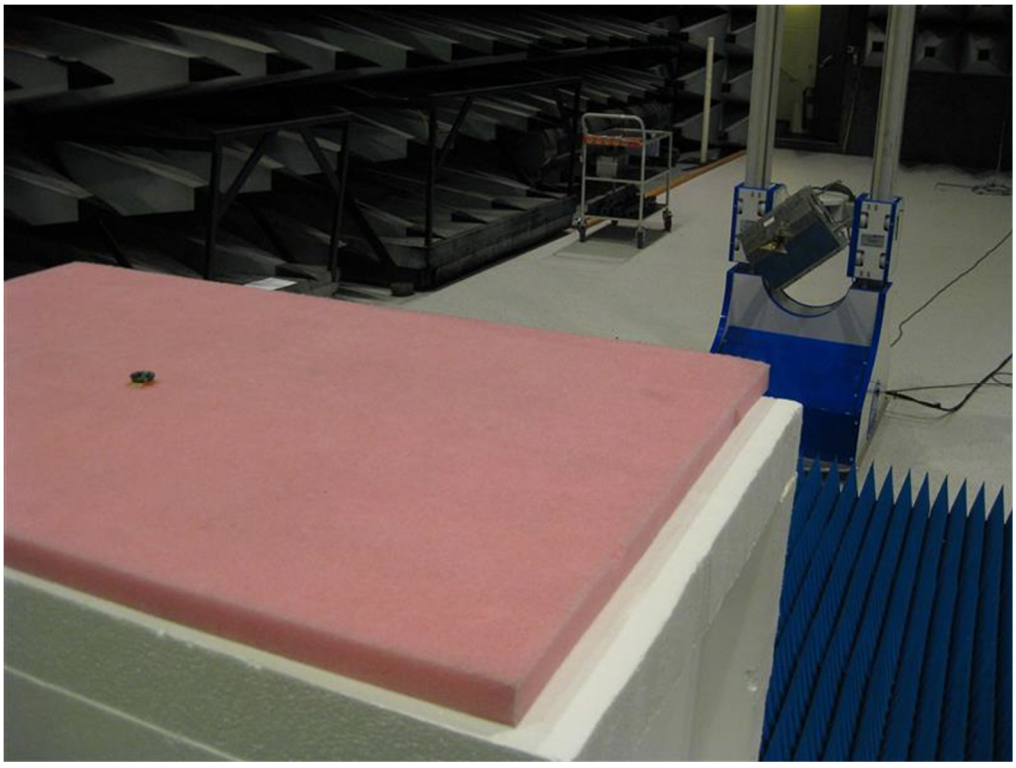
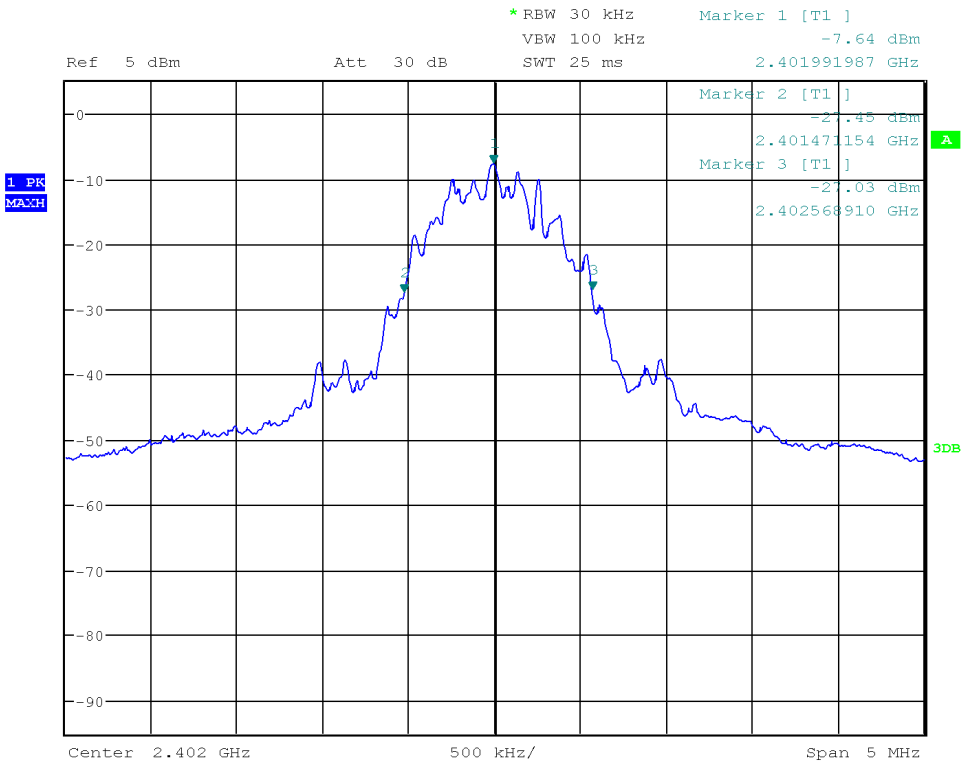


