

# **Test Report**



# INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C and INDUSTRY CANADA REQUIREMENTS

Bluegiga Oy Sinikalliontie 5 A FI-02630 ESPOO

Bluegiga Oy Sinikalliontie 5 A FI-02630 ESPOO

Finland

Finland

Model: BLE113

Type:

Manufacturer:

Customer:

FCC Rule Part KDB::

IC Rule Part

15.247: 2012 558074 D01 DTS Meas Guidance v03r01 RSS-210, Issue 8, 2010 RSS-GEN Issue 3, 2010

Date:

Issued by:

26.4.2013

Jari Merikari Technical Manager Date:

26.4.2013

Checked by:

Hentre

Ari Honkala Product Line Manager

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**Product Description** 

# Equipment Under Test (EUT)

Bluetooth module	
Model:	BLE113
Туре:	-
Serial no:	-
HW version:	-
SW version:	-
FCC ID number:	QOQBLE113
Industry Canada number:	5123A-BLE113

# **Description of the EUT**

The EUT is a Bluetooth low energy single mode module targeted for low power sensors and accessories. Device can be used with batteries or from DC power supply.

# **Classification of the device**

Fixed device	
Mobile Device (Human body distance > 20cm)	$\boxtimes$
Portable Device (Human body distance < 20cm)	

# **Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing

# **Ratings and declarations**

Operating Frequency Range (OFR):	2402 – 2480 MHz
Channels:	40
Channel separation:	2 MHz
Channel bandwidth:	674.4 kHz
Conducted power:	0.54 dBm
Transmission technique:	Digital Transmission
Modulation:	GFSK
Antenna connector type	Internal antenna
Antenna gain:	0.5 dBi

# **Power Supply**

Battery operatedOperating voltage rangeNormal input voltage:3.0 V coin battery or 2 x 1,5V AAA batteriesTested by using external power supply and 3.6 VDC voltage level



# Mechanical Size of the EUT

Height: 1.9 mm	Width:15.73 mm	Depth: 9.15 mm

# Peripherals

#### Peripheral

DC power supply Thandar TS3021S.

## Samples

All tests were performed with two samples installed on to the evaluation board provided by the client.

Sample A: equipped with  $50\Omega$  connector

Sample B: normal construction.

All conducted measurements were made to sample A, and radiated measurements to sample B. No modifications were done during the tests.



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# SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.247(b)(3) / RSS-210 A8.4	Maximum Peak Conducted Output Power	PASS
§15.247(a)(2) / RSS-210 A8.2	6 dB Bandwidth	PASS
§15.247(e) / RSS-210 A8.2	Power Spectral Density	PASS
RSS-GEN 4.6.1	99% Occupied Bandwidth	PASS
§15.247(d) / RSS-210 A8.5	100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions	PASS
§15.209(a), §15.247(d) / RSS-210 A8.5	Radiated Emissions Within The Restricted Bands	PASS
§15.109 / RSS-GEN 7.2.3.2	Unintentional Radiated Emissions	PASS
§15.207 / RSS-GEN 7.2.2	Conducted emissions	PASS

# **EUT Test Conditions During Testing**

The EUT was in continuous transmit mode during all the tests.

The hopping was stopped and the EUT was configured into the wanted channel. Normal modulation and duty cycle was applied in all the tests.

Following channels were used during the tests when the hopping was stopped:

Channel LOW (CH 0) = 2402 MHz Channel MID (CH 20) = 2442 MHz Channel HIGH (CH 39) = 2480 MHz

# **Test Facility**

	Testing Location / address:	SGS Fimko Ltd
	FCC registration number: 90598	Särkiniementie 3
		FI-00210, HELSINKI
		FINLAND
$\square$	Testing Location / address:	SGS Fimko Ltd
	FCC registration number: 178986	Karakaarenkuja 4
	Industry Canada registration	FI-02610, ESPOO
	number: 8708A-2	FINLAND



## **Maximum Peak Conducted Output Power**

Standard:	ANSI C63.10	(2009)
Tested by:	JJM	
Date:	5.4.2013	
Humidity:	18 %	
Temperature:	23 °C	
Measurement uncertainty	± 2,87dB	Level of confidence 95 % (k = 2)

#### FCC Rule: 15.247(b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz, employing less that 75 channels limit is 0.125 Watt. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

#### **Results:**

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	0.54	30	29.46	PASS
Mid	-0.39	30	30.39	PASS
High	-1.27	30	31.27	PASS



# **Conducted Output Power Test**

Spectrum									
Ref Level Att TDF	5.00 dBm 20 dB	<b>SWT</b> 1.9	_	WIMHZ WI3MHZ M	l <b>ode</b> Aut	o FFT			
●1Pk View									
0 dBm						M1[1]	_	2.402	0.54 dBm 226420 GHz
-10 dBm									
-20 dBm	_/	r							
-30 dBm									<u> </u>
-40 dBm									
-50 dBm									
-60 dBm									
-70 dBm									
-80 dBm									
-90 dBm									
CF 2.402 GH	Ηz			691	pts			Span	4.804 MHz
Marker Type Ref M1	Trc	<b>Stimulu</b> 2.402264		Response		Inction	Fund	ction Result	t
	)[	2,,0220		0.04 4		1easuring		4/4	05.04.2013 14:27:55

Date: 5.APR.2013 14:27:56

Figure 1. Channel LOW.



# **Conducted Output Power Test**

Spectrum	'n								
Ref Level Att TDF	5.00 dBm 20 dB	<b>SWT</b> 1.9 μ	_	WIMHZ WI3MHZ MI	ode Auto P	FT			
●1Pk View									
0 dBm					M	11[1]		2.441	-0.39 dBm 72890 GHz
-10 dBm									
-20 dBm—									
-30 dBm-									
-40 dBm									
-50 dBm									
-60 dBm									
-70 dBm—									
-80 dBm									
-90 dBm									
CF 2.442 G	Hz			691	pts			Span 4	1.804 MHz
Marker									
Type Ret	f   Trc   1	Stimulus 2.441728		Response -0.39 dB	Fund m	tion	Func	tion Result	
	)[]				Me	asuring		<b>440</b>	14:29:05

Date: 5.APR.2013 14:29:05

Figure 2. Channel MID.



# **Conducted Output Power Test**

Spectrum	, T								
	5.00 dBm		_	W 1 MHz					
🔵 Att	20 dB	<b>SWT</b> 1.9	ha 🔵 AB.	WI3 MHZ MO	de Auto F	FT			
TDF									
⊖1Pk View						1[1]			
0 dBm				M	-1.27 dBm				
o abiii			_			1		2.479	976360 GHz
-10 dBm									
10 0.0.11								$\sim$	
-20 dBm									
20 0.0									$\mathbf{k}$
30 dBm									
-40 dBm									
-50 dBm									
-60 dBm									
-70 dBm—				_					
-80 dBm									
-90 dBm—									
					-				
CF 2.47972	219 GHZ			691 p	ts			span	4.804 MHz
Marker	. I <del></del>	ou!!	- 1	<b>D</b>	1 5				
Type Ref	f Trc 1	<u>Stimulus</u> 2.479763		Response -1.27 dBm	Func	tion	Fund	ction Resul	<u>t</u>
	<u> </u>	2.11510.		1.27 001	-	suring		4444	05.04.2013
						saring			14:30:28

Date: 5.APR.2013 14:30:28

Figure 3. Channel HIGH.