Photo 1.1.2 Test setup regarding measurement of band edge compliance.

4.9 Measurement of 20 dB bandwidth

Test object	CSN V2	Sheet	PROF-4
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (5), TX_MID (7) and TX_HIGH (8)	Date	21 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)		

Test method Characteristics	ANSI C63.10:2013 Test voltage: External power supply at 3 VDC	Temperature Humidity	21 °C 35 % RH
Test equipm.	SRD lab Hørsholm 49550	Uncertainty	1.6 dB
SA Settings	RBW: 30 kHz VBW: 100 kHz SPAN: 5 MHz DET: Peak CF: Operating freq. Trace: Max. hold		

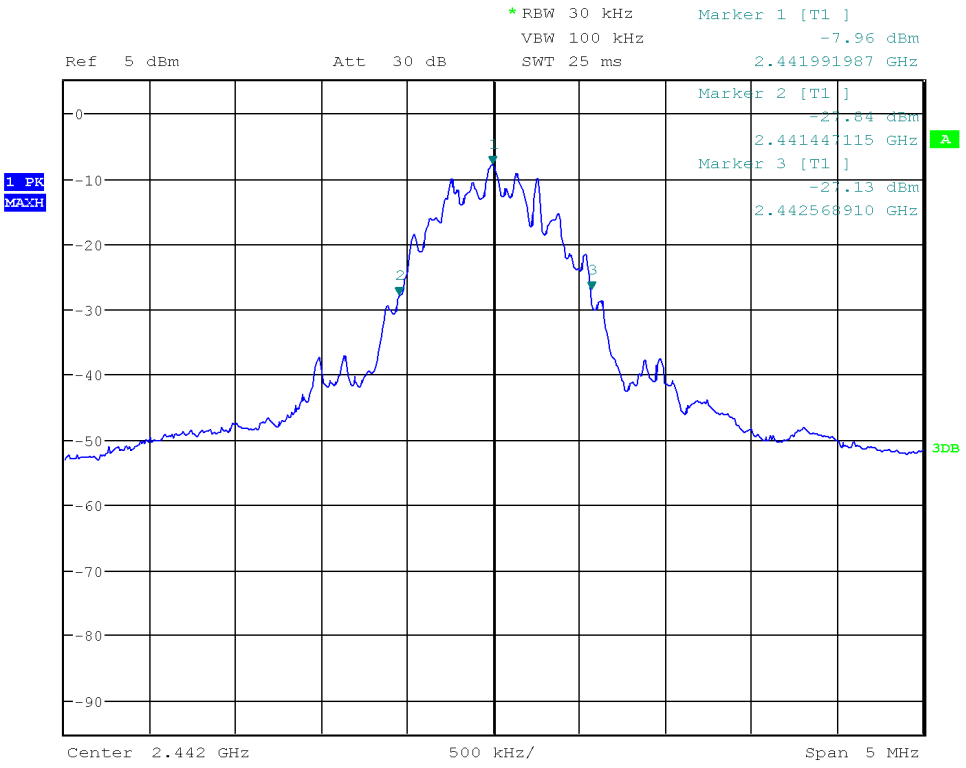


Date: 21.NOV.2017 14:09:46

Comments Operating frequency: 2402 MHz.