# Transmitter Radiated Emissions 30 – 1000 MHz

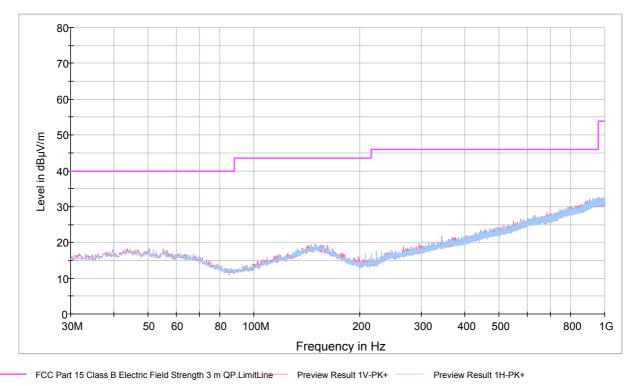
Standard:	ANSI C63.10	(2009)
Tested by:	JJM	
Date:	22 – 23.4.2013	
Humidity:	20 - 21%	
Temperature:	19 °C	
Measurement uncertainty	± 4.51 dB	Level of confidence 95 $\%$ (k = 2)

#### FCC Rule: 15.247(d), 15.209(a)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.205(a).

The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables). The QuasiPeak value is the measured value corrected with the correction factor.

#### Measured Peak Values In The Frequency Range 30 MHz - 1000 MHz.



FCC Part 15 Class B Spurious Emission 30-1000MHz 3m

Figure 4. Measured curve with peak-detector. Channel LOW.

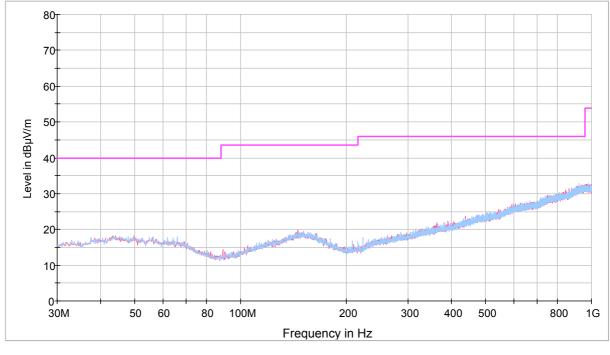
No final measurements were made since the emission level was more than 10 dB from the limit.







#### FCC Part 15 Class B Spurious Emission 30-1000MHz 3m



FCC Part 15 Class B Electric Field Strength 3 m QP.LimitLine Preview Result 1V-PK+ Preview Result 1H-PK+

Figure 5. Measured curve with peak-detector. Channel MID.

No final measurements were made since the emission level was more than 10 dB from the limit.





#### FCC Part 15 Class B Spurious Emission 30-1000MHz 3m

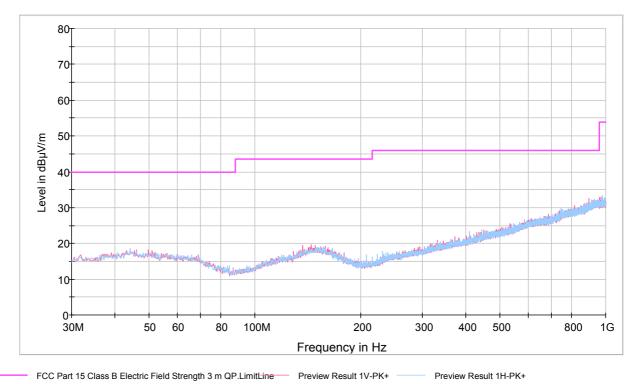


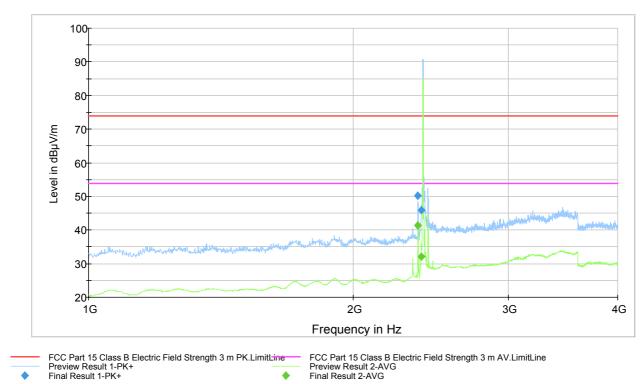
Figure 6. Measured curve with peak-detector. Channel HIGH.

No final measurements were made since the emission level was more than 10 dB from the limit.

# Transmitter Radiated Emissions 1 000 – 26 500 MHz

#### Measured Peak and Average Values In The Frequency Range 1 000 MHz – 4 000 MHz.

The correction factor in the final result tables contains the sum of the transducers (antenna + amplifier + cables). The Max Peak and Average values are measured values corrected with the correction factor.



FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)

Figure 7. Measured curve with peak- and average detector. Channel LOW.

#### Final measurements from the worst frequencies

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2369.775000	50.2	1000.0	1000.000	100.0	V	266.0	0.5	23.7	73.9
2390.000000	45.9	1000.0	1000.000	100.0	V	296.0	0.6	28.0	73.9

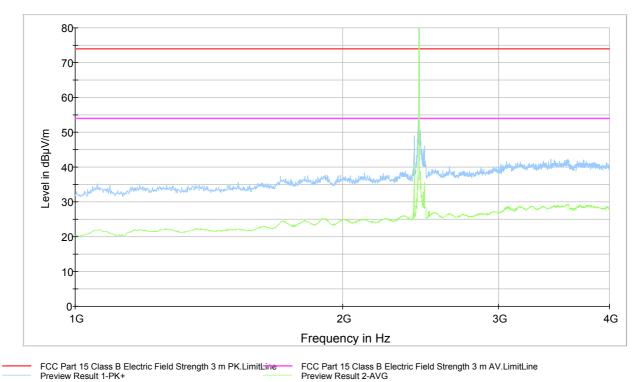
Table 1. Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2370.025000	41.4	1000.0	1000.000	100.0	V	266.0	0.5	12.5	53.9
2389.600000	32.1	1000.0	1000.000	100.0	V	266.0	0.6	21.8	53.9

Table 2. Final Average results.







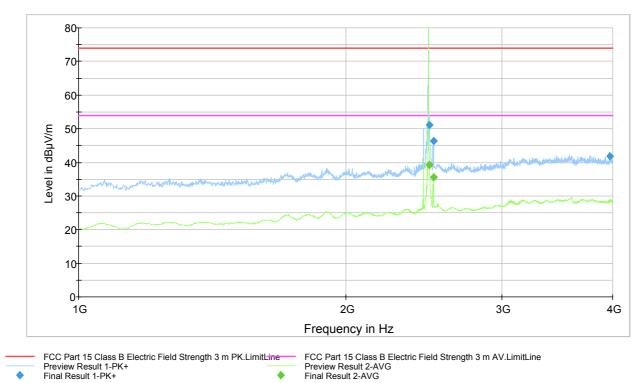
FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)

Figure 8. Measured curve with peak- and average detector. Channel MID.

No final measurements were made since the peak level of the emission was below the average limit line outside the assigined operating band.







FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)

Figure 9. Measured curve with peak- and average detector. Channel HIGH.

Final measurements from the worst frequencies

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2485.100000	51.2	1000.0	1000.000	100.0	V	270.0	1.0	22.7	73.9
2512.275000	46.4	1000.0	1000.000	100.0	V	283.0	1.2	27.5	73.9
3971.525000	41.8	1000.0	1000.000	154.0	V	0.0	6.7	32.1	73.9

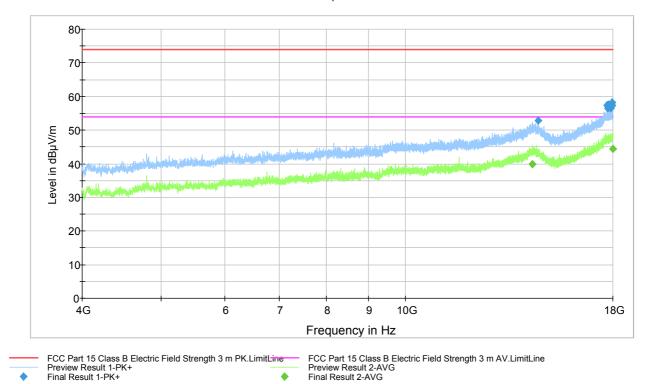
Table 3. Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2485.100000	39.3	1000.0	1000.000	105.0	V	287.0	1.0	14.6	53.9
2512.025000	35.6	1000.0	1000.000	138.0	V	289.0	1.2	18.3	53.9

 Table 4. Final Average results.



#### Measured Peak and Average Values In The Frequency Range 4 000 MHz – 18 000 MHz.



FCC Part 15 Class B Spurious Emission 4-18GHz 3m

Figure 10. Measured curve with peak- and average detector. Channel LOW.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
14552.600000	52.9	1000.0	1000.000	100.0	V	95.0	23.5	21.0	73.9
17701.800000	57.4	1000.0	1000.000	100.0	V	17.0	28.5	16.5	73.9
17716.600000	57.4	1000.0	1000.000	275.0	Н	164.0	28.4	16.5	73.9
17760.400000	56.5	1000.0	1000.000	400.0	V	192.0	28.2	17.4	73.9
17780.800000	57.5	1000.0	1000.000	179.0	V	173.0	28.4	16.4	73.9
17825.600000	57.3	1000.0	1000.000	100.0	V	242.0	28.6	16.6	73.9
17881.000000	56.6	1000.0	1000.000	154.0	V	238.0	29.0	17.3	73.9
17921.000000	57.2	1000.0	1000.000	284.0	V	90.0	29.3	16.7	73.9
17964.000000	57.4	1000.0	1000.000	391.0	V	249.0	29.4	16.5	73.9
17979.200000	58.1	1000.0	1000.000	154.0	Н	236.0	29.5	15.8	73.9

#### Final measurements from the worst frequencies

 Table 5. Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
14314.600000	39.8	1000.0	1000.000	362.0	V	200.0	24.0	14.1	53.9
17996.600000	44.4	1000.0	1000.000	337.0	V	200.0	29.6	9.5	53.9

 Table 6. Final Average results.



#### FCC Part 15 Class B Spurious Emission 4-18GHz 3m

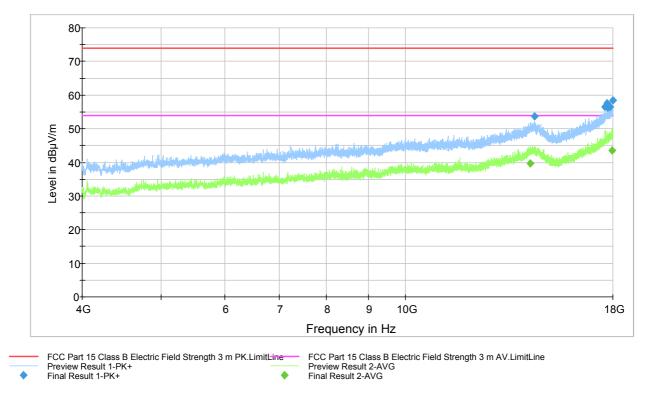


Figure 11. Measured curve with peak- and average detector. Channel MID.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
14414.400000	53.7	1000.0	1000.000	374.0	Н	30.0	23.9	20.2	73.9
17595.200000	56.5	1000.0	1000.000	385.0	Н	48.0	27.9	17.4	73.9
17700.400000	57.5	1000.0	1000.000	299.0	Н	304.0	28.5	16.4	73.9
17741.600000	56.3	1000.0	1000.000	376.0	Н	32.0	28.1	17.6	73.9
17840.400000	56.5	1000.0	1000.000	146.0	Н	168.0	28.6	17.4	73.9
17997.800000	58.5	1000.0	1000.000	296.0	V	320.0	29.7	15.4	73.9

#### Final measurements from the worst frequencies

Table 7. Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
14248.600000	39.7	1000.0	1000.000	354.0	V	19.0	23.8	14.2	53.9
17959.200000	43.6	1000.0	1000.000	378.0	Н	242.0	29.4	10.3	53.9

Table 8. Final Average results.

FCC Part 15 Class B Spurious Emission 4-18GHz 3m

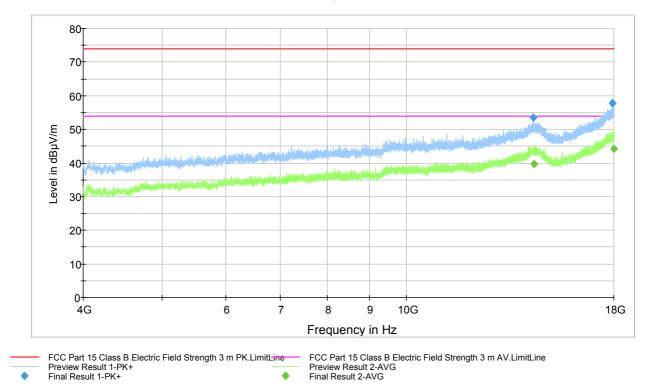


Figure 12. Measured curve with peak- and average detector. Channel HIGH.

#### Final measurements from the worst frequencies

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
14323.200000	53.4	1000.0	1000.000	329.0	V	327.0	24.0	20.5	73.9
17914.200000	57.7	1000.0	1000.000	256.0	V	188.0	29.3	16.2	73.9

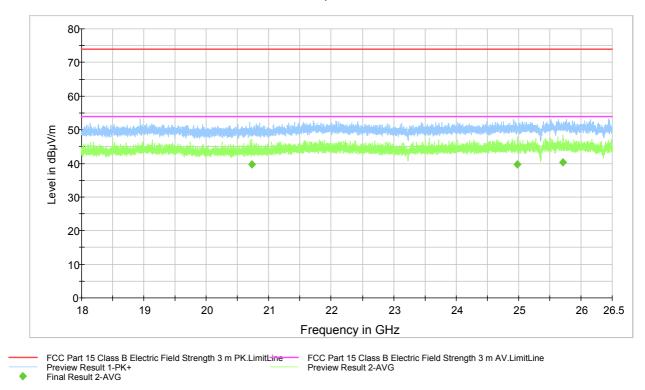
Table 9. Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
14344.800000	39.6	1000.0	1000.000	100.0	V	147.0	23.9	14.3	53.9
17999.200000	44.3	1000.0	1000.000	203.0	V	322.0	29.7	9.6	53.9

 Table 10. Final Average results.