Test object	CSN V2	Sheet	PROF-5
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (5), TX_MID (7) and TX_HIGH (8)	Date	21 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)		

Test method Characteristics	ANSI C63.10:2013 Test voltage: External power supply at 3 VDC	Temperature Humidity	21 °C 35 % RH
Test equipm.	SRD lab Hørsholm 49550	Uncertainty	1.6 dB
SA Settings	RBW: 30 kHz VBW: 100 kHz SPAN: 5 MHz DET: Peak CF: Operating freq. Trace: Max. hold		

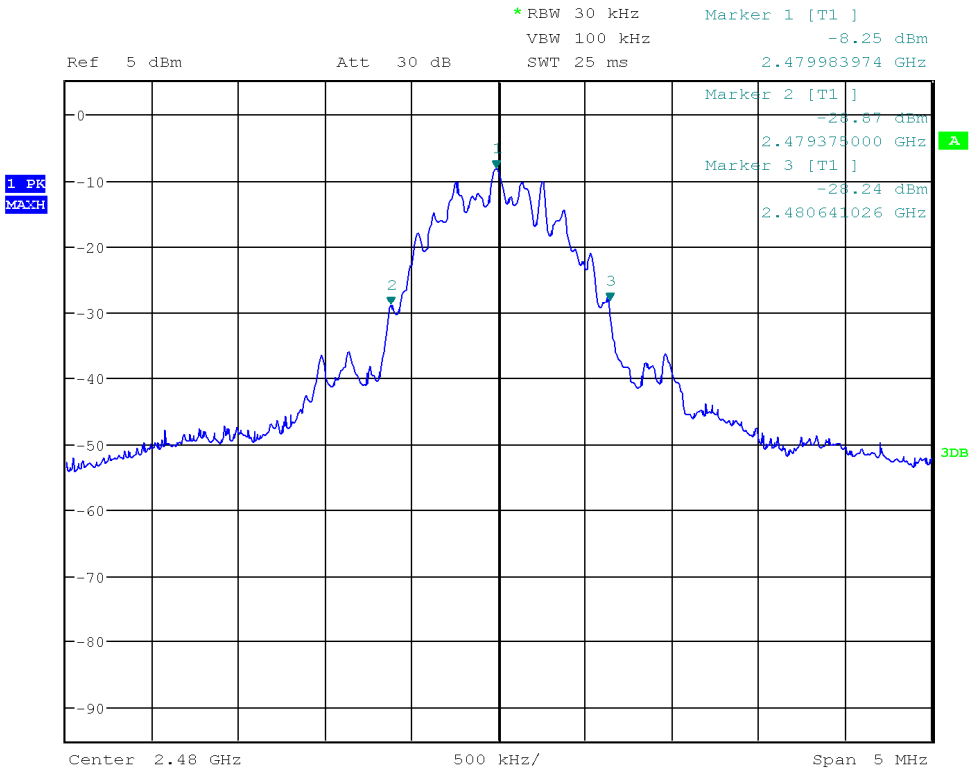


Date: 21.NOV.2017 14:14:33

Comments Operating frequency: 2442 MHz.

Test object	CSN V2	Sheet	PROF-1
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (5), TX_MID (7) and TX_HIGH (8)	Date	21 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)		

Test method Characteristics	ANSI C63.10:2013 Test voltage: External power supply at 3 VDC	Temperature Humidity	21 °C 35 % RH
Test equipm.	SRD lab Hørsholm 49550	Uncertainty	1.6 dB
SA Settings	RBW: 30 kHz VBW: 100 kHz SPAN: 5 MHz DET: Peak CF: Operating freq. Trace: Max. hold		



Date: 21.NOV.2017 14:16:55

Comments Operating frequency: 2480 MHz.

Test object	CSN V2	Sheet	PROF-6
Type	Bluetooth Low Energy 4.2 Sensor Node	Project no.	117-28082-7
Serial no.	TX_LOW (5), TX_MID (7) and TX_HIGH (8)	Date	21 Nov. 2017
Client	Pirelli Tyre LLC	Initials	PWF
Specification	47 CFR Part 15, Subpart C (Specific rule part §15.249)		

Test method Characteristics	ANSI C63.10:2013 Test voltage: External power supply at 3 VDC	Temperature Humidity	21 °C 35 % RH
Test equipm.	SRD lab Hørsholm 49550	Uncertainty:	1.6 dB
SA Settings	RBW: 30 kHz VBW: 100 kHz SPAN: 5 MHz DET: Peak CF: Operating freq. Trace: Max. hold		

Operating frequency [MHz]	Low frequency [MHz]	High frequency [MHz]	Remarks
2402	2401.47	2402.57	-
2442	2441.45	2442.57	-
2480	2479.38	2480.64	-
Note 1:			

Operating frequency [MHz]	Measured [MHz]	Limit [MHz]	Remarks
Lowest frequency	2401.47	2400.00	Passed
Highest frequency	2480.64	2483.50	Passed

Band edge criteria	20 dB bandwidth (-20 dBc)
Test result	The measured 20 dB bandwidth were within limit designated in 15.215(c)
Test port	Antenna replaced by SMA connector
Test frequency	2402, 2442 and 2480 MHz
Test mode	Continuous Tx - normal modulation - hopping off
Condition	Normal
Compliant	Yes
Comments	Test voltage: External power supply at 3 VDC.