#### Measured Peak and Average Values In The Frequency Range 18 000 MHz – 26 500 MHz.



FCC Part 15 Class B Spurious Emission 18-26.5GHz 3m

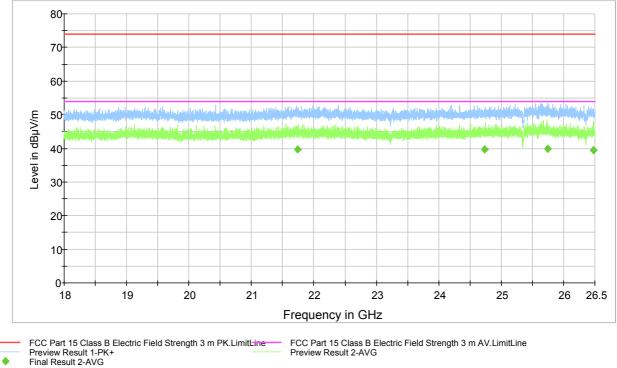
Figure 13. Measured curve with peak- and average detector. Channel LOW.

#### Final measurements from the worst frequencies

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
20727.650000	39.7	1000.0	1000.000	400.0	V	135.0	26.2	14.2	53.9
24977.850000	39.7	1000.0	1000.000	400.0	V	135.0	28.3	14.2	53.9
25710.800000	40.3	1000.0	1000.000	400.0	V	210.0	29.1	13.6	53.9

 Table 11. Final Average results.

#### FCC Part 15 Class B Spurious Emission 18-26.5GHz 3m



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FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine Preview Result 2-AVG

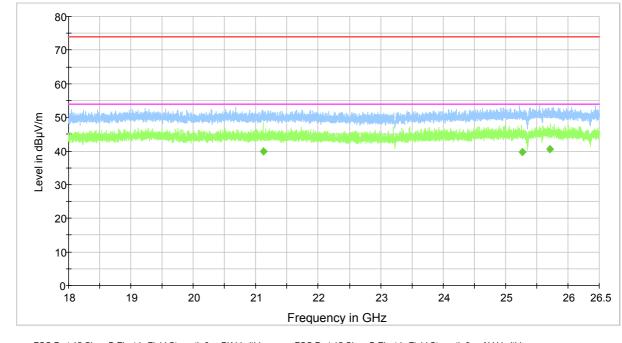
Figure 14. Measured curve with peak- and average detector. Channel MID.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
21744.700000	39.7	1000.0	1000.000	397.0	V	185.0	26.8	14.2	53.9	
24738.850000	39.6	1000.0	1000.000	375.0	Н	116.0	28.1	14.3	53.9	
25742.550000	39.9	1000.0	1000.000	400.0	V	210.0	29.1	14.0	53.9	
26475.450000	39.4	1000.0	1000.000	400.0	V	358.0	29.2	14.5	53.9	

 Table 12. Final Average results.



FCC Part 15 Class B Spurious Emission 18-26.5GHz 3m



<sup>.</sup> 

FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine Preview Result 1-PK+ Final Result 2-AVG FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine Preview Result 2-AVG

Figure 15. Measured curve with peak- and average detector. Channel HIGH.

#### Final measurements from the worst frequencies

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
21117.900000	39.8	1000.0	1000.000	368.0	V	54.0	26.4	14.1	53.9
25263.350000	39.7	1000.0	1000.000	386.0	Н	15.0	28.5	14.2	53.9
25712.550000	40.5	1000.0	1000.000	374.0	V	15.0	29.1	13.4	53.9

Table 13. Final Average results.



Standard:	ANSI C63.10	(2009)
Tested by: Date:	JJM 1545.2013	
Humidity: Temperature:	25 % 24 °C	
Measurement uncertainty	± 2.87 dB	Level of confidence 95 % (k = 2)

#### FCC Rule: 15.247(d), 15.209(a)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emission swhich fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.205(c)).

Band Edge Attenuation									
Lower Band Edge	Upper Band Edge								
-39.41 dBc	-44.37 dBc								
Limit:	-20dBc								

Table 14. Band edge attenuation.

No significant emissions were detected close to the limit.

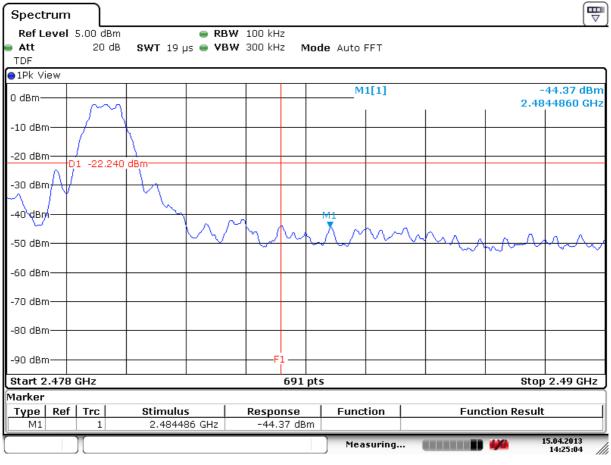


Specti	rum										
	evel 5	5.00 dBm		_	<b>BW</b> 100 kHz						
👄 Att		20 dB	SWT 37.9	ιμs 👄 V	<b>'BW</b> 300 kHz	Mode	Auto FFT				
TDF											
😑 1Pk Ma	ax					1					
0 dBm—							_M1[1]				-39.41 dBm )92600 ៨អាខ
-10 dBm	<u>ا</u> ل-										
-20 dBm		1 -20.600	dBm								
-30 dBm	ı										
-40 dBm	<u>ا</u> ــــ									M1	p <sup>N</sup>
-50 dBm	η			-1 - 0-	mm	MA	MA	A	MM	WV V	V
 -60 dBm	n.	m	www	~~~~	Man	ľ					
-70 dBm	<u>،                                    </u>										
-80 dBm											
-90 dBm										F1	
										Ĺ	L
Start 2	.38 GI	Hz			691	pts				Stop 2	.4025 GHz
Marker		- 1									1
Type M1	Ref	Trc 1	2,3992	5 26 GHz	Response -39.41 di		unction		Fund	tion Result	<u> </u>
		)[					Measuring	(		444	15.04.2013 13:09:38

Date: 15.APR.2013 13:09:38

Figure 16. Lower Band Edge.





Date: 15.APR.2013 14:25:04

Figure 17. Upper Band Edge.