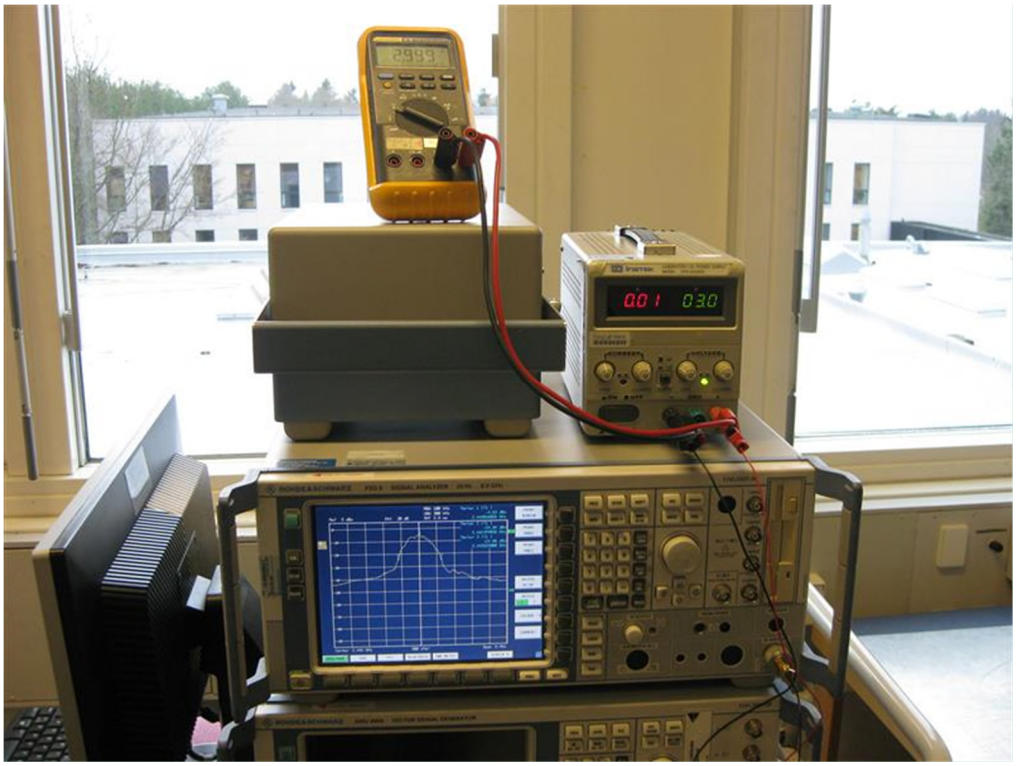


Photo 4.9.1 Test setup regarding measurement of 20 dB bandwidth.