Spectrum									
Ref Level Att TDF		3m dB 👄 <b>SWT</b> 1	_	100 kHz 300 kHz <b>M</b> i	ode Auto S	weep			
●1Pk View									
0 dBm					M	1[1]			45.49 dBm 80450 GHz
-10 dBm									
-20 dBm	D1 -20.6	500 dBm							
-30 dBm									
-40 dBm									M1
-50 dBm							Human		المراجع والمراجع والمراجع
-60 dBm	whenever	mathematic	www.www.	مىرىيى ئىللەرمىيىنى ئىرىمىيى <mark>لەرمىرىمى ال</mark> ىرىكى كەلىرىكى كەلىكى ئىلىكى ئىلىكى ئىلىكى ئىلىكى ئىلىكى ئىلىكى ئىلى ئىلىكى ئىلىكى ئ	town too do and the case of th	hi adahar	Contraction and and		
-70 dBm									
-80 dBm									
-90 dBm									
Start 30.0	MHz			691	pts			Sto	p 5.0 GHz
Marker Type Ref M1	Trc	Stimul 4.8	us	Response -45.49 dB	Func	tion	Fund	ction Result	
						suring		1 <b>440</b> 1	15.04.2013 12:57:42 //

Date: 15.APR.2013 12:57:42

Figure 18. Conducted Spurious Emissions 30 – 5 000 MHz. Channel LOW.

Peak over the limit is the carrier.



Spectrun	ι					
Ref Leve Att	1 5.00 dBm	_	RBW 100 kHz			· · · · · ·
	20 dB	SWT 200 ms 👄 🕅	BW 300 KHZ N	lode Auto Swee	ep	
O 1Pk View						
0 dBm				M1[1]		-48.23 dBm 20.3260 GHz
-10 dBm—				M2[1]		-47.52 dBm 24.8120 GHz
-20 dBm	D1 -20.60	) dBm				
-30 dBm—						
-40 dBm—					M1	M
-50 dBm			المحمد ويتداور ومريد الأراد رارد	a and a state of the second	al the advantation of the second s	Lawran was have der the second
mound	montable	when to other mounder	- record and the second s			
-60 dBm						
-70 dBm						
-80 dBm						
-90 dBm						
Start 5.0 G	Hz		691 pt	:5		Stop 25.0 GHz
Marker						
Type   Re	f   Trc	Stimulus	Response	Function	Fun	ction Result
M1	1	20.326 GHz	-48.23 dBm			
M2	1	24.812 GHz	-47.52 dBm			
	][			Measuring		15.04.2013 13:01:43
Date: 15.AH	PR.2013 1	13:01:44				

Figure 19. Conducted Spurious Emissions 5 000 – 25 000 MHz. Channel LOW.



Spectrum											
Ref Level				<b>BW</b> 100 kHz		-					
Att TDF	20 dB	3 SWT 49.7	' ms 👄 🗸	' <b>BW</b> 300 kHz	Moo	ie Aut	o Swee	p			
●1Pk View											
0 dBm						M	1[1]				46.46 dBm 88130 GHz
-10 dBm											
-20 dBm	01 -21.40	10 dBm									
-30 dBm											
-40 dBm											M1
-50 dBm									•		
-60 dBm		John Martine	Altania di Maria da Ba	unite services and the	have	n n n n n n n n n n n n n n n n n n n	Unon	wind	Muthhamm	un and a stand of the	and
-70 dBm											
-80 dBm											
-90 dBm											
Start 30.0 N	/IHz	•		691	l pts					Sto	p 5.0 GHz
Marker											
Type Ref	Trc 1	Stimulus 4.88	5   13 GHz	Response -46.46 d		Func	tion		Fund	tion Result	
	)[					Mea	suring			<b>4/0</b>	15.04.2013 13:13:39 ///

Figure 20. Conducted Spurious Emissions 30 – 5 000 MHz. Channel MID.

Peak over the limit is the carrier.

Date: 15.APR.2013 13:13:40



Spectrun	n					
🖷 Att	l 5.00 dBm 20 dB	● SWT 200 ms ●	RBW 100 kHz VBW 300 kHz M	<b>1ode</b> Auto Swe	ер	· · · · · · · · · · · · · · · · · · ·
TDF 1Pk View						
OIPK VIEW				544[4]		47.04 dBm
0 dBm				M1[1]		-47.84 dBm 22.8440 GHz
				M2[1]		-47.84 dBm
-10 dBm—				mz[1]		24.5220 GHz
				1		
-20 dBm	D1 -21.400	) dBm				
-30 dBm—						
-40 dBm—						M1 M2
-50 dBm		munound	my my me me marken my my my my	wand grad be and	وكلار ومعاومة والعوامية والمعاركة والمعاركة والمعاركة والمعاركة والمعاركة والمعاركة والمعاركة والمعاركة والمعا	and the of the second of the s
	yearly bourse	and the man in	Ť,			
-60 dBm						
-70 dBm—						
00 d0						
-80 dBm—						
-90 dBm						
-90 aBm						
Start 5.0 C	GHz		691 pi	ts		Stop 25.0 GHz
Marker						
Type Re	f   Trc	Stimulus	Response	Function	Fun	ction Result
M1	1	22.844 GHz	-47.84 dBm			
M2	1	24.522 GHz	-47.84 dBm			
				Measuring	j <b>E</b> RREAR	15.04.2013 13:17:22
						13:17:22
Date: 15.Al	PR.2013 1	3:17:22				

Figure 21. Conducted Spurious Emissions 5 000 – 25 000 MHz. Channel MID.



Spectrum	ı )								
Ref Level	5.00 de	Bm	🖷 R	<b>BW</b> 100 kHz					
🖷 Att	20	dB <b>SWT</b> 49.	7 ms 👄 🗸	<b>BW</b> 300 kHz	Mode	Auto Swee	р		
TDF									
⊖1Pk View									
0 dBm						M1[1]			47.98 dBm 96040 GHz
-10 dBm—									
-20 dBm—	D1 -22.2	240 dBm							
-30 dBm—									
-40 dBm									MI
-50 dBm									
-60 dBm	Junaharah	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		esta marina	hunnel	halled and the second	www.www.while	- when the destro	n with marked
-70 dBm									
-80 dBm									
-90 dBm									
Start 30.0	MHz		·	691	pts		I	Sto	p 5.0 GHz
Marker									
Type Ret	f Trc	Stimulu 4.96	<b>s</b>	Response -47.98 dB		unction	Fund	ction Result	
						Measuring		1 <b>440</b> 1	15.04.2013 13:20:53

Date: 15.APR.2013 13:20:53

Figure 22. Conducted Spurious Emissions 30 – 5 000 MHz. Channel HIGH.

Peak over the limit is the carrier.



Spectrum	, )											
Ref Level Att	5.00 dBm 20 dB		_		100 kHz	Mad	a					· · · ·
	20 UB	5WI 200	ms 💻	¥ D W	300 KH2	MUU	e Auti	o Sweep				
●1Pk View												
0 dBm							M1[1] -48.22 dB 20.3840 GF			48.22 dBm 0.3840 GHz		
-10 dBm—							M	2[1]				47.30 dBm 4.2040 GHz
-20 dBm	D1 -22.240	) dBm										
-30 dBm												
-40 dBm										M1		M2
-50 dBm-	well when the second	manum	mune	rown	wither	Hold the second	Water the	ouro Allo	an and the second second	~ <b>~</b>	العاريب وكالبرز والمريط	mon un tryan
-60 dBm	· · ·											
-70 dBm												
-80 dBm												
-90 dBm												
Start 5.0 G	Hz	·			691	pts		•			Stop	25.0 GHz
Marker												
Type Re				Response		Function			Function Result			
M1 M2	1		84 GHz 04 GHz		-48.22 dB -47.30 dB							
	)[]						Mea	suring			<b>444</b>	15.04.2013 13:22:50 //
Date: 15.AB	PR.2013 1	3:22:51										

Figure 23. Conducted Spurious Emissions 5 000 – 25 000 MHz. Channel HIGH.



# 6 dB Bandwidth of the Channel

# FCC Rule: 15.247(a)(2)

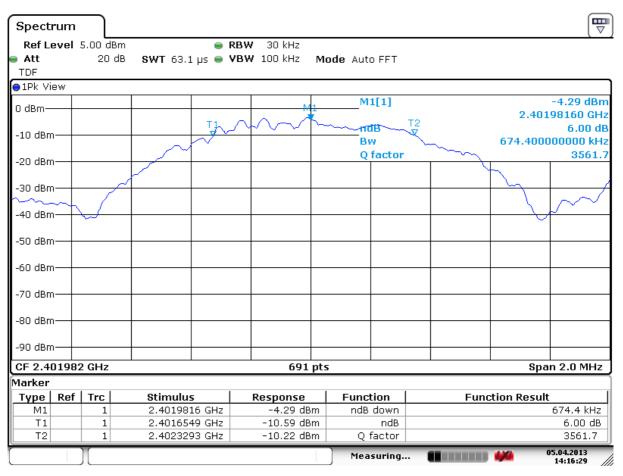
#### Results:

Channel	6 dB BW [kHz]	Minimum limit [kHz]			
Low	674.4				
Mid	657.0	500			
High	659.9				

 Table 15. 6 dB bandwidth test results.

#### 6 dB Channel Bandwidth



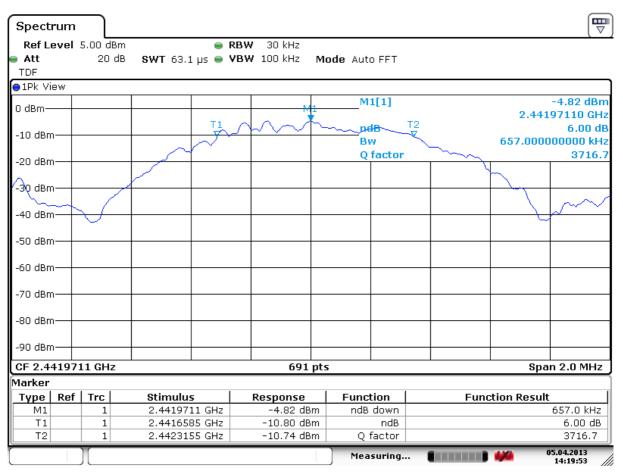


Date: 5.APR.2013 14:16:29

Figure 24. 6 dB channel BW. Channel LOW

#### 6 dB Channel Bandwidth



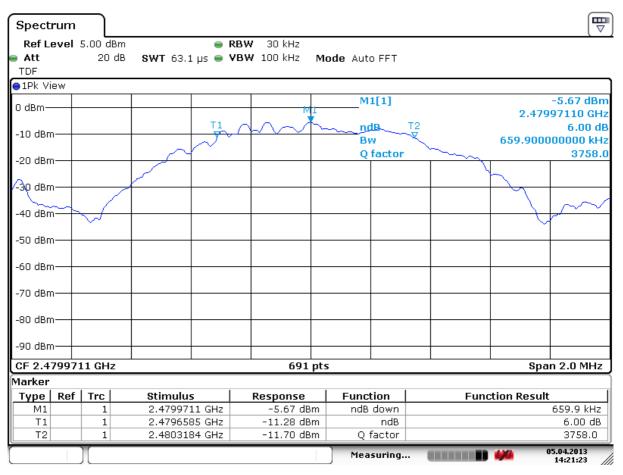


Date: 5.APR.2013 14:19:54

Figure 25. 6 dB channel BW. Channel MID.

#### 6 dB Channel Bandwidth





Date: 5.APR.2013 14:21:23

Figure 26. 6 dB channel BW. Channel HIGH



# **Power Spectral Density**

Standard: Tested by: Date: Humidity: Temperature:	ANSI C63.10 NTO 5.4.2013 18 % 23 °C	(2009)
---	---	--------

#### FCC Rule: 15.247(e) RSS-210 A8.2

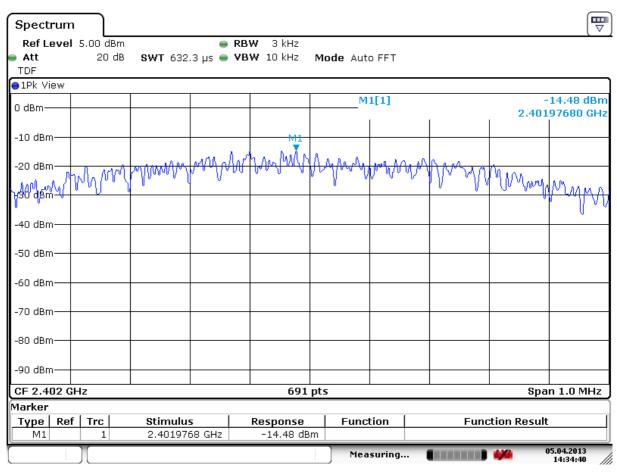
#### **Results:**

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
Low	-14.48	
Mid	-15.52	+8.00
High	-16.26	

 Table 16. Power Spectral Density test results.



#### **Power Spectral Density**



Date: 5.APR.2013 14:34:40

Figure 27. Power Spectral Density of the channel LOW.

# SGS

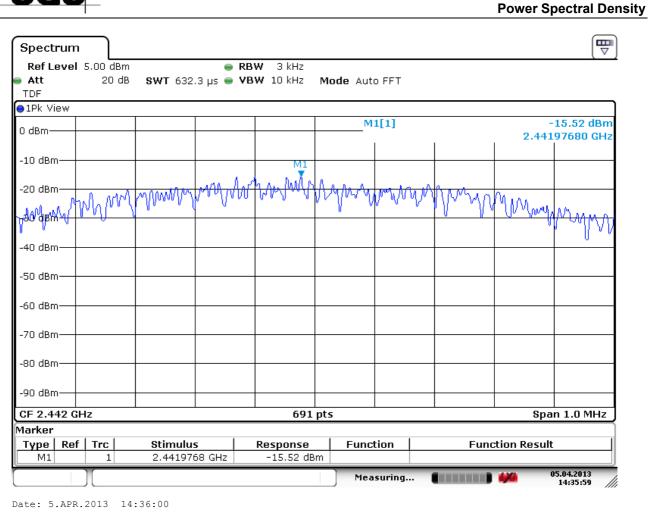


Figure 28. Power Spectral Density of the channel MID.