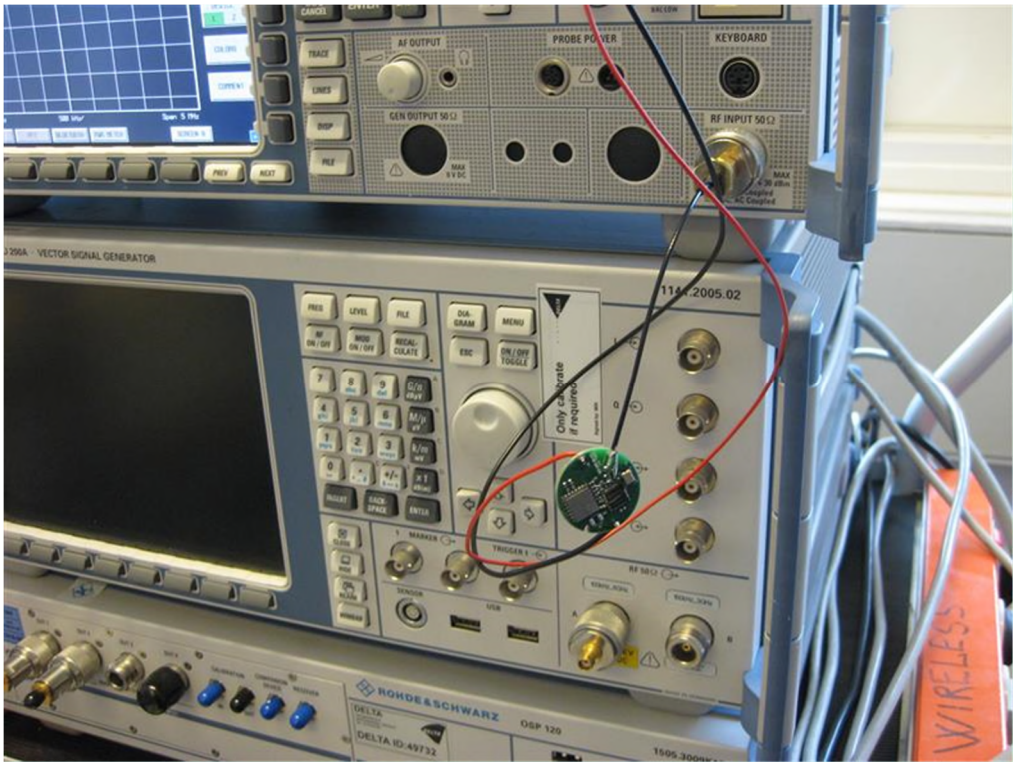


Photo 4.9.2 Test setup regarding measurement of 20 dB bandwidth.

5. National registrations and accreditations

5.1 DANAK Accreditation

Organization: Danish Accreditation and Metrology Fund - DANAK, see www.danak.dk and www.ilac.org

Registration Number: 19

Area Number: C

DANAK is part of ILAC (International Laboratory Accreditation Cooperation) including its MRA (Mutual Recognition Arrangement). The MRA includes the Australian NATA and Canadian SCC.

5.2 FCC Registrations

Organization: Federal Communications Commission, USA

Registration Number: 913950

Facilities: EMC room 2 Hørsholm (EMC-2)
EMC room 3 Hørsholm (EMC-3)
EMC room 4 Hørsholm (EMC-4)
EMI room Hørsholm (EMC-5)

5.3 VCCI Registrations

Organization: Voluntary Control Council for Interference by Information Technology, Japan

Member Number: 910

Facilities:

EMC room 3 Hørsholm (EMC-3):	C-2532 and T-1548
EMC room 4 Hørsholm (EMC-4):	C-2533 and T-1549
EMI room Hørsholm (EMC-5):	R-1180, C-706, T-1550 and G-470

5.4 IC Registrations

Organization: Industry Canada, Certification and Engineering Bureau

Registration Number: IC4187A-5

Facilities: EMI room Hørsholm (EMC-5)

6. List of instruments

No	Category/Action	Manufacturer	Type no	Cal. date	Cal. exp.
49154	Bilog Antenne	CHASE	CBL6111A	23-06-2016	23-06-2018
49550	SIGNAL ANLYZER	ROHDE & SCHWARZ	FSQ8	25-10-2016	25-11-2017
49590	CABLE, LOW-LOSS uWAVE CABLE, N-N, 8.0 m "EMI"	SUHNER	SUCOFLEX 104 PB	02-11-2017	02-11-2018
49622	CABLE 3.25 M PC3.5 MALE-FEMALE SUCOFLEX 104	HUBER+SUHNER		03-11-2017	03-11-2018
49623	CABLE 16 M PC3.5 MALE-MALE SUCOFLEX 104PB	HUBER+SUHNER		03-11-2017	03-11-2018
49624	DUAL RIDGE HORN ANTENNA – 1GHZ-26GHZ (2GHZ-32GHZ)	SATIMO	SH2000	04-11-2014	04-11-2017
49625	SRD COAX SWITCH MATRIX USED IN 1GHZ TO 26GHZ SRD ANTENNASYSTEM	DELTA	COAX SWITCH MATRIX	03-11-2017	03-11-2018
49704	CABLE 3 m SMA-N	SUHNER	SUCOFLEX104	04-11-2017	04-11-2018
49807	ATTENUATOR, DC-12.4GHz, 6 dB	HUBER-SUHNER	6806.17A	15-02-2017	15-02-2018
49817	CABLE, LOW-LOSS uWAVE CABLE, N-N, 8.0 m "EMI"	SUHNER	SUCOFLEX 104 PB	02-11-2017	02-11-2018
49900	SPECTRUM ANALYZER / MEASUREMENT RECEIVER	ROHDE & SCHWARZ	ESW26	11-09-2017	11-09-2018
49999	EMC32-SOFTWARE	ROHDE & SCHWARZ	Ver. 9.26	n/a	n/a