**Power Spectral Density** 

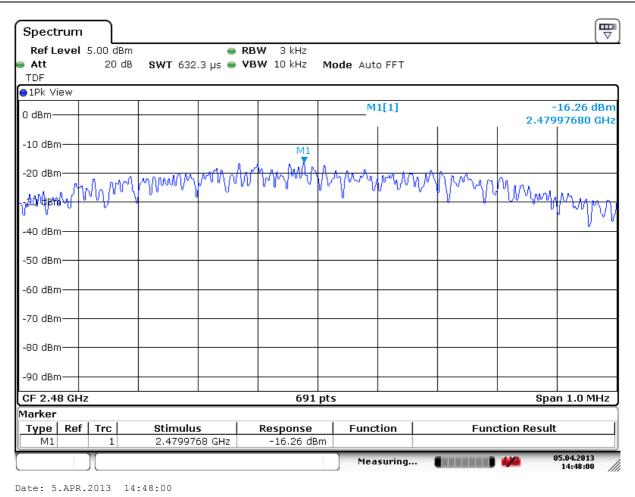


Figure 29. Power Spectral Density of the channel HIGH.



## 99% Occupied Bandwidth

Standard:	RSS-GEN	(2010)
Tested by:	JJM	. ,
Date:	5.4.2013	
Humidity:	18 %	
Temperature:	23 °C	

#### **RSS-GEN 4.7**

Channel	Limit	99 % BW [MHz]
Low	-	1.08593
Mid	-	1.07960
High	-	1.07960

Table 17. 99 % OBW test results.



Spectr	um										
Att TDF		5.00 dBm 20 dB	<b>SWT</b> 18.9	_	<b>RBW</b> 100 kHz <b>/BW</b> 300 kHz	Mo	ode Aut	o FFT			
😑 1Pk Vie	ew										
0 dBm—						-		1[ <b>]</b> M1			-0.31 dBm 224020 GHz
-10 dBm			T1	<b>-</b>			0	CC BW	7	1.0853	383502 MHz
-20 dBm											
-30 dBm	+										
-40 dBm						-					
-50 dBm											
-60 dBm											
-70 dBm											
-80 dBm											
-90 dBm											
CF 2.40	2 GH	z			691	l pts	;	•	•	Spa	an 2.0 MHz
Marker											
	Ref	Trc	Stimulu		Response		Func	tion	Fund	ction Resul	t
M1		1	2.40224		-0.31 d						00500 111
T1 T2		1	2.401461 2.402547		-13.35 d -13.95 d		0	cc Bw		1.0853	83502 MHz
							Mea	suring.		4/4	05.04.2013 14:41:39

Date: 5.APR.2013 14:41:39

Figure 30. 99 % OBW. Channel low.



Spect	rum										
Att TDF		5.00 dBm 20 dB	<b>SWT</b> 18.1	_	<b>BW</b> 100 kHz <b>'BW</b> 300 kHz	Mo	o <b>de</b> Aut	o FFT			
😑 1Pk Vi	ew										
0 dBm—					₹_ <sub>141</sub>	-	M				-1.35 dBm L75980 GHz
-10 dBm	י		<u>T1</u>			-	0	CC BW	12	1.0795	94790 MHz
-20 dBm	י										
-30 dBn	4										
-40 dBm	ו										
-50 dBm	ו										
-60 dBm	ו										
-70 dBm	ו										
-80 dBm	ו										
-90 dBm											
CF 2.4	42 GH	IZ			691	. pts				Spa	n 2.0 MHz
Marker											]
Туре	Ref		Stimulu		Response		Func	tion	Fun	ction Result	t
M1		1	2.44175		-1.35 di			a a Dur		1.070	50470 MU-
T1 T2		1	2.441455		-14.66 dł -14.74 dł		0	cc Bw		1.079	59479 MHz
							) Mea	suring.		-	05.04.2013 14:44:22

Date: 5.APR.2013 14:44:22

Figure 31. 99 % OBW. Channel mid.



Spect	rum										
Ref Le Att TDF	evel .	5.00 dBm 20 dB	<b>SWT</b> 18.	_	W 100 kHz W 300 kHz	Mo	o <b>de</b> Aut	o FFT			
😑 1Pk Vi	ew										
0 dBm—				M			M	1[1]		2.479	-2.23 dBm 976270 GHz
-10 dBm	<u>ا</u> _ر		TI				0	cc Bw			594790 MHz
-20 dBm	<u>ا</u> _ر									$\sim$	
-30 dBm	<u> </u>										
-40 dBm	<u>ا</u> _ر										
-50 dBm	<u>ا</u> _ر										
-60 dBm	۱ <u> </u>										
-70 dBm	۱ <u> </u>										
-80 dBm	۰ <u>–</u>										
-90 dBm	۱ <u> </u>										
CF 2.48	B GHz	1		•	691	pts		•	•	Spa	an 2.0 MHz
Marker											
Туре	Ref		Stimulu		Response		Func	tion	Fu	nction Resul	t
M1		1	2.47976		-2.23 dE						
T1 T2		1	2.479455 2.480535		-15.59 dE -15.67 dE		0	cc Bw		1.079	59479 MHz
		)[]					) Mea	suring.		. 444	05.04.2013 14:45:34

Date: 5.APR.2013 14:45:34

Figure 32. 99 % OBW. Channel high.



#### **Receiver Radiated Emissions**

### Receiver Radiated Emissions 30 – 26 500 MHz

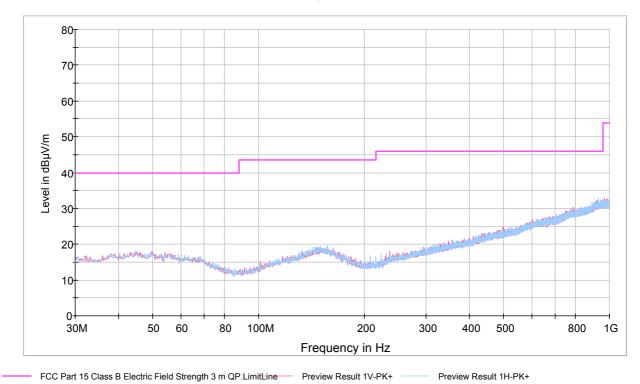
Standard:	ANSI C63.10	(2009)
Tested by:	JJM	
Date:	22 – 23.4.2013	
Humidity:	20 - 21%	
Temperature:	19 °C	
Measurement uncertainty	$\pm$ 4.51 dB	Level of confidence 95 $\%$ (k = 2)

#### FCC Rule: 15.109

The EUT was in a receiving mode and measurement was performed using middle channel only.

The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables). The QuasiPeak value is the measured value corrected with the correction factor.

#### Measured Peak Values In The Frequency Range 30 MHz - 1000 MHz.



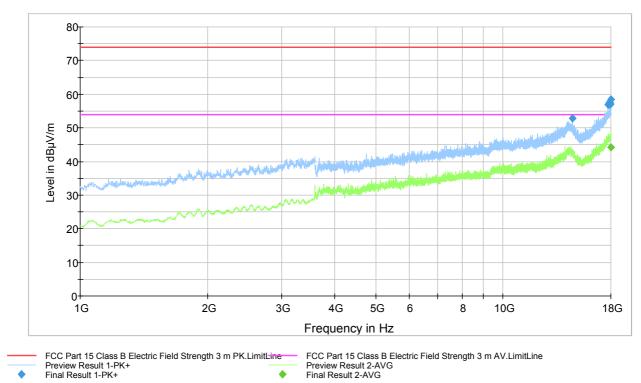
FCC Part 15 Class B Spurious Emission 30-1000MHz 3m

Figure 33. Measured curve with peak-detector.

No final measurements were made since the emission level was more than 10 dB from the limit.

**Receiver Radiated Emissions** 

#### Measured Peak Values In The Frequency Range 1 000 MHz - 18 000 MHz.



FCC Part 15 Class B Spurious Emission 1-18GHz 3m Rx

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Figure 34. Measured curve with peak-and average detector.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
14588.200000	52.8	1000.0	1000.000	236.0	Н	78.0	23.5	21.1	73.9
17710.800000	57.0	1000.0	1000.000	400.0	Н	59.0	28.4	16.9	73.9
17811.000000	56.9	1000.0	1000.000	138.0	V	3.0	28.6	17.0	73.9
17857.900000	57.5	1000.0	1000.000	385.0	Н	15.0	28.7	16.4	73.9
17902.200000	57.0	1000.0	1000.000	400.0	Н	2.0	29.3	16.9	73.9
17937.400000	57.4	1000.0	1000.000	292.0	Н	137.0	29.3	16.5	73.9
17991.300000	58.4	1000.0	1000.000	359.0	Н	187.0	29.6	15.5	73.9

#### Final measurements from the worst frequencies

Table 18. Final MaxPeak results.

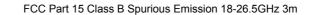
F	Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
17	7976.500000	44.2	1000.0	1000.000	383.0	V	52.0	29.5	9.7	53.9

Table 19. Final Average results.

**Receiver Radiated Emissions** 



#### Measured Peak Values In The Frequency Range 18 000 MHz – 26 500 MHz.



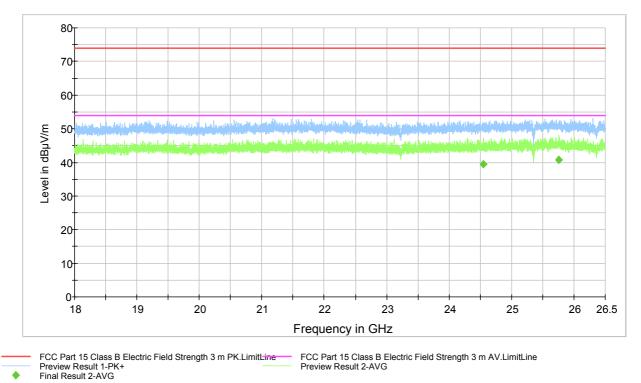


Figure 35. Measured curve with peak-and average detector.

Final measurements from the worst frequencies

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
24544.850000	39.4	1000.0	1000.000	400.0	V	338.0	28.0	14.5	53.9
25757.750000	40.7	1000.0	1000.000	393.0	Н	111.0	29.1	13.2	53.9

Table 20. Final Average results.



#### **Conducted emissions**

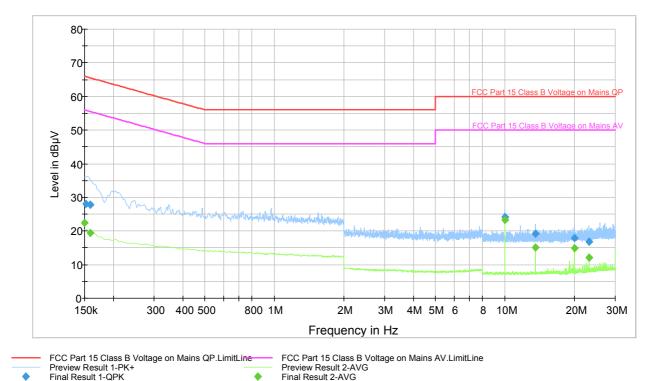
Standard:	ANSI C63.10	(2009)
Tested by:	JJM	
Date:	23.4.2013	
Humidity:	21 %	
Temperature:	20 °C	
Measurement uncertainty	± 2,87 dB	Level of confidence 95 $\%$ (k = 2)

#### FCC Rule: 15.207

Conducted disturbance voltage was measured with an artificial main network from 150 kHz to 30 MHz with 4.5 kHz steps and a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors.

During the test the EUT was powered from the separate AC / DC power supply which was connected to the LISN. The supply voltage through the LISN to the power supply was 115 VAC / 60 Hz.

#### Test results



Conducted Emission Mains FCC Part 15 Class B with ESH3-Z5 8019

Figure 36. The measured curves with peak- and average-detectors





Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.152250	28.0	1000.0	9.000	GN	Ν	10.7	37.8	65.9
0.159000	27.7	1000.0	9.000	GN	Ν	10.8	37.8	65.5
10.000000	24.2	1000.0	9.000	GN	Ν	10.9	35.8	60.0
13.559500	19.1	1000.0	9.000	GN	L1	11.1	40.9	60.0
19.999000	17.8	1000.0	9.000	GN	Ν	11.3	42.2	60.0
23.126500	16.9	1000.0	9.000	GN	L1	11.6	43.1	60.0

#### Final measurements from the worst frequencies

Table 21. Final quasi-peak measurements from the worst frequencies

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	22.3	1000.0	9.000	GN	L1	10.7	33.7	56.0
0.159000	19.4	1000.0	9.000	GN	Ν	10.8	36.1	55.5
10.000000	23.2	1000.0	9.000	GN	L1	10.9	26.8	50.0
13.559500	15.0	1000.0	9.000	GN	L1	11.1	35.0	50.0
20.001250	14.9	1000.0	9.000	GN	L1	11.5	35.1	50.0
23.128750	12.0	1000.0	9.000	GN	L1	11.6	38.0	50.0

Table 22. Final average measurements from the worst frequencies

The correction factor in the final result tables contains the sum of the transducers (cables + transient limiter + LISN).

The QuasiPeak and Average values are the measured values corrected with the correction factor.



List of test equipments

Manufacturer	Туре	Serial no	lnv. no				
ROHDE & SCHWARZ							
Spectrum analyzer EMI Test receiver Test software LISN Transient limiter Antenna (1 – 18 GHz)	FSV40 ESU 26 EMC32 ESH2-Z5 ESH3-Z2 HF906	101068 100185 Ver. 8.30.0 863794/014 10083	9093 8453 - 8019 8396 7910				
DAVIS							
Weather station	Vantage Pro	-	5297				
EMCO							
Antenna (1 - 18 GHz)	3117	29617	7293				
SCHWARZBECK							
Antenna (30 MHz - 1 GHz)	VULB9168	9168-503	8911				
HEWLETT- PACKARD							
Microwave amplifier	83017A	-	5226				
HUBER-+ SUHNER							
Attenuator 10dB	6810.17B	-	-				
DEISEL							
Antenna mast Tilt option Controller Turntable	MA 240 T KE 220 HD 100 DS 420	240/394/96 220/307/96 100/413/96 420/420/96	5017 - 5018 5015				
WAINWRIGHT							
High Pass Filter	WHKX	10	8267				
CALIFORNIA INSTRUMENTS							
Power Supply	5001 iX Series II	58209	7826				

Calibration was valid to all equipment use in testing